Silent Messenger
Solar Powered Portable Changeable
Message Boards

Procurement Specifications
for MB IV Message Boards

SOLARTECH ®

As Reliable as the Sun

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This document presents a detailed specification for a small-size solar powered portable dynamic (changeable) message sign. 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 MESSENGER IV** is a solar powered portable dynamic message sign. The **SILENT MESSENGER IV** consists of a sign display panel, a supporting structure for the display panel, 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 1/2 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 they are neither susceptible to nor produce any electromagnetic interference.

2.   Physical

2.1   Dimensions

2.1.1   Length Overall

   Transport position   – 117 in. (298 cm)

   Storage/Operational position   – 75 in. (191 cm)

2.1.2   Width, Across Fenders   – 56 in (142 cm)

2.1.3   Height

   Transport position   – 90 in. (229 cm)

   Operational position   – 129 in. (328 cm)

2.1.4   Ground Clearance   – 13 in. (33 cm) minimum

2.1.5   Weight   – 1,200 lbs (544 kg) maximum

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, max. 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 shall be constructed of welded 7 Gauge (3/16-inch) CNC formed steel plate and structural steel tubing with a 7 Gauge formed steel plate assembly reinforced and welded to front crossmember for pivoting tongue.

3.1.1.2 The trailer tongue shall consist of 2 1/2 x 2 1/2 x 3/16 inch structural steel tubing. The tongue shall bolt to a formed steel plate assembly with an additional removable hitch pin to allow for easy pivoting upward into the storage position.

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

3.1.2   Suspension

3.1.2.1 Trailer shall be equipped with an independent suspension, torsion-type axle with a 2,200 pound overall capacity. Axle load capacity shall be set at 1,400 pounds nominal.

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 Trailer tongue shall be capable of accepting a 2-inch ball coupler, a 2 1/2-inch pintle ring, an optional removable combination coupler (2-inch ball coupler & 2 1/2-inch pintle ring), or an optional adjustable height coupler (2-inch ball coupler and/or 3-inch pintle ring).

3.1.3.2 Trailer shall be equipped with 1/4-inch safety chains with snap-type hooks for secure attachment to tow vehicle hitch.

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

3.1.3.4 Hitch Heights

- Pintle couplers are measured from the ground to the bottom of the pintle ring.

- Ball couplers are measured from the ground to the top of the ball socket.

Tongue Angle	2 ½" Pintle	2" Ball	3-Position Pintle	3 Position Ball	6 Position Pintle	6 Position Ball
-1°	18"	18 ¾"	17"-21"	18 ¾"-22 ¾"	17"-27"	18 ¾"-22 ¾"
-4°	13 ¾"	14"	12 ¾-"16 ¾"	14"-18"	12¾"-22¾"	14"-24"

3.1.3.5 Tongue lengths shall be approximately 54 inches (measured from centerline of 2-inch ball).

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 (4) swivel type screw jacks, minimum capacity rating of 2,000 pounds, mounted at each corner of the trailer frame.

3.1.7.2 The jacks shall be capable of lifting the trailer frame so trailer wheels and tires can be removed for additional security.

3.1.7.3 Trailer shall be constructed such that the outrigger jacks are protected by CNC formed steel plate guards when the jacks are in the travel position to prevent damage to jacks during transport

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 dress 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) lock nuts to prevent loosening of fasteners during normal transportation and operation.

3.2.4   Sign Panel Lifting Mechanism

3.2.4.1 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 transport (down) position.

3.2.4.2 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 operating position.

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

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

3.2.4.5 Sign panel shall be secured in the operating (up) position by two stainless steel, spring-loaded, locking pins.

3.2.5   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.

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

3.2.7   Trailer superstructure shall be equipped with a steel angle upper rear crossmember and formed steel upper side members to reinforce the sign panel and solar array support frame.

3.2.8   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.   Message Display Panel

4.1   Dimensions

4.1.1   Width Overall – 60 in. (152 cm)   OR   78 in. (198 cm)

4.1.2   Height Overall – 30 in. (76 cm)   OR   33 in. (84 cm) – 78 in. wide sign panel only!

4.1.3   Depth Overall – 6 in. (15 cm)

4.2   Construction

4.2.1   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 black powered coated stainless steel torx head 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 Interior of message display panel case shall be equipped with extruded aluminum channels to reinforce the display case and to support internal wiring and cables.

