Pulse Oximeter Service

Bluetooth® Test Specification

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Group Prepared by Medical Devices Working Group

Feedback Email med-main@bluetooth.org

Abstract

This document defines test structures and procedures for conformance testing of products implementing the Pulse Oximeter Service Specification.
Revision History

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1 Scope

This Bluetooth document contains the Test Suite Structure (TSS) and Test Cases (TC) to test the Pulse Oximeter Service.

The objective of this test specification is to provide a basis for interoperability tests for Bluetooth devices giving a high probability of air interface interoperability between different manufacturers’ Bluetooth devices.
2 References, Definitions, and Abbreviations

2.1 References
This Bluetooth document incorporates, by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter.

[1] Test Strategy and Terminology Overview
[2] Bluetooth Core Specification v4.0 or later
[3] Pulse Oximeter Profile Specification V1.0
[4] ICS Proforma for Pulse Oximeter Service
[6] Pulse Oximeter Service Specification V1.0
[7] Characteristic and Descriptor descriptions are accessible via the Bluetooth SIG Assigned Numbers

2.2 Definitions
For the purpose of this Bluetooth document, the definitions in [1] and [2] apply.

2.3 Abbreviations
For the purpose of this Bluetooth document, the abbreviations in [1] and [2] apply.
Additionally:

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Meaning</th>
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<td>PLX</td>
<td>Pulse Oximeter</td>
</tr>
<tr>
<td>RACP</td>
<td>Record Access Control Point</td>
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Table 2.1: TC Class Naming Convention
3 Test Suite Structure (TSS)

3.1 Overview

The Pulse Oximeter Monitoring Profile requires the presence of GAP, SM/SDP and GATT. This is illustrated in Figure 3.1.

![Pulse Oximeter Service Test Model](image)

**Figure 3.1:** Pulse Oximeter Service Test Model

3.2 Test Strategy

The test objectives are to verify functionality of the Pulse Oximeter Service within a Bluetooth Host and enable interoperability between Bluetooth Hosts on different devices. The testing approach is to cover mandatory and optional requirements in the service specification and to match these to the support of the IUT as described in the ICS Proforma.

The test equipment shall provide an implementation of the Radio Controller and the parts of the Host Subsystem needed to perform the test cases defined in the Pulse Oximeter Service Test Specification. For some test cases, it is necessary to stimulate the IUT from an Upper Tester. In practice, this could be implemented as a special test interface, an MMI, or another interface supported by the IUT.

The Pulse Oximeter Service test suite contains Behavior Valid (BV) tests complemented with Behavior Invalid (BI) tests where required. The test coverage mirrored in the test suite structure
is the result of a process that started with catalogued specification requirements that were logically grouped and assessed for testability enabling coverage in defined Test Cases.

The test suite structure is a tree with the first level representing the protocol groups and described on Section 3.3.

### 3.3 Test Groups

The following test groups have been defined.

#### 3.3.1 Service Definition

Verify the service definition.

#### 3.3.2 Characteristic Declaration

Verify the presence and contents of characteristic declarations.

#### 3.3.3 Characteristic Descriptors

Verify the presence and contents of characteristic descriptors.

#### 3.3.4 Characteristic Read

Verify that characteristics that support reading can be read. Verify the format and value of characteristic values.

#### 3.3.5 Configure Indication and Notification

Verify characteristics can be configured for indication or notification.

#### 3.3.6 Characteristic Indication

Verify that characteristics that support indication can be indicated.

#### 3.3.7 Characteristic Notification

Verify that characteristics that support notification can be notified.

#### 3.3.8 Record Access Control Point (RACP) Procedures

Verify the operation of additional procedures defined in the service specification including aborting procedures, deleting records, reporting records and counting the number of records.
4 Test Cases

4.1 Introduction

4.1.1 Test Case Identification Conventions

Test cases shall be assigned unique identifiers per the conventions in [2]. The convention used here is PLXS/SEN/<feat>/<xx>-<nn>-<y>.

Test group abbreviations for "feature" are defined in Table 4.1.

<table>
<thead>
<tr>
<th>Identifier</th>
<th>Feature Identifier &lt;feat&gt;</th>
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<td>CW</td>
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</tr>
<tr>
<td>CI</td>
<td>Characteristic Indication</td>
</tr>
<tr>
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<td>RACP – Abort Procedure</td>
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<tr>
<td>RAD</td>
<td>RACP – Delete Procedure</td>
</tr>
<tr>
<td>RAN</td>
<td>RACP – Number Procedure</td>
</tr>
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<td>RAR</td>
<td>RACP – Report Procedure</td>
</tr>
<tr>
<td>RAE</td>
<td>RACP – Specific Errors</td>
</tr>
<tr>
<td>SEN</td>
<td>Sensor Role</td>
</tr>
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</table>

Table 4.1: TC Feature Naming Convention

4.1.2 Conformance

When conformance is claimed, all capabilities indicated as mandatory for this Specification shall be supported in the specified manner (process-mandatory). This also applies for all optional and conditional capabilities for which support is indicated. All mandatory capabilities, and optional and conditional capabilities for which support is indicated are subject to verification as part of the Bluetooth certification program.

The Bluetooth Qualification Program may employ tests to verify implementation robustness. The level of implementation robustness that is verified varies from one Specification to another and may be revised for cause based on interoperability issues found in the market.

Such tests may verify:
• That claimed capabilities may be used in any order and any number of repetitions that is not excluded by the Specification, OR

• That capabilities enabled by the implementations are sustained over durations expected by the use case, OR

• That the implementation gracefully handles any quantity of data expected by the use case, OR

• That in cases where more than one valid interpretation of the Specification exists, the implementation complies with at least one interpretation and gracefully handles other interpretations OR

• That the implementation is immune to attempted security exploits.

A single execution of each of the required tests is required in order to constitute a pass verdict. However, it is noted that in order to provide a foundation for interoperability, it is necessary that a qualified implementation consistently and repeatedly pass any of the applicable tests.

In any case, where a member finds an issue with the Test Plan Generator, the Test Case as described in the Test Specification, or with the Test System utilized, the Member is required to notify the responsible party via an errata request such that the issue may be addressed.

4.1.3 Pass/Fail Verdict Conventions

Each test case has an Expected Outcome section, which outlines all the detailed pass criteria conditions that shall be met by the IUT to merit a Pass Verdict.

The convention in this test specification is that, unless there is a specific set of fail conditions outlined in the test case, the IUT fails the test case as soon as one of the pass criteria conditions cannot be met. If this occurs, the outcome of the test shall be the Fail Verdict.

4.2 Setup Preambles

The procedures defined in this section are provided for information, as they are used by test equipment in achieving the initial conditions in certain tests.

4.2.1 ATT Bearer on LE Transport

Follow the preamble procedure described in Section 4.2.1.2 in [5] with the IUT operating in the Peripheral role.

4.2.2 ATT Bearer on BR/EDR Transport

Follow the preamble procedure described in Section 4.2.1.1 in [5] with the IUT operating in the Peripheral role.

4.2.3 RACP

Follow this preamble procedure to enable IUT for use with RACP.
1. If a connection exists, it shall be disconnected.

2. Establish an ATT Bearer connection between the Lower Tester and IUT as described in Section 4.2.1 if using LE Transport or Section 4.2.2 if using a BR/EDR Transport.

3. The handle of the PLX Spot-check Measurement characteristic and RACP characteristic has been previously discovered by the Lower Tester during the test procedure in Section 4.4 or is known to the Lower Tester by other means.

