



# Using KODAK VMIII, King and Max Off-Grid inverters with Pylontech and KODAK batteries



## INTRODUCTION

The KODAK off-grid inverter range, matched with Pylontech batteries or their own Force L1 and FL5.2 ranges, offer a compelling solution for reliably delivering energy to an off-grid or end-of-line supply, including during periods of load-shedding.

The inverter prioritises how it uses power from the different supply sources to maximise the use of solar generation and energy storage, all while ensuring seamless provision of power to important loads.

Energy produced by the PV system is used firstly to supply household loads; excess energy is used to charge the batteries. The inverter communicates with the battery BMS to determine accurately when to reduce the charge rate as the battery nears capacity or when to reduce the discharge rate as the battery nears empty. This is important to maximise the potential of the battery and prolong its life.

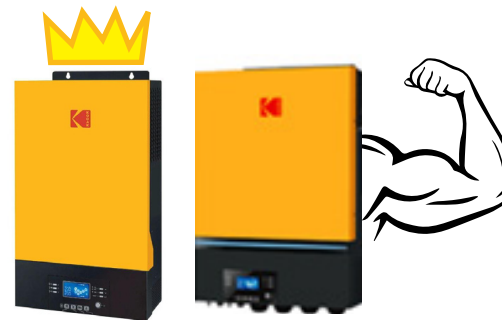
When the PV energy output is insufficient to support the loads, the system automatically uses stored energy from the batteries. If the battery capacity is also insufficient to meet consumption requirements, electricity will be drawn from the grid. In addition, the KODAK King inverter can combine energy sources to meet the load. For example, taking the available PV power and discharging the battery at the appropriate rate.

Load shedding is the radical practice of shutting off whole districts for several hours to reduce the peak load to within available capacity. It has been common in South Africa and lately in Zimbabwe. A correctly specified KODAK system will provide energy security to a home.

## THE KODAK OG INVERTER RANGE

KODAK has a range of off-grid inverters in stock at SegenSolar:

- [OG5.48](#) VMIII rated 5kW at 48V
- [OG3.24](#) VMIII rated 3kW at 24V
- [OG-PLUS5.48](#) King rated 5kW at 48V
- [OG-PLUS3.24](#) King rated 3kW at 24V
- [OGX5.48](#) MKSII rated 5kW at 48V
- [OG-7.2](#) Max rated at 7kW at 48V



The inverters are split into four models: the VMIII, the MKSII, the King and the Max. This document focusses on the VMIII, King and Max models because of their suitability for load-shedding systems. On the next pages, the main features of all four KODAK OG inverters are compared. All of them come with the SegenSolar Assured certification. After that, three example KODAK systems are shown, each perfectly suited to supplying power during load shedding. Choose which is the most appropriate for your customer based on their needs.



**KODAK Off-Grid Inverters**

[OG5.48](#) or [OG3.24](#)

[OGX5.48](#)

[OG-PLUS5.48](#) or [OG-PLUS3.24](#)

[OG-7.2](#)

**KODAK Partno**

Most simple and affordable of the KODAK off-grid inverter range with battery BMS communication.

Mid-range KODAK off-grid inverter that can be offered instead of the Axpert MKSII

Clever off-grid inverter that features UPS and permanent smooth 230V AC

Why parallel when you can power up to 7kW with a single inverter? Higher PV yield and boosted capacity.

Equivalent Voltronic Model

VMIII

MKSII

KING

MAX

**DC Operation**

MPPT Voltage Range

120-430V

120-430V

60-115V

90-450V

Max MPPT Voltage

500V

450V

145V

500

Max PV Module Power

5000W(@48V) 4000W(24V)

4500W

4000W(@48) 1500W(@24V)

8000W

**Battery**

Battery Voltage

48V or 24V

48V

48V or 24V

48V

Max Solar Charge Current

80A

80A

80A

80A

Max AC Charge Current

60A

80A

60A

80A

**AC Operation**

Parallel Operation

No, single unit only

Yes, up to 6 units

Yes, up to 6 units

Yes, up to 6 units

Direct Battery BMS Communication

Yes, connect directly to Pylon battery

No, add the [ICC](#) for detailed battery communication.

