

WAGO-I/O-SYSTEM 750

Manual



750-889

KNX IP Controller

Version 1.0.2

© 2016 by WAGO Kontakttechnik GmbH & Co. KG
All rights reserved.

WAGO Kontakttechnik GmbH & Co. KG

Hansastraße 27
D-32423 Minden

Phone: +49 (0) 571/8 87 – 0
Fax: +49 (0) 571/8 87 – 1 69

E-Mail: info@wago.com

Web: <http://www.wago.com>

Technical Support

Phone: +49 (0) 571/8 87 – 5 55
Fax: +49 (0) 571/8 87 – 85 55

E-Mail: support@wago.com

Every conceivable measure has been taken to ensure the accuracy and completeness of this documentation. However, as errors can never be fully excluded, we always appreciate any information or suggestions for improving the documentation.

E-Mail: documentation@wago.com

We wish to point out that the software and hardware terms as well as the trademarks of companies used and/or mentioned in the present manual are generally protected by trademark or patent.

Table of Contents

1	Notes about this Documentation.....	11
1.1	Validity of this Documentation.....	11
1.2	Copyright.....	11
1.3	Symbols.....	12
1.4	Number Notation.....	14
1.5	Font Conventions	14
2	Important Notes	15
2.1	Legal Bases	15
2.1.1	Subject to Changes	15
2.1.2	Personnel Qualifications.....	15
2.1.3	Use of the WAGO-I/O-SYSTEM 750 in Compliance with Underlying Provisions	15
2.1.4	Technical Condition of Specified Devices	16
2.2	Safety Advice (Precautions).....	17
2.3	Special Use Conditions for ETHERNET Devices	19
3	System Description.....	20
3.1	Manufacturing Number	21
3.2	Hardware Address (MAC ID).....	21
3.3	Component Update.....	22
3.4	Storage, Assembly and Transport	22
3.5	Assembly Guidelines/Standards.....	22
3.6	Power Supply	23
3.6.1	Isolation	23
3.6.2	System Supply	24
3.6.2.1	Connection	24
3.6.2.2	Dimensioning.....	25
3.6.3	Field Supply.....	28
3.6.3.1	Connection	28
3.6.3.2	Fusing	30
3.6.4	Supplementary Power Supply Regulations	33
3.6.5	Supplementary Power Supply Regulations for KNX.....	34
3.6.5.1	Notes	35
3.6.6	Supply Example.....	36
3.6.7	Power Supply Unit	38
3.7	Grounding	39
3.7.1	Grounding the DIN Rail	39
3.7.1.1	Framework Assembly	39
3.7.1.2	Insulated Assembly.....	39
3.7.2	Grounding Function.....	40
3.8	Shielding	41
3.8.1	General	41
3.8.2	Bus Cables	41
3.8.3	Signal Lines	42
3.8.4	WAGO Shield Connecting System	42

4	The WAGO KNX Concept.....	43
4.1	KNX IP Controller 750-889.....	44
4.2	KNX/EIB/TP1 Module 753-646.....	45
4.2.1	Router Mode.....	46
4.2.2	Device Mode.....	47
4.3	Hardware Concept.....	48
4.4	Software Concept.....	49
4.4.1	The IEC Application.....	50
4.4.2	ETS, Product Database and Plug-in.....	52
4.4.3	Web Visualization and Web-based Management.....	55
4.4.3.1	Web Visualization.....	55
4.4.3.2	Web-based Management.....	56
4.5	Application Examples.....	57
4.5.1	KNXnet/IP Router.....	57
4.5.2	KNX IP Application Controller + I/O Modules.....	58
4.5.3	KNX IP Application Controller + Router.....	59
4.5.4	KNX IP Application Controller + I/O Modules + Router.....	60
4.5.5	KNX IP Application Controller + Router + Additional KNX Module with Independent Line.....	61
4.5.6	KNX IP Application Controller + Router + KNX Module as Device in the Router Line.....	62
4.5.7	Any Fieldbus Controller with KNX Module.....	63
5	Device Description.....	65
5.1	KNX IP Device in the Controller.....	66
5.2	KNXnet/IP Router in the Controller.....	67
5.3	View.....	68
5.4	Connectors.....	70
5.4.1	Device Supply.....	70
5.4.2	Fieldbus Connection.....	70
5.5	Display Elements.....	72
5.6	Operating Elements.....	74
5.6.1	Service Interface.....	74
5.6.2	Mode Selector Switch.....	75
5.6.3	Buttons.....	77
5.6.4	Memory Card Slot.....	78
5.6.4.1	Inserting a Memory Card.....	79
5.6.4.2	Removing the Memory Card.....	79
5.7	Technical Data.....	80
5.7.1	Device Data.....	80
5.7.2	System Data.....	81
5.7.3	Supply.....	82
5.7.4	Fieldbus MODBUS/TCP.....	82
5.7.5	KNX.....	82
5.7.6	Accessories.....	83
5.7.7	Connection Type.....	83
5.7.8	Climatic Environmental Conditions.....	83
5.7.9	Mechanical Strength.....	84
5.8	Approvals.....	85
5.9	Standards and Guidelines.....	87

6	Mounting.....	88
6.1	Installation Position.....	88
6.2	Overall Configuration	88
6.3	Mounting onto Carrier Rail.....	90
6.3.1	Carrier Rail Properties.....	90
6.3.2	WAGO DIN Rail.....	91
6.4	Spacing.....	91
6.5	Mounting Sequence.....	92
6.6	Inserting and Removing Devices	93
6.6.1	Inserting the Fieldbus Coupler/Controller.....	94
6.6.2	Removing the Fieldbus Coupler/Controller	94
6.6.3	Inserting the I/O Module	95
6.6.4	Removing the I/O Module.....	96
7	Connect Devices	97
7.1	Data Contacts/Internal Bus	97
7.2	Power Contacts/Field Supply.....	98
7.3	Connecting a Conductor to the CAGE CLAMP®	99
8	Function Description	100
8.1	Operating System.....	100
8.1.1	Run-up	100
8.1.2	PFC Cycle.....	100
8.2	Process Data Architecture	102
8.2.1	Basic Structure.....	102
8.2.2	Example of an Input Process Image	104
8.2.3	Example of an Output Data Process Image.....	105
8.2.4	MODBUS Process Data	106
8.2.5	Process Data – KNXnet/IP	106
8.3	Data Exchange	109
8.3.1	MODBUS Memory Areas.....	110
8.3.2	Addressing.....	113
8.3.2.1	Addressing of I/O Modules	114
8.3.2.2	Example of Addressing.....	114
8.3.2.3	IEC-61131-3 Address Areas.....	116
8.3.2.4	Absolute Addressing.....	117
8.3.3	Data Exchange between MODBUS/TCP Master and I/O Modules.	119
8.3.4	Data Exchange between PLC Function (CPU) and I/O Modules	121
8.3.5	Data Exchange between Master and PLC Function (CPU).....	122
8.3.5.1	Example of MODBUS/TCP Master and PLC Function (CPU) ..	122
8.3.6	Application Example	124
8.4	Memory Card Function	125
8.4.1	Project Copying and Automatic System Start	127
8.4.2	Back-up Function (Storing Device-internal Data and Settings on the Memory Card)	129
8.4.3	Restore Function (Loading Device-internal Data and Settings from the Memory Card)	131
8.4.4	Inserting a Memory Card During Operation	133
8.4.5	Removing the Memory Card During Operation.....	134
8.4.6	Saving WAGO-I/O-PRO project to Memory Card	135
8.4.7	FTP Network Access to the File System of the Memory Card	138

8.4.8	Access to Web Pages in the File System of the Memory Card	139
8.4.9	Directory Structure	139
9	Commissioning	141
9.1	Connecting Client PC and Fieldbus Nodes	142
9.2	Allocating the IP Address to the Fieldbus Node	142
9.2.1	Assigning the IP Address (default) Using the Addressing Button ...	143
9.2.2	Assigning an IP Address using AutoIP	144
9.2.3	Assigning IP Address via DHCP	145
9.2.3.1	Enable DHCP	145
9.2.4	Assigning IP Address via WAGO-ETHERNET-Settings	147
9.2.5	Assigning the IP Address with a PLC program	149
9.2.6	Assigning the IP Address with a BootP Server	149
9.2.6.1	Note MAC ID	151
9.2.6.2	Determining IP addresses	152
9.2.6.3	Assigning the IP address	153
9.2.6.4	Assigning the IP address permanently by option “use IP from EEPROM“	153
9.2.6.5	Reasons for Failed IP Address Assignment	155
9.3	Testing the Function of the Fieldbus Node	156
9.4	Testing Fieldbus Controller Communication via ETS	158
9.5	Preparing the Flash File System	160
9.6	Synchronizing the Real-Time Clock	162
9.7	Restoring Factory Settings	165
10	Programming the PFC Using WAGO-I/O-PRO	166
10.1	Configuring the Fieldbus Controller using the I/O Configurator	169
10.1.1	Configuration using the “EA-config.xml” File	172
10.2	Creating/Exporting the SYM_XML	174
10.2.1	Processing in ETS	175
10.3	ETHERNET Libraries for WAGO-I/O-PRO	176
10.4	Functional Restrictions and Limits	178
10.4.1	Configuration using the “EA-config.xml” File	178
10.5	General Information about IEC Tasks	181
10.5.1	IEC Task Sequence	183
10.5.2	Overview of Most Important Task Priorities	183
10.6	System Events	185
10.6.1	Enabling/Disabling System Events	185
10.7	Transfer the IEC program to the Fieldbus controller	187
10.7.1	Transfer via Serial Service Port	188
10.7.2	Transfer via Fieldbus and ETHERNET	191
11	Configuring via the Web-Based Management System (WBM)	193
11.1	Information	195
11.2	Ethernet	197
11.3	TCP/IP	200
11.4	Port	202
11.5	SNMP	204
11.5.1	SNMP V1/V2c	205
11.5.2	SNMP V3	207
11.6	Watchdog	209

11.7	Clock	211
11.8	Security	214
11.9	MODBUS.....	217
11.10	KNX	219
11.11	PLC Info.....	221
11.12	PLC	222
11.13	Features	227
11.14	I/O Config	228
11.15	Disk Info.....	231
11.16	SD Card.....	232
11.17	Backup & Restore	234
11.18	WebVisu.....	237
12	Diagnostics.....	239
12.1	LED Signaling.....	239
12.1.1	Evaluating Fieldbus Status	240
12.1.2	Evaluating Node Status – I/O LED (Blink Code Table)	242
12.1.2.1	USR LED.....	254
12.1.3	Evaluating Memory Card Status	254
12.1.4	Evaluating Power Supply Status	254
12.2	Fault Behavior.....	255
12.2.1	Loss of Fieldbus	255
12.2.2	Internal Data Bus Failure.....	257
13	Fieldbus Communication	258
13.1	Implemented Protocols.....	258
13.1.1	Communication Protocols	258
13.1.1.1	IP (Internet Protocol)	258
13.1.1.2	TCP (Transmission Control Protocol).....	263
13.1.1.3	UDP (User Datagram Protocol).....	263
13.1.2	Configuration and Diagnostics Protocols.....	264
13.1.2.1	AutoIP	264
13.1.2.2	DHCP (Dynamic Host Configuration Protocol).....	264
13.1.2.3	BootP (Bootstrap Protocol).....	266
13.1.2.4	HTTP (Hypertext Transfer Protocol).....	268
13.1.2.5	DNS (Domain Name Systems).....	268
13.1.2.6	SNTP-Client (Simple Network Time Protocol)	269
13.1.2.7	FTP-Server (File Transfer Protocol).....	269
13.1.2.8	SMTP (Simple Mail Transfer Protocol)	270
13.1.2.9	SNMP (Simple Network Management Protocol)	270
13.1.2.9.1	MIB II Description.....	271
13.1.2.9.2	Traps.....	272
13.1.3	Application Protocols	273
13.2	KNXnet/IP.....	274
13.2.1	KNX Standard	274
13.2.1.1	KNX Configuration Modes	274
13.2.1.2	KNX Transfer Media	275
13.2.2	Network Structure	276
13.2.2.1	KNX TP1	276
13.2.2.1.1	Physical Structure	276
13.2.2.1.2	Logical Structure.....	278

13.2.2.2	KNX IP	278
13.2.2.2.1	Physical Structure	278
13.2.2.2.2	Logical Structure	278
13.2.2.3	Communication Objects	278
13.2.2.4	Physical Device Address	279
13.2.2.5	Logical Group Address	279
13.2.2.6	EIB Interworking Standard (EIS) Types	280
13.2.2.7	Interworking Datapoint Types (DPTs)	282
13.2.2.8	Control and Programming	282
13.2.2.8.1	Brief Description of ETS Functions.....	282
13.2.3	Network Communication	283
13.2.3.1	Data transmission.....	283
13.2.3.2	KNXnet/IP Protocol.....	284
13.3	MODBUS Functions	287
13.3.1	General	287
13.3.2	Use of the MODBUS Functions.....	290
13.3.3	Description of the MODBUS Functions	291
13.3.3.1	Function Code FC1 (Read Coils)	292
13.3.3.2	Function Code FC2 (Read Discrete Inputs).....	294
13.3.3.3	Function Code FC3 (Read Multiple Registers)	296
13.3.3.4	Function Code FC4 (Read Input Registers).....	297
13.3.3.5	Function Code FC5 (Write Coil)	298
13.3.3.6	Function Code FC6 (Write Single Register)	299
13.3.3.7	Function Code FC11 (Get Comm Event Counter)	300
13.3.3.8	Function Code FC15 (Write Multiple Coils).....	301
13.3.3.9	Function Code FC16 (Write Multiple Registers)	303
13.3.3.10	Function Code FC22 (Mask Write Register).....	304
13.3.3.11	Function Code FC23 (Read/Write Multiple Registers)	305
13.3.4	MODBUS Register Mapping	307
13.3.5	MODBUS Registers	310
13.3.5.1	Accessing Register Values	311
13.3.5.2	Watchdog Registers	311
13.3.5.3	Diagnostic Registers	317
13.3.5.4	Configuration Registers	318
13.3.5.5	Firmware Information Registers.....	323
13.3.5.6	Constant Registers	325
14	I/O Modules	327
14.1	Overview	327
14.2	Process Data Architecture for MODBUS/TCP	328
14.2.1	Digital Input Modules.....	329
14.2.1.1	1 Channel Digital Input Module with Diagnostics	329
14.2.1.2	2 Channel Digital Input Modules	329
14.2.1.3	2 Channel Digital Input Module with Diagnostics	329
14.2.1.4	2 Channel Digital Input Module with Diagnostics and Output Process Data.....	330
14.2.1.5	4 Channel Digital Input Modules	330
14.2.1.6	8 Channel Digital Input Modules	330
14.2.1.7	8 Channel Digital Input Module PTC with Diagnostics and Output Process Data.....	331
14.2.1.8	16 Channel Digital Input Modules	331

14.2.2	Digital Output Modules	332
14.2.2.1	1 Channel Digital Output Module with Input Process Data	332
14.2.2.2	2 Channel Digital Output Modules	332
14.2.2.3	2 Channel Digital Input Modules with Diagnostics and Input Process Data	333
14.2.2.4	4 Channel Digital Output Modules	334
14.2.2.5	4 Channel Digital Output Modules with Diagnostics and Input Process Data	334
14.2.2.6	8 Channel Digital Output Module	334
14.2.2.7	8 Channel Digital Output Modules with Diagnostics and Input Process Data	335
14.2.2.8	16 Channel Digital Output Modules	335
14.2.2.9	8 Channel Digital Input/Output Modules	336
14.2.3	Analog Input Modules	337
14.2.3.1	1 Channel Analog Input Modules	337
14.2.3.2	2 Channel Analog Input Modules	337
14.2.3.3	4 Channel Analog Input Modules	338
14.2.3.4	3-Phase Power Measurement Module	339
14.2.3.5	8 Channel Analog Input Modules	340
14.2.4	Analog Output Modules	341
14.2.4.1	2 Channel Analog Output Modules	341
14.2.4.2	4 Channel Analog Output Modules	341
14.2.4.3	8 Channel Analog Output Modules	342
14.2.5	Specialty Modules	343
14.2.5.1	Counter Modules	343
14.2.5.2	Pulse Width Modules	345
14.2.5.3	Serial Interface Modules with alternative Data Format	345
14.2.5.4	Serial Interface Modules with Standard Data Format	346
14.2.5.5	Data Exchange Module	346
14.2.5.6	SSI Transmitter Interface Modules	346
14.2.5.7	Incremental Encoder Interface Modules	347
14.2.5.8	DC-Drive Controller	349
14.2.5.9	Stepper Controller	350
14.2.5.10	RTC Module	351
14.2.5.11	DALI/DSI Master Module	351
14.2.5.12	DALI Multi-Master Module	352
14.2.5.13	LON [®] FTT Module	354
14.2.5.14	EnOcean Radio Receiver	354
14.2.5.15	MP Bus Master Module	354
14.2.5.16	Bluetooth [®] RF-Transceiver	355
14.2.5.17	Vibration Velocity/Bearing Condition Monitoring VIB I/O	356
14.2.5.18	KNX/EIB/TP1 Module	356
14.2.5.19	AS-interface Master Module	357
14.2.6	System Modules	359
14.2.6.1	System Modules with Diagnostics	359
14.2.6.2	Binary Space Module	359
15	Accessories	360
15.1	Winsta [®] EIB Products for KNX Systems	360
16	Application Examples	361

16.1	Test of MODBUS protocol and fieldbus nodes	361
16.2	Visualization and Control using SCADA Software.....	361
17	Appendix.....	364
17.1	MIB II Groups.....	364
17.1.1	System Group	364
17.1.2	Interface Group.....	365
17.1.3	IP Group	367
17.1.4	IpRoute Table Group.....	368
17.1.5	ICMP Group	369
17.1.6	TCP Group.....	370
17.1.7	UDP Group.....	371
17.1.8	SNMP Group.....	372
17.2	WAGO MIB Groups	373
17.2.1	Company Group	373
17.2.2	Product Group	373
17.2.3	Versions Group.....	374
17.2.4	Real-Time Clock Group	375
17.2.5	Ethernet Group	376
17.2.6	Actual Error Group.....	376
17.2.7	PLC Project Group	377
17.2.8	Http Group.....	378
17.2.9	Ftp Group.....	378
17.2.10	Sntp Group.....	379
17.2.11	Snmp Group.....	379
17.2.12	Snmp Trap String Group	381
17.2.13	Snmp User Trap String Group.....	382
17.2.14	Plc Connection Group	382
17.2.15	Modbus Group.....	383
17.2.16	Process Image Group.....	383
17.2.17	Plc Data Group	385
18	Use in Hazardous Environments	385
18.1	Marking Configuration Examples.....	386
18.1.1	Marking for Europe According to ATEX and IEC-Ex	386
18.1.2	Marking for America According to NEC 500.....	391
18.2	Installation Regulations.....	392
18.2.1	Special Conditions for Safe Use (TÜV 14 ATEX 148929 X)	393
18.2.2	Special Conditions for Safe Use (ATEX Certificate TÜV 12 ATEX 106032 X).....	394
18.2.3	Special Conditions for Safe Use (IEC-Ex Certificate TUN 14.0035X).....	395
18.2.4	Special Conditions for Safe Use (IEC-Ex Certificate IECEX TUN 12.0039 X).....	396
18.2.5	Special Conditions for Safe Use according to ANSI/ISA 12.12.01	397
	Glossary	398
	Literature List.....	414
	List of Figures	415
	List of Tables.....	418

1 Notes about this Documentation



Note

Always retain this documentation!

This documentation is part of the product. Therefore, retain the documentation during the entire service life of the product. Pass on the documentation to any subsequent user. In addition, ensure that any supplement to this documentation is included, if necessary.

1.1 Validity of this Documentation

This documentation is only applicable to the “KNX IP Controller” (750-889).

The product “KNX IP Controller” (750-889) shall only be installed and operated according to the instructions in this manual and the system description for the WAGO-I/O-SYSTEM 750.

NOTICE

Consider power layout of the WAGO-I/O-SYSTEM 750!

In addition to these operating instructions, you will also need the system description for the WAGO-I/O-SYSTEM 750, which can be downloaded at www.wago.com. There, you can obtain important information including information on electrical isolation, system power and supply specifications.

1.2 Copyright

This Manual, including all figures and illustrations, is copyright-protected. Any further use of this Manual by third parties that violate pertinent copyright provisions is prohibited. Reproduction, translation, electronic and phototechnical filing/archiving (e.g., photocopying) as well as any amendments require the written consent of WAGO Kontakttechnik GmbH & Co. KG, Minden, Germany. Non-observance will involve the right to assert damage claims.

1.3 Symbols

DANGER

Personal Injury!

Indicates a high-risk, imminently hazardous situation which, if not avoided, will result in death or serious injury.

DANGER



Personal Injury Caused by Electric Current!

Indicates a high-risk, imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING

Personal Injury!

Indicates a moderate-risk, potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

Personal Injury!

Indicates a low-risk, potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

NOTICE

Damage to Property!

Indicates a potentially hazardous situation which, if not avoided, may result in damage to property.

NOTICE



Damage to Property Caused by Electrostatic Discharge (ESD)!

Indicates a potentially hazardous situation which, if not avoided, may result in damage to property.

Note



Important Note!

Indicates a potential malfunction which, if not avoided, however, will not result in damage to property.



Information

Additional Information:

Refers to additional information which is not an integral part of this documentation (e.g., the Internet).

1.4 Number Notation

Table 1: Number Notation

Number Code	Example	Note
Decimal	100	Normal notation
Hexadecimal	0x64	C notation
Binary	'100' '0110.0100'	In quotation marks, nibble separated with dots (.)

1.5 Font Conventions

Table 2: Font Conventions

Font Type	Indicates
<i>italic</i>	Names of paths and data files are marked in italic-type. e.g.: <i>C:\Program Files\WAGO Software</i>
Menu	Menu items are marked in bold letters. e.g.: Save
>	A greater-than sign between two names means the selection of a menu item from a menu. e.g.: File > New
Input	Designation of input or optional fields are marked in bold letters, e.g.: Start of measurement range
“Value”	Input or selective values are marked in inverted commas. e.g.: Enter the value “4 mA” under Start of measurement range .
[Button]	Pushbuttons in dialog boxes are marked with bold letters in square brackets. e.g.: [Input]
[Key]	Keys are marked with bold letters in square brackets. e.g.: [F5]

2 Important Notes

This section includes an overall summary of the most important safety requirements and notes that are mentioned in each individual section. To protect your health and prevent damage to devices as well, it is imperative to read and carefully follow the safety guidelines.

2.1 Legal Bases

2.1.1 Subject to Changes

WAGO Kontakttechnik GmbH & Co. KG reserves the right to provide for any alterations or modifications that serve to increase the efficiency of technical progress. WAGO Kontakttechnik GmbH & Co. KG owns all rights arising from the granting of patents or from the legal protection of utility patents. Third-party products are always mentioned without any reference to patent rights. Thus, the existence of such rights cannot be excluded.

2.1.2 Personnel Qualifications

All sequences implemented on WAGO-I/O-SYSTEM 750 devices may only be carried out by electrical specialists with sufficient knowledge in automation. The specialists must be familiar with the current norms and guidelines for the devices and automated environments.

All changes to the coupler or controller should always be carried out by qualified personnel with sufficient skills in PLC programming.

2.1.3 Use of the WAGO-I/O-SYSTEM 750 in Compliance with Underlying Provisions

Fieldbus couplers, fieldbus controllers and I/O modules found in the modular WAGO-I/O-SYSTEM 750 receive digital and analog signals from sensors and transmit them to actuators or higher-level control systems. Using programmable controllers, the signals can also be (pre-) processed.

The devices have been developed for use in an environment that meets the IP20 protection class criteria. Protection against finger injury and solid impurities up to 12.5 mm diameter is assured; protection against water damage is not ensured. Unless otherwise specified, operation of the devices in wet and dusty environments is prohibited.

Operating the WAGO-I/O-SYSTEM 750 devices in home applications without further measures is only permitted if they meet the emission limits (emissions of interference) according to EN 61000-6-3. You will find the relevant information in the section “Device Description” > “Standards and Guidelines” in the manual for the used fieldbus coupler/controller.

Appropriate housing (per 2014/34/EU) is required when operating the WAGO-I/O-SYSTEM 750 in hazardous environments. Please note that a prototype test certificate must be obtained that confirms the correct installation of the system in a housing or switch cabinet.

2.1.4 Technical Condition of Specified Devices

The devices to be supplied ex works are equipped with hardware and software configurations, which meet the individual application requirements. WAGO Kontakttechnik GmbH & Co. KG will be exempted from any liability in case of changes in hardware or software as well as to non-compliant usage of devices.

Please send your request for modified and new hardware or software configurations directly to WAGO Kontakttechnik GmbH & Co. KG.

2.2 Safety Advice (Precautions)

For installing and operating purposes of the relevant device to your system the following safety precautions shall be observed:



DANGER

Do not work on devices while energized!

All power sources to the device shall be switched off prior to performing any installation, repair or maintenance work.

DANGER

Install the device only in appropriate housings, cabinets or in electrical operation rooms!

The WAGO-I/O-SYSTEM 750 and its components are an open system. As such, install the system and its components exclusively in appropriate housings, cabinets or in electrical operation rooms. Allow access to such equipment and fixtures to authorized, qualified staff only by means of specific keys or tools.

NOTICE

Do not use in telecommunication circuits!

Only use devices equipped with ETHERNET or RJ-45 connectors in LANs. Never connect these devices with telecommunication networks.

NOTICE

Replace defective or damaged devices!

Replace defective or damaged device/module (e.g., in the event of deformed contacts), since the long-term functionality of device/module involved can no longer be ensured.

NOTICE

Protect the components against materials having seeping and insulating properties!

The components are not resistant to materials having seeping and insulating properties such as: aerosols, silicones and triglycerides (found in some hand creams). If you cannot exclude that such materials will appear in the component environment, then install the components in an enclosure being resistant to the above-mentioned materials. Clean tools and materials are imperative for handling devices/modules.

NOTICE**Clean only with permitted materials!**

Clean soiled contacts using oil-free compressed air or with ethyl alcohol and leather cloths.

NOTICE**Do not use any contact spray!**

Do not use any contact spray. The spray may impair contact area functionality in connection with contamination.

NOTICE**Do not reverse the polarity of connection lines!**

Avoid reverse polarity of data and power supply lines, as this may damage the devices involved.

NOTICE**Avoid electrostatic discharge!**

The devices are equipped with electronic components that may be destroyed by electrostatic discharge when touched. Please observe the safety precautions against electrostatic discharge per DIN EN 61340-5-1/-3. When handling the devices, please ensure that environmental factors (personnel, work space and packaging) are properly grounded.

2.3 Special Use Conditions for ETHERNET Devices

If not otherwise specified, ETHERNET devices are intended for use on local networks. Please note the following when using ETHERNET devices in your system:

- Do not connect control components and control networks to an open network such as the Internet or an office network. WAGO recommends putting control components and control networks behind a firewall.
- Limit physical and electronic access to all automation components to authorized personnel only.
- Change the default passwords before first use! This will reduce the risk of unauthorized access to your system.
- Regularly change the passwords used! This will reduce the risk of unauthorized access to your system.
- If remote access to control components and control networks is required, use a Virtual Private Network (VPN).
- Regularly perform threat analyses. You can check whether the measures taken meet your security requirements.
- Use “defense-in-depth” mechanisms in your system's security configuration to restrict the access to and control of individual products and networks.

3 System Description

The WAGO-I/O-SYSTEM 750 is a modular, fieldbus-independent input/output system (I/O system). The configuration described here consists of a fieldbus coupler/controller (1) and the modular I/O modules (2) for any signal shapes that form the fieldbus node together. The end module (3) completes the node and is required for correct operation of the fieldbus node.

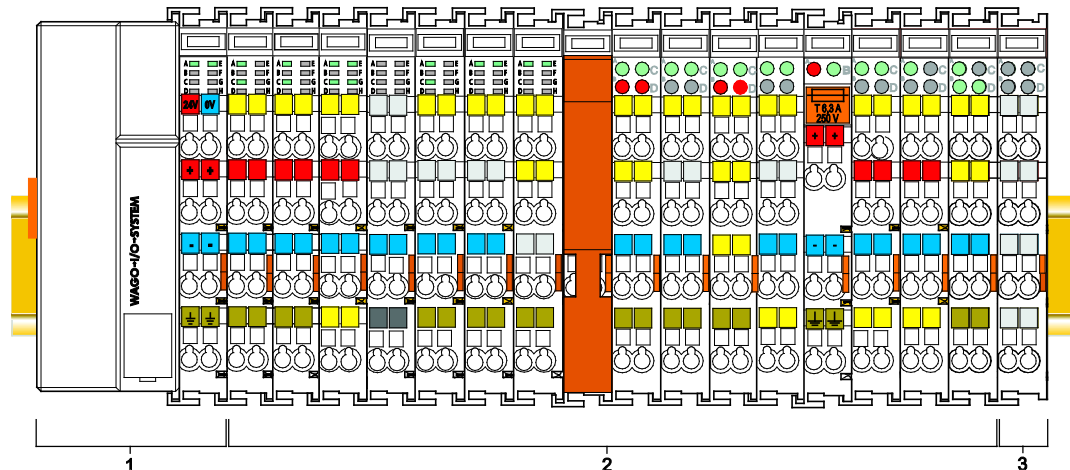


Figure 1: Fieldbus Node (Example)

Fieldbus couplers/controllers are available for different fieldbus systems.

The extended ECO fieldbus couplers contain the fieldbus interface, electronics and a power supply terminal. The fieldbus interface forms the physical interface to the relevant fieldbus. The electronics process the data of the bus modules and make it available for the fieldbus communication. The 24 V system supply and the 24 V field supply are fed in via the integrated power supply terminal.

The fieldbus coupler/controller communicates via the relevant fieldbus. The programmable fieldbus controller (PFC) enables the implementation of additional PLC functions. Programming is done with the WAGO-I/O-PRO in accordance with IEC 61131-3.

I/O modules for diverse digital and analog I/O signals as well as special functions can be connected to the fieldbus coupler/controller. The communication between the fieldbus coupler/controller and the I/O modules is carried out via an internal bus.

The components of the WAGO-I/O-SYSTEM 750 have clear termination points, light emitting diodes for status display, plug-in mini WSB tags and group marker cards for labeling.

The 1, 2 or 3 wire technology supplemented by a ground wire connection allows for direct sensor or actuator wiring.

3.1 Manufacturing Number

The serial number indicates the delivery status directly after production. This number is part of the labeling on the side of each component.

In addition, the serial number is printed on the cover cap of the configuration and programming interface of the fieldbus coupler/controller, so that it can also be read when installed.

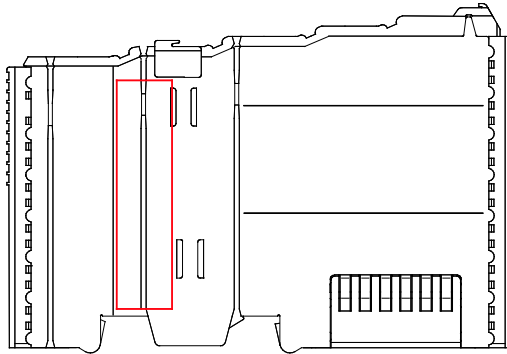


Figure 2: Marking Area for Serial Numbers

There are two serial numbers in two rows in the side marking. They are left of the release tab. The first 10 positions in the longer row of the serial numbers contain version and date identifications.

Example structure of the rows: 0114010101...

01	14	01	01	01	(additional positions)
WW	YY	FW --	HW	FL	-
Calendar	Year	Firmware	Hardware	Firmware	Internal information
week		version	version	loader	
				version	

The row order can vary depending on the production year, only the longer row is relevant. The back part of this and the shorter row contain internal administration information from the manufacturer.

3.2 Hardware Address (MAC ID)

Each KNX IP Controller has an internationally unambiguous physical address, referred to as the MAC-ID (Media Access Control Identity).

As part of the labeling on the right side of this component, the MAC ID is printed in the block diagram of the fieldbus coupler/controller.

In addition, the MAC ID is located on the paper strip with two self-adhesive peel-off strips on the left side of the fieldbus coupler/controller.

The MAC ID has a fixed length of 6 bytes (48 bits) which are presented hexadecimal. The first three bytes identify the manufacturer (e.g. 00:30 DE for WAGO). The second 3 bytes comprise the unique serial number of the hardware.

3.3 Component Update

For the case of an update of one component, the lateral marking on each component contains a prepared matrix.

This matrix makes columns available for altogether three updates to the entry of the current update data, like production order number (NO; starting from calendar week 13/2004), date stamp (DS), software version (SW), hardware version (HW) and the firmware loader version (FWL, if available).

Current version data for		1. Update	2. Update	3. Update	
Production order no.	NO				← only starting from calendar week 13/2004
Date stamp	DS				
Software version	SW				
Hardware version	HW				← only for fieldbus couplers/controllers
Firmware loader vers.	FWL				

If the update of a component took place, the current version data are registered into the columns of the matrix.

Additionally with the update of a fieldbus coupler or controller also the cover of the configuration and programming interface of the fieldbus coupler or controller is imprinted with the current production order number.

The original manufacturing information on the device's housing remains unchanged.

3.4 Storage, Assembly and Transport

Whenever possible, the components are to be stored in their original packaging. Likewise, the original packaging provides optimal protection during transport.

When assembling or repacking the components, the contacts must not be soiled or damaged. The components must be stored and transported in appropriate containers/packaging. Thereby, the ESD information is to be regarded.

3.5 Assembly Guidelines/Standards

- DIN 60204 Electrical equipment of machines
- DIN EN 50178 Electronic equipment for use in power installations (replacement for VDE 0160)
- EN 60439 Low-voltage switchgear and controlgear assemblies

3.6 Power Supply

3.6.1 Isolation

Within the fieldbus node, there are three electrically isolated potentials:

- Electrically isolated fieldbus interface via transformer
- Electronics of the fieldbus couplers/controllers and the I/O modules (internal bus)
- All I/O modules have an electrical isolation between the electronics (internal bus, logic) and the field electronics. Some digital and analog input modules have each channel electrically isolated, please see catalog.

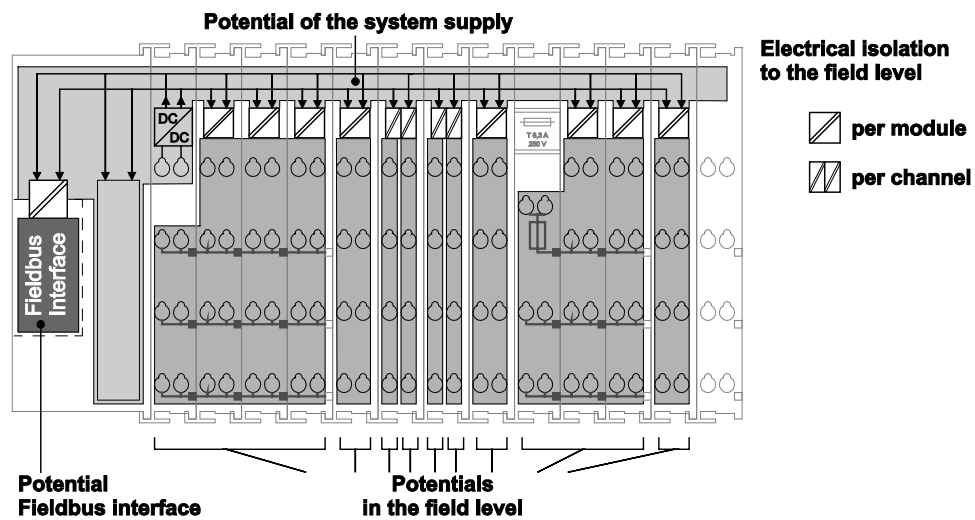


Figure 3: Isolation for Fieldbus Couplers/Controllers (Example)

3.6.2 System Supply

3.6.2.1 Connection

The WAGO-I/O-SYSTEM 750 requires a 24 V direct current system supply. The power supply is provided via the fieldbus coupler/controller and, if necessary, in addition via internal system supply modules 750-613. The power supply is reverse voltage protected.

NOTICE

Do not use an incorrect voltage/frequency!

The use of an incorrect supply voltage or frequency can cause severe damage to the components.

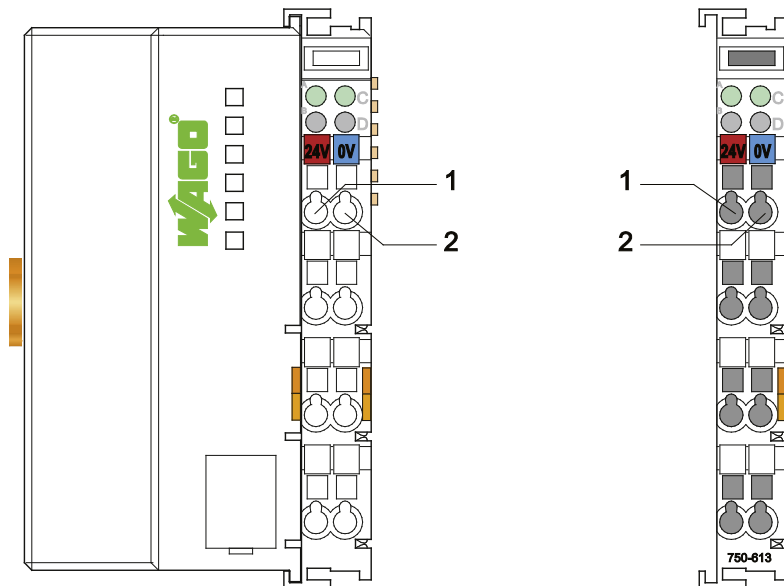


Figure 4: System Supply via Fieldbus Coupler/Controller (left) and via Internal System Supply Module (right)

Table 3: Legend for Figure “System Supply via Fieldbus Coupler/Controller (left) and via Internal System Supply Module (right)”

Position	Description
1	System supply DC 24 V (-25 % ... +30 %)
2	System supply 0 V

The fed DC 24 V supplies all internal system components, e.g. fieldbus coupler/controller electronics, fieldbus interface and I/O modules via the internal bus (5 V system voltage). The 5 V system voltage is galvanically connected to the 24 V system supply.

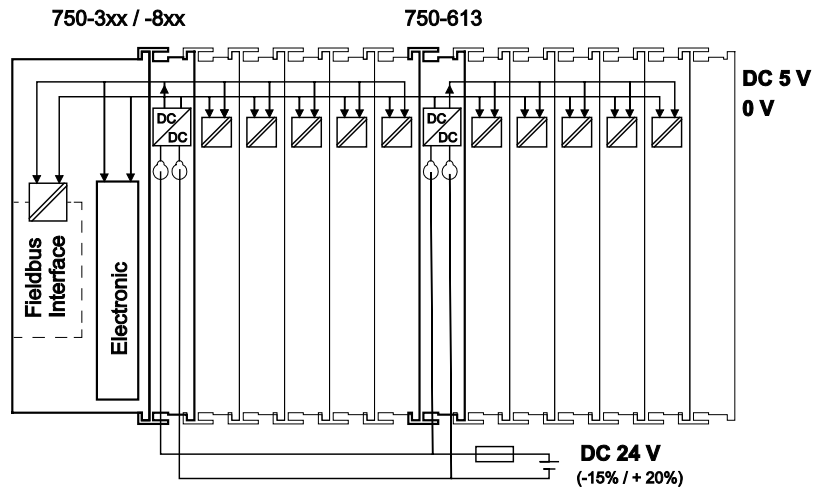


Figure 5: System Voltage for Standard Couplers/Controllers and Extended ECO Couplers

Note



Only reset the system simultaneously for all supply modules!

Reset the system by switching the system supply simultaneously at all supply modules (fieldbus coupler/controller and potential supply module with bus power supply) off and on again.

3.6.2.2 Dimensioning

Note



Recommendation

A stable power supply cannot always be assumed. Therefore, you should use regulated power supplies to ensure the quality of the supply voltage.

The supply capacity of the fieldbus coupler/controller or the internal system supply module can be taken from the technical data of the components.

Table 4: Alignment

Internal current consumption^{*)}	Current consumption via system voltage (5 V for electronics of I/O modules and fieldbus coupler/controller).
Total current for I/O modules^{*)}	Available current for the I/O modules. Provided by the bus power supply unit. See fieldbus coupler/controller and internal system supply module

^{*)} See current catalog, manuals, Internet

Example:**Calculating the current consumption on an Example Coupler:**

Internal current consumption	380 mA at 5 V
<u>Residual current for bus modules</u>	<u>1620 mA at 5 V</u>
Sum $I_{(5\text{ V})\text{ total}}$	2000 mA at 5V

The internal current consumption is indicated in the technical data for each bus terminal. In order to determine the total requirement, add together the values of all I/O modules in the node.

Note

Please note the aggregate current for I/O modules. It may be necessary to supply potential!

When the sum of the internal current consumption for the I/O modules exceeds their aggregate current, you must use a supply module with bus power supply. Install it before the position where the permissible aggregate current would be exceeded.

Example:**Calculating the total current on the example coupler described above:**

A node with the example coupler, which is described above, consists of:
20 relay modules (750-517) and 10 digital input modules (750-405).

Internal current consumption	$20 \times 90\text{ mA} = 1800\text{ mA at }5\text{ V}$
	$+ 10 \times 2\text{ mA} = 20\text{ mA at }5\text{ V}$
Sum	1820 mA at 5 V

The example coupler can only provide 1620 mA (see previous example) for the I/O modules. This value is given in the associated data sheet. Consequently, an internal system supply module with bus power supply (750-613), e. g. in the middle of the node, should be added.

Note**Recommendation**

Utilize the **smartDESIGNER** feature WAGO ProServe[®] software to configure fieldbus node assembly. You can test the configuration via the integrated plausibility check.

The maximum input current of the 24 V system supply is 500 mA. The exact electrical consumption ($I_{(V)}$) can be determined with the following formulas:

Fieldbus coupler or controller

$I_{(5\text{ V})\text{ total}}$ = Sum of all the internal current consumption of the connected I/O modules + internal current consumption of the fieldbus coupler/controller

Internal system supply module

$I_{(5\text{ V})\text{ total}}$ = Sum of all the internal current consumption of the connected I/O modules at internal system supply module

$$\text{Input current } I_{(24\text{ V})} = \frac{5\text{ V}}{24\text{ V}} \times \frac{I_{(5\text{ V})\text{ total}}}{\eta}$$

$$\eta = 0.87$$

(87 % Efficiency of the power supply at nominal load 24 V)



Note

Activate all outputs when testing the current consumption!

If the electrical consumption of a power supply point for the 24 V system supply exceeds 500 mA, then the cause may be an improperly dimensioned node or a defect.

During the test, you must activate all outputs.

3.6.3 Field Supply

3.6.3.1 Connection

Sensors and actuators can be directly connected to the relevant channel of the I/O module in 1, 2, 3 or 4 conductor connection technology. The I/O module supplies power to the sensors and actuators. The input and output drivers of some I/O modules require the field side supply voltage.

The fieldbus coupler/controller provides field side power (DC 24 V). In this case it is a passive power supply without protection equipment.

Power supply modules with or without fuse holder and diagnostic capability are available for the power supply of other field potentials (DC 24 V, AC/DC 0 ... 230 V, AC 120 V, AC 230 V). The power supply modules can also be used to set up various potential groups. The connections are connected in pairs to a power contact.

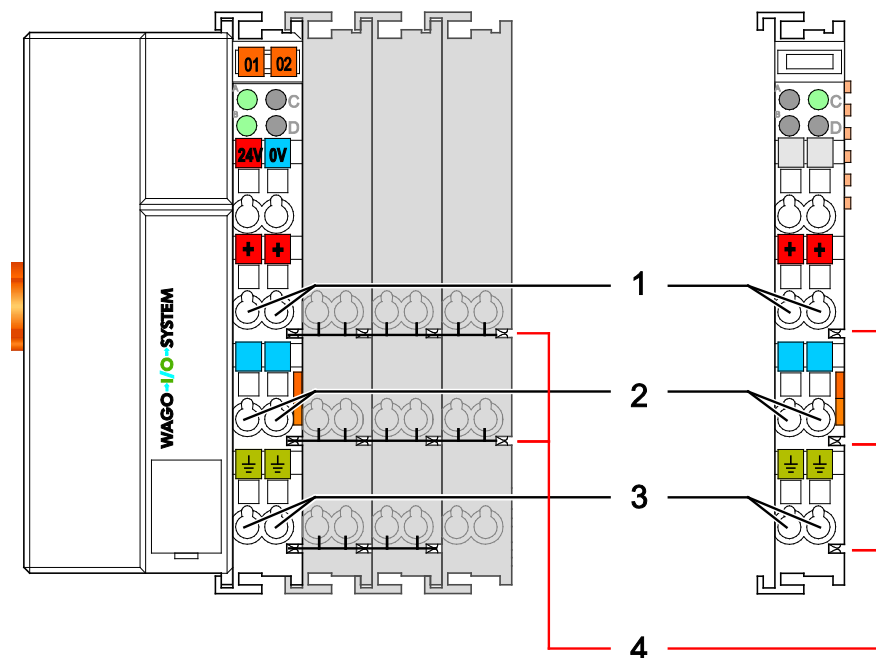


Figure 6: Field Supply for Standard Couplers/Controllers and Extended ECO Couplers

Table 5: Legend for Figure “Field Supply for Standard Couplers/Controllers and Extended ECO Couplers”

Field supply	
1	24 V (-15 % / +20 %)
2	0 V
3	Optional ground potential
Power jumper contacts	
4	Potential distribution to adjacent I/O modules

The field-side power supply is automatically derived from the power jumper contacts when snapping an I/O module.

The current load of the power contacts must not exceed 10 A on a continual basis.

By inserting an additional power supply module, the field supply via the power contacts is disrupted. From there a new power supply occurs which may also contain a new voltage potential.

Note



Re-establish the ground connection when the connection to the power jumper contacts is disrupted!

Some I/O modules have no or very few power contacts (depending on the I/O function). Due to this, the passing through of the relevant potential is disrupted. If you require a field supply via power jumper contacts for subsequent I/O modules, then you have to use a power supply module.

Note the data sheets of the I/O modules.

Note



Use a spacer module when setting up a node with different potentials!

In the case of a node setup with different potentials, e.g. the alteration from DC 24 V to AC 230 V, you should use a spacer module. The optical separation of the potentials acts as a warning to heed caution in the case of wiring and maintenance works. Thus, you can prevent the results of wiring errors.

3.6.3.2 Fusing

Internal fusing of the field supply is possible for various field voltages via an appropriate power supply module.

Table 6: Power Supply Modules

Order No.	Field Voltage
750-601	24 V DC, Supply/Fuse
750-609	230 V AC, Supply/Fuse
750-615	120 V AC, Supply/Fuse
750-617	24 V AC, Supply/Fuse
750-610	24 V DC, Supply/Fuse/Diagnosis
750-611	230 V AC, Supply/Fuse/Diagnosis
750-606	Supply Module 24 V DC, 1,0 A, Ex i
750-625/000-001	Supply Module 24 V DC, 1,0 A, Ex i (without diagnostics)

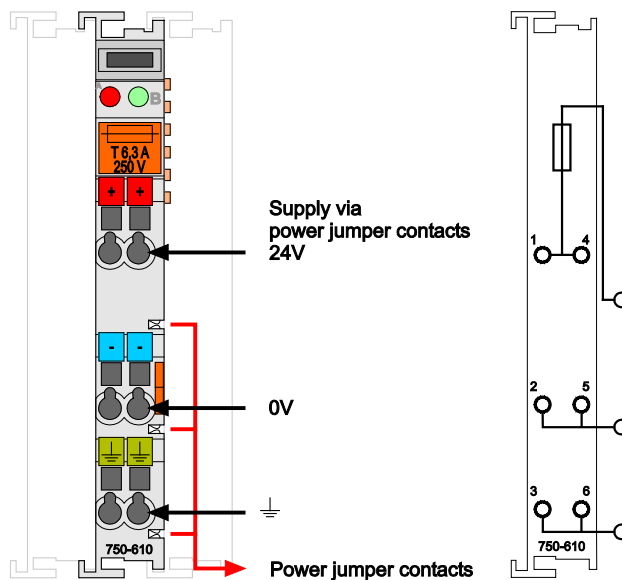


Figure 7: Supply Module with Fuse Carrier (Example 750-610)

NOTICE

Observe the maximum power dissipation and, if required, UL requirements!
In the case of power supply modules with fuse holders, you must only use fuses with a maximum dissipation of 1.6 W (IEC 127).
For UL approved systems only use UL approved fuses.

In order to insert or change a fuse, or to switch off the voltage in succeeding I/O modules, the fuse holder may be pulled out. In order to do this, use a screwdriver for example, to reach into one of the slits (one on both sides) and pull out the holder.



Figure 8: Removing the Fuse Carrier

Lifting the cover to the side opens the fuse carrier.

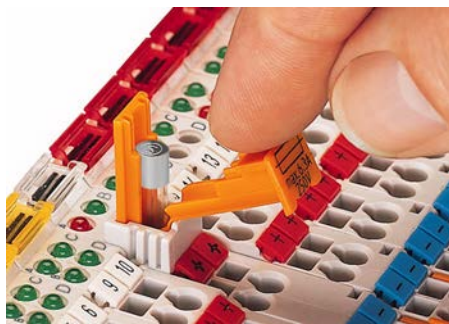


Figure 9: Opening the Fuse Carrier



Figure 10: Changing the Fuse

After changing the fuse, the fuse carrier is pushed back into its original position.

Alternatively, fusing can be done externally. The fuse modules of the WAGO series 281 and 282 are suitable for this purpose.

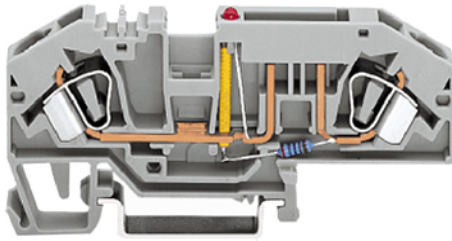


Figure 11: Fuse Modules for Automotive Fuses, Series 282

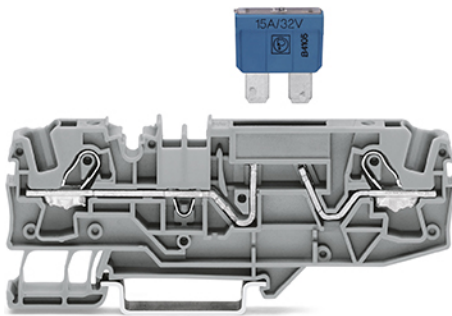


Figure 12: Fuse Modules for Automotive Fuses, Series 2006

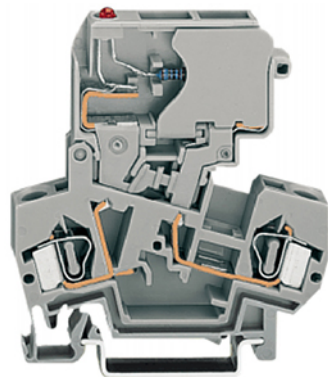


Figure 13: Fuse Modules with Pivotable Fuse Carrier, Series 281

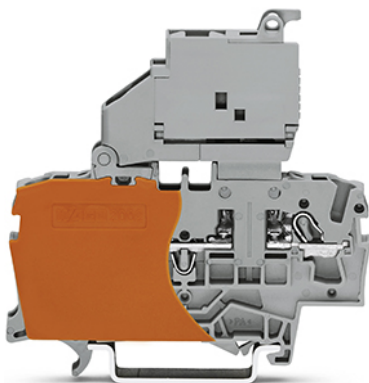


Figure 14: Fuse Modules with Pivotable Fuse Carrier, Series 2002

3.6.4 Supplementary Power Supply Regulations

The WAGO-I/O-SYSTEM 750 can also be used in shipbuilding or offshore and onshore areas of work (e. g. working platforms, loading plants). This is demonstrated by complying with the standards of influential classification companies such as Germanischer Lloyd and Lloyds Register.

Filter modules for 24 V supply are required for the certified operation of the system.

Table 7: Filter Modules for 24 V Supply

Order No.	Name	Description
750-626	Supply Filter	Filter module for system supply and field supply (24 V, 0 V), i. e. for fieldbus coupler/controller and bus power supply (750-613)
750-624	Supply Filter	Filter module for the 24 V field supply (750-602, 750-601, 750-610)

Therefore, the following power supply concept must be absolutely complied with.

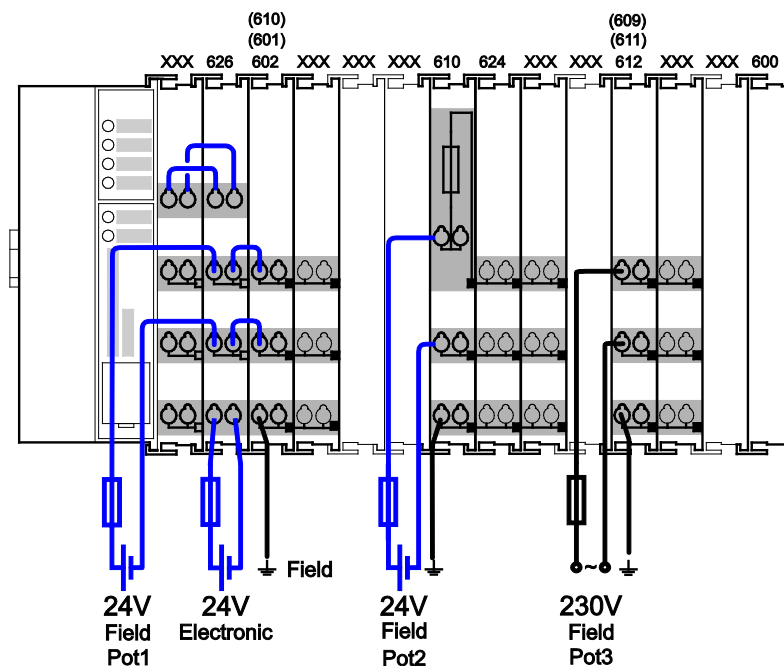


Figure 15: Power Supply Concept

Note



Use a supply module for equipotential bonding!

Use an additional 750-601/ 602/ 610 Supply Module behind the 750-626 Filter Module if you want to use the lower power jumper contact for equipotential bonding, e.g., between shielded connections and require an additional tap for this potential.

3.6.5 Supplementary Power Supply Regulations for KNX

The 750-626/020 Filter Module is required when a supply line exceeds 3 m between the fieldbus controller and the power supply.
Proper (certified) operation is ensured by using this filter module. The module filters the 24 V system power supply and is equipped with surge suppression.

NOTICE

Observe the isolation voltage!

When using the 750-626 /020 Filter Module, the isolation voltage of the field and electronic power supply is reduced to 150 V against ground.

NOTICE

Ensure the correct conductor cross-sectional area!

Use conductor cross-sections ranging from 0.08 mm² to 2.5 mm² (28 - 14 AWG) only for the CAGE-CLAMP[®] connections of the filter module.

Therefore, the following power supply requirements must be observed for cable runs > 3 m:

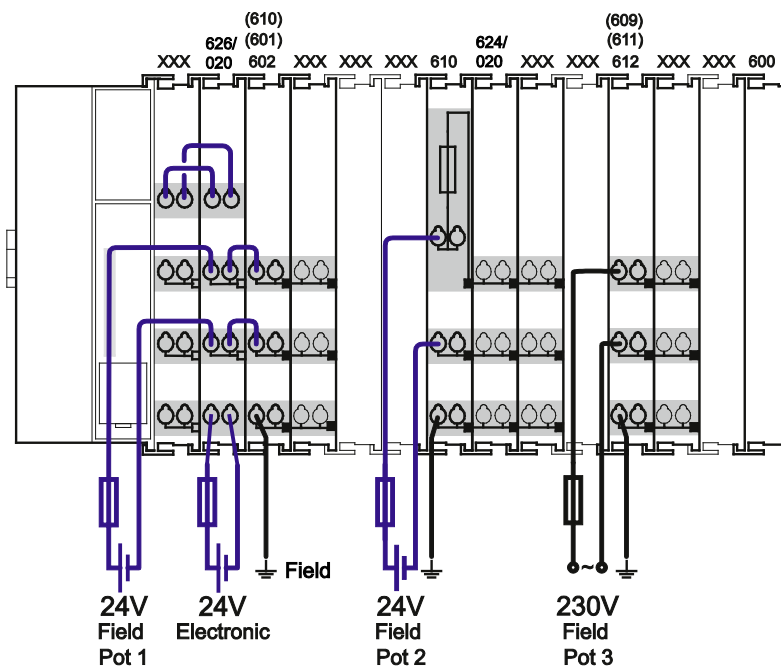


Figure 16: Power supply concept for cable runs > 3 m

Note



Use a supply module for equipotential bonding!

Use an additional 750-601/ 602/ 610 Supply Module behind the 750-626/020 Filter Module if you want to use the lower power jumper contact for equipotential bonding, e.g., between shielded connections and require an additional tap for this potential.

If you don't want to use the lower power jumper contact for equipotential bonding, a supply module is not required in addition to the 750-626/020 Filter Module. Power supply to the adjacent I/O modules is then performed directly via the power jumper contacts of the 750-626/020 Filter Module.

In addition to using a 750-601, 750-602 or 750-610 Supply Module, a 750-624/020 Filter Module is also required for any additional 24 V field power supply.

No filter module is required for a 230 V field power supply.

3.6.5.1 Notes



DANGER



Electric voltage!

Only operate the fieldbus controller with 24 V DC PELV (Protective Extra Low Voltage) or SELV (Safety Extra Low Voltage) power sources. There is a danger of electric shock if this precaution is not observed.

Note



Interruption of the supply voltage

If the power supply is interrupted by more than 1ms, the fieldbus controller is backed up and automatically restarted.

- To ensure electrical isolation, a power supply unit each for the electronic supply and the field supply must be used.
- Connect the power supply lines only when they are in a de-energized state.
- Keep power supply lines a sufficient distance away from electromagnetic sources of interference in order to maintain a high level of interference resistance of the 750 Series components against electromagnetic emissions.
- When laying any lines, make sure that you do not lay them within the shear range of movable machine parts.
- Observe the correct layout of the potential equalization.

3.6.6 Supply Example

Note



The system supply and the field supply shall be separated!

You should separate the system supply and the field supply in order to ensure bus operation in the event of a short-circuit on the actuator side.

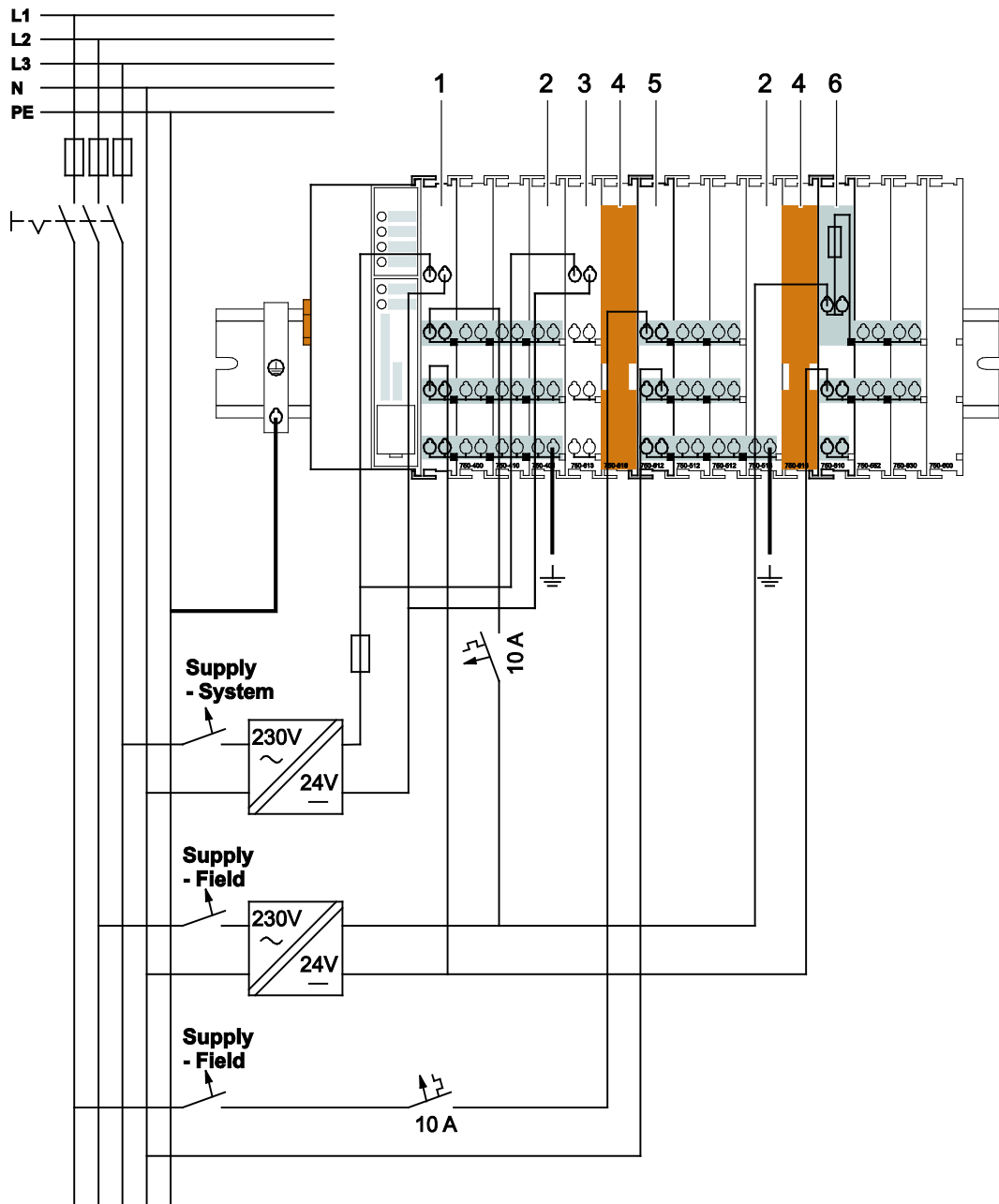


Figure 17: Supply Example for Standard Couplers/Controllers

Table 8: Legend for Figure “Supply Example for Fieldbus Coupler/Controller”

Pos.	Description
1	Power Supply on fieldbus coupler/controller via external Supply Module
2	Power Supply with optional ground
3	Internal System Supply Module
4	Separation module recommended
5	Supply Module passive
6	Supply Module with fuse carrier/diagnostics

3.6.6 Power Supply Unit

The WAGO-I/O-SYSTEM 750 requires a 24 VDC voltage (system supply).

Note



Recommendation

A stable power supply cannot always be assumed everywhere. Therefore, you should use regulated power supplies to ensure the quality of the supply voltage.

For brief voltage dips, a buffer (200 µF per 1 A load current) must be provided.

Note



Buffer for system power supply!

The system power supply must be buffered to bridge power outages. As the power demand depends on the respective node configuration, buffering is not implemented internally.

To achieve power outages of 1 ms to 10 ms according to IEC61131-2, determine the buffering appropriate for your node configuration and structure it as an external circuit.

The power demand must be determined individually depending on the entry point of the field supply. All loads through field devices and I/O modules must be taken into account. The field supply also impacts the I/O modules because the input and output drivers of some I/O modules require the voltage of the field supply.

Note



System and field supply must be isolated!

The system supply and field supply must be isolated to ensure bus operation in the event of short circuits on the actuator side.

Information



Power supply units are available in the eShop.

You can find suitable power supply units, e. g. from the EPSITRON series, in the eShop on www.wago.com.

3.7 Grounding

3.7.1 Grounding the DIN Rail

3.7.1.1 Framework Assembly

When setting up the framework, the carrier rail must be screwed together with the electrically conducting cabinet or housing frame. The framework or the housing must be grounded. The electrical connection is established via the screw. Thus, the carrier rail is grounded.



DANGER

Ensure sufficient grounding is provided!

You must take care to ensure the flawless electrical connection between the carrier rail and the frame or housing in order to guarantee sufficient grounding.

3.7.1.2 Insulated Assembly

Insulated assembly has been achieved when there is constructively no direct ohmic contact between the cabinet frame or machine parts and the carrier rail. Here, the earth ground must be set up via an electrical conductor in accordance with valid national safety regulations.



Note

Recommendation

The optimal setup is a metallic assembly plate with grounding connection which is electrically conductive linked to the carrier rail.

The separate grounding of the carrier rail can be easily set up with the aid of the WAGO ground wire terminals.

Table 10: WAGO Ground Wire Terminals

Order No.	Description
283-609	1-conductor ground (earth) terminal block make an automatic contact to the carrier rail; conductor cross section: 0.2 mm ² ... 16 mm ² Note: Also order the end and intermediate plate (283-320).

3.7.2 Grounding Function

The grounding function increases the resistance against electro-magnetic interferences. Some components in the I/O system have a carrier rail contact that dissipates electro-magnetic interferences to the carrier rail.

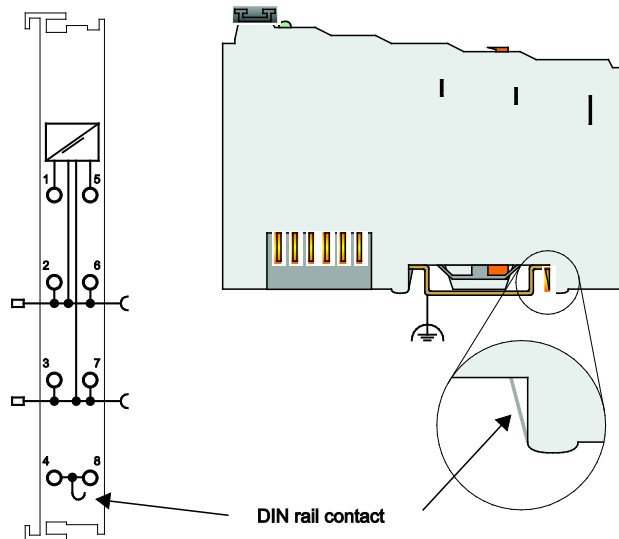


Figure 18: Carrier Rail Contact (Example)



⚠ DANGER

Ensure sufficient grounding is provided!

You must take care to ensure the direct electrical connection between the carrier rail contact and the carrier rail.

The carrier rail must be grounded.

For information on carrier rail properties, see section “Mounting” > ... > “Carrier Rail Properties”.

The bottom CAGE CLAMP[®] connectors of the supply modules enable optional connection of a field-side functional ground. This potential is made available to the I/O module arranged on the right through the spring-loaded contact of the three power contacts. Some I/O modules are equipped with a knife-edge contact that taps this potential. This forms a potential group with regard to functional ground with the I/O module arranged on the left.

3.8 Shielding

3.8.1 General

Use of shielded cables reduces electromagnetic interference and thus increases signal quality. Measurement errors, data transmission errors and interference due to excessive voltage can be prevented.

Note



Connect the cable shield to the ground potential!

Integrated shielding is mandatory to meet the technical specifications in regards to measuring accuracy. Connect the cable shield and ground potential at the inlet to the cabinet or housing. This allows induced interference to dissipate and to be kept away from devices in the cabinet or housing.

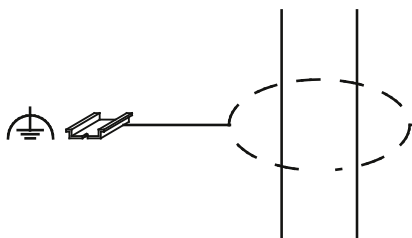


Figure 19: Cable Shield at Ground Potential

Note



Improve shielding performance by placing the shield over a large area!

Higher shielding performance is achieved via low-impedance connection between shield and ground. For this purpose, connect the shield over a large surface area, e.g., WAGO shield connecting system. This is especially recommended for large-scale systems where equalizing current or high impulse-type currents caused by atmospheric discharge may occur.

Note



Keep data and signal lines away from sources of interference!

Route data and signal lines separately from all high voltage cables and other sources of high electromagnetic emission (e.g., frequency converter or drives).

3.8.2 Bus Cables

The shielding of the bus line is described in the respective configuration guidelines and standards of the bus system.

3.8.3 Signal Lines

I/O modules for analog signals and some interface I/O modules are equipped with shield clamps.

Note



Use shielded signal lines!

Only use shielded signal lines for analog signals and I/O modules which are equipped with shield clamps. Only then can you ensure that the accuracy and interference immunity specified for the respective I/O module can be achieved even in the presence of interference acting on the signal cable.

3.8.4 WAGO Shield Connecting System

The WAGO shield connecting system consists of shield clamping saddles, busbars and various mounting carriers. These components can be used to achieve many different configurations.



Figure 20: Examples of the WAGO Shield Connecting System

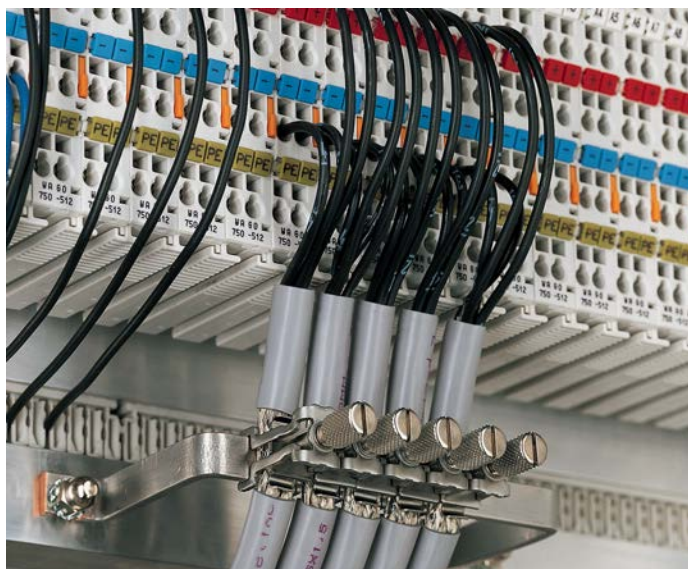


Figure 21: Application of the WAGO Shield Connecting System

4 The WAGO KNX Concept

As the demand for flexible and convenient electrical installations increases, more emphasis is given to convenient functionality combined with least energy consumption. This results in the development of modern, resource-saving systems for the building automation, using common infrastructures and combining all functions of intelligent house and building technologies across the trades.

KNX is well established as a flexible bus system for building automation in this field. The KNX standard is based on the bus standards of the European Installation bus (EIB), BatiBUS and European Home Systems (EHS). It assures compatibility and interoperability of the various devices and systems by different manufacturers.

For the activation of the KNX devices and networks, a central tool exists in the Engineering Tool Software (ETS) developed by the European-Installation-Bus-Association (EIBA, today “KNX-Association”) in cooperation with software developers and KNX/EIB manufacturers.

The WAGO KNX products, controller and module, are – in many respects – an innovative development in the field of KNX.

- The KNX IP controller 750-889 is utilized in the **KNX ETHERNET network** as a flexible, freely programmable application controller.
- The KNX/EIB/TP1 module 753-646 (abbreviated KNX module) provides the interface between a two-wire TP1 network to the WAGO controllers, which are used as freely programmable application controllers on the **TP1 network**.
- The KNX module expands the KNX IP controller to a full-scale KNXnet/IP router. This router couples TP1 networks to IP networks and also provides the access to ETS.
- The KNX IP controller contains two logical devices, of which one functions as application controller to be freely programmed. The other device becomes active when the KNX module is plugged and performs routing functions. Then, any further plugged KNX modules can be freely programmed.
- The KNX module can be operated on all programmable fieldbus controllers of the Series 750, as they are relevant for building automation, and it assumes gateway functions (e.g., protocol transformation between KNX and BACnet).

4.1 KNX IP Controller 750-889

The KNX IP controller works on the hardware basis of the WAGO ETHERNET controller 750-880. Except for EtherNet/IP, the same protocols are used for the data transfer. In addition, the KNX IP protocol is implemented. This protocol to the KNX standard combines the benefit of a high transmission rate of 10 to 100 Mbit via ETHERNET with the well-known KNX procedures for commissioning and communication between several controllers in the network.

In the controller hardware, two independent KNX devices - KNX IP device and KNXnet/IP router - are located which will become active depending on the application. Both KNX IP devices use a common IP configuration and have a common IP address. The devices only differ in their port numbers.

The controller is set up and configured with the ETS, the setup tool for KNX/EIB devices. In the ETS, the WAGO product database is imported containing the WAGO ETS Plug-in which provides the configuration of the WAGO KNX devices. Depending on the device type, the ETS decides how the device is displayed in the network, how it communicates and how it must be configured for such communication. The principal task of the ETS Plug-in is the assignment of the variables used in the application, to KNX group addresses via which the communication in the TP1 network is conducted.



Figure 22: KNX IP Controller 750-889

4.2 KNX/EIB/TP1 Module 753-646

The KNX module provides the connection to two-wire TP1 networks with a transmission rate of 9600 Baud. The wiring types and structures of subordinate networks are following the KNX standard.

Depending on the application situation, the module operates in the following operating modes:

- Router mode
- Device mode



Figure 23: KNX/EIB/TP1 Module 753-646

4.2.1 Router Mode

If KNX modules are operated on the KNX IP controller, the controller will automatically identify the **first module of this type** as a module with routing function. It does not matter how many **non-KNX** modules are plugged upstream. Further plugged KNX modules will be operated in device mode.

With the first plugged KNX module, a KNX IP controller can be operated as KNXnet/IP router, without additional PLC program (see note). A connection is established between the KNX IP network of the controller and the TP1 network at the first KNX module. The network of the KNX module becomes a subordinate line of the KNX IP network, creating a routing between twisted-pair and ETHERNET.

The router enables the direct access of the ETS – which is connected to the IP network of the controller – to the TP1 network, via the controller itself and the

Note



Router function can be deactivated in the Web-Based Management system!

You have the option of disabling the router functionality in the web-based management system on the “KNX” page. In this case, all connected KNX modules including the first one are operated in device mode.

It is assumed in the following that the routing function is enabled (default setting).

Note



Routing is possible only via the first plugged KNX module!

Routing is possible only via the first plugged KNX module. The routing function is independent from whether an IEC application is running on the controller. All other KNX modules plugged to the controller can be addressed only via the IEC-61131-3 application.

Note



IEC application is only required for the logic processing within the IP controller!

The PLC program in the controller is an IEC application, created with the programming tool WAGO-I/O-PRO in conformance with IEC-61131-3. An IEC application is only required for the logic processing within the IP controller.

4.2.2 Device Mode

If the KNX module operates as second or further module of this type on a WAGO KNX IP controller or if the first I/O module is deactivated in the Web-based management system, the KNX module will work in device mode. In this case, it is connected to the controller via the IEC-61131-3 application. The module also operates in device mode when it is operated at any location in another WAGO controller.

Communication objects are programmed in the IEC-61131-3 application. They represent a specific data format (e.g. DPT_Switch as 1 bit value) and are connected to actions such as “Switch light” or “Operate blinds”. The communication objects, of which each device owns at least one, are mapped in the ETS.

Via the linkage of these objects to the KNX group addresses, a connection is established between the IEC application of the controller and the network of the module. Depending on the number of plugged KNX modules, two or more independent TP1 networks can be interconnected. The commissioning of the controller with the assignment of communication objects to group addresses is performed using the ETS Plug-in.

If the module is operating on WAGO controllers, gateway functionalities to other fieldbus systems, such as LON, BACnet etc. can be realized. For the information of the subordinate TP1 network, as mapped in the process image, a specific address processing is required, which cannot be performed in the couplers or superordinate controllers. For this reason, an application of the KNX module on WAGO couplers is not possible.

The KNX I/O module can be operated on all programmable fieldbus controllers relevant for building automation.

4.3 Hardware Concept

The KNX IP controller features two RJ-45 connectors which are connected via a 2-port switch. Two logic devices are coupled to this switch, which devices differ in their port numbers but use a common IP address.

The first device connects the first plugged KNX module for routing operation between the IP and the TP1 networks. In addition to this module, additional modules for the connection of physical inputs and outputs or complex modules for the connection to networks such as DALI, MP-Bus and EnOcean can be plugged.

A possible node structure and the connection to TP1 and KNX IP networks are shown in the following figure.

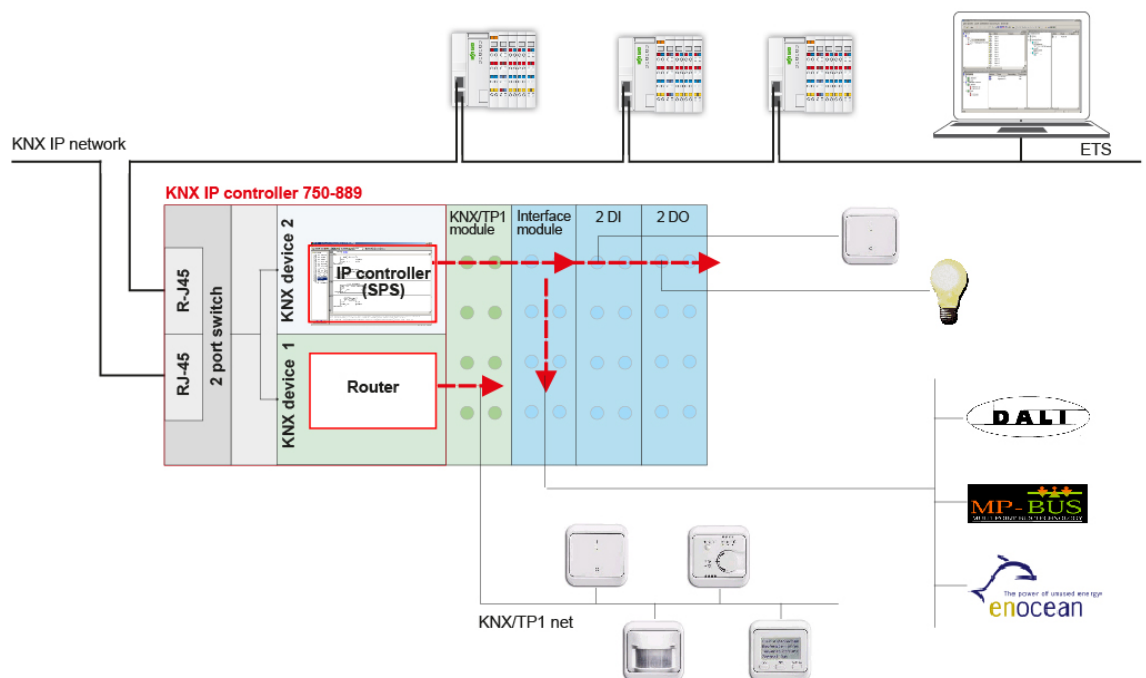


Figure 24: KNX Hardware Concept

During the startup phase, the controller recognizes the plugged modules. If a KNX module is detected on the KNX IP controller, the first module of this type is locked for the PLC function and serves only in the routing function for the connected TP1 network. All other devices connected via the 2nd to nth KNX module are connected using the IEC application.

4.4 Software Concept

The WAGO-I/O-PRO is a programming software standardized per IEC- 61131-3. This standard defines five programming languages: AWL (statement list - STL), ST (structured text), AS (process structure), FUP (function plan), KOP (contact plan). WAGO supports also the CFC function plan editor. The language selection depends on the respective application situation, personal knowledge and preferences. An application can be programmed freely using the WAGO-I/O-PRO software. Predefined function blocks can be integrated into the software to simplify the programming task (e. g., blinds, lighting, HVAC). There are specific function blocks realizing a connection to the TP1 network. Using an export file (SYM_XML file) imports, amongst others, the names and addresses of the function blocks as so-called network variables into the WAGO ETS Plug-in.

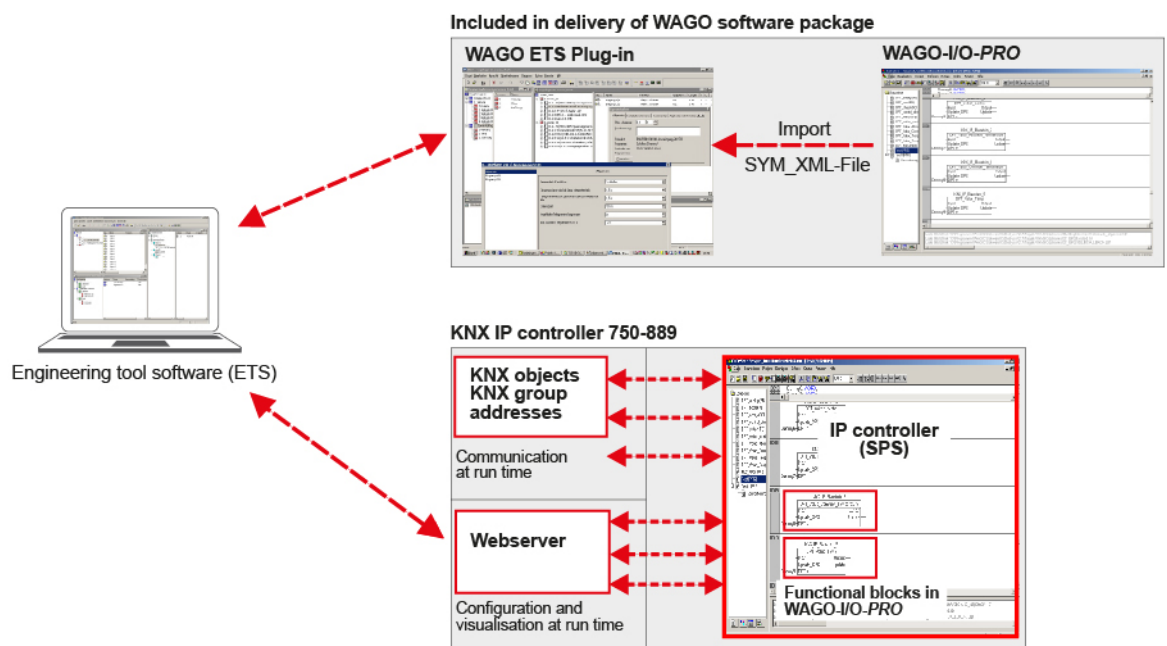


Figure 25: KNX Software Concept

Using the ETS or Excel spreadsheets, KNX group addresses are assigned to the network variables of the IEC application. Thus, communication objects are created, representing data formats, which are linked to specific actions. The mapping table from KNX and IEC specific addressing is loaded into the controller, enabling the exchange of messages in the TP1 network.

The controller contains a web server, permitting the user communication via a standard web browser. Pre-created webpages (web-based management) are contained in the web server, for the controller to be configured when in operation (e. g. port settings, protocols, etc). In addition, project-specific web visualizations can be created with WAGO-I/O-PRO and downloaded into the controller.

4.4.1 The IEC Application

A program is created using the *WAGO-I/O-PRO* software. The function blocks of the KNX library are loaded into this program, as they are required for the respective application situation for communication via the TP1 network. They serve as communication interface between the IEC variables and the KNX specific group addresses.

Upon creation of the program, it can be compiled, simulated and downloaded using the *WAGO-I/O-PRO* software.

For further processing of the IEC data in the TP1 network, a *SYM_XML* file is generated during the compilation of the IEC application. This *SYM_XML* file contains network variables generated from the IEC function blocks. The network variables bear the same names as the function blocks.

The data of the *SYM_XML* file are imported to the ETS Plug-in and processed there.

Information



Additional Information

Network variables provide for the communication in the TP1 network. They are of the DPT data type (data point type) and can be filtered for their EIS basic types during further processing in the ETS Plug-in. When network variables are linked to group addresses in the ETS Plug-in, communication objects are generated. They form the basis for the communication between the IEC application and the TP1 network.

