



Power Quality and Revenue Meter  
EM720/EM720T

IEC 61850 Communications Protocol

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Reference Guide

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# 1 General

The EM720 is provided with an embedded IEC 61850 server compliant with the IEC 61850 set of standards.

This document contains the IEC 61850 conformance statements that give the summary of the device data object model, protocol implementations and communication capabilities of the EM720.

For detailed information on operating the EM720 and communication settings refer to the EM720 Operation Manual.

## 2 ACSI (Abstract Communication Service Interface) Conformance Statement

This chapter contains the ACSI conformance statement as defined in Annex A of IEC 61850-7-2 that specifies the device communication features mapped to an SCSM (Specific Communication Service Mapping).

### 2.1 ACSI basic conformance statement

Services		Client/ Subscriber	Server/ Publisher	Value/ Comments
<b>Client-server roles</b>				
B11	Server side (of TWO-PARTY-APPLICATION-ASSOCIATION)		● c1	
B12	Client side of (TWO-PARTY-APPLICATION-ASSOCIATION)			
<b>SCSMs supported</b>				
B21	SCSM: IEC 61850-8-1 used		●	
B22	SCSM: IEC 61850-9-1 used			
B23	SCSM: IEC 61850-9-2 used			
B24	SCSM: other			
<b>Generic substation event model (GSE)</b>				
B31	Publisher side			
B32	Subscriber side			
<b>Transmission of sampled value model (SVC)</b>				
B41	Publisher side			
B42	Subscriber side			
c1– declared support for LOGICAL-DEVICE model ● – supported				

### 2.2 ACSI models conformance statement

Services		Client/ Subscriber	Server/ Publisher	Value/ Comments
<b>If Server side (B11) supported</b>				
M1	Logical device		● c2	
M2	Logical node		● c3	
M3	Data		● c4	
M4	Data set		● c5	
M5	Substitution			
M6	Setting group control			
<b>Reporting</b>				
M7	Buffered report control		●	
M7-1	sequence-number		●	
M7-2	report-time-stamp		●	
M7-3	reason-for-inclusion		●	
M7-4	data-set-name		●	
M7-5	data-reference		●	
M7-6	buffer-overflow		●	
M7-7	entryID		●	
M7-8	BufTm		●	
M7-9	IntgPd		●	
M7-10	GI		●	
M8	Unbuffered report control		●	
M8-1	sequence-number		●	
M8-2	report-time-stamp		●	
M8-3	reason-for-inclusion		●	
M8-4	data-set-name		●	

Services		Client/ Subscriber	Server/ Publisher	Value/ Comments
M8-5	data-reference		●	
M8-6	BufTm		●	
M8-7	IntgPd		●	
M8-8	GI		●	
	Logging			
M9	Log control			
M9-1	IntgPd			
M10	Log			
M11	Control		●	
<b>If GSE (B31/B32) is supported</b>				
	<b>GOOSE</b>			
M12-1	entryID			
M12-2	DataRefInc			
M13	GSSE			
<b>If SVC (B41/B42) is supported</b>				
M14	Multicast SVC			
M15	Unicast SVC			
M16	Time		●	Time source with required accuracy shall be available
M17	File Transfer		●	
c2 – declared support for LOGICAL-NODE model c3 – declared support for DATA model c4 – declared support for DATA-SET, Report, or Time model c5 – declared support for Report model ● – supported				

## 2.3 ACSI service conformance statement

AA – APPLICATION-ASSOCIATION; TP – TWO- PARTY; MC – Multicast

Services		AA: TP/MC	Client/ Subscriber	Server/ Publisher	Comments
<b>Server (Clause 6)</b>					
S1	ServerDirectory	TP		●	
<b>Application association (Clause 7)</b>					
S2	Associate			●	
S3	Abort			●	
S4	Release			●	
<b>Logical device (Clause 8)</b>					
S5	LogicalDeviceDirectory	TP		●	
<b>Logical node (Clause 9)</b>					
S6	LogicalNodeDirectory	TP		●	
S7	GetAllDataValues	TP		●	
<b>Data (Clause 10)</b>					
S8	GetDataValues	TP		●	
S9	SetDataValues	TP			
S10	GetDataDirectory	TP		●	
S11	GetDataDefinition	TP		●	
<b>Data set (Clause 11)</b>					
S12	GetDataSetValues	TP		●	
S13	SetDataSetValues	TP		●	
S14	CreateDataSet	TP		●	
S15	DeleteDataSet	TP		●	
S16	GetDataSetDirectory	TP		●	
<b>Substitution (Clause 12)</b>					
S17	SetDataValues	TP			

Services		AA: TP/MC	Client/ Subscriber	Server/ Publisher	Comments
<b>Setting group control (Clause 13)</b>					
S18	SelectActiveSG	TP			
S19	SelectEditSG	TP			
S20	SetSGValues	TP			
S21	ConfirmEditSGValues	TP			
S22	GetSGValues	TP			
S23	GetSGCBValues	TP			
<b>Reporting (Clause 14)</b>					
Buffered report control block (BRCB)					
S24	Report	TP		●	
S24-1	data-change (dchg)			●	
S24-2	qchg-change (qchg)			●	
S24-3	data-update (dupd)			●	
S25	GetBRCBValues	TP		●	
S26	SetBRCBValues	TP		●	
Unbuffered report control block (URCB)					
S27	Report	TP		●	
S27-1	data-change (dchg)			●	
S27-2	qchg-change (qchg)			●	
S27-3	data-update (dupd)			●	
S28	GetURCBValues	TP		●	
S29	SetURCBValues	TP		●	
<b>Logging (Clause 14)</b>					
Log control block					
S30	GetLCBValues	TP			
S31	SetLCBValues	TP			
Log					
S32	QueryLogByTime	TP			
S33	QueryLogAfter	TP			
S34	GetLogStatusValues	TP			
<b>Generic substation event model (GSE) (Clause 15)</b>					
GOOSE-CONTROL-BLOCK					
S35	SendGOOSEMessage	MC			
S36	GetGoReference	TP			
S37	GetGOOSEElementNumber	TP			
S38	GetGoCBValues	TP			
S39	SetGoCBValues	TP			
GSSE-CONTROL-BLOCK					
S40	SendGSSEMessage	MC			
S41	GetGsReference	TP			
S42	GetGSSEElementNumber	TP			
S43	GetGsCBValues	TP			
S44	SetGsCBValues	TP			
<b>Transmission of sampled value model (SVC) (Clause 16)</b>					
Multicast SVC					
S45	SendMSVMessage	MC			
S46	GetMSVCBValues	TP			
S47	SetMSVCBValues	TP			
Unicast SVC					
S48	SendUSVMessage	TP			
S49	GetUSVCBValues	TP			
S50	SetUSVCBValues	TP			
<b>Control (Clause 17)</b>					
S51	Select	TP		●	
S52	SelectWithValue	TP			
S53	Cancel	TP		●	

Services		AA: TP/MC	Client/ Subscriber	Server/ Publisher	Comments
S54	Operate	TP		●	
S55	Command-Termination	TP			
S56	TimeActivated-Operate	TP			
<b>File transfer (Clause 20)</b>					
S57	GetFile	TP		●	
S58	SetFile	TP			
S59	DeleteFile	TP			
S60	GetFileAttributeValues	TP		●	
<b>Time (Clause 18)</b>					
T1	Time resolution of internal clock (nearest value of 2** -n in seconds)			n=10 (T1)	
T2	Time accuracy of internal clock			n=10 (T1)	
T3	Supported TimeStamp resolution (nearest value of 2** -n in seconds)			n=10 (T1)	
● – supported					

### 3 MICS - Model Implementation Conformance Statement

This chapter contains the MICS conformance statement as required by IEC 61850-10. It lists data object model elements supported by the EM720 and provides definitions of the logical nodes, common data classes and data attribute types as defined in IEC 61850-7-3 and IEC 61850-7-4.

