



IEC61850 PROTOCOL

APPLICATION NOTES

— Preface

The IEC 61850 protocol was born for the automation of electrical substations with the objective of:

- eliminate the large amount of conventional wiring currently found in substations,
- optimize communication through multi-purpose architectures that support future technological developments,
- ensure interoperability between manufacturers,
- reduce manufacturing costs and outage times,
- help parameterization.

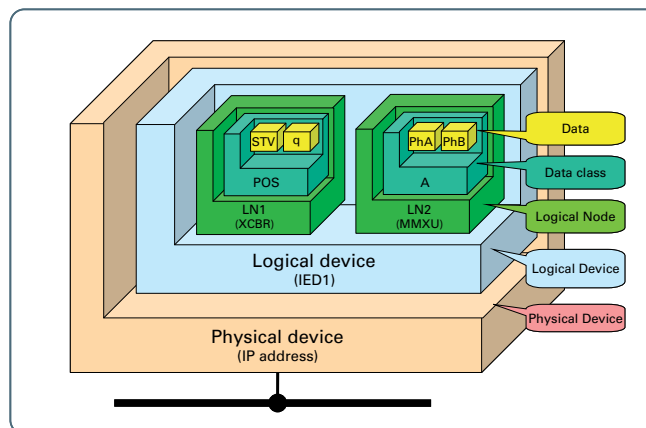
Two types of communication are supported:

- realtime data exchange necessary for the functions of protection and control;
- the off-line communication required for configuration, parameterization and diagnostics of devices.

The standard defines the programming language that should be used for the IED configuration, called SCL (Substation Configuration Language) based on XML allowing description, in standard mode, of all devices in the substation.

To ensure reliable communication a rigorously data model is can be defined: so the main part of the standard is the data structure definition, methods to access them and how they can be assembled.

Once the compliance of the model is ensured, interoperability between devices from different manufacturers can be achieved so that each device can easily operate with any other node inside the network.



The features of the substation are divided into a series of logical Nodes. Each logical node consists of data classes and the set of logical nodes constitutes the Logical Device, which is the logical representation of a real device, for example the protection relay or the circuit breaker.

The data within a LN can be accessed in two ways:

- through a client-server mechanism;
- through a publisher-subscriber mechanism (Goose - Generic Object Oriented Substation Events).

A set of attributes with a fixed semantics and a method of data exchange is contained in the Common Data Class (CDC).

Four primary classes are provided to model any type of device.

— **Certifications**

The IEC 61850 conformity assurance of Pro-N and N-Pro Ext Thytronic protection relays is certified by TUV and KEMA international competent bodies.



IEC 61850 Certificate Level A¹

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No. 74101712-MOC/INC 12-01382

Issued to:
Thytronic SpA
Piazza Mistral, 7
20139 – Milano
Italy

For the product:
PRON NV10P
Version 1.30



**The product has not shown to be non-conforming to:
IEC 61850-6, 7-1, 7-2, 7-3, 7-4 and 8-1
Communication networks and systems in substations**

The conformance test has been performed according to IEC 61850-10, the UCA International Users Group Device Test Procedures version 2.3 with TPCL² version 1.5, the product's protocol, model and technical issue implementation conformance statements: "NV10P_PICS, revision 1.0 11-07-2012", "NV10P_MICS, revision 1.0 11-07-2012" and "NV10P_TICS, revision 1.0 11-07-2012" and the extra information for testing: "NV10P_PIXIT, revision 1.0 11-07-2012".

The following IEC 61850 conformance blocks have been tested with a positive result (number of relevant and executed test cases / total number of test cases):

1	Basic Exchange (18/24)	9a	GOOSE Publish (7/13)
2	Data Sets (3/6)	9b	GOOSE Subscribe (10/11)
2+	Data Set Definition (23/23)	12a	Direct Control (4/12)
5	Unbuffered Reporting (17/19)	13	Time Synchronization (4/5)
6	Buffered Reporting (19/21)	14	File Transfer (4/7)

This certificate includes a summary of the test results as carried out at Thytronic SpA in Italy with UniCasim 61850 version 3.23.02 with test suite 3.23.00 and UniCA 61850 analyzer 4.25.00. This document has been issued for information purposes only, and the original paper copy of the KEMA report. No. 74101712-MOC/INC 12-01381 will prevail.

The test has been carried out on one single specimen of the product as referred above and submitted to KEMA by Thytronic SpA. The manufacturer's production process has not been assessed. This attestation does not imply that KEMA has approved any product other than the specimen tested.

