



Inside Rear View Mirrors - Telematics Requirements

1 Introduction

Note: Nothing in this standard supersedes 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 specification establishes the minimum requirements and associated test methods that apply to all Inside Rear View Mirrors (ISRV) with telematics content 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.

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.

CMVSS101 FMVSS101
SAE J276

2.2 GM Standards/Specifications.

GMN11333 GMW15119
GMW3059 GMW15760
GMW3172 GMW16159
GMW3431 GMW16162
GMW14298 GMW16282
GMW15118

2.3 Additional References.

GM Global Best Practice HVI-132
GM Global Best Practice INFOTEL-21
GM Global Best Practice ISRV-16
GM Global Best Practice ISRV-24
GM Global Best Practice ISRV-26
GM Global Best Practice ISRV-27
GM Global Best Practice ISRV-28
GM Global Best Practice ISRV-29

GM Global Best Practice ISRV-37

GM Global Best Practice ISRV-43

3 Requirements

3.1 System/Subsystem/Component/Part Definition.

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

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

3.1.1.1.1 Lower Bezel Chin. If the telematics controls are buttons with graphics, then the lower bezel of the ISRV shall feature "chin" styling to optimize forward visibility as shown in Figure 1. For more details, reference GM Global Best Practice ISRV-43.



Figure 1: Lower Bezel Styling

3.1.1.1.2 Phone Button Graphic. The phone button on the telematics ISRV shall only support one logo, which is a phone icon. This icon graphic is released by GM Design Studio. For more details, reference GM Global Best Practice ISRV-28.

3.1.1.1.3 Advisor Button Graphic. The advisor button on the telematics ISRV shall only support one brand or logo released by GM Design Studio.

This can either be an ISO-type symbol for telematics, or it can be a specific GM Global brand (e.g., OnStar). The ISRVM shall not support regional brands or services (e.g., ChevyStar, Holden Assist, etc.) with unique graphics or design requirements. For more details, reference GM Global Best Practice ISRVM-29.

3.1.1.1.4 Emergency Button Graphic. The emergency button on the telematics ISRVM shall only support one logo, which is a red circle with a white cross with a small red star on it. This icon graphic is released by GM Design Studio. For more details, reference GM Global Best Practice ISRVM-28.

3.1.1.2 Perceived Quality (PQ). The ISRVM shall meet the PQ requirements of GMW16162. For more information regarding PQ enablers, reference GM Global Best Practice ISRVM-16.

3.1.1.2.1 Button Backlighting Color. The color of the button backlighting shall be True White, and not a white based on another color (e.g., a green-white). For more details, reference GM Global Best Practice ISRVM-16.

3.1.1.2.2 Placement of Button Graphics. The graphics shall be centered on each individual button. When the button shape is not symmetrical, as per the “cutaway” designs shown in Figure 1 (lower picture) and in Figure 3, then the aesthetic centered position shall be determined by the GM Global Cross-Brand Strategic Design Studio (not a program-specific or a regional-specific Interior Design Studio). For more details, reference GM Global Best Practice ISRVM-37.

3.1.1.2.3 Relative Sizes of Button Graphics. Refer to 3.2.5.2 for the minimum size requirements for button graphics.

3.1.1.2.3.1 Outboard Button Graphics. The two outboard buttons shall always have their graphics identically sized to maintain symmetry about the vehicle’s centerline, as shown in Figure 2. For more details, reference GM Global Best Practices ISRVM-28 and ISRVM-37.



Figure 2: Large (120%) Center Button Graphic

3.1.1.2.3.2 Center Button Graphic. If Marketing or the Design Studio would like to increase the prominence of the Advisor button graphic (i.e., for a “billboard” effect), this is acceptable as long as the button size is large enough to accommodate the larger graphic, and still meet all requirements in this standard. Refer to paragraphs 3.2.5.2, 3.2.5.4, 3.2.5.5, and 3.3.2.2.

The relative size of the center button graphic shall be either equal to the outboard buttons’ graphics as shown in Figure 3, or 120 to 150% the size of the outboard buttons’ graphics, as shown in Figure 2. For more details, reference GM Global Best Practices ISRVM-28 and ISRVM-37.



