

Modular I/O System

Quick-Start Manual for ETHERNET Fieldbus Controller 750-872

Version 1.0.0



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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.

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



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1 Important Notes

To ensure fast installation and start-up of the units described in this manual, we strongly recommend that the following information and explanations are carefully read and adhered to.

1.1 Legal Principles

1.1.1 Copyright

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1.1.2 Personnel Qualification

The use of the product described in this manual is exclusively geared to specialists having qualifications in PLC programming, electrical specialists or persons instructed by electrical specialists who are also familiar with the appropriate applicable standards. WAGO Kontakttechnik GmbH & Co. KG declines any liability resulting from improper action and damage to WAGO products and third-party products due to non-observance of the information contained in this manual.

1.1.3 Intended Use

For each individual application, the components are supplied from the factory with a dedicated hardware and software configuration. Modifications are only admitted within the framework of the possibilities documented in the manuals. All other changes to the hardware and/or software and the non-conforming use of the components entail the exclusion of liability on the part of WAGO Kontakttechnik GmbH & Co. KG.

Please direct any requirements pertaining to a modified and/or new hardware or software configuration directly to WAGO Kontakttechnik GmbH & Co. KG.



1.2 Symbols

DANGER

Always observe this information to protect persons from injury.

NOTICE

Always observe this information to prevent damage to the device.

NOTE

Marginal conditions that must always be observed to ensure smooth operation.

ESD (Electrostatic Discharge)

Warning of damage to the components through electrostatic discharge. Observe the precautionary measure for handling components at risk of 'electrostatic discharge.

Note

Routines or advice for efficient use of a device and software optimization.

Additional Information

References to additional literature, manuals, data sheets and INTERNET pages.

1.3 Number Notation

Number code	Example	Note		
Decimal	100	Normal notation		
Hexadecimal	0x64	C notation		
Binary	'100' '0110.0100'	In inverted commas, nibbles separated by dots (.)		



1.4 Safety Information

NOTICE

Switch off the power before replacing any components!

In the event of deformed contacts, the module in question is to be replaced, as its functionality can no longer be ensured on a long-term basis.

The components are not resistant against materials having seeping and insulating properties. Belonging to this group of materials are: e.g., aerosols, silicones, triglycerides (found in some hand creams).

If it cannot be ruled out that these materials appear in the component environment, then additional measures are to be taken:

- Installation of the components in an appropriate enclosure.

- Handling of the components only with clean tools and materials.

NOTE

Soiled contacts may only be cleaned with ethyl alcohol and a leather cloth. In doing so, attention must be paid to the ESD information.

Do not use contact sprays, which in extreme cases could impair the operation of the contact.

The WAGO-I/O-SYSTEM 750 and its components are an open system. It must only be assembled in housings, cabinets or in electrical operation rooms. Access must only be given via a key or tool to authorized, qualified personnel.

The relevant valid and applicable standards and guidelines regarding the installation of switch cabinets must be observed.

ESD (Electrostatic Discharge)

The modules are equipped with electronic components that may be destroyed by electrostatic discharge. When handling the modules, ensure that the items in the environment (personnel, workplace and packaging) are well grounded. Do not touch conducting parts; e.g., gold data contacts.

1.5 Scope of Validity

This quick-start manual describes the programming of the 750-872 controller as the master of an outstation as defined by IEC 60870-5-101 and -104 with some basic modules from the WAGO-I/O-SYSTEM for telecontrol.

Detailed information relating to handling, assembly and start-up is described in the "Ethernet TCP/IP 750-872" and "WAGO-I/O-PRO CAA" manuals. This documentation is therefore only valid in conjunction with the appropriate manuals.



Additional Information:

You will find the "Ethernet TCP/IP 750-872" and "WAGO-I/O-PRO CAA" manuals on the "WAGO-I/O-PRO CAA" CD (759-911), on the "ELECTRONICC Tools & Docs" CD (Item No.: 0888-0412/0001-0101) and on the Internet at: www.wago.com



2 Quick-Start Guide

2.1 Hardware Design

Build up the node as follows (from left to right):

750-872; 750-400; 750-501; 750-461; 750-600.

Connect the 24V DC power unit to the supply (24V and 0V) for the controller and for the power contacts (see Fig. 1).

For the application used in the example, it is sufficient to connect a jumper between "24V" and "+" and between "0V" and "-".



Fig. 1: Connections for the 750-872 controller





Fig. 2: Node with the 750-872 telecontrol fieldbus controller

2.2 Ethernet Network Start-Up

The IP address is conveniently assigned using the serial programming cable provided and the "WAGO Ethernet Settings" program. Connect your PC to the node's configuration and programming interface. Install the "WAGO Ethernet Settings" program. You will find it on the "Tools & Docs" CD as well as on the WAGO website under Service Downloads Software. After starting, the program will determine the current node settings.



🖬 WAGO Ethernet	WAGO Ethernet Settings					
WAGO Ethe Version 4.0.3	ernet Settings					
Exit	Image: Market back Image: Market back Image: Market back Image: Market back Write Beset Default Extract Format COM1					
750-872, WAGO (Contr. Telecontrol-FBC					
Common TCP/IP	Real Time Clock					
Article Number	750-872					
Description	WAGO Contr.Telecontrol-FBC					
SW Version 01.01.06(01)						
HW Version	01					
FWL Version	FWL Version FBK V01.00.01 IDX=02					
Serial Number	Serial Number SN20080528T090104-0155705#PFC/0030DE026417					
MAC Address 0030DE026417						
Fieldhus coupler succe						
, leidede coupier succe						

Fig. 3: WAGO Ethernet Settings

If the connection should time out, you can force the display to update with "Identify". If the problem should persist, check the COM port setting and the cabling.



