PAGlink™

PAG™

V-Mount Intelligent Linking Batteries

User Guide

U5132V

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Contents

PAGlink™

Thank you for choosing PAGlink V-Mount Intelligent Linking Batteries. Please read the important safety information and instructions before using your battery.

1. Introduction

1.1 Models covered by these instructions:

PAGlink V-Mount
PAGlink V-Mount batteries are designed for compatibility with the Sony V-Mount specification. There is a choice between 96Wh and 150Wh capacities, and a choice between a 5-light and a numeric Run-Time & Capacity Display.

Model	Name	Capacity	Display
9303	PAGlink PL96e	96Wh	5-Light
9304	PAGlink PL96T	96Wh	Numeric
9308	PAGlink PL150e	150Wh	5-Light
9309	PAGlink PL150T	150Wh	Numeric

1.2 The unique PAGlink system allows up to 8 batteries to be linked for charge or discharge, regardless of their rated capacity or their state-of-charge.

1.3 When linked, PAGlink batteries form a network that allows them to communicate with each other and report to the camera as one battery.

1.4 The PAGlink system will automatically select the most suitable batteries for discharge, according to their charge status. Batteries do not discharge into each other. The system ensures that the maximum linked output is kept to a safe level.

1.5 PAGlink batteries can deliver a current of up to 12A when linked, using superior, high-current pin contacts.

1.6 PAGlink batteries can be hot-swapped to deliver continuous power, which means no more time-wasting camera reboots.

1.7 All PAGlink batteries feature a display that provides remaining run-time for the total of all linked batteries, and remaining capacity for each individual battery.

1.8 The battery display maintains accuracy by tracking performance and adjusting calibration values to compensate for the ageing of the cells.

1.9 PAGlink batteries will automatically detect and adapt to a multitude of camera data systems to provide capacity information in the camera viewfinder/LCD.

1.10 Batteries in any state of charge, regardless of capacity, can be linked for charging, in multiples of 8 or less. During charging, the least-charged batteries are given priority. The charge status for each battery is shown on its own display.

1.11 The intelligent PAGlink batteries manage their own charging safely and efficiently, and can be charged whilst linked using other reputable manufacturer's Li-Ion chargers.

1.12 Power from the battery linking contacts can be accessed using the PAGlink PowerHub, an accessory power plate which provides multiple D-Tap ouputs, (interchangeable with Hirose, Lemo and 2.1mm connectors) and a USB output.

1.13 PAGlink battery and charger firmware can be updated easily by the customer, via external contacts, using an update tool provided by PAG.

1.14 PAGlink Li-Ion batteries are tested by an independent authority to UN standards in compliance with IATA Air Transport regulations.

Micro Charger - World's smallest V-Mount multi-battery charger

PowerHub - Provides outputs to power camera accessories

PL16 Charger - 16 batteries charged simultaneously

2. Specification

2.1 Cell Technology: Premium-grade Lithium-Ion sealed rechargeable cylindrical cells.

2.2 Capacities:

Models 9303 & 9304:
Nominal 6.5 Ampere-hours (96 Watt-hours).

Models 9308 & 9309:
Nominal 10 Ampere-hours (150 Watt-hours).

2.3 Voltage: 14.8V nominal. 12 cells connected in series/parallel. Each cell has a nominal voltage of 3.7V.

2.4 Output Current: The rated maximum continuous output current for two or more linked batteries is 12 Amperes (8 Amperes for individual batteries).

2.5 Temperature Range:

Charging:

0°C to +45°C	Optimum +10 to +40°C
+32°F to +113°F	Optimum +50°F to +104°F

Discharging:

-20°C to +50°C	Optimum +10°C to +40°C
-4°F to +122°F	Optimum +50°F to +104°F

Storage:

-10°C to +40°C	Optimum 0°C to +20°C
+14°F to +104°F	Optimum +32°F to +68°F

2.6 Dimensions (L x W x H):
133mm (5.2") x 84mm (3.3") x 50mm (1.9")

2.7 Weight:

Models 9303 & 9304:	726g (1.6lbs) approx.
Models 9308 & 9309:	770g (1.7lbs) approx.

