LEAB
mobile energy

G3 Combi from CLAYTON POWER™

1012-50, 1024-30, 1312-80,
1512-80, 1524-40, 2012-100, 2324-50

Lightweight and compact sine wave inverter and battery charger

User Manual

LEAB Automotive GmbH
Thorshammer 6
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User Manual
Version: 2.0
Issue date: 12.02.2019

Table of Contents

1 About this Manual

Read this manual carefully and keep it in a safe place. This manual is intended for electrically trained persons and professionals in the automotive electrical field.
Throughout the manual, you will be alerted to warnings and safety notices about potential hazards associated with handling the device. The colours and signal words indicate the severity of the hazard:

Signal word	Meaning
⚠ DANGER	Warns of imminent danger resulting in death or serious injury.
⚠ WARNING	Warns of a potentially dangerous situation that can result in death or serious injury.
⚠ CAUTION	Warns of a potentially dangerous situation that can result in moderate or minor injuries.
NOTICE	Warns of a potentially dangerous situation that can result in material and environmental damage.

In this manual you will find the following symbols:

	Shows you useful tips and information about the device.
	Indicates a mandatory requirement for the following instruction.
	Shows the result of an instruction.

2 General Safety

This manual supports the safe handling of the device. Use the device solely in accordance with its intended use:

The G3 Combi with a lightweight and compact design has switching power supply technology and is suitable for mobile and stationary use. The inverter integrated in the G3 Combi converts DC voltage into sinusoidal AC voltage, which also supplies sensitive consumers. The G3 Combi is also suitable for charging lead-acid batteries (wet, gel, AGM) and lithium batteries.
The integrated mains priority circuit supplies consumers (AC) with an external 230-V supply via the 230-V mains. In the event of a failure of the 230-V mains power supply (AC), the backup power supply enables an almost uninterruptible switchover (from approx. 25 ms) to inverter operation.

Any modifications to the device or its components are prohibited and do not conform to its intended use.
Observe the following safety instructions:

- Device defect due to incorrect installation: Install the device in a dry and cool location.
- Danger from damaged, frozen or deformed batteries:
  Before operation, make sure that the battery is undamaged and the electrolyte is not frozen.
- Only charge batteries in well-ventilated rooms and away from ignition sources.
- When handling open batteries, wear acid-proof clothing.

3 Technical Specifications

12-V Devices

Model	1012-50	1312-80	1512-80	2012-100
Output power				
Continuous power	1,000 W	1,300 W	1,500 W	2,000 W
Overload (1 s)	2,000 W	3,000 W	3,000 W	4,000 W
Overload (10 s)	1,500 W	1,800 W	2,000 W	2,800 W
Overload (15 min)	1,200 W	1,500 W	1,700 W	2,200 W
Degree of efficiency	>90%			
Internal consumption				
Normal idling speed	10 W		15 W	
Idling with search mode	< 2 W			
Standby mode	< 5 mA			
Operating temperature				
Max. operating temperature	+50°C			
Min. operating temperature	-20°C			
Switch-off temperature	+80°C			
Output voltage (AC)				
Nominal voltage	230 V			
Voltage tolerance	-10% ... +5%			
Frequency	50 Hz			
Voltage waveform	Sine			
Max. distortion (THD)	3%			

Model	1012-50	1312-80	1512-80	2012-100
Input voltage (DC)				
Nominal voltage of the battery	12 V			
Max. input voltage	15 V			
Switch-off voltage (Response time 3 s)	10.5 V			
Switch-off voltage (Response time < 10 s)	9 V			
Switch-on voltage (restart)	12.75 V			
Mechanical specification				
Protection class	IP21			
Dimensions, housing (LxWxH)	299 x 198.2 x 116 mm		376 x 198.2 x 116 mm	
Dimensions, housing with connections (LxWxH)	334 x 198.2 x 116 mm		412 x 198.2 x 116 mm	
Weight	6 kg		7.5 kg	
Battery				
Battery type	Lead-acid (wet, gel AGM) and lithium			
Charging characteristic	IU_1U_2			
Temperature sensor (NTC)	optional			
Charging current (adjustable)	0-50 A	0-80 A	0-80 A	0-100 A
Current reduction at 50°C	0%			
Current reduction at 60°C	15%			
Current reduction at 80°C	50%			
Charging voltage (default setting)				
Main charging	14.4 V			
Trickle charging	13.5 V			
Supply voltage (AC)				
Max. input voltage	265 V			
Minimum voltage for main charging	185 V			
Minimum voltage for trickle charging	110 V			
Max. current peaks	100 A			
Frequency	45 Hz … 65 Hz			
Cos φ	0.9			
Integrated input fuse	10 A			