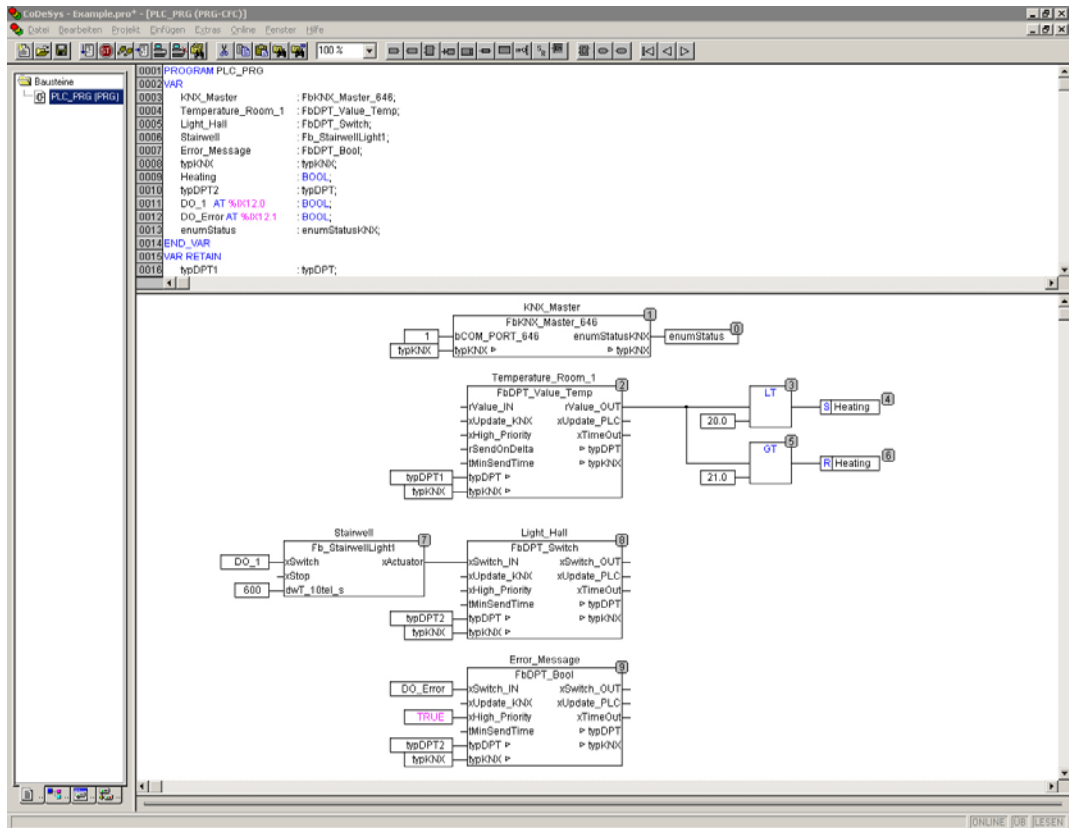


Figure 26: IEC Application with CFC Program (Function Plan Editor)

4.4.2 ETS, Product Database and Plug-in

The ETS software is the principal tool for the setup and configuration of KNX components. Here, building and network topologies are mapped and devices, such as controllers and modules, are integrated into the structure (see following figure).

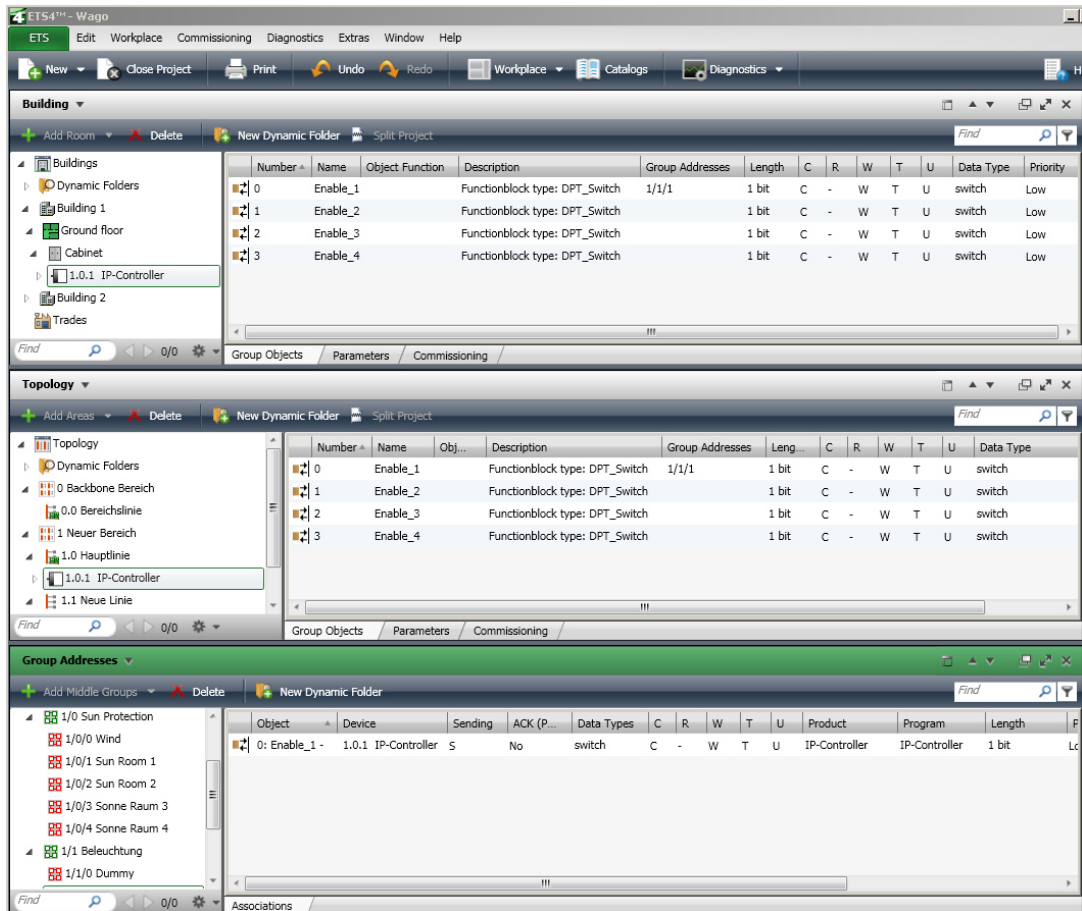


Figure 27: Surface of ETS

The two physical WAGO KNX devices (KNX IP controller and KNX module) have the following functions:

Table 11: Functions/Application Options for WAGO KNX Devices

Function	Components
IP (application) controller	750-889 KNX IP controller
Router	750-889 KNX IP controller + 753-646 KNX/EIB/TP1 module as 1 st plugged KNX/EIB/TP1 module
Device (gateway function)	750-889 KNX IP controller + 753-646 KNX/EIB/TP1 module as 2 nd to n th plugged KNX/EIB/TP1 module or 750-8xx WAGO fieldbus controller + 753-646 KNX/EIB/TP1 module as 1 st to n th plugged KNX/EIB/TP1 module

For the integration of three WAGO devices – “IP controller”, “router” and “module” - as device in ETS, the WAGO product database is imported. This database contains descriptions of the devices with all objects and parameters, as well as the WAGO ETS Plug-in.

The devices are parameterized with the WAGO ETS Plug-in. In addition, the SYM_XML file with the variables must be imported from WAGO-I/O-PRO.

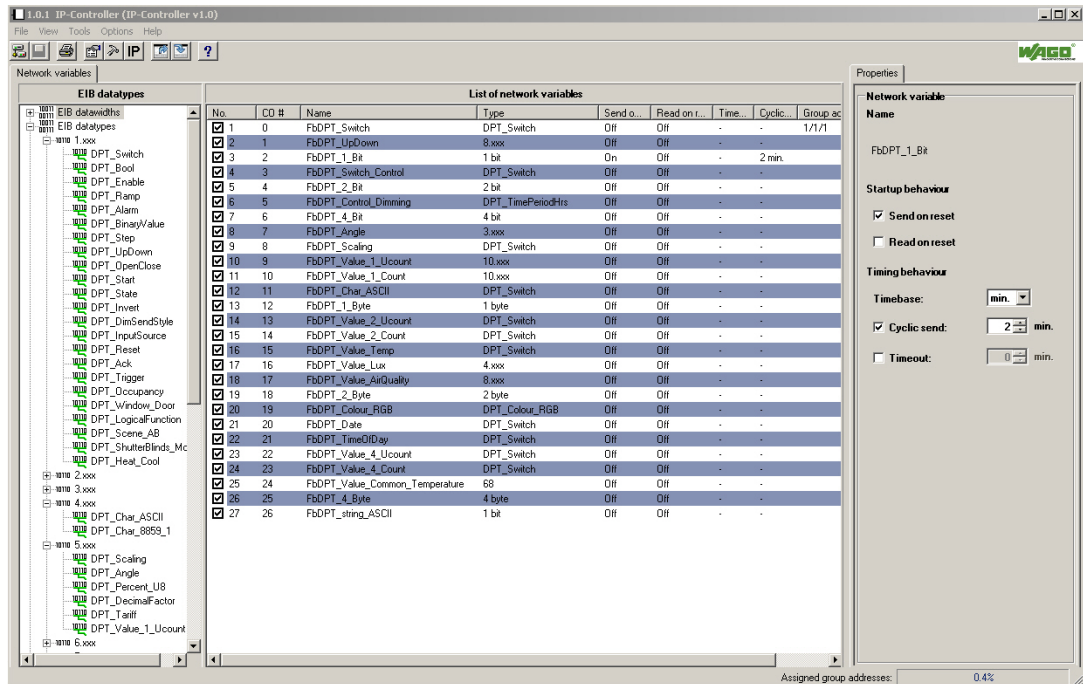


Figure 28: Surface of ETS Plug-ins

In the ETS, the variables are filed as communication objects (e.g., DPT_SWITCH for ON/OFF switching). They either represent EIB interworking standard types (EIS) or data point types (DPT's). The Plug-in is designed for the display of both types, enabling the selection between the EIS types used in the KNX environment and the new DPT variant. The DPTs offer a more detailed differentiation of the types. Where the 1 bit EIS type is defined for general switching between two states, the 1 bit DTP types number 14 already. In this case as well, two states are recognized in principle, but - in respect to the application - in much more detail, e.g., DPT_SWITCH (off/on), DPT_BOOL (false/true), (DPT_UPDOWN (up/down)).

This differentiation improves clarity. In addition, it offers the option to filter communication objects not only by their data width but also their function.

Group addresses are used in the KNX environment for the communication with other devices. They can be stored in the ETS. Group addresses are logical virtual connections to the data communication within the TP1 network. A group address is divided in main, medium and subgroup (e.g., 2/5/5) which can be freely defined for the actual application. If a device receives a telegram, it will be only evaluated when the device is registered in the group for this message. With these group addresses, the communication objects are easily linked using drag & drop.

A communication object can be assigned to several groups and a group may contain several communication objects. A group address owns only one sending communication object, however, several communication objects can respond to this one group address.

In addition to the device configuration, the KNX group addresses are loaded into the address table of the controller. The controller is thus prepared for communication in the TP1 network.

4.4.3 Web Visualization and Web-based Management

Two options are available for making changes to the HTML pages.

4.4.3.1 Web Visualization

The WAGO-I/O-PRO provides for a visualization of automation installations. For example, a lighting scheme can be mapped graphically and the graphical elements can then be linked to program variables. The finished visualization is then loaded to the controller and can be opened from any PC in the network, using a standard web browser.

The individual variable values can be modified via the web visualization. Hence, lamps may be turned on and off via predefined buttons, the lighting system status may be queried and whole lighting schemes can be modified. In this manner, complete HVAC systems can be represented and parameterized.

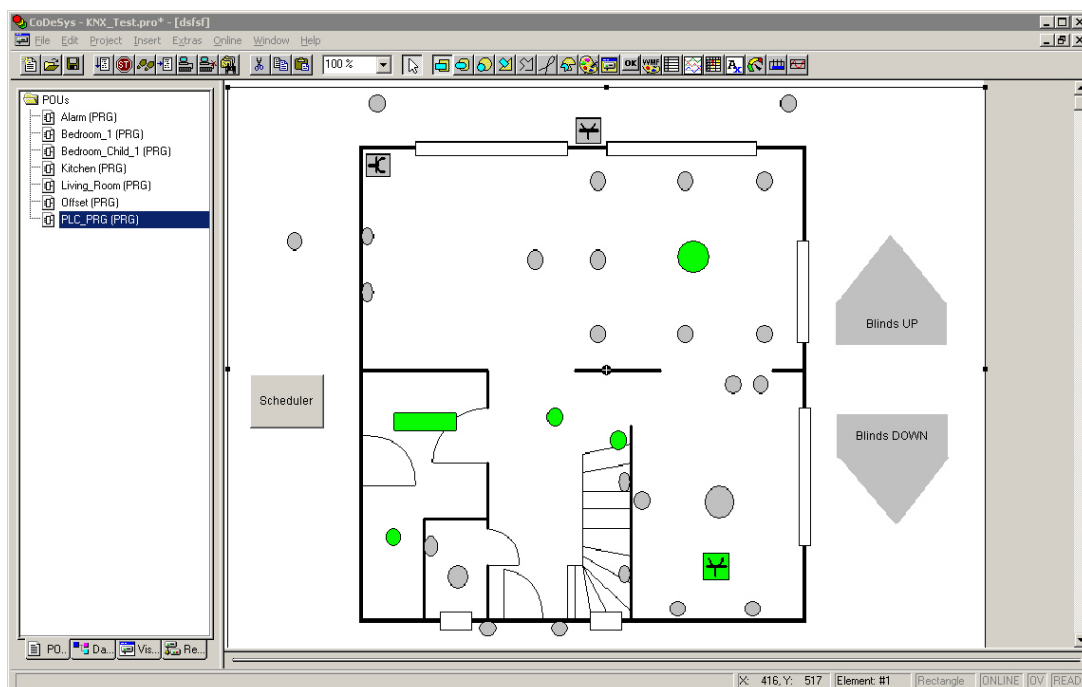



Figure 29: Web Visualization of a Residential Dwelling

4.4.3.2 Web-based Management

Administration and monitoring is performed with the web-based management system (WBM) which can be accessed using a browser. Contrary to the web visualization, the controller itself is configured in this case (e.g., transmission modes, protocols, switch ports, etc.). Such a WBM is present for configuration in every controller, even in a not yet programmed state.

Web-based Management



Status information

Coupler details

Order number	750-889
Mac address	0030DE026047
Firmware revision	01.01.12 (00)

Actual network settings

IP address	192.168.1.17 <small>Determined by DFLT Button</small>
Subnet mask	255.255.255.0
Gateway	0.0.0.0
Host Name	
Domain Name	
(S)NTP-Server	0.0.0.0
DNS-Server 1	0.0.0.0
DNS-Server 2	0.0.0.0

Module status

State Modbus Watchdog:	Disabled
Error code:	0
Error argument:	0
Error description:	Coupler running, OK

Figure 30: Sample Page of the Web-based Management System

4.5 Application Examples

The KNX IP controller 750-889 and the KNX/EIB/TP1 module 753-646 can be utilized in many ways and combined with other WAGO components. The KNX IP controller 750-889 features two internal devices: an application controller (IP controller with IEC program) and a router which becomes active when a KNX module is plugged in.

The following illustrates the main application options.

4.5.1 KNXnet/IP Router

In this application, the WAGO KNX IP controller is operated with the KNX module as a simple router in an IP backbone. An IEC application is not required for the router functionality. The ETS, connected to the IP backbone via ETHERNET, has access to all devices connected to the TP1 networks shown, using the KNX modules. The device 1.1.1 can communicate with device 1.2.1 via the IP backbone.

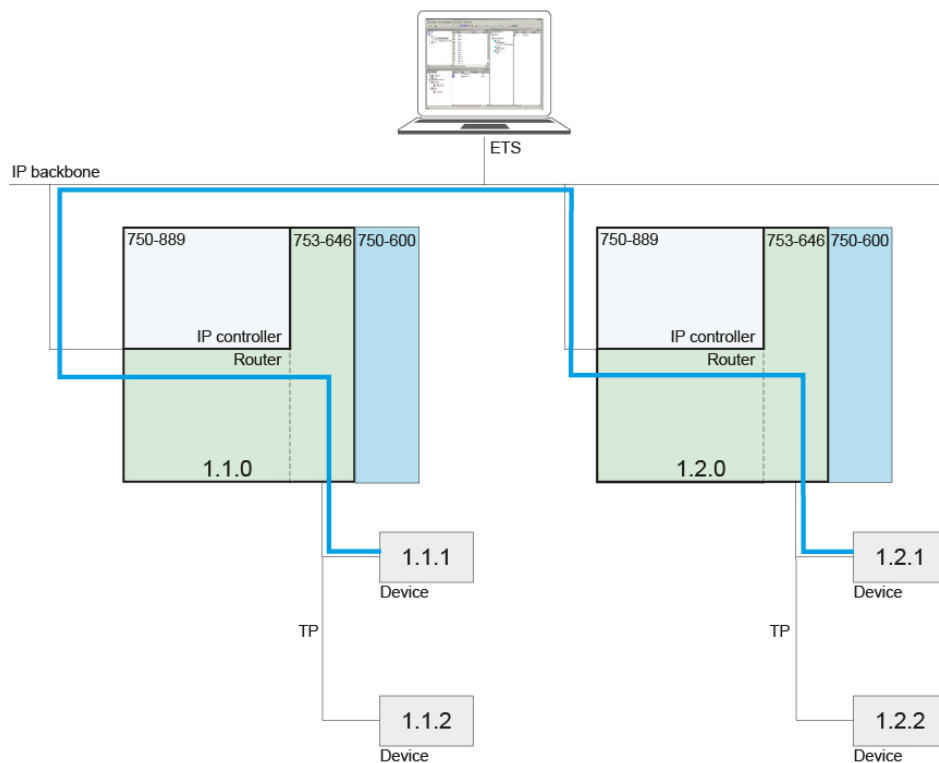


Figure 31: Application Example KNX IP Router

Components to be used

750-889	KNX IP controller	} Function as KNXnet/IP router
753-646	KNX/EIB/TP1 module	
750-600	End module	

4.5.2 KNX IP Application Controller + I/O Modules

In this application, the KNX IP controller functions as application controller with standard I/O modules only. The communication between conventional switches and lights does not require a routing function, and therefore, no KNX module.

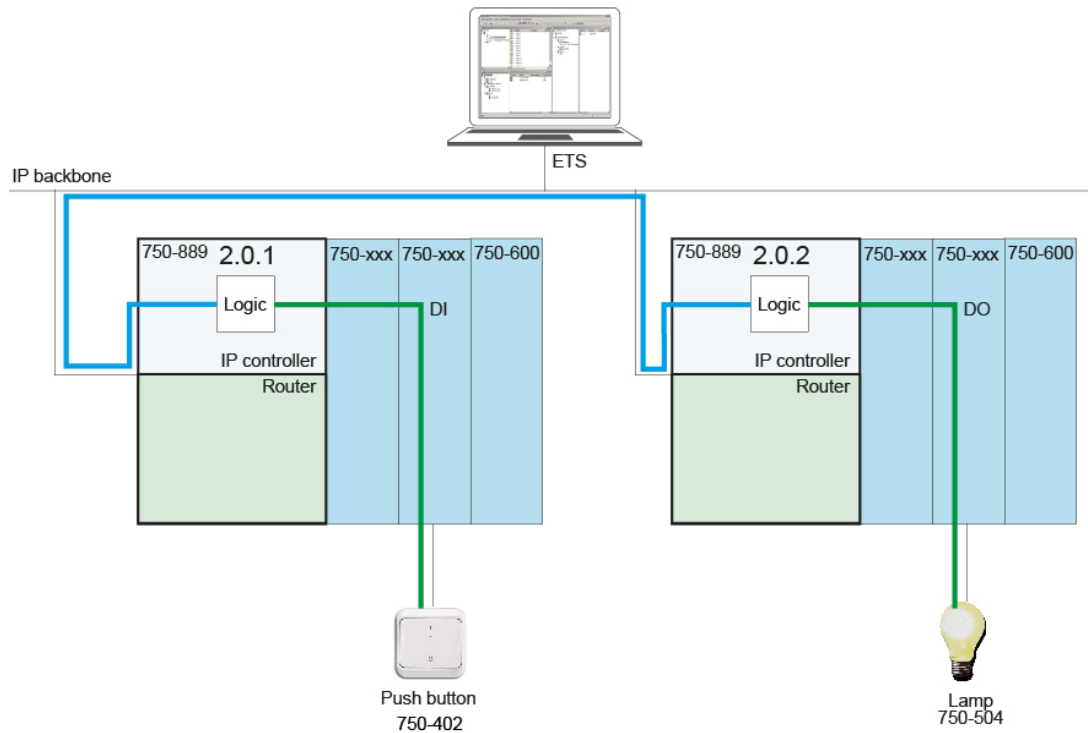


Figure 32: Application Example: KNX IP Application Controller + I/O Modules

Components to be used

- 750-889 KNX IP controller
- 75x-xxx Any modules of the WAGO-I/O-SYSTEM 750/753
- 750-600 End module

4.5.3 KNX IP Application Controller + Router

This application demonstrates the processing of data from two devices in the same TP1 network, displayed by a “logic” link. The data are made available to the controller via group address, are logically processed and returned to the network via other group addresses. The ETS has access to the application and the devices in the TP1 network.

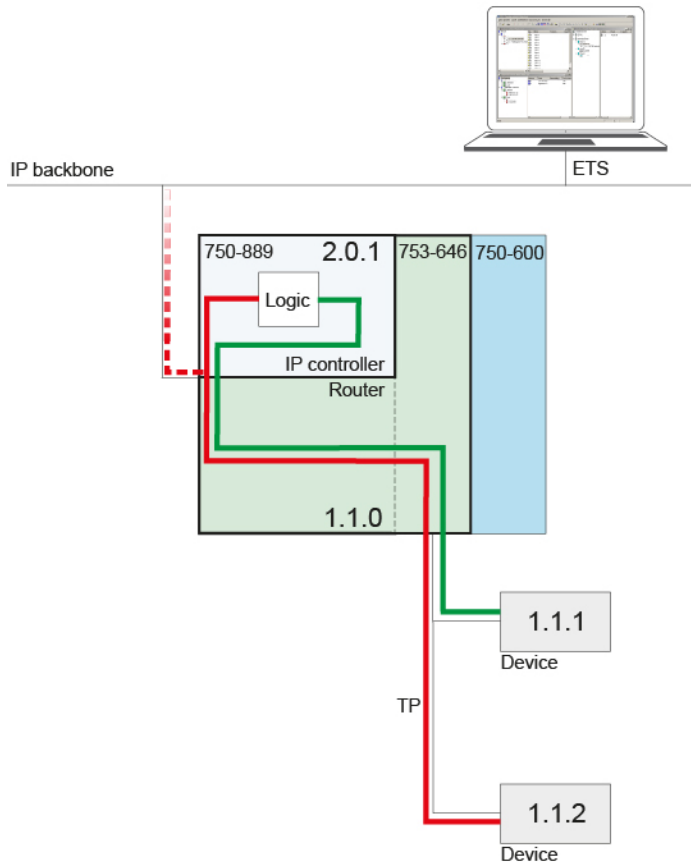


Figure 33: Application Example: KNX IP Application Controller + Router

Components to be used

750-889	KNX IP controller	} Function as KNXnet/IP router
753-646	KNX/EIB/TP1 module	
750-600	End module	

4.5.4 KNX IP Application Controller + I/O Modules + Router

This application differs from the previous in that additional modules of the WAGO series 750/753 are plugged downstream of the KNX module. For example, conventional switches can be connected via these modules. The switching commands of the switch and the devices on the TP1 network can be processed together in the IEC application.

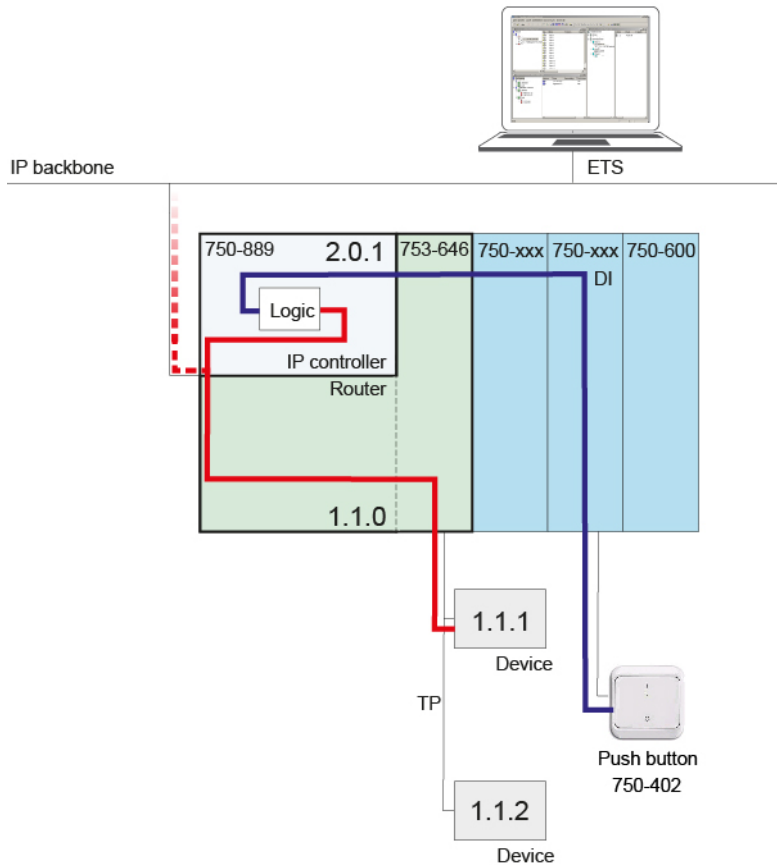


Figure 34: Application Example: KNX IP Application Controller + I/O Modules + Router

Components to be used

750-889	KNX IP controller	} Function as KNXnet/IP router
753-646	KNX/EIB/TP1 module	
75x-xxx	Any modules of the WAGO-I/O-SYSTEM 750/753	
750-600	End module	

4.5.5 KNX IP Application Controller + Router + Additional KNX Module with Independent Line

If two KNX modules are utilized, the first TP1 network is connected to the IP backbone and the ETS via the router in the controller. The network of the second KNX module is connected to the controller via the IEC application.

In this application, 255 group addresses are available via the IEC. Up to 64 stations can be connected to every module. Because the two TP1 networks are independent from each other, the device address of both networks may be identical. However, it is recommended to use different device addresses in order to maintain a clear and unambiguous network structure.

The ETS approaches the configuration of the two TP1 networks from two positions: once as superordinate ETS at the backbone (project A) and also within the TP1 line (project B). These are two completely independent ETS projects.

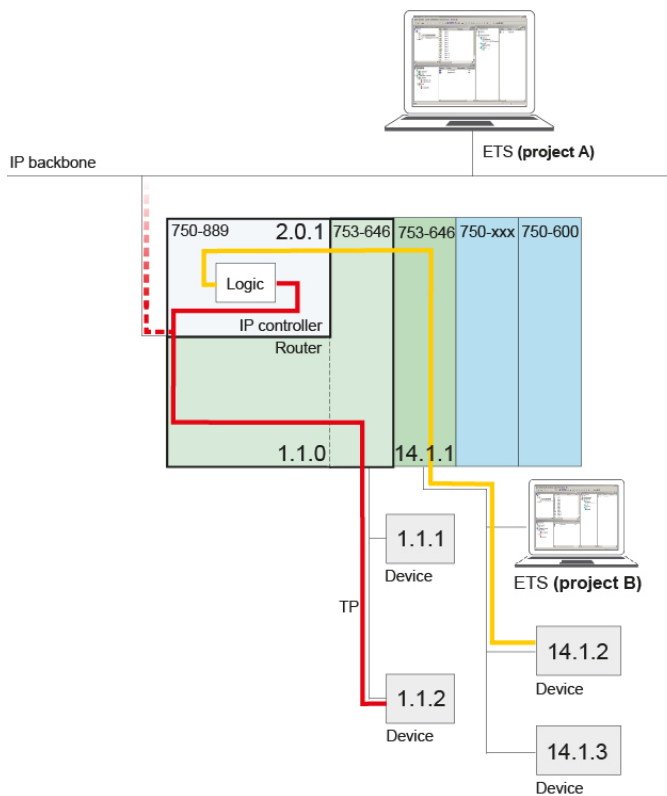


Figure 35: Application Example: KNX IP Application Controller + Router + 2 KNX/EIB/TP1 Modules

Components to be used

750-889	KNX IP controller	}	Function as KNXnet/IP router
753-646	KNX/EIB/TP1 module		
753-646	KNX/EIB/TP1 module	→	Function as KNX/EIB/TP1 device
(75x-xxx	Any modules of the WAGO-I/O-SYSTEM 750/753)		
750-600	End module		

4.5.6 KNX IP Application Controller + Router + KNX Module as Device in the Router Line

If a jumper is plugged between the first and the second KNX module, the second KNX module becomes a standard device in the line downstream of the router. The module is actuated via the ETS connected to the IP backbone. In this case, the application in the KNX IP controller can be addressed by a total of 510 communication objects (255 via the IP controller and 255 via the second KNX module).

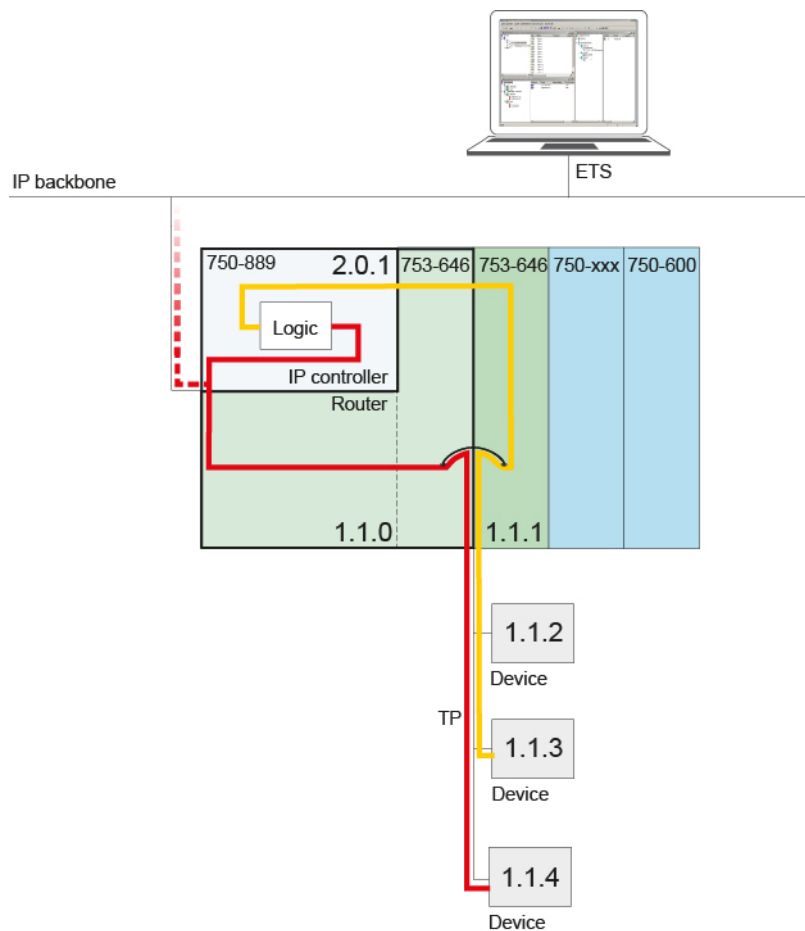


Figure 36: Application Example: KNX IP Application Controller + Router + 2 KNX Modules in a Router Line

Components to be used

750-889	KNX IP controller	}	Function as KNXnet/IP router
753-646	KNX/EIB/TP1 module		
753-646	KNX/EIB/TP1 module	→	Function as KNX/EIB/TP1 device
(75x-xxx	Any modules of the WAGO-I/O-SYSTEM 750/753)		
750-600	End module		

4.5.7 Any Fieldbus Controller with KNX Module

In this application, the KNX module is not operated on a KNX IP controller, but on a different WAGO fieldbus controller (e.g. BACnet/IP Controller 750-831). The KNX module serves as gateway. It is actuated via the ETS, which is connected to the subordinate TP1 network.

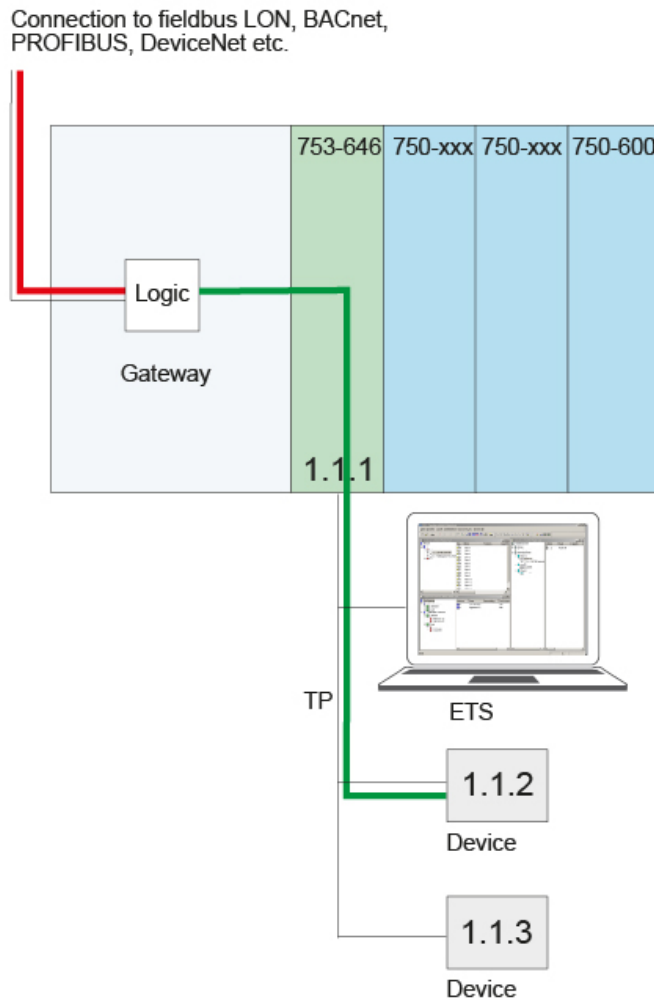


Figure 37: Any Fieldbus Controller with KNX Module

Components to be used

- 750-8xx Any controller of the WAGO-I/O-SYSTEM 750
- 753-646 KNX/EIB/TP1 module as gateway
- (75x-xxx Any module of the WAGO-I/O-SYSTEM 750/753)
- 750-600 End module

Information



Additional Information

Further documentation about KNX is available at <http://www.wago.com>:

- KNX/EIB/TP1 Module 753-646
 - KNX IP Controller 750-889
 - WAGO ETS Plug-in
 - Libraries for Building Automation (Description of function blocks for EIB/KNX)
 - Application Notes
-

5 Device Description

The 750-889 Programmable Fieldbus controller 750-889 is a combination of two KNX devices with a 2-port ETHERNET switch.

First logical device:

The KNX IP controller can operate directly in an IP network as a stand-alone, freely programmable **KNX IP device**. The controller is linked to the IP network via one of the two RJ-45 connectors. The controller can then communicate with other devices or with the higher-order systems either via 10/100 Mbit/s (ETHERNET), "100BaseTX" or "10BaseT".

An application program can be created using the WAGO-I/O-*PRO* software, based on IEC-61131-3. The controller provides 1024 KB program memory, 1024 KB data memory and 32 KB retain memory for this.

The user can then access all fieldbus input and output data.

Second logical device:

When combined with the KNX/EIB/TP1 module 753-646 (short name KNX module) the controller is automatically expanded to a complete **KNXnet/IP router**. When functioning as a KNXnet/IP router, the controller enables coupling between an IP network and a two-wire TP1 network. The router function is available exclusively for the first KNX module at the controller. This means that routing is possible for exactly one line per controller.

In order to send process data via ETHERNET, the controller supports a series of network protocols.

The MODBUS/TCP(UDP) protocol and the KNXnet/IP protocol are implemented for exchanging process data. Both of these communication protocols can be used either simultaneously or alternately.

The following protocols are available for system communication:

- DHCP (Dynamic Host Configuration Protocol)
- BootP (Bootstrap Protocol)
- FTP (File Transfer Protocol)
- SMTP (Simple Mail Transfer Protocol)
- SNMP V3 (Simple Network Management Protocol)
- SNTP (Simple Network Time Protocol)
- DNS (Domain Name Service)
- MODBUS/TCP
- HTTP (Hypertext Transfer Protocol)
- KNXnet/IP

This controller is based on a 32-bit CPU with multitasking capabilities, allowing several programs to be executed in a near-simultaneous manner.

The controller has an internal server for the configuration and administration of the system.

By default, the controller's built-in HTML pages contain information on the configuration and status of the PFC, and can be read using a normal web browser. In addition, a file system is implemented that allows you to store custom HTML pages in the controller using FTP download or to store your own HTML pages or call up programs directly.

Information



Compatibility with IEC-61131-3 programming software!

The compatibility between your fieldbus controller and the IEC 61131-3 programming software used depends on the fieldbus controller's firmware version and the version of the programming software.

A list of recommended combinations can be found at www.wago.com.

Use the search function (search for "Compatibility Notes").

Information



Additional Information about current Software

To get the current software version for programming and configuring the controller 750-889, go to our Web site at <http://www.wago.com>.

Note



Compatibility of WAGO KNX Products

The KNX IP 750-849 and 750-889 controller and the KNX/EIB/TP1 module 753-646 are compatible with one another independent of the firmware.

The "KNX-02.lib" library is available for both engineering and commissioning.

Using this library requires a fieldbus controller firmware ≥ 07 .

The "KNX-Standard.lib" library is available for older devices or firmware versions (750-849).

5.1 KNX IP Device in the Controller

The freely programmable application controller is recognized as a standard KNX IP device by the Engineering Tool Software (ETS) and started up using standard KNX methods.

Information



Additional Information

The ETS itself can be obtained from the Konnex Association at

<http://www.konnex.org>. The WAGO ETS plug-in and the associated

documentation are available at <http://www.wago.com> under Downloads.

Using dedicated variables, the KNX device application sets up the link between the IEC-61131-3 application and the TP1 network. This permits cross communication between controllers using standardized data types and protocols.

Corresponding IEC-61131-3 function blocks for WAGO-I/O-PRO are available for linking IEC variables to communication objects.

Information



Additional Information

Detailed information about programming is provided in the section “Programming the PFC using WAGO-I/O-PRO”.

5.2 KNXnet/IP Router in the Controller

In conjunction with the KNX module that is plugged in first, the KNX IP controller automatically expands to a complete KNXnet/IP router. This KNXnet/IP router enables coupling between KNX two-wire networks and an IP network, without having to have an IEC-61131-3 application installed in the controller.

The controller is immediately ready for operation when it is connected to the power supply and started up with the ETS.

Note



Definition of the description KNXnet/IP Router!

In the following document, interaction between the KNXnet/IP controller and the KNX module the first module of type KNX/EIB/TP1 at the KNX IP controller is designated as KNXnet/IP router.

The link to the IP network is set up via KNX IP controller, with the KNX module providing the access point to the TP1 network.

Note



Routing is possible only via the first plugged KNX module!

The KNXnet/IP controller only routes data to the first module of type KNX/EIB/TP1; all other KNX modules connected to the controller are addresses via IEC 61131-3 application.

Information



Additional Information

For more details about the special structure and a description of functions of the KNX module, refer to the manual “KNX/EIB/TP1 Module 753-646 Router Mode” at <http://www.wago.com> under Documentation.

5.3 View

The view below shows the three parts of the device:

- The fieldbus connection is on the left side.
- LEDs for operation status, bus communication, error messages and diagnostics, as well as the service interface are in the middle area.
- The right side shows the power supply unit for the system supply and for the field supply of the attached I/O modules via power jumper contacts. LEDs show the status of the operating voltage for the system and field supply (jumper contacts).

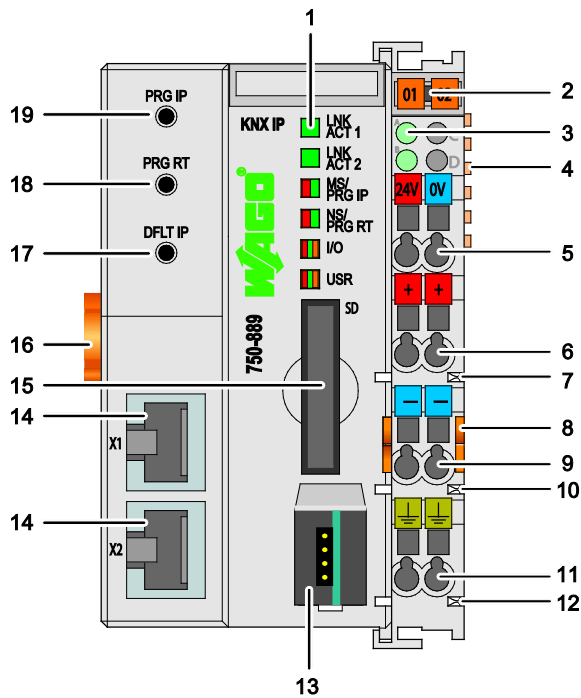


Figure 38: View KNX IP Controller

Table 12: Legend for Figure “View”

Pos.	Designation	Meaning	Details see Section:
1	LINK ACT 1, 2, MS, NS, I/O, USR	Status LEDs Fieldbus	“Device Description” > “Display Elements”
2	---	Group marking carrier (retractable) with additional marking possibility on two miniature WSB markers	---
3	A, B or C	Status LED’s System/Field Supply	“Device Description” > “Display Elements”
4	---	Data Contacts	“Connect Devices” > “Data Contacts/Internal Bus”
5	24 V, 0 V	CAGE CLAMP® Connections System Supply	“Connect Devices” > “Connecting a conductor to the CAGE CLAMP®”
6	+	CAGE CLAMP® Connections Field Supply 24 VDC	“Connect Devices” > “Connecting a conductor to the CAGE CLAMP®”
7	---	Power Jumper Contact 24 VDC	“Connect Devices” > “Power Contacts/Field Supply”
8	---	Unlocking Lug	“Mounting” > “Inserting and Removing Devices”
9	-	CAGE CLAMP® Connections Field Supply 0 V	“Connect Devices” > “Connecting a conductor to the CAGE CLAMP®”
10	---	Power Jumper Contact 0 V	“Connect Devices” > “Power Contacts/Field Supply”
11	(Ground)	CAGE CLAMP® Connections Field Supply (Ground)	“Connect Devices” > “Connecting a conductor to the CAGE CLAMP®”
12	---	Power Jumper Contact (Ground)	“Connect Devices” > “Power Contacts/Field Supply”
13	---	Service Interface (open flap)	“Device Description” > “Operating Elements”
14	X1, X2	Fieldbus connection 2 x RJ-45 as 2-Port Switch	“Device Description” > “Connectors”
15	---	SD card slot with cover lid	„Device Description“ > „Operating Elements“
16	---	Locking Disc	“Mounting” > “Inserting and Removing Devices”
17	DFLT IP	Button to use the default IP address	„Device Description“ > „Operating Elements“
18	PRG RT	Programming Probe for Router Mode	„Device Description“ > „Operating Elements“
19	PRG IP	Programming Probe for Device Mode	„Device Description“ > „Operating Elements“

5.4 Connectors

5.4.1 Device Supply

The device is powered via terminal blocks with CAGE CLAMP® connections.

The device supply generates the necessary voltage to power the electronics of the device and the internal electronics of the connected I/O modules.

The fieldbus interface is galvanically separated to the electrical potential of the device.

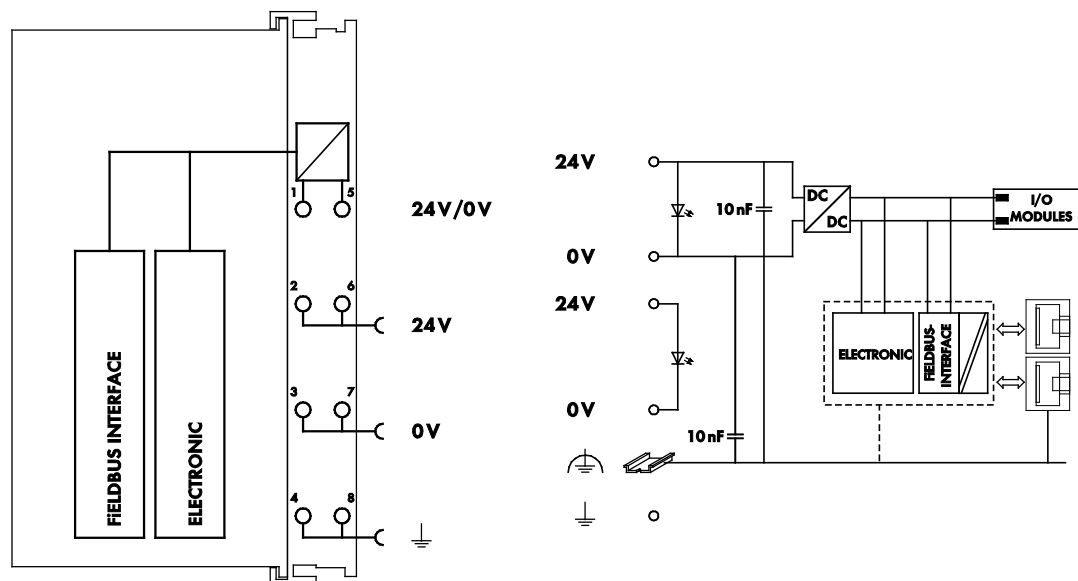


Figure 39: Device Supply

5.4.2 Fieldbus Connection

The connection to the ETHERNET based fieldbuses is made via two RJ-45 plugs (also called “Western plugs”), which are connected to the fieldbus controller via an integrated switch.

The integrated switch works in store-and-forward operation and for each port, supports the transmission speeds 10/100 Mbit as well as the transmission modes full and half-duplex.

The wiring of these plugs corresponds to the specifications for 100BaseTX, which prescribes a category 5 twisted pair cable as the connecting cable. Cable types S-UTP (Screened Unshielded Twisted Pair) and STP (Shielded Twisted Pair) with a maximum segment length of 100 m (approximately 328.08 feet) can be used.

The RJ-45 socket is arranged physically lower, allowing the coupler to fit in an 80 mm high enclosure once connected.

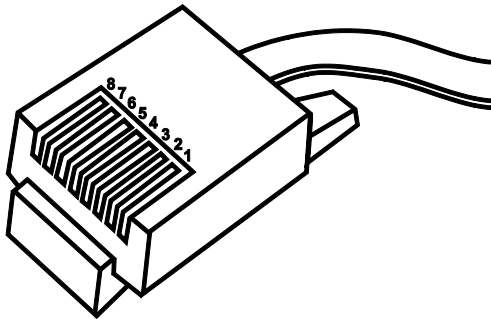


Figure 40: RJ-45 Connector

Table 13: RJ-45 Connector and RJ-45 Connector Configuration

Contact	Signal	
1	TD +	Transmit +
2	TD -	Transmit -
3	RD +	Receive +
4		free
5		free
6	RD -	Receive -
7		free
8		free

NOTICE

Do not use in telecommunication circuits!

Only use devices equipped with ETHERNET or RJ-45 connectors in LANs.
Never connect these devices with telecommunication networks.

5.5 Display Elements

The operating condition of the fieldbus controller or the node is displayed with the help of illuminated indicators in the form of light-emitting diodes (LEDs). The LED information is routed to the top of the case by light fibres. In some cases, these are multi-colored (red, green or red/green (=orange)).

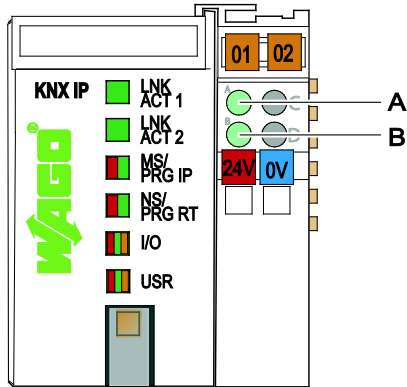


Figure 41: Display Elements

For the diagnostics of the different domains fieldbus, node and supply voltage, the LEDs can be divided into three groups:

Table 14: Display Elements Fieldbus Status

LED	Color	Meaning
LNK ACT 1	green	indicates a connection to the physical network at port 1
LNK ACT 2	green	indicates a connection to the physical network at port 2
MS/PRG IP	red/green	indicates the programming mode for the IP device
NS/PRG RT	red/green	indicates the programming mode for the router

Table 15: Display Elements Node Status

LED	Color	Meaning
I/O	red/green/ orange	Indicates the operation of the node and signals via a blink code faults encountered.
USR	red/green/ orange	indicates the state, which is programmed in the user program
SD	orange	indicates an access to the SD memory card

Table 16: Display Elements Supply Voltage

LED	Color	Meaning
A	green	indicates the status of the operating voltage – system
B	green	indicates the status of the operating voltage – power jumper contacts



Information

More information about the LED Signaling

Read the detailed description for the evaluation of the displayed LED state in the section “Diagnostics” > ... > “LED Signaling”.

5.6 Operating Elements

5.6.1 Service Interface

The service interface is located behind the flap.

It is used for the communication with WAGO-I/O-CHECK, WAGO-I/O-PRO and for update the firmware.

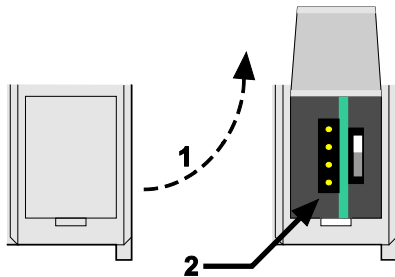


Figure 42: Service Interface (Closed and Opened Flap)

Table 17: Legend for Figure “Service Interface (Closed and Opened Flap)”

Number	Description
1	Open closed flap
2	View Service Interface

NOTICE

Device must be de-energized!

To prevent damage to the device, unplug and plug in the communication cable only when the device is de-energized!

The connection to the 4-pin header under the cover flap can be realized via the communication cables with the item numbers 750-920 and 750-923 or via the WAGO radio adapter with the item number 750-921.

5.6.2 Mode Selector Switch

The mode selector switch is located behind the cover flap.

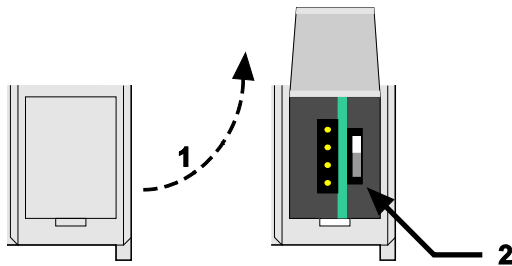


Figure 43: Mode Selector Switch (Closed and Open Damper of the Service Port)

Table 18: Legend for Figure „Mode Selector Switch“

Number	Description
1	Open the damper
2	Mode selector switch

The mode selector switch determines the loading, starting and stopping of the PLC-application by the fieldbus controller. This multifunction sliding switch features 3 slide lock positions and a push-button function.

The sliding switch is designed for a number of operations in compliance with EN61131T2.

NOTICE

Property damages due to set outputs!

Please note that set outputs remain set, when you switch the operating switch from “RUN” to “STOP” during the current operation. Since the program is no longer processed, software-related switch offs, i.e. by initiators, are ineffective. Therefore, program or define all outputs, so that these switch to a safe mode at a program stop.

Note



Defining the outputs for a program stop!

In order to switch the outputs to a safe mode at the program stop, define the status of the outputs at “STOP”.

1. For this, open in the web-based Management System (WBM) a website via the “PLC Settings” link, on which you can define the function *Process image - Set outputs to zero, if user program is stopped*.
2. Now activate this function by placing a check mark in the control box, then all outputs are set to zero, if this function is not activated, the outputs remain at the last current value.



Note

The mode selector switch position does not affect software start/stop!

The position of the operating mode switch does not prevent the starting and stopping of the PFC application from WAGO-I/O-PRO.

One of the following functions is active, depending on which of the three static positions — “top”, “center” or “bottom” — the switch is located at when energized or during a hardware or software reset:

Table 19: Mode Selector Switch Positions, Static Positions on PowerOn/Reset

Positions for the mode selector switch	Function
“Top” position	“RUN” – activate program processing, Boot project (if available) is started
“Center” position	“STOP” – stop program processing, PFC application is stopped
“Bottom” position	Do not use. This position is not relevant for the user.

The fieldbus controller performs the following functions if the switch’s position is changed during operation:

Table 20: Mode Selector Switch Positions, Dynamic Positions During Ongoing Operation

Position change for the mode selector switch	Function
From the top to the center position	“STOP” – stop program processing, PFC application is stopped
From the center to the top position	“RUN” – activate program processing, Boot project (if available) is started
From the center to the bottom position	No reaction. The bootstrap loader is started after PowerOn/Reset
From the bottom to the center position	No reaction.
Press down (e.g., using a screwdriver)	Hardware reset. All outputs are reset; variables are set to 0, FALSE, or to an initial value. Retain variables or markers are not changed. A hardware reset can be executed on STOP or on RUN at any position of the mode selector switch! Fieldbus coupler restart.

The operating mode is changed internally at the end of a PFC cycle.

5.6.3 Buttons

The fieldbus coupler has two programming buttons. The buttons are used to assign the physical address in ETS. Device or router mode is enabled depending on the button.

In addition, the fieldbus controller has a button for setting a predefined default IP address.

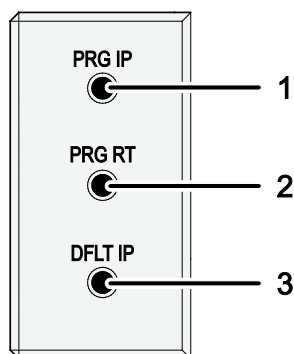


Figure 44: Buttons

Pos.	Description
1	PRG IP Programming button of the KNXnet/IP application controller for programming the physical address (use device mode).
2	PRG RT Programming button of the KNXnet/IP router for programming the physical address (use router mode).
3	DFLT IP Button for setting a predefined default IP address.

Note



Use an appropriate tool to operate the “DFLT IP” button!

To press the “DFLT IP” button, use a blunt tool (e.g. a screw driver or WAGO operating tool) with a minimum diameter of 1.5 mm to avoid pushing through to the underlying level between the button and the enclosure.

Doing so can damage the button, enclosure or circuit board.

5.6.4 Memory Card Slot

The memory card slot accommodates a secure digital memory card (or SD card for short) or an SD card with a higher storage capacity (SD high capacity, or SDHC for short).

Note



Only use recommended memory cards!

Use only the SD memory card available from WAGO (order no. 758-879/000-001) since it is suitable for industrial applications under difficult environmental conditions and for use in the fieldbus controller.

The compatibility to other storage media available in trade cannot be ensured.

The memory card slot has a transparent protective flap that is folded upwards to open it.

Note



Memory card is not included in the scope of delivery!

Note, the fieldbus controller is delivered without memory card.

To use a memory card, you must order one separately. The fieldbus controller can also be operated without memory card expansion, the use of a memory card is optional.

Information



Additional information about the memory card

For technical information about the memory card, see the data sheet for the SD memory card (order no. 758-879/000-001).

The data sheet is on the Internet at: www.wago.com

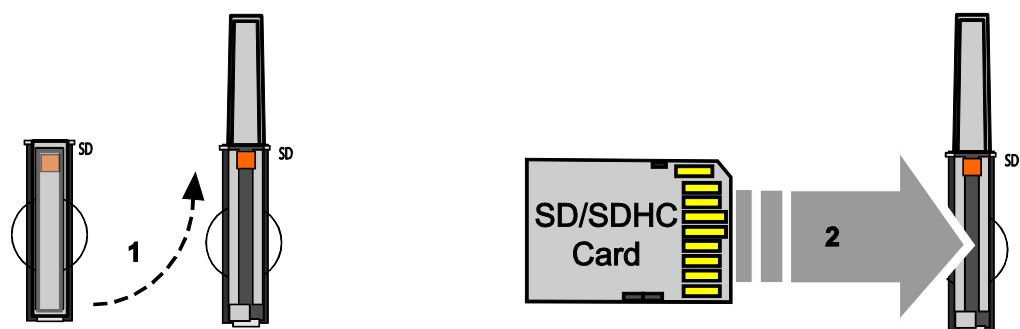


Figure 45: Opening the Memory Card Slot, Inserting an SD/SDHC Memory Card

5.6.4.1 Inserting a Memory Card

1. Use an activation tool or a screwdriver to open the transparent cover flap by folding it upwards.
2. Hold the memory card so that the contacts are visible on the right side and the sloping edge is towards the bottom, as depicted in the figure above.
3. Insert the memory card into the slot of the fieldbus controller.
4. Push the memory card all the way in. When you let go, the memory card will move back a little and then snap in.
5. Push the cover flap back in by folding it downwards until it snaps in.

5.6.4.2 Removing the Memory Card

1. Use an activation tool or a screwdriver to open the transparent cover flap by folding it upwards.
2. To remove the memory card, first press it into the slot.
This loosens the mechanical locking
3. As soon as you let go of the memory card, the memory card is pushed out a bit and you can remove it.
4. Push the cover flap back in by folding it downwards until it snaps in.

5.7 Technical Data

5.7.1 Device Data

Table 21: Technical data – Device data

Width	62 mm
Height (from upper-edge of DIN 35)	65 mm
Length	100 mm
Weight	approx. 164 g
Degree of protection	IP 20

5.7.2 System Data

Table 22: Technical data – System data

Number of controllers connected to Master	Limited by ETHERNET specification
Transmission medium	Twisted Pair S/UTP, STP 100 Ω Cat 5
Bus coupler connection	2 x RJ-45
Max. length of fieldbus segment	100 m
Baud rate	10/100 Mbit/s
Transmission performance	Class D acc. to EN 50173
Protocols	KNXnet/IP, AutoIP, MODBUS/TCP (UDP), HTTP, BootP, DHCP, DNS, SNTP, FTP, SNMP
Programming	WAGO-I/O-PRO
IEC-61131-3	AWL, KOP, FUP, ST, AS
SD memory card slot	push/push mechanism, cover cap lead-sealable
Memory card type	SD and SDHC up to 32 Gbyte *)
Max. number of socket links	3 HTTP, 15 MODBUS/TCP, 10 FTP, 2 SNMP, 5**) for IEC 61131-3 program, 2 for WAGO-I/O-PRO, 1 Multicast for KNXnet/IP
Powerfail RTC Buffer	at least 6 days***)
Number of I/O modules with bus extension	64 250
Configuration	via PC
Program memory	1024 kByte
Data memory	1024 kByte
Non-volatile memory (retain)	32 kByte

*) Use only the SD memory card available from WAGO (order no. 758-879/000-001) since it is suitable for industrial applications under difficult environmental conditions and for use in the fieldbus controller.

The compatibility to other storage media available in trade cannot be ensured.

**) Using the Ethernet.lib, when the SysLibSocket.lib is used, there are 143.

***) This value is valid for brand-new devices with an ambient temperature of 25 °C. The guaranteed buffer time for the real time clock is reduced with rising temperature and operating time.

5.7.3 Supply

Table 23: Technical data – Supply

Voltage supply	DC 24 V (-25 % ... +30 %)
Input current max.	500 mA at 24 V
Power failure time acc. IEC 61131-2	Depending on external buffering
Efficiency of the power supply	90 %
Internal current consumption	450 mA at 5 V
Total current for I/O modules	1700 mA at 5 V
Isolation	500 V system/supply

Note



Buffer for system power supply!

The system power supply must be buffered to bridge power outages. As the power demand depends on the respective node configuration, buffering is not implemented internally.

To achieve power outages of 1 ms to 10 ms according to IEC61131-2, determine the buffering appropriate for your node configuration and structure it as an external circuit.

5.7.4 Fieldbus MODBUS/TCP

Table 24: Technical data – Fieldbus MODBUS/TCP

Input process image max	1020 words
Output process image max	1020 words

5.7.5 KNX

Table 25: Technical data – KNX

KNX specification	1.0
Commissioning	with ETS3 plug-in, 2 programming keys
KNX IP Device	
Number of communication objects	253
Number of group addresses/associations	254
Max. number of logical KNX devices, simultaneous	2 logical devices: 1. Device 2. Router (with 1. KNX/EIB/TP1 module)

5.7.6 Accessories

Table 26: Technical data – Accessories

Miniature WSB Quick marking system	
WAGO-I/O-PRO	759-333
WAGO ETS product database and plug-in	
SD Memory Card	758-879/000-001

5.7.7 Connection Type

Table 27: Technical Data – Field Wiring

Wire connection	CAGE CLAMP®
Cross section	0.08 mm ² ... 2.5 mm ² , AWG 28 ... 14
Stripped lengths	8 mm ... 9 mm / 0.33 in

Table 28: Technical Data – Power Jumper Contacts

Power jumper contacts	Spring contact, self-cleaning
Voltage drop at I _{max.}	< 1 V/64 modules

Table 29: Technical Data – Data Contacts

Data contacts	Slide contact, hard gold plated, self-cleaning
---------------	--

5.7.8 Climatic Environmental Conditions

Table 30: Technical Data – Climatic Environmental Conditions

Operating temperature range	0 °C ... 55 °C
Operating temperature range for components with extended temperature range (750-xxx/025-xxx)	-20 °C ... +60 °C
Storage temperature range	-25 °C ... +85 °C
Storage temperature range for components with extended temperature range (750-xxx/025-xxx)	-40 °C ... +85 °C
Relative humidity	Max. 5 % ... 95 % without condensation
Resistance to harmful substances	Acc. to IEC 60068-2-42 and IEC 60068-2-43
Maximum pollutant concentration at relative humidity < 75 %	SO ₂ ≤ 25 ppm H ₂ S ≤ 10 ppm
Special conditions	Ensure that additional measures for components are taken, which are used in an environment involving: – dust, caustic vapors or gases – ionizing radiation

NOTICE**Reduced buffer time at high storage temperature!**

Ensure that the storage of devices with a real time clock at high temperatures leads to a reduced buffer time for the real time clock.

5.7.9 Mechanical Strength

Table 31: Technical Data – Mechanical Strength

Vibration resistance	acc. to IEC 60068-2-6 Comment to the vibration resistance: a) Type of oscillation: sweep with a rate of change of 1 octave per minute $10 \text{ Hz} \leq f < 57 \text{ Hz}$, const. Amplitude 0,075 mm $57 \text{ Hz} \leq f < 150 \text{ Hz}$, const. Acceleration 1 g b) Period of oscillation: 10 sweep per axis in each of the 3 vertical axes
Shock resistance	acc. to IEC 60068-2-27 Comment to the shock resistance: a) Type of impulse: half sinusoidal b) Intensity of impulse: 15 g peak value, 11 ms maintenance time c) Route of impulse: 3 impulses in each pos. And neg. direction of the 3 vertical axes of the test object, this means 18 impulses in all.
Free fall	acc. IEC 60068-2-32 $\leq 1 \text{ m}$ (module in original packing)

5.8 Approvals

Information



More information about approvals.

Detailed references to the approvals are listed in the document “Overview Approvals **WAGO-I/O-SYSTEM 750**”, which you can find via the internet under: www.wago.com > SERVICES > DOWNLOADS > Additional documentation and information on automation products > WAGO-I/O-SYSTEM 750 > System Description.

The following approvals have been granted to 750-889 fieldbus coupler/controller:

 Conformity Marking

 cUL_{us} UL508

 KNX certified

The following Ex approvals have been granted to 750-889 fieldbus coupler/controller:



The following ship approvals have been granted to 750-889 fieldbus coupler/controller:



ABS (American Bureau of Shipping)



Federal Maritime and Hydrographic Agency



BV (Bureau Veritas)



GL (Germanischer Lloyd) Cat. A, B, C, D (EMC 1)



KR (Korean Register of Shipping)



LR (Lloyd's Register) Env. 1, 2, 3, 4



PRS (Polski Rejestr Statków)



RINA (Registro Italiano Navale)

Information



For more information about the ship approvals:

Note the “Supplementary Power Supply Regulations” section for the ship approvals.

5.9 Standards and Guidelines

750-889 meets the following requirements on emission and immunity of interference:

EMC CE-Immunity to interference acc. to EN 61000-6-2

EMC CE-Emission of interference acc. to EN 61000-6-3

EMC marine applications-Immunity to interference acc. to DNV GL

EMC marine applications-Emission of interference acc. to DNV GL

6 Mounting

6.1 Installation Position

Along with horizontal and vertical installation, all other installation positions are allowed.

Note



Use an end stop in the case of vertical mounting!

In the case of vertical assembly, an end stop has to be mounted as an additional safeguard against slipping.

WAGO order no. 249-116 End stop for DIN 35 rail, 6 mm wide

WAGO order no. 249-117 End stop for DIN 35 rail, 10 mm wide

6.2 Overall Configuration

The maximum total length of a fieldbus node without fieldbus coupler/controller is 780 mm including end module. The width of the end module is 12 mm. When assembled, the I/O modules have a maximum length of 768 mm.

Examples:

- 64 I/O modules with a 12 mm width can be connected to a fieldbus coupler/controller.
- 32 I/O modules with a 24 mm width can be connected to a fieldbus coupler/controller.

Exception:

The number of connected I/O modules also depends on the type of fieldbus coupler/controller is used. For example, the maximum number of stackable I/O modules on one PROFIBUS DP/V1 fieldbus coupler/controller is 63 with no passive I/O modules and end module.

NOTICE

Observe maximum total length of a fieldbus node!

The maximum total length of a fieldbus node without fieldbus coupler/controller and without using a 750-628 I/O Module (coupler module for internal data bus extension) may not exceed 780 mm.

Also note the limitations of individual fieldbus couplers/controllers.

Note



Increase the total length using a coupler module for internal data bus extension!

You can increase the total length of a fieldbus node by using a 750-628 I/O Module (coupler module for internal data bus extension). For such a configuration, attach a 750-627 I/O Module (end module for internal data bus extension) after the last I/O module of a module assembly. Use an RJ-45 patch cable to connect the I/O module to the coupler module for internal data bus extension of another module block.

This allows you to segment a fieldbus node into a maximum of 11 blocks with maximum of 10 I/O modules for internal data bus extension.

The maximum cable length between two blocks is five meters.

More information is available in the manuals for the 750-627 and 750-628 I/O Modules.

6.3 Mounting onto Carrier Rail

6.3.1 Carrier Rail Properties

All system components can be snapped directly onto a carrier rail in accordance with the European standard EN 50022 (DIN 35).

NOTICE

Do not use any third-party carrier rails without approval by WAGO!

WAGO Kontakttechnik GmbH & Co. KG supplies standardized carrier rails that are optimal for use with the I/O system. If other carrier rails are used, then a technical inspection and approval of the rail by WAGO Kontakttechnik GmbH & Co. KG should take place.

Carrier rails have different mechanical and electrical properties. For the optimal system setup on a carrier rail, certain guidelines must be observed:

- The material must be non-corrosive.
- Most components have a contact to the carrier rail to ground electro-magnetic disturbances. In order to avoid corrosion, this tin-plated carrier rail contact must not form a galvanic cell with the material of the carrier rail which generates a differential voltage above 0.5 V (saline solution of 0.3 % at 20°C).
- The carrier rail must optimally support the EMC measures integrated into the system and the shielding of the I/O module connections.
- A sufficiently stable carrier rail should be selected and, if necessary, several mounting points (every 20 cm) should be used in order to prevent bending and twisting (torsion).
- The geometry of the carrier rail must not be altered in order to secure the safe hold of the components. In particular, when shortening or mounting the carrier rail, it must not be crushed or bent.
- The base of the I/O components extends into the profile of the carrier rail. For carrier rails with a height of 7.5 mm, mounting points are to be riveted under the node in the carrier rail (slotted head captive screws or blind rivets).
- The medal springs on the bottom of the housing must have low-impedance contact with the DIN rail (wide contact surface is possible).

6.3.2 WAGO DIN Rail

WAGO carrier rails meet the electrical and mechanical requirements shown in the table below.

Table 32: WAGO DIN Rail

Order number	Description
210-113 /-112	35 × 7.5; 1 mm; steel yellow chromated; slotted/unslotted
210-114 /-197	35 × 15; 1.5 mm; steel yellow chromated; slotted/unslotted
210-118	35 × 15; 2.3 mm; steel yellow chromated; unslotted
210-198	35 × 15; 2.3 mm; copper; unslotted
210-196	35 × 8.2; 1.6 mm; aluminum; unslotted

6.4 Spacing

The spacing between adjacent components, cable conduits, casing and frame sides must be maintained for the complete fieldbus node.

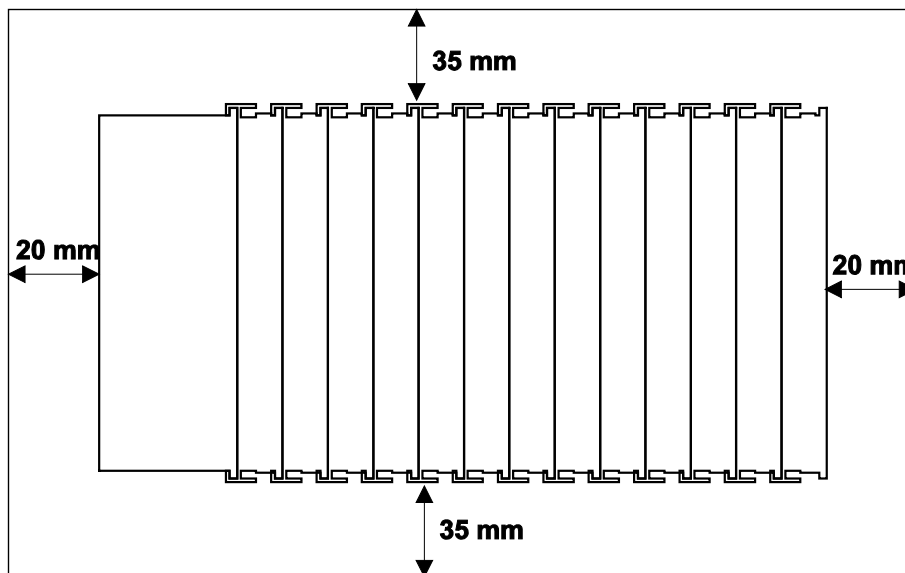


Figure 46: Spacing

The spacing creates room for heat transfer, installation or wiring. The spacing to cable conduits also prevents conducted electromagnetic interferences from influencing the operation.

6.5 Mounting Sequence

Fieldbus couplers/controllers and I/O modules of the WAGO-I/O-SYSTEM 750/753 are snapped directly on a carrier rail in accordance with the European standard EN 50022 (DIN 35).

The reliable positioning and connection is made using a tongue and groove system. Due to the automatic locking, the individual devices are securely seated on the rail after installation.

Starting with the fieldbus coupler/controller, the I/O modules are mounted adjacent to each other according to the project design. Errors in the design of the node in terms of the potential groups (connection via the power contacts) are recognized, as the I/O modules with power contacts (blade contacts) cannot be linked to I/O modules with fewer power contacts.

CAUTION

Risk of injury due to sharp-edged blade contacts!

The blade contacts are sharp-edged. Handle the I/O module carefully to prevent injury.

NOTICE

Insert I/O modules only from the proper direction!

All I/O modules feature grooves for power jumper contacts on the right side. For some I/O modules, the grooves are closed on the top. Therefore, I/O modules featuring a power jumper contact on the left side cannot be snapped from the top. This mechanical coding helps to avoid configuration errors, which may destroy the I/O modules. Therefore, insert I/O modules only from the right and from the top.

Note



Don't forget the bus end module!

Always plug a bus end module 750-600 onto the end of the fieldbus node! You must always use a bus end module at all fieldbus nodes with WAGO-I/O-SYSTEM 750 fieldbus couplers/controllers to guarantee proper data transfer.

6.6 Inserting and Removing Devices

NOTICE

Perform work on devices only if they are de-energized!

Working on energized devices can damage them. Therefore, turn off the power supply before working on the devices.

6.6.1 Inserting the Fieldbus Coupler/Controller

1. When replacing the fieldbus coupler/controller for an already available fieldbus coupler/controller, position the new fieldbus coupler/controller so that the tongue and groove joints to the subsequent I/O module are engaged.
2. Snap the fieldbus coupler/controller onto the carrier rail.
3. Use a screwdriver blade to turn the locking disc until the nose of the locking disc engages behind the carrier rail (see the following figure). This prevents the fieldbus coupler/controller from canting on the carrier rail.

With the fieldbus coupler/controller snapped in place, the electrical connections for the data contacts and power contacts (if any) to the possible subsequent I/O module are established.

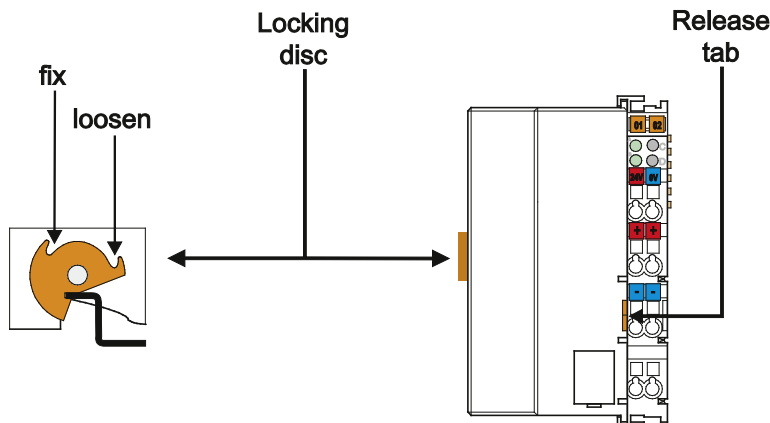


Figure 47: Release Tab of Extended ECO Fieldbus Coupler (Example)

6.6.2 Removing the Fieldbus Coupler/Controller

1. Use a screwdriver blade to turn the locking disc until the nose of the locking disc no longer engages behind the carrier rail.
2. Remove the fieldbus coupler/controller from the assembly by pulling the release tab.

Electrical connections for data or power contacts to adjacent I/O modules are disconnected when removing the fieldbus coupler/controller.

6.6.3 Inserting the I/O Module

1. Position the I/O module so that the tongue and groove joints to the fieldbus coupler/controller or to the previous or possibly subsequent I/O module are engaged.

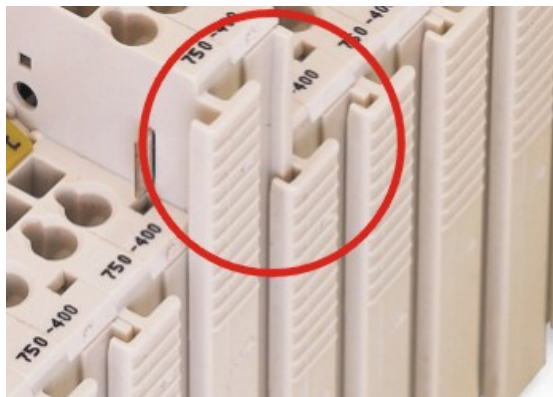


Figure 48: Insert I/O Module (Example)

2. Press the I/O module into the assembly until the I/O module snaps into the carrier rail.

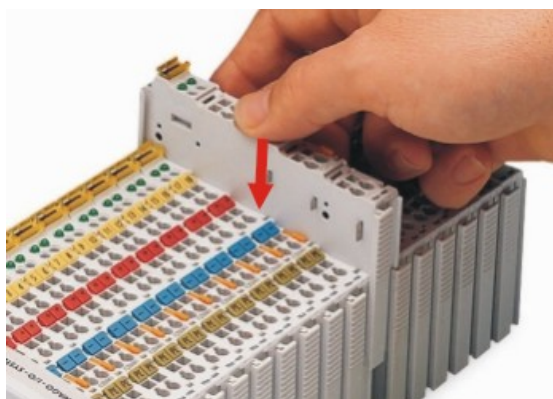


Figure 49: Snap the I/O Module into Place (Example)

With the I/O module snapped in place, the electrical connections for the data contacts and power jumper contacts (if any) to the fieldbus coupler/controller or to the previous or possibly subsequent I/O module are established.

6.6.4 Removing the I/O Module

1. Remove the I/O module from the assembly by pulling the release tab.

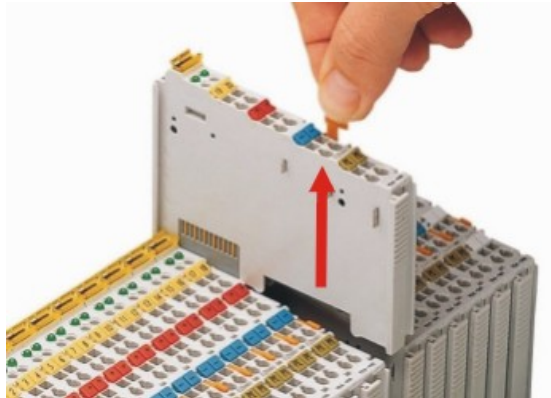


Figure 50: Removing the I/O Module (Example)

Electrical connections for data or power jumper contacts are disconnected when removing the I/O module.

7 Connect Devices

7.1 Data Contacts/Internal Bus

Communication between the fieldbus coupler/controller and the I/O modules as well as the system supply of the I/O modules is carried out via the internal bus. It is comprised of 6 data contacts, which are available as self-cleaning gold spring contacts.

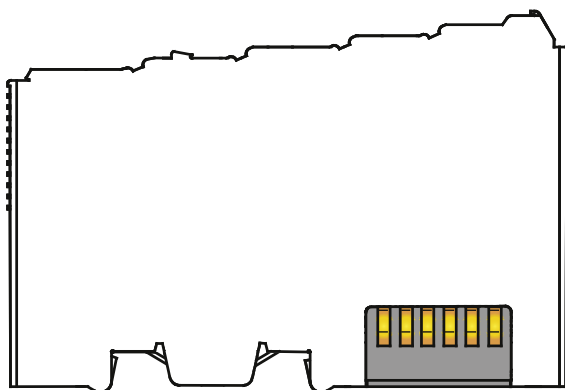


Figure 51: Data Contacts

NOTICE

Do not place the I/O modules on the gold spring contacts!

Do not place the I/O modules on the gold spring contacts in order to avoid soiling or scratching!

NOTICE



Ensure that the environment is well grounded!

The devices are equipped with electronic components that may be destroyed by electrostatic discharge. When handling the devices, ensure that the environment (persons, workplace and packing) is well grounded. Avoid touching conductive components, e.g. data contacts.

7.2 Power Contacts/Field Supply

⚠ CAUTION

Risk of injury due to sharp-edged blade contacts!

The blade contacts are sharp-edged. Handle the I/O module carefully to prevent injury.

Self-cleaning power jumper contacts used to supply the field side are located on the right side of most of the fieldbus couplers/controllers and on some of the I/O modules. These contacts come as touch-proof spring contacts. As fitting counterparts the I/O modules have male contacts on the left side.

Power jumper contacts

Blade	0	0	3	2
Spring	0	3	3	2

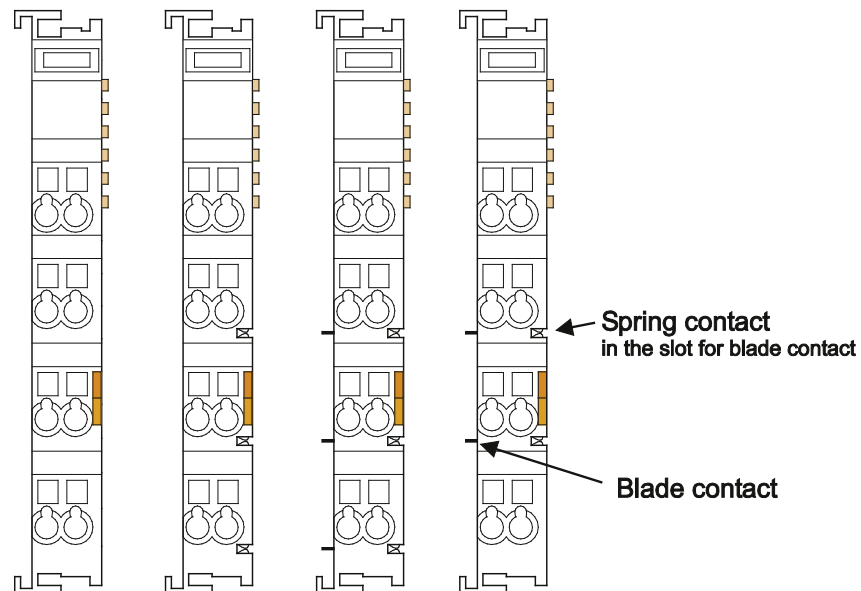


Figure 52: Example for the Arrangement of Power Contacts

Note



Field bus node configuration and test via smartDESIGNER

With the WAGO ProServe® Software smartDESIGNER, you can configure the structure of a fieldbus node. You can test the configuration via the integrated accuracy check.

7.3 Connecting a Conductor to the CAGE CLAMP®

The WAGO CAGE CLAMP® connection is appropriate for solid, stranded and finely stranded conductors.

Note



Only connect one conductor to each CAGE CLAMP®!

Only one conductor may be connected to each CAGE CLAMP®.

Do not connect more than one conductor at one single connection!

If more than one conductor must be routed to one connection, these must be connected in an up-circuit wiring assembly, for example using WAGO feed-through terminals.

1. For opening the CAGE CLAMP® insert the actuating tool into the opening above the connection.
2. Insert the conductor into the corresponding connection opening.
3. For closing the CAGE CLAMP® simply remove the tool. The conductor is now clamped firmly in place.

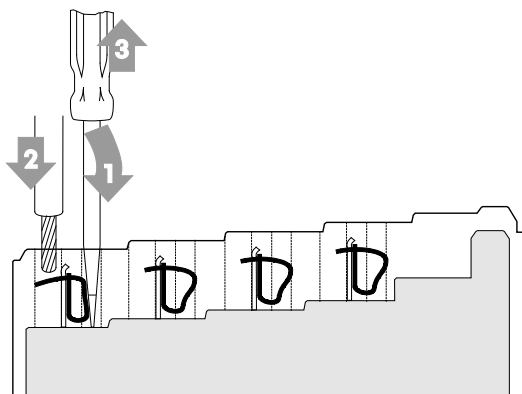


Figure 53: Connecting a Conductor to a CAGE CLAMP®

8 Function Description

8.1 Operating System

8.1.1 Run-up



Note

The mode selector switch may not be located in the lower position!

The mode selector switch may not be set at the bottom position during run-up!

The fieldbus controller begins running up after switching on the power supply or after a reset. The internal PFC program is then transferred to the RAM.

During the initialization phase, the fieldbus controller detects the I/O modules and the current configuration and sets the variables to 0 or FALSE, or to an initial value specified by the PFC program. The flags retain their status. During this phase the I/O LED will flash red.

When run-up is successful, the I/O LED then stays lit continuously in green.



Information

More information about the LED Signaling

Read the detailed description for the evaluation of the displayed LED state in the section “Diagnostics” > ... > “LED Signaling”.

8.1.2 PFC Cycle

After error-free run-up, the PFC cycle starts with the mode selector switch at the top position, or on a Start command from WAGO-I/O-PRO. The input and output data for the fieldbus, I/O modules and the timer values are read. The PFC program contained in the RAM is then processed, after which the output data for the fieldbus and I/O modules is written to the process image. At the end of the PFC cycle, the operating system functions are executed for diagnostics and communication (among other things) and the timer values are updated. The new cycle begins by reading in of the input and output data and the timer values.

The operating mode is changed (“STOP”/“RUN”) at the end of a PFC cycle.

The cycle time is the time from the beginning of the PFC program up to the next beginning of the cycle. If a loop is programmed within the PFC program, the PFC runtime and the PFC cycle time will be extended accordingly.

The inputs, outputs and timer values are not updated while the PFC program is being processed. Updating is performed only as defined at the end of the PFC program. As a result, it is not possible to wait on an event from the process or a set period to expire while a loop is in progress.

