



Relion® Protection and Control

630 series IEC 60870-5-103 Communication Protocol Manual



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This product complies with the directive of the Council of the European Communities on the approximation of the laws of the Member States relating to electromagnetic compatibility (EMC Directive 2004/108/EC) and concerning electrical equipment for use within specified voltage limits (Low-voltage directive 2006/95/EC). This conformity is the result of tests conducted by ABB in accordance with the product standards EN 50263 and EN 60255-26 for the EMC directive, and with the product standards EN 60255-1 and EN 60255-27 for the low voltage directive. The IED is designed in accordance with the international standards of the IEC 60255 series.

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Section 1 Introduction

1.1 This manual

The communication protocol manual describes a communication protocol supported by the IED. 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 for communication setup in a substation from an IED 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

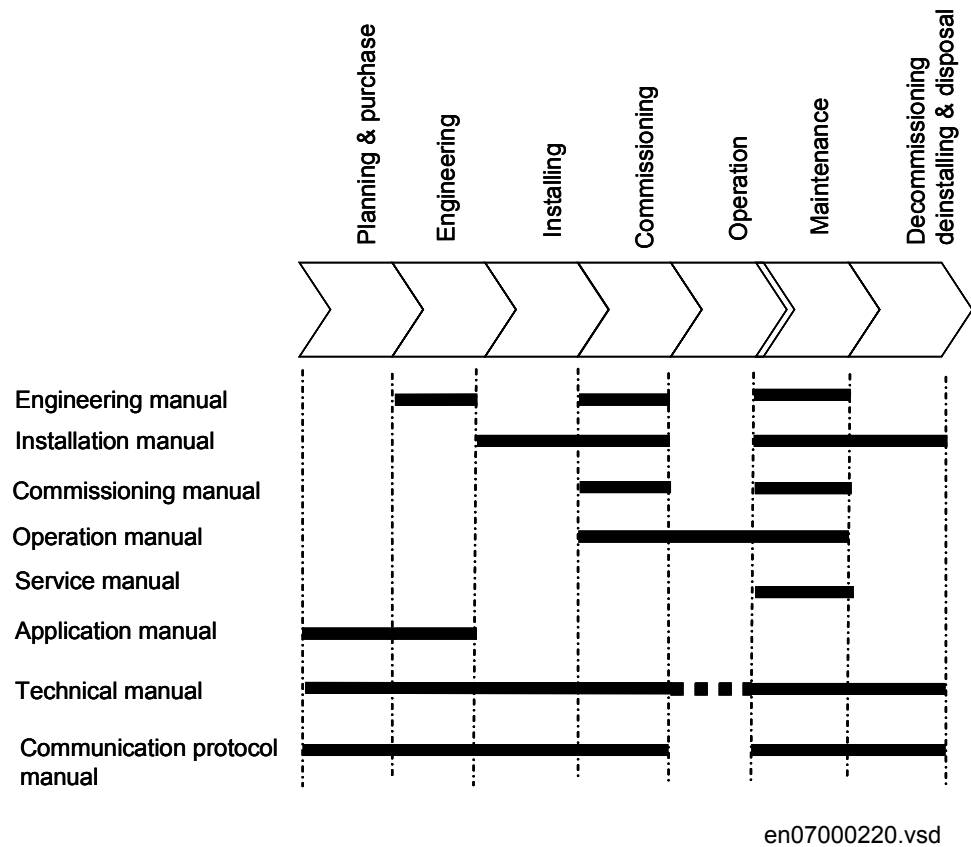


Figure 1: The intended use of manuals in different lifecycles

The engineering manual contains instructions on how to engineer the IEDs using the different tools in PCM600. The manual provides instructions on how to set up a PCM600 project and insert IEDs to the project structure. The manual also recommends a sequence for engineering of protection and control functions, LHMI functions as well as communication engineering for IEC 60870-5-103, IEC 61850 and DNP3.

