



samlexpower®

**Portable
Solar
Charging Kit**

MSK-90
MSK-135

**Owner's
Manual**

Please read this
manual BEFORE
using your
Portable Solar
Charging Kit

OWNER'S MANUAL | Index

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SECTION 1 | Safety Instructions

IMPORTANT SAFETY INSTRUCTIONS

PLEASE READ THE FOLLOWING SAFETY INSTRUCTIONS BEFORE USING THE KIT. FAILURE TO ABIDE BY THE RECOMMENDATIONS MAY CAUSE PERSONAL INJURY / DAMAGE.

The following safety symbols will be used in this manual to highlight safety and information:



WARNING!

Indicates possibility of physical harm to the user in case of non-compliance.



CAUTION!

Indicates possibility of damage to the equipment in case of non-compliance.



INFO

Indicates useful supplemental information.



WARNING!



CAUTION!

1. Although the solar modules are waterproof (Ingress Protection Rating is IP-65), the charge controller MSK-10A attached at the back of one of the modules is not waterproof (Ingress Protection Rating is IP-30). PLEASE ENSURE THAT THE KITS ARE INSTALLED IN DRY ENVIRONMENT
2. The design of the Charge Controller allows ONLY Positive grounding where required. Ground the Positive terminal of the solar array input on the Charge Controller or the Positive terminal of the battery. DO NOT ground the Negative
3. To reduce the risk of injury, charge only 12V Lead Acid Batteries - Sealed/AGM types. Other types of batteries may be subject to bursting which can lead to personal injury and damage.
4. Comply with battery manufacturer's recommendations
5. Avoid charging damaged, defective or old battery.
6. Ensure correct polarity is maintained when connecting the Charge Controller to the battery - Connect the Positive Battery Clip (Red) to the Positive Battery Post and the Negative Battery Clip (Black) to the Negative Battery Post. Reversal of polarity connection will blow the inline protective fuse.
7. When charging, removal of the battery from the vehicle is not necessary provided the battery is being charged in a well-ventilated area.
8. Batteries contain very corrosive diluted Sulphuric Acid as electrolyte. Precautions should be taken to prevent contact with skin, eyes or clothing. If the battery acid makes contact with skin or clothing, flush immediately with water. See a doctor immediately.

SECTION 1 | Safety Instructions

9. Batteries generate Hydrogen and Oxygen during charging which may result in an explosive gas mixture. Care should be taken to ventilate the battery area and follow battery manufacturer's recommendations.
10. Ensure there are no flammable substances, explosive gases, flames, smoke or spark near the battery or the panels.
11. Use caution to reduce the risk of dropping a metal tool on the battery. It could spark or short circuit the battery or other electrical parts and could cause an explosion.
12. Remove metal items like rings, bracelets and watches when working with batteries. Batteries can produce a short circuit current high enough to weld a ring or the like to metal and thus cause a severe burn.
13. If you need to remove a battery, always remove the ground terminal from the battery first. Make sure that all the accessories are off so that you do not cause a spark.
14. Solar panels generate electrical power when exposed to sunlight. Place a dark cover over the panels when handling panels that have bare, un-insulated output wires. Accidental shorting of panel terminals or wiring connected to the panels can result in spark causing personal injury or a fire hazard.
15. It is important that the battery gets fully charged frequently (at least once per week). Otherwise, the battery can become permanently damaged due to under charging. Partially charged batteries can quickly sulfate internally which is an irreversible condition. It is good practice to prevent a battery from being discharged below 50%. Deeper discharging severely shortens battery life.
16. Keep the surface of solar panels clean from dust. Clean with a soft cloth.
17. Do not walk on the panels.
18. Avoid solar panel contact with water, acid or alkali.
19. Do not scratch or bend solar panels.
20. Do not disassemble or open the solar panels or the Charge Controller. There are no user-serviceable parts in this Kit .
21. Never allow young children to play with this kit.
22. Do not stack heavy items on top of the solar panels during storage / transportation.
23. Installation of wiring must comply with local and National Electrical Codes and must be carried out by a certified electrician.

