



Silent Runner

Inverter/Charger Power System



Model
SRC12-1100PT

Owners Manual A911426-E

Generic Inverter Installation

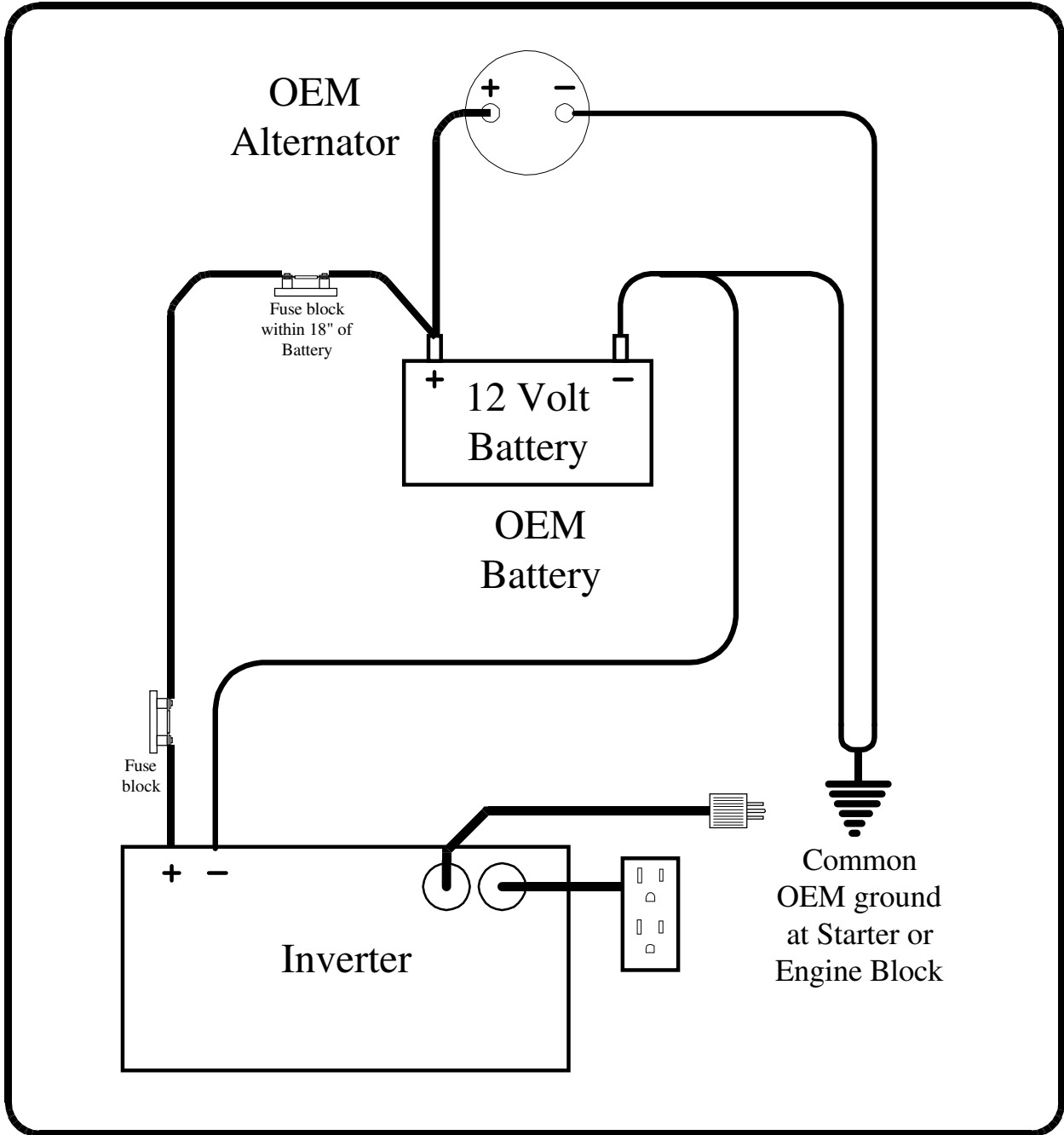




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1 Introduction

Thank you for purchasing Vanner's, Silent Runner (SR) Series Inverter/Charger. We are confident that you will be satisfied with its performance and its many features. With proper installation and care, you can look forward to years of service from this high performance product.

This document will describe the operation, technical specifications, installation procedures and accessories offered for the SR-Series. We suggest that you familiarize yourself with the model numbers of the inverter and optional accessories you have purchased before proceeding with this manual. If you require additional information please contact Vanner at 800-227-6937 (800-AC Power) or 614-771-2718.

WARNING: Before you install and use your SR-Series Inverter/Charger be sure to read and save these safety instructions.

PLEASE NOTE YOUR MODEL AND SERIAL NUMBER HERE FOR FUTURE REFERENCE

Model Number _____ Serial Number _____

Date of Installation _____



1.1 Specifications

Inverter		SRC12-1100PT
Output at 120 VAC RMS (Continuous Power Rating)	1500 Watts @ 25°C (77°F)	
Total Surge Capacity	2600 Watts	
Input Voltage, VDC	12 VDC, Nominal	
(Deep Cycle Battery Recommended)	10.5 VDC min., 16.0 VDC max.	
Output Voltage	120 VAC ± 10%	
DC Current Draw (Battery)		
OFF	0.025 Amps Typical	
Load Demand (waiting)*	0.055 Amps Typical	
Full ON at No Load	0.650 Amps Typical	
Full ON with Load	Approx. AC Load Watts ÷ 10 or AC Load Amps x 12	
Frequency	60 Hz ± 0.1%	
Output Wave Form	Modified Sine Wave	
Battery Charger		
Charging Capacity*	55 Amps (High)	
	15 Amps (Low)	
Input Voltage	120 VAC ± 10%	
Input Current	12.3 Amps	
Bulk Voltage*	14.2 VDC (flooded), 14.1 VDC (gel)	
Float Voltage*	13.2 VDC (flooded), 13.6 VDC (gel)	
Bypass Transfer		
Output Current at 77°C (25°C)	12.5 Amps	
Other Specifications		
AC Input Termination	Molded Connector	
AC Output Termination	Molded Connector	
Ambient Temperature	-40° to +104°F, -40° to + 40.0°C	
Cooling Air	Fan Cooled	
Chassis	Powder Coated Aluminum	
Dimensions	10.4"W x 6.0"H x 14.4"D	
Weight	25 lbs.	

