



Interfacing Tutorial

Freedom Lite and Axpert/Kodak King

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1. Introduction

This manual is intended to guide an installer on the installation and commissioning of the range of 52V **Freedom Lite** lithium iron phosphate (LiFePO4) energy storage models along with a **Voltronic Axpert** (also branded **Kodak**) **King** inverter.

The interface compatibility between the Lite and the Axpert King relies on a Freedom Won supplied CAN Bus to RS485 converter. Other models from Voltronic that employ the same lithium battery interface as the Axpert King may also be compatible through the use of this converter.

This document is not intended to provide the complete installation and commissioning details and must be complemented by both the Freedom Lite installation manual and the Axpert/Kodak installation and user manual.

2. CAN Bus to RS485 Converter

The Freedom Lite Battery Management System (BMS) employs a digital language called **CAN Bus** to interface with other Lite's and inverters, or system controllers. The Voltronic Axpert/Kodak King can only receive an interface in a different digital language, called **RS485**. Freedom Won has therefore developed a converter that converts the Lite CAN Bus messages into the RS485 language and format that is required by the Axpert.

The interface using this converter provides an excellent energy storage system solution because the Axpert can operate in harmony with the Lite. The Axpert receives the battery charge and discharge limits, temperature, state of charge, and other data. Freedom Won has extensively tested the Axpert/Kodak King with a Freedom Lite with positive results.

The converter is fitted into a plastic enclosure with three leads coming out of it:

1. USB Cable with power socket – for the converter power supply and updating of software (note that the converter is shipped with the correct software for the Axpert and no programming is required by the installer).
2. CAN Bus connector – this is a female RJ45 plug and is labelled as the CAN Bus Freedom Lite battery connection lead
3. RS485 Connector – this is a female RJ45 plug and is labelled as the RS485 Axpert/Kodak connection lead

Refer to Figure 2.1 below for an image of the converter. The converter can be mounted in any orientation, but preferably vertically on a wall. The lid of the converter may be removed temporarily for the purpose of mounting onto a wall using screws through the back side of the enclosure. Be careful not to damage the PC board inside while the lid is off. The converter must be located indoors away from the elements and must not be placed near a heat source.

Fig 2.1 CAN Bus to RS485 Converter Image



3. Cable Connections for Freedom Lite to Axpert/Kodak Communication Interface

The connection of the CAN Bus to RS485 converter to the Freedom Lite and the Axpert/Kodak is extremely simple. After the battery, inverter and converter have all been mounted follow the following steps:

- Connect a standard ethernet (LAN) cable with standard straight through pin configuration RJ45 plugs from a CAN Bus port (see figure 3.1 below) on the Lite to the female RJ45 plug on the converter labelled "CAN Bus".

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- Plug a termination resistor into the second port of the Lite or into the last open port on the last Lite in the row if multiple Lite's are installed. Note that only the termination resistor supplied with the Lite must be used. The converter board already includes a termination resistor on it, so only this one resistor on the Lite needs to be added.
- Connect another standard ethernet cable from the female RJ45 plug on the converter labelled "RS485 Axpert/King" to the RJ45 port on the Axpert labelled for Li-ion as per figure 3.2 below.
- Plug in the USB power supply adapter to a 230V AC power socket that is **supplied directly from the AC output of the Axpert**. It is important to supply the USB power supply from the AC output of the Axpert instead of the from the grid, because a grid outage will result in the converter losing power and ceasing to operate.

Fig 3.1 CAN Bus Port on Lite with Termination Resistor Shown in Second Port



Fig 3.2 Axpert Port for RS485 Cable Coming from the Converter RS485 Output Lead.



4. Setting up the Axpert/Kodak Inverter for operation with the Freedom Lite battery

The Axpert/Kodak inverter is quite simple to set up for operation with the Freedom Lite 52V batteries.

