

Volume Control Service (VCS)

Bluetooth® Test Suite

- **Revision:** VCS.TS.p0
- **Revision Date:** 2020-12-22
- **Group Prepared By:** Generic Audio Working Group



This document, regardless of its title or content, is not a Bluetooth Specification subject to the licenses granted by the Bluetooth SIG Inc. ("Bluetooth SIG") and its members under the Bluetooth Patent/Copyright License Agreement and Bluetooth Trademark License Agreement.

THIS DOCUMENT IS PROVIDED "AS IS" AND BLUETOOTH SIG, ITS MEMBERS, AND THEIR AFFILIATES MAKE NO REPRESENTATIONS OR WARRANTIES AND DISCLAIM ALL WARRANTIES, EXPRESS OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY, TITLE, NON-INFRINGEMENT, FITNESS FOR ANY PARTICULAR PURPOSE, THAT THE CONTENT OF THIS DOCUMENT IS FREE OF ERRORS.

TO THE EXTENT NOT PROHIBITED BY LAW, BLUETOOTH SIG, ITS MEMBERS, AND THEIR AFFILIATES DISCLAIM ALL LIABILITY ARISING OUT OF OR RELATING TO USE OF THIS DOCUMENT AND ANY INFORMATION CONTAINED IN THIS DOCUMENT, INCLUDING LOST REVENUE, PROFITS, DATA OR PROGRAMS, OR BUSINESS INTERRUPTION, OR FOR SPECIAL, INDIRECT, CONSEQUENTIAL, INCIDENTAL OR PUNITIVE DAMAGES, HOWEVER CAUSED AND REGARDLESS OF THE THEORY OF LIABILITY, AND EVEN IF BLUETOOTH SIG, ITS MEMBERS, OR THEIR AFFILIATES HAVE BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

This document is proprietary to Bluetooth SIG. This document may contain or cover subject matter that is intellectual property of Bluetooth SIG and its members. The furnishing of this document does not grant any license to any intellectual property of Bluetooth SIG or its members.

This document is subject to change without notice.

Copyright © 2019–2020 by Bluetooth SIG, Inc. The Bluetooth word mark and logos are owned by Bluetooth SIG, Inc. Other third-party brands and names are the property of their respective owners.



Contents

1	Scope	4
2	References, definitions, and abbreviations	5
2.1	References	5
2.2	Definitions	5
2.3	Acronyms and abbreviations	5
3	Test Suite Structure (TSS)	6
3.1	Overview	6
3.2	Test Strategy	6
3.3	Test groups	6
4	Test cases (TC)	8
4.1	Introduction	8
4.1.1	Test case identification conventions	8
4.1.2	Conformance	8
4.1.3	Pass/Fail verdict conventions	9
4.2	Setup Preambles	9
4.2.1	ATT Bearer on LE Transport	9
4.2.2	ATT Bearer on BR/EDR Transport	9
4.2.3	EATT Bearer on LE Transport	9
4.2.4	EATT Bearer on BR/EDR Transport	9
4.2.5	Volume Control Point	10
4.3	Generic GATT Integration Tests	10
	VCS/SR/SGGIT/SER/BV-01-C [Service GGIT – Volume Control]	10
	VCS/SR/SGGIT/SDP/BV-01-C [SDP GGIT – Volume Control Service]	10
	VCS/SR/SGGIT/CHA/BV-01-C [Characteristic GGIT – Volume State]	10
	VCS/SR/SGGIT/CHA/BV-02-C [Characteristic GGIT – Volume Control Point]	10
	VCS/SR/SGGIT/CHA/BV-03-C [Characteristic GGIT – Volume Flags]	10
4.4	Control Point Procedures	10
	VCS/SR/CP/BV-01-C [Relative Volume Down]	11
	VCS/SR/CP/BV-02-C [Relative Volume Up]	12
	VCS/SR/CP/BV-03-C [Unmute / Relative Volume Down]	13
	VCS/SR/CP/BV-04-C [Unmute / Relative Volume Up]	14
	VCS/SR/CP/BV-05-C [Set Absolute Volume]	15
	VCS/SR/CP/BV-06-C [Unmute Volume]	16
	VCS/SR/CP/BV-07-C [Mute Volume]	17
4.5	Service Procedure Error Handling	19
	VCS/SR/SGGIT/CP/BI-01-C [Volume Control Point – Invalid Change Counter]	19
	VCS/SR/SGGIT/CP/BI-02-C [Volume Control Point – Op Code Not Supported]	19
5	Test case mapping	20
6	Revision history and contributors	21

1 Scope

This Bluetooth document contains the Test Suite Structure (TSS) and Test Cases (TC) to test the implementation of the Bluetooth Volume Control Service 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 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 hereinafter.

