Environmental Sensing Profile (ESP)

Bluetooth® Test Specification

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- **Group Prepared By:** BTI
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**Abstract:**
This document defines test structures and procedures for conformance test of products implementing the Bluetooth Environmental Sensing Profile Specification.
### Revision History

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<tr>
<th>Revision Number</th>
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1 Scope

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

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

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

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

2.2 Definitions
For the purpose of this Bluetooth document, the definitions from [1], [2] and [6] apply.

2.3 Acronyms and Abbreviations
For the purpose of this Bluetooth document, the abbreviations from [1], [2] and [6] apply.

ES = Environmental Sensing

ESS = Environmental Sensing Service
3  Test Suite Structure (TSS)

3.1  Overview

The Environmental Sensing Profile requires the presence of GAP, ATT and GATT. Where the LE transport is used, SM is also required. Where the BR/EDR transport is used, SDP is also required. This is illustrated in Figure 3.1.

![Figure 3.1: Environmental Sensing Test Model](image)

Supporting the Battery Service and Device Information Service is optional for the Collector and for the Environmental Sensor.

3.2  Test Strategy

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

The 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 Environmental Sensing Profile Test Specification. For some test cases, it is necessary to stimulate the IUT from an Upper Tester. In practice, this could be implemented as a special test interface, an MMI, or another interface supported by the IUT.

The Environmental Sensing 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, Characteristics and Characteristic Descriptors**
  
  This group tests that the IUT is able to discover the supported services and their associated characteristics and characteristic descriptors.

- **Read Characteristics and Characteristic Descriptors**
  
  This group tests that the IUT is able to read the supported characteristics and their associated characteristic descriptors.

- **Write Characteristics and Characteristic Descriptors**
  
  This group tests that the IUT is able to write to the writable characteristics and characteristic descriptors for which support is indicated.

- **Environmental Sensing Features**
  
  This group tests IUT implementation of Environmental Sensing Profile Features.

- **Service Procedures**
  
  This group tests the operation of additional procedures defined in the service specification such as error procedures.
4 Test Cases (TC)

4.1 Introduction

4.1.1 Test Case Identification Conventions

Test cases shall be assigned unique identifiers per the conventions in [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 ID parts (if applicable) shall appear between the bolded parts. The order of the non-bolded parts may vary from test specification to test specification, but shall be consistent within each individual test specification.

<table>
<thead>
<tr>
<th>Identifier Abbreviation</th>
<th>Spec Identifier &lt;spec abbreviation&gt;</th>
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<tr>
<td>ESP</td>
<td>Environmental Sensing Profile</td>
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<tr>
<th>Identifier Abbreviation</th>
<th>Role Identifier &lt;IUT role&gt;</th>
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<td>SEN</td>
<td>Environmental Sensor Role</td>
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<td>COL</td>
<td>Collector Role</td>
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<tr>
<th>Identifier Abbreviation</th>
<th>Feature Identifier &lt;feat&gt;</th>
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<td>ESD</td>
<td>Discovery of Services, Characteristics and Characteristic Descriptors</td>
</tr>
<tr>
<td>ESF</td>
<td>Environmental Sensing Features</td>
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<tr>
<td>ESR</td>
<td>Reading of Characteristics and Characteristic Descriptors</td>
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<tr>
<td>ESW</td>
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<tr>
<td>SEN</td>
<td>Environmental Sensor Role</td>
</tr>
<tr>
<td>SPE</td>
<td>Service Procedure – Error Handling</td>
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Table 4.1: Environmental Sensing Profile TC Feature Naming Convention

4.1.2 Conformance

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

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

• That claimed capabilities may be used in any order and any number of repetitions that is not excluded by the Specification, OR
• That capabilities enabled by the implementations are sustained over durations expected by the use case, OR
• That the implementation gracefully handles any quantity of data expected by the use case, OR
• That in cases where more than one valid interpretation of the Specification exist, the implementation complies with at least one interpretation and gracefully handles other interpretations OR
• That the implementation is immune to attempted security exploits.

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

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

4.1.3 Pass/Fail Verdict Conventions

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

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

4.2 Setup Preambles

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

4.2.1 Set up LE Transport

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

4.2.2 Set up BR/EDR Transport


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

• Preamble Purpose

This LE preamble procedure specifies how the Collector IUT scans for Environmental Sensor connectable advertisements.

• Reference

[3] 5.2
[2] GAP 9.3.3 and GAP 9.3.4
• Preamble Procedure

1. Configure the Collector IUT to accept commands from the Upper Tester to receive data from the Environmental Sensor (Lower Tester).
2. The Upper Tester commands the Collector IUT to initiate a connection and the IUT starts scanning.
3. The Environmental Sensor (Lower Tester) advertises to the Collector IUT either using:
   - ALT 1: GAP Directed Connectable Mode (send ADV_DIRECT_IND packets), if receipt of directed advertising is supported by the Collector IUT,
   or
   - ALT 2: GAP Undirected Connectable Mode (send ADV_IND packets).
4. The Lower Tester waits for responses from the Collector IUT.
5. The Collector IUT sends a CONNECT_REQ and an optionally empty PDU to the Lower Tester.

### 4.2.4 BR/EDR Collector

#### 4.2.4.1 Unbonded Devices

• Preamble Purpose

This BR/EDR preamble procedure specifies how the Collector IUT scans for the Environmental Sensor.

• Reference

[3] 5.3
[2] GAP 4.1 and GAP 4.2

• Preamble Procedure
1. Configure the Collector IUT to accept commands to receive data from the Environmental Sensor (Lower Tester).
2. Put the Environmental Sensor in General Discoverable or Limited Discoverable mode.
3. The Upper Tester commands the Collector IUT to initiate a connection and the IUT starts scanning.
4. The Environmental Sensor (Lower Tester) exposes the SDP record for the Environmental Sensing Service.
5. The Collector IUT validates the SDP record and establishes a connection to the Environmental Sensor.
6. The Collector IUT uses the GAP General Discovery or GAP Limited Discovery procedure to discover and establish a connection to an Environmental Sensor.

### 4.2.4.2 Bonded Devices

- **Preamble Purpose**
  
  In case of BR/EDR, either an Environmental Sensor or Collector could initiate connection when they are bonded. The device initiating the connection becomes a Master and is referred here as “Master to be” and the device accepting the connection becomes a Slave and is referred here as “Slave to be”.
  
  This BR/EDR preamble procedure specifies how a “Master to be” connects to “Slave to be”.

- **Reference**
  
  [3] 5.3
  [2] GAP 4.1 and GAP 4.2

- **Preamble Procedure**
  
  1. Configure the Collector IUT to accept commands to receive data from the Environmental Sensor (Lower Tester).
  2. Put the “Slave to be” in connectable mode to accept a connection from the “Master to be”.
  3. The connection is initiated by “Master to be”.
  4. The “Slave to be” exposes the SDP record for the Environmental Sensing Service.
  5. The “Master to be” validates the SDP record and establishes a connection to the “Slave to be”.
  6. The “Master to be” uses the GAP Link Establishment Procedure to connect to any bonded device.

### 4.3 Discover Services, Characteristics and Characteristic Descriptors

The procedures defined in this test group verify IUT’s ability to discover the services, characteristics and characteristic descriptors exposed by an Environmental Sensor (Lower Tester).

#### 4.3.1 ESP/COL/ESD/BV-01-I [Discover Environmental Sensing Service over LE]

- **Test Purpose**
  
  Verify that the Environmental Sensing 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 connection to an Environmental Sensor included in Section 4.2.3.

The Lower Tester exposes one instantiation of the Environmental Sensing 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] or
  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 “Environmental Sensing 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.

Verify that the attribute handle range discovered by the IUT, contains the starting handle and the ending handle of the instantiation of an Environmental Sensing Service definition.

4.3.2 ESP/COL/ESD/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 connection to an Environmental Sensor included in Section 4.2.3.

