EBBETT

INVERTER-CHARGER

OWNERS MANUAL

31/8/11

1. SCOPE

The scope of the hand book is to provide the user with sufficient information to plan and carry out the installation of an Ebbett Inverter-Charger in such a way as to be able to maximise the features and benefits of the unit, and achieve a convenient and reliable power supply system within the battery capability. Sufficient information is also provided to establish the origin of any problems with the system, or faults with a unit, and refer back to the seller for repair or replacement.

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2. SPECIFICATIONS, PERFORMANCE

Insert Spec Sheet 5/05

3. QUICK CHECKOUT- Inverter-Charger System

Order
Correct unit size for the load:-
- 1500VA model for a fridge (1 x 1/4 hp induction motor) plus other load.
- 3000VA model for separate fridge & freezer (2 x 1/4 hp induction motors) plus other load.

Mount brackets to screw it on the wall or bulkhead.

Fan cooling option & charge rate reduced to 60% if battery is over:-
- 150 Ah on the 80A charge model.
- 75 Ah on the 40A charge model.

Fan cooling & connected to output for 20% increase in continuous rating of inverter.

Charge voltage setting left at standard ex factory “float/boost voltage” for lead acid batteries when on mains (ie marina etc).

Charge voltage setting raised to “elevated boost voltage” for lead acid batteries in cycled use on a generator (but never on mains). Boost transformer supplied for generators of insufficient peak output.

Max charge rate set within battery manufacturer specification. Reduced for battery less than ≈75 Ah or sealed batteries.

Non-standard voltage for Ni-Cad or other special batteries.

An external increased load transfer unit if generator is larger than 3 kVA (& unit link options set for no load-limit).

Link options set for load-limit, & charge rate reduced if generator is smaller than the unit rating.

Extra filter for electric fence unit or other specialised appliances, telecom installation etc

Transport
Unit in plastic & double-layer packaging (cardboard around the unit & inside a carton with at least 4 inches of foam or tight newspaper balls between).

Install
Well ventilated, dry, preferably vertical position, separate from batteries.

3 pin plug, flex, & junction box going from the unit 230V outlet socket to the fixed wiring.

Low voltage switch in the kitchen or control consul, (connected to terminals under front cover for remote on/off/reset).

230V neon near the switch to indicate unit output.

A deep cycle battery large enough not to discharge more than ≈25% each cycle.

Battery leads as supplied (no more than 2 m).

4. THEORY OF OPERATION

Marine and Remote Area Power Supply (RAPS) Systems often use diesel or petrol generators as a source of energy. Units are comparatively noisy and inefficient on light loads. Maintenance costs are high.

Many industrial processes require mains-failure back-up.

The Ebbett Inverter-Charger, or standby power supply (SPS), connects inline between the mains (or generator) and load. When power is available it supplies straight through to the load and charges a battery at the same time. When not, it automatically changes over and supplies power from the battery via an inverter.

For RAPS, generators need only be run for short periods but power is available 24 hours per day. While running, their load is increased by the battery charge, closer to full load rating, so overall efficiency is improved.

In **mains (generator) mode**, power is switched to the output by a contactor.

The charger is brought into operation at the same time.

For optimum performance and long life, batteries must be correctly charged. In standby systems this means maintaining a very precise "float voltage" that contains minimal "ripple", and also limiting the maximum charge current to a specified level for a particular type of battery. In cycled systems a “boost voltage” is required that brings batteries to their full charge quickly. Furthermore, the "taper" from maximum current to zero should be very steep so that batteries receive maximum current for as long as possible before becoming fully charged. Overall recovery time is then reduced.

Higher voltage settings are required for batteries in cycled use on generators, and large batteries need a continuous current level setting on the Ebbett Inverter-Charger with additional fan cooling for sustained long term charging.

In **inverter mode** the output waveform is a quasi sine wave that closely approximates the normal utility power. Special digital phase-correction techniques are used to ensure sinusoidal currents flow in inductive loads. Switching edges are slowed down to reduce electrical interference. A waveform of this type is suitable for most AC loads including linear and switching power supplies used in electronic equipment, transformers, and motors. However a few appliances need a filter fitted to their supply (eg electric fence controllers that have a capacitive input).

RMS voltage is maintained the same as the normal utility. However most AC meters (digital or analogue) respond to average value, are calibrated for a sine wave and will read high or low depending on load and battery voltage. (ref section 9.1)

Inverter mode performance is determined by the combination of inverter and battery characteristics.

