



AMERICAN SIGNAL COMPANY

NTCIP Series

Portable Changeable Message Signs

331, 332, 333
NTCIP, G4

Trailer Operation, Service & Maintenance Manual

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I. Revision Information

Rev.	Date	Author	Description	Page
A	8-25-2010	Price R. Potter	Initial Release	-

1.0 Statement

The addition of components other than those permitted herein, or modifications or enhancements that have not been approved by the equipment supplier may invalidate the warranty of this product

1.1 Introduction

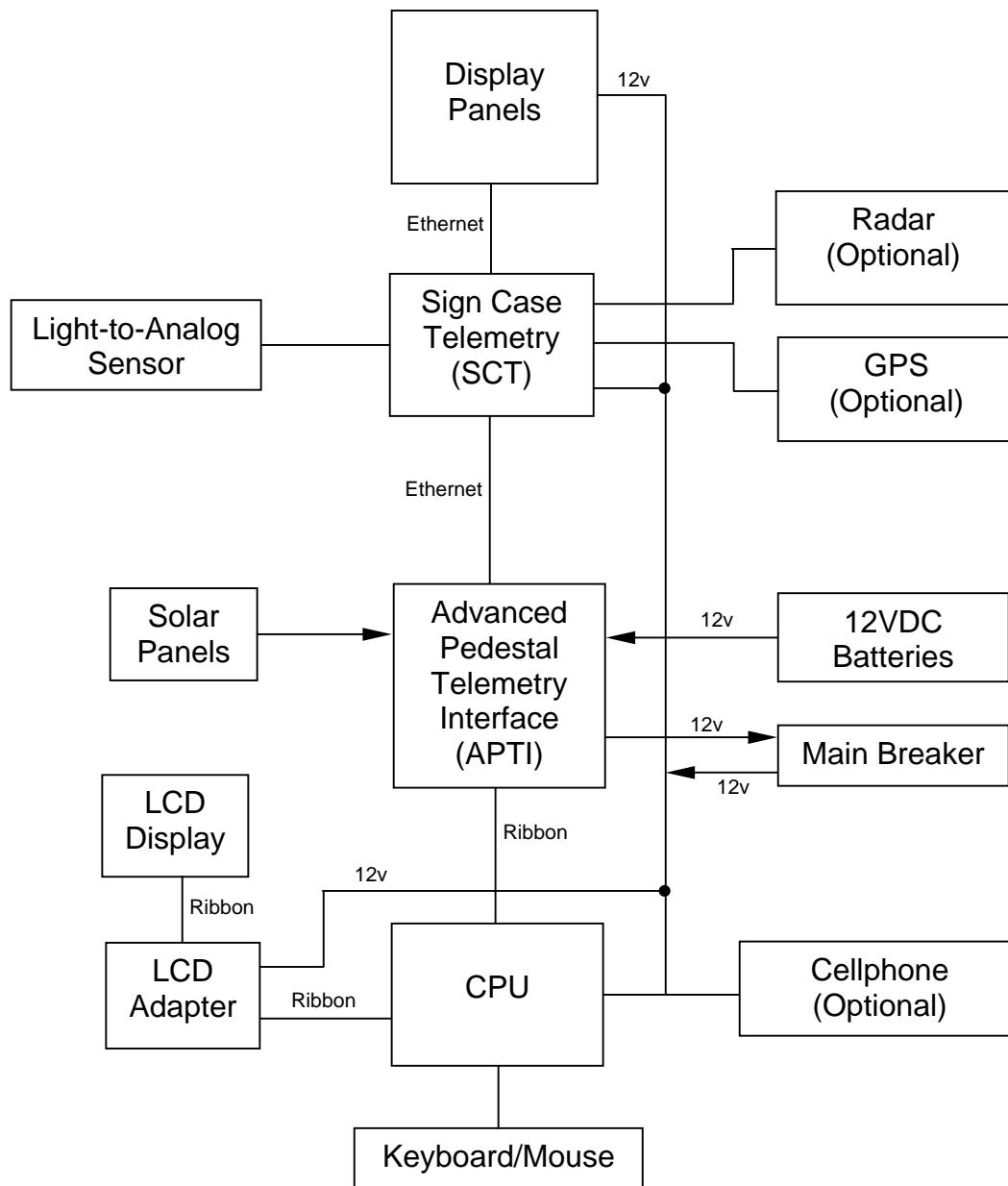
The information contained in this manual describes the 33x NTCIP, Gen 4 Series portable variable message sign (VMS). The American Signal model numbers for these 33x NTCIP Series of VMS products are 331, 332 and 333. These models use the same Display Panel however they are arranged differently in each one. The different configurations of the LED Display Panels are illustrated in the following chart:

		LED Configuration			
Model #	Sign Case size	Matrix	Rows	Columns	Pixel
331 NTCIP	79.5" High x 137.5" Wide	Character	21	40	4 LEDs/Pixel
332 NTCIP	79.5" High x 137.5" Wide	Line	21	50	4 LEDs/Pixel
333 NTCIP	79.5" High x 137.5" Wide	Full	28	50	4 LEDs/Pixel

See Sections 6.0 for a visual representation of each Sign Case and the Display Panel configuration. A more complete list of the standard features and available options for each model is contained in the next subsections.

Detailed information on the operation and programming of the VMS software is contained in the 33x NTCIP G4 Software Operations Manual (MAN00000041-2).

1.2 33x NTCIP, G4 Series Block Diagram



1.3 Standard Features and Options 33x NTCIP, G4 Series

Standard Configuration

VMS & Trailer

Standard model includes:

- | | |
|---|---|
| ✓ Gen 4.x Control System | ✓ 75/80A Charger |
| ✓ Support for NTCIP 1201 Ver. 1 & 1203 Ver. 1 | ✓ 80W Solar Panels (3x) |
| ✓ Standard AmSig MIB | ✓ BlueSky Solar Controller |
| ✓ Highway Orange/Flat Black Color | ✓ Bolt-On Mast |
| ✓ 331: 3-Line Character Matrix (40 Columns) | ✓ Nema 4 Style Pedestal Enclosure |
| ✓ 332: 3-Line Line Matrix (50 Columns) | ✓ 10.4" 640x480 dpi Color LCD |
| ✓ 333: Full Matrix (50 Columns) | ✓ Keyboard with Trackball |
| ✓ 18" High Characters, 5x7 Matrix, 4 LEDs/Pixel | ✓ 2" Removable Pinned-On Ball Hitch |
| ✓ DynaPoint Lens | ✓ Removable Tongue |
| ✓ 6V Batteries (16x) | ✓ Hydraulic Surge Brake |
| | ✓ Hydraulic Pump & Cylinder (for raising/lowering Sign) |
| | ✓ Tail Lights and Side Running Lights |
| | ✓ Leveling Jacks (4x) |

Available Options

<u>Color:</u>	Optional color must be specified by FHWA Color Standard 595A (or manufacturer # or color chip)	
<u>Batteries:</u>	OPT30065046-3	Battery, Gel Cell Sub. 6V 16x 33xN
<u>Solar Panels:</u>	OPT30065112-2	Solar Panel, Addition 80W (1x)
	OPT30065112-1	Solar Panel, Addition 80W (2x)
	OPT30065098	AimStar® Solar Assy, 123W (2x) 331/332 (replaces standard)
	OPT30065098-3	AimStar® Solar Assy, 80W (2x) 331/332 (replaces standard)
<u>Communication:</u>	OPT30065134	Activation, Cell Digital 33x/Adv
	-	(see Master Phone List – ENG-RCD-001 – for current available Cell Phone Options)
<u>Radar:</u>	OPT30125076-2	Radar, Kustom DRUIII MPH 33x NT G4
	OPT30125076-3	Radar, Kustom DRUIII KPH 33x NT G4
<u>Hitch/Harness:</u>	OPT30065255-1	Hitch, 1-7/8" Ball Lever x32/33x
	OPT30065255-2	Hitch, 2" Bulldog x32/33x
	OPT30065255-3	Hitch, 2-5/16" Bulldog x32/33x

<u>Hitch/Harness (cont):</u>	OPT30065255-4	Hitch, 2-1/2" Lunette Eye x32/33x
	OPT30065255-5	Hitch, 3" Lunette Eye x32/33x
	OPT30065255-6	Hitch, 2" Ball/2.5" Lunette x32/33x
	OPT30065255-7	Hitch, 2" Ball/3" Lunette x32/33x
	OPT30065265-1	Hitch, Adj 1-7/8" Ball Lever 33x
	OPT30065265-2	Hitch, Adj 2" Bulldog 33x
	OPT30065265-3	Hitch, Adj 2-5/16" Bulldog 33x
	OPT30065265-4	Hitch, Adj 2-1/2" Lunette Eye 33x
	OPT30065265-5	Hitch, Adj 3" Lunette Eye 33x
	OPT30065265-6	Hitch, Adj 2" Ball/2.5" Lunette 33x
	OPT30065265-7	Hitch, Adj 2" Ball/3" Lunette 33x
	OPT30065047-1	Harness, 6-Pin Trailer Connection T-33x
	OPT30065048	Harness, 7-Pin Trailer Connection T-33x
<u>Tire/Jack:</u>	OPT30065110	Spare Tire, Tongue-mounted T-33x
	OPT30065074	Extra Jack, Tongue-mounted 6" Swivel 33x
<u>Security:</u>	OPT30065096-2	Wheel Lock Bar & Padlock
	OPT30065102	Locking Lug Nuts
<u>Misc.</u>	OPT30065144-1	Keyboard, Touchpad Weatherproof USB
	OPT30145010-2	Global Positioning System, G4
<u>Extended Warranty:</u>	OPT30065079	Warranty, Extended 1 Year
	OPT30065080	Warranty, Extended 2 Years
<u>Additional Manuals:</u>	MAN000000034-1	Manual, Trailer Operations 33x NTCIP G4
	MAN000000041-2	Manual, Software Operations 33xN G4

2.0 The 33x NTCIP, G4 Series Components & Options

The 33x NTCIP, G4 Series standard components and their functions are briefly described in this section. References to and pictures showing specific brands of equipment are included for discussion purposes only. All brands, equipment and designs are subject to change at any time without notice. Wiring diagrams, mechanical drawings, part numbers and technical specifications are contained in other sections. NOTE: P/Ns with revisions are denoted with an “-x” suffix. Call factory for applicable or current revision level.

2.1 Sign Case Assembly

The Sign Case Assembly provides the housing for many of the major VMS components including the Display Panels (40-00044-01), Sign Case Telemetry (SCT) Board (40-00046-01), Light to Digital Sensor Board (40-00036-01) and Lens. See the Trailer Operation section for information on accessing the internal components of the Sign Case.

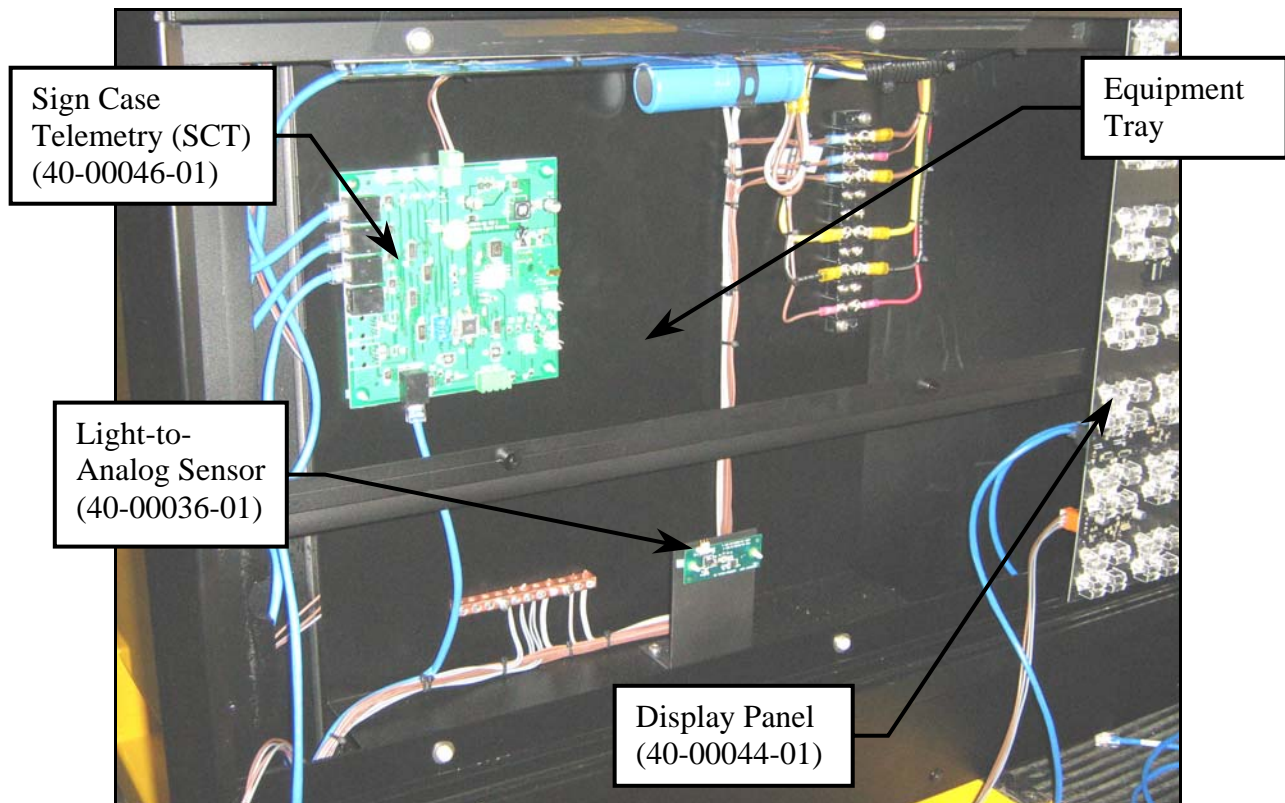


Figure 2-1 Sign Case Components

Display Panel

The Display Panels contain the LEDs and are mounted in the middle to a horizontal z-bar. Each row of Display Panels is connected to the Sign Case Telemetry (SCT) Board via Ethernet cables to carry data. 12VDC power connections are made to each row of Display Panels from the 10 Pos. Terminal on the Equipment Tray. Both power and data cables connect to the rear of the Display Panel. Each Display Panel in a row has a column address based on its physical position. The address is decoded so data to a specific Panel can be loaded to render a message. This column address is achieved by utilizing the Panel Autoconfig command on the Admin Screen (see Software Operations Manual, MAN00000041-2).

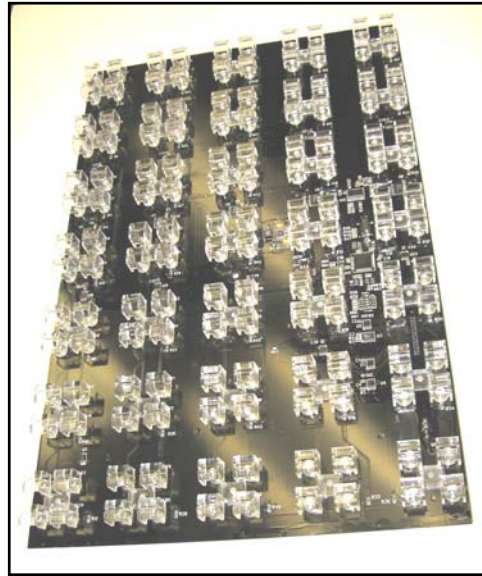


Figure 2-2 Display Panel (40-00044-01)

Sign Case Telemetry (SCT) Board

The Sign Case Telemetry (SCT) board provides system housekeeping functions and is located on the Equipment Tray. It connects the system via the Ethernet network and performs the following functions:

- Provides digital input for the Light to Digital Photosensor
- Monitors temperature
- Acts as the Beacon Controller for optional Beacons
- Provides connections point for optional Radar
- Provides connection & mounting for optional Global Positioning System (GPS)

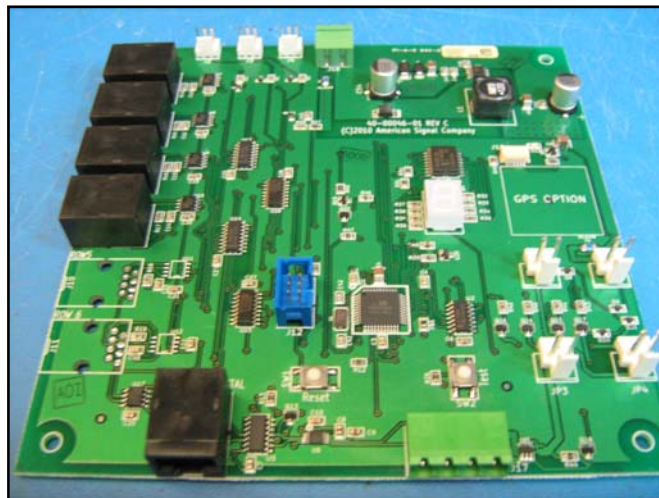


Figure 2-3 Telemetry Board (40-00046-01)

The Telemetry Board mainly serves as a conduit for information (via the Ethernet network) being exchanged between the CPU, Display boards, and other onboard monitoring systems.

Light to Analog Sensor Board

The Light to Analog Sensor Board is located at the bottom of the pivoting Display Rack and faces forward through the Lens. This sensor measures the amount of ambient light that is present at its position in the VMS. The value is correlated to a brightness level in the DIM Table and allows control of the LEDs to be brighter or dimmer as conditions require.

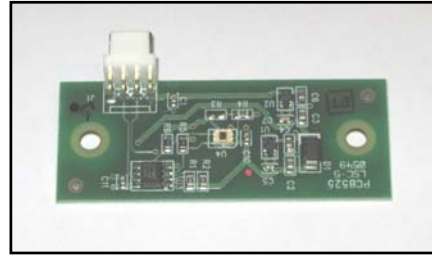


Figure 2-4 Light to Analog Sensor Board
(40-00036-01)

Lens

The Lens is a UV-protected polycarbonate and protects the LEDs from damage.

2.2 Hydraulic Pump and Cylinder

The Hydraulic Pump & Cylinder provide the lifting mechanism to raise (for operating) and lower (for travel and storage) the Sign Case.

Hydraulic Pump

The Hydraulic Pump is a 12VDC pump and hydraulic reservoir that provides the hydraulic pressure to the Cylinder to raise and lower the Sign Case Assembly. The Pump is mounted in the Battery Box and the “Up-Down” toggle Switch that controls it is located in the Pedestal Assembly Dash Panel. In the event that the Hydraulic Pump malfunctions, it can be manually operated to raise and lower the Sign Case. See Trailer Operation and Specifications section for more information on the Hydraulic Pump.

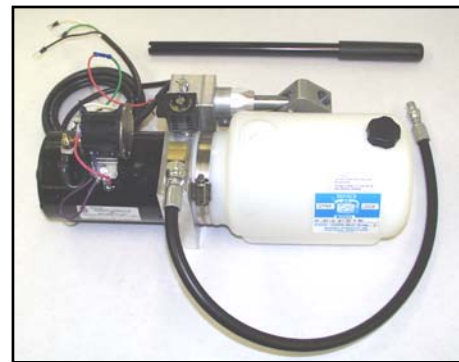


Figure 2-5 Hydraulic Pump (HYD-160)

Cylinder

The lifting Cylinder is located inside of the Mast Assembly and is connected to the Pump by a hydraulic hose and fittings assembly. As the Cylinder extends and retracts, the Sign Case is raised and lowered.

2.3 Solar Panel Assembly

The Solar Panels convert sunlight into electrical power (12VDC) to maintain the charge state of the Batteries. This re-charging of the Batteries allows the VMS to operate over a longer period of time before requiring landline (or generator) charging. The standard Solar Rack Assembly on the 33x NTCIP Series consists of three 80W solar panels. See Specifications section for more information on the Solar Panel. (NOTE: Solar Panel wattage & vendor may change and more or less may be used depending on the application or customer preference.)

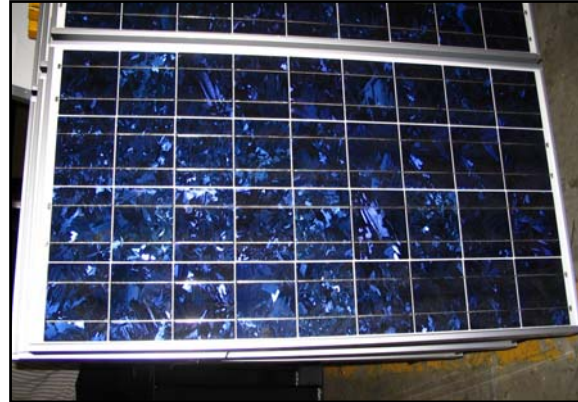


Figure 2-6 Solar Panel (CEL-120)

2.4 Pedestal Assembly

The Pedestal Assembly is located on the Trailer frame in front of the front Battery Box. It is a double-flange NEMA rated enclosure that is pad lockable and contains the following major components:

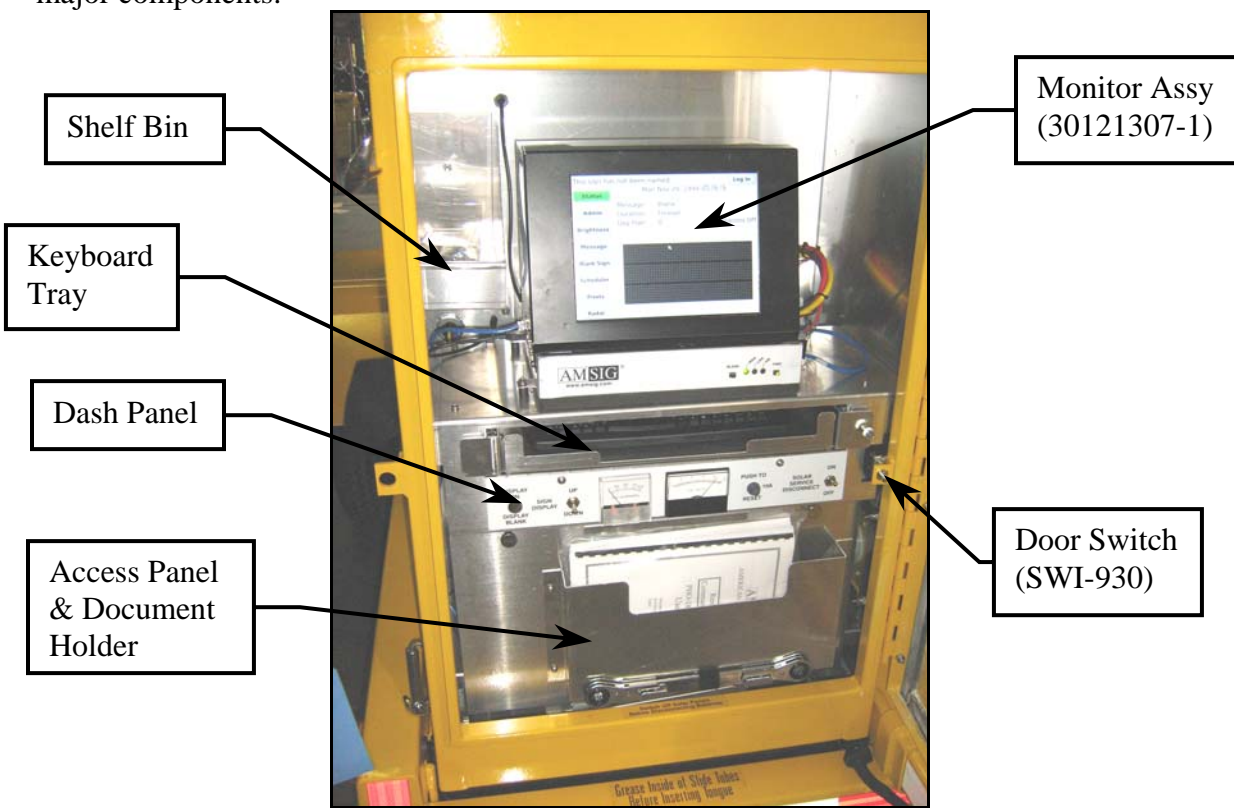


Figure 2-7 Pedestal Assy, G4

Monitor Assembly

The Monitor Assembly houses another set of major system components: CPU (PCB-585), Advanced Pedestal Telemetry Interface (APTI) board (40-00045-01) and the LCD Screen (LCD-030).

- The CPU is the “brain” of the VMS and is the component that receives commands from the Local User Interface (keyboard/mouse) or the Remote Host. It, in turn, supplies commands to and receives feedback from the Sign Case Telemetry (SCT) Board, Advanced Pedestal Telemetry Interface (APTI) board and other devices. The RAM chip is located on the front underside of the CPU and can be accessed when the Monitor Assembly is open.
- The Advanced Pedestal Telemetry Interface (APTI) board contains the Monitor Assy Power and “Blank” buttons as well as LED indicators for Heartbeat, Local Area Network (LAN) and Wide Area Network (WAN) communication status. The “PWR” button controls power to all components in the Monitor Assembly. The “Blank” button allows for a user to blank the sign message while still maintaining power on to the rest of the system. While the sign is blanked, solar charging of the batteries continues.
- The LCD Screen has a 10.4” diagonal screen with 640x480 dpi Color capability and is backlit for superior visibility. Other components that interface the LCD Screen to the system are the LCD Adapter board (40-00043-01) and the LCD Inverter board (PCB-615). (NOTE: To conserve power, the Pedestal Assy has a Door Switch, SWI-930, that kills power to the LCD Screen whenever the Door is closed.)