The installation manual contains instructions on how to install the IED. The manual provides procedures for mechanical and electrical installation. The chapters are organized in chronological order in which the IED should be installed.

The commissioning manual contains instructions on how to commission the IED. The manual can also be used by system engineers and maintenance personnel for assistance during the testing phase. The manual provides procedures for checking of external circuitry and energizing the IED, parameter setting and configuration as

well as verifying settings by secondary injection. The manual describes the process of testing an IED in a substation which is not in service. The chapters are organized in chronological order in which the IED should be commissioned.

The operation manual contains instructions on how to operate the IED once it has been commissioned. The manual provides instructions for monitoring, controlling and setting the IED. The manual also describes how to identify disturbances and how to view calculated and measured power grid data to determine the cause of a fault.

The service manual contains instructions on how to service and maintain the IED. The manual also provides procedures for de-energizing, de-commissioning and disposal of the IED.

The application manual contains descriptions of preconfigurations. The manual can be used as a reference for configuring control, protection, measurement, recording and LED functions. The manual can also be used when creating configurations according to specific application requirements.

The technical manual contains application and functionality descriptions and lists function blocks, logic diagrams, input and output signals, setting parameters and technical data sorted per function. The manual can be used as a technical reference during the engineering phase, installation and commissioning phase, and during normal service.

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

The point list manual describes the outlook and properties of the data points specific to the IED. The manual should be used in conjunction with the corresponding communication protocol manual.



The service manual is not available yet.

1.3.2

Document revision history

Document revision/date	Product series version	History
A/2011-02-23	1.1	First release



Download the latest documents from the ABB web site <http://www.abb.com/substationautomation>.

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 Safety indication 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 Manual conventions

Conventions used in IED manuals. A particular convention may not be used in this manual.

- Abbreviations and acronyms in this manual 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, for example:
To navigate between the options, use  and .
- HMI menu paths are presented in bold, for example:
Select **Main menu/Settings**.
- LHMI messages are shown in Courier font, for example:
To save the changes in non-volatile memory, select `Yes` and press .
- Parameter names are shown in italics, for example:

- 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. 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

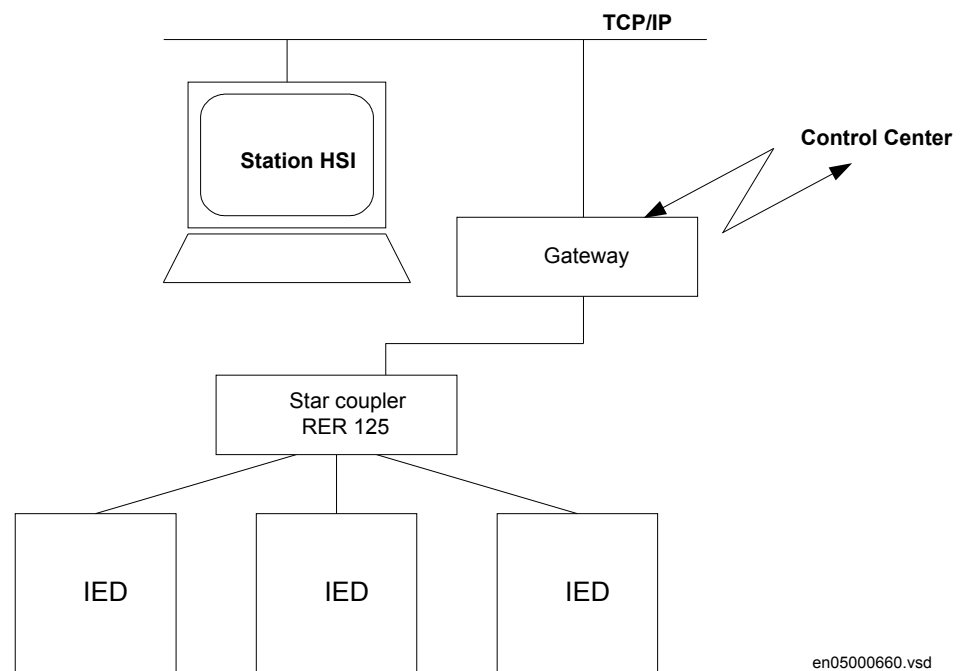


Figure 2: Example of IEC 60870-5-103 communication structure for a substation automation system

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 IEC 60870-5-103 communication engineering

3.1 IEC 60870-5-103 engineering in PCM600

The Application Configuration tool (ACT) and the Parameter Setting tool (PST) 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.

