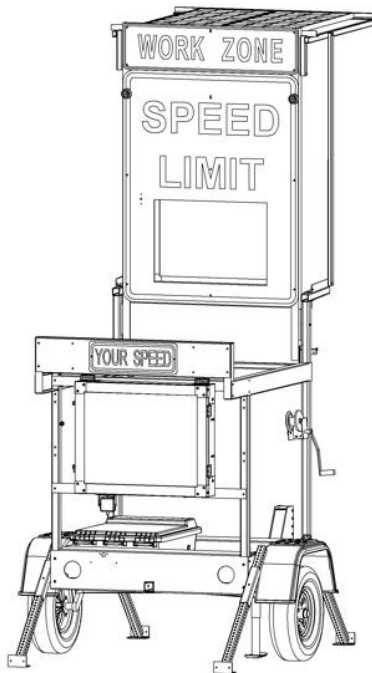


SILENT ADVISOR VSL

SOLAR POWERED PORTABLE
VARIABLE SPEED LIMIT AND FEEDBACK TRAILER

Procurement Specifications

(RST-V-2000)



As Reliable as the Sun

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This document presents a detailed specification for a Solar Powered Portable Variable Speed Limit and Radar Speed Trailer. This specification typically requires additions and/or modifications to meet a user's specific requirements.

This specification is subject to periodic revisions as required without notice.

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1. General

1.1 Product Description

The **SILENT ADVISOR Variable Speed Limit (VSL)** is a Solar Powered Portable Radar Feedback and Speed Limit Trailer. The **SILENT ADVISOR VSL** consists of a changeable LED speed display panel set into a legal speed limit sign panel, a supporting structure for the entire speed limit sign panel, a LED speed feedback display, a radar speed monitor, a photovoltaic array, a battery power supply, an energy management system control unit, and an electronic control console, all mounted on a heavy duty trailer frame.

1.2 Design Objectives

- 1.2.1 Maximize reliability by using generally accepted design techniques for outdoor-use electrical and electronic equipment.
- 1.2.2 Minimize operating cost by using a renewable energy source, requiring minimal maintenance.
- 1.2.3 Maximize safety and effectiveness by using a non-glare, high contrast display panel with long-life expectancy, high-reliability display technology.
- 1.2.4 Meet or exceed the standards for Portable Changeable Message Signs as listed in the U.S. Federal Highway Administration (FHWA) Manual on Uniform Traffic Control Devices (MUTCD).

1.3 Performance Objectives

- 1.3.1 Visibility up to 1 mile.
- 1.3.2 Legibility up to 1/4 mile.
- 1.3.3 Minimal glare from sunlight and head lights.
- 1.3.4 Continuous, uninterrupted operation on solar power.
- 1.3.5 One (1) month minimum, three (3) month typical maintenance interval.

1.4 Quality Assurance Objectives

- 1.4.1 All manufacturing shall be carried out in a facility with a completely implemented and properly maintained ISO 9001:2015 certified quality management system.
- 1.4.2 All units shall be tested to ensure that the units are neither susceptible to nor produce any electromagnetic interference.

2. Physical

2.1 Dimensions

2.1.1 Length Overall

2.1.1.1 Transport position: 138 in. (351 cm)

2.1.1.2 Operating position: 122 in. (310 cm)

2.1.2 Width

2.1.2.1 Overall: 76 in. (193 cm)

2.1.2.2 Across fenders: 76 in. (193 cm)

2.1.3 Height

2.1.3.1 Transport position: 96 in. (244 cm)

2.1.3.2 Operating position: 156 in. (396 cm)

2.1.4 Ground Clearance, minimum: 13 in. (33 cm)

2.1.5 Weight, maximum: 1,600 lbs. (725 kg)

2.2 Environmental

2.2.1 Temperature, operating and storage : -40 to +185 °F (-40 to +85 °C)

2.2.2 Relative Humidity: 20% to 98%, non-condensing

2.2.3 Wind

2.2.3.1 Transport position, maximum trailering speed - 70 MPH (112 KPH)

2.2.3.2 Operating position, maximum height, outriggers in place - 80 MPH (128 KPH) sustained

2.2.4 Electrical Interference - Unaffected by RFI (Radio Frequency Interference) and EMI (Electromagnetic Interference).

3. Trailer Chassis and Sign Support

3.1 Trailer Chassis

3.1.1 Frame Construction

3.1.1.1 Trailer Frame

Trailer frame shall be constructed of welded 7 Gauge (3/16-inch) CNC formed steel plate and structural steel tubing with 3 x 3 x 3/16 inch structural steel tubing receiver for the tongue, reinforced and welded to the front cross member.

Trailer shall be equipped with a 2 ½ x 2 ½ x 3/16 inch structural steel tubing receiver capable of accepting a standard Class II (2) drawbar and hitch pin to accommodate tandem towing. The rear hitch receiver shall be reinforced and welded to a 7 Gauge (3/16-inch) CNC formed steel plate rear cross member. Tandem trailer towing using rear hitch receiver is intended for off road use only and is subject to local laws and regulations!

Trailer frame shall be equipped with tie down points to facilitate securing unit to utility trailer or truck deck for transport.

3.1.1.2 Trailer Tongue

Trailer tongue shall consist of 2 ½ x 2 ½ x 1/4 inch structural steel tubing. The tongue shall bolt into the tongue receiver tube to facilitate easy removal of the tongue for repair, transportation, or security purposes. The trailer tongue shall be equipped with a 2,000-pound capacity swivel-type top-wind screw jack with a formed steel footpad.

Tongue length shall be approximately 61.5 inches (measured from the centerline of 2-inch ball).

