

RELION® PROTECTION AND CONTROL

## 630 series

# IEC 60870-5-103 Communication Protocol Manual







Document ID: 1MRS757203

Issued: 2019-02-25

Revision: D

Product version: 1.3

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## Table of contents

<b>Section 1</b>	<b>Introduction.....</b>	<b>5</b>
	This manual.....	5
	Intended audience.....	5
	Product documentation.....	6
	Product documentation set.....	6
	Document revision history.....	6
	Related documentation.....	7
	Symbols and conventions.....	7
	Symbols.....	7
	Document conventions.....	7
<b>Section 2</b>	<b>IEC 60870-5-103 overview.....</b>	<b>9</b>
	IEC 60870-5-103 standard.....	9
	Communication system principle.....	10
<b>Section 3</b>	<b>Communication engineering.....</b>	<b>11</b>
	Engineering in PCM600.....	11
	Specific IEC 60870-5-103 settings .....	11
	Settings.....	12
	IEC 60870-5-103 time synchronization.....	12
<b>Section 4</b>	<b>Vendor specific implementation.....</b>	<b>15</b>
	Signals in monitoring direction.....	15
	Measurands for IEC 60870-5-103 I103MEAS.....	15
	Function block.....	15
	Functionality.....	15
	Signals.....	16
	Settings.....	16
	Supported information types.....	17
	Measurands user defined signals for IEC 60870-5-103 I103MEASUSR.....	17
	Function block.....	17
	Functionality.....	18
	Signals.....	18
	Settings.....	18
	Supported information types.....	19
	Function status auto-recloser for IEC 60870-5-103 I103AR.....	19
	Function block.....	19
	Functionality.....	20
	Signals.....	20

# Table of contents

---

Settings.....	20
Supported information types.....	20
Function status earth-fault for IEC 60870-5-103 I103EF.....	21
Function block.....	21
Functionality.....	21
Signals.....	21
Settings.....	21
Supported information types.....	21
Function status fault protection for IEC 60870-5-103 I103FLTPROT.....	22
Function block.....	22
Functionality.....	22
Signals.....	23
Settings.....	24
Supported information types.....	24
IED status for IEC 60870-5-103 I103IED.....	26
Function block.....	26
Functionality.....	26
Signals.....	26
Settings.....	26
Supported information types.....	26
Supervision status for IEC 60870-5-103 I103SUPERV.....	27
Function block.....	27
Functionality.....	27
Signals.....	27
Settings.....	28
Supported information types.....	28
Status for user defined signals for IEC 60870-5-103 I103USRDEF.....	29
Function block.....	29
Functionality.....	29
Signals.....	30
Settings.....	30
Supported information types.....	30
Commands in control direction.....	31
Function commands for IEC 60870-5-103 I103CMD.....	31
Function block.....	31
Functionality.....	31
Signals.....	31
Settings.....	32
Supported information types.....	32
IED commands for IEC 60870-5-103 I103IEDCMD.....	32
Function block.....	32
Functionality.....	33

		33
	Signals.....	33
	Settings.....	33
	Supported information types.....	33
	Function commands user defined for IEC 60870-5-103	
	I103USRCMD.....	34
	Function block.....	34
	Functionality.....	34
	Signals.....	34
	Settings.....	35
	Supported information types.....	35
	Function commands generic for IEC 60870-5-103	
	I103GENCMD.....	36
	Function block.....	36
	Functionality.....	36
	Signals.....	36
	Settings.....	36
	Supported information types.....	36
	IED commands with position and select for IEC 60870-5-103	
	I103POSCMD.....	37
	Function block.....	37
	Functionality.....	37
	Signals.....	37
	Settings.....	37
	Supported information types.....	38
	Disturbance recorder file transfer.....	39
	Disturbance upload .....	39
	Deviations from the standard .....	39
<b>Section 5</b>	<b>Interoperability profile for 630 series IEC 60870-5-103..</b>	<b>43</b>
	Physical layer.....	43
	Electrical interface.....	43
	Optical interface.....	43
	Transmission speed.....	43
	Link layer.....	43
	Application layer.....	43
	Transmission mode for application data.....	43
	COMMON ADDRESS of ASDU.....	44
	Selection of standard information numbers in monitor direction..	44
	System functions in monitor direction.....	44
	Status indications in monitor direction.....	44
	Supervision indications in monitor direction.....	45
	Earth fault indications in monitor direction.....	45
	Fault indications in monitor direction.....	45
	Auto-reclosure indications in monitor direction.....	46

## Table of contents

---

Measurands in monitor direction.....	46
Generic functions in monitor direction.....	46
Selection of standard information numbers in control direction...	47
System functions in control direction.....	47
General commands in control direction.....	47
Generic functions in monitor direction.....	47
Basic application functions.....	48
Miscellaneous.....	48
<b>Section 6 Glossary.....</b>	<b>51</b>

# Section 1      Introduction

## 1.1      This manual

The communication protocol manual describes a communication protocol supported by the protection relay. The manual concentrates on vendor-specific implementations.

## 1.2      Intended audience

This manual addresses the communication system engineer or system integrator responsible for pre-engineering and engineering the communication setup in a substation from a protection relay's perspective.

The system engineer or system integrator must have a basic knowledge of communication in protection and control systems and thorough knowledge of the specific communication protocol.

## 1.3 Product documentation

### 1.3.1 Product documentation set

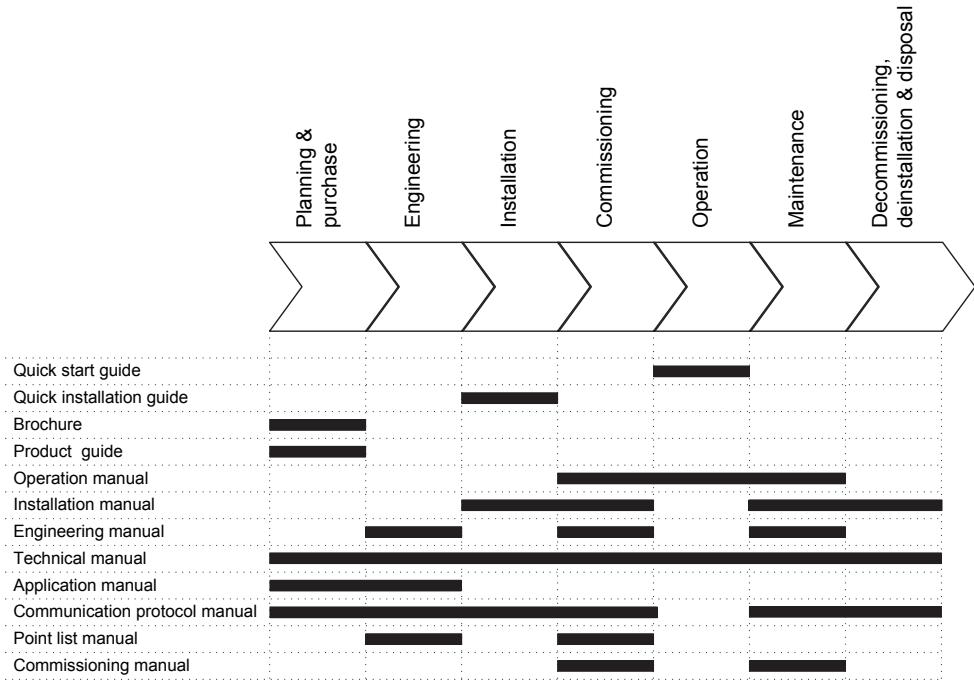


Figure 1: The intended use of documents during the product life cycle



Product series- and product-specific manuals can be downloaded from the ABB Web site <http://www.abb.com/relion>.

### 1.3.2 Document revision history

Document revision/date	Product series version	History
A/2011-02-23	1.1	First release
B/2012-08-29	1.2	Content updated to correspond to the product series version
C/2014-11-28	1.3	Content updated to correspond to the product series version
D/2019-02-25	1.3	Content updated



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### 1.3.3

### Related documentation

Product-specific point list manuals and other product series- and product-specific manuals can be downloaded from the ABB Web site  
<http://www.abb.com/substationautomation>.

## 1.4

## Symbols and conventions

### 1.4.1

### Symbols



The caution icon indicates important information or warning related to the concept discussed in the text. It might indicate the presence of a hazard which could result in corruption of software or damage to equipment or property.



The information icon alerts the reader of important facts and conditions.



The tip icon indicates advice on, for example, how to design your project or how to use a certain function.

Although warning hazards are related to personal injury, it is necessary to understand that under certain operational conditions, operation of damaged equipment may result in degraded process performance leading to personal injury or death. Therefore, comply fully with all warning and caution notices.

