



LITHIUM BATTERY

USER MANUAL



Model:
HU6490, HU6491,
HU6494



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LITHIUM BATTERY

USER MANUAL

Dear customer,

This manual contains all relevant information necessary to install, use and maintain HULK Professional Lithium Iron Phosphate 12.8V Batteries. Read this manual carefully before installing and using the product.

This manual is meant for the installer and the user of the LiFePO₄ batteries. Only qualified, certified personnel may install and perform maintenance on HULK Professional Lithium Batteries.

Please consult the index at the start of this manual to read information relevant to you.

This is the original manual, keep it in a safe location!



1. INTRODUCTION

1.1 Product Description

HULK Professional Lithium Batteries are Lithium Iron Phosphate rechargeable batteries. Lithium Iron Phosphate (LiFePO4) technology is considered as the latest and safest lithium technology available in the market.

Potential applications of this LiFePO4 battery include: recreational vehicles, caravans, boats, mobile homes, camping & industrial energy storage solutions.

1.2 Glossary of Terminology

BMS:	Battery Management System
Charge cycle:	A period of use from fully charged, to fully discharged and fully recharged again
Endurance Life-cycle:	The products maximum lifespan, achieved by following the guidelines presented in this manual
LiFePO4:	Lithium Iron Phosphate
SoC:	State of Charge
CC-CV:	Constant Current - Constant Voltage
DOD:	Depth of Discharge

2. PRODUCT SPECIFICATION

2.1 Product Features & Benefits

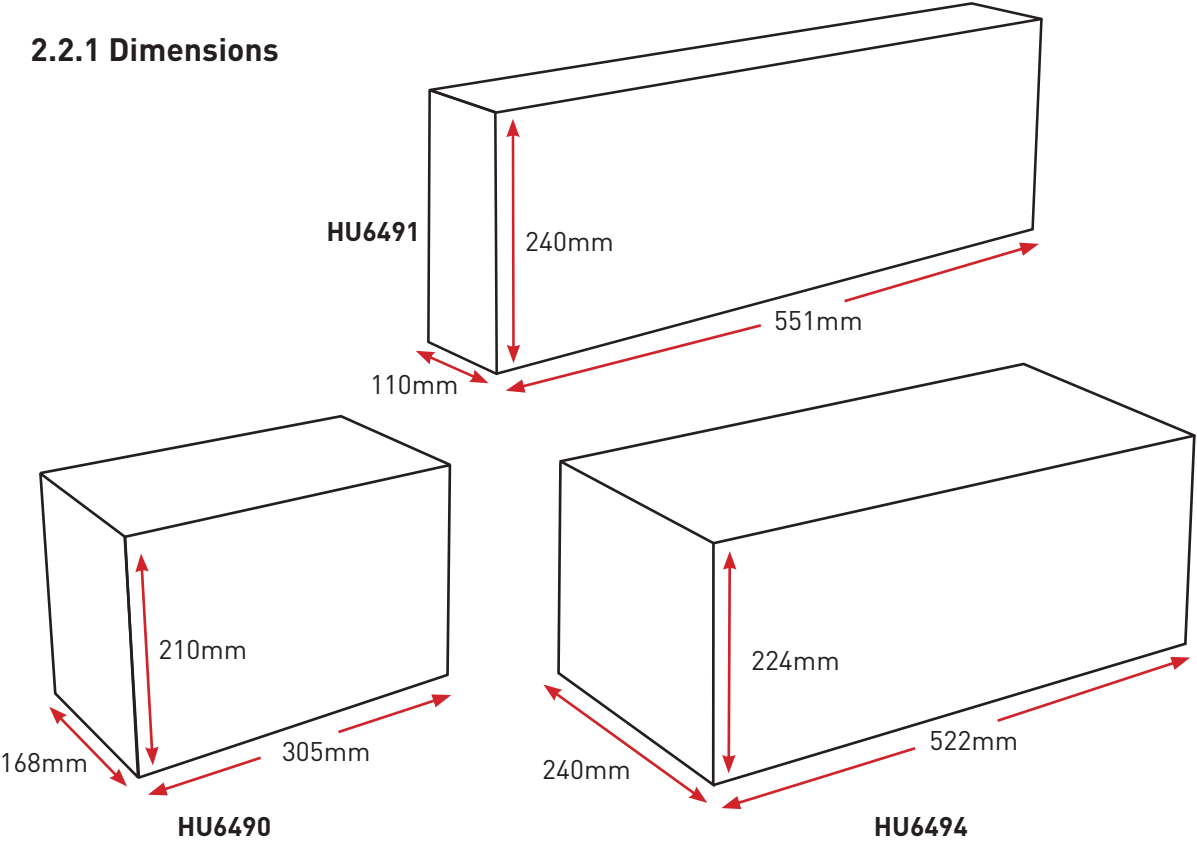
- Replacement for sealed lead acid batteries
- Traction battery behavior
- Lithium Iron Phosphate (LiFePO4): Safe lithium technology
- High performance, even under extreme conditions
- Integrated BMS (Battery Management System)
- Fast charging and discharging
- Very efficient, no charge factor
- Maintenance free
- Adaptive cell balancing
- Low self-discharge
- 6,000 cycles @ 50% DOD
- 4,000 cycles @ 80% DOD
- 2,000 cycles @ 100% DOD