- [1] Bluetooth Core Specification v4.2 or later
- [2] Bluetooth Test Strategy and Terminology Overview
- [3] Volume Control Service v1.0
- [4] Volume Control Service ICS, VCS.ICS
- [5] GATT Test Suite, GATT.TS
- [6] Characteristic and Descriptor descriptions are accessible via the [Bluetooth SIG Assigned Numbers](#).
- [7] Volume Control Service Implementation eXtra Information for Test, IXIT

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 from [1] and [2] apply.

3 Test Suite Structure (TSS)

3.1 Overview

The Volume Control Service requires the presence of GAP, SM (when used over LE transport), SDP (when used over BR/EDR transport), L2CAP, and GATT. EATT can optionally be used. This is illustrated in Figure 3.1.

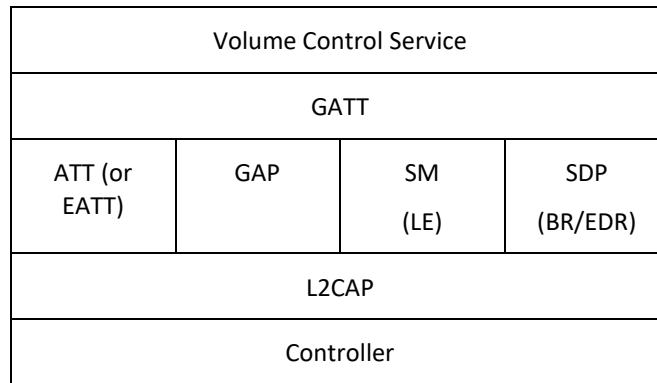


Figure 3.1: Volume Control Service Test Model

3.2 Test Strategy

The test objectives are to verify functionality of the Volume Control Service within a Bluetooth Host and to enable interoperability between Bluetooth Hosts on different devices, specifically between a VCS server and a GATT enabled client. The testing approach covers mandatory and optional requirements in the service specification and to match these to the support of the IUT as described in the ICS. Any defined test in here is applicable to the IUT, if the ICS logical expression defined in the Test Case Mapping Table (TCMT) is valid.

The 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 Volume Control Service Test Suite. 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 Volume Control Service Test Suite contains Valid Behavior (BV) tests complemented with Invalid Behavior (BI) tests where required. Additionally, since Volume Control Service is a GATT Server based service, Generic GATT Integrated Tests (GGIT) are used to validate parts of the specification. The test coverage is logically grouped in test groups and described below after careful evaluation of requirements defined in the service specification.

3.3 Test groups

The following test groups have been defined:

- Generic GATT Integrated Tests
Verify the generic GATT behavior for discovery, characteristics, descriptors, indications, notifications, etc.
- Volume Control Point Procedures
Verify the behavior of the procedure triggered by writing Opcodes to the Volume Control Point.

- Service Procedure – Error Handling

Verify that the IUT correctly handles error conditions that result from the characteristic writes or failure to perform a requested operation due to rejection of the request by a peer device.

- Validation Tests

Verify the behavior of characteristics.

4 Test cases (TC)

4.1 Introduction

4.1.1 Test case identification conventions

Test cases shall be assigned unique identifiers per the conventions in [2]. The convention used here is **<spec abbreviation>/<IUT role>/<class>/<feat>/<func>/<subfunc>/<cap>/<xx>-<nn>-<y>**.

Additionally, testing of this specification includes a set of tests from the GATT Test Suite [5] referred to as Generic GATT Integrated Tests (GGIT); when used, the GGIT tests 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>
VCS	Volume Control Service
Identifier Abbreviation	Role Identifier <IUT role>
SR	Server
Identifier Abbreviation	Feature Identifier <feat>
CP	Control Point
SGGIT	Server Generic GATT Integrated Tests
SPE	Service Procedure – Error handling
VAL	Validation

Table 4.1: VCS TC feature naming convention

4.1.2 Conformance

When conformance is claimed for a particular specification, all capabilities are to be supported in the specified manner (process-mandatory). 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 that is 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 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 generated by Launch Studio, 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 errata 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, the outcome of the test is a Fail Verdict.

