Installation Manual
for
Solar Powered
Assembly
Panel p/n 502598SW

"Helping Kids Get To School Since 1987"

RTC Manufacturing, Inc.
1016 Enterprise Place * Arlington, TX 76001
www.rtc-traffic.com
(817) 860-1217

Theory of Operation Manual for Solar Powered Assembly Panel p/n 502598SW

Operational Theory

Theory of Operation
502598SW

The Cabinet's System Components
The cabinet system is composed of a timer, flasher circuit board, voltage regulator, solar panel, and one battery.

The Protection Elements
The voltage regulator plays a major role in the system as it controls the power supply and loads.
The voltage regulator is connected through the flasher circuit board which provides fuses for the solar array, battery, and load connections. It prevents over charging and over discharging of the battery which reduces its lifetime. During normal operation the load will be disconnected when the battery voltage is discharged to 11.5 volts or below and the load will be reconnected when the battery is recharged to 12.6 volts. The voltage regulator regulates the charging voltage to 14.1 volts for sealed batteries.

The Operational Elements
The system contains a 12 volt battery that serves as the power supply. When the battery is discharged, the solar array converts solar energy into electrical energy to charge the 12 volt battery. The voltage regulator has a charging LED which is ON when daylight is present and the solar array is functional. The LED is OFF during nightfall or when the solar array wiring fails. In addition, the load disconnect LED is OFF during normal operation and it will be ON when the load is disconnected. Under normal operations, when the timer is enabled, the timer provides power to the flasher circuit to operate the loads for flashing operations. The flasher circuit board serves as the system interface as it connects all components that operate the system.

System Overview

A solar flasher assembly consists of a battery or batteries that supply power for a specified load (flashing indications).
The batteries are recharged by a solar panel or several solar panels grouped together.

Three things must be known to design (or size) a solar flasher assembly:	
1. LOAD SIZE:	Total wattage of load.
2. HOURS:	How many hours per day, days per week the load will be operating.
3. LOCATION:	The region of country determines the “Full Sunlight Hours” per winter day.

“Battery Back-up. This is the number of days the flasher will operate without any sunlight before failing. (7 to 10 days average unless otherwise specified, 24 hour systems 10 to 14 days)
Battery Reserve: The battery ampere hours remaining after normal cycle of use. (RTC designs to 0.8 battery reserve per winter day sunlight)

NOTE: System calculation of back-up days and battery reserve differ between suppliers.

If the load or operating hours are increased, failure may occur.

SOLAR PANELS: 12 volt traffic flasher system solar panels supply 16 to 21+ volts to the solar controller (regulator). To read solar panel voltage, carefully remove solar panel wires from the control panel terminals, then measure voltage.
Each watt of a solar panel will produce approximately 0.05744 amperes. The watt to ampere output varies between solar panel sizes and manufacturers.

BATTERY: A battery is completely discharged at 10.5 volts. A battery must be fully charged before being load tested. A gel cell battery can be damaged if charged with a battery charger that does not have temperature sensing. In a multi-battery system, if one battery in a system fails, all the batteries must be replaced at the same time. Older batteries have higher internal resistance to charging. A new battery that is paired with an old battery will be overcharged when charged and will have a slightly higher discharge rate than the older battery. The new battery is overcharged and over discharged until it is brought down to the same level (condition) as the older battery.
A battery that is never allowed to fully recharge before the next discharge cycle is reached will be prematurely destroyed.

LED OPERATION: Some LEDs are polarity sensitive. The DCF2 flasher breaks the negative side of the 12 volts. Fl 1 and Fl 2 are connections for the LED negative wires. The LED positive wires should be connected to “LOAD” connections.

LOAD DISCONNECT: See regulator manual or instruction sheet for exact load disconnect method.

WARNING : Avoid Regulator Error
Follow wiring steps

New Install

* First connect wires from the battery to control panel's "BATTERY" terminals.
  When "landing" the wires to the terminal screws, the less the wiggling and momentary loss of contact, the better in avoiding regulator errors.
*Second connect wires from the solar panel to the control panel's "SOLAR" terminals.
*Last connect wires from the field to appropriate terminal positions.

When changing out the battery

*First remove the solar wiring from the control panel's "SOLAR" terminals.
*Second remove battery wiring from the control panel's "BATTERY" terminals.
  When removing the wires from the terminal screws, the less the wiggling and momentary contacting, the better in avoiding regulator errors.

Connections after battery change out

*First connect wires from the battery to the control panel's "BATTERY" terminal.
*Second connect wires from the solar panel to the control panel's "SOLAR" terminals.

The solar regulator is powered by the battery.

Battery power must be present for the solar regulator to operate correctly.

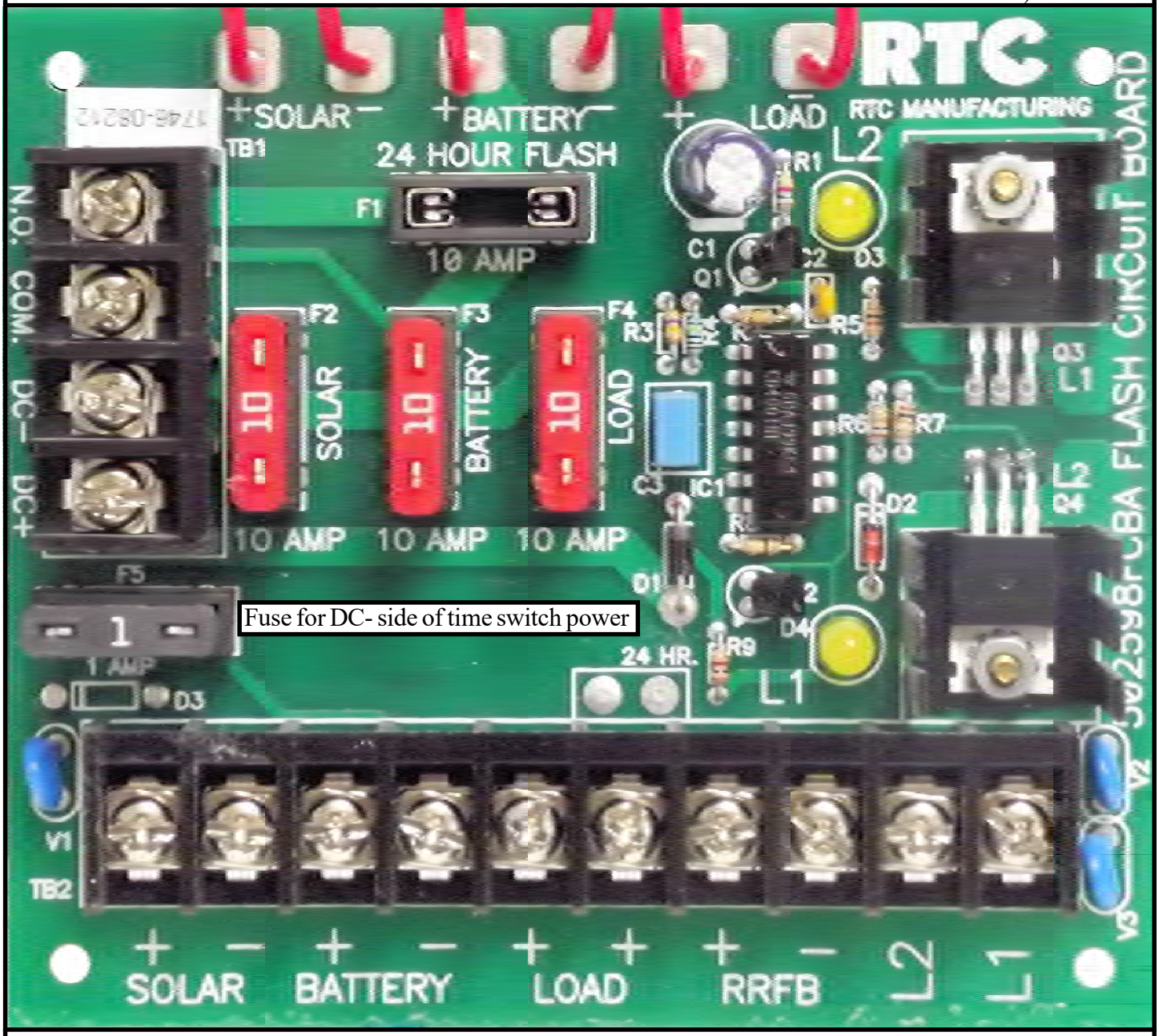
NOTE: If the solar regulator is not disconnected during battery change out, arcing will occur that may cause the regulator's micro-processor to error.

This unit may come with glass fuses or atuomative type fuses.