  The Lower Tester exposes 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:
  1. The IUT executes the procedure included in GATT.TS [5] Discover All Primary Services, GATT/CL/GAD/BV-01-C once, with the database specified in [8] implemented in the Lower Tester or

- Expected Outcome
  Pass verdict

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

4.3.3 ESP/COL/ESD/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 connection to an Environmental Sensor included in Section 4.2.3.

  The Lower Tester exposes 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:

1. The IUT executes the procedure included in GATT.TS [5] Discover All Primary Services, GATT/CL/GAD/BV-01-C once, with the database specified in [9] implemented in the Lower Tester or


- Expected Outcome
  Pass verdict

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

4.3.4 ESP/COL/ESD/BV-04-I [SDP Service Discovery]

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

- Reference
Environmental Sensing Profile (ESP) / Test Specification

[3] 4.2

• Initial Condition
  An ACL connection over BR/EDR is established between the Lower Tester and IUT.

• Test Procedure
  1. Induce the IUT to establish 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 Environmental Sensing Service is retrieved.
  Optionally, the SDP record for the Device Information Service is retrieved.
  Optionally, the SDP record for the Battery Service is retrieved.

4.3.5 ESP/SEN/ESD/BV-05-I [Environmental Sensing Service not discoverable over BR/EDR]

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

• Reference
  [3] 2.5, 4.2

• Initial Condition
  The IUT includes one instantiation of the Environmental Sensing 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 uses the SDP Service Discovery procedure to discover the services supported by the IUT over BR/EDR.

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

4.3.6 ESP/COL/ESD/BV-06-I [Discover ESS Characteristic]

• Test Purpose
  Verify that all ESS Characteristics that are supported by the Collector IUT are discovered.

• Reference
  [3] 4.3.1
Initial Condition

Via the ICS [4], the IUT manufacturer specifies which ESS Characteristics are supported by the IUT.

Establish an ATT Bearer connection between the Lower Tester and IUT, running the preamble procedure for the Collector to initiate connection to an Environmental Sensor as described in Section 4.2.3 if using a LE transport or Section 4.2.4 if using a BR/EDR transport.

The Lower Tester includes one instantiation of the Environmental Sensing Service [6] including all defined characteristics.

This instantiation also contains one «future» characteristic. The «future» characteristic is a 16-bit UUID randomly selected from unassigned UUID’s at the time of the test.

There are at least two instances of an ESS Characteristic with the same UUID. The UUID of the ESS Characteristic of which multiple instances are exposed is a UUID that is supported by the Collector IUT. Each instance of this ESS Characteristic also has an ES Measurement descriptor associated with it.

The instances of the ESS Characteristic with the same UUID are distinguishable from each other by means of their ES Measurement descriptors which have different values in at least one field (e.g. the Application field defines one sensor location as ‘Upper’ (0x0F) and the other as ‘Lower’ (0x10)).

The IUT has previously discovered the Environmental Sensing Service and has saved the handle range for an instantiation of the Environmental Sensing Service. Service discovery was done by using the GATT method in ESP/COL/ESD/BV-01-I [Discover Environmental Sensing Service over LE] for LE, or using the SDP method in ESP/COL/ESD/BV-04-I [SDP Service Discovery] for BR/EDR.

Test Procedure

1. The Upper Tester issues a command to the IUT to discover ESS Characteristics.
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 Environmental Sensing Service, or Discover Characteristics by UUID, GATT/CL/GAD/BV-05-C, with the specified handle range for the instantiation of the Environmental Sensing Service and UUID set to a specific ESS Characteristic UUID. In the selected procedure, only one pass is needed with the server database defined in Initial Condition.

Expected Outcome

Pass verdict

For each instance of the ESS Characteristics exposed by the Lower Tester that is supported by the Collector IUT according to its ICS [4], verify that an Attribute handle/value pair discovered by the IUT contains a valid UUID with the appropriate property and handle.

If the Discover All Characteristics of a Service sub-procedure was used by the IUT, one handle/value pair may also be returned for the Descriptor Value Changed characteristic.

4.3.7 ESP/COL/ESD/BV-07-I [Discover ESS Characteristic – Characteristic Descriptors]

Test Purpose

Verify that the Collector IUT can discover the characteristic descriptors associated with an ESS Characteristic.
• Reference
  [3] 4.3.1

• Initial Condition
Via the ICS [4], the IUT manufacturer specifies which ESS Characteristics and associated characteristic descriptors are supported by the IUT.

Establish an ATT Bearer connection between the Lower Tester and IUT, running the preamble procedure for the Collector to initiate connection to an Environmental Sensor as described in Section 4.2.3 if using a LE transport or Section 4.2.4 if using a BR/EDR transport.

The Lower Tester includes one instantiation of the Environmental Sensing Service [6] in which at least three ESS Characteristics are exposed. These include two instances of an ESS Characteristic with the same UUID. The UUID of the ESS Characteristic of which multiple instances are exposed is a UUID that is supported by the Collector IUT.

The Lower Tester exposes all of the following characteristic descriptors for each instance of an ESS Characteristic:

- one instance of the ES Measurement descriptor
- one instance of the Client Characteristic Configuration descriptor
- three instances of the ES Trigger Setting descriptor
- one instance of the ES Configuration descriptor
- one instance of the Characteristic User Description descriptor
- one instance of the Valid Range descriptor

The instances of the ESS Characteristic with the same UUID are distinguishable from each other by means of their ES Measurement descriptors which have different values in at least one field (e.g. the Application field defines one sensor location as ‘Upper’ (0x0F) and the other as ‘Lower’ (0x10)).

The IUT has discovered the handle range of each ESS Characteristic.

• Test Procedure
1. The Upper Tester issues a command to the IUT to Discover All Characteristic Descriptors using the handle range of the ESS 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

For each instance of an ESS Characteristic exposed by the Lower Tester that are supported by the Collector IUT according to its ICS [4]:

- One attribute handle/value pair is returned containing the UUID «ES Measurement».
- One attribute handle/value pair is returned containing the UUID «Client Characteristic Configuration», if supported by the Collector IUT.
Three attribute handle/value pairs are returned containing the UUID «ES Trigger Setting», if supported by the Collector IUT.

One attribute handle/value pair is returned containing the UUID «ES Configuration», if supported by the Collector IUT.

One attribute handle/value pair is returned containing the UUID «Characteristic User Description», if supported by the Collector IUT.

One attribute handle/value pair is returned containing the UUID «Valid Range», if supported by the Collector IUT.

The Collector IUT associates the discovered characteristic descriptors with the correct instance of the ESS Characteristic in every case.

4.3.8 ESP/COL/ESD/BV-08-I [Discover Descriptor Value Changed Characteristic]

- **Test Purpose**
  Verify that a Descriptor Value Changed 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 connection to an Environmental Sensor included in the Section 4.2.3 if using an LE transport or 4.2.4 if using a BR/EDR transport.

  The Lower Tester includes one instantiation of the Environmental Sensing Service [6] including all defined characteristics. This instantiation also contains one «future» characteristic.

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

  The IUT has discovered the Environmental Sensing Service and has saved the handle range for an instantiation of the Environmental Sensing Service. That instantiation contains an instantiation of the Descriptor Value Changed characteristic. This was done by previously using the GATT method in ESP/COL/ESD/BV-01-I [Discover Environmental Sensing Service over LE] for LE, or using the SDP method in ESP/COL/ESD/BV-04-I [SDP Service Discovery] for BR/EDR.

- **Test Procedure**
  1. The Upper Tester issues a command to the IUT to discover the Descriptor Value Changed characteristic.
  2. The IUT executes either of the procedures included in GATT.TS [5]: Discover All Characteristic of a Service, GATT/CL/GAD/BV-04-C, with the specified handle range for the instantiation of the Environmental Sensing Service, or Discover Characteristic by UUID, GATT/CL/GAD/BV-05-C, with the specified handle range for the instantiation of the Environmental Sensing Service and UUID set to «Descriptor Value Changed».