4.2.1.4 The display panel case shall be equipped with vents, designed to allow the flow of vapor but not fluid, located at the top and bottom of the case frame to provide adequate ventilation to minimize condensation and fogging of the display panel door.

4.2.2   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 black powered coated stainless steel torx head 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 secured in the open position for servicing by a pair of zinc-plated steel telescoping lid supports equipped with automatic latches. The door supports shall be located completely inside of the display panel housing, protected from 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 Surface Preparation and Finishing

4.2.3.1 Message display panel case and door shall be completely cleaned and deburred prior to finishing.

4.2.3.3 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   The message display area shall be approximately 54 inches in width by 24 inches in height (60" x 30" sign panel), 72 inches in width by 24 inches in height (78" x 30" sign panel), or 72 inches in width by 27 inches in height (78" x 33" sign panel).

4.3.2   The display area shall consist of a continuous (full) matrix of (Specify):

⸺ 36 pixels in width by 16 pixels in height [60" x 30" sign panel with 1.5" (38 mm) pixel pitch]

⸺ 48 pixels in width by 16 pixels in height [78" x 30" sign panel with 1.5" (38 mm) pixel pitch]

⸺ 48 pixels in width by 18 pixels in height [78" x 33" sign panel with 1.5" (38 mm) pixel pitch]

⸺ 72 pixels in width by 32 pixels in height [60" x 30" sign panel with 0.75" (19 mm) pixel pitch]

⸺ 96 pixels in width by 32 pixels in height [78" x 30" sign panel with 0.75" (19 mm) pixel pitch]

4.3.3   For 19 mm sign panels, the pixels shall consist of one (1) LED (Light Emitting Diode). For 38 mm sign panels, the pixels shall consist of two (2) LEDs arranged in a close-spaced pattern to produce the appearance of a round dot at normal viewing distances.

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

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

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

4.3.7   The message display shall be capable of displaying multiple lines of alphanumeric characters or text with a nominal character height ranging from:

19 mm sign panels: 3.75 inches (9.5 cm) minimum to 30 inches (76 cm) maximum

38 mm sign panels: 7.5 inches (19 cm) minimum to 30 inches (76 cm) maximum

4.3.8   The message display panel shall be capable of displaying a minimum of two (2) lines of text with a minimum of eight (8) characters per line, at a nominal character height of 10.5 inches and a minimum of 3 inches between lines.

4.3.9   The message display shall also be capable of displaying graphic images and symbols using the full pixel array.

4.4   Display Modules

4.4.1   Display modules shall be mounted in the sign panel using captive 1/4-turn fasteners to permit quick, easy module replacement without the need for any special 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 special 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

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 sealed to accommodate operation in all types of weather.

5.1.3   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. Slide mechanism shall permit quick, easy removal of control console without the need for any tools.

5.1.4   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.

5.1.5   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.

5.2   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) and remotely (via integrated cellular transceiver and antenna), 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.

5.2.2   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), console shall have the ability to completely blank the sign panel to prevent the display of incorrect and/or potentially misleading messages.

5.2.2.1 Control console, in conjunction with the message display panel, shall have the capability of continuously and dynamically (as well as on command) testing and reporting the operational status of each individual pixel in the sign panel. Non-operational pixels shall be indicated on both local and remote user interfaces.

5.2.2.2 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.

5.2.2.3 Control console shall have the capability of reporting complete sign panel operational status remotely (including web-access, NTCIP, and UTMC).

5.2.3   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. 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.

5.2.4   Control console shall be capable of connection to any standard IBM or compatible desktop or laptop computer via either a standard serial interface (COM) or an Ethernet port to facilitate routine service, repair, extensive diagnostics, and the analysis of user files or operating programs.

5.2.5   Control console shall be equipped with at least one (1) USB port, one (1) Ethernet port, two (2) serial ports (DB-9 connector), four (4) digital outputs, six (6) digital inputs, and four (4) analog inputs.

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. Additionally, upgrades shall be provided by manufacturer free of charge for life of machine and automatically applied via integrated cellular transceiver and included remote control service from date of original purchase.

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 (5) 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 (i.e. for vehicle mounted applications).

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 being setup for either a Standard US DOT, Power-Miser US DOT, Standard US 3-Line DOT, French Canadian, Ontario MTO-2, Quebec Road Safety, MTQ, or an international font set by an operator with Administrator access to prevent unauthorized use of inappropriate fonts by operators with User access.

