IEC 61850 and ION technology

This protocol document provides setup and configuration information for using PowerLogic™ ION™ meters with IEC 61850, and assumes that you are familiar with the IEC 61850 protocol.

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Additional information

- IEC (International Electrotechnical Commission) website at www.iec.ch
- Your meter's documentation
- Your IEC 61850 configuration software's documentation
- More information about IEC 61850 and Schneider Electric devices is available from www.schneider-electric.com

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Safety information

Important information

Read these instructions carefully and look at the equipment to become familiar with the device before trying to install, operate, service or maintain it. The following special messages may appear throughout this bulletin or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

The addition of either symbol to a “Danger” or “Warning” safety label indicates that an electrical hazard exists which will result in personal injury if the instructions are not followed.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

⚠ DANGER

DANGER indicates a hazardous situation which, if not avoided, **will result in** death or serious injury.

⚠ WARNING

WARNING indicates a hazardous situation which, if not avoided, **could result in** death or serious injury.

⚠ CAUTION

CAUTION indicates a hazardous situation which, if not avoided, **could result in** minor or moderate injury.

NOTICE

NOTICE is used to address practices not related to physical injury.

Please note

Electrical equipment should be installed, operated, serviced and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

A qualified person is one who has skills and knowledge related to the construction, installation, and operation of electrical equipment and has received safety training to recognize and avoid the hazards involved.

Notices

Legal information

Safety precautions

Installation, wiring, testing and service must be performed in accordance with all local and national electrical codes.

⚠ DANGER

ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

- Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices. See NFPA 70E in the USA, CSA Z462 or applicable local standards.
- Turn off all power supplying this device and the equipment in which it is installed before working on it.
- Always use a properly rated voltage sensing device to confirm that all power is off.
- Replace all devices, doors and covers before turning on power to this equipment.

Failure to follow these instructions will result in death or serious injury.

IEC 61850 meter models and firmware

Your ION meter must have Ethernet communications and be a model that supports IEC 61850. New meters can be purchased with IEC 61850 or IEC 61850 firmware can be loaded onto an existing meter.

Meter models

The following table lists the meter models and firmware versions that support IEC 61850, as well as the IEC 61850 editions each meter model supports:

Meter	Models	Firmware	IEC 61850 Edition
ION7400	All models	All firmware versions	Edition 2
ION7550/ ION7650[1]	All models	v360 (with IEC 61850 designation	Edition 1
ION8650	All models (A, B, C)	v408 and earlier v4.20 and later	Edition 1 Edition 1 and Edition 2 (with correct ICD file)
ION8800[1]	All models (A, B, C) 5 MB logging memory	v340,v350, v351 (with IEC 61850 designation) v360 and later (with IEC 61850 designation)	Edition 1 Edition 1 and Edition 2 (with correct ICD file)
PM8000	All models	All firmware versions v1.2.15 and later	Edition 1 Edition 1 and Edition 2 (with correct ICD file)

[1] For meters with firmware earlier than v400, upgrading a 10 MB meter with IEC 61850 firmware reduces the logging memory to 5 MB.

NOTE: Not all ION meters support IEC 61850. Contact your local Schneider Electric sales representative for updated information.

NOTE: Changing your meter's firmware deletes all IEC 61850 files stored on your meter.

Your meter's digital and analog outputs may change state when being configured, during an option module reset or power cycle, or during firmware or framework upgrade.

⚠ WARNING

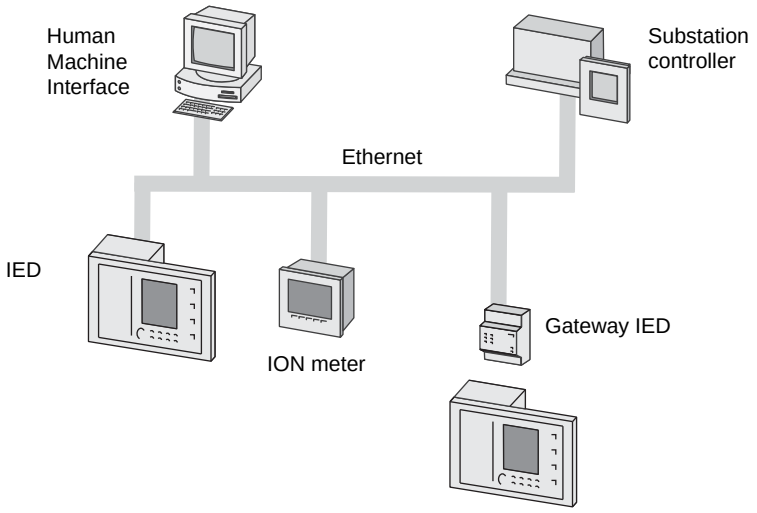
UNEXPECTED OPERATION

Do not use your meter for critical control or protection applications where human or equipment safety relies on the operation of the control circuit.

Failure to follow these instructions can result in death, serious injury or equipment damage.

IEC 61850 protocol overview

IEC 61850 is an Ethernet-based protocol designed for electrical substations. It is a standardized method of communications, developed to support integrated systems composed of multi-vendor, self-describing IEDs (Intelligent Electronic Device) that are networked together to perform monitoring, metering, real-time protection and control.



Terminology

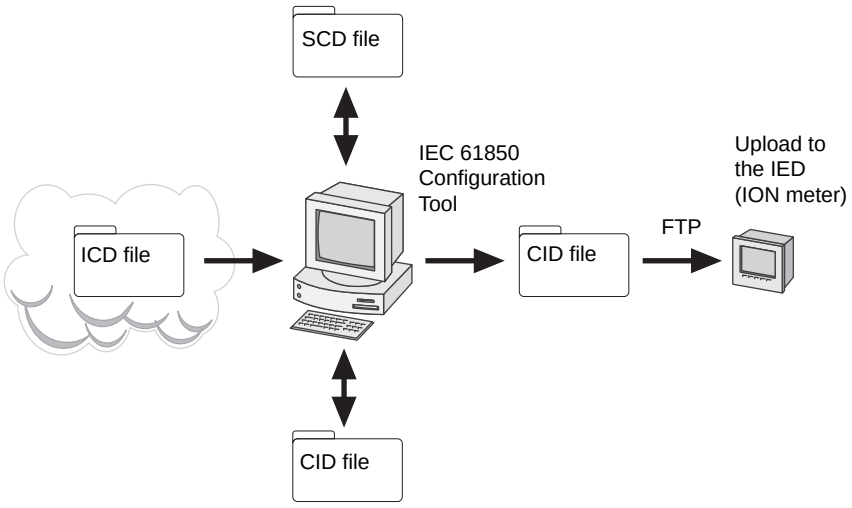
The following table defines some of the terms used in IEC 61850. For a complete listing of IEC 61850 terms, refer to IEC 61850-2.

Term	Definition
ACSI	Abstract Communications Service Interface, defines how to model and organize the data of an IED independently from the communication stack.
CID	Configured IED Description, which is an ICD that has been configured for a specific IED using IEC 61850 configuration software. Refer to “IEC 61850 files” on page 7.
Client	An IEC 61850 system terminal that receives data, reports and controls the I/O of the meter, and may provide real-time data or event viewing, or similar functions. Only the client can initiate requests.
Data class	Groupings of similar types of data, such as phase-to-ground amperage for phases A, B and C, that are used to construct a logical node.
Data set	A predefined or user-selected set of data that can be reported via IEC 61850.
FTP	File Transfer Protocol, a method of transferring computer files over Ethernet.
ICD	IED Capability Description, which is supplied by the vendor of the IED. Refer to “IEC 61850 files” on page 7.
IED	Intelligent Electronic Device, a device with a microprocessor controller.
Logical device	The IED’s set of typical substation functions (such as metering, measurement and alerting) which are referred to as logical nodes.
Logical node	is one typical substation function of the IED, for example the MMTR logical node, which contains energy information. Refer to “Logical nodes supported in the ION implementation of IEC 61850” on page 11.
Physical device	The IED’s physical device Ethernet access point. In the context of IEC 61850 this is the same as an IED. The physical device contains one or more logical devices.
SCD	Substation Configuration Description, an integration of the CID files for a particular substation. Refer to “IEC 61850 files” on page 7.

Term	Definition
SCL	Substation Configuration Language, in IEC 61850 this is the xml-based language used to create the IEC 61850 description files. There are four types of SCL files required to define an IEC 61850 substation (ICD, CID, SCD, SSD).
Self-description	The IED's capability to provide the IEC 61850 system with information on the device's function and data.
Server	The IEC 61850 meter that sends reports to clients and responds to I/O commands. The server can only respond to requests, not initiate them.
SSD	System Specification Description, which describes the single line diagram of the substation and the required logical nodes. Refer to "IEC 61850 files" on page 7.

IEC 61850 files

The **ICD** file is a template supplied by Schneider Electric that defines the IED (such as your meter) in terms of its capabilities. You can download the ICD file from www.schneider-electric.com. Select the ICD file that matches your meter's model and hardware configuration.



NOTE: Ensure you are using the ICD file that matches your meter's hardware configuration in order to support your meter's input and output hardware ports in IEC 61850.

The **ICD** file is loaded into an IEC 61850 configuration tool, such as Schneider Electric's CET850 IEC 61850 configuration software, and the parameters are edited as required with the information specific to that instance of the IED. Once the parameters are edited, the IEC 61850 configuration tool can build the **CID** file. The **CID** file is then loaded into the IED via FTP.

IEDs with the same feature set use the same ICD file. However, every IED requires its own unique CID file. To create a CID file, begin with the correct ICD file and then configure the ICD file using IEC 61850 configuration software.

Implementation of IEC 61850

TCP/IP client connections

IEC 61850 is only available through the Ethernet port. The maximum number of IEC 61850 client connections for each meter is:

Maximum client connections	Meter
4	ION7550/ION7650, ION8800 (v351 or earlier), PM8000
5	ION8650, ION7400, ION8800 (v360 or later)

NOTE: The maximum number of client connections is subject to change. Refer to your device's documentation or contact your local Schneider Electric sales representative for updated information.

Your meter's digital and analog outputs may change state when being configured, during an option module reset or power cycle, or during firmware or framework upgrade. Changing your meter's Ethernet settings will terminate all IEC 61850 client connections and controls.

⚠ WARNING

DIGITAL AND/OR ANALOG OUTPUT STATE CHANGE

Do not use your meter for critical control or protection applications where human or equipment safety relies on the operation of the control circuit.

Failure to follow these instructions can result in death, serious injury or equipment damage.

NOTE: Changing the Ethernet settings on your meter resets the meter's IEC 61850 functions and deletes any unsent reports.

