

Charge Controllers / Regulators

Why you need a Controller

The main function a controller or regulator is to fully charge a battery without permitting overcharge while preventing reverse current flow at night. If a non-self-regulating solar array is connected to lead acid batteries with no overcharge protection, battery life will be compromised. Simple controllers contain a transistor that shunts the PV charging circuit, terminating the charge at a pre-set high voltage and, once a pre-set reconnect is reached, opens the shunt, allowing charging to resume. More sophisticated controllers utilize pulse width modulation (PWM) or maximum power point tracking (MPPT) to assure the battery is being fully charged. The first 70% to 80% of battery capacity is easily replaced, but the last 20% to 30% requires more attention and therefore more complexity.

How controllers work and available options

The circuitry in a controller reads the voltage of the batteries to determine the state of charge. Designs and circuits vary, but most controllers read voltage to control the amount of current flowing into the battery as the battery nears full charge. Features of a controller to consider include:

- Reverse current leakage protection - by disconnecting the array or using a blocking diode to prevent current loss into the solar modules at night.
- Low-voltage load disconnect (LVD) - to reduce damage to batteries by avoiding deep discharge.
- System monitoring - analog or digital meters, indicator lights and/or warning alarms.
- Overcurrent protection - with fuses and/or circuit breakers
- Mounting options - flush mounting, wall mounting, indoor or outdoor enclosures.
- System control - control of other components in the system; standby generator or auxiliary charging system, diverting array power once batteries are charged, transfer to secondary batteries.
- Load control - automatic control of secondary loads, or control of lights, water pumps or other loads with timers or switches
- Temperature compensation - utilized whenever batteries are placed in a non-climate controlled space. The charging voltage is adjusted to the temperature.



- Pulse Width Modulation (PWM) - an efficient charging method that maintains a battery at its maximum state of charge and minimizes sulfation build-up by pulsing the battery voltage at a high frequency.
- Maximum Power Point Tracking (MPPT) - a new charging method designed to extract the most power possible out of a solar module by altering its operating voltage to maximize the power output.

Sizing a Controller

Some systems require most of these functions, others require only one or a certain combination. Your KSI dealer can help you select a unit to meet your specific needs. Charge controllers are rated and sized by the array current and system voltage. Most common are 12, 24, and 48-volt controllers. Amperage ratings run from 1 amp to 60 amps, voltages from 6-60 volts.

For example, if one module in your 12-volt system produces 7.45 amps and two modules are utilized, your system will produce 14.9 amps of current at 12 volts. Because of light reflection and the edge of cloud effect, sporadically increased current levels are not uncommon. For this reason we increase the controller amperage by a minimum of 25% bringing our minimum controller amperage to 18.6. Looking through the products we find a 20-amp controller, as close a match as possible. There is no problem going with a 30-amp or larger controller, other than the additional cost. If you think the system may increase in size, additional amperage capacity at this time should be considered.

ProStar Charge Controllers

Morningstar has upgraded their very popular ProStar line of pulse width modulated (PWM) charge controllers to include several new features. The new design is still dual voltage at 12 or 24 volts with an optional LCD display, but it is now available only in 15 or 30 amp capacities. Morningstar has added a 15 amp 48 volt model to the ProStar lineup that comes standard with the LCD display. A 15A/48V positive ground model (PN 34939) is available. The ProStar's LCD display still shows battery voltage, array amperage and load amperage (if applicable), but now it also shows system information when a self diagnostics test is performed as well as error codes to let you know what is going on if it detects a fault. Internal temperature compensation is still standard. These additional features make the new ProStar controllers one of the most advanced on the market. Five year warranty.

