



Relion® 615 series

Feeder Protection and Control REF615 IEC 60870-5-103 Point List Manual



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Section 1 Introduction

1.1 This manual

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

1.2 Intended audience

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

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

1.3 Product documentation

1.3.1 Product documentation set

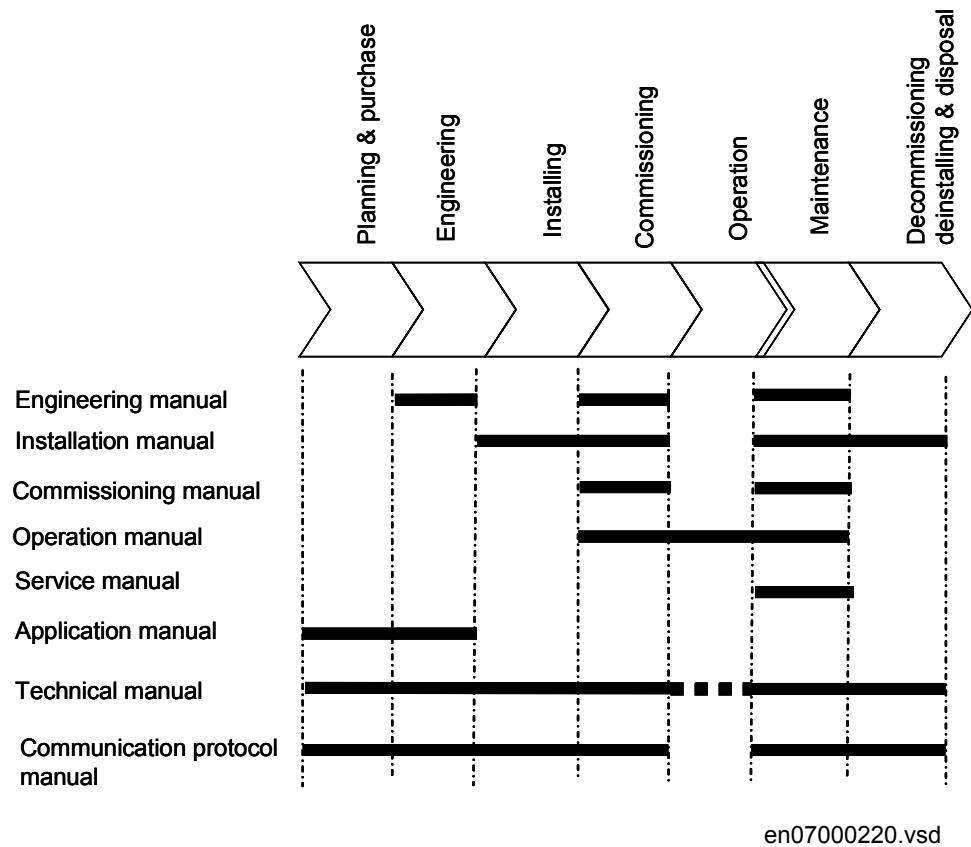


Figure 1: The intended use of manuals in different lifecycles

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

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

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

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

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

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

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

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

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

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



Some of the manuals are not available yet.

1.3.2

Document revision history

Document revision/date	Product version	History
A/2009-03-04	2.0	First release
B/2009-07-03	2.0	Content updated
C/2010-06-11	3.0	Content updated to correspond to the product version



Download the latest documents 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 Symbols and conventions

1.4.1 Safety indication symbols



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



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






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

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

1.4.2 Manual conventions

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

- Abbreviations and acronyms in this manual are spelled out in the glossary. The glossary also contains definitions of important terms.
- Push button navigation in the LHMI menu structure is presented by using the push button icons, for example:
To navigate between the options, use  and .
- HMI menu paths are presented in bold, for example:
Select **Main menu/Settings**.
- LHMI messages are shown in Courier font, for example:
To save the changes in non-volatile memory, select `Yes` and press .
- Parameter names are shown in italics, for example:
The function can be enabled and disabled with the *Operation* setting.
- 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

Table 1: REF615 Functions, codes and symbols

Function	IEC 61850	IEC 60617	IEC-ANSI
Protection			
Three-phase non-directional overcurrent protection, low stage, instance 1	PHLPTOC1	3I> (1)	51P-1 (1)
Three-phase non-directional overcurrent protection, high stage, instance 1	PHHPTOC1	3I>> (1)	51P-2 (1)
Three-phase non-directional overcurrent protection, high stage, instance 2	PHHPTOC2	3I>> (2)	51P-2 (2)
Three-phase non-directional overcurrent protection, instantaneous stage, instance 1	PHIPTOC1	3I>>> (1)	50P/51P (1)
Three-phase directional overcurrent protection, low stage, instance 1	DPHLPDOC1	3I> -> (1)	67-1 (1)
Three-phase directional overcurrent protection, low stage, instance 2	DPHLPDOC2	3I> -> (2)	67-1 (2)
Three-phase directional overcurrent protection, high stage	DPHHPDOC1	3I>> ->	67-2
Non-directional earth-fault protection, low stage, instance 1	EFLPTOC1	Io> (1)	51N-1 (1)
Non-directional earth-fault protection, low stage, instance 2	EFLPTOC2	Io> (2)	51N-1 (2)
Non-directional earth-fault protection, high stage, instance 1	EFHPTOC1	Io>> (1)	51N-2 (1)
Non-directional earth-fault protection, instantaneous stage	EFIPTOC1	Io>>>	50N/51N
Directional earth-fault protection, low stage, instance 1	DEFLPDEF1	Io> -> (1)	67N-1 (1)
Directional earth-fault protection, low stage, instance 2	DEFLPDEF2	Io> -> (2)	67N-1 (2)
Directional earth-fault protection, high stage	DEFHPDEF1	Io>> ->	67N-2
Admittance based earth-fault protection, instance 1	EFPADM1	Yo> -> (1)	21YN (1)
Admittance based earth-fault protection, instance 2	EFPADM2	Yo> -> (2)	21YN (2)
Admittance based earth-fault protection, instance 3	EFPADM3	Yo> -> (3)	21YN (3)
Table continues on next page			