*Determined by Setup Switch setting on front panel



STANDARD FEATURES

1.2 Standard Features on the SRC12-1100PT

- 1 True RMS regulated 120 volt $\pm 10\%$ AC 60 Hz Quasi-sine wave output
- 2 Output Short circuit / overload protection through electronic sensing
- 3 Output circuit breakers
- 4 Automatic shutoff for Low Battery
- 5 Automatic shutoff for Overload
- 6 Automatic momentary shutoff/restart for Over temperature
- 7 Load Demand enable/disable switch
- 8 Built-in Phillips & Tempro receptacle protected by a 15 amp circuit breaker.
- 9 Remote Operating Panel and Remote ON/OFF Switch (capable of single wire control)
- 10 Three Stage Battery Charger
- 11 Adjustable charge rate
- 12 Charging settings for gel or wet batteries
- 13 Automatic Power Management (charger input power control prevents overloading)
- 14 Automatic Transfer Switch with 5 second acceptance time delay
- 15 Thermostatically controlled cooling intake fan.
- 16 Indicator lights for Low Battery Warning/Shutoff, Over Temperature Shutoff, Overload, Inverter ON/OFF/Load Demand status and two charger status lights.

Please note: The Battery Charger, Automatic Transfer Switch and Automatic Power Management are operational only when AC input power (shore power) is present.

1.3 Definitions

Quasi Sine Wave:

Quasi Sine Wave Inverters are sometimes called "modified sine wave inverters" or "modified square wave inverters." Quasi sine wave inverters produce an AC output wave different from the power produced by the electric utility companies and rotating generators.

Load Demand Feature and Load Demand Mode:

The Load Demand Feature is an energy conserving feature which allows the inverter to enter the 'Load Demand Mode' whenever the inverter is ON and the AC load has been less than 5 watts for approximately 5 seconds. While in the 'Load Demand Mode' the inverter does not produce 120 volts AC but instead produces pulses of 120 volts AC which the inverter uses to look for a load at a one second rate. When an AC load greater than 5 watts is sensed, the inverter will turn fully ON to produce a constant 120 Volts AC. The 'Load Demand Mode' is often also described as 'stand-by mode' or 'sleep mode'. While in the 'Load Demand Mode' the inverter consumes approximately 140 milliamps of 12 volt DC power.

The Load Demand Feature can be turned OFF by setting Selector Switch 2 to the OFF position. This will cause the inverter to remain fully ON, producing 120 Volts AC, whenever the inverter switch is ON and regardless of AC load. It is desirable to do this when the device being powered draws less than 5 watts. With the Load Demand Feature turned OFF and operating no AC load the inverter consumes approximately 1.8 amps of 12 volt DC power.



Automatic Transfer Switch:

The Transfer Switch is a standard feature provided on the Silent Runner. The Transfer Switch automatically allows input power, from an external AC power source such as shore power or a generator, to pass through the inverter output circuit used to operate loads.

1.4 Parts and Accessories

<u>Part Number</u>	<u>Name</u>	<u>Description</u>
SR10	Silent Runner Series Remote	Remote Display with On/Off Switch
011486	Silent Runner Communication Cable	10 foot Communication Cable



2 SAFETY INSTRUCTIONS

README

This manual contains important safety and operating instructions for the Vanner Incorporated Silent Runner Series Power Inverter/Charger System. The SR-Series Inverter/Charger is designed to be compliant with UL 458, Power Converters/Inverters and Power Converter/Inverter Systems for Land Vehicles.

SAVE THESE INSTRUCTIONS

- WARNING** This equipment employs components that tend to produce arcs and sparks. To prevent fire or explosion, DO NOT install in confined areas or compartments that contain batteries or flammable materials.
- WARNING** Risk of electrical shock. Use only the circuit breaker(s) specified in the installation and operating instructions supplied with this inverter. Other types may fail to operate properly when connected to this equipment.
- CAUTION** Read Owners Manual BEFORE wiring or powering up.
- CAUTION** DO NOT cover or obstruct ventilation openings. DO NOT mount in zero-clearance compartments. Overheating may result which may diminish system capacity.
- NOTICE** The output of this device is not sinusoidal. The SR-SERIES inverter has a total harmonic distortion of 34.6 percent and maximum single harmonic of 24 percent.

2.1 General Precautions

- 1 Do not expose the SR-Series Inverter to direct water spray or snow.
- 2 To reduce the risk of a fire hazard, do not cover or obstruct the ventilation openings.
- 3 Do not install this unit in a zero clearance compartment the result may be overheating or diminished performance.
- 4 To avoid the risk of fire, electric shock, or injury to persons, do not use attachments, breakers, fuses, etc. not recommended or sold by Vanner Incorporated.
- 5 Vanner recommends that all DC and AC electrical wiring be performed by a certified electrician or technician to ensure compliance with all proper national and local wiring regulations.
- 6 To avoid a risk of fire and/or electric shock, always verify wiring connections are in good electrical condition. All external conductors must use proper wire size to avoid dangerous overheating or diminished performance.
- 7 If the Vanner inverter system has been dropped or damaged in any way, do not operate until its operation has been verified to be safe by a qualified technician.
- 8 To reduce the risk of electric shock always disconnect the AC and DC connections to the Vanner Inverter system before attempting any maintenance. Simply turning the unit off does not prevent electric shock.
- 9 The SR-Series inverter system must be properly grounded in accordance with local and national codes and ordinances before operation. For most installations the negative (ground) conductor should be bonded to the grounding system at one and only one point in the system.
- 10 Do not disassemble the SR-Series Inverter/Charger; see the service section of this manual for instructions on obtaining service for your Inverter/Charger. Attempting to service the unit yourself may result in a risk of electrical shock or fire



2.2 Explosive Gas Precautions

This equipment contains components, which tend to produce arcs or sparks. To prevent fire or explosion do not install in compartments containing batteries or flammable materials or in locations, which require ignition, protected equipment. This includes any space containing gasoline-powered machinery, fuel tanks, or joints, fittings, or other connection between components of the fuel system.