24-V Devices

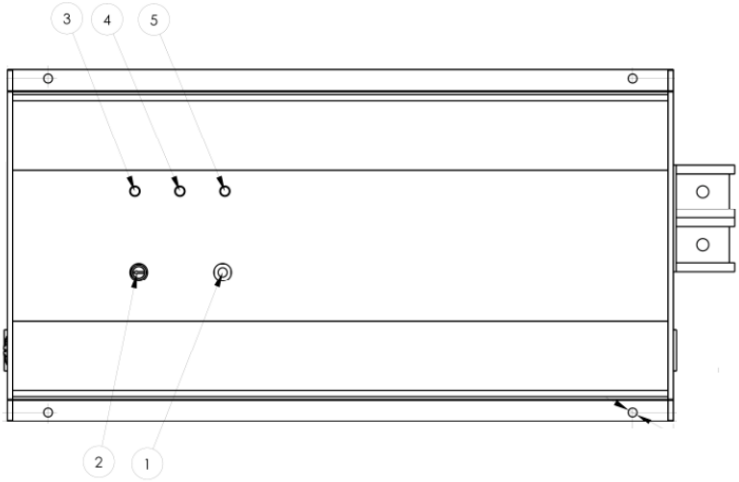
Model	1024-30	1524-40	2324-50
Output power			
Continuous power	1,000 W	1,500 W	2,300 W
Overload (1 s)	2,000 W	3,000 W	3,000 W
Overload (10 s)	1,500 W	1,800 W	3,000 W
Overload (15 min)	1,200 W	1,700 W	2,500 W
Degree of efficiency	>90%		
Internal consumption			
Normal idling speed	10 W		15 W
Idling with search mode	< 2 W		
Standby mode	< 5 mA		
Operating temperature			
Max. operating temperature	+50°C		
Min. operating temperature	-20°C		
Switch-off temperature	+80°C		
Output voltage (AC)			
Nominal voltage	230 V		
Voltage tolerance	-10% ... +5%		
Frequency	50 Hz		
Voltage waveform	Sine		
Max. distortion (THD)	3%		
Input voltage (DC)			
Nominal voltage of the battery	24 V		
Max. input voltage	30 V		
Switch-off voltage (Response time 3 s)	21 V		
Switch-off voltage (Response time < 10 s)	18 V		
Switch-on voltage (restart)	25.5 V		
Mechanical specification			
Protection class	IP21		
Dimensions, housing (LxWxH)	299 x 198.2 x 116 mm		376 x 198.2 x 116 mm
Dimensions, housing with connections (LxWxH)	334 x 198.2 x 116 mm		412 x 198.2 x 116 mm
Weight	6 kg		7.5 kg

Model	1024-30	1524-40	2324-50
Battery			
Battery type	Lead-acid (wet, gel AGM) and lithium		
Charging characteristic	IU_1U_2		
Temperature sensor (NTC)	optional		
Max charging current (adjustable)	0-30 A	0-40 A	0-50 A
Current reduction at 50°C	0%		
Current reduction at 60°C	15%		
Current reduction at 80°C	50%		
Charging voltage (default setting)			
Main charging	28.8 V		
Trickle charging	27 V		
Supply voltage (AC)			
Max. input voltage	265 V		
Minimum voltage for main charging	185 V		
Minimum voltage for trickle charging	110 V		
Max. current peaks	100 A		
Frequency	45 Hz … 65 Hz		
Cos φ	0.9		
Integrated input fuse	10 A		

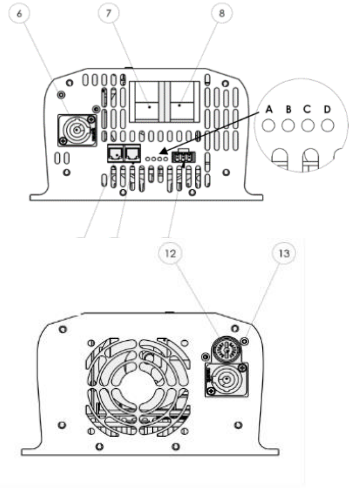
4 Package Contents

Package contents	
G3 Combi	x1
AC output plug, Neutrik NAC3FCB model – grey	x1
Phoenix plug, MSTB 2.5 / 3-ST-5.08 – green	x1
AC input plug, Neutrik NAC3FCA model – blue	x1
Manual	x1