- **Expected Outcome**
  Pass verdict
Verify that the attribute handle/value pair discovered by the IUT contains the UUID «Descriptor Value Changed» characteristic with the appropriate property and handle.

4.3.9 **ESP/COL/ESD/BV-09-I [Discover Descriptor Value Changed – Client Characteristic Configuration Descriptor]**

- **Test Purpose**
  Verify that the Collector IUT can discover the Client Characteristic Configuration descriptor of the Descriptor Value Changed 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 connection to an Environmental Sensor included in the Section 4.2.3 if using an LE transport or 4.2.4 if using a BR/EDR transport.

  The Lower Tester includes one instantiation of the Environmental Sensing Service [6] in which the Descriptor Value Changed characteristic and an associated Client Characteristic Configuration descriptor are exposed.

  The IUT has discovered the handle range of the Descriptor Value Changed 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

    Verify that the attribute handle/value pair discovered by the IUT contains the UUID «Client Characteristic Configuration».

4.3.10 **ESP/COL/ESD/BV-10-I [Discover Device Information Service Characteristics]**

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

- **Reference**
  [3] 4.3.2

- **Initial Condition**
All characteristics of the Device Information Service supported by the IUT are specified in the IXIT [12].

Run the preamble procedure to enable the Collector to initiate connection to an Environmental Sensor included in Section 4.2.3 if using an LE transport or 4.2.4 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 has a 16-bit UUID randomly selected from unassigned UUIDs at the time of the test.

The IUT has discovered the handle range for the instantiation of the Device Information Service contained in the Lower Tester. The Device Information Service contains one or more characteristics. DIS was previously discovered using the GATT method in ESP/COL/ESD/BV-02-I [Discover Device Information Service over LE] for LE, or using the SDP method in ESP/COL/ESD/BV-04-I [SDP Service Discovery] for BR/EDR.

**Test Procedure**

1. The IUT executes the procedure included in GATT.TS [5] Discover All Characteristics of a Service, GATT/CL/GAD/BV-04-C, using the specified handle range, with the Lower Tester instantiating the database specified in the Initial Condition

or

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, as specified in the IXIT [12], the IUT shall report an attribute handle/value pair to the Upper Tester.

**4.3.11 ESP/COL/ESD/BV-11-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 the ICS [4], the IUT manufacturer specifies all characteristics of the Battery Service supported by
the IUT.

Run the preamble procedure to enable the Collector to initiate connection to an Environmental
Sensor included in Section 4.2.3 if using an LE transport or 4.2.4 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:

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

The «future» characteristic has 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 the GATT method in ESP/COL/ESD/BV-03-I [Discover Battery Service over LE] for LE, or using
the SDP method in ESP/COL/ESD/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 Battery Service
supported by the IUT. There are two alternatives:

1. The IUT executes the procedure included in GATT.TS [5] Discover All Characteristics of a
   Service, GATT/CL/GAD/BV-04-C, using the specified handle range, with the Lower Tester
   instantiating the database specified in the Initial Condition

or

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
   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, as specified in the ICS [4], the IUT shall report an attribute handle/value pair to the
Upper Tester.

4.4 Read Characteristics and Characteristic Descriptors

The procedures defined in this test group verify the IUT’s ability to read characteristics and characteristic
descriptors exposed by an Environmental Sensor (Lower Tester).

4.4.1 ESP/COL/ESR/BV-01-I [Read ESS Characteristic]

• Test Purpose

Verify that the Collector IUT can read the ESS Characteristic from an Environmental Sensor.
• Reference
[3] 4.4

• Initial Condition
Via the ICS [4], the IUT manufacturer specifies which ESS Characteristics are supported by the IUT.

A preamble procedure defined in Section 4.2.3 if using an LE transport or 4.2.4, if using a BR/EDR transport, is used to setup the transport and L2CAP channel and initiate connection to an Environmental Sensor.

The Upper Tester knows the handle of an ESS Characteristic contained in the Lower Tester.

• Test Procedure
1. Send a command from Upper Tester to request IUT to read an ESS Characteristic from the Lower Tester e.g., ESP_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 ESS Characteristic.
3. Repeat steps 1-2 for each ESS Characteristic supported by the Collector IUT according to its ICS [4].

• Expected Outcome
Pass verdict

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

For each, the IUT receives the response from the Lower Tester and sends the ESP_ReadResponse containing the correct ESS Characteristic value to the Upper Tester.

If measurement units (e.g. kg, meters) are provided by the Collector IUT, these meet the requirements of the service and any scaling factors are correctly applied.
### 4.4.2 ESP/COL/ESR/BV-02-I [Read ES Measurement Descriptor]

- **Test Purpose**
  
  Verify that the Collector IUT can read the ES Measurement descriptor of an ESS Characteristic in an Environmental Sensor.

- **Reference**
  
  [3] 4.4.1

- **Initial Condition**

  Via the ICS [4], the IUT manufacturer specifies which ESS Characteristics are supported by the IUT.

  For test purposes, one of the supported ESS Characteristics has an ES Measurement descriptor that contains a RFU value in one of its fields (e.g. a RFU bit in the Flags field is set to 1) while the remaining fields contain valid values.

  A preamble procedure defined in Section 4.2.3 if using an LE transport or 4.2.4 if using a BR/EDR transport is used to setup the transport and L2CAP channel and initiate connection to an Environmental Sensor.

  The Upper Tester knows the handle of an ESS Characteristic and of its ES Measurement descriptor contained in the Lower Tester.

- **Test Procedure**

  1. Send a command from Upper Tester to request IUT to read the ES Measurement descriptor of an ESS Characteristic from the Lower Tester e.g., `ESP_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 ES Measurement descriptor of the ESS Characteristic.

  3. Repeat steps 1-2 for the ES Measurement descriptor of each ESS Characteristic supported by the Collector IUT according to its ICS [4].

- **Expected Outcome**

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

For each, the IUT receives the response from the Lower Tester and sends the ESP_ReadResponse containing the correct ES Measurement descriptor value to the Upper Tester.

The RFU value is ignored and the other fields of the ES Measurement descriptor are read as if the RFU value had been set to 0. It is permissible for the field that contained the RFU value to be reported by the Collector IUT as unspecified or not in use or for the field to be hidden from the user.

4.4.3 ESP/COL/ESR/BV-03-I [Read ES Trigger Setting Descriptor]

- Test Purpose
  Verify that the Collector IUT can read the ES Trigger Setting descriptor(s) of an ESS Characteristic in an Environmental Sensor.

- Reference
  [3] 4.4.2

- Initial Condition
  Via the ICS [4], the IUT manufacturer specifies which ESS Characteristics are supported by the IUT.

  A preamble procedure defined in Section 4.2.3 if using an LE transport or 4.2.4 if using a BR/EDR transport is used to setup the transport and L2CAP channel and initiate connection to an Environmental Sensor.

  The Upper Tester knows the handle of an ESS Characteristic and of three ES Trigger Setting descriptors associated with the ESS Characteristic, contained in the Lower Tester.

  For test purposes, one of the supported ESS Characteristics has an ES Trigger Setting descriptor that contains a RFU value in its Condition field. The remaining ES Trigger Setting descriptors contain valid values.

- Test Procedure
  1. Send a command from Upper Tester to request IUT to read an ES Trigger Setting descriptor of an ESS Characteristic from the Lower Tester e.g., ESP_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 requested ES Trigger Setting descriptor of the ESS Characteristic.
  3. Repeat steps 1-2 for each ES Trigger Setting descriptor, for each ESS Characteristic supported by the Collector IUT according to its ICS [4].
### Expected Outcome

**Pass verdict**

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

For each, the IUT receives the response from the Lower Tester and sends the `ESP_ReadResponse` containing the correct ES Trigger Setting descriptor value to the Upper Tester.