- The battery limits the amount of current that can be drawn by the inverter.
- The inverter is designed so that as nameplate-load is exceeded, output voltage is reduced, and current limited to safe levels. Also, as semiconductor temperature rises, current-limiting is biased towards further reduction.

Overall performance and load-handling ability is therefore determined firstly by battery condition, and secondly by inverter temperature.

Despite changing conditions, the electronic logic of the unit monitors, adjusts, and continues to maintain output to specification. When control limits are reached, it activates one or more of it's many protection circuits, and tapers off or locks out until reset.

Care has been taken in the design to ensure a robust system with "fool proof" operation. Automatic protection, and other control circuits are included to accommodate such occurrences as dead-flat-

battery, reverse polarity connection, overload, short circuit etc.

However, optimum performance cannot be obtained without a **good battery** and **correct installation.**

Please note the quick check. Check the specifications. Read the directions.

A successful system requires careful engineering. Consider load management before system requirements.

Run any large heating appliances only off the generator. Alternatively use solid fuel/gas stove, space heating and hot water heating (or solar). Use compact fluorescent lights instead of incandescent.

Typically an electrical system would have a fridge/freezer, washing machine and other small appliances and require approx 3 hours per day of generator run-time. (Usually 1.5 hours in the morning and 1.5 hours in the evening at maximum power usage times).

5. LOAD RATING

5.1 Battery

Many types of battery are now available, from nickel-cadmium through to lead-acid, sealed, and maintenance-free. For optimum performance batteries should be chosen for a specific purpose, according to type of load and duty. Our standard inverter-charger is designed for **lead-acid batteries**.

Some batteries are rated by a "Reserve Capacity" rating which is defined as the time in minutes that a new, fully-charged battery can deliver 25 amps (A) continuously before the voltage falls to a specified end point. Most manufacturers specify 1.68 to 1.7 volts (V) per cell (10.08 to 10.2 battery volts for a 12V battery) and the low voltage trip of the inverter is factory-set to this. For a battery with "Reserve Capacity of 90 minutes", an inverter drawing 25A would sustain load for 90 minutes. If the battery was charged at the same time by a 40A generator, then the load discharge would be less than the charging capability, and the battery would last indefinitely.

Other types of battery are rated in ampere-hour (Ah) capacity at given discharge rates.
For example, specification curves show a battery to have a capacity of 40 Ah if discharged at the rate of 10A.
The battery will last for, 40 Ah divided by 10A = 4 hours

Actual Ah capacity decreases as discharge rate increases. A battery rated at 100 Ah which can deliver 5A for 20 hours, may deliver 20A for 4 hours, resulting in an actual capacity of 80 Ah.

To estimate the battery capacity you require:-

1) Add up the wattage of each item of equipment. If only the current is given, multiply the current drawn by 230V to get power consumption in watts (W).

2) Estimate battery current drawn. Divide by
   10 for a 12V system
   20 for a 24V system

3) For each piece of equipment, estimate how many hours it will operate.

4) Multiply amps x time for each item to get total Ah as in the following example.

Item	wattage	Battery V (div by 20 for 24V)	Battery Amps	Operating hrs/day	Ah/day
fridge	200	20	10	8	80
TV/video	60	20	3	4	12
lights	400	20	20	4	80
washing machine	200	20	10	0.75	8
microwave oven	1100	20	55	0.2	11
vacuum cleaner	800	20	40	0.25	10
kitchen appliances	100	20	5	1	5
sewing machine	100	20	5	1	5
workshop tools	300	20	15	0.5	8
water pump	200	20	10	2	20
total					238

5) Recharge Ampere-hours are calculated by
amps x time = Ah

The life of automotive batteries is seriously reduced by low discharge, and specially designed deep cycle, heavy duty, marine, low loss, industrial standby and traction batteries are available. But they too have life shortened by deep cycle.
Consult the supplier for specifications.

For RAPS applications use deep cycle batteries and try not to discharge them more than ≈25% to gain full life (5-10 years). To do this is calculate the Ah load drawn, ensure recharge Ah are ≈10% greater, and check the specific gravity with a hydrometer regularly.

In marine and automotive systems, operation of an electric starter motor requires a battery almost fully charged. It is important therefore, that either the inverter be powered by an auxiliary battery not required for essential use such as motor starting, or that it be run only while an alternator of sufficient current is charging the battery. (Ref 13.1).

The inverter continually monitors battery voltage under load; so overall system operation depends primarily on the battery's ability to maintain terminal voltage while supplying current.

A good battery is essential.