Figure 3: Common Button Graphic Size

3.1.1.2.4 Relative Button Size. All three buttons shall be equally sized. It is acceptable for the two outboard buttons to vary in shape from the center button, as shown in Figure 3, but they must still be equally sized, and still meet all requirements in this standard. Refer to paragraphs 3.2.5.2, 3.2.5.4, 3.2.5.5, and 3.3.2.2. For more details, reference GM Global Best Practice ISRVM-37.

3.1.1.2.5 Maximum Button Size. The three buttons shall be sized and styled to minimize forward vision obscuration. For more details, reference GM Global Best Practice ISRVM-37.

3.1.1.2.6 Button Surface. For optimum PQ and for interior switch styling harmony, it is recommended that the outer surface of the buttons be hardcaps, as shown in Figure 4. For more details, reference GM Global Best Practice ISRVM-26.

3.1.1.2.7 Relative Button Spacing. The three buttons shall be evenly spaced (equal button-to-button distance). For more details, reference GM Global Best Practice ISRVM-37.

3.1.1.2.8 Relative Location of Three Button Assembly (3BA). The three button assembly shall be centered (Left to Right) on the ISRVM head.

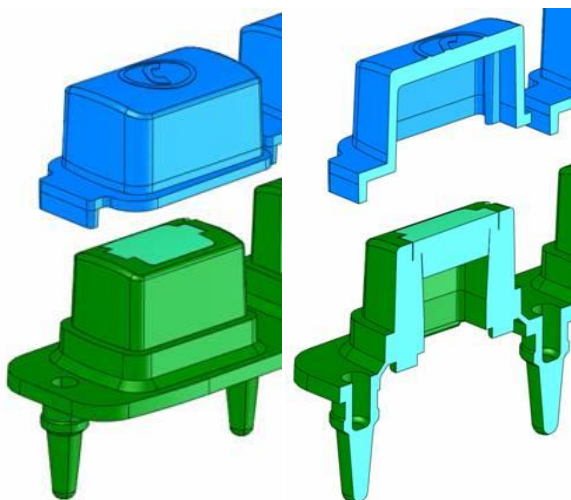


Figure 4: Example of Hardcap Buttons

3.1.1.2.9 Status Indicator Light Emitting Diode (LED) Colors. The colors of the Telematics Status Indicator “Telltale” shall be GM Red, and True Green. For more details, reference GM Global Best Practice ISRVM-16.

3.1.1.2.10 Size of Status Indicator.

3.1.1.2.10.1 Maximum. The status indicator shall be no larger than a 2.0 × 5.0 mm rectangle. For more details, reference GM Global Best Practice ISRVM-28.

3.1.1.2.10.2 Minimum. The status indicator shall be no smaller than a 2.0 × 5.0 mm rounded rectangle with a 1.0 mm radius at the ends. For more details, reference GM Global Best Practice ISRVM-28.

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

3.1.1.3.1 Button Backlighting Color. The backlighting illumination of the buttons shall be a True White, and shall meet the requirements of GMW15118. For more details, reference GM Global Best Practice ISRVM-37.

3.1.1.3.1.1 Nominal Value. Per GMW15118, the nominal values of True White shall be $x = 0.2992$ and $y = 0.2936$.

3.1.1.3.1.2 Tolerance Boundary. Per GMW15118, the tolerance boundary of True White shall be defined by the values in Table 1.

3.1.1.3.2 On/Operating Status Indicator LED Color. The Telematics Status Indicator On/Operating “Telltale” shall be a True Green, and shall meet the requirements of GMW15118.

Table 1: True White Tolerance Boundary Points

x	y
0.296	0.276
0.287	0.295
0.316	0.329
0.318	0.305

3.1.1.3.2.1 Nominal Value. Per GMW15118, the nominal values of True Green shall be $x = 0.175$ and $y = 0.710$.

3.1.1.3.2.2 Tolerance Boundary. Per GMW15118, the tolerance boundary of True Green shall be defined by the values in Table 2.

Table 2: True Green Tolerance Boundary Points

x	y
0.120	0.670
0.120	0.750
0.230	0.670
0.230	0.750

3.1.1.3.3 Fault Status Indicator LED Color. The Telematics Status Indicator Fault “Telltale” shall be a GM Red, and shall meet the requirements of GMW15118.