File transfer

FTP is used to upload the CID file to the meter, using FTP client software such as WinSCP or Windows Explorer. Refer to your meter's documentation for specific FTP information. Once a valid CID file has been uploaded to the meter it will begin functioning as an IEC 61850 server, and can provide information to the IEC 61850 client substation systems.

NOTE: Changing the firmware on your meter deletes your meter's CID file.

The IEC 61850 folders on your meter are factory-configured and cannot be modified. You cannot change the file or folder structure of the FTP files on your meter; you can only add or remove files in the existing folders.

File names are limited to standard ASCII characters, meaning they cannot contain a blank space or \, /, “, *, ? “, < or >, and are limited to 68 characters in length, including the file extension. The “/” character is used as part of the FTP file directory information.

NOTE: FTP files from your meter can only be accessed and modified by Windows-based machines.

Files relating to IEC 61850

ICD files

ICD files are available from www.schneider-electric.com. There are multiple ICD files available, corresponding to the different types of meters and meter options available. Make sure you select the ICD file that matches your meter's hardware configuration and IEC 61850 edition. Refer to your meter's documentation for more information on meter types and specific meter configurations.

CID files

CID files are created from the ICD file using an IEC 61850 configuration tool. The CID file contains information specific to your meter, such as deadband values, data sets and reports. Your IEC 61850 configuration tool may require that you include Ethernet communications information in your CID file, but this information is not used; the communications information for IEC 61850 is taken from the meter's configuration.

CID files can be created offline, without the meter present. Existing CID files can be reconfigured/reused in other meters providing that they are of the same type and have the same options (i.e., the meters would use the same ICD file).

NOTE: Do not manually alter CID files created with CET850 because these files contain a security key that is verified by some ION meters.

A valid CID file must fit within the allocated directory space (including space for the log.txt file), with a maximum filename length of 68 characters (including file extension) from the regular ASCII character set (no special characters). The CID file must also be compatible with the IEC 61850 conformance of the meter. Refer to "Appendix A: Conformity" on page 20. If the CID file is invalid, an error message is written to the log.txt file.

NOTE: The CID file controls whether the meter is operating as an IEC 61850 server. If the meter does not have a valid CID file loaded, the meter will not perform any IEC 61850 functions.

log.txt

The log.txt file is stored on your meter in the IEC 61850 folder. It contains up to fifty of the most recent informational messages related to IEC 61850 operations on your meter. Refer to "Appendix A: Conformity" on page 20 for details on how IEC 61850 operates on your meter.

NOTE: The log.txt timestamp is in Coordinated Universal (UTC) time.

CID messages in log.txt files

Refer to the log.txt file when transferring a new CID file to confirm that the CID file is valid and the IEC 61850 aspects of your meter are operating. If the CID file is invalid, the log.txt file contains additional information to assist in creating a valid CID file. You must delete the invalid CID file and use the ICD file to correct the invalid attributes and build a new CID file. Refer to "Appendix A: Conformity" on page 20 for details on the IEC 61850 attributes of your meter.

Example of log.txt for a valid CID file:

2010-02-09 23:19:34 - testing.cid - File Detected
    Uploaded File is Valid

IEC61850 protocol is Online

Example of log.txt for an invalid CID file:

2010-04-13 17:25:17 - Meter powering up
IEC61850 protocol is offline
2010-04-13 17:27:43 - Testing.cid - File detected
'daName' attribute must be specified in data set member
Uploaded file is invalid
IEC61850 protocol is offline

Meter security

The meter can be configured with standard or advanced security. These security settings should be reviewed for compatibility with your IEC 61850 client or FTP software.

If standard security is enabled, the FTP login name can be any value (not including invalid characters), and the login password is the front panel password. If advanced security is enabled, the login name and password must match with an advanced user that has full read/write access. Once logged in, you have read and write access to the FTP files and subfolders.

NOTE: To connect to your meter using Windows Explorer, you must have the login and password included in the FTP connection string. For example, with standard meter security and the default front panel password of **0**, to connect to a meter with an IP address of 123.45.6.78, the Windows Explorer connection string would be: **ftp://0:0@123.45.6.78**

Refer to your meter's documentation for more information about meter security.

Device information

These logical nodes have corresponding ION modules that map the information from the ION protocol into IEC 61850.

NOTE: A valid CID file can only contain the supported Logical Nodes in their associated quantities.

Logical nodes supported in the ION implementation of IEC 61850

Logical Node	Description
GGIO	Generic process I/O. There are four types of GGIO logical nodes: – onboard I/O (the meter's onboard I/O status and control). – expanded I/O (the meter's expansion (option module) I/O status and control). – custom analog (to map additional numeric values into IEC 61850). – custom digital (to map additional Boolean values into IEC 61850). For information on how to configure the GGIO, refer to your meter's user guide.
LLN0[1]	Logical node zero. Contains the data related to the associated IED.
LPHD[1]	Physical device. Contains information related to the physical device.
MHAI	Harmonics. Consists of harmonic values such as THD, K factor, Crest factor.
MMTR	Metering. Consists of the integrated values (energy), primarily for billing purposes.
MMXU	Measurements. Contains per-phase and total current, voltage and power flow for operational purposes.
MSQI	Sequence. Consists of sequence values for three/multi-phase power systems via symmetrical components
MSTA[2]	Metering statistics. Consists of average, min and max for metered (MMXU) data.
RDRE	Disturbance Recorder Function. Indicates to a client that a new COMTRADE file has been created and is available for transfer. Refer to the *COMTRADE and ION Technology* technical note for more information.

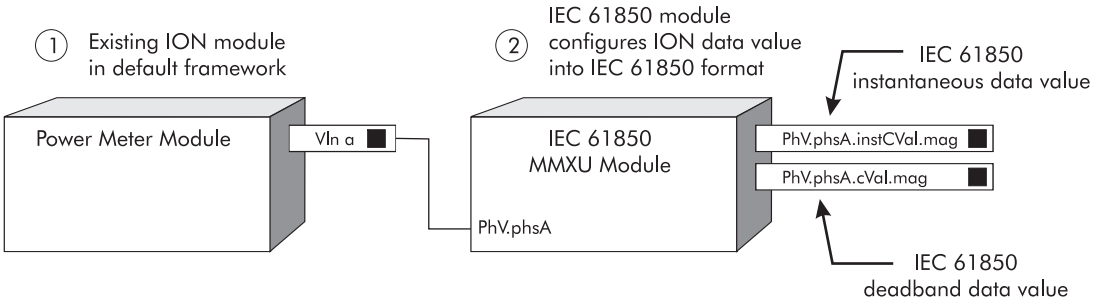
1. ION meters act like a single physical device, with one logical device. Only one instance of LLNO and LPHD can be defined.
2. The MSTA logical node is obsolete for edition 2, but it is continued to be supported for backward compatibility with namespace attributes in edition 1 (IEC 61850-7-4:2003).

Please refer to"Appendix A: Conformity" for detailed IEC 61850 attributes.

ION modules

Within the device's native ION architecture, specific ION modules map data to each of the IEC 61850 logical nodes, performing data conversion in addition to deadband monitoring calculations. The IEC 61850 data is updated once per second, regardless of the update rate of the related ION data.

Example of ION module mapping:



Because the ION modules are for mapping data only, the timestamps of the IEC 61850 data is based on the timestamp of the ION module's input. If a particular ION module is

not available, the associated IEC 61850 module's data values are set to N/A, and the IEC 61850 data's Quality attribute indicates that no valid data is available.

The IEC 61850 ION modules are created and connected by default in the meter templates that support IEC 61850. Manual creation and configuration of these modules, or modification of existing modules should only be undertaken by personnel with a thorough understanding of ION and IEC 61850 protocols. If modifying existing modules, make sure you use inputs that have the same units as the original register values to ensure consistency of the IEC 61850 related data.

You must configure the GGIO Custom modules to allow additional numeric and Boolean data values to be mapped from your meter into IEC 61850. Refer to your meter's user guide for instructions on how to configure the GGIO modules.

Refer to the *ION Reference* for detailed module information.

Features in the ION implementation of IEC 61850

Feature	Description
Data Sets	A collection of data values from any logical node. Data sets are configurable in the CID file using an IEC 61850 configuration tool. You can have a maximum of 6 data sets containing up to 50 data values each.
Report Control Blocks	Report control blocks (RCBs) are associated with a specific data set. When the report is enabled and the trigger conditions are met, the report is sent to a specific client. RCBs are configurable in the CID file using an IEC 61850 configuration tool. There are a total of 20 unbuffered reports and 4 buffered reports available.
Trigger Options	Specified in the RCB options in the CID file. Options include: – Quality Change – Data Change (using deadband values) – Data Update – Integrity Period – General Interrogation. Refer to "Configuring reporting triggers" on page 18.

Configuring your meter in IEC 61850

This section outlines how to create and download a CID file to your meter. When a correctly configured CID file has been downloaded to and validated by your meter, your meter's IEC 61850 server functions start. You can configure and create the IEC 61850 CID file offline, without any connection to the meter. You require an FTP connection to the meter to transfer the CID file to the meter.

Refer to your meter's user guide for instructions on how to add custom data values into IEC 61850 and how to enable IEC 61850 status values or control of the meter's input/output hardware ports.

Before you begin

You must completely configure all the non-IEC 61850 aspects of your meter (including communications and hardware inputs and outputs) separately from the IEC 61850 configuration process. Please refer to your meter's documentation for details.

NOTE: IEC 61850 I/O control and status must be configured using ION Setup. Refer to your meter's User Guide for details.

You need the ICD file that matches with your meter's hardware options and the supported edition version. The ICD files for each meter option and supported edition are available from www.schneider-electric.com.

You need an IEC 61850 configuration tool (such as Schneider Electric's CET850 IEC 61850 configuration tool) in order to create the CID file, and an FTP program (such as Windows Explorer or WinSCP) to load the CID file onto your meter.

Offline configuration

Generating your meter's CID file

For instructions on how to use your IEC 61850 configuration tool, please refer to the configuration tool's documentation.

1. Access the ICD file using the IEC 61850 configuration tool.
2. Enter the file properties to configure your meter. Properties that must be configured in the CID file include:
   - IED Name
   - Deadband values (refer to "Configuring reporting triggers" on page 18)

NOTE: Revision notes and change tracking information can be entered into the Header properties.

3. Review the default data sets (DS) and report control blocks (RCB) and create, delete and modify them as required. Refer to "Configurable aspects of IEC 61850" on page 16 for details on data sets, including permitted data members and quantities.
4. If desired, configure the descriptions ('d' field) for any logical node leafs.
5. Build the CID file.

