

GOLDEN GENESIS SOLAR COMMANDER SERIES IV

FM16 SOLAR BATTERY CHARGE CONTROLLER

OPERATOR'S MANUAL

Introduction. Golden Genesis's FM16 series Models are advanced products designed for intermediate size PV systems used specifically for recreational vehicles, boats, small rural electrification and power centers. The controller utilizes a solid state design without relay providing a cost effective migration of technology for users and systems currently using relay based or traditional "ON/OFF" controllers in their RV's. The FM16 series features a pulse-width-modulation circuit which will positively ensure a well controlled bulk and taper charge of the battery at all times. This unique design finally brings an attractively priced LCD meter controller to the first time users of a PWM product to replace the older charging technology. The FM16C is a charge-only model for RV applications and the FM16 comes with a LVD as standard.

PHOTOVOLTAIC CHARGING

Photovoltaic charging of a battery is best achieved by employing a pulse-width-modulation (PWM) type of charge algorithm to control the switching of a power MOSFET. The charging voltage and current are precisely controlled by the PWM action so a discharged battery is charged at full power from the solar module in the beginning of the charge cycle and the charging current is gradually tapered off as the battery approaches the fully charged state. Once the battery is fully charged, the FM16 series PV controllers use the PWM algorithm to replenish the battery so that the

battery is kept in a fully charged state at all times.

The voltage control points in the algorithm are different for the lead acid flooded type battery and the sealed type battery where gel is used instead of liquid. The FM16 series has both the options and is field selectable.

Battery voltage varies with temperature. The voltage level settings in the PWM algorithm must change with the change of battery temperature in order to maintain the optimal property of the algorithm at all times. Otherwise, batteries may either be under-charged or overcharged, and in either case battery life may be reduced. The FM16 series controllers have a built-in temperature sensor and a temperature compensation algorithm to extend the optimal property of the PWM to wide temperature range of from -30 degree to +70 degree Celsius.

BATTERY PROTECTION

The FM16 series has a special protection circuit to protect from polarity reversal of photovoltaic array, which may occur at time of installation. If reversed, no damage would result, and a warning LED will light up to indicate polarity reversed.

Similarly, a battery could be installed with wrong polarity. The FM16 series controllers have built-in protection circuit to protect the

system from accidental battery polarity reversal.

DIGITAL LCD METER

A digital LCD meter is standard in the FM16 series models. The meter is default set to read battery voltage. FM16C is a "charge-only" model. On the right side of this PV controller panel there is one current reading push button switch. When this push button switch is pressed, the LCD meter displays the PV current.

Model FM16 has two current reading push button switches. This model has the low-voltage-disconnect function as standard and includes a load current reading circuit. The current reading switches as marked will read PV current and load current, respectively.

RATINGS

All FM16 series models have the following ratings.

Battery voltage : 12 Volts
Max. PV current : 16 Amps
Max. load current : 16 Amps (on Model FM16 only)

INSTALLATION PROCEDURE

1. Make sure the PV charge and load current is consistent with the ratings of the controller being installed.
2. Confirm that the battery voltage is 12 volts.
3. Double check the battery the PV controller is to be connected to: flooded lead-acid or gel sealed battery. The charging voltages are different for these two types of batteries, so it

is very important to set the PV controller to match with the type of battery in use. If you have a sealed-gel battery, do not do anything. The controller is default set to gel battery.

The battery type selection is achieved by the use of jumper plug. If you have a flooded type wet battery, then turn over the controller and observe the PC board and identify the jumper shorting block. When the jumper shorting block is removed, the charging operation will be set to that of the flooded lead-acid battery.

4. Connect the battery first to the charge controller. Remember the wire colors, RED=POSITIVE, BLACK=NEGATIVE. Observe the RED LED on the controller labeled "Reverse polarity". If the Red LED is on, then the battery has been installed with reverse polarity. Please remove the cables and reconnect them properly. Your controller is protected against the reverse polarity connection of the battery. However, if the fault is not removed as indicated by the RED LED and the system is connected with the battery of wrong polarity for a prolonged period, you risk the MOSFETs in the controller being destroyed.