3.1.2 Suspension

3.1.2.1 Trailer shall be equipped with an independent suspension, torsion-type axle with a 2,000 pound overall capacity. Axle load capacity shall be set at 1,400 pounds.

3.1.2.2 Axle wheel spindles shall be equipped with grease fittings to accommodate wheel bearing lubrication.

3.1.3 Coupler

3.1.3.1 Adjustable height coupler shall install on front of trailer tongue, secured with 1/2-inch diameter hitch pins locked into place with locking-type (rue ring) pins or with 1/2-inch diameter, Grade 8 bolts and all metal (stover) lock nuts.

3.1.3.2 Trailer shall be equipped with a 6-position adjustable height coupler mount capable of accepting a 2-inch ball, 2-5/16-inch ball, or a 3-inch pintle ring coupler, with minimum capacity ratings of 10000, 13000 and 20000 lbs.

3.1.3.3 Adjustable height coupler shall accommodate 6-position hitch heights ranging from 18 to 28 inches.

3.1.3.4 Trailer shall be equipped with 44" long 1/4-inch safety chains with snap-type hooks for

secure attachment to tow vehicle hitch.

3.1.3.5 All coupler and safety chain configurations shall comply with SAE J684 standards for Class II (2) trailers.

3.1.4 Surface Preparation and Finishing

3.1.4.1 Trailer chassis and superstructure shall be completely cleaned and deburred prior to finishing. All metal surfaces shall be prepared for finishing using an iron phosphate wash-down process.

3.1.4.2 A polyamide epoxy primer shall be applied to a dry film thickness of 1.5 mils.

3.1.4.3 A high gloss federal safety orange aliphatic acrylic urethane finish shall be applied to a dry film thickness of 1.25 mils.

3.1.5 Lighting

3.1.5.1 Trailer shall be equipped with sealed flush-mounted combination stop, tail and turn lights.

3.1.5.2 Trailer shall be equipped with a lighted license plate holder.

3.1.5.3 Trailer wiring harness shall be completely sealed and water resistant.

3.1.6 Fenders

3.1.6.1 Trailer shall be equipped with unbreakable, molded, solid color, UV-stabilized HDPE (High Density Polyethylene) fenders completely closed on the inner side to protect trailer frame.

3.1.6.2 Fenders shall be secured to trailer frame with zinc-plated steel thread forming screws and fender washers to facilitate easy repair or replacement.

3.1.7 Leveling Jacks

3.1.7.1 Trailer shall be equipped with four telescoping jacks consisting of 2" x 2" x 12 Gauge perforated galvanized steel tubing equipped with a 3 x 3 x 3/16 inch x 6 inch wide steel foot plate.

3.1.7.2 Jack stands shall be inserted into 2 1/4" x 2 1/4" x 12 Gauge galvanized steel tubing, welded to the trailer frame at a 45 degree angle.

3.1.7.3 Jack stands shall be locked into position by 3/8-inch zinc-plated steel tab lock pins secured to trailer frame by nylon-coated stainless steel lanyards.

3.1.7.4 Jack stands and tongue jack shall be configured such that unit can be set up on jack stands, level, in operating position, with the trailer wheels raised completely off the ground, permitting removal of wheels and tires for additional security.

3.1.7.5 Jack stands shall be configured such that, when in the operating position, they create a footprint of at least 93 inches (236 cm), front to rear, and 61 inches (155 cm), side to side, to provide adequate stability of unit in high winds.

3.1.8 Tires and Wheels

3.1.8.1 Tires shall be ST175/80 R13 Load Range C.

3.1.8.2 Wheels shall be 13-inch x 4 1/2-inch, 5-lug pattern (4 1/2-inch bolt circle), white steel wheel.

3.1.8.3 Wheels and tires shall be sized according to load requirements of trailer and axle.

3.2 Sign Panel Support

3.2.1 Trailer superstructure shall provide complete support of the sign panel in the transport (down) position. Cantilevered support of sign panel is not acceptable!

3.2.2 Trailer superstructure shall be completely assembled with removable fasteners to accommodate quick, easy maintenance and repair.

3.2.3 All fasteners shall be rust resistant and equipped with all metal (stover) or nylon-stop type lock nuts to prevent loosening of fasteners during normal transportation and operation.

3.2.4 All aluminum to steel attachments shall be made with stainless steel hardware and stainless steel or nylon spacers to minimize galvanic corrosion.

3.2.5 Sign panel lifting mechanism shall consist of a 1,000-pound capacity, automatic brake type winch with 1/4-inch wire rope capable of holding the sign panel in any position from full upright to the travel (down) position.

3.2.5.1 Lifting mechanism, through a series of pulleys, shall provide for balanced pull on both sides of sign panel support frame during raising of sign panel into the operate position.

3.2.5.2 Winch shall be zinc-plated to minimize rust and corrosion.

3.2.5.3 Winch shall be designed such that the handle can be removed, for added security, without interfering with the operation of the automatic brake.

3.2.6 Trailer superstructure shall provide for support and operation of solar array, with solar array positioned to accommodate charging in both the operating and transport positions.

3.2.7 Solar array shall fold flat and flush onto back of sign panel when sign panel is in the transport (down) position to minimize wind resistance without the need for an air deflector or spoiler.

3.2.8 Trailer superstructure shall be equipped with a formed steel upper rear cross-member and formed steel upper side members to reinforce the sign panel and solar array support frame.

3.2.9 Trailer superstructure shall be equipped with an integral sighting device, welded in place, to accommodate proper alignment of the sign panel with oncoming traffic, during setup.

