



## ELSETA

IEC 60870-5-103 PID Interoperability

For WCC200 & WCC Lite devices

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(in accordance with ISO / IEC Guide 22 and EN Section 45014)

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# 1 Preface

**This document is applicable to the following product(s):**

WCC200 and WCC Lite RTUs

## **Purpose of this manual**

This manual describes the interoperability of WCC200 and WCC Lite RTUs using protocol element according to IEC 60870-5-103 and essentially contains:

- Interoperability IEC 60870-5-103

## **Target Group**

The document you are reading right now is addressed to users, who are in charge of the following tasks:

- Sales engineering and technical clarification
- Conceptual activities, as for example design and configuration

## 2 Introduction

In this document all definitions are described that are necessary for communication between automation units or between automation and control room process computer systems as per IEC 60870-5-103 protocol specification.

## 3 Protocol architecture

### 3.1 Communication Protocol

Communication Protocols are the grammars through which computer-based devices communicate with one another - the way they organise, and transmit the bits and bytes of electronic on-off (binary) signals whose patterns encode data. Simply, a protocol is a set of rules that governs how message containing data and control information are assembled at a source for their transmission across the network and then dissembled when they reach their destination.

### 3.2 Anatomy of a communication Protocol

Most standards organisations use a layered model or stack to develop protocol specifications, with each layer performing some very specific functions and services.

#### 3.2.1 The open Systems Interconnect Reference Model

The Open Systems Interconnect (OSI) reference model is a layered set of protocols to facilitate open communications between computer networks. It was developed by the International Organisation for Standardisation (ISO) in conjunction with the Consultative Committee on International Telegraphy and Telephony (CCITT).

The purpose of the OSI communication model is to make multivendor networking easy to implement, thereby reducing the overall costs and enhancing the level of system integration that normally could be realised with constantly changing and expanding protocol solutions.

#### 3.2.2 The 7 - Layer Stack

The 7-Layer stack is based on established international ISO protocol standards. The architecture intended to provide full communications functionality based on the OSI Reference Model and is capable of supporting the majority and the industry data communication requirements.

#### 3.2.3 The 3 - Layer Stack

The 3 - layer stack is also based on stable international standards. The 3 - layer stack provides a simpler mechanism for data communication and is based on the “Enhanced Performance Architecture” (EPA) as specified in clause 4 of IEC 870-5-3.

Table 1: Anatomy of communication protocol

7-layer	3-layer
7. Application	7. Application
6. Presentation	
5. Session	
4. Transport	
3. Network	
2. Data Link	2. Data Link
1. Physical	1. Physical

### 3.3 Scope and Object of IEC 60870-5-103

#### 3.3.1 Introduction

IEC 60870-5-103 provides a communication profile for sending basic telecontrol messages between a central telecontrol station (controlling station) and telecontrol outstations (controlled stations), which uses permanent directly connected data circuits between the central station and individual outstations.

#### 3.3.2 Scope

The defined telecontrol companion standard IEC 60870-5-103 utilizes standards of the series IEC 60870-5.

### 3.4 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this section of IEC 60870-5. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this section of IEC 60870-5 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 50(371):	1984, International Electrotechnical Vocabulary (IEV) Chapter 371: Tele-control
IEC 60870-1-1:	1988, Telecontrol equipment and systems - Part 1: General considerations - Section One: General principles
IEC 60870-1-3:	1997 Ed. 2, Telecontrol equipment and systems - Part 1: General considerations - Section Three: Glossary
IEC 60870-1-4:	1994, Telecontrol equipment and systems - Part 1: General considerations - Section 4: Basic aspects of telecontrol data transmission and organization of standards of IEC 60870-5 and IEC 60870-6
IEC 60870-5-3:	1992, Telecontrol equipment and systems - Part 5: Transmission protocols - Section 3: General structure of application data
IEC 60870-5-4:	1993, Telecontrol equipment and systems - Part 5: Transmission protocols - Section 4: Definition and coding of application information elements

IEC 60870-5-5:	1995, Telecontrol equipment and systems - Part 5: Transmission protocols - Section 5: Basic application functions
IEC 60870-5-103 ed.2:	2000, Telecontrol equipment and systems - Part 5: Transmission protocols - Section 103: & Companion standard for basic telecontrol tasks
ISO/IEC 8208:	1990, Information technology - Data communications - X.25 packet layer protocol for data terminal equipment

## 3.5 Definitions

### 3.5.1 Companion standard

A companion standard adds semantics to the definitions of the basic standard or a functional profile. This may be expressed by defining particular uses for information objects or by defining additional information objects, service procedures and parameters of the basic standard.