Arnhem, July 25, 2012

M. Adriaensen
Director Management and Operations Consulting

R. Schimmel
Certification Manager

1 Level A - Independent Test lab with certified ISO 9000 or ISO 17025 Quality System
2 TPCL - test procedures change list

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Applicable Test Procedures from the UCA International Users Group Device Test Procedures version 2.3 with TPCL version 1.5

Conformance Block	Mandatory	Conditional
1: Basic Exchange	Ass1, Ass2, Ass3, AssN2, AssN3, AssN4, AssN5 Srv1, Srv2, Srv3, Srv4, Srv5, SrvN1abcd, SrvN4	Srv6, Srv7, Srv8, SrvN3
2: Data Sets	Dset1, Dset10a, DsetN1ae	
2+: Data Set Definition	Dset2, Dset3, Dset4, Dset5, Dset6, Dset7, Dset8, Dset9 DsetN1cd, DsetN2, DsetN3, DsetN4, DsetN5, DsetN6, DsetN7, DsetN8, DsetN9, DsetN10, DsetN11, DsetN12, DsetN13, DsetN14, DsetN15	
5: Unbuffered Reporting	Rp1, Rp2, Rp3, Rp4, Rp7, Rp10, Rp12 RpN1, RpN2, RpN3, RpN4	Rp5, Rp6, Rp8, Rp9, RpN5, RpN6
6: Buffered Reporting	Br1, Br2, Br3, Br4, Br7, Br8, Br9, Br12, Br14 BrN1, BrN2, BrN3, BrN4, BrN5	Br5, Br6, Br10, Br11, BrN6
9a: GOOSE publish	Gop2, Gop3, Gop4, Gop7, Gop10a	Gop1, GopN1
9b: GOOSE subscribe	Gos1a, Gos2, Gos3, GosN1, GosN2, GosN3, GosN4, GosN5, GosN6	Gos1b
12a: Direct control	CtlN3, CtlN8, DOns1, DOns3	
13: Time sync	Tm1, Tm2, TmN1	Tm3
14: File transfer	Ft1, Ft2ab, Ft4, FtN1ab	

MODEL DEFINITION (DESCRIPTION EXAMPLE FOR “NVA100X-PEX0-D” DEVICE)

— General

All the protective relay (IED) implementing a IEC61850 server have the information organized in a tree structure called the “model.” This model is defined in a “xml” file with the “.icd” extension and its standard conformity is defined in the relevant document “MICS” (Model Implementation Conformance Statement) of each device. The tree root consists of the node <IED> where the name of the device is the attribute, as shown in the following figure:

```

<IED name="TEMPLATE_0001">
  <Services>
    <AccessPoint name="P1">
      <Server>
        <Authentication>
          <LDevice inst="PROT" desc="Protection">
          <LDevice inst="CTRL" desc="Control">
          <LDevice inst="MEAS" desc="Measurements">
          <LDevice inst="RD" desc="Disturbance Recorder">
        </Server>
      </AccessPoint>
    </IED>
  
```

Inside the <IED> node there are the <LDevice>, “Logical Device” nodes that combine the functionality of the device organized by type:

- 1) **PROT**: protective functions
- 2) **CTRL**: I/O (real + virtual) functions
- 3) **MEAS**: measures
- 4) **RD**: oscillographic functions

The standard does not define how many <LDevice> an IED must have and how they should be called; it is an application choice of the manufacturer, some have a highly structured model while others have a flat pattern.

Every <LDevice> in turn contains a set of nodes defined as <LN>, “Logical Node”.

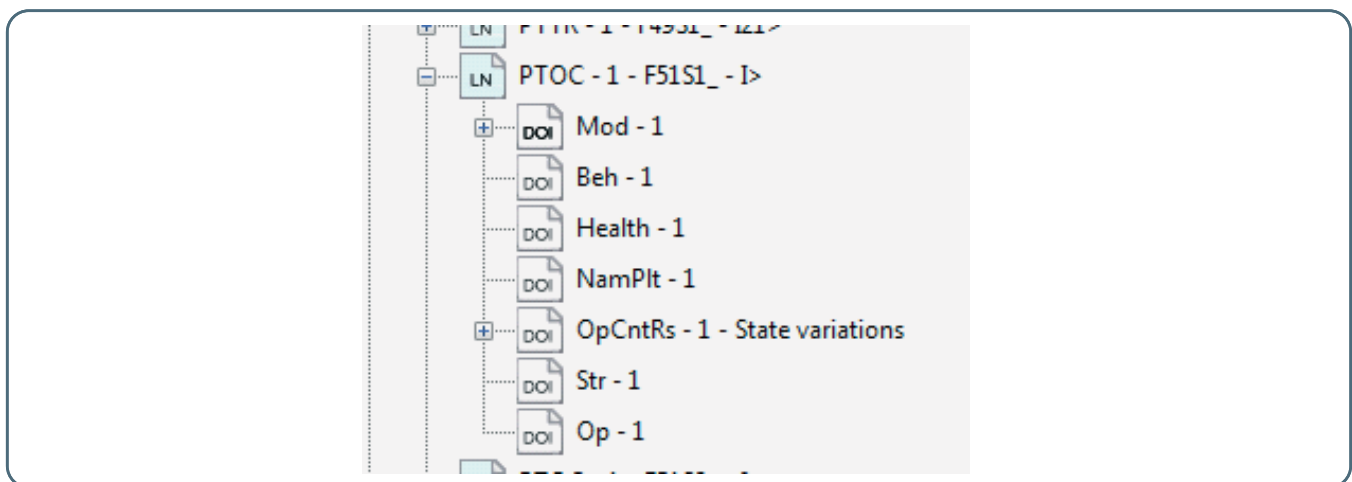
Each <LN> defines a single functionality defined by the IEC61850 standard with detailed I/O interfaces.