In practice it will be observed that the inverter will trip on "Low Battery" for say full load, but if reset, will continue to run for some hours on a light load. Conversely, a load increase after it has been running for some time on a light load, may be sufficient to drop the terminal voltage and actuate "Low Battery Trip".

In the event of accidental reverse polarity connection or other fault, the battery must be capable of supplying sufficient current to trip circuit breakers instantaneously; otherwise, heating, explosion, or serious damage may occur to a battery.

Generally an inverter-charger needs to have a battery of Ah rating at least twice its name-plate-maximum current rating for optimum performance.

When being recharged, lead acid batteries in standby applications are generally held at a “float-charge voltage” (≈2.25-2.3 volts per cell), whereas batteries in cycled use are “boost charged” to an initially higher voltage (≈2.4-2.6 volts per cell).

Battery tips
All batteries have maximum charge and discharge current rates specified, and these should be observed when calculating the load and charge requirements.

Sealed lead-acid batteries are unable to "gas" like conventional vented types, and it is essential

that the battery charger be set so as not to exceed the specified maximum charge rate. Consult the battery manufacturer.

Battery capacity (Ah) is increased by connecting batteries in parallel. Battery voltage is increased by connecting in series but there is no actual change in capacity.

Do not connect batteries from different manufacturers, or with different Ah ratings, in parallel. Decreased battery life may result.

If larger capacity is required, it is better to connect larger batteries of lower voltage, in series.
ie 2 x 6V 200 Ah batteries in series giving 12V is better than 2 x 12V 100 Ah batteries in parallel.

Lead acid batteries emit hydrogen , oxygen, and sulphuric acid fumes when recharging. Vent the battery enclosure and keep the inverter-charger or other electronic equipment in a separate enclosure. **Do not use a naked flame in the vicinity.**

Battery capacity is temperature sensitive. Normal Ah rating is at 25 deg C. At 10 deg C the rating will be ≈90%.

Do not leave batteries in a discharged state for more than a day or two. Permanent damage can result from sulphation. Also self discharge will occur over a period of 3-6 months, so periodically recharge even when not in use.
Monthly, top up with distilled water (when the battery is bubbling on charge). Ensure the minimum water level always covers the plates. If there is no maximum level mark, then fill to about 10 mm below the inlet tube. Excessive fluid loss is a sign of overcharging.

Connections to the battery posts should be made with permanent connectors to provide a long-term, reliable, low-resistance connection. Clean the connections regularly and prevent corrosion by using an insulating spray or Vaseline.

Battery state-of-charge can be measured with a hydrometer or a digital voltmeter that can display tenths of a volt. For accuracy, measurements must be made after the battery has been disconnected and neither charged nor discharged for an hour.

For a 12V lead acid battery at 25 deg C, the following table may be used:-

State-of-Charge	Automotive Batteries		Deep Cycle (RAPS) Batteries	
	Voltage	Specific Gravity (SG)	Voltage	Specific Gravity (SG)
100%	12.7-12.9	1275	12.6	1255
80%	12.5-12.6		12.4	1225
60%	12.3-12.4	1200	12.3	1200
40%	12.1-12.2		12.2	1180
20%	11.9-12.0	1125	12.1	1160

An approximation of battery state-of-charge can be made by taking SG readings while the battery is in operation.
For automotive batteries a simple hydrometer can be obtained from the battery supplier for less than $20. Deep cycle batteries require a more accurate hydrometer with a lower scale.

5.2 Inverter

The maximum rating for the inverter is a 20 minute maximum (plus allowance for surges), such as would be required to run a typical appliance.
i e a 1500VA inverter will run a circular saw rated at 1500VA, with start surges of 2000 VA.
A continuous rating (24 hr at nominal battery voltage) is determined by long term thermal build up of the transformer. At 20 deg C, and without fan cooling, this rating will be approx 50% of the nameplate maximum. With fan cooling the rating can be increased by ≈20%. Performance curves for specific models can be obtained for details.

If cycled on heavier loads it will be observed that temperature compensation in protection circuits,

and thermal trip, reduce the inverter's ability to handle surges.

Make sure the inverter will be large enough for your load surges.
This is especially important for **induction motors** (fridges, pumps, etc) which typically require 4-6 times run-current, on start-up.

A typical estimate is as follows:-

Normal motor run current 1.3A
Estimated start current = 1.3A x 6 = 7.8A
Estimated start surge = 7.8A x 230V = 1794 VA
1500VA model specified surge rating = 2000 VA

Therefore the 1500VA model would be required even though the actual continuous load requirement is only 1.3A x 230V = 299 VA

5.3 Charger

The charger is capable of supplying various types of battery mentioned, but it is factory-set as a general-purpose, lead-acid battery charger, in unattended use. The factory settings are for a float-charge voltage and a maximum current to the nameplate rating. These ratings will be satisfactory for general mains standby applications.

