Protocol Implementation eXtra Information for Testing (PIXIT)
for the IEC 61850 Edition 2 server interface in SEL-451-6, SEL-487B-2,
SEL-487E-5, SEL-421-7S, SEL-421-7P, SEL-401, SEL-411L-0, SEL-
411L-1, SEL-411L-A, SEL-411L-2, SEL-400G-0, SEL-400G-1

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Based Upon UCAIug Server PIXIT Template version 20

PIXIT for Server

Introduction

This document specifies the protocol implementation extra information for testing (PIXIT) of the IEC 61850 interface in
SEL-451-6 with firmware version R405,
SEL-487B-2 with firmware version R404,
SEL-487E-5 with firmware version R405,
SEL-421-7S with firmware version R410,
SEL-421-7P with firmware version R410,
SEL-401 with firmware version R410,
SEL-411L-0 with firmware version R130,
SEL-411L-1 with firmware version R130,
SEL-411L-A with firmware version R130,
SEL-411L-2 with firmware version R203,
SEL-400G-0 with firmware version R104 and
SEL-400G-1 with firmware version R104.
All variants have the same IEC 61850 library LIB61850ID=49DD6E42 and use the same hardware SEL-4XX MB6E.

Together with the PICS and the MICS the PIXIT forms the basis for a conformance test according to IEC 61850-10. The PIXIT entries contain information which is not available in the PICS, MICS, TICS documents or SCL file.

Each table specifies the PIXIT for applicable ACSI service model as structured in IEC 61850-10. The "Ed" column indicates if the entry is applicable for IEC 61850 Edition 1 and/or Edition 2. A hyphen ("-") in the Ed column indicates the PIXIT entry is not applicable fro any version.

PIXIT for Documentation

ID	Ed	Description	Value / Clarification
Do1	2	How to expose required firmware versions not present in the datamodel	Perform the following to display firmware version from the front panel: • From the initial screen press ENTER. • Repeatedly press the down arrow button until RELAY STATUS is selected then press ENTER.

ID	Ed	Description	Value / Clarification
			From a terminal session, issue the ID command. FID is listed as the first entry in the response. Note: These are aditional ways to expose firmware version. Firmware version is exposed in the LLN0.DC.NamPlt.swRev

PIXIT for Association model

ID	Ed	Description	Value / Clarification
As1	1	Maximum number of clients that can set-up an association simultaneously	7
As2	1,2	TCP_KEEPALIVE value. The recommended range is 1..20s	1-20 seconds Note: This time is settable through the ETCPKA and KAIDLE settings in the SET P 5 settings.
As3	1,2	Lost connection detection time	1-20 seconds
As4	-	Authentication is not supported yet	
As5	1,2	What association parameters are necessary for successful association: Called values: Calling values:	Transport selector Y Session selector Y Presentation selector Y AP Title N AE Qualifier N other Transport selector N Session selector N Presentation selector N AP Title N AE Qualifier N other
As6	1,2	If association parameters are necessary for association, describe the correct Called values: e.g.	Transport selector NA Session selector NA Presentation selector NA AP Title NA AE Qualifier NA other

ID	Ed	Description	Value / Clarification
		Calling parameters: e.g.	Transport selector 0001 Session selector 0001 Presentation selector 00000001 AP Title NA AE Qualifier NA other
As7	1,2	What is the maximum and minimum MMS PDU size	Max MMS PDU size 12000 Min MMS PDU size 512
As8	1,2	What is the maximum start up time after a power supply interrupt	~15 seconds
As9	1,2	Does this device function only as test equipment? (test equipment need not have a non-volatile configuration; but it cannot be part of the substation automation system)	N

PIXIT for Server model

ID	Ed	Description	Value / Clarification
Sr1	1,2	Which analogue value (MX) quality bits are supported (can be set by server)	Validity: Y Good, Y Invalid, N Reserved, N Questionable Detail Quality N Overflow N OutofRange N BadReference N Oscillatory Y Failure N OldData N Inconsistent N Inaccurate Miscellaneous: Y Source Y Test N OperatorBlocked
Sr2	1,2	Which status value (ST) quality bits are supported (can be set by server)	Validity: Y Good, Y Invalid,

