Cycling Speed and Cadence Service (CSCS)

***Bluetooth*® Test Suite**

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Contents

1 Scope

This Bluetooth document contains the Test Suite Structure (TSS) and test cases to test the implementation of the Bluetooth Cycling Speed and Cadence Service Specification with the objective to provide a high probability of air interface interoperability between the tested implementation and other manufacturers' Bluetooth devices.

2 References, definitions, and abbreviations

2.1 References

This document incorporates provisions from other publications by dated or undated reference. These references are cited at the appropriate places in the text, and the publications are listed hereinafter. Additional definitions and abbreviations can be found in [1] and [2].

[1] Test Strategy and Terminology Overview

[2] Bluetooth Core Specification, Version 4.0 or later

[3] Cycling Speed and Cadence Service Specification, Version 1.0 or later

[4] ICS Proforma for Cycling Speed and Cadence Service, CSCS.ICS

[5] GATT Test Suite, GATT.TS

[6] Cycling Speed and Cadence Service Specification, Version 1.0.1

2.2 Definitions

In this Bluetooth document, the definitions from [1] and [2] apply.

2.3 Acronyms and abbreviations

In this Bluetooth document, the definitions, acronyms, and abbreviations from [1] and [2] apply.

3 Test Suite Structure (TSS)

3.1 Overview

The Cycling Speed and Cadence Service requires the presence of GAP, SM (LE), SDP (BR/EDR), and GATT. This is illustrated in Figure 3.1.

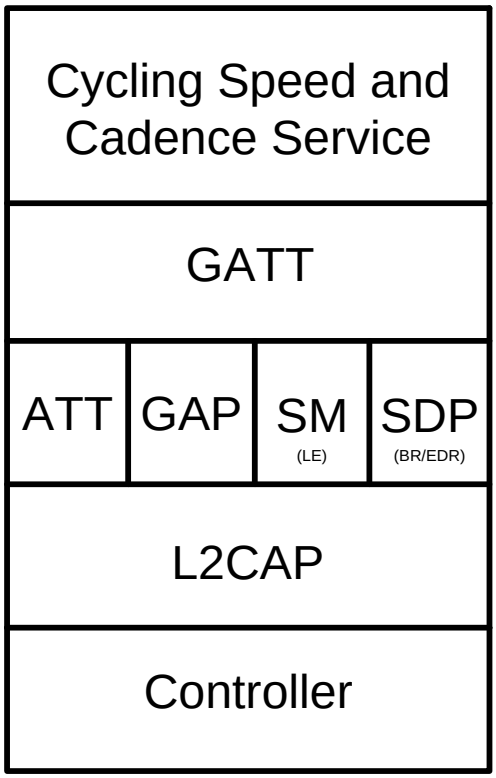

Figure 3.1: Cycling Speed and Cadence Service Test Model

3.2 Test Strategy

The test objectives are to verify the functionality of the Cycling Speed and Cadence Service within a Bluetooth Host and enable interoperability between Bluetooth Hosts on different devices. The testing approach covers mandatory and optional requirements in the specification and matches these to the support of the IUT as described in the ICS. Any defined test herein is applicable to the IUT if the ICS logical expression defined in the Test Case Mapping Table (TCMT) evaluates to true.

The test equipment provides an implementation of the Radio Controller and the parts of the Host needed to perform the test cases defined in this Test Suite. A Lower Tester acts as the IUT's peer device and interacts with the IUT over-the-air interface. The configuration, including the IUT, needs to implement similar capabilities to communicate with the test equipment. 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, a Man Machine Interface (MMI), or another interface supported by the IUT.

This 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.

3.3 Test groups

The following test groups have been defined:

- Generic GATT Integrated Tests
- Characteristic Read
- Characteristic Write
- Configure Notification
- Configure Indication
- Characteristic Notification
- Characteristic Indication

4 Test cases (TC)

4.1 Introduction

4.1.1 Test case identification conventions

Test cases are 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>**.

Additionally, testing of this specification includes tests from the GATT Test Suite [5] referred to as Generic GATT Integrated Tests (GGIT); when used, the test cases in GGIT are referred to through a TCID string using the following convention:
<spec abbreviation>/<IUT role>/<GGIT test group>/< GGIT class >/<xx>-<nn>-<y>.

Identifier Abbreviation	**Spec Identifier <spec abbreviation>**
CSCS	Cycling Speed and Cadence Service
Identifier Abbreviation	**Role Identifier <IUT role>**
SEN	Sensor Role
Identifier Abbreviation	**Reference Identifier <GGIT test group>**
SGGIT	Server Generic GATT Integrated Tests
Identifier Abbreviation	**Reference Identifier <GGIT class>**
CHA	Characteristic
ISFC	Indication Supported Features Characteristic
SDP	Validate SDP Record
SER	Service
Identifier Abbreviation	**Feature Identifier <feat>**
CN	Characteristic Notification
CON	Configure Indication or Notification
CR	Characteristic Read
CW	Characteristic Write
SPE	Service Procedure – Error Handling
SPL	Service Procedure – Request Supported Sensor Locations
SPS	Service Procedure – Set Cumulative Value
SPU	Service Procedure – Update Sensor Location

Table 4.1: CSCS TC feature naming conventions

4.1.2 Conformance

When conformance is claimed for a particular specification, all capabilities are to be supported in the specified manner. The mandated tests from this Test Suite depend on the capabilities to which conformance is claimed.

