

# **USER INSTRUCTION MANUAL**

Models: TPH-1000 TPV-1000

#### Congratulations on purchasing the ToughPower Compact BMS Controller

#### You can take great pleasure in knowing that the ToughPower Dual Battery system has:

1. 1000W/2000W peak Pure Sine Wave Inverter for high power appliances

2. Automatic Low Voltage Shutdown and Recovery to protect the Dual (Auxiliary) Battery

3. The BMS Microprocessor Monitors and Displays on the LCD Touch Screen

4. Dual Battery Bypass Controller - direct connection to the vehicle Alternator for BULK charging and then DC-DC Charger to finish off the battery charge - automatically controlled

5. Direct BULK power from your vehicle Alternator to the 1000W/2000W peak Pure Sine Wave Inverter. Effectively providing power indefinitely to high power appliances.

6. Integrated 10A Mains Charger, 10A DC-DC Charger and MPPT Solar Controller (for 12V Nominal Solar Panels).





This User Manual is available online www.intelliquip.com.au

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# 2. Product Safety & Warnings

The ToughPower is intended for fixed instalment only. Ensure the ToughPower is mounted securely with **adequate ventilation** at the front of unit.

Avoid all contact with water, rain, snow or spray! Do not power ON the ToughPower if it is wet as it could potentially result in electrocution and/or permanent irreparable damage to the internal electronics. Warranty will be voided if there is damage caused by water.

**Do not attempt to disassemble** the ToughPower as this may result in electric shock. Warranty will be voided if any attempt is made to modify, repair or attempt unauthorised access to the electronics.

Disconnect all Charging power supply leads or connections before making or breaking the connections to the Battery.

The ToughPower is not a toy! **Children must not play** with the ToughPower. The ToughPower can only be used by children aged from 8yrs and above and persons with reduced physical, sensory or mental capacities or lack of experience and knowledge only if they have been given supervision or instruction concerning the use of the ToughPower in a safe way and understand the hazards involved.

**Do not insert foreign objects into the outlets** as this may lead to electrocution and/or damage the electronics. The 240V AC outlet socket should be respected the same as a standard mains electrical socket. Warranty will be voided if there is damage caused by such activity.

**Warning – Explosive gases.** Prevent flames and sparks. Do not locate the Battery in close proximity of flammable fumes, gases, or naked flames. Provide adequate ventilation to allow any heat and battery gases to be safely dissipated during charging.

Do not attempt to charge non-rechargeable batteries. This product is designed for charging 12V deep cycle rechargeable batteries 80-120 Ahr capacity.

Cleaning and user maintenance shall not be made by children without supervision.

For all PLUGGABLE equipment - the socket outlet shall be installed near the equipment and shall be easily accessible.

#### CAUTION

Risk of Explosion if Battery is replaced by an incorrect type. Dispose of used batteries according to the instructions on the battery.

Certifications: AU Prov Pat Appln No 2017903530 Electromagnetic Compatibility (EMC) AS/NZS 61000.6.4:2007 Information Technology Equipment - Safety AS/NZS 60950:2015 Safety of Portable Inverters AS/NZS 4763:2011 Household and similar Electrical Appliances - Safety - Particular requirements for Battery Chargers AS/NZS 60335.2.29:2004 + A1 + A2 with Household and similar Electrical Appliances - Safety AS/NZS 60335.1:2011 + A1 + A2

# 3. What's Included...

# TPV-1000 & TPH-1000

- 1 x ToughPower (Vertical or Horizontal orientation)
- 1 x Kettle Cord
- 1 x 12 Pin Harness assembly
- 1 x 10 Pin Harness assembly
- 1 x User Manual



TPH-1000



TPV-1000

# 4. General Specifications

For 12VDC Deep Cycle Batteries - Battery not included Lead Acid, AGM, Calcium, GEL, & Lithium (LiFeP04) battery types Key Switch Battery type selection Reverse Battery Protection Battery Bank Compatible Advanced LCD Touch Screen Battery Monitor Dual Battery Bypass Controller + Vehicle Battery Isolator Direct BULK Charging from Vehicle Alternator Vehicle Input: 8-16VDC 10A Multi-Stage DC-DC Charger Solar MPPT Controller: 10A - 12V Nominal Solar Panels (Max Voc = 25V) MAINS AC-DC Charger: Input: 100-240VAC 50/60Hz 2A Output 12VDC 10A Protections: Temperature Compensation Charging High Voltage, High Current – Charging Protection Automatic Low Voltage Shutdown & Recovery Electronics - Automatic High Temperature shutdown 50A Self Resetting Circuit Breaker (Anderson Connector) 15A Manual Reset Circuit Breakers (CIG Sockets, 6 x Switched Circuits) Powered Outlets: 1000W/2000W Peak - Pure Sine Wave Inverter USB – fast charge 2 x independent 5VDC 2.5A 1 x 50A 12VDC Anderson Connector 2 x 12VDC Circuits 3 x Independent circuits - each with individual 15A Circuit Breaker 3 x Shared circuit - single 15A Circuit Breaker External Dimensions: TPV-1000, TPH-1000: 200mm x 155mm x 370mm (L x W x H) Operating Temperature: 0 – 50°C Material: Aluminium Alloy construction Weight: TPV-1000, TPH-1000 5kg	
Lead Acid, AGM, Calcium, GEL, & Lithium (LiFeP04) battery types Key Switch Battery type selection Reverse Battery Protection Battery Bank Compatible Advanced LCD Touch Screen Battery Monitor Dual Battery Bypass Controller + Vehicle Battery Isolator Direct BULK Charging from Vehicle Alternator Vehicle Input: 8-16VDC 10A Multi-Stage DC-DC Charger Solar MPPT Controller: 10A - 12V Nominal Solar Panels (Max Voc = 25V) MAINS AC-DC Charger: Input: 100-240VAC 50/60Hz 2A Output 12VDC 10A Protections: Temperature Compensation Charging High Voltage, High Current – Charging Protection Automatic Low Voltage Shutdown & Recovery Electronics - Automatic High Temperature shutdown SoA Self Resetting Circuit Breaker (Anderson Connector) 15A Manual Reset Circuit Breakers (CIG Sockets, 6 x Switched Circuits) Powered Outlets: 1000W/2000W Peak - Pure Sine Wave Inverter USB – fast charge 2 x independent SVDC 2.5A 1 x 50A 12VDC Anderson Connector 2 x 12VDC CIG Sockets 6 x Switched 12VDC Circuits 3 x Independent circuits - each with individual 15A Circuit Breaker 3 x Shared circuit - single 15A Circuit Breaker External Dimensions: TPV-1000, TPH-1000: 200mm x 155mm x 370mm (L x W x H) Operating Temperature: 0 – 50°C Waterial: Aluminium Alloy construction Weight: TPV-1000, TPH-1000 Skg	For 12VDC Deep Cycle Batteries - Battery not included
Key Switch Battery type selection         Reverse Battery Protection         Battery Bank Compatible         Advanced LCD Touch Screen Battery Monitor         Dual Battery Bypass Controller + Vehicle Battery Isolator         Direct BULK Charging from Vehicle Alternator         Vehicle Input: 8-16VDC 10A Multi-Stage DC-DC Charger         Solar MPPT Controller: 10A - 12V Nominal Solar Panels (Max Voc = 25V)         MAINS AC-DC Charger:         Input: 100-240VAC 50/60Hz 2A         Output 12VDC 10A         Protections:         Temperature Compensation Charging         High Voltage, High Current – Charging Protection         Automatic Low Voltage Shutdown & Recovery         Electronics - Automatic High Temperature shutdown         SOA Self Resetting Circuit Breaker (Anderson Connector)         15A Manual Reset Circuit Breakers (CIG Sockets, 6 x Switched Circuits)         Powered Outlets:         1000W/2000W Peak - Pure Sine Wave Inverter         USB – fast charge 2 x independent SVDC 2.5A         1 x 50A 12VDC Anderson Connector         2 x 12VDC ClG Sockets         6 x Switched 12VDC Circuits         3 x Independent circuit - each with individual 15A Circuit Breaker         2 x 12VDC ClG Sockets         6 x Switched 12VDC Circuits         3 x Independent circuit - each with individual 15A Circuit	Lead Acid, AGM, Calcium, GEL, & Lithium (LiFeP04) battery types
Reverse Battery Protection Battery Bank Compatible Advanced LCD Touch Screen Battery Monitor Dual Battery Bypass Controller + Vehicle Battery Isolator Direct BULK Charging from Vehicle Alternator Vehicle Input: 8-16VDC 10A Multi-Stage DC-DC Charger Solar MPPT Controller: 10A - 12V Nominal Solar Panels (Max Voc = 25V) MAINS AC-DC Charger: Input: 100-240VAC 50/60Hz 2A Output 12VDC 10A Protections: Temperature Compensation Charging High Voltage, High Current – Charging Protection Automatic Low Voltage Shutdown & Recovery Electronics - Automatic High Temperature shutdown SOA Self Resetting Circuit Breaker (Anderson Connector) 15A Manual Reset Circuit Breaker (CIG Sockets, 6 x Switched Circuits) Powered Outlets: 1000W/2000W Peak - Pure Sine Wave Inverter USB – fast charge 2 x independent SVDC 2.5A 1 x 50A 12VDC Aderson Connector 2 x 12VDC Circuits 3 x Independent circuits - each with individual 15A Circuit Breaker 3 x Shared circuit - single 15A Circuit Breaker External Dimensions: TPV-1000, TPH-1000: 200mm x 155mm x 370mm (L x W x H) Operating Temperature: 0 – 50°C Material: Aluminium Alloy construction Weight: TPV-1000, TPH-1000 Skg	Key Switch Battery type selection
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<ul> <li>High Voltage, High Current – Charging Protection</li> <li>Automatic Low Voltage Shutdown &amp; Recovery</li> <li>Electronics - Automatic High Temperature shutdown</li> <li>50A Self Resetting Circuit Breaker (Anderson Connector)</li> <li>15A Manual Reset Circuit Breakers (CIG Sockets, 6 x Switched Circuits)</li> <li>Powered Outlets:</li> <li>1000W/2000W Peak - Pure Sine Wave Inverter</li> <li>USB – fast charge 2 x independent 5VDC 2.5A</li> <li>1 x 50A 12VDC Anderson Connector</li> <li>2 x 12VDC CIG Sockets</li> <li>6 x Switched 12VDC Circuits</li> <li>3 x Independent circuits - each with individual 15A Circuit Breaker</li> <li>3 x Shared circuit - single 15A Circuit Breaker</li> <li>External Dimensions: TPV-1000, TPH-1000: 200mm x 155mm x 370mm (L x W x H)</li> <li>Operating Temperature: 0 – 50°C</li> <li>Material: Aluminium Alloy construction</li> <li>Weight: TPV-1000, TPH-1000 5kg</li> </ul>	Temperature Compensation Charging
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3 x Independent circuits - each with individual 15A Circuit Breaker 3 x Shared circuit - single 15A Circuit Breaker External Dimensions: TPV-1000, TPH-1000: 200mm x 155mm x 370mm (L x W x H) Operating Temperature: 0 – 50°C Material: Aluminium Alloy construction Weight: TPV-1000, TPH-1000 5kg	6 x Switched 12VDC Circuits
3 x Shared circuit - single 15A Circuit Breaker External Dimensions: TPV-1000, TPH-1000: 200mm x 155mm x 370mm (L x W x H) Operating Temperature: 0 – 50°C Material: Aluminium Alloy construction Weight: TPV-1000, TPH-1000 5kg	3 x Independent circuits - each with individual 15A Circuit Breaker
External Dimensions: TPV-1000, TPH-1000: 200mm x 155mm x 370mm (L x W x H) Operating Temperature: 0 – 50°C Material: Aluminium Alloy construction Weight: TPV-1000, TPH-1000 5kg	3 x Shared circuit - single 15A Circuit Breaker
Operating Temperature: 0 – 50°C Material: Aluminium Alloy construction Weight: TPV-1000, TPH-1000 5kg	External Dimensions: TPV-1000, TPH-1000: 200mm x 155mm x 370mm (L x W x H)
Material: Aluminium Alloy construction Weight: TPV-1000, TPH-1000 5kg	Operating Temperature: 0 – 50°C
Weight: TPV-1000, TPH-1000 5kg	Material: Aluminium Alloy construction
	Weight: TPV-1000, TPH-1000 5kg

# 5. Installation

Follow these instructions to set-up your ToughPower unit correctly.

#### TPV-1000 & TPH-1000 models

The TPV-1000 model is intended to be mounted vertically The TPH-1000 model is intended to be mounted horizontally

Do not mount the unit upside down.



# 5.1 Fitting the ToughPower to your Vehicle

There are several M4 "Closed" Nutserts located on the front and other walls of the ToughPower unit. Use standard M4 bolts and Spring Washers (also known as Lock & Split Washers) to attach the ToughPower unit to your chassis. Popular fixing points are Alloy right angle "L" brackets, C beams, & into the top of draw slides. IntelliQuip recommend a minimum of 4 Nutsert fixing points be used to secure the ToughPower unit.

Warning - Be sure to check the length of your M4 bolts that they do not bottom out in the Closed Nutserts.

# 5.2 Familiarize yourself with the Electronic Fixing Points



# 5.3 Connecting the Dual (Auxiliary) Battery to the ToughPower unit

Using the appropriate sized cable (see table below for recommended size) connect your Dual (Auxiliary) Battery to the ToughPower via the 2 large M8 Terminal Posts on the ToughPower. (You will need to make your own cables with M8 Ring Terminal Connectors).

intelliQuip highly recommend a **100A** MIDI style FUSE be fitted between the ToughPower unit and the Dual (Auxiliary) Battery. The fuse should be located as close to the battery as possible.

Note: Red = Positive Terminal. Black = Negative Terminal.

To maximise performance at high current loadings, the following cable size is recommended:

Length of cable from Dual Battery to the ToughPower	Cable Size	Nominal Area mm <sup>2</sup>
0 – 1m (Max)	B&S 2	32



 Warning:
 Check the Polarity of your connections!

 Reds to Red (Positive to Positive)
 Blacks to Black (Negative to Negative)

 Always use Spring Washers (Split/Lock Washers)
 Ensure each cable connection to the Dual (Auxiliary) Battery terminals and to the terminal posts on the ToughPower unit are secure and tight

# 5.4 Key Switch selection for Battery type

The ToughPower has a built-in integrated Multi-Stage DC-DC Battery Charger. This Charger has specific Charging Profiles for each deep cycle Battery chemistry. These are:

- Wet Lead Acid/GEL
  - AGM
  - Calcium
- Lithium LiFePO4. For other Lithium-Ion batteries refer to Section Charging Voltage Limits to confirm if compatible.

To ensure your safety, ongoing integrity of the Battery, and to provide optimised Charging, it is very important that you **correctly set the Battery Type**. Failure to do so could result in significant damage to the battery and electronics, rendering them both inoperable, and/or permanently damage any device attached to the ToughPower.

Due to the high current Charging capability of the ToughPower, and the safety and product damage risks mentioned above, the selection of the Battery Type has been provided by a **Key Switch**.

Using the Key provided, simply turn the Key to select the Battery Type that you intend to attach to the ToughPower. After making the selection we recommend that you remove the Key and store it in a secure

location. After which there is no risk that an unsupervised child, or anyone else, can change the Battery Type selected.

Using the Key inserted in the Key-Switch, select the 12V Battery Type that you intend to use:

Lead Acid/GEL Calcium AGM Lithium (LiFePO4)

Remove the Key and store in a secure location



## 5.5 Connecting to the Vehicle Start Battery

Using a **B&S 4** sized cable, connect your vehicle battery to the ToughPower Unit terminal posts. (You will need to make your own cables with Ring Terminal Connectors).

intelliQuip highly recommend an **80A** MIDI style FUSE be fitted between the ToughPower unit and the Vehicle Battery. The fuse should be located as close to the Vehicle Battery as possible.

Vehicle Battery Positive to attach to the ToughPower "Vehicle Battery Positive" M6 terminal post. Vehicle Battery Negative to attach to the ToughPower "Dual Battery Negative (Common Ground)" M8 terminal post.

Note: Maximum length of Cable = 8m.



 Warning:
 Check the Polarity of your connections!

 Reds to Red (Positive to Positive)
 Blacks to Black (Negative to Negative)

 Always use Spring Washers (Split/Lock Washers)
 Ensure each cable connection to the Vehicle Battery terminals and to the terminal posts on the ToughPower unit are secure and tight

# 5.6 Connecting 12V Nominal Solar Panels

The ToughPower can accept Regulated and Unregulated *12V Nominal* Solar Panels only. When Unregulated Solar Panels are connected the internal electronics automatically detect this and will switch to MPPT Solar Controller mode.

Note: 12V Nominal Solar Panels typically have a Max Voc = 25V.

Warning: Only 12V Nominal Solar panels can be fitted to the ToughPower! Permanent damage to the internal electronics will occur if 24V or 36V (House) Solar Panels are connected.

Connect your Solar Panel to the ToughPower terminal posts. (You will need to attach Ring Terminal Connectors to your Solar Panel lead).



Solar Positive to attach to the ToughPower "12V Nominal Solar Positive" M6 terminal post. Solar Negative to attach to the ToughPower "Dual Battery Negative (Common Ground)" M8 terminal post.

 Warning:
 Check the Polarity of your connections!

 Reds to Red (Positive to Positive)
 Blacks to Black (Negative to Negative)

 Always use Spring Washers (Split/Lock Washers)
 Ensure each cable connection to the terminal posts on the ToughPower unit are secure and tight

# 5.7 Connecting Kettle Cord for Mains Charging

Simply connect the supplied Kettle Cord into the 3 Pin Socket on the ToughPower unit.





# 5.8 Connecting the Temp Sensor, Voltage Sensor, Ignition Sensor & LED Light

The three sensors MUST be connected correctly for the ToughPower to operate - Temperature Sensor, Voltage Sensor & Vehicle Ignition Power sensor. Each sensor provides essential information to the internal processor to enable the ToughPower to correctly Charge and provide the necessary protections during both Charging and Discharging of the Dual (Auxiliary) Battery.



The Temperature Sensor Ring Terminal (connected to Pins 1 & 6) attaches to the Negative Terminal Post of the Dual (Auxiliary) Battery.

The Voltage Sensor + (red wire connected to Pin 2) attaches to the Positive Terminal Post of the Dual (Auxiliary) Battery.

The Voltage Sensor – (black wire connected to Pin 7) attaches to the Negative Terminal Post of the Dual (Auxiliary) Battery.

Connect the blue Ignition Controlled Power wire (connected to Pin 3) to the Vehicle Ignition.

PIN	DESCRIPTION
1	Temperature Sensor
2	+ Voltage Sensor
3	Ignition Controlled Power
4	+ LED Light (MAX 300mA)
5	
6	Temperature Sensor
7	- Voltage Sensor
8	
9	- LED Light
10	



Connected to Pins 4 & 9 is a short 2 Wire Breakout cable, fitted with a standard 2 Pin Connector. This is made available to connect to a small LED light (Not provided). User Control of this circuit is detailed in the Section **8.8 LED Lighting**.

**Warning:** The LED light MUST be no larger than **300mA** Current Rating. Permanent damage to the internal electronics will occur if >300mA is powered through this circuit.

Pins 5, 8, 10 are intentionally left empty.

# 5.9 Connecting the 6 Switched Output Circuits

The ToughPower has 6 Switched 12V DC Output Circuits. These are protected with 15A Manual Reset Circuit Breakers positioned on the front of the ToughPower unit. Wiring connections for each circuit are made via the 12-Pin Connector located on the rear of the ToughPower unit.

3 "Lights" Circuits share a common 15A Manual Reset Circuit Breaker. These are ideal for wiring in strip or spot LED lights that typically have very low Wattage ratings, e.g. Strip LED lights for inside canopy, outside, side awning etc.

3 "General" Circuits each have their own 15A Manual Reset Circuit Breaker for protection. These are ideal for wiring in low current 12V DC devices such as a Fridge/Freezer, Water Pump, or to run a remote 12V DC CIG Socket in a convenient location.



**Note:** The 15A Manual Reset Circuit Breakers fitted enable continuous carrying capacity at 15 Amps. The higher the over-current, the faster the trip time.

Using the 12 Pin Breakout Harness Assembly provided, the 6 Switched Output Circuits are configured as shown:







The "positive" Red Wires are fitted into Pins 1, 2, 3, 10, 11, 12.

The "negative" Black Ground Wires are fitted into Pins 4, 5, 6, 7, 8, 9.



**TPV-1000** 



The three "Lights" circuits are wired through Pins 1, 2 & 3. For ease of assembly and to reduce confusion when making wiring connections, intelliQuip suggest that you pair the adjacent Pins together for each circuit.

Light Circuit 1 = Pins 3 & 6 Light Circuit 2 = Pins 2 & 5 Light Circuit 3 = Pins 1 & 4



**TPH-1000** 



The three "Power" circuits are wired through Pins 10, 11, 12. For ease of assembly and to reduce confusion when making wiring connections, intelliQuip suggest that you pair the adjacent Pins together for each circuit.

Power Circuit 1 = Pins 12 & 9 Power Circuit 2 = Pins 11 & 8 Power Circuit 3 = Pins 10 & 7

For your convenience, standard 6.3mm FEMALE Spade Connectors with plastic Insulator Sleeves have been attached to all 12 wires. Simply fit 6.3mm MALE Spade Connectors to the device's power harness wires for quick and easy assembly, then slide the plastic Insulator Sleeve over both connectors.

# 6. Powering Up and Configuration

After securing the ToughPower in your vehicle and making all the necessary electrical connections as detailed in Section **5 Installation**, you can now turn the ToughPower ON.

- 1. Turn the Master Switch to the ON position
- 2. The LCD touchscreen will prompt you to update the battery settings:
  - a. Touch the arrows to select the correct values for your Battery Condition and Capacity (refer to Section 6.1 Battery Capacity & Condition Setup for more information)
  - b. When finished touch SAVE and then HOME



3. Although the unit is now ready to be used, it is highly recommended to allow the ToughPower unit to complete a full charge cycle so the internal battery monitor gets synchronised with the battery state of charge. If you don't do this, you will only ever see the Voltage displayed on the LCD, and no % or time predictions will be displayed on the LCD screen.

The easiest way to achieve a complete full charge cycle is with the Mains Charger (though you can use Solar or Vehicle charging):

- a. Plug the desired input charge source (Mains power Kettle cord)
- b. Ensure the Master Switch is in the ON position
- c. Turn OFF or remove all output LOADS from the ToughPower eg Fridge.
- d. Wait until charging is FULL or Battery percentage shows 100% on the LCD screen



# 6.1 Battery Capacity & Condition Setup

In addition to selecting the battery chemistry type it is necessary to set-up its Capacity and Condition. This is only required when fitting a new battery, and by doing so, it will ensure that the ToughPower is able to perform calculations and estimations to keep track of the charge in and out of the unit based on the battery characteristics.

To update the battery configuration, follow these steps:

- 1. From the Home screen touch the Battery Icon to see the Battery Setup Configuration.
- 2. Touch and hold the **EDIT** button, the screen will update and display >> next to each parameter.
  - a. To save the configuration touch SAVE button
  - b. To reset the configuration to the default factory settings touch DFLT button and then touch SAVE
  - c. To modify each parameter, touch the arrows >> next to them and select the desired value:

Туре	LEAD/GEL	Туре	LEAD/GEL	
Condition	NEW	Condition >>	NEW	
Capacity 100Ah		Capacity >>	100Ah	
(HOME)Batt s	etup <b>EDT</b>	(HOME) DFLT	SAVE I EDIT	

- 3. For Battery Condition, available options are:
  - a. NEW (new battery)
  - b. USED (regular use up to 2yrs old)
  - c. OLD (2yrs or older)
- 4. For Battery Capacity, available options are:
  - a. From 80Ah to 360Ah in 5Ah increments
  - b. Enter the Battery Capacity as stated on your Battery
  - c. For a "Battery Bank" configuration, simply add the Ah capacity of the batteries, and enter this number. Eg, 2 x 105Ah batteries = 210Ah. Enter '210' into the unit.
- 5. When completed, touch SAVE to save the current configuration.
- 6. Touch HOME button to exit Battery Configuration and return to the Home screen.

Note: Updating the battery setup will reset all LOGS and USAGE records.

# 6.2 Battery Bank Setup

A second (or third) battery can be connected to the Dual (Auxiliary) Battery to create a *Battery Bank*. With the addition of a second Battery connected in **parallel** you will be able to either extend the time between charging, or power more devices. The additional Battery must be the same *Type* of Battery chemistry otherwise you risk damaging the Battery as the *Charging Voltage* is specific to the Battery Type!

You will need to make a small cable with Ring Terminals on **both ends** to connect to the *terminal posts* of both Batteries. **Remember:** connect Positive to Positive, & Negative to Negative. Keep the cable as short as possible and we recommend using B&S 6 sized cable.

This method of connecting the two batteries directly to the terminal posts allows the ToughPower to provide the same *Low Voltage Shutdown* and *Charging Protections* to the second Auxiliary Battery.

Refer to Section **6.1 Battery Capacity & Condition Setup** for instructions on how to set the correct Battery Capacity on the ToughPower LCD Screen.

**Note:** Take special care to attach the Battery Terminals correctly! It must be **Parallel Connection** - Red to Red (Positive to Positive), and Black to Black (Negative to Negative). Incorrect terminals connection will cause permanent damage to the sensitive electronics inside the ToughPower.

Warning: You cannot make a Series Configuration to increase the system Voltage! The ToughPower is a 12V system only.

# 7. Charging the Battery

The ToughPower is controlled by an integrated Battery Management System (BMS) microprocessor and includes:

- 10 Amp Multi-Stage DC-DC Charger Input 8-16 VDC
- 10 Amp AC-DC Mains Charger Input 100-240VAC 50/60Hz 2A
- MPPT Solar High Efficient Controller for 12V Nominal Solar Panels
- Dual Battery Smart Charging Controller

The BMS technology provides maximum flexibility and options for charging – Mains Power to charge when at home, Vehicle Charging for when you are on the move, Solar Power for when you're free camping.

To enable charging of your Dual (Auxiliary) Battery from any source the Master ON/OFF Switch must be in the **ON** position.

**Note:** The battery is protected from OVER-VOLTAGE. Automatic shut-off will occur when the battery is fully charged.

# 7.1 Mains Power Charging – (MAINS)

With the supplied Kettle Cord attached to the REAR of the connect the Australian 3-Pin Plug into a standard power point socket.

The LCD display will show that the Dual (Auxiliary) Battery is being charged from **MAINS** input.





The internal 10 Amp AC-DC Charger will receive and regulate the Mains input power to charge the Dual (Auxiliary) Battery. The multistage charger will Charge and Condition the Dual (Auxiliary) Battery and will shut-off when charging is complete.

**Note:** If this Kettle Cord is damaged, do not use and discard immediately! Contact the manufacturer, or designated service agent, or similar qualified person for a suitable replacement part.

# 7.2 Solar Power Charging – (SOLAR) 12V Nominal Solar Panels only

The ToughPower can accept Regulated and Unregulated Solar Power **12V Nominal Solar Panels only**. When Unregulated Solar Panels are connected the internal electronics automatically detect this and will switch to MPPT Solar Controller mode.

12V Nominal Solar Panels: Max Voc = 25V

The LCD screen will show that the battery is being charged from  $\ensuremath{\textbf{SOLAR}}$  input.

The internal MPPT Solar Controller and multi-stage Charger will

receive and regulate the power to charge the Dual (Auxiliary) Battery. Up to 10 Amp charging can be achieved through Solar Charging. The multi-stage Charger will charge and condition the Dual (Auxiliary) Battery and will shut-off when charging is complete.



# 7.3 Dual Battery Bypass Controller

#### Direct Alternator Bulk Charge & DC-DC Charging

The advanced technology inside the ToughPower controls when to bypass the internal DC-DC Charger to allow the Vehicle's Alternator to provide BULK charging power direct to the ToughPower Battery, and then switch the internal DC-DC Charger inline to finish charging the Dual (Auxiliary) Battery.

This unique capability in the ToughPower allows the best of both existing dual battery charging technologies! Direct connection to the vehicle Alternator for BULK charging (no excess heat generated as with high current DC-DC Charging electronics) and then switch the 10A DC-DC Charger inline to complete the charging.

The Ignition Sensor Wire (refer Section **5.8 Connecting the Temperature Sensor, Voltage Sensor & Ignition Sensor**) allows the ToughPower to turn the internal Battery Isolator Relay On/Off ensuring the Vehicle's Battery is isolated from the Dual (Auxiliary) Battery when the vehicle is NOT running

The LCD Screen will show "BULK" to indicate when the Vehicle Alternator is providing BULK charging to the Dual (Auxiliary) Battery.



When BULK charge has finished, the built-in DC-DC Charger will finish off the charging process providing the required final charging stages for the selected Battery Type. "CAR" will be displayed to indicate the DC-DC Charger is controlling the final stages of charging



Note: A Lithium LiFePO4 Battery does not have a float stage.

# 7.4 Multiple Charging Sources Connected

The ToughPower can be set-up with multiple Input Charging Sources *permanently* connected. The advanced technology automatically controls when to switch between Input Sources.

This capability includes the Mains Power supply. Obviously, this cannot be done when driving, however it is a convenient charging option when you have an overnight stay at a Caravan Park or when your Vehicle will be garaged for an extended length of time.

Charging priority:

- 1. Mains
- 2. Vehicle
- 3. Solar

# 7.5 Charging Stages

The ToughPower it is equipped with a built-in integrated multi-stage DC-DC Battery Charger. This section provides a brief description of each stage.

For all Lead-Acid battery types the charger will progress through the following stages:



#### LEAD-ACID CHARGING STAGES

For Lithium LiFePO4 batteries, the charger will progress through the following stages:



#### LITHIUM CHARGING STAGES

- OFF: Charger is disabled.
- CHECKING: In this stage (reduced constant-current/trickle charge), the charger charges the battery
  with a reduced constant current. This trickle charge stage occurs for battery voltages between 35%
  to 70% (typical) of the voltage limit provided in the *Charging Voltage Limits* section below.
- **BULK:** In this stage (full constant-current) the charger charges the battery with a constant current. This constant current stage occurs for battery voltages between 70% to 98% (typical) of the voltage limit provided in the *Charging Voltage Limits* section below.
- ABSORPTION: In this stage (constant-voltage) the charger charges the battery with a configured constant voltage. This constant voltage stage occurs for battery voltages above 98% (typical) of the voltage limit described in *Charging Voltage Limits* section below.
- FLOAT: In this stage, the charger charges the battery with a reduced constant voltage. Note: This stage is not applicable for Lithium LiFePO4 batteries.
- FULL: Charger disabled, charging complete.

# 7.6 Charging Voltage Limits

The Battery Charger applies the appropriate Charging and Float Voltages depending on the Battery Type as well as combining automatic Temperature Compensation.

Battery Type	Charging Voltage (V <sub>DC</sub> ) at 25°c	Float Voltage (V <sub>DC</sub> ) at 25°c		
Lead Acid/GEL	14.2	13.3		
Calcium	15.3	13.3		
AGM	14.6	13.3		
Lithium LiFePO4	14.6	N/A		

**Note:** For *Lithium LiFePO4* batteries there is no FLOAT stage.



# 7.7 Charging Complete

When charging finishes the HOME screen will show the charging source with a FULL message. At this point the Battery Charger will automatically shut off and there is no risk of overcharging the Dual (Auxiliary) Battery.

With the Dual (Auxiliary) Battery fully charged and synchronized the ToughPower will be able to keep track of the charge in and out of the unit and estimate the remaining time to Full or Empty.



Under some circumstances the **FULL** message may disappear because the Battery Charger will resume charging again if the Battery Charge Level drops. The user can identify that the charge has been completed because the Battery Charge Level will automatically change from showing **Volts** to **Percentage** as well as showing the time remaining icon.

**Note:** In the event of LOW VOLTAGE (battery protection), the ToughPower will automatically shut-off and the Battery Charging State will be reset.

# 7.8 BMS Charging Protections

The built-in integrated Multi-Stage DC-DC Charger is equipped with several protections that will ensure the battery is always protected. The LCD Screen will indicate this condition with a *Warning icon* to the left of the Input Source icon as shown. The *FAULT led* will also pulse. To find out more information simply touch the Warning icon.



#### Fault: BattTemp

If the battery temperature falls below 0°C or rises above 50°C charging will be immediately disabled to prevent any damage to the battery. Charging will automatically resume after the battery temperature gets above 5°C or below 45°C. During this condition the *FAULT led* will pulse red twice every 3 seconds.

#### Fault: BattSense

If the battery sensor harness gets damaged, the multi-stage charger will be immediately disabled to prevent damage to the battery. *Please contact IntelliQuip support for assistance*. Under this condition the FAULT led will pulse red once every 3 seconds.

Batt Volts	12.0V
Volts In	0.0V
Amps In	0.0A
Amps Out	0.3A
Fault	BattTemp
(HOME) Genera	al (NEXT)
Batt Volts	12.00
Volts In	0.00
Amps In	0.0A
Amps Out	0.3A
Fault	BattSense
(HOME) Gener	al NEXT

# 8. Using the ToughPower

# 8.1 Time Prediction - LCD Screen

As described in the Section **7.7 Charging Complete**, the *Time Prediction* feature will be enabled after a FULL charge of the battery has been completed. This is to ensure that the built-in Charger is synchronized with the battery state and can start keep tracking of the charge in and out of the Dual (Auxiliary) Battery.

For *Time Prediction*, the ToughPower uses built-in sensors to measure current (Amps) flowing in and out of the ToughPower as well as a combination of software algorithms to compensate for the changes in capacity of Lead-Acid type batteries when being used. The effects are described by Peukert's Law, the internal algorithms use the following constants for each type of battery:

Туре	Peukert constant			
Lead Acid/GEL	1.30			
Calcium	1.20			
AGM	1.10			
Lithium LiFePO4	1.00			

In addition, the Battery Condition influences the overall capacity as well. The following values are added to the Peukert constant to improve the accuracy of the calculations:

Condition	Add
New	0
Used	0.1
Old	0.2

**Note:** In terms of *Time Prediction* it is almost impossible to have 100% accuracy due to several external variables impacting the result. Hence, time prediction calculations should be taken as a *reference only*. Always check the Battery Voltage and use that as a reference as well.

The time remaining icon will change depending on the overall **Load** on the system. When the ToughPower is being discharged the time icon will show *Empty* and whilst charging it will show *Full*, as shown in the examples below. **Note:** Time prediction is updated every 15 seconds.



# 8.2 LCD Touch Screen Calibration

The ToughPower is equipped with a resistive Touch Screen panel which comes factory calibrated. If for any reason the touch functionality becomes inaccurate you can attempt to recalibrate it by following these instructions.

Touch-screen calibration steps:

- 1. Turn OFF the Master ON/OFF Switch
- 2. Press and hold the Pure Sine Wave Inverter ON/OFF button
- 3. Turn ON the Master ON/OFF Switch
- 4. Follow the on-screen instructions:
  - a. TOUCH BOTTOM LEFT, a small square will appear on the bottom left corner, touch it with your finger
  - b. TOUCH UPPER RIGHT, a small square will appear on the upper right corner, touch it with your finger



5. End of calibration

# 8.3 LCD Automatic Shutoff

The ToughPower LCD Screen will automatically turn off after 30 seconds of inactivity to reduce current consumption. To wake up the LCD Screen simply touch the screen once. The LCD Screen will also wake up automatically when a new charging Input is connected, or the Inverter is turned ON.

# 8.4 LCD HOME Screen

#### 8.4.1 Battery Status

The *Battery icon* located on the HOME Screen indicates the *State of Charge* of the battery. If a new battery has been set-up but it has not been completely charged the HOME screen will only show the *Battery Voltage*. *Time Prediction* has not yet been enabled so will not be displayed.



After a *full battery charge* has been completed, the HOME screen will now display the *Time Prediction* icon as well as allow the user to switch between *Charge Percentage* or *Battery Voltage* (whatever your preference) simply by touching it.



#### 8.4.2 System Output LOAD

The system **LOAD** bar graph located in the HOME screen provides a quick representation of how much load the ToughPower unit is providing to the Outlets.



The Load Bar is configured with 'full' load pre-set at 100Amps OUT.

#### 8.4.3 System Input CHARGE

The system **INPUT** charge icon appears on the HOME screen as soon as an *Input Source* is detected. It shows the *active* source input while the bar graph provides a quick representation of how much load the Input Charger is taking.

Based on the connected Input Source type the System Input *Bar Graph* will represent the Charging Current (A) with respect to the maximum Amps IN for its type.

Input Source	Maximum Amps IN (A)			
Mains Power	10			
Car	10			
BULK Vehicle Charing	100			
Solar	20			



# 8.5 LCD INFO Screen

From the HOME screen touch the INFO icon to access the ToughPower information screens. This view provides useful and detailed information about real-time status of the ToughPower. To navigate through the different information screens, simply touch the NEXT icon located on the bottom right corner or use a swipe right/left gesture.

#### 8.5.1 General Information

This view provides dynamic information about the ToughPower real-time status:

- Batt Volts: Indicates the Battery voltage.
- Volts In: Indicates the charging input voltage.
- Amps In / Watts In: When charging from SOLAR input the LCD screen will display Watts In to indicate the power in. Any other charging source will show the Current In (Amps) on the screen.
- Amps Out: Indicates the current consumption of the unit.
- Stage / Timer / Fault: This label can show the Charger Stage whilst charging or the time remaining of the Timer AC if it has been enabled or Charger Fault information.

If the multi-stage charger detects a fault condition, the INFO screen will show Fault details.

Possible fault conditions are:

- BattSense: Battery Sensor fault
- BattTemp: Battery Temperature fault



For more details refer to the **Protections** section.

#### Example A:

This shows the General INFO screen whilst charging the ToughPower. The Charger Stage can vary as described in the **Charging Stages** section.



Example B:

This shows the General INFO screen when the Timer AC has been activated.



Example C:

This shows the General INFO screen when a Solar panel is connected.



#### 8.5.2 Usage Information

The ToughPower keeps track of the charge *in* and *out* of the battery. This information is displayed on the *Usage* page of the **INFO** screen:

- Used: Amps Hour used from any of the Outlets.
- Mains In: Amps Hour charged from Mains.
- Solar In: Amps Hour charged from Solar.
- Car In: Amps Hour charged from Vehicle input.



At any time, the user can reset the log time by touching and holding the >> arrows next to *Log time*. Otherwise the logging time will automatically reset after 99:59:59 (approximately 41 days).



# 8.6 LCD LOGS Screen

The built-in sensors of the ToughPower actively monitor three key *Battery Status* measurements: Voltage, Amperes In and Amperes Out. The LOGS screens represent this information in two time frames, 2Hrs and 24Hrs. The user can switch between them by touching the 2HRS/24HR button on the bottom right corner. To navigate through the different log screens simply touch the bottom log label or use a swipe right/left gesture on the screen.



The 2Hrs time interval log provides real time data allowing the user to *closely* monitor the battery status over the last 120 minutes. To represent this data, the ToughPower takes a sample every 1 second, after 60 samples it computes the average and updates the graph with the latest value. **Note:** This data will be reset when the unit is turned off.

The 24Hrs time interval log provides history of the battery for the last 24 running hours (system up-time) allowing the user to have an *overall view* of a complete system charge or how much charge has been used.

The 24Hrs data is updated every 12 minutes and it is saved in the internal system memory. This means restarting the ToughPower will *not* reset this data. However, setting a new battery will reset the logs.

In every log screen near the axis origin there is a small square tick marker that flashes every 1 second to indicate the logging feature is running. Under LOW VOLTAGE protection mode, the logging stops to allow the user to analyse the logs.

#### 8.6.1 Battery Voltage logs

The *Battery Voltage* logs allow the user to monitor the Voltage over the last 2Hrs or 24Hrs time frames. By default, this log displays the voltage range from 10.8 - 15.3 Volts.

Touching the lower end of the vertical axis changes the range to 10.8 - 13 Volts.

Touching the upper end of the vertical axis changes the range to 13 - 15.3 Volts.



#### 8.6.2 Amps In logs

The *Amps In* logs show the charging current from any source during the last 2Hrs or 24Hrs time frames. By default, these logs display the charging current ranging from 0 - 45 Amps.

This range can be expanded to 0 - 95 Amps by touching the vertical axis.

Touching once more in the upper portion of the vertical axis will change the range from 45 - 95 Amps.



#### 8.6.3 Amps Out logs

The *Amps Out* logs show the Output Current used from any Outlet over the last 2Hrs or 24Hrs time frames. By default, these logs display the output current ranging from 0 - 95 Amps.

By touching the lower end of the vertical axis, the range changes to 0 - 45 Amps.

Touching the axis one more time returns to the default range.

By touching the upper portion of the vertical axis will change the range from 45 - 95 Amps.



## 8.7 USB Charger

The ToughPower is equipped with two independent fast charge USB Chargers - compatible with Android and Apple smartphones and tablets. Each USB port can provide up to 2.5A @ 5V. For additional information about USB low voltage cut-off please refer to section **USB Low Voltage Protection**.

To start charging your USB device, simply connect it to any of the two USB port on the front panel and ensure the ToughPower is turned ON. The USB ports are disabled when the ToughPower is switched OFF.

**Note:** For Apple devices, it is recommended to use original Apple USB leads to get the maximum charging capabilities. Using non-original Apple leads may result in slower charging rates.

**Note:** When the system is in LOW VOLTAGE mode, the two USB ports are still powered so that you can use them for emergency only.

## 8.8 LED Lighting

As detailed in **Section 5.8** a short 2 Wire Breakout Cable is provided at the rear of the ToughPower to connect a small (up to 300mA) LED Light (not provided). ON/OFF control for this circuit is managed through the LCD Screen.

Simply touch the **LEDS** button on the **HOME** screen to toggle ON/OFF. A brightness control screen will be displayed to adjust the brightness in 10% increments or to select one of the three *brightness pre-sets* (Low, Med, Max).



To access the brightness control while the LED light strip is already ON, touch and hold the **LEDS** button from the HOME screen and it will pop up.

To modify any pre-set value simply dial in the desired brightness value then press and hold the pre-set button, the LED strip will blink to confirm the updated value. To reset the presets back to default configuration touch and hold the percentage textbox, the LED strip will blink twice to confirm the new settings.

**Warning:** The LED light MUST be **no larger than 300mA** Current Rating. Permanent damage to the internal electronics will occur if >300mA is powered though this circuit.

### 8.9 240V<sub>AC</sub> 50Hz Mains Power Output

Fully integrated inside the Toughpower is a 1000W Pure Sine Wave Inverter:

- Continuous Power 800W
- 1000W (5min)
- Peak Power 2000W

This provides 240V AC 50Hz "Mains" Power 10A maximum load.

Simply connect your mains power appliance into the 3 Pin Socket and press the push button to switch ON. A green LED will light to show that the Inverter has sufficient power from the battery to operate.

Typical appliances that can be used:



Note: Always check the Wattage capacity of the appliance before connecting to the ToughPower!

#### 8.9.1 Timer AC

A *Timer* is integrated for the Pure Sine Wave Inverter. This allows the user to turn ON and run the Inverter for a specific time interval. Simply turn ON the Pure Sine Wave Inverter, and the LCD screen will show the *Timer AC* control window to allow the selection of a timer pre-set, or alternatively, adjust the timer in 15 min increments. If timer is left as OFF the Inverter will run until it is turned OFF by the user.



When the timer is set, once the configured time expires the inverter will automatically turn OFF. The progress of the timer can be checked from the INFO screen.



#### 8.9.2 Pure Sine Wave Inverter Safety Protections

The Pure Sine Wave Inverter has an in-built safety cut-off function that will automatically disable the Inverter when a *Low Voltage Battery* condition exists – this is to protect the battery from damage. The battery will need to be recharged before you can recommence using 240V<sub>AC</sub> power.

The Inverter has an audible alarm that will sound when an *Over Temperature* condition exists. Power to the  $240V_{AC}$  socket will shut off so to prevent damaging the electronic circuits. After a 15-minute cool-down period the Inverter can then be switched back on.

**Note:** The Inverter cannot be used whilst the ToughPower is charging from MAINS. The following message will appear to indicate this restriction.



#### 8.9.3 AC Overload

If the electrical device that you have connected has a higher Power Rating than the built-in Pure Sine Wave Inverter, then the Inverter will not have enough power to power the device and will turn itself OFF. An audible alarm will indicate this condition. This includes devices that have a rating above the Continuous Power Rating of the Inverter, and below the Peak Power Rating of the Inverter.

Example A: An Angle Grinder with 1500W Power Rating, or Pod Coffee Machine with Power Rating 1360W can be connected. Both devices can be powered for a shortened period as their Power ratings exceed 1000W but are below the instantaneous Peak Power rating of 2000W. The Inverter will automatically shut itself OFF after a short period of powering these devices.

Example B: A Kettle with 2200W Power Rating, or Gerni (High Pressure hose) with 2400W Power Rating can-not be connected. The Inverter will immediately shut itself OFF should you attempt to power these devices.

#### 8.9.4 Vehicle Alternator BULK Power supply to Inverter

When the ToughPower is connected as per manufacturer's instructions, with the vehicle running and the Inverter powering an appliance, the ToughPower will attempt to obtain the required power from *the Vehicle Alternator*. Direct BULK power from the Vehicle Alternator effectively means that your vehicle can provide an "unlimited" source of power to high power appliances instead of discharging the Dual (Auxiliary) battery.

#### 8.10 12VDC Power

#### 8.10.1 Low Current Outlets

The ToughPower unit is equipped with two low current  $12V_{DC}$  CIG Sockets on the front panel.

The combined simultaneous load on these outlets cannot exceed 15 Amps, otherwise the Circuit Breaker will disconnect the power.

Simply connect your appliance to the CIG socket. Power is immediately available. The two CIG Sockets are protected by a single **15 Amp Manual Reset Circuit Breaker**. The circuit breaker button will "pop" out to indicate that current has been stopped to the two CIG Sockets. After waiting a few minutes, the Circuit Breaker Button can be depressed and power to the two CIG Sockets will resume.

The Circuit Breaker is a "thermal" style that enables continuous carry capacity at the rated 15 Amps. The higher the over-current, the faster the trip time.

#### 8.10.2 6xSwitched Output Circuits

The 6 Switched 12V DC Output Circuits are protected with 15A Manual Reset Circuit Breakers positioned on the front of the ToughPower unit.



The 3 "Lights" Circuits share a common 15A Manual Reset Circuit Breaker. These are ideal for wiring in strip or spot LED lights that typically have very low Wattage ratings, e.g. Strip LED lights for inside canopy, outside, side awning etc. The combined simultaneous load on these outlets cannot exceed 15 Amps, otherwise the Circuit Breaker will disconnect the power.

3 "General" Circuits each have their own 15A Manual Reset Circuit Breaker for protection. These are ideal for wiring in low current 12V DC devices such as a Fridge/Freezer, Water Pump, or to run a remote 12V DC CIG Socket in a convenient location.

**Note:** The 15A Manual Reset Circuit Breakers fitted enable continuous carrying capacity at 15 Amps. The higher the over-current, the faster the trip time. The circuit breaker button will "pop" out to indicate that current has been stopped to that circuit. After waiting a few minutes, the Circuit Breaker Button can be depressed, and power will resume to the circuit.

#### 8.10.3 High Current Outlets

For **High Current**  $12V_{DC}$  Power the ToughPower is equipped with a single Anderson Connector on the front panel.

Attach your high current device to the Anderson Connector and power is immediately available. The Anderson Connector has a **50 Amp Max** load protected with a **50 Amp Self Resetting Circuit Breaker**.

When an overcurrent condition exists the internal circuit-breaker will activate and stop power to the Anderson Connector. After a few minutes, the circuit breaker will automatically reset and power to the Anderson Connector will resume.

The Circuit Breaker is a "thermal" style that enables continuous carry capacity at the rated 50 Amps. The higher the over-current, the faster the trip time.

#### 8.11 System Protections

The ToughPower is equipped with software and hardware protections that will ensure the internal electronics components and the connected Dual (Auxiliary) Battery remain within safety operating parameters. If the unit enters any protection mode or detects any faults the status LED located on the front of the ToughPower (next to the Master Switch) will pulse RED to notify this condition as detailed in section **FAULT LED Indication**.

Under normal operation the LED will turn on GREEN.

The table below summarizes what features are enabled and available depending on the active protection mode.

PROTECTION	INPUTS		POWER OUTLETS			LICD	
MODE	MAINS	CAR	SOLAR	AC	DC	LED	USB
NORMAL	ENABLED	ENABLED	ENABLED	ENABLED	ENABLED	ENABLED	ENABLED
LOW-VOLTAGE	ENABLED	ENABLED	ENABLED	DISABLED	DISABLED	DISABLED	ENABLED*
RECOVERY	ENABLED	ENABLED	ENABLED	DISABLED	DISABLED	DISABLED	ENABLED*
OVER-TEMP	DISABLED	DISABLED	DISABLED	DISABLED	ENABLED	DISABLED	ENABLED
OVER-TEMP-LCD	DISABLED	DISABLED	DISABLED	DISABLED	ENABLED	DISABLED	ENABLED

Note \* - When the system is in LOW VOLTAGE & RECOVERY modes, the two USB ports are still powered so that you can use them for emergency only.

#### 8.11.1 Low Voltage Protection

The built-in sensors monitor the Battery Voltage constantly. If during usage the Battery Voltage drops below the pre-set limits defined for each battery type (see table below) the ToughPower will automatically activate the LOW VOLTAGE Protection Mode. All AC and DC Power Outlets are automatically *disabled* to isolate and protect the battery from damage. All Charging Inputs remain *open* to accept Charging Power as soon as it becomes available. The LCD screen will display the following message to notify this event.



Туре	Low Voltage Cut-off (V <sub>DC</sub> )
Lead Acid/GEL	10.8
Calcium	10.8
AGM	10.8
Lithium LiFePO4	11.6

For Lead-Acid family battery types the Low Voltage limit is dynamic depending on the System Load to compensate for the internal battery losses associated with these types of batteries.

System LOAD	Low Voltage Cut-off (V⊳c)
0% - 20%	10.8
20% - 40%	10.7
40% - 60%	10.6
60% - 80%	10.5
80% - 100%	10.4

When the built-in Pure Sine Wave Inverter is in operation, if the Battery Voltage drops below the safety limits the unit may activate the LOW VOLTAGE Protection Mode or in some cases the Inverter's built-in protection may beep to alert of a Low Voltage condition and turn the AC output *off*.

At this point it is recommended to connect a Charging Source before trying to continue to use any of the ToughPower Power Outlets. Follow recommendations detailed in the next Section **Recovery Protection**.

**Note:** It is highly recommended that a full charge be completed after the ToughPower goes into LOW VOLTAGE Protection Mode. This will extend the Dual (Auxiliary) Battery lifespan and prevent any long-term damage.

#### 8.11.2 Recovery Protection

If the ToughPower enters LOW VOLTAGE Protection Mode, connect any active Charging Source as described in Section **7 Charging the Battery**. By doing this the ToughPower will enter RECOVERY Protection Mode. In this mode the ToughPower will charge the battery but will keep the AC and DC Power Outlets *disabled* for a period to allow the battery to recover some charge.

Depending on the type of Charging Source a *Recovery Timer* will automatically be set. For MAINS and CAR the Recovery Timer will count down 15 minutes, and for SOLAR it will take 30 minutes. When the Recovery Timer expires, the ToughPower clears the RECOVERY Protection Mode condition and returns to Normal operation.



The Recovery Timer can be overridden at any time by touching the **YES** button to re-enable the AC & DC Power Outlets and return to Normal operation.

When in RECOVERY Protection Mode the INFO screen will show the Battery Volts as Not Available (N/A). When the Recovery Timer expires, or the user overrides it, the Battery Voltage will be displayed again.

Examples below show the INFO General Screen when in Recovery Protection Mode. The left image indicates that the Battery Voltage reading is N/A (i.e. Power is disabled to Power Outlets) and the right image showing that a Charging Source is inputting 8 Amps 12V into the Battery and that Power to the Power Outlets is still disabled.



#### 8.11.3 Over Temperature Protection

The ToughPower built in Temperature Sensors monitor different internal temperatures and the Dual (Auxiliary) Battery temperature constantly to protect the internal components as well as the Dual (Auxiliary) Battery. While using the Toughpower, if any of these sensors surpasses a predefined safety limit the ToughPower will enter OVER TEMPERATURE Protection Mode.



ToughPower needs to cool down before you can use it. (HOME) INFO CORST TANK Refer to the table in the Section **8.11 System Protections** for the features that are disabled and available during this Mode.

Allow the unit to cool down before trying to use any of the Power Outlets. The OVER TEMPERATURE Mode will clear automatically once the internal temperatures fall below safe temperature limits and return to Normal operation. Any Charging Inputs that are connected and active will automatically resume at the return of Normal operation.

#### 8.11.4 Over Temperature LCD Protection

A second stage, Over Temperature safety limit will automatically shut off the LCD Screen to prevent any damage to the screen. Refer to the table in the Section **8.11 System Protections** for the features that are disabled and available during this Mode.

Allow the unit to cool down before trying to use any of the Power Outlets. The Over Temperature LCD Protection Mode will clear automatically once the internal temperatures fall below safe temperature limits and return to Normal operation. Any Charging Inputs that are connected and active will automatically resume at the return to Normal operation.

#### 8.11.5 Over Load Protection

In the possible event of an *overload*, all Power Outlets of the ToughPower are protected to prevent any damage.

The 12V<sub>DC</sub> Low Current Outlets are protected with **15 Amp Manual Reset Circuit Breakers**. If the output current exceeds 15 Amps, the Circuit Breaker button will "pop" out to indicate that current has been stopped. After waiting a few minutes, the Circuit Breaker button can be depressed, and power will resume.

For the  $12V_{DC}$  High Current Outlet a **50 Amp Self Resetting Circuit Breaker** protects the circuit. When an overcurrent condition exists the internal Circuit Breaker will activate and stop power to the Anderson Connector. After a few minutes the Circuit Breaker will automatically reset and power to the Anderson Connector will resume.

The 240V<sub>AC</sub> Inverter Outlet is protected in case of an overload. In such event an audible alarm will emit a "beep" sound and the Inverter Fault LED will turn ON (red). The  $240V_{AC}$  outlet will be *disabled* until the device causing the overload is disconnected.

#### 8.11.6 USB Low Voltage Protection

The two independent fast charge USB Chargers are independent of the DC Outlets and the Pure Sine Wave Inverter. This means that they will remain *enabled* and available even during a Protection event.

To protect the battery from Low Voltage damage, the circuitry controlling the USB Chargers will be disabled when the Battery Voltage gets below 11.2V.

#### 8.11.7 FAULT LED Indication

The table below indicates the FAULT led behaviour when a Fault is detected, or the system is in Protection mode.

Fault / Protection	LED PULSES RED (every 3 seconds)
Low Voltage Recovery Protection Over Temperature Protection Over Temperature LCD Protection	4
Charger - Battery Invalid temperature	2
Charger - Battery sensor error	1

# 9. Warranty & Contact

For standard Warranty terms and conditions please visit our Website: http://www.intelliquip.com.au

Company contact details:

IntelliQuip PO Box 5281 Victoria Point Qld 4165 Australia

1800 442 873 info@intelliquip.com.au

# **10. Trouble-Shooting**

# I've set the Battery Type key switch, attached the Battery, switched it ON, but the LCD doesn't light up - what's wrong?

Maybe you have attached the cables to the battery terminals "back-to-front". Don't worry, you haven't blown a fuse or done any damage as the electronics inside are fully protected for Reverse Battery Protection. Check: Red to Positive, Black to Negative. Otherwise, the battery could be faulty, or old and dead flat.

#### What type of Battery can I connect?

It must be a rechargeable 12V Deep Cycle battery. Lead Acid, GEL, Calcium, AGM, & Lithium LiFePO4.

#### Can I Charge the Battery and use Power at the same time?

Yes you can! All the charging electronics are fully protected with current limiting capability, so you can be using Power at the same time you are Charging the Dual (Auxiliary) Battery. The only restriction is that you can't charge with MAINS power and use the INVERTER at the same time.

#### Can I leave the ToughPower outside?

No - we don't. It has sensitive electronics inside and water and electronics don't mix! You wouldn't leave your fridge, coffee pod machine or phone outside either. Install it inside a fully covered canopy or camper, out of the weather and in a well-ventilated area.

#### 1000W Inverter - that will pull heaps of power, won't that flatten the battery?

Yes it will! If you are going to use it every day to run high energy appliances like a camp fridge *and* make a few cups of coffee with your pod machine *and* make a few slices of toast then you need a **plan** to re-charge the battery - every day! Simply idle your car if you plan to run the Inverter for a long time and the Alternator will put in BULK charge. BTW - this is a good idea if you need to use an Angle Grinder or Sabre Saw for the odd job!

#### Can I undo the screws and access the electronics?

No. There are sensitive electronics inside. If you do, it will void the warranty.

#### What Solar Panels can I connect?

Any Unregulated 12V nominal Solar Panel, or any Regulated 12V nominal Solar Panel. Max Voc = 25V

#### Can I attach a 2nd Battery to create a Battery Bank so I have more capacity?

Yes sure! The 2<sup>nd</sup> or 3<sup>rd</sup> Auxiliary battery must be the same type. Remember: Connect Positive to Positive, & Negative to Negative. Keep the cables as short as possible. Refer to the User Manual for instructions.

#### Can I remove the metal air grille to clean the foam behind it?

No! The metal air grille can NOT be removed. Gently vacuum the air grille to remove dust.

#### What size lithium battery do I need to be able to run the Inverter?

If you're wanting to run high powered appliance such as a toasted sandwich maker, toaster, or pod machine - which will all draw high current (~100A), then you'll need to check the specifications of the lithium battery. Some commonly available 100Ahr lithium batteries have reduced "Maximum Continuous Current" output settings. 50A output limited is not uncommon! Be sure to ask your Lithium battery retailer what the current output limitations are.