An IP address always consists of a network and a computer address; the network mask determines which bits belong to the network address and which do not.

ou can get IP settings assigned is capability. Otherwise, you ne e appropriate IP settings.	d automatically if your network supports eed to ask your network administrator for
C Obtain an IP address autor	matically
Use the following IP address	\$8:
IP address:	192.168.0.44
Subnet mask:	255 . 255 . 255 . 0
Default gateway:	
C Obtain DNS server address	s automatically.
Use the following DNS service	ver addresses:
Preferred DNS server:	
Alternate DNS server:	
	Advanced

Fig. 4: Setting the PC network address under Windows

IP address : 192.168. 0. 44

SubNetMask : 255.255.255.0

Network address : 192.168. 0. Computer address: 44

Select a free computer address from the local network. You can identify the network address of your PC under "Start" \rightarrow "Settings" \rightarrow "Network and Dialup Connections" \rightarrow "LAN Connection" \rightarrow "Properties". To do this, highlight the Internet protocol (TCP/IP) in the drop-down list box and press the "Properties" button.

NOTE:

The double assignment of IP addresses can lead to serious network errors.



Switch to the "TCP/IP" tab and enter an IP address for the node. Then transfer the change to the node with "Write".

WAGO EN WAGO	thernet s Ether	^{settings} * net Set	tings	2						(Inc	
Version	4.0.3								1	INNOVAT	TWE CONNECTIONS
Exit]⇒ . Identify	₽ ⇒¶ ⊻rite	() <u>R</u> ese	t	<u>D</u> e	1 fau	lt	<u>E</u> xt	a ct	Format	ел
750-872, N Common T	WAGO Co CP/IP R	Write (A Writes connec	urrent current) se	tting: Is de	; to /ice	the e.				
◯ Addre	esses from:			1	*	0	Use f	ollov	ving a	ddresses:	
	IP≁	\ddress:	192	20	168		0	7	3	Call V	₩ВМ
	Subne	et Mask:	255		255		255	28	0]	
	G	ateway:	0	30	0	•	0	30	0		
Pre	efered DNS	-Server:	0	10	0	×.	0	10	0]	
Alterr	native DNS	-Server:	0	-	0	•	0	10	0		
Fieldbus coup	ler succes	sfully identifi	ed								

Fig. 5: IP address settings for the 750-872 controller

Now connect the node to the Ethernet network. Either directly with a crossover cable to a PC or with a 1-to-1 patch cable to a hub or switch.

NOTE:

Alternatively, the IP address for the controller can also be assigned with the "WAGO BootP Server" instead of with "WAGO Ethernet Settings". The address is assigned via the Ethernet interface on the device. A separate serial cable is not then necessary. However, the transferred IP address is only used temporarily. To save this permanently, the BootP protocol must also be deactivated in the Web-Based Management (WBM).

To test the connection, open the "DOS Shell" with "Start" \rightarrow "Programs" \rightarrow "Accessories" \rightarrow "Input prompt" and set off a PING on the IP address of the node.



Shortcut to cmd	- 🗆 ×
Microsoft Windows XP [Version 5.1.2600] (C) Copyright 1985-2001 Microsoft Corp.	<u>^</u>
C:\WINDOWS\system32>ping 192.168.0.3	
Pinging 192.168.0.3 with 32 bytes of data:	
Reply from 192.168.0.3: bytes=32 time<1ms TTL=64 Reply from 192.168.0.3: bytes=32 time<1ms TTL=64 Reply from 192.168.0.3: bytes=32 time<1ms TTL=64 Reply from 192.168.0.3: bytes=32 time<1ms TTL=64	
Ping statistics for 192.168.0.3: Packets: Sent = 4, Received = 4, Lost = 0 (0% loss), Approximate round trip times in milli-seconds: Minimum = Oms, Maximum = Oms, Average = Oms	
C:\VINDOWS\system32>_	
	-

Fig. 6: Testing the connection to the 750-872 telecontrol controller with "PING"

If the node does not answer, please contact your network administrator.

All settings can be viewed and changed using Web-Based Management (WBM). To use this, start your browser and enter <u>http://</u> in the URL line, followed by the IP address of the node (for example: http://192.168.0.3).

The integrated web server will then return the following website.

anne 🌒 http://192.168.0.3/webserv/index.sa		Wechselin zur Liniu
W/AGO'	Web-based Management	WARD Exclamating transfer to RE Heaven 27 B-1042 Minder WHEENGLASS
Novigation	Cárdun Information	-
Navigation	Status information	
- Information		
- Ethernet	Coupler details	
- тсряр	Order number 750-872/000-000	
- Port	Mac address 0030DE026417	
- SNMP	Firmware revision 01.01.06 (01)	
Watchdog		
- Clock	Network details	
- Security	IP address 192.168.0.3	
-+ Modbus	Subnet mask 255 255 255 0	
-+ PLC	Gateway 0.000	
- Features	Domanna	
- IO config	The second se	
-• WebVisu	Module status	
	State Modbus Watchdog, Disabled	
	Error code: 0	

Fig. 7: WEB server homepage

When a proxy server is used, this must be bypassed for local addresses. You will find information on bypassing the proxy server for local addresses in your browser Help under Proxy servers or LAN settings.



The configuration sites linked via Hyperlinks require a login. In the default state the following users are defined:

User	Password
admin	wago
user	user
guest	guest

Fig. 7: Users and passwords of the 750-849 controller's web server

2.3 Installing the WAGO Target System for CoDeSys

The following installation is only to be carried out when a CoDeSys version below 2.3.9.7 is used. From CoDeSys Version 2.3.9.7, the WAGO target system is already included in the installation.

To install the WAGO target system, the installation file (Customer.exe) must first be downloaded and saved in any folder. The installation program must then be run by double-clicking on Customer.exe.

The installation will start and the following two windows will be seen one after the other; when neither of the two windows is displayed, the installation is complete.



Fig. 8: Installation of WAGO target system for CoDeSys 1/2



Fig. 9: Installation of WAGO target system for CoDeSys 2/2



Create a copy of the link to CoDeSys and open the "Properties" from the context menu (right mouse button).

In the newly opened window you must enter a "space" and "-remote" in the "Target" box after (...\CoDeSys V2.3\Codesys.exe").

ieneral Shorto	cut Security
s o	oDeSys V2.3
Target type:	Application
Target location	: CoDeSys V2.3
Target:	Software\CoDeSys V2.3\Codesys.exe'' -remote
Start in: Shortcut kev:	"C:\Program Files\WAGO Software\CoDeSys V2
Start in: Shortcut key: Run:	"C:\Program Files\WAGO Software\CoDeSys V2 None Normal window
Start in: Shortcut key: Run: Comment:	"C:\Program Files\WAGO Software\CoDeSys V2 None Normal window
Start in: Shortcut key: Run: Comment:	"C:\Program Files\WAGD Software\CoDeSys V2 None Normal window Find Target Change Icon

Fig. 10: Properties for the copy of CoDeSys V2.3

The settings are saved by clicking "Apply" and the window is closed by clicking "OK".