LITHIUM BATTERY

2.2 General product Specifications

TECHNICAL SPECIFICATIONS	12.8V
Nominal Voltage (V)	12.8V
Charge Cut-off Voltage	15.6V
End Charge Voltage	14.6V +- 0.2V
Cycle Life @ 1C 100% DOD	>2,000 cycles
Monthly Self Discharge	<3%
Temperature Range (Charging)	0°C to 45°C
Temperature Range (Discharging)	-20°C to +60°C
Temperature Range (Storage)	0°C to +40°C
Water Dust Resistance	IP56
Cell Configuration	4S
Cell Size	18,650/26,650
Cell Chemistry	LiFePO4, Lithium Iron Phosphate Battery
Battery Housing	ABS Plastic, UL V0-94

2.2.1 Dimensions



2.3 Environmental Conditions

Caution!

LiFePO₄ batteries may only be used in conditions specified in this manual. Exposing the LiFePO₄ battery to conditions beyond the specified boundaries may lead to serious damage to the product and/or the user.

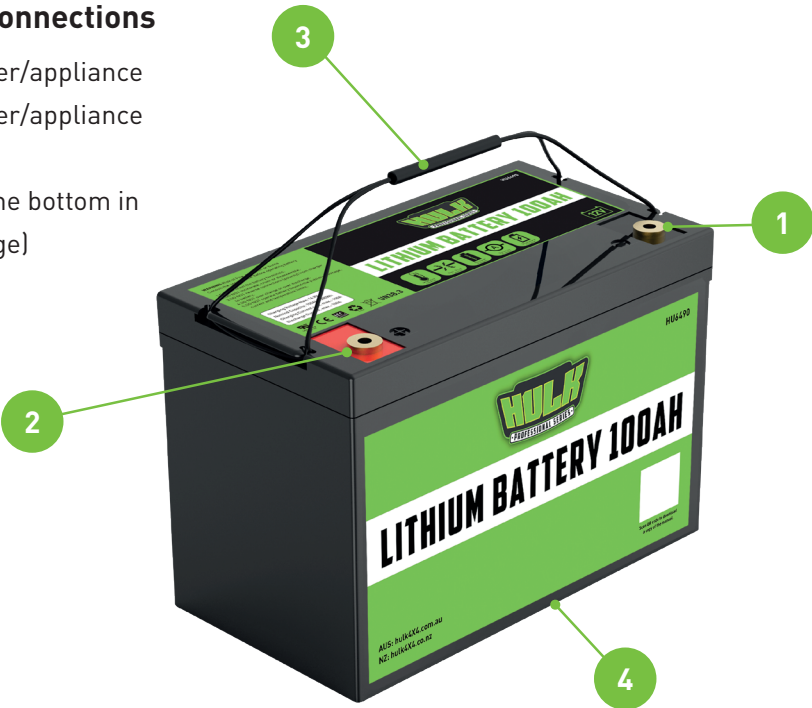
Use the LiFePO₄ battery in a dry, clean, dust free, well ventilated space. Do not expose the LiFePO₄ battery to fire or water or solvents.

When the batteries are placed in an enclosed environment without air circulation, it is advised to provide 2 ventilation holes of 100mm x 100mm each, to prevent heat built-up.