502598FCBA (Flasher Circuit Board Automotive Fuses)

Serial number 1746- 08212 (17 yr, 46 week, 08212 one made)

24 HOUR FLASH fuse mount-insert a fuse to have override flash)



500441 Fuse AT0F 10 AMP
500441-1 1 AMP
500441-20 (20 AMP used for higher wattage systems)

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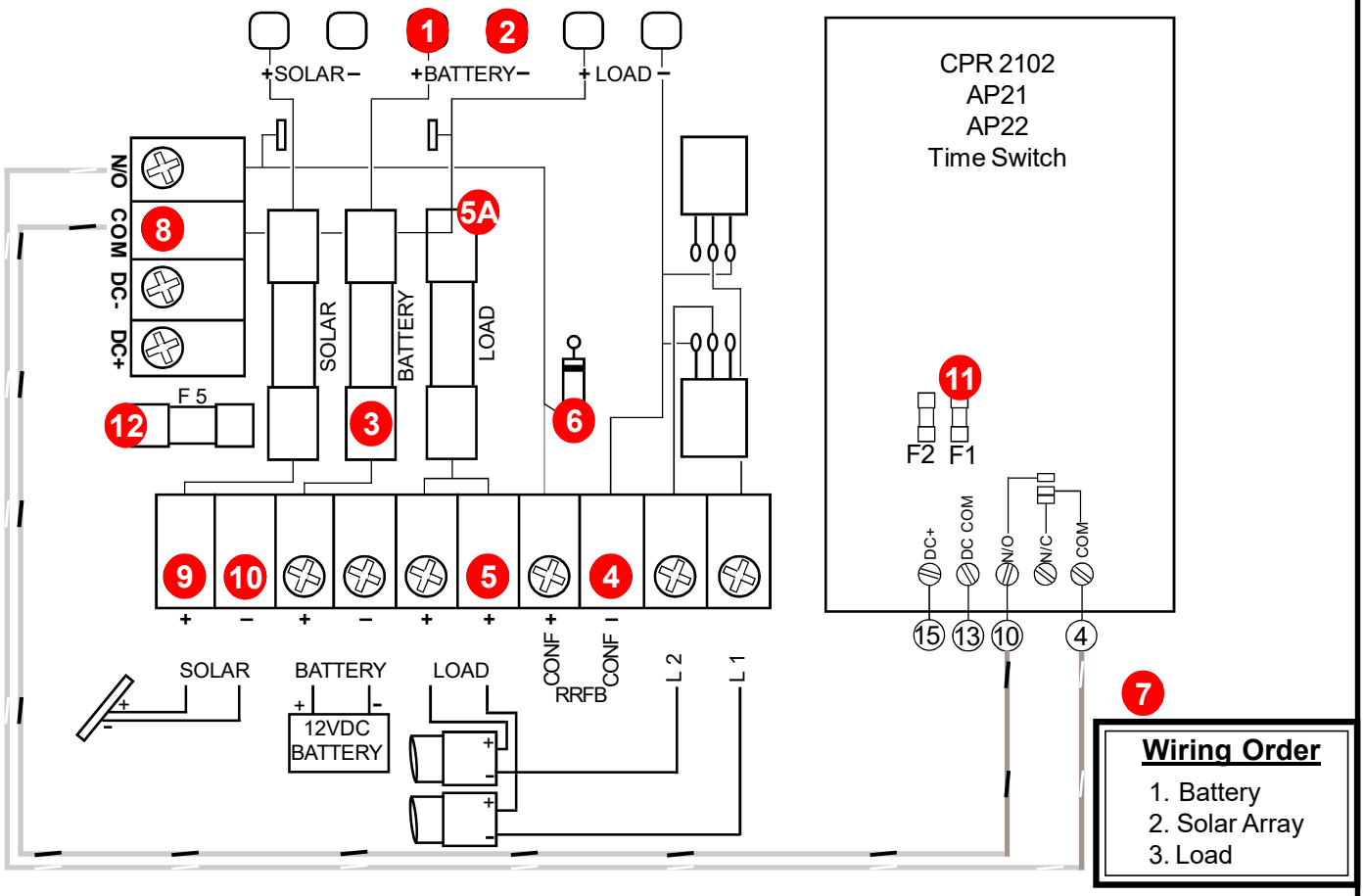
Troubleshooting Test Points 502598FCB Version 98-011C for the 502598SW & 502598LCB Panels

See Page 6 Warning on wiring control panel



1 **2** Measure battery voltage- 12.6 or greater. If no voltage- check battery side of fuse. **2** **3** Battery voltage should be 12.6 to 13.2 -13.8

4 **5** Measure LOAD + & -, will read near battery voltage. No voltage: check fuse at - **5A** Fuse good, no voltage; load may be disconnected by regulator. Morningstar "opens" the positive side / Stecca unit "opens" negative side. Refer to regulator quick ref. or manual.

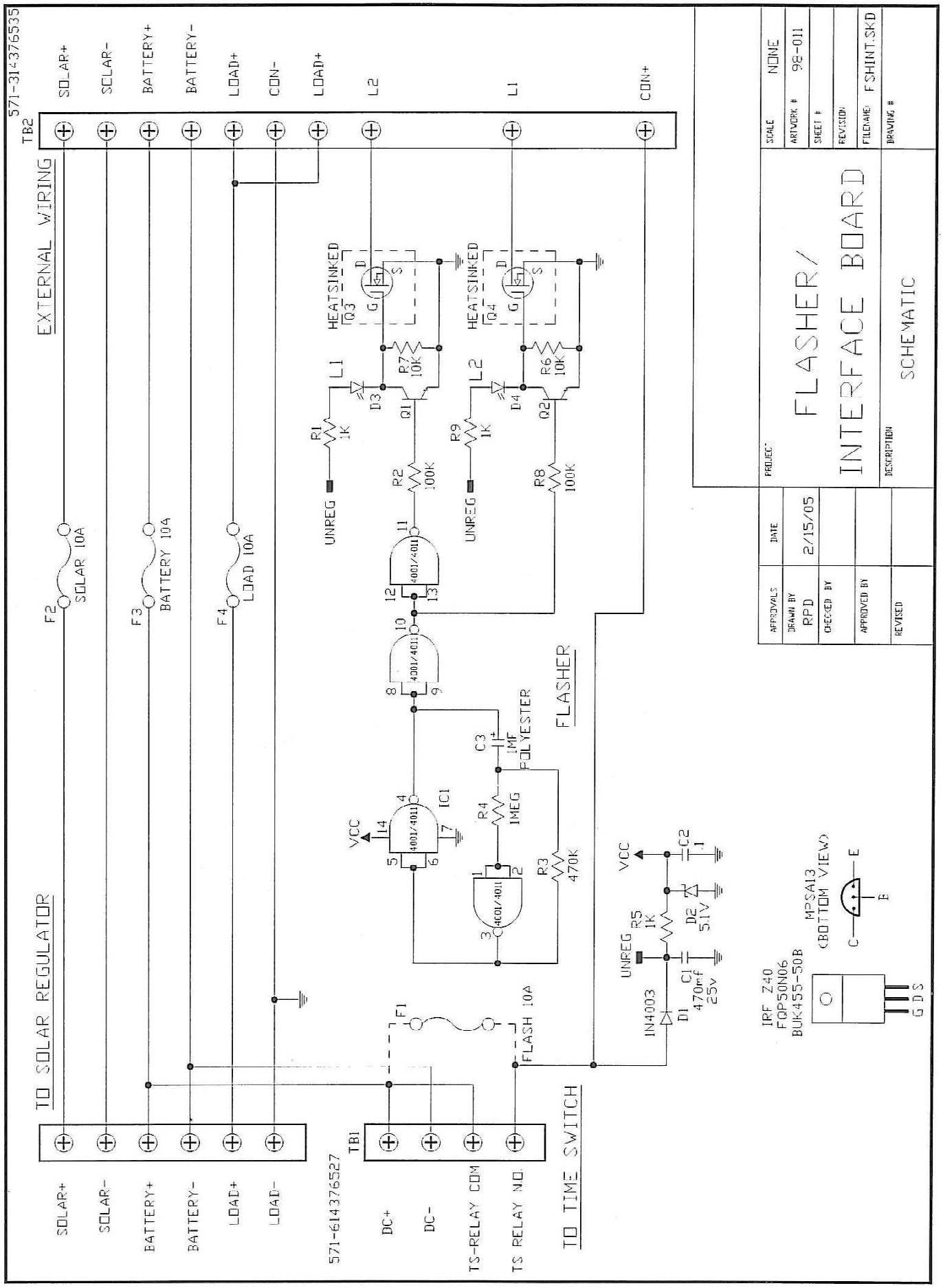
6 12VDC + at this point activates the flash output of the 502598FCB (L1 & L2). L1 & L2 provide flashing negative outputs to flash the LED modules, the LED positive voltage is provided by the "LOAD+".

7 The 12VDC + at point 6 is provided by the COM contact of the time switch. No voltage at point 7 when relay is energized indicates that no voltage is present on the NO contact of the relay. The NO contact 12VDC+ is supplied by the regulator "LOAD +". **8**

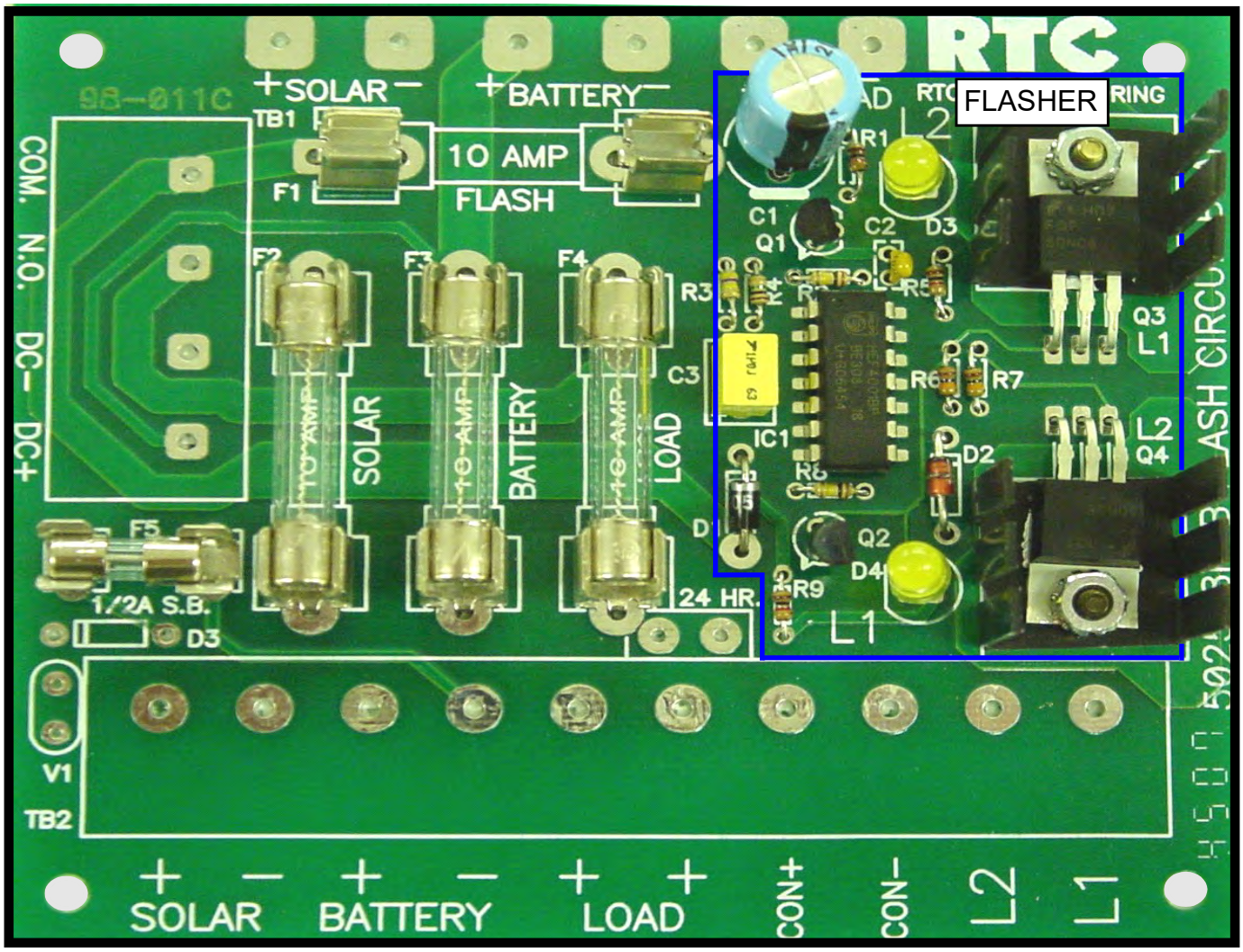
9 **10** Solar Array voltage can be checked by carefully removing wires from terminal block and measuring across the open wires. Voltage reading should be same as shown on array panel label. Voltage presence does not indicate correct current level. Check solar array panel to determine current output capacity. To measure amperage; connect negative wire to terminal block, route positive wire through a multimeter.

