



Inside Rear View Mirrors – Auto-Dimming Reflectance Requirements

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 Scope. This standard establishes the minimum requirements and associated test methods that apply to all Auto-Dimming (i.e., ElectroChromic (EC), or variable reflectance) Inside Rear View Mirrors (ISRVs) for use in passenger cars, multi-purpose passenger vehicles and trucks, engineered by General Motors, for the worldwide market. Requirements that apply uniquely to other types of mirrors and their features are found in other documents. Certain variable reflectance parameters are specified differently when a **Transflective** coating is applied (i.e., for **display on demand** video or other devices), which are noted throughout as **Transflective**.

1.2 Mission/Theme. Not applicable.

1.3 Classification. Not applicable.

2 References

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

2.1 External Standards/Specifications.

IEC 60068-2-13

2.2 GM Standards/Specifications.

GMW3059 GMW15898
GMW3172 GMW16162
GMW15760

2.3 Additional References.

- GM DFSS Project 2063
- GM Global Best Practice ISRV-6
- GM Global Best Practice ISRV-13
- GM Global Best Practice ISRV-30
- GM Global Best Practice ISRV-42
- GM Global Best Practice ISRV-49

- GM ISRV Knowledge Set ISRV-S1017
- International Commission on Illumination at www.cie.co.at
- International Electrotechnical Commission (IEC) at www.iec.ch

3 Requirements

3.1 System/Subsystem/Component/Part Definition.

3.1.1 Appearance. The ISRVs shall meet the Appearance requirements of GMW16162.

3.1.1.1 Styling. The ISRVs shall meet the Styling requirements of GMW16162.

3.1.1.2 Perceived Quality. The ISRVs shall meet the Perceived Quality (PQ) requirements of GMW16162.

3.1.1.3 Color, Gloss, and Grain. The ISRVs must meet the Color, Gloss, and Grain requirements of GMW16162.

3.1.2 Content.

3.1.2.1 Physical Content. Not applicable.

3.1.2.2 Functional Content.

3.1.2.2.1 Ambient Light Sensor (ALS) Calibrations. Auto-Dim ISRVs with GMLAN capability shall have an alternative ALS calibration to address conditions where the ALS field of view (FOV) is blocked (i.e., by a vehicle's Sensor Farm, windshield blackout, etc.) below the minimum visibility criteria. Reference 3.1.4.3.

3.1.2.2.1.1 Alternative Operating Range. This alternative 80% calibration shall maintain the same range of ALS visibility as the default settings, but shift the maximum down from 100% to 80%, and the minimum down from 70% to 50%.

3.1.2.2.1.2 80% Calibration Activation. The General Motors Local Area Network (GMLAN), capable ISRV shall have both the default ALS calibration and the alternative 80% calibration preloaded from the supplier. If the 80% calibration is required for certain vehicles and/or Regular Production Options (RPOs), it shall be activated (i.e., to over-ride the default settings) by a software "flash" at the vehicle assembly plant.

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3.1.3 Ambient Environment. Unless otherwise specified, the ambient environment conditions (i.e., T_{room}) of GMW16162 shall be applied to this standard.

3.1.3.1 Nominal Voltage. Unless otherwise specified, the nominal voltage (U_{nom}) as defined in GMW16162 shall be applied to this standard.

3.1.4 Interfaces. All the interface requirements of GMW16162 shall be met.

3.1.4.1 ISRVM Wiring Pinouts. All Auto-Dimming ISRVMs shall utilize common wiring pinouts. There are two basic arrangements, depending upon whether GMLAN is part of the ISRVM circuit or not. Care has been taken in the design of these two pinouts to eliminate the potential for ISRVM damage and/or vehicle damage in the event of a "wrong mirror installed" operator error in the vehicle assembly plant.

If there are additional input signals required for a specific application and/or feature that are not covered by the non-GMLAN (hardwired) pin arrangement, then GMLAN must be utilized to accommodate this demand.

Optional feature-driven circuits are labeled as "reserved"; it is not required to install a terminal if the ISRVM's feature content does not need that particular input/output. Detailed pinouts per ISRVM feature content (listed per RPO codes) are in the Interface Control Document (ICD). The ISRVM's electrical connector and its common terminal layout/orientation referenced in the ICD are shown in Figure 1.