2.4 Telecontrol with CoDeSys 2.3

<u>Prerequisite</u>: The WAGO-I/O-PRO CAA software (CoDeSys) and the WAGO target system must be installed correctly.

You can start a new project with "File" \rightarrow "New".

A brief example is shown below:

Before programming the 750-872, the controller must be selected in the "Target system settings" dialog window.

Target Settings			×
Configuration:	None	ОК	Cancel

Fig. 11: Target system settings

Please select "WAGO_750-872" as the target system.

In the next dialog window, the selected target system must be confirmed with "OK".

If you do not want to write your own program as an addition to the program generated by the configurator (to IEC 60870), as is the case in this example, you can press "Cancel" in the next window.

In this example, you must press "OK" in the next dialog window and select the programming language "FUP" in the following window and accept it with "OK".

Switch to the "Resources" tab and here go to "PLC configuration".



Fig. 12: WAGO-I/O-PRO CAA, PLC Configuration



Highlight the entry "K-Bus[FIX]" in the PLC configuration, open the context menu with the right mouse button and select "Add sub-module". This will open the I/O configurator.

Configuration		
I/O Module Catalogue:	Number of I/O Modules: 0 Selected I/O Modules:	
Digital Output Analog Input Analog Output Counter Serial Interface Special Interface	Insert >>	1
	Data Sheet	
	Import Export	
	OK Cancel	

Fig. 13: WAGO-I/O-PRO CAA, I/O configuration

In the example application, as described in section 2.1, only one digital input module 750-400, one digital output module 750-501 and one analog input module 750-461 have been plugged into the 750-872 controller. The 750-600 end module is plugged in at the extreme right.

Consequently, now first select the module 750-400 from the "I/O Module Catalog" under "Digital Input" on the left-hand side and transfer it to the right-hand side in your selection using the "Insert" button.

Then select the module 750-501 from the "I/O Module Catalog" under "Digital Output" on the left-hand side and likewise transfer it to the right-hand side in your selection using the "Insert" button.

Then select the module 750-461 from the "I/O Module Catalog" under "Analog Input" on the left-hand side and likewise transfer it to the right-hand side in your selection using the "Insert" button.

If you want to delete modules from your selection, then highlight the module concerned on the right-hand side and press "Delete".

You can change the position of a module in your selection by highlighting the module and moving it up or down with the arrow buttons on the right-hand side of the window.



The 750-600 end module is not specified in the "I/O Configuration".

Next confirm your selection with "OK".

For each I/O module, under module parameters, you can now assign whether the module outputs are to be written by the controller (PLC) or by a specified Ethernet protocol (Fieldbus 1 = Modbus/TCP or Fieldbus 2 = Ethernet/IP) (Fig. 11).



Fig. 14: WAGO-I/O-PRO CAA, I/O configurator

In the example, the value "PLC" is to be used for the moment.

The I/O configurator now shows the addresses of each channel on the module, that is to say each individual bit/word.







If you click the address designation in front of the word "AT" with the left mouse button, a label will open in which a variable name can be entered (Fig. 13).

III PLC Configuration	
 Hardware configuration IK-Bus[FX] IX2.0: BOOL; (* Ch_1 Digital input * AT % IX2.1: BOOL; (* Ch_2 Digital input * 0750-0501 2 D0 24V DC 0.5A[VAR] AT %QX0.0: BOOL; (* Ch_1 Digital output * AT %QX0.1: BOOL; (* Ch_2 Digital output * AT %QX0.1: INT; (* Ch_1 2 signed input value * AT %WV: INT; (* Ch_2 signed input value * Fieldbus variables(FIX) 	Base parameters Comment: Ch_1 Digital input Channel-Id: 2010200001 Class: 1 Size: 1 Default identifier:

Fig. 16: WAGO-I/O-PRO CAA, Variable declaration in the I/O configurator

Now enter the following variable names:

Start (for address %IX2.0) Valve1_closed (for address %IX2.1) Valvel1_open (for address %QX0.0) Valvel2_open (for address %QX0.1) Temperature1 (for address %IW 0) Temperature2 (for address %W 1)

The configuration generator for telecontrol according to IEC 60870-5 can be activated by clicking with the right mouse button on "Hardware configuration" and selecting "Add IEC 60870-5 config" from the context menu.



Fig. 17: Adding IEC 60870-5 Config



This produces another sub-item "IEC 60870-5-Config[VAR]" in the system configuration. Clicking this item opens a new window in which 2 tabs are shown. Now open the "IEC 60870 - Config" tab.

E- 0750-0400 2 DI 24 V DC 3 0ms/VAEI	Execution time [default short long]	1822	1#500mi	1#5:
	History Buffer Size	30	- and the state of	a second second
+ Valuet Closed AT \$5/21 BOC	Clock synchronization	SNTP	-	
E 0750-0501 2 DO 26V DC 0 56VARI	EC60870 [Task (Pio1Time]	EC600701 esk1	* 20	1#20mi
Value1 Onen 6T %0XD 0: HOOL	IEC60970 [Task IPito I Time]	IEC6087117 epi2	- 21	t#20ns
- Value2 Open AT \$6000 1:8000	EC50870 [Task Pio Time]	IECECHI707 ass.3	* 22	1#20ms
EI- 0.0750.0461 2 ALET100 (ETT)/MARI	IEC50870 [Task Pio Time]	IECS08707ash4	- 23	1#20mi
- A Temperatural ST \$100 INT /	Automatic variable declaration	ver	•	
- # Fieldbus variables/FD0				
EC60870-5-KonfigNARI				
	101 Datencervers [seriel]	600	EC68870 Konfigura	lian
	104 Diatenservers (TLP/IP)	AUG 75		
		1		
		<< DEL		
		Generate		
		Code		
		1		
		Export XML		
		1112 00 02		
		1 V I DU U		

Fig. 18: PLC configuration

The basic settings for telecontrol according to IEC 60870-5 can now be made in this window. Set the "Create variables automatically" option to "no". This window must also be used to define the communications protocol with which communication is to be set up with the data server.

