Point List Manual

IEC 60870-5-103
REF615

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Conformity

This product complies with the directive of the Council of the European Communities on the approximation of the laws of the Member States relating to electromagnetic compatibility (EMC Council Directive 2004/108/EC) and concerning electrical equipment for use within specified voltage limits (Low-voltage directive 2006/95/EC). This conformity is the result of a test conducted by ABB in accordance with Article 10 of the directive in agreement with the product standards EN 50263 and EN 60255-26 for the EMC directive, and with the product standards EN 60255-6 and EN 60255-27 for the low voltage directive. The IED is designed in accordance with the international standards of the IEC 60255 series.

Table of contents

Section 1 Introduction

1.1 This manual

Point List Manual describes the outlook and properties of the data points specific to the IED. The manual should be used in conjunction with the corresponding Communication Protocol Manual.

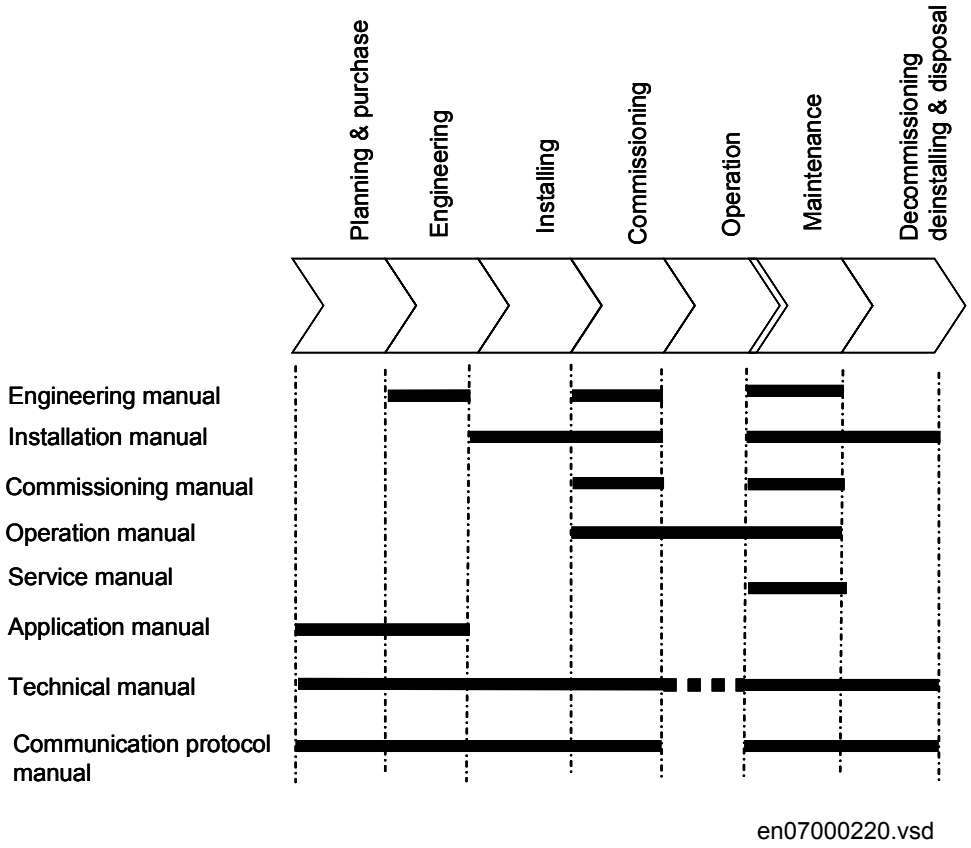
1.2 Intended audience

This manual addresses the communication system engineer or system integrator responsible for pre-engineering and engineering for communication setup in a substation from an IED perspective.

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

1.3 Protocol documentation

1.3.1 Product documentation set



Engineering Manual contains instructions on how to engineer the IEDs. The manual provides instructions on how to use the different tools for IED engineering. It also includes instructions on how to handle the tool component available to read disturbance files from the IEDs on the basis of the IEC 61850 definitions. It further introduces the diagnostic tool components available for IEDs and the PCM600 tool.

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

Commissioning Manual contains instructions on how to commission the IED. The manual can also be used as a reference during periodic testing. The manual provides procedures for energizing and checking of external circuitry, setting and configuration as well as verifying settings and performing directional tests. The chapters are organized in chronological order in which the IED should be commissioned.

Operation Manual contains instructions on how to operate the IED during normal service once it has been commissioned. The manual can be used to find out how to handle disturbances or how to view calculated and measured network data to determine the cause of a fault.

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

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

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

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

Point List Manual describes the outlook and properties of the data points specific to the IED. The manual should be used in conjunction with the corresponding Communication Protocol Manual.

All manuals are not available yet.

1.3.2 Document revision history

Document revision/date	Product version	History
A/04.03.2009	2.0	First release

Download the latest revision of the document from the ABB web site http://www.abb.com/substationautomation.

1.3.3 Related documentation

Name of the document	Document ID
IEC 60870-5-103 Communication Protocol Manual	1MRS756710

1.4 Document symbols and conventions

1.4.1 Safety indication symbols

This publication includes icons that point out safety-related conditions or other important information.

The electrical warning icon indicates the presence of a hazard which could result in electrical shock.

The warning icon indicates the presence of a hazard which could result in personal injury.

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

The information icon alerts the reader to relevant facts and conditions.

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

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

1.4.2 Document conventions

- Abbreviations and acronyms in this manual are spelled out in Glossary. Glossary also contains definitions of important terms.
- Push button navigation in the LHMI menu structure is presented by using the push button icons, for example:
  To navigate between the options, use  and  .
- HMI menu paths are presented in bold, for example:
  Select **Main menu/Configuration/HMI**.
- Menu names are shown in bold in WHMI, for example:
  Click **Information** in the WHMI menu structure.

- LHMI messages are shown in Courier font, for example:
  To save the changes in non-volatile memory, select `Yes` and press ↵.
- Parameter names are shown in italics, for example:
  The function can be enabled and disabled with the *Operation* setting.
- Parameter values are indicated with quotation marks, for example:
  The corresponding parameter values are "On" and "Off".
- IED input/output messages and monitored data names are shown in Courier font, for example:
  When the function starts, the `START` output is set to TRUE.

1.4.3 Functions, codes and symbols

All available functions are listed in the table. All of these may not be applicable to all products.

Table 1: Functions included in standard configurations

Function	IEC 61850	IEC 60617	IEC-ANSI
Three-phase non-directional overcurrent protection	PHLPTOC1	3I>	51P-1
	PHHPTOC1	3I>> (1)	51P-2 (1)
	PHHPTOC2	3I>> (2)	51P-2 (2)
	PHIPTOC1	3I>>>	50P/51P
Three-phase directional overcurrent, low stage	DPHLPDOC1	3I> → (1)	67-1 (1)
	DPHLPDOC2	3I> → (2)	67-1 (2)
Three-phase directional overcurrent, high stage	DPHHPDOC1	3I>> →	67-2
Arc protection	ARCSARC1	ARC (1)	50L/50NL (1)
	ARCSARC2	ARC (2)	50L/50NL (2)
	ARCSARC3	ARC (3)	50L/50NL (3)
Non-directional earth-fault protection	EFLPTOC1	I_0> (1)	51N-1 (1)
	EFLPTOC2	I_0> (2)	51N-1 (2)
	EFHPTOC1	I_0>>	51N-2
	EFIPTOC1	I_0>>>	50N/51N
Directional earth-fault protection	DEFLPDEF1	I_0> → (1)	67N-1 (1)
	DEFLPDEF2	I_0> → (2)	67N-1 (2)
	DEFHPDEF1	I_0>> →	67N-2
Transient/Intermittent earth-fault protection	INTRPTEF1	I_0> → IEF	67NIEF
Non-directional (cross-country) earth fault, using calculated I_0	EFHPTOC1	I_0>>	51N-2
Negative-sequence overcurrent protection	NSPTOC1	I_2> (1)	46 (1)
	NSPTOC2	I_2> (2)	46 (2)
Phase discontinuity	PDNSPTOC1	I_2/I1>	46PD
Table continues on next page			

