Cycling Power Profile (CPP)

*Bluetooth® Test Specification*

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- **Revision Date**: 2017-11-28
- **Group Prepared By**: BTI
- **Feedback Email**: bti-main@bluetooth.org

**Abstract:**
This document defines test structures and procedures for conformance test of products implementing the Cycling Power Profile Specification.
## Revision History

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Removed test case [Receive Cycling Power Measurement Notifications from a CP Sensor – Unknown Distributed System |
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1 Scope

This Bluetooth document contains the Test Suite Structure (TSS) and Test Cases (TC) to test the Bluetooth Cycling Power 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. For the purpose of this Bluetooth document, the definitions, and abbreviations in [1], [2], and [3] apply.

[1] Test Strategy and Terminology Overview
[2] Bluetooth Core Specification v4.0 or later
[3] Cycling Power Profile Specification v1.0 or later
[4] Cycling Power Profile ICS, CPP.ICS
[6] Cycling Power Service Specification v1.0 or later
[8] Device Information Service Specification v1.1 or later
[9] Battery Service Specification v1.0 or later
[10] Cycling Power Profile Implementation Extra Information for Test, IXIT
[11] Characteristic and Descriptor descriptions are accessible via the Bluetooth SIG Assigned Numbers

2.2 Abbreviations

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

CP Sensor refers to a Cycling Power Sensor.
3 Test Suite Structure (TSS)

3.1 Overview

The Cycling Power Profile requires the presence of GAP, SM, and GATT. This is illustrated in Figure 3.1.

3.2 Test Strategy

The test objectives are to verify the functionality of the Cycling Power 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.

Conformance testing is the appropriate test method to meet these intents. The basis for the test approach is the general concepts and conformance testing principles defined in ISO/ IEC 9646-1 and ISO/IEC 9646-2; both are part of the OSI Conformance Testing Methodology and Framework (CTMF).

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 Cycling Power 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.

Some test cases in this test specification emulates simultaneous connection with two Sensors and therefore require two Lower Testers that are independent of each other.

The Cycling Power 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 purposes.

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.

Discovery of Services and Characteristics
- This group tests IUT discovery of the Cycling Power Service and characteristics and Device Information Service characteristics.

Features
- This group tests IUT implementation of Cycling Power Profile Features.

Service Procedures
- This group tests the operation of additional procedures defined in the service specification including the Cycling Power Control Point procedures.
4 Test Cases

4.1 Introduction

4.1.1 Test Case Identification Conventions

Test cases shall be assigned unique identifiers per the conventions in [1]. 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 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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<td>CPP</td>
<td>Cycling Power Profile</td>
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<thead>
<tr>
<th>Identifier Abbreviation</th>
<th>Role Identifier &lt;IUT role&gt;</th>
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<td>COL</td>
<td>Collector Role</td>
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</table>

<table>
<thead>
<tr>
<th>Identifier Abbreviation</th>
<th>Class identifier &lt;class&gt;</th>
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</thead>
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<tr>
<td>CPD</td>
<td>Discovery of Services and Characteristics</td>
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<td>CPF</td>
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<td>OBS</td>
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<td>SPS</td>
<td>Service Procedures – Set Cumulative Value</td>
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<td>SPP</td>
<td>Service Procedures – Handle CP Sensor Parameters</td>
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<tr>
<td>SPO</td>
<td>Service Procedure – Start Offset Compensation</td>
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<tr>
<td>SPM</td>
<td>Service Procedure – Mask Characteristic Content</td>
</tr>
<tr>
<td>SPE</td>
<td>Service Procedure – Error Handling</td>
</tr>
</tbody>
</table>

Table 4.1: CPP TC Class 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 are not
excluded by the Specification, OR

- that capability 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 the implementation gracefully rejects any attempt to exercise capabilities which were declared
as not supported. Graceful rejection means that the implementation demonstrates uninterrupted
conformance to the specification immediately after rejecting such attempts without any need to be
externally reset or adjusted, 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 passes 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, then the IUT fails the test case as soon one of the pass criteria conditions cannot be met
and in case 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 Set up LE Transport

Use GATT.TS [5] Preamble [Setup ATT Bearer over LE].

#### 4.2.2 Set up BR/EDR Transport


#### 4.2.3 Collector: Configure CP Sensor for use with Cycling Power Control Point

This preamble procedure specifies how the Collector IUT configures the CP Sensor for use with Cycling
Power Control Point and is valid for LE and BR/EDR transports.

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

- The handles of the Cycling Power Measurement, the Cycling Power Feature, the Sensor Location,
  the Cycling Power Control Point, and the Cycling Power Vector characteristics 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.

- The handles of the Client Characteristic Configuration descriptor of the Cycling Power Measurement characteristic and Cycling Power Control Point characteristic have been previously discovered by the Lower Tester during the test procedure in Section 4.3 or are known to the Lower Tester by other means.

- The Lower Tester may perform a bonding procedure. If previously bonded, enable encryption if not already enabled.

- The Cycling Power Measurement characteristic is configured for notifications.

- The Cycling Power Control Point characteristic is configured for indications.

- The Cycling Power Vector characteristic, if discovered, is configured for notifications.

### 4.2.4 LE Collector: Scan to detect Sensor Connectable Advertisements and initiate a connection

This LE preamble procedure specifies how the Collector IUT scans for CP Sensor connectable advertisements for the case when a Sensor has new data available.

- Reference
  
  [3] 7.2
  
  [2] 9.3.3 and 9.3.4

- Preamble Procedure

  Configure the Collector IUT to accept commands from the Upper Tester to receive data from the CP Sensor (Lower Tester).

  The Upper Tester commands the Collector IUT to initiate a connection and the IUT starts scanning.

  The CP Sensor (Lower Tester) advertises to the Collector IUT either using:

  - ALT 1: GAP Directed Connectable Mode (send ADV_DIRECT_IND packets); or
  - ALT 2: GAP Undirected Connectable Mode (send ADV_IND packets).

  The Lower Tester waits for responses from the Collector IUT.

  The Collector IUT sends a CONNECT_REQ and an optionally empty PDU to the Lower Tester.
4.2.5 LE CP Observer: Scan to detect Sensor Non-Connectable Advertisements

This LE preamble procedure specifies how the CP Observer IUT scans for CP Sensor (Lower Tester) non-connectable advertisements for the case when a CP Sensor is broadcasting the Cycling Power Measurement characteristic value.

- Reference
  
  [3] 7

- Preamble Procedure
  
  Configure the CP Observer IUT to accept commands from the Upper Tester to receive data from the CP Sensor (Lower Tester).

  The Upper Tester commands the CP Observer IUT to scan with an appropriate filter policy (e.g. the address of the Lower Tester).

  The CP Sensor (Lower Tester) advertises using undirected non-connectable advertisement including the Cycling Power Measurement characteristic to be broadcasted as defined in [6].

4.2.6 BR/EDR Collector

4.2.6.1 Unbonded Devices

This BR/EDR preamble procedure specifies how the Collector IUT scans for the CP Sensor for the case when a CP Sensor has new records available.

- Reference
  
  [3] 7.3
  
  [2] 4.1 and 4.2
• Preamble Procedure
  Configure the Collector IUT to accept commands to receive data from the CP Sensor (Lower Tester).

Put the CP Sensor in General Discoverable mode.

The Upper Tester commands the Collector IUT to initiate a connection and the IUT starts scanning.

The CP Sensor (Lower Tester) exposes the SDP record for the Cycling Power Service.

The Collector IUT validates the SDP record and establishes a connection to the CP Sensor.

The Collector uses the GAP General Discovery procedure to discover a CP Sensor to establish a connection to a CP Sensor.

4.2.6.2 Bonded Devices
In the case of BR/EDR, either a CP Sensor or Collector could initiate a connection when they are bonded. The device initiating the connection becomes a master and is referred to herein as “master to be”, and the device accepting the connection becomes a slave and is referred to herein as “slave to be”.

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

• Reference
  [3] 7.3
  [2] 4.1 and 4.2

• Preamble Procedure
  Configure the Collector IUT to accept commands to receive data from the CP Sensor (Lower Tester).

Put the “slave to be” in the connectable mode to accept a connection from the “master to be”.

The connection is initiated by “master to be”.

The “slave to be” exposes the SDP record for the Cycling Power Service.

The “master to be” validates the SDP record and establishes a connection to the “slave to be”.

The “master to be” uses the GAP Link Establishment Procedure to connect to any bonded device.

4.3 Discover Services and Characteristics
The procedures defined in this test group verify IUT’s ability to discover the services and characteristics exposed by a CP Sensor (Lower Tester).

4.3.1 CPP/COL/CPD/BV-01-I [Discover Cycling Power Service over LE]
• Test Purpose
  Verify that the Cycling Power Service can be discovered by the Collector IUT when using an LE Transport

• Reference
  [3] 4.2
• **Initial Condition**

Establish an ATT Bearer connection between the Lower Tester and IUT and run the preamble procedure for the Collector to initiate a connection to a CP Sensor included in the Section 4.2.4.

The Lower Tester exposes one instantiation of the Cycling Power Service [6].

• **Test Procedure**

The Upper Tester issues a command to the IUT to discover primary services. There are two alternatives:

1. Execute the procedure included in GATT.TS [5] Discover All Primary Services, GATT/CL/GAD/BV-01-C, once, with the database specified in [6].

2. Execute the procedure included in GATT.TS [5] Discover Primary Services by Service UUID, GATT/CL/GAD/BV-02-C, with the service UUID set to «Cycling Power Service», with the database specified in [6].

• **Expected Outcome**

**Pass verdict**

The IUT performs, at least, one of the two alternatives to discover the primary services.

An attribute handle range is returned, containing the starting handle and the ending handle of the instantiation of a Cycling Power Service definition.

### 4.3.2 CPP/COL/CPD/BV-02-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] 4.2

• **Initial Condition**

Run the preamble procedure to enable the Collector to initiate a connection to a CP Sensor included in Section 4.2.4.

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

• **Test Procedure**

The Upper Tester issues a command to the IUT to discover primary services. There are two alternatives:


- Expected Outcome
  Pass verdict

An attribute handle range is returned, containing the starting handle and the ending handle of the instantiation of the Device Information Service definition.

4.3.3 CPP/COL/CPD/BV-03-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] 4.2

- Initial Condition
  Run the preamble procedure to enable the Collector to initiate a connection to a CP Sensor included in Section 4.2.4.

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

- Test Procedure
  The Upper Tester issues a command to the IUT to discover primary services. There are two alternatives:


- Expected Outcome
  Pass verdict

An attribute handle range is returned, containing the starting handle and the ending handle of the instantiation of the Battery Service definition.

4.3.4 CPP/COL/CPD/BV-04-I [SDP Service Discovery]

- Test Purpose
  Verify that the Collector IUT can discover the SDP record for the Cycling Power Service, Device Information Service (if supported) and Battery Service (if supported) of the Lower Tester when using the BR/EDR transpor

- Reference
  [3] 4.2
• Initial Condition
An ACL connection over BR/EDR is established between the Lower Tester and IUT.

• Test Procedure
1. The IUT establishes an SDP connection to the Lower Tester.
2. The IUT sends SDP requests to retrieve all attributes of all SDP records from the Lower Tester.

• Expected Outcome
Pass verdict
The SDP record for the Cycling Power Service is retrieved.
If supported, the SDP record for the Device Information Service is retrieved.
If supported, the SDP record for the Battery Service is retrieved.

4.3.5 CPP/SEN/CPD/BV-05-I [Cycling Power Service not discoverable over BR/EDR]

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

• Reference
[3] 2.5

• Initial Condition
The IUT includes one instantiation of the Cycling Power Service [6].

• Test Procedure
1. Establish a BR/EDR ATT Bearer connection between the Lower Tester and IUT (4.2.2).
2. 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 «Cycling Power Service».
3. If no instances of Cycling Power Service as a primary service are found over BR/EDR, the Lower Tester sends an ATT_Find_By_Type_Value_Request (0x0001, 0xFFFF) to the IUT, with type set to «Secondary Service» and Value set to the UUID for «Cycling Power Service».

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

4.3.6 CPP/COL/CPD/BV-06-I [Discover Cycling Power Feature Characteristic]

• Test Purpose
Verify that a Cycling Power Feature characteristic can be discovered by the Collector IUT

- Reference
  
  [3] 4.3.1

- Initial Condition

Establish an ATT Bearer connection between the Lower Tester and IUT and run the preamble procedure for the Collector to initiate a connection to a CP Sensor included in the Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport.

The Lower Tester includes one instantiation of the Cycling Power Service [6] including all defined characteristics. This instantiation also contains two «future» characteristics:

- One inserted between the last mandatory characteristic and the first optional characteristic.
- One appended after the last optional characteristic.
- The «future» characteristic is a 16-bit UUID randomly selected from unassigned UUIDs at the time of the test.

The IUT has discovered the Cycling Power Service and has saved the handle range for an instantiation of the Cycling Power Service that contains an instantiation of the Cycling Power Feature characteristic. This was done by previously using GATT-based methods as in CPP/COL/CPD/BV-01-I [Discover Cycling Power Service over LE] for LE or using SDP as in CPP/COL/CPD/BV-04-I [SDP Service Discovery] for BR/EDR.

- Test Procedure

  1. The Upper Tester issues a command to the IUT to Discover Cycling Power Feature characteristic.

  2. The IUT executes either of the procedures included in GATT.TS [5]: Discover All Characteristics of a Service, GATT/CL/GAD/BV-04-C, with the specified handle range for the instantiation of the Cycling Power Service, or Discover Characteristic by UUID, GATT/CL/GAD/BV-05-C, with the specified handle range for the instantiation of the Cycling Power Service and UUID set to «Cycling Power Feature». In the selected procedure, only one pass is needed with the server database defined in Initial Condition.

- Expected Outcome

  Pass verdict

  One attribute handle/value pair is returned containing the UUID «Cycling Power Feature» characteristic.

4.3.7 CPP/COL/CPD/BV-07-I [Discover Cycling Power Measurement Characteristic]

- Test Purpose

  Verify that a Cycling Power Measurement characteristic can be discovered by the Collector IUT

- Reference

  [3] 3.1
• **Initial Condition**

Establish an ATT Bearer connection between the Lower Tester and IUT and run the preamble procedure for the Collector to initiate a connection to a CP Sensor included in the Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport.

The Lower Tester includes one instantiation of the Cycling Power Service [6] including all defined characteristics. This instantiation also contains two «future» characteristics:

- One inserted between the last mandatory characteristic and the first optional characteristic.
- One appended after the last optional characteristic.
- The «future» characteristic is a 16-bit UUID randomly selected from unassigned UUIDs at the time of the test.

The IUT has discovered the Cycling Power Service and has saved the handle range for an instantiation of the Cycling Power Service. That instantiation contains an instantiation of the Cycling Power Measurement characteristic. This was done by previously using GATT-based methods as in CPP/-Col/CPD/BV-01-I [Discover Cycling Power Service over LE] for LE or using SDP as in CPP/Col/CPD/BV-04-I [SDP Service Discovery] for BR/EDR.

• **Test Procedure**

1. The Upper Tester issues a command to the IUT to Discover Cycling Power Measurement Characteristic.

2. The IUT executes either of the procedures included in GATT.TS [5]: Discover All Characteristics of a Service, GATT/CL/GAD/BV-04-C, with the specified handle range for the instantiation of the Cycling Power Service, or Discover Characteristic by UUID, GATT/CL/GAD/BV-05-C, with the specified handle range for the instantiation of the Cycling Power Service and UUID set to «Cycling Power Measurement». In the selected procedure, only one pass is needed with the server database defined in Initial Condition.

• **Expected Outcome**

Pass verdict

One attribute handle/value pair is returned containing the UUID «Cycling Power Measurement» characteristic with the appropriate property and handle.

### 4.3.8 CPP/Col/CPD/BV-08-I [Discover Cycling Power Measurement – Client Characteristic Configuration Descriptor]

• **Test Purpose**

Verify that the Collector IUT can discover the Client Characteristic Configuration descriptor of the Cycling Power Measurement characteristi

• **Reference**

[3] 4.3.1

• **Initial Condition**

Establish an ATT Bearer connection between the Lower Tester and IUT and run the preamble procedure for the Collector to initiate a connection to a CP Sensor included in the Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport.
The Lower Tester includes one instantiation of the Cycling Power Service [6] in which the Cycling Power Measurement characteristic and an associated Client Characteristic Configuration descriptor are exposed.

The IUT has discovered the handle range of the Cycling Power Measurement.

• 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 [5]: 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

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

4.3.9 CPP/COL/CPD/BV-09-I [Discover Cycling Power Measurement – Server Characteristic Configuration Descriptor]

• Test Purpose
  Verify that the Collector IUT can discover the Server Characteristic Configuration descriptor of the Cycling Power Measurement characteristic.

• Reference
  [3] 4.3.1

• Initial Condition
  Establish an ATT Bearer connection between the Lower Tester and IUT and run the preamble procedure for the Collector to initiate a connection to a CP Sensor included in the Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport.

The Lower Tester includes one instantiation of the Cycling Power Service [6] in which the Cycling Power Measurement characteristic and an associated Server Characteristic Configuration descriptor are exposed.

The IUT has discovered the handle range of the Cycling Power Measurement.

• 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 [5]: 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
One attribute handle/value pair is returned containing the UUID «Server Characteristic Configuration» descriptor.

4.3.10 CPP/COL/CPD/BV-10-I [Discover Sensor Location Characteristic]

- **Test Purpose**
  Verify that a Sensor Location characteristic can be discovered by the Collector IUT

- **Reference**
  [3] 4.3.1

- **Initial Condition**
  Establish an ATT Bearer connection between the Lower Tester and IUT and run the preamble procedure for the Collector to initiate a connection to a CP Sensor included in the Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport.

  The Lower Tester includes one instantiation of the Cycling Power Service [6] including all defined characteristics. This instantiation also contains two «future» characteristics:
  - One inserted between the last mandatory characteristic and the first optional characteristic.
  - One appended after the last optional characteristic.
  - The «future» characteristic is a 16-bit UUID randomly selected from unassigned UUIDs at the time of the test.

  The IUT has discovered the Cycling Power Service and has saved the handle range for an instantiation of the Cycling Power Service that contains an instantiation of the Sensor Location characteristic. This was done by previously using GATT-based methods as in CPP/COL/CPD/BV-01-I [Discover Cycling Power Service over LE] for LE or using SDP as in CPP/COL/CPD/BV-04-I [SDP Service Discovery] for BR/EDR.

- **Test Procedure**
  1. The Upper Tester issues a command to the IUT to Discover Sensor Location Characteristic.
  2. The IUT executes either of the procedures included in GATT.TS [5]: Discover All Characteristics of a Service, GATT/CL/GAD/BV-04-C, with the specified handle range for the instantiation of the Cycling Power Service, or Discover Characteristic by UUID, GATT/CL/GAD/BV-05-C, with the specified handle range of the instantiation of the Cycling Power Service and UUID set to «Sensor Location». In the selected procedure, only one pass is needed with the server database defined in Initial Condition.

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

  One attribute handle/value pair is returned containing the UUID «Sensor Location» characteristic.

4.3.11 CPP/COL/CPD/BV-11-I [Discover Cycling Power Control Point Characteristic]

- **Test Purpose**
  Verify that a Cycling Power Control Point characteristic can be discovered by the Collector IUT
• Reference

[3] 4.3.1

• Initial Condition

Establish an ATT Bearer connection between the Lower Tester and IUT and run the preamble procedure for the Collector to initiate a connection to a CP Sensor included in the Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport.

The Lower Tester includes one instantiation of the Cycling Power Service [6] including all defined characteristics. This instantiation also contains two «future» characteristics:

- One inserted between the last mandatory characteristic and the first optional characteristic.
- One appended after the last optional characteristics.