A choice can be made from the following communications protocols: 101 via the serial interface [Serial] 104 via the RJ-45 interface [TCP/IP]

2.4.1 Communication via the RJ-45 Interface [TCP/IP]

Highlight the required interface to the data server in the bottom left-hand box, in this case "104 Data servers [TCP/IP]", and click the "ADD>>" button between the bottom two boxes in order to select the communications interface. The interface "IEC60870_Server104 [001.000 = 1]" will appear in the bottom right-hand box under "IEC60870 configuration".

To remove an interface which appears in the right-hand window, the interface can be selected in this window and removed by clicking the "<<DEL" button between the two windows.

Settings can be adjusted by highlighting the interface in the bottom right-hand window. These are not relevant for this Quick-Start manual.



	Base parameters IEC 60870 - Config IEC60870-Task	(increased as a set	
	IEC60870-Task	Unconcentration and	
		IELEUR/UT ask1	
	Number of client connections	1 Client ·	
- Valve1_Closed AT %6(2.1: BOC	Source address	TEYTE # 0	
0750-0501 2 DO 24V DC 0.54(VAR)	Common Address of ADSU [112]	20715 7 1	0
Valve1_Open AT %QX0.0: BOOI			
- 0750-0461 2 ALPT100 (RTD)(VAR)			
Temperature1 AT %/W0: INT; (*			
- Temperature1 AT %/W1: INT; C			
🇰 Fieldbus variables (FDQ			
HEC60870-5-Konfig(VAR)			
	1.2.5 Single-pair information with (P241) 2.3. Disable-pair information with (P242) 4.3. Disable-pair information with (P242) 5.3. Measured value, recruitable value (10) Measured value, recruitable value (11) Measured value, scaled value (12) Measured value, scaled value (13) Measured value, scaled value (14) Measured value, schott floating poi (14) Measured value, schott floating poi (14) Measured value, schott floating poi (15) Integrated total) (15) Integrated total) (13) Double-point with (P551 mea2a inte (13) Measured value, received value (13) Measured value (15) Measured (13) Measured value, received value (13) Measured value (15) Measured value (13) Measured value (15) Measured value (13) Measured value (15) Measured value (15) Measured value (15) Measured value (15) Measured (15) Measured (15) Measured (15) Measured (15) Measured (15) Measured (15) Measured (15) Measured (15) Measured (15) Measured (15) Measured (15) Measured	Trine2a to Trine2a to ADD >> Trine2a to ADD >> ADD >> Trine2a to ADD >> ADD >> Trine2a to ADD >> ADD >> ADDD >> ADDD >> ADDD >> ADDD >> ADDD >> ADDD >> ADDD >> ADDD >>	2/01/comp3.statum CEGER70_Serven104(000.000 = 1)

Fig. 19: IEC 60870 settings - Config Ethernet

The various information objects can now be selected by highlighting the appropriate information object and adding it by clicking the "ADD>>" button between the two bottom windows. In this example, the information object "<1> Individual message" is selected. The message then appears in the right-hand window as "IEC870_01M_SP_NA [0001.001.001 = 65793]". In order to assign a variable to the message it must be highlighted.

ddress Into Objects (AID 12113)	1	1		1	
lepeat Time	1#30m	Elen			
PI (BOOL)		· 1	Automatic variable	declaration	
IL (BOOL)		5	Automatic variable	declaration	
58 (BOOL)		1	Automatic variable	declaration	
IT (BOOL)		R 1	Automatic variable	declaration	
V (800L)			Automatic variable	declaration	
Singlescent information Single-point information with CP24Ti Double-point information 44 Double-point information Measured value, normalized value Measured value, normalized value	ne2a line tag ine2a line tag wth CP24Ture2a line	ADD >>	IEC60870 K IEC60870 K IEC60870 K	onfiguration 70_Server104 (001:000 = 1) 870_01M_SP_NA (001:001:0	01 = 65793)
Single-point information Single-point information with CP24T Disple-point information with CP24T Disple-point information with CP24T Measured value, normalized value To Measured value, normalized value To Measured value, scaled value Measured value, scaled value Measured value, thot floating poin Measured value, thot floating poin Measured value	me2a time tag ime2a time tag with CP24Time2a time CP24Time2a time tag value with CP24Time2a tim	ADD >> << DEL Generate Code	ECGOBIO K	onfguration 70_Server104 (001.000 = 1) 870_01M_SP_NA (001.001.0	01 = 65793)
Singlespoint information Singlespoint intermation with CP2411 Souble-point intermation with CP2413 Measured value, normalized value Measured value, normalized value Measured value, normalized value Measured value, acceled value Measured value, scaled value Measured value, scaled value Measured value, stort floating poin Integrated totals Integrated totals Singlepoint with CP361 me2a time Measured value, CP561 me2a time Measured value, CP561 me2a time Measured value, normalized totals Measured value, CP561 me2a time Measured value, CP561 me2a time Measured value, normalized value	ne2a time tag ine2a time tag with CP24T ine2a time CP24T ine2a time tag value with CP24T ine2a time tag tag tag tag	ADD >> << DEL Generate Code Export >ML	EC60970 K	onfiguration 27.5ervet104 (001.000 = 1) 870_01M_SP_NA (001.001.0	01 = 65793)