#### 3.1 Model conformance

The model conformance of the EM720 is described by its ICD file.

#### 3.2 Common data attributes classes

The following tables indicate which fields are supported in each Common Data Attribute Class. Not listed fields are either optional (O) or conditional (C) and are not supported by the EM720. Mandatory fields (M) are always present.

##### Quality

Attribute name	Attribute type	Value/Range	M/O/C	Comments
validity	CODED ENUM	good   invalid	M	Supported
detailQual	PACKED LIST		M	Supported
overflow	BOOLEAN	FALSE	M	Defaulted
outOfRange	BOOLEAN	TRUE   FALSE	M	Supported
badReference	BOOLEAN	TRUE   FALSE	M	Supported
oscillatory	BOOLEAN	FALSE	M	Defaulted
failure	BOOLEAN	TRUE   FALSE	M	Supported
oldData	BOOLEAN	FALSE	M	Defaulted
inconsistent	BOOLEAN	FALSE	M	Defaulted
inaccurate	BOOLEAN	FALSE	M	Defaulted
source	CODED ENUM	process	M	Defaulted
test	BOOLEAN	FALSE	M	Defaulted
operatorBlocked	BOOLEAN	FALSE	M	Defaulted

##### Analog value

Attribute name	Attribute type	Value/Range	M/O/C	Comments
i	INT32	integer value	C	
f	FLOAT32	floating point value	C	

Only one of the attributes may be present for a given instance of DATA.

##### Configuration of analogue value

Common data attribute class is not supported.

##### Range configuration

Common data attribute class is not supported.

##### Step position with transient indication

Common data attribute class is not supported.

## Pulse configuration

Attribute Name	Attribute Type	Value/Range	M/O/C	Comments
cmdQual	ENUMERATED	pulse   persistent	M	For pulse output a relay must be set to pulse mode in the device via the device Relay Setup
onDur	INT32U		M	Default = 500 ms
offDur	INT32U		M	Not supported
numPls	INT32U	1	M	Read only

## Originator

Attribute Name	Attribute Type	Value/Range	M/O/C	Comments
orCat	ENUMERATED	not-supported   bay-control   station-control   remote-control   automatic-bay   automaticstation   automatic-remote   maintenance   process	M	
orIdent	OCTET STRING64		M	

## Unit definition

Attribute Name	Attribute Type	Value/Range	M/O/C	Comments
SIUnit	ENUMERATED	See IEC61850-7-3, Tables A.1 to A.4 in Annex A	M	
multiplier	ENUMERATED	See IEC61850-7-3, Table A.5 in Annex A	O	

The default value of the multiplier is 0 and the multiplier value is 1:  $10^{*0} = 1$ .

## Vector

Attribute Name	Attribute Type	Value/Range	M/O/C	Comments
mag	AnalogueValue		M	Only one of the attributes of the AnalogueValue may be present for a given instance of DATA.
ang	AnalogueValue		O	ang attribute is used for data objects of the phzrMMXU LN (see below) only

## Point definition

Common data attribute class is not supported.

## CtlModels definition

Attribute Value	Comments
status-only	Not controllable SPS, DPS and INS
direct-with-normal-security	Controllable SPC and INC
sbo-with-normal-security	Controllable SPC and INC
directwith-enhanced-security	Not supported
sbo-with-enhanced-security	Not supported

## SboClasses definition

Attribute Value	Comments
operate-once	
operate-many	Not supported

### 3.3 Common data classes

The following tables indicate mandatory, conditional and optional attributes of each Common Data Class (CDC) that are supported by the EM720. Mandatory attributes (M) are always present.

#### Single point status (SPS)

Attribute Name	Attribute Type	FC	M/O/C
stVal	BOOLEAN	ST	M
q	Quality	ST	M
t	TimeStamp	ST	M
d	VISIBLE STRING64	DC	O

#### Double point status (DPS)

Common data class is not supported.

#### Integer status (INS)

Attribute Name	Attribute Type	FC	M/O/C
stVal	INT32	ST	M
q	Quality	ST	M
t	TimeStamp	ST	M
d	VISIBLE STRING64	DC	O

#### Protection activation information (ACT)

Common data class is not supported.

#### Directional protection activation information (ACD)

Common data class is not supported.

#### Security violation counting (SEC)

Common data class is not supported.

#### Binary counter reading (BCR)

Attribute Name	Attribute Type	FC	M/O/C	Comments
actVal	INT32	ST	M	
q	Quality	ST	M	
t	TimeStamp	ST	M	
units	Unit	CF	O	
pulsQty	FLOAT32	CF	M	
d	VISIBLE STRING64	DC	O	

#### Measured value (MV)

Attribute Name	Attribute Type	FC	M/O/C	Comments
mag	AnalogueValue	MX	M	Only one of the attributes (i or f) of the AnalogueValue may be present for a given instance of DATA
q	Quality	MX	M	
t	TimeStamp	MX	M	
units	Unit	CF	O	
db	INT32U	CF	O	
d	VISIBLE STRING64	DC	O	

### Complex measured value (CMV)

Attribute Name	Attribute Type	FC	M/O/C	Comments
cVal	Vector	MX	M	
q	Quality	MX	M	
t	TimeStamp	MX	M	
units	Unit	CF	O	
db	INT32U	CF	O	
d	VISIBLE STRING64	DC	O	

### Sampled value (SAV)

Common data class is not supported.

### WYE

Attribute Name	Attribute Type	FC	M/O/C	Comments
phsA	CMV		C	
phsB	CMV		C	
phsC	CMV		C	
neut	CMV		C	Signed with (*) where available

### Delta (DEL)

Attribute Name	Attribute Type	FC	M/O/C	Comments
phsAB	CMV		C	
phsBC	CMV		C	
phsCA	CMV		C	

### Sequence (SEQ)

Attribute Name	Attribute Type	FC	M/O/C	Comments
c1	CMV		M	
c2	CMV		M	
c3	CMV		M	
seqT	ENUMERATED	MX	M	pos-neg-zero   dir-quad-zero

### Harmonic value (HMV)

Common data class is not supported.

