



Power Quality and Revenue Meter EM720/EM720T

IEC 61850 Communications Protocol

Reference Guide

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REVISION HISTORY

A1	July 2010	Initial release.
A2	Aug 2012	Added IEC 61850 IED properties setup.
A3	Jan 2013	Added the GOOSE publisher, configurable IED options, configurable datasets and RCBS, generating CID files.
A4	May 2019	Added maxMMXU1 maximum/peak measurements node.

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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
Client-server roles				
B11	Server side (of TWO-PARTY-APPLICATION-ASSOCIATION)		● c1	
B12	Client side of (TWO-PARTY-APPLICATION-ASSOCIATION)			
SCSMs supported				
B21	SCSM: IEC 61850-8-1 used		●	
B22	SCSM: IEC 61850-9-1 used			
B23	SCSM: IEC 61850-9-2 used			
B24	SCSM: other			
Generic substation event model (GSE)				
B31	Publisher side			
B32	Subscriber side			
Transmission of sampled value model (SVC)				
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
If Server side (B1.1) supported				
M1	Logical device		● c2	
M2	Logical node		● c3	
M3	Data		● c4	
M4	Data set		● c5	
M5	Substitution			
M6	Setting group control			
Reporting				
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		●	
If GSE (B31/B32) is supported				
	GOOSE			
M12-1	entryID			
M12-2	DataRefInc			
M13	GSSE			
If SVC (B41/B42) is supported				
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
Server (Clause 6)					
S1	ServerDirectory	TP		●	
Application association (Clause 7)					
S2	Associate			●	
S3	Abort			●	
S4	Release			●	
Logical device (Clause 8)					
S5	LogicalDeviceDirectory	TP		●	
Logical node (Clause 9)					
S6	LogicalNodeDirectory	TP		●	
S7	GetAllDataValues	TP		●	
Data (Clause 10)					
S8	GetDataValues	TP		●	
S9	SetDataValues	TP			
S10	GetDataDirectory	TP		●	
S11	GetDataDefinition	TP		●	
Data set (Clause 11)					
S12	GetDataSetValues	TP		●	
S13	SetDataSetValues	TP		●	
S14	CreateDataSet	TP		●	
S15	DeleteDataSet	TP		●	
S16	GetDataSetDirectory	TP		●	
Substitution (Clause 12)					
S17	SetDataValues	TP			

Services		AA: TP/MC	Client/ Subscriber	Server/ Publisher	Comments
Setting group control (Clause 13)					
S18	SelectActiveSG	TP			
S19	SelectEditSG	TP			
S20	SetSGValues	TP			
S21	ConfirmEditSGValues	TP			
S22	GetSGValues	TP			
S23	GetSGCBValues	TP			
Reporting (Clause 14)					
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		●	
Logging (Clause 14)					
Log control block					
S30	GetLCBValues	TP			
S31	SetLCBValues	TP			
Log					
S32	QueryLogByTime	TP			
S33	QueryLogAfter	TP			
S34	GetLogStatusValues	TP			
Generic substation event model (GSE) (Clause 15)					
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			
Transmission of sampled value model (SVC) (Clause 16)					
Multicast SVC					
S45	SendMSVMessage	MC			
S46	GetMSVCBValues	TP			
S47	SetMSVCBValues	TP			
Unicast SVC					
S48	SendUSVMessage	TP			
S49	GetUSVCBValues	TP			
S50	SetUSVCBValues	TP			
Control (Clause 17)					
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			
File transfer (Clause 20)					
S57	GetFile	TP		●	
S58	SetFile	TP			
S59	DeleteFile	TP			
S60	GetFileAttributeValues	TP		●	
Time (Clause 18)					
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 automatic-station 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
direct-with-enhanced-security	Not supported
sbo-with-enhanced-security	Not supported

SboClasses definition

Attribute Value	Comments
operate-once	
operate-many	Not supported

ClcMth definition

Attribute Name	Attribute Type	Value/Range	M/O/C
ClcMth	ENUMERATED	UNSPECIFIED TRUE_RMS PEAK_FUNDAMENTAL RMS_FUNDAMENTAL MIN MAX AVG SDV PREDICTION RATE	O

ClcMod definition

Attribute Name	Attribute Type	Value/Range	M/O/C
ClcMod	ENUMERATED	TOTAL PERIOD SLIDING	O

ClcIntvTyp definition

Attribute Name	Attribute Type	Value/Range	M/O/C
ClcIntvTyp	ENUMERATED	MS PER_CYCLE CYCLE DAY WEEK MONTH YEAR EXTERNAL	O

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

Enumerated status setting (ENG)

Attribute Name	Attribute Type	FC	M/O/C
setVal	ENUMERATED	SP	O
d	VISIBLE STRING64	DC	O

Integer status setting (ING)

Attribute Name	Attribute Type	FC	M/O/C
setVal	INT32	SP	O
d	VISIBLE STRING64	DC	O

Single point setting (SPG)

Common data class is not supported.

Analog setting (ASG)

Common data class is not supported.

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
ctVal	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.

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	LLN0 only
ldNs	VISIBLE STRING255	DC	C	LLN0 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 domain name of a logical device can incorporate a configurable IED name (see Section 6.2) that will precede a logical device name.