The «future» characteristic is a 16-bit UUID randomly selected from unassigned UUIDs at the time of the test.

The IUT has discovered the Cycling Power Service and has saved the handle range for an instantiation of the Cycling Power Service that contains an instantiation of the Cycling Power Control Point characteristic. This was done by previously using GATT-based methods as in CPP/COL/CPD/BV-01-I [Discover Cycling Power Service over LE] for LE or using SDP as in CPP/COL/CPD/BV-04-I [SDP Service Discovery] for BR/EDR.

• Test Procedure

1. The Upper Tester issues a command to the IUT to Discover Cycling Power Control Point Characteristic.

2. The IUT executes either of the procedures included in GATT.TS [5]: Discover All Characteristics of a Service, GATT/CL/GAD/BV-04-C, with the handle range for the instantiation of the Cycling Power Service, or Discover Characteristic by UUID, GATT/CL/GAD/BV-05-C, with the handle range for the instantiation of the Cycling Power Service and UUID set to «Cycling Power Control Point characteristic». In the selected procedure, only one pass is needed with the server database defined in Initial Condition.

• Expected Outcome

Pass verdict

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

4.3.12 CPP/COL/CPD/BV-12-I [Discover Cycling Power Control Point – Client Characteristic Configuration Descriptor]

• Test Purpose

Verify that the Collector IUT can discover the Client Characteristic Configuration descriptor of the Cycling Power Control Point characteristic.

• Reference

[3] 4.3.1
• Initial Condition

Establish an ATT Bearer connection between the Lower Tester and IUT and run the preamble procedure for the Collector to initiate a connection to a CP Sensor included in the Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport.

The Lower Tester includes one instantiation of the Cycling Power Service [6] in which the Cycling Power Control Point characteristic and an associated Client Characteristic Configuration descriptor are exposed.

The IUT has discovered the handle range of the Cycling Power 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 characteristic.

2. The IUT executes one pass of the procedure included in GATT.TS [5] 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

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

4.3.13 CPP/COL/CPD/BV-13-I [Discover Cycling Power Vector Characteristic]

• Test Purpose

Verify that a Cycling Power Vector characteristic can be discovered by the Collector IUT

• Reference

[3] 4.3.1

• Initial Condition

Establish an ATT Bearer connection between the Lower Tester and IUT and run the preamble procedure for the Collector to initiate a connection to a CP Sensor included in the Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport.

The Lower Tester includes one instantiation of the Cycling Power Service [6] including all defined characteristics. This instantiation also contains two «future» characteristics:

- One inserted between the last mandatory characteristic and the first optional characteristic.
- One appended after the last optional characteristics.

The «future» characteristic is a 16-bit UUID randomly selected from unassigned UUIDs at the time of the test.

The IUT has discovered the Cycling Power Service and has saved the handle range for an instantiation of the Cycling Power Service that contains an instantiation of the Cycling Power Vector characteristic. This was done by previously using GATT-based methods as in CPP/COL/CPD/BV-01-I
[Discover Cycling Power Service over LE] for LE or using SDP as in CPP/COL/CPD/BV-04-I [SDP Service Discovery] for BR/EDR.

- **Test Procedure**
  1. The Upper Tester issues a command to the IUT to Discover Cycling Power Vector Characteristic.
  2. The IUT executes either of the procedures included in GATT.TS [5]: Discover All Characteristics of a Service, GATT/CL/GAD//BV-04-C, with the handle range for the instantiation of the Cycling Power Service; or Discover Characteristic by UUID, GATT/CL/GAD//BV-05-C, with the handle range for the instantiation of the Cycling Power Service and UUID set to «Cycling Power Control Point characteristic». In the selected procedure, only one pass is needed with the server database defined in Initial Condition.

- **Expected Outcome**
  
  Pass verdict

  One attribute handle/value pair is returned containing the UUID «Cycling Power Vector» characteristic.

4.3.14 CPP/COL/CPD/BV-14-I [Discover Cycling Power Vector – Client Characteristic Configuration Descriptor]

- **Test Purpose**
  Verify that the Collector IUT can discover the Client Characteristic Configuration descriptor of the Cycling Power Vector characteristic

- **Reference**
  
  [3] 4.3.1

- **Initial Condition**
  
  Establish an ATT Bearer connection between the Lower Tester and IUT and run the preamble procedure for the Collector to initiate a connection to a CP Sensor included in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport.

  The Lower Tester includes one instantiation of the Cycling Power Service [6] in which the Cycling Power Measurement characteristic and an associated Client Characteristic Configuration descriptor are exposed.

  The IUT has discovered the handle range of the Cycling Power Vector 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 [5] 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
One attribute handle/value pair is returned containing the UUID «Client Characteristic Configuration» descriptor.

4.3.15 CPP/COL/CPD/BV-15-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 IU

- **Reference**
  [3] 4.3.2

- **Initial Condition**
  Via IXIT [10] the IUT manufacturer specifies all characteristics of the Device Information Service supported by the IUT.

Run the preamble procedure to enable the Collector to initiate a connection to a CP Sensor included in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport.

The Lower Tester includes one instantiation of the Device Information Service including all defined characteristics. This instantiation also contains two «future» characteristics:

  - One inserted before the first characteristic defined in [8].
  - One appended after the last characteristic defined in [8].

The «future» characteristic is a 16-bit UUID randomly selected from unassigned UUIDs at the time of the test.

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 GATT-based methods as in CPP/COL/CPD/BV-02-I [Discover Device Information Service over LE] for LE or using SDP as in CPP/COL/CPD/BV-04-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 [5] 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 shall report an attribute handle/value pair for each characteristic specified in the IXIT [10] to the Upper Tester.

### 4.3.16 CPP/COL/CPD/BV-16-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] 4.3.2 and 4.9

- **Initial Condition**
  Via IXIT [10] the IUT manufacturer specifies all characteristics of the Device Information Service supported by the IUT.

Run the preamble procedure for the Collector to initiate a connection to a CP Sensor included in Section 4.2.4 if using an LE transport or 4.2.6 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 CPP/COL/CPD/BV-15-I [Discover Device Information Service Characteristics], so it has the handle/value pairs for all characteristics of the Device Information Service supported by the IUT.

- **Test Procedure**
  1. For string based characteristics (i.e. Manufacturer Name String, Model Number String, Serial Number String, Hardware Revision String, Firmware Revision String and Software Revision String), this test shall be run twice and a disconnection may occur between the two tests. In the first pass, the string shall include only character values in the ASCII printable range (i.e. 0x20 – 0x7E). In the second pass, the string shall include character values outside the ASCII printable range. For System ID characteristic, the Manufacturer Identifier shall be set to 0xFFFE9ABCDE and Organizationally Unique Identifier shall be set to 0x123456. For 11073-20601 Regulatory Certification Data List characteristic, the Data field shall be set to 0x0000-0002-8008-0200-0001-0105-0008-0201-0012-0002. For PnP_ID characteristic, the Vendor ID Source shall be set to 0x01, the Vendor ID shall be set to 0x006B, the Product ID shall be set to 0x1234 and the Product Version shall be set to 0x0102.
  2. The Upper Tester issues a command to the IUT to read all characteristics of the Device Information Service supported by the IUT.
  3. For each characteristic of the Device Information Service supported by the IUT, the IUT shall execute the procedure included in GATT.TS [5] GATT/CL/GAR/BV-01-C [Read Characteristic Value – by the 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 shall report the characteristic value for all characteristics specified in the IXIT [10] to the Upper Tester, including:

For string-based characteristics, any printable or non-printable ASCII values.

For System ID characteristic, the Manufacturer Identifier and Organizationally Unique Identifier.

For 11073-20601 Regulatory Certification Data List characteristic, the IEEE 11073-20601 Regulatory Certification Data List (note that this value is defined in big endian format).

For PnP_ID characteristic, the Vendor ID Source, the Vendor ID, the Product ID, and the Product Version.

4.3.17 CPP/COL/CPD/BV-17-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] 4.3.3

- **Initial Condition**
  Via IXIT [10] the IUT manufacturer specifies all characteristics of the Battery Service supported by the IUT.

Run the preamble procedure to enable the Collector to initiate a connection to a CP Sensor included in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport.

The Lower Tester includes one instantiation of the Battery Service including all defined characteristics. This instantiation also contains two «future» characteristics:

- One inserted before the first characteristic defined in [8].
- One appended after the last characteristic defined in [8].

The «future» characteristic is a 16-bit UUID randomly selected from unassigned UUIDs at the time of the test.

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 GATT-based methods as in CPP/COL/CPD/BV-03-I [Discover Battery Service over LE] for LE or using SDP as in CPP/COL/CPD/BV-04-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 [5] 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 shall report an attribute handle/value pair for each characteristic specified in the IXIT [10] to the Upper Tester.

### 4.3.18 CPP/COL/CPD/BV-18-I [Read Battery Level Characteristic]

- **Test Purpose**
  Verify that the Collector IUT can read the Battery Level characteristic from a CP Sensor.

- **Reference**
  [3] 4.10

- **Initial Condition**
  A preamble procedure defined in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport is used to setup the transport and L2CAP channel and initiate connection to a CP Sensor.

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, e.g., `CPP_ReadRequest` (handle, value).
  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.

```
<table>
<thead>
<tr>
<th>Lower Tester</th>
<th>IUT</th>
<th>Upper Tester</th>
</tr>
</thead>
<tbody>
<tr>
<td>L2CAP</td>
<td></td>
<td>Connection Established over selected channel.</td>
</tr>
<tr>
<td>ATT_Read_Request</td>
<td>(Code = 0x0A, handle of Battery Level)</td>
<td></td>
</tr>
<tr>
<td>ATT_Read_Response</td>
<td>(Code = 0x0B, Battery Level value)</td>
<td></td>
</tr>
<tr>
<td>CPP_ReadReq</td>
<td>(handle of Battery Level)</td>
<td></td>
</tr>
<tr>
<td>CPP_ReadRes</td>
<td>(Battery Level value)</td>
<td></td>
</tr>
</tbody>
</table>
```

**Figure 4.2: Read 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 `CPP_ReadResponse` containing the correct Battery Level value to the Upper Tester.

4.4 Cycling Power Features

The procedures defined in this test group verify Cycling Power Sensor IUT implementation of the features defined in the Cycling Power Profile Specification [3] by a CP Sensor IUT and usage of the same features by a Collector IUT.

4.4.1 CPP/SEN/CPF/BV-01-I [Cycling Power Service UUID in AD]

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

- **Reference**
  [3] 3.1.1.1

- **Initial Condition**
  The IUT is powered on in GAP Discoverable Mode.

  The IUT is induced to generate Advertising Packets using preamble defined in Section 4.2.3.

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

- **Expected Outcome**
  Pass verdict

  At least, one received Advertising Packet contains the defined Service UUID for «Cycling Power Service».

4.4.2 CPP/SEN/CPF/BV-02-I [Local Name included in AD or Scan Response]

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

- **Reference**
  [3] 3.1.1.2

- **Initial Condition**
  The IUT is powered on in GAP Discoverable Mode.

  The IUT is induced to generate Advertising Packets using the preamble in Section 4.2.3.

- **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.

**Figure 4.3: Local Name included in AD or Scan Response**

- **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.

**4.4.3 CPP/SEN/CPF/BV-03-I [Appearance included in AD or Scan Response]**

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

- **Reference**
  
  [3] 3.1.1.4

- **Initial Condition**
  
  The IUT is powered on in GAP Discoverable Mode.

  The IUT is induced to generate Advertising Packets using the preamble in Section 4.2.3.

- **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.
4.4.4 CPP/COL/CPF/BV-04-I [Read Cycling Power Feature characteristic]

- **Test Purpose**
  Verify that the Collector IUT can read the Cycling Power Feature characteristic from a CP Sensor.

- **Reference**
  [3] 4.4

- **Initial Condition**
  A preamble procedure defined in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport is used to setup the transport and L2CAP channel and initiate connection to a CP Sensor.

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

- **Test Procedure**
  1. Send a command from Upper Tester to request IUT to read a Cycling Power Feature characteristic from the Lower Tester, e.g., `CPP_ReadRequest` (handle, value).
  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 Cycling Power Feature characteristic.
Figure 4.5: Read Cycling Power Feature 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 `CPP_ReadResponse` containing the correct Cycling Power Feature value to the Upper Tester.

4.4.5 **CPP/COL/CPF/BI-01-I [Read Cycling Power Feature characteristic with reserved value]**

- **Test Purpose**

  Verify that the Collector IUT can read the Cycling Power Feature characteristic from a CP Sensor, and ignore reserved bits.

- **Reference**

  [3] 4.4

- **Initial Condition**

  A preamble procedure defined in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transports used to setup the transport and L2CAP channel and initiate connection to a CP Sensor.

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

- **Test Procedure**

  1. Send a command from Upper Tester to request the IUT to read a Cycling Power Feature Characteristic from the Lower Tester, e.g., `CPP_ReadRequest (handle, value)`.

  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 values with some reserved bits set to 1.
4.4.6 CPP/COL/CPF/BV-05-I [Configure Cycling Power Measurement for Notification]

• Test Purpose
  Verify that the Collector IUT can configure a CP Sensor (Lower Tester) to notify Cycling Power Measurement characteristics.

• Reference
  [3] 4.5

• Initial Condition
  A preamble procedure defined in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport is used to setup the transport and L2CAP channel and initiate connection to a CP Sensor.

  The IUT has discovered the Client Characteristic Configuration Descriptor for a Cycling Power Measurement characteristic contained in the Lower Tester.

• Test Procedure
  The Upper Tester sends a command to the IUT to configure the CP Sensor to send Cycling Power Measurement characteristics.
Figure 4.7: Configure Cycling Power Measurement for Notification

- 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 a Cycling Power Measurement characteristic, and the value set to «notification».

### 4.4.7 CPP/COL/CPF/BV-06-I [Receive Cycling Power Measurement Notifications]

- Test Purpose
  
  Verify that the Collector IUT can receive notifications of the Cycling Power Measurement Characteristic, including all variants.

- Reference
  
  [3] 4.5

- Initial Condition
  
  A preamble procedure defined in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport is used to setup the transport and L2CAP channel and initiate connection to a CP Sensor.

The IUT has executed the procedure included in CPP/COL/CPF/BV-05-I [Configure Cycling Power Measurement for Notification], which configures it to expect Cycling Power Measurement Notifications.

The IUT knows the handle of the Cycling Power Measurement characteristic.

- Test Procedure
  
  1. The Lower Tester sends an `ATT_Handle_Value_Notification` containing a Cycling Power Measurement characteristic value to the IUT.
  2. The Lower Tester sends one Cycling Power Measurement characteristic notification for each Test Pattern shown in the following table. For each Test Pattern, the value of the Flags field is shown along with the corresponding pass criteria.
<table>
<thead>
<tr>
<th>Test Pattern</th>
<th>Flags Field Value (bit15 ... bit0)</th>
<th>Pass Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>00000000 – 00000001</td>
<td>Only optional field present is Pedal Power Balance with the Pedal Power Balance Reference set to “Unknown”.</td>
</tr>
<tr>
<td>2</td>
<td>00000000 – 00000011</td>
<td>Only optional field present is Pedal Power Balance with the Pedal Power Balance Reference set to “Left”.</td>
</tr>
<tr>
<td>3</td>
<td>00000000 – 00000100</td>
<td>Only optional field present is Accumulated Torque with the Accumulated Torque Source set to “Wheel based”.</td>
</tr>
<tr>
<td>4</td>
<td>00000000 – 00001100</td>
<td>Only optional field present is Accumulated Torque with the Accumulated Torque Source set to “Crank based”.</td>
</tr>
<tr>
<td>5</td>
<td>00000000 – 00010000</td>
<td>Only optional fields present are Cumulative Wheel Revolutions and Last Wheel Event Time.</td>
</tr>
<tr>
<td>6</td>
<td>00000000 – 00100000</td>
<td>Only optional fields present are Cumulative Crank Revolutions and Last Crank Event Time.</td>
</tr>
<tr>
<td>7</td>
<td>00000000 – 01000000</td>
<td>Only optional fields present are Maximum Force Magnitude and Minimum Force Magnitude.</td>
</tr>
<tr>
<td>8</td>
<td>00000000 – 10000000</td>
<td>Only optional fields present are Maximum Torque Magnitude and Minimum Torque Magnitude.</td>
</tr>
<tr>
<td>9</td>
<td>00000001 – 00000000</td>
<td>Only optional fields present are Maximum Angle and Minimum Angle.</td>
</tr>
<tr>
<td>10</td>
<td>00000010 – 00000000</td>
<td>Only optional field present is Top Dead Spot.</td>
</tr>
<tr>
<td>11</td>
<td>00000100 – 00000000</td>
<td>Only optional field present is Bottom Dead Spot.</td>
</tr>
<tr>
<td>12</td>
<td>00001000 – 00000000</td>
<td>Only optional field present is Accumulated Energy.</td>
</tr>
<tr>
<td>13</td>
<td>00010000 – 00000000</td>
<td>No optional field present. Offset Compensation Indicator set to True.</td>
</tr>
</tbody>
</table>

Table 4.2: Receive Cycling Power Measurement Notifications
Expected Outcome

Pass verdict

IUT is able to correctly parse the received Cycling Power Measurement values according to the pass criteria in the table above. The reported Cycling Power Measurement field values match the ones sent by the Lower Tester.

4.4.8  CPP/COL/CPF/BV-07-I [Receive Cycling Power Measurement Notifications – Accumulated Torque Roll Over]

Test Purpose

Verify that the Collector IUT can receive notifications of the Cycling Power Measurement Characteristic and properly calculate accumulated torque when the value of the Accumulated Torque field rolls over.

Reference

[3] 4.5

Initial Condition

A preamble procedure defined in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport is used to setup the transport and L2CAP channel and initiate connection to a CP Sensor.

The IUT has executed the procedure included in CPP/COL/CPF/BV-05-I [Configure Cycling Power Measurement for Notification], which configures it to expect Cycling Power Measurement Notifications.

The IUT knows the handle of the Cycling Power Measurement characteristic.

Test Procedure

1. Perform an action on the Lower Tester that will induce it to set the Accumulated Torque values in the table below such as to induce an Accumulated Torque rollover event.
### Table 4.3: Receive Cycling Power Measurement Notifications – Accumulated Torque Rollover

<table>
<thead>
<tr>
<th>Accumulated Torque Value [1/32 Nm]</th>
<th>Expected Accumulated Torque at IUT [Nm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 64960 (0xFDC0)</td>
<td>2030.0</td>
</tr>
<tr>
<td>2 65280 (0xFF00)</td>
<td>2040.0</td>
</tr>
<tr>
<td>3 64 (0x0040)</td>
<td>2050.0</td>
</tr>
<tr>
<td>4 384 (0x0180)</td>
<td>2060.0</td>
</tr>
<tr>
<td>5 704 (0x02C0)</td>
<td>2070.0</td>
</tr>
</tbody>
</table>

2. The Lower Tester sends five `ATT_Handle_Value_Notifications` containing a Cycling Power Measurement characteristic value to the IUT (corresponding to the sequence of rows in the table above) that simulate a regular and consistent torque accumulation as on a bike including an Accumulated Torque field rollover event.

3. The IUT responds correctly when the Accumulated Torque value rolls over.
   - Expected Outcome
     - Pass verdict

IUT receives notifications of Cycling Power Measurement values from the Lower Tester that include Accumulated Torque field.

IUT correctly calculates consistent accumulated torque values before and after the rollover event.