ID	Ed	Description	Value / Clarification	
			N Reserved,	
			N Questionable	
			Detail Quality	
			N BadReference	
			N Oscillatory	
			Y Failure	
			N OldData	
			N Inconsistent	
			N Inaccurate	
			Miscellaneous:	
			Y Source	
			Y Test	
			N OperatorBlocked	
Sr3	-	What is the maximum number of data object references in one GetDataValues request	Deprecated	
Sr4	-	What is the maximum number of data object references in one SetDataValues request	Deprecated	
Sr5	1	Which Mode values are supported [1]	On	Y
			[On-]Blocked	Y
			Test	Y
			Test/Blocked	Y
			Off	Y

PIXIT for Data set model

ID	Ed	Description	Value / Clarification
Ds1	1	What is the maximum number of data elements in one data set (compare ICD setting)	Not Applicable
Ds2	1	How many persistent data sets can be created by one or more clients (this number includes predefined datasets)	Not Applicable
Ds3	1	How many non-persistent data sets can be created by one or more clients	Not Applicable

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[1] IEC 61850-6:2009 clause 9.5.6 states that if only a subrange of the enumeration value set is supported, this shall be indicated within an ICD file by an enumeration type, where the unsupported values are missing

PIXIT for Substitution model

ID	Ed	Description	Value / Clarification
Sb1	1	Are substituted values stored in volatile memory	Not Applicable

PIXIT for Setting group control model

ID	Ed	Description	Value / Clarification
Sg1	1	What is the number of supported setting groups for each logical device	Not Applicable
Sg2	1,2	What is the effect of when and how the non-volatile storage is updated (compare IEC 61850-8-1 §16.2.4)	Not Applicable
Sg3	1	Can multiple clients edit the same setting group	Not Applicable
Sg4	1	What happens if the association is lost while editing a setting group	Not Applicable
Sg5	1	Is EditSG value 0 allowed	Not Applicable
Sg6	2	When ResvTms is not present how long is an edit setting group locked	Not Applicable

PIXIT for Reporting model

ID	Ed	Description	Value / Clarification	
Rp1	1	The supported trigger conditions are (compare PICS)	integrity	Y
			data change	Y
			quality change	Y
			data update	Y
			general interrogation	Y
Rp2	1	The supported optional fields are	sequence-number	Y
			report-time-stamp	Y
			reason-for-inclusion	Y
			data-set-name	Y
			data-reference	Y
			buffer-overflow	Y
			entryID	Y
			conf-rev	Y
			segmentation	Y
Rp3	1,2	Can the server send segmented reports (when not supported the device shall refuse an association request with a smaller than minimum PDU size)	Y	
Rp4	1,2	Mechanism on second internal data change notification of the same analogue data value within buffer period (Compare IEC 61850-7-2 Ed2 §17.2.2.9)	Send report immediately	
Rp5	1	Multi client URCB approach (compare IEC 61850-7-2:2003 §14.2.1)	Each URCB is visible to all clients	
Rp6	-	What is the format of EntryID	Deprecated	
Rp7	1,2	What is the buffer size for each BRCB or how many reports can be buffered	120k bytes or 200 reports, whichever limit is reached first	
Rp8	-	Pre-configured RCB attributes that are dynamic, compare SCL report settings	Deprecated	
Rp9	1	May the reported data set contain:		
		- structured data objects	Y	
		- data attributes	Y	
Rp10	1,2	What is the scan cycle for binary events Is this fixed, configurable	2 ms Fixed	
Rp11	1	Does the device support to pre-assign a RCB to a specific client in the SCL	Y	
Rp12	2	After restart of the server is the value of ConfRev restored from the original configuration or retained prior to restart	Restored from original configuration	

ID	Ed	Description	Value / Clarification
Rp13	1,2	Does the server accept any client to configure / enable a BRCB with ResvTms=-1? What fields are used to do the identification?	Y AP-Title N AE-Qualifier N \<other field\> N
Rp14	1,2	When BRCB.ResvTms is exposed, what is the default value for BRCB.ResvTms if client does not write (must be > 0) or When BRCB.ResvTms is not exposed, what is the internal reservation time (must be >= 0)	60 seconds N/A
Rp15	2	Is data model db=0 supported	N