11 **12** F 5 is a circuit board mounted fuse that protects the DC- input to the time switch from overcurrent. F 1 is housed in the time switch and protects the DC+ input. No voltage at 11 or 12 will remove power from the time switch.

Schematic 502598FCB
for the 502598SW & 502598LCB Panels



Component Layout 502598FCB
for the 502598SW & 502598LCB Panels



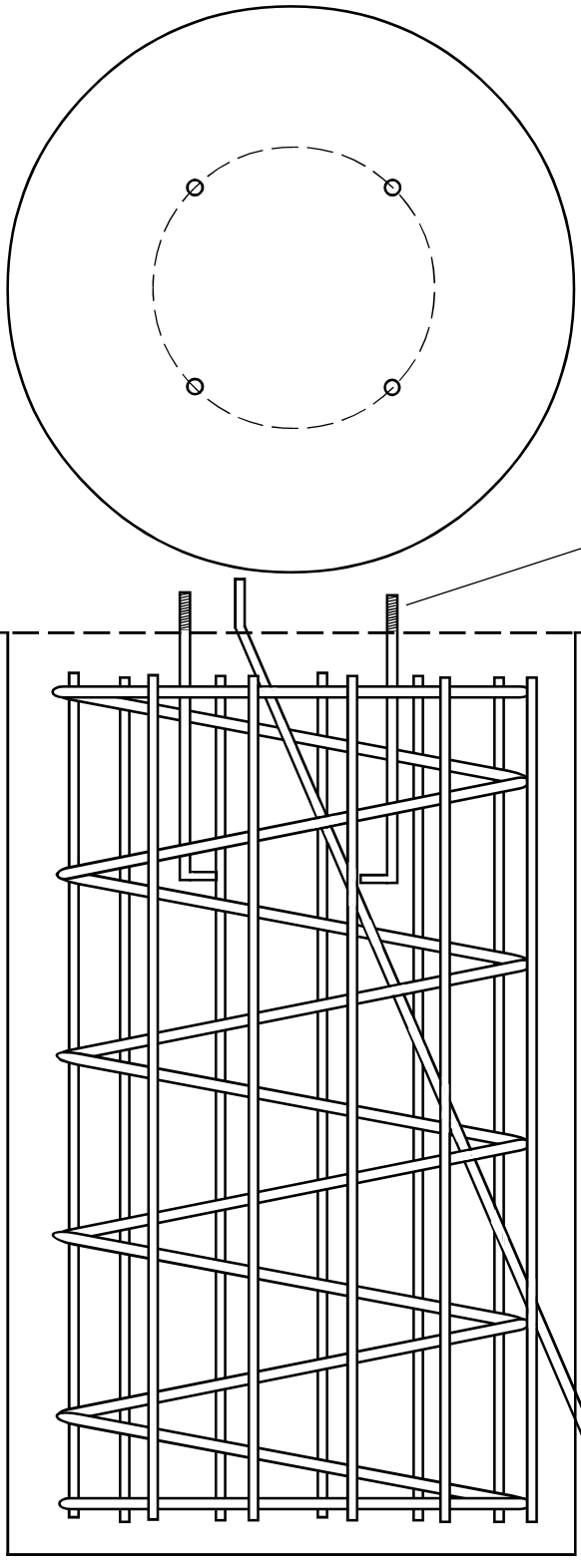
Part List 502598FCB
for the 502598SW & 502598LCB Panels

PART	QTY	LOCATION
1K 1/8W RESISTOR	3	R1,5,9
10K 1/8W RESISTOR	2	R6,7
100K 1/8W RESISTOR	2	R2,8
1M 1/8W RESISTOR	1	R4
470K 1/8W RESISTOR	1	R3
1uf POLY CAPACITOR	1	C3
470uf RADIAL CAPACITOR	1	C1
4003, DIODE	1	D1
4733, DIODE	1	D2
MPSA13, TRANSISTOR	2	Q1,2
FQP50NO6, (IRFZ40)	2	Q3,4
IC, 4001	1	IC1
LED, YELLOW	2	L1,2
1/2A FUSE, 2AG	1	F5
10A FUSE, 3AG	3	F2,3,4
FUSE CLIP, 2AG	2	F5
FUSE CLIP, 3AG	8	F1-4
BRASS SCREW	2	TO HOLD Q3,4 TO HEAT SINKS
#4 KEP NUT	2	TO SECURE Q3,4 TO HEAT SINKS
HEAT SINK	2	UNDER Q3,4

Foundation Drawing

RTC Manufacturing, Inc. assumes no liability for the use or misuse of information contained within this document

Consult manufacturer for anchor bolt size and pattern. Only use anchor bolts designed for this type of installation



NOTE: Some agencies add a conduit stub-out for future use.

Standard anchor bolt 18” in length (consult base manufacturer before using standard; product may vary)

Diameter and depth of foundation dependant on wind load and local soil conditions. Must support 15’ pole and solar panel array with mounting hardware. Example given. Minimum 24” Dia. x 60” Depth. Consult Project Engineer

Use concrete mix specified for pier foundations as determined by project engineer .

Re-enforcement steel: size, number of uprights and spiral pitch determined by Project Engineer

Grounding:
Minimum or as determined by Project Engineer.
5/8” x 8’-10’ Copper clad ground rod or coil copper in bottom of pier. Bond to pedestal base.

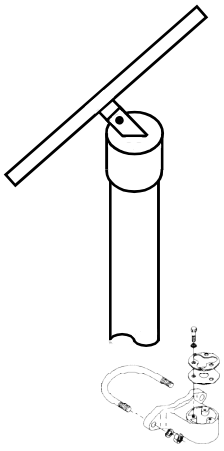
Do Not Scale

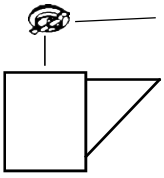
Detail Drawing for Pedestal Pole Arrangement

Panel to face True South.
Tilt Angle

Location Latitude	Tilt Angle
0 - 15°	15°
15 - 25°	Same as Latitude
25 - 30°	Latitude + 5°
30 - 35°	Latitude + 10°
35 - 40°	Latitude + 15°
40°+	Latitude + 20°

Eample: Dallas Location
33° + 10° = 43°

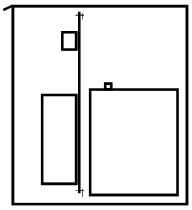




Signal closure kit

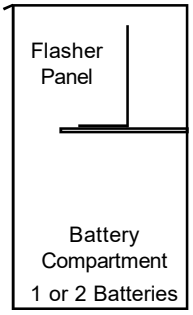
Traffic signal, red or yellow Lens
with 12 VDC halogen bulb
or with red or yellow 12 VDC LED
module

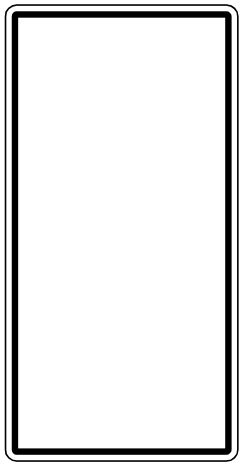
Cabinet
H-17" W-18.5"
D-12.75



Mount cabinet to
the pole using the
brackets supplied

Cabinet
H-26" W-17" D-16"

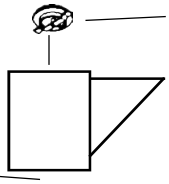




Sign size and text as
needed

Mount cabinet to the pole
behind the sign using the
brackets supplied

4-Battery
Compartment
Cabinet
H-39" W-17" D-16"