### Harmonic value for WYE (HWYE)

Attribute Name	Attribute Type	FC	M/O/C	Comments
q	Quality	MX	M	
t	TimeStamp	MX	M	
phsAHar	ARRAY[0..numHar] OF Vector	MX	M	
phsBHar	ARRAY[0..numHar] OF Vector	MX	O	
phsCHar	ARRAY[0..numHar] OF Vector	MX	O	
numHar	INT16U	CF	M	numHar = 63 (no subharmonics)
numCyc	INT16U	CF	M	numCyc = 1
units	Unit	CF	O	
evalTm	INT16U	CF	M	evalTm = nominal period
frequency	FLOAT32	CF	M	frequency = nominal frequency
d	VISIBLE STRING64	DC	O	

### Harmonic value for DEL (HDEL)

Attribute Name	Attribute Type	FC	M/O/C	Comments
q	Quality	MX	M	
t	TimeStamp	MX	M	
phsABHar	ARRAY[0..numHar] OF Vector	MX	M	
phsBCHar	ARRAY[0..numHar] OF Vector	MX	O	
phsCAHar	ARRAY[0..numHar] OF Vector	MX	O	
numHar	INT16U	CF	M	numHar = 63 (no subharmonics)
numCyc	INT16U	CF	M	numCyc = 1
units	Unit	CF	O	
evalTm	INT16U	CF	M	evalTm = nominal period
frequency	FLOAT32	CF	M	frequency = nominal frequency
d	VISIBLE STRING64	DC	O	

### Controllable single point (SPC)

Attribute Name	Attribute Type	FC	M/O/C	Comments
ctlVal	BOOLEAN	CO	C	See notes below for explanation
stVal	BOOLEAN	ST	M	
q	Quality	ST	M	
t	TimeStamp	ST	M	
d	VISIBLE STRING64	DC	O	
pulseConfig	PulseConfig	CF	O	
ctlModel	CtlModels	CF	M	

Relay output operation depends on the configurable cmdQual attribute value (see pulseConfig) and the relay operation mode configured in the device via the Relay Setup as described in the following table.

cmdQual	Relay operation mode	Relay operation
pulse	Pulse/KYZ	Pulse output. ctlVal = 1 – generates a pulse (normal/KYZ) with a duration defined by the onDur attribute; ctlVal = 0 – no effect
pulse	Latched/unlatched	No effect
persistent	Pulse/KYZ	Pulse output. ctlVal = 1 – generates a pulse (normal/KYZ) with a duration defined by the pulse width pre-configured in the device setup; ctlVal = 0 – no effect
persistent	Latched/unlatched	Latched output. ctlVal = 1 – switch on, ctlVal = 0 – switch off

### Controllable double point (DPC)

Common data class is not supported.

### Controllable integer status (INC)

Attribute Name	Attribute Type	FC	M/O/C	Comments
ctlVal	INT32	CO	C	
stVal	INT32	ST	M	
q	Quality	ST	M	
t	TimeStamp	ST	M	
d	VISIBLE STRING64	DC	O	

### Binary controlled step position information (BSC)

Common data class is not supported.

### Binary controlled step position information (ISC)

Common data class is not supported.

### Controllable analog set point information (APC)

Common data class is not supported.

### Single point setting (SPG)

Common data class is not supported.

### Integer status setting (ING)

Common data class is not supported.

### Analog setting (ASG)

Common data class is not supported.

### Setting curve (CURVE)

Common data class is not supported.

### Device name plate (DPL)

Attribute Name	Attribute Type	FC	M/O/C	Comments
vendor	VISIBLE STRING255	DC	M	
model	VISIBLE STRING255	DC	O	
location	VISIBLE STRING255	DC	O	

### Logical node name plate (LPL)

Attribute Name	Attribute Type	FC	M/O/C	Comments
vendor	VISIBLE STRING255	DC	M	
swRev	VISIBLE STRING255	DC	M	
d	VISIBLE STRING255	DC	M	
configRev	VISIBLE STRING255	DC	C	LLNO only
ldNs	VISIBLE STRING255	DC	C	LLNO only

### Curve shape description (CSD)

Common data class is not supported.

## 3.4 Logical device and logical nodes

The EM720 IEC 61850 server provides a single logical device with the name MET1.

The IEC 61850 server contains logical nodes LPHD and LLNO dedicated to the EM720 unit, and a set of logical nodes for functions supported by the EM720. The names of logical nodes are fixed.

The following tables list attributes of logical nodes supported by the EM720. Attributes that are not listed in the tables are optional (O) or conditional (C) and are not supported by the EM720. Mandatory (M) attributes are always present.

The EM720 device also uses extension (E) attributes for some logical nodes.

### 3.4.1 System logical nodes: L group

#### Physical device information (LPHD class)

Attribute name	Attribute type	Explanation/Value	T	M/O/C/E	Comments
LNName	Object name	LPHD1		M	
PhyNam	DPL	Physical device name plate		M	
PhyHealth	INS	Physical device health		M	

Proxy	SPS	Indicates if this LN is a proxy		M	Defaulted to FALSE
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### Logical node zero (LLNO class)

Attribute name	Attribute type	Explanation/Value	T	M/O/C/E	Comments
LNName	Object name	LLNO		M	
<b>Common Logical Node Information</b>					
Mod	INC	Mode		M	
Beh	INS	Behavior		M	
Health	INS	Health		M	
NamePlt	LPL	Name plate		M	

### 3.4.2 Logical nodes for protection related functions: R group

#### Disturbance recorder function (RDRE class)

##### Disturbance recorders: drRDRE1-drRDRE3

Attribute name	Attribute type	Explanation/Value	T	M/O/C/E	Comments
LNName	Object name	drRDRE1, drRDRE2, drRDRE3		M	
<b>Common Logical Node Information</b>					
Mod	INC	Mode		M	
Beh	INS	Behavior		M	
Health	INS	Health		M	
NamePlt	LPL	Name plate		M	
<b>Status Information</b>					
RcdMade	SPS	Recording made		M	Set to TRUE when at least one disturbance waveform is available for a read.
FitNum	INS	Fault number		M	Indicates the last waveform series number available in a disturbance recorder.