5. To connect the solar array, first cover the solar module with an opaque material before making any electrical connections. It is important that the solar module's wires be connected to the PV controller with the correct polarity. Observe the "Reverse Polarity" LED. If it is lit, the solar array polarity is reversed and should be corrected immediately. Double check the wiring and the polarity.

Remove the opaque material covering the solar module and then observe if the controller's green "charge" LED is on. Do not short circuit the solar array while it is connected to the controller, for this will damage the PV controller.

6. On Model FM16 connect the load to the PV controller. The load current goes through a solid state switch in the controller, which normally is closed to provide current to the load. When the battery voltage drops below 11.4 volts which is an indication that the battery is almost drained, the load switch will be open to prevent further draining of the battery.

CAUTION: Do not tie PV-, B- and L- terminals together. Otherwise some of the PV controller functions may be defeated.

LED INDICATORS

FM16 series PV controllers has a 5-LED indicators arranged in a easy-to-read configuration. Their functions are described below.

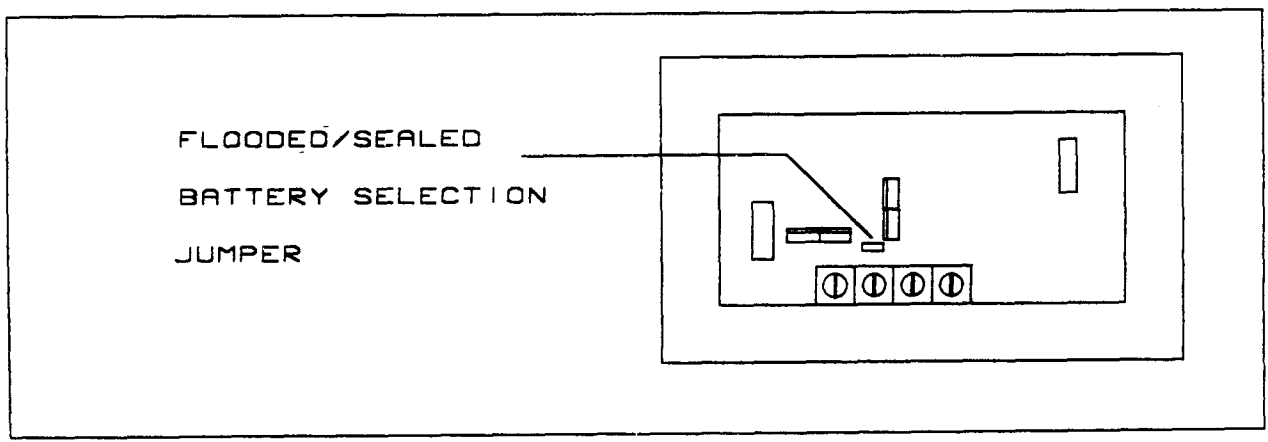
- "REVERSE POLARITY"**: Displayed with red LED. This LED is "on" if PV or battery polarity is reversed.
- "BATTERY ON"** : Displayed with green LED. This LED is "on" when battery is connected.

"CHARGING" : Displayed with green LED. This LED is "on" when battery is being charged.

" BATTERY FULL " : Displayed with yellow LED. This LED is "on" when the battery is at or near full charged state. PWM is activated during the charge phase to taper off the charge current and to keep the battery fully charged.

"BATTERY LOW" : Displayed with red LED. This LED is "on" when the battery voltage is low .

For Model FM16 this also opens the load switch to cut off the load current.



TECHNICAL SPECIFICATION

CONTROL SETPOINTS (AT 25C)

	<u>Sealed Battery</u>	<u>Flooded Battery</u>
Regulation voltage :	14.1V	14.4V
Load Reconnect after low voltage disconnect :	12.0V	12.0V
Battery low voltage disconnect :	11.4 V	11.4V

SYSTEM FEATURE

PWM charging algorithm

Battery temperature compensation

Low battery voltage warning and load
disconnect

PV reverse polarity warning & protection

Battery reverse polarity warning & protection

Flooded/sealed battery selection

Lightning protection

LCD digital meter displaying battery voltage and
PV current. On model FM16 the load current is
also displayed.