CHARGE CONTROLLERS

Charge Controller Basics

Solar modules produce electricity when the sun shines. The charge controller regulates the flow of electricity from the solar modules to the battery bank. When the battery bank is low, the charge controller feeds all of the electricity from the array to the batteries. When the batteries reach a state of full charge, the charge controller stops or redirects the supply of electricity to prevent overcharging. Modern charge controllers have the ability to hold the battery bank in a "float" state of charge if the bank is not being used. At night the charge controller prevents a reverse flow of current from the batteries to the modules.

There are three basic types of charge controllers - series, shunt and pulse-width-modulated. A series controller, the most basic type, acts as a switch to disconnect and re-connect the solar modules to the battery bank. A shunt type controller redirects the current from the solar modules - either by simply short-circuiting the array or by directing the current to some other load. Pulse-width-modulated charge controllers, the most up-to-date type, maintain the battery bank in a float state of charge. "Float" is the voltage level just below gassing voltage. Keeping the batteries in this state of charge delivers their best possible life without using excessive electrolytic.

Charge controllers are generally selected by their size or ability to control a given amount of current, and by their operating voltage. Listed on this and the next few pages are some of the most popular and effective charge controllers on the market.

Xantrex Charge Controllers C35, C40 and C60

730-035	**C35 35A, 12 or 24 volt**	**$119**
730-040	**C40 40A, 12, 24 or 48 volt**	**$159**
730-060	**C60 60A, 12 or 24 volt**	**$199**

C40 without CM on left and with CM on right.

The C35, C40 and C60 charge controllers are 3 stage solid-state, pulse width modulated devices.They work as charge controllers, DC load controllers or DC diversion regulators. They are electronically protected for short circuit, overload, over-temperature and reverse polarity conditions They will control 12V, 24V and in the case of the C40, 48V PV systems. They feature field adjustable set-points, automatic or manual battery bank equalization settings and status LED indicators. As their names suggest, the C35 is rated for 35 amps, the C40 for 40 amps and the C60 for 60 amps. But they will actually control up to 60 amps before they self limit. They each have automatic high current overload protection which simply turns the unit off until the high current condition is removed. Restart is automatic. Each can be fitted with a digital meter as an option which monitors battery bank voltage, array current and amp-hours.

Xantrex CM for C35, C40 and C60 Digital Volt/Amp/Power Meter

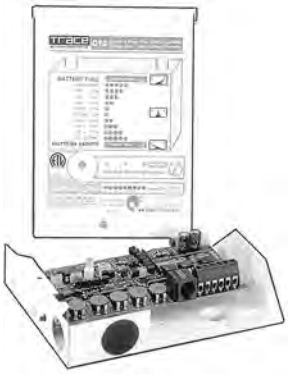
730-041	**CM/C35,C40,C60**	**$99**
730-042	**CM R/50' Remote**	**$126**
730-043	**CM R/100' Remote**	**$146**
	Battery Temperature Sensors	
741-032	**15' BTS/15**	**$29**
741-033	**35' BTS/35**	**$32**

For use with all Trace charge controllers and Trace DR and SW Plus inverters

The Xantrex CM displays volts, amps, and cumulative amp-hours for the solar array. It mounts directly on the C35, C40 or C60. The CM R/50 or R/100 can be remotely mounted up to 50' or 100' away, respectively. All three versions of the CM have a backlight LCD Display. The Xantrex remote meters require a dual-ganged electrical box for mounting. See page 16 for a surface mount version.

Xantrex C12 Charge/ Load Controller

730-012	**12 amp, 12 volt only**	**$110**



The C12 was designed to completely control small systems, automatic lighting systems and unattended remote systems. It can function as a charge controller, load controller and lighting controller at the same time. The C12 can regulate either wet or sealed lead-acid batteries. Its automatic equalization capability makes the C12 an ideal controller for unattended lead acid battery banks. Excellent installation instructions and Trace's standard 2 year warranty are included.