Function	IEC 61850	IEC 60617	IEC-ANSI
Residual overvoltage protection	ROVPTOV1	U_0> (1)	59G (1)
	ROVPTOV2	U_0> (2)	59G (2)
	ROVPTOV3	U_0> (3)	59G (3)
Three-phase undervoltage protection	PHPTUV1	3U< (1)	27 (1)
	PHPTUV2	3U< (2)	27 (2)
	PHPTUV3	3U< (3)	27 (3)
Three-phase overvoltage protection	PHPTOV1	3U> (1)	59 (1)
	PHPTOV2	3U> (2)	59 (2)
	PHPTOV3	3U> (3)	59 (3)
Positive-sequence undervoltage	PSPTUV1	U1<	47U+
Negative-sequence overvoltage	NSPTOV1	U2>	47O-
Three-phase inrush detector	INRPHAR1	3I2f>	68
Three-phase thermal protection for feeders, cables and distribution transformers	T1PTTR1	3Ith>F	49F
Autoreclosure	DARREC1	O → I	79
Circuit breaker failure protection	CCBRBRF1	3I>/I_0>BF	51BF/51NBF
Master Trip	TRPPTRC1	Master Trip (1)	94/86 (1)
	TRPPTRC2	Master Trip (2)	94/86 (2)
Trip circuit supervision	TCSSCBR1	TCS (1)	TCM (1)
	TCSSCBR2	TCS (2)	TCM (2)
Fuse failure supervision	SEQRFUF1	FUSEF	60
Disturbance recorder	RDRE1	-	-
Circuit breaker condition monitoring	SSCBR1	CBCM	CBCM
Three-phase current measurement	CMMXU1	3I	3I
Sequence current measurement	CSMSQI1	I_1, I_2, I_0	I_1, I_2, I_0
Residual current measurement	RESCMMXU1	I_0	I_n
Residual voltage measurement	RESVMMXU1	U_0	V_n
Three-phase voltage measurement	VMMXU1	3U	3U
Sequence voltage measurement	VSMSQI1	U_1, U_2, U_0	U_1, U_2, U_0
Three-phase power and energy measurement	PEMMXU1	P, E	P, E

Section 2 IEC 60870-5-103 data mappings

2.1 Overview

These tables show the default point definitions. The user is able to freely remap all these data. In that case PCM600 can provide an updated point list export of the new outlook.

Indications and controls table columns

Original IEC 61850 data	Internal signal that is mapped to the IEC 60870-5-103 point. Expressed in the form 'Logical Device.Logical Node.Data Object.Data Attribute'.
IEC 60870-5-103 value (DPI coded)	Value description. DPI value 10 means ON and value 01 means OFF.
FUN	Default Function Type definition for the point. Observe that Function Type 0 means that FUN in practice contains the given Device Function Type. The user-definable Function Type definition is set to the same FUN value as default.
INF	Default Information Number definition for the point. The user-definable Information Number definition is set to the same INF value as default.
InUse	1 means that the point is taken in use as default, and 0 that the point is not in use as default.
ASDU	ASDU point type. 1 and 2 are indications in monitoring direction. 20 means that the point is controllable.
GI	Default setting for General Interrogation. 1 means ON, 0 means OFF.
Coding	IEC 60870-5-103 DPI value coding. 1 means that the point shows OFF (01) and ON (10) values only. 2 means that the point shows values Intermediate (00), OFF (01), ON (10) and Error (11).

Class 2 data table columns

Default scale	Value that corresponds to the maximum IEC 60870-5-103 measurand value 1.
FrameNo 6	Shows if the value is present in Class2 frame 6.
FrameNo 7	Shows if the value is present in Class2 frame 7.

2.2 Point list for REF615 Ver. 2.0 FE01-06

Table 2: Indications and controls

Original IEC 61850 data	Signal name	IEC 60870-5-103 DPI value (bin)	FUN	INF	In Use	ASDU	GI	Coding
Device function type - standard, all variants								
LD0.DARREC1.AROn.stVal	Autorecloser state	10=AR On, 01=AR Off	0	16	1	1	1	1
LD0.LLN0.LEDRs1.ctlVal	LED reset	10=Reset indications and alarm LEDs	0	19	1	20	0	1
LD0.LLN0.Beh.stVal (Test mode)	Test mode	10=Test mode ON, 01=Test mode OFF	0	21	1	1	1	1
LD0.I3CGGIO1.ActSG.ctlVal	Parameter setting group 1	10=Setting group 1 in use	0	23	1	1,20	1	1
LD0.I3CGGIO1.ActSG.ctlVal	Parameter setting group 2	10=Setting group 2 in use	0	24	1	1,20	1	1
LD0.I3CGGIO1.ActSG.ctlVal	Parameter setting group 3	10=Setting group 3 in use	0	25	1	1,20	1	1
LD0.I3CGGIO1.ActSG.ctlVal	Parameter setting group 4	10=Setting group 4 in use	0	26	1	1,20	1	1
LD0.TCSSCBR1.CirAlm.stVal	Trip circuit 1 alarm	10=TCS1 alarm	0	36	1	1	1	1
LD0.LEDPTRC1.Op.general	Global operate	10=Operate (LEDPTRC)	0	68	1	2	0	1
LD0.LEDPTRC1.Str.general	Global start	10=Start (LEDPTRC)	0	84	1	2	1	1
LD0.DARREC1.SucRec.stVal	Successful reclose status	10=Successful reclose	0	128	1	1	0	1
LD0.DARREC1.InInhRec.stVal	Inhibit reclose (status)	10=Reclose inhibit	0	130	1	1	1	1
Device function type - private, all variants								
LD0.TRPPTRC1.Op.general	TRPTRC1 input signal	10=Input signal ON	10	1	1	2	0	1
LD0.TRPPTRC1.Tr.general	TRPTRC1 trip output signal	10=Trip output signal ON	10	2	1	2	0	1
LD0.TRPPTRC2.Op.general	TRPTRC2 input signal	10=Input signal ON	10	3	1	2	0	1
LD0.TRPPTRC2.Tr.general	TRPTRC2 trip output signal	10=Trip output signal ON	10	4	1	2	0	1
CTRL.LLN0.Loc.stVal	Local/Remote state	10=Remote, 01=Local	10	10	1	1	1	1
CTRL.LLN0.Loc1.stVal	Local/Remote Off	10=Local/Remote OFF, 01=ON	10	11	1	1	1	1
LD0.LLN0.RecRs.ctlVal	Reset all data	10=Reset all data	10	19	1	20	0	1
LD0.LLN0.LEDRs2.ctlVal	Reset alarm LEDs	10=Reset alarm LEDs only	10	21	1	20	0	1
LD0.TCSSCBR2.CirAlm.stVal	Trip circuit 2 alarm	10=TCS2 alarm	10	36	1	1	1	1
DR.RDRE1.RcdTrg.ctlVal	Trig DR recording	10=External DR trig	10	41	1	20	0	1
DR.RDRE1.MemClr.ctlVal	Clear DR memory	10=Clear memory	10	42	1	20	0	1
LD0.CMSTA1.RecRs.ctlVal	Reset CMMXU1 max.demands	10=Reset max values	10	45	1	20	0	1
Negative sequence overcurrent protection (2 stages), all variants								
LD0.NSPTOC1.Str.general	Stage1 start	10=Stage1 start	21	84	1	2	1	1
LD0.NSPTOC1.Op.general	Stage1 operate	10=Stage1 operate	21	90	1	2	0	1
LD0.NSPTOC2.Op.general	Stage2 operate	10=Stage2 operate	21	91	1	2	0	1

Table continues on next page

Original IEC 61850 data	Signal name	IEC 60870-5-103 DPI value (bin)	FUN	INF	In Use	ASDU	GI	Coding
LD0.NSPTOC2.Str.general	Stage2 start	10=Stage2 start	21	94	1	2	1	1
Fuse failure protection (1 stage), FE05,06								
LD0.SEQRFUF1.Str.general	General start	10=General Start	22	84	1	2	1	1
LD0.SEQRFUF1.Str3Ph.general	3 phase start	10=3 phase start	22	94	1	2	1	1
Current circuit failure protection (1 stage), FE05,06								
LD0.CCRDIF1.Alm.stVal	Alarm	10 = Alarm	23	1	1	1	1	1
LD0.CCRDIF1.Op.general	Operate	10 = Operate	23	90	1	2	0	1
Three-phase directional overcurrent protection (3 stages), FE06								
LD0.DPHHPTOC1.Str.phsA	High stage Start[.phsA]	10=High stage phsA start	32	44	0	2	1	1
LD0.DPHHPTOC1.Str.phsB	High stage Start[.phsB]	10=High stage phsB start	32	45	0	2	1	1
LD0.DPHHPTOC1.Str.phsC	High stage Start[.phsC]	10=High stage phsC start	32	46	0	2	1	1
LD0.DPHLPTOC2.Str.phsA	Low(2) stage Start[.phsA]	10=Low(2) stage phsA start	32	54	0	2	1	1
LD0.DPHLPTOC2.Str.phsB	Low(2) stage Start[.phsB]	10=Low(2) stage phsB start	32	55	0	2	1	1
LD0.DPHLPTOC2.Str.phsC	Low(2) stage Start[.phsC]	10=Low(2) stage phsC start	32	56	0	2	1	1
LD0.DPHLPTOC1.Str.phsA	Low(1) stage Start[.phsA]	10=Low(1) stage phsA start	32	64	0	2	1	1
LD0.DPHLPTOC1.Str.phsB	Low(1) stage Start[.phsB]	10=Low(1) stage phsB start	32	65	0	2	1	1
LD0.DPHLPTOC1.Str.phsC	Low(1) stage Start[.phsC]	10=Low(1) stage phsC start	32	66	0	2	1	1
LD0.DPHLPTOC1.Str.general	Low(1) stage Start[.general]	10=Low(1) stage start	32	84	1	2	1	1
LD0.DPHLPTOC1.Op.general	Low(1) stage Operate[.general]	10=Low(1) stage operate	32	90	1	2	0	1
LD0.DPHLPTOC2.Op.general	Low(2) stage Operate[.general]	10=Low(2) stage operate	32	91	1	2	0	1
LD0.DPHLPTOC2.Str.general	Low(2) stage Start[.general]	10=Low(2) stage start	32	94	1	2	1	1
LD0.DPHHPTOC1.Str.general	High stage Start[.general]	10=High stage start	32	96	1	2	1	1
LD0.DPHHPTOC1.Op.general	High stage Operate[.general]	10=High stage operate	32	98	1	2	0	1
Phase overvoltage protection (3 stages), FE06								
LD0.PHPTOV3.Str.phsA	Stage 3 Start[.phsA]	10=Stage 3 phsA start	40	44	0	2	1	1
LD0.PHPTOV3.Str.phsB	Stage 3 Start[.phsB]	10=Stage 3 phsB start	40	45	0	2	1	1
LD0.PHPTOV3.Str.phsC	Stage 3 Start[.phsC]	10=Stage 3 phsC start	40	46	0	2	1	1
LD0.PHPTOV2.Str.phsA	Stage 2 Start[.phsA]	10=Stage 2 phsA start	40	54	0	2	1	1
LD0.PHPTOV2.Str.phsB	Stage 2 Start[.phsB]	10=Stage 2 phsB start	40	55	0	2	1	1
LD0.PHPTOV2.Str.phsC	Stage 2 Start[.phsC]	10=Stage 2 phsC start	40	56	0	2	1	1
LD0.PHPTOV1.Str.phsA	Stage 1 Start[.phsA]	10=Stage 1 phsA start	40	64	0	2	1	1
LD0.PHPTOV1.Str.phsB	Stage 1 Start[.phsB]	10=Stage 1 phsB start	40	65	0	2	1	1
LD0.PHPTOV1.Str.phsC	Stage 1 Start[.phsC]	10=Stage 1 phsC start	40	66	0	2	1	1
LD0.PHPTOV1.Str.general	Stage 1 Start[.general]	10=Stage 1 start	40	84	1	2	1	1

Table continues on next page

Original IEC 61850 data	Signal name	IEC 60870-5-103 DPI value (bin)	FUN	INF	In Use	ASDU	GI	Coding
LD0.PHPTOV1.Op.general	Stage 1 Operate[.general]	10=Stage 1 operate	40	90	1	2	0	1
LD0.PHPTOV2.Op.general	Stage 2 Operate[.general]	10=Stage 2 operate	40	91	1	2	0	1
LD0.PHPTOV2.Str.general	Stage 2 Start[.general]	10=Stage 2 start	40	94	1	2	1	1
LD0.PHPTOV3.Str.general	Stage 3 Start[.general]	10=Stage 3 start	40	96	1	2	1	1
LD0.PHPTOV3.Op.general	Stage 3 Operate[.general]	10=Stage 3 operate	40	98	1	2	0	1
Phase undervoltage protection (3 stages), FE06								
LD0.PHPTUV3.Str.phsA	Stage 3 Start[.phsA]	10=Stage 3 phsA start	41	44	0	2	1	1
LD0.PHPTUV3.Str.phsB	Stage 3 Start[.phsB]	10=Stage 3 phsB start	41	45	0	2	1	1
LD0.PHPTUV3.Str.phsC	Stage 3 Start[.phsC]	10=Stage 3 phsC start	41	46	0	2	1	1
LD0.PHPTUV2.Str.phsA	Stage 2 Start[.phsA]	10=Stage 2 phsA start	41	54	0	2	1	1
LD0.PHPTUV2.Str.phsB	Stage 2 Start[.phsB]	10=Stage 2 phsB start	41	55	0	2	1	1
LD0.PHPTUV2.Str.phsC	Stage 2 Start[.phsC]	10=Stage 2 phsC start	41	56	0	2	1	1
LD0.PHPTUV1.Str.phsA	Stage 1 Start[.phsA]	10=Stage 1 phsA start	41	64	0	2	1	1
LD0.PHPTUV1.Str.phsB	Stage 1 Start[.phsB]	10=Stage 1 phsB start	41	65	0	2	1	1
LD0.PHPTUV1.Str.phsC	Stage 1 Start[.phsC]	10=Stage 1 phsC start	41	66	0	2	1	1
LD0.PHPTUV1.Str.general	Stage 1 Start[.general]	10=Stage 1 start	41	84	1	2	1	1
LD0.PHPTUV1.Op.general	Stage 1 Operate[.general]	10=Stage 1 operate	41	90	1	2	0	1
LD0.PHPTUV2.Op.general	Stage 2 Operate[.general]	10=Stage 2 operate	41	91	1	2	0	1
LD0.PHPTUV2.Str.general	Stage 2 Start[.general]	10=Stage 2 start	41	94	1	2	1	1
LD0.PHPTUV3.Str.general	Stage 3 Start[.general]	10=Stage 3 start	41	96	1	2	1	1
LD0.PHPTUV3.Op.general	Stage 3 Operate[.general]	10=Stage 3 operate	41	98	1	2	0	1
Positive sequence undervoltage protection (1 stage), FE06								
LD0.PSPTUV1.Str.phsA	Start[.phsA]	10=phsA start	42	64	0	2	1	1
LD0.PSPTUV1.Str.phsB	Start[.phsB]	10=phsB start	42	65	0	2	1	1
LD0.PSPTUV1.Str.phsC	Start[.phsC]	10=phsC start	42	66	0	2	1	1
LD0.PSPTUV1.Str.general	Start[.general]	10=Start	42	84	1	2	1	1
LD0.PSPTUV1.Op.general	Operate[.general]	10=Operate	42	90	1	2	0	1
Negative sequence overvoltage protection (1 stage), FE06								
LD0.NSPTOV1.Str.phsA	Start[.phsA]	10=phsA start	43	64	0	2	1	1
LD0.NSPTOV1.Str.phsB	Start[.phsB]	10=phsB start	43	65	0	2	1	1
LD0.NSPTOV1.Str.phsC	Start[.phsC]	10=phsC start	43	66	0	2	1	1
LD0.NSPTOV1.Str.general	Start[.general]	10=Start	43	84	1	2	1	1
LD0.NSPTOV1.Op.general	Operate[.general]	10=Operate	43	90	1	2	0	1
Residual overvoltage protection (3 stages), FE06								
LD0.ROVPTOV1.Str.general	Stage 1 Start	10=Stage 1 start	44	84	1	2	1	1
LD0.ROVPTOV1.Op.general	Stage 1 Operate	10=Stage 1 operate	44	90	1	2	0	1
LD0.ROVPTOV2.Op.general	Stage 2 Operate	10=Stage 2 operate	44	91	1	2	0	1
LD0.ROVPTOV2.Str.general	Stage 2 Start	10=Stage 2 start	44	94	1	2	1	1
LD0.ROVPTOV3.Str.general	Stage 3 Start	10=Stage 3 start	44	96	1	2	1	1

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Original IEC 61850 data	Signal name	IEC 60870-5-103 DPI value (bin)	FUN	INF	In Use	ASDU	GI	Coding
LD0.ROVPTOV3.Op.general	Stage 3 Operate	10=Stage 3 operate	44	98	1	2	0	1
Physical binary I/O signals								
LD0.XGGIO130.Ind1.stVal	X130-Input 1	10=ON, 01=OFF	50	1	0	1	1	1
LD0.XGGIO130.Ind2.stVal	X130-Input 2	10=ON, 01=OFF	50	2	0	1	1	1
LD0.XGGIO130.Ind3.stVal	X130-Input 3	10=ON, 01=OFF	50	3	0	1	1	1
LD0.XGGIO130.Ind4.stVal	X130-Input 4	10=ON, 01=OFF	50	4	0	1	1	1
LD0.XGGIO130.Ind5.stVal	X130-Input 5	10=ON, 01=OFF	50	5	0	1	1	1
LD0.XGGIO130.Ind6.stVal	X130-Input 6	10=ON, 01=OFF	50	6	0	1	1	1
LD0.XGGIO130.SPCSO1.stVal	X130-Output 1	10=ON, 01=OFF	50	101	0	1	1	1
LD0.XGGIO130.SPCSO2.stVal	X130-Output 2	10=ON, 01=OFF	50	102	0	1	1	1
LD0.XGGIO130.SPCSO3.stVal	X130-Output 3	10=ON, 01=OFF	50	103	0	1	1	1
LD0.XGGIO120.Ind1.stVal	X120-Input 1	10=ON, 01=OFF	51	1	0	1	1	1
LD0.XGGIO120.Ind2.stVal	X120-Input 2	10=ON, 01=OFF	51	2	0	1	1	1
LD0.XGGIO120.Ind3.stVal	X120-Input 3	10=ON, 01=OFF	51	3	0	1	1	1
LD0.XGGIO120.Ind4.stVal	X120-Input 4	10=ON, 01=OFF	51	4	0	1	1	1
LD0.XGGIO110.Ind1.stVal	X110-Input 1	10=ON, 01=OFF	52	1	0	1	1	1
LD0.XGGIO110.Ind2.stVal	X110-Input 2	10=ON, 01=OFF	52	2	0	1	1	1
LD0.XGGIO110.Ind3.stVal	X110-Input 3	10=ON, 01=OFF	52	3	0	1	1	1
LD0.XGGIO110.Ind4.stVal	X110-Input 4	10=ON, 01=OFF	52	4	0	1	1	1
LD0.XGGIO110.Ind5.stVal	X110-Input 5	10=ON, 01=OFF	52	5	0	1	1	1
LD0.XGGIO110.Ind6.stVal	X110-Input 6	10=ON, 01=OFF	52	6	0	1	1	1
LD0.XGGIO110.Ind7.stVal	X110-Input 7	10=ON, 01=OFF	52	7	0	1	1	1
LD0.XGGIO110.Ind8.stVal	X110-Input 8	10=ON, 01=OFF	52	8	0	1	1	1
LD0.XGGIO110.SPCSO1.stVal	X110-Output 1	10=ON, 01=OFF	52	101	0	1	1	1
LD0.XGGIO110.SPCSO2.stVal	X110-Output 2	10=ON, 01=OFF	52	102	0	1	1	1
LD0.XGGIO110.SPCSO3.stVal	X110-Output 3	10=ON, 01=OFF	52	103	0	1	1	1
LD0.XGGIO110.SPCSO4.stVal	X110-Output 4	10=ON, 01=OFF	52	104	0	1	1	1
LD0.XGGIO100.SPCSO1.stVal	X100-Output 1	10=ON, 01=OFF	53	101	0	1	1	1
LD0.XGGIO100.SPCSO2.stVal	X100-Output 2	10=ON, 01=OFF	53	102	0	1	1	1
LD0.XGGIO100.SPCSO3.stVal	X100-Output 3	10=ON, 01=OFF	53	103	0	1	1	1
LD0.XGGIO100.SPCSO4.stVal	X100-Output 4	10=ON, 01=OFF	53	104	0	1	1	1
LD0.XGGIO100.SPCSO5.stVal	X100-Output 5	10=ON, 01=OFF	53	105	0	1	1	1
LD0.XGGIO100.SPCSO6.stVal	X100-Output 6	10=ON, 01=OFF	53	106	0	1	1	1
LD0.XAGGIO130.Ind1.stVal	XA130-Input 1	10=ON, 01=OFF	54	1	0	1	1	1
LD0.XAGGIO130.Ind2.stVal	XA130-Input 2	10=ON, 01=OFF	54	2	0	1	1	1
LD0.XAGGIO130.Ind3.stVal	XA130-Input 3	10=ON, 01=OFF	54	3	0	1	1	1
LD0.XAGGIO130.Ind4.stVal	XA130-Input 4	10=ON, 01=OFF	54	4	0	1	1	1
Arc protection (3 stages), optional in all variants								
LD0.ARCSARC11.FADet.stVal	Stage1 Fault arc detected	10=Stage1 arc detected	156	211	1	1	0	1
LD0.ARCSARC11.InRemFA.stVal	Stage1 Remote fault arc detected	10=Stage1 Remote arc detected	156	212	1	1	0	1
LD0.ARCPTRC11.Op.general	Stage1 Operate	10=Stage1 operate	156	213	1	2	0	1
LD0.ARCSARC21.FADet.stVal	Stage2 Fault arc detected	10=Stage2 arc detected	156	221	1	1	0	1
LD0.ARCSARC21.InRemFA.stVal	Stage2 Remote fault arc detected	10=Stage2 Remote arc detected	156	222	1	1	0	1
LD0.ARCPTRC21.Op.general	Stage2 Operate	10=Stage2 operate	156	223	1	2	0	1
LD0.ARCSARC31.FADet.stVal	Stage3 Fault arc detected	10=Stage3 arc detected	156	231	1	1	0	1