4. Speed Limit Display Panel, LED Message Display Panel, Speed Limit Sign

4.1 Dimensions

4.1.1 Speed Limit Display Panel:

4.1.1.1 Width Overall – 29.5 in. (75 cm)

4.1.1.2 Height Overall – 19.5 in. (50 cm)

4.1.1.3 Depth Overall – 6 in. (15 cm)

4.1.2 LED Message Display Panel

4.1.2.1 Width Overall – 36 in. (92 cm)

4.1.2.2 Height Overall – 29 in. (74 cm)

4.1.2.3 Depth Overall – 6 in. (15 cm)

4.1.3 Speed Limit Sign (R2-1):

4.1.3.1 Width Overall – 48 in. (122 cm)

4.1.3.2 Height Overall – 60 in. (152 cm)

4.1.3.3 Height Above Ground in Operating Position (to bottom of sign) – 84 in. (214 cm)

4.1.4 Work Zone Sign:

4.1.4.1 Width Overall – 48 in. (122 cm)

4.1.4.2 Height Overall – 12 in. (30 cm)

4.2 Construction

4.2.1 Speed Limit Display Panel Case & LED Message Display Panel Case

4.2.1.1 The message display panel case shall be constructed of heavy duty aluminum extrusion secured at each corner by a molded, fiberglass-reinforced plastic corner and stainless steel screws and nylon insert locknuts.

4.2.1.2 The back of the message display panel case shall be constructed of aluminum sheet bonded and riveted to the case frame.

4.2.1.3 The interior of message display panel case shall be equipped with formed aluminum channels to reinforce the display case and to support internal wiring and cables.

4.2.2 Speed Limit Display Panel Door & LED Message Display Panel Door

4.2.2.1 The display panel door shall be constructed of heavy duty extruded aluminum secured at the corners with glass fiber reinforced molded plastic inserts and stainless steel screws and nuts.

4.2.2.2 The door shall fit within a flange around the perimeter of the message display panel case frame to provide for a secure weatherproof enclosure.

4.2.2.3 A rubber seal shall be located inside of the flange on the case frame to provide a water-

tight, dust tight closure.

4.2.2.4 The message display panel shall be enclosed over the display area by a 3/16-inch thick clear UV resistant, scratch resistant, acrylic coated polycarbonate material with a non-glare outer surface to reduce reflection of ambient light and oncoming vehicle head lamps.

4.2.2.5 The polycarbonate material shall be secured in the door frame with an extruded rubber U-channel to provide a cushioned, weatherproof seal.

4.2.2.6 The message display panel door shall be hinged for ease of servicing. The door hinges shall be of a corrosion-resistant material, for maximum protection from the weather.

4.2.2.7 The display panel door shall be secured in the closed position with adjustable, positive locking, stainless steel draw latches.

4.2.2.8 The message display panel door and case shall be equipped with stainless steel locking hasps capable of accepting standard padlocks to secure the door in the closed position.

4.2.3 Speed Limit Sign (2R-1)

4.2.3.1 The speed limit sign shall be of all aluminum, Type III coated construction.

4.2.4 Surface Preparation and Finishing

4.2.4.1 Message display panel case and door shall be completely cleaned and de-burred prior to finishing.

4.2.4.2 A matte black acrylic finish shall be applied to a dry film thickness of 1.0-1.2 mils.

4.3 Display Characteristics

4.3.1 LED Message Display Panel

4.3.1.1 The message display area shall be approximately 30 inches in width by 23 inches in height.

4.3.1.2 The display area shall consist of a continuous (full) matrix of 12 pixels in width by 9 pixels in height.

4.3.1.3 The pixels shall consist of three (3) LEDs (Light Emitting Diodes) arranged in a triangular pattern to produce the appearance of a round dot at normal viewing distances.

4.3.1.4 The display color shall be amber (592 nanometer wavelength).

4.3.1.5 The display shall produce brightness greater than 10,000 candela per square meter at maximum intensity.

4.3.1.6 The display shall produce a viewing angle of greater than 60 degrees standard (per NTPEP testing), with consistent intensity and color across the entire display panel.

4.3.1.7 The message display shall be capable of displaying alphanumeric characters with a nominal character height of 18 inches (46 cm). The message display is also capable of displaying a BOLD font with a nominal height of 23 inches (58 cm).

4.3.2 Speed Limit Display Panel

- 4.3.2.1 The message display area shall be approximately 31 inches in width by 21 inches in height.
- 4.3.2.2 The display area shall consist of a continuous (full) matrix of 12 pixels in width by 7 pixels in height.
- 4.3.2.3 The character (numeral) display size shall be 5 pixels width by 7 pixels height.
- 4.3.2.4 The pixels or dots shall consist of three (3) LEDs (Light Emitting Diodes) arranged in a triangular pattern to produce the appearance of a round dot at normal viewing distances
- 4.3.2.5 The display color shall be white (color temperature 9000K).
- 4.3.2.6 The display shall produce brightness greater than 10,000 candela per square meter at maximum intensity.
- 4.3.2.7 The display shall produce a viewing angle of greater than 60 degrees standard (per NTPEP testing), with consistent intensity and color across the entire display panel.
- 4.3.2.8 The message display shall be capable of displaying alphanumeric characters with a nominal character height of 18 inches (46 cm).

4.4 Display Modules

- 4.4.1 Display modules shall be mounted in the sign panel using captive 1/4-turn wing-head fasteners to permit quick, easy module replacement without the need for any tools.
- 4.4.2 Display modules shall be mounted on rubber cushions to provide shock absorption during transport and to accommodate thermally-induced expansion and contraction of message display panel during operation.
- 4.4.3 Display module control circuitry shall include a fail-safe device, also known as a watchdog timer, to automatically monitor the performance of the display module and provide a reset / restart command to the on-board microcontroller in the event of any disruption of normal operation.
- 4.4.4 Display module control circuitry shall be designed to accommodate "hot swapping" - exchange of display modules while sign is operating.
- 4.4.5 The message display shall consist of an array of identical display modules capable of functioning in any position without the need for switch or jumper setup or special programming.
- 4.4.6 Display modules and message display panel shall accommodate complete service and exchange of display modules without the need for any tools.
- 4.4.7 Display modules shall be equipped with locking-type electrical / electronic connectors to provide secure, reliable operation while permitting quick, easy service and repair of message display.