3. Charging

3.1 IMPORTANT: READ THE CHARGER HANDBOOK BEFORE ATTEMPTING TO CHARGE THE BATTERY.

3.2 The following PAGlink chargers will charge PAGlink V-Mount batteries, individually or linked, regardless of their capacity or state of charge:

9707	PAGlink PL16 Charger	2-positions, 8 batteries on each
9711	PAGlink PL16+ Charger	4-positions, 4 batteries on each
9708	PAGlink Cube Charger	4-positions, 4 batteries on each
9710	PAGlink Micro Charger	1-position, 4 batteries in total
9713V	PAGlink Micro Charger	1-position, 4 batteries in total

The following chargers will charge PAGlink V-Mount batteries individually or linked (batteries must be within 40% state-of-charge of each other to be charged fully):

9702V	PAG Cube Charger	4 positions, 4 batteries on each
9702VR	PAG RMC4X Charger	4 positions, 4 batteries on each

Constant-voltage V-Mount Li-Ion chargers of other reputable manufacturers are also suitable.

3.3 The batteries incorporate a temperature sensor which will inhibit charging if their temperature is below 0°C. See Section 2 Specification for the charging temperature range of PAGlink batteries.

3.4 **Charge Times:** Times given are for fully-discharged batteries to fully-charged, using a PAGlink PL16 charger.

1 x 96Wh battery	2 hrs 30 mins
2 x 96Wh batteries	3 hrs
4 x 96Wh batteries	6 hrs
6 x 96Wh batteries	9 hrs 30 mins
8 x 96Wh batteries	11 hrs 45 mins
16 x 96Wh batteries	24 hrs

1 x 150Wh battery	3 hrs 45 mins
2 x 150Wh batteries	4 hrs 30 mins
4 x 150Wh batteries	9 hrs
6 x 150Wh batteries	13 hrs
8 x 150Wh batteries	18 hrs
16 x 150Wh batteries	36 hrs

3.5 PAGlink batteries display their individual status, during charging, on their built-in display. When using PL16 chargers, the characters of the numeric display can be inverted, for legibility, with a single button press. The display reverts automatically after removal from the charger.

4. Discharging

4.1 The batteries incorporate a precision fixed end-of-discharge cutoff set to 12.5V, as measured by the battery. This cutoff will only operate if the battery capacity is less than 5%, eliminating unwanted operation due to high current and low battery temperature.

4.2 The maximum continuous discharge current for a single PAGlink V-Mount battery is 8A. The batteries incorporate a current limit, and consumption above this for more than 5 seconds will trigger the over-current protection, turning the battery output off.

4.3 If the battery is discharged at too high a rate, even momentarily, the protection circuit may be triggered, disconnecting the battery output. It can be recovered by simply removing it from the load and pressing the display button, provided the battery still retains some charge.

4.4 Where total continuous consumption is above 8A, two or more PAGlink batteries should be linked. This will increase the maximum continuous discharge current to 12A, provided the batteries are in a similar state of charge.

4.5 The battery may be discharged within the temperature range -20°C to +50°C, but for optimum performance, +10°C to +40°C is recommended. The operating time will be shorter in conditions of low temperature, and discharging will be electronically inhibited if the battery temperature is below -20°C.

4.6 When the battery has been discharged at a high rate it will become warm, and it is advisable to let it cool before charging it.

4.7 Computer Reset
The battery features a computer reset function. In exceptional circumstances, a computer reset may be required. This is achieved by holding the display button in for 20 seconds.

5. Storage

5.1 PAGlink batteries can be left stacked on a charger until required; the charger will keep them topped-up ready for use.

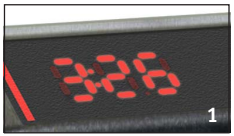
5.2 For long-term storage, batteries should be in a half-charged state, and unlinked. Storing batteries linked accelerates the rate at which they self-discharge.

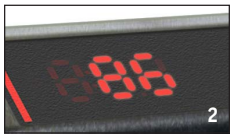
5.3 Batteries should be stored in a cool, dry place at a temperature between 0°C and +20°C. Long-term storage outside of this temperature range may reduce the battery's life. Maintenance charging is not required during long term storage.

5.4 After storage it is advisable to fully-charge batteries before use.

6. Run-Time & Capacity Information

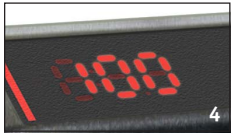
6.1 The Numeric Display:
The battery is able to display a numeric run-time prediction against load, and charge status as a percentage.





(1) When connected to a camera that is turned on, two presses of the battery's display button will show a predicted run-time against the given load, expressed in hours and minutes. When batteries are linked the run-time displayed relates to the **total** for the connected batteries. The battery requires up to 5 seconds before it is able to give an accurate run-time prediction.

(2) A single button press of the display, whether the battery is off or on-load, shows a percentage figure of available capacity. When the batteries are linked this figure still relates to the battery's individual capacity.



(3) When battery capacity drops below 5% the display will indicate that the battery should be charged as above.