An intelligent 3 stage auto-boost option is available for batteries in cycled use.

Generally therefore, for nickel-cadmium or continuously cycled battery systems, the voltage and current settings must be altered at the time of ordering.
Large deep cycle batteries need an elevated boost voltage setting and the fan cooling option.

Sealed batteries may require a factory-setting for a reduced maximum current. Usually this is approx 10% of the Ah capacity of the battery.

ie 40 Ah / 10 = 4 A max charge

Lead acid batteries in deep cycle use are set for boost voltage approx 2.65 V per cell (ie 32V on a 24V system). This allows them to “gas” to achieve full charge.

The battery supplier should be consulted for recommended settings.

6. WARNINGS AND SPECIAL NOTES

* - The inverter-charger is a high voltage apparatus that must be used in accordance with the electrical wiring regulations and treated with the same respect as other 230V appliances.

* - Under no circumstances should the front cover be removed while it is connected to the battery, mains or generator.
To dissipate dangerous charges retained in capacitors after disconnection from the battery, wait 60 seconds.

* - The unit must be connected, only to the specified battery voltage. Connection to a higher voltage can cause serious damage to electronic components and invalidate the warranty.

* - Keep battery leads as short as possible.

* - Ensure the battery is of sufficient size to match the inverter-charger charge and discharge currents.

* - Ensure correct polarity battery-connection. Incorrect connection can cause battery damage.

* - Turn the unit off during connection and disconnection to avoid sparking and minimise the risk of explosion of hydrogen gas from the battery.

* - Ventilation is required for cooling. House the unit in a separate compartment from batteries, to avoid corrosion damage to components.
Do not smoke or use a naked flame.

* - Battery acid is harmful to the skin, eyes and clothing. Wear goggles, & rubber gloves. Keep water and baking soda at hand to neutralise any acid spill. Flush eyes with water. Lock everything away from children.

* - Keep batteries at approximately 20 deg C. Do not leave them in a discharged state. Mount them on wood or rubber (not directly on cold concrete). Insulate terminals.

* - The battery output should be floated above earth in a marine installation to avoid electrolysis problems with an alloy hull.

* - For mains failure or generator changeover, always use proper interlocked contactors or switch with dead position between selections. Use of a simple 230V relay can cause contact flash-over between power sources, catastrophic inverter failure, and invalidate the warranty.

Our extended warranty is offered only for occurrences other than failure as a result of abuse.

7. INSTALLATION

Before unpacking, ensure the unit has been ordered with options and settings suitable for the application. **Run through the quick checkout list (section 3).**

Unpack, and examine for any signs of in-transit damage due to impact, vibration or moisture. Select a **dry, well ventilated place**, and position the unit, **preferably vertically**.

Before connection note warnings and special notes section 6.

Portable Unit:

Supplied as a standard multipurpose inverter-charger. Merely bolt or clamp leads onto correct battery polarity and turn on (**red positive, black negative**). Rubber feet are fitted to the base for free standing use.

Permanent Installation:

Inverter-chargers are supplied with lugs to ensure a solid battery connection. This is because they draw very large **battery** currents and it is essential for proper operation, to maintain good electrical connection. Make sure **connections are tight**, otherwise excessive volt-drop, heating and melted insulation may result.

The unit can be wall-mounted by ordering the mounting strap option. The straps are attached to the rear of the cabinet by four 6 mm screws. With the 1500VA model, remove the existing screws from the four rubber buffers and attach the mounting strap into the same holes, using the longer screws provided. Use the buffers as spacers by pushing them onto the shaft of each of the screws before inserting them into the cabinet.

Permanent installations require a battery isolator, and all models come fitted with an miniature circuit-breaker (MCB) fitted in the front panel for this purpose. However, installations **using multiple battery connections, in various applications, will have specific regulations and official codes of practice that require separate fuses and isolators etc located at each battery**. Please refer to installation examples section 13.1 to 13.5 for reference to these.

Marine/caravan dual battery systems require additional isolators at the batteries (ref section 13.2). **The suggested automotive or marine installation uses an optional auxiliary battery and blocking diode**. The auxiliary battery is automatically charged with the main battery from the engine alternator, but can be discharged without affecting the essential power source. The charging regulator must be modified to compensate for the volt-drop of the diodes. This can be done by rewiring its sensing lead to be after the diode, or adjusting its setting up ≈0.7V to compensate. The start battery can only be charged from the inverter-charger if the battery selector switch is closed.