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 not excluded by the specification
- That capabilities enabled by the implementations are sustained over durations expected by the use case
- That the implementation gracefully handles any quantity of data expected by the use case
- 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
- That the implementation is immune to attempted security exploits

A single execution of each of the required tests is required to constitute a Pass verdict. However, it is noted that 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 generated by the Bluetooth SIG qualification tool, with the test case as described in the Test Suite, or with the test system utilized, the member is required to notify the responsible party via an erratum request such that the issue may be addressed.

4.1.3 Pass/Fail verdict conventions

Each test case has an Expected Outcome section. The IUT is granted the Pass verdict when all the detailed pass criteria conditions within the Expected Outcome section are met.

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

4.2 Setup preambles

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

4.2.1 ATT Bearer on LE Transport

- Preamble Procedure
  1. Establish an LE transport connection between the IUT and the Lower Tester.
  2. Establish an L2CAP channel 0x0004 between the IUT and the Lower Tester over that LE transport.

4.2.2 ATT Bearer on BR/EDR Transport

- Preamble Procedure
  1. Establish a BR/EDR transport connection between the IUT and the Lower Tester.
  2. Establish several L2CAP channels (PSM 0x001F) between the IUT and the Lower Tester over that BR/EDR transport.

4.2.3 SC Control Point

- Preamble Purpose

  Follow the preamble procedure to enable the IUT for use with the SC Control Point.

- Preamble Procedure

  1. 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.
  2. The handle of the CSC Measurement characteristic, CSC Feature characteristic, Sensor Location and SC Control Point characteristic has been previously discovered by the Lower Tester during the test procedure in Section 1 or is known to the Lower Tester by other means.
  3. The handle of the Client Characteristic Configuration descriptor of the CSC Measurement characteristic and SC Control Point characteristic has been previously discovered by the Lower Tester during the test procedure in Section 1 or is known to the Lower Tester by other means.
  4. If the Lower Tester and IUT were not previously bonded, perform a bonding procedure. If previously bonded, re-enable encryption.
  5. The IUT configures the SC Control Point characteristic for indications, and if the test case requires notifications of the CSC Measurement characteristic, the IUT configures the CSC Measurement characteristic for notifications. These configurations may occur in any order.

4.3 Generic GATT Integrated Tests

Execute the Generic GATT Integrated Tests defined in Section 6.3, Server test procedures (SGGIT), in [5] using Table 4.2 as input:

TCID	Service/ Characteristic/ Descriptor	Reference	Properties	Value Length (Octets)	Service Type
CSCS/SEN/SGGIT/SER/BV-01-C [Service GGIT – Cycling Speed and Cadence Service]	Cycling Speed and Cadence Service	[3] 2	-	-	Primary or Secondary Service
CSCS/SEN/SGGIT/SDP/BV-01-C [SDP Record - Cycling Speed and Cadence Service]	Cycling Speed and Cadence Service	[3] 4	-	-	-
CSCS/SEN/SGGIT/CHA/BV-01-C [Characteristic GGIT – CSC Measurement]	CSC Measurement Characteristic	[3] 3	0x10 (Notify)	Skip	-
CSCS/SEN/SGGIT/CHA/BV-02-C [Characteristic GGIT – CSC Feature]	CSC Feature Characteristic	[3] 3	0x02 (Read)	Skip	-
CSCS/SEN/SGGIT/CHA/BV-05-C [Characteristic GGIT – CSC Feature]	CSC Feature Characteristic	[6] 3, 3.2.1	0x22 (Read, Indicate)	Skip	-
CSCS/SEN/SGGIT/CHA/BV-03-C [Characteristic GGIT – Sensor Location]	Sensor Location Characteristic	[3] 3	0x02 (Read)	Skip	-
CSCS/SEN/SGGIT/CHA/BV-04-C [Characteristic GGIT – SC Control Point]	SC Control Point Characteristic	[3] 3	0x28 (Write, Indicate)	Skip	-

Table 4.2: Input for the GGIT Client Test Procedure

4.3.1 Generic GATT Indication Supported Features Characteristic

Execute the Generic GATT Indication Supported Features Characteristic Tests defined in Section 6.3, Server test procedures (SGGIT), in [5] using Table 4.3 below as input:

TCID	Characteristic	Reference	TC Configuration
CSCS/SEN/SGGIT/ISFC/BV-01-C [Characteristic GGIT – CSC Feature Indication]	CSC Feature Characteristic	[6] 3.2.1	N/A

Table 4.3: Input for the GGIT Indication Supported Features Characteristic tests

4.4 Characteristic Read

- Test Purpose

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

- Reference

  [3] 3.2.1

- Initial Condition

  - The handle range of each characteristic referenced in the test cases below has been previously discovered by the Lower Tester during the test procedure in Section 1 or is known to the Lower Tester by other means.
  - If the IUT requires a bonding procedure then perform a bonding procedure.
  - Establish an ATT Bearer connection between the Lower Tester and IUT as described in Section 4.2.1 if using an LE transport or Section 4.2.2 if using a BR/EDR transport.
  - If IUT permissions for the characteristic require a specific security mode or security level, establish a connection meeting those requirements.