(4) When the battery is fully charged the display will indicate 100%.

6.2 The 5-Light Display:
The battery is able to indicate a run-time prediction, against load, and charge status as a percentage.

(5) When connected to a camera that is turned on, two presses of the battery's display button activates the time display. The 'HRS' LED will flash twice.

(6) The number of hours will then be indicated by the number of lit segments: each light = 1 hour.

(7) The 'MINS' light will then flash twice.

(8) The number of minutes will be indicated by the number of lit segments: each light = 10 mins. When batteries are linked the run-time displayed relates to the **total** for the connected batteries.

6. Run-Time & Capacity Information

(9) A single button-press, whether the battery is on or off-load, displays charge status in terms of percentage. When batteries are linked this figure still relates to the battery's individual capacity. The lights indicate remaining capacity in percentage blocks:

	80 - 100% remaining
	60 - 79% remaining
	40 - 59% remaining
	20 - 39% remaining
	10 - 19% remaining
	1 Flashing = 0 - 10% remaining

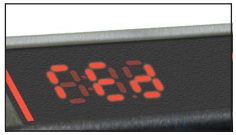
6.3 In-Viewfinder Battery Status

Battery status can be shown as a percentage of available capacity in the viewfinder/LCD of cameras designed to accept this data. Different data standards are used by camera and battery manufacturers. PAGlink V-Mount batteries automatically adjust the data output standard to support SMB (Sony) and I²C (IDX).

When the batteries are linked, the data displayed in the viewfinder/LCD is for the combined capacity available.

Red Cameras and Reversed SMB

PAGlink V-Mount batteries can be programmed easily by the user to provide capacity data in the viewfinder of Red cameras that use the reversed SMB data protocol.



Press the display button twice, and hold down on the second press until 'RED' appears (on the numeric display) or until the top 2 segments are lit (5-light indicator). This indicates that the battery is now compatible with the reversed SMB data protocol. When the battery is connected to a camera with a different data protocol it will automatically adjust to communicate with that system. To return to reversed SMB, repeat the two-button-press process.

6. Run-Time & Capacity Information

6.4 PAG Numeric Display Data Output

Data stored in the battery's microprocessor can be revealed using the battery display by following this procedure:

1. Press the display button 3 times (in 1 second intervals) and hold down on the 3rd press.
2. After 5 seconds all segments of the display will be lit.
3. Release the display button and the 1st menu option will appear.
4. Press the button again to move on to the other menu items.
5. When the desired menu item is displayed, press and hold in the button. The display will then show the data for that item.

The menu items are indicated as follows:

1. Battery voltage (Pd stands for potential difference).

2. Temperature in degrees Celsius.

3. No. of charge/discharge cycles.

4. Battery firmware version.

5. Battery reset.
If you press and hold the display button when Battery Reset has been selected, it will perform a computer reset on the battery.

6.5 PAGlink Battery Reader

The PAGlink Battery Reader is an accessory that can be used to display data stored in the battery's microprocessor. When connected to the battery contacts it will provide information that is beneficial for managing your batteries, such as: number of cycles, date of manufacture and software version.

7. Battery Protection Features

7.1 Over-charge Protection
Charging will be inhibited if the battery voltage exceeds a pre-set level.

7.2 Over-discharge Protection
When the battery voltage reaches 12.5V, discharging is inhibited.

7.3 Over-current Protection
If a single battery is subjected to a current greater than 8A, but less than 15A, the output will be turned off after 5 seconds. If the current is greater than 15A, the output will be turned off immediately. In either case, the battery display will be inoperative and there will be no voltage available at the terminals. The battery can be reset by removing it from the load and pressing the display button.

7.4 Thermal Protection
Software protection inhibits charging if the battery temperature is below 0°C. Return the battery to the charger when the battery temperature rises above 0°C.

Software protection inhibits discharging if the battery temperature falls to -20°C, or if it rises to +70°C. The output can be restored when the battery temperature becomes within the specified range by pressing the display button.

A thermal fuse is incorporated within the battery construction as a 'backstop' protection device, and this cannot be reset. In the unlikely event of this fuse operating, please contact PAG or your dealer.

7.5 Construction
The battery cases consist of high-impact, polycarbonate injection mouldings, designed to protect the cells from impact damage. The circuits are conformally-coated, making them resistant to electrolyte and ensuring the operation of the safety systems in the event of damage to the battery.

Internal wiring is rated for high current and high temperature, and is double-insulated for added safety and protection.