### 1.4.2

### Document conventions

A particular convention may not be used in this manual.

- Abbreviations and acronyms are spelled out in the glossary. The glossary also contains definitions of important terms.
- Push button navigation in the LHMI menu structure is presented by using the push button icons.  
 To navigate between the options, use and .
- Menu paths are presented in bold.  
 Select **Main menu/Settings**.
- WHMI menu names are presented in bold.  
 Click **Information** in the WHMI menu structure.
- LHMI messages are shown in Courier font.  
 To save the changes in nonvolatile memory, select **Yes** and press .
- Parameter names are shown in italics.

- 
- The function can be enabled and disabled with the *Operation* setting.
  - The ^ character in front of an input or output signal name in the function block symbol given for a function, indicates that the user can set an own signal name in PCM600.
  - The \* character after an input or output signal name in the function block symbol given for a function, indicates that the signal must be connected to another function block in the application configuration to achieve a valid application configuration.

## Section 2

# IEC 60870-5-103 overview

### 2.1

## IEC 60870-5-103 standard

IEC 60870-5-103 is defined as a companion standard for the informative element of protection equipment. While the official IEC 60870-5-103 standard dates back to 1997, the protocol has its roots in the VDEW6 communication protocol from the late 1980's. A VDEW6 device can be seen as a subset of an IEC 60870-5-103 device but not the opposite.

IEC 60870-5-103 defines communication for a serial, unbalanced link only. Communication speeds are defined as either 9600 or 19200 baud.

### Standard documentation

This manual assumes that the reader has some basic knowledge of the IEC 60870-5-103 protocol and the standard IEC 60870 documents relating to the protocol.

*Table 1: Standard IEC 60870 documents relating to IEC 60870-5-103*

IEC 60870 document part	Description
5-1	Transmission frame formats
5-2	Link transmission procedures
5-3	General structure of application data
5-4	Definition and coding of application information elements
5-5	Basic application functions
5-6	Conformance testing guidelines
5-103	Companion standard for the informative interface of protection equipment.

The IEC 60870-5-1...6 parts are also used in communication protocols like IEC 60870-5-101 and IEC 60870-5-104.

### Interoperability and interchangeability

An IEC 60870-5-103 device can be interoperable and interchangeable or only interoperable. Interoperability means that any required application data in the device, which can be coded into an IEC 60870-5-103 data type, can be mapped into the IEC 60870-5-103 address space. This data is recognized by any IEC 60870-5-103 master.

Interchangeability means supporting the application data (informative elements) whose semantics are pre-defined by the IEC 60870-5-103 standard. However, only a very limited set of application data informative elements has been defined by the standard. It should also be noticed that these sets of data are mainly defined for a

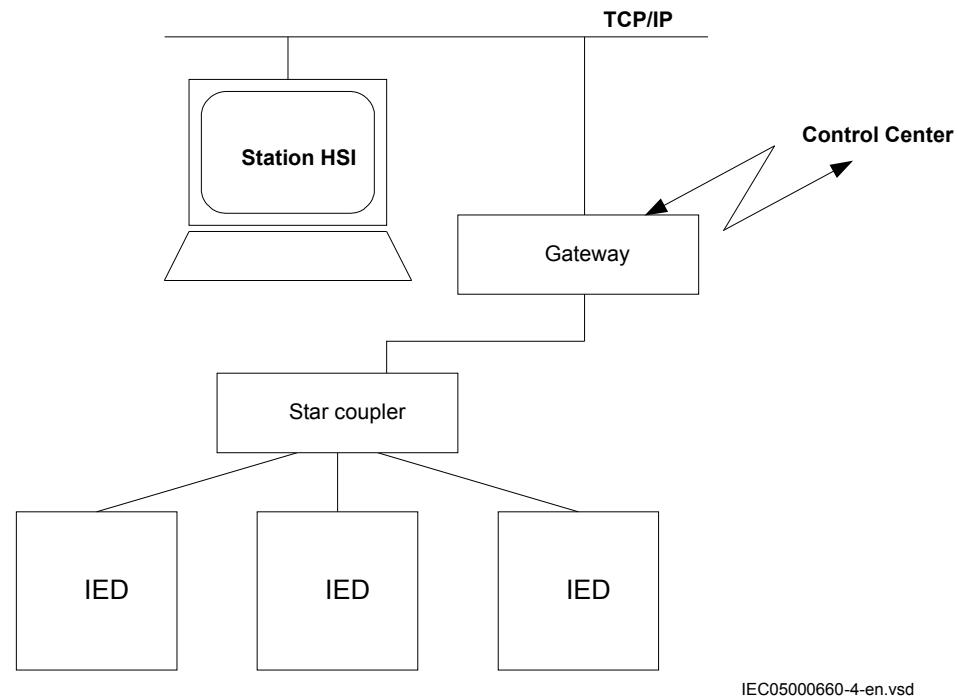
single-function protection IED. The 630 series IEDs in turn are multifunctional protection and control IEDs whose internal data model is based on the IEC 61850 standard.

### **Interoperability list**

The standard requires the IEC 60870-5-103 device to provide an interoperability list, which actually is more an interchangeability list. See the vendor-specific implementation section in this manual for the interoperability list.

#### **2.1.1**

### **Communication system principle**



*Figure 2: Example of IEC 60870-5-103 communication structure for a substation automation system*

IEC 60870-5-103 communication protocol is mainly used when a protection IED communicates with a third party control or monitoring system. This system must have software that can interpret the IEC 60870-5-103 communication messages.

*Table 2: Max. distances between IED/nodes*

Connector	Distance
Glass (ST connector)	<1000 m according to optical budget

## Section 3

# Communication engineering

### 3.1

## Engineering in PCM600

Application Configuration and Parameter Setting in PCM600 are used to configure the communication for IEC 60870-5-103 protocol.

1. Add the desired IEC 60870-5-103 function blocks to the application configuration in the Application Configuration tool.
2. Connect the outputs of desired protection and monitoring function in the application configuration to the inputs of the corresponding IEC 60870-5-103 function block.
3. Set the function type and desired information number, where an information number must be supplied, for each IEC 60870-5-103 function block instance in the Parameter Setting tool.
4. Set the general communication parameters for IEC 60870-5-103 and time synchronization parameters in the Parameter Setting tool.

### 3.2

## Specific IEC 60870-5-103 settings

Set parameter *Operation* to *On* either in Parameter Setting tool or from the local HMI.

Parameter *Operation* is found under **IED Configuration/Station communication/IEC60870-5-103:1** in PST. The IED is automatically restarted when any general parameter is changed.

The general settings for IEC 60870-5-103 communication are the following:

- *SlaveAddress* and *BaudRate*: Settings for slave number and communication speed (baud rate).  
The slave number can be set to any value between 1 and 31. The communication speed, can be set either to 9600 bits/s or 19200 bits/s.
- *RevPolarity*: Setting for connection idle state (light on or light off).
- *CycMeasRepTime*: Setting for *CycMeasRepTime* must be coordinated with the *xDbRepInt* and *xAngDbRepInt* reporting setting on the MMXU measurement function blocks. See I103MEAS function block for more information.
- *EventRepMode*: Defines the mode for how events are reported.



The event buffer size is 1000 events.

### Event reporting mode

If "SeqOfEvent" is selected, all GI and spontaneous events will be delivered in the order they were generated by BSW. The most recent value is the latest value delivered. All GI data from a single block will come from the same cycle.

If "HiPriSpont" is selected, spontaneous events will be delivered prior to GI event. To prevent old GI data from being delivered after a new spontaneous event, the pending GI event is modified to contain the same value as the spontaneous event. As a result the GI dataset is not time-correlated.

## 3.2.1 Settings

**Table 3:** IEC60870-5-103 Non group settings (basic)

Name	Values (Range)	Unit	Step	Default	Description
Operation	Off On	-	-	Off	Operation
SlaveAddress	1 - 31	-	1	1	Slave address
BaudRate	9600 Bd 19200 Bd	-	-	9600 Bd	Baudrate on serial line
RevPolarity	Off On	-	-	On	Invert polarity
CycMeasRepTime	1.0 - 1800.0	s	0.1	5.0	Cyclic reporting time of measurements
MasterTimeDomain	UTC Local Local with DST	-	-	UTC	Master time domain
TimeSyncMode	IEDTime LinMastTime IEDTimeSkew	-	-	IEDTime	Time synchronization mode
EvalTimeAccuracy	5ms 10ms 20ms 40ms Off	-	-	5ms	Evaluate time accuracy for invalid time
EventRepMode	SeqOfEvent HiPriSpont	-	-	SeqOfEvent	Event reporting mode

## 3.3

## IEC 60870-5-103 time synchronization

An IED with IEC 60870-5-103 protocol can be used for time synchronization, but for accuracy reasons, it is not recommended. In some cases, however, this kind of synchronization is needed, for example, when no other synchronization is available.