### 4.4.9 CPP/COL/CPF/BV-08-I [Receive Cycling Power Measurement Notifications – Last Wheel Event Time Roll Over]

- **Test Purpose**
  Verify that the Collector IUT can receive notifications of the Cycling Power Measurement Characteristic and properly calculate speed when the value of the Last Wheel Event Time field rolls over.

- **Reference**
  [3] 4.5

- **Initial Condition**
  A preamble procedure defined in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport is used to setup the transport and L2CAP channel and initiate connection to a CP Sensor.

  The IUT has executed the procedure included in CPP/COL/CPF/BV-05-I [Configure Cycling Power Measurement for Notification], which configures it to expect Cycling Power Measurement Notifications.

  The IUT knows the handle of the Cycling Power Measurement characteristic.

- **Test Procedure**
1. Configure the IUT for Instantaneous Speed calculation with a wheel circumference of 210 centimeters. An IUT may be configured to an alternative value for calculation. Any alternative value shall be noted and included in testing evidence to support the calculated value of Instantaneous Speed.

2. Perform an action on the Lower Tester that will induce it to set the Cumulative Wheel Revolutions values and the Last Wheel Event Time values in the table below such as to induce a Last Wheel Event Time rollover event.

<table>
<thead>
<tr>
<th>Cumulative Wheel Revolution</th>
<th>Last Wheel Event Time [1/2048s]</th>
<th>Expected Instantaneous Speed at IUT [km/h]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1000</td>
<td>N/A</td>
</tr>
<tr>
<td>2</td>
<td>1008</td>
<td>60.48</td>
</tr>
<tr>
<td>3</td>
<td>1016</td>
<td>60.48</td>
</tr>
<tr>
<td>4</td>
<td>1024</td>
<td>60.48</td>
</tr>
<tr>
<td>5</td>
<td>1032</td>
<td>60.48</td>
</tr>
</tbody>
</table>

Table 4.4: Receive Cycling Power Measurement Notifications – Last Wheel Event Time Rollover

3. The Lower Tester sends five `ATT_Handle_Value_Notifications` containing a Cycling Power Measurement characteristic value to the IUT (corresponding to the sequence of rows in the table above) that simulate a regular and consistent wheel rotation as on a bike including a Last Wheel Event Time field rollover event.

4. The IUT responds correctly when the Last Wheel Event Time value rolls over.
   - Expected Outcome
     - Pass verdict
     
     IUT receives notifications of Cycling Power Measurement values from the Lower Tester that include Wheel Revolution Data.

     IUT correctly calculates consistent instantaneous speed values before and after the rollover event.

4.4.10 CPP/COL/CPF/BV-09-I [Receive Cycling Power Measurement Notifications – Cumulative Crank Revolutions Roll Over]

   - Test Purpose
     Verify that the Collector IUT can receive notifications of the Cycling Power Measurement Characteristic and properly calculate cadence when the value of the Cumulative Crank Revolutions field rolls over.

   - Reference
     [3] 4.5

   - Initial Condition
     A preamble procedure defined in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport is used to setup the transport and L2CAP channel and initiate connection to a CP Sensor.
The IUT has executed the procedure included in CPP/COL/CPF/BV-05-I [Configure Cycling Power Measurement for Notification], which configures it to expect Cycling Power Measurement Notifications.

The IUT knows the handle of the Cycling Power Measurement characteristic.

- **Test Procedure**
  1. Perform an action on the Lower Tester that will induce it to set the Cumulative Crank Revolutions values and the Last Crank Event Time values in the table below such as to induce a Cumulative Crank Revolutions rollover event.

<table>
<thead>
<tr>
<th>Cumulative Crank Revolutions</th>
<th>Last Crank Event Time [1/1024s]</th>
<th>Expected Instantaneous Cadence [rpm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>65534</td>
<td>9300</td>
</tr>
<tr>
<td>2</td>
<td>65535</td>
<td>9982</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>11348</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>12030</td>
</tr>
<tr>
<td>5</td>
<td>4</td>
<td>13396</td>
</tr>
</tbody>
</table>

*Table 4.5: Receive Cycling Power Measurement Notifications – Cumulative Crank Revolutions Roll Over*

2. The Lower Tester sends five `ATT_Handle_Value_Notifications` containing a Cycling Power Measurement characteristic value to the IUT (corresponding to the sequence of rows in the table above) that simulate a regular and consistent crank rotation as on a bike including a Cumulative Crank Revolutions field rollover event.

3. The IUT responds correctly when the Cumulative Crank Revolutions value rolls over.

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

  IUT receives notifications of Cycling Power Measurement values from the Lower Tester that include Crank Revolution Data.

  IUT correctly calculates consistent instantaneous cadence values before and after the rollover event.

**4.4.11 CPP/COL/CPF/BV-10-I [Receive Cycling Power Measurement Notifications – Last Crank Event Time Roll Over]**

- **Test Purpose**
  
  Verify that the Collector IUT can receive notifications of the Cycling Power Measurement Characteristic and properly calculate cadence when the value of the Last Crank Event Time field rolls over.

- **Reference**
  
  [3] 4.5

- **Initial Condition**

  A preamble procedure defined in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport is used to setup the transport and L2CAP channel and initiate connection to a CP Sensor.
The IUT has executed the procedure included in CPP/COL/CPF/BV-05-I [Configure Cycling Power Measurement for Notification], which configures it to expect Cycling Power Measurement Notifications.

The IUT knows the handle of the Cycling Power Measurement characteristic.

• Test Procedure

1. Perform an action on the Lower Tester that will induce it to set the Cumulative Crank Revolutions values and the Last Crank Event Time values in the table below such as to induce a Last Crank Event Time rollover event.

<table>
<thead>
<tr>
<th>Cumulative Crank Revolutions</th>
<th>Last Crank Event Time [1/1024s]</th>
<th>Expected Instantaneous Cadence [rpm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>N/A</td>
</tr>
<tr>
<td>2</td>
<td>64682</td>
<td>90</td>
</tr>
<tr>
<td>3</td>
<td>512</td>
<td>90</td>
</tr>
<tr>
<td>4</td>
<td>1194</td>
<td>90</td>
</tr>
<tr>
<td>5</td>
<td>2560</td>
<td>90</td>
</tr>
</tbody>
</table>

Table 4.6: Receive Cycling Power Measurement Notifications – Last Crank Event Time Rollover

2. The Lower Tester sends five ATT_Handle_Value_Notifications containing a Cycling Power Measurement characteristic value to the IUT (corresponding to the sequence of rows in the table above) that simulate a regular and consistent crank rotation as on a bike including a Last Crank Event Time field rollover event.

3. The IUT responds correctly when the Last Crank Event Time value rolls over.

• Expected Outcome

Pass verdict

IUT receives notifications of Cycling Power Measurement values from the Lower Tester that include Crank Revolution Data.

IUT correctly calculates consistent instantaneous cadence values before and after the rollover event.

4.4.12 CPP/COL/CPF/BV-11-I [Receive Cycling Power Measurement Notifications – Accumulated Energy Roll Over]

• Test Purpose

Verify that the Collector IUT can receive notifications of the Cycling Power Measurement Characteristic and properly calculate accumulated energy when the value of the Accumulated Energy field rolls over.

• Reference

[3] 4.5

• Initial Condition

A preamble procedure defined in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport is used to setup the transport and L2CAP channel and initiate connection to a CP Sensor.
The IUT has executed the procedure included in CPP/COL/CPF/BV-05-I [Configure Cycling Power Measurement for Notification], which configures it to expect Cycling Power Measurement Notifications.

The IUT knows the handle of the Cycling Power Measurement characteristic.

**Test Procedure**

1. Perform an action on the Lower Tester that will induce it to set the Accumulated Energy values in the table below such as to induce an Accumulated Energy rollover event.

<table>
<thead>
<tr>
<th>Accumulated Energy Value [kJ]</th>
<th>Expected Accumulated Energy at IUT [kJ]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 65532</td>
<td>65532</td>
</tr>
<tr>
<td>2 65534</td>
<td>65534</td>
</tr>
<tr>
<td>3 0</td>
<td>65536</td>
</tr>
<tr>
<td>4 2</td>
<td>65538</td>
</tr>
<tr>
<td>5 4</td>
<td>65540</td>
</tr>
</tbody>
</table>

*Table 4.7: Receive Cycling Power Measurement Notifications – Accumulated Energy Rollover*

2. The Lower Tester sends five `ATT_Handle_Value_Notifications` containing a Cycling Power Measurement characteristic value to the IUT (corresponding to the sequence of rows in the table above) that simulate a regular and consistent energy accumulation as on a bike including an Accumulated Energy field rollover event.

3. The IUT responds correctly when the Accumulated Energy value rolls over.

**Expected Outcome**

**Pass verdict**

IUT receives notifications of Cycling Power Measurement values from the Lower Tester that include Accumulated Energy field.

IUT correctly calculates consistent accumulated energy values before and after the rollover event.

### 4.4.13 CPP/COL/CPF/BV-12-I [Receive Cycling Power Measurement Notifications – Wheel Revolution Data After Link Loss]

**Test Purpose**

Verify that the Collector IUT can receive notifications of the Cycling Power Measurement Characteristic that contain Wheel Revolution Data and that it properly recovers following a link loss.

**Reference**

[3] 4.5

**Initial Condition**

A preamble procedure defined in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport is used to setup the transport and L2CAP channel and initiate connection to a CP Sensor.
The IUT has executed the procedure included in CPP/COL/CPF/BV-05-I [Configure Cycling Power Measurement for Notification], which configures it to expect Cycling Power Measurement Notifications.

The IUT knows the handle of the Cycling Power Measurement characteristic.

- **Test Procedure**

1. Configure the IUT for Instantaneous Speed calculation with a wheel circumference of 210 centimeters. An IUT may be configured to an alternative value for calculation. Any alternative value shall be noted and included in testing evidence to support the calculated value of Instantaneous Speed.

2. Perform an action on the Lower Tester that will induce it to set the Cumulative Wheel Revolutions values and the Last Wheel Event Time values in the following table.

<table>
<thead>
<tr>
<th>Cumulative Wheel Revolution</th>
<th>Last Wheel Event Time [1/2048s]</th>
<th>Expected Instantaneous Speed at IUT [km/h]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1000</td>
<td>1200</td>
</tr>
<tr>
<td></td>
<td></td>
<td>N/A</td>
</tr>
<tr>
<td>2</td>
<td>1008</td>
<td>3248</td>
</tr>
<tr>
<td></td>
<td></td>
<td>60.48</td>
</tr>
<tr>
<td>Link Loss and Reconnection (simulated for 10 seconds)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>1088</td>
<td>23728</td>
</tr>
<tr>
<td></td>
<td></td>
<td>60.48</td>
</tr>
<tr>
<td>4</td>
<td>1096</td>
<td>25776</td>
</tr>
<tr>
<td></td>
<td></td>
<td>60.48</td>
</tr>
<tr>
<td>5</td>
<td>1104</td>
<td>27824</td>
</tr>
<tr>
<td></td>
<td></td>
<td>60.48</td>
</tr>
</tbody>
</table>

   *Table 4.8: Receive Cycling Power Measurement Notifications – Wheel Revolution Data After Link Loss*

3. The Lower Tester sends two `ATT_Handle_Value_Notifications` containing a Cycling Power Measurement characteristic value to the IUT (corresponding to the sequence of rows 1 and 2 in the table above) that simulate a regular and consistent wheel rotation as on a bike for several seconds.

4. Perform an action on the Lower Tester that will cause the link to be lost for several seconds while continuing to simulate wheel rotation for several seconds at the IUT.

5. Perform an action on the Lower Tester that allows the link to be restored.

6. The Lower Tester sends the three remaining `ATT_Handle_Value_Notifications` containing a Cycling Power Measurement characteristic value to the IUT (corresponding to the sequence of rows 3, 4 and 5 in the table above) that simulate a regular and consistent wheel rotation as on a bike for several seconds.

7. The IUT responds correctly during the link loss and after the link is restored.

- **Expected Outcome**

   **Pass verdict**

   IUT receives notifications of Cycling Power Measurement values from the Lower Tester that include Wheel Revolution Data.

   IUT correctly calculates consistent instantaneous speed values despite the link loss.
4.4.14 CPP/COL/CPF/BV-13-I [Receive Cycling Power Measurement Notifications – Crank Revolution Data After Link Loss]

- **Test Purpose**
  
  Verify that the Collector IUT can receive notifications of the Cycling Power Measurement Characteristic that contain Crank Revolution Data and that it properly recovers following a link loss.

- **Reference**
  
  [3] 4.5

- **Initial Condition**
  
  A preamble procedure defined in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport is used to setup the transport and L2CAP channel and initiate connection to a CP Sensor.

  The IUT has executed the procedure included in CPP/COL/CPF/BV-05-I [Configure Cycling Power Measurement for Notification], which configures it to expect Cycling Power Measurement Notifications.

  The IUT knows the handle of the Cycling Power Measurement characteristic.

- **Test Procedure**

  1. Perform an action on the Lower Tester that will induce it to set the Cumulative Crank Revolutions values and the Last Crank Event Time values in the following table.

     | Cumulative Crank Revolutions | Last Crank Event Time [1/1024s] | Expected Instantaneous Cadence [rpm] |
     |-----------------------------|---------------------------------|-------------------------------------|
     | 1                           | 1000                            | 10000                               |
     | 2                           | 1001                            | 10682                               |
     | Link Loss and Reconnection (simulated for 10 seconds) |
     | 3                           | 1016                            | 20922                               |
     | 4                           | 1018                            | 22288                               |
     | 5                           | 1019                            | 22970                               |

     *Table 4.9: Receive Cycling Power Measurement Notifications – Crank Revolution Data After Link Loss*

  2. The Lower Tester sends two `ATT_Handle_Value_Notifications` containing a Cycling Power Measurement characteristic value to the IUT (corresponding to the sequence of rows 1 and 2 in the table above) that simulate a regular and consistent crank rotation as on a bike for several seconds.

  3. Perform an action on the Lower Tester that will cause the link to be lost for several seconds while continuing to simulate crank rotation for several seconds at the IUT.

  4. Perform an action on the Lower Tester that allows the link to be restored.

  5. The Lower Tester sends the three remaining `ATT_Handle_Value_Notifications` containing a Cycling Power Measurement characteristic value to the IUT (corresponding to the sequence of
rows 3, 4 and 5 in the table above) that simulate a regular and consistent crank rotation as on a bike for several seconds.

6. The IUT responds correctly during the link loss and after the link is restored.

- **Expected Outcome**

  **Pass verdict**

  IUT receives notifications of Cycling Power Measurement values from the Lower Tester that include Crank Revolution Data.

  IUT correctly calculates consistent instantaneous cadence values despite the link loss.

### 4.4.15 CPP/COL/CPF/BV-14-I [Receive Cycling Power Measurement Notifications – Reverse Wheel Revolution]

- **Test Purpose**

  Verify that the Collector IUT is tolerant of CP Sensors that have the capability to decrement the Cumulative Wheel Revolutions field (e.g. when the wheel rotates in reverse).

- **Reference**

  [3] 4.5

- **Initial Condition**

  A preamble procedure defined in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport is used to setup the transport and L2CAP channel and initiate connection to a CP Sensor.

  The IUT has executed the procedure included in CPP/COL/CPF/BV-05-I [Configure Cycling Power Measurement for Notification], which configures it to expect Cycling Power Measurement Notifications.

  The IUT knows the handle of the Cycling Power Measurement characteristic.

- **Test Procedure**

  1. Configure the IUT for Instantaneous Speed calculation with a wheel circumference of 210 centimeters. An IUT may be configured to an alternative value for calculation. Any alternative value shall be noted and included in testing evidence to support the calculated value of Instantaneous Speed.

  2. Perform an action on the Lower Tester that will induce it to set the Cumulative Wheel Revolutions values and the Last Wheel Event Time values in the following table.

<table>
<thead>
<tr>
<th>Cumulative Wheel Revolution</th>
<th>Last Wheel Event Time [1/2048s]</th>
<th>Expected Instantaneous Speed at IUT [km/h]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1010</td>
<td>N/A</td>
</tr>
<tr>
<td>2</td>
<td>1012</td>
<td>15.12</td>
</tr>
<tr>
<td>3</td>
<td>1008</td>
<td>N/A</td>
</tr>
<tr>
<td>4</td>
<td>1006</td>
<td>N/A</td>
</tr>
</tbody>
</table>
### Table 4.10: Receive Cycling Power Measurement Notifications – Reverse Wheel Revolution

<table>
<thead>
<tr>
<th>Cumulative Wheel Revolution</th>
<th>Last Wheel Event Time [1/2048s]</th>
<th>Expected Instantaneous Speed at IUT [km/h]</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>1007</td>
<td>8704</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7.56</td>
</tr>
<tr>
<td>6</td>
<td>1009</td>
<td>10752</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15.12</td>
</tr>
<tr>
<td>7</td>
<td>1011</td>
<td>12800</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15.12</td>
</tr>
</tbody>
</table>

3. The Lower Tester sends six `ATT_Handle_Value_Notifications` containing a Cycling Power Measurement characteristic value to the IUT (corresponding to the sequence of rows in the table above) that simulate an initial consistent forward rotation, followed by consistent reverse wheel rotation followed by consistent forward wheel rotation as on a bike.

4. The IUT responds correctly when the Cumulative Wheel Revolutions value initially increases.

- Expected Outcome
  - Pass verdict

  IUT receives notifications of Cycling Power Measurement values from the Lower Tester that include Wheel Revolution Data.

  IUT correctly calculates consistent instantaneous speed values when the wheel rotates forward both before and after the Cumulative Wheel Revolutions value decreases.

  Note that the behavior of the IUT while the wheel rotates in reverse corresponding to rows 3 and 4 is left to the implementation (e.g. the implementation may or may not calculate and display reverse speed during that time.).

#### 4.4.16 CPP/COL/CPF/BV-15-I [Receive Cycling Power Measurement Notifications – Accumulated Torque Value Decreases]

- **Test Purpose**
  Verify that the Collector IUT is tolerant of CP Sensors that have the capability to decrement the Accumulated Torque field (e.g. when the user pulls the pedals).

- **Reference**
  [3] 4.5

- **Initial Condition**
  A preamble procedure defined in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport is used to setup the transport and L2CAP channel and initiate connection to a CP Sensor.

  The IUT has executed the procedure included in CPP/COL/CPF/BV-05-I [Configure Cycling Power Measurement for Notification], which configures it to expect Cycling Power Measurement Notifications.

  The IUT knows the handle of the Cycling Power Measurement characteristic.

- **Test Procedure**
1. Perform an action on the Lower Tester that will induce it to set the Accumulated Torque values in the following table such as to induce an Accumulated Torque rollover event (when the value decreases).

<table>
<thead>
<tr>
<th>Accumulated Torque Value [1/32 Nm]</th>
<th>Expected Accumulated Torque at IUT [Nm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 64960 (0xFDC0)</td>
<td>2030.0</td>
</tr>
<tr>
<td>2 65280 (0xFF00)</td>
<td>2040.0</td>
</tr>
<tr>
<td>3 64 (0x0040)</td>
<td>2050.0</td>
</tr>
<tr>
<td>4 384 (0x0180)</td>
<td>2060.0</td>
</tr>
<tr>
<td>5 704 (0x02C0)</td>
<td>2070.0</td>
</tr>
<tr>
<td>6 384 (0x0180)</td>
<td>2060.0</td>
</tr>
<tr>
<td>7 64 (0x0040)</td>
<td>2050.0</td>
</tr>
<tr>
<td>8 65280 (0xFF00)</td>
<td>2040.0</td>
</tr>
<tr>
<td>9 64960 (0xFDC0)</td>
<td>2030.0</td>
</tr>
</tbody>
</table>

Table 4.11: Receive Cycling Power Measurement Notifications – Accumulated Torque Value Decreases

2. The Lower Tester sends two `ATT_Handle_Value_Notifications` containing a Cycling Power Measurement characteristic value to the IUT (corresponding to the sequence of rows the table above) that simulate a regular and consistent torque accumulation as on a bike for several seconds including two Accumulated Torque field rollover events.