8. PAGlink Features

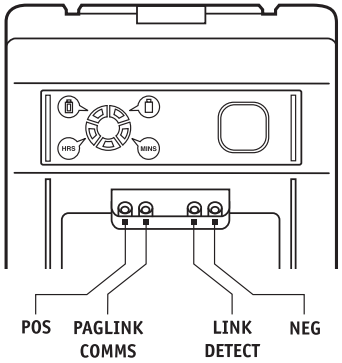
8.1 Linking Batteries:

Align the V-Mount connectors and push the battery down until you hear a click, indicating that the lock is engaged.

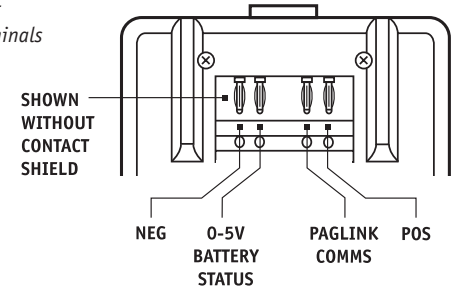
To release the battery, hold down the release button (1) and slide the battery up (2).

PAGlink V-Mount Terminals:

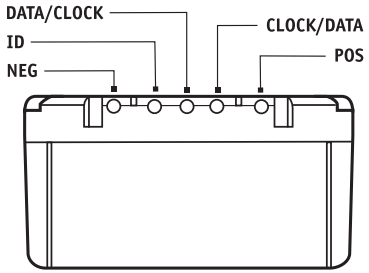
Front Terminals



Rear Terminals



Base Terminals



8.2 PAGlink batteries can be linked to combine their capacities, for example, two 96Wh batteries provide 192Wh, and 3 offer 288Wh. Two 150Wh batteries offer 300Wh when linked. Batteries of any rated capacity, in any state of charge, can be linked for charge or discharge. Linking batteries also increases the maximum continuous current draw capability from 8A to 12A, provided they are in a similar state of charge.

The maximum number of PAGlink batteries that may be linked has been limited to 8. If more than 8 batteries are linked, the management system will shut-down the supply, and no current will flow.

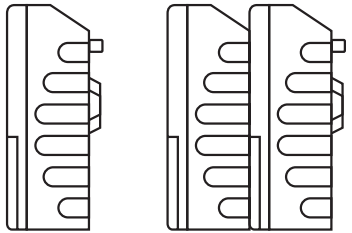
8. PAGlink Features

Linked batteries form a network which allows communication between batteries, ensuring that a safe protocol is followed under all circumstances. The PAGlink management system elects the battery with one or more connected to its front contacts to be the ‘master’ and ensures that this battery is always active (but not necessarily delivering current). The system makes the most efficient use of the energy available, and prevents a transfer of charge between batteries.

As discharge progresses, batteries are electronically added to or subtracted from the bus bar to deliver the current required. The status of individual batteries and total run-time can be viewed via the battery displays. As long as the ‘master’ remains connected, batteries may be added to or removed from the stack (hot-swapped) in order to achieve continuous running.

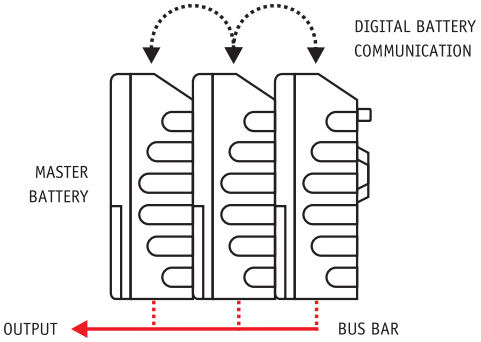
NOTE: When not in use, batteries should be kept in an unlinked state to ensure a lower self-discharge rate.

CAPACITY IN WATT-HOURS / MAX. CURRENT-DRAW IN AMPS



96Wh / 8A
150Wh / 8A

192Wh / 12A
300Wh / 12A



9. Safety & Disposal

9.1 When used correctly, Lithium-Ion batteries are a rugged, safe, clean and trouble-free method of storing power. However, the user should be aware that incorrect treatment could present a hazard. In the interest of safety, and the protection of our environment, please read and observe the following health and safety information.

9.2 GENERAL:
Do not drop, puncture or crush the battery. Do not short-circuit the battery. Do not attempt to use the battery if it has been submerged in water. Do not continue to use the battery if there is any change in the appearance of the casing. Do not open the battery case.

9.3 CORROSIVE ELECTROLYTE:
The electrolyte is an alkaline solution, which can cause chemical burns to human tissue if leakage occurs. Wear protective gloves when handling all contaminated materials. In the event of contact with the skin, flood copiously with clean water. If significant amounts of electrolyte are involved, or if any has touched the eyes, seek immediate medical attention.