On-site configuration

For on-site configuration you need an Ethernet connection to your meter to transfer files via FTP or using ION Setup.

Transmitting the CID file to your meter via FTP

You need to transmit the CID file you have built in the configuration tool to your meter via FTP. Only one CID file can be loaded onto the meter's FTP site for IEC 61850 to function; some meters will prevent you from loading more than one file.

NOTE: If you load different firmware onto your meter, the CID file on your meter will be erased and you will need to re-transmit the CID file to your meter.

These steps outline how to transmit your IEC 61850 CID file to your meter.

1. Run your FTP program (such as Windows Explorer or WinSCP).
2. Connect to your meter via FTP by entering your meter's IP address. Depending on your FTP program and meter security settings, you may be prompted for a user name and password.

NOTE: To connect to your meter using Windows Explorer, you must have the login and password included in the FTP connection string. For example, with standard meter security and the default front panel password of **0**, to connect to a meter with an IP address of 123.45.6.78, the Windows Explorer connection string would be: **ftp://0:0@123.45.6.78**

3. Open the IEC 61850 folder on your meter. If a CID file has already been loaded onto your meter then delete the old CID file or, if the old CID file and new CID file have the same name, overwrite the old file with the new CID file.

NOTE: You may want to archive your previous CID file as part of your IED's historical information.

4. Copy the CID file to the IEC 61850 folder on your meter.
5. The meter validates the CID file and writes the results to the log.txt file located in the meter's IEC 61850 directory.

NOTE: Depending on the device, there may be a delay of up to 90 seconds while your meter validates the CID file before it updates the log.txt file.

6. Open the log.txt file and review the CID file entry to confirm that the CID file is a valid configuration file. If the CID file is invalid, the IEC 61850 aspects of the meter will not function and an error description will be written in the log.txt file. Use the error description information to correct your CID file.

Refer to "log.txt" on page 9 for details.

Transmitting the CID file to your meter via ION Setup

You can load an IEC 61850 configuration (CID) file using ION Setup over an Ethernet connection.

You must have:

- The IEC 68150 configuration file stored in a location accessible by ION Setup. The configuration file is created by customizing the IEC 61850 device (ICD) file, which can be downloaded from www.schneider-electric.com.

- FTP access to your meter from the computer running ION Setup.

NOTE: Your meter can have only one IEC 61850 configuration (CID) file loaded onto its internal FTP site. If additional CID files are loaded, IEC 61850 functions are deactivated until the additional files are removed. See your meter's documentation for information on accessing your meter's internal FTP site.

1. Start ION Setup.
2. Open the Setup Assistant for your meter.
3. Navigate to **Communications > 3rd Party Protocols** and select the **IEC 61850** tab.
4. Highlight a parameter and click **Upload**. Navigate to where you stored your meter's CID file, select the file, and click **Open**.

   Your meter reviews the CID file to determine if it is valid. This process may take several minutes.

   The CID status indicates whether the meter has received and validated an IEC 61850 CID file and is operating as an IEC 61850 server.

Configurable aspects of IEC 61850

The following sections describe the configurable IEC 61850 aspects of the meter. To set up client connections and enable reports, please refer to your IEC 61850 client software documentation.

Configuring IEC 61850 ION modules

The GGIO modules are the only modules intended for user configuration. Modifying any other IEC 61850 modules is an advanced feature that should only be undertaken by personnel with a thorough understanding of ION and IEC 61850 protocols. The GGIO modules can be configured using ION Setup. You can download ION Setup from www.schneider-electric.com. Refer to your meter's documentation for details.

GGIO Custom Digital and GGIO Custom Analog modules

The GGIO Custom modules are intended to be configured using ION Setup or ION Enterprise software to map analog (numeric) or digital (Boolean) values from the meter that are not provided in the default IEC 61850 implementation.

Configuring additional data for IEC 61850 using ION Setup

You can map additional data to IEC 61850 using ION Setup.

You must have a valid IEC 61850 configuration file loaded onto your meter for IEC 61850 functionality, but it is not necessary for configuring additional data.

NOTE: You can configure additional data at any time, whether or not IEC 61850 is operating on your meter.

1. Start ION Setup.
2. Open the Setup Assistant for your meter.
3. Navigate to **Communications > 3rd Party Protocols** and select the **IEC 61850** tab.
4. Select the information type that corresponds to the type of meter information that you want to add to your IEC 61850 data. Select analog for numeric information and digital for boolean or binary information. Click **Edit**. The custom configuration screen is displayed.
5. Select the desired meter value from those available. If the value you want is not shown, select **Show all available registers**.
6. Select an IEC 61850 leaf to associate with the meter data, and click **>>** to map the value. Click **<<** to unmap values. Click **OK** to send and save your changes to the meter.

GGIO Onboard and Expansion modules

The GGIO Onboard and Expansion modules are already configured to provide information about the meter's onboard and expansion (option module) I/O. These modules can be configured (using Power Monitoring Expert or ION Setup) for IEC 61850 control of the meter's hardware outputs. Refer to your meter's documentation for instructions on how to configure IEC 61850 control of your meter's hardware outputs.

Configuring data sets

Data sets are configured using your IEC 61850 configuration tool. You can have up to 6 datasets containing a maximum of 50 data values each. If you exceed this limit, the resulting CID file will not function on your meter. Data sets must be located in LLN0 so that they can contain data from any logical node within that logical device. The ICD file for your meter is preconfigured with six default datasets:

Dataset	Description
Status	Device operational status dataset
MMXU	Default measurements dataset
MMTR	Default metering dataset
GGIO	Default hardware input/output dataset
PQ	Default power quality dataset
CustomIO	Default Custom GGIO dataset

Use your IEC 61850 configuration tool to modify, create or delete datasets in the CID file.

Data sets cannot contain members that are harmonics, or whose “doName” and “daName” attributes are not configured.

NOTE: IEC 61850 data is only updated every second, even if the associated ION data is updated more frequently.

Configuring reports

Reports are configured using your IEC 61850 configuration tool. Each client connection can enable all available reports. Reports are only sent to the client that has enabled the report. Reports must be located in logical node LLN0 so that they can contain any data set.

Unbuffered reports, when enabled, are transmitted one time only, and if the client is not connected or there is a communications issue, the report is lost. Buffered reports are transmitted while the client is connected and the report has been enabled. If the client is not connected the report is loaded into a circular, first-in-first-out buffer, to be resent when client connection is re-established and the buffered report is re-enabled. Data sets cannot be shared between buffered and unbuffered reports.

NOTE: Make sure that you have consistent IEC 61850 client connections. Intermittent or limited connection times may result in lost data reports.

The ICD file for your meter is preconfigured with five unbuffered reports and one buffered report per client connection:

Report	Buffered/ Unbuffered	Description
Device Status	Unbuffered	Contains Status dataset.
Measurements	Unbuffered	Contains MMXU dataset
Energy	Unbuffered	Contains MMTR dataset
Power Quality	Unbuffered	Contains PQ dataset
CustomIO	Unbuffered	Contains GGIO custom dataset
Hardware I/O	Buffered	Contains GGIO dataset

Use your IEC 61850 configuration tool to modify, create or delete reports in the CID file.

Your meter's configuration file is limited to four buffered and 20 unbuffered reports for a maximum of 24 reports. If you exceed the maximum number of reports or client connections, the resulting CID file will be invalid and will not run on your meter.

Configuring reporting triggers

Reporting triggers allow your meter to automatically generate and send reports to clients when certain conditions are met. They are configured using the IEC 61850 configuration tool. The most commonly-used triggers are:

Trigger Option	Description
dchg (data-change)	Report is triggered when there is a change in value of a member of the data set.
Integrity period	Report is triggered at user specified, periodic intervals.
gi (general-interrogation)	Report is triggered upon client request.

Refer to the "ACSI conformance statement" on page 21 for a full listing of reporting triggers.

Deadband values

In IEC 61850 certain parameters have an instantaneous value (which begins with "inst") and a deadbanded value. The instantaneous value is updated every second. The deadbanded value is set to the new instantaneous value when the difference between the new instantaneous value and the deadbanded value either equals or exceeds the deadband configured for that parameter.

You must use the IEC 61850 configuration tool to configure a data point's deadband value in the CID file. This value is stored in the "db" parameter associated with that data point. Deadband is an absolute value and is usually in different units than the banded data.

Example:

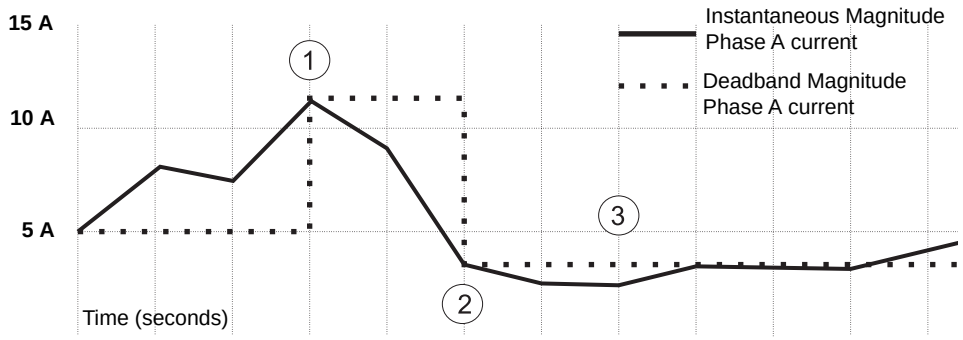
Configure the power quality report for client connection one (URCBPQ01) to be triggered (sent) when phase A current changes by 5 A or more from one reading to the next. The phase A current is in units of 1 A and the deadband (db) parameter is in units of 0.1 A.

Use the IEC 61850 configuration software to build a CID file that includes the following settings:

1. The phase A 'db' parameter (MMXU > A > phsA) is set to **50** which specifies a deadband range of 5 A (50 x 0.1 A = 5 A).
2. The power quality report for client connection one (LLN0 > URCBPQ01 > TrgOps) has the "dchg" option set to **True.**

NOTE: Reports are only sent if they have been enabled by the client.

Example of operation:



Initially, the phase A current has a instantaneous magnitude and a deadbanded magnitude of 5A. The deadband quantity, set through the IEC 61850 configuration tool, is 5.

