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**Test procedures for Sampled Values Publishers  
according to the "Implementation Guideline for  
Digital Interface to Instrument Transformers using  
IEC 61850-9-2" (9-2LE)**

**Version 1.1**

On request of UCAIUG

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## Revision history

Version	Changes
1.0, January 12, 2010	Initial approved version
1.1, May 28, 2010	Changes based upon application of first test Added Annex B, Certificate Form

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# 1 INTRODUCTION

The scope of the test is an IED publishing IEC 61850-9-2 sampled value messages constrained by the 9-2LE guideline. For example such IED could be a merging unit. A merging unit is a physical device that converts input signals from (non) conventional CT's and/or VT's and merges the signals into a digital IEC 61850-9-2 sampled value message.

The test procedures in this document are based on the "Implementation Guideline for Digital Interface to Instrument Transformers using IEC 61850-9-2, version 2.1, July 2004" further referred to as 9-2LE.

Note: In case a 9-2 publishing IED supports GOOSE or MMS based services to transfer binary status or control indications the applicable server conformance test procedures version 2.2 have to be used for the test

## 1.1 Glossary

DUT	Device Under Test
ICD	IED configuration description in SCL-format
IED	Intelligent Electronic Device
MICS	Model Implementation Conformance Statement
MU	Merging Unit
PICS	Protocol Implementation Conformance Statement
TICS	Technical Issues Implementation Conformance Statement
PIXIT	Protocol Implementation eXtra Information for Testing
PPS	Pulse Per Second
SCD	Substation configuration description in SCL-format
SCL	Substation Configuration Language
TISSUE	Technical issue
UCA IUG	UCA International Users Group

## 1.2 Identifications

The following table gives the exact identification of tested equipment and test environment used for this conformance test.

<i>DUT</i>	<identification and short name of the device under test, type, hardware / software version> Supported sampling rates: 80 and/or 256 samples per cycle Supported frequencies: 50Hz and/or 60Hz
<i>MANUFACTURER</i>	<name, location of the manufacturer of the DUT>
<i>PICS</i>	<complete reference description of the PICS>
<i>MICS</i>	<complete reference description of the MICS> OR reference to 9-2LE
<i>TICS</i>	<complete reference description of the TICS> OR reference to 9-2LE
<i>PIXIT</i>	<complete reference description of the PIXIT>
<i>ICD or SCD</i>	<complete reference description of the SCL configuration file>
<i>TEST INITIATOR</i>	<i>MANUFACTURER</i>
<i>TEST FACILITY</i>	<name and address of test facility>
<i>TEST ENGINEER</i>	<name and e-mail address of test engineer>
<i>TEST SESSION</i>	<date and location of the test session>
<i>ANALYSER</i>	<name and type analyzer(s), version X.Y>
<i>SIGNAL GENERATOR</i>	<name and type equipment simulator>
<i>PPS TIME MASTER</i>	<name and type of time master>
<i>MEDIA CONVERTERS</i>	<name and type of media converters>

## 2 TEST ENVIRONMENT

The test environment consists of the following components:

- DUT = 9-2LE publisher
- Current and/or Voltage signal generator
- 9-2LE Analyzer
- PPS time master

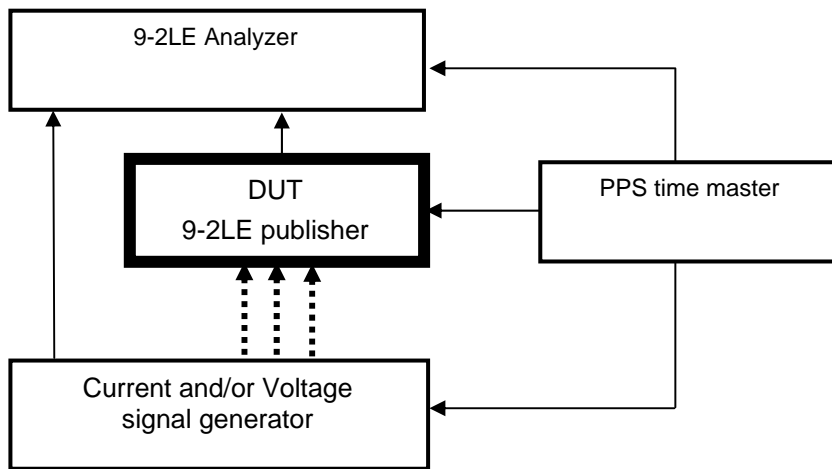


Figure 2.1 The test environment

The analyser can compare the "reference" sampled values from the signal generator with the sampled values from the DUT. The signal generator shall be accurate enough to perform the accuracy plausibility tests.

