



# High **PROTEC**

IEC 61850 | PIXIT

**MRMV4**

Software-Version: 3.6.b

Protocol Implementation Extra Information for Testing (PIXIT)

UCA International Users Group Testing Sub Committee

English

## **Contents of this document**

This document is applicable for MRMV4 Version 3.6.b (Firmware-Build 41480).

Each chapter specifies the PIXIT for each applicable ACSI service model as structured in IEC 61850-10.

## PIXIT for Association model

| Description   | Value / Clarification   |                    |      |                  |      |                       |          |          |     |              |     |
|---|---|--------------------|------|------------------|------|-----------------------|----------|----------|-----|--------------|-----|
| Maximum number of clients that can set-up an association simultaneously                   | 4   |                    |      |                  |      |                       |          |          |     |              |     |
| TCP_KEEPALIVE values  | Keep Alive Time : configurable between 1 – 7200s<br>Keep Alive Interval : configurable between 1 – 60s<br>Keep Alive Retry : fix 3  |                    |      |                  |      |                       |          |          |     |              |     |
| Lost connection detection time  | A lost connection is detected after<br>Keep Alive Time + (Keep Alive Retry + 1) * Keep Alive Interval   |                    |      |                  |      |                       |          |          |     |              |     |
| Is authentication supported?  | N   |                    |      |                  |      |                       |          |          |     |              |     |
| What association parameters are necessary for successful association?                     | <table border="0"> <tr> <td>Transport selector</td> <td>Y</td> </tr> <tr> <td>Session selector</td> <td>Y</td> </tr> <tr> <td>Presentation selector</td> <td>Y</td> </tr> <tr> <td>AP Title</td> <td>N</td> </tr> <tr> <td>AE Qualifier</td> <td>N</td> </tr> </table>                  | Transport selector | Y    | Session selector | Y    | Presentation selector | Y        | AP Title | N   | AE Qualifier | N   |
| Transport selector  | Y   |                    |      |                  |      |                       |          |          |     |              |     |
| Session selector  | Y   |                    |      |                  |      |                       |          |          |     |              |     |
| Presentation selector   | Y   |                    |      |                  |      |                       |          |          |     |              |     |
| AP Title  | N   |                    |      |                  |      |                       |          |          |     |              |     |
| AE Qualifier  | N   |                    |      |                  |      |                       |          |          |     |              |     |
| If association parameters are necessary for association, describe the correct values e.g. | <table border="0"> <tr> <td>Transport selector</td> <td>0001</td> </tr> <tr> <td>Session selector</td> <td>0001</td> </tr> <tr> <td>Presentation selector</td> <td>00000001</td> </tr> <tr> <td>AP Title</td> <td>any</td> </tr> <tr> <td>AE Qualifier</td> <td>any</td> </tr> </table> | Transport selector | 0001 | Session selector | 0001 | Presentation selector | 00000001 | AP Title | any | AE Qualifier | any |
| Transport selector  | 0001  |                    |      |                  |      |                       |          |          |     |              |     |
| Session selector  | 0001  |                    |      |                  |      |                       |          |          |     |              |     |
| Presentation selector   | 00000001  |                    |      |                  |      |                       |          |          |     |              |     |
| AP Title  | any   |                    |      |                  |      |                       |          |          |     |              |     |
| AE Qualifier  | any   |                    |      |                  |      |                       |          |          |     |              |     |
| What is the maximum and minimum MMS PDU size?   | <table border="0"> <tr> <td>Max MMS PDU size</td> <td>64kB</td> </tr> <tr> <td>Min MMS PDU size</td> <td>4000</td> </tr> </table>   | Max MMS PDU size   | 64kB | Min MMS PDU size | 4000 |                       |          |          |     |              |     |
| Max MMS PDU size  | 64kB  |                    |      |                  |      |                       |          |          |     |              |     |
| Min MMS PDU size  | 4000  |                    |      |                  |      |                       |          |          |     |              |     |
| What is the maximum start-up time after a power supply interrupt?                         | max 300 seconds until HMI is operable<br>max 30 seconds until protection and IEC61850 is operable   |                    |      |                  |      |                       |          |          |     |              |     |

