

User Guide

ZKL 3000 RC Battery Management

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User Guide: Original

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1 Version History

VERSION NO.	DATE	CHANGE LOG	REFERENCE	APPROVED
1.0.0	12.09.2024	First Draft	-	<u>Rob Fox</u>

2 Introduction

The purpose of this guide is to outline the best conditions and configurations to manage the ZKL 3000 RC battery to ensure that batteries are maintained in optimal condition for peak performance. This guide will also detail the *battery products* available to increase device longevity and operational availability.

To suit different locations and applications, Dual Inventive provides a variety of Battery Management Products, upgrades and combinations.

Using Dual Inventive's cloud application, **Insight**, the devices' battery levels can be monitored enabling timely preventive maintenance.

 This User Guide is for reference purposes, please refer to the User Manuals for additional and up-to-date information.

2.1 Convention

To alert the reader to safety-critical and essential information, this User Guide uses the following symbols:

2.1.1 Symbols







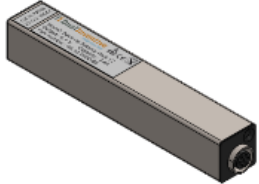

S/N	SYMBOLS	MEANING
a.		DANGER Indicates a hazardous situation that <i>will</i> result in death or serious injury if the safety instructions are not followed.
b.		WARNING Indicates a hazardous situation that <i>could</i> result in serious injury, and/or significant damage to the product or the surrounding area if the safety instructions are not followed.
c.		CAUTION Indicates a hazardous situation that <i>might</i> result in minor or moderate injury, and/or minor damage to the product or the surrounding area if the safety instructions are not followed.
d.		ADDITIONAL INFORMATION Provides additional information or tips to enhance understanding or give more context.
e.		REFERENCE Points to additional documentation or resources for further information.

Table 1 Symbols used in the User Guide

3 Battery Management Products

Below is the list of power management products used under different applications for the ZKL 3000 RC.

S/N	BATTERY MANAGEMENT PRODUCTS	ID	IMAGE
1.	<p>Main Battery</p> <p>The main power source for any ZKL 3000 RC setup. A single Main battery will keep the ZKL 3000 RC powered for up to 6 weeks.</p>	40.10.0000.52.38	
2.	<p>Main Battery Charger</p> <p>Charger for main battery only.</p>	40.10.0044.72	
3.	<p>Backup Battery</p> <p>The backup battery will keep the ZKL 3000 RC powered for up to 30 hours in the event of a loss of power from the main battery.</p>	40.10.0000.65	
4.	<p>Backup Battery Charger</p> <p>Charger for backup battery only.</p>	40.10.0044.70	
5.	<p>Battery Linking Cable</p> <p>The battery linking cable allows you to extend the operating time of the ZKL 3000 RC from 6 weeks to up to 12 weeks by connecting a second main battery, increasing the overall capacity.</p>	40.10.0000.68	
6.	<p>10m Power Cable</p> <p>20m Power Cable</p> <p>The power cables allow the main battery to be connected to the ZKL 3000 RC allowing the battery setup to be left at a distance well away from the track</p>	<p>40.10.0000.58</p> <p>40.10.0000.63</p>	

S/N	BATTERY MANAGEMENT PRODUCTS	ID	IMAGE
	allowing safe replacement of depleted main batteries.		
7.	<p>Solar NRG 3000 plus</p> <p>The solar panel will maintain the charge of the ZKL 3000 RC main battery. It can be used to charge the main battery of the ZKL 3000 RC.</p>	40.10.0000.09	
8.	<p>BBX 3000</p> <p>The BBX 3000 ballast box allows for easy mounting of the Solar NRG 3000 Plus.</p>	40.10.0000.08	
9.	<p>Winter Pack</p> <p>The Winter Pack Kit contains a Main Battery, Battery Linking cable and Solar NRG 3000 Optimiser Upgrade Kit.</p> <p>The Winter Pack looks to optimise ZKL 3000 RC's power during the winter period, resulting in fewer visits to the trackside to change batteries and better efficiency of the Solar NRG 3000.</p>	15.00.0000.00	
10.	<p>Solar NRG 3000 Optimiser Upgrade Kit.</p> <p>Upgrading the Solar NRG 3000 with the Solar NRG Optimiser Upgrade Kit increases its efficiency by 1.5 times when converting energy into the battery.</p> <p>All new Solar NRG 3000s come with the Optimiser fitted as standard.</p>	40.10.0000.10	



For further information on any of our products please contact sales@dualinventive.com

4 Charging

4.1 Instructions before use

1. **Environment:** Charge, transport, and store batteries in a dry, indoor environment. Chargers have an IP20 protection level.
2. **Ventilation:** Place chargers at least 50 mm apart to ensure adequate ventilation.
3. **Inspection:** Check the charger and cables for visible damage before use. Do not use the charger if any damage is detected.
4. **Storage Temperature:** Adhere to the Technical Specifications for the correct storage temperature range of the battery.
5. **Repairs and Maintenance:** Only Dual Inventive is authorized to repair and maintain the charger for backup and main batteries.
6. **Charger Use:** Use only the charger specifically supplied for each model.