Fig. 20: Message settings - Ethernet

The variable is assigned to the message under the item SPI [BOOL]. Any variable or an input or output module variable can be declared here. If a variable has not yet been created, a tick must be placed after the name of the variable against "Create variables automatically". As no further variables are



to be interrogated for this message, no variables must be ticked after the following items:

ddress Info-Objects [AIO 12] 13]	1	1	1	
lepsat Time	t#30m	- Care		
PI (800L)		1 1	Automatic variable declaration	
L (BOOL)		- F /	Automatic variable declaration	
B (BOOL)		- F 4	Automatic variable declaration	
T (BOOL)		- F 4	Automatic variable declaration	
(BOOL)		- F 7	Automatic variable declaration	
 Single social information Single point information with CP2 33 Double point information Double point information with CP2 39 Measured value, normaticed value,	AT ine2a time tag (4T ine2a time tag e with CP24T ine2a time	ADD >> << DEL	EC60970 Konfguration EC60970_Server104 (001.000 - EC60970_01M_SP_NA (001.00	1) 01.001 = 65793)
 Single soft/ Infomation Single soft/ Infomation with CP2 Double-point infomation with CP2 Double-point infomation with CP2 Measured value, nomaliced value Measured value, normaliced value Measured value, scaled value Measured value, normalized value Measured value, normalized value 	AT me2a time tag AT me2a time tag e with CP24T me2a time th CP24T me2a time tag ont with CP24T me2a tin ta time tag ne tag ne tag ne tag the CP56T me2a time tag	ADD >> << DEL Generate Code	IEC60870 Konfiguration IEC60870 Server 104 (001.000 - IEC6070_01M_SP_NA (001.00	1) 01.001 - 65793)

BL [BOOL], SB [BOOL], NT [BOOL] and IV [BOOL].

Fig. 21: Setting the variables for Ethernet messages

In the case of the message setting for "< 9> Measurement, normalized", the variable for an analog input; e.g., "Temperature", must be specified after the item NVA[INT]. An individual command "<45> Individual command" should also be included with the "SCD (BOOL)" variable "Valve2_open".

Address Info-Objects [AIO 12 13]	1	1 1
SCO (BOOL)	Valve2_Up	Automatic variable declaration
101 Datenservers (seriell) 104 Datenservers (TCP/IP)	ADD >>	IEC60870 Konfiguration IEC60870, Server104 (001.000 = 1)
	<< DEL	FieldRY0_01M_SP_NA (001.001.001 = 8 FieldRY0_09M_ME_NA (001.001.001 = 6 FieldRY0_09M_ME_NA (001.001.001 = 6 FieldRY0_45C_SC_NA (001.001.001 = 65
	<< DEL Generate Code Export XML	EC870_09M_ME_NA (001.001.001 = 66





The finished functions can now be generated from the stored entries using the "Generate Code" button between the two bottom windows.

The priority and the cyclic interval for calling the programs generated by the configuration generator ("IEC60870_ServerPRG_1_104 (PRG)" and "InitAction") can be set under "Task configuration" on the "Resources" tab.

Taskathbutes Taskathbutes Taskathbutes P- ③ IEC60870Task1
IEC670_SyncClockOnRTCQUUSeSh IEC60870_ServerPRG_1_1040; O[PLC_PRG Type Image: server in the server in

Fig. 23: Task configuration

By automatically creating the new task, the normal program "PLC_PRG (PRG)" will no longer be called/processed. To rectify this, an additional task must also be generated for the "PLC_PRG (PRG)".

To do this, click on "Task configuration" with the right mouse button and select "Add task" from the context menu. A new task will now be created and immediately opened for the settings to be made. The name PLC_PRG, for example, can be entered under Name in Task Properties. The call interval should be set to "Cyclic" with a time of "t#20ms".

Now click on the newly created task with the right mouse button and select "Add program call". The appropriate program (PLC_PRG) can now be selected by clicking on the button with the three dots.

Please continue with section 2.5 "Creating a program" for PLC_PRG.



2.4.2 Communication via the Serial Interface

Highlight the required interface to the data server in the bottom left-hand box, in this case "101 Data servers [serial]", and click the "ADD>>" button between the bottom two boxes in order to select the communications interface. The interface "IEC60870_Server101 [001]" will appear in the bottom right-hand box under "IEC60870 configuration".

Execution time [default short long]	t#2s	t#500ms	t#5s
History Buffer Size	32	_	
Clock synchronization	SNTP	-	
EC60870 [Task Prio Time]	IEC60870Task1	20	t#20ms
EC60870 [Task Prio Time]	IEC60870Task2	21	t#20ms
EC60870 [Task Prio Time]	IEC60870Task3	22	t#20ms
EC60870 [Task Prio Time]	IEC60870Task4	23	t#20ms
Automatic variable declaration	yes	•	
	<< DEI		
	General Code Export XI	te ML	

Fig. 24: IEC 60870 settings - Config with serial

To remove an interface which appears in the right-hand window, the interface can be selected in this window and removed by clicking the "<<DEL" button between the two windows.



Highlight the interface in the bottom right-hand window. The various information objects will now be displayed in the left-hand window, and at the top there will be several setting options, which must be set as can be seen in Fig. 25.

PLC Configuration	and the second se		
Hardware configuration	A Rese exception JEC 60870 - Cortica		
回一图 K-Bus[FD]	Base parameters TEC 60070 - Comp		
0750-0400	IDI IELEUB/0-Fack	IEC60870Task1	
- 🔶 Start A	F % Address Info Objects (AIO 1.2 (1.3)	1 BYTE	•
- I Valve1	_Cic Interface	COM 0	•
B- 0750-0501	DC Baudrate	9600	•
E 0750-0461	1 AU 1 Flowcontrol	NO_FLOW_CONTROL	
- Fieldbus variable	session layer	asymmetric	
EC60870-5-Konfig[V	R1 address Id session layer	nonexistent	• · · · · · · · · · · · · · · · · · · ·
	Common Address of ADSU [1]2]	2 BYTE	1 1
	Source address	nonexistent	
	Citor resoluted Valle, Infinised Valle C11: Measured value, scaled value C12: Measured value, scaled value C13: Measured value, short likeling po C16: Measured value, short likeling po C16: Measured value, short likeling po C16: Single point value (CPST ims2.8 and C10: Single point value), CPST ims2.8 and C10: Measured value, normalized value C26: Measured value, normalized value C26: Measured value, short Defining and C26: Measured value, short Defining and C26: Measured value, short Defining and C27: Measured	h CP24Tim22a tim h CP24Tim22a tim rit value a time tag a time tag b tog c CP56Tim22a tim to Value to Value	24- ICLOIN_MA_3L_NA(UUI)
	(45) Single command (46) Double command (48) Sat paid command	d a	

Fig. 25: Settings for the serial interface in CoDeSys

Now add the appropriate message type by highlighting and clicking the "ADD>>" button between the two bottom windows.