5.3.2   Control console shall be capable of storing all messages in alphabetical order by the first letter of the first word of the name assigned to the message to permit quick recall of messages without the need for maintaining a numeric listing of pages and/or messages. Messages shall be automatically named and sorted any time messages are added to or deleted from the library. Because of difficulty in locating and retrieving stored pages and/or messages via numerical codes, number coded storage of pages and/or messages requiring any form of a lookup table/directory shall be strictly forbidden.

5.3.3   Control console shall accommodate a minimum of fifty (50) full alphanumeric passwords each providing one of four 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 four 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.

5.3.4   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.

5.3.5   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.

5.3.5.1 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.

5.3.5.2 Manual control of sign panel intensity shall be provided; an operator with Supervisor access may override automatic sign panel intensity control and set sign panel intensity manually from 1% to 100% in 1% increments.

5.3.6   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.

5.3.6.1 Scheduler shall also 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.

5.3.6.2 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).

5.3.6.3 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.

5.3.7   Control console shall provide special function buttons to provide access to common user functions in a single step including (from the main log-on screen) Managing Messages, Scheduling Messages, Blanking the Sign Panel, creating an Instant Message, and selecting from Quick Picks.

5.3.8   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.

5.3.9   Control console shall be capable of storing a minimum of 5,000 messages, each message capable of accommodating a minimum of 500 pages (text or graphic images).

5.3.10 Control console shall provide a minimum of twelve (12) font sizes (with full uni-code support for each font) including an adaptive font that automatically and dynamically sizes text to fit on a page as it is typed such that the largest font is always used for a

given amount of text on a page to ensure maximum visibility and legibility. One of the included font sizes shall be a standard 5x7 DOT pixel font.

5.3.11   Control console shall support the incorporation of multiple dynamic data sources per page during message creation such that multiple pages within a message can include output from multiple dynamic data sources. Pages containing dynamic data sources shall be automatically refreshed and updated prior to each display such that the most recent data is always displayed on the sign panel. System shall include, as a minimum, the following data sources: radar gun (if equipped), real-time clock (time and date - day, month, year and time in various formats), photocell (ambient light level), battery voltage, and countdown& count-up features from a specified date and/or time. System shall also provide operator with the ability to create and incorporate additional dynamic data sources for display and scheduler control for maximum flexibility during system integration.

5.3.12   Control console shall be capable of page display times from 0.1 seconds to a minimum of 99 seconds in 0.1 second increments.

5.3.13   Control console shall be capable of displaying messages in a preview screen, during message creation, editing or selection, exactly as they will appear on the message display panel including an exact graphical representation of all non-operational/failed pixels on sign panel.

5.3.14   Control console shall permit the editing of messages that are currently being displayed, showing the revised message as soon as message editing has been completed.

5.3.15   Control console shall enable an operator to create, copy, add/insert, move about, edit and delete/remove pages to/from a message dynamically during message creation and/or editing. It shall not be necessary to create pages first and then assemble the pages into a message. Control console shall have the ability to insert pages and/or messages from a master library into a new message and move them about within the message. Control console shall also accommodate the creation and editing of graphic images directly from the GUI during message creation. Additionally, control console shall provide the operator with the ability to easily flash a page within a message, flash a line(s) within a page and/or add static or dynamic arrows/chevrons to a page within a message through the use of page annotations. Control console shall have the capability (if enabled by an operator with Supervisory access) to create pages with scrolling text.

5.3.16   Control console shall provide a selection of standard highway work zone sign graphic images, including but not limited to: flagman, fixed left and right arrow images, moving or sequential left and right arrow images, and moving or sequential left and right chevrons, etc.

5.3.17   Control console shall provide the capability to display Battery Bank Voltage to 0.1 Vdc accuracy, Battery Bank Current to 0.1 Amp accuracy, Solar Array Voltage to 0.1 Vdc accuracy and Solar Array Current to 0.1 Amp accuracy directly on the control console display.

5.3.18   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.

5.3.19   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.

5.3.20   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.

5.3.21   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).

5.3.22   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.

5.3.23   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.

5.3.24   Control console shall provide a method for setting a battery offset and temperature offset to calibrate battery voltage and temperature readings.

5.3.25   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.