4. The handle of the Client Characteristic Configuration descriptor of the PLX Spot-check Measurement characteristic and RACP characteristic has been previously discovered by the Lower Tester during the test procedure in Section 4.4 or is known to the Lower Tester by other means.

5. If the Lower Tester and IUT were not previously bonded, perform a bonding procedure. If previously bonded, re-enable encryption.

6. The PLX Spot-check Measurement characteristic is configured for indications.

7. The RACP characteristic is configured for indications.

### 4.3 Service Definition

Verify the service definition.

#### 4.3.1 PLXS/SEN/SD/BV-01-C [Service Definition over LE– ‘Pulse Oximeter Service’]

- **Test Purpose**
  
  Verify that the IUT has one instantiation of the Pulse Oximeter Service as a primary service. This test case only applies when using the LE transport.

- **Reference**
  
  Section 2 in [6]

- **Initial Condition**
  
  Establish an ATT Bearer connection between the Lower Tester and IUT as described in Section 4.2.1 if using LE Transport or Section 4.2.2 if using a BR/EDR Transport.

- **Test Procedure**
  
  1. The Lower Tester sends an ATT_Find_By_Type_Value_Request (0x0001, 0xFFFF) to the IUT, with type set to «Primary Service» and Value set to «Pulse Oximeter Service». Verify one attribute handle range is returned, containing the starting handle and the ending handle of the «Pulse Oximeter Service» definition.

  2. If no instances of Pulse Oximeter Service as a primary service are found, the Lower Tester sends an ATT_Read_By_Type_Request (0x0001, 0xFFFF) to the IUT, with type set to «Include». Verify one attribute handle range is returned, containing the starting handle and the ending handle of the «Pulse Oximeter Service» definition.
PLXS.TS.1.0.2

Figure 4.1: Pulse Oximeter Service Discovery

- Notes
  Ending handle may be 0xFFFF if «Pulse Oximeter Service» is the last service.

- Expected Outcome
  Pass verdict
  One attribute handle range is returned either as a primary service or a secondary service containing the starting handle and the ending handle of the «Pulse Oximeter Service» definition.

4.3.2 PLXS/SEN/SD/BV-02-C [SDP Record]

- Test Purpose
  Verify the SDP Record for the Pulse Oximeter Service. This test case only applies when using the BR/EDR transport.

- Reference
  Section 2 in [6]

- Initial Condition
  An ACL connection over BR/EDR is established between the Lower Tester and IUT as described in Section 4.2.2.

- Test Procedure
1. The Lower Tester establishes an SDP connection to the IUT.
2. The Lower Tester sends SDP requests to retrieve all attributes of the SDP record for the Pulse Oximeter.

**Expected Outcome**

Pass verdict
The SDP record for the service is found.
All attributes, which are mandatory for the service, are present in the SDP record.
The values of all attributes in the SDP record meet the requirements of the service.
The GATT Start Handle and GATT End Handle parameters in the SDP record match the start handle and end handle of the service.

### 4.4 Characteristic Declaration

**Test Purpose**

This test group is for generic use and contains one or more test cases to verify that the characteristic property field of the characteristic declaration meets the requirements of the service. The verification is performed one property at a time, as enumerated in the test cases in Table 4.2 below, using this generic test procedure.

**Reference**

Section 3 in [6]

**Initial Condition**

The handle range of the service has been previously discovered by the Lower Tester in test case PLXS/SEN/SD/BN-01-C [Service Definition over LE– ‘Pulse Oximeter Service’] or PLXS/SEN/SD/BN-02-C [SDP Record].

Establish an ATT Bearer connection between the Lower Tester and IUT as described in Section 4.2.1 if using LE Transport or Section 4.2.2 if using a BR/EDR Transport.

**Test Procedure**

The following test procedure applies to the test cases listed in Table 4.2:
1. Discover all characteristics of the service by executing the test procedure of GATT test case GATT/SR/GAD/BN-04-C in [5].
2. For a discovered characteristic that is listed in the table below, verify the characteristic properties field of the characteristic declaration meets the requirements of the service.

**Expected Outcome**

The following pass verdicts apply to the test cases listed in Table 4.2:
Pass verdict

Each characteristic is discovered and the corresponding characteristic properties field of the characteristic declaration meets the requirements of the service.

<table>
<thead>
<tr>
<th>Test Case</th>
<th>Characteristic Properties Value (Requirements)</th>
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<tbody>
<tr>
<td>4.4.1 PLXS/SEN/DEC/BV-01-C [Characteristic Declaration – ‘PLX Spot-check Measurement’]</td>
<td>0x20 (see [7])</td>
</tr>
<tr>
<td>4.4.2 PLXS/SEN/DEC/BV-02-C [Characteristic Declaration – ‘PLX Continuous Measurement’]</td>
<td>0x10 (see [7])</td>
</tr>
<tr>
<td>4.4.3 PLXS/SEN/DEC/BV-03-C [Characteristic Declaration – ‘PLX Features’]</td>
<td>0x02 (see [7])</td>
</tr>
<tr>
<td>4.4.4 PLXS/SEN/DEC/BV-04-C [Characteristic Declaration – ‘RACP’]</td>
<td>0x28 (see [7])</td>
</tr>
</tbody>
</table>

*Table 4.2: Characteristic Declaration Test Cases*

### 4.5 Characteristic Descriptors

- **Test Purpose**
  
  This test group is for generic use and contains one or more test cases to verify that the characteristic descriptors meet the requirements of the service. The verification is done one descriptor at a time, as enumerated in the test cases in *Table 4.3*, using this generic test procedure.

- **Reference**

  Section 3 in [6]

- **Initial Condition**

  The handle range of each characteristic referenced in the test cases below has been previously discovered by the Lower Tester during the test procedure in Section 4.4 or is known to the Lower Tester by other means.

  Establish an ATT Bearer connection between the Lower Tester and IUT as described in Section 4.2.1 if using LE Transport or Section 4.2.2 if using a BR/EDR Transport.

- **Test Procedure**

  The following test procedure applies to the test cases listed in *Table 4.3:*
For each characteristic referenced in a test case below:

1. Discover all characteristic descriptors of the characteristic by executing the test procedure of GATT test case GATT/SR/GAD/BV-06-C in [5] using the handle range of the characteristic. The IUT returns one or more handle-UUID pairs.

2. If the UUID in a handle-UUID pair is for a characteristic descriptor referenced in a test case below, read the characteristic descriptor by executing the test procedure of GATT test case GATT/SR/GAR/BV-06-C in [5].

3. Verify the value of the characteristic descriptor meets the requirements of the service.

- **Expected Outcome**

The following pass verdicts apply to the test cases listed in Table 4.3:

**Pass verdict**
The characteristic descriptor is discovered, the characteristic descriptor is read, and the value of the characteristic descriptor meets the requirements of the service.

<table>
<thead>
<tr>
<th>Test Case</th>
<th>Value (Requirements)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.5.1 PLXS/SEN/DES/BV-01-C [PLX Spot-check Measurement – ‘Client Characteristic Configuration Descriptor’]</td>
<td>0x0000 or 0x0002 (3 in [6])</td>
</tr>
<tr>
<td>4.5.2 PLXS/SEN/DES/BV-02-C [PLX Continuous Measurement – ‘Client Characteristic Configuration Descriptor’]</td>
<td>0x0000 or 0x0001 (3 in [6])</td>
</tr>
<tr>
<td>4.5.3 PLXS/SEN/DES/BV-03-C [RACP – ‘Client Characteristic Configuration Descriptor’]</td>
<td>0x0000 or 0x0002 (3 in [6])</td>
</tr>
</tbody>
</table>

**Table 4.3:** Characteristic Descriptor Test Cases

### 4.6 Characteristic Read

- **Test Purpose**

This test group is for generic use and contains one or more test cases to read and verify that the characteristic values required by the service are compliant. The verification is done one value at the time, as enumerated in the test cases in Table 4.4 below, using this generic test procedure.