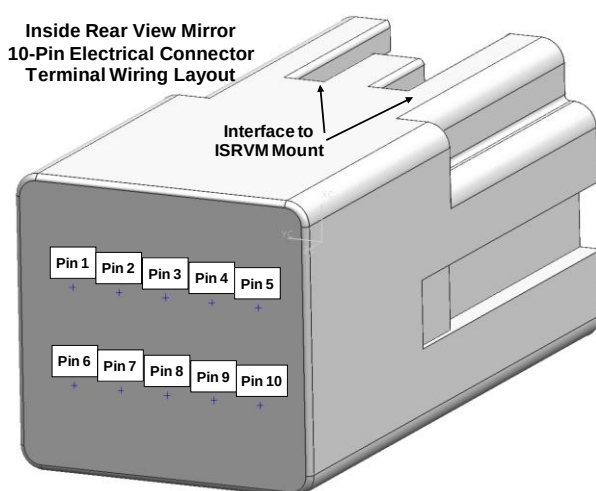


Figure 1: ISRVM Electrical Connector

3.1.4.1.1 Non-GMLAN Pinout Strategy. The following is the non-GMLAN (hardwired) terminal pinout arrangement.

- Pin 1 = Backup Lamp Supply Voltage
- Pin 2 = Run/Crank Ignition 1 Voltage
- Pin 3 = Reserved for OnStar Keypad Out
- Pin 4 = Reserved for OnStar Keypad Power
- Pin 5 = Ground
- Pin 6 = Reserved for OnStar Enabled (Green LED)
- Pin 7 = Reserved for OnStar Fault (Red LED)
- Pin 8 = OSRVM ElectroChromic (-)
- Pin 9 = OSRVM ElectroChromic (+)
- Pin 10 = Open

3.1.4.1.1.1 Pin 2 and Pin 5 are to be twisted pair wires (highly recommended) on the vehicle's wire harness.

3.1.4.1.2 GMLAN Pinout Strategy. The following is the GMLAN-enabled terminal pinout arrangement.

- Pin 1 = GMLAN In
- Pin 2 = GMLAN Out
- Pin 3 = Reserved for OnStar Keypad Out
- Pin 4 = Reserved for OnStar Keypad Power
- Pin 5 = Ground
- Pin 6 = Reserved for NTSC Video Signal (+)
- Pin 7 = Reserved for NTSC Video Signal (-)
- Pin 8 = OSRVM ElectroChromic (-)
- Pin 9 = OSRVM ElectroChromic (+)
- Pin 10 = Battery

3.1.4.1.2.1 Pin 6 and Pin 7 shall be shielded twisted pair cables (required) on the vehicle's wire harness.

3.1.4.1.2.2 Pin 5 and Pin 10 are to be twisted pair wires (highly recommended) on the vehicle's wire harness.

3.1.4.1.2.3 The video shield shall be terminated at the source (camera end) on the vehicle's wire harness.

3.1.4.1.2.4 Global A Electrical Architecture. Required GMLAN Messages for Auto-Dimming ISRVMs include:

- Vehicle_Movement_State (reverse/forward/neutral/park).
- System Power Mode (off/accessory/run/crank request).

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- System_Power_Mode_Backup.

3.1.4.1.2.4.1 Common Arch Vehicles. Required GMLAN Messages for Auto-Dimming ISRVMs include:

- Transmission_Gear_Information (reverse/forward/neutral/park).
- System Power Mode (off/accessory/run/crank request).
- System_Power_Mode_Backup.

3.1.4.2 Interface Control Document (ICD). The ISRVM shall meet the ICD requirements of GMW16162.

3.1.4.3 ALS Visibility. The Auto-Dimming ISRVM's forward-facing ALS and its FOV are shown in Figure 2. The vehicle shall be designed to meet the Auto-Dimming ISRVM's ALS visibility requirements of $\geq 70\%$ minimum. For more details, reference GM Global Best Practice ISRVM-30, sections 3.3.2.3 and 3.3.2.4, and Figure 10.