4.2 Setup Preambles

The procedures defined in this section are provided as 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 an L2CAP channel (PSM 0x001F) between the IUT and the Lower Tester over that BR/EDR transport.

4.2.3 EATT Bearer on LE Transport

Preamble procedure:

1. Establish an LE transport connection between the IUT and the Lower Tester.
2. Establish an L2CAP channel 0x0005 for signaling and one L2CAP channel (for ATT bearers) with EATT PSM (as defined in Assigned Numbers) between the IUT and the Lower Tester over that LE transport.

4.2.4 EATT Bearer on BR/EDR Transport

Preamble procedure:

1. Establish a BR/EDR transport connection between the IUT and the Lower Tester.
2. Establish an L2CAP channel 0x0001 for signaling and one L2CAP channel (for ATT bearers) with EATT PSM (as defined in Assigned Numbers) between the IUT and the Lower Tester over that BR/EDR transport.

4.2.5 Volume Control Point

- Preamble Purpose

This preamble procedure enables the IUT for use with the Volume Control Point.

- Preamble Procedure

1. Establish an ATT Bearer connection between the Lower Tester and the IUT as described in Section 4.2.1, if using ATT over an LE transport, or 4.2.2 if using ATT over a BR/EDR transport, or 4.2.3 if using EATT over an LE transport, or 4.2.4 if using EATT over a BR/EDR transport.
2. The handle of the Volume Control Point characteristic has been previously discovered by the Lower Tester during a test procedure in Section 4.3 or is known to the Lower Tester by other means.
3. The handle of the Client Configuration Descriptor of the Volume State characteristic has been previously discovered by the Lower Tester during a test procedure in Section 4.4 or is known to the Lower Tester by other means.
4. If the IUT requires bonding, then the Lower Tester performs a bonding procedure.

4.3 Generic GATT Integration Tests

Execute the Generic GATT Integrated Tests defined in Section 6.3 of [5] Server Test Procedures using Table 4.2 below as input:

Test Case	Service / Characteristic / Descriptor	Reference	Properties	Value Length (Octets)
VCS/SR/SGGIT/SER/BV-01-C [Service GGIT – Volume Control]	Volume Control Service	[3] 2.1	-	-
VCS/SR/SGGIT/SDP/BV-01-C [SDP GGIT – Volume Control Service]	Volume Control Service	[3] 4	-	-
VCS/SR/SGGIT/CHA/BV-01-C [Characteristic GGIT – Volume State]	Volume State Characteristic	[3] 3.1	0x12 (Read, Notify)	3
VCS/SR/SGGIT/CHA/BV-02-C [Characteristic GGIT – Volume Control Point]	Volume Control Point Characteristic	[3] 3.2	0x08 (Write)	Skip
VCS/SR/SGGIT/CHA/BV-03-C [Characteristic GGIT – Volume Flags]	Volume Flags Characteristic	[3] 3.3	0x12 (Read, Notify)	1

Table 4.2: Input for the GGIT Server Test Procedure

4.4 Control Point Procedures

Test group to test Volume Control Point procedures.

VCS/SR/CP/BV-01-C [Relative Volume Down]

- Test Purpose

Verify that a VCS Server IUT responds to setting the Relative Volume Down Opcode and updates the Volume State characteristic.

- Reference

[3] 3.2.2.1

- Initial Condition

- Enable the IUT for use with the Volume Control Point by performing the preamble described in Section 4.2.5.
- Enable notification by writing the value 0x0001 using the GATT Write Characteristic Descriptor sub-procedure for the Volume State CCCD.
- If the Volume Flags CCCD notification is supported, enable notification by writing the value 0x0001 using the GATT Write Characteristic Descriptor sub-procedure for the Volume Flags CCCD and Volume_Setting Persisted to 0x00.
- The IUT has set its Volume_Setting to (2 x TSPX_Step_Size).