### 3.4.3 Logical nodes for generic reference: G group

#### Generic process I/O (GGIO class)

##### Digital inputs: biGGIO1

Attribute name	Attribute type	Explanation/Value	T	M/O/C/E	Comments
LNName	Object name	biGGIO1		M	
<b>Common Logical Node Information</b>					
Mod	INC	Mode		M	
Beh	INS	Behavior		M	
Health	INS	Health		M	
NamePlt	LPL	Name plate		M	
<b>Status Information</b>					
Ind1 to Ind8	SPS	General indication: Digital inputs DI1-DI8		O	TRUE = closed FALSE = open

##### Relay outputs: boGGIO1

Attribute name	Attribute type	Explanation/Value	T	M/O/C/E	Comments
LNName	Object name	boGGIO1		M	
<b>Common Logical Node Information</b>					
Mod	INC	Mode		M	
Beh	INS	Behavior		M	

Health	INS	Health		M	
NamePlt	LPL	Name plate		M	
Loc	SPS	Local operation		O	
<b>Controls</b>					
SPCS01 to SPCS04	SPC	Single point controllable status output: Relay outputs RO1-RO4		O	

#### Setpoint status: spGGIO1

Attribute name	Attribute type	Explanation/Value	T	M/O/C/E	Comments
LNName	Object name	spGGIO1		M	
<b>Common Logical Node Information</b>					
Mod	INC	Mode		M	
Beh	INS	Behavior		M	
Health	INS	Health		M	
NamePlt	LPL	Name plate		M	
<b>Status Information</b>					
Ind1 to Ind16	SPS	General indication for setpoints SP1-SP16		O	TRUE = setpoint operated FALSE = setpoint released

### 3.4.4 Logical nodes for metering and measurement: M group

#### Metering (MMTR class)

##### Energy counters: engMMTR1

Attribute name	Attribute type	Explanation/Value	T	M/O/C/E	Comments
LNName	Object name	engMMTR1		M	
<b>Common Logical Node Information</b>					
Mod	INC	Mode		M	
Beh	INS	Behavior		M	
Health	INS	Health		M	
NamePlt	LPL	Name plate		M	
<b>Measured values</b>					
TotVAh	BCR	Apparent energy		O	Total
TotWh	BCR	Net real energy		O	Net
TotVArh	BCR	Net reactive energy		O	Net
SupWh	BCR	Real energy supply		O	Exported
SupVArh	BCR	Reactive energy supply		O	Exported
DmdWh	BCR	Real energy demand		O	Imported
DmdVArh	BCR	Reactive energy demand		O	Imported

#### Harmonics (MHAI class)

##### Harmonic demands: demMHAI1

Attribute name	Attribute type	Explanation/Value	T	M/O/C/E	Comments
LNName	Object name	demMHAI1		M	
<b>Common Logical Node Information</b>					
Mod	INC	Mode		M	
Beh	INS	Behavior		M	
Health	INS	Health		M	
NamePlt	LPL	Name plate		M	
<b>Measured values</b>					
ThdPhV	WYE	Voltage THD demand for phase to		O	In 4LN3, 3LN3 and 3BLN3

Attribute name	Attribute type	Explanation/Value	T	M/O/C/E	Comments
		ground			wiring modes
ThdPPV	DEL	Voltage THD demand for phase to phase		O	In 4LL3, 3LL3, 3BLL3, 3DIR2, 3OP2 and 3OP3 wiring modes
ThdA	WYE	Current THD demand		O	
TddA	WYE	Current TDD demand per IEEE 519		O	
ThdAuxA	MV	Current THD demand for auxiliary current input I4		E	
TddAuxA	MV	Current TDD demand for auxiliary current input I4		E	

### Sequence of harmonics: hrmMHAI 1

Attribute name	Attribute type	Explanation/Value	T	M/O/C/E	Comments
LNName	Object name	hrmMHAI1		M	
<b>Common Logical Node Information</b>					
Mod	INC	Mode		M	
Beh	INS	Behavior		M	
Health	INS	Health		M	
NamePlt	LPL	Name plate		M	
<b>Measured values</b>					
HA	HWYE	Sequence of harmonics current		O	
HPhV	HWYE	Sequence of harmonics phase to ground voltages		O	In 4LN3, 3LN3 and 3BLN3 wiring modes
HPPV	HDEL	Sequence of harmonics phase to phase voltages		O	In 4LL3, 3LL3, 3BLL3, 3DIR2, 3OP2 and 3OP3 wiring modes

### Total harmonics: ocvMHAI 1

Attribute name	Attribute type	Explanation/Value	T	M/O/C/E	Comments
LNName	Object name	ocvMHAI1		M	
<b>Common Logical Node Information</b>					
Mod	INC	Mode		M	
Beh	INS	Behavior		M	
Health	INS	Health		M	
NamePlt	LPL	Name plate		M	
<b>Measured values</b>					
ThdPhV	WYE	Voltage THD for phase to ground		O	In 4LN3, 3LN3 and 3BLN3 wiring modes
ThdPPV	DEL	Voltage THD for phase to phase		O	In 4LL3, 3LL3, 3BLL3, 3DIR2, 3OP2 and 3OP3 wiring modes
ThdA	WYE	Current THD		O	
HKf	WYE	K-Factor		O	
TddA	WYE	Current TDD per IEEE 519		O	

### 3-second total harmonics: osvMHAI 1

Attribute name	Attribute type	Explanation/Value	T	M/O/C/E	Comments
LNName	Object name	osvMHAI1		M	
<b>Common Logical Node Information</b>					
Mod	INC	Mode		M	
Beh	INS	Behavior		M	
Health	INS	Health		M	
NamePlt	LPL	Name plate		M	

Attribute name	Attribute type	Explanation/Value	T	M/O/C/E	Comments
<b>Measured values</b>					
ThdPhV	WYE	Voltage THD for phase to ground		O	In 4LN3, 3LN3 and 3BLN3 wiring modes
ThdPPV	DEL	Voltage THD for phase to phase		O	In 4LL3, 3LL3, 3BLL3, 3DIR2, 3OP2 and 3OP3 wiring modes
ThdA	WYE	Current THD		O	
HKf	WYE	K-Factor		O	
TddA	WYE	Current TDD per IEEE 519		O	

## Measurement (MMXU class)

### Present demands: demMMXU1

Attribute name	Attribute type	Explanation/Value	T	M/O/C/E	Comments
LNNName	Object name	demMMXU1		M	
<b>Common Logical Node Information</b>					
Mod	INC	Mode		M	
Beh	INS	Behavior		M	
Health	INS	Health		M	
NamePlt	LPL	Name plate		M	
<b>Measured values</b>					
PhV	WYE	Phase to ground voltage demands		O	In 4LN3, 3LN3 and 3BLN3 wiring modes
PPV	DEL	Phase to phase voltage demands		O	In 4LL3, 3LL3, 3BLL3, 3DIR2, 3OP2 and 3OP3 wiring modes
A	WYE	Phase current demands		O	
TotkWImp	MV	Total active power imported block demand		E	
TotkWExp	MV	Total active power exported block demand		E	
TotkVarImp	MV	Total reactive power imported block demand		E	
TotkVarExp	MV	Total reactive power exported block demand		E	
TotVA	MV	Total apparent power demand		O	
AuxA	CMV	Auxiliary current I4 demand		E	