1. At marker 1, Phase A current has an instantaneous magnitude of 12 A.
   - The difference between the instantaneous magnitude and deadbanded magnitude is greater than 5 A (the deadband range).
   - The dchg trigger is set, which sends URCBPQ01 to the client.
   - The deadbanded magnitude is set to the instantaneous magnitude (12 A).
2. At marker 2, Phase A current has an instantaneous magnitude of 4 A.
   - The difference between the instantaneous magnitude and deadbanded magnitude is greater than 5 A (the deadband range).
   - The dchg trigger is set, which sends URCBPQ01 to the client.
   - The deadbanded magnitude is set to the instantaneous magnitude (4 A).
3. At marker 3, Phase A current has an instantaneous magnitude of 3 A.
   - The difference between the instantaneous magnitude and deadbanded magnitude is less than 5 A (the deadband range).
   - The dchg trigger is not set, no reports are sent to the client.
   - The deadbanded magnitude remains at its existing value (4 A).

Appendix A: Conformity

This appendix describes the conformity with IEC 61850. It does not describe the standard itself, only the details of the IEC 61850 implementation in the ION meter in terms of services, modeling, exceptions, extensions and adaptations.

The conformance is described in the following statements:

- ACSI conformance statement: describes the abstract services interface (which services are implemented). These services are mapped to specific communication services (SCSM) described in the PICS.
- MICS (Model Implementation Conformance Statement): describes how the information model is implemented.
- PICS (Protocol Implementation Conformance Statement): describes how the IEC 61850 protocol is implemented.
- PIXIT (Protocol Implementation eXtra Information for Testing): describes additional implementation-specific information not contained within the previous standard statements.
- TICS (TISSUES Implementation Conformance Statement): describes technical issues that have been incorporated into our implementation of the IEC 61850 protocol.

ACSI conformance statement

The Abstract Communication Services Interface (ACSI) is defined by IEC 61850-7-2, and provides the following specifications:

- a basic information model.
- information exchange service models.

Supported features are denoted with an “X”.

ACSI basic conformance statement

ACSI basic conformance statement		Client/ subscriber	Server/ publisher	Value/ comments
Client-server roles				
B11	Server side (of two-party application-association)		X	
B12	Client side (of two-party application-association)			
SCSMs supported				
B21	SCSM: IEC 61850-8-1 used		X	
B22	SCSM: IEC 61850-9-1 used			
B23	SCSM: IEC 61850-9-2 used			
B24	SCSM: other			
Generic substation event model (GSE)				
B31	Publisher side			
B32	Subscriber side			

ACSI models conformance statement

ACSI models conformance statement		Client/ subscriber	Server/ publisher	Value/ comments
If Server side (B11) supported				
M1	Logical device		X	
M2	Logical node		X	
M3	Data		X	
M4	Data set		X	
M5	Substitution			
M6	Setting group control			
Reporting				
M7	Buffered report control		X	
M7-1	sequence number		X	
M7-2	report-time-stamp		X	
M7-3	reason-for-inclusion		X	
M7-4	data-set-name		X	
M7-5	data-reference		X	
M7-6	buffer-overflow		X	
M7-7	entryID		X	
M7-8	BufTm		X	
M7-9	IntgPd		X	
M7-10	GI		X	
M8	Unbuffered report control		X	
M8-1	sequence-number		X	
M8-2	report-time-stamp		X	
M8-3	reason-for-inclusion		X	
M8-4	data-set-name		X	
M8-5	data-reference		X	
M8-6	BufTm		X	

ACSI models conformance statement		Client/ subscriber	Server/ publisher	Value/ comments
M8-7	IntgPd		X	
M8-8	GI		X	
Logging				
M9	Log control			
M9-1	IntgPd			
M10	Log			
Control				
M11	Control		X	
If SVC (B41/42) is supported				
M14	Multicast SVC			
M15	Unicast SVC			
Other				
M16	Time		X	
M17	File Transfer			

ACSI service conformance statement

ACSI service conformance statement		Client/ subscriber	Server/ publisher	Value/ comments
Server (Clause 6)				
S1	ServerDirectory		X	
Application association (Clause 7)				
S2	Associate		X	
S3	Abort		X	
S4	Release		X	
Logical device (Clause 8)				
S5	LogicalDeviceDirectory		X	
Logical node (Clause 9)				
S6	LogicalNodeDirectory		X	
S7	GetAllDataValues		X	
Data (Clause 10)				
S8	GetDataValues		X	
S9	SetDataValues			
S10	GetDataDirectory		X	
S11	GetDataDefinition		X	
Data set (Clause 11)				
S12	GetDataSetValues		X	
S13	SetDataSetValues			
S14	CreateDataSet			
S15	DeleteDataSet			
S16	GetDataSetDirectory		X	
Substitution (Clause 12)				
S17	SetDataValues			
Setting group control (Clause 13)				
S18	SelectActiveSG			
S19	SelectEditSG			
S20	SetSGValues			
S21	ConfirmEditSGValues			
S22	GetSGValues			
S23	SetSGCBValues			
Reporting (Clause 14)				
Buffered report control block (BRCB)				

ACSI service conformance statement		Client/ subscriber	Server/ publisher	Value/ comments
S24	Report		X	
S24-1	data-change (dchg)		X	
S24-2	qchg-change (qchg)		X	
S24-3	data-update (dupd)		X	
S25	GetBRCBValues		X	
S26	SetBRCBValues		X	
Unbuffered report control block (URCB)				
S27	Report		X	
S27-1	data-change (dchg)		X	
S27-2	qchg-change (qchg)		X	
S27-3	data-update (dupd)		X	
S28	GetURCBValues		X	
S29	SetURCBValues		X	
Logging (Clause 14)				
Log control block				
S30	GetLCBValues			
S31	SetLCBValues			
Log				
S32	QueryLogByTime			
S33	QueryLogAfter			
S34	GetLogStatusValues			
Transmission of sampled value model (SVC) (Clause 16)				
Multicast SVC				
S45	SendMSVMessage			
S46	GetMSVCBValues			
S47	SetMSVCBValues			
Unicast SVC				
S48	SendUSVMessage			
S49	GetUSVCBValues			
S50	SetUSVCBValues			
Control (17.5.1)				
S51	Select			
S52	SelectWithValue			
S53	Cancel			
S54	Operate		X	
S55	Command-termination			
S56	TimeActivated-operate			
File transfer (Clause 20)				
S57	GetFile			
S58	SetFile			
S59	DeleteFile			
S60	GetFileAttributeValues			
Time (5.5)				
T1	Time resolution of internal clock		X	-3
T2	Time accuracy of internal clock		X	0
T3	Supported Timestamp resolution		X	0

Model implementation conformance statement

The model implementation conformance statement is defined by IEC 61850-7-3 and IEC 61850-7-4, and provides the following specifications:

- logical nodes, used to model substation devices and functions.
- common data classes and common data attribute classes used in the logical nodes.

Data requirements are rated M/O/C/E, as follows:

- M: Mandatory
- O: Optional
- C: Conditional
- E: Extension

Supported data requirements are indicated with an “X”.

Supported models

The supported models are:

- ION7400
- ION7550/ION7650
- ION8650
- ION8800
- PM8000

Logical node

System logical nodes (L group)

Physical device information (LPHD) class:

Attribute name	Attribute type	Explanation/value	M/O/C/E	See "Supported models" on page 24.
LNName	Object name	LPHD	M	X
PhyNam	DPL	Physical device name plate	M	X
PhyHealth	INS	Physical device health	M	X
Proxy	SPS	Indicates if this LN is a proxy	M	X

Logical node zero (LLN0) class:

Attribute name	Attribute type	Explanation/value	M/O/C/E	See "Supported models" on page 24.
LNName	Object name	LLN0	M	X
Common logical node information				
Mod	INC	Mode	M	X
Beh	INS	Behaviour	M	X
Health	INS	Health	M	X
NamPlt	LPL	Name plate	M	X

Metering and measurement logical nodes (M group)

NOTE: Logical node names may vary by device and hardware implementation.

Harmonics (MHAI) class:

Attribute name	Attribute type	Explanation/value	M/O/C/E	See "Supported models" on page 24.
LNName	Object name	MHAI	M	X
Common logical node information				
Mod	INC	Mode	M	X
Beh	INS	Behaviour	M	X
Health	INS	Health	M	X
NamPlt	LPL	Name plate	M	X
Measured or calculated values				
Hz	MV	Basic frequency	O	X
HA	HWYE	Sequence of harmonics or interharmonics current	O	X
HPhV	HWYE	Sequence of harmonics or interharmonics voltage	O	X
HPPV	HDEL	Sequence of harmonics or interharmonics phase to phase voltages	O	X
HKf	WYE	K factor	O	X
ThdA	WYE	Current total harmonic or interharmonic distortion	O	X
ThdOddA	WYE	Current total harmonic or interharmonic distortion (odd components only)	O	X

Attribute name	Attribute type	Explanation/value	M/O/C/E	See "Supported models" on page 24.
ThdEvnA	WYE	Current total harmonic or interharmonic distortion (even components only)	O	X
ThdPhV	WYE	Phase to ground voltage total harmonic or interharmonic distortion	O	X
ThdOddPhV	WYE	Phase to ground voltage total harmonic or interharmonic distortion (odd components only)	O	X
ThdEvnPhV	WYE	Phase to ground voltage total harmonic or interharmonic distortion (even components only)	O	X
HCfA	WYE	Current crest factors	O	X
ThdPPV	DEL	Phase to phase voltage total harmonic or interharmonic distortion	O	X
ThdOddPPV	DEL	Phase to phase voltage total harmonic or interharmonic distortion (odd components only)	O	X
ThdEvnPPV	DEL	Phase to phase voltage total harmonic or interharmonic distortion (even components only)	O	X

Metering (MMTR) class:

Attribute name	Attribute type	Explanation/value	M/O/C/E	See "Supported models" on page 24.
LNName	Object name	MMTR	M	X
Common logical node information				
Mod	INC	Mode	M	X
Beh	INS	Behaviour	M	X
Health	INS	Health	M	X
NamPlt	LPL	Name plate	M	X
Measured or calculated values				
TotVAh[1]	BCR	Net apparent energy	O	X
TotWh[1]	BCR	Net real energy	O	X
TotVarh[1]	BCR	Net reactive energy	O	X
SupWh	BCR	Real energy supplied (default supply direction: energy flow towards busbar)	O	X
SupVArh	BCR	Reactive energy supplied (default supply direction: energy flow towards busbar)	O	X
DmdWh	BCR	Real energy demand (default demand direction: energy flow from busbar)	O	X
DmdVArh	BCR	Reactive energy demand (default demand direction: energy flow from busbar)	O	X

[1] Values accumulated since last reset

Measurement (MMXU) class:

Attribute name	Attribute type	Explanation/value	M/O/C/E	See "Supported models" on page 24.
LNName	Object name	MMXU	M	X
Common logical node information				
Mod	INC	Mode	M	X
Beh	INS	Behaviour	M	X
Health	INS	Health	M	X
NamPlt	LPL	Name plate	M	X
Measured or calculated values				
TotW	MV	Total real power	O	X
TotVAr	MV	Total reactive power	O	X
TotVA	MV	Total apparent power	O	X
TotPF	MV	Average power factor	O	X
Hz	Mv	Power system frequency	O	X
PPV	DEL	Phase to phase voltages, including angles	O	X
PhV	WYE	Phase to ground voltages, including angles	O	X
A	WYE	Phase currents	O	X
W	WYE	Phase active power	O	X
VAr	WYE	Phase reactive power	O	X
VA	WYE	Phase apparent power	O	X
PF	WYE	Phase to ground power factor	O	X

Sequence (MSQI) class:

Attribute name	Attribute type	Explanation/value	M/O/C/E	See "Supported models" on page 24.
LNName	Object name	MSQI	M	X
Common logical node information				
Mod	INC	Mode	M	X
Beh	INS	Behaviour	M	X
Health	INS	Health	M	X
NamPlt	LPL	Name plate	M	X
Measured or calculated values				
SeqA	SEQ	Positive, negative and zero sequence current	C	X
SeqV	SEQ	Positive, negative and zero sequence voltage	C	X

Statistics (MSTA) class:

Attribute name	Attribute type	Explanation/value	M/O/C/E	See "Supported models" on page 24.
LNName	Object name	MSTA	M	X
Common logical node information				
Mod	INC	Mode	M	X
Beh	INS	Behaviour	M	X
Health	INS	Health	M	X

Attribute name	Attribute type	Explanation/value	M/O/C/E	See "Supported models" on page 24.
NamPlt	LPL	Name plate	M	X
Measured or calculated values				
AvVA	MV	Average apparent power	O	X
MaxVA	MV	Maximum apparent power	O	X
MinVA	MV	Minimum apparent power	O	X
AvW	MV	Average real power	O	X
MaxW	MV	Maximum real power	O	X
MinW	MV	Minimum real power	O	X
AvVAr	MV	Average reactive power	O	X
MaxVAr	MV	Maximum reactive power	O	X
MinVAr	MV	Minimum reactive power	O	X

Recording logical nodes (R group)

Disturbance recorder (RDRE) class:

Attribute name	Attribute type	Explanation/value	M/O/C/E	See "Supported models" on page 24.
LNName	Object name	RDRE	M	X
Common logical node information				
Mod	INC	Mode	M	X
Beh	INS	Behaviour	M	X
Health	INS	Health	M	X
NamPlt	LPL	Name plate	M	X
Functional attributes				
RcdMade	SPS	Recording made	M	X
FltNum	INS	Fault number	M	X

Generic reference logical nodes (G group)

NOTE: Logical node names may vary by device and hardware implementation.

Generic process I/O (GGIO)

Onboard I/O (GGIOOnb) class:

Attribute name	Attribute type	Explanation/value	M/O/C/E	ION7550/ ION7650	ION8650	ION8800	PM8000, ION7400
LNName	Object name	GGIOOnb	M	X	X	X	X
Common logical node information							
Mod	INC	Mode	M	X	X	X	X
Beh	INS	Behaviour	M	X	X	X	X
Health	INS	Health	M	X	X	X	X
NamPlt	LPL	Name plate	M	X	X	X	X
Functional attributes							
SPCS01	SPC	Single point controllable status output	O	X	X	X	X
SPCS02	SPC	Single point controllable status output	O	X	X	X	
SPCS03	SPC	Single point controllable status output	O	X	X	X	

Attribute name	Attribute type	Explanation/value	M/O/C/E	ION7550/ ION7650	ION8650	ION8800	PM8000, ION7400
SPCS04	SPC	Single point controllable status output	O	X	X	X	
SPCS05	SPC	Single point controllable status output	O	X	X	X	
SPCS06	SPC	Single point controllable status output	O	X		X	
SPCS07	SPC	Single point controllable status output	O	X		X	
SPCS08	SPC	Single point controllable status output	O			X	
SPCS09	SPC	Single point controllable status output	O			X	
SPCS010	SPC	Single point controllable status output	O			X	
SPCS011	SPC	Single point controllable status output	O			X	
SPCS012	SPC	Single point controllable status output	O			X	
SPCS013	SPC	Single point controllable status output	O			X	
Ind1	SPS	General indication (binary input)	O	X	X	X	X
Ind2	SPS	General indication (binary input)	O	X	X	X	X
Ind3	SPS	General indication (binary input)	O	X	X	X	X
Ind4	SPS	General indication (binary input)	O	X			
Ind5	SPS	General indication (binary input)	O	X			
Ind6	SPS	General indication (binary input)	O	X			
Ind7	SPS	General indication (binary input)	O	X			
Ind8	SPS	General indication (binary input)	O	X			

Expansion Card I/O (GGIOExp) class:

NOTE: The ION8800 does not have expansion card I/O.

Attribute name	Attribute type	Explanation/value	M/O/C/E	ION7550/ ION7650	ION8650	PM8000, ION7400
LNName	Object name	GGIOExp	M	X	X	X
Common logical node information						
Mod	INC	Mode	M	X	X	X
Beh	INS	Behaviour	M	X	X	X
Health	INS	Health	M	X	X	X
NamPlt	LPL	Name plate	M	X	X	X
Functional attributes						
SPCS01	SPC	Single point controllable status output	O		X	X
SPCS02	SPC	Single point controllable status output	O		X	X
SPCS03	SPC	Single point controllable status output	O		X	

Attribute name	Attribute type	Explanation/value	M/O/C/E	ION7550/ ION7650	ION8650	PM8000, ION7400
SPCS04	SPC	Single point controllable status output	O		X	
SPCS05	SPC	Single point controllable status output	O		X	
SPCS06	SPC	Single point controllable status output	O		X	
SPCS07	SPC	Single point controllable status output	O		X	
SPCS08	SPC	Single point controllable status output	O		X	
ISCS01	INC	Integer status controllable status output	O	X	X	X
ISCS02	INC	Integer status controllable status output	O	X	X	X
ISCS03	INC	Integer status controllable status output	O	X	X	
ISCS04	INC	Integer status controllable status output	O	X	X	
AnIn1	MV	Analog input	O	X		X
AnIn2	MV	Analog input	O	X		X
AnIn3	MV	Analog input	O	X		X
AnIn4	MV	Analog input	O	X		X
Ind1	SPS	General indication (binary input)	O	X	X	X
Ind2	SPS	General indication (binary input)	O	X	X	X
Ind3	SPS	General indication (binary input)	O	X	X	X
Ind4	SPS	General indication (binary input)	O	X	X	X
Ind5	SPS	General indication (binary input)	O	X	X	X
Ind6	SPS	General indication (binary input)	O	X	X	X
Ind7	SPS	General indication (binary input)	O	X	X	
Ind8	SPS	General indication (binary input)	O	X	X	

Custom Analog I/O (GGIOCus1) class:

Attribute name	Attribute type	Explanation/value	M/O/C/E	See “Supported models” on page 24.
LNName	Object name	GGIOCus1	M	X
Common logical node information				
Mod	INC	Mode	M	X
Beh	INS	Behaviour	M	X
Health	INS	Health	M	X
NamPlt	LPL	Name plate	M	X
Functional attributes				
AnIn1	MV	Analog input	O	X
AnIn2	MV	Analog input	O	X
AnIn3	MV	Analog input	O	X
AnIn4	MV	Analog input	O	X
AnIn5	MV	Analog input	O	X
AnIn6	MV	Analog input	O	X
AnIn7	MV	Analog input	O	X
AnIn8	MV	Analog input	O	X
AnIn9	MV	Analog input	O	X
AnIn10	MV	Analog input	O	X

Attribute name	Attribute type	Explanation/value	M/O/C/E	See "Supported models" on page 24.
AnIn11	MV	Analog input	O	X
AnIn12	MV	Analog input	O	X
AnIn13	MV	Analog input	O	X
AnIn14	MV	Analog input	O	X
AnIn15	MV	Analog input	O	X
AnIn16	MV	Analog input	O	X

Custom Digital I/O (GGIOCus2) class:

Attribute name	Attribute type	Explanation/value	M/O/C/E	See "Supported models" on page 24.
LNName	Object name	GGIOCus2	M	X
Common logical node information				
Mod	INC	Mode	M	X
Beh	INS	Behaviour	M	X
Health	INS	Health	M	X
NamPlt	LPL	Name plate	M	X
Functional attributes				
Ind1	SPS	General indication (binary input)	O	X
Ind2	SPS	General indication (binary input)	O	X
Ind3	SPS	General indication (binary input)	O	X
Ind4	SPS	General indication (binary input)	O	X
Ind5	SPS	General indication (binary input)	O	X
Ind6	SPS	General indication (binary input)	O	X
Ind7	SPS	General indication (binary input)	O	X
Ind8	SPS	General indication (binary input)	O	X
Ind9	SPS	General indication (binary input)	O	X
Ind10	SPS	General indication (binary input)	O	X
Ind11	SPS	General indication (binary input)	O	X
Ind12	SPS	General indication (binary input)	O	X
Ind13	SPS	General indication (binary input)	O	X
Ind14	SPS	General indication (binary input)	O	X
Ind15	SPS	General indication (binary input)	O	X
Ind16	SPS	General indication (binary input)	O	X

Common data attributes classes

The following tables list which fields are found in each common data attribute class. Fields not found in these tables are optional (O) or conditional (C) fields not supported by ION devices. Mandatory fields (M) are always present.