3. The IUT responds correctly when the Accumulated Torque value rolls over.

   • Expected Outcome
     
     Pass verdict

IUT receives notifications of Cycling Power Measurement values from the Lower Tester that include Accumulated Torque field.

   IUT correctly calculates consistent accumulated torque values before and after the rollover event.

4.4.17 CPP/COL/CPF/BI-02-I [Receive Cycling Power Measurement Notifications with reserved flags]

   • Test Purpose

   Verify that the Collector IUT can receive notifications of the Cycling Power Measurement Characteristic from a CP Sensor including reserved flags.

   • Reference

   [3] 4.5

   • Initial Condition
A preamble procedure defined in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport is used to setup the transport and L2CAP channel and initiate connection to a CP Sensor.

The IUT has executed the procedure included in CPP/COL/CPF/BV-05-I [Configure Cycling Power Measurement for Notification], which configures it to expect Cycling Power Measurement Notifications.

The IUT knows the handle of the Cycling Power Measurement characteristic.

- **Test Procedure**

  The Lower Tester sends an `ATT_Handle_Value_Notification` containing a Cycling Power Measurement characteristic value to the IUT. There are many combinations of reserved flag settings. For this test use Flags = 0xE000. This includes reserved bits 15, 14, and 13 = 111. Optional fields are not present in the Cycling Power Measurement characteristic, so other bits of the Flags field are set to 0 as well as the Offset Compensation Indicator.

- **Expected Outcome**

  Pass verdict

  IUT reports the received Cycling Power Measurement value to the Upper Tester. The reported Cycling Power Measurement value matches the one sent by the Lower Tester, including the reserved bits of the Flags field.

4.4.18 CPP/COL/CPF/BI-03-I [Receive Cycling Power Measurement Notifications with additional octets not represented in the flags field]

- **Test Purpose**

  Verify that the Collector IUT can receive notifications of the Cycling Power Measurement Characteristic from a CP Sensor including additional octets not represented in the flags field.

- **Reference**

  [3] 4.5
• Initial Condition

A preamble procedure defined in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport is used to setup the transport and L2CAP channel and initiate connection to a CP Sensor.

The IUT has executed the procedure included in CPP/COL/CPF/BV-05-I [Configure Cycling Power Measurement for Notification], which configures it to expect Cycling Power Measurement Notifications.

The IUT knows the handle of the Cycling Power Measurement characteristic.

• Test Procedure

The Lower Tester sends an ATT_Handle_Value_Notification containing a Cycling Power Measurement characteristic value to the IUT. That value shall contain: Flags = 0x0000 and Instantaneous Power. The optional fields are not present, and, at least, two additional octets not represented in the flags field are present. The total number of octets shall not exceed the maximum MTU size.

Figure 4.10: Receive Cycling Power Measurement Notifications with additional octets not represented in the flags field

• Expected Outcome

Pass verdict

IUT reports the received Cycling Power Measurement value to the Upper Tester with no additional octets. The reported Cycling Power Measurement value matches the one sent by the Lower Tester.

4.4.19 CPP/COL/CPF/BV-16-I [Receive Cycling Power Measurement Notifications from a Distributed Power System]

• Test Purpose

Verify that the collector IUT can receive multiple Cycling Power Measurement notifications from a distributed power system (e.g. 2 CP Sensors).

• Reference
4.5 and 4.3.3

• Initial Condition

A preamble procedure defined in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport is used to setup the transport and L2CAP channel and initiate connection to a CP Sensor. This preamble is repeated to initiate a connection to both CP Sensors (Lower Tester) involved in this test case. The first Lower Tester is configured with a Sensor Location set to “Left Pedal” (0x07) and the second Lower Tester is configured with a Sensor Location set to “Right Pedal” (0x08).

The IUT has executed the procedure included in CPP/COL/CPF/BV-05-I [Configure Cycling Power Measurement for Notification], which configures it to expect Cycling Power Measurement Notifications for both CP Sensors.

The IUT knows the handle of the Cycling Power Measurement characteristic of both CP Sensors.

• Test Procedure

1. The Lower Testers send two or more ATT_Handle_Value_Notifications to the IUT; each contains the Cycling Power Measurement characteristic value with at least the mandatory fields (the Flags field and the Instantaneous Power).

2. The IUT displays the values of the Instantaneous Power for each CP Sensor and decodes properly the other optional fields, if present.

• Expected Outcome

Pass verdict

For each ATT_Handle_Value_Notification sent to the IUT:

- The IUT reports the received Cycling Power Measurement values to the Upper Tester.
- The reported Cycling Power Measurement values match that sent by the Lower Tester.

4.4.20 CPP/COL/CPF/BV-17-I [Receive Cycling Power Measurement Notifications from a Distributed Power System – Calculates Total Instantaneous Power]

• Test Purpose

Verify that the collector IUT can receive multiple Cycling Power Measurement notifications from a distributed power system (e.g. 2 CP Sensors) and calculates the total instantaneous power based on each instantaneous power component.

• Reference

[3] 4.5

• Initial Condition

A preamble procedure defined in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport is used to setup the transport and L2CAP channel and initiate connection to a CP Sensor. This preamble is repeated to initiate a connection to both CP Sensors (Lower Tester) involved in this test case. The first Lower Tester is configured with a Sensor Location set to “Left Pedal” (0x07) and the second Lower Tester is configured with a Sensor Location set to “Right Pedal” (0x08).
The IUT has executed the procedure included in CPP/COL/CPF/BV-05-I [Configure Cycling Power Measurement for Notification], which configures it to expect Cycling Power Measurement Notifications for both CP Sensors.

The IUT knows the handle of the Cycling Power Measurement characteristic of both CP Sensors.

- **Test Procedure**
  1. Perform an action on the Lower Tester that will induce it to set the Instantaneous Power values in the table below.

<table>
<thead>
<tr>
<th>Instantaneous Power [W]</th>
<th>Expected Total Instantaneous Power [W]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower Tester 1 (Left Pedal)</td>
<td>Lower Tester 2 (Right Pedal)</td>
</tr>
<tr>
<td>1</td>
<td>200</td>
</tr>
<tr>
<td>2</td>
<td>200</td>
</tr>
<tr>
<td>3</td>
<td>180</td>
</tr>
<tr>
<td>4</td>
<td>180</td>
</tr>
</tbody>
</table>

*Table 4.12: Receive Cycling Power Measurement Notifications from a Distributed Power System – Calculates Total Instantaneous Power*

2. The Lower Testers send three *ATT_Handle_Value_Notifications* containing a Cycling Power Measurement characteristic value to the IUT (corresponding to the sequence of rows in the table above) that simulate a regular and consistent power measurement as on a bike.

3. The IUT displays the value of the total instantaneous power value calculated by summing both values coming from the two different Lower Testers.

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

IUT receives notifications of Cycling Power Measurement values from the Lower Testers that include the Flags field and, at least, the Instantaneous Power field.

IUT correctly calculates consistent total instantaneous power.

**4.4.21 CPP/COL/CPF/BV-18-I [Receive Cycling Power Measurement Notifications from a Distributed Power System – Calculates Pedal Power Balance]**

- **Test Purpose**
  Verify that the collector IUT can receive multiple Cycling Power Measurement notifications from a distributed power system (e.g. 2 CP Sensors) and calculates the total instantaneous power based on each instantaneous power component.

- **Reference**
  [3] 4.5
• Initial Condition

A preamble procedure defined in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport is used to setup the transport and L2CAP channel and initiate connection to a CP Sensor. This preamble is repeated to initiate a connection to both CP Sensors (Lower Tester) involved in this test case. The first Lower Tester is configured with a Sensor Location set to “Left Pedal” (0x07) and the second Lower Tester is configured with a Sensor Location set to “Right Pedal” (0x08).

The IUT has executed the procedure included in CPP/COL/CPF/BV-05-I [Configure Cycling Power Measurement for Notification], which configures it to expect Cycling Power Measurement Notifications for both CP Sensors.

The IUT knows the handle of the Cycling Power Measurement characteristic of both CP Sensors.

• Test Procedure

1. Perform an action on the Lower Tester that will induce it to set the Instantaneous Power values in the table below.

<table>
<thead>
<tr>
<th>Instantaneous Power [W]</th>
<th>Expected Pedal Power Balance [%] (Left Pedal as the reference)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower Tester 1 (Left Pedal)</td>
<td>Lower Tester 2 (Right Pedal)</td>
</tr>
<tr>
<td>1</td>
<td>200</td>
</tr>
<tr>
<td>2</td>
<td>200</td>
</tr>
<tr>
<td>3</td>
<td>180</td>
</tr>
<tr>
<td>4</td>
<td>180</td>
</tr>
</tbody>
</table>

Table 4.13: Receive Cycling Power Measurement Notifications from a Distributed Power System – Calculates Pedal Power Balance

2. The Lower Testers send three ATT_Handle_Value_Notifications containing a Cycling Power Measurement characteristic value to the IUT (corresponding to the sequence of rows in the table above) that simulate a regular and consistent power measurement as on a bike.

3. The IUT displays the value of the pedal power balance value calculated with the values coming from the two different Lower Testers.

• Expected Outcome

Pass verdict

IUT receives notifications of Cycling Power Measurement values from the Lower Testers that include the Flags field and, at least, the Instantaneous Power field.

IUT correctly calculates consistent pedal power balance.

4.4.22 CPP/COL/CPF/BV-19-I [Read Sensor Location characteristic]

• Test Purpose

Verify that the Collector IUT can read the Sensor Location characteristic from a CP Sensor.
• Reference

[3] 4.6

• Initial Condition

A preamble procedure defined in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport is used to setup the transport and L2CAP channel and initiate connection to a CP Sensor.

The Upper Tester knows the handle of a Sensor Location characteristic contained in the Lower Tester.

• Test Procedure

1. Send a command from Upper Tester to request IUT to read a Sensor Location characteristic from the Lower Tester, e.g., \textit{CPP\_ReadRequest} (handle, value).

2. After receipt of the expected result by the Lower Tester from the IUT, send an \textit{ATT\_Read\_Response} (0x0B) from the Lower Tester to the IUT containing a defined value of the Sensor Location characteristic.

**Figure 4.11:** Read Sensor Location characteristic

• Expected Outcome

Pass verdict

The IUT sends a correctly formatted \textit{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 \textit{CPP\_ReadResponse} containing the correct Sensor Location value to the Upper Tester.

4.4.23 CPP/COL/CPF/BI-04-I [Read Sensor Location characteristic with reserved value]

• Test Purpose

Verify that the Collector IUT can read the Sensor Location characteristic from a CP Sensor, and discard a reserved value or change it to ‘Other’.

• Reference

[3] 4.6
• Initial Condition

A preamble procedure defined in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport is used to setup the transport and L2CAP channel and initiate connection to a CP Sensor.

The Upper Tester knows the handle of a Sensor Location characteristic contained in the Lower Tester.

• Test Procedure

1. Send a command from Upper Tester to request IUT to read a Sensor Location Characteristic from the Lower Tester, e.g., `CPP_ReadRequest` (handle, value).

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 reserved value.

   ![Diagram](image)

   *Figure 4.12: Read Sensor Location characteristic with reserved value*

• 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 discards it or changes it to ‘Other’.

4.4.24 CPP/COL/CPF/BV-20-I [Configure Cycling Power Vector for Notification]

• Test Purpose

Verify that the Collector IUT can configure a CP Sensor (Lower Tester) to notify Cycling Power Vector characteristics.

• Reference

[3] 4.7 and 4.8

• Initial Condition

A preamble procedure defined in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport is used to setup the transport and L2CAP channel and initiate connection to a CP Sensor.
The IUT has discovered the Client Characteristic Configuration Descriptor for a Cycling Power Vector characteristic contained in the Lower Tester.

Following the completion of the discovery procedures, the Lower Tester requests slow connection parameters (e.g. connection interval of one second using the GAP Connection Parameter Update procedure), and the IUT has updated the connection parameters as requested.

- **Test Procedure**
  1. The Upper Tester sends a command to the IUT to configure the CP Sensor to receive Cycling Power Vector characteristics.
  2. The IUT writes 0x0001 to the Client Characteristic Configuration descriptor of the Cycling Power Vector characteristic to enable the notification.
  3. The Lower Tester requests faster connection parameters in order to send the notification of the Cycling Power Vector characteristic (e.g. connection interval of 200 milliseconds using the GAP Connection Parameter Update procedure).
  4. The IUT accepts the request and updates the connection parameters as requested by the Lower Tester.
  5. The Lower Tester sends a Write Response to the IUT to acknowledge the write request sent in step 2.

![Diagram of L2CAP Connection Established over selected channel. IUT has discovered the Client Characteristic Configuration Descrip](image)

**Figure 4.13: Configure Cycling Power Vector for Notification**

- **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 a Cycling Power Vector characteristic, and the value set to «notification».
The IUT accepts a request from the Lower Tester and updates the connection parameter as requested.

4.4.25 CPP/COL/CPF/BV-21-I [Receive Cycling Power Vector Notifications]

- **Test Purpose**

  Verify that the Collector IUT can receive notifications of the Cycling Power Vector Characteristic, including all variants.

- **Reference**

  [3] 4.7 and 4.8

- **Initial Condition**

  A preamble procedure defined in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport is used to setup the transport and L2CAP channel and initiate connection to a CP Sensor.

  The IUT has executed the procedure included in CPP/COL/CPF/BV-20-I [Configure Cycling Power Vector for Notification], which configures it to expect Cycling Power Vector Notifications.

  The IUT knows the handle of the Cycling Power Vector characteristic.

- **Test Procedure**

  1. The Lower Tester sends an `ATT_Handle_Value_Notification` containing a Cycling Power Vector characteristic value to the IUT.

  2. The Lower Tester sends one Cycling Power Vector characteristic notification for each Test Pattern shown in the following table. For each Test Pattern, the value of the Flags field is shown along with the corresponding pass criteria.

<table>
<thead>
<tr>
<th>Test Pattern</th>
<th>Sensor Measurement Context of the Cycling Power Feature characteristic</th>
<th>Flags Field Value</th>
<th>Pass Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Force based (0)</td>
<td>00000100</td>
<td>Only optional field present is Instantaneous Force Magnitude Array.</td>
</tr>
<tr>
<td>2</td>
<td>Force based (0)</td>
<td>00000111</td>
<td>Only optional fields present are Cumulative Crank Revolutions, Last Crank Event Time, First Crank Measurement Angle and Instantaneous Force Magnitude Array.</td>
</tr>
<tr>
<td>3</td>
<td>Torque based (1)</td>
<td>00001000</td>
<td>Only optional field present is Instantaneous Torque Magnitude Array.</td>
</tr>
<tr>
<td>4</td>
<td>Torque based (1)</td>
<td>00001011</td>
<td>Only optional fields present are Cumulative Crank Revolutions, Last Crank Event Time, First Crank Measurement Angle and Instantaneous Torque Magnitude Array.</td>
</tr>
</tbody>
</table>

*Table 4.14: Receive Cycling Power Vector Notifications*
Figure 4.14: Receive Cycling Power Vector Notifications

- Expected Outcome
  Pass verdict

IUT is able to correctly parse the received Cycling Power Vector values according to the pass criteria in the table above. The reported Cycling Power Measurement field values match the ones sent by the Lower Tester.

4.4.26 CPP/COL/CPF/BV-22-I [Receive Cycling Power Vector Notifications – Cumulative Crank Revolutions Roll Over]

- Test Purpose
  Verify that the Collector IUT can receive notifications of the Cycling Power Vector Characteristic and properly calculate cadence when the value of the Cumulative Crank Revolutions field rolls over.

- Reference
  [3] 4.7 and 4.8

- Initial Condition
  A preamble procedure defined in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport is used to setup the transport and L2CAP channel and initiate connection to a CP Sensor.

  The IUT has executed the procedure included in CPP/COL/CPF/BV-20-I [Configure Cycling Power Vector for Notification], which configures it to expect Cycling Power Vector Notifications.

  The IUT knows the handle of the Cycling Power Vector characteristic.

- Test Procedure
  Perform an action on the Lower Tester that will induce it to set the Cumulative Crank Revolutions values and the Last Crank Event Time values in the table below such as to induce a Cumulative Crank Revolutions rollover event.
### Table 4.15: Receive Cycling Power Vector Notifications – Cumulative Crank Revolutions Rollover

<table>
<thead>
<tr>
<th>Cumulative Crank Revolutions</th>
<th>Last Crank Event Time [1/1024s]</th>
<th>Expected Instantaneous Cadence [rpm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>65534</td>
<td>65534</td>
</tr>
<tr>
<td></td>
<td>9300</td>
<td>N/A</td>
</tr>
<tr>
<td>2</td>
<td>9982</td>
<td>9982</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>90</td>
</tr>
<tr>
<td>3</td>
<td>11348</td>
<td>11348</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>00</td>
</tr>
<tr>
<td>4</td>
<td>12030</td>
<td>12030</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>90</td>
</tr>
<tr>
<td>5</td>
<td>13396</td>
<td>13396</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>90</td>
</tr>
</tbody>
</table>

The Lower Tester sends five `ATT_Handle_Value_Notifications` containing a Cycling Power Vector characteristic value to the IUT (corresponding to the sequence of rows in the table above) that simulate a regular and consistent crank rotation as on a bike including a Cumulative Crank Revolutions field rollover event.

The IUT responds correctly when the Cumulative Crank Revolutions value rolls over.

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

  IUT receives notifications of Cycling Power Vector values from the Lower Tester that include Crank Revolution Data.

  IUT correctly calculates consistent instantaneous cadence values before and after the rollover event.

---

### 4.4.27 CPP/COL/CPF/BV-23-I [Receive Cycling Power Vector Notifications – Last Crank Event Time Roll Over]

- **Test Purpose**
  Verify that the Collector IUT can receive notifications of the Cycling Power Vector Characteristic and properly calculate cadence when the value of the Last Crank Event Time field rolls over.

- **Reference**
  [3] 4.7 and 4.8

- **Initial Condition**
  A preamble procedure defined in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport is used to setup the transport and L2CAP channel and initiate connection to a CP Sensor.

  The IUT has executed the procedure included in CPP/COL/CPF/BV-20-I [Configure Cycling Power Vector for Notification], which configures it to expect Cycling Power Vector Notifications.

  The IUT knows the handle of the Cycling Power Vector characteristic.

- **Test Procedure**
1. Perform an action on the Lower Tester that will induce it to set the Cumulative Crank Revolutions values and the Last Crank Event Time values in the table below such as to induce a Last Crank Event Time rollover event.

<table>
<thead>
<tr>
<th>Cumulative Crank Revolutions</th>
<th>Last Crank Event Time [1/1024s]</th>
<th>Expected Instantaneous Cadence [rpm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>N/A</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>64000</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>64682</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>512</td>
</tr>
<tr>
<td>5</td>
<td>6</td>
<td>1194</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2560</td>
</tr>
</tbody>
</table>

Table 4.16: Receive Cycling Power Vector Notifications – Last Crank Event Time Rollover

2. The Lower Tester sends five \texttt{ATT\_Handle\_Value\_Notifications} containing a Cycling Power Vector characteristic value to the IUT (corresponding to the sequence of rows in the table above) that simulate a regular and consistent crank rotation as on a bike including a Last Crank Event Time field rollover event.