Recommended charge temperature range	0°C to +45°C*
Discharging operating temperature range	-30°C to +60°C*
Short term (<1 month) storage temperature range	-10°C to +35°C
Long term (>1 month) storage temperature range	23 ± 5°C
Relative humidity	10-90%

2.4 Product Lay-out and Connections

- 1. (-) Terminal to connect charger/appliance
- 2. (+) Terminal to connect charger/appliance
- 3. Handle for lifting
- 4. Bottom (we advise to install the bottom in position as shown on the image)



2.5 Operation Modes

Discharge mode

When the LiFePO₄ battery voltage is below 2.5 V/Cell.

Deep discharge mode

For example, with 12V battery, when the LiFePO₄ voltage is below 6V. The LiFePO₄ battery is not usable anymore and cannot be repaired, only recycled. Make sure the batteries are not deeper discharged than 10V.

3. SAFETY GUIDELINES AND MEASURES

3.1 General

- Do not short-circuit LiFePO4 battery.
- Treat LiFePO4 battery as described in this manual.
- Do not dismantle, crush, puncture, open or shred LiFePO4 battery.
- Do not expose LiFePO4 battery to heat or fire. Avoid exposure to direct sunlight.
- Do not remove LiFePO4 battery from its original packaging until required for use.
- In the event of LiFePO4 battery leaking, do not allow the liquid to come in contact with the skin or eyes. If contact has been made, wash the affected area with copious amounts of water and seek medical advice.
- Use battery charging devices that are capable of charging a LiFePO4 battery.
- Observe the plus (+) and minus (–) marks on LiFePO4 battery and equipment and ensure correct use.
- Do not use any battery which is not designed for use with LiFePO4 battery.
- Do not mix batteries of different manufacturer, capacity, size or type within a device.
- Keep LiFePO4 battery clean and dry.
- Secondary batteries need to be charged before use. Always use the correct charger and refer this manual for proper charging instructions.
- Do not leave LiFePO4 battery on continuous charge when not in use.
- After extended periods of storage, it may be necessary to charge and discharge LiFePO4 battery several times to obtain maximum performance.
- Retain the original product documentation for future reference.

Attention

Warning! Keep the battery away from water, dust and contamination.

Warning! Do not crush or puncture the battery.

Warning! Never touch the battery contacts or allow (conductive) objects to touch the contacts.

3.2 Disposal

Dispose of LiFePO4 battery in accordance with local, state and federal laws and regulations. Batteries may be returned to the seller.

Do not mix with other (industrial) waste.





4. INSTALLATION

4.1 General Information

Attention

Warning! Never install or use a damaged LiFePO4 battery.

Caution! Do not reverse connect the power cables (polarity)

When connecting several batteries in parallel, always use batteries of the same brand, type, age, capacity and state of charge.

4.2 Unpacking

Check HULK Professional LiFePO4 battery for damage after unpacking. If the battery is damaged, contact your reseller. Do not install or use the battery if it is damaged!

4.3 Preparing the Battery for Use

Attention

Warning! Always remain within the limits indicated in chapter 2 during the use of the LiFePO4 battery.

Caution! In case of an empty LiFePO4 battery shutdown, charge immediately.

4.3.1 Location of the LiFePO4 battery

Before it is used, the battery must be positioned in such a way that it will not move around in its compartment during use.

Use appropriate LN5 (DIN88) or alternative metal fastening brackets for mounting. Note: battery hold-down mounting brackets are not provided with the LiFePO4 battery.

4.4 Connection Cables (+ and -)

Use appropriate wire for the connection wires to ensure no overheating or unnecessary losses occur. Use appropriate fuses matching the wires and load.

4.5 Connecting a Charger to the LiFePO4 Battery

Attention

Warning! Ensure you have completed all the previous steps described in chapter 4 before connecting the battery to the charger.