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.

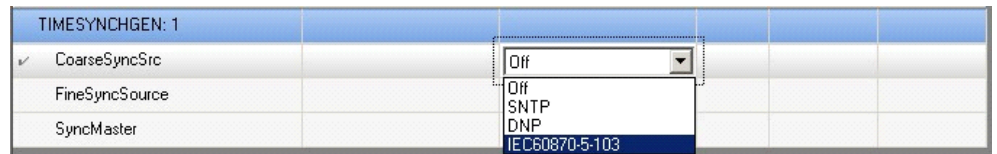


Figure 3: Settings under TIMESYNCHGEN:1 in PST

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 IEC 60870-5-103 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

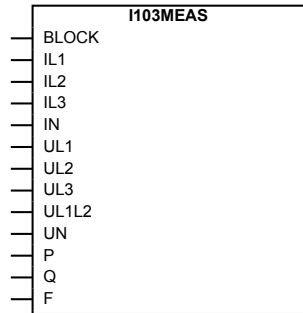
4.1.1.1 Functionality

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.

4.1.1.2 Function block



IEC10000287-1-en.vsd

Figure 4: I103MEAS function block

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

Table continues on next page

Name	Values (Range)	Unit	Step	Default	Description
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.

Upper limit for measured voltages and frequency is 1.2 times rated value.

Only the measurand standard frames defined in IEC 60870-5-103 are supported. See the Table [I103MEASUSR Input signals](#).

Table 6: *Interchangeable Class 2 measurand frames*

Frame No	ASDU	FUN ¹⁾	INF	Number of data	Data in the Class 2 frame
1	3	0	144	1	IL2
2	3	0	145	2	IL2, U12
3	3	0	146	4	IL2, U12, P3, Q3
4	3	0	147	2	Io, Uo
5	9	0	148	9	IL1, IL2, IL3, UL1, UL2, UL3, P3, Q3, f

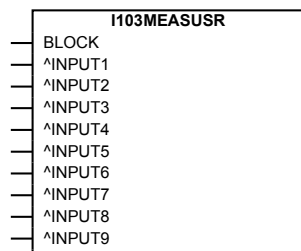
1. FUN= 0 means that the Function type is coded as the Device function type which in turn is defined by the setting parameter **Main menu/Configuration/System/IEDMainFunType**.

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

4.1.2.1 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.

4.1.2.2 Function block



IEC10000288-1-en.vsd

Figure 5: I103MEASUSR function block

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
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.

Info.	Message	Supported
*1)	Meas1	Yes
*	Meas2	Yes
*	Meas3	Yes
*	Meas4	Yes
*	Meas5	Yes
*	Meas6	Yes
*	Meas7	Yes
*	Meas8	Yes
*	Meas9	Yes

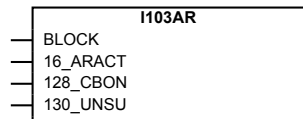
1) * User defined information number

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

4.1.3.1 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.

4.1.3.2 Function block



IEC10000289-1-en.vsd

Figure 6: I103AR function block

4.1.3.3 Signals

Table 9: 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, auto-recloser blocked

4.1.3.4 Settings

Table 10: 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 11: *I103AR supported indications*

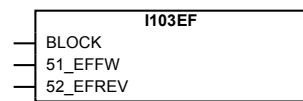
Info. no.	Message	Supported
16	Autorecloser active	Yes
17	Teleprotection active	No
18	Protection active	No
128	CB on by Autorecloser	Yes
129	CB 'on' by long-time AR	No
130	Autorecloser blocked	Yes

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

4.1.4.1 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.

