



SDARS Reception Drive Test

1 Introduction

Note: Nothing in this standard supercedes applicable laws and regulations.

Note: In the event of conflict between the English and domestic language, the English language shall take precedence.

1.1 Purpose. To determine the Satellite Digital Audio Radio Service (SDARS), i.e., SiriusXM satellite radio, reception performance of a vehicle.

The requirements stated in this document supersede all Component Technical Specifications (CTS), Subsystem Technical Specifications (SSTS), and Vehicle Technical Specifications (VTS) that pertain to AM/FM tuner components until Model Year (MY) MY2022, after which all requirements will reside in Dynamic Object Oriented Requirements System (DOORS).

1.2 Applicability. This test procedure shall apply to all GM vehicle audio systems capable of reception and playback of SDARS that will be marketed and sold inside the United States of America and Canada. This procedure applies to passenger vehicles and light-duty trucks.

1.3 Remarks. The results of this test will be a collection of probability plots indicating the probability versus reception quality over each of the time-based routes and a graphical map for the location-based routes. The value of Good Reception and Reed Solomon Errors (RSE) will be used as the pass/fail criteria. Good Reception and RSE on any route shall be defined as either time-based or location-based.

1.3.1 The operational status of the SDARS repeater network shall be confirmed prior to testing and after testing when necessary. SiriusXM shall be contacted at least five (5) business days in advance of any test, to provide sufficient rescheduling of any routine work that may be planned.

1.3.2 For all routes, the acceptance criteria will be based on the performance delta compared to a known Good Reception and RSE Reference Vehicle (RV) that is tested simultaneously with the Vehicle Under Test (VUT).

1.3.3 Satellite-Only reception criteria shall be adjusted to account for seasons of the year due to changes in foliage and temperature that affect satellite reception. Summer conditions are typically May through October with both tree foliage $\geq 50\%$ and the outdoor temperature $> 0^\circ\text{C}$ ($> 32^\circ\text{F}$). Spring/Fall conditions typically occur during the months of April and November with both tree foliage $< 50\%$ and the outdoor temperature $> 0^\circ\text{C}$ ($> 32^\circ\text{F}$). Winter conditions are typically December through March with any temperature $\leq 0^\circ\text{C}$ ($\leq 32^\circ\text{F}$) regardless of foliage. The months of year are only typical for Southeast Michigan, and vary across the continental United States. Temperature and foliage shall always be the Summer, Spring/Fall, and Winter requirement.

2 References

Note: Only the latest approved standards are applicable unless otherwise specified.

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

GMW15649 GMW16261

2.3 Additional References.

- Antenna, Infotainment and Telematics Performance SharePoint site. at Uniform Resource Locator (URL) <https://share.gm.com/sites/MPGInfoDevVal/Documents/Forms/AllItems.aspx?RootFolder=%2Fsites%2FM>

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PGInfoDevVal%2FDocuments%2FSDARS&FolderCTID=0x012000788D0A9DA7EBDD40882C485A97B14450&View=%7B558478A3%2D61B3%2D4414%2D9432%2D019794B8B092%7D (ID)

- Applicable Tuner Diagnostic Specification
- CG4071 SDARS Reception Routes (ID)
- Component Technical Specifications (CTS)
- Subsystem Technical Specifications (STS)
- SX-9835-0024 Type Acceptance Field Test Procedure available from SiriusXM at URL <http://www.siriusxm.com/contactus>
- SX-9835-0046 Type Approval Part Two Receiver Hardware Requirements available from SiriusXM at URL <http://www.siriusxm.com/contactus>
- Vehicle Technical Specifications (VTS)

(ID) = These references are limited to internal use within General Motors and shall not be accessed outside this company. Contact the GM Lead Engineer for further instructions.