Solar panels or wind turbine (or micro-hydro in a **RAPS system**), can be connected to charge the batteries, but they must use an **appropriate charge controller. A universal shunt regulator is available** to do this by dumping excess energy into hot water heating.

Special **Optional ammeter and voltmeter can be connected as shown (section 13.2),** but often it is more convenient to connect instrumentation externally.

Output and charge ratings are for a specified time and ambient temperature. These can be increased by **ordering with the addition of external fan cooling to assist natural convection.**

Battery lead-length must be as short as possible and no longer than one and a half times that supplied. (Volt drop causes dramatically decreased performance).

Remote on-off-reset should be installed by removal of the link (pointer 12, section 11.2.1 & 11.2.2) and installation of a normally-open contact switch (low voltage & 0.1A rating).

Do not disconnect any other wires, serious damage to the inverter-charger may result and invalidate the warrantee.

A 230V neon should be located near the switch and wired to the output of the unit to indicate when it

is on. (Be careful to segregate low voltage and 230V wiring by using separate cable runs and conduits). This is usually best located in the kitchen of a house or the control consul of a boat etc. A PDL combination switch and light flush-plate or similar can be used.

In order to accommodate various international electrical wiring conventions the inverter-charger maintains the integrity of the type of system applied to its input. The output of the inverter stage is fully isolated from the input and has no electrical connection between either of its output lines and earth. Furthermore the input battery connections are also floating, allowing either positive or negative earth connections on the battery, if desired.

The unit is easiest installed into fixed wiring with a three-pin plug and flex, to a junction box, and then hard-wired to a conventional switch board or splitter box.

The decision is then made to maintain a floating system or connect one line to neutral and create a multiple-earth-neutral system (MEN). Depending on the application, it is essential that wiring be carried out in accordance with specific regulations and official codes of practice that apply. Please refer to the installation examples (section 13.1 to 13.5) for NZ requirements. Local regulations must be followed in other countries.

Installations that have peak supply and demand **ratings greater than that of the unit must have an increased-load-transfer unit installed.**
(eg a 6 kVA peak load on a 6 kVA generator, but a 3000VA inverter-charger at off-peak times). (Please refer to section 13.5). The unit effectively bypasses the inverter-charger when the generator is running.

Where manual selection of multiple power sources is required, a **centre-off switch is required to prevent contact flash-over**. (ie shore power-off-generator-off-inverter-charger output).

For automatic changeover **use a proper motor start contactor with at least a 20A 400V rating** to allow for the possible voltages between the different power sources. The remote on-off-reset circuit of the inverter-charger should be interlocked via a normally-closed auxiliary contact.

Ground solar panels or wind turbines to prevent lightning travelling back through the entire system.

In telecommunications-type installations the inverter-charger should to be ordered with an optional extra input filter if it is to share a common battery with other measurement or communications equipment sensitive to HF ripple. This is not normally the case with most domestic, automotive or marine installations, but care must always be taken to ensure the inverter-charger or cabling is at least 1 metre away from aerials or other radio equipment. If this distance cannot be achieved, battery cables may have to be screened or installed in an earthed metal duct.
For a sensitive telecommunications environment:
- The unit should be ordered with the input filter
- Output cables should be screened if load is a non-linear, pulse-current load (personal computer etc).
- Input cables should be as short as possible, less than 0.2 ohm & screened or ducted away from communication cables.
- The case & one battery terminal should be earthed.

8. OPERATION

Once installed, turning on the main circuit breaker (battery isolator) will automatically start the unit in **inverter mode** (provided the remote option remains linked out, or a switch, if installed, is closed).

8.1 Inverter Mode

On-Off-Reset:

The inverter draws no power from the battery until initiated by failure of the mains or generator. On start up, the unit ramps-up to provide a "soft start" to external loads. Appliances can then be plugged-in, started, and stopped at will. Resetting of the fault-latches is achieved automatically by restart of the generator or operation of the remote on/off/reset switch (or local switch on the 48V model). Fault-reset can also achieved by disconnection of the battery supply.
If the MCB or battery disconnection is used, a pause of approximately 30 seconds is required. Reset using the remote switch option is instantaneous.

Power On:

When the inverter is switched on, the two "Power On" lights indicate that the electronic output-drivers are functioning.