The functionality can be a protective function, an I/O, the circuit breaker status and so on.

The standard defines how to group the various LN according to their specialties in Table 1 in paragraph 5.1 of **IEC61850-7-4**, in particular, it defines the first letter in the name, such as “P” for protection, “M” for measures etc. This standard also defines how the compounds are LN and their interfaces, based on CDC “Common data classes” defined in **IEC61850-7-3**.

— LN example

For the 51.S1 element the Logical Node, will be defined as (IEC61850-7-4):



- 1) The LN type is “PTOC”, the group is “Protection Functions”, the function is “Time overcurrent”
- 2) The LN has instance = “1” and prefix “F51S1_”
- 3) The LN is made by seven “DOI” “Instantiated Data Object (DATA)”, data structures that define the LN interface
- 4) The first four DOI are inherited from “abstract logical node class (LN)” defined inside the **IEC61850-7-2** and define the LN basic mode of operation, in particular the “Mod”, “Behaviour”, “Health” e “NamePlt”. These DOI are “M” (mandatory)
- 5) The DOI “OpCntRs” represents a resettable counter that is incremented by 1 for each trip of the function. Thid DOI is “O” (optional)
- 6) The DOI “Str” represents the start of the protective element and is M
- 7) The DOI “Op” represents the trip of the protective element and is M.

The composition of the LN PTOC is dealt inside the IEC61850-7-4, for example:

PTOC class					
Attribute Name	Attr. Type	Explanation	T	M	O
LNName		Shall be inherited from Logical-Node Class (see IEC 61850-7-2)			
Data					
<i>Common Logical Node Information</i>					
		LN shall inherit all Mandatory Data from Common Logical Node Class			M
OpCntRs	INC	Resetable operation counter			O
<i>Status Information</i>					
Str	ACD	Start			M
Op	ACT	Operate		T	M
TmASt	CSD	Active curve characteristic			O
<i>Settings</i>					
TmAcrv	CURVE	Operating Curve Type			O
StrVal	ASG	Start Value			O
TmMult	ASG	Time Dial Multiplier			O
MinOpTmms	ING	Minimum Operate Time			O
MaxOpTmms	ING	Maximum Operate Time			O
OpDITmms	ING	Operate Delay Time			O
TypRsCrv	ING	Type of Reset Curve			O
RsDITmms	ING	Reset Delay Time			O
DirMod	ING	Directional Mode			O

In the Thytronic model only the CDC Mandatory and "OpCntRs" as optional are implemented.

The composition of the basic types CDC (common data classes) is defined inside the IEC61850-7-3, for example for the DOI "Str":

ACD class						
Attribute Name	Attribute Type	FC	TrgOp	Value/Value Range	M	O/C
DataName	Inherited from Data Class (see IEC 61850-7-2)					
DataAttribute						
<i>status</i>						
general	BOOLEAN	ST	dchg			M
dirGeneral	ENUMERATED	ST	dchg	unknown forward backward both		M
phsA	BOOLEAN	ST	dchg			GC_2 (1)
dirPhsA	ENUMERATED	ST	dchg	unknown forward backward		GC_2 (1)
phsB	BOOLEAN	ST	dchg			GC_2 (2)
dirPhsB	ENUMERATED	ST	dchg	unknown forward backward		GC_2 (2)
phsC	BOOLEAN	ST	dchg			GC_2 (3)
dirPhsC	ENUMERATED	ST	dchg	unknown forward backward		GC_2 (3)
neut	BOOLEAN	ST	dchg			GC_2 (4)
dirNeut	ENUMERATED	ST	dchg	unknown forward backward		GC_2 (4)
q	Quality	ST	qchg			M
t	TimeStamp	ST				M
<i>configuration, description and extension</i>						
d	VISIBLE STRING255	DC		Text		O
dU	UNICODE STRING255	DC				O
cdcNs	VISIBLE STRING255	EX				AC_DLNDA_M
cdcName	VISIBLE STRING255	EX				AC_DLNDA_M
dataNs	VISIBLE STRING255	EX				AC_DLN_M
Services						
As defined in Table 13						

