

Relion[®] Protection and Control

RER620 IEC 60870-5-101/104 Communication Protocol Manual





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ABB Inc. Distribution Automation 4300 Coral Ridge Drive Coral Springs, FL 33065, USA Toll-free: 1 (800) 523-2620 Phone: +1 954-752-6700 Fax: +1 954 345-5329 http://www.abb.com/substationautomation

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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 and ANSI C37.90.

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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 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 application descriptions and setting guidelines sorted per function. The manual can be used to find out when and for what purpose a typical protection function can be used. The manual can also be used when calculating settings.

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.



Some of the manuals are not available yet.

1.3.2 Document revision history

| Document revision/date | Product series version | History |
|------------------------|------------------------|---------------|
| 2010-11-03 | 1.0 | First release |



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

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.

Symbols and conventions 1.4

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 to 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 should be understood that operation of damaged equipment could, under certain operational conditions, 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 \uparrow and \downarrow .

- HMI menu paths are presented in bold, for example: Select Main menu/Settings.
- ٠ LHMI messages are shown in Courier font, for example:

To save the changes in non-volatile memory, select Yes and press \leftarrow .

- Parameter names are shown in italics, for example: The function can be enabled and disabled with the *Operation* setting.
- Parameter values are indicated with quotation marks, for example: The corresponding parameter values are "Enabled" and "Disabled".
- IED input/output messages and monitored data names are shown in Courier font, for example:
 - When the function picks up, the PICKUP output is set to TRUE.
- Dimensions are provided both in inches and mm. If it is not specifically mentioned then the dimension is in mm.

Section 2 IEC 60870-5 overview

2.1 IEC 60870-5 protocol

The companion standards IEC 60870-5-101 and IEC 60870-5-104 are derived from the IEC 60870-5 protocol standard definition. It specifies a functional profile for basic telecontrol tasks.

The IEC 60870-5 protocol stack is based on the reduced reference model called enhanced performance architecture (EPA). EPA includes three layers of the ISO-OSI model.

- Application layer
- Link layer
- Physical layer

The IEC 60870-5 protocol is described by standard documents.

Table 1:Selected standard provision of the defined telecontrol companion standard

| Selected application functions of IEC 60870-5-5 | User process |
|--|-----------------------|
| Selected application information elements of IEC 60870-5-4 Selected application service data units of IEC 60870-5-3 | Application layer (7) |
| Selected link transmission procedures of IEC 60870-5-2 Selected transmission frame formats of IEC 60870-5-1 | Link layer (2) |
| Selected ITU-T recommendations | Physical layer (1) |

Application layer defines the information elements for structuring application data and the communication service functions. The user process describes an assortment of basic application functions.

Link layer defines the frame formats and the transmission procedures of the IEC communication.

Physical layer defines the hardware-dependent specifications of the IEC 60870-5-101/ IEC 60870-5-104 communication interfaces.

2.2 Transmission

IEC 60870-5-101 allows two alternative transmission procedures, unbalanced and balanced, to be used in the communication between the controlling station (SCADA system) and the controlled outstation.

2.2.1 Unbalanced transmission

When using unbalanced transmission, the controlling station controls the data traffic by polling the controlled outstations sequentially. In this case, the controlling station initiates all the message transfers while the controlled outstations can transmit only in response to the message from the controlling station.

Table 2: Supported transmission services initiated by the controlling station

| Service | Purpose |
|-----------------|--|
| SEND/NO REPLY | For global messages and for cyclic set-point commands from the controlling station |
| SEND/CONFIRM | For control commands and set-point commands from the controlling station |
| REQUEST/RESPOND | For polling data from the controlled outstations |

2.2.2 Balanced transmission

When using balanced transmission, each station can initiate message transfer. The stations may act simultaneously as controlling stations and controlled outstations. Therefore they are called combined stations. In this manual, a combined station is called either a controlling station or a controlled outstation according to its function in the message exchange.

The balanced transmission is restricted to point-to-point and to multiple point-to-point configurations.

The balanced transmission supports SEND/CONFIRM and SEND/NO REPLY transmission services. The SEND/NO REPLY transmission service can be initiated only by a controlling station with a broadcast address in a multiple point-to-point configuration.