4.2 Charging Backup Battery

Step 1: Insert the backup battery charger into the mains power socket. A green LED light will turn on, indicating that the charger is correctly connected to the power supply.

Step 2: Connect the charger to the backup battery. A red LED light will turn on to show the battery charging.

Step 3: When the red LED changes to green, the battery is fully charged.

Step 4: The backup battery can remain connected to the charger without damage. Note that the red LED may illuminate again after some time.

4.3 Charging Main Battery

Step 1: Connect one end of the main battery charger to the Main battery 4-pin input charging connector and the other end to a mains power socket.

Step 2: Both LEDs on the charger will illuminate red and the fan in the main battery charger should start at this point.



WARNING

If the fan does not start, do not use the charger and contact DI immediately, as there is a risk of the main battery charger catching fire.

Step 3: Both LEDs remain red during main battery charging.

Step 4: When charged, one LED turns green.

Step 5: The main battery can stay connected but won't trickle charge.



Figure 1 Main battery 7-pin power connector



Figure 2 Main battery 4-pin input charging connector



WARNING

1. Before connecting the main battery charger to a new battery, it **must be unplugged from the power source**, especially when reusing the charger with different batteries. This step is crucial, otherwise, the charger may not detect a new battery and therefore won't charge the main battery. Ideally set up a charging station, where the independent sockets can be switched on/off.
2. Batteries may not charge effectively if they have been *depleted for an extended period*.

5 Technical Specifications

5.1 Backup Battery Tech Specs

Battery Type		Li-ion
Ingress Protection Level		IP67
Standards		EN-60529 (IP), EN-50121-4 (EMC), EN-50125-3 (T1, A1, Shock & Vibration)
Voltage (V)		6.4
Capacity (Wh)		19.2
Charging Time (approx.)		6 hours
Storage Temperature		-20 / +25°C
Operating Temperature	Charging Temperature (min/max)	-20°C / +60°C
	Discharging Temperature (min/max)	-45°C / +60°C

5.2 Main Battery Tech Specs

Battery Type		Lithium Yttrium
Ingress Protection Level		IP67
Standards		EN-60529 (IP), EN-50121-4 (EMC), EN-50125-3 (T1, A1, Shock & Vibration)
Voltage (V)		6.4
Capacity (Wh)		572
Charging Time (approx.)		24 hours
Storage Temperature (min/max)		-45°C / +85°C
Operating Temperature	Charging Temperature (min/max)	-45°C / +85°C
	Discharging Temperature (min/max)	-45°C / +85°C

6 Installation Setup and Configurations

The Battery Management Products can be combined in various ways to meet different needs and environments.

Before use:

- Ensure all batteries are fully charged before installation.
- Inspect all equipment for signs of damage.

6.1 Installing the Battery in the ZKL 3000 RC

Step 1: Open the ZKL 3000 RC Battery Compartment using the battery compartment key.

Step 2: Place the power cable on the notched side of the battery compartment, labelled "Main Battery (Battery 2)" as shown in Figure 3. Ensure the cable exits through the notch without getting trapped.

Step 3: Insert the battery and power cable into their designated slots. Pull the rubber fastener over the ends to secure them in position.

Step 4: Close the battery cover and lock it with the battery compartment key.