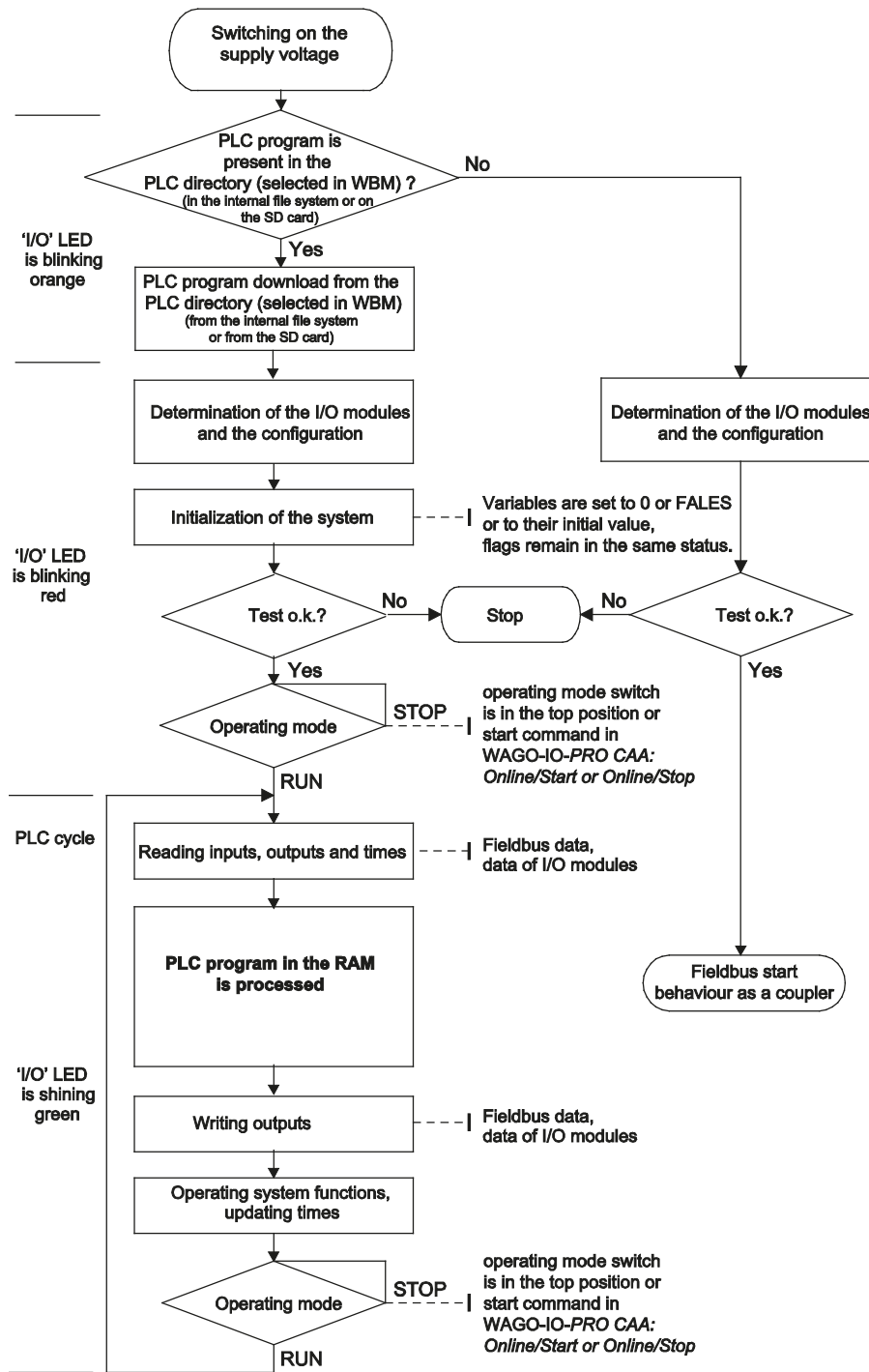


Figure 54: Run-up of the Controller

8.2 Process Data Architecture

The following sections provide an insight into the internal functioning, data processing and addressing of the KNX IP controller in conjunction with the modules that are connected.

8.2.1 Basic Structure

After switching on, the fieldbus controller identifies all I/O modules connected with the node that send or receive data (data width/bit width > 0).

In a node can consist of a mixed arrangement of analog input/analog output modules and digital input/digital output modules and special modules.

Note



Up to 250 I/O modules can be connected with the data bus extension modules.

Using the WAGO module bus extension coupler module 750-628 and end module 750-627 makes it possible to connect up to 250 modules to the KNX IP Controller.

Information



Additional Information

For the number of input and output bits or bytes of the individual I/O modules, refer to the corresponding description of the I/O modules.

The controller creates an internal local process image on the basis of the data width, the type of I/O module and the position of the module in the node. This process image is broken down into an input and an output data range.

The data of the digital I/O modules is bit-oriented; i.e., digital data is sent bit by bit. Analog I/O modules represent the group of byte-oriented modules – data is sent byte by byte.

This group includes: counter modules, angle and distance measurement modules and communication modules.

For both, the local input and output process image, the I/O module data is stored in the corresponding process image depending on the order in which the modules are connected to the fieldbus controller.

Note



Hardware changes can result in changes of the process image!

If the hardware configuration is changed by adding, changing or removing of I/O modules with a data width > 0 bit, this result in a new process image structure. The process data addresses would then change. If adding I/O modules, the process data of all previous I/O modules has to be taken into account.

A memory range of 256 words (word 0...255) is initially available in the controller for the process image of the physical input and output data.

For the image of the MODBUS/PFC variables, the memory range of words 256...511 is reserved; meaning the image for the MODBUS/PFC variables is created behind the process image for the I/O module data.

If the quantity of module data is greater than 256 words, all the physical input and output data above this value is added to the end of the current process image in a memory range; i.e., attached behind the MODBUS/PFC variables (word 512...1275).

The range from word 1276 to word 1531 is not available to the user.

The subsequent range, starting from word 1532, is reserved for future protocol expansion and other PFC variables.

Access by the PLC to process data is made independently from the fieldbus system in all WAGO fieldbus controllers; access is always conducted through an application-related IEC-61131-3 program.

How the data is accessed from the fieldbus side depends on the fieldbus however.

A MODBUS/TCP Master can access the data for the KNX IP controller via implemented MODBUS functions.

Information



Additional Information

For a detailed description of these fieldbus-specific data access methods, refer to the Section "MODBUS Functions."

Information



Additional Information:

For the fieldbus-specific process image of any WAGO I/O module, please refer to the section "I/O Modules" > ... > "Structure of the process data".

8.2.2 Example of an Input Process Image

The following figure is an example of an input process image. The configuration comprises 16 digital and 8 analog inputs. The input process image thus has a data length of 8 words for the analog modules and 1 word for the digital modules; i.e., 9 words in total.

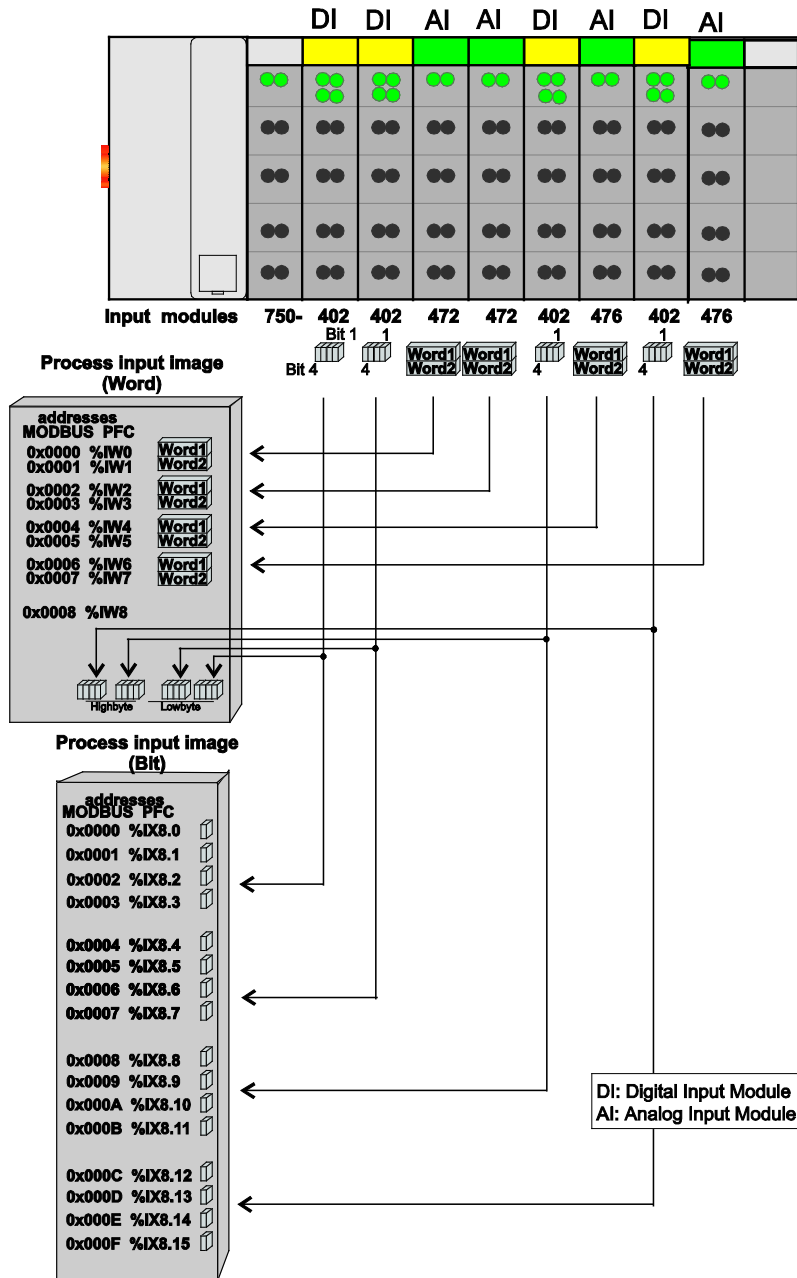


Figure 55: Example of Process Image for Input Data

8.2.3 Example of an Output Data Process Image

The following example for the output process image comprises 2 digital and 4 analog outputs. It comprises 4 words for the analog outputs and 1 word for the digital outputs; i.e., 5 words in total.

In addition, the output data can also be read back with an offset of 200_{hex} (0x0200) added to the MODBUS address.

Note



Data > 256 words can be read back by using the cumulative offset!

All output data greater than 256 words and, therefore located in the memory range 6000_{hex} (0x6000) to 66F9_{hex} (0x66F9) can be read back with an offset of 1000_{hex} (0x1000) added to the MODBUS address.

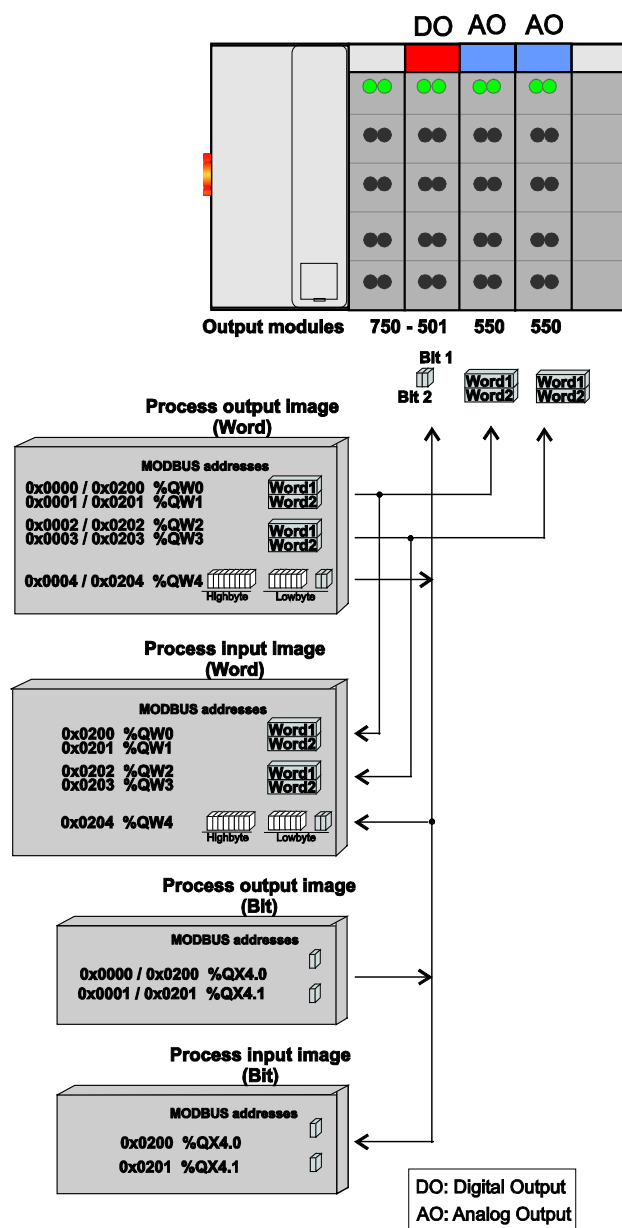


Figure 56: Example of Process Image for Output Data

8.2.4 MODBUS Process Data

For some I/O modules (and their variations), the structure of the process data depends on the fieldbus.

When applying the MODBUS protocol, the process image has a word structure (with word alignment). The internal mapping method for data greater than one byte conforms to the Intel format. The modules can be mapped directly via addresses with MODBUS.

Information



Additional Information

For the fieldbus-specific structure of the process values of any I/O module within the 750 or 753 Series of the WAGO-I/O-SYSTEM, refer to Section "Structure of process data for MODBUS/TCP".

8.2.5 Process Data – KNXnet/IP

With the KNXnet/IP protocol, the fieldbus controller communicates via function blocks contained in the IEC-61131-3 application rather than via the process image. The function blocks provide the interface between the KNX objects and the IEC application.

Each of these function blocks represents a data format specified in the KNX standard (DPT or EIS) and defines a memory range by its data width.

In addition, the function blocks are used to ensure that telegrams with the same value can be sent multiple times and that the receiving of identical, consecutive telegrams is detected. For this, the KNX stack informs the IEC application that a new telegram has arrived.

These can also be optionally saved as retain variables to ensure that the received KNX data is retained, even after power loss in the application program.

A list of the network variables mapped to the group addresses is created in the controller (see following Figure). When a telegram is sent to a group address, reference is made to the corresponding object (here, "DPT_date"). The associated function block "FbDPT_Date_pro" in the IEC application outputs the received value.

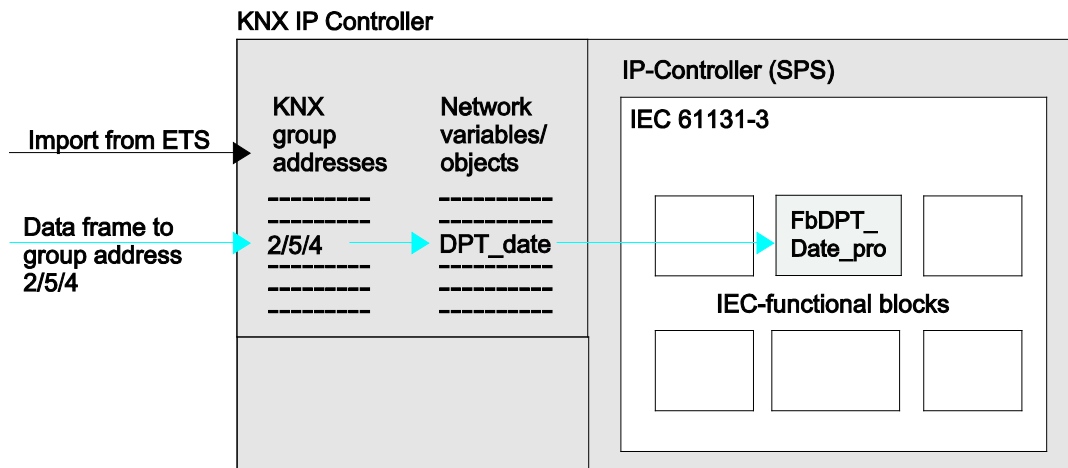


Figure 57: Telegram processing

Each arriving telegram is then routed properly by the controller with the aid of the “KNX-IEC Translation table”.

Information



Additional Information

The function blocks to be utilized for implementation of this communication are located in the library “KNX_02.lib”. The library “KNX_IP_889_Controller_02.lib” contains the master module for the KNX IP controller. Both libraries are available at <http://www.wago.com> in the “Downloads” area.

Example of a function block, type “DPT_date”

(Other function blocks are structured in the same manner.)

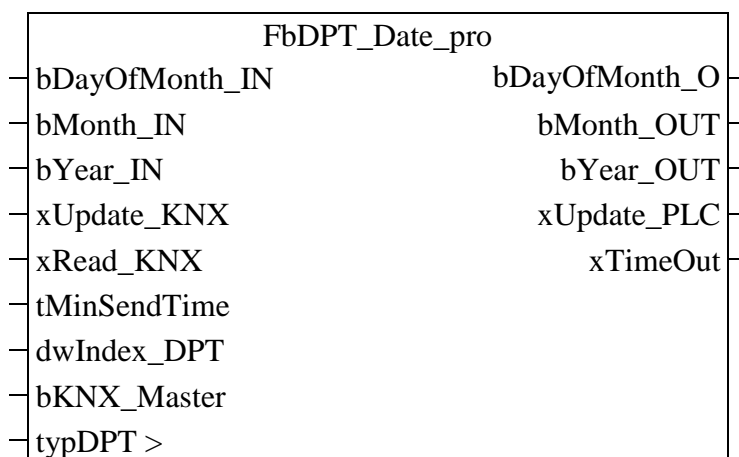


Figure 58: Function block “FbDPT_Date_pro”

Function Description

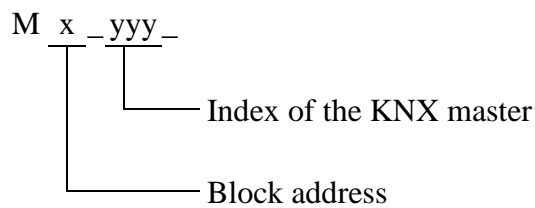
A function block provides data exchange with KNX group addresses. The function block operates as an input or output block. A value change at the inputs of the function block causes a telegram to be sent to the KNX IP controller.

If the function block is used for receiving data (output), the data received from the controller is signaled at the function block output. The non-scaled value for these variables is available as an input/output variable at the “**typDPT**” input.

Receiving a new telegram at a group address is signaled at the “**xUpdate: PLC**” output. The variable will then switch to TRUE for one cycle. Sending of the KNX group address can also be forced by a rising edge being present at the “**xUpdate_KNX**” input.

Syntax for Function Blocks with Fixed Addressing

When using fixed addressing (i.e., when using the optional "dwIndex_DPT" input), the following prefix is used for function blocks:



Example: M1_003_BlockName → bKNX_Master = 1 / dwIndex_DPT = 3

If the input is not used, the function block does not receive a prefix. Addressing is the dynamic.

8.3 Data Exchange

Exchange of process data takes place with KNX IP controllers using the KNXnet/IP protocol or, as an alternative, using the MODBUS protocol.

The KNX IP controller functions according to the multimaster principle. The masters request communication; this request can be directed to certain nodes by addressing. The nodes receive the request and, depending on the request type, send a reply to the master.

A controller can set up a defined number of simultaneous connections (socket connections) to other network subscribers:

- 3 connections for HTTP (read HTML pages from the fieldbus controller)
- 15 connections via MODBUS/TCP (read or write input and output data read by fieldbus controller)
- 5 connections via PFC (available in the PLC function for IEC-61131-3 application programs)
- 2 connection for the WAGO-I/O-PRO. (This connection is reserved for downloading and debugging of the application program.)
- 10 connections for FTP
- 2 connections for SNMP
- 1 multicast connection for KNXnet/IP

The maximum number of simultaneous connections can not be exceeded. Existing connections must first be terminated before new ones can be set up. The KNX IP Controller is essentially equipped with three interfaces for data exchange:

- the interface to the fieldbus (Master),
- the PLC function of the PFC (CPU) and
- the interface to the I/O modules.

Data exchange takes place between

- the fieldbus master and the I/O modules,
- the PLC function of the PFC (CPU) and the I/O modules
- between the fieldbus master and the PLC function of the PFC (CPU).

If MODBUS is used as the fieldbus, the MODBUS master accesses the data using the MODBUS functions implemented in the controller.

Data access is carried out with the aid of an IEC-61131-3 application program. Data addressing varies greatly here.

8.3.1 MODBUS Memory Areas

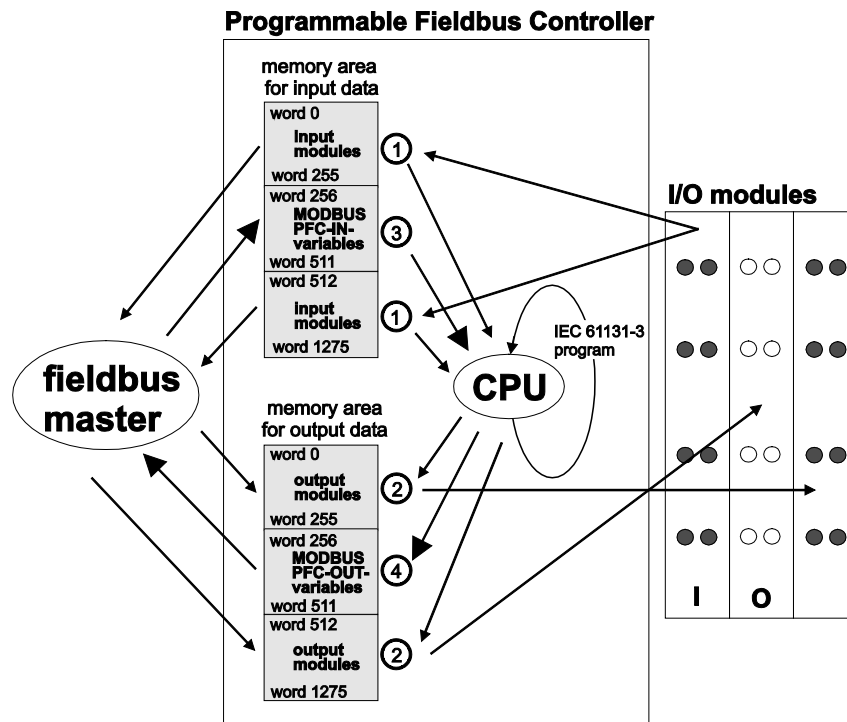


Figure 59: Memory Areas and Data Exchange

The controller process image contains the physical data for the bus modules. These have a value of 0 ... 255 and word 512 ... 1275.

- ① The input module data can be read by the CPU and by the fieldbus side.
- ② Likewise, data can be written to the output modules from the CPU and the fieldbus side.

The MODBUS PFC variables are stored in each of the memory areas for word 256 ... 511 between these sides.

- ③ The MODBUS-PFC input variables are written to the input memory area from the fieldbus side and read in by the CPU for processing.
- ④ The variables processed by the CPU using the IEC-61131-3 program are places in the output memory area, where they can be read out by the master.

The memory area for word 1276 ... 1531 is adjacent to the physical I/O module data. This area is reserved and may not be used.

The subsequent memory area, starting from word 1532, is reserved for future protocol expansion and other PFC variables.

In addition, all output data is mirrored in the KNX IP Controller to a memory area with the address offset 0x0200 and 0x1000. This allows output values to be read back in by adding 0x0200 or 0x1000 to the MODBUS address.

Other memory areas are also provided in the controller, some of which cannot be accessed by the fieldbus side, however:

- Data memory (1024 kByte)**
The data memory is a volatile RAM memory for creating variables that are not required for communication with the interfaces, but rather for internal processing procedures, such as calculation of results.
- Program memory (1024 kByte)**
The IEC-61131-3 program is stored in the program memory. The code memory is a Flash ROM. When power is switched on, the program is transferred from the flash to the RAM memory. After error-free run-up, the PFC cycle starts with the mode selector switch at the top position, or on the Start command from the WAGO-I/O-PRO.
- NOVRAM Remanent memory (32 kByte)**
The remanent memory is a non-volatile memory; i.e., all values of flags and variables, that are explicitly defined by “var retain”, are retained even after a loss of power. Memory management is performed automatically. The 32 kByte memory area is normally divided into an 16 kByte addressable range for flags (%MW0 ... %MW 8191) and a 16 kByte retain area for variables without memory area addressing, that are defined by “var retain”.

Note



Markers are only remanent under “var retain”!

Please note that the bit memory is only retentive if you have declared it as such under “var retain”.

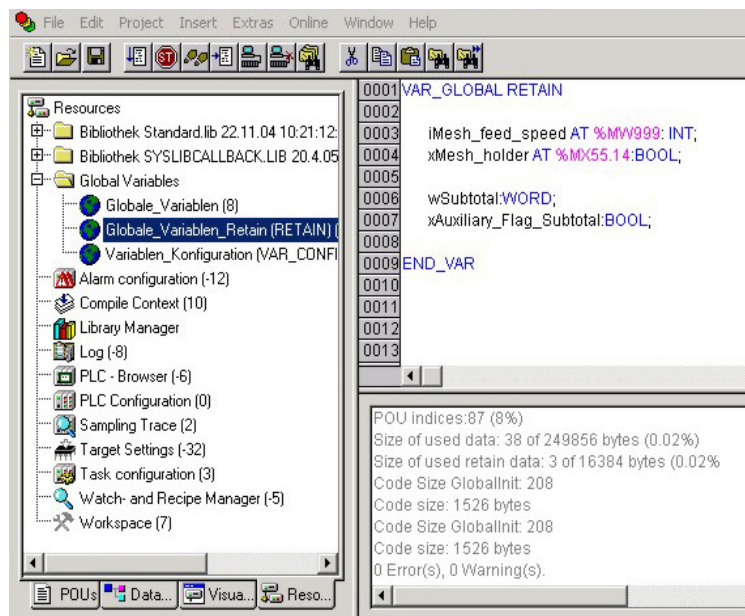


Figure 60: Example declaration of remanent flags by “var retain”

This breakdown can be varied (see following explanation).

Note



NOVRAM memory allocation can be changed in WAGO-I/O-PRO!

The breakdown of the NOVRAM can be modified when required in the programming software WAGO-I/O-PRO/Register “Resources”/Dialog window “Target system settings”.

The start address for the flag area is fixed. The area sizes and the start address for the retain memory can be varied.

We do recommend keeping the standard settings, however, in order to avoid any overlapping of the areas.

In these default settings the size of the flag area is set at 16#4000, followed by the retain memory, with the size 16#4000

8.3.2 Addressing

Module inputs and outputs in a fieldbus controller are addressed internally as soon as they are started. The order in which the connected modules are addressed depends on the type of module that is connected (input module, output module). The process image is formed from these addresses. The physical arrangement of the I/O modules in the fieldbus node is arbitrary.

Note



Use various options for addressing the bus terminals!

Connected modules in more detail. It is essential that you understand these correlations in order to conduct conventional addressing by counting.

The **WAGO I/O Configurator** is also available as a further addressing option. The Configurator can assist you in addressing and protocol assignment for the connected modules. You must select the connected modules in the I/O Configurator; the software then takes care of correct addressing (see following Figure).

The I/O Configurator is started from the *WAGO-I/O-PRO*.

For more details, refer to section “Programming the PFC Using *WAGO-I/O-PRO*” > ... > “Configuring the Fieldbus Controller using the I/O Configurator”.

8.3.2.1 Addressing of I/O Modules

Addressing first references complex modules (modules that occupy several bytes) in accordance with their physical order downstream of the fieldbus coupler/controller; i.e., they occupy addresses starting from word 0.

Following these is the data for the remaining modules, compiled in bytes (modules that occupy less than one byte). In this process, byte by byte is filled with this data in the physical order. As soon a complete byte is occupied by the bit oriented modules, the process begins automatically with the next byte.

Note



Hardware changes can result in changes of the process image!

If the hardware configuration is changed and/or expanded; this may result in a new process image structure. In this case, the process data addresses also change. If adding modules, the process data of all previous modules has to be taken into account.

Note



Observe process data quantity!

For the number of input and output bits or bytes of the individual IO modules please refer to the corresponding description of the IO modules.

Table 33: Data Width for I/O Modules

Data width > 1 byte (channel)	Data width = 1 bit (channel)
Analog input modules	Digital input modules
Analog output modules	Digital output modules
Input modules for thermocouples	Digital output modules with diagnostics (2 bits/channel)
Input modules for resistor sensors	Supply modules with fuse carrier/diagnostics
Pulse width output modules	Solid-state load relays
Interface modules	Relay output modules
Up/down counters	
I/O modules for angle and distance measurement	

8.3.2.2 Example of Addressing

A controller to which two digital input modules (2 DI), two digital output modules (2 DO) and two analog input modules (2 AI) and two analog output modules (2AO) are connected. The final element is an end module that is not taken into account for addressing.

Table 34: Example of Addressing

Counting order	Module	Function	Data width	Hardware Address
1.	750-467	2 AI / 0-10 Volt	2 x 16 bit	%IW0 u. %IW1
2.	750-400	2 DI	2 x 1 bit	%IX2.0 u. %IX2.1
3.	750-550	2 AO / 0-10 Volt	2 x 16 bit	%QW0 u. %QW1
4.	750-501	2 DO	2 x 1 bit	%QX2.0 u. %QX2.1
-	750-600	End module	none	-

Refer to the technical data for the specific modules for the data width. The analog input modules (AI) are mapped first in the process image. Analog modules are processed word-by-word (W).

Module 467 occupies 2 words here (1 word = 16 Bit); i.e.; the first word **%IW0** and the second word **%IW1** in the memory image. Note here that counting begins at “0”.

The digital inputs (DI) are taken into account after this. These occupy 2 bits. Two complete words have been previously counted (Word 0 and 1). Now, counting is continued from Word 2 and 2 bits are added (Bit 0 and Bit 1). Words and bits are each separated by a decimal point. The hardware addresses are **%IX2.0** and **%IX2.1**.

The two analog output modules 750-550 (AO) are then processed. Each of these modules occupies 1 word; i.e., together they occupy 2 words. Counting for the output process image begins anew at “0”. The hardware output addresses are then **%QW0** and **%QW1**.

Now the digital outputs (DO) are dealt with. These occupy 2 bits. Two complete words have been previously counted (Word 0 and 1). Now, counting is continued from Word 2 and 2 bits are added (Bit 0 and Bit 1). The hardware addresses are then **%QX2.0** and **%QX2.1**.

Note



Hardware changes can result in changes of the process image!

Changing or adding of digital, analog or complex modules (DALI, EnOcean, etc.) may result in a new process image being generated. The process data addresses would then also be changed. Therefore, the process data of all previous modules has to be taken into account when modules are added.

8.3.2.3 IEC-61131-3 Address Areas

Table 35: IEC-61131-3 Address Areas

Address area	MODBUS Access	PLC Access	Description
phys. inputs	read	read	Physical inputs (%IW0...%IW255 und %IW512...%IW1275)
phys. outputs	read/write	read/write	Physical outputs (%QW0...%QW255 und %QW512...%QW1275)
MODBUS/TCP PFC-IN variables	read/write	read	Volatile PLC input variables (%IW256...%IW511)
MODBUS/TCP PFC-OUT variables	read	read/write	Volatile PLC output variables (%QW256...%QW511)
Configuration register	read/write	-	see Section “Fieldbus Communication” > “Configuration Registers”
Firmware register	read	-	see Section “Fieldbus Communication” > “Firmware Information Registers”
Marker variables (retain)	read/write	read/write	Remanent memory (%MW0...%MW8191)

8.3.2.4 Absolute Addressing

Direct presentation of individual memory cells (absolute addresses) based on IEC-61131-3 is performed using character strings:

Table 36: Absolute Addressing

Position	Prefix	Designation	Comment
1	%	Introduces an absolute address	
2	I Q M	Input Output Flag	
3	X* B W D	Single bit Byte (8 bits) Word (16 bits) Doubleword (32 bits)	Data width
4		Address	

such as word-by-word: %QW27 (28th word), bit-by-bit: %IX1.9 (10th bit in the 2nd word)

* The designator “X” for bits can be omitted

Note



Enter character strings without spaces or special characters!

The character strings for absolute addresses must be entered connected, i.e. without spaces or special characters!

Addressing example:

Table 37: Addressing Example

Inputs			
Bit	%IX14.0 ... 15		%IX15.0 ... 15
Byte	%IB28	%IB29	%IB30 ... %IB31
Word	%IW14		%IW15
Double word	%ID7		
Outputs			
Bit	%QX5.0 ... 15		%QX6.0 ... 15
Byte	%QB10	%QB11	%QB12 ... %QB13
Word	%QW5		%QW6
Double word	%QD2 (top section)		%QD3 (bottom section)

		Flags			
Bit		%MX11.0 ... 15		%MX12.0 ... 15	
Byte		%MB22	%MB23	%MB24	%MB25
Word		%MW11		%MW12	
Double word		%MD5 (top section)		%MD6 (bottom section)	

Calculating addresses (as a function of the word address):

Bit address: Word address .0 to .15

Byte address: 1st byte: 2 x word address

2nd byte: 2 x word address + 1

DWord address: Word address (even number) / 2

or Word address (uneven number) / 2, rounded down

8.3.3 Data Exchange between MODBUS/TCP Master and I/O Modules

Data exchange between the MODBUS/TCP Master and the I/O modules is conducted using the MODBUS functions implemented in the controller by means of bit-by-bit or word-by-word reading and writing routines.

There are 4 different types of process data in the controller:

- Input words
- Output words
- Input bits
- Output bits

Access by word to the digital I/O modules is carried out in accordance with the following table:

Table 38: Allocation of Digital Inputs and Outputs to Process Data Words in Accordance with the Intel Format

Digital inputs/ outputs	16.	15.	14.	13.	12.	11.	10.	9.	8.	7.	6.	5.	4.	3.	2.	1.
Process data word	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte	High byte D1								Low byte D0							

Output can be read back in by adding an offset of 200_{hex} (0x0200) to the MODBUS address.

Note



Data > 256 words can be read back by using the cumulative offset!

All output data greater than 256 words and, therefore located in the memory range 0x6000 to 0x62FC, can be read back by adding an offset of 1000_{hex} (0x1000) to the MODBUS address.

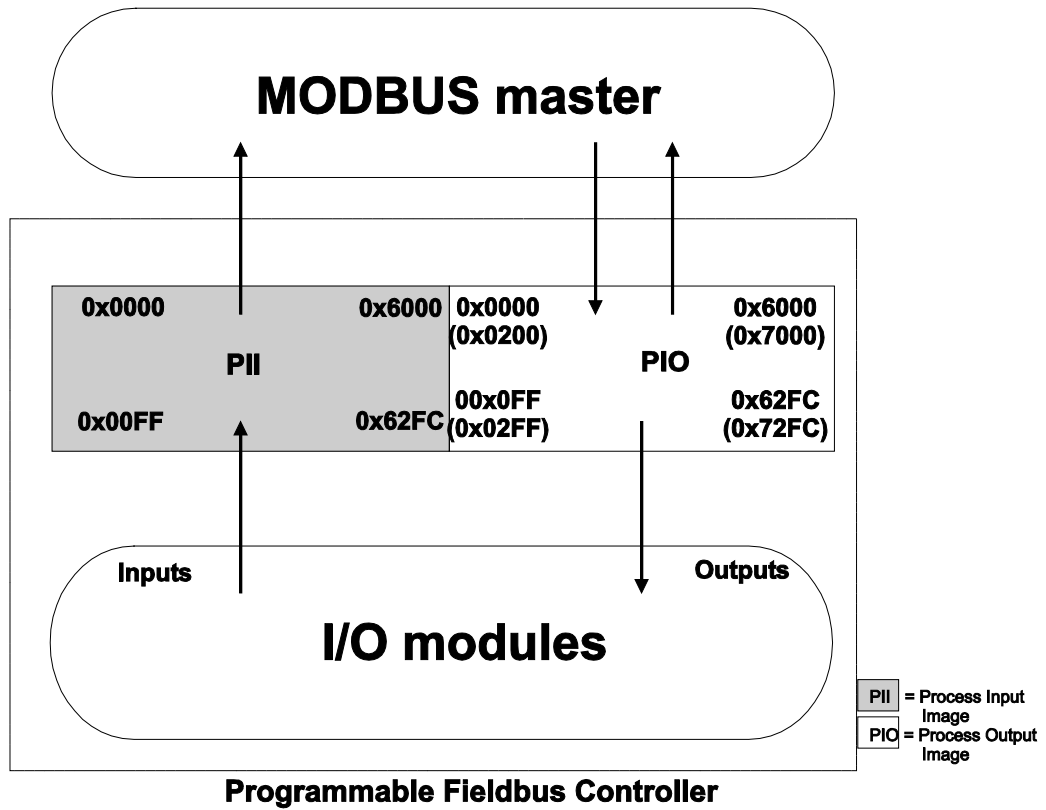


Figure 61: Data Exchange Between MODBUS Master and I/O Modules

Register functions start at address 0x1000. These functions can be addressed in a similar manner with the MODBUS function codes that are implemented (read/write).

The specific register address is then specified instead of the address for a module channel.

Information



Additional Information

A detailed description of the MODBUS addressing may be found in Chapter "MODBUS Register Mapping".

8.3.4 Data Exchange between PLC Function (CPU) and I/O Modules

The PLC function (CPU) of the PFC uses direct addresses to access the I/O module data.

The PFC uses absolute addresses to reference the input data. The data can then be processed internally in the controller using the IEC-61131-3 program. Flags are stored in a non-volatile memory area in this process. The results of linking can then be written directly to the output data employing absolute addressing.

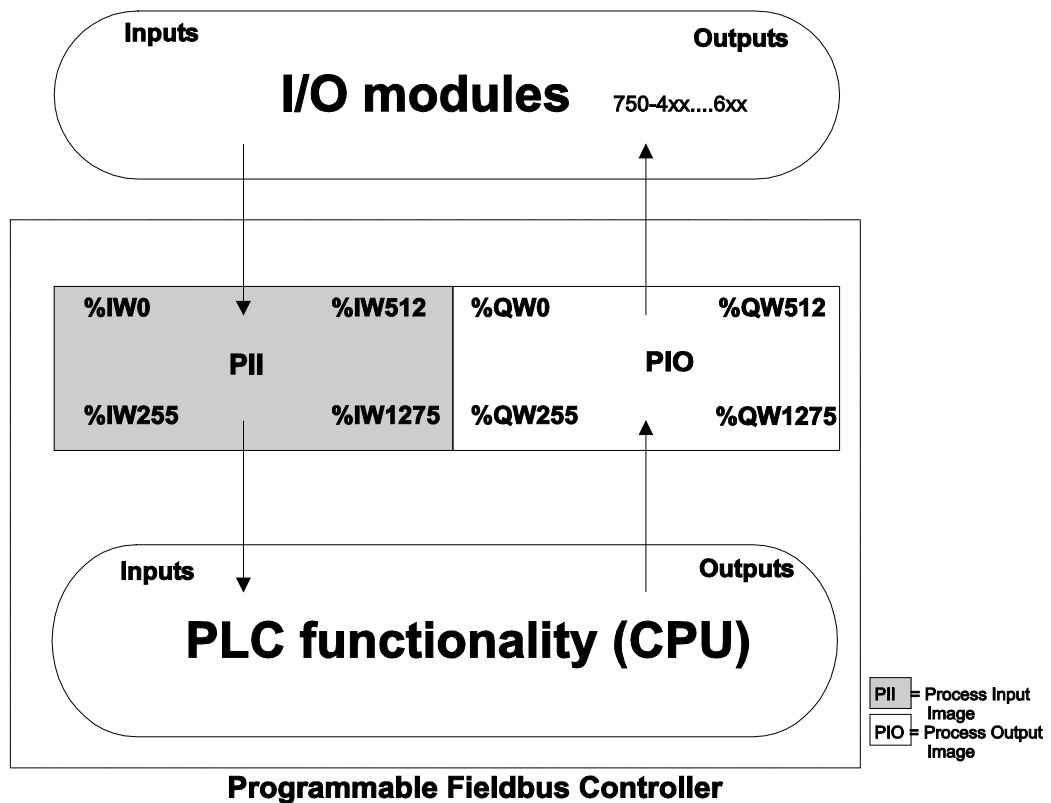


Figure 62: Data Exchange Between PLC Function (CPU) of the PFC and the I/O Modules

8.3.5 Data Exchange between Master and PLC Function (CPU)

The fieldbus master and the PLC function (CPU) of the PFC have different perspectives on data.

Variable data generated by the master are routed as input variables to the PFC, where they are further processed.

Data created in the PFC are transmitted via fieldbus to the master as output variables.

In the PFC, access to the MODBUS/TCP PFC variable data is possible starting from word address 256 to 511 (double-word address 128-255, byte address 512-1023), while access to the PFC variable data is possible starting from a word address of 1276 to 1531 (double-word address 638-765, byte address 2552-3063).

8.3.5.1 Example of MODBUS/TCP Master and PLC Function (CPU)

Data access by the MODBUS/TCP Master

Access to data by the MODBUS Master is always either by word or by bit. Addressing of the first 256 data words by the I/O modules begins with word-by-word and bit-by-bit access at 0.

Addressing of the data by the variables begins at 256 for word-based access; bit-by-bit access then takes place starting at:

4096 for bit 0 in word 256
4097 for bit 1 in word 256
...
8191 for bit 15 in word 511.

The bit number can be determined using the following equation:

$$\text{Bit No.} = (\text{word} * 16) + \text{Bit No. in word}$$

Example: 4097 = (256 * 16) + 1

Data Access by PLC Function (CPU)

The PLC function of the PFC employs a different type of addressing for accessing the same data. PLC addressing is identical with word-by-word addressing by the MODBUS Master for the declaration of 16-bit variables. However, a different notation is used for declaration of Boolean variables (1 bit) than that used by MODBUS. Here, the bit address is composed of the elements word address and bit number in the word, separated by a decimal point.

Example:

Bit access by MODBUS to bit number 4097 => Bit addressing in the PLC
<Word No.>.<Bit No.> = 256.1

The PLC function of the PFC can also access data by bytes and by doubleword access.

Addresses are calculated based on the following equations for byte-based access:

$$\begin{aligned}\text{High Byte address} &= \text{Word address} * 2 \\ \text{Low Byte address} &= (\text{Word address} * 2) + 1\end{aligned}$$

Addresses are calculated according to the following equation for double-word based access:

$$\begin{aligned}\text{Double-word address} &= \text{High word address} / 2 \text{ (rounded down)} \\ &\text{or} = \text{Low word address} / 2\end{aligned}$$

Information



Additional Information

There is a detailed description of the MODBUS and the corresponding IEC 61131 addressing in section “MODBUS Register Mapping”.

8.3.6 Application Example

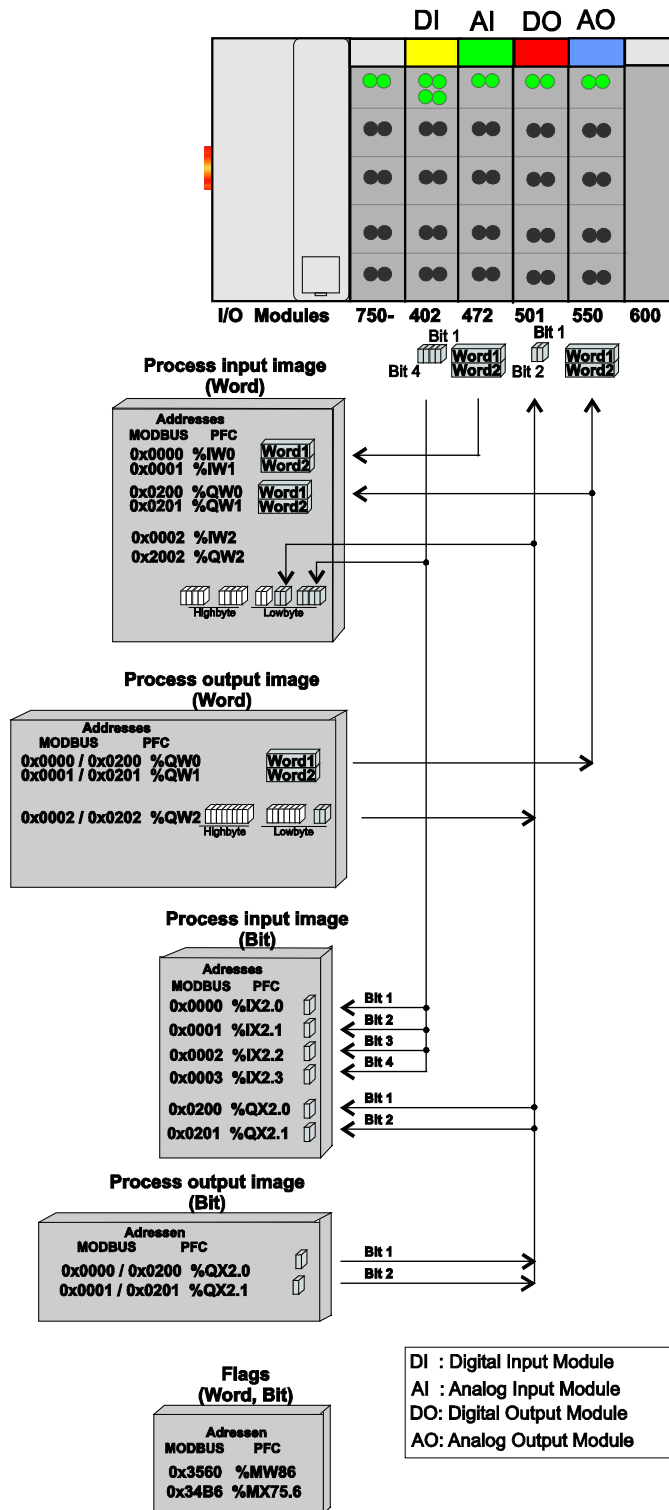


Figure 63: Example of Addressing for a Fieldbus Node

8.4 Memory Card Function

The memory card is optional and serves as memory in addition to the internal memory in the fieldbus controller. The user program, user data, the source code of the project or device settings can be saved on the memory card and thus already-existing project data and programs can be copied to one or more fieldbus controller(s).

Note



Only use recommended memory cards!

Use only the SD memory card available from WAGO (item no. 758-879/000-001) since it is suitable for industrial applications under difficult environmental conditions and for use in the fieldbus controller. Compatibility with other commercially available storage media cannot be guaranteed.

If the memory card has been inserted, it is incorporated into the directory structure of the internal file system of the fieldbus controller as drive S:. This way, the memory card can be addressed like a changeable medium on a PC.

Note



Deactivate write protection!

In order to be able to write data on the memory card, you must deactivate the small push switch for the write protection setting. This switch is on one of the long sides of the memory card.

The function of the memory card in normal operation and possible errors that can arise when using the memory card will be described in the following sections for various steps during operation:

- Project copying and automatic system start
- Back-up function (Storing device-internal data and settings on the memory card)
- Restore function (Loading device-internal data and settings from the memory card)
- Inserting a memory card during ongoing operation
- Removing the memory card during ongoing operation
- Saving WAGO-I/O-PRO project to memory card
- FTP network access to the file system of the memory card
- Directory structure

Note



Note the pre-formatting of SD card!

Note that SD cards ≤ 2 GB are often formatted with the file system type “FAT16”, and the creation of a maximum of 512 entries in the root directory is possible. For more than 512 entries, create them in a subdirectory, or format the SD card with “FAT32”.

8.4.1 Project Copying and Automatic System Start

This function is useful for project updates or project copying between several fieldbus controllers using an SD card.



Note

Replication only possible between fieldbus controllers of the same type!
Make sure to execute the “Restore” function for replication between fieldbus controllers with identical item numbers only.

First, start the fieldbus controller without the SD card being inserted.

The “Autorestore Global Enable” function is enabled in the Web-based Management on the “Backup & Restore” website. In this context, choose to restore after each reboot or in this case, to replicate (“Always restore settings from disk on reboot”) or to restore once on the next reboot only (“Restore settings from disk on next reboot only”).

Restore Option Setting	
Setting	Description
<input checked="" type="checkbox"/>	Autorestore Global Enable This option will be disabled after the next reboot if the following option is set to next reboot only
<input checked="" type="radio"/>	Restore settings from disk on next reboot only
<input type="radio"/>	Always restore settings from disk on reboot

Figure 64: Restore Function

Select the data to be copied from the SD card of another fieldbus controller in the “Settings” column. Only selected options are transferred (e.g., device settings, ports, CODESYS settings, file system, etc.).

Power supply is interrupted, allowing you to insert the SD card from a different fieldbus controller.

Then switch on the power for the fieldbus controller.

The fieldbus controller is started and the data selected in “Settings” is copied from the S:/copy/xxx directories on the memory card to the respective directories of the internal file system.

Identical data that is already present in the internal file system is not copied.

The LED above the SD card flashes while copying is in progress.

The copied data is then loaded automatically. Device settings and other data are saved in the fieldbus controller and are executed.

Note



Disable automatic restore function when not used!

If the “Autorestore Global Enable” function, as well as the associated “Always restore settings from SD card on reboot” or “Restore settings from disk on next reboot only” functions are enabled, then the fieldbus controller is checked each time or on the next reboot if there is already a back-up on the SD card (“copy/xxx” directory). If there is a back-up, the selected parts of the back-up are loaded from the SD card to the fieldbus controller (Restore). The internal file system is written using the data from the SD card.

Attention: Any boot project in the fieldbus controller is deleted. Disable the “Autorestore Global Enable” function if you do not want the automatic restore function to execute on each or the next reboot.

Table 39: Possible Errors on System Start

Possible error	Procedure	Error message	Solution
No /copy/ and /settings/ directories on the memory card	System start of the fieldbus controller is running as if no memory card were present.	No message.	If memory card use is desired, map the directory structure of the internal drive under /copy/ on the memory card on the PC. Then restart the fieldbus controller.
Manual interrupt	If the /copy/ directory has not yet been copied in full, then the copy process is stopped on manual interrupt. The data is incomplete.	Blink code of the I/O LED for 30 seconds (error code 14, error argument 2) or until the error is eliminated.	Restart system.
Internal file system is full	As much data is copied until the file system is full. The copy function is cancelled. The data is incomplete.	Blink code of the I/O LED (error code 14, error argument 3) until the error is eliminated.	Check internal file system and /copy/ directory on the memory card and delete data if necessary (e.g. via FTP, formatting internal drive or cleaning the memory card on the PC).
General internal error	The copy function is cancelled. The data is incomplete.	Blink code of the I/O LED (error code 14, error argument 7).	If necessary, restart function and device.

Note



The file size may not be larger than the size of the internal drive!

Note that the amount of data in the /copy/ directory must not exceed the total size of the internal drive when restoring.

8.4.2 Back-up Function (Storing Device-internal Data and Settings on the Memory Card)

The fieldbus nodes and the SPS program are in operation and the memory card is plugged in.

On the “Backup & Restore” page in the Web-based management system start the function “Backup ALL device settings to removable disk” to save the data on the internal drive and the device settings to the memory card during operation.

Services		
Command	Description	Status
<input type="button" value="START"/>	Backup ALL device settings to removable disk (77 kB needed).	OK
<input type="button" value="START"/>	Restore device settings from removable disk using the option settings below.	OK

Figure 65: WBM Page “Backup & Restore”

In this process, the files from the internal drive are stored in the directory S:/copy/xxx and in the corresponding subdirectories on the memory card. The information that is not present as files on the fieldbus controller is stored in XML format in the S:/settings/ directory.

Meanwhile, the SD-LED blinks yellow/orange.

The device settings and files of the internal drive are then saved on the memory card.

Table 40: Possible Errors During the Backup Function

Possible error	Procedure	Error message	Solution
Memory card is full	The copy function is cancelled. Device settings and files in the /copy/ directory and the subdirectories are not saved completely on the memory card.	Blink code of the I/O LED (error code 14, error argument 4) until the error is eliminated.	Replace the memory card with a new one, then restart the backup function. Create storage space on the memory card with the PC.
Memory card is write-protected.	Copying is not possible, the backup function is cancelled and the memory card remains as it was.	Blink code of the I/O LED (error code 14, error argument 6) until the error is eliminated.	Remove the memory card, remove the write protection, insert the card again, then restart the backup function.
Manual interrupt	The copy function is cancelled. Device settings and files in the /copy/ directory and the subdirectories are not saved completely on the memory card.	Blink code of the I/O LED for 30 seconds (error code 14, error argument 2) or until the error is eliminated.	Insert memory card, then restart the backup function.
General internal error	The copy function is cancelled. Device settings and files in the /copy/ directory and the subdirectories are not saved completely on the memory card.	Blink code of the I/O LED (error code 14, error argument 6).	If necessary, restart function and device.

8.4.3 Restore Function (Loading Device-internal Data and Settings from the Memory Card)

The fieldbus nodes and the SPS program are in operation and the memory card is plugged in.

On the “Backup & Restore” page in the Web-based management system, start the “Restore device settings to removable disk using the options below” function in order to load the device settings from the memory card to the internal drive during normal operation.

Services		
Command	Description	Status
<input type="button" value="START"/>	Backup ALL device settings to removable disk (77 kB needed).	OK
<input type="button" value="START"/>	Restore device settings from removable disk using the option settings below.	OK

Figure 66: WBM Page “Backup & Restore”

For the Restore function, other options can be set that are described in the chapter “Configuring in the Web-based Management System (WBM)”.

Restore Option Setting	
Setting	Description
<input checked="" type="checkbox"/>	Autorestore Global Enable This option will be disabled after the next reboot if the following option is set to next reboot only
<input checked="" type="radio"/>	Restore settings from SD card on next reboot only
<input type="radio"/>	Always restore settings from SD card on reboot
<input checked="" type="checkbox"/>	IP address, dip switch IP address, network mask, domain name, host name, gateway, DNS servers, auto reset on system error, BOOTP request before static IP
<input checked="" type="checkbox"/>	Ports, security, time server, multicast settings, blocked Modbus flag registers, MAC filter, Ethernet hardware settings
<input checked="" type="checkbox"/>	PLC settings, PLC folder and subfolders, boot project, ETC folder and web visualisation
<input checked="" type="checkbox"/>	Non-volatile memory
<input checked="" type="checkbox"/>	KNX configuration
<input checked="" type="checkbox"/>	File system
<input checked="" type="checkbox"/>	Watchdog, trace settings, SNMP, clock settings

Figure 67: WBM page “Backup & Restore”

In this process of loading device settings from the Memory Card, the data are copied from the directory S:/copy/ on the memory card to the appropriate directories on the internal drive.

The SD LED flashes yellow/orange while this is in progress.

Note



In case of parameter changes, the device executes a restart!

Note that the device taking the data executes a restart if parameters in the internal drive are overwritten with other parameter settings from the memory card.

The boot project is loaded automatically and the settings automatically activated after a restart. The “PLC ROOT Location” defined on the “PLC” Web page determines whether the boot project of the internal drive or the SD card is loaded.

Table 41: Possible Errors During the Restore Function

Possible error	Procedure	Error message	Solution
No /copy/ and /settings/ directories on the memory card	Fieldbus controller is working as if no memory card were present.	No message.	If memory card use is desired, map the directory structure of the internal drive under /copy/ on the memory card on the PC. Then restart the fieldbus controller.
Manual interrupt	If the /copy/ directory has not yet been copied in full, then the copy process is stopped on manual interrupt. The data is incomplete.	Blink code of the I/O LED for 30 seconds (error code 14, error argument 2) or until the error is eliminated.	Restart system.
Internal file system is full	As much data is copied until the file system is full. The copy function is cancelled. The data is incomplete.	Blink code of the I/O LED (error code 14, error argument 3) until the error is eliminated.	Check internal file system and /copy/ directory on the memory card and if necessary, delete files (e.g. through FTP, formatting internal drive or cleaning the memory card on the PC).
General internal error	The copy function is cancelled. The data is incomplete.	Blink code of the I/O LED (error code 14, error argument 7).	If necessary, restart function and device.

Note



The file size may not be larger than the size of the internal drive!

Note that the amount of data in the S:/copy/ directory must not exceed the total size of the internal drive when restoring.

8.4.4 Inserting a Memory Card During Operation

The fieldbus nodes and the SPS program are running.

Insert a memory card during ongoing operation.

During normal operation, the memory card is incorporated into the file system of the fieldbus controller as a drive.

No automatic copy procedures are triggered.

The SD-LED blinks yellow/orange during the access.

The memory card is then ready for operation and available as drive **S:**.

Table 42: Possible Errors when Inserting the Memory Card During Ongoing Operation

Possible error	Procedure	Error message	Solution
Access to the memory card is not possible	The incorporation (mounting) of the memory card as drive is cancelled. The fieldbus controller behaves as if no memory card were present.	Blink code of the I/O LED (error code 14, error argument 1) until the error is eliminated.	Replace the memory card with a new one.
Memory card cannot be read	The incorporation (mounting) of the memory card as drive is cancelled.	Blink code of the I/O LED (error code 14, error argument 1) until the error is eliminated. For access through SPS, the error is reported via the CODESYS library.	Replace the memory card with a new one.
Memory card is not formatted	The incorporation (mounting) of the memory card as drive is cancelled.	Blink code of the I/O LED (error code 14, error argument 1) until the error is eliminated. For access through SPS, the error is reported via the CODESYS library.	Replace memory card with a new one or format with PC.
Memory card is not in FAT or FAT32 format.	The incorporation (mounting) of the memory card as drive is cancelled.	Blink code of the I/O LED (error code 14, error argument 1) until the error is eliminated. For access through SPS, the error is reported via the CODESYS library.	Replace memory card with a new one or format with PC.

8.4.5 Removing the Memory Card During Operation

The fieldbus nodes and the SPS program are in operation and the memory card is plugged in.

Remove the memory card during ongoing operation.

Note



Data can be lost during writing!

The SD-LED blinks yellow/orange during the access.

Note that if you pull the memory card out during a write procedure, data will be lost.

The fieldbus controller then works without memory card.

Table 43: Possible Errors when Removing the Memory Card During Ongoing Operation

Possible error	Procedure	Error message	Solution
Read procedure is running	Read access is cancelled. The fieldbus controller then works without memory card.	Blink code of the I/O LED for 30 seconds (error code 14, error argument 2) if the backup or restore function is active. For access through SPS, the error is reported via the CODESYS library.	If memory card usage is desired, insert the memory card, then restart the access function.
Write procedure is running	Write access is cancelled. The fieldbus controller then works without memory card.	Blink code of the I/O LED for 30 seconds (error code 14, error argument 2) if the backup or restore function is active. For access through SPS, the error is reported via the CODESYS library.	If memory card usage is desired, insert the memory card, then restart the access function.

8.4.6 Saving WAGO-I/O-PRO project to Memory Card

To save a WAGO-I/O-PRO project on the SD card and to have it executed from that location, activate the option “External SD memory card” on the WBM page “PLC” (see also the Section “Configuration in the Web-based Management-System” > “PLC page”).

This setting is remanent. Normally, “Internal File System” is activated.

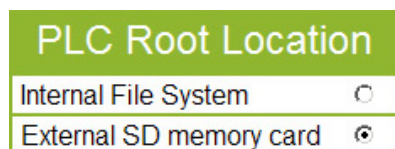


Figure 68: Setting the Storage Location in the Web-based Management System

Switching of the PLC root location occurs immediately when you click the button [SUBMIT].

If no “PLC” directory exists on the SD card, one is created.

If one exists, it is neither deleted nor overwritten.

WAGO-I/O PRO will then access the SD card file system (S:/PLC) instead of the internal drive.

In this case, data (e.g., retain data) are read/written to or from the memory card, or copied from/to the memory card file system.

In normal operation, data is read into the file system of the memory card or read from it for further processing by the IEC-61131 application via a firmware library.

The LED above the SD card flashes yellow/orange while this is in progress.

The data is then written or read.

Note



Redefine the boot project after changing the "PLC Root Location"!

If you have changed the "PLC Root Location", the fieldbus controller boot project will not be started, as it is then not located at the current "PLC Root Location".

No old data will be copied to the new "PLC Root Location".

You must therefore generate a new boot project using the menu item "Create boot project" in WAGO-I/O-PRO.

If you require data for this which were created at the old "PLC Root Location", copy these manually into the new root directory.

Note



Changing of the storage location for KNX configuration files when changing the PLC root location!

The storage location for KNX configuration files changes when you change the PLC root location. The files are then located in the "KNX" subfolder on the memory card.

Note



Provide sufficient storage space for PLC folders!

The following can occur when there is less free storage space on the SD card than is normally required for the PLC folder and the files it contains:

- The files "webvisu.htm" and "error_ini.xml" are created without any content, meaning that the WBM page "Web Visu" is blank.
- The files "webvisu.htm" and "error_ini.xml" are created but are incomplete.

In either case, this condition remains until the entire "PLC" folder is deleted and sufficient storage space made available.

The function "PLC Root Location" remains set to "External SD memory card".

Note



Log in to use the PLC browser with administrator user data!

To use the PLC browser functionality in WAGO-I/O-PRO, log into the PLC browser with the administrator user data (default user "admin", password "wago"). Enter "login admin wago" in the command line of the PLC browser.

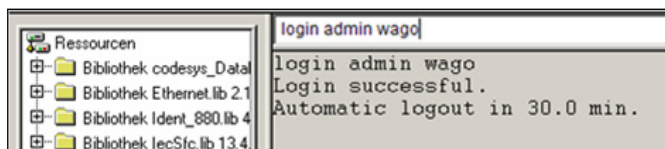


Figure 69: Logging into the PLC Browser

Note



Use proper path for Web pages when saving to SD card!

Web pages on the SD card can be accessed by entering the following path in the browser URL line:

[http://\[IP address\]/SD/\[subdirectory structure on SD card\]](http://[IP address]/SD/[subdirectory structure on SD card])

Note



Save the PLC program and Web visualization on same drive!

If you are using a PLC program and Web visualization, it is imperative that you have both of these items on the same drive, as otherwise Web visualization may not start.

Table 44: Possible Errors During SPS Access to the File System of the Memory Card

Possible error	Procedure	Error message	Solution
Memory card is full	Read functions are executed, in case of write access, the function is cancelled. The data is incomplete or not updated.	Error is reported via the CODESYS library.	Replace the memory card with a new one, then restart the access function. Make space on the memory card with the PC.
Memory card is write-protected.	Read functions are executed, write access is not possible. The memory card remains as it was.	Error is reported via the CODESYS library.	Remove the memory card, remove the write protection, insert the card again, then restart the access function.
No memory card is plugged in.	Access function is cancelled.	Error is reported via the CODESYS library.	If memory card usage is desired, insert the memory card, then restart the access function.
Manual interrupt	Access function is cancelled.	Error is reported via the CODESYS library.	Restart the access function.

8.4.7 FTP Network Access to the File System of the Memory Card

The fieldbus node is in operation and the memory card is plugged in.

The FTP client accesses the file system of the memory card (drive **S:**) via the network.

In normal operation, the FTP client writes data to the file system of the memory card or reads data from the file system of the memory card.

Meanwhile, the SD-LED blinks yellow/orange.

The data is then written or read.

Table 45: Possible Errors During the FTP Network Access on the File System of the Memory Card

Possible error	Procedure	Error message	Solution
No memory card is plugged in.	Access function is cancelled.	Depending on the FTP client used, the error is reported.	If memory card usage is desired, insert a memory card, then if necessary, close the existing FTP connection and establish a new one, then restart FTP access.
Manual interrupt	Access function is cancelled.	Depending on the FTP client used, the error is reported.	If necessary, close existing FTP connection and establish a new one, then restart FTP access.

Note



Observe FTP access rights!

The FTP access rights correspond to those for the WBM. Note here that with “guest” access rights you are provided only with read access to the file system. Log in as “admin” to obtain write access.

Note



FTP connection must be closed and then re-established!

Note that if you pull the memory card out with an existing FTP connection and then insert it again, that you must then close the existing FTP connection and establish it again so that access to the memory card is possible.

8.4.8 Access to Web Pages in the File System of the Memory Card

The fieldbus nodes and the SPS program are in operation and the memory card is plugged in.

By entering in the address bar of the web browser, access to stored web pages on the memory card is possible.

Additional to the syntax of the Web page address, the reference field switch “/sd/” is to be inserted to specify the directory of the SD card.

The address for the Web page is entered in the following manner:

http://<IP_address>/sd/<any_folder_except_PLC>/<any_file>.ssi

8.4.9 Directory Structure

On the WBM page “Backup & Restore”, you can create a backup copy of the internal drive using the function “**Backup** ALL device settings to removable disk”. The folder “copy” is created for this on the SD card. All of the files and subdirectories on the internal drive "A:" will then be copied to this folder.

In addition, the device settings are also written to the directory “S:\settings” on the memory card.

On the WBM page “Backup & Restore” you can restore the SD card data to the internal drive “A:” using the function “**Restore** device settings from removable disk”.

All of the files and subdirectories are copied for this from the directory “S:/copy” on the memory card to the internal drive “A:”.

In addition, the device settings are loaded from the directory “S:\settings” and activated.

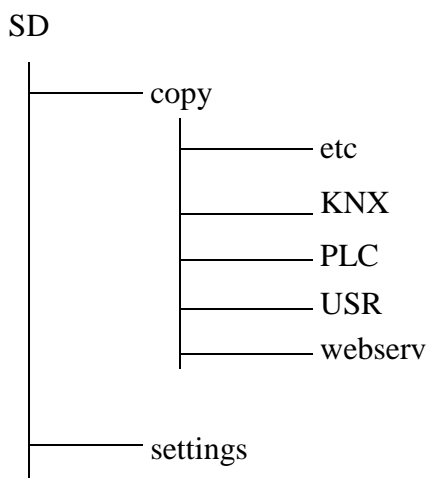


Figure 70: Example of directory structure on the SD card

Table 46: Data saved in the directory structure

Directory	Data saved
S:\copy	The folder “copy” is created on the SD card via the backup function of the Web-based Management System (WBM page “Backup & Restore”). This folder contains a copy of the internal drive.
S:\copy\etc	Node configuration, BACnet files (backup)
S:\copy\KNX	KNX configuration files (backup)
S:\copy\PLC	Project files (backup) A boot project is started, provided the “PLC Root Location” is set to “internal” in the WBM.
S:\copy\USR	User-specific files
S:\copy\webserv	WBM Web pages (backup)
S:\settings	All saved EEPROM parameters (backup)
If saving to an “External SD memory card” is activated in the WBM on the page “PLC”, the following directories will also be created in the SD card directory:	
S:\etc	KNX configuration files (SYM_XML, EDE, etc.)
S:\PLC	Project files A boot project is started, provided the “PLC Root Location” is set to “external/SD” in the WBM.

9 Commissioning

This section shows a step-by-step procedure for starting up exemplarily a WAGO fieldbus node.

Note



Good example!

This description is just an example and only serves to describe the procedure for a local start-up of a single fieldbus node with a non-networked computer under Windows.

Two work steps are required for start-up. The description of these work steps can be found in the corresponding following sections.

- **Connecting PC and fieldbus node**
- **Assigning the IP address to the fieldbus node**

The assignment of the IP address belongs to the basic setting for the fieldbus controller to allow access to the fieldbus controller via the integrated web interface.

Note



The IP address must occur in the network only once!

For error-free network communication, note that the assigned IP address must occur only once in the network!

In the event of an error, the error message “IP address configuration error” (error code 6 – error argument 7) is indicated by 'I/O' LED at the next power-on.

There are various ways to assign the IP address.
The various options are described in the following sections individually.

Following the commissioning descriptions after which the fieldbus node is ready for communication, the following topics are described:

- **Preparing the Flash File System**
- **Synchronizing the real-time clock**
- **Restoring factory settings**

After the topics specified above, you can find instructions for programming the fieldbus controller with WAGO-I/O-PRO and the description of the internal web pages of the web-based Management System (WBM) for additional settings of the fieldbus controller.

9.1 Connecting Client PC and Fieldbus Nodes

1. Mount the fieldbus node to the carrier rail.
Observe the installation instructions described in "Mounting" section.
2. Connect the 24V power supply to the supply module.
3. Connect an ETHERNET interface from the client PC to an ETHERNET interface of the fieldbus controller.
4. Turn the operating voltage on.
Make sure that the mode selector is not in the bottom position.

After the power is switched on, the fieldbus controller is initialized. The fieldbus controller determines the I/O module configuration and creates a process image. During startup, the I/O LED (red) will flash. After a brief period, the I/O LED lights up green, indicating that the fieldbus controller is operational.

If an error has occurred during startup, a fault code is flashed by the I/O LED. If the I/O LED flashes 6 times (indicating error code 6) and then 4 times (indicating error argument 4), an IP address has not been assigned yet.

9.2 Allocating the IP Address to the Fieldbus Node

The controller must be assigned an IP address before it can communicate properly. The four different methods of assigning IP addresses are clarified here.

- **Assigning the IP address (default) using the addressing button**
(fixed IP address using the addressing button on the enclosure)
- **Assigning an IP address using AutoIP**
(Automatic address assignment within a defined address range)
- **Automatic assignment of addresses via DHCP**
(IP address via the fieldbus)
- **Assigning IP Address via WAGO ETHERNET Settings**
(static IP address via the serial communication port)
- **Assigning IP Address via PLC program**
(Static IP address)
- **Assigning IP Address via BootP server**
(Static IP address via the fieldbus)

Information



Additional Information

Normally, IP address assignment is set to “AutoIP” for the KNX IP controller. This setting implies two link set-up attempts with a DHCP server in the network to obtain an IP address via DHCP. If neither of these attempts is successful, the system switches automatically to the AutoIP mode (see Section “Assigning an IP address using AutoIP”).

If address assignment is not successful at the setting “AutoIP”, either use the BootP server (see Section “Startup using the WAGO-BootP server”) or manually assign the controller a static IP address via WAGO-ETHERNET Settings (see Section “Startup using WAGO ETHERNET Settings”).

9.2.1 Assigning the IP Address (default) Using the Addressing Button

If the set IP address of the fieldbus controller is unknown, a fixed IP address can be temporarily assigned by pushbutton to address the fieldbus controller in the network.

1. When powering up, press and hold the “DFLT IP” button on the enclosure of the fieldbus controller until the NS LED flashes green continuously.

The IP address **192.168.1.17** is assigned to the fieldbus controller by default (subnet mask 255.255.255.0, gateway = 0.0.0.0).

When restarting without pressing the button, the configured IP settings are used again.

Note



Use an appropriate tool to operate the “DFLT IP” button!

To press the “DFLT IP” button, use a blunt tool (e.g. a screw driver or WAGO operating tool) with a minimum diameter of 1.5 mm to avoid pushing through to the underlying level between the button and the enclosure.

Doing so can damage the button, enclosure or circuit board.

Note



Restarting the fieldbus controller disables the temporary IP address!

After restarting, the fieldbus controller again has the IP address you configured. The specified default IP address set using the addressing button is only temporary by pressing the addressing button.

9.2.2 Assigning an IP Address using AutoIP

AutoIP serves the simple networking in local area networks. The fieldbus controller automatically obtains an IP address from the fixed IP range 169.254.1.0 to 169.254.254.255.

The KNX IP controller is normally set to AutoIP.

If AutoIP is not active, activate the function in the web-based Management System on the “Port” page.

A test is conducted with the stored IP address when the fieldbus controller is switched on, or after connecting the controller with the ETHERNET cable, and the IP address accepted when the configuration test is successful.

1. Write down the controller’s MAC address (see label or peel-off strip). If the fieldbus is already installed, turn off the operating voltage of the fieldbus controller, then take the fieldbus controller out of the assembly of your fieldbus node and note the MAC ID of your fieldbus controller.

The MAC ID is applied to the back of the fieldbus controller or on the paper strip with two self-adhesive peel-off strips on the side of the fieldbus controller.

MAC ID of the fieldbus controller: **00:30:DE:__:__:__**

2. Plug the fieldbus controller into the assembly of the fieldbus node.

After the power is switched on, the fieldbus controller is initialized. The fieldbus controller determines the I/O module configuration and creates a process image. During startup, the I/O LED (red) will flash. After a brief period, the I/O LED lights up green, indicating that the fieldbus controller is operational.

If an error occurs during start-up indicated by the I/O LED flashing red, evaluate the error code and argument and resolve the error.

Information



More information about LED signaling

The exact description for evaluating the LED signal displayed is available in the section “Diagnostics” > ... > “LED Signaling”.

The controller is automatically assigned available IP addresses from the address range 169.254.1.0 to 169.254.254.255.

Use the ETS to test the IP assignment (see Chapter “Testing for Proper Functioning of the Fieldbus Node with ETS”).

9.2.3 Assigning IP Address via DHCP

If you want to use DHCP to assign the IP address, it happens automatically via a DHCP server on the network.

Note



Total network failure when there are two DHCP servers in the network!

To prevent network failure, never connect a PC, on which a DHCP server is installed, to a global network. In larger networks, there is usually a DHCP server already that can cause collisions and subsequent network failure.

Note



There must be a DHCP server in the network for further configuration!

Install a DHCP server on your client PC in the local network if not already available. You can download a DHCP server free of charge on the Internet, e.g., http://windowspedia.de/dhcp-server_download/.

Note



Assign the DHCP server a fixed IP address and note common subnet!

Note that the DHCP server must have a fixed IP address and that the fieldbus node and DHCP server must be in the same subnet.

Note



Via DHCP assigned IP addresses are only temporarily valid!

Note that an IP address assigned via DHCP is limited in time. If the DHCP server is not available at the end of its useful life, the fieldbus node sets the IP address free and then the fieldbus node is no longer accessible!

The following step is included:

- Enable DHCP
- Assigning the IP address permanently by option “use IP from EEPROM“

9.2.3.1 Enable DHCP

Alternatively, DHCP will be enabled on the internal Web pages or via WAGO-ETHERNET-Settings.

Note



DHCP must be enabled on the Web pages or in WAGO-Ethernet-Settings!

Note if an access to the internal Web pages of WBM is already possible via an IP address, you enable DHCP on the "Port" HTML page of the WBM, so is assigned via DHCP a new IP address. DHCP is not enabled by default when delivered. In other case you can also enable DHCP via WAGO-Ethernet-Settings in the **Network** tab.

An IP address is automatically assigned after restarting the fieldbus node.

Information



More information about reading the IP address

You can use WAGO-ETHERNET-Settings, button [**Identify**], via Service Interface to read the IP addresses currently assigned.

Use the ETS to test the IP assignment (see Chapter "Testing for Proper Functioning of the Fieldbus Node with ETS").

9.2.4 Assigning IP Address via WAGO-ETHERNET-Settings

“WAGO-ETHERNET Settings 759-316” is a Windows application used to read and edit bus-specific parameters of WAGO ETHERNET fieldbus couplers/controllers.

You can use the following functions with the WAGO-ETHERNET Settings:

- configure an IP address at start-up via the serial communications interface
- reset the fieldbus coupler/controller parameter to factory default settings
- delete and unzip the flash file system on which the html pages of the fieldbus coupler are stored

Information



More information about WAGO-ETHERNET-Settings

The program “WAGO-ETHERNET-Settings” is available for download at <http://www.wago.com> under Downloads → AUTOMATION.

You can find a short description in the “Quick Start” of the ETHERNET 750-841 Fieldbus Controller. The brief description is also available on the Internet at <http://www.wago.com> under Documentation.

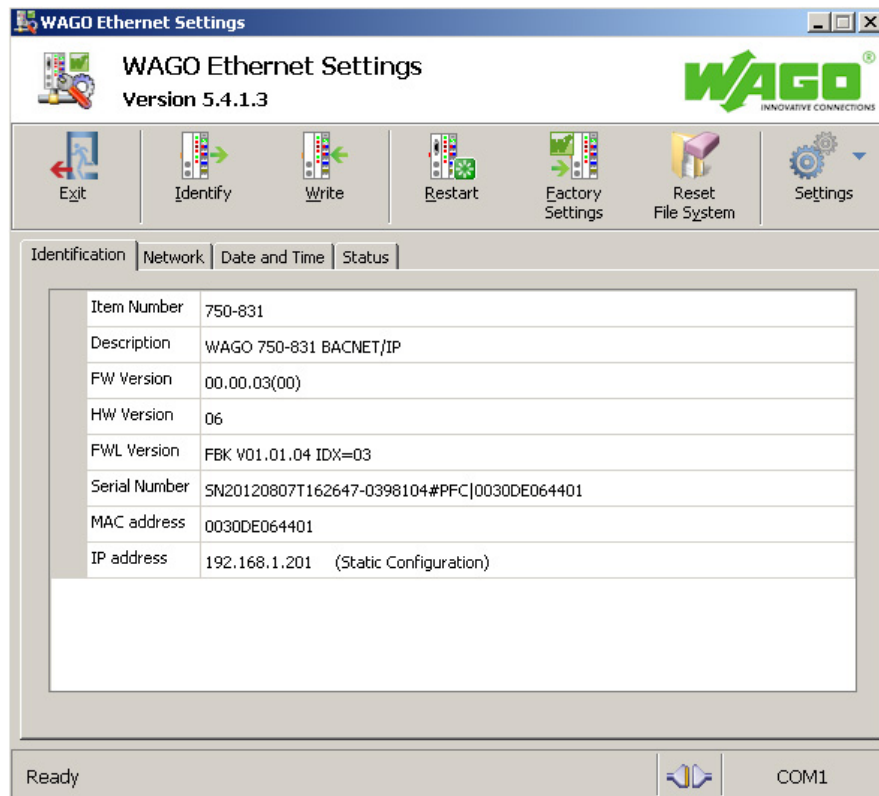
WAGO communication cables or WAGO radio-link adapters can be used for data communication.

NOTICE

Do not connect Communication Cable when energized!

To prevent damage to the communications interface, do not connect or disconnect Communication Cable 750-920 respectively 750-923 when energized!
The fieldbus controller must be de-energized!

1. Switch off the supply voltage of the fieldbus controller.
2. Connect the communication cable 750-920 or 750-923 respectively the *Bluetooth*[®] Adapter 750-921 to the configuration interface of the fieldbus controller and to your computer.
3. Switch on the supply voltage of the fieldbus controller.
4. Start **WAGO-ETHERNET-Settings** program.
5. Click on **[Read]** to read in and identify the connected fieldbus node.
6. Select the **Network** tab.



7. To assign a permanent address, select the option "Static configuration" in the field **Source** (BootP is the default).
8. Enter the required **IP Address** and, if applicable, the address of the subnet mask and gateway.
9. Click on the [**Write**] button to apply the settings in the fieldbus node.
10. You can now close ETHERNET-Settings or make other changes in the Web-based Management System as required. To open the Web-based Management System click on the button [**WBM**] on the right side.

9.2.5 Assigning the IP Address with a PLC program

A PLC program can be used to assign a fixed IP address.

When assigning an address using a PLC program, this can be done using the "Ethernet_Set_Network_Config" function block from the "Ethernet.lib" library integrated in WAGO-I/O-PRO.

Information



Additional Information about IP address assignment via a PLC program!

A detailed description of the library for the address assignment via a PLC program, refer to the manual for the WAGO-I/O-PRO library "Ethernet.lib". This can be found on the website under <http://www.wago.com> → Downloads → Additional documentation and Information on automation products → WAGO Software → WAGO-I/O-PRO/CODESYS → Additional Information → Libraries → Ethernet.lib!

9.2.6 Assigning the IP Address with a BootP Server

A BootP server can be used to assign a fixed IP address.

Assigning the IP address using a BootP server depends on the respective BootP program. Handling is described in the respective manual for the program or in the respective integrated help texts.

Note



IP address assignment is not possible via the router!

The IP address is assigned via patch cable, switches, hubs, or via direct link using a crossover cable. Addresses cannot be assigned via routers.

Note



BootP must be enabled on the Web pages!

Note that BootP must be enabled on the internal Web pages of the WBM, HTML page "Port configuration".
BootP is enabled by default when delivered.

Information



Additional Information

Assigning IP addresses using a BootP server can be carried out in any Windows and Linux operating system. Any other BootP servers may also be used, besides the WAGO-BootP server.



Information

More information about the WAGO-BootP-Server

The "WAGO-BootP-Server 759-315" is available free of charge at <http://www.wago.com>.

The following steps are included:

- Note MAC ID
- Note IP address
- Assigning the IP address and enable BootP
- Assigning the IP address permanently by option "use IP from EEPROM"

9.2.6.1 Note MAC ID

1. Write down the controller's MAC address (see label or peel-off strip).
If the fieldbus is already installed, turn off the operating voltage of the fieldbus controller, then take the fieldbus controller out of the assembly of your fieldbus node and note the MAC ID of your fieldbus controller.

The MAC ID is applied to the back of the fieldbus controller or on the paper strip with two self-adhesive peel-off strips on the side of the fieldbus controller.

MAC ID of the fieldbus controller: **00:30:DE:__:__:__**

2. Plug the fieldbus controller into the assembly of the fieldbus node.
3. Use the fieldbus cable to connect the fieldbus connection of your mechanically and electrically assembled fieldbus node to an open interface on your PC.
The PC must be equipped with a network card for this connection. The controller transfer rate then depends on the network card of your PC.
4. Start the PC that assumes the function of the master and BootP server.
5. Switch on the power at the fieldbus controller (DC 24 V power supply unit).

After the power is switched on, the fieldbus controller is initialized. The fieldbus controller determines the I/O module configuration and creates a process image. During startup, the I/O LED (red) will flash. After a brief period, the I/O LED lights up green, indicating that the fieldbus controller is operational.

If an error occurs during start-up indicated by the I/O LED flashing red, evaluate the error code and argument and resolve the error.

Information



More information about LED signaling

The exact description for evaluating the LED signal displayed is available in the section "Diagnostics" > ... > "LED Signaling".

Error codes and error arguments are indicated by the frequency of a LED flash sequence. For example: Error code 6, followed by error argument 4, is indicated by the I/O LED after controller start-up with 6 red error code flashes, followed by four red flashes of the error argument. This indicates that an IP address has not yet been assigned.

9.2.6.2 Determining IP addresses

1. If the PC is already integrated into an IP network, you can determine the PC's IP address by clicking on **Control Panel** from the **Start Menu / Settings**.
2. Double-click on the **Network** icon.
The network dialog window appears.

For Windows 2000/XP:

- Select **Network and Dial-Up Connections**
- In the dialog window that then appears, right click on **LAN Connection** and open the **Properties** link.
- Mark the entry **Internet Protocol (TCP/IP)**

For Windows 7:

- Choose **Network and Sharing Center** by using Control Panel.
- In the dialog window that then appears, right click on **LAN Connection** and open the **Properties** link.
- Mark the entry **Internet Protocol V4**

Note



Reinstall TCP/IP components if required!

If the "Internet Protocol TCP/IP" entry is missing, install the corresponding TCP/IP components and reboot your computer.

You will need the installation CD for Windows 2000, XP or 7.

3. Then click on the **Properties...** button
4. The IP address, subnet mask and, where required, the PC's gateway address appear in the Properties window. Note these values:

PC IP address: _ _ _ . _ _ _ . _ _ _ . _ _ _
Subnet mask: _ _ _ . _ _ _ . _ _ _ . _ _ _
Gateway: _ _ _ . _ _ _ . _ _ _ . _ _ _

5. Now select the desired IP address for your fieldbus node.

Note



Assign the PC a fixed IP address and note common subnet!

Note that the PC, on which the BootP server is listed, must have a fixed IP address and that the fieldbus node and PC must be in the same subnet.

6. Note the IP address you have selected:

Fieldbus node IP address: _ _ _ . _ _ _ . _ _ _ . _ _ _

9.2.6.3 Assigning the IP address

1. Based on the handling, which depends on the BootP program set, assign the required IP address for your fieldbus node.
2. Enable the query/response mechanism of the BootP protocol based on the handling, which depends on the BootP program set. Alternatively, do the activation of BootP in WAGO-Ethernet-Settings or if an access to the internal Web pages of WBM is already possible via an IP address, in the Web-based management system.
3. To apply the new IP address, use e.g. a hardware reset to restart your fieldbus node by interrupt the voltage supply for approx. 2 seconds.