4.1.4.2 Function block



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Figure 7: *I103EF function block*

4.1.4.3 Signals

Table 12: *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 13: *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 14: *I103EF supported indications*

Info. no.	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

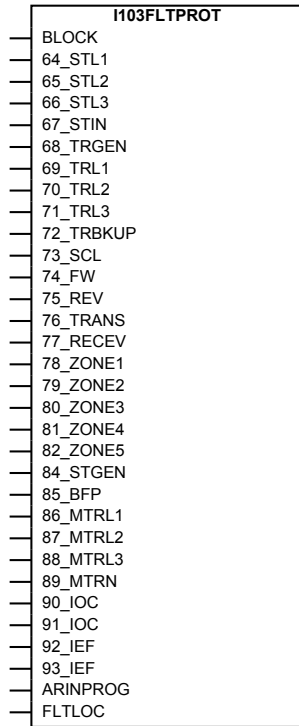
4.1.5 Function status fault protection for IEC 60870-5-103 I103FLTPROT

4.1.5.1 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.

4.1.5.2 Function block



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Figure 8: I103FLTPROT function block

4.1.5.3 Signals

Table 15: 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 l>>
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

Table continues on next page

Name	Type	Default	Description
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
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)

4.1.5.4 Settings

Table 16: 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 17: *I103FLTPROT supported indications*

Info. no.	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
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 I>>	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	Y	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 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.

4.1.6.2 Function block

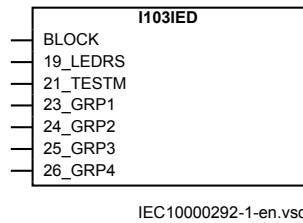


Figure 9: I103IED function block

4.1.6.3 Signals

Table 18: I103IED Input signals

Name	Type	Default	Description
BLOCK	BOOLEAN	0	Block of status reporting
19_LEDERS	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 19: 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 20: I103IED supported indications

Info. no.	Message	Supported
19	LED reset	Yes
20	Monitor direction blocked	No
21	TestMode	Yes
Table continues on next page		

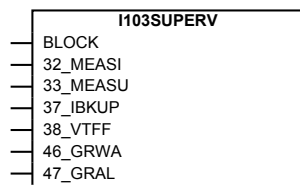
Info. no.	Message	Supported
22	Local Parameter setting	No
23	Setting group 1 active	Yes
24	Setting group 2 active	Yes
25	Setting group 3 active	Yes
26	Setting group 4 active	Yes

4.1.7 Supervision status for IEC 60870-5-103 I103SUPERV

4.1.7.1 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.

4.1.7.2 Function block



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Figure 10: I103SUPERV function block

4.1.7.3 Signals

Table 21: 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
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 22: 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 23: I103SUPERV supported indications

Info. no.	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	No	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 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 11: I103USRDEF example settings

4.1.8.2

Function block

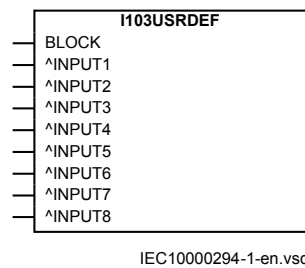


Figure 12: I103USRDEF function block

4.1.8.3

Signals

Table 24: 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 25: 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.

Info. no.	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 Functionality

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

4.2.1.2 Function block

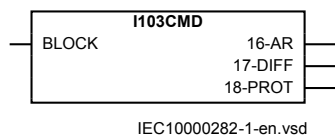


Figure 13: I103CMD function block

4.2.1.3 Signals

Table 26: I103CMD Input signals

Name	Type	Default	Description
BLOCK	BOOLEAN	0	Block of commands

Table 27: 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 28: 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 signals.