Figure 3 ZKL 3000 RC Battery Connections



Figure 4 ZKL 3000 RC Battery Fitment Configuration

6.2 Basic Setup

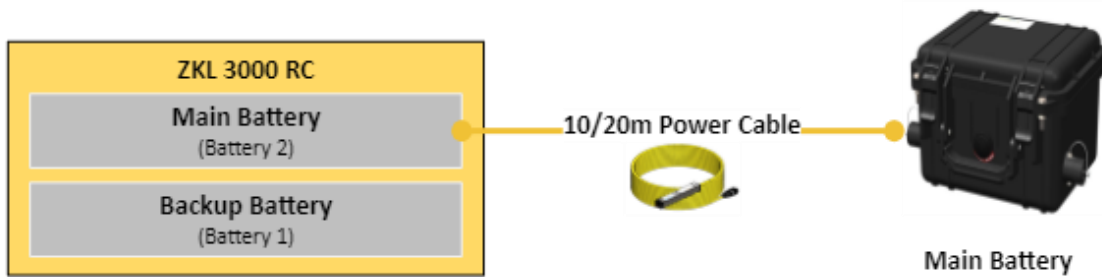


Figure 5 ZKL 3000 RC & Single Main Battery Configuration

This basic setup should be the starting point for any ZKL 3000 RC installation. Battery Life up to 6 weeks.

6.3 Tandem Setup



Figure 6 ZKL 3000 RC & Tandem Main Battery Configuration

By adding a second main battery in tandem the lifespan can be extended up to 12 weeks.

i A maximum of two main batteries can be used for each device.

6.4 Solar Setup

By adding a solar panel to the main battery setup, the batteries can be charged while in the field during *daylight* hours.

6.4.1 Advantages

The main advantage of having the solar setup is that it will reduce site visits, which in turn will:

1. Increase safety by reducing boots on ballast.
2. Improve the environmental impact.
3. Keep costs low.

6.4.2 Conditions

1. The Solar NRG 3000 panels come pre-built with the *optimal angle* to capture *maximum sunlight*.
2. It is recommended to place the panels *facing south in the northern hemisphere and facing north in the southern hemisphere*.

3. Take into consideration any obstacles (signs, trees, bridges, embankments etc.) that may block sunlight.
4. Placing the battery(ies) inside the BBX 3000 reduces line-side trip hazards and makes for a tidier and more compact installation.

6.4.3 Basic Solar Setup

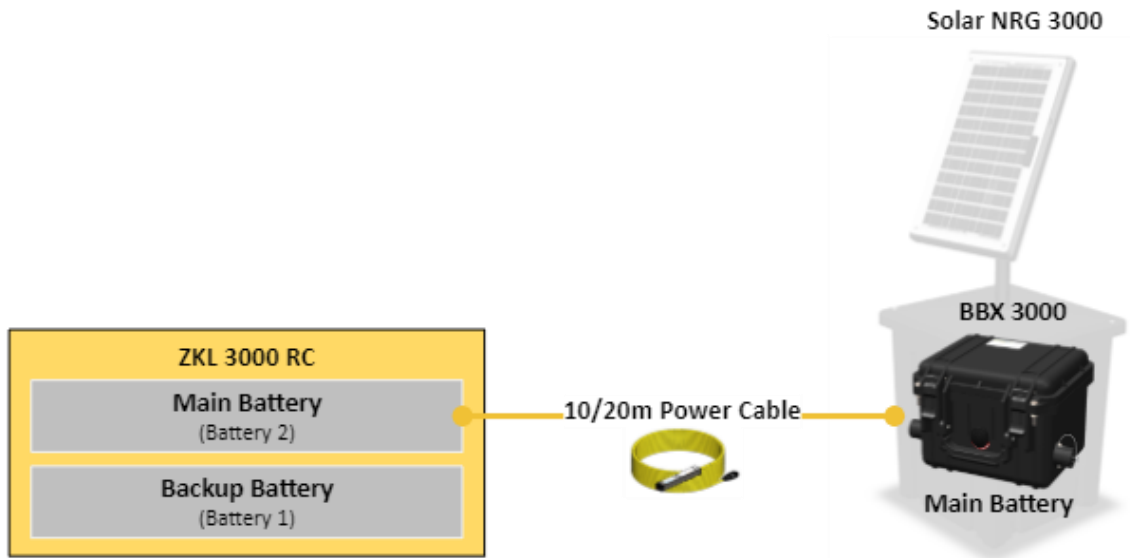


Figure 7 ZKL 3000 RC & Single Main Battery with Solar NRG 3000 Configuration

- i** This option does have *restrictions* as installations are often in locations with limited sunlight such as cuttings or in the shade of trees or buildings, this can particularly be an issue during winter months when natural daytime sunlight is limited.

6.4.4 Tandem Solar Setup

This is the **best setup** for the system and is recommended for use in most situations.

This tandem battery method sees that if charging is limited there is plenty of battery capacity to store any charge as and when it becomes available.

- i** A maximum of two main batteries can be used with Solar NRG 3000 and BBX 3000 for each device.

