Protocol Implementation eXtra Information for Testing (PIXIT)
for the IEC 61850 interface in SEL-787-2,-3,-4

Date:
April 19, 2018

Schweitzer Engineering Laboratories, Inc.

PIXIT template for Server

Introduction

This document specifies the protocol implementation extra information for testing (PIXIT) of the IEC 61850 interface in SEL-787-2,-3,-4 with firmware version R200, LIB61850ID=3DB89FD6, and hardware board 1525-1-03. The following are variants of the SEL-787-2,-3,-4: The SEL-710-5 with firmware version R200 and the SEL-700G with firmware version R200. All variants have LIB61850ID=3DB89FD6.

Note: To verify the firmware for multi-variant testing designation, using an ASCII terminal from any access level, issue the following command: ID <cr>. The relay will return information similar to the following:

=>>ID

"FID=SEL-787-4-X347-V0-Z003002-D20180405","091F"
"BFID=BOOTLDR-R501-V0-Z000000-D20140224","0947"
"CID=7FFD","0284"
"DEVID=SEL-787-2E","0474"
"DEVCODE=79","0317"
"PARTNO=07872EE1A0X1D79850670","072C"
"CONFIG=111112010","041B"
"SEL DISPLAY PACKAGE=1.0.40787.3460","0895"
"CUSTOMER DISPLAY PACKAGE=1.575719065","099D"
"iedName=SEL_7XX","058A"
"type=SEL_787d4","04F0"
"configVersion=ICD-787-4-X203-V0-Z200006-D20180403","0D8C"
"LIB61850ID=3DB89FD6","04FF"

Where FID is the relay firmware, iedName is the device name for IEC61850, and LIB61850ID is the checksum indicating the 61850 library. LIB61850ID response is the same on products that use the same 61850 library and are variants.

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.

Schweitzer Engineering Laboratories, Inc.

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.

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
As3	1,2	Lost connection detection time	1-20 seconds
As4	-	Authentication is not supported yet	N
As5	1,2	What association parameters are necessary for successful association	Transport selector Y Session selector Y Presentation selector Y AP Title N AE Qualifier N
As6	1,2	If association parameters are necessary for association, describe the correct values e.g.	Transport selector 0001 Session selector 0001 Presentation selector 00000001 AP Title NA AE Qualifier NA
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 starting 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 N Overflow N OutofRange N BadReference N Oscillatory Y Failure N OldData N Inconsistent N Inaccurate Source: Y Process Y Substituted 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, N Reserved, N Questionable N BadReference N Oscillatory Y Failure N OldData N Inconsistent N Inaccurate Source: Y Process Y Substituted Y Test N OperatorBlocked

ID	Ed	Description	Value / Clarification
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]	Not Applicable

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

PIXIT for Substitution model

Service Not Supported

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	4

---

[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.

Schweitzer Engineering Laboratories, Inc.

ID	Ed	Description	Value / Clarification
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)	Settings group edit not supported
Sg3	1	Can multiple clients edit the same setting group	N/A
Sg4	1	What happens if the association is lost while editing a setting group	N/A
Sg5	1	Is EditSG value 0 allowed	N/A
Sg6	2	When ResvTms is not present how long is an edit setting group locked	N/A

PIXIT for Reporting model

ID	Ed	Description	Value / Clarification
Rp1	1	The supported trigger conditions are (compare PICS)	Not Applicable
Rp2	1	The supported optional fields are	Not Applicable
Rp3	1,2	Can the server send segmented reports (when not supported it is allowed to refuse an association 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 $14.2.2.9)	Send report immediately
Rp5	1	Multi client URCB approach (compare IEC 61850-7-2:2003 $14.2.1)	Not Applicable
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

ID	Ed	Description	Value / Clarification
Rp9	1	May the reported data set contain: - structured data objects - data attributes	Not Applicable
Rp10	1,2	What is the scan cycle for binary events Is this fixed, configurable	500 ms Fixed
Rp11	1	Does the device support to pre-assign a RCB to a specific client in the SCL	Not Applicable
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
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?	Not Applicable

PIXIT for Logging model

Service Not Supported

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 To enable the simulation bit in a GOOSE publication, set the value of SEL_7XXCFG/DevIDLPHD1COPubSim$Oper to True. To disable the simulation bit, set the value of the reference to False.
Gp2	1	What is the behaviour when the GOOSE publish configuration is incorrect	Not Applicable

Schweitzer Engineering Laboratories, Inc.

ID	Ed	Description	Value / Clarification
Gp3	1,2	Published FCD supported common data classes are	ACD, ACT, CMV, DEL, DPC, DPL, INC, INS, LPL, MV, SEQ, SPC, SPS, and WYE
Gp4	1,2	What is the slow retransmission time Is it fixed or configurable	60000 ms Configured by SCL
Gp5	1,2	What is the fastest retransmission time Is it fixed or configurable	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	Not Applicable

Schweitzer Engineering Laboratories, Inc.

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 a ethernet switch and shall not be checked • the simulation flag shall always be checked (Ed2)	Y destination MAC address= as configured in the CID file. Y APPID Y gocbRef = length must be as configured in the CID file. N timeAllowedtoLive Y datSet= length must be as configured in the CID file. Y If goID is present in the message then length must be as configured in the CID file. N, If goID is not present. N t N stNum N sqNum Y simulation / test = false Y confRev = as configured in the CID Y ndsCom all data accepted if false Y numDatSetEntries as configured in the CID file
Gs2	1,2	When is a subscribed GOOSE marked as lost? (TAL = time allowed to live value from the last received GOOSE message)	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.