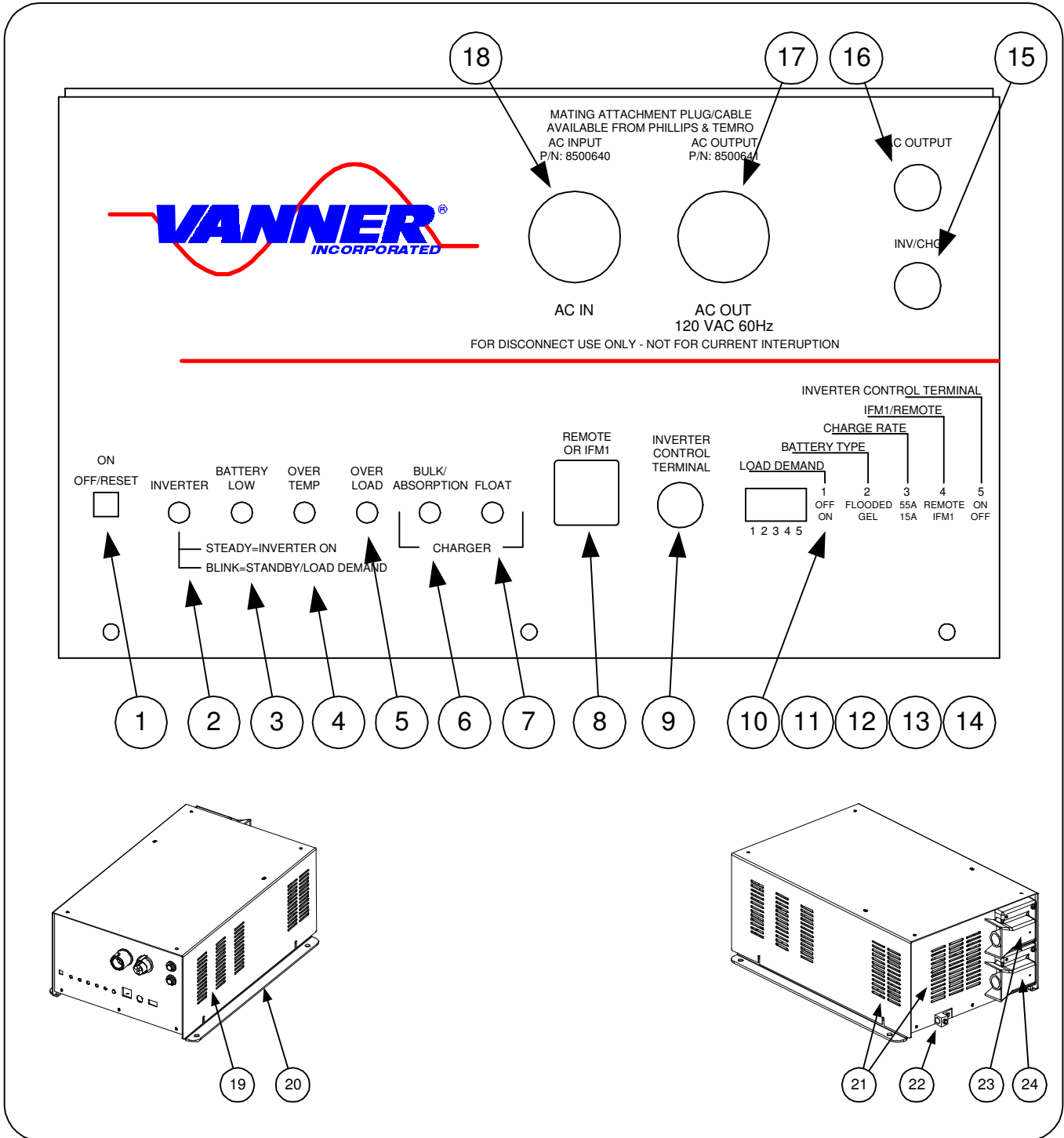
Working in the vicinity of a lead-acid battery is dangerous. Batteries generate explosive gases during normal battery operation. To reduce the risk of battery explosion, follow these instructions and those published by the battery manufacturer and the manufacturer of the equipment in which the battery is installed.

2.3 Precautions When Working with Batteries

- 1 Always have someone within range of your voice to come to your aid when you work near a lead-acid battery.
- 2 Have access to plenty of fresh water and soap nearby in case battery acid contacts skin, clothing, or eyes.
- 3 Always wear complete eye protection and clothing protection. Avoid touching eyes while working near batteries.
- 4 If battery acid contacts skin or clothing, wash immediately with soap and water. If acid enters eye, immediately flood eye with running cold water for at least 20 minutes and get medical attention immediately.
- 5 NEVER smoke or allow a spark of flame in the vicinity of batteries. Gases produced by batteries are explosive.
- 6 Be careful when working with metal tools around batteries. Potential for spark exists or short-circuit of the battery or other electrical part that may cause an explosion.
- 7 Never charge a frozen battery. Battery temperature needs to be above 32°F (0°C) before charging.

3 Component Identification

Figure 2 SRC-Series Illustration





Inverter Lights

(1) **ON/OFF/RESET**

The ON/OFF Switch is a pushbutton switch used to turn only the inverter ON/OFF and is used as a RESET Switch. When the inverter has automatically shut itself OFF due to a fault, the inverter must be RESET by turning the ON/OFF Switch OFF or by turning a remote switch OFF. (If an automatic shutdown has occurred due to a fault, one of the fault indicator lights will be displayed until the inverter is RESET)

(2) **“Inverter” Indicator Light**

<u>Light Display</u>	<u>Description</u>
No light	Inverter is OFF
Solid Green	Inverter is ON and is producing AC power
Blinking Green	Inverter is in Load Demand Mode

(3) **“Battery Low” Indicator Light**

<u>Light Display</u>	<u>Description</u>
Red Light is ON	The inverter is ON and battery voltage has decreased to less than 11 volts DC. Automatic inverter shutdown for low battery at 10.5 volts is imminent unless the battery voltage is increased.
Blinking Red Light	The inverter has shutdown due to a low battery voltage dropped below 10.5 volts.

(4) **“Over Temp” (Temperture) Indicator Light**

<u>Light Display</u>	<u>Description</u>
Red Light is ON	The inverter has shut itself OFF due to excessive heating. Check for blocked vents or any type of air obstruction to the inverter. The Inverter will automatically restart when the inverter cools down.

(5) **Overload Indicator Light**

<u>Light Display</u>	<u>Description</u>
Blinking Red	The inverter has shut itself OFF due to overload. The Inverter ON/OFF Switch must be cycled to reset and restart the inverter.

Charger Lights

(6) **“BULK/ABSORPTION” Indicator Light**

(See ‘Battery Charger Theory of Operation’ for battery charging performance details.)

