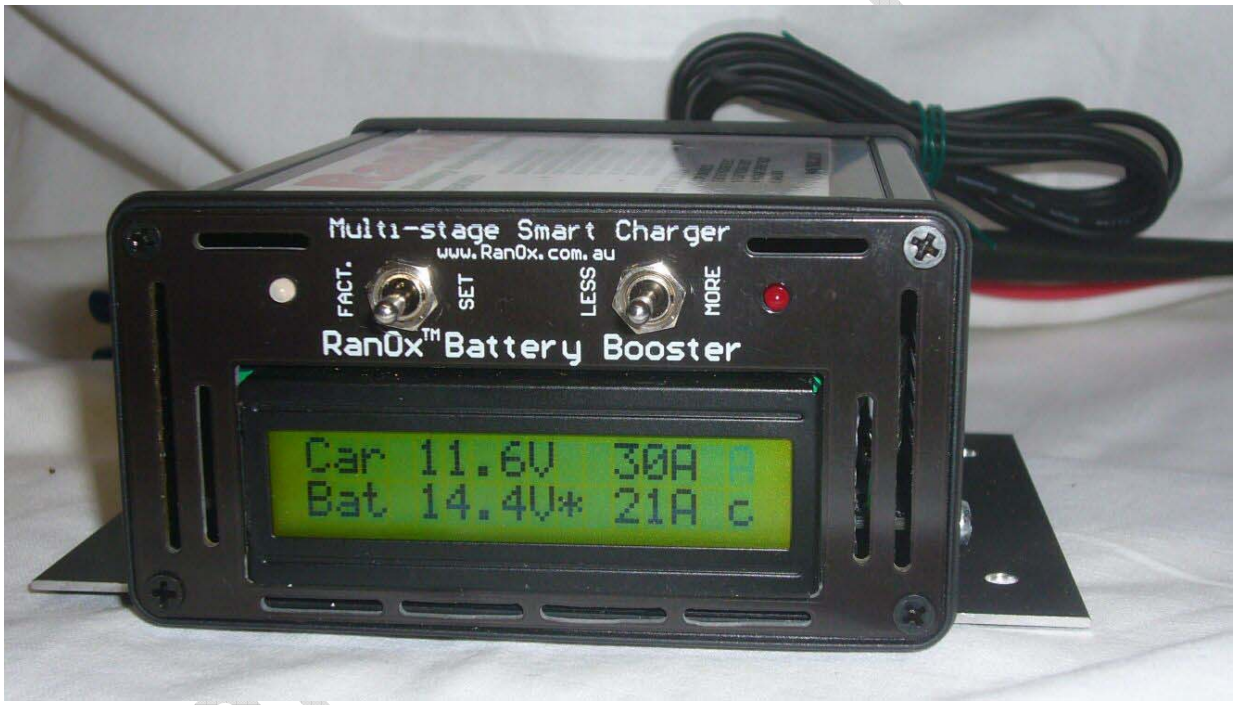
RanOx™

Battery Booster Systems



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1. RanOx™ BATTERY BOOSTER: BASIC DESCRIPTION and USE

1.1. BRIEF FUNCTIONAL DESCRIPTION:

We believe the RanOx™ Battery Booster delivers the best (features for price) mobile voltage and current feed to a Caravan, Camper, Trailer, 4WD or Motorhome battery available in Australia today. It takes the limited feed from your car/engine and "boosts" it to provide a controlled (multi-stage) regulated supply to this auxiliary battery. This provides much higher stored charge, prolonging the life of the battery and ensuring maximum capacity to run all those 12 Volt devices at your remote campsite.

It suits a variety of Lead-acid battery types: flooded (conventional car type), sealed gel-type, deep-cycle type, AGM type etc. It will provide up to 25 Amp of CONTROLLED charging current for these batteries, provided that adequate car/engine supply is available.

In addition it will act to protect this auxiliary battery during discharge, by disconnecting loads before "low-voltage" is reached.

1.2. SIMPLIFIED INSTALLATION:

In its simplest installation, the RanOx™ Battery Booster has only three connections:

- Vehicle feed (**NOT** shared by any other load, protected by fuses etc)
- Boosted output and earth, connecting directly to the caravan battery (sheathed cable)

The later installation section provides details and **restrictions**, particularly for applications using more of the RanOx™ Battery Booster advanced features.

1.3. SIMPLIFIED OPERATION:

The RanOx™ can be simply left with its factory default parameter values for most batteries. It will automatically detect engine "run" status and appropriately charge the "caravan" battery. The LCD and LEDs will advise of charge state/stage, with vehicle and caravan battery voltage and current displayed appropriately.

If you wish to have more detailed understanding of RanOx™, please review the rest of this User manual and its diagrams.

1.4. PRECAUTIONS:

Please read and **follow** the start-up procedure described at the end of the installation section.

Do not connect power from **ANY** battery or other power source to the RanOx™, without **CAREFULLY** checking polarity.

Incorrect connection will **DESTROY** sections of RanOx™ and will void your warranty.

2. RanOx™ BATTERY BOOSTER: FEATURES and DESCRIPTION

2.1. FULL FEATURE TABLE:

The following table outlines the significant features of the RanOx™ Battery Booster (from August 2008).

Feature	Description	Comment
Wide Ranging Input voltage	From 9 to 14 Volt feed.	Any van fridge should be operated by this input feed, BEFORE the booster. The unit will automatically drive a suitable relay to control a fridge.
Engine running detection	Inbuilt detection of engine running by prediction of alternator voltage. Automatically compensates for cable/connector resistance.	Avoids need for ignition operated relay or other similar device. Must not have other loads on THIS feed (eg. fridge in car), with this option selected.
Regulated stable Output Voltage (or Current)	Output is regulated to provide constant current, or boost/float voltage, regardless of input variations.	Mode/Stage is automatically selected to suit auxiliary battery condition. Output cable voltage drop compensated.
Rugged Input/Output circuitry	Protected against: - ignition voltages - short circuit - overloaded output - over-charging - over heating - faulty external chargers	Unit automatically limits current drawn from car/engine to about 30 Amp (provided wiring is adequate). In-line 40 Amp fuses further protect. **REVERSE** polarity will damage unit.
Transfer facility, with Timer and Low-Voltage Input protection.	Timed (45 min) transfer of charge from 4WD auxiliary battery to caravan, with automatic excessive discharge prevention. Used with extended campsite stays.	User may manually start/stop Transfer. Nominal cut-out at 9 Volt (at the RanOx™). Booster will reduce its output current when input voltage is below 10 Volt, to avoid premature shutdown.
Low-Voltage Battery protection	Prevents excessive discharge of auxiliary battery whilst “camping”.	The unit will automatically drive a suitable relay to protect auxiliary battery.
Sophisticated multi-stage charging system.	- prepares battery with constant current or “bulk” charge stage - absorption charge at “boost” voltage - held at “float” to sustain capacity - PLUS many other intermediate stages/modes	- suits deep cycle batteries which have limited initial current - typically near 15 Volt for maximum charging, till current reduces below threshold - typically near 13.5 Volt
LCD display, with switch controls and LED indicators.	Provides two line detailed parameter display and adjustment. User may alter basic parameters (maximum current, boost and float voltage). User can select option and reset to Factory-Default.	Changes are restricted to sensible values. Altered parameters are remembered without power. Extensive diagnostic indications are provided for abnormal conditions.
Automatic Cooling Fan.	Fan to cool unit only operates as required, normally at higher currents and/or temperatures.	Unit operates in high ambient conditions. Unit will limit current to default if hot. Will shutdown if further overheated.
Battery Temperature Sensor.	Adjusts voltage to suit battery temperature for best capacity and life.	Provides protection against over-heating auxiliary battery. Will not charge if battery is too cold. Temperature may be viewed.
Time-Limit for Boost charging.	User can select 2, 3 & 4 hour limit on “boost/ absorption stage” charging. When time exceeded, charging drops to “float”.	May be required if “static” loads on auxiliary battery upset charge current monitoring.
Master Switch function.	User can easily isolate loads from auxiliary battery.	Uses external relay, which also protects against auxiliary battery excessive discharge.
External relay drives.	Unit provides voltage/current measurements, timing and logic to support optional relay wiring. Unit incorporates internal FET switches to isolate auxiliary battery from car/engine charging feed.	Relay functions: ▪ Engine Running: transfer loads to engine feed from auxiliary battery, so that it (and charger) is not loaded. Isolate absorption fridges when stopped. ▪ Auxiliary battery low: isolate this battery to protect against excessive discharge (when stopped). Also Master-Load-Off function.