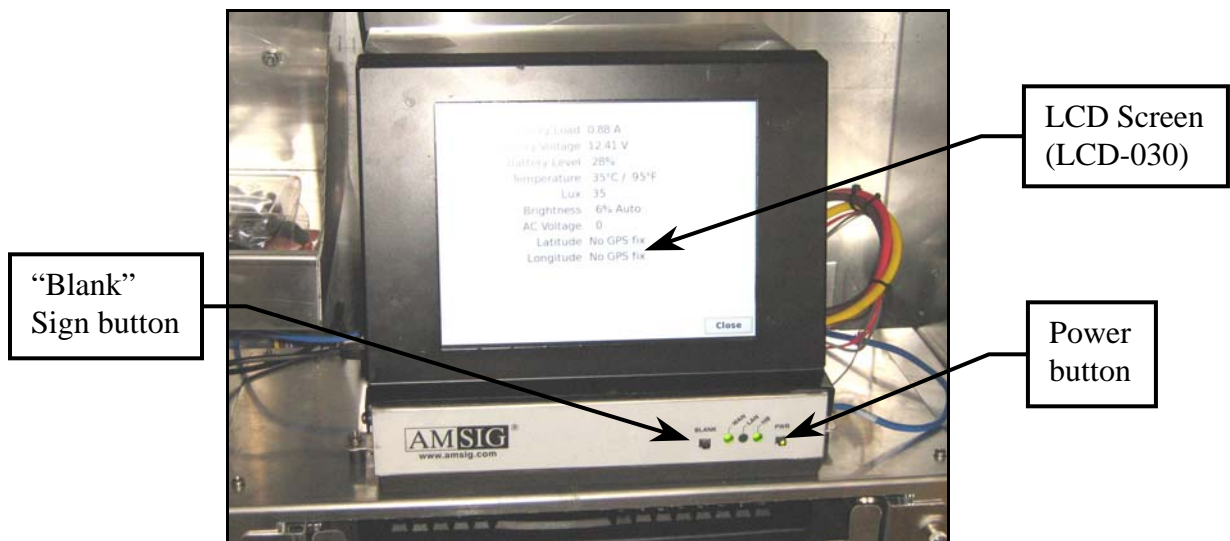


Figure 2-8 Monitor Assy (closed)

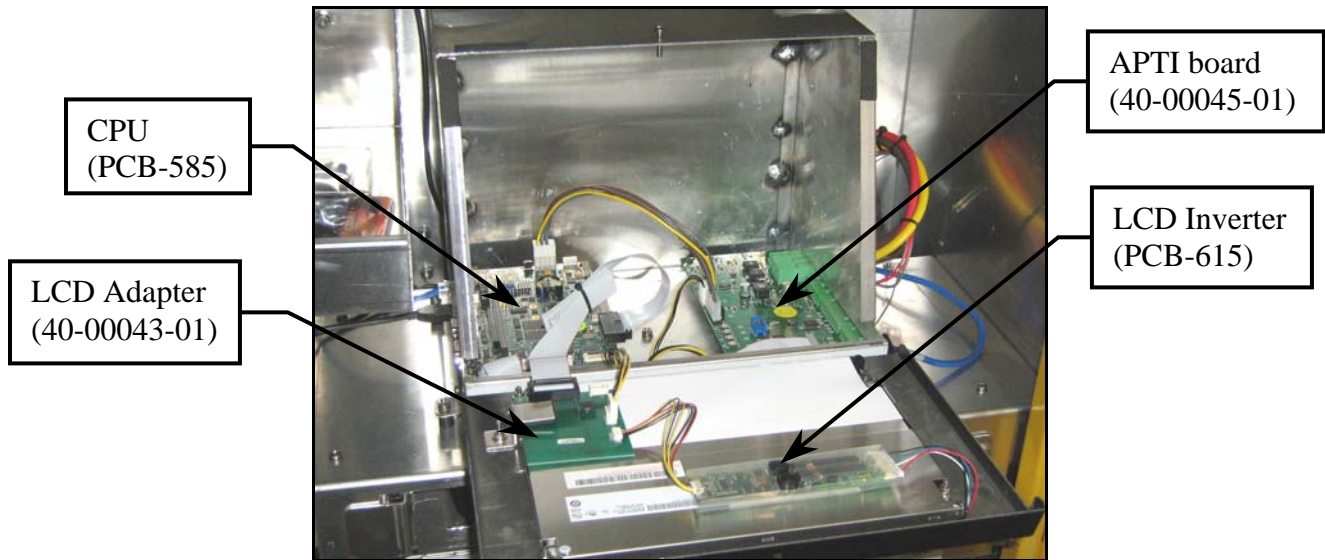


Figure 2-9 Monitor Assy (open)

Keyboard Tray

The Keyboard (KEY-070) comprises the input side of the Local User Interface, which allows for local control of the VMS. The Keyboard contains a built-in pointing device for easy movement of the cursor and navigation through the on-screen menus.



Figure 2-10 Keyboard Tray

Dash Panel

The Dash Panel contains the Sign Display “Up-Down” toggle switch, Battery Ammeter and Voltmeter, “Push To Reset” 10A Fuse and the Solar Service Disconnect “On-Off” switch.

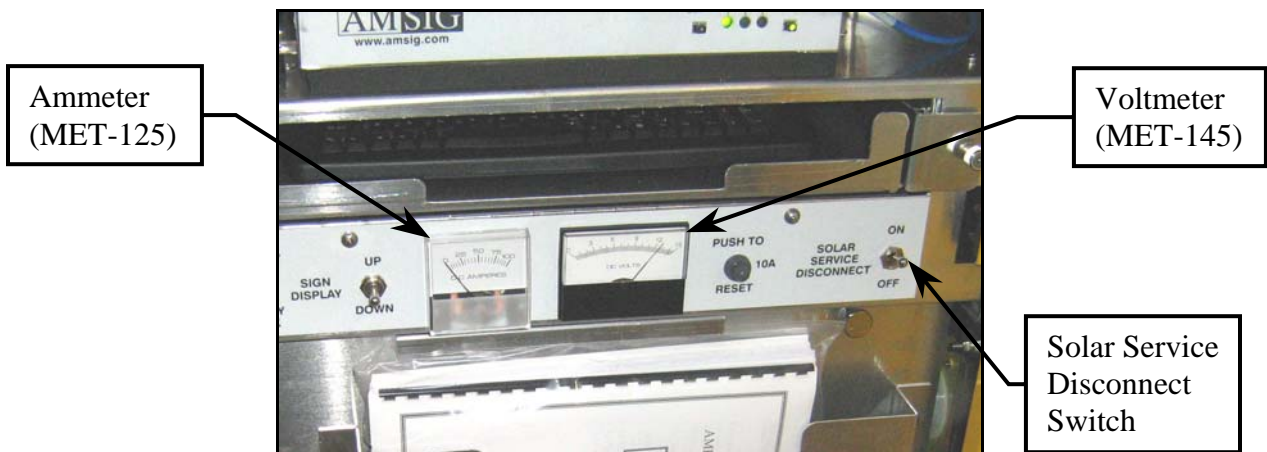


Figure 2-11 Dash Panel Assy

The Solar Service Disconnect Switch allows the Solar Panels to be isolated from the rest of the charging system.

Access Panel & Document Holder

The Access Panel covers the opening to the inside of the Pedestal Assy and provides a location for the Document Holder and Wrench. To remove the Access Panel, rotate the spring-loaded knobs at the upper right and left-hand corners of the Panel, pull the upper portion of the Panel forward and lift out. Papers, manuals or other items may be stored in the Document Holder compartment. Addition storage of miscellaneous items is provided for in the Shelf Bin on the left-hand side of the Monitor Assembly. The Pedestal Door Prop Rod is located just below the Document Holder and can be utilized to maintain the Pedestal Door open.



Figure 2-12 Access Panel & Document Holder

Inside Pedestal Assembly

Once the Access Panel is removed, the internal area of the Pedestal is easily reached. The main items are the Main “On-Off” Power Switch, Charger and Communications Tray.

- The Main “On-Off” Power Switch disconnects power to the VMS Sign Case and Pedestal, but NOT the Solar System. Solar charging of the Batteries can still occur when the Main Switch is “Off”.
- The 75/80amp Charger unit is provided that converts landline 120VAC to 12VDC for charging of the Batteries. The Charger is located internally at the base of the Pedestal Assembly (under the Communications Tray) while the covered receptacle for the 120VAC extension cord is accessed from the outside the Pedestal Assembly on the right side. Detailed information on the Charger is found in the Specifications section.
- The Communications Tray is an area that holds any optional equipment (i.e. cell phone modem) that is installed on the unit.

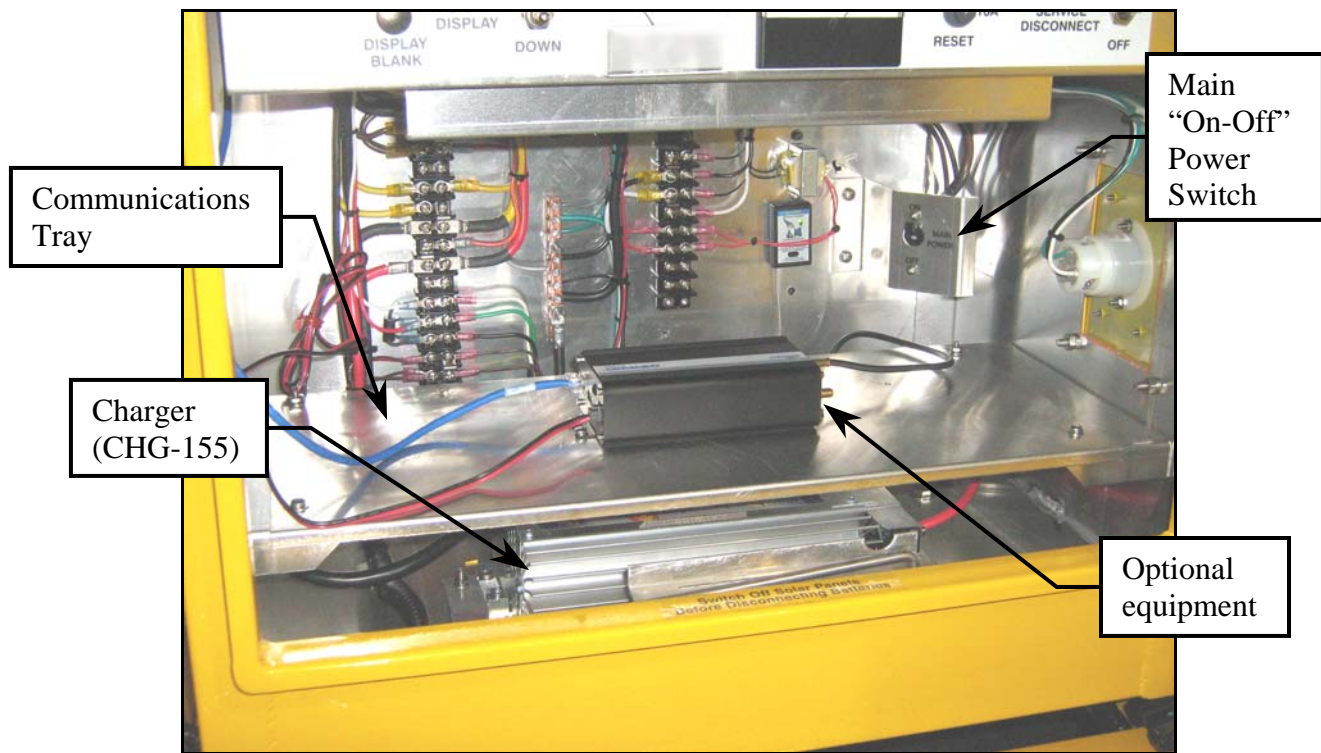


Figure 2-13 Inside Pedestal Assembly

Umbilical Assembly

An Umbilical Assembly connects the Sign Case and Pedestal Assembly. This Umbilical contains data and power wires and is comprised of watertight, vandal-resistant tubing.

2.5 Batteries and Fuse

Batteries

The 33x series of Trailers are populated with an even number of 6V Batteries wired to provide 12VDC to the sign. The specific number of Batteries can vary depending on the model and more or less can be provided depending on the application and/or customer preference. The Batteries are located in the front and rear Battery Box compartments. Detailed information on the Battery is found in the Trailer Operation section, Maintenance section and Specifications section.



Figure 2-14 6V Battery (BAT-140)

Fuse

A 90amp Fuse is mounted in the Battery Box to provide protection to the electrical system.



Figure 2-15 90A Fuse (FUS-325) & Fuse Holder (FUS-315)

2.6 Tires & Axle

Tires

The Tires are 15" 6 ply tires and mount to the axle hub with 5 lugs on 4-1/2" centers. They are load rated for 1820 lbs each.

Axle

The Axle is 3500 lb. rated straight idler with 71" hub face distance and 5 lugs on 4-1/2" centers. The Axle assembly includes free-backing hydraulic brakes. The suspension is double eye leaf springs with 56.5" centers.

2.7 Tongue Assembly

The Tongue Assembly is a removable Tongue that allows the Trailer to be towed by other vehicles. A 2" Ball Hitch that is rated for 5,000 lbs and is pinned to a 3" square tube as standard. For safety purpose during towing, the Safety Chains must be attached to the towing vehicle. Also, the Lever Safety Pin must be inserted into the hole in the Hitch Lever to insure that the Hitch stays engaged. See Trailer Operation section for more information on the Tongue Assembly and see the Specification section for more information on the Hitch.

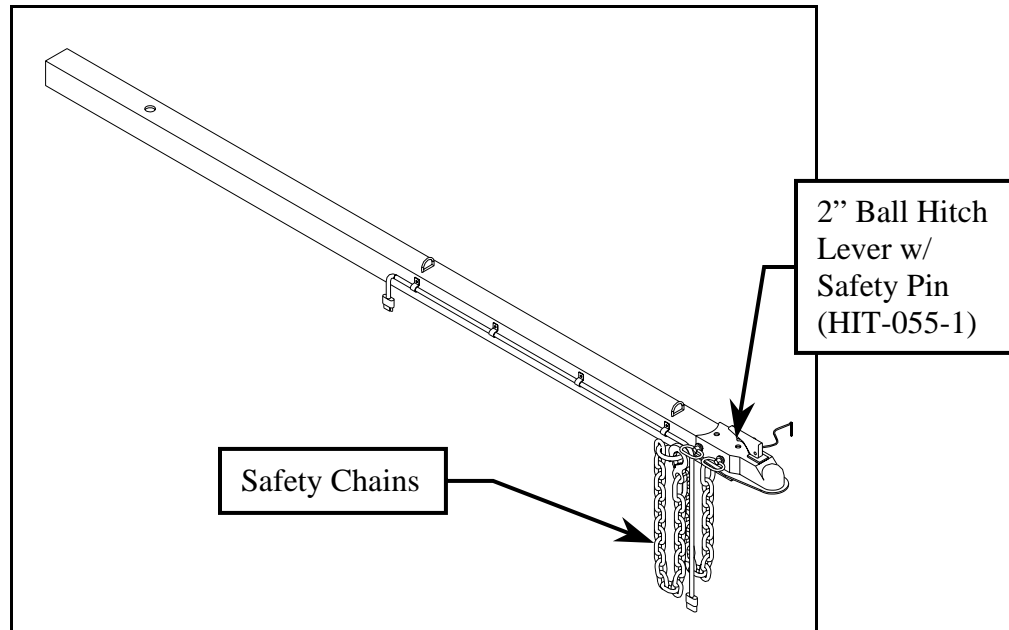


Figure 2-16 Tongue Assy

2.8 Leveling Jacks

The Leveling Jacks are located at the four corners of the Trailer and are top wind, swivel-mounted Jacks used to level and stabilize the VMS. The Jacks are rated for 2,000 lbs. each and have a travel range of 15". See Trailer Operation section and Specification section for more information on the Leveling Jacks.



Figure 2-17 Leveling Jack (JAC-085)

2.9 33x NTCIP Series Trailer Options

The following is a brief description of the options available with the Trailers. More complete and detailed information for some options is contained in other literature.

2.9.1 Battery Options

An even number (up to 4) of additional 6V Batteries can be included with each Trailer to provide a longer period of autonomous operation before recharging. Conversely, for cost savings reasons, the Trailer may be ordered with less 6V Batteries.

2.9.2 Solar Options

Additional fixed Solar Panels (up to 2) can also be included with each Trailer to provide more solar recharging of the Batteries. Conversely, for cost savings reasons, the Trailer may be ordered with less Solar Panels which provide less solar charging capability.

The AimStar® Solar Panel Assembly contains two 123W or two 80W Solar Panels that can be oriented and angled independent of the Sign Case. By pointing the Solar Panels more toward the path of the sun, they can generate additional power during available daylight hours for recharging of the Batteries. The AimStar® options replaces the existing flat Solar Panel Assembly.

2.9.3 Communication Options

The 33x Series VMS can be remotely controlled and operated through a cell phone/modem or WiFi connection from a personal computer. Contact your sales representative for available Cell Phone Option options offered for the 33x NTCIP Series.

2.9.4 Radar Options

The optional Radar unit is a Kustom Directional Radar Unit (DRU) that can measure oncoming traffic data (speed). This speed can also be dynamically displayed on the VMS to inform motorist of their rate of travel. The Radar is mounted under the Sign Case Assembly and is provided in a fixed configuration.

2.9.5 Hitch Options

The standard 2" Ball Hitch can be replaced or used in conjunction with by a 2.5" or 3.0" Lunette Eye. An adjustable bolt-on mounting configuration can also be provided.

2.9.6 Tire Options

A spare tire and mount can be bolted to the Trailer. An extra tongue-mounted Jack can also be added to the Trailer.

2.9.7 Brakes Option

The Trailers may be equipped with Electric Brakes which replace the standard Hydraulic Brakes.

2.9.8 Security Options

A Wheel Lock Bar & Padlock can be provided to give added security to the VMS. By sliding the Wheel Lock Bar through both tire rims and padlocked in place, unauthorized movement of the Trailer and/or removal of the tires is prevented. Another security option is the Locking Lug Nuts that deter theft of the tires.

3.0 33x NTCIP Series Trailer Operation

3.1 Raise & Lower Sign Case (Hydraulically)

To Raise Sign Case:

Under normal operating conditions, the Sign Case is raised and lowered via the Hydraulic Pump and Cylinder mechanism. To raise the Sign Case, perform the following steps:

- Loosen the both Brake Band Rods on the Mast Assembly with the provided closed-end ratchet (located in the bottom of the Dash Panel Assembly). Failure to loosen both Brake Bands before attempting to raise the VMS may cause damage to the unit.
- Toggle the “Up-Down” switch on the Dash Panel in Pedestal Assembly to the upper position. The operator can place a hand on the Sign Case as it is raised to avoid unwanted rotational movement.



Figure 3-1 Dual Brake Rods & Bands

- When the Cylinder has reached its maximum extension, the Sign Case will stop (with an audible thump). Slide the Safety Pin, chained to the outer Mast, through the two holes in the inner Mast. It will be necessary to stand on the Trailer frame to reach the Safety Pin and inner Mast holes. The Safety Pin will stop the Sign Case from failing in the event of Cylinder malfunction or loss of hydraulic pressure.



Figure 3-2 Safety Pin

- Once the Safety Pin is in place, the Sign Case should be lowered to rest on the Pin. The Sign Case is free to rotate more than 360 degrees and can now be aimed in the desired direction.

★ ★ ★ CAUTION ★ ★ ★

Ensure that the Sign Case is lowered so that the outer Mast rests on the Safety Pin. Failure to do so may enable the Safety Pin to become dislodged and fall out resulting in equipment/property damage or personal injury in the event of hydraulic system failure.

- After the VMS is oriented correctly, use the ratchet to tighten both Brake Bands thereby preventing the Sign Case from rotating.

To Lower Sign Case:

- Use the ratchet to loosen the both Brake Bands.
- Toggle the “Up-Down” switch on the Dash Panel to the upper position to lift the Sign Case off of the Mast Safety Pin.
- Remove Mast Safety Pin from inner Mast and replace in hole in outer Mast bracket.
- Rotate the VMS so as to orientate the Sign face to the side of the Trailer and away from the Pedestal Assembly.
- Toggle the “Up-Down” switch on the Dash Panel to the lower position to begin lowering the Sign Case. It will be necessary to place a hand on the Sign Case as it is lowered to avoid unwanted rotational movement. It is important that the Sign Case be guided downward so as to not be lowered onto the Trailer Pedestal Assembly (damage) or other personnel (serious injury or death).
- Continue guiding the Sign Case down until it rests on the front and rear cradle rubber strips on the front and rear Battery Boxes (travel position).
- After the VMS is oriented correctly on the Battery Box, use the ratchet to tighten both Brake Bands thereby preventing the Sign Case from rotating. The Sign Case must be in the cradle and both Brake Bands must be tightened prior to towing the trailer.



Figure 3-3 Sign Case Front Cradle



Figure 3-4 Sign Case Rear Cradle

3.2 Raise & Lower Sign Case (Manually)

In the event that the Hydraulic Pump malfunctions, it can be manually operated to raise and lower the Sign Case. To manually raise or lower the Sign, follow all of the steps involved in hydraulically moving it up and down, except instead of operating the “Up-Down” toggle Switch, do the following:

To Manually Raise Sign Case:

- Open the split lid on the front Battery Box (the side that does not have the Sign Case cradle)
- Insert the Pump handle (mounted in Battery Box next to Pump) into the manifold on the side of the Pump.
- Push the Pump handle back & forth to force hydraulic fluid into the Cylinder, thereby raising the Sign.



Figure 3-5 Manual Pump Operation

To Manually Lower Sign Case:

- Open the split lid on the front Battery Box (the side that does not have the Sign Case cradle)
- Place notch in end of Pump handle over T-handle valve on top of Pump.
- Rotate the Pump handle counter-clockwise to release hydraulic pressure in the Cylinder and lower the Sign.

3.3 Open the Sign Case

The Sign Case Telemetry (SCT) Board and the Light to Analog Sensor Board are located on an Equipment Tray in the Sign Case. The Display Panels are also located in the Sign Case.

To access the Equipment Tray:

- Remove the upper and lower screws holding the End Cap on the right side of the silkscreened Lens
 - On a 331 and 332, remove RH End Cap on the bottom Lens.
 - On a 333, remove RH End Cap on the 2nd from bottom Lens.
- Slide the Lens to the right approximately 3 ft.