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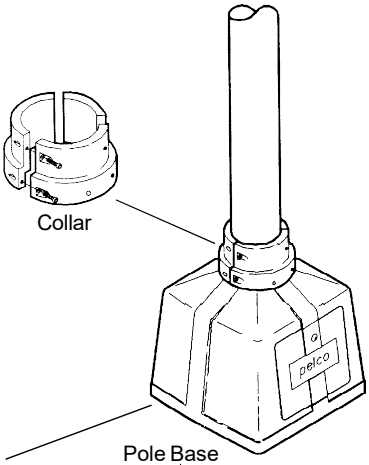
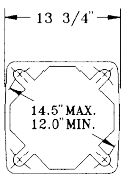
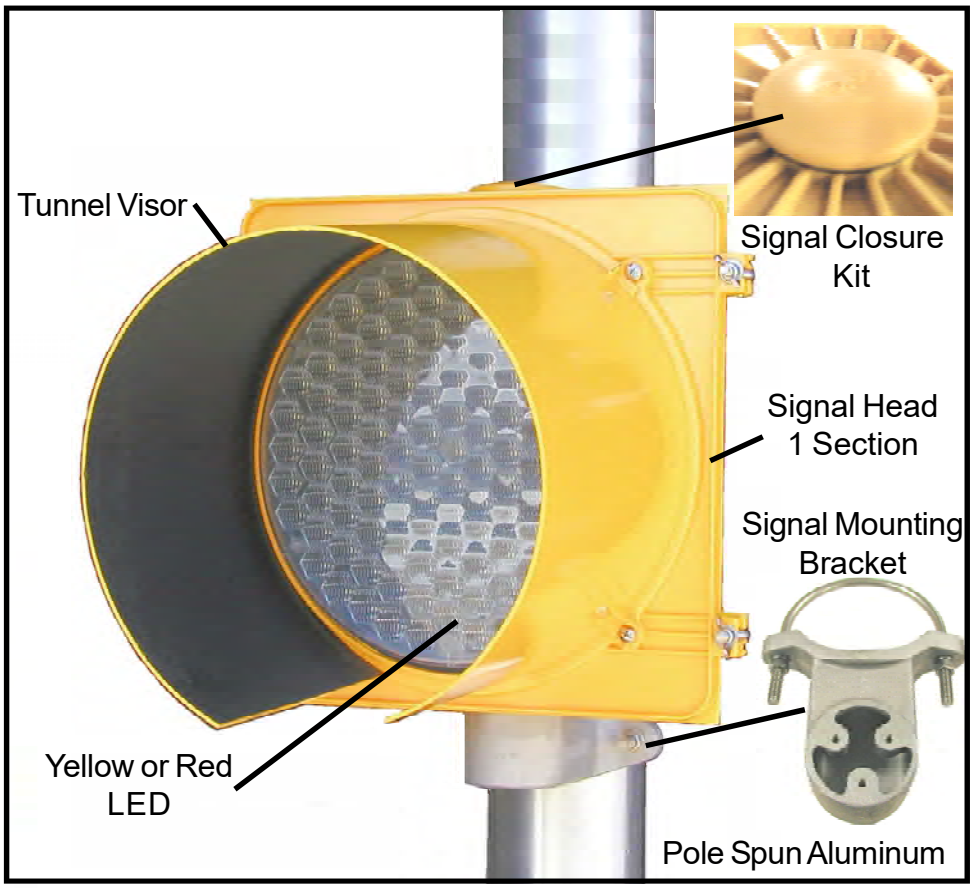


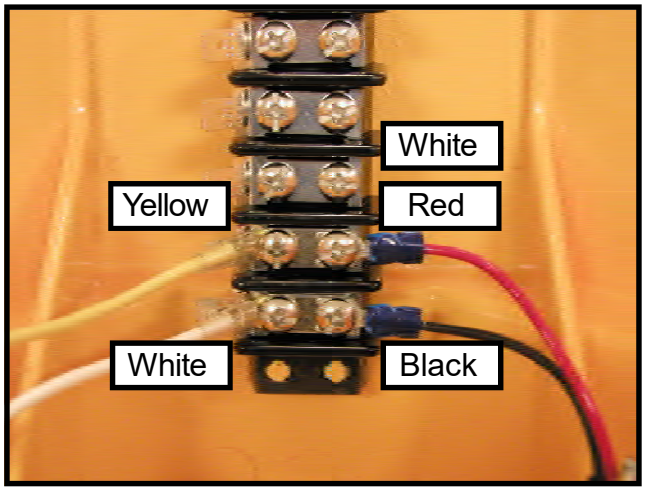


Pole Base

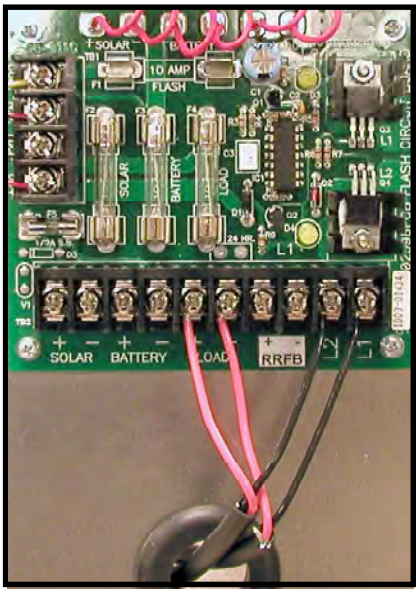
Detail Drawing for Signal Head to Pedestal Pole



Signal Equipment Wire Connection



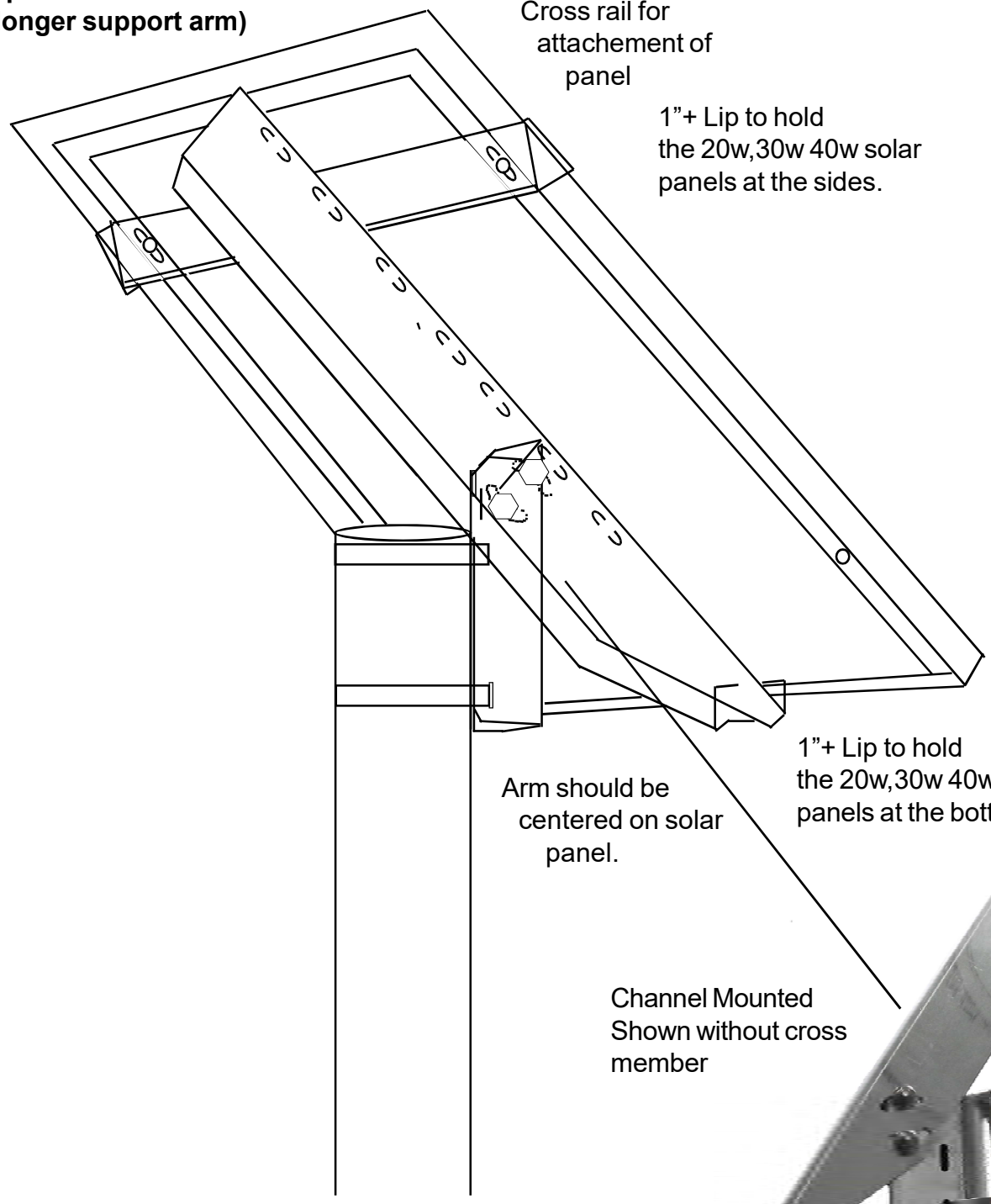
Typical LED Connection
Inside Signal Head
Signal Hook Up Kit
may have Black and white
conductors



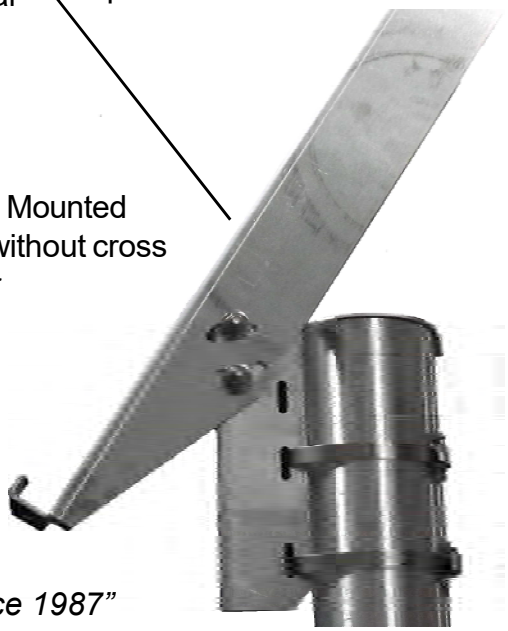
SOLAR MOUNT INSTRUCTIONS

Solar mounts vary in design and in bolt kit.
Each bolt kit has instruction insert.
Please review bolt kit insert and the manual.