3. INSTALLATION

3.1. RECOMMENDED WIRING and CONFIGURATIONS:

The RanOx™ Battery-Booster should be securely mounted close to caravan/camper battery, but protected from water, dust and vibration. Typically this would be inside the front locker. The LCD display and switches should be visible/accessible, with locker door open. Adequate ventilation **MUST** be provided around and under the RanOx™. The unit can be mounted in any orientation **EXCEPT** front down, as this would reduce essential cooling air-flow.

Do **NOT** drill into the case or otherwise tamper with RanOx™. Do **NOT** lengthen mounting screws.

It must NOT be located under the vehicle bonnet ! This location is too hot, dusty and wet**.**

The booster should be located as close as possible to the **receiving** battery to avoid losses from the booster to this battery. If the supplied output lead needs to be extended, ensure that high **quality** joins to **large** (well over 10 mm^2) cross-section cable are used.

Please refer to the suggested wiring diagrams for connection information. These diagrams are for information purposes only and are subject to change at any time. RanOx Pty. Ltd. is **NOT** responsible for any damages, direct or indirect, arising from or related to the use of this information.

The booster MUST be connected to the supply battery/alternator via a heavy-duty feed as shown. We recommend at least 40 Amp rating, preferably higher, particularly if other loads (eg absorption fridge) share this feed. Suitably rated fuse/s or circuit breaker/s **MUST** protect all feeds. It is **VERY** important that this feed (all the way from alternator/cranking-battery) through to RanOx™ be high quality. All joins should be inspected and soldered if necessary. Our experience suggests that many vehicle and caravan installations are **FAR BELOW** the required standard. Please check and inspect to ensure your feed can deliver over 30 Amp to the RanOx™ at above 11 Volt. Suitable high-current circuit-breakers are Jaycar SF-2265 (70 Amp) or SZ-6000 (twin 60 Amp).

For option (0) the relay energising circuit/s **MUST** be connected to the ignition circuit, so that power is only fed to the RanOx™ booster (and any absorption fridge) with the engine running. Failure to do so WILL result in discharging the supply battery. Other loads MAY share this feed, although this will reduce overall efficiency and lower available charging current.

With option 1-4 selected, RanOx™ automatically detects engine running (alternator active). For these options, RanOx™ requires a **dedicated** supply feed from the vehicle battery/alternator for correct operation. **Any** other connection to this circuit will severely affect the operation of the booster and it's charging characteristics. This includes excessive discharge of the vehicle battery and possible damage to the receiving battery.

Note that the Transfer facility (described later) requires the same dedicated "live" feed, as required for Option 1-4. It should not be switched by a relay ("smart" or otherwise). It is **MORE** important to have **HEAVY** cabling (well over 10 mm^2), as any losses are wasted.

We recommend that a separate 50 Amp Anderson style plug/socket is used for the RanOx™ booster feed; with the standard trailer (7 or 12 pin) plug/socket used for the fridge feed. The booster feed wire should be **AT-LEAST** 6 mm^2 size, preferably over 10 mm^2. This feed will still drop at least 1 Volt at 30 Amp, with typical cable lengths. Any join should be soldered.

In-line 40 Amp fuses (provided) protect the RanOx™ input and output. The booster may be **DESTROYED** by reverse polarity connection of input or output ! Check that yours is correct **BEFORE** connecting.

Note that the caravan/camper Anderson plug is **NOT** live, when it is disconnected from the vehicle. Thus if it becomes dislodged from the vehicle and damaged, there is no current flow from the auxiliary battery back to this connector. This also prevents damage from malicious "mischief".

Under NO circumstances should an absorption fridge be connected directly to the battery under charge, with option 0 selected. It is highly **undesirable** with other option choices. Direct connection wastes over half the RanOx™ output current, holding it in BOOST stage/mode. This may result in overcharging and possible permanent battery damage. We recommend the Battery-Temperature-Sensor to help protect

the battery. However, RanOx™ can limit BOOST charging to 2, 3 or 4 hour, by User selection, if loads MUST be permanently connected to the battery. These time limits are **NOT** available with Option 0.

Absorption style fridge current (typically 13 Amp) will rapidly flatten any battery, so should not be operated unless fed from the vehicle alternator whilst engine running. An optional relay for an absorption fridge connection is shown in the diagrams. RanOx™ will automatically control this relay. This fridge feed wire should be AT LEAST 4 mm^2 size. This feed will still drop over 0.5 Volt at 13 Amp, with typical cable lengths.

Fitting of the optional battery-load relay (shown on the diagrams) will automatically protect the caravan/camper battery against excessive discharge, when stopped/camped. We recommend that all caravan/camper battery loads (apart from absorption fridge) be through this relay, which can be driven by RanOx™ as shown. This also provides a Master-Load-OFF facility, to conveniently disconnect all loads, which is ideal for travelling/charging, unless a compressor fridge is fitted to van.

If desired (to run a compressor fridge etc) an optional load changeover relay may be fitted, which will still drive all van loads whilst driving, but not waste RanOx™ capacity.

We recommend the Battery-Temperature-Sensor to help protect the battery. The probe should be fixed to the battery body (or either battery terminal) with quality adhesive tape or cable-tie. The small connector should be fully inserted into the socket at the rear of the RanOx™. The small lead should be protected against physical strain and damage.

If you are still have doubts about your installation, reread this manual and review the circuit diagrams. Your dealer or factory will also assist you. It is much better to ensure an optimum installation than to proceed quickly and regret later.

3.2. START-UP SEQUENCE:

Check polarity of your power sources BEFORE making any connections.

Do NOT disconnect output battery (positive or negative) whilst input feed/battery is connected.

Do NOT connect case to ANY power source.

The correct RanOx™ "power-up" sequence is to **FIRST** connect the **output** battery

- **negative** (black lead in sheath)
- then positive (red fused lead, which is in sheath with black lead)
  - you may wish to remove the output fuse whilst you connect
  - you will notice a small spark when connect (fuse or terminal)

RanOx™ should start-up and be "alive" (without **ANY** fault code)

- if the unit is not alive, or there are error codes, do **NOT** proceed
  - check wiring/fuse and consult pages 8 and 9 for remedial action

If RanOx™ is alive, with normal display (should report "Car Feed Off"), **THEN** connect up **input** wiring

- you may wish to remove the input fuse whilst you connect, in an under-bonnet application (in caravan/camper/trailer application this is not required, as you should **not** be connected to vehicle)
- connect temperature probe to rear socket (RanOx™ may re-start)

Set the appropriate parameters for your battery and application (see page 10)

- LCD will show the output battery voltage, as well as any connected input supply (else will report "Car Feed Off"). Battery temperature should have been displayed during “Saving Data”.

Connect caravan/camper/trailer to vehicle, if appropriate and ensure input fuse **firmly** fitted

- START and idle engine, without headlights or air-conditioning etc
- observe RanOx™ LCD and LEDs
- monitor charging stage behaviour (see page 7)

If you have problems, carefully read installation section and recheck your work. If problems persist contact your installer, retailer or the factory. Do **NOT** attempt to open or tamper with RanOx™.

4. EXPLANATION of OPERATION

Initially (and after "restart") the liquid crystal display will indicate the software version and serial number.

RanOx 7.6z4a5 Serial Num 00513

Whilst waiting for the car engine to start, you will see similar to one of these displays, depending on whether RanOx™ is using Option 0 or otherwise respectively:

Car feed is OFF Bat 12.8V 00A S

Car 12.5V 00A Bat 12.8V* 00A o

After the engine has started and the unit has stabilised (few minutes), it will then display its normal screen, **similar** to one of these:

Car 12.7V 06A M Bat 13.8V* 05A c

Car 10.2V 17A Bat 14.2V* 11A b

Car 12.3V 03A Bat 13.5V 02A f

4.1. CHARGING STAGES:

The above examples illustrate **some** of the RanOx™ charging stages. If the temperature compensation probe is functional, an asterisk (*) will appear after the battery "V" symbol. The last character/symbol on the **lower** line indicates the charging stage. You should expect to see the unit progress through these stages, as it automatically charges your battery, following a sophisticated algorithm. It may take minutes or **hours** to advance to completed charge. Not all stages apply to any particular situation. There are also additional stages. Note that the LEDs also indicate the stage, as shown below. The LCD display backlight automatically turns-off after a few minutes. It automatically "wakes-up" at any charging stage change, or if the "FACT" switch is briefly pressed.