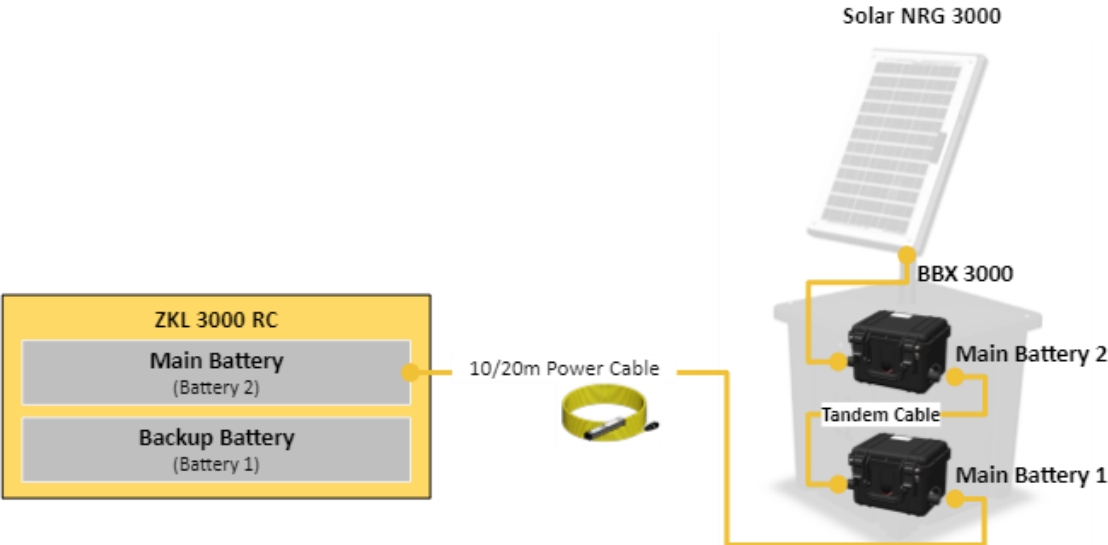


Figure 8 ZKL 3000 RC & Tandem Main Battery with Solar NRG 3000 Configuration

7 Cascading Power


When installed correctly, each Solar Setup with the ZKL 3000 RC will provide power by trickle charging the main battery. The charge will then flow through the *10m/20m power cable to trickle charge the backup battery*. This will keep the backup battery at its optimum voltage until the main battery is depleted.

7.1 Main battery gets depleted

1. The main battery can provide power for up to six weeks; usage may reduce this time frame.
2. When the main battery starts to deplete, replace it before it is fully depleted and power is drawn from the backup battery. This is important when:
 - A Solar NRG 3000 is not installed.
 - The solar panel is not collecting enough energy.
 - The solar panel is faulty.
3. The backup battery can only provide up to *30 hours* of power.

7.2 Both batteries are fully depleted

1. Replace both with fully charged batteries at the same time.
2. If it is *only safe to replace the main battery*, note that a fully charged main battery will trickle charge the backup battery to its optimum level. This process will deplete the main battery and reduce its lifespan.
3. If a solar panel is installed and functioning correctly, the main battery will recharge and provide stable power.

 The *backup battery will not trickle charge* from the main battery if the temperature falls *below 6°C* to avoid potential damage. The ZKL 3000 RC will stop charging at this temperature and resume once it rises above 6°C.

8 Battery and Charger Longevity

To ensure the longevity and optimal performance of your battery chargers and batteries, follow these guidelines:

1. **Cycle Chargers Weekly:** *Swap chargers* in use with those in stock *every week*, ideally on the same day (e.g., every Sunday evening). This practice reduces wear and tear and ensures *even usage* across all chargers.
2. **Remove Batteries When Not in Use:** Always remove all batteries from the ZKL 3000 RC when it is not in use.
3. **Charge After Removal:** Charge each battery immediately after it is removed from the track.
4. **Charge Before Installation:** Always charge each battery before installing it on the track.
5. **Use Original Chargers:** Only use the original battery chargers supplied by Dual Inventive for both main and backup batteries.
6. **Indoor Charging:** Perform all charging *indoors*, as the chargers are designed with *IP20 protection* and are not suitable for outdoor use.
7. **Inspect Chargers and Batteries:** Regularly check chargers, batteries, and cables for visible damage. If any damage is detected, do not use the charger or battery.
8. **Monitor Performance:** Regularly monitor *battery charge levels* to identify potential performance issues early on.
9. **Log Maintenance Activities:** Maintain a record of your battery and charger cycling and charging activities to track the health and performance of your equipment.
10. **Handle Damaged Chargers Carefully:** If any chargers exhibit degraded performance or physical damage, immediately quarantine them and refrain from further use.