SECTION 2 | Description, Applications & Features

DESCRIPTION

MSK-135 and MSK-90 are 135W / 90W Portable and Foldable Solar Battery Charging Kits designed to charge 12V Lead-acid batteries. Basic module is a 30W/45W, 12V nominal high efficiency, monocrystalline solar panel. MSK-135 consists of 3 x 45W solar panels connected in parallel and MSK-90 consists of 3x30W solar panels in parallel to form solar panel array. The kit can be folded neatly into a carrying case with handle, for easy storage while the kit is not in use.

APPLICATIONS

The kits are perfect for charging and maintaining any 12V battery system in the following applications:

- Automotive, Recreation Vehicles, Trailers
- Boats and marine craft
- Motorcycles
- Cabins and cottages
- Camping
- Construction and farm equipment
- Material handling equipment
- All Terrain Vehicles (ATV) and Snowmobiles
- Disaster / emergency preparedness

FEATURES

Modular and durable integrated design with high efficiency monocrystalline solar panels. Panels are built with strong anodized aluminum frames and high transparency solar glass for maximum light permeability and high efficiency.

Maximizing Solar Energy Capture and System Efficiency with Tilting Arrangement

Folding type of support legs with tilt adjustment arrangement have been provided. The unfolded solar array can be conveniently pointed towards the direction (azimuth) of the sun. Ease of adjusting the azimuth of the solar array i.e. the direction that the face of the solar array points and convenient tilting arrangement allow the solar array to point perpendicular to the sun for maximizing solar energy capture and system efficiency.

Portable and Simple

Fold away conveniently into a stylish carrying case with handle, for quick transport or stowage.

Easy “Plug-and-Charge” Battery Connection

Charging starts as soon as battery is plugged to the Charge Controller using 16 ft. of battery cable with Battery clips. Heavy duty, 50A Anderson Type SB50 compatible mating connectors are used for battery cable connection. Additional adapter from Anderson to SAE connector is also provided. No complicated installation, brackets or electrical diagrams.

SECTION 2 | Description, Applications & Features

DESCRIPTION AND FEATURES OF CHARGE CONTROLLER MSK-10A

MSK-10A is a 10A rated, Series Type PWM (Pulse Width Modulation) Charge Controller. It is based on an advanced design using a microcontroller for digital accuracy and fully automatic operation. PWM battery charging has been optimized for longer battery life. The unit is designed for user-friendly operation.

