Pulse Oximeter Profile (PLXP)

*Bluetooth*® Test Specification

- **Revision**: PLXP.TS.1.0.2
- **Revision Date**: 2017-11-28
- **Group Prepared By**: Medical Devices Working Group
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**Abstract:**
This document defines test structures and procedures for conformance testing of products implementing the Pulse Oximeter Profile Specification.
Revision History

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<tr>
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<tbody>
<tr>
<td>D0.9.0</td>
<td>2014-09-17</td>
<td>Initial draft</td>
</tr>
<tr>
<td>D0.9.0r1</td>
<td>2014-11-12</td>
<td>Some small editorial changes made</td>
</tr>
<tr>
<td>D0.9.0r2</td>
<td>2014-12-22</td>
<td>Changes due to changes in the specification itself, as well as incorporation of comments from BTI review.</td>
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<tr>
<td>D0.9.0r3</td>
<td>2015-01-14</td>
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<tr>
<td>D1.0.0r0</td>
<td>2015-02-17</td>
<td>Made adjustments from IOP</td>
</tr>
<tr>
<td>D1.0.0r1</td>
<td>2015-06-17</td>
<td>Incorporated technical editing</td>
</tr>
<tr>
<td>1.0.0</td>
<td>2015-07-21</td>
<td>Prepare for publication</td>
</tr>
<tr>
<td>1.0.1r00</td>
<td>2016-05-16</td>
<td>Converted to new Test Case ID conventions as defined in TSTO v4.1.</td>
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<tr>
<td>1.0.1r01</td>
<td>2016-06-01</td>
<td>Review by Miles Smith</td>
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<tr>
<td>1.0.1</td>
<td>2016-07-14</td>
<td>Prepared for TCRL 2016-1 publication.</td>
</tr>
<tr>
<td>1.0.2r00</td>
<td>2017-08-21</td>
<td>TSE 9551: For PLXP/COL/BMS/Bi-05-I, updated Test Procedure text.</td>
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<td>2017-09-22</td>
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<tr>
<td>1.0.2r02</td>
<td>2017-10-13</td>
<td>TSE 9875: Revised PLXP/SEN/CTS/BV-03-I in the TCMT.</td>
</tr>
<tr>
<td>1.0.2</td>
<td>2017-11-28</td>
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1 Scope

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

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] Bluetooth Core Specification 4.0 or later
[3] Pulse Oximeter Profile
[4] Pulse Oximeter Service
[5] ICS Proforma for Pulse Oximeter Profile
[7] Current Time Service Specification v1.0 or later
[8] Device Information Service Specification v1.1
[9] Battery Service Specification v1.0
[10] GAP Test Specification
[12] Pulse Oximeter Service Test Specification
[13] 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.
3 Test Suite Structure (TSS)

3.1 Overview

The Pulse Oximeter Profile requires the presence of GAP, SM (for LE), SDP (for BR/EDR), ATT, and GATT. This is illustrated in Figure 3.1.

![Figure 3.1: Pulse Oximeter Profile Test Model](image)

Supporting the Device Information Service and the Pulse Oximeter Service is mandatory. Supporting the Bond Management Service, Battery Service and/or Current Time Service is optional.

3.2 Test Strategy

The test objectives are to verify functionality of the Pulse Oximeter Profile 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 profile specification and to match these to the support of the IUT as described in the ICS Proforma.

The conformance test equipment shall provide an implementation of the Radio Controller and the parts of the Host needed to perform the test cases defined in the Pulse Oximeter Profile 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 Profile test suite contains Valid Behavior (BV) tests complemented with Invalid Behavior (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. This structure is shown in Section 3.3.

3.3 Test Groups

The following test groups have been defined:
3.3.1 **Requirements**
This group tests IUT for the Sensor Role Requirements.

3.3.2 **Discovery of Services and Characteristics**
This group tests IUT discovery of:
- Pulse Oximeter Service
- Pulse Oximeter Characteristics
- Device Information Service
- Device Information Service Characteristics
- Read Device Information Service Characteristics
- Bond Management Service
- Bond Management Service Characteristics
- Current Time Service
- Current Time Service Characteristics
- Battery Service
- Battery Service Characteristics
- Read Battery Service Characteristics

3.3.3 **Measurements**
This group tests IUT implementation of pulse oximetry measurements (spot-check and continuous).

3.3.4 **Features**
This group tests IUT implementation of Pulse Oximeter Features characteristic.

3.3.5 **Record Access Control Point Procedures**
This group tests the operation of additional procedures defined in the service specification including aborting procedures, deleting records, reporting records and counting the number of records.

3.3.6 **Bond Management Service Procedures**
This group tests the Bond Management Service procedures defined in the service specification.

3.3.7 **Current Time Service Features**
This group tests the configuration, ability to read, and characteristic values of the Current Time Service.
4 Test Cases (TC)

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 `<spec abbreviation>/<IUT role>/<class>/<feat>/<func>/<subfunc>/<cap>/<xx>-<nn>-<y>.

Bolded ID parts shall appear in the order prescribed. Non-bolded ID parts (if applicable) shall appear between the bolded parts. The order of the non-bolded parts may vary from test specification to test specification, but shall be consistent within each individual test specification.

<table>
<thead>
<tr>
<th>Identifier Abbreviation</th>
<th>Spec Identifier &lt;spec abbreviation&gt;</th>
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<tr>
<td>PLXP</td>
<td>Pulse Oximeter Profile</td>
</tr>
<tr>
<td>Identifier Abbreviation</td>
<td>Role Identifier &lt;IUT role&gt;</td>
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<tr>
<td>COL</td>
<td>Collector Role</td>
</tr>
<tr>
<td>SEN</td>
<td>Sensor Role</td>
</tr>
<tr>
<td>Identifier Abbreviation</td>
<td>Feature Identifier &lt;feat&gt;</td>
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<td>BAS</td>
<td>Battery Service</td>
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<td>BMS</td>
<td>Bond Management Service</td>
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<td>CECC</td>
<td>Connection Establishment</td>
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<td>CTS</td>
<td>Current Time Service Features</td>
</tr>
<tr>
<td>PLXS</td>
<td>(Sensor) Requirements</td>
</tr>
<tr>
<td>PLXSD</td>
<td>Discovery of Services and Characteristics</td>
</tr>
<tr>
<td>PLXSC</td>
<td>Pulse Oximeter Spot-check Measurement</td>
</tr>
<tr>
<td>PLXC</td>
<td>Pulse Oximeter Continuous Measurement</td>
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<tr>
<td>PLXF</td>
<td>Pulse Oximeter Features</td>
</tr>
<tr>
<td>RAA</td>
<td>Record Access Control Point – Abort Procedures</td>
</tr>
<tr>
<td>RAD</td>
<td>Record Access Control Point – Delete Procedures</td>
</tr>
<tr>
<td>RAR</td>
<td>Record Access Control Point – Report Procedures</td>
</tr>
<tr>
<td>RAT</td>
<td>Record Access Control Point – Procedure Timeout</td>
</tr>
</tbody>
</table>

*Table 4.1: Pulse Oximeter 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 Setup LE Transport

Use GATT TS [6] Preamble [Set up ATT Bearer over LE]

4.2.2 Setup BR/EDR Transport

Use GATT TS [6] Preamble [Setup ATT Bearer over BR/EDR]
4.2.3 Collector: Configure Sensor for use

Follow this preamble procedure for the Collector to configure the Sensor for use with Record Access Control Point.

1. 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.

2. The handles of the PLX Spot-check Measurement characteristic, PLX Continuous Measurement characteristic, and RACP characteristic have been previously discovered by the Lower Tester during the test procedures in Section 4.3 or are known to the Lower Tester by other means.

3. The handles of the Client Characteristic Configuration descriptor of the PLX Spot-check Measurement characteristic, PLX Continuous Measurement characteristic, and RACP characteristic have been previously discovered by the Lower Tester during the test procedures in Section 4.3 or are known to the Lower Tester by other means.

4. If the Lower Tester and IUT were not previously bonded, perform a bonding procedure. If previously bonded, enable encryption if not already enabled.

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

6. The PLX Continuous Measurement characteristic is configured for notifications.

7. The RACP characteristic is configured for indications.

4.2.4 LE Collector: Scan to detect Sensor advertisements

This procedure specifies how a Collector IUT scans and detects Sensor advertisements.

- Reference
  
  Section 6.1 in [3], GAP 9.3.3, 9.3.4 in [1]

- Initial Condition
  
  The Collector has been configured to accept commands from the Upper Tester to request and receive pulse oximetry measurements.

- Preamble Procedure
  
  1. Execute one of the following test procedures:
     
     Alt 1: GAP/CONN/ACEP/BV-01-C [10]

     or

     Alt 2: GAP/CONN/GCEP/BV-02-C [10]

  2. Connection is established.
4.2.5 BR/EDR Collector

4.2.5.1 Connection Establishment for Unbonded Device

This BR/EDR preamble procedure specifies how the Collector IUT scans the Sensor for the case when the Sensor and Collector have not bonded.

- Reference
  Section 6.3.1 in [3], GAP 4.1, 4.2 in [1]

- Initial Condition
  A preamble procedure defined in Section 4.2.3 is used as a prerequisite to this preamble.

- Preamble Procedure
  1. Put the Sensor in General Discoverable mode.
  2. The Upper Tester commands the Collector IUT to initiate a connection and the IUT starts scanning.
  3. The Sensor (Lower Tester) exposes the SDP record for the Pulse Oximeter Service.
  4. The Collector IUT validates the SDP record and establishes a connection to the Sensor.
  5. The Collector uses the GAP General Discovery procedures to discover a Sensor and to establish a connection to a Sensor.

4.2.5.2 Connection Establishment for Bonded Device

In the case of BR/EDR, either a Sensor or Collector could initiate a connection when they are bonded. The device which initiates a connection becomes a master is referred here as “master to be” and the device which accepts the connection becomes a slave and is referred here as “slave to be”.