## PIXIT for Server model

| Description   | Value / Clarification   |
|---|---|
| <p>Which analogue value (MX) quality bits are supported (can be set by server)?</p> | <p>Validity:</p> <ul style="list-style-type: none"> <li>Y Good,</li> <li>N Invalid,</li> <li>N Reserved,</li> <li>N Questionable</li> <li>N Overflow</li> <li>N OutofRange</li> <li>N BadReference</li> <li>N Oscillatory</li> <li>N Failure</li> <li>N OldData</li> <li>N Inconsistent</li> <li>N Inaccurate</li> </ul> <p>Source:</p> <ul style="list-style-type: none"> <li>Y Process</li> <li>N Substituted</li> <li>N Test</li> <li>N OperatorBlocked</li> </ul> |
| <p>Which status value (ST) quality bits are supported (can be set by server)?</p>   | <p>Validity:</p> <ul style="list-style-type: none"> <li>Y Good</li> <li>Y Invalid</li> <li>N Reserved</li> <li>Y Questionable</li> <li>N BadReference</li> <li>N Oscillatory</li> <li>Y Failure</li> <li>N OldData</li> <li>Y Inconsistent</li> <li>N Inaccurate</li> </ul> <p>Source:</p> <ul style="list-style-type: none"> <li>Y Process</li> <li>N Substituted</li> <li>N Test</li> <li>N OperatorBlocked</li> </ul>  |

| <b>Description</b>  | <b>Value / Clarification</b>  |
|---|---|
| What is the maximum number of data values in one GetDataValues request? | Not restricted; MMS PDU is the limit.   |
| What is the maximum number of data values in one SetDataValues request? | Not restricted; MMS PDU is the limit.   |
| Deadband calculation for measurement                                    | 0 – Deadbanding disabled. Measurements follow the instantaneous value.<br>1 – 100000 - The delta sum up from the last updated value every second. If the sum is bigger than the deadband measurement value will be updated. |

## PIXIT for Data set model

| Description  | Value / Clarification   |
|--|---|
| What is the maximum number of data elements in one data set (compare ICD setting)? | 60  |
| How many persistent data sets can be created by one or more clients?               | 15<br>(If there are datasets defined in the SCL file, only the remaining amount can be created by the clients during run-time.) |
| How many non-persistent data sets can be created by one or more clients?           | 15  |