- Characteristic Read Value Test Cases

Test Case	Requirements
CSCS/SEN/CR/BV-01-C [Characteristic Read – CSC Feature]	2 octets with RFU bits set to 0. ([3] 3.2.1)
CSCS/SEN/CR/BV-02-C [Characteristic Read – Sensor Location]	1 octet with value other than RFU range. ([3] 3.3.1)

Table 4.4: Characteristic Read Value test cases

- Test Procedure

  The following test procedure applies to the test cases listed in Table 4.4:

  1. The Lower Tester sends an ATT_Read_Request to the IUT to read the characteristic value.
  2. The IUT sends an ATT_Read_Response to the Lower Tester.
  3. Verify that the characteristic value meets the requirements of the service.

- Expected Outcome

  Pass verdict

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

4.5 Configure Indication and Notification

- Test Purpose

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

- Reference

  [3] 3.1.2, 3.4.5

- Initial Condition

  - The handle range of each characteristic referenced in the test cases below has been previously discovered by the Lower Tester during the test procedure in Section 1 or is known to the Lower Tester by other means.
  - The handle of the Client Characteristic Configuration descriptor of each characteristic referenced in the test cases below has been previously discovered by the Lower Tester during the test procedure in Section 1 or is known to the Lower Tester by other means.
  - If the IUT requires a bonding procedure then perform a bonding procedure.
  - Establish an ATT Bearer connection between the Lower Tester and IUT as described in Section 4.2.1 if using an LE transport or Section 4.2.2 if using a BR/EDR transport.
  - If IUT permissions for the characteristic require a specific security mode or security level, establish a connection meeting those requirements.

- Configure Indication and Notification Test Cases

Test Case	Requirements
CSCS/SEN/CON/BV-01-C [Configure Notification - CSC Measurement]	0x01 ([3] 3.1.2.1)
CSCS/SEN/CON/BV-02-C [Configure Indication - SC Control Point]	0x02 ([3] 3.4.5.1)

Table 4.5: Configure Indication and Notification test cases

- Test Procedure

  The following test procedure applies to the test cases listed in Table 4.5:

  1. Disable indication or notification by writing value 0x0000 to the client characteristic configuration descriptor of the characteristic.
  2. If the test case is for notification, enable notification by writing value 0x0001 to the client characteristic configuration descriptor of the characteristic.
  3. Otherwise, if the test case is for indication, enable indication by writing value 0x0002 to the client characteristic configuration descriptor of the characteristic.
  4. The Lower Tester reads the value of the client characteristic configuration descriptor.

- Expected Outcome

  Pass verdict

  The characteristic descriptor is successfully written and the value returned when read is consistent with the value written.

4.6 Characteristic Notification

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

CSCS/SEN/CN/BV-01-C [CSC Measurement Notifications – Wheel Revolution Data]

- Test Purpose

  Verify that the IUT can send notifications of the CSC Measurement characteristic that include Wheel Revolution Data.

- Reference

  [3] 3.1

- Initial Condition

  - An action is performed on the IUT that will induce it, once connected, to send notifications of the CSC Measurement characteristic with Wheel Revolution Data.
  - An ATT Bearer connection between the Lower Tester and IUT is established as described in Section 4.2.1 if using an LE transport or Section 4.2.2 if using a BR/EDR transport.
  - If IUT permissions for the CSC Measurement characteristic require a specific security mode or security level, establish a connection meeting those requirements.
  - If the IUT requires a bonding procedure then perform a bonding procedure.
  - The CSC Measurement characteristic is configured for notification.

- Test Procedure

  1. The IUT sends an ATT_Handle_Value_Notification containing the CSC Measurement characteristic handle and value to the Lower Tester.
  2. Verify that the characteristic value meets the requirements of the service.
  3. Perform an action on the IUT that will induce it, to send notifications of the CSC Measurement characteristic with Wheel Revolution Data until the Lower Tester receives one or more additional notifications.
  4. The Lower Tester configures the CSC Measurement characteristic to disable notifications.
  5. Repeat step 3 with notifications disabled.
  6. Verify that the Lower Tester does not receive an ATT_Handle_Value_Notification from the IUT containing the CSC Measurement characteristic.

- Expected Outcome

  Pass verdict

  The IUT sends more than one notification of the CSC Measurement characteristic.

  The CSC Measurement characteristic contains a Flags field, a Cumulative Wheel Revolutions field and a Last Wheel Event Time field.

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

  The value of the Wheel Revolution Data Supported bit of the CSC Feature characteristic is set to 1.

The IUT stops sending notifications of the CSC Measurement characteristic after the Lower Tester configures the characteristic to disable notifications.

In all cases, ensure that the RFU bits of the flags field are set to zero.

CSCS/SEN/CN/BV-02-C [CSC Measurement Notifications – Forward Wheel Revolution Data]

- Test Purpose

  Verify that the IUT can send notifications of the CSC Measurement characteristic that include Cumulative Wheel Revolutions and Last Wheel Event Time values when the wheel is rotated in the forward direction.

- Reference

  [3] 3.1

- Initial Condition

  - An action is performed on the IUT that will induce it, once connected, to send notifications of the CSC Measurement characteristic along with Cumulative Wheel Revolutions and Last Wheel Event Time values when the wheel is rotated in the forward direction.
  - An ATT Bearer connection is established between the Lower Tester and IUT as described in Section 4.2.1 if using an LE transport or Section 4.2.2 if using a BR/EDR transport.
  - If IUT permissions for the CSC Measurement characteristic require a specific security mode or security level, establish a connection meeting those requirements.
  - If the IUT requires a bonding procedure then perform a bonding procedure.
  - The CSC Measurement characteristic is configured for notification.