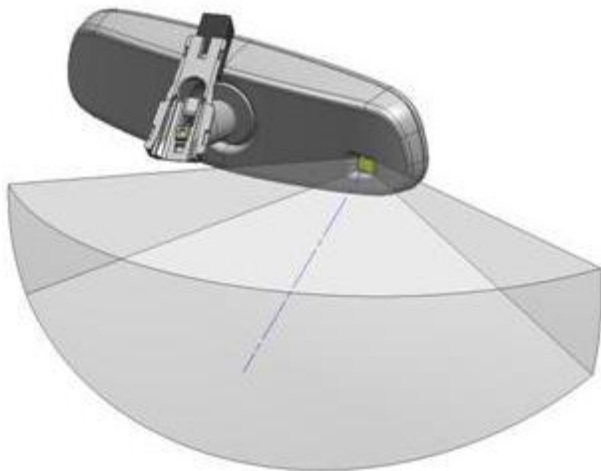


Figure 2: ISRVM Showing ALS Field of View

3.1.4.4 Auto-Dimming OSRVMs. At this time, the Auto-Dimming feature (ElectroChromic (EC) technology) for the Outside Rear View Mirrors (OSRVM) is controlled by the sensors and microprocessor of the ISRVM. This is currently a hardwired master-slave control strategy, but has the potential to be replaced by GMLAN. This standard will be updated in the future if the OSRVM Auto-Dim feature integration strategy evolves beyond a hardwired master-slave to the ISRVM. Auto-Dim OSRVMs are considered a global mainstream feature and ISRVM Pins 8 and 9 shall remain exclusively dedicated for this function.

3.1.4.5 Software.

3.1.4.5.1 Vehicle Assembly Plant Software “Flash” Loading. The ISRVM with GMLAN shall meet the requirements of GMW16162.

3.1.4.5.2 GM Dealer and/or Service Center Loading and/or Updating. The ISRVM with GMLAN shall meet the requirements of GMW16162.

3.1.4.5.3 GM Telematics Service Loading and/or Updating. The ISRVM with GMLAN shall meet the requirements of GMW16162.

3.1.4.5.4 Customer-Requested Tuning. The auto-dim ISRVM with GMLAN shall have the capability for the following customer-requested tuning. This shall be executed by the GM dealer and/or service center, or the GM telematics service.

3.1.4.5.4.1 Default Settings. All ISRVMs shall be shipped from the supplier with the default settings activated as documented in this standard.

3.1.4.5.4.2 Default Restoration. All ISRVMs shall have the ability to be easily restored to “default”. This is especially important if the vehicle changes hands (new owner or lease).

3.1.4.5.4.3 Change History. For all changes from the default settings, the ISRVM shall record the date, time, and whether it was a GM dealer/service center or GM telematics that executed this change. In addition, the ISRVM shall also record the old and new settings as a result of each change.

3.1.4.5.4.4 Change History Accessibility. This change history data shall be retrievable by a GM dealer/service center, so that defective-component warranty would not be improperly charged (i.e., if a customer asks to have settings changed and later decides that this is not what they really wanted).

3.1.4.5.4.5 Enable/Disable. The auto-dim ISRVM with GMLAN shall have the capability to enable or disable the auto-dimming feature only through a GM Dealer and/or Service Center, or through a GM Telematics Service. For more details, reference GM Global Best Practice ISRVM-6.

3.1.4.6 Diagnostic Tools. The ISRVM with GMLAN shall meet the requirements of GMW16162.

3.1.4.6.1 Diagnostic Trouble Codes (DTC). The ISRVM with GMLAN shall meet the requirements of GMW16162.

3.1.4.6.2 Feature Settings History. The ISRVM shall record when feature settings are selected from the original default conditions, as described in 3.1.4.5.4.

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3.1.5 Usage Definition. The auto-dim ISRVM shall meet the requirements of GMW16162.

3.1.5.1 Auto-Dim Feature Usage. Vehicles shall offer the Auto-Dimming ISRVM within the guidelines detailed in GM Global Best Practice ISRVM-42.

3.1.5.1.1 Vehicles with Privacy Glass. Auto-Dim ISRVMs shall not be offered on vehicles with privacy glass, unless the vehicle also has non-independent Auto-Dimming OSRVs (i.e., not stand-alone; the OSRV Auto-Dimming feature is dependent upon an Auto-Dim ISRVM for its operation). For more details reference GM Design for Six Sigma (DFSS) Project No. 2063, which is part of GM ISRVM Knowledge Set ISRVM-S1017.