The IUT tolerates the RFU value in a manner meeting the requirements of the service and the IUT continues to function normally. The IUT may treat the affected trigger setting information as unavailable due to the presence of the RFU value – this is an acceptable outcome.

#### 4.4.4 ESP/COL/ESR/BV-04-I [Read ES Configuration Descriptor]

**Test Purpose**

Verify that the Collector IUT can read the ES Configuration descriptor of an ESS Characteristic in an Environmental Sensor.

**Reference**

[3] 4.4.2

**Initial Condition**

Via the ICS [4], the IUT manufacturer specifies which ESS Characteristics are supported by the IUT.

A preamble procedure defined in Section 4.2.3 if using an LE transport or 4.2.4 if using a BR/EDR transport is used to setup the transport and L2CAP channel and initiate connection to an Environmental Sensor.

The Upper Tester knows the handle of an ESS Characteristic and of its ES Configuration descriptor contained in the Lower Tester.

**Test Procedure**
1. Send a command from the Upper Tester to request the IUT to read the ES Configuration descriptor of an ESS Characteristic from the Lower Tester e.g. *ESP_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 the value 0x01 (Boolean OR) for the ES Configuration descriptor of the ESS Characteristic.

3. Verify the value received by the IUT.

4. Send a command from the Upper Tester to request the IUT to read the same ES Configuration descriptor again from the Lower Tester e.g. *ESP_ReadRequest* (handle, value).

5. 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 an RFU value for the ES Configuration descriptor of the ESS Characteristic.

6. Verify the value received by the IUT.

7. Repeat steps 1-3 for the ES Configuration descriptor of each ESS Characteristic supported by the Collector IUT according to its ICS [4].

### **Expected Outcome**

**Pass verdict**

For each ESS Characteristic supported:

In step 1 and step 4, the IUT sends a correctly formatted *ATT_Read_Request* (0x0A) to the Lower Tester, containing the handle specified by the Upper Tester.

In step 2 and step 5, the IUT receives the response from the Lower Tester and sends the *ESP_ReadResponse* containing the correct ES Configuration descriptor value to the Upper Tester.

In step 6, the IUT tolerates the RFU value in a manner meeting the requirements of the service and the IUT continues to function normally. The IUT may treat the affected trigger setting information as unavailable in the presence of the RFU value – this is an acceptable outcome.

### 4.4.5 ESP/COL/ESR/BV-05-I [Read Characteristic User Description Descriptor]

**Test Purpose**
Verify that the Collector IUT can read the Characteristic User Description descriptor(s) of an ESS Characteristic in an Environmental Sensor.

- **Reference**
  
  [3] 4.4.3

- **Initial Condition**

  Via the ICS [4], the IUT manufacturer specifies which ESS Characteristics are supported by the IUT and their respective Characteristic User Description descriptor.

  A preamble procedure defined in Section 4.2.3 if using an LE transport or 4.2.4 if using a BR/EDR transport is used to setup the transport and L2CAP channel and initiate connection to an Environmental Sensor.

  The Upper Tester knows the handle of an ESS Characteristic and of its Characteristic User Description descriptor contained in the Lower Tester.

  The length of the Characteristic User Description descriptor value used in this test case is sufficiently short such that its value can be read in its entirety using the GATT Read Characteristic Descriptors sub-procedure when the default ATT_MTU size is used.

- **Test Procedure**

  1. Send a command from Upper Tester to request IUT to read the Characteristic User Description descriptor of an ESS Characteristic from the Lower Tester e.g. ESP_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 Characteristic User Description descriptor of the ESS Characteristic.

  3. Repeat steps 1-2 for the Characteristic User Description descriptor of each ESS Characteristic supported by the Collector IUT according to its ICS [4].

- **Expected Outcome**

  Pass verdict
For each, the IUT sends a correctly formatted \textit{ATT\_Read\_Request} (0x0A) to the Lower Tester, containing the handle specified by the Upper Tester.

For each, the IUT receives the response from the Lower Tester and sends the \textit{ESP\_Read\_Response} containing the correct Characteristic User Description descriptor value to the Upper Tester.

\textbf{4.4.6 ESP/COL/ESR/BV-06-I [Read Long Characteristic User Description Descriptor]}

\begin{itemize}
  \item Test Purpose
  
  Verify that the Collector IUT can read the Characteristic User Description descriptor(s) of an ESS Characteristic in an Environmental Sensor when the length of the characteristic descriptor requires the GATT Read Long procedure to be used.

  \item Reference
  
  [3] 4.4.3

  \item Initial Condition
  
  Via the ICS [4], the IUT manufacturer specifies which ESS Characteristics are supported by the IUT.

  A preamble procedure defined in Section 4.2.3 if using an LE transport or 4.2.4 if using a BR/EDR transport is used to setup the transport and L2CAP channel and initiate connection to an Environmental Sensor.

  The Upper Tester knows the handle of an ESS Characteristic and of its Characteristic User Description descriptor contained in the Lower Tester.

  For the purposes of this test case, the Lower Tester does not permit an ATT\_MTU size larger than the default ATT\_MTU size for LE to be negotiated.

  The length of the characteristic descriptor used in this test case is sufficiently long such that its value cannot be read in its entirety using the GATT Read Characteristic Descriptors sub-procedure when the default ATT\_MTU size is used, requiring the GATT Read Long Characteristic Descriptors sub-procedure to be used.

  The UTF-8 string value contained in the value of the Characteristic User Description descriptor to be read also includes some character values outside the ASCII printable range.

  \item Test Procedure
  
  1. Send a command from the Upper Tester to request the IUT to read the Characteristic User Description descriptor of an ESS Characteristic from the Lower Tester.


  3. Note that the first request may be an ATT\_Read Request; in that case the Lower Tester replies with an ATT\_Read\_Response.

  4. The IUT detects that the characteristic descriptor is long and sends one or more ATT\_Read\_Blob\_Requests until the IUT determines that it has read the complete characteristic descriptor value.

  5. The Lower Tester responds in each ATT transaction as shown in GATT.TS [5] GATT/CL/GAR/BV-07-C [Read Long Characteristic Descriptor - by client].
• Expected Outcome

Pass verdict

The ATT requests sent by the IUT include correctly formatted ATT_Read_Blob_Requests, containing the handle specified by the Upper Tester.

The IUT receives the responses from the Lower Tester and sends one ESP_ReadResponse containing the complete Characteristic User Description descriptor value to the Upper Tester.

The IUT reports the Characteristic User Description descriptor value correctly, in its entirety, including all the printable and non-printable ASCII values.

4.4.7 ESP/COL/ESR/BV-07-I [Read Valid Range Descriptor]

• Test Purpose

Verify that the Collector IUT can read the Valid Range descriptor(s) of an ESS Characteristic in an Environmental Sensor.

• Reference

[3] 4.4.4

• Initial Condition

Via the ICS [4], the IUT manufacturer specifies which ESS Characteristics are supported by the IUT.

A preamble procedure defined in Section 4.2.3 if using an LE transport or 4.2.4 if using a BR/EDR transport is used to setup the transport and L2CAP channel and initiate connection to an Environmental Sensor.

The Upper Tester knows the handle of an ESS Characteristic and of its Valid Range descriptor contained in the Lower Tester.

• Test Procedure

1. Send a command from Upper Tester to request IUT to read the Valid Range descriptor of an ESS Characteristic from the Lower Tester e.g. ESP_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 Valid Range descriptor of the ESS Characteristic.
3. Repeat steps 1-2 for the Characteristic User Description descriptor of each ESS Characteristic supported by the Collector IUT according to its ICS [4].
• Expected Outcome

Pass verdict

For each Valid Range descriptor to be read, the IUT sends a correctly formatted `ATT_Read_Request` (0x0A) to the Lower Tester, containing the handle specified by the Upper Tester.