Overload:

Multifunction indicator of all solid state load-monitoring protection circuits.

(1) **Maximum Current:** As name-plate-load rating is gradually exceeded, output voltage is reduced and current limited. Fast current-limiting and spike-suppression circuits accept overloads, but in general, the unit will trip on any load with start surges (motors etc.) in excess of 250% of nameplate rating.

(2) **Thermal Protection:** Electronic monitoring of heat-sink temperatures reduces the current limit as temperature rises. Long term rating is limited primarily by thermal rise of the transformer. A temperature sensor in the windings shuts the inverter down and is reset by turning the inverter off and on again. After a thermal trip, the inverter cannot be restarted until it has cooled sufficiently.

(3) **Output Voltage Monitor:** The unit continually monitors its own output. From start up, a minimum voltage of at least 195-205 volts must be detected or lockout will occur.

During normal operation, should the output voltage drop as a result of overload, lockout will occur. Allowance is made for brief overloads during motor starting.

The output monitor remains active even when "Low Battery" has tripped, so any “Low Battery” lockout is always immediately followed by an “Overload” lockout 3-5 seconds later.

Low Battery:

Primarily employed to protect the inverter but factory-set to suit the minimum battery voltage requirements of a lead acid battery under average heavy load. (12V set 10V, 24V set 20V).

Under normal operation then, after turn on, the two "Power On" lights will operate. If a fault occurs, they will extinguish. If overloaded, the "Overload Trip" **alone** will operate. If the battery is flat, **both** "Battery Low" and "Overload Trip" lights will operate.

8.2 Charger Mode

When 230V power from the mains or a generator is applied to the input, the inverter stage is disabled and power is switched directly to the output via a 3 kVA contactor. The unit automatically goes into **charge mode** with a soft start.

If the auto-boost option is installed, the 3 stage intelligent charge cycle will be initiated.

Input Fuse:

The input fuse is in the line feeding all 230V power to the unit.

Main Circuit Breaker/Battery Isolator:

All battery power to and from the unit is isolated by the operation of the miniature circuit breaker (MCB) on the front. This should be operated upwards to turn the unit on. In the event of certain faults it will automatically trip, and must be turned off and on again to reset.

It should be turned on only after a battery has been connected.

Power On:

When the charger is turned on, the "Power On" indication LED on the front cover (1500VA model only) will light up. It will increase in intensity as the charge rate increases.

Ammeter:

The ammeter on the front indicates the rate of charge. It will tend to read downscale when in inverter mode.

Overload:

(1) **Maximum Current:** Factory set to 100% of nameplate rating.
Automatic current limiting means that the unit can never supply more than its specified maximum output.
The "Power On" LED reduces in intensity as this point is reached.

(2) **Thermal Protection:** Long term rating is limited primarily by the thermal rise of the transformer. A temperature sensor in the windings shuts the unit down until it has cooled sufficiently. It will then reset automatically. This is indicated by the "Power On" LED extinguishing and then resetting.

(3) **Gross Overload:** Faults such as a load short circuit, reverse polarity connection of the battery, or component failure, will trip the front MCB.

No Load:

A fully charged or disconnected battery will require no current, and the "Power On" LED will extinguish.

9. ELECTRONIC CONTROL CIRCUIT BOARDS

9.1 Adjustment

Adjustments on the circuit boards are factory-set and normally require no field adjustment.

9.1.1 Inverter

V - Output Voltage	-	Factory set 230-240 volts.
I - Maximum Current	-	Factory set 100 percent and must not be altered. Breaking of the seal will invalid the warranty.
F - Frequency	-	Factory set 50 Hz.

Note:-

Comparisons of voltage and current using standard multimeters are valid only on a perfect sine-wave.
For precise measurements on the output waveform of the inverter-charger, true RMS-reading meters must be used.
(ie meter models Fluke 87, Fluke 8060A, Beckman 4410, or a moving iron panel meter)

9.1.2 Charger

Vb - Output Voltage	-	Factory set for float voltage of lead acid batteries. Can be altered to suit alternative batteries. (≈0.1 turn anticlockwise to raise battery voltage ≈1V)
Ib - Maximum Current	-	Factory set to specified maximum load. Must not be altered. Breaking of the seal will invalidate the warranty. Settings for other types of battery must be specified ex-factory.