The BR/EDR preamble procedure specifies how a “master to be” connects to a “slave to be”.

- Reference

Figure 4.1: Scan to detect Sensor advertisements
Section 6.3.2 in [3], GAP 4.1, 4.2 in [1]

- **Initial Condition**
  A preamble procedure defined in Section 4.2.3 is used as a prerequisite to this preamble.

- **Preamble Procedure**
  1. Put the “slave to be” in connectable mode to accept a connection from “master to be”.
  2. The connection is initiated by “master to be”.
  3. The “slave to be” exposes the SDP record for the Pulse Oximeter Service.
  4. The “master to be” validates the SDP record and establishes a connection to the “slave to be”.
  5. The “master to be” uses the GAP Link Establishment procedures to connect to any bonded device.

### 4.3 Pulse Oximeter Sensor Role Requirements – Additional Requirements for LE

These procedures defined in this test group verify implementation of the additional Sensor requirements and recommendations defined in the Pulse Oximeter Profile Specification [3] when using this profile over Low Energy transport.

#### 4.3.1 PLXP/SEN/PLXS/BV-01-I [Pulse Oximeter Service UUID in AD over LE]

- **Test Purpose**
  Verify that the Pulse Oximeter Service UUID is included in AD (Advertising Data) from the Pulse Oximeter Sensor IUT when using LE Transport.

- **Reference**
  [3] 4.1.2.1

- **Initial Condition**
  The IUT is induced to enter a GAP discoverable mode and generate Advertising Packets (see Section 4.2.4).

- **Test Procedure**
  The Lower Tester listens for Advertising Packets from the IUT.

- **Expected Outcome**
  **Pass verdict:**
  The Advertising Packets contain the defined Service UUID for «Pulse Oximeter Service».

#### 4.3.2 PLXP/SEN/PLXS/BV-02-I [Local Name included in AD or Scan Response over LE]

- **Test Purpose**
Verify that the Local Name is included in AD (Advertising Data) or Scan Response data from the Sensor IUT when using LE Transport.

- **Reference**
  [3] 4.1.2.2

- **Initial Condition**
The IUT is induced to enter a GAP connectable mode and generate Advertising Packets.

- **Test Procedure**
The Lower Tester listens for Advertising Packets from the IUT. When the Lower Tester receives an Advertising Packet from IUT, it sends a Scan Request to the IUT. Then the Lower Tester listens for a Scan Response from the IUT.

- **Expected Outcome**
  Pass verdict
The IUT sends an Advertising packet and a Scan Response packet.
The IUT includes the Local Name in either the Advertising packet or Scan Response packet, but not both.

### 4.3.3 PLXP/SEN/PLXS/BV-03-I [Appearance included in AD or Scan Response over LE]

- **Test Purpose**
Verify that the Appearance is included in AD (Advertising Data) or Scan Response data from the Sensor IUT when using LE Transport.

- **Reference**
  [3] 4.1.2.3

- **Initial Condition**
The IUT is induced to enter a GAP connectable mode and generate Advertising Packets.

- **Test Procedure**
The Lower Tester listens for Advertising Packets from the IUT. When the Lower Tester receives an Advertising Packet from IUT, it sends a Scan Request to the IUT. Then the Lower Tester listens for a Scan Response from the IUT.

- **Expected Outcome**
  Pass verdict
The IUT sends an Advertising packet and a Scan Response packet.
The IUT includes the Appearance in either the Advertising packet or Scan Response packet, but not both.
4.4 Discovery of Services and Characteristics

4.4.1 PLXP/COL/PLXSD/BV-01-I [Discover Pulse Oximeter Service over LE]

- **Test Purpose**
  Verify that the Pulse Oximeter Service can be discovered by the Collector IUT when using an LE Transport.

- **Reference**
  [3] 5.2.1

- **Initial Condition**
  Run the preamble procedure for the Collector to initiate connection to a Pulse Oximeter Sensor included in Section 4.2.1.

  The Lower Tester exposes one instantiation of the Pulse Oximeter Service [4].

- **Test Procedure**
  The IUT executes the Discover All Primary Services sub-procedure and/or the Discover Primary Services by Service UUID sub-procedure with the Service UUID set to «Pulse Oximeter Service».

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

  Verify that the attribute handle range discovered by the IUT contains the starting handle and the ending handle of the instantiation of a Pulse Oximeter Service definition.

4.4.2 PLXP/COL/PLXSD/BV-02-I [Discover Current Time Service over LE]

- **Test Purpose**
  Verify that the Current Time Service can be discovered by the Collector IUT when using an LE Transport.

- **Reference**
  [3] 5.2.4

- **Initial Condition**
  Run the preamble procedure to enable the Collector to initiate connection to a Pulse Oximeter Sensor included in Section 4.2.1.

  The Lower Tester has one instantiation of the Current Time Service [7].

- **Test Procedure**
  The IUT executes the Discover All Primary Services sub-procedure and/or the Discover Primary Services by Service UUID sub-procedure with the Service UUID set to «Current Time Service».

- **Expected Outcome**
Pass verdict

Verify that the attribute handle range discovered by the IUT contains the starting handle and the ending handle of the instantiation of the Current Time Service definition.

4.4.3 PLXP/COL/PLXSD/BV-03-I [Discover Device Information Service over LE]

• Test Purpose
  Verify that the Device Information Service can be discovered by the Collector IUT when using an LE Transport.

• Reference
  [3] 5.2.2

• Initial Condition
  Run the preamble procedure to enable the Collector to initiate connection to a Pulse Oximeter Sensor included in Section 4.2.1.

  The Lower Tester has one instantiation of the Device Information Service [8].

• Test Procedure
  The IUT executes the Discover All Primary Services sub-procedure and/or the Discover Primary Services by Service UUID sub-procedure with the Service UUID set to «Device Information Service».

• Expected Outcome
  Pass verdict
  Verify that the attribute handle range discovered by the IUT contains the starting handle and the ending handle of the instantiation of the Device Information Service definition.

4.4.4 PLXP/COL/PLXSD/BV-04-I [Discover Battery Service over LE]

• Test Purpose
  Verify that the Battery Service can be discovered by the Collector IUT when using an LE Transport.

• Reference
  [3] 5.2.5

• Initial Condition
  Run the preamble procedure to enable the Collector to initiate connection to a Pulse Oximeter Sensor included in Section 4.2.1.

  The Lower Tester has one instantiation of the Battery Service [9].

• Test Procedure
  The IUT executes the Discover All Primary Services sub-procedure and/or the Discover Primary Services by Service UUID sub-procedure with the Service UUID set to «Battery Service».
• Expected Outcome
  Pass verdict

Verify that the attribute handle range discovered by the IUT contains the starting handle and the ending handle of the instantiation of the Battery Service definition.

4.4.5 PLXP/COL/PLXSD/BV-05-I [Discover Bond Management Service over LE]

• Test Purpose
  Verify that the Bond Management Service can be discovered by the Collector IUT when using an LE Transport.

• Reference
  [3] 5.2.3

• Initial Condition
  Run the preamble procedure to enable the Collector to initiate connection to a Pulse Oximeter Sensor included in Section 4.2.1.

  The Lower Tester has one instantiation of the Bond Management Service [11].

• Test Procedure
  The IUT executes the Discover All Primary Services sub-procedure and/or the Discover Primary Services by Service UUID sub-procedure with the Service UUID set to «Bond Management Service».

• Expected Outcome
  Pass verdict

Verify that the attribute handle range discovered by the IUT contains the starting handle and the ending handle of the instantiation of the Bond Management Service definition.

4.4.6 PLXP/COL/PLXSD/BV-06-I [SDP Service Discovery]

• Test Purpose
  Verify that the Collector IUT can discover the SDP record for the Pulse Oximeter Service, Device Information Service, Current Time Service (if supported), Bond Management Service (if supported), and Battery Service (if supported) of the Lower Tester when using the BR/EDR transport.

• Reference
  [3] 5.2

• Initial Condition
  Run the preamble included in Section 4.2.2 to establish an ACL connection over BR/EDR between the Lower Tester and IUT.

• Test Procedure
Monitor the SDP requests sent by the IUT to retrieve attributes of SDP records from the Lower Tester.

- Expected Outcome
  
  **Pass verdict**
  
  The SDP record for the Pulse Oximeter Service is retrieved.
  
  The SDP record for the Device Information Service is retrieved.
  
  Optionally, the SDP record for the Bond Management Service is retrieved.
  
  Optionally, the SDP record for the Current Time Service is retrieved.
  
  Optionally, the SDP record for the Battery Service is retrieved.

4.4.7 PLXP/SEN/PLXSD/BV-07-I [Pulse Oximeter Service not discoverable over BR/EDR]

- Test Purpose
  
  Verify that the Pulse Oximeter Service on a BR/EDR/LE (i.e. dual mode) Pulse Oximeter Sensor IUT that only supports the service over LE cannot be discovered by a Collector when using a BR/EDR based ATT Bearer.

- Reference
  
  [3] 5.2

- Initial Condition
  
  The IUT includes one instantiation of the Pulse Oximeter Service [4].

- Test Procedure
  
  1. Establish a BR/EDR ATT Bearer connection between the Lower Tester and IUT (4.2.2).
  2. The Lower Tester uses the SDP Service Discovery procedure to attempt to discover the services supported by the IUT over BR/EDR.

- Expected Outcome
  
  **Pass verdict**
  
  The Pulse Oximeter Service is not discovered over BR/EDR.

4.4.8 PLXP/SEN/PLXSD/BV-08-I [Device Information Service not discoverable over BR/EDR]

- Test Purpose
  
  Verify that the Device Information Service on a BR/EDR/LE (i.e. dual mode) Pulse Oximeter Sensor IUT that only supports the service over LE cannot be discovered by a Collector when using a BR/EDR based ATT Bearer.