9.2.6.4 Assigning the IP address permanently by option “use IP from EEPROM”

When the BootP protocol is activated the fieldbus controller expects the BootP server to be permanently available. If there is no BootP server available after a PowerOn reset, the network will remain inactive.

You must then deactivate the BootP protocol so that the controller uses the configured IP address from the EEPROM; this does away with the need for the BootP server to be permanently available.

Note



The IP address stored in the EEPROM must be used for permanent address assignment!

To apply the IP address obtained via BootP permanently in the fieldbus controller, you must select the option “use IP from EEPROM”.

When this option is selected, the IP address is entered and used automatically as a static address in the EEPROM.

Note



The IP address is not lost when the BootP-Protocol is disabled!

If the BootP protocol is deactivated after addresses have been assigned, the stored IP address is retained, even after an extended loss of power, or when the fieldbus controller is removed.

You can enable the option “use IP from EEPROM” in the Web-based Management System.

Disable BootP in the Web-based Management System

1. Open the **Web browser** on your client (such as the Microsoft Internet Explorer) to have the HTML pages displayed.
2. Enter the **IP address** for your fieldbus node in the address line of the browser and press [**Return**].
3. If a dialog window then appears with a password prompt, as Administrator, enter the user name: "**admin**" and the password "**wago**".

This is provided for secure access and entails three different user groups: admin, guest and user.

A start page is then displayed in the browser window with information about your fieldbus controller (start page can be changed on HTML page "Security").

You can navigate to other information using the hyperlinks in the left navigation bar.

4. In the left navigation bar click on **Port** to open the HTML page for selecting a protocol.

You are shown a list of all the protocols supported by the fieldbus controller.

5. Select the "use IP from EEPROM" option.
At the same time disables the request of BootP server.
6. Confirm your changes with button [**SUBMIT**].
7. Then restart in order for the settings to take effect.
8. For a software reset, click in the left navigation bar on the link [**Security**] to open the HTML page on which you can set passwords and trigger a software reset.
9. Click on the button [**Software Reset**] at the bottom of the page.

Then the coupler/controller starts with the configurations, which were previously loaded into the EEPROM and the connection to the browser is interrupted.

10. Now you must use the changed IP address, if you want to access again on this device via browser.

9.2.6.5 Reasons for Failed IP Address Assignment

- The PC on whom the BootP server is running is not located in the same subnet as the fieldbus controller; i.e., the IP addresses do not match.

Example:

Sub net mask: 255.255.255.0 (default value for fieldbus controllers)

PC IP: 192.168.2.100

Fieldbus controller IP: 192.168.1.200

Due to the sub net mask, the first 3 digits of the IP addresses must match.

- PC and/or controller is/are not linked to the ETHERNET
- Poor signal quality (use switches or hubs)

9.3 Testing the Function of the Fieldbus Node

Information



More information about reading the IP address

You can use WAGO-ETHERNET-Settings, button [**Identify**], via Service Interface to read the IP addresses currently assigned.

1. To ensure that the IP address is correct and to test communication with the fieldbus node, first turn off the operating voltage of the fieldbus node.
2. Create a non-serial connection between your client PC and the fieldbus node.

After the power is switched on, the fieldbus controller is initialized. The fieldbus controller determines the I/O module configuration and creates a process image. During startup, the I/O LED (red) will flash. After a brief period, the I/O LED lights up green, indicating that the fieldbus controller is operational.

If an error occurs during start-up indicated by the I/O LED flashing red, evaluate the error code and argument and resolve the error.

Information



More information about LED signaling

The exact description for evaluating the LED signal displayed is available in the section "Diagnostics" > ... > "LED Signaling".

3. To test the coupler's newly assigned I/P address, start a DOS window by clicking on the **Start** menu item **Programs/MS-DOS Prompt**.
4. In the DOS window, enter the command: "**ping** " followed by the IP address of your coupler in the following format:

`ping [space] XXX . XXX . XXX . XXX (=IP address)`

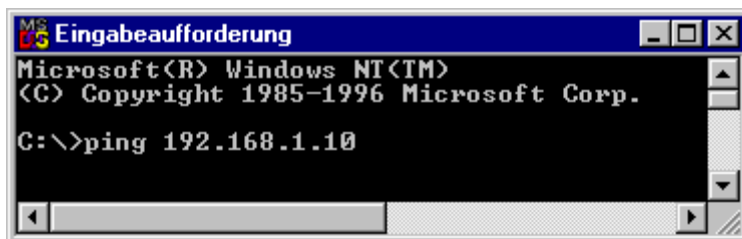


Figure 71: Example for the Function test of a Fieldbus Node

5. When the [**Enter**] key has been pressed, your PC will receive a query from the coupler, which will then be displayed in the DOS window. If the error message: "Timeout" appears, please compare your entries again to the allocated IP address and check all connections.

6. When the test has been performed successfully, you can close the DOS prompt.

The fieldbus node is now ready for communication.

9.4 Testing Fieldbus Controller Communication via ETS

To test if the KNX IP controller is accessible via the network, you can use, among other things, the “Engineering Tool Software” (ETS) available in the network:

1. Launch the **ETS**.
2. Click [**Settings**] > [**Communication**].
3. Click [**New**] to configure the connection.
4. In the Properties window, select the type “KNXnet/IP Routing”.

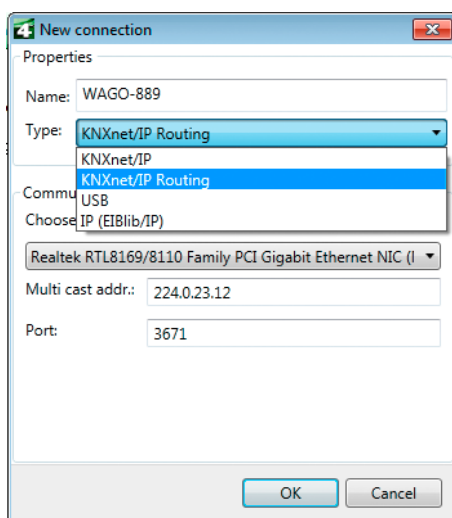


Figure 72: Selecting KNXnet/IP routing

The available connections are displayed.

5. Click the [**Select**] button to enable the new connection.

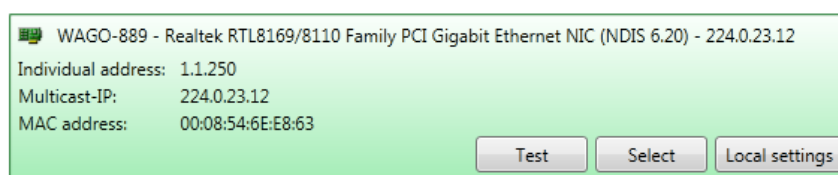


Figure 73: Enabling the connection

6. Click [**Overview**].
7. Double-click the respective project in the project overview. The project topology is displayed.
8. Create a WAGO KNXnet/IP router in the project topology by right-clicking a line and selecting **Add: Device** in the context menu.
9. Select the IP router added by double-clicking.
10. Click the IP router in the project topology and right-click to display the context menu.

11. Select the **Edit Parameters** function.
The ETS plug-in opens.
12. Enter the MAC address of the KNX IP 750-889 controller in the “MAC Address” field.
13. Then click the [**Scan IP**] button.

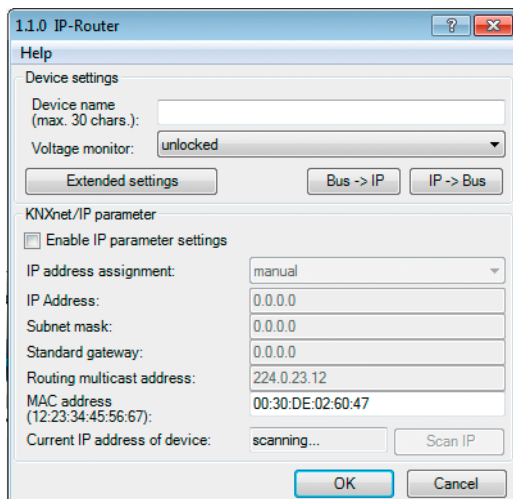


Figure 74: Checking the IP address

14. Check if the IP address of your fieldbus controller appears in the “Current IP address of device” field.

If so, your fieldbus controller was assigned an IP address successfully.
The fieldbus controller can be reached on the network via this IP address.

9.5 Preparing the Flash File System

The flash file system must be prepared in order to use the Web interface of the fieldbus controller to make all configurations.

The flash file system is already prepared when delivered. However, if the flash file system has not been initialized on your fieldbus controller or it has been destroyed due to an error, you must first extract it to the flash memory to access it.

NOTICE

Do not connect Communication Cable when energized!

To prevent damage to the communications interface, do not connect or disconnect 750-920 respectively 750-923 Communication Cable when energized! The fieldbus coupler/controller must be de-energized!

Note



Formatting erases data!

Note that formatting erases all data and configurations. Only use this function when the flash file system has not been initialized yet or has been destroyed due to an error.

1. Switch off the supply voltage of the fieldbus controller.
2. Connect the communication cable 750-920 or 750-923 respectively the *Bluetooth*[®] Adapter 750-921 to the configuration interface of the fieldbus controller and to your computer.
3. Switch on the supply voltage of the fieldbus controller.

After the power is switched on, the fieldbus controller is initialized. The fieldbus controller determines the I/O module configuration and creates a process image. During startup, the I/O LED (red) will flash. After a brief period, the I/O LED lights up green, indicating that the fieldbus controller is operational.

If an error occurs during start-up indicated by the I/O LED flashing red, evaluate the error code and argument and resolve the error.

Information



More information about LED signaling

The exact description for evaluating the LED signal displayed is available in the section “Diagnostics” > ... > “LED Signaling”.

4. Start the **WAGO-ETHERNET-Settings** program.

5. In the top menu bar, select **Reset File System** to format the file system and to extract the Web pages of the flash file system.

Formatting and extracting is complete when the status window displays "Resetting the file system successfully".

Note



Restart the Fieldbus coupler/controller after resetting file system!

Make a restart of the fieldbus coupler/controller, so that the Web pages can be displayed after resetting file system.

9.6 Synchronizing the Real-Time Clock

The fieldbus controller's real-time clock enables a date and time indication for files in the flash file system.

At start-up, synchronize the real-time clock with the PC's current time.

There are two options to synchronize the real-time clock:

- Synchronize the real-time clock using **WAGO-ETHERNET-Settings**
- Synchronize the real-time clock using the **Web-based Management-System**

Synchronize the real-time clock using WAGO-ETHERNET-Settings

1. Switch off the supply voltage of the fieldbus controller.
2. Connect the communication cable 750-920 or 750-923 respectively the *Bluetooth*[®] Adapter 750-921 to the configuration interface of the fieldbus controller and to your computer.
3. Switch on the supply voltage of the fieldbus controller.

After the power is switched on, the fieldbus controller is initialized. The fieldbus controller determines the I/O module configuration and creates a process image. During startup, the I/O LED (red) will flash. After a brief period, the I/O LED lights up green, indicating that the fieldbus controller is operational.

If an error occurs during start-up indicated by the I/O LED flashing red, evaluate the error code and argument and resolve the error.



Information

More information about LED signaling

The exact description for evaluating the LED signal displayed is available in the section "Diagnostics" > ... > "LED Signaling".

4. Start the **WAGO Ethernet Settings** program.
5. Select the **Date and Time** tab.

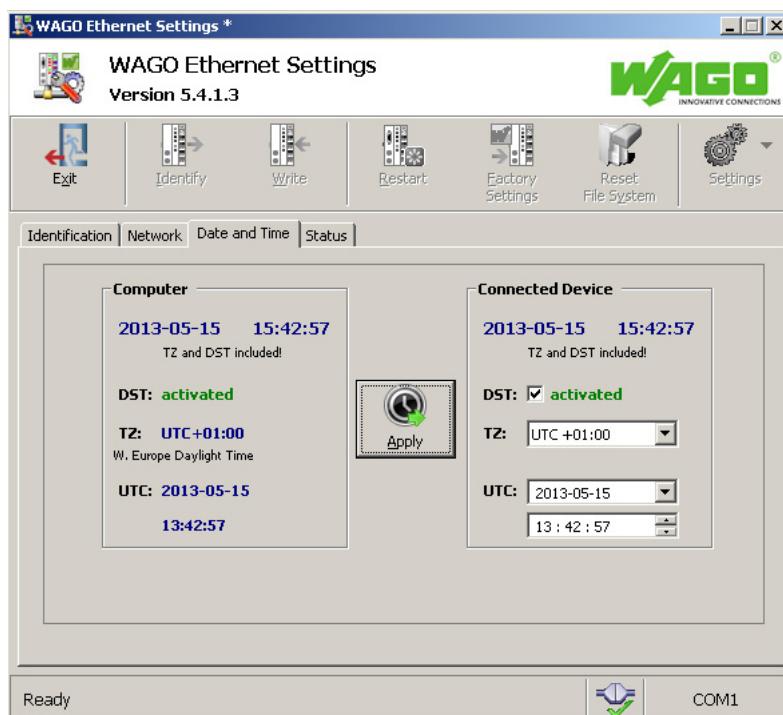



Figure 75: Example of Time Synchronization in ETHERNET Settings

6. Click on the **[Apply]** button.

Synchronize the real-time clock using the Web-based Management-System

1. Launch a Web browser (e.g., MS Internet Explorer or Mozilla) and enter the IP address you have assigned your fieldbus node in the address bar.
2. Click **[Enter]** to confirm.
The start page of the Web interface loads.
3. Select “Clock” in the left menu bar.
4. If an inquiry screen appears, enter your user name and password (default: user = “admin”, password = “wago” or user = “user”, password = “user”).
The HTML page “Clock configuration” loads.
5. Set the values in the fields “Time on device”, “Date” and “Timezone” to the current values and enable the desired “Daylight Saving Time (DST)” option.

Web-based Management



Clock configuration

Configuration Data

Time on device	<input type="text" value="11:07:54"/>
Date (YYYY-MM-DD)	<input type="text" value="2015-11-19"/>
Timezone (+/- hour:minute)	<input type="text" value="+1:00"/>
Daylight Saving Time (DST)	<input checked="" type="radio"/> Automatic (USA) Second sunday in March 02:00 AM first sunday in November 02:00 AM
	<input type="radio"/> Automatic (EU) Last sunday in March 01:00 UTC last sunday in October 01:00 UTC
	<input type="radio"/> Manual: <input type="checkbox"/>
12 hour clock	<input type="checkbox"/>

Figure 76: Example of WBM Clock Configuration

6. Click on **[SUBMIT]** to apply the changes in your fieldbus node.
7. Restart the fieldbus node to apply the settings of the Web interface.

9.7 Restoring Factory Settings



Note

For total deletion, first make a file system reset!

Note that you first reset the file system for the complete deletion of the controller. Use for this the program **WAGO-ETHERNET-Settings**, as described below, and click first on the button [**Reset File System**].

Then, you restore the factory settings.

To restore the factory settings, proceed as follows:

1. Switch off the supply voltage of the fieldbus controller.
2. Connect the communication cable 750-920 or 750-923 respectively the *Bluetooth*[®] Adapter 750-921 to the configuration interface of the fieldbus controller and to your computer.
3. Switch on the supply voltage of the fieldbus controller.
4. Start the **WAGO-ETHERNET-Settings** program.
5. In the top menu bar, select [**Factory Settings**] and click [**Yes**] to confirm.

A restart of the fieldbus node is implemented automatically. The start takes place with the default settings.

10 Programming the PFC Using WAGO-I/O-PRO

Using IEC 61131-3 programming, the KNX IP Controller 750-889 can also utilize the function of a PLC in addition to the functions of a fieldbus coupler. Creation of an application program in line with IEC 61131-3 is performed using the programming tool WAGO-I/O-PRO.

Information



Compatibility with IEC-61131-3 programming software!

The compatibility between your fieldbus controller and the IEC 61131-3 programming software used depends on the fieldbus controller's firmware version and the version of the programming software.

A list of recommended combinations can be found at www.wago.com.

Use the search function (search for “Compatibility Notes”).

Note



Activate option “CODESYS” in the web-based Management System for programming!

Pay attention, the IEC 61131-3 programming of the controller via ETHERNET requires that the check box **CODESYS** be activated at the Website “Port Configuration” (default).

You can, however, also connect the client PC and controller serially for programming using a programming cable.

Note



Log in with the administrator password to program the fieldbus controller!

If you have activated password protection for port 2455 on the “Security” page of the WBM, you have to log into WAGO-I/O-PRO in the menu **Online** > **Log In** to obtain programming access to the fieldbus controller (default password “wago”).



Figure 77: Logging in for Programming Access

Note



Log in to use the PLC browser with administrator user data!

To use the PLC browser functionality in *WAGO-I/O-PRO*, log into the PLC browser with the administrator user data (default user “admin”, password “wago”). Enter “login admin wago” in the command line of the PLC browser.

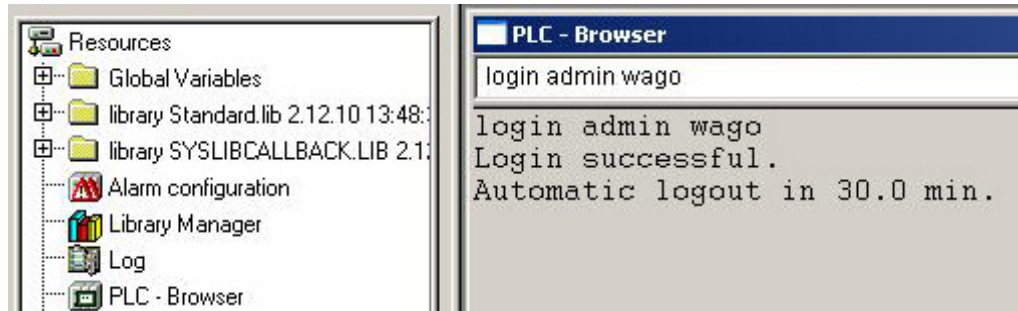


Figure 78: Logging Into the PLC Browser

A description of programming using *WAGO-I/O-PRO* is not included in this manual. The following sections, on the other hand, contain important information about creating projects in *WAGO-I/O-PRO* and about special modules that you can use explicitly for programming of the KNX IP Controller.

Explanations are also provided as to how the IEC 61131-3 program is transferred and how suitable communication drivers are loaded.

Note



One *WAGO-I/O-PRO*/(CODESYS)-Instance per target system!

Note that a simultaneous connection of multiple *WAGO-I/O-PRO*/(CODESYS) Instances on one target system is not possible.

Note



Name Conventions for *WAGO-I/O-PRO*/(CODESYS) Projects!

Note that you do not use special characters for the name of your *WAGO-I/O-PRO*/(CODESYS) project and limit the name to a maximum of 8 characters.

This will ensure that not always, in case of the online change function is activated simultaneously, for each online change event a new TxT file is created, which contains the paths and the project ID, and that for this additional memory is consumed. With proper choice of the file name, the TxT file is only overwritten each time and does not consume additional memory space.

Information



Additional Information:

For a detailed description of using the software, refer to the manual for the “WAGO-I/O-PRO”. This manual is located in the Internet under <http://www.wago.com>.

1. Start the programming tool at **Start \ Programs \ WAGO-I/O-PRO**.
2. Under **File / New** create a new project

A dialog window then appears on which you can set the target system for programming.



Figure 79: Dialog window for target system settings

3. Select the 750-889 KNX IP Controller by entering **WAGO_750-889** and then click **OK**.
4. In the dialog window that appears select the program type (AWL, KOP, FUP, AS, ST or CFC).

To ensure that you can access all I/O module data properly in your new project, first compile the I/O module configuration based on the existing fieldbus node hardware and map it in the configuration file “EA-config.xml”.

This file defines whether write access is permitted to the modules from the IEC-61131-3 program, or from the MODBUS/TCP.

As described below, this file can be generated via configuration using the WAGO I/O Configurator.

10.1 Configuring the Fieldbus Controller using the I/O Configurator

The I/O Configurator is a plug-in integrated into WAGO-I/O-PRO used to determine addresses for I/O modules at a fieldbus controller.

1. In the left half of the screen for the WAGO-I/O-PRO interface, select the tab **Resources**.
2. To start the I/O Configurator, double-click in the tree structure on **Control system configuration**.
3. Expand the branch **Hardware configuration** in the tree structure.
4. Right-click on the entry **K-Bus** and then select **Edit** in the context menu.
5. In the “Configuration” window that then opens, click on **Add** to open the module selection window.
6. Select the I/O module you wish to add from the module catalog and attach it to the end of the internal data bus structure by clicking on [**>>**] and **OK**.
7. Position all of the required I/O modules in their correct order until this arrangement matches the configuration of the physical node.

Arrange the tree structure in the hardware configuration in the same manner. Include all I/O modules which supply or receive data.

If you access your fieldbus controller online, you can use the [**Start WAGO-I/O-CHECK and scan**] button in the “Configuration” window to read in the physically linked fieldbus controllers with the series-connected I/O modules and display all of the components.

Note



The internal data bus structure in the WAGO I/O Configurator must match the physical node structure!

The number of I/O modules that send or receive data must correspond to the existing hardware (except for supply modules, copying modules or end modules, for example). For the number of input and output bits or bytes of the individual I/O modules please refer to their corresponding descriptions.

Information



Additional information

To open the data sheet for an I/O module, click in the “Configuration” window on the corresponding I/O module and then click the **[Data sheet]** button. The data sheet is then shown in a separate window.

All current data sheets are available on our website <http://www.wago.com> under Documentation.

8. Click **[OK]** to accept the node configuration and close the dialog window.

The addresses for the control system configuration are then recalculated and the tree structure for the configuration is updated.

If required, you can also modify the authorization privileges for individual I/O modules if they are to be accessed via fieldbus (MODBUS/TCP/IP). Initially, write access from the PLC is defined for each module that is added.

Proceed as follows to change this setting:

9. Click the “PI Assignment” tab in the “Configuration” dialog.
10. Define for each module from where access to the module data is to be carried out.

You can choose from the following settings in the column “PI Assignment” for this:

- MODBUS TCP/UDP, fieldbus1 - Access from MODBUS/TCP
- PLC, PLC (standard setting) - Access from PLC

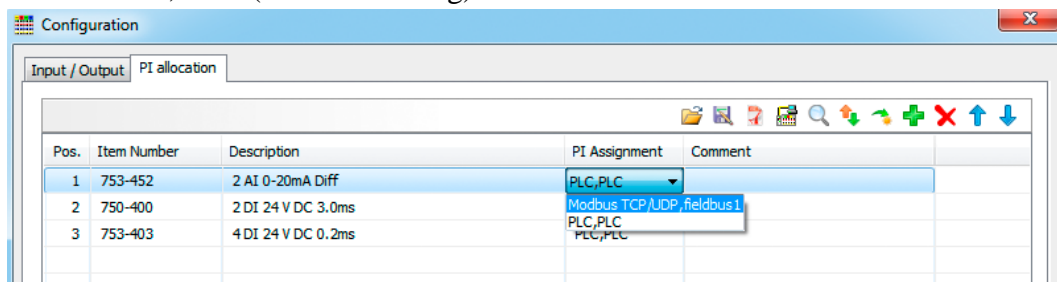


Figure 80: Write access via module parameters

After completing these settings you can begin the IEC-61131-3 programming.

An “EA-config.xml” configuration file is automatically generated and stored in the fieldbus controller, when you transfer the project (Menu **project > transfer/transfer all**) and download it in the fieldbus controller.

Note



Set “MODBUS TCP/UDP, fieldbus1”, when directly writing to a hardware address via MODBUS!

Set “MODBUS TCP/UDP, fieldbus 1” if you wish to write directly to a hardware address via MODBUS. Otherwise the modules will be allocated to the PLC, making writing from a different location impossible.

Information



Additional Information

For a detailed description of using the software *WAGO-I/O-PRO* and the I/O Configurator, refer to the online Help function for *WAGO-I/O-PRO*.

10.1.1 Configuration using the “EA-config.xml” File

You can also create the file “EA-config.xml” using an editor and store it in the controller directory “/etc” by means of FTP.

Configuration using the file “EA-config.xml” that is already stored in the fieldbus controller is described in this section.

Note



Configuration entries in WAGO-I/O-PRO overwrite “EA-config.xml” upon download!

If you wish to perform module assignment directly using the “EAconfig.xml” file stored in the controller, do not save any configuration data in WAGO-I/O-PRO prior to this, as the file is overwritten by entries in the WAGO-I/O-PRO on each download.

1. Open any FTP client. You can also use the Windows FTP client in the DOS prompt window:

[ftp://\[IP address of controller\]](ftp://[IP address of controller]), e.g. <ftp://192.168.1.201>

2. Then, enter **admin** as the user login and **wago** as the password.

The file “EA-config.xml” is located in the “etc” folder.

3. Copy this file to a local directory on your PC and open it in an editor installed on your PC (e.g., “WordPad”).

The file already contains the following syntax:

```
<?xml version="1.0" encoding="ISO-8859-1"?>
<?xml-stylesheet type="text/xsl" href="\cplcfg\EA-config.xsl" ?>
<WAGO>
<Module ARTIKELNR="" MAP="PLC" LOC="ALL"></Module>
</WAGO>
```

Figure 81: EA-config.xml

The fourth line contains the necessary information for the first I/O module. The entry MAP=PLC assigns write access privileges to the IEC-61131-3 program for the first module.

4. If you wish to change the access rights, replace “PLC” with “FB1” as the access privileges from MODBUS/TCP.

```
<Module ARTIKELNR=" " MAP="PLC" LOC="ALL"> </Module>
↓
<Module ARTIKELNR=" " MAP="FB1" LOC="ALL"> </Module>
```


5. Then complete the fourth line for each individual module using this syntax and set the corresponding assigned access privileges.

Note



The number of line entries must correspond with the number of bus terminals used!

It is imperative that the number of line entries concurs with the number of existing hardware modules.

6. Save the file and reload it to the controller file system via FTP client.

You can then begin with IEC-61131-3 programming.

Information



Additional Information:

For a detailed description of how to use the software, refer to the WAGO-I/O-PRO manual. The manual is available in the Internet under:

<http://www.wago.com> → Documentation → WAGO Software → WAGO-I/O-PRO → 759-333

10.2 Creating/Exporting the SYM_XML

Note



End the simulation mode for the symbol configuration!

If you are in the simulation mode you can not perform configuration of symbols or settings for generating the SYM_XML file. The category **Symbol configuration** is not available for selection in this case.

You can make this category visible by selecting **Online \ Logoff** in the main menu and removing the check mark in front of **Simulation**.

The SYM_XML file is a file that contains all project variables. This file is required in ETS to set up a link between the IEC application and the TP1 network.

Proceed as follows to create this file:

1. In the WAGO-I/O-PRO software under **Project \ Options** select the category **Symbol configuration**.
2. Place a check mark in the check box **Generate XML Symbol table**.
3. Click the button **Configure symbol file...**. A dialog window then appears in which you can set the object attributes.
4. Place a check mark in the check box **Issue object variables**. The check marks must appear in black!

Note



Export the SYM_XML files only, if the set check mark is displayed in black!

If the check mark in the check box Issue object variables is illustrated in grey, it is not set for all minor elements. Click in the box again to make sure that the check mark appears in black.

Once these options have been activated, an SYM_XML file will be generated automatically with project variables when a project is compiled.

10.2.1 Processing in ETS

The exported SYM_XML file with the project variables is imported to the ETS plug-in, allowing the network variables contained in this file (type EIS or DPT) to be accessed in that program. These variables are linked with the KNX group addresses in the ETS and the associated WAGO specific ETS plug-in, making them visible as communication.

Information



Additional Information:

The ETS and the associated documentation can be obtained from the Konnex Association (<http://www.konnex.org>).

The ETS plug-in is available at <http://www.wago.com> under Building Automation. Documentation for the ETS plug-in is provided under Documentation.

10.3 ETHERNET Libraries for WAGO-I/O-PRO

Various libraries are available in WAGO-I/O-PRO for different IEC 61131-3 programming tasks. These libraries contain function blocks that can be used universally to facilitate and accelerate the creation of programs.

Once the libraries have been integrated, function blocks, functions and data types will be available that you can use the same as ones you have specifically defined.



Information

Additional Information

All libraries are included on the installation CD for the software WAGO-I/O-PRO or in the Internet under <http://www.wago.com>.

The libraries described below are specific to ETHERNET projects with WAGO-I/O-PRO.

Table 47: ETHERNET Libraries for WAGO-I/O-PRO

Library	Description
Ethernet.lib	Function blocks for communication via ETHERNET
WAGOLibEthernet_01.lib	Function blocks that can set up a link to a remote server or client via TCP protocol to exchange data with any potential UDP server or client via UDP protocol
WAGOLibModbus_IP_01.lib	Function blocks that set up links with one or more slaves
ModbusEthernet_04.lib	Function blocks for data exchange with several MODBUS/TCP/UDP slaves Also a function block that provides a MODBUS server that maps the MODBUS services on a word array.
SysLibSockets.lib	Function block for access to sockets for communication via TCP/IP and UDP.
WagoLibSockets.lib	Function blocks for access to sockets for communication via TCP/IP and UDP Contains additional functions in addition to SysLibSockets.lib.
Mail_02.lib	Function block for sending e-mails
WAGOLibMail_02.lib	Function block for sending e-mails
WagoLibSnmpEx_01.lib	Function blocks for sending SNMP-V1 traps together with the parameters for the type DWORD and STRING(120) (starting with software version SW >= 07).
WagoLibSntp.lib	Function blocks for setting and using the simple network time protocol (SNTP)
WagoLibFtp.lib	Function blocks for setting and using the file transfer protocol (FTP)
WAGOLibTerminalDiag.lib	Function blocks for the output of module, channel and diagnostic data of I/O modules that provide diagnostic data
WAGOLibKBUS.lib	Function blocks for permitting both task-synchronous and consistent access to process data, as well as register communication between fieldbus coupler/controller and connected I/O modules.



Information

Additional Information

For a detailed description of the function blocks and use of the software, refer to the online Help function for *WAGO-I/O-PRO* or the *WAGO-I/O-PRO* manual in the Internet under: <http://www.wago.com>.

10.4 Functional Restrictions and Limits

The basis of WAGO-I/O-PRO, the standard programming system CoDeSys by 3S, has an integrated visualization. Depend on the target, this visualization can be used in the variants “HMI”, “TargetVisu” and “WebVisu”.

The fieldbus controller supports the process variants “HMI” and “WebVisu”. Depending on the version, there are technological limitations.

Several options for complex visualization objects “Alarm” and “Trend” are only provided by the “HMI” version. This applies, for example, to sending emails as a response to an alarm or for navigating through and generating historical trend data.

Compared with “HMI”, the “WebVisu” on the fieldbus controller is executed within considerably tighter physical limits. Whereas the “HMI” can call upon the resources of a PC, the “WebVisu” operate within the following restrictions:

10.4.1 Configuration using the “EA-config.xml” File

You can also create the file “EA-config.xml” using an editor and store it in the controller directory “/etc” by means of FTP.

Configuration using the file “EA-config.xml” that is already stored in the fieldbus controller is described in this section.

File system (4,5 MB):

The overall size of the PLC program, visualization files, bitmaps, log files, configuration files, etc. must fit into the file system.

The PLC browser delivers the amount of free disk space in response to the command “fds” (FreeDiscSpace).

If there is not enough internal memory, the memory can be set to “external” by changing the PLC root location (Web-based Management System) to use the SD card.

Process data buffer (16 kB):

The WebVisu uses its own protocol for exchanging process data between applet and control system. In doing so, the process data is transmitted with ASCII coding. The pipe character (“|”) separates two process values. For this reason, the required space of a process data variable in the process data buffer not only depends on the data type, but also on the process values itself. A “WORD” variable therefore occupies between one byte for the values 0...9 and five bytes for values greater than 10000. The selected format allows only a rough estimate of the space required for the individual process data in the process data buffer. If the size is exceeded, the WebVisu no longer works as expected.

The number of modules (1023/default):

The total size of the PLC program is determined, among other things, by the

maximum number of modules. This value can be configured in the target system settings.

Computing power/processor time:

The 750-889 is based on a real-time operating system with pre-emptive multitasking. High-priority processes such as the PLC program will eliminate low-priority processes.

The web server supplies process data and applets for the web visualization.

Make sure when configuring tasks, that there is sufficient processor time available for all processes. The “freewheeling” task call option is not suitable in conjunction with the “WebVisu”; as in this case, the high-priority PLC program suppresses the web server. Instead of this, use the “cyclic” task call option with a realistic value.

The PLC browser provides an overview of the real execution times for all CoDeSys tasks with the command “tsk”.

If in a PLC program, operating system functions are used; e.g., for the handling of “sockets” or the “file system”, these execution times are not taken into consideration covered by the command “tsk”.

CTU counter:

The CTU counter operates in a value range of 0 to 32767.

Note



Note the maximum number of write cycles of the EEPROM!

Fieldbus couplers/controllers save some information such as IP addresses and IP parameters in the EEPROM to make it available after a restart. The memory cycles of an EEPROM are generally limited. Beyond a limit of approx. 1 million write cycles, memory can no longer be assured. A defective EEPROM only becomes apparent after a restart by software reset or power-on.

Due to a bad checksum, the fieldbus coupler/controller then always starts with the default parameters.

The following functions use the EEPROM:

- **WAGO-I/O-PRO**
 - **WagoLibDaylightSaving** SetDaylightSavings
 - **EthernetLib** SetNetworkConfig
SetVariables
- **MODBUS**
 - Register 0x1035 Time Offset
 - Register 0x100B Watchdog parameters
 - Register 0x1028 Network configuration
 - Register 0x1036 Daylight saving
 - Register 0x1037 Modbus response delay
 - Register 0x2035 PI parameter
 - Register 0x2043 Default configuration

- **Parameter assignments**
 - **BootP** new parameters
 - **DHCP** new parameters
 - **WAGO MIB** write access
-

10.5 General Information about IEC Tasks

Please note the following information when programming your IEC tasks:



Note

Use different priorities for IEC tasks!

Give IEC tasks (in WAGO-I/O-PRO under the **Resources** tab > **Task Configuration**) different priorities to prevent an error from occurring when compiling the user program.

An interruption of IEC tasks is possible through tasks of higher priority!

An ongoing task may be interrupted by tasks with higher priorities. Execution of the task that has been interrupted is resumed only when there are no other higher-priority tasks to be executed.

Distortion of variables in overlapping areas of the process image!

If several IEC tasks utilize input or output variables with the same, or overlapping addresses in the process image, the values for the input or output variables may change while the IEC task is being executed!

Observe waiting periods of free-running tasks!

Running tasks are halted after each task cycle for half the time that the task proper requires (min. 1 ms). Execution of the task is then resumed.

Example: 1st Task 4 ms → Waiting period 2 ms
 2nd Task 2 ms → Waiting period 1 ms

The default task is created by default!

If no task has been defined in the task configuration, a running default task is created during translation. This task, called “Default task”, is recognized by this name in the firmware, meaning that the name “Default task” cannot be used for other task names.

Observe the watchdog sensitivity for cyclic tasks!

The watchdog sensitivity indicates how many times the watchdog time is exceeded for an even to be triggered. You set the sensitivity in WAGO-I/O-PRO under Register **Resources** > **Task Configuration** for Cyclical Tasks. The values 1 and 0 are equivalent with regard to sensitivity. A sensitivity value of 0 or 1 results in the watchdog event being triggered when the watchdog time is exceeded on time. With a sensitivity value of 2, for instance, the watchdog time must be exceeded in two consecutive task cycles in order for the watchdog event to be triggered.

The following applies to cyclic tasks with watchdog activated:

Note



Reference for Watchdog Settings!

For each task created, a watchdog can be enabled that monitors the execution time of a task.

If the task runtime exceeds the specified watchdog time (e.g., $t_{\#200\text{ ms}}$), then the watchdog event has occurred.

The runtime system stops the IEC program and reports an error.

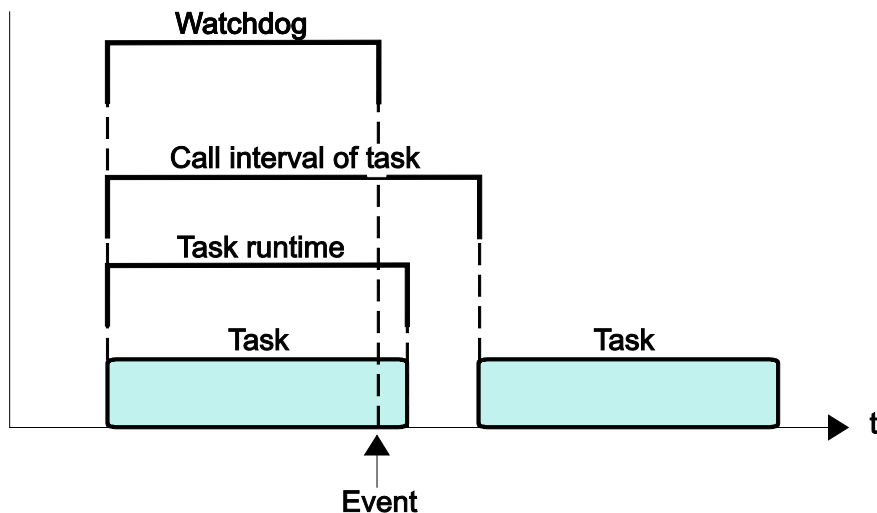


Figure 82: Watchdog Runtime is Less Than the Task Runtime

If the watchdog time set is greater than the call interval of the task, then the watchdog is restarted for each task call interval.

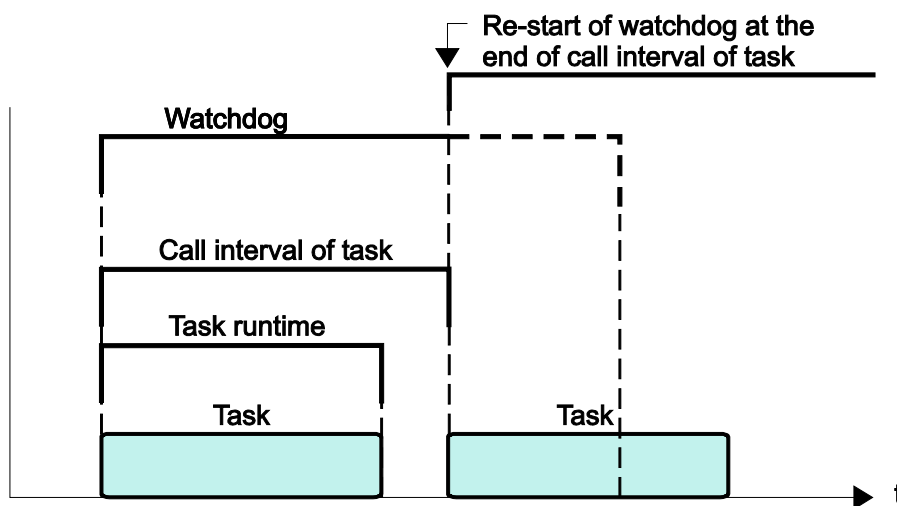


Figure 83: Watchdog Runtime Is Greater Than the Task Call Interval

To cyclic tasks applies:



Note

Cyclic tasks with > 30 min. call intervals not possible!

Cyclic tasks with a call interval of more than 30 minutes are not possible.

10.5.1 IEC Task Sequence

1. Determine the system time (tStart).
2. If no full internal bus cycle has run since the last time the outputs were written:
→ Wait until the next internal bus cycle is completed.
3. Reading of inputs and reading back of the outputs from the process image.
4. If the application program has been started.
→ Execute the program codes for this task.
5. Writing of the outputs to the process image.
6. Determine the system time (tEnd).
→ $tEnd - tStart = \text{runtime for the IEC task}$

10.5.2 Overview of Most Important Task Priorities

Table 48: Task priorities

Task	Importance of the execution
Router task, internal bus task, fieldbus task	of priority before all others
Normal task	after the router task, internal bus task, and fieldbus task
PLC-Comm task	after the normal tasks
Background task	after the PLC-Comm tasks

Internal bus task / Fieldbus tasks (internal) / Router task

The internal bus task matches the process image to the I/O data of the input and output modules in defined cycles.

The fieldbus tasks are performed as triggered by events and only require computing time when communication is performed via fieldbus (MODBUS).

The router task transfers KNX IP data to the first KNX module and also waits for data from the TP1 network. TP1 data is then sent by IP.

Normal task (IEC-Task priorities 1-10 that can be set in CODESYS)

IEC tasks with this priority may be interrupted by the internal bus tasks.

Therefore, configuration for the connected modules and communication via

fieldbus with the watchdog activated for the task call interval must be taken into account here.

PLC-Comm task (internal)

The PLC-Comm task is active when logged in and takes up communication with the CODESYS gateway.

Background task (IEC-Task priorities 11-31 that can be set in CODESYS)

All internal tasks have a priority higher than that for the IEC background tasks. These tasks are therefore very well-suited for performing time-intensive and non-critical time tasks, such as calling up functions in the SysLibFile.lib.

Note

**Maximum number of IEC tasks!**

Note that the fieldbus controller supports a total of 30 tasks (task ID 0 ... 29), the two tasks (task ID 0 ... 1) are used by the runtime system in the Firmware. It will thus remain 28 tasks (task ID 2 ... 29) for your user program. The task ID of exceeding tasks than has task ID of an invalid handle (0xFFFFFFFF).

Information

**Additional Information**

For a detailed description of using the software, refer to the manual for the “WAGO-I/O-PRO”. This manual is located in the Internet under <http://www.wago.com>.

10.6 System Events

In place of a task, a system event can also call up a project module for processing.

The system events to be employed for this depend on the target system. These events consist of the list of supported standard system events for the control system and any other manufacturer-specific events which may have been added.

Possible events, for example: Stop, Start, Online change.

A complete list of all system events is provided at WAGO-I/O-PRO in tab **Resources > Task configuration > System events**.

10.6.1 Enabling/Disabling System Events

1. Open the register **resources > task configuration > system events** in WAGO-I/O-PRO (see the following Figure).
2. In order to call up a module via an event, activate the entries by setting a hatch mark in the respective control boxes.
3. Disable the control boxes by removing the hatch marks through a mouse click.

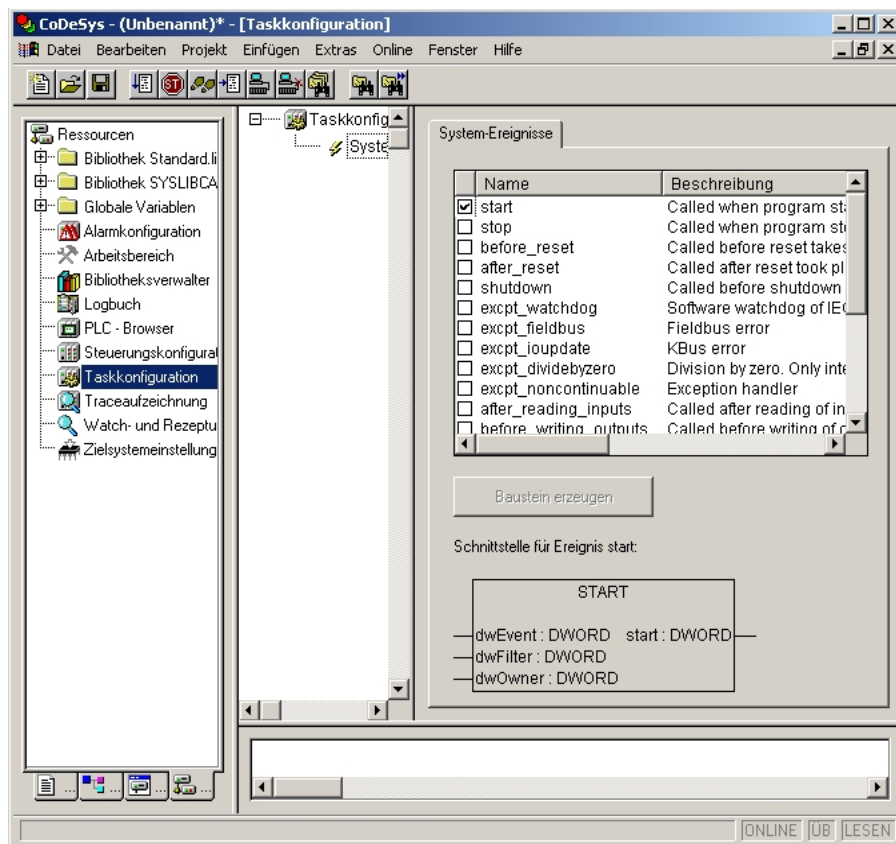


Figure 84: Enabling/Disabling System Events

Note



Only use global variables and functions (Fun)!

Note that the fetch of function blocks (FB) such as Timer modules , or the fetch of blocking functions such as file operations can lead to a malfunction of the system. Therefore use in system events exclusively Global variables and functions (Fun).

Information



Additional Information:

Allocation of the system events to the specific modules to be called up is clarified in the manual for the programming tool WAGO-I/O-PRO in the Internet under <http://www.wago.com>.

10.7 Transfer the IEC program to the Fieldbus controller

Transfer from the PC to the fieldbus controller of the program for the created IEC-61131-3 application can be performed two ways (see following sections).

- Direct transfer via serial port
- Transfer via fieldbus

Suitable communication drivers are required for transfer; these can be loaded and configured using *WAGO-I/O-PRO*.

Note



Check/adjust communications parameters of the driver

When selecting the desired driver, watch for the proper settings and adjustments of the communications parameters (see the following description).

Note



“Reset” and “Start” are required to set the physical outputs!

The initialization values for the physical outputs are not set immediately after downloading. Select **Online** > **Reset** and subsequently **Online** > **Start** in the menu bar of *WAGO I/O-PRO* to set the values.

Note



Stop application before generating large boot projects!

Stop the *WAGO-I/O-PRO* application via **Online** > **Stop** before generating a very large boot project, since this may otherwise cause stopping the internal bus. You can restart the application after creating the boot project.

Note



Handling persistent data affects the program start!

Depending on the variable type, the number and sizes of the persistent data and their combination, such as in function modules, handling with persistent data can delay the program start by an extended initialization phase.

Information



Additional Information

The following description is used for fast access. For details on installing missing communication drivers and using the software, refer to “*WAGO-I/O-PRO*” available in the Internet under <http://www.wago.com>.

10.7.1 Transfer via Serial Service Port



Note

Watch the position of the mode selector switch when accessing the fieldbus controller!

Prerequisite for the access to the fieldbus controller is that the operating mode switch of the fieldbus controller, which is located behind the cover of the fieldbus controller next to the service interface, is in the center or top position.

Use the WAGO communication cable to set up a physical connection via serial service port. This cable is included in the scope of supply for the IEC-61131-3 programming tool (order no. 759-333), or can be procured as an accessory item under order no. 750-920.

NOTICE

Do not connect Communication Cable when energized!

To prevent damage to the communications interface, do not connect or disconnect Communication Cable 750-920 respectively 750-923 when energized!

The fieldbus controller must be de-energized!

1. Check that the fieldbus controller mode selector switch is set to the center or top position.
If this is not the case, move the mode selector switch to the center or top position.
2. Use the WAGO communication cable to connect a COM port of your PC to the fieldbus controller communication port.

A communication driver is required for serial data transfer. This driver and its parameters must be entered in the WAGO-I/O-PRO in the dialog window "Communication parameters".

3. Start the WAGO-I/O-PRO software **under Start > Programs > WAGO Software > WAGO-I/O-PRO.**
4. In the menu **Online** select the item **Communication parameters.**

The dialog window "Communication parameters" then appears. The channels of the currently connected gateway servers are shown on the left side of the dialogue and the already installed communications drivers are shown below. This window is empty in its default settings.

5. Click **New** to set up a link and then enter a name, such as RS-232 Connection.

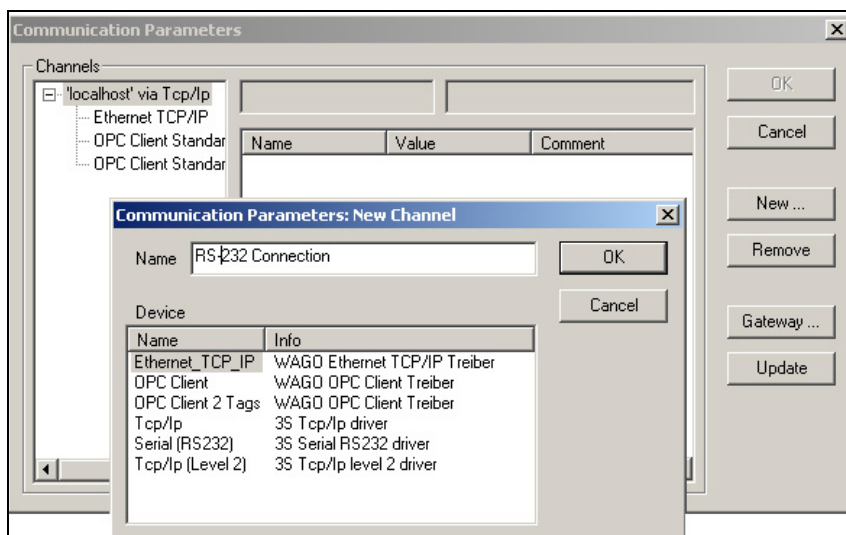


Figure 85: Dialog Window “Communication Parameters”

6. In the selection window, mark the required driver in the right side of the window, Serial (RS-232) 3S Serial RS-232 driver, to configure the serial link between the PC and the fieldbus controller.

The following properties for the serial port are shown in the center dialog window:

- Port: COM1
- Baud rate: 19200
- Parity: Even
- Stop-bits: 1
- Motorola byte order: No

7. If necessary, change the entries according to the above values by clicking on the respective value and editing it.
8. Confirm these settings by clicking **OK**

The RS-232 port is now configured for transferring the application.

Note



Log in with the administrator password to program the fieldbus controller!

If you have activated password protection for port 2455 on the “Security” page of the WBM, you have to log into WAGO-I/O-PRO in the menu **Online** > **Log In** to obtain programming access to the fieldbus controller (default password “wago”).



Figure 86: Logging in for Programming Access

9. Under **Online**, click the menu item **Login** to log in to the fieldbus controller

The WAGO-I/O-PRO Server is active during online operation. The communication parameters can not be called up during this time.

Depending on whether a program is already present in the fieldbus controller, a window will appear asking whether a (new) program should be loaded.

10. Respond with **Yes** to load the current program.
11. In menu **Online**, click on **Create Boot project**.

Your compiled project will also be executed by this method, if you restart the fieldbus controller or if there is a power failure.

12. Once the program has been loaded, start program processing in the menu **Online**, menu item **Start**.

This command starts the processing of your program in the control system or in the simulation.

“ONLINE” and “RUNNING” will then appear at the right of the status bar.

13. To terminate online operation, click the menu item **Log off** in the menu **Online**.

10.7.2 Transfer via Fieldbus and ETHERNET

The physical link between the PC and the controller is set up via fieldbus. An appropriate communication driver is required for data transfer. The driver and its parameters must be entered in the WAGO-I/O-PRO in the dialog window “Communication parameters”.

Note



Controller needs IP address for access!

The controller must have an IP address before it can be accessed. The operating mode switch, which is located behind the cover of the fieldbus controller next to the service interface, must be in the center or top position.

1. Start the WAGO-I/O-PRO software under **Start / Programs / WAGO-I/O-PRO** or by clicking the program icon on the desktop).
2. In the menu **Online** select the item **Communication parameters**.

The dialog window “Communication parameters” then appears. The channels of the currently connected gateway servers are shown on the left side of the dialogue and the already installed communications drivers are shown below. This window is empty in its default settings.

3. Click **New** to set up a connection and then specify a name, e.g. TcpIp connection.
4. Mark the required TCP/IP driver in the right side of the dialog window to configure the link between the PC and the controller via ETHERNET. Use the new driver version “Tcp/Ip” (3S Tcp/Ip driver).

The following standard entries are shown in the center dialog window:

- IP address: IP address of your controller
- Port number: 2455
- Motorolabyteorder: No
- Debug level: 16#0000

5. Change any entries as you may require.
6. Confirm with **OK**.

You have now configured the TCP/IP link with the communication parameters/drivers.

7. Under **Online**, click the menu item **Login** to log in to the fieldbus controller

The WAGO-I/O-PRO Server is active during online operation. The communication parameters can not be called up during this time.

Depending on whether a program is already present in the fieldbus controller, a window will appear asking whether a (new) program should be loaded.

8. Respond with **Yes** to load the current program.
9. In menu **Online**, click on **Create Boot project**.

Your compiled project will also be executed by this method, if you restart the fieldbus controller or if there is a power failure.

10. Once the program has been loaded, start program processing in the menu **Online**, menu item **Start**.

This command starts the processing of your program in the control system or in the simulation.

“ONLINE” and “RUNNING” will then appear at the right of the status bar.

11. To terminate online operation, click the menu item **Log off** in the menu **Online**.

11 Configuring via the Web-Based Management System (WBM)

An internal file system and an integrated Web server can be used for configuration and administration of the system. Together, they are referred to as the Web-based Management System (WBM).

The HTML pages saved internally provide you with information about the configuration and status of the fieldbus node. In addition, you can also change the configuration of the device here.

You can also save HTML pages created yourself via the implemented file system.

Note



Always restart after making changes to the configuration (not necessary after changing the physical addresses for the KNX IP controller)!

The system must always be restarted for the changed configuration settings to take effect.

This does not apply to the configuration of the physical addresses of the KNX IP controller. Changes are applied immediately when you click **[SUBMIT]**.

1. To open the WBM, launch a Web browser (e.g., Microsoft Internet Explorer or Mozilla Firefox).
2. Enter the IP address of the fieldbus coupler/controller in the address bar.
3. Click **[Enter]** to confirm.
The start page of WBM loads.
4. Select the link to the desired HTML page in the left navigation bar.
A query dialog appears.
5. Enter your user name and password in the query dialog (default: user = "admin", password = "wago" or user = "user", password = "user").
The corresponding HTML page is loaded.
6. Make the desired settings.
7. Press **[SUBMIT]** to confirm your changes or press **[UNDO]** to discard the changes.
8. Restart the system to apply the settings (HTML page "Security", button **[Software Reset]**).

You can access the following WBM pages via the links given in the navigation bar:

- Information
- Ethernet
- TCP/IP
- Port
- SNMP
- SNMP V3
- Watchdog
- Clock
- Security
- Modbus
- KNX
- PLC Info
- PLC
- Features
- I/O config
- Disk Info
- SD Card
- Backup & Restore
- WebVisu

11.1 Information

The WBM page “Information” contains an overview of all important information about your fieldbus coupler/controller.

The screenshot shows the 'Web-based Management' interface. At the top right is a globe icon. Below the header is a blue bar, followed by a green bar containing the text 'Status information'. Underneath are three sections:

- Coupler details:**

Order number	750-889
Mac address	0030DE026047
Firmware revision	01.01.12 (00)
- Actual network settings:**

IP address	192.168.1.17 Determined by DFLT Button
Subnet mask	255.255.255.0
Gateway	0.0.0.0
Host Name	
Domain Name	
(S)NTP-Server	0.0.0.0
DNS-Server 1	0.0.0.0
DNS-Server 2	0.0.0.0
- Module status:**

State Modbus Watchdog:	Disabled
Error code:	0
Error argument:	0
Error description:	Coupler running, OK

Figure 87: WBM page “Information”

Table 49: WBM page "Information"

Coupler details			
Entry	Default	Value (example)	Description
Order number	750-889/000-000	750-889/000-000	Order number
Mac address	0030DEXXXXXX	0030DE000006	Hardware MAC address
Firmware revision	kk.ff.bb (rr)	01.01.09 (00)	Firmware revision number (kk = compatibility, ff = functionality, bb = bugfix, rr = revision)
Actual network settings			
Entry	Default	Value (example)	Description
IP address	169.254.9.10 (AutoIP)	192.168.1.111 (Static)	IP address, default: AutoIP
Subnet mask	255.255.0.0	255.255.255.0	Subnet mask
Gateway	0.0.0.0	192.168.1.251	Gateway
Hostname	___	___	Host name (not assigned here)
Domainname	___	___	Domain name (not assigned here)
(S)NTP server	0.0.0.0	0.0.0.0	Address of (S)NTP server
DNS server 1	0.0.0.0	0.0.0.0	Address of first DNS server
DNS server 2	0.0.0.0	0.0.0.0	Address of second DNS server
Module status			
Entry	Default	Value (example)	Description
State Modbus Watchdog	Disabled	Disabled	Status of Modbus Watchdog
Error code	0	10	Error code
Error argument	0	5	Error argument
Error description	Coupler running, OK	Mismatch in CODESYS IO-configuration	Error description

11.2 Ethernet

Use the “Ethernet” HTML page to set the data transfer rate and bandwidth limit for each of the two switch ports for data transfer via Ethernet.

Web-based Management

Ethernet configuration

This page is for the configuration of the Ethernet Switch and Aging settings. The configuration is stored in an EEPROM and changes will take effect after the next software or hardware reset.

Phy Configuration

Description	Port 1	Port 2
Enable Port	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Enable Autonegotiation	<input checked="" type="radio"/>	<input checked="" type="radio"/>
10 MBit Half Duplex	<input type="radio"/>	<input type="radio"/>
10 MBit Full Duplex	<input type="radio"/>	<input type="radio"/>
100 MBit Half Duplex	<input type="radio"/>	<input type="radio"/>
100 MBit Full Duplex	<input type="radio"/>	<input type="radio"/>

MAC Address Filter

Enable

Whitelist format: xx:yy:zz:aa:bb:cc

WAGO 750/767 devices <input type="checkbox"/>	
MAC 1	00:00:00:00:00:00
MAC 2	00:00:00:00:00:00
MAC 3	00:00:00:00:00:00
MAC 4	00:00:00:00:00:00
MAC 5	00:00:00:00:00:00

Misc. Configuration

Description	Port 1	Port 2	internal Port
Input Limit Rate	No Limit ▾	No Limit ▾	No Limit ▾
Output Limit Rate	No Limit ▾	No Limit ▾	No Limit ▾
Fast Aging	<input type="checkbox"/>		
BC protection	<input type="checkbox"/>	<input type="checkbox"/>	
Port Mirror	<input type="checkbox"/>		
Sniffer Port	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Mirror Port	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ethernet MTU	1500		

Figure 88: WBM page “Ethernet”

Table 50: WBM Page "Ethernet"

Phy Configuration				
Entry	Default	Description		
Enable Port	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Enable Port 1/Port 2		
		<input type="checkbox"/> Disable Port 1/Port 2		
Enable autonegotiation	<input checked="" type="radio"/>	<input checked="" type="radio"/> Enable Autonegotiation Automatically set the best possible transmission speed with "Enable Autonegotiation".		
		<input type="radio"/> Enable Autonegotiation		
10 MBit Half Duplex	<input type="radio"/>	Select half or full duplex for the ETHERNET to configure a fixed transmission speed 10 or 100 MBit		
10 MBit Full Duplex	<input type="radio"/>			
100 MBit Half Duplex	<input type="radio"/>			
100 MBit Full Duplex	<input type="radio"/>			
MAC Address Filter				
Entry	Default value	Description		
Enable	<input type="checkbox"/>	<input checked="" type="checkbox"/> Activate MAC address filter. Only the following registered MAC addresses have network access to the fieldbus controller, others are blocked		
		<input type="checkbox"/> Deactivate MAC address filter. All MAC addresses have network access to the fieldbus controller.		
WAGO 750/767 devices	<input type="checkbox"/>	<input checked="" type="checkbox"/> The WAGO devices of the WAGO-I/O-SYSTEM 750 and 767 have always network access to the fieldbus controller, regardless of the list entries.		
		<input type="checkbox"/> Only the devices whose MAC address is included in the list have network access to the fieldbus controller.		
MAC 1	00:00:00:00:00:00	Filter for the first MAC address (hexadecimal).		
MAC 2	00:00:00:00:00:00	Filter for the second MAC address (hexadecimal).		
MAC 3	00:00:00:00:00:00	Filter for the third MAC address (hexadecimal).		
MAC 4	00:00:00:00:00:00	Filter for the fourth MAC address (hexadecimal).		
MAC 5	00:00:00:00:00:00	Filter for the fifth MAC address (hexadecimal).		
Misc. Configuration				
Entry	Port			Description
	1	2	int.	
Input Limit Rate	No Limit ▼			The Input Limit Rate limits network traffic when receiving. The rate is indicated in megabits or kilobits per second. If the limit is exceeded, packets are lost.
Output Limit Rate	No Limit ▼			The Output Limit Rate limits network traffic when sending. The rate is indicated in megabits or kilobits per second. If the limit is exceeded, packets are lost.
Fast Aging	<input type="checkbox"/>	<input checked="" type="checkbox"/> Enable "Fast Aging" "Fast Aging" ensures that the cache for the MAC addresses is cleared faster in the switch. This may be required if a redundancy system (e.g., using a Jet-Ring network or comparable technology) needs to be set up.		
		<input type="checkbox"/> Disable "Fast Aging". The time to discard the cache entries is five minutes.		

BC protection	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/> Broadcast Protection limits the number of broadcast telegrams per unit of time. If protection is on, the broadcast packets are limited at 100 Mbit to 8 packets per 10 ms and at 10 Mbit to 8 packets per 100 ms. If the limit is exceeded, packets are lost.	
			<input type="checkbox"/> Broadcast Protection disabled.	
Port Mirror	<input type="checkbox"/>		<input checked="" type="checkbox"/> Enable port mirroring Port Mirroring is used for network diagnostics. Packets are mirrored from one port (mirror port) to another (sniffer port).	
			<input type="checkbox"/> Disable port mirroring	
Sniffer Port	<input type="radio"/>	<input checked="" type="radio"/>	Select the sniffer port the mirror port should be mirrored to.	
Mirror Port	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	Select the mirror port which should be mirrored to the sniffer port.
Ethernet MTU	1500		Maximum packet size of a protocol, which can be transferred without fragmentation ("Maximum Transmission Unit" - MTU)	

Note



Set the MTU value for fragmentation only!

Only set the value for MTU, i.e., the maximum packet size between client and server, if you are using a tunnel protocol (e.g., VPN) for ETHERNET communication and the packets must be fragmented.

Setting the value is independent of the transmission mode selected.

Note



Configure ETHERNET transmission mode correctly!

A fault configuration of the ETHERNET transmission mode may result in a lost connection, poor network performance or faulty performance of the fieldbus coupler/controller.

11.3 TCP/IP

You can configure network addressing and network identification on the “TCP/IP” HTML page.

Web-based Management

TCP/IP configuration

This page is for the configuration of the basic TCP/IP network parameters. The parameters are stored in an EEPROM and changes will take effect after the next software or hardware reset.

Note that these settings are used only if the DFLT button is not pressed and you have selected 'use IP from EEPROM' at 'Port' configuration page!

Default IP configuration (DFLT)

DFLT IP-Address	192.168.1.17
DFLT Subnet mask	255.255.255.0

EEPROM Configuration Data

IP-Address	<input type="text" value="192.168.1.10"/>
Subnet Mask	<input type="text" value="255.255.0.0"/>
Gateway	<input type="text" value="0.0.0.0"/>
Host Name	<input type="text" value="0030DE07B953"/>
Domain Name	<input type="text"/>
DNS Server 1	<input type="text" value="0.0.0.0"/>
DNS Server 2	<input type="text" value="0.0.0.0"/>
(S)NTP Server	<input type="text" value="0.0.0.0"/>
SNTP Update Time (sec, max. 65535)	<input type="text" value="3600"/>

Figure 89: WBM Page “TCP/IP”


Table 51: WBM page "TCP/IP"

Default IP configuration (DFLT)			
Entry	Default	Description	
DFLT IP-Address	192.168.1.17	Fixed default IP address when pressing the DFLT button on the enclosure	
DFLT IP Subnet Mask	255.255.255.0	Fixed subnet mask when pressing the DFLT button on the enclosure	
EEPROM Configuration Data			
Entry	Default	Value (example)	Description
IP address	169.254.9.10 (AutoIP)	192.168.1.111 (Static)	IP address
Subnet mask	255.255.0.0	255.255.255.0	subnet mask
Gateway	0.0.0.0	0.0.0.0	gateway
Host name	0030DEXXX XXX	0030DE026005	host name
Domain name			domain name
DNS Server1	0.0.0.0	0.0.0.0	IP address of the first DNS server
DNS Server2	0.0.0.0	0.0.0.0	optional IP address of the second DNS server
(S)NTP Server	0.0.0.0	0.0.0.0	Enter IP address of the (S)NTP server
SNTP Update Time (sec. max. 65535)	3600	0	Enter the delay after which the (S)NTP server requests the network time again

11.4 Port

Use the “Port” HTML page to enable or disable services available via the IP protocol.

Web-based Management



Port configuration


This page is for the configuration of the network protocols. The configuration is stored in an EEPROM and changes will take effect after the next software or hardware reset.

Port Settings

Protocol	Port	Enabled
FTP	21	<input checked="" type="checkbox"/>
SNTP	123	<input type="checkbox"/>
HTTP	80	<input checked="" type="checkbox"/>
HTTPS	443	<input type="checkbox"/>
SNMP	161, 162	<input checked="" type="checkbox"/>
Modbus UDP	502	<input checked="" type="checkbox"/>
Modbus TCP	502	<input checked="" type="checkbox"/>
WAGO Services	6626	<input checked="" type="checkbox"/>
CoDeSys	2455	<input checked="" type="checkbox"/>
BootP	68	<input type="radio"/>
DHCP	68	<input type="radio"/>
Auto-IP/Zeroconf	--	<input type="radio"/>
use IP from EEPROM	--	<input checked="" type="radio"/>

Figure 90: WBM page “Port”

Table 52: WBM page "Port"

Port Settings		
Entry	Entry	Entry
FTP (Port 21)	Enabled <input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> activating "File Transfer Protocol"
		<input type="checkbox"/> deactivating "File Transfer Protocol"
SNTP (Port 123)	Enabled <input type="checkbox"/>	<input checked="" type="checkbox"/> activating "Simple Network Time Protocol"
		<input type="checkbox"/> deactivating "Simple Network Time Protocol"
HTTP (Port 80)	Enabled <input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> activating "Hypertext Transfer Protocol"
		<input type="checkbox"/> deactivating "Hypertext Transfer Protocol"
HTTPS (Port 443)	Enabled <input type="checkbox"/>	<input checked="" type="checkbox"/> activating "Hypertext Transfer Protocol over SSL-encrypted connection"
		<input type="checkbox"/> deactivating "Hypertext Transfer Protocol over SSL-encrypted connection"
		Note Operate WebVisu via HTTPS! You can operate WebVisu via HTTPS protocol, provided HTTPS is activated and you use a WAGO-I/O-PRO version >= .42.
SNMP (Port 161, 162)	Enabled <input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Activating "Simple Network Management Protocol"
		<input type="checkbox"/> Deactivating "Simple Network Management Protocol"
Modbus UDP (Port 502)	Enabled <input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Activating MODBUS/UDP protocol
		<input type="checkbox"/> Deactivating MODBUS/UDP protocol
Modbus TCP (Port 502)	Enabled <input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Activating MODBUS/TCP protocol
		<input type="checkbox"/> Deactivating MODBUS/TCP protocol
WAGO Services (Port 6626)	Enabled <input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Activating WAGO services
		<input type="checkbox"/> Deactivating WAGO services
CODESYS (Port 2455)	Enabled <input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Activating CODESYS
		<input type="checkbox"/> Deactivating CODESYS
BootP (Port 68)	Enabled <input checked="" type="radio"/>	<input checked="" type="radio"/> Activating Boots Trap Protocol
		<input type="radio"/> Deactivating Boots Trap Protocol
DHCP (Port 68)	Enabled <input type="radio"/>	<input checked="" type="radio"/> Activating Dynamic Host Configuration Protocol
		<input type="radio"/> Deactivating Dynamic Host Configuration Protocol
Auto-IP/Zerokonf	Enabled <input type="radio"/>	<input checked="" type="radio"/> Activating Auto-IP
		<input type="radio"/> Deactivating Auto-IP
use IP from EEPROM	Enabled <input type="radio"/>	<input checked="" type="radio"/> Activating use of IP address from EEPROM
		<input type="radio"/> Deactivating use of IP address from EEPROM



Note

Alternative IP address assignment!

You can only select the DHCP, BootP, AutoIP and "use IP from EEPROM" settings as an alternative!

11.5 SNMP

On the HTML page “SNMP”, you can perform the settings for the Simple Network Management Protocol.

SNMP is a standard for device management within a TCP/IP network. The Simple Network Management Protocol (SNMP) is responsible for transporting the control data that allows the exchange of management information, the status and statistic data between individual network components and a management system.

The fieldbus coupler/controller supports SNMP in versions 1, 2c and 3.

The SNMP of the ETHERNET TCP/IP controller includes the general MIB according to RFC1213 (MIB II).

In addition, a special WAGO-MIB is integrated.

SNMP is processed via port 161. The port number for SNMP traps (agent messages) is 162.

Note

**Enable port 161 and 162 to use SNMP!**

Enable ports 161 and 162 in the WBM in menu “port”, so that the fieldbus coupler/controller can be reached via SNMP. The port numbers cannot be modified.

Note

**Modify parameter via WBM or SNMP objects!**

However, parameters that can be set on the html pages can also be changed directly by the appropriate SNMP objects.

Information

**Additional Information:**

Additional information for SNMP, the Management Information Base (MIB) and traps (event messages via SNMP) may be obtained from section “Fieldbus Communication” > ... > “SNMP (Simple Network Management Protocol).”

Note that the settings for SNMPV1/V2c and SNMPV3 are separate from each other: The different SNMP versions can be activated or used in parallel or individually on a fieldbus controller.

11.5.1 SNMP V1/V2c

The SNMP version 1/2c represents a community message exchange. The community name of the network community must thereby be specified.

Web-based Management

SNMP Configuration

This page is dedicated to the SNMP configuration. The new configuration is stored in an EEPROM and changes will take effect after the next software or hardware reset.

SNMP Configuration

Description	WAGO 750-889 KNX PFC ETHERNE
Physical location	LOCAL
Contact	support@wago.com

SNMP v1/v2c Manager Configuration

Protocol Enable	SNMP V1/V2c <input checked="" type="checkbox"/>
Local Community Name	public

SNMP v1/v2c Trap Receiver Configuration

Trap Receiver 1	0.0.0.0
Community Name 1	public
Trap Version	V1 <input checked="" type="radio"/> V2 <input type="radio"/>
Trap Receiver 2	0.0.0.0
Community Name 2	public
Trap Version	V1 <input checked="" type="radio"/> V2 <input type="radio"/>

Figure 91: WBM page “SNMP”

Table 53: WBM page "SNMP"

SNMP Configuration		
Entry	Value (Default)	Description
Description	WAGO 750-889 KNX PFC ETHERNET	Device description (sysDescription)
Physical location	LOCAL	Location of device (sysLocation)
Contact	support@wago.com	E-mail contact address (sysContact)
SNMP v1/v2 Manager Configuration		
Entry	Value (Default)	Description
Protocol Enable	SNMP V1/V2c <input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Activating SNMP Version 1/2c
		<input type="checkbox"/> Deactivating SNMP-Version 1/2c
Local Community Name	public	Used community name
SNMP v1/v2 Trap Receiver Configuration		
Entry	Value (Default)	Description
Trap Receiver 1	0.0.0.0	IP address of 1. used SNMP manager
Community Name 1	public	1. Community name of the network community used
Trap Version	V1 <input checked="" type="radio"/> V2 <input type="radio"/>	V1 <input checked="" type="radio"/> V2 <input type="radio"/> Activating Traps Version 1
		V1 <input type="radio"/> V2 <input checked="" type="radio"/> Activating Traps Version 2
Trap Receiver 2	0.0.0.0	IP address of 2. used SNMP manager
Community Name 2	public	2. Community name of the network community used
Trap Version	V1 <input checked="" type="radio"/> V2 <input type="radio"/>	V1 <input checked="" type="radio"/> V2 <input type="radio"/> Activating Traps Version 1
		V1 <input type="radio"/> V2 <input checked="" type="radio"/> Activating Traps Version 2

11.5.2 SNMP V3

In SNMP version 3, exchanging messages is user-related. Each device, that knows the passwords set via WBM, may read or write values from the fieldbus coupler/-controller.

In SNMP V3, user data from SNMP messages can also be transmitted in encoded form. This is why SNMP V3 is often used in safety-related networks.

Web-based Management

SNMP Configuration

This page is dedicated to the SNMP configuration. The new configuration is stored in an EEPROM and changes will take effect after the next software or hardware reset.

'Authentication Key' and 'Privacy Key' have to be at least 8 characters.

SNMP v3 (user based)	
1.User	activate <input type="checkbox"/>
Authentication Type	None <input type="radio"/> MD5 <input checked="" type="radio"/> SHA1 <input type="radio"/>
Security Authentication Name	<input type="text" value="SecurityName"/>
Authentication Key	<input type="text" value="AuthenticationKey"/>
Privacy Enable	DES <input checked="" type="checkbox"/>
Privacy Key	<input type="text" value="PrivacyKey"/>
Notification/Trap enable	V3 <input type="checkbox"/>
Notification Receiver IP	<input type="text" value="0.0.0.0"/>
2.User	activate <input type="checkbox"/>
Authentication Type	None <input type="radio"/> MD5 <input checked="" type="radio"/> SHA1 <input type="radio"/>
Security Authentication Name	<input type="text" value="SecurityName"/>
Authentication Key	<input type="text" value="AuthenticationKey"/>
Privacy Enable	DES <input checked="" type="checkbox"/>
Privacy Key	<input type="text" value="PrivacyKey"/>
Notification/Trap enable	V3 <input type="checkbox"/>
Notification Receiver IP	<input type="text" value="0.0.0.0"/>

Figure 92: WBM page “SNMP V3”

Table 54: WBM Page “SNMP V3”


SNMP v3 (user based)		
Entry	Value (Example)	Description
1. User / 2. User	activate <input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Activating user 1 or 2
		<input type="checkbox"/> Deactivating user 1 or 2
Authentication Type	None <input type="radio"/>	None <input checked="" type="radio"/> MD5 <input type="radio"/> SHA1 <input type="radio"/> No encryption of the authentication
	MD5 <input checked="" type="radio"/>	None <input type="radio"/> MD5 <input checked="" type="radio"/> SHA1 <input type="radio"/> Encryption of the authentication with MD5
	SHA1 <input type="radio"/>	None <input type="radio"/> MD5 <input type="radio"/> SHA1 <input checked="" type="radio"/> Encryption of the authentication with SHA1
Security Authentication Name	Security Name	Enter the name, if the “authentication type” MD5 or SHA1 has been selected
Authentication Key	Authentication Key	Enter the password with at least 8 characters, if “authentication type” MD5 or SHA1 has been selected
Privacy Enable	DES <input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Activate the DES encryption of the data
		<input type="checkbox"/> Deactivate the DES encryption of the data
Privacy Key	Privacy Key	Enter the password of at least 8 characters in the encryption with DES
Notification/Trap enable	V3 <input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Activate the notification traps of the SNMP version 3
		<input type="checkbox"/> Deactivate the notification traps of the SNMP version 3
Notification Receiver IP	192.168.1.10	IP address of the notification manager

Two independent SNMPv3 users can be defined and activated via the html page (user 1 and user 2).

11.6 Watchdog

Click the link "Watchdog" to go to a Web site where you can specify the settings for the connection and MODBUS watchdog.

Web-based Management



Watchdogs

This page is for the configuration of the watchdogs. The configuration is stored in an EEPROM. Changes of the Connection Time will take effect immediately. Changes of the Modbus Watchdog will take effect after the next software or hardware reset. For more information see the manual.

Connection Watchdog

Connection Timeout Value (100ms):

Modbus Watchdog

State Modbus Watchdog:	Disabled
Watchdog Type :	Standard <input checked="" type="radio"/>
	Alternative <input type="radio"/>
Watchdog Timeout Value (100ms):	<input style="width: 100%;" type="text" value="100"/>
Watchdog Trigger Mask (F1 to F16):	<input style="width: 100%;" type="text" value="0xFFFF"/>
Watchdog Trigger Mask (F17 to F32):	<input style="width: 100%;" type="text" value="0xFFFF"/>

Figure 93: WBM Page "Watchdog"

Table 55: WBM Page "Watchdog"

Connection watchdog		
Entry	Default	Description
Connection Timeout Value (100 ms)	600	Monitoring period for TCP links. After the completion of this period without any subsequent data traffic, the TCP connection is closed.
Modbus Watchdog		
Entry	Default	Description
State Modbus Watchdog	Disabled	Enabled – Watchdog is activated Disabled – Watchdog is disabled
Watchdog Type	Standard <input checked="" type="radio"/>	The set coding mask (watchdog trigger mask) is evaluated to determine whether the watchdog time is reset.
	Alternative <input type="radio"/>	The watchdog time is reset by any Modbus/TCP telegram.
Watchdog Timeout Value (100 ms)	100	Monitoring period for Modbus links. After the completion of this period without receiving a Modbus telegram, the physical outputs are set to "0".
Watchdog Trigger Mask (F 1 to F16)	0xFFFF	Coding mask for certain Modbus telegrams (Function Code FC1 ... FC16)
Watchdog Trigger Mask (F17 to F32)	0xFFFF	Coding mask for certain Modbus telegrams (Function Code FC17 ... FC32)

11.7 Clock

Specify the settings for the internal real-time clock on the “Clock” HTML page. Here, enter the current time and date and also select standard or daylight saving time.

Note



Reset the internal clock after a specified time without power supply!

The internal clock must be reset on initial startup or after the end of days, specified in the technical Data without power supply (Powerfail RTC Buffer). If the clock is not set, the clock begins with the date 01.01.2000 around 0:00 clock with time measurement.

Note



Daylight Saving Time (DST) change via function block or automatically!

To switch between standard and daylight-saving time via the web-based management system, select on page “Clock” the “Automatic (USA / EU)” option or optional “Manual”. To ensure that all functions are correctly carried out properly and at the right time even if the “Manual” option is selected, you can also obtain automatic conversion means of the function block “PrgDaylightSaving”. Exclusively in case of the “Manual” option it is allowed to use this function block, which is available in WAGO-I/O-PRO by integration of the library “DaylightSaving.lib”.

Note



Error message in WAGO I/O CHECK is possible after a power failure!

If you are using the software “WAGO-I/O-CHECK” after a loss of power has occurred, error messages may be generated. Should this occur, call up the Web-based management system and set the actual time under “Clock”. Then, call up the “WAGO-I/O-CHECK” program again

Note



Loss of telegrams possible when performing configuration during ongoing operation!

Telegrams may be lost if configuration is performed using WAGO-I/O-CHECK while the system is in operation.

Note



Use a WAGO RTC module for time synchronization!

You can also use a WAGO 750-640 RTC Module for your node to utilize the actual encoded time (Real-time – RTC) in your higher-level control system. An even greater degree of accuracy is achieved via RTC module than that obtained using the real-time clock in the coupler or controller.

Web-based Management

Clock configuration

Configuration Data

Time on device	<input type="text" value="11:07:54"/>
Date (YYYY-MM-DD)	<input type="text" value="2015-11-19"/>
Timezone (+/- hour:minute)	<input type="text" value="+1:00"/>
Daylight Saving Time (DST)	<input checked="" type="radio"/> Automatic (USA) <small>Second sunday in March 02:00 AM first sunday in November 02:00 AM</small>
	<input type="radio"/> Automatic (EU) <small>Last sunday in March 01:00 UTC last sunday in October 01:00 UTC</small>
	<input type="radio"/> Manual: <input type="checkbox"/>
12 hour clock	<input type="checkbox"/>

Figure 94: WBM Page “Clock”

Table 56: WBM Page “Clock”

Configuration Data			
Entry	Default	Value (example)	Description
Time on device	Coordinated Universal Time UTC	13:00:31	Set current time
Date (YYYY-MM-DD)	Date based on UTC	2013-02-08	Set current date
Time zone (+/- hour)	0	1 (MEZ)	Set time zone offset from the Coordinated Universal Time (UTC)
Daylight Saving Time (DST)	<input checked="" type="radio"/> Automatic (USA)	<input checked="" type="radio"/>	<input checked="" type="radio"/> Enable automatic Daylight Saving Time (USA) (second Sunday in March, clocks are advanced from 02:00 AM to 03:00 AM / first Sunday in November, clocks are set back from 02:00 AM to 01:00 AM)
	<input type="radio"/> Automatic (EU)	<input type="radio"/>	<input type="radio"/> Disable automatic Daylight Saving Time (USA)
	<input type="radio"/> Automatic (EU)	<input type="radio"/>	<input checked="" type="radio"/> Enable automatic Daylight Saving Time (EU) (last Sunday in March, clocks are advanced from 02:00 AM to 03:00 AM / last Sunday in October, clocks are set back from 03:00 AM to 02:00 AM)
	<input type="radio"/> Manual:	<input checked="" type="radio"/>	<input type="radio"/> Disable automatic Daylight Saving Time (EU)
12 hour clock	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Manually enable summer time <input type="checkbox"/> Manually enable winter time
		<input type="checkbox"/>	Disable manual summer/winter time
12 hour clock	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Enable 12-hour display
		<input type="checkbox"/>	<input type="checkbox"/> Enable 24-hour display

11.8 Security

Use the “Security” HTML page with passwords to set up read and/or write access for various user groups to protect against configuration changes.

Note



Passwords can only be changed by “admin” and after software reset!

The “admin” user and associated password are required to change passwords.

Press the [**Software Reset**] button to restart the software for the setting changes to take effect.

Note



Note password restrictions!

The following restriction is applied for passwords:

- Max. 32 characters inclusive special characters.
-

Web-based Management

Security

This page is intended to disable the basic authentication. Additionally you can set new passwords for the existing user. The new values are stored in an EEPROM and changes will take effect immediately.

Webserver Security

Webserver authentication enabled

Webserver, FTP and PLC User configuration

User: Password:

Confirm Password:

PLC Security

Port 2455 authentication enabled

Attention: You will lose the connection to the webserver after the software reset, if the IP configuration was changed. Please load the webpage with the proper address in this case again.

Figure 95: WBM Page “Security”

Table 57: WBM Page "Security"

Webserver Security		
Entry	Default	Description
Webserver authentication enabled	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Enable password protection to access the Web interface
		<input type="checkbox"/> Disable password protection to access the Web interface
Webserver, FTP and PLC User configuration *)		
Entry	Default	Description
User	*)	Select admin, guest or user
Password	*)	Enter password
Confirm password		Enter password again to confirm
PLC Security		
Entry	Default	Description
Port 2455 authentication enabled	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Enable password protection to access to the PLC program.
		<input type="checkbox"/> Disable password protection to access to the PLC program.

*) The following default groups exist:

User: admin	Password: wago
User: guest	Password: guest
User: user	Password: user

Note



Renew access after software reset!

If you initiate a software reset on this page, then the fieldbus coupler/controller starts with the configurations previously loaded into the EEPROM and the connection to the browser is interrupted.

If you changed the IP address previously, you have to use the changed IP address to access the device from the browser.

You have not changed the IP address and performed other settings; you can restore the connection by refreshing the browser.

11.9 MODBUS

Use the “MODBUS” HTML page to specify the settings for the MODBUS protocol.

Web-based Management

MODBUS Configuration

This page is for the configuration of Modbus features. The configuration is stored in an EEPROM. Changes of the multicast setup will take effect after the next software or hardware reset.
Changes of Modbus Configuration Registers and Modbus flag register blocking will take effect immediately after submit.