## PIXIT for Reporting model

| Description   | Value / Clarification   |                 |   |                   |   |                      |   |               |   |                       |   |                 |   |         |   |          |   |              |   |
|---|---|-----------------|---|-------------------|---|----------------------|---|---------------|---|-----------------------|---|-----------------|---|---------|---|----------|---|--------------|---|
| The supported trigger conditions are<br>(compare PICS)  | <table border="0"> <tr><td>integrity</td><td>Y</td></tr> <tr><td>data change</td><td>Y</td></tr> <tr><td>quality change</td><td>Y</td></tr> <tr><td>data update</td><td>N</td></tr> <tr><td>general interrogation</td><td>Y</td></tr> </table>  | integrity       | Y | data change       | Y | quality change       | Y | data update   | N | general interrogation | Y |                 |   |         |   |          |   |              |   |
| integrity   | Y   |                 |   |                   |   |                      |   |               |   |                       |   |                 |   |         |   |          |   |              |   |
| data change   | Y   |                 |   |                   |   |                      |   |               |   |                       |   |                 |   |         |   |          |   |              |   |
| quality change  | Y   |                 |   |                   |   |                      |   |               |   |                       |   |                 |   |         |   |          |   |              |   |
| data update   | N   |                 |   |                   |   |                      |   |               |   |                       |   |                 |   |         |   |          |   |              |   |
| general interrogation   | Y   |                 |   |                   |   |                      |   |               |   |                       |   |                 |   |         |   |          |   |              |   |
| The supported optional fields are   | <table border="0"> <tr><td>sequence-number</td><td>Y</td></tr> <tr><td>report-time-stamp</td><td>Y</td></tr> <tr><td>reason-for-inclusion</td><td>Y</td></tr> <tr><td>data-set-name</td><td>Y</td></tr> <tr><td>data-reference</td><td>Y</td></tr> <tr><td>buffer-overflow</td><td>Y</td></tr> <tr><td>entryID</td><td>Y</td></tr> <tr><td>conf-rev</td><td>Y</td></tr> <tr><td>segmentation</td><td>Y</td></tr> </table> | 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 |
| 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   |                 |   |                   |   |                      |   |               |   |                       |   |                 |   |         |   |          |   |              |   |
| Can the server send segmented reports?  | Y   |                 |   |                   |   |                      |   |               |   |                       |   |                 |   |         |   |          |   |              |   |
| Mechanism on second internal data change notification of the same analogue data value within buffer period<br>(Compare IEC 61850-7-2 §14.2.2.9) | The last data value within buffer period will be reported.  |                 |   |                   |   |                      |   |               |   |                       |   |                 |   |         |   |          |   |              |   |
| Multi client URCB approach<br>(compare IEC 61850-7-2 §14.2.1)   | Each URCB is visible to all clients   |                 |   |                   |   |                      |   |               |   |                       |   |                 |   |         |   |          |   |              |   |
| What is the format of EntryID?  | Octet string, the last 4 bytes are used as counter.   |                 |   |                   |   |                      |   |               |   |                       |   |                 |   |         |   |          |   |              |   |
| What is the buffer size for each BRCB or how many reports can be buffered?  | 10000 bytes for each BRCB   |                 |   |                   |   |                      |   |               |   |                       |   |                 |   |         |   |          |   |              |   |
| Pre-configured RCB attributes that cannot be changed online when RptEna = FALSE<br>(see also the ICD report settings)                           | All RCB attributes can be changed online.   |                 |   |                   |   |                      |   |               |   |                       |   |                 |   |         |   |          |   |              |   |
| May the reported data set contain:<br>- structured data objects?<br>- data attributes?<br>- timestamp data attributes?                          | <table border="0"> <tr><td>Y</td></tr> <tr><td>Y</td></tr> <tr><td>Y</td></tr> </table>   | Y               | Y | Y                 |   |                      |   |               |   |                       |   |                 |   |         |   |          |   |              |   |
| Y   |   |                 |   |                   |   |                      |   |               |   |                       |   |                 |   |         |   |          |   |              |   |
| Y   |   |                 |   |                   |   |                      |   |               |   |                       |   |                 |   |         |   |          |   |              |   |
| Y   |   |                 |   |                   |   |                      |   |               |   |                       |   |                 |   |         |   |          |   |              |   |
| What is the scan cycle for binary events?<br><br>Is this fixed, configurable?   | <p>There is no scan cycle for binary events. Reporting works event driven</p> <p>Fixed</p>  |                 |   |                   |   |                      |   |               |   |                       |   |                 |   |         |   |          |   |              |   |