Side/Top of Pole Mount
20,30,40 Watt solar panels,
Optional 50 Watt mount
(longer support arm)



Channel Mounted
Shown without cross member



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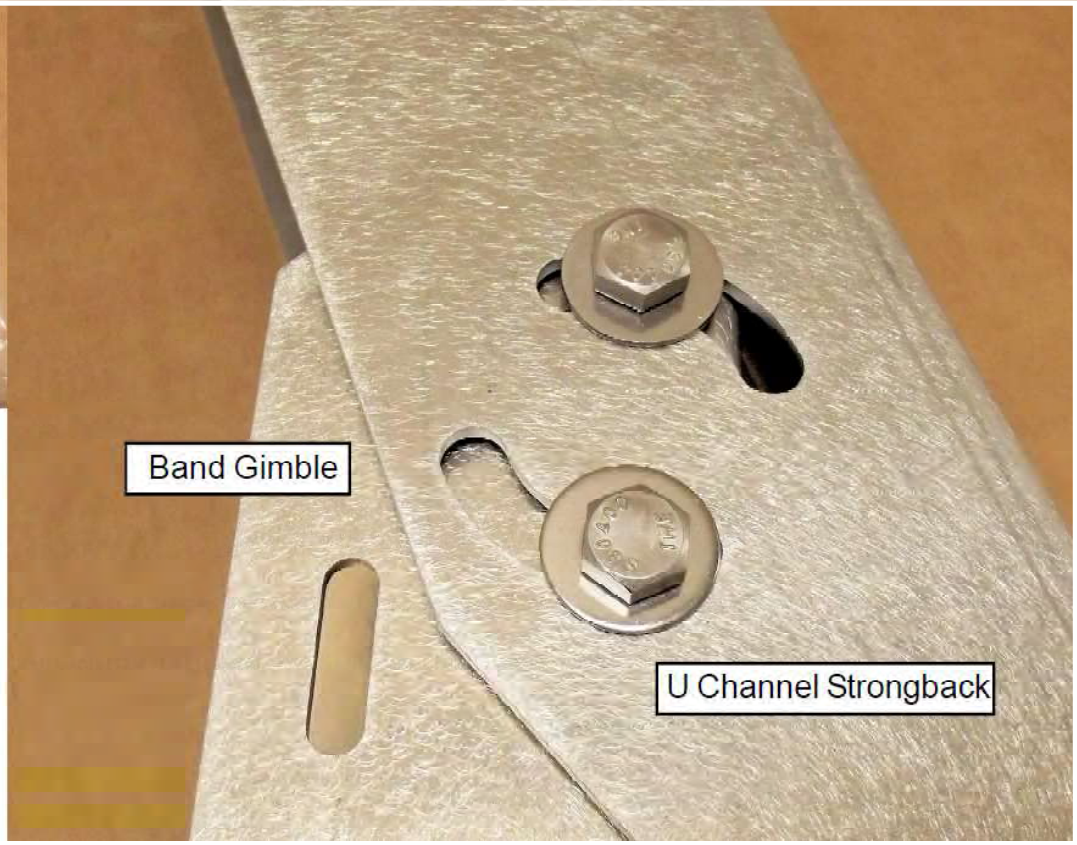
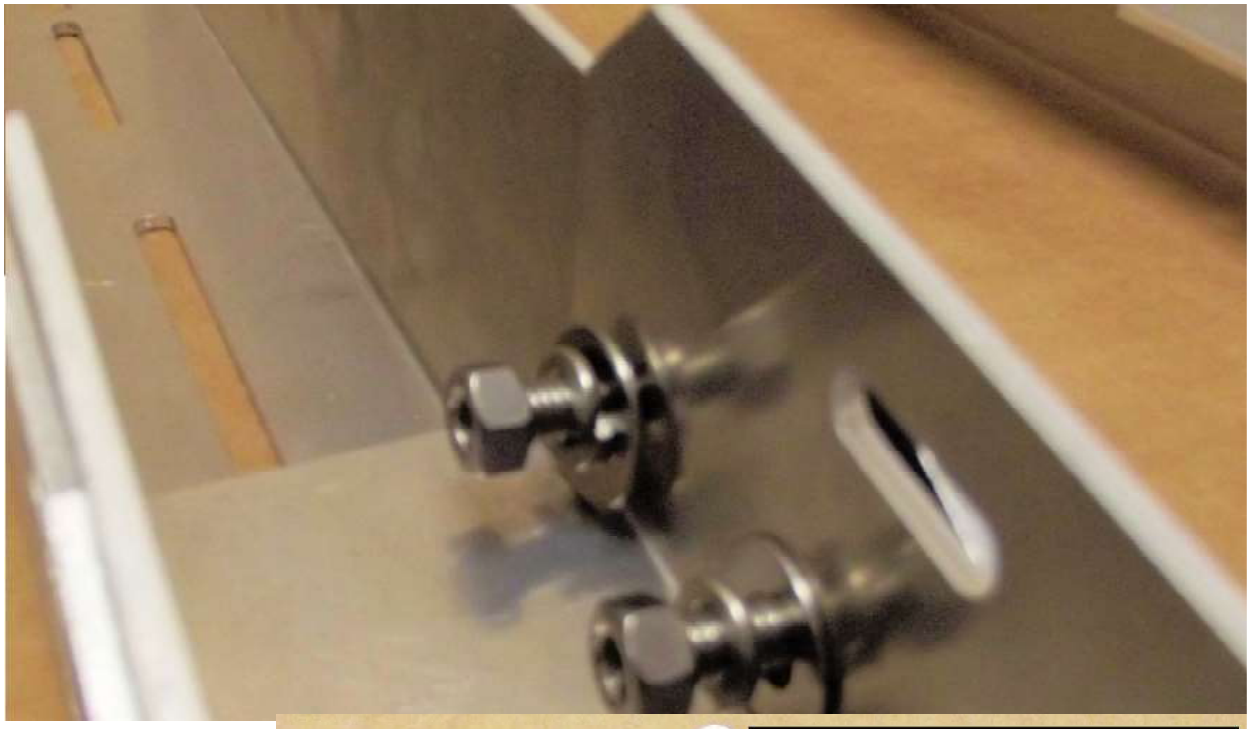
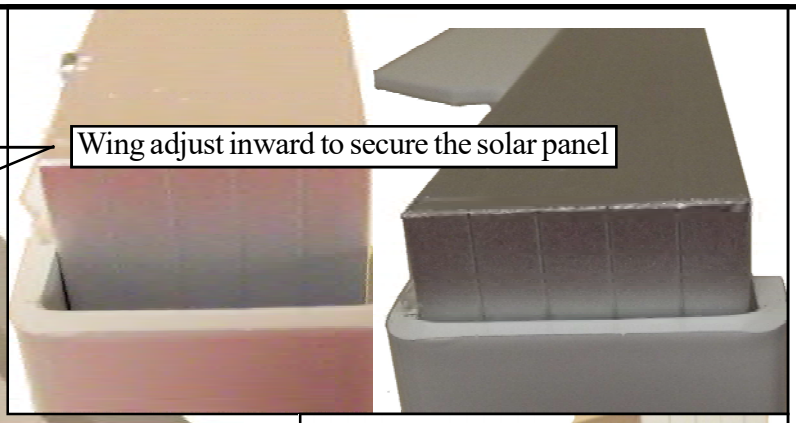
RTC 504540A


Band Gimble
U Channel Strongback

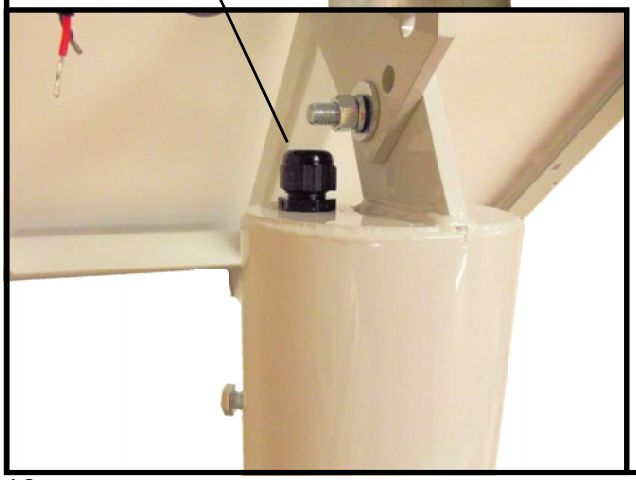



4 sets for Strongback to Band Gimble



Once solar panel wing is tight, tech screws will be used for further securement of the solar panel

Wire grip

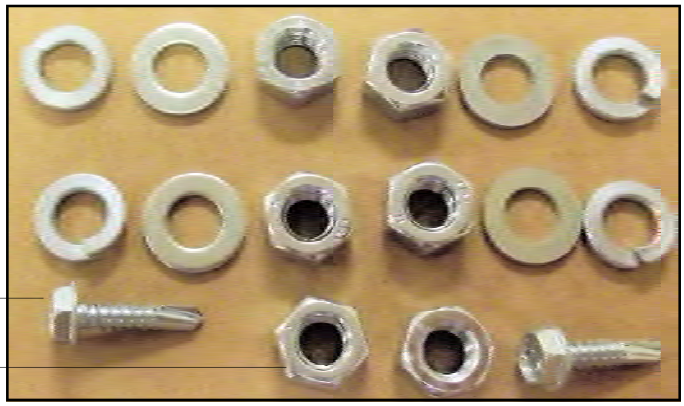


RTC (800) 782-8721

P/N 503169K

503169K Bolt Kit 502400 Series Top of Pole Mounts

Solar panel wing

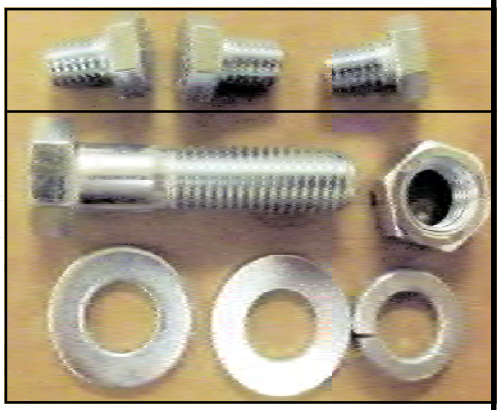


Tech screws secure mount to solar panel frame.