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Original IEC 61850 data	Signal name	IEC 60870-5-103 DPI value (bin)	FUN	INF	In Use	ASDU	GI	Coding
LD0.ARCSARC31.InRemFA.stVal	Stage3 Remote fault arc detected	10=Stage3 Remote arc detected	156	232	1	1	0	1
LD0.ARCPTRC31.Op.general	Stage3 Operate	10=Stage3 operate	156	233	1	2	0	1
Phase discontinuity protection (1 stage), all variants								
LD0.PDNSPTOC1.Str.general	Start	10=Stage start	157	84	1	2	1	1
LD0.PDNSPTOC1.Op.general	Operate	10=Stage operate	157	90	1	2	0	1
Transient/intermittent earth-fault protection (1 stage), FE01,02,05,06								
LD0.INTRPTEF1.Str.general	Start	10=Stage start	158	84	1	2	1	1
LD0.INTRPTEF1.Op.general	Operate	10=Stage operate	158	90	1	2	0	1
Non-directional earth-fault and sensitive earth-fault protection (4 stages), partly supported in all variants, full support in FE03,04								
LD0.EFLPTOC1.Str.general	Low(1) stage Start	10=Low(1) stage start	159	84	1	2	1	1
LD0.EFLPTOC1.Op.general	Low(1) stage Operate	10=Low(1) stage operate	159	90	1	2	0	1
LD0.EFLPTOC2.Op.general	Low(2) stage Operate	10=Low(2) stage operate	159	91	1	2	0	1
LD0.EFLPTOC2.Str.general	Low(2) stage Start	10=Low(2) stage start	159	94	1	2	1	1
LD0.EFHPTOC1.Str.general	High stage Start	10=High stage start	159	96	1	2	1	1
LD0.EFIPTOC1.Str.general	Instanteous stage Start	10=Instanteous stage start	159	97	1	2	1	1
LD0.EFHPTOC1.Op.general	High stage Operate	10=High stage operate	159	98	1	2	0	1
LD0.EFIPTOC1.Op.general	Instanteous stage Operate	10=Instanteous stage operate	159	99	1	2	0	1
Phase overcurrent protection (4 stages), FE01,02,03,04,05								
LD0.PHIPTOC1.Str.phsA	Instanteous stage Start[.phsA]	10=Inst. stage phsA start	162	34	0	2	1	1
LD0.PHIPTOC1.Str.phsB	Instanteous stage Start[.phsB]	10=Inst. stage phsB start	162	35	0	2	1	1
LD0.PHIPTOC1.Str.phsC	Instanteous stage Start[.phsC]	10=Inst. stage phsC start	162	36	0	2	1	1
LD0.PHHPTOC2.Str.phsA	High(2) stage Start[.phsA]	10=High(2) stage phsA start	162	44	0	2	1	1
LD0.PHHPTOC2.Str.phsB	High(2) stage Start[.phsB]	10=High(2) stage phsB start	162	45	0	2	1	1
LD0.PHHPTOC2.Str.phsC	High(2) stage Start[.phsC]	10=High(2) stage phsC start	162	46	0	2	1	1
LD0.PHHPTOC1.Str.phsA	High(1) stage Start[.phsA]	10=High(1) stage phsA start	162	54	0	2	1	1
LD0.PHHPTOC1.Str.phsB	High(1) stage Start[.phsB]	10=High(1) stage phsB start	162	55	0	2	1	1
LD0.PHHPTOC1.Str.phsC	High(1) stage Start[.phsC]	10=High(1) stage phsC start	162	56	0	2	1	1
LD0.PHLPTOC1.Str.phsA	Low stage Start[.phsA]	10=Low stage phsA start	162	64	0	2	1	1
LD0.PHLPTOC1.Str.phsB	Low stage Start[.phsB]	10=Low stage phsB start	162	65	0	2	1	1
LD0.PHLPTOC1.Str.phsC	Low stage Start[.phsC]	10=Low stage phsC start	162	66	0	2	1	1
LD0.PHLPTOC1.Str.general	Low stage Start[.general]	10=Low stage start	162	84	1	2	1	1
LD0.PHLPTOC1.Op.general	Low stage Operate[.general]	10=Low stage operate	162	90	1	2	0	1
LD0.PHHPTOC1.Op.general	High(1) stage Operate[.general]	10=High(1) stage operate	162	91	1	2	0	1