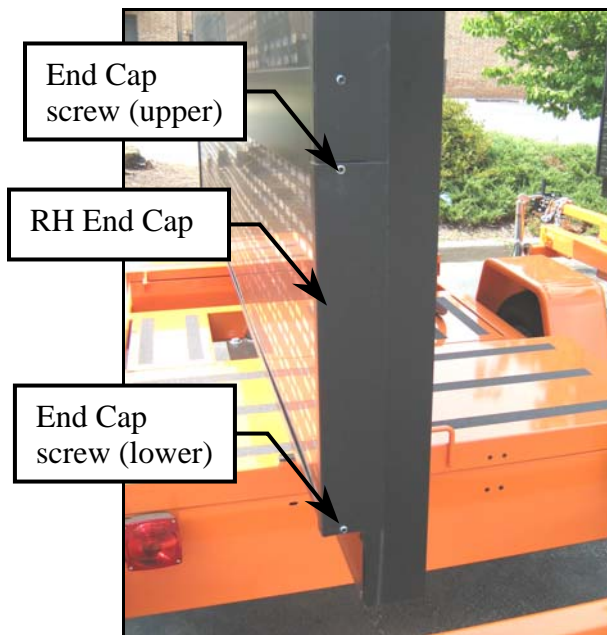


Figure 3-6a RH End Cap

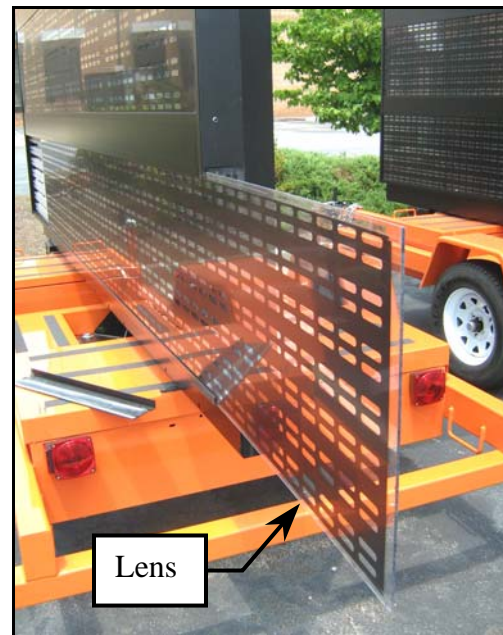


Figure 3-6b Lens removal

- Remove the Display Panels on the LH-side of the row

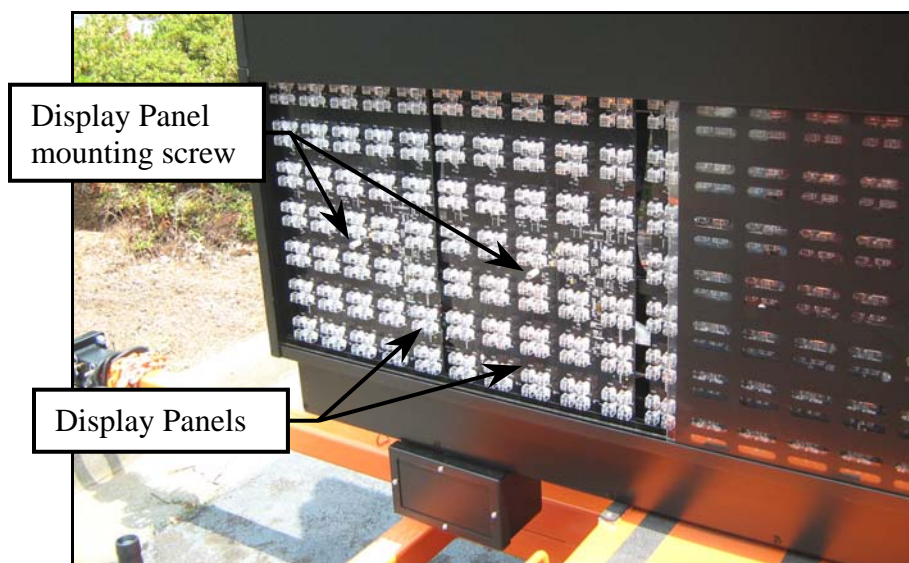


Figure 3-7 Display Panels in front of Equipment Tray

- Lift clear plastic sheeting covering Equipment Tray and components

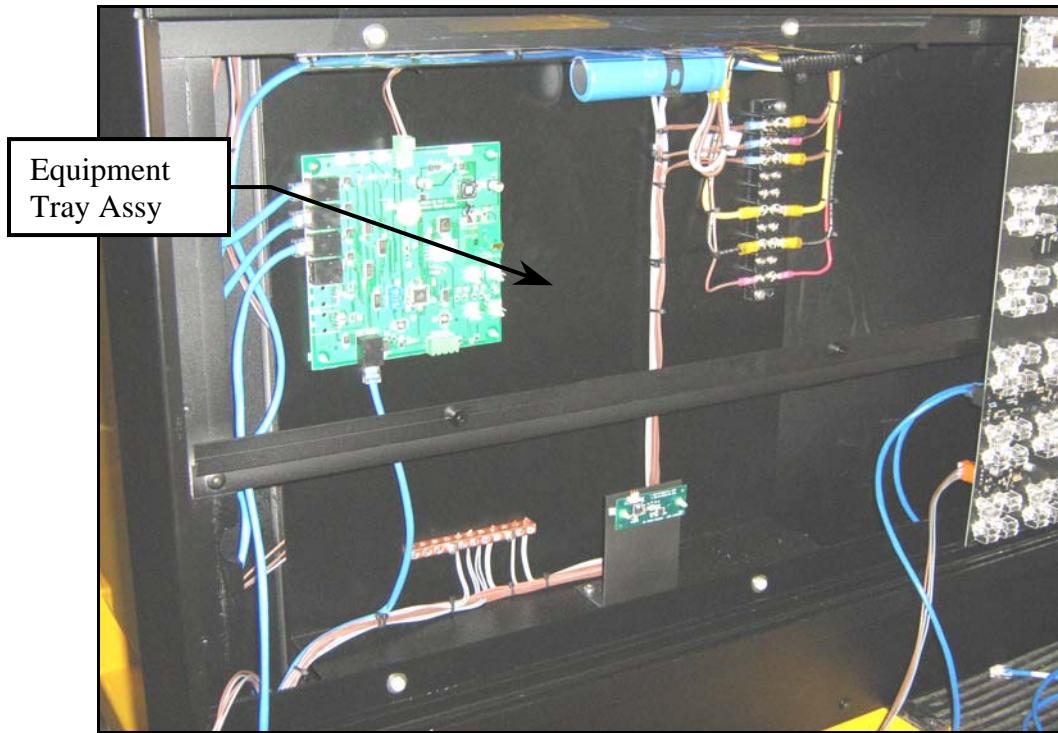


Figure 3-8 Access Equipment Tray

To access the Display Panels:

- Remove the screws holding the End Cap on the right side of the silkscreened Lens. Remove End Caps from as many rows as need to be accessed. (See Fig. 3-6a)
- Slide the appropriate Lens to the right far enough to get access to the desired Display Panel. (See Fig. 3-6b)
- Turn sign display power OFF by accessing Main “On-OFF” power switch in Pedestal Assy. (See Fig. 2-13)

★ ★ ★ CAUTION ★ ★ ★

DO NOT disconnect or reconnect Display Panels with Main Power Switch ON.

To close Sign Case after accessing the Equipment Tray or Display Panels, reverse the steps shown above.

Display Panel Maintenance

The Display Panels do not need maintenance, however if an LED is not operating, the Panels can be removed and replaced. To remove a Display Panel:

- Open the Sign Case Lens (see “To access Display Panel” section above).

★ ★ ★ CAUTION ★ ★ ★

DO NOT disconnect or reconnect Display Panels with Main Power Switch ON.

- Remove center screw securing the Display Panel. (see Fig. 3-7)
- Remove the MTA power connector and data ribbon cable from the rear of the Panel.
- While still in rail groove, lift Display Panel up and tilt bottom of Panel forward.
- Slide Display Panel down and away from rails.

Lens Maintenance

In order to provide maximum visibility and clarity, the Lens should be cleaned periodically. It is recommended that the lens be cleaned with a mild soap and water solution, using a soft cloth so as not to scratch the lens. If the Len is damaged (cracked or severely scratched) or visibility is impaired, it can be removed and replaced. To remove the Lens:

- Remove the screws holding the End Cap on the either right or left side of the silkscreened Lens.
- Remove End Caps from as many rows as need to be accessed.
- Slide the appropriate Lens out of the groove in Sign Case extrusion and remove.

3.4 Charge the Batteries

The Solar power supply system furnished with the VMS includes multiple deep-cycle 6V Batteries which are uniquely able to withstand the deep discharges that occur periodically during normal operation. The system has been designed to provide sign operation over all of the usable state of charge level of the Batteries.

Depending upon several factors (i.e. length & duration of message displayed, the brightness level, the number of Solar Panels, the amount of available sunlight, the number of Batteries, the age of the Batteries and the ambient temperature), voltage level of the Battery pack can eventually drop below 11.2VDC (Default) and the VMS will stop operating. At that time (or sooner if desired), it will be necessary to recharge the Batteries from a landline or generator. An abbreviated summary of steps to charge the Batteries with a Charger are shown below:

- Turn the VMS system off at Main Power or Sign Display Switch. (Note: The system can be left on during charging, however, it will require more time to fully recharge the Batteries.)
- Bring Charger system to Trailer and attach cables to the battery terminals.
- For fully discharged Batteries, charge for a minimum of 72 hours. Batteries in a higher state of initial charge can be charged for less than 72 hours.
- When Batteries are fully charged, disconnect the cables from batteries. Batteries are fully charged when the Specific Gravity with a temperature compensated hydrometer is $1.25 \pm .010$.

In dealing with Batteries, great care should be taken during their handling, charging and maintenance. More detailed information on aspects of and precautions for charging Batteries is provided in the Maintenance section and Specification section.

3.5 Install/Remove Tongue Assembly or Remove Hitch

Install the Tongue Assembly

In order to reduce the space needed to transport the Trailers, the Tongue Assembly may be shipped separate to the Trailer unit. To re-install the Tongue Assembly:

- Open front Battery Box and remove 1" diameter Pin from Surge Brake assembly.
- Align rear of Tongue Assembly with sleeve in front of Trailer and insert Tongue until hole in Tongue lines up with hole in Surge Brake assembly.
- Reinsert 1" diameter Pin thorough mating holes.
- Connect mating Trailer light connectors on Tongue and Trailer together.

Remove the Tongue Assembly

The Tongue Assembly can also be removed to inhibit theft of the Trailer. To remove the Tongue Assembly:

- Open front Battery Box and remove 1" diameter Pin from Surge Brake assembly.
- Unplug mating Trailer light connectors on Tongue and Trailer.
- Pull Tongue Assembly forward until Tongue comes completely out of the sleeve.
- Reinsert 1" diameter Pin thorough hole in Surge Brake.

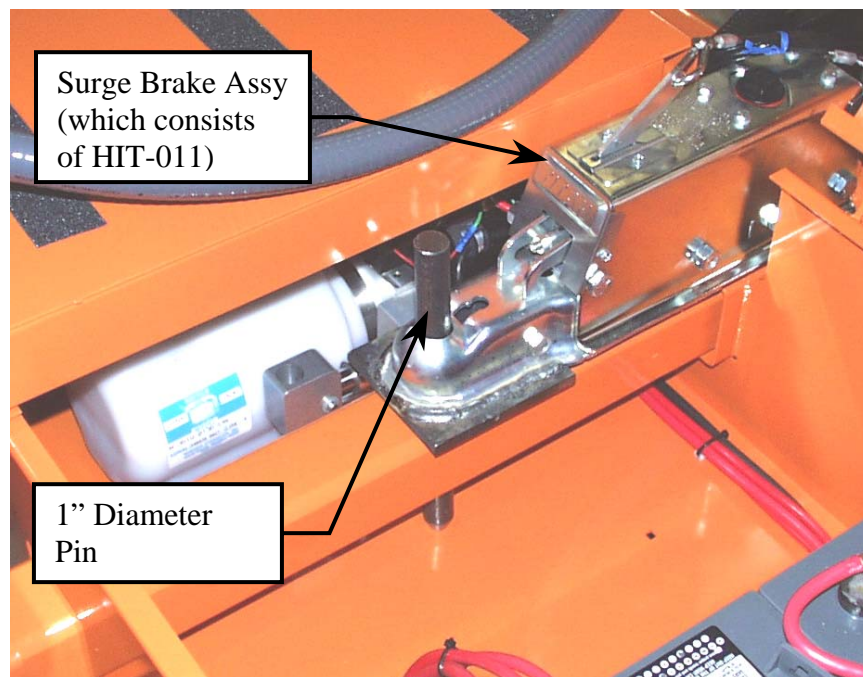


Figure 3-9 Surge Brake Assy & Pin

Remove the Hitch

Instead of removing the entire Tongue Assembly, the Hitch can be removed individually to inhibit theft of the Trailer. Due to size and weight considerations, removal of the Hitch is sometimes a more appropriate method of preventing theft. To remove the Hitch:

- Remove cotter pins (2x) from Hitch Pins (2x).
- Slide Hitch Pins out of Hitch.

- Remove the Hitch from Tongue tube.

3.6 Level Trailer

Operating Position – Trailer Jack

To level the Advantage Trailer, pull the spring-loaded lock pin and rotate Jacks to the down position. Crank the handle at the top of each Jack to extend the support leg and foot down to the ground/pavement. Adjust extension of four Jacks as needed to level the Trailer.

Travel Position – Trailer Jack

Before moving the Trailer, secure the Tongue Hitch to the towing vehicle. Crank the handle at the top of each Jack to fully retract the support leg and foot. Pull the spring-loaded lock pin and rotate the four (4) Jacks to the horizontal position. In order to keep the horizontal Jacks within the footprint of the Trailer, rotate each Jack with the foot facing outward and the top crank handle pointing inward. Ensure that the lock pin snaps into position when the Jack is horizontal.



Figure 3-10 Jack Operating



Figure 3-11 Jack Travel Position

3.7 Connect Surge Brake Cable

Travel Position

Prior to towing the Trailer behind another vehicle, the Surge Brake Cable should be extended and the S-hook connected to the towing vehicle. In case of accidental separation from the towing vehicle, the Surge Brake Cable would activate the Surge Brake and the Trailer brakes would be applied.



Figure 3-12 Surge Brake Cable

4.0 33x NTCIP Series Maintenance

4.1 Sign Case Assembly Maintenance

Display Panel Maintenance

The Display Panels do not need maintenance, however if an LED is not operating, the Panels can be removed and replaced. To remove a Display Panel, see Trailer Operation section.

Lens Maintenance

In order to provide maximum visibility and clarity, the Lens should be cleaned periodically. It is recommended that the lens be cleaned with a mild soap and water solution, using a soft cloth so as not to scratch the lens.

If the Len is damaged (cracked or severely scratched) or visibility is impaired, it can be removed and replaced. To remove the Lens, follow the steps detailed in the Trailer Operation section. Slide replacement Lens into grooves in door frame.

4.2 Hydraulic Pump Maintenance

In order for the Hydraulic Pump to operate correctly, it requires adequate quantities of hydraulic fluid. The level of fluid in the holding tank on the Pump should be periodically checked and refilled to 1" below the filler opening if low. Also check the hose and fittings for leaking and repair if necessary. See the Specifications section for more information on the Hydraulic Pump.

4.3 Battery Maintenance

During operation (particularly in the summer months), it is necessary to insure that the Battery electrolyte level is properly maintained.

During the winter months, it is necessary to insure that the Battery state of charge remains above the level necessary to prevent the batteries from freezing. When temperatures below freezing are forecast, test the electrolyte levels in the Batteries using a hydrometer. The voltage level alone is not an accurate indicator of electrolyte freezing temperature. A chart in the Specification section shows how to determine electrolyte freezing points at various hydrometer readings. In the event the hydrometer reading shows that the specific gravity of the electrolyte is low enough to allow the Batteries to freeze, it may be necessary to recharge them.

Stratification

Stratification occurs when the Batteries have not moved over a long period of time and the electrolyte fluid in the Battery begins to separate. Stratification results in only the lower parts of the Battery cells doing the work causing reduced Battery capacity and life. The electrolyte stratification that occurs in wet Batteries, standing still at float voltages, can be reduced by inserting the Dual Voltage Plug into the Charger. The Dual Voltage Plug allows for occasional fast charging at 14.2VDC and can cause the Batteries to bubble for a few hours. Be sure to check and maintain the water levels in the batteries before and after the bubbling charge. After the fast charge, remove the Dual Voltage Plug to avoid boiling the batteries dry. See Specification section for more information on Charger.

Stratification does not occur in Batteries, which are jostled by frequent moving of the vehicle they are mounted in.

Detailed Sequence of Battery Charging Actions

- Make sure you wear protective clothing and a face shield when doing any kind of maintenance or charging of Battery system.
- Disconnect Battery Cables.
- Wash dirt off the top of the Batteries.
- Measure the specific gravity of all cells and remove those Batteries having more than .050 variation between the cells.
- Reconnect the Battery cables to allow charging of those remaining.
- Be sure that all remaining Battery cells have sufficient electrolyte to cover the plates plus ¼ of an inch. Use only distilled or deionized water.
- Connect 120VAC to the covered Receptacle on right side of Pedestal Assembly.
- Do a “dirty connection” check by using a sensitive DC voltmeter to measure the voltage drop between the battery “Posts” at the ends of each jumper cable of the battery pack. If there is more than 4 millivolts drop from Post to Post, then disconnect the power source from the Receptacle and clean and reconnect the cable connections.
- Reconnect the power source to the Pedestal Receptacle.
- After Batteries become fully charged (specific gravity 1.25 +/- .010 with a temperature compensated hydrometer), replace those, which were rejected with good, fully charged batteries of the **SAME** brand and size as the rest of the pack.

IMPORTANT NOTES:

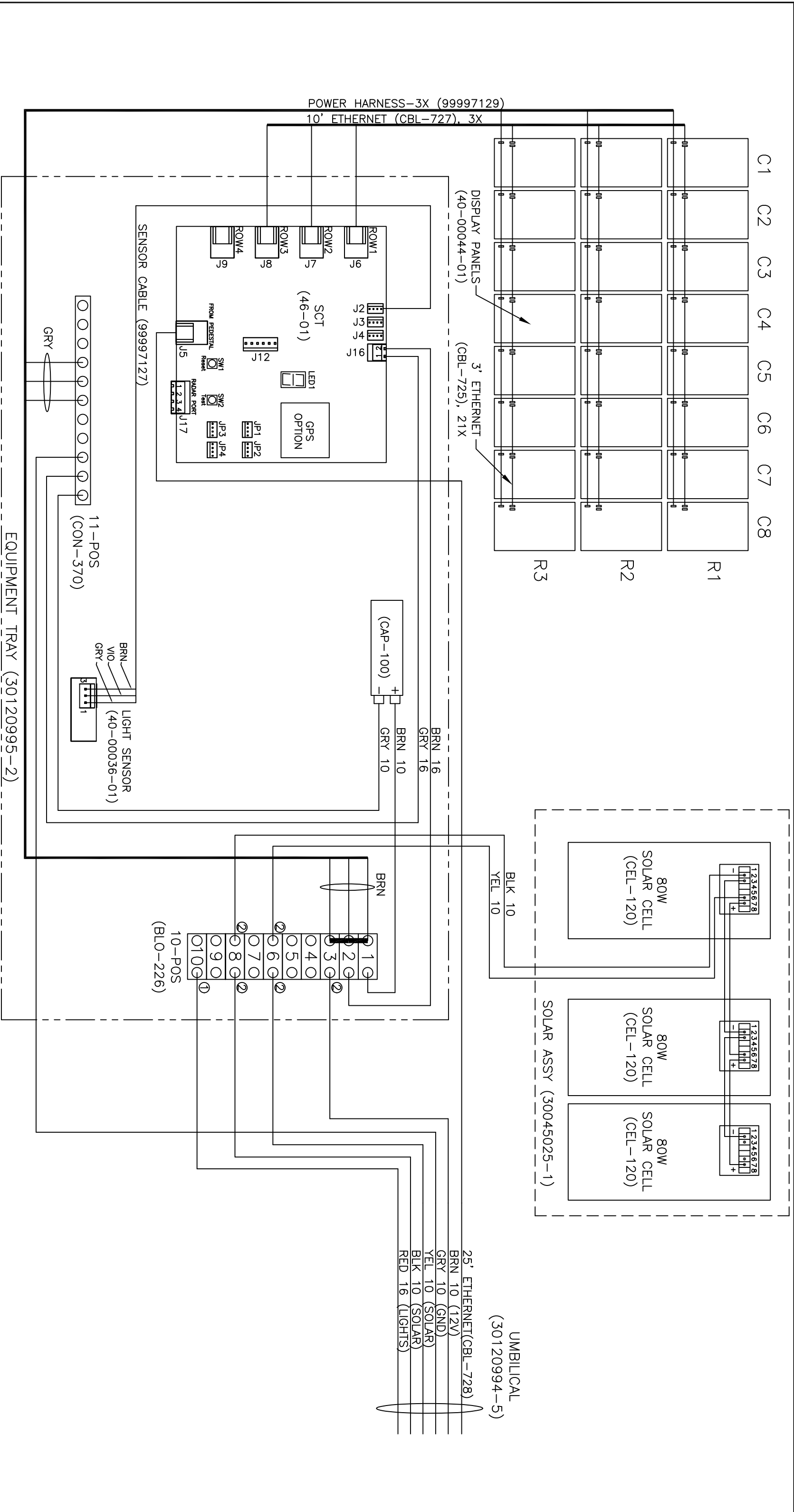
- ✓ Electrolyte level in the Batteries should be checked before and after each charging in addition to regular, periodic examinations. Replenish electrolyte with either distilled or de-ionized water up to the bottom of the ‘fill’ vent tube (but no higher). Note: adding water just before taking hydrometer readings will yield erroneous readings.
- ✓ A battery having a lesser or greater charge level than the pack must not be connected to that pack. To do so risks battery explosion.

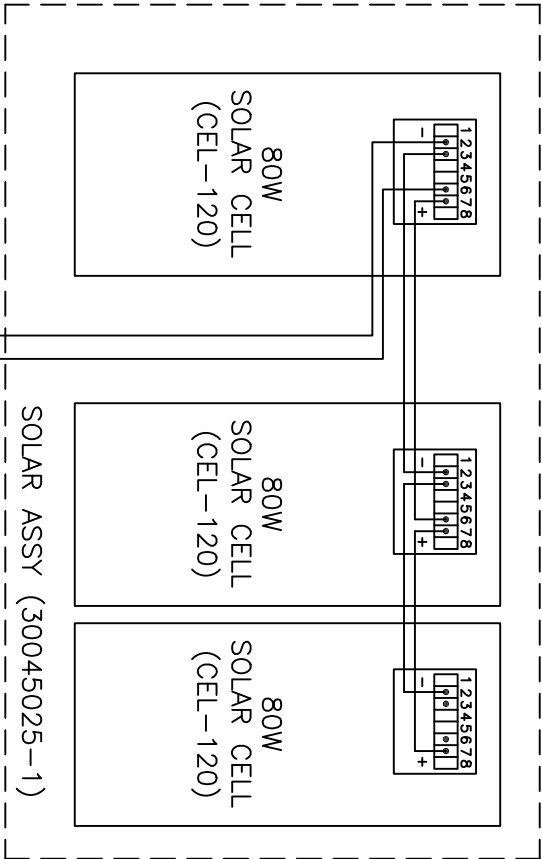
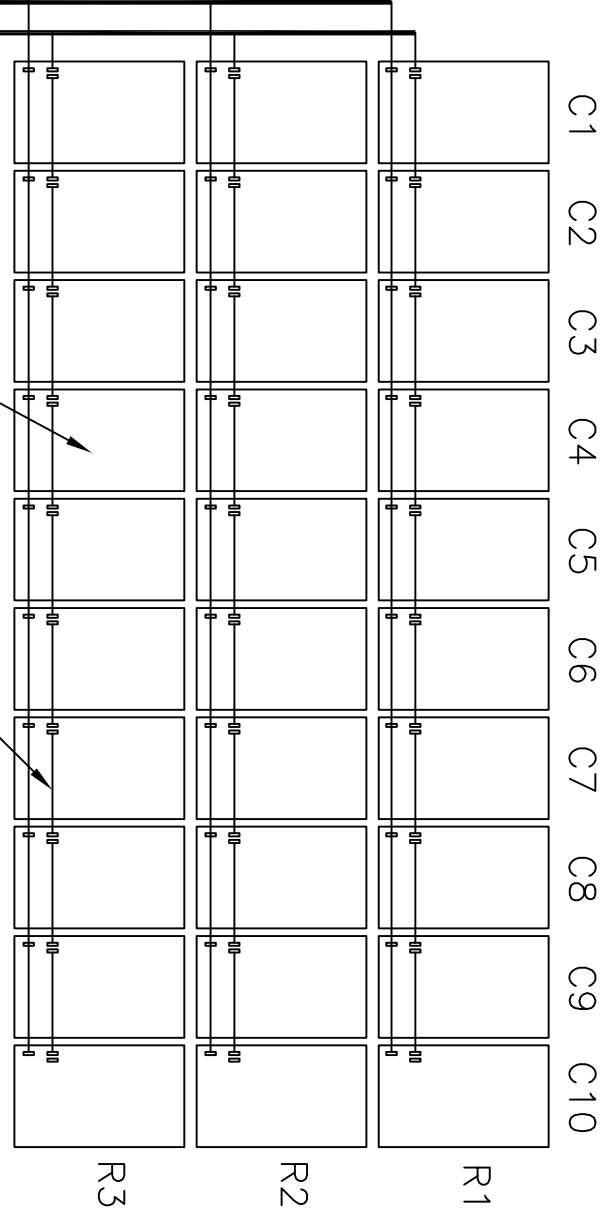
- ✓ Any sparking as the cables are being connected indicates uneven charging and may ignite an explosion.
- ✓ Charging to specific gravity readings above 1.265 will cause damage to the Battery plates.
- ✓ For proper charging and electrolyte destratification, allow charging, from the landline, to continue until the charging voltage drops back from 14.1V+/- to 13.2V+/- . Note that, at the start of charging, the charging voltage may be 13.2V, more or less, but will be rising rather than dropping back.
- ✓ Batteries allowed to be abused by being discharged below the factory 'default' level will require considerable time on the Charger just to bring them up to a condition in which they can begin to accept a charge. Under certain low temperature conditions, excessive discharging can permanently damage the Batteries due to freezing. Charging of damaged Batteries can cause a potentially dangerous condition for personnel and equipment. Therefore, maintain a good charge level in the Batteries during cold weather because lead/acid batteries can freeze and can be ruined if they are sufficiently discharged.
- ✓ Interruptions of the landline supply line may cause the Charger to reset, which will lengthen the charging time. It may be necessary to disconnect both AC and DC from the Charger, put a load on the Batteries to burn off any surface charge and then reconnect the Batteries and land line to restart the Charger.