First, set the IED to be synchronized via IEC 60870-5-103 from **IED Configuration/Time/Synchronization/TIMESYNCHGEN:1** in PST.



Figure 3: Settings under TIMESYNCHGEN:1 in PST

Only *CoarseSyncSrc* can be set to IEC 60870-5-103, not *FineSyncSource*.

After setting up the time synchronization source, the user must check and modify the IEC 60870-5-103 time synchronization specific settings, under: **IED Configuration/Communication/Station communication/IEC60870-5-103:1**.

- *MasterTimeDomain* specifies the format of the time sent by the master. Format can be:
  - Coordinated Universal Time ("UTC")
  - Local time set in the master ("Local")
  - Local time set in the master adjusted according to daylight saving time ("Local with DST")
- *TimeSyncMode* specifies the time sent by the IED. The time synchronisation is done using the following ways:
  - "IEDTime": The IED sends the messages with its own time.
  - "LinMasTime": The IED measures the offset between its own time and the master time, and applies the same offset for the messages sent as in the "IEDTimeSkew". But in "LinMasTime" it applies the time changes occurred between two synchronised messages.
  - *IEDTimeSkew*: The IED measures the offset in between its own time and the master time and applies the same offset for the messages sent.
- *EvalTimeAccuracy* evaluates time accuracy for invalid time. Specifies the accuracy of the synchronization (5, 10, 20 or 40 ms). If the accuracy is worse than the specified value, the "Bad Time" flag is raised. To accommodate those masters that are really bad in time sync, the *EvalTimeAccuracy* can be set to "Off".

According to the standard, the "Bad Time" flag is reported when synchronization has been omitted in the protection for >23 h.



## Section 4

# Vendor specific implementation

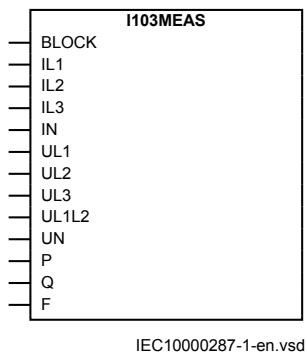
The signal and setting tables specify the information types supported by the IEDs with the communication protocol IEC 60870-5-103 implemented.

The information types are supported when corresponding functions are included in the protection and control IED.

## 4.1 Signals in monitoring direction

### 4.1.1 Measurands for IEC 60870-5-103 I103MEAS

#### 4.1.1.1 Function block



IEC10000287-1-en.vsd

Figure 4: Function block

#### 4.1.1.2 Functionality

I103MEAS is a function block that reports all valid measuring types depending on connected signals.

The measured values come from the corresponding MMXU function block and are depending on the function block settings. The event reporting interval is set by the *CycMeasRepTime* parameter of the IEC 60870-5-103 communication settings.

Input signals of the IEC 60870-5-103 I103MEAS block should be connected to the corresponding outputs of the MMXU application functions. Depending on the connected input signals, the IEC 60870-5-103 protocol automatically selects the proper ASDU Meas 3 or Meas 9 to be used as Class 2 data.

#### 4.1.1.3

#### Signals

*Table 4: I103MEAS Input signals*

Name	Type	Default	Description
BLOCK	BOOLEAN	0	Block of service value reporting
IL1	REAL	0.0	Service value for current phase L1
IL2	REAL	0.0	Service value for current phase L2
IL3	REAL	0.0	Service value for current phase L3
IN	REAL	0.0	Service value for residual current IN
UL1	REAL	0.0	Service value for voltage phase L1
UL2	REAL	0.0	Service value for voltage phase L2
UL3	REAL	0.0	Service value for voltage phase L3
UL1L2	REAL	0.0	Service value for voltage phase-phase L1-L2
UN	REAL	0.0	Service value for residual voltage UN
P	REAL	0.0	Service value for active power
Q	REAL	0.0	Service value for reactive power
F	REAL	0.0	Service value for system frequency

#### 4.1.1.4

#### Settings

*Table 5: I103MEAS Non group settings (basic)*

Name	Values (Range)	Unit	Step	Default	Description
FunctionType	1 - 255	-	1	1	Function type (1-255)
MaxIL1	1 - 99999	A	1	3000	Maximum current phase L1
MaxIL2	1 - 99999	A	1	3000	Maximum current phase L2
MaxIL3	1 - 99999	A	1	3000	Maximum current phase L3
MaxIN	1 - 99999	A	1	3000	Maximum residual current IN
MaxUL1	0.05 - 2000.00	kV	0.05	230.00	Maximum voltage for phase L1
MaxUL2	0.05 - 2000.00	kV	0.05	230.00	Maximum voltage for phase L2
MaxUL3	0.05 - 2000.00	kV	0.05	230.00	Maximum voltage for phase L3
MaxUL1-UL2	0.05 - 2000.00	kV	0.05	400.00	Maximum voltage for phase-phase L1-L2
MaxUN	0.05 - 2000.00	kV	0.05	230.00	Maximum residual voltage UN
MaxP	0.00 - 2000.00	MW	0.05	1200.00	Maximum value for active power
MaxQ	0.00 - 2000.00	MVA	0.05	1200.00	Maximum value for reactive power
MaxF	50.0 - 60.0	Hz	10.0	50.0	Maximum system frequency

Maximum value corresponds to the value 4096 on the master side.

#### 4.1.1.5

#### Supported information types

##### Measurands in public range, I103MEAS

Number of instances: 1

The IED reports all valid measuring types depending on connected signals.

According to standard the upper limit for measured currents, active/reactive-power is 2.4 times rated value.

According to standard the upper limit for measured voltages and frequency is 1.2 times rated value. The rated values can be seen from the settings of the I/O modules (AIM2 for example).

Only the measurand standard frames defined in IEC 60870-5-103 are supported.

*Table 6: Interchangeable Class 2 measurand frames*

Frame No	ASDU	FUN <sup>1)</sup>	INF	Number of data	Data in the Class 2 frame
1	3	1	144	1	IL2
2	3	1	145	2	IL2, U12
3	3	1	146	4	IL2, U12, P3, Q3
4	3	1	147	2	Io, Uo
5	9	1	148	9	IL1, IL2, IL3, UL1, UL2, UL3, P3, Q3, f

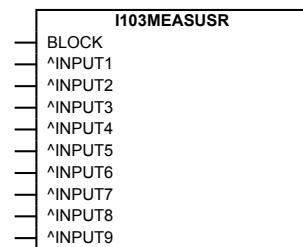
1) FUN = 1 means that the Function type is coded as the Device function type which in turn is defined by the setting parameter *FunctionType*.

#### 4.1.2

#### Measurands user defined signals for IEC 60870-5-103 I103MEASUSR

##### 4.1.2.1

##### Function block



IEC10000288-1-en.vsd

*Figure 5: Function block*

#### 4.1.2.2

#### Functionality

I103MEASUSR is a function block with user defined input measurands in monitor direction. These function blocks include the *FunctionType* parameter for each block in the private range, and the Information number parameter for each block.

If I103MEASUSR is used to report angles, they are in radians.

#### 4.1.2.3

#### Signals

**Table 7:** *I103MEASUSR Input signals*

Name	Type	Default	Description
BLOCK	BOOLEAN	0	Block of service value reporting
INPUT1	REAL	0.0	Service value for measurement on input 1
INPUT2	REAL	0.0	Service value for measurement on input 2
INPUT3	REAL	0.0	Service value for measurement on input 3
INPUT4	REAL	0.0	Service value for measurement on input 4
INPUT5	REAL	0.0	Service value for measurement on input 5
INPUT6	REAL	0.0	Service value for measurement on input 6
INPUT7	REAL	0.0	Service value for measurement on input 7
INPUT8	REAL	0.0	Service value for measurement on input 8
INPUT9	REAL	0.0	Service value for measurement on input 9

#### 4.1.2.4

#### Settings

**Table 8:** *I103MEASUSR Non group settings (basic)*

Name	Values (Range)	Unit	Step	Default	Description
FunctionType	1 - 255	-	1	25	Function type (1-255)
InfNo	1 - 255	-	1	1	Information number for measurands (1-255)
MaxMeasur1	0.05 - 10000000000.00	-	0.05	1000.00	Maximum value for measurement on input 1
MaxMeasur2	0.05 - 10000000000.00	-	0.05	1000.00	Maximum value for measurement on input 2
MaxMeasur3	0.05 - 10000000000.00	-	0.05	1000.00	Maximum value for measurement on input 3
MaxMeasur4	0.05 - 10000000000.00	-	0.05	1000.00	Maximum value for measurement on input 4
MaxMeasur5	0.05 - 10000000000.00	-	0.05	1000.00	Maximum value for measurement on input 5
MaxMeasur6	0.05 - 10000000000.00	-	0.05	1000.00	Maximum value for measurement on input 6

Table continues on next page

Name	Values (Range)	Unit	Step	Default	Description
MaxMeasur7	0.05 - 10000000000.00	-	0.05	1000.00	Maximum value for measurement on input 7
MaxMeasur8	0.05 - 10000000000.00	-	0.05	1000.00	Maximum value for measurement on input 8
MaxMeasur9	0.05 - 10000000000.00	-	0.05	1000.00	Maximum value for measurement on input 9

#### 4.1.2.5

#### Supported information types

##### Measurands in private range, I103MEASUSR

Number of instances: 3

Function type parameter for each block in private range. Default values are defined in private range 25...27. One for each instance.

