



samlexpower®

**Switch Mode
DC Power
Supply
with Battery
Backup**

SEC-1223BBM-230

Owner's
Manual

Please read this
manual BEFORE
installing unit

OWNER'S MANUAL | Index

SECTION 1

Safety Instructions..... 3

SECTION 2

Layout, Output Connection & Dimensions 5

SECTION 3

Description & Principle of Operation 6

SECTION 4

Protections 8

SECTION 5

Installation 10

SECTION 6

Operation 13

SECTION 7

Limiting Electro-Magnetic Interference (EMI) 15

SECTION 8

Troubleshooting Guide 18

SECTION 9

Specifications 21

SECTION 10

Warranty 23

SECTION 1 | Safety Instructions

IMPORTANT SAFETY INSTRUCTIONS

SAVE THESE INSTRUCTIONS

This manual contains important Safety and Operating Instructions. Please read before using this unit .

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.

Please read these instructions before installing or operating the unit to prevent personal injury or damage to the unit.



WARNINGS!

1. DO NOT OPEN TO REDUCE RISK OF FIRE OR ELECTRIC SHOCK. THERE ARE NO USER SERVICEABLE PARTS INSIDE—REFER TO QUALIFIED SERVICE PERSONNEL.
2. The unit should be grounded to reduce the risk of electric shock. It comes with a detachable power cord that has a 2-Pole, 3Wire grounding European CEE-7/7 "Schuko" plug. The grounding contact of the plug gets connected to the chassis of the unit. When the power cord is plugged into the corresponding European CEE-7/7 "Schuko" receptacle in the power outlet, the chassis of the unit is automatically connected to the Earth Ground through the Equipment Grounding Conductor that is connected to the grounding contact of the European CEE-7/7 "Schuko" outlet. The power cord must be plugged into a European CEE-7/7 "Schuko" outlet that is properly installed and grounded in accordance with all local codes and ordinances. Never alter the power cord that has been provided. If the plug of the cord will not fit the outlet, have a proper outlet installed by a qualified electrician. Improper connection can result in risk of electric shock.
3. It is recommended that you return your power supply to a qualified dealer for any service or repair. Incorrect assembly may result in electric shock or fire.
4. To reduce the risk of electric shock, unplug the power supply from the outlet before attempting any maintenance or cleaning. Turning off controls will not reduce this risk.
5. To reduce risk of damage to electric plug and cord, pull by plug rather than cord when disconnecting the unit.
6. An extension cord should not be used unless absolutely necessary. If an extension

SECTION 1 | Safety Instructions

cord is used, make sure that it has 2-Pole, 3 wire grounding, European CEE-7/7 "Schuko" configuration with current carrying capacity of at least 10A.

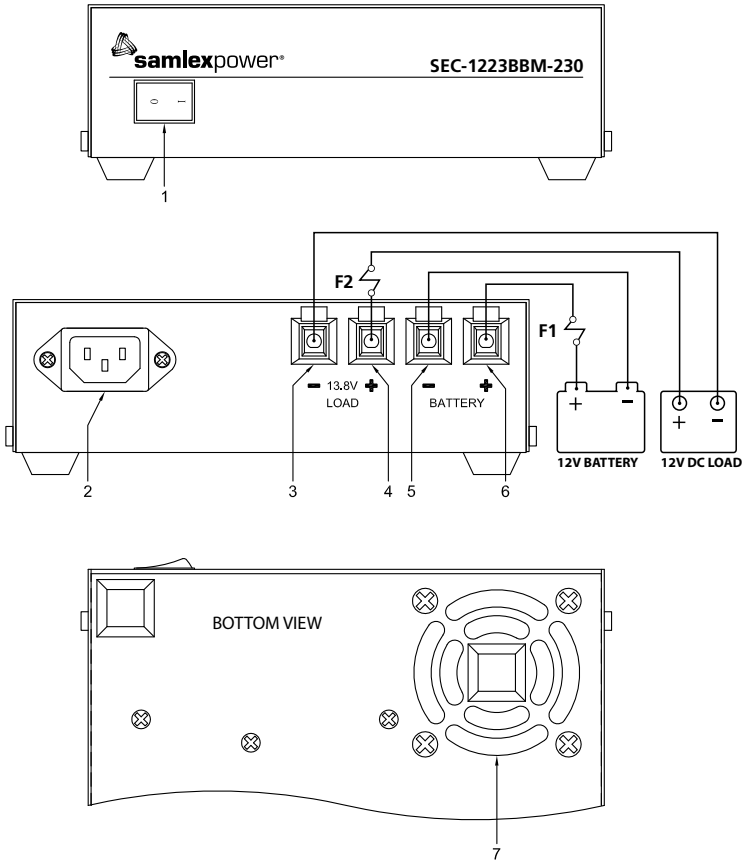
7. Place the unit in an area that will allow air to flow freely around the unit. **DO NOT** block or obstruct vent openings on the sides and at the bottom or install the unit in an enclosed compartment.
8. Keep the unit away from moisture and water.
9. NEVER OPERATE TWO OR MORE UNITS IN PARALLEL.
10. **Precautions when working with batteries.**
 - Batteries contain very corrosive diluted Sulphuric Acid as electrolyte. Precautions should be taken to prevent contact with skin, eyes or clothing.
 - Batteries generate Hydrogen and Oxygen during charging resulting in evolution of explosive gas mixture. Care should be taken to ventilate the battery area and follow the battery manufacturer's recommendations.
 - NEVER smoke or allow a spark or flame near the batteries.
 - 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.
 - Remove metal items like rings, bracelets and watches when working with batteries. The batteries can produce a short circuit current high enough to weld a ring or the like to metal and thus cause a severe burn.
 - If you need to remove a battery, always remove the Negative Ground Terminal from the battery first. Make sure that all the accessories are off so that you do not cause a spark.



CAUTIONS!

1. Please refer to Fig 2.1 at page 5. Please ensure that the battery is connected with correct polarity - Positive of the battery to the "Battery +" terminal (6) and the Negative of the battery to the "Battery -" terminal (5). Reversal of polarity will blow external Fuse F1. Reversal of polarity may result in permanent damage to the unit and to the load. **DAMAGE DUE TO REVERSE POLARITY IS NOT COVERED UNDER WARRANTY.**
2. Protect the unit against AC line input transients. Use Transient Suppressor in line with the AC input.

SECTION 2 | Layout, Output Connection & Dimensions



LEGEND

1. Lighted Power ON /OFF Rocker Switch (Lights Red when ON)
 2. AC Power Cord Inlet – Type "IEC 320-C14" (Detachable Power Cord with "IEC 320-C13" connector on one end and CEE-7/7 "Schuko" Plug on the other end is provided with the unit)
 3. Black Negative (-) DC Load Terminal
 4. Red Positive (+) DC Load Terminal
 5. Black Negative (-) Battery Terminal
 6. Red Positive (+) Battery Terminal
 7. Vent opening for cooling fan discharge (Bottom of the unit)
- F1. Fast blow Fuse: 32V, 25A
 F2. Fast blow Fuse: 32V, 25A

Fig. 2.1 Layout and Output Connections

SECTION 2 | Layout, Output Connection & Dimensions

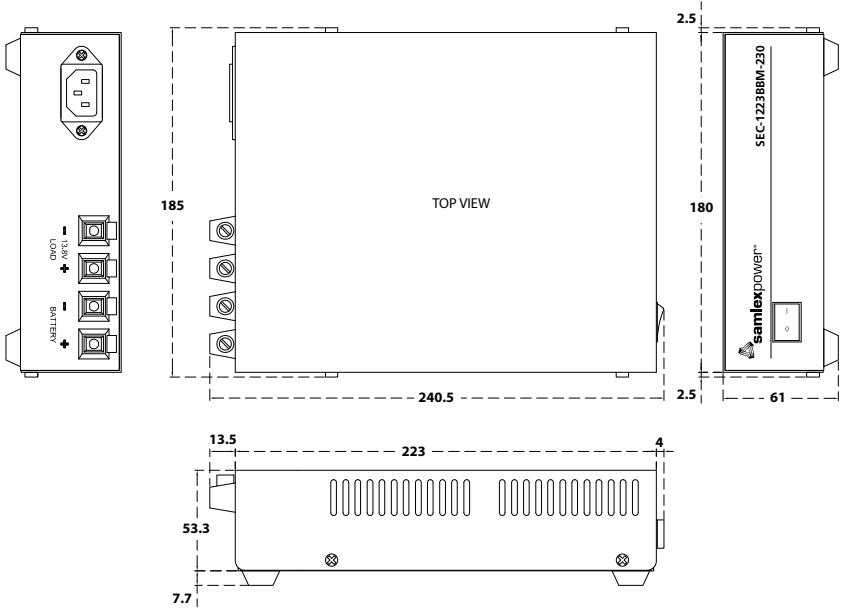


Fig 2.2 Dimensional Drawing

SECTION 3 | Description & Principle of Operation

DESCRIPTION

SEC-1223BBM-230 is a Switch Mode Power Supply (SMPS), which converts 230 VAC, 50/60 Hz to regulated 13.8VDC \pm 0.2V at 23A continuous. It has additional provision for battery backup with charging in conjunction with external 12V Lead Acid Battery.

FEATURES

- Advanced Switch Mode Technology
- Reliable, 12V DC Uninterruptible Power Source (DC UPS) in conjunction with external 12V Lead Acid Battery backup
- Under battery backup function, short time overload of up to 50A for < 1 sec can be supplied to allow starting of devices that require higher starting surge current.
- High efficiency, compact and portable
- Protected against short circuit, overload, over voltage and over temperature
- Cooling by temperature controlled fan improves efficiency and prolongs life of the fan

SECTION 3 | Description & Principle of Operation

PRINCIPLE OF OPERATION

Please refer to the Layout at Fig. 2.1. The unit consists of 2 Sections - Switch Mode Power Supply (SMPS) Section and Battery Backup and Charging Section. The unit works as a DC Uninterruptible Power Source (DC UPS) in conjunction with an external 12V, Lead Acid backup battery. As long as AC input power is available, the unit will put out $13.8 \pm 0.2V$ at the Load Terminals (3, 4) and provide a maximum continuous load current of 19A to 23A. At the same time, charging current of up to a maximum of 4A (When battery is completely discharged to Standing Voltage of 11.1V) will be fed through the Battery Terminals (5, 6) to charge the external battery. The voltage at the Battery Terminals (5, 6) will always be clamped to the actual voltage of the battery corresponding to its State of Charge. If AC input power fails, the DC load will be instantaneously transferred to the external 12V backup battery and the battery will start discharging. When AC input power is restored, the DC load will once again be transferred instantaneously to the Power Supply Section and the external backup battery will be recharged and kept in charged condition all the time at Float Voltage of $13.8 \pm 0.2V$ (when fully charged).

When operating in DC UPS Battery Backup Mode (external 12V battery is connected), the unit is capable of providing short-term surge current overload of up to 50A for < 1 sec (external 25A fuse on the load side will not blow as 50A overload occurs for a very short period of < 1 sec). During this overload of 50A, the Power Supply Section will provide 25A and the balance 25A will be supplied by the battery and the battery will discharge at 25A for the period of the surge. During the period of this surge current overload, the voltage seen by the load will be = (battery voltage – $0.3V \pm 0.2V$).

If battery backup function is not used (external backup battery is not connected), the unit will work as a normal power supply with ability to supply 23A continuous at $13.8 \pm 0.2VDC$ at the Load Terminals (3, 4). The maximum overload current will be limited to 25A. Under overload conditions, the output voltage will not be regulated and will drop.

COOLING AND OVER TEMPERATURE PROTECTION

The unit is cooled by convection and in addition, has a temperature-controlled fan located at the bottom for forced air-cooling. Two Normally Closed Thermal Switches are mounted on the windings of the Switching Power Transformer – one for fan control and the other for over temperature shut down. When the temperature of the transformer windings rises to $\geq 60^{\circ}C \pm 5^{\circ}C / 140^{\circ}F \pm 9^{\circ}F$, Thermal Switch for fan control will open and will activate fan switching circuit to switch ON the fan. When the transformer windings cool down to $\leq 40^{\circ}C \pm 5^{\circ}C / 104^{\circ}F \pm 9^{\circ}F$, the switch will close and de-activate fan switching circuit to switch OFF the fan.

NOTE: The fan may not switch ON at all in case of low loads or in colder ambient temperatures because the temperature of the transformer windings may not rise to threshold of $\geq 60^{\circ}C \pm 5^{\circ}C / 140^{\circ}F \pm 9^{\circ}F$ under these conditions.

In case the fan fails or if the cooling is not adequate due to higher ambient temperature, inadequate air circulation or blockage of ventilation openings, the temperature of the transformer windings will rise. At temperature $\geq 105^{\circ}C \pm 5^{\circ}C / 221^{\circ}F \pm 9^{\circ}F$, Thermal

SECTION 3 | Description & Principle of Operation

Switch for over temperature shut down will open and will activate over-temperature protection circuit to shut down the Power Supply Section. When the windings cool down to temperature $\leq 75^{\circ}\text{C} \pm 5^{\circ}\text{C} / 167^{\circ}\text{F} \pm 9^{\circ}\text{F}$, the switch will close, shut down circuit will be de-activated and the output power from the Power Supply Section will be restored automatically. During the time the Power Supply Section is shut down due to over temperature, the backup battery will supply the load and will start discharging. When the Power Supply Section cools down and resets, it will once again start supplying the load and re-charge the battery.



CAUTION!

The fan sucks cool air from the vent openings on the sides of the unit and discharges hot air through vent openings at the bottom of the unit. **PLEASE ENSURE THAT THESE VENT OPENINGS ARE NOT OBSTRUCTED.**

SECTION 4 | Protections

NOTE: Please refer to Fig 2.1, page 5 and explanation under heading “Principle of Operation”, page 7.

OVER LOAD / SHORT CIRCUIT CURRENT PROTECTION

Battery Backup Function is not Used - External Battery is not Connected and the Unit is Used as a Power Supply

In this case, the entire load current will be supplied by the Power Supply Section and will be limited to a maximum of 25A by its Current Limit Circuitry. If the load tries to draw a higher current than the current limit value of 25A, the output voltage at the Load Terminals (3, 4) and the Battery Terminals (5, 6) will not be regulated and will drop below $13.8\text{V} \pm 0.2\text{V}$. If the load impedance is further reduced, the current will remain limited at 25A but the voltage will drop further. In case of short circuit, maximum limited current of 25A will continue to be supplied into the short circuit but the voltage will drop to $< 2\text{V}$ in case of a near dead short (Load impedance will be very low – say < 100 milli Ohm). If over-load / short-circuit current of 25A continues over prolonged period (> 100 sec), the external 25A load side Fuse (F2) will blow and will disconnect the load. If the overload / short circuit is removed before the external 25A load side Fuse (F2) blows, the output voltage at the Load / Battery Terminals will automatically recover when the load current drops to less than 25A.

Battery Backup Function is Used - External Battery is Connected

If the load tries to draw current higher than the current limit value of 25A of the Power Supply Section, the output voltage of the Power Supply Section will not be regulated and the voltage at the Load Terminals (3, 4) will drop. Portion of overload current beyond 25A will now be fed from the battery and the battery will start draining at this differential current. For example, if the overload current was 40A, the Power Supply

SECTION 4 | Protections

Section will provide 25A and the battery will provide the balance 15A. The battery will start draining at 15A. The voltage at the Battery Terminals (5, 6) will start dropping and will be equal to the voltage corresponding to its actual State of Charge. The voltage at the Load Terminals (3, 4) will be around $0.3 \pm 0.2V$ below the voltage at the Battery Terminals (5, 6). External 25A Fuse (F2) on the load side will blow only on sustained current $\geq 25A$ for > 100 sec but will not blow at higher short duration surge currents determined by its Time Current characteristics. For example, based on the Time Current Characteristics of 32V, 25A fuse Type ATC-25 from Cooper Bussmann, the fuse can pass extremely high currents for shorter durations is as follows:

- 550A for 10 ms
- 170A for 100 ms
- 40A for 1 sec
- 25A continuous (for > 100 sec)

In case of short circuit on the load side, the external 25A Fuse (F2) on the load side will blow because of very high additional current supplied by the battery (Additional battery current supplied into the short circuit on the load side = Short circuit current - 25A from the Power Supply Section). For example, if a short circuit current of 170A tries to flow for > 100 ms, 25A will be supplied by the Power Supply Section and the balance 145A will be supplied by the battery. As the external 25A Fuse (F2) on the load side will see 170A and the external 25A Fuse (F1) on the battery side will see 145A, the external 25A load side Fuse (F2) will blow first.

PROTECTION AGAINST REVERSE POLARITY OF BATTERY CONNECTION

In case of reverse polarity of battery connection, internal Diode connected across the battery output terminals will be forward biased and the external 32V, 25A battery side Fuse (F1) will blow.



CAUTION!

Reversal of polarity may result in permanent damage to the unit and to the load.
DAMAGE DUE TO REVERSE POLARITY IS NOT COVERED UNDER WARRANTY.

OVER TEMPERATURE PROTECTION



CAUTION!

Keep the unit in a well-ventilated, cool and open area. **DO NOT** block the vent holes on the sides or the discharge openings of the cooling fan at the bottom of the unit.

In case the fan fails or if cooling is not adequate due to higher ambient temperature or inadequate air circulation or blockage of air ventilation openings, the temperature of the output power transformer windings will rise and at temperature $\geq 105^{\circ}C \pm 5^{\circ}C$ / $221^{\circ}F \pm 9^{\circ}F$, Thermal Switch mounted on the windings will open and will activate over-temperature protection circuit to shut down the Power Supply Section. When the

SECTION 4 | Protections

windings cool down to temperature $\leq 75^{\circ}\text{C} \pm 5^{\circ}\text{C} / 167^{\circ}\text{F} \pm 9^{\circ}\text{F}$, the Switch will close, shut down circuit will be de-activated and the Power Supply Section will be reset automatically. During the time the Power Supply Section is shut down due to over temperature, the backup battery will supply the load and will start discharging. When the Power Supply Section cools down and resets, it will once again start supplying the load and re-charge the battery.

OVER VOLTAGE PROTECTION

Over voltage protection is provided through the internal PWM controller

SECTION 5 | Installation



WARNINGS!

PLEASE READ "SECTION 1 - SAFETY INSTRUCTIONS" FOR SAFE INSTALLATION.

NOTE:

Please refer to Fig 2.1, page 5 - Layout & Output Connections

LOCATION, MOUNTING AND SAFETY

The unit is required to be installed in a safe, well-ventilated and dry location. Please see details given under Section 1 "Safety Instructions". The unit can be mounted horizontally or vertically. When mounting vertically, please ensure that the Output Terminals are pointing up or down.

AC INPUT CONNECTION

A detachable power cord has been supplied. Connect the power cord to the AC Power cord Inlet (2). Plug the power cord to the AC outlet. Please ensure that the voltage of AC input power at the outlet is 230 VAC, 50/60 Hz.

DC OUTPUT CONNECTIONS

The Load Terminals (3,4) and the Battery Terminals (5,6) have 5mm / 0.2" diameter tubular hole with set screw (#10, 24 TPI, 5/16" long).

For ensuring firm connection under the set screw, 4 pieces of Pin Type of Terminal Lugs "PTNB10-12" have been provided for crimping to the bare ends of stranded wires for the load and battery connections. The terminal can accept wire of up to 10 mm² / AWG #8. After crimping the Terminal Lugs, use insulating heat shrink tubing or tape to insulate the bare cylindrical portion of the lug.

SECTION 5 | Installation

Load Connection: The load is connected to the terminals marked "Load +" (4) and "Load -" (3) through 32V, 25A Fuse (F2) (See details below under heading "External Fuses"). Please ensure that the polarity of the connection is correct - Positive of the load to the "Load +" terminal (4) and the Negative of the load to the "Load -" terminal (3).

Battery Connection: The Positive of the battery is connected to the "Battery +" terminal (6) and the Negative of the battery to the "Battery -" terminal (5) through 32V, 25A Fuse (F1) (See details on page 5 under heading "External Fuses on Battery and Load Sides").

Recommended Battery Capacity: Battery should not be charged at very high current. Normally, as a Rule of Thumb, the maximum charging current should be limited to 10% of the Ah capacity at 20 Hour Rate unless higher current is allowed by the manufacturer. Higher charging current produces higher heating which reduces the life of the battery. Further, higher charging current will not re-charge the battery to full 100% capacity unless the charging voltage is increased proportionately. It is recommended that the capacity of the battery used with this unit should be in the range of 40 to 100Ah.

DC OUTPUT WIRE SIZING

Use AWG #10, 90°C / 194°F insulation wire for the load and battery connections for a distance of up to 3 ft. Thicker wire will be required for distance longer than 3 ft. (See Table 5.1 below). **USE THICKER WIRE OUT THE 2 SIZES CALCULATED BASED ON THE FOLLOWING 2 CONSIDERATIONS:**

1. Safety of Conductor Insulation

Current (I) flowing through resistance (R) of conductor produces power loss (I^2R) in the form of heat which results in temperature rise in the conductor. Temperature rise is higher for higher current, higher resistance (longer length and thinner cross section produce higher resistance) and higher ambient temperature. Temperature rise higher than the temperature rating of conductor insulation will melt / burn the insulation resulting in possibility of electrical shock and fire. The National Electrical Code specifies maximum current flow (ampacity) through a particular wire size (normally specified as cross-section in American Wire Gauge (AWG) for a particular temperature rating of conductor insulation, ambient temperature and type of surrounding medium (like free air, raceway, etc.). NEC further specifies that the ampacity of the wire should be 1.25 times the maximum current flow. The maximum output current in the unit is 25A.

- The maximum output current in the unit is 25A. Hence, the ampacity of the wires as per NEC should $1.25 \times 25 = 31.25A$ or say 40A
- As per NEC Table 310.15(B)(17) for 90°C / 194°F conductor insulation, free air, 40°C / 104°F ambient and ampacity of 40A, the minimum conductor size should be AWG #10.

2. Limiting Voltage Drop along the Length of the Wiring

Current flowing through resistance produces voltage drop. Voltage drop is higher for higher resistance (longer length and thinner cross section produce higher

SECTION 5 | Installation

resistance). Excessive voltage drop across the length of wires connecting the power source to the load produces excessive power loss and may also shut down the load due to under voltage created at the load end. Hence, the voltage drop should be kept to the minimum at around 2% by using thicker wires for longer distances. Table 5.1 given below shows thickness of wire for 2% voltage drop consideration for 12 V battery / load when carrying 25A:

TABLE 5.1: RECOMMENDED WIRE SIZES FOR 3 FT., 6FT. AND 10 FT. DISTANCES			
Rated Current	Size of Wiring for 2% Voltage Drop		
	3 ft.	6 ft.	10 ft.
25A	AWG #10	AWG #8	AWG #6

As mentioned above, the calculated wire size is AWG #10 when considering safety of conductor insulation. Hence, use AWG #10, 90°C / 194°F insulation wire for the load and battery connections for a distance of up to 3 ft. If the distance of the Load / Battery is > 3 ft., the size on account of 2% voltage drop and 25A current flow consideration will be thicker than AWG #10 as shown in Table 5.1 above and these thicker sizes should be used.

EXTERNAL FUSES ON THE BATTERY AND LOAD SIDES

A battery is an unlimited source of current that can drive thousands of Amperes of current into a short circuit leading to overheating and burning of wiring / circuit components along the path from the battery terminals to the point of short circuit. This can cause injury and is a fire hazard. Similarly, a power source is also capable of driving considerably high value of current into a short circuit on the load side and causing damage as above (the current will, however, be limited to the maximum rated overload current and not unlimited as in the case of a battery). Appropriate fuse should, therefore, be used in series with the battery Positive post / Load terminal of power source to protect against the above safety hazard. **FOR EFFECTIVE PROTECTION, APPROPRIATE SIZES OF FUSES SHOULD BE LOCATED AS FOLLOWS:**

- External Battery Side Fuse (F1) should be LOCATED as close to the battery Positive post as possible, preferably within 7" of the battery Positive post
- External Load Side Fuse (F2) should be installed as close as possible to the Positive Load Terminal (4)

For this unit, external fuses must be used for protection against reverse polarity and short circuit as follows (Please see Fig 2.1, page 5.)

- 32V, 25A fast acting Fuse (F1) in series with the Positive battery wire within 7" from the battery Positive post. This fuse provides the following protections:
 - Prevents overheating and burning of wiring due to very heavy current fed from the battery into a short circuit along the length of wiring from the battery to the Battery Input Terminals (5, 6).
 - Prevents damage to the unit and to the load due to reverse polarity of battery connection
- 32V, 25A fast acting Fuse (F2) in series with the Positive load wire and within 7" of the Positive Load Terminal (4). This fuse protects against overload and short circuit on the load side.

SECTION 6 | Operation

Please refer to Fig 2.1, page 5 - Layout & Output Connections.



CAUTION!

If AC input power is not available and a battery has been connected for backup function, the load will be powered by the battery and the battery will continue to discharge as long as the load is in ON condition. When the load is not delivering power, it still draws current for its self-consumption (called "No Load Current"). When AC input power is not available, switch OFF the load if not required, otherwise the battery will get discharged because of the "No Load Current" drawn by the load.

To protect the battery against deep discharge, please consider using Samlex America, Inc. Battery Guard Model No: BG-40, which is a 40A, programmable low voltage disconnect switch to be used in line with the battery.

SWITCHING ON / OFF

Switching ON (Without Battery Backup - No External Battery - Unit Operates as a Normal Power Supply):

- Check that the load has been connected to the Load Terminals (3, 4) and NOT TO THE BATTERY TERMINALS (5, 6)
- Switch ON the unit with the help of the Red Power ON / OFF Switch (1). If AC power is available and the internal AC side fuse is intact, the ON / OFF Switch will be lighted Red indicating that the Power Supply Section is in ON condition
- After a few milli sec, $13.8V \pm 0.2V$ will be available at the Load and Battery Terminals
- Switch ON the load

Switching ON (With Battery Backup - External Battery is Connected):

- Check that the load has been connected to the Load Terminals (3, 4) through external 25A Load Side Fuse (F2)
- Check that the external battery has been connected to the Battery Terminals (5, 6) through external 25A Battery Side Fuse (F1)
- Switch ON the unit with the help of the Red Power ON / OFF Switch (1). If AC power is available and the internal AC side fuse is intact, the ON / OFF Switch will be lighted Red indicating that the Power Supply Section is in ON condition
- After a few milli sec, $13.8V \pm 0.2V$ will be available at the Load Terminals (3, 4) and the external battery will start charging at current of up to 4A determined by its State of Charge. The voltage at the Battery Terminals (5,6) will get clamped to the actual terminal voltage of the battery corresponding to its State of Charge
- Switch ON the load
- The Power Supply Section will supply all the current consumed by the load and the external battery will be maintained in charged condition all the time at Float Voltage of $13.8V \pm 0.2V$ (when fully charged)

Switching OFF:

- Switch OFF the load first
- Switch OFF the unit with the help of the Red Power ON / OFF Switch (1). Red light inside the ON /OFF switch will switch OFF

SECTION 6 | Operation

CHARGING AND BACKUP OPERATION

Charging current will be proportional to the discharged state of the battery and is limited to maximum of 4A when the battery is completely discharged (Standing Voltage of 11.4V). The current will taper down from 4A as the battery gets charged and its voltage rises. When the battery is fully charged, the current will drop down to 0.1% of the Ah capacity of the battery to compensate for self-discharge. When fully charged, the voltage at the Battery Terminals (5, 6) will be the Float Voltage of $13.8V \pm 0.2V$.

Battery should not be charged at very high current. Normally, as a Rule of Thumb, the maximum charging current should be limited to 10% of the Ah capacity at 20 Hour Rate unless higher current is allowed by the manufacturer. Higher charging current produces higher heating, which reduces the life of the battery. Further, higher charging current will not re-charge the battery to full 100% capacity unless the Absorption Voltage is increased proportionately. This may not be possible with chargers that do not have programmable charging voltages. It is, therefore, recommended that the capacity of the battery used with this unit should be in the range of 40 to 100Ah which is appropriate for 4A charging current.

The voltage seen at the Battery Terminals (5, 6) will be the actual terminal voltage of the battery (assuming no voltage drop in the battery cables) and will be proportional to its State of Charge. When the battery is fully charged, the voltage at the Battery Terminals (5, 6) will approach $13.8V \pm 0.2V$.

If AC input power fails, the DC load(s) will be instantaneously transferred to the external 12V backup battery and the battery will start discharging. When the battery is supplying the load, the voltage seen at the Load Terminals will be $0.3V \pm 0.2V$ less than the voltage at the Battery Terminals. When AC input power is restored, the DC load will once again be transferred instantaneously to the Power Supply Section and the external backup battery will be recharged and kept in charged condition all the time at Float Voltage of $13.8V \pm 0.2V$.

SURGE POWER CAPABILITY IN DC UPS BATTERY BACKUP MODE

When operating in DC UPS Battery Backup Mode (external 12V battery is connected), the unit is capable of providing short term surge current of up to 50A for < 1 sec (external 25A fuse on the load side will not blow for this short duration). Maximum 25A will be provided by the Power Supply Section and balance 25A will be supplied by the battery. During the period of this short term overload, the voltage seen by the load will be = (battery voltage – $0.3V \pm 0.2V$).

OPERATION AS NORMAL POWER SUPPLY WITHOUT EXTERNAL BATTERY

If battery backup function is not used (external backup battery is not connected), the unit will work as a normal power supply with ability to supply 23A continuous at $13.8V \pm 0.2VDC$ at the Load Terminals (3, 4). The maximum overload current will be limited to 25A. Under overload conditions, the output voltage will not be regulated and will drop.

SECTION 7 | Limiting Electro-Magnetic Interference (EMI)



CAUTION!

This unit generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, this does not guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the measures recommended in the following paragraphs.

UN-INTENTIONAL RF NOISE GENERATED BY SWITCHED MODE POWER SUPPLIES (SMPS)

Switched Mode Power Supplies (SMPS) employ high frequency switching (25 KHz in this unit) and thus, are a source of radio interference, a recipient of radio interference and a conduit of radio interference. (Older Linear Type, low frequency 50 / 60 Hz transformer based power supplies do not employ high frequency switching voltages and will be quieter as compared to SMPS).

The primary emission sources originate in the switching devices due to their fast switching current transitions: harmonics of the switching frequency and broadband noise created by under-damped oscillations in the switching circuit. The secondary source is from the bridge rectifier, both rectifier noise and diode recovery. The AC input rectifier / capacitor in the front end of the SMPS (excepting those with Power Factor correction) generate power supply harmonics due to the non-linear input current waveform. The noise is both conducted and radiated through the input power cord and the DC output wiring to the radio.

FILTRATION OF CONDUCTED NOISE

The conducted RF noise from this SMPS unit is limited to the maximum allowable levels by internal filtration. The filtered RF noise currents (< few hundred micro Amps) are bypassed to the chassis of the power supply. The chassis is, in turn, connected to the Earth Ground pin of the AC input power cord (for Class 1 units). Thus, the filtered noise currents are intentionally leaked to the Earth Ground. This is termed as the "Earth Leakage Current".

EXCESSIVE RF OUTPUT INTERFERENCE BY SMPS DUE TO INCOMING RF INTERFERENCE WHEN POWERING RADIO TX / RX

SMPS are also recipients of radio interference. The normal operation of the power supply can be disturbed due to RF noise getting coupled into the power supply. Thus, the power supply may generate excessive RF noise and lose output voltage regulation due to excessive transmitter energy being coupled through the AC / DC lines to the power supply's regulator feedback path. This may be due to antenna being too close or due to the antenna or feed system not radiating properly. First check the antenna system SWR.

Then, if necessary, relocate either the antenna or the power supply farther apart. The receiver may "hear" the power supply. A slowly moving, slightly buzzing carrier heard

SECTION 7 | Limiting Electro-Magnetic Interference (EMI)

in the receiver may be caused by the antenna being too close. As with the transmitter related noise pick up, a loose coaxial connector or a broken or a missing ground may aggravate this problem. Normally, this noise will be below the background or “band” noise. Increase the separation between the power supply and the receiving antenna. Use an outdoor antenna. This will reduce the amount of signal picked up from the power supply and also increase the amount of the desired signal.

ADDITIONAL GUIDELINES FOR REDUCING RF NOISE

- Use additional appropriate AC Radio Frequency Interference (RFI) Power Line Filter rated for minimum 10A immediately before the AC input of the power supply. For example, consider suitability of Model # 6VN1 from Tyco Electronics www.te.com or similar. Filtered, Ferrite Coated Cord Set is another choice. These cord sets, with integral line interference filters, reduce Common and Differential Mode Interferences over a wide frequency range. Because they are shielded, they are also effective against radiated interferences. In addition to the built-in filter networks, the cable conductors are coated with an RF absorbing ferrite compound. This provides additional attenuation at high frequencies that is lacking in most regular LC filters. The RF absorption of the ferrite-coated cable avoids resonances at high frequencies, reducing the conducted and radiated RF noises even further. For example, consider suitability of EMC Cord “IMU-13” from EMC Eupen www.emceupen.com or similar.
- Use additional appropriate DC radio frequency interference (RFI) power line filter rated for minimum 30 A immediately after the DC output of the power supply. For example, consider suitability of 30A filter Model # “FD10EE030” from Curtis Industries www.curtisind.com or similar.
- Twist the Positive and Negative wires from the output of the power supply to the radio.
- The DC side Positive and Negative outputs of these power supplies are isolated from the chassis. As explained earlier, the noise currents are filtered to the chassis of the unit and the chassis is connected to the Earth Ground through the Earth Ground Pin of the AC power outlet receptacle. Avoid connecting (referencing) the DC Negative output terminal of the power supply to the Earth Ground.
- Connect a ¼” wavelength of wire on the Negative terminal of the power supply. Connect one end of the wire to the Negative terminal and leave the other end free. The wavelength corresponds to the wavelength of the interfering frequency. (May not be practical for long wave lengths).

[Formula: Wave length (Meters) = 300 / frequency in MHz]

COMBINED FILTERED NOISE CURRENTS FROM MULTIPLE SMPS ON A BRANCH CIRCUIT MAY TRIP GROUND FAULT CIRCUIT INTERRUPTER (GFCI)

During malfunction or an accident, the metal chassis of a device may get energized to unsafe voltage due to internal high voltage section coming in contact with the chassis. If a person standing on Earth touches this energized chassis, a leakage current proportional to the person’s skin resistance will flow through the person’s body to Earth Ground. The leakage current through the body is higher when the skin contact

SECTION 7 | Limiting Electro-Magnetic Interference (EMI)

resistance is lower i.e. if the skin is wet or wounded. This leakage current does not return to the power source but is dissipated in Earth Ground. A leakage current of $> 5\text{mA}$ could produce lethal electrical shock. Ground Fault Circuit Interrupter (GFCI) is used for safety against electrical shock due to leakage. GFCI measures the difference between the

current sent to the load and returned from the load and will trip and disconnect the power circuit if the difference is $> 5\text{mA}$. GFCIs are normally installed in AC Branch Circuits feeding power outlets in wet areas like marine craft, RVs, spas, hot-tubs, kitchens, washrooms, etc.

As explained earlier, RF noise filtration circuits in SMPS generate intentional Earth Leakage Current. SMPS are used extensively as DC power sources in modern day electrical / electronic devices e.g. Audio / Video / Computing devices, power supplies, battery chargers etc. A single GFCI outlet / GFCI breaker may be serving multiple SMPS loads and therefore, will be sensing the sum of all the Earth Leakage Currents and, if the sum is $> 5\text{mA}$ after connecting this unit, the GFCI will trip. In such a case, disconnect other SMPS based device(s) being served by this GFCI one by one till the net leakage current is reduced to $< 5\text{mA}$ and the GFCI does not trip. **Other solution is to power this unit from a GFCI outlet / GFCI breaker that does not have any SMPS load or power from an outlet that is not protected by GFCI.**

SECTION 8 | Troubleshooting Guide

OPERATION AS A SIMPLE POWER SUPPLY - ONLY LOAD IS CONNECTED. NO EXTERNAL BATTERY AND NO BATTERY BACKUP.

Symptom	Possible Cause	Remedy
<p>ON / OFF Switch is ON</p> <ul style="list-style-type: none"> Switch is NOT lighted No DC output 	<p>No AC power from the AC outlet</p> <p>Internal AC side fuse is blown</p>	<p>Check AC power is available at the AC outlet. Breaker feeding the AC outlet may have tripped.</p> <p>Open the top cover and check the 4A AC side fuse. Replace if blown.</p> <p>If the fuse blows again, the input section is damaged. Please call Tech Support.</p>
<p>ON / OFF Switch is ON</p> <ul style="list-style-type: none"> Switch is lighted No DC output 	<p>Unit has shut down due to over temperature – Temperature of output transformer windings is: $\geq 105^{\circ}\text{C} \pm 5^{\circ}\text{C} / 221^{\circ}\text{F} \pm 9^{\circ}\text{F}$</p>	<p>Check that the fan is running. If not, the fan / fan control circuit may have been damaged. Call Tech Support.</p> <p>Check that the fan suction vents on the sides of the unit and the discharge vents on the bottom of the unit are not blocked.</p> <p>The unit will reset automatically when the transformer windings cool down to $\leq 75^{\circ}\text{C} \pm 5^{\circ}\text{C} / 167^{\circ}\text{F} \pm 9^{\circ}\text{F}$</p>
<p>ON / OFF Switch is ON</p> <ul style="list-style-type: none"> Switch is lighted DC Output voltage drops 	<p>If the voltage loses regulation and drops to $< 13.5\text{V}$, the unit is overloaded and is in current limit. The load is trying to draw \geq the current limit value of 25A</p> <p>If the voltage drop is considerable with voltage $< 2\text{V}$, the load side is seeing a short circuit and short circuit current limited to 25A is being driven into the short circuit</p>	<p>Reduce the current drawn by the load to less than the continuous rating of 23A.</p> <p>Switch OFF the load. Remove the short circuit on the load side.</p>
<p>GFCI outlet / GFCI breaker supplying AC power to the unit trips when the unit is switched ON</p>	<p>Additional RF noise currents from the unit that are filtered to Earth Ground increase the net Leakage Current on the GFCI outlet / GFCI breaker to $> 5\text{mA}$</p>	<p>Switch OFF other SMPS devices operating from the same GFCI outlet / GFCI breaker to reduce the net leakage current to $< 5\text{mA}$</p> <p>Move the unit to another GFCI outlet / GFCI breaker that has lesser number of SMPS load(s) or no SMPS load</p> <p>Power the unit from normal, non GFCI outlet or from an outlet not protected by GFCI breaker</p>

SECTION 8 | Troubleshooting Guide

BATTERY BACKUP OPERATION - EXTERNAL BATTERY IS CONNECTED

Symptom	Possible Cause	Remedy
<p>ON / OFF Switch is ON</p> <ul style="list-style-type: none"> Switch is NOT lighted Load is ON and is operating normally Output voltage at the Battery Terminals (5, 6) is $< 13.8 \pm 0.2V$ and is dropping Output voltage at the Load Terminals (3, 4) is $0.3V \pm 0.2V$ lower than the Battery Terminals (5, 6) and is dropping 	<p>No AC power from the AC outlet</p> <p>Internal AC side fuse of the Power Supply Section is blown</p>	<p>Check AC power is available at the AC outlet. Breaker feeding the AC outlet may have tripped.</p> <p>Open the top cover and check the 4A AC side fuse. Replace if blown.</p> <p>If the fuse blows again, the input section is damaged. Please call Tech Support.</p>
<p>ON / OFF Switch is ON</p> <ul style="list-style-type: none"> Switch IS lighted Load is ON and is operating normally Output voltage at the Battery terminals (5, 6) is $< 13.8V \pm 0.2V$ and is dropping Output voltage at the Load Terminals (3, 4) is $0.3 \pm 0.2V$ lower than the Battery Terminals (5, 6) and is dropping 	<p>Power Supply Section of the Unit has shut down due to over temperature – Temperature of output transformer windings is $\geq 105^{\circ}C \pm 5^{\circ}C / 221^{\circ}F \pm 9^{\circ}F$.</p>	<p>Check that the fan is running. If not, the fan / fan control circuit may have been damaged. Call Tech Support.</p> <p>Check that the fan suction vents on the sides of the unit and the discharge vents on the bottom of the unit are not blocked.</p> <p>The Power Supply Section will reset automatically when the transformer windings cool down to $\leq 75^{\circ}C \pm 5^{\circ}C / 167^{\circ}F \pm 9^{\circ}F$. During the time the Power Supply Section is OFF, the battery will supply the load and will discharge during this period.</p>
<p>ON / OFF Switch is ON</p> <ul style="list-style-type: none"> Switch is lighted Load is ON Output voltage at the Load Terminals (3, 4) loses regulation and drops below $13.8 \pm 0.2V$ Output voltage at the Load Terminals (3, 4) is $0.3 \pm 0.2V$ lower than the Battery Terminals (5, 6) and is dropping 	<p>Power Supply Section is overloaded and is in current limit condition. The load is trying to draw excessive current \geq the current limit value of 25A. The Time Current Characteristic of the 25A fuse (F2) in the Load circuit will determine the allowable value of overload current $> 25A$ and the time it can be sustained before the fuse blows. The allowable value will be higher for shorter duration of overload.</p> <p>Power Supply Section provides 25A and the balance of current is fed from the battery and the battery starts discharging at current = (Overload current - 25A)</p>	<p>Remove the cause of overload</p>

SECTION 8 | Troubleshooting Guide

Symptom	Possible Cause	Remedy
<p>ON / OFF Switch is ON</p> <ul style="list-style-type: none"> • Switch is lighted • There is no voltage at the at the load end and the load is shut down • Voltage at the Load Terminals (3, 4) is $13.8 \pm 0.2V$ • Voltage at Battery Terminals (5, 6) is lower than the voltage at the Load terminals and is $\leq 13.8 \pm 0.2V$ 	<p>25A Fuse (F2) in the Load circuit is blown due to:</p> <ul style="list-style-type: none"> - Excessive short time overload current > 25A exceeding the Time Current Characteristics of the 25A fuse, or - Short circuit in the load circuit 	<p>Remove the cause of the overload or short circuit</p>
<p>ON / OFF Switch is ON</p> <ul style="list-style-type: none"> • Switch is lighted • Load is ON • Voltage at the Load Terminals (3, 4) is $13.8 \pm 0.2V$ • Voltage at Battery Terminals (5, 6) is the same as the Load Terminals (3, 4) • Battery backup function does not operate – Load shuts OFF when AC power is interrupted 	<p>25A Fuse F1 in the battery circuit is blown due to:</p> <ul style="list-style-type: none"> - Reversal of battery input connections - Short circuit in the battery wiring 	<p>Check that the polarity of battery connections is correct. Replace the fuse.</p> <p>Check for short circuit in the battery wiring and correct.</p>
<p>GFCI outlet / GFCI breaker supplying AC power to the unit trips when the unit is switched ON</p>	<p>Additional RF noise current from the unit that is filtered to Earth Ground increases the net Leakage Current on the GFCI outlet / GFCI breaker to > 5mA</p>	<p>Switch OFF other SMPS devices operating from the same GFCI outlet / GFCI breaker to reduce the net leakage current to < 5mA.</p> <p>Move the unit to another GFCI outlet / GFCI breaker that has lesser number of SMPS load(s) or no SMPS load.</p> <p>Power the unit from normal, non GFCI outlet or from an outlet not protected by GFCI breaker.</p>

SECTION 9 | Specifications

CATEGORY	PARAMETER	SPECIFICATION
AC INPUT	Input Voltage	230 VAC Nominal (+6% / -10%), 50/60 Hz
	Input Current	2.75A @ 120 VAC
	Input Current at No Load	105 mA \pm 10%
	Inrush current at Startup	32A \pm 5% for 2.4 ms
DC OUTPUT	Output Voltage at Load Terminals	13.8VDC \pm 0.2V
	Output Voltage at Battery Terminals (Without battery)	13.8VDC \pm 0.2V
	Output Voltage at Battery Terminals (With battery)	Actual battery voltage corresponding to State of Charge; 13.5V \pm 0.2V when battery is fully charged and floating
	Output Voltage Noise and Ripple	< 150 mV Peak to Peak
	Continuous Output Current at Load Terminals	19A (With battery backup); 23A (Without battery backup)
	Continuous Output Current at Battery Terminals (Battery Backup)	Up to 4A (When battery is completely discharged to Standing Voltage of 11.1V)
	Output Current Limit at Load Terminals	- 25A for 100 sec (External 25A fuse will blow) - Surge > 25A as permitted by Time Current Characteristics of 25A load side fuse (In Battery backup Mode)
	Output Current Limit at Battery Terminals (Battery Backup)	4A (When battery is completely discharged to Standing Voltage of 11.4V)
	Peak Efficiency	85% \pm 5%
EXTERNAL BACKUP BATTERY	Type & Voltage	Lead Acid, 12V
	Capacity	40Ah to 100 Ah
PROTECTIONS	Short Circuit, Overload	External 25A Fuse will blow
	Over Voltage	Regulated by PWM Controller
	Over Temperature (Power Supply Section)	Output of Power Supply Section shuts down when Power Transformer winding temperature \geq 105°C \pm 5°C / 221°F \pm 9°F; Auto reset on cooling down to \leq 75°C \pm 5°C / 167°F \pm 9°F
COOLING	Forced Air	Temperature controlled fan. ON when Power Transformer winding temperature is \geq 60°C \pm 5°C / 140°F \pm 9°F; OFF when cools down to \leq 40°C \pm 5°C / 104°F \pm 9°F
FUSES	Internal AC Side Fuse	- 5 mm x 20 mm Glass Fuse - 250V, 4A, Time Delay Type - Bussmann: "GDC-4"; Littelfuse - "218004"
	External Battery Side Fuse (By User)	- 32V, 25 A, Fast Acting - Within 7" of the Battery Positive Post
	External Load Side Fuse (By User)	- 32V, 25 A, Fast Acting - Within 7" from Load Terminal of the unit

SECTION 9 | Specifications

CATEGORY	PARAMETER	SPECIFICATION
INPUT / OUTPUT CONNECTIONS	AC Input Connection	- "IEC 320-C14" Inlet Connector on the unit - Detachable Power Cord with: "IEC 320-C13" Connector on one end and CEE-7/7 "Schuko" Plug on the other end
	DC Output Connectors for Load and Battery Connections	Terminal with Tubular Hole - Diameter 5mm / 0.2" and set screw (#10, 24 TPI, 5/16" long)
	Battery wires	Minimum AWG #10 as per NEC Table 310.15(B)(17): - Ampacity 40A (1.25 times Maximum current of 25A) - Conductor temperature rating of 90°C / 194°F
ENVIRONMENTAL	Operating Temperature Range	0°C / 32°F to 30°C / 86°F
DIMENSIONS & WEIGHT	Dimensions (W x D x H)	185 x 240.5 x 61 mm
		7.28 x 9.47 x 2.40 in
	Weight	1.6 kg
3.4 lb		
NOTE: Above specifications are subject to change without notice		

SECTION 10 | Warranty

2 YEAR LIMITED WARRANTY

SEC-1223BBM-230 manufactured by Samlex America, Inc. (the "Warrantor") is 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.

Samlex America Inc. (the "Warrantor")

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