- Test Procedure

1. The Lower Tester executes the GATT Read Characteristic Value sub-procedure for the Volume State characteristic.

Repeat steps 2–5 three times

2. The Lower Tester executes the GATT Write Characteristic Value sub-procedure for the Volume Control Point characteristic with the Relative Volume Down Opcode and the Change_Counter parameter.
3. The Lower Tester receives a Write Response indicating that the IUT has accepted the Opcode.
4. The Lower Tester receives a GATT Characteristic Value Notification for the Volume State characteristic.
5. If the Volume Flags notification is supported, the Lower Tester receives a GATT Characteristic Value Notification for the Volume Flags characteristic; otherwise, the Lower Tester executes the GATT Read Characteristic Value sub-procedure for the Volume Flags characteristic.

- Expected Outcome

Pass verdict

The IUT sends a notification of the Volume State characteristic for the first two and not for the third iteration.

The Volume_Setting value is decremented by TSPX_Step_Size. The Volume_Setting does not go below 0.

The Change_Counter parameter is incremented.

In step 5, the Volume_Setting_Persisted field is 0x01.

VCS/SR/CP/BV-02-C [Relative Volume Up]

- Test Purpose

Verify that a VCS Server IUT responds to setting the Relative Volume Up Opcode and updates the Volume State characteristic.

- Reference

[3] 3.2.2.2

- Initial Condition

- Enable the IUT for use with the Volume Control Point by performing the preamble described in Section 4.2.5.
- Enable notification by writing the value 0x0001 using the GATT Write Characteristic Descriptor sub-procedure for the Volume State CCCD.
- If the Volume Flags CCCD notification is supported, enable notification by writing the value 0x0001 using the GATT Write Characteristic Descriptor sub-procedure for the Volume Flags CCCD and Volume_Setting_Persisted to 0x00.
- The IUT has set its Volume_Setting to 255 – (2 x TSPX_Step_Size).

- Test Procedure

1. The Lower Tester executes the GATT Read Characteristic Value sub-procedure for the Volume State characteristic.

Repeat steps 2–4 three times:

2. The Lower Tester executes the GATT Write Characteristic Value sub-procedure for the Volume Control Point characteristic with the Relative Volume Up Opcode and the Change_Counter parameter.
3. The Lower Tester receives a Write Response indicating that the IUT has accepted the Opcode.
4. The Lower Tester receives a GATT Characteristic Value Notification for the Volume State characteristic.
5. If the Volume Flags notification is supported, the Lower Tester receives a GATT Characteristic Value Notification for the Volume Flags characteristic; otherwise, the Lower Tester executes the GATT Read Characteristic Value sub-procedure for the Volume Flags characteristic.

- Expected Outcome

Pass verdict

The IUT sends a notification of the Volume State characteristic for the first two and not for the third iteration.

The Volume_Setting value is incremented by the TSPX_Step_Size IXIT entry until a setting of 255 is reached.

The Change_Counter parameter is incremented.

In step 5, the Volume_Setting_Persisted field is 0x01.

VCS/SR/CP/BV-03-C [Unmute / Relative Volume Down]

- Test Purpose

Verify that a VCS Server IUT responds to setting the Unmute / Relative Volume Down Opcode and updates the Volume State characteristic.

- Reference

[3] 3.2.2.3

- Initial Condition

- Enable the IUT for use with the Volume Control Point by performing the preamble described in Section 4.2.5.
- Enable notification by writing the value 0x0001 using the GATT Write Characteristic Descriptor sub-procedure for the Volume State CCCD.
- If the Volume Flags CCCD notification is supported, enable notification by writing the value 0x0001 using the GATT Write Characteristic Descriptor sub-procedure for the Volume Flags CCCD and Volume_Setting_Persisted to 0x00.
- The IUT has set its Volume_Setting to (2 x TSPX_Step_Size).
- The IUT has the Mute state set to Muted (0x1).