Once the Lite DC power cables have been connected to the positive and negative terminals of the Axpert, the AC cables connected to the input and output terminals of the Axpert, and the converter wiring has been completed as per Section 3 above, you are ready to power up the system and enter the required settings. Follow the following steps:

1. Check that the AC in and out breakers are switched off,
2. Check that the circuit to the dedicated AC socket for the converter is switched on,
3. Press the ON Button on the front of the Lite until the Lite display lights up,
4. Switch on the Lite breaker (note it may be necessary to press the lever down to reset the breaker internal mechanism before you lift the lever to the top position for switching it on). Pre-charging the DC bus with the Axpert inverter is not necessary like on many other inverters because the inrush current on the Axpert is relatively low,
5. The Axpert screen will light up and 230V will be placed onto the “AC out” of the inverter. This 230V will power up the CAN Bus to RS485 converter,

6. Enter the Axpert settings menu on the LCD (see Axpert manual for details on this procedure) and set up as follows (note that only the settings relevant to the Lite interface are provided here, make sure that you also set all other settings that are relevant to your system as per your requirements)
 - a. Move to parameter Number 5 (battery type) and select “Lib” (short for Lithium Battery). Note – if “Lib” is not shown as an option you need to update the Axpert firmware to the latest version. Ask your Axpert/Kodak for assistance with this firmware update if needed.
 - b. Parameter 12 – this is the voltage at which the Axpert will revert during a discharge cycle to using the grid instead of the battery in certain modes. Unfortunately using voltage is not ideal but at this point the Axpert does not have a State of Charge (SoC) percentage parameter for this function, so we need to use voltage. To revert to using grid to reserve the battery SoC to around 30%, set this value to 51V. To revert to grid only at around 20% set this value to 50.5V. Higher and lower settings are acceptable, but Freedom Won recommends not setting higher than 51.5V or lower than 50V.
 - c. Parameter 13 – The Axpert will in certain modes switch to battery consumption again after being in a grid consumption phase upon the battery reaching the voltage set in this parameter. Again, using SoC is more accurate, but for now we only have voltage as an option. Freedom Won recommends 53.5V as the ideal level, which is close to 80% SoC. The lowest recommended level is 53V (about 60% SoC) and the highest is 54V (about 90% SoC).
 - d. Parameter 29 – Set to 48V. This is the lowest ideal voltage level for the Freedom Lite and equates to about 10% SoC.

Once you have entered all the other settings according to your requirements return to the home page on the Axpert screen. The battery icon should now be flashing and there should be no fault (red LED) showing. This means that the Axpert is communicating with the Lite. After switching on the Axpert with the “Lib” setting already entered, the Axpert will take about 30 seconds to recognise the Lite – also indicated by the flashing battery icon.

The SoC of the battery is not represented by the Axpert as an actual percentage but instead as four blocks each representing 25%. The highest indicated block will flash when the battery is charging. For further details refer to the Axpert/Kodak manual.

Fig 4.1 Home Screen of Axpert showing the battery icon (flashing when communication is normal) and the SoC bar reflecting 25% increments of the battery SoC)



5. Control of Battery Parameters

Since the Lite can transmit its parameters to the Axpert, the Lite is in turn able to set the limit for charge to a defined amperage level as required at the time. The Axpert will also respond to a command from the Lite to stop discharging should the Lite find this to be necessary. Should the charge current limit and/or the discharge current limit be set to zero by the Lite, the Axpert will show information code “60”. This is not something to be concerned about because when the limit is restored to an operational level again this code will disappear, and the system will continue operating normally.

6. Troubleshooting Guide

Most issues with can be resolved using the guide below. If a problem cannot be resolved after referencing this table, please contact Freedom Won or your approved Freedom Won supplier.

Table 14.1 Troubleshooting Guide

No	Problem Description	Cause/Solution
1	Axpert does not detect Lite	<ol style="list-style-type: none"> 1. Check that the CAN Bus to RS485 Converter has power – this can be verified by removing the lid and checking that there are LED’s illuminated on the Converter’s PC board. 2. Check that you have connected the CAN Bus cable from the Lite to the CAN Bus cable on the Converter and not to the RS485 cable on the Converter 3. Confirm that you have used standard cables and that they have no faults i.e. poorly fitted plugs 4. Confirm that parameter 5 is selected as “Lib” on the Axpert 5. Confirm that you have the termination resistor plugged into the second CAN Bus port on the Lite 6. Confirm that you have plugged the RS485 plug into the correct “Li-ion” port on the Axpert King 7. Check that the Axpert has the latest firmware
2	Lite reverts to grid too early or at a higher than desired SoC	Reduce slightly the voltage value in Parameter 12. If you want to revert to grid earlier i.e. at a higher SoC, increase the voltage value in Parameter 12
3	Lite SoC climbs too high before the Axpert will begin discharging the Lite again	Reduce the voltage value in Parameter 13. Conversely, if the Axpert begins discharging to the Lite too soon, increase the voltage in Parameter 13.
4	Axpert cuts out completely when off grid when the Lite SoC is still too high (above 10%)	Reduce the voltage value in Parameter 29 to 47V from the standard 48V.