Modbus UDP Multicast Address Setup

Enable Multicast

Do not reply to Modbus UDP multicast messages

MCAST Address 1:	0.0.0.0	
MCAST Address 2:	0.0.0.0	
MCAST Address 3:	0.0.0.0	
MCAST Address 4:	0.0.0.0	
MCAST Address 5:	0.0.0.0	

Valid address range:
225.0.0.0 to 238.255.255.255

Modbus Configuration Registers

	Range	Enabled
	0x1028 - 0x1037:	<input checked="" type="checkbox"/>
	0x2040 - 0x2043:	<input checked="" type="checkbox"/>

Blocked Modbus Flag Registers

Range: 0x3000 - 0x5FFF

	Range Start	Range End	Enabled
1	0x0000	0x0000	<input type="checkbox"/>
2	0x0000	0x0000	<input type="checkbox"/>
3	0x0000	0x0000	<input type="checkbox"/>
4	0x0000	0x0000	<input type="checkbox"/>
5	0x0000	0x0000	<input type="checkbox"/>

Figure 96: WBM page “MODBUS”

Table 58: WBM Page “Modbus”

Modbus UDP Multicast Address Setup		
Entry	Default value	Description
Enable Multicast	<input type="checkbox"/>	<input checked="" type="checkbox"/> Enable Multicast for MODBUS UDP transmission. In addition to its own IP address, the fieldbus controller receives MODBUS commands for the following registered MCAST addresses.
		<input type="checkbox"/> Multicast for MODBUS UDP transmission is not enabled. The fieldbus controller receives MODBUS commands only for the own IP address.
Do not reply to Modbus UDP multicast messages	<input type="checkbox"/>	<input checked="" type="checkbox"/> The reply to Modbus UDP multicast messages is deactivated.
		<input type="checkbox"/> The reply to Modbus UDP multicast messages is activated.
MCAST Address 1 ... 5:	0.0.0.0	Multicast address 1... 5, for the multicast will be enabled. The valid address range is shown in the WBM. Multiple assigned addresses are not valid.
Modbus Configuration Registers		
Entry	Default value	Description
Range 0x1028 – 0x1037 0x2040 – 0x2043	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Enable MODBUS configuration register range.
	<input checked="" type="checkbox"/>	<input type="checkbox"/> Disable MODBUS configuration register range.
Blocked Modbus Flag Registers		
Entry 1 ... 5	Default value	Description
Range Start	0x0000	Start address for the blocked ModbusTCP register range.
Range End	0x0000	End address for the blocked ModbusTCP register range.
Enabled	<input type="checkbox"/>	<input checked="" type="checkbox"/> Requests to the blocked addresses of ModbusTCP flag register range are answered with the exception code 0x02 "Illegal Data Address". If a request is partially in the valid and partially in the restricted range, this is also answered with an exception.
		<input type="checkbox"/> The respective table entry is not considered.

Note



Multicast function only with a valid MCAST address active!

Activate the function “**Enable Multicast**”, without you enter an address not equal to 0.0.0.0, the function is automatically deactivated, after a click on the [SUBMIT] button.

If the function “**Enable Multicast**” is already enabled with valid addresses, you can not describe this MCAST address fields with invalid addresses, because of a click on the [SUBMIT] button resets to the last valid addresses. Thereby, the function “**Enable Multicast**” maintains its State.

11.10 KNX

Click the “KNX” link to access a Web site that provides KNX-specific information and standard KNX addresses.

Web-based Management

KNX Settings

This page is dedicated to the KNX configuration.

**KNX IP Controller
physical address configuration**

Format: x.y.z
The new values are stored in an EEPROM and changes will take effect immediately.

Router address	<input type="text" value="15.15.0"/>
Router tunneling address	<input type="text" value="15.15.254"/>
KNX IP Device address	<input type="text" value="15.15.255"/>

**KNX IP Controller
global configuration**

The new values are stored in an EEPROM and changes will take effect after the next software or hardware reset.

Enable transmission limit for KNX IP	<input checked="" type="checkbox"/>
Enable KNXnet/IP Router	<input checked="" type="checkbox"/>
Non-adaptive terminal bus speed	<input checked="" type="checkbox"/>

Figure 97: WBM page “KNX IP”

Table 59: WBM page “KNX”

KNX IP Controller / physical address configuration			
Entry	Default	Example	Description
Router address	15.15.0	1.1.0	Router address
Router tunneling address	15.15.255	1.1.254	Router tunneling address
KNX IP Device address	15.15.254	1.0.1	KNX IP Device address
KNX IP Controller / global configuration			
Entry	Default	Description	
Enable transmission limit for KNX IP	<input checked="" type="checkbox"/>	Routers can achieve a baud rate of 9,600 via twisted pair cables. This rate is considerably higher via ETHERNET	
		<input checked="" type="checkbox"/> The output via ETHERNET is limited to 9.600 Baud. This prevents a network overload.	
		<input type="checkbox"/> No Baud limitation	
Enable KNXnet/IP Router	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> The router function of the KNX IP controller is enabled.	
		<input type="checkbox"/> All connected KNX modules including the first one are operated in device mode.	
Non-adaptive terminal bus speed in ms	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> The transmission speed is constant and does not adjust to the node structure. This not only helps reduce the run-up time, but it also reduces the transmission rate.	
		<input type="checkbox"/> Remove the check mark to increase the transmission rate. The transmission speed adjusts to the node structure.	

11.11 PLC Info

The WBM page “PLC Info” contains information about the current CODESYS project. First, this information has to be registered in the CODESYS project under the menu “Project” → “Project Information”.

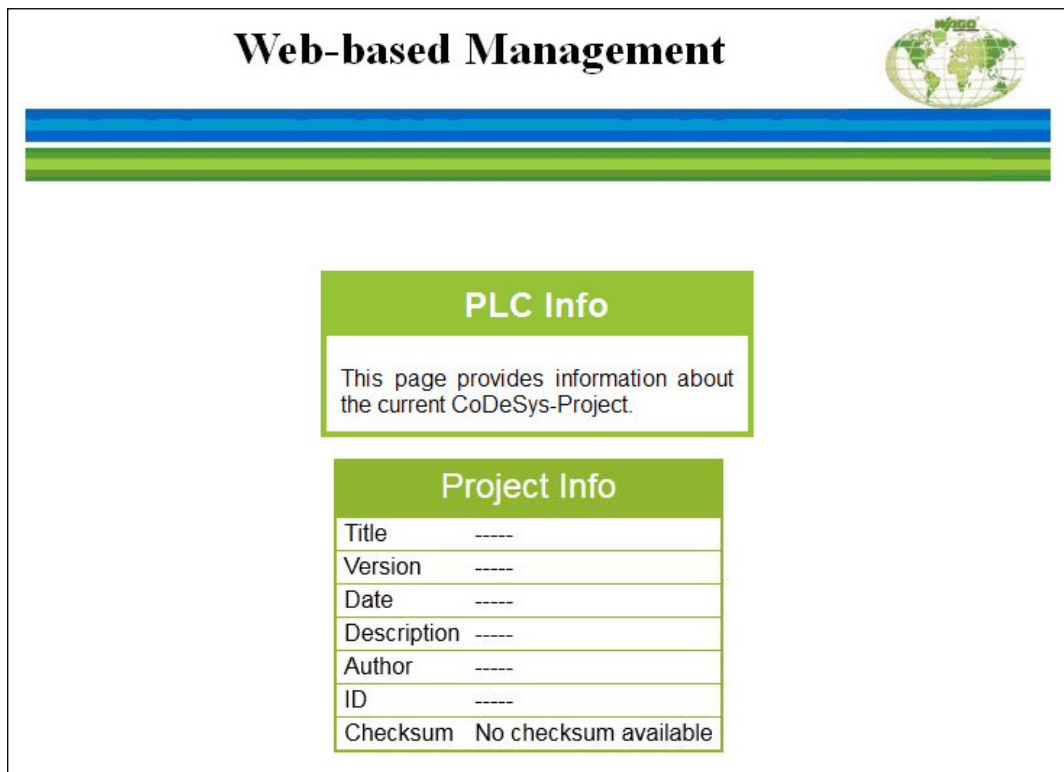


Figure 98: WBM page “PLC Info”

Table 60: WBM Page “PLC Info”

Project Info			
Entry	Default value	Value (Example)	Description
Title	_____	SSL Client Example	Name of project
Version	_____	1.0.0	Project version
Date	_____	15.05.2012 08:50:27	Date and Time of the project
Description	_____	Test client to establish SSL connections	Description
Author	_____	JW	Project author
ID	_____	70632	Project ID
Checksum	No checksum available		Checksum of the boot project on the fieldbus controller. The checksum is formed from the read-out data as unsigned long 32-bit number in little-endian format and displayed in decimal. If the file "default.chk" is not available, "No checksum available" appears.

11.12 PLC

Click the “PLC” link to access a Web site where you can define the PFC functionality settings for your controller.

Web-based Management

PLC Configuration

This page is for the configuration of the PLC. The configuration is stored in an EEPROM. Changes will take effect after the next software or hardware reset. For more information see the manual.

PLC Features

Function	Description	Enabled
Process image	Set outputs to zero, if user program is stopped.	<input checked="" type="checkbox"/>
WebVisu	Set 'webvisu.htm' as default.	<input type="radio"/>
	Open 'webvisu.htm' in frame.	<input type="radio"/>
	Open 'webvisu.htm' in new window.	<input checked="" type="radio"/>
I/O configuration	Compatible handling for ea-config.xml	<input type="checkbox"/>
	Insert monitoring entries into ea-config.xml	<input type="checkbox"/>

WARNING:
After changing the PLC root location you must download the boot project from the CoDeSys IDE. Otherwise, your PLC may malfunction or lose its program.

PLC Root Location

Internal File System	<input checked="" type="radio"/>
External SD memory card	<input type="radio"/>
SD card is not present .	

Figure 99: WBM page “PLC”



Note

Return to “WebVisu.htm” page via the IP address of the fieldbus controller!

The “Webvisu.htm” page does not have any hyperlinks to the other Web sites. To deactivate this starting page function, or to go to other pages using hyperlinks, enter the IP address for your controller and the address for the original starting page in the URL line of your browser with the following syntax:

<http://IP address of your controller/webserv/Index.ssi>

Table 61: WBM Page “PLC”

PLC Features		
Function	Default	Description
Process image	Set outputs to zero, if user program is stopped <input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Activate, if all outputs must be set at zero when stopping the user program
		<input type="checkbox"/> Disable, if all outputs must remain at the last current value when stopping the user program
WebVisu	Set 'webvisu.htm' as default <input type="radio"/>	<input checked="" type="radio"/> Activate, if the page “Webvisu.htm” must be opened as starting page when calling up WMB instead of the standard starting page "Status Information"
		<input type="radio"/> Activate, if the standard starting page “Status Information” must be opened when calling up WMB
	Open 'webvisu.htm' in frame <input type="radio"/>	<input checked="" type="radio"/> Activate, if the page “Webvisu.htm” must be opened in the same frame
		<input type="radio"/> Activate, if the page “Webvisu.htm” must be opened in another frame
	Open 'webvisu.htm' in new window <input checked="" type="radio"/>	<input checked="" type="radio"/> Activate, if the page “Webvisu.htm” must be opened in the same window
		<input type="radio"/> Activate, if the page “Webvisu.htm” must be opened in another window

Table: WBM Page “PLC”

PLC Features														
Function	Default	Description												
I/O configuration	Compatible handling for ea-config.xml <input type="checkbox"/>	<p>Activate, if the write authorizations must be assigned to the outputs of all bus terminals based on an existing file “ea-config.xml”.</p> <p>Here, note whether a control system configuration has already been created and, if so, whether this configuration is correct or incorrect (see the following table).</p> <p>The current process values are displayed on the website “IO config”, in addition to the displayed data channels.</p> <p><input checked="" type="checkbox"/></p>												
		<p>Disable, if the write authorizations must be assigned to the outputs of all bus terminals of the PLC</p> <p>Here, note whether a control system configuration has already been created and, if so, whether this configuration is correct or incorrect (see the following table).</p> <p><input type="checkbox"/></p>												
		<table border="1"> <thead> <tr> <th></th> <th>I/O configuration (function activated)</th> <th>I/O configuration (function deactivated, standard setting):</th> </tr> </thead> <tbody> <tr> <td> <p>No control system configuration has been created in the project</p> </td> <td> <p>Writing privileges to the outputs of all modules are assigned on the basis of an existing ea-config.xml.</p> <p>The ea-config.xml file must be completely error-free; otherwise the writing privileges for all modules will be assigned to the standard fieldbus.</p> </td> <td> <p>The outputs for all modules are assigned to the PLC. Any ea-config.xml file that may already be present is ignored and overwritten.</p> </td> </tr> <tr> <td> <p>Correct control system configuration has been created in the project</p> </td> <td colspan="2"> <p>Writing privileges to the module outputs is taken from the control system configuration. A corresponding ea-config.xml file is generated in the file system.</p> </td> </tr> <tr> <td> <p>Incorrect control system configuration has been created in the project</p> </td> <td colspan="2"> <p>The standard fieldbus is granted writing privileges to the outputs of all the modules.</p> </td> </tr> </tbody> </table>		I/O configuration (function activated)	I/O configuration (function deactivated, standard setting):	<p>No control system configuration has been created in the project</p>	<p>Writing privileges to the outputs of all modules are assigned on the basis of an existing ea-config.xml.</p> <p>The ea-config.xml file must be completely error-free; otherwise the writing privileges for all modules will be assigned to the standard fieldbus.</p>	<p>The outputs for all modules are assigned to the PLC. Any ea-config.xml file that may already be present is ignored and overwritten.</p>	<p>Correct control system configuration has been created in the project</p>	<p>Writing privileges to the module outputs is taken from the control system configuration. A corresponding ea-config.xml file is generated in the file system.</p>		<p>Incorrect control system configuration has been created in the project</p>	<p>The standard fieldbus is granted writing privileges to the outputs of all the modules.</p>	
			I/O configuration (function activated)	I/O configuration (function deactivated, standard setting):										
		<p>No control system configuration has been created in the project</p>	<p>Writing privileges to the outputs of all modules are assigned on the basis of an existing ea-config.xml.</p> <p>The ea-config.xml file must be completely error-free; otherwise the writing privileges for all modules will be assigned to the standard fieldbus.</p>	<p>The outputs for all modules are assigned to the PLC. Any ea-config.xml file that may already be present is ignored and overwritten.</p>										
		<p>Correct control system configuration has been created in the project</p>	<p>Writing privileges to the module outputs is taken from the control system configuration. A corresponding ea-config.xml file is generated in the file system.</p>											
	<p>Incorrect control system configuration has been created in the project</p>	<p>The standard fieldbus is granted writing privileges to the outputs of all the modules.</p>												
<p>Correct control system configuration has been created in the project</p>	<p>Writing privileges to the module outputs is taken from the control system configuration. A corresponding ea-config.xml file is generated in the file system.</p>													
<p>Incorrect control system configuration has been created in the project</p>	<p>The standard fieldbus is granted writing privileges to the outputs of all the modules.</p>													
<p>Insert monitoring entries into ea-config.xml <input type="checkbox"/></p>	<p>Activate to also display the current process values on the html page “IO config” for the displayed data channels.</p> <p><input checked="" type="checkbox"/></p>													
	<p>Disable, if no process values must be displayed on the html page “IO config”.</p> <p><input type="checkbox"/></p>													

PLC Root Location		
Function	Default value	Description
Internal File System	<input checked="" type="radio"/>	<p>Activate this function if all of the files related to the boot project and the WAGO-I/O-PRO application are to be saved to the internal file system in the future (A:\PLC).</p> <p><input checked="" type="radio"/> No files are copied from the SD card to the internal file system. The configuration stored on the internal drive will be used.</p>
		<p><input type="radio"/> This is deactivated when the option "External SD memory card" is selected.</p>
External SD memory card	<input type="radio"/>	<p>Activate this function if all of the files related to WebVisu, the boot project and the WAGO-I/O-PRO application are to be saved to the SD card in the future (S:\PLC).</p> <p><input checked="" type="radio"/> No files are copied from the internal file system to the SD card. The configuration stored on the SD card will be used.</p>
		<p><input type="radio"/> This is deactivated when the option "Internal File System" is selected.</p>

Note



Provide sufficient storage space for PLC folders!

The following can occur when there is less free storage space on the SD card than is normally required for the PLC folder and the files it contains:

- The files "webvisu.htm" and "error_ini.xml" are created without any content, meaning that the WBM page "WebVisu" is blank.
- The files "webvisu.htm" and "error_ini.xml" are created but are incomplete. In either case, this condition remains until the entire "PLC" folder is deleted and sufficient storage space made available.

The function "PLC Root Location" remains set to "External SD memory card".

Note



Only the "PLC" and "KNX" folder is affected by the switchover!

Note that the selection of the data storage location is always limited to the "PLC" and "KNX" directories, while all other directories and the WBM pages retain their settings.

The "PLC" and "KNX" directories are not deleted.

A distinction must be drawn between the following cases when changing the options for storage from the internal file system to storage on the SD card:

- **SD card not inserted:**
You have selected the option "External SD memory card" and clicked the button [SUBMIT]. Error code 10-1 is output via the IO LED.

- **Empty SD card inserted:**
You have selected the option **“External SD memory card”**, clicked the button **[SUBMIT]** and have restarted the fieldbus controller; the directories **“S:\PLC”** and **“KNX”** are created automatically on the SD card and the standard files **“webvisu.htm”** and **"error_ini.xml"** are extracted to the directory **“PLC”**.
- **Inserted SD card is already written:**
You have selected the option **“External SD memory card”** and clicked the button **[SUBMIT]**. The PLC program is started from the SD card, provided a boot project exists on the SD card and the start/stop switch is at the proper position.

11.13 Features

Use the “Features” HTML page to enable or disable additional functions.

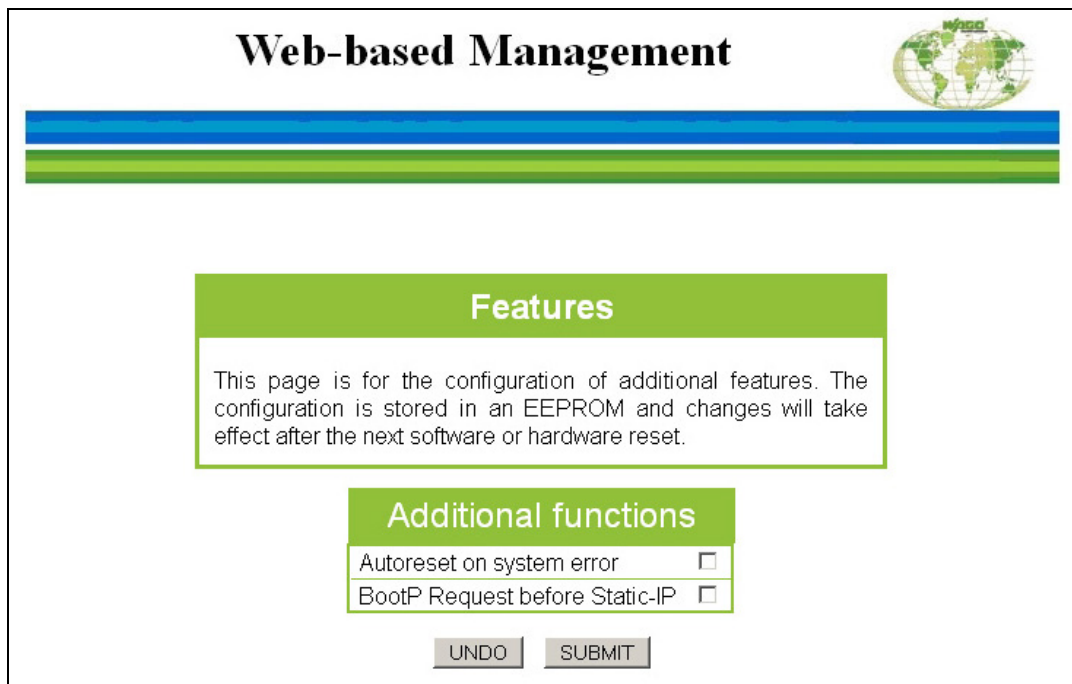


Figure 100: WBM page “Features”

Table 62: WBM page "Features"

Additional functions		
Entry	Default	Description
Autoreset on system error	<input type="checkbox"/>	<input checked="" type="checkbox"/> enables an automatic software reset to be conducted when a system error occurs
		<input type="checkbox"/> disables an automatic software reset to be conducted when a system error occurs
BootP Request before Static-IP	<input type="checkbox"/>	<input checked="" type="checkbox"/> Automatically set the static IP address enabled. For this configuration, the fieldbus coupler uses an automatically, statically configured IP address if the request via BootP fails.
		<input type="checkbox"/> Automatically set the static IP address disabled. For this configuration, the IP address request via BootP is repeated in the event of error.

11.14 I/O Config

Click the link “I/O Config” to view the configuration and/or write access privileges for the outputs of your fieldbus node.

The node structure created using the “WAGO-I/O-PRO I/O Configurator” hardware configuration tool is displayed in the window. If no modules are shown in this window, no hardware configuration and, thus, no allocation of write access privileges have been assigned. In this case, the handling defined at the Web site “PLC” by the function “I/O configuration - Compatible handling for ea-config.xml” will be applied to assign the write privileges for all outputs either to the standard fieldbus, or to the PLC.

Web-based Management

I/O configuration

Configuration details

Number of modules on terminalbus	4
Number of modules in I/O configuration	4

I/O configuration file

Pos	Module	Type	Mapping
1	750-5xx	2DO	Fieldbus 1
	M001Ch1		0
	M001Ch2		0
2	750-5xx	4DO/DIA	Fieldbus 1
	M002Ch1		0
	M002Ch2		0
	M002Ch3		0
	M002Ch4		0
	M002Ch5		0
	M002Ch6		0
3	750-467/000-000	2AI	Fieldbus 1
	M003Ch1		0x0000
	M003Ch2		0x0000
4	750-556/000-000	2AO	Fieldbus 1
	M004Ch1		0x0000
	M004Ch2		0x0000

Figure 101: WBM page “I/O Config”

Information



Additional Information

For more detailed information about the WAGO-I/O-PRO I/O Configurator, refer to the Section “Startup of Fieldbus Node”.

When the function “I/O configuration Insert monitoring entries into ea-config.xml” is also activated at the Web site “PLC”, the current process values will also be shown for the data channels that are displayed.

Table 63: WBM Page “I/O Config”

Configuration details		
Entry	Value (Example)	Description
Number of modules on terminal bus	5	Number of I/O modules (hardware)
Number of modules in I/O configuration	5	Number of I/O modules in the hardware configuration of the I/O
[create ea-config.xml]	-	Writes the current bus terminal structure and the field bus assignment in the „ea-config.xml” file.
I/O configuration file		
Entry	Value (Example)	Description
Pos	1	Position of the I/O module in the hardware
Module	750-4xx M001Ch1 M001Ch2	Product number of the integrated I/O module M = module, 001 = position 1, Ch1 = channel 1 M = module, 002 = position 2, Ch2 = channel 2
Type	2DI	I/O module type, e.g. 2 DI (2 Channel Digital Input Module)
Mapping	Fieldbus 3	Mapping via PLC, fieldbus 1 etc. (Entries depend on the coupler/controller, see WAGO-I/O-PRO under control parameters/module parameters)

Note



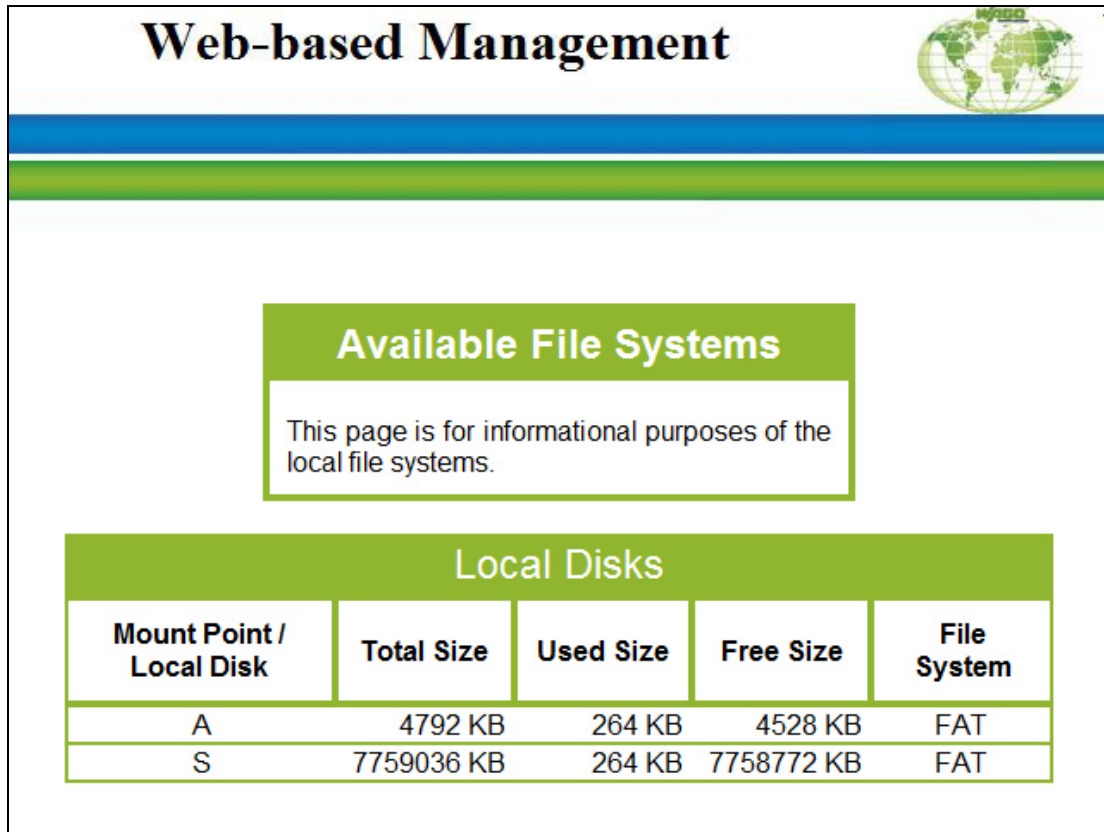
Enter I/O modules in the I/O Configurator!

Enter the I/O modules used in the I/O configurator of WAGO-I/O-PRO. Here, open the **Control Configuration** in the **Resources** register and add your I/O modules to the I/O module figure.

The added I/O modules must match the hardware in sequence and quantity. The entries “Number of modules on terminalbus” and “Number of modules in I/O configuration” on the html page “I/O Config” serve as control.

11.15 Disk Info

Information about the internal drive is given on the “Disk Info” page. Additional information about the SD card is also displayed there when the SD card is inserted.



Local Disks				
Mount Point / Local Disk	Total Size	Used Size	Free Size	File System
A	4792 KB	264 KB	4528 KB	FAT
S	7759036 KB	264 KB	7758772 KB	FAT

Figure 102: WBM page “Disk-Info”

Table 64: WBM Page “Disk Info”

Local Disks		
Entry	Value (Example)	Description
Mount Point/Local Disk	A	Directory - A: internal memory - S: removable disk
Total Size	1868 KB	Total size of the file system
Used Size	172 KB	Used memory capacity
Free Size	1696 KB	Free memory capacity
File System	FAT	File system (File Allocation Table)

11.16 SD Card

On the “SD Card” HTML page, you can find information about the memory card used, as well as delete the content of the “PLC” folder or create the “PLC” folder on the memory card via two buttons.

Web-based Management

SD Card

This page contains SD card info and tools.

SD Card Info

Description	Value
Card Serial Number:	76169405
Card Name:	SAMSUNG_8GB
Free card space:	7.4 GB
Configuration file S:\settings\750-8xx.xml is present.	

Tools

Description	Command	Status
Delete PLC folder contents	<input type="button" value="START"/>	READY
Create PLC folder in SD root directory	<input type="button" value="START"/>	READY

Figure 103: WBM Page “SD Card”

Table 65: WBM Page “SD Card”


SD Card Info			
Entry	Default	Value (example)	Description
Card Serial Number	_____	76169405	Serial number of the memory card
Card Name	_____	SAMSUNG_ 8 GB	Designation of the memory card
Free Card Space	_____	7.4 GB	Available space on the memory card
		Configuration file S:\settings\750-88x.xml is present.	Status message if the configuration file is on the memory card.
Tools			
Entry	Button	Status (Example)	Description
Delete PLC folder contents	[START]	READY	Delete the content in the “PLC” folder
Create PLC folder in SD root directory	[START]	READY	Create the “PLC” folder in the root directory of the memory card if it does not already exist with subsequent extraction of the webvisu.htm and error_ini.xml default files.

11.17 Backup & Restore

On the “Backup & Restore” HTML page, configure the settings to back up and restore device data.

Use an SD card to transfer device data from one fieldbus controller to one or more other fieldbus controller.

Web-based Management



Backup & Restore

This page is for the configuration of backup & restore functionality.

Services

Command	Description	Status
<input type="button" value="START"/>	Backup ALL device settings to removable disk (77 kB needed).	OK
<input type="button" value="START"/>	Restore device settings from removable disk using the option settings below.	OK

Restore Option Setting

Setting	Description
<input checked="" type="checkbox"/>	Autorestore Global Enable This option will be disabled after the next reboot if the following option is set to next reboot only
<input checked="" type="radio"/>	Restore settings from SD card on next reboot only
<input type="radio"/>	Always restore settings from SD card on reboot
<input checked="" type="checkbox"/>	IP address, dip switch IP address, network mask, domain name, host name, gateway, DNS servers, auto reset on system error, BOOTP request before static IP
<input checked="" type="checkbox"/>	Ports, security, time server, multicast settings, blocked Modbus flag registers, MAC filter, Ethernet hardware settings
<input checked="" type="checkbox"/>	PLC settings, PLC folder and subfolders, boot project, ETC folder and web visualisation
<input checked="" type="checkbox"/>	Non-volatile memory
<input checked="" type="checkbox"/>	KNX configuration
<input checked="" type="checkbox"/>	File system
<input checked="" type="checkbox"/>	Watchdog, trace settings, SNMP, clock settings

Figure 104: WBM page “Backup & Restore”

Table 66: WBM Page “Backup & Restore”

Services		
Entry	Button	Description
Backup ALL device settings to removable disk (160 kB needed).	[START]	Save all device's internal data and settings to SD card. Under the entry "Status" the status signal is displayed.
Restore device settings from removable disk using the option settings below.	[START]	Taking into account the choosen settings, which are listed below under "Restore Option Setting", the device's internal data and settings loading from the SD card to the device. Under the entry "Status" the status signal is displayed.
Entry	Status Signal	Description
Status	OK	Storage completed (Backup).
	DONE	Loading completed (Restore).
	ERROR(1)	The source location for synchronization doesn't exist.
	ERROR(2)	The EEPROM settings have been modified.
	ERROR(10)	Memory card is full.
	ERROR(11)	There is no target memory left for function execution.
	ERROR(12)	The length of an absolute path exceeds the buffer size.
	ERROR(20)	No access to the source file.
	ERROR(21)	No access to the target file.
	ERROR(30)	An error occurred during reading directory content.
	ERROR(31)	An error occurred creating a (sub)directory.
	ERROR(32)	The source or target location for synchronization is invalid.
	ERROR(40)	No access to the EEPROM.
	ERROR(41)	The parameter block table is invalid.
	ERROR(42)	The file length is different from the size of the NOVRAM.
ERROR(43)	No access to the NOVRAM file.	
Restore Option Setting		
Entry	Value (Default)	Description
Autorestore Global Enable This option will be disabled after the next reboot if the following option is set to next reboot only	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Device data is loaded from the SD card when restarting.
		<input type="checkbox"/> No device data is loaded from the SD card when restarting. If the „Only load at next restart” setting is enabled, this option is automatically disabled.
- Restore settings from SD card on next reboot only	<input checked="" type="radio"/>	Data is only loaded from the SD card after the device is restarted.
- Always restore settings from SD card on reboot	<input type="radio"/>	Data is loaded from the SD card each time the device is restarted.

IP address, dip switch IP address, network mask, domain name, host name, gateway, DNS servers, auto reset on system error, BOOTP request before static IP, non-adaptive Kbus speed	☑	<input checked="" type="checkbox"/> The most important startup settings such as IP addresses, etc. are loaded.
		<input type="checkbox"/> The specified IP settings are not loaded.
Ports, security, time server, multicast settings, blocked Modbus flag registers, MAC filter, Ethernet hardware settings	☑	<input checked="" type="checkbox"/> Protocol and network settings are loaded from the SD card.
		<input type="checkbox"/> The specified protocol and network settings are not loaded.
PLC settings, PLC folder und subfolders, boot project, ETC folder and web visualization	☑	<input checked="" type="checkbox"/> PLC settings, boot project, ETC files and pages of the Web-based Management System are loaded.
		<input type="checkbox"/> The specified settings are not loaded.
Non-volatile memory	☑	<input checked="" type="checkbox"/> Non-volatile memory is loaded.
		<input type="checkbox"/> Non-volatile memory is not loaded.
KNX configuration	☑	<input checked="" type="checkbox"/> KNX configuration data is loaded.
		<input type="checkbox"/> No KNX configuration data is loaded.
File system	☑	<input checked="" type="checkbox"/> User files and folders stored in the file system are loaded from the SD card.
		<input type="checkbox"/> No user files and folders stored in the file system are loaded from the SD card.
Watchdog, trace settings, SnpM, Ethernet/IP padding, clock settings	☑	<input checked="" type="checkbox"/> Watchdog, trace, SNMP, Ethernet/IP padding and time settings are loaded from the SD card.
		<input type="checkbox"/> No Watchdog, trace, SNMP, Ethernet/IP padding and time settings are loaded from the SD card.

Note



Note about using a memory card with an empty “Backup” directory!

Please note the following before inserting a memory card with an empty "Backup" directory in the fieldbus controller:

If the PLC root location is set to “External SD memory card”, then disable the “Autorestore Global Enable” function before inserting the memory card and before switching on the fieldbus controller in WBM on the “Backup & Restore” page.

Otherwise, the I/O LED will output the error god 14/7 (“Restore function failed!”).

11.18 WebVisu

The visualization of your programmed application is displayed on the html page “WebVisu”, provided you have created it with the visualization editor in WAGO-I/O-PRO and loaded it into the controller.

Perform the following settings in WAGO-I/O-PRO, so that an html page with your visualization is automatically created at the transmission of your project:

1. Double click to open the **Target System Settings** in the **Resource** register.
2. Open the **Visualization** register.
3. Select the **Web Visualization** option with a hatch mark.
4. Confirm with **OK**.

A link is then created to this html page “WebVisu” by the Web-based Management system. You can set the html page “WebVisu” as the starting page.

1. Call up the page “PLC” in the web-based Management-System.
2. a.) To set the HTML page “WebVisu” as the start page, use the function **WebVisu – Set 'webvisu.htm' as default**. When accessing the web-based management system, the “WebVisu” page is opened instead of the default WBM start page “Information”. However, the links to switch to the other WBM pages is then no longer available.

Note



Returning to the “WebVisu.htm” page is only possible via the IP address of the fieldbus controller!

The “Webvisu.htm” page does not have any hyperlinks to other Web sites. To deactivate the starting page function again, or to go to other pages using hyperlinks, enter the IP address for your controller and the address for the original starting page in the URL line of your browser with the following syntax:

<http://IP address of your controller/webserv/Index.ssi>.

- b.) To call up the the HTML page “WebVisu” in an eternal window (default setting), use the function **WebVisu – Open 'webvisu.htm' in new window**. Clicking on the “WebVisu” link opens a new window that displays the HTML page with visualization of your configured application. The links to switch to the other WBM pages are still available with this setting.
- c.) To call up the HTML page “WebVisu” on the WBM site directly, use the function **WebVisu – Open 'webvisu.htm' in frame**. Clicking on the “WebVisu” link opens the HTML page with visualization of your configured application in a frame in the WBM window directly. The

links to switch to the other WBM pages are still available with this setting.



Figure 105: WBM page “WebVisu”

12 Diagnostics

12.1 LED Signaling

For on-site diagnostics, the fieldbus controller has several LEDs that indicate the operational status of the fieldbus controller or the entire node (see following figure).

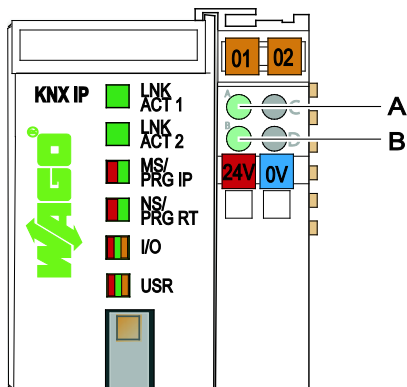


Figure 106: Display Elements

The diagnostics displays and their significance are explained in detail in the following section.

The LEDs are assigned in groups to the various diagnostics areas:

Table 67: LED Assignment for Diagnostics

Diagnostics area	LEDs
Fieldbus status	<ul style="list-style-type: none"> • LNK/ACT 1 • LNK/ACT 2 • MS/PRG IP • NS/PRG RT
Node status	<ul style="list-style-type: none"> • I/O • USR
SD memory card status	<ul style="list-style-type: none"> • SD
Status Supply Voltage	<ul style="list-style-type: none"> • A (system supply) • B (field supply)

12.1.1 Evaluating Fieldbus Status

The communication status via ETHERNET is indicated by the top group of LEDs (“LNK/ACT 1” and “LNK/ACT 2”).

The two-colored LEDs “MS/PRG IP” (device) and “NS/PRG RT” (router) are used by the KNXnet/IP and MODBUS protocol.

Table 68: Fieldbus Diagnostics – Solution in Event of Error

LED status	Meaning	Solution
LNK/ACT 1		
green	Link to a physical network available at Port 1	-
green flashing	Data traffic at Port 1	-
off	Fieldbus node has no link to the physical network at Port 1	Check fieldbus cable.
LNK/ACT 2		
green	Link to a physical network available at Port 2	-
green flashing	Data traffic at Port 2	-
off	Fieldbus node has no link to the physical network at Port 2	Check fieldbus cable.
MS/PRG IP		
green	System operating correctly.	-
green flashing	System is not yet configured.	-
red	The system exhibits an unrecoverable error.	Restart the bus coupler by turning the power supply off and on again. Please contact I/O Support if the error continues.
	<u>After pressing the PRG-RT button:</u> KNX programming mode activated for the KNXnet/IP device	Unit shut down by ETS or by pressing the PRG-RT button.
red/green flashing	Self test	-
off	No power available for the system.	Check cabling.
NS/PRG RT		
green	At least one connection (MODBUS/TCP) has been set up.	-
green flashing	There is no connection (MODBUS/TCP).	-
red	The system has detected an IP address that is used twice.	Select an IP address that has not yet been assigned.
	<u>After pressing the PRG-RT button:</u> KNX programming mode activated for the KNXnet/IP router	Unit shut down by ETS or by pressing the PRG-RT button.
red flashing	At least one connection (MODBUS/TCP) has reported a timeout at which the controller functions as a target.	Set up the connection again.

Table 68: Fieldbus Diagnostics – Solution in Event of Error

LED status	Meaning	Solution
red/green flashing	Self test	-
off	No IP address has been assigned to the system.	Assign an IP address to the system, for example using BootP, DHCP or using the Ethernet settings software.

12.1.2 Evaluating Node Status – I/O LED (Blink Code Table)

The communication status between fieldbus coupler/controller and the I/O modules is indicated by the I/O LED.

Table 69: Node Status Diagnostics – Solution in Event of Error

LED Status	Meaning	Solution
I/O		
green	The fieldbus node is operating correctly.	Normal operation.
green flashing	The fieldbus controller is in Bootstrap loader mode.	Change the position of the operating mode switch from the bottom to the top position.
orange flashing	Start of the firmware. 1 ... 2 seconds of rapid flashing indicate start-up.	-
red	Fieldbus coupler/controller hardware defect	Replace the fieldbus coupler/controller.
red flashing	Flashing with approx. 10 Hz indicates the initialization of the internal bus or of a internal bus error.	Note the following flashing sequence.
red cyclical flashing	Up to three successive flashing sequences indicate internal data bus errors. There are short intervals between the sequences.	Evaluate the flashing sequences based on the following blink code table. The blinking indicates an error message comprised of an error code and error argument.
off	No data cycle on the internal bus.	The fieldbus coupler/controller supply is off.

Device boot-up occurs after turning on the power supply. The I/O LED flashes orange.

Then the bus is initialized. This is indicated by flashing red at 10 Hz for 1 ... 2 seconds.

After a trouble-free initialization, the I/O LED is green.

In the event of an error, the I/O LED continues to blink red. Blink codes indicate detailed error messages. An error is indicated cyclically by up to 3 flashing sequences.

After elimination of the error, restart the node by turning the power supply of the device off and on again.

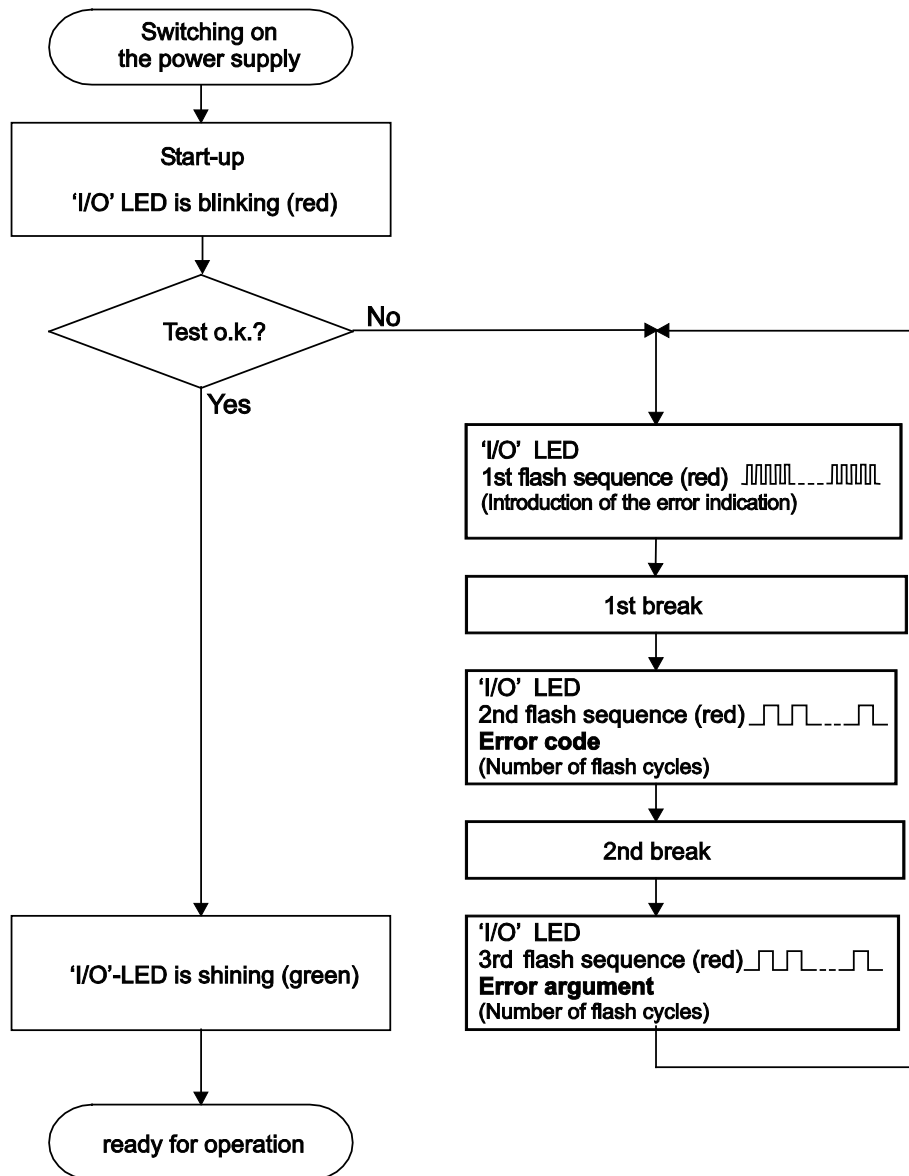


Figure 107: Node Status – I/O LED Signaling

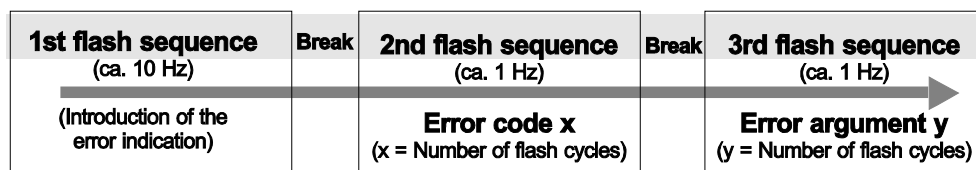


Figure 108: Error Message Coding

Example of a module error:

- The I/O LED starts the error display with the first flashing sequence (approx. 10 Hz).
- After the first break, the second flashing sequence starts (approx. 1 Hz): The I/O LED blinks four times. Error code 4 indicates “data error internal data bus”.

- After the second break, the third flashing sequence starts (approx. 1 Hz):
The I/O LED blinks twelve times.
Error argument 12 means that the internal data bus is interrupted behind the twelfth I/O module.

The thirteenth I/O module is either defective or has been pulled out of the assembly.

Table 70: Blink Code Table for the I/O LED Signaling, Error Code 1

Error code 1: "Hardware and configuration error"		
Error Argument	Error Description	Solution
1	Overflow of the internal buffer memory for the attached I/O modules.	<ol style="list-style-type: none"> 1. Turn off the power for the node. 2. Reduce the number of I/O modules. 3. Turn the power supply on again. 4. If the error persists, replace the fieldbus controller.
2	I/O module(s) with unknown data type	<ol style="list-style-type: none"> 1. Determine the faulty I/O module by first turning off the power supply. 2. Plug the end module into the middle of the node. 3. Turn the power supply on again. 4. - LED continues to flash? - Turn off the power supply and plug the end module into the middle of the first half of the node (toward the fieldbus controller). - LED not flashing? - Turn off the power and plug the end module into the middle of the second half of the node (away from the fieldbus controller). 5. Turn the power supply on again. 6. Repeat the procedure described in step 4 while halving the step size until the faulty I/O module is detected. 7. Replace the faulty I/O module. 8. Inquire about a firmware update for the fieldbus controller.
3	Invalid check sum in the parameter area of the fieldbus controller.	<ol style="list-style-type: none"> 1. Turn off the power supply for the node. 2. Replace the fieldbus controller. 3. Turn the power supply on again.
4	Fault when writing in the serial EEPROM.	<ol style="list-style-type: none"> 1. Turn off the power supply for the node. 2. Replace the fieldbus controller. 3. Turn the power supply on again.
5	Fault when reading the serial EEPROM	<ol style="list-style-type: none"> 1. Turn off the power supply for the node. 2. Replace the fieldbus controller. 3. Turn the power supply on again.
6	The I/O module configuration after AUTORESET differs from the configuration determined the last time the fieldbus controller was powered up.	<ol style="list-style-type: none"> 1. Restart the fieldbus controller by turning the power supply off and on.
7	Invalid hardware-firmware combination.	<ol style="list-style-type: none"> 1. Turn off the power supply for the node. 2. Replace the fieldbus controller. 3. Turn the power supply on again.

Table 70: Blink Code Table for the I/O LED Signaling, Error Code 1

Error code 1: "Hardware and configuration error"		
Error Argument	Error Description	Solution
8	Timeout during serial EEPROM access.	<ol style="list-style-type: none"> 1. Turn off the power supply for the node. 2. Replace the fieldbus controller. 3. Turn the power supply on again.
9	Bus controller initialization error	<ol style="list-style-type: none"> 1. Turn off the power supply for the node. 2. Replace the fieldbus controller. 3. Turn the power supply on again.
10	Buffer power failure real-time clock (RTC)	<ol style="list-style-type: none"> 1. Set the clock. 2. Maintain the power supply of the fieldbus controller for at least 15 minutes in order to charge the Goldcap capacitor.
11	Fault during read access to the real-time clock (RTC)	<ol style="list-style-type: none"> 1. Set the clock. 2. Maintain the power supply of the fieldbus controller for at least 15 minutes in order to charge the Goldcap capacitor.
12	Fault during write access to the real-time clock (RTC)	<ol style="list-style-type: none"> 1. Set the clock. 2. Maintain the power supply of the fieldbus controller for at least 15 minutes in order to charge the Goldcap capacitor.
13	Clock interrupt fault	<ol style="list-style-type: none"> 1. Set the clock. 2. Maintain the power supply of the fieldbus controller for at least 15 minutes in order to charge the Goldcap capacitor.
14	Maximum number of gateway or mailbox modules exceeded	<ol style="list-style-type: none"> 1. Turn off the power for the node. 2. Reduce the number of corresponding modules to a valid number.

Table 71: Blink Code Table for the I/O LED Signaling, Error Code 2

Error code 2: "Exceeded Process Image"		
Error Argument	Error Description	Solution
1	Not used	-
2	Process image is too large.	<ol style="list-style-type: none"> 1. Turn off the power supply of the node. 2. Reduce number of I/O modules. 3. Turn the power supply on.

Table 72: Blink Code Table for the I/O LED Signaling, Error Code 3

Error code 3: "Protocol error, internal bus"		
Error Argument	Error Description	Solution
-	Internal data bus communication is faulty, defective module cannot be identified.	<p>- Are passive power supply modules (750-613) located in the node? -</p> <ol style="list-style-type: none"> 1. Check that these modules are supplied correctly with power. 2. Determine this by the state of the associated status LEDs. <p>- Are all modules connected correctly or are there any 750-613 Modules in the node? -</p> <ol style="list-style-type: none"> 1. Determine the faulty I/O module by turning off the power supply. 2. Plug the end module into the middle of the node. 3. Turn the power supply on again. 4. - LED continues to flash? - Turn off the power supply and plug the end module into the middle of the first half of the node (toward the fieldbus controller). - LED not flashing? - Turn off the power and plug the end module into the middle of the second half of the node (away from the fieldbus controller). 5. Turn the power supply on again. 6. Repeat the procedure described in step 4 while halving the step size until the faulty I/O module is detected. 7. Replace the faulty I/O module. 8. If there is only one I/O module on the fieldbus controller and the LED is flashing, either the I/O module or fieldbus controller is defective. 9. Replace the defective component.

Table 73: Blink Code Table for the I/O LED Signaling, Error Code 4

Error code 4: “Physical error, internal bus”		
Error Argument	Error Description	Solution
-	Internal bus data transmission error or interruption of the internal data bus at the fieldbus controller	<ol style="list-style-type: none"> 1. Turn off the power supply to the node. 2. Plug in an end module behind the fieldbus controller. 3. Turn the power supply on. 4. Observe the error argument signaled. <p>- Is no error argument indicated by the I/O LED? -</p> <ol style="list-style-type: none"> 5. Replace the fieldbus controller. <p>- Is an error argument indicated by the I/O LED? -</p> <ol style="list-style-type: none"> 5. Identify the faulty I/O module by turning off the power supply. 6. Plug the end module into the middle of the node. 7. Turn the power supply on again. 8. - LED continues to flash? - Turn off the power and plug the end module into the middle of the first half of the node (toward the fieldbus controller). - LED not flashing? - Turn off the power and plug the end module into the middle of the second half of the node (away from the fieldbus controller). 9. Turn the power supply on again. 10. Repeat the procedure described in step 6 while halving the step size until the faulty I/O module is detected. 11. Replace the faulty I/O module. 12. If there is only one I/O module on the fieldbus controller and the LED is flashing, either the I/O module or fieldbus controller is defective. 13. Replace the defective component.
n*	Interruption of the internal data bus behind the nth bus module with process data, the maximum supported number is reached, the following modules are no longer supported.	<ol style="list-style-type: none"> 1. Turn off the power supply of the node. 2. Reduce number of I/O modules. 3. Turn the power supply on.

* The number of light pulses (n) indicates the position of the I/O module.
I/O modules without data are not counted (e.g., supply modules without diagnostics)

Table 74: Blink Code Table for the I/O LED Signaling, Error Code 5

Error code 5: “Initialization error, internal bus”		
Error Argument	Error Description	Solution
n*	Error in register communication during internal bus initialization	<ol style="list-style-type: none"> 1. Turn off the power supply to the node. 2. Replace the (n+1) I/O module containing process data. 3. Turn the power supply on.

* The number of light pulses (n) indicates the position of the I/O module.
I/O modules without data are not counted (e.g., supply modules without diagnostics)

Table 75: Blink Code Table for the I/O LED Signaling, Error Code 6

Error code 6: "Fieldbus specific errors"		
Error Argument	Error description	Solution
1	Invalid MACID	<ol style="list-style-type: none"> 1. Turn off the power supply of the node. 2. Exchange fieldbus controller. 3. Turn the power supply on again.
2	Ethernet Hardware initialization error	<ol style="list-style-type: none"> 1. Restart the fieldbus controller by turning the power supply off and on again. 2. If the error still exists, exchange the fieldbus controller.
3	TCP/IP initialization error	<ol style="list-style-type: none"> 1. Restart the fieldbus coupler by turning the power supply off and on again. 2. If the error still exists, exchange the bus coupler.
4	Network configuration error (no IP Address)	<ol style="list-style-type: none"> 1. Check the settings of BootP server.
5	Application protocol initialization error	<ol style="list-style-type: none"> 1. Restart the fieldbus coupler by turning the power supply off and on again. 2. If the error still exists, exchange the bus coupler.
6	Process image is too large	<ol style="list-style-type: none"> 1. Turn off the power supply of the node. 2. Reduce number of I/O modules
7	Double IP address in network	<ol style="list-style-type: none"> 1. Change configuration. Use another IP address, which is not yet present in network. 2. Restart the fieldbus coupler by turning the power supply off and on again.
8	Error when building the process image	<ol style="list-style-type: none"> 1. Turn off the power supply of the node. 2. Reduce number of I/O modules 3. Restart the fieldbus coupler by turning the power supply off and on again. 4. If the error still exists, exchange the bus coupler.
9	Error with mapping between bus modules and fieldbus	<ol style="list-style-type: none"> 1. Check EA-Config.xml file on the fieldbus controller

10	-	Not used
11	Global initialization error in the KNX section	<ol style="list-style-type: none"> Restart the bus coupler by turning the power supply off and on again. If the error persists, please contact I/O support.
12	Global runtime error in the KNX section	<ol style="list-style-type: none"> Restart the bus coupler by turning the power supply off and on again. If the error persists, please contact I/O support.
13	Initialization error on startup of the KNXnet/IP router	<ol style="list-style-type: none"> Restart the bus coupler by turning the power supply off and on again. If the error persists, please contact I/O support.
14	Initialization error on startup of the KNX IP device	<ol style="list-style-type: none"> Restart the bus coupler by turning the power supply off and on again. Should this error persist, contact I/O support.
15	Runtime error in the KNX/IP router	<ol style="list-style-type: none"> Restart the bus coupler by turning the power supply off and on again. If the error persists, please contact I/O support.
16	Runtime error in KNX IP device	<ol style="list-style-type: none"> Restart the bus coupler by turning the power supply off and on again. If the error persists, please contact I/O support.
17	Reception timeout during communication with the KNXnet/IP router module	<ol style="list-style-type: none"> Check both your device configuration (e.g., SPS-PRG) and the bus load on KNX TP. Should this error persist, contact I/O support.
18	Transmission timeout during communication with the KNXnet/IP router module	<ol style="list-style-type: none"> Check both your device configuration (e.g., SPS-PRG) and the bus load on KNX TP. Should this error persist, contact I/O Support.
19	Error when accessing the KNX configuration files of the KNXnet/IP router or KNX IP device	<p>If "PLC root" external (SD card):</p> <ol style="list-style-type: none"> Remove the memory card and if necessary, disable write protection. Insert the memory card again. Restart the access function. If the error continues, replace the memory card. Restart the access function. If the error continues, please contact I/O Support. <p>If "PLC root" internal:</p> <ol style="list-style-type: none"> Restart the bus coupler by turning the power supply off and on again. If the error persists, please contact I/O support.

Table 76: Blink Code Table for the I/O LED Signaling, Error Code 7

Error code 7: "Not supported I/O module"		
Error Argument	Error Description	Solution
n	First unsupported I/O module in place of n.	<ol style="list-style-type: none"> Turn off the power supply to the node. Replace the nth I/O module containing process data or reduce the number of modules to the number of n-1. Turn the power supply on.

Table 77: Blink Code Table for the I/O LED Signaling, Error Code 8 ... 9

Error code 8 ... 9 –not used–		
Error Argument	Error Description	Solution
-	not used	-

Table 78: Blink Code Table for the I/O LED Signaling, Error Code 10

Error code 10: "PLC program fault"		
Error Argument	Error Description	Solution
1	Error when implementing the PFC run time system	<ol style="list-style-type: none"> 1. Plug the SD card into the fieldbus controller. 2. Restart the fieldbus controller by turning the power supply off and on again. 3. If the error still exists, please contact the I/O Support.
2	Error when generating the PFC inline code	<ol style="list-style-type: none"> 1. Restart the fieldbus controller by turning the power supply off and on again. 2. If the error still exists, please contact the I/O Support.
3	An IEC task exceeded the maximum running time or the sampling interval of the IEC task could not be kept (Watchdog)	<ol style="list-style-type: none"> 1. Check the task configuration concerning the adjusted sampling intervals and watchdog times.
4	PFC Web-Visualization initialization error	<ol style="list-style-type: none"> 1. Restart the fieldbus controller by turning the power supply off and on again. 2. If the error still exists, please accomplish a reset (origin) in <i>WAGO-I/O-PRO</i>. 3. Compile the project again. 4. Transfer the project to the controller.
5	Error when synchronizing the PLC configuration with the internal data bus	<ol style="list-style-type: none"> 1. Check the information of the connected modules in the PLC configuration of <i>WAGO-I/O-PRO</i>. 2. Compare this information with the modules that are actually connected. 3. Compile the project again. 4. Transfer the project to the controller.

Table 79: Blink Code Table for the I/O LED Signaling, Error Code 11

Error code 11: "Gateway-/Mailbox I/O module fault"		
Error Argument	Error Description	Solution
1	Maximum number of Gateway modules exceeded	<ol style="list-style-type: none"> 1. Turn off the power supply of the node. 2. Reduce number of Gateway modules. 3. Turn the power supply on again.
2	Maximum size of Mailbox exceeded	<ol style="list-style-type: none"> 1. Turn off the power supply of the node. 2. Reduce the Mailbox size. 3. Turn the power supply on again.
3	Maximum size of process image exceeded due to the put Gateway modules	<ol style="list-style-type: none"> 1. Turn off the power supply of the node. 2. Reduce the data width of the Gateway modules. 3. Turn the power supply on again.

* The number of blink pulses (n) indicates the position of the I/O module.
I/O modules without data are not counted (e.g. supply module without diagnosis)

Table 80: Blink Code Table for the I/O LED Signaling, Error Code 14

Error code 14: "Error in external storage (memory card)"		
Error Argument	Error Description	Solution
1	Memory card cannot be used (message from driver)	<ol style="list-style-type: none"> 1. Replace the memory card with a new one. 2. Should this error persist, contact I/O Support..
2	Function cancelled by the user (30 s)	<ol style="list-style-type: none"> 1. Plug in the memory card. 2. a) During the system start: Restart the fieldbus controller by switching the power supply off and on. b) In ongoing operation: Restart the access function.
3	Internal memory is full	<ol style="list-style-type: none"> 1. Check the internal file system and the /copy/ directory on the memory card. The size of the /copy/ directory may not exceed the total size of the internal file system! 2. If necessary, delete files (e.g. through FTP, formatting the internal drive or cleaning the memory card on the PC).
4	Memory card is full	<ol style="list-style-type: none"> 1. Use the PC to create storage space on the memory card or replace the memory card with a new one. 2. Restart the access function.
5	No access to EEPROM	<ol style="list-style-type: none"> 1. Plug in the memory card. a) During system start: Start the fieldbus controller by switching the power supply off and on. b) In ongoing operation: Restart the access function. 2. Should this error persist, contact I/O Support.
6	Backup function failed	<ol style="list-style-type: none"> 1. Remove the memory card and remove the write protection. 2. Plug the memory card back in. 3. Restart the access function. 4. If the error persists, replace the memory card with a new one. 5. Restart the access function. 6. Should the error persist, contact I/O Support.
7	Restore function failed	<ol style="list-style-type: none"> 1. Plug the memory card back in if the memory card has been removed. 2. Close any existing FTP connection, establish a new connection, and restart the access function. 3. Should the error persist, restart the device and the access function. 4. If the error should persist, contact I/O Support.

12.1.2.1 USR LED

The bottom indicator LED (“USR”) is provided for visual output of information.

Control of the LED from the application program is conducted using the functions from the WAGO-I/O-PRO library “Visual.lib”.

12.1.3 Evaluating Memory Card Status

The access to the memory card is indicated by the SD-LED.

The SD-LED is directly above the memory card slot behind the transparent cover flap.

12.1.4 Evaluating Power Supply Status

The power supply unit of the device has two green LEDs that indicate the status of the power supplies.

LED “A” indicates the 24 V supply of the fieldbus coupler.

LED “B” or “C” reports the power available on the power jumper contacts for field side power.

Table 81: Power Supply Status Diagnostics – Solution in Event of Error

LED Status	Meaning	Solution
A		
Green	Operating voltage for the system is available.	-
Off	No power is available for the system	Check the power supply for the system (24 V and 0 V).
B or C		
Green	The operating voltage for power jumper contacts is available.	-
Off	No operating voltage is available for the power jumper contacts.	Check the power supply for the power jumper contacts (24 V and 0 V).

12.2 Fault Behavior

12.2.1 Loss of Fieldbus

A fieldbus and, hence, a link failure is recognized when the set reaction time for the watchdog expires without initiation by the higher-order control system. This may occur, for example, when the Master is switched off, or when there is a disruption in the bus cable. An error at the Master can also result in a fieldbus failure. No connection via ETHERNET.

The MODBUS watchdog monitors the ongoing MODBUS communication via MODBUS protocol. A fieldbus failure is signaled by the red "I/O" LED lighting up, provided the MODBUS watchdog has been configured and activated.

Fieldbus monitoring independently of a certain protocol is possible using the function block 'FBUS_ERROR_INFORMATION' in the library "Mod_com.lib". This checks the physical connection between modules and the controller and assumes evaluation of the watchdog register in the control system program. The I/O bus remains operational and the process images are retained. The control system program can also be processed independently.

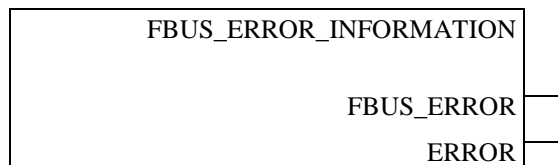


Figure 109: Function Block for Determining Loss of Fieldbus, Independently of Protocol

'FBUS_ERROR' (BOOL)	= FALSE	= no fault
	= TRUE	= loss of field bus
'ERROR' (WORD)	= 0	= no fault
	= 1	= loss of field bus

The node can be put into a safe status in the event of a fieldbus failure with the aid of these function block outputs and an appropriately programmed control system program.

Information



Loss of fieldbus detection through MODBUS protocol:

For detailed information about the watchdog register, refer to Section “MODBUS Functions”, in particular Section “Watchdog (Fieldbus failure)”.

Protocol-independent detection of loss of fieldbus:

The library “Mod_com.lib” with function block ‘FBUS_ERROR_INFORMATION’ is normally included in the setup for the WAGO-I/O-PRO. You can integrate the library via register “Resources” at the bottom on the left of the workspace. Click **Insert** and then **Other libraries**. The “Mod_com.lib” is located in folder C:\Programme\WAGO Software\CODESYS V2.3\Targets\WAGO\Libraries\32_Bit

12.2.2 Internal Data Bus Failure

I/O LED indicates an internal bus failure.

I/O LED flashed red:

When an internal data bus failure occurs, the fieldbus controller generates an error message (error code and error argument).

An internal data bus failure occurs, for example, if an I/O module is removed.

If the error occurs during operation, the output modules operate as they do during an internal data bus stop.

If the internal data bus error is resolved, the fieldbus controller starts up after turning the power off and on similar to that of a normal start-up. The process data is transmitted again and the outputs of the node are set accordingly.

If the “KBUS_ERROR_INFORMATION” function block is evaluated in the control program, then the “ERROR”, ”BITLEN”, “TERMINALS” and ”FAILADDRESS” output values are relevant.

ERROR	= FALSE	= No fault
(BITLEN		= Bit length of the internal bus shift register
TERMINALS		= Number of I/O modules)
ERROR	= TRUE	= Internal Bus Error
(BITLEN		= 0
TERMINALS		= 0
FAILADDRESS		= Position of the I/O module after which the internal bus interruption arose, similar to the flashed error argument of the I/O LED)

13 Fieldbus Communication

Fieldbus communication between master application and a WAGO fieldbus coupler/controller based on the ETHERNET standard normally occurs via an implemented fieldbus-specific application protocol.

Depending on the application, this can be e.g., MODBUS/TCP (UDP), EtherNet/IP, BACnet/IP, KNXnet/IP, PROFINET, sercos or other.

In addition to the ETHERNET standard and the fieldbus-specific application protocol, there are also other communications protocols important for reliable communication and data transmission and other related protocols for configuring and diagnosing the system implemented in the WAGO fieldbus coupler/controller based on ETHERNET.

These protocols are explained in more detail in the other sections.

13.1 Implemented Protocols

13.1.1 Communication Protocols

13.1.1.1 IP (Internet Protocol)

The Internet protocol divides datagrams into segments and is responsible for their transmission from one network subscriber to another. The stations involved may be connected to the same network or to different physical networks which are linked together by routers.

Routers are able to select various paths (network transmission paths) through connected networks, and bypass congestion and individual network failures. However, as individual paths may be selected which are shorter than other paths, datagrams may overtake each other, causing the sequence of the data packets to be incorrect.

Therefore, it is necessary to use a higher-level protocol, for example, TCP to guarantee correct transmission.

IP Packet

In addition to the data units to be transported, the IP data packets contain a range of address information and additional information in the packet header.

Table 82: IP Packet

IP Header	IP Data
------------------	----------------

The most important information in the IP header is the IP address of the transmitter and the receiver and the transport protocol used.

IP Addresses

To allow communication over the network each fieldbus node requires a 32 bit Internet address (IP address).



Note

IP Address must be unique!

For error free operation, the IP address must be unique within the network. The same IP address may not be assigned twice.

As shown below there are various address classes with net identification (net ID) and subscriber identification (subscriber ID) of varying lengths. The net ID defines the network in which the subscriber is located. The subscriber ID identifies a particular subscriber within this network.

Networks are divided into various network classes for addressing purposes:

- **Class A:** (Net ID: Byte 1, Host ID: Byte 2... Byte 4)

Table 83: Network Class A

e. g. 101 . 16 . 232 . 22

01100101	00010000	11101000	00010110
0	Net ID	Host ID	

The highest bit in Class A networks is always '0'. This means the highest byte can be in a range of '0 0000000' to '0 1111111'.

Therefore, the address range of a Class A network in the first byte is always between 0 and 127.

- **Class B:** (Net ID: Byte 1 ... Byte 2, Host ID: Byte 3... Byte 4)

Table 84: Network Class B

e. g. 181 . 16 . 232 . 22

10110101	00010000	11101000	00010110
10	Net ID	Host ID	

The highest bits in Class B networks are always '10'. This means the highest byte can be in a range of '10 000000' to '10 111111'.

Therefore, the address range of Class B networks in the first byte is always between 128 and 191.

- **Class C:** (Net ID: Byte 1 ... Byte 3, Host ID: Byte 4)

Table 85: Network Class C

e. g. 201 . 16 . 232 . 22

11000101	00010000	11101000	00010110
110	Net ID	Host ID	

The highest bits in Class C networks are always '110'. This means the highest byte can be in a range of '110 00000' to '110 11111'.

Therefore, the address range of Class C networks in the first byte is always between 192 and 223.

- **Additional network classes (D, E):** are only used for special tasks.

Key Data

Table 86: Key Data Class A, B and C

Network Class	Address range of the subnetwork	Possible number of	
		Networks	Hosts per Network
Class A	0.XXX.XXX.XXX ... 127.XXX.XXX.XXX	128 (2^7)	Approx. 16 Million (2^{24})
Class B	128.000.XXX.XXX ... 191.255.XXX.XXX	Approx. 16 Thousand (2^{14})	Ca. 65 Thousand (2^{16})
Class C	192.000.000.XXX ... 223.255.255.XXX	Approx. 2 Million (2^{21})	254 (2^8)

Each WAGO ETHERNET fieldbus coupler or controller can be easily assigned an IP address via the implemented BootP protocol. For small internal networks we recommend selecting a network address from Class C.

Note



Do not set IP addresses to 0.0.0.0 or 255.255.255.255!

Never set all bits to equal 0 or 1 in one byte (byte = 0 or 255). These are reserved for special functions and may not be allocated. Therefore, the address 10.0.10.10 may not be used due to the 0 in the second byte.

If a network is to be directly connected to the Internet, only registered, internationally unique IP addresses allocated by a central registration service may be used. These are available from InterNIC (International Network Information Center).

Note



Internet access only by the authorized network administrator!

Direct connection to the Internet should only be performed by an authorized network administrator and is therefore not described in this manual.

Subnets

To allow routing within large networks a convention was introduced in the specification RFC 950. Part of the Internet address, the subscriber ID is divided up again into a subnetwork number and the station number of the node. With the aid of the network number it is possible to branch into internal subnetworks within the partial network, but the entire network is physically connected together. The size and position of the subnetwork ID are not defined; however, the size is dependent upon the number of subnets to be addressed and the number of subscribers per subnet.

Table 87: Example: Class B Address with Field for Subnet IDs

1		8		16		24		32	
1	0	...	Network ID		Subnet ID		Host ID		

Subnet Mask

A subnet mask was introduced to encode the subnets in the Internet. This involves a bit mask, which is used to mask out or select specific bits of the IP address. The mask defines the subscriber ID bits used for subnet coding, which denote the ID of the subscriber. The entire IP address range theoretically lies between 0.0.0.0 and 255.255.255.255. Each 0 and 255 from the IP address range are reserved for the subnet mask.

The standard masks depending upon the respective network class are as follows:

- **Class A Subnet mask:**

Table 88: Subnet Mask for Class A Network

255	.0	.0	.0
-----	----	----	----

- **Class B Subnet mask:**

Table 89: Subnet Mask for Class B Network

255	.255	.0	.0
-----	------	----	----

- **Class C Subnet mask:**

Table 90: Subnet Mask for Class C Network

255	.255	.255	.0
-----	------	------	----

Depending on the subnet division the subnet masks may, however, contain other values beyond 0 and 255, such as 255.255.255.128 or 255.255.255.248.

Your network administrator allocates the subnet mask number to you.

Together with the IP address, this number determines which network your PC and your node belongs to.

The recipient node, which is located on a subnet, initially calculates the correct network number from its own IP address and subnet mask. Only then the node checks the node number and, if it corresponds, delivers the entire packet frame.

Table 91: Example for an IP Address from a Class B Network

IP address	172.16.233.200	'10101100 00010000 11101001 11001000'
Subnet mask	255.255.255.128	'11111111 11111111 11111111 10000000'
Net ID	172.16.0.0	'10101100 00010000 00000000 00000000'
Subnet ID	0.0.233.128	'00000000 00000000 11101001 10000000'
Host ID	0.0.0.72	'00000000 00000000 00000000 01001000'



Note

Specification of the network mask necessary!

Specify the network mask defined by the administrator in the same way as the IP address when installing the network protocol.

Gateway

The subnets of the Internet are normally connected via gateways. The function of these gateways is to forward packets to other networks or subnets.

This means that in addition to the IP address and network mask for each network card, it is necessary to specify the correct IP address of the standard gateway for a PC or fieldbus node connected to the Internet. You should also be able to obtain this IP address from your network administrator.

The IP function is limited to the local subnet if this address is not specified.

To communicate directly with each other, host and gateway must be on the same subnet, that means the network ID must be the same.

RAW IP

Raw IP manages without protocols such as PPP (point-to-point protocol). With RAW IP, the TCP/IP packets are directly exchanged without handshaking, thus enabling the connection to be established more quickly.

However, the connection must beforehand have been configured with a fixed IP address. The advantages of RAW IP are high data transfer rate and good stability.

IP Multicast

Multicast refers to a method of transmission from a point to a group, which is a point-to-multipoint transfer or multipoint connection. The advantage of multicast is that messages are simultaneously transferred to several users or closed user groups via one address.

IP multicasting at the Internet level is realized with the help of the Internet Group Message Protocol IGMP; neighboring routers use this protocol to inform each other on membership to the group.

For distribution of multicast packets in the sub-network, IP assumes that the datalink layer supports multicasting. In the case of Ethernet, you can provide a packet with a multicast address in order to send the packet to several recipients with a single send operation. Here, the common medium enables packets to be sent simultaneously to several recipients. The stations do not have to inform each other on who belongs to a specific multicast address – every station physically receives every packet. The resolution of IP address to Ethernet address is solved

by the use of algorithms, IP multicast addresses are embedded in Ethernet multicast addresses.

13.1.1.2 TCP (Transmission Control Protocol)

As the layer above the Internet protocol, TCP (Transmission Control Protocol) guarantees the secure transport of data through the network.

TCP enables two subscribers to establish a connection for the duration of the data transmission. Communication takes place in full-duplex mode (i.e., transmission between two subscribers in both directions simultaneously).

TCP provides the transmitted message with a 16-bit checksum and each data packet with a sequence number.

The receiver checks that the packet has been correctly received on the basis of the checksum and then sets off the sequence number. The result is known as the acknowledgement number and is returned with the next self-sent packet as an acknowledgement.

This ensures that the lost TCP packets are detected and resent, if necessary, in the correct sequence.

TCP Data Packet

The packet header of a TCP data packet is comprised of at least 20 bytes and contains, among others, the application port number of the transmitter and the receiver, the sequence number and the acknowledgement number.

The resulting TCP packet is used in the data unit area of an IP packet to create a TCP/IP packet.

TCP Port Numbers

TCP can, in addition to the IP address (network and subscriber address), respond to a specific application (service) on the addressed subscriber. For this the applications located on a subscriber, such as a web server, FTP server and others are addressed via different port numbers. Well-known applications are assigned fixed ports to which each application can refer when a connection is built up (Examples: Telnet Port number: 23, http Port number: 80).

A complete list of “standardized services” is contained in the RFC 1700 (1994) specifications.

13.1.1.3 UDP (User Datagram Protocol)

The UDP protocol, like the TCP protocol, is responsible for the transport of data. Unlike the TCP protocol, UDP is not connection-orientated; meaning that there are no control mechanisms for the data exchange between transmitter and receiver. The advantage of this protocol is the efficiency of the transmitted data and the resulting higher processing speed.

13.1.2 Configuration and Diagnostics Protocols

13.1.2.1 AutoIP

AutoIP, also known as “Zeroconf” or “Automatic private IP addressing” (APIPA) is employed for easy networking within a LAN. When AutoIP is activated for the controller (see Section 4.1.8.10 “Port”) the controller automatically obtains an IP address from the fixed IP range 169.254.1.0 to 169.254.254.255.

Configuration is performed based on a simple plug-and-play mechanism. No configuration tool is required and no DHCP server is required in the network for this.

The addresses are “calculated” in the specified range using random numbers. Computer-specific data, such as the controller MAC address, are included in this calculation to permit the same IP address to be generated as frequently as possible in case there is a network/device failure.

A test is conducted with the stored IP address when the controller is switched on, or after connecting the controller with the ETHERNET cable, and the IP address accepted when the configuration test is successful.

13.1.2.2 DHCP (Dynamic Host Configuration Protocol)

The fieldbus coupler/controller internal HTML page opened via the “Port” link provides the option to configure the network using the data saved in the EEPROM or via DHCP instead of via the BootP protocol.

DHCP (Dynamic Host Configuration Protocol) is a further development of BootP and is backwards compatible with BootP.

Both BOOTP and DHCP assign an IP address to the fieldbus node (Client) when starting; the sequence is the same as for BootP.

For configuration of the network parameters via DHCP, the fieldbus coupler/controller sends a client request to the DHCP server e.g., on the connected PC.

A broadcast request is transmitted to Port 67 (DHCP server) via the protocol that contains the hardware address (MAC ID) for the fieldbus coupler/controller.

The DHCP server then receives this message. The server contains a database in which the MAC ID and IP addresses are assigned to one another. When a MAC address is found a broadcast reply is transmitted via the network.

The fieldbus coupler/controller “listens” at the specified Port 68 for a response from the DHCP server. Incoming packets contain information such as the IP address and the MAC address for the fieldbus coupler/controller. A fieldbus coupler/controller recognizes by the MAC address that the message is intended for that particular fieldbus coupler/controller and accepts the transmitted IP address into its network.

If there is no reply, the inquiry is sent again after 4 seconds, 8 seconds and 16 seconds.

If all inquiries receive no reply, a blink code is reported via the I/O LED.

If you want the IP address and subnet mask are stored in the EEPROM when using DHCP, then the option “use IP from EEPROM” has to be switched (via the WBM, HTML page “Port”) following the configuration via DHCP.

When booting next the fieldbus coupler/controller uses the parameters saved in the EEPROM.

The difference between BOOTP and DHCP is that both use different assignment methods and that configuration with DHCP is time limited. The DHCP client always has to update the configuration after the time has elapsed. Normally, the same parameters are continuously confirmed by the server.

BOOTP can be used to assign a fixed IP address for each client where the addresses and their reservation are permanently saved in the BOOTP server database.

Because of this time dependency, DHCP is also used to dynamically assign available IP addresses through client leases (lease time after which the client requests a new address) where each DHCP client address is saved temporarily in the server database.

In addition, DHCP clients do not require a system restart to rebind or renew configuration with the DHCP server. Instead, clients automatically enter a rebinding state at set timed intervals to renew their leased address allocation with the DHCP server. This process occurs in the background and is transparent to the user.

There are three different operating modes for a DHCP server:

- **Manual assignment**

In this mode, the IP addresses are permanently assigned on the DHCP server to specific MAC addresses. The addresses are assigned to the MAC address for an indefinite period.

Manual assignments are used primarily to ensure that the DHCP client can be reached under a fixed IP address.

- **Automatic assignment**

For automatic assignment, a range of IP addresses is assigned on the DHCP server.

If the address was assigned from this range once to a DHCP client, then it belongs to the client for an indefinite period as the assigned IP address is also bound to the MAC address.

- **Dynamic assignment**

This process is similar to automatic assignment, but the DHCP server has a statement in its configuration file that specifies how long a certain IP address may be “leased” to a client before the client must log into the server again and request an “extension”.

If the client does not log in, the address is released and can be reassigned to

another (or the same) client. The time defined by the administrator is called Lease Time.

Some DHCP servers also assign IP addresses based on the MAC address, i.e., a client receives the same IP address as before after longer network absence and elapse of the Lease Time (unless the IP address has been assigned otherwise in the mean time).

DHCP is used to dynamically configure the network parameters. The ETHERNET TCP/IP fieldbus controller has a DHCP client that supports the following options in addition to the default “IP address” option:

Table 92: Meaning of DHCP Options

Option	Meaning
[OPT1] Subnet mask	32-bit address mask that displays which bits of the IP address identify the network and which identify the network stations.
[OPT2] Time zone	Time difference between the local time and the UTC (Universal Time Coordinated).
[OPT3] Gateway	IP address of the router that permits access to other networks.
[OPT6] DNS server	IP address of the name servers that converts a name into an IP address. Up to 2 DNS servers can be configured.
[OPT15] Domain name *)	The name of the domain is the unique name of a network. The domain name can contain up to 32 characters.
[OPT42] NTP server	IP address of the Network Time Server. When assigning an NTP server, the SNTP client is automatically enabled in the coupler.
[OPT51] Lease time	The maximum duration (i.e., how long the fieldbus coupler/controller maintains the assigned IP address) can be defined here. The maximum lease time for the fieldbus controller is 48 days. This is due to the internal timer resolution.
[OPT58] Renewing time	The renewing time indicates when the fieldbus coupler/controller must renew the lease time. The renewing time should be approximately half of the lease time.
[OPT59] Rebinding time	The rebinding time indicates after what amount of time the fieldbus coupler/controller must have received its new address. The rebinding time should be approximately 7/8 of the lease time.

*) In contrast to BootP, the DHCP client does not support assignment of the host name.

13.1.2.3 BootP (Bootstrap Protocol)

The “Bootstrap Protocol” (BootP) can be used to assign an IP address and other parameters to the fieldbus coupler/controller in a TCP/IP network. Subnet masks and gateways can also be transferred using this protocol. Protocol communication is comprised of a client request from the fieldbus coupler or controller and a server response from the PC.

A broadcast request is transmitted to Port 67 (BootP server) via the protocol that contains the hardware address (MAC ID) for the fieldbus coupler or controller.

The BootP server then receives this message. The server contains a database in which the MAC ID and IP addresses are assigned to one another. When a MAC address is found a broadcast reply is transmitted via the network.

The fieldbus coupler/controller “listens” at the specified Port 68 for a response from the BootP server. Incoming packets contain information such as the IP address and the MAC address for the fieldbus coupler/controller. A fieldbus coupler/controller recognizes by the MAC address that the message is intended for that particular fieldbus coupler/controller and accepts the transmitted IP address into its network.

Note



IP addresses can be assigned via BootP under Windows and Linux!

You can use WAGO-BootP-Server to assign an IP address under the Windows and Linux operating systems. You can also use any other BootP server besides WAGO-BootP-Server. You can also use any other BootP server besides the WAGO-BootP-Server.

Information



More information about WAGO-BootP-Server

The process for assigning addresses using WAGO-BootP-Server is described in detail in the section “Commissioning”.

The BootP Client assists in the dynamic configuration of the network parameters: The ETHERNET TCP/IP fieldbus controller has a BootP client that supports the following options in addition to the default “IP address” option:

Table 93: BootP Options

Option	Meaning
[OPT1] Subnet mask	32-bit address mask that displays which bits of the IP address identify the network and which identify the network stations.
[OPT2] Time zone	Time difference between the local time and the UTC (Universal Time Coordinated).
[OPT3] Gateway	IP address of the router that permits access to other networks.
[OPT6] DNS server	IP address of the name servers that converts a name into an IP address. Up to 2 DNS servers can be configured.
[OPT12] Host name	The name of the host is the unique name of a computer in a network. The host name can contain up to 32 characters.
[OPT15] Domain name	The name of the domain is the unique name of a network. The domain name can contain up to 32 characters.
[OPT42] NTP server	IP address of the Network Time Server. When assigning an NTP server, the SNTP client is automatically enabled in the coupler.

The “Features” WBM page can also be used to select the “BootP Request before static IP” option. After the restart, 5 BootP queries are sent. If there is no response to any of these queries, the fieldbus coupler/controller tries to configure itself with the IP parameters saved in the EEPROM.

If you want the IP address and subnet mask are stored in the EEPROM when using the Bootstrap protocol, then the option “use IP from EEPROM” has to be switched (via the WBM, HTML page “Port”) following the configuration via BootP.

When booting next the fieldbus coupler/controller uses the parameters saved in

the EEPROM.

By default, BootP is activated in the fieldbus coupler/controller.

When BootP is activated, the fieldbus coupler/controller expects the BootP server to be permanently available.

If there is no BootP server available after a PowerOn reset, the network will remain inactive.

If there is an error in the saved parameters, the I/O LED reports a blink code and configuration via BootP is turned on automatically.

13.1.2.4 HTTP (Hypertext Transfer Protocol)

HTTP is a protocol used by WWW (World Wide Web) servers for the forwarding of hypermedia, texts, images, audiodata, etc.

Today, HTTP forms the basis of the Internet and is also based on requests and responses in the same way as the BootP protocol.

The HTTP server implemented in the (programmable) fieldbus coupler or controller is used for viewing the HTML pages saved in the coupler/controller. The HTML pages provide information about the coupler/controller (state, configuration), the network and the process image.