### 3 TEST RESULTS

Table 3.1 in this Chapter gives an overview of the conformance test results. References shown in the table columns refer to references of individual test procedures in clause 5.

The **Mandatory** column indicates the mandatory test cases with test result passed and the **Conditional** column indicates the conditional test cases with test result passed.

The **Verdict** column indicates the test result of all applicable test procedures in the test group. When one or more test procedures have test result Failed the test group receives verdict Failed.

Table 3.1 Overview of applicable test cases for *DUT*

Test Group	Mandatory	Conditional	Verdict
Documentation	Doc1, Doc2		
Configuration	Cnf1, Cnf2, Cnf3, Cnf4, Cnf5, Cnf6, Cnf7, Cnf8	Cnf9	
11a Sampled Value Publishing 50 Hz, 80 samples/cycle	Svp1, Svp2, Svp3, Svp6, Svp10, Svp11, Svp14, Svp15	Svp4, Svp7, Svp8, Svp12, Svp13, Svp16, Svp17	
11a Sampled Value Publishing 60Hz, 80 samples/cycle	Svp1, Svp2, Svp3, Svp6, Svp10, Svp11, Svp14, Svp15	Svp4, Svp7, Svp8, Svp12, Svp13, Svp16, Svp17	
11a Sampled Value Publishing 50 Hz, 256 samples/cycle	Svp1, Svp2, Svp3, Svp6, Svp10, Svp11, Svp14, Svp15	Svp5, Svp7, Svp9, Svp12, Svp13, Svp16, Svp17	
11a Sampled Value Publishing 60Hz, 256 samples/cycle	Svp1, Svp2, Svp3, Svp6, Svp10, Svp11, Svp14, Svp15	Svp5, Svp7, Svp9, Svp12, Svp13, Svp16, Svp17	



## **4 CONCLUSION AND RECOMMENDATIONS**

Based on the test results described in this report, TEST FACILITY declares the tested IEC 61850 implementation in the DUT has **[not shown/shown] to be non-conforming** to 9-2LE as specified in the PICS, MICS, PIXIT, TICS and ICD and configured according to the SCD.

### **4.1 Recommendations following from the test**

The following comments and recommendations apply for the *DUT*:

<comments and recommendation from test facility>

## 5 TEST PROCEDURES FOR 9-2LE PUBLISHERS

### 5.1 Documentation

Id	Test procedure	Verdict
Doc1	Check if the manufacturer documentation and hardware / software versions of the DUT do match: a) PICS b) MICS (reference to 9-2LE) c) PIXIT d) TICS (reference to 9-2LE) e) Hardware/software versions match	<input type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
Doc2	Verify the PIXIT matches the PIXIT template from the test procedures document	<input type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive

### 5.2 Configuration

Id	Test procedure	Verdict
Cnf1	Test if the ICD configuration file conforms to the SCL schema (IEC 61850-6)	<input type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
Cnf2	Check if the SCL configuration file corresponds with the actual names, data-sets, and values exposed by the DUT on the network.  For ICD: MsvID = xxxxMUnn01 or xxxxMUnn02, ConfRev=1, APPID = 0x4000  For SCD: MsvID and all SV communication parameters	<input type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
Cnf3	Check if the server "SMVSettings" capabilities in the ICD "services" section do match with the IED capabilities	<input type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
Cnf4	Verify the name and logical nodes (LLN0, LPHD, InnATCTR1, InnBTCTR2, InnCTCTR3, InnNTCTR4, UnnATVTR1, UnnBTVTR2, UnnCTVTR3, UnnNTVTR4) of the logical device "xxxxMUnn" (9-2LE table 4) in the SCL	<input type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive

Id	Test procedure	Verdict
Cnf5	Verify the logical node LLN0 of the logical device xxxxMUnn (9-2LE table 5) in the SCL: - dataset "PhsMeas1" - sampled value control block "MSVCB01" or "MSVCB02"	<input type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
Cnf6	Verify the dataset PhsMeas1 (9-2LE table 6) in the SCL	<input type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
Cnf7	Verify the common data class SAV and scale factor values (9-2LE table 7) in the SCL: 0.001 for current; 0.01 for voltage	<input type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
Cnf8	Verify the Multicast sampled value control block "MSVCB01" and/or "MSVCB02" (9-2LE table 8 and table 9) in the SCL	<input type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
Cnf9	Verify that if the device does not supply all samples, 'dummy' SAV data objects might be referenced in the data set. To detect the difference between dummy and real samples in the SCL, the ICD shall have all LN's included but the ones that are not supported have the LN Mode preconfigured to "Off".	<input type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive <input type="checkbox"/> Not applicable

### 5.3 Communication services

Only supported system frequencies and sampling rates shall be tested.

#### 5.3.1 Abstract test cases

Test ID	Test Case	M/C
Svp1	Verify that the maximum delay time from taking the sample to sending the corresponding message is within the limit specified in IEC 60044-8 clause 5.3.2 Note 2: 3 ms (+10 % , -100 %)	M
Svp2	Verify that physical layer is 100Base-FX full duplex with ST or MT-RJ connectors or 100Base-TX with RJ45 connector	M
Svp3	Verify that the format of the link layer matches with 9-2LE Annex A figure 3	M
Svp4	Verify that application layer matches with MSVCB01: APDU with 1 ASDU (9-2LE Annex A figure 4)	C1
Svp5	Verify that application layer matches with MSVCB02: APDU with 8 ASDU (9-2LE Annex A figure 4)	C1
Svp6	Verify the format of the ASDU matches with 9-2LE Annex A figure 5	M
Svp7	Verify that the calculated neutral samples have the derived quality bit set	C2
Svp8	Verify that the MSVCB01 samples are transmitted with 80 messages per cycle	C1
Svp9	Verify that the MSVCB02 samples are transmitted with 32 (256/8) messages per cycle	C1
Svp10	Verify that SmpCnt will be incremented each time a new sampling value is taken. The counter shall be set to zero if the sampling is synchronised by clock signal (SmpSynch = TRUE) and the synchronising signal occurs. The value zero shall be given to the data set where the sampling of the primary current coincides with the sync pulse.	M
Svp11	Verify that the sampled values match with the analog signals	M
Svp12	Verify that the voltage scaling parameters are configured as specified in the PIXIT and correctly applied	C3
Svp13	Verify that the current scaling parameters are configured as specified in the PIXIT and correctly applied	C3
Svp14	Verify that the DUT is synchronised with PPS signal. Verify that in case the PPS signal is lost the SmpSynch in the SV message shall be set to FALSE. "SmpCnt" shall wrap as if a synchronization pulse would be present	M
Svp15	Verify that after restoring the power the DUT shall publish valid 9-2 messages within specified time (PIXIT).	M
Svp16	Verify that in TEST mode the quality bit TEST is set for each sample (PIXIT)	C4
Svp17	Signals that are not measured or calculated shall have the corresponding Quality bit = Invalid	C5

Conditions
C1 = at least 80 or 256 sample rate shall be supported C2 = mandatory in case neutral values are calculated C3 = mandatory in case the DUT is connected to a conventional CT/VT C4 = mandatory in case TEST mode is supported C5 = mandatory in case DUT does measure less then 3 currents and 3 voltages or the DUT supports Quality = Invalid

**5.3.2 Detailed test procedures**

Svp1	Verify that the maximum delay time from taking the sample to sending the corresponding message is within the limit	<input type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
9-2LE clause 5 IEC 60044-8 clause 5.3.2 note 2 <sup>1</sup> PIXIT		
<u>Expected result</u> 2. DUT samples the signals as configured 3. DUT sends sampled value messages. The measured delay time shall be less than 3 ms (+10% , -100%). The measured delay time is defined as the fraction of second of the capture time of the message with SmpCnt=0 Maximum delay does not exceed value specified in PIXIT		
<u>Test description</u> 1. Configure the DUT with the correct parameters 2. Generate 50 Hz current and/or voltage signals 3. Capture the sampled values messages for 1 minute 4. Repeat step 1 to 3 five times 5. Repeat step 1 to 4 for 60 Hz with supported sampling rates		
<u>Comment</u> Note: the test case is passed when the measured delay time is below the specified limit. The measured delays are: - 50 Hz and 80 samples = .... - 50 Hz and 256 samples = - 60 Hz and 80 samples = - 60 Hz and 256 samples =		

<sup>1</sup> IEC 60044-8 clause 5.3.2: NOTE 2 If the merging unit is intended to be used with synchronization pulses, the rated delay time is 3 ms (+10 % , -100 %) for all data rates, since it is not relevant for phase error.

Svp2	Verify that physical layer is 100Base-FX full duplex with ST or MT-RJ connectors or 100Base-TX with RJ45 connector	<input type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
9-2LE clause 6.2.1		
<u>Expected result</u> 3. DUT sends sampled value messages on the configured connector 6. DUT sends sampled value messages on the configured connector		
<u>Test description</u> 1. Configure the DUT using the copper connection 2. Generate current and/or voltage signals 3. Capture the sampled values messages for 1 minute 4. Configure the DUT using the fiber connection 5. Generate current and/or voltage signals 6. Capture the sampled values messages for 1 minute		
<u>Comment</u> DUT has 100Base-FX full duplex with ST / MT-RJ connectors and/or 100Base-TX with a RJ45 connector		

Svp3	Verify the format of the link layer	<input type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
9-2LE Annex A figure 3, clause 6.2.2		
<u>Expected result</u> 3. DUT sends sampled value messages with the following format of the link layer: <ul style="list-style-type: none"><li>- destination MAC address = 01-0C-CD-04-xx-xx</li><li>- TPID = 0x8100</li><li>- VLAN priority as configured (default = 4)</li><li>- VLAN ID as configured (default = 0x000)</li><li>- Ethertype = 0x88BA</li><li>- APPID = 0x4000</li><li>- reserved 1 = 0x0000</li><li>- reserved 2 = 0x0000</li></ul>		
<u>Test description</u> <ol style="list-style-type: none"><li>1. Configure the DUT</li><li>2. Generate current and/or voltage signals</li><li>3. Capture the sampled values messages for 1 minute</li></ol>		
<u>Comment</u>		

Svp4	Verify that application layer matches with MSVCB01: APDU with 1 ASDU	<input type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
9-2LE Annex A figure 4, clause 7.1.4		
<u>Expected result</u> 3. DUT sends sampled value messages with 1 ASDU <ul style="list-style-type: none"><li>- noAsdu = 1</li><li>- svID = xxxxMUnn01</li><li>- smpCount = 0..3999 (50Hz) or 0..4799 (60Hz)</li><li>- confRev = 1</li><li>- smpSynch = TRUE in case PPS is connected</li><li>- sequence of data</li><li>- refresh time and sample rate are not present</li></ul>		
<u>Test description</u> <ol style="list-style-type: none"><li>1. Configure the DUT</li><li>2. Generate current and/or voltage signals</li><li>3. Capture the sampled values messages for 1 minute</li></ol>		
<u>Comment</u>		



Svp5	Verify that application layer matches with MSVCB02: APDU with 8 ASDU	<input type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
9-2LE Annex A figure 4, clause 7.1.4		
<u>Expected result</u> 3. DUT sends sampled value messages with 8 ASDU <ul style="list-style-type: none"><li>- noAsdu = 8</li><li>- svID = xxxxMUnn02</li><li>- smpCount = 0..12799 (50Hz) or 0.. 15359 (60Hz)</li><li>- confRev = 1</li><li>- smpSynch = TRUE in case PPS is connected</li><li>- sequence of data</li><li>- refresh time and sample rate are not present</li></ul>		
<u>Test description</u> <ol style="list-style-type: none"><li>1. Configure the DUT</li><li>2. Generate 50 Hz current and/or voltage signals</li><li>3. Capture the sampled values messages for 1 minute</li><li>4. Repeat step 1 to 3 for 60 Hz</li></ol>		
<u>Comment</u>		

Svp6	Verify the format of the ASDU dataset	<input type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
9-2LE Annex A figure 5		
<u>Expected result</u>		
3. DUT sends sampled value messages with the correct format of the ASDUs <ul style="list-style-type: none"> <li>- 4 phase Currents</li> <li>- 4 phase Voltages</li> <li>- Not supported values are 0 and have the corresponding invalid quality bit set</li> </ul>		
<u>Test description</u>		
1. Configure the DUT with the correct sample rate 2. Generate current and/or voltage signals 3. Capture the sampled values messages for 1 minute		
<u>Comment</u>		