Product Name and Description	Part Number	Array/Load Amperage	Meter	Price
PS-15	703062	15	No	\$115.00
PS-15M	703063	15	Yes	\$184.00
PS-15M/48V	703064	15	Yes	\$229.00
PS-30	703057	30	No	\$157.00
PS-30M	703056	30	Yes	\$226.00
PS-15M/48V-PG	703050	15	Yes	\$246.00
PS-30M-PG	703070	30	Yes	\$243.00



Morningstar ProStar



Morningstar SunSaver

SunSaver and SunGuard Charge Controllers

The SunSaver line of controllers offers most of the same features of the ProStar line, but without the battery status LED's, automatic equalization circuit or the optional LCD display. The SunSaver is a PWM controller and is available in 12 or 24 volt models from 6 to 20 amps. Morningstar makes a variation of the SunSaver called the SunLight controller that is designed specifically for 12 or 24V lighting systems. Turn to page 38 for details and pricing on the SunLight controllers. Five year warranty.

The SunGuard is the little brother of the SunSaver and it is only available in a 12V version with a 4 amp capacity. It is also a PWM controller with temperature compensation and simple 4 wire hookup. The SunGuard has a slightly lower output voltage (14.1 V) than the SunSaver and ProStar and may not be the best choice for flooded batteries that require a higher voltage. Five year warranty.

SHS and SunKeeper Controllers

The SHS was specifically designed to meet the needs of solar home systems in developing countries. This controller meets World Bank specifications and features protections such as blinking the loads as a warning prior to LVD disconnect. They also have built-in electronic fuses that do not require : **These controllers switch the negative leg and do not meet NEC code. The voltage is preset at 14.3 volts and is not adjustable.** If the system is grounded in more than 1 point, charging or load control may be disabled. Two year warranty. The SK controller provides a low cost regulated output directly from the solar module and mounts directly to the module junction box. Class 1, Div 2 rated for hazardous locations. Regulates at 14.1 volts. Optional temp comp (RTS). 5yr warr.

Product Name and Description	Part Number	Array Amperage	Load Amperage	Voltage	LVD	Price
SunSaver 6	703058	6.5	N/A	12	No	\$50.00
SunSaver 6L	703059	6.5	6	12	Yes	\$61.00
SunSaver 10	703060	10	N/A	12	No	\$57.00
SunSaver 10L	703061	10	10	12	Yes	\$73.00
SunSaver 20L	703048	20	20	12	Yes	\$99.00
SunSaver 10L-24	703051	10	10	24	Yes	\$79.00
SunSaver 20L-24	703049	20	20	24	Yes	\$105.00
SunGuard 4	703045	4.5	N/A	12	No	\$31.00
SHS 6	703046	6	6	12	Yes	\$30.00
SHS 10	703047	10	10	12	Yes	\$40.00
SK-6	703076	6	N/A	12	No	\$63.00
SK-12	703078	12	N/A	12	No	\$89.00
DIN-1 Mounting Clips	706332	50 pair	with screws	-	-	\$50.00



Morningstar SunGuard Controller



Morningstar SHS Controller



Morningstar SK-12

TriStar™ Controllers

Morningstar's TriStar Controller is a three-function controller that provides reliable solar battery charging, load control or diversion regulation. This controller operates in only one of these modes at a time but two or more controllers may be used to provide multiple functions. The TriStar uses advanced technology and automated production to provide exciting new features at a competitive cost. The controller is UL listed and is designed for both solar home systems and industrial applications. Five year warranty.

- Rated for 45A or 60A, both at 12V or 24V or 48V
- Includes RS-232 communication port for customizing controller set points or data logging
- Optional on-board digital meter and remote meter
- Designed for mechanical fit on a Xantrex power panel or OutBack PSDC
- Provides extra bending room for large wires
- 100% solid state microprocessor controller

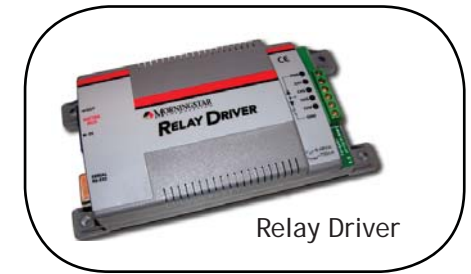


TriStar Controller

Relay Driver

The Relay Driver is a logic module which provides high level system control functions such as high/low voltage alarms, load control and generator start. The Relay Driver is less expensive than other alarm and generator start packages. It controls four independent relay driver outputs by reading digital data inputs from Morningstar's TriStar controller or by reading battery voltage when used in systems with other controllers.