Function	IEC 61850	IEC 60617	IEC-ANSI
Transient / intermittent earth-fault protection	INTRPTEF1	lo> -> IEF	67NIEF
Non-directional (cross-country) earth fault protection, using calculated lo	EFHPTOC1	lo>> (1)	51N-2 (1)
Negative-sequence overcurrent protection, instance 1	NSPTOC1	I2> (1)	46 (1)
Negative-sequence overcurrent protection, instance 2	NSPTOC2	I2> (2)	46 (2)
Phase discontinuity protection	PDNSPTOC1	I2/I1>	46PD
Residual overvoltage protection, instance 1	ROVPTOV1	Uo> (1)	59G (1)
Residual overvoltage protection, instance 2	ROVPTOV2	Uo> (2)	59G (2)
Residual overvoltage protection, instance 3	ROVPTOV3	Uo> (3)	59G (3)
Three-phase undervoltage protection, instance 1	PHPTUV1	3U< (1)	27 (1)
Three-phase undervoltage protection, instance 2	PHPTUV2	3U< (2)	27 (2)
Three-phase undervoltage protection, instance 3	PHPTUV3	3U< (3)	27 (3)
Three-phase overvoltage protection, instance 1	PHPTOV1	3U> (1)	59 (1)
Three-phase overvoltage protection, instance 2	PHPTOV2	3U> (2)	59 (2)
Three-phase overvoltage protection, instance 3	PHPTOV3	3U> (3)	59 (3)
Positive-sequence undervoltage protection, instance 1	PSPTUV1	U1< (1)	47U+ (1)
Negative-sequence overvoltage protection, instance 1	NSPTOV1	U2> (1)	47O- (1)
Frequency protection, instance 1	FRPFRQ1	f>/f<,df/dt (1)	81 (1)
Frequency protection, instance 2	FRPFRQ2	f>/f<,df/dt (2)	81 (2)
Frequency protection, instance 3	FRPFRQ3	f>/f<,df/dt (3)	81 (3)
Three-phase thermal protection for feeders, cables and distribution transformers	T1PTTR1	3lth>F	49F
Circuit breaker failure protection	CCBRBRF1	3I>/lo>BF	51BF/51NBF
Three-phase inrush detector	INRPHAR1	3I2f>	68
Master trip, instance 1	TRPPTRC1	Master Trip (1)	94/86 (1)
Master trip, instance 2	TRPPTRC2	Master Trip (2)	94/86 (2)
Arc protection, instance 1	ARCSARC1	ARC (1)	50L/50NL (1)
Arc protection, instance 2	ARCSARC2	ARC (2)	50L/50NL (2)
Arc protection, instance 3	ARCSARC3	ARC (3)	50L/50NL (3)
Control			
Circuit-breaker control	CBXCBR1	I <-> O CB	I <-> O CB
Table continues on next page			

Function	IEC 61850	IEC 60617	IEC-ANSI
Disconnecter position indication, instance 1	DCSXSW1	I <-> O DC (1)	I <-> O DC (1)
Disconnecter position indication, instance 2	DCSXSW2	I <-> O DC (2)	I <-> O DC (2)
Disconnecter position indication, instance 3	DCSXSW3	I <-> O DC (3)	I <-> O DC (3)
Earthing switch indication	ESSXSW1	I <-> O ES	I <-> O ES
Auto-reclosing	DARREC1	O -> I	79
Synchronism and energizing check	SECRSYN1	SYNC	25
Condition monitoring			
Circuit-breaker condition monitoring	SSCBR1	CBCM	CBCM
Trip circuit supervision, instance 1	TCSSCBR1	TCS (1)	TCM (1)
Trip circuit supervision, instance 2	TCSSCBR2	TCS (2)	TCM (2)
Current circuit supervision	CCRDI1	MCS 3I	MCS 3I
Fuse failure supervision	SEQRUF1	FUSEF	60
Measurement			
Disturbance recorder	RDRE1	-	-
Three-phase current measurement, instance 1	CMMXU1	3I	3I
Sequence current measurement	CSMSQ1	I1, I2, I0	I1, I2, I0
Residual current measurement, instance 1	RESCMMXU1	Io	In
Three-phase voltage measurement	VMMXU1	3U	3U
Residual voltage measurement	RESVMMXU1	Uo	Vn
Sequence voltage measurement	VSMSQ1	U1, U2, U0	U1, U2, U0
Three-phase power and energy measurement, including power factor	PEMMXU1	P, E	P, E
Frequency measurement	FMMXU1	f	f

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

IEC 61850 name	Internal signal that is mapped to the IEC 60870-5-103 point. Expressed in the form 'Logical Device.Logical Node.Data Object.Data Attribute'.
AFL-Common SA name	AFL name of the corresponding data signal.
Description	Signal description.
DPI value	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

Index	Value position within the Class2 frame.
IEC 61850 name	Internal signal that is mapped to the IEC 60870-5-103 point.
Description	Signal description.
Default scale	Value that corresponds to the maximum IEC 60870-5-103 measurand value 1.

Table continues on next page

Frame No6	Shows if the value is present in Class2 frame 6.
Frame No7	Shows if the value is present in Class2 frame 7.
Comment	Additional information.

2.2

Point list for REF615 Ver. 3.0 FE01-08

Table 2: Indications and controls

IEC 61850 name	AFL-Common SA name	Description	DPI value	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.ctVal	-	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.ctfVal	-	Parameter setting group 1	10=Setting group 1 in use	0	23	1	1,20	1	1
LD0.I3CGGIO1.ActSG.ctfVal	-	Parameter setting group 2	10=Setting group 2 in use	0	24	1	1,20	1	1
LD0.I3CGGIO1.ActSG.ctfVal	-	Parameter setting group 3	10=Setting group 3 in use	0	25	1	1,20	1	1
LD0.I3CGGIO1.ActSG.ctfVal	-	Parameter setting group 4	10=Setting group 4 in use	0	26	1	1,20	1	1
LD0.I3CGGIO1.ActSG.ctfVal	-	Parameter setting group 5	10=Setting group 5 in use	0	27	1	1,20	1	1
LD0.I3CGGIO1.ActSG.ctfVal	-	Parameter setting group 6	10=Setting group 6 in use	0	28	1	1,20	1	1
LD0.TCSSCBR1.CirAlm.stVal	TCSSCBR1.ALARM	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	DARREC1.SUC_RECL	Successful reclose status	10=Successful reclose	0	128	1	1	0	1
LD0.DARREC1.InhRec.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=Local, 01=Remote	10	10	1	1	1	1
CTRL.LLN0.LocRem.Station	-	Station state	10=Station ON, 01=OFF	10	11	1	1	1	1
LD0.LLN0.RecRs.ctfVal	-	Reset all data	10=Reset all data	10	19	1	20	0	1
LD0.LLN0.LEDRs2.ctfVal	-	Reset alarm LEDs	10=Reset alarm LEDs only	10	21	1	20	0	1
LD0.TCSSCBR2.CirAlm.stVal	TCSSCBR2.ALARM	Trip circuit 2 alarm	10=TCS2 alarm	10	36	1	1	1	1
DR.RDRE1.RcdTg.ctfVal	-	Trig DR recording	10=External DR trig	10	41	1	20	0	1
DR.RDRE1.MemCir.ctfVal	-	Clear DR memory	10=Clear memory	10	42	1	20	0	1
LD0.CMSTA1.RecRs.ctfVal	-	Reset CMMXU1 max demands	10=Reset max values	10	45	1	20	0	1
Multipurpose inputs (all variants)									
LD0.MVGAPC1.Q1.stVal	-	MVGAPC1 input 1 signal	10=Input ON, 01=OFF	11	1	0	1	1	1
LD0.MVGAPC1.Q2.stVal	-	MVGAPC1 input 2 signal	10=Input ON, 01=OFF	11	2	0	1	1	1
LD0.MVGAPC1.Q3.stVal	-	MVGAPC1 input 3 signal	10=Input ON, 01=OFF	11	3	0	1	1	1
LD0.MVGAPC1.Q4.stVal	-	MVGAPC1 input 4 signal	10=Input ON, 01=OFF	11	4	0	1	1	1
LD0.MVGAPC1.Q5.stVal	-	MVGAPC1 input 5 signal	10=Input ON, 01=OFF	11	5	0	1	1	1
LD0.MVGAPC1.Q6.stVal	-	MVGAPC1 input 6 signal	10=Input ON, 01=OFF	11	6	0	1	1	1
LD0.MVGAPC1.Q7.stVal	-	MVGAPC1 input 7 signal	10=Input ON, 01=OFF	11	7	0	1	1	1
LD0.MVGAPC1.Q8.stVal	-	MVGAPC1 input 8 signal	10=Input ON, 01=OFF	11	8	0	1	1	1