3.1.1.3.3.1 Nominal Value. Per GMW15118, the nominal values of GM Red shall be $x = 0.6879$ and $y = 0.3086$.

3.1.1.3.3.2 Tolerance Boundary. Per GMW15118, the tolerance boundary of GM Red shall be defined by the values in Table 3.

Table 3: GM Red Tolerance Boundary Points

x	y
0.6756	0.3010
0.6756	0.3174
0.6843	0.3174
0.6989	0.3010

3.1.1.3.4 Button Surface Texture. The touch surface of the buttons shall be ungrained to optimize clarity of the graphics. For more details, reference GM Global Best Practice ISRVM-43.

3.1.2 Content.

3.1.2.1 Physical Content. Not applicable.

3.1.2.2 Functional Content. Not applicable.

3.1.3 Ambient Environment. Unless otherwise specified, the ambient environment conditions (i.e., room temperature = 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 ISRVMs with electric content shall utilize common wiring pinouts. There are two basic arrangements, depending upon whether GM Local Area network (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 feature content does not need that particular input/output. Detailed pinouts per ISRVM feature content (listed per Regular Production Option (RPO) codes) are in the Interface Control Document (ICD). The ISRVM electrical connector and its common terminal layout/orientation referenced in the ICD are shown in Figure 5.

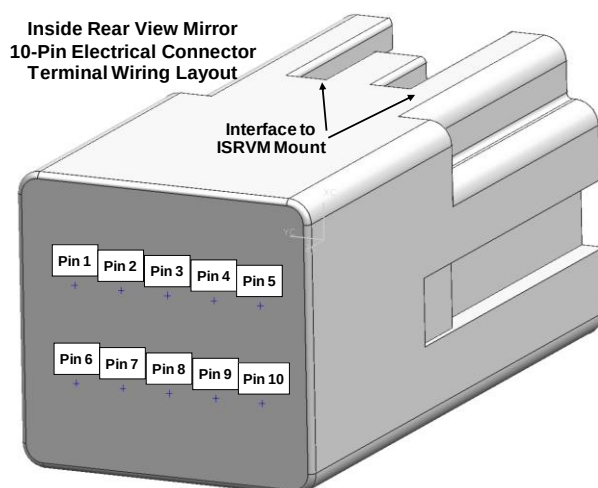


Figure 5: ISRVM Electrical Connector

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

Pin 1 = Reserved for Backup Lamp Supply Voltage

Pin 2 = Reserved for Run/Crank Ignition 1 Voltage

Pin 3 = Telematics Keypad Out

Pin 4 = Telematics Keypad Power

Pin 5 = Ground

Pin 6 = Telematics Enabled (Green LED)

Pin 7 = Telematics Fault (Red LED)

Pin 8 = Reserved for Outside Rear View Mirror (OSRVM) ElectroChromatic (-)

Pin 9 = Reserved for OSRVM ElectroChromatic (+)

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 = Telematics Keypad Out

Pin 4 = Telematics Keypad Power

Pin 5 = Ground

Pin 6 = Reserved for National Television System Committee (NTSC) Video Signal (+)

Pin 7 = Reserved for NTSC Video Signal (-)

Pin 8 = Reserved for OSRVM ElectroChromatic (-)

Pin 9 = Reserved for OSRVM ElectroChromatic (+)

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 Required messages for all GMLAN-capable ISRVMs with telematics controls are as follows. GMLAN-capable ISRVMs with Auto-Dimming glare reduction technology have additional messages for that feature which are documented in GMW16159. Similarly, GMLAN-capable ISRVMs with video display technology have additional messages for that feature which are documented in GMW16282.

3.1.4.1.2.4.1 Global A Vehicles.

- Dimming_Information_LS (Day/Night)
- Infotainment_Operation_LS
- Telematics_Indication_Request_LS

3.1.4.1.2.4.2 Common Arch Vehicles.

- Dimming_Information (Day/Night)
- Infotainment_Operation_Allowed
- Telematics_Indication_Request

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

3.1.4.3 Interface to Telematics Module.

3.1.4.3.1 Input/Output Matrix. The ISRVM shall interact with the Telematics module per the Input/Output matrix as shown in Table 4 (Non-GMLAN) or Table 5 (GMLAN), as applicable.

3.1.4.3.2 Circuit Strategy. The Telematics module shall provide output to the ISRVM per the electrical schematic shown in Figure 6.