9 Storage Guidance

i While there are no specific regulations, the following guidance ensures the safe and optimal use of Lithium batteries.

S/N	GUIDANCE	DETAILS
1.	Battery Lifespan	The lifespan of lithium batteries decreases if they are fully discharged before being recharged.
2.	Battery Maintenance	Ensure batteries <i>are fully charged before storage</i> . Storing depleted batteries for long periods can reduce their ability to hold a sufficient charge and shorten their lifespan.
3.	Storage and Transport Conditions	<ul style="list-style-type: none"> • Store batteries in a <i>dry environment</i> at temperatures ranging from -20°C to +20°C. • Temperatures below 0°C slow chemical reactions, reducing capacity. Improper storage, transport, or handling can damage the battery casing or cells, leading to a difficult-to-extinguish fire.
4.	Self-discharge	Batteries can self-discharge over a period of time during storage. This can be countered by charging them periodically (<i>every 3 months</i>), ensuring the battery level stays over 40% during extended storage.



WARNING

1. Dual Inventive disclaims liability for lithium batteries that fail prematurely if they are fully discharged before recharging.
2. In case of a fire involving Lithium batteries, the fire should only be extinguished using carbon dioxide (CO₂) or dry chemical powder. *Water must not be used*, as it can worsen the fire or cause an explosion.

10 Replacing a Battery

10.1 Depleted Battery

1. If all the batteries are depleted, you cannot access up-to-date information on MTinfo 3000. The device will then show as “offline.”
2. The responsible person will receive a notification *via Insight*.

 Additionally, for a released project, the responsible person will receive notification *via MTinfo 3000*.

10.2 Replacing battery

1. If you need to go on or near the track, ensure you have a safe system of work according to the rules of the relevant Railway Infrastructure Controller.
2. Disconnect the main battery only and replace it with a charged battery.
3. Check the status of the ZKL 3000 RC in MTinfo 3000. The ‘Main bat. status’ should be ‘Full’.
4. Make sure to charge the depleted batteries after returning them to the depot. Store them accordingly (see [Storage](#))
5. After replacing the main battery, if track access is possible, it is recommended to replace the backup battery.
6. Recommend performing a new Functional Test.