Table continues on next page

IEC 61850 name	AFL-Common SA name	Description	DPI value	FUN	INF	In Use	ASDU	GI	Coding
SRGAPC1, flip-flop reset control (all variants)									
LD0.SRGAPC1.Rs1.ctiVal	-	Reset SRGAPC1 flip-flop 1	10=Reset	11	101	1	20	0	1
LD0.SRGAPC1.Rs2.ctiVal	-	Reset SRGAPC1 flip-flop 2	10=Reset	11	102	1	20	0	1
LD0.SRGAPC1.Rs3.ctiVal	-	Reset SRGAPC1 flip-flop 3	10=Reset	11	103	1	20	0	1
LD0.SRGAPC1.Rs4.ctiVal	-	Reset SRGAPC1 flip-flop 4	10=Reset	11	104	1	20	0	1
LD0.SRGAPC1.Rs5.ctiVal	-	Reset SRGAPC1 flip-flop 5	10=Reset	11	105	1	20	0	1
LD0.SRGAPC1.Rs6.ctiVal	-	Reset SRGAPC1 flip-flop 6	10=Reset	11	106	1	20	0	1
LD0.SRGAPC1.Rs7.ctiVal	-	Reset SRGAPC1 flip-flop 7	10=Reset	11	107	1	20	0	1
LD0.SRGAPC1.Rs8.ctiVal	-	Reset SRGAPC1 flip-flop 8	10=Reset	11	108	1	20	0	1
Negative sequence overcurrent protection (2 stages), all variants									
LD0.NSPTOC1.Str.general	NSPTOC1.START	Stage1 start	10=Stage1 start	21	84	1	2	1	1
LD0.NSPTOC1.Op.general	NSPTOC1.OPERATE	Stage1 operate	10=Stage1 operate	21	90	1	2	0	1
LD0.NSPTOC2.Op.general	NSPTOC2.OPERATE	Stage2 operate	10=Stage2 operate	21	91	1	2	0	1
LD0.NSPTOC2.Str.general	NSPTOC2.START	Stage2 start	10=Stage2 start	21	94	1	2	1	1
Fuse failure protection (1 stage), FE05.06.07									
LD0.SEQRUF1.Str.general	SEQRUF1.FUSEF_U	General start	10=General Start	22	84	1	2	1	1
LD0.SEQRUF1.Str3Ph.general	SEQRUF1.FUSEF_3PH	3 phase start	10=3 phase start	22	94	1	2	1	1
Current circuit failure protection (1 stage), FE05.06.07									
CTRL.CCRDIF1.Alm.stVal	CCRDIF1.FAIL	Alarm	10 = Alarm	23	1	1	1	1	1
CTRL.CCRDIF1.Op.general	CCRDIF1.ALARM	Operate	10 = Operate	23	90	1	2	0	1
Admittance based earthfault protection, 3 stages (FE01.02.05.06.07)									
LD0.EFPADM1.Str.general	EFPADM1.START	Stage1 start	10 = Stage 1 start	25	84	1	2	1	1
LD0.EFPADM1.Op.general	EFPADM1.OPERATE	Stage1 operate	10 = Stage 1 operate	25	90	1	2	0	1
LD0.EFPADM2.Op.general	EFPADM2.OPERATE	Stage2 operate	10 = Stage 2 operate	25	91	1	2	0	1
LD0.EFPADM2.Str.general	EFPADM2.START	Stage2 start	10 = Stage 2 start	25	94	1	2	1	1
LD0.EFPADM3.Str.general	EFPADM3.START	Stage3 start	10 = Stage 3 start	25	96	1	2	1	1
LD0.EFPADM3.Op.general	EFPADM3.OPERATE	Stage3 operate	10 = Stage 3 operate	25	98	1	2	0	1
Synchronisation indications (FE08)									
LD0.SECRSYN1.SynPrg.stVal	SECRSYN1.SYNC_INPRO	Synchronization in progress	10 = In progress	26	1	1	1	1	1
LD0.SECRSYN1.FailCmd.stVal	SECRSYN1.CMD_FAIL_AL	CB closing request failed	10 = Request failed	26	2	1	1	0	1
LD0.SECRSYN1.FailSyn.stVal	SECRSYN1.GL_FAIL_AL	CB closing command failed	10 = Command failed	26	3	1	1	0	1
Frequency protection (FRPFRQ1...3), 3 stages (FE08)									
LD0.FRPTRC1.Str.general	FRPFRQ1.START	Stage 1 start	1 = Stage1 start	27	11	1	2	1	1
LD0.FRPTOF1.Op.general	FRPFRQ1.OPR_OFRRQ	Operate 1 signal for overfrequency	1 = Stage1 overfrequency operate	27	12	1	2	0	1
LD0.FRPTUF1.Op.general	FRPFRQ1.OPR_UFRQ	Operate 1 signal for underfrequency	1 = Stage1 underfrequency operate	27	13	1	2	0	1
LD0.FRPFRC1.Op.general	FRPFRQ1.OPR_FRG	Operate 1 signal for frequency gradient	1 = Stage1 frequency gradient operate	27	14	1	2	0	1
LD0.FRPTRC2.Str.general	FRPFRQ2.START	Stage 2 start	1 = Stage2 start	27	21	1	2	1	1
LD0.FRPTOF2.Op.general	FRPFRQ2.OPR_OFRRQ	Operate 2 signal for overfrequency	1 = Stage2 overfrequency operate	27	22	1	2	0	1