3.1.4.3.3 Telematics Operational Power During Vehicle Shut-Off. The telematics module shall provide a switched power feed to the three (3) button assembly if a vehicle is shut off when a call is in process. This power shall be retained until the telematics function has been terminated. The power moding of the switched power feed shall be maintained in the telematics module.

Table 4: Input/Output Matrix for Three Button Assembly - Non-GMLAN

I/O	Name	Description	Interface Definition
OUT	VEH_KEYPAD_IN	Output of resistive ladder	Vbatt pull up resistor = 1.5 kΩ for EMERGENCY button press, 3.0 kΩ for ADVISOR press and 13.0 kΩ for PHONE button press. All resistances are 1% tolerance.
IN	VEH_LED_GRN	Green Indicator	Daytime with 300 Ω forward voltage drop of 2.1 V. Daytime Mode: 20 mA typical, 28 mA maximum. Nighttime Mode: 5 mA ± 15% Off Mode: 100 μA maximum with a 100 mV maximum.
IN	VEH_LED_RED	Red Indicator	Daytime with 300 Ω forward voltage drop of 1.66 V. Daytime Mode: 7.0 mA (typical) Night time Mode: 2 mA ± 15% Off Mode: 100 μA max with a 100 mV max
IN	VEH_KEYPAD_PWR	Backlighting and resistive ladder power	60 mA typical, 80 mA maximum 10 V ± 10%
OUT	KEYPAD_GND	Ground	Ground (Return)

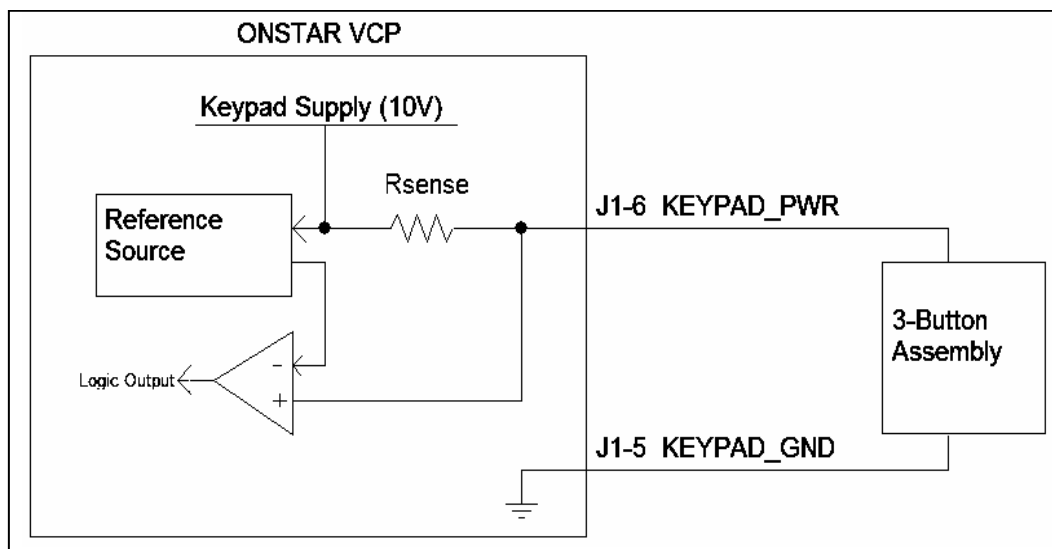


Figure 6: Telematics Module Output to Three Button Assembly

Table 5: Input/Output Matrix for Three Button Assembly – GMLAN

I/O	Name	Description	Interface Definition
OUT	VEH_KEYPAD_IN	Output of resistive ladder	Vbatt pull up resistor = 1.5 kΩ for EMERGENCY button press, 3.0 kΩ for ADVISOR press, and 13.0 kΩ for PHONE button press. All resistances are 1% tolerance.
IN	VEH_LED_GRN	Green indicator	GMLAN messages per 3.1.4.1.2.4. Also diagnostic control parameter identifier (CPID) control.
IN	VEH_LED_RED	Red indicator	GMLAN messages per 3.1.4.1.2.4. Also diagnostic CPID control.
IN	VEH_KEYPAD_PWR	Backlighting and resistive ladder power	60 mA typical, 80 mA maximum. 10 V ± 10%
OUT	KEYPAD GND	Ground	Ground (Return)

3.1.4.4 Software.

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

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

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

3.1.4.4.4 Customer-Requested Tuning. The GMLAN-capable ISRVM with telematics shall have the capability for the following customer-requested tuning. If this feature is activated, it shall be executed by the GM dealer and/or service center, or the GM telematics service.