- Reference
5.2  

- Initial Condition
  The IUT includes one instantiation of the Device Information Service [8].

- Test Procedure
  1. Establish a BR/EDR ATT Bearer connection between the Lower Tester and IUT (4.2.2).
  2. The Lower Tester uses the SDP Service Discovery procedure to attempt to discover the services supported by the IUT over BR/EDR.

- Expected Outcome
  **Pass verdict**

  The Device Information Service is not discovered over BR/EDR.

4.4.9 PLXP/SEN/PLXSD/BV-09-I [Current Time Service not discoverable over BR/EDR]

- Test Purpose
  Verify that the Current Time Service on a BR/EDR/LE (i.e. dual mode) Pulse Oximeter Sensor IUT that only supports the service over LE cannot be discovered by a Collector when using a BR/EDR based ATT Bearer.

- Reference
  [3] 5.2

- Initial Condition
  The IUT includes one instantiation of the Current Time Service [7].

- Test Procedure
  1. Establish a BR/EDR ATT Bearer connection between the Lower Tester and IUT (4.2.2).
  2. The Lower Tester uses the SDP Service Discovery procedure to attempt to discover the services supported by the IUT over BR/EDR.

- Expected Outcome
  **Pass verdict**

  The Current Time Service is not discovered over BR/EDR.

4.4.10 PLXP/SEN/PLXSD/BV-10-I [Bond Management Service not discoverable over BR/EDR]

- Test Purpose
  Verify that the Bond Management Service on a BR/EDR/LE (i.e. dual mode) Pulse Oximeter Sensor IUT that only supports the service over LE cannot be discovered by a Collector when using a BR/EDR based ATT Bearer.
• Reference
  [3] 5.2

• Initial Condition
  The IUT includes one instantiation of the Bond Management Service [11].

• Test Procedure
  1. Establish a BR/EDR ATT Bearer connection between the Lower Tester and IUT (4.2.2).
  2. The Lower Tester uses the SDP Service Discovery procedure to attempt to discover the services supported by the IUT over BR/EDR.

• Expected Outcome
  Pass verdict
  The Bond Management Service is not discovered over BR/EDR.

### 4.4.11 PLXP/SEN/PLXSD/BV-11-I [Battery Service not discoverable over BR/EDR]

• Test Purpose
  Verify that the Battery Service on a BR/EDR/LE (i.e. dual mode) Pulse Oximeter Sensor IUT that only supports the service over LE cannot be discovered by a Collector when using a BR/EDR based ATT Bearer.

• Reference
  [3] 5.2

• Initial Condition
  The IUT includes one instantiation of the Battery Service [9].

• Test Procedure
  1. Establish a BR/EDR ATT Bearer connection between the Lower Tester and IUT (4.2.2).
  2. The Lower Tester uses the SDP Service Discovery procedure to attempt to discover the services supported by the IUT over BR/EDR.

• Expected Outcome
  Pass verdict
  The Battery Service is not discovered over BR/EDR.

### 4.4.12 PLXP/COL/PLXSD/BV-12-I [Discover PLX Spot-check Measurement Characteristic]

• Test Purpose
  Verify that a PLX Spot-check Measurement characteristic can be discovered by the Collector IUT.

• Reference
5.3.1.1

• Initial Condition

Run the preamble procedure for the Collector to initiate connection to a Pulse Oximeter Sensor included in the Section 4.2.4, if using an LE transport, or 4.2.5 if using a BR/EDR transport.

The Lower Tester includes one instantiation of the Pulse Oximeter Service [4] including all defined characteristics.

The IUT has discovered the Pulse Oximeter Service and has saved the handle range for an instantiation of the Pulse Oximeter Service that contains an instantiation of the PLX Spot-check Measurement characteristic. This was done by previously using the GATT method in PLXP/COL/PLXSD/BV-01-I [Discover Pulse Oximeter Service over LE] for LE, or using the SDP method in PLXP/COL/PLXSD/BV-06-I [SDP Service Discovery] for BR/EDR.

• Test Procedure

1. The Upper Tester issues a command to the IUT to discover PLX Spot-check Measurement characteristic.

2. The IUT executes either of the procedures included in GATT.TS [6]: Discover All Characteristics of a Service, GATT/CL/GAD/BV-04-C, with the specified handle range for the instantiation of the Pulse Oximeter Service, or Discover Characteristic by UUID, GATT/CL/GAD/BV-05-C, with the specified handle range for the instantiation of the Pulse Oximeter Service and UUID set to «PLX Spot-check Measurement».

• Expected Outcome

Pass verdict

Verify that one attribute handle/value pair is received by the IUT containing the UUID «PLX Spot-check Measurement».

4.4.13 PLXP/COL/PLXSD/BV-13-I [PLX Spot-check Measurement – Client Characteristic Configuration Descriptor]

• Test Purpose

Verify that the Collector IUT can discover the Client Characteristic Configuration descriptor of the PLX Spot-check Measurement characteristic.

• Reference

[3] 5.3.1.1

• Initial Condition

Run the preamble procedure for the Collector to initiate connection to a Pulse Oximeter Sensor included in the Section 4.2.4, if using an LE transport, or 4.2.5 if using a BR/EDR transport.

The Lower Tester includes one instantiation of the Pulse Oximeter Service [4] in which the PLX Spot-check Measurement characteristic and an associated Client Characteristic Configuration descriptor are exposed.

The IUT has discovered the handle range of the PLX Spot-check Measurement characteristic.
**Test Procedure**

1. The Upper Tester issues a command to the IUT to Discover All Characteristic Descriptors using the handle range of the characteristic.

2. The IUT executes one pass of the procedure included in GATT.TS [6]: Discover all Characteristic Descriptors, GATT/CL/GAD/BV-06-C using the specified handle range, with the server database defined in Initial Condition.

**Expected Outcome**

**Pass verdict**

Verify that one attribute handle/value pair is received by the IUT containing the UUID «Client Characteristic Descriptor».

### 4.4.14 PLXP/COL/PLXSD/BV-14-I [Discover PLX Continuous Measurement Characteristic]

**Test Purpose**

Verify that a PLX Continuous Measurement characteristic can be discovered by the Collector IUT.

**Reference**

[3] 5.3.1.2

**Initial Condition**

Run the preamble procedure for the Collector to initiate connection to a Pulse Oximeter Sensor included in the Section 4.2.4, if using an LE transport, or 4.2.5 if using a BR/EDR transport.

The Lower Tester includes one instantiation of the Pulse Oximeter Service [4] including all defined characteristics.

The IUT has discovered the Pulse Oximeter Service and has saved the handle range for an instantiation of the Pulse Oximeter Service that contains an instantiation of the PLX Continuous Measurement characteristic. This was done by previously using the GATT method in PLXP/COL/PLXSD/BV-01-I [Discover Pulse Oximeter Service over LE] for LE, or using the SDP method in PLXP/COL/PLXSD/BV-06-I [SDP Service Discovery] for BR/EDR.

**Test Procedure**

1. The Upper Tester issues a command to the IUT to PLX Continuous Measurement characteristic.

2. The IUT executes either of the procedures included in GATT.TS [6]: Discover All Characteristic of a Service, GATT/CL/GAD/BV-04-C, with the specified handle range for the instantiation of the Pulse Oximeter Service, or Discover Characteristic by UUID, GATT/CL/GAD/BV-05-C, with the specified handle range for the instantiation of the Pulse Oximeter Service and UUID set to «PLX Continuous Measurement».

**Expected Outcome**

**Pass verdict**

Verify that one attribute handle/value pair is received by the IUT containing the UUID «PLX Continuous Measurement».
4.4.15 PLXP/COL/PLXSD/BV-15-I [PLX Continuous Measurement – Client Characteristic Configuration Descriptor]

- Test Purpose
  Verify that the Collector IUT can discover the Client Characteristic Configuration descriptor of the PLX Continuous Measurement characteristic.

- Reference
  [3] 5.3.1.2

- Initial Condition
  Run the preamble procedure for the Collector to initiate connection to a Pulse Oximeter Sensor included in the Section 4.2.4, if using an LE transport, or 4.2.5 if using a BR/EDR transport.

  The Lower Tester includes one instantiation of the Pulse Oximeter Service [4] in which the PLX Continuous Measurement characteristic and an associated Client Characteristic Configuration descriptor are exposed.

  The IUT has discovered the handle range of the PLX Continuous Measurement characteristic.

- Test Procedure
  1. The Upper Tester issues a command to the IUT to Discover All Characteristic Descriptors using the handle range of the characteristic.
  2. The IUT executes one pass of the procedure included in GATT.TS [6]: Discover all Characteristic Descriptors, GATT/CL/GAD/BV-06-C using the specified handle range, with the server database defined in the Initial Condition.

- Expected Outcome
  Pass verdict

  Verify that one attribute handle/value pair is received by the IUT containing the UUID «Client Characteristic Descriptor».

4.4.16 PLXP/COL/PLXSD/BV-16-I [Discover PLX Features Characteristic]

- Test Purpose
  Verify that a PLX Features characteristic can be discovered by the Collector IUT.

- Reference
  [3] 5.3.1.3

- Initial Condition
  Run the preamble procedure for the Collector to initiate connection to a Pulse Oximeter Sensor included in the Section 4.2.4, if using an LE transport, or 4.2.5 if using a BR/EDR transport.

  The Lower Tester includes one instantiation of the Pulse Oximeter Service [4] including all defined characteristics.
The IUT has discovered the Pulse Oximeter Service and has saved the handle range for an instantiation of the Pulse Oximeter Service that contains an instantiation of the PLX Features characteristic. This was done by previously using the GATT method in PLXP/COL/PLXSD/BV-01-I [Discover Pulse Oximeter Service over LE] for LE, or using the SDP method in PLXP/COL/PLXSD/BV-06-I [SDP Service Discovery] for BR/EDR.