Table continues on next page

Section 2
IEC 60870-5-103 data mappings

IEC 61850 name	AFL-Common SA name	Description	DPI value	FUN	INF	In Use	ASDU	GI	Coding
LD0.FRPTUF2.Op.general	FRPFRQ2.OPR_UFRQ	Operate 2 signal for underfrequency	1 = Stage2 underfrequency operate	27	23	1	2	0	1
LD0.FRPRRC2.Op.general	FRPFRQ2.OPR_FRG	Operate 2 signal for frequency gradient	1 = Stage2 frequency gradient operate	27	24	1	2	0	1
LD0.FRPTIRC3.Str.general	FRPFRQ3.START	Stage 3 start	1 = Stage3 start	27	31	1	2	1	1
LD0.FRPTOF3.Op.general	FRPFRQ2.OPR_OF3	Operate 3 signal for overfrequency	1 = Stage3 overfrequency operate	27	32	1	2	0	1
LD0.FRPTUF3.Op.general	FRPFRQ3.OPR_UFRQ	Operate 3 signal for underfrequency	1 = Stage3 underfrequency operate	27	33	1	2	0	1
LD0.FRPRRC3.Op.general	FRPFRQ3.OPR_FRG	Operate 3 signal for frequency gradient	1 = Stage3 frequency gradient operate	27	34	1	2	0	1
Three-phase directional overcurrent protection (3 stages), FE06,07									
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	DPHLPDOC1.START	Low(1) stage Start[.general]	10=Low(1) stage start	32	84	1	2	1	1
LD0.DPHLPTOC1.Op.general	DPHLPDOC1.OPERATE	Low(1) stage Operate[.general]	10=Low(1) stage operate	32	90	1	2	0	1
LD0.DPHLPTOC2.Op.general	DPHLPDOC2.OPERATE	Low(2) stage Operate[.general]	10=Low(2) stage operate	32	91	1	2	0	1
LD0.DPHLPTOC2.Str.general	DPHLPDOC2.START	Low(2) stage Start[.general]	10=Low(2) stage start	32	94	1	2	1	1
LD0.DPHHPTOC1.Str.general	DPHHPDOC1.START	High stage Start[.general]	10=High stage start	32	96	1	2	1	1
LD0.DPHHPTOC1.Op.general	DPHHPDOC1.OPERATE	High stage Operate[.general]	10=High stage operate	32	98	1	2	0	1
Phase overvoltage protection (3 stages), FE06,07									
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	PHPTOV1.START	Stage 1 Start[.general]	10=Stage 1 start	40	84	1	2	1	1
LD0.PHPTOV1.Op.general	PHPTOV1.OPERATE	Stage 1 Operate[.general]	10=Stage 1 operate	40	90	1	2	0	1
LD0.PHPTOV2.Op.general	PHPTOV2.OPERATE	Stage 2 Operate[.general]	10=Stage 2 operate	40	91	1	2	0	1
LD0.PHPTOV2.Str.general	PHPTOV2.START	Stage 2 Start[.general]	10=Stage 2 start	40	94	1	2	1	1
LD0.PHPTOV3.Str.general	PHPTOV3.START	Stage 3 Start[.general]	10=Stage 3 start	40	96	1	2	1	1

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IEC 61850 name	AFL-Common SA name	Description	DPI value	FUN	INF	In Use	ASDU	GI	Coding
LD0.PHPTOV3.Op.general	PHPTOV3.OPERATE	Stage 3 Operate[.general]	10=Stage 3 operate	40	98	1	2	0	1
Phase undervoltage protection (3 stages), FE06.07									
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	PHPTUV1.START	Stage 1 Start[.general]	10=Stage 1 start	41	84	1	2	1	1
LD0.PHPTUV1.Op.general	PHPTUV1.OPERATE	Stage 1 Operate[.general]	10=Stage 1 operate	41	90	1	2	0	1
LD0.PHPTUV2.Op.general	PHPTUV2.OPERATE	Stage 2 Operate[.general]	10=Stage 2 operate	41	91	1	2	0	1
LD0.PHPTUV2.Str.general	PHPTUV2.START	Stage 2 Start[.general]	10=Stage 2 start	41	94	1	2	1	1
LD0.PHPTUV3.Str.general	PHPTUV3.START	Stage 3 Start[.general]	10=Stage 3 start	41	96	1	2	1	1
LD0.PHPTUV3.Op.general	PHPTUV3.OPERATE	Stage 3 Operate[.general]	10=Stage 3 operate	41	98	1	2	0	1
Positive sequence undervoltage protection (1 stage), FE06.07									
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	PSPTUV1.START	Start[.general]	10=Start	42	84	1	2	1	1
LD0.PSPTUV1.Op.general	PSPTUV1.OPERATE	Operate[.general]	10=Operate	42	90	1	2	0	1
Negative sequence overvoltage protection (1 stage), FE06.07									
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	NSPTOV1.START	Start[.general]	10=Start	43	84	1	2	1	1
LD0.NSPTOV1.Op.general	NSPTOV1.OPERATE	Operate[.general]	10=Operate	43	90	1	2	0	1
Residual overvoltage protection (3 stages), FE06.07									
LD0.ROVPTOV1.Str.general	ROVPTOV1.START	Stage 1 Start	10=Stage 1 start	44	84	1	2	1	1
LD0.ROVPTOV1.Op.general	ROVPTOV1.OPERATE	Stage 1 Operate	10=Stage 1 operate	44	90	1	2	0	1
LD0.ROVPTOV2.Op.general	ROVPTOV2.OPERATE	Stage 2 Operate	10=Stage 2 operate	44	91	1	2	0	1
LD0.ROVPTOV2.Str.general	ROVPTOV2.START	Stage 2 Start	10=Stage 2 start	44	94	1	2	1	1
LD0.ROVPTOV3.Str.general	ROVPTOV3.START	Stage 3 Start	10=Stage 3 start	44	96	1	2	1	1
LD0.ROVPTOV3.Op.general	ROVPTOV3.OPERATE	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