3. The IUT responds correctly when the Last Crank Event Time value rolls over.

- Expected Outcome

  Pass verdict

  IUT receives notifications of Cycling Power Vector values from the Lower Tester that include Crank Revolution Data.

  IUT correctly calculates consistent instantaneous cadence values before and after the rollover event.

4.4.28 CPP/COL/CPF/BI-05-I [Receive Cycling Power Vector Notifications with reserved flags]

- Test Purpose

  Verify that the Collector IUT can receive notifications of the Cycling Power Vector Characteristic from a CP Sensor including reserved flags.

- Reference

  [3] 4.7 and 4.8

- Initial Condition

  A preamble procedure defined in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport is used to setup the transport and L2CAP channel and initiate connection to a CP Sensor.

  The IUT has executed the procedure included in CPP/COL/CPF/BI-20-I [Configure Cycling Power Vector for Notification], which configures it to expect Cycling Power Vector Notifications.

  The IUT knows the handle of the Cycling Power Vector characteristic.
• Test Procedure

The Lower Tester sends an `ATT_Handle_Value_Notification` containing a Cycling Power Vector characteristic value to the IUT. There are many combinations of reserved flag settings. For this test use Flags = 0xC4. This includes reserved bits 7 and 6 = 11. Only optional fields present in the Cycling Power Vector characteristic is the Instantaneous Force Magnitude Array, so bit 2 of the Flags field is set to 1 and other bits are set to 0.

![Diagram](image)

*Figure 4.15: Receive Cycling Power Vector Notifications with reserved flags*

• Expected Outcome

**Pass verdict**

IUT reports the received Cycling Power Vector value to the Upper Tester. The reported Cycling Power Measurement value matches the one sent by the Lower Tester, including the reserved bits of the Flags field.

**4.4.29 CPP/COL/CPF/BV-24-I [Lost Bond Procedure when using LE Transport]**

• Test Purpose

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

• Reference

[3] 7.2.1

• Initial Condition

The IUT and the Lower Tester have previously bonded.

The IUT has configured the Lower Tester to enable notifications on the Cycling Power Measurement characteristic of the Lower Tester's Cycling Power Service.

The Lower Tester has the "Service Changed" characteristic.

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 GAP undirected connectable mode.
  2. The IUT establishes a connection to the Lower Tester.
  3. The Lower Tester does not send any notifications to IUT.
  4. The IUT starts encryption when the connection is established and rediscover and reconfigures the CP Sensor upon detection of the lost bond.

• Expected Outcome
  Pass verdict
  The IUT starts encryption when the connection is established.
  The IUT rediscover the Cycling Power Service.
  The IUT reconfigures the Client Characteristic Configuration descriptors of the Cycling Power Measurement characteristic, the Cycling Power Control Point characteristic and the Cycling Power Vector (if supported).

4.4.30 CPP/COL/CPF/BV-25-I [Lost Bond Procedure when using BR/EDR transport]

• Test Purpose
  Verify that the Collector IUT reconfigures the CP Sensor if the 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 to herein as “master to be”, and the device accepting the connection becomes a slave and is referred to herein as “slave to be”. Verify that the “master to be” starts encryption with a bonded “slave to be” on reconnection.

• Reference
  [3] 7.3. 2

• Initial Condition
  The IUT and the Lower Tester have previously bonded.
  The IUT has configured the Lower Tester to enable notifications on the Cycling Power Measurement characteristic of the Lower Tester's Cycling Power Service.
  The Lower Tester has the «Service Changed» characteristic.
  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 Lower Tester does not send any notifications to IUT.
4. The “master to be” starts encryption when the connection is established.
5. The IUT rediscovers and reconfigures the CP 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 Cycling Power Service.
  
  The IUT reconfigures the Client Characteristic Configuration descriptors of the Cycling Power Measurement characteristic, the Cycling Power Control Point characteristic and the Cycling Power Vector (if supported).

### 4.4.31 CPP/COL/CPF/BV-26-I [Configure Cycling Power Measurement for Broadcast]

- **Test Purpose**
  
  Verify that the Collector IUT can configure a CP Sensor (Lower Tester) to broadcast Cycling Power Measurement characteristics (e.g. include the characteristic value in a undirected non-connectable advertisement).

- **Reference**
  
  [3] 4.5.1

- **Initial Condition**
  
  A preamble procedure defined in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport is used to setup the transport and L2CAP channel and initiate connection to a CP Sensor.
  
  The IUT has discovered the Server Characteristic Configuration Descriptor for a Cycling Power Measurement characteristic contained in the Lower Tester.

- **Test Procedure**
  
  The Upper Tester sends a command to the IUT to configure the CP Sensor to broadcast the Cycling Power Measurement characteristics (e.g. include the characteristic value in an undirected non-connectable advertisement).
• 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 Server Characteristic Configuration Descriptor for a Cycling Power Measurement characteristic, and the value set to «broadcast».

4.4.32 CPP/OBS/CPF/BV-27-I [Receive Cycling Power Measurement Broadcast]

• Test Purpose

Verify that the CP Observer IUT can receive undirected non-connectable advertisement with the Cycling Power Measurement Characteristic, including all variants.

• Reference

[3] 6.1

• Initial Condition

Perform the preamble described in Section 4.2.5.

The IUT knows the UUID of the Cycling Power Service.

• Test Procedure

The Lower Tester sends one or more undirected non-connectable advertisements including the Cycling Power Measurement characteristic value for each Test Pattern shown in the following table. For each Test Pattern, the value of the Flags field is shown along with the corresponding pass criteria.

<table>
<thead>
<tr>
<th>Test Pattern</th>
<th>Flags Field Value ( (\text{bit}15 \ldots \text{bit}0) )</th>
<th>Pass Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>000000000 – 00000001</td>
<td>Only optional field present is Pedal Power Balance with the Pedal Power Balance Reference set to “Unknown”.</td>
</tr>
<tr>
<td>2</td>
<td>000000000 – 00000011</td>
<td>Only optional field present is Pedal Power Balance with the Pedal Power Balance Reference set to “Left”.</td>
</tr>
</tbody>
</table>
### Test Pattern Flags Field Value (bit15 ... bit0) Pass Criteria

<table>
<thead>
<tr>
<th>Test Pattern</th>
<th>Flags Field Value (bit15 ... bit0)</th>
<th>Pass Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>00000000 – 00000100</td>
<td>Only optional field present is Accumulated Torque with the Accumulated Torque Source set to “Wheel based”.</td>
</tr>
<tr>
<td>4</td>
<td>00000000 – 00001100</td>
<td>Only optional field present is Accumulated Torque with the Accumulated Torque Source set to “Crank based”.</td>
</tr>
<tr>
<td>5</td>
<td>00000000 – 00010000</td>
<td>Only optional fields present are Cumulative Wheel Revolutions and Last Wheel Event Time.</td>
</tr>
<tr>
<td>6</td>
<td>00000000 – 00100000</td>
<td>Only optional fields present are Cumulative Crank Revolutions and Last Crank Event Time.</td>
</tr>
<tr>
<td>7</td>
<td>00000000 – 01000000</td>
<td>Only optional fields present are Maximum Force Magnitude and Minimum Force Magnitude.</td>
</tr>
<tr>
<td>8</td>
<td>00000000 – 10000000</td>
<td>Only optional fields present are Maximum Torque Magnitude and Minimum Torque Magnitude.</td>
</tr>
<tr>
<td>9</td>
<td>00000001 – 00000000</td>
<td>Only optional fields present are Maximum Angle and Minimum Angle.</td>
</tr>
<tr>
<td>10</td>
<td>00000100 – 00000000</td>
<td>Only optional field present is Top Dead Spot.</td>
</tr>
<tr>
<td>11</td>
<td>00000100 – 00000000</td>
<td>Only optional field present is Bottom Dead Spot.</td>
</tr>
<tr>
<td>12</td>
<td>00001000 – 00000000</td>
<td>Only optional field present is Accumulated Energy.</td>
</tr>
<tr>
<td>13</td>
<td>00100000 – 00000000</td>
<td>No optional field present. Offset Compensation Indicator set to True.</td>
</tr>
</tbody>
</table>

Table 4.17: Receive Cycling Power Measurement Broadcast

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

  IUT is able to correctly parse the received Cycling Power Measurement values according to the pass criteria in the table above. The reported Cycling Power Measurement field values match the ones sent by the Lower Tester.

#### 4.4.33 CPP/OBS/CPF/BV-28-I [Receive Cycling Power Measurement Broadcast – Accumulated Torque Roll Over]

- **Test Purpose**
  
  Verify that the Collector IUT can receive undirected non-connectable advertisement with the Cycling Power Measurement characteristic and properly calculate accumulated torque when the value of the Accumulated Torque field rolls over.

- **Reference**
  
  [3] 6.1

- **Initial Condition**
Perform the preamble described in Section 4.2.5.

The IUT knows the UUID of the Cycling Power Service.

- **Test Procedure**
  1. Perform an action on the Lower Tester that will induce it to set the Accumulated Torque values in the table below such as to induce an Accumulated Torque rollover event.

<table>
<thead>
<tr>
<th>Accumulated Torque Value [1/32 Nm]</th>
<th>Expected Accumulated Torque at IUT [Nm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 64960 (0xFDC0)</td>
<td>2030.0</td>
</tr>
<tr>
<td>2 65280 (0xFF00)</td>
<td>2040.0</td>
</tr>
<tr>
<td>3 96 (0x0060)</td>
<td>2050.0</td>
</tr>
<tr>
<td>4 416 (0x01A0)</td>
<td>2060.0</td>
</tr>
<tr>
<td>5 736 (0x02E0)</td>
<td>2070.0</td>
</tr>
</tbody>
</table>

*Table 4.18: Receive Cycling Power Measurement Broadcast – Accumulated Torque Rollover*

  2. The Lower Tester sends five undirected non-connectable advertisements containing a Cycling Power Measurement characteristic value to the IUT (corresponding to the sequence of rows in the table above) that simulate a regular and consistent torque accumulation as on a bike including an Accumulated Torque field rollover event.

  3. The IUT responds correctly when the Accumulated Torque value rolls over.

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

  IUT receives notifications of Cycling Power Measurement values from the Lower Tester that include Accumulated Torque field.

  IUT correctly calculates consistent accumulated torque values before and after the rollover event.

### 4.4.34 CPP/OBS/CPF/BV-29-I [Receive Cycling Power Measurement Broadcast – Last Wheel Event Time Roll Over]

- **Test Purpose**
  
  Verify that the Collector IUT can receive undirected non-connectable advertisement with the Cycling Power Measurement characteristic and properly calculate accumulated torque when the value of the Last Wheel Event Time field rolls over.

- **Reference**
  
  [3] 6.1

- **Initial Condition**
  
  Perform the preamble described in Section 4.2.5.

  The IUT knows the UUID of the Cycling Power Service.
• **Test Procedure**

1. Configure the IUT for Instantaneous Speed calculation with a wheel circumference of 210 centimeters. An IUT may be configured to an alternative value for calculation. Any alternative value shall be noted and included in testing evidence to support the calculated value of Instantaneous Speed.

2. Perform an action on the Lower Tester that will induce it to set the Cumulative Wheel Revolutions values and the Last Wheel Event Time values in the table below such as to induce a Last Wheel Event Time rollover event.

<table>
<thead>
<tr>
<th>Cumulative Wheel Revolution</th>
<th>Last Wheel Event Time [1/2048s]</th>
<th>Expected Instantaneous Speed at IUT [km/h]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1000</td>
<td>N/A</td>
</tr>
<tr>
<td>2</td>
<td>1008</td>
<td>60.48</td>
</tr>
<tr>
<td>3</td>
<td>1016</td>
<td>60.48</td>
</tr>
<tr>
<td>4</td>
<td>1024</td>
<td>60.48</td>
</tr>
<tr>
<td>5</td>
<td>1032</td>
<td>60.48</td>
</tr>
</tbody>
</table>

Table 4.19: Receive Cycling Power Measurement Broadcast – Last Wheel Event Time Rollover

3. The Lower Tester sends five undirected non-connectable advertisements containing a Cycling Power Measurement characteristic value to the IUT (corresponding to the sequence of rows in the table above) that simulate a regular and consistent wheel rotation as on a bike including a Last Wheel Event Time field rollover event.

4. The IUT responds correctly when the Last Wheel Event Time value rolls over.

• **Expected Outcome**

  **Pass verdict**

  IUT receives notifications of Cycling Power Measurement values from the Lower Tester that include Wheel Revolution Data.

  IUT correctly calculates consistent instantaneous speed values before and after the rollover event.

**4.4.35 CPP/OBS/CPF/BV-30-I [Receive Cycling Power Measurement Broadcast – Cumulative Crank Revolutions Roll Over]**

• **Test Purpose**

  Verify that the Collector IUT can receive undirected non-connectable advertisement with the Cycling Power Measurement characteristic and properly calculate accumulated torque when the value of the Cumulative Crank Revolutions field rolls over.

• **Reference**

  [3] 6.1

• **Initial Condition**

  Perform the preamble described in Section 4.2.5.
The IUT knows the UUID of the Cycling Power Service.

- Test Procedure
  1. Perform an action on the Lower Tester that will induce it to set the Cumulative Crank Revolutions values and the Last Crank Event Time values in the table below such as to induce a Cumulative Crank Revolutions rollover event.

<table>
<thead>
<tr>
<th>Cumulative Crank Revolutions</th>
<th>Last Crank Event Time [1/1024s]</th>
<th>Expected Instantaneous Cadence [rpm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>65470</td>
<td>9300</td>
</tr>
<tr>
<td>2</td>
<td>65530</td>
<td>9982</td>
</tr>
<tr>
<td>3</td>
<td>54</td>
<td>11348</td>
</tr>
<tr>
<td>4</td>
<td>114</td>
<td>12030</td>
</tr>
<tr>
<td>5</td>
<td>174</td>
<td>13396</td>
</tr>
</tbody>
</table>

*Table 4.20: Receive Cycling Power Measurement Broadcast – Cumulative Crank Revolutions Rollover*

2. The Lower Tester sends five undirected non-connectable advertisements containing a Cycling Power Measurement characteristic value to the IUT (corresponding to the sequence of rows in the table above) that simulate a regular and consistent crank rotation as on a bike including a Cumulative Crank Revolutions field rollover event.

3. The IUT responds correctly when the Cumulative Crank Revolutions value rolls over.

- Expected Outcome
  - Pass verdict

IUT receives notifications of Cycling Power Measurement values from the Lower Tester that include Crank Revolution Data.

IUT correctly calculates consistent instantaneous cadence values before and after the rollover event.

4.4.36 CPP/OBS/CPF/BV-31-I [Receive Cycling Power Measurement Broadcast – Last Crank Event Time Roll Over]

- Test Purpose
  Verify that the Collector IUT can receive undirected non-connectable advertisement with the Cycling Power Measurement characteristic and properly calculate accumulated torque when the value of the Last Crank Event Time field rolls over.

- Reference
  [3] 6.1

- Initial Condition
  Perform the preamble described in Section 4.2.5.

The IUT knows the UUID of the Cycling Power Service.
• Test Procedure

1. Perform an action on the Lower Tester that will induce it to set the Cumulative Crank Revolutions values and the Last Crank Event Time values in the table below such as to induce a Last Crank Event Time rollover event.

<table>
<thead>
<tr>
<th>Cumulative Crank Revolutions</th>
<th>Last Crank Event Time [1/1024s]</th>
<th>Expected Instantaneous Cadence [rpm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>64000</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>64682</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>512</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>1194</td>
</tr>
<tr>
<td>5</td>
<td>6</td>
<td>2560</td>
</tr>
</tbody>
</table>

Table 4.21: Receive Cycling Power Measurement Broadcast – Last Crank Event Time Rollover

2. The Lower Tester sends five undirected non-connectable advertisements containing a Cycling Power Measurement characteristic value to the IUT (corresponding to the sequence of rows in the table above) that simulate a regular and consistent crank rotation as on a bike including a Last Crank Event Time field rollover event.

3. The IUT responds correctly when the Last Crank Event Time value rolls over.

• Expected Outcome

Pass verdict

IUT receives notifications of Cycling Power Measurement values from the Lower Tester that include Crank Revolution Data.

IUT correctly calculates consistent instantaneous cadence values before and after the rollover event.

4.4.37 CPP/OBS/CPF/BV-32-I [Receive Cycling Power Measurement Broadcast – Accumulated Energy Roll Over]

• Test Purpose

Verify that the Collector IUT can receive five undirected non-connectable advertisements of the Cycling Power Measurement Characteristic and properly calculate accumulated energy when the value of the Accumulated Energy field rolls over.

• Reference

[3] 6.1

• Initial Condition

Perform the preamble described in Section 4.2.5.

The IUT knows the UUID of the Cycling Power Service.

• Test Procedure
1. Perform an action on the Lower Tester that will induce it to set the Accumulated Energy values in the table below such as to induce an Accumulated Energy rollover event.

<table>
<thead>
<tr>
<th>Accumulated Energy Value [kJ]</th>
<th>Expected Accumulated Energy at IUT [kJ]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>65532</td>
</tr>
<tr>
<td>2</td>
<td>65534</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

Table 4.22: Receive Cycling Power Measurement Broadcast – Accumulated Energy Rollover

2. The Lower Tester sends five undirected non-connectable advertisements containing a Cycling Power Measurement characteristic value to the IUT (corresponding to the sequence of rows in the table above) that simulate a regular and consistent energy accumulation as on a bike including an Accumulated Energy field rollover event.

3. The IUT responds correctly when the Accumulated Energy value rolls over.
   - Expected Outcome
     Pass verdict
     IUT receives notifications of Cycling Power Measurement values from the Lower Tester that include Accumulated Energy field.
     IUT correctly calculates consistent accumulated energy values before and after the rollover event.

4.4.38 CPP/OBS/CPF/BI-06-I [Receive Cycling Power Measurement Broadcast with reserved flags]
   - Test Purpose
     Verify that the CP Observer IUT can receive undirected non-connectable advertisement with the Cycling Power Measurement Characteristic, including reserved flags.
   - Reference
     [3] 6.1
   - Initial Condition
     Perform the preamble described in Section 4.2.5.
     The IUT knows the UUID of the Cycling Power Service.
   - Test Procedure
     The Lower Tester sends one or more undirected non-connectable advertisements including the Cycling Power Measurement characteristic value to the IUT. There are many combinations of reserved flag settings. For this test use Flags = 0xE000. This includes reserved bits 15, 14, and 13 =
111. Optional fields are not present in the Cycling Power Measurement characteristic, so other bits of the Flags field are set to 0 as well as the Offset Compensation Indicator.

- Expected Outcome
  Pass verdict

IUT is able to correctly parse the received Cycling Power Measurement values according to the pass criteria in the table above. The reported Cycling Power Measurement field values match the ones sent by the Lower Tester, including the reserved bits of the Flags field.

4.4.39 CPP/OBS/CPF/BI-07-I [Receive Cycling Power Measurement Broadcast with additional octets not represented in the flags field]

- Test Purpose
  Verify that the CP Observer IUT can receive undirected non-connectable advertisement with the Cycling Power Measurement Characteristic, including additional octets not represented in the flags field.

- Reference
  [3] 6.1

- Initial Condition
  Perform the preamble described in Section 4.2.5.

  The IUT knows the UUID of the Cycling Power Service.

- Test Procedure
  The Lower Tester sends one or more undirected non-connectable advertisements including the Cycling Power Measurement characteristic value to the IUT. That value shall contain: Flags = 0x00 and Instantaneous Power. The optional fields are not present, and, at least, two additional octets not represented in the flags field are present. The total number of octets shall not exceed the maximum size allowed in an advertisement event.