5.0 Wiring Diagrams

The following pages contain the system wiring diagrams for the various 33x NTCIP, G4 Series Trailers:

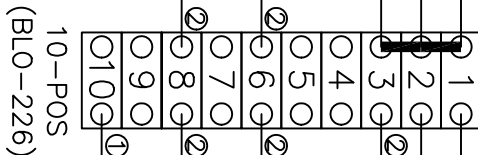
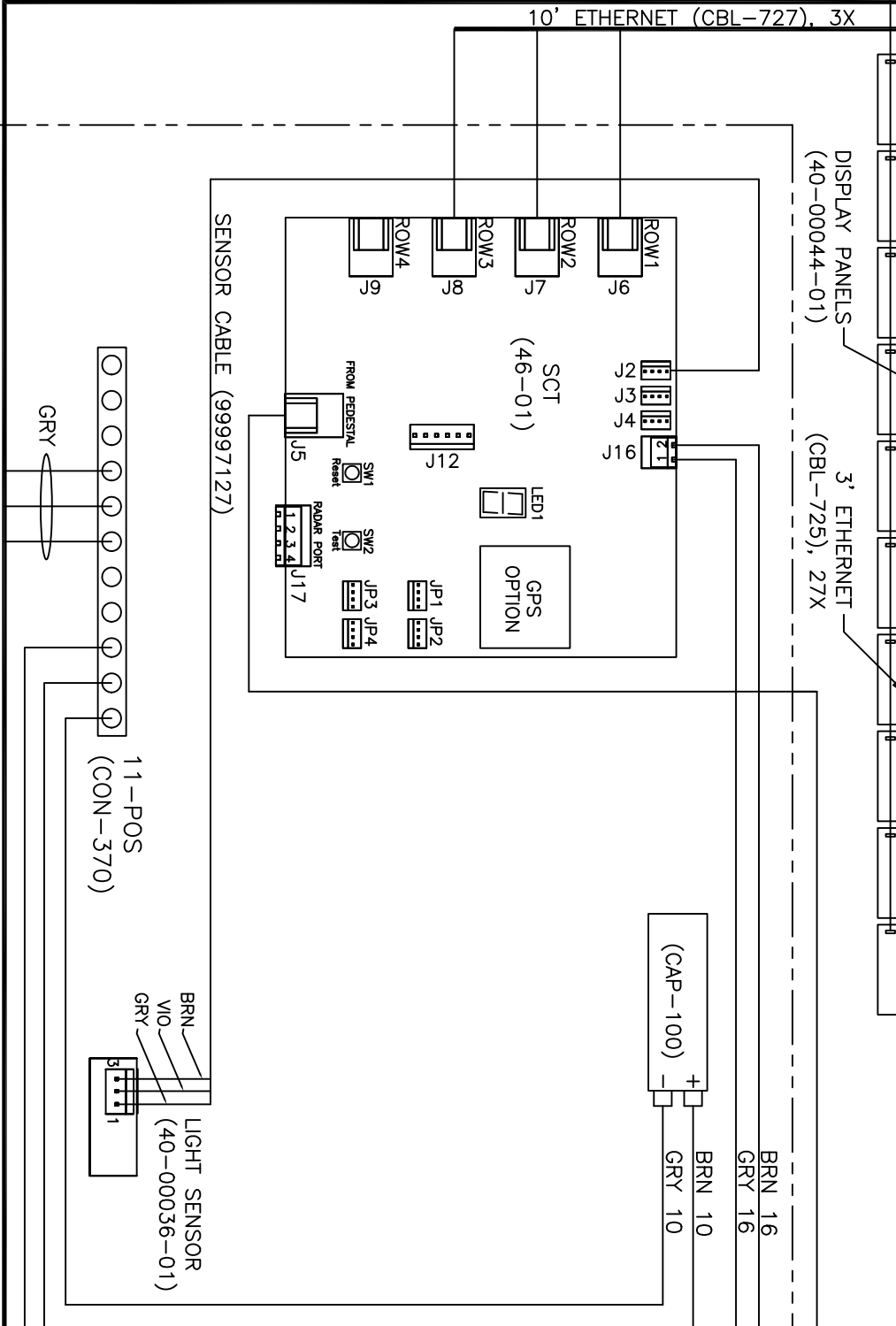
- Model 331 NTCIP, G4 (2 pages)
- Model 332 NTCIP, G4 (2 pages)
- Model 333 NTCIP, G4 (2 pages)





UMBILICAL (30120994-5)

- 25' ETHERNET(CBL-728)
- BRN 10 (12V)
- GRY 10 (GND)
- YEL 10 (SOLAR)
- BLK 10 (SOLAR)
- RED 16 (LIGHTS)



EQUIPMENT TRAY (30120995-2)

TITLE:				REV.	DATE:	REV. BY		
332 NTCIP				B	7/21/10	mmt	Updated 30120995-2	
SYSTEM WIRING - SIGNCASE							Display panels re-wired	
WIRING DIA, 332 NTCIP TRAILER G4				C	8/19/10	mmt	UPDATED 30120995-2 WIRING	
DRAWN. BY:		mmt	DATE:	5/5/10	PAGE 2 OF 2	SCALE:	NONE	

AM SIG

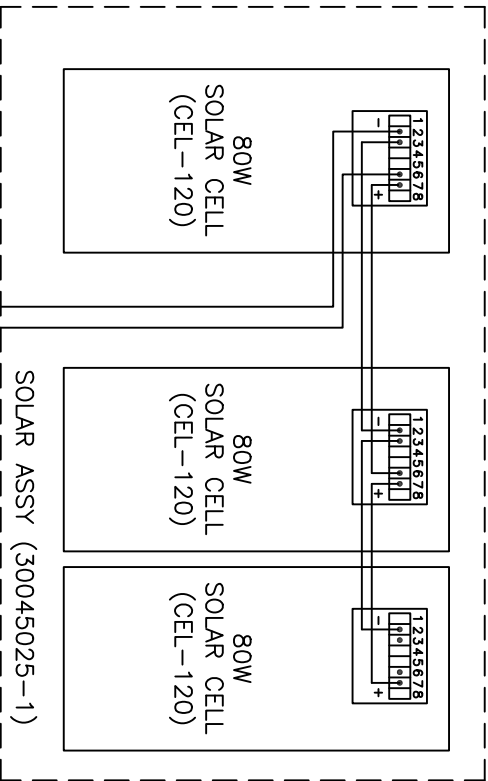
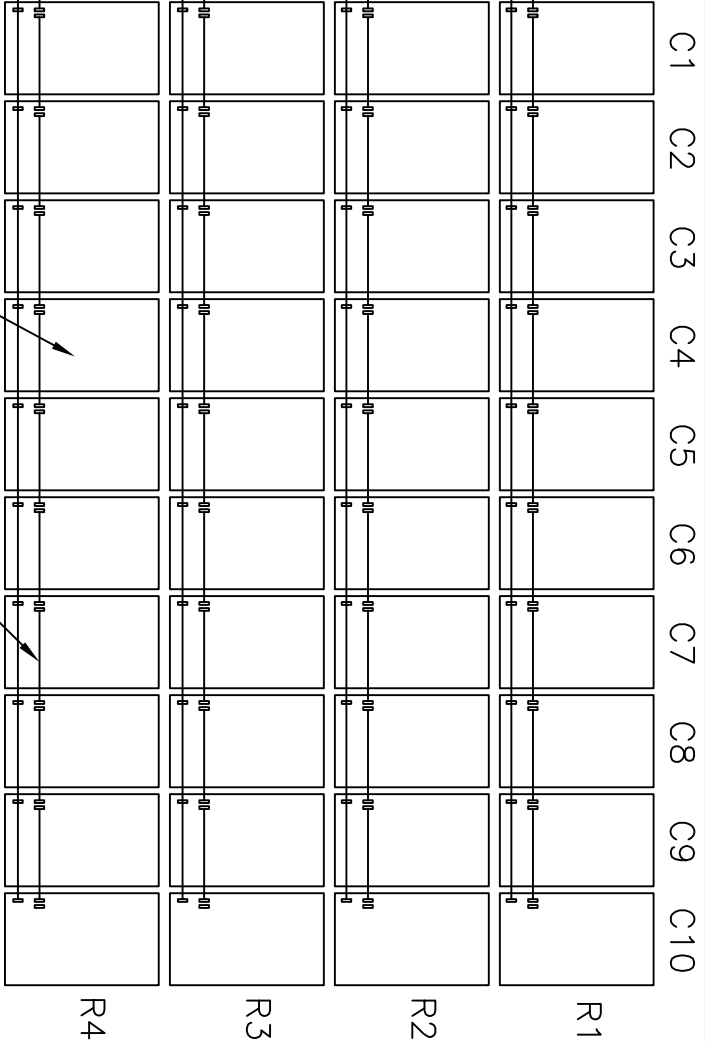
AMERICAN SIGNAL COMPANY

2755 BANKERS INDUSTRIAL DRIVE
ATLANTA, GA 30360
(770) 448-6650 FAX: (770) 448-8970

DWG. NO.
30067202-WIR

REV.
C

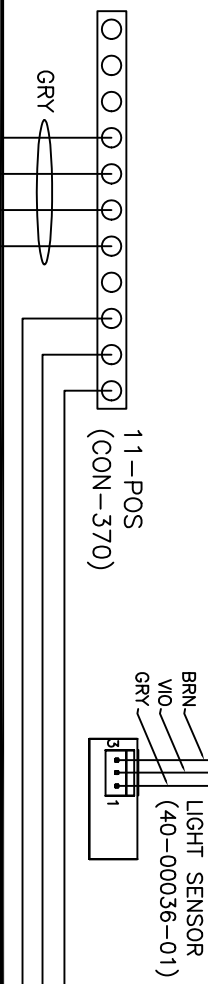
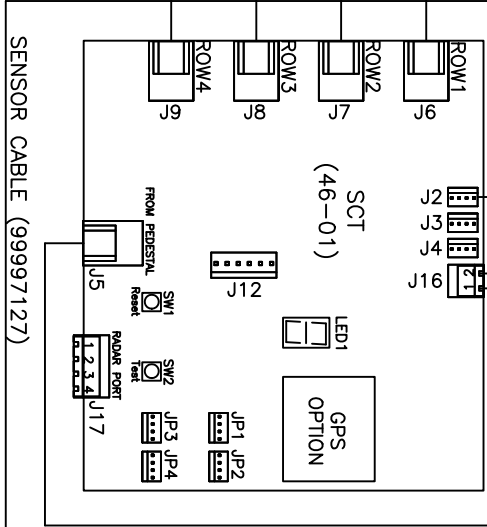
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UMBILICAL
(30120994-5)

25' ETHERNET(CBL-728)
BRN 10 (12V)
GRY 10 (GND)
YEL 10 (SOLAR)
BLK 10 (SOLAR)
RED 16 (LIGHTS)

POWER HARNESS-4X (99997129)
10' ETHERNET (CBL-727), 4X



EQUIPMENT TRAY (30120995-2)

TITLE:

333 NTCIP

SYSTEM WIRING – SIGNCASE

WIRING DIA, 333 NTCIP TRAILER G4

DRAWN. BY: mmt

DATE: 5/5/10

PAGE 2 OF 2

SCALE: NONE

REV. B

DATE: 7/21/10

BY: mmt

Updated 30120995-2

Display panels re-wired

REV. C

DATE: 8/19/10

BY: mmt

Updated 30120995-2

WIRING

AM SIG

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DWG. NO. 30067402-WIR

REV. C

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6.0 Mechanical Drawings

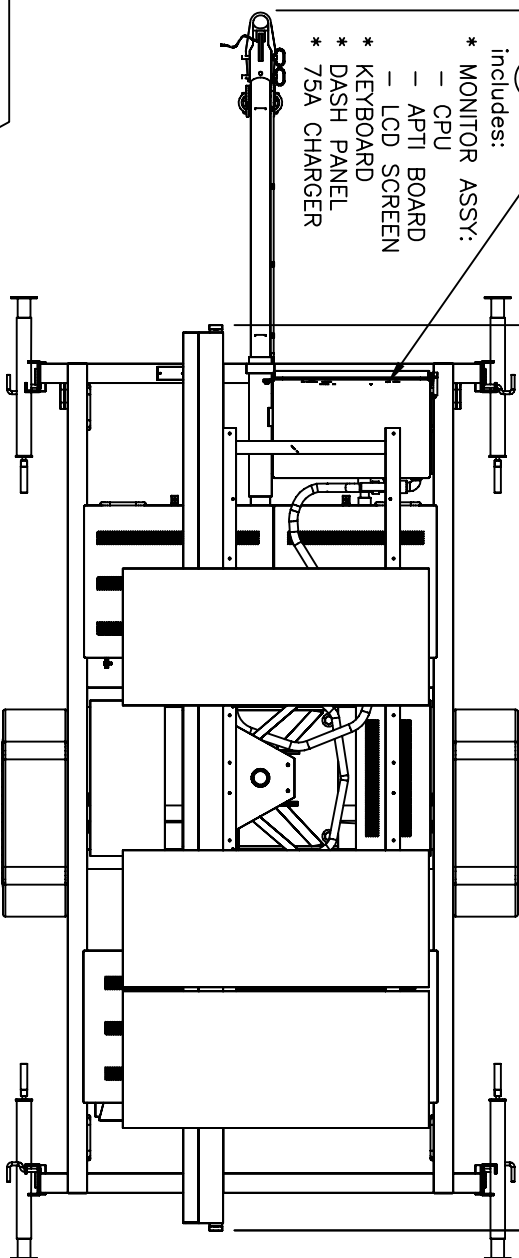
The following pages contain the system mechanical component drawings for the various 33x NTCIP Series Trailers:

- Model 331 NTCIP, G4
- Model 332 NTCIP, G4
- Model 333 NTCIP, G4

TRAILER LENGTH W/TONGUE (TRAVEL) 188.3"

TRAILER LENGTH W/O TONGUE (STORAGE) 139.7" <11'-8">

- includes:
- * MONITOR ASSY:
 - CPU
 - APTI BOARD
 - LCD SCREEN
 - * KEYBOARD
 - * DASH PANEL
 - * 75A CHARGER

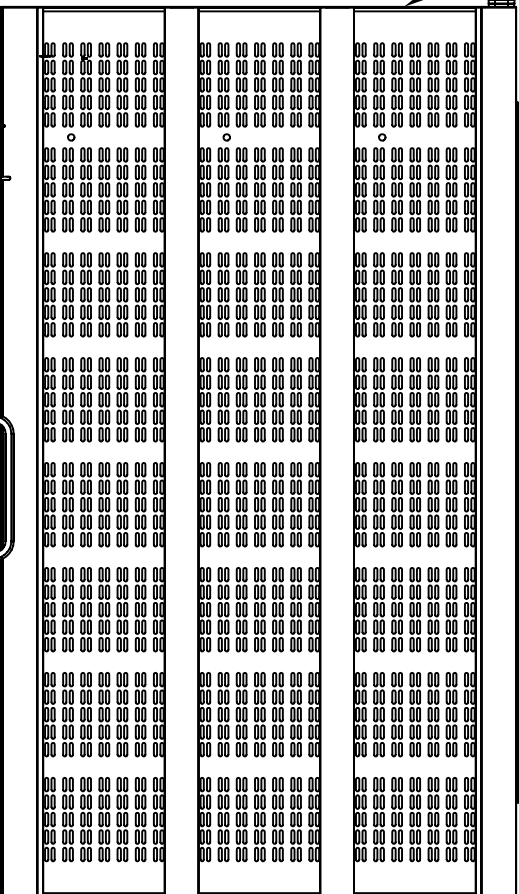


- includes:
- * DISPLAY PANELS
 - * SIGN CASE
 - * TELEMETRY (SCT)
 - * PHOTOSENSOR
 - * SILKSCREENED LENS
 - * MARKER LIGHTS

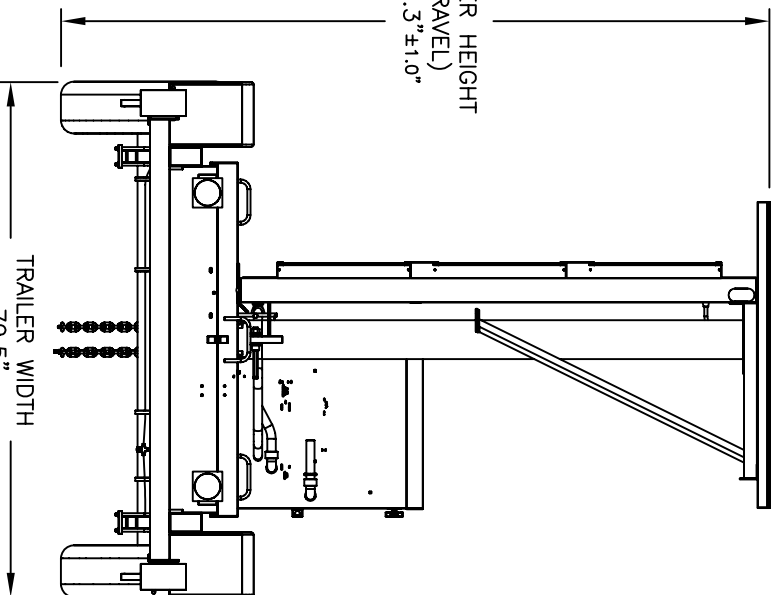
SIGN CASE WIDTH 137.5"

- includes:
- * 80W SOLAR PANELS (3x)

SIGN CASE HEIGHT 79.5"



TRAILER HEIGHT (TRAVEL) 109.3" ±1.0"



- includes:
- * 12VDC HYDRAULIC PUMP
 - * LIFTING CYLINDER (in MAST)
 - * 6V BATTERIES
 - * 90A FUSE
 - * 15" TIRES & 3500# RATED AXLE
 - * LEVELING JACKS (4x)
 - * TAIL LIGHTS
 - * SIDE RUNNING LIGHTS

TRAILER WIDTH 79.5"

ITEM #	PART #	DESCRIPTION	QTY
1	30125130-2	SIGN CASE ASSEMBLY, GEN4 331 NTCIP 2010	1
2	30045025-1	ARRAY, SOLAR PANEL ASSY 3X 80W	1
3	30121502-3	PEDESTAL ASSEMBLY, GEN. 4 33X NTCIP	1
4	30125015-21	TRAILER BASE ASSY, 33X G4 NTCIP	1
5	30040318	TONGUE ASSY, REM 1/4" LEVER 33X	1

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OVERALL ASSEMBLY:

T-331 NTCIP G4 VMS TRAILER

NEXT LEVEL ASSEMBLY:

3-LINE, CHARACTER MATRIX, 40 COL.

THIS ASSEMBLY:

18 CHARACTERS, 5x7, 4 LEDS/PIXEL

DRAWN. BY: PRP

DATE: 7/28/10

PAGE 1 OF 1

SCALE: NONE

REV. DATE: REV. BY



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30067002

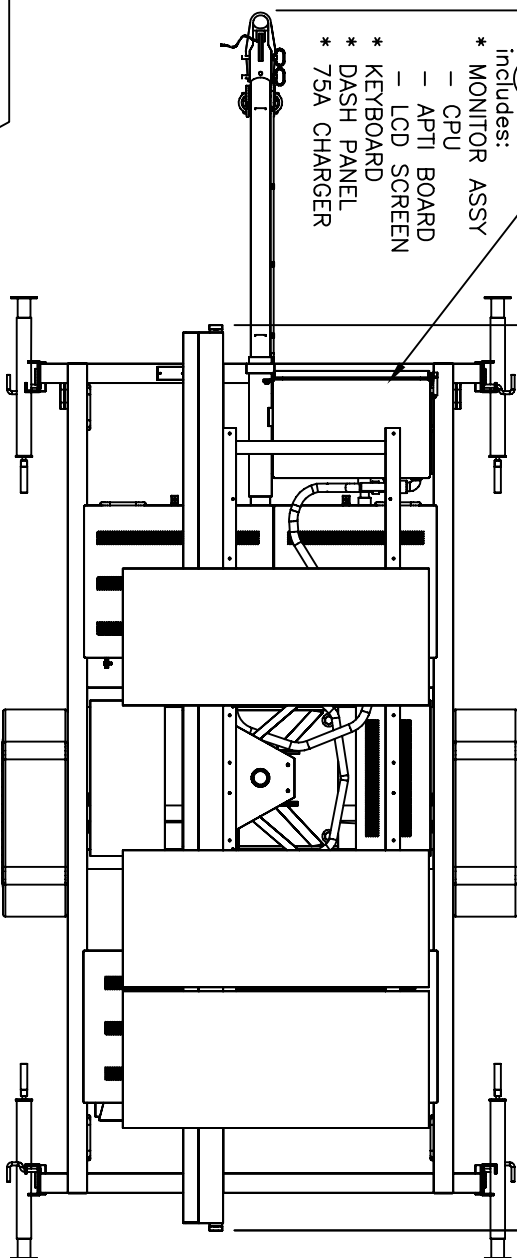
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TRAILER LENGTH W/TONGUE (TRAVEL) 188.3"

TRAILER LENGTH W/O TONGUE (STORAGE) 139.7" <11'-8">

- includes:
- * MONITOR ASSY
 - CPU
 - APTI BOARD
 - LCD SCREEN
 - * KEYBOARD
 - * DASH PANEL
 - * 75A CHARGER



- includes:

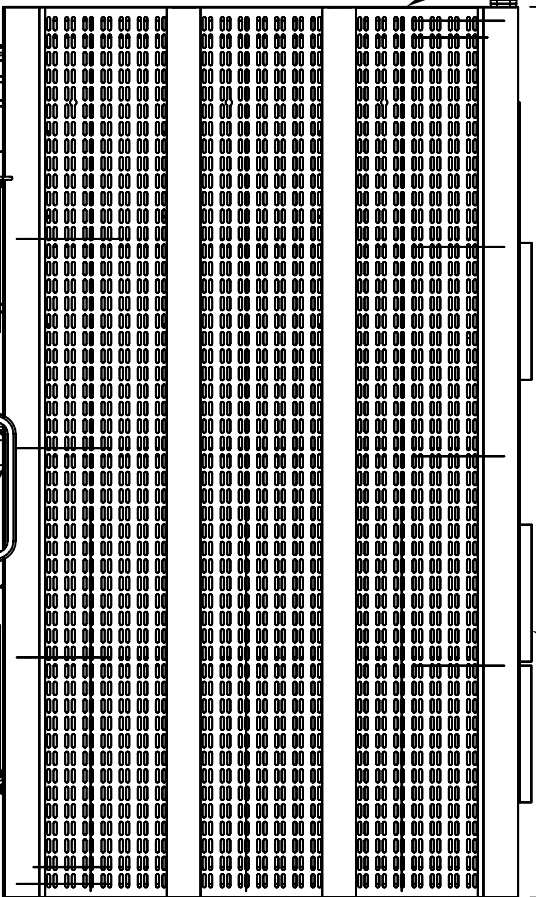
- * DISPLAY PANELS
- * SIGN CASE
- * TELEMETRY (SCT)
- * PHOTOSENSOR
- * SILKSCREENED LENS
- * MARKER LIGHTS

- includes:

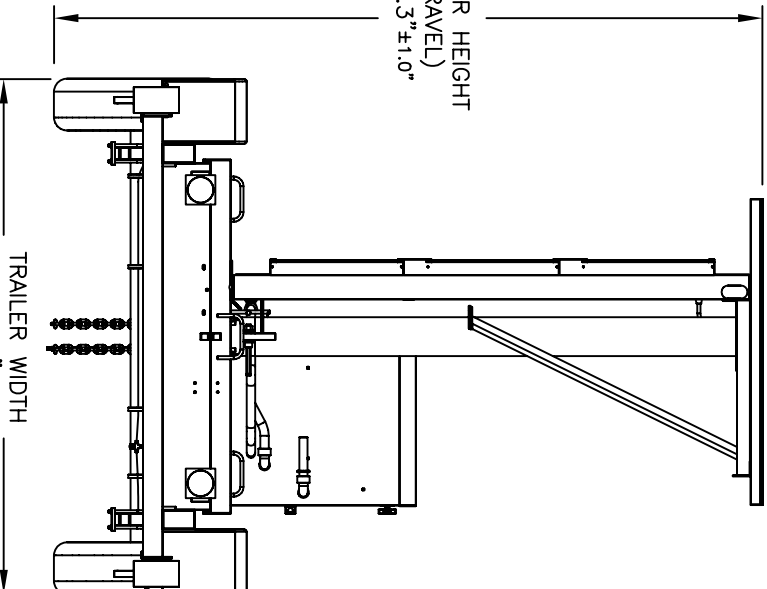
- * 80W SOLAR PANELS (3x)

SIGN CASE
HEIGHT
79.5"

SIGN CASE WIDTH
137.5"



TRAILER HEIGHT
(TRAVEL)
109.3" ±1.0"



- includes:

- * 12VDC HYDRAULIC PUMP
- * LIFTING CYLINDER (in MAST)
- * 6V BATTERIES
- * 90A FUSE
- * 15" TIRES & 3500# RATED AXLE
- * LEVELING JACKS (4x)
- * TAIL LIGHTS
- * SIDE RUNNING LIGHTS

TRAILER WIDTH
79.5"

OVERALL ASSEMBLY:

T-332 NTCIP G4 VMS TRAILER

NEXT LEVEL ASSEMBLY:

3-LINE, LINE MATRIX, 50 COL.