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Original IEC 61850 data	Signal name	IEC 60870-5-103 DPI value (bin)	FUN	INF	In Use	ASDU	GI	Coding
LD0.PHHPTOC1.Str.general	High(1) stage Start[.general]	10=High(1) stage start	162	94	1	2	1	1
LD0.PHHPTOC2.Str.general	High(2) stage Start[.general]	10=High(2) stage start	162	96	1	2	1	1
LD0.PHIPTOC1.Str.general	Instanteous stage Start[.general]	10=Instanteous stage start	162	97	1	2	1	1
LD0.PHHPTOC2.Op.general	High(2) stage Operate[.general]	10=High(2) stage operate	162	98	1	2	0	1
LD0.PHIPTOC1.Op.general	Instanteous stage Operate[.general]	10=Instanteous stage operate	162	99	1	2	0	1
Directional earth-fault protection (3 stages), FE01,02,05,06								
LD0.DEFLPTOC1.Str.general	Low(1) stage start	10=Low(1) stage start	163	84	1	2	1	1
LD0.DEFLPTOC1.Op.general	Low(1) stage operate	10=Low(1) stage operate	163	90	1	2	0	1
LD0.DEFLPTOC2.Op.general	Low(2) stage operate	10=Low(2) stage operate	163	91	1	2	0	1
LD0.DEFLPTOC2.Str.general	Low(2) stage start	10=Low(2) stage start	163	94	1	2	1	1
LD0.DEFHPTOC1.Str.general	High stage start	10=High stage start	163	96	1	2	1	1
LD0.DEFHPTOC1.Op.general	High stage operate	10=High stage operate	163	98	1	2	0	1
Three-phase inrush detection, all variants								
LD0.INRPHAR1.Str.phsA	Start[.phsA]	10=Start phsA	167	64	0	2	1	1
LD0.INRPHAR1.Str.phsB	Start[.phsB]	10=Start phsB	167	65	0	2	1	1
LD0.INRPHAR1.Str.phsC	Start[.phsC]	10=Start phsC	167	66	0	2	1	1
LD0.INRPHAR1.Str.general	Start[.general]	10=Start general	167	84	1	2	1	1
Thermal overload protection, all variants								
LD0.T1PTTR1.Str.general	Start	10=Start	168	84	1	2	1	1
LD0.T1PTTR1.AlmThm.general	Thermal alarm	10=Thermal alarm	168	85	1	2	1	1
LD0.T1PTTR1.Op.general	Operate	10=Operate	168	90	1	2	0	1
Auto-reclosing, optional in all variants								
LD0.DARREC1.RsRec.ctlVal	AR reset	10=Reset	169	19	1	20	0	1
LD0.DARREC1.RsCnt.ctlVal	AR counters reset	10=Reset	169	20	1	20	0	1
LD0.DARREC1.PrgRec1.stVal	AR in progress 1st reclose	10=In progress	169	101	1	2	0	1
LD0.DARREC1.PrgRec2.stVal	AR in progress 2nd reclose	10=In progress	169	102	1	2	0	1
LD0.DARREC1.PrgRec3.stVal	AR in progress 3rd reclose	10=In progress	169	103	1	2	0	1
LD0.DARREC1.PrgRec4.stVal	AR in progress 4th reclose	10=In progress	169	104	1	2	0	1
LD0.DARREC1.PrgRec5.stVal	AR in progress 5th reclose	10=In progress	169	105	1	2	0	1
LD0.DARREC1.PrgRec.stVal	AR in progress	10=In progress	169	120	1	2	0	1
LD0.DARREC1.CBManCls.stVal	CB manually closed	10=CB manually closed	169	159	1	2	0	1
LD0.DARREC1.LO.stVal	Lockout status	10=Lockout	169	164	1	2	0	1
LD0.DARREC1.UnsRec.stVal	Unsuccessful reclose status	10=Unsuccessful reclose	169	170	1	2	0	1
LD0.DARREC1.InBlkThm.stVal	Thermal block (status)	10=Thermal block	169	171	1	2	0	1
LD0.DARREC1.RdyRec.stVal	Ready reclose status	10=Reclose ready	169	172	1	2	0	1
LD0.DARREC1.ActRec.stVal	Active reclose status	10=Reclose active	169	173	1	2	0	1
LD0.DARREC1.PrgDsr.stVal	Discrimination time in progress	10=Discriminatio n time in progress	169	174	1	2	0	1
LD0.DARREC1.PrgCutOut.stVal	Cutout time in progress	10=Cutout time in progress	169	175	1	2	0	1
LD0.DARREC1.FrqOpAlm.stVal	Frequent operation counter alarm	10=Frequent operation alarm	169	176	1	2	0	1

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Original IEC 61850 data	Signal name	IEC 60870-5-103 DPI value (bin)	FUN	INF	In Use	ASDU	GI	Coding
LD0.DARREC1.RclTmStr.stVal	Reclaim time started	10=Reclaim time started	169	177	1	2	0	1
LD0.DARREC1.ProCrd.stVal	Protection coordination	10=Protection coordination	169	178	1	2	0	1
LD0.DARREC1.Op.general	Operate (close command to XCBR)	10=Close command to CB	169	179	1	2	0	1
LD0.DARREC1.OpOpn.general	Operate (open command to XCBR)	10=Open command to CB	169	180	1	2	0	1
LD0.DARREC1.UnsCBCls.stVal	Unsuccessful CB closing status	10=Unsuccessful CB closing	169	181	1	2	0	1
LD0.DARREC1.WtMstr.stVal	Master signal to follower	10=Master signal to follower	169	182	1	2	0	1
Phase currents limit supervision, all variants								
LD0.CMMXU1.HiAlm.stVal	High alarm	10=High alarm	210	1	0	1	1	1
LD0.CMMXU1.HiWrn.stVal	High warning	10=High warning	210	2	0	1	1	1
LD0.CMMXU1.LoWrn.stVal	Low warning	10=Low warning	210	3	0	1	1	1
LD0.CMMXU1.LoAlm.stVal	Low alarm	10=Low alarm	210	4	0	1	1	1
Residual current limit supervision, all variants								
LD0.RESCMMXU1.HiAlm.stVal	High alarm	10=High alarm	210	11	0	1	1	1
LD0.RESCMMXU1.HiWrn.stVal	High warning	10=High warning	210	12	0	1	1	1
Phase-to-phase voltage limit supervision, FE05,06								
LD0.VMMXU1.HiAlm.stVal	High alarm	10=High alarm	211	1	0	1	1	1
LD0.VMMXU1.HiWrn.stVal	High warning	10=High warning	211	2	0	1	1	1
LD0.VMMXU1.LoWrn.stVal	Low warning	10=Low warning	211	3	0	1	1	1
LD0.VMMXU1.LoAlm.stVal	Low alarm	10=Low alarm	211	4	0	1	1	1
Residual voltage limit supervision, FE01,02,05,06								
LD0.RESVMMXU1.HiAlm.stVal	High alarm	10=High alarm	211	11	0	1	1	1
LD0.RESVMMXU1.HiWrn.stVal	High warning	10=High warning	211	12	0	1	1	1
Circuit breaker position and failure protection, all variants								
CTRL.CBCILO1.EnaOpn.stVal	CB open enabled	10=Open enabled	240	21	1	1	1	1
CTRL.CBCILO1.EnaCls.stVal	CB close enabled	10=Close enabled	240	22	1	1	1	1
CTRL.CBXCBR1.BlkOpn.stVal	CB open blocked	10=Open blocked	240	23	1	1	1	1
CTRL.CBXCBR1.BlkCls.stVal	CB close blocked	10=Close blocked	240	24	1	1	1	1
LD0.CCBRBRF1.InStr.stVal	Start command	10=Start command	240	100	0	2	1	1
LD0.CCBRBRF1.Str.general	Start, timer running	10=Start,timer running	240	101	0	2	1	1
LD0.CCBRBRF1.OpEx.general	Failure, external trip	10=Failure,external trip	240	102	0	2	0	1
LD0.CCBRBRF1.OpIn.general	Operate, internal retrip	10=Operate, internal re-trip	240	103	0	2	0	1
LD0.CCBRBRF1.InCBFlt.stVal	CB faulty and unable to trip	10=CB faulty, trip unable	240	104	0	2	1	1
CTRL.CBCSWI1.Pos.stVal	Circuit breaker position	10=Close; 10=Open; 00=Intermediate; 11=Error	240	160	1	1,20	1	2
Circuit breaker condition monitoring, FE02,04,05,06								
LD0.SSCBR1.RsAccAPwr.ctlVal	Reset accumulation energy	10=Reset	242	19	1	20	0	1
LD0.SSCBR1.RsCBWear.ctlVal	Reset CB remaining life and op.counters	10=Reset	242	20	1	20	0	1
LD0.SSCBR1.RsTrvTm.ctlVal	Reset CB travelling time alarm	10=Reset	242	21	1	20	0	1
LD0.SSCBR1.RsSprChaTm.ctlVal	Reset CB spring charge time alarm	10=Reset	242	22	1	20	0	1
LD0.SSCBR1.OpnAlm.stVal	Open travel time exceeded	10=Open travel time alarm	242	101	0	1	0	1
LD0.SSCBR1.ClsAlm.stVal	Close travel time exceeded	10=Close travel time alarm	242	102	0	1	0	1