SCI ASC-8/12 Charge Controller

731-008	**12 volts, 8 amps**	**$53**
731-009	**24 volts, 8 amps**	**$53**

This is a small, compact, epoxy encapsulated charge controller that will work with an array output up to 8 amps (two 50W modules, or one 110W module). The ASC-8 has a red LED which lights while charging and flashes as the battery bank reaches full charge. This controller is most often used on one module systems that will not later become large systems.

C35 Charge Controller with CM Meter attached.

CM R/50 Remote

Morningstar Charge Controllers

TriStar TS-45 with Meter

We now carry the full line of Morning Star charge controllers: the TriStar, ProStar, SunSaver and SunGuard charge controllers as well as the SunLight lighting control. The TriStar will fit into any of our pre-wired power panels or charge controller panels. It is fully protected (short circuit,, reverse polarity and overload) and is rated at 45 or 60 amps at 12 to 48 volts. Both remote and attached meters are available for the TriStar. The ProStar and Sunsaver offer low battery disconnect from 6 to 30 amps and 12 to 48 volts. The SunGuard is an inexpensive 4.5A 12V controller and the SunLight Controller allows 10 lighting options at 10 to 20A at 12 or 24V. Morningstar has many more options in their charge controller line than we have room to list here. Please call for more details about this versatile line of charge controllers.

736-045	**TriStar TS-45 45A 12 to 48V**	**$174**
736-060	**TriStar TS-60 60A 12 to 48V**	**$233**
736-047	**TriStar Digital Meter**	**$113**
736-003	**TriStar Remote Digital Meter**	**$136**
736-001	**Remote Temperature Sensor**	**$32**
736-210	**SunSaver 10A 12V**	**$57**
736-210L	**SunSaver 10A 12V w/LVD**	**$72**
736-310L	**SunSaver 10A 24V w/LVD**	**$79**
736-406	**SunGuard 4A 12V**	**$34**

Morningstar also has maximum power point tracking (MPPT) charge controllers available. They have MPPT versions of their popular TriStar TS-45 and TS-60 as well as a less powerful model, good for small systems.

736-145	**TS-MPPT-45 45A 12 to 48V**	**$547**
736-160	**TS-MPPT-60 60A 12 to 48V**	**$689**
736-147	**Digital Meter for MPPT**	**$104**
736-103	**Remote Meter for MPPT**	**$147**
736-	**MPPT SunSaver 15A 12 & 24V**	**$286**

SunSaver 15A MPPT

Steca Charge Controllers

737-010	**PR 1010 12/24V 10A**	**$150**
737-015	**PR 1515 12/24V 15A**	**$279**

Steca PR1010

Steca charge controllers are made in Germany and incorporate all the aspects of German engineering that one would expect. The controllers include a load controller as well as a charge controller. They feature an LCD meter which monitors state-of-charge in percent, array current and battery bank voltage. The meter also monitors load current. The current rating is for both charge and load control. The included manual guides you through very thorough installation and operation procedures. A very nice charge controller for someone who wants excellent control for a smaller system.

SunSaver 10 w/LVD

Tri-Star MPPT Charge Controller with attached digital meter.

MPPT CHARGE CONTROLLERS

Maximum Power Point Tracking

Many people have asked about power point tracking and whether it has any real advantages. Maximum Power Point Tracking (MPPT) converts the difference between a solar modules rated voltage, (usually 17 volts) and a battery banks charging voltage (up to 14.7 volts) into usable charging current. Often claims are made for up to a 30% increase in charging current. This gain, however, is possible under a very limited set of conditions. The "extra" module voltage is there for a reason: to allow for real world use of the solar module, ie. the voltage drop caused by the array wiring and other components, including the charge controller, between the solar array and batteries. Also, high ambient temperatures cause the solar module to drop in voltage further reducing this "extra" voltage.

Having said that, there are times when the voltage difference will be high enough to provide extra current to a battery bank utilizing this type of charge controller. Cold weather comes to mind, as well as low battery bank voltage. Under these conditions, it can be possible to get as much as 10% to 30% more current from your solar modules.