THIS ASSEMBLY:

18 CHARACTERS, 5x7, 4 LEDS/PIXEL

DRAWN. BY: PRP

DATE:
7/28/10

PAGE 1 OF 1

SCALE:
NONE

ITEM #	PART #	DESCRIPTION	QTY
1	30125140-2	SIGN CASE ASSEMBLY, GEN4 332 NTCIP 2010	1
2	30045025-1	ARRAY, SOLAR PANEL ASSY 3X 80W	1
3	30121502-3	PEDESTAL ASSEMBLY, GEN. 4 33X NTCIP	1
4	30125015-21	TRAILER BASE ASSY, 33X G4 NTCIP	1
5	30040318	TONGUE ASSY, REM 1/4" LEVER 33X	1



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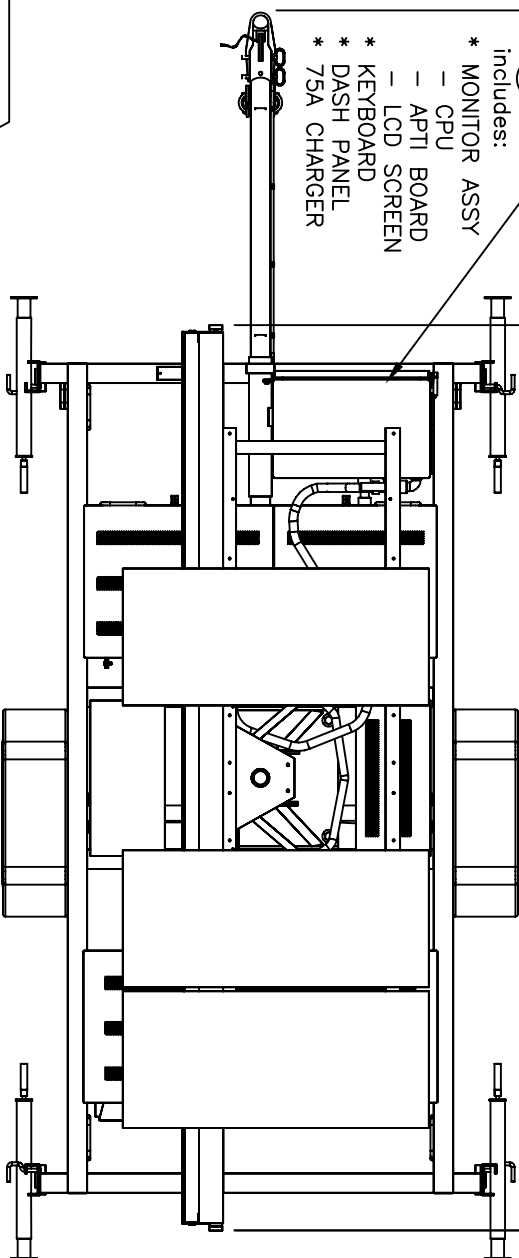
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TRAILER LENGTH W/O TONGUE (STORAGE) 139.7" <11'-8">

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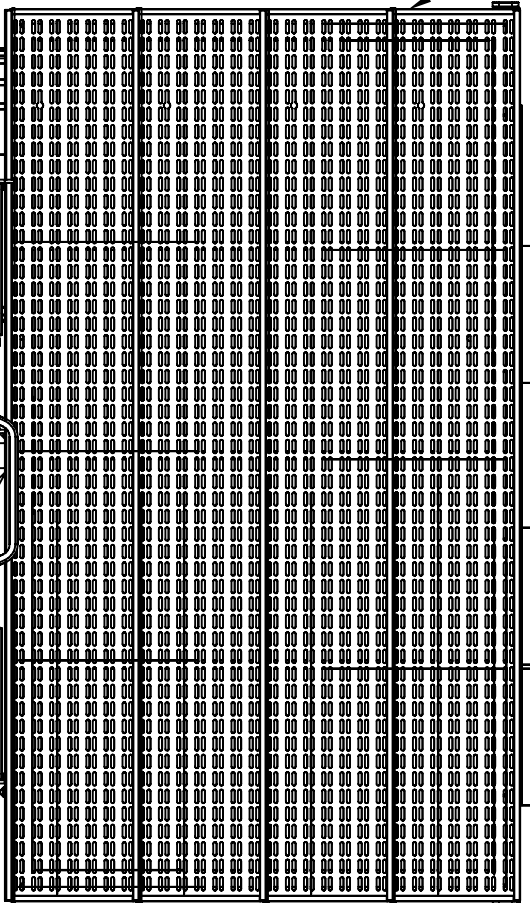


- includes:
- * DISPLAY PANELS
 - * SIGN CASE
 - * TELEMETRY (SCT)
 - * PHOTOSENSOR
 - * SILKSCREENED LENS
 - * MARKER LIGHTS

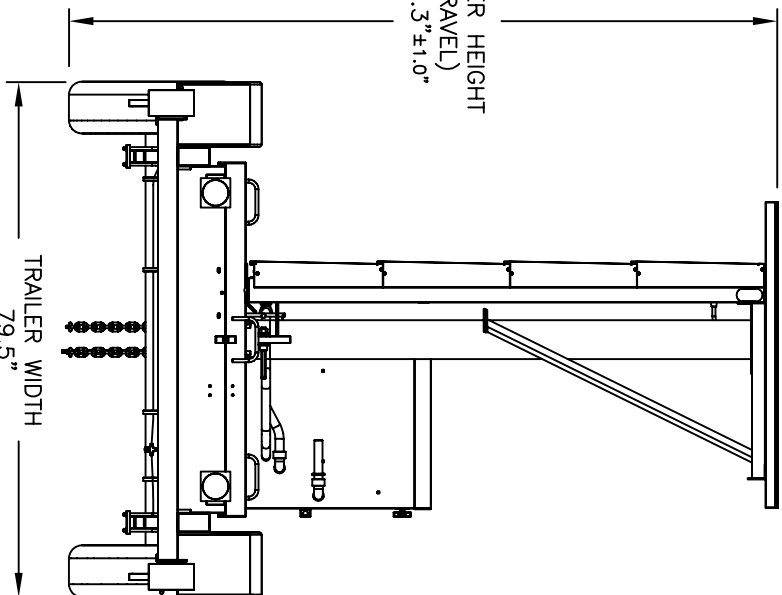
SIGN CASE WIDTH 137.5"

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TRAILER HEIGHT (TRAVEL) 109.3" ±1.0"



- includes:
- * 12VDC HYDRAULIC PUMP
 - * LIFTING CYLINDER (in MAST)
 - * 6V BATTERIES
 - * 90A FUSE
 - * 15" TIRES & 3500# RATED AXLE
 - * LEVELING JACKS (4x)
 - * TAIL LIGHTS
 - * SIDE RUNNING LIGHTS

TRAILER WIDTH 79.5"

OVERALL ASSEMBLY:

T-333 NTCIP G4 VMS TRAILER

NEXT LEVEL ASSEMBLY:

4-LINE, FULL MATRIX, 50 COL.

THIS ASSEMBLY:

18 CHARACTERS, 5x7, 4 LEDS/PIXEL

DRAWN. BY: PRP

DATE: 7/28/10

PAGE 1 OF 1

SCALE: NONE

ITEM #	PART #	DESCRIPTION	QTY
1	30125135-2	SIGN CASE ASSEMBLY, GEN4 333 NTCIP 2010	1
2	30045025-1	ARRAY, SOLAR PANEL ASSY 3x 80W	1
3	30121502-3	PEDESTAL ASSEMBLY, GEN. 4 33X NTCIP	1
4	30125015-21	TRAILER BASE ASSY, 33X G4 NTCIP	1
5	30040318	TONGUE ASSY, REM 1/4" LEVER 33X	1



AMERICAN SIGNAL COMPANY
2755 BANKERS INDUSTRIAL DRIVE
ATLANTA, GA 30360
(770) 448-6650 FAX: (770) 448-8970

DWG. NO.

30067402

REV.

A

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7.0 Spare Parts List

		33x NTCIP, G4		
AmSig® P/N	Description	331	332	333
Sign Case Assy:				
40-00044-01	Display Panel, 18" 5x7 4L/30D FB NTCIP	●	●	●
40-00046-01	Sign Case Telemetry (SCT) Board G4	●	●	●
40-00017-01	Light to Analog Sensor	●	●	●
CAP00000100	Capacitor, 100k mF 16VDC Alum	●	●	●
CBL00000725	Cable, CAT5E Ethernet Patch 3Ft BL	●	●	●
CBL00000727	Cable, CAT5E Ethernet Patch 10Ft BL	●	●	●
AMS99997129	Cable Assy, Display Power 33x G4	●	●	●
AMS99997127	Cable, Sensor-Disp Ctrl 3G	●	●	●
AMS30120023	Lens, Silkscreened T331	●		
AMS30120024	Lens, Silkscreened T332/333		●	●
Hydraulic Pump and Cylinder:				
HYD00000160	Hydraulic Pump, Combo 12V + Lever	●	●	●
HYD00000181	Cylinder, Hydraulic 1-1/2 Bore 57" Stroke	●	●	●
Solar Panel Assembly:				
CEL00000120	Solar Panel, 80W @17.1V	●	●	●
Pedestal Assembly:				
PCB00000585	CPU, Embedded PC PXA270	●	●	●
40-00045-01	Advanced Ped. Telemetry Interface (APTI)	●	●	●
LCD00000030	LCD Display, 10.4" VGA 640x480 TFT	●	●	●
40-00043-01	Display Adapter, LCD	●	●	●
PCB00000615	Display Inverter, 3.5W 2Lamp Single	●	●	●
SWI00000585	Switch, Breaker Duty 2 Pole 40A	●	●	●
SWI00000930	Switch, NO PB 15A Panel MT 15/32	●	●	●
CEL00000135	Controller, Solar Charge 12VDC 25A	●	●	●
KEY00000070	Keyboard, Mini 88/89 Keys Trackball USB	●	●	●
CHG00000155	Charger, 75A 120V 13.2V to 14.4V	●	●	●
Trailer Assembly:				
BAT00000140	Battery, 6V Deep Cycle 215 Amp-Hrs	●	●	●
FUS00000325	Fuse, Circuit Breaker 90A	●	●	●
WHE00000010	Wheel, Tire F78-15ST 6 Ply 1820#	●	●	●
AXL00000220	Axle, 3500# 71" Hubs Hydraulic	●	●	●
HIT00000011	Hitch, w/Hydraulic Surge Brake	●	●	●
AMS30040318	Tongue Assembly, Rem 1/4" Lever 33x	●	●	●
HIT00000055-1	Hitch, 2" Ball Socket Lever w/ Pin	●	●	●
JAC00000085	Jack, 2000# Top Wind Swivel Mount 15"	●	●	●
LAM00000020	Lamp, Tail Left Side	●	●	●
LAM00000030	Lamp, Tail Right Side	●	●	●

Miscellaneous:				
WRE00000010	Wrench, Box Ratchet 5/8" x 11/16"	●	●	●
BIT00000190	Bit, Torx 1/4" Pin-In-Head Screw	●	●	●

NOTE: Components not specifically described in the main portions of the manual can be found in either Section 5.0 – Wiring Diagrams or Section 6.0 – Mechanical Drawings.

8.0 Specification Section

The following pages contain vendor specifications of components utilized in the 33x NTCIP Series Trailers.



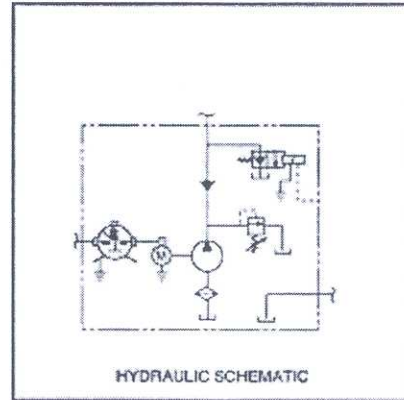
Monarch D.C. Hydraulic Power Systems

Model M-3519

How to Order Your M-3519 Dyna-Jack

Description:

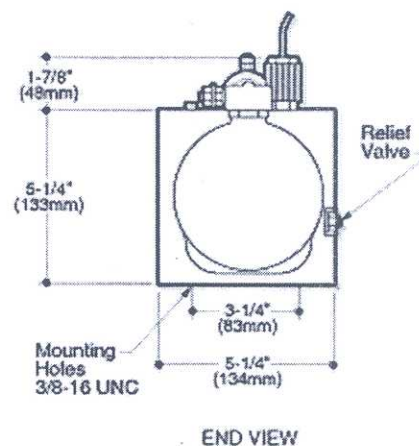
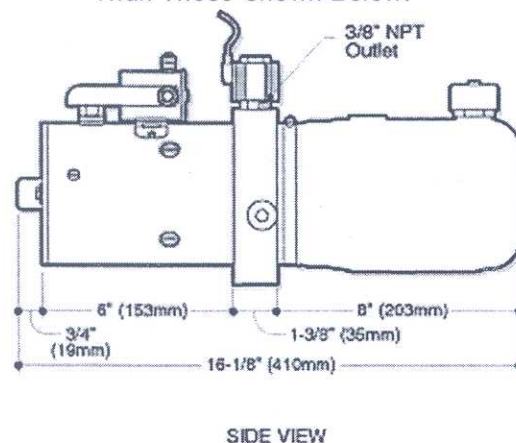
- Pump/Motor/Reservoir/Valve
- Check Valve
- Externally Adjustable Relief Valve
- 2-Way/2-Position Normally Closed Solenoid Cartridge Valve
- .375 Inch NPT Outlet
- Horizontal Mounting Standard



Popular Options:

- Control Box and Cord
- Vertical Mounting. Motor Up.
- Pressure Compensated (Cartridge Style) Orifice on Lowering Circuit*
- Lowering Valve Recessed into Base and Protected From Abuse*
- Large Return Valve For Faster Lowering Speed*
- Manual Override*
- Hand Pump Manifold Mounts Directly to Base*

** Operation Requires Power Unit Dimensions and Features Different Than Those Shown Below.*



[Back to Top of Page](#)

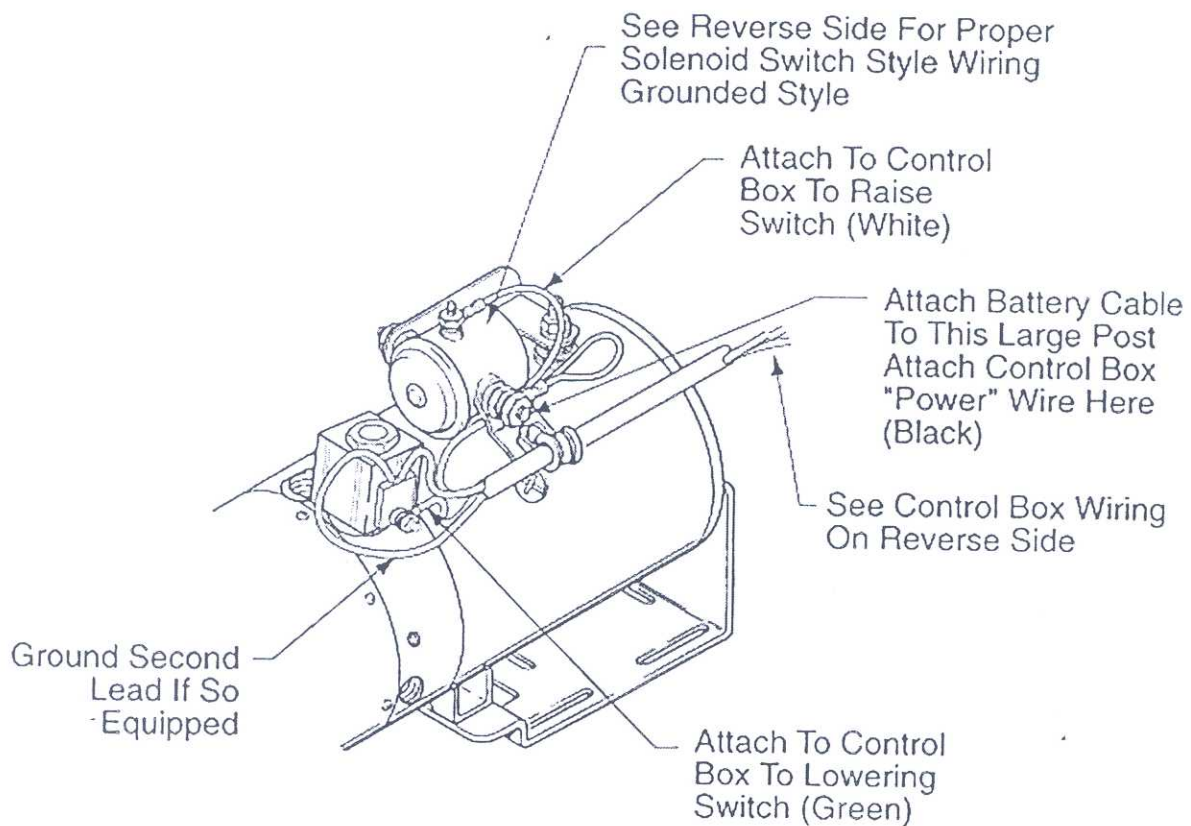
M-319
(M-719 & M-3519 Are Similar)

http://www.monarchhyd.com/tech/wiring_guide/3way_1sol.html

6/18/2004

3 Way Units w/1 Solenoid Valve

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SHARP

PLEASE READ THIS MANUAL COMPLETELY BEFORE INSTALLING OR USING THE MODULES

INSTALLATION MANUAL

PHOTOVOLTAIC MODULE

NE-80EJEA

SHARP CORPORATION

1. INTRODUCTION

This manual contains information of electrical and mechanical installation and safety information which you should know before using photovoltaic module **NE-80EJEA**.

The information in this manual is described on the basis of Sharp's knowledge and experience. But such information and suggestions do not constitute a warranty.

Sharp Corporation reserves the right to make changes to the product, specifications, or to the manual without prior notice.

2. MECHANICAL INSTALLATION

The modules may be fastened to a support using the bolt holes in the bottom of the frame at location "C", as shown in Figure 1 (back view of the module) and Figure 6 (mounting detail). The module should be fastened with four (4) M8 (5/16") bolts. The mounting method is designed to allow module loading of 2400 Pa. Take care during installation to not block the drain holes (D) shown in Figure 1.

3. ELECTRICAL INSTALLATION

To ensure proper system operation and maintain your warranty, be careful to observe the correct cable connection polarity (Figure A) when connecting the modules to a battery or to other modules.

All solar modules must be grounded by electrical connection of the module frames to ground. Care must be taken to arrange the system ground so that the removal of one module from the circuit will not interrupt the grounding of any of the other modules.

Each photovoltaic module has a hole in the side frame for either a bolt, nut and washer grounding the module to the frame, a ground lug fastened by bolt or screw, or an appropriate screw (hardware not provided). An example of an acceptable ground connection using a bolt, nut and washer retaining a ground lug is shown in Figure B. In a connection of this type, the hardware (such as a star washer) must score the frame surface to make positive electrical contact with the frame. The ground wire must not be smaller than No. 14 AWG (2.1mm²), and should be sized according to The National Electrical Code.

The terminal box is shown in Figure 2. When connecting the modules to a battery or to other modules, you must carefully observe correct cable connection polarity as shown Figure 3 and Figure A. If not connected correctly the bypass diodes could be destroyed. This will void your warranty.

By loosening the two cover screws as shown in Figure 2, open the cover of wiring box. Figure 3 shows the inside of the wiring box. The range of typical terminal cabling is AWG 14. Remove the appropriate grommets and route the interconnecting cables through grommets as shown in Figure 3. To remove the grommets, push them from inside of the box.

To connect wires to terminal block, a wire lug connector may be used as shown in Figure 4. For direct wiring, strip back insulation about 16mm and wrap stripped wire around screw under square washer as shown in Figure 5. Tighten terminal screw securely with a proper screwdriver. After completed terminal wiring, secure the cover of wiring box.

When connecting the modules to a battery or to other modules, you must carefully observe correct cable connection polarity as shown in Figure A. If not connected correctly, the bypass diode could be destroyed. This will void your warranty.

4.ELECTRICAL RATINGS

Rated electrical characteristics are within ± 10 percent of the indicated values of I_{sc} , V_{oc} and within $+10/-5$ percent of P_{max} under standard test conditions (irradiance of 100 mW/cm^2 , AM 1.5 spectrum, and a cell temperature of 25°C (77°F)).

The above electrical characteristics are based on the results of out going test. The warranty condition is specified in the warranty card separately issued.

Maximum Power (P_{max})	80.0 W
Open-Circuit Voltage (V_{oc})	21.6 V
Short-Circuit Current (I_{sc})	5.15 A
Operating Voltage (V_{pmax})	17.3 V
Current at V_{pmax} (I_{pmax})	4.63 A
Maximum System Voltage	600 V
Maximum Series Fuse	10 A

The above electrical characteristics are based on the results of out going test. Please do not expose solar module to sunlight concentrated with mirrors, lenses or similar means.

Under normal conditions, a photovoltaic module may experience conditions that produce more current and/or voltage than reported at Standard Test Conditions. Accordingly, the values of I_{sc} and V_{oc} marked on UL Listed modules should be multiplied by a factor of 1.25 when determining component voltage ratings, conductor capacities, fuse sizes and size of controls connected to the module output. Refer to Sec. 690-8 of the National Electric Code for an additional multiplying factor of 125 percent (80 percent of rating) which may be applicable.

Installation for wiring shall be in accordance with the NEC and grounding method shall comply with the NEC, article 250 (see instruction manual Figure A and B). In the coverage of Canadian UL listing, installation shall be in accordance with CSA C22.1, Safety Standard for Electrical Installations, Canadian Electrical Code, Part 1.

IMPORTANT SAFETY WARNINGS

- (1) Never touch the end of output cables with bare hands when the module is irradiated. Cover the surface of module with cloth or other suitable sufficiently opaque material to isolate the module from incident light and handle the wires with rubber-gloved hands to avoid electric shock.
- (2) Do not wear metallic jewelry which may become cause of electric shock during installation.
- (3) Do not expose solar module to sunlight concentrated with mirrors, lenses or similar means.
- (4) Consult local codes and other applicable laws and statutes concerning required permits, regulations concerning installation, and inspection requirements.
- (5) Install modules and ground frames in accordance with applicable codes.
- (6) Product should be installed and maintained by qualified personnel.
- (7) Do not drop tools or hard objects on the solar module.
- (8) Do not scratch the back film by hard objects.
- (9) Do not shadow cells, if possible, to avoid causing module hot spots.
- (10) Do not pour chemicals on modules when cleaning.
- (11) Keep children away from modules.
- (12) Do not connect the modules directly to the loads such as motor since the variation of the output power depending on the solar irradiation causes the damage for the connected motor.
 - 1: In case of brushless motor, the lock function gets active and the hall IC is most likely to be damaged.
 - 2: In case of the motor with brush, the coil is most likely to be damaged.
- (13) Do not block up D-holes on the establishment.

