SOLAR POWER SYSTEMS MANUAL

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Two solar power systems have been constructed as follows:

System	Solar Panel & Connections	Charge Controller	Batteries	Output Access
1	250 Watt 30-volt nominal solar panel, connected by MC4 connectors to approx 100 feet 14-2 solid house wire (bare ground and negative black wire connected together; +V on white wire; fused at 15 A. Typical output 8A dc @ 30+ volts.	Greely MPPT charge controller, capable of 15 A output to either 12V or 24V systems (auto sensing) Controller is mounted on a plastic battery box.	Charger controller is attached to battery box for a 100A-Hr (1-Amp rate) deep cycle marine battery; expected to be connected in parallel to Travel Trailer 100 A-Hr deep cycle battery, 30A fuse in interconnection.	12V DC available via two PowerPole 30A connectors right front (Passenger side) of Travel Trailer
2	250 Watt 30-volt nominal solar panel, connected by MC4 connectors to approx 100 feet 14-2 solid house wire (bare ground and negative black wire connected together; +V on white wire; fused at 15 A.	Greely MPPT charge controller, capable of 15 A output to either 12V or 24V systems (auto sensing) Controller is	100 A-hr (1 amp rate) marine deep cycle battery as part of the inverter assembly (may be used to power the refrigerator silently through the night). Designed to be paralleled with an additional battery through a 10-gauge 36”	Either DC (Power Pole) or AC (from the 2kw sine wave inverter) may be obtained.

	Typical output 8A dc @ 30+ volts.	mounted on a wood 2x4, part of a battery/ inverter assembly.	extension set with 30A fuse.	

SOLAR PANELS: This panel includes a blocking diode to avoid nighttime discharge of connected systems. For peak solar power generation, if possible, re-oriented (in both elevation and azimuth) the solar panel approximately every 2-3 hours. MC4 connectors should be left connected; they may require a special tool to disconnect (latching plastic ratchets)

The maximum loss through the 100 foot connecting cable is estimated to be less than 12% of solar power generation.

View of some solar system components:

- 100 feet of wire fromsolar panel to controller, with MC4 connectors on solar panel end; and bullet connectors (Polarized) for the MPPT controller end.
- MPPT Greely controller, right hand side of picture
- Fused battery interconnection wiring
- Additionally shown is a Power Pole extension cable for the inside of the Travel Trailer that also had screw terminals for ring terminal connection.