Svp7	Verify that the calculated neutral samples have the derived quality bit set	<input type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
9-2LE clause 6.2.3		
<u>Expected result</u>		
3. DUT sends sampled value messages with the correct format of the ASDUs <ul style="list-style-type: none"> <li>- Calculated neutral values have the derived quality bit (0x2000) set</li> </ul>		
<u>Test description</u>		
1. Configure the DUT with the correct sample rate 2. Generate current and/or voltage signals 3. Capture the sampled values messages for 1 minute		
<u>Comment</u>		

Svp8	Verify that the MSVCB01 samples are transmitted with 80 messages per cycle	<input type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
9-2LE clause 7.1.4		
<u>Expected result</u> 2. DUT samples the signals as configured 3. In one minute DUT sends 240000±1 sampled value messages for 50 Hz and 288000±1 messages for 60 Hz.		
<u>Test description</u> 1. Configure the DUT with the correct parameters 2. Generate 50 Hz current and/or voltage signals 3. Capture the sampled values messages for 1 minute 4. Repeat step 1 to 3 five times 5. Repeat step 1 to 4 for 60 Hz		
<u>Comment</u>		

Svp9	Verify that the MSVCB02 samples are transmitted with 32 (256/8) messages per cycle	<input type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
9-2LE clause 7.1.4		
<u>Expected result</u> 2. DUT samples the signals as configured 3. In one minute DUT sends 96000±1 sampled value messages for 50 Hz and 115200±1 for 60 Hz.		
<u>Test description</u> 1. Configure the DUT with the correct parameters 2. Generate 50 Hz current and/or voltage signals 3. Capture the sampled values messages for 1 minute 4. Repeat step 1 to 3 five times 5. Repeat step 1 to 4 for 60 Hz		
<u>Comment</u>		

Svp10	Verify that SmpCnt will be incremented and reset	<input type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
9-2LE clause 7.2.1		
<p><u>Expected result</u></p> <p>3. DUT sends sampled value messages.</p> <ul style="list-style-type: none"> <li>- SmpCnt is incremented at each sample (ASDU)</li> <li>- SmpCnt value zero shall be given to the data set where the sampling of the primary current coincides with the sync pulse (plausibility check)</li> </ul> <p>5. If the merging unit does not receive a synchronization signal SmpCnt shall wrap as if a synchronization pulse would be present.</p>		
<p><u>Test description</u></p> <ol style="list-style-type: none"> <li>1. Configure the DUT with the correct parameters</li> <li>2. Generate 50 Hz current and/or voltage signals</li> <li>3. Capture the sampled values messages for 1 minute</li> <li>4. Disconnect the PPS</li> <li>5. Capture the sampled values messages for 1 minute</li> <li>6. Repeat step 1 to 5 for 60 Hz</li> </ol>		
<p><u>Comment</u></p> <p>The SmpCnt zero at synch pulse is a plausibility check not an accuracy test.</p>		

Svp11	Verify that the sampled values match with the analog signals	<input type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
9-2LE Annex C and Annex D		
<p><u>Expected result</u></p> <p>3. Voltages</p> <ul style="list-style-type: none"> <li>- If VN is calculated, check that VN is equal to VA, VB, VC when applying 1 phase voltage</li> <li>- When applying a symmetrical 3 phase voltage system the calculated VN is close to zero</li> <li>- When applying the same voltage to VA, VB, VC, the magnitude and polarity are the same and VN is 3 times the magnitude of a phase voltage</li> </ul> <p>Currents</p> <ul style="list-style-type: none"> <li>- If IN is calculated, check that IN is equal to IA, IB, IC when applying 1 phase current</li> <li>- When applying a symmetrical 3 phase current system the calculated IN is close to zero</li> <li>- When applying "line-to-line" current, the magnitude is the same and the polarity has the opposite value, IN is close to zero</li> </ul>		
<p><u>Test description</u></p> <ol style="list-style-type: none"> <li>1. Configure the DUT with the correct parameters 50 Hz</li> <li>2. Generate the following 50 Hz current and/or voltage signals for 3 phase signal generator:                     <ul style="list-style-type: none"> <li>- 10 seconds symmetrical 3 phase</li> <li>- 10 seconds per phase: A -&gt; B -&gt; C</li> </ul>                     OR for one phase test generator:                     <ul style="list-style-type: none"> <li>- 10 seconds inject same voltage to A, B and C</li> <li>- 10 seconds inject "line-to-line" current into 2 phases A-B</li> <li>- 10 seconds inject "line-to-line" current into 2 phases B-C</li> <li>- 10 seconds inject "line-to-line" current into 2 phases C-A</li> <li>- 10 seconds per phase: A -&gt; B -&gt; C</li> </ul> </li> <li>3. Capture the sampled values messages</li> <li>4. Repeat step 1 to 3 for 60 Hz</li> </ol>		
<p><u>Comment</u></p> <p>This is a plausibility check not an accuracy test.</p>		