Lower Symbol	Stage	LED	Explanation
o	Off	Green-Pulse (heart-beat)	RanOx™ is monitoring input and output voltages, ready to charge when it detects engine running or active input feed.
W	Waiting	Green-Pulse (heart-beat)	Waiting for I/P to stabilise, after Low-V I/P (cranking engine); OR waiting for battery to require charging. For example, solar system may already be charging.
O	Off/Cold	-	Ensures that a very cold battery is not charged until it has warmed above 0°C.
E	Engine Start	Green-blink	Input voltage has lifted, Engine running being confirmed/verified.
C	Increasing Current (soft start)	Yellow-blink	Smoothly increasing initial current charging until desired current is reached. Ensures "soft-start" for very flat batteries.
c	Constant Current	Yellow-blink	Constant current charging until battery reaches boost voltage. Also known as "**bulk**" stage of charging.
b	Boost	Yellow	Holds battery at boost voltage, until almost fully charged, when the charging current reduces significantly. Also known as "**absorption**" stage of charging. Optional time limits of 2 - 4 hour apply.
F	Forced Float	Green	Time limit on "boost" has expired. Holds battery at float voltage, to finalise charging.
f	Float	Green	Holds battery at float voltage, to finalise charging, after charge current has reduced normally.
S	Low Battery	Red blink	Right hand LED indicates that caravan battery is very flat, so RanOx™ will try to disconnect loads. Appropriate LCD message is shown.
any	*Master-Load-Off*	Red Pulse (heart-beat)	Right hand LED indicates that User has disabled battery loads (provided external relay fitted). Appropriate LCD message is shown, during Heart-Beat. *Will still **charge** !*

4.2. OUTPUT VOLTAGE CONTROL and INDICATION:

The output battery voltage shown is that at the **end** of the standard RanOx™ cable and its fuse. RanOx™ now adjusts its internal drive to keep this external voltage at the desired value, regardless of the output current, in "absorption" and "float" stages. This provides slightly faster "absorption" stage charging, with tighter control of battery voltage during "float", when external loads are applied. Thus most load current will come from RanOx™**,** rather than from the battery, sustaining higher charge levels.

4.3. ADDITIONAL LCD CHARGING PHASE LEGEND:

As well as the above charging stage information, which is indicated by the symbol on the **lower** line and the LEDs, RanOx™ has some other intermediate phases. These are indicated by the last character/symbol on the **upper** line, as explained below.

Upper Symbol	Explanation
V	The vehicle feed voltage is low (< 10 Volt), so charging has been reduced.
A	The vehicle feed is being limited near the 30 Amp maximum.
M	The battery charging current is being controlled.
e	The engine status is being v**e**rified.

Please note that this information is provided for those Users who wish to understand the details of the RanOx™ operation. It is not required knowledge to install and operate the unit. During the "v**e**rify" phase, RanOx™ pauses its charging, so that the engine voltage may be **verified**. This 30 Sec pause repeats every 5 minute (only during options 1-4), or if RanOx™ suspects that the engine has stopped. RanOx™ learns the cable resistance between itself and the alternator, to reliably predict the engine voltage, regardless of the current being drawn from the vehicle. When RanOx™ has "learnt" this value, a longer 10 minute interval is used.

4.4. FAULT INDICATIONS:

The right-hand LED indicates other conditions, mainly faults. Some conditions **stop** all charging. However, RanOx™ will tolerate its case becoming hot, by automatically reducing the current. The LCD will provide more detailed information in all cases.

With "Case HOT" condition, the full current capability may be restored (provided the cause of the high temperature has been eliminated) by a "restart". This can be done by selecting "Master-Load-Off", then cancelling, to resume normal operation.

Completing a "Set Parameter" sequence will also recheck fault conditions. Note that actual and maximum battery temperatures are displayed at the completion of a "Set Parameter" sequence. See paragraph 4.5 below for MAJOR fault conditions.

Fault	LED	Explanation
Bat Fault	Red	This indicates a short or **faulty** temperature sensor. Charging is stopped. Check the lead for damage. It should be unplugged (and returned for repair) if the fault persists.
Over-Temp	Red	Case or Battery **IS** Over Temperature. Charging is stopped. Must be manually acknowledged and "cleared". However, if they cool, message changes to "**was** HOT" and charging resumes, as detailed below.
Hot Battery	Red	Battery Temperature **WAS** HIGH. Charging has resumed as normal. A warning message remains on the LCD, which must be manually acknowledged and "cleared".
Hot Case	Red	Case Temperature **WAS** HIGH. RanOx has resumed charging with default current, to reduce the internal heat. A warning message remains on the LCD, which must be manually acknowledged and "cleared".
Low-Voltage	Red-blink	Low-Voltage Protection, when the **auxiliary** battery is so flat, that loads should be disconnected, to protect it from damage. RanOx™ provides a relay drive for this function. You may try to **restore normal operation** by Master-Load-Off "restart" as described above.
Major	Red-fast blink	Major fault with the installation has occurred. See the following section for details.

4.5. MAJOR FAULT INDICATIONS:

There are some special “Major” faults that prevent RanOx™ from continuing operation. If any of these occur, the right-hand red LED will blink rapidly. All charging will **cease**, external relays will release etc.

The LCD (without backlight) will advise to **See Manual**, with a Fault number. These generally relate to external problems with the installation.

Note that RanOx**™** will **not** resume operation after a major fault, until the fault is cleared and the booster is “restarted”. This can **ONLY** be done by holding the “**FACT**” switch, to restart normal operation, which is shown by the “welcome” message with serial number display. Other switch operation is ignored.

If any of these faults will not “clear” after completing/checking the corrective action suggested below, please do **not** continue to use the unit.

Remove both input and output fuses and contact your dealer or the factory for assistance.

Fault Number	Meaning	Explanation with Suggested **{Corrective-Action}**
00016	Input voltage too high (> 16 Volt) from vehicle.	Car has faulty/high external charger {check/disconnect}.
00032	Auxiliary battery voltage too low (< 8 Volt).	Connected input **BEFORE** output {disconnect and **follow** “START-UP SEQUENCE” section} Output fuse blown {check/replace} Faulty/dead “caravan” battery {check/charge/replace}.
00064	Auxiliary battery voltage too high (> 16 Volt).	Faulty/high “caravan” mains or solar charger {check/disconnect}.
00128	Output to auxiliary battery whilst RanOx**™** is supposed to be “Off”.	Possible RanOx™ internal fault.

It is possible (although unlikely) for more than one fault to occur, which will combine to produce other fault numbers.

5. SET PARAMETERS and OPTION CHOICE

This provides the user with the ability to customise the charging parameters to suit any battery. Factory defaults are provided. Care should be taken with the setting of these parameters, to suit the battery being charged. If necessary, contact your supplier for battery specifications. Note that whilst setting parameters, charging is disabled. If you do not complete the sequence, the unit will revert to normal operation, after a wait.

Pressing (and holding briefly) the "**Set**" switch will briefly display "SET PARAMETERS", which provides the User with the ability to customise the unit to suit their application:

The LCD then displays "**Set Option** x". Use **More/Less** to change or **Set** to step to the next function:

Option 0:	This option is used when a relay controlled by the vehicle ignition circuit controls the booster supply feed. No charge time-out.
Option 1:	Auto engine running detect. Booster automatically detects engine status, removing the requirement for a relay as in option 0. No charge time-out. **This is the Factory default option**.
Option 2:	Auto engine status detect but with a charge time limit of two hours
Option 3:	Auto engine status detect but with a charge time limit of three hours
Option 4:	Auto engine status detect but with a charge time limit of four hours
Option 5:	Special Transfer facility, with time limit of approximately 45 minute. *This does NOT change the "real" option, but is used to manually start a timed Transfer of charge from a vehicle auxiliary battery through the RanOx™ to the "caravan" battery. See below for details.*

Note the **restrictions** detailed in the Installation section, for these options.

Briefly pressing the "**Set**" switch again will display "Set Float Volts" on the top line and "was" on the lower line, with the previously set voltage. Use the **More/Less** switches to change the desired float voltage: Range 13.0 to 14.5 in 0.1 Volt steps. Factory default is 13.5 Volt.