Information number must be selected for measurands.

*Table 9: I103MEASUSR supported measurands*

Information number	Message	Supported
*1)	Meas1	Yes
*	Meas2	Yes
*	Meas3	Yes
*	Meas4	Yes
*	Meas5	Yes
*	Meas6	Yes
*	Meas7	Yes
*	Meas8	Yes
*	Meas9	Yes

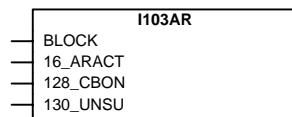
1) User defined information number

#### 4.1.3

#### Function status auto-recloser for IEC 60870-5-103 I103AR

##### 4.1.3.1

##### Function block



*Figure 6: Function block*

#### 4.1.3.2 Functionality

I103AR is a function block with defined functions for autorecloser indications in monitor direction. This block includes the *FunctionType* parameter, and the information number parameter is defined for each output signal.

#### 4.1.3.3 Signals

*Table 10: I103AR Input signals*

Name	Type	Default	Description
BLOCK	BOOLEAN	0	Block of status reporting
16_ARACT	BOOLEAN	0	Information number 16, auto-recloser active
128_CBON	BOOLEAN	0	Information number 128, circuit breaker on by auto-recloser
130_UNSU	BOOLEAN	0	Information number 130, unsuccessful reclosing

#### 4.1.3.4 Settings

*Table 11: I103AR Non group settings (basic)*

Name	Values (Range)	Unit	Step	Default	Description
FunctionType	1 - 255	-	1	1	Function type (1-255)

#### 4.1.3.5 Supported information types

##### Autorecloser indications in monitor direction, I103AR

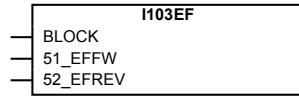
Number of instances: 1

Function type is selected with parameter *FunctionType*.

Information number is defined for each output signal.

*Table 12: I103AR supported indications*

Information number	Message	Supported
16	Autorecloser active	Yes
17	Teleprotection active	No
18	Protection active	No
128	CB on by Autorecloser	Yes
129	CB 'on' by long-time AR	No
130	Autorecloser blocked	Yes

**4.1.4****Function status earth-fault for IEC 60870-5-103 I103EF****4.1.4.1****Function block**

IEC10000290-1-en.vsd

*Figure 7: Function block***4.1.4.2****Functionality**

I103EF is a function block with defined functions for earth fault indications in monitor direction. This block includes the *FunctionType* parameter, and the information number parameter is defined for each output signal.

**4.1.4.3****Signals***Table 13: I103EF Input signals*

Name	Type	Default	Description
BLOCK	BOOLEAN	0	Block of status reporting
51_EFFW	BOOLEAN	0	Information number 51, earth-fault forward
52_EFREV	BOOLEAN	0	Information number 52, earth-fault reverse

**4.1.4.4****Settings***Table 14: I103EF Non group settings (basic)*

Name	Values (Range)	Unit	Step	Default	Description
FunctionType	1 - 255	-	1	160	Function type (1-255)

**4.1.4.5****Supported information types****Earth fault indications in monitor direction, I103EF**

Number of instances: 1

Function type is selected with parameter *FunctionType*.

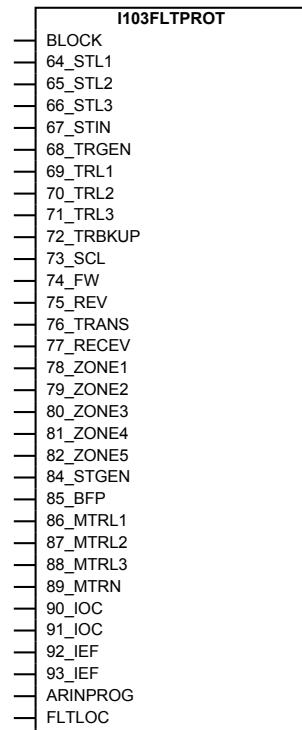
Information number is defined for each output signal.

*Table 15: I103EF supported indications*

Information number	Message	Supported
48	Earth fault L1	No
49	Earth fault L2	No
50	Earth fault L3	No
51	Earth fault forward	Yes
52	Earth fault reverse	Yes

## 4.1.5 Function status fault protection for IEC 60870-5-103 I103FLTPROT

### 4.1.5.1 Function block



IEC10000291-1-en.vsd

*Figure 8: Function block*

### 4.1.5.2 Functionality

I103FLTPROT is used for fault indications in monitor direction. Each input on the function block is specific for a certain fault type and therefore must be connected to a correspondent signal present in the configuration. For example, 68\_TRGEN

represents the General Trip of the device, and therefore must be connected to the general trip signal SMPPTRC\_TRIP or equivalent.

The delay observed in the protocol is the time difference in between the signal that is triggering the Disturbance Recorder and the respective configured signal to the IEC 60870-5-103 I103FLTPROT.

#### 4.1.5.3

#### Signals

*Table 16: I103FLTPROT Input signals*

Name	Type	Default	Description
BLOCK	BOOLEAN	0	Block of status reporting.
64_STL1	BOOLEAN	0	Information number 64, start phase L1
65_STL2	BOOLEAN	0	Information number 65, start phase L2
66_STL3	BOOLEAN	0	Information number 66, start phase L3
67_STIN	BOOLEAN	0	Information number 67, start residual current IN
68_TRGEN	BOOLEAN	0	Information number 68, trip general
69_TRL1	BOOLEAN	0	Information number 69, trip phase L1
70_TRL2	BOOLEAN	0	Information number 70, trip phase L2
71_TRL3	BOOLEAN	0	Information number 71, trip phase L3
72_TRBKUP	BOOLEAN	0	Information number 72, back up trip I>>
73_SCL	REAL	0	Information number 73, fault location in ohm
74_FW	BOOLEAN	0	Information number 74, forward/line
75_REV	BOOLEAN	0	Information number 75, reverse/busbar
76_TRANS	BOOLEAN	0	Information number 76, signal transmitted
77_RECEV	BOOLEAN	0	Information number 77, signal received
78_ZONE1	BOOLEAN	0	Information number 78, zone 1
79_ZONE2	BOOLEAN	0	Information number 79, zone 2
80_ZONE3	BOOLEAN	0	Information number 80, zone 3
81_ZONE4	BOOLEAN	0	Information number 81, zone 4
82_ZONE5	BOOLEAN	0	Information number 82, zone 5
84_STGEN	BOOLEAN	0	Information number 84, start general
85_BFP	BOOLEAN	0	Information number 85, breaker failure
86_MTRL1	BOOLEAN	0	Information number 86, trip measuring system phase L1
87_MTRL2	BOOLEAN	0	Information number 87, trip measuring system phase L2
88_MTRL3	BOOLEAN	0	Information number 88, trip measuring system phase L3
89_MTRN	BOOLEAN	0	Information number 89, trip measuring system neutral N
90_IOC	BOOLEAN	0	Information number 90, over current trip, stage low
91_IOC	BOOLEAN	0	Information number 91, over current trip, stage high
Table continues on next page			

Name	Type	Default	Description
92_IEF	BOOLEAN	0	Information number 92, earth-fault trip, stage low
93_IEF	BOOLEAN	0	Information number 93, earth-fault trip, stage high
ARINPROG	BOOLEAN	0	Autorecloser in progress (SMBRREC- INPROGR)
FLTLOC	BOOLEAN	0	Faultlocator faultlocation valid (LMBRFLO-CALCMADE)

### ARINPROG

Input signal ARINPROG shall be connected to the autorecloser output signal ACTIVE, which indicates that the reclosing is started and the sequence is ongoing. The purpose of the ARINPROGRESS input is to establish the base time for the relative timestamps. While ARINPROGRESS is asserted, a new fault does not reset the base for the relative time reported for trip indications, and all timestamps will be relative to last fault with ARINPROGRESS deasserted.