- **Reference**

Section 3.3 in [6]

- **Initial Condition**
The handle of each characteristic value referenced in the test cases below has been previously discovered by the Lower Tester during the test procedure in Section 4.4 or is known to the Lower Tester by other means.

Establish an ATT Bearer connection between the Lower Tester and IUT as described in Section 4.2.1 if using LE Transport or Section 4.2.2 if using a BR/EDR Transport.

- **Test Procedure**

  The following test procedure applies to the test cases listed in the table below for each characteristic referenced in a test case below:

  1. Read the characteristic value by executing the test procedure of GATT test case GATT/SR/GAR/BV-01-C in [5].

  2. Verify the characteristic value meets the requirements of the service.

- **Expected Outcome**

  The following pass verdicts apply to the test cases listed in Table 4.4:

  Pass verdict

  The characteristic is successfully read and the characteristic value meets the requirements of the service.

<table>
<thead>
<tr>
<th>Test Case</th>
<th>Value (Requirements)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.6.1 PLXS/SEN/CR/BV-01-C [Characteristic Read – ‘PLX Features’]</td>
<td>2, 4, 5, or 7 octets received with RFU bits set to 0. (Section 3.3 in [6])</td>
</tr>
<tr>
<td>4.6.2 PLXS/SEN/CR/BV-02-C [Characteristic Read – ‘PLX Features – Measurement Status Support Field’]</td>
<td>2 octets received in the correct position in the characteristic (after Supported Features field and before Device and Sensor Status Support field, if present) with RFU bits set to 0 (Section 3.3 in [6])</td>
</tr>
<tr>
<td>4.6.3 PLXS/SEN/CR/BV-03-C [Characteristic Read – ‘PLX Features – Device and Sensor Status Support Field’]</td>
<td>3 octets received in the correct position (after Supported Features field and after Measurement Status Support field, if present) in the characteristic with RFU bits set to 0 (Section 3.3 in [6])</td>
</tr>
</tbody>
</table>

*Table 4.4: Characteristic Read Value Test Cases*

### 4.7 Configure Indication and Notification

- **Test Purpose**
This test group is for generic use and contains one or more test cases to verify compliant operation in response to enable and disable characteristic indication or notification. The verification is done one value at a time, as enumerated in the test cases in Table 4.5 below, using this generic test procedure.

- **Reference**
  
  Section 3 in [6]

- **Initial Condition**
  
  The handle of each characteristic value referenced in the test cases below has been previously discovered by the Lower Tester during the test procedure in Section 4.4 or is known to the Lower Tester by other means.

  The handle of the client characteristic configuration descriptor of each characteristic referenced in the test cases below has been previously discovered by the Lower Tester during the test procedure in Section 4.5 or is known to the Lower Tester by other means.

  Establish an ATT Bearer connection between the Lower Tester and IUT as described in Section 4.2.1 if using LE Transport or Section 4.2.2 if using a BR/EDR Transport.

- **Test Procedure**
  
  The following test procedure applies to the test cases listed in the table below:

  1. Disable indication or notification by writing value 0x0000 to the client characteristic configuration descriptor of the characteristic using the test procedure of GATT test case GATT/SR/GAW/BV-08-C in [5].

  2. The Lower Tester reads the value of the client characteristic configuration descriptor.

  3. If the test case is for notification, enable notification by writing value 0x0001 to the client characteristic configuration descriptor of the characteristic.

  4. Otherwise, if the test case is for indication, enable indication by writing value 0x0002 to the client characteristic configuration descriptor of the characteristic.

  5. The Lower Tester reads the value of the client characteristic configuration descriptor.

- **Expected Outcome**
  
  **Pass verdict**

  The characteristic descriptor is successfully written and the value returned when read is consistent with the value written.
### Table 4.5: Configure Indication and Notification Test Cases

<table>
<thead>
<tr>
<th>Test Case</th>
<th>Value (Requirements)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.7.1 PLXS/SEN/CON/BV-01-C [Configure Indication – ‘PLX Spot-check Measurement]</td>
<td>0x0002 (Section 3 in [6])</td>
</tr>
<tr>
<td>4.7.2 PLXS/SEN/CON/BV-02-C [Configure Indication – ‘RACP’]</td>
<td>0x0002 (Section 3 in [6])</td>
</tr>
<tr>
<td>4.7.3 PLXS/SEN/CON/BV-03-C [Configure Notification – ‘PLX Continuous Measurement]</td>
<td>0x0001 (Section 3 in [6])</td>
</tr>
</tbody>
</table>

### 4.8 PLX Spot-check Measurement Indication

This test group contains test cases to verify compliant operation when the IUT sends indications of characteristic values.

#### 4.8.1 PLXS/SEN/CI/BV-01-C [PLX Spot-check Measurement Indication]

- **Test Purpose**
  
  Verify the IUT can send an indication of the Spot-Check Measurement characteristic that includes the mandatory fields (i.e., the Flags field and the SpO2PR-Spot-Check field).

- **Reference**
  
  Section 3.1 in [6]

- **Initial Condition**
  
  The handle of the PLX Spot-check Measurement characteristic value referenced in the test cases below has been previously discovered by the Lower Tester during the test procedure in Section 4.4 or is known to the Lower Tester by other means.

  The handle of the client characteristic configuration descriptor of each characteristic referenced in the test cases below has been previously discovered by the Lower Tester during the test procedure in Section 4.5 or is known to the Lower Tester by other means.

  The client characteristic configuration descriptor for the IUT has been configured for indications.

  Establish an ATT Bearer connection between the Lower Tester and IUT as described in Section 4.2.1 if using LE Transport or Section 4.2.2 if using a BR/EDR Transport.

- **Test Procedure**
  
  1. Verify that a connection between the Lower Tester and IUT is established.
2. Perform an action on the IUT to create at least one PLX Spot-check Measurement characteristic with mandatory field values as defined in [6].

3. Verify the Lower Tester sends an `ATT_Handle_Value_Indication` from the IUT containing the characteristic handle and value.

4. Verify the Lower Tester sends an `ATT_Handle_Value_Confirmation` from the IUT.

5. Verify the characteristic value meets the requirements of the service.

- Expected Outcome

  **Pass verdict**

  The IUT sends one and only one indication of the PLX Spot-check Measurement characteristic.

  A Flags field and a SpO2PR-Spot-Check field are present in the record.

  The value of the characteristic meets the requirements of the service.

4.8.2 PLXS/SEN/CI/BV-02-C [PLX Spot-check Measurement Indication – Timestamp]

- Test Purpose

  Verify the IUT can send indications of the PLX Spot-check Measurement characteristic that include Time Stamp values.

- Reference

  Section 3.11 in [6]

- Initial Condition

  The handle of the PLX Spot-check Measurement characteristic value referenced in the test cases below has been previously discovered by the Lower Tester during the test procedure in Section 4.4 or is known to the Lower Tester by other means.

  The handle of the client characteristic configuration descriptor of each characteristic referenced in the test cases below has been previously discovered by the Lower Tester during the test procedure in Section 4.5 or is known to the Lower Tester by other means.

  The client characteristic configuration descriptor for the IUT has been configured for indications.