- Test Procedure

  1. The Lower Tester reads the CSC Feature characteristic (e.g., by executing test case CSCS/SEN/CR/BV-01-C [Characteristic Read – CSC Feature] or by other means).
  2. The Lower Tester receives one or more ATT_Handle_Value_Notifications from the IUT containing the CSC Measurement characteristic handle and value along with Cumulative Wheel Revolutions and Last Wheel Event Time values.
  3. Verify that the characteristic value meet the requirements of the service.

- Expected Outcome

  Pass verdict

  The IUT sends one or more notifications of the CSC Measurement characteristic and at least one includes the Cumulative Wheel Revolutions and Last Wheel Event Time values with the appropriate flag set in the Flags field.

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

  The value of the Wheel Revolution Data Supported bit of the CSC Feature characteristic is set to 1.

  In all cases, ensure that the RFU bits of the flags field are set to zero.

CSCS/SEN/CN/BV-03-C [CSC Measurement Notifications – Reverse Wheel Revolution Data]

- Test Purpose

  Verify that when an IUT supports the ability for the Cumulative Wheel Revolutions that can count in reverse (i.e., when the wheel is rotated in the reverse direction), it does not decrement below zero.

- Reference

  [3] 3.1.1.2

- Initial Condition

  - An ATT Bearer connection is established between the Lower Tester and IUT as described in Section 4.2.1 if using an LE transport or Section 4.2.2 if using a BR/EDR transport.
  - If IUT permissions for the CSC Measurement characteristic require a specific security mode or security level, establish a connection meeting those requirements.
  - If the IUT requires a bonding procedure then perform a bonding procedure.
  - The CSC Measurement characteristic is configured for notification.

- Test Procedure

  1. Perform an action to set the set the value of the Cumulative Wheel Revolutions to a value near zero (e.g., set to of 0x00000005 using the procedure in CSCS/SEN/SPS/BV-01-C [Set Cumulative Value - Set to zero]).
  2. Perform an action on the IUT that will induce it, once connected, to send notifications of the CSC Measurement characteristic along with Cumulative Wheel Revolutions and Last Wheel Event Time values when the wheel is rotated in the reverse direction.
  3. A connection is established between the Lower Tester and IUT meeting the security requirements of the IUT, if not already done so prior to step 1.
  4. The Lower Tester reads the CSC Feature characteristic (e.g., by executing test case CSCS/SEN/CR/BV-01-C [Characteristic Read – CSC Feature] or by other means).
  5. Perform an action on the IUT that will induce it to count down a number of times greater than the value set in step 1.
  6. The Lower Tester receives one or more ATT_Handle_Value_Notifications from the IUT containing the CSC Measurement characteristic handle and value along with Cumulative Wheel Revolutions and Last Wheel Event Time values.
  7. Verify that the characteristics value meet the requirements of the service.

- Expected Outcome

  Pass verdict

  The IUT sends one or more notifications of the CSC Measurement characteristic and at least one includes the Cumulative Wheel Revolutions and Last Wheel Event Time values with the appropriate flag set in the Flags field.

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

  The value of the Wheel Revolution Data Supported bit of the CSC Feature characteristic is set to 1.

The value of the Cumulative Wheel Revolutions field reverses and ends at a count of 0x00000000 and does not roll over.

In all cases, ensure that the RFU bits of the flags field are set to zero.

CSCS/SEN/CN/BV-04-C [CSC Measurement Notifications – Crank Revolution Data]

- Test Purpose

  Verify that the IUT can send notifications of the CSC Measurement characteristic that include Cumulative Crank Revolutions and Last Crank Event Time values.

- Reference

  [3] 3.1

- Initial Condition

  - An ATT Bearer connection is established between the Lower Tester and IUT as described in Section 4.2.1 if using an LE transport or Section 4.2.2 if using a BR/EDR transport.
  - If IUT permissions for the CSC Measurement characteristic require a specific security mode or security level, establish a connection meeting those requirements.
  - If the IUT requires a bonding procedure then perform a bonding procedure.
  - The CSC Measurement characteristic is configured for notification.

- Test Procedure

  1. Perform an action on the IUT that will induce it, once connected, to send notifications of the CSC Measurement characteristic along with Cumulative Crank Revolutions and Last Crank Event Time values.
  2. A connection is established between the Lower Tester and IUT meeting the security requirements of the IUT, if not already done so prior to step 1.
  3. The Lower Tester receives one or more ATT_Handle_Value_Notifications from the IUT containing the CSC Measurement characteristic handle and value along with Cumulative Crank Revolutions and Last Crank Event Time values.
  4. Verify that the characteristic value meets the requirements of the service.

- Expected Outcome

  Pass verdict

  The IUT sends one or more notifications of the CSC Measurement characteristic and at least one includes the Cumulative Crank Revolutions and Last Crank Event Time values with the appropriate flag set in the Flags field.

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

  The value of the Crank Revolution Data Supported bit of the CSC Feature characteristic is set to 1.

  In all cases, ensure that the RFU bits of the flags field are set to zero.

4.7 Service Procedure – Set Cumulative Value

This test group contains test cases to verify compliant operation when the Lower Tester uses SC Control Point Set Cumulative Value procedure.