Timestamp

Attribute name	Attribute type	Value/value range	M/O/C	Comments
SecondsSinceEpoch	INT32	(0...MAX)	M	
FractionOfSecond	INT24U	Default: 0	M	Default
TimeQuality	TimeQuality	See TimeQuality table	M	Default

TimeQuality

Attribute name	Attribute type	Value/value range	M/O/C	Comments
LeapSecondsKnown	Boolean	Default: false	M	Default
ClockFailure	Boolean	Default: false	M	Default
ClockNotSynchronized	Boolean	Default: false	O	Default
TimeAccuracy	Coded Enum	Default: 00000	M	Default

Quality

Attribute name	Attribute type	Value/value range	M/O/C	Comments
validity	Coded enum	good/invalid	M	
detailQual	Packed list		M	
– overflow	Boolean	True/false	M	Default: false
– outOfRange	Boolean	True/false	M	Default: false
– badReference	Boolean	True/false	M	Default: false
– oscillatory	Boolean	True/false	M	Default: false
– failure	Boolean	True/false	M	Default: false
– oldData	Boolean	True/false	M	Default: false
– inconsistent	Boolean	True/false	M	Default: false
– inaccurate	Boolean	True/false	M	Default: false
source	Coded enum	process/substituted default: false	M	Default: process
test	Boolean	True/false	M	Default: false
operatorBlocked	Boolean	True/false	M	Default: false

Vector

Attribute name	Attribute type	Value/value range	M/O/C	Comments
mag	AnalogValue	Analog value	M	
ang	AnalogValue	Analog value	O	

Operate configuration

Attribute name	Attribute type	Value/value range	M/O/C	Comments
ctlVal	Boolean		M	
origin	Originator		M	
ctlNum	INT8U		M	
T	Timestamp		O	
Test	Boolean		O	
Check	Check		O	

Operate configuration 2

Attribute name	Attribute type	Value/value range	M/O/C	Comments
ctlVal	INT32		M	
origin	Originator		M	
ctlNum	INT8U		M	
T	Timestamp		O	
Test	Boolean		O	
Check	Check		O	

Analog value

Attribute name	Attribute type	Value/value range	M/O/C	Comments

f	Float32	floating point value	C	

Originator

Attribute name	Attribute type	Value/value range	M/O/C	Comments
orCat	Enum	Refer to IEC 61850 standard	M	
orIdent	Octet String64		M	

Unit

Attribute name	Attribute type	Value/value range	M/O/C	Comments
SIUnit	SIUnit	Refer to IEC 61850 standard	M	
multiplier	Multiplier	Refer to IEC 61850 standard	O	

Sub-data attributes

CtlModel value

Attribute name	Attribute order	Supported/Not Supported
status-only	0	Supported
direct-with-normal-security	1	Supported
sbo-with-normal-security	2	Not Supported
direct-with-enhanced-security	3	Not Supported
sbo-with-enhanced-security	4	Not Supported

Sequence value

Attribute name	Attribute order	Supported/Not Supported
pos-neg-zero	0	Supported
dir-quad-zero	1	Not Supported

Common data classes

The following tables list which attributes are found in each common data class. Fields that are not supported by ION devices are optional (O) or conditional (C). Mandatory fields (M) are always present.

Single point status (SPS)

Attribute name	Attribute type	FC	M/O/C	Comments
stVal	Boolean	ST	M	
q	Quality	ST	M	
t	Timestamp	ST	M	
d	Visible string 255	DC	O	

Integer status (INS)

Attribute name	Attribute type	FC	M/O/C	Comments
stVal	INT32	ST	M	
q	Quality	ST	M	
t	Timestamp	ST	M	
d	Visible string 255	DC	O	

Integer status 2 (INS)

Attribute name	Attribute type	FC	M/O/C	Comments
stVal	Enumerated	ST	M	
q	Quality	ST	M	
t	Timestamp	ST	M	
d	Visible string 255	DC	O	

Enumerated status (ENS)

Attribute name	Attribute type	FC	M/O/C	Comments
stVal	Enumerated	ST	M	
q	Quality	ST	M	
t	Timestamp	ST	M	
d	Visible string 255	DC	O	

Binary counter reading (BCR)

Attribute name	Attribute type	FC	M/O/C	Comments
actVal	Int64	ST	M	
q	Quality	ST	M	
t	Timestamp	ST	M	
units	Unit	CF	O	
pulsQty	Float32	CF	O	
d	Visible string 255	DC	O	

Measured value (MV)

Attribute name	Attribute type	FC	M/O/C	Comments
instMag	AnalogVal	MX	O	
mag	AnalogVal	MX	M	
q	Quality	MX	M	
t	Timestamp	MX	M	
units	Unit	CF	O	
db	Int32U	CF	O	
d	Visible string 255	DC	O	

Complex measured value (CMV)

Attribute name	Attribute type	FC	M/O/C	Comments
instCVal	Vector	MX	O	
cVal	Vector	MX	M	
q	Quality	ST	M	
t	Timestamp	ST	M	
units	Unit	CF	O	
db	Int32U	CF	O	
d	Visible string 255	DC	O	

Complex measured value 2 (CMV)

Attribute name	Attribute type	FC	M/O/C	Comments
cVal	Vector	MX	M	
q	Quality	ST	M	
t	Timestamp	ST	M	

WYE (WYE)

Attribute name	Attribute type	FC	M/O/C	Comments
phsA	CMV		C	
phsB	CMV		C	
phsC	CMV		C	
neut	CMV		C	If supported by meter
net	CMV		C	If supported by meter
d	Visible string 255	DC	O	

Delta (DEL)

Attribute name	Attribute type	FC	M/O/C	Comments
phsAB	CMV		C	
phsBC	CMV		C	
phsCA	CMV		C	
d	Visible string 255	DC	O	

Sequence (SEQ)

Attribute name	Attribute type	FC	M/O/C	Comments
c1	CMV		M	
c2	CMV		M	
c3	CMV		M	
seqT	SeqT	MX	M	
d	Visible string 255	DC	O	

Harmonic value for WYE (HWYE) - IEC 61850 Edition 1

Attribute name	Attribute type	FC	M/O/C	Comments
q	Quality	ST	M	
t	Timestamp	ST	M	
phsAHar	Vector	MX	M	
phsBHar	Vector	MX	O	
phsCHar	Vector	MX	O	
neutHar	Vector	MX	O	
numHar	Int16U	CF	M	
numCyc	Int16U	CF	M	
evalTm	Int16U	CF	M	
frequency	Float32	CF	M	
d	Visible string 255	DC	O	

Harmonic value for WYE (HWYE) - IEC 61850 Edition 2

Attribute name	Attribute type	FC	M/O/C	Comments
q	Quality	ST	M	
t	Timestamp	ST	M	
phsAHar	Array of CMV	MX	M	
phsBHar	Array of CMV	MX	O	
phsCHar	Array of CMV	MX	O	
neutHar	Array of CMV	MX	O	
numHar	Int16U	CF	M	
numCyc	Int16U	CF	M	

Attribute name	Attribute type	FC	M/O/C	Comments
evalTm	Int16U	CF	M	
frequency	Float32	CF	M	
d	Visible string 255	DC	O	

Harmonic value for DEL (HDEL) - IEC 61850 Edition 1

Attribute name	Attribute type	FC	M/O/C	Comments
q	Quality	ST	M	
t	Timestamp	ST	M	
phsABHar	Vector	MX	M	
phsBCHar	Vector	MX	O	
phsCAHar	Vector	MX	O	
numHar	Int16U	CF	M	
numCyc	Int16U	CF	M	
evalTm	Int16U	CF	M	
frequency	Float32	CF	M	
d	Visible string 255	DC	O	

Harmonic value for DEL (HDEL) - IEC 61850 Edition 2

Attribute name	Attribute type	FC	M/O/C	Comments
q	Quality	ST	M	
t	Timestamp	ST	M	
phsABHar	Array of CMV	MX	M	
phsBCHar	Array of CMV	MX	O	
phsCAHar	Array of CMV	MX	O	
numHar	Int16U	CF	M	
numCyc	Int16U	CF	M	
evalTm	Int16U	CF	M	
frequency	Float32	CF	M	
d	Visible string 255	DC	O	

Controllable single point (SPC)

Attribute name	Attribute type	FC	M/O/C	Comments
stVal	Boolean	ST	M	
q	Quality	ST	M	
t	Timestamp	ST	M	
Oper	Operate	CO	M	
ctlVal	Boolean	CO	M	
ctlModel	CtlModel	CF	M	
d	Visible string 255	DC	O	

Controllable integer status (INC)

Attribute name	Attribute type	FC	M/O/C	Comments
stVal	Int32	ST	M	
q	Quality	ST	M	
t	Timestamp	ST	M	
ctlVal	Int32	CO	C	
ctlModel	CtlModel	CF	M	
d	Visible string 255	DC	O	

Controllable integer status 2 (INC)

Attribute name	Attribute type	FC	M/O/C	Comments
stVal	Enumerated	ST	M	
q	Quality	ST	M	
t	Timestamp	ST	M	
ctlVal	Int32	CO	C	
ctlModel	CtlModel	CF	M	
d	Visible string 255	DC	O	

Controllable enumerated status (ENC)

Attribute name	Attribute type	FC	M/O/C	Comments
stVal	Enumerated	ST	M	
q	Quality	ST	M	
t	Timestamp	ST	M	
ctlVal	Int32	CO	C	
ctlModel	CtlModel	CF	M	
d	Visible string 255	DC	O	

Device name plate (DPL)

Attribute name	Attribute type	FC	M/O/C	Comments
vendor	Visible string 255	DC	M	
swRev	Visible string 255	DC	O	
serNum	Visible string 255	DC	O	
model	Visible string 255	DC	O	
location	Visible string 255	DC	O	

Logical node name plate (LPL)

Attribute name	Attribute type	FC	M/O/C	Comments
vendor	Visible string 255	DC	M	
swRev	Visible string 255	DC	M	
d	Visible string 255	DC	M	
configRev	Visible string 255	DC	C	
ldNs	Visible string 255	EX	C	

Logical node name plate 2 (LPL)

Attribute name	Attribute type	FC	M/O/C	Comments
vendor	Visible string 255	DC	M	
swRev	Visible string 255	DC	M	
d	Visible string 255	DC	M	
configRev	Visible string 255	DC	C	
ldNs	Visible string 255	EX	C	
dataNs	Visible string 255	EX	C	

Logical nodes per device type

Logical node	ION7550/ ION7650	ION8650	ION8800	PM8000, ION7400
LLN0	X	X	X	X
LPHD1	X	X	X	X
MHAI1	X	X	X	X

Logical node	ION7550/ ION7650	ION8650	ION8800	PM8000, ION7400
MMTR1	X	X	X	X
M03_MMXU1	X	X	X	X
MSQI1	X	X	X	X
MSTA1	X	X	X	X
RDRE1[1]	X	X	X	X
RDRE2[1]	X	X	X	X
RDRE3[1]				X
ONB1_GGIO1[2]	X	X	X	X
ONB2_GGIO1[2]		X	X	
ONB3_GGIO1[2]			X	
ONB4_GGIO1[2]			X	
ONB5_GGIO1[2]			X	
EXP1_GGIO2[3]	X	X		X
EXP1_GGIO3[3]				X
EXP1_GGIO4[3]				X
EXP1_GGIO5[3]				X
EXP2_GGIO2[3]	X	X		X
EXP2_GGIO3[3]				X
EXP2_GGIO4[3]				X
EXP2_GGIO5[3]				X
EXP3_GGIO2[3]	X	X		
EXP4_GGIO2[3]	X	X		
EXP5_GGIO2[3]	X			
EXP6_GGIO2[3]	X			
CUS1_GGIO3 (Analog values)	X	X	X	
CUS2_GGIO4 (Digital values)	X	X	X	
CUS1_GGIO6 (Analog values)				X
CUS2_GGIO7 (Digital values)				X

[1] The RDRE Logical Nodes are only available if waveform recording is available.