Yes, connect directly to Pylon battery

Yes, connect directly to Pylon battery

Transfer Time: Grid to Battery Mode

15-20ms

15-20ms




0-4ms. Best for vital loads: servers, ATMs etc

15-20ms

Special Feature

Produces permanent 230V AC, even when the grid is connected.

Features dual MPPT for superior PV yield and therefore more charging.

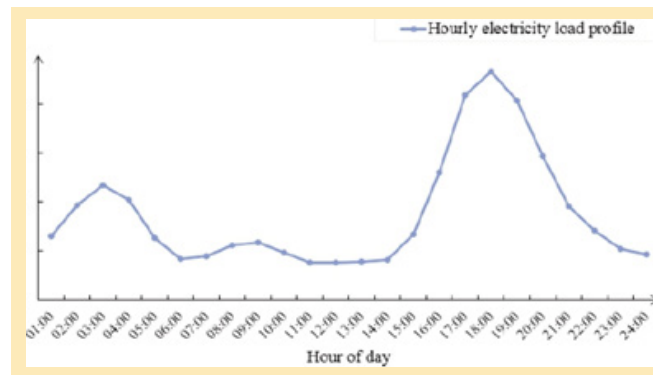
<b>KODAK Off-Grid Storage Systems</b>			
<b>KODAK System Partno</b>	<a href="#">OG5.48-FL5.2</a>	<a href="#">OG-PLUS5.48-L1-BATT-7.1</a>	<a href="#">OG-7.2-FL5.2-2</a>
Why install this storage system?	Simple and affordable system suitable for managing sudden loads of up to 5kW thanks to the 1C battery discharge rate.	Mid-range system with more storage capacity and useful features: UPS and permanent smooth 230V AC for keeping loads running reliably.	Premium load shedding system with high discharge power of up to 7kW. Max PV input of 8kW with dual MPPT helps improve battery SoC.
<b>PV Array Charging</b>			
MPPT Voltage Range	120-430V	60-115V	90-450V
Max MPPT Voltage	500V	145V	500V
Typical DC String Layout	2 Strings of 8 x 60 or 72 cell modules	4 Strings of 3 x 60 cell modules	2 Strings of 11 x 60 or 9 x 72 cell modules
Max PV module power	5000W	4000W	8000W
<b>Battery</b>			
Battery Capacity	5.1kWh	7.1kWh	10.2kWh
Battery Voltage	48V		
Max Solar Charge Current	80A	80A	80A
Max AC Charge Current	60A	60A	80A
<b>AC Operation</b>			
Max Sustained Load	5kW	5kW	7kW
Peak Load (3 secs)	10kW	5kW	15kW
Parallel Inverter Operation	No, single unit only	Yes, up to 6 units	Yes, up to 6 units
Direct Battery BMS Communication	Yes, connect directly to KODAK battery		
Transfer Time: Grid to battery mode	15-20ms	0-4ms. Suitable for important loads: servers, ATMs etc	15-20ms
Special Feature		Produces permanent 230V AC, even when the grid is connected.	Dual MPPT for superior PV generation and improved battery charging.

## SUCCESSFUL SYSTEM SIZING

### How much power should the system deliver?

A properly specified system will be able to discharge fast enough to power the specified household loads and have enough battery capacity to last long enough. Ultimately, the questions of "how much power" and "how long for" can only be answered by speaking to your customer and understanding what they want to achieve from their KODAK system.

A thorough understanding of how your customer typically uses energy in their home will enable you to plot how their power use varies during a typical day: a load profile. An example domestic curve is shown below. The base loads are represented by a straight line because they do not vary. Base loads are typically fridges, security or routers. Then, depending on the time of day, other loads might be added and result in a total power demand that's much higher than the baseline. If the grid is available any sudden peaks that are too high for the KODAK system to provide are drawn from the grid instead. During load shedding though, the grid isn't available, so the KODAK system must be able to provide enough power for any loads the customer may want to run, including the peaks.