PIXIT for Logging model

ID	Ed	Description	Value / Clarification
Lg1	1,2	What is the default value of LogEna (Compare IEC 61850-8-1 §17.3.3.2.1, the default value should be FALSE)	Not Applicable
Lg2	-	What is the format of EntryID	Deprecated
Lg3	1,2	Are there multiple Log Control Blocks that specify the Journaling of the same MMS NamedVariable and TrgOps and the Event Condition (Compare IEC 61850-8-1 §17.3.3.3.2)	Not Applicable
Lg4	-	Pre-configured LCB attributes that cannot be changed online	Not Applicable
Lg5	1	Which TrgOps are supported for logging (note Ed2 and up requires support for all TrgOps)	Not Applicable

PIXIT for GOOSE publish model

ID	Ed	Description	Value / Clarification
Gp1	1,2	Can the test (Ed1) / simulation (Ed2) flag in the published GOOSE be set	Y Notes: Go to CAL level. If the DUT asks for a password to enter in level CAL: ACC = OTTER 2AC = TAIL CAL = Sel-1 To enable the simulation bit in a GOOSE publication; from a terminal session, issue the PUB SIM GOO command. To disable the simulation bit, issue PUB SIM OFF command.
Gp2	1	What is the behaviour when the GOOSE publish configuration is incorrect	Not Applicable
Gp3	1,2	Published FCD supported common data classes are	ACD, ACT, APC, ASG, BAC, BCR, BSC, BTS, CMV, CTS, CUG, CURVE, DEL, DPC, DPS, DPL, ENS, ENC, ENG, INC, ING, INS, ISC, LPL, MV, ORG, SAV, SEQ, SPC, SPG, SPS, STS, TSG, UTS, VSG, VSS and WYE.
Gp4	1,2	What is the maximum value of TAL (maxTime) Is it fixed or configurable	60000 ms Configured by SCL
Gp5	1,2	What is the fastest retransmission time	4 ms Configured by SCL
Gp6	-	Can the GOOSE publish be turned on / off by using SetGoCBValues(GoEna)	Deprecated See PICS – SetGoCBValues
Gp7	1,2	What is the initial GOOSE sqNum after restart	sqNum = 0
Gp8	1	May the GOOSE data set contain: - structured data objects (FCD) - timestamp data attributes	 Y Y

ID	Ed	Description	Value / Clarification
Gp9	1,2	Does Server or ICT refuse GOOSE payload dataset length greater than SCSM supports?	Y

PIXIT for GOOSE subscribe model

ID	Ed	Description	Value / Clarification
Gs1	1,2	What elements of a subscribed GOOSE message are checked to decide the message is valid and the allData values are accepted? If yes, describe the conditions. Notes: • the VLAN tag may be removed by an Ethernet switch and shall not be checked • the simulation flag shall always be checked (Ed2)	Y destination MAC address Y APPID Y gocbRef N timeAllowedtoLive Y datSet Y goID N T N stNum N sqNum Y simulation / test Y confRev Y ndsCom Y numDatSetEntries Y out-of-order dataset members
Gs2	1,2	When is a subscribed GOOSE marked as lost (TAL = time allowed to live value from the last received GOOSE message)	d) other GOOSE messages are not accepted or rejected based on TAL from the last received GOOSE message. The device sets an error status for the subscription if a GOOSE message is not received within the TAL interval. The device can be configured to transmit the error status in a GOOSE publication.
Gs3	1,2	What is the behaviour when one or more subscribed GOOSE messages is not received or syntactically incorrect (missing GOOSE)	If GOOSE messages are skipped, the GOOSE subscriber will issue an out-of-sequence error and wait for the next message to update the status. For syntax errors, the GOOSE subscriber will issue message-corrupted error and wait for the next message to update the status.

ID	Ed	Description	Value / Clarification
Gs4	1,2	What is the behaviour when a subscribed GOOSE message is out-of-order	The GOOSE subscriber will issue an out-of-sequence error and process the received GOOSE message.
Gs5	1,2	What is the behaviour when a subscribed GOOSE message is duplicated	The GOOSE subscriber will issue an out-of-sequence error.
Gs6	1	Does the device subscribe to GOOSE messages with/without the VLAN tag	Y, with the VLAN tag Y, without the VLAN tag
Gs7	1	May the GOOSE data set contain: - structured data objects (FCD) - timestamp data attributes	 Y Y
Gs8	1,2	Subscribed FCD supported common data classes are	All CDCs except these: HMV, HWYE, HDEL, and CSD Note: 4XX DUTs only support maping Boolean and Analogs.
Gs9	1	Are subscribed GOOSE with test=T (Ed1) / simulation=T (Ed2) accepted in test/simulation mode	Y
Gs10	1,2	Max number of dataset members	Count = 200
Gs11	1	Is Fixed-length encoded GOOSE supported	Y
Gs12	2	Is IEC 62351-6 security supported	N
Gs13	Amd1	How does the subscriber handle incoming data flagged as test when the destination LN.Beh is On or Blocked? Is this behavior:	Processed as Invalid Fixed