[2] The onboard I/O GGIO Logical Node is determined based on the input/output hardware option of your meter. Only one instance of this Logical Node is present on your meter.

[3] The expansion I/O GGIO Logical Nodes are determined based on the input/output hardware expansion option of your meter. Only one instance of each Logical Node is present on your meter.

Expansion I/O Logical Nodes

Meter	Logical Node	Analog in	Analog out	Digital in	Digital out	Current range
ION7650	EXP1	4	—	8	—	0 - 1 mA in
	EXP2	4	—	8	—	0 - 20 mA in
	EXP3	—	4	8	—	-1 - 1 mA out
	EXP4	—	4	8	—	0 - 20 mA out
	EXP5	4	4	8	—	0 - 20 mA in 0 - 20 mA out
	EXP6	4	4	8	—	-1 - 1 mA out 0 - 20 mA in

ION8650	EXP1	—	—	8	8	—
	EXP2	—	4	8	4	0-20 mA out
	EXP3	—	4	8	4	-1 - 1 mA out
	EXP4	—	4	8	4	-1 - 1 mA Qty1 0 - 20 mA Qty2
Digital option module METSEPM89M2600[1]	EXP1	—	—	6	—	—
Analog option module METSEPM89M0024[1]	EXP2	4	2	—	—	4 - 20 mA or 0V - 10V out 4 - 20 mA or 0V - 30V in

1. Option modules are compatible with the PM8000 and ION7400 meters.

NOTE: The ION8800 meter does not have Expansion I/O Logical Nodes.

Profile implementation conformance statement

The profile implementation conformance statement is defined by IEC 61850-8-1, and provides the following specifications:

- mapping of the objects and services of the ACSI to MMS.
- mapping of time-critical information exchanges to ISO/IEC 8802-3.

Support is indicated M/O/C/I/X as follows:

- M: Mandatory
- O: Optional
- C: Conditional
- I: Out of scope
- X: Supported

Profile conformance

A-profile support

Profile		Client	Server	Comments
A1	Client/server		X	
A2	GOOSE/GSE Management			
A3	GSSE			
A4	Time sync			

T-profile support

Profile		Client	Server	Comments
T1	TCP/IP profile		X	
T2	OSI T profile		X	
T3	GOOSE/GSE T profile			
T4	GSSE T profile			
T5	Time sync T profile			

MMS conformance

MMS service supported CBB (server)	M/O/C/I	Supported
status	M	X
getNameList	C	X
identify	M	X
rename	O	
read	C	X
write	C	X
getVariableAccessAttributes	C	X
defineNamedVariable	O	X
defineScatteredAccess	I	
getScatteredAccessAttributes	I	
deleteVariableAccess	O	
defineNamedVariableList	O	
getNamedVariableListAttributes	C	X
defineNamedType	I	
getNamedTypeAttributes	I	
deleteNamedType	I	
input	I	
output	I	
takeControl	I	
relinquishControl	I	
defineSemaphore	I	
deleteSemaphore	I	
reportPoolSemaphoreStatus	I	
reportSemaphoreStatus	I	
initiateDownloadSequence	I	
downloadSegment	I	
terminateDownloadSequence	I	
initiateUploadSequence	I	
uploadSegment	I	
terminateUploadSequence	I	
requestDomainDownload	I	

MMS service supported CBB (server)	M/O/C/I	Supported
requestDomainUpload	I	
loadDomainContent	I	
storeDomainContent	I	
deleteDomain	I	
getDomainAttributes	C	X
createProgramInvocation	I	
deleteProgramInvocation	I	
start	I	
stop	I	
resume	I	
reset	I	
kill	I	
getProgramInvocationAttributes	I	
obtainFile	I	
defineEventCondition	I	
deleteEventContition	I	
getEventConditionAttributes	I	
reportEventConditionStatus	I	
alterEventConditionMonitoring	I	
triggerEvent	I	
defineEventAction	I	
deleteEventAction	I	
alterEventEnrollment	I	
reportEventEnrollmentStatus	I	
getEventEnrollmentAttributes	I	
acknowledgeEventNotification	I	
getAlarmSummary	I	
getAlarmEnrollmentSummary	I	
readJournal	C	
writeJournal	I	
intializeJournal	C	
reportJournalStatus	I	
createJournal	I	
deleteJournal	I	
fileOpen	C	
fileRead	C	
fileClose	C	
fileRename	I	
fileDelete	C	
fileDirectory	C	
unsolicitedStatus	I	
informationReport	C	X
eventNotification	I	
attachToEventCondition	I	
attachToSemaphore	I	
conclude	M	X
cancel	M	X
getDataExchangeAttributes	C	
exchangeData	C	
defineAccessControlList	C	
getAccessControlListAttributes	C	
reportAccessConrolledObjects	C	

MMS service supported CBB (server)	M/O/C/I	Supported
deleteAccessControlList	C	
alterAccessControl	C	
reconfigureProgramInvocation	C	

SCL conformance

SCL conformance		M/O/C	Supported
SCL.1	SCL file for implementation available (offline)	M	X
SCL.2	SCL file available from implementation online	O	
SCL.3	SCL implementation reconfiguration supported online	O	

Protocol implementation extra information for testing

Device configuration

The entire device configuration is read-only and can only be modified by the CID file. In particular, data objects with functional constraints of DC and CF can never be written.

You must configure the meter's Ethernet settings using the front panel or ION Enterprise or ION Setup software. Some IEC 61850 configuration tools require that the communications information entered in order to generate the CID file, however the CID communications values are not used by the meter.

ACSI models

Association model

ID	IEC 61850 Edition	Item	Value/comments
As1	1	Maximum simultaneous client associations	– 4 (ION7550/ION7650, PM8000, ION8800 v351 or earlier) – 5 (ION8650, ION7400, ION8800 v360 or later)
As2	1, 2	TCP Keepalive	– 1 minute (ION7400[1], ION7550/ION7650, PM8000[2]) – 2 minutes (ION8650, ION8800)
As3	1, 2	Lost connection detection time	10 minutes
As4	-	Authentication	Yes
As5/As6	1, 2	Association parameters	
		– TSEL	001
		– SSEL	001
		– PSEL	00000001
		– AP-title	Not required, ignored if present
		– AE-qualifier	Not required, ignored if present
As7	1, 2	Maximum MMS PDU size	25,600
As8	1, 2	Typical startup time after a power supply interrupt	20 to 120 seconds
-	-	TCP Retransmission Format[3]	Normal Frame or Exact Duplicate Frame

1. TCP Keepalive is a configurable parameter, issued every minute by default. This keepalive request is resent up to nine times before terminating the connection.
2. TCP Keepalive is a configurable parameter, issued every minute by default. This keepalive request is resent up to nine times before terminating the connection.
3. Contact Technical Support for information on changing this value.

Server model

ID	IEC 61850 Edition	Item	Value/comments
Sr1	1, 2	Quality bits for analog values (MX)	
		Validity	Good, Invalid
		– OutofRange	Not supported
		– Failure	Not supported
		– Inconsistent	Not supported
		– Source	Not supported
		– Other quality bits and values	Not supported

ID	IEC 61850 Edition	Item	Value/comments
Sr2	1, 2	Quality bits for status values	
		Validity	Good, Invalid
		– BadReference	Not supported
		– Failure	Not supported
		– Inconsistent	Not supported
		– Inaccurate	Not supported
		– Source	Not supported
		– Other quality bits and values	Not supported
Sr3/Sr4	Deprecated	Maximum number of data values in Get/SetDataValues requests[1]	Limited by Maximum MMS PDU size and the device's internal memory limitations
Sr5	1, 2	Mode values	
		– On	Supported
		– [On-] Blocked	Not supported
		– Test	Not Supported
		– Test/Blocked	Not Supported
		– Off	Supported

[1] Recommended maximum of 100 data attributes per read/write request.

Dataset model

ID	IEC 61850 Edition	Item	Value/comments
Ds1	1	Maximum number of data elements in one dataset[1]	50
Ds2	1	Maximum number of persistent datasets	Not supported
Ds3	1	Maximum number of non-persistent datasets	Not supported
-	-	Predefined datasets in the ICD files	6 datasets, refer to “Configuring data sets” on page 17
-	-	Mandatory data set member attributes	Data set members must have ‘doName’ and ‘daName’ specified
-	-	Excluded data	Data sets cannot include harmonics data

[1] IEC 61850 configuration tools may not provide warning if the maximum number of data elements is exceeded. However, the resulting CID file will not be validated by the meter and an ‘invalid CID’ message will be logged in the log.txt file.

Substitution model

ID	IEC 61850 Edition	Item	Value/comments
Sb1	1	Substituted values stored in volatile memory	Not supported

Setting group control model

ID	IEC 61850 Edition	Item	Value/comments
Sg1	1	Number of supporting setting groups for each logical device	Not supported
Sg2	1, 2	Effect of when and how the non-volatile storage is updated	Not supported
Sg3	1	Multiple clients edit the same setting group	Not supported
Sg4	1	Lost association while editing a group	Not supported
Sg5	1	Allow EditSG value 0	Not supported
Sg6	2	How long is an edit setting group locked when ResvTms is not present	Not supported

Reporting model

ID	IEC 61850 Edition	Item	Value/comments
Rp1	1, 2	Support of trigger conditions	
		– Integrity	Supported
		– Data change	Supported
		– Data update[1]	Supported
		– Quality change	Supported
		– General interrogation	Supported
Rp2	1	Support of optional fields	
		– Sequence number	Supported
		– Report time-stamp	Supported
		– Reason for inclusion	Supported
		– Dataset name	Supported
		– Data reference	Supported
		– Buffer overflow	Supported
		– EntryID	Supported
		– Conf-rev	Supported
		– Segmentation	Supported
Rp3	1, 2	Sending of segmented reports	Yes, supported
Rp4	1, 2	Buffer time (BufTm)	If a second event occurs on the same data value then the report is immediately sent.
Rp5	1	Multi client URCB approach	Each URCB is visible to all clients
Rp6		EntryID	8 bytes total: first 4 bytes = CID parse timestamp last 4 bytes = new buffered report entry ID
Rp7	1, 2	Buffer size for each BRCB	32kB
Rp9	1	Reported data set	
		– Structured data objects	Supported
		– Data attributes	Supported
Rp10	1, 2	Report scan rate	Data scanned every 1 second Fixed
Rp11	1	Pre-assign RCB to a specific client in the SCL	Not supported
Rp12	2	ConfRev restored from original configuration or retained prior to restart	ConRev restored from original configuration
-	-	Predefined RCBs in the ICD files	Yes, ICD
-	-	Mandatory RCB location	Logical Node LLN0
-	-	Shared data sets between unbuffered reports	Yes
-	-	Shared data sets between buffered reports	Yes
-	-	Shared data sets between buffered and unbuffered reports	No