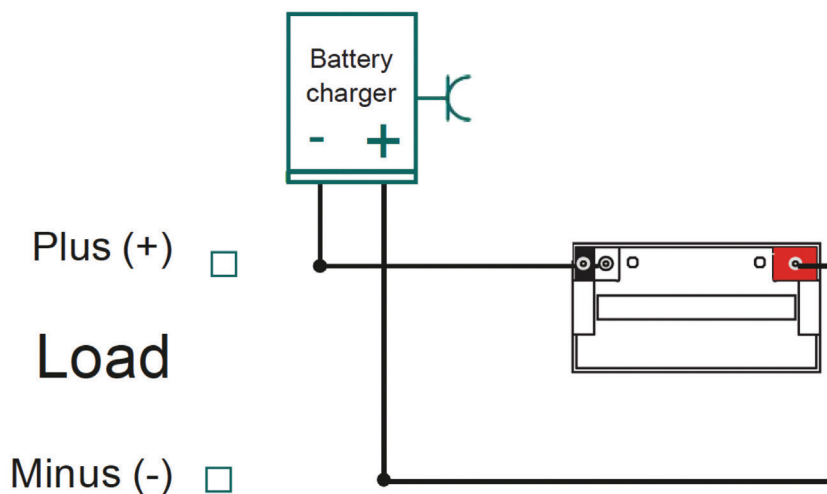


Figure 1. Connecting a charger to the battery

4.6 Connecting Batteries in Parallel to a Charger Device

The max. number of batteries in parallel is 20pcs and the max. number of batteries in series is 4pcs. To divide the current equally amongst batteries, use the schematic bellow:

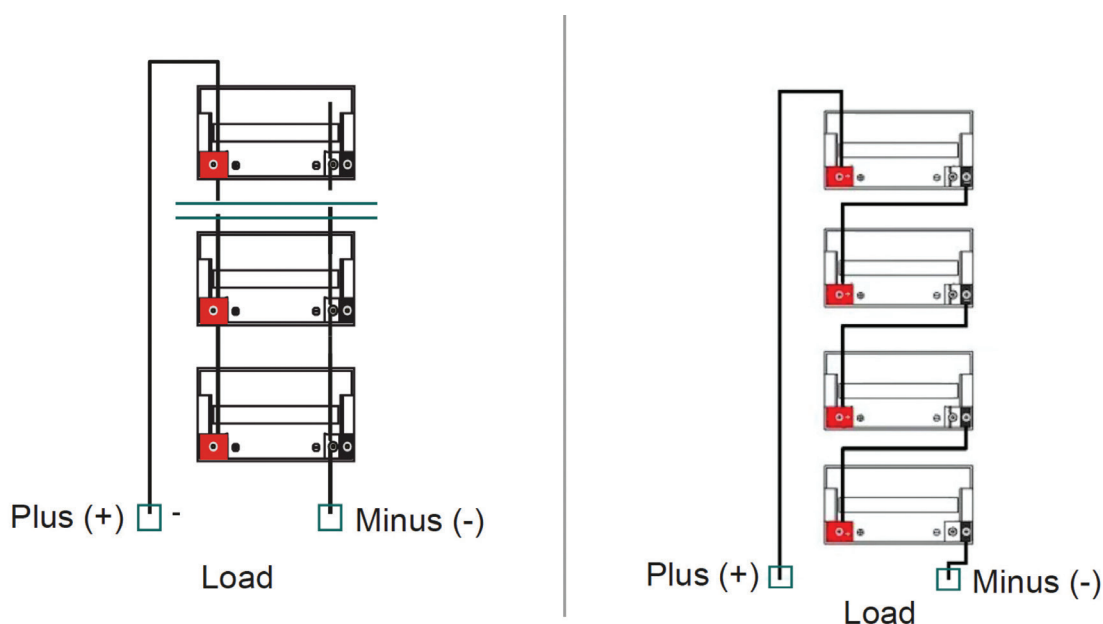


Figure 2. Connecting batteries in parallel or in series



OK: Equally divided battery current. All batteries contribute equally to the current into the load.

NOT OK: Current not equally divided.

Batteries closest to load will have the highest contribution to the current into the load. Whereas batteries further away from load will have lesser current contribution.

Wear and tear will be higher on batteries closest to the load.

4.7 DC Load Connected - Discharge Protection

HULK Professional LiFePO4 batteries are as standard equipped with a DC switch-off device which is integrated inside the battery, which is activated at 80% discharge.

However, we recommend to install a bi-stable latch relay which should be installed between the battery and the entire DC load (or inverter) as an extra security. Ask your dealer or supplier for the right device.

4.8 Parallel Battery Use

- 12V batteries can be connected in parallel up to 20 pcs
- 12V batteries can be connected in series up to 4 pcs

Attention

Caution! Please sort the voltage and internal resistance of the battery blocks before make the connection. To make sure the battery blocks for a battery pack have the same/similar parameters.