2.3 Basic application functions

2.3.1 Data acquisition

The data delivered by a controlled outstation can be replies to commands or process values which are collected cyclically, upon change, or upon request from the controlling station.

All the data is buffered in the controlled outstation because the data may appear faster than the communication link is able to transfer it to the controlling station.

When unbalanced transmission is used on the link layer, the buffered data must be polled by the controlling station. The controlled outstation must always wait for a request for transmission from the controlling station.

When balanced transmission is used on the link layer, the buffered data is transmitted by the controlled outstation to the controlling station without a delay.

2.3.2 Event acquisition

Events occur spontaneously at the controlled outstation's application level. The events are buffered in the controlled outstation because the events may appear faster than the communication link is able to transfer them.

When unbalanced transmission is used on the link layer, the buffered events must be polled by the controlling station. The controlled outstation must always wait for a request for transmission from the controlling station.

When balanced transmission is used on the link layer, the buffered events are sequentially, without a delay, transmitted by the controlled outstation to the controlling station.

2.3.3 Interrogation

The controlled outstation's interrogation function is used for updating the controlling station after an internal station initialization, or when the controlling station detects loss of information.

When the function is used, the controlling station requests the controlled outstations to transmit the actual values of all their process variables. Normally, the amount of information is known by the application functions in both the controlling stations and controlled outstations. The interrogation can be done either by an interrogation group (1...16) at a time or all groups at once (general).

2.3.4 Clock synchronization

The clock of the controlled outstation has to be synchronized with the clock of the controlling station. Synchronizing of the clocks provides a correct chronological sequence of time-tagged events or information objects that are transmitted to the controlling station, or that are logged locally.

After system initialization, the clocks are initially synchronized by the controlling station. After, the clocks are periodically resynchronized by transmission of a clock synchronization command (C_CS ACT).

The time information must always be corrected either by the controlling station before sending or by the outstation when an ASDU with time tag is received. A delay acquisition command can be used to define the measured or estimated transmission delay in the outstation. The command corrects the time on the outstation side when sending.

2.3.5 Command transmission

A command is used in telecontrol systems to change the state of operational equipment, for example, a circuit breaker. A command may be initiated by an operator or by automatic supervisory procedures in the controlling station. Provision against unauthorized access or against unwanted actions are system- or process-dependent.

The two standard procedures for command transmission are a Direct command or a Select and execute command.

Direct commands are used by the controlling station to immediately control operations in the controlled outstations. For safety reasons, the controlled outstation's application function checks the permissibility and the validity of the received command message, and operates if the check results are positive.

The two-step command Select and execute is used by the controlling station to:

- Prepare a specified control operation in a controlled outstation
- Check that the correct control operation is prepared
- Execute the command

The preparation is checked by an operator or by an application procedure. The controlled outstation does not start the control operation until it has received the correct execute indication. The command transmission is confirmed to the controlled outstation by an activation confirmation response. After the command is executed, an activation termination response is sent to the controlling station.

2.3.6 Transmission of integrated totals

An integrated total is a value that is integrated over a specified time period. The specific clock times and the periodic time interval of successive acquisitions of the integrated totals are system parameters. There are two methods for acquiring counter information.

- Acquisition of integrated totals (Freeze-and-Read)
- Acquisition of incremental information (Clear-and-Read)

2.3.7 Changes in protocol and link parameters

When the values of the protocol and link parameters are changed, the new values take effect after they have been committed.

2.3.8 Acquisition of transmission delay

The value of time correction is determined by the sum of the transmission delay and the internal equipment delay. The transmission delay is a value which can be acquired either separately by parameterization, or via a dynamic procedure initiated by the controlling station.

Section 3 Vendor-specific implementation

3.1 615/620 series implementation

3.1.1 Internal IEC 61850 data modeling

The IED is natively using the IEC 61850 data model for data processing. In practice, some data which is not used by the system database might not be available. Furthermore, the data must be enabled in an IEC 61850 dataset to be able to be reported by IEC 60870-5-101/104.

3.1.2 Instances

The protocol can be run as multiple instances. Each instance has its own database and therefore all the data accesses are independently managed. For example, if a client is not available for event receiving, that does not affect the data buffering for other clients.