3.2 Product Characteristics.

3.2.1 Performance Requirements. The ISRVMs must also meet all the requirements of GMW16162.

3.2.1.1 Regulatory Requirements. The mirrors shall comply with all global regulatory requirements, and shall be certified (when required) for all countries in which GM does business unless otherwise stated in the SOR. The list of governmental documents has to be updated on a regular basis since new editions can always be introduced. If this standard has not been updated recently, check validity of these regulations referenced below before usage and/or distribution. Regardless, the Supplier Integrated Engineer (SIE) and the GM Lead Engineer are both co-responsible for meeting all applicable government regulations, as identified in the Validation Cross-Reference Index (VCRI) in Section 4.

3.2.1.2 Reflectance. Unless stated otherwise, all requirements in this section shall apply the 1-point functional/parametric check conditions of GMW3172. Also reference 3.1.3 and 3.1.3.1.

3.2.1.2.1 Reflectance Limits.

3.2.1.2.1.1 Multi-Layered Silver-Based Coatings.

3.2.1.2.1.1.1 Low Reflectance State. The reflectance shall be 4 to 10% as received, and after durability testing.

3.2.1.2.1.1.2 High Reflectance State. The reflectance shall be 65% minimum as received and 60% minimum after durability testing, except at -40°C when the reflectance shall be 40% minimum.

3.2.1.2.1.2 Transflective Coating. This requirement applies to ISRVMs with Display on Demand through-glass projected images.

3.2.1.2.1.2.1 Low Reflectance State. The reflectance shall be 4 to 10% as received, and after durability testing.

3.2.1.2.1.2.2 High Reflectance State. The reflectance shall be 50% minimum under all conditions.

3.2.1.2.1.3 Procedure.

3.2.1.2.1.3.1 Measure the high-reflectance condition and the low-reflectance condition per the procedures in GMW15898.

3.2.1.2.1.3.1.1 For the low-reflectance condition, ensure that the rearward-facing “glare” sensor, shown in Figure 3 (top center of the reflective surface), is exposed to an illumination level greater than 5 lux, while the ALS (on the plastic ISRVM housing) is dark (i.e., ≤ 0.25 lux).

3.2.1.2.1.3.2 Reflectance values specified in 3.2.1.2.1.1 or 3.2.1.2.1.2 (dependent upon the glass reflectance technology) shall be met at input voltages of U_{min} , U_{nom} , and U_{max} , per the Electrical Loads code letter sequence C of GMW3172, and at the following temperatures: -20, +23, and +50°C.

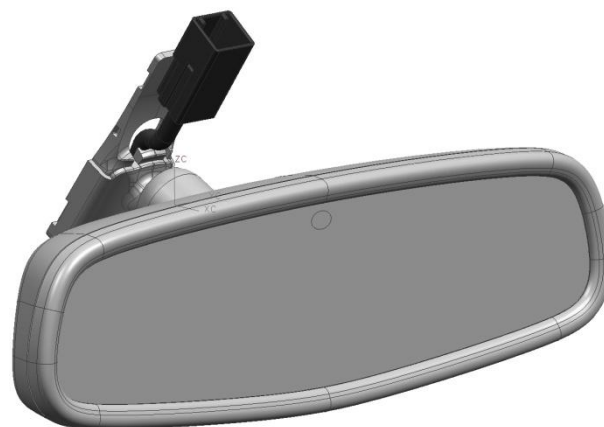


Figure 3: ISRVM Showing Glare Sensor

3.2.1.2.2 Uniform Reflectance and Nuisance Dimming. The reflectance range shall be $\leq 20\%$ peak to peak when subjected to the procedure in 3.2.1.2.2.1.

3.2.1.2.2.1 Procedure.

3.2.1.2.2.1.1 Set the light level at the glare sensor to 1.0 ± 0.5 lux and the light level at the ambient sensor to 5.0 ± 0.5 lux and stabilize for 60 seconds.

3.2.1.2.2.1.2 Toggle the light level at the ALS from 5.0 ± 0.5 lux to 0.0 ± 0.1 lux for 5 s at each level with a maximum of 0.5 seconds for each transition. Continue for 60 seconds.

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3.2.1.2.2.1.3 Adjust the light level at the glare sensor so that the reflectance cycle range is centered around $35 \pm 5\%$ reflectivity.

3.2.1.2.2.1.4 Continue toggling the light at the ALS for 60 seconds in order to stabilize the reflectance cycle range.

3.2.1.2.2.1.5 Record and plot the reflectance and ambient light level versus time.

3.2.1.3 Color Uniformity. Unless stated otherwise, all requirements in this section shall apply the 1 point functional/parametric check conditions of GMW3172. Also reference 3.1.3 and 3.1.3.1.