The logical device contains logical nodes LPHD and LLN0 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

Logical node zero (LLN0 class)

Attribute name	Attribute type	Explanation/Value	T	M/O/C/E	Comments
LNName	Object name	LLN0		M	
Common Logical Node Information					
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	
Common Logical Node Information					
Mod	INC	Mode		M	
Beh	INS	Behavior		M	
Health	INS	Health		M	
NamePlt	LPL	Name plate		M	
Status Information					
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

Attribute name	Attribute type	Explanation/Value	T	M/O/C/E	Comments
					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	
Common Logical Node Information					
Mod	INC	Mode		M	
Beh	INS	Behavior		M	
Health	INS	Health		M	
NamePlt	LPL	Name plate		M	
Status Information					
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	
Common Logical Node Information					
Mod	INC	Mode		M	
Beh	INS	Behavior		M	
Health	INS	Health		M	
NamePlt	LPL	Name plate		M	
Loc	SPS	Local operation		O	
Controls					
SPCSO1 to SPCSO4	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	
Common Logical Node Information					
Mod	INC	Mode		M	
Beh	INS	Behavior		M	
Health	INS	Health		M	
NamePlt	LPL	Name plate		M	
Status Information					
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	
Common Logical Node Information					
Mod	INC	Mode		M	
Beh	INS	Behavior		M	
Health	INS	Health		M	
NamePlt	LPL	Name plate		M	
Measured values					
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	
Common Logical Node Information					
Mod	INC	Mode		M	
Beh	INS	Behavior		M	
Health	INS	Health		M	
NamePlt	LPL	Name plate		M	
Measured values					
ThdPhV	WYE	Voltage THD demand for phase to ground		O	In 4LN3, 3LN3 and 3BLN3 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: hrmMHAI1

Attribute name	Attribute type	Explanation/Value	T	M/O/C/E	Comments
LNName	Object name	hrmMHAI1		M	
Common Logical Node Information					
Mod	INC	Mode		M	
Beh	INS	Behavior		M	
Health	INS	Health		M	
NamePlt	LPL	Name plate		M	
Measured values					
HA	HWYE	Sequence of harmonics current		O	

Attribute name	Attribute type	Explanation/Value	T	M/O/C/E	Comments
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: ocvMHAI1

Attribute name	Attribute type	Explanation/Value	T	M/O/C/E	Comments
LNName	Object name	ocvMHAI1		M	
Common Logical Node Information					
Mod	INC	Mode		M	
Beh	INS	Behavior		M	
Health	INS	Health		M	
NamePlt	LPL	Name plate		M	
Measured values					
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: osvMHAI1

Attribute name	Attribute type	Explanation/Value	T	M/O/C/E	Comments
LNName	Object name	osvMHAI1		M	
Common Logical Node Information					
Mod	INC	Mode		M	
Beh	INS	Behavior		M	
Health	INS	Health		M	
NamePlt	LPL	Name plate		M	
Measured values					
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
LNName	Object name	demMMXU1		M	
Common Logical Node Information					
Mod	INC	Mode		M	
Beh	INS	Behavior		M	
Health	INS	Health		M	
NamePlt	LPL	Name plate		M	
Measured values					
PhV	WYE	Phase to ground voltage demands		O	In 4LN3, 3LN3 and 3BLN3

					wiring modes
PPV	DEL	Phase to phase voltage demands		O	In all 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	MV	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	
Common Logical Node Information					
Mod	INC	Mode		M	
Beh	INS	Behavior		M	
Health	INS	Health		M	
NamePlt	LPL	Name plate		M	
Measured values					
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 window demand		O	

Accumulated power demands: demMMXU3

Attribute name	Attribute type	Explanation/Value	T	M/O/C/E	Comments
LNNName	Object name	demMMXU3		M	
Common Logical Node Information					
Mod	INC	Mode		M	
Beh	INS	Behavior		M	
Health	INS	Health		M	
NamePlt	LPL	Name plate		M	
Measured values					
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	
Common Logical Node Information					
Mod	INC	Mode		M	
Beh	INS	Behavior		M	
Health	INS	Health		M	
NamePlt	LPL	Name plate		M	
Measured values					
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	
Common Logical Node Information					
Mod	INC	Mode		M	
Beh	INS	Behavior		M	
Health	INS	Health		M	
NamePlt	LPL	Name plate		M	
Measured values					
PhV	WYE	Phase to ground voltages		O	
PPV	DEL	Phase to phase voltages		O	
A	WYE	Phase and neutral currents		O	(*) See WYE
AuxA	MV	Auxiliary current I4		E	

One-second measurements: osvMMXU1

Attribute name	Attribute type	Explanation/Value	T	M/O/C/E	Comments
LNName	Object name	osvMMXU1		M	
Common Logical Node Information					
Mod	INC	Mode		M	
Beh	INS	Behavior		M	
Health	INS	Health		M	
NamePlt	LPL	Name plate		M	
Measured values					
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	

Attribute name	Attribute type	Explanation/Value	T	M/O/C/E	Comments
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	MV	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
LNNName	Object name	phsrMMXU1		M	
Common Logical Node Information					
Mod	INC	Mode		M	
Beh	INS	Behavior		M	
Health	INS	Health		M	
NamePlt	LPL	Name plate		M	
Measured values					
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	

Maximum/peak measurements: maxMMXU1

Attribute name	Attribute type	Explanation/Value	T	M/O/C/E	Comments
LNNName	Object name	maxMMXU1		M	
Common Logical Node Information					
Mod	INC	Mode		M	
Beh	INS	Behavior		M	
Health	INS	Health		M	
NamePlt	LPL	Name plate		M	
Measured values					
PhV	WYE	Max. phase to ground voltages		O	
PPV	DEL	Max. phase to phase voltages		O	
A	WYE	Max. phase and neutral currents		O	(*) See WYE
TotWImp	MV	Max. total active power imported		E	
TotWExp	MV	Max. total active power exported		E	
TotVArImp	MV	Max. total reactive power imported		E	
TotVArExp	MV	Max. total reactive power exported		E	
TotVA	MV	Max. total apparent power		O	
TotPF	MV	Max. total power factor		O	Absolute value
TotPF Lag	MV	Max. total power factor lag		E	
TotPFLead	MV	Max. total power factor lead		E	
SeqV0	MV	Max. zero sequence voltage		E	
SeqI0	MV	Max. zero sequence current		E	

Attribute name	Attribute type	Explanation/Value	T	M/O/C/E	Comments
Settings					
ClcMth	ENG	Calculation method		O	MAX
ClcMod	ENG	Calculation mode		O	TOTAL – recorded since the last external min/max reset PERIOD – updated periodically
ClcIntvTyp	ENG	Calculation interval type		O	MS = defined by the ClcIntvPer in ms. EXTERNAL = continuous recording since the last external min/max reset
ClcIntvPer	ING	Calculation interval duration		O	Configurable by the Min/Max Log Period setting in the Basic Setup. 0 for EXTERNAL interval type