1. The data update (dupd) trigger condition is supported; however, the data model cannot trigger a dupd report.

Logging model

ID	IEC 61850 Edition	Item	Value/comments
Lg1	1, 2	Default value of LogEna	False
Lg2		Format of EntryID	8 bytes total: first 4 bytes = CID parse timestamp last 4 bytes = new buffered report entry ID

ID	IEC 61850 Edition	Item	Value/comments
Lg3	1, 2	Multiple Log Control Blocks specifying the Journaling of the same MMS NamedVariable and TrgOps and the Event Condition	Not supported
Lg4	1	Pre-configured LCB attributes that cannot be changed online	Not supported

Control model

ID	IEC 61850 Edition	Item	Value/comments
Ct1	Deprecated	Control models supported	
		– Status only	Supported
		– Direct with normal security	Supported
		– Direct with enhanced security	Not supported
		– SBO with normal security	Not supported
		– SBO with enhanced security	Not supported
Ct2	1, 2	Control Model fixed, configurable and/or dynamic	Fixed
Ct3	Deprecated	Time activated operate (operTm)	Not supported
Ct4	Deprecated	Operate many	Not supported
Ct5	1	DUT activate the control output when the test attribute is set in the SelectWithValue and/or Operate request	Not supported
Ct7	Deprecated	Pulse configuration	Not supported
Ct8	1	DUT Behavior when check conditions are set.	Not supported
Ct9	1, 2	Cause diagnosis	Not supported
Ct10	1, 2	Force test-not-ok response with SelectWithValue request	Not supported Meter executes operation as usual (test-not-ok Not supported.)
Ct11	1, 2	Force test-not-ok response with Select request	Not supported Meter executes operation as usual (test-not-ok Not supported.)
Ct12	1, 2	Force test-not-ok response with Operate request	DOns: Incorrect orCat SBOns: Not supported DOes: Not supported SBOes Not supported
Ct13/ Ct14	1, 2	Origin categories (orCat)	Not supported Meter executes control operation as usual (ignores orCat value)
Ct15	1, 2	IED accept a Select/SelectWithvalue/Operate with the same control value as the current status value Is this behavior configurable	DOns: Supported SBOns: Not supported DOes: Not supported SBOes Not supported Configurable: Not supported
Ct16	1, 2	Multi-client control object select/operate	Not supported Meter executes operations serially
Ct17	1	IED accept a Select/SelectWithValue from the same client when the control object is already selected,	SBOns: Not supported SBOes: Not supported
Ct18	1,2	Internal validation for SBOes performed during the SelectwithValue and/or Operate step	Not supported
Ct20	1,2	Local/remote operation	Not supported Meter executes control operation as usual (ignores local/remote operation value)
-	-	Check conditions	Not supported Meter executes control operation as usual (ignores check value)
-	-	Command termination timeout	Not supported

ID	IEC 61850 Edition	Item	Value/comments
-	-	Service error types	Not supported

Time and time synchronization model

ID	IEC 61850 Edition	Item	Value/comments
Tm1, Tm4	1, 2	Time quality bits	
		– LeapSecondsKnown	Supported, dependent on Clock ION module *Enable NTP Time Sync* register setting.
		– ClockFailure	Supported, default value 0
		– ClockNotSynchronized[1]	Supported, dependent on Clock ION module *Enable NTP Time Sync* register setting.
Tm2	1, 2	Time synchronization signal loss	Data timestamp is set to instantaneous meter time
Tm3	1,2	Time to take over new time from time server	Polling time configurable Min: 60 seconds Max 365 days Default: 1 day
Tm7	1	Timezone and DST	Supported
Tm8	1, 2	SNTP response validated attributes	
		– Leap year indicator does not equal 3	Yes
		– Mode is equal to SERVER	Yes
		– Originate timestamp equals value sent by SNTP client as transmit timestamp	Yes
		– RX/TX timestamp fields checked	Yes
		– SNTP version 3 or 4 supported	Yes
Tm9	1, 2	COMTRADE - Local or UTC time Configurable	UTC Not Configurable
-	-	Maximum time to wait for time server responses	2 seconds

[1] If *Enable NTP Time Sync* set to NO, ClockNotSynchronized = 0, LeapSecondsKnown = 1
If *Enable NTP Time Sync* set to YES, SNTP or NTP and unsuccessful timesync, ClockNotSynchronized = 1, LeapSecondsKnown = 0
If *Enable NTP Time Sync* set to YES, SNTP or NTP and successful timesync, ClockNotSynchronized = 0, LeapSecondsKnown = 1

Time stamps

Time stamping is based on the timestamp of the input data.

File transfer model

ID	IEC 61850 Edition	Item	Value/comments
Ft1	1	Structure of files and directories	<IED IP address>/IEC61850/filename
Ft2	1, 2	Separator for files and directories path	/
Ft3	1	Maximum length of names	68 characters including file extension
Ft4	1, 2	Case sensitivity	Not case sensitive
Ft5	1, 2	Maximum file size for SetFile	Dependent on memory size
Ft6	1	Requested file path included in MMS fileDirectory request	Available
Ft7	1	wild char supported MMS fileDirectory (*)	Not supported
Ft8	1, 2	2 clients get file at the same time	Not supported
Ft9	1, 2	files that can be deleted	log.txt cannot be deleted from IEC61850. Maximum 2 files in dir including log.txt.

Impact of meter settings

NOTE: The GGIO Onboard and GGIO Expansion ION modules must be online for IEC 61850 I/O status values or control commands to function.

Your meter's digital and analog outputs may change state when being configured, during an option module reset or power cycle, or during firmware or framework upgrade. Changing your meter's Ethernet settings will terminate all IEC 61850 client connections and controls.

⚠ WARNING

DIGITAL AND/OR ANALOG OUTPUT STATE CHANGE

Do not use your meter for critical control or protection applications where human or equipment safety relies on the operation of the control circuit.

Failure to follow these instructions can result in death, serious injury or equipment damage.

Digital output control

To control the meter's digital outputs via IEC 61850, the meter's GGIO Onboard and GGIO Expansion ION modules must be configured using ION Enterprise or ION Setup software.

To control a meter's digital output through IEC 61850, navigate to the GGIO module for that digital output and set the ISC Control Mode register to 61850 CTVAL. To have the meter control the digital output, set the ISC Control Mode register to ION input. When the meter controls the digital output IEC 61850 control commands will be ignored.

Analog output control

To control the meter's analog outputs via IEC 61850, connect the GGIO Expansion module's *ISCS.stVal* output register to the Analog Output module's *Source* input register.

For detailed information about ION modules, refer to the *ION Reference*.

Analog values

Measurements

Units

Measurement type	Units
Current	1 A
Voltage	1 V
Power	1 kW, 1 kVA, 1 kVAR
Energy	1 kWh, 1 kVARh
Angle	1 degree
Rate	1 %

Deadbands

Default deadband values are provided in the ICD file, and can be modified using an IEC 61850 configuration tool. Unlike IEC 61850-7-3, which specifies deadband values be expressed as a percentage, deadband values in ION devices are expressed as integer values that are usually in different units than the deadbanded value. For

example, a value with units of Amps may have a deadband value with units of milliamps.

TISSUES implementation conformance statement

The TISSUES implementation conformance statement is required by UCA IUG QAP to perform a conformance test.

Support is indicated Y/Na as follows:

- Y: Implemented
- Na: Not applicable

Mandatory interoperability (Intop) issues

Implemented intop TISSUES

Part	TISSUE	Description	Implemented
8-1	116	GetNameList with empty response?	Y
	165	Improper error response for GetDataSetValues	Y
	183	GetNameList error handling	Y
7-4	None		
7-3	28	Definition of APC	Na
	54	Point def xVal, not cVal	Na
	55	Ineut = Ires?	Na
	60	Services missing in tables	Na
	63	mag in CDC CMV	Y
	65	Deadband calculation of a Vector and trigger option	Na
	219	operTm in ACT	Na
	270	WYE and DEL RMS values	Na
7-2	30	Control parameter T	Y
	31	Typo	Na
	32	Typo in syntax	Na
	35	Typo syntax Control time	Na
	36	Syntax parameter Dset-Ref missing	Na
	37	Syntax GOOSE “T” type	Na
	39	Add DstAddr to GoCB	Na
	40	GOOSE Message “AppID” to “GoID”	Na
	41	GsCb “AppIE” to “GoID”	Na
	42	SV timestamp: “EntryTime” to “TimeStamp”	Na
	43	Control “T” semantic	Na
	44	AddCause - Object not sel	Na
	45	Missing AddCauses (neg range)	Na
	46	Synchro check cancel	Na
	47	“.” in LD name?	Y
	49	BRCB TimeOfEntry (part of # 453)	Y

Part	TISSUE	Description	Implemented
7-2 cont'd	50	LLName start with number?	Y
	51	ARRAY [0..num] missing	Y
	52	Ambiguity GOOSE SqNum	Na
	53	Add DstAddr to GsCB, SV	Na
	151	Name constraint for control blocks etc.	Y
	166	DataRef attribute in Log	Na
	185	Logging - Integrity period	Na
	189	SV format	Na
	190	BRCB: EntryID and TimeOfEntry (part of #453)	Y
	191	BRCB: Integrity and buffering reports (part of #453)	Y
	234	New type CtxInt (Enumerated values are mapped to 8 bit integer)	Na
	275	Confusing statement on GI usage (part of #453)	Y
	278	EntryID not valid for a server (part of #453)	Y
6	1	Syntax	Na
	5	tExtensionAttributeNameEnum is restricted	Na
	8	SIUnit enumeration for W	Y
	10	Base type for bitstring usage	Y
	17	DAI/SDI elements syntax	Na
	169	Ordering of Enumerated values differs from 7-3	Y

Optional interoperability (intop) issues

Implemented intop TISSUES

Part	TISSUE	Description	Implemented
8-1	235	Extension of Name length	Y
	246	Control negative response (SBOns) with LastApplError	Na
	545	Skip file directories with no files	Na
7-2	333	Enabling of an incomplete GoCB	Na
	453	Combination of all reporting and logging issues	Na
6	245	Attribute RptId in SCL	Y
	529	Replace sev - Unknown by unknown	Na