5 About the Combi



Details	
No.	**Description**
1	On/off button
2	Potentiometer charging current limitation in %
3	Charger LED – green
4	Inverter LED – blue
5	Battery LED – red



Control displays between the data slots

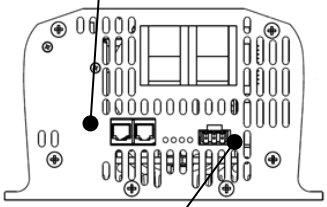
Control displays		
Pos.	**Colour**	**Function**
A	Green	Illuminates when data connection is “high”
B	Yellow	Illuminates when data connection is “low”
C	Orange	Illuminates when remote switch “on”
D		Not assigned

Details	
No.	**Description**
6	AC input, Neutrik model – blue
7	Connection, positive terminal of the battery
8	Connection, negative terminal of the battery
9	Data connection, model RJ12 (6P6C)
10	Data connection, model RJ12 (6P6C)
11	Data connection, Phoenix model – green
12	Fuse, AC input
13	AC inverter output, Neutrik model – grey

6 Component Drawing and Description

The pins for single wire communication are connected in parallel.

Plug, RJ12		
Pin	**Signal**	**Description**
1	-Temp X1	Temperature sensor (-)
2	Ground	Ground, consumer (fused)
3	+Temp X1	Temperature sensor (+)
4	Sync_In/Out	Not assigned
5	Data	Single wire communication (Clayton)
6	Remote	Connection for connecting an external on/off switch.



Plug, Phoenix Combicon		
Pin	**Signal**	**Description**
1	Data	Single wire communication (Clayton)
2	Remote	Connection for connecting an external on/off switch.
3		Not assigned

7 Mounting

To mount the device, perform the following steps:

NOTICE
• Choose a cool, dry and well-ventilated mounting site. The device must be protected from dust and moisture. • Do not mount the device directly next to or above batteries.

- Mount the device on a flat surface.
- Optimum cooling is achieved with vertical mounting.

1. Fasten the device with screws to the 4 lateral holes (5 mm Ø).

The device is mounted.

8 Installation

Determining the Cable Cross-section of the Input Lead (DC)

The following table shows the required cable cross-sections in relation to the respective cable length. Select the cross-sections so that the voltage drop to the G3 Combi is no more than 250 mV.

To avoid voltage dips, select a higher cable cross-section for consumers with high starting currents (e.g. motors, compressors).

Cable Cross-section	Device model						
mm²	1012-50	1312-80	1512-80	2012-100	1024-30	1524-40	2324-50
15	-	-	-	-	1.5 m	-	-
25	1.5 m	-	-	-	2.5 m	1.5 m	-
35	2 m	1.5 m	1.5 m	-	3 m	2.5 m	1.5 m
50	3 m	2 m	2 m	1.5 m	-	3 m	2 m
70	-	3 m	2.5 m	2 m	-	-	3 m

Connecting the Battery (DC Cable)

To connect the battery, perform the following steps:

1. Connect one DC cable to the negative terminal of the device.
2. Connect one DC cable to the positive terminal of the device.
3. Connect the negative terminal of the device to the negative terminal of the battery.
4. Secure the positive cable as close as possible to the vehicle battery with a suitable fuse (see table).
5. Connect the positive terminal of the device with the positive terminal of the battery.

Model	Fuse
1012	125 A, slow-blow
1024	80 A, slow-blow
1312	175 A, slow-blow
1512	175 A, slow-blow
1524	100 A, slow-blow
2012	250 A, slow-blow
2324	150 A, slow-blow

The battery is connected.

Connecting the Remote Switch

To connect an external remote switch, perform the following steps:

1. Connect an external on/off switch to the positive terminal of the battery (DC voltage min. 10 V, max. 30 V).
   Notice: Secure the on/off switch with max. 1 A (with 0.75 mm^2).
2. Connect the on/off switch to the remote pin of the device.

The remote switch is connected.