- Test Procedure

1. The Lower Tester executes the GATT Read Characteristic Value sub-procedure for the Volume State characteristic.
2. The Lower Tester executes the GATT Write Characteristic Value sub-procedure for the Volume Control Point characteristic with the Unmute / Relative Volume Down Opcode and the Change_Counter parameter.
3. The Lower Tester receives a Write Response indicating that the IUT has accepted the Opcode.
4. The Lower Tester receives one GATT Characteristic Value Notification for the Volume State characteristic, with all parameters changed.
5. If the Volume Flags notification is supported, the Lower Tester receives one GATT Characteristic Value Notification for the Volume Flags characteristic; otherwise, the Lower Tester executes the GATT Read Characteristic Value sub-procedure for the Volume Flags characteristic.
6. The Lower Tester executes the GATT Write Characteristic Value sub-procedure for the Volume Control Point characteristic with the Unmute / Relative Volume Down Opcode and the Change_Counter parameter.
7. The Lower Tester receives a Write Response indicating that the IUT has accepted the Opcode.
8. The Lower Tester receives one GATT Characteristic Value Notification for the Volume State characteristic, with only the Volume_Setting and Change_Counter parameters changed.

- Expected Outcome

Pass verdict

The IUT sends 2 notifications of the Volume State characteristic where Volume Settings changes twice, and the Mute State only changes once.

The Volume_Setting value is decremented by TSPX_Step_Size. The Volume_Setting does not go below 0.

The Mute value is Not Muted (0x0).

The Change_Counter parameter is incremented.

In step 5, the Volume_Setting_Persisted field is 0x01.

VCS/SR/CP/BV-04-C [Unmute / Relative Volume Up]

- Test Purpose

Verify that a VCS Server IUT responds to setting the Unmute / Relative Volume Up Opcode and updates the Volume State characteristic.

- Reference

[3] 3.2.2.4

- Initial Condition

- Enable the IUT for use with the Volume Control Point by performing the preamble described in Section 4.2.5.
- Enable notification by writing the value 0x0001 using the GATT Write Characteristic Descriptor sub-procedure for the Volume State CCCD.
- If the Volume Flags CCCD notification is supported, enable notification by writing the value 0x0001 using the GATT Write Characteristic Descriptor sub-procedure for the Volume Flags CCCD and Volume_Setting_Persisted to 0x00.
- The IUT has set its Volume_Setting to 255 – (2 x TSPX_Step_Size).
- The IUT has the Mute state set to Muted.

- Test Procedure

1. The Lower Tester executes the GATT Read Characteristic Value sub-procedure for the Volume State characteristic.
2. The Lower Tester executes the GATT Write Characteristic Value sub-procedure for the Volume Control Point characteristic with the Unmute / Relative Volume Up Opcode and the Change_Counter parameter.
3. The Lower Tester receives a Write Response indicating that the IUT has accepted the Opcode.
4. The Lower Tester receives one GATT Characteristic Value Notification for the Volume State characteristic.
5. If the Volume Flags notification is supported, the Lower Tester receives a GATT Characteristic Value Notification for the Volume Flags characteristic; otherwise, the Lower Tester executes the GATT Read Characteristic Value sub-procedure for the Volume Flags characteristic.
6. The Lower Tester executes the GATT Write Characteristic Value sub-procedure for the Volume Control Point characteristic with the Unmute / Relative Volume Up Opcode and the Change_Counter parameter.
7. The Lower Tester receives a Write Response indicating that the IUT has accepted the Opcode.
8. The Lower Tester receives one GATT Characteristic Value Notification for the Volume State characteristic.

- Expected Outcome

Pass verdict

The IUT sends 2 notifications of the Volume State characteristic where Volume_Settings changes twice and the Mute State only changes once.

The Volume_Setting value is incremented by the TSPX_Step_Size IXIT until a setting of 255 is reached.

The Mute value is Not Muted (0x0).

The Change_Counter parameter is incremented.

In step 5, the Volume_Setting_Persisted field is set to 0x01.

VCS/SR/CP/BV-05-C [Set Absolute Volume]

- Test Purpose

Verify that a VCS Server IUT responds to setting the Set Absolute Volume Opcode and updates the Volume State characteristic.

- Reference

[3] 3.2.2.5

- Initial Condition

- Enable the IUT for use with the Volume Control Point by performing the preamble described in Section 4.2.5.
- Enable notification by writing the value 0x0001 using the GATT Write Characteristic Descriptor sub-procedure for the Volume State CCCD.
- If the Volume Flags CCCD notification is supported, enable notification by writing the value 0x0001 using the GATT Write Characteristic Descriptor sub-procedure for the Volume Flags CCCD and Volume_Setting_Persisted to 0x00.
- The IUT has the Mute state set to Muted.
- The Upper Tester sets the Change_Counter field of the Volume State characteristic to 254 if the IUT supports setting of the Change_Counter.