For each request, the IUT receives the response from the Lower Tester and sends the `ESP_ReadResponse` containing the correct Valid Range descriptor value to the Upper Tester.

4.4.8 ESP/COL/ESR/BV-08-I [Read Device Information Service Characteristics]

• Test Purpose

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

• Reference

[3] 4.7

• Initial Condition

All characteristics of the Device Information Service supported by the IUT are specified in the IXIT [12].

Run the preamble procedure for the Collector to initiate connection to an Environmental Sensor included in Section 4.2.3 if using an LE transport or 4.2.4 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 ESP/COL/ESD/BV-10-I, so it has the handle/value pairs for all characteristics of the Device Information Service supported by the IUT.
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), the string shall initially include only character values in the ASCII printable range (i.e. 0x20 – 0x7E).

For the System ID characteristic, the Manufacturer Identifier shall be set to 0xFFFE9ABCDE and the Organizationally Unique Identifier shall be set to 0x123456.

For the IEEE 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 the 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.

**Test Procedure**

1. The Upper Tester issues a command to the IUT to read all characteristics of the Device Information Service supported by the IUT.
2. For each characteristic of the Device Information Service supported by the IUT, the IUT shall execute the procedure included in GATT.TS \[5\] GATT/CL/GAR/BV-01-C [Read Characteristic Value – by client].
3. Repeat steps 1-2 with the string-based characteristics changed to include character values outside the ASCII printable range.

**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 \[12\] 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 the IEEE 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 the PnP_ID characteristic, the Vendor ID Source, the Vendor ID, the Product ID and the Product Version.

### 4.4.9 ESP/COL/ESR/BV-09-I [Read Battery Level Characteristic]

**Test Purpose**

Verify that the Collector IUT can read the Battery Level characteristic from an Environmental Sensor.

**Reference**

\[3\] 4.8

**Initial Condition**

A preamble procedure defined in Section 4.2.3 if using an LE transport or 4.2.4 if using a BR/EDR transport is used to setup the transport and L2CAP channel and initiate connection to an Environmental 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 the IUT to read the Battery Level characteristic from the Lower Tester e.g., `ESP_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.

- **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 `ESP_ReadResponse` containing the correct Battery Level value to the Upper Tester.

### 4.5 Write Characteristics and Characteristic Descriptors

The procedures defined in this test group verify IUT’s ability to write the characteristic descriptors exposed by an Environmental Sensor (Lower Tester).

#### 4.5.1 ESP/COL/ESW/BV-01-I [Write ES Trigger Setting Descriptor]

- **Test Purpose**
  Verify that the Collector IUT can write one or more ES Trigger Setting descriptors of an ESS Characteristic in an Environmental Sensor.

- **Reference**
  [3] 4.4.2

- **Initial Condition**
A preamble procedure defined in Section 4.2.3 if using an LE transport or 4.2.4 if using a BR/EDR transport is used to setup the transport and L2CAP channel and initiate connection to an Environmental Sensor.

The Collector IUT and the Lower Tester are bonded.

The Upper Tester knows the handle of an ESS Characteristic and of its ES Trigger Setting descriptor(s) contained in the Lower Tester.

The ES Trigger Setting descriptor selected for the test permits writing.

- **Test Procedure**
  1. Send a command from the Upper Tester to request the IUT to write a new value to an ES Trigger Setting descriptor in the Lower Tester e.g., *ESP_WriteRequest* (handle, value).
  2. Note: the values that the Collector IUT is able to write to the ES Trigger Setting descriptor(s) depend on the implementation.
  3. After receipt of the expected result by the Lower Tester from the IUT, send an *ATT_Write_Response* (0x13) from the Lower Tester to the IUT.

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

  The IUT sends a correctly formatted *ATT_Write_Request* (0x12) to the Lower Tester, containing the correct handle and the new value that is to be written as specified by the Upper Tester.

  The IUT receives the response from the Lower Tester and sends the *ESP_WriteResponse* to the Upper Tester.

### 4.5.2 ESP/COL/ESW/BV-02-I [Write ES Configuration Descriptor]

- **Test Purpose**

  Verify that the Collector IUT can write the ES Configuration descriptor of an ESS Characteristic in an Environmental Sensor.
• Reference
  [3] 4.4.2

• Initial Condition
A preamble procedure defined in Section 4.2.3 if using an LE transport or 4.2.4 if using a BR/EDR transport is used to setup the transport and L2CAP channel and initiate connection to an Environmental Sensor.

The Collector IUT and the Lower Tester are bonded.

The Upper Tester knows the handle of an ESS Characteristic and its ES Configuration descriptor contained in the Lower Tester.

The ES Configuration descriptor selected for the test permits writing.

• Test Procedure
  1. Send a command from the Upper Tester to request the IUT to write a new value to an ES Configuration descriptor in the Lower Tester e.g., \textit{ESP\_WriteRequest} (handle, value).
  2. After receipt of the expected result by the Lower Tester from the IUT, send an \textit{ATT\_Write\_Response} (0x13) from the Lower Tester to the IUT.

• Expected Outcome
  
  **Pass verdict**

  The IUT sends a correctly formatted \textit{ATT\_Write\_Request} (0x12) to the Lower Tester, containing the correct handle and the new value that is to be written as specified by the Upper Tester.

  The IUT receives the response from the Lower Tester and sends the \textit{ESP\_WriteResponse} to the Upper Tester.

4.5.3 ESP/COL/ESW/BV-03-I [Write Characteristic User Description Descriptor]

• Test Purpose
Verify that the Collector IUT can write the Characteristic User Description descriptor of an ESS Characteristic in an Environmental Sensor when authenticated.

- Reference
  [3] 4.4.3

- Initial Condition
  A preamble procedure defined in Section 4.2.3 if using an LE transport or 4.2.4 if using a BR/EDR transport is used to setup the transport and L2CAP channel and initiate connection to an Environmental Sensor.

  The Upper Tester knows the handle of a Characteristic User Description descriptor contained in the Lower Tester.

  The Collector IUT has been authenticated by the Lower Tester.

  The Characteristic User Description descriptor selected for the test permits writing.

  The length of the Characteristic User Description descriptor value used in this test case is sufficiently short such that its value can be written in its entirety using the GATT Write Characteristic Descriptors sub-procedure when the default ATT_MTU size is used.

- Test Procedure
  1. Send a command from Upper Tester to request IUT to write the value of the Characteristic User Description descriptor of the ESS Characteristic to the Lower Tester e.g., ESP_WriteRequest (handle, value).
  2. After receipt of the expected result by the Lower Tester from the IUT, send an ATT_Write_Response (0x13) from the Lower Tester to the IUT.

- Expected Outcome
  Pass verdict

  The IUT sends a correctly formatted ATT_Write_Request (0x12) to the Lower Tester, containing the correct handle and the new value that is to be written as specified by the Upper Tester.
The IUT receives the response from the Lower Tester and sends the *ESP_WriteResponse* to the Upper Tester.

### 4.5.4 ESP/COL/ESW/BV-04-I [Write Long Characteristic User Description Descriptor]

- **Test Purpose**
  Verify that the Collector IUT can write to the Characteristic User Description descriptor(s) of an ESS Characteristic in an Environmental Sensor when the length of the value to be written requires the GATT Write Long procedure to be used.

- **Reference**
  [3] 4.4.3

- **Initial Condition**
  Via the ICS [4], the IUT manufacturer specifies which ESS Characteristics are supported by the IUT.

  A preamble procedure defined in Section 4.2.3 if using an LE transport or 4.2.4 if using a BR/EDR transport is used to setup the transport and L2CAP channel and initiate connection to an Environmental Sensor.

  The Upper Tester knows the handle of an ESS Characteristic and of its Characteristic User Description descriptor contained in the Lower Tester.