• Test Procedure
  1. The Upper Tester issues a command to the IUT to Discover PLX Features characteristic.
  2. The IUT executes either of the procedures included in GATT.TS [6]: Discover All Characteristic of a Service, GATT/CL/GAD/BV-04-C, with the specified handle range for the instantiation of the Pulse Oximeter Service, or Discover Characteristic by UUID, GATT/CL/GAD/BV-05-C, with the specified handle range for the instantiation of the Pulse Oximeter Service and UUID set to «PLX Features».

• Expected Outcome
  Pass verdict
  Verify that one attribute handle/value pair is received by the IUT containing the UUID «PLX Features».

4.4.17 PLXP/COL/PLXSD/BV-17-I [Discover Record Access Control Point Characteristic]

• Test Purpose
  Verify that a Record Access Control Point characteristic can be detected by the Collector IUT.

• Reference
  [3] 5.3.1.4

• Initial Condition
  Establish an ATT Bearer connection between the Lower Tester and IUT and run the preamble procedure for the Collector to initiate connection to a Pulse Oximeter Sensor included in Section 4.2.4 if using an LE transport or 4.2.5 if using a BR/EDR transport.

  The Lower Tester has one instance of the Pulse Oximeter Service [4] as a primary service including all defined characteristics.

  The IUT has discovered the handle range of the Record Access Control Point characteristic.

• Test Procedure
  1. The Upper Tester issues a command to the IUT to Discover the Record Access Control Point characteristic.
  2. The IUT executes either of the procedures included in GATT.TS [6]: Discover All Characteristic of a Service, GATT/CL/GAD/BV-04-C, with the specified handle range for the instantiation of the Pulse Oximeter Service, or Discover Characteristic by UUID, GATT/CL/GAD/BV-05-C, with the specified handle range for the instantiation of the Pulse Oximeter Service and UUID set to «Record Access Control Point». 
• Expected Outcome
  Pass verdict

  One attribute handle/value pair is returned containing the UUID «Record Access Control Point» characteristic.

**4.4.18 PLXP/COL/PLXSD/BV-18-I [Discover Record Access Control Point – Client Characteristic Configuration Descriptor]**

• Test Purpose
  Verify that the Collector IUT can discover the Client Characteristic Configuration descriptor of the Record Access Control Point characteristic.

• Reference
  [3] 5.3.1.4

• Initial Condition
  Establish an ATT Bearer connection between the Lower Tester and IUT and run the preamble procedure for the Collector to initiate connection to a Pulse Oximeter Sensor included in Section 4.2.4 if using an LE transport or 4.2.5 if using a BR/EDR transport.

  The Lower Tester has an instance of the Pulse Oximeter Service [4] as a primary service and an associated Client Characteristic Configuration descriptor.

  The IUT has discovered the handle range of the Record Access Control Point characteristic.

• Test Procedure
  1. The Upper Tester issues a command to the IUT to Discover All Characteristic descriptors using the handle range of the Record Access Control Point characteristic.
  2. The IUT executes one pass of the procedure included in GATT.TS [6] Discover all Characteristic Descriptors, GATT/CL/GAD/BV-06-C using the specified handle range with the Record Access Control Point characteristic contained in the server database defined in the Initial Condition.

• Expected Outcome
  Pass verdict

  One attribute handle/value pair is returned containing the UUID «Client Characteristic Configuration» descriptor.

**4.4.19 PLXP/COL/PLXSD/BV-19-I [Discover Device Information Service Characteristics]**

• Test Purpose
  Verify that a Collector IUT can discover all characteristics of a Device Information Service supported by the IUT.

• Reference
  [3] 5.3.3
• **Initial Condition**

Establish an ATT Bearer connection between the Lower Tester and IUT and run the preamble procedure for the Collector to initiate connection to a Pulse Oximeter Sensor included in Section 4.2.4 if using an LE transport or 4.2.5 if using a BR/EDR transport.

The Lower Tester includes one instantiation of the Device Information Service including all defined characteristics.

The IUT has the handle range for the instantiation of the Device Information Service contained in the Lower Tester. The Device Information Service contains one or more characteristics. DIS was previously discovered using the GATT method in PLXP/COL/PLXSD/BV-03-I [Discover Device Information Service over LE] for LE, or using the SDP method in PLXP/COL/PLXSD/BV-06-I [SDP Service Discovery] for BR/EDR.

• **Test Procedure**

The Upper Tester issues a command to the IUT to discover all characteristics of the Device Information Service supported by the IUT. There are two alternatives:


2. The IUT executes the procedure included in GATT.TS [6] Discover Characteristics by UUID, GATT/CL/GAD/BV-05-C several times, using each of the UUIDs for the characteristics of the Device Information Service supported by the IUT, with the Lower Tester instantiating the database specified in the Initial Condition.

• **Expected Outcome**

**Pass verdict**

For each characteristic supported by the IUT contained in the Lower Tester’s instantiation of the Device Information Service, the IUT reports an attribute handle/value pair.

**4.4.20 PLXP/COL/PLXSD/BV-20-I [Read Device Information Service Characteristics]**

• **Test Purpose**

Verify that a Collector IUT can read all characteristics of a Device Information Service supported by the IUT.

• **Reference**

[3] 5.3.3

• **Initial Condition**

Establish an ATT Bearer connection between the Lower Tester and IUT and run the preamble procedure for the Collector to initiate connection to a Pulse Oximeter Sensor included in Section 4.2.4 if using an LE transport or 4.2.5 if using a BR/EDR transport.

The Lower Tester includes one instantiation of the Device Information Service [8] including all defined characteristics.
The IUT has previously executed the procedure included in Section 4.4.3, so it has the handle/value pairs for all characteristics of the Device Information Service supported by the IUT.

- **Test Procedure**
  1. The Upper Tester issues a command to the IUT to read all characteristics of the Device Information Service supported by the IUT.
  2. For each characteristic of the Device Information Service supported by the IUT, the IUT executes the procedure included in GATT.TS [6] GATT/CL/GAR/BV-01-C [Read Characteristic Value – by client].

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

  For each characteristic contained in the Lower Tester's instantiation of the Device Information Service supported by the IUT, the IUT reports the characteristic value.

### 4.4.21 PLXP/COL/PLXSD/BV-21-I [Discover Bond Management Service Characteristics]

- **Test Purpose**
  Verify that a Collector IUT can discover all characteristics of a Bond Management Service (if supported) by the IUT.

- **Reference**
  [3] 5.3.2

- **Initial Condition**
  Establish an ATT Bearer connection between the Lower Tester and IUT and run the preamble procedure for the Collector to initiate connection to a Pulse Oximeter Sensor included in Section 4.2.4 if using an LE transport or 4.2.5 if using a BR/EDR transport.

  The Lower Tester has one instance of the Bond Management Service [11] as a primary service including all defined characteristics.

  The IUT has executed the procedure included in PLXP/COL/PLXSD/BV-01-I [Discover Pulse Oximeter Service over LE] (see Section 4.4.1), and has saved the handle range for the instantiation of the BMS Service.

- **Test Procedure**
  1. The Upper Tester issues a command to the IUT to read all characteristics of the Bond Management Service supported by the IUT.
  2. For each characteristic of the Bond Management Service supported by the IUT, the IUT executes the procedure included in GATT.TS [6] GATT/CL/GAR/BV-01-C [Read Characteristic Value – by client].

- **Expected Outcome**
  **Pass verdict**
Two attribute handle/value pairs are returned containing the UUIDs «Bond Management Control Point» and «Bond Management Feature» characteristics.

4.4.22 PLXP/COL/PLXSD/BV-22-I [Read BMS Feature characteristic]

- **Test Purpose**
  Verify that the Collector IUT can read the BMS Features characteristic from a Pulse Oximeter Sensor.

- **Reference**
  [3] 5.8

- **Initial Condition**
  Establish an ATT Bearer connection between the Lower Tester and IUT and run the preamble procedure for the Collector to initiate connection to a Pulse Oximeter Sensor included in Section 4.2.4 if using an LE transport or 4.2.5 if using a BR/EDR transport.

  The Upper Tester knows the handle of a BMS Feature characteristic contained in the Lower Tester.

- **Test Procedure**
  1. Configure the Lower Tester with different Test Pattern values for BMS Feature (see BMS Feature in [11]).
  2. For each Test Pattern send a command from Upper Tester to request IUT to read a BMS Feature characteristic from the Lower Tester.
  3. After receipt of the expected message (ATT_Read_Request(handle)) by the Lower Tester, send an **ATT_Read_Response** (0x0B) from the Lower Tester to the IUT.

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

  The IUT sends a correctly formatted **ATT_Read_Request** (0x0A) to the Lower Tester, containing the correct handle (according to the GATT database), specified by the Upper Tester.

  The IUT receives the response from the Lower Tester and sends the response containing the correct BMS Feature values for BMS Features supported by device to the Upper Tester.

  Reserved for future use bit values shall be ignored.

4.4.23 PLXP/COL/PLXSD/BV-23-I [Discover Current Time Service Current Time Characteristic]

- **Test Purpose**
  Verify that a Current Time characteristic can be discovered by the Collector IUT.

- **Reference**
  [3] 5.3.4

- **Initial Condition**
Establish an ATT Bearer connection between the Lower Tester and IUT and run the preamble procedure for the Collector to initiate connection to a Pulse Oximeter Sensor included in Section 4.2.4 if using an LE transport or 4.2.5 if using a BR/EDR transport.

The Lower Tester includes one instantiation of the Current Time Service [7] including all defined characteristics.

The IUT has discovered the Current Time Service and has saved the handle range for an instantiation of the Current Time Service. That instantiation contains an instantiation of the Current Time characteristic. This was done by previously using the GATT method in PLXP/COL/PLXSD/BV-02-I [Discover Current Time Service over LE] for LE, or using the SDP method in PLXP/COL/PLXSD/BV-06-I [SDP Service Discovery] for BR/EDR.