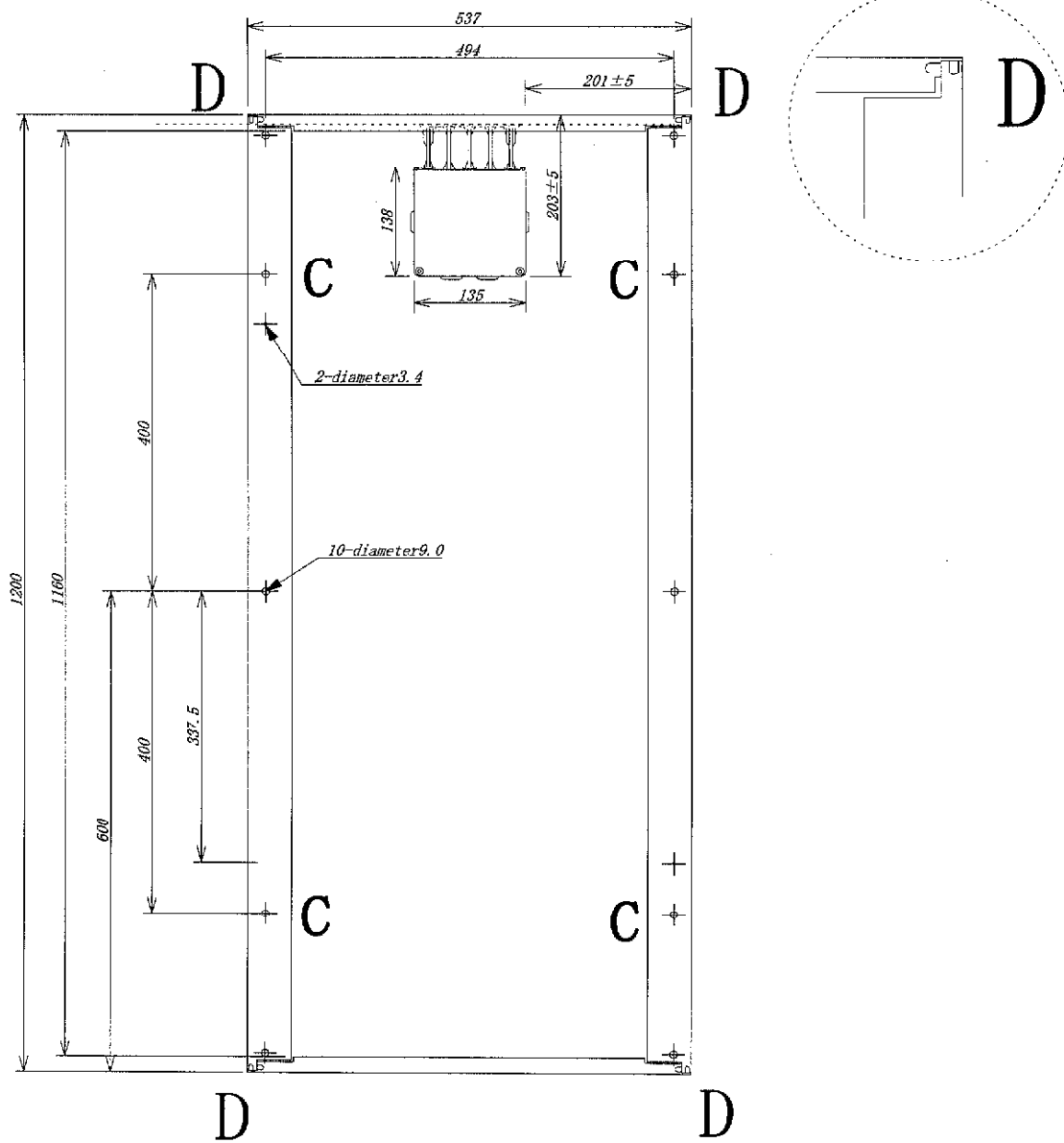
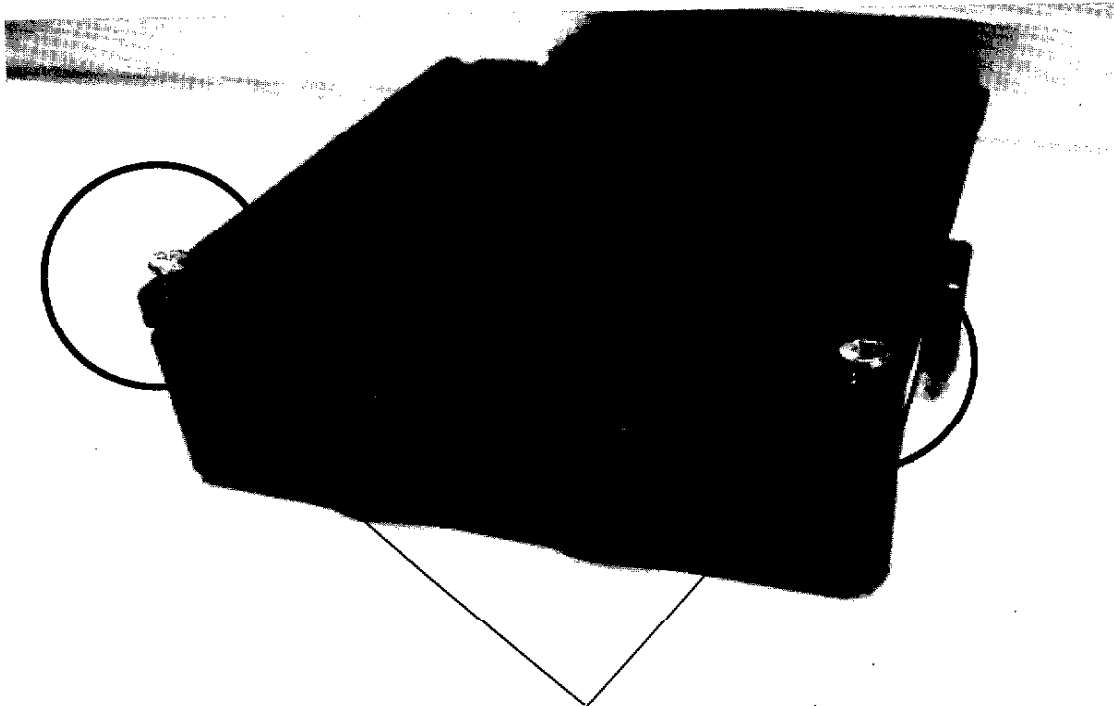


Figure1

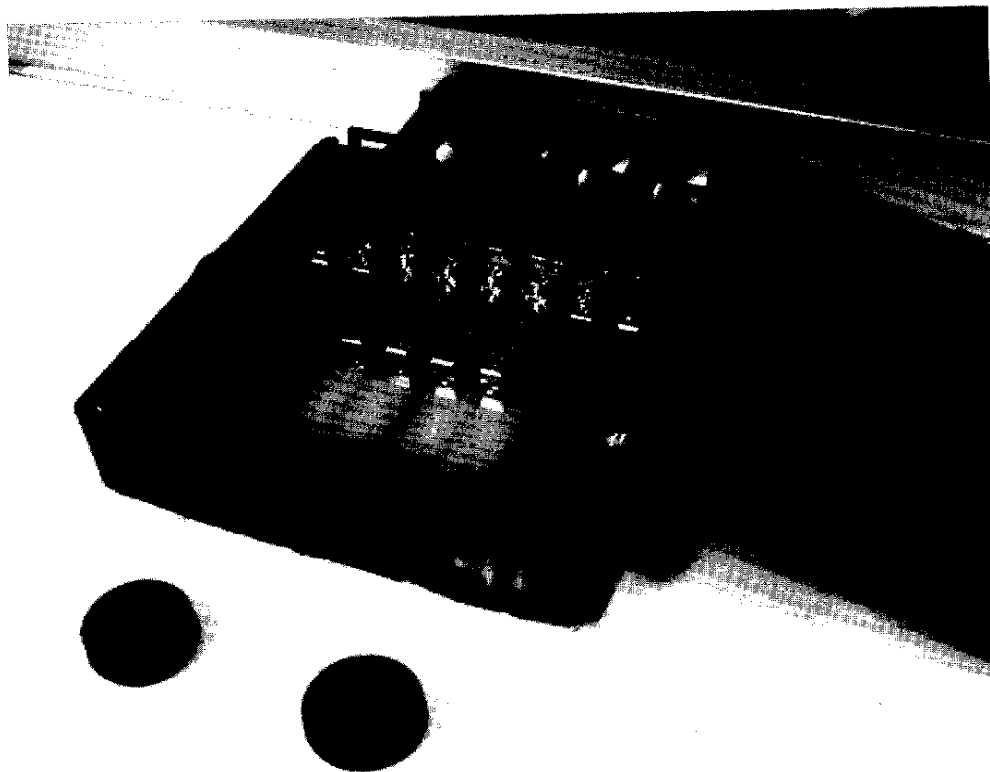
Table A

Dimension : L	Permissible Deviation
0.5 < L < 3	+0.2
3 < L < 6	+0.3
6 < L < 30	+0.5
30 < L < 120	+0.8
120 < L < 400	+1.2
400 < L < 1000	+2
1000 < L < 2000	+3
2000 < L < 4000	+4

Permissible deviations in dimensions without tolerance indication is shown in table A

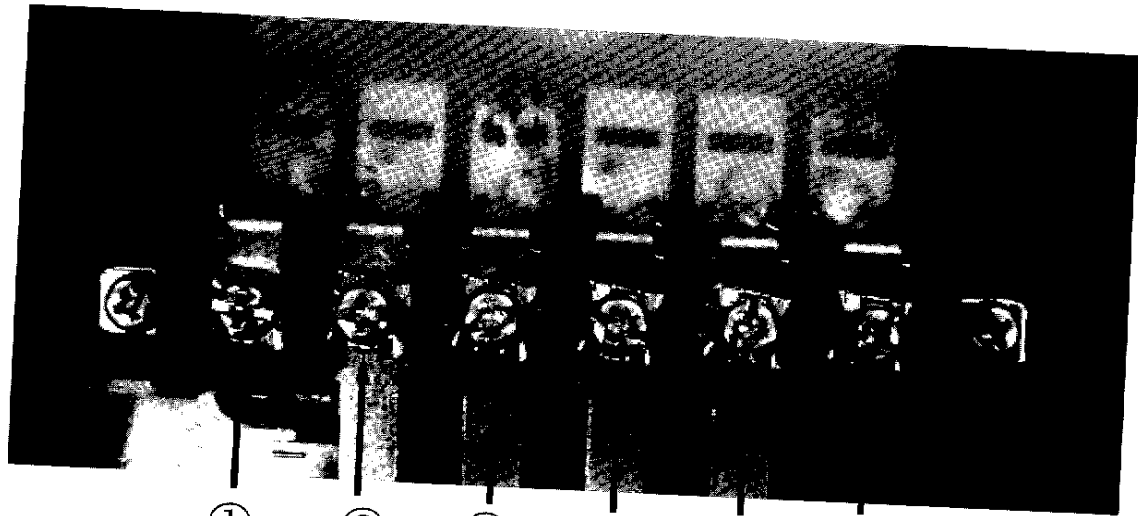


Loosen the two cover screws to open the cover



Remove the appropriate grommets. (Push them from inside of the box)

Figure 2



① ② ③ ④ ⑤ ⑥

①,② : Negative Terminal
③,④ : Diode Connection
⑤,⑥ : Positive Terminal

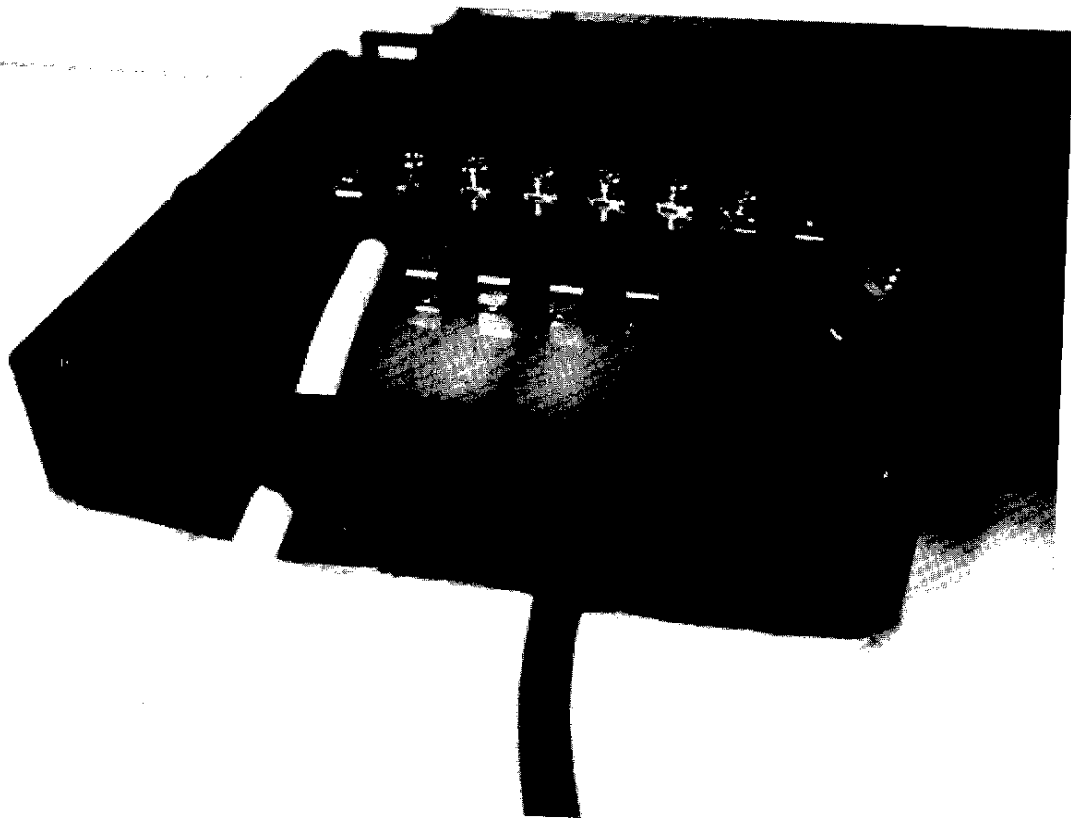


Figure 3

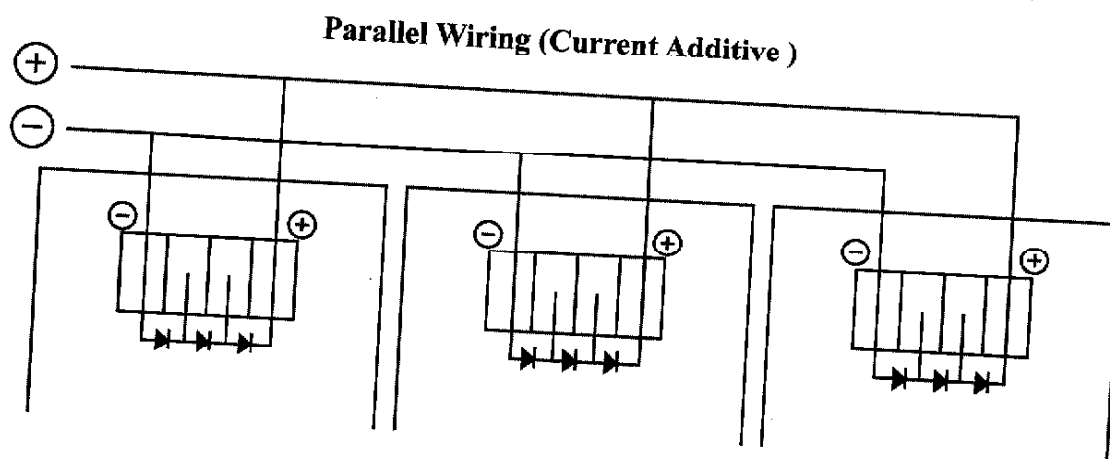
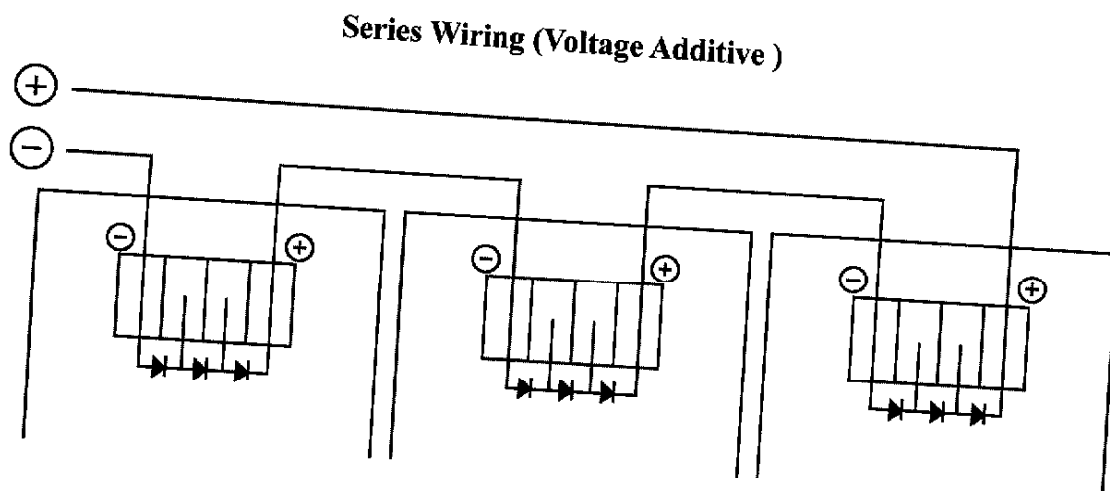


Figure A

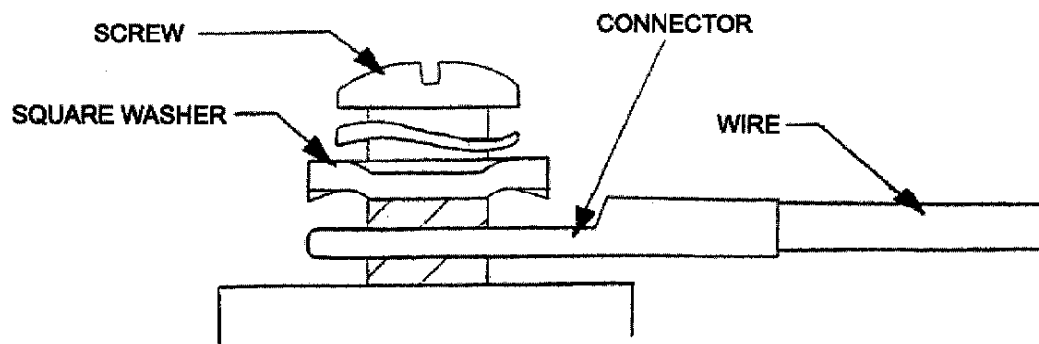


Figure 4

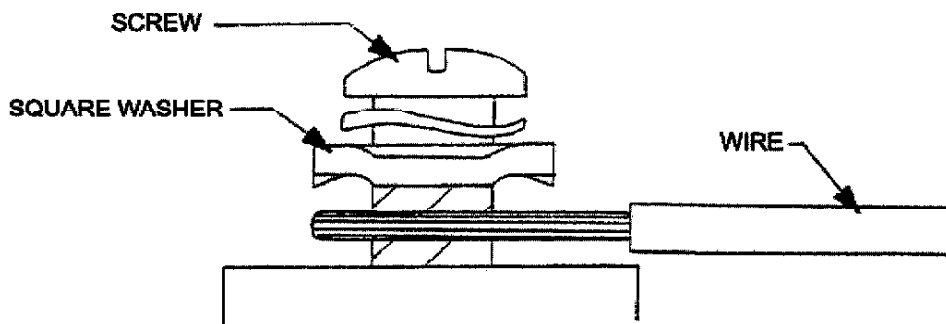


Figure 5

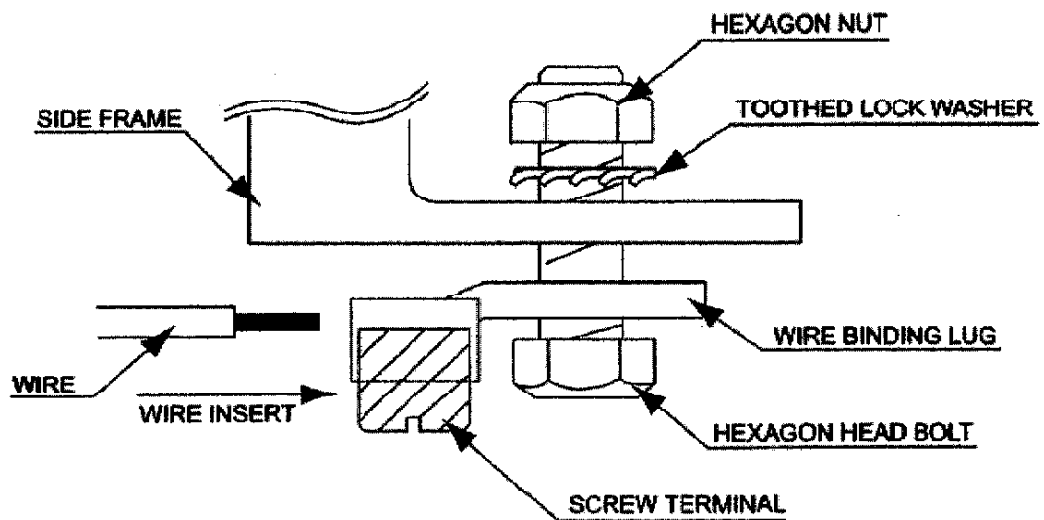
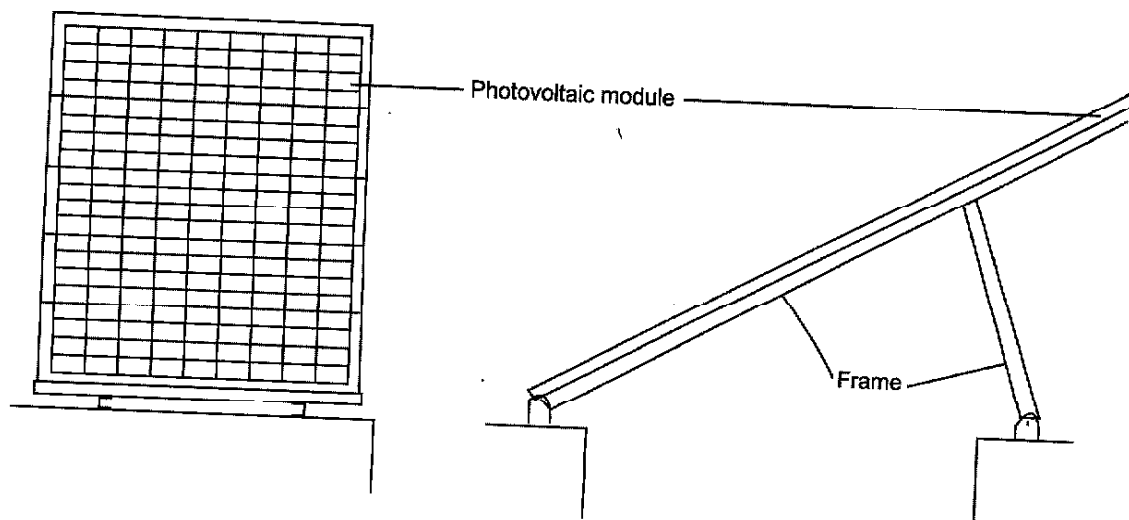


Figure B



Photovoltaic module mounting method

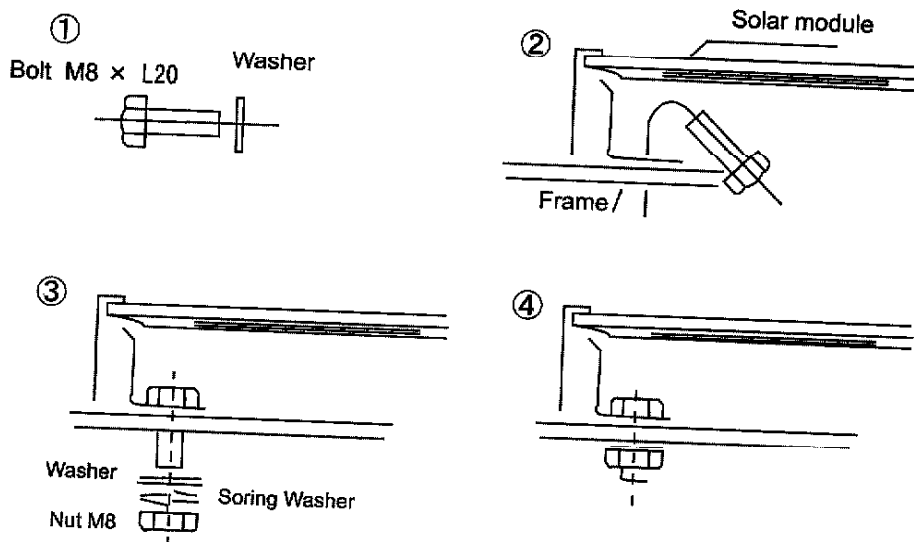


Figure 6

SHARP

PLEASE READ THIS MANUAL COMPLETELY BEFORE INSTALLING OR USING THE MODULES

INSTALLATION MANUAL

PHOTOVOLTAIC MODULE

ND-L3EJE

SHARP CORPORATION

1.INTRODUCTION

This manual contains information of electrical and mechanical installation and safety information which you should know before using photovoltaic module ND-L3EJE.

The information in this manual is described on the basis of Sharp's knowledge and experience. But such information and suggestions do not constitute a warranty.

Sharp Corporation reserves the right to make changes to the product, specifications, or to the manual without prior notice.

2.INSTALLATION

Back view of the module is shown in Fig.1. Each module has six 9.0 mm diameter mounting holes. These are used to fix the modules to supporting structure. For withstanding load 2400Pa, module shall be fastened with 4-C holes with M8 bolts.

The terminal box is shown in Fig.2. When connecting the modules to a battery or to other modules, you must carefully observe correct cable connection polarity as shown Fig.3 and Fig.4. If not connected correctly the bypass diodes could be destroyed. This will void your warranty.

By loosening the two cover screws as shown in Fig.2, open the cover of wiring box. Fig.3 shows the inside of the wiring box. The range of typical terminal cabling is AWG 14. Remove the appropriate grommets and route the interconnecting cables through grommets as shown in Fig.3. To remove the grommets, push them from inside of the box.