Connecting Consumers

To connect consumers, perform the following steps:

1. Insert the plug of the consumer into the Neutrik input (grey) of the device.

A Neutrik plug is included. You will find information on how to install the Neutrik plug on p. 18.

2. Be sure that sufficient personal and line safety devices are available according to your application.

The consumer is connected.

9 Normal Operation

Switching On

The device is mounted and installed.

To switch on the device, perform the following steps:

1. Press the on/off button for 2 s.

- Red and blue LEDs illuminate.
- Red LED goes out.
- Blue LED illuminates and indicates the start process.
- Blue LED lights up continuously, AC voltage is activated.

The device is switched on.

Switching Off

To switch off the device, perform the following steps:

1. Press the on/off button for 0.5 s.

- Blue LED goes out.
- Device switches off.

The device is switched off.

10 Functions

Standby Mode

If the AC voltage is not required continuously, a standby mode can be activated. In standby mode, the internal consumption is less than 2 W. In standby mode, the device generates a short pulse every 2 seconds.

- If the actual consumption is more than 10 W, the device switches on.
- If the consumer is switched off, the device switches to standby mode after 1 minute.
- The standby mode cannot be activated or deactivated via an external remote switch.
- The standby mode is not suitable for lithium batteries.

Activating the Standby Mode

To activate the standby mode, perform the following steps:

The device is switched off.

1. Press the on/off button until the blue and red LEDs illuminate.

The standby mode is activated.

Deactivating the Standby Mode

To deactivate the standby mode, perform the following steps:

The device is switched off.

1. Press the on/off button until the blue and red LEDs flash.

The standby mode is deactivated.

Battery Charging

The battery is charged automatically as soon as a supply voltage (185 V – 265 V) is applied to the AC input.

- The battery is also charged when the device is switched off.
- The charging takes place with reduced charging current when the supply voltage (AC) is between 110 V and 185 V.

Mains Priority Circuit

The mains priority circuit is activated automatically when a supply voltage (AC) is applied to the AC input.

If a supply voltage is applied to the AC input, the consumers are supplied with power by the 230-V mains and batteries are charged by the charger.

Backup Power Supply

The backup power supply is only provided when the inverter function is switched on.

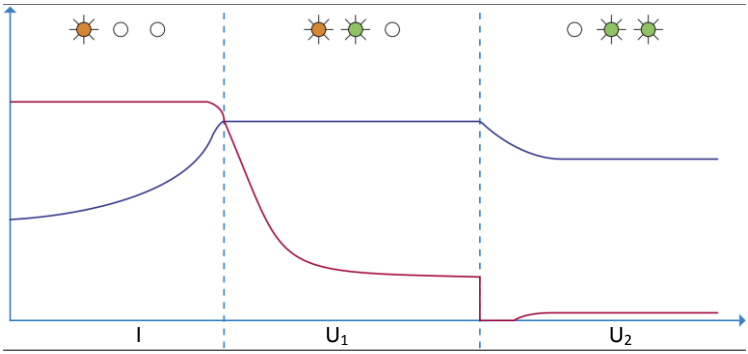
As soon as the supply voltage is interrupted, the integrated inverter supplies the consumers with power from the batteries with almost no delay (from approx. 25 ms).

If a supply voltage is once again applied to the AC input again, the G3 Combi automatically switches back and supplies the consumers. In addition, the battery is recharged.

Charging Process

Battery charging takes place with a 3-stage IU_1U_2 characteristic curve for gentle and optimum charging of the batteries.

The characteristic curves can be adapted by LEAB to the batteries to be charged.



Charging with constant current (I-phase, green LED flashes fast)

In order to store as much energy as possible in the battery as quickly as possible, it is charged at the maximum charging current, depending on the battery charge status. In order not to damage the battery, heavily discharged batteries are first charged with reduced current. After a certain main charging voltage (depending on battery type) has been reached, the G3 Combi switches to the next charging phase.

Charging with constant voltage (U_1 phase, green LED flashes slowly)

In this phase the battery is fully charged. The voltage is kept constant at a value of 14.4 V (standard value). As the charge of the battery increases, the current decreases continuously and approaches a lower limit which depends on the type and size of the battery. As soon as the value falls below this or a safety time is exceeded, the charger switches to phase 3.