On some HTML pages, (programmable) fieldbus coupler or controller settings can also be defined and altered via the web-based management system (e.g. whether IP configuration of the coupler/controller is to be performed via the DHCP protocol, the BootP protocol or from the data stored in the EEPROM).

The HTTP server uses port number 80.

13.1.2.5 DNS (Domain Name Systems)

The DNS client enables conversion of logical Internet names such as www.wago.com into the appropriate decimal IP address represented with separator stops, via a DNS server. Reverse conversion is also possible.

The addresses of the DNS server are configured via DHCP, BootP or web-based management. Up to 2 DNS servers can be specified. The host identification can be achieved with two functions; an internal host table is not supported.

13.1.2.6 SNTP-Client (Simple Network Time Protocol)

The SNTP client is used for synchronization of the time of day between a time server (NTP and SNTP server Version 3 and 4 are supported) and the internal system time in the (programmable) fieldbus coupler or controller. The protocol is executed via a UDP port. Only unicast addressing is supported.

Configuration of the SNTP client

The configuration of the SNTP client is performed via the web-based management system. The following parameters must be set:

Table 94: Meaning of the SNTP Parameters

Parameter	Meaning
WBM page "TCP/IP" → "(S)NTP Server"	The address assignment can be made over an IP address.
WBM page "TCP/IP" → „SNTP Update Time (sec, max. 65535) ”	The update time indicates the interval in seconds, in which the synchronization with the time server is to take place.
WBM page "Clock" → "Timezone (+/- hour:minute)"	The time zone relative to GMT (Greenwich Mean time). A range of -12 to +14 hours is acceptable.
WBM page "Port" → "SNTP"	It indicates whether the SNTP Client is to be activated or deactivated.

13.1.2.7 FTP-Server (File Transfer Protocol)

The file transfer protocol (FTP) enables files to be exchanged between different network stations regardless of operating system.

In the case of the ETHERNET coupler/controller, FTP is used to store and read the HTML pages created by the user, the IEC61131 program and the IEC61131 source code in the (programmable) fieldbus coupler or controller.

A total memory of 4,5 MB is available for the file system.

Note



Cycles for flash limited to 1 million!

Up to 1 million write cycles per sector are allowed when writing the flash for the file system. The file system supports "Wear-Leveling", so that the same sectors are not always written to.

Information



More Information about the implemented Protocols

You can find a list of the exact available implemented protocols in the section "Technical Data" to the fieldbus coupler and/or controller.

13.1.2.8 SMTP (Simple Mail Transfer Protocol)

The Simple Mail Transfer Protocol (SMTP) enables sending of ASCII text messages to mail boxes on TCP/IP hosts in a network. It is therefore used for sending and receiving e-mails.

The e-mail to be sent is created with a suitable editor and placed in a mail outbasket.

A send SMTP process polls the out-basket at regular intervals and therefore finds mail waiting to be sent. It then establishes a TCP/IP connection with the target host, to which the message is transmitted. The receive SMTP process on the target host accepts the TCP connection. The message is then transmitted and finally placed in an in-basket on the target system. SMTP expects the target system to be online, otherwise no TCP connection can be established. Since many desktop computers are switched off at the end of the day, it is impractical to send SMTP mail there. For that reason, in many networks special SMTP hosts are installed in many networks, which are permanently switched on to enable distribution of received mail to the desktop computers.

13.1.2.9 SNMP (Simple Network Management Protocol)

The Simple Network Management Protocol (SNMP) is responsible for transporting the control data that allows the exchange of management information as well as status and statistic data between individual network components and a management system.

An SNMP management workstation polls the SNMP agents to obtain information on the relevant devices.

SNMP is supported in versions 1/2c and some fieldbus couplers/controllers in version 3.

This represents a community message exchange in SNMP versions 1 and 2c. The community name of the network community must thereby be specified.

In SNMP version 3, exchanging messages is user-related. Each device, that knows the passwords set via WBM, may read or write values from the controller. In SNMPv3, user data from SNMP messages can also be transmitted in encoded form. This way, both requested values and values to be written cannot be easily decoded by others via ETHERNET. This is why SNMPv3 is often used in safety-related networks.

The device data, that can be accessed or modified by an SNMP agent, is called SNMP object. The sets of SNMP objects are stored in a logical database called Management Information Base (MIB); this is why these objects are typically known as “MIB objects”.

The SNMP of the ETHERNET controller includes both the general MIB acc. to RFC1213 (MIB II) and a special WAGO MIB.

SNMP is processed via port 161. The port number for SNMP traps (agent messages) is 161. Both ports must be enabled to use SNMP.

13.1.2.9.1 MIB II Description

MIB II acc. to RFC1213 is divided into the following groups:

Table 95: MIB II Groups

Group	Identifier
System Group	1.3.6.1.2.1.1
Interface Group	1.3.6.1.2.1.2
IP Group	1.3.6.1.2.1.4
IpRoute Table Group	1.3.6.1.2.1.4.21
ICMP Group	1.3.6.1.2.1.5
TCP Group	1.3.6.1.2.1.6
UDP Group	1.3.6.1.2.1.7
SNMP Group	1.3.6.1.2.1.11



Information

Additional Information

Please find detailed information on these individual groups in section “MIB II groups” of the manual appendix.

13.1.2.9.2 Traps

Standard Traps

For specific events, the SNMP agent will independently send one of the following messages without polling the manager.



Note

Enable event messages (traps) in the WBM!

Initially enable the event messages in the WBM in menu “SNMP” under “Trap Enable”. Traps in version 1, 2c and 3 may be activated separately.

The following messages are triggered automatically as traps (SNMPv1) by the fieldbus coupler/controller:

Table 96: Standard Traps

TrapType/TrapNumber/ OID of the provided value	Name	Event
TrapType = 0	ColdStart	Restart the coupler/controller
TrapType = 1	WarmStart	Reset via service switch
TrapType = 3	EthernetUp	Network connection detected
TrapType = 4	AuthenticationFailure	Unauthorized (abortive) MIB access
TrapType = 6/ ab Trap-Nummer 25 benutzerspezifisch	enterpriseSpecific	Enterprise-specific messages and function poll in the PFC program starting with enterprise trap number 25

13.1.3 Application Protocols

If fieldbus specific application protocols are implemented, then the appropriate fieldbus specific communication is possible with the respective coupler/controller. Thus the user is able to have a simple access from the respective fieldbus on the fieldbus node.

The implemented fieldbus specific application protocols these protocols are individual described in the following chapters.

13.2 KNXnet/IP

In 1999, the members of the three organizations BatiBUS Club International (BCI), European-Installation Bus Association (EIBA) and the European Home Systems Association (EHSA) founded the Konnex Association (known today as the KNX Association). This international organization combines three European bus standards into one newly defined, uniform standard for home and building automation systems.

This standard (KNX) is based on EIB technology. On account of the upward compatibility to EIB, these systems can be easily integrated into TP1 networks.

The KNXnet/IP protocol, which sets up direct links between KNX devices, is also used for communication. As this KNXnet/IP protocol is based on ETHERNET, remote access is rendered easier and existing hardware can continue to be used.

A prerequisite for compatibility among devices is merely the use of a suitable modem, such as ETHERNET, twisted pair, Powerline or radio frequency.

13.2.1 KNX Standard

The KNX standard is an open, flexible and interoperable communication solution between sensors, actuators and controllers for standard applications on a bus level.

KNX is defined in the ISO/IEC 14543-3 standard "Home and Building Electronic System". This standard is divided into two parts: "Product and System Requirements" and "KNXnet/IP Communication".

This standard ensures compatibility and interoperability between various devices and systems from different manufacturers. Devices that fulfill this standard's requirement and that have been tested and certified are marked with the KNX logo from the KNX Association.

The KNX standard leaves the choice of different configuration modes and transfer media up to the various manufacturers for their specific product development..

13.2.1.1 KNX Configuration Modes

The KNX standard contains three different configuration modes:

A Mode (Automatic mode):

- Direct use of the device using automatic configuration
- Well-suited for consumer goods
- Solution for end customers

E Mode (Easy mode)

- Can be configured using easy-to-use startup software
- Limited functions

- Solution for specialists with basic experience (training)

S-Mode (System mode)

- Parameterization using standard startup tool (Engineering Tool Software – ETS)
- Comprehensive functions
- Solutions for well-trained (experienced) specialists

13.2.1.2 KNX Transfer Media

In addition to the three configuration modes, the KNX standard also describes various transfer media. Each of these transfer media can be used together with one or more configuration modes.

The different transfer media are distinguished by differing parameters, such as the data transfer rate.

TP 0 (Twisted Pair, Type 0)

- Twisted pair wiring permits data transfer up to a bit rate of 4,800 bit/s. This medium has been incorporated by BatiBUS.
- Important: Products with KNX certification that are suited for use with this medium will function in the same network as BatiBUS products, but will not exchange any data with those products KNX.

TP 1 (Twisted Pair, Type 1)

- Twisted pair wiring permits data transfer up to a bit rate of 9,600 bit/s. This medium has been incorporated by EIB. The products certified for EIB and KNX that have been developed for this medium function and communicate with one another on the same bus.

PL 110 (Power Line, 110 kHz)

- Data transfer via power grid, with a bit rate of 1,200 bit/s; also incorporated by EIB. The products certified for EIB/PL 110 and KNX for this medium function and communicate with one another on the same bus.

PL 132 (Power Line, 132 kHz)

- Data transfer via power grid, with a bit rate of 2,400 bit/s; also used in the EHS Standard. This is also being introduced into the KNX standard. Important: Although products with KNX certification that have been developed for this medium function together with products based on EHS 1.3a on the same bus, they can only communicate with one another by means of a special protocol converter.

RF Radio Frequency at 868 MHz

- Radio transmission allows data exchange at a bit rate of 38.4 kbit/s. This medium has been introduced as part of the KNX Standard.

ETHERNET

- ETHERNET as a “medium” provides a bit rate of up to 100 Mbit/s for KNX IP Tunneling and KNXnet/IP Routing communication techniques. This medium was introduced as part of the KNX Standard.
- The bus line is used for transmission of user data and for power supply. In this process, data is transmitted symmetrically and serially as a series of 1s and 0s.

Note



The bus line shielding may not be interconnected or grounded!
The bus line shielding may not be interconnected or grounded.

13.2.2 Network Structure

This section provides basic information and guidelines concerning the structure of a KNX network in which KNX messages are transmitted via twisted pair and Ethernet links.

13.2.2.1 KNX TP1

A TP1 network consists of **sensors** that generate commands in the form of telegrams, **actuators** that transform the received telegrams into actions and **controllers** that control or regulate different processes. These devices/users are linked by an appropriate KNX transfer medium.

13.2.2.1.1 Physical Structure

A TP1 network is broken down into ranges and lines, with the smallest unit here being a line. A maximum of 64 subscribers can be placed within one line.

Permissible line lengths:

- max. line length per line 1000 m
 - max. line length between two subscribers 700 m
- Source: KNX standard (3/2/2)

A line length of 350 m is recommended as the distance between subscribers and power supply. The power supply points are spaced 200 m apart.

Malfunctions may occur if these distances are not maintained. The bus conductor may have any number of branches, but may not be routed as a ring line. No termination resistors are required here.

Using line couplers, up to 15 lines may be combined to form a range via main line, or line 0. Subscribers may also be placed on the main line (max. 64).

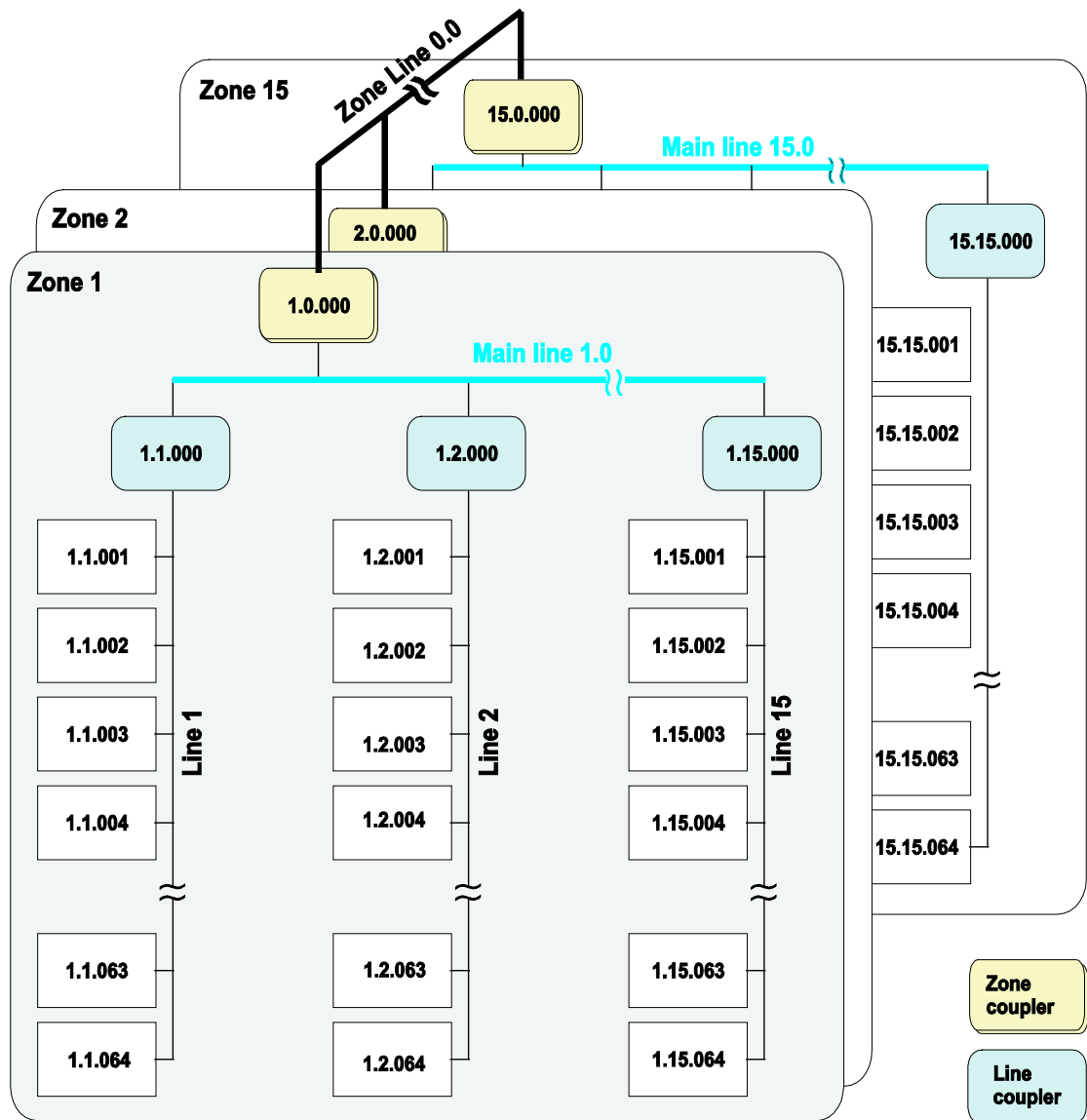


Figure 110: KNX network structure

Using range couplers, up to 15 ranges can be linked via range line (also called backbone). Up to 15 subscribers or line couplers can also be placed on the range line.

This may yield up to a maximum of 14,400 subscribers ($15 \cdot 15 \cdot 64$).

Line and range couplers perform two different tasks within the TP1 network. They isolate the bus sections (lines and ranges) electrically. This prevents a loss of the entire network in the event of a loss of power in only one bus section.

These couplers also provide for logical linking of the bus sections using **filter tables**. With the aid of these filter tables, the line and range couplers can determine whether certain telegrams from or to a bus section are to be passed on or blocked. This helps reduce traffic volume in the overall network. The filter

tables are created automatically and downloaded by the ETS during parameterization and commissioning of the line and range couplers.

13.2.2.1.2 Logical Structure

The subscribers possess physical device addresses and logical group addresses to facilitate and ensure interaction between the subscribers in the system. This allows recipients to be determined for a certain message and data to be exchanged via communication objects.

13.2.2.2 KNX IP

KNX messages can be transmitted both within a twisted pair network and via Ethernet medium.

13.2.2.2.1 Physical Structure

This network structure is similar to that of an Ethernet network. However, twisted pair may not be used above an IP network in the network topology. Moreover, network expansion is restricted to 15 ranges, 15 lines and 64 subscribers per line (see Section KNX-TP1 > Physical Structure).

13.2.2.2.2 Logical Structure

The logical address structure in KNX networks corresponds to the address structure in twisted pair networks; i.e., the subscribers possess physical device addresses and logical group addresses to determine recipients for certain messages and exchange data via communication objects. KNX telegrams are "packed" in UDP/IP telegrams and sent as multicast messages for transmission via Ethernet.

13.2.2.3 Communication Objects

Communication objects represent certain actions/functions that a KNX device executes. For example, there may be a safety object that has the task of moving a blind to a safer position in the event of strong winds. Communication objects are linked with physical or logical data that initiate such actions.

A device has at least one communication object. Group addresses are assigned to the communication objects. When data is sent to a group address, it is received by all communication objects which belong to that group.

In IEC-61131-3 function blocks can be created which represent KNX communication objects.

Communication objects possess defined formats Data Point Type (DPT) or EIB Interworking Standard (EIS); these are explained in more detail in Section "EIB Interworking Standard (EIS) Types" and "Data Point Types (DPTs)".

13.2.2.4 Physical Device Address

The physical device addresses identify the bus devices uniquely within a TP1 network. This address consists of the subscriber number, line number and range number.

A bus device, for example, may be located in range 2, on line 10 and have subscriber number 63. This data is shown separated by decimal points. The physical address would then be 2.10.63

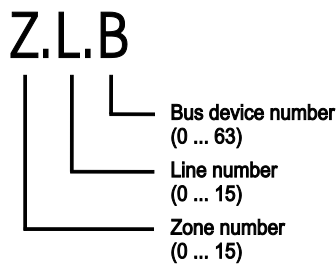


Figure 111: Physical address

A physical address may be allocated only one time within a KNX system. This address is assigned during initial startup using the configuration and startup tool.

13.2.2.5 Logical Group Address

The logical group address defines the bus subscribers that are to interact. These addresses represent a 15-bit value, with 4 bits being used for the subgroups and 11 bits for the main groups. This representation is on two levels.

A three-level breakdown into main group (4 bits), intermediate group (3 bits) and subgroup (8 bits) can also be set to carry out a more detailed structure of the overview and breakdown.

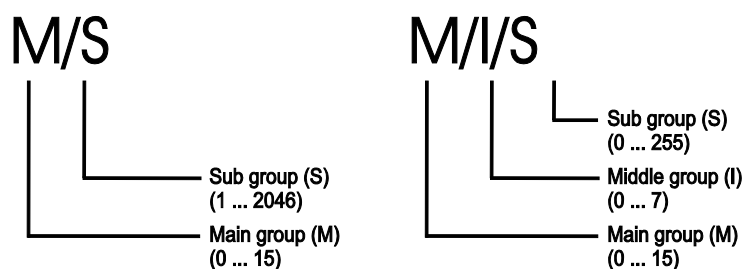


Figure 112: Structure of a group address

There is no data loss when converting/switching between these two display representations. The subgroup in the two-level representation is converted and divided up among the intermediate and subgroups in the three-level representation using a corresponding equation.

Calculation (conversion) of a three-level address 3/4/5 to a two-level address

$$\begin{aligned}
 \text{M/I/S} &= \text{M}/(\text{I} * 256 + \text{S}) &= \text{M/S} \\
 3/4/5 &= 3/(4 * 256 + 5) &= 3/1029
 \end{aligned}$$

Calculation (conversion) of a two-level address 3/1029 to a three-level address:

M/S2
3/1029

Calculation for intermediate group

1029/256 ~ 4,01953125 → **4**

Calculation for subgroup

1029 – (4*256) = **5**
→ **3/4/5**

Any number of group addresses can be assigned to the communication objects using the ETS plug-in. Assignment is freely selectable, according to specific needs. The following spatial breakdown has proven useful:

- **Main group** → Building
- **Intermediate group** → Floors
- **Subgroup** → Rooms

Other breakdown structures, for example according to function, may, of course, also be used.

Example:

- **Main group 0** – Safety
 - **Intermediate group 0** – Faults
 - **Subgroup 0** – Faults, movement of blinds
 - **Subgroup 1** – Faults, heating system
 - **Subgroup 2** – Faults, lighting
- **Main group 1** – Central functions
 - **Intermediate group 0** – Lighting
 - **Subgroup 0** – Lighting, basement
 - **Subgroup 1** – Lighting, 1st floor
 - **Subgroup 2** – Lighting, 2st floor

Group addresses can be edited after assignment and, contrary to physical addresses, can exist more than once in TP1 networks. Actuators can react to several group addresses, while sensors only transmit to one group address.

13.2.2.6 EIB Interworking Standard (EIS) Types

Data that is exchanged between devices, which not all may be from the same manufacturer, must be handled and interpreted identically. Despite the different internal structures and processes within the devices, data types are interpreted identically. For this reason, they form the common denominator for

interoperability. Data types were therefore classified as EIB Interworking Standard (EIS) types, which describe the type and function of a communication object. This allows cryptic bits and bytes to be converted to readable types that can then be evaluated.

This table shows the standard formats for data transmission:

Table 97: EIS data types

EIS	Data type	Data width	Function
EIS 1 (DPT 1)	Boolean	1 bit	Switching (on/off, up/down)
EIS 2 (DPT 3)	3 Bit Controlled	3 bit	Dimming (brighter/darker)
EIS 3 (DPT 10)	Time	3 bytes	Time
EIS 4 (DPT 11)	Date	3 bytes	Date
EIS 5 (DPT 9)	2 Octet Float Value	2 bytes	Analog value, with decimal portion
EIS 6 (DPT 5)	8 Bit Unsigned Value	1 byte	Relative value (0-100%)
EIS 7 (DPT 1)	Boolean	1 bit	Drive control
EIS 8 (DPT 2)	1 Bit Controlled	2 bit	Forced control
EIS 9 (DPT 14)	4 Octet Float Value	4 bytes	Number with decimal portion (as per IEEE 754)
EIS 10.000 (DPT 7)	2 Octet Unsigned Value	2 bytes	Positive whole number (0...65535)
EIS 10.001 (DPT 8)	2 Octet Signed Value	2 bytes	Whole number (-32768 to +32767)
EIS 11.000 (DPT 12)	4 Octet Unsigned Value	4 bytes	Positive whole number
EIS 11.001 (DPT 13)	4 Octet Signed Value	4 bytes	Whole number (-2147483648 to +2147483647)
EIS 12 (DPT 15)	Entrance access	4 bytes	Access control
EIS 13 (DPT 4)	Character	1 byte	(one) ASCII character
EIS 14.001 (DPT 5.010)	8 Bit Unsigned Value	1 byte	Counter value (0...255)
EIS 14.000 (DPT 6)	8 Bit Signed Value	1 byte	Counter value (0...255)
EIS 15 (DPT 16)	Character string	14 bytes	Character string (max. 14 characters)

The Konnex Organization introduced a new data structure, the data point types (DPTs) permit more accurate distinctions to be made. Whereas there are a total of 15 EIS types, the number of DPTs with several main types and a number of subtypes is significantly higher.

13.2.2.7 Interworking Datapoint Types (DPTs)

DPTs describe defined formats and data widths of communication objects. DPTs are assigned to communication objects via the ETS.

The KNX IP controller supports the following data widths:

- 1 ... 7 Bit
- 1 ... 4 Byte
- 6 Byte
- 8 Byte
- 10 Byte
- 14 Byte



Information

Additional information about “Interworking Datapoint Types”!

Additional information about “Interworking Datapoint Types” can be found at <http://www.konnex.org>.

13.2.2.8 Control and Programming

Use the engineering Tool Software (ETS) to perform programming of the subscribers and assigning of group addresses. This software is developed and marketed by the KNX Association.

The ETS is a manufacturer-independent tool for the installation, commissioning, design, documentation, diagnostics and maintenance of KNX devices.

The ETS has a modular design, allowing to easily integrating any manufacturer-specific extensions/plugin. To use devices from different manufacturers together, the corresponding product databases from the manufacturer must be incorporated into the ETS.

13.2.2.8.1 Brief Description of ETS Functions

The ETS creates topological ranges, lines and devices within the network. Devices are integrated using the manufacturer’s product databases and placed as required in subsections, buildings, rooms or, for example, distribution units.

Use the WAGO ETS plug-in contained in the WAGO product database to configure the KNX IP controller and the KNX module. The main task of the plug-in is to select IEC network variables to be assigned to the KNX group addresses in the ETS. Other functions, such as download and start up of the application are also provided.

Define group addresses to instruct devices to execute certain actions. These are broken down into main, where applicable intermediate and subgroups (such as

Lighting/1st Floor/Hall Light_1). Statuses can be read and values transmitted using these addresses.

The group addresses can be linked to IEC network variables using the Drag & Drop function. The communication objects are yielded from these links.

The devices for which parameters have been defined must then be assigned to the required building/room sections (e.g., Hall light_1 to 1st floor hall). Lines and devices must be assigned parameters after they have been created and structures (e.g., defining the running time for a blind).

In addition to these functions, the ETS can also be used for diagnostics, recording of values using filter functions and documentation (applies to configuration of the controller). The entire configuration for a device can be exported and re-imported.

Information



Additional Information

The ETS itself can be obtained from the Konnex Organization at <http://www.konnex.org>.

The WAGO ETS plug-in can be downloaded at <http://www.wago.com> in the “Downloads” area (WAGO product database including the plug-in for the ETS). You can find a description of the WAGO ETS plug-in at <http://www.wago.com> in the “Documentation” area.

13.2.3 Network Communication

13.2.3.1 Data transmission

Data (switching commands, messages, etc.) is exchanged between the individual bus subscribers by means of telegrams.

A telegram consists of bus-specific information, such as the source and destination address, control field, etc., and the user data for event transmission.

Table 98: Telegram

Control field	Source address	Destination address	Address change	Routing counter	User data length	User data	Fuse
			1 bit	3 bit	4 bit		
8 bit	16 bit	16 bit	8 bit			Up to 16 bit x 8	8 bit

The control and security fields are evaluated by the recipient of the telegram and are utilized to check for completeness of the telegram.

The source address corresponds to the physical address of the sender and indicates in which range and in which line the subscriber sending the data is located. The destination address defines the communication partner. This may be an individual subscriber, or a group of subscribers. A subscriber may belong to several groups.

Telegrams can be transmitted internally within the line, across several lines and across several ranges. Bus access is made in line with the CSMA/CA- procedure (Carrier Sense Multiple Access/Collision Avoidance). With this procedure, all the subscribers on the bus can “listen in”, but only the subscriber(s) whose address is given may process the transmitted user data.

In order for a subscriber to send data, first listen in on the bus and wait until no other subscriber is sending data (carrier sense). When the bus is available, each subscriber can basically begin sending data (Multiple Access).

If two subscribers begin sending data simultaneously, the subscriber with the higher priority is allowed to send first (Collision Avoidance). The other subscriber must begin sending again at a later time. If both subscribers have the same priority, the subscriber with the lowest physical address is allowed to send first. In addition to collision detection (cf. CSMA/CD), CSM/CA also provides for collision avoidance. This mechanism is implemented through “coordination” amongst the stations, for example via “Request to Send/Clear to Send” (RTS/CTS) packets.

If data has been transmitted correctly, the recipient will then send an acknowledgement to the sender to complete data transfer. If errors occur, however, the procedure will be repeated up to three (3) times.

13.2.3.2 KNXnet/IP Protocol

An easily-to-establish link between the different levels, floors, rooms and distribution units in buildings is achieved through the KNXnet/IP protocol and the ETHERNET network.

The KNXnet/IP protocol is defined by routing and tunneling protocols. The KNXnet/IP routing protocol defines how telegrams are exchanged and/or forwarded between lines and ranges via an IP network.

The **KNXnet/IP router** integrates itself into the IP backbone and replaces the line or range couplers. Functioning as a line or range coupler is determined by the physical address of the KNXnet/IP router.

Networking effort and expenditure is kept low by integration of the KNX devices into existing IP networks. The KNX and ETHERNET technologies operate optimally together and provide a significant contribution to comprehensive building networking.

Forwarding of the KNX telegrams is performed using “packed” UDP/IP telegrams as multicast messages via ETHERNET. The routers in the network (and the routers in the IP backbone) must also have multicast capabilities. All KNXnet/IP routers within the network receive the telegrams and decide whether they should forward the telegrams to subordinate lines on the basis of the routing tables.

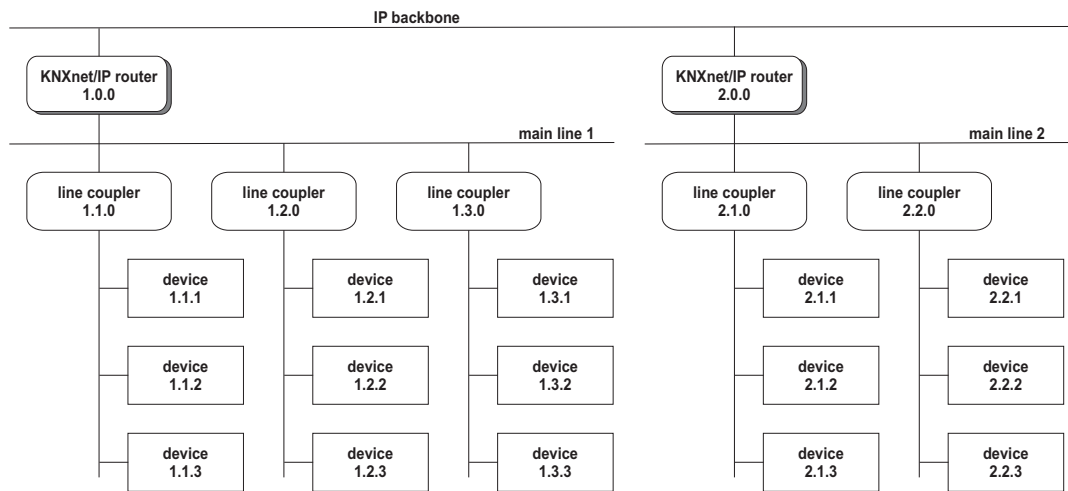


Figure 113: KNXnet/IP router as a range coupler

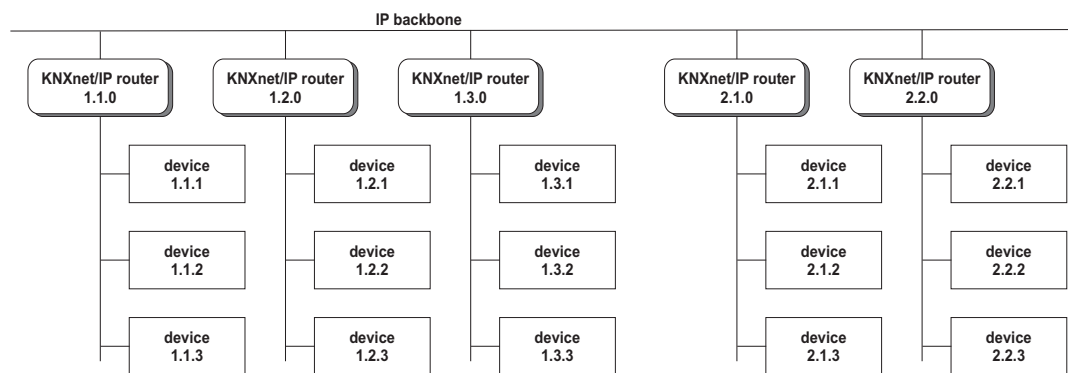


Figure 114: KNXnet/IP router as a line coupler

Note



The physical address determines the application as line or range coupler!
Always ensure that the correct physical address is assigned when the KNXnet/IP router is used as a line or range coupler (see following Figure).
A line coupler is identified in the network by its user number “0” in the physical address (e.g., 3.3.0),
a range coupler by the line number “0” (e.g., 2.0.0).

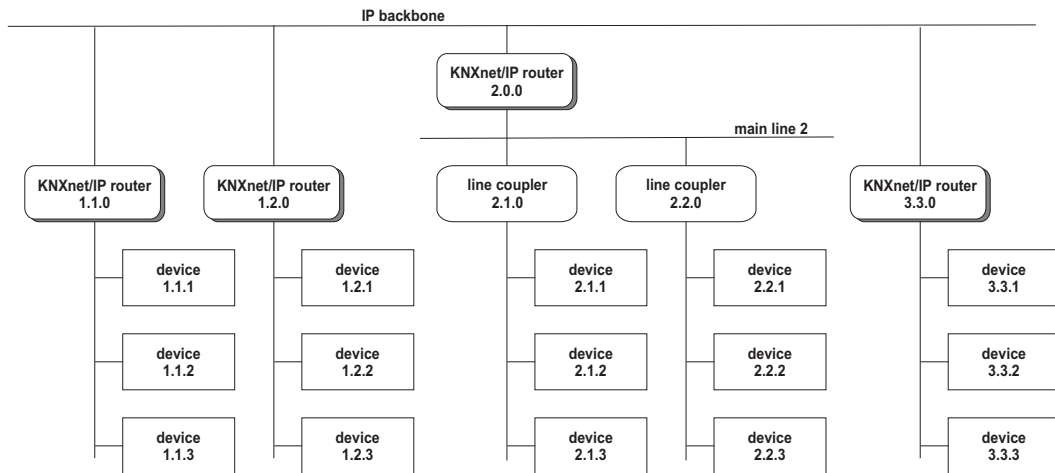


Figure 115: WAGO-KNXnet/IP router as a range and line coupler

KNX IP Tunneling defines point-to-point links between KNX devices and the ETS. This type of data transfer is usually employed for commissioning, programming and diagnostics. A client PC is linked directly with a bus or a KNX device in this process.

Note



Use tunneling address from router line!

As tunneling address, use an address from the line in which the router is located (e.g. Router 1.1.0 Tunneling 1.1.250).

13.3 MODBUS Functions

13.3.1 General

MODBUS is a manufacturer-independent, open fieldbus standard for diverse applications in manufacturing and process automation.

The MODBUS protocol is implemented according to the current Internet Draft of the IETF (Internet Engineering Task Force) and performs the following functions:

- Transmission of the process image
- Transmission of the fieldbus variables
- Transmission of different settings and information on the coupler/controller

The data transmission in the fieldside takes place via TCP and via UDP.

The MODBUS/TCP protocol is a variation of the MODBUS protocol, which was optimized for communication via TCP/IP connections.

This protocol was designed for data exchange in the field level (i.e. for the exchange of I/O data in the process image).

All data packets are sent via a TCP connection with the port number 502.

MODBUS/TCP segment

The general MODBUS/TCP header is as follows:

Table 99: MODBUS/TCP Header

Byte	0	1	2	3	4	5	6	7	8 ... n
	Identifier (entered by receiver)		Protocol- identifier (is always 0)		Length field (High byte, low byte)		Unit identifier (Slave address)	MODBUS function code	Data



Information

Additional Information

The structure of a datagram is specific for the individual function. Refer to the descriptions of the MODBUS Function codes.

For the MODBUS protocol 15 connections are made available over TCP. Thus it allows digital and analog output data to be directly read out at a fieldbus node and special functions to be executed by way of simple MODBUS function codes from 15 stations simultaneously.

For this purpose a set of MODBUS functions from the Open MODBUS/TCP specification is realized.



Information

More information

More information on the “Open MODBUS/TCP specification” you can find in the Internet: www.modbus.org.

Therefore the MODBUS protocol based essentially on the following basic data types:

Table 100: Basic Data Types of MODBUS Protocol

Data type	Length	Description
Discrete inputs	1 bit	Digital inputs
Coils	1 bit	Digital outputs
Input register	16 bits	Analog input data
Holding register	16 bits	Analog output data

For each basic data type one or more function codes are defined.

These functions allow digital or analog input and output data, and internal variables to be set or directly read out of the fieldbus node.

Table 101: List of the MODBUS Functions in the Fieldbus Controller

Function code	Function	Access method and description	Access to resources
FC1 0x01	Read Coils	Reading of several output bits	R: Process image, PFC variables
FC2 0x02	Read Discrete Inputs	Reading of several input bits	R: Process image, PFC variables
FC3 0x03	Read Holding Registers	Reading of several input registers	R: Process image, PFC variables, internal variables, NOVRAM
FC4 0x04	Read Input Registers	Reading of several input registers	R: Process image, PFC variables, internal variables, NOVRAM
FC5 0x05	Write Single Coil	Writing of an individual output bit	W: Process image, PFC variables
FC6 0x06	Write Single Register	Writing of an individual output register	W: Process image, PFC variables, internal variables, NOVRAM
FC11 0x0B	Get Comm Event Counters	Communication event counter	R: None
FC15 0x0F	Write Multiple Coils	Writing of several output bits	W: Process image, PFC variables
FC16 0x10	Write Multiple Registers	Writing of several output registers	W: Process image, PFC variables, internal variables, NOVRAM
FC22 0x16	Mask Write Register	Writing of several bits of an individual output register by mask	W: Process image, PFC variables, NOVRAM

FC23 0x17	Read/Write Multiple Registers	Reading and writing of several output registers	R/W: Process image, PFC variables, NOVRAM
------------------	-------------------------------------	--	--

To execute a desired function, specify the respective function code and the address of the selected input or output data.

Note



Note the number system when addressing!

The examples listed use the hexadecimal system (i.e.: 0x000) as their numerical format. Addressing begins with 0. The format and beginning of the addressing may vary according to the software and the control system. All addresses then need to be converted accordingly.

13.3.2 Use of the MODBUS Functions

The example below uses a graphical view of a fieldbus node to show which MODBUS functions can be used to access data of the process image.

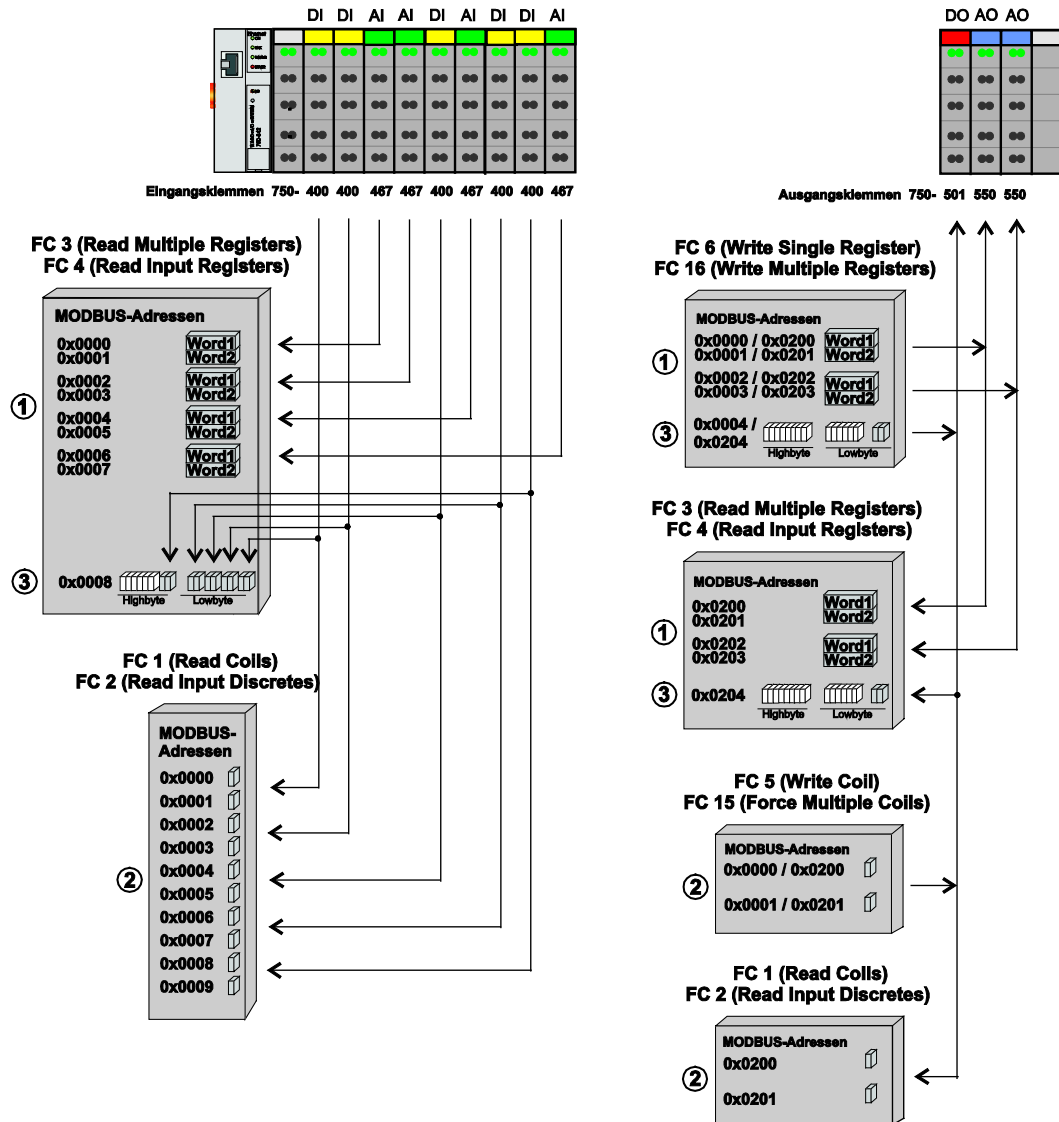


Figure 116: Use of the MODBUS Functions



Note

Use register functions to access analog signals and coil functions to access binary signals!

It is recommended that analog data be accessed with register functions ① and digital data with coil functions ②. If reading or writing access to binary signals is performed via register functions ③, an address shift may occur as soon as further analog modules are operated on the coupler/controller.

13.3.3 Description of the MODBUS Functions

All MODBUS functions are executed as follows:

1. A MODBUS TCP master (e.g., a PC) makes a request to the WAGO fieldbus node using a specific function code based on the desired operation..
2. The WAGO fieldbus node receives the datagram and then responds to the master with the proper data, which is based on the master's request.

If the WAGO fieldbus node receives an incorrect request, it sends an error datagram (Exception) to the master.

The exception code contained in the exception has the following meaning:

Table 102: Exception Codes

Exception code	Meaning
0x01	Illegal function
0x02	Illegal data address
0x03	Illegal data value
0x04	Slave device failure

The following chapters describe the datagram architecture of request, response and exception with examples for each function code.



Note

Reading and writing of outputs via FC1 to FC4 is also possible by adding an offset!

In the case of the read functions (FC1 ... FC4) the outputs can be additionally written and read back by adding an offset of 200hex (0x0200) to the MODBUS addresses in the range of [0_{hex} ... FF_{hex}] and an offset of 1000_{hex} (0x01000) to the MODBUS addresses in the range of [6000_{hex} ... 62FC_{hex}].

13.3.3.1 Function Code FC1 (Read Coils)

This function reads the status of the input and output bits (coils) in a slave device.

Request

The request specifies the reference number (starting address) and the bit count to read.

Example: Read output bits 0 to 7.

Table 103: Request of Function Code FC1

Byte	Field name	Example
Byte 0, 1	Transaction identifier	0x0000
Byte 2, 3	Protocol identifier	0x0000
Byte 4, 5	Length field	0x0006
Byte 6	Unit identifier	0x01 not used
Byte 7	MODBUS function code	0x01
Byte 8, 9	Reference number	0x0000
Byte 10, 11	Bit count	0x0008

Response

The current values of the response bits are packed in the data field. A binary 1 corresponds to the ON status and a 0 to the OFF status. The lowest value bit of the first data byte contains the first bit of the request. The others follow in ascending order. If the number of inputs is not a multiple of 8, the remaining bits of the last data byte are filled with zeroes (truncated).

Table 104: Response of Function Code FC1

Byte	Field name	Example
...		
Byte 7	MODBUS function code	0x01
Byte 8	Byte count	0x01
Byte 9	Bit values	0x12

The status of the inputs 7 to 0 is shown as byte value 0x12 or binary 0001 0010. Input 7 is the bit having the highest significance of this byte and input 0 the lowest value.

The assignment is thus made from 7 to 0 as follows:

Table 105: Assignment of Inputs

	OFF	OFF	OFF	ON	OFF	OFF	ON	OFF
Bit	0	0	0	1	0	0	1	0
Coil	7	6	5	4	3	2	1	0

Exception

Table 106: Exception of Function Code FC1

Byte	Field name	Example
...		
Byte 7	MODBUS function code	0x81
Byte 8	Exception code	0x01 or 0x02

13.3.3.2 Function Code FC2 (Read Discrete Inputs)

This function reads the input bits from a slave device.

Request

The request specifies the reference number (starting address) and the bit count to be read.

Example: Read input bits 0 to 7

Table 107: Request of Function Code FC2

Byte	Field name	Example
Byte 0, 1	Transaction identifier	0x0000
Byte 2, 3	Protocol identifier	0x0000
Byte 4, 5	Length field	0x0006
Byte 6	Unit identifier	0x01 not used
Byte 7	MODBUS function code	0x02
Byte 8, 9	Reference number	0x0000
Byte 10, 11	Bit count	0x0008

Response

The current value of the requested bits are packed into the data field. A binary 1 corresponds to the ON status and a 0 the OFF status. The lowest value bit of the first data byte contains the first bit of the inquiry. The others follow in an ascending order. If the number of inputs is not a multiple of 8, the remaining bits of the last data byte are filled with zeroes (truncated).

Table 108: Response of Function Code FC2

Byte	Field name	Example
...		
Byte 7	MODBUS function code	0x02
Byte 8	Byte count	0x01
Byte 9	Bit values	0x12

The status of the inputs 7 to 0 is shown as a byte value 0x12 or binary 0001 0010. Input 7 is the bit having the highest significance of this byte and input 0 the lowest value. The assignment is thus made from 7 to 0 as follows:

Table 109: Assignment of Inputs

	OFF	OFF	OFF	ON	OFF	OFF	ON	OFF
Bit	0	0	0	1	0	0	1	0
Coil	7	6	5	4	3	2	1	0

Exception

Table 110: Exception of Function Code FC2

Byte	Field name	Example
...		
Byte 7	MODBUS function code	0x82
Byte 8	Exception code	0x01 or 0x02

13.3.3.3 Function Code FC3 (Read Multiple Registers)

This function reads the contents of holding registers from a slave device in word format.

Request

The request specifies the reference number (start register) and the word count (register quantity) of the registers to be read. The reference number of the request is zero based, therefore, the first register starts at address 0.

Example: Read registers 0 and 1.

Table 111: Request of Function Code FC3

Byte	Field name	Example
Byte 0, 1	Transaction identifier	0x0000
Byte 2, 3	Protocol identifier	0x0000
Byte 4, 5	Length field	0x0006
Byte 6	Unit identifier	0x01 not used
Byte 7	MODBUS function code	0x03
Byte 8, 9	Reference number	0x0000
Byte 10, 11	Word count	0x0002

Response

The reply register data is packed as 2 bytes per register. The first byte contains the higher value bits, the second the lower values.

Table 112: Response of Function Code FC3

Byte	Field name	Example
...		
Byte 7	MODBUS function code	0x03
Byte 8	Byte count	0x04
Byte 9, 10	Value register 0	0x1234
Byte 11, 12	Value register 1	0x2345

The contents of register 0 are displayed by the value 0x1234 and the contents of register 1 is 0x2345.

Exception

Table 113: Exception of Function Code FC3

Byte	Field name	Example
...		
Byte 7	MODBUS function code	0x83
Byte 8	Exception code	0x01 or 0x02

13.3.3.4 Function Code FC4 (Read Input Registers)

This function reads contents of input registers from the slave device in word format.

Request

The request specifies a reference number (start register) and the word count (register quantity) of the registers to be read. The reference number of the request is zero based, therefore, the first register starts at address 0.

Example: Read registers 0 and 1

Table 114: Request of Function Code FC4

Byte	Field name	Example
Byte 0, 1	Transaction identifier	0x0000
Byte 2, 3	Protocol identifier	0x0000
Byte 4, 5	Length field	0x0006
Byte 6	Unit identifier	0x01 not used
Byte 7	MODBUS function code	0x04
Byte 8, 9	Reference number	0x0000
Byte 10, 11	Word count	0x0002

Response

The register data of the response is packed as 2 bytes per register. The first byte has the higher value bits, the second the lower values.

Table 115: Response of Function Code FC4

Byte	Field name	Example
...		
Byte 7	MODBUS function code	0x04
Byte 8	Byte count	0x04
Byte 9, 10	Value register 0	0x1234
Byte 11, 12	Value register 1	0x2345

The contents of register 0 are shown by the value 0x1234 and the contents of register 1 is 0x2345.

Exception

Table 116: Exception of Function Code FC4

Byte	Field name	Example
...		
Byte 7	MODBUS function code	0x84
Byte 8	Exception code	0x01 or 0x02

13.3.3.5 Function Code FC5 (Write Coil)

This function writes a single output bit to the slave device.

Request

The request specifies the reference number (output address) of output bit to be written. The reference number of the request is zero based; therefore, the first coil starts at address 0.

Example: Turn ON the second output bit (address 1)

Table 117: Request of Function Code FC5

Byte	Field name	Example
Byte 0, 1	Transaction identifier	0x0000
Byte 2, 3	Protocol identifier	0x0000
Byte 4, 5	Length field	0x0006
Byte 6	Unit identifier	0x01 not used
Byte 7	MODBUS function code	0x05
Byte 8, 9	Reference number	0x0001
Byte 10	ON/OFF	0xFF
Byte 11		0x00

Response

Table 118: Response of Function Code FC5

Byte	Field name	Example
...		
Byte 7	MODBUS function code	0x05
Byte 8, 9	Reference number	0x0001
Byte 10	Value	0xFF
Byte 11		0x00

Exception

Table 119: Exception of Function Code FC5

Byte	Field name	Example
...		
Byte 7	MODBUS function code	0x85
Byte 8	Exception code	0x01, 0x02 or 0x03

13.3.3.6 Function Code FC6 (Write Single Register)

This function writes the value of one single output register to a slave device in word format.

Request

The request specifies the reference number (register address) of the first output word to be written. The value to be written is specified in the “Register Value” field. The reference number of the request is zero based; therefore, the first register starts at address 0.

Example: Write a value of 0x1234 to the second output register

Table 120: Request of Function Code FC6

Byte	Field name	Example
Byte 0, 1	Transaction identifier	0x0000
Byte 2, 3	Protocol identifier	0x0000
Byte 4, 5	Length field	0x0006
Byte 6	Unit identifier	0x01 not used
Byte 7	MODBUS function code	0x06
Byte 8, 9	Reference number	0x0001
Byte 10, 11	Register value	0x1234

Response

The reply is an echo of the inquiry.

Table 121: Response of Function Code FC6

Byte	Field name	Example
...		
Byte 7	MODBUS function code	0x06
Byte 8, 9	Reference number	0x0001
Byte 10, 11	Register value	0x1234

Exception

Table 122: Exception of Function Code FC6

Byte	Field name	Example
...		
Byte 7	MODBUS function code	0x85
Byte 8	Exception code	0x01 or 0x02

13.3.3.7 Function Code FC11 (Get Comm Event Counter)

This function returns a status word and an event counter from the slave device's communication event counter. By reading the current count before and after a series of messages, a master can determine whether the messages were handled normally by the slave.

Following each successful new processing, the counter counts up. This counting process is not performed in the case of exception replies, poll commands or counter inquiries.

Request

Table 123: Request of Function code FC11

Byte	Field name	Example
Byte 0, 1	Transaction identifier	0x0000
Byte 2, 3	Protocol identifier	0x0000
Byte 4, 5	Length field	0x0002
Byte 6	Unit identifier	0x01 not used
Byte 7	MODBUS function code	0x0B

Response

The reply contains a 2-byte status word and a 2-byte event counter. The status word only contains zeroes.

Table 124: Response of Function Code FC11

Byte	Field name	Example
...		
Byte 7	MODBUS function code	0x0B
Byte 8, 9	Status	0x0000
Byte 10, 11	Event count	0x0003

The event counter shows that 3 (0x0003) events were counted.

Exception

Table 125: Exception of Function Code FC 11

Byte	Field name	Example
...		
Byte 7	MODBUS function code	0x85
Byte 8	Exception code	0x01 or 0x02

13.3.3.8 Function Code FC15 (Write Multiple Coils)

This function sets a sequence of output bits to 1 or 0 in a slave device. The maximum number is 256 bits.

Request

The request message specifies the reference number (first coil in the sequence), the bit count (number of bits to be written), and the output data. The output coils are zero-based; therefore, the first output point is 0.

In this example 16 bits are set, starting with the address 0. The request contains 2 bytes with the value 0xA5F0, or 1010 0101 1111 0000 in binary format.

The first data byte transmits the value of 0xA5 to the addresses 7 to 0, whereby 0 is the lowest value bit. The next byte transmits 0xF0 to the addresses 15 to 8, whereby the lowest value bit is 8.

Table 126: Request of Function Code FC15

Byte	Field name	Example
Byte 0, 1	Transaction identifier	0x0000
Byte 2, 3	Protocol identifier	0x0000
Byte 4, 5	Length field	0x0009
Byte 6	Unit identifier	0x01 not used
Byte 7	MODBUS function code	0x0F
Byte 8, 9	Reference number	0x0000
Byte 10, 11	Bit count	0x0010
Byte 12	Byte count	0x02
Byte 13	Data byte1	0xA5
Byte 14	Data byte2	0xF0

Response

Table 127: Response of Function Code FC15

Byte	Field name	Example
...		
Byte 7	MODBUS function code	0x0F
Byte 8, 9	Reference number	0x0000
Byte 10, 11	Bit count	0x0010

Exception

Table 128: Exception of Function Code FC15

Byte	Field name	Example
...		
Byte 7	MODBUS function code	0x8F
Byte 8	Exception code	0x01 or 0x02

13.3.3.9 Function Code FC16 (Write Multiple Registers)

This function writes a sequence of registers in a slave device in word format.

Request

The Request specifies the reference number (starting register), the word count (number of registers to write), and the register data. The data is sent as 2 bytes per register. The registers are zero-based; therefore, the first output is at address 0. Example: Set data in registers 0 and 1

Table 129: Request of Function Code FC16

Byte	Field name	Example
Byte 0, 1	Transaction identifier	0x0000
Byte 2, 3	Protocol identifier	0x0000
Byte 4, 5	Length field	0x000B
Byte 6	Unit identifier	0x01 not used
Byte 7	MODBUS function code	0x10
Byte 8, 9	Reference number	0x0000
Byte 10, 11	Word count	0x0002
Byte 12	Byte count	0x04
Byte 13, 14	Register value 1	0x1234
Byte 15, 16	Register value 2	0x2345

Response

Table 130: Response of Function Code FC16

Byte	Field name	Example
...		
Byte 7	MODBUS function code	0x10
Byte 8, 9	Reference number	0x0000
Byte 10, 11	Word count	0x0002

Exception

Table 131: Exception of Function Code FC16

Byte	Field name	Example
...		
Byte 7	MODBUS function code	0x85
Byte 8	Exception code	0x01 or 0x02

13.3.3.10 Function Code FC22 (Mask Write Register)

This function manipulates individual bits within a register using a combination of an AND mask, an OR mask, and the register's current content.

Request

Table 132: Request of Function Code FC22

Byte	Field name	Example
Byte 0, 1	Transaction identifier	0x0000
Byte 2, 3	Protocol identifier	0x0000
Byte 4, 5	Length field	0x0002
Byte 6	Unit identifier	0x01 not used
Byte 7	MODBUS function code	0x16
Byte 8, 9	Reference number	0x0000
Byte 10, 11	AND mask	0x0000
Byte 12, 13	OR mask	0xAAAA

Response

Table 133: Response of Function Code FC22

Byte	Field name	Example
...		
Byte 7	MODBUS function code	0x10
Byte 8, 9	Reference number	0x0000
Byte 10, 11	AND mask	0x0000
Byte 12, 13	OR mask	0xAAAA

Exception

Table 134: Exception of Function Code FC22

Byte	Field name	Example
...		
Byte 7	MODBUS function code	0x85
Byte 8	Exception code	0x01 or 0x02

13.3.3.11 Function Code FC23 (Read/Write Multiple Registers)

This function performs a combination of a read and write operation in a single request. The function can write the new data to a group registers, and then return the data of a different group. The write operation is performed before the read.

Request

The reference numbers (addresses) are zero-based in the request message; therefore, the first register is at address 0.

The request message specifies the registers to read and write. The data is sent as 2 bytes per register.

Example: The data in register 3 is set to value 0x0123, and values 0x0004 and 0x5678 are read out of the two registers 0 and 1.

Table 135: Request of Function Code FC23

Byte	Field name	Example
Byte 0, 1	Transaction identifier	0x0000
Byte 2, 3	Protocol identifier	0x0000
Byte 4, 5	Length field	0x000D
Byte 6	Unit identifier	0x01 not used
Byte 7	MODBUS function code	0x17
Byte 8, 9	Reference number for read	0x0000
Byte 10, 11	Word count for read (1...125)	0x0002
Byte 12, 13	Reference number for write	0x0003
Byte 14, 15	Word count for write (1...100)	0x0001
Byte 16	Byte count (2 x word count for write)	0x02
Byte 17...(B+16)	Register values (B = Byte count)	0x0123

Response

Table 136: Response of Function Code FC23

Byte	Field name	Example
...		
Byte 7	MODBUS function code	0x17
Byte 8	Byte count (2 x word count for read)	0x04
Byte 9...(B+1)	Register values (B = Byte count)	0x0004 or 0x5678

Exception

Table 137: Exception of Function Code FC23

Byte	Field name	Example
...		
Byte 7	MODBUS function code	0x97
Byte 8	Exception code	0x01 or 0x02



Note

Note that if the register ranges overlap, the results are undefined!
If register areas for read and write overlap, the results are undefined.

13.3.4 MODBUS Register Mapping

The following tables display the MODBUS addressing and the corresponding IEC61131 addressing for the process image, the PFC variables, the NOVDRAM data, and the internal variables is represented.

Via the register services the states of the complex and digital I/O modules can be determined or changed.

Register Access Reading (with FC3, FC4 and FC23)

Table 138: Register access reading (with FC3, FC4 and FC23)

MODBUS address		IEC 61131	Memory range
[dec]	[hex]	address	
0...255	0x0000...0x00FF	%IW0...%IW255	Physical input area (1) First 256 words of physical input data
256...511	0x0100...0x01FF	%QW256...%QW511	PFC OUT area Volatile PFC output variables
512...767	0x0200...0x02FF	%QW0...%QW255	Physical output area (1) First 256 words of physical output data
768...1023	0x0300...0x03FF	%IW256...%IW511	PFC IN area Volatile PFC input variables
1024...4095	0x0400...0x0FFF	-	MODBUS exception: "Illegal data address"
4096...12287	0x1000...0x2FFF	-	Configuration register (see following chapter "Configuration Functions") Not with FC23!
12288...24575	0x3000...0x5FFF	%MW0...%MW12287	NOVDRAM 24 kB retain memory *) *) In Target settings RETAIN on 0, flags on MAX (24 kB)
24576...25340	0x6000...0x62FC	%IW512...%IW1275	Physical input area (2) Additional 764 words physical input data
25341...28671	0x62FD...0x6FFF	-	MODBUS exception: "Illegal data address"
28672...29435	0x7000...0x72FB	%QW512...%QW1275	Physical output area (2) Additional 764 words physical output data
29436...32767	0x72FC...0x7FFF	-	MODBUS exception: "Illegal data address"
32768...36863	0x8000...0x8FFF	-	NOVDRAM "8 kB retain memory *) *) In Target settings RETAIN on 0, flags on MAX (32 kB)
36864...65535	0x9000...0xFFFF	-	MODBUS exception: "Illegal data address"

Register Access Writing (with FC6, FC16, FC22 and FC23)

Table 139: Register access writing (with FC6, FC16, FC22 and FC23)

MODBUS address		IEC 61131	Memory range
[dec]	[hex]	address	
0...255	0x0000...0x00FF	%QW0...%QW255	Physical output area (1) First 256 words of physical output data
256...511	0x0100...0x01FF	%IW256...%IW511	PFC IN area Volatile PFC input variables
512...767	0x0200...0x02FF	%QW0...%QW255	Physical output area (1) First 256 words of physical output data
768...1023	0x0300...0x03FF	%IW256...%IW511	PFC IN area Volatile PFC input variables
1024...4095	0x0400...0x0FFF	-	MODBUS exception: "Illegal data address"
4096...12287	0x1000...0x2FFF	-	Configuration register (see following chapter „Configuration Functions“) Not with FC22 and FC23!
12288...24575	0x3000...0x5FFF	%MW0...%MW12287	NOVRAM 24 kB retain memory *) *) In Target settings RETAIN on 0, flags on MAX (24 kB)
24576...25340	0x6000...0x62FC	%QW512...%QW1275	Physical output area (2) Additional 764 words physical output data
25341...28671	0x62FD...0x6FFF	-	MODBUS exception: "Illegal data address"
28672...29435	0x7000...0x72FB	%QW512...%QW1275	Physical output area (2) Additional 764 words physical output data
29436...32767	0x72FC...0x7FFF	-	MODBUS exception: "Illegal data address"
32768...36863	0x8000...0x8FFF	-	NOVRAM "8 kB retain memory *) *) In Target settings RETAIN on 0, flags on MAX (32 kB)
36864...65535	0x9000...0xFFFF	-	MODBUS exception: "Illegal data address"

The digital MODBUS services (coil services) are bit accesses, with which only the states of digital I/O modules can be determined or changed. Complex I/O modules are not attainable with these services and so they are ignored. Because of this the addressing of the digital channels begins again with 0, so that the MODBUS address is always identical to the channel number, (i.e. the digital input no. 47 has the MODBUS address "46").

Bit Access Reading (with FC1 and FC2)

Table 140: Bit Access Reading (with FC1 and FC2)

MODBUS address		Memory range	Description
[dec]	[hex]		
0...511	0x0000...0x01FF	Physical input area (1)	First 512 digital inputs
512...1023	0x0200...0x03FF	Physical output area (1)	First 512 digital outputs
1024...4095	0x0400...0x0FFF	-	MODBUS exception: "Illegal data address"
4096...8191	0x1000...0x1FFF	%QX256.0...%QX511.15	PFC OUT area Volatile PFC output variables
8192...12287	0x2000...0x2FFF	%IX256.0...%IX511.15	PFC IN area Volatile PFC input variables
12288...32767	0x3000...0x7FFF	%MX0...%MX1279.15	NOVRAM 2 kB retain memory (max. 24 kB)
32768...34295	0x8000...0x85F7	Physical input area (2)	Starts with the 513 th and ends with the 2039 th digital input
34296...36863	0x85F8...0x8FFF	-	MODBUS exception: "Illegal data address"
36864...38391	0x9000...0x95F7	Physical output area (2)	Starts with the 513 th and ends with the 2039 th digital output
38392...65535	0x95F8...0xFFFF	-	MODBUS exception: "Illegal data address"

Bit Access Writing (with FC5 and FC15)

Table 141: Bit Access Writing (with FC5 and FC15)

MODBUS address		Memory range	Description
[dec]	[hex]		
0...511	0x0000...0x01FF	Physical output area (1)	First 512 digital outputs
512...1023	0x0200...0x03FF	Physical output area (1)	First 512 digital outputs
1024...4095	0x0400...0x0FFF	-	MODBUS exception: "Illegal data address"
4096...8191	0x1000...0x1FFF	%IX256.0...%IX511.15	PFC IN area Volatile PFC input variables
8192...12287	0x2000...0x2FFF	%IX256.0...%IX511.15	PFC IN area Volatile PFC input variables
12288...32767	0x3000...0x7FFF	%MX0...%MX1279.15	NOVRAM 2 kB retain memory
32768...34295	0x8000...0x85F7	Physical output area (2)	Starts with the 513 th and ends with the 2039 th digital input
34296...36863	0x85F8...0x8FFF	-	MODBUS-Exception: "Illegal data address"
36864...38391	0x9000...0x95F7	Physical output area (2)	Starts with the 513 th and ends with the 2039 th digital output
38392...65535	0x95F8...0xFFFF	-	MODBUS-Exception: "Illegal data address"

13.3.5 MODBUS Registers

Table 142: MODBUS Registers

Register address	Access	Length (Word)	Description
0x1000	R/W	1	Watchdog time read/write
0x1001	R/W	1 ... 2	Watchdog coding mask 1...16
0x1002	R/W	1	Watchdog coding mask 17...32
0x1003	R/W	1	Watchdog trigger
0x1004	R	1	Minimum trigger time
0x1005	R/W	1	Watchdog stop (Write sequence 0xAAAA, 0x5555)
0x1006	R	1	Watchdog status
0x1007	R/W	1	Restart watchdog (Write sequence 0x1)
0x1008	R/W	1	Stop watchdog (Write sequence 0x55AA or 0xAA55)
0x1009	R/W	1	MODBUS and HTTP close at watchdog time-out
0x100A	R/W	1	Watchdog configuration
0x100B	W	1	Save watchdog parameter (Write sequence 0x55AA or 0xAA55)
0x1020	R	1 ... 2	LED error code
0x1021	R	1	LED error argument
0x1022	R	1 ... 4	Number of analog output data in the process image (in bits)
0x1023	R	1 ... 3	Number of analog input data in the process image (in bits)
0x1024	R	1 ... 2	Number of digital output data in the process image (in bits)
0x1025	R	1	Number of digital input data in the process image (in bits)
0x1028	R/W	1	Boot configuration
0x1029	R/W	1 ... 9	MODBUS/TCP statistics (Write sequence 0x55AA or 0xAA55)
0x102A	R	1	Number of TCP connections
0x102B	W	1	KBUS Reset
0x1030	R/W	1	Configuration MODBUS/TCP time-out
0x1031	R	1 ... 3	Read out the MAC-ID of the coupler/controller
0x1035	R/W	1	Timeoffset RTC
0x1036	R/W	1	Daylight Saving
0x1037	R/W	1	Modbus Response Delay (ms)
0x1050	R	3	Diagnosis of the connected I/O modules
0x2000	R	1 ... 9	Constant 0x0000
0x2001	R	1 ... 8	Constant 0xFFFF
0x2002	R	1 ... 7	Constant 0x1234
0x2003	R	1 ... 6	Constant 0xAAAA
0x2004	R	1 ... 5	Constant 0x5555
0x2005	R	1 ... 4	Constant 0x7FFF
0x2006	R	1 ... 3	Constant 0x8000
0x2007	R	1 ... 2	Constant 0x3FFF
0x2008	R	1	Constant 0x4000
0x2010	R	1	Firmware version
0x2011	R	1	Series code
0x2012	R	1	Coupler/controller code
0x2013	R	1	Firmware version major revision
0x2014	R	1	Firmware version minor revision

Table 143: MODBUS registers (Continuation)

Register address	Access	Length (Word)	Description
0x2020	R	1 ... 16	Short description controller
0x2021	R	1 ... 8	Compile time of the firmware
0x2022	R	1 ... 8	Compile date of the firmware
0x2023	R	1 ... 32	Indication of the firmware loader
0x2030	R	1 ... 65	Description of the connected I/O modules (module 0...64)
0x2031	R	1 ... 64	Description of the connected I/O modules (module 65...128)
0x2032	R	1 ... 64	Description of the connected I/O modules (module 129...192)
0x2033	R	1 ... 63	Description of the connected I/O modules (module 193...255)
0x2040	W	1	Software reset (Write sequence 0x55AA or 0xAA55)
0x2041	W	1	Format flash disk
0x2042	W	1	Extract HTML sides from the firmware
0x2043	W	1	Factory settings

13.3.5.1 Accessing Register Values

You can use any MODBUS application to access (read from or write to) register values. Both commercial (e.g., "Modscan") and free programs (from <http://www.modbus.org/tech.php>) are available.

The following sections describe how to access both the registers and their values.

13.3.5.2 Watchdog Registers

The watchdog monitors the data transfer between the fieldbus master and the controller. Every time the controller receives a specific request (as define in the watchdog setup registers) from the master, the watchdog timer in the controller resets.

In the case of fault free communication, the watchdog timer does not reach its end value. After each successful data transfer, the timer is reset.

If the watchdog times out, a fieldbus failure has occurred. In this case, the fieldbus controller answers all following MODBUS TCP/IP requests with the exception code 0x0004 (Slave Device Failure).

In the controller special registers are used to setup the watchdog by the master (Register addresses 0x1000 to 0x1008).

By default, the watchdog is not enabled when you turn the controller on. To activate it, the first step is to set/verify the desired time-out value of the Watchdog Time register (0x1000). Second, the function code mask must be specified in the mask register (0x1001), which defines the function code(s) that will reset the timer for the first time. Finally, the Watchdog-Trigger register (0x1003) or the register 0x1007 must be changed to a non-zero value to start the timer subsequently.

Reading the Minimum Trigger time (Register 0x1004) reveals whether a watchdog fault occurred. If this time value is 0, a fieldbus failure is assumed. The

timer of watchdog can manually be reset, if it is not timed out, by writing a value of 0x1 to the register 0x1003 or to the Restart Watchdog register 0x1007.

After the watchdog is started, it can be stopped by the user via the Watchdog Stop register (0x1005) or the Simply Stop Watchdog register (0x1008).

The watchdog registers can be addressed in the same way as described with the MODBUS read and write function codes. Specify the respective register address in place of the reference number.

Table 144: Register Address 0x1000

Register address 0x1000 (4096 _{dec})	
Value	Watchdog time, WS_TIME
Access	Read/write
Default	0x0064
Description	This register stores the watchdog timeout value as an unsigned 16 bit value. The default value is 0. Setting this value will not trigger the watchdog. However, a non zero value must be stored in this register before the watchdog can be triggered. The time value is stored in multiples of 100ms (e.g., 0x0009 is .9 seconds). It is not possible to modify this value while the watchdog is running.

Table 145: Register Address 0x1001

Register address 0x1001 (4097 _{dec})	
Value	Watchdog function coding mask, function code 1...16, WDFCM_1_16
Access	Read/write
Default	0xFFFF
Description	Using this mask, the function codes can be set to trigger the watchdog function. The function code can be selected via a "1" FC 1 Bit 0 FC 2 Bit 1 FC 3 Bit 2 FC 4 Bit 3 FC 5 Bit 4 ... FC 16 Bit 15 Changes to the register value can only be made if the watchdog is deactivated. The bit pattern stored in the register defines the function codes that trigger the watchdog. Some function codes are not supported. For those the watchdog will not be triggered even if another MODBUS device transmits one of them.

Table 146: Register Address 0x1002

Register address 0x1002 (4098_{dec})	
Value	Watchdog function coding mask, function code 17...32, WD_FCM_17_32
Access	Read/write
Default	0xFFFF
Description	<p>Same function as above, however, with the function codes 17 to 32.</p> <p>FC 17 Bit 0 FC 18 Bit 1 ... FC 32 Bit 15</p> <p>These codes are currently not supported, for this reason the default value should not be changed. Changes to the register value can only be made if the watchdog is deactivated. It is not possible to modify this value while the watchdog is running.</p>

Table 147: Register Address 0x1003

Register address 0x1003 (4099_{dec})	
Value	Watchdog trigger, WD_TRIGGER
Access	Read/write
Standard	0x0000
Description	<p>This register is used for an alternative trigger method. The watchdog is triggered by writing different values in this register. Values following each other must differ in size. Writing of a value not equal to zero starts the watchdog after a Power-on. For a restart the written value must necessarily be unequal the before written value! A watchdog fault is reset and writing process data is possible again.</p>

Table 148: Register Address 0x1004

Register address 0x1004 (4100_{dez})	
Value	Minimum current trigger time, WD_AC_TRG_TIME
Access	Read
Standard	0xFFFF
Description	<p>This register saves the minimum current watchdog trigger time. If the watchdog is triggered, the saved value is compared with the current value. If the current value is smaller than the saved value, this is replaced by the current value. The unit is 100 ms/digit. The saved value is changed by writing new values, which does not affect the watchdog. 0x0000 is not permissible.</p>

Table 149: Register Address 0x1005

Register address 0x1005 (4101_{dez})	
Value	Stop watchdog, WD_AC_STOP_MASK
Access	Read/write
Standard	0x0000
Description	<p>The watchdog is stopped if here the value 0xAAAA is written first, followed by 0x5555. The watchdog fault reaction is blocked. A watchdog fault is reset and writing on the process data is possible again.</p>

Table 150: Register Address 0x1006

Register address 0x1006 (4102 _{dez})	
Value	While watchdog is running, WD_RUNNING
Access	Read
Standard	0x0000
Description	Current watchdog status. at 0x0000: Watchdog not active at 0x0001: Watchdog active at 0x0002: Watchdog exhausted.

Table 151: Register Address 0x1007

Register address 0x1007 (4103 _{dez})	
Value	Restart watchdog, WD_RESTART
Access	Read/write
Standard	0x0000
Description	This register restarts the watchdog timer by writing a value of 0x1 into it. If the watchdog was stopped before the overrun, it is not restarted.

Table 152: Register Address 0x1008

Register address 0x1008 (4104 _{dez})	
Value	Simply stop watchdog, WD_AC_STOP_SIMPLE
Access	Read/write
Standard	0x0000
Description	This register stops the watchdog by writing the value 0xAA55 or 0x55AA into it. The watchdog timeout fault is deactivated and it is possible to write in the watchdog register again. If there is an existing watchdog fault, it is reset

Table 153: Register Address 0x1009

Register address 0x1009 (4105 _{dez})	
Value	Close MODBUS socket after watchdog timeout
Access	Read/write
Description	0: MODBUS socket is not closed 1: MODBUS socket is closed

Table 154: Register Address 0x100A

Register address 0x100A (4106 _{dez})	
Value	Alternative watchdog
Access	Read/write
Standard	0x0000
Description	This register provides an alternate way to activate the watchdog timer. Procedure: Write a time value in register 0x1000; then write a 0x0001 into register 0x100A. With the first MODBUS request, the watchdog is started. The watchdog timer is reset with each MODBUS/TCP instruction. If the watchdog times out, all outputs are set to zero. The outputs will become operational again, after communications are re-established. Register 0x00A is non-volatile, including register 0x1000. It is not possible to modify the time value in register 0x1000 while the watchdog is running.

The length of each register is 1 word; i.e., with each access only one word can be written or read. Following are two examples of how to set the value for a time overrun:

Setting the watchdog for a timeout of more than 1 second:

1. Write 0x000A in the register for time overrun (0x1000).
Register 0x1000 works with a multiple of 100 ms;
1 s = 1000 ms; 1000 ms / 100 ms = 10_{dec} = A_{hex})
2. Use the function code 5 to write 0x0010 (=2⁽⁵⁻¹⁾) in the coding mask (register 0x1001).

Table 155: Starting Watchdog

FC	FC16	FC15	FC14	FC13	FC12	FC11	FC10	FC9	FC8	FC7	FC6	FC5	FC4	FC3	FC2	FC1
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
bin	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
hex	0				0				1				0			

Function code 5 (writing a digital output bit) continuously triggers the watchdog to restart the watchdog timer again and again within the specified time. If time between requests exceeds 1 second, a watchdog timeout error occurs.

3. To stop the watchdog, write the value 0xAA55 or 0x55AA into 0x1008 (Simply Stop Watchdog register, WD_AC_STOP_SIMPLE).

Setting the watchdog for a timeout of 10 minutes or more:

1. Write 0x1770 (= 10*60*1000 ms / 100 ms) in the register for time overrun (0x1000).
(Register 0x1000 works with a multiple of 100 ms;
10 min = 600,000 ms; 600,000 ms / 100 ms = 6000_{dec} = 1770_{hex})
2. Write 0x0001 in the watchdog trigger register (0x1003) to start the watchdog.
3. Write different values (e.g., counter values 0x0000, 0x0001) in the watchdog to trigger register (0x1003).

Values following each other must differ in size. Writing of a value not equal to zero starts the watchdog. Watchdog faults are reset and writing process data is possible again.

4. To stop the watchdog, write the value 0xAA55 or 0x55AA into 0x1008 (Simply Stop Watchdog register, WD_AC_STOP_SIMPLE).

Table 156: Register Address 0x100B

Register address 0x100B (4107_{dez})	
Value	Save watchdog parameter
Access	Write
Standard	0x0000
Description	With writing of '0x55AA' or '0xAA55' in register 0x100B the registers 0x1000, 0x1001, 0x1002 are set on remanent.

13.3.5.3 Diagnostic Registers

The following registers can be read to determine errors in the node:

Table 157: Register Address 0x1020

Register address 0x1020 (4128 _{dec})	
Value	LedErrCode
Access	Read
Description	Declaration of the error code

Table 158: Register Address 0x1021

Register address 0x1021 (4129 _{dec})	
Value	LedErrArg
Access	Read
Description	Declaration of the error argument

13.3.5.4 Configuration Registers

The following registers contain configuration information of the connected modules:

Table 159: Register Address 0x1022

Register address 0x1022 (4130 _{dec})	
Value	CnfLen.AnalogOut
Access	Read
Description	Number of word-based outputs registers in the process image in bits (divide by 16 to get the total number of analog words)

Table 160: Register Address 0x1023

Register address 0x1023 (4131 _{dec})	
Value	CnfLen.AnalogInp
Access	Read
Description	Number of word-based inputs registers in the process image in bits (divide by 16 to get the total number of analog words)

Table 161: Register Address 0x1024

Register address 0x1024 (4132 _{dec})	
Value	CnfLen.DigitalOut
Access	Read
Description	Number of digital output bits in the process image

Table 162: Register Address 0x1025

Register address 0x1025 (4133 _{dec})	
Value	CnfLen.DigitalInp
Access	Read
Description	Number of digital input bits in the process image

Table 163: Register Address 0x1028

Register address 0x1028 (4136 _{dec})	
Value	Boot options
Access	Read/write
Description	Boot configuration: 1: BootP 2: DHCP 3: BootP-Request before static IP 4: EEPROM

Table 164: Register Address 0x1029

Register address 0x1029 (4137 _{dec}) with 9 words		
Value	MODBUS TCP statistics	
Access	Read/write	
Description	1 word SlaveDeviceFailure	→ internal bus error, fieldbus error by activated watchdog
	1 word BadProtocol	→ error in the MODBUS TCP header
	1 word BadLength	→ Wrong telegram length
	1 word BadFunction	→ Invalid function code
	1 word BadAddress	→ Invalid register address
	1 word BadData	→ Invalid value
	1 word TooManyRegisters	→ Number of the registers which can be worked on is too large, Read/Write 125/100
	1 word TooManyBits	→ Number of the coils which can be worked on is too large, Read/Write 2000/800
	1 word ModTcpMessageCounter	→ Number of received MODBUS/TCP requests
	With writing 0xAA55 or 0x55AA in the register will reset this data area.	

Table 165: Register Address 0x102A

Register address 0x102A (4138 _{dec}) with a word count of 1	
Value	MODBUS/TCP connections
Access	Read
Description	Number of TCP connections

Table 166: Register Address 0x102B

Register address 0x102B (4139 _{dec}) with a word count of up to 1	
Value	KBUS reset
Access	Write
Description	Writing of this register restarts the internal bus

Table 167: Register Address 0x1030

Register address 0x1030 (4144 _{dec}) with a word count of 1	
Value	Configuration MODBUS/TCP time-out
Access	Read/write
Default	0x0258 (600 decimal)
Description	This is the maximum number of milliseconds the fieldbus coupler will allow a MODBUS/TCP connection to stay open without receiving a MODBUS request. Upon time-out, idle connection will be closed. Outputs remain in last state. Default value is 600 ms (60 seconds), the time base is 100 ms, the minimal value is 100 ms. If the value is set to '0', the timeout is disabled. On this connection, the watchdog is triggered with a request.

Table 168: Register Address 0x1031

Register address 0x1031 (4145 _{dec}) with a word count of 3	
Value	Read the MAC-ID of the controller
Access	Read
Description	This register gives the MAC-ID, with a length of 3 words

Table 169: Register Address 0x1035

Register address 0x1035 (4149_{dez}) 1 word	
Value	Configuration of the time offsets to the GMT time
Access	Read/write
Default	0x0000
Description	Register to set the time offset to the UTC time (Greenwich meridian) with a possible setting range from -12 to +12.

Table 170: Register Address 0x1036

Register address 0x1036 (4150_{dez}) 1 word	
Value	Configuration of summer or winter time
Access	Read/write
Default	0x0000
Description	Register to set winter or summer time (Daylight Saving Time). The values 0 and 1 are valid.

Table 171: Register Address 0x1037

Register address 0x1031 (4151_{dez}) with a word count of 3	
Value	Configuration of Modbus Response Delay Time
Access	Read/write
Default	0x0000
Description	This register saves the value for the Modbus Response Delay Time for a Modbus connection. The time base is 1 ms. On the Modbus TCP connection, the response will be delayed by the inscribed time.

Table 172: Register Address 0x1050

Register address 0x1050 (4176_{dec}) with a word count of 3	
Value	Diagnosis of the connected I/O modules
Access	Read
Description	Diagnosis of the connected I/O modules, length 3 words Word 1: Number of the module Word 2: Number of the channel Word 3: Diagnosis

Table 173: Register Address 0x2030

Register address 0x2030 (8240_{dec}) with a word count of up to 65																
Value	Description of the connected I/O modules															
Access	Read module 0...64															
Description	Length 1...65 words These 65 registers identify the controller and the first 64 modules present in a node. Each module is represented in a word. Because order numbers cannot be read out of digital modules, a code is displayed for them, as defined below: Bit position 0 → Input module Bit position 1 → Output module Bit position 2...7 → Not used Bit position 8...14 → Module size in bits Bit position 15 → Designation digital module															
Examples:																
4 Channel Digital Input Module = 0x8401																
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Code	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Hex	8				4				0				1			
2 Channel Digital Output Module = 0x8202																
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Code	1	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0
Hex	8				2				0				2			

Table 174: Register Address 0x2031

Register address 0x2031 (8241_{dec}) with a word count of up to 64															
Value	Description of the connected I/O modules														
Access	Read modules 65...128														
Description	Length 1...64 words These 64 registers identify the 2nd block of I/O modules present (modules 65 to 128). Each module is represented in a word. Because order numbers cannot be read out of digital modules, a code is displayed for them, as defined below: Bit position 0 → Input module Bit position 1 → Output module Bit position 2...7 → Not used Bit position 8...14 → Module size in bits Bit position 15 → Designation digital module														

Table 175: Register Address 0x2032

Register address 0x2032 (8242_{dec}) with a word count of up to 64															
Value	Description of the connected I/O modules														
Access	Read modules 129...192														
Description	Length 1...64 words These 64 registers identify the 3rd block of I/O modules present (modules 129 to 192). Each module is represented in a word. Because order numbers cannot be read out of digital modules, a code is displayed for them, as defined below: Bit position 0 → Input module Bit position 1 → Output module Bit position 2...7 → Not used Bit position 8...14 → Module size in bits Bit position 15 → Designation digital module														

Table 176: Register Address 0x2033

Register address 0x2033 (8243_{dec}) with a word count of up to 65	
Value	Description of the connected I/O modules
Access	Read modules 193 ... 255
Description	<p>Length 1...63 words</p> <p>These 63 registers identify the 4th block of I/O modules present (modules 193 to 255). Each module is represented in a word. Because order numbers cannot be read out of digital modules, a code is displayed for them, as defined below:</p> <p>Bit position 0 → Input module</p> <p>Bit position 1 → Output module</p> <p>Bit position 2...7 → Not used</p> <p>Bit position 8...14 → Module size in bits</p> <p>Bit position 15 → Designation digital module</p>

Table 177: Register Address 0x2040

Register address 0x2040 (8256_{dec})	
Value	Implement a software reset
Access	Write (Write sequence 0xAA55 or 0x55AA)
Description	With writing 0xAA55 or 0x55AA the register will be reset.

Table 178: Register Address 0x2041

Register address 0x2041 (8257_{dez})	
Value	Flash format
Access	Write (Write sequence 0xAA55 or 0x55AA)
Description	The file system Flash is again formatted.