A more important use for the MPPT charge controllers featured on this page, is the ability to use higher voltage arrays to charge lesser voltage battery banks, ie. a 48 volt array can charge a 24 volt bank (or even a 12V bank). The higher voltage means less current through the array wires and therefore less voltage drop. Longer distances can now be done using smaller wire sizes. This is a very important feature of these particular charge controllers.

MidNite Classic 150 Charge Controller

757-110 Classic 150 Charge Controller $850

The MidNite Classic charge controller features maximum power point tracking (MPPT) which allows all available energy to be extracted from the solar array. (See the side bar for a more detailed description of MPPT). The Classic is also the only charge controller to meet all requirements of the 2011 National Electric Code, including built-in ground-fault and arc-fault protection. The Classic substantially increases the flexibility, features and range currently found on MPPT controllers.

- 5 Year Warranty
- Integrated PV Ground Fault & Arc Fault Protection
- 150, 200 and 250V operating voltages
- Three Stage Controller: Bulk, Absorption and Float
- Reverse Current Protection
- Over and Under Voltage Protection
- Output Over Current Protection
- Remote & Local Display Option showing Battery Bank Voltage,Array Current and Battery Charging Current
- Dimensions (inches): 14.91H x 6.00W x 3.94D
- Ethernet, USB and RS232 (20 megs data logging)
- Battery Temperature Sensor Included
- Programmable Output for Battery Box Vent Fan
- UL 1741 and CSA Certified

Xantrex XW MPPT60-150 Charge Controller

730-061 XW-60 Charge Controller $685

The XW charge controller features maximum power point tracking (MPPT) which allows all available energy to be extracted from the solar array.

The XW can be used with 12, 24, 36, 48 and 60 volt battery systems. It is also capable of charging a lower voltage battery bank with a higher voltage array. This allows longer array wiring runs without the higher cost of larger wire while still maintaining maximum array output. The MPPT power points are constantly adjusted to maintain maximum array output for all sunlight conditions. The XW 60 is capable of 60 amps charging current into the battery bank and can withstand 150 VDC open circuit voltage from the array.

- 5 Year Warranty
- Integrated PV Ground Fault Protection
- Three Stage Controller: Bulk, Absorption and Float
- Reverse Current Protection
- Over and Under Voltage Protection
- Output Over Current Protection
- Digital Display Option showing Battery Bank Voltage, Array Current and Battery Charging Current
- Battery Temperature Sensor Included
- Programmable Output for Battery Box Vent Fan
- UL 1741 and CSA Certified

Outback Charge Controller

735-060 Outback FLEXmax60 $749
735-080 OutBack FLEXmax80 $849

The Outback FLEXmax Series charge controllers are maximum power point tracking charge controllers with the ability to charge lower voltage battery banks with higher voltage arrays. That means it could charge a 12VDC battery bank with a 48V or 24V array.

This ability to work on a 12V to 60V battery bank with an open circuit voltage of up to 150V allows your system to achieve its greatest possible performance.

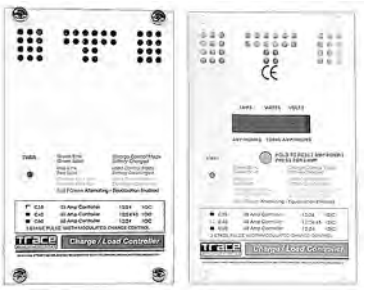
The FLEXmax60 and 80 have a backlit LCD display which monitors system performance and is also used for programming system operation. These are among the finest charge controllers on the market.