To connect wires to terminal block, a wire lug connector may be used as shown in Fig.5. For direct wiring, strip back insulation about 16mm and wrap stripped wire around screw under square washer as shown in Fig.6. Tighten terminal screw securely with a proper screwdriver. After completed terminal wiring, secure the cover of wiring box.

When connecting the modules to a battery or to other modules, you must carefully observe correct cable connection polarity as shown in Fig.4. If not connected correctly, the bypass diode could be destroyed. This will void your warranty.

Each photovoltaic module has a hole in the side frame for installation of a bolt, a nut and washer. The ground wire lug connector can be attached to each photovoltaic module using provided bolts, nut and washer as shown in Fig.7. The ground wire shall be not smaller than No.14 AWG (2.1mm²).

3.MOUNTING STRUCTURE

An example of acceptable mounting structure is shown Fig.8.

4.ELECTRICAL RATINGS

Rated electrical characteristics are within ± 10 percent of the indicated values of I_{sc} , V_{oc} , P_{max} under standard Test Conditions (irradiance of 100 mW/cm², AM 1.5 spectrum, and a cell temperature of 25 °C(77° F)).

The above electrical characteristics are based on the results of out going test. The warranty condition is specified in the warranty card separately issued.

Maximum Power (Pmax)	123.0 W
Open-Circuit Voltage (Voc)	21.3 V
Short-Circuit Current (Isc)	7.90 A
Operating Voltage (Vpmax)	17.2 V
Current at Vpmax (Ipmax)	7.16 A
Maximum System Voltage	600 V
Minimum Bypass diode	15 A
Series Fuse	15 A

The above electrical characteristics are based on the results of out going test.
Please do not expose solar module to sunlight concentrated with mirrors, lenses or similar means.

Under normal conditions, a photovoltaic module may experience conditions that produce more current and/or voltage than reported at Standard Test Conditions.
Accordingly, the values of Isc and Voc marked on UL Listed modules should be multiplied by a factor of 1.25 when determining component voltage ratings, conductor capacities, fuse sizes and size of controls connected to the module output. Refer to Sec. 690-8 of the National Electric Code for an additional multiplying factor of 125 percent (80 percent of rating) which may be applicable.

Please refer to Section 690-8 of the National Electrical Code for an additional multiplying factor of 1.25 which may be applicable.

In the coverage of Canadian UL listing, installation shall be in accordance with CSA C22.1, Safety Standard for Electrical Installations, Canadian Electrical Code, Part 1.

5.CAUTION

- (1) Never touch the end of output cables with bare hands when the module is irradiated. Cover the surface of module by sufficiently thick cloth or something suitable to prevent incident light, and handle the wires with rubber-gloved hands not to receive electric shock.
- (2) Do not wear metallic jewelry which may become cause of electric shock during installation.
- (3) Consult the government office concerned for permit installation and inspection requirement.
- (4) Install modules and ground frames in accordance with applicable law of each country.
- (5) Product should be installed and maintained by qualified personnel.
- (6) Do not drop tools or hard things on the glass of solar module.
- (7) Do not scratch the back film by hard things.
- (8) When part of solar module is shadowed, hot spot may be caused. Therefore do not shadow cells.
- (9) Do not pour chemicals on modules when cleaning.
- (10) Keep modules away from children.

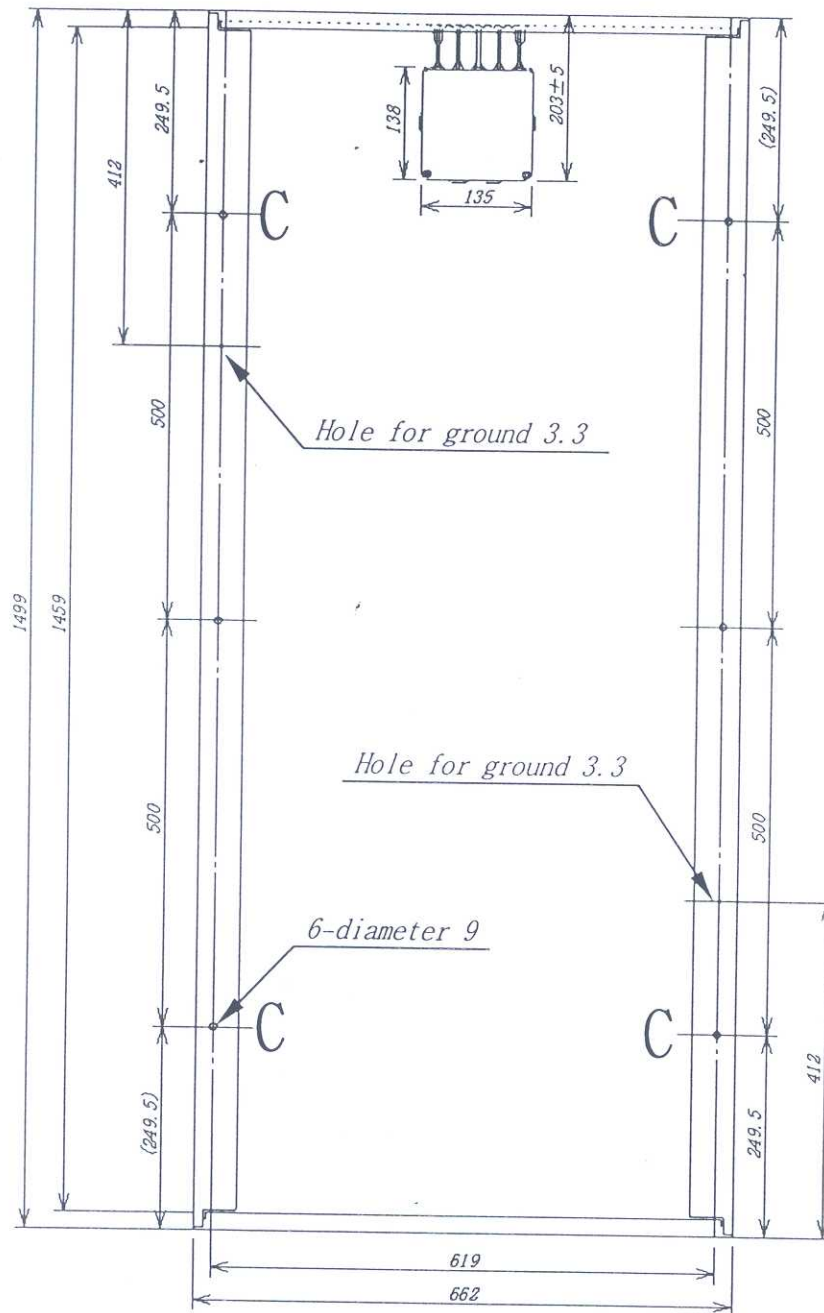
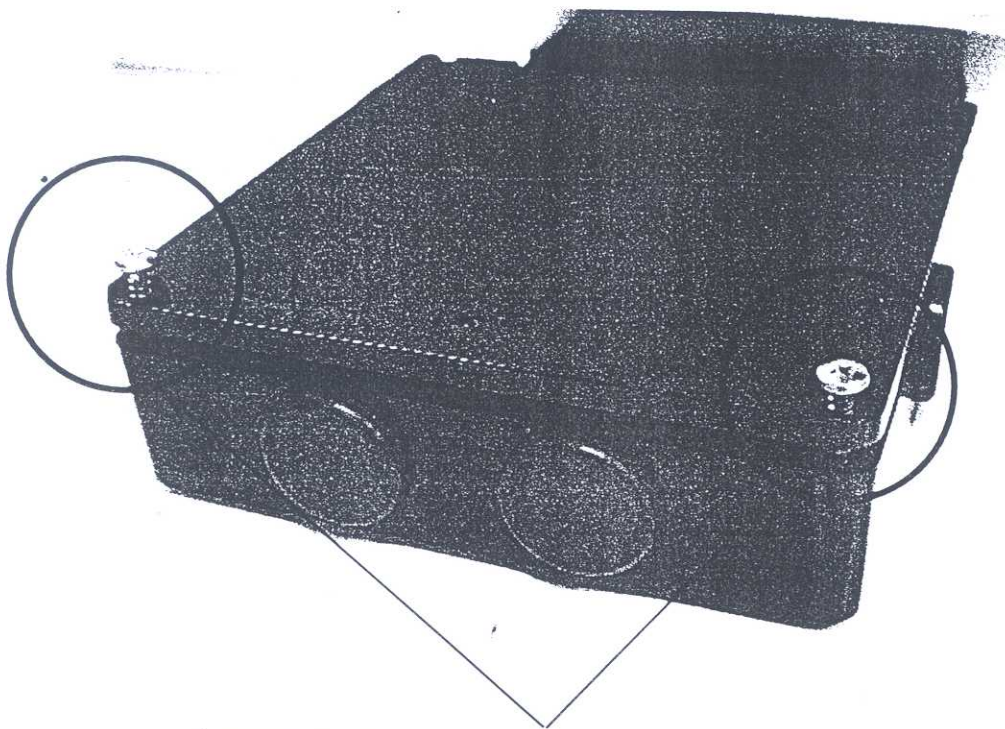


Fig.1

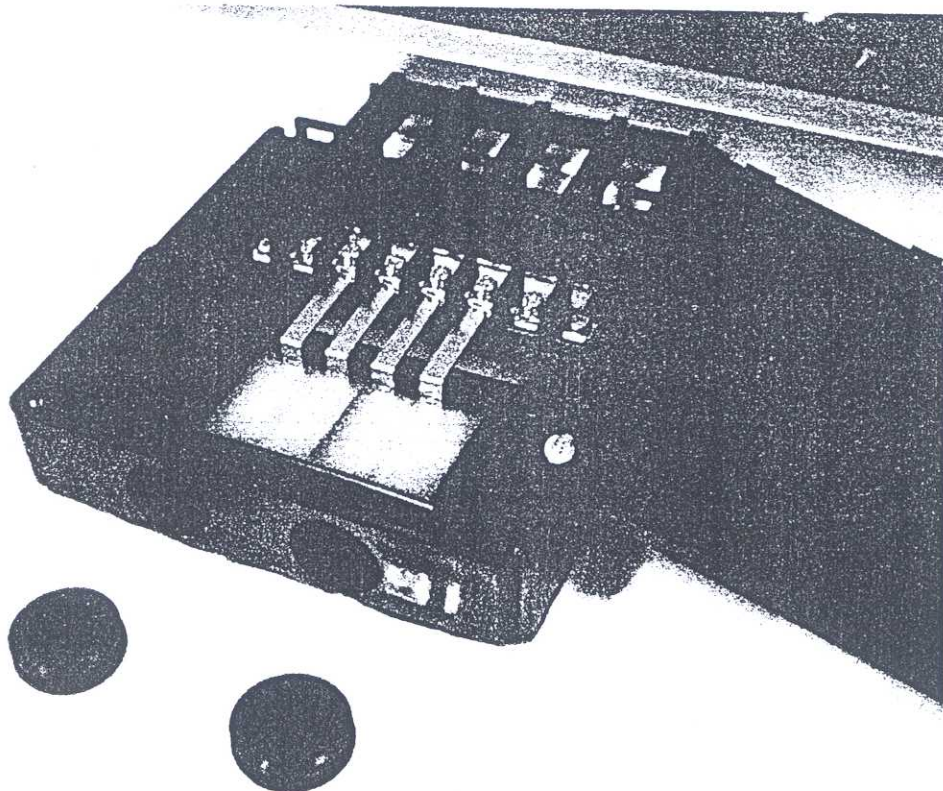
Table A

Dimension ; L	Permissible Deviation
0.5 < L < 3	+0.2
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6 < L < 30	+0.5
30 < L < 120	+0.8
120 < L < 400	+1.2
400 < L < 1000	+2
1000 < L < 2000	+3
2000 < L < 4000	+4

Permissible deviations in dimensions without tolerance indication is shown in table A

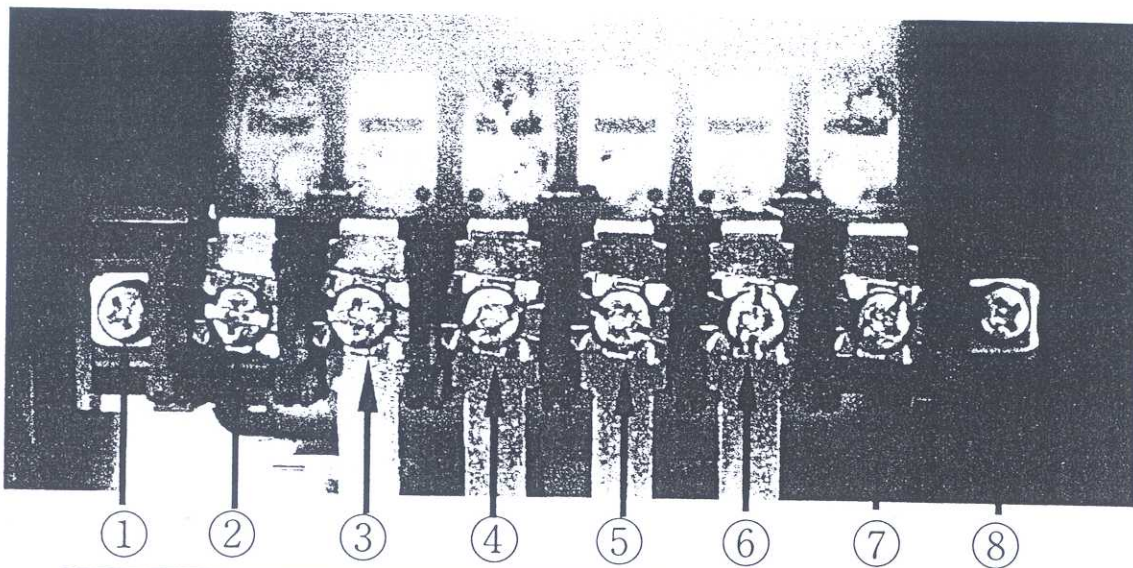


Loosen the two cover screws to open the cover.



Remove the appropriate grommets. (Push them from inside of the box)

Fig.2



②,③ : Negative Terminal ④,⑤ : Diode Connection

⑥,⑦ : Positive Terminal

※①,⑧ are just for fixing the terminal block to the box.

So, do not connect any cable to ①,⑧terminal.

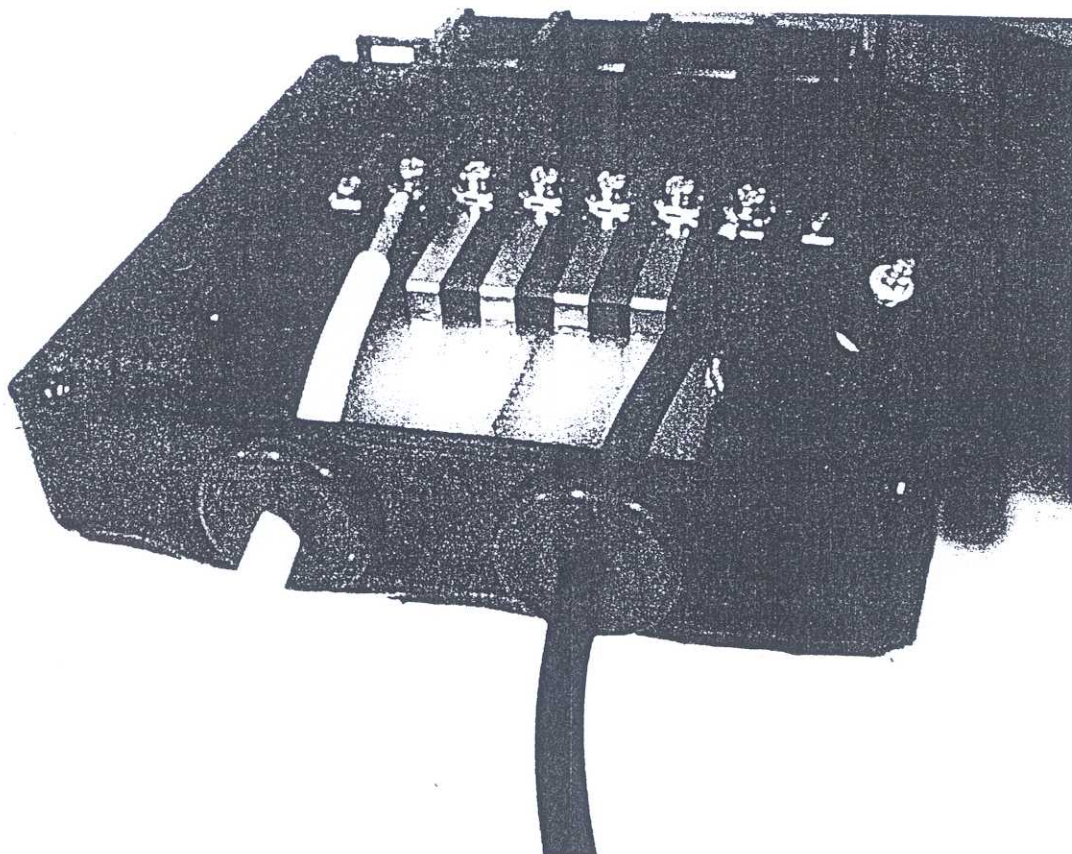


Fig.3

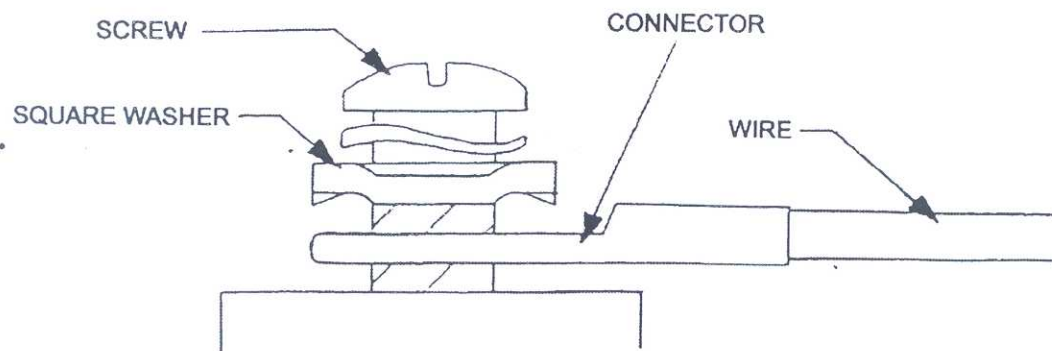


Fig.5

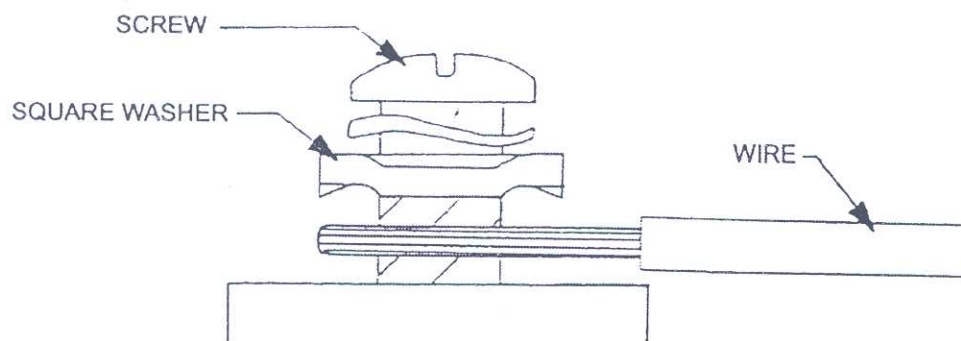


Fig.6

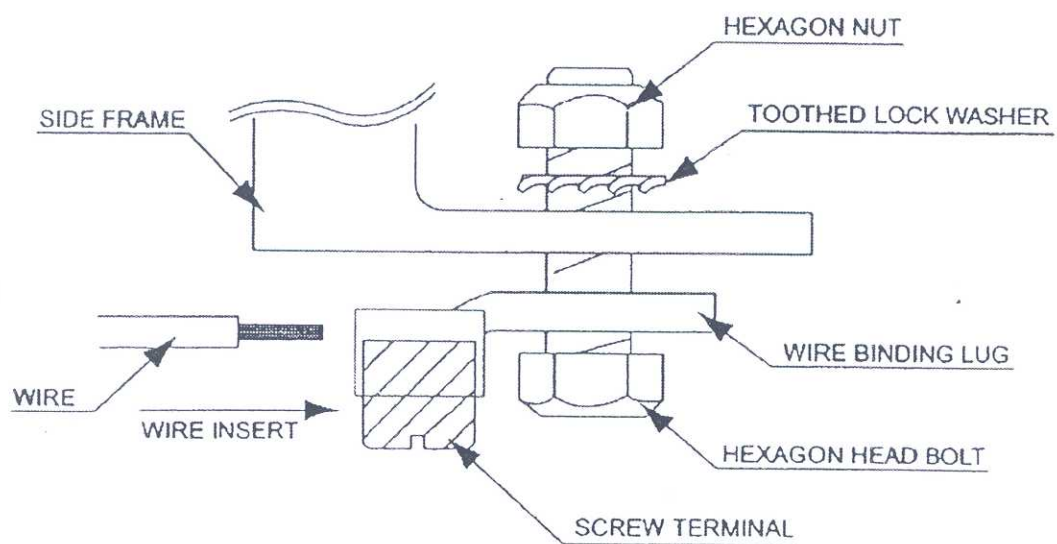
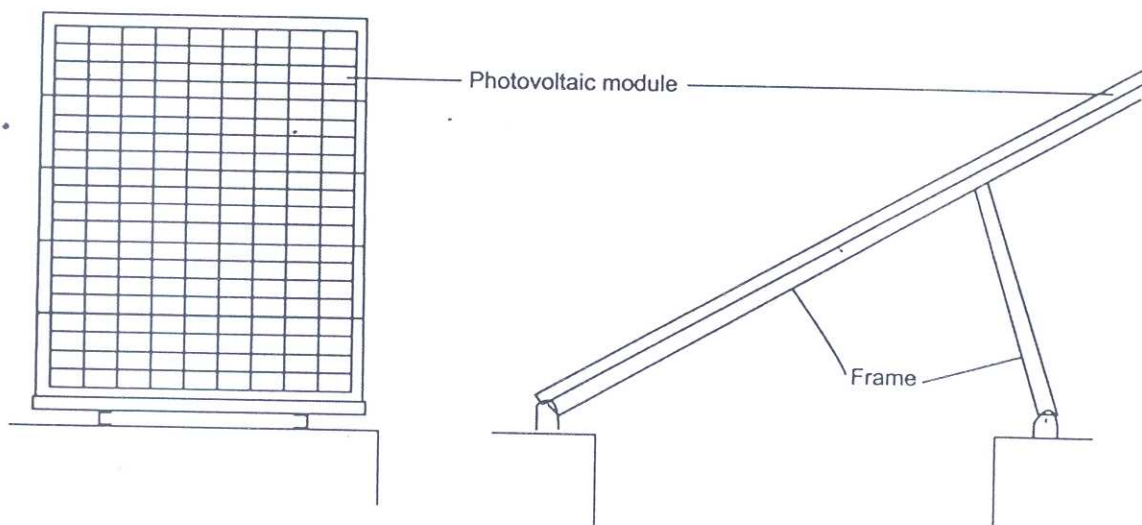


Fig.7



Photovoltaic module mounting method

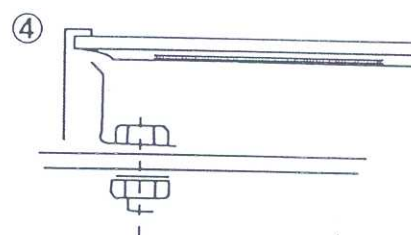
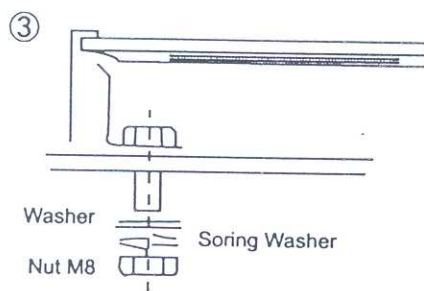
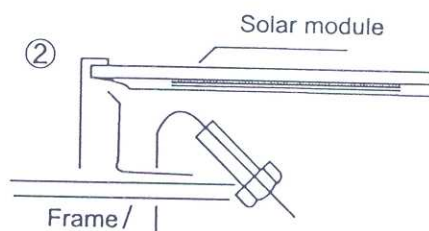
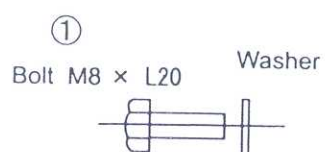



Fig.8



PROGRESSIVE DYNAMICS, INC.

The Source of Bright Ideas Since 1964!