Svp12	Verify that the voltage scaling parameters are configured as specified in the PIXIT and correctly applied	<input type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
9-2LE Annex C and Annex D PIXIT		
<u>Expected result</u> 3. Voltages - The magnitude of sampled values for VA, VB, VC, (VN) match applied voltage. - The configured scaling parameters (VT ratios) are correctly taken into account		
<u>Test description</u> 1. Configure the DUT with the correct parameters 50 Hz 2. Generate the following 50 Hz voltage signals - 15 seconds all 3 phases - 15 seconds per phase: A -> B -> C 3. Capture the sampled values messages 4. Repeat step 1 to 3 for 60 Hz		
<u>Comment</u> This is a plausibility check not an accuracy test.		

Svp13	Verify that the current scaling parameters are configured as specified in the PIXIT and correctly applied	<input type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
9-2LE Annex C and Annex D PIXIT		
<u>Expected result</u> 3. - The magnitude of sampled values for IA, IB, IC, (IN) match applied current. - The configured scaling parameters (CT ratios) are correctly taken into account		
<u>Test description</u> 1. Configure the DUT with the correct parameters 50 Hz 2. Generate the following 50 Hz current signals - 15 seconds all 3 phases - 15 seconds per phase: A -> B -> C 3. Capture the 9-2 sampled values messages 4. Repeat step 1 to 3 for 60 Hz		
<u>Comment</u> This is a plausibility check not an accuracy test.		

Svp14	Verify that the DUT is synchronised with PPS signal	<input type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
9-2LE clause 7.2.1 PIXIT		
<u>Expected result</u> 3. When PPS is connected DUT sends sampled value messages with SmpSynch = TRUE. When PPS is disconnected and when DUT has left the hold-over mode it sends messages with SmpSynch = FALSE		
<u>Test description</u> 1. Configure the DUT with the correct parameters 2. Generate 50 Hz current and/or voltage signals 3. Capture the sampled values messages, disconnect the PPS after 10 seconds and connect it again after 1.5 times the specified holdover time 4. Repeat step 1 to 3 for 60 Hz		
<u>Comment</u>		

Svp15	Verify that after restoring the power the DUT shall publish valid 9-2 messages within specified time (PIXIT).	<input type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
9-2LE clause 7.2.1 PIXIT		
<u>Expected result</u> 3. DUT sends valid sampled value messages within the PIXIT specified time after restoring the power		
<u>Test description</u> 1. Configure the DUT with the correct parameters 2. Generate 50 Hz current and/or voltage signals, after 10 seconds disconnect and restore the power supply 3. Capture the sampled values messages until valid samples are transmitted 4. Repeat step 1 to 3 for 60 Hz		
<u>Comment</u>		



Svp16	Verify that in TEST mode the quality bit TEST is set for each sample (PIXIT)	<input type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
9-2LE clause 7.2.1 PIXIT		
<u>Expected result</u> 3. DUT sends sampled value messages with quality bit TEST (0x0800) for each sample		
<u>Test description</u> 1. Configure the DUT with the correct parameters and enable TEST mode 2. Generate 50 Hz current and/or voltage signals 3. Capture the sampled values messages for 1 minute 4. Repeat step 1 to 3 for 60 Hz		
<u>Comment</u>		

Svp17	Signals that are not measured or calculated shall have the corresponding Quality bit = Invalid (PIXIT)	<input type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
9-2LE clause 7.1.3 PIXIT		
<u>Expected result</u> 3. Signals that are not measured or calculated or as specified in the PIXIT shall have the corresponding Quality bit Invalid (0x0001). Any derived values have quality bit invalid as well		
<u>Test description</u> 1. Configure the DUT as specified in the PIXIT 2. Generate 50 Hz current and/or voltage signals 3. Capture the sampled values messages for 1 minute 4. Repeat step 1 to 3 for 60 Hz		
<u>Comment</u>		