- Expected Outcome
  Pass verdict

IUT reports the received Cycling Power Measurement value to the Upper Tester with no additional octets. The reported Cycling Power Measurement value matches the one sent by the Lower Tester.

4.4.40 CPP/OBS/CPF/BV-33-I [Receive Cycling Power Measurement Broadcast from a Distributed Power System]

- Test Purpose
  Verify that the collector IUT can receive multiple Cycling Power Measurement broadcast from a distributed power system (e.g. 2 CP Sensors).

- Reference
  [3] 6.1
• Initial Condition

A preamble procedure defined in Section 4.2.5 is used to setup the IUT to receive the broadcast from the Lower Tester 1 including the Cycling Power Measurement characteristic. This preamble is repeated to setup the IUT to receive the broadcast from the Lower Tester 1 including the Cycling Power Measurement characteristic. The Lower Tester 1 simulates a CP Sensor located on the left pedal and the Lower Tester 2 simulates a CP Sensor located on the right pedal.

The IUT knows the UUID of the Cycling Power Service.

The IUT knows which Lower Tester correspond to which measured data (e.g. left or right).

• Test Procedure

1. The Lower Testers send one or more undirected non-connectable advertisements the Cycling Power Measurement characteristic value with at least the mandatory fields (e.g. the Flags field and the Instantaneous Power).

2. The IUT displays the values of the Instantaneous Power for each CP Sensor and decodes properly the other optional fields, if present.

• Expected Outcome

Pass verdict

For each undirected non-connectable advertisement sent to the IUT:

- The IUT reports the received Cycling Power Measurement values to the Upper Tester.

- The reported Cycling Power Measurement values match that sent by the Lower Tester.

4.4.41 CPP/OBS/CPF/BV-34-I [Receive Cycling Power Measurement Broadcast from a Distributed Power System – Calculates Total Instantaneous Power]

• Test Purpose

Verify that the collector IUT can receive multiple Cycling Power Measurement broadcast from a distributed power system (e.g. 2 CP Sensors) and calculates the total instantaneous power based on each instantaneous power component.

• Reference

[3] 6.1

• Initial Condition

A preamble procedure defined in Section 4.2.5 is used to setup the IUT to receive broadcast from the Lower Tester 1 including the Cycling Power Measurement characteristic. This preamble is repeated to setup the IUT to receive broadcast from the Lower Tester 1 including the Cycling Power Measurement characteristic. The Lower Tester 1 simulates a CP Sensor located on the left pedal and the Lower Tester 2 simulates a CP Sensor located on the right pedal.

The IUT knows the UUID of the Cycling Power Service.

The IUT knows which Lower Tester correspond to which sensor (e.g. left or right).

• Test Procedure
1. Perform an action on the Lower Testers that will induce it to set the Instantaneous Power values in the table below.

<table>
<thead>
<tr>
<th>Instantaneous Power [W]</th>
<th>Expected Total Instantaneous Power [W]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower Tester 1 (Left Pedal)</td>
<td>Lower Tester 2 (Right Pedal)</td>
</tr>
<tr>
<td>1</td>
<td>200</td>
</tr>
<tr>
<td>2</td>
<td>200</td>
</tr>
<tr>
<td>3</td>
<td>200</td>
</tr>
</tbody>
</table>

Table 4.23: Receive Cycling Power Measurement Broadcast from a Distributed Power System – Calculates Total Instantaneous Power

2. The Lower Testers send three undirected non-connectable advertisements containing a Cycling Power Measurement characteristic value to the IUT (corresponding to the sequence of rows in the table above) that simulate a regular and consistent power measurement as on a bike.

3. The IUT displays the value of the total instantaneous power value calculated by summing both values coming from the two different Lower Testers.

   • Expected Outcome

   **Pass verdict**

   IUT receives undirected non-connectable advertisements containing Cycling Power Measurement values from the Lower Testers that include the Flags field and, at least, the Instantaneous Power field.

   IUT correctly calculates consistent total instantaneous power.

4.4.42 CPP/OBS/CPF/BV-35-I [Receive Cycling Power Measurement Broadcast from a Distributed Power System – Calculates Pedal Power Balance]

   • Test Purpose

   Verify that the collector IUT can receive multiple Cycling Power Measurement broadcast from a distributed power system (e.g. 2 CP Sensors) and calculates the pedal power balance based on each instantaneous power component.

   • Reference

   [3] 6.1

   • Initial Condition

   A preamble procedure defined in Section 4.2.5 is used to setup the IUT to receive broadcast from the Lower Tester 1 including the Cycling Power Measurement characteristic. This preamble is repeated to setup the IUT to receive broadcast from the Lower Tester 1 including the Cycling Power Measurement characteristic. The Lower Tester 1 simulates a CP Sensor located on the left pedal and the Lower Tester 2 simulates a CP Sensor located on the right pedal.

   The IUT knows the UUID of the Cycling Power Service.
The IUT knows which Lower Tester correspond to which sensor (e.g. left or right).

- **Test Procedure**
  1. Perform an action on the Lower Testers that will induce it to set the Instantaneous Power values in the table below.

<table>
<thead>
<tr>
<th>Instantaneous Power [W]</th>
<th>Expected Pedal Power Balance [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower Tester 1 (Left Pedal)</td>
<td>Lower Tester 2 (Right Pedal)</td>
</tr>
<tr>
<td>1</td>
<td>200</td>
</tr>
<tr>
<td>2</td>
<td>200</td>
</tr>
<tr>
<td>3</td>
<td>200</td>
</tr>
</tbody>
</table>

Table 4.24: Receive Cycling Power Measurement Broadcast from a Distributed Power System – Calculates Pedal Power Balance

2. The Lower Testers send three undirected non-connectable advertisements containing a Cycling Power Measurement characteristic value to the IUT (corresponding to the sequence of rows in the table above) that simulate a regular and consistent power measurement as on a bike.

3. The IUT displays the value of the pedal power balance value calculated with the values coming from the two different Lower Testers.

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

IUT receives undirected non-connectable advertisements containing Cycling Power Measurement values from the Lower Testers that include the Flags field and, at least, the Instantaneous Power field.

IUT correctly calculates consistent pedal power balance.

4.4.43 CPP/COL/CPF/BV-36-I [Receive Cycling Power Measurement Notifications from a Legacy CP Sensor]

- **Test Purpose**
  Verify that the Collector IUT can receive notifications of the Cycling Power Measurement Characteristic, including all variants.

- **Reference**
  [3] 4.5

- **Initial Condition**
  A preamble procedure defined in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport is used to setup the transport and L2CAP channel and initiate connection to a CP Sensor.

The Lower Tester has the Distributed System Support bits of the Cycling Power Feature characteristic set to "Unspecified" (0b00).
The IUT has read the Cycling Power Feature characteristic.

The IUT has executed the procedure included in CPP/COL/CPF/BV-05-I [Configure Cycling Power Measurement for Notification], which configures it to expect Cycling Power Measurement Notifications.

The IUT knows the handle of the Cycling Power Measurement characteristic.

- Test Procedure
  1. The Lower Tester sends an *ATT_Handle_Value_Notification* containing a Cycling Power Measurement characteristic value to the IUT.
  2. The Lower Tester sends one Cycling Power Measurement characteristic notification for each Test Pattern shown in the following table. For each Test Pattern, the value of the Flags field is shown along with the corresponding pass criteria.

<table>
<thead>
<tr>
<th>Test Pattern</th>
<th>Flags Field Value</th>
<th>Pass Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>00000000 – 00000001</td>
<td>Only optional field present is Pedal Power Balance with the Pedal Power Balance Reference set to “Unknown”.</td>
</tr>
<tr>
<td>2</td>
<td>00000000 – 00000011</td>
<td>Only optional field present is Pedal Power Balance with the Pedal Power Balance Reference set to “Left”.</td>
</tr>
<tr>
<td>3</td>
<td>00000000 – 00000100</td>
<td>Only optional field present is Accumulated Torque with the Accumulated Torque Source set to “Wheel based”.</td>
</tr>
<tr>
<td>4</td>
<td>00000000 – 00001100</td>
<td>Only optional field present is Accumulated Torque with the Accumulated Torque Source set to “Crank based”.</td>
</tr>
<tr>
<td>5</td>
<td>00000000 – 00010000</td>
<td>Only optional fields present are Cumulative Wheel Revolutions and Last Wheel Event Time.</td>
</tr>
<tr>
<td>6</td>
<td>00000000 – 00100000</td>
<td>Only optional fields present are Cumulative Crank Revolutions and Last Crank Event Time.</td>
</tr>
<tr>
<td>7</td>
<td>00000000 – 01000000</td>
<td>Only optional fields present are Maximum Force Magnitude and Minimum Force Magnitude.</td>
</tr>
<tr>
<td>8</td>
<td>00000000 – 10000000</td>
<td>Only optional fields present are Maximum Torque Magnitude and Minimum Torque Magnitude.</td>
</tr>
<tr>
<td>9</td>
<td>00000001 – 00000000</td>
<td>Only optional fields present are Maximum Angle and Minimum Angle.</td>
</tr>
<tr>
<td>10</td>
<td>00000010 – 00000000</td>
<td>Only optional field present is Top Dead Spot.</td>
</tr>
<tr>
<td>11</td>
<td>00000100 – 00000000</td>
<td>Only optional field present is Bottom Dead Spot.</td>
</tr>
<tr>
<td>12</td>
<td>00001000 – 00000000</td>
<td>Only optional field present is Accumulated Energy.</td>
</tr>
<tr>
<td>13</td>
<td>00010000 – 00000000</td>
<td>No optional field present. Offset Compensation Indicator set to True.</td>
</tr>
</tbody>
</table>

*Table 4.25: Receive Cycling Power Measurement Notifications from a Legacy CP Sensor*
• Expected Outcome

Pass verdict

IUT is able to correctly parse the received Cycling Power Measurement values according to the pass criteria in the table above. The reported Cycling Power Measurement field values match the ones sent by the Lower Tester.

4.4.44 CPP/COL/CPF/BV-37-I [Receive Cycling Power Measurement Notifications from a CP Sensor – Not For Use In A Distributed Power System]

• Test Purpose

Verify that the Collector IUT can receive notifications of the Cycling Power Measurement Characteristic, including all variants.

• Reference

[3] 4.5

• Initial Condition

A preamble procedure defined in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport is used to setup the transport and L2CAP channel and initiate connection to a CP Sensor.

The Lower Tester has the Distributed System Support bits of the Cycling Power Feature characteristic set to “Not For Use In A Distributed Power System” (0b01).

The IUT has read the Cycling Power Feature characteristic.

The IUT has executed the procedure included in CPP/COL/CPF/BV-05-I [Configure Cycling Power Measurement for Notification], which configures it to expect Cycling Power Measurement Notifications.

The IUT knows the handle of the Cycling Power Measurement characteristic.
• Test Procedure

1. The Lower Tester sends an ATT_Handle_Value_Notification containing a Cycling Power Measurement characteristic value to the IUT.

2. The Lower Tester sends one Cycling Power Measurement characteristic notification for each Test Pattern shown in the following table. For each Test Pattern, the value of the Flags field is shown along with the corresponding pass criteria. The value of the Instantaneous Power value is set to 150 Watts.

<table>
<thead>
<tr>
<th>Test Pattern</th>
<th>Flags Field Value (bit15 ... bit0)</th>
<th>Pass Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>00000000 – 00000001</td>
<td>Only optional field present is Pedal Power Balance with the Pedal Power Balance Reference set to “Unknown”.</td>
</tr>
<tr>
<td>2</td>
<td>00000000 – 00000011</td>
<td>Only optional field present is Pedal Power Balance with the Pedal Power Balance Reference set to “Left”.</td>
</tr>
<tr>
<td>3</td>
<td>00000000 – 00000100</td>
<td>Only optional field present is Accumulated Torque with the Accumulated Torque Source set to “Wheel based”.</td>
</tr>
<tr>
<td>4</td>
<td>00000000 – 00001100</td>
<td>Only optional field present is Accumulated Torque with the Accumulated Torque Source set to “Crank based”.</td>
</tr>
<tr>
<td>5</td>
<td>00000000 – 00010000</td>
<td>Only optional fields present are Cumulative Wheel Revolutions and Last Wheel Event Time.</td>
</tr>
<tr>
<td>6</td>
<td>00000000 – 00100000</td>
<td>Only optional fields present are Cumulative Crank Revolutions and Last Crank Event Time.</td>
</tr>
<tr>
<td>7</td>
<td>00000000 – 01000000</td>
<td>Only optional fields present are Maximum Force Magnitude and Minimum Force Magnitude.</td>
</tr>
<tr>
<td>8</td>
<td>00000000 – 10000000</td>
<td>Only optional fields present are Maximum Torque Magnitude and Minimum Torque Magnitude.</td>
</tr>
<tr>
<td>9</td>
<td>00000001 – 00000000</td>
<td>Only optional fields present are Maximum Angle and Minimum Angle.</td>
</tr>
<tr>
<td>10</td>
<td>00000010 – 00000000</td>
<td>Only optional field present is Top Dead Spot.</td>
</tr>
<tr>
<td>11</td>
<td>00000100 – 00000000</td>
<td>Only optional field present is Bottom Dead Spot.</td>
</tr>
<tr>
<td>12</td>
<td>00010000 – 00000000</td>
<td>Only optional field present is Accumulated Energy.</td>
</tr>
<tr>
<td>13</td>
<td>00100000 – 00000000</td>
<td>No optional field present. Offset Compensation Indicator set to True.</td>
</tr>
</tbody>
</table>

Table 4.26: Receive Cycling Power Measurement Notifications from a CP Sensor – Not For Use In A Distributed Power System
• Expected Outcome

Pass verdict

IUT is able to correctly parse the received Cycling Power Measurement values according to the pass criteria in the table above. The reported Cycling Power Measurement field values match the ones sent by the Lower Tester and the Instantaneous Power value is equal to 150 Watts.

4.4.45 CPP/COL/CPF/BV-38-I [Receive Cycling Power Measurement Notifications from a CP Sensor – Can Be Used In A Distributed Power System]

• Test Purpose

Verify that the Collector IUT can receive notifications of the Cycling Power Measurement Characteristic, including all variants.

• Reference

[3] 4.5

• Initial Condition

A preamble procedure defined in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport is used to setup the transport and L2CAP channel and initiate connection to a CP Sensor.

The Lower Tester is configured with a Sensor Location set to “Left Pedal” (0x07).

The Lower Tester has the Distributed System Support bits of the Cycling Power Feature characteristic set to “Can be used in a distributed power system” (0b10).

The IUT has read the Cycling Power Feature characteristic.

The IUT has executed the procedure included in CPP/COL/CPF/BV-05-I [Configure Cycling Power Measurement for Notification], which configures it to expect Cycling Power Measurement Notifications.

The IUT knows the handle of the Cycling Power Measurement characteristic.
### Test Procedure

1. The Lower Tester sends an `ATT_Handle_Value_Notification` containing a Cycling Power Measurement characteristic value to the IUT.

2. The Lower Tester sends one Cycling Power Measurement characteristic notification for each Test Pattern shown in the following table. For each Test Pattern, the value of the Flags field is shown along with the corresponding pass criteria. The value of the Instantaneous Power value sent by the Lower Tester 1 is set to 75 Watts.

<table>
<thead>
<tr>
<th>Test Pattern</th>
<th>Flags Field Value (bit15 ... bit0)</th>
<th>Pass Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>00000000 – 00000001</td>
<td>Only optional field present is Pedal Power Balance with the Pedal Power Balance Reference set to “Unknown”.</td>
</tr>
<tr>
<td>2</td>
<td>00000000 – 00000011</td>
<td>Only optional field present is Pedal Power Balance with the Pedal Power Balance Reference set to “Left”.</td>
</tr>
<tr>
<td>3</td>
<td>00000000 – 00000100</td>
<td>Only optional field present is Accumulated Torque with the Accumulated Torque Source set to “Wheel based”.</td>
</tr>
<tr>
<td>4</td>
<td>00000000 – 00001100</td>
<td>Only optional field present is Accumulated Torque with the Accumulated Torque Source set to “Crank based”.</td>
</tr>
<tr>
<td>5</td>
<td>00000000 – 00010000</td>
<td>Only optional fields present are Cumulative Wheel Revolutions and Last Wheel Event Time.</td>
</tr>
<tr>
<td>6</td>
<td>00000000 – 00100000</td>
<td>Only optional fields present are Cumulative Crank Revolutions and Last Crank Event Time.</td>
</tr>
<tr>
<td>7</td>
<td>00000000 – 01000000</td>
<td>Only optional fields present are Maximum Force Magnitude and Minimum Force Magnitude.</td>
</tr>
<tr>
<td>8</td>
<td>00000000 – 10000000</td>
<td>Only optional fields present are Maximum Torque Magnitude and Minimum Torque Magnitude.</td>
</tr>
<tr>
<td>9</td>
<td>00000001 – 00000000</td>
<td>Only optional fields present are Maximum Angle and Minimum Angle.</td>
</tr>
<tr>
<td>10</td>
<td>00000010 – 00000000</td>
<td>Only optional field present is Top Dead Spot.</td>
</tr>
<tr>
<td>11</td>
<td>00000100 – 00000000</td>
<td>Only optional field present is Bottom Dead Spot.</td>
</tr>
<tr>
<td>12</td>
<td>00010000 – 00000000</td>
<td>Only optional field present is Accumulated Energy.</td>
</tr>
<tr>
<td>13</td>
<td>00100000 – 00000000</td>
<td>No optional field present. Offset Compensation Indicator set to True.</td>
</tr>
</tbody>
</table>

*Table 4.27: Receive Cycling Power Measurement Notifications from a CP Sensor – Can Be Used in a Distributed Power System*
**Expected Outcome**

**Pass verdict**

IUT is able to correctly parse the received Cycling Power Measurement values according to the pass criteria in the table above. The reported Cycling Power Measurement field values match the ones sent by the Lower Tester except the Instantaneous Power value that may be multiplied by two by the IUT (i.e. 150 Watts).

**Notes**

The Instantaneous Power value reported by the IUT may be multiplied by two as explained in [3] 4.4.

### 4.4.46 CPP/COL/CPF/BV-39-I [Receive Cycling Power Measurement Notifications from two CP Sensors – Can Be Used In A Distributed Power System – Total Instantaneous Power]

**Test Purpose**

Verify that the collector IUT can receive multiple Cycling Power Measurement notifications from a distributed power system (e.g. two CP Sensors) and calculates the total instantaneous power based on each instantaneous power component.

**Reference**

[3] 4.5

**Initial Condition**

A preamble procedure defined in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport is used to setup the transport and L2CAP channel and initiate connection to a CP Sensor. This preamble is repeated to initiate a connection to both CP Sensors (Lower Tester) involved in this test case. The first Lower Tester is configured with a Sensor Location set to “Left Pedal” (0x07) and the second Lower Tester is configured with a Sensor Location set to “Right Pedal” (0x08).

Both Lower Testers have the Distributed System Support bits of the Cycling Power Feature characteristic set to “Can be used in a distributed system” (0b10).

The IUT has read the Cycling Power Feature characteristic.
The IUT has executed the procedure included in CPP/COL/CPF/BV-05-I [Configure Cycling Power Measurement for Notification], which configures it to expect Cycling Power Measurement Notifications for both CP Sensors.

The IUT knows the handle of the Cycling Power Measurement characteristic of both CP Sensors.

- **Test Procedure**
  1. Perform an action on the Lower Tester that will induce it to set the Instantaneous Power values in the table below.