4.5 Cables and Wiring

- 4.5.1 All message display panel wiring and cables shall be equipped with modular power and signal connectors to permit repairs without the need for any tools.
- 4.5.2 All power circuit connectors shall use tin or silver plated contacts.
- 4.5.3 All signal circuit connectors shall use gold plated or gold flashed contacts.
- 4.5.4 All system wiring, power and signal, shall consist of marine grade wire and cable, with multi-strand, aluminum or tin-plated conductors.
- 4.5.5 All power and sign panel signal wiring and cables shall be installed in nonmetallic, flexible, liquid-tight conduits. All conduit fittings shall be installed with rubber sealing rings to maintain liquid-tight characteristics.

5. Main Control Console (MegaTech)

5.1 Physical

- 5.1.1 Control console shall be enclosed in a weather resistant, lockable, molded HDPE (High Density Polyethylene) enclosure secured to the trailer chassis.
- 5.1.2 Control console shall be mounted on heavy duty slides which allow the control console to slide up and pivot into a position enabling the operator to program the unit while facing traffic from a comfortable standing position. A controller location which requires the operator to stoop, bend or kneel for operation such that the operator cannot see approaching traffic shall not be permitted.
- 5.1.3 Control console front panel shall consist of a backlit full color 10.4 inch LCD (liquid Crystal Display) with integrated industrial grade touch-screen, sealed and waterproof, to provide a reliable and user-friendly interface for the operator under any weather condition.
- 5.1.4 Slide mechanisms shall permit quick, easy removal of the control console without the need for any tools.
- 5.1.5 Control console power and control cables shall include sealed, locking-type connectors to permit quick, easy removal of control console without the need for any tools.

5.2 General Operation

NOTE: Cellular/GPS connection is an optional upgrade.

- 5.2.1 Control console shall include all necessary hardware and software to operate the dynamic message sign locally via integrated full color LCD display and touch-screen.
- 5.2.2 Control console shall have the ability to be configured to allow for remote operation of the display panel including geographic location monitoring (when optional integrated GPS module and antenna connected), radar speed monitoring and statistical data collection (when equipped with optional radar speed monitor), and sign panel orientation monitoring (when equipped with optional digital flux-gate compass), without the need for additional hardware, software, external computers or hand-held control devices.
- 5.2.3 Control console, in conjunction with the message display panel, shall have the capability of monitoring and detecting sign panel communication loop failures. In the event of a soft error (temporary disruption of message display), the control console shall have the ability to correct the failure immediately. In the event of a hard error (hardware failure), the control console shall have the ability to completely blank the sign panel to prevent the display of incorrect and/or potentially misleading messages.
- 5.2.3.1 The control console, in conjunction with the message display panel, shall have the capability of testing and reporting the operational status of every individual pixel in the sign panel. Non-operational pixels shall be indicated as such on both local and remote

user interfaces.

- 5.2.3.2 The control console shall have multiple diagnostic modes (manual & automatic with both local and remote controls) for troubleshooting sign panel (including a graphical representation of all modules with non-operational pixels) to enable an operator to quickly track down and replace faulty display modules in the sign panel.
- 5.2.4 Control console embedded CPU shall incorporate an ARM based microprocessor design to ensure future hardware and software compatibility through upgrades provided by manufacturer free for life of the machine. Additionally, upgrades shall be automatically applied via integrated cellular transceiver and included remote control service from date of original purchase. Operating system shall be Linux based and include multiple watchdog timers to ensure automatic system restarts in the event that any critical function stops working properly or communication with remote control servers is interrupted.
- 5.2.5 Control console shall be equipped with at least one USB port, one Ethernet port, two (2) serial ports (DB-9 connector), two (2) digital outputs, and one (1) digital input.
- 5.2.6 Control console shall be capable of simultaneously driving more than one sign panel for dual sign panel installations.
- 5.2.7 Control console operating processor, firmware and software shall be field (locally) upgradeable with a standard USB flash-drive (memory key) or remotely upgradeable over an IP addressable network connection - wire-line or wireless via IP addressable modem.
- 5.2.8 Full color LCD display shall be equipped with an automatic backlight with automatic dimming capability to accommodate both direct sunlight daytime and low ambient light level night time operation. Backlighting shall automatically activate upon any touch-screen activity and remain on for five minutes following the last touch-screen activity. Additionally, an automatic log-out feature shall be incorporated to ensure security of the unit when left unattended. Automatic log-out feature shall be capable of being disabled by the operator as desired.
- 5.2.9 Main power to the sign panel and the control console shall be controlled by a combination switch and circuit breaker to provide electrical protection without the need for fuses. All connections to controller and Energy Management System shall be made with locking type quick disconnect connectors. The use of fuses and/or terminal strips for connections shall be strictly forbidden.

5.3 Programming

- 5.3.1 Control console shall provide an intuitive icon-driven graphical user interface (GUI) along with step by step instructions to the operator, via the LCD display, as the various programming functions are performed, for simple easy programming and operation. On-

screen help files shall be included in all languages.

5.3.1.1 Control console shall support a minimum of six (6) standard operating languages (English, Spanish, French, Dutch, German and Portuguese) and four (4) standard keyboards (English, French, Portuguese/Spanish, and Arabic) along with associated font sets.