Every instance has independent configuration and data object mapping. It is possible to build a configuration where the amount of information objects is different for the clients. For example, a client with slow connection gets only the most important data.

3.1.3 Selecting between IEC 60870-5-101 and IEC 60870-5-104

All available protocol instances support both the IEC 60870-5-101 and IEC 60870-5-104 communication. The communication is selected in the *Port configuration* parameter.



Some parameters are applicable only to either one of the protocols.

3.2

Configuring



It is assumed that all the other settings have their default values. Avoid changing the other settings unless something is clearly wrong by default.

3.2.1 Configuring IEC 60870-5-101

To configure one protocol instance to work as IEC 60870-5-101 slave, configure the parameters to enable basic communication.

Port

According to the physical wiring, set either to "IEC101-COM1" or "IEC101-COM2". Set the correct serial mode and communication baud rate under COM1/COM2 settings.



Check the communication card jumpers. Refer to applicable manual for details.

• Device Address Set to match the address set in th

Set to match the address set in the master.

- ASDU Address Usually ASDU Address is the same as link address.
- Link Mode

If the system is configured to use unbalanced communication, set *Link Mode* to "Unbalanced". Otherwise, no change is needed.

- *COT Length* Usually set to 1. This setting must have the same value in the master and slave devices.
- *IOA Length* Usually, set to 2. This setting must have the same value in the master and slave devices.
- *Link Address Length* Usually set to 1. This setting must have the same value in the master and slave devices.
- *ASDU Address Length* Usually set to 1. This setting must have the same value in the master and slave devices.

3.2.2 Configuring IEC 60870-5-104

To configure one protocol instance to work as IEC 60870-5-104 server, configure the parameters to enable basic communication.

- *Port* Set to "IEC104 - Ethernet".
- *Client IP* Set to match the IP address of the client device. *ASDU Address*

Set to match the address set in the master.

- COT Length Usually set to 2. This setting must have the same value in the master and slave devices.
- *IOA Length* Usually, set to 3. This setting must have the same value in the master and slave devices.
- *Link Address Length* Usually set to 2. This setting must have the same value in the master and slave devices.
- ASDU Address Length Usually set to 2. This setting must have the same value in the master and slave devices.

3.2.3 Troubleshooting

After setting the communication parameters correctly, check the communication.

- Use the communication card LED's to diagnose if the messages are properly transmitted and received. There are diagnostic counters available in the IED's Monitoring section.
- Check also that the other settings for the protocol instance match the master configuration, as they affect the data interpretation.

3.3 Event overflow handling

3.3.1 Overflow mode

The protocol instance can be configured to keep either the newest or the oldest events in case of buffer overflow. The event buffer overflows typically in a situation, where a lot of signals change at the same time and the client is not able to fetch all the event reports quickly enough. In these cases, the events that occurred in that critical moment are the most important. It is recommended to use the keep oldest events mode. In addition, in this mode the IED can be configured to generate an event buffer overflow indication. After receiving overflow indication, the client can interrogate the IED to ensure data integrity.

3.3.2 Overflow indication addresses

If the keep oldest events mode is enabled, the IED sends an event buffer overflow indication. If the lost event is included in the interrogation list, the IED sends the indication event with the address configured as "OvInd IOA". If the data is not

available for interrogation, the IED uses address configured as "OvInd NoGI IOA". Both indications are sent if there are multiple events lost fulfilling both of the criteria.

Knowing that the missed data is not included in the interrogation list, the client can skip interrogation. If the addresses are configured to same (default), only one indication is sent regardless if the data is included in the interrogation or not.

3.3.3 Overflow situation clearing



Overflow situation clearing is applicable only for the keep oldest events mode.

After the event buffer overflow is cleared, the IED discards new events for 3 seconds to allow the client to start fetching the events and to free some space in the event buffer. Otherwise, the event buffer overflows immediately again and the communication is disturbed more.

3.4 Supported data types

3.4.1 Indications (MSP, MDP)

The IED supports both single and double-bit indications with configurable timestamp format.

3.4.2 Measurements (MMENA, MMENB, MMENC, MMEND)

By default, analog measurements are transmitted in primary units, such as A, V or Hz. The scaling is based on the measuring transformer ratio.

3.4.3 Control objects (CSC, CDC)

Two types of control objects are available. Single bit controls are normally used for setting group selection and clearing the indication LED's or recorded data.

Double bit controls normally include circuit breaker controlling. The circuit breaker can be configured to be in direct or the select-before-operate (SBOW) mode. The IEC 60870-5-101/104 implementation allows both controlling mechanisms in both cases.

A command is rejected because of:

- Control direction is wrong.
- Legal values for double-bit controls are 1 and 2. Both 0 and 3 are rejected.
- Control object is set to "Status-only".
- Control operation is denied by the circuit breaker itself because of, for example, interlocking.

3.4.4 Packed protection events (MEPTB, MEPTC)

The protection pickup/trip signals are reported as packed protection events.

3.4.5 Integrated totals (MIT)

The integrated totals can be used by the standard mechanism.

| Table 3: Con | nmands |
|--------------|--------|
|--------------|--------|

| Operation | Description |
|-----------|---|
| Read | The read operation causes the integrated totals to be interrogated. The IED sends the values after the Read command. |
| Reset | The integrated totals can be cleared by the Reset command. The Reset command is not only for IEC 60870-5-101/104. It clears the counter values globally in the IED. |
| Freeze | With the Freeze command, the IED copies the momentary values and stores them as frozen. After, the frozen values can be read by using the Read command. |

3.5 Addressing scheme

3.5.1 Default addresses

There are some protection functions, which are not available in this IED, but might be available in other IEDs in the 615/620 series. The main principle is to keep the data mapped in a consistent way in the whole 615/620 series, which means that there are some gaps in the address range. The addresses are laid in a structured form to have a different address range for the different information object types.

3.5.2 Configuring communication options

- Configure the communication options by using LHMI or PCM600 to set the parameters in **Configuration/Communication/IEC60870-5-101/104**.
- For remapping the data object use the Communication Management tool in PCM600.

3.6 Communication parameters



All the parameter names have a number in the end of the caption. The setting affects only to the protocol instance marked by the number.

3.6.1 Port

- NONE (default)
- IEC101 COM1
- IEC101 COM2
- IEC104 Ethernet

The setting enables/disables the protocol instance and defines the link layer.

3.6.2 ClientIP



Applicable for IEC 60870-5-104 only.

The setting defines the IP address of the client. If the protocol instance is enabled, the *ClientIP* setting must be different from other instances' ClientIPs. The meaning of the parameter depends on the link mode.

In the balanced mode, *ClientIP* is the address where the IED tries to connect when the communication is started. Once connected, the communication continues with that client.

In the unbalanced mode, *ClientIP* defines the address from where the client's communication initiative is accepted. If the protocol instance's *ClientIP* setting does not match with the client's, the IED does not respond.

3.6.3 End delay



Applicable for IEC 60870-5-101 only.

- Min: 0
 - Max: 20
- Default: 4
- Unit: characters at the current baud rate

The setting defines the maximum allowed time between the characters in the IEC101 frame. If this setting is too low, the IED may interpret incoming message as multiple frames, which causes discarding of the frame. If the link uses, for example, radio modem, it might be needed to adjust the *End delay* setting to a higher value. The delay time is defined in characters at the current baud rate.

3.6.4 Device address

- Min: 1
- Max: 255/65535
- Default: 1

The *Device address* is the identification number of the device. This setting must match the address defined in the client configuration. The maximum value of this setting depends on the link address length.

3.6.5 ASDU address

- Min: 1
- Max: 255/65535
- Default: 1

Each device on the communication network has a common address of ASDU. *ASDU address* must match the address defined in the client configuration. The maximum value of this setting depends on the ASDU address length.

3.6.6 Link mode

- Unbalanced (default)
 - Balanced

The settings defines the link mode. In the unbalanced mode, the IED listens for the client's commands and responds when needed. In the balanced mode, the IED opens the connection and sends a spontaneous report when something happens.

3.6.7 COT length

- Min: 1
- Max: 2
- Default: 1
- Unit: bytes

Many communication frames include the cause of transmission information (COT). The length of COT element is configurable and should be set to same value throughout the network. Typical values are '1' for IEC 60870-5-101 and '2' for IEC 60870-5-104.