- Test Procedure

1. The Lower Tester executes the GATT Read Characteristic Value sub-procedure for the Volume State characteristic.

Repeat Steps 2–3 for (255 – Change_Counter value) + 1 times.

2. The Lower Tester executes the GATT Write Characteristic Value sub-procedure for the Volume Control Point characteristic with the Set Absolute Volume Opcode, the Volume_Setting parameter set to a random value that is different than the current value, and the Change_Counter parameter.
3. The Lower Tester receives a Write Response indicating that the IUT has accepted the Opcode.
4. The Lower Tester receives one GATT Characteristic Value Notification for the Volume State characteristic.

5. If the Volume Flags notification is supported, the Lower Tester receives a GATT Characteristic Value Notification for the Volume Flags characteristic; otherwise, the Lower Tester executes the GATT Read Characteristic Value sub-procedure for the Volume Flags characteristic.

- Expected Outcome

Pass verdict

The IUT sends notifications of the Volume State characteristic where the Volume_Settings changed, and the Mute state did not change.

The Volume_Setting value is set to the random value.

The Change_Counter field increments and rolls over to zero.

In step 5, the Volume_Setting_Persisted field is set to 0x01.

VCS/SR/CP/BV-06-C [Unmute Volume]

- Test Purpose

Verify that a VCS Server IUT responds to setting the Unmute Opcode and updates the Volume State characteristic.

- Reference

[3] 3.2.2.6

- Initial Condition

- Enable the IUT for use with the Volume Control Point by performing the preamble described in Section 4.2.5.
- Enable notification by writing the value 0x0001 using the GATT Write Characteristic Descriptor sub-procedure for the Volume State CCCD.
- If the Volume Flags CCCD notification is supported, enable notification by writing the value 0x0001 using the GATT Write Characteristic Descriptor sub-procedure for the Volume Flags CCCD.
- The IUT has the Mute state set to Muted.

- Test Procedure

1. The Lower Tester executes the GATT Read Characteristic Value sub-procedure for the Volume State characteristic.
2. The Lower Tester executes the GATT Write Characteristic Value sub-procedure for the Volume Control Point characteristic with the Unmute Opcode and the Change_Counter parameter.
3. The Lower Tester receives a Write Response indicating that the IUT has accepted the Opcode.
4. The Lower Tester receives one GATT Characteristic Value Notification for the Volume State characteristic.
5. If the Lower Tester receives a GATT Characteristic Value Notification for the Volume Flags characteristic, then the test ends with a fail verdict.

- Expected Outcome

Pass verdict

The IUT sends a notification of the Volume State characteristic where the Volume_Setting has not changed, and the Mute value is set to Not Muted.

The Change_Counter parameter is incremented.

Fail verdict

The IUT sent a Volume Flag notification after step 2.

VCS/SR/CP/BV-07-C [Mute Volume]

- Test Purpose

Verify that a VCS Server IUT responds to setting the Mute Opcode and updates the Volume State characteristic.

- Reference

[3] 3.2.2.7

- Initial Condition

- Enable the IUT for use with the Volume Control Point by performing the preamble described in Section 4.2.5.
- Enable notification by writing the value 0x0001 using the GATT Write Characteristic Descriptor sub-procedure for the Volume State CCCD.
- If the Volume Flags CCCD notification is supported, enable notification by writing the value 0x0001 using the GATT Write Characteristic Descriptor sub-procedure for the Volume Flags CCCD.
- The IUT has the Mute state set to Not Muted.

- Test Procedure

1. The Lower Tester executes the GATT Read Characteristic Value sub-procedure for the Volume State characteristic.
2. The Lower Tester executes the GATT Write Characteristic Value sub-procedure for the Volume Control Point characteristic with the Mute Opcode and the Change_Counter parameter.
3. The Lower Tester receives a Write Response indicating that the IUT has accepted the Opcode.
4. The Lower Tester receives one GATT Characteristic Value Notification for the Volume State characteristic.
5. If the Lower Tester receives a GATT Characteristic Value Notification for the Volume Flags characteristic, then the test ends with a fail verdict.

- Expected Outcome

Pass verdict

The IUT sends a notification of the Volume State characteristic where the Volume_Setting has not changed, and the Mute value is set to Muted.