### 3.5.2 Group (of information objects)

A group (of information objects) is a selection of COMMON ADDRESSES or INFORMATION ADDRESSES which is specifically defined for a particular system.

### 3.5.3 Unbalanced transmission

Unbalanced transmission procedures are used in supervisory control and data acquisition (SCADA) systems in which a master station controls the data traffic by polling outstations sequentially. In this case the master station (master) is the primary station that initiates all message transfers while outstations are secondary stations (slaves) that may transmit only when they are polled.

The unbalanced mode procedure can be used generally, but must be used in party line «multidrop» configuration.

### 3.5.4 Balanced transmission

If balanced transmission procedures are used, each station may initiate message transfers. The balanced mode procedure is restricted to the configurations “point to point or multiple point to point”. Balanced mode the most effective way of communication on «point to point or multiple point to point». Balanced transmission can be used in full duplex mode. A balanced system thus contains a primary and a secondary side.

### 3.5.5 Controlling Station (Master station)

A location at which telecontrol of outstations is performed (IEV 371-06-01). Controlled Station (Outstation, Remote station, Remote terminal unit (RTU), Slave station) A station which is monitored or commanded by a master station (IEV 371-06-04).



### **3.5.6 Control direction**

The direction of transmission from the controlling station, typical a SCADA system, to a controlled station, typical a station control system or a RTU.

### **3.5.7 Monitor direction**

The direction of transmission from a controlled station to the controlling station.

### **3.5.8 Primary station**

The station which starts the communication procedure, the master. In unbalanced transmission this is fixed, in balanced transmission the primary station is alternating.

### **3.5.9 Secondary station**

The station which respond on the communication procedure, the slave. In unbalanced transmission this is fixed, in balanced transmission the secondary station is alternating.

## 4 Interoperability list

The IEC 60870-5-103 Interoperability defines presents sets of parameters and alternatives from which subsets have to be selected to implement particular tele control systems. Other parameters, such as the listed set of different IEC 60870-5-103 Function Codes or IEC 60870-5-103 Data Formats in command and in monitor direction allow the specification of the complete set or subsets, as appropriate for given applications. This clause summarizes the parameters of the previous clauses to facilitate a suitable selection for a specific application. If a system is composed of equipment stemming from different manufacturers it is necessary, that all partners agree on the selected parameters.

The selected parameters should be marked in the white boxes as follows:

- ☐ Function or ASDU is not used
- ☒ Function or ASDU is used as standardized (default)
- ☐ Function or ASDU is used in reverse mode
- ☐ Function or ASDU is used in standard and reverse mode
- ☐ Parameter is not applicable to this companion standard

The possible selection (blank, X, R, or B) is specified for each specific clause or parameter.



In addition, the full specification of a system may require individual selection of certain parameters for certain parts of the system, such as the individual selection of scaling factors for individually addressable measured values.

### 4.1 Network configuration

(network - specific parameter)

- ☒ Point-to-point <sup>1</sup>
- ☒ Multiple point-to-point <sup>2</sup>
- ☒ Multidrop (Multipoint-partyline) <sup>3</sup>
- ☒ Multi-point-star

<sup>1</sup> Multipoint-Partyline (half duplex) with one Slave RS232 or RS485 (or RS422)

<sup>2</sup> Only available in WCC RTUs supporting more than one serial interfaces

<sup>3</sup> Over RS-485

## 4.2 Physical layer

### 4.2.1 Electrical interface

Implementation	Configuration	Remark
<input checked="" type="checkbox"/>	RS-232	V.24/V.28 Standard - Point-to-Point (Master with 1 Slave)
<input checked="" type="checkbox"/>	RS-422	V.11 (4-wire) - Point-to-Point (Master with 1 Slave)
<input checked="" type="checkbox"/>	RS-485	V.11 (2-wire): <ul style="list-style-type: none"> <li>• Multipoint-Partyline (Master with max. 32-Slaves)</li> <li>• Point-to-Point (Master with 1 Slave)</li> </ul>