• Test Procedure
  1. The Upper Tester issues a command to the IUT to discover Current Time Characteristic.
  2. The IUT executes either of the procedures included in GATT.TS [6]: Discover All Characteristic of a Service, GATT/CL/GAD/BV-04-C, with the specified handle range for the instantiation of the Current Time Service, or Discover Characteristic by UUID, GATT/CL/GAD/BV-05-C, with the specified handle range for the instantiation of the user Current Time Service and UUID set to «Current Time».

• Expected Outcome
  Pass verdict
  Verify that one attribute handle/value pair is received by the IUT containing the UUID «Current Time».

4.4.24 PLXP/COL/PLXSD/BV-24-I [Discover Current Time Service Current Time Characteristic Client Characteristic Configuration Descriptor]

• Test Purpose
  Verify that the Collector IUT can discover the Client Characteristic Configuration descriptor of the Current Time characteristic.

• Reference
  [3] 5.3.4

• Initial Condition
  Establish an ATT Bearer connection between the Lower Tester and IUT and run the preamble procedure for the Collector to initiate connection to a Pulse Oximeter Sensor included in Section 4.2.4 if using an LE transport or 4.2.5 if using a BR/EDR transport.

  The Lower Tester includes one instantiation of the Current Time Service [7] in which the Current Time characteristic and an associated Client Characteristic Configuration descriptor are exposed.

  The IUT has discovered the handle range of the Current Time characteristic.

• Test Procedure
  1. The Upper Tester issues a command to the IUT to Discover All Characteristic Descriptors using the handle range of the characteristic.
2. The IUT executes one pass of the procedure included in GATT.TS [6]: Discover all Characteristic Descriptors, GATT/CL/GAD/BV-06-C using the specified handle range, with the server database defined in Initial Condition.

• Expected Outcome

Pass verdict

Verify that one attribute handle/value pair is received by the IUT containing the UUID «Client Characteristic Descriptor».

4.4.25 PLXP/COL/PLXSD/BV-25-I [Discover Battery Service Characteristics]

• Test Purpose

Verify that a Collector IUT can discover all characteristics of a Battery Service supported by the IUT.

• Reference

[3] 5.3.5

• Initial Condition

Establish an ATT Bearer connection between the Lower Tester and IUT and run the preamble procedure for the Collector to initiate connection to a Pulse Oximeter Sensor included in Section 4.2.4 if using an LE transport or 4.2.5 if using a BR/EDR transport.

The Lower Tester includes one instantiation of the Battery Service [9] including all defined characteristics.

The IUT has the handle range for the instantiation of the Battery Service contained in the Lower Tester. The Battery Service contains one or more characteristics. These were previously discovered using the GATT method in PLXP/COL/PLXSD/BV-04-I [Discover Battery Service over LE] for LE, or using the SDP method in PLXP/COL/PLXSD/BV-06-I [SDP Service Discovery] for BR/EDR.

• Test Procedure

1. The Upper Tester issues a command to the IUT to discover all characteristics of the Battery Service supported by the IUT. There are two alternatives:


3. The IUT executes the procedure included in GATT.TS [6] Discover Characteristics by UUID, GATT/CL/GAD/BV-05-C several times, using each of the UUIDs for the characteristics of the Battery Service supported by the IUT, with the Lower Tester instantiating the database specified in the Initial Condition.

• Expected Outcome

Pass verdict

For each characteristic supported by the IUT contained in the Lower Tester’s instantiation of the Battery Service, the IUT reports an attribute handle/value pair for each characteristic to the Upper Tester.
4.4.26 PLXP/COL/PLXSD/BV-26-I [Discover Battery Service Battery Level Characteristic Client Characteristic Configuration Descriptor]

- **Test Purpose**
  Verify that the Collector IUT can discover the Client Characteristic Configuration descriptor of the Battery Level characteristic.

- **Reference**
  [3] 5.3.5

- **Initial Condition**
  Establish an ATT Bearer connection between the Lower Tester and IUT and run the preamble procedure for the Collector to initiate connection to a Pulse Oximeter Sensor included in Section 4.2.4 if using an LE transport or 4.2.5 if using a BR/EDR transport.

  The Lower Tester includes one instantiation of the Battery Service [7] in which the Battery Level characteristic and an associated Client Characteristic Configuration descriptor are exposed.

  The IUT has discovered the handle range of the Battery Level characteristic.

- **Test Procedure**
  1. The Upper Tester issues a command to the IUT to Discover All Characteristic Descriptors using the handle range of the characteristic.
  2. The IUT executes one pass of the procedure included in GATT.TS [6]: Discover all Characteristic Descriptors, GATT/CL/GAD/BV-06-C using the specified handle range, with the server database defined in Initial Condition.

- **Expected Outcome**
  Pass verdict

  Verify that one attribute handle/value pair is received by the IUT containing the UUID «Client Characteristic Descriptor».

4.5 PLX Spot-check Measurements

The procedures defined in this test group verify implementation of the spot-check measurement characteristics for indication as defined in the Pulse Oximeter Profile Specification [3] by a Pulse Oximeter Sensor IUT, and usage of the same features by a Collector IUT.

4.5.1 PLXP/COL/PLXSC/BV-01-I [Configure PLX Spot-check Measurement Characteristic for Indication]

- **Test Purpose**
  Verify that the Collector IUT can configure a Pulse Oximeter Sensor (Lower Tester) to Indicate PLX Spot-check Measurement characteristics.

- **Reference**
  [3] 5.4
• Initial Condition

Establish an ATT Bearer connection between the Lower Tester and IUT and run the preamble procedure for the Collector to initiate connection to a Pulse Oximeter Sensor included in Section 4.2.4 if using an LE transport or 4.2.5 if using a BR/EDR transport.

The IUT has executed the procedure included in PLXP/COL/PLXSD/BV-13-I [PLX Spot-check Measurement – Client Characteristic Configuration Descriptor], which returns the handle of a Client Characteristic Configuration Descriptor for a PLX Spot-check Measurement characteristic contained in the Lower Tester.

• Test Procedure

The Upper Tester sends a command to the IUT to configure it to receive PLX Spot-check Measurement characteristic indications.

• Expected Outcome

Pass verdict

IUT sends a correctly formatted \textit{ATT\_Write\_Request} (0x12) to the Lower Tester, with the handle set to that of the Client Characteristic Configuration Descriptor for PLX Spot-check Measurement characteristic, and the value set to «indication».

\textbf{4.5.2 PLXP/COL/PLXSC/BV-02-I [Receive PLX Spot-check Measurement Indications]}

• Test Purpose

Verify that the Collector IUT can receive indications of the PLX Spot-check Measurement Characteristic for various field configurations.

• Reference

[3] 5.4

• Initial Condition

Establish an ATT Bearer connection between the Lower Tester and IUT and run the preamble procedure for the Collector to initiate connection to a Pulse Oximeter Sensor included in Section 4.2.4 if using an LE transport or 4.2.5 if using a BR/EDR transport.

The IUT has executed the procedure included in PLXP/COL/PLXSC/BV-01-I [Configure PLX Spot-check Measurement Characteristic for Indication], which configures it to expect a PLX Spot-check Measurement indication.

The IUT knows the handle of the PLX Spot-check Measurement characteristic.

• Test Procedure

1. The Lower Tester sends only one \textit{ATT\_Handle\_Value\_Indication} containing a PLX Spot-check Measurement characteristic value to the IUT.
2. The IUT sends an \textit{ATT\_Handle\_Value\_Confirmation} to the Lower Tester.
3. Verify the characteristic value meets the requirements of the service.
• Expected Outcome
  Pass verdict

  The reported field values and units match the ones sent by the Lower Tester.

4.6 PLX Continuous Measurements

The procedures defined in this test group verify implementation of the PLX Continuous Measurement characteristic for notifications as defined in the Pulse Oximeter Profile Specification [3] by a Pulse Oximeter Sensor IUT, and usage of the same features by a Collector IUT.

4.6.1 PLXP/COL/PLXC/BV-01-I [Configure PLX Continuous Measurement Characteristic for Notification]

• Test Purpose
  Verify that the Collector IUT can configure a Pulse Oximeter Sensor (Lower Tester) to Indicate PLX Continuous Measurement characteristics.

• Reference
  [3] 5.5

• Initial Condition
  Establish an ATT Bearer connection between the Lower Tester and IUT and run the preamble procedure for the Collector to initiate connection to a Pulse Oximeter Sensor included in Section 4.2.4 if using an LE transport or 4.2.5 if using a BR/EDR transport.

  The IUT has executed the procedure included in PLXP/COL/PLXSD/BV-15-I [PLX Continuous Measurement – Client Characteristic Configuration Descriptor], which returns the handle of a Client Characteristic Configuration Descriptor for a PLX Continuous Measurement characteristic contained in the Lower Tester.

• Test Procedure
  1. The Upper Tester sends a command to the IUT to configure it to receive PLX Continuous Measurement characteristic notifications.

• Expected Outcome
  Pass verdict

  IUT sends a correctly formatted ATT_Write_Request (0x12) to the Lower Tester, with the handle set to that of the Client Characteristic Configuration Descriptor for PLX Continuous Measurement characteristic, and the value set to «notification».

4.6.2 PLXP/COL/PLXC/BV-02-I [Receive PLX Continuous Measurement Notifications]

• Test Purpose
  Verify that the Collector IUT can receive notifications of the PLX Continuous Measurement characteristic for various field configurations.
• Reference

[3] 5.5

• Initial Condition

Establish an ATT Bearer connection between the Lower Tester and IUT and run the preamble procedure for the Collector to initiate connection to a PLX Sensor included in Section 4.2.4 if using an LE transport or 4.2.5 if using a BR/EDR transport.