Info. no.	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 Functionality

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

4.2.2.2 Function block

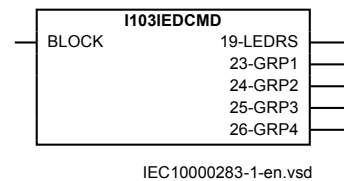


Figure 14: I103IEDCMD function block

4.2.2.3 Signals

Table 29: I103IEDCMD Input signals

Name	Type	Default	Description
BLOCK	BOOLEAN	0	Block of commands

Table 30: 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 31: 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 signals.

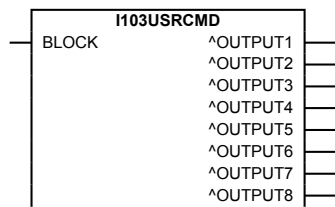
Info. no	Message	Supported
19	LED Reset	Yes
23	Activate setting group 1	Yes
24	Activate setting group 2	Yes
25	Activate setting group 3	Yes
26	Activate setting group 4	Yes

4.2.3 Function commands user defined for IEC 60870-5-103 I103USRCMD

4.2.3.1 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.

4.2.3.2 Function block



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Figure 15: I103USRCMD function block

4.2.3.3 Signals

Table 32: *I103USRCMD Input signals*

Name	Type	Default	Description
BLOCK	BOOLEAN	0	Block of commands

Table 33: *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 34: *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.

Info. no.	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 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.

4.2.4.2 Function block

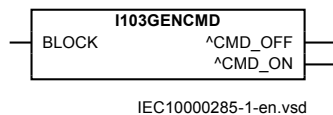


Figure 16: I103GENCMD function block

4.2.4.3 Signals

Table 35: I103GENCMD Input signals

Name	Type	Default	Description
BLOCK	BOOLEAN	0	Block of command

Table 36: I103GENCMD Output signals

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

4.2.4.4 Settings

Table 37: I103GENCMD Non group settings (basic)

Name	Values (Range)	Unit	Step	Default	Description
FunctionType	1 - 127	-	1	1	Function type (1-255)
PulseLength	0.000 - 60.000	s	0.001	0.400	Pulse length
InfNo	32 - 239	-	1	32	Information number for command output (1-255)

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.

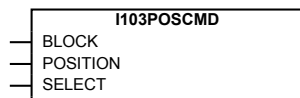
4.2.5 IED commands with position and select for IEC 60870-5-103 I103POSCMD

4.2.5.1 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 will block 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)

4.2.5.2 Function block



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Figure 17: I103POSCMD function block

4.2.5.3 Signals

Table 38: I103POSCMD Input signals

Name	Type	Description
BLOCK	BOOLEAN	Block of indications
POSITION	INTEGER	Position indication of controllable object
SELECT	BOOLEAN	Select indication of controllable object

4.2.5.4 Settings

Table 39: I103POSCMD Non group settings (basic)

Name	Values (Range)	Unit	Step	Default	Description
FunctionType	1 - 255	-	1	1	Function type (1-255)
InfNo	160 - 196	-	4	160	Information number for position indication and command output (160-196.)

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.



The current implementation of the IEC 60870-5-103 commands will reject 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 will be 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 that are reported by polling are those that are connected to the disturbance function blocks B1RBDR to B6RBDR. These function blocks include the function type and the information number for each signal. For more information on the description of the Disturbance report in the Technical reference manual. The analog channels, that are reported, are those 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.

The following elements are used in the ASDUs (Application Service Data Units) defined in the standard.

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

- 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
- V_{L1E} connected to channel 5 on disturbance function block A1RADR
- V_{L2E} connected to channel 6 on disturbance function block A1RADR
- V_{L3E} connected to channel 7 on disturbance function block A1RADR
- V_{EN} connected to channel 8 on disturbance function block A1RADR

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

Binary signals, 96-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 and 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 and indicates whether:

- 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) to:

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.