  Establish an ATT Bearer connection between the Lower Tester and IUT as described in Section 4.2.1 if using LE Transport or Section 4.2.2 if using a BR/EDR Transport.

- Test Procedure

  1. Verify that a connection between the Lower Tester and IUT is established.
2. Perform an action on the IUT to create at least one PLX Spot-check Measurement characteristic that include the Timestamp field.

3. Verify the Lower Tester sends an `ATT_Handle_Value_Indication` from the IUT containing the characteristic handle and value.

4. Verify the Lower Tester sends an `ATT_Handle_Value_Confirmation` from the IUT.

5. Verify the characteristic value meets the requirements of the service.

- Expected Outcome

  **Pass verdict**

  The IUT sends one or more indications of the PLX Spot-check measurement characteristic that includes the Timestamp value.

  The value of the characteristic meets the requirements of the service.

4.8.3 PLXS/SEN/CI/BV-03-C [PLX Spot-check Measurement Indication – Measurement Status]

- Test Purpose

  Verify the IUT can send indications of the PLX Spot-check Measurement characteristic that include Measurement Status values.

- Reference

  Section 3.1 in [6]

- Initial Condition

  The handle of the PLX Spot-check Measurement characteristic value referenced in the test cases below has been previously discovered by the Lower Tester during the test procedure in Section 4.4 or is known to the Lower Tester by other means.

  The handle of the client characteristic configuration descriptor of each characteristic referenced in the test cases below has been previously discovered by the Lower Tester during the test procedure in Section 4.5 or is known to the Lower Tester by other means.

  The client characteristic configuration descriptor for the IUT has been configured for indications.

  Establish an ATT Bearer connection between the Lower Tester and IUT as described in Section 4.2.1 if using LE Transport or Section 4.2.2 if using a BR/EDR Transport.

- Test Procedure

  1. Verify that a connection between the Lower Tester and IUT is established.

  2. Perform an action on the IUT to create at least one PLX Spot-check Measurement characteristic that include the Measurement Status field.
3. Verify the Lower Tester sends an `ATT_Handle_Value_Indication` from the IUT containing the characteristic handle and value.

4. Verify the Lower Tester sends an `ATT_Handle_Value_Confirmation` from the IUT.

5. Verify the characteristic value meets the requirements of the service.

- **Expected Outcome**

  **Pass verdict**

  The IUT sends one or more indications of the PLX Spot-check measurement characteristic that includes the Measurement Status value.

  The value of the characteristic meets the requirements of the service.

4.8.4 **PLXS/SEN/CI/BV-04-C [PLX Spot-check Measurement Indication – Device and Sensor Status]**

- **Test Purpose**

  Verify the IUT can send indications of the PLX Spot-check Measurement characteristic that include Device and Sensor Status values.

- **Reference**

  Section 3.1 in [6]

- **Initial Condition**

  The handle of the PLX Spot-check Measurement characteristic value referenced in the test cases below has been previously discovered by the Lower Tester during the test procedure in Section 4.4 or is known to the Lower Tester by other means.

  The handle of the client characteristic configuration descriptor of each characteristic referenced in the test cases below has been previously discovered by the Lower Tester during the test procedure in Section 4.5 or is known to the Lower Tester by other means.

  The client characteristic configuration descriptor for the IUT has been configured for indications.

  Establish an ATT Bearer connection between the Lower Tester and IUT as described in Section 4.2.1 if using LE Transport or Section 4.2.2 if using a BR/EDR Transport.

- **Test Procedure**

  1. Verify that a connection between the Lower Tester and IUT is established.

  2. Perform an action on the IUT to create at least one PLX Spot-check Measurement characteristic that include the Device and Sensor Status field.

  3. Verify the Lower Tester sends an `ATT_Handle_Value_Indication` from the IUT containing the characteristic handle and value.
4. Verify the Lower Tester sends an `ATT_Handle_Value_Confirmation` from the IUT.
5. Verify the characteristic value meets the requirements of the service.

- **Expected Outcome**

  **Pass verdict**
  The IUT sends one or more indications of the PLX Spot-check measurement characteristic that includes the Device and Sensor Status value.
  The value of the characteristic meets the requirements of the service.

**4.8.5 PLXS/SEN/CI/BV-05-C [PLX Spot-check Measurement Indication – Pulse Amplitude Index]**

- **Test Purpose**

  Verify the IUT can send indications of the PLX Spot-check Measurement characteristic that include Pulse Amplitude Index values.

- **Reference**

  Section 3.1 in [6]

- **Initial Condition**

  The handle of the PLX Spot-check Measurement characteristic value referenced in the test cases below has been previously discovered by the Lower Tester during the test procedure in Section 4.4 or is known to the Lower Tester by other means.
  The handle of the client characteristic configuration descriptor of each characteristic referenced in the test cases below has been previously discovered by the Lower Tester during the test procedure in Section 4.5 or is known to the Lower Tester by other means.
  The client characteristic configuration descriptor for the IUT has been configured for indications.
  Establish an ATT Bearer connection between the Lower Tester and IUT as described in Section 4.2.1 if using LE Transport or Section 4.2.2 if using a BR/EDR Transport.

- **Test Procedure**

  1. Verify that a connection between the Lower Tester and IUT is established.
  2. Perform an action on the IUT to create at least one PLX Spot-check Measurement characteristic that include the Pulse Amplitude Index field.
  3. Verify the Lower Tester sends an `ATT_Handle_Value_Indication` from the IUT containing the characteristic handle and value.
  4. Verify the Lower Tester sends an `ATT_Handle_Value_Confirmation` from the IUT.
  5. Verify the characteristic value meets the requirements of the service.
Expected Outcome

Pass verdict
The IUT sends one or more indications of the PLX Spot-check measurement characteristic that includes the Pulse Amplitude Index value.

The value of the characteristic meets the requirements of the service.

4.9 PLX Continuous Measurement Notification
This test group contains test cases to verify compliant operation when the IUT sends notifications of characteristic values.

4.9.1 PLXS/SEN/CN/BV-01-C [PLX Continuous Measurement Notification]

- Test Purpose
  Verify the IUT can send an indication of the Continuous Measurement characteristic that includes the mandatory fields (i.e., the Flags field and the SpO2PR-Normal field).

- Reference
  Section 3.2 in [6]

- Initial Condition
  The handle of the PLX Continuous Measurement characteristic value referenced in the test cases below has been previously discovered by the Lower Tester during the test procedure in Section 4.4 or is known to the Lower Tester by other means.
  The handle of the client characteristic configuration descriptor of each characteristic referenced in the test cases below has been previously discovered by the Lower Tester during the test procedure in Section 4.5 or is known to the Lower Tester by other means.
  The client characteristic configuration descriptor for the IUT has been configured for notifications.
  Establish an ATT Bearer connection between the Lower Tester and IUT as described in Section 4.2.1 if using LE Transport or Section 4.2.2 if using a BR/EDR Transport.

- Test Procedure
  1. Verify that a connection between the Lower Tester and IUT is established.
  2. Perform an action on the IUT to create at least one PLX Continuous Measurement characteristic with mandatory field values as defined in [6].
  3. Verify the Lower Tester sends an ATT_Handle_Value_Notification from the IUT containing the characteristic handle and value.
  4. Verify the characteristic value meets the requirements of the service.
• **Expected Outcome**

  **Pass verdict**
  The IUT sends at least one notification of the PLX Continuous Measurement characteristic. 
  A Flags field and a SpO2PR-Normal field are present in the record.
  The value of the characteristic meets the requirements of the service.