Sequence and imbalance (MSQI class)

Sequence components: seqMSQI1

Attribute name	Attribute type	Explanation/Value	T	M/O/C/E	Comments
LNName	Object name	seqMSQI1		M	
Common Logical Node Information					
Mod	INC	Mode		M	
Beh	INS	Behavior		M	
Health	INS	Health		M	
NamePlt	LPL	Name plate		M	
Measured values					
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
LNName	Object name	ocvMSTA1 (one-cycle values), osvMSTA1 (one-second values)		M	
Common Logical Node Information					
Mod	INC	Mode		M	
Beh	INS	Behavior		M	
Health	INS	Health		M	
NamePlt	LPL	Name plate		M	
Measured values					
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	

Attribute name	Attribute type	Explanation/Value	T	M/O/C/E	Comments
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 ground		E	
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		Yes	
A2	GOOSE/GSE Management		Yes	SendGOOSEMessage only
A3	GSSE			
A4	Time sync	Yes		SNTP (RFC 2030, RFC 4330)

T-Profile support

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

4.2 MMS conformance

MMS service supported CBB (server)	M/O/C/I	Supported
status	M	Yes
getNameList	C	Yes
identify	M	Yes
rename	O	
read	C	Yes
write	C	Yes
getVariableAccessAttributes	C	Yes
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	Yes
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	Yes
fileRead	C	Yes
fileClose	C	Yes
fileRename	I	
fileDelete	C	
fileDirectory	C	Yes
unsolicitedStatus	I	
informationReport	C	Yes
eventNotification	I	
attachToEventCondition	I	
attachToSemaphore	I	
conclude	M	Yes
cancel	M	Yes
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		Yes	
GetGoReference			
GetGOOSEElementNumber			
GetGoCBValues		Yes	
SetGoCBValues		Yes	GoEna, DstAddress.addr, DstAddress.APPID
GSENotSupported			
GOOSE Control Block (GoCB)		Yes	

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: MET1/LLN0\$DSet01Mx

Item	Value/Comments
	MET1/LLN0\$DSet02Mx MET1/LLN0\$DSet03Mx MET1/LLN0\$DSet04St Status data: MET1/LLN0\$DSet05StInd MET1/LLN0\$DSet06StSPCSO MET1/LLN0\$DSet07StInd MET1/LLN0\$DSet08StFltNum GOOSE publisher data set: MET1/LLN0\$DSetGOOSE1
Maximum number of data elements in one Dataset	64
Maximum number of persistent Datasets	9 predefined + 16 deletable

Predefined Dataset members

Data Set name	Members
MET1/LLN0\$DSet01Mx	MET1/osvMMXU1\$MX\$AvPhV MET1/osvMMXU1\$MX\$AvPPV MET1/osvMMXU1\$MX\$AvA MET1/osvMMXU1\$MX\$TotW MET1/osvMMXU1\$MX\$TotVAr MET1/osvMMXU1\$MX\$TotVA MET1/osvMMXU1\$MX\$TotPF MET1/osvMMXU1\$MX\$Hz
MET1/LLN0\$DSet02Mx	MET1/osvMMXU1\$MX\$PhV\$phsA MET1/osvMMXU1\$MX\$PhV\$phsB MET1/osvMMXU1\$MX\$PhV\$phsC MET1/osvMMXU1\$MX\$PPV\$phsAB MET1/osvMMXU1\$MX\$PPV\$phsBC MET1/osvMMXU1\$MX\$PPV\$phsCA MET1/osvMMXU1\$MX\$A\$phsA MET1/osvMMXU1\$MX\$A\$phsB MET1/osvMMXU1\$MX\$A\$phsC MET1/osvMMXU1\$MX\$A\$neut MET1/osvMMXU1\$MX\$AuxA
MET1/LLN0\$DSet03Mx	MET1/osvMMXU1\$MX\$W\$phsA MET1/osvMMXU1\$MX\$W\$phsB MET1/osvMMXU1\$MX\$W\$phsC MET1/osvMMXU1\$MX\$VAr\$phsA MET1/osvMMXU1\$MX\$VAr\$phsB MET1/osvMMXU1\$MX\$VAr\$phsC MET1/osvMMXU1\$MX\$VA\$phsA MET1/osvMMXU1\$MX\$VA\$phsB MET1/osvMMXU1\$MX\$VA\$phsC MET1/osvMMXU1\$MX\$PF\$phsA MET1/osvMMXU1\$MX\$PF\$phsB MET1/osvMMXU1\$MX\$PF\$phsC
MET1/LLN0\$DSet04St	MET1/engMMTR1\$ST\$SupWh MET1/engMMTR1\$ST\$DmdWh MET1/engMMTR1\$ST\$SupVArh MET1/engMMTR1\$ST\$DmdVArh
MET1/LLN0\$DSet05StInd	MET1/biGGIO1\$ST\$Ind1 MET1/biGGIO1\$ST\$Ind2 ... MET1/biGGIO1\$ST\$Ind8
MET1/LLN0\$DSet06StSPCSO	MET1/boGGIO1\$ST\$SPCSO1 MET1/boGGIO1\$ST\$SPCSO2 MET1/boGGIO1\$ST\$SPCSO2 MET1/boGGIO1\$ST\$SPCSO4
MET1/LLN0\$DSet07StInd	MET1/spGGIO1\$ST\$Ind1 MET1/spGGIO1\$ST\$Ind2 ... MET1/spGGIO1\$ST\$Ind16
MET1/LLN0\$DSet08StFltNum	MET1/drRDRE1\$ST\$FltNum MET1/drRDRE2\$ST\$FltNum

Data Set name	Members
	MET1/drRDRE3\$ST\$FitNum
MET1/LLN0\$DSetGOOSE1	MET1/osvMMXU1\$MX\$PhV\$phsA\$cVal MET1/osvMMXU1\$MX\$PhV\$phsA\$q MET1/osvMMXU1\$MX\$PhV\$phsB\$cVal MET1/osvMMXU1\$MX\$PhV\$phsB\$q MET1/osvMMXU1\$MX\$PhV\$phsC\$cVal MET1/osvMMXU1\$MX\$PhV\$phsC\$q MET1/osvMMXU1\$MX\$PPV\$phsAB\$cVal MET1/osvMMXU1\$MX\$PPV\$phsAB\$q MET1/osvMMXU1\$MX\$PPV\$phsBC\$cVal MET1/osvMMXU1\$MX\$PPV\$phsBC\$q MET1/osvMMXU1\$MX\$PPV\$phsCA\$cVal MET1/osvMMXU1\$MX\$PPV\$phsCA\$q

Reporting model

Item	Value/Comments
Predefined RCBs in the ICD file (See Section 6.2 on configuring the number of RCB instances)	Number of RCB instances = 1 (non-indexed RCBs) 8 URCBs: MET1/LLN0\$RP\$URep01 MET1/LLN0\$RP\$URep02 MET1/LLN0\$RP\$URep03 MET1/LLN0\$RP\$URep04 MET1/LLN0\$RP\$URep05 MET1/LLN0\$RP\$URep06 MET1/LLN0\$RP\$URep07 MET1/LLN0\$RP\$URep08 8 BRCBs: MET1/LLN0\$BR\$BRep01 MET1/LLN0\$BR\$BRep02 MET1/LLN0\$BR\$BRep03 MET1/LLN0\$BR\$BRep04 MET1/LLN0\$BR\$BRep05 MET1/LLN0\$BR\$BRep06 MET1/LLN0\$BR\$BRep07 MET1/LLN0\$BR\$BRep08 Number of RCB instances = 1 (indexed RCBs, RptEnabled max=1) 8 URCBs: MET1/LLN0\$RP\$URepA01 MET1/LLN0\$RP\$URepB01 MET1/LLN0\$RP\$URepC01 MET1/LLN0\$RP\$URepD01 MET1/LLN0\$RP\$URepE01 MET1/LLN0\$RP\$URepF01 MET1/LLN0\$RP\$URepG01 MET1/LLN0\$RP\$URepH01 8 BRCBs: MET1/LLN0\$BR\$BRepA01 MET1/LLN0\$BR\$BRepB01 MET1/LLN0\$BR\$BRepC01 MET1/LLN0\$BR\$BRepD01 MET1/LLN0\$BR\$BRepE01 MET1/LLN0\$BR\$BRepF01 MET1/LLN0\$BR\$BRepG01 MET1/LLN0\$BR\$BRepH01 Number of RCB instances = 2 (indexed RCBs, RptEnabled max=2) 4 URCBs x 2 clients: MET1/LLN0\$RP\$URepA01 MET1/LLN0\$RP\$URepA02 MET1/LLN0\$RP\$URepB01 MET1/LLN0\$RP\$URepB02 MET1/LLN0\$RP\$URepC01 MET1/LLN0\$RP\$URepC02 MET1/LLN0\$RP\$URepD01 MET1/LLN0\$RP\$URepD02 4 BRCBs x 2 clients:

Item	Value/Comments
	MET1/LLN0\$BR\$BRepA01 MET1/LLN0\$BR\$BRepA02 MET1/LLN0\$BR\$BRepB01 MET1/LLN0\$BR\$BRepB02 MET1/LLN0\$BR\$BRepC01 MET1/LLN0\$BR\$BRepC02 MET1/LLN0\$BR\$BRepD01 MET1/LLN0\$BR\$BRepD02 Number of RCB instances = 4 (indexed RCBs, RptEnabled max=4) 2 URCBs x 4 clients: MET1/LLN0\$RP\$URRepA01 MET1/LLN0\$RP\$URRepA02 MET1/LLN0\$RP\$URRepA03 MET1/LLN0\$RP\$URRepA04 MET1/LLN0\$RP\$URRepB01 MET1/LLN0\$RP\$URRepB02 MET1/LLN0\$RP\$URRepB03 MET1/LLN0\$RP\$URRepB04 2 BRCBs x 4 clients: MET1/LLN0\$BR\$BRepA01 MET1/LLN0\$BR\$BRepA02 MET1/LLN0\$BR\$BRepA03 MET1/LLN0\$BR\$BRepA04 MET1/LLN0\$BR\$BRepB01 MET1/LLN0\$BR\$BRepB02 MET1/LLN0\$BR\$BRepB03 MET1/LLN0\$BR\$BRepB04
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-revision	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 BRBC

Report Control Blocks predefined attribute values

RptID	Datset	OptFlds	BufTm	TrgOps
MET1/LLN0\$RP\$URRep01	MET1/LLN0\$DSet01Mx	0x7C, 0x00	0	0x60
MET1/LLN0\$RP\$URRep02	MET1/LLN0\$DSet02Mx	0x7C, 0x00	0	0x60
MET1/LLN0\$RP\$URRep03	MET1/LLN0\$DSet03Mx	0x7C, 0x00	0	0x60
MET1/LLN0\$RP\$URRep04	Not defined	0x7C, 0x00	0	0x60
MET1/LLN0\$RP\$URRep05	Not defined	0x7C, 0x00	0	0x60
MET1/LLN0\$RP\$URRep06	Not defined	0x7C, 0x00	0	0x60
MET1/LLN0\$RP\$URRep07	Not defined	0x7C, 0x00	0	0x60
MET1/LLN0\$RP\$URRep08	Not defined	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