CSCS/SEN/SPS/BV-01-C [Set Cumulative Value - Set to zero]

- Test Purpose

  Verify that the IUT can perform the Set Cumulative Value procedure to set a zero value to the Cumulative Wheel Revolutions.

- Reference

  [3] 3.4.2.1

- Initial Condition

  - Perform the preamble described in Section 4.2.3.
  - The value of Cumulative Wheel Revolutions in the IUT is not set to a known non-zero value.

- Test Procedure

  1. A connection is established between the Lower Tester and IUT.
  2. The IUT sends one or more notifications of the CSC Measurement characteristic.
  3. The Lower Tester writes the Set Cumulative Value Op Code (0x01) to the SC Control Point with a Parameter Value of 0x00000000.
  4. The IUT sends an indication of the SC Control Point characteristic with the Response Code Op Code (0x10), a Parameter Value representing Request Op Code (0x01) followed by the Response Value for 'success' (0x01) without Response Parameter.
  5. The Lower Tester receives an ATT_Handle_Value_Indication from the IUT containing the SC Control Point characteristic handle and value.
  6. The Lower Tester sends an ATT_Handle_Value_Confirmation to the IUT.
  7. Verify that the characteristic value meets the requirements of the service.

- Expected Outcome

  Pass verdict

  The IUT sends one or more notifications of the CSC Measurement characteristic with the Cumulative Wheel Revolutions field set to a non-zero value.

  The IUT sends one indication of the SC Control Point characteristic with the Response Code Op Code containing a valid Parameter Value.

  After setting the value to zero, the IUT sends the next notification of the CSC Measurement characteristic with the Cumulative Wheel Revolutions field set to 0 (or slightly higher in case of movement).

  The value of the Wheel Revolution Data Supported bit of the CSC Feature characteristic is set to 1.

CSCS/SEN/SPS/BV-02-C [Set Cumulative Value - Set to non-zero]

- Test Purpose

  Verify that the IUT can perform the Set Cumulative Value procedure to set a non-zero value to Cumulative Wheel Revolutions.

- Reference

  [3] 3.4.2.1

- Initial Condition

  - Perform the preamble described in Section 4.2.3.
  - The value of Cumulative Wheel Revolutions in the IUT is not set to a known non-zero value.

- Test Procedure

  1. A connection is established between the Lower Tester and IUT.
  2. The IUT sends one or more notifications of the CSC Measurement characteristic.
  3. The Lower Tester writes the Set Cumulative Value Op Code (0x01) to the SC Control Point with a Parameter Value other than 0x00000000 and different from the initial value.
  4. The IUT sends an indication of the SC Control Point characteristic with the Response Code Op Code (0x10), a Parameter Value representing Request Op Code (0x01) followed by the Response Value for 'success' (0x01) without Response Parameter.
  5. The Lower Tester receives an ATT_Handle_Value_Indication from the IUT containing the SC Control Point characteristic handle and value.
  6. The Lower Tester sends an ATT_Handle_Value_Confirmation to the IUT.
  7. Verify that the characteristic value meets the requirements of the service.

- Expected Outcome

  Pass verdict

  The IUT sends one or more notifications of the CSC Measurement characteristic with the Cumulative Wheel Revolutions field set to a non-zero value.

  The IUT sends one indication of the SC Control Point characteristic with the Response Code Op Code containing a valid Parameter Value.

  After setting the value to a non-zero value, the IUT sends the next notification of the CSC Measurement characteristic with the Cumulative Wheel Revolutions field set to the specified value (or slightly higher in case of movement).

  The value of the Wheel Revolution Data Supported bit of the CSC Feature characteristic is set to 1.

4.8 Service Procedure – Request Supported Sensor Locations

This test group contains test cases to verify compliant operation when the Lower Tester uses SC Control Point Request Supported Sensor Locations procedure.

CSCS/SEN/SPL/BV-01-C [Request Supported Sensor Locations]

- Test Purpose

  Verify that the IUT can perform the Request Supported Sensor Location procedure.

- Reference

  [3] 3.4.2.4

- Initial Condition

  - Perform the preamble described in Section 4.2.3.

- Test Procedure

  1. A connection is established between the Lower Tester and IUT.
  2. The Lower Tester writes the Request Supported Sensor Locations Op Code (0x04) to the SC Control Point without any Parameter Value.
  3. The IUT sends an indication of the SC Control Point characteristic with the Response Code Op Code (0x10), a Parameter Value representing Request Op Code (0x04) followed by the Response Value for 'success' (0x01) followed with the list of the supported sensor locations.
  4. The Lower Tester receives an ATT_Handle_Value_Indication from the IUT containing the SC Control Point characteristic handle and value.
  5. The Lower Tester sends an ATT_Handle_Value_Confirmation to the IUT.
  6. Verify that the characteristic value meets the requirements of the service.

- Expected Outcome

  Pass verdict

  The IUT sends one indication of the SC Control Point characteristic with the Response Code Op Code containing a valid Parameter Value.

  The value of the Multiple Sensor Locations Supported bit of the CSC Feature characteristic is set to 1.

4.9 Service Procedure – Update Sensor Location

This test group contains test cases to verify compliant operation when the Lower Tester uses SC Control Point Update Sensor Location procedure.