The relay Driver may be mounted to a DIN rail and is fully programmable with the included PC software via serial RS-232 port connection. Other key product benefits include high reliability, flexibility to choose the exact relay needed for each application and advanced generator control.



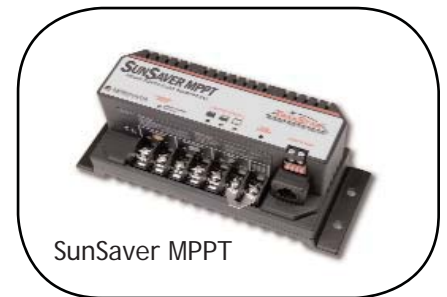
Relay Driver

Product Name and Description	Part Number	Voltage	Load Amperage	Price	Shipping Weight (lbs.)
TriStar-45	703065	12V, 24V, 48V	45	\$175.00	4.5
TriStar-60	703066	12V, 24V, 48V	60	\$226.00	4.5
TriStar Digital Meter	703067	-	-	\$102.00	0.5
TriStar Remote Digital Meter	703068	-	-	\$141.00	0.5
Remote Temperature Sensor (33 ft.)	703069	-	-	\$32.00	1.0
Relay Driver	703071	12V, 24V, 48V	750mA	\$169.00	0.4
PC Meterbus Adapter	706953	-	-	\$39.00	0.5
Remote Meter RM-1(fits; Suresine, MPPT, Duo)	706951	-	-	\$97.00	0.5

SunSaver MPPT

Morningstar's SunSaver MPPT solar controller with TrakStar Technology is an advanced maximum power point tracking (MPPT) battery charger for off-grid photovoltaic (PV) systems. The controller features a smart tracking algorithm that maximizes the energy harvest from the PV and also provides load control to prevent over discharge of the battery. Adjustable via PC or on-board switches. Remote meter and battery temperature sensor are options. Five year warranty.

Product Name and Description	Part Number	Voltage	Amperage	Price	Shipping Weight (lbs.)
SS-MPPT-15L	706347	12 or 24	15	\$278.00	1.3



SunSaver MPPT

SunLight Solar Lighting Controllers

This controller performs both battery charging and light controlling functions by utilizing your solar array as a photocell. It turns your DC light on at dusk when the solar array voltage drops and will operate the light for a user selectable time period from 2 hours to dusk to dawn. Built-in temperature compensation, low voltage disconnect and manual test button greatly simplify system operation. Sunrise overrides lighting timer and the controller turns the light off. Five year warranty.

Product Name and Description	Part Number	Voltage	Amperage	Price	Shipping Weight (lbs.)
SL10	703052	12	10	\$111.00	.69
SL10-24	703053	24	10	\$119.00	.69
SL20	703054	12	20	\$145.00	.69



SunLight 10



Automatic Sequencing Charger (ASC)

Specialty Concepts, Inc.

The ASC is a very compact, efficient, 100% solid-state battery charge regulator for use in photovoltaic systems. It is available in 12-volt and 24-volt units up to 16 amps. The ASC is a negative-ground shunt regulator, housed in an anodized aluminum chassis and encapsulated in a hard epoxy resin. The terminal block accepts up to 12 gauge wire or a spade connector, providing simple installation. Shipping weight 2 lbs. Five year warranty.

- Solid state, encapsulated for high reliability.
- Low frequency, pulse charge method - no RF noise.
- UL listed, CSA, FM approved for hazardous locations.
- Optional low voltage disconnect or alarm contacts.
- 5 year warranty.
- Optional temperature compensation is on a remote sensor for accurate temperature monitoring.