4.9.2  **PLXS/SEN/CN/BV-02-C [PLX Continuous Measurement Indication – SpO2PR-Fast]**

• **Test Purpose**

  Verify the IUT can send notifications of the PLX Continuous Measurement characteristic that include SpO2PR-Fast values.

• **Reference**

  Section 3.2 in [6]

• **Initial Condition**

  The handle of the PLX Continuous Measurement characteristic value referenced in the test cases below has been previously discovered by the Lower Tester during the test procedure in Section 4.4 or is known to the Lower Tester by other means.

  The handle of the client characteristic configuration descriptor of each characteristic referenced in the test cases below has been previously discovered by the Lower Tester during the test procedure in Section 4.5 or is known to the Lower Tester by other means.

  The client characteristic configuration descriptor for the IUT has been configured for notifications.

  Establish an ATT Bearer connection between the Lower Tester and IUT as described in Section 4.2.1 if using LE Transport or Section 4.2.2 if using a BR/EDR Transport.

• **Test Procedure**

  1. Verify that a connection between the Lower Tester and IUT is established.

  2. Perform an action on the IUT to create at least one PLX Continuous Measurement characteristic that includes the SpO2PR-Fast field [6].

  3. Verify the Lower Tester sends an ATT_Handle_Value_Notification from the IUT containing the characteristic handle and value.

  4. Verify the characteristic value meets the requirements of the service.

• **Expected Outcome**

  **Pass verdict**
The IUT sends at least one notification of the PLX Continuous Measurement characteristic that includes the SpO2PR-Fast field.

The value of the characteristic meets the requirements of the service.

### 4.9.3 PLXS/SEN/CN/BV-03-C [PLX Continuous Measurement Indication – SpO2PR-Slow]

- **Test Purpose**

  Verify the IUT can send notifications of the PLX Continuous Measurement characteristic that include SpO2PR-Slow values.

- **Reference**

  Section 3.2 in [6]

- **Initial Condition**

  The handle of the PLX Continuous Measurement characteristic value referenced in the test cases below has been previously discovered by the Lower Tester during the test procedure in Section 4.4 or is known to the Lower Tester by other means.

  The handle of the client characteristic configuration descriptor of each characteristic referenced in the test cases below has been previously discovered by the Lower Tester during the test procedure in Section 4.5 or is known to the Lower Tester by other means.

  The client characteristic configuration descriptor for the IUT has been configured for notifications.

  Establish an ATT Bearer connection between the Lower Tester and IUT as described in Section 4.2.1 if using LE Transport or Section 4.2.2 if using a BR/EDR Transport.

- **Test Procedure**

  1. Verify that a connection between the Lower Tester and IUT is established.

  2. Perform an action on the IUT to create at least one PLX Continuous Measurement characteristic that includes the SpO2PR-Slow field [6].

  3. Verify the Lower Tester sends an `ATT_Handle_Value_Notification` from the IUT containing the characteristic handle and value.

  4. Verify the characteristic value meets the requirements of the service.

- **Expected Outcome**

  **Pass verdict**

  The IUT sends at least one notification of the PLX Continuous Measurement characteristic that includes the SpO2PR-Slow field.

  The value of the characteristic meets the requirements of the service.
4.9.4 PLXS/SEN/CN/BV-04-C [PLX Continuous Measurement Indication – Measurement Status]

- **Test Purpose**
  
  Verify the IUT can send notifications of the PLX Continuous Measurement characteristic that include Measurement Status values.

- **Reference**
  
  Section 3.2 in [6]

- **Initial Condition**
  
  The handle of the PLX Continuous Measurement characteristic value referenced in the test cases below has been previously discovered by the Lower Tester during the test procedure in Section 4.4 or is known to the Lower Tester by other means.

  The handle of the client characteristic configuration descriptor of each characteristic referenced in the test cases below has been previously discovered by the Lower Tester during the test procedure in Section 4.5 or is known to the Lower Tester by other means.

  The client characteristic configuration descriptor for the IUT has been configured for notifications.

  Establish an ATT Bearer connection between the Lower Tester and IUT as described in Section 4.2.1 if using LE Transport or Section 4.2.2 if using a BR/EDR Transport.

- **Test Procedure**
  
  1. Verify that a connection between the Lower Tester and IUT is established.
  2. Perform an action on the IUT to create at least one PLX Continuous Measurement characteristic that includes the Measurement Status field [6].
  3. Verify the Lower Tester sends an `ATT_Handle_Value_Notification` from the IUT containing the characteristic handle and value.
  4. Verify the characteristic value meets the requirements of the service.

- **Expected Outcome**
  
  **Pass verdict**

  The IUT sends at least one notification of the PLX Continuous Measurement characteristic that includes the Measurement Status field.

  The value of the characteristic meets the requirements of the service.

4.9.5 PLXS/SEN/CN/BV-05-C [PLX Continuous Measurement Indication – Device and Sensor Status]

- **Test Purpose**
Verify the IUT can send notifications of the PLX Continuous Measurement characteristic that include Device and Sensor Status values.

- Reference
  
  Section 3.2 in [6]

- Initial Condition
  
  The handle of the PLX Continuous Measurement characteristic value referenced in the test cases below has been previously discovered by the Lower Tester during the test procedure in Section 4.4 or is known to the Lower Tester by other means.

  The handle of the client characteristic configuration descriptor of each characteristic referenced in the test cases below has been previously discovered by the Lower Tester during the test procedure in Section 4.5 or is known to the Lower Tester by other means.

  The client characteristic configuration descriptor for the IUT has been configured for notifications.

  Establish an ATT Bearer connection between the Lower Tester and IUT as described in Section 4.2.1 if using LE Transport or Section 4.2.2 if using a BR/EDR Transport.

- Test Procedure

  1. Verify that a connection between the Lower Tester and IUT is established.

  2. Perform an action on the IUT to create at least one PLX Continuous Measurement characteristic that includes the Device and Sensor Status field [6].

  3. Verify the Lower Tester sends an ATT_Handle_Value_Notification from the IUT containing the characteristic handle and value.

  4. Verify the characteristic value meets the requirements of the service.

- Expected Outcome

  Pass verdict
  
  The IUT sends at least one notification of the PLX Continuous Measurement characteristic that includes the Device and Sensor Status field.

  The value of the characteristic meets the requirements of the service.

**4.9.6 PLXS/SEN/CN/BV-06-C [PLX Continuous Measurement Indication – Pulse Amplitude Index]**

- Test Purpose

  Verify the IUT can send notifications of the PLX Continuous Measurement characteristic that include Pulse Amplitude Index values.

- Reference
Section 3.2 in [6]

- **Initial Condition**

  The handle of the PLX Continuous Measurement characteristic value referenced in the test cases below has been previously discovered by the Lower Tester during the test procedure in Section 4.4 or is known to the Lower Tester by other means.

  The handle of the client characteristic configuration descriptor of each characteristic referenced in the test cases below has been previously discovered by the Lower Tester during the test procedure in Section 4.5 or is known to the Lower Tester by other means.

  The client characteristic configuration descriptor for the IUT has been configured for notifications.

  Establish an ATT Bearer connection between the Lower Tester and IUT as described in Section 4.2.1 if using LE Transport or Section 4.2.2 if using a BR/EDR Transport.

- **Test Procedure**

  1. Verify that a connection between the Lower Tester and IUT is established.

  2. Perform an action on the IUT to create at least one PLX Continuous Measurement characteristic that includes the Pulse Amplitude Index field [6].

  3. Verify the Lower Tester sends an `ATT_Handle_Value_Notification` from the IUT containing the characteristic handle and value.

