

VERIFICATION REPORT

IEC 61850 Sampled Values publisher conformance test in REX640

ABB Oy

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Task and objective:

Does the protocol implementation of the DUT, conform to the IEC 61850 standard and the PICS, MICS, PIXIT and ICD specifications as configured with SCD?

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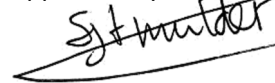
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| Rev. No. | Date | Reason for Issue | Prepared by | Verified by | Approved by |
|----------|------------|------------------|--------------|--------------|---------------|
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| 1 | 2018-11-27 | First revision | N. de Bruijn | R. Schimmel | S.J.T. Mulder |



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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 (low power) 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 9-2LE publishing IED supports GOOSE or MMS based services to transfer binary status or control indications the applicable server conformance test procedures have to be used for the test.

The described procedures and results are the basis of this verification report, the DNVGL Attestation of Conformity and the UCAIug Level A certificate/conformance statement.

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> | REX 640 Protection and Control Software version 1.0 Supported sampling rates: 80 samples per cycle Supported frequencies: 50Hz and 60Hz |
| <i>MANUFACTURER</i> | ABB Oy Distribution Solutions Muottitie 2 A FI-65101 Vaasa Finland |
| <i>PICS</i> | REX640 Protocol Implementation Conformance Statement (PICS) for the IEC 61850 interface in REX640, Revision A |
| <i>MICS</i> | reference to 9-2LE |
| <i>TICS</i> | reference to 9-2LE |
| <i>PIXIT</i> | REX640 Protocol Implementation extra Information for Testing (PIXIT) for the IEC 61850 9-2LE interface in REX640, Revision A |
| <i>ICD or SCD</i> | 640_Ed1_LE.cid |
| <i>TEST INITIATOR</i> | <i>MANUFACTURER</i> |
| <i>TEST FACILITY</i> | DNV GL Netherlands B.V. Protocol Competence & Test Center Utrechtseweg 310-B50, Arnhem, The Netherlands Accredited as independent Level A test lab by the UCAiug |
| <i>TEST ENGINEER</i> | Richard Schimmel, Richard.schimmel@dnvgl.com |
| <i>TEST SESSION</i> | September 2018, at DNVGL in the Netherlands |
| <i>ANALYSER</i> | UniCA 61850 Analyser version 5.34.02 and Omicron SV Scout with Napatech capture card |
| <i>SIGNAL GENERATOR</i> | Omicron CMC 256 |
| <i>PPS TIME MASTER</i> | Meinberg M600 |
| <i>MEDIA CONVERTERS</i> | Not applicable |

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

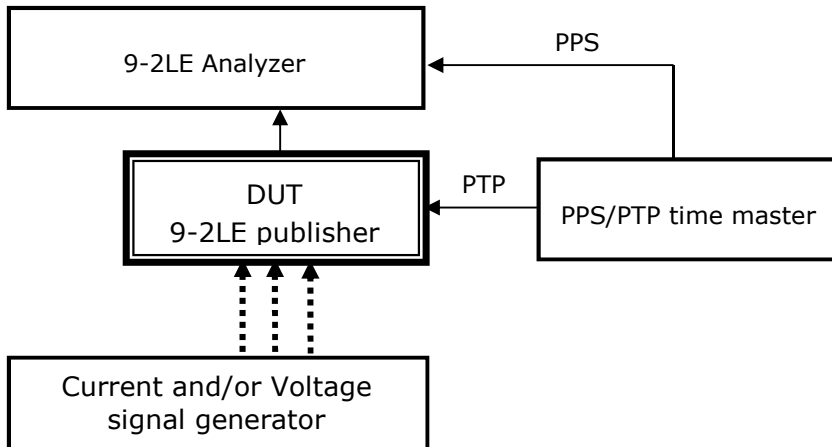


Figure 2.1 The test environment

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 passed for DUT

| Test Group | Mandatory | Conditional |
|---|---|--|
| Configuration | Cnf1, Cnf2, Cnf3, Cnf4, Cnf5, Cnf6, Cnf7, Cnf8 | |
| 11a Sampled Value Publishing: 50Hz, 80 samples | Svp1, Svp2, Svp3 Svp6, Svp10, Svp11, Svp15 | Svp4, Svp7, Svp8, Svp12, Svp13, Svp16 |
| 11a Sampled Value Publishing: 60Hz, 80 samples | Svp1, Svp2, Svp3 Svp6, Svp10, Svp11, Svp15 | Svp4, Svp7, Svp8, Svp12, Svp13, Svp16 |