<u>Light Action</u>	<u>Description</u>
Blinking Yellow	The unit is in Charger Mode (shore power is ON) and the charger is in either the BULK STAGE or ABSORPTION STAGE of the battery charging cycle.



- (7) **‘FLOAT’ Indicator Light**
(See ‘Battery Charger Theory of Operation’ for charger performance details.)

Light Action Description

Solid Green The unit is in Charger Mode (shore power is ON) and the charger is in the FLOAT STAGE of the battery charging cycle.

Remote Control Features

- (8) **‘REMOTE OR IFM1’ CONTROL JACK**
8 wire modular jack for use with optional Remote Operating Panels.
- (9) **‘INVERTER CONTROL TERMINAL’**
Front panel Faston for connection of ignition source to control Inverter power on. Configuration switches 4 and 5 must be up for this feature. The inverter will turn on when 12 volts is applied to this terminal. When the 12 volts goes away, the inverter will turn off.
Note! A one amp fuse must be installed in line with the turn ON connection.

Configuration Switches

- (10) **‘Load Demand’ (Switch 1)**
Select Load Demand option if desired, With Load demand ON, the inverter conserves battery energy and operates only when a load greater than 5 Watts is applied. Some appliances and tools require this feature to be disabled (turned off) in order to operate properly.
- (11) **‘Battery Type’ (Switch 2)**
The charger is capable of charging both gel and flooded lead acid batteries.
- (12) **‘Charging Rate’ (Switch 3)**
In the high position, the charge rate is 55 Amps. In the low position the charge rate is 15.0 Amps. We recommend the low position as the best selection when two (group 31 or smaller) batteries are used. Charging at too high of a rate for a given battery may damage the batteries.
- (13) **Select IFM1/Remote**
The unit is capable of having either a remote status unit (IFM1) that can run separate warning and status lights or Remote Panel with Fault/Status light’s.
- (14) **Select Inverter Control Terminal**
The unit is capable of having an Ignition source to Master control the remote. The unit cannot be turned on or off with the remote unless the vehicle ignition is in the ON position

Additional Features



- (15) **15 Amp INV/CHG Circuit Breaker**
CIRCUIT BREAKER (bottom breaker) protects the Inverter/Charger.
- (16) **15 Amp AC Output Circuit Breaker**
CIRCUIT BREAKER (top breaker) protects AC Output at the connector.
- (17) **120V, 60Hz @ 15A Max. AC Output**
- (18) **120V, 60Hz @ 15A Max. AC Input**
- (19) **Air Exhaust Vents**
Keep two inches clearance around Vent area
- (20) **Mounting Flanges with 5/16 mounting holes**
- (21) **Air Intake Vents (three sides)**
Keep two inches clearance around Vent area
- (22) **Chassis Ground Bonding Lug**
- (23) **Positive DC Input Connection (Red)**
BE AWARE that, as a large number of capacitors become charged upon completion of the DC circuit, **THERE WILL BE A LARGE SPARK** when the last battery connection is made. The spark is normal and will occur every time batteries are connected.
- (24) **Negative DC input Connection (Black)**
BE AWARE that, as a large number of capacitors become charged upon completion of the DC circuit, **THERE WILL BE A LARGE SPARK** when the last battery connection is made. The spark is normal and will occur every time batteries are connected.



4 INSTALLATION

4.1 Unpacking the Inverter

Inspect the shipping container and equipment for loose or damaged parts. If any damage is found, immediately notify the freight carrier.

4.2 Inverter Installation Considerations

The wiring of your inverter installation should conform to the National Electric Code (NEC) and any other state or local codes in effect at the time of installation. These codes have been written for your protection and their requirements should be followed.

Mounting

Locate a secure, dry, flat horizontal or vertical surface large enough to mount the inverter. The location should be as close to the battery as possible without being in the same compartment and should provide adequate ventilation to maintain room temperature while the inverter is operating. The location must allow unobstructed cooling air flow at sides and bottom of the unit, and the location must be free from road spray, dripping water or other moisture contamination. A recommended minimum clearance of 2 inches (51 mm) should be maintained on all sides of the unit.

4.3 DC Wiring Considerations

BE AWARE that, as a large number of capacitors become charged upon completion of the DC circuit, **THERE WILL BE A LARGE SPARK** when the last battery connection is made. The spark is normal and will occur every time batteries are connected.

1. The DC cables should be as short as possible. It is more electrically efficient to run the lower current AC wiring longer distances (see battery cable sizing table for proper size)
2. Route the DC positive and negative cables as close together as possible, and use cable ties to keep them together. This reduces electromagnetic radiation that could interfere with sensitive electronics.
3. Do not use the vehicle chassis as the DC negative conductor. Use a cable the same size as the DC positive to go directly from the inverter to the battery negative (-).
4. Route the AC and DC power wiring separately, and with as much physical separation as possible, from low voltage wiring such as audio and video signal wires.
5. DC power input cables which pass through steel or other ferrous metal walls need to pass through the same hole. If two holes are required, cut a slot connecting the two holes to prevent a transformer effect.

WARNING: Do not allow wire fragments or metal shavings to fall into the inverter in any way.

DC INPUT WIRING CONNECTIONS

A DC fuse is REQUIRED to properly protect the inverter.

DC input studs have been provided to accommodate crimp lugs, with 5/16" hole, with battery cable up to 4/0 AWG, see table below. Good DC connections and proper wire sizing are critical for the performance and safe operation of the inverter system. The positive and negative DC inputs have color coded covers to protect the "live" connection from any shorting materials.



The Table below shows the recommended minimum cable size, and lug, which should be used. Wire sizing charts published in the NEC may allow a greater amp capacity than we recommend. We have sized the cable for a minimum voltage drop to maintain better performance of your inverter installation. For best performance, wire the DC negative directly back to the battery, do not use the vehicle chassis as the DC negative conductor.

The wiring of your inverter installation should conform to the National Electric Code (NEC) and any other state or local codes in effect at the time of installation. Article 551 of the NEC requires the overcurrent protective device shall be installed in an accessible location on the vehicle within 18 in. (457 mm) of the point where the power supply connects to the vehicle circuits.

Wire and Fuse Size Chart

Wire Size AWG	Ring Terminal AMP or UL recognized equal	Max wire length, in feet, between SRC12-1100PT and battery to keep voltage drop under 0.1 volt. The chart assumes wire carries no other load and wire temperature is below 80°C.
#2	322870	12
#1/0	321867	20
Fuse Bussman Fuse		ANN200 or FS-HVBF-200
Bussman Fuse Holder		4164 (Required with ANN Style fuse)

Crimp the ring terminals using **AMP** ROTA-CRIMP 600850 (2/0 - 8ga).