  4. Verify the characteristic value meets the requirements of the service.

- **Expected Outcome**

  **Pass verdict**

  The IUT sends at least one notification of the PLX Continuous Measurement characteristic that includes the Pulse Amplitude Index field.

  The value of the characteristic meets the requirements of the service.

### 4.10 RACP Indications

#### 4.10.1 Report number of stored records

This test group contains test cases to verify compliant operation when the Lower Tester uses the RACP ‘Report Number of Stored Records’ procedure.

#### 4.10.1.1 PLXS/SEN/RAN/BV-01-C [Report Number of Stored Records – ‘All Records’]

- **Test Purpose**

  Verify that the IUT can perform the ‘Report Number of Stored Records’ procedure with an Operator of ‘All records’.
• Reference

Section 3.4.7 in [6]

• Initial Condition

Perform the preamble described in Section 4.2.3.

• Test Procedure

1. Perform an action on the IUT that will induce it to generate a defined number of patient records.
2. Verify that a connection between the Lower Tester and IUT is established.
3. The Lower Tester writes the ‘Report number of stored records’ Op Code (0x04) to the RACP using an Operator of ‘All records’ (0x01) and no Operand.
4. The IUT sends an indication of the RACP characteristic with the ‘Report Number of Stored Records Response’ Op Code (0x05) an Operator of Null (0x00) and an Operand representing the number of records a generated in Step 1.
5. The Lower Tester receives an ATT_Handle_Value_Indication from the IUT containing the RACP characteristic handle and value.
6. The Lower Tester sends an ATT_Handle_Value_Confirmation to the IUT.
7. Verify the characteristic value meets the requirements of the service.

• Expected Outcome

Pass verdict

For the ‘Success’ case, the IUT sends one indication of the RACP characteristic with the ‘Number of Stored Records Response’ Op Code (0x05) an Operator of Null (0x00) and an Operand representing the number of records a generated in Step 1.

The value of the Operand represents the correct number of all records in the IUT.

4.10.2 Delete Stored Records

This test group contains test cases to verify compliant operation when the Lower Tester uses the RACP ‘Delete Stored Records’ procedure.

4.10.2.1 PLXS/SEN/RAD/BV-01-C [Delete Stored Records – ‘All records’]

• Test Purpose

Verify that the IUT can perform the ‘Delete Stored Records’ procedure with an Operator of ‘All records’.

• Reference

Section 3.4.5 in [6]
Initial Condition

Perform the preamble described in Section 4.2.3.

Test Procedure

1. Verify that a connection between the Lower Tester and IUT is established.
3. The Lower Tester writes the ‘Delete stored records’ Op Code (0x02) to the RACP using an Operator of ‘All records’ (0x01) and no Operand.
4. The IUT sends an indication of the RACP characteristic with the ‘Response Code’ Op Code (0x06) an Operator of Null (0x00) and an Operand representing Request Op Code (0x02) followed by the Response Code for ‘Success’ (0x01).
5. The Lower Tester receives an ATT_Handle_Value_Indication from the IUT containing the RACP characteristic handle and value.
6. The Lower Tester sends an ATT_Handle_Value_Confirmation to the IUT.
7. The Lower Tester writes the ‘Report Number of Stored Records’ Op Code (0x05) to the RACP using an Operator of ‘All records’ (0x01) and no Operand.
8. The IUT sends an indication of the RACP characteristic with the ‘Number of Stored Records Response’ Op Code (0x05) an Operator of Null (0x00) and an Operand representing that no records were found (0x0000).
9. The Lower Tester receives an ATT_Handle_Value_Indication from the IUT containing the RACP characteristic handle and value.
10. The Lower Tester sends an ATT_Handle_Value_Confirmation to the IUT.

Expected Outcome

Pass verdict

In step 4 the IUT sends one indication of the RACP characteristic with the ‘Response Code’ Op Code (0x06) an Operator of Null (0x00) and an Operand representing Request Op Code (0x02) followed by the Response Code for ‘Success’ (0x01).

In step 8 the IUT responds, indicating that all records had been deleted from the IUT.

4.10.3 Report Stored Records

This test group contains test cases to verify compliant operation when the Lower Tester uses the RACP ‘Report Stored Records’ procedure.

4.10.3.1 PLXS/SEN/RAR/BV-01-C [Report Stored Records – ‘All records’]

Test Purpose
Verify that the IUT can perform the ‘Report Stored Records’ procedure with an Operator of ‘All records’.

- **Reference**
  
  Section 3.4.4 in [6]

- **Initial Condition**
  
  Perform the preamble described in Section 4.2.3.

- **Test Procedure**

  1. Perform an action on the IUT that will induce it to generate a defined number of records.
  2. Verify that a connection between the Lower Tester and IUT is established.
  3. The Lower Tester writes the ‘Report Stored Records’ Op Code (0x01) to the RACP using an Operator of ‘All Records’ (0x01) and no Operand.
  4. The IUT sends a number of indications of the PLX Spot-check Measurement characteristic.
  5. The Lower Tester receives an `ATT_Handle_Value_Indication(s)` from the IUT containing the PLX Spot-check Measurement characteristic handle and value.
  6. The IUT sends an indication of the RACP characteristic with the ‘Response Code’ Op Code (0x06) an Operator of Null (0x00) and an Operand representing Request Op Code (0x01) followed by the Response Code for ‘Success’ (0x01).
  7. The Lower Tester receives an `ATT_Handle_Value_Indication` from the IUT containing the RACP characteristic handle and value.
  8. The Lower Tester sends an `ATT_Handle_Value_Confirmation` to the IUT.
  9. The Lower Tester writes the ‘Report Stored Records’ Op Code (0x01) to the RACP using an Operator of ‘All Records’ (0x01) and no Operand.
  10. The IUT sends an indication of the RACP characteristic with the ‘Response Code’ Op Code (0x06), an Operator of Null (0x00), and an Operand representing Request Op Code (0x01) followed by the Response Code for ‘No Records Found’ (0x06).
  11. The Lower Tester receives an `ATT_Handle_Value_Indication` from the IUT containing the RACP characteristic handle and value.
  12. The Lower Tester sends an `ATT_Handle_Value_Confirmation` to the IUT.

- **Expected Outcome**

  **Pass verdict**
  
  During the first Report Stored Records Procedure, the IUT sends a number of indications of the PLX Spot-check Measurement characteristic.
The received PLX Spot-check Measurement characteristic values contain the records generated in step 1.

The IUT sends one indication of the RACP characteristic with the ‘Response Code’ Op Code (0x06) an Operator of Null (0x00) and an Operand representing Request Op Code (0x01) followed by the Response Code for ‘Success’ (0x01).

The oldest record is transmitted before newer records.

During the second Report Stored Records Procedure, the IUT sends one indication of the RACP characteristic with the ‘Response Code’ Op Code (0x06) and an Operator of Null (0x00) and an Operand representing Request Op Code (0x01) followed by the Response Code for ‘No Records Found’ (0x06).

4.10.3.2 PLXS/SEN/RAR/BV-02-C [Report Stored Records – ‘No Records Found’]

- **Test Purpose**
  
  Verify that the IUT can perform the ‘Report Stored Records’ procedure with an Operator of ‘All records’ when no stored records are available.

- **Reference**
  
  Section 3.4.4 in [6]

- **Initial Condition**
  
  Perform the preamble described in Section 4.2.3.