5. BATTERY USE

5.1 General Information

Attention

Warning! Follow the safety guidelines and measures of chapter 3.

5.1 Charging

Attention

- Warning!** Never charge the battery with a charging current larger than 1C.
- Warning!** Stop charging if the LiFePO4 battery switches into warning mode.
- Warning!** Never charge a battery with a charging current larger than 1C.
- Caution!** Charge before use.
- Caution!** Disconnect the charger from the LiFePO4 battery if it is not to be used for an extended period
- Caution!** To preserve the lifespan of LiFePO4 battery use a HULK Professional charger

1. Connect the charger to the battery as described in paragraph 4.6.
2. Charge the LiFePO4 battery in case of an empty shutdown or if the state of charge drops below 20% to preserve the lifespan of LiFePO4 battery.

5.3 Charging Rate

HULK Professional Lithium Iron Phosphate batteries can be charged in 1 hour. Displayed in the Table are thecharge times for a LiFePO4 battery at different charge currents. Always use the indicated charge current and end of charge voltage during charging.

CHARGING RATE		
Parameter	Time	Change current
Maximum	1 hour	1C (90A)
Endurance lifecycle	3 hours	C3 (30A)

Table 1. Charging rates at different charge currents

5.3.1 Charging Method

We recommend using the following charging method.

A. Constant voltage, constant current, 14.6V +/- 0.2V for a 12V battery, 29.2V +/- 0.2V for a 24V battery.

B. Multiple or three-stage charging, see graphic at right, is allowed.

We recommend using HULK Professional battery chargers with settings at “Lithium-mode” for best result.

Bulk phase

In this phase the batteries are charged with a constant current up to the end of charge voltage (UBulk), If UBulk is reached the charger will automatically switch to absorption phase. The maximum charge current.

(Imax) for HULK Professional batteries is 1C, however for endurance cycle life we suggest to limit the current to C3 (1C = nominal battery capacity, C3 = 1/3 of nominal capacity). On some chargers the maximum charger active time (t0) can be programmed. We suggest setting t0 to: $t0 = 2 \cdot (BTcap / Chcur)$ Example: Battery capacity = 90Ah, Charger = 45A, Set to to a maximum of $2 \cdot (90/45) = 2$ hours.

BULK PHASE				
Parameter	Typical	Min	Max	Remark
Imax	-	-	-	1C (90A)
t0	Depends on the battery SoC	-	-	$2 \cdot (BTcap / Chcur)$

Table 2. Bulk Phase

Absorption phase

In this phase the charge voltage must be maintained at UAbsorption to fully charge the battery and set the SoC counter to 100%, see Table. This phase is finished when the SoC is indicating 100%.

ABSORPTION PHASE			
Parameter	Typical	Min	Max
UAbsorption	14,6V	14,2V	14,6V
t1	20 minutes	10 minutes	1 hour

Table 3. Absorption Phase

Float phase

In this phase the charge voltage is set to UFloat.

FLOAT PHASE			
Parameter	Typical	Min	Max
UFloat	13,8V	13,6V	14V

Table 4. Float Phase

DISCHARGE PHASE			
Parameter	Typical	Min	Max
UFloat	13,5V	13,4V	13.6V

Table 5. Maintenance phase

5.3.2. Battery Balancing

The BMS automatically balances the cells if necessary. Balancing can take place during charging and idle mode and will not have an effect on the functionality of the battery.

6. INSPECTION, CLEANING AND MAINTENANCE

6.1 General Information

Attention

Warning! Never attempt to open or dismantle a LiFePO₄ battery! The inside of a HULK Professional LiFePO₄ battery does not contain serviceable parts.

1. Disconnect the battery from all loads and charging devices before performing cleaning and maintenance activities (see paragraph 4.8).
2. Place the enclosed protective caps over the terminals before cleaning and maintenance activities to avoid the risk of contacting the terminals.

6.2 Inspection

1. Inspect for loose and/or damaged wiring and contacts, cracks, deformations, leakage or damage of any other kind. If damage to the battery is found, it must be replaced by a professional. Do not attempt to charge or use a damaged battery. Do not touch the liquid from a ruptured battery.
2. Regularly check the battery's state of charge. The battery will slowly self-discharge when not in use or whilst in storage. (see paragraph 5.3)
3. Consider replacing the battery with a new one if you note either of the following conditions: The battery run time drops below 80% of the original run time. The battery charge time increases significantly.