### Sliding power demands: demMMXU2

Attribute name	Attribute type	Explanation/Value	T	M/O/C/E	Comments
LNNName	Object name	demMMXU2		M	
<b>Common Logical Node Information</b>					
Mod	INC	Mode		M	
Beh	INS	Behavior		M	
Health	INS	Health		M	
NamePlt	LPL	Name plate		M	
<b>Measured values</b>					
TotkWImp	MV	Total active power imported sliding window demand		E	
TotkWExp	MV	Total active power exported sliding window demand		E	
TotkVarImp	MV	Total reactive power imported sliding window demand		E	
TotkVarExp	MV	Total reactive power exported sliding window demand		E	
TotVA	MV	Total apparent power sliding		O	

Attribute name	Attribute type	Explanation/Value	T	M/O/C/E	Comments
		window demand			

#### Accumulated power demands: demMMXU3

Attribute name	Attribute type	Explanation/Value	T	M/O/C/E	Comments
LNName	Object name	demMMXU3		M	
<b>Common Logical Node Information</b>					
Mod	INC	Mode		M	
Beh	INS	Behavior		M	
Health	INS	Health		M	
NamePlt	LPL	Name plate		M	
<b>Measured values</b>					
TotkWImp	MV	Total active power imported accumulated demand		E	
TotkWExp	MV	Total active power exported accumulated demand		E	
TotkVarImp	MV	Total reactive power imported accumulated demand		E	
TotkVarExp	MV	Total reactive power exported accumulated demand		E	
TotVA	MV	Total apparent power accumulated demand		O	

#### Predicted power demands: demMMXU4

Attribute name	Attribute type	Explanation/Value	T	M/O/C/E	Comments
LNName	Object name	demMMXU4		M	
<b>Common Logical Node Information</b>					
Mod	INC	Mode		M	
Beh	INS	Behavior		M	
Health	INS	Health		M	
NamePlt	LPL	Name plate		M	
<b>Measured values</b>					
TotkWImp	MV	Total active power imported predicted demand		E	
TotkWExp	MV	Total active power exported predicted demand		E	
TotkVarImp	MV	Total reactive power imported predicted demand		E	
TotkVarExp	MV	Total reactive power exported predicted demand		E	
TotVA	MV	Total apparent power predicted demand		O	

#### Half-cycle measurements: hcvMMXU1

Attribute name	Attribute type	Explanation/Value	T	M/O/C/E	Comments
LNName	Object name	hcvMMXU1		M	
<b>Common Logical Node Information</b>					
Mod	INC	Mode		M	
Beh	INS	Behavior		M	
Health	INS	Health		M	
NamePlt	LPL	Name plate		M	
<b>Measured values</b>					
PhV	WYE	Phase to ground voltages		O	
PPV	DEL	Phase to phase voltages		O	
A	WYE	Phase and neutral currents		O	(*) See WYE

AuxA	CMV	Auxiliary current I4		E	
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#### One-second measurements: osvMMXU1

Attribute name	Attribute type	Explanation/Value	T	M/O/C/E	Comments
LNName	Object name	osvMMXU1		M	
<b>Common Logical Node Information</b>					
Mod	INC	Mode		M	
Beh	INS	Behavior		M	
Health	INS	Health		M	
NamePlt	LPL	Name plate		M	
<b>Measured values</b>					
PhV	WYE	Phase to ground voltages		O	
PPV	DEL	Phase to phase voltages		O	
A	WYE	Phase and neutral currents		O	(*) See WYE
W	WYE	Phase active power		O	
VAr	WYE	Phase reactive power		O	
VA	WYE	Phase apparent power		O	
PF	WYE	Phase power factor		O	
TotW	MV	Total active power		O	
TotVAr	MV	Total reactive power		O	
TotVA	MV	Total apparent power		O	
TotPF	MV	Total power factor		O	
TotPFLag	MV	Total power factor lag		E	
TotPFLead	MV	Total power factor lead		E	
TotkWImp	MV	Total active power imported		E	
TotkWExp	MV	Total active power exported		E	
TotkVarImp	MV	Total reactive power imported		E	
TotkVarExp	MV	Total reactive power exported		E	
AuxA	CMV	Auxiliary current I4		E	
Hz	MV	Frequency		O	
AvPhV	MV	Average voltage phase to ground		E	
AvPPV	MV	Average voltage phase to phase		E	
AvA	MV	Average current		E	

#### Phasors: phsrMMXU1

Attribute name	Attribute type	Explanation/Value	T	M/O/C/E	Comments
LNName	Object name	phsrMMXU1		M	
<b>Common Logical Node Information</b>					
Mod	INC	Mode		M	
Beh	INS	Behavior		M	
Health	INS	Health		M	
NamePlt	LPL	Name plate		M	
<b>Measured values</b>					
PhV	WYE	Phase to ground voltages (magnitude and angle)		O	In 4LN3, 3LN3 and 3BLN3 wiring modes
PPV	DEL	Phase to phase voltages (magnitude and angle)		O	In 4LL3, 3LL3, 3BLL3, 3DIR2, 3OP2 and 3OP3 wiring modes
A	WYE	Phase currents (magnitude and angle)		O	
AuxA	CMV	Auxiliary current I4 (magnitude and angle)		E	

## Sequence and imbalance (MSQI class)

### Sequence components: seqMSQI 1

Attribute name	Attribute type	Explanation/Value	T	M/O/C/E	Comments
LNNName	Object name	seqMSQI1		M	
<b>Common Logical Node Information</b>					
Mod	INC	Mode		M	
Beh	INS	Behavior		M	
Health	INS	Health		M	
NamePlt	LPL	Name plate		M	
<b>Measured values</b>					
SeqV	SEQ	Positive, negative and zero sequence voltage		O	
ImbNgV	MV	Imbalance negative sequence voltage		O	
ImbZroV	MV	Imbalance zero sequence voltage		O	
SeqA	SEQ	Positive, negative and zero sequence current		O	
ImbNgA	MV	Imbalance negative sequence current		O	
ImbZroA	MV	Imbalance zero sequence current		O	

## Metering statistics (MSTA class)

### Minimum/maximum on any phase: ocvMSTA1, osvMSTA1

Attribute name	Attribute type	Explanation/Value	T	M/O/C/E	Comments
LNNName	Object name	ocvMSTA1 (one-cycle values), osvMSTA1 (one-second values)		M	
<b>Common Logical Node Information</b>					
Mod	INC	Mode		M	
Beh	INS	Behavior		M	
Health	INS	Health		M	
NamePlt	LPL	Name plate		M	
<b>Measured values</b>					
MinVolts	MV	Minimum voltage		O	
MinPPV	MV	Minimum voltage phase to phase		E	
MinAmps	MV	Minimum current		O	
MinW	MV	Minimum phase real power		O	
MinVAr	MV	Minimum phase reactive power		O	
MinVA	MV	Minimum phase apparent power		O	
MinPFLag	MV	Minimum phase PF lag		E	
MinPFLead	MV	Minimum phase PF lead		E	
MinThdPhV	MV	Minimum voltage THD phase to ground		E	
MinThdA	MV	Minimum current THD		E	
MinHKf	MV	Minimum K-Factor		E	
MinTddA	MV	Minimum current TDD		E	
MaxVolts	MV	Maximum voltage		O	
MaxPPV	MV	Maximum voltage phase to phase		E	
MaxAmps	MV	Maximum current		O	
MaxW	MV	Maximum phase real power		O	
MaxVAr	MV	Maximum phase reactive power		O	
MaxVA	MV	Maximum phase apparent power		O	
MaxPFLag	MV	Maximum phase PF lag		E	
MaxPFLead	MV	Maximum phase PF lead		E	
MaxThdPhV	MV	Maximum voltage THD phase to		E	