RptID	Datset	OptFlds	BufTm	TrgOps
MET1/LLN0\$BR\$BRep04	Not defined	0x7C, 0x00	0	0x60
MET1/LLN0\$BR\$BRep05	Not defined	0x7C, 0x00	0	0x60
MET1/LLN0\$BR\$BRep06	Not defined	0x7C, 0x00	0	0x60
MET1/LLN0\$BR\$BRep07	Not defined	0x7C, 0x00	0	0x60
MET1/LLN0\$BR\$BRep08	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
Check conditions	Not supported
Operate many	Not supported
Pulse configuration	Not supported
Service error types:	
instance-not-available	Not supported
access-violation	Supported
parameter-value-inappropriate	Not supported
instance-locked-by-another-client	Not supported
failed-due-to-server-constraint	Not supported
generic-error	Not supported

GOOSE Publisher model

Item	Value/Comments
Maximum number of supported GOOSE data sets	1 (fixed)
Maximum data change detection delay	8 ms @ 60Hz/10 ms @ 50Hz
Initial retransmission interval	8 ms @ 60Hz/10 ms @ 50Hz for the first 5 messages
Maximum retransmission interval	Configurable from 0.5 s to 60 s
Publisher retransmission strategy	Geometric with a time multiplier of 2 after the 5th message
Declared message timeAllowedToLive time	Twice the message retransmission interval + 10 ms

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

Item	Value/Comments
	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 LLN0.Mod is always ON.

Controls

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

Measurement units

Voltage, current and power units are selectable (see Section 6.2 for details).

Measurement type	Units (precision)	
	PT = 1	PT > 1
Current	A/kA (0.01 A)	A/kA (0.01 A)
Voltage AC	V/kV (0.1 V)	V/kV (1 V)
Power	kW, kVA, kvar or MW, Mvar, MVA (0.001 kW/kVA/kvar)	kW, kVA, kvar or MW, Mvar, MVA (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 ^{1, 2} (Imax)
Auxiliary current I4		0	Current Scale × I4 CT Ratio ^{1, 2}
Voltage		0	Voltage Scale × PT Ratio ³ (Vmax)
Power signed (kW, kvar)		-Vmax × Imax × 2/1000	Vmax × Imax × 2/1000 ⁴
Power unsigned (kVA, kW import/export, kvar import/export) and power demands		0	Vmax × Imax × 2/1000 ⁴
Power factor signed		-1.000	1.000
Power factor unsigned (lag, lead)		0	1.000
Unbalance		0	300.0
THD		0	999.9

Measurement type	Measurement limits		
	Condition	min	max
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 $4 \times$ CT secondary current for devices with a 400% overload (ANSI) or $2 \times$ 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

The PAS software supplied with the EM720 provides a configuration tool for customizing your meter and generating a configured IED description (CID) file for use with IEC 61850 client applications. See the EM720 Operation Manual for more information on installation and operating PAS on your computer.

To reset the IEC 61850 settings to the factory defaults:

1. Select Administration->Master Reset from the Monitor menu.
2. Click the "Reset IEC 61850 Configuration" button, and then confirm the command.

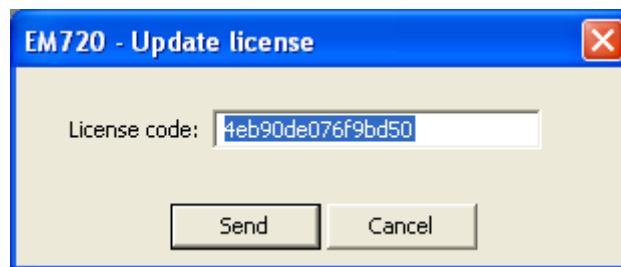
6.1 Licensing IEC 61850

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 and click Send.

6.2 Configuring IED Properties

The IEC 61850 configurator allows you to configure the IED name, device location, measurement units and communication options, and arrange a set of report control blocks for multi-client installations

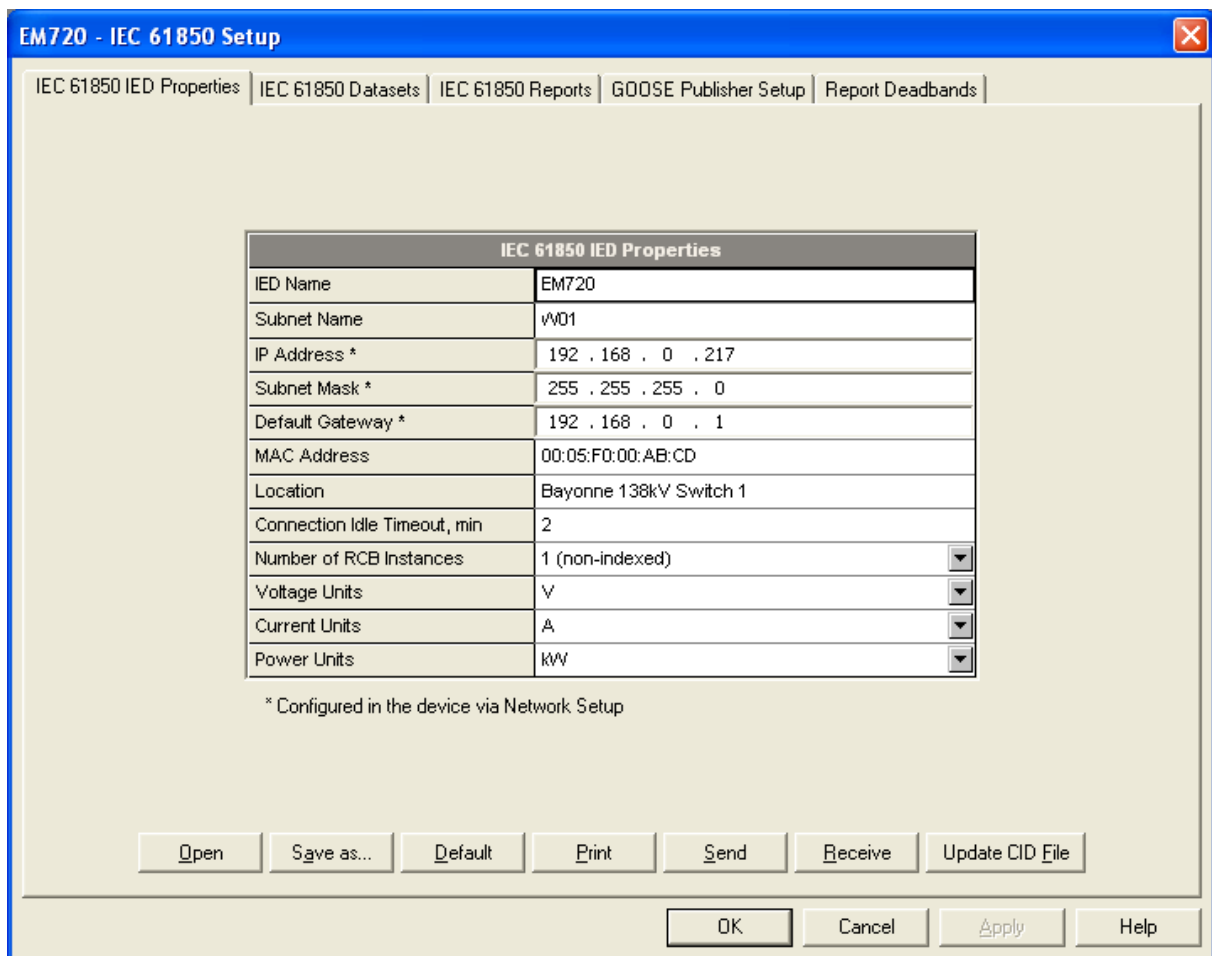
To configure the IED properties in your meter:

1. Select IEC 61850 Setup from the Meter Setup menu, and then click on the IEC 61850 IED Properties tab.
2. Configure IED options for your application as required.

NOTES

- The configured IED name accompanies logical device names in object references.
- The device location also identifies the substation location in COMTRADE configuration files as the station_name attribute.
- Attributes marked with the asterisk cannot be changed in the device via this setup but you can define and store them to the device database when working offline to use for updating a device CID file.
- The number of RCB instances defines how pre-defined RCBs are arranged in the meter for use in multi-client applications. The RCBs are automatically pre-configured in the meter in the way indicated in Section "Reporting model". The RCB names and report IDs are set to defaults as the number of RCB instances changes. If you intend to change the default setting, set it first before configuring report control blocks.

3. Send your setup to the device and save it to the device database.



6.3 Configuring Datasets

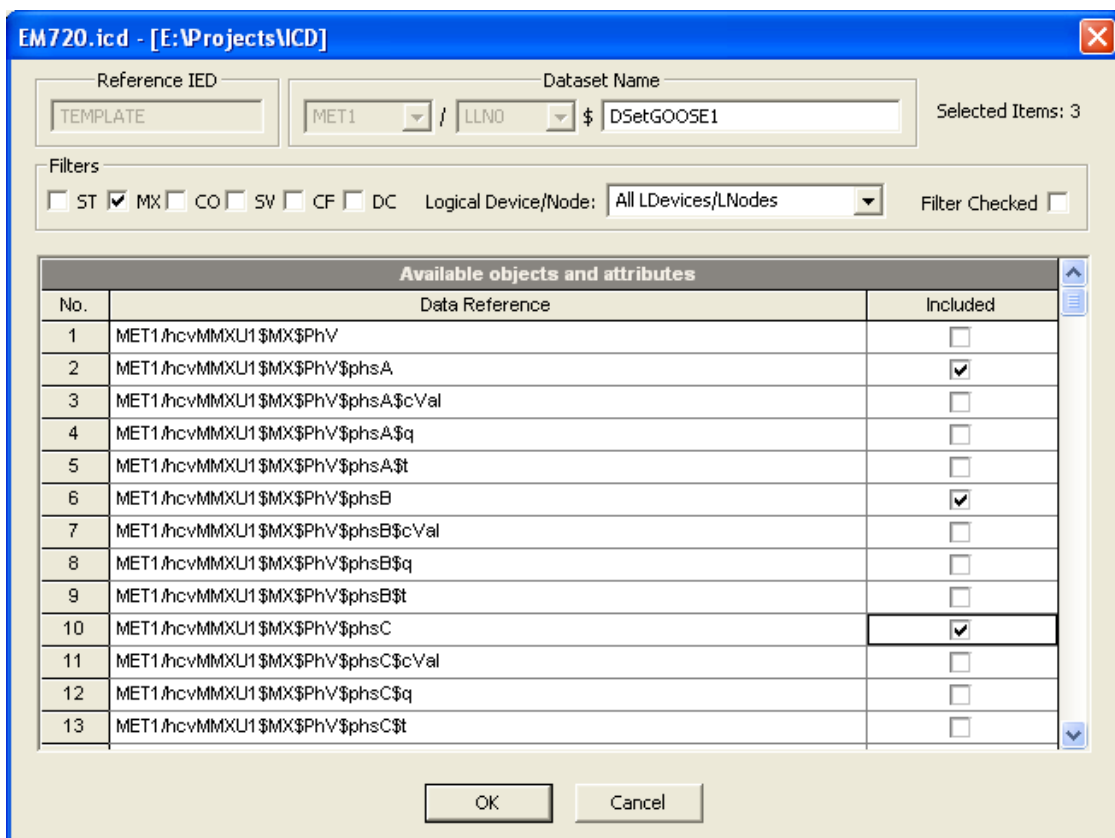
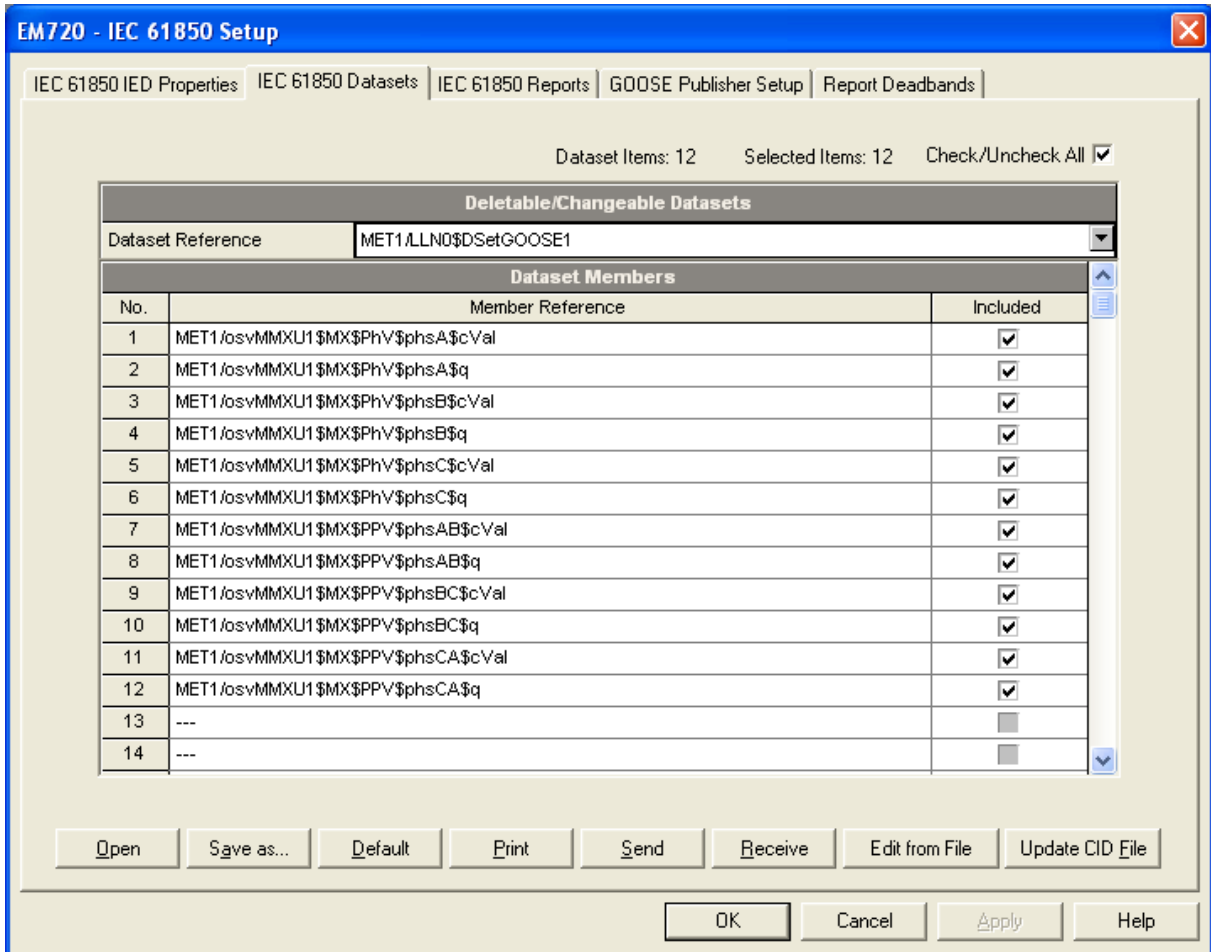
To review or configure the IEC 61850 datasets:

1. Select IEC 61850 Setup from the Meter Setup menu, and then click on the IEC 61850 Datasets tab.
2. Select a dataset you wish to view or configure in the "Dataset Reference" box. Select "New Dataset" to create a new dataset.
3. To delete dataset members, uncheck the appropriate "Included" boxes. Uncheck all dataset members to delete the entire dataset.
4. To add or change dataset members, click "Edit from file", locate the EM720.icd template file or a CID file you generated for your meter, and click Open.

A full list of the available data objects and data attributed is displayed, where included dataset members are checked. Check the "Included" boxes for items you wish to be members of the dataset and click OK.

To make easy selection of items across the list, use filters - functional constraints or/and selected logical nodes. Click "Filter checked" to see and revise a list of the selected items.

5. Send your new setup to the device and save it to the device database.



6.4 Configuring Report Control Blocks

To configure Report Control Blocks in your meter:

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

EM720 - IEC 61850 Setup

IEC 61850 IED Properties | IEC 61850 Datasets | IEC 61850 Reports | GOOSE Publisher Setup | Report Deadbands

RCB #1 - Unbuffered Report Control Block	
RCB Reference	MET1.ALLNO\$RP\$UR01
Report ID	MET1.ALLNO\$RP\$UR01
Enabled	----
Reserved	----
Dataset Reference	MET1.ALLNO\$DSet01Mx
Configuration Revision	1
Optional Fields	0111110000
Buffer Time	----
Sequence Number	----
Trigger Options	011000
Integrity Period, ms	0

Buttons: Open, Save as..., Default, Print, Send, Receive, Update CID File, OK, Cancel, Apply, Help

2. Select an RCB you wish to view or configure in the "RCB Reference" box.
3. Configure the RCB attributes as required for your application. The following items can be configured:
 - Report ID
 - Dataset reference (can be selected from the available datasets list)
 - Optional fields
 - Trigger options
 - Integrity period for periodic reports with the integrity trigger option selected

To change the Optional fields or Trigger options, click the arrow button at the right to the item, check the appropriate options and click OK.

NOTE

Configure your new and customized datasets and update them in the meter, or save to the device database if you work offline, before configuring reports; otherwise you may get an incomplete dataset list.

4. Send your new setup to the device and save it to the device database.

6.5 Configuring the GOOSE Publisher

The EM720 GOOSE publisher uses the dedicated dataset MET1/LLN0\$DSetGOOSE1 for GOOSE communications. The default dataset variables list can be modified via the IEC 61850 Datasets setup (see Section 6.3).

To configure the GOOSE publisher:

1. Select IEC 61850 Setup from the Meter Setup menu, and then click on the GOOSE Publisher Setup tab.
2. Configure the destination MAC address, application ID and the maximum message retransmission interval as required for your application. Other setup attributes are not changeable and are indicated for information only.
3. Select Yes in the Publisher Enabled box to enable publisher operation.
4. Send your setup to the device.