5.3.1.2 Controller shall be capable of quickly and easily enabling an operator so setup three operational speed thresholds (in 1 MPH or KPH increments):

- **Over-speed mode** which will cause the sign panel to statically display the actual speed of approaching vehicles updating the speed once every two (2) seconds. This is the normal display mode for speeds between a user entered desired minimum display speed (default 5 MPH) and a desired maximum (speed limit). The refresh display interval can be manually entered by the user (default is 2 seconds).
- **Excessive Speed mode** which will cause the display panel to rapidly flash the actual speed of approaching vehicles updating the speed once every two (2) seconds. This is the display mode for speeds above the user entered maximum speed (speed limit) to 10 MPH over the entered maximum speed (speed limit). Flash rate can be manually entered by the user (default 0.1 seconds).
- **Extreme Speed mode** which will cause the display to either (user selectable):
 - Flash the numerical setting of the upper limit of the Excessive Speed window (maximum speed limit + 10 MPH)
 - Flash in an alternating pattern all LEDs on each display module when speed exceeds the Excessive Speed window
 - Display a blank panel (i.e. display nothing at all) when speed exceeds the Excessive Speed window

5.3.1.3 Full customization shall be available as well, such that an operator can program the controller to display any desired output based on multiple speed thresholds / events.

- 5.3.2 Control console shall accommodate a minimum of fifty (50) full alphanumeric passwords each providing levels of access to various control console functions. Each password shall allow access to only the functions required by that particular dynamic message sign operator. The levels of access are as follows:

Quick Picks	Select from up to six (6) pre-programmed messages with no programming required. Simply touch a message for display. No access to any permanent data files.
User Menu	Create, Edit, Delete, Save, Display, and Schedule messages. Create, Assign, and Edit Quick Picks. Check System Status and perform basic diagnostics.
Supervisor Menu	All User Menu Functions. Create and Delete Quick-Picks and User passwords. Set system operating parameters.
Administrator Menu	All Supervisor Functions. Create and Delete Administrator and Supervisor passwords. Set Controller operating parameters.

- 5.3.3 Control console shall be capable of displaying a message on the message sign display panel during such time as the operator may be adding, editing or deleting messages from the control console user files. Blanking of the message sign display panel during normal operator activity is considered unsafe and shall be strictly forbidden.
- 5.3.4 Control console shall be capable of monitoring ambient light conditions and making appropriate adjustments to the intensity of the sign panel to maintain an acceptable display contrast during all ambient lighting conditions. The control console shall provide a minimum of sixteen (16) intensity levels between minimum and maximum display brightness.
- 5.3.4.1 An operator with Supervisor access shall be capable of adjusting the upper and lower photocell set-points as to adjust the overall range for the automatic brightness control to accommodate any local variations in ambient lighting.
- 5.3.4.2 Manual control of sign panel intensity shall be provided to enable an operator with Supervisor access to override automatic sign panel intensity control and set sign panel intensity manually from 1% to 100% in 1% increments.
- 5.3.5 Control console shall be equipped with a Scheduler that utilizes a real time clock and calendar feature to accommodate automatic, unattended changing of messages at predetermined dates and times. Scheduler shall support unique, single event schedules along with recurrent schedules such that messages may be easily scheduled for daily, weekly or monthly repetition. Recurrent schedules shall be capable of incorporating a start and stop date as desired.
- 5.3.5.1 Scheduler shall be capable of displaying messages based upon data driven events such

as input from a radar gun, photocell, battery voltage, temperature and/or switch closures (up to six(6)). Data driven events shall also be capable of being restricted to specific dates and times.

- 5.3.5.2 Scheduler shall incorporate a priority system for resolution of conflicting schedules and/or events to permit one schedule/event to override another based upon level of importance (i.e. priority).
- 5.3.5.3 The control console shall have the capability to create and display on the sign panel an Override Message that takes priority and overrides all programmed Schedules and Events until cleared to enable an operator to display a message continuously on the sign panel regardless of programmed schedules and/or events.
- 5.3.6 Control console shall provide a system status page that enables an operator to quickly and easily determine the unit's current time, date, photocell reading, photocell set-points, battery bank voltage, battery bank current, solar array voltage, solar array current, temperature, MAC address, IP address, run-time since last re-boot, current run-time (resettable timer), lifetime run-time, and serial modem type along with modem signal strength and quality, latitude & longitude and sign panel heading.
- 5.3.7 Control console shall be capable of page display times from 0.1 seconds to a minimum of 99 seconds in 0.1 second increments.
- 5.3.8 Control console shall provide the capability to display Battery Bank Voltage to 0.1 Volt accuracy, Battery Bank Current to 0.1 Amp accuracy, Solar Array Voltage to 0.1 Volt accuracy and Solar Array Current to 0.1 Amp accuracy directly on the control console display.
- 5.3.9 Control console shall have the capability to calculate and display an estimated run-time (autonomy) based on current battery bank status and historical system energy (generation vs. consumption) trends to provide the operator with an estimated number of days system is capable of operating prior to shutting down on a low-battery condition.
- 5.3.10 Control console shall provide for a user selectable low-battery-voltage caution message when the battery voltage drops to a user specified level (above the low-battery automatic shutdown voltage). The low-battery-voltage caution message shall be user programmable by an operator with Supervisor access.
- 5.3.11 Control console shall incorporate a feature know as Adaptive Blanking that will as necessary, based upon current battery bank voltage and/or recorded battery bank voltage trends, automatically insert variable length blanks between pages (0.25s to 0.50s) of messages to reduce overall power consumption and extend run-time. An operator with Supervisory access shall be capable of either enabling or disabling the Adaptive Blanking feature.