The following requirements shall be met at both high and low reflectance conditions.

3.2.1.3.1 The mirror glass chroma value (C^*) shall be within the tolerance boundary of $C^*=16$ as defined in Figure 4. $C^* = [(a^* \pm da^*)^2 + (b^* \pm db^*)^2]^{1/2}$. For more details behind the CIELAB system, reference the web site of the International Commission on Illumination (CIE) at www.cie.co.at.

3.2.1.3.2 The mirror glass surface area shall have a consistent hue with a tolerance of $da^* = \pm 1$ and $db^* = \pm 1$.

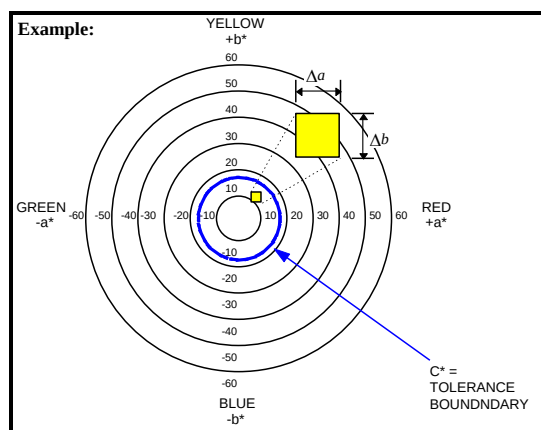


Figure 4: CIELAB Color Chart

3.2.1.4 Operation. Unless stated otherwise, all requirements in this section shall apply the 1-point functional/parametric check conditions of GMW3172. Also reference 3.1.3 and 3.1.3.1.

3.2.1.4.1 Daylight Detection.

3.2.1.4.1.1 Daylight Threshold Definition.

3.2.1.4.1.1.1 Default ALS Calibration. The Auto-Dim ISRVM shall be at a steady state high reflectance mode, with minimum values per 3.2.1.2.1, when the ambient light level is 86 ± 15 lux (daylight detection).

3.2.1.4.1.1.2 Alternative 80% ALS Calibration. The Auto-Dim ISRVM shall be at a steady state high reflectance mode, with minimum values per 3.2.1.2.1, when the ambient light level is 69 ± 15 lux (daylight detection).

3.2.1.4.1.2 Minimum Lag Time. If the Auto-Dim ISRVM is in a low reflectance condition when the daylight condition is sensed, the reflectance shall begin to increase to the high reflectance condition within 3.0 seconds.

3.2.1.4.1.2.1 Procedure.

3.2.1.4.1.2.1.1 Record ambient light level versus mirror reflectance.

3.2.1.4.1.2.1.2 Adjust the light level at the glare sensor to 9 lux.

3.2.1.4.1.2.1.3 Adjust the ambient light level to 0.5 lux.

3.2.1.4.1.2.1.4 Increase the ambient light level at a rate that is ≤ 0.2 lux/s, to a maximum light level of 90 lux.

3.2.1.4.2 Vehicle Reverse Mode. Vehicle reverse mode is defined when the vehicle's transmission (manual, automatic, or electric propulsion) is set to initiate rearward travel; it is not dependent upon vehicle motion. This state shall be recognized by the ISRVM whether its wiring is following the hardwired or GMLAN strategies.

3.2.1.4.2.1 Reverse Signal Recognition.

3.2.1.4.2.1.1 Non-GMLAN ISRVMs.

3.2.1.4.2.1.1.1 Reverse Mode. The ISRVM shall operate in the Reverse mode when the Backup Lamp Supply Voltage (Pin 1) is within the vehicle's operating voltage level. Operating voltage for this requirement is defined to be within the range of U_{max} and U_{min} as per the Electrical Loads code letter sequence C of GMW3172.

3.2.1.4.2.1.1.2 Normal Mode. The ISRVM shall function in the normal mode when the Backup Lamp Supply Voltage (Pin 1) is ≤ 1.0 volts direct current (VDC).

3.2.1.4.2.1.2 GMLAN ISRVMs. Reference 3.1.4.1.2.4 for the appropriate GMLAN messages.

3.2.1.4.2.1.2.1 Reverse Mode. The ISRVM shall operate in the Reverse mode based on the Vehicle_Movement_State message for Global A vehicle applications, and based on the Transmission_Gear_Information message for Common Architecture vehicle applications.