Product Name and Description	Part Number	Volts	Amp Capacity	Price
ASC 12/8	703884	12.0	8.0	\$53.00
ASC 12/8A - with Temp. Comp.	703885	12.0	8.0	\$62.00
ASC 12/8AE - with Temp. Comp. Low Voltage Disconnect	703887	12.0	8.0	\$76.00
ASC 12/16	703888	12.0	16.0	\$70.00
ASC 12/16A - with Temp. Comp.	703889	12.0	16.0	\$81.00
ASC 24/16	703891	24.0	16.0	\$70.00



ASC Controller

RV / Cabin Controllers

Specialty Concepts, Inc.

MARK Series controllers are cost effective, flush mount, battery charge controllers with digital system monitoring. Both MARK/15 and 22 provide efficient charging while protecting the batteries from damage due to overcharging. These controllers are designed for use in mobile or stationary PV systems, and offer complete system monitoring of battery voltage, solar charging current, and charge set-point calibration. Five year warranty.

Product Name and Description	Part Number	Amp Capacity	Price
MARK/15-12	703893	15	\$134.00
MARK/22-12	703894	22	\$147.00



MARK/15-12



Morningstar's SunSaver Duo is an advanced PWM two battery controller for RV's, caravans, boats and cottages. The product will charge two separate and isolated batteries at the same time, such as a house and an engine battery, based on user selectable priorities. The remote meter and LED's display system status data and any system errors. Custom icons and back lighting make the meter easy to read and understand. Five year warranty.

Product Name and Description	Part Number	Amp Capacity	Price
SunSaver Duo	703079	25	\$188.00



SunSaver Duo



OutBack MPPT Charge Controller

FLEXmax 60

The OutBack FM60 Maximum Power Point Tracking (MPPT) charge controller enables your PV system to achieve its highest possible performance. Rated for up to 60 amps of DC output current, the MX60 can be used with battery systems from 12 to 60 VDC with PV open circuit voltage as high as 145 VDC. The MX60's set points are fully adjustable to allow use with virtually any battery type, chemistry and charging profile. The MX60 allows you to use a higher output voltage PV array with a lower voltage battery. This reduces wire size and power loss from the PV array to the battery / inverter location and can maximize the performance of your PV system.

The FM60 comes standard with an easy to use and understand display of the PV system's performance. The four line, 80 character, back-lit LCD display is also used for programming and monitoring of the system's operation, including built-in data logging with 128 days of memory.

The FM60 can also be connected to the OutBack MATE system controller and display to allow control & monitoring of up to eight FM60 controllers from a location up to 1000 feet away. The MATE also includes an opto-isolated RS232 port for connection to a PC for data logging and system monitoring. See page 62 for more information on the MATE.



FLEXmax 60

Model Number	FM 60
Part Number	706660
Price	\$699.00
Output Current Rating	60.0 Amps DC Maximum at 12, 24, or 48 VDC
Nominal Battery Voltage	12, 24, 32, 36, 48, 54, or 60 VDC
PV Maximum Open Circuit Voltage	150 VDC absolute max coldest conditions/145 VDC startup & op. max.
Standby Power Consumption	Less than 1 Watt typical
Charging Regulation Methods	Five Stage: Bulk, Absorption, Float, Silent, Equalization
Charging Regulation Set Points	10 - 60 VDC
Data Logging	Last 128 days of operation
Equalization Voltage	Adjustable 1.0 to 5.0 VDC above Bulk Setpoint
Temperature compensation	Programmable slope -2.0mV/oC/Cell to -5.0mV/oC/Cell
Voltage Step-Down Capability	Can change a lower voltage battery from a higher voltage PV array
Power Conversion Efficiency	98.1% @60A with a 48V battery & nominal 48V PV array
Digital Display	4 line 80 character backlit LCD Display
Remote Interface	RJ45 Modular Connector CAT 5 Cable 8 wire
Operating Temperature Range	-40 to 60 oC Power derated above 40 oC
Environmental Rating	Indoor Type 1
Conduit Knockouts	Two 1/2 & 3/4" on the back; One 3/4" & 1" on each side; Two 1" 3/4" on the bottom
Warranty	5 years / optional 10 year warranty
Dimensions (HxWxD) (in)	Enclosure: 13.5 x 5.75 x 4 / Shipping Box: 18 x 11 x 8
Shipping Weight (lbs.)	14.0