3 Resources

3.1 Facilities. The infrastructure for SDARS is only available in North America. For vehicles originating at an engineering center outside of North America, a workshare agreement shall reflect that SDARS testing for all applicable vehicles to be sold in North America will be tested in the United States. Testing for SDARS shall take place on the public roads of Southeast Michigan and/or other areas of the continental United States as approved by General Motors Antenna, Infotainment and Telematics Performance Development/Validation personnel. Routes may or may not be coincident with those specified by SiriusXM in SX-9835-0024.

3.1.1 Calibration. The test facilities and equipment shall be in good working order and shall have a valid calibration label.

3.1.2 Alternatives. Alternative test facilities and equipment may also be used. However, all measuring variables as specified in this standard shall be determined correctly with respect to their physical definition.

3.2 Equipment.

3.2.1 Two laptop computers with serial and Global Positioning System (GPS) data capability and Microsoft Excel (a spreadsheet program).

3.2.2 Two alternating Current/Direct Current (AC/DC) inverters to power the laptops.

3.2.3 Two GPS receivers or the ability to capture geo-location data from the vehicle network.

3.2.4 Two digital audio recorders (optional) to record audio aberrations/disturbances (mutes).

3.3 Test Vehicle/Test Piece. The VUT shall have a SiriusXM type approved receiver, as specified by SiriusXM in SX-9835-0046, and an antenna/cable assembly that has been verified per GMW15649 and GMW16261.

Note: Testing should be performed using the poorest performing antenna and worst case VUT configuration, e.g., sunroof open, convertible top down, etc. based on antenna component testing and weather permitting. The VUT shall be in a customer usable state, i.e., seats shall be in their upright positions, trim pieces installed, as appropriate.

3.4 Test Time.

Calendar time: 2 d

Test time: 3.5 h

Coordination time: 8 h

3.5 Test Required Information. Not applicable.

3.6 Personnel/Skills. The test personnel shall have a valid driver's license and be familiar with the operation of serial and GPS data tools.

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4 Procedure

4.1 Preparation. The SiriusXM repeater network operational status (see 1.3.1) should be reconfirmed with SiriusXM 24 h in advance to ensure the repeater network in the test area is operating normally.

4.1.1 Verify the VUT has the intended SiriusXM type approved receiver, as specified by SiriusXM in SX-9835-0046, and an antenna/cable assembly that has been verified per GMW15649 and GMW16261. If the receiver cannot be verified as type approved, do not move on with the tests.

4.1.2 Prepare data sheets, e.g., Data Sheet A1, Appendix A to record the following information for the VUT and RV prior to testing:

- Vehicle identification number
- VUT content that may impact SDARS reception, e.g., roof racks, spoilers, sunroofs, etc. and their state during the test, e.g., open, closed, up, down, etc.
- Electronic Serial Number (ESN) of the SDARS receiver, i.e., SiriusXM radio identification, receiver part number, serial number, software level, etc.
- Antenna part number and serial number
- Antenna cable part number, if applicable

4.1.3 Fully fuel and prepare the VUT and RV for a 483 km (300 mi) trip.

4.1.4 Mount the GPS receivers on the VUT and RV with a clear view of the sky and interface the GPS receivers to the laptop computers or ensure vehicle network geo-location messages are being captured.

4.1.5 Interface the laptops to the VUT and RV serial data buses and initiate requests for Bit Error Rate (BER), RSE, and GPS data. Review the data to ensure it is being collected correctly. If the Electronic Control Unit (ECU) does not respond to BER and RSE diagnostic messages in < 200 ms, do not move on with the tests.

Note: Coordinate GPS data coincident with BER data during the tests. The BER should be low in open areas, and high, or maximum, when the vehicle is parked inside a building. When the BER for both satellites and terrestrial increases to the point where audio is not available, the RSE values for both satellite and terrestrial should be 100%.