The IUT has executed the procedure included in PLXP/COL/PLXC/BV-01-I [Configure PLX Continuous Measurement Characteristic for Notification], which configures it to expect PLX Continuous Measurement notifications.

The IUT knows the handle of the PLX Continuous Measurement characteristic.

• Test Procedure

1. The Lower Tester sends several ATT_Handle_Value_Notifications containing a PLX Continuous Measurement characteristic value to the IUT.
2. Verify the characteristic values meet the requirements of the service.

• Expected Outcome

Pass verdict

The reported field values and units match the ones sent by the Lower Tester.

Characteristic values meet the requirements of the service.

4.7 PLX Features

The procedures defined in this test group verify implementation of the PLX Features characteristic defined in the Pulse Oximeter Profile Specification [3] by a Pulse Oximeter Sensor IUT, and usage of the same features by a Collector IUT.

4.7.1 PLXP/COL/PLXF/BV-01-I [Read PLX Features characteristic]

• Test Purpose

Verify that the Collector IUT can read the PLX Features characteristic from a Pulse Oximeter Sensor.

• Reference

[3] 5.6

• Initial Condition

Establish an ATT Bearer connection between the Lower Tester and IUT and run the preamble procedure for the Collector to initiate connection to a Pulse Oximeter Sensor included in Section 4.2.4 if using an LE transport or 4.2.5 if using a BR/EDR transport.

The Upper Tester knows the handle of a PLX Features characteristic contained in the Lower Tester.

• Test Procedure
1. Send a command from Upper Tester to request IUT to read a PLX Features characteristic from the Lower Tester.
2. After receipt of the expected result by the Lower Tester, send an `ATT_Read_Response (0x0B)` from the Lower Tester to the IUT.

   • Expected Outcome

   **Pass verdict**

   The IUT sends a correctly formatted `ATT_Read_Request (0x0A)` to the Lower Tester, containing the handle specified by the Upper Tester.

   The IUT receives the response from the Lower Tester and sends the response containing the correct PLX Features value for PLX Features supported by device to the Upper Tester.

   Reserved for future use bit values will be ignored.

4.8 Record Access – Report Stored Records

This test group contains test cases to verify compliant operation when the Record Access Control Point (RACP) 'Report Stored Records' procedure is used.

4.8.1 PLXP/COL/RAR/BV-01-I [Report Stored Records – ‘All records’]

   • Test Purpose

       Verify that the Collector IUT can perform the ‘Report Stored Records’ procedure with an Operator of ‘all records’, as well as verify that measurements that are successfully indicated are not sent again.

   • Reference

       [3] 5.7.2.3

   • Initial Condition

       Perform the preamble described in Section 4.2.3.

   • Test Procedure

       1. Perform an action on the Lower Tester that will induce it to generate 3 records.
       2. Verify that a connection between the Lower Tester and IUT is established.
       3. The IUT writes the ‘Report Stored Records’ Op Code (0x01) to the RACP using an Operator of ‘all records’ (0x01) and no Operand.
       4. The Lower Tester sends 3 `ATT_Handle_Value_Indications` of the PLX Spot-check Measurement characteristic.
       5. The IUT sends an `ATT_Handle_Value_Confirmation` to the Lower Tester.
       6. The Lower Tester sends an `ATT_Handle_Value_Indication` of the Record Access Control Point 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 IUT sends an `ATT_Handle_Value_Confirmation` to the Lower Tester.
8. Verify the characteristic values meet the requirements of the service.

9. The IUT writes the ‘Report Stored Records’ Op Code (0x01) to the RACP using an Operator of ‘All records’ (0x01) and no Operand.

10. The Lower Tester sends zero \textit{ATT\_Handle\_Value\_Indications} of the PLX Spot-check Measurement characteristic.

11. The Lower Tester sends an \textit{ATT\_Handle\_Value\_Indication} of the Record Access Control Point 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).

12. The IUT sends an \textit{ATT\_Handle\_Value\_Confirmation} to the Lower Tester.

\begin{itemize}
\item Expected Outcome
\end{itemize}

\textbf{Pass verdict}

The IUT receives 3 of the PLX Spot-check Measurement characteristic on the first request.

The PLX Measurement characteristic contains the values of the three records.

The IUT receives the Response Code for ‘Success’ (0x01).

The oldest record is transmitted before newer records.

The IUT sends no indications PLX Spot-check Measurement characteristic on the second request to show they will not be transmitted again.

The IUT receives the Response Code for ‘Success’ (0x01).

\subsection*{4.8.2 PLXP/COL/RAR/BV-02-I [Report Stored Records – ‘No Records Found’]}

\begin{itemize}
\item Test Purpose
Verify that the Collector IUT can perform the ‘Report Stored Records’ procedure with an Operator of ‘all records’ when the Sensor responds with ‘No Records Found’.
\item Reference
\cite{3} 5.7.2.1
\item Initial Condition
Perform the preamble described in Section 4.2.3.
\item Test Procedure
1. Perform an action on the Lower Tester that will induce it to contain no stored records.
2. Verify that a connection between the Lower Tester and IUT is established.
3. The IUT writes the ‘Report Stored Records’ Op Code (0x01) to the RACP using an Operator of ‘All records’ (0x01) and no Operand.
4. The Lower Tester sends an \textit{ATT\_Handle\_Value\_Indication} of the Record Access Control Point 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 IUT sends an ATT_Handle_Value_Confirmation to the Lower Tester.

- Expected Outcome

  Pass verdict

  The IUT receives the Response Code for ‘No Records Found’ (0x06).

4.9  Record Access - Delete Stored Records

This test group contains test cases to verify compliant operation when the Record Access Control Point (RACP) ‘Delete Stored Records’ procedure is used.

4.9.1  PLXP/COL/RAD/BV-01-I [Delete Stored Records – ‘All records’]

- Test Purpose

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

- Reference

  [3] 5.7.2.2

- Initial Condition

  Perform the preamble described in Section 4.2.3.

- Test Procedure

  1. Perform an action on the Lower Tester that will induce it to generate 3 records.
  2. Verify that a connection between Lower Tester and IUT is established.
  3. The IUT 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 Lower Tester sends an ATT_Handle_Value_Indication of the Record Access Control Point characteristic with the ‘Report Number of stored Records’ response Op Code (0x05) an Operator of Null (0x00) and an Operand representing that three records were found (0x0003).
  5. The IUT sends an ATT_Handle_Value_Confirmation to the Lower Tester.
  6. The IUT writes the ‘Delete Stored Records’ Op Code (0x02) to the RACP using an Operator of ‘All records’ (0x01) and no Operand.
  7. The Lower Tester sends an ATT_Handle_Value_Indication of the Record Access Control Point 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).
  8. The IUT sends an ATT_Handle_Value_Confirmation to the Lower Tester.
  9. The IUT writes the ‘Report Number of Stored Records’ Op Code (0x04) to the RACP using an Operator of ‘All records’ (0x01) and no Operand.
10. The Lower Tester sends an *ATT_Handle_Value_Indication* of the Record Access Control Point characteristic with the 'Report Number of stored Records' response Op Code (0x05) an Operator of Null (0x00) and an Operand representing that zero records were found (0x0000).

11. The IUT sends an *ATT_Handle_Value_Confirmation* to the Lower Tester.

   - Expected Outcome

      **Pass verdict**

      The number of stored records is changed to zero after the delete operation.

4.10 **Record Access - Abort Operation**

This test group contains test cases to verify compliant operation when the Record Access Control Point (RACP) 'Abort Operation' procedure is used.

4.10.1 **PLXP/COL/RAA/BV-01-I [Abort Operation – ‘Report Stored Records’]**

   - Test Purpose

      Verify that the Collector IUT can perform an Abort of the Report Stored Records procedure.

   - Reference

      [3] 5.7.2.4

   - Initial Condition

      Perform the preamble described in Section 4.2.3.

   - Test Procedure

      1. Perform an action on the Lower Tester that will induce it to generate enough records such that the transmission is not able to complete before the RACP abort is attempted. In most cases ~200 records is sufficient since this will take over 5 seconds to transfer. Alternatively, the IUT could transmit the records slowly.

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

      3. IUT writes the 'Report Stored Records' Op Code (0x01) to the RACP using an Operator of 'All records' (0x01) and no Operand.

      4. The Lower Tester starts to send number of indications of the PLX Spot-check Measurement characteristic.

      5. The IUT receives one or more *ATT_Handle_Value_Indication* from the Lower Tester containing the PLX Spot-check Measurement characteristic handle and value.

      6. IUT writes the 'Abort Operation' Op Code (0x03) to the RACP with an Operator of Null and no Operand.

      7. The Lower Tester sends a *ATT_Handle_Value_Indication* of the Record Access Control Point 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 IUT sends an *ATT_Handle_Value_Confirmation* to the Lower Tester.

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

- Expected Outcome
  Pass verdict

The IUT receives some, but not all indications of the PLX Spot-check Measurement characteristic. The IUT receives one indication of the Record Access Control Point 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).

4.11 Record Access – Report Number of Stored Records
This test group contains test cases to verify compliant operation when the Record Access Control Point (RACP) ‘Report Number of Stored Records’ procedure is used.

4.11.1 PLXP/COL/RAN/BV-01-I [Report Number of Stored Records – ‘All records’]

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

- Reference
  [3] 5.7.2.1

- Initial Condition
  Perform the preamble described in Section 4.2.3.

- Test Procedure
  1. Perform an action on the Lower Tester that will induce it to generate 3 records.
  2. Verify that a connection between Lower Tester and IUT is established.
  3. The IUT 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 Lower Tester sends an ATT_Handle_Value_Indication of the Record Access Control Point characteristic with the ‘Report Number of stored Records’ response Op Code (0x05) an Operator of Null (0x00) and an Operand representing that three records were found (0x0003).
  5. The IUT sends an ATT_Handle_Value_Confirmation to the Lower Tester.
  6. Verify the characteristic value meets the requirements of the service.