### FLTLOC

Input signal FLTLOC shall be connected to the fault locator output signal CALCMADE, the trigger to send the 73\_SCL value.

#### 4.1.5.4

### Settings

Table 17: I103FLTPROT Non group settings (basic)

Name	Values (Range)	Unit	Step	Default	Description
FunctionType	1 - 255	-	1	128	Function type (1-255)

#### 4.1.5.5

### Supported information types

#### Function status fault protection for IEC60870-5-103, I103FLTPROT

Number of instances: 1

Function type is selected with parameter *FunctionType*.

Information number is defined for each input signals.

Table 18: I103FLTPROT supported indications

Information number	Message	Supported	Type	GI	COT
64	Start phase L1	Yes	2	Y	1,7,9
65	Start phase L2	Yes	2	Y	1,7,9
66	Start phase L3	Yes	2	Y	1,7,9
67	Start residual current IN	Yes	2	Y	1,7,9
68	Trip general	Yes	2	N	1,7,9

Table continues on next page

Information number	Message	Supported	Type	GI	COT
69	Trip phase L1	Yes	2	N	1,7
70	Trip phase L2	Yes	2	N	1,7
71	Trip phase L3	Yes	2	N	1,7
72	Back up trip  >>	Yes	2	N	1,7
73	Fault location in ohm	Yes	4	N	1,7
74	Forward/line	Yes	2	N	1,7
75	Reverse/ busbar	Yes	2	N	1,7
76	Signal transmitted	Yes	2	N	1,7
77	Signal received	Yes	2	N	1,7
78	Zone 1	Yes	2	N	1,7
79	Zone 2	Yes	2	N	1,7
80	Zone 3	Yes	2	N	1,7
81	Zone 4	Yes	2	N	1,7
82	Zone 5	Yes	2	N	1,7
83	Zone 6	No	2	N	1,7
84	Start general	Yes	2	N	1,7,9
85	Breaker failure	Yes	2	N	1,7
86	Trip measuring system phase L1	Yes	2	N	1,7
87	Trip measuring system phase L2	Yes	2	N	1,7
88	Trip measuring system phase L3	Yes	2	N	1,7
89	Trip measuring system neutral N	Yes	2	N	1,7
90	Over current trip, stage low	Yes	2	N	1,7
91	Over current trip, stage high	Yes	2	N	1,7
92	Earth-fault trip, stage low	Yes	2	N	1,7
93	Earth-fault trip, stage high	Yes	2	N	1,7

## 4.1.6 IED status for IEC 60870-5-103 I103IED

### 4.1.6.1 Function block

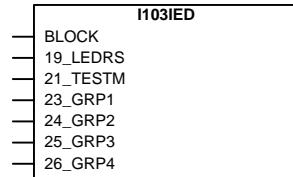


Figure 9: Function block

### 4.1.6.2 Functionality

I103IED is a function block with defined IED functions in monitor direction. This block uses parameter as *FunctionType*, and information number parameter is defined for each input signal.

### 4.1.6.3 Signals

Table 19: I103IED Input signals

Name	Type	Default	Description
BLOCK	BOOLEAN	0	Block of status reporting
19_LEDRS	BOOLEAN	0	Information number 19, reset LEDs
21_TESTM	BOOLEAN	0	Information number 21, test mode is active
23_GRP1	BOOLEAN	0	Information number 23, setting group 1 is active
24_GRP2	BOOLEAN	0	Information number 24, setting group 2 is active
25_GRP3	BOOLEAN	0	Information number 25, setting group 3 is active
26_GRP4	BOOLEAN	0	Information number 26, setting group 4 is active

### 4.1.6.4 Settings

Table 20: I103IED Non group settings (basic)

Name	Values (Range)	Unit	Step	Default	Description
FunctionType	1 - 255	-	1	1	Function type (1-255)

### 4.1.6.5 Supported information types

#### Terminal status indications in monitor direction, I103IED

Number of instances: 1

Function type is selected with parameter *FunctionType*.

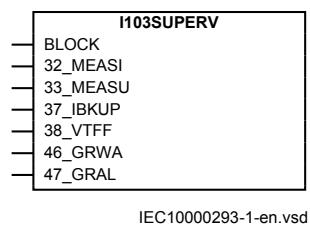
Information number is defined for each input signals.

*Table 21:* I103IED supported indications

Information number	Message	Supported
19	LED reset	Yes
20	Monitor direction blocked	No
21	TestMode	Yes
22	Local Parameter setting	No
23	Setting group 1 active	Yes
24	Setting group 2 active	Yes
25	Setting group 3 active	Yes
26	Setting group 4 active	Yes

## 4.1.7 Supervision status for IEC 60870-5-103 I103SUPERV

### 4.1.7.1 Function block



IEC10000293-1-en.vsd

*Figure 10:* Function block

### 4.1.7.2 Functionality

I103SUPERV is a function block with defined functions for supervision indications in monitor direction. This block includes the *FunctionType* parameter, and the information number parameter is defined for each output signal.

### 4.1.7.3 Signals

*Table 22:* I103SUPERV Input signals

Name	Type	Default	Description
BLOCK	BOOLEAN	0	Block of status reporting
32_MEASI	BOOLEAN	0	Information number 32, measurand supervision of I
33_MEASU	BOOLEAN	0	Information number 33, measurand supervision of U
37_IBKUP	BOOLEAN	0	Information number 37, I high-high back-up protection
Table continues on next page			

Name	Type	Default	Description
38_VTFF	BOOLEAN	0	Information number 38, fuse failure VT
46_GRWA	BOOLEAN	0	Information number 46, group warning
47_GRAL	BOOLEAN	0	Information number 47, group alarm

#### 4.1.7.4 Settings

Table 23: I103SUPERV Non group settings (basic)

Name	Values (Range)	Unit	Step	Default	Description
FunctionType	1 - 255	-	1	1	Function type (1-255)

#### 4.1.7.5 Supported information types

##### Supervision indications in monitor direction, I103SUPERV

Number of instances: 1

Function type is selected with parameter *FunctionType*.

Information number is defined for output signals.

Table 24: I103SUPERV supported indications

Information number	Message	Supported	Type	GI	COT
32	Measurand supervision I	Yes	1	Y	1,7,9
33	Measurand supervision U	Yes	1	Y	1,7,9
35	Phase sequence supervision	No	1	Y	1,7,9
36	Trip circuit supervision	No	1	Y	1,7,9
37	I>>back-up operation	Yes	1	Y	1,7,9
38	VT fuse failure	Yes	1	Y	1,7,9
39	Teleprotection disturbed	Yes	1	Y	1,7,9
46	Group warning	Yes	1	Y	1,7,9
47	Group alarm	Yes	1	Y	1,7,9

## 4.1.8

### Status for user defined signals for IEC 60870-5-103 I103USRDEF

#### 4.1.8.1

##### Function block

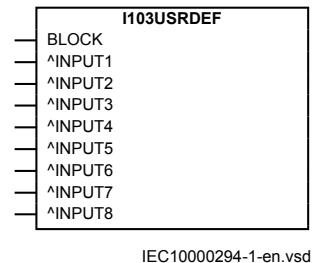


Figure 11: Function block

#### 4.1.8.2

##### Functionality

I103USRDEF is a function blocks with user defined input signals in monitor direction. These function blocks include the *FunctionType* parameter for each block in the private range, and the information number parameter for each input signal.