CSCS/SEN/SPU/BV-01-C [Update Sensor Location]

- Test Purpose

  Verify that the IUT can perform the Update Sensor Location procedure.

- Reference

  [3] 3.4.2.3

- Initial Condition

  - Perform the preamble described in Section 4.2.3.

- Test Procedure

  1. A connection is established between the Lower Tester and IUT.
  2. The Lower Tester reads the Sensor Location characteristic to determine the present value.

3. For each supported Sensor Location value (known by executing CSCS/SEN/SPL/BV-01-C [Request Supported Sensor Locations] or by other means), perform the following:
    - The Lower Tester writes the Update Sensor Location Op Code (0x03) to the SC Control Point with a Parameter Value set to another supported sensor location (e.g., by executing test case CSCS/SEN/SPL/BV-01-C [Request Supported Sensor Locations] or by other means).
    - The IUT sends an indication of the SC Control Point characteristic with the Response Code Op Code (0x10), a Parameter Value representing Request Op Code (0x03) followed by the Response Value for 'success' (0x01) without Response Parameter.
    - The Lower Tester receives an ATT_Handle_Value_Indication from the IUT containing the SC Control Point characteristic handle and value.
    - The Lower Tester sends an ATT_Handle_Value_Confirmation to the IUT.
    - Verify that the characteristic value meets the requirements of the service.
    - The Lower Tester reads the Sensor Location characteristic and verifies that the characteristic value meets the requirements of the service.

- Expected Outcome

  Pass verdict

  For each supported Sensor Location value, verify the following:

  - The IUT sends one indication of the SC Control Point characteristic with the Response Code Op Code containing a valid Parameter Value.
  - The Sensor Location value is set to the value written as a Parameter to the SC Control Point.

  The value of the Multiple Sensor Locations Supported bit of the CSC Feature characteristic is set to 1.

4.10 Service Procedure – General Error Handling

This test group contains test cases to verify compliant operation when the Lower Tester uses SC Control Point procedure and an error results.

CSCS/SEN/SPE/BI-01-C [Op Code Not Supported]

- Test Purpose

  Verify that the IUT responds appropriately when a Client writes an unsupported Op Code to the SC Control Point.

- Reference

  [3] 3.4.3

- Initial Condition

  - Perform the preamble described in Section 4.2.3.

- Test Procedure

  1. A connection is established between the Lower Tester and IUT.
  2. The Lower Tester writes an Op Code Value of 0x00 to the SC Control Point without Parameter Value.

3. Verify that the IUT response meets the requirements of the service.
4. The Lower Tester writes an Op Code value from the Reserved for Future Use range other than 0x00 to the SC Control Point without Parameter Value.
5. Verify that the IUT response meets the requirements of the service.

- Expected Outcome

  Pass verdict

  For both cases, the IUT sends a Write Response followed by an indication of the SC Control Point characteristic with the Response Code Op Code (0x10), a Parameter Value representing Request Op Code (i.e., 0x00 for step 2 and the RFU value written for step 4) followed by the Response Value for 'Op Code not supported' (0x02) and without Response Parameter.

CSCS/SEN/SPE/BI-02-C [Invalid Parameter]

- Test Purpose

  Verify that the IUT responds appropriately when a Client writes a supported Op Code followed by an invalid Parameter Value to the SC Control Point.

- Reference

  [3] 3.4.3

- Initial Condition

  - Perform the preamble described in Section 4.2.3.

- Test Procedure

  1. A connection is established between the Lower Tester and IUT.
  2. The Lower Tester writes the Update Sensor Location Op Code (0x03) to the SC Control Point with a Parameter Value set to a sensor location from the RFU range.
  3. Verify that the IUT response meets the requirements of the service.

- Expected Outcome

  Pass verdict

  The IUT sends a Write Response followed by an indication of the SC Control Point characteristic with the Response Code Op Code (0x10), a Parameter Value representing Request Op Code (0x03) followed by the Response Value for 'Invalid Parameter' (0x03) and without Response Parameter.

CSCS/SEN/SPE/BI-03-C [Client Characteristic Configuration Descriptor Improperly Configured]

- Test Purpose

  Verify that the IUT responds appropriately when a Client attempts to perform an SC Control Point procedure with a Client Characteristic Configuration descriptor that is improperly configured.

- Reference

  [3] 1.6, 3.4.3

- Initial Condition

  - Perform the preamble described in Section 4.2.3.

- Test Procedure

  1. A connection is established between the Lower Tester and IUT.
  2. The Lower Tester resets to 0 the Client Characteristic Configuration descriptor of the SC Control Point characteristic.
  3. The Lower Tester writes a valid Op Code to the SC Control Point.
  4. Verify that the IUT response meets the requirements of the service.

- Expected Outcome

  Pass verdict

  The IUT rejects the Write Request by sending an Error Response with an Attribute Protocol Application Error Code set to Client Characteristic Configuration Descriptor Improperly Configured (0x81).

CSCS/SEN/SPE/BI-04-C [Procedure Already in Progress]

- Test Purpose

  Verify that the IUT responds appropriately when a Client attempts to perform an SC Control Point procedure when a procedure is already in progress.

- Reference

  [3] 1.6, 3.4.3

- Initial Condition

  - Perform the preamble described in Section 4.2.3.