- 5.3.12 Control console shall be equipped with three (3) Run-Time counters: an Up-Time counter that indicates total number of days, hours and minutes since last re-boot, a Current Run-Time counter that indicates total hours of operation since last reset of the counter (resettable run-time counter), and a Lifetime Run-Time counter that indicates total hours of control console operation (non-resettable).
- 5.3.13 Control console shall include the ability to reset the Current Run-Time counter, Message Library, Scheduler, and all Factory Settings automatically, individually or all at once through performing a variety of Master Resets which will clear all memory and reset all settings to original factory set-points to various levels.
- 5.3.14 Control console, in addition to an integrated LTE Cat M1 transceiver, shall support both dynamic and static IP address network connections along with direct serial communications to support legacy NTCIP installations.
- 5.3.15 Control console shall provide a method for setting a battery offset and temperature offset to calibrate battery voltage and temperature readings.
- 5.3.16 Control console shall provide a method for switching radar gun output from MPH to KPH directly from control console GUI or remotely via remote control software.
- 5.3.17 Control console shall be NTCIP compatible. The following NTCIP standards must be supported:

NTCIP 1201 (v3.15r) - Global Object Definitions

NTCIP 1203 (v2.39b) - Object Definitions for Dynamic Message Signs

NTCIP 2101 (v1.19) - Subnetwork Profile: PMPP over RS232

NTCIP 2104 (v1.11) - Subnetwork Profile: Internet

NTCIP 2201 (v1.15) - Transport Profile: Transportation

NTCIP 2202 (v1.05) - Transport Profile: Internet

Unit shall support an administrator community string along with 255 other communities. Each community shall be capable of being assigned read-only or read-write access.

Unit shall support up to 65,535 user-defined permanent messages.

Unit shall support a configurable number of changeable (persistent) messages. This number shall be configurable between 1 and 65,535, and shall default to 32.

Unit shall support a configurable number of volatile (non-persistent) messages. This number shall be configurable between 1 and 65,535, and shall default to 32.

Each message shall support at least 16 pages.

Unit shall support a scheduler with support for up to 16 schedule, 16 day plans, and 96 day plan events.

Unit shall support at least 255 graphics via the monochrome 1 bit color scheme.

Unit shall support a configurable number of user-definable fonts. This number shall be configurable between 1 and 127, and shall default to 32.

6. Radar Speed Monitor

6.1 General

- 6.1.1 Operating Frequency – 24.15 GHz $\pm$ 10Mhz (K-Band)
- 6.1.2 Antenna Beam Angle – 9° (vertical) x 18° (horizontal)
- 6.1.3 Target Speed Range – 1 to 205 mph (2 to 329 km/h)
- 6.1.4 Target Speed Accuracy – $\pm$ 0.5% of reading + 0.1 mph
- 6.1.5 Detection Distance – based on radar mounted 5 feet above level road, pointed into oncoming traffic. Detection Distances vary with vehicle characteristics, installation and road conditions.
 - Non-range boost mode – 1500 ft (450 meters)
 - Range boost mode – 2600 ft (760 meters)
- 6.1.6 Radar unit shall install in the field with minimum effort.
- 6.1.7 Message sign shall be pre-wired and pre-programmed for radar speed monitor option.

6.2 Operating Features

- 6.2.1 Target Speed Display - The speed of the target may be displayed as part of any user-created messages, in any character size, in any position in the message. Multiple messages which include target speed can be stored in the message library.
- 6.2.2 Triggered Display - A message may be displayed only when an acquired target exceeds a preset speed threshold. This message may include the display of the target speed. If no target is acquired or if the acquired target is below the preset threshold, the default message will be displayed. Default message can be a blank display.
- 6.2.3 Window Triggered Display - Upper and lower speed thresholds may be preset such that the special message is displayed only when the target speed is above the lower threshold but below the upper threshold. This message can include the display of the target speed. If no target is acquired or if the acquired target is above or below the preset thresholds, the default message will be displayed. Default message can be a blank display. Multiple windows can be programmed each with a different message to be displayed when the acquired target speed is above the minimum speed but below the maximum speed threshold for that particular window. Each of these messages can include the display of the target speed.
- 6.2.4 All necessary software features shall be included with the basic message sign package.

6.3 Radar Statistical Data Collection

- 6.3.1 Control Console shall automatically log and record (to a standard USB memory stick) all raw data provided by the radar gun along with basic statistical information about the collected data in 15 minute intervals. The data shall be stored in two CSV (Comma Separated Value) files which may be opened in Microsoft Excel or any other similar spreadsheet type application for viewing, manipulation and analysis. Additionally, the

most recent 30 days' worth of Radar Statistics (statistical radar data logged every 15 minutes) shall be maintained in the control consoles nonvolatile memory and shall be retrieved remotely via Command Center

6.3.2 Data Provided

Raw Data File: (radar_data file) - (Year, Month, Day, Time, Reading) - every reading - readings recorded every 250 milliseconds while tracking a target.

Statistical Data File: (radar_statistics file) - (Year, Month, Day, Time, # of Readings, Mean, Median, Mode, Standard Deviation, Lowest Reading, Highest Reading) - based on all readings - readings recorded every 250 milliseconds while tracking a target.

7. Power System

7.1 General

7.1.1 Operating Voltage - 12 Volts DC nominal

7.1.2 Main Power Switch - Main power switch shall be a combination switch and electromagnetic, thermal circuit breaker to provide complete electrical system protection without the inconvenience of conventional fuses. Main power switch shall be splash proof and weather resistant.