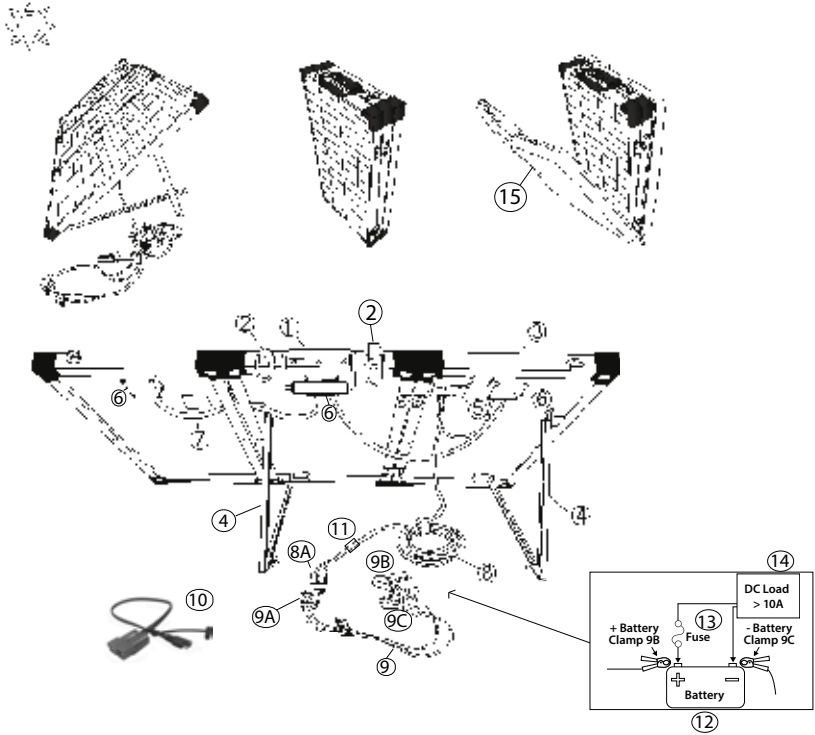
FEATURES

- Advanced microcontroller based, high performance design for digital accuracy and fully automatic and intelligent operation
- Series Type PWM (Pulse Width Modulation) charging for low loss, higher efficiency charging and longer battery life
- 4 Stages of charging for 100% return of capacity and long battery life – Bulk, Absorption (Boost), Equalization and Float Stages
- User friendly LED display for monitoring of operation and self diagnostics for troubleshooting
- Integrated Temperature Sensor for temperature compensation to ensure improved charging of batteries that experience wider temperature variations during the year
- MOSFET based reverse current blocking for night-time battery discharge prevention. This allows much lower losses as compared to Diode based blocking
- Electronic protections: Over charging, over discharging, over heating and overload and short circuit on the Load Terminals.
- Reverse polarity protection: any combination of PV Panel(s) and battery

NOTE: For more detailed information on PWM Battery Charging, Charging Stages and Batteries, please visit www.samlexamerica.com/support/white-papers

SECTION 3 | Layout

OVERALL LAYOUT AND CONNECTION ARRANGEMENT

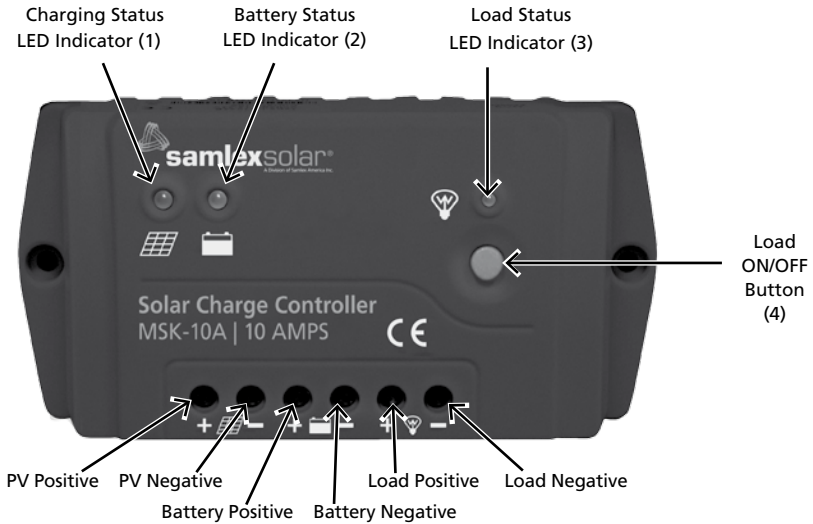


1	Carrying handle
2	Latches
3	Aluminum frame
4	Aluminum support legs with tilting arrangement
5	Solar Charge Controller MSK-10A - see Fig 3.2 for details
6	Junction Box
7	Label
8	14 ft battery cable with Anderson SB50 compatible Connector at battery end
8A, 9A	Anderson SB-50 compatible mating connector
9	2 ft Adapter Cable - Anderson to Battery Clips
9B	Red, Positive Battery Clip
9C	Black, Negative Battery Clip
10	2 ft Adapter Cable - Anderson to SAE
11	10A Fuse and Fuse Holder
12	12V Battery (not included)
13	Fuse for load(s) connected directly to the battery (not included)
14	12V load connected directly to the battery
15	Carrying Case

Fig 3.1 Overall Layout and Connection Arrangement

SECTION 3 | Layout

LAYOUT - CHARGE CONTROLLER MSK-10A



NOTE: RJ-45/RS-485 Communication Port and Temperature Sensor Port located under the terminals are not used for this application.