6.3 Cleaning

If necessary, clean the battery with a soft, dry cloth. Never use liquids, solvents, or abrasives to clean the battery.



7. STORAGE

Follow the storage instructions in this manual to optimize the lifespan of HULK Professional LiFePO4 battery during storage. If these instructions are not followed and the battery has no charge remaining when it is checked, consider it to be damaged. Do not attempt to recharge or use it.

Replace it with a new LiFePO4 battery.

See chapter 2.4 for storage temperature conditions.

The self-discharge of HULK Professional LiFePO4 battery is 1-2% per month.

Attention

Warning

1. Charge the LiFePO4 battery to > 80% of its capacity before storage.
2. Disconnect the LiFePO4 battery from all loads and, if present, the charging device.
3. Place the terminal covers over battery's terminals during storage.
4. Charge the LiFePO4 battery to > 80% of its capacity every 100 days. After charging set the LiFePO4 battery in storage mode again.

8. DISPOSAL AND RECYCLING

8.1 General Information

Always discharge a LiFePO4 battery before disposal. Use electrical tape or other approved covering over the battery connection points to prevent short circuits.

Battery recycling is encouraged. Dispose of the battery in accordance with local, state and federal laws and regulations. Batteries may be returned to the seller.

9. WARRANTY AND LIABILITY

- 9.1 Upon delivery, the customer is obliged to immediately verify whether the products have been damaged during transport. The customer must notify the dealer of such transport damage as soon as possible, in any event no later than within three (3) days of delivery, by means of an accurate, written statement, stating the damage and where possible a photograph. Failure to inspect the products and inform the dealer within the stated time or the use of the products at any time shall be conclusive evidence that HULK Professional has satisfactorily tendered delivery.
- 9.2 In the event that the customer demonstrates that any of the delivered products do not conform to the agreement, HULK Professional (at its option, upon having received those products returned by the customer) has the option to either repair or replace such products by new products, or to refund the invoice value, exclusive of any dispatch costs.
- 9.3 HULK Professional grants a 5 years limited warranty (PRO-RATA) for damages caused by manufacturing defects starting at the time of delivery. Damages caused by manufacturing defects do not include damage resulting from (a) general wear and tear, (b) short circuit, (c) overcharging, (d) deep discharging, (e) overheating of the products (f) installation of the product by persons unskilled to work with electro-technical devices or components, (g) any other wrongful use contrary to the HULK Professional user manual or the safety instruction, (h) any use contrary to the product specifications of that product; (i) any acts of force majeure.
- 9.4 Except as specified in the clause 9.3 HULK Professional makes no warranty, whether express or implied, including without limitation any implied warranty of merchantability and fitness for a particular purpose or any warranty arising from any course of dealing, course of performance or usage of trade and specifically disclaims any representation or warranty that the product will meet customer's requirements, perform any specific function or achieve a desired result other than expressly stated by HULK Professional in writing.
- 9.5 Any liability to the customer in any case ceases to apply in the event that the customer fails to notify HULK Professional of the existence of the defect within ten (10) days of having discovered the defect, in writing, in order to enable HULK Professional to investigate the damage.
- 9.6 Any liability of HULK Professional for damage suffered by the customer is in any case limited to the invoice amount of the relevant products, unless such damage has been caused by gross negligence or willful misconduct of HULK Professional.
- HULK Professional can never be held liable for (a) damage caused by any of the circumstances mentioned in clause 9.3, leading to damage to the HULK Professional products or to any other device located near those products, or (b) consequential damage or (c) loss of profits or goodwill.
- 9.7 To the extent that a court determines that the limitation of liability as meant in clause 9.6 cannot be invoked against a particular claim for damages by the customer, HULK Professional's liability for loss of property, damage to property, and bodily injury (including death) caused by the application of those particular HULK Professional products shall in any event be limited to the amount actually paid out by HULK Professional's insurance company to HULK Professional in accordance with the insurance cover of that insurance policy for that particular type of damage. HULK Professional has taken out insurance against certain risks, as described in the respective insurance policies. These policies contain a usual limitation of insurance payment to be paid out to HULK Professional if, and to the extent that, the event is a covered event.



Automotive Imports Pty Ltd
22 - 28 Lexton Road
Box Hill, Victoria,
Australia

hulk4x4.com.au | hulk4x4.co.nz