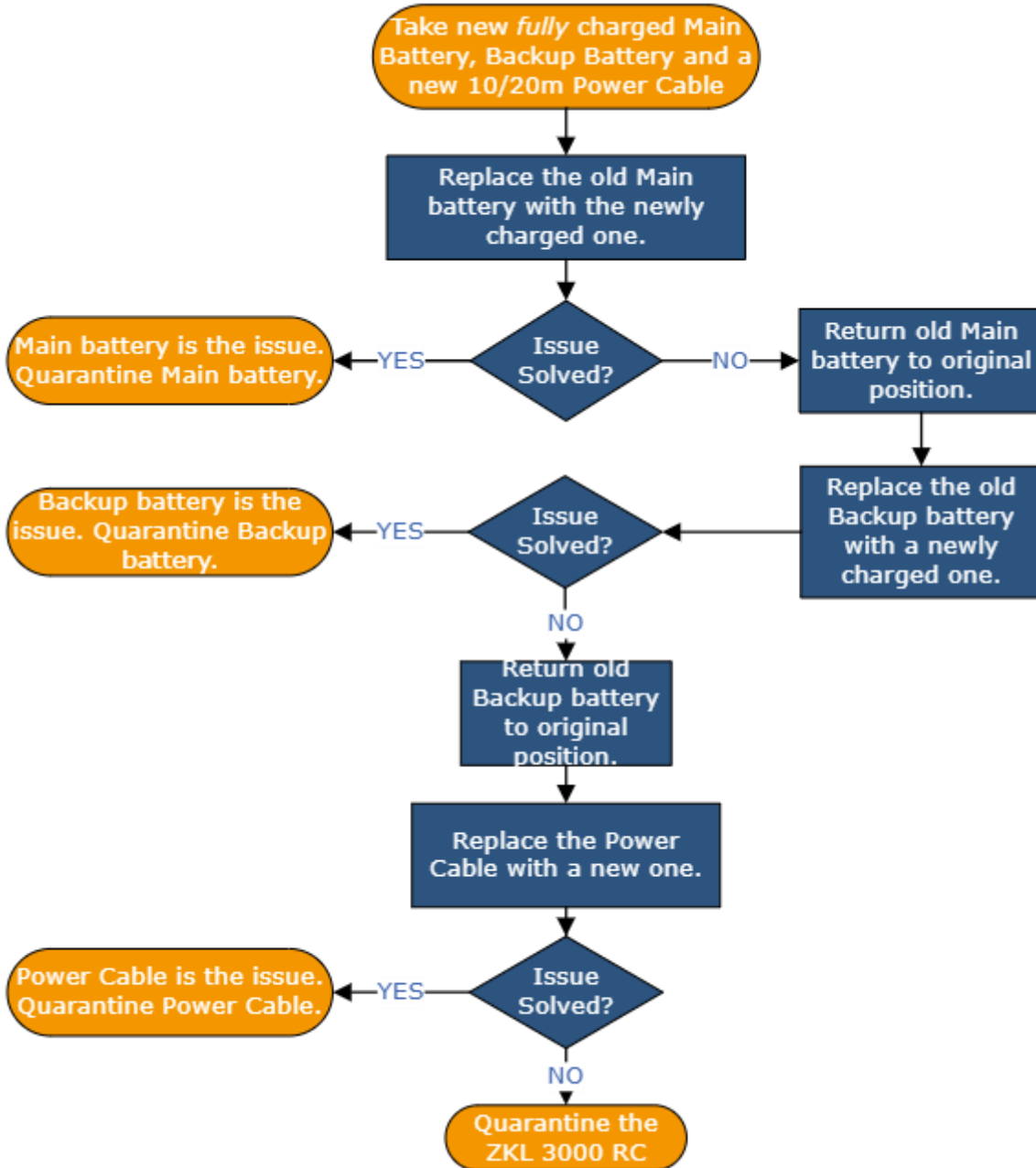


Reference

For ZKL 3000 RC functional test, refer to the ZKL 3000 RC User Manual (section 6. c) or ZKL 3000 RC Quick Guide (Section 1) from the [Dual Inventive downloads page](#).

11 Troubleshooting

11.1 ZKL 3000 RC Power Issues



Follow similar troubleshooting steps for [Tandem Setup](#), [Basic Solar Setup](#) and [Tandem Solar Setup](#). Make sure to check the Solar NRG 3000 as the final step.

11.2 View ZKL 3000 RC status via MTinfo 3000

1. Log in to the MTinfo 3000 App.
2. Select 'Real-Time' on the home screen.
3. Select 'devices'.
4. Search for the device, via the ZKL 3000 RC Serial number (printed on the ZKL).

5. Tick the device of interest.
6. Select the 'List' tab.
7. Select the expand button (plus symbol).
8. Confirm that the 'Backup bat. status' and 'Main Bat. Status' is showing 'Full'.



Figure 9 Battery Status MTinfo 3000

11.3 Troubleshooting Conclusion

1. If the backup battery does not show 'Full', contact [DI Technical Support](#).
2. If the main battery does not show 'Full', replace the 10/20m cable. If the problem persists, contact [DI Technical Support](#).

Battery status (backup, main)	Battery Percentage
Full	Sufficient Power (67-100%)
Half	Adequate Power (34-66%)
Low	Low Power (16-33%)
Critical	Almost Empty (4-15%).
Depleted	Completely Empty (0-3%).
Removed	Completely Empty (0%).

11.4 Reporting An Issue

1. Quarantine the faulty item (Place sticker on and identify as 'Do not use')
2. Provide the following information to [DI Technical Support](#).
 - a. Brief description of the item and the issue (e.g. Main Battery Low Voltage, ZKL 3000 RC not coming online etc.).
 - b. Serial number? (Provide a picture of labels where possible).
 - c. ZKL 3000 RC serial number that the item was installed on.

- d. Date and time of replacement.
- e. Description of Troubleshooting.
- f. Date and Time of Issue Occurrence.
- g. Additional Remarks.

12 Dual Inventive Technical Support

You can contact Dual Inventive Technical support through the email address support@dualinventive.co.uk or contact 03300 169033.

Alternatively, for customer support contact details specific to your project, please refer to the 'Contact Us' section within the *MTinfo3000 web app and mobile app*.

Your feedback is crucial for improving safety and optimising the distribution of rail capacity.

13 Disposal of Batteries

Lithium batteries and peripherals, such as chargers, are not domestic waste. For detailed recycling information, contact local authorities or [DI Technical Support](#).