I103USRDEF can be mapped to the INF that are not supported directly by specific function blocks, for example, INF17, INF18, INF20 or INF35. After connecting the appropriate signals to the I103USRDEF inputs, the user must also set the *InfNo\_x* values in the settings

I103USRDEF: 1				
FunctionType	5		1	255
NAME1	INPUT1			13 character(s)
InfNo_1	17		1	255
NAME2	INPUT2			13 character(s)
InfNo_2	18		1	255
NAME3	INPUT3			13 character(s)
InfNo_3	20		1	255
NAME4	INPUT4			13 character(s)
InfNo_4	35		1	255

Figure 12: I103USRDEF example settings

#### 4.1.8.3

#### Signals

*Table 25: I103USRDEF Input signals*

Name	Type	Default	Description
BLOCK	BOOLEAN	0	Block of status reporting
INPUT1	BOOLEAN	0	Binary signal Input 1
INPUT2	BOOLEAN	0	Binary signal input 2
INPUT3	BOOLEAN	0	Binary signal input 3
INPUT4	BOOLEAN	0	Binary signal input 4
INPUT5	BOOLEAN	0	Binary signal input 5
INPUT6	BOOLEAN	0	Binary signal input 6
INPUT7	BOOLEAN	0	Binary signal input 7
INPUT8	BOOLEAN	0	Binary signal input 8

#### 4.1.8.4

#### Settings

*Table 26: I103USRDEF Non group settings (basic)*

Name	Values (Range)	Unit	Step	Default	Description
FunctionType	1 - 255	-	1	5	Function type (1-255)
InfNo_1	1 - 255	-	1	1	Information number for binary input 1 (1-255)
InfNo_2	1 - 255	-	1	2	Information number for binary input 2 (1-255)
InfNo_3	1 - 255	-	1	3	Information number for binary input 3 (1-255)
InfNo_4	1 - 255	-	1	4	Information number for binary input 4 (1-255)
InfNo_5	1 - 255	-	1	5	Information number for binary input 5 (1-255)
InfNo_6	1 - 255	-	1	6	Information number for binary input 6 (1-255)
InfNo_7	1 - 255	-	1	7	Information number for binary input 7 (1-255)
InfNo_8	1 - 255	-	1	8	Information number for binary input 8 (1-255)

#### 4.1.8.5

#### Supported information types

##### Function status indications in monitor direction, user-defined, I103USRDEF

Number of instances: 20

Function type is selected with parameter *FunctionType* for each function block instance in private range. Default values are defined in private range 5...24. One for each instance.

Information number is required for each input signal. Default values are defined in range 1...8.

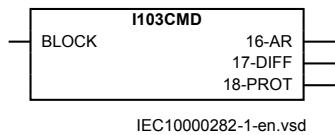
*Table 27: I103USRDEF supported indications*

Information number	Message	Supported
1	Binary signal input	Yes
2	Binary signal input	Yes
3	Binary signal input	Yes
4	Binary signal input	Yes
5	Binary signal input	Yes
6	Binary signal input	Yes
7	Binary signal input	Yes
8	Binary signal input	Yes

## 4.2 Commands in control direction

### 4.2.1 Function commands for IEC 60870-5-103 I103CMD

#### 4.2.1.1 Function block



*Figure 13: Function block*

#### 4.2.1.2 Functionality

I103CMD is a command function block in control direction with pre-defined output signals.

#### 4.2.1.3 Signals

*Table 28: I103CMD Input signals*

Name	Type	Default	Description
BLOCK	BOOLEAN	0	Block of commands

*Table 29: I103CMD Output signals*

Name	Type	Description
16-AR	BOOLEAN	Information number 16, block of autorecloser
17-DIFF	BOOLEAN	Information number 17, block of differential protection
18-PROT	BOOLEAN	Information number 18, block of protection

#### 4.2.1.4 Settings

*Table 30: I103CMD Non group settings (basic)*

Name	Values (Range)	Unit	Step	Default	Description
FunctionType	1 - 255	-	1	1	Function type (1-255)

#### 4.2.1.5 Supported information types

##### Function commands in control direction, pre-defined I103CMD

Number of instances: 1

Function type is selected with parameter *FunctionType*.

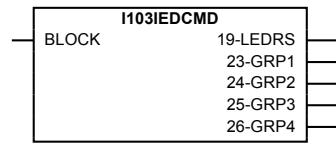
Information number is defined for each output signal.

*Table 31: I103CMD supported commands*

Information number	Message	Supported
16	Auto-recloser on/off	Yes
17	Teleprotection on/off	Yes
18	Protection on/off	Yes

#### 4.2.2 IED commands for IEC 60870-5-103 I103IEDCMD

##### 4.2.2.1 Function block



*Figure 14: Function block*

#### 4.2.2.2

#### Functionality

I103IEDCMD is a command block in control direction with defined IED functions.

#### 4.2.2.3

#### Signals

*Table 32: I103IEDCMD Input signals*

Name	Type	Default	Description
BLOCK	BOOLEAN	0	Block of commands

*Table 33: I103IEDCMD Output signals*

Name	Type	Description
19-LEDRS	BOOLEAN	Information number 19, reset LEDs
23-GRP1	BOOLEAN	Information number 23, activate setting group 1
24-GRP2	BOOLEAN	Information number 24, activate setting group 2
25-GRP3	BOOLEAN	Information number 25, activate setting group 3
26-GRP4	BOOLEAN	Information number 26, activate setting group 4

#### 4.2.2.4

#### Settings

*Table 34: I103IEDCMD Non group settings (basic)*

Name	Values (Range)	Unit	Step	Default	Description
FunctionType	1 - 255	-	1	255	Function type (1-255)

#### 4.2.2.5

#### Supported information types

##### Commands in control direction, I103IEDCMD

Number of instances: 1

Function type is selected with parameter *FunctionType*.

Information number is defined for each output signal.

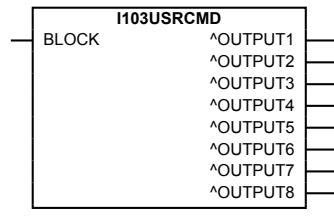
*Table 35: I103IEDCMD supported commands*

Information number	Message	Supported
19	LED Reset	Yes
23	Activate setting group 1	Yes
24	Activate setting group 2	Yes
25	Activate setting group 3	Yes
26	Activate setting group 4	Yes

## 4.2.3 Function commands user defined for IEC 60870-5-103

### I103USRCMD

#### 4.2.3.1 Function block



IEC10000284-1-en.vsd

Figure 15: Function block

#### 4.2.3.2 Functionality

I103USRCMD is a command block in control direction with user defined output signals. These function blocks include the *FunctionType* parameter for each block in the private range, and the Information number parameter for each output signal.

#### 4.2.3.3 Signals

Table 36: I103USRCMD Input signals

Name	Type	Default	Description
BLOCK	BOOLEAN	0	Block of commands

Table 37: I103USRCMD Output signals

Name	Type	Description
OUTPUT1	BOOLEAN	Command output 1
OUTPUT2	BOOLEAN	Command output 2
OUTPUT3	BOOLEAN	Command output 3
OUTPUT4	BOOLEAN	Command output 4
OUTPUT5	BOOLEAN	Command output 5
OUTPUT6	BOOLEAN	Command output 6
OUTPUT7	BOOLEAN	Command output 7
OUTPUT8	BOOLEAN	Command output 8

#### 4.2.3.4

#### Settings

*Table 38: I103USRCMD Non group settings (basic)*

Name	Values (Range)	Unit	Step	Default	Description
FunctionType	1 - 255	-	1	1	Function type (1-255)
PulseMode	Steady Pulsed	-	-	Pulsed	Pulse mode
PulseLength	0.200 - 60.000	s	0.001	0.400	Pulse length
InfNo_1	1 - 255	-	1	1	Information number for output 1 (1-255)
InfNo_2	1 - 255	-	1	2	Information number for output 2 (1-255)
InfNo_3	1 - 255	-	1	3	Information number for output 3 (1-255)
InfNo_4	1 - 255	-	1	4	Information number for output 4 (1-255)
InfNo_5	1 - 255	-	1	5	Information number for output 5 (1-255)
InfNo_6	1 - 255	-	1	6	Information number for output 6 (1-255)
InfNo_7	1 - 255	-	1	7	Information number for output 7 (1-255)
InfNo_8	1 - 255	-	1	8	Information number for output 8 (1-255)

#### 4.2.3.5

#### Supported information types

##### Function commands in control direction, user-defined, I103USRCMD

Number of instances: 4

Function type for each function block instance in private range is selected with parameter *FunctionType*. Default values are defined in private range 1...4. One for each instance.

Information number must be selected for each output signal. Default values are 1...8.

*Table 39: I103USRCMD supported commands*

Information number	Message	Supported
1	Output signal 01	Yes
2	Output signal 02	Yes
3	Output signal 03	Yes
4	Output signal 04	Yes
5	Output signal 05	Yes
6	Output signal 06	Yes
7	Output signal 07	Yes
8	Output signal 08	Yes

## 4.2.4 Function commands generic for IEC 60870-5-103

### I103GENCMD

#### 4.2.4.1 Function block

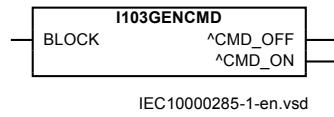


Figure 16: Function block

#### 4.2.4.2 Functionality

I103GENCMD is used for transmitting generic commands over IEC 60870-5-103. The function has two outputs signals CMD\_OFF and CMD\_ON that can be used to implement double-point command schemes.

#### 4.2.4.3 Signals

Table 40: I103GENCMD Input signals

Name	Type	Default	Description
BLOCK	BOOLEAN	0	Block of command

Table 41: I103GENCMD Output signals

Name	Type	Description
CMD_OFF	BOOLEAN	Command output OFF
CMD_ON	BOOLEAN	Command output ON

#### 4.2.4.4 Settings

Table 42: I103GENCMD Non group settings (basic)

Name	Values (Range)	Unit	Step	Default	Description
FunctionType	1 - 127	-	1	1	Function type (1-127)
PulseLength	0.000 - 60.000	s	0.001	0.400	Pulse length
InfNo	32 - 239	-	1	32	Information number for command output (32-239)

#### 4.2.4.5 Supported information types

### Function commands generic for IEC60870-5-103, I103GENCMD

Number of instances: 50

Function type for each function block instance is selected with parameter *FunctionType*.

Information number must be selected for command output.

## 4.2.5 IED commands with position and select for IEC 60870-5-103 I103POSCMD

### 4.2.5.1 Function block

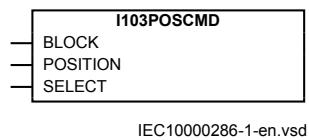


Figure 17: Function block

### 4.2.5.2 Functionality

I103POSCMD is used for controllable switching devices. It has double-point position indicators that are getting the position value as an integer (POSITION output of the GNRLCSWI function block) and sending it over IEC 60870-5-103 (1=OPEN; 2=CLOSE). The standard does not define the use of values 0 and 3. However, when connected to a switching device, these values are transmitted.

The BLOCK input blocks only the signals in monitoring direction (the position information), not the commands via IEC 60870-5-103. The SELECT input is used to indicate that the monitored apparatus has been selected (in a select-before-operate type of control)

### 4.2.5.3 Signals

Table 43: I103POSCMD Input signals

Name	Type	Default	Description
BLOCK	BOOLEAN	0	Block of command
POSITION	INTEGER	0	Position of controllable object
SELECT	BOOLEAN	0	Select of controllable object

### 4.2.5.4 Settings

Table 44: I103POSCMD Non group settings (basic)

Name	Values (Range)	Unit	Step	Default	Description
FunctionType	1 - 255	-	1	1	Fucntion type (1-255)
InfNo	160 - 196	-	4	160	Information number for command output (1-255)

#### 4.2.5.5

#### Supported information types

##### IED commands with position and select for IEC60870-5-103, I103POSCMD

Number of instances: 50

Function type for each function block instance is selected with parameter *FunctionType*.

Information number must be selected for command output.

**Table 45:** *Each I103POSCMD has four INF forming four commands and two indications*

INF	Inst 1	Inst 2	Inst 3	Type	Purpose	Comment
Base + 0	160	164	168	20	Direct operate	Set position direct
Base + 1	161	165	169	20	Select	Select before operate
Base + 2	162	166	170	20	Operate	Set position
Base + 3	163	167	171	20	Cancel	Cancel select
Base + 0	160	164	168	1	Position	Current position
Base + 1	161	165	169	1	Selected	Device selected



Use the same RII for both Select and Operate. Otherwise, the Operate command results in a NAK signal.



The current implementation of the IEC 60870-5-103 commands rejects any new command if a previously issued command has not yet been completed.



The value of the control model parameter of the switching device has no effect on operation.

## 4.3

# Disturbance recorder file transfer

### 4.3.1

## Disturbance upload

The transfer functionality is based on the Disturbance recorder function. The analog and binary signals recorded are reported to the master by file transfer. The eight last disturbances that are recorded are available for transfer to the master. A file that has been transferred and acknowledged by the master cannot be transferred again.

The binary signals reported by polling are connected to the disturbance function blocks B1RBDR to B4RBDR. These function blocks include the function type and the information number for each signal. The reported analog channels are connected to the disturbance function blocks A1RADR to A4RADR. The eight first ones belong to the public range and the remaining ones to the private range.



See the technical manual for more information on the description of the disturbance report.

The following elements are used in the ASDUs defined in the standard.

Analog signals, 40 channels: the channel number for each channel has to be specified. Channels 1...8 are used in the public range.

- $I_{L1}$  connected to channel 1 on disturbance function block A1RADR
- $I_{L2}$  connected to channel 2 on disturbance function block A1RADR
- $I_{L3}$  connected to channel 3 on disturbance function block A1RADR
- $I_N$  connected to channel 4 on disturbance function block A1RADR
- $U_{L1E}$  connected to channel 5 on disturbance function block A1RADR
- $U_{L2E}$  connected to channel 6 on disturbance function block A1RADR
- $U_{L3E}$  connected to channel 7 on disturbance function block A1RADR
- $U_{EN}$  connected to channel 8 on disturbance function block A1RADR

Channel numbers used for the remaining 32 analog signals are numbers in the private range 64...95.

Binary signals, 64 channels: for each channel the user can specify a function type and an information number.

### 4.3.2

## Deviations from the standard

For each input of the Disturbance recorder function there is a setting for the information number of the connected signal. The information number can be set to any value between 0...255. Default value is "0".

Furthermore, there is a setting on each input of the Disturbance recorder function for the function type.

### Disturbance upload

All analog and binary signals that are recorded with disturbance recorder can be reported to the master. The last eight disturbances that are recorded are available for transfer to the master. A successfully transferred disturbance (acknowledged by the master) will not be reported to the master again.

When a new disturbance is recorded by the IED a list of available recorded disturbances (ASDU 23) will be sent to the master, an updated list of available disturbances will also be sent whenever something has happened to disturbances in this list. For example, when a disturbance is deleted (by other client, for example, PCM600) or when a new disturbance has been recorded or when the master has uploaded a recording.

### Deviations from the standard

This section describes all data that is not exactly as specified in the standard.

#### ASDU23

In ‘list of recorded disturbances’ (ASDU23) an information element named SOF (status of fault) exists. This information element consists of 4 bits.

- Bit TP: the protection equipment has tripped during the fault
- Bit TM: the disturbance data are currently being transmitted
- Bit TEST: the disturbance data have been recorded during normal operation or test mode.
- Bit OTEV: the disturbance data recording has been initiated by another event than start

The only information that is easily available is test-mode status. The other information is always set (hard coded) according to the following table.

**Table 46:** Default bit descriptions

Bit	Description
TP	Recorded fault with trip [1]
TM	Disturbance data waiting for transmission [0]
OTEV	Disturbance data initiated by other events [1]

Another information element in ASDU23 is the FAN (fault number). According to the standard this is a number that is incremented when a protection function takes action.

#### ASDU26

When a disturbance has been selected by the master; (by sending ASDU24), the protection equipment answers by sending ASDU26, which contains an information element named NOF (number of grid faults). This number must indicate fault number in the power system, that is, a fault in the power system with several trip and auto-reclosing has the same NOF (while the FAN must be incremented).

To get INF and FUN for the recorded binary signals there are parameters on the disturbance recorder for each input. The user must set these parameters to identify the corresponding inputs.

ASDU27

To use the full dynamic range of the transfer representation, RPV is set to the maximum dynamic value in the recorded signal, RSV to 1.0 and RFA to 1 - 2e-15.



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## Section 5

# Interoperability profile for 630 series IEC 60870-5-103

### 5.1

## Physical layer

#### 5.1.1

### Electrical interface

- EIA RS-485
- Number of loads ..... for one protection equipment

#### 5.1.2

### Optical interface

- Glass fibre
- Plastic fibre
- F-SMA type connector
- BFOC/2,5 type connector

#### 5.1.3

### Transmission speed

- 9 600 bit/s
- 19 200 bit/s

### 5.2

## Link layer

There are no choices for the link layer.