SegenSolar has a detailed [Battery Calculator](#) which allows you to choose a load profile that matches your customer's energy use and then test how different storage systems perform. A complete user guide for the battery calculator is available [here](#).

The maximum sustained output power for each of the systems is given in the chart above, allowing you to choose which can deliver enough energy to meet your customer's needs.

### Battery Capacity

Once you've agreed with the customer how much power the system should be able to supply the other question is how long those loads should be powered for. Again, having a good understanding of the customer's energy use is vital because delivering high power for an extended period requires far more battery capacity than for a brief surge. A load profile like the one above helps here as well.

All the 48V KODAK OG inverters are compatible with Pylontech US2000 and US3000 batteries and the KODAK Force L1 and FL5.2 batteries, so there are plenty of combinations available to suit your customer's requirements. The chart on the previous page gives the battery capacity for each of the suggested KODAK systems. For example, the OG5.48-FL5.2 system can discharge the FL5.2 at 5kW because that's the capacity of the inverter, but at that rate the battery will be empty in one hour. Given that a period of load shedding typically lasts for three hours, the OG5.48-FL5.2 should be used to power smaller loads, say 1kW essential loads, for longer. If higher power loads do need to be powered during load shedding, more battery capacity should be added.

## Inverter Features and Limitations

The [OG5.48](#) is the most affordable and simplest combination available and is suitable for low power domestic demands. The VMIII is also available in a 3kW 24V model to be used with the 24V Pylontech models for supplying even smaller loads. The VMIII **cannot** be paralleled, and so should only be chosen for systems where the loads do not exceed 5kW.

For larger demands, consider installing an KODAK [OGX5.48](#) which has the same rated power but can be connected in parallel with other units. The current sharing cable and communication cable are included with the inverter. The parallel board is factory-installed.

The KODAK [OG-PLUS5.48](#) can be used when more features are needed to support particularly important loads, and also has the ability to support parallel connections.

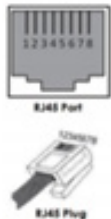
Finally, the [OG-7.2](#) has a much higher max PV input, which makes it much more effective at topping up the battery during the sunlight hours. It has dual MPPTs, which means it can extract far more energy from PV arrays on dual-aspect roof areas. Putting a portion of the PV array on a north-west facing roof means more energy will be available in the late afternoon and early evening, when most homes use more energy (as seen from the load profile earlier). The high output power of the Max means it should be sufficient for the vast majority of homes, which means there is no need to increase the complexity of the system by adding extra inverters in parallel.

Please check out SegenSolar's full range of pre-defined [packages](#) that show what combinations of KODAK inverters and batteries are most recommended. A full range of installation manuals and other technical guidance can be found on the product pages.

## Direct BMS Communication

A very useful feature available with the OG (VMIII) and OG-PLUS (King) and Max models is the ability to connect the inverter directly to the battery with a Cat5 cable. This enables the BMS to tell the inverter exactly what charge current to supply based on its precise SoC. This prevents the inverter wasting energy or potentially damaging the battery. This also means no other external communication module is needed to get the best out of the battery.

To enable this communication, use the included cable pre-terminated with RJ45s. The end with Pin 7 and 8 is for the battery connection.

Definition of RJ45 Port Pin (Battery side)			Definition of RJ45 Port Pin (Inverter side)	
No.	RS485 Pin		No.	RS485-Pin
1	--	1	--	
2	--	2	--	
3	--	3	RS485B	
4	--	4	--	
5	--	5	RS485A	
6	GND	6	--	
7	RS485A	7	--	
8	RS485B	8	--	

The KODAK inverters have Bluetooth for local communication using a phone. Use the WatchPower app and password '123456' to pair your phone with the inverter. It's then possible to see detailed information about the system operation, including battery SoC and the charging current. The full user guide for inverter/battery communication is [here](#).



### **Remote Monitoring**

The KODAK inverter range does not feature remote monitoring. The WatchPower app can be used for communicating with the system locally, or the inverter can be hardwired to a PC with the bundled software installed.