OutBack Charge Controller Accessory

Product Name and Description	Part Number	Shipping Weight (lbs.)	Price
RTS - Outback Remote Temperature Sensor w/ 20' cable	704275	1.0	\$29.00



OutBack MPPT Charge Controller

FM80

The FLEXmax 80 is the latest innovation in Maximum Power Point Tracking (MPPT) charge controllers from OutBack Power Systems. The FLEXmax 80's innovative MPPT algorithm is both continuous and active, increasing your renewable energy yield up to 30%. Thanks to enhanced cooling, the FLEXmax 80 can operate at its full 80 amp maximum current rating in ambient temperatures as high as 104°F (40°C).

Included in the FLEXmax 80 are all of the features first developed by OutBack Power in the revolutionary MX60, such as support for a wide range of nominal battery voltages and the ability to step-down a high voltage solar array to recharge a low voltage battery. A built-in backlit display shows status information at the touch of a button. Enhanced network communications allow the FLEXmax 80 to be remotely programmed via the optional MATE system display and controller.

The new FLEXmax 80 is the only choice when you demand a high performance, efficient and customizable charge controller for your advanced power system.



Model Number	FM 80
Part Number	705981
Price	\$749.00
Output Current Rating	80.0 Amps DC at 104F (40C) w/adj. current limit
Nominal Battery Voltage	12, 24, 32, 36, 48, 54, or 60 VDC
PV Maximum Open Circuit Voltage	150 VDC absolute max coldest conditions/145 VDC startup & op. max.
Standby Power Consumption	Less than 1 Watt typical
Charging Regulation Methods	Five Stage: Bulk, Absorption, Float, Silent, Equalization
Charging Regulation Set Points	13 - 80 VDC user adjustable with password protection
Data Logging	Last 128 days of operation
Equalization Voltage	Programmable voltage setpoint and duration - Auto termination
Temperature compensation	Automatic with optional RTS installed / 5.0 mVper degree C per 2V cell
Voltage Step-Down Capability	Can change a lower voltage battery from a higher voltage PV array
Power Conversion Efficiency	97.5% @80A with a 48V system - Typical
Digital Display	4 line 80 character 3.1" backlit LCD Display
Remote Interface	RJ45 Modular Connector CAT 5 Cable 8 wire
Operating Temperature Range	-40 to 60 oC Power derated above 40 oC
Environmental Rating	Indoor Type 1
Conduit Knockouts	One 1" on the back; One 1" - 1" on the left side; Two 1" on the bottom
Warranty	5 year warranty
Dimensions (HxWxD) (in)	Enclosure: 16.25 x 5.75 x 4 / Shipping Box: 21 x 10.5 x 9.75
Shipping Weight (lbs.)	15.75



Solar Charge Controller

The simplicity and high performance of the Steca Solarix PRS solar charge controller makes it particularly appealing. At the same time, it offers a modern design and a convenient display, all at an extremely attractive price. Several LEDs in various colours emulate a tank display, which gives information on the battery's state of charge. Here, Steca's latest algorithms are employed, resulting in optimal battery maintenance. The Solarix PRS charge controllers are equipped with an electronic fuse, thus making optimal protection possible. They operate on the serial principle, and separate the solar module from the battery in order to protect it against overcharging. For larger projects, the charge controllers can also be equipped with special functions. These include a night light function, a selectable charging plateau and deep-discharge protection voltages. Two year warranty.