5.3.26   Control console shall be NTCIP compatible. The following NTCIP standards must be supported:

NTCIP 1201 (v3.15r) – Global Objective 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-defined fonts. This number shall be configurable between 1 and 127, and shall default to 32

5.3.27 Web-Interface (Smart-Phone Control): Control console shall function as a Web-Server which enables an operator (via user name and password access) through any standard Web-Browser to:

- Create a unique Web-Name for the unit for browser ID

- View the current status of the unit to include current message displayed on sign panel, battery voltage, photocell reading, date & time, and NTCIP control status

- Blank the unit's sign panel

- Select, preview, edit and activate any message from the unit's message library

- Create, edit, preview and activate a new multi-page text message (up to 6 pages)

- Turn NTCIP control on/off if NTCIP control is enabled on control console

Access to the Web-Server shall be though any standard web browser over a standard network connection and/or public IP address (i.e. IP addressable modem). Access shall be protected by a user name and password created by the operator through the manufacturer's proprietary remote control software to ensure security is maintained at all times. The Web-Server shall be capable of being controlled (i.e. turned on and off) via manufacturer's proprietary remote control software. Web-Access to the control console shall not require access to a central server. All access to the Web-Server shall be logged and recorded.

6.   Power System

6.1   General

6.1.1   Operating Voltage - 12 Volts DC nominal

6.1.2   Operating Energy Requirement -30 Amp Hours per day at Spring or Fall Equinox (12 hours of daylight, 12 hours of darkness)

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

6.2   Battery Bank

6.2.1   Number of batteries - Four (4)

6.2.2   Battery type - 6-Volt, heavy duty, deep cycle - Specify Flooded Lead-Acid, Gel-Cell or AGM

6.2.3   Energy capacity - 520 Amp Hours nominal (4 batteries). Sufficient energy capacity to operate the message sign, displaying typical three-line normal size character messages for up 20 days without any energy input from the solar array.

6.2.4   Battery / Equipment Compartment

6.2.4.1 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.

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

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

6.2.4.4 Compartment(s) shall be designed such that the lid automatically 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.

6.2.4.5 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.

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

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

6.3 Solar Array

6.3.1   Photovoltaic module type - Single crystal (monocrystalline) silicon

6.3.2   Number of solar cells per module - 36

6.3.3   Solar array power output – Specify 160, 220, 270, 330 Watts peak (min.)

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

6.3.4   Entire trailer shall tilt, with sign panel in the down or transport position to allow for fast, easy cleaning and maintenance of the solar array.

6.3.5   Solar array energy output shall be sufficient to operate the changeable message sign, 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.

6.3.6   Photovoltaic module junction boxes shall be equipped with watertight strain reliefs at all cable entry points.

6.4 Wiring and Cabling

6.4.1   All power and control wiring and cables shall be in nonmetallic, flexible, liquid tight conduits.

6.4.2   All conduit fittings shall be sealed at bulkheads or enclosure entry points.

6.4.3   All wiring shall be marine grade, multi-strand, tin-plated copper with PVC insulation rated for outdoor use.

6.4.4   All power system wire terminals shall be tin-plated copper to minimize the effects of galvanic corrosion.

6.4.5   Main power wiring shall be 10 AWG minimum.

6.4.6   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.

6.4.7   Solar panel terminations shall consist of stainless steel screws with #8 tin-plated copper snap spade terminal.

6.4.8   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.

6.5 Energy Management System

6.5.1   Solar energy management system 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.

6.5.2   All wiring connections to the energy management system shall be made with locking-type multi-pin connectors to facilitate quick, easy servicing of the energy management system without the need of any tools. Electrical connections shall include an auxiliary 12 Vdc power connection to provide power for accessory devices.

6.5.3   Energy management system shall monitor solar array voltage, solar array current, battery voltage, battery current, and ambient temperature and use MPPT (Maximum

Power Point Tracking) algorithm based on the monitored inputs to ensure maximum energy transfer from solar array to batteries under all operating conditions.

6.5.4   Energy management system shall regulate energy flow from the solar array into the battery bank based on ambient temperature to avoid overcharging of the batteries and minimize the consumption of electrolyte.

6.5.5   Energy management system unit shall provide for the controlled periodic pulsing of the solar array current to assist in minimizing sulfate deposit buildup on the battery plates.

6.5.6   Energy management system shall provide for remote monitoring of the battery bank voltage, directly across the battery bank, to assist in optimizing the transfer of power into the battery bank.