If remote monitoring is required, consider adding the Centurion [ICC](#) for connecting the system to the Internet and using their comprehensive monitoring software.

### **KODAK King Steady 230V**

The two King models are particularly useful for using in homes that have a variable voltage AC supply. This is quite common at locations at the end of a transmission area or rural locations. The variable AC voltage can cause appliances, particularly those with motors or pumps, to not operate efficiently. At best, this will waste energy. At worst, it could cause appliances to fail.

Other comparable off-grid inverters only produce nominal 230V when the grid goes down, but the King models produce it all the time. This steady 230V available to the home at all times improves the running of appliances and ensures that very important loads can run all the time. Notice the output voltage taken from the King LCD below:



### **KODAK King Rapid Reactions**

The KODAK King models have an extremely fast reaction time when detecting a loss of AC supply. They can switch to discharging the battery in as little as 4 milliseconds, which is barely detectable. This means important loads such as servers, ATMs or security equipment can continue operation with no interruption. The King is not technically a UPS specifically because it has no dedicated storage for covering the changeover time, but its speed and reliability mean that it performs as well as UPS equipment that would be much more expensive to run.

## Lithium Ion Battery Partners to KODAK OG Inverters

All are fully compatible with the KODAK hybrid inverters mentioned earlier. This table compares some of their important features.



Pylontech Partno	<a href="#">FL5.2</a>	<a href="#">L1-BATT-7.1-BMU</a>	<a href="#">PYLON-US2000C</a>	<a href="#">PYLON-US3000C</a>
Nominal Voltage	48V	48V	48V	48V
Nominal Capacity	5.12kWh per battery	3.55kWh per battery	2.4kWh per battery	3.55kWh per battery
Usable Capacity	4.6kWh per battery	3.2kWh per battery	2.28kWh per battery	3.374kWh per battery
Minimum per system	1	2	2	2
Maximum per system	4 (20.48kWh)	7 (24.85kWh)	16 (38.4kWh)	16 (56.8kWh)
Nominal Charge/Discharge	106A	74A	24A	37A
Max Charge/Discharge	106A	74A	24A	37A
Weight	48kg per battery	32kg per battery	24kg per battery	34kg per battery

The charging parameters currently need to be pre-programmed into the inverter at point of commissioning. This is where SegenSolar's Assured service comes into its own. We will ship the inverter and battery to you with the inverter communication configuration already done.

## Compare Lithium with Lead

Lithium-ion batteries, such as the KODAK range, have various distinct advantages over lead-acid which are described in detail in our separate [application note](#) about choosing the best battery for your off-grid inverter.

This quick summary table compares some of the important features of a similarly sized lithium and lead battery bank and shows the estimated lifetime cost of energy. That lower cost for lithium, combined with the other benefits lithium brings, make it an obvious choice to work best in a dependable load-shedding system.

Lead Acid price per kWh					KODAK FL5.2 Lithium-Ion price per kWh				
Lead Acid Bank (48V)	Cycles @ 50% DoD	kWh Storage	Initial Cost	Price per kWh	KODAK Bank (48V)	Cycles @ 90% DoD	kWh Storage	Initial Cost	Price per kWh
8 x 200Ah (400Ah)	2200	9.6kWh	R36,000	R1.72	2 x FL5.2 (200Ah)	6000	8.6kWh	R57,000	R1.10

When considering the size of the required Lithium battery bank there are two key factors:

1. The usable storage capacity
2. The power required

Both aspects should be considered, and the number of KODAK Lithium-Ion batteries specified should meet at least the minimum required based on both criteria.

