



Remote Function Actuation System Range Performance

1 Scope

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 vehicle level operating range performance of the Remote Function Actuation (RFA) subsystem in various operational environments. These include open range, temperature, humidity, and jamming by on-board and external sources.

1.2 Foreword. This test procedure is primarily a performance test that can be used for development and validation purposes. This procedure is divided into sections that can be run independently of one another, depending on performance concerns and the criteria defined by the GM Component Technical Specification (CTS) or Subsystem Technical Specification (SSTS).

1.3 Applicability. This procedure applies to all vehicles with active Remote Function Actuation systems. These include but are not limited to RFA, Remote Keyless Entry (RKE), Remote Start, Remote Control Door Lock (RCDL), and Easy Key active systems. This procedure does not apply to passive RFA systems.

2 References

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

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

None

2.3 Additional References.

- ISO Work Instruction EN-6.3-W-EMCTV-0071 for RFA remote start test using turntable.
- ISO Work Instruction EN-XX-W-EMCTV-0062 for RFA jamming test using turntable
- Radio Frequency (RF) Receiver CTS.
- RF Transmitter CTS.
- RFA SSTS.

3 Resources

3.1 Facilities. Any open range area, free from Electromagnetic Interference (EMI) that meets the criteria in Appendix D. Examples in the United States include GM Milford Proving Ground (MPG) Antenna Range (Building 95) which can be reserved on-line at myfacility.gm.com using the Resource Scheduler. Contact the Electromagnetic Compatibility (EMC) Department at MPG for further assistance.

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. Complete the Instrumentation Calibration Data Sheet A1 in Appendix A.

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3.2.1 Thermo-Hygrometer or similar device to measure ambient air temperature, vehicle interior temperature, and relative humidity.

3.2.2 Digital Multimeter capable of 0 V to 18 V measurements.

3.2.3 Metric ruler or measuring stick (1 m).

3.2.4 Angle template (remote site test only).

3.2.5 Rope 11 m long (remote site test only).

3.3 Test Vehicle/Test Piece. Test vehicle equipped with the RFA system to be tested (fobs/receiver).

3.3.1 For validation testing, the vehicle shall be of the proper build phase with production intent wire harnesses and routings.

3.3.2 All RFA parts to be tested shall have passed component level testing prior to performing these vehicle level tests. If necessary, samples should be provided representing nominal, best-case, and worst-case performance ratings.

3.3.3 Other electrical components on the test vehicle shall be of the latest EMC design to test for any interference with the RFA system.

3.4 Test Time.

Calendar time: 1 to 3 days

Test hours: 5 to 10 hours

Coordination hours: 1 to 2 days

3.5 Test Required Information.

3.5.1 Obtain the RFA range specifications per the appropriate SSTS/CTS (or requesting engineer) for the following variable values. Typical values for these variables are listed in Table 1.

Maximum Range: Maximum test range.

Specified Range: Range performance defined by the SSTS/CTS.

EMI Range: Allowable range in the presence of jamming due to on-board or off-board electromagnetic (EM) fields.

Wait: Time between button presses of the fob.

Angle: Degree increment between test points.

Percent: Percentage of data points that must meet the range performance specification.

Pass: Calculated number of data points that must meet the range performance specification.

Pause: Time to wait between data points (to allow for receiver to reset, sleep, etc.)

Table 1: Typical Variable Values

Variable	Development/Validation	Remote Site	Remote Start Validation
Maximum Range	Refer to RFA SSTS	Refer to RFA SSTS	Refer to RFA SSTS
Specified Range:			
315 MHz	Refer to RFA SSTS	Refer to RFA SSTS	Refer to RFA SSTS
433 MHz	Refer to RFA SSTS	Refer to RFA SSTS	Refer to RFA SSTS
EMI Range	Refer to RFA SSTS	Refer to RFA SSTS	Refer to RFA SSTS
Wait	0.5 s	0.5 s	1.0 s
Pause	1.0 s	1.0 s	2.0 s
Angle	5 degrees to 15 degrees	45 degrees	5 degrees
Percent	Refer to RFA SSTS	Refer to RFA SSTS	Refer to RFA SSTS
Pass	Refer to RFA SSTS	Refer to RFA SSTS	Refer to RFA SSTS

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3.5.2 Determine with the requesting engineer the sections of 4.2.2 that will be tested and if any functions other than lock/unlock will need to be tested for 4.2.2.7 and 4.2.2.9.

3.6 Personnel/Skills. No special skills are required. Driving privileges at MPG will be needed to access those sites.

4 Procedure

4.1 Preparation.

4.1.1 Test Information. Complete the Test Information Data Sheet A2 in Appendix A. Install the RFA receiver and transmitter to be tested. Verify the location and orientation of the receiver per instructions provided by the requesting engineer. If none given, use the production design intent location and orientation.