7.2 Battery Bank

7.2.1 Number of batteries – Specify four (4) standard, upgradable to six (6) or eight (8)

7.2.2 Battery type – 6-Volt, heavy duty, deep cycle – specify Flooded Lead-Acid or Gel-Cell or AGM

7.2.3 Energy capacity – 520 Amp-Hours nominal (4 batteries) to 1040 Amp-Hours nominal (8 batteries). Sufficient energy capacity to operate the unit without any energy input from the solar array for thirty (30) days, with appropriately sized battery bank.

7.2.4 Battery / Equipment Compartment

7.2.4.1 Battery / Equipment Compartment shall be constructed of molded HMWPE (High Molecular Weight Polyethylene), color impregnated with Federal Safety Orange with 0.5% UV stabilizer added to prevent fading.

7.2.4.2 Compartment shall be designed to completely contain spills from a failed or damaged battery case.

7.2.4.3 Compartment shall be capable of supporting an operator standing on top of the battery equipment compartment to service unit.

7.2.4.4 Compartment shall be designed such that the lid latches in the closed position and holds the batteries in place. Lid shall be capable of being locked in the closed position with a standard padlock.

7.2.4.5 Lid shall be secured to compartment by an integral plastic hinge that permits the lid to be completely removed from the compartment for service. Lid on the compartment containing the control console shall be automatically supported in the open position by a telescoping lid support.

7.2.4.6 Compartment shall be designed to provide adequate ventilation for the batteries during charging yet prevent the ingress of water during use or transport.

7.2.4.7 Compartment shall be capable of housing up to four (4) BCI Group GC-2 batteries.

7.2.4.8 Each compartment shall use a metal bracket to secure the batteries in place. The bracket shall be fastened to the bottom of the compartment using tamper-resistant security fasteners to deter unauthorized removal. The bracket shall also restrain the batteries against movement and vibration during transport.

7.3 Solar Array

- 7.3.1 Photovoltaic module type - Single crystal (mono-crystalline) silicon
- 7.3.2 Number of solar cells per module - 36
- 7.3.3 Solar array power output – 160 Watts (peak) Standard, upgradable to 220 Watts

NOTE: Solar energy system performance charts are available to assist in selection of appropriate solar array power output requirements

- 7.3.4 Trailer shall tilt to the rear, with sign panel in the down or transport position to allow for fast, easy cleaning and maintenance of the solar array.
- 7.3.5 Solar array energy output shall be sufficient to operate the speed limit display and LED feedback display, under normal operating conditions, with the solar array in a flat, horizontal position. It shall not be necessary to tilt or rotate the solar array to provide sufficient energy output from the solar array to operate the message sign continuously.
- 7.3.6 Photovoltaic module junction boxes shall be equipped with watertight strain reliefs at all cable entry points.

7.4 Wiring and Cabling

- 7.4.1 All power and control wiring and cables shall be in nonmetallic, flexible, liquid tight conduits.
- 7.4.2 All conduit fittings shall be sealed at bulkheads or enclosure entry points.
- 7.4.3 All wiring shall be marine grade, multi-strand, tin-plated copper with PVC insulation rated for outdoor use.
- 7.4.4 All power system wire terminals shall be tin-plated copper to minimize the effects of galvanic corrosion.
- 7.4.5 Main power wiring shall be 10 AWG minimum.
- 7.4.6 Battery terminations shall consist of 5/16-18 UNC marine stud with stainless steel split lock washer and hex nut with 5/16 tin-plated copper ring terminal.
- 7.4.7 Solar panel terminations shall consist of stainless steel screws with #8 tin-plated copper snap spade terminals.
- 7.4.8 All other terminations shall consist of locking-type quick-disconnect connectors with tin-plated terminals for power connections and gold-plated terminals for signal connections. Terminal strips, screw or compression type, shall not be permitted.

7.5 Energy Management System

- 7.5.1 Solar energy management system control unit shall include a completely solid state charge controller capable of operating in an outdoor environment. No mechanical or electromechanical switching to control charging current is permitted.
- 7.5.2 All wiring connections to the energy management system control unit shall be made with locking- type multi-pin connectors to facilitate quick, easy servicing of the control unit without the need of any tools. Electrical connections shall include an auxiliary 12-

Volt power connection to provide power for accessory devices.

- 7.5.3 Energy management system control unit shall monitor solar array voltage, solar array current, battery voltage, battery current and ambient temperature.
- 7.5.4 Energy management system control unit shall regulate energy flow from the solar array into the battery bank based on ambient temperature so as to avoid over charging of the batteries and minimize the consumption of electrolyte.
- 7.5.5 Energy management system control unit shall provide for the controlled periodic pulsing of the solar array current to assist in minimizing sulfate deposit buildup on the battery plates.
- 7.5.6 Energy management system control unit shall provide for remote monitoring of the battery bank voltage, at the terminals of one of the batteries, to assist in optimizing the transfer of power into the battery bank.
- 7.5.7 Energy management system control unit shall be equipped with a 2-line by 16-character LCD (Liquid Crystal Display) displaying sequentially, solar array voltage, solar array current, battery voltage, and battery current. In addition, the energy management system control unit shall display a low battery voltage-warning message whenever the battery bank voltage drops below 10.9 Volts.
- 7.5.8 Energy management system control unit shall automatically switch current to the message sign off whenever the battery bank voltage drops below 10.7 Volts to prevent damage to the battery bank due to over-discharging the batteries.
- 7.5.9 Energy management system control unit shall provide for automatic reverse polarity protection, including reverse polarity indicator lamps, for the solar array and the battery bank.
- 7.5.10 Energy management system shall monitor and report to control console battery bank voltage, battery bank load current, solar array voltage and solar array charge current.
- 7.5.11 Energy management system shall have an integrated watchdog timer that is continuously reset by the control console during normal operations such that if the control console were to become unresponsive due to a software failure/lockup, upon expiration of the timer the energy management system will completely power down and re-start the entire system (including control console and all accessories such as modem, sign panel compass, etc.) in an attempt to recover the system from a temporary software failure/lockup.