Section 5 Interoperability

5.1 Physical layer

Table 40: Electrical Interface

	Supported
EIA RS-485	No
number of loads	No

5.1.1 Optical interface

Table 41: Optical interface

	Supported
Glass fibre	Yes
Plastic fibre	No
F-SMA type connector	No
BFOC/2,5 type connector	Yes

5.1.2 Transmission speed

Table 42: Transmission speed

	Supported
9 600 bit/s	Yes
19 200 bit/s	Yes

5.2 Application layer

5.2.1 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.

5.2.2 Common address of ASDU

Table 43: Common address of ASDU

	Supported
One COMMON ADDRESS OF ASDU (identical with station address)	Yes
More than one COMMON ADDRESS OF ASDU	No

5.2.3 Selection of standard information numbers in monitor direction

5.2.3.1 System functions in monitor direction

Table 44: System functions in monitor direction

INF	Semantics	Supported
0	End of general interrogation	Yes
0	Time synchronization	Yes
2	Reset FCB	Yes
3	Reset CU	Yes
4	Start/restart	Yes
5	Power on	No

5.2.3.2 Status indications in monitor direction

Table 45: Status indications in monitor direction

INF	Semantics	Supported
16	Auto-recloser active	Yes
17	Teleprotection active	No
18	Protection active	No
19	LED reset	Yes
20	Monitor direction blocked	No
21	Test mode	Yes
22	Local parameter setting	No
23 to 26	Characteristic 1 to Characteristic 4	Yes
27 to 30	Auxiliary input 1 to Auxiliary input 4	No

5.2.3.3 Supervision indications in monitor direction

Table 46: *Supervision indications in monitor direction*

INF	Semantics	Supported
32	Measurand supervision I	Yes
33	Measurand supervision V	Yes
35	Phase sequence supervision	No
36	Trip circuit supervision	No
37	I>> back-up operation	Yes
38	VT fuse failure	Yes
39	Teleprotection disturbed	No
46	Group warning	Yes
47	Group alarm	Yes

5.2.3.4 Earth fault indications in monitor direction

Table 47: *Earth fault indications in monitor direction*

INF	Semantics	Supported
48 to 50	Earth fault L ₁ to Earth fault L ₃	No
51	Earth fault forward, i.e. Line	Yes
52	Earth fault reverse, i.e. Busbar	Yes

5.2.3.5 Fault indications in monitor direction

Table 48: *Fault indications in monitor direction*

INF	Semantics	Supported
64 to 66	Start /pick-up L ₁ to Start /pick-up L ₃	Yes
67	Start /pick-up N	Yes
68	General trip	Yes
69 to 71	Trip L ₁ to Trip L ₃	Yes
72	Trip I>> (back-up operation)	Yes
73	Fault location X in ohms	Yes
74	Fault forward/line	Yes
75	Fault reverse/busbar	Yes
76	Teleprotection signal transmitted	Yes
77	Teleprotection signal received	Yes
78 to 82	Zone 1 to Zone 5	Yes
83	Zone 6	No
Table continues on next page		

INF	Semantics	Supported
84	General start/pick-up	Yes
85	Breaker failure	Yes
86 to 88	Trip measuring system L ₁ to Trip measuring system L ₃	Yes
89	Trip measuring system E	Yes
90	Trip I>	Yes
91	Trip I>>	Yes
92	Trip IN>	Yes
93	Trip IN>>	Yes

5.2.3.6

Auto-reclosure indications in monitor direction

Table 49: Auto-reclosure indications in monitor direction

INF	Semantics	Supported
128	CB 'on' by AR	Yes
129	CB 'on' by long-time AR	No
130	AR blocked	Yes

5.2.3.7

Measurands in monitor direction

Table 50: Measurands in monitor direction

INF	Semantics	Supported
144	Measurand I	Yes
145	Measurands I, V	Yes
146	Measurands I, V, P, Q	Yes
147	Measurands I _N , V _{EN}	Yes
148	Measurands I _{L1,2,3} , V _{L1,2,3} , P, Q, f	Yes