The implementation of ACD is as follows:

```
<DOType id="ACD_0/TEMPLATE_0001" cdc="ACD">
  <DA name="general" bType="BOOLEAN" fc="ST" dchg="true">
  <DA name="dirGeneral" type="dir/TEMPLATE_0001" bType="Enum" fc="ST" dchg="true">
  <DA name="q" bType="Quality" fc="ST" qchg="true">
  <DA name="t" bType="Timestamp" fc="ST">
</DOType>
```

The M attributes were inserted:

- **general (M)**: start
- **dirGeneral (M)**: fault direction
- **q**: quality
- **t**: last change timestamp

SERVICES

The implementation of IEC61850 service in the Thytronic protections is described in the relative public document "PICS" (Protocol Implementation Conformance Statement) provided to the certifying body in the testing phase; please refer to the document for more details.

Some informations:

— Dataset

Some notes concerning the data set:

- 1) You can create up to 15 persistent datasets for each LDevice
- 2) You can create up to 15 non persistent datasets for each LDevice
- 3) Each dataset can have up to 60 elements

— Report

- 1) Each LDevice supports four unbuffered report
- 2) Each LDevice supports two buffered report

— GOOSE Publication:

- 1) Up to five goose can be configured for each device
- 2) The dataset can contain DO and DA

— GOOSE subscription:

- 1) Up to 64 goose can be configured <Input>
- 2) Each node <Input> can have up to 64 nodes <ExtRef>

— Deadband

- 1) On some measures, the main, the parameters can be configured for the use of the deadband

— Operation

Two configuration files are available inside the device memory for the 61850 protocol:

- 1) the ".icd" file
- 2) the ".cid" file

With regard to these files you can say that:

- 1) on default the ".cid" file is the same as the ".icd" file
- 2) the protection relay always uses the ".cid" file to initialize the 61850 stack
- 3) all static programming, datasets, reports, goose, subscriptions are done editing the file ".cid"
- 4) the ".icd" and ".cid" files can be read via ftp directly from protection device or via 61850 file transfer or via Thyvisor sw.
- 5) the ".icd" file of each Thytronic protective relay is contained in the template setup, so it can be read with any editor just by installing such program.

— Tools

All editing and sending the new file ".cid" occur through dedicated program "Thyvisor."

Any IEC61850 client, eg. IEDScout, is able to perform the dynamic browsing of the model without ".icd" or ".cid" file; any IEC61850 client can also configure dynamic dataset and associate them to the report.

An IEC61850 client can not programming / sending static ".cid" file .

NVA100X-PEX0-D MODEL

— **Logical Device PROT**

Function	LN	inst	prefix		
	LPHD	1			
				PhyNam	
				PhyHealth	
				Proxy	
(U/f)AL	PVPH	1	F24AL_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				Str	
				Op	
(U/f)>>	PVPH	1	F24S1_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				Str	
				Op	
(U/f)>>	PVPH	1	F24S2_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				Str	
				Op	
Trip State	RSYN	1	F25_		
				Mod	
				Beh	
				Health	
				NamPlt	
				Rel	
Th>1	PTTR	1	F26S1_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				Op	
				AlmThm	
Th>2	PTTR	1	F26S2_		
				Mod	
				Beh	
				Health	
				NamPlt	

				OpCntRs	State variations
				Op	
				AlmThm	
Th>3	PTTR	1	F26S3_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				Op	
				AlmThm	
Th>4	PTTR	1	F26S4_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				Op	
				AlmThm	
Th>5	PTTR	1	F26S5_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				Op	
				AlmThm	
Th>6	PTTR	1	F26S6_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				Op	
				AlmThm	
Th>7	PTTR	1	F26S7_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				Op	
				AlmThm	
Th>8	PTTR	1	F26S8_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				Op	
				AlmThm	

U<	PTUV	1	F27S1_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				Str	
				Op	
U<<	PTUV	1	F27S2_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				Str	
				Op	
U1<	PTUV	1	F27V1_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				Str	
				Op	
32P P1>	PDOP	1	F32P1_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				Str	
				Op	
32P P2>	PDOP	1	F32P2_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				Str	
				Op	
32Q Q1>	PDOP	1	F32Q1_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				Str	
				Op	
32Q Q2>	PDOP	1	F32Q2_		
				Mod	
				Beh	