3.2.1.4.2.1.2.2 Normal Mode. The ISRVM shall operate in normal mode when the vehicle movement state information on GMLAN is any signal other than "Reverse".

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3.2.1.4.2.2 Reflectance State. The Auto-Dim ISRVM shall be at a steady state high reflectance mode with minimum values per 3.2.1.2.1, or switch to this condition, when the vehicle is shifted to reverse.

3.2.1.4.2.3 Minimum Lag Time. The auto-dim ISRVM shall remain at, or begin to shift to, the high reflectance condition within 2.0 seconds or less after the vehicle has been shifted into reverse.

3.2.1.4.3 Ignition Off and/or Power Failure. The Auto-Dim ISRVM shall be at a steady state high reflectance mode with minimum values per 3.2.1.2.1, or switch to this condition, when the vehicle's ignition is in the off position, when the ISRVM is electrically disconnected from the vehicle, and/or when the EC element becomes open circuited.

3.2.1.4.3.1 Non-GMLAN. The ISRVM shall determine that the vehicle is in the off position when the Run/Crank Ignition 1 voltage (Pin 2) is ≤ 1.0 VDC.

3.2.1.4.3.2 GMLAN. The ISRVM shall determine vehicle on/off status based on both the System_Power_Mode and the System_Power_Mode_Backup GMLAN messages.

3.2.1.4.3.2.1 Sleep Mode. Once the GMLAN-capable ISRVM detects the vehicle's off signal, the ISRVM shall go to sleep within 8 seconds.

3.2.1.4.3.3 Maximum Delay. If the ISRVM is in the low reflectance condition when the vehicle's ignition is switched to the off position, when the ISRVM is electrically disconnected from the vehicle, or when the EC element becomes open circuited, the ISRVM shall noticeably initiate returning to the high reflectance state within 3 seconds.

3.2.1.4.3.4 Maximum Lag Time. If the ISRVM is in the low reflectance condition when the vehicle's

ignition is switched to the off position, when the ISRVM is electrically disconnected from the vehicle, or when the EC element becomes open circuited, the ISRVM shall return to a minimum of 40% reflectance within 20 seconds.

3.2.1.5 Auto-Dimming Performance. Unless stated otherwise, all requirements in this section shall apply the 1-point functional/parametric check conditions of GMW3172. Also reference 3.1.3 and 3.1.3.1.

3.2.1.5.1 Transition Time.

3.2.1.5.1.1 Multi-Layered Silver-Based Coatings. The Auto-Dim ISRVM shall meet the transition time responses under the conditions shown in Table 1.

3.2.1.5.1.2 Transflective Coating. The Auto-Dim ISRVM shall meet the transition time responses under the conditions shown in Table 2.

3.2.1.5.1.3 Procedure.

3.2.1.5.1.3.1 ALS Input. Input light to the ISRVM's ALS shall be ≤ 0.25 lux.

3.2.1.5.1.3.2 Glare Sensor Input. Input light to the ISRVM's glare sensor shall be ≥ 5.0 lux.

3.2.1.5.1.3.3 ISRVM Voltage. Input voltages to the ISRVM shall be U_{min} , U_{nom} , and U_{max} , per the Electrical Loads code letter sequence C of GMW3172.

3.2.1.5.1.3.4 Cycle the input light to the glare sensor at the evaluation temperatures indicated in the appropriate table per 3.2.1.5.1.1 or 3.2.1.5.1.2, and with the voltages in 3.2.1.5.1.3.3. The ISRVM shall meet both the dimming and the brightening times between the specified changes in reflectance.

3.2.1.5.1.3.4.1 Brightening can be achieved by either switching off the glare sensor input (i.e., changing its value to ≤ 0.25 lux), or by activating the vehicle reverse signal per 3.2.1.4.2.1.

Table 1: Transition Times: Multi-Layered Silver-Based Coatings

Dimming Time	Dimming Reflectance	Brightening Time	Brightening Reflectance	Evaluation Temperature
6 s	60 to 15%	8 s	15 to 60%	+50°C
6 s	60 to 15%	8 s	15 to 60%	+23°C
8 s	60 to 15%	30 s	15 to 60%	-20°C

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