The screenshot shows the 'EM720 - IEC 61850 Setup' dialog box with the 'GOOSE Publisher Setup' tab selected. The dialog contains a table with the following data:

GOOSE Publisher	
GOOSE CB Reference	MET1/LLN0\$GO\$GoCBPub1
Publisher Enabled	NO
GOOSE ID	Pub1
Dataset Reference	MET1/LLN0\$DSetGOOSE1
Configuration Revision	1
Needs Commissioning	NO
Destination MAC Address	01:0C:CD:01:01:FF
Priority	4
VLAN ID	0
Applicaton ID	3001
Max. Retransmission Interval, ms	5000

At the bottom of the dialog, there are buttons for 'Open', 'Save as...', 'Default', 'Print', 'Send', 'Receive', 'Update CID File', 'OK', 'Cancel', 'Apply', and 'Help'.

6.6 Configuring Report Deadbands

Deadbands for reporting measured analog values can be configured at once via PAS without the need to setup individual deadbands for every data element. If required, you can then change deadbands for individual variables via your IEC 61850 application.

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

NOTE

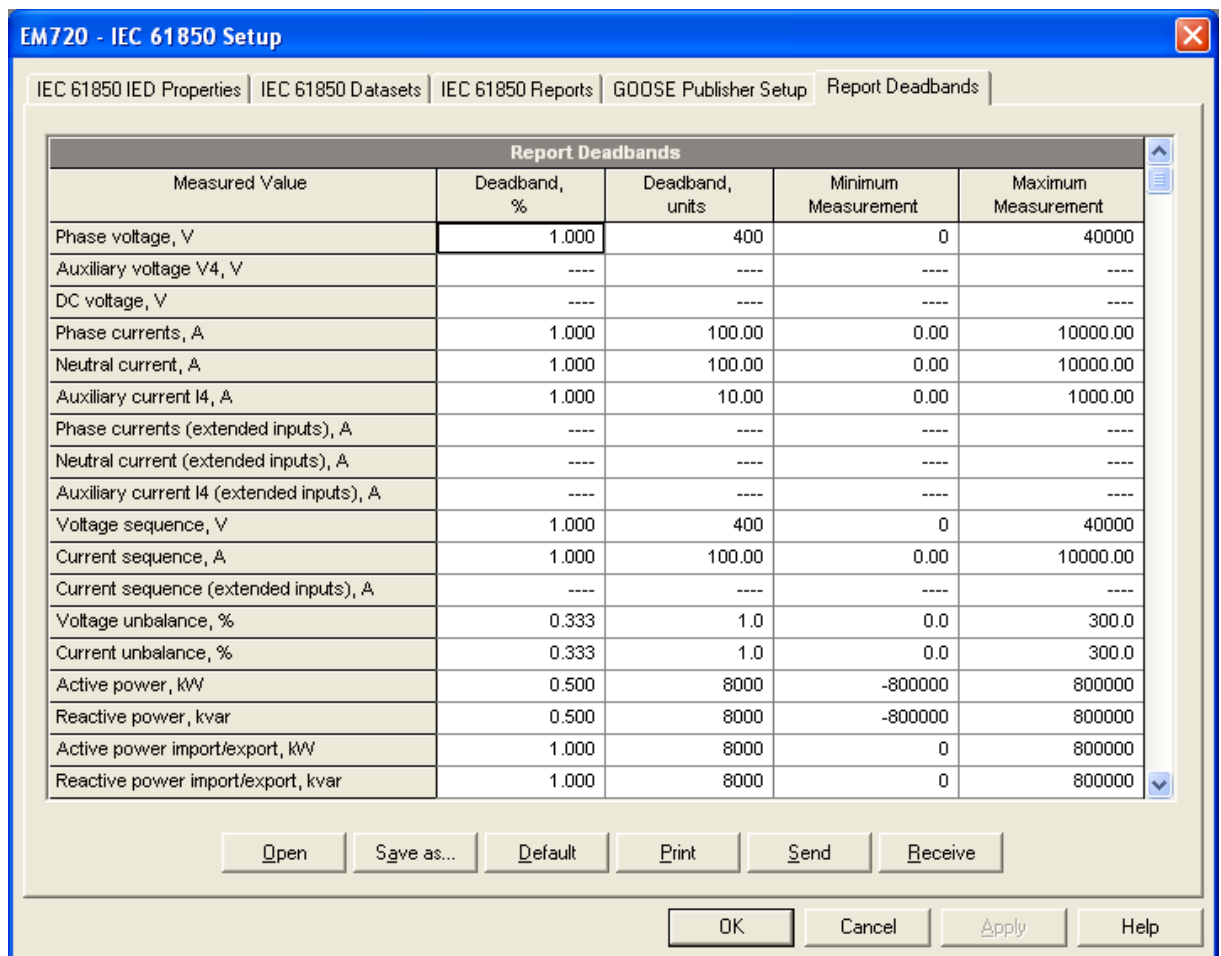
The process measurement scales for most analog values depend on your external PT and CT settings and on the voltage and current scales defined in the meter. Configure them in your meter and save to the device site database before changing report deadbands. See Basic Setup and Device Options Setup in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

Measured Value	Default Deadband, %
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

6.7 Generating a CID File

Generating a new or updating a preconfigured CID file for your meter is done separately for each configuration setup. The following order is recommended but not mandatory:

- IED properties
- Datasets
- Report control blocks
- GOOSE publisher setup

To create or update a device CID file:

1. Click the "Update CID file" button on the setup tab.
2. Locate a source ICD or CID file for your meter you wish to update and click Open. Use the EM720.icd file provided with your meter as a primary template file to create a new CID file, and then use the new file as a source to update remaining settings.
3. Select the folder and the name of the target CID file where to store your new configuration description and click Open. It may be the same CID file you used as the source.
4. Repeat this procedure for other configuration setups you wish to update.

NOTE

In the event an RCB reference is used as the Report ID (the default setting for non-indexed RCBs), you should update the RCBs in the CID file after changing the IED name even if no changes to RCBs have been made to keep consistency with your device.