				Health	
				NamPlt	
				OpCntRs	State variations
				Str	
				Op	
I<	PTUC	1	F37S1_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				Str	
				Op	
37P P1<	PDUP	1	F37P1_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				Str	
				Op	
37P P2<	PDUP	1	F37P2_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				Str	
				Op	
37Q Q1<	PDUP	1	F37Q1_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				Str	
				Op	
37Q Q2<	PDUP	1	F37Q2_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				Str	
				Op	
I2>	PTOC	1	F46S1_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations

				Str	
				Op	
I2>>	PTOC	1	F46S2_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				Str	
				Op	
47S1	PTOV	1	F47_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				Str	
				Op	
I21>	PTOC	1	FI21_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				Str	
				Op	
I21>	PTTR	1	F49S1_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				Op	
I>	PTOC	1	F51S1_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				Str	
				Op	
I>>	PTOC	1	F51S2_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				Str	
				Op	
I>>>	PTOC	1	F51S3_		
				Mod	

				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				Str	
				Op	
IE>	PTOC	1	F51N1_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				Str	
				Op	
IE>>	PTOC	1	F51N2_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				Str	
				Op	
IE>>>	PTOC	1	F51N3_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				Str	
				Op	
IEC>	PTOC	1	F5NC1_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				Str	
				Op	
IEC>>	PTOC	1	F5NC2_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				Str	
				Op	
IEC>>>	PTOC	1	F5NC3_		
				Mod	
				Beh	
				Health	
				NamPlt	

				OpCntRs	State variations
				Str	
				Op	
55 CPhi1<	PUPF	1	F55S1_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				Str	
				Op	
55 CPhi2<	PUPF	1	F55S2_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				Str	
				Op	
U>	PTOV	1	F59S1_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				Str	
				Op	
U>>	PTOV	1	F59S2_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				Str	
				Op	
UE>	PTOV	1	F59N1_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				Str	
				Op	
UE>>	PTOV	1	F59N2_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				Str	
				Op	

U2>	PTOV	1	F59V1_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				Str	
				Op	
IPD>	PTOC	1	F67S1_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				Str	
				Op	
IPD>>	PTOC	1	F67S2_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				Str	
				Op	
IPD>>>	PTOC	1	F67S3_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				Str	
				Op	
IPD>>>>	PTOC	1	F67S4_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				Str	
				Op	
IED>	PTOC	1	F67N1_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				Str	
				Op	
IED>>	PTOC	1	F67N2_		
				Mod	
				Beh	

				Health	
				NamPlt	
				OpCntRs	State variations
				Str	
				Op	
IED>>>	PTOC	1	F67N3_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				Str	
				Op	
IED>>>>	PTOC	1	F67N4_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				Str	
				Op	
79	RREC	1	F79_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				BlkRec	Block Reclosing
				Auto	
				Op	
				AutoRecSt	
810 f>	PTOF	1	F8101_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				Str	
				Op	
810 f>>	PTOF	1	F8102_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				Str	
				Op	
81U f<	PTUF	1	F81U1_		
				Mod	
				Beh	
				Health	

				NamPlt	
				OpCntRs	State variations
				Str	
				Op	
81U f<<	PTUF	1	F81U2_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				Str	
				Op	
81U f<<<	PTUF	1	F81U3_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				Str	
				Op	
81U f<<<<	PTUF	1	F81U4_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				Str	
				Op	
81R df>	PFRC	1	F81R1_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				Str	
				Op	
81R df>>	PFRC	1	F81R2_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				Str	
				Op	
81R df>>>	PFRC	1	F81R3_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				Str	

				Op	
81R df>>>>	PFRC	1	F81R4_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				Str	
				Op	
I2ndh>	PHAR	1	FI2S1_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				Str	
General Trip	PTRC	1	FGTRP_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				Tr	
CB	XCBR	1	CB1_		
				Mod	
				Beh	
				Health	
				NamPlt	
				Loc	
				OpCnt	
				Pos	
				BlkOpn	
				BlkCls	
				CBOpCap	
IBF>	RBRF	1	BF1_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				Str	
				OpIn	
Supervi- sion	GGIO	1	SPV_		
				Mod	
				Beh	
				Health	
				NamPlt	
				IntIn1	Active Profile (0:A, 1:B, 2:by Input)
				IntIn2	Counter Open CB