AMP Product Information Center: 800-522-6752

AMP Tooling Assistance Center: 800-722-1111

4.4 DC Wiring Installation Procedure

Steps

1. Make sure power to the vehicle wiring harness is disconnected. Verify that the inverter is turned OFF by checking that the ON-OFF/RESET Inverter Switch is in the OFF-RESET position. (The button should NOT be pushed in.)
2. Select a location for the unit. An ideal installation location has the following characteristics:
 - a. Close to the battery (usually within six feet).
 - b. Protected from the weather.
 - c. Well ventilated.
3. Prepare DC cable end with appropriate terminals, verify battery positive cable is disconnected from battery. Install cables in the following manner: Connect the positive cable to the positive DC input terminal, tighten stud nut to a maximum of 120 lb./in. of torque, then install the protective cover with the supplied hardware. Connect the negative cable to the negative DC input terminal, tighten stud nut to a maximum of 120 lb./in. of torque, then install the protective cover with the supplied hardware.
4. Route the negative and positive DC input cables from the inverter to the battery but do not connect to battery at this time. Protect cables with grommets or other appropriate means where they may contact hard, sharp edges throughout the installation path.
5. Install fuse in the positive DC input cable between the battery and inverter. Fuse must be installed within 18 in. of the battery or DC wiring bus system to comply with safety agency installation requirements. Be sure

to mount fuse in an easily accessible location for replacement. It is also “good practice” to note on the inverter to check the fuse condition before involving any troubleshooting procedure.

6. Connect Bonding Lug. (see 22). Use 8 AWG or larger copper conductor to connect chassis bonding lug to the vehicle chassis.
7. Connect the negative DC input cable to the battery negative (-) terminal. This battery negative terminal is usually where the battery negative connects to the engine block or frame. Connect the red, positive DC input cable to the in/line fuse near the battery positive (+) terminal. This battery terminal is usually connected to the DC electrical system at the load side of the Battery.

4.5 AC Wiring Installation Procedure

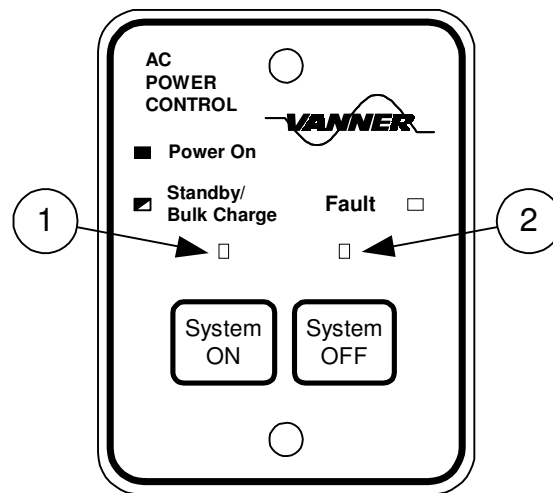
1. Insert the AC Input and Output connections to the mating AC connectors on the front panel of the unit, make sure that strain relief’s “snap” when installing to prevent them from coming loose during vibration.
2. The Vanner SRC12-1100PT has been tested with the following GFCI outlet’s:

Manufacturer	Model
Hubbell	GFR5252W
Hubbell	GFR5252WA
Hubbell	GFR5252I
Leviton	1591
Leviton	6599-I

4.6 (Optional) Remote Monitor and Control Panel Installation

Unpacking the Remote Monitor/Control Panel

Inspect the shipping container and equipment for loose, damaged, or missing parts. The remote panel includes a 10-ft. interconnecting cable. If any damage is found, immediately notify the freight carrier.



Remote Indicator Display Description

LED	Light Display	Description
1	No Light	Inverter is OFF
1	Solid Green	Inverter is ON and producing AC power or Foat Charge Mode
1	Blinking Green	Inverter is in Load Demand Mode or Bulk Charge Mode



- | | | |
|---|-----------|--|
| 2 | No Light | No Fault Conditions |
| 2 | Solid Red | Inverter is in Overtemp/Overload/or Battery Low Mode |

Steps

1. Locate a suitable place to install the remote panel such as a flat surface near the power control/distribution panel or driver's compartment. The mounting surface should have sufficient back space to accommodate the remote panel's min. depth and cable routing requirements of 1 ½". Cut surface material large enough to accommodate the remote cable connector and board area leaving sufficient surface material to attach panel with #8 mounting screws(ref. template).
2. Route the 10-ft. interface cable (011486) from the remote panel mounting area to the inverter being careful to avoid unprotected sharp corners or moving parts.
3. Turn off inverter, then plug the interface cable into the inverter's front panel 'Remote/IFM1' connector. Verify that pos. 4 of the switch settings is set to Remote. Plug the other end of the cable into the rear of the remote panel.
4. Mount the remote panel using two #8 screws.

5 SYSTEM START-UP AND TESTING PROCEDURES

WARNING: THESE PROCEDURES ARE TO BE PERFORMED ONLY BY A QUALIFIED INSTALLER.

After the SR-Series inverter has been properly mounted with sufficient ventilation, DC cables have been connected, AC wiring has been completed, and all remote connections have been checked, the Start-up and Testing procedure may now be performed .

5.1 Inverter Start-up and Testing

- 1 Place the System On/Off switch on the inverter in the OFF position.
2. Place the Load Demand switch on the front panel, Switch 1, to the ON position to test Load Demand function. It can be changed later if this feature is not preferred.
3. Place the Wet/Gel Setup switch to the correct position for the installed battery type.
- 4 Verify that the external breakers, or receptacles are reset and connect an AC load, such as a 100-Watt light.
- 4 Connect both battery cables to battery and turn on the battery DC power to the inverter (if battery switch is used).
7. Do not connect shore/utility (generator) power at this time.
8. Place the System On/Off switch on the Inverter panel to the ON position.
9. Place the System On/Off switch on the Remote panel (if used) to the ON position.