3.6.8 IOA length

- Min: 1
- Max: 3
- Default: 2
- Unit: bytes

For the communication frames, the information object address (IOA) length is configurable and should be set to the same value throughout the network. Typical values are '2' for IEC 60870-5-101 and '3' for IEC 60870-5-104.

3.6.9 Link address length

- Min: 1
- Max: 2
- Default: 1
- Unit: bytes

In a communication frame, the destination address is defined. The length of a link address element is configurable and should be set to same value throughout the network. Typical values are '1' for IEC 60870-5-101 and '2' for IEC 60870-5-104.

3.6.10 ASDU address length

- Min: 1
- Max: 2
- Default: 1
- Unit: bytes

In some communication frames, the ASDU address is defined. The length of ASDU address element is configurable and should be set to the same value throughout the network. Typical values are '1' for IEC 60870-5-101 and '2' for IEC 60870-5-104.

3.6.11 Single character response



Applicable only for IEC 60870-5-101.

- Enabled
- Disabled (default)

The setting allows the IED to respond with the single character response for some acknowledgement frames. If used, the client must also support this feature.

3.6.12 Show bad time

- Enabled (default)
- Disabled

If the IED time is not synchronized properly, the time quality is marked as bad or inaccurate. The time quality is indicated as a flag in the changed data report. If *Show bad time* is set to "Disabled", the IED does not indicate the bad time flag which may be useful in some systems. If the time quality indication is disabled, the client is not able to trust the time stamped event correctness.

3.6.13 Time format

- Short: 24 bit
- Full: 56 bit
- Default: 56 bit

There are two different time stamp formats used in the IEC 60870-5 standard. The shorter format includes only the time, and the full format includes both the date and the time. The changed data reports include the time stamp in the format specified with the Time format setting.



Select the time format which is supported by the client.

3.6.14 Event time

- Local
- UTC (default)

The setting selects between the time stamp modes for event reporting.

3.6.15 Overflow mode

- Oldest+Indication (default)
- Keep newest

The setting defines the handling of the event buffer overflow situation. In the oldest +indication mode, the IED discards the newest events to protect the older ones. In that mode, the IED generates an overflow indication event. The keep newest mode is added for compatibility for the systems that prefer latest information. In that case, the oldest events in the buffer are discarded.

3.6.16 OvInd IOA



Applicable only if Overflow mode is set to "Oldest+Indication".

- Min: 0
- Max: 255/65535/16777215
- Default: 60000

The IED generates an overflow indication event with this address if the lost event is included in any of the interrogation groups. Based on this information, the client requests for interrogation to get the latest momentary values.

- If *OvInd IOA* is set to 0, the overflow indication is disabled for the points that are part of some interrogation groups.
- If *OvInd IOA* is set to the same value as *OvInd NoGI IOA*, only one indication event is generated regardless whether the point is included in the interrogation group or not.
- The maximum value depends on the IOA length setting.

3.6.17 OvInd NoGI IOA



Applicable only if Overflow mode is set to "Oldest+Indication".

- Min: 0
- Max: 255/65535/16777215
- Default: 60000

The IED generates an overflow indication event with this address if the lost event is not included in any of the interrogation groups. Based on this information, the client knows that the interrogation is not needed because the missed data is not updated anyway.

- If *OvInd NoGI IOA* is set to zero, the overflow indication is disabled for the points that are not part of some interrogation groups.
- If *OvInd NoGI IOA* is set to same value as *OvInd IOA*, only one indication event is generated regardless whether the point is included in the interrogation group or not.
- The maximum value depends on the IOA length setting.

3.6.18 Event order

- Accurate time (default)
- Preserve chronology

The IED has accurate time stamps for every data attribute which is part of an IEC 61850 dataset. Most of them are updated in a chronological manner. However, there may be some special data items that do not have system-level timestamp available, such as circuit breaker control return indication. If the client needs strictly chronological event buffering, *Event order* should be set to "Preserve chronology". If the events are collected to a SCADA system, which is able to buffer and sort the received events at the system level, it is recommended to use "Accurate time" instead.