				IntIn3	Counter Close CB
				Ind1	NTP Status (0:Not Sync, 1: Sync)
				Ind2	74TCS Start state
				Ind3	74TCS Trip state
				Ind4	74CT Start state
				Ind5	74CT Trip state
				Ind6	74VT Output block state
				Ind7	74VT Alarm state
				Ind8	dphi> Start state
				Ind9	dphi> Trip state
				Ind10	Reclosure Ready
				Ind11	Reclosure InProgress
				Ind12	Reclosure Successful
				Ind13	Reclosure Unsuccessful
				Ind14	Reclosure Blocked
Function	LN	inst	prefix		
	LPHD	1			
				PhyNam	
				PhyHealth	
				Proxy	
	CALH	1			
				Mod	
				Beh	
				Health	
				NamPlt	
				GrAlm	
Alarm	GGIO	1	ALM_		
				Mod	
				Beh	
				Health	
				NamPlt	
				Alm1	Protection
				Alm2	DSP
				Alm3	MEMORY
				Alm4	PLC
				Alm5	MMI
				Alm6	PT100
				Alm7	DAC1
				Alm8	SRC1
				Alm9	SRC2
				Alm10	SING1
				Alm11	SING2
	CSWI	1	SWI1_		
				Mod	
				Beh	
				Health	
				NamPlt	

				Loc	
				Pos	
SING1 module	GGIO	1	SING1_		
				Mod	
				Beh	
				Health	
				NamPlt	
				Ind1	ING1_1
				Ind2	ING1_2
				Ind3	ING1_3
				Ind4	ING1_4
				Ind5	ING1_5
				Ind6	ING1_6
				Ind7	ING1_7
				Ind8	ING1_8
				Ind9	ING1_9
				Ind10	ING1_10
				Ind11	ING1_11
				Ind12	ING1_12
				Ind13	ING1_13
				Ind14	ING1_14
				Ind15	ING1_15
				Ind16	ING1_16
SING2 module	GGIO	1	SING2_		
				Mod	
				Beh	
				Health	
				NamPlt	
				Ind1	ING2_1
				Ind2	ING2_2
				Ind3	ING2_3
				Ind4	ING2_4
				Ind5	ING2_5
				Ind6	ING2_6
				Ind7	ING2_7
				Ind8	ING2_8
				Ind9	ING2_9
				Ind10	ING2_10
				Ind11	ING2_11
				Ind12	ING2_12
				Ind13	ING2_13
				Ind14	ING2_14
				Ind15	ING2_15
				Ind16	ING2_16
SRC1 module	GGIO	1	SRC1_		
				Mod	
				Beh	
				Health	
				NamPlt	

				Ind1	SRC1_K1
				Ind2	SRC1_K2
				Ind3	SRC1_K3
				Ind4	SRC1_K4
				Ind5	SRC1_K5
				Ind6	SRC1_K6
				Ind7	SRC1_K7
				Ind8	SRC1_K8
SRC2 module	GGIO	1	SRC2_		
				Mod	
				Beh	
				Health	
				NamPlt	
				Ind1	SRC2_K1
				Ind2	SRC2_K2
				Ind3	SRC2_K3
				Ind4	SRC2_K4
				Ind5	SRC2_K5
				Ind6	SRC2_K6
				Ind7	SRC2_K7
				Ind8	SRC2_K8
VIn 1	GGIO	1	VI001_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				SPCSO	
				Alm	
VIn 2	GGIO	1	VI002_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				SPCSO	
				Alm	
VIn 3	GGIO	1	VI003_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				SPCSO	
				Alm	
VIn 4	GGIO	1	VI004_		
				Mod	
				Beh	
				Health	
				NamPlt	

				OpCntRs	State variations
				SPCSO	
				Alm	
VIn 5	GGIO	1	VI005_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				SPCSO	
				Alm	
VIn 6	GGIO	1	VI006_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				SPCSO	
				Alm	
VIn 7	GGIO	1	VI007_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				SPCSO	
				Alm	
VIn 8	GGIO	1	VI008_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				SPCSO	
				Alm	
VIn 9	GGIO	1	VI009_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				SPCSO	
				Alm	
VIn 10	GGIO	1	VI010_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				SPCSO	
				Alm	

VIn 11	GGIO	1	VI011_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				SPCSO	
				Alm	
VIn 12	GGIO	1	VI012_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				SPCSO	
				Alm	
VIn 13	GGIO	1	VI013_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				SPCSO	
				Alm	
VIn 14	GGIO	1	VI014_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				SPCSO	
				Alm	
VIn 15	GGIO	1	VI015_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				SPCSO	
				Alm	
VIn 16	GGIO	1	VI016_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				SPCSO	
				Alm	
VIn 17	GGIO	1	VI017_		
				Mod	
				Beh	