Set Float 13.6V was 13.5V

Briefly pressing the "**Set**" switch again will display "Set Boost" and "was", similar to above.
Use the **More/Less** switches to select desired boost (also known as "absorption" stage of charging) voltage: Range 14.0 to 15.5 in 0.1 Volt steps. Factory default is 14.5 Volt.

Briefly pressing the "**Set**" switch again will display "Set Max Current" and "was", as explained previously. Use the **More/Less** switches to select required maximum charge current. For a normal lead acid battery this should be approximately **25% of the battery's Ah rating** (eg: for a 100 Ah battery set max current at 25 Amp. For battery capacity over 100 Ah, select 25 Amp.) Range 5 to 25 in 1 Amp steps. Factory default is 15 Amp.

The charging is held approximately constant near this current during the initial "bulk" phase. Actual output may vary by about +/- 1 Amp around this nominal current. Note that this nominal current will be automatically reduced with a very flat battery, or if the case becomes hot. If a sudden "large" load is placed upon the auxiliary battery during this stage, the RanOx™ will restart itself to protect against excessive over-current.

Briefly pressing the "**Set**" again displays "Saving Data". This preserves data in non-volatile memory. If the temperature probe is fitted (and functional), the actual and maximum battery temperatures will also be displayed (eg 25/34°C). The unit then reverts to one of the initial displays and begins the charging sequence. Any fault conditions will be rechecked.

Once set, there is no need to change these parameters again unless you change batteries.

Note that "Factory Default" values may be restored to **option** and **all** these parameters, by pressing the "**FACT**" switch, from within this sequence. The unit will advise accordingly. This will clear the maximum battery temperature and force a complete "restart" of the RanOx™.

6. ADDITIONAL OPERATIONS and DISPLAYS

6.1. AUTOMATIC ENGINE RUNNING DETECTION:

When any "option" other than option 0 is selected, the RanOx™ booster will automatically detect when the engine is running or shut down. There is a delay in both these cases as the unit "verifies" the change of state from one to the other. This function is monitored throughout all stages of charging, by briefly interrupting the charge current about every 5 minutes. The RanOx™ then calculates the resistance of the connecting cable and applies this figure in internal algorithms. When RanOx™ has "learnt" this value, a longer 10 minute interval is used.

For this option to operate correctly there MUST be **NO** other connections to the supply feed from the vehicle battery/alternator to the booster. **Any** other connection to this circuit will severely affect the operation of the booster and it's charging characteristics. This includes excessive discharge of the vehicle battery and possible damage to the receiving battery. Please see Installation section and wiring diagrams.

6.2. TIMED TRANSFER FACILITY:

6.2.1. Description

This RanOx™ facility will **efficiently** transfer charge (when stationary) from the vehicle auxiliary battery to the "caravan" battery. During extended stays at an un-powered campsite, it is possible to "run-out" of charge from the "caravan" batteries. Solar power may reduce this problem, for some Users.

Typically during such an extended stay, a User may still make trips in their vehicle. For example: fire-wood, shopping, touring etc. This will normally ensure that the vehicle cranking and auxiliary battery (if fitted) are charged. RanOx™ can efficiently transfer this charge (from the auxiliary battery) into the "van" battery, whilst "boosting" the voltage to the desired level. This "top-up" can significantly extend the possible "powered" duration of a "stay" without requiring solar power or generators etc.

6.2.2. Connection

The vehicle (or some other portable battery source) must be connected to the RanOx™, typically by connecting the "caravan" Anderson plug into the vehicle outlet. This outlet must be powered, **NOT** fed through an ignition operated relay or "smart" solenoid etc". A portable battery-pack should be connected to the "caravan" inlet, if that is to be the "transfer" energy source. All these cables must be **very heavy** duty, as losses during Transfer can NOT be recovered; as there is no alternator to just supply a bit more power. For example, 10 metre of 4 mm^2 **wastes** 40 Watt of energy at 30 Amp.

6.2.3. Operation

This special facility is invoked by using "Set Parameters" to select Option 5. Then **complete** the "Set" sequence. As soon as RanOx™ has finished "Saving Data", it will commence the special Transfer charging. The first LCD line will indicate the approximate time remaining, in tens of Seconds.

254t12.7V 00A
Bat 12.5V* 00A o

This time replaces the "Car" word. The "t' is to indicate **T**ransfer time in ten Sec steps. It will count down, taking roughly 45 min to complete a sequence, through the normal charging stages. Voltage and current for the "source" and the "caravan" battery are continuously displayed. LED indications will be normal. Note that as the source battery becomes discharged, RanOx™ may reduce the charging current, if its input reduces below 10 Volt. Note that this includes all the voltage drops in the fuses, cables and connectors from the source battery to the RanOx™. Additional protection at 9 Volt input will abort the charge transfer. The Transfer can be aborted by executing a 'Master-Load-Off/On" sequence.

Note that internally the RanOx™ behaviour is Option-0 during a "Transfer". At completion of the transfer time, RanOx™ will complete a "restart" and restore your normal "Option" choice. Another "Transfer" can be performed, but this would require significant source battery capacity.

6.3. MASTER-LOAD-OFF FACILITY:

This provides a convenient **Safety** facility to isolate all loads (lights, fans, radios, accessories etc) from a "caravan" battery before towing or storage. It requires an external relay, as detailed below.

To activate or cancel this facility, **Hold** the **Less** switch, and then press the **Set** switch (for > ½ Sec.). The LCD will advise accordingly, with LED indication, at the "Heart-Beat" rate. Note that cancelling will "restart" the complete RanOx™ charging sequence.

A compressor style fridge would normally be fed directly (fused) or via a separate vehicle feed. Please refer to the Installation section and diagrams.

6.4. LOW BATTERY PROTECTION:

RanOx™ will automatically protect a "caravan" battery from excessive discharge (and possible damage) by isolating its loads (using an external relay) when its voltage drops too low. This is typically whilst camping and disconnected from all charging sources. Refer to the "Battery Load Relay" description below for more information. The LCD will advise accordingly, with LED indication. RanOx™ will still charge this battery, if there is an appropriate active supply feed. Reset can be tried by selecting "Master-Load-Off", then cancelling, to resume operation, provided the battery has partially recovered.

6.5. OTHER DISPLAY MESSAGES:

Car feed is OFF: The booster will automatically reduce the output current when the supply voltage reduces to less than 10 Volt to avoid a low voltage shut down. However, when the supply voltage (under load) deteriorates to less than 9 Volt, the unit will stop charging. Generally this is a cabling problem. With option 0, it merely indicates that the engine is off.

Bat 10V8 Low S: This indicates that RanOx™ thinks the "caravan" battery voltage is too low to operate any loads. It will also remove drive to the appropriate external relay, to isolate its loads. The actual voltage threshold may be different in your unit, as it is a software controlled parameter.

Case Overtemp: electronics are in over temperature condition. Unit will **stop** charging. Resetable by "restart". If this condition persists, check to ensure adequate ventilation airflow through fan and case. If necessary relocate the unit to improve airflow.

Case was HOT: electronics temperature **is**/**was** high. Unit will automatically reduce charging current (to default), but otherwise continue charging. Resetable by "restart". If this condition occurs, please check to ensure adequate ventilation airflow through fan and case. If necessary relocate the unit to improve airflow.

Bat Overtemp: The battery temperature **IS** over 50 °C.

Bat was HOT : The battery temperature **WAS** over 50 °C.
The unit will **stop** charging, whilst battery temperature **is** over 50ºC. This probably indicates the ambient around the battery is too hot. Otherwise, it **could** indicate poor battery condition or the charge voltage/rate is set too high. Note the display of actual and maximum battery temperatures described above. Resetable by "restart". The maximum temperature is cleared by "Factory Default".

Bat Fault: This indicates a short or faulty temperature sensor. Check the lead for damage. It should be unplugged (and returned for repair) if the fault persists. Resetable by "restart".

7. PHYSICAL OPTIONS

7.1. TEMPERATURE COMPENSATION PROBE:

When installed, this probe provides battery temperature to the RanOx™, which adjusts the charge voltage to the optimum value for the battery temperature. It may also reduce the threshold current for the bulk to float stage transition. This helps to maximise charge capacity.