3.6.19 Selection time-out

- Min: 1
- Max: 65
- Default: 30
- Unit: seconds

This is the maximum time between the Select and Execute commands for the circuit breaker controlling in the select-before-operate mode. The controllable object's IEC 61850-level *Selection time-out* parameter is not used when the control is made by the IEC 60870-5-101/104 client.

3.6.20 Cyclical period

- Min: 1
- Max: 604800
- Default: 10
- Unit: seconds

Cyclical period is the periodical timer for the cyclical data sending. The maximum of 604800 seconds means one week.

3.7 Diagnostics

All of the counters, with the exception of the Status point, show value '-1' when no connection is established after the IED restart.

3.7.1 Status

The Status value is "True" when the communication is active, that is, a client has been connected within the last 30 seconds. Otherwise it is "False".

It is possible to reset the diagnostic counters by setting the Status value to "True".

3.7.2 Received frames

The Received frames counter shows the number of accepted frames received by the IED since the last startup or a diagnostic reset.

3.7.3 Transmitted frames

The Transmitted frames counter shows the number of frames transmitted by the IED since last the startup or a diagnostic reset.

3.7.4 Physical errors

The Physical errors counter shows the number of detected errors on the physical layer since last the startup or a diagnostic reset.

3.7.5 Link errors

The Link errors counter shows the number of detected errors on the link layer since the last startup or a diagnostic reset.

3.7.6 Transport errors

The Transport errors counter shows the number of detected errors on the transport layer since the last startup or a diagnostic reset.

Section 4 IEC 60870-5-101 and IEC 60870-5-104 parameters

4.1 Parameter list

Table 4: IEC 60870-5-101 and IEC 60870-5-104 settings

| Parameter | Values (range) | Unit | Step | Default | Description |
|----------------------------|--|------|------|-------------------------|---|
| Port 1 | 0=Not in use 1=IEC101 - COM1 2=IEC101 - COM2 3=IEC104 - Ethernet | | | 0=Not in use | Port selection for instance 1 |
| ClientIP 1 | | | | 0.0.0.0 | IP address of the client |
| End Delay 1 | 020 | char | | 4 | Frame end delay for serial communication |
| Device Address 1 | 165535 | | | 1 | Link address of the instance 1 |
| ASDU Address 1 | 165535 | | | 1 | ASDU address of the instance 1 |
| Link Mode 1 | 0=Balanced 1=Unbalanced | | | 0=Balanced | Link mode setting for instance 1 |
| COT Length 1 | 12 | | | 1 | Cause of transmission length |
| IOA Length 1 | 13 | | | 2 | Information object address length |
| Link Address Length 1 | 12 | | | 1 | Link address length |
| ASDU Address Length 1 | 12 | | | 1 | ASDU address length |
| Single Char Resp 1 | 0=Disabled 1=Enabled | | | 0=Disabled | Single character response enabled/disabled |
| Show Bad Time 1 | 0=Disabled 1=Enabled | | | 1=Enabled | Enable/disable bad time quality indication in events |
| Time Format 1 | 0=Short 24bit 1=Full 56bit | | | 1=Full 56bit | Time stamp format 3 or 7 octet |
| Event Time 1 | 0=Local 1=UTC | | | 1=UTC | Selects between UTC/local time |
| Overflow Mode 1 | 0=Oldest +indication 1=Keep newest | | | 0=Oldest +indication | Event buffer overflow handling mechanism |
| OvInd IOA 1 | 016777215 | | | 60000 | Overflow indication address for interrogated data 1 |
| OvInd NoGI IOA 1 | 016777215 | | | 60000 | Overflow indication address for non- interrogated data 1 |
| Table continues on next pa | ige | | | | |

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Section 4 IEC 60870-5-101 and IEC 60870-5-104 parameters