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Original IEC 61850 data	Signal name	IEC 60870-5-103 DPI value (bin)	FUN	INF	In Use	ASDU	GI	Coding
LD0.SSCBR1.SprChaAlm.stVal	Spring charging time exceeded	10=Spring charging time alarm	242	103	0	1	0	1
LD0.SSCBR1.OpNumAlm.stVal	Num of CB operations alarm	10=CB operations alarm	242	104	0	1	0	1
LD0.SSCBR1.OpNumLO.stVal	Num of CB operations lockout limit	10=CB operations lockout alarm	242	105	0	1	0	1
LD0.SSCBR1.LonTmAlm.stVal	CB 'not operated for long time' alarm	10=CB unactive alarm	242	106	0	1	0	1
LD0.SSCBR1.PresAlm.stVal	Pressure below alarm level	10=Low pressure alarm	242	107	0	1	0	1
LD0.SSCBR1.PresLO.stVal	Pressure below lockout level	10=Low pressure lockout alarm	242	108	0	1	0	1
LD0.SSCBR1.APwrAlm.stVal	Acc. currents power (Iyt),alarm limit	10=Iyt alarm	242	109	0	1	0	1
LD0.SSCBR1.APwrLO.stVal	Acc. currents power (Iyt),lockout limit	10=Iyt lockout alarm	242	110	0	1	0	1
LD0.SSCBR1.CBLifAlm.stVal	Remaining life of CB exceeded alarm limit	10=CB life alarm	242	111	0	1	0	1
Disconnector positions, FE02,04,05,06								
CTRL.DCSXSWI1.Pos.stVal	Disconnector 1 position	10=Close; 10=Open; 00=Intermediate; 11=Error	253	1	1	1	1	2
CTRL.DCSXSWI2.Pos.stVal	Disconnector 2 position	10=Close; 10=Open; 00=Intermediate; 11=Error	253	2	1	1	1	2
CTRL.DCSXSWI3.Pos.stVal	Disconnector 3 position	10=Close; 10=Open; 00=Intermediate; 11=Error	253	3	1	1	1	2
CTRL.ESSXSWI1.Pos.stVal	Earth switch position	10=Close; 10=Open; 00=Intermediate; 11=Error	253	11	1	1	1	2
LHMI alarm LED indications, all variants								
LD0.LEDGGIO1.SPCSO1.stVal	LED 1 state	10=LED ON, 01=LED OFF	253	89	1	1	1	1
LD0.LEDGGIO1.SPCSO2.stVal	LED 2 state	10=LED ON, 01=LED OFF	253	90	1	1	1	1
LD0.LEDGGIO1.SPCSO3.stVal	LED 3 state	10=LED ON, 01=LED OFF	253	91	1	1	1	1
LD0.LEDGGIO1.SPCSO4.stVal	LED 4 state	10=LED ON, 01=LED OFF	253	92	1	1	1	1
LD0.LEDGGIO1.SPCSO5.stVal	LED 5 state	10=LED ON, 01=LED OFF	253	93	1	1	1	1
LD0.LEDGGIO1.SPCSO6.stVal	LED 6 state	10=LED ON, 01=LED OFF	253	94	1	1	1	1
LD0.LEDGGIO1.SPCSO7.stVal	LED 7 state	10=LED ON, 01=LED OFF	253	95	1	1	1	1
LD0.LEDGGIO1.SPCSO8.stVal	LED 8 state	10=LED ON, 01=LED OFF	253	96	1	1	1	1
LD0.LEDGGIO1.SPCSO9.stVal	LED 9 state	10=LED ON, 01=LED OFF	253	97	1	1	1	1
LD0.LEDGGIO1.SPCSO10.stVal	LED 10 state	10=LED ON, 01=LED OFF	253	98	1	1	1	1
LD0.LEDGGIO1.SPCSO11.stVal	LED 11 state	10=LED ON, 01=LED OFF	253	99	1	1	1	1

Table 3: Class 2 PRIVATE measurand frames 6 and 7 for REF615 variants FE01,02,03,04

Index	IEC 61850 data	Signal name	Default scale	Frame No6	Frame No7
1	LD0.CMMXU1.A.phsA.instCVal.mag	Phase current A	2.4	x	x
2	LD0.CMMXU1.A.phsB.instCVal.mag	Phase current B	2.4	x	x
3	LD0.CMMXU1.A.phsC.instCVal.mag	Phase current C	2.4	x	x
4	LD0.RESCMMXU1.A.res.instCVal.mag	Residual current	2.4	x	x
5	LD0.RESVMMXU1.PhV.res.instCVal.mag	Residual voltage	2.4	x	x
6	LD0.CSMSQI1.SeqA.c1.instCVal.mag	Positive sequence current	2.4	x	x
7	LD0.CSMSQI1.SeqA.c2.instCVal.mag	Negative sequence current	2.4	x	x
8	LD0.CSMSQI1.SeqA.c3.instCVal.mag	Zero sequence current	2.4	x	x
9	LD0.T1PTTR1.Tmp.mag	Temperature of protected object	1000	x	x
10	LD0.CMSTA1.AvAmps1.mag	Phase current A -average	2.4		x
11	LD0.CMSTA1.AvAmps2.mag	Phase current B -average	2.4		x
12	LD0.CMSTA1.AvAmps3.mag	Phase current C -average	2.4		x

Table 4: Class 2 PRIVATE measurand frames 6 and 7 for REF615 variant FE05,06

Index	IEC 61850 data	Signal name	Default scale	Frame No6	Frame No7
1	LD0.CMMXU1.A.phsA.instCVal.mag	Phase current A	2.4	x	x
2	LD0.CMMXU1.A.phsB.instCVal.mag	Phase current B	2.4	x	x
3	LD0.CMMXU1.A.phsC.instCVal.mag	Phase current C	2.4	x	x
4	LD0.RESCMMXU1.A.res.instCVal.mag	Residual current	2.4	x	x
5	LD0.RESVMMXU1.PhV.res.instCVal.mag	Residual voltage	2.4	x	x
6	LD0.CSMSQI1.SeqA.c1.instCVal.mag	Positive sequence current	2.4	x	x
7	LD0.CSMSQI1.SeqA.c2.instCVal.mag	Negative sequence current	2.4	x	x
8	LD0.CSMSQI1.SeqA.c3.instCVal.mag	Zero sequence current	2.4	x	x
9	LD0.T1PTTR1.Tmp.mag	Temperature of protected object	1000	x	x
10	LD0.VMMXU1.phV.phsA.cVal.mag	Phase-to-ground voltage phase A	2.4	x	x
11	LD0.VMMXU1.phV.phsB.cVal.mag	Phase-to-ground voltage phase B	2.4	x	x
12	LD0.VMMXU1.phV.phsC.cVal.mag	Phase-to-ground voltage phase C	2.4	x	x
13	LD0.VMMXU1.PPV.phsAB.cVal.mag	Phase-to-phase voltage phase AB	2.4	x	x
14	LD0.VMMXU1.PPV.phsBC.cVal.mag	Phase-to-phase voltage phase BC	2.4	x	x
15	LD0.VMMXU1.PPV.phsCA.cVal.mag	Phase-to-phase voltage phase CA	2.4	x	x
16	LD0.VSMSQI1.SeqA.c1.instCVal.mag	Positive sequence voltage	2.4	x	x
17	LD0.VSMSQI1.SeqA.c2.instCVal.mag	Negative sequence voltage	2.4	x	x
18	LD0.VSMSQI1.SeqA.c3.instCVal.mag	Zero sequence voltage	2.4	x	x
19	LD0.PEMMXU1.TotW.instMag	Active power P	1000	x	x
20	LD0.PEMMXU1.TotVAr.instMag	Reactive power Q	1000	x	x
21	LD0.PEMMXU1.TotVA.instMag	Apparent power S	1000	x	x
22	LD0.PEMMXU1.TotPF.instMag	Power factor	1	x	x
23	Reserved (value 0)	Reserved (value 0)	0	x	x
24	LD0.CMSTA1.AvAmps1.mag	Phase current A -average	2.4		x
25	LD0.CMSTA1.AvAmps2.mag	Phase current B -average	2.4		x
26	LD0.CMSTA1.AvAmps3.mag	Phase current C -average	2.4		x

Section 3 Interoperability profile for REF615 IEC 60870-5-103

3.1 Physical layer

3.1.1 Electrical interface

☒ EIA RS-485

☐ Number of loads ..... for one protection equipment

NOTE - EIA RS-485 standard defines unit loads so that 32 of them can be operated on one line. For detailed information refer to clause 3 of EIA RS-485 standard.