Attribute name	Attribute type	Explanation/Value	T	M/O/C/E	Comments
		ground			
MaxThdA	MV	Maximum current THD		E	
MaxHKf	MV	Maximum K-Factor		E	
MaxTddA	MV	Maximum current TDD		E	

## 4 PICS – Protocol Implementation Conformance Statement

This chapter contains the PICS conformance statement as defined by IEC 61850-8-1 that specifies mapping to MMS and to ISO/IEC 8802-3.

### 4.1 Profile conformance

#### A-Profile support

Profile	Profile description type	Client	Server	Comments
A1	Client/server		●	
A2	GOOSE/GSE Management			
A3	GSSE			
A4	Time sync	●		SNTP (RFC 2030, RFC 4330)

#### T-Profile support

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

### 4.2 MMS conformance

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

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

MMS service supported CBB (server)	M/O/C/I	Supported
reconfigureProgramInvocation	NP	
M: mandatory support O: optional support C: conditional support I: out of scope NP: not present (MMS minor version 1 compatibility)		

### 4.3 GOOSE conformance statement (GOOSE Services)

Service	Subscriber	Publisher	Value/comments
SendGOOSEMessage			
GetGoReference			
GetGOOSEElementNumber			
GetGoCBValues			
SetGoCBValues			
GSENotSupported			
GOOSE Control Block (GoCB)			

### 4.4 GSSE conformance statement (GSSE Services)

Service	Subscriber	Publisher	Value/comments
SendGSSEMessage			
GetGsReference			
GetGSSEDataOffset			
GetGsCBValues			
SetGsCBValues			
GSENotSupported			
GSSE Control Block (GsCB)			

### 4.5 SCL services (SCL conformance)

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

## 5 PIXIT - Protocol Implementation Extra Information for Testing

This chapter describes device specific implementation of the protocol and communication capabilities of the EM720.

### 5.1 Device configuration

The device configuration except of the listed items cannot be modified and is listed for information only.

### 5.2 ACSI models

#### Association model

Item	Value/Comments
Maximum simultaneous client associations	4
TCP Keepalive	120 s, fixed value
Authentication	Not supported
Association parameters	
TSEL	0001, fixed value
SSEL	0001, fixed value
PSEL	00000001, fixed value
AP-Title	Not required, ignored if present
AE-Qualifier	Not required, ignored if present
Maximum MMS PDU size	16000
Typical startup time after a power supply interrupt	5 s

#### Server model

Item	Value/Comments
Quality bits for analog values (MX)	
Validity	Good
OutOfRange	Not supported
Failure	Not supported
Inconsistent	Not supported
Source	Process
Other quality bits and values	Not supported
Quality bits for status values (ST)	
Validity	Good
BadReference	Not supported
Failure	Not supported
Inconsistent	Not supported
Inaccurate	Not supported
Source	Process
Other quality bits and values	Not supported
Maximum number of data values in Get/SetDataValues requests	Limited only by the MMS PDU size

#### Setting group model

Item	Value/Comments
Number of setting groups	Not supported

#### Dataset model

Item	Value/Comments
Predefined Datasets in ICD file	Measurand data: LLN0\$DSet01Mx

Item	Value/Comments
	LLN0\$DSet02Mx LLN0\$DSet03Mx LLN0\$DSet04St  Status data: LLN0\$DSet05StInd LLN0\$DSet06StSPCSO LLN0\$DSet07StInd LLN0\$DSet08StFitNum
Maximum number of data elements in one Dataset	Depends on available memory
Maximum number of persistent Datasets	15

### Predefined Dataset members

Data Set name	Members
LLN0\$DSet01Mx	MET1/LLN0\$osvMMXU1\$MX\$AvPhV MET1/LLN0\$osvMMXU1\$MX\$AvPPV MET1/LLN0\$osvMMXU1\$MX\$AvA MET1/LLN0\$osvMMXU1\$MX\$TotW MET1/LLN0\$osvMMXU1\$MX\$TotVA MET1/LLN0\$osvMMXU1\$MX\$TotVA MET1/LLN0\$osvMMXU1\$MX\$TotPF MET1/LLN0\$osvMMXU1\$MX\$Hz
LLN0\$DSet02Mx	MET1/LLN0\$osvMMXU1\$MX\$PhV\$phsA MET1/LLN0\$osvMMXU1\$MX\$PhV\$phsB MET1/LLN0\$osvMMXU1\$MX\$PhV\$phsC MET1/LLN0\$osvMMXU1\$MX\$PPV\$phsAB MET1/LLN0\$osvMMXU1\$MX\$PPV\$phsBC MET1/LLN0\$osvMMXU1\$MX\$PPV\$phsCA MET1/LLN0\$osvMMXU1\$MX\$A\$phsA MET1/LLN0\$osvMMXU1\$MX\$A\$phsB MET1/LLN0\$osvMMXU1\$MX\$A\$phsC MET1/LLN0\$osvMMXU1\$MX\$A\$neut MET1/LLN0\$osvMMXU1\$MX\$AuxA
LLN0\$DSet03Mx	MET1/LLN0\$osvMMXU1\$MX\$W\$phsA MET1/LLN0\$osvMMXU1\$MX\$W\$phsB MET1/LLN0\$osvMMXU1\$MX\$W\$phsC MET1/LLN0\$osvMMXU1\$MX\$VAr\$phsA MET1/LLN0\$osvMMXU1\$MX\$VAr\$phsB MET1/LLN0\$osvMMXU1\$MX\$VAr\$phsC MET1/LLN0\$osvMMXU1\$MX\$VA\$phsA MET1/LLN0\$osvMMXU1\$MX\$VA\$phsB MET1/LLN0\$osvMMXU1\$MX\$VA\$phsC MET1/LLN0\$osvMMXU1\$MX\$PF\$phsA MET1/LLN0\$osvMMXU1\$MX\$PF\$phsB MET1/LLN0\$osvMMXU1\$MX\$PF\$phsC
LLN0\$DSet04St	MET1/LLN0\$engMMTR1\$ST\$SupWh MET1/LLN0\$engMMTR1\$ST\$DmdWh MET1/LLN0\$engMMTR1\$ST\$SupVArh MET1/LLN0\$engMMTR1\$ST\$DmdVArh
LLN0\$DSet05StInd	MET1/LLN0\$biGGIO1\$ST\$Ind1 MET1/LLN0\$biGGIO1\$ST\$Ind2 ... MET1/LLN0\$biGGIO1\$ST\$Ind8
LLN0\$DSet06StSPCSO	MET1/LLN0\$boGGIO1\$ST\$SPCSO1 MET1/LLN0\$boGGIO1\$ST\$SPCSO2 MET1/LLN0\$boGGIO1\$ST\$SPCSO2 MET1/LLN0\$boGGIO1\$ST\$SPCSO4
LLN0\$DSet07StInd	MET1/LLN0\$spGGIO1\$ST\$Ind1 MET1/LLN0\$spGGIO1\$ST\$Ind2 ... MET1/LLN0\$spGGIO1\$ST\$Ind16
LLN0\$DSet08StFitNum	MET1/LLN0\$drRDRE1\$ST\$FitNum MET1/LLN0\$drRDRE2\$ST\$FitNum MET1/LLN0\$drRDRE3\$ST\$FitNum