In this example, the information object "<1> Individual message" is selected. The individual message then appears in the right-hand window as "IEC870_01M_SP_NA [001]".

Also add the message "< 9> Measurement, normalized" and the individual command "<45> Individual command".

If you now highlight the message "IEC870_01M_SP_NA [001]" in the bottom right-hand window, a variable for the message can be created after the item "SPI [BOOL]". Name the variable "Product_Request".

In this example no further variables are to be interrogated for this message, so the ticks must be removed after the following items: BL [BOOL], SB [BOOL], NT [BOOL] and IV [BOOL].



fff PLC Configuration				
Hardware configuration				
ф 🕅 K-Bus(FIX) 📃	Base parameters IEC 60870 - Config			, _ _
🗄 🗍 0750-0400 2 DI	Address Info-Objects [AIO 12 13]	1		
🗕 🛏 🕁 Start AT %I	Repeat Time	t#30m		
4 Valve1 Cir	SPI (BOOL)	Product Information	Automatic variable declaration	
E 0750 0501 2 DC	BL (BOOL)		Automatic variable declaration	
	SB (BOOL)		Automatic variable declaration	
E 0/50-0461 2 AT	NT (BOOL)		Automatic variable declaration	
Fieldbus variables[FI>	IV (BOOL)			
IEC60870-5-Konfig[VAR]	10 (000)		Automatic variable declaration	
	 (1) Single-point information (2) Single-point information with CP24Tin (3) Double-point information with CP24Tin (4) Double-point information with CP24Tin (5) Measured value, normalized value (10) Measured value, normalized value (12) Measured value, scaled value (13) Measured value, scaled value (14) Measured value, scaled value (15) Integrated totals (16) Integrated totals with CP24Tim22a tit (30) Single-point with CP56Tim22a time (34) Measured value, scaled value with C (35) Measured value, scaled value with C (36) Measured value, short floating point (37) Integrated totals with CP56Tim22a time (38) Measured value, short floating point (37) Integrated totals with CP56Tim22a time (38) Measured value, short floating point (39) Measured value, short floating point (30) Measured value, short floating point (31) Double-point with CP56Tim22a time (34) Set point command (48) Set point command, short floating point 	ne2a time tag me2a time tag ith CP24Time2 2 P24Time2a tim value with CP24Time Generate Code Export XML P56Time2a tim P56Time2a tim P56Time2a tim P56Time2a tim V 1.00.01 me tag e int value	IEC60870 Konfiguration IEC60870 Server101 (001.001 = 257) IEC870_01M_SP_NA (001) IEC870_09M_ME_NA (001) IEC870_45C_SC_NA (001)	_

Fig. 26: Message settings - serial

In the case of the information object settings for "< 9> Measurement, normalized", the variable for an analog value, e.g. "Temperature", must be specified after the item NVA[INT]. In this example the other options for entering variables can be ignored and the ticks removed.

The variable "Valve2_open" must be entered in the command settings for the individual command "<45> Individual command" in the box "SCD (BOOL)" variable.

The commands and messages are automatically generated in a new module by pressing the "Generate Code" button.

Changes must be made in the task configuration so that the standard program module (PLC_PRG) is also called and processed for the newly generated module. The task configuration can be found on the "Resources" tab.

The priority and the cyclic interval (call) for programs generated by the configuration generator ("IEC60870_ServerPRG_1_104 (PRG)" and "InitAction") can also be set here.



Task configuration		
Task configuration Task configuration System events EC60870Task1 EC870_SyncClockOnRTC(uUseSh EC60870_ServerPR6_1_1040; EC2PR0	Taskatributes Name PLC_PRG Diointy(0.31) Type © gyclic C triggered by givent © triggered by givent Watchdog © divide watchdog Tittele.g. ##200ms): [1]	
<u>vi</u>		

Fig. 27: Task configuration serial

Next create a new task. To do this, click on "Task configuration" with the right mouse button and select "Add task" from the context menu. A new task will now be created and immediately opened for the settings to be made. The name "PLC_PRG", for example, can be entered under Name in Task Properties. The call interval "Cyclic" can be selected and a time of "t#20ms" set.

Click on the newly created task with the right mouse button and select "Add program call" from the context menu.

The new task will be created. The program (PLC_PRG) can now be selected in the input box on the right with the help of the button with the three dots.



2.5 Creating a Program

The program "PLC_PRG" must now be opened from the "Modules" tab and a simple program created in the instruction section; e.g., as shown below.

1 2 2 4	▲	
 POUs IEC60870_ServerPf IEC_PRG (PRG) 	0001 0002 0003 0004	PROGRAM PLC_PRG VAR END_VAR
		Start-AND Start-Product_Requirement Valve1_Closed-
	0002	Temperature1Valve1_Open 300
	0003	Temperature1 –Temperature
	0004	Valve2_UpValve2_Open

Fig. 28: The program

When the test program has been compiled without errors, it can now be loaded into the PLC.

The compilation is started via "Project \rightarrow Translate all".

The project can now be saved under "File" \rightarrow "Save"



2.6 Downloading the Program to the 750-872 Controller

Click "Online" \rightarrow "Communications parameters" in the menu and create a new communications channel. Select "TCP/IP" (3S TCP/IP driver).

Enter the IP address of your coupler (e.g., 192.168.0.3) under "Address". Enter 2455 as the port. The transport protocol is TCP. Confirm your entry by clicking "OK".

Make sure that the simulation is deactivated.

You can now transfer the program via "Online" \rightarrow "Login".

Start the program via "Online" \rightarrow "Start".



3 Simulation

Load the demo version of WinPP101 and WinPP104 from the website <u>http://www.ppfink.de/</u> \rightarrow "Products" and then select the tool.

After downloading, install the software according to the instructions which are also available on the website.

The central processor and/or the outstations can be simulated using the tool. The communication can also be logged with this tool.