10. Plug AC output test light (eg. 100 watt trouble light) into 15A convenience receptacle and turn on to verify inverter produces AC power and the Load Demand function powers up from stand-by mode. Applying any AC load greater than 5 Watts should start inverter from Load Demand “stand by” mode.
11. Connect and activate AC shore/power (or generator).
12. When shore/utility power (or generator) has been connected the inverter the following should occur:

If AC test light is off.
 - Inverter Light will blink slowly
 - Charge Bulk or Charge Float mode Lights will illuminate. (If the battery is fully charged, it will advance from Bulk mode to Float mode after a time delay).
If AC test light is on.
 - Inverter Light will blink.
 - Battery charge stage Lights will illuminate as described above.
 - The AC output test light should be on, indicating the presence of shore power and correct operation of the AC Transfer switch.
13. Disconnect the AC shore power input. The AC output test light blinks momentarily, indicating the operation of the Transfer switch connection to connect the AC loads to the inverter output.
14. The Inverter Light on the inverter control panel has a solid green light indicating correct inverter operation. At this point, apply AC loads up to the models rated capacity to verify full-power operation.
15. Disconnect all AC loads. The Inverter Light blinks, indicating that the inverter has returned to Load Demand mode.
16. If the Load Demand function is not appropriate for the intended application, reset the Load Demand Switch, Switch (1), to the OFF position. This will allow the inverter to be fully ON continuously unless switched off with the On/Off front panel switch or remote control.

5.2 Procedure to Check Battery Charger Operation

Due to the amount of time to perform this procedure, verifying the battery charger function, it may be postponed to a convenient time.

Determine the correct charger output amps and place the front panel switch (3) position to match this value.

To test the battery charger operations, first discharge the battery by placing a large AC load (approx. 50% of the unit’s rated capacity) on the system and operating the inverter with AC input disconnected. The AC load will discharge the battery over a time relative to the amount of battery capacity, size of load, and ambient temperature.

When the battery charge level is low, the Battery Low Light turns on and will stay on until the battery voltage has dropped to the Battery Low shutdown. The inverter then shuts off and the Light begins to blink. The battery voltage has decayed to 10.5 Vdc. Now, apply shore power and observe the battery charger operation. The system begins with the Charger-Bulk Light blinking, indicating bulk charge operation. This



supplies a constant current charge output. Connect an ammeter to the DC cables between the inverter and the battery to monitor the current (DC amps), and a volt meter to the battery to monitor the battery voltage rising.

After some time, the battery voltage rises to the Absorption voltage (14.4 VDC for wet batteries or 14.1 VDC for gel batteries). The Charger-Bulk light continues to flash, indicating the charger is in Bulk or Absorption mode. The battery voltage remains constant (Absorption voltage value), and the charger output current tapers off. After approximately twenty minutes, the charge advances to Float mode. The Charger Float Light turns ON and the battery voltage drops to the float voltage value (13.2 VDC for wet batteries or 13.6 VDC for gel batteries). The charger will remain in this stage until shore power is removed or until the battery will again accept the bulk charge amperage.

6 THEORY OF OPERATION

Battery Charger Operation

The Silent Runner Battery Charger incorporates an automatic, three-stage charger. This design enables the unit to automatically charge batteries, maintaining the battery's integrity and reducing the likelihood of premature failure. The battery charger is designed to be used with lead-acid type batteries including sealed and gel types, but not for nickel-cadmium (Ni-Cad) or nickel-iron types.

There are three automatic charge stages; Bulk, Absorption, and Float.

Bulk Charge Stage

The Bulk Charge Stage (fixed current) provides a fixed charging current for rapid charging of the battery bank. The charger output current is adjustable, 15-Amp or 55-Amp, to match the charging requirements of the battery. The Bulk Stage is initiated when the battery will accept the charging amps selected. As the battery accepts charge the battery voltage will rise to the charger's Bulk Voltage value, 14.4 VDC for flooded batteries, or 14.1 VDC for gel batteries. When battery voltage reaches the Bulk Voltage Value the Bulk Charging Stage is complete. At this point, the battery is approximately 80-percent charged.

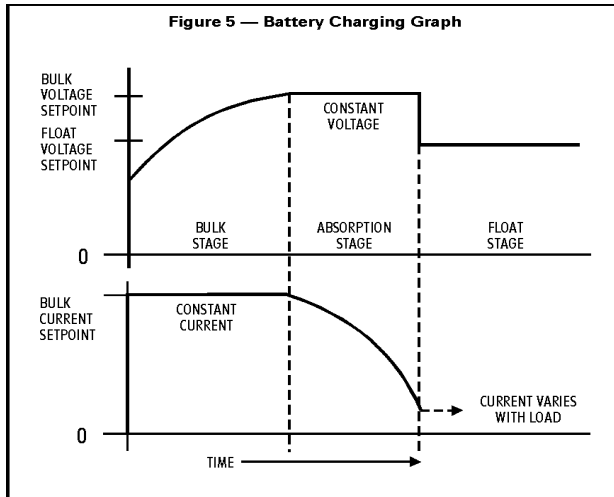
Absorption Charge Stage

During Absorption Charge Stage (fixed voltage), the charger's output voltage remains fixed at the Bulk Charge value and the output current will decrease as the battery becomes fully charged. The Absorption Stage ends after twenty minutes and the charger advances to the Float Stage.

Float Charge Stage

When the charger enters Float Stage, its output voltage is reduced to the float voltage value 13.2 VDC for flooded batteries, or 13.6 VDC for gel batteries. This setting is sufficient to keep the battery charged, but not so high as to boil or over-charge the batteries. The charger will remain in Float Stage until the battery will accept the Bulk Charge Output Amps selected.

Figure 1 Battery Charging Graph



Automatic Power Transfer Switch Theory of Operation

The function of the Automatic Transfer Switch is to automatically accept AC input power from shore or generator, and use this power to operate inverter loads and to provide power for battery charging. Upon loss of AC input power, the transfer switch automatically switches the AC loads back to inverter power. Transfer time is approximately 30 milliseconds (0.030 seconds). The 0.030 second transfer time allows all but the most sensitive loads to transfer from inverter power to shore power and back to inverter power without interruption.

AC input voltage is monitored for proper tolerance at all times. When the AC input is within tolerance for approximately 5 seconds, the power is passed through to the output circuit and the SR-Series automatically switches from inverter mode to battery charger mode. The SR-Series automatically switches back to inverter mode when input power is disconnected or when input power is no longer within tolerance. See SRC12-1100PT Specifications page for AC input voltage tolerances. The 5 second delay occurs only if the inverter is fully ON when input power becomes available. There is no 5 second time delay if the inverter is in the ‘Load Demand Mode’ when input power becomes available.