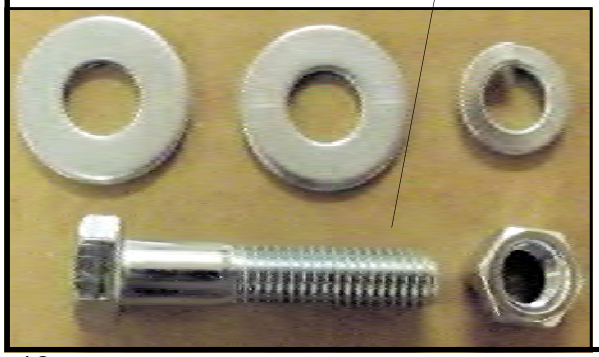
M8 Nut - 4 needed for the 4 studs on Solar Panel Slide. 2 spares provided (special mm size)

Secure solar panel slide pieces to mounting studs with M8 hardware. Adjust slide to solar panel and tighten the M8 hardware. Always use flat washers and lock washers. Use tech screws to secure solar panel to slide.

Gimble to pole



1/2-13 x 2" Bolt for Strongback to Gimble attachment



3/8-16 x 1 3/4" Bolt for Strongback to Gimble attachment and angle adjustment

RTC (800) 782-8721
BOLT KIT
P/N 503169K

503371 MOUNT for 503405CE 506437CE & 500461CE

503405CE 40W

506437CE 30W

500461CE 20W

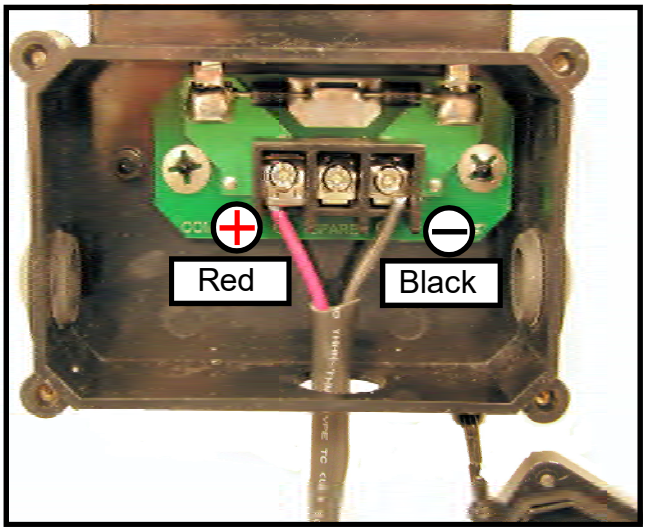
Solar Panel Tilt Angle
Face panel towards true South at angle that allows most hours of full sunlight throughout the day.
Shown at 60 degree tilt

Junction Box: Five - 1/2" conduit openings for a conduit connector or cable grip
Gimble: One -1/2" conduit opening for a conduit connector or cable grip
2 cable grips & jacketed cable supplied with solar panel & mount
Solar Panel: 25 Yr limited power output warranty

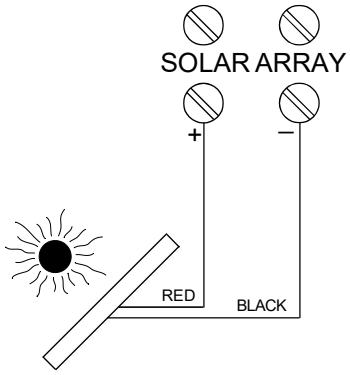
06/01/2010	RTC Manufacturing, Inc.
	TOP OF POLE MOUNT
	503405CE, 506437CE & 500461CE PANELS
	000000

Solar Array Wire Connection

504580SA WIRE KIT SOLAR HOOK UP 14 AWG



CONTROL PANEL CONNECTION



NOTE: ALIGN SOLAR PANEL TO FACE SOUTH AT A 45 DEGREE ANGLE

CAUTION:

INCORRECT WIRING OF BATTERY AND SOLAR ARRAY WILL CAUSE DAMAGE.

USE CAUTION WHEN CONNECTING RED AND BLACK WIRES.

DATE 11/25/2008	RTC Manufacturing, Inc.	
REV 1	PROJECT SOLAR PANEL WIRING KIT	
REV 2		
REV 3	DESCRIPTION N/A	ASSEMBLY NUMBER: 504580SA

Top of Pole Mounting

for 65 watt & larger solar panels
(not 150 Watt)

Screws shown actual size

1.
Kit contains 8:
1/4" X 3/4"
as shown for Solar panel to rail connection.
Only 4 needed for single panel

Use 7/16 wrench

2.
Kit contains 4:
3/8" X 1 1/4"
as shown for rail to strongback connection

Use 9/16 wrench

3.
Kit contains 1:
1/2" X 2"
as shown for strongback to gimble connection.

4. Use 3/4 wrench
Kit contains 1:
3/8" X 1 3/4" for setting solar panel angle.

Use 9/16 wrench

Solar Panel Tilt Angle
Face panel towards true South at angle that allows most hours of full sunlight throughout the day.

5.
Kit contains 3:
3/8" X 1/2" for gimble to pole connection.
(Bagged with 1/2" x 2" screw)

Use 9/16 wrench

503371 MOUNT for 503405CE, 506437CE & 500461CE

503405CE 40W

506437CE 30W

500461CE 20W

Solar Panel Tilt Angle
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at angle that allows most hours
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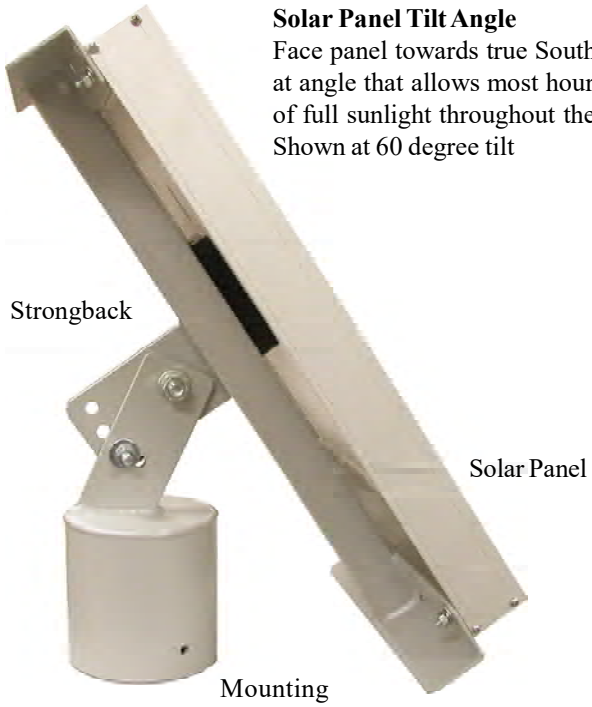
Shown at 60 degree tilt



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2 cable grips & jacketed cable supplied with solar panel & mount.
Solar Panel: 25 Yr limited power output warranty

DATE 06/01/2010	RTC Manufacturing, Inc.	
REV 1	PROJECT TOP OF POLE MOUNT	
REV 2		
REV 3	DESCRIPTION 503405CE, 506437CE & 500461CE PANELS	ASSEMBLY NUMBER: 000000

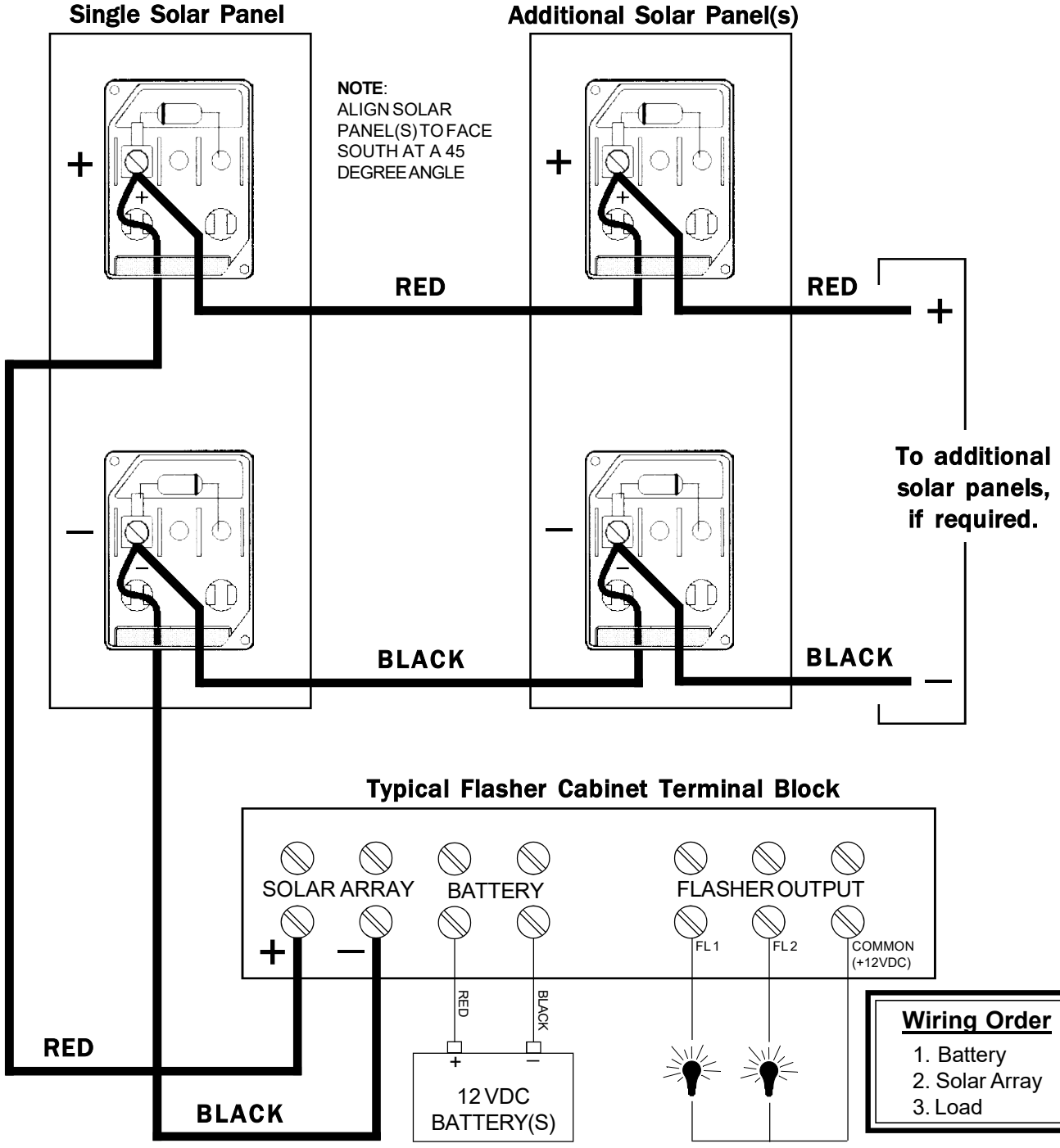
Typical Multiple Solar Array Connection

WARNINGS:

Contact with electrically active parts of the solar panel such as terminals can result in burns, sparks and lethal shock whether the module is connected or disconnected.