PIXIT for GOOSE performance

ID	Ed	Description	Value / Clarification	
Gf1	1,2	Performance class	P1 = 3 ms	
Gf2	1,2	GOOSE ping-pong processing method	Scan cycle based	
Gf3	1,2	Application logic scan cycle (ms)	Max.	4ms at 60Hz 5ms at 50Hz
			Min.	2ms at 60Hz 5ms at 50Hz

ID	Ed	Description	Value / Clarification
Gf4	1	Maximum number of data attributes in GOOSE dataset (value and quality has to be counted as separate attributes)	Count = 200

PIXIT for Control model

ID	Ed	Description	Value / Clarification
Ct1	1	What control models are supported (compare ~~PICS~~ICD file enums for Ed2)	DOns: Y SBOns: N DOes: Y SBOes: Y
Ct2	1,2	Is the control model fixed, configurable and/or dynamic	Configurable
Ct3	-	Is TimeActivatedOperate supported (compare PICS or SCL)	Deprecated
Ct4	-	Is "operate-many" supported (compare sboClass)	Deprecated, see sboClass in datamodel (ICD)
Ct5	1	Will the DUT activate the control output when the test attribute is set in the SelectWithValue and/or Operate request (when N test procedure Ctl2 is applicable)	Not Applicable
Ct6	-	What are the conditions for the time (T) attribute in the SelectWithValue and/or Operate request	Deprecated
Ct7	-	Is pulse configuration supported (compare pulseConfig)	Deprecated
Ct8	1	What is the behaviour of the DUT when the check conditions are set Is this behaviour fixed, configurable, online changeable	Not Applicable

ID	Ed	Description	Value / Clarification
Ct9	1,2	Which additional cause diagnosis are supported	N Unknown Y Not-supported Y Blocked-by-switching-hierarchy Y Select-failed Y Invalid-position Y Position-reached Y Step-limit Y Blocked-by-Mode N Blocked-by-process Y Blocked-by-interlocking N Blocked-by-synchrocheck Y Command-already-in-execution N Blocked-by-health N 1-of-n-control N Abortion-by-cancel N Time-limit-over N Abortion-by-trip Y Object-not-selected **Edition 2 specific values:** Y Object-already-selected Y No-access-authority N Ended-with-overshoot N Abortion-due-to-deviation N Abortion-by-communication-loss N Blocked-by-command N None Y Inconsistent-parameters Y Locked-by-other-client N Parameter-change-in-execution (Ed2 semantics)
Ct10	1,2	How to force a "test-not-ok" respond with SelectWithValue request	Send the SelectWithValue request with an orCat value greater than 8

ID	Ed	Description	Value / Clarification
Ct11	1,2	How to force a "test-not-ok" respond with Select request	The control service Select is not supported.
Ct12	1,2	How to force a "test-not-ok" respond with Operate request	DOns: SBOns: Not supported DOes: SBOes: Send the Operate request with an orCat value greater than 8.
Ct13	1,2	Which origin categories are supported / accepted	Y bay-control Y station-control Y remote-control Y automatic-bay Y automatic-station Y automatic-remote Y maintenance
Ct14	1,2	What happens if the orCat value is not supported or invalid	DOns: SBOns: Not Supported DOes: SBOes: DUT issues "test-not-ok" response with AddCause value "Not-supported"
Ct15	1,2	Does the IED accept a SelectWithValue / Operate with the same control value as the current status value Is this behaviour configurable	DOns: Y SBOns: NA DOes: N SBOes: N Configurable N
Ct16	1	Does the IED accept a select/operate on the same control object from 2 different clients at the same time	DOns: N SBOns: NA DOes: N SBOes: N
Ct17	1	Does the IED accept a Select/SelectWithValue from the same client when the control object is already selected (Tissue #334)	SBOns: NA SBOes: N
Ct18	1	Deprecated	

ID	Ed	Description	Value / Clarification
Ct19	-	Can a control operation be blocked by Mod=Off or [On-]Blocked (Compare PIXIT-Sr5)	Deprecated
Ct20	1,2	Does the IED support local / remote operation	Y
Ct21	1,2	Does the IED send an InformationReport with LastApplError as part of the Operate response- for control with normal security	SBOns: NA DOns: Y
Ct22	2	How to force a "parameter-change-in-execution"	SBOns: Not Applicable SBOes: Not Applicable
Ct23	1,2	How many SBOns/SBOes control objects can be selected at the same time?	SBOns: N/A SBOes: multiple = 10
Ct24	1,2	Can a controllable object be forced to keep its old state e.g. Internal Controllable Objects may not be accessible to force this, whereas a switch like Circuit Breaker outside the DUT can?	Y
Ct25	1,2	When CDC=DPC is supported, is it possible to have DPC (Controllable Double Point) go to the intermediate state? (00)	Y
Ct26	1,2	Name an enhanced security control point (if any) with a finite operate timeout Specify the operate timeout (in milliseconds)	SEL_4XX_1PRO/DC1CSWI1, DOes: Configurable in the CID file SBOes: Configurable in the CID file. Default: 10 seconds
Ct27	2	Does the IED support control objects with external signals?	DOns: Y SBOns: Not Applicable DOes: Y SBOes: Y
Ct28		Deprecated, kept as placeholder	

PIXIT for Time synchronisation model

ID	Ed	Description	Value / Clarification
Tm1	1	What time quality bits are supported (may be set by the IED)	Y LeapSecondsKnown Y ClockFailure Y ClockNotSynchronized
Tm2	1,2	Describe the behaviour when all time server(s) cease to respond What is the time server lost detection time	Assert ClockNotSynchronized after lost detection time 5-20 seconds depending on DUT settings. Default 5 seconds
Tm3	1,2	How long does it take to take over the new time from time server	15-3600 seconds depending on DUT settings. Default is 60 seconds.
Tm4	1,2	When is the time quality bit "ClockFailure" set	The IED sets ClockFailure when the DUT is in a "Disabled" state
Tm5	1	When is the time quality bit "Clock not Synchronized" set	When connection to all time servers is lost (see PIXIT-Tm2)
Tm6	-	Is the timestamp of a binary event adjusted to the configured scan cycle	Deprecated
Tm7	1	Does the device support time zone and daylight saving	Not Applicable
Tm8	1,2	Which attributes of the SNTP response packet are validated	Y Leap indicator not equal to 3 Y Mode is equal to SERVER Y OriginateTimestamp is equal to value sent by the SNTP client as Transmit Timestamp N RX/TX timestamp fields are checked for reasonableness Y SNTP version 3 and/or 4 N other (describe)
Tm9	1,2	Do the COMTRADE files have local time or UTC time and is this configurable	Local for COMTRADE C37.111 - 1999 files UTC for COMTRADE C37.111 - 2013 files N Configurable

PIXIT for File transfer model

ID	Ed	Description	Value / Clarification
Ft1	1	What is the structure of files and directories	File system with folders
		Where are the COMTRADE files stored	/COMTRADE/
		Are COMTRADE files zipped and what files are included in each zip file	Not zipped
Ft2	1,2	Directory names are separated from the file name by	"/"
Ft3	1	The maximum file name size including path (recommended 64 chars)	255 chars
Ft4	1,2	Are directory/file name case sensitive	Not Case sensitive
Ft5	1,2	Maximum file size for SetFile	Not limited. Depends on available memory.
Ft6	1	Is the requested file path included in the MMS fileDirectory respond file name	Y
Ft7	1	Is the wild card supported in the MMS fileDirectory request	Yes, wild card = *
Ft8	1,2	Is it allowed that 2 clients get a file at the same time	N same file N different files
Ft9	1,2	Which files can be deleted	Not Applicable

PIXIT for Service tracking model

ID	Ed	Description	Value / Clarification
Tr1	2	Which ACSI services are tracked by LTRK.GenTrk	SpcTrk DpcTrk EncTrk1 BrcbTrk UrcbTrk SgcbTrk