Charge retention with reduced voltage (U_2 phase, green LED illuminates)

In this phase, the charging voltage is reduced to 13.5 V (standard value) in order to maintain the battery charge and counteract self-discharge. In this phase, additionally connected consumers are supplied via the charger without placing strain on the battery.

Load Reduction

The charger integrated in the G3 Combi automatically limits the charging current when the total load (charging and output power) exceeds the rated power.

Charging Current Limit

The charging current limit is pre-set at the factory according to customer wishes.

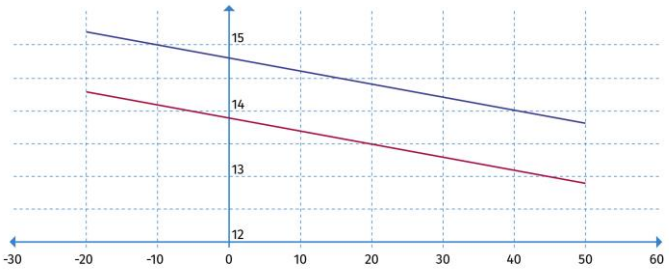
The maximum charging current can be set using the potentiometer on the top of the device. The table shows the recommended charging current in relation to the battery capacity.

Charging current	Capacity
15 A	75 Ah … 150 Ah
20 A	100 Ah … 200 Ah
25 A	100 Ah … 250 Ah
30 A	150 Ah … 300 Ah
40 A	200 Ah … 400 Ah
50 A	250 Ah … 500 Ah
60 A	300 Ah … 600 Ah
80 A	400 Ah … 800 Ah
120 A	600 Ah … 1200 Ah

Temperature Compensation (NTC Sensor)

If an external temperature sensor (NTC) is connected, the charging voltage adapts to the battery voltage in relation to the ambient temperature.

The figure shows the adjustment of the charging voltage in relation to the operating temperature (in degrees Celsius). The upper line is the voltage line for the main charging process. The lower line is the voltage line for the trickle charge.



blue = final voltage red = trickle charge

11 Control Displays and Error Descriptions

Blue LED	Description
Steady light	Inverter in operation
●.....●.....●.....●.....●.....	Start mode – Load adjustment
●..●..●.....	Output overloaded
●●..●●..●●.....	Operating temperature too high (automatic cooling and restart)
●●●..●●●..●●●.....	Short-circuit at the inverter output
●●●●..●●●●..●●●●	Short-circuit in the power supply
●●●●●..●●●●●..●●●●●	Overload in the power supply during the start process

Green LED	Description
Steady light	Charging status: U_2 phase
Slow flashing	Charging status: U_1 phase
Fast flashing	Charging status: I phase
●.....●.....●.....●.....●.....	• Supply voltage (AC) too low (< 185 V) • No sine-wave voltage present
●..●..●.....	Supply voltage (AC) too high (> 265 V)

Red LED	Description
Off	Battery voltage OK
Steady light	Battery voltage low To prevent battery draining, the device switches off as soon as the battery voltage drops below 10.3 V.
●..●..●..●..●..●..●..●	Battery voltage too high

Red and green LED	Description
●●●●..●●●●..●●●●	• Failure of the external temperature sensor (NTC) • If no external NTC is connected, the signal appears for 20 s after switching on the supply voltage (AC).

All LEDs	Description
Flickering	Remote and mains switch on the device at the same time
●..●..●.....	NTC error (internal temperature sensor)
●●..●●..●●.....	Overvoltage in the internal high-voltage DC connection
●●●..●●●..●●●.....	Defect in half of the bridge circuit
●●●●..●●●●..●●●●	Defect in the entire bridge circuit

12 Maintenance

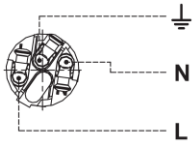
Maintain the device at regular intervals.

- Ensure that the cables on the battery and the G3 Combi are secure.
- To ensure the air supply, clean the ventilation grille of the device.