- Test Procedure

  1. A connection is established between the Lower Tester and IUT.
  2. The Lower Tester sets the Client Characteristic Configuration descriptor of the SC Control Point characteristic to 1.
  3. The Lower Tester writes a valid Op Code (e.g., by executing test case CSCS/SEN/SPL/BV-01-C [Request Supported Sensor Locations] or by other means) to the SC Control Point without Parameter Value.
  4. The Lower Tester receives one Indication of the SC Control Point to acknowledge the first request. The Lower Tester does not send any Confirmation to acknowledge this Indication.
  5. The Lower Tester sends five consecutive write requests all with valid Op Codes to the SC Control Point without Parameter Value.
  6. There are two alternatives (a or b):
     a. The Lower Tester receives an Error Response with an Attribute Protocol Application Error Code set to Procedure Already In Progress (0X80).
     b. The Lower Tester receives five indications of the SC Control Point to acknowledge each request sent by the Lower Tester in Step 5.
  7. Verify that the IUT response(s) meet the requirements of the service.

- Expected Outcome

  Pass verdict

  The IUT acknowledges the first write request with appropriate Response Value.

  The IUT successfully performs one of the following alternatives (a or b):

  a. Rejects a Write Request in Step 5 by sending an Error Response with an Attribute Protocol Application Error Code set to Procedure Already In Progress (0x80).

  b. Acknowledges all five write requests with appropriate Response Values.

CSCS/SEN/SPE/BI-05-C [SC Control Point Procedure Timeout]

- Test Purpose

  Verify that the IUT stops sending indications related to the operation after an ATT Transaction Timeout.

- Reference

  [3] 3.4.4

- Initial Condition

  - Perform the preamble described in Section 4.2.3.

- Test Procedure

  1. A connection is established between the Lower Tester and IUT.
  2. The Lower Tester sends write request for any of the supported Op Codes supported by the IUT (Set Cumulative Value or Update Sensor Location or Request Supported Sensor Locations) to the SC Control Point using an appropriate Parameter for the Op Code.
  3. The IUT sends an indication of the SC Control Point characteristic with the Response Code Op Code (0x10), a Parameter Value representing the Request Op Code (0x01 or 0x03 or 0x04) followed by the Response Value for 'success' (0x01) without Response Parameter or followed with the list of the supported sensor locations (if Request Supported Sensor Locations)
  4. The Lower Tester receives an ATT_Handle_Value_Indication from the IUT containing the SC Control Point characteristic handle and value.
  5. The Lower Tester receives the indication but does not send a handle/value confirmation for an ATT Transaction Timeout plus several seconds.
  6. After the ATT Transaction Timeout, the IUT does not send any further notifications and considers the procedure to have failed.

- Expected Outcome

  Pass verdict

  The IUT stops sending any further notifications after the ATT Transaction Timeout.

  The IUT returns to a stable state and may disconnect based on implementation.

5 Test case mapping

The Test Case Mapping Table (TCMT) maps test cases to specific requirements in the ICS. The IUT is 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 logical expression based on specific entries from the associated ICS document. Contains a logical expression (using the operators AND, OR, NOT as needed) based on specific entries from the applicable ICS document(s). The entries are in the form of y/x references, where y corresponds to the table number and x corresponds to the feature number as defined in the ICS document for Cycling Speed and Cadence Service (CSCS) [4].

Feature: A brief, informal description of the feature being tested.

Test Case(s): The applicable test case identifiers are required for Bluetooth Qualification if the corresponding y/x references defined in the Item column are supported. Further details about the function of the TCMT are elaborated in [1].

For the purpose and structure of the ICS/IXIT, refer to [1].

Item	Feature	Test Case(s)
CSCS 3/1	Discover Cycling Speed and Cadence Service	CSCS/SEN/SGGIT/SER/BV-01-C
CSCS 1/1 AND CSCS 3/1	Cycling Speed and Cadence Service - SDP Record	CSCS/SEN/SGGIT/SDP/BV-01-C
CSCS 3/2	CSC Measurement Characteristic	CSCS/SEN/SGGIT/CHA/BV-01-C CSCS/SEN/CON/BV-01-C
CSCS 2/1	Wheel Revolution Data fields of CSC Measurement Characteristic	CSCS/SEN/CN/BV-01-C
CSCS 2/1	Wheel Revolution Data fields of CSC Measurement Characteristic (Forward)	CSCS/SEN/CN/BV-02-C
CSCS 3/5	Wheel Revolution Data fields of CSC Measurement Characteristic (Reverse)	CSCS/SEN/CN/BV-03-C
CSCS 2/2	Crank Revolution Data fields of CSC Measurement Characteristic	CSCS/SEN/CN/BV-04-C
CSCS 3/6	CSC Feature Characteristic Read	CSCS/SEN/CR/BV-01-C
CSCS 3/6 AND NOT CSCS 3a/2	CSC Feature Characteristic	CSCS/SEN/SGGIT/CHA/BV-02-C
CSCS 3a/2	CSC Feature Indication	CSCS/SEN/SGGIT/CHA/BV-05-C CSCS/SEN/SGGIT/ISFC/BV-01-C
CSCS 3/7	Sensor Location Characteristic	CSCS/SEN/SGGIT/CHA/BV-03-C CSCS/SEN/CR/BV-02-C
CSCS 3/8	SC Control Point Characteristic	CSCS/SEN/SGGIT/CHA/BV-04-C CSCS/SEN/CON/BV-02-C CSCS/SEN/SPE/BI-01-C CSCS/SEN/SPE/BI-03-C CSCS/SEN/SPE/BI-04-C CSCS/SEN/SPE/BI-05-C