The factor that determines whether the unit is in ‘inverter mode’ or ‘battery charger mode’ is the presence or absence of ‘in-tolerance’ input power. Whenever ‘in-tolerance’ input power becomes available the unit automatically switches from inverter mode to charger mode.

The transfer switch switches both hot and neutral. For safety purposes the inverter output neutral is connected to the inverter chassis ground only when the unit is in inverter mode. This is a requirement of the National Electric Code for all systems of this type that neutral should be connected to ground only at the source of AC power, which is the inverter when in inverter mode. When an external AC input (shore power, generator) is available, the SR-Series Transfer Switch system breaks the connection between neutral and inverter chassis ground. The neutral-to-ground connection for passthrough power is then provided by the AC input source.



7 PREVENTIVE MAINTENANCE

There are no user serviceable components inside the inverter. For service refer to the Vanner Incorporated Service Department or other qualified service personnel.

7.1 Maintenance Items

For continued reliability and safety, a monthly maintenance program should be implemented to include the following:

1. Check to insure that all DC and AC wiring connections are secure and corrosion free.
- 1 Check air ventilation openings for dust and other obstructions
- 2 Examine receptacle, indicators and switches for cracks and breaks.
- 3 Examine for any surfaces that are discolored or deformed due to excessive heat.

7.2 Troubleshooting Procedures

The following are the most common questions heard by Vanner service professionals. If your situation does not apply to the following categories, please contact your local Vanner Incorporated Service Center or the Vanner Incorporated Customer Service department: 1-800-AC-POWER (1-800-227-6937). Please have your model and serial number available when consulting customer service.

ALWAYS CHECK THE FOLLOWING FIRST:

- DC Fuse condition
- AC output and input breakers
- Check all GFCI breakers as equipped throughout AC system
- Unit On/Off and Remote On/Off switch positions
- Check battery connections for tightness or corrosion
- Check battery voltage at battery and inverter

Symptom ON Light does not light steadily after pushing in the ON-OFF/RESET Inverter Switch.

Solution Light flashes in Load Demand Waiting mode.
Check battery connections if utility power is OFF.
Check DC fuses if utility power is OFF.
Light flashes when utility power is present.

Symptom Inverter Light does not illuminate

Solution Reset On/Off switch on unit and remote
Disconnect remote switch and attempt starting with unit On/Off switch
Check DC fuse condition

Symptom ON light fully illuminates. AC load does not run.

Solution Check and reset AC circuit breakers.
Check and reset any GFCI breakers in AC circuit.
Verify AC load and wiring are in proper condition.



Symptom	BATTERY LOW light illuminates when AC load is applied.
Solution	Check battery connections. Check battery condition. Recharge battery if voltage is less than 10.5 VDC. Check the charging system for proper operation (vehicle alternator, generator).
Symptom	OVERTEMP light illuminates.
Solution	Something has caused the unit to overheat. Check for obstruction of air flow to the cooling fan or from ventilation holes. Verify AC load is within unit' s rated capacity.
Symptom	OVERLOAD light illuminates with AC load applied.
Solution	Verify AC load is within unit' s rated capacity.
Symptom	DC fuse blows when connecting DC input cables.
Solution	Check for reverse polarity: red cable to battery positive (+), black cable to battery negative (-) The unit may be damaged and require repair service.
Symptom	Excessive audible buzzing during inverter operation but inverter operates loads.
Solution	Check mounting bracket bolt tightness Remount inverter with rubber insulator washers
Symptom	AC loads do not seem to be fully energized when operating from inverter power.
Solution	Check AC output voltage at convenience receptacle with a "True RMS" meter. Check for overheated DC or AC wiring
Symptom	Unit does not operate and a "burnt wire" smell emits from inverter.
Solution	Disconnect AC loads and battery immediately Unit may require service



8 APPENDICES

8.1 Problem Loads

Although modified sine wave inverters will operate most AC loads, some loads may exhibit problems because the wave form is different than the pure sine wave of utility power. This is due to the square wave components and that the peak voltage is not quite as high as a pure sine wave. Loads that may exhibit problems include motor speed controls found on ceiling fans and air conditioner fans; light dimmer controls; clocks; microwave ovens (cooking time may vary and the clock may be erratic); video monitors and TVs (may have lines in the picture); AM radios (may pick a noise); laser printers; copying machines; fluorescent lights; and power supplies in some electronic devices. Rechargeable battery devices may also overheat and be damaged by the inverter. If you desire to operate a rechargeable battery device on the inverter you should first power it up and closely observe it for a period of time to ensure that it does not run too hot.

Ampere-Hour (A-H):

A unit of measure for a battery's electrical storage capacity, obtained by multiplying the discharge current in amperes by the time in hours of discharge. The rating is usually for a discharge period of 20 hours and an end voltage of 10.5 volts. Example: A battery which delivers 5 amperes for 20 hours has a capacity of 100 A-H. $5 \text{ amperes} \times 20 \text{ hours} = 100 \text{ Amp-Hr.}$

The reason the A-H rating is misunderstood is simple. A battery that has a rating of 100 AH cannot always deliver 100 A-H. The underlying reason is the efficiency with which the battery converts its chemical energy into electric energy. The A-H capacity of a battery is affected in the following ways:

Discharge Rate:

A battery becomes less efficient as the discharge current increases. For example, a typical 100 A-H battery is specified to be able to deliver 5 amps for a period of 20 hours. If the discharge current were increased to 25 amps, the capacity will be reduced to approximately 75 A-H ($25 \text{ amps} \times 3 \text{ hours} = 75 \text{ A-H}$).

Operating Temperature:

A battery becomes less efficient at lower temperatures. Most battery manufacturers specify the battery A-H capacity at 80°F. At a temperature of 32°F, the same battery will have only about 65% of its rated capacity even though it may be fully charged. At a temperature of 0°F, a battery's capacity will be reduced to about 40% of its rated capacity.

Battery Age:

As a battery is used, some of the active material on the battery plates will deteriorate and become useless. As the battery gets older, there will be less and less useful material left on the plates and the operating time will become noticeably shorter. A battery will age faster (lose active material from its plates faster) if it is deeply discharged regularly, if it is left in a discharged state for extended periods of time, or if it is repeatedly overcharged.



8.2 DC Power Consumption

An inverter takes in DC power, and produces AC power to operate attached loads. In general, we can see a direct relationship between DC input power and AC output power. This allows us to establish the following rule:

For every 10 watts of AC output power, an inverter requires one amp of DC input power on a 12 volt input inverter.