- Expected Outcome
  Pass verdict

The IUT receives one indication of the Record Access Control Point characteristic with the ‘Report Number of stored Records’ Response Op Code (0x05) an Operator of Null (0x00) and an Operand representing that three records were found (0x0003).

4.12 Record Access- Error Handling
RACP error handling is covered in the Pulse Oximeter Service Test Specification [12].
4.13 Record Access – ‘Procedure Timeout’
This test group contains test cases to verify compliant operation when the Lower Tester uses Control Point procedures and a procedure timeout occurs.

4.13.1 PLXP/COL/RAT/BI-01-I [Procedure Timeout Handling]

- Test Purpose
  Verify that if the Collector IUT does not receive a response to a RACP Op Code, it will time out after the Attribute Protocol Timeout.

- Reference
  [3] 5.7.2.6

- Initial Condition
  Establish an ATT Bearer connection between the Lower Tester and IUT and run the preamble procedure for the Collector to initiate connection to a Pulse Oximeter Sensor included in Section 4.2.4 if using an LE transport or 4.2.5 if using a BR/EDR transport.

  Perform the preamble described in Section 4.2.3.

- Test Procedure
  1. Create a stored record with at least one PLX Spot-check Measurement characteristic value.
  2. Verify that a connection between the Lower Tester and IUT is established.
  3. The IUT writes e.g. the ‘Report Stored Records’ Op Code (0x01) to the RACP, using an Operator of ‘All records’ (0x01) and no Operand.
  4. The Lower Tester does NOT send an indication of the Record Access Control Point characteristic for at least longer than the Attribute Protocol Timeout.
  5. After the specified timeout the IUT sends a notification of the Attribute Transaction Timeout to the Upper Tester, and the IUT and considers the procedure to have failed.

- Expected Outcome
  Pass verdict

  After the Attribute Protocol Timeout, the IUT notifies the local upper layer of the time out.

  The IUT returns to a stable state and can process commands normally.

4.14 BMS Procedures
This test group contains test cases to verify compliant operation when the Bond Management Control Point procedures are used.

Table 3.3 in [11] defines the Op Codes and parameter values used in the test procedures in this section.

4.14.1 PLXP/COL/BMS/BV-01-I [Write BMSCP characteristic value]

- Test Purpose
  Verify that a Collector IUT can write the BMSCP characteristic using ATT Write Request.
• Reference

[11] 3.1.1

• Initial Condition
Establish an ATT Bearer connection between the Lower Tester and IUT and run the preamble procedure for the Collector to initiate connection to a Pulse Oximeter Sensor included in Section 4.2.4 if using an LE transport or 4.2.5 if using a BR/EDR transport.

• Test Procedure
The following test procedure has to be repeated for each defined Op Code in Table 3.3 in [11] valid for the used transport:


• Expected Outcome
Pass verdict

The IUT receives an ATT_Write_Response from the Lower Tester.

Upon receiving an ATT_Write_Response from the Lower Tester the IUT sends the result to the Upper Tester.

4.14.2 PLXP/COL/BMS/BV-02-I [Write BMSCP characteristic value – with Parameter]

• Test Purpose
Verify that a Collector IUT can write the BMSCP characteristic with data larger than Op Code, using ATT Write Request.

• Reference

[11] 3.1.1

• Initial Condition
Establish an ATT Bearer connection between the Lower Tester and IUT and run the preamble procedure for the Collector to initiate connection to a Pulse Oximeter Sensor included in Section 4.2.4 if using an LE transport or 4.2.5 if using a BR/EDR transport.

• Test Procedure
The following test procedure has to be repeated for each Op Code in Table 3.3 in [11] valid for the used transport:

1. Execute GATT/CL/GAW/BV-03-C in [6] with the handle and the value of the BMSCP characteristic. The value shall fit within the used MTU size.

• Expected Outcome
Pass verdict
The IUT receives an `ATT_Write_Response` from the Lower Tester.

The parameter value received by the Lower Tester corresponds to the value sent by IUT.

Upon receiving an `ATT_Write_Response` from the Lower Tester the IUT sends the result to the Upper Tester.

### 4.14.3 PLXP/COL/BMS/BV-03-I [Write BMSCP characteristic value – Insufficient Authorization]

- **Test Purpose**
  Verify that a Collector IUT can write the BMSCP characteristic with an invalid or missing authorization code, using ATT Write Request.

- **Reference**
  [11] 3.1.1

- **Initial Condition**
  Establish an ATT Bearer connection between the Lower Tester and IUT and run the preamble procedure for the Collector to initiate connection to a Pulse Oximeter Sensor included in Section 4.2.4 if using an LE transport or 4.2.5 if using a BR/EDR transport.

- **Test Procedure**
  The following test procedure has to be repeated for each Op Code in Table 3.3 in [11] valid for the used transport.

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

2. The IUT sends an `ATT_Write_Request` with the handle of the BMSCP characteristic and a value containing an Op code as defined in Table 3.3 in [11] and a parameter value containing a value which fits within the used MTU size. The value shall not contain the required authorization code.

3. The IUT receives an `ATT_Error_Response` with the Error Code set to ‘Insufficient Authorization’ from the Lower Tester.

4. Verify that the IUT considers the procedure to have failed.

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

  The IUT receives an `ATT_Error_Response` with the Error Code set to ‘Insufficient Authorization’ from the Lower Tester.

  Upon receiving an `ATT_Error_Response` from the Lower Tester the IUT sends the result to the Upper Tester and returns to a stable state and can process commands normally.

### 4.14.4 PLXP/COL/BMS/BI-04-I [Write BMSCP characteristic value – Operation Failed]

- **Test Purpose**
Verify that a Collector IUT behaves appropriately when it receives an 'Operation Failed' Error Response.

- Reference
  [11] 3.1.1

- Initial Condition
  Establish an ATT Bearer connection between the Lower Tester and IUT and run the preamble procedure for the Collector to initiate connection to a Pulse Oximeter Sensor included in Section 4.2.4 if using an LE transport or 4.2.5 if using a BR/EDR transport.

- Test Procedure
  The following test procedure has to be repeated for one of the Op Codes in Table 3.3 in [11] valid for the used transport.
  1. Verify that a connection between the Lower Tester and IUT is established.
  2. The IUT sends an ATT_Write_Request with the handle of the BMSCP characteristic and a value containing an Op code without parameter value as defined in Table 3.3 in [11].
  3. The IUT receives an ATT_Error_Response with the Error Code set to 'Operation Failed' from the Lower Tester.
  4. Verify that the IUT considers the procedure to have failed.

- Expected Outcome
  Pass verdict
  The IUT receives an ATT_Error_Response with the Error Code set to 'Operation Failed' from the Lower Tester.
  Upon receiving an ATT_Error_Response from the Lower Tester the IUT sends the result to the Upper Tester and returns to a stable state and can process commands normally.


- Test Purpose
  Verify that a Collector IUT behaves appropriately when it receives an 'Op Code not supported' Error Response.

- Reference
  [11] 3.1.1

- Initial Condition
  Establish an ATT Bearer connection between the Lower Tester and IUT and run the preamble procedure for the Collector to initiate connection to a Pulse Oximeter Sensor included in Section 4.2.4 if using an LE transport or 4.2.5 if using a BR/EDR transport.

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

2. The IUT sends an `ATT_Write_Request` with the handle of the BMSCP characteristic and a value containing a valid Op code value.

3. The IUT receives an `ATT_Error_Response` with the Error Code set to ‘Op Code not Supported’ from the Lower Tester.

Verify that the IUT considers the procedure to have failed.

- Expected Outcome
  
  **Pass verdict**

  The IUT receives an `ATT_Error_Response` with the Error Code set to ‘Op Code not Supported’ from the Lower Tester.

  Upon receiving an `ATT_Error_Response` from the Lower Tester the IUT sends the result to the Upper Tester and returns to a stable state and can process commands normally.

### 4.14.6 PLXP/COL/BMS/BV-06-I [Write Long BMSCP characteristic value]

- Test Purpose
  
  Verify that a Collector IUT can write a long characteristic value to the BMSCP characteristic.

- Reference
  
  [11] 3.1.1

- Initial Condition
  
  Establish an ATT Bearer connection between the Lower Tester and IUT and run the preamble procedure for the Collector to initiate connection to a Pulse Oximeter Sensor included in Section 4.2.4 if using an LE transport or 4.2.5 if using a BR/EDR transport.

  The length of the parameter used shall be higher than the used MTU size.

- Test Procedure
  
  The following test procedure has to be executed for one of the Op Codes in Table 3.3 in [11] valid for the used transport.


- Expected Outcome
  
  **Pass verdict**

  The IUT receives an `ATT_Execute_Write_Response` from the Lower Tester. Upon receiving an `ATT_Execute_Write_Response` from the Lower Tester the IUT sends the result to the Upper Tester.

  The characteristic value received by the Lower Tester meets the requirements of the service.
4.15 Current Time Service Features

4.15.1 PLXP/COL/CTS/BV-01-I [Configure Current Time Characteristic for Notification]

- **Test Purpose**
  Verify that the Collector IUT can configure a Pulse Oximeter Sensor (Lower Tester) to notify the Current Time characteristic of the Current Time Service.

- **Reference**
  [3] 5.3.4

- **Initial Condition**
  Establish an ATT Bearer connection between the Lower Tester and IUT and run the preamble procedure for the Collector to initiate connection to a Pulse Oximeter Sensor included in Section 4.2.4 if using an LE transport or 4.2.5 if using a BR/EDR transport.

  The IUT has discovered the Client Characteristic Configuration Descriptor of the Current Time characteristic contained in the Lower Tester.

- **Test Procedure**
  The Upper Tester sends a command to the IUT to configure the Pulse Oximeter Sensor to notify the Current Time characteristic.