3.1.2 Optical interface

☒ Glass fibre

☐ Plastic fibre

☐ F-SMA type connector

☐ BFOC/2,5 type connector

3.1.3 Transmission speed

☒ 9 600 bit/s

☒ 19 200 bit/s

3.2 Link layer

There are no choices for the link layer.

3.3 Application layer

3.3.1 Transmission mode for application data

Mode 1 (least significant octet first), as defined in 4.10 of IEC 60870-5-4, is used exclusively in this companion standard.

3.3.2 COMMON ADDRESS of ASDU

☒ One COMMON ADDRESS OF ASDU (identical with station address)

☐ More than one COMMON ADDRESS OF ASDU

3.3.3 Selection of standard information numbers in monitor direction

3.3.3.1 System functions in monitor directions

	INF	Semantics
☒	<0>	End of general interrogation
☒	<0>	Time synchronization
☒	<2>	Reset FCB
☒	<3>	Reset CU
☒	<4>	Start/restart
☒	<5>	Power on

3.3.3.2 Status indications in monitor direction

	INF	Semantics
☒	<16>	Auto-recloser active 1
☐	<17>	Teleprotection active
☐	<18>	Protection active
☐	<19>	LED reset
☐	<20>	Monitor direction blocked
☒	<21>	Test mode
☐	<22>	Local parameter setting
☒	<23>	Characteristic 1
☒	<24>	Characteristic 2
☒	<25>	Characteristic 3
☒	<26>	Characteristic 4

Table continues on next page

☐	<27>	Auxiliary input 1
☐	<28>	Auxiliary input 2
☐	<29>	Auxiliary input 3
☐	<30>	Auxiliary input 4

Note <27>...<30>: Depending on Binary I/O options and application usage there may be additional auxiliary inputs available in the IED. As default, all "raw" binary input data are mapped to private data. It is possible for user to re-map these additional inputs into standard <27>...<30> 'Auxiliary Inputs', if wanted.

3.3.3.3 Supervision indications in monitor direction

	INF	Semantics
☐	<32>	Measurand supervision I
☐	<33>	Measurand supervision V
☐	<35>	Phase sequence supervision
☒	<36>	Trip circuit supervision
☐	<37>	I>> back-up operation
☐	<38>	VT fuse failure
☐	<39>	Teleprotection disturbed
☐	<46>	Group warning
☐	<47>	Group alarm

Note <32>, <33> and <38>: IED current and voltage measurement supervision signals and alarms are found in private data definitions. Semantics of these signals are more complex in 615 series than what is defined by the IEC 60870-5-103 standard.

3.3.3.4 Earth fault indications in monitor direction

	INF	Semantics
☐	<48>	Earth fault L_1
☐	<49>	Earth fault L_2
☐	<50>	Earth fault L_3
☐	<51>	Earth fault forward, for example line
☐	<52>	Earth fault reverse, for example busbar

Note: In 615 series there exist different functions (and signals) for non-directional or directional earth fault protection. Function- and stage-dependent start/pickup signals are found in private data locations.

3.3.3.5 Fault indications in monitor direction

	INF	Semantics
☐	<64>	Start /pick-up L_1
☐	<65>	Start /pick-up L_2

Table continues on next page

☐	<66>	Start /pick-up L_3
☐	<67>	Start /pick-up N
☒	<68>	General trip
☐	<69>	Trip L_1
☐	<70>	Trip L_2
☐	<71>	Trip L_3
☐	<72>	Trip I>> (back-up operation)
☐	<73>	Fault location X in ohms
☐	<74>	Fault forward/line
☐	<75>	Fault reverse/busbar
☐	<76>	Teleprotection signal transmitted
☐	<77>	Teleprotection signal received
☐	<78>	Zone 1
☐	<79>	Zone 2
☐	<80>	Zone 3
☐	<81>	Zone 4
☐	<82>	Zone 5
☐	<83>	Zone 6
☐	<84>	General start/pick-up
☒	<85>	Breaker failure
☐	<86>	Trip measuring system L_1
☐	<87>	Trip measuring system L_2
☐	<88>	Trip measuring system L_3
☐	<89>	Trip measuring system E
☐	<90>	Trip I>
☐	<91>	Trip I>>
☐	<92>	Trip IN>
☐	<93>	Trip IN>>

Note: Function-specific fault signals are as default mapped to private data locations in 615 series IEDs.

3.3.3.6 Auto-reclosure indications in monitor direction

	INF	Semantics
☒	<128>	CB ’on’ by AR
☐	<129>	CB ’on’ by long-time AR
☒	<130>	AR blocked

Note <129>: Terms 'short-' or 'long-time' AR are not directly usable in 615 series. The AR functionality in the IED performs AR shots (1..5) that are user configurable. See private AR data definitions. Depending on user AR configuration it is possible to re-map some private data into standard data, if wanted.

3.3.3.7 Measurands in monitor direction

	INF	Semantics
☒	<144>	Measurand I
☒	<145>	Measurands I, V
☒	<146>	Measurands I, V, P, Q
☒	<147>	Measurands I_N, V_{EN}
☒	<148>	Measurands $I_{L1,2,3}$, $V_{L1,2,3}$, P, Q, f

3.3.3.8 Generic functions in monitor direction

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

3.3.4 Selection of standard information numbers in control direction

3.3.4.1 System functions in control direction

	INF	Semantics
☒	<0>	Initiation of general interrogation
☒	<0>	Time synchronization

3.3.4.2 Generic functions in monitor direction

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

3.3.5 Basic application functions

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

3.3.6 Miscellaneous

Measurands are transmitted as Class2 data using ASDU 3 or ASDU 9. The default MVAL scalings in 615 series devices is 2.4. User can freely reprogram the MVAL for each separate measurand.

Measurand	Max. MVAL = rated value times	
	1.2 or	2.4
Current L_1	☒	☒
Current L_2	☒	☒
Current L_3	☒	☒
Voltage L_{1-E}	☒	☒
Voltage L_{2-E}	☒	☒
Voltage L_{3-E}	☒	☒
Active power P	☒	☒
Reactive power Q	☒	☒
Frequency f	☒	☒
Voltage L_1 - L_2	☒	☒

REF615 contains additional private Class2 frames, including private measurands. User can freely select between standard or private Class2 frames.

Section 4 Glossary

AR	Autoreclosure
ASDU	Application-layer service data unit
CB	Circuit breaker
DPI	Double point information
DR	Disturbance recorder
EMC	Electromagnetic compatibility
FUN	Default function type
GI	General interrogation
I/O	Input/output
IEC	International Electrotechnical Commission
IEC 60870-5-103	Communication standard for protective equipment. A serial master/slave protocol for point-to-point communication.
IEC 61850	International standard for substation communication and modelling.
IED	Intelligent Electronic Device
INF	Default information number
LED	Light-emitting diode
LHMI	Local Human-Machine Interface
PCM600	Protection and Control IED Manager
TCS	Trip-circuit supervision
WHMI	Web Human-Machine Interface

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