3.1 Simulating Telecontrol via Ethernet (TCP/IP) with the WinPP104 Program

Ele	Mo	de Send V	lew Ea	ometerize Filte	er <u>H</u> elp	0			
	1	Received	Error	Transmitted	Error	Status	IP Partner	C1-, Se-Port	Function
ec/Tr	1	0	0	0	1	-	192.168.0.3	-,2404	Substation
sc/Tr	2	0	0	0	0		0.0.0	-,0	off

Start the WinPP104 program.

Fig. 29: WinPP104 start screen

The following settings must first be transferred under "Parameter setting" \rightarrow "General parameters" as can be seen in Fig. 29.



Message parameters	55 55 55 55 55 55 55 55 55 55 55 55 55
Structure common address	16
Structure object address	24
⊻alue normalized for 100%	32767
File transfer	
Eile addressing by	name=with out subdire 💌
Time out [s]	8
S <u>e</u> lect first file	off
lD≚file	off
Max. size of Log file [MB]	10
Data directory	Dokumente und Einstellung
Summer time flag in lists, c	command responses
Substituted time flag in list	s, command responses
Tr <u>a</u> nsmit all data to Trans	mitter 1 and 2
	ancel <u>H</u> elp
	° 1 1

Fig. 30: General settings WinPP 104

When these general parameters have been entered, the parameters for the appropriate partner can be specified. These are reached via "Parameter setting" \rightarrow "Receiver/Transmitter1...".

First of all, the function of the PC must be defined. In this example, the program is intended to simulate the central processor, so "Central processor" must be selected after the item "Function". The IP address will be added automatically. The IP address of the 750-872 controller (192.168.0.3) must be entered after the item "IP address of partner station". The other values can remain unchanged as can be seen in the illustration below.

Eunction	Master
Own IP eddreps	-
P address partner station	192.168.0.3
Port number RTU (Server)	2404
Frame type (for Monitoring)	IP and VLAN +
① Time-out connect. establ.[s]	30
t Time-out wait of ACK [s]	15
2 Send acknowledges after [s]	10
3 Idle Time-out for test frames [s]	20
s Max. APDUs without ACK	12
<u>w</u> Latest ACK after rec. w APDUs	8
May transm message length	65
Command, ic. param. msg	not confirmed •

Fig. 31: Receiver/Transmitter settings WinPP104



The settings are incorporated into the program by pressing the "OK" button.

The simulation can be started by clicking the **button**.

All signals from the outstation (WAGO Controller 750-872) to the central processor (PC) are now displayed when their values change.

Commands from the central processor to the station can be simulated. These can be executed under "Parameter setting" \rightarrow "Telegrams" \rightarrow "B individual command with date ...".

in ressage 11 parameter		ioda, sare in		
Message designation	Single com	nand		
\underline{T} ransm. instigation by	Operation	•	Typen 0	
Msg. to b <u>e</u> sent how oft	en	1	T <u>r</u> ansm. 1	
Wait time after transmis	sion	0		
Туре	45=Singl	e command	•	
Ca <u>u</u> se E	Test 🗆 Neg	6=activatio	n 💌	
Originator a <u>d</u> dress		0		
Common <u>a</u> ddress		0		
O <u>bj</u> ect address		0	-	
<u>1</u> Command state		1	<u>*</u>	
2 Command type		□ S/E	3	
<u>×</u> Transmit	<u>o</u> k	<u>C</u> ancel	<u>H</u> elp	
		o 1 1.		

Fig. 32: Parameterizing a command WinPP104

In the newly started window the "Type" must be set to "45=Individual command" and "2 Command recognition" must be set to "3" (continuous command).

Command recognition can be set from "0" - "31". The values "1" = short, "2" = long and "3" = continuous are of interest for individual commands. The time is set in CoDeSys on the "Resources" tab under "Controller configuration" \rightarrow highlight "IEC 60870-5 config [VAR]" \rightarrow highlight "IEC 60870 configuration" on the right-hand side under "Execution time".

The station and object address can be seen from CoDeSys on the "Resources" tab under "Controller configuration" \rightarrow highlight "IEC 60870-5 config [VAR]" on the right-hand side.

In this case it is the No. 65793 from the command "IEC870_45C_SC_NA (001.001.001 = 65793)".





Fig. 33: Detail of system controller

The command is sent to the station (Controller 750-872) by clicking Send and the digital output 2 is permanently energized.

3.2 Simulating Telecontrol via the Serial Interface with the WinPP101 Program

Start the WinPP101 program.

🚰 WinPP10	i - SeTel.sti									
Die Me	ode <u>S</u> end)	New Ba	remeterize Filte	er <u>H</u> elp	•				-	
1	Received	Error	Transmitted	Error	L-Rec	L-Tr	COM	Baud	Function	Procedur
Rec/Tr 1	0	0	0	0	9	-	1	9600	Baster	unbalanc
Rec/Tr 2	D	0	0	0	-		-	19200	Honitoring	unbalanc

Fig. 34: WinPP101 start screen

The General Parameters must be set first. To do this, go to "Parameter setting" \rightarrow "General...".

The settings can be made in the new window as can be seen in Fig. 34.



General parameters	×
Message parameters	1
Length of link <u>a</u> ddress	0 = not present 🔹
Originator address	not present 🔹
Structure common address	8
Structure object address	16
⊻alue normalized for 100%	32767
File transfer	
Eile addressing by	name=with out subdire 💌
Time out [s]	41
S <u>e</u> lect first file	off
lD⊻file	off
Max size of Log file [MB]	[10
Data directory	Dokumente und Einstellung
🗖 S <u>u</u> mmer time flag in lists, comma	and responses
🔲 Su <u>b</u> stituted time flag in lists, com	mand responses
<u> </u>	el <u>H</u> elp
1 - 2000 MBytes	

Fig. 35: General parameters WinPP101

Next the parameters for the function of the central processor must be entered. The window for setting the parameters is reached via "Parameter setting" \rightarrow "Receiver/Transmitter1...".

The illustrations show the settings necessary for this example.