## PIXIT for Generic substation events model

| Description  | Value / Clarification  |
|--|--|
| <p>What elements of a subscribed GOOSE header are checked to decide the message is valid and the allData values are accepted? If yes, describe the conditions.</p> <p>Note: the VLAN tag may be removed by a ethernet switch and should not be checked</p>   | <p>N source MAC address</p> <p>Y destination MAC address</p> <p>Y Ethertype = 0x88B8</p> <p>N APPID</p> <p>Y gocbRef</p> <p>Y timeAllowedtoLive</p> <p>Y datSet</p> <p>Y goID</p> <p>N t</p> <p>Y stNum</p> <p>Y sqNum</p> <p>Y test</p> <p>Y confRev</p> <p>Y ndsCom</p> <p>Y numDatSetEntries</p>  |
| <p>What is the behavior when one or more subscribed GOOSE messages aren't received or are syntactically incorrect (missing GOOSE)?</p> <p>device reaction:</p> <ol style="list-style-type: none"> <li>1. Messages will be ignored.</li> <li>2. Status change will be ignored by the DUT and the quality is set as INVALID</li> <li>3. Status change will be accepted by the DUT and the quality is set as QUESTIONABLE</li> <li>4. Status change will be accepted by the DUT and the quality is set as GOOD</li> </ol> | <p>Reaction to received incorrect or missing GOOSE message:</p> <ul style="list-style-type: none"> <li>• wrong destination MAC address (1)</li> <li>• Ethertype != 0x88B8 (1)</li> <li>• wrong gocbRef (1)</li> <li>• timeAllowedtoLive exceeded: <ul style="list-style-type: none"> <li>- by factor 1: (3)</li> <li>- by factor 2: (2)</li> </ul> </li> <li>• wrong datSet (2)</li> <li>• wrong goID (2)</li> <li>• unexpected stNum (3)</li> <li>• unexpected sqNum (3)</li> <li>• test flag set (1)</li> <li>• wrong confRev (2)</li> <li>• ndsCom flag set (2)</li> <li>• numDatSetEntries != data entries in received message (1)</li> <li>• unexpected datatype in received message (2)</li> <li>• numDatSetEntries &lt; expected (2)</li> <li>• numDatSetEntries &gt; expected (4)</li> </ul> |