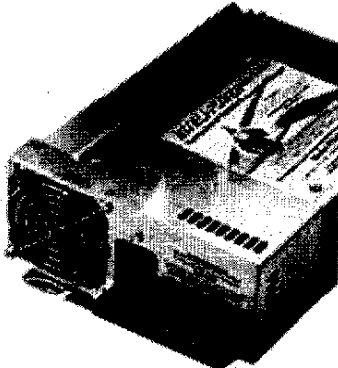
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PD9280

80 Amp RV Converter/Charger

The **PD9280**, 80 amp power converter is designed to provide reliable filtered DC power to all recreational vehicle 12-volt lighting and appliance circuits. The **PD9280** converter also provides safe and rapid recharging of RV batteries. Built-in features such as electronic current limiting, reverse battery protection, high voltage protection, low voltage operation, and over temperature shut down ensure long term reliability. The built-in Charge Wizard is a microprocessor-controlled system that constantly monitors the battery voltage and ensures a rapid; yet, safe, recharge. The Charge Wizard can select one of three charging



voltages and one of four operating modes depending on the condition and battery. The built-in Accessory Port makes it easy to add the Converter Status Remote Pendant that shows the charger/converter status.

Specifications

Input:	105-130 VAC, 1,300 Watts
Output:	13.6 VDC, 80 Amps
Dimensions:	3.6" x 11.5" x 9"
Weight:	7.5 lbs.

Features

- Built-in Charge Wizard.
- Reverse Battery Protection.
- Delivers filtered DC power to all 12 Volt lighting and appliance circuit providing safe and reliable service.
- Electronic Current Limiting.
- Low line Voltage Protection.
- Variable speed intelligent Cooling Fan.
- High Voltage Protection.
- Automatic thermal shutdown.
- Built-in accessory port for the Converter Status Remote Pendant.


- 2 year limited warranty.

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The Source of Bright Ideas Since 1964!

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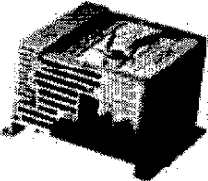
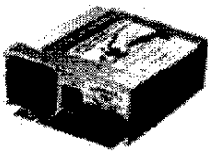

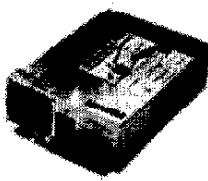

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PD9200 Series RV Power Converters

<p><u>PD9245C (45 Amp)</u></p> 	<p><u>PD9260C (60 Amp)</u></p> 
<p><u>PD9270 (70 Amp)</u></p> 	<p><u>PD9280 (80 Amp)</u></p> 
<p><u>PD92201 Converter Status Remote Pendant</u></p> 	

Patent # 6,184,649

The Progressive Dynamics 9200 Series INTELI-POWER converters are UL listed for the I They provide safe, reliable, filtered DC power to all Recreational Vehicle 12-Volt lighting and The Intelli-Power converter also safely recharges and maintains the RV battery and has a two warranty.



The built-in Charge Wizard is a microprocessor-controller that constantly monitors voltage to determine if the battery requires a quick recharge, is fully charged and fully charged and is in storage. The Charge Wizard then selects one of four opera (Boost, Normal, Storage, or Desulfation) to properly re-charge or maintain the bat for more information on the Charge Wizard.

Patent #'s: 6,184,640- 5,600,650- 5,687,066- 5,982,643

INTELI-POWER 9200 SERIES OPERATION

Progressive Dynamics 9200 Series Electronic Power Converters have several features that electronic power converters presently marketed to the RV industry. Reliability data over the past 10 years over 400,000 units in the field have proven that these design features increase our reliability and provide the following additional customer benefits.

1. ELECTRONIC CURRENT LIMITING – This safety feature will rapidly reduce the output current in the event of an electrical short or overload condition. This rapid shutdown like the circuit breaker in your home prevents possible RV wiring and converter damage. The converter automatically returns to normal operation once the short or overload is corrected.

2. VARIABLE SPEED INTELLIGENT COOLING FAN – Solid state temperature sensing and control automatically monitors converter temperature and activates the fan at speed required. Variable speed fans are used when demand is low, such as during sleeping hours. Some competitive converters use mechanical devices to provide temperature sensing and fan control. Electro-mechanical sensors are subject to failure and may stick in the closed mode causing the fan to operate all the time, resulting in irritating noise. They can also fail to close during high temperature conditions and prevent the converter from operating. This failure may cause over heating and possible converter failure.

3. AUTOMATIC THERMAL SHUTDOWN – This safety feature will shut the converter down in the event of a fan failure and prevent damage to the converter. This safety feature will also activate if the location where the converter is mounted is too small, has inadequate ventilation, or is accidentally covered by the customer. This Automatic Thermal Shutdown turns the converter off when unit temperature exceeds 140 degrees F. Please refer to the installation instructions for information regarding spacing and ventilation requirements.

4. LOW LINE VOLTAGE PROTECTION – The Progressive Dynamics 9200 Series Converters will operate on low AC line voltages without damage. This feature is especially important in RV campgrounds where line voltage can be as low as 90 volts. Low AC line voltages may damage competitive converters. Low Voltage Protection will automatically shut converter down if input voltage is insufficient. This protects 12-volt appliances from damaging low voltage irregularities. The converter will automatically resume operation when adequate line voltage is available.

5. HIGH VOLTAGE PROTECTION – All converters incorporate our patented High Voltage Sensing. This feature automatically shuts the converter down to protect sensitive electronics in the event of high voltage transients on the AC power line, or if the RV generator regulator should momentarily fail. The converter will automatically return to normal operation when the high voltage transient is corrected.

6. REVERSE BATTERY PROTECTION – Our patented Reverse Battery circuitry prevents incorrect wiring and unnecessary warranty calls in the event the customer or dealer accidentally connects the converter in reverse. Simple replacement of the fuse(s) located on the front of the converter restores the converter to normal operation. Some competitive converters can be damaged and require replacement if the battery is accidentally reversed.

7. BUILT-IN ACCESSORY PORT – All PD9200 Series Power Converters incorporate an accessory port for the optional Converter Status Remote Pendant which is used to monitor the Charge Wizard and

Inteli-Power Specifications Table

	PD9245C	PD9260C	PD9270
Maximum DC Output Current	45-AMPS	60-AMPS	70-AMPS
Maximum Continuous Input Power	725 WATTS	1,000 WATTS	1,250 WATTS
No Load DC Output Voltage	13.6 VDC	13.6 VDC	13.6 VDC
No Load Voltage Tolerance	+/- .3 VDC	+/- .3 VDC	+/- .3 VDC
Full Load Output Voltage	> 12.6 VDC	> 12.6 VDC	> 12.6 VDC

Ripple and Noise Voltage	<50 MV RMS	<50 MV RMS	<50 MV RMS
Input Voltage Tolerance	105 - 130 VAC	105 - 130 VAC	105 - 130 VAC
Input Voltage Frequency	50-60 HZ	50-60 HZ	50-60 HZ
Peak Inrush Current	32-AMPS	47-AMPS	47-AMPS
Efficiency (Typical)	> 80%	> 80%	> 80%
Reverse Battery Protection	YES	YES	YES
Electronic Current Limiting	YES	YES	YES
Variable speed Intelligent Cooling Fan *	Auto-speed	Auto-speed	Auto-speed
Back Up Thermal Protection	YES	YES	YES
Storage Temperature	20-80C	20-80C	20-80C
Operating Temperature	0-50C	0-50C	0-50C
Hipot Voltage Test	<----- 1240 V @ INPUT TERMINALS ----->		
Accessory Port for optional Pendant**	Standard	Standard	Standard
Weight	4.5 LBS.	5.8 LBS.	5.8 LBS.
Dimensions	8.25"L X 7.25"W X 4.5"H	8"L X 9.00"W X 3.6"H	8"L X 9.00"W X 3.6"H
UL & c UL Listed	YES	YES	YES

* Fan speed automatically controlled according to converter temperature.

** Allows the customer to easily install the optional Pendant to monitor the built-in Charge Wizard and also allows manual n

[Click Here: For More Information Regarding Power Converters](#)

[View The Inteli-Power PD9200 Series Owners Manual \(PDF\)](#)

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FEATURES	BENEFITS
• High density oxide paste...	• Produces more energy per pound.
• Integrated "twist-and-release" vent cap "quick fill" system...	• Releases vent caps in single motion design, making maintenance a snap. Leakproof design.
• Ergonomic lift handles...	• Reduces the risk of slippage. Designed for easier installation.
• Heavier grids and plates...	• Provides longer cycle life, better added value.
• Thicker plate straps...	• Lowers resistance, delivers better performance, longer life.
• Heavy-duty, bulge-resistant polypropylene casing material...	• Stabilizes and protects the groups for longer battery life. Resists bulging.
• Case heat sealed to the cover...	• Ensures leakproof design.
• Through-partition connectors...	• Decreases internal resistance, increasing power.
• Computer-controlled production...	• Assures that grid casting, plate pasting, curing, and formation meet rigid quality specifications.
• Glass mat, dual-insulation, "deep pocket" envelope separators...	• Protects plates and locks active material to the grid to retard shedding and prevent shorts. Glass fibers strengthen plate.
• Three terminal configurations...	• Fits virtually any application.
• Over 250 quality control checks...	• Assures the highest quality.

NEW PART NO.		COLOR CODE COVER/ CASE	TERMINAL	FOOT NOTES	20 A.H. RATE ≈	6 A.H. RATE ≈	MINS. OF DISCH. @ 75 AMPS	VOLTS	QUARTS (LITERS) OF ACID	APPROXIMATE WEIGHT lbs. (kgs.)		MAXIMUM OVERALL DIMENSIONS inches (mm)			OLD PART NO.
WET	DRY									WET	DRY	L	W	H	
GOLF CAR															
GC10	—	BB	T872	• O ^	190	156	100	6	—	59 (26.8)	—	10 1/4" (260)	7 1/4" (181)	11 1/4" (289)	7GCS
GC10G	—	BB	T881	• G ^	190	156	100	6	—	59 (26.8)	—			10 1/4" (276)	7G
GC10P	—	BB	TSAE	• S ^	190	156	100	6	—	59 (26.8)	—			10 1/4" (270)	7GCA
GC15	—	CC	T872	• O ^	215	178	115	6	—	63 (28.6)	—			11 1/4" (289)	9GCS
GC15G	GC15GD	CC	T881	• G ^	215	178	115	6	6 1/2" (6.1)	63 (28.6)	44 (19.9)			10 1/4" (276)	9G / 9GD
GC15P	—	CC	TSAE	• S ^	215	178	115	6	—	63 (28.6)	—			10 1/4" (270)	9GCA
GCSTRAP Golf Car Strap Handle when ordered individually. One strap shipped per full pallet of 6-volt golf car batteries.															
For gas engine golf cars:															
426G	—	BB	T881	+GHM	530CA	425CCA	60RC	12	—	26 (11.8)	—	8 1/4" (225)	6 1/4" (171)	8 1/4" (213)	

Vent Cap Information: All batteries are shipped with quick release one-quarter turn gang vent caps. To order individual vent caps on batteries, add a "V" suffix i.e., GC10GV, GC15V, etc.

All batteries are wet except the GC15GD.

All above types have microporous polyethylene envelope separators with glass mat (except 424/26G).

424/26G battery has microporous, polyethylene envelope separators.

All batteries manufactured in polypropylene cases.

All ratings conform to B.C.I. specifications.

Dry = Up to 10% reduced capacity.

≈ Nominal Rating

COLOR CODE:

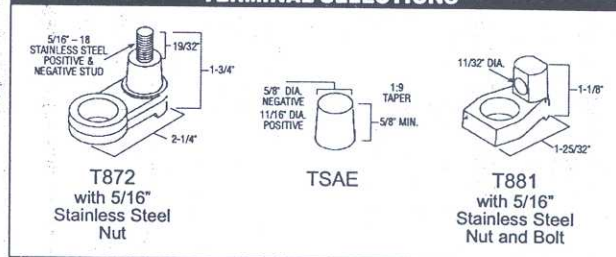
First letter indicates COVER, second letter indicates CASE.

B - Black C - Charcoal Gray

FOOTNOTES:

- - Low maintenance - Low antimony grids
- G - Maintenance-free calcium grids
- + - Offset post w/ horizontal hole, stainless steel 5/16" bolt and hex nut - T881
- H - Includes a handle
- M - Flush manifold vented cover
- O - Offset post w/ vertical stainless steel 5/16" stud and hex nut - T872
- S - SAE "automotive type" post - TSAE
- ^ - Ratings after 15 cycles

TERMINAL SELECTIONS



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ALWAYS WEAR EYE PROTECTION WHEN WORKING AROUND BATTERIES!

SCRUBBER/SWEEPER/GOLF CAR BATTERY MAINTENANCE INSTRUCTIONS

BE CAREFUL!

WARNING: Batteries produce explosive gases. Keep sparks, flames and cigarettes away from batteries at all times. Protect your eyes at all times. Never lean over battery when jump starting or performing other maintenance.

California Proposition 65 Warning: Battery posts, terminals and related accessories contain lead and lead compounds, and other chemicals known to the State of California to cause cancer and birth defects or other reproductive harm. Wash hands after handling.

⚠ DANGER/POISON



KEEP OUT OF THE REACH OF CHILDREN.
DO NOT TIP. KEEP VENT CAPS TIGHT AND LEVEL.
DO NOT OPEN FLUSH COVER BATTERIES.

MAINTENANCE - CHARGING INSTRUCTIONS

1. After the equipment has been in service, and before placing on charge, check the water level of the batteries. If the level is below the separators at the start of charge, add only enough water to cover the separators.
2. Always check specific gravity and temperature readings before charging batteries. Correct specific gravity readings to 80°F (27°C).
3. If an automatic or taper-type charger is used, set the rate of charge according to the manufacturer's instructions.
4. **DO NOT OVER-CHARGE — DO NOT UNDER-CHARGE**
If the battery temperature reaches 125°F (52°C) during the charging cycle, the rate should be lowered or the charge interrupted until battery has cooled to room temperature. Specific gravity readings should be corrected to 80°F (27°C). For each 10 degrees above 80°F (27°C), add four points to the hydrometer reading, i.e., 90°F (32°C) at 1.250 Sp. Gr. = 1.254 Sp. Gr. For each 10 degrees below 80°F (27°C), subtract four points from the hydrometer reading, i.e., 70°F (21°C) at 1.250 Sp. Gr. = 1.246 Sp. Gr.
5. Before charging, be sure that the electrolyte covers the top of the plates. If not, add approved water to bring level to the top of plates. **DO NOT OVERFILL**, as the electrolyte will expand during charging. Always replace vent caps before charging. After charging follow step 6.
6. **DO NOT OVERFILL — DO NOT UNDERFILL**
Fill each cell to approximately 1/8" below the bottom of the extended vent tube. Overfilling the cells when adding water results in loss of electrolyte, lowering specific gravity and ampere hour capacity. **NOTE:** Never add acid to a battery. Use only approved water.
7. Keep battery tops dry and clean.
A moist condition will result in electrical leakage across the battery to the metal hold-down, causing a corrosion buildup on hold-down and terminal connections.
 - a. With vent caps firmly in place, periodically clean battery tops, hold-down and terminal connections with a baking soda solution and brush. Flush with clear water. Dry off thoroughly.
 - b. Check all terminals and tighten firmly. Apply a thin coating of petroleum jelly to retard corrosion.
8. Never allow batteries to stand in a discharged condition. After each use, no matter how short, batteries should be fully charged.
9. If batteries do not come up to full charge, after following the charger manufacturer's instructions, check for low line voltage and/or a faulty charger. Consult your power company or electrician.
10. If the battery seems weak or slow in performance while in service, make the following checks. Using a hydrometer take specific gravity readings of all cells. If specific gravity readings are above 1.225, apply a load test to each individual battery using a load tester according to the manufacturer's instructions. If a battery proves unserviceable, it should be replaced. (Do not apply tester if cell readings are below 1.225 specific gravity.)
11. All batteries in the equipment should be approximately the same age.
12. If the temperature of the batteries or the outside temperature is below 60°F (15°C), their capacity will be reduced and they will require more hours of charge. The colder the batteries are, the faster they will build up in voltage and reduce the charging rate.

OFF-DUTY STORAGE

1. Batteries that are not in service during the off-duty period must be cared for as follows:
 - a. Keep fully charged.
 - b. Store in cool, dry place with temperatures not below 32°F (0°C) or above 80°F (27°C). (A battery at 1.100 specific gravity will freeze at 19°F (-7°C)).
 - c. It is important that batteries should be charged every 45 days or when specific gravity readings drop to 1.200, corrected to 80°F (27°C).

2. BATTERIES SELF-DISCHARGE WHEN NOT IN USE

- at 100°F (38°C) Discharge Rate = 3 Pts. in Sp. Gr. per day
- at 80°F (27°C) Discharge Rate = 2 Pts. in Sp. Gr. per day
- at 50°F (10°C) Discharge Rate = 1/2 Pts. in Sp. Gr. per day
- at 30°F (-1°C) Discharge Rate = 1/10 Pts. in Sp. Gr. per day

Proper care and maintenance of batteries used in motive power service is the key to maximum performance, long trouble-free life and greatly reduced equipment operating costs.

and lower in the electrolyte as the specific gravity became lower.

Never take a hydrometer reading immediately after water has been added to a cell. The water must be thoroughly mixed with the underlying electrolyte, by charging, before hydrometer readings are reliable. If a reading is being taken immediately after the battery has been subjected to prolonged cranking, it will be higher than the true value. The water formed in the plates during the rapid discharge has not had time to mix with the higher specific gravity above the plates.

Temperature Correction

Hydrometer floats are calibrated to give a true reading at one fixed temperature only. A correction factor must be applied for any specific gravity reading made when the electrolyte temperature is not 80°F (26.7°C). Some standard hydrometers use a reference temperature of 60°F (15.5°C). A temperature correction must be used because the electrolyte will expand and become less dense when heated. The float will sink lower in the less dense solution and give a lower specific gravity reading. The opposite occurs if the electrolyte is cooled. It will shrink in volume, becoming more dense. The float will rise higher and give a false high reading.

Regardless of the reference temperature used as a standard, a correction factor of .004 specific gravity (sometimes referred to as 4 "points of gravity") is used for each 10°F (5.5°C) change in temperature. Four "points of gravity" (.004) are added to the indicated reading each 10°F (5.5°C) increment above 80°F (26.7°C) and four points are subtracted for each 10°F (5.5°C) drop below 80°F (26.7°C). This correction is important at temperature extremes because it can be a substantial value.

The thermometer used should be of the mercury-in-glass type with a scale reading as high as 125°F (52°C). The smaller the bulb the better, but it should not exceed 1" (25mm).

The electrolyte should be drawn in and out of the hydrometer barrel a few times to bring the temperature of the hydrometer float and barrel to that of the electrolyte in the cell.

Fig. 5 illustrates the correction for hydrometer readings when the electrolyte temperature is above or below 80°F (26.7°C). In example No. 1, in cold weather, a dealer might install a partially discharged battery in a car at +20°F (6.7°C). A hydrometer reading of 1.250 would indicate that the battery is almost fully charged. However, when the correction factor is applied,

the true value is only 1.226.

Example No. 2 could be encountered in a battery exposed to the sun in hot weather; also, electrolyte can easily exceed 110°F (43°C) in car service in warm weather. The 1.235 specific gravity reading might indicate too low a state of charge to install in a car or that there is a problem with the electrical system if the battery is in service. However, the true reading of 1.243 may not be unreasonably low depending on the length of storage of the battery or the type of service which it has been experiencing in the car.

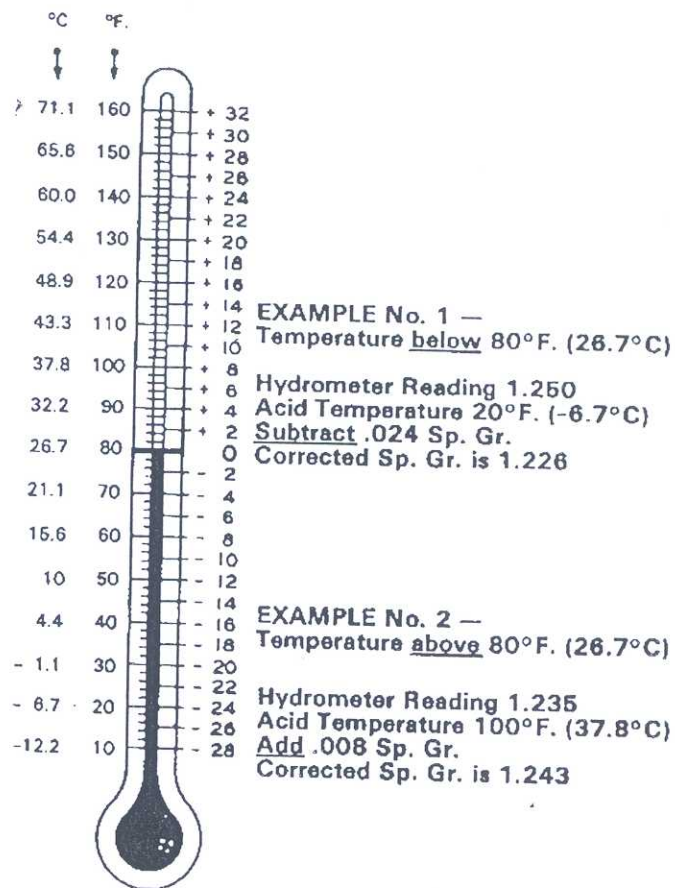


Fig. 5 Thermometer showing °Celsius, ° Fahrenheit and correction factors.

TROPICAL AND ARCTIC CLIMATES

Most batteries used in temperate climates have a fully charged specific gravity in the 1.260 to 1.280 range. A fully charged electrolyte specific gravity of 1.210 to 1.230 is used in tropical climates. A tropical climate is considered one in which water never freezes. The lower strength electrolyte does not deteriorate the separators and grids as fast as a higher specific gravity electrolyte thereby increasing the service life of the battery. However, lower specific gravity decreases the electrical capacity of the battery, especially the Cold Cranking Performance. This loss is offset by the fact that the battery is operating at warm temperatures where it is more efficient and Cold Cranking Performance is not required.

The following chart shows the approximate specific gravity values of batteries at various states of charge. One column shows values for batteries whose electrolyte specific gravity has been prepared for use in a temperate climate; the other column is for batteries prepared for use in a tropical climate. The chart illustrates that batteries may be fully charged and yet have different values of specific gravity. The values shown are for a cell in various states of charge with respect to its ability to crank an engine at 80°F (26.7°C). The specific gravity values shown will vary depending on the ratio of electrolyte volume to active material and the battery construction.

STATE OF CHARGE	*SPECIFIC GRAVITY USED IN TEMPERATE CLIMATES	SPECIFIC GRAVITY AS USED IN TROPICAL CLIMATES
Fully Charged	1.265	1.225
75% Charged	1.225	1.185
50% Charged	1.190	1.150
25% Charged	1.155	1.115
Discharged	1.120	1.080

* This table assumes a fully charged specific gravity of 1.265. See **bolded statement in ELECTROLYTE AND SPECIFIC GRAVITY** section on page 6.

Batteries prepared for service in extremely cold weather use a higher specific gravity electrolyte. In some instances specific gravities of 1.290 to 1.300 are used. The Cold Cranking Performance increases as the specific gravity is increased until a value around 1.300 is reached. It should be noted that

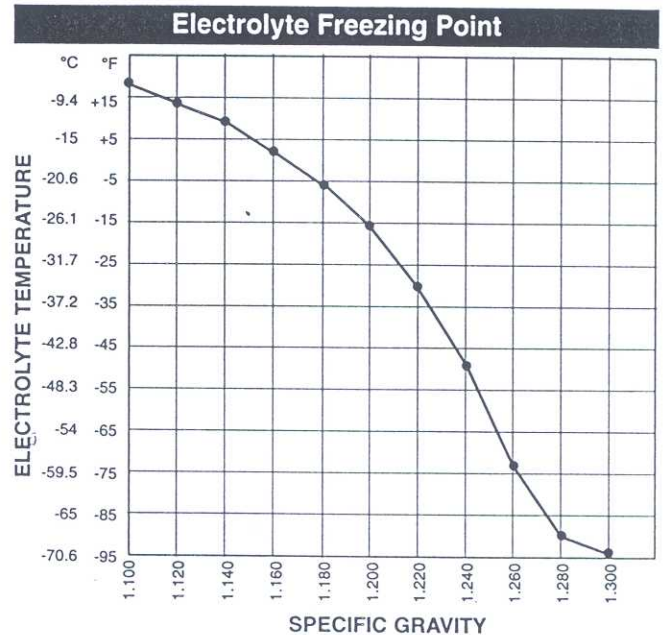


Fig. 6

higher specific gravities decrease the service life of a battery.

As a battery approaches the discharged state, the easier it becomes for the electrolyte to freeze. However, a fully charged battery can be stored at subfreezing temperatures without freezing the electrolyte. The self-discharge rate of the battery at sub-freezing temperatures is so low that it will not require a recharge for many months.

Fig. 6 shows the approximate freezing points of electrolyte at various specific gravities.