10. FAULT FINDING CHART

	Problem	Cause	Remedy
A	When mains/generator running:-		
1	No 230V output from unit.	Wiring fault, no power to input plug & lead.	Electrician correct feed to unit.
		Input fuse blown.	Replace fuse with labelled size.
		Output socket switched off(1500VA unit).	Switch on outlet socket.
		Mains detect relay/spade terminal dislodged.	Technician remove cover, re-insert.
		Internal load transfer contactor faulty.	Refer seller, repair / replacement.
2	Generator labours under load.	Excessive load on inverter-charger output.	Reduce load, remove motor start surges.
	(Contactors may chatter)	Excessive combined load of output+charger.	Return to factory for load-limit link option.
			Install larger generator.
3	Lights flicker.	Small petrol generator, no flywheel.	Use compact fluorescent lights.
			Install larger diesel generator.
4	Output fails, input fuse blows.	Excessive load on output.	Reduce load, remove motor start surges.
		Excessive combined load of output+charger.	Return to factory for load-limit link option.
			Refer seller, replace with larger model.
		Electronics failure.	Refer seller, repair / replacement.
5	No battery charge on ammeter &		
	no indicator LED (1500VA model).		
	But contactor heard to pull in.	Battery fully charged.	Normal condition, confirm with voltmeter.
		Circuit breaker/battery isolator turned off.	Operate MCB upwards for "on".
		Intelligent charge watchdog lockout	Turn mains off, MCB off, wait 30s, on again
		Circuit breaker faulty.	Refer seller, repair / replacement.
		No battery connection.	Clean, re-clamp terminals.
		Battery sulphated, prolonged discharge.	Leave 24 hr boost, boost several cycles.
		Battery faulty (high resistance).	Confirm charge voltage. Replace battery.
		Over-temp trip - insufficient cooling.	Change filter, clear louvres.
			Vent enclosure.
		Over-temp trip - long term rating exceeded.	Allow unit to cool & auto reset.
			Return seller reduce max current setting.
			Order fan option.
		Temperature sensor failure.	Refer seller, repair / replacement.
		Electronics failure.	Refer seller, repair / replacement.
		Electronics failure.	Refer seller, repair / replacement.
6	Insufficient charge current		
	towards end of charge cycle.	Voltage set too low for application.	Technician raise battery voltage setting.
		Generator output voltage/frequency too low.	Serviceman raise supply voltage/freq.
		Small generator waveform peak clipped.	Fit voltage boost transformer.
			Install larger generator.
7	Insufficient charge current		
	at any stage of charge cycle.	Faulty battery connection.	Clean, re-clamp terminals.
		Charge rate set too low for application.	Return seller raise max current setting.
8	Circuit-breaker trips		
	immediately on turn on.	Battery connected reverse polarity.	Correct connection.
		Battery short circuited.	Replace shorted wiring, or
			check / replace battery.
		Electronics failure.	Refer seller, repair / replacement.

			check / replace battery.
		Electronics failure.	Refer seller, repair / replacement.
B	When mains/generator stopped:-		
1	No 230V output from unit &		
	no indicator lights.	No battery connection.	Clean, re-clamp terminals.
		Circuit breaker turned off.	Operate MCB upwards for "on".
		Circuit breaker faulty.	Refer seller, repair/replacement.
		On-off switch (48V model) turned off.	Operate switch.
		Remote switch (if installed) not turned on.	Operate switch.
		Alternatively remote option not linked.	Connect link.
		Electronics failure.	Refer seller, repair/replacement.
2	No 230V output from unit &		
	Circuit-breaker trips immediately.	Battery connected reverse polarity.	Correct connection.
		Electronics failure.	Refer seller, repair/replacement.
3	Low battery lockout		
	(followed by overload lockout);		
	immediately.	Power-supply not reset.	Turn MCB off, wait 30 secs, turn on again.
			Operate remote, off/on to reset.
			Start/stop generator to reset.
		Faulty battery connection.	Clean, re-clamp terminals.
		Battery dead-flat or faulty.	Recharge/replace battery.
	under load.	Battery discharged.	Recharge battery.
		Load too great for battery condition.	Recharge or replace battery.
		Battery too small.	Replace with larger battery.
		Battery affected by another surge load	Install auxiliary battery / blocking diode.
		(eg starter motor).	
4	Overload lockout;		
	immediately.	Power-supply not reset.	Turn MCB off, wait 30 secs, turn on again.
			Operate remote, off/on to reset.
			Start/stop generator to reset.
		Unit overheated.	Reset, when cooled down.
		Electronics failure.	Refer seller, repair/replacement.
	after 3-5 secs.	Load short-circuited.	Disconnect load, repair fault.
		Start load too heavy.	Reduce load, or replace with larger unit.
		Electronics failure.	Refer seller repair/replacement.
	prematurely within 0.3 hr rating	Insufficient air flow in unit.	Clear louvres, change air filter.
		Ambient too high.	Vent enclosure.
			Connect continuous fan option.
		Continuous load too heavy.	Reduce load, or replace with larger unit.
		Excessive capacitive load.	Fit electrical filter.
			Remove PF capacitors, fluorescent lights
		Temperature sensor failure.	Refer seller, repair / replacement.
		Electronics failure.	Refer seller, repair / replacement.
5	Motor fails to start & stalls.	Inverter-charger output voltage too low.	Raise to 240-250V(≈1 turn clockwise).
		Battery too small.	Increase battery size.
		Battery leads too small.	Install leads at least 25 mm sq.
		Inverter-charger too small.	Replace with larger unit.
		Leads incorrectly lengthened.	Shift closer. Revert to original 2m leads.
6	Fluorescent light fails to strike.	Inverter-charger output voltage too low.	Raise to 240-250V(≈1 turn clockwise).