LED DESCRIPTION	COLOR OF LED	LED LIGHTING PATTERN	OPERATIONAL STATUS
CHARGING STATUS (1) 	Green	On Solid	Normal
	Green	Slowly Flashing	In charging
	Green	OFF	No charge
BATTERY STATUS (2) 	Green	On Solid	Normal
	Green	Slowly Flashing	Full
	Green	Fast Flashing	Over voltage
	Orange	On Solid	Under voltage
	Red	On Solid	Over discharged
	Red	Flashing	Battery over temperature
LOAD STATUS (3) 	Red	On Solid	Normal
	Red	Slowly Flashing	Overload
	Red	Fast Flashing	Short circuit
Charging, Load and Battery Status LED (Red) flashing simultaneously			System voltage error
Charging, Load and Battery Status LED (Orange) flashing simultaneously			Controller overheating

LOAD ON/OFF BUTTON (4)

This button is used to switch ON and switch OFF battery voltage to 12V DC load connected to the Load Terminals (load current should be less than 10A). It is also used to reset to normal operation after fault has been identified and cleared.

Fig 3.2 Layout of Charge Controller MSK-10A

SECTION 4 | Installation & Operation



WARNINGS & CAUTIONS!

PLEASE READ ALL THE SAFETY INSTRUCTIONS GIVEN IN SECTION 1 BEFORE INSTALLING AND OPERATING THE KIT. FAILURE TO ABIDE BY THE RECOMMENDATIONS MAY CAUSE PERSONAL INJURY / DAMAGE TO THE KIT.

Do not use the unit in wet environment

Please note that the solar modules are waterproof (IP-65). However, the Charge Controller MSK-10A attached at the back of one of the modules is not waterproof (IP-30). Hence, please ensure that the kits are installed in dry environment.

OVERALL CONNECTION ARRANGEMENT - SOLAR PANELS, CHARGE CONTROLLER, BATTERY AND LOAD

Fig 3.1 shows overall connection arrangement of the panels, Charge Controller, battery and load. Fig 3.2 shows layout of Charge Controller.

Connection Arrangement of Solar Panels to the Charge Controller

The 3 panels are already connected in parallel to the PV+ and PV- terminals of the Charge Controller (Fig 3.2) through their respective Junction Boxes (6 - Fig 3.1). No additional connection is required to be made.

Connection of Battery or Battery Bank to the Charge Controller

The following arrangement has been provided for connecting the Charge Controller to the battery:

- Battery Terminals of the Charge Controller (Fig 3.2) are prewired to 14ft cable with heavy duty, 50A Anderson Type SB50 compatible, 2-pole Battery Connector (8A, Fig 3.1) through 10A Inline Fuse and Fuse Holder (11, Fig 3.1)
- 2 ft. Adaptor Cable (9, Fig 3.1) with heavy duty, 50A Anderson Type SB50 compatible, 2-pole Battery Connector (9A, Fig 3.1) on one end for connecting to the mating connector on the Charge Controller side (8A, Fig 3.1). Battery alligator clips (9B, 9C - Fig 3.1) are provided on the other end for connecting to the battery.
- 2 ft. Adapter Cable (10, Fig 3.1) with heavy duty 50A Anderson Type SB50 Connector on one end for connecting to the mating Anderson Connector (8A, Fig 3.1) on the Charge Controller side and SAE Connector on the other end to mate with corresponding SAE mating connector for Battery inlet.

SECTION 4 | Installation & Operation

Connect the Battery as follows:

1. Connect the Battery Alligator Clips to the Battery Terminals. **IMPORTANT: OBSERVE POLARITY.** Be careful to attach the RED Positive Alligator Clip (9B, Fig 3.1) to 'Positive' or '+' of the battery and the black Negative Alligator Clip (9C, Fig 3.1) to the 'Negative' or '-' of the battery. If polarity is reversed accidentally, no permanent damage will occur, but the 10A in-line fuse (11, Fig 3.1) will blow. In this case, correct the polarity and replace the fuses.
2. If SAE type of battery inlet is provided on the vehicle, use the Anderson to SAE Adapter Cable (10, Fig 3.1).
3. Removal of the battery from the vehicle is not necessary provided the battery is being charged in a well-ventilated area.
4. It is recommended that the kit be attached to the battery at the beginning of each camping event rather than wait until the battery is dead before connecting. This allows the solar charging system to supply the loads on the battery and fully charge it each day.

Connection of Loads <10A to the Load Terminals of the Charge Controller

The Charge Controller is provided with Load Terminals (Fig 3.2) for powering small loads of up to 10A (max 100 W). Load powered from these terminals provide the following benefits:

- The battery will be protected against deep discharge as the Charge Controller will cut off the load when the battery drops below 11.1V. The load will be automatically re-connected after the battery has recharged to 12.6V.
- The load is protected against overload ($\geq 10A$)

Connection of Loads >10A Directly to the Battery

Loads >10A (14, Fig 3.1) should be connected directly to the battery through appropriate fuse and cable rated at 1.25 times the continuous DC input current of the load (Fig 3.1). The fuse (13, Fig 3.2) should be located as close to the battery as possible (within 7" of Battery Positive). The fuse is required to protect the cable run from the battery to the load against overheating/fire due to short circuit along the cable run. The cable should be sized based on amacity = 1.25 times the continuous current or 2% voltage drop, whichever is thicker.



CAUTION!

Please note that the Solar Modules are permanently connected to the Input Terminals of the Charge Controller. The modules will start generating power as soon as these are exposed to sunlight. However, there will be no power output from the Charge Controller until the controller is connected to the battery. Make sure that the battery voltage is > 6V in order to start the Charge Controller. The following spurious LED indications may be seen at the Charge Controller and may be disregarded:

- **Solar panels are exposed to sunlight and battery has not been connected:**
 - No LED indication
- **Solar Panels are exposed to sunlight, battery is connected and then removed:**
 - Charging Status LED (1, Fig 3.2)Steady GREEN
 - Battery Status LED (2, Fig 3.2).....Steady GREEN with RED flickering

SECTION 4 | Installation & Operation

PROTECTIONS

Solar Array Short Circuit - If solar array short circuit occurs, charging will stop. Charging will resume automatically once the short circuit is removed.

Overload On Load Terminals - If the load current of 12V load connected to the load terminals exceeds 10.5A, the controller will disconnect the load. Clear overloading, then press the Load ON/OFF button (4).

Load Short Circuit - Fully protected against load wiring short-circuit ≥ 2 times rated discharge current of 10A. After one automatic load reconnect attempt, the fault must be cleared by restarting the controller or pressing the Load ON/OFF Button (4).

Solar Array Reverse Polarity - Fully protected against Solar Array reverse polarity, no damage to the controller will result. Correct the polarity to resume normal operation.

Battery Reverse Polarity - Fully protected against battery reverse polarity, no damage to the controller will result. Correct the polarity to resume normal operation.

Battery Voltage Error - If battery voltage does not match controller operating voltage, controller will stop working. After correcting the voltage, the failure can be eliminated by pushing the Load ON/OFF Button (4).

Damaged Temperature Sensor - If the temperature sensor is short-circuited or damaged, the controller will be charging or discharging at the default temperature of 25°C to prevent damage to the battery from overcharging or over discharging.

Overheating Protection - If the temperature of the controller heat sink exceeds 85°C, the controller will stop charging and discharging. When the temperature drops to below 75°C, the controller will resume operation.

High Voltage Transients - Solar Array is protected against smaller high voltage transients. In lightning prone areas, additional external lightning protection is recommended.

Note: The controller has daily automatic fault recovery function which will reduce manual operation and can intelligently eliminate faults not caused by hardware failure.

SECTION 5 | Troubleshooting & Maintenance

TROUBLESHOOTING

Table 4.1 given below provides troubleshooting guidance

Symptom	Possible Reason	Remedy
Charging Status LED Indicator (1) is OFF during daytime when PV panels are exposed to direct sunlight	Input connection from solar panels has been disconnected	Check that wiring from solar panels to the Solar Panel Input Connections is connected and connections are tight
Battery Status LED Indicator (2) is Green and is flashing fast	Battery voltage has risen to the Over Voltage Disconnect Threshold of 16.0V	Measure battery voltage. If \geq than 16.0V, disconnect the battery. The controller is defective. Call Technical Support
Battery Status LED Indicator (2) is steady Orange. Battery voltage at Load Terminals is available and the load is operating normally	Battery voltage has dropped to Under Voltage Warning Threshold of 12.0V	The Battery Status Indicator (1) will return to Green when the battery voltage rises to Under Voltage Warning Reconnect Threshold of 12.2V
Battery Status LED Indicator (2) is steady Red. There is no battery voltage at Load Terminals and the load has switched off	Battery voltage has dropped to Low Battery Disconnect Threshold of 11.1V	The Battery Status Indicator (1) will reset to Green when the battery voltage rises to Low Battery Reconnect Threshold of 12.6V. Battery voltage will then be restored at the Load Terminals.
Load Status LED Indicator (3) is Red and flashing slowly. There is no output voltage at Load Terminals and the load has switched off	Current drawn from the Load Terminals is $>$ 10A	Reduce the load to $<$ 10A. Press the Load On/Off Button (4). After 3 sec, the output voltage at the Load Terminals will be restored.
Load Status LED Indicator (3) is Red and flashing fast. There is no output voltage at Load Terminals and the load has switched off	There is short circuit at the Load Terminals	Clear the short Circuit. Press the Load On/Off Button (4). After 3 sec, the output voltage at the Load Terminals will be restored and the load will once again start operating normally.
All 3 LED Indicators are flashing: Charging Status LED (1) = Flashes Green Battery Status LED (2) = Flashes Orange Load Status LED (3) = Flashes Red	Heat sink is overheated.	When the heat sink temperature is $>$ 85°C, the input and output circuits will be cut off. Once the temperature falls below 75°C, operation will be resumed.
All 3 LED Indicators are flashing: Charging Status LED (1) = Flashes Green Battery Status LED (2) = Flashes Red Load Status LED (3) = Flashes Red	System error. Battery voltage does not match controller	Check battery voltage and ensure it is 12V. Press Load On/Off Button (4) to clear the malfunction

MAINTENANCE

Dust and dirt should be swept off the solar panel surface using soft brush. Then, a wet cloth may be used to wipe the panel surface to remove remaining dirt and grime. It is recommended that any bird droppings should be removed as soon as possible as these can cause damage to the surface.

SECTION 6 | Specifications

OVERALL SPECIFICATIONS

PARAMETER	MSK-135	MSK-90
SOLAR ARRAY		
NOMINAL MAXIMUM POWER AT STC, P _{max}	135W (3 x 45W Panels ±3% in parallel)	90W (3 x 30W Panels ±3% in parallel)
MAXIMUM POWER VOLTAGE, V _{mp}	17.5V	17.5V
MAXIMUM POWER CURRENT, I _{mp}	7.71A (2.57A per 45W Panel)	5.13A (1.71A per 30W Panel)
OPEN CIRCUIT VOLTAGE, V _{oc}	21.6V	21.6V
SHORT CIRCUIT CURRENT, I _{sc}	8.34A (2.78A per 45W Panel)	5.55A (1.85A per 30W Panel)
TYPE OF CELLS / SIZE	Monocrystalline	
NUMBER OF CELLS	36 Cell per Panel	
MAXIMUM SYSTEM VOLTAGE	1000 VDC	
OPERATING TEMPERATURE	- 40°C to +85°C / - 40°F to +185°F	
INGRESS PROTECTION (IP) RATING	IP 65 (Waterproof)	
STANDARD TEST CONDITIONS (STC) FOR SOLAR MODULE	Irradiance Level: 1000W/m ² Spectrum: AM1.5 Cell Temperature: 25°C / 77°F	
OTHER COMPONENTS / PARAMETERS		
CABLE SETS FOR BATTERY	<p>Main Cable Set: 14ft cable with 50A, Anderson Type SB-50 compatible connector and 10A fuse on battery end</p> <p>Adapter Set 1: Anderson to Battery Clips, 2ft</p> <p>Adapter Set 2: Anderson to SAE Connector, 2ft</p>	
DIMENSIONS (Unfolded) W x H x D	1515 x 620 x 30 mm 59.65 x 24.41 x 1.18 in	1035 x 645 x 30 mm 40.75 x 25.39 x 1.18 in
Weight	16.18 kg / 35.6 lb	11.45 kg / 25.2 lb

Note: Specifications are subject to change without notice.

SECTION 6 | Specifications

SPECIFICATIONS OF CHARGE CONTROLLER - MSK-10A

PARAMETER	SPECIFICATIONS
Electrical	
Nominal Battery System Voltage	12V
Rated Charge / Discharge Current	10A
Minimum Battery Voltage to Start Controller	6V
Self Consumption	≤ 8.4mA
Temperature Compensation	18mV/°C (With built-in Temperature Sensor)
Battery Charging	NOTES: (i) Specifications are for Sealed / AGM Lead Acid Battery (ii) All voltage specifications are at 25°C
Type of Lead Acid Battery	Sealed, AGM
Bulk Charge Current	Equal to instantaneous Short Circuit Current Isc of the Solar Array
Absorption (Boost) Stage Voltage, "Va"	14.4V
Absorption (Boost) Stage Duration	2 Hrs
Equalization Stage Voltage, "Ve"	14.6V
Equalization Stage Duration	2 Hrs
Condition for Executing Equalization Cycle	Battery Voltage drops to 10.8V
Float Voltage, "Vf"	13.8V
Exit to Absorption (Boost) when in Float Stage	13.2V
Under Voltage Warning	12.0V (LED Battery Status Indicator Orange)
Under Voltage Warning Auto Reset	12.2V
Over Voltage Limit	≥15.5V (Charging Stops)
Over Voltage Limit Auto Reset	≤ 15.0V (Charging Resumes)
Over Voltage Disconnect Indication	16.0V
Control on Load Terminals	
Low Battery Disconnect	11.1V
Low Battery Reconnect	12.6V
Environmental	
Operating Temperature	-35°C to +55°C
Storage Temperature	-35°C to 80°C
Humidity	≤95% Non Condensing
Ingress Protection (IP) Rating	IP-30 (Protected against ingress of objects > 2.5mm; Not protected against ingress of water)
Mechanical	
Input Output Connections	Moving Cage Type, 4mm ² /AWG#12
Compliance	
Electro Magnetic Compatibility	CE Marked – Conformity with EMC Directive 2004/108/EC

Note: Specifications are subject to change without notice.

SECTION 7 | Warranty

25 YEAR 80% POWER OUTPUT WARRANTY ON SOLAR PANELS 2 YEAR WARRANTY ON REMAINING COMPONENTS

MSK-90 & MSK-135 Kits manufactured by Samlex America, Inc. (the “Warrantor”) are warranted to be free from defects in workmanship and materials under normal use and service. The warranty period is 2 years for the United States and Canada, and is in effect from the date of purchase by the user (the “Purchaser”).

Warranty outside of the United States and Canada is limited to 6 months. For a warranty claim, the Purchaser should contact the place of purchase to obtain a Return Authorization Number.

The defective part or unit should be returned at the Purchaser’s expense to the authorized location. A written statement describing the nature of the defect, the date of purchase, the place of purchase, and the Purchaser’s name, address and telephone number should also be included.

If upon the Warrantor’s examination, the defect proves to be the result of defective material or workmanship, the equipment will be repaired or replaced at the Warrantor’s option without charge, and returned to the Purchaser at the Warrantor’s expense. (Contiguous US and Canada only)

No refund of the purchase price will be granted to the Purchaser, unless the Warrantor is unable to remedy the defect after having a reasonable number of opportunities to do so. Warranty service shall be performed only by the Warrantor. Any attempt to remedy the defect by anyone other than the Warrantor shall render this warranty void. There shall be no warranty for defects or damages caused by faulty installation or hook-up, abuse or misuse of the equipment including exposure to excessive heat, salt or fresh water spray, or water immersion.

No other express warranty is hereby given and there are no warranties which extend beyond those described herein. This warranty is expressly in lieu of any other expressed or implied warranties, including any implied warranty of merchantability, fitness for the ordinary purposes for which such goods are used, or fitness for a particular purpose, or any other obligations on the part of the Warrantor or its employees and representatives.

There shall be no responsibility or liability whatsoever on the part of the Warrantor or its employees and representatives for injury to any persons, or damage to person or persons, or damage to property, or loss of income or profit, or any other consequential or resulting damage which may be claimed to have been incurred through the use or sale of the equipment, including any possible failure of malfunction of the equipment, or part thereof. The Warrantor assumes no liability for incidental or consequential damages of any kind.

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