4.1.2 Test Setup – Test Pad. Park the test vehicle on the center dot of the test pad facing the direction marked zero degrees. Center the vehicle over the dot (left/right and front/back). The front of the vehicle is defined as zero degrees and testing will proceed **clockwise** around the vehicle. Program the vehicle, if possible, for audible and visual RFA activation verification (usually horn honks and flashing headlamps) to make it easier to detect an activation. Place the vehicle in Park, turn ignition off, remove keys/fob, close and lock all doors as if parked at a shopping center, etc. Measure the vehicle battery voltage and the fob battery voltage. Replace the fob battery if necessary. Complete the rest of the test data sheet header information.

4.1.3 Test Setup – Turntable. If a turntable is to be used, refer to ISO Work Instruction EN-6.3-W-EMCTV0071 or specific setup instructions for the equipment.

4.1.4 Test Setup – Remote Site. Create an angle template as shown in Appendix B. Affix the template to the center of the roof of the vehicle, with 0 degrees facing front center.

Use Range Finder Device.

4.1.5 Holding the Key Fob. Measure 1 m from the ground to a point along the right side of your body. This is the height you must hold the fob for the entire test. Hold the fob in your hand with index finger curled under fob (current fobs have a groove on the underside). The fob polarization positions shown in Figure 1 are the most common.

4.1.5.1 Place your forearm and elbow against your body, extending your hand so that the fob is 1 m in height from the ground and 15 cm (6 in) in front of your body. Press fob buttons with thumb only, unless multiple buttons need to be pressed simultaneously.

4.1.5.2 The most common sources of test to test variation come from how the key fob is held (height, distance from body, orientation) and routing of the wire harness to the receiver. Be sure to keep these factors in control. Do not wear gloves or jewelry on the hand being used to hold the fob.

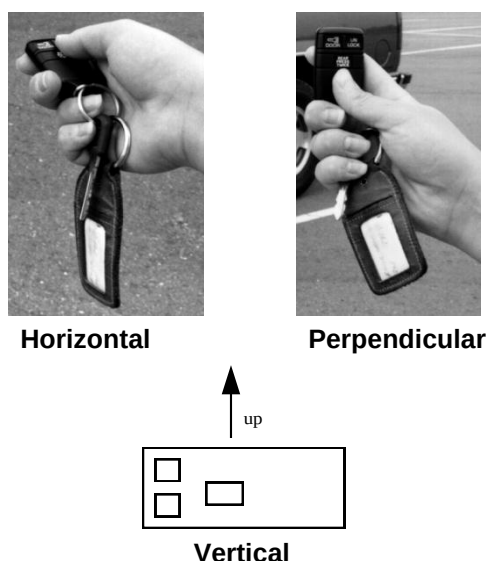


Figure 1: Fob Positions

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4.2 Conditions.

4.2.1 Environmental Conditions. Testing can be completed under any ambient temperature as described in 4.2.2. See the RFA CTS or SSTS for any limitations.

Allow enough time for the vehicle interior temperature to come to ambient or test conditions. Measure and record weather conditions on the test data sheet.

Unless directed by the requesting engineer, do not test when it is, raining or snowing, or there is standing water or dense fog on the test pad. Test variations in these conditions have not been thoroughly studied.

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.

Validation testing should perform all of the following conditions unless directed otherwise by the requesting engineer.

4.2.2.1 Right Hand, Open Range, Normal Ambient. Baseline RFA range performance with no outside influences (jamming, temperature, humidity) using the right hand to activate the fob in the horizontal position from Figure 1.

4.2.2.2 Left Hand, Open Range, Normal Ambient. Same as preceding, using the left hand to activate the fob.

4.2.2.3 Vertical, Open Range, Normal Ambient. Test using worst case hand from preceding using vertical hand position shown in Figure 1.

4.2.2.4 High Temperature, Open Range. Test with vehicle interior temperature (at receiver) $\geq 60^{\circ}\text{C}$ (140°F). Test using worst case hand and position.

4.2.2.5 Low Temperature, Open Range. Test with vehicle interior temperature (at receiver) $< 0^{\circ}\text{C}$ (32°F). Test using worst case hand and position.

4.2.2.6 On-Board EMI Jamming, Open Range. Turn on as many continuously running EMI sources as possible. See examples in Table 2.

Test using worst case hand and position. Substitute the Variable EMI Range for the Specified Range in the instructions. If significant range degradation is found, turn off noise sources one at a time and retest to identify the root cause source.

Table 2: EMI Noise Sources ^{Note 1}

Engine running at idle	Interior lights Pulse Width Modulated (PWM)
Engine cooling fan	Rear defogger grid
HVAC blower (front)	Radio tune to 105.1 FM
HVAC blower (rear)	Rear entertainment
Wipers (front and rear)	Displays Driver Information Center (DIC), Heads Up Display (HUD)
Seat heat/message	Video screens
Ventilated seat fan	Headlights High Intensity Discharge (HID)
Panic alarm horn	Other electric motors

Note 1: Use the highest speed settings unless another speed is known to be worst case or specified by the requesting engineer.