The Change_Counter parameter is incremented.

Fail verdict

The IUT sent a Volume Flag notification after step 2.

4.5 Service Procedure Error Handling

Test Case	Control Point Characteristic	Reference	TC Configuration	Parameter(s)	Pass Verdict
VCS/SR/SGGIT/CP/BI-01-C [Volume Control Point – Invalid Change Counter]	Volume Control Point Characteristic	[3] 3.2.2	Test procedure run in rounds. 1: Opcode = Relative Volume Down 2: Opcode = Relative Volume Up 3: Opcode = Unmute/Relative Volume Down 4: Opcode = Unmute/Relative Volume Up 5: Opcode = Set Absolute Volume 6: Opcode = Unmute 7: Opcode = Mute	Change_Counter = different than current one	Invalid Change Counter (0x80)
VCS/SR/SGGIT/CP/BI-02-C [Volume Control Point – Op Code Not Supported]	Volume Control Point Characteristic	[3] 1.6		Opcode = 0x07 (RFU)	Op Code Not Supported(0x81)

Table 4.3: Service Procedure Error Handling Generic Test Cases

5 Test case mapping

The Test Case Mapping Table (TCMT) maps test cases to specific requirements in the ICS. The IUT will 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 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 Volume Control Service.

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

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 the purpose and structure of the ICS/IXIT and instructions for completing the ICS/IXIT, refer to the Bluetooth ICS and IXIT Proforma documents.

Item	Feature	Test Case(s)
VCS 1/1	Service Supported over BR/EDR	VCS/SR/SGGIT/SDP/BV-01-C
VCS 1/1 OR VCS 1/2	Volume Control Service	VCS/SR/SGGIT/SER/BV-01-C
VCS 2/1	Volume State Characteristic	VCS/SR/SGGIT/CHA/BV-01-C
VCS 2/2	Volume Control Point Characteristic	VCS/SR/SGGIT/CHA/BV-02-C VCS/SR/SGGIT/CP/BI-01-C VCS/SR/SGGIT/CP/BI-02-C
VCS 2/3	Volume Flags Characteristic	VCS/SR/SGGIT/CHA/BV-03-C
VCS 3/1	Relative Volume Down Procedure	VCS/SR/CP/BV-01-C
VCS 3/2	Relative Volume Up Procedure	VCS/SR/CP/BV-02-C
VCS 3/3	Unmute / Relative Volume Down Procedure	VCS/SR/CP/BV-03-C
VCS 3/4	Unmute / Relative Volume Up Procedure	VCS/SR/CP/BV-04-C
VCS 3/5	Absolute Volume Up Procedure	VCS/SR/CP/BV-05-C
VCS 3/6	Unmute Procedure	VCS/SR/CP/BV-06-C
VCS 3/7	Mute Procedure	VCS/SR/CP/BV-07-C

Table 5.1: Test case mapping

6 Revision history and contributors

Revision History

Publication Number	Revision Number	Date	Comments
	d09r00–r10	2019-05-15 – 2019-12-12	Track VolumeControlService_d09r03. Address PTS Comments. Track VolumeControlService_d09r05 and Seoul IOP Feedback. Track VolumeControlService_d09r06. Address BTI Comments and track VolumeControlService_d09r09. Changes for TCA. Changes for E12555, E12621, E12945. Update the EATT preambles to match the Media Control version. Address BTI comments to test template raised against Media Control. Remove the heading numbers in the Test Case Configuration Table TCIDs.
	p0r00–r06	2019-12-15 – 2020-10-27	Resolved formatting, hyperlink, cross references, capitalization, TCMT, and other minor editorial corrections. Update some control point tests to use the GGIT control point template. Format tables using the new BTI proposed format. Remove heading numbers in all headings with TCIDs. Integrate E13391. Integrate E15105, Test Issue 15701. Update contributors list.
0	p0	2020-12-22	Approved by BTI on 2020-11-29. VCS v1.0 adopted by the BoD on 2020-12-15. Prepared for publication.

Contributors

Name	Company
Dejan Berec	Bluetooth SIG, Inc.
Gene Chang	Bluetooth SIG, Inc.
Charlie Lenahan	Bluetooth SIG, Inc.
Jawid Mirani	Bluetooth SIG, Inc.