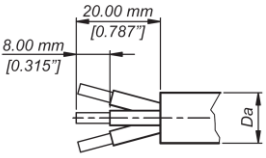
13 Mount Neutrik Plug

Use the following plug to connect the consumers:

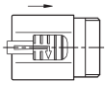
- AC output plug, Neutrik NAC3FCB model – grey
- AC input plug, Neutrik NAC3FCA model – blue



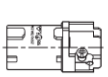
Connections



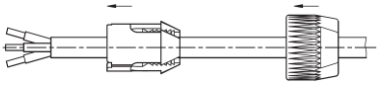
Cable preparation



Sleeve

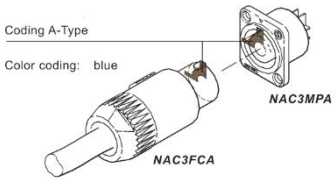


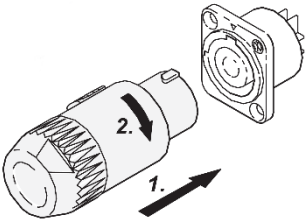
Insert



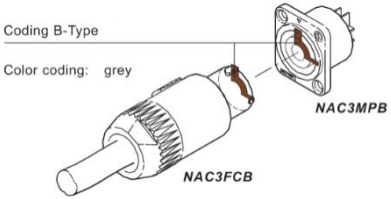
Clamp sleeve **Screw connection**

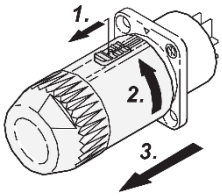
Coding, type A (blue)





Coding, type B (grey)





14 Disposal

Dispose of the device in accordance with the Waste Electrical and Electronic Equipment Regulations (WEEE).

The device must not be disposed of with household waste. Take it to a recycling point or send it to your point of sale.

15 EU Declaration of Conformity

The **G3 Combi**

in models **1012-50, 1024-30, 1312-80, 1512-80, 1524-40, 2012-100, 2324-50**

complies with the requirements of the following directives:

2014/30/EC:	EMC
2014/35/EC:	NRL
2011/65/EC:	RoHS

The current and complete document is available on request from techdoc@leab.eu.

Appendix: Use of Lead-acid Batteries

Selection of the Battery

Select a deep-cycle battery (e.g. lead-gel battery) as the power source for the inverter. These batteries are designed for higher continuous loads and cyclical discharges of up to 80% of their capacity without damaging the battery.

Starter batteries are not suitable for operating an inverter.

Size of the Battery

Undersized batteries are often drained too deeply. This reduces their efficiency and the service life of the batteries. The main causes of premature ageing and defects are insufficient capacity, insufficient charging and battery maintenance.

Wiring the Battery

- Only connect batteries of the same type and size to each other.
- Never combine open and sealed batteries.

- Clean the battery terminals with a brass wire brush.
- Carefully fit the connecting terminals and tighten the clamping screws.
- Grease the battery connections.
- Charge new batteries before use.

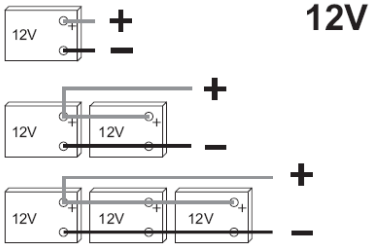
Connecting Batteries in Series

2 batteries connected in series provide double the supply voltage.
However, the total capacity does not increase.

Example: 2 batteries 12 V / 100 Ah connected in series provide a supply voltage of 24 V with 100 Ah.

Connecting Batteries in Parallel

2 batteries connected in parallel provide double the battery capacity.
However, the supply voltage does not increase.



Example: 2 batteries 12 V / 100 Ah connected in parallel provide a supply voltage of 12 V with 200 Ah.

Maintenance of the Battery

Lead-acid batteries must be maintained at regular intervals. The battery must be maintained at least once a month in hot seasons and quarterly in cold seasons. Older batteries should be checked every 14 days.

Maintenance of Open Batteries

With open batteries, check the condition of the liquid and measure the acid density with an acid syphon.

To increase battery life, make sure the battery surface is clean and dry. Carefully remove dirt and acid stains with hot water and a soda solution. Remove the soda solution with fresh water and dry the battery. Ensure that the venting flaps are clean and correctly fitted. Then check the installation of the connecting terminals. Tighten the clamping screws if necessary.

Topping up Acid Level

Ensure that the cell grids are always covered with acid. Always use distilled water to top up the battery, never normal drinking or sea water. Follow the manufacturer's instructions when topping up the acid level.

Storing the Battery

- Store batteries in a cool, but frost-free and dry environment.
- To prevent the battery from freezing, ensure continuous trickle charging in cold conditions.
- Never store batteries in a discharged state.
- If stored for a long time, check the charge status regularly and recharge if necessary.

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