9.4 SEVERE DAMAGE:
PAGlink batteries incorporate several levels of internal electrical protection, but severe mechanical abuse could result in damage to the cells, and short-circuit internal to the battery. Li-Ion cells can deliver power at very high rates. Arcing, excessive heat and the liberation of combustible gas could result, with the potential for personal injury or ignition of adjacent flammable materials.

9.5 SERVICING:
The battery case is sealed to maintain the integrity of the UN tested build standard. Customers should not attempt to open the battery case for repair or any other purpose.

The PAGlink V-Mount rear latching mechanism is external to the sealed battery case and can be replaced by the user in the event of damage. Parts and instructions can be obtained from PAG or your PAG dealer.

For any other servicing requirement please contact your nearest authorised PAG service centre:
PAG America: T: 631 300 8215 E: sales@pagamerica.com
PAG UK: T: 020 8543 3131 E: support@paguk.com
If you are located outside the US and the UK please visit **www.paguk.com/agents** to discover your nearest point of contact.
Please do not attempt to return Li-Ion batteries without first contacting a PAG service centre.

9.6 DISPOSAL:
Do not mutilate or incinerate batteries as the cells may burst and release toxic material. Do not dispose of batteries or cells in a charged condition. Expired batteries should be disposed of in accordance with the appropriate regulations or legislation.

PAG offers a recycling service for its expired batteries. They can be returned to PAG Ltd. only by prior arrangement. They must be in a discharged state, and clearly marked "FOR RECYCLING".

10. Guarantee

10.1 Notwithstanding any provision of any agreement the following guarantee is exclusive: PAG Limited guarantees each PAGlink battery it manufactures to be free of defects in material and workmanship, under normal use and service, from the date of purchase, for the period indicated below:

PL96 Models 9303 & 9304

PL150 Models 9308 & 9309

This guarantee extends only to the original purchaser. This guarantee shall not apply to fuses or any product or parts which have been subject to misuse, neglect, accident or abnormal conditions of operation.

In the event of failure of a product covered by this guarantee, PAG Limited will repair and calibrate equipment returned to an authorised Service Facility within the period of the guarantee, provided the guarantor's examination discloses to its satisfaction the product was defective.

The guarantor may, at its option, replace the product in lieu of repair. With regard to any equipment returned within this period, said repairs or replacements will be made without charge. If the failure has been caused by misuse, neglect, accident or abnormal conditions of operation, repairs will be billed at a nominal cost. In such a case, an estimate will be submitted before work is started, if requested.

The foregoing guarantee is in lieu of all other guarantees, express or implied, including but not limited to any implied guarantee or merchantability, fitness or adequacy for any particular purpose or use. PAG Limited shall not be liable for any special, incidental, or consequential damages, whether in contract, tort, or otherwise.

11. Air Transport Regulations

11.1 All PAG Li-Ion batteries comply with the International Air Transport Association (IATA) Dangerous Goods Regulations, January 2017, Section 2.3.5.9, which state that Li-Ion batteries must be independently tested in accordance with the UN Manual of Tests and Criteria, Part III, subsection 38.3, and manufactured by a company that has a quality control programme such as ISO 9001:2008 (which PAG is accredited).

PAGlink V-Mount Li-Ion batteries have been independently tested and certified by Intertek Group PLC to comply with UN Standard 38.3. in accordance with the IATA DGR.

Each PAG Li-Ion battery is labelled with the test report number applicable to that battery design.

Models 9303 & 9304: **Test Report No. 11054580**
Models 9308 & 9309: **Test Report No. 102617072**

Copies of the test certificates and reports for each battery type can be obtained from PAG.

11.2 Advice for Travelling by Air with Li-Ion batteries

Li-Ion batteries cannot be transported in the hold of passenger aircraft unless attached to equipment. Spare Li-Ion batteries must be carried in your hand luggage.

You are allowed to carry-on an unspecified quantity of UN tested Li-Ion batteries that have capacities of **100Wh or less** (as the operator and state variations allow). In addition, you can fly with two Li-Ion batteries that have capacities **greater than 100Wh, but less than 160Wh.**

It is advisable to keep the batteries in separate plastic bags, and you should bring a copy of the manufacturer's UN test certificate and report.

You cannot fly with Li-Ion batteries that have capacities **greater than 160Wh.** These are forbidden from passenger aircraft, unless a state exemption has been obtained (ie CAA/FAA operator).

Since the interpretation and application of regulations may vary with each aviation company PAG, advises that you contact the carrier prior to travelling.