4.2.2.7 Remote Start, Open Range, Normal Ambient. Test using the worst case hand and position from preceding. Substitute the Remote Start button function for Unlock and Remote Stop button function for Lock in the instructions. Substitute **cycle** for **data point** in the instructions. Wait time is time between a successful Remote Start and Remote Stop function. Contact requesting engineer for button press sequence and time delay requirements to perform Remote Start and Remote Stop functions.

4.2.2.8 External EMI Jamming Sources. Perform in an EMC chamber (per ISO Work Instruction EN-XX-W-EMCTV0062). Large RF transmitting facilities (AM/FM, TV, cell phone, radar, etc.) in South East Michigan and

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other parts of the United States are listed in Table C1 in Appendix C. Select sites with the assistance of the requesting engineer and/or EMC Engineer in your region especially if there have been customer complaints. Test with worst case hand and position. Substitute the Variable EMI Range for the Specified Range in the instructions.

4.2.2.9 Other RFA Functions. If the transmitter performs functions that have a different range than the lock/unlock function or that require a button(s) to be continuously depressed while performing the function, then repeat tests 4.2.2.1, 4.2.2.2 and 4.2.2.3 for each of these other functions.

4.3 Instructions.

4.3.1 Specified Range Validation (Pass/Fail). Record the Pass/Fail Range Test results on Data Sheet A3 in Appendix A. Start at the 0 degree test radius (front of vehicle) at the Specification Range marking, holding the fob as described in 4.1.5 for the condition being tested. Make sure that your hand and the fob, **not your body**, are centered over the line of dots. Your body should be positioned to the side of the line of dots. Perform the following steps:

4.3.1.1 Press the Unlock button on the fob with your thumb.

4.3.1.2 If there is an **activation**, then attempt to obtain a **data point**, allowing at least WAIT seconds between button presses.

4.3.1.3 If a **data point** is obtained, then mark YES on Data Sheet A3, Appendix A for that test radius. If not, mark NO on the data sheet.

4.3.1.4 Move ANGLE degrees clockwise to the next test radius and wait at least PAUSE seconds.

4.3.1.5 Repeat 4.3.1.1 thru 4.3.1.4 around the vehicle until you return to 0 (360) degrees.

4.3.2 Maximum Range Development Test (Polar Plot). Record the test results on Data Sheet A3 or Data Sheet A4 of Appendix A as needed. Start at the 0 degree test radius (front of vehicle) at the Maximum Range marking, holding the fob as described in 4.1.5 for the condition being tested. Make sure that your hand and the fob, **not your body**, are centered over the line of dots. Your body should be positioned to the side of the line of dots. Perform the following steps:

4.3.2.1 Press the Unlock button on the fob with your thumb.

4.3.2.2 If there is an activation, then attempt to obtain a data point, pausing at least WAIT seconds between unlock and lock.

4.3.2.3 If a **data point** is obtained, then mark MAXIMUM RANGE + on the data sheet for that test radius and skip to step 4.3.2.8.

4.3.2.4 If a **data point** is not obtained, move forward 2.5 m.

4.3.2.5 Press the Unlock button on the fob with your thumb.

4.3.2.6 If there is an **activation**, then attempt to obtain a **data point**, allowing at least WAIT seconds between button presses.

4.3.2.7 If a **data point** is obtained, then mark your current distance on the data sheet for that test radius. If not, then go back to step 4.3.2.4.

4.3.2.8 Move ANGLE degrees clockwise to the next test radius and wait at least PAUSE seconds.

4.3.2.9 Repeat steps 4.3.2.1 through 4.3.2.8 around the vehicle until you return to 0 (360) degrees.

4.3.3 Remote Site External Jamming Test. Record all details of the site being used (address, distance and type of EM sources, etc.) and the test results on Data Sheet A5 (45 degrees) or Data Sheet A6 (30 degrees) of Appendix A. Additional setup is required per 4.1.3. Start at the 0 degree test radius (front of vehicle), holding the fob in worst case test position. Hold the end of the test rope in the opposite hand from the fob, in a similar fashion to holding the fob. Pull the rope taut and align over the 0 degree template marking on the roof of the vehicle. Start so that the Maximum Range tape marking is in your rope hand. Perform the following steps:

4.3.3.1 Press the Unlock button on the fob with your thumb.

4.3.3.2 If there is an **activation**, then attempt to obtain a **data point**, allowing at least WAIT seconds between button presses.

4.3.3.3 If a **data point** is obtained, then mark MAXIMUM RANGE + on the data sheet for that test radius and skip to step 4.3.3.8.

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