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

3.1.4.4.4.2 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).

3.1.4.4.4.3 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.

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

3.1.4.4.4.5 Button Backlighting. The GMLAN ISRVM with telematics shall have the capability for three settings of brightness: Low, Default, and High. This requirement does not apply to the hardwired (non-GMLAN) ISRVMs. For more details, reference GM Global Best Practice ISRVM-37.

3.1.4.4.4.6 Green Status Indicator LED. The GMLAN ISRVM with telematics shall have the capability for three (3) settings of brightness: Low, Default, and High. The option of three settings shall be applied to both the Day and Night intensities. This requirement does not apply to the hardwired (non-GMLAN) ISRVMs. For more details, reference GM Global Best Practice ISRVM-28.

3.1.4.4.4.7 Red Status Indicator LED. The GMLAN ISRVM with telematics shall have the capability for three (3) settings of brightness: Low, Default, and High. The option of three settings shall be applied to both the Day and Night intensities. This requirement does not apply to the hardwired (non-GMLAN) ISRVMs. For more details, reference GM Global Best Practice ISRVM-28.

3.1.4.5 Diagnostic Tools. The GMLAN-capable ISRVM with telematics shall meet the requirements of GMW16162.

3.1.4.5.1 Diagnostic Trouble Codes (DTCs). The GMLAN-capable ISRVM with telematics shall meet the requirements of GMW16162.

3.1.4.5.2 Feature Settings History. The GMLAN-capable ISRVM shall record when feature settings are selected from the original default conditions, as described in 3.1.4.4.4.

3.1.4.6 Telematics Control Location within Vehicle. The Telematics controls shall be located within the reach zone defined by SAE J287. For more details, reference GM Global Best Practices HVI-132.

3.1.5 Usage Definition. The ISRVM with telematics shall meet the requirements of GMW16162.

3.1.5.1 Telematics Feature Usage. Vehicles shall offer the ISRVM with telematics within the guidelines detailed in GM Global Best Practice ISRVM-24.

3.2 Product Characteristics.

3.2.1 Performance Requirements. The ISRVM 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 Statement of Requirements (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.

3.2.1.1.1 Canada. CMVSS 101 Controls and Displays.

3.2.1.1.2 United States. FMVSS 101 Controls and Displays.

3.2.1.2 Three Button Assembly Electrical Requirements.

3.2.1.2.1 Theory of Operation. The voltage developed across a current sense resistor in series with the Three Button Assembly is compared with a reference voltage to determine whether "enough" current is being drawn by the keypad assembly to be considered connected.