		Leads incorrectly lengthened.	Shift closer. Revert to original 2m leads.
6	Fluorescent light fails to strike.	Inverter-charger output voltage too low.	Raise to 240-250V(≈1 turn clockwise).
7	Unit output voltage seems wrong.	Measurement error from incorrect meter.	Use true RMS reading V & A meters only.
			(ref section 9.1)
8	Stereo/TV stops on light loads.	Waveform	Raise to 240-250V(≈1 turn clockwise).
			Fit electrical filter.
9	Fridge stalls on generator stop.	240V fridge motor, interrupted while loaded.	Raise to 240-250V(≈1 turn clockwise).
			Turn off, wait 5 mins (compressor unload).
			Change over when cycle finished.
10	Elec fence controller shuts down	Waveform	Fit electrical filter.
11	Washing machine skips cycles.	waveform	Fit electrical filter.
12	Digital clocks lose time.	Short break changeover gen/inverter.	Unsuitable. Use analogue clocks.
13	Unit making abnormal		
	audible noise & power-on LEDs		
	not lit to same intensity.	Electronics failure.	Turn off, refer seller

14. Maintenance

Routine maintenance is required. Clean the exterior of the unit periodically with a damp cloth to prevent accumulation of dust and dirt.

Make sure the fan air filter is clean. Replacement can be made with a standard foam kitchen pot cleaner from your local store.

Do not allow water or generator exhaust to be drawn in by the cooling fan.

Tighten all screws and connections.

Clean battery terminals with warm water, allow to dry and coat with petroleum jelly.
Obtain a hydrometer and measure battery specific gravity at regular intervals. Keep a note of battery condition initially. Ensure that each charge cycle raises the SG of the battery into the green (1250+).

Once you get used to the load/charge pattern, it will not be necessary to take readings so often (perhaps then only a weekly check).

Check battery water level weekly initially and then at least monthly. Always ensure water level is maintained above the top of the plates. Top up when bubbling on charge.
Use distilled water or clean rain water.
Do not overfill. Allow enough room for the cell to gas without water rising up the intake.
Excessive water use is an indication of over charging.

Consult your supplier for advice on maintenance of your specific batteries.

EBBETT AUTOMATION - CONDITIONS OF SALE

Warranty: The Company warrants that the equipment shall remain free from defect in material and workmanship for 12 months from date of dispatch from the Seller's factory.

In the event of any such defect occurring, the Seller, at his option, will repair, or replace free of charge and F.O.B. his factory, the part of the equipment found to be defective, provided that the Purchaser, at his own cost, shall have previously returned to the Seller's factory for examination, the part alleged to be defective, and the Seller agrees that such part of the equipment has been supplied by the Seller and is in fact defective.

This warranty shall not apply to defects in the equipment caused by or resulting from fair wear and tear, wilful damage, negligent or unskilled use in operation or storage, or storage or use in unsuitable conditions by the Purchaser or any third party after delivery by the Seller.

The Seller shall not be liable for any consequential losses, damages or expenses whatsoever incurred by or resulting from defects in the equipment supplied by the Seller.

Prices: Current prices are subject to change without notice.

Sales Tax: Unless stated otherwise, all prices quoted are not inclusive of sales tax where applicable.

Payment: Unless otherwise agreed in writing, all sales are on a basis of cash prior to delivery.

For credit arrangements, all goods remain the property of the Seller until full and final payment is received, and until that time, the Seller reserves the right to take back into his possession any goods held by the buyer or any third party.

Freight: Freight is extra.