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

  IUT sends a correctly formatted `ATT_Write_Request` (0x12) to the Lower Tester, with the handle set to that of the Client Characteristic Configuration descriptor for the Current Time characteristic with the value set to «Notification».

4.15.2 PLXP/COL/CTS/BV-02-I [Read Current Time Characteristic]

- **Test Purpose**
  Verify that the Collector IUT can read the Current Time characteristic from a Pulse Oximeter Sensor.

- **Reference**
  [3] 5.3.4

- **Initial Condition**
  Establish an ATT Bearer connection between the Lower Tester and IUT and run the preamble procedure for the Collector to initiate connection to a Pulse Oximeter Sensor included in Section 4.2.4 if using an LE transport or 4.2.5 if using a BR/EDR transport.

  The Upper Tester knows the handle of a Current Time characteristic contained in the Lower Tester.

- **Test Procedure**
1. Send a command from Upper Tester to request IUT to read a Current Time characteristic from the Lower Tester.

2. After receipt of the expected result by the Lower Tester from the IUT, send an ATT_Read_Response (0x0B) from the Lower Tester to the IUT containing a defined value of the Current Time characteristic.

   • Expected Outcome

     Pass verdict

     The IUT sends a correctly formatted ATT_Read_Request (0x0A) to the Lower Tester, containing the handle specified by the Upper Tester.

     The IUT receives the response from the Lower Tester and sends the response containing the correct Date Time value to the Upper Tester.

4.15.3 PLXP/SEN/CTS/BV-03-I [Verify that the timestamp in the PLX Spot-check Measurement characteristic agrees with the Current Time Service value]

   • Test Purpose

     Verify that the value of the Time Stamp field provided in the PLX Spot-check Measurement characteristic is the same as the value of the Date Time field within the Current Time characteristic, within a small tolerance.

   • Reference

     [3] 5.3.1.1

   • Initial Condition

     Establish an ATT Bearer connection between the Lower Tester and IUT and run the preamble procedure for the Collector to initiate connection to a PLX Sensor included in Section 4.2.4 if using an LE transport or 4.2.5 if using a BR/EDR transport.

     If IUT permissions for the PLX Spot-check Measurement characteristic require a specific security mode or security level, establish a connection meeting those requirements.

     The handle of each characteristic value referenced in the test case below has been previously discovered by the Lower Tester or is known to the Lower Tester by other means.

   • Test Procedure

     1. The Lower Tester configures the PLX Spot-check Measurement characteristic for indication.

     2. Perform an action on the IUT that will induce it to send an indication of the PLX Spot-check Measurement characteristic along with the Time Stamp field.

     3. The IUT receives an ATT_Handle_Value_Indication from the Lower Tester containing the PLX Spot-check Measurement characteristic handle and value including the Time Stamp field.

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

     5. Immediately upon receiving the ATT_Handle_Value_Indication, the IUT reads the value of the Current Time Characteristic. The characteristic value is read by executing the test procedure of GATT test case GATT/SR/GAR/BV-01-C in [6].
6. Compare the timestamp value reported in the PLX Spot-check Measurement characteristic indication received at step #3 with the time value reported in the Current Time characteristic received at step #5.

   • Expected Outcome
     Pass verdict
     The difference between the two time values compared is less than or equal to one second.

4.16 Battery Service Features

4.16.1 PLXP/COL/BAS/BV-01-I [Configure Battery Level Characteristic for Notification]

   • Test Purpose
     Verify that the Collector IUT can configure a Pulse Oximeter Sensor (Lower Tester) to notify the Battery Level characteristic of the Battery Service.

   • Reference
     [3] 5.3.5

   • Initial Condition
     Establish an ATT Bearer connection between the Lower Tester and IUT and run the preamble procedure for the Collector to initiate connection to a Pulse Oximeter Sensor included in Section 4.2.4 if using an LE transport or 4.2.5 if using a BR/EDR transport.

     The IUT has discovered the Client Characteristic Configuration Descriptor of the Battery Level characteristic contained in the Lower Tester.

   • Test Procedure
     The Upper Tester sends a command to the IUT to configure the Pulse Oximeter Sensor to notify the Battery Level characteristic.

   • Expected Outcome
     Pass verdict
     IUT sends a correctly formatted ATT_Write_Request (0x12) to the Lower Tester, with the handle set to that of the Client Characteristic Configuration descriptor for the Battery Level characteristic with the value set to «Notification».

4.16.2 PLXP/COL/BAS/BV-02-I [Read Battery Level Characteristic]

   • Test Purpose
     Verify that the Collector IUT can read the Battery Level characteristic from a Pulse Oximeter Sensor.

   • Reference
     [3] 5.3.5
• Initial Condition

Establish an ATT Bearer connection between the Lower Tester and IUT and run the preamble procedure for the Collector to initiate connection to a Pulse Oximeter Sensor included in Section 4.2.4 if using an LE transport or 4.2.5 if using a BR/EDR transport.

The Upper Tester knows the handle of a Battery Level characteristic contained in the Lower Tester.

• Test Procedure

  1. Send a command from Upper Tester to request IUT to read the Battery Level characteristic from the Lower Tester.

  2. After receipt of the expected result by the Lower Tester from the IUT, send an `ATT_Read_Response (0x0B)` from the Lower Tester to the IUT containing a defined value of the Battery Level characteristic.

• Expected Outcome

   Pass verdict

   The IUT sends a correctly formatted `ATT_Read_Request (0x0A)` to the Lower Tester, containing the handle specified by the Upper Tester.

   The IUT receives the response from the Lower Tester and sends the response containing the correct Battery Level value to the Upper Tester.

4.17 Connection Establishment

This test group contains test cases to verify the compliant behavior of a Pulse Oximeter Sensor in bonded and unbonded situations.

4.17.1 PLXP/COL/CECC/BV-01-I [Lost Bond Procedure when using LE transport]

• Test Purpose

   Verify that the Collector IUT starts encryption with a bonded Pulse Oximeter Sensor on reconnection and rediscovers and reconfigures the Pulse Oximeter Sensor if bond is lost.

• Reference

   [3] 6.2.1

• Initial Condition

   The IUT and the Lower Tester have previously bonded.

   Perform the preamble procedure described in Section 4.2.3 to enable indications and notifications on the required characteristics of the Lower Tester's Pulse Oximeter Service.

   No connection is established between the IUT and Lower Tester.

   The bond is deleted at the Lower Tester.

• Test Procedure

  1. The Lower Tester begins advertising using a GAP undirected connectable mode.
2. The IUT establishes a connection to the Lower Tester.
3. Verify that the IUT starts encryption when the connection is established and redisCOVERS and reconfigures the Pulse Oximeter Sensor upon detection of the lost bond.

- Expected Outcome
  
PASs verdict

  The IUT starts encryption when the connection is established.

  The IUT redisCOVERS the Pulse Oximeter Service.

  The IUT reconfigures the Client Characteristics Configuration descriptors of the PLX Spot-check Measurement characteristic, PLX Continuous Measurement characteristic, the Record Access Control Point characteristic.

4.17.2 PLXP/COL/CECC/BV-02-I [Lost Bond Procedure when using BR/EDR transport]

- Test Purpose
  
  Verify that the Collector IUT reconfigures the Pulse Oximeter Sensor if bond is lost.

  In case of BR/EDR, either the Lower Tester or Collector IUT could initiate a connection when they are bonded. The device initiating the connection becomes a master and is referred here as “master to be” and the device accepting the connection becomes a slave and is referred here as “slave to be”. Verify that the “master to be” starts encryption with a bonded “slave to be” on connection.

- Reference
  
  [3] 6.3.3

- Initial Condition
  
The IUT and the Lower Tester have previously bonded.

  No connection is established between the IUT and Lower Tester.

  The bond is deleted at the Lower Tester.

- Test Procedure
  
  1. The “slave to be” is in connectable mode.
  2. The “master to be” establishes a connection to the “slave to be”.
  3. The “master to be” starts encryption when the connection is established.
  4. Verify that the IUT redisCOVERS and reconfigures the Pulse Oximeter Sensor upon detection of the lost bond.

- Expected Outcome
  
PASs verdict

  The “master to be” starts encryption when the connection is established.

  The IUT redisCOVERS the Pulse Oximeter Service.
The IUT reconfigures the Client Characteristics Configuration descriptors of the PLX Spot-check Measurement characteristic, PLX Continuous Measurement characteristic, the Record Access Control Point characteristic.
## 5 Test Case Mapping

The Test Case Mapping Table (TCMT) maps test cases to specific capabilities in the ICS. Profiles, protocols and services may define multiple roles, and it is possible that a product may implement more than one role. The product shall be tested in all roles for which support is declared in the ICS document. For products which support more than one role, a separate TCMT shall be filled out for each role, and separate tests shall be conducted for each role.

The columns for the TCMT are defined as follows:

- **Item**: contains a y/x reference, where y corresponds to the table number and x corresponds to the feature number as defined in the ICS Proforma for Pulse Oximeter Profile [5]. 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.

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.

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<th>Test Case(s)</th>
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</tr>
<tr>
<td>PLXP 3/4</td>
<td>Local Name included in AD or Scan Response over LE</td>
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<tr>
<td>Item</td>
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<td>Test Case(s)</td>
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</tr>
<tr>
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<td>Battery Service not discoverable over BR/EDR</td>
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<td>Discover Record Access Control Point – Client Characteristic Configuration Descriptor</td>
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<tr>
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</tr>
<tr>
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<tr>
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<td>PLXP/COL/PLXSC/BV-01-I</td>
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<td>Receive PLX Spot-check Measurement Indications</td>
<td>PLXP/COL/PLXSC/BV-02-I</td>
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<tr>
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<tr>
<td>Item</td>
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</tr>
<tr>
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</tbody>
</table>

**Table 5.1: Test Case Mapping**