<table>
<thead>
<tr>
<th>Instantaneous Power [W]</th>
<th>Expected Total Instantaneous Power [W]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower Tester 1 (Left Pedal)</td>
<td>Lower Tester 2 (Right Pedal)</td>
</tr>
<tr>
<td>1</td>
<td>200</td>
</tr>
<tr>
<td>2</td>
<td>200</td>
</tr>
<tr>
<td>3</td>
<td>180</td>
</tr>
<tr>
<td>4</td>
<td>180</td>
</tr>
</tbody>
</table>

Table 4.28: Receive Cycling Power Measurement Notifications from two CP Sensors – Can Be Used In A Distributed Power System – Total Instantaneous Power

2. The Lower Testers send three ATT_Handle_Value_Notifications containing a Cycling Power Measurement characteristic value to the IUT (corresponding to the sequence of rows in the table above) that simulate a regular and consistent power measurement as on a bike.

3. The IUT displays the value of the total instantaneous power value calculated by summing both values coming from the two different Lower Testers (e.g. 420 Watts).

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

  IUT receives notifications of Cycling Power Measurement values from the Lower Testers that include the Flags field and, at least, the Instantaneous Power field.

  IUT correctly calculates consistent total instantaneous power.

**4.4.47 CPP/COL/CPF/BV-40-I [Receive Cycling Power Measurement Notifications from two CP Sensors – Can Be Used in A Distributed Power System – Pedal Power Balance]**

- **Test Purpose**
  Verify that the collector IUT can receive multiple Cycling Power Measurement notifications from a distributed power system (e.g. two CP Sensors) and calculates the total instantaneous power based on each instantaneous power component.

- **Reference**
  [3] 4.5
• **Initial Condition**

A preamble procedure defined in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport is used to setup the transport and L2CAP channel and initiate connection to a CP Sensor. This preamble is repeated to initiate a connection to both CP Sensors (Lower Tester) involved in this test case. The first Lower Tester is configured with a Sensor Location set to “Left Pedal” (0x07) and the second Lower Tester is configured with a Sensor Location set to “Right Pedal” (0x08).

Both Lower Testers have the Distributed System Support bits of the Cycling Power Feature characteristic set to “Can be used in a distributed system” (0b10).

The IUT has read the Cycling Power Feature characteristic.

The IUT has executed the procedure included in CPP/COL/CPF/BV-05-I [Configure Cycling Power Measurement for Notification], which configures it to expect Cycling Power Measurement Notifications for both CP Sensors.

The IUT knows the handle of the Cycling Power Measurement characteristic of both CP Sensors.

• **Test Procedure**

1. Perform an action on the Lower Tester that will induce it to set the Instantaneous Power values in the table below.

<table>
<thead>
<tr>
<th>Instantaneous Power [W]</th>
<th>Expected Pedal Power Balance [%] (Left Pedal as the reference)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower Tester 1 (Left Pedal)</td>
<td>Lower Tester 2 (Right Pedal)</td>
</tr>
<tr>
<td>1</td>
<td>200</td>
</tr>
<tr>
<td>2</td>
<td>200</td>
</tr>
<tr>
<td>3</td>
<td>180</td>
</tr>
<tr>
<td>4</td>
<td>180</td>
</tr>
</tbody>
</table>

Table 4.29: Receive Cycling Power Measurement Notifications from two CP Sensors – Can Be Used in A Distributed Power System – Pedal Power Balance

2. The Lower Testers send three `ATT_Handle_Value_Notifications` containing a Cycling Power Measurement characteristic value to the IUT (corresponding to the sequence of rows in the table above) that simulate a regular and consistent power measurement as on a bike.

3. The IUT displays the value of the pedal power balance value calculated with the values coming from the two different Lower Testers.

• **Expected Outcome**

**Pass verdict**

IUT receives notifications of Cycling Power Measurement values from the Lower Testers that include the Flags field and, at least, the Instantaneous Power field.

IUT correctly calculates consistent pedal power balance.
4.4.48 CPP/COL/CPF/BV-41-I [Receive Cycling Power Measurement Notifications from two Legacy CP Sensors]

• Test Purpose
Verify that the Collector IUT can receive notifications of the Cycling Power Measurement Characteristic, including all variants.

• Reference
[3] 4.5

• Initial Condition
A preamble procedure defined in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport is used to setup the transport and L2CAP channel and initiate connection to a CP Sensor. This preamble is repeated to initiate a connection to both CP Sensors (Lower Tester) involved in this test case. The first Lower Tester is configured with a Sensor Location set to “Left Pedal” (0x07) and the second Lower Tester is configured with a Sensor Location set to “Right Pedal” (0x08).

Both Lower Testers have the Distributed System Support bits of the Cycling Power Feature characteristic set to “Undefined” (0b00).

The IUT has read the Cycling Power Feature characteristic.

The IUT has executed the procedure included in CPP/COL/CPF/BV-05-I [Configure Cycling Power Measurement for Notification], which configures it to expect Cycling Power Measurement Notifications for both CP Sensors.

The IUT knows the handle of the Cycling Power Measurement characteristic of both CP Sensors.

• Test Procedure
1. The Lower Testers send each an ATT_Handle_Value_Notification containing a Cycling Power Measurement characteristic value to the IUT.
2. The Lower Testers send one Cycling Power Measurement characteristic notification for each Test Pattern shown in the following table. For each Test Pattern, the value of the Flags field is shown along with the corresponding pass criteria.

<table>
<thead>
<tr>
<th>Test Pattern</th>
<th>Flags Field Value (bit15 … bit0)</th>
<th>Pass Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>000000000 – 00000001</td>
<td>Only optional field present is Pedal Power Balance with the Pedal Power Balance Reference set to “Unknown”.</td>
</tr>
<tr>
<td>2</td>
<td>000000000 – 00000011</td>
<td>Only optional field present is Pedal Power Balance with the Pedal Power Balance Reference set to “Left”.</td>
</tr>
<tr>
<td>3</td>
<td>000000000 – 00000100</td>
<td>Only optional field present is Accumulated Torque with the Accumulated Torque Source set to “Wheel based”.</td>
</tr>
<tr>
<td>4</td>
<td>000000000 – 00001100</td>
<td>Only optional field present is Accumulated Torque with the Accumulated Torque Source set to “Crank based”.</td>
</tr>
<tr>
<td>Test Pattern</td>
<td>Flags Field Value (bit15 ... bit0)</td>
<td>Pass Criteria</td>
</tr>
<tr>
<td>--------------</td>
<td>-----------------------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>5</td>
<td>000000000 – 00010000</td>
<td>Only optional fields present are Cumulative Wheel Revolutions and Last Wheel Event Time.</td>
</tr>
<tr>
<td>6</td>
<td>000000000 – 00100000</td>
<td>Only optional fields present are Cumulative Crank Revolutions and Last Crank Event Time.</td>
</tr>
<tr>
<td>7</td>
<td>000000000 – 01000000</td>
<td>Only optional fields present are Maximum Force Magnitude and Minimum Force Magnitude.</td>
</tr>
<tr>
<td>8</td>
<td>000000000 – 10000000</td>
<td>Only optional fields present are Maximum Torque Magnitude and Minimum Torque Magnitude.</td>
</tr>
<tr>
<td>9</td>
<td>000000001 – 00000000</td>
<td>Only optional fields present are Maximum Angle and Minimum Angle.</td>
</tr>
<tr>
<td>10</td>
<td>000000100 – 00000000</td>
<td>Only optional field present is Top Dead Spot.</td>
</tr>
<tr>
<td>11</td>
<td>000001000 – 00000000</td>
<td>Only optional field present is Bottom Dead Spot.</td>
</tr>
<tr>
<td>12</td>
<td>000010000 – 00000000</td>
<td>Only optional field present is Accumulated Energy.</td>
</tr>
<tr>
<td>13</td>
<td>000100000 – 00000000</td>
<td>No optional field present. Offset Compensation Indicator set to True.</td>
</tr>
</tbody>
</table>

Table 4.30: Receive Cycling Power Measurement Notifications from two Legacy CP Sensors

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

IUT is able to correctly parse the received Cycling Power Measurement values according to the pass criteria in the table above. The reported Cycling Power Measurement field values match the ones sent by the Lower Testers.
4.5 Service Procedures – Set Cumulative Value

This test group contains test cases to verify compliant operation when the Cycling Power Control Point Set Cumulative Value procedure is used.

4.5.1 CPP/COL/SPS/BV-01-I [Set Cumulative Value – Set to zero]

- Test Purpose
  Verify that the Collector IUT can perform the Set Cumulative Value procedure to set a zero value.

- Reference
  [3] 4.7.2.1

- Initial Condition
  Perform the preamble described in Section 4.2.3.

  The value of Cumulative Wheel Revolutions in the Lower Tester is set to a known non-zero value.

- Test Procedure
  1. A connection is established between the IUT and Lower Tester using the Preamble defined in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport.
  2. The Lower Tester sends one or more notifications of the Cycling Power Measurement characteristic with the Cumulative Wheel Revolutions field set to a non-zero value.
  3. IUT writes the Set Cumulative Value Op Code (0x01) to the Cycling Power Control Point with a Parameter Value of 0x00000000.
  4. The Lower Tester sends an indication of the Cycling Power Control Point characteristic with the Response Code Op Code (0x20) and a Parameter representing Request Op Code (0x01) followed by the Response Code for ‘success’ (0x01).
  5. The IUT sends ATT_Handle_Value_Confirmation to the Lower Tester.
  6. The Lower Tester sends a notification of the Cycling Power Measurement characteristic with the Cumulative Wheel Revolutions field set to 0 (or close to 0).

- Expected Outcome
  Pass verdict
  The IUT receives one or more notifications of the Cycling Power Measurement characteristic with the Cumulative Wheel Revolutions field set to a non-zero value.
  After setting the value to zero, the IUT receives the next notification of the Cycling Power Measurement characteristic containing the Cumulative Wheel Revolutions with the value of the Cumulative Wheel Revolutions field set to 0 (or slightly higher in case of movement).

4.5.2 CPP/COL/SPS/BV-02-I [Set Cumulative Value - Set to non-zero]

- Test Purpose
  Verify that the Collector IUT can perform the Set Cumulative Value procedure to set a non-zero value.

- Reference
4.7.2.1

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

  The value of Cumulative Wheel Revolutions in the Lower Tester is set to a known value.

- **Test Procedure**
  1. A connection is established between the IUT and Lower Tester using the Preamble defined in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport.
  2. The Lower Tester sends one or more notifications of the Cycling Power Measurement characteristic with the Cumulative Wheel Revolutions field set to any value.
  3. The IUT writes the Set Cumulative Value Op Code (0x01) to the Cycling Power Control Point with a Parameter Value that is different than the initial value (e.g. 0x0000FFFF).
  4. The Lower Tester sends an indication of the Cycling Power Control Point characteristic with the Response Code Op Code (0x20) and a Parameter representing Request Op Code (0x01) followed by the Response Code for ‘success’ (0x01).
  5. The IUT sends ATT_Handle_Value_Confirmation to the Lower Tester.
  6. The Lower Tester sends a notification of the Cycling Power Measurement characteristic with the Cumulative Wheel Revolutions field set to the specified value (or close to the specified value).

- **Expected Outcome**
  Pass verdict

  The IUT receives one or more notifications of the Cycling Power Measurement characteristic with the Cumulative Wheel Revolutions field set to the specified non-zero value.

  After setting the value, the IUT receives the next notification of the Cycling Power Measurement characteristic containing the Cumulative Wheel Revolutions field with the value of the Cumulative Wheel Revolutions field set to the specified value (or slightly higher in case of movement).

### 4.6 Service Procedures – Handle CP Sensor Parameters

This test group contains test cases to verify compliant operation when the IUT uses the Cycling Power Control Point to handle internal CP Sensor parameters (e.g. Set or Request).

#### 4.6.1 CPP/COL/SPP/BV-01-I [Update Sensor Location]

- **Test Purpose**
  Verify that the Collector IUT can perform the Update Sensor Location procedure.

- **Reference**
  [3] 4.7.2.2

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

- **Test Procedure**
1. A connection is established between the IUT and Lower Tester using the Preamble defined in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport.

2. IUT writes the Update Sensor Location Op Code (0x02) to the Cycling Power Control Point with the Parameter of this Control Point set to a location supported by the CP Sensor.

3. The Lower Tester sends an indication of the Cycling Power Control Point characteristic with the Response Code Op Code (0x20) and a Parameter representing Request Op Code (0x02) followed by the Response Code for ‘success’ (0x01).

4. The IUT sends ATT_Handle_Value_Confirmation to the Lower Tester.
   - Expected Outcome
     Pass verdict
     The Sensor Location value is updated with the correct value.
     The IUT receives the Request Op Code ‘success’.

4.6.2 CPP/COL/SPP/BV-02-I [Request Supported Sensor Locations]

- Test Purpose
  Verify that the Collector IUT can perform the Request Supported Sensor Locations procedure.

- Reference
  [3] 4.7.2.3

- Initial Condition
  Perform the preamble described in Section 4.2.3.

- Test Procedure
  1. A connection is established between the IUT and Lower Tester using the Preamble defined in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport.
  2. IUT writes the Request Supported Sensor Location Op Code (0x03) to the Cycling Power Control Point with no Parameter.
  3. The Lower Tester sends an indication of the Cycling Power Control Point characteristic with the Response Code Op Code (0x20) and a Parameter representing Request Op Code (0x03) followed by the Response Code for ‘success’ (0x01) and a list of supported sensor locations.
  4. The IUT sends ATT_Handle_Value_Confirmation to the Lower Tester.
   - Expected Outcome
     Pass verdict
     The IUT receives a list of supported and valid sensor locations.

4.6.3 CPP/COL/SPP/BV-03-I [Set Crank Length]

- Test Purpose
  Verify that the Collector IUT can perform the Set Crank Length procedure.

- Reference
4.7.2.4

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

- **Test Procedure**
  1. A connection is established between the IUT and Lower Tester using the Preamble defined in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport.
  2. IUT writes the Set Crank Length Op Code (0x04) to the Cycling Power Control Point with a Parameter Value set to a valid crank length value (UINT16) in millimeters with a resolution of 1/2 millimeter.
  3. The Lower Tester sends an indication of the Cycling Power Control Point characteristic with the Response Code Op Code (0x20) and a Parameter representing Request Op Code (0x04) followed by the Response Code for ‘success’ (0x01).
  4. The IUT sends ATT_Handle_Value_Confirmation to the Lower Tester.

- **Expected Outcome**
  - **Pass verdict**
  The crank length value is updated with the correct value.
  The IUT receives the Request Op Code ‘success’.

4.6.4 **CPP/COL/SPP/BV-04-I [Request Crank Length]**

- **Test Purpose**
  Verify that the Collector IUT can perform the Request Crank Length procedure.

- **Reference**
  [3] 4.7.2.5

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

- **Test Procedure**
  1. A connection is established between the IUT and Lower Tester using the Preamble defined in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport.
  2. IUT writes the Request Crank Length Op Code (0x05) to the Cycling Power Control Point with no Parameter.
  3. The Lower Tester sends an indication of the Cycling Power Control Point characteristic with the Response Code Op Code (0x20) and a Parameter representing Request Op Code (0x05), the Response Code for ‘success’ (0x01) followed by the value of the crank length (UINT16) in millimeters with a resolution of 1/2 millimeter.
  4. The IUT sends ATT_Handle_Value_Confirmation to the Lower Tester.

- **Expected Outcome**
Pass verdict

The IUT receives valid crank length value.

### 4.6.5 CPP/COL/SPP/BV-05-I [Set Chain Length]

- **Test Purpose**
  
  Verify that the Collector IUT can perform the Set Chain Length procedure.

- **Reference**
  
  [3] 4.7.2.6

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

- **Test Procedure**
  
  1. A connection is established between the IUT and Lower Tester using the Preamble defined in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport.
  
  2. IUT writes the Set Chain Length Op Code (0x06) to the Cycling Power Control Point with a Parameter Value set to a valid chain length value (UINT16) in millimeters with a resolution of 1 millimeter.
  
  3. The Lower Tester sends an indication of the Cycling Power Control Point characteristic with the Response Code Op Code (0x20) and a Parameter representing Request Op Code (0x06) followed by the Response Code for ‘success’ (0x01).
  
  4. The IUT sends ATT_Handle_Value_Confirmation to the Lower Tester.

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

  The chain length value is updated with the correct value.

  The IUT receives the Request Op Code ‘success’.

### 4.6.6 CPP/COL/SPP/BV-06-I [Request Chain Length]

- **Test Purpose**
  
  Verify that the Collector IUT can perform the Request Chain Length procedure.

- **Reference**
  
  [3] 4.7.2.7

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

- **Test Procedure**
  
  1. A connection is established between the IUT and Lower Tester using the Preamble defined in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport.
2. IUT writes the Request Chain Length Op Code (0x07) to the Cycling Power Control Point with no Parameter.

3. The Lower Tester sends an indication of the Cycling Power Control Point characteristic with the Response Code Op Code (0x20) and a Parameter representing the Request Op Code (0x07), the Response Code for 'success' (0x01) followed by the value of the chain length (UINT16) in millimeters with a resolution of 1 millimeter.

4. The IUT sends ATT_Handle_Value_Confirmation to the Lower Tester.

   • Expected Outcome
     Pass verdict

     The IUT receives valid chain length value.

4.6.7 CPP/COL/SPP/BV-07-I [Set Chain Weight]

   • Test Purpose
     Verify that the Collector IUT can perform the Set Chain Weight procedure.

   • Reference
     [3] 4.7.2.8

   • Initial Condition
     Perform the preamble described in Section 4.2.3.

   • Test Procedure
     1. A connection is established between the IUT and Lower Tester using the Preamble defined in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport.
     2. IUT writes the Set Chain Weight Op Code (0x08) to the Cycling Power Control Point with a Parameter Value set to a valid chain weight value (UINT16) in grams with a resolution of one gram.
     3. The Lower Tester sends an indication of the Cycling Power Control Point characteristic with the Response Code Op Code (0x20) and a Parameter representing Request Op Code (0x08) followed by the Response Code for ‘success’ (0x01).
     4. The IUT sends ATT_Handle_Value_Confirmation to the Lower Tester.

   • Expected Outcome
     Pass verdict

     The chain weight value is updated with the correct value.

     The IUT receives the Request Op Code 'success'.

4.6.8 CPP/COL/SPP/BV-08-I [Request Chain Weight]

   • Test Purpose
     Verify that the Collector IUT can perform the Request Chain Weight procedure.

   • Reference
4.7.2.9

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

- **Test Procedure**
  1. A connection is established between the IUT and Lower Tester using the Preamble defined in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport.
  2. IUT writes the Request Chain Weight Op Code (0x09) to the Cycling Power Control Point with no Parameter.
  3. The Lower Tester sends an indication of the Cycling Power Control Point characteristic with the Response Code Op Code (0x20) and a Parameter representing the Request Op Code (0x09), the Response Code for ‘success’ (0x01) followed by the value of the chain weight (UINT16) in grams with a resolution of one gram.
  4. The IUT sends ATT_Handle_Value_Confirmation to the Lower Tester.

- **Expected Outcome**
  Pass verdict

  The IUT receives valid chain weight value.

4.6.9 CPP/COL/SPP/BV-09-I [Set Span Length]

- **Test Purpose**
  Verify that the Collector IUT can perform the Set Span Length procedure.

- **Reference**
  [3] 4.7.2.10

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

- **Test Procedure**
  1. A connection is established between the IUT and Lower Tester using the Preamble defined in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport.
  2. IUT writes the Set Span Length Op Code (0x0A) to the Cycling Power Control Point with a Parameter Value set to a valid span length value (UINT16) in millimeters with a resolution of 1 millimeter.
  3. The Lower Tester sends an indication of the Cycling Power Control Point characteristic with the Response Code Op Code (0x20) and a Parameter representing Request Op Code (0x0A) followed by the Response Code for ‘success’ (0x01).
  4. The IUT sends ATT_Handle_Value_Confirmation to the Lower Tester.