- **Test Procedure**
  
  1. Ensure that the IUT has no stored records.
  2. Verify that a connection between the Lower Tester and IUT is established.
  3. The Lower Tester writes the ‘Report Stored Records’ Op Code (0x01) to the RACP using an Operator of ‘All Records’ (0x01) and no Operand.
  4. The IUT sends an indication of the RACP characteristic with the ‘Response Code’ Op Code (0x06) an Operator of Null (0x00) and an Operand representing Request Op Code (0x01) followed by the Response Code for ‘No Records Found’ (0x06).
  5. The Lower Tester receives an `ATT_Handle_Value_Indication` from the IUT containing the RACP characteristic handle and value.
  6. The Lower Tester sends an `ATT_Handle_Value_Confirmation` to the IUT.

- **Expected Outcome**
  
  Pass verdict
The IUT sends one indication of the RACP characteristic with the ‘Response Code’ Op Code (0x06) an Operator of Null (0x00) and an Operand representing Request Op Code (0x01) followed by the Response Code for ‘No Records Found’ (0x06).

4.10.4 Abort operation

This test group contains test cases to verify compliant operation when the Lower Tester uses RACP ‘Abort Operation’ procedure.

4.10.4.1 PLXS/SEN/RAA/BV-01-C [Abort Operation – ‘Report Stored Records’]

- Test Purpose
  Verify that the IUT can perform an ‘Abort’ of the Report Stored Records procedure.

- Reference
  Section 3.4.6 in [6]

- Initial Condition
  Perform the preamble described in Section 4.2.3.

- Test Procedure
  1. Perform an action on the IUT that will induce it to generate enough records such that the transmission is not able to complete before the abort is attempted.
  2. Verify that a connection between the Lower Tester and IUT is established.
  3. The Lower Tester writes the ‘Report Stored Records’ Op Code (0x01) to the RACP using an Operator of ‘All records’ (0x01) and no Operand.
  4. The IUT starts to send indications of the PLX Spot-check Measurement characteristic.
  5. The Lower Tester receives a number of ATT_Handle_Value_Indications from the IUT containing the PLX Spot-check Measurement characteristics handle and value.
  6. The Lower Tester writes the ‘Abort Operation’ Op Code (0x03) to the RACP with an Operator of Null (0x00) and no Operand.
  7. The IUT sends an indication of the RACP characteristic with the ‘Response Code’ Op Code (0x06) an Operator of Null (0x00) and an Operand representing Request Op Code (0x03) followed by the Response Code for ‘Success’ (0x01).
  8. The Lower Tester receives an ATT_Handle_Value_Indication from the IUT containing the RACP characteristic handle and value.
  9. The Lower Tester sends an ATT_Handle_Value_Confirmation to the IUT.
  10. Verify the measurement indications stop.
  11. Verify the characteristic value meets the requirements of the service.
• Expected Outcome

Pass verdict
The IUT sends one / multiple notification(s) of the PLX Spot-check Measurement characteristic.

The PLX Spot-check Measurement characteristics contain some but not all record values.
The IUT sends one indication of the RACP characteristic with the ‘Response Code’ Op
Code (0x06) an Operator of Null (0x00) and an Operand representing Request Op Code
(0x03) followed by the Response Code for ‘Success’ (0x01).
The indications stopped after writing the ‘Abort Operation’ Op Code.

4.10.5 RACP Errors

4.10.5.1 PLXS/SEN/RAE/BI-01-C [RACP Errors – ‘Procedure Already In Progress’]

• Test Purpose
Verify that the IUT responds appropriately when a Client attempts to perform a procedure
before another procedure is completed.

• Reference
Section 3.4.8 in [6]

• Initial Condition
Perform the preamble described in Section 4.2.3.

• Test Procedure
1. Perform an action on the IUT that will induce it to generate several records.
2. Verify that a connection between the Lower Tester and IUT is established.
3. The Lower Tester writes the ‘Report Stored Records’ Op Code (0x01) to the RACP using
an Operator of ‘all records’ (0x01) and no Operand.
4. Before the procedure is completed, the Lower Tester performs the same procedure
again.
5. Verify the characteristic value meets the requirements of the service.

• Expected Outcome

Pass verdict
The IUT rejects the Write Request to start the second procedure and responds with an
Attribute Protocol Application Error Code set to ‘Procedure Already in Progress’ (0xFE).
4.10.5.2 PLXS/SEN/RAE/BI-02-C [RACP Errors – ‘Client Characteristic Configuration Descriptor Improperly Configured’]

- Test Purpose
  Verify that the IUT responds appropriately when a Client attempts to perform an RACP procedure with a Client Characteristic Configuration descriptor that is improperly configured.

- Reference
  Section 3.4.8 in [6]

- Initial Condition
  Perform the preamble described in Section 4.2.3.

- Test Procedure
  1. Perform an action on the IUT that will induce it to generate 3 records.
  2. Verify that a connection between the Lower Tester and IUT is established.
  3. The Lower Tester resets to 0 one or more of the Client Characteristic Configuration descriptors from the PLX Spot-check Measurement characteristic or RACP characteristic.
  4. The Lower Tester writes the ‘Report Stored Records’ Op Code (0x01) to the RACP using an Operator of ‘all records’ (0x01) and no Operand.
  5. Verify the characteristic value meets the requirements of the service.

- Expected Outcome
  Pass verdict
  The IUT rejects the Write Request to start the second procedure and responds with an Attribute Protocol Application Error Code set to ‘Client Characteristic Configuration Descriptor Improperly Configured’ (0xFD).

4.10.5.3 PLXS/SEN/RAE/BI-03-C [RACP Errors – ‘Operator Not Supported’]

- Test Purpose
  Verify that the IUT responds appropriately when a Client writes an Op Code to the RACP with an unsupported Operator.

- Reference
  Section 3.4.8 in [6]

- Initial Condition
  Perform the preamble described in Section 4.2.3.
Test Procedure

1. Perform an action on the IUT that will induce it to generate 3 or more records.
2. Verify that a connection between the Lower Tester and IUT is established.
3. The Lower Tester writes the ‘Report Stored Records’ Op Code (0x01) to the RACP using an Operator from the ‘Reserved for Future Use’ range and no Operand.
4. The IUT sends an indication of the RACP characteristic with the ‘Response Code’ Op Code (0x06) an Operator of Null (0x00) and an Operand representing the Request Op Code (0x01) followed by the Response Code Value for ‘Operator not supported’ (0x04).
5. The Lower Tester receives an ATT_Handle_Value_Indication from the IUT containing the RACP characteristic handle and value.
6. The Lower Tester sends an ATT_Handle_Value_Confirmation to the IUT.
7. Verify the characteristic value meets the requirements of the service.

Expected Outcome

Pass verdict

The IUT sends an indication of the RACP characteristic with the ‘Response Code’ Op Code (0x06) an Operator of Null (0x00) and an Operand representing the Request Op Code (0x01) followed by the Response Code Value for ‘Operator not supported’ (0x04).

4.10.5.4 PLXS/SEN/RAE/BI-04-C [RACP Errors – ‘Invalid Operator’]

Test Purpose

Verify that the IUT responds appropriately when a Client writes a ‘Report Stored Records’ Op Code to the RACP with an invalid Operator.

Reference

Section 3.4.8 in [6]

Initial Condition

Perform the preamble described in Section 4.2.3.

Test Procedure

1. Perform an action on the IUT that will induce it to generate 3 or more records.
2. Verify that a connection between the Lower Tester and IUT is established.
3. The Lower Tester writes the ‘Report Stored Records’ Op Code (0x01) to the RACP using an Operator of Null (0x00) and no Operand.
4. The IUT sends an indication of the RACP characteristic with the ‘Response Code’ Op Code (0x06) an Operator of Null (0x00) and an Operand representing Request Op Code (0x01) followed by the Response Code Value for ‘Invalid Operator’ (0x03).