## Reporting model

Item	Value/Comments
Predefined RCBs in the ICD file	3 URCBs: MET/LLN0\$RP\$URep01 MET/LLN0\$RP\$URep02 MET/LLN0\$RP\$URep03 3 BRCBs: MET/LLN0\$BR\$BRep01 MET/LLN0\$BR\$BRep02 MET/LLN0\$BR\$BRep03
Support of trigger conditions	
Integrity	Supported
Data change	Supported
Data update	Can be set, but there is no process data to report for this condition
Quality change	Can be set, but there is no process data to report for this condition
General interrogation	Supported
Support of optional fields	
Sequence number	Supported, default = TRUE
Report time-stamp	Supported, default = TRUE
Reason for inclusion	Supported, default = TRUE
Dataset name	Supported, default = TRUE
Data reference	Supported, default = TRUE
Buffer overflow	Supported, default = FALSE
EntryID	Supported, default = FALSE
Conf-rev	Supported, default = FALSE
Segmentation	Not supported
Sending of segmented reports	Not supported
EntryID	Only the first 4 octets are used. Remaining octets must be 0.
Buffer size	1000 octets for each BRCB

## Report Control Blocks predefined attribute values

RptID	Datset	OptFlds	BufTm	TrgOps
MET1/LLN0\$RP\$URep01	MET1/LLN0\$DSet01Mx	0x7C, 0x00	0	0x60
MET1/LLN0\$RP\$URep02	MET1/LLN0\$DSet02Mx	0x7C, 0x00	0	0x60
MET1/LLN0\$RP\$URep03	MET1/LLN0\$DSet03Mx	0x7C, 0x00	0	0x60
MET1/LLN0\$BR\$BRep01	MET1/LLN0\$DSet07StInd	0x7C, 0x00	0	0x60
MET1/LLN0\$BR\$BRep02	MET1/LLN0\$DSet08StFitNum	0x7C, 0x00	0	0x60
MET1/LLN0\$BR\$BRep03	Not defined	0x7C, 0x00	0	0x60

## Report service information

Any predefined RCB attribute value may be written when RptEna is FALSE. Only existing data sets (see Dataset model table) may be used for DatSet attribute changing. Internal events, caused by data-change and quality-change trigger options only, result in immediate sending of reports or buffering events for transmission (limited by a buffer size of 1000 bytes per report).

## Control model

Item	Value/Comments
Control models supported	
Status only	Supported
Direct with normal security	Supported
Direct with enhanced security	Not supported
SBO with normal security	Supported
SBO with enhanced security	Not supported
Time activated operate (operTm)	Not supported
Test mode	Not supported

Item	Value/Comments
Check conditions	Not supported
Operate many	Not supported
Pulse configuration	Not supported
Service error types: instance-not-available access-violation parameter-value-inappropriate instance-locked-by-another-client failed-due-to-server-constraint generic-error	Not supported Supported Not supported Not supported Not supported Not supported

### Time and time synchronization model

Item	Value/Comments
Time synchronization sources	SNTP, IRIG-B
Time quality bits	
LeapSecondsKnown	Supported
ClockFailure	Supported
ClockNotSynchronized	Supported
Meaning of ClockFailure bit	The bit is set when the device clock is reset as a result of losing backup battery power. The bit is cleared when the device clock is updated from any external time source or via communications.
Meaning of ClockNotSynchronized bit	The bit is set in the event of using unsynchronized internal clock for time stamping in the following cases: a) if none of the external time sources is selected for time synchronization b) if no valid time synchronization message arrives in 10 minutes after the expected time from either a SNTP server, or from the IRIG-B time code input
Number of SNTP servers supported	2
SNTP polling interval	Programmable, 60 to 86400 seconds
Allowable SNTP server response time	10 seconds
Number of SNTP connection retries for each server	Up to 3 retries in 1 minute intervals
Failed SNTP server reconnection time	10 minutes

### File transfer model

Item	Value/Comments
Maximum length of names (incl. path)	64
Separator for file and directories path	'\'
Maximum number of directory entries	10 per recorder (the last 10 events recorded, starting from the newest record)
Structure of directories	COMTRADE\filename
Filename structure	drRDRE<1...3>\$<fault number>\$<trigger event ID>.cfg drRDRE<1...3>\$<fault number>\$<trigger event ID>.dat

## 5.3 Impact of the device settings

### Logical device mode

Logical device mode given by LLNO.Mod is always ON.

### Controls

The Loc attribute (available in every logical node containing controls) must be OFF to enable control execution.

## Measurement units

Measurement type	Units (precision)	
	PT = 1	PT > 1
Current	A (0.01 A)	A (0.01 A)
Voltage AC	V (0.1 V)	V (1 V)
Power	kW, kVA, kvar (0.001 kW/kVA/kvar)	kW, kVA, kvar (1 kW/kVA/kvar)
Energy	0.1 kWh/kVAh/kvarh	0.1 kWh/kVAh/kvarh

## Process Measurement Limits

Measurement type	Measurement limits		
	Condition	min	max
Current		0	Current Scale × CT Ratio <sup>1, 2</sup> (Imax)
Auxiliary current I4		0	Current Scale × I4 CT Ratio <sup>1, 2</sup>
Voltage		0	Voltage Scale × PT Ratio <sup>3</sup> (Vmax)
Power signed (kW, kvar)		-Vmax × Imax × 2/1000	Vmax × Imax × 2/1000 <sup>4</sup>
Power unsigned (kVA, kW import/export, kvar import/export) and power demands		0	Vmax × Imax × 2/1000 <sup>4</sup>
Power factor signed		-1.000	1.000
Power factor unsigned (lag, lead)		0	1.000
Unbalance		0	300.0
THD		0	999.9
TDD		0	999.9
K-Factor		1.0	999.9
Harmonics		0	100.00

### NOTES:

1. CT Ratio = CT primary current/CT secondary current.
2. The default Current Scale is 4 × CT secondary current for devices with a 400% overload (ANSI) or 2 × CT secondary current for devices with a 200% overload (IEC). It can be changed via the Device Options setup in PAS.
3. The default Voltage Scale is 144V. It can be changed via the Device Options setup in PAS.
4. If PT Ratio = 1.0 and Pmax is greater than 9,999 kW, then it is truncated to 9,999 kW.