### 5.3

## Application layer

#### 5.3.1

### 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.

### 5.3.2

### COMMON ADDRESS of ASDU

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

### 5.3.3

### Selection of standard information numbers in monitor direction

#### 5.3.3.1

#### System functions in monitor direction

	<b>INF</b>	<b>Semantics</b>
<input checked="" type="checkbox"/>	<0>	End of general interrogation
<input checked="" type="checkbox"/>	<1>	Time synchronization
<input checked="" type="checkbox"/>	<2>	Reset FCB
<input checked="" type="checkbox"/>	<3>	Reset CU
<input checked="" type="checkbox"/>	<4>	Start/restart
<input checked="" type="checkbox"/>	<5>	Power on

#### 5.3.3.2

#### Status indications in monitor direction

	<b>INF</b>	<b>Semantics</b>
<input checked="" type="checkbox"/>	<16>	Auto-recloser active
<input type="checkbox"/>	<17>	Teleprotection active
<input type="checkbox"/>	<18>	Protection active
<input checked="" type="checkbox"/>	<19>	LED reset
<input type="checkbox"/>	<20>	Monitor direction blocked
<input checked="" type="checkbox"/>	<21>	Test mode
<input type="checkbox"/>	<22>	Local parameter setting
<input checked="" type="checkbox"/>	<23>	Characteristic 1
<input checked="" type="checkbox"/>	<24>	Characteristic 2
<input checked="" type="checkbox"/>	<25>	Characteristic 3
<input checked="" type="checkbox"/>	<26>	Characteristic 4
<input type="checkbox"/>	<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

### 5.3.3.3

### Supervision indications in monitor direction

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

### 5.3.3.4

### Earth fault indications in monitor direction

INF	Semantics
<input type="checkbox"/>	<48> Earth fault L <sub>1</sub>
<input type="checkbox"/>	<49> Earth fault L <sub>2</sub>
<input type="checkbox"/>	<50> Earth fault L <sub>3</sub>
<input checked="" type="checkbox"/>	<51> Earth fault forward, for example line
<input checked="" type="checkbox"/>	<52> Earth fault reverse, for example busbar

### 5.3.3.5

### Fault indications in monitor direction

INF	Semantics
<input checked="" type="checkbox"/>	<64> Start /pick-up L <sub>1</sub>
<input checked="" type="checkbox"/>	<65> Start /pick-up L <sub>2</sub>
<input checked="" type="checkbox"/>	<66> Start /pick-up L <sub>3</sub>
<input checked="" type="checkbox"/>	<67> Start /pick-up N
<input checked="" type="checkbox"/>	<68> General trip
<input checked="" type="checkbox"/>	<69> Trip L <sub>1</sub>
<input checked="" type="checkbox"/>	<70> Trip L <sub>2</sub>
<input checked="" type="checkbox"/>	<71> Trip L <sub>3</sub>
<input checked="" type="checkbox"/>	<72> Trip I>> (back-up operation)
<input checked="" type="checkbox"/>	<73> Fault location X in ohms
<input checked="" type="checkbox"/>	<74> Fault forward/line
<input checked="" type="checkbox"/>	<75> Fault reverse/busbar
<input checked="" type="checkbox"/>	<76> Teleprotection signal transmitted
<input checked="" type="checkbox"/>	<77> Teleprotection signal received
<input checked="" type="checkbox"/>	<78> Zone 1

Table continues on next page

- 
- <79> Zone 2
  - <80> Zone 3
  - <81> Zone 4
  - <82> Zone 5
  - <83> Zone 6
  - <84> General start/pick-up
  - <85> Breaker failure
  - <86> Trip measuring system L<sub>1</sub>
  - <87> Trip measuring system L<sub>2</sub>
  - <88> Trip measuring system L<sub>3</sub>
  - <89> Trip measuring system E
  - <90> Trip I>
  - <91> Trip I>>
  - <92> Trip IN>
  - <93> Trip IN>>

#### 5.3.3.6 Auto-reclosure indications in monitor direction

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

#### 5.3.3.7 Measurands in monitor direction

INF	Semantics
<input checked="" type="checkbox"/> <144>	Measurand I
<input checked="" type="checkbox"/> <145>	Measurands I, V
<input checked="" type="checkbox"/> <146>	Measurands I, V, P, Q
<input checked="" type="checkbox"/> <147>	Measurands I <sub>N</sub> , V <sub>EN</sub>
<input checked="" type="checkbox"/> <148>	Measurands I <sub>L1,2,3</sub> , V <sub>L1,2,3</sub> , P, Q, f

#### 5.3.3.8 Generic functions in monitor direction

INF	Semantics
<input type="checkbox"/> <240>	Read headings of all defined groups
<input type="checkbox"/> <241>	Read values or attributes of all entries of one group
<input type="checkbox"/> <243>	Read directory of a single entry
<input type="checkbox"/> <244>	Read value or attribute of a single entry

Table continues on next page

- <245> End of general interrogation of generic data
- <248> Write entry
- <249> Write entry with confirmation
- <250> Write entry with execution
- <251> Write entry aborted

## 5.3.4 Selection of standard information numbers in control direction

### 5.3.4.1 System functions in control direction

INF	Semantics
<input checked="" type="checkbox"/>	<0> Initiation of general interrogation
<input checked="" type="checkbox"/>	Time synchronization

### 5.3.4.2 General commands in control direction

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

### 5.3.4.3 Generic functions in monitor direction

INF	Semantics
<input type="checkbox"/>	<240> Read headings of all defined groups
<input type="checkbox"/>	<241> Read values or attributes of all entries of one group
<input type="checkbox"/>	<243> Read directory of a single entry
<input type="checkbox"/>	<244> Read value or attribute of a single entry
<input type="checkbox"/>	<245> End of general interrogation of generic data
<input type="checkbox"/>	<248> Write entry
<input type="checkbox"/>	<249> Write entry with confirmation
<input type="checkbox"/>	<250> Write entry with execution
<input type="checkbox"/>	<251> Write entry aborted

### 5.3.5

### Basic application functions

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

### 5.3.6

### Miscellaneous

Measurands are transmitted as Class2 data using ASDU 3 or ASDU 9. The maximum MVAL can either be 1.2 or 2.4 times the rated value. No different rating shall be used in ASDU 3 and ASDU 9, that is, there is only one choice for each measurand.

Measurand	Max. MVAL = rated value times	
	1.2 or	2.4
Current L <sub>1</sub>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Current L <sub>2</sub>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Current L <sub>3</sub>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Voltage L <sub>1-E</sub>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Voltage L <sub>2-E</sub>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Voltage L <sub>3-E</sub>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Active power P	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Reactive power Q	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Frequency f	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Voltage L <sub>1</sub> - L <sub>2</sub>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

Recorded analog channels are sent with ASDU26 and ASDU31. One information element in these ASDUs is called ACC and it indicates the actual channel to be processed. The channels on disturbance recorder are sent with an ACC according to the following table.

*Table 47: ACC information*

DRA#-Input	ACC	IEC103 meaning
1	1	IL1
2	2	IL2
3	3	IL3
4	4	IN
5	5	UL1
6	6	UL2
7	7	UL3

Table continues on next page

DRA#-Input	ACC	IEC103 meaning
8	8	UN
9	64	Private range
10	65	Private range
11	66	Private range
12	67	Private range
13	68	Private range
14	69	Private range
15	70	Private range
16	71	Private range
17	72	Private range
18	73	Private range
19	74	Private range
20	75	Private range
21	76	Private range
22	77	Private range
23	78	Private range
24	79	Private range
25	80	Private range
26	81	Private range
27	82	Private range
28	83	Private range
29	84	Private range
30	85	Private range
31	86	Private range
32	87	Private range
33	88	Private range
34	89	Private range
35	90	Private range
36	91	Private range
37	92	Private range
38	93	Private range
39	94	Private range
40	95	Private range



## Section 6      Glossary

<b>ACC</b>	Actual channel, related to IEC 60870-5-103 disturbance record
<b>ASDU</b>	Application-layer service data unit
<b>COT</b>	Cause of transmission
<b>EIA RS-485</b>	Electrical communication interface standard
<b>EMC</b>	Electromagnetic compatibility
<b>FAN</b>	Fault number
<b>FUN</b>	Function type
<b>GI</b>	General interrogation
<b>IEC</b>	International Electrotechnical Commission
<b>IEC 60870-5-101</b>	Companion standard for basic telecontrol tasks
<b>IEC 60870-5-103</b>	1. Communication standard for protective equipment 2. A serial master/slave protocol for point-to-point communication
<b>IEC 60870-5-104</b>	Network access for IEC 60870-5-101
<b>IED</b>	Intelligent electronic device
<b>INF</b>	Information number
<b>LHMI</b>	Local human-machine interface
<b>NAK</b>	Negative acknowledgement
<b>NOF</b>	Number of grid faults
<b>OTEV</b>	Disturbance recording triggered from start bit
<b>PCM600</b>	Protection and Control IED Manager
<b>RFA</b>	Reference factor
<b>RII</b>	Return information identifier
<b>RPV</b>	Rated primary value
<b>RSV</b>	Rated secondary value
<b>SOF</b>	Status of fault
<b>TEST</b>	Disturbance data recorded in test mode bit
<b>TM</b>	Disturbance data transmission in progress bit
<b>TP</b>	Disturbance data recorded with or without trip bit
<b>VDEW6</b>	Communication protocol standard for protection devices

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WHMI	Web human-machine interface
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