Parameterize Rec/Trans. 1	x		
Page 1 Page 2			
Eunction	Master		
<u>T</u> ransmission mode	unbalanced = polling 💌		
Link address	1		
Cycle time Polling [ms]	200		
Direction bit (balanced)	One 🔹		
Use of single character E5	as ack, rec.+transm. 💌		
Type cyclic RTU Call	Data type 2		
Co <u>m</u> mand, ic, param. msg	not confirmed		
Spikes before/after message	display 💌		
Display changes of	DCD DSR CTS		
	201 201 201		
<u>O</u> K <u>C</u> anc	el <u>H</u> elp		
Balanced: 1 address, unbalanced: m	ax. 15 addresses, eg.: 1 5 23		

Fig. 36: Receiver / Transmitter settings Page 1 WinPP101

Parameterize Rec/Trans. 1	×
Page 1 Page 2	
Log file comment	
COM Port to receive/transmit	COM 1
Baud, Parity, Data 9600 -	Even 🔻 8 🖌 1 🗸
<u>M</u> ax. transm. message length	250
Wait time for ACK [ms]	297
Number of transm. repetitions	1
Cycle time req. link status [sec]	5
<u>⊤</u> ransmission delay by [ms]	0
Eunction RTS signal	0 on transmission, DTR 💌
Leading time RTS [ms]	0
Tr <u>a</u> iling time RTS [ms]	0
<u>O</u> K <u>C</u> anc	el <u>H</u> elp
1 - 100 secs	

Fig. 37: Receiver / Transmitter settings Page 2 WinPP101

The settings are incorporated into the program by pressing the "OK" button.

The simulation can be started by clicking the **____** button.

All signals from the outstation (WAGO Controller 750-872) to the central processor (PC) are now displayed when their values change.

Commands from the central processor to the station can be simulated. These can be executed under "Parameter setting" \rightarrow "Telegrams" \rightarrow "B individual command with date ..."

In the newly started window the "Type" must be set to "45=Individual command" and "2 Command recognition" must be set to "3" (continuous command). The object address can be seen from CoDeSys on the "Resources" tab under "Controller configuration" \rightarrow highlight "IEC 60870-5 config [VAR]" on the right-hand side.



🚰 Message 11 parameterize, right click:	=load/save file.
Message designation Einzelbefeh	l
Transm. instigation by Operation	▼ Typen O
Msg. to b <u>e</u> sent how often	1 T <u>r</u> ansm. 1
Wait time after transmission	0
Tr <u>a</u> nsmission procedure	Send/Confirm
Link address	1
Type 45=IEC-	104_Single command
<u>C</u> ause □ Test □ Neg	6=activation
Station address	1
O <u>b</u> ject address	1-0-0
1 Command state	1
<u>2</u> Command type	□ S/E 3
<u>x</u> Transmit <u>O</u> K	<u>Cancel</u> <u>H</u> elp
0 - 31, 1=short cmd., 2=long cmd., 3=cc	ontinuous cmd.

Fig. 38: Command specification and confirmation that the command has arrived at the controller

!!! Important !!!

All entries made in the parameter settings must be identical to the data in the CoDeSys program!!!



4 Appendix

4.1 Application Data Structure



Fig. 39: Application data structure

ASDU: Telegram data unit

Common ASDU address: The ASDU station address consists of an address part and one or more information objects



4.2 Difference between Symmetrical and Asymmetrical Transmission Procedures



Fig. 40: Symmetrical transmission procedures of the primary and secondary connection layer



Fig. 41: Asymmetrical transmission procedure, primary and secondary station



4.3 Explanation of the Set-Up Options for an Information Object

Address Info-Objects [AIO 12 13]	1	
Repeat Time	t#30m	
SPI (BOOL)	Product Information	Automatic variable declaration
3L (BOOL)		Automatic variable declaration
SB (BOOL)		Automatic variable declaration
NT (BOOL)		Automatic variable declaration
V (BOOL)		Automatic variable declaration
 1> Single-point information 2> Single-point information with CP24Time2 3> Double-point information 	a time tag ADD >>	■ IEC60870 Konfiguration ■ IEC60870_Server101 (001.001 = 257) ■ IEC60870_NOTM_SP_NATION
 (1) Single-point information (2) Single-point information with CP24Time2 (3) Double-point information (4) Double-point information with CP24Time2 (3) Measured value, normalized value with (10) Measured value, scaled value (12) Measured value, scaled value 	a time tag 2a time tag CP24Time2 KTm 25 tim	■ IEC60870 Konfiguration ■ IEC60870_Server101 (001.001 = 257) ■ IEC60870_OIM_SP_NA(001) ■ IEC870_09M_ME_NA(001) ■ IEC870_45C_SC_NA(001)

Fig. 42: Information object settings

Address Info Object [A|01|..2|..3]: Is the message address, which can be up to 3 bytes long

Repeat Time:

Is the time when the master polls the se message in order to check whether it is still working and what the current value is.

SPI (BOOL) = single point information: Specifies the function variable.

BL (BOOL) = Blocked / Not blocked:

The value of the information object is blocked for the transmission; the value retains the state that was detected before it was blocked. A block may be applied and removed by a local interlock or automatic system, for example.

SB (BOOL) = Substituted / Not substituted: The value of the information object is specified by an operator's input (load distributor) or by an automatic system.

NT (BOOL) = Not Topical / Topical:

A value is topical when the most recent update was successful. It is not topical if it has not been updated or made available in a defined time period.

IV (BOOL) = A value is valid when it has been correctly measured. If the measuring function detects abnormal conditions at the information source (missing or non-functional measuring units), the value is identified as being invalid. The value of the information object is not defined under these



conditions. The identification "invalid" is used to inform the target that the value may be wrong and must not be used.

OV = Overflow / No overflow:

The value of an information object is outside a predetermined range (used mainly for analog values)

Intermediate equipment may change the quality identifiers BL, SB, NT and IV.

e.g.:

BL: If an intermediate device blocks the transmission of an information object, it must set the quality identifier BL. Otherwise it must pass on the quality identifier BL as received from the lower level.

SB: If an intermediate device replaces the value of an information object, it must set the quality identifier SB. Otherwise it must pass on the quality identifier SB as received from the lower level.

4.4 Finding Incorrect Address Information with CoDeSys

The visualization produced in CoDeSys records the data traffic between the central processor and the outstation.

If the communication does not work, for example, no values will be displayed in the visualization. If only one information object is wrongly addressed or if it does not answer, this can be easily traced.



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