When installing or working with solar panel or wiring, cover the solar panel face completely with opaque material to stop production of electricity.

When installing a multiple solar panel system, wire the panels in parallel. Panels wired in parallel can produce high current which constitutes an increased hazard that could cause serious injury or death.



CAUTION:

INCORRECT WIRING OF BATTERY AND SOLAR PANEL(S) WILL CAUSE DAMAGE.

USE CAUTION WHEN CONNECTING RED AND BLACK WIRES.

DATE	9/2/99
REV 1	
REV 2	
REV 3	
RTC	RTC Manufacturing, Inc.
PROJECT	12VDC FLASHER SYSTEM SOLAR PANEL INSTALLATION
DESCRIPTION	WIRING DIAGRAM

Warnings & Battery Wiring Instructions

WARNINGS:

Contact with electrically active parts of the solar panel such as terminals can result in burns, sparks and lethal shock whether the module is connected or disconnected.

When installing or working with solar panel or wiring, cover the solar panel face completely with opaque material to stop production of electricity.

Do not touch terminals while solar panel is exposed to light or during installation. As an added precaution, use properly insulated tools only.

When installing a multiple solar panel system, wire the panels in parallel. Panels wired in parallel can produce high current which constitutes an increased hazard that could cause serious injury or death.

CAUTIONS:

Avoid electrical hazards when installing, wiring, operating and maintaining the solar panel.

A photovoltaic module (solar panel) generates DC electricity when exposed to sunlight or other light sources.

Do not drop solar panel or allow objects to fall on the solar panel.

Do not stand or step on the solar panel.

Do not install solar panel where flammable gases or vapors are present.

Work with the solar panel only under dry conditions with dry tools.

Do not break the glass that protects the solar panel. A solar panel with broken glass cannot be repaired and must not be used.

BATTERY WIRING INSTRUCTIONS:

IMPORTANT NOTE: Connect the wires from the flasher panel to the battery(s) before you connect the wires from the flasher panel to the solar panel(s). Follow the instructions

Proposition 65 Warning
Warning: Battery posts, terminals & related accessories contain lead & lead compounds, chemicals known to the State of California to cause cancer & reproductive harm.
Wash Hands After Handling

Step 1) Connect the long black wire to the "Battery -" terminal on the flasher panel.

Step 2) Connect the other end of the long black wire to the negative terminal of the battery.

Step 3) Connect the long red wire to the "Battery +" terminal on the flasher panel.

Step 4) Connect the other end of the long red wire to the positive terminal of the battery.

If you are using two batteries complete steps 5 through 8:

Step 5) Connect the short black wire to the negative terminal of the second battery.

Step 6) Connect the other end of the short black wire to the negative terminal of the first battery.

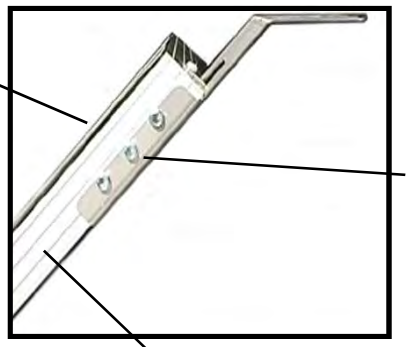
Step 7) Connect the short red wire to the positive terminal of the second battery.

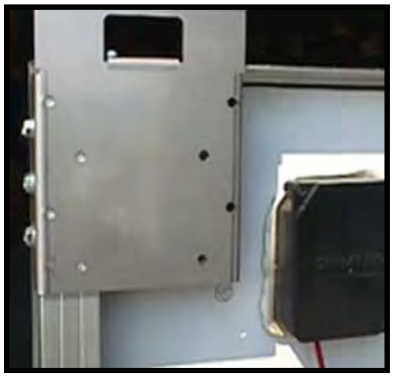
Step 8) Connect the other end of the short red wire to the positive terminal of the first battery.

Wiring Order
1. Battery
2. Solar Array
3. Load

DATE 9/2/99	RTC Manufacturing, Inc.
REV 1	PROJECT 12VDC FLASHER SYSTEM SOLAR PANEL INSTALLATION
REV 2	
REV 3	DESCRIPTION WARNINGS AND CAUTIONS

Antenna Bracket 500335E Detail





Bottom View

Antenna bracket has flanges and screw openings on both sides to allow bracket to be mounted on left or right side of solar panel.

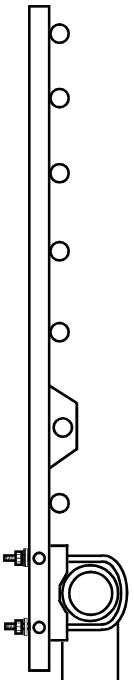
Mount solar antenna bracket p/n 500335E onto solar panel. Install antenna on bracket. Slide strain relief bracket onto hub, tighten hub nut. Cable tie coax cable to strain relief bracket.

Typical Yagi Antenna Mount

WARNING:
Watch for wires; you can be injured or killed if this antenna comes in contact with electrical power lines.

Most efficient installation of Yagi antenna and antenna bracket assembly shown. Signal strength readings should be performed and antenna & bracket mounted to point directly to highest signal strength.

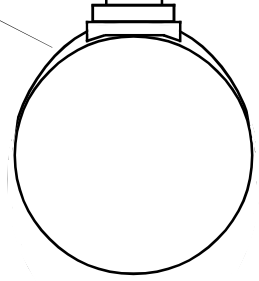
Mounting height: If the antenna must be mounted on the lower side of the solar panel; mount antenna (top of elements) 18 inches from the lowest point of the solar panel.



Always use flat washer & lock washer when installing U-bolt clamp

Place antenna bracket one inch from the top of the vertical pipe

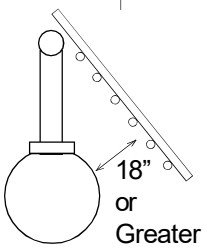
Use 3/4"- .030 stainless steel banding at minimum Bracket to Pole attachment

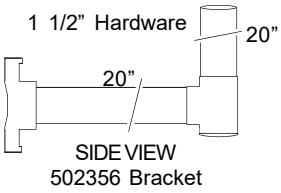


TOP VIEW

Optimal Positioning

Not Acceptable





SIDE VIEW
502356 Bracket

Antenna Mount Cabinet Top

Mounting the antenna on top of the cabinet is not recommended,
however circumstances may require top of cabinet mounting.
This does not apply to "In Building-Short Range" cabinet mounting of antennas.

Top of Cabinet Mount:

1. Maintain line of sight to other antenna locations.
2. Locate antenna as far away as possible from cabinet pole support.
3. If a nonconductive bushing is part of the antenna mounting kit, that bushing must be used in the mounting of the antenna to avoid contacting the metal cabinet.
4. If/when reducing the length of the antenna coax, the antenna coax must be greater than 24" in length.
5. If not a Myers Hub type of antenna connection, complete appropriate weather proofing as needed.

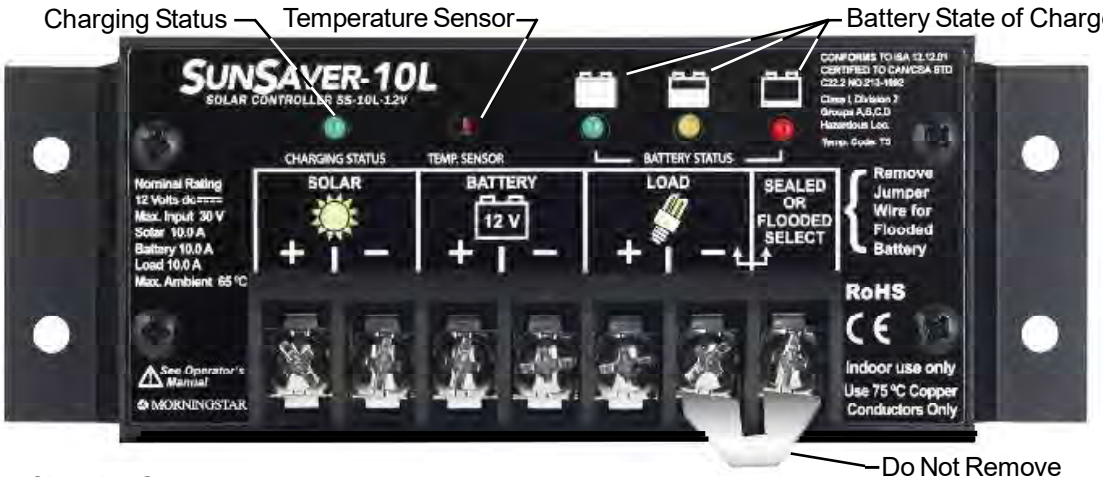
ANTENNA MOUNTING CONNECTOR MAY VARY, LOOK BEFORE DRILLING OPENING

Before drilling opening in cabinet top: Is there any other method of mounting the antenna?
The cabinet pole may interfere with the reception of the antenna.

Drill/knockout correct size opening for the antenna mounting. Avoid making the opening any larger than necessary for the antenna mounting. Turn off and cover electrical components to avoid shavings coming in contact with electrical current.