				Health	
				NamPlt	
				OpCntRs	State variations
				SPCSO	
				Alm	
VIn 18	GGIO	1	VI018_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				SPCSO	
				Alm	
VIn 19	GGIO	1	VI019_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				SPCSO	
				Alm	
VIn 20	GGIO	1	VI020_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				SPCSO	
				Alm	
VIn 21	GGIO	1	VI021_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				SPCSO	
				Alm	
VIn 22	GGIO	1	VI022_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				SPCSO	
				Alm	
VIn 23	GGIO	1	VI023_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations

				SPCSO	
				Alm	
VIn 24	GGIO	1	VI024_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				SPCSO	
				Alm	
VIn 25	GGIO	1	VI025_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				SPCSO	
				Alm	
VIn 26	GGIO	1	VI026_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				SPCSO	
				Alm	
VIn 27	GGIO	1	VI027_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				SPCSO	
				Alm	
VIn 28	GGIO	1	VI028_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				SPCSO	
				Alm	
VIn 29	GGIO	1	VI029_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				SPCSO	
				Alm	
VIn 30	GGIO	1	VI030_		

				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				SPCSO	
				Alm	
VIn 31	GGIO	1	VI031_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				SPCSO	
				Alm	
VIn 32	GGIO	1	VI032_		
				Mod	
				Beh	
				Health	
				NamPlt	
				OpCntRs	State variations
				SPCSO	
				Alm	
Virtual Outputs	GGIO	1	VOUT_		
				Mod	
				Beh	
				Health	
				NamPlt	
				Ind1	VOUT1
				Ind2	VOUT2
				Ind3	VOUT3
				Ind4	VOUT4
				Ind5	VOUT5
				Ind6	VOUT6
				Ind7	VOUT7
				Ind8	VOUT8
				Ind9	VOUT9
				Ind10	VOUT10
				Ind11	VOUT11
				Ind12	VOUT12
				Ind13	VOUT13
				Ind14	VOUT14
				Ind15	VOUT15
				Ind16	VOUT16
Plc State	GGIO	1	PLC_		
				Mod	
				Beh	
				Health	
				NamPlt	
				IntIn1	

				IntIn2	
				IntIn3	
				IntIn4	
				IntIn5	
				IntIn6	
				IntIn7	
				IntIn8	
				IntIn9	
				IntIn10	
				IntIn11	
				IntIn12	
				IntIn13	
				IntIn14	
				IntIn15	
				IntIn16	
				IntIn17	
				IntIn18	
				IntIn19	
				IntIn20	
				IntIn21	
				IntIn22	
				IntIn23	
				IntIn24	
				IntIn25	
				IntIn26	
				IntIn27	
				IntIn28	
				IntIn29	
				IntIn30	
				IntIn31	
				IntIn32	
Testing purpose	GGIO	1	TEST_		
				Mod	
				Beh	
				Health	
				NamPlt	
				SPCS01	
				SPCS02	
				SPCS03	
				SPCS04	
PinPongG- GIO	GGIO	1	PONG_		
				Mod	
				Beh	
				Health	
				NamPlt	
				IntIn	
				Ind1	
				Ind2	

Function	LN	inst	prefix		
	LPHD	1			
				PhyNam	
				PhyHealth	
				Proxy	
Measure	MMXU	1	MEAS_		
				Mod	
				Beh	
				Health	
				NamPlt	
				TotW	Total P
				TotVAr	Total Q
				TotVA	Total S
				TotPF	Total PF
				Hz	f
				PPV	Phase to Phase Voltages
				PhV	Phase to Ground Voltages
				A	I
				W	P
				VAr	Q
				PF	
Statistics 1	MSTA	1	STAT1_		
				Mod	
				Beh	
				Health	
				NamPlt	
				AvAmps	Average Current between IL1-IL2-IL3
				MaxAmps	Maximum Current between IL1-IL2-IL3
				MinAmps	Minimum Current between IL1-IL2-IL3
				AvVolts	Average Voltage between UL1-UL2-UL3
				MaxVolts	Maximum Voltage between UL1-UL2-UL3
				MinVolts	Minimum Voltage between UL1-UL2-UL3
Statistics2	MSTA	1	STAT2_		
				Mod	
				Beh	
				Health	
				NamPlt	
				AvVolts	Average Voltage between U12-U23-U31
				MaxVolts	Maximum Voltage between U12-U23-U31
				MinVolts	Minimum Voltage between U12-U23-U31
Synchro Check	GGIO	1	SYNC_		
				Mod	