Item	Feature	Test Case(s)
CSCS 2/1	Wheel Revolution Data Supported	CSCS/SEN/SPS/BV-01-C
CSCS 2/1 AND CSCS 3/10	Wheel Revolution Data Supported - Set Cumulative Value Procedure – Set to non-zero	CSCS/SEN/SPS/BV-02-C
CSCS 2/3	Multiple Sensor Locations Supported	CSCS/SEN/SPL/BV-01-C CSCS/SEN/SPU/BV-01-C CSCS/SEN/SPE/BI-02-C

Table 5.1: Test case mapping

6 Revision history and acknowledgments

Revision History

Publication Number	Revision Number	Date	Comments
0	1.0.0	2012-08-21	Adopted by the Bluetooth SIG Board of Directors
	1.0.1r1	2012-09-07	TSE 4938: Change wording in test case TP/CN/BV-01-C from “one or more” to “more than one.”
1	1.0.1	2012-10-31	Prepare for publication
	1.0.2r1	2013-04-23	TSE 5023: Revision of SC Control Point preamble. TSE 5075: Edits to the test procedure and pass verdict of TP/SPE/BI-04-C.
	1.0.2r2	2013-05-13	Updated TSE 5075 implementation, test procedure Step 5, “simultaneous” changed to “consecutive”
2	1.0.2	2013-07-02	Prepare for Publication
	1.0.3r1	2013-08-16	TCRL 2013-2 TSE 5237: Updated Step 2 of the Test Procedure and updated the MSC for TP/SD/BV-01-C.
3	1.0.3	2013-12-03	Prepare for Publication
	1.0.4r00	2016-05-24	Converted to new Test Case ID conventions as defined in TSTO v4.1.
	1.0.4r01	2016-06-14	Converted to current test specification template
4	1.0.4	2016-07-14	Prepared for TCRL 2016-1 publication.
	1.0.4 edition 2r00	2018-11-29	Editorial changes only. Template updated. Revision History and contributors moved to the end of the document.
5	1.0.4 edition 2	2019-11-25	Updated copyright page and confidentiality markings to support new Documentation Marking Requirements, performed minor formatting updates, and accepted all tracked changes to prepare for edition 2 publication.
	p6r00–r01	2020-09-14 – 2020-11-11	TSE 15511 (rating 1): Removed duplicated entry for test case CSCS/SEN/SD/BV-01-C from the TCMT. Minor editorial/formatting updates. Consistency Checker and template-related updates, including assigning previous v1.0.4e2 as publication 5 and updating the doc ID; updating TCID headings, locating TCID tables per latest template, and replacing the Conformance and Pass/Fail Verdict Conventions text.
6	p6	2020-12-22	Approved by BTI on 2020-12-02. Prepared for TCRL 2020-1 publication.

Publication Number	Revision Number	Date	Comments
	p7r00–r04	2022-03-18 – 2022-05-18	TSE 17258 (rating 2): Converted the following test cases to GGIT: CSCS/SEN/SD/BV-01-C and -02-C, CSCS/SEN/DEC/BV-01-C – -04-C, and CSCS/SEN/DES/BV-01-C and -02-C. The new GGIT converted TCIDs are: CSCS/SEN/SGGIT/SER/BV-01-C, CSCS/SEN/SGGIT/SDP/BV-01-C, CSCS/SEN/SGGIT/CHA/BV-01-C – -04-C. Updated TCMT accordingly. Updated the Test Groups section. Updated section cross-references the SC Control Point section of the setup preambles and in the initial condition for CSCS/SEN/CR/BV-01-C and -02-C and CSCS/SEN/CON/BV-01-C and -02-C. TSE 18435 (rating 1): Removed direct references to GATT test cases from the test procedure for CSCS/SEN/CR/BV-01-C – -02-C and CSCS/SEN/CON/BV-01-C – -02-C. Removed direct references to GATT TS sections from the ATT Bearer preambles and replaced with preamble procedure text. TSE 18714 (rating 1): Editorials to align the document with the latest TS template in anticipation of a .Z release. Performed template-related formatting fixes. Aligned copyright page with v2 of the DNMD. Consistency checker update.
7	p7	2022-06-28	Approved by BTI on 2022-05-31. Prepared for TCRL 2022-1 publication.
	p8r00	2022-08-18	TSE 19016 (rating 2): Corrected the value length for GGIT test CSCS/SEN/SGGIT/CHA/BV-04-C.
8	p8	2023-02-07	Approved by BTI on 2022-12-28. Prepared for TCRL 2022-2 publication.
	p9r00–r01	2023-09-07 – 2023-09-25	TSE 17239 (rating 4): Per E16649, added two new test cases, CSCS/SEN/SGGIT/CHA/BV-05-C and CSCS/SEN/SGGIT/ISFC/BV-01-C. Updated the TCMT accordingly. Added test group ISFC. Updated the TCMT for CSCS/SEN/SGGIT/CHA/BV-05-C. Updated the references and the TCID conventions table. Editorials to align the document with the latest TS template.
9	p9	2024-07-01	Approved by BTI on 2024-04-21. Prepared for TCRL 2024-1 publication.

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