Table 179: Register Address 0x2042

Register address 0x2042 (8258_{dez})	
Value	Extract data files
Access	Write (Write sequence 0xAA55 or 0x55AA)
Description	The standard files (HTML pages) of the Coupler/Controller are extracted and written into the Flash.

Table 180: Register Address 0x2043

Register address 0x2043 (8259_{dez})	
Value	0x55AA
Access	Write
Description	Factory settings

13.3.5.5 Firmware Information Registers

The following registers contain information on the firmware of the controller:

Table 181: Register Address 0x2010

Register address 0x2010 (8208 _{dec}) with a word count of 1	
Value	Revision, INFO_REVISION
Access	Read
Description	Firmware index, e.g. 0x0005 for version 5

Table 182: Register Address 0x2011

Register address 0x2011 (8209 _{dec}) with a word count of 1	
Value	Series code, INFO_SERIES
Access	Read
Description	WAGO serial number, e.g. 0x02EE (750 dec.) for WAGO-I/O-SYSTEM 750

Table 183: Register Address 0x2012

Register address 0x2012 (8210 _{dec}) with a word count of 1	
Value	Order number, INFO_ITEM
Access	Read
Description	First part of WAGO order number, e.g. 0x0349 (841 dec.) for the controller 750-841 or 0x0155 (341 dec.) for the coupler 750-341 etc.

Table 184: Register Address 0x2013

Register address 0x2013 (8211 _{dec}) with a word count of 1	
Value	Major sub item code, INFO_MAJOR
Access	Read
Description	Firmware version major revision

Table 185: Register Address 0x2014

Register address 0x2014 (8212 _{dec}) with a word count of 1	
Value	Minor sub item code, INFO_MINOR
Access	Read
Description	Firmware version minor revision

Table 186: Register Address 0x2020

Register address 0x2020 (8224 _{dec}) with a word count of up to 16	
Value	Description, INFO_DESCRIPTION
Access	Read
Description	Information on the controller, 16 words

Table 187: Register Address 0x2021

Register address 0x2021 (8225_{dec}) with a word count of up to 8	
Value	Description, INFO_DESCRIPTION
Access	Read
Description	Time of the firmware version, 8 words

Table 188: Register Address 0x2022

Register address 0x2022 (8226_{dec}) with a word count of up to 8	
Value	Description, INFO_DATE
Access	Read
Description	Date of the firmware version, 8 words

Table 189: Register Address 0x2023

Register address 0x2023 (8227_{dec}) with a word count of up to 32	
Value	Description, INFO_LOADER_INFO
Access	Read
Description	Information to the programming of the firmware, 32 words

13.3.5.6 Constant Registers

The following registers contain constants, which can be used to test communication with the master:

Table 190: Register Address 0x2000

Register address 0x2000 (8192 _{dec})	
Value	Zero, GP_ZERO
Access	Read
Description	Constant with zeros

Table 191: Register Address 0x2001

Register address 0x2001 (8193 _{dec})	
Value	Ones, GP_ONES
Access	Read
Description	Constant with ones <ul style="list-style-type: none"> • -1 if this is declared as "signed int" • MAXVALUE if it is declared as "unsigned int"

Table 192: Register Address 0x2002

Register address 0x2002 (8194 _{dec})	
Value	1,2,3,4, GP_1234
Access	Read
Description	This constant value is used to test the Intel/Motorola format specifier. If the master reads a value of 0x1234, then with Intel format is selected – this is the correct format. If 0x3412 appears, Motorola format is selected.

Table 193: Register Address 0x2003

Register address 0x2003 (8195 _{dec})	
Value	Mask 1, GP_AAAA
Access	Read
Description	This constant is used to verify that all bits are accessible to the fieldbus master. This will be used together with register 0x2004.

Table 194: Register Address 0x2004

Register address 0x2004 (8196 _{dec})	
Value	Mask 1, GP_5555
Access	Read
Description	This constant is used to verify that all bits are accessible to the fieldbus master. This will be used together with register 0x2003.

Table 195: Register Address 0x2005

Register address 0x2005 (8197 _{dec})	
Value	Maximum positive number, GP_MAX_POS
Access	Read
Description	Constant in order to control arithmetic.

Table 196: Register Address 0x2006

Register address 0x2006 (8198_{dec})	
Value	Maximum negative number, GP_MAX_NEG
Access	Read
Description	Constant in order to control arithmetic

Table 197: Register Address 0x2007

Register address 0x2007 (8199_{dec})	
Value	Maximum half positive number, GP_HALF_POS
Access	Read
Description	Constant in order to control arithmetic

Table 198: Register Address 0x2008

Register address 0x2008 (8200_{dec})	
Value	Maximum half negative number, GP_HALF_NEG
Access	Read
Description	Constant in order to control arithmetic

Table 199: Register Addresses 0x3000 to 0x5FFF

Register addresses 0x3000 to 0x5FFF (12288_{dec} to 24575_{dec})	
Value	Retain range
Access	Read/write
Description	These registers can be accessed as the flag/retain range

14 I/O Modules

14.1 Overview

For modular applications with the WAGO-I/O-SYSTEM 750/753, different types of I/O modules are available

- Digital Input Modules
- Digital Output Modules
- Analog Input Modules
- Analog Output Modules
- Specialty Modules
- System Modules

For detailed information on the I/O modules and the module variations, refer to the manuals for the I/O modules.

You will find these manuals on the WAGO web pages under www.wago.com.

Information



More Information about the WAGO-I/O-SYSTEM

Current information on the modular WAGO-I/O-SYSTEM is available in the Internet under: www.wago.com.

14.2 Process Data Architecture for MODBUS/TCP

With some I/O modules, the structure of the process data is fieldbus specific.

MODBUS/TCP process image uses a word structure (with word alignment). The internal mapping method for data greater than one byte conforms to the Intel format.

The following section describes the process image for various WAGO-I/O-SYSTEM 750 and 753 I/O modules with MODBUS/TCP.

NOTICE

Equipment damage due to incorrect address!

Depending on the specific position of an I/O module in the fieldbus node, the process data of all previous byte or bit-oriented modules must be taken into account to determine its location in the process data map.

The structure of the process data mapping is identical for the PFC process image of the programmable fieldbus controller.

14.2.1 Digital Input Modules

Digital input modules supply one bit of data per channel to specify the signal state for the corresponding channel. These bits are mapped into the Input Process Image.

Some digital modules have an additional diagnostic bit per channel in the Input Process Image. The diagnostic bit is used for detecting faults that occur (e.g., wire breaks and/or short circuits).

When analog input modules are also present in the node, the digital data is always appended after the analog data in the Input Process Image, grouped into bytes.

14.2.1.1 1 Channel Digital Input Module with Diagnostics

750-435

Table 200: 1 Channel Digital Input Module with Diagnostics

Input Process Image							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
						Diagnostic bit S 1	Data bit DI 1

14.2.1.2 2 Channel Digital Input Modules

750-400, -401, -405, -406, -410, -411, -412, -427, -438, (and all variations),
753-400, -401, -405, -406, -410, -411, -412, -427

Table 201: 2 Channel Digital Input Modules

Input Process Image							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
						Data bit DI 2 Channel 2	Data bit DI 1 Channel 1

14.2.1.3 2 Channel Digital Input Module with Diagnostics

750-419, -421, -424, -425,
753-421, -424, -425

Table 202: 2 Channel Digital Input Module with Diagnostics

Input Process Image							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
				Diagnostic bit S 2 Channel 2	Diagnostic bit S 1 Channel 1	Data bit DI 2 Channel 2	Data bit DI 1 Channel 1

14.2.1.4 2 Channel Digital Input Module with Diagnostics and Output Process Data

750-418,
753-418

The digital input module supplies a diagnostic and acknowledge bit for each input channel. If a fault condition occurs, the diagnostic bit is set. After the fault condition is cleared, an acknowledge bit must be set to re-activate the input. The diagnostic data and input data bit is mapped in the Input Process Image, while the acknowledge bit is in the Output Process Image.

Table 203: 2 Channel Digital Input Module with Diagnostics and Output Process Data

Input Process Image							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
				Diagnostic bit S 2 Channel 2	Diagnostic bit S 1 Channel 1	Data bit DI 2 Channel 2	Data bit DI 1 Channel 1

Output Process Image							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
				Acknowledgement bit Q 2 Channel 2	Acknowledgement bit Q 1 Channel 1	0	0

14.2.1.5 4 Channel Digital Input Modules

750-402, -403, -408, -409, -414, -415, -422, -423, -428, -432, -433, -1420, -1421, -1422, -1423
753-402, -403, -408, -409, -415, -422, -423, -428, -432, -433, -440

Table 204: 4 Channel Digital Input Modules

Input Process Image							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
				Data bit DI 4 Channel 4	Data bit DI 3 Channel 3	Data bit DI 2 Channel 2	Data bit DI 1 Channel 1

14.2.1.6 8 Channel Digital Input Modules

750-430, -431, -436, -437, -1415, -1416, -1417, -1418
753-430, -431, -434

Table 205: 8 Channel Digital Input Modules

Input Process Image							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Data bit DI 8 Channel 8	Data bit DI 7 Channel 7	Data bit DI 6 Channel 6	Data bit DI 5 Channel 5	Data bit DI 4 Channel 4	Data bit DI 3 Channel 3	Data bit DI 2 Channel 2	Data bit DI 1 Channel 1

14.2.1.7 8 Channel Digital Input Module PTC with Diagnostics and Output Process Data

750-1425

The digital input module PTC provides via one logical channel 2 byte for the input and output process image.

The signal state of PTC inputs DI1 ... DI8 is transmitted to the fieldbus coupler/controller via input data byte D0.

The fault conditions are transmitted via input data byte D1.

The channels 1 ... 8 are switched on or off via the output data byte D1. The output data byte D0 is reserved and always has the value "0".

Table 206: 8 Channel Digital Input Module PTC with Diagnostics and Output Process Data

Input Process Image															
Input Byte D0								Input Byte D1							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Signal status DI 8 Channel 8	Signal status DI 7 Channel 7	Signal status DI 6 Channel 6	Signal status DI 5 Channel 5	Signal status DI 4 Channel 4	Signal status DI 3 Channel 3	Signal status DI 2 Channel 2	Signal status DI 1 Channel 1	Wire break/short circuit DB/KS 8 Channel 8	Wire break/short circuit DB/KS 7 Channel 7	Wire break/short circuit DB/KS 6 Channel 6	Wire break/short circuit DB/KS 5 Channel 5	Wire break/short circuit DB/KS 4 Channel 4	Wire break/short circuit DB/KS 3 Channel 3	Wire break/short circuit DB/KS 2 Channel 2	Wire break/short circuit DB/KS 1 Channel 1

Output Process Image															
Output Byte D0								Output Byte D1							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	0	0	0	0	0	0	DI Off 8 Channel 8	DI Off 7 Channel 7	DI Off 6 Channel 6	DI Off 5 Channel 5	DI Off 4 Channel 4	DI Off 3 Channel 3	DI Off 2 Channel 2	DI Off 1 Channel 1
								0: Channel ON 1: Channel OFF	0: Channel ON 1: Channel OFF	0: Channel ON 1: Channel OFF	0: Channel ON 1: Channel OFF	0: Channel ON 1: Channel OFF	0: Channel ON 1: Channel OFF	0: Channel ON 1: Channel OFF	0: Channel ON 1: Channel OFF

14.2.1.8 16 Channel Digital Input Modules

750-1400, -1402, -1405, -1406, -1407

Table 207: 16 Channel Digital Input Modules

Input Process Image															
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Data bit DI 16 Channel 16	Data bit DI 15 Channel 15	Data bit DI 14 Channel 14	Data bit DI 13 Channel 13	Data bit DI 12 Channel 12	Data bit DI 11 Channel 11	Data bit DI 10 Channel 10	Data bit DI 9 Channel 9	Data bit DI 8 Channel 8	Data bit DI 7 Channel 7	Data bit DI 6 Channel 6	Data bit DI 5 Channel 5	Data bit DI 4 Channel 4	Data bit DI 3 Channel 3	Data bit DI 2 Channel 2	Data bit DI 1 Channel 1

14.2.2 Digital Output Modules

Digital output modules use one bit of data per channel to control the output of the corresponding channel. These bits are mapped into the Output Process Image.

Some digital modules have an additional diagnostic bit per channel in the Input Process Image. The diagnostic bit is used for detecting faults that occur (e.g., wire breaks and/or short circuits). For modules with diagnostic bit is set, also the data bits have to be evaluated.

When analog output modules are also present in the node, the digital image data is always appended after the analog data in the Output Process Image, grouped into bytes.

14.2.2.1 1 Channel Digital Output Module with Input Process Data

750-523

The digital output modules deliver 1 bit via a process value Bit in the output process image, which is illustrated in the input process image. This status image shows "manual mode".

Table 208: 1 Channel Digital Output Module with Input Process Data

Input Process Image							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
						not used	Status bit "Manual Operation"

Output Process Image							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
						not used	controls DO 1 Channel 1

14.2.2.2 2 Channel Digital Output Modules

750-501, -502, -509, -512, -513, -514, -517, -535, (and all variations),
753-501, -502, -509, -512, -513, -514, -517

Table 209: 2 Channel Digital Output Modules

Output Process Image							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
						controls DO 2 Channel 2	controls DO 1 Channel 1

14.2.2.3 2 Channel Digital Input Modules with Diagnostics and Input Process Data

750-507 (-508), -522,
753-507

The digital output modules have a diagnostic bit for each output channel. When an output fault condition occurs (i.e., overload, short circuit, or broken wire), a diagnostic bit is set. The diagnostic data is mapped into the Input Process Image, while the output control bits are in the Output Process Image.

Table 210: 2 Channel Digital Input Modules with Diagnostics and Input Process Data

Input Process Image							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
						Diagnostic bit S 2 Channel 2	Diagnostic bit S 1 Channel 1

Output Process Image							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
						controls DO 2 Channel 2	controls DO 1 Channel 1

750-506,
753-506

The digital output module has 2-bits of diagnostic information for each output channel. The 2-bit diagnostic information can then be decoded to determine the exact fault condition of the module (i.e., overload, a short circuit, or a broken wire). The 4-bits of diagnostic data are mapped into the Input Process Image, while the output control bits are in the Output Process Image.

Table 211: 2 Channel Digital Input Modules with Diagnostics and Input Process Data 75x-506

Input Process Image							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
				Diagnostic bit S 3 Channel 2	Diagnostic bit S 2 Channel 2	Diagnostic bit S 1 Channel 1	Diagnostic bit S 0 Channel 1

Diagnostic bits S1/S0, S3/S2: = '00' standard mode
 Diagnostic bits S1/S0, S3/S2: = '01' no connected load/short circuit against +24 V
 Diagnostic bits S1/S0, S3/S2: = '10' Short circuit to ground/overload

Output Process Image							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
				not used	not used	controls DO 2 Channel 2	controls DO 1 Channel 1

14.2.2.4 4 Channel Digital Output Modules

750-504, -516, -519, -531,
753-504, -516, -531, -540

Table 212: 4 Channel Digital Output Modules

Output Process Image							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
				controls DO 4 Channel 4	controls DO 3 Channel 3	controls DO 2 Channel 2	controls DO 1 Channel 1

14.2.2.5 4 Channel Digital Output Modules with Diagnostics and Input Process Data

750-532

The digital output modules have a diagnostic bit for each output channel. When an output fault condition occurs (i.e., overload, short circuit, or broken wire), a diagnostic bit is set. The diagnostic data is mapped into the Input Process Image, while the output control bits are in the Output Process Image.

Table 213: 4 Channel Digital Output Modules with Diagnostics and Input Process Data

Input Process Image							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
				Diagnostic bit S 4 Channel 4	Diagnostic bit S 3 Channel 3	Diagnostic bit S 2 Channel 2	Diagnostic bit S 1 Channel 1

Diagnostic bit S = '0' no Error

Diagnostic bit S = '1' overload, short circuit, or broken wire

Output Process Image							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
				controls DO 4 Channel 4	controls DO 3 Channel 3	controls DO 2 Channel 2	controls DO 1 Channel 1

14.2.2.6 8 Channel Digital Output Module

750-530, -536, -1515, -1516
753-530, -534

Table 214: 8 Channel Digital Output Module

Output Process Image							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
controls DO 8 Channel 8	controls DO 7 Channel 7	controls DO 6 Channel 6	controls DO 5 Channel 5	controls DO 4 Channel 4	controls DO 3 Channel 3	controls DO 2 Channel 2	controls DO 1 Channel 1

14.2.2.7 8 Channel Digital Output Modules with Diagnostics and Input Process Data

750-537

The digital output modules have a diagnostic bit for each output channel. When an output fault condition occurs (i.e., overload, short circuit, or broken wire), a diagnostic bit is set. The diagnostic data is mapped into the Input Process Image, while the output control bits are in the Output Process Image.

Table 215: 8 Channel Digital Output Modules with Diagnostics and Input Process Data

Input Process Image							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Diagnostic bit S 8	Diagnostic bit S 7	Diagnostic bit S 6	Diagnostic bit S 5	Diagnostic bit S 4	Diagnostic bit S 3	Diagnostic bit S 2	Diagnostic bit S 1
Channel 8	Channel 7	Channel 6	Channel 5	Channel 4	Channel 3	Channel 2	Channel 1

Diagnostic bit S = '0' no Error
Diagnostic bit S = '1' overload, short circuit, or broken wire

Output Process Image							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
controls DO 8	controls DO 7	controls DO 6	controls DO 5	controls DO 4	controls DO 3	controls DO 2	controls DO 1
Channel 8	Channel 7	Channel 6	Channel 5	Channel 4	Channel 3	Channel 2	Channel 1

14.2.2.8 16 Channel Digital Output Modules

750-1500, -1501, -1504, -1505

Table 216: 16 Channel Digital Output Modules

Output Process Image															
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
controls DO 16	controls DO 15	controls DO 14	controls DO 13	controls DO 12	controls DO 11	controls DO 10	controls DO 9	controls DO 8	controls DO 7	controls DO 6	controls DO 5	controls DO 4	controls DO 3	controls DO 2	controls DO 1
Channel 16	Channel 15	Channel 14	Channel 13	Channel 12	Channel 11	Channel 10	Channel 9	Channel 8	Channel 7	Channel 6	Channel 5	Channel 4	Channel 3	Channel 2	Channel 1

14.2.2.9 8 Channel Digital Input/Output Modules

750-1502, -1506

Table 217: 8 Channel Digital Input/Output Modules

Input Process Image							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Data bit DI 8	Data bit DI 7	Data bit DI 6	Data bit DI 5	Data bit DI 4	Data bit DI 3	Data bit DI 2	Data bit DI 1
Channel 8	Channel 7	Channel 6	Channel 5	Channel 4	Channel 3	Channel 2	Channel 1

Output Process Image							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
controls DO 8	controls DO 7	controls DO 6	controls DO 5	controls DO 4	controls DO 3	controls DO 2	controls DO 1
Channel 8	Channel 7	Channel 6	Channel 5	Channel 4	Channel 3	Channel 2	Channel 1

14.2.3 Analog Input Modules

The hardware of an analog input module has 16 bits of measured analog data per channel and 8 bits of control/status.

However, the coupler/controller with MODBUS/TCP does not have access to the 8 control/status bits.

Therefore, the coupler/controller with MODBUS/TCP can only access the 16 bits of analog data per channel, which are grouped as words and mapped in Intel format in the Input Process Image.

When digital input modules are also present in the node, the analog input data is always mapped into the Input Process Image in front of the digital data.

Information



Information on the structure of control and status bytes

For detailed information on the structure of a particular I/O module's control/status bytes, please refer to that module's manual. Manuals for each module can be found on the Internet at www.wago.com.

14.2.3.1 1 Channel Analog Input Modules

750-491, (and all variations)

Table 218: 1 Channel Analog Input Modules

Input Process Image			
Offset	Byte Destination		Description
	High Byte	Low Byte	
0	D1	D0	Measured Value U_D
1	D3	D2	Measured Value U_{ref}

14.2.3.2 2 Channel Analog Input Modules

750-452, -454, -456, -461, -462, -465, -466, -467, -469, -472, -474, -475, 476, -477, -478, -479, -480, -481, -483, -485, -492, (and all variations),
753-452, -454, -456, -461, -465, -466, -467, -469, -472, -474, -475, 476, -477, 478, -479, -483, -492, (and all variations)

Table 219: 2 Channel Analog Input Modules

Input Process Image			
Offset	Byte Destination		Description
	High Byte	Low Byte	
0	D1	D0	Measured Value Channel 1
1	D3	D2	Measured Value Channel 2

14.2.3.3 4 Channel Analog Input Modules

750-450, -453, -455, -457, -459, -460, -468, (and all variations),
753-453, -455, -457, -459

Table 220: 4 Channel Analog Input Modules

Input Process Image			
Offset	Byte Destination		Description
	High Byte	Low Byte	
0	D1	D0	Measured Value Channel 1
1	D3	D2	Measured Value Channel 2
2	D5	D4	Measured Value Channel 3
3	D7	D6	Measured Value Channel 4

14.2.3.4 3-Phase Power Measurement Module

750-493

The above Analog Input Modules have a total of 9 bytes of user data in both the Input and Output Process Image (6 bytes of data and 3 bytes of control/status). The following tables illustrate the Input and Output Process Image, which has a total of 6 words mapped into each image. Word alignment is applied.

Table 221: 3-Phase Power Measurement Module

Input Process Image			
Offset	Byte Destination		Description
	High Byte	Low Byte	
0	-	S0	Status byte 0
1	D1	D0	Input data word 1
2	-	S1	Status byte 1
3	D3	D2	Input data word 2
4	-	S2	Status byte 2
5	D5	D4	Input data word 3

Output Process Image			
Offset	Byte Destination		Description
	High Byte	Low Byte	
0	-	C0	Control byte 0
1	D1	D0	Output data word 1
2	-	C1	Control byte 1
3	D3	D2	Output data word 2
4	-	C2	Control byte 2
5	D5	D4	Output data word 3

14.2.3.5 8 Channel Analog Input Modules

750-451

Table 222: 8 Channel Analog Input Modules

Input Process Image			
Offset	Byte Destination		Description
	High Byte	Low Byte	
0	D1	D0	Measured Value Channel 1
1	D3	D2	Measured Value Channel 2
2	D5	D4	Measured Value Channel 3
3	D7	D6	Measured Value Channel 4
4	D9	D8	Measured Value Channel 5
5	D11	D10	Measured Value Channel 6
6	D13	D12	Measured Value Channel 7
7	D15	D14	Measured Value Channel 8

14.2.4 Analog Output Modules

The hardware of an analog output module has 16 bits of measured analog data per channel and 8 bits of control/status. However, the coupler/controller with MODBUS/TCP does not have access to the 8 control/status bits. Therefore, the coupler/controller with MODBUS/TCP can only access the 16 bits of analog data per channel, which are grouped as words and mapped in Intel format in the Output Process Image.

When digital output modules are also present in the node, the analog output data is always mapped into the Output Process Image in front of the digital data.



Information

Information on the structure of control and status bytes

For detailed information on the structure of a particular I/O module's control/status bytes, please refer to that module's manual. Manuals for each module can be found on the Internet at www.wago.com.

14.2.4.1 2 Channel Analog Output Modules

750-550, -552, -554, -556, -560, -562, 563, -585, (and all variations),
753-550, -552, -554, -556

Table 223: 2 Channel Analog Output Modules

Output Process Image			
Offset	Byte Destination		Description
	High Byte	Low Byte	
0	D1	D0	Output Value Channel 1
1	D3	D2	Output Value Channel 2

14.2.4.2 4 Channel Analog Output Modules

750-553, -555, -557, -559,
753-553, -555, -557, -559

Table 224: 4 Channel Analog Output Modules

Output Process Image			
Offset	Byte Destination		Description
	High Byte	Low Byte	
0	D1	D0	Output Value Channel 1
1	D3	D2	Output Value Channel 2
2	D5	D4	Output Value Channel 3
3	D7	D6	Output Value Channel 4

14.2.4.3 8 Channel Analog Output Modules

Table 225: 8 Channel Analog Output Modules

Output Process Image			
Offset	Byte Destination		Description
	High Byte	Low Byte	
0	D1	D0	Output Value Channel 1
1	D3	D2	Output Value Channel 2
2	D5	D4	Output Value Channel 3
3	D7	D6	Output Value Channel 4
4	D9	D8	Output Value Channel 5
5	D11	D10	Output Value Channel 6
6	D13	D12	Output Value Channel 7
7	D15	D14	Output Value Channel 8

14.2.5 Specialty Modules

WAGO has a host of Specialty I/O modules that perform various functions. With individual modules beside the data bytes also the control/status byte is mapped in the process image.

The control/status byte is required for the bidirectional data exchange of the module with the higher-ranking control system. The control byte is transmitted from the control system to the module and the status byte from the module to the control system.

This allows, for example, setting of a counter with the control byte or displaying of overshooting or undershooting of the range with the status byte.

The control/status byte always is in the process image in the Low byte.

Information



Information to the structure of the Control/Status byte

For detailed information about the structure of a particular module's control/status byte, please refer to that module's manual. Manuals for each module can be found on the Internet under: www.wago.com.

14.2.5.1 Counter Modules

750-404, (and all variations except of /000-005),
753-404, (and variation /000-003)

The above Counter Modules have a total of 5 bytes of user data in both the Input and Output Process Image (4 bytes of counter data and 1 byte of control/status). The counter value is supplied as 32 bits. The following tables illustrate the Input and Output Process Image, which has a total of 3 words mapped into each image. Word alignment is applied.

Table 226: Counter Modules 750-404, (and all variations except of /000-005),
753-404, (and variation /000-003)

Input Process Image			
Offset	Byte Destination		Description
	High Byte	Low Byte	
0	-	S	Status byte
1	D1	D0	Counter value
2	D3	D2	

Output Process Image			
Offset	Byte Destination		Description
	High Byte	Low Byte	
0	-	C	Control byte
1	D1	D0	Counter setting value
2	D3	D2	

750-404/000-005

The above Counter Modules have a total of 5 bytes of user data in both the Input and Output Process Image (4 bytes of counter data and 1 byte of control/ status). The two counter values are supplied as 16 bits. The following tables illustrate the Input and Output Process Image, which has a total of 3 words mapped into each image. Word alignment is applied.

Table 227: Counter Modules 750-404/000-005

Input Process Image			
Offset	Byte Destination		Description
	High Byte	Low Byte	
0	-	S	Status byte
1	D1	D0	Counter Value of Counter 1
2	D3	D2	Counter Value of Counter 2

Output Process Image			
Offset	Byte Destination		Description
	High Byte	Low Byte	
0	-	C	Control byte
1	D1	D0	Counter Setting Value of Counter 1
2	D3	D2	Counter Setting Value of Counter 2

750-638,
753-638

The above Counter Modules have a total of 6 bytes of user data in both the Input and Output Process Image (4 bytes of counter data and 2 bytes of control/status). The two counter values are supplied as 16 bits. The following tables illustrate the Input and Output Process Image, which has a total of 4 words mapped into each image. Word alignment is applied.

Table 228: Counter Modules 750-638, 753-638

Input Process Image			
Offset	Byte Destination		Description
	High Byte	Low Byte	
0	-	S0	Status byte von Counter 1
1	D1	D0	Counter Value von Counter 1
2	-	S1	Status byte von Counter 2
3	D3	D2	Counter Value von Counter 2

Output Process Image			
Offset	Byte Destination		Description
	High Byte	Low Byte	
0	-	C0	Control byte von Counter 1
1	D1	D0	Counter Setting Value von Counter 1
2	-	C1	Control byte von Counter 2
3	D3	D2	Counter Setting Value von Counter 2

14.2.5.2 Pulse Width Modules

750-511, (and all variations /xxx-xxx)

The above Pulse Width modules have a total of 6 bytes of user data in both the Input and Output Process Image (4 bytes of channel data and 2 bytes of control/status). The two channel values are supplied as 16 bits. Each channel has its own control/status byte. The following table illustrates the Input and Output Process Image, which has a total of 4 words mapped into each image. Word alignment is applied.

Table 229: Pulse Width Modules 750-511, /xxx-xxx

Input and Output Process			
Offset	Byte Destination		Description
	High Byte	Low Byte	
0	-	C0/S0	Control/Status byte of Channel 1
1	D1	D0	Data Value of Channel 1
2	-	C1/S1	Control/Status byte of Channel 2
3	D3	D2	Data Value of Channel 2

14.2.5.3 Serial Interface Modules with alternative Data Format

750-650, (and the variations /000-002, -004, -006, -009, -010, -011, -012, -013),
750-651, (and the variations /000-001, -002, -003),
750-653, (and the variations /000-002, -007),
753-650, -653

Note



The process image of the / 003-000-variants depends on the parameterized operating mode!

With the freely parameterizable variations /003 000 of the serial interface modules, the desired operation mode can be set. Dependent on it, the process image of these modules is then the same, as from the appropriate variation.

The above Serial Interface Modules with alternative data format have a total of 4 bytes of user data in both the Input and Output Process Image (3 bytes of serial data and 1 byte of control/status). The following table illustrates the Input and Output Process Image, which have a total of 2 words mapped into each image. Word alignment is applied.

Table 230: Serial Interface Modules with alternative Data Format

Input and Output Process Image				
Offset	Byte Destination		Description	
	High Byte	Low Byte		
0	D0	C/S	Data byte	Control/status byte
1	D2	D1	Data bytes	

14.2.5.4 Serial Interface Modules with Standard Data Format

750-650/000-001, -014, -015, -016
750-653/000-001, -006

The above Serial Interface Modules with Standard Data Format have a total of 6 bytes of user data in both the Input and Output Process Image (5 bytes of serial data and 1 byte of control/status). The following table illustrates the Input and Output Process Image, which have a total of 3 words mapped into each image. Word alignment is applied.

Table 231: Serial Interface Modules with Standard Data Format

Input and Output Process Image				
Offset	Byte Destination		Description	
	High Byte	Low Byte		
0	D0	C/S	Data byte	Control/status byte
1	D2	D1	Data bytes	
2	D4	D3		

14.2.5.5 Data Exchange Module

750-654, (and the variation /000-001)

The Data Exchange modules have a total of 4 bytes of user data in both the Input and Output Process Image. The following tables illustrate the Input and Output Process Image, which has a total of 2 words mapped into each image. Word alignment is applied.

Table 232: Data Exchange Module

Input and Output Process Image				
Offset	Byte Destination		Description	
	High Byte	Low Byte		
0	D1	D0	Data bytes	
1	D3	D2		

14.2.5.6 SSI Transmitter Interface Modules

750-630 (and all variations)



Note

The process image of the / 003-000-variants depends on the parameterized operating mode!

The operating mode of the configurable /003-000 I/O module versions can be set. Based on the operating mode, the process image of these I/O modules is then the same as that of the respective version.

The above SSI Transmitter Interface modules have a total of 4 bytes of user data in the Input Process Image, which has 2 words mapped into the image. Word alignment is applied.

Table 233: SSI Transmitter Interface Modules

Input Process Image			
Offset	Byte Destination		Description
	High Byte	Low Byte	
0	D1	D0	Data bytes
1	D3	D2	

14.2.5.7 Incremental Encoder Interface Modules

750-631/000-004, -010, -011

The above Incremental Encoder Interface modules have 5 bytes of input data and 3 bytes of output data. The following tables illustrate the Input and Output Process Image, which have 4 words into each image. Word alignment is applied.

Table 234: Incremental Encoder Interface Modules 750-631/000-004, --010, -011

Input Process Image			
Offset	Byte Destination		Description
	High Byte	Low Byte	
0	-	S	not used Status byte
1	D1	D0	Counter word
2	-	-	not used
3	D4	D3	Latch word

Output Process Image			
Offset	Byte Destination		Description
	High Byte	Low Byte	
0	-	C	not used Control byte
1	D1	D0	Counter setting word
2	-	-	not used
3	-	-	not used

750-634

The above Incremental Encoder Interface module has 5 bytes of input data (6 bytes in cycle duration measurement mode) and 3 bytes of output data. The following tables illustrate the Input and Output Process Image, which has 4 words mapped into each image. Word alignment is applied.

Table 235: Incremental Encoder Interface Modules 750-634

Input Process Image			
Offset	Byte Destination		Description
	High Byte	Low Byte	
0	-	S	not used Status byte
1	D1	D0	Counter word
2	-	(D2) *)	not used (Periodic time)
3	D4	D3	Latch word

*) If cycle duration measurement mode is enabled in the control byte, the cycle duration is given as a 24-bit value that is stored in D2 together with D3/D4.

Output Process Image			
Offset	Byte Destination		Description
	High Byte	Low Byte	
0	-	C	not used Control byte
1	D1	D0	Counter setting word
2	-	-	not used
3	-	-	

750-637

The above Incremental Encoder Interface Module has a total of 6 bytes of user data in both the Input and Output Process Image (4 bytes of encoder data and 2 bytes of control/status). The following table illustrates the Input and Output Process Image, which have 4 words mapped into each image. Word alignment is applied.

Table 236: Incremental Encoder Interface Modules 750-637

Input and Output Process Image			
Offset	Byte Destination		Description
	High Byte	Low Byte	
0	-	C0/S0	Control/Status byte of Channel 1
1	D1	D0	Data Value of Channel 1
2	-	C1/S1	Control/Status byte of Channel 2
3	D3	D2	Data Value of Channel 2

750-635,
753-635

The above Digital Pulse Interface module has a total of 4 bytes of user data in both the Input and Output Process Image (3 bytes of module data and 1 byte of control/status). The following table illustrates the Input and Output Process Image, which have 2 words mapped into each image. Word alignment is applied.

Table 237: Digital Pulse Interface Modules 750-635

Input and Output Process Image				
Offset	Byte Destination		Description	
	High Byte	Low Byte		
0	D0	C0/S0	Data byte	Control/status byte
1	D2	D1	Data bytes	

14.2.5.8 DC-Drive Controller

750-636

The DC-Drive Controller maps 6 bytes into both the input and output process image. The data sent and received are stored in up to 4 input and output bytes (D0 ... D3). Two control bytes (C0, C1) and two status bytes (S0/S1) are used to control the I/O module and the drive.

In addition to the position data in the input process image (D0 ... D3), it is possible to display extended status information (S2 ... S5). Then the three control bytes (C1 ... C3) and status bytes (S1 ... S3) are used to control the data flow.

Bit 3 of control byte C1 (C1.3) is used to switch between the process data and the extended status bytes in the input process image (Extended Info_ON). Bit 3 of status byte S1 (S1.3) is used to acknowledge the switching process.

Table 238: DC-Drive Controller 750-636

Input Process Image				
Offset	Byte Destination		Description	
	High Byte	Low Byte		
0	S1	S0	Status byte S1	Status byte S0
1	D1*) / S3**)	D0*) / S2**)	Actual position*) / Extended status byte S3**)	Actual position (LSB) / Extended status byte S2**)
2	D3*) / S5**)	D2*) / S4**)	Actual position (MSB) / Extended status byte S3**)	Actual position*) / Extended status byte S4**)

*) ExtendedInfo_ON = '0'.

***) ExtendedInfo_ON = '1'.

Output Process Image				
Offset	Byte Destination		Description	
	High Byte	Low Byte		
0	C1	C0	Control byte C1	Control byte C0
1	D1	D0	Setpoint position	Setpoint position (LSB)
2	D3	D2	Setpoint position (MSB)	Setpoint position

14.2.5.9 Stepper Controller

750-670

The Stepper controller RS422 / 24 V / 20 mA 750-670 provides the fieldbus coupler 12 bytes input and output process image via 1 logical channel. The data to be sent and received are stored in up to 7 output bytes (D0 ... D6) and 7 input bytes (D0 ... D6), depending on the operating mode.

Output byte D0 and input byte D0 are reserved and have no function assigned.

One I/O module control and status byte (C0, S0) and 3 application control and status bytes (C1 ... C3, S1 ... S3) provide the control of the data flow.

Switching between the two process images is conducted through bit 5 in the control byte (C0 (C0.5)). Activation of the mailbox is acknowledged by bit 5 of the status byte S0 (S0.5).

Table 239: Stepper Controller RS 422 / 24 V / 20 mA 750-670

Input Process Image				
Offset	Byte Destination		Description	
	High Byte	Low Byte		
0	reserved	S0	reserved	Status byte S0
1	D1	D0	Process data*) / Mailbox**)	
2	D3	D2		
3	D5	D4		
4	S3	D6	Status byte S3	Process data*) / reserved**)
5	S1	S2	Status byte S1	Status byte S2

*) Cyclic process image (Mailbox disabled)

***) Mailbox process image (Mailbox activated)

Output Process Image				
Offset	Byte Destination		Description	
	High Byte	Low Byte		
0	reserved	C0	reserved	Control byte C0
1	D1	D0	Process data*) / Mailbox**)	
2	D3	D2		
3	D5	D4		
4	C3	D6	Control byte C3	Process data*) / reserved**)
5	C1	C2	Control byte C1	Control byte C2

- *) Cyclic process image (Mailbox disabled)
- ***) Mailbox process image (Mailbox activated)

14.2.5.10 RTC Module

750-640

The RTC Module has a total of 6 bytes of user data in both the Input and Output Process Image (4 bytes of module data and 1 byte of control/status and 1 byte ID for command). The following table illustrates the Input and Output Process Image, which have 3 words mapped into each image. Word alignment is applied.

Table 240: RTC Module 750-640

Input and Output Process Image				
Offset	Byte Destination		Description	
	High Byte	Low Byte		
0	ID	C/S	Command byte	Control/status byte
1	D1	D0	Data bytes	
2	D3	D2		

14.2.5.11 DALI/DSI Master Module

750-641

The DALI/DSI Master module has a total of 6 bytes of user data in both the Input and Output Process Image (5 bytes of module data and 1 byte of control/status). The following tables illustrate the Input and Output Process Image, which have 3 words mapped into each image. Word alignment is applied.

Table 241: DALI/DSI Master Module 750-641

Input Process Image				
Offset	Byte Destination		Description	
	High Byte	Low Byte		
0	D0	S	DALI Response	Status byte
1	D2	D1	Message 3	DALI Address
2	D4	D3	Message 1	Message 2

Output Process Image				
Offset	Byte Destination		Description	
	High Byte	Low Byte		
0	D0	C	DALI command, DSI dimming value	Control byte
1	D2	D1	Parameter 2	DALI Address
2	D4	D3	Command extension	Parameter 1

14.2.5.12 DALI Multi-Master Module

753-647

The DALI Multi-Master module occupies a total of 24 bytes in the input and output range of the process image.

The DALI Multi-Master module can be operated in "Easy" mode (default) and "Full" mode. "Easy" mode is used to transmit simply binary signals for lighting control. Configuration or programming via DALI master module is unnecessary in "Easy" mode.

Changes to individual bits of the process image are converted directly into DALI commands for a pre-configured DALI network. 22 bytes of the 24-byte process image can be used directly for switching of electronic ballasts (ECG), groups or scenes in "Easy" mode. Switching commands are transmitted via DALI and group addresses, where each DALI and each group address is represented by a 2-bit pair.

The structure of the process data is described in detail in the following tables.

Table 242: Overview of Input Process Image in the "Easy" Mode

Input process image				
Offset	Byte designation		Note	
	High byte	Low byte		
0	-	S	res.	Status, activate broadcast Bit 0: 1-/2-button mode Bit 2: Broadcast status ON/OFF Bit 1,3-7: -
1	DA4...DA7	DA0...DA3	Bitpaar für DALI-Adresse DA0: Bit 1: Bit set = ON Bit not set = OFF Bit 2: Bit set = Error Bit not set = No error Bit pairs DA1 ... DA63 similar to DA0.	
2	DA12...DA15	DA8...DA11		
3	DA20...DA23	DA16...DA19		
4	DA28...DA31	DA24...DA27		
5	DA36...DA39	DA32...DA35		
6	DA44...DA47	DA40...DA43		
7	DA52...DA55	DA48...DA51		
8	DA60...DA63	DA56...DA59		
9	GA4...GA7	GA0...GA3	Bit pair for DALI group address GA0: Bit 1: Bit set = ON Bit not set = OFF Bit 2: Bit set = Error Bit not set = No error Bit pairs GA1 ... GA15 similar to GA0.	
10	GA12...GA15	GA8...GA11		
11	-	-		

DA = DALI address
GA = Group address

Table 243: Overview of the Output Process Image in the "Easy" Mode

Output process image				
Offset	Byte designation		Note	
	High byte	Low byte		
0	-	S	res.	Broadcast ON/OFF and activate: Bit 0: Broadcast ON Bit 1: Broadcast OFF Bit 2: Broadcast ON/OFF/dimming Bit 3: Broadcast short ON/OFF Bits 4 ... 7: reserved
1	DA4...DA7	DA0...DA3	Bit pair for DALI address DA0: Bit 1: short: DA switch ON long: dimming, brighter Bit 2: short: DA switch OFF long: dimming, darker Bit pairs DA1 ... DA63 similar to DA0.	
2	DA12...DA15	DA8...DA11		
3	DA20...DA23	DA16...DA19		
4	DA28...DA31	DA24...DA27		
5	DA36...DA39	DA32...DA35		
6	DA44...DA47	DA40...DA43		
7	DA52...DA55	DA48...DA51		
8	DA60...DA63	DA56...DA59		
9	GA4...GA7	GA0...GA3	Bitpaar für DALI-Gruppenadresse GA0: Bit 1: short: GA switch ON long: dimming, brighter Bit 2: short: GA switch OFF long: dimming, darker Bit pairs GA1 ... GA15 similar to GA0.	
10	GA12...GA15	GA8...GA11		
11	Bit 8...15	Bit 0...7		

DA = DALI address
GA = Group address

14.2.5.13 LON[®] FTT Module

753-648

The process image of the LON[®] FTT module consists of a control/status byte and 23 bytes of bidirectional communication data that is processed by the WAGO-I/O-*PRO* function block "LON_01.lib". This function block is essential for the function of the LON[®] FTT module and provides a user interface on the control side.

14.2.5.14 EnOcean Radio Receiver

750-642

The EnOcean radio receiver has a total of 4 bytes of user data in both the Input and Output Process Image (3 bytes of module data and 1 byte of control/status). The following tables illustrate the Input and Output Process Image, which have 2 words mapped into each image. Word alignment is applied.

Table 244: EnOcean Radio Receiver 750-642

Input Process Image				
Offset	Byte Destination		Description	
	High Byte	Low Byte		
0	D0	S	Data byte	Status byte
1	D2	D1	Data bytes	

Output Process Image				
Offset	Byte Destination		Description	
	High Byte	Low Byte		
0	-	C	not used	Control byte
1	-	-	not used	

14.2.5.15 MP Bus Master Module

750-643

The MP Bus Master Module has a total of 8 bytes of user data in both the Input and Output Process Image (6 bytes of module data and 2 bytes of control/status). The following table illustrates the Input and Output Process Image, which have 4 words mapped into each image. Word alignment is applied.

Table 245: MP Bus Master Module 750-643

Input and Output Process Image				
Offset	Byte Destination		Description	
	High Byte	Low Byte		
0	C1/S1	C0/S0	extended Control/Status byte	Control/status byte
1	D1	D0	Data bytes	
2	D3	D2		
3	D5	D4		

14.2.5.16 Bluetooth® RF-Transceiver

750-644

The size of the process image for the *Bluetooth*® module can be adjusted to 12, 24 or 48 bytes.

It consists of a control byte (input) or status byte (output); an empty byte; an overlay able mailbox with a size of 6, 12 or 18 bytes (mode 2); and the *Bluetooth*® process data with a size of 4 to 46 bytes.

Thus, each *Bluetooth*® module uses between 12 and 48 bytes in the process image. The sizes of the input and output process images are always the same.

The first byte contains the control/status byte; the second contains an empty byte.

Process data attach to this directly when the mailbox is hidden. When the mailbox is visible, the first 6, 12 or 18 bytes of process data are overlaid by the mailbox data, depending on their size. Bytes in the area behind the optionally visible mailbox contain basic process data. The internal structure of the *Bluetooth*® process data can be found in the documentation for the *Bluetooth*® 750-644 RF Transceiver.

The mailbox and the process image sizes are set with the startup tool WAGO-I/O-CHECK.

Table 246: Bluetooth® RF-Transceiver 750-644

Input and Output Process Image				
Offset	Byte Destination		Description	
	High Byte	Low Byte		
0	-	C0/S0	not used	Control/status byte
1	D1	D0	Mailbox (0, 3, 6 or 9 words) and Process data (2-23 words)	
2	D3	D2		
3	D5	D4		
...		
max. 23	D45	D44		

14.2.5.17 Vibration Velocity/Bearing Condition Monitoring VIB I/O

750-645

The Vibration Velocity/Bearing Condition Monitoring VIB I/O has a total of 12 bytes of user data in both the Input and Output Process Image (8 bytes of module data and 4 bytes of control/status). The following table illustrates the Input and Output Process Image, which have 8 words mapped into each image. Word alignment is applied.

Table 247: Vibration Velocity/Bearing Condition Monitoring VIB I/O 750-645

Input and Output Process Image				
Offset	Byte Destination		Description	
	High Byte	Low Byte		
0	-	C0/S0	not used	Control/status byte (log. Channel 1, Sensor input 1)
1	D1	D0	Data bytes (log. Channel 1, Sensor input 1)	
2	-	C1/S1	not used	Control/status byte (log. Channel 2, Sensor input 2)
3	D3	D2	Data bytes (log. Channel 2, Sensor input 2)	
4	-	C2/S2	not used	Control/status byte (log. Channel 3, Sensor input 1)
5	D5	D4	Data bytes (log. Channel 3, Sensor input 3)	
6	-	C3/S3	not used	Control/status byte (log. Channel 4, Sensor input 2)
7	D7	D6	Data bytes (log. Channel 4, Sensor input 2)	

14.2.5.18 KNX/EIB/TP1 Module

753-646

The KNX/TP1 module appears in router and device mode with a total of 24-byte user data within the input and output area of the process image, 20 data bytes and 2 control/status bytes. Even though the additional bytes S1 or C1 are transferred as data bytes, they are used as extended status and control bytes. The opcode is used for the read/write command of data and the triggering of specific functions of the KNX/EIB/TP1 module. Word-alignment is used to assign 12 words in the process image. Access to the process image is not possible in router mode. Telegrams can only be tunneled.

In device mode, access to the KNX data can only be performed via special function blocks of the IEC application. Configuration using the ETS engineering tool software is required for KNX.

Table 248: KNX/EIB/TP1 Module 753-646

Input Process Image				
Offset	Byte Destination		Description	
	High Byte	Low Byte		
0	-	S0	not used	Status byte
1	S1	OP	extended Status byte	Opcode
2	D1	D0	Data byte 1	Data byte 0
3	D3	D2	Data byte 3	Data byte 2
4	D5	D4	Data byte 5	Data byte 4
5	D7	D6	Data byte 7	Data byte 6
6	D9	D8	Data byte 9	Data byte 8
7	D11	D10	Data byte 11	Data byte 10
8	D13	D12	Data byte 13	Data byte 12
9	D15	D14	Data byte 15	Data byte 14
10	D17	D16	Data byte 17	Data byte 16
11	D19	D18	Data byte 19	Data byte 18

Output Process Image				
Offset	Byte Destination		Description	
	High Byte	Low Byte		
0	-	C0	not used	Control byte
1	C1	OP	extended Control byte	Opcode
2	D1	D0	Data byte 1	Data byte 0
3	D3	D2	Data byte 3	Data byte 2
4	D5	D4	Data byte 5	Data byte 4
5	D7	D6	Data byte 7	Data byte 6
6	D9	D8	Data byte 9	Data byte 8
7	D11	D10	Data byte 11	Data byte 10
8	D13	D12	Data byte 13	Data byte 12
9	D15	D14	Data byte 15	Data byte 14
10	D17	D16	Data byte 17	Data byte 16
11	D19	D18	Data byte 19	Data byte 18

14.2.5.19 AS-interface Master Module

750-655

The length of the process image of the AS-interface master module can be set to fixed sizes of 12, 20, 24, 32, 40 or 48 bytes.

It consists of a control or status byte, a mailbox with a size of 0, 6, 10, 12 or 18 bytes and the AS-interface process data, which can range from 0 to 32 bytes.

The AS-interface master module has a total of 6 to maximally 24 words data in both the Input and Output Process Image. Word alignment is applied.

The first Input and output word, which is assigned to an AS-interface master module, contains the status / control byte and one empty byte.

Subsequently the mailbox data are mapped, when the mailbox is permanently superimposed (Mode 1).

In the operating mode with suppressible mailbox (Mode 2), the mailbox and the cyclical process data are mapped next.
The following words contain the remaining process data.

The mailbox and the process image sizes are set with the startup tool WAGO-I/O-CHECK.

Table 249: AS-interface Master Module 750-655

Input and Output Process Image				
Offset	Byte Destination		Description	
	High Byte	Low Byte		
0	-	C0/S0	not used	Control/status byte
1	D1	D0	Mailbox (0, 3, 5, 6 or 9 words)/ Process data (0-16 words)	
2	D3	D2		
3	D5	D4		
...		
max. 23	D45	D44		

14.2.6 System Modules

14.2.6.1 System Modules with Diagnostics

750-610, -611

The modules provide 2 bits of diagnostics in the Input Process Image for monitoring of the internal power supply.

Table 250: System Modules with Diagnostics 750-610, -611

Input Process Image							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
						Diagnostic bit S 2 Fuse	Diagnostic bit S 1 Fuse

14.2.6.2 Binary Space Module

750-622

The Binary Space Modules behave alternatively like 2 channel digital input modules or output modules and seize depending upon the selected settings 1, 2, 3 or 4 bits per channel. According to this, 2, 4, 6 or 8 bits are occupied then either in the process input or the process output image.

Table 251: Binary Space Module 750-622 (with Behavior Like 2 Channel Digital Input)

Input and Output Process Image							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
(Data bit DI 8)	(Data bit DI 7)	(Data bit DI 6)	(Data bit DI 5)	(Data bit DI 4)	(Data bit DI 3)	Data bit DI 2	Data bit DI 1

15 Accessories

15.1 Winsta[®] EIB Products for KNX Systems

It is recommended that lines be cut to length to link the individual KNX devices. These are available at WAGO as 1, 3 and 5 m lines, or as any other length upon request. The lines are very well-suited for short connections. We recommend installing flat, flexible cables when routing lines over longer distances.

Plug-in connectors and snap-in device connectors for two-wire ribbon cables enable quick, flexible installation using insulation displacement techniques for tapping at any point along the ribbon cable. A great deal of space is saved in this process, as tapping is performed along the cable.

Winsta[®] EIB products cover all areas of cabling for TP1 networks in which EIB certified bus conductors must be used. EIB-certified plug-in connectors and cables are colored green.



Figure 117: Plug-in connectors, snap-ins, precut cables, tapping

16 Application Examples

16.1 Test of MODBUS protocol and fieldbus nodes

You require a MODBUS master to test the function of your fieldbus node. For this purpose, various manufacturers offer a range of PC applications that you can, in part, download from the Internet as free of charge demo versions.

One of the programs which is particularly suitable to test your ETHERNET TCP/IP fieldbus node, is for instance **ModScan** from Win-Tech.

Information



Additional Information

A free of charge demo version from ModScan32 and further utilities from Win-Tech can be found in the Internet under:

<http://www.win-tech.com/html/demos.htm>

ModScan32 is a Windows application that works as a MODBUS master.

This program allows you to access the data points of your connected ETHERNET TCP/IP fieldbus node and to proceed with the desired changes.

Information



Additional Information

For a description example relating to the software operation, refer to:

<http://www.win-tech.com/html/modscan32.htm>

16.2 Visualization and Control using SCADA Software

This chapter is intended to give insight into how the WAGO ETHERNET fieldbus coupler/controller can be used for process visualization and control using standard user software.

There is a wide range of process visualization programs, called SCADA Software, from various manufacturers.

SCADA is the abbreviation for Supervisory Control and Data Acquisition.

It is a user-orientated tool used as a production information system in the areas of automation technology, process control and production monitoring.

The use of SCADA systems includes the areas of visualization and monitoring, data access, trend recording, event and alarm processing, process analysis and targeted intervention in a process (control).

The WAGO ETHERNET fieldbus node provides the required process input and output values.



Note

SCADA software has to provide a MODBUS device driver and support MODBUS/TCP functions!

When choosing suitable SCADA software, ensure that it provides a MODBUS device driver and supports the MODBUS/TCP functions in the coupler.

Visualization programs with MODBUS device drivers are available from i.e. Wonderware, National Instruments, Think&Do or KEPware Inc., some of which are available on the Internet as demo versions.

The operation of these programs is very specific. However, a few essential steps are described to illustrate the way an application can be developed using a WAGO ETHERNET fieldbus node and SCADA software in principle:

1. Load the MODBUS ETHERNET driver and select MODBUS ETHERNET
2. Enter the IP address for addressing the fieldbus node

At this point, some programs allow the user to give the node an alias name, i.e. to call the node "Measuring data". The node can then be addressed with this name.

3. Create a graphic object, such as a switch (digital) or a potentiometer (analog)

This object is displayed on the work area.

4. Link the object to the desired data point on the node by entering the following data:
 - Node address (IP address or alias name)
 - The desired MODBUS function codes (register/bit read/write)
 - The MODBUS address of the selected channel

Entry is program specific.

Depending on the user software the MODBUS addressing of a bus module can be represented with up to 5 digits.

Example of the MODBUS Addressing

In the case of SCADA Software Lookout from National Instruments the MODBUS function codes are used with a 6 digit coding, whereby the first digit represents the MODBUS table (0, 1, 3 or 4) and implicit the function code (see following table):

Table 252: MODBUS Table and Function Codes

MODBUS table	MODBUS function code	
0	FC1 or FC15	Reading of input bits or writing of several output bits
1	FC2	Reading of several input bits
3	FC4 or FC 16	Reading of several input registers or writing of several output registers
4	FC3	Reading of several input registers

The following five digits specify the channel number (beginning with 1) of the consecutively numbered digital or analog input and/or output channels.

Examples:

- Reading/writing the first digital input: i.e. 0 0000 1
- Reading/writing the second analog input: i.e. 3 0000 2

Application Example:

Thus, the digital input channel 2 of the above node “Measuring data” can be read out with the input: “Measuring data. 0 0000 2”.

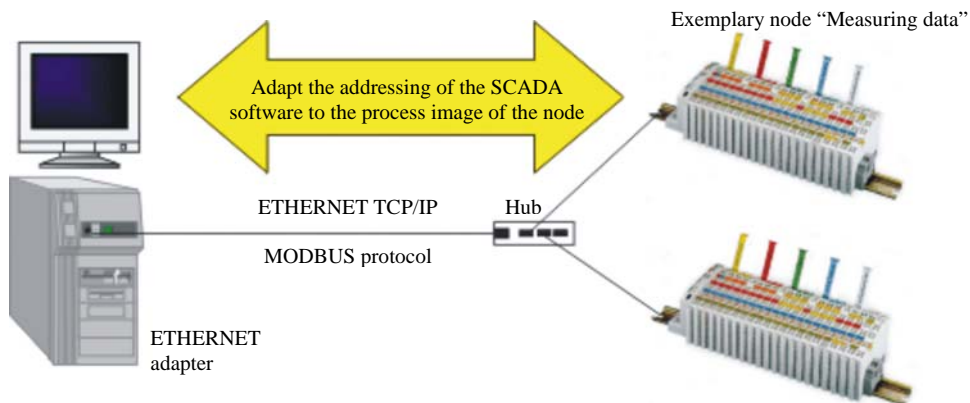


Figure 118: Example SCADA Software with MODBUS Driver

Information



Additional Information

Please refer to the respective SCADA product manual for a detailed description of the particular software operation.

17 Appendix

17.1 MIB II Groups

17.1.1 System Group

The system group contains general information about the coupler/controller.

Table 253: MIB II – System Group

Identifier	Entry	Access	Description
1.3.6.1.2.1.1.1	sysDescr	R	This entry contains the device identification. The object has a fixed code (e.g., "WAGO 750-841")
1.3.6.1.2.1.1.2	sysObjectID	R	This entry contains the manufacturer's authorization identification.
1.3.6.1.2.1.1.3	sysUpTime	R	This entry contains the time (in hundredths of a second) since the management unit has been last reset.
1.3.6.1.2.1.1.4	sysContact	R/W	This entry contains the identification and contact information for the system contact person.
1.3.6.1.2.1.1.5	sysName	R/W	This entry contains the administration-assigned device name.
1.3.6.1.2.1.1.6	sysLocation	R/W	This entry contains the node's physical location.
1.3.6.1.2.1.1.7	sysServices	R	This entry designates the quantity of services that this coupler/controller contains.

17.1.2 Interface Group

The interface group contains information and statistics about the device interface.

A device interface describes the Ethernet interface of a coupler/controller and provides status information on the physical Ethernet ports as well as on the internal loopback interface.

Table 254: MIB II – Interface Group

Identifier	Entry	Access	Description
1.3.6.1.2.1.2.1	ifNumber	R	Number of network interfaces in this system
1.3.6.1.2.1.2.2	ifTable	-	List of network interfaces
1.3.6.1.2.1.2.2.1	ifEntry	-	Network interface entry
1.3.6.1.2.1.2.2.1.1	ifIndex	R	This entry contains a unique value for each interface
1.3.6.1.2.1.2.2.1.2	ifDescr	R	This entry contains the name of the manufacturer, the product name, and the version of the hardware interface: e.g., "WAGO Kontakttechnik GmbH 750-841: Rev 1.0"
1.3.6.1.2.1.2.2.1.3	ifType	R	This entry describes the type of interface. ETHERNET CSMA/CD = 6 Software Loopback = 24
1.3.6.1.2.1.2.2.1.4	ifMtu	R	This entry specifies the largest transfer unit; i.e., the maximum telegram length that can be transferred via this interface.
1.3.6.1.2.1.2.2.1.5	ifSpeed	R	This entry indicates the interface speed in bits per second.
1.3.6.1.2.1.2.2.1.6	ifPhysAddress	R	This entry indicates the physical address of the interface. For example, for Ethernet, this entry contains a MAC ID.
1.3.6.1.2.1.2.2.1.7	ifAdmin-Status	R/W	This entry specifies the desired state of the interfaces. Possible values are: up(1): Ready for operation for transmission and reception down(2): Interface is switched off testing(3): Interface is in test mode
1.3.6.1.2.1.2.2.1.8	ifOperStatus	R	This entry indicates the current operational state of the interface.
1.3.6.1.2.1.2.2.1.9	ifLastChange	R	This entry indicates the value of the sysUpTime when the state was last changed.
1.3.6.1.2.1.2.2.1.10	ifInOctets	R	This entry gives the total number of bytes received via interface.
1.3.6.1.2.1.2.2.1.11	ifInUcastPkts	R	This entry indicates the number of received unicast packets delivered to a higher layer.
1.3.6.1.2.1.2.2.1.12	ifInNUcastPkts	R	This entry indicates the number of received broad and multicast packets delivered to a higher layer.
1.3.6.1.2.1.2.2.1.13	ifInDiscards	R	This entry indicates the number of packets that were discarded even though no errors had been detected.
1.3.6.1.2.1.2.2.1.14	ifInErrors	R	This entry indicates the number of received packets that contained errors preventing them from being deliverable to a higher layer.

Table 254: MIB II – Interface Group

Identifier	Entry	Access	Description
1.3.6.1.2.1.2.2.1.15	IfInUnknown-Protos	R	This entry indicates the number of received packets sent to an unknown or unsupported port number.
1.3.6.1.2.1.2.2.1.16	ifOutOctets	R	This entry gives the total number of bytes sent via interface.
1.3.6.1.2.1.2.2.1.17	ifOutUcastPkts	R	This entry contains the number of outgoing unicast packets delivered to a higher layer.
1.3.6.1.2.1.2.2.1.18	ifOutNUcastPkts	R	This entry indicates the number of outgoing broad and multicast packets delivered to a higher layer.
1.3.6.1.2.1.2.2.1.19	ifOutDiscards	R	This entry indicates the number of packets that were discarded even though no errors had been detected.
1.3.6.1.2.1.2.2.1.20	ifOutErrors	R	This entry indicates the number of packets that could not be transmitted because of errors.

17.1.3 IP Group

The IP group contains information about IP communication.

Table 255: MIB II – IP Group

Identifier	Entry	Access	Description
1.3.6.1.2.1.4.1	ipForwarding	R/W	1: Host is a router; 2: Host is not a router
1.3.6.1.2.1.4.2	ipDefaultTTL	R/W	Default value for the Time-To-Live field of each IP frame.
1.3.6.1.2.1.4.3	ipInReceives	R	Number of received IP frames, including those received in error.
1.3.6.1.2.1.4.4	ipInHdrErrors	R	Number of received IP frames with header errors.
1.3.6.1.2.1.4.5	ipInAddrErrors	R	Number of received IP frames with a misdirected IP address.
1.3.6.1.2.1.4.6	ipForwDatagrams	R	Number of received IP frames passed on (routed)
1.3.6.1.2.1.4.7	ipUnknownProtos	R	Number of received IP frames with an unknown protocol type.
1.3.6.1.2.1.4.8	ipInDiscards	R	Number of received IP frames rejected although no disturbance was present.
1.3.6.1.2.1.4.9	ipInDelivers	R	Number of received IP frames passed on a higher protocol layer.
1.3.6.1.2.1.4.10	ipOutRequests	R	Number of sent IP frames
1.3.6.1.2.1.4.11	ipOutDiscards	R	Number of rejected IP Frames that should have been sent.
1.3.6.1.2.1.4.12	ipOutNoRoutes	R	Number of sent IP frames rejected because of incorrect routing information.
1.3.6.1.2.1.4.13	ipReasmTimeout	R	Minimum time duration until an IP frame is re-assembled.
1.3.6.1.2.1.4.14	ipReasmReqds	R	Minimum number of the IP fragments for building up and passing on.
1.3.6.1.2.1.4.15	ipReasmOKs	R	Number of IP frames re-assembled successfully.
1.3.6.1.2.1.4.16	ipReasmFails	R	Number of IP frames not re-assembled successfully.
1.3.6.1.2.1.4.17	ipFragOKs	R	Number of IP frames fragmented and passed on.
1.3.6.1.2.1.4.18	ipFragFails	R	Number of IP frames that should have been fragmented but could not be, because their don't fragment bit was set in the header.
1.3.6.1.2.1.4.19	ipFragCreates	R	Number of generated IP fragment frames
1.3.6.1.2.1.4.20	ipAddrTable	-	Table of all local IP addresses of the coupler/controller.
1.3.6.1.2.1.4.20.1	ipAddrEntry	-	Address information for an entry
1.3.6.1.2.1.4.20.1.1	ipAdEntAddr	R	The IP address corresponding to the entry's address information
1.3.6.1.2.1.4.20.1.2	ipAdEntIfIndex	R	Index of the interface
1.3.6.1.2.1.4.20.1.3	ipAdEntNetMask	R	The entry's associated subnet mask
1.3.6.1.2.1.4.20.1.4	ipAdEntBcastAddr	R	Value of the last significant bit in the IP broadcast address
1.3.6.1.2.1.4.20.1.5	ipAdEntReasm- MaxSize	R	The size of the longest IP telegram that can be defragmented (reassembled) again.
1.3.6.1.2.1.4.23	ipRoutingDiscards	R	Number of deleted routing entries

17.1.4 IpRoute Table Group

The IP route table contains information about the routing table in the coupler/controller.

Table 256: MIB II – IpRoute Table Group

Identifier	Entry	Access	Description
1.3.6.1.2.1.4.21	ipRouteTable	-	IP routing table
1.3.6.1.2.1.4.21.1	ipRouteEntry	-	A routing entry for a particular destination
1.3.6.1.2.1.4.21.1.1	ipRouteDest	R/W	This entry indicates the destination address of the routing entry
1.3.6.1.2.1.4.21.1.2	ipRouteIfIndex	R/W	This entry indicates the index of the interface, which is the next route destination
1.3.6.1.2.1.4.21.1.3	ipRouteMetric1	R/W	The primary route to the target system
1.3.6.1.2.1.4.21.1.4	ipRouteMetric2	R/W	An alternative route to the target system
1.3.6.1.2.1.4.21.1.5	ipRouteMetric3	R/W	An alternative route to the target system
1.3.6.1.2.1.4.21.1.6	ipRouteMetric4	R/W	An alternative route to the target system
1.3.6.1.2.1.4.21.1.7	ipRouteNextHop	R/W	The IP address of the next route section
1.3.6.1.2.1.4.21.1.8	ipRouteType	R/W	The route type
1.3.6.1.2.1.4.21.1.9	ipRouteProto	R	Routing mechanism via which the route is developed
1.3.6.1.2.1.4.21.1.10	ipRouteAge	R/W	Number of seconds since then the route was last renewed/examined
1.3.6.1.2.1.4.21.1.11	ipRouteMask	R/W	This entry contents the subnet mask for this entry
1.3.6.1.2.1.4.21.1.12	ipRouteMetric5	R/W	An alternative route to the target system
1.3.6.1.2.1.4.21.1.13	ipRouteInfo	R/W	A reference to a special MIB

17.1.5 ICMP Group

Table 257: MIB II – ICMP Group

Identifier	Entry	Access	Description
1.3.6.1.2.1.5.1	icmpInMsgs	R	Number of received ICMP messages
1.3.6.1.2.1.5.2	icmpInErrors	R	Number of received ICMP errors containing ICMP-specific errors
1.3.6.1.2.1.5.3	icmpInDestUnreachs	R	Number of received ICMP destination unreachable messages
1.3.6.1.2.1.5.4	icmpInTimeExcds	R	Number of received ICMP time exceeded messages
1.3.6.1.2.1.5.5	icmpInParmProbs	R	Number of received ICMP parameter problem messages
1.3.6.1.2.1.5.6	icmpInSrcQuenchs	R	Number of received ICMP source quench messages
1.3.6.1.2.1.5.7	icmpInRedirects	R	Number of received ICMP redirect messages
1.3.6.1.2.1.5.8	icmpInEchos	R	Number of received ICMP echo request messages (Ping)
1.3.6.1.2.1.5.9	icmpInEchoReps	R	Number of received ICMP echo reply messages (Ping)
1.3.6.1.2.1.5.10	icmpInTimestamps	R	Number of received ICMP timestamp request messages
1.3.6.1.2.1.5.11	icmpInTimestampReps	R	Number of received ICMP timestamp reply messages
1.3.6.1.2.1.5.12	icmpInAddrMasks	R	Number of received ICMP address mask request messages
1.3.6.1.2.1.5.13	icmpInAddrMaskReps	R	Number of received ICMP address mask reply messages
1.3.6.1.2.1.5.14	icmpOutMsgs	R	Number of sent ICMP messages
1.3.6.1.2.1.5.15	icmpOutErrors	R	Number of sent ICMP messages that could not be sent due to errors
1.3.6.1.2.1.5.16	icmpOutDestUnreachs	R	Number of sent ICMP destination unreachable messages
1.3.6.1.2.1.5.17	icmpOutTimeExcds	R	Number of sent ICMP time exceeded messages
1.3.6.1.2.1.5.18	icmpOutParmProbs	R	Number of sent ICMP parameter problem messages
1.3.6.1.2.1.5.19	icmpOutSrcQuenchs	R	Number of sent ICMP source quench messages
1.3.6.1.2.1.5.20	icmpOutRedirects	R	Number of sent ICMP redirection messages
1.3.6.1.2.1.5.21	icmpOutEchos	R	Number of sent ICMP echo request messages
1.3.6.1.2.1.5.22	icmpOutEchoReps	R	Number of sent ICMP echo reply messages
1.3.6.1.2.1.5.23	icmpOutTimestamps	R	Number of sent ICMP timestamp request messages
1.3.6.1.2.1.5.24	icmpOutTimestampReps	R	Number of sent ICMP timestamp reply messages
1.3.6.1.2.1.5.25	icmpOutAddrMasks	R	Number of sent ICMP address mask request messages
1.3.6.1.2.1.5.26	icmpOutAddrMaskReps	R	Number of sent ICMP address mask reply messages

17.1.6 TCP Group

Table 258: MIB II – TCP Group

Identifier	Entry	Access	Description
1.3.6.1.2.1.6.1	tcpRtoAlgorithm	R	Retransmission time: 1 = other, 2 = constant, 3 = RSRE, 4 = VANJ
1.3.6.1.2.1.6.2	tcpRtoMin	R	Minimum value for the retransmission timer
1.3.6.1.2.1.6.3	tcpRtoMax	R	Maximum value for the retransmission timer
1.3.6.1.2.1.6.4	tcpMaxConn	R	Number of maximum TCP connections that can exist simultaneously
1.3.6.1.2.1.6.5	tcpActiveOpens	R	Number of existing active TCP connections
1.3.6.1.2.1.6.6	tcpPassiveOpens	R	Number of existing passive TCP connections
1.3.6.1.2.1.6.7	tcpAttemptFails	R	Number of failed connection attempts
1.3.6.1.2.1.6.8	tcpEstabResets	R	Number of connection resets
1.3.6.1.2.1.6.9	tcpCurrEstab	R	The number of TCP connections for which the current state is either Established or Close-Wait
1.3.6.1.2.1.6.10	tcpInSegs	R	Number of received TCP frames including the error frames
1.3.6.1.2.1.6.11	tcpOutSegs	R	Number of correctly sent TCP frames with data
1.3.6.1.2.1.6.12	tcpRetransSegs	R	Number of sent TCP frames retransmitted because of errors
1.3.6.1.2.1.6.13	tcpConnTable	-	For each existing connection, a table entry is created
1.3.6.1.2.1.6.13.1	tcpConnEntry	-	Table entry for connection
1.3.6.1.2.1.6.13.1.1	tcpConnState	R	This entry indicates the status of the TCP connection
1.3.6.1.2.1.6.13.1.2	tcpConnLocalAddress	R	The entry contains the IP address for the connection. For a server, this entry is constant 0.0.0.0
1.3.6.1.2.1.6.13.1.3	tcpConnLocalPort	R	The entry indicates the port number of the TCP connection.
1.3.6.1.2.1.6.13.1.4	tcpConnRemAddress	R	The entry contains the remote IP address of the TCP connection.
1.3.6.1.2.1.6.13.1.5	tcpConnRemPort	R	The entry contains the remote port of the TCP connection.
1.3.6.1.2.1.6.14	tcpInErrs	R	Number of received incorrect TCP frames
1.3.6.1.2.1.6.15	tcpOutRsts	R	Number of sent TCP frames with set RST flag

17.1.7 UDP Group

Table 259: MIB II – UDP Group

Identifier	Entry	Access	Description
1.3.6.1.2.1.7.1	udpInDatagrams	R	Number of received UDP frames that could be passed on to the appropriate applications
1.3.6.1.2.1.7.2	udpNoPorts	R	Number of received UDP frames that could not be passed on to the appropriate applications (port unreachable)
1.3.6.1.2.1.7.3	udpInErrors	R	Number of received UDP frames that could not be passed on to the appropriate applications for other reasons.
1.3.6.1.2.1.7.4	udpOutDatagrams	R	Number of sent UDP frames
1.3.6.1.2.1.7.5	udpTable	-	A table entry is created for each application that received UDP frames
1.3.6.1.2.1.7.5.1	udpEntry	-	Table entry for an application that received an UDP frame
1.3.6.1.2.1.7.5.1.1	udpLocalAddress	R	IP address of the local UDP server
1.3.6.1.2.1.7.5.1.2	udpLocalPort	R	Port number of the local UDP server

17.1.8 SNMP Group

Table 260: MIB II – SNMP Group

Identifier	Entry	Access	Description
1.3.6.1.2.1.11.1	snmpInPkts	R	Number of received SNMP frames
1.3.6.1.2.1.11.2	snmpOutPkts	R	Number of sent SNMP frames
1.3.6.1.2.1.11.3	snmpInBadVersions	R	Number of received SNMP frames with an invalid version number
1.3.6.1.2.1.11.4	snmpInBadCommunity-Names	R	Number of received SNMP frames with an invalid community
1.3.6.1.2.1.11.5	snmpInBadCommunity Uses	R	Number of received SNMP frames whose community did not have sufficient authorization for the actions that it tried to execute
1.3.6.1.2.1.11.6	snmpInASNParseErrs	R	Number of received SNMP frames with an incorrect structure
1.3.6.1.2.1.11.8	snmpInTooBigs	R	Number of received SNMP frames that acknowledged the result too Big
1.3.6.1.2.1.11.9	snmpInNoSuchNames	R	Number of received SNMP frames that acknowledged the result noSuchName
1.3.6.1.2.1.11.10	snmpInBadValues	R	Number of received SNMP frames that acknowledged the result bad value
1.3.6.1.2.1.11.11	snmpInReadOnlys	R	Number of received SNMP frames that acknowledged the result readOnly
1.3.6.1.2.1.11.12	snmpInGenErrs	R	Number of received SNMP frames that acknowledged the result genError
1.3.6.1.2.1.11.13	snmpInTotalReqVars	R	Number of received SNMP frames with valid GET or GET-NEXT requests
1.3.6.1.2.1.11.14	snmpInTotalSetVars	R	Number of received SNMP frames with valid SET requests
1.3.6.1.2.1.11.15	snmpInGetRequests	R	Number of GET requests received and processed
1.3.6.1.2.1.11.16	snmpInGetNexts	R	Number of GET-NEXT requests received and processed
1.3.6.1.2.1.11.17	snmpInSetRequests	R	Number of SET requests received and processed
1.3.6.1.2.1.11.18	snmpInGetResponses	R	Number of received GET responses
1.3.6.1.2.1.11.19	snmpInTraps	R	Number of received traps
1.3.6.1.2.1.11.20	snmpOutTooBigs	R	Number of sent SNMP frames that contained the result too Big
1.3.6.1.2.1.11.21	snmpOutNoSuchNames	R	Number of sent SNMP frames that contained the result noSuchName
1.3.6.1.2.1.11.22	snmpOutBadValues	R	Number of sent SNMP frames that contained the result bad value
1.3.6.1.2.1.11.24	SnmpOutGenErrs	R	Number of sent SNMP frames that contained the result genErrs
1.3.6.1.2.1.11.25	snmpOutGetRequests	R	Number of GET requests sent
1.3.6.1.2.1.11.26	SnmpOutGetNexts	R	Number of GET NEXT requests sent
1.3.6.1.2.1.11.27	snmpOutSetRequests	R	Number of SET requests sent
1.3.6.1.2.1.11.28	snmpOutGetResponses	R	Number of GET responses sent
1.3.6.1.2.1.11.29	snmpOutTraps	R	Number of traps sent
1.3.6.1.2.1.11.30	snmpEnableAuthenTraps	R/W	Authentication failure traps(1 = on, 2 = off)

17.2 WAGO MIB Groups

17.2.1 Company Group

The company group contains general information about the company WAGO Kontakttechnik GmbH & Co. KG.

Table 261: WAGO MIB – Company Group

Identifier	Entry	Access	Description
1.3.6.1.4.1.13576.1.1	wagoName	R	Company's registered name Default value: "WAGO Kontakttechnik GmbH & Co. KG"
1.3.6.1.4.1.13576.1.2	wagoDescription	R	Description of company Default value: "WAGO Kontakttechnik GmbH & Co. KG, Hansastr. 27, D-32423 Minden"
1.3.6.1.4.1.13576.1.3	wagoURL	R	URL for company web site Default value: "www.wago.com"

17.2.2 Product Group

The product group contains information about the controller.

Table 262: WAGO MIB – Product Group

Identifier	Entry	Access	Description
1.3.6.1.4.1.13576.10.1.1	wioArticleName	R	Name of article Default value: "750-8xx/000-000"
1.3.6.1.4.1.13576.10.1.2	wioArticleDescription	R	Description of article Default value: "WAGO Ethernet (10/100MBit) FBC"
1.3.6.1.4.1.13576.10.1.3	wioSerialNumber	R	Serial number of article Default value: "SNxxxxxxxx-Txxxxxx-mac 0030DExxxxxx"
1.3.6.1.4.1.13576.10.1.4	wioMacAddress	R	MAC address of article Default value: "0030DExxxxxx"
1.3.6.1.4.1.13576.10.1.5	wioURLDatasheet	R	URL to datasheet of article Default value: "http://www.wago.com/wagoweb/documentation/navigate/nm0dc__e.htm#ethernet"
1.3.6.1.4.1.13576.10.1.6	wioURLManual	R	URL to manual of article Default value: "http://www.wago.com/wagoweb/documentation/navigate/nm0dc__e.htm#ethernet"

Identifier	Entry	Access	Description
1.3.6.1.4.1.13576.10.1.7	wioDeviceClass	R	Device class 10 = controller 20 = coupler 30 = switch 40 = display 50 = sensor 60 = actuator
1.3.6.1.4.1.13576.10.1.8	wioDeviceGroup	R	Device group 10 = Serie 750 20 = Serie 758 30 = Serie 767 40 = Serie 762 PERSPECTO

17.2.3 Versions Group

The version group contains information about the hardware/software versions used in the controller.

Table 263: WAGO MIB – Versions Group

Identifier	Entry	Access	Description
1.3.6.1.4.1.13576.10.1.10.1	wioFirmwareIndex	R	Index of firmware version
1.3.6.1.4.1.13576.10.1.10.2	wioHardwareIndex	R	Index of hardware version
1.3.6.1.4.1.13576.10.1.10.3	wioFwlIndex	R	Index of software version from firmware loader
1.3.6.1.4.1.13576.10.1.10.4	wioFirmwareVersion	R	Complete firmware string

17.2.4 Real-Time Clock Group

The real-time clock group contains information about the system's real-time clock.

Table 264: WAGO MIB – Real Time Clock Group

Identifier	Entry	Access	Description
1.3.6.1.4.1.13576.10.1.11.1	wioRtcDateTime	R/W	Date/time of coupler in UTC as string. For writing date/time use the following string time 11:22:33 date 13-1-2007 Default value: "time xx:xx:xx date xx-xx-xxxx (UTC)"
1.3.6.1.4.1.13576.10.1.11.2	wioRtcTime	R/W	Date/time of coupler in UTC as integer in seconds from 1970-01-01 Default value: "0"
1.3.6.1.4.1.13576.10.1.11.3	wioTimezone	R/W	"Actual time zone of article in hours (-12 - +12) Default value: "0"
1.3.6.1.4.1.13576.10.1.11.4	wioRtcHourMode	R	Hour mode 0 = 12h mode 1 = 24h mode Default value: "0"
1.3.6.1.4.1.13576.10.1.11.5	wioRtcBatteryStatus	R	RTC battery status: 0 = ok 1 = battery empty Default value: "1"
1.3.6.1.4.1.13576.10.1.11.6	wioRtcDayLightSaving	R/W	Time offset of 1 hour: 0 = not offset 1 = offset 1 hour (DayLightSaving) Default value: "0"

17.2.5 Ethernet Group

The Ethernet group contains the settings for the controller on the Ethernet.

Table 265: WAGO MIB – Ethernet Group

Identifier	Entry	Access	Description
1.3.6.1.4.1.13576.10.1.12.1	wioEthernetMode	R/W	IP configuration of Ethernet connection: 0 = fix Ip address 1 = dynamic IP address over Bootp 2 = dynamic IP address over DHCP Default value: "1"
1.3.6.1.4.1.13576.10.1.12.2	wioIp	R/W	Actual IP address of coupler
1.3.6.1.4.1.13576.10.1.12.3	wioSubnetMask	R/W	Actual subnet mask of coupler
1.3.6.1.4.1.13576.10.1.12.4	wioGateway	R/W	Actual gateway IP of coupler
1.3.6.1.4.1.13576.10.1.12.5	wioHostname	R/W	Actual host name of coupler
1.3.6.1.4.1.13576.10.1.12.6	wioDomainName	R/W	Actual domain name of coupler
1.3.6.1.4.1.13576.10.1.12.7	wioDnsServer1	R/W	IP address of first DNS server
1.3.6.1.4.1.13576.10.1.12.8	wioDnsServer2	R/W	IP address of second DNS server

17.2.6 Actual Error Group

The actual error group contains information about the last system status/error status.

Table 266: WAGO MIB – Actual Error Group

Identifier	Entry	Access	Description
1.3.6.1.4.1.13576.10.1.20.1	wioErrorGroup	R	Error group of last error
1.3.6.1.4.1.13576.10.1.20.2	wioErrorCode	R	Error code of last error
1.3.6.1.4.1.13576.10.1.20.3	wioErrorArgument	R	Error argument of last error
1.3.6.1.4.1.13576.10.1.20.4	wioErrorDescription	R	Error description string

17.2.7 PLC Project Group

The PLC project group contains information about the controller's PLC program.

Table 267: WAGO MIB – PLC Project Group

Identifier	Entry	Access	Description
1.3.6.1.4.1.13576.10.1.30.1	wioProjectId	R	ID of CODESYS project
1.3.6.1.4.1.13576.10.1.30.2	wioProjectDate	R	Date of CODESYS project
1.3.6.1.4.1.13576.10.1.30.3	wioProjectName	R	Name of CODESYS project
1.3.6.1.4.1.13576.10.1.30.4	wioProjectTitle	R	Title of CODESYS project
1.3.6.1.4.1.13576.10.1.30.5	wioProjectVersion	R	Version of CODESYS project
1.3.6.1.4.1.13576.10.1.30.6	wioProjectAuthor	R	Author of CODESYS project
1.3.6.1.4.1.13576.10.1.30.7	wioProjectDescription	R	Description of CODESYS project
1.3.6.1.4.1.13576.10.1.30.8	wioNumberOfIecTasks	R	Number of IEC tasks in the CODESYS project
1.3.6.1.4.1.13576.10.1.30.9	wioIecTaskTable	-	
1.3.6.1.4.1.13576.10.1.30.9.1	wioIecTaskEntry	-	
1.3.6.1.4.1.13576.10.1.30.9.1.1	wioIecTaskId	R	ID of IEC task in the CODESYS project
1.3.6.1.4.1.13576.10.1.30.9.1.2	wioIecTaskName	R	Name of IEC task in the CODESYS project
1.3.6.1.4.1.13576.10.1.30.9.1.3	wioIecTaskStatus	R	Status of IEC task in the CODESYS project
1.3.6.1.4.1.13576.10.1.30.9.1.4	wioIecTaskMode	R	Mode of IEC task in the CODESYS project
1.3.6.1.4.1.13576.10.1.30.9.1.5	wioIecTaskPriority	R	Priority of IEC task in the CODESYS project
1.3.6.1.4.1.13576.10.1.30.9.1.6	wioIecTaskInterval	R	Interval of cyclic IEC task in the CODESYS project
1.3.6.1.4.1.13576.10.1.30.9.1.7	wioIecTaskEvent	R	Event for IEC task in the CODESYS project
1.3.6.1.4.1.13576.10.1.30.9.1.8	wioIecTaskCycleCount	R	Count of IEC task in the CODESYS project
1.3.6.1.4.1.13576.10.1.30.9.1.9	wioIecTaskCycleTime	R	Last cycle time of IEC task in the CODESYS project
1.3.6.1.4.1.13576.10.1.30.9.1.10	wioIecTaskCycleTime-Min	R	Minimal cycle time of IEC task in the CODESYS project
1.3.6.1.4.1.13576.10.1.30.9.1.11	wioIecTaskCycleTime-Max	R	Maximal cycle time of IEC task in the CODESYS project
1.3.6.1.4.1.13576.10.1.30.9.1.12	wioIecTaskCycleTime-Avg	R	Average cycle time of IE task in the CODESYS project

17.2.8 Http Group

The Http group contains information and settings for the controller's Web server.

Table 268: WAGO MIB – Http Group

Identifier	Entry	Access	Description
1.3.6.1.4.1.13576.10.1.40.1.1	wioHttpEnable	R/W	Enable/disable the port of the webserver: 0 = port of webserver disable 1 = port of webserver enable Default value: { 1 }
1.3.6.1.4.1.13576.10.1.40.1.2	wioHttpAuthenticationEnable	R/W	Enable/disable the authentication on the websides: 0 = authentication disabled 1 = authentication enable Default value: { 1 }
1.3.6.1.4.1.13576.10.1.40.1.3	wioHttpPort	R/W	Port of the http web server Default value: { 80 }

17.2.9 Ftp Group

The Ftp group contains information and settings for the controller's Ftp server.