### Storage Capacity

The Force L1 and FL5.2 Lithium-Ion batteries have a DoD of 90% when used with the KODAK inverters, which compares to 50% for typical lead-acid batteries. In order to provide the same storage capacity the minimum suggested replacement options, whereby KODAK is used to replace the most commonly used 48V lead acid battery banks, are shown in the table below:

Pylontech Lithium-Ion options for replacing Lead Acid					
Current Lead Solution		KODAK FL5.2		KODAK Force L1	
Lead Acid Bank(48V)	kWh Useable (50% DoD)	Pylontech US2000B-PLUS Li-Ion Bank	kWh Useable (90% DoD)	Pylontech US3000 Li-Ion Bank	kWh Useable (90% DoD)
4 x 200Ah (150Ah)	3.6kWh	1 x FL5.2 (100Ah)	4.3kWh	2 x Force L1 (148Ah)	6.4kWh
4 x 200Ah (200Ah)	4.8kWh	1 x FL5.2 (100Ah)	4.6kWh	2 x Force L1 (148Ah)	6.4kWh
8 x 200Ah (300Ah)	7.2kWh	2 x FL5.2 (200Ah)	8.6kWh	3 x Force L1 (220Ah)	9.5kWh
8 x 200Ah (400Ah)	9.6kWh	2 x FL5.2 (200Ah)	8.6kWh	4 x Force L1 (295Ah)	12.7kWh
12 x 200Ah (450Ah)	10.8kWh	3 x FL5.2 (300Ah)	12.9kWh	4 x Force L1 (295Ah)	12.7kWh
12 x 200Ah (600Ah)	14.4kWh	4 x FL5.2 (400Ah)	17.3kWh	6 x US3000 (370Ah)	16.0kWh



So for example, a 150Ah 48V lead acid battery bank comprising 4 x 150Ah batteries and giving an effective 3.6kWh of storage at 50% DoD could realistically be replaced with 2 x Force L1 Lithium-Ion batteries, or a single FL5.2 which provide 6.4kWh and 4.3kWh storage respectively at 90% DoD.

In many cases the original lead-acid battery bank being replaced may have been too small to fully meet the client’s requirements and therefore consideration should be given to replacing it with a Lithium-Ion battery bank with a larger capacity.

**Power Rating**

When used with a KODAK inverter, a Pylontech US2000 Lithium-Ion battery will deliver 1.5kWh usable energy when discharged at 1.2kW, or 1.9kWh usable energy can be utilised if drawing at 600W.

Therefore, to take into account the expected current draw of the inverter, SegenSolar recommends that the minimum number of Pylontech Lithium-Ion batteries be linked to the site-specific base load as follows:

Recommended Base Load	Max Nominal Load	No. of Pylontech Lithium-Ion 2.4kWh Batteries	No. of Pylontech Lithium-Ion 3.5kWh Batteries
1.2kW	2.4kW	2	2
1.8kW	3.6kW	3	2
2.4kW	4.8kW	4	3
3.0kW	6.0kW	5	4
3.6kW	7.2kW	6	4
4.2kW	8.4kW	7	5
4.8kW	9.6kW	8	6
6.0kW	12.0kW	10	7

**BATTERY SETUP**



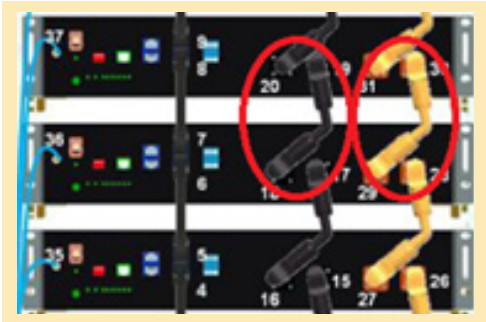
**Pylontech US2000 and US3000**

Use the binary switches to give the battery an address. Each battery must have its own number i.e in a two-battery system, one battery will be number 1 and the other number 2.

To set these the following guide shows numbers 1 to 4 in relation to the switches position.

Battery address	1st DIP position	2nd DIP position	3rd DIP position	4th DIP position
1	ON	OFF	OFF	OFF
2	OFF	ON	OFF	OFF
3	ON	ON	OFF	OFF
4	OFF	OFF	ON	OFF

DC Cable connection: With multiple batteries, you will need to connect the batteries together in parallel. The cable to do this comes with the battery (inside the box) The links should be fitted as per the image below.