ID	Ed	Description	Value / Clarification
Gs3	1,2	What is the behaviour when one or more subscribed GOOSE messages isn't 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.
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 duplicate GOOSE message will be ignored.
Gs6	1	Does the device subscribe to GOOSE messages with/without the VLAN tag	Not Applicable
Gs7	1	May the GOOSE data set contain: - structured data objects (FCD) - timestamp data attributes	Not Applicable
Gs8	1,2	Subscribed FCD supported common data classes are	All CDCs except these: HMV, HWYE, HDEL, and CSD
Gs9	1,2	Are subscribed GOOSE with test=T (Ed1) / simulation=T (Ed2) accepted in test/simulation mode	Y, the LGOS Logical Node type is not implemented, so acceptance or rejection of GOOSE messages in simulation mode must be determined by evaluating an associated data object, e.g. by using a GOOSE ping-pong technique.
Gs10	1,2	Max number of dataset members	Count = 200

PIXIT for GOOSE performance

ID	Ed	Description	Value / Clarification	
Gf1	1,2	Performance class	P2/P3	
Gf2	1,2	GOOSE ping-pong processing method	Scan cycle based	
Gf3	1,2	Application logic scan cycle (ms)	Max.	500 ms
			Min.	4 ms
Gf4	1	Maximum number of data attributes in GOOSE dataset (value and quality has to be counted as separate attributes)	Based on maximum Ethernet frame size	

PIXIT for Control model

ID	Ed	Description	Value / Clarification
Ct1	1	What control models are supported (compare ~~PICS~~ICD file enums for Ed2)	Not Applicable
Ct2	1,2	Is the control model fixed, configurable and/or dynamic	Configurable in the CID file
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

Schweitzer Engineering Laboratories, Inc.

ID	Ed	Description	Value / Clarification
Ct8	1	What is the behaviour of the DUT when the check conditions are set Is this behaviour fixed, configurable, online changeable	Not Applicable
Ct9	1,2	Which additional cause diagnosis are supported	N Unknown N Not-supported for Ed1, Y for Ed2 Y Blocked-by-switching-hierarchy Y Select-failed Y Invalid-position Y Position-reached Y Parameter-change-in-execution N Step-limit Y Blocked-by-Mode Y Blocked-by-process N 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 Y Time-limit-over N Abortion-by-trip Y Object-not-selected Y Object-already-selected Y No-access-authority Y Inconsistent-parameters Y Locked-by-other-client
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 Y process
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: Y SBOns: Not Applicable DOes: DOes does not accept oper from second client. SBOes: Y

ID	Ed	Description	Value / Clarification
Ct17	1	Does the IED accept a Select/SelectWithValue from the same client when the control object is already selected (Tissue #334)	Not Applicable
Ct18	1,2	Is for SBOes the internal validation performed during the SelectWithValue and/or Operate step	Mod=Off check performed at Operate
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: Not applicable 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

ID	Ed	Description	Value / Clarification
Ct26	1,2	Name a DOes point (if any) with a finite operate timeout and specify the timeout (in milliseconds)	SEL_7XXPRO/DC1CSWI1, DOes: Configurable in the CID file SBOes: Configurable in the CID file Default: 10seconds
Ct27	2	Does the IED support control objects with external signals?	DOns: Y SBOns: Not Applicable DOes: Y SBOes: Y
Ct28	2	Does the IED support DPC control objects with external signals?	DOns: Y SBOns: Not Applicable DOes: Y SBOes: Y

Schweitzer Engineering Laboratories, Inc.

PIXIT for Time synchronisation model

ID	Ed	Description	Value / Clarification
Tm1	1	What time quality bits are supported (may be set by the IED)	Not Applicable
Tm2	1,2	Describe the behaviour when the time server(s) ceases to respond What is the time server lost detection time	On one time server: Time is received from remaining server On all time servers: The IED sets ClockNotSynchronized 5-20 seconds depending on relay settings. Default is 5 secs.
Tm3	1,2	How long does it take to take over the new time from time server	15-3600 seconds depending on relay settings. Default is 60 secs.
Tm4	1,2	When is the time quality bit "ClockFailure" set	The IED sets ClockFailure when the relay is in a "Disabled" state
Tm5	1,2	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 N Configurable

PIXIT for File transfer model

ID	Ed	Description	Value / Clarification
Ft1	1	What is structure of files and directories Where are the COMTRADE files stored Are comtrade files zipped and what files are included in each zip file	Not Applicable
Ft2	1,2	Directory names are separated from the file name by	"/"
Ft3	1	The maximum file name size including path (recommended 64 chars)	Not Applicable
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	Not Applicable
Ft7	1	Is the wild char supported MMS fileDirectory request	Not Applicable
Ft8	1,2	Is it allowed that 2 clients get a file at the same time	N same file Y different files
Ft9	1,2	Which files can be deleted	Not supported

PIXIT for Service tracking model

Service Not Supported

Schweitzer Engineering Laboratories, Inc.