- Output Current 60A, 80A
- Nominal Battery Voltage 12,24,32,36,48,60 VDC
- PV Open Circuit Voltage 150V Rated
- Charging regulation Methods Bulk, Absorption, Float, Silent and Equalization
- Voltage Regulation Set-points 10 to 80 VDC
- Equalization Voltage Up to 5V above Absorption
- Digital Display 4 Line, 80 character
- Warranty Standard 5 Year
- Dimensions Fm 60 13.5" H x 5.75" W x 4" D
  Fm 80 16.5" H x 5.75" W x 4" D

Charge Controller Kit #1

783-001 For both 12V and 24V systems $199

This kit consists of a Trace C35 charge controller and a Trace CM meter set. The CM digital meter takes the place of the original C35 cover plate. This has what you need for a small cabin PV system or an RV system. The C35 can handle up to 35 amps at either 12 or 24 volts DC. The C35 has integral over current protection. If an over current condition is present, the C35 shuts down, and restarts automatically when the condition is removed. For added safety, a fuse should be added between the controller and the positive wire to the batteries. See page 32 for more information on the C35.



Charge Controller Kit #1: C35 and CM Digital Meter

Charge Controller Kit #2

783-102 For both 12V and 24V systems $259

This kit consists of a Trace C35 charge controller, a Trace CM meter set and a MidNite "Big Baby Box" with two circuit breakers. This kit is the same as Kit #1 with the breakers included for a main disconnect and array disconnect. There is room for two more circuit breakers for DC loads. The Big Baby Box also includes a negative bus-bar. You do the wiring.

Charge Controller Kit #2: Big Baby Box and C35 + CM Meter

Charge Controller Kit #3

Pre-wired with a C-Series Charge Controller and CM Meter

783-103	**With C35 & CM 35A, 12V & 24V**	**$459**
783-104	**With C40 & CM 40A, 12V, 24V**	**$499**
783-105	**With C40 & CM 40A, 48V/L. Arrestor**	**$589**
783-108	**With C60 & CM 60A, 12V & 24V**	**$529**
783-201	**One Additional 15A DC Load Breaker**	**add $23**
783-202	**Two Additional 15A DC Load Breakers**	**add $36**
783-203	**Three Additional 15A DC Load Breakers**	**add $63**

Most PV system buyers now take advantage of this option. For a small amount more than the individual components, you get a pre-wired set of controls. This kit consists of a C35, C40 or C60, a CM meter, an array disconnect, a controller disconnect, a lightning protector and a 10 foot, #6 ga. cable with lugs for battery connection. The circuit breakers and a terminal strip for the array input are pre-wired in a MidNite Solar Mini-Disconnect Panel, creating an integral and labeled unit. Just run the wires in from the solar modules and connect the 6 Ga. cable to the batteries and you are all set. Specify array size and we will size the circuit breaker for you (20A, 30A, 40A, 63A).

Up to three additional DC circuit breakers can be added to this assembly for DC load circuits. This makes the CC Kit #3 an ideal complete solution for DC wiring in a camp or cabin.

Charge Controller Kit #3: Exterior and Interior Views

Charge Controller Kit #4

Prewired with an MPPT Charge Controller

783-1	**With MidNite Classic 150 Charge Controller**	
	90A, 12V to 72V, NEC Compliant	**$1099**
783-114	**With OutBack FM-60 60A, 12V to 60V**	**$989**
783-116	**With OutBack FM-80 80A, 12V to 60V**	**$1099**
783-115	**With Xantrex XW60 60A, 12V to 60V**	**$939**

Charge Controller Kit #4 has an MPPT charge controller mounted on the door of a MidNite Mini-Disconnect panel.The controller disconnect is a DC circuit breaker breaker sized for the charge controller (60A to 90A). The array disconnect is also a DC circuit breaker sized for your array downlead. The breakers are labeled as to function and voltage. A 10' #4 or #6 AWG cable with lugs for connection to the battery bank is included. A MidNite Lightning Arrestor is also wired on the array input terminal strip.All wiring and circuit breakers are in place and ready to go. Just run the array cable in from the solar modules and connect the battery cable to the battery bank. CC Kit#4's can have one to three breakers added for DC loads.

Note: In order for CC Kit # 3 or CC Kit #4 to meet the National Electrical code, a ground fault interrupt breaker set must be added to the kit (except for the Classic 150). This would add $69 to the kit price.

Charge Controller Kit #4 with Classic 150