6.5.7   Energy management system shall be equipped with a 2-Line by 16-character LCD (Liquid Crystal Display) displaying sequentially, solar array voltage, solar array current, battery bank voltage, battery bank current, battery load voltage, and battery load current. In addition, the energy management system shall display a low battery voltage warning message whenever the battery bank voltage drops below 10.9 Vdc.

6.5.8   Energy management system shall automatically switch current to the message sign off whenever the battery bank voltage drops below 10.7 Vdc to prevent damage to the battery bank due to over-discharging the batteries.

6.5.9   Energy management system shall provide for automatic reverse polarity protection, including reverse polarity indicator lamps.

6.5.10   Energy management system shall provide automatic fault protection without the need for fuses. The use of fuses for fault protection shall not be permitted.

6.5.11   Energy management system shall monitor and report to control console: solar array voltage, solar array current, batter charge current, battery bank voltage, and battery load current.

6.5.12   Energy management system shall have an integrated watchdog timer that is continuously reset by the 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 from a temporary software failure/lockup.

7.   Documentation

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

7.1.1   Setup and Operation

7.1.2   Programming

7.1.3   Maintenance

7.1.4   Troubleshooting and Repair

7.1.5   Assembly Diagrams and Parts Lists

7.1.6   Specifications

7.1.7   Appendix

7.2   Command Center - Users Manual - available online at www.solartechnology.com

7.2.1   Installation and Setup

7.2.2   Command Center Operation

7.2.3   Appendix

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

7.3.1   Pre-transport checklist.

7.3.2   Job site setup checklist.

7.3.3   Basic programming instructions.

7.3.4   Basic system status evaluation.

7.3.5   Weatherproof card attached to unit with nylon lanyard.

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

7.4.1   Proprietary Protocol Documentation for Custom System Integrators

7.4.2   NTCIP Support Documentation for NTCIP System Integrators

7.4.3   Web-Server Protocol Documentation for Web Based Application System Integrators

8.   Maintenance

8.1   Scheduled Maintenance

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

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

8.2   Preventive Maintenance

8.2.1   Inspect and lubricate axle hubs once per year.

9.   Warranty

9.1   Standard Warranty

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

9.1.2   Solar Panels – Ten (10) years

10.   Options

10.1   Battery Charger

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

10.1.2 Input Voltage - 110 VAC 50/60 Hz (specify 220 VAC 50 Hz for international use)

10.1.3 Available models with typical recharge times:

45-Amp: 12 hours (4 batteries)

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

10.2   Remote Control

10.2.1 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 geographical 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 from units equipped with optional Radar Speed Monitor.

–   Provide for the ability to perform various system resets including a complete re-boot/restart of the system for all PCMS.

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

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

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

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

10.2.5.1   Data rate - 10/100 Base-T Ethernet

10.2.5.2   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.

10.2.6 IP Addressable Cellular Transceiver Operation

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

10.2.6.2   MNP 2-4 Error Control - Automatic error detection and correction

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

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

10.3   Radar Speed Monitor

10.3.1 General

10.3.1.1   Operating Frequency –   24.15 GHz $\pm$ 10Mhz (K-Band)

10.3.1.2   Antenna Beam Angle –   9° (vertical) x 18° (horizontal)

10.3.1.3   Target Speed Range –   1 to 206 mph (2 to 331 km/h)

10.3.1.4   Target Speed Accuracy – $\pm$ 0.5% of reading + 0.1 mph

10.3.1.5   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)

10.3.1.6   Radar unit shall install in the field with minimum effort.

10.3.1.7   Message sign shall be pre-wired and pre-programmed for radar speed monitor option.

10.3.2 Operating Features

10.3.2.1   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.

10.3.2.2   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.

10.3.2.3   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.

10.3.2.4   All necessary software features shall be included with the basic message sign package.

10.3.3 Radar Statistical Data Collection

10.3.3.1   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.

10.3.3.2   Data Provided

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

10.3.3.2.2   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 are taken every 250ms while tracking a target

10.4   Cellular Transceiver & GPS Receiver Module

10.4.1 Integrated into Control Console – proprietary

10.5   Sign Panel Flux-Gate Digital Compass

10.5.1 Operating Voltage – 5-36 V_{dc}

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

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

10.5.4 Accuracy – ±0.5 degrees

10.5.5 Repeatability – ±0.2 degrees

10.5.6 Resolution – 0.1 degrees

10.5.7 Dip Angle – ±80 degrees

10.5.8 Tilt Angle – ±16 degrees

10.5.9 Response Time – 1 second