4.1.6 Install the digital audio recorders on the VUT and RV (optional) to record audio aberrations/disturbances (mutes).

4.1.7 Set ensemble channel based on the test route type (see 4.3.1). Channel changes shall not be made during each test. A channel with program material familiar to the person performing the test should be used for easier identification of audio aberrations/disturbances (mutes). Verify the latest physical to logical channel mapping with SiriusXM prior to testing. GM test personnel can find this mapping on the Antenna, Infotainment and Telematics Performance SharePoint site.

4.2 Conditions. For any test on a Satellite-Only route, the amount of foliage must be estimated and recorded on the data sheet, e.g., Data Sheet A1, Appendix A, on a scale of 0% to 100% with 0% being Winter with no foliage and 100% being Summer with full foliage as well as the temperature for that specific route during the test. See 5.2.4.

4.2.1 Environmental Conditions. Record weather conditions and temperature at the start and end of test on the data sheet, e.g., Data Sheet A1, Appendix A.

4.2.2 Test Conditions. Deviations from the requirements of this standard shall have been agreed upon. Such requirements shall be specified on component drawings, test certificates, reports, etc.

4.3 Instructions. Drive the VUT and RV on the test routes (see 4.3.1) while recording/monitoring serial, GPS and audibility data (see 4.3.2). Document route locations/maps, type of data collection and equipment used (time-based or location-based), route drive time, for time-based routes, binning distance for location-based routes, and ensemble. These are already defined in CG4071 for GM test personnel. The supplier shall work with the GM Design Responsible Engineer to comprehend this requirement.

4.3.1 Test Routes. There are four categories of test routes. Multiple routes of the same category may be required depending on the specific conditions that route was designed to test. These routes may be located anywhere in the continental United States.

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Note: Whenever possible, avoid driving close to large vehicles such as semi-tractor trailers since large vehicles can "shadow" the SDARS antenna, affecting the data and possibly causing audio aberrations/disturbances (mutes). All test routes assume the legal speed limit is observed.

4.3.2.1 Satellite-Only. Areas where only satellite signal and no decodable terrestrial signal is available.

4.3.2.2 General/3-Stream. Areas with both satellite and terrestrial signal available.

4.3.2.3 Overload/Strong Coded Orthogonal Frequency Division Multiplex (COFDM) Overload. Areas near a SiriusXM repeater with strong terrestrial signals.

4.3.2.4 Wireless Communications Service (WCS). Areas near a WCS downlink tower or locations of dense WCS uplink devices.

4.3.2 Parameters to Record/Monitor.

4.3.1.1 Serial Data. BER and RSE parameters as follows, available from the SiriusXM chipset firmware and over the GM serial data network as defined in the applicable tuner diagnostic specification. The Electronic Control Unit (ECU) shall respond to BER and RSE diagnostic messages in < 200 ms.

- Satellite 1 BER
- Satellite 2 BER
- Terrestrial BER
- Satellite RSE
- Terrestrial RSE

4.3.1.2 GPS Location. Coordinated GPS data coincident with BER data.

4.3.1.3 Audibly Data. Audio aberrations/disturbances (mutes) shall be recorded on the data sheet, e.g., Data Sheet A1, Appendix A for informational purposes only. A minor mute is ≤ 1 s and a major mute is > 1 s. The location and number of major and minor mutes and the length of all major mutes shall be recorded. There are no requirements for mutes, data is for reference only.

5 Data

5.1 Calculations.

5.1.1 Time-Based Route Calculations. The time-based route data calculation is a series of probability function calculations. These calculations are plotted in a BER probability chart. The probability function for a specific BER over a route is as follows:

$$Probability = \frac{\text{Number of lines below specific BER}}{\text{Total number of BER readings for that route}}$$

Example: Five data points with a range from 0 to 10 (unitless) as follows: 0.7, 1.7, 2.7, 2.7, 4.3

$$Probability (1) = \frac{1}{5} = 0.2$$

$$Probability (2) = \frac{2}{5} = 0.4$$

$$Probability (3) = \frac{4}{5} = 0.8$$

$$Probability (4) = \frac{4}{5} = 0.8$$

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