Table 269: WAGO MIB – Ftp Group

Identifier	Entry	Access	Description
1.3.6.1.4.1.13576.10.1.40.2.1	wioFtpEnable	R/W	Enable/disable the port of the ftp server 0 = port of ftp server disable 1 = port of ftp server enable Default value: { 1 }

17.2.10 Sntp Group

The Sntp group contains information and settings for the controller's Sntp server.

Table 270: WAGO MIB – Sntp Group

Identifier	Entry	Access	Description
1.3.6.1.4.1.13576.10.1.40.3.1	wioSntpEnable	R/W	Enable/disable the port of the SNTP server 0 = port of SNTP server disable 1 = port of SNTP server enable Default value: { 1 }
1.3.6.1.4.1.13576.10.1.40.3.2	wioSntpServer-Address	R/W	IP address of SNTP server Default value: { 0 }
1.3.6.1.4.1.13576.10.1.40.3.3	wioSntpClient-Intervall	R/W	Interval to pool SNTP manager Default value: { 0 }
1.3.6.1.4.1.13576.10.1.40.3.4	wioSntpClient-Timeout	R/W	Timeout to corrupt SNTP answer Default value: { 2000 }
1.3.6.1.4.1.13576.10.1.40.3.5	wioSntpClient-DayLightSaving	R/W	Time offset of 1 hour: 0 = not offset 1 = offset 1 hour (DayLightSaving) Default value: { 0 }

17.2.11 Snmp Group

The Snmp group contains information and settings for the controller's SNMP agent.

Table 271: WAGO MIB – Snmp Group

Identifier	Entry	Access	Description
1.3.6.1.4.1.13576.10.1.40.4.1	wioSnmpEnable	R/W	Enable/disable the port of the SNMP server 0 = port of SNMP server disable 1 = port of SNMP server enable Default value: { 1 }
1.3.6.1.4.1.13576.10.1.40.4.2.1	wioSnmp1-ProtocolEnable	R/W	Enable/disable first SNMPv1/v2c agent Default value: { 1 }
1.3.6.1.4.1.13576.10.1.40.4.2.2	wioSnmp1-ManagerIp	R/W	IP address of first SNMP server Default value: { 'COA80101'h }
1.3.6.1.4.1.13576.10.1.40.4.2.3	wioSnmp1-Community	R/W	Community identification string for SNMPv1/v2c Default value: { "public" }
1.3.6.1.4.1.13576.10.1.40.4.2.4	wioSnmp1Trap-V1enable	R/W	Enable/disable SNMPv1 traps to first SNMP server Default value: { 1 }
1.3.6.1.4.1.13576.10.1.40.4.2.5	wioSnmp1Trap-V2enable	R/W	Enable/disable SNMPv2c traps to first SNMP server Default value: { 0 }

Table 271: WAGO MIB – Snmp Group

Identifier	Entry	Access	Description
1.3.6.1.4.1.13576.10.1.40.4.2.6	wioSnmp2-ProtocolEnable	R/W	Enable/disable first SNMPv1/v2c agent Default value: { 0 }
1.3.6.1.4.1.13576.10.1.40.4.2.7	wioSnmp2-ManagerIp	R/W	IP address of second SNMP server Default value: { '00000000'h }
1.3.6.1.4.1.13576.10.1.40.4.2.8	wioSnmp2-Community	R/W	Community identification string for SNMPv1/v2c Default value: { "public" }
1.3.6.1.4.1.13576.10.1.40.4.2.9	wioSnmp2Trap-V1enable	R/W	Enable/disable SNMPv1 traps to first SNMP server Default value: { 0 }
1.3.6.1.4.1.13576.10.1.40.4.2.10	wioSnmp2Trap-V2enable	R/W	Enable/disable SNMPv2c traps to first SNMP server Default value: { 0 }
1.3.6.1.4.1.13576.10.1.40.4.3.1	wioSnmp1User-Enable	R/W	Enable/disable first SNMPv3 user Default value: { 1 }
1.3.6.1.4.1.13576.10.1.40.4.3.2	wioSnmp1-Authentication-Typ	R/W	Authentication typ for first SNMPv3 user: 0 = no Authentication 1 = MD5 Authentication 2 = SHA1 Authentication Default value: { 1 }
1.3.6.1.4.1.13576.10.1.40.4.3.3	wioSnmp1-Authentication-Name	R/W	Authentication name for first SNMPv3 user Default value: { "SecurityName" }
1.3.6.1.4.1.13576.10.1.40.4.3.4	wioSnmp1-Authentication-Key	R/W	Authentication key for first SNMPv3 user Default value: { "AuthenticationKey" }
1.3.6.1.4.1.13576.10.1.40.4.3.5	wioSnmp1-PrivacyEnable	R/W	Disable/enable data encryption for first SNMPv3 user:: 0 = no Encryption 1 = DES Encryption Default value: { 1 }
1.3.6.1.4.1.13576.10.1.40.4.3.6	wioSnmp1-PrivacyKey	R/W	Privacy key for SNMPv3 for first SNMPv3 user Default value: { "PrivacyKey" }
1.3.6.1.4.1.13576.10.1.40.4.3.7	wioSnmp1-Notification-Enable	R/W	Enable/disable notification (SNMPv3 traps) with SNMPv3 user Default value: { 1 }
1.3.6.1.4.1.13576.10.1.40.4.3.8	wioSnmp1-Notification-ReceiverIP	R/W	Receiver IP address for notification (SNMPv3 traps) with SNMPv3 user Default value: { 'C0A80101'h }
1.3.6.1.4.1.13576.10.1.40.4.3.9	wioSnmp2User-Enable	R/W	Enable/disable second SNMPv3 user Default value: { 0 }
1.3.6.1.4.1.13576.10.1.40.4.3.10	wioSnmp2-Authentication-Typ	R/W	Authentication typ for second SNMPv3 user: 0 = no authentication 1 = MD5 authentication 2 = SHA1 authentication Default value: { 1 }
1.3.6.1.4.1.13576.10.1.40.4.3.11	wioSnmp2-Authentication-Name	R/W	Authentication name for second SNMPv3 user Default value: { "SecurityName" }

Table 271: WAGO MIB – Snmp Group

Identifier	Entry	Access	Description
1.3.6.1.4.1.13576.10.1.40.4.3.12	wioSnmp2-Authentication-Key	R/W	Authentication key for second SNMPv3 user Default value: {"AuthenticationKey"}
1.3.6.1.4.1.13576.10.1.40.4.3.13	wioSnmp2-PrivacyEnable	R/W	Privacy key for SNMPv3 for second SNMPv3 user Default value: { 1 }
1.3.6.1.4.1.13576.10.1.40.4.3.14	wioSnmp2-PrivacyKey	R/W	Privacy key for SNMPv3 for second SNMPv3 user Default value: {"PrivacyKey" }
1.3.6.1.4.1.13576.10.1.40.4.3.15	wioSnmp2-Notification-Enable	R/W	Enable/disable notification (SNMPv3 traps) with SNMPv3 user Default value: { 0 }
1.3.6.1.4.1.13576.10.1.40.4.3.16	wioSnmp2-Notification-ReceiverIP	R/W	Receiver IP address for notification (SNMPv3 traps) with SNMPv3 user Default value: { '00000000'h }

17.2.12 Snmp Trap String Group

The Snmp trap string group contains strings that are attached to the manufacturer-specific traps.

Table 272: WAGO MIB – Snmp Trap String Group

Identifier	Entry	Access	Description
1.3.6.1.4.1.13576.10.1.40.4.4.1	wioTrapKbus-Error	R/W	String for 1st SNMP trap Default value: {"Kbus Error" }
1.3.6.1.4.1.13576.10.1.40.4.4.2	wioTrapPlcStart	R/W	String for 2nd SNMP trap Default value: {"Plc Start" }
1.3.6.1.4.1.13576.10.1.40.4.4.3	wioTrapPlcStop	R/W	String for 3rd SNMP trap Default value: {"Plc Stop" }
1.3.6.1.4.1.13576.10.1.40.4.4.4	wioTrapPlc-Reset	R/W	String for 4th SNMP trap Default value: {"Plc Reset" }
1.3.6.1.4.1.13576.10.1.40.4.4.5	wioTrapPlcSoftwareWatchdog	R/W	String for 5th SNMP trap Default value: {"Plc Software Watchdog" }
1.3.6.1.4.1.13576.10.1.40.4.4.6	wioTrapPlc-DivideByZero	R/W	String for 6th SNMP trap Default value: {"Plc Divide By Zero" }
1.3.6.1.4.1.13576.10.1.40.4.4.7	wioTrapPlc-OnlineChange	R/W	String for 7th SNMP trap Default value: {"Plc Online Change" }
1.3.6.1.4.1.13576.10.1.40.4.4.8	wioTrapPlc-Download	R/W	String for 8th SNMP trap Default value: {"Plc Download Programm" }
1.3.6.1.4.1.13576.10.1.40.4.4.9	wioTrapPlc-Login	R/W	String for 9th SNMP trap Default value: {"Plc Login" }
1.3.6.1.4.1.13576.10.1.40.4.4.10	wioTrapPlc-Logout	R/W	String for 10th SNMP trap Default value: {"Plc Logout" }

17.2.13 Snmp User Trap String Group

The Snmp user trap string group contains strings that can be attached to user-specific traps. These strings can be changed via SNMP or Wago_SNMP.lib in CODESYS.

Table 273: WAGO MIB – Snmp User Trap String Group

Identifier	Entry	Access	Description
1.3.6.1.4.1.13576.10.1.40.4.5.1	wioUserTrapMsg1	R/W	String for 1st SNMP trap
1.3.6.1.4.1.13576.10.1.40.4.5.2	wioUserTrapMsg2	R/W	String for 2nd SNMP trap
1.3.6.1.4.1.13576.10.1.40.4.5.3	wioUserTrapMsg3	R/W	String for 3rd SNMP trap
1.3.6.1.4.1.13576.10.1.40.4.5.4	wioUserTrapMsg4	R/W	String for 4th SNMP trap
1.3.6.1.4.1.13576.10.1.40.4.5.5	wioUserTrapMsg5	R/W	String for 5th SNMP trap
1.3.6.1.4.1.13576.10.1.40.4.5.6	wioUserTrapMsg6	R/W	String for 6th SNMP trap
1.3.6.1.4.1.13576.10.1.40.4.5.7	wioUserTrapMsg7	R/W	String for 7th SNMP trap
1.3.6.1.4.1.13576.10.1.40.4.5.8	wioUserTrapMsg8	R/W	String for 8th SNMP trap
1.3.6.1.4.1.13576.10.1.40.4.5.9	wioUserTrapMsg9	R/W	String for 9th SNMP trap
1.3.6.1.4.1.13576.10.1.40.4.5.10	wioUserTrapMsg10	R/W	String for 10th SNMP trap

17.2.14 Plc Connection Group

Activate or deactivate the connection to CODESYS with the Plc connection group.

Table 274: WAGO MIB – Plc Connection Group

Identifier	Entry	Access	Description
1.3.6.1.4.1.13576.10.1.40.5.1	wioCODESYSEnable	R/W	Enable/disable the port of the CODESYS server 0 = port of CODESYS server disable 1 = port of CODESYS server enable Default value: { 1 }

17.2.15 Modbus Group

The Modbus group contains information and settings about the controller's modbus server.

Table 275: WAGO MIB – Modbus Group

Identifier	Entry	Access	Description
1.3.6.1.4.1.13576.10.1.40.6.1	wioModbusTcp-Enable	R/W	Enable/disable the port of the Modbus TCP server 0 = port of Modbus TCP server disable 1 = port of Modbus TCP server enable Default value: { 1 }
1.3.6.1.4.1.13576.10.1.40.6.2	wioModbusUdb-Enable	R/W	Enable/disable the port of the Modbus UDP server 0 = port of Modbus UDP server disable 1 = port of Modbus UDP server enable Default value: { 1 }
1.3.6.1.4.1.13576.10.1.40.6.3	wioMax-Connections	R/W	The maximal count of modbus connections Default value: { 15 }
1.3.6.1.4.1.13576.10.1.40.6.4	wioConnection-Timeout	R/W	Timeout of the modbus connection Default value: { 600 }
1.3.6.1.4.1.13576.10.1.40.6.5	wioModbus-WatchdogMode	R/W	Mode of the modbus watchdog Default value: { 0 }
1.3.6.1.4.1.13576.10.1.40.6.6	wioModbus-WatchdogTime	R/W	Timeout of the modbus watchdog Default value: { 100 }
1.3.6.1.4.1.13576.10.1.40.6.7	wioFreeModbus-Sockets	R/W	Unused and free modbus connections Default value: { 15 }
1.3.6.1.4.1.13576.10.1.40.6.8	wioModbus-ConnectionTable	-	
1.3.6.1.4.1.13576.10.1.40.6.8.1	wioModbus-ConnectionEntry	-	
1.3.6.1.4.1.13576.10.1.40.6.8.1.1	wioModbus-ConnectionIndex	R/W	Index of modbus connection
1.3.6.1.4.1.13576.10.1.40.6.8.1.2	wioModbus-ConnectionIp	R/W	IP address of modbus connection
1.3.6.1.4.1.13576.10.1.40.6.8.1.3	wioModbus-ConnectionPort	R/W	Port of modbus connection

17.2.16 Process Image Group

The process image group contains a list of information about the terminals connected to the controller.

Table 276: WAGO MIB – Process Image Group

Identifier	Entry	Access	Description
1.3.6.1.4.1.13576.10.1.50.1	wioModulCount	R	Count of modules
1.3.6.1.4.1.13576.10.1.50.2	wioAnalogOutLength	R	Length of analog output process datas
1.3.6.1.4.1.13576.10.1.50.3	wioAnalogInLength	R	Length of analog input process datas
1.3.6.1.4.1.13576.10.1.50.4	wioDigitalOutLength	R	Length of digital output process datas
1.3.6.1.4.1.13576.10.1.50.5	wioDigitalInLength	R	Length of digital input process datas
1.3.6.1.4.1.13576.10.1.50.6	wioDigitalOutOffset	R	Offset of digital output process datas
1.3.6.1.4.1.13576.10.1.50.7	wioDigitalInOffset	R	Offset of digital input process datas
1.3.6.1.4.1.13576.10.1.50.8	wioModuleTable	-	
1.3.6.1.4.1.13576.10.1.50.8.1	wioModuleEntry	-	
1.3.6.1.4.1.13576.10.1.50.8.1.1	wioModuleNumber	R	Number of module slot
1.3.6.1.4.1.13576.10.1.50.8.1.2	wioModuleName	R	Name of module

Table 276: WAGO MIB – Process Image Group

Identifier	Entry	Access	Description
1.3.6.1.4.1.13576.10.1.50.8.1.3	wioModuleType	R	Type of module
1.3.6.1.4.1.13576.10.1.50.8.1.4	wioModuleCount	R	Count of module
1.3.6.1.4.1.13576.10.1.50.8.1.5	wioModule-AlternativeFormat	R	Module in alternative format
1.3.6.1.4.1.13576.10.1.50.8.1.6	wioModuleAnalog-OutLength	R	Length of analog output data of module (Bit)
1.3.6.1.4.1.13576.10.1.50.8.1.7	wioModuleAnalog-InLength	R	Length of analog input data of module (Bit)
1.3.6.1.4.1.13576.10.1.50.8.1.8	wioModuleDigital-OutLength	R	Length of digital output data of module (Bit)
1.3.6.1.4.1.13576.10.1.50.8.1.9	wioModuleDigital-InLength	R	Length of digital input data of module (Bit)

17.2.17 Plc Data Group

The Plc data group contains values that can be used for data exchange with CODESYS.

Table 277: WAGO MIB – Plc Data Group

Identifier	Entry	Access	Description
1.3.6.1.4.1.13576.10.1.100.1	wioPlcDataTable	-	
1.3.6.1.4.1.13576.10.1.100.1.1	wioPlcDataEntry	-	
1.3.6.1.4.1.13576.10.1.100.1.1.1	wioPlcDataIndex	R/W	Number of plc data DWORD
1.3.6.1.4.1.13576.10.1.100.1.1.2	wioPlcDataReadArea	R/W	Readable plc data (DWORD)
1.3.6.1.4.1.13576.10.1.100.1.1.3	wioPlcDataWriteArea	R	Write-/readable plc data (DWORD)

18 Use in Hazardous Environments

The **WAGO-I/O-SYSTEM 750** (electrical equipment) is designed for use in Zone 2 hazardous areas.

The following sections include both the general identification of components (devices) and the installation regulations to be observed. The individual subsections of the “Installation Regulations” section must be taken into account if the I/O module has the required approval or is subject to the range of application of the ATEX directive.

18.1 Marking Configuration Examples

18.1.1 Marking for Europe According to ATEX and IEC-Ex

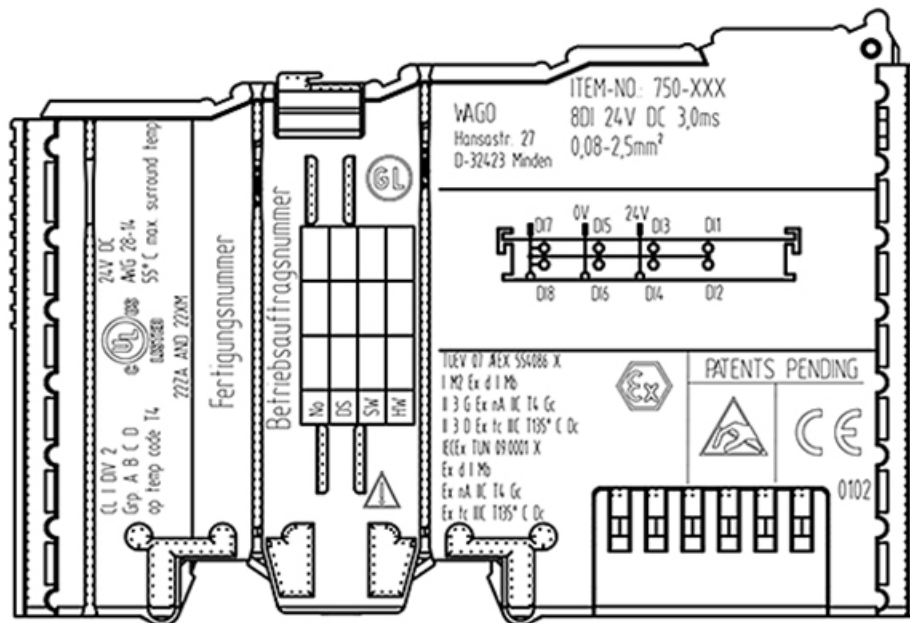


Figure 119: Side Marking Example for Approved I/O Modules According to ATEX and IECEx

TUEV 07 AEX 554086 X
 I M2 Ex d I Mb
 II 3 G Ex nA IIC T4 Gc
 II 3 D Ex tc III C T135° C Dc
 IECEx TUN 09.0001 X
 Ex d I Mb
 Ex nA IIC T4 Gc
 Ex tc III C T135° C Dc




Figure 120: Text Detail – Marking Example for Approved I/O Modules According to ATEX and IECEx.

Table 278: Description of Marking Example for Approved I/O Modules According to ATEX and IECEx

Printing on Text	Description
TÜV 07 ATEX 554086 X IECEx TUN 09.0001 X	Approving authority and certificate numbers
Dust	
II	Equipment group: All except mining
3D	Category 3 (Zone 22)
Ex	Explosion protection mark
tc Dc	Type of protection and equipment protection level (EPL): protection by enclosure
IIIC	Explosion group of dust
T 135°C	Max. surface temperature of the enclosure (without a dust layer)
Mining	
I	Equipment group: Mining
M2	Category: High level of protection
Ex	Explosion protection mark
d Mb	Type of protection and equipment protection level (EPL): Flameproof enclosure
I	Explosion group for electrical equipment for mines susceptible to firedamp
Gases	
II	Equipment group: All except mining
3G	Category 3 (Zone 2)
Ex	Explosion protection mark
nA Gc	Type of protection and equipment protection level (EPL): Non-sparking equipment
nC Gc	Type of protection and equipment protection level (EPL): Sparking apparatus with protected contacts. A device which is so constructed that the external atmosphere cannot gain access to the interior
IIIC	Explosion group of gas and vapours
T4	Temperature class: Max. surface temperature 135°C

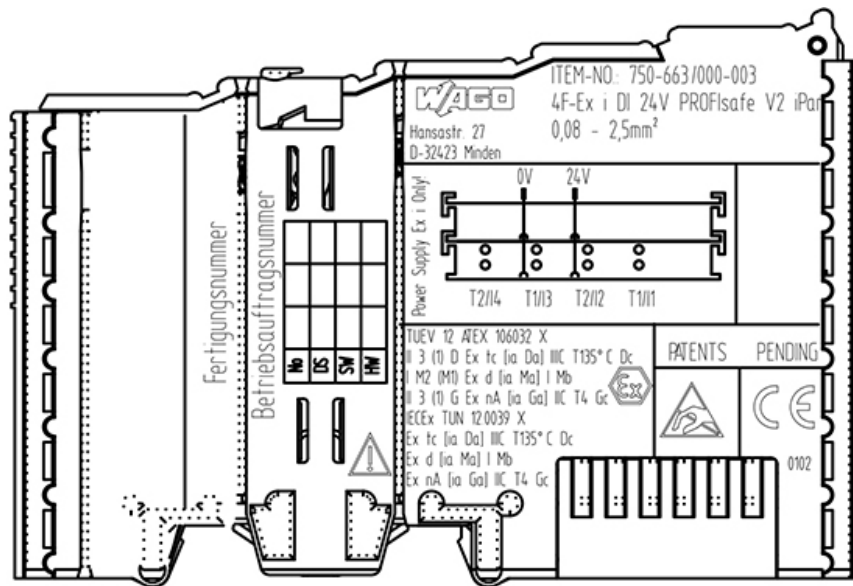


Figure 121: Side Marking Example for Approved Ex i I/O Modules According to ATEX and IECEx.


TUEV 12 ATEX 106032 X
 II 3 (I) D Ex tc [ia Da] IIC T135° C Dc
 I M2 (M1) Ex d [ia Ma] I Mb
 II 3 (I) G Ex nA [ia Ga] IIC T4 Gc 
 IECEX TUN 120039 X
 Ex tc [ia Da] IIC T135° C Dc
 Ex d [ia Ma] I Mb
 Ex nA [ia Ga] IIC T4 Gc

Figure 122: Text Detail – Marking Example for Approved Ex i I/O Modules According to ATEX and IECEx.

Table 279: Description of Marking Example for Approved Ex i I/O Modules According to ATEX and IECEx

Inscription Text	Description
TÜV 07 ATEX 554086 X IECEX TUN 09.0001X	Approving authority and certificate numbers
TÜV 12 ATEX 106032 X IECEX TUN 12.0039 X	
Dust	
II	Equipment group: All except mining
3(1)D	Category 3 (Zone 22) equipment containing a safety device for a category 1 (Zone 20) equipment
3(2)D	Category 3 (Zone 22) equipment containing a safety device for a category 2 (Zone 21) equipment
Ex	Explosion protection mark
tc Dc	Type of protection and equipment protection level (EPL): protection by enclosure
[ia Da]	Type of protection and equipment protection level (EPL): associated apparatus with intrinsic safety circuits for use in Zone 20
[ib Db]	Type of protection and equipment protection level (EPL): associated apparatus with intrinsic safety circuits for use in Zone 21
IIIC	Explosion group of dust
T 135°C	Max. surface temperature of the enclosure (without a dust layer)
Mining	
I	Equipment Group: Mining
M2 (M1)	Category: High level of protection with electrical circuits which present a very high level of protection
Ex d Mb	Explosion protection mark with Type of protection and equipment protection level (EPL): Flameproof enclosure
[ia Ma]	Type of protection and equipment protection level (EPL): associated apparatus with intrinsic safety electrical circuits
I	Explosion group for electrical equipment for mines susceptible to firedamp

Table 279: Description of Marking Example for Approved Ex i I/O Modules According to ATEX and IECEx

Gases	
II	Equipment group: All except mining
3(1)G	Category 3 (Zone 2) equipment containing a safety device for a category 1 (Zone 0) equipment
3(2)G	Category 3 (Zone 2) equipment containing a safety device for a category 2 (Zone 1) equipment
Ex	Explosion protection mark
nA Gc	Type of protection and equipment protection level (EPL): Non-sparking equipment
[ia Ga]	Type of protection and equipment protection level (EPL): associated apparatus with intrinsic safety circuits for use in Zone 0
[ia Gb]	Type of protection and equipment protection level (EPL): associated apparatus with intrinsic safety circuits for use in Zone 1
IIC	Explosion group of gas and vapours
T4	Temperature class: Max. surface temperature 135°C

18.1.2 Marking for America According to NEC 500

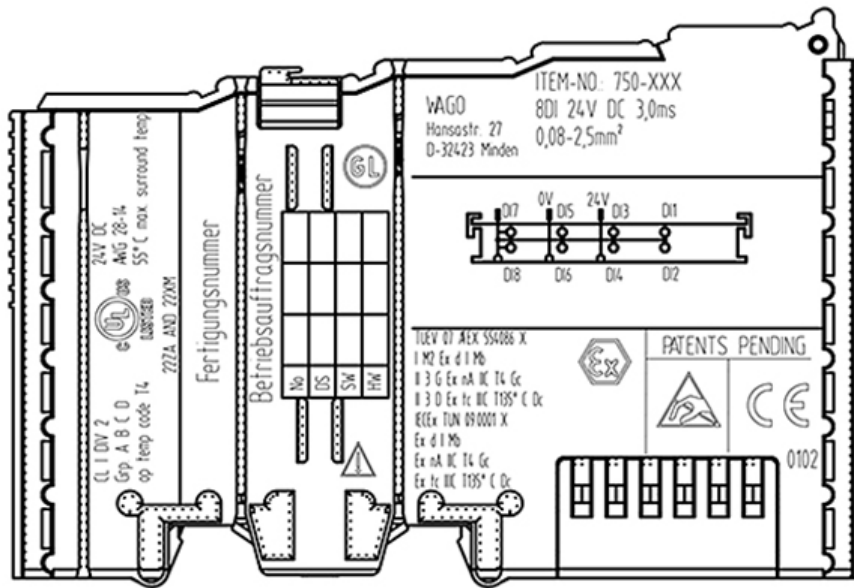


Figure 123: Side Marking Example for I/O Modules According to NEC 500

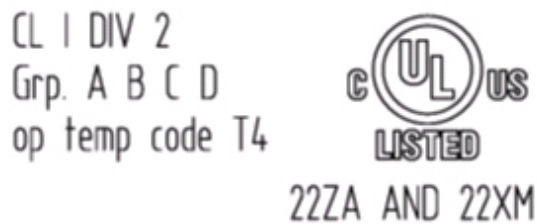


Figure 124: Text Detail – Marking Example for Approved I/O Modules According to NEC 500

Table 280: Description of Marking Example for Approved I/O Modules According to NEC 500

Printing on Text	Description
CL I	Explosion protection group (condition of use category)
DIV 2	Area of application
Grp. ABCD	Explosion group (gas group)
Op temp code T4	Temperature class

18.2 Installation Regulations

For the installation and operation of electrical equipment in hazardous areas, the valid national and international rules and regulations which are applicable at the installation location must be carefully followed.

18.2.1 Special Conditions for Safe Use (TÜV 14 ATEX 148929 X)

1. The modules of the WAGO-I/O-SYSTEM 750-*** have to be erected in such a way, that corresponding to EN 60079-15 a degree of protection of at least IP 54 according to EN 60529 is achieved.
2. Measures have to be taken, external to the modules, to provide a transient protection that ensures that the rated voltage, connected to the power supply terminals, is not exceeded by more than 40 %.
3. The connecting and disconnecting of the non-intrinsically safe circuits is only permitted if no explosive atmosphere exists. This although applies for the all switches, interfaces (Fieldbus, Ethernet, Serial) and the SD-card.
4. The ambient temperature range is: $0\text{ °C} \leq T_{\text{amb}} \leq +60\text{ °C}$
The ambient temperature range for modules with suffix extension /025-**** is: $-20\text{ °C} \leq T_{\text{amb}} \leq +60\text{ °C}$

18.2.2 Special Conditions for Safe Use (ATEX Certificate TÜV 12 ATEX 106032 X)

1. For use as Gc- or Dc-apparatus (in zone 2 or 22) the Field bus Independent I/O Modules WAGO-I/O-SYSTEM 750-*** Ex i shall be erected in an enclosure that fulfils the requirements of the applicable standards (see the marking) EN 60079-0, EN 60079-11, EN 60079-15 and EN 60079-31. For use as group I electrical apparatus M2 the apparatus shall be erected in an enclosure that ensures a sufficient protection according to EN 60079-0 and EN 60079-1 and the degree of protection IP64. The compliance of these requirements and the correct installation into an enclosure or a control cabinet of the devices shall be certified by an ExNB.
2. Measures have to be taken outside of the device that the rating voltage is not being exceeded of more than 40 % because of transient disturbances.
3. The connecting and disconnecting of the non-intrinsically safe circuits is only permitted during installation, for maintenance or for repair purposes. The temporal coincidence of explosion hazardous atmosphere and installation, maintenance resp. repair purposes shall be excluded.
4. For the type the following shall be considered: The Interface circuits shall be limited to overvoltage category I/II (non mains/mains circuits) as defined in EN 60664-1.

18.2.3 Special Conditions for Safe Use (IEC-Ex Certificate TUN 14.0035X)

1. The modules of the WAGO-I/O-SYSTEM 750-*** have to be erected in such a way, that corresponding to IEC 60079-15 a degree of protection of at least IP 54 according to IEC 60529 is achieved.
2. Measures have to be taken, external to the modules, to provide a transient protection that ensures that the rated voltage, connected to the power supply terminals, is not exceeded by more than 40 %.
3. The connecting and disconnecting of the non-intrinsically safe circuits is only permitted if no explosive atmosphere exists. This although applies for the all switches, interfaces (Fieldbus, Ethernet, Serial) and the SD-card.
4. The ambient temperature range is: $0\text{ °C} \leq T_{amb} \leq +60\text{ °C}$
The ambient temperature range for modules with suffix extension /025-*** is: $-20\text{ °C} \leq T_{amb} \leq +60\text{ °C}$

18.2.4 Special Conditions for Safe Use (IEC-Ex Certificate IECEx TUN 12.0039 X)

1. For use as Gc- or Dc-apparatus (in zone 2 or 22) the Field bus independent I/O Modules WAGO-I/O-SYSTEM 750-*** Ex i shall be erected in an enclosure that fulfils the requirements of the applicable standards (see the marking) IEC 60079-0, IEC 60079-11, IEC 60079-15, IEC 60079-31.
For use as group I electrical apparatus M2 the apparatus shall be erected in an enclosure that ensures a sufficient protection according to IEC 60079-0 and IEC 60079-1 and the degree of protection IP64.
The compliance of these requirements and the correct installation into an enclosure or a control cabinet of the devices shall be certified by an ExCB.
2. Measures have to be taken outside of the device that the rating voltage is not being exceeded of more than 40 % because of transient disturbances.
3. The connecting and disconnecting of the non-intrinsically safe circuits is only permitted during installation, for maintenance or for repair purposes.
The temporal coincidence of explosion hazardous atmosphere and installation, maintenance resp. repair purposes shall be excluded.
4. For the type the following shall be considered: The Interface circuits shall be limited to overvoltage category I/II (non mains/mains circuits) as defined in IEC 60664-1.

18.2.5 Special Conditions for Safe Use according to ANSI/ISA 12.12.01

- A. “This equipment is suitable for use in Class I, Division 2, Groups A, B, C, D or non-hazardous locations only.”
- B. “This equipment is to be fitted within tool-secured enclosures only.”
- C. “WARNING Explosion hazard - substitution of components may impair suitability for Class I, Div. 2.”
- D. “WARNING – Do not disconnect equipment unless power has been switched off or the area is known to be non-hazardous” has to be placed near each operator accessible connector and fuse holder.
- E. When a fuse is provided, the following information shall be provided: “A switch suitable for the location where the equipment is installed shall be provided to remove the power from the fuse.”
- F. For devices with EtherCAT/Ethernet connectors “Only for use in LAN, not for connection to telecommunication circuits.”
- G. “WARNING - Use Module 750-642 only with antenna module 758-910.”
- H. For Couplers/Controllers and Economy bus modules only: The instructions shall contain the following: “The configuration interface Service connector is for temporary connection only. Do not connect or disconnect unless the area is known to be non-hazardous. Connection or disconnection in an explosive atmosphere could result in an explosion.”
- I. Modules containing fuses only: “WARNING - Devices containing fuses must not be fitted into circuits subject to over loads, e.g. motor circuits.”
- J. Modules containing SD card reader sockets only: “WARNING - Do not connect or disconnect SD-Card while circuit is live unless the area is known to be free of ignitable concentrations of flammable gases or vapors.”
- K. The modules 750-439, 750-538, 750-633, 750-663/000-003 shall only be supplied with 750-606 or 750-625/000-001.
- L. Module 750-538 only “In Hazardous Locations, Non-Incendive only when installed per Control Drawing No. 750-538”.

Information



Additional Information

Proof of certification is available on request.

Also take note of the information given on the operating and assembly instructions.

The manual, containing these special conditions for safe use, must be readily available to the user.

Glossary

B

Baseband

Baseband systems are systems that operate without carrier frequencies, i.e. with non-modulated signals. This means they provide exactly one channel that must be logically adapted to the various, specific requirements.

Opposite: *Broadband*

BatiBUS

BatiBUS is one of the first open fieldbus systems for building automation systems. CSMA/CA is used as the access method. BatiBUS can have a bus, star-shaped or ring topology, with each station having a dedicated address through which it is contacted. This makes expansion, either by adding or removing stations, extremely easy. The BatiBUS Club International (BCI) was founded in 1989 to broaden the scope of use for BatiBUS in building automation. The members of this organization come from HVAC, lighting and building automation companies. The BatiBUS has been standardized as JTC1/SC25 through CENELEC (Europe) and ISO/IEC.

Bit

Smallest information unit. Its value can either be 1 or 0.

Bit rate

Number of bits transmitted within a time unit.

BootP

The Bootstrap Protocol sends configuration data to several controllers/ computers, etc. (without hard drives). This eliminates the need for manual, individual configuration.

BootP is used at WAGO for assigning IP addresses to couplers/controllers. DHCP reverts back to BootP.

Bridge

A bridge runs on Layer 2 of the ISO/OSI model. Although the bridge corresponds to a *Switch*, it only has one output.

Bridges separate the network into Segments, allowing the number of nodes to be increased. Corrupt data can be filtered out. Telegrams are then sent when the target address is located in the linked *Segment*. Only the frame of the MAC layer is treated. If the destination address is known, the bridge then forwards the data (when the destination address is on a different string than the one where the *Frame* originated), or destroys it (subscriber already has the frame). If the address is not known, the bridge floods it (forwards all *Segments* that it is aware of) and notes the source address.

A bridge is used to transfer messages independently of the message destination.

Broadcast

A message sent to all stations connected to the network

Bus

Bus is a general designation for a line used for bit-parallel or bit-serial data transfer. The bus consists of address, data, control and supply bus. The width of the bus (8-, 16-, 32-, 64-bit) and its frequency are the determining factors for the data transmission rate. The width of the address bus limits network expansion. The *Fieldbus* is a special type of serial bus.

Byte (Binary Yoked Transfer Element)

A data element larger than a bit and smaller than a word. A byte generally contains 8 bits. A byte may contain 9 bits in 36-bit computers.

C

Client

A device that requests services within the Client/Server system. With the aid of the service request, the client can access objects (data) on the *Server*. The service is provided by the server.

Coaxial cable

This cable contains one, single conductor and radial shielding for transmitting information.

Communication Object (KNX)

Communication objects are obtained from KNX-specific function blocks that are programmed in the IEC application and imported as network variables in the ETS. Network variables are linked with KNX group addresses in the ETS, yielding communication objects. The objects represent certain data formats and are linked to actions that instruct a device how and when to react.

Although several group addresses can be assigned to one communication object, only one group address may be used as the sending address. Data can, however, be received from several group addresses at one communication object. The response of a communication object on the bus can be determined using communication object flags. A KNX device has at least one communication object.

The format for a communication object is defined as data point type (DPT), or EIB Interworking Standard (EIS).

CSMA/CA (Carrier Sense Multiple Access/Collision Avoidance)

CSMA/CA is a bus access procedure that allows all participants to have equal access to the bus. Collisions are avoided to the greatest extent possible with CSMA/CA (Collision Avoidance), whereas they are only detected with *CSMA/CD* (Collision Detection). Information is transmitted using inter-frame spacing with an additional back-off time. The time is stopped when a station begins transmitting and held until transmission is concluded. No data is transferred during this period. Reservations for “Request to send”/“Clear to send” (RTS/CTS) packets can also be employed for mutual “coordination”.

CSMA/CD (Carrier Sense Multiple Access/Collision Detection)

Random bus access procedure (Carrier Sense Multiple Access with Collision Detection). When a collision is detected, all subscribers back off. After waiting (a random delay time), the subscribers attempt to re-transmit the data.

D**Deterministic ETHERNET**

Deterministic ETHERNET denotes that the runtimes can be defined and calculated in an ETHERNET network. This is possible by setting up a *Switched ETHERNET*.

Device address (logical address in TP1 network)

Device addresses are physical addresses used for unique identification of subscribers within the network. In this format, *range*, *line* and subscriber numbers are listed sequentially and are separated by a decimal point.

Example: 1.2.14 = *Range 1, Line 2, Subscriber 14*

Device mode

If a *KNX/EIB/TP1* module 753-646 is operated as second or subsequent module of this type on a *KNX IP controller*, or if it is plugged into another WAGO controller at any location, the module works in device mode. Module and controller then communicate via the *IEC-61131-3* application of the controller. However, if the KNX module operates as the first module of this type on a KNX IP controller, it operates in the *router mode*.

DNS (Domain Name System)

The Domain Name System is a distributed, decentralized database that manages the name sector in the *Internet*. Unique domain names (such as <http://www.wago.de>) are transformed into IP addresses (such as 123.45.67.123) using a “forward lookup”. IP addresses can be converted back to domain names using a “reverse lookup”. Using the naming service, several IP address can be used for one domain name for distribution of network load. Besides this, domain names are easier to remember than IP addresses. If an IP address changes in the background, this does not affect the domain name. Paul Mockapetris developed the DNS in 1983. Since then it has been expanded to include other standards and has become anchored in the *RFC 1034* and *RFC 1035*.

DPT (Data Point Type)

The data point type describes the property/function for a *communication object* and is assigned to that object via ETS. The format, coding, size and unit are specified here.

Example: A data point type “Boolean” may be a data type 1.001 DPT_Switch. Its data width is 1 bit. This means that it encodes the statuses “on/off”. A total of 14 different DPTs exist for the “Boolean” data type.

In addition to data types, there are also EIS types (EIB Interworking Standard Types). This is an older definition, however, that shows less details than the DPTs.

Driver

Software code which communicates with a hardware device. This communication is normally performed by internal device registers.

E

EHS (European Home System)

The European Home Systems (EHS) describe specifications for communication between electronic/electrical home devices (systems). These specifications are based on the ISO/OSI reference model.

EIB (European Installation Bus)

see KNX

EIBA (European Installation Bus Association)

The EIBA is an organization founded in 1990 for KNX/EIB standardization. Today, this task is carried out by the *KNX Association*.

EIS (EIB Interworking Standard)

The EIS types define the properties/functions of KNX objects. These have been standardized as EIS 1 to EIS 15 by the EIBA, ensuring interoperability and non-dependence of manufacturers. The EIS types are certified by the KNX Association. They are being increasingly replaced by the data point types, which are more detailed in structure.

ETHERNET

Specifies a Local Area Network (LAN), which was developed by Xerox, Intel and DEC in the 70's. The bus access process takes place according to the *CSMA/CD* method.

ETHERNET Standard

ETHERNET was standardized in 1983 with *IEEE 802.3* 10Base-5. ISO accepted this standardization with the ISO Standard 8802/3. *ETHERNET* can, in the meantime, be used with all common types of cables and with optic fibers. There are, however, some technical and considerable logical differences between the standardized variants and the original "*ETHERNET*", which is why the term "*ETHERNET*" is used when the older design is meant and "802.3" is used for standardized systems. The essential differences between the *ETHERNET* and the IEEE standard are found in the frame architecture and in the handling of pad characters.

ETS (Engineering Tool Software)

The ETS is a manufacturer-independent tool for the installation, commissioning, design, documentation, diagnostics and maintenance of KNX devices. The ETS defines which bus users, *lines* and *ranges* execute which function at which location.

ETS-Plug-in

Manufacturers supply their products together with a product database and, where applicable, a specific ETS plug-in. This plug-in is incorporated into ETS. In WAGO products, the ETS plug-in sets up, among other things, a link between the data point of the programmed application and the KNX group addresses.

F**Fieldbus**

The fieldbus is a dedicated bus for the serial transmission of information. Fieldbuses connect sensors, actuators and controls from the field level to the management level. Numerous different fieldbuses have been developed for various purposes. For example, the LON and KNX fieldbuses are mostly used in building automation, whereas CANbus and Interbus are mostly applied in the automotive industry.

Firewall

Collective term for solutions that protect LANs connected to the Internet from unauthorized access. They are also able to control and regulate the traffic from the LAN into the Internet. The crucial parts of firewalls are static *Routers*, which have an access control list used to decide which data packets can pass from which Host.

Frame

Unit of data transferred at the Data-Link layer. It contains the header and addressing information.

FTP (File Transfer Protocol)

A standard application for TCP/IP, which permits files to be transferred without files being accessed.

Function

Functions are *Modules* that always return the same results (as a function value) when the input values are identical; they have no local variables that store values beyond an invoke.

Function block

Function blocks are used for IEC-61131 programming and stored in libraries for repeated utilization. A function block is a structured module, which has a name and contains input and output variables, as well as local variables. The values of the local variables can be stored locally for a temporary period. The input and output variables are stored in the controller memory. The respective memory sectors and entity names of the function blocks are exported as a network variable when the IEC program is compiled, and they are imported to the ETS, as a SYM_XML file, together with other data. In the WAGO ETS plug-in, the network variables are then linked to the KNX group addresses and create the basis for the communication between the IEC application and the TP1 network.

G

Gateway

Device for connecting two different networks performs the translation between differing protocols.

Group address (logical address in TP1 network)

The group address is a logical address used for communication within the TP1 network. Subscribers within the network evaluate messages when they belong to the group that is addressed using the group address. These are displayed as two or three-level addresses, as the main, or also as intermediate and subgroups, with the associated value ranges [0...13], [0...7] and [0...255], for example 3/4/12.

Group classification is freely assignable, but should follow set rules; e.g., main group for main function, intermediate group for floors/buildings, subgroup for detailed information.

Communication objects and group addresses are assigned to one another in the *ETS Plug-in*. The group address assumes the length format for the communication object in this process. After that, this group address may only be assigned to communication objects of the same length.

H

Hardware

Electronic, electric and mechanical components of a module.

Header

A portion of the data packet, containing information such as the receiver's address information.

Host computer/Subscriber

Originally used to describe a central mainframe computer accessed from other systems. The services provided by the subscriber can be called up by means of local and remote request. Today, host can also refer to computers that provide certain *services* from a central location (such as UNIX hosts on the Internet).

HTML (Hypertext Markup Language)

HTML is the descriptive language for documents on the World Wide Web. It contains language elements for the design of *hypertext* documents.

HTTP (Hyper Text Transfer Protocol)

Client/Server TCP/IP protocol which is used on the *Internet* or *Intranets* for exchange of *HTML* documents. It normally uses *Port 80*.

Hub

A device allowing communication between several network users via *Twisted pair* cable; its topology is star-shaped.

Hypertext

Document format used by *HTTP*. Hypertext documents are text files that provide links to other text documents via particular highlighted keywords.

I**ICMP (Internet Control Message Protocol)**

ICMP is a protocol for transmission of status information and error messages of the *IP*, *TCP* and *UDP* protocols between IP network nodes. ICMP offers, among other things, the possibility of an echo (ping) request to determine whether a destination is available and is responding.

IEC-61131-3

International standard for modern systems with PLC functionality created in 1993. Based on a structured software model, it defines a series of powerful programming languages to be utilized for different automation tasks. AWL (statement list - STL), ST (structured text), AS (process structure), FUP (function plan), KOP (contact plan).

IEEE

Institute of Electrical and Electronic Engineers.

IEEE 802.3

IEEE 802.3 is an IEEE standard. *ETHERNET* only supports the yellow cable as a medium (Thicknet *ETHERNET* coaxial cable). IEEE 802.3 also supports S UTP and Broadband coaxial cable. The segment lengths range from 500 m for yellow cable, 100 m for TP and 1800 m for wideband coaxial cable. The topology may either be star-shaped or Bus. *ETHERNET* (IEEE 802.3) uses CSMA/CD as a channel access method.

Intel format

Set configuration for the coupler/controller for setting up the process image. In the coupler/controller memory, the module data is aligned in different ways, depending on the set configuration (Intel/Motorola-Format, *word alignment*, etc.). The format determines whether or not high and low bytes are changed over – they are not changed with the Intel format.

Internet

A collection of networks interconnected to each other throughout the world. It is most commonly referred to as the World Wide Web, or simply as the Web.

Intranet

A private network within an organization that allows users to exchange data within that particular organization.

IP (Internet Protocol)

Internet protocol is a network protocol that performs packet-oriented, connectionless and non-acknowledged transfer of data within a network. This

protocol builds upon the transfer layer for the *ISO/OSI model*. Stations identify themselves using IP addresses.

ISO/OSI (Open Systems Interconnection) Model

The ISO/OSI model is a reference model for networks, with the goal of creating open communication. This model defines the interface standards among computer manufacturers in the corresponding hardware and software requirements. The model treats communication removed from specific implementations, using seven layers: 1 - Bit transfer layer, 2 - Backup layer, 3 - Transfer layer, 4 - Transport layer, 5 - Session layer, 6 - Presentation layer and 7 - Application layer.

K

KNX

KNX has been established as a flexible bus system for building automation and has been standardized by the KNX Association in ISO/IEC 14543. KNX was developed by the European installation bus (EIB), BatiBUS and European Home Systems (EHS). In addition to twisted pair, other transmission media, such as powerline, radio and links to Ethernet (“KNXnet/IP”) are also supported.

KNX Association

The KNX Association is the founder and owner of the KNX technology. The association has signed partnership agreements with more than 21,000 installation companies in 70 countries (<http://www.konnex.org>).

KNX IP

KNX IP denotes the use of the Internet Protocol (IP) as the only KNX medium.

KNX IP Controller

The 750-889 programmable fieldbus controller is a combination of two logic devices with a 2-port switch. The KNX IP Controller can be operated directly in an IP network as a stand-alone, freely programmable *KNX IP device* using an RJ-45 connector. In combination with a *KNX/EIB/TP1 module*, the controller is expanded to a full-size *KNXnet/IP router* and enables the coupling between an IP network and a two-wire TP1 network.

KNX IP Device

KNX IP Device describes a KNX end device using the Internet Protocol (IP) as the only KNX medium.

KNX/EIB/TP1 Module

The KNX/EIB/TP1 module 753-646 serves in the connection of two-wire TP1 networks to all WAGO controllers, except for the CANopen and the MODBUS controllers. The KNX module may be operated in device mode or router mode. The operating mode is set by the *KNX IP controller* and also depends on the position of the KNX module on the controller.

KNXnet/IP Protocol Series

The KNXnet/IP protocol corresponds to the already standardized EIBnet/IP protocol series. KNXnet/IP is the integration of the KNX protocol implementations on top of Internet Protocol (IP) networks. Via the KNXnet/IP protocol, a direct connection between two KNX IP devices is established. Because the KNXnet/IP protocol is based on the *ETHERNET*, it permits connection across large distances (e.g. via the internet). This can mean very high speeds to one or several remote networks.

KNXnet/IP router

If the 753-646 *KNX/EIB/TP1 module* operates as the first KNX module of this type on a *KNX IP controller*, it operates in router mode. The controller and the module together are designated as a KNXnet/IP router. The routing function enables the module's TP1 network to be linked to the rapid medium IP. In addition, the KNXnet/IP router is also used as a line and range coupler that contains filter tables and contributes to a flattening out of the hierarchies in the network.

KNX/EIB/TP1 module

The 753-646 KNX/EIB/TP1 module links two-wire TP1 networks to all WAGO controllers, except for the CANopen and MODBUS controller. The KNX module can be operated in the Device or Router mode. The mode is determined by the *KNX IP controller* and also depends on the point at which the KNX module is plugged into the controller.

KNXnet/IP Tunneling

The KNXnet/IP Tunneling Protocol establishes a direct link between the *KNX IP devices* and the configuration software. A tunneling link exists, for example, when KNX devices are configured using the *ETS*.

L**LAN (Local Area Network)**

A LAN is a spatially limited, local network for permanently linking computers over shorter distances. Data transfer can take place via *ETHERNET*, Token Ring and FDDI, as well as wireless (WLAN).

Library

Collection of *Modules* available to the programmer in the *WAGO-I/O-PRO* programming tool for creating control programs in accordance with IEC-61131-3.

Line (KNX)

A line connects up to 64 bus users in one TP1 network. If more users are present, additional lines are created. The lines are connected to the main line each using a line coupler. These main lines form *ranges*, which are connected to the backbone via range couplers. Lines may also be connected directly to the backbone. A line coupler is identified in the network by its user number "0" in the physical address (e.g., 2.6.0).

Logical address (Group address)

see Group address

LON (Local Operating Network)

LON is used as a *fieldbus* for building automation. It was developed in 1990 by Echelon and enables the communication between different devices, as does KNX, independent of the manufacturer and active application.

M

MIB (Management Information Base)

MIB is a collection of information about all parameters, which can be handed over to the management software with a request via *SNMP*. This enables remote maintenance, monitoring and control of networks to be performed via *SNMP* protocol.

MODBUS

MODBUS is an open protocol based on the Master/Slave principle. The MODBUS links the master with several *clients*, via either serial interface or *ETHERNET*. Three data transmission types are available: MODBUS/RTU (binary data transmission), MODBUS/TCP (data transmission using TCP/IP packets) and MODBUS/ASCII (ASCII code transmission).

Module

Modules consist of functions, *Function blocks* and programs.

Every module is made up of a declaration part and a body. The body is written in one of the IEC programming languages AWL (statement list - STL), ST (structured text), AS (process structure), FUP (function plan) or KOP (contact plan).

N

Network Variables

Network variables each reference a memory sector in the controller, where the input and output data of the KNX-specific function blocks are stored. The network variable names are identical to the entity names for the KNX-specific function blocks. Network variables are exported to an *SYM_XML* file when IEC applications are compiled and copied to the WAGO ETS plug-in for further processing. In the WAGO ETS plug-in, the network variables are linked with KNX device addresses and create the basis for communication between the IEC applications and the TP1 network.

O

Open MODBUS/TCP Specification

Specification which establishes the specific structure of a MODBUS/TCP data packet. This is dependent upon the selected function code.

Operating System

An operating system is software used for managing equipment such as memory and connected devices, and for executing programs.

P

Parameter Setting

Parameterization is defined as the assignment and storage of set-up and configuration data as they are required for the execution of predefined functions.

Physical address (Device address)

see Device address

Ping command

When a ping command (ping<IP address) is entered, the ping program ICMP generates echo request packets. It is used to test for node availability.

Port number

The port number, in conjunction with the IP address, is the unique connection point between two processes (applications).

Predictable ETHERNET

The predictable message delay time on an *ETHERNET* network. The measures that are taken here enable nearly real-time requests to be realized.

Proxy Server

Proxy basically means agent or representative. A proxy server (or proxy gateway) allows indirect access to the network by systems which do not have direct access to the *Internet*. This may be systems that are restricted from direct access by a *firewall* for security reasons. A proxy can filter out individual data packets between the Internet and a local network *LAN* to enhance security. Proxies are also used to limit access to particular *servers*.

In addition, proxy servers can also have a cache function, in which case they check whether the respective URL address is already available locally and return it immediately, if necessary. This saves time and costs associated with multiple accesses. If the URL is not in the cache, the proxy forwards the request as normal.

The user should not notice the proxy gateway apart from the single configuration in the web browser. Most web browsers can be configured so that they use different or no proxy gateways per access method (FTP, HTTP).

R

Range (KNX)

A range is a summary with maximum of 15 *lines*. These are connected to a main line via line coupler. Up to 15 ranges can be interconnected with range couplers. They are positioned at range line and have the physical addresses x.0.0 (e.g., 2.0.0).

Repeater

Repeaters operate (like hubs, but with only one, instead of several outputs) on Layer 1 of the *ISO/OSI model*.

Repeaters are physical amplifiers without their own processing function. They refresh data without detecting damaged data and forward all signals. Repeaters are used for implementing greater transmission distances, or when the maximum number of nodes of (normally) 64 devices for each *twisted-pair* segment is exceeded. The repeater is then always counted as a node in a *segment* when the maximum number of nodes is reached.

The media can also be changed when *routers* are used that are configured as repeaters.

Request

A service request from a client which requests the provision of a service from a server.

Response

Response from a server in reply to a *request* from a client.

RFC Specifications

Specifications, suggestions, ideas and guidelines regarding the *Internet* are published in the form of RFCs (Request For Comments).

RJ-45 connector

The RJ-45 plug is also referred to as a Western connector. This connector creates the connection of two network controllers via a *twisted-pair* cable.

Router

Routers are used to connect neighboring *subnets*, with the router operating with addresses and protocols of the third *ISO/OSI layer*. As this layer is hardware independent, the routers allow transition to another transmission medium.

To transmit a message the router evaluates the logical address (source and destination address) and finds the best path if there are several possibilities.

Routers can be operated in the *Repeater* or *Bridge* modes.

Router mode

If a KNX module is operated at a *KNXnet/IP controller*, the module operates in router mode enabling a data exchange between the TP1 network of the module and IP network of the controller. Thus, even devices of different TP1 networks can communicate with each other if they are connected via IP backbone.

Routing

Method of selecting the best path for sending data to a distant network.

S**SCADA (Supervisory Control and Data Acquisition)**

SCADA software is a program for the control and visualization of processes (supervisory control and data acquisition).

Segment

Typically, a network is divided up into different physical network segments by way of routers or *repeaters*.

Server

Device providing services within a client/server system. The service is requested by the Client.

Service

Operation (read, write) directed toward an object, which is often designated as a service.

Service Port

The service port is located next to the mode switch, behind the cover flap on the controller. This port acts as the configuration and programming interface and is used for communication with *WAGO-I/O-CHECK*, *WAGO-I/O-PRO* and for downloading firmware.

A special programming/connecting cable (750-920) is required for this port.

SMTP (Simple Mail Transfer Protocol)

Standard protocol, with which E-mails are sent via *Internet*.

SNMP (Simple Network Management Protocol)

SNMP is used for remote maintenance of servers. This allows *routers*, for example, to be configured directly from the network provider's office, without having to physically visit the customer.

SNTP (Simple Network Time Protocol)

This connectionless network protocol performs time synchronization in networks with a time server *via Internet*. SNTP is a simplified version of the NTP protocol. On account of this simplification (also with regard to the software), SNTP operates somewhat less exact than NTP. SNTP is defined in *RFC 4330*.

Socket

A software interface implemented with BSD-UNIX for inter-process communication. Sockets are also possible in the network via TCP/IP. Per Windows 3.11, they are also available in Microsoft operating systems.

STP (Shielded twisted Pair)

An STP cable is a symmetrical cable with shielded cores twisted in pairs. The classic STP cable is a multi-core cable, whose stranded conductors are isolated. The conductors of the STP cable are individually protected; it has no total shielding.

S-STP (Screened/Shielded Twisted Pair)

In addition to STP cables, S-STP cables are provided with total shielding consisting of foil or network shielding in addition to the single shielding for the individual conductors.

Structured Cabling

With structured cabling, maximum permissible cable lengths are defined (EIA/TIA 568, IS 11801) for site, building and floor cabling, with recommendations for topologies also indicated.

Subnet

A portion of a network that shares the same network address as the other portions. These subnets are distinguished through the subnet mask.

Subnet mask

Subnet masks can be used to manipulate the address ranges in the IP address area in reference to the number of *subnets* and *hosts*. A standard subnet mask, for example, is 255.255.255.0.

S-UTP (Screened Unshielded Twisted-Pair)

Screened *twisted pair* cable which only has one external shield. However, the twisted pair cables are not shielded from each other.

Switch

Switches are comparable to *bridges*, but with several outputs. Each output uses the full *ETHERNET* bandwidth. Each output uses the full *ETHERNET* bandwidth. Switches learn which nodes are connected and filter the information transmitted over the network accordingly. Switches learn which nodes are connected and filter the information transmitted over the network accordingly.

Switched-ETHERNET

ETHERNET network set up using switches. There are many applications for switching technologies. ETHERNET switching is becoming increasingly popular in local networks as it allows *deterministic* ETHERNET.

T

TCP (Transport Control Protocol)

TCP is a connection-oriented network protocol for the transport layer (Layer 4) of the *ISO/OSI model* provided with relatively secure transmission mechanisms.

TCP/IP Protocol Stack

The TCP/IP protocol stack denotes network protocols that enable communication between different networks and topologies.

Telnet

The Telnet protocol fulfills the function of a virtual terminal. It allows remote access from the user's computer to other computer systems on the network.

Traps

Traps are unsolicited messages, which are sent by an agent to a management system upon the detection of an unexpected event. Traps are comparable to interrupts from *hardware*. A well-known example of a trap message is the "Blue screen" with Win95/98.

Twisted Pair

Twisted pair cables (abbreviated to TP).

U

UDP (Users Datagram Protocol)

The user datagram protocol is a communication protocol between two computers and an alternative to *TCP* (Transmission Control Protocol). As with *TCP*, UDP communicates via Internet Protocol (IP), although it is somewhat less reliable due to its uncontrolled communication method.

URL (Uniform Resource Locator)

Address form for Internet files which are mostly applied within the World Wide Web (WWW). The URL format makes the unambiguous designation of all documents on the Internet possible by describing the address of a document or object which can be read by a web browser. URL includes the transmission type (*HTTP*, *FTP*), the computer which contains the information and the path on the computer. A URL has the following format:

Document type://Computer name/List of contents/File name.

UTP (Unshielded Twisted Pair)

The UTP cable is a symmetrical, non-protected cable with twisted, colored wires in pairs. This cable type, either of a two-pair or four-pair design, is the cable type most used for floor wiring and terminal wiring.

W

WAGO-I/O-PRO (CODESYS)

Uniform programming environment, programming tool by WAGO Kontakttechnik GmbH & Co. KG for the generation of a control program per IEC-61131-3 for all programmable fieldbus controllers. The software enables a program to be created, tested, debugged and started-up. WAGO-I/O-PRO consists of the basic tool "CODESYS" and the target files with the WAGO-specific Drivers.

Word-alignment

Set configuration for the fieldbus coupler/controller for setting up the process image. Word-alignment is used to establish the process image word-by-word (2 bytes).

Literature List



Information

EIB. Gebäudebussystem

Dietrich/Kastner/Sauter

Hüthig Verlag, 2000

ISBN 3-7785-2795-9

EIB/KNX – Projektplanung und Durchführung

Willi Meyer

Christiani Verlag, 2006, <http://www.christiani.de>ISBN-13: 978-3-86522-149-0, ISBN-10 3-86522-149-1

EIB Tool Software

Willi Meyer

Hüthig & Pflaum Verlag GmbH & Co. Fachliteratur KG München/Heidelberg

ISBN: 3-8101-0243-1

Ethernet – TCP/IP für die Industrieautomation. Grundlagen und Praxis

Frank J. Furrer

Hüthig GmbH, Heidelberg 2000

ISBN 3-7785-2779-7

Internet intern – Technik & Programmierung

Tischer und Jennrich

DATA Becker Verlag, 1997

ISBN 3-8158-1160-0

TCP/IP. Aufbau und Betrieb eines TCP/IP-Netzes

Kevin Washburn, Jim Evans

Addison-Wesley Publishing Company, 1997

ISBN 3-8273-1145-4

TCP/IP-Ethernet bis Web-IO

Wiesemann & Theis GmbH

<http://www.WuT.de>, Druckschriften

TCP/IP – Grundlagen. Protokolle und Routing

Gerhard Lienemann

Verlag Heinz Heise, 2000

ISBN 3-8822-9180-X

TCP/IP. Internet-Protokolle im professionellen Einsatz

Mathias Hein

International Thomson Publishing, Bonn 1997

ISBN 3-8266-4035-7

List of Figures

Figure 1: Fieldbus Node (Example)	20
Figure 2: Marking Area for Serial Numbers	21
Figure 3: Isolation for Fieldbus Couplers/Controllers (Example).....	23
Figure 4: System Supply via Fieldbus Coupler/Controller (left) and via Internal System Supply Module (right).....	24
Figure 5: System Voltage for Standard Couplers/Controllers and Extended ECO Couplers	25
Figure 6: Field Supply for Standard Couplers/Controllers and Extended ECO Couplers	28
Figure 7: Supply Module with Fuse Carrier (Example 750-610)	30
Figure 8: Removing the Fuse Carrier	31
Figure 9: Opening the Fuse Carrier	31
Figure 10: Changing the Fuse	31
Figure 11: Fuse Modules for Automotive Fuses, Series 282	32
Figure 12: Fuse Modules for Automotive Fuses, Series 2006	32
Figure 13: Fuse Modules with Pivotal Fuse Carrier, Series 281	32
Figure 14: Fuse Modules with Pivotal Fuse Carrier, Series 2002	32
Figure 15: Power Supply Concept.....	33
Figure 16: Power supply concept for cable runs > 3 m.....	34
Figure 17: Supply Example for Standard Couplers/Controllers	36
Figure 18: Carrier Rail Contact (Example)	40
Figure 19: Cable Shield at Ground Potential.....	41
Figure 20: Examples of the WAGO Shield Connecting System.....	42
Figure 21: Application of the WAGO Shield Connecting System	42
Figure 22: KNX IP Controller 750-889	44
Figure 23: KNX/EIB/TP1 Module 753-646.....	45
Figure 24: KNX Hardware Concept.....	48
Figure 25: KNX Software Concept	49
Figure 26: IEC Application with CFC Program (Function Plan Editor).....	51
Figure 27: Surface of ETS.....	52
Figure 28: Surface of ETS Plug-ins	53
Figure 29: Web Visualization of a Residential Dwelling.....	55
Figure 30: Sample Page of the Web-based Management System.....	56
Figure 31: Application Example KNX IP Router	57
Figure 32: Application Example: KNX IP Application Controller + I/O Modules	58
Figure 33: Application Example: KNX IP Application Controller + Router.....	59
Figure 34: Application Example: KNX IP Application Controller + I/O Modules + Router.....	60
Figure 35: Application Example: KNX IP Application Controller + Router + 2 KNX/EIB/TP1 Modules.....	61
Figure 36: Application Example: KNX IP Application Controller + Router + 2 KNX Modules in a Router Line.....	62
Figure 37: Any Fieldbus Controller with KNX Module	63
Figure 38: View KNX IP Controller	68
Figure 39: Device Supply	70
Figure 40: RJ-45 Connector	71
Figure 41: Display Elements	72

Figure 42: Service Interface (Closed and Opened Flap)	74
Figure 43: Mode Selector Switch (Closed and Open Damper of the Service Port)	75
Figure 44: Buttons	77
Figure 45: Opening the Memory Card Slot, Inserting an SD/SDHC Memory Card	78
Figure 46: Spacing.....	91
Figure 47: Release Tab of Extended ECO Fieldbus Coupler (Example).....	94
Figure 48: Insert I/O Module (Example).....	95
Figure 49: Snap the I/O Module into Place (Example).....	95
Figure 50: Removing the I/O Module (Example)	96
Figure 51: Data Contacts	97
Figure 52: Example for the Arrangement of Power Contacts	98
Figure 53: Connecting a Conductor to a CAGE CLAMP®	99
Figure 54: Run-up of the Controller.....	101
Figure 55: Example of Process Image for Input Data.....	104
Figure 56: Example of Process Image for Output Data	105
Figure 57: Telegram processing	107
Figure 58: Function block “FbDPT_Date_pro”	107
Figure 59: Memory Areas and Data Exchange	110
Figure 60: Example declaration of remanent flags by “var retain”	111
Figure 61: Data Exchange Between MODBUS Master and I/O Modules.....	120
Figure 62: Data Exchange Between PLC Function (CPU) of the PFC and the I/O Modules.....	121
Figure 63: Example of Addressing for a Fieldbus Node.....	124
Figure 64: Restore Function	127
Figure 65: WBM Page “Backup & Restore”	129
Figure 66: WBM Page “Backup & Restore”	131
Figure 67: WBM page “Backup & Restore”	131
Figure 68: Setting the Storage Location in the Web-based Management System	135
Figure 69: Logging into the PLC Browser.....	136
Figure 70: Example of directory structure on the SD card.....	139
Figure 71: Example for the Function test of a Fieldbus Node	156
Figure 72: Selecting KNXnet/IP routing.....	158
Figure 73: Enabling the connection.....	158
Figure 74: Checking the IP address.....	159
Figure 75: Example of Time Synchronization in ETHERNET Settings.....	163
Figure 76: Example of WBM Clock Configuration	164
Figure 77: Logging in for Programming Access.....	166
Figure 78: Logging Into the PLC Browser.....	167
Figure 79: Dialog window for target system settings.....	168
Figure 80: Write access via module parameters.....	170
Figure 81: EA-config.xml	172
Figure 82: Watchdog Runtime is Less Than the Task Runtime.....	182
Figure 83: Watchdog Runtime Is Greater Than the Task Call Interval	182
Figure 84: Enabling/Disabling System Events.....	185
Figure 85: Dialog Window “Communication Parameters”	189
Figure 86: Logging in for Programming Access.....	190
Figure 87: WBM page “Information”	195

Figure 88: WBM page “Ethernet”	197
Figure 89: WBM Page “TCP/IP”	200
Figure 90: WBM page “Port”	202
Figure 91: WBM page “SNMP”	205
Figure 92: WBM page “SNMP V3”	207
Figure 93: WBM Page “Watchdog”	209
Figure 94: WBM Page “Clock”	212
Figure 95: WBM Page “Security”	215
Figure 96: WBM page “MODBUS”	217
Figure 97: WBM page “KNX IP”	219
Figure 98: WBM page “PLC Info”	221
Figure 99: WBM page “PLC”	222
Figure 100: WBM page “Features”	227
Figure 101: WBM page “I/O Config”	229
Figure 102: WBM page “Disk-Info”	231
Figure 103: WBM Page “SD Card”	232
Figure 104: WBM page “Backup & Restore”	234
Figure 105: WBM page “WebVisu”	238
Figure 106: Display Elements	239
Figure 107: Node Status – I/O LED Signaling.....	243
Figure 108: Error Message Coding	243
Figure 109: Function Block for Determining Loss of Fieldbus, Independently of Protocol.....	255
Figure 110: KNX network structure.....	277
Figure 111: Physical address	279
Figure 112: Structure of a group address	279
Figure 113: KNXnet/IP router as a range coupler.....	285
Figure 114: KNXnet/IP router as a line coupler.....	285
Figure 115: WAGO-KNXnet/IP router as a range and line coupler	286
Figure 116: Use of the MODBUS Functions	290
Figure 117: Plug-in connectors, snap-ins, precut cables, tapping	360
Figure 118: Example SCADA Software with MODBUS Driver.....	363
Figure 119: Side Marking Example for Approved I/O Modules According to ATEX and IECEX	386
Figure 120: Text Detail – Marking Example for Approved I/O Modules According to ATEX and IECEX.	386
Figure 121: Side Marking Example for Approved Ex i I/O Modules According to ATEX and IECEX.	388
Figure 122: Text Detail – Marking Example for Approved Ex i I/O Modules According to ATEX and IECEX.	388
Figure 123: Side Marking Example for I/O Modules According to NEC 500 ...	391
Figure 124: Text Detail – Marking Example for Approved I/O Modules According to NEC 500.....	391

List of Tables

Table 1: Number Notation.....	14
Table 2: Font Conventions	14
Table 3: Legend for Figure “System Supply via Fieldbus Coupler/Controller (left) and via Internal System Supply Module (right)”	24
Table 4: Alignment.....	25
Table 5: Legend for Figure “Field Supply for Standard Couplers/Controllers and Extended ECO Couplers”	28
Table 6: Power Supply Modules	30
Table 7: Filter Modules for 24 V Supply	33
Table 8: Legend for Figure “Supply Example for Fieldbus Coupler/Controller”. ..	37
Table 9: WAGO Power Supply Units (Selection).....	38
Table 10: WAGO Ground Wire Terminals.....	39
Table 11: Functions/Application Options for WAGO KNX Devices.....	52
Table 12: Legend for Figure “View”	69
Table 13: RJ-45 Connector and RJ-45 Connector Configuration	71
Table 14: Display Elements Fieldbus Status.....	72
Table 15: Display Elements Node Status	72
Table 16: Display Elements Supply Voltage	72
Table 17: Legend for Figure “Service Interface (Closed and Opened Flap)”	74
Table 18: Legend for Figure „Mode Selector Switch“	75
Table 19: Mode Selector Switch Positions, Static Positions on PowerOn/Reset..	76
Table 20: Mode Selector Switch Positions, Dynamic Positions During Ongoing Operation.....	76
Table 21: Technical data – Device data	80
Table 22: Technical data – System data	81
Table 23: Technical data – Supply	82
Table 24: Technical data – Fieldbus MODBUS/TCP	82
Table 25: Technical data – KNX.....	82
Table 26: Technical data – Accessories	83
Table 27: Technical Data – Field Wiring.....	83
Table 28: Technical Data – Power Jumper Contacts	83
Table 29: Technical Data – Data Contacts	83
Table 30: Technical Data – Climatic Environmental Conditions	83
Table 31: Technical Data – Mechanical Strength	84
Table 32: WAGO DIN Rail.....	91
Table 33: Data Width for I/O Modules	114
Table 34: Example of Addressing	115
Table 35: IEC-61131-3 Address Areas	116
Table 36: Absolute Addressing	117
Table 37: Addressing Example	117
Table 38: Allocation of Digital Inputs and Outputs to Process Data Words in Accordance with the	119
Table 39: Possible Errors on System Start	128
Table 40: Possible Errors During the Backup Function.....	130
Table 41: Possible Errors During the Restore Function.....	132
Table 42: Possible Errors when Inserting the Memory Card During Ongoing Operation.....	133

Table 43: Possible Errors when Removing the Memory Card During Ongoing Operation.....	134
Table 44: Possible Errors During SPS Access to the File System of the Memory Card.....	137
Table 45: Possible Errors During the FTP Network Access on the File System of the Memory Card	138
Table 46: Data saved in the directory structure.....	140
Table 47: ETHERNET Libraries for WAGO-I/O-PRO.....	176
Table 48: Task priorities.....	183
Table 49: WBM page “Information”.....	196
Table 50: WBM Page “Ethernet”	198
Table 51: WBM page “TCP/IP”	201
Table 52: WBM page “Port”	203
Table 53: WBM page “SNMP”.....	206
Table 54: WBM Page “SNMP V3”.....	208
Table 55: WBM Page “Watchdog”	210
Table 56: WBM Page “Clock”	213
Table 57: WBM Page “Security”	216
Table 58: WBM Page “Modbus”	218
Table 59: WBM page “KNX”	220
Table 60: WBM Page “PLC Info”	221
Table 61: WBM Page “PLC”	223
Table 62: WBM page "Features"	227
Table 63: WBM Page “I/O Config”	230
Table 64: WBM Page “Disk Info”	231
Table 65: WBM Page “SD Card”.....	233
Table 66: WBM Page “Backup & Restore”	235
Table 67: LED Assignment for Diagnostics	239
Table 68: Fieldbus Diagnostics – Solution in Event of Error	240
Table 69: Node Status Diagnostics – Solution in Event of Error.....	242
Table 70: Blink Code Table for the I/O LED Signaling, Error Code 1	245
Table 71: Blink Code Table for the I/O LED Signaling, Error Code 2	246
Table 72: Blink Code Table for the I/O LED Signaling, Error Code 3	247
Table 73: Blink Code Table for the I/O LED Signaling, Error Code 4	248
Table 74: Blink Code Table for the I/O LED Signaling, Error Code 5	248
Table 75: Blink Code Table for the I/O LED Signaling, Error Code 6	249
Table 76: Blink Code Table for the I/O LED Signaling, Error Code 7	250
Table 77: Blink Code Table for the I/O LED Signaling, Error Code 8 ... 9	251
Table 78: Blink Code Table for the I/O LED Signaling, Error Code 10	251
Table 79: Blink Code Table for the I/O LED Signaling, Error Code 11	252
Table 80: Blink Code Table for the I/O LED Signaling, Error Code 14	253
Table 81: Power Supply Status Diagnostics – Solution in Event of Error.....	254
Table 82: IP Packet.....	258
Table 83: Network Class A	259
Table 84: Network Class B	259
Table 85: Network Class C	259
Table 86: Key Data Class A, B and C.....	260
Table 87: Example: Class B Address with Field for Subnet IDs	261
Table 88: Subnet Mask for Class A Network.....	261
Table 89: Subnet Mask for Class B Network.....	261

Table 90: Subnet Mask for Class C Network.....	261
Table 91: Example for an IP Address from a Class B Network.....	261
Table 92: Meaning of DHCP Options.....	266
Table 93: BootP Options.....	267
Table 94: Meaning of the SNTP Parameters.....	269
Table 95: MIB II Groups.....	271
Table 96: Standard Traps.....	272
Table 97: EIS data types.....	281
Table 98: Telegram.....	283
Table 99: MODBUS/TCP Header.....	287
Table 100: Basic Data Types of MODBUS Protocol.....	288
Table 101: List of the MODBUS Functions in the Fieldbus Controller.....	288
Table 102: Exception Codes.....	291
Table 103: Request of Function Code FC1.....	292
Table 104: Response of Function Code FC1.....	292
Table 105: Assignment of Inputs.....	292
Table 106: Exception of Function Code FC1.....	293
Table 107: Request of Function Code FC2.....	294
Table 108: Response of Function Code FC2.....	294
Table 109: Assignment of Inputs.....	294
Table 110: Exception of Function Code FC2.....	295
Table 111: Request of Function Code FC3.....	296
Table 112: Response of Function Code FC3.....	296
Table 113: Exception of Function Code FC3.....	296
Table 114: Request of Function Code FC4.....	297
Table 115: Response of Function Code FC4.....	297
Table 116: Exception of Function Code FC4.....	297
Table 117: Request of Function Code FC5.....	298
Table 118: Response of Function Code FC5.....	298
Table 119: Exception of Function Code FC5.....	298
Table 120: Request of Function Code FC6.....	299
Table 121: Response of Function Code FC6.....	299
Table 122: Exception of Function Code FC6.....	299
Table 123: Request of Function code FC11.....	300
Table 124: Response of Function Code FC11.....	300
Table 125: Exception of Function Code FC 11.....	300
Table 126: Request of Function Code FC15.....	301
Table 127: Response of Function Code FC15.....	301
Table 128: Exception of Function Code FC15.....	302
Table 129: Request of Function Code FC16.....	303
Table 130: Response of Function Code FC16.....	303
Table 131: Exception of Function Code FC16.....	303
Table 132: Request of Function Code FC22.....	304
Table 133: Response of Function Code FC22.....	304
Table 134: Exception of Function Code FC22.....	304
Table 135: Request of Function Code FC23.....	305
Table 136: Response of Function Code FC23.....	305
Table 137: Exception of Function Code FC23.....	305
Table 138: Register access reading (with FC3, FC4 and FC23).....	307
Table 139: Register access writing (with FC6, FC16, FC22 and FC23).....	308

Table 140: Bit Access Reading (with FC1 and FC2).....	309
Table 141: Bit Access Writing (with FC5 and FC15).....	309
Table 142: MODBUS Registers.....	310
Table 143: MODBUS registers (Continuation).....	311
Table 144: Register Address 0x1000	312
Table 145: Register Address 0x1001	312
Table 146: Register Address 0x1002	313
Table 147: Register Address 0x1003	313
Table 148: Register Address 0x1004	313
Table 149: Register Address 0x1005	313
Table 150: Register Address 0x1006	314
Table 151: Register Address 0x1007	314
Table 152: Register Address 0x1008	314
Table 153: Register Address 0x1009	314
Table 154: Register Address 0x100A	314
Table 155: Starting Watchdog.....	315
Table 156: Register Address 0x100B.....	316
Table 157: Register Address 0x1020	317
Table 158: Register Address 0x1021	317
Table 159: Register Address 0x1022	318
Table 160: Register Address 0x1023	318
Table 161: Register Address 0x1024	318
Table 162: Register Address 0x1025	318
Table 163: Register Address 0x1028	318
Table 164: Register Address 0x1029	319
Table 165: Register Address 0x102A	319
Table 166: Register Address 0x102B.....	319
Table 167: Register Address 0x1030	319
Table 168: Register Address 0x1031	319
Table 169: Register Address 0x1035	320
Table 170: Register Address 0x1036	320
Table 171: Register Address 0x1037	320
Table 172: Register Address 0x1050	320
Table 173: Register Address 0x2030	321
Table 174: Register Address 0x2031	321
Table 175: Register Address 0x2032	321
Table 176: Register Address 0x2033	322
Table 177: Register Address 0x2040	322
Table 178: Register Address 0x2041	322
Table 179: Register Address 0x2042	322
Table 180: Register Address 0x2043	322
Table 181: Register Address 0x2010	323
Table 182: Register Address 0x2011	323
Table 183: Register Address 0x2012	323
Table 184: Register Address 0x2013	323
Table 185: Register Address 0x2014	323
Table 186: Register Address 0x2020	323
Table 187: Register Address 0x2021	324
Table 188: Register Address 0x2022	324
Table 189: Register Address 0x2023	324

Table 190: Register Address 0x2000	325
Table 191: Register Address 0x2001	325
Table 192: Register Address 0x2002	325
Table 193: Register Address 0x2003	325
Table 194: Register Address 0x2004	325
Table 195: Register Address 0x2005	325
Table 196: Register Address 0x2006	326
Table 197: Register Address 0x2007	326
Table 198: Register Address 0x2008	326
Table 199: Register Addresses 0x3000 to 0x5FFF	326
Table 200: 1 Channel Digital Input Module with Diagnostics	329
Table 201: 2 Channel Digital Input Modules	329
Table 202: 2 Channel Digital Input Module with Diagnostics	329
Table 203: 2 Channel Digital Input Module with Diagnostics and Output Process Data	330
Table 204: 4 Channel Digital Input Modules	330
Table 205: 8 Channel Digital Input Modules	330
Table 206: 8 Channel Digital Input Module PTC with Diagnostics and Output Process Data	331
Table 207: 16 Channel Digital Input Modules	331
Table 208: 1 Channel Digital Output Module with Input Process Data	332
Table 209: 2 Channel Digital Output Modules	332
Table 210: 2 Channel Digital Input Modules with Diagnostics and Input Process Data	333
Table 211: 2 Channel Digital Input Modules with Diagnostics and Input Process Data 75x-506	333
Table 212: 4 Channel Digital Output Modules	334
Table 213: 4 Channel Digital Output Modules with Diagnostics and Input Process Data	334
Table 214: 8 Channel Digital Output Module	334
Table 215: 8 Channel Digital Output Modules with Diagnostics and Input Process Data	335
Table 216: 16 Channel Digital Output Modules	335
Table 217: 8 Channel Digital Input/Output Modules	336
Table 218: 1 Channel Analog Input Modules	337
Table 219: 2 Channel Analog Input Modules	337
Table 220: 4 Channel Analog Input Modules	338
Table 221: 3-Phase Power Measurement Module	339
Table 222: 8 Channel Analog Input Modules	340
Table 223: 2 Channel Analog Output Modules	341
Table 224: 4 Channel Analog Output Modules	341
Table 225: 8 Channel Analog Output Modules	342
Table 226: Counter Modules 750-404, (and all variations except of / 000-005), 753-404, (and variation /000-003)	343
Table 227: Counter Modules 750-404/000-005	344
Table 228: Counter Modules 750-638, 753-638	344
Table 229: Pulse Width Modules 750-511, /xxx-xxx	345
Table 230: Serial Interface Modules with alternative Data Format	345
Table 231: Serial Interface Modules with Standard Data Format	346
Table 232: Data Exchange Module	346

Table 233: SSI Transmitter Interface Modules	347
Table 234: Incremental Encoder Interface Modules 750-631/000-004, - -010, -011	347
Table 235: Incremental Encoder Interface Modules 750-634	348
Table 236: Incremental Encoder Interface Modules 750-637	348
Table 237: Digital Pulse Interface Modules 750-635	349
Table 238: DC-Drive Controller 750-636	349
Table 239: Stepper Controller RS 422 / 24 V / 20 mA 750-670	350
Table 240: RTC Module 750-640	351
Table 241: DALI/DSI Master Module 750-641	351
Table 242: Overview of Input Process Image in the "Easy" Mode	353
Table 243: Overview of the Output Process Image in the "Easy" Mode“	353
Table 244: EnOcean Radio Receiver 750-642	354
Table 245: MP Bus Master Module 750-643	355
Table 246: Bluetooth® RF-Transceiver 750-644	355
Table 247: Vibration Velocity/Bearing Condition Monitoring VIB I/O 750-645	356
Table 248: KNX/EIB/TP1 Module 753-646	357
Table 249: AS-interface Master Module 750-655	358
Table 250: System Modules with Diagnostics 750-610, -611	359
Table 251: Binary Space Module 750-622 (with Behavior Like 2 Channel Digital Input)	359
Table 252: MODBUS Table and Function Codes	363
Table 253: MIB II – System Group	364
Table 254: MIB II – Interface Group	365
Table 255: MIB II – IP Group	367
Table 256: MIB II – IpRoute Table Group	368
Table 257: MIB II – ICMP Group	369
Table 258: MIB II – TCP Group	370
Table 259: MIB II – UDP Group	371
Table 260: MIB II – SNMP Group	372
Table 261: WAGO MIB – Company Group	373
Table 262: WAGO MIB – Product Group	373
Table 263: WAGO MIB – Versions Group	374
Table 264: WAGO MIB – Real Time Clock Group	375
Table 265: WAGO MIB – Ethernet Group	376
Table 266: WAGO MIB – Actual Error Group	376
Table 267: WAGO MIB – PLC Project Group	377
Table 268: WAGO MIB – Http Group	378
Table 269: WAGO MIB – Ftp Group	378
Table 270: WAGO MIB – Sntp Group	379
Table 271: WAGO MIB – Snmp Group	379
Table 272: WAGO MIB – Snmp Trap String Group	381
Table 273: WAGO MIB – Snmp User Trap String Group	382
Table 274: WAGO MIB – Plc Connection Group	382
Table 275: WAGO MIB – Modbus Group	383
Table 276: WAGO MIB – Process Image Group	384
Table 277: WAGO MIB – Plc Data Group	385
Table 278: Description of Marking Example for Approved I/O Modules According to ATEX and IECEx	387

Table 279: Description of Marking Example for Approved Ex i I/O Modules According to ATEX and IECEx	389
Table 280: Description of Marking Example for Approved I/O Modules According to NEC 500.....	391

WE! INNOVATE!

WAGO Kontakttechnik GmbH & Co. KG
Postfach 2880 • D-32385 Minden
Hansastraße 27 • D-32423 Minden
Phone: 05 71/8 87 – 0
Fax: 05 71/8 87 – 1 69
E-Mail: info@wago.com
Internet: <http://www.wago.com>