Table 3.2 Overview of applicable test cases failed or inconclusive for DUT

| Test Group | Inconclusive | Failed | Comment |
|---|--------------|--------|--------------------|
| 11a Sampled Value Publishing: 50Hz, 80 samples | Svp10 | Svp14 | See recommendation |
| 11a Sampled Value Publishing: 60Hz, 80 samples | Svp10 | Svp14 | See recommendation |

4 CONCLUSION AND RECOMMENDATIONS

Based on the test results described in this verification report, TEST FACILITY declares the tested IEC 61850 implementation in the DUT has **been shown to be non-conforming** to 9-2LE as specified in the PICS, PIXIT and ICD and configured according to the provided SCD.

4.1 Recommendations following from the test

The following comments and recommendations apply for the DUT:

- During the test, it was noted that PPS support was not available, we recommend, in order being fully compliant with the IEC 61850 9-2LE standard, to implement a PPS clock synchronisation mechanism. Documentation specifies IEEE 1588 v2 (PTP) is supported.

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: <ul style="list-style-type: none"> a PICS b MICS (reference to 9-2LE) c PIXIT d TICS (reference to 9-2LE). | Passed |
| Doc2 | Verify the PIXIT matches the PIXIT template from the test procedures document. | Passed |

5.2 Configuration

| Id | Test procedure | Verdict |
|-----------|--|----------------|
| Cnf1 | Test if the ICD configuration file conforms to the SCL schema (IEC 61850-6). | Passed |
| 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. | Passed |
| Cnf3 | Check if the server "SMVSettings" capabilities in the ICD "services" section do match with the IED capabilities. | Passed |
| 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. | Passed |
| 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". | Passed |
| Cnf6 | Verify the dataset PhsMeas1 (9-2LE table 6) in the SCL. | Passed |
| 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. | Passed |
| Cnf8 | Verify the Multicast sampled value control block "MSVCB01" and/or "MSVCB02" (9-2LE table 8 and table 9) in the SCL. | Passed |
| 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". | Not applicable |

5.3 Communication services

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

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 | Passed |
|---|--|--------|
| 9-2LE clause 5 IEC 60044-8 clause 5.3.2 note 2 ¹ 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 4 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 and other 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 = between 1.810 and 1.811 msec - 60 Hz and 80 samples = between 1.539 and 1.540 msec | | |

| Svp2 | Verify that physical layer is 100Base-FX full duplex with ST, LC or MT-RJ connectors or 100Base-TX with RJ45 connector | Passed |
|---|--|--------|
| 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-TX with a RJ45 connector | | |

¹ 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.

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

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

| Svp5 | Verify that application layer matches with MSVCB02: APDU with 8 ASDU | Passed |
|---|--|--------|
| 9-2LE Annex A figure 4, clause 7.1.4 | | |
| <u>Expected result</u> 3 DUT sends sampled value messages with 8 ASDU - noAsdu = 8 - svID = xxxxMUnn02 - smpCount = 0..12799 (50Hz) or 0.. 15359 (60Hz) - confRev = 1 - smpSynch = TRUE in case PPS is connected - sequence of data - refresh time and sample rate are not present. | | |
| <u>Test description</u> 1 Configure the DUT 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> | | |