- **Expected Outcome**
  Pass verdict
The span length value is updated with the correct value.

The IUT receives the Request Op Code ‘success’.

4.6.10 CPP/COL/SPP/BV-10-I [Request Span Length]

• Test Purpose
Verify that the Collector IUT can perform the Request Span Length procedure.

• Reference
[3] 4.7.2.11

• Initial Condition
Perform the preamble described in Section 4.2.3.

• Test Procedure
1. A connection is established between the IUT and Lower Tester using the Preamble defined in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport.
2. IUT writes the Request Span Length Op Code (0x0B) to the Cycling Power Control Point with no Parameter.
3. The Lower Tester sends an indication of the Cycling Power Control Point characteristic with the Response Code Op Code (0x20) and a Parameter representing the Request Op Code (0x0B), the Response Code for ‘success’ (0x01) followed by the value of the span length (UINT16) in millimeters with a resolution of 1 millimeter.
4. The IUT sends ATT_Handle_Value_Confirmation to the Lower Tester.

• Expected Outcome
Pass verdict
The IUT receives valid span length value.

4.6.11 CPP/COL/SPP/BV-11-I [Request Factory Calibration Date]

• Test Purpose
Verify that the Collector IUT can perform the Request Factory Calibration Date procedure.

• Reference
[3] 4.7.2.15

• Initial Condition
Perform the preamble described in Section 4.2.3.

• Test Procedure
1. A connection is established between the IUT and Lower Tester using the Preamble defined in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport.
2. IUT writes the Request Factory Calibration Date Op Code (0x0F) to the Cycling Power Control Point with no Parameter.
3. The Lower Tester sends an indication of the Cycling Power Control Point characteristic with the Response Code Op Code (0x20) and a Parameter representing the Request Op Code (0x0F), the Response Code for 'success' (0x01) followed by the factory calibration date (see Date Time characteristic format in [11]).

4. The IUT sends ATT_Handle_Value_Confirmation to the Lower Tester.

• Expected Outcome
  Pass verdict

  The IUT receives valid the factory calibration date.

4.6.12 CPP/COL/SPP/BV-12-I [Request Sampling Rate]

• Test Purpose
  Verify that the Collector IUT can perform the Request Sampling Rate procedure.

• Reference
  [3] 4.7.2.15

• Initial Condition
  Perform the preamble described in Section 4.2.3.

• Test Procedure
  1. A connection is established between the IUT and Lower Tester using the Preamble defined in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport.
  2. IUT writes the Request Sampling Rate Op Code (0x0E) to the Cycling Power Control Point with no Parameter.
  3. The Lower Tester sends an indication of the Cycling Power Control Point characteristic with the Response Code Op Code (0x20) and a Parameter representing the Request Op Code (0x0E), the Response Code for ‘success’ (0x01) followed by the value of the sampling rate (UINT8) in Hertz with a resolution of 1 Hertz.
  4. The IUT sends ATT_Handle_Value_Confirmation to the Lower Tester.

• Expected Outcome
  Pass verdict

  The IUT receives valid sampling rate.

4.7 Service Procedure – Offset Compensation

4.7.1 CPP/COL/SPO/BV-01-I [Start Offset Compensation – Force Based CP Sensor]

• Test Purpose
  Verify that the Collector IUT can perform the Start Offset Compensation procedure and interpret correctly the Response Parameter from a Force-based CP Sensor.

• Reference
[3] 4.7.2.13

• Initial Condition
  Perform the preamble described in Section 4.2.3.

• Test Procedure
  1. A connection is established between the IUT and Lower Tester using the Preamble defined in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport.
  2. IUT writes the Start Offset Compensation Op Code (0x0C) to the Cycling Power Control Point with no Parameter.
  3. The Lower Tester sends an indication of the Cycling Power Control Point characteristic with the Response Code Op Code (0x20) and a Parameter representing the Request Op Code (0x0C), the Response Code for ‘success’ (0x01) followed by the Response Parameter representing the value of the offset before the offset is compensated (SINT16) in Newton meters with a resolution of 1/32 Newton meter.
  4. The IUT sends ATT_Handle_Value_Confirmation to the Lower Tester.

• Expected Outcome
  Pass verdict

  The IUT receives valid offset value and interprets the unit correctly, based on the Sensor Measurement Context bit of the Cycling Power Measurement context.

4.7.2 CPP/COL/SPO/BV-02-I [Start Offset Compensation – Torque Based CP Sensor]

• Test Purpose
  Verify that the Collector IUT can perform the Start Offset Compensation procedure and interpret correctly the Response Parameter from a Torque-based CP Sensor.

• Reference
  [3] 4.7.2.13

• Initial Condition
  Perform the preamble described in Section 4.2.3.

• Test Procedure
  1. A connection is established between the IUT and Lower Tester using the Preamble defined in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport.
  2. IUT writes the Start Offset Compensation Op Code (0x0C) to the Cycling Power Control Point with no Parameter.
  3. The Lower Tester sends an indication of the Cycling Power Control Point characteristic with the Response Code Op Code (0x20) and a Parameter representing the Request Op Code (0x0C), the Response Code for ‘success’ (0x01) followed by the Response Parameter representing the value of the offset before the offset is compensated (SINT16) in Newton meters with a resolution of 1/32 Newton meter.
4. The IUT sends ATT_Handle_Value_Confirmation to the Lower Tester.

- Expected Outcome
  Pass verdict

The IUT receives valid offset value and interprets the unit correctly, based on the Sensor Measurement Context bit of the Cycling Power Measurement context.

4.8 Service Procedure – Mask Characteristic Content

4.8.1 CPP/COL/SPM/BV-01-I [Mask Cycling Power Measurement Characteristic Content]

- Test Purpose
  Verify that the Collector IUT can perform the Mask Cycling Power Measurement Characteristic Content procedure.

- Reference
  [3] 4.7.2.13

- Initial Condition
  Perform the preamble described in Section 4.2.3.

- Test Procedure
  1. A connection is established between the IUT and Lower Tester using the Preamble defined in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport.
  2. IUT writes the Mask Cycling Power Measurement Characteristic Content Op Code (0x0D) to the Cycling Power Control Point with a Parameter Value set to a valid mask value (UINT16).
  3. The Lower Tester sends an indication of the Cycling Power Control Point characteristic with the Response Code Op Code (0x20) and a Parameter representing Request Op Code (0x0D) followed by the Response Code for ‘success’ (0x01).
  4. The IUT sends ATT_Handle_Value_Confirmation to the Lower Tester.
  5. The Lower Tester sends one or more ATT_Handle_Value_Notifications of the Cycling Power Measurement characteristic with the masked fields not present.

- Expected Outcome
  Pass verdict

The mask value is updated with the correct value.

The IUT receives the Request Op Code ‘success’.

4.9 Service Procedure – Enhanced Offset Compensation

4.9.1 CPP/COL/SPO/BV-03-I [Start Enhanced Offset Compensation – Force Based CP Sensor]

- Test Purpose
Verify that the Collector IUT can perform the Start Enhanced Offset Compensation procedure and interpret correctly the Response Parameter from a Force-based CP Sensor.

- **Reference**
  
  [3] 4.7.2.16

- **Initial Condition**

  Perform the preamble described in Section 4.2.3.

  The IUT has read the Cycling Power Feature characteristic showing that the CP Sensor is Force Based.

- **Test Procedure**

  1. A connection is established between the IUT and Lower Tester using the Preamble defined in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport.

  2. IUT writes the Start Enhanced Offset Compensation Op Code (0x10) to the Cycling Power Control Point with no Parameter.

  3. The Lower Tester sends an indication of the Cycling Power Control Point characteristic with the Response Code Op Code (0x20) and a Parameter representing the Request Op Code (0x10), the Response Code for ‘success’ (0x01) followed by the Response Parameter representing the value of the offset before the offset is compensated (SINT16) in Newtons with a resolution of 1 Newton followed by a UINT16 value representing the manufacturer Company ID as given in the SIG assigned numbers (e.g. 0x003F for Bluetooth SIG), a UINT8 representing the number of octets (e.g. 0x03) of manufacturer specific data (e.g. Analog to Digital Conversion data), and the corresponding manufacturer specific data in the Response Parameter (e.g. 0x123456).

  4. The IUT sends ATT_Handle_Value_Confirmation to the Lower Tester.

- **Expected Outcome**

  **Pass verdict**

  The IUT receives valid offset value and interprets the unit correctly, based on the Sensor Measurement Context bit of the Cycling Power Measurement context. The IUT may ignore the manufacturer specific data included in the Response Parameter.

### 4.9.2 CPP/COL/SPO/BV-04-I [Start Enhanced Offset Compensation – Torque Based CP Sensor]

- **Test Purpose**

  Verify that the Collector IUT can perform the Start Enhanced Offset Compensation procedure and interpret correctly the Response Parameter from a Torque-based CP Sensor.

- **Reference**

  [3] 4.7.2.16

- **Initial Condition**

  Perform the preamble described in Section 4.2.3.
The IUT has read the Cycling Power Feature characteristic showing that the CP Sensor is Torque Based.

• Test Procedure
  1. A connection is established between the IUT and Lower Tester using the Preamble defined in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport.
  2. IUT writes the Start Enhanced Offset Compensation Op Code (0x10) to the Cycling Power Control Point with no Parameter.
  3. The Lower Tester sends an indication of the Cycling Power Control Point characteristic with the Response Code Op Code (0x20) and a Parameter representing the Request Op Code (0x10), the Response Code for ‘success’ (0x01) followed by the Response Parameter representing the value of the offset before the offset is compensated (SINT16) in Newton meters with a resolution of 1/32 Newton meter followed by a UINT16 value representing the manufacturer Company ID as given in the SIG assigned numbers (e.g. 0x003F for Bluetooth SIG), a UINT8 representing the number of octets (e.g. 0x03) of manufacturer specific data (e.g. Analog to Digital Conversion data), and the corresponding manufacturer specific data in the Response Parameter (e.g. 0x123456).
  4. The IUT sends ATT_Handle_Value_Confirmation to the Lower Tester.

• Expected Outcome
  Pass verdict

  The IUT receives valid offset value and interprets the unit correctly, based on the Sensor Measurement Context bit of the Cycling Power Measurement context. The IUT may ignore the manufacturer specific data included in the Response Parameter.

4.9.3  CPP/COL/SPO/BI-01-I [Start Enhanced Offset Compensation – Incorrect Calibration Position]

• Test Purpose
  Verify that the Collector IUT can perform the Start Enhanced Offset Compensation procedure and interpret correctly the Response Parameter when the CP Sensor is in an incorrect calibration position.

• Reference
  [3] 4.7.2.16

• Initial Condition
  Perform the preamble described in Section 4.2.3.

• Test Procedure
  1. A connection is established between the IUT and Lower Tester using the Preamble defined in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport.
  2. IUT writes the Start Enhanced Offset Compensation Op Code (0x10) to the Cycling Power Control Point with no Parameter.
  3. The Lower Tester sends an indication of the Cycling Power Control Point characteristic with the Response Code Op Code (0x20) and a Parameter representing the Request Op Code (0x10), the
Response Code for 'operation failed' (0x04) followed by the Response Parameter value set to Incorrect Calibration Position (0x01).

4. The IUT sends ATT_Handle_Value_Confirmation to the Lower Tester.

- Expected Outcome
  Pass verdict

  The IUT interprets the Response Code and the Response Parameter correctly.

4.9.4 CPP/COL/SPO/BI-02-I [Start Enhanced Offset Compensation – Manufacturer Specific Error]

- Test Purpose
  Verify that the Collector IUT can perform the Start Enhanced Offset Compensation procedure and interpret correctly the Response Parameter when the CP Sensor returns a Manufacturer Specific Error.

- Reference
  [3] 4.7.2.16

- Initial Condition
  Perform the preamble described in Section 4.2.3.

- Test Procedure
  1. A connection is established between the IUT and Lower Tester using the Preamble defined in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport.
  2. IUT writes the Start Enhanced Offset Compensation Op Code (0x10) to the Cycling Power Control Point with no Parameter.
  3. The Lower Tester sends an indication of the Cycling Power Control Point characteristic with the Response Code Op Code (0x20) and a Parameter representing the Request Op Code (0x10), the Response Code for 'operation failed' (0x04) followed by the Response Parameter value set to Manufacturer Specific Error (0xFF) followed by a UINT16 value representing the manufacturer Company ID as given in the SIG assigned numbers (e.g. 0x003F for Bluetooth SIG), a UINT8 representing the number of octets (e.g. 0x03) of manufacturer specific data (e.g. Analog to Digital Conversion data), and the corresponding manufacturer specific data in the Response Parameter (e.g. 0x123456).
  4. The IUT sends ATT_Handle_Value_Confirmation to the Lower Tester.

- Expected Outcome
  Pass verdict

  The IUT interprets the Response Code and the Response Parameter correctly. The IUT may ignore the manufacturer specific data included in the Response Parameter.

4.10 Service Procedures – General Error Handling

This test group contains test cases to verify compliant operation when an error is caused by the Server side.
### 4.10.1 CPP/COL/SPE/BI-01-C [Unsupported Op Code]

- **Test Purpose**
  Verify that the Collector IUT behaves appropriately when it receives an ‘Op Code not supported’ Cycling Power Control Point Response Code.

- **Reference**
  [3] 4.7.3

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

- **Test Procedure**
  1. A connection is established between the IUT and Lower Tester using the Preamble defined in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport.
  3. The Lower Tester sends an indication of the Cycling Power Control Point characteristic with the Response Code Op Code (0x20) and a Parameter representing Request Op Code followed by the Response Code Value for ‘Op Code not supported’ (0x02) (i.e. the Lower Tester simulates an unsupported Op Code).
  4. The IUT considers the procedure to have failed.

- **Expected Outcome**
  **Pass verdict**
  The IUT returns to stable state and can process commands normally.

- **Notes**
  The test case is to verify the IUT’s capability to handle an Op Code not supported response by the Sensor. This Sensor response may be provoked by the IUT writing an Op Code that is not supported by the responding compliant Sensor, or where the Sensor response to the IUT may be yielded by a test system that emulates that it does not support an Op Code.

### 4.10.2 CPP/COL/SPE/BI-02-C [Invalid Parameter]

- **Test Purpose**
  Verify that the Collector IUT behaves appropriately when it receives an ‘Invalid Parameter’ Cycling Power Control Point Response Code.

- **Reference**
  [3] 4.7.3

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

- **Test Procedure**
1. A connection is established between the IUT and Lower Tester using the Preamble defined in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport.

2. IUT writes the Update Sensor Location Op Code to the Cycling Power Control Point using any Sensor Location value.

3. The Lower Tester sends an indication of the Cycling Power Control Point characteristic with the Response Code Op Code (0x20) and a Parameter representing Request Op Code (0x02) followed by the Response Code Value for 'Invalid Parameter' (0x03) (i.e. the Lower Tester simulates an unsupported value).

   • Expected Outcome
     Pass verdict

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

4.10.3 CPP/COL/SPE/BI-03-C [Operation Failed]

   • Test Purpose
     Verify that the Collector IUT behaves appropriately when it receives an ‘Operation Failed’ Cycling Power Control Point Response Code.

   • Reference
     [3] 4.7.3

   • Initial Condition
     Perform the preamble described in Section 4.2.3.

   • Test Procedure
     1. A connection is established between the IUT and Lower Tester using the Preamble defined in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport.


     3. The Lower Tester sends an indication of the Cycling Power Control Point characteristic with the Response Code Op Code (0x20) and a Parameter representing Request Op Code followed by the Response Code Value for ‘Operation Failed’ (0x04) (i.e. the Lower Tester simulates a failed operation).

   • Expected Outcome
     Pass verdict

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

4.10.4 CPP/COL/SPE/BI-04-C [Cycling Power Control Point Procedure Timeout]

   • Test Purpose
     Verify that if the Collector IUT does not receive a response to a Cycling Power Control Point Op Code, it will time out after the Attribute Transaction Timeout.

   • Reference
[3] 4.7.4

• Initial Condition
  Perform the preamble described in Section 4.2.3.

• Test Procedure
  1. A connection is established between the IUT and Lower Tester using the Preamble defined in Section 4.2.4 if using an LE transport or 4.2.6 if using a BR/EDR transport.
  2. IUT writes any of the supported Op Codes to the Cycling Power Control Point using an appropriate Parameter for the Op Code.
  3. The Lower Tester does not send an indication of the Cycling Power Control Point characteristic for at least longer than the Attribute Protocol Timeout.
  4. After the specified timeout the IUT sends a notification of Attribute Transaction Timeout to the Upper Tester and the IUT considers the procedure to have failed.

• Expected Outcome
  Pass verdict

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

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 Cycling Power Profile [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.

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<td>CPP 10/21 AND CPP 11/19</td>
<td>Request Span Length</td>
<td>CPP/COL/SPP/BV-10-I</td>
<td></td>
</tr>
<tr>
<td>CPP 10/26 AND CPP 11/22</td>
<td>Request Factory Calibration Date</td>
<td>CPP/COL/SPP/BV-11-I</td>
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<tr>
<td>CPP 10/25 AND CPP 11/22</td>
<td>Request Sampling Rate</td>
<td>CPP/COL/SPP/BV-12-I</td>
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<tr>
<td>CPP 10/23 AND CPP 11/20</td>
<td>Start Offset Compensation</td>
<td>CPP/COL/SPO/BV-01-I, CPP/COL/SPO/BV-02-I</td>
<td></td>
</tr>
<tr>
<td>CPP 10/24 AND CPP 11/21</td>
<td>Mask Characteristic Content</td>
<td>CPP/COL/SPM/BV-01-I</td>
<td></td>
</tr>
<tr>
<td>CPP 11/6 AND CPP 11/7</td>
<td>Write to SC Control Point characteristic and Receive SC Control Point characteristic indications</td>
<td>CPP/COL/SPE/BV-01-C, CPP/COL/SPE/BV-02-C, CPP/COL/SPE/BV-03-C</td>
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<tr>
<td>CPP 11/24</td>
<td>SC Control Point Characteristic – Procedure Time Out</td>
<td>CPP/COL/SPE/BV-04-C</td>
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<tr>
<td>CPP 0/2 AND CPP 10/3</td>
<td>Receive Cycling Power Measurement characteristic notifications from a Distributed Power System</td>
<td>CPP/COL/CPF/BV-36-I, CPP/COL/CPF/BV-37-I, CPP/COL/CPF/BV-38-I</td>
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<tr>
<td>CPP 0/2 AND CPP 10/3 AND CPP 10/4</td>
<td>Receive Cycling Power Measurement characteristic notifications from 2 Legacy sensors</td>
<td>CPP/COL/CPF/BV-41-I</td>
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<tr>
<td>CPP 0/2 AND CPP 10/3 AND CPP 10/4</td>
<td>Calculates Total Instantaneous Power from 2 sensors which can be used in a distributed power system</td>
<td>CPP/COL/CPF/BV-39-I</td>
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<tr>
<td>CPP 0/2 AND CPP 10/3 AND CPP 10/5</td>
<td>Calculates Power Balance from 2 sensors which can be used in a distributed power system</td>
<td>CPP/COL/CPF/BV-40-I</td>
<td></td>
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<tr>
<td>CPP 11/28</td>
<td>Enhanced Offset Compensation</td>
<td>CPP/COL/SPO/BV-03-I, CPP/COL/SPO/BV-04-I, CPP/COL/SPO/BV-01-I, CPP/COL/SPO/BV-02-I</td>
<td></td>
</tr>
</tbody>
</table>

*Table 5.1: Test Case Mapping*