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IEC 61850 name	AFL-Common SA name	Description	DPI value	FUN	INF	In Use	ASDU	GI	Coding
LD0.XGGIO130.lnd3.stVal	-	X130-Input 3	10=ON, 01=OFF	50	3	0	1	1	1
LD0.XGGIO130.lnd4.stVal	-	X130-Input 4	10=ON, 01=OFF	50	4	0	1	1	1
LD0.XGGIO130.lnd5.stVal	-	X130-Input 5	10=ON, 01=OFF	50	5	0	1	1	1
LD0.XGGIO130.lnd6.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.lnd1.stVal	-	X120-Input 1	10=ON, 01=OFF	51	1	0	1	1	1
LD0.XGGIO120.lnd2.stVal	-	X120-Input 2	10=ON, 01=OFF	51	2	0	1	1	1
LD0.XGGIO120.lnd3.stVal	-	X120-Input 3	10=ON, 01=OFF	51	3	0	1	1	1
LD0.XGGIO120.lnd4.stVal	-	X120-Input 4	10=ON, 01=OFF	51	4	0	1	1	1
LD0.XGGIO110.lnd1.stVal	-	X110-Input 1	10=ON, 01=OFF	52	1	0	1	1	1
LD0.XGGIO110.lnd2.stVal	-	X110-Input 2	10=ON, 01=OFF	52	2	0	1	1	1
LD0.XGGIO110.lnd3.stVal	-	X110-Input 3	10=ON, 01=OFF	52	3	0	1	1	1
LD0.XGGIO110.lnd4.stVal	-	X110-Input 4	10=ON, 01=OFF	52	4	0	1	1	1
LD0.XGGIO110.lnd5.stVal	-	X110-Input 5	10=ON, 01=OFF	52	5	0	1	1	1
LD0.XGGIO110.lnd6.stVal	-	X110-Input 6	10=ON, 01=OFF	52	6	0	1	1	1
LD0.XGGIO110.lnd7.stVal	-	X110-Input 7	10=ON, 01=OFF	52	7	0	1	1	1
LD0.XGGIO110.lnd8.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.lnd1.stVal	-	XA130-Input 1	10=ON, 01=OFF	54	1	0	1	1	1
LD0.XAGGIO130.lnd2.stVal	-	XA130-Input 2	10=ON, 01=OFF	54	2	0	1	1	1
LD0.XAGGIO130.lnd3.stVal	-	XA130-Input 3	10=ON, 01=OFF	54	3	0	1	1	1
LD0.XAGGIO130.lnd4.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	ARCSARC1.ARC_FLT_DE T	Stage1 Fault arc detected	10=Stage1 arc detected	156	211	1	1	0	1
LD0.ARCPTRC11.Op.general	ARCSARC1.OPERATE	Stage1 Operate	10=Stage1 operate	156	213	1	2	0	1
LD0.ARCSARC21.FADet.stVal	ARCSARC2.ARC_FLT_DE T	Stage2 Fault arc detected	10=Stage2 arc detected	156	221	1	1	0	1
LD0.ARCPTRC21.Op.general	ARCSARC2.OPERATE	Stage2 Operate	10=Stage2 operate	156	223	1	2	0	1

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IEC 61850 name	AFL-Common SA name	Description	DPI value	FUN	INF	In Use	ASDU	GI	Coding
LD0.ARCSARC3.1.FADet.stVal	ARCSARC3.ARC_FLT_DE T	Stage3 Fault arc detected	10=Stage3 arc detected	156	231	1	1	0	1
LD0.ARCPTRC3.1.Op.general	ARCSARC3.OPERATE	Stage3 Operate	10=Stage3 operate	156	233	1	2	0	1
Phase discontinuity protection (1 stage), all variants									
LD0.PDNSPTOC.1.Str.general	PDNSPTOC.1.START	Start	10=Stage start	157	84	1	2	1	1
LD0.PDNSPTOC.1.Op.general	PDNSPTOC.1.OPERATE	Operate	10=Stage operate	157	90	1	2	0	1
Transient/intermittent earth-fault protection (1 stage), FE01,02,05,06									
LD0.INTRPTEF.1.Str.general	INTRPTEF.1.START	Start	10=Stage start	158	84	1	2	1	1
LD0.INTRPTEF.1.Op.general	INTRPTEF.1.OPERATE	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.EFLPTOC.1.Str.general	EFLPTOC.1.START	Low(1) stage start	10=Low(1) stage start	159	84	1	2	1	1
LD0.EFLPTOC.1.Op.general	EFLPTOC.1.OPERATE	Low(1) stage operate	10=Low(1) stage operate	159	90	1	2	0	1
LD0.EFLPTOC.2.Op.general	EFLPTOC.2.OPERATE	Low(2) stage operate	10=Low(2) stage operate	159	91	1	2	0	1
LD0.EFLPTOC.2.Str.general	EFLPTOC.2.START	Low(2) stage start	10=Low(2) stage start	159	94	1	2	1	1
LD0.EFHPTOC.1.Str.general	EFHPTOC.1.START	High stage start	10=High stage start	159	96	1	2	1	1
LD0.EFIPTOC.1.Str.general	EFIPTOC.1.START	Instantaneous stage start	10=Instantaneous stage start	159	97	1	2	1	1
LD0.EFHPTOC.1.Op.general	EFHPTOC.1.OPERATE	High stage operate	10=High stage operate	159	98	1	2	0	1
LD0.EFIPTOC.1.Op.general	EFIPTOC.1.OPERATE	Instantaneous stage operate	10=Instantaneous stage operate	159	99	1	2	0	1
Phase overcurrent protection (4 stages), FE01,02,03,04,05									
LD0.PHIPTOC.1.Str.phsA	-	Instantaneous stage Start[,phsA]	10=Inst. stage phsA start	162	34	0	2	1	1
LD0.PHIPTOC.1.Str.phsB	-	Instantaneous stage Start[,phsB]	10=Inst. stage phsB start	162	35	0	2	1	1
LD0.PHIPTOC.1.Str.phsC	-	Instantaneous stage Start[,phsC]	10=Inst. stage phsC start	162	36	0	2	1	1
LD0.PHIPTOC.2.Str.phsA	-	High(2) stage Start[,phsA]	10=High(2) stage phsA start	162	44	0	2	1	1
LD0.PHIPTOC.2.Str.phsB	-	High(2) stage Start[,phsB]	10=High(2) stage phsB start	162	45	0	2	1	1
LD0.PHIPTOC.2.Str.phsC	-	High(2) stage Start[,phsC]	10=High(2) stage phsC start	162	46	0	2	1	1
LD0.PHIPTOC.1.Str.phsA	-	High(1) stage Start[,phsA]	10=High(1) stage phsA start	162	54	0	2	1	1
LD0.PHIPTOC.1.Str.phsB	-	High(1) stage Start[,phsB]	10=High(1) stage phsB start	162	55	0	2	1	1
LD0.PHIPTOC.1.Str.phsC	-	High(1) stage Start[,phsC]	10=High(1) stage phsC start	162	56	0	2	1	1
LD0.PHLPTOC.1.Str.phsA	-	Low stage Start[,phsA]	10=Low stage phsA start	162	64	0	2	1	1
LD0.PHLPTOC.1.Str.phsB	-	Low stage Start[,phsB]	10=Low stage phsB start	162	65	0	2	1	1
LD0.PHLPTOC.1.Str.phsC	-	Low stage Start[,phsC]	10=Low stage phsC start	162	66	0	2	1	1
LD0.PHLPTOC.1.Str.general	PHLPTOC.1.START	Low stage Start[,general]	10=Low stage start	162	84	1	2	1	1
LD0.PHLPTOC.1.Op.general	PHLPTOC.1.OPERATE	Low stage Operate[,general]	10=Low stage operate	162	90	1	2	0	1
LD0.PHHPTOC.1.Op.general	PHHPTOC.1.OPERATE	High(1) stage Operate[,general]	10=High(1) stage operate	162	91	1	2	0	1
LD0.PHHPTOC.1.Str.general	PHHPTOC.1.START	High(1) stage Start[,general]	10=High(1) stage start	162	94	1	2	1	1
LD0.PHHPTOC.2.Str.general	PHHPTOC.2.START	High(2) stage Start[,general]	10=High(2) stage start	162	96	1	2	1	1
LD0.PHIPTOC.1.Str.general	PHIPTOC.1.START	Instantaneous stage Start[,general]	10=Instantaneous stage start	162	97	1	2	1	1
LD0.PHHPTOC.2.Op.general	PHHPTOC.2.OPERATE	High(2) stage Operate[,general]	10=High(2) stage operate	162	98	1	2	0	1
LD0.PHIPTOC.1.Op.general	PHIPTOC.1.OPERATE	Instantaneous stage Operate[,general]	10=Instantaneous stage operate	162	99	1	2	0	1