| Svp6 | Verify the format of the ASDU dataset | Passed |
|---|---------------------------------------|--------|
| 9-2LE Annex A figure 5 | | |
| <u>Expected result</u> 3 DUT sends sampled value messages with the correct format of the ASDUs - 4 phase Currents - 4 phase Voltages - Not supported values are 0 and have the corresponding invalid quality bit set. | | |
| <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 | Passed |
|---|--|---------------|
| 9-2LE clause 6.2.3 | | |
| <u>Expected result</u> | | |
| 3 DUT sends sampled value messages with the correct format of the ASDUs - Calculated neutral values have the derived quality bit (0x2000) set. | | |
| <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 | Passed |
|--|---|---------------|
| 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 | Passed |
|-------------------------|---|---------------|
| 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 | Inconclusive |
|--|---|---------------------|
| 9-2LE clause 7.2.1 | | |
| <u>Expected result</u> | | |
| 3 | DUT sends sampled value messages. | |
| | - SmpCnt is incremented at each sample (ASDU) | |
| | - SmpCnt value zero shall be given to the data set where the sampling of the primary current coincides with the sync pulse (plausibility check) | |
| 5 | If the merging unit does not receive a synchronization signal SmpCnt shall wrap as if a synchronization pulse would be present. | |
| <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 | Disconnect the PPS | |
| 5 | Capture the sampled values messages for 1 minute | |
| 6 | Repeat step 1 to 5 for 60 Hz. | |
| <u>Comment</u> | | |
| The SmpCnt zero at synch pulse is a plausibility check not an accuracy test. | | |
| During the test, instead of a PPS clock, a PTP clock is used. Since this device does not support PPS | | |

| Svp11 | Verify that the sampled values match with the analog signals | Passed |
|--|--|--------|
| 9-2LE Annex C and Annex D | | |
| <p><u>Expected result</u></p> <p>3 Voltages</p> <ul style="list-style-type: none"> - If VN is calculated, check that VN is equal to VA, VB, VC when applying 1 phase voltage - When applying a symmetrical 3 phase voltage system the calculated VN is close to zero - 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 <p>Currents</p> <ul style="list-style-type: none"> - If IN is calculated, check that IN is equal to IA, IB, IC when applying 1 phase current - When applying a symmetrical 3 phase current system the calculated IN is close to zero - When applying "line-to-line" current, the magnitude is the same and the polarity has the opposite value, IN is close to zero. | | |
| <p><u>Test description</u></p> <p>1 Configure the DUT with the correct parameters 50 Hz</p> <p>2 Generate the following 50 Hz current and/or voltage signals for 3 phase signal generator:</p> <ul style="list-style-type: none"> - 10 seconds symmetrical 3 phase - 10 seconds per phase: A -> B -> C <p>OR for one phase test generator:</p> <ul style="list-style-type: none"> - 10 seconds inject same voltage to A, B and C - 10 seconds inject "line-to-line" current into 2 phases A-B - 10 seconds inject "line-to-line" current into 2 phases B-C - 10 seconds inject "line-to-line" current into 2 phases C-A - 10 seconds per phase: A -> B -> C <p>3 Capture the sampled values messages</p> <p>4 Repeat step 1 to 3 for 60 Hz.</p> | | |
| <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 | Passed |
|--|--|---------------|
| 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 | Passed |
|--|--|---------------|
| 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 | Failed |
| 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> | | |
| For this test, PPS was not used, since the device does not support this. We have used a PTP clock to set up the time synchronization mechanism. When disconnecting the time master from the DUT, the DUT becomes the PTP time master itself and set/keeps the SmpSynch true | | |

| | | |
|-----------------------------|--|---------------|
| Svp15 | Verify that after restoring the power the DUT shall publish valid 9-2 messages within specified time (PIXIT). | Passed |
| 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) | Passed |
|---|---|---------------|
| 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) | Passed |
|--|---|---------------|
| 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). | | |
| <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> | | |



ABOUT DNV GL

Driven by our purpose of safeguarding life, property and the environment, DNV GL enables organizations to advance the safety and sustainability of their business. We provide classification and technical assurance along with software and independent expert advisory services to the maritime, oil and gas, and energy industries. We also provide certification services to customers across a wide range of industries. Operating in more than 100 countries, our 16,000 professionals are dedicated to helping our customers make the world safer, smarter and greener.