| Description   | Value / Clarification  |           |            |           |                            |         |         |                    |         |         |                              |         |          |   |          |          |   |          |          |           |        |        |
|---|--|-----------|------------|-----------|----------------------------|---------|---------|--------------------|---------|---------|------------------------------|---------|----------|---|----------|----------|---|----------|----------|-----------|--------|--------|
| Can the test flag in the published GOOSE be turned on / off ?   | N  |           |            |           |                            |         |         |                    |         |         |                              |         |          |   |          |          |   |          |          |           |        |        |
| What is the behavior when the GOOSE publish configuration is incorrect?   | Wrong GOOSE configuration in SCD-File is not possible, because it is checked when downloading it to the device.<br><br>Changing the GOOSE configuration during runtime is not supported.   |           |            |           |                            |         |         |                    |         |         |                              |         |          |   |          |          |   |          |          |           |        |        |
| When is a subscribed GOOSE marked as lost?<br>(TAL = time allowed to live value from the last received GOOSE message) | message does not arrive prior to TAL   |           |            |           |                            |         |         |                    |         |         |                              |         |          |   |          |          |   |          |          |           |        |        |
| What is the behavior when a subscribed GOOSE message is out-of-order?   | This means that the DUT receives unexpected sqNum and/ or stNum. DUT reaction see item above.  |           |            |           |                            |         |         |                    |         |         |                              |         |          |   |          |          |   |          |          |           |        |        |
| What is the behavior when a subscribed GOOSE message is duplicated?   | This means that the DUT receives unexpected sqNum and stNum. DUT reaction see item above.  |           |            |           |                            |         |         |                    |         |         |                              |         |          |   |          |          |   |          |          |           |        |        |
| Does the device subscribe to GOOSE messages with/without the VLAN tag?  | Y with the VLAN tag<br>Y without the VLAN tag  |           |            |           |                            |         |         |                    |         |         |                              |         |          |   |          |          |   |          |          |           |        |        |
| May the GOOSE data set contain:<br>- structured data objects?<br>- data attributes?<br>- timestamp data attributes?   | <table border="1"> <thead> <tr> <th></th> <th>Subscribed</th> <th>Published</th> </tr> </thead> <tbody> <tr> <td>- structured data objects?</td> <td>N</td> <td>N</td> </tr> <tr> <td>- data attributes?</td> <td>Y</td> <td>Y</td> </tr> <tr> <td>- timestamp data attributes?</td> <td>Y</td> <td>Y</td> </tr> </tbody> </table>   |           | Subscribed | Published | - structured data objects? | N       | N       | - data attributes? | Y       | Y       | - timestamp data attributes? | Y       | Y        |   |          |          |   |          |          |           |        |        |
|   | Subscribed   | Published |            |           |                            |         |         |                    |         |         |                              |         |          |   |          |          |   |          |          |           |        |        |
| - structured data objects?  | N  | N         |            |           |                            |         |         |                    |         |         |                              |         |          |   |          |          |   |          |          |           |        |        |
| - data attributes?  | Y  | Y         |            |           |                            |         |         |                    |         |         |                              |         |          |   |          |          |   |          |          |           |        |        |
| - timestamp data attributes?  | Y  | Y         |            |           |                            |         |         |                    |         |         |                              |         |          |   |          |          |   |          |          |           |        |        |
| What is the slow retransmission time?<br>Is it fixed or configurable?   | 33 sec with TAL = 66 sec<br><br>Fixed  |           |            |           |                            |         |         |                    |         |         |                              |         |          |   |          |          |   |          |          |           |        |        |
| What is the fast retransmission scheme?<br>Is it fixed or configurable?   | Fixed scheme<br>retrans: retrans time <b>before next</b> message<br><br><table border="1"> <thead> <tr> <th>sqNum</th> <th>retrans</th> <th>TAL</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>32 msec</td> <td>64 msec</td> </tr> <tr> <td>1</td> <td>32 msec</td> <td>64 msec</td> </tr> <tr> <td>2</td> <td>64 msec</td> <td>128 msec</td> </tr> <tr> <td>3</td> <td>128 msec</td> <td>256 msec</td> </tr> <tr> <td>4</td> <td>256 msec</td> <td>512 msec</td> </tr> <tr> <td>... until</td> <td>33 sec</td> <td>66 sec</td> </tr> </tbody> </table> | sqNum     | retrans    | TAL       | 0                          | 32 msec | 64 msec | 1                  | 32 msec | 64 msec | 2                            | 64 msec | 128 msec | 3 | 128 msec | 256 msec | 4 | 256 msec | 512 msec | ... until | 33 sec | 66 sec |
| sqNum   | retrans  | TAL       |            |           |                            |         |         |                    |         |         |                              |         |          |   |          |          |   |          |          |           |        |        |
| 0   | 32 msec  | 64 msec   |            |           |                            |         |         |                    |         |         |                              |         |          |   |          |          |   |          |          |           |        |        |
| 1   | 32 msec  | 64 msec   |            |           |                            |         |         |                    |         |         |                              |         |          |   |          |          |   |          |          |           |        |        |
| 2   | 64 msec  | 128 msec  |            |           |                            |         |         |                    |         |         |                              |         |          |   |          |          |   |          |          |           |        |        |
| 3   | 128 msec   | 256 msec  |            |           |                            |         |         |                    |         |         |                              |         |          |   |          |          |   |          |          |           |        |        |
| 4   | 256 msec   | 512 msec  |            |           |                            |         |         |                    |         |         |                              |         |          |   |          |          |   |          |          |           |        |        |
| ... until   | 33 sec   | 66 sec    |            |           |                            |         |         |                    |         |         |                              |         |          |   |          |          |   |          |          |           |        |        |
| Can the Goose publish be turned on / off by using SetGoCBValues(GoEna)?   | N  |           |            |           |                            |         |         |                    |         |         |                              |         |          |   |          |          |   |          |          |           |        |        |