### 4.2.2 Transmission speed

Unbalanced interchange circuit V.24/V.28

- ☐ 100 bit/s
- ☐ 200 bit/s
- ☒ 300 bit/s
- ☒ 600 bit/s
- ☒ 1200 bit/s
- ☒ 2400 bit/s
- ☒ 4800 bit/s
- ☒ 9600 bit/s
- ☒ 19200 bit/s
- ☐ 38400 bit/s
- ☐ 56000 bit/s

### 4.2.3 Byte framing

- ☒ No parity
- ☒ Even parity
- ☒ Odd parity
- ☒ 1 stop bit
- ☐ 1.5 stop bits
- ☒ 2 stop bits

## 4.3 Application layer

### 4.3.1 Transmission mode for application data

Mode 1 (least significant octet first), as defined in 4.10 of IEC 60870-5-4, is used exclusively in this companion standard.

### 4.3.2 COMMON ADDRESS of ASDU

- ☒ One COMMON ADDRESS OF ASDU (identical with station address)
- ☐ More than one COMMON ADDRESS OF ASDU

### 4.3.3 Selection of standard information numbers in monitor direction

#### System functions in monitor direction

INF    Semantics

- ☒ <0>    End of general interrogation
- ☒ <0>    Time synchronization
- ☒ <2>    Reset FCB
- ☒ <3>    Reset CU
- ☒ <4>    Start/restart
- ☒ <5>    Power on

#### Status indications in monitor direction

INF    Semantics

- ☒ <16>    Auto-recloser active
- ☒ <17>    Teleprotection active
- ☒ <18>    Protection active
- ☒ <19>    LED reset
- ☒ <20>    Monitor direction blocked
- ☒ <21>    Test mode
- ☒ <22>    Local parameter setting
- ☒ <23>    Characteristic 1
- ☒ <24>    Characteristic 2
- ☒ <25>    Characteristic 3
- ☒ <26>    Characteristic 4
- ☒ <27>    Auxiliary input 1

- |                          |      |                   |
|--------------------------|------|-------------------|
| <input type="checkbox"/> | <28> | Auxiliary input 2 |
| <input type="checkbox"/> | <29> | Auxiliary input 3 |
| <input type="checkbox"/> | <30> | Auxiliary input 4 |

### Supervision indications in monitor direction

- |                          |      |                                |
|--------------------------|------|--------------------------------|
|                          | INF  | Semantics                      |
| <input type="checkbox"/> | <32> | Measurand supervision <i>I</i> |
| <input type="checkbox"/> | <33> | Measurand supervision <i>V</i> |
| <input type="checkbox"/> | <35> | Phase sequence supervision     |
| <input type="checkbox"/> | <36> | Trip circuit supervision       |
| <input type="checkbox"/> | <37> | <i>I</i> >> back-up operation  |
| <input type="checkbox"/> | <38> | VT fuse failure                |
| <input type="checkbox"/> | <39> | Teleprotection disturbed       |
| <input type="checkbox"/> | <46> | Group warning                  |
| <input type="checkbox"/> | <47> | Group alarm                    |

### Earth fault indications in monitor direction

- |                          |      |                                  |
|--------------------------|------|----------------------------------|
|                          | INF  | Semantics                        |
| <input type="checkbox"/> | <48> | Earth fault $L_1$                |
| <input type="checkbox"/> | <49> | Earth fault $L_2$                |
| <input type="checkbox"/> | <50> | Earth fault $L_3$                |
| <input type="checkbox"/> | <51> | Earth fault forward, i.e. line   |
| <input type="checkbox"/> | <52> | Earth fault reverse, i.e. busbar |

### Fault indications in monitor direction

- |                          |      |                         |
|--------------------------|------|-------------------------|
|                          | INF  | Semantics               |
| <input type="checkbox"/> | <64> | Start /pick-up $L_1$    |
| <input type="checkbox"/> | <65> | Start /pick-up $L_2$    |
| <input type="checkbox"/> | <66> | Start /pick-up $L_3$    |
| <input type="checkbox"/> | <67> | Start /pick-up <i>N</i> |
| <input type="checkbox"/> | <68> | General trip            |
| <input type="checkbox"/> | <69> | Trip $L_1$              |
| <input type="checkbox"/> | <70> | Trip $L_2$              |
| <input type="checkbox"/> | <71> | Trip $L_3$              |