3.2.1.2.2 Current Draw.

3.2.1.2.2.1 Maximum. The current draw of the keypad shall be no more than 80 mA.

3.2.1.2.2.2 Minimum. The current draw of the keypad shall be at least 5 mA.

3.2.1.2.3 Contact (Pressed Button) Resistance.

3.2.1.2.3.1 Phone Button. The resistance shall be $13.0 \Omega \pm 1\%$.

3.2.1.2.3.2 Advisor Button. The resistance shall be $3.0 \Omega \pm 1\%$.

3.2.1.2.3.3 Emergency Button. The resistance shall be $1.5 \Omega \pm 1\%$.

3.2.1.2.4 Open Circuit Resistance. Un-depressed buttons shall have an open circuit resistance of at least 20 M Ω .

3.2.1.2.5 Total Switch Contact Resistance. The resistance shall be $\leq 5.0 \Omega \pm 1\%$.

3.2.1.2.6 Output Voltage.

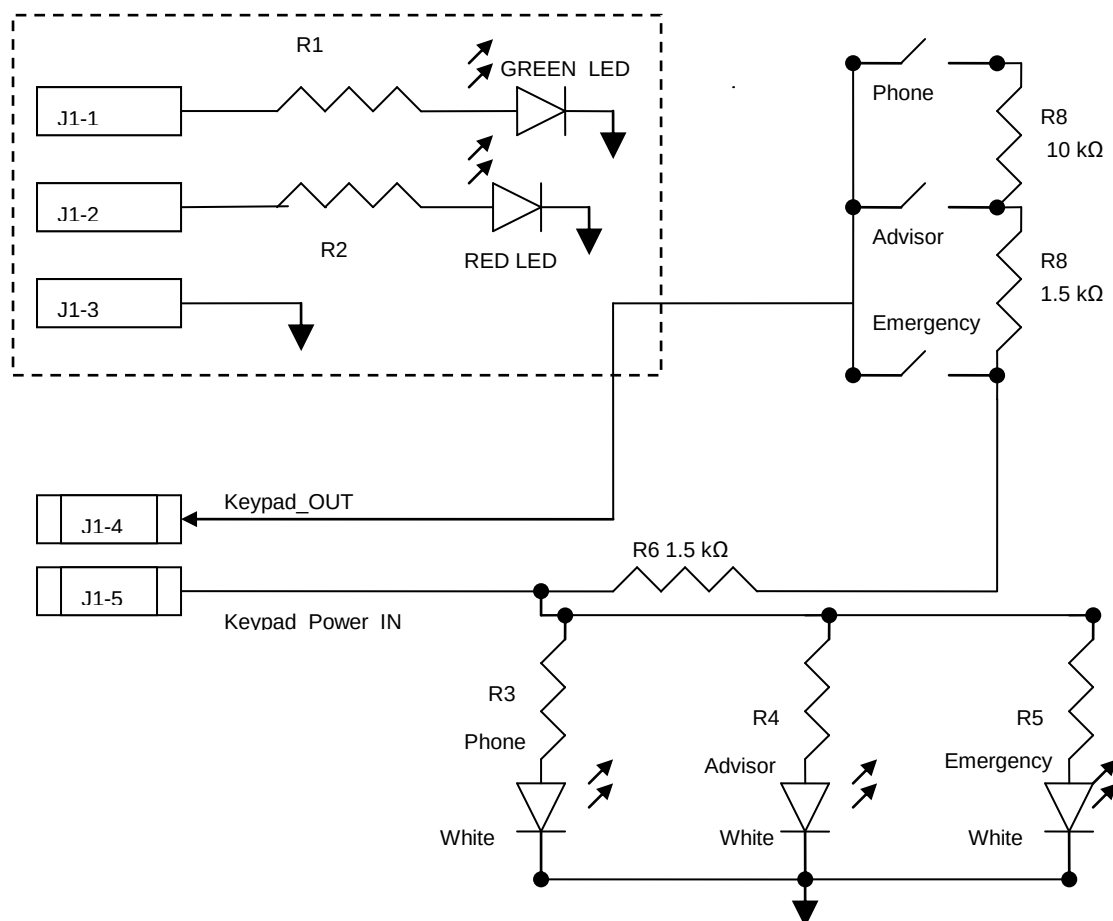
3.2.1.2.6.1 Theory of Operation. The keypad button resistance, termed " R_{BUTTON} ", and an internal telematics module resistor, form a resistive voltage divider between KEYPAD_PWR (10.0 VDC) and Ground. The output of the voltage divider is coupled to an analog-to-digital (A/D) converter for determination by the Vehicle

Communication Platform (VCP) software of the button-press state. See Figure 7, for more details concerning the wiring schematic.

3.2.1.2.6.2 Voltage Out for Each Button Press State. Based on the circuit design in Figure 7, and also the details in section 3.3.2.4.1, the voltage out (measured at the terminals) shall fall within the range specified in Table 6, when 10.0 VDC is supplied to the Three Button Assembly.

Table 6: Measured Terminal Voltage for the Three Button Assembly

Button Pressed (R_{BUTTON} value)	Voltage at RUI1 Pin			A/D Reading		
	Minimum	Nominal	Maximum	Minimum	Nominal	Maximum
None ($>1 \text{ M}\Omega$)	0.000	~0	0.155	0	6	52
Phone (13 k Ω)	0.156	0.434	0.820	53	147	278
Advisor (3 k Ω)	0.821	1.641	1.908	279	557	647
Emergency (1.5 k Ω)	1.909	2.817	3.182	648	956	1023



Note: The LED details within dashed lines are for hardwired (Non-GMLAN) ISRVMs only.