With this connection done, there will be one battery with a DC output spare, this will be where the DC cable to the KODAK inverter is fitted. Please note that the battery leads to connect the inverter needs to be purchased separately. The Pylon battery cable set can be found on the portal. [Part No: CAB-PK-PYLON](#)

With multiple batteries, you will need to connect the BMS of each on together, as per the image below, connecting LAN ports 0 to 1 until all batteries are linked.



The battery with the highlighted LAN port 0 empty will be the master. All others will be slaves. Please note that The LAN port 0 is NOT used beyond this point.




Turn on the battery – flick all of the battery rocker switches to ON, then hold the RED SW button of the MASTER BATTERY only until the battery turns on. In turn the master will then turn all of the other batteries on.

## Other KODAK Package Components

Each SegenSolar's pre-defined domestic packages include all the essential components to get the system up and running.

- KODAK inverter
- KODAK batteries
- A DC protection box. The box will feature inputs for up to 4 DC strings when purchased with the King models, or 2 inputs for the VMIII and MKSII models. This is to suit differing MPPT ranges of the KODAK models. The DC boxes also feature fusing where required and Type II SPDs.
- Robust Keto-O fused DC disconnecter



**Kodak Solar 5kW King Off-Grid/Kodak Force L1 7.1kWh Battery**  
Part No: OG-PLUS5-48-L1-BATT-7.1 Storage Systems - Offgrid Packages

**SPECIAL OFFER** This part is a special offer made up of the following items:

Part		Discount
2 x L1-BATT	KODAK Force L1 Li-Ion Battery 3.5kWh	3%
1 x OG-PLUS5-48	KODAK Solar Off-Grid Inverter King with UPS 5kW 48V	3%
1 x L1-BMU-BASE	KODAK Force L1 BMU with Base	3%
1 x KETO-00	Fuse-switch-disconnector KETO size 00 body (battery isolator)	3%
1 x KQ25-T200-GBA25	K&N Single Phase AC Switch Disconnecter 25A	3%
2 x N5014697-125A	NH Fuse-link 125A for KETO-00	3%
1 x BATCAB25-1M-RED	25mm <sup>2</sup> Battery Cable (H01ND-D) 1m - Red	3%
1 x BATCAB25-1M	25mm <sup>2</sup> Battery Cable (H01ND-D) 1m - Black	3%
4 x LUG25-8	25mm <sup>2</sup> Cable Terminal Lug 88 - Single	3%

High performance scale off-grid hybrid storage system from KODAK. Don't compromise: for sites that need reliable 230V AC at all times, the King is King.

The 5kW rated power of the KODAK King inverter, when matched with a stack of three Pylon Force L1 batteries, delivers up to 3.6kW of continuous discharge power, based on Max Discharge of 1.2kW per Pylon battery.

That's perfect for supplying some of the higher powered electrical loads in the evening, or running the essential household loads with no interruption during a grid failure.

The KODAK King hybrid is a pure sine wave inverter that boasts a power factor of 1. It has a selectable input voltage range for distinguishing between home appliances and computers, and a selectable charging current based on the application.

The inverter data sheets and inverter installation manuals can be found on the SegenSolar portal.

## SegenSolar portal services

The SegenSolar portal has a System Designer tool which allows installers to create their own battery packages:  
<http://portal.segensolar.co.za/Reseller/PVDesigner>

Please speak to your Account Manager or Technical Support representative if you require training on how to use the System Design tool. The design tool will allow the user to create a quote quickly and easily with all the necessary components. All the available stock levels are shown as well as any incoming deliveries.

## **About KODAK**

KODAK is a globally recognised brand synonymous with quality and putting the end user experience first. It was founded officially in 1888 in New York and has been involved with producing a wide range of electronic and printing products since. Its PV inverters are a strong blend of great functionality focussed on what homeowners need, with a simple install process and affordable prices. KODAK's solar products are licenced in South Africa by Blue Mountain Solar Ltd.

Further info: <https://bluemountainpv.com/kodaksolarproducts/>

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