TAL = Time Allowed to Live

## PIXIT for Control model

| Description   | Value / Clarification   |
|---|---|
| What control modes are supported (compare PICS)?  | N status-only<br>Y direct-with-normal-security<br>N sbo-with-normal-security<br>N direct-with-enhanced-security<br>Y sbo-with-enhanced-security   |
| Is the control model fixed, configurable and/or online changeable?  | Fixed   |
| Is Time activated operate (operTm) supported?   | N   |
| Is "operate-many" supported?  | N   |
| What is the behavior of the DUT when the test attribute is set in the SelectWithValue and/or Operate request?                 | DUT ignores the test value and execute the command as usual   |
| What are the conditions for the time (T) attribute in the SelectWithValue and/or Operate request?                             | DUT ignores the time value and execute the command as usual   |
| Is pulse configuration supported?   | N   |
| What is the behavior of the DUT when the check conditions are set<br>Is this behavior fixed, configurable, online changeable? | DUT ignores the check value transmitted by IEC61850 and performs the check depending on the device settings.<br>Behavior is fixed   |
| What additional cause diagnosis are supported?  | Y Blocked-by-switching-hierarchy<br>Y Select-failed<br>N Invalid-position<br>Y Position-reached<br>Y Parameter-change-in-execution<br>N Step-limit<br>N Blocked-by-Mode<br>N Blocked-by-process<br>Y Blocked-by-interlocking<br>Y Blocked-by-synchrocheck<br>Y Command-already-in-execution<br>N Blocked-by-health<br>Y 1-of-n-control<br>N Abortion-by-cancel<br>Y Time-limit-over<br>N Abortion-by-trip |
| How to force a "test-not-ok" respond with SelectWithValue request?  | Double select of the same object.   |
| How to force a "test-not-ok" respond with Select request?   | n.a.  |

| Description  | Value / Clarification   |
|--|---|
| How to force a "test-not-ok" respond with Operate request?   | DOns: n.a.<br>SBOns: n.a.<br>DOes: n.a.<br>SBOes: Send an Operate with actual value to an unselected SBOes object.  |
| Which origin categories are supported?   | Values 0 – 8 are supported  |
| <p>What happens if the orCat is not supported?</p> <p>Does the IED accept an selectwithvalue/operate with the same ctVal as the current status value?</p> <p>Does the IED accept a select/operate on the same control object from 2 different clients at the same time?</p> <p>Does the IED accept a select/selectwithvalue from the same client when the control object is already selected (tissue 334)?</p> <p>Is for SBOes the internal validation performed during the SelectWithValue and/or Operate step?</p> <p>Can a control operation be blocked by Mod=Off or Blocked?</p> <p>Does the IED support local / remote operation?</p> <p>Is it possible to select more than one switch at the same time?</p> | <p>DOns: Error message "not supported"</p> <p>SBOns: n.a.</p> <p>DOes: n.a.</p> <p>SBOes: Error message "not supported"</p> <p>DOns: Y</p> <p>SBOns: n.a.</p> <p>DOes: n.a.</p> <p>SBOes: N</p> <p>The DUT performs the check during the SelectWithValue phase.</p> <p>DOns: N</p> <p>SBOns: n.a.</p> <p>DOes: n.a.</p> <p>SBOes: N</p> <p>SBOns: n.a.</p> <p>SBOes: N</p> <p>SelectWithValue or Operate</p> <p>It depends on the performed validation step.</p> <p>N</p> <p>Y</p> <p>N</p> <p>The DUT allows to select only one switch at a time</p> |

## PIXIT for Time and time synchronisation model

| Description  | Value / Clarification   |
|--|---|
| What quality bits are supported?   | N LeapSecondsKnown<br>N ClockFailure<br>Y ClockNotSynchronized  |
| Describe the behavior when the time synchronization signal/messages are lost | The quality bit "ClockNotSynchronized" is set to TRUE after a fixed time period.  |
| When is the time quality bit "Clock failure" set?                            | Not supported   |
| When is the time quality bit "Clock not synchronised" set?                   | 90 seconds after receiving the last synchronization signal/messages   |
| Is the timestamp of a binary event adjusted to the configured scan cycle?    | N<br>(Timestamps of binary events lying in the past are not adjusted when the system clock is updated.)   |
| Does the device support time zone and daylight saving?                       | Y   |
| Which attributes of the SNTP response packet are validated?                  | N Leap indicator not equal to 3?<br>Y Mode is equal to SERVER<br>N OriginateTimestamp is equal to value sent by the SNTP client as Transmit Timestamp<br>N RX/TX timestamp fields are checked for reasonableness<br>Y SNTP version (3 and 4 accepted) |