5. The Lower Tester receives an ATT_Handle_Value_Indication from the IUT containing the RACP handle and value.

6. The Lower Tester sends an ATT_Handle_Value_Confirmation to the IUT.

7. Verify the characteristic value meets the requirements of the service.

- Expected Outcome

Pass verdict

The IUT sends an indication of the RACP characteristic with the ‘Response Code’ Op Code (0x06) an Operator of Null (0x00) and an Operand representing Request Op Code (0x01) followed by the Response Code Value for ‘Invalid Operator’ (0x03).

4.10.5.5 PLXS/SEN/RAE/BI-05-C [RACP Errors – ‘Unsupported Operand’]

- Test Purpose

Verify that the IUT responds appropriately when a Client writes a ‘Report Stored Records’ Op Code to the RACP with an unsupported Operand.

- Reference

Section 3.4.8 in [6]

- Initial Condition

Perform the preamble described in Section 4.2.3.

- Test Procedure

1. Verify that a connection between Tester and IUT is established.


3. The IUT sends an indication of the RACP characteristic with the ‘Response Code’ Op Code (0x06) an Operator of Null (0x00) and an Operand representing Request Op Code followed by the ‘Response Code’ value (0x09) for ‘Operand not supported’.

- Expected Outcome

Pass verdict

The IUT sends the ‘Response Code’ value (0x09) for ‘Operand not supported’.

4.10.5.6 PLXS/SEN/RAE/BI-06-C [RACP Errors – ‘Op Code not Supported’]

- Test Purpose
Verify that the IUT responds appropriately when a Client writes an Op Code to the RACP that is not supported.

- Reference
  Section 3.4.8 in [6]

- Initial Condition
  Perform the preamble described in Section 4.2.3.

- Test Procedure
  1. Verify that a connection between Tester and IUT is established.
  2. Collector writes any unsupported Op Code to the RACP.
  3. The IUT sends an indication of the RACP characteristic with the ‘Response Code’ Op Code (0x06) an Operator of Null (0x00) and an Operand representing Request Op Code followed by the ‘Response Code’ value (0x02) for ‘Op Code Not Supported’.

- Expected Outcome
  Pass verdict
  The IUT sends the ‘Response Code’ value (0x02) for ‘Op Code not Supported’.
# 5 Test Case Mapping

The Test Case Mapping Table (TCMT) maps test cases to specific capabilities in the ICS.

The columns for the TCMT are defined as follows:

- **Item:** contains an y/x reference, where y corresponds to the table number and x corresponds to the feature number as defined in the ICS Proforma for the Pulse Oximeter Service [4]. If the item is defined with Protocol, Profile or Service abbreviation before y/x, the table and feature number referenced are defined in the abbreviated ICS proforma document.

- **Feature:** recommended to be the primary feature defined in the ICS being tested or may be the test case name.

- **Test Case(s):** the applicable test case identifiers required for Bluetooth Qualification if the corresponding y/x references defined in the Item column are supported.

- **Test Case Applicable:** may be used to note if a test is required based on the supported features.

For purpose and structure of the ICS/IXIT proforma and instructions for completing the ICS/IXIT proforma refer to the Bluetooth ICS and IXIT proforma document.

<table>
<thead>
<tr>
<th>Item</th>
<th>Feature</th>
<th>Test Case(s)</th>
<th>Test Case Applicable</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/1 AND (1/1 OR 1/2)</td>
<td>Service definition</td>
<td>PLXS/SEN/SD/BV-01-C</td>
<td></td>
</tr>
<tr>
<td>1/1</td>
<td>SDP Record</td>
<td>PLXS/SEN/SD/BV-02-C</td>
<td></td>
</tr>
<tr>
<td>3/17</td>
<td>Features characteristic</td>
<td>PLXS/SEN/DEC/BV-03-C</td>
<td></td>
</tr>
<tr>
<td>3/21 AND 2/3</td>
<td>RACP characteristic</td>
<td>PLXS/SEN/DEC/BV-04-C, PLXS/SEN/DES/BV-03-C, PLXS/SEN/CON/BV-02-C</td>
<td></td>
</tr>
<tr>
<td>3/17 AND 3/18</td>
<td>Read Features</td>
<td>PLXS/SEN/CR/BV-01-C</td>
<td></td>
</tr>
<tr>
<td>3/19 AND 2/1</td>
<td>Read Features, Measurement</td>
<td>PLXS/SEN/CR/BV-02-C</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Status field</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3/20 AND 2/2</td>
<td>Read Features, Device and</td>
<td>PLXS/SEN/CR/BV-03-C</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sensor status field</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item</td>
<td>Feature</td>
<td>Test Case(s)</td>
<td>Test Case Applicable</td>
</tr>
<tr>
<td>--------------</td>
<td>----------------------------------------------</td>
<td>----------------------------</td>
<td>----------------------</td>
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<tr>
<td>3/5 AND 2/4</td>
<td>Spot-check characteristic - Timestamp</td>
<td>PLXS/SEN/CI/BV-02-C</td>
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<tr>
<td>3/6 AND 2/1</td>
<td>Spot-check characteristic – Measurement Status</td>
<td>PLXS/SEN/CI/BV-03-C</td>
<td></td>
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<tr>
<td>3/7 AND 2/2</td>
<td>Spot-check characteristic – Device and Sensor Status</td>
<td>PLXS/SEN/CI/BV-04-C</td>
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<tr>
<td>3/8 AND 2/7</td>
<td>Spot-check characteristic – Pulse Amplitude Index</td>
<td>PLXS/SEN/CI/BV-05-C</td>
<td></td>
</tr>
<tr>
<td>3/12 AND 2/5</td>
<td>Continuous characteristic – SpO2PR-Fast</td>
<td>PLXS/SEN/CN/BV-02-C</td>
<td></td>
</tr>
<tr>
<td>3/13 AND 2/6</td>
<td>Continuous characteristic – SpO2PR-Slow</td>
<td>PLXS/SEN/CN/BV-03-C</td>
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<tr>
<td>3/14 AND 2/1</td>
<td>Continuous characteristic – Measurement Status</td>
<td>PLXS/SEN/CN/BV-04-C</td>
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<tr>
<td>3/15 AND 2/2</td>
<td>Continuous characteristic – Device and Sensor Status</td>
<td>PLXS/SEN/CN/BV-05-C</td>
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<tr>
<td>3/16 AND 2/7</td>
<td>Continuous characteristic – Pulse Amplitude Index</td>
<td>PLXS/SEN/CN/BV-06-C</td>
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<tr>
<td>3/25 AND 7/1 AND 8/1 AND 9/1</td>
<td>RACP – Report number of stored records</td>
<td>PLXS/SEN/RAN/BV-01-C</td>
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<tr>
<td>3/23 AND 5/1 AND 9/1</td>
<td>RACP – Delete stored records</td>
<td>PLXS/SEN/RAD/BV-01-C</td>
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<tr>
<td>3/22 AND 4/1 AND 9/1</td>
<td>RACP – Report stored records – all records</td>
<td>PLXS/SEN/RAR/BV-01-C PLXS/SEN/RAR/BV-02-C</td>
<td></td>
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<tr>
<td>3/24 AND 6/1 AND 9/1</td>
<td>RACP – Abort operation – report stored records</td>
<td>PLXS/SEN/RAA/BV-01-C</td>
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</tbody>
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*Table 5.1: Test Case Mapping*