Example:

An inverter powering a 1,000 watt AC load requires 100 amps DC.

$1000 \text{ watts} / 10 = 100 \text{ amps}$

Using our rule, we can determine the requirements for an electrical system needed to power our inverter (typically, an alternator and battery combination, or a photovoltaic panel and battery combination).

Inverter DC Input Current Requirements

A DC to AC inverter converts DC power into AC power. For the purposes of this discussion, power (watts) is equal to the supply voltage (volts) multiplied by the current draw (amps) from the supply for both AC and DC circuits. For example, 2400 watts = 12 volts DC x 200 amps, and 2400 watts = 120 volts AC x 20 amps. From these two examples of 2400 watts at 12 volts and 2400 watts at 120 volts, it is easy to see that since there is a 1 to 10 voltage conversion (12 to 120), there is a 10 to 1 amp conversion (200 to 20). A more accurate relationship between the input power and output power is:

$$(\text{DC Input Power}) \times (\text{Efficiency}) = (\text{AC Output Power})$$

This formal relationship has lead to the following rule of thumb for estimating the DC input amps for an inverter:

For 12 volt DC inverters: $\text{output watts} \div 10 = \text{DC input current}$

This rule of thumb can be used to estimate the minimum alternator size required for your application and is also used later in calculating the minimum size battery required when operating from battery only. The following examples should help to clarify the use of this rule of thumb.

Example A:

What is the DC current draw of a 12 volt DC input inverter when it is operating a vacuum cleaner with a name plate rating of 6 amps at 120 volts AC?

The appliance rating is given in amperes, so we must first calculate the power it consumes. Then the rule of thumb can be used to find the DC input current of the inverter.

Output power =

$120 \text{ volts} \times 6 \text{ amps} = 720 \text{ watts}$, and $\text{DC input current} = 720 \div 10 = 72 \text{ amps DC}$.

This information on estimating the DC input current requirement for an inverter will allow you to size an alternator or charging system to supply an inverter for continuous operation.



9 International and North American Warranties

International Limited Warranty

Vanner Inc., referred to herein as Vanner, warrants that this product is free from defects in materials and workmanship for a period of two (2) years from date of installation or two and one half (2½) years from date of manufacture, whichever is less if and only if the following requirements are complied with:

1. The product is installed and checked out properly according to all guidelines, instructions, and checkout procedures set forth in the product Installation and Operating Manual.
2. The installer records all checkout data required and completes, signs, and returns the warranty registration card to Vanner within ten (10) days after installation.

Vanner does not warrant its products against any and all defects when: defect is a result of material or workmanship not provided by Vanner; normal wear and tear, or defects caused by misuse or use is contrary to instructions supplied, neglect, accident, reversed polarity, unauthorized repairs and/or replacements.

All warranties of merchantability and fitness for a particular purpose: written or oral, expressed or implied, shall extend only for a period of two (2) years from date of installation or two and one half (2½) years from date of manufacture, whichever is first. There are no other warranties which extend beyond those described on the face of this warranty.

Vanner does not undertake responsibility to any purchaser of its product for any undertaking, representation, or warranty made by any dealers or distributors selling its products beyond those herein expressed unless expressed in writing by an officer of Vanner.

Vanner does not assume responsibility for incidental or consequential damages, including, but not limited to responsibility for loss of use of this product, removal or replacement labor, loss of time, inconvenience, expense for telephone calls, shipping expense, loss or damage to property, or loss of revenue.

Vanner reserves the right to repair, replace, or allow credit for any material returned under this warranty. Any damage caused by the customer will be charged or deducted from the allowance.

All warranty work will be performed at Vanner's factory, or authorized repair facility utilizing a valid Warranty Authorization Number (WAN) prior to repair. Products shall be delivered to Vanner's facility, freight prepaid and fully insured. Transportation charges, fees, duties and export documentation are the responsibility of the product's owner.



NORTH AMERICAN LIMITED WARRANTY

Vanner Inc., referred to herein as Vanner, warrants that this product is free from defects in materials and workmanship for a period of two (2) years from date of installation or two and one half (2 ½) years from date of manufacture, whichever is less if and only if the following requirements are complied with:

1. The product is installed and checked out properly according to all guidelines, instructions, and checkout procedures set forth in the product Installation and Operating Manual.
2. The installer records all checkout data required and completes, signs, and returns the warranty registration card to Vanner within ten (10) days after installation.
3. The product was purchased after January 1, 2000.

Vanner does not warrant its products against any and all defects when: defect is a result of material or workmanship not provided by Vanner; normal wear and tear, or defects caused by misuse or use is contrary to instructions supplied, neglect, accident, reversed polarity, unauthorized repairs and/or replacements.

All warranties of merchantability and fitness for a particular purpose: written or oral, expressed or implied, shall extend only for a period of two (2) years from date of installation or two and one half (2 ½) years from date of manufacture, whichever is first. There are no other warranties that extend beyond those described on the face of this warranty. Some states do not allow limitation on how long an implied warranty lasts, so the above limitations may not apply to you.

Vanner does not undertake responsibility to any purchaser of its product for any undertaking, representation, or warranty made by any dealers or distributors selling its products beyond those herein expressed unless expressed in writing by an officer of Vanner.

Vanner does not assume responsibility for incidental or consequential damages, including, but not limited to, responsibility for loss of use of this product, removal or replacement labor, loss of time, inconvenience, expense for telephone calls, shipping expense, loss or damage to property, or loss of revenue. Some states do not allow the exclusion or limitation of incidental or consequential damages, so these limitations may not apply to you.

Vanner reserves the right to repair, replace, or allow credit for any material returned under this warranty. Any damage caused by the customer will be charged or deducted from the allowance.

All warranty work will be performed at Vanner's factory, or authorized repair facility utilizing a valid Warranty Authorization Number (WAN) prior to repair. Products shall be delivered to Vanner's facility, freight prepaid and fully insured. Products repaired under warranty, or replacement parts or products will be returned to North American location prepaid via same transportation means and level of service as received, unless directed otherwise. Prepaid freight policy does not apply to locations outside North America.





**Vanner Incorporated
4282 Reynolds Drive
Hilliard, Ohio 43026**

**1-800-AC POWER
(1-800-227-6937)
Tel: 614-771-2718
Fax: 614-771-4904**

**www.vanner.com
e-mail: pwrsales@vanner.com**

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