**ANNEX A PIXIT FOR 9-2LE PUBLISHER**

<b>Description</b>	<b>Value / Clarification</b>
Supported nominal frequencies	50 Hz Y/N 60 Hz Y/N
Supported sampling rates	80 samples per cycle Y/N 256 samples per cycle Y/N
9-2 connector type	ST, MT-RJ and/or RJ45
Support test mode	Y/N
Input voltage and currents signals	0, 1, 3 or 4 phase voltages 0, 1, 3 or 4 phase currents
Are neutral sampled values calculated?	Y/N/Configurable
How are the CT/VT ratios configured (only applicable for MU connected to conventional CT/VT)?	
At losing the PPS signal after how much time sets the MU 'SmpSynch' to false (hold over mode)?	0 if there is no hold-over mode ... seconds
At restoring the PPS signal after how much time sets the MU 'SmpSynch' to true?	... seconds
Max length for IED name	Max length of MsvID = 32
What is the (rated) delay time between taking the sample and sending the corresponding SV message?	... microseconds
Which quality codes are supported?	Derived Y/N Test Y/N
What data is sent in test mode?	
In which conditions is the quality field Validity set to the value Invalid?	For example a MU without voltage inputs the voltage samples have quality invalid
What is the maximum startup time after a power supply interrupt?	... seconds
<additional items>	

## ANNEX B 9-2LE PUBLISHER CERTIFICATE FORM

The template form for certificates issued upon completion of device testing is as follows:

No. <document reference>

IEC 61850 Certificate Level A/B<sup>1</sup>

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Issued to:  
<Name and Address>

For the 92LE publisher:

<device>

<Hardware version>

<Firmware version>

Supporting:

1/3/4 phase voltage and current

Neutral is <calculated>

Issued by: <testlab>

**The product has not shown to be non-conforming to:  
IEC 61850-6, 7-2 and 9-2  
Communication networks and systems in substations**

The conformance test has been performed according to IEC 61850-10 with 92LE publisher's protocol implementation conformance statement: "<PICS PIXIT>" and extra information for testing: "<PIXIT>".

The following IEC 61850 conformance blocks have been tested with a positive result (number of relevant and executed test cases / total number of test cases as defined in the UCAIUG Test procedures for Sampled Values Publishers according to the "Implementation Guideline for Digital Interface to Instrument Transformers using IEC 61850-9-2" (9-2LE), version 1.1):

11a Sampled Value publish (13/17)	50 Hz with 80 samples per cycle
11a Sampled Value publish (13/17)	60 Hz with 80 samples per cycle

This Certificate includes a summary of the test results as carried out at <location> with <Analyzer version>. The test is based on the UCAIUG "Test procedures for Sampled Values Publishers according to the "Implementation Guideline for Digital Interface to Instrument Transformers using IEC 61850-9-2" (9-2LE), version 1.1". This document has been issued for information purposes only, and the original paper copy of the test report: No. <document reference> will prevail.

The test has been carried out on one single specimen of the client system as referred above and submitted to <testlab> by <manufacturer>. The manufacturer's production process has not been assessed. This Certificate does not imply that <testlab> has certified or approved any product other than the specimen tested.

<Location & date>

<manager name>

<name>

<title>

<Test Engineer>

<sup>1</sup> Level A - Independent Test lab with certified ISO 9000 or ISO 17025 Quality System

Applicable Test Procedures from the UCAIUG "Test procedures for Sampled Values Publishers according to the "Implementation Guideline for Digital Interface to Instrument Transformers using IEC 61850-9-2 (9-2LE)", version 1.1"

<b>Conformance Block</b>	<b>Mandatory</b>	<b>Conditional</b>
Configuration	Cnf1, Cnf2, Cnf3, Cnf4, Cnf5, Cnf6, Cnf7, Cnf8	Cnf9
11a Sampled Value Publishing 50 Hz, 80 samples/cycle	Svp1, Svp2, Svp3, Svp6, Svp10, Svp11, Svp14, Svp15	Svp4, Svp7, Svp8, Svp16, Svp17
11a Sampled Value Publishing 60Hz, 80 samples/cycle	Svp1, Svp2, Svp3, Svp6, Svp10, Svp11, Svp14, Svp15	Svp4, Svp7, Svp8, Svp16, Svp17