504459SS Solar Regulator Quick View

WARNING: Do not disconnect unit while the circuit is live unless the area is known to be nonhazardous. A spark can cause non-ventilated gas vapors from a battery to explode. Severe injury can occur due to shorting of battery wiring. Read Sunsaver Operator's Manual.



Charging Status

Color	Indication	Operating State
None	Flickers "on"	Night (LED flickers every 5 seconds)
Green	Solid: flickers "off"	Charging (LED flickers every 5 seconds)
Red	Flashing	Error -Solar array current too high disconnect -High Voltage disconnect -High temperature disconnect
Red	Solid : flicker "off"	Critical error -Temp sensor damaged (for battery charging) -Heatsink temp damage (for internal heat level) -MOSFIT damage -Firmware error

Battery Status

Led	Indication	Battery Status	Load Status
Green	2 flash per second	Full Battery (N/U for Gel Cell)	Regulator "LOAD" output good
Green	1 flash per second	Final stage of charge	Regulator "LOAD" output good
Green	Solid	Battery nearly full charge	Regulator "LOAD" output good
Green	1 flash per 2 seconds	Maintaining full charge	Regulator "LOAD" output good
Yellow	Solid	Battery half full state	Regulator "LOAD" output good
Red	1 flash per second	Battery low	"LOAD" good near disconnect
Red	Solid	Battery state critical	**L**ow **V**oltage **D**isconnect (LVD) (No Field Indications) LVD occurs at 11.5 VDC Reconnects "LOAD" at 12.6 VDC

Battery Status LED Error Indications

R - G Sequencing	High voltage disconnect (15.3V, Re-14V)
R - Y Sequencing	High temp disconnect
R&G - Y Sequencing	External wiring error
R&G - Y Sequencing	Load overcurrent
R&G - Y Sequencing	Load short circuit
R - Y - G - Sequencing	Self-test error

Battery Status LED Voltage Points

G to Y 12.1 Y to G 13.1 Y to Flash R 11.7 Flash R to Y 11.8
Flash R to R 11.5 R to Y 12.6

Temperature Sensor

Measures ambient temperature in cabinet and adjusts charging of battery based on that temperature.

Field Testing Procedure:

1) No Power applied to the SunSaver

A) With no power applied to the SunSaver, check for short circuits to ground between the following terminals:

i) PV (+) and PV (-) terminals

ii) Battery (+) and Battery (-) terminals

iii) Load (+) and Load (-) terminals

B) Check the LVD FET (if controller is equipped with LVD) by measuring a diode drop between the Battery (+) and Load (+) terminals. If no diode drop is present or if an open circuit is measured, the LVD FET is damaged.

If no diode drop is present (a short circuit), the unit will still (most likely) regulate the battery voltage properly, however the controller will no longer have LVD capability.

C) Check for continuity between the ground connections on the terminal strip (PV(-), Battery (-) and Load (-)).

D) Remove cover from controller. Inspect for burns, damaged traces etc.

2) Battery power applied to the Battery terminals only. The green "Charging" LED should be off.

A) Measure the voltage at the battery terminals.

B) Measure the voltage at the load terminals. The voltage should be the same as the battery voltage.

If it is significantly lower, the LVD FET's or the power traces inside the SunSaver are damaged.

C) Measure the voltage at the array terminals. The voltage should be about –2.5Vdc (negative due to the diode drop across the input FET's). If the Green LED is on and/or if battery voltage is measured, the input FET's are damaged and the unit will not regulate the Battery voltage properly.

D) A PC Board "via" is located to the left of the SunSaver terminal strip. This via carries the Gate drive signal to the PWM FET's during charging. With no PV Power connected, the voltage between this via and ground should be less than 1 Vdc. If there is more than 1 volt, then the PWM FET's are most likely damaged.

3) PV and battery power applied to the controller. The green "Charging" LED should be lit.

A) The voltage across the PV terminals should be the same as the voltage across the Battery terminals if the batteries are not fully charged.

B) If the batteries are charged, there will be a voltage difference between the Battery (+) terminal and the PV (+) terminal. If you DVM has a frequency measuring option, a 300Hz AC signal should be measured between Battery (+) and PV (+).

The duty cycle of this signal can also be measured to give a rough indication of the battery state of charge. The lower the duty cycle, the more fully charged the battery.

C) Measure the voltage at the via located at the left edge of the terminal strip. If the batteries are not fully charged, this voltage should be approximately 20-24Vdc. If the controller is in voltage regulation, this voltage will vary according to the state of charge of the battery. The frequency and duty cycle can be measured here as well.

4) PV, Battery and a small (2A) load connected to the controller, a standard 12V automotive brake lamp (type 1156) works well for this test. This will provide a simple system to verify the correct operation of the controller. With the lamp turned on, measure the load voltage, it should be within 20-30 mV of the battery voltage. If it is more than 0.25V lower than the battery voltage, the LVD FET's are damaged.

5) SunSaver installed in the Power system.

A) Check the correct operation of the SunSaver based on the above tests.

B) Check the condition of any fuses that might be in the power path.

C) Verify the system wiring is correct and intact.

D) Check all connections and terminals for good electrical contact.

Bench Test Important Information:

• The bench testing procedure pertains to individuals with access to external power sources, a battery, and the various tools and materials outlined below. For on-site testing or troubleshooting of the SunSaver controller where a power supply is not available, refer to the SunSaver Field Testing document.

• Due to the fabrication process of the SunSaver controller, it may only be possible to determine if the unit is functioning properly. The exact damaged component or part may not be evident. Other factors however, may be apparent that will enable the technician to determine the cause for failure. These factors include, but are not limited to:

burned leads
excessive loads
evidence of short circuits on load leads
over-rated current input

Recommended Tools:

• Digital Multi-meter with fine tip probes (frequency and duty cycle measurements helpful)
• Phillips Screwdriver
• Flat Bladed Screwdriver

Materials and Equipment:

• Small motorcycle type battery (12V)
• Variable power supply capable of supplying 2A @ 15-20Vdc
• 12V/2A load (e.g. type 1156 automotive lamp with socket)
• Short length (8-12cm) of 12AWG(3.23mm2) solid wire

Caution:

The procedures outlined below assume a basic knowledge of electric circuits. Exercise the necessary precautions when dealing with the live circuits present in solar energy systems.

Testing Procedure:

Step 1: *No Power* Applied to the SunSaver

A) With no power applied to the SunSaver, check for short circuits to ground between the following terminals:

i)PV (+) and PV (-) terminals
ii)Battery (+) and Battery (-) terminals
iii)Load (+) and Load (-) terminals

B)If the controller has LVD, check the LVD FET by measuring a diode drop between the Battery (+) and Load (+) terminals. If no diode drop is present or if an open circuit is measured, the LVD FET is damaged. If there is a short circuit between the terminals, the unit will still (most likely) regulate the battery voltage properly, however the controller will no longer have LVD capability.

C)Check for continuity between the ground connections on the terminal strip (PV(-), Battery (-) and Load (-)). If an open circuit exists between any of the ground terminals, the controller has a damaged ground trace. The unit is not operational.

D)Remove the 4 screws from the face plate. Bend a small hook in the end of the 12AWG(3.23 mm2) wire. Insert the hook into one of the open screw holes and pull of the face plate. The face may be stuck to the internal potting and may make a cracking sound when removed. This is normal and will not damage the internal circuitry. Inspect for burns, damaged traces etc.

Step 2: Power Supply connected to battery terminals of the SunSaver

A) Adjust the Power supply output voltage to about 13.5Vdc. Check the voltage at the battery terminals with a multi-meter.

B) Attach the 2A load to the Load terminals of the SunSaver. The load should operate correctly (assuming the power supply is capable of driving the load). C) If the SunSaver is equipped with the LVD option, adjust the voltage down to about 11.0Vdc. The Red LVD LED should light and the load should turn off when the voltage drops below 11.4Vdc. Adjust the power supply voltage to 14Vdc, the red LED should go out and the load should turn on.

Step 3: Only Battery Connected to the Battery Terminals

Note: The green “Charging” LED should be off.

A) Using a multi-meter, measure the voltage at the battery terminals.

B) Using a multi-meter, measure the voltage at the load terminals. The voltage should be the same as the battery voltage. If it is significantly lower, the LVD FET’s or the power traces inside the SunSaver are damaged.

C) Using a multi-meter, measure the voltage at the array terminals. The voltage should be less than 2.5Vdc. If the Green LED is on and/or if battery voltage is measured, the input FET’s are damaged and the unit will not regulate the Battery voltage properly.

Step 4: Power Supply connected to PV Terminals and Battery connected to the controller.
A) Adjust the Power supply voltage to 14.0Vdc and limit the power supply current to about 2 Amps. The green “Charging” LED should be lit.
B) The voltage across the PV terminals should be the same as the voltage across the
Battery terminals if the batteries are not fully charged.
C) Disconnect the power supply.
D) Adjust the output voltage of the power supply to 15Vdc and reconnect the power supply to the PV terminals. If the batteries are charged, there will be a voltage difference between the Battery (+) terminal and the PV (+) terminal. If the multimeter has a frequency measuring option, a 300Hz AC signal should be measured between Battery (+) and PV (+). The duty cycle of this signal can also be measured to give a rough indication of the battery state of charge. The lower the duty cycle, the more fully charged the battery.
Step 5: Power Supply Connected to PV, Connected Battery and a Small (2A) Load Connected to the Controller
Note: This test will provide a simple system to verify the correct operation of the controller.
A) Adjust power supply voltage to approximately 15Vdc.
B) With the lamp turned on, measure the load voltage, it should be within 20-30 mV of
the battery voltage. If it is more than 0.25V lower than the battery voltage, the LVD FET’s are damaged.
Step 6: SunSaver Installed in the Power System.
A) Check the correct operation of the SunSaver based on the above tests.
B) Check the condition of any fuses that might be in the power path.
C) Verify the system wiring is correct and intact.
D) Check all connections and terminals for good electrical contact.

PROPOSITION 65 WARNING

Warning: Battery posts, terminals & related accessories contain lead & lead compounds, chemicals known to the State of California to cause cancer & reproduction harm.

WASH HANDS AFTER HANDLING