				Beh	
				Health	
				NamPlt	
				AnIn1	Voltage V1
				AnIn2	Voltage V2
				AnIn3	Frequency V1
				AnIn4	Frequency V2
				AnIn5	Voltage difference V1 V2
				AnIn6	Frequency difference V1 V2
				AnIn7	Phase shift V2 respect to V1
Displacement	GGIO	1	DISP_		
				Mod	
				Beh	
				Health	
				NamPlt	
				AnIn1	Displacement angle of IL1 respect to UL1
				AnIn2	Displacement angle of IL2 respect to UL2
				AnIn3	Displacement angle of IL3 respect to UL3
				AnIn4	Displacement angle of IL1 respect to U23
				AnIn5	Displacement angle of IL2 respect to U31
				AnIn6	Displacement angle of IL3 respect to U12
				AnIn7	Displacement angle of UE respect to IE
				AnIn8	Displacement angle of UEC respect to IE
Sequence	MSQI	1	SEQ_		
				Mod	
				Beh	
				Health	
				NamPlt	
				SeqA	
				SeqV	
Harmonics	MHAI	1	HARM_		
				Mod	
				Beh	
				Health	
				NamPlt	
				Hz	f
				HA	
				HPhV	
Demand Phase	GGIO	1	DPHS_		
				Mod	
				Beh	
				Health	
				NamPlt	

				AnIn1	L1 Phase fixed currents demand
				AnIn2	L2 Phase fixed currents demand
				AnIn3	L3 Phase fixed currents demand
				AnIn4	L1 Phase rolling currents demand
				AnIn5	L2 Phase rolling currents demand
				AnIn6	L3 Phase rolling currents demand
				AnIn7	L1 Phase peak currents demand
				AnIn8	L2 Phase peak currents demand
				AnIn9	L3 Phase peak currents demand
				AnIn10	L1 Phase minimum currents demand
				AnIn11	L2 Phase minimum currents demand
				AnIn12	L3 Phase minimum currents demand
Demand Power	GGIO	1	DPOW_		
				Mod	
				Beh	
				Health	
				NamPlt	
				AnIn1	Fixed active power demand
				AnIn2	Fixed reactive power demand
				AnIn3	Rolling active power demand
				AnIn4	Rolling reactive power demand
				AnIn5	Peack active power demand
				AnIn6	Peack reactive power demand
				AnIn7	Minimum active power demand
				AnIn8	Minimum reactive power demand
Energy	MMTR	1	ENE_		
				Mod	
				Beh	
				Health	
				NamPlt	
				TotWh	EA Net Real Energy
				TotVARh	EQ Net Reactive Energy
				SupWh	EA+ Real Energy Supply
				SupVARh	EQ+ Reactive Energy Supply
				DmdWh	EA- Real Energy Demand
				DmdVARh	EQ- Reactive Energy Demand
PT100 Measure	GGIO	1	PT100_		
				Mod	

				Beh	
				Health	
				NamPlt	
				AnIn1	PT1
				AnIn2	PT2
				AnIn3	PT3
				AnIn4	PT4
				AnIn5	PT5
				AnIn6	PT6
				AnIn7	PT7
				AnIn8	PT8
Extended measure	GGIO	1	EXM_		
				Mod	
				Beh	
				Health	
				NamPlt	
				AnIn1	Thermal Image
				AnIn2	Negative sequence current/positive sequence current ratio
				AnIn3	Maximum of the second harmonic phase currents/fundamental component percentage ratio
				AnIn4	Frequency U12
				AnIn5	Frequency U23
				AnIn6	Frequency U31
				AnIn7	Frequency rate of change
				AnIn8	Flux Umax/f
Function	LN	inst	prefix		
	LPHD	1			
				PhyNam	
				PhyHealth	
				Proxy	
Disturbance Recording	RDRE	1	OSC_		
				Mod	
				Beh	
				Health	
				NamPlt	
				RcdMade	
				FltNum	

— ThyVisor

Besides all the ThySetter tools, the following features are included:

- Management of one or more network with Pro-N and others devices based on Modbus protocol: each network (devices set) is defined in a single file; multiple files may be open, so multiple networks can be simultaneously monitored. In Ethernet configuration with tcp/ip, an automatic scan can be performed with the possibility of dynamic IP address assignment
- The synoptic development with monitoring of electrical measurements, digital status and alarm information: synoptic-based devices and electrical symbols and possible interconnections can be drawn where each properties of graphic element can be viewed and edited in any time via the context menu. All variables of devices can be associated to graphic elements, (eg, the state of a circuit breaker, measures, diagnostics,...) and the graphic element will follow the status of the variable (eg, the circuit breaker opens / closes, the alarm will change color according to the concerning function,...)
- Reading and setting for threshold and oscillographic recorder
- Interlocking/remote trip setting and managing via Ethernet network and tcp/ip protocol
- Firmware updating.