| Parameter | Values (range) | Unit | Step | Default | Description |
|-----------------------|--|------|------|-------------------------|---|
| Event Order 1 | 0=Accurate time 1=Preserve chronology | | | 0=Accurate time | Selects the event ordering principle |
| Selection Timeout 1 | 165 | | | 30 | Selection time-out for control SBO operations |
| Cyclical Period 1 | 1604800 | | | 10 | Cyclical period in seconds |
| Port 2 | 0=Not in use 1=IEC101 - COM1 2=IEC101 - COM2 3=IEC104 - Ethernet | | | 0=Not in use | Port selection for instance 2 |
| ClientIP 2 | | | | 0.0.0.0 | IP address of the client |
| End Delay 2 | 020 | char | | 4 | Frame end delay for serial communication |
| Device Address 2 | 165535 | | | 1 | Link address of the instance 2 |
| ASDU Address 2 | 165535 | | | 1 | ASDU address of the instance 2 |
| Link Mode 2 | 0=Balanced 1=Unbalanced | | | 0=Balanced | Link mode setting for instance 2 |
| COT Length 2 | 12 | | | 1 | Cause of transmission length |
| IOA Length 2 | 13 | | | 2 | Information object address length |
| Link Address Length 2 | 12 | | | 1 | Link address length |
| ASDU Address Length 2 | 12 | | | 1 | ASDU address length |
| Single Char Resp 2 | 0=Disabled 1=Enabled | | | 0=Disabled | Single character response enabled/disabled |
| Show Bad Time 2 | 0=Disabled 1=Enabled | | | 1=Enabled | Enable/disable bad time quality indication in events |
| Time Format 2 | 0=Short 24bit 1=Full 56bit | | | 1=Full 56bit | Time stamp format 3 or 7 octet |
| Event Time 2 | 0=Local 1=UTC | | | 1=UTC | Selects between UTC/local time |
| Overflow Mode 2 | 0=Oldest +indication 1=Keep newest | | | 0=Oldest +indication | Event buffer overflow handling mechanism |
| OvInd IOA 2 | 016777215 | | | 60000 | Overflow indication address for interrogated data 2 |
| OvInd NoGI IOA 2 | 016777215 | | | 60000 | Overflow indication address for non- interrogated data 2 |
| Event Order 2 | 0=Accurate time 1=Preserve chronology | | | 0=Accurate time | Selects the event ordering principle |
| Selection Timeout 2 | 165 | | | 30 | Selection time-out for control SBO operations |
| Cyclical Period 2 | 1604800 | | | 10 | Cyclical period in seconds |

4.2

Monitored data

| Table 5: Protocol diagnostic counters | | | | |
|---|---------|-------------------|------|------------------------|
| Name | Туре | Values (range) | Unit | Description |
| Status 1 | BOOLEAN | 0=False 1=True | | Status |
| Received frames 1 | INT32 | -12147483646 | | Received frames |
| Transmitted frames 1 | INT32 | -12147483646 | | Transmitted frames |
| Physical errors 1 | INT32 | -12147483646 | | Physical layer errors |
| Link errors 1 | INT32 | -12147483646 | | Link layer errors |
| Transport errors 1 | INT32 | -12147483646 | | Transport layer errors |
| Status 2 | BOOLEAN | 0=False 1=True | | Status |
| Received frames 2 | INT32 | -12147483646 | | Received frames |
| Transmitted frames 2 | INT32 | -12147483646 | | Transmitted frames |
| Physical errors 2 | INT32 | -12147483646 | | Physical layer errors |
| Link errors 2 | INT32 | -12147483646 | | Link layer errors |
| Transport errors 2 | INT32 | -12147483646 | | Transport layer errors |

Section 5 Glossary

| ANSI | American National Standards Institute |
|-----------------|--|
| 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 |
| EPA | Enhanced performance architecture |
| Ethernet | A standard for connecting a family of frame-based computer networking technologies into a LAN |
| НМІ | Human-machine interface |
| IEC 60870-5 | IEC standard for telecontrol equipment and systems. Part 5 defines transmission protocols. |
| IEC 60870-5-101 | Companion standard for basic telecontrol tasks |
| IEC 60870-5-104 | Network access for IEC 60870-5-101 |
| IEC 61850 | International standard for substation communication and modelling |
| IED | Intelligent electronic device |
| LHMI | Local human-machine interface |
| PCM600 | Protection and Control IED Manager |
| SCADA | Supervision, control and data acquisition |
| | |

Contact us

 ABB Inc.

 Distribution
 Automation

 4300 Coral Ridge Drive
 Coral Springs, FL 33065, USA

 Phone
 +1 (800) 523-2620

 Phone
 +1 954-752-6700

 Fax
 +1 954 345-5329

www.abb.com/substationautomation