Figure 7: Telematics Three Button Assembly Schematic Drawing

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3.2.1.3 Three-Button Assembly Switch Isolation Resistance. Perform the Isolation Resistance Test and meet the performance criteria per GMW3172.

3.2.1.4 Three Button Assembly Switch Effort/Travel. Each button in the assembly shall meet the following requirements. Unless stated otherwise, measurements shall be taken at the center of each button in the direction of motion. For more details of the tests and definitions in this section reference GMW3431.

3.2.1.4.1 Force Level.

3.2.1.4.1.1 Peak Force (P_f). For more details, reference GM Global Best Practice HVI-132.

3.2.1.4.1.1.1 Micro-Switches. The following only applies to ISRVMs with micro-switches, as these are off-the-shelf components with less capability to be tuned by design.

The Peak Force shall range from 2.0 to 6.0 N.

3.2.1.4.1.1.2 Carbon Puck Switches with an Elastomeric Spring. The following applies to ISRVMs with carbon puck and/or any other switch type that has the capability to be tuned to meet design targets. Reference Figure 4 for an example of a carbon puck switch with an elastomeric spring and hardcaps.

The Peak Force shall be 3.0 ± 0.5 N.

3.2.1.4.1.2 Contact Force (C_f). The force at contact shall be 2.25 ± 0.15 N.

3.2.1.4.1.2.1 Definition. Contact force is the force that exists when the switching mechanism has released its stored energy and the slope of the curve becomes positive.

3.2.1.4.1.3 Return Force. The return force shall be at least 0.25 N.

3.2.1.4.1.3.1 Definition. Return force is the minimum force exerted by the plunger or button return spring.

3.2.1.4.2 Travel.

3.2.1.4.2.1 Maximum Travel. The maximum travel shall be no greater than 2.4 mm. For more details, reference GM Global Best Practice HVI-132.

3.2.1.4.2.2 Travel to Detent. The travel to detent shall be between 30% and 50%.

3.2.1.4.2.3 Travel to Contacts. The travel to contacts shall be 1.2 ± 0.2 mm.

3.2.1.4.3 Tactile Ratio (T_r). The tactile ratio shall be $40\% \pm 10\%$.

3.2.1.4.3.1 Definition. The tactile ratio is defined by the following relationship:

$$T_r = [(P_f) - (C_f)] / (P_f)$$

3.2.1.4.4 Button Wobble. Button wobble shall be minimized, and displacements shall be no greater than 0.5 mm. For additional information related to button wobble, reference GMW15199.

3.2.1.4.4.1 Definition. Button wobble is described as a loose, side-to-side motion (not in the intended travel direction).

3.2.1.4.4.2 Procedure. Perform either one of the following test procedures.

3.2.1.4.4.2.1 Measure the displacement of the button after applying a lateral force of 5 times the peak actuation force ($5 \times P_f$), on the side of the button or knob, at its tip. This applied force shall be 15.0 N minimum.

3.2.1.4.4.2.2 Perform the wobble test of GMW15199.

3.2.1.5 Three-Button Assembly Switch Durability. This test should be run with continuous monitoring to catch any intermittent operation. Post-test, the ISRVM Functional Status Classification shall be A, per GMW3172. In addition, each switch button shall return to the designated "at rest" position without binding.

3.2.1.5.1 Procedure.

3.2.1.5.1.1 Test Environment. The following requirements summarize the required conditions of the test environment. As long as these overall percentages are met, the specific tests can be run in any order.

3.2.1.5.1.1.1 Fifty-five percent (55%) of test cycles at $+25^\circ\text{C}$; no relative humidity requirement.

3.2.1.5.1.1.2 Twenty-five percent (25%) of test cycles at $+25^\circ\text{C}$, and at 95% relative humidity.

3.2.1.5.1.1.3 10% of test cycles at $+85^\circ\text{C}$; no relative humidity requirement.

3.2.1.5.1.1.4 10% of test cycles at -40°C ; no relative humidity requirement.

3.2.1.5.1.2 Test Voltage. $U_{\text{nom}} = 14.0$ VDC.

3.2.1.5.1.3 Durability Cycles.

3.2.1.5.1.3.1 Cycle Definition. One switch cycle shall be defined as full travel (round trip) from the Off position, to the On position, then back to the Off position.

3.2.1.5.1.3.2 Total Cycles. The total number of test cycles is 5000.