  For the purposes of this test case, the Lower Tester does not permit an ATT_MTU size larger than the default ATT_MTU size for LE to be negotiated.

  The Collector IUT has been authenticated by the Lower Tester.

  The Characteristic User Description descriptor selected for the test permits writing.

  The length of the characteristic descriptor used in this test case is such that its value is sufficiently long that it cannot be written in its entirety using the GATT Write Characteristic Descriptors sub-procedure when the default ATT_MTU size is used, requiring the IUT to use the GATT Write Long Characteristic Descriptors sub-procedure.

  The test value to be written to the Characteristic User Description descriptor is a UTF-8 string. The string contains some character values outside the ASCII printable range, if supported by the IUT.

- **Test Procedure**
  1. Send a command from the Upper Tester to request the IUT to write the test value to the Characteristic User Description descriptor of an ESS Characteristic in the Lower Tester.

- **Expected Outcome**
  Pass verdict
The IUT sends two or more ATT_Prepare_Write_Request commands to the Lower Tester. Each ATT_Prepare_Write_Request is correctly formatted and specifies the handle of the correct characteristic descriptor.

After sending all the required ATT_Prepare_Write_Requests to write the complete characteristic descriptor value to the Lower Tester, the IUT sends a correctly formatted ATT_Execute_Write_Request.

The size of each ATT_Prepare_Write_Request does not exceed the ATT_MTU size.

The Lower Tester receives the expected Characteristic User Description descriptor value, in its entirety, including all the printable and non-printable ASCII values.

4.6 Environmental Sensing Features

The procedures defined in this test group verify Environmental Sensing Sensor IUT implementation of the features defined in the Environmental Sensing Profile Specification [3] by an Environmental Sensor IUT, and usage of the same features by a Collector IUT.

4.6.1 ESP/SEN/ESF/BV-01-I [Environmental Sensing Service UUID in AD]

- Test Purpose
  Verify that the Environmental Sensing Service UUID is included in AD (Advertising Data) from the Environmental 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.

- 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 «Environmental Sensing Service».

4.6.2 ESP/SEN/ESF/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 Environmental 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.

• **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.

4.6.3 ESP/SEN/ESF/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 Environmental 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.

- **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.

  ![Diagram](image)

  Advertising Packet
  (Appearance included if not in Scan Response)

  Scan_Request

  IUT

  Command to advertise

  Scan_Response
  (Appearance Included if not in Advertising Packet)

  Lower Tester

  Upper Tester

- **Expected Outcome**

  **Pass verdict**

  The IUT sends an Advertising packet and a Scan Response packet.

  The IUT includes the Appearance characteristic value in either the Advertising packet or Scan Response packet, but not both.

**4.6.4 ESP/SEN/ESF/BV-04-I [Service Data included in AD]**

- **Test Purpose**

  Verify that the Service Data value is included in AD (Advertising Data) from the Environmental Sensor IUT when using the LE Transport.

- **Reference**

  [3] 3.1.1.5

- **Initial Condition**

  The IUT is powered on in GAP Discoverable Mode.

  The IUT is induced to generate Advertising Packets.
The Environmental Sensor IUT is in a mode in which it will include the Service Data AD Type in its advertising data.

• **Test Procedure**

  The Lower Tester listens for Advertising Packets from the IUT.

  ![Diagram](image)

  - **Command to advertise**
  - **Advertising Packet** (Service Data AD Type included)
  - **Lower Tester**
  - **IUT**
  - **Upper Tester**

• **Expected Outcome**

  **Pass verdict**

  The IUT sends an Advertising packet.

  The IUT includes the Service Data AD type in the advertising packet with a format meeting the requirements of the service [6].

  In addition to the UUID of the Environmental Sensing Service, the Service AD Type value includes two octets containing the Change Index field value as defined in [6].

4.6.5 **ESP/COL/ESF/BV-05-I [Configure ESS Characteristic for Notification]**

• **Test Purpose**

  Verify that the Collector IUT can configure an Environmental Sensor (Lower Tester) to notify an ESS Characteristic.

• **Reference**

  [3] 4.4

• **Initial Condition**

  A preamble procedure defined in Section 4.2.3 if using an LE transport or 4.2.4 if using a BR/EDR transport is used to setup the transport and L2CAP channel and initiate connection to an Environmental Sensor.
The IUT has discovered the Client Characteristic Configuration Descriptor for an ESS Characteristic contained in the Lower Tester.

- **Test Procedure**
  
The Upper Tester sends a command to the IUT to configure the Environmental Sensor to send ESS Characteristics.

---

**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 an ESS Characteristic, and the value set to «notification».

---

### 4.6.6 ESP/COL/ESF/BV-06-I [Receive ESS Characteristic Notifications]

- **Test Purpose**
  
Verify that the Collector IUT can receive notifications of the ESS Characteristic.

- **Reference**
  
[3] 4.4

- **Initial Condition**

A preamble procedure defined in Section 4.2.3 if using an LE transport or 4.2.4 if using a BR/EDR transport is used to setup the transport and L2CAP channel and initiate connection to an Environmental Sensor.

The IUT has executed the procedure included in ESP/COL/ESF/BV-05-I [Configure ESS Characteristic for Notification], which configures it to expect ESS Characteristic Notifications.

The IUT knows the handle of the ESS Characteristic.

---

- **Test Procedure**
1. The Lower Tester sends an ATT_Handle_Value_Notification containing an ESS Characteristic value to the IUT.
2. The Lower Tester sends one ESS Characteristic notification for each ESS Characteristic supported by the IUT.

• Expected Outcome

Pass verdict

The reported ESS Characteristic values match the ones sent by the Lower Tester.

If measurement units (e.g. lb, kg, feet, meters) are provided by the Collector IUT when the values are presented to the user, the units meet the requirements of the service and any scaling factors are correctly applied.

4.6.7 ESP/COL/ESF/BV-07-I [Configure Descriptor Value Changed for Indication]

• Test Purpose

Verify that the Collector IUT can configure an Environmental Sensor (Lower Tester) to indicate a Descriptor Value Changed indication.

• Reference

[3] 4.5

• Initial Condition

A preamble procedure defined in Section 4.2.3 if using an LE transport or 4.2.4 if using a BR/EDR transport is used to setup the transport and L2CAP channel and initiate connection to an Environmental Sensor.

The IUT has discovered the Client Characteristic Configuration Descriptor for the Descriptor Value Changed characteristic contained in the Lower Tester.
• **Test Procedure**

1. The Upper Tester sends a command to the IUT to configure the Environmental Sensor to send the Descriptor Value Changed characteristic.
2. The IUT writes 0x0002 to the Client Characteristic Configuration descriptor of the Descriptor Value Changed characteristic to enable indication.
3. 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.](image)

• **Expected Outcome**

*Pass verdict*

IUT sends a correctly formatted `ATT_Write_Request` (0x12) to the Lower Tester, with the handle set to that of the Client Characteristic Configuration Descriptor for the Descriptor Value Changed characteristic and the value set to «indication».

### 4.6.8 ESP/COL/ESF/BV-08-I [Receive Descriptor Value Changed Indications]

• **Test Purpose**

Verify that the Collector IUT can receive indications of the Descriptor Value Changed characteristic, including all variants.

• **Reference**

[3] 4.5

• **Initial Condition**

Via the ICS [4], the IUT manufacturer specifies which ESS Characteristics and associated characteristic descriptors are supported by the IUT.

A preamble procedure defined in Section 4.2.3 if using an LE transport or 4.2.4 if using a BR/EDR transport is used to setup the transport and L2CAP channel and initiate connection to an Environmental Sensor.
The IUT has executed the procedure included in ESP/COL/ESF/BV-07-I [Configure Descriptor Value Changed for Indication], which configures it to expect Descriptor Value Changed indications.

The IUT knows the handle of the Descriptor Value Changed characteristic.