8. Documentation

8.1 Operation and Maintenance Manual - available online at www.solartechnology.com

- 8.1.1 Setup and Operation
- 8.1.2 Programming
- 8.1.3 Maintenance
- 8.1.4 Troubleshooting and Repair
- 8.1.5 Assembly Diagrams and Parts Lists
- 8.1.6 Specifications
- 8.1.7 Appendix

8.2 Command Center - User's Manual - available online at www.solartechnology.com

- 8.2.1 Installation and Setup
- 8.2.2 Command Center Operation
- 8.2.3 Appendix

8.3 User Guide - Hard Copy - attached to unit with Nylon lanyard

- 8.3.1 Pre-transport checklist.
- 8.3.2 Job site setup checklist.
- 8.3.3 Basic programming instructions.
- 8.3.4 Basic system status evaluation.
- 8.3.5 Weatherproof card attached to unit with a 5/32-inch diameter nylon lanyard.

8.4 Integration Support Documentation - Per request from customer support (1-800-475-5442)

- 8.4.1 Proprietary Protocol Documentation for Custom System Integrators
- 8.4.2 NTCIP Support Documentation for NTCIP System Integrators
- 8.4.3 Web-Server Protocol Documentation for Web Based Application System Integrators

9. Maintenance**9.1 Scheduled Maintenance**

9.1.1 Solar Array - Clean with water and mild detergent as needed.

9.1.2 Battery Bank - Check electrolyte level once each month and add distilled water as needed. (NOTE: Not required with Gel-Cell or AGM batteries.)

9.2 Preventive Maintenance

9.2.1 Inspect and lubricate axle hubs once per year.

10. Warranty

10.1 Standard Warranty

10.1.1 Limited Bumper to Bumper - Five (5) years - consult factory for terms & conditions

10.1.2 Solar Panels – Ten (10) years

11. Options

11.1 Battery Charger

11.1.1 Charger type - Switching regulator, constant voltage with automatic switch to maintenance or trickle charge.

11.1.2 Input Voltage - 120 VAC 50/60 Hz (specify 220 VAC 50 Hz for international use)

11.1.3 Available models with typical recharge times.

45-Amp: 24 hours (8 batteries), 18 hours (6 batteries), 12 hours (4 batteries)

55-Amp: 20 hours (8 batteries), 15 hours (6 batteries), 10 hours (4 batteries)

100-Amp: 14 hours (8 batteries), 11 hours (6 batteries), 8 hours (4 batteries)

11.1.4 Battery charger unit shall install in the field with minimum effort.

11.2 Remote Control

11.2.1 General

11.2.1.1 The remote control option shall provide for complete control of all dynamic message sign functions. The remote control option shall, at a minimum, provide for:

- Simultaneously geographically tracking, managing, operating and maintaining a minimum of 1,000 remotely located PCMS units including setting up automatic e-mail notifications/alerts for unit movement, change of displayed message, low estimated runtime, low battery condition, sign panel failures, and pixel failures.
- Sending a message to one or more remote PCMS for immediate display.
- Receiving the message currently displayed on all remote PCMS.
- Managing the message libraries and message schedules & events on all remote PCMS.
- Checking the operating status, including sign panel status, system date & time, battery voltage, estimated autonomy, temperature, unit Up-Time, Current Run-Time, Life-Time Run-Time, and ambient light level of all remote PCMS.
- Reporting and managing NTCIP status of all PCMS.
- Retrieve up to 30 days' worth of logged Radar Statistics
- Provide for the ability to perform various system resets including a complete re-boot/restart of the system for all PCMS.

11.2.1.2 Communication Protocol - Proprietary with complete CRC error detection and correction and full challenge-response password authentication.

11.2.1.3 Data Format - Data is encrypted and compressed for added security and reliability.

11.2.2 All operating software for message sign control console and host computer shall be included with basic message sign package (downloadable from www.solartechnology.com).

11.2.3 TCP/IP Network Communications (Dynamic or Static IP Address)

11.2.3.1 Data rate - 10/100 Base-T Ethernet

11.2.3.2 Remote control of any networked (IP addressable) PCMS may be achieved from any host computer with Internet connectivity (either with standard NTCIP commands via SNMP or STMP, or with Command Center). Remote control software (Command Center) shall be provided free of charge (downloadable from www.solartechnology.com) with unit and function on any host computer, independent of operating system. Control console and remote control software shall incorporate a challenge/response encrypted type password security system to prevent unauthorized access of any networked PCMS.

11.2.4 IP Addressable Cellular Transceiver Operation

11.2.4.1 Wireless modem with up to a 3-Watt cellular transceiver.

11.2.4.2 MNP 2-4 Error Control - Automatic error detection and correction.

11.2.4.3 MNP 5 Data Compression - Higher data rates, shorter connection times.

11.2.4.4 MNP 10EC - Enhanced performance over noisy cellular connections.

11.3 Cellular Transceiver & GPS Receiver Module

11.3.1 Integrated into Control Console – proprietary

11.4 Sign Panel Flux-Gate Digital Compass

11.4.1 Operating Voltage – 5-36 V_{dc}

11.4.2 Input Current – 5.7 mA @ 12 V_{dc} maximum

11.4.3 Operating Temperature Range – -40°C to +65°C (-40°F to +150°F)

11.4.4 Accuracy – ±0.5 degrees

11.4.5 Repeatability – ±0.2 degrees

11.4.6 Resolution – 0.1 degrees

11.4.7 Dip Angle – ±80 degrees

11.4.8 Tilt Angle – ±16 degrees

11.4.9 Response Time – 1 second