## Deadbands

The db value represents the percentage of difference between max and min process measurement limits indicated in the table above. The default db (deadband) attribute values in functional constraint CF are defined in the ICD file. They can be changed to provide reasonable conditions for generating reportable events.

## Textual descriptions

The default d (textual description of the data) attribute values in functional constraint DC are defined in the device. They can be changed for descriptions of measured/metered and status data.

## 6 Configuring IEC 61850

You can use the PAS software provided with your meter to configure the default deadbands for measured analog values. See the EM720 Operation Manual for more information on installation and operating PAS on your computer.

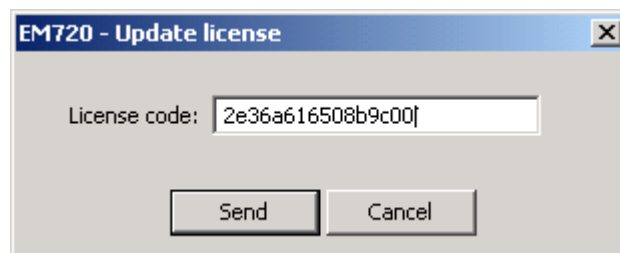
### 6.1 Licensing IEC 61850

A valid license key must be provided in the EM720 for IEC 61850 communications. The device is normally shipped with a temporary license, which is valid for a 30-day operation and then can be extended for an additional month.

A permanent license can be obtained from your local distributor for an additional fee. A device serial number must be provided in the license request. The device may also be shipped with the permanent license in the event of a pre-paid fee.

To program a license key in you device:

1. Select Administration->Update License from the Monitor menu.



2. Type in the license code.
3. Click on Send.

### 6.2 Configuring Report Deadbands

PAS allows you to configure the deadbands used to create reports for all measured analog values at once without the need to setup individual deadbands for every data element listed in the logical nodes. If required, you can then change deadbands for individual variables via your IEC 61850 application.

Downloading the new report deadbands to the device changes deadband values for all analog data in accordance with its engineering type in all logical nodes, so it is recommended to do that before you make your individual adjustments.

#### NOTE

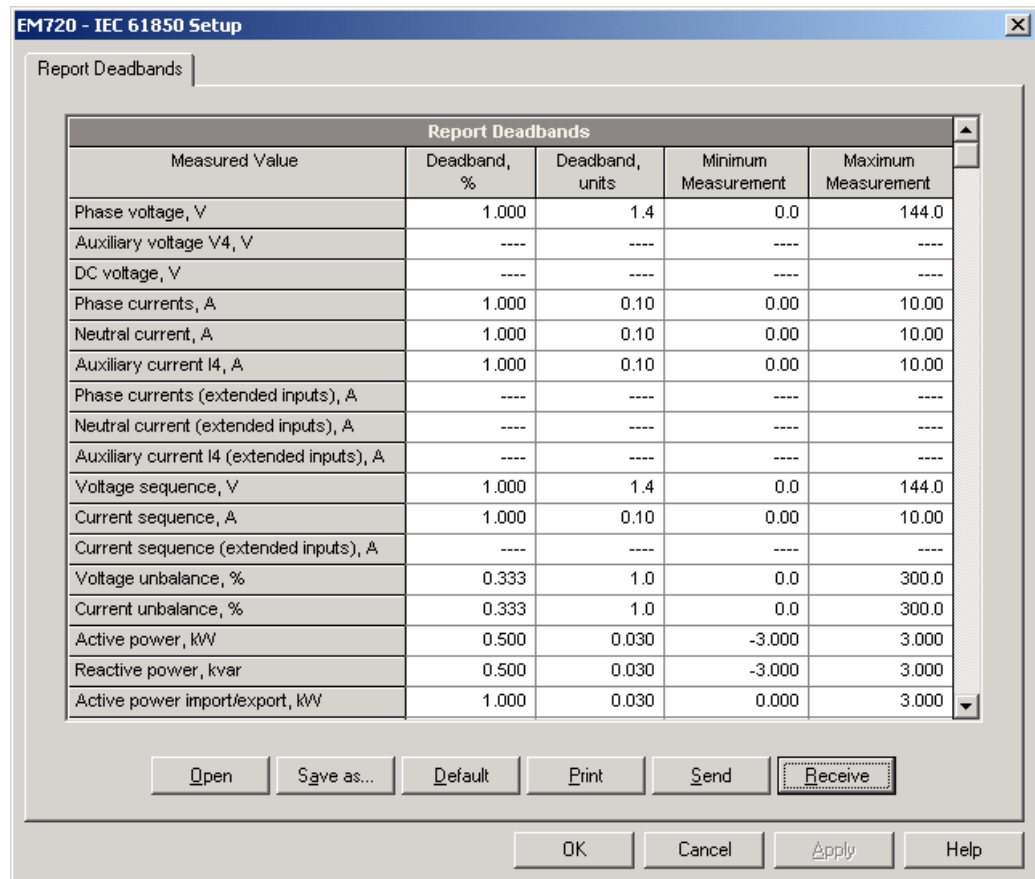
The process measurement scales for most analog values depend on your external PT and CT settings and on the voltage and current scales defined in the meter. Configure them in your meter and save to the device site database before changing report deadbands. See Basic Setup and Device Options Setup in the EM720 Operation Manual on how to configure these parameters in the meter.

To configure the deadbands for measured analog values:

1. Select IEC 61850 Setup from the Meter Setup menu, and then click on the Report Deadbands tab.

For your convenience, PAS shows the deadbands both in percent and in engineering units, and also indicates the minimum and maximum process measurements from which the percent deadband is taken.

2. Adjust the default percent deadbands to the desired values as required for your application. The allowable range is 0.001% to 50.000%. Press Enter or click with the left mouse button elsewhere on the dialog window to update the engineering deadbands.



3. Send your setup to the device.

The following table shows the default factory-set deadbands for all measured analog values.

Measured Value	Default Deadband, %
Phase voltage	1.000
Phase currents	1.000
Neutral current	1.000
Auxiliary current I4	1.000
Voltage sequence	1.000
Current sequence	1.000
Voltage unbalance	0.333
Current unbalance	0.333
Active power	0.500
Reactive power	0.500
Active power import/export	1.000
Reactive power import/export	1.000
Apparent power	1.000
Active power demand	1.000
Reactive power demand	1.000
Apparent power demand	1.000
Power factor	5.000
Power factor lag/lead	10.000
Frequency	0.100
Voltage THD	0.100
Current THD	0.500
Voltage interharmonic THD	0.100
Current interharmonic THD	0.500
Current TDD	1.000
Current K-factor	0.100