5.2.3.8

Generic functions in monitor direction

Table 51: Generic functions in monitor direction

INF	Semantics	Supported
240	Read headings of all defined groups	No
241	Read values or attributes of all entries of one group	No
243	Read directory of a single entry	No
244	Read value or attribute of a single entry	No
245	End of general interrogation of generic data	No
249	Write entry with confirmation	No
250	Write entry with execution	No
251	Write entry aborted	No

5.2.4 Selection of standard information numbers in control direction

5.2.4.1 System functions in control direction

Table 52: System functions in control direction

INF	Semantics	Supported
0	Initiation of general interrogation	Yes
0	Time synchronization	Yes

5.2.4.2 General commands in control direction

Table 53: General commands in control direction

INF	Semantics	Supported
16	Auto-recloser on/off	Yes
17	Teleprotection on/off	Yes
18	Protection on/off	Yes
19	LED reset	Yes
23 to 26	Activate characteristic 1 to Activate characteristic 4	Yes

5.2.4.3 Generic functions in control direction

Table 54: Generic functions in control direction

INF	Semantics	Supported
240	Read headings of all defined groups	No
241	Read values or attributes of all entries of one group	No
243	Read directory of a single entry	No
244	Read value or attribute of a single entry	No
245	General interrogation of generic data	No
248	Write entry	No
249	Write entry with confirmation	No
250	Write entry with execution	No
251	Write entry abort	No

5.2.5 Basic application functions

Table 55: *Basic application functions*

Supported	
Yes	Test mode
No	Blocking of monitor direction
Yes	Disturbance data
No	Generic services
Yes	Private data

5.2.6 Miscellaneous

Measurands are transmitted with ASDU 3 as well as with ASDU 9. As defined in 7.2.6.8, 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, i.e. for each measurand there is only one choice.

Table 56: *Miscellaneous*

Measurand	Max. MVAL = rated value times	
	1,2	2,4
Current L ₁	Yes	Yes
Current L ₂	Yes	Yes
Current L ₃	Yes	Yes
Voltage L _{1-E}	Yes	Yes
Voltage L _{2-E}	Yes	Yes
Voltage L _{3-E}	Yes	Yes
Active power P	Yes	Yes
Reactive power Q	Yes	Yes
Frequency f	Yes	Yes
Voltage L ₁ - L ₂	Yes	Yes

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

DRA#-Input	ACC	IEC103 meaning
1	1	IL1
2	2	IL2
3	3	IL3
4	4	IN
Table continues on next page		

DRA#-Input	ACC	IEC103 meaning
5	5	UL1
6	6	UL2
7	7	UL3
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

ASDU	Application-layer service data unit
DNP3	A distributed network protocol originally developed by Westronic. The DNP3 Users Group has the ownership of the protocol and assumes responsibility for its evolution.
EMC	Electromagnetic compatibility
FAN	Fault number
FUN	Default function type
GI	General interrogation
HMI	Human-machine interface
IEC	International Electrotechnical Commission
IEC 60870-5-101	Companion standard for basic telecontrol tasks
IEC 60870-5-103	Communication standard for protective equipment; A serial master/slave protocol for point-to-point communication
IEC 60870-5-104	Network access for IEC 60870-5-101
IEC 61850	International standard for substation communication and modeling
IED	Intelligent electronic device
INF	Default information number
LED	Light-emitting diode
LHMI	Local human-machine interface
NOF	Number of grid faults
OTEV	Disturbance recording triggered from start bit
PCM600	Protection and Control IED Manager
SOF	Status of fault
TEST	Disturbance data recorded in test mode bit
TM	Disturbance data transmission in progress bit
TP	Disturbance data recorded with or without trip bit
VDEW6	Communication protocol standard for protection devices

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