An ESS Characteristic and its associated characteristic descriptors that are supported by the Collector IUT are exposed by the Lower Tester.

- Test Procedure

1. The Lower Tester sends an ATT_Handle_Value_Indication to the IUT containing a valid Descriptor Value Changed value.
2. The Lower Tester sends one Descriptor Value Changed indication 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 Characteristic UUID field is set to that of an ESS Characteristic that is supported by the Collector IUT and exposed by the Lower Tester.

<table>
<thead>
<tr>
<th>Test Pattern</th>
<th>Flags Field Value (bit15 ... bit0)</th>
<th>Description</th>
<th>Pass Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0000 0000 0001 1110</td>
<td>Source of Change is 'Server'. Change to one or more ES Trigger Setting Descriptors; and Change to ES Configuration Descriptor; and Change to ES Measurement Descriptor; and Change to Characteristic User Description Descriptor.</td>
<td>IUT re-reads all the characteristic descriptors that it supports, for the correct ESS Characteristic as specified by the Characteristic UUID field of the Descriptor Value Changed characteristic.</td>
</tr>
<tr>
<td>2</td>
<td>0000 0000 0001 0001</td>
<td>Source of Change is 'Client'. Change to Characteristic User Description Descriptor.</td>
<td>IUT re-reads the Characteristic User Description descriptor, if supported, for the correct ESS Characteristic as specified by the Characteristic UUID field of the Descriptor Value Changed characteristic.</td>
</tr>
<tr>
<td>3</td>
<td>XXXX XXXX XXX0 1000</td>
<td>Source of Change is 'Server'. Change to ES Measurement Descriptor; and A flag value from the RFU range of the Flags field is set to 1.</td>
<td>IUT re-reads the ES Measurement descriptor for the correct ESS Characteristic as specified by the Characteristic UUID field of the Descriptor Value Changed characteristic. The flag from the RFU range of the Flags field is ignored by the IUT.</td>
</tr>
</tbody>
</table>

At least one bit marked ‘X’ above is set to 1 – see Description.
• **Expected Outcome**

**Pass verdict**

The IUT confirms receipt of each indication by sending a correctly formatted *Handle Value Confirmation* to the Lower Tester.

The IUT reads the affected characteristic descriptors that it supports according to the pass criteria in the table above. The reported bits match the values sent by the Lower Tester.

### 4.6.9   ESP/COL/ESF/BV-09-I [Configure a Battery Level Characteristic for Notification]

• **Test Purpose**

Verify that the Collector IUT can configure an Environmental Sensor (Lower Tester) to notify the Battery Level characteristic.

• **Reference**

[3] 4.8

• **Initial Condition**

A preamble procedure defined in Section 4.2.3 if using an LE transport or 4.2.4 if using a BR/EDR transport is used to setup the transport and L2CAP channel and initiate connection to an Environmental Sensor.

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

• **Test Procedure**
1. The Upper Tester sends a command to the IUT to configure the Environmental Sensor to send the Battery Level characteristic.

2. The IUT writes 0x0001 to the Client Characteristic Configuration descriptor of the Battery Level characteristic to enable notification.

3. The Lower Tester sends a Write Response to the IUT to acknowledge the write request sent in step 2.

4.6.10 ESP/COL/ESF/BV-10-I [Receive Battery Level Characteristic Notifications]

- Test Purpose
  Verify that the Collector IUT can receive notifications of the Battery Level characteristic.

- Reference
  [3] 4.8

- Initial Condition
  A preamble procedure defined in Section 4.2.3 if using an LE transport or 4.2.4 if using a BR/EDR transport is used to setup the transport and L2CAP channel and initiate connection to an Environmental Sensor.

  The IUT has executed the procedure included in ESP/COL/ESF/BV-09-I [Configure a Battery Level Characteristic for Notification], which configures it to expect notifications of the Battery Level characteristic.

  The IUT knows the handle of the Battery Level characteristic.

- Test Procedure
1. The Lower Tester sends an \textit{ATT\_Handle\_Value\_Notification} containing a Battery Level characteristic value to the IUT.

- Expected Outcome
  
  \textbf{Pass verdict}

  The reported Battery Level characteristic value matches the one sent by the Lower Tester.

\textbf{4.6.11 ESP/SEN/ESF/BV-11-I [Send ESS Characteristic Notifications – Change Index Update]}

- Test Purpose
  
  Verify the IUT (an Environmental Sensor) updates the value of the Change Index field in the Service Data AD Type included in the advertising data each time a new notification is pending.

- Reference
  
  [3] 3.1.1.5, 5.1.4

- Initial Condition
  
  Since the IUT is typically a device that measures environmental parameters, this test may require the tester to be able to control the environmental conditions in order to trigger new measurement values to be notified to the Lower Tester. This may be achieved by using an environmental chamber or by other means.

  The Environmental Sensor IUT is in a mode in which it will include the Service Data AD Type in its advertising data.

  The Lower Tester and the IUT are bonded.
Test Procedure

The following test procedure is required to be run for only one of the supported ESS Characteristics identified in the ESS ICS [11]:

1. Ensure that the Lower Tester and the IUT are not connected.
2. Perform an action on the IUT that will induce a notification of the ESS Characteristic to be sent with a new measurement value.
3. Verify that the IUT advertises using the Service Data AD Type in the Advertising Packet.
4. Record the value of the Change Index included in the Service Data AD Type.
5. The Lower Tester attempts to connect.
6. Verify that a connection is established with the Lower Tester and a notification of the ESS Characteristic is sent to the Lower Tester.
7. The Lower Tester disconnects from IUT.
8. Repeat steps 1-3.
9. Record the value of the Change Index included in the Service Data AD Type in its advertising data.
10. Repeat steps 1-3.
11. Record the value of the Change Index included in the Service Data AD Type in its advertising data.

Expected Outcome

Pass verdict

The Change Index Field contains a different value in step 4, step 9 and step 11.

A notification of the expected ESS Characteristic is received by the Lower Tester in step 6.

4.6.12 ESP/COL/ESF/BV-12-I [Receive ESS Characteristic Notifications – Change Index Filtering]

Test Purpose

Verify the IUT (a Collector) can properly filter based on the value of the Change Index field of the Service Data AD Type.

The following test procedure is required to be run on only one of the supported notifiable ESS Characteristics identified in the ICS [4].

Reference

[3] 3.1.1.5, 5.2.2

Initial Condition

The IUT has executed the procedure included in ESP/COL/ESF/BV-05-I [Configure ESS Characteristic for Notification], which configures it to expect ESS Characteristic Notifications.

The client characteristic configuration descriptor of at least one ESS Characteristic is configured for notification.

The IUT knows the handle of the ESS Characteristic.

The IUT and the Lower Tester are bonded.
• Test Procedure

1. Ensure that the Lower Tester and the IUT are not connected.
2. The Lower Tester advertises using the Service Data AD Type in the Advertising Packet. The value of the Change Index field is set to a pseudo-random value.
3. The IUT connects to the Lower Tester.
4. The Lower Tester sends a notification of the ESS Characteristic to the IUT.
5. The IUT receives the notification of the ESS Characteristic.
6. The Lower Tester and the IUT disconnect.
7. The Lower Tester advertises again using the Service Data AD Type in the Advertising Packet. The value of the Change Index field is set to a new pseudo-random value.
8. The IUT attempts to connect to the Lower Tester and the Lower Tester rejects the connection.
9. The Lower Tester continues to advertise using the Service Data AD Type in the Advertising Packet with the same Change Index field value as in step 7.
10. Verify that the IUT does not attempt to connect.
11. The Lower Tester advertises using the Service Data AD Type in the Advertising Packet with a new pseudo-random value (not the same as in step 2 or step 7) in the Change Index field.
12. The IUT connects to the Lower Tester.
13. The Lower Tester sends a notification of the ESS Characteristic to the IUT.
14. The IUT receives the notification of the ESS Characteristic.

• Expected Outcome

Pass verdict

In step 3, verify that the IUT connects to retrieve the notification.

In step 8, verify that the IUT attempts to connect to the Lower Tester before being rejected.

In step 10, verify that the IUT does not attempt to connect to the Lower Tester.

In step 12, verify that the IUT connects to retrieve the notification.

4.7 Service Procedures – General Error Handling

This test group contains test cases to verify compliant operation when an error is caused by the Server side.

4.7.1 ESP/COL/SPE/BI-01-I [Application Error Handling – Condition Not Supported]

• Test Purpose

Verify that the Collector IUT can handle receipt of an ATT Application Error defined in [6] when it attempts to write a value to the Lower Tester.

• Reference

[3] 4.4.2, 4.6

• Initial Condition

A preamble procedure defined in Section 4.2.3 if using an LE transport or 4.2.4 if using a BR/EDR transport is used to setup the transport and L2CAP channel and initiate connection to an Environmental Sensor.
The Collector IUT and the Lower Tester are bonded.

The Upper Tester knows the handle of an ESS Characteristic and of its ES Trigger Setting descriptor(s) contained in the Lower Tester.

The ES Trigger Setting descriptor selected for the test permits writing.

**Test Procedure**

1. Send a command from the Upper Tester to request the IUT to write a new value to an ES Trigger Setting descriptor in the Lower Tester e.g., *ESP_WriteRequest* (handle, value).
2. After receipt of the expected result by the Lower Tester from the IUT, send an *ATT_Application_Error* (0x81) from the Lower Tester to the IUT.

**Expected Outcome**

*Pass verdict*

The IUT sends a correctly formatted *ATT_Write_Request* (0x12) to the Lower Tester, containing the correct handle and the new value that is to be written as specified by the Upper Tester.

The IUT receives the *Condition Not Supported* (0x81) ATT Application Error response from the Lower Tester and sends the *ESP_ErrorResponse* to the Upper Tester.

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 requirements in the ICS. 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 the Environmental Sensing 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.

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

<table>
<thead>
<tr>
<th>Item</th>
<th>Feature</th>
<th>Test case(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESP 2/2 AND ESP 3/2</td>
<td>Discover Environmental Sensing Service – LE</td>
<td>ESP/COL/ESD/BV-01-I</td>
</tr>
<tr>
<td>ESP 3/2 AND ESP 7/2</td>
<td>Discover Device Information Service - LE</td>
<td>ESP/COL/ESD/BV-02-I</td>
</tr>
<tr>
<td>ESP 3/2 AND ESP 7/3</td>
<td>Discover Battery Service – LE</td>
<td>ESP/COL/ESD/BV-03-I</td>
</tr>
<tr>
<td>ESP 2/2 AND ESP 3/1</td>
<td>Discover Services – BR/EDR</td>
<td>ESP/COL/ESD/BV-04-I</td>
</tr>
<tr>
<td>ESP 2/1 AND GAP 0/3 AND ESP 3/2 AND NOT ESP 3/1</td>
<td>Discover Environmental Sensing Service – Not Discoverable over BR/EDR</td>
<td>ESP/SEN/ESD/BV-05-I</td>
</tr>
<tr>
<td>ESP 2/2</td>
<td>Mandatory Collector tests</td>
<td>ESP/COL/ESD/BV-06-I, ESP/COL/ESD/BV-07-I</td>
</tr>
<tr>
<td>ESP 8/7</td>
<td>Discover Descriptor Value Changed Characteristic</td>
<td>ESP/COL/ESD/BV-08-I</td>
</tr>
<tr>
<td>ESP 7/2</td>
<td>Device Information Service Characteristics</td>
<td>ESP/COL/ESD/BV-10-I, ESP/COL/ESR/BV-08-I</td>
</tr>
<tr>
<td>ESP 7/3</td>
<td>Discover Battery Service Characteristics</td>
<td>ESP/COL/ESD/BV-11-I</td>
</tr>
<tr>
<td>Item</td>
<td>Feature</td>
<td>Test case(s)</td>
</tr>
<tr>
<td>---------</td>
<td>-------------------------------------------------------</td>
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</tr>
<tr>
<td>ESP 12/1</td>
<td>Read ESS Characteristic</td>
<td>ESP/COL/ESR/BV-01-I</td>
</tr>
<tr>
<td>ESP 12/2</td>
<td>Read ES Measurement Descriptor</td>
<td>ESP/COL/ESR/BV-02-I</td>
</tr>
<tr>
<td>ESP 12/3</td>
<td>Read ES Trigger Setting Descriptor</td>
<td>ESP/COL/ESR/BV-03-I</td>
</tr>
<tr>
<td>ESP 12/6</td>
<td>Read ES Configuration Descriptor</td>
<td>ESP/COL/ESR/BV-04-I</td>
</tr>
<tr>
<td>ESP 12/8</td>
<td>Read and Read Long Characteristic User Description Descriptor</td>
<td>ESP/COL/ESR/BV-05-I, ESP/COL/ESR/BV-06-I</td>
</tr>
<tr>
<td>ESP 12/11</td>
<td>Read Valid Range Descriptor</td>
<td>ESP/COL/ESR/BV-07-I</td>
</tr>
<tr>
<td>ESP 9/1</td>
<td>Read Battery Level Characteristic</td>
<td>ESP/COL/ESR/BV-09-I</td>
</tr>
<tr>
<td>ESP 12/4</td>
<td>Write ES Trigger Setting Descriptor</td>
<td>ESP/COL/ESW/BV-01-I, ESP/COL/SPE/BI-01-I</td>
</tr>
<tr>
<td>ESP 12/7</td>
<td>Write ES Configuration Descriptor</td>
<td>ESP/COL/ESW/BV-02-I</td>
</tr>
<tr>
<td>ESP 12/10</td>
<td>Write and Write Long Characteristic User Description Descriptor</td>
<td>ESP/COL/ESW/BV-03-I, ESP/COL/ESW/BV-04-I</td>
</tr>
<tr>
<td>ESP 4/2</td>
<td>Environmental Sensing Service UUID in AD</td>
<td>ESP/SEN/ESF/BV-01-I</td>
</tr>
<tr>
<td>ESP 4/3</td>
<td>Local Name in AD or Scan Response</td>
<td>ESP/SEN/ESF/BV-02-I</td>
</tr>
<tr>
<td>ESP 4/4</td>
<td>Appearance in AD or Scan Response</td>
<td>ESP/SEN/ESF/BV-03-I</td>
</tr>
<tr>
<td>ESP 4/5</td>
<td>Service Data included in AD</td>
<td>ESP/SEN/ESF/BV-04-I</td>
</tr>
<tr>
<td>ESP 12/8</td>
<td>ESS Characteristic Notifications</td>
<td>ESP/COL/ESF/BV-05-I, ESP/COL/ESF/BV-06-I</td>
</tr>
<tr>
<td>ESP 12/12</td>
<td>Descriptor Value Changed Characteristic Indications</td>
<td>ESP/COL/ESD/BV-09-I, ESP/COL/ESF/BV-07-I, ESP/COL/ESF/BV-08-I</td>
</tr>
<tr>
<td>Item</td>
<td>Feature</td>
<td>Test case(s)</td>
</tr>
<tr>
<td>------</td>
<td>---------</td>
<td>-------------</td>
</tr>
</tbody>
</table>
| ESP 9/2 | Receive Battery Level Characteristic Notifications | ESP/COL/ESF/BV-09-I  
ESP/COL/ESF/BV-10-I |
| ESP 4/5 | Send ESS Notifications – Change Index Update | ESP/SEN/ESF/BV-11-I |
| ESP 10/1 AND ESP 12/4 AND ESP 12/8 | Receive ESS Characteristic Notifications – Filter using Change Index | ESP/COL/ESF/BV-12-I |

*Table 5.1: Test Case Mapping*