Secta Solarix PRSt

More Features

- Temperature-adjusted SOC
- Automatic voltage detection
- PWM control
- Multistage charging technology
- Current compensated load disconnection
- LEDs, fixed / flashing, different colors, provide SOC and operation status-on Solarix line
- Reverse polarity protection of load, module & battery
- Extremely low electromagnetic emissions
- Integrated self test

Product Name and Description	Solariz PRS 1010	Solarix PRS 1515	Solarix PRS 2020	Solariz PRS 3030	Solarix PA RC 100
Part Number	707063	706206	706207	706208	707123
Price	\$67.60	\$72.80	\$80.60	\$106.60	\$130.00
Max charge current at 25°C	10A	15A	20A	30A	N/A
Max load current at 25°C	10A	15A	20A	30A	N/A
Temperature compensation	-4mv/k/zelle				N/A
Admissible ambient temperature	-25 to 50°C				N/A
Connection terminal (fine/single wire)	#6/4 AWG				N/A
Weight (lbs.)	0.8				
Dimensions (mm)	187 x 96 x 45				
Enclosure	IP 32				
System voltage	12/24V				

SolSum™

The new Steca Solsum F-Line continues the huge success of one of the most used SHS controllers. With a power range of up to 10 A it automatically recognizes 12 V or 24 V it accommodates system sizes up to 240 W.

The circuit board is completely electronically protected and with the new designed LED user interface it is easy to check the battery state of charge at any time. Large terminals guarantee a simple connection of solar panels, battery and load. The brand new Solsum works on PWM as a low loss serial controller. Two year warranty.

More Features

- Overvoltage protection
- Series PWM controller
- Built-in electronic fuse
- Automatic voltage detection 12/24V
- Reverse polarity protection
- CE Certified
- Temperature Compensation
- Current compensated load disconnection



Solsum 6.6F

Product Name and Description	Solsum 6.6F (with LVD)	Solsum 8.8F (with LVD)	Solsum 10.10F (with LVD)
Part Number	707109	707120	707121
Price	\$24.00	\$32.00	\$42.00
Max charge current at 50oC	6A	8A	10A
Load current at 50oC	6A	8A	10A
Connection terminal (fine/single wire)	#9/12 AWG		
Weight (lbs.)	0.33		
Dimensions (mm)	145 x 97 x 24		
Enclosure	IP32		
Ambient temperature	-25 to 50oC		
System voltage	12/24V		

XW Solar Charge Controller (XW SCC)

The Xantrex Solar Charge Controller is a photovoltaic (PV) charge controller that tracks the electrical maximum power point of a PV array to deliver the maximum available current for charging batteries. The XW SCC can be used with 12, 24, 36, 48, and 60-volt DC battery systems. Two or three-stage charging process, with manual equalization to maximize system performance and maintain expected battery life

- Maximum Power Point Tracking (MPPT) to deliver the maximum available power from a PV array to a battery bank
- Configurable auxiliary power output
- Two-line, 16-character liquid crystal display (LCD) and four buttons for configuration and system monitoring in stand alone applications
- Battery Temperature Sensor (BTS) to provide automatically temperature-compensated battery charging
- The Charge Controller is able to communicate its settings and activity to other Xanbus™ enabled devices
- Integrated PV ground-fault protection



Xantrex
XW-MPPT60-150

Model Number	XW-MPPT60-150
Part Number	705199
Price	\$685.00
Array Short Circuit Current	60.0 Amps DC Maximum
Nominal Battery Voltage	12, 24, 36, 48 or 60 VDC
PV Maximum Open Circuit Voltage	150 VDC (140VDC operating)
Charging Regulation Methods	Three Stage: Bulk, Absorption, Float
Charging Regulation Set Points	13 - 80 VDC
Temperature compensation	Remote BTS included
Voltage Step-Down Capability	Can charge a lower voltage battery from a higher voltage PV array
Digital Display	2 line 16 character LCD Display
System Interface	Xanbus
Operating Temperature Range	-4 to 113F (-20 to +45 oC)
Environmental Rating	Indoor Type 1
Warranty	5 year warranty
Shipping Dimensions (HxWxD)	19 x 9 x 9.75" (483 x 229 x 350mm)
Shipping Weight (lbs.)	17.6 (8kg)