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IEC 61850 name	AFL-Common SA name	Description	DPI value	FUN	INF	In Use	ASDU	GI	Coding
Directional earth-fault protection (3 stages), FE01.02.05.06, 07									
LD0.DEFLPTOC1.Str.general	DEFLPDEF1.START	Low(1) stage start	10=Low(1) stage start	163	84	1	2	1	1
LD0.DEFLPTOC1.Op.general	DEFLPDEF1.OPERATE	Low(1) stage operate	10=Low(1) stage operate	163	90	1	2	0	1
LD0.DEFLPTOC2.Op.general	DEFLPDEF2.OPERATE	Low(2) stage operate	10=Low(2) stage operate	163	91	1	2	0	1
LD0.DEFLPTOC2.Str.general	DEFLPDEF2.START	Low(2) stage start	10=Low(2) stage start	163	94	1	2	1	1
LD0.DEFHPTOC1.Str.general	DEFHPDEF1.START	High stage start	10=High stage start	163	96	1	2	1	1
LD0.DEFHPTOC1.Op.general	DEFHPDEF1.OPERATE	High stage operate	10=High stage operate	163	98	1	2	0	1
Three-phase intrush 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.T1PTR1.Str.general	T1PTR1.START	Start	10=Start	168	84	1	2	1	1
LD0.T1PTR1.AlmThm.general	T1PTR1.ALARM	Thermal alarm	10=Thermal alarm	168	85	1	2	1	1
LD0.T1PTR1.Op.general	T1PTR1.OPERATE	Operate	10=Operate	168	90	1	2	0	1
Auto-reclosing, optional in all variants									
LD0.DARREC1.RsRec.ctfVal	-	AR reset	10=Reset	169	19	1	20	0	1
LD0.DARREC1.RsCnt.ctfVal	-	AR counters reset	10=Reset	169	20	1	20	0	1
LD0.DARREC1.PrgRec1.stVal	DARREC1.INPRO_1	AR in progress 1st reclose	10=In progress	169	101	1	2	0	1
LD0.DARREC1.PrgRec2.stVal	DARREC1.INPRO_2	AR in progress 2nd reclose	10=In progress	169	102	1	2	0	1
LD0.DARREC1.PrgRec3.stVal	DARREC1.INPRO_3	AR in progress 3rd reclose	10=In progress	169	103	1	2	0	1
LD0.DARREC1.PrgRec4.stVal	DARREC1.INPRO_4	AR in progress 4th reclose	10=In progress	169	104	1	2	0	1
LD0.DARREC1.PrgRec5.stVal	DARREC1.INPRO_5	AR in progress 5th reclose	10=In progress	169	105	1	2	0	1
LD0.DARREC1.PrgRec.stVal	DARREC1.INPRO	AR in progress	10=In progress	169	120	1	2	0	1
LD0.DARREC1.CBManClis.stVal	DARREC1.MAN_CB_CL	CB manually closed	10=CB manually closed	169	159	1	2	0	1
LD0.DARREC1.LO.stVal	DARREC1.LOCKED	Lockout status	10=Lockout	169	164	1	2	0	1
LD0.DARREC1.UnsRec.stVal	DARREC1.UNSUC_RECL	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	DARREC1.READY	Ready reclose status	10=Reclose ready	169	172	1	2	0	1
LD0.DARREC1.ActRec.stVal	DARREC1.ACTIVE	Active reclose status	10=Reclose active	169	173	1	2	0	1
LD0.DARREC1.PrgDsr.stVal	DARREC1.DISCR_INPRO	Discrimination time in progress	10=Discrimination time in progress	169	174	1	2	0	1
LD0.DARREC1.PrgCutOut.stVal	DARREC1.CUTOUT_INPRO	Cutout time in progress	10=Cutout time in progress	169	175	1	2	0	1
LD0.DARREC1.FrqOpAlm.stVal	DARREC1.FRQ_OP_ALM	Frequent operation counter alarm	10=Frequent operation alarm	169	176	1	2	0	1
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	DARREC1.CLOSE_CB	Operate (close command to XCBR)	10=Close command to CB	169	179	1	2	0	1

Table continues on next page

IEC 61850 name	AFL-Common SA name	Description	DPI value	FUN	INF	In Use	ASDU	GI	Coding
LD0.DARREC1.Opn.general	DARREC1.OPEN_CB	Operate (open command to XCBR)	10=Open command to CB	169	180	1	2	0	1
LD0.DARREC1.UnsCBCIs.stVal	DARREC1.UNSUC_CB	Unsuccessful CB closing status	10=Unsuccessful CB closing	169	181	1	2	0	1
LD0.DARREC1.WMstr.stVal	DARREC1.CMD_WAIT	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	CMMXU1.HIGH_ALARM	High alarm	10=High alarm	210	1	0	1	1	1
LD0.CMMXU1.HiWrn.stVal	CMMXU1.HIGH_WARN	High warning	10=High warning	210	2	0	1	1	1
LD0.CMMXU1.LoWrn.stVal	CMMXU1.LOW_WARN	Low warning	10=Low warning	210	3	0	1	1	1
LD0.CMMXU1.LoAlm.stVal	CMMXU1.LOW_ALARM	Low alarm	10=Low alarm	210	4	0	1	1	1
Residual current limit supervision, all variants									
LD0.RESCMMXU1.HiAlm.stVal	RESCMMXU1.HIGH_ALARM	High alarm	10=High alarm	210	11	0	1	1	1
LD0.RESCMMXU1.HiWrn.stVal	RESCMMXU1.HIGH_WARN	High warning	10=High warning	210	12	0	1	1	1
Phase-to-phase voltage limit supervision, FE05.06.07									
LD0.VMMXU1.HiAlm.stVal	VMMXU1.HIGH_ALARM	High alarm	10=High alarm	211	1	0	1	1	1
LD0.VMMXU1.HiWrn.stVal	VMMXU1.HIGH_WARN	High warning	10=High warning	211	2	0	1	1	1
LD0.VMMXU1.LoWrn.stVal	VMMXU1.LOW_WARN	Low warning	10=Low warning	211	3	0	1	1	1
LD0.VMMXU1.LoAlm.stVal	VMMXU1.LOW_ALARM	Low alarm	10=Low alarm	211	4	0	1	1	1
Residual voltage limit supervision, FE01.02.05.06.07									
LD0.RESVMMXU1.HiAlm.stVal	RESVMMXU1.HIGH_ALARM	High alarm	10=High alarm	211	11	0	1	1	1
LD0.RESVMMXU1.HiWrn.stVal	RESVMMXU1.HIGH_WARN	High warning	10=High warning	211	12	0	1	1	1
Circuit breaker position and failure protection, all variants									
CTRL.CBCILO1.EnaOpn.stVal	CBXCBR1.ENA_OPEN	CB open enabled	10=Open enabled	240	21	1	1	1	1
CTRL.CBCILO1.EnaCls.stVal	CBXCBR1.ENA_CLOSE	CB close enabled	10=Close enabled	240	22	1	1	1	1
CTRL.CBXCBR1.BkOpn.stVal	CBXCBR1.BLK_OPEN	CB open blocked	10=Open blocked	240	23	1	1	1	1
CTRL.CBXCBR1.BkCls.stVal	CBXCBR1.BLK_CLOSE	CB close blocked	10=Close blocked	240	24	1	1	1	1
CTRL.CCBRRF1.Str.general	CCBRRF1.CB_FAULT_AL	Start, timer running	10=Start, timer running	240	101	0	2	1	1
CTRL.CCBRRF1.OpEx.general	CCBRRF1.TRBU	Failure, external trip	10=Failure, external trip	240	102	0	2	0	1
CTRL.CCBRRF1.OpIn.general	CCBRRF1.TRRET	Operate, internal retrip	10=Operate, internal re-trip	240	103	0	2	0	1
CTRL.CBCSWI1.Pos.stVal	CBXCBR1.POSITION	Circuit breaker position	10=Close;01=Open;00=Intermediate;11=Error	240	160	1	1,20	1	2
Circuit breaker condition monitoring, FE02.04.05.06.07									
LD0.SSCBR1.RsAccAPwr.ctiVal	SSCBR1.RST_IPOW	Reset accumulation energy	10=Reset	242	19	1	20	0	1
LD0.SSCBR1.RsCBWear.ctiVal	SSCBR1.RST_CB_WEAR	Reset CB remaining life and op.counters	10=Reset	242	20	1	20	0	1
LD0.SSCBR1.RsTrvTm.ctiVal	SSCBR1.RST_TRV_T	Reset CB travelling time alarm	10=Reset	242	21	1	20	0	1
LD0.SSCBR1.RsSprChgTm.ctiVal	SSCBR1.RST_SPR_T	Reset CB spring charge time alarm	10=Reset	242	22	1	20	0	1
LD0.SSCBR1.OpnAlm.stVal	SSCBR1.TRV_T_OP_ALM	Open travel time exceeded	10=Open travel time alarm	242	101	0	1	0	1

Table continues on next page

IEC 61850 name	AFL-Common SA name	Description	DPI value	FUN	INF	In Use	ASDU	GI	Coding
LD0.SSCBR1.CisAlm.stVal	SSCBR1.TRV_T_CL_ALM	Close travel time exceeded	10=Close travel time alarm	242	102	0	1	0	1
LD0.SSCBR1.SprChaAlm.stVal	SSCBR1.SPR_CHR_ALM	Spring charging time exceeded	10=Spring charging time alarm	242	103	0	1	0	1
LD0.SSCBR1.OpNumAlm.stVal	SSCBR1.OPR_ALM	Num of CB operations alarm	10=CB operations alarm	242	104	0	1	0	1
LD0.SSCBR1.OpNumLO.stVal	SSCBR1.OPR_LO	Num of CB operations lockout limit	10=CB operations lockout alarm	242	105	0	1	0	1
LD0.SSCBR1.LonTmAlm.stVal	SSCBR1.MON_ALM	CB 'not operated for long time' alarm	10=CB unactive alarm	242	106	0	1	0	1
LD0.SSCBR1.PresAlm.stVal	SSCBR1.PRES_ALM	Pressure below alarm level	10=Low pressure alarm	242	107	0	1	0	1
LD0.SSCBR1.PresLO.stVal	SSCBR1.PRES_LO	Pressure below lockout level	10=Low pressure lockout alarm	242	108	0	1	0	1
LD0.SSCBR1.APwrAlm.stVal	SSCBR1.IPOW_ALM	Acc. currents power (lyt). alarm limit	10=lyt alarm	242	109	0	1	0	1
LD0.SSCBR1.APwrLO.stVal	SSCBR1.IPOW_LO	Acc. currents power (lyt). lockout limit	10=lyt lockout alarm	242	110	0	1	0	1
LD0.SSCBR1.CBLifAlm.stVal	SSCBR1.CB_LIFE_ALM	Remaining life of CB exceeded alarm limit	10=CB life alarm	242	111	0	1	0	1
Disconnecter positions, FE02_04_05_06_07									
CTRL.DCSXSW1.Pos.stVal	DCSXSW1.POSITION	Disconnecter 1 position	10=Close;01=Open;00=Intermediate;11=Error	253	1	1	1	1	2
CTRL.DCSXSW2.Pos.stVal	DCSXSW2.POSITION	Disconnecter 2 position	10=Close;01=Open;00=Intermediate;11=Error	253	2	1	1	1	2
CTRL.DCSXSW3.Pos.stVal	DCSXSW3.POSITION	Disconnecter 3 position	10=Close;01=Open;00=Intermediate;11=Error	253	3	1	1	1	2
CTRL.ESSXSW1.Pos.stVal	ESSXSW1.POSITION	Earth switch position	10=Close;01=Open;00=Intermediate;11=Error	253	11	1	1	1	2
LHMI alarm LED indications, all variants									
LD0.LEDGGIO1.SPSCO1.stVal	-	LED 1 state	10=LED ON, 01=LED OFF	253	89	1	1	1	1
LD0.LEDGGIO1.SPSCO2.stVal	-	LED 2 state	10=LED ON, 01=LED OFF	253	90	1	1	1	1
LD0.LEDGGIO1.SPSCO3.stVal	-	LED 3 state	10=LED ON, 01=LED OFF	253	91	1	1	1	1
LD0.LEDGGIO1.SPSCO4.stVal	-	LED 4 state	10=LED ON, 01=LED OFF	253	92	1	1	1	1
LD0.LEDGGIO1.SPSCO5.stVal	-	LED 5 state	10=LED ON, 01=LED OFF	253	93	1	1	1	1
LD0.LEDGGIO1.SPSCO6.stVal	-	LED 6 state	10=LED ON, 01=LED OFF	253	94	1	1	1	1
LD0.LEDGGIO1.SPSCO7.stVal	-	LED 7 state	10=LED ON, 01=LED OFF	253	95	1	1	1	1
LD0.LEDGGIO1.SPSCO8.stVal	-	LED 8 state	10=LED ON, 01=LED OFF	253	96	1	1	1	1
LD0.LEDGGIO1.SPSCO9.stVal	-	LED 9 state	10=LED ON, 01=LED OFF	253	97	1	1	1	1
LD0.LEDGGIO1.SPSCO10.stVal	-	LED 10 state	10=LED ON, 01=LED OFF	253	98	1	1	1	1
LD0.LEDGGIO1.SPSCO11.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 name	Description	Default scale	Frame No6	Frame No7	Comment
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	n.a in FE03,04
6	LD0.CSMSQ11.SeqA.c1.instCVal.mag	Positive sequence current	2.4	x	x	
7	LD0.CSMSQ11.SeqA.c2.instCVal.mag	Negative sequence current	2.4	x	x	
8	LD0.CSMSQ11.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 FE05,06,07 and 08

Index	IEC 61850 name	Description	Default scale	Frame No6	Frame No7	Comment
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.Prv.res.instCVal.mag	Residual voltage	2.4	x	x	n.a in FE07
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	n.a in FE08
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.TotVA.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	LD0.FMMXU1.Hz.Mag	Frequency	100	x	x	n.a in FE05,06,07
24	LD0.CMSTA1.AvAmps1.mag	Phase current A -average	2.4	x	x	
25	LD0.CMSTA1.AvAmps2.mag	Phase current B -average	2.4	x	x	
26	LD0.CMSTA1.AvAmps3.mag	Phase current C -average	2.4	x	x	

Section 3 Interoperability profile for 615 series 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
<input checked="" type="checkbox"/> <0>	End of general interrogation
<input checked="" type="checkbox"/> <0>	Time synchronization
<input checked="" type="checkbox"/> <2>	Reset FCB
<input checked="" type="checkbox"/> <3>	Reset CU
<input checked="" type="checkbox"/> <4>	Start/restart
<input checked="" type="checkbox"/> <5>	Power on

3.3.3.2 Status indications in monitor direction

INF	Semantics
<input checked="" type="checkbox"/> <16>	Auto-recloser active 1
<input type="checkbox"/> <17>	Teleprotection active
<input type="checkbox"/> <18>	Protection active
<input type="checkbox"/> <19>	LED reset
<input type="checkbox"/> <20>	Monitor direction blocked
<input checked="" type="checkbox"/> <21>	Test mode
<input type="checkbox"/> <22>	Local parameter setting
<input checked="" type="checkbox"/> <23>	Characteristic 1
<input checked="" type="checkbox"/> <24>	Characteristic 2
<input checked="" type="checkbox"/> <25>	Characteristic 3
<input checked="" type="checkbox"/> <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 |
|--|----------------------------|
| <input type="checkbox"/> <32> | Measurand supervision I |
| <input type="checkbox"/> <33> | Measurand supervision V |
| <input type="checkbox"/> <35> | Phase sequence supervision |
| <input checked="" type="checkbox"/> <36> | Trip circuit supervision |
| <input type="checkbox"/> <37> | I>> back-up operation |
| <input type="checkbox"/> <38> | VT fuse failure |
| <input type="checkbox"/> <39> | Teleprotection disturbed |
| <input type="checkbox"/> <46> | Group warning |
| <input type="checkbox"/> <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 |
|-------------------------------|---|
| <input type="checkbox"/> <48> | Earth fault L ₁ |
| <input type="checkbox"/> <49> | Earth fault L ₂ |
| <input type="checkbox"/> <50> | Earth fault L ₃ |
| <input type="checkbox"/> <51> | Earth fault forward, for example line |
| <input type="checkbox"/> <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 |
|-------------------------------|-------------------------------|
| <input type="checkbox"/> <64> | Start /pick-up L ₁ |
| <input type="checkbox"/> <65> | Start /pick-up L ₂ |

Table continues on next page

- <66> Start /pick-up L₃
- <67> Start /pick-up N
- <68> General trip
- <69> Trip L₁
- <70> Trip L₂
- <71> Trip L₃
- <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 L₁
- <87> Trip measuring system L₂
- <88> Trip measuring system L₃
- <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 |
|---|-------------------------|
| <input checked="" type="checkbox"/> <128> | CB 'on' by AR |
| <input type="checkbox"/> <129> | CB 'on' by long-time AR |
| <input checked="" type="checkbox"/> <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
<input checked="" type="checkbox"/> <144>	Measurand I
<input checked="" type="checkbox"/> <145>	Measurands I, V
<input checked="" type="checkbox"/> <146>	Measurands I, V, P, Q
<input checked="" type="checkbox"/> <147>	Measurands I _N , V _{EN}
<input checked="" type="checkbox"/> <148>	Measurands I _{L1,2,3} , V _{L1,2,3} , P, Q, f

3.3.3.8 Generic functions in monitor direction

INF	Semantics
<input type="checkbox"/> <240>	Read headings of all defined groups
<input type="checkbox"/> <241>	Read values or attributes of all entries of one group
<input type="checkbox"/> <243>	Read directory of a single entry
<input type="checkbox"/> <244>	Read value or attribute of a single entry
<input type="checkbox"/> <245>	End of general interrogation of generic data
<input type="checkbox"/> <249>	Write entry with confirmation
<input type="checkbox"/> <250>	Write entry with execution
<input type="checkbox"/> <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
<input checked="" type="checkbox"/> <0>	Initiation of general interrogation
<input checked="" type="checkbox"/> <0>	Time synchronization

3.3.4.2 Generic functions in monitor direction

INF	Semantics
<input type="checkbox"/> <240>	Read headings of all defined groups
<input type="checkbox"/> <241>	Read values or attributes of all entries of one group
<input type="checkbox"/> <243>	Read directory of a single entry
<input type="checkbox"/> <244>	Read value or attribute of a single entry
<input type="checkbox"/> <245>	End of general interrogation of generic data
<input type="checkbox"/> <249>	Write entry with confirmation
<input type="checkbox"/> <250>	Write entry with execution
<input type="checkbox"/> <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	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Current L ₂	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Current L ₃	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Voltage L _{1-E}	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Voltage L _{2-E}	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Voltage L _{3-E}	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Active power P	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Reactive power Q	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Frequency f	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Voltage L ₁ - L ₂	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

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

Section 4 Glossary

AFL	Application function block library
AR	Autoreclosing
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
HMI	Human-machine interface
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

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