As charging figures recommended for batteries by the manufacturer are generally for a temperature of near 20 °C, if the temperature compensation probe is used, you may notice a slightly different charge voltage to that selected. This is correct operation. i.e. the lower the temperature, the higher the charge voltage.

When temperature compensation probe is functional, an asterisk (*) will appear after the battery “V” symbol on the LCD. The actual and maximum battery temperatures (eg 25/34°C) are shown during “saving data” after a “Set Parameter” or “Factory Default” sequence. If the battery is colder than 0 °C, charging will be delayed till the battery warms.

If the unit is used without the temperature compensation probe, then the indicated charge voltages will be as you have selected. Charge may, however, not be the optimum, **nor** will battery temperature protection be available.

7.2. ENGINE RUN RELAY: (external)

When RanOx™ has detected "engine-running" (Option 1-4), or an active vehicle feed (Option 0), it will drive an external relay coil, which can divert/control loads. For example, an absorption fridge can be operated (from a separate feed) when the engine is running, but automatically turned-off, when engine stops. See the diagrams for visual explanations. The nominal wire colour is brown.

7.3. BATTERY LOAD RELAY: (external)

The "battery-load" relay coil feed provides **two** features. As shown on the diagrams, a suitable relay is connected between the "auxiliary" battery and its loads (such as pumps, lights, radios etc). This relay will isolate these loads if **EITHER**: Master-Load-Off is selected by User (for example before towing, to ensure all caravan loads are off) **OR** this battery voltage falls below a lower limit. This "low battery" state is "cleared" and loads reconnected, when its voltage rises satisfactorily (unless Master-Load-Off). This is designed to protect the "caravan" battery during discharge, when it may be completely disconnected from the vehicle. Reset can be tried by selecting “Master-Load-Off”, then cancelling, to resume normal operation, provided the battery has partially recovered. The nominal wire colour is blue.

7.4. RELAY DRIVE:

Both the above relay coil drives are active low, thus RanOx™ provides an earth when active. Each drive can sink about 300 mA, so they can each operate 1 or 2 suitable coils (in parallel) which are powered from nominal +12V. RanOx™ provides over-current protection and back-emf damping to these coil drives. Suitable relays are Jaycar SY-4068 (30 Amp SPST), SY-4070 (30 Amp SPDT) and SY-4074 (60 Amp SPDT). One single higher coil current (< 300mA) relay may be used.

8. NOTES

The maximum charge current of 25 Amp at maximum boost voltage is **only** achievable with high quality, **very low** resistance cabling and connectors from the power supply (alternator) to the booster. Preferably, there should be no other load on this cable (such as fridges), as this will lower the input voltage, reducing the maximum output current. There must **NOT** be any such loads, with Option 1-4 selected. The booster may also be forced into “low voltage shutdown”.

Before setting voltages and current limit, consult your battery supplier for correct charging figures. RanOx Pty. Ltd. accepts no responsibility for these settings.

Note that there may be occasions when the actual voltage in the Float stage **exceeds** the preset value, if there is another charger (eg solar) active. The RanOx™ booster will wait (cycling between the Off and Wait stages) till the battery “rest” voltage decays to the Float (temperature compensated) voltage. The LCD back-light will stay on, indicating this condition. Note that **extreme** external charger voltage will result in a Major Fault indication by the RanOx™.

Also, if the vehicle has a high feed voltage (say 14 Volt) through RanOx™ to a hot battery (which may only require a temperature-compensated Float voltage of 13.1 Volt), there may be transitory higher output voltage at the Float charging stage. RanOx™ detects this condition and will suspend charging till required.

9. SPECIFICATIONS *(additional information ONLY)*

The RanOx™ booster is a very sophisticated device, but simple to operate. We have tried to provide many features in a compact affordable package. The following table summarises some of the technical specifications of the product, for those Users who are interested. We reserve the right to **vary** these figures. It is **NOT** required knowledge for satisfactory installation and operation. Many items are also specified throughout the text.

Item	Value	Comment
Input-Voltage: minimum	9 Volt	Any input below this implies the vehicle feed is OFF.
Input-Voltage: reduce	10 Volt	If input falls below this level, the "boost" is reduced to lower the current drawn from the vehicle and hopefully raise the voltage.
Input-Voltage: maximum	16 Volt	Any input above this implies faulty vehicle feed, so RanOx™ will shutdown.
Output Battery Voltage: min.	8 Volt	Below this implies faulty/dead "auxiliary" battery.
Output Battery Voltage: low.	10.8 Volt	Below this implies flat "auxiliary" battery. RanOx™ will release external relay to isolate loads.
Output Battery Voltage: OK.	12.6 Volt	Above this implies "auxiliary" battery is normal. RanOx™ will operate external relay to feed loads.
Output Battery Voltage: maximum	16 Volt	Any level above this implies faulty "auxiliary" battery charging system, so RanOx™ will shutdown.
Engine-Voltage: running	13.2 Volt	If predicted engine/alternator above threshold, this implies engine is running (Option 1-4).
Engine-Voltage: stopped	12.8 Volt	If predicted engine/alternator below threshold, this implies engine is stopped (Option 1-4).
Boost stage voltage	14.0 – 15.5 Volt	Increment of 0.1 Volt. Default of 14.5 Volt.
Float stage voltage	13.0 – 14.5 Volt	Increment of 0.1 Volt. Default of 13.5 Volt.
Maximum charge current	5 – 25 Amp	Increment of 1 Amp. Default of 15 Amp. Should be roughly 25% of "auxiliary" battery AmpHour capacity.
Maximum Input current	30 Amp	Additional 40 Amp fuse protection.
Quiescent current	< 0.01 Amp	RanOx™ draws roughly this current, whilst "Off" (LCD backlight off), waiting for engine to start and commence charging.
Charge current threshold	2.5 – 6 Amp or 2.5 – 5 Amp (with probe)	During "boost" stage, when current drops below threshold, changes to "float" stage, as battery is almost fully charged. Threshold rises from 2.5 Amp (when Maximum charge current about 10 Amp) up to 5 (or 6) Amp when Maximum charge current is 25 Amp. Lower current applies with functional temperature probe.
Over Current Margin	2 Amp	If current rises above desired level by this margin, RanOx™ will restart.
Relay Coil Current limit	0.3 Amp	Self-resetting Polyfuses protect, with 18 Volt zeners to damp/clamp back emf.
Fan On Current	5.5 Amp	Fan will **also** operate if case hotter than 53 °C (whilst charging).
Fan Off Current	4.5 Amp	Fan **may** also operate for some time after transition to low current.
Case Temperature: high.	55 °C	RanOx™ will reduce current if it reaches this temperature.
Case Temperature: max.	62 °C	RanOx™ will shutdown if it reaches this temperature.
Battery Temperature	0 – 50 °C	RanOx™ will only charge if "auxiliary" battery within this range.
Battery Temperature Compensation Factor	- 24 mV/°C	Charging voltage is corrected with reference to 20 °C.
LCD backlight timer	3 min	LCD light will extinguish after this time, unless charge stage changes or any switch operated.
Set-Parameters abort timer	~10 min	If User does not complete a "Set Parameter" sequence within this time, RanOx™ will abort the sequence and automatically return to normal operation.
Engine Verify timer	5 min or 10 min	Charging pauses at this interval (with options 1-4), to verify that engine is still running. Longer interval applies when system stabilises and cable resistance has been "learnt".
Transfer timer	42 min	Total time for Transfer facility, for all charging stages.

10. PHYSICAL DIMENSIONS

The RanOx™ booster is housed inside an extruded alloy case, as shown in the title page photographs. Its approximate dimensions are 120 * 105 * 55 mm (length * width * height). Mounting feet occupy an additional 20 mm each side. Extra space must be allowed for its switches, leads etc, as well as **considerable** clearance for the air flow required. Its mass is approximately 1 kg.

We reserve the right to alter this case and any dimensions as required to suit our high standards.

A drilling guide/template is provided for your convenience.

11. EMC COMPLIANCE (Radio/TV Interference)

The RanOx™ battery booster complies with the requirements of CSIPR 22 Class A. N21629

However, if you experience any apparent interference from this device, try re-routing input/output cables away from sensitive electronic devices and their cabling. Ensure that the negative battery terminal is bonded to a good chassis ground, as close as possible to the auxiliary battery. If necessary, reorient or relocate the receiving antenna away from the booster and its cabling.

Consult your dealer or the factory for further advice.

12. WARNINGS

12.1. DISCLAIMER:

This booster is designed specifically for use between a vehicle and a caravan/camper/trailer. It may also be used with an auxiliary battery in a 4WD or Motorhome. If installed and programmed correctly, it will compensate for cable losses and/or low alternator voltage, to fully charge then float a recreational battery, with the correct voltage and current for **that** battery.

Using this booster for any other purpose may cause damage to the booster and/or other appliances. Please consult your dealer or the factory to discuss many other possible applications.

This product is built from quality components using approved engineering design techniques available at the time of construction however, the designer, assembler and dealer will not be held in any way responsible for any damages, direct or indirect, arising from or related to this product.

Although we have made every endeavour to provide accurate and up-to-date information in this manual and its diagrams, there may be unintentional errors or omissions.

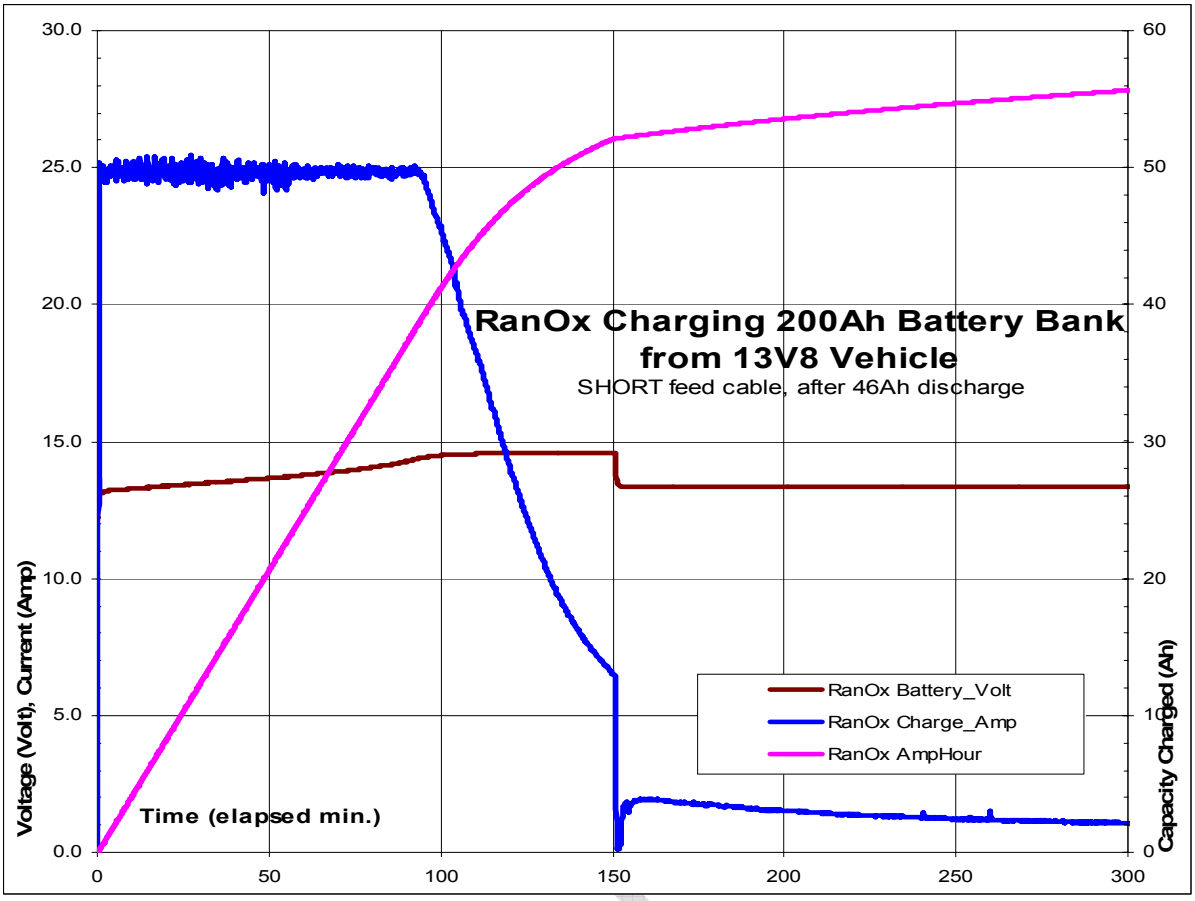
12.2. REVERSE POLARITY CONNECTION:

Take particular care when installing or connecting batteries, as the RanOx™ booster will be **DESTROYED** by reverse polarity connection ! This is regarded as abuse of the unit.

12.3. USER ACCESS:

There are NO user serviceable parts inside the RanOx™ booster. Opening of the case or tampering with the unit in any way will void any warranty.

13. ACTUAL VOLTAGE/CURRENT CHARGING DIAGRAM



.....BULK...../..ABSORPTION.../... FLOAT.....

This diagram shows a typical sequence, as the RanOx™ charges a battery through constant-current (bulk) stage, to boost voltage (absorption) stage, then holding at float voltage. This may take minutes or several hours, depending on the battery. This graphs actual current and voltage, using RanOx to charge a battery-bank, in an under bonnet application (with a fixed 13.8 Volt alternator source).

14. SUMMARY

The RanOx™ Battery Booster is proudly designed, manufactured and fully supported in Australia by RanOx Pty. Ltd. It suits the rugged Australian conditions, where many travellers wish to spend many days away from mains-powered sites, being self-reliant, but with an ever-increasing range of electrical devices.

As RanOx™ is a sophisticated product, we reserve the right to improve the unit; thus the LED behaviour, actual LCD text and symbols indicated above may vary with your particular unit. Parameter values and Stage behaviour may also be modified to continually keep RanOx™ the "*best*" mobile DC powered charger available in Australia today.

15. CONTACT DETAILS

Alan Ransley (Director), Alan Oxenbould (Director)

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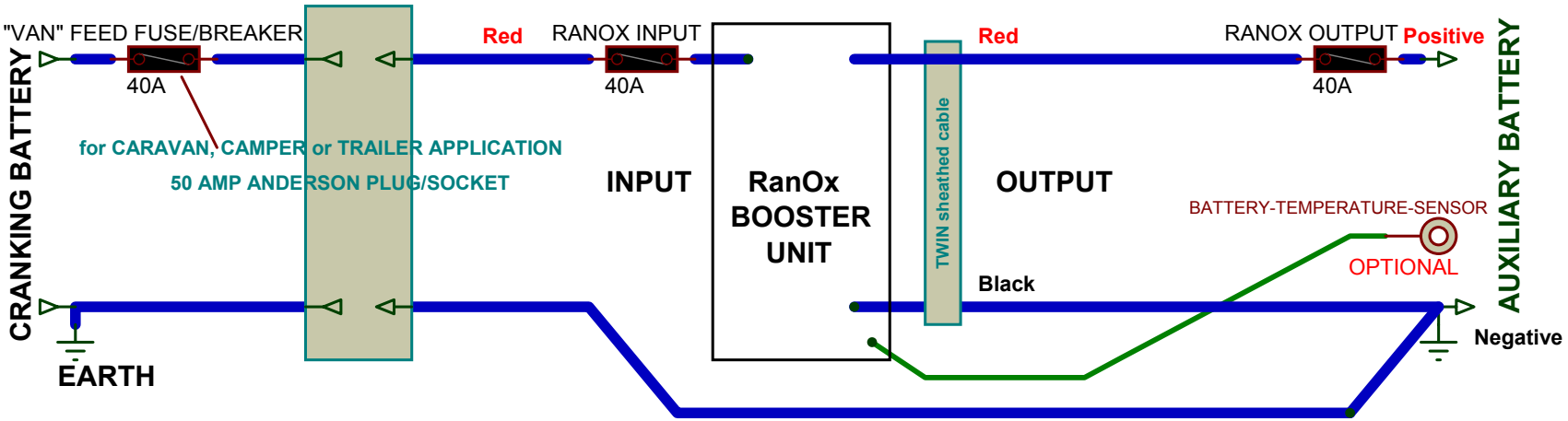
Victoria, Australia
website: ranox.com.au
Email: info@ranox.com.au
Mobile: 0400 289 671

RanOx BATTERY-BOOSTER WIRING DIAGRAM (simple)

Option 1,2,3,4

This diagram is for information purposes only and is subject to change at any time.
RanOx Pty. Ltd. is NOT responsible for any damages, direct or indirect,
arising from or related to the use of this information sheet.

The Booster should be securely mounted close to auxiliary battery,
but protected from water, dust and vibration.
The LCD display and switches should be visible/accessible.
Adequate ventilation MUST be provided around and under the RanOx.



With option 1-4 selected, RanOx automatically detects engine running (alternator active). There must NOT be any other loads sharing either RanOx feed or connected to auxiliary battery in this configuration. If loads must be connected to the auxiliary battery during charge, then a RanOx controlled load relay is required (see other circuits and consult User Manual).

Suitably rated fuse/s or circuit breaker/s MUST protect vehicle feeds. The booster feed wire should be al least 6 square mm size. Any join should be soldered.

For caravan/camper/trailer applications, a heavy duty connector (preferably 50 Amp Anderson style) should be used for JUST the RanOx feed.
The standard trailer plug/socket should be used should be used for any fridge feed.

In-line 40 amp fuses (provided) protect the RanOx input and output. However, the booster may be DESTROYED by reverse polarity connection of input or output !

If loads MUST be permanently connected to the auxiliary battery, consult User Manual for other suggested circuits.

RanOx also provides a Master-OFF facility, to conveniently dis-connect all loads.

If desired (to run a compressor fridge etc) an optional load changeover relay may be fitted, which will still drive all auxiliary loads whilst moving, but not waste RanOx capacity.

RanOx BATTERY-BOOSTER WIRING DIAGRAM 4WD/MOTORHOME/MARINE: Option 1,2,3,4

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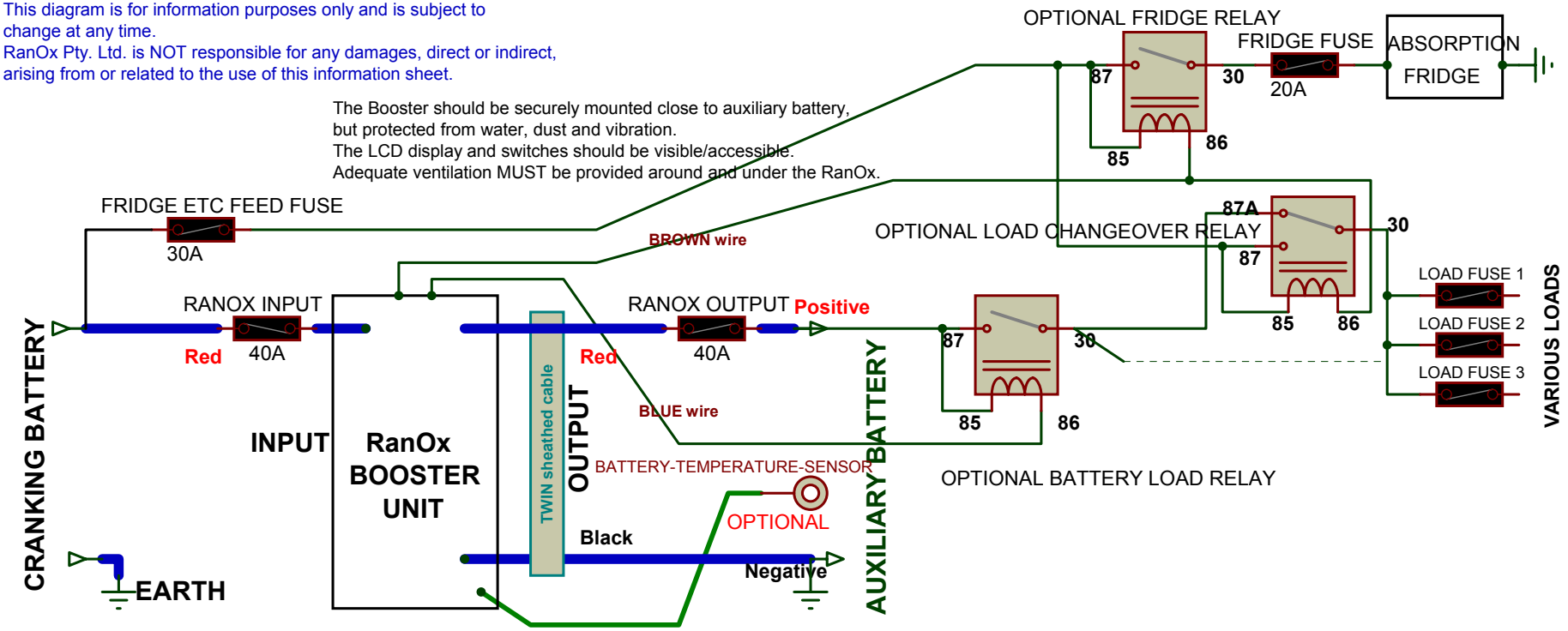
Adequate ventilation MUST be provided around and under the RanOx.



With option 1-4 selected, RanOx automatically detects engine running (alternator active). There must NOT be any other loads sharing the RanOx feed in this configuration.
Suitably rated fuse/s or circuit breaker/s MUST protect vehicle feeds. The booster feed wire should be al least 6 square mm size. Any join should be soldered.

In-line 40 Amp fuses (provided) protect the RanOx input and output. The booster may be DESTROYED by reverse polarity connection of input or output !

If an absorption fridge circuit is connected directly to the battery under charge, this will waste over half the maximum 25 Amp RanOx output current, holding it in BOOST mode.
This usually results in overcharging and possible permanent battery damage. We recommend the optional Battery-Temperature-Sensor to help protect the battery.

However, RanOx can limit BOOST charging to 2, 3 or 4 hour, by User selection, if loads MUST be permanently connected to the battery.
Absorption style fridge current (typically 13 Amp) will rapidly flatten any battery, so should not be operated unless fed from the vehicle alternator whilst engine running.
An optional relay for an absorption fridge connection is shown. RanOx will automatically control this relay. This fridge feed wire should be AT LEAST 4 square mm size.

Fitting of the optional battery-load relay will automatically protect the auxiliary battery against excessive discharge, when stopped/camped/moored.
We recommend that all auxiliary battery loads (apart from absorption fridge) be through this relay, which can be driven by the RanOx as shown.
This also provides a Master-OFF facility, to conveniently dis-connect all loads.

If desired (to run a compressor fridge etc) an optional load changeover relay may be fitted, which will still drive all auxiliary loads whilst moving, but not waste RanOx capacity.

RanOx BATTERY-BOOSTER WIRING DIAGRAM

4WD/CARAVAN/CAMPER: Option 1,2,3,4

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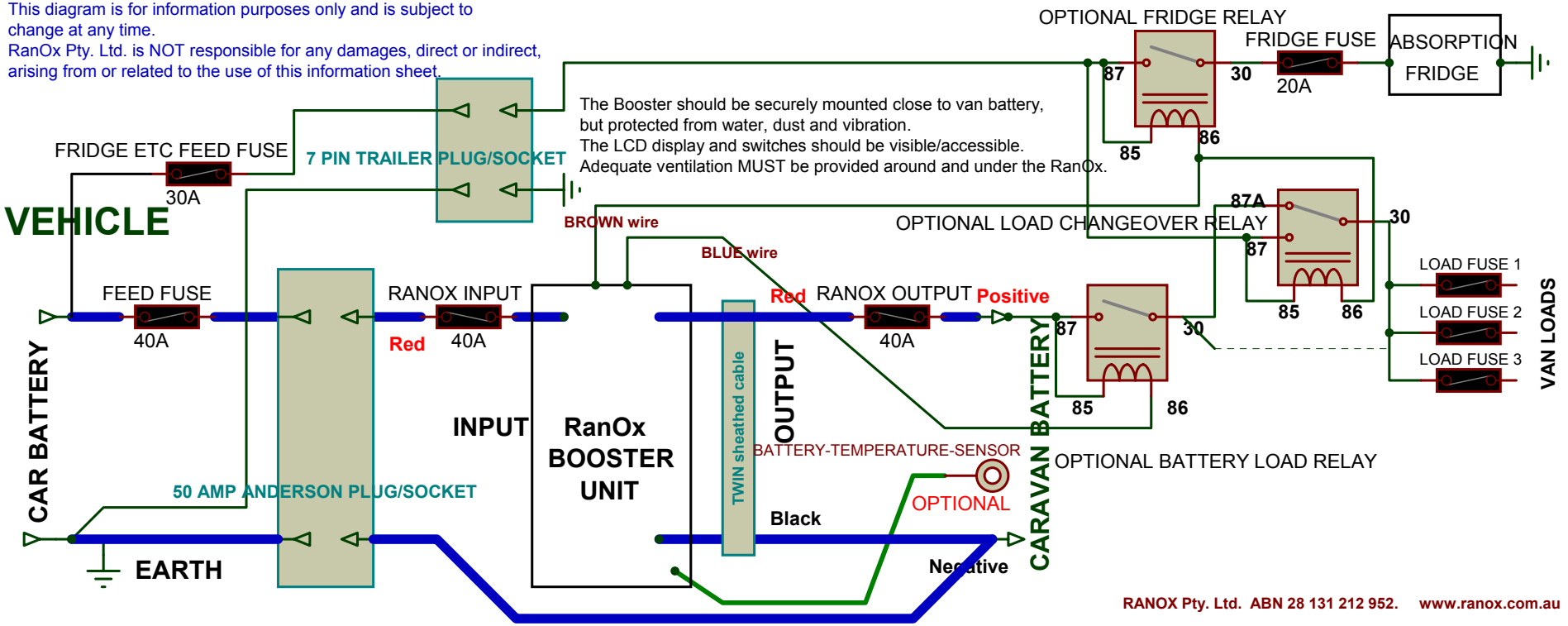

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With option 1-4 selected, RanOx automatically detects engine running (alternator active). There must NOT be any other loads sharing the RanOx feed in this configuration.
Suitably rated fuse/s or circuit breaker/s MUST protect vehicle feeds.

We insist that a separate (preferably 50 Amp Anderson style) plug/socket is used for the RanOx booster feed; with the standard trailer (7-pin) plug/socket used for the fridge feed.
The booster feed wire should be AT LEAST 6 square mm size (preferably >= 10 sq. mm). This feed will still drop over 1 Volt at 30 Amp, with typical cable lengths. Any join should be soldered.

In-line 40 Amp fuses (provided) protect the RanOx input and output. The booster may be DESTROYED by reverse polarity connection of input or output !

If an absorption fridge circuit is connected directly to the battery under charge, this will waste over half the maximum 25 Amp RanOx output current, holding it in BOOST mode.
This usually results in overcharging and possible permanent battery damage. We recommend the optional Battery-Temperature-Sensor to help protect the battery.
However, RanOx can limit BOOST charging to 2, 3 or 4 hour, by User selection, if loads MUST be permanently connected to the battery.
Absorption style fridge current (typically 13 Amp) will rapidly flatten any battery, so should not be operated unless fed from the vehicle alternator whilst engine running.
An optional relay for an absorption fridge connection is shown. RanOx will automatically control this relay.
This fridge feed wire should be AT LEAST 4 square mm size. This feed will still drop over 0.5 Volt at 13 Amp, with typical cable lengths.

Fitting of the optional battery-load relay will automatically protect the van battery against excessive discharge, when stopped/camped.
We recommend that all caravan/camper battery loads (apart from absorption fridge) be through this relay, which can be driven by the RanOx as shown.
This also provides a Master-OFF facility, to conveniently dis-connect all loads, which is ideal for travelling/charging, unless a compressor fridge is fitted to van.

If desired (to run a compressor fridge etc) an optional load changeover relay may be fitted, which will still drive all van loads whilst driving, but not waste RanOx capacity.

16 DEC 2008

RanOx BATTERY-BOOSTER WIRING DIAGRAM

4WD/CARAVAN/CAMPER: Option 0

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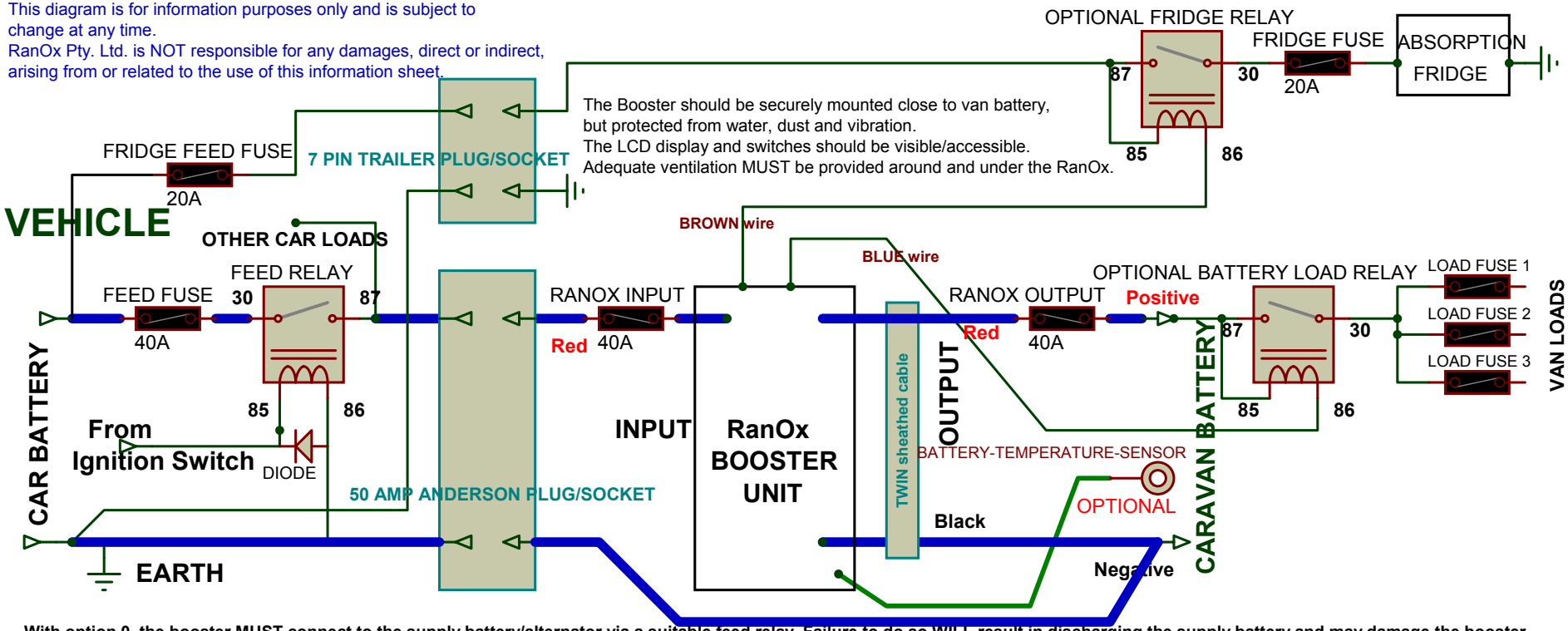

With option 0, the booster MUST connect to the supply battery/alternator via a suitable feed relay. Failure to do so WILL result in discharging the supply battery and may damage the booster.
We recommend at least 40 Amp rating, preferably higher, particularly if other car loads are fed. Suitably rated fuse/s or circuit breaker/s should protect such feeds.
The relay energising circuit/s should be connected to the ignition circuit, so that power is only fed to the RanOx booster (and other car loads) with the engine running.

We recommend that a separate 50 Amp Anderson style plug/socket is used for the RanOx booster feed; with the standard trailer (7-pin) plug/socket used for the fridge feed.
The booster feed wire should be AT LEAST 6 square mm size (preferably >= 10 sq. mm). This feed will still drop over 1 Volt at 30 Amp, with typical cable lengths.
Other loads MAY share this feed, provided appropriate cable, fuse and relay are used. Any join should be soldered.

In-line 40 Amp fuses (provided) protect the RanOx input and output. The booster may be DESTROYED by reverse polarity connection of input or output !

Under NO circumstances should an absorption fridge circuit be connected directly to the battery under charge. This will waste over half the RanOx output current, holding it in BOOST mode.
This results in overcharging and possible permanent battery damage. We recommend the optional Battery-Temperature-Sensor to help protect the battery.
Absorption style fridge current (typically 13 Amp) will rapidly flatten any battery, so should not be operated unless fed from the vehicle alternator whilst engine running.
An optional relay for an absorption fridge connection is shown. RanOx will automatically control this relay.
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We recommend that all caravan/camper battery loads (apart from absorption fridge) be through this relay, which can be driven by the RanOx as shown.
This also provides a Master-OFF facility, to conveniently dis-connect all loads, which is ideal for travelling/charging, unless a compressor fridge is fitted to van.