<input type="checkbox"/>	<72>	Trip I» (back-up operation)
<input type="checkbox"/>	<73>	Fault location X in ohms
<input type="checkbox"/>	<74>	Fault forward/line
<input type="checkbox"/>	<75>	Fault reverse/busbar
<input type="checkbox"/>	<76>	Teleprotection signal transmitted
<input type="checkbox"/>	<77>	Teleprotection signal received
<input type="checkbox"/>	<78>	Zone 1
<input type="checkbox"/>	<79>	Zone 2
<input type="checkbox"/>	<80>	Zone 3
<input type="checkbox"/>	<81>	Zone 4
<input type="checkbox"/>	<82>	Zone 5
<input type="checkbox"/>	<83>	Zone 6
<input type="checkbox"/>	<84>	General start/pick-up
<input type="checkbox"/>	<85>	Breaker failure
<input type="checkbox"/>	<86>	Trip measuring system $L_1$
<input type="checkbox"/>	<87>	Trip measuring system $L_2$
<input type="checkbox"/>	<88>	Trip measuring system $L_3$
<input type="checkbox"/>	<89>	Trip measuring system $E$
<input type="checkbox"/>	<90>	Trip $I >$
<input type="checkbox"/>	<91>	Trip $I >>$
<input type="checkbox"/>	<92>	Trip $IN >$
<input type="checkbox"/>	<93>	Trip $IN >>$

#### Auto-reclosure indications in monitor direction

INF Semantics

<input type="checkbox"/>	<128>	CB 'on' by AR
<input type="checkbox"/>	<129>	CB 'on' by long-time AR
<input type="checkbox"/>	<130>	AR blocked

#### Measurands in monitor direction

INF Semantics

<input type="checkbox"/>	<144>	Measurand I
<input type="checkbox"/>	<145>	Measurands $I, V$
<input type="checkbox"/>	<146>	Measurands $I, V, P, Q$

- ☒ <147> Measurands  $I_N$ ,  $V_{EN}$
- ☒ <148> Measurands  $I_{L1,2,3}$ ,  $V_{L1,2,3}$ ,  $P$ ,  $Q$ ,  $f$

### Generic functions in monitor direction

- INF Semantics
- ☒ <240> Read headings of all defined groups
  - ☒ <241> Read values or attributes of all entries of one group
  - ☒ <243> Read directory of a single entry
  - ☒ <244> Read value or attribute of a single entry
  - ☒ <245> End of general interrogation of generic data
  - ☒ <249> Write entry with confirmation
  - ☒ <250> Write entry with execution
  - ☒ <251> Write entry aborted

### 4.3.4 Selection of standard information numbers in control direction

#### System functions in control direction

- INF Semantics
- ☒ <0> Initiation of general interrogation
  - ☒ <0> Time synchronization

#### General commands in control direction

- INF Semantics
- ☒ <16> Auto-recloser on/off
  - ☒ <17> Teleprotection on/off
  - ☒ <18> Protection on/off
  - ☒ <19> LED reset
  - ☒ <23> Activate characteristic 1
  - ☒ <24> Activate characteristic 2
  - ☒ <25> Activate characteristic 3
  - ☒ <26> Activate characteristic 4

#### Generic functions in control direction

- INF Semantics
- ☒ <240> Read headings of all defined groups

- ☒ <241> Read values or attributes of all entries of one group
- ☒ <243> Read directory of a single entry
- ☒ <244> Read value or attribute of a single entry
- ☒ <245> General interrogation of generic data
- ☒ <248> Write entry
- ☒ <249> Write entry with confirmation
- ☒ <250> Write entry with execution
- ☒ <251> Write entry abort

#### **4.3.5 Basic application functions**

- ☐ Test mode
- ☐ Blocking of monitor direction
- ☐ Disturbance data
- ☐ Generic services
- ☒ Private data



## 5 Information about the equipment manufacturer



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