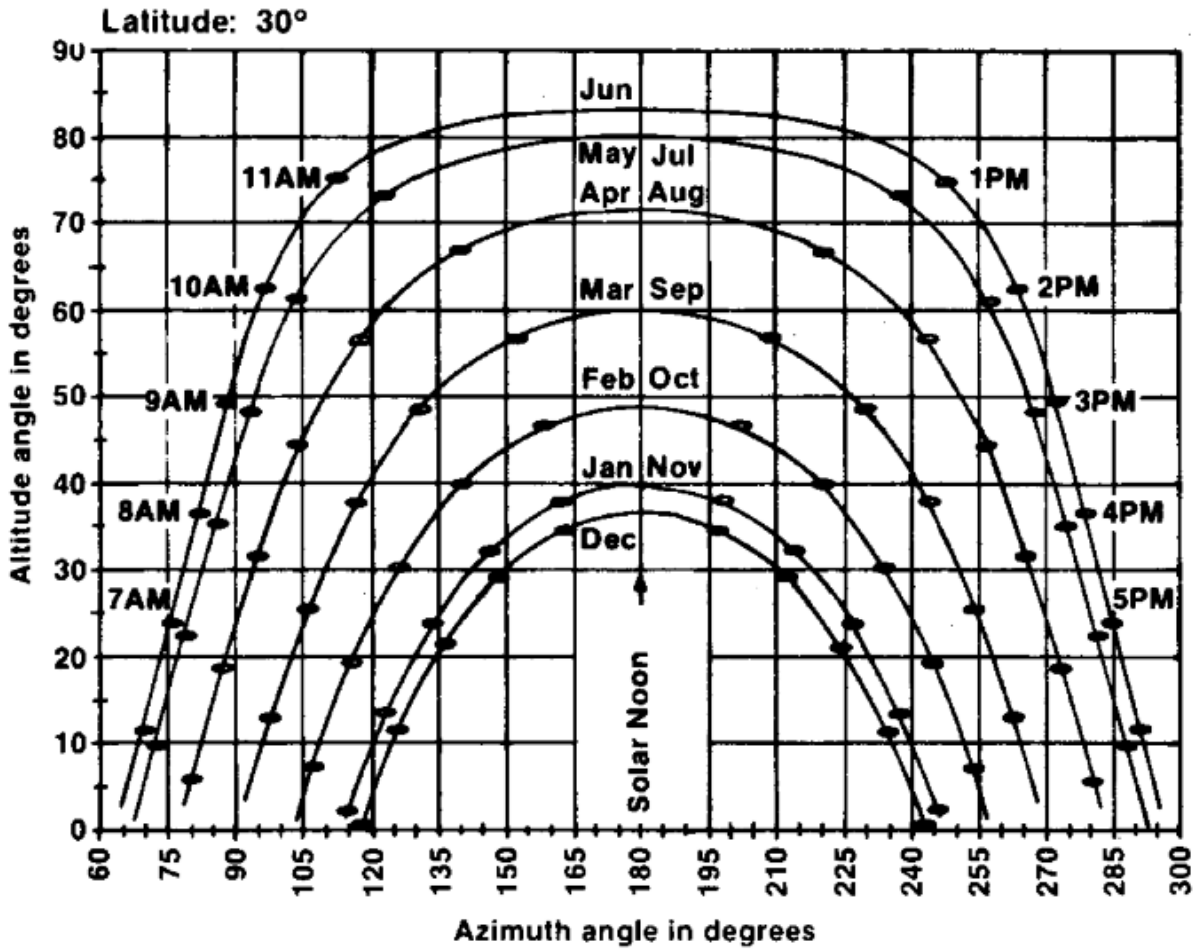

Figure 3. Sunpath plot for zone 1.

The Sun Path Plot above shows where the Sun will be for the Alachua County area, in both azimuth and elevation, for any hour (based on noon being solar noon). During June the path goes above the east-west line in the morning and evening hours…

MPPT Controller:

This controller is polarity protected, and thermal protected. Red and green LED's provide limited monitoring capability. Note that at turn-on, both reg (fault) and green (operation) LEDs will illuminate for 1 second.

GREEN LED INTERPRETATION

Off	Not connected to a battery.
ON (solid)	Connected to a battery, no solar power input (e.g., nighttime or no panel connected)
Flashing	CHARGING Slow Flash (0.5 sec, 2 seconds) — Daytime detected Slow flash (1 sec/ 1 sec) — Float charging Flash (½ sec, ½ sec) — Boost charging Fast Flash(0.2sec / 0.5 sec) — Equalization charging Fast Flast (0.1 sec/0.1 sec) — MPPT Charging

RED LED INTERPRETATION

Off	No fault detected
ON (solid)	Battery voltage is too low
Flashing	Fault Slow Flash (1sec on, 1 sec off) — Overcurrent/short Flash (½ sec, ½ sec) — Over temperature Fast Flast (0.1 sec/0.1 sec) — Over voltage protection

BATTERY:
Lead Acid storage cell.

Some specifications

Solar Panel Maximum Output:	250 Watts, Expect 32 Volts, 8 Amps
Fusing of Solar Panel wiring	15 Amp fuese
MPPT controller maximum output current	15 Amps (but note has thermal protection – may not be able to provide this power indefinitely without external cooling)
MPPT charging fusing to battery	25 A

Battery	Nominally 100 A-hr marine deep cycle, but expect more in the range of 60-75 Ahr at higher discharge rates. Avoid discharging past 50% for longer battery life.
Parallel Battery	10 Gauge wiring to connect an additional battery in parallel (the two batteries MUST be in a similar state or charge or the fuse will quickly blow as one battery charges the other—consider connecting the batteries briefly with jumper cables to equalize them before making connection with theprovided cables, and then do not disconnect unless absolutely necessary. Typical battery connections: Solar battery --- connects to Travel Trailer Battery, providing DC for the travel trailer and radios Solar battery with Inverter --- connects to additional auto battery, provides power for a second radio station or for the refrigerator.

OPEN CIRCUIT, **NO-LOAD**, VOLTAGE PREDICTION OF STATE OF CHARGE OF A LEAD-ACID BATTERY: