Leica Geosystems
Chargers & Batteries
Product Information

- when it has to be **right**

Leica Geosystems

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Introduction

The reliable supply of power to surveying equipment forms one of the most important preconditions for all surveying tasks in the field. It is a basic precondition for the function of the equipment and a key factor for reliable, malfunction-free operation in all environmental conditions.

For batteries to have a long service life, retain their performance and operate without malfunctions, they must be correctly maintained, stored, charged and discharged. Incorrect handling of batteries and chargers can lead to malfunctions or premature loss of capacity of the batteries.

This product information summarises the most important and useful information on the chargers and batteries for Leica Geosystems surveying instruments and surveying systems.

1. Chargers

1.1 Charging technology

Leica Geosystems currently provides quick chargers as a matter of preference (accelerated charging). These charge the batteries in a correspondingly short time. They ensure, thanks to the latest charging technology, appropriate charging and therefore, the long life of the batteries. Our chargers are divided into two product lines. The Professional Series for the highest of demands and functionality, and the Basic Series as a simple, low cost alternative.
For batteries with 5-pin charging sockets, a simple, low cost normal charger with reduced functionality is still offered.

1.2 Professional Charging Station GKL221

The GKL221 is an intelligent charging station with advanced charging technology. It is suitable for charging all Leica Geosystems batteries and ensures the optimal battery operation with your equipment.

Supply

The GKL221 can be connected to the mains electricity supply with an input voltage range from 100 to 240 V AC, using the country specific power cable. With the optional GDC221 car adapter, the charging station can be connected to the battery circuit of a vehicle.

Battery – Identification

The microprocessor controlled charging station recognises the type of battery connected and derives the charging parameters such as time and current. The batteries are optimally and appropriately charged. This guarantees the maximum possible service life. The charging station can recognise and charge cells of the NiCd, NiMH and Li-Ion types. Up to five batteries can be connected to the charger simultaneously. Two batteries are charged at the same time and the rest are charged in the order they were connected.

GKL221 with 2x GDI222

The following batteries can be charged with the GKL221:

Version	Name	Cell type	Nominal capacity (mAh)	Typical charging time
Leica Geosystems Li-Ion batteries	GEB90	Li-Ion	2100	2.5 h
	GEB221	Li-Ion	3800	3.0 h
	GEB211	Li-Ion	1900	2.5 h
Leica Geosystems camcorder type batteries	GEB121	NiMH	4200	2.5 h
	GEB111	NiMH	2100	2.0 h
Leica Geosystems batteries with 5-pin sockets	GEB70	NiCd	2200	1.5 h
	GEB77	NiCd	600	1.0 h
	GEB79	NiCd	600	1.0 h
	GEB87	NiCd	1100	1.0 h
	GEB187	NiMH	2100	1.5 h
	GEB171	NiMH	8000	5.0 h

Charging times

The charging time depends primarily on the maximum charging current, the battery capacity and the charge state of the batteries when connected. Charging time of discharged batteries at +20 °C (+68 °F):

- **NiCd batteries:**
  max 2200 mAh 1.0 to 1.5 h
  max 7200 mAh 2.5 to 4.0 h
- **NiMH batteries:**
  max 2200 mAh 1.5 to 2.0 h
  max 4900 mAh 2.0 to 2.5 h
  max 10000 mAh 2.5 to 5.5 h
- **Li-Ion batteries:**
  max 4600 mAh 2.5 to 3.5 h

At ambient temperatures above +20 °C (+68 °F) the charging time for NiCd and NiMH batteries can increase by up to 1 hour. (For recommended charging temperature range see Section 2.4.) As the temperature of the battery increases towards the end of charging, the efficiency of the storage of the charge drops. For example with the GEB121, in the first 90 minutes approximetely 80% of the battery is charged and a further 60 minutes is required for the remaining 20%.

A temperature control mode is built into the GKL221 charging station. This temperature control mode is activated as soon as the battery becomes warm. In temperature control mode, the charging current is switched off until the temperature of the battery has dropped back to a specific value. Charging is then continued with reduced charging current. The switch off in temperature control mode of the charging current is not noticeable to the user as the indicator remains green (charge). The temperature control mode is also activated if the ambient temperature is too high.

Trickle charging

If fully charged batteries remain connected to the charging station, trickle charging is performed automatically. This compensates for the self-discharge of the batteries that occurs for technical reasons. The batteries are thus always available with full capacity. The trickle charging feature only activates for NiCd and NiMH batteries as Li-Ion batteries only have a very small discharge when not in use.

Refresh function

If the capacity of a NiCd or NiMH battery drops noticeably, it is recommended to subject the battery to the refresh function 2 to 3 times. The refresh function comprises a full discharge of the battery with subsequent quick charging. Further information can be found in the user manual of the GKL221. The memory effect of batteries is explained in Section 2.8.

Battery Adapter

The GKL221 charger is supplied with two battery adapters. Using the charger in combination with the battery adapters, the following batteries can be connected to the charger:

Battery adapter	Rechargeable batteries
GKL221 with two GDI221	Up to four Li-Ion batteries and one battery with 5 pole socket.
GKL221 with one GDI221 & one GDI222	Up to two Li-Ion batteries, one camcorder type battery and two batteries with 5 pole sockets.
GKL221 with two GDI222	Up to two camcorder type batteries and three batteries with 5 pole sockets.

1.3 Normal Charger GKL22

The GKL22 is a simple, low cost normal charger (14-hour charger) for charging NiCd and NiMH batteries. It is available in the GKL22 (EU) and GKL22-1 (US) mains supply versions.

Battery – Identification

The GKL22 has no facility for the recognition of the battery type and charges all batteries with the same charging current. All Leica Geosystems batteries with 5-pin charging socket can be charged except the GEB171.

Charging time

The charging time is 14 hours at a current of 200mA.

Trickle charging and refresh function

This charger has no trickle charge or battery refresh function.

GKL22

1.4 Basic Series Charger GKL211

The GKL211 is a simple, low cost quick charger (accelerated charging) for charging Li-Ion batteries. Only Leica Geosystems Li-Ion batteries, the GEB90, GEB211 and GEB221 can be charged.

Supply

The GKL211 can be connected to the mains electricity supply or to the battery circuit of a vehicle. A country specific AC/DC adapter and a car adapter cable are included with the charger.

Battery identification

The type of battery connected is recognised by an identification chip and derives the charging parameters such as time and current. The batteries are optimally and appropriately charged which guarantees the maximum possible service life.

Charging times

Charging times and change in capacity during charging are similar to that for the GKL221.

Trickle charging and refresh function

This charger has no trickle charge or battery refresh function.

1.5 Basic Series Charger GKL112

The GKL112 is a simple, low cost quick charger for charging NiCd and NiMH batteries. It is used for the Leica GEB111 and GEB121 batteries. The specifications are similiar to the GKL211 charger as detailed above.

Trickle charging

The charger has a trickle charge feature. This ensures that the battery is always fully charged and ready for use.

1.6 Safety/precautionary measures

For the safe usage of chargers, please refer to the section on safety in the User Manual supplied with the products.

GKL211/112

2. Batteries

2.1 Cell types

Leica Geosystems currently uses nickel-cadmium (NiCd), nickel-metal hydride (NiMH) and Lithium Ion (Li-Ion) cells. The cell type is marked on the battery.

NiCd

The NiCd cell is a proven, mature type of cell requiring little maintenance. Suitable for high charging and discharging currents and problem-free usage down to –20 °C (–4 °F).

NiMH

NiMH cells have a higher internal resistance than NiCd cells and are therefore not suitable for such high charging and discharging currents, or low temperatures as NiCd cells. The voltage of the battery collapses rapidly at negative temperatures and high current loading. This can result in the activation of the deep discharge protection fitted in all Leica Geosystems batteries. This means that the full capacity of the NiMH batteries cannot be drawn at low temperatures. **Leica Geosystems only uses NiMH cells that provide problem-free operation when supplying the current drawn by all Leica equipment, even at –20 °C (–4 °F).**

Li-Ion

Li-Ion cells have a high energy density. This minimises battery size and weight. It is a low maintenance battery; there is no memory effect and no scheduled cycling is required to prolong the battery's life. In addition, the self-discharge is less than half that compared to NiCd.
The batteries have a lifetime of about 3 years from manufacture. This is caused by internal oxidation which is hastened at high temperatures. **The Li-Ion batteries supplied by Leica Geosystems have a protection circuit to maintain safe operation, limits the peak voltage of each cell during charge and prevents the cell voltage from dropping too low on discharge. In addition, the cell temperature is monitored to prevent temperature extremes.**

GEB221 GEB211

2.2 Condition when delivered

NiCd

For safety reasons, the batteries are only dispatched from the factory in a discharged state.
In this way, in the case of misuse or damage to the battery, hazardous conditions or physical damage caused by a large amount of stored energy are prevented.

NiMH

For safety reasons, damage free storage and shipment, the batteries are dispatched with a minimal quantity of energy. NiMH batteries must not be stored in a discharged state. The batteries should therefore be fully charged as soon as possible once received.

Li-Ion

For safety reasons, damage free storage and shipment the batteries are dispatched with a minimal quantity of energy.

2.3 Charging the batteries

New and stored batteries

New NiCd and NiMH batteries reach their maximum capacity only after a few charging and discharging cycles. The batteries should be fully discharged and charged three to five times. NiMH batteries that have been stored and not used for an extended period (more than a month) should be refreshed simularly. For Li-Ion batteries, a single discharging and charging cycle is sufficient.
The easiest way to perform this cycling is by using the GKL221 Charging Station which has a discharge function. Alternatively, the batteries can be charged and then placed in the related survey equipment during normal use and discharged until the equipment switches off.

Batteries in regular use

After use the battery can be placed in the charger until fully charged (the green light flashes). The charging time depends on the battery capacity and temperature.
An indication of charging times is shown on Page 3.

2.4 Charging temperature

The charging temperature (ambient temperature) has a significant impact on the life of the batteries. Charging at high temperature can cause loss of capacity. These losses in capacity are irreversible. Even with several charging and discharging cycles, the original capacity can no longer be obtained.
For optimal charging, we recommend that the batteries be charged at ambient temperatures as low as possible (+10 °C to +20 °C / +50 °F to +68 °F). The permitted temperature range in which charging can still be performed is between 0 °C and +35 °C (+32 °F and +95 °F). Due to a temperature control mode built into the GKL221, GKL211 and GKL112, charging at temperatures that may cause damage to the batteries is not possible.

2.5 Useful capacity

The temperature has a particularly significant effect on the useful capacity of a battery. In accordance with the operating range for the surveying instruments, the batteries can be operated from –20 °C to +55 °C (–4 °F to +131 °F). With reducing temperature the useful capacity drops rapidly. Continuous use in the upper temperature range (> +45 °C / +131 °F) shortens the life of the battery.

2.6 Storage

Leica Geosystems batteries can be stored at –40 °C to +55 °C (–40 °F to +131 °F). Do not store batteries inside the surveying instrument. After storage, charge the battery fully before use.

NiCd

NiCd batteries can be stored for an unlimited period in any state of charge.

NiMH

NiMH batteries must always be stored fully charged and recharged after 180 days at the latest. High temperatures and high atmospheric humidity accelerate self-discharging. **We recommend storage in the range from 0 °C to +20 °C (+32 °F to +68 °F) in a dry environment.** If NiMH batteries are stored in the discharged state for an extended period irreversible damage can be caused.

Li-Ion

Li-Ion batteries start to deteriorate from manufacture. To reduce the aging effect, store the battery in a cool place at 10%–50% state-of-charge. Li-Ion batteries do not require regular charging while in storage.

2.7 Shipment

To prevent hazardous conditions or physical damage (fire, chemical or toxic hazards) batteries must be shipped discharged. The regulations relating to the shipment of batteries must be adhered to.

2.8 Memory effect

The «Memory Effect» occurs if the same charging and discharging (partial discharge) conditions are continuously applied to a battery. The battery then no longer provides the full capacity. The operating time per battery charge reduces. If the capacity of the battery drops noticeably, it is recommended to subject the battery to the refresh function 2 to 3 times (see Section 2.9). The memory effect occurs particularly with NiCd batteries. With NiMH batteries the memory effect is not so pronounced. Li-Ion batteries are not influenced by the memory effect.

2.9 Battery refresh function

If the capacity of a NiCd or NiMH battery drops noticeably, the battery can be refreshed using two to three full charge and discharge cycles.
The GKL221 Charging Station has a discharging and charging function for refreshing batteries. Since GKL112 and GKL211 do not have a discharge function the batteries are to be discharged in the instrument (i.e. operate until the instrument switches off).

2.10 Defective batteries

Even in the case of correct handling, it may occur that a statistically small number of batteries fail prematurely. A possibly defective cell must never be replaced in a battery pack. The cells in a battery pack are all from the same manufacturing batch and thus have the same manufacturing tolerances. If new and old cells are mixed, the weaker (old) cells in the battery pack are more heavily loaded and further failures inevitable. For this reason, the entire battery pack is always replaced in Leica Geosystems service centres.
The Li-Ion and camcorder type batteries are in sealed housings and the cells cannot be replaced.

2.11 Life

The life of batteries is primarily defined by the following factors:
- Electrical loading
- Charging method
- Temperatures on charging, discharging and storage
- Quality of the cells

Losses in capacity caused by incorrect charging are practically excluded with the Leica Geosystems chargers which have special switch off criteria to protect the battery. Reduction in battery capacity is normally due to age. However it can also be the result of storage at excessively low or high temperatures (see Section 2.6). The suppliers who provide batteries to Leica Geosystems are among the leading manufacturers of batteries and guarantee good quality.

2.12 Protecting the environment/disposal

For reasons of environmental protection and safety, used or defective batteries must not be thrown away. They must be correctly disposed of in a discharged state. Follow the national regulations on disposal.

2.13 Safety/precautionary measures

For the safe usage of batteries, please refer to the section on safety in the User Manual supplied with the products.

3. Supply from other 12 V DC sources

GEV71 Cable

For the supply of power to Leica Geosystems equipment from external 12 V DC networks (i.e. vehicle electrical systems) the GEV71 car battery connecting cable must be used. This is connected to the standard battery cable used for Leica Geosystems external batteries.

Protection

The GEV71 cable protects the instrument from damage due to pole reversal, voltage spikes occurring over a limited period and electrostatic discharges. The cable also provides a deep discharge protection to the connected battery.

Malfunctions

To prevent malfunctions, a «basic suppresser» is integrated into the adapter. With the engine running or on the switch on of other loads (i.e. electric windows) there are often large interference spikes in vehicle electrical systems. These cannot be sufficiently attenuated by the basic suppresser. If vehicle electrical systems are used to supply power, it is imperative that the engine and other loads are switched off to prevent malfunctions.

Mains supply

On the usage of a 12 V DC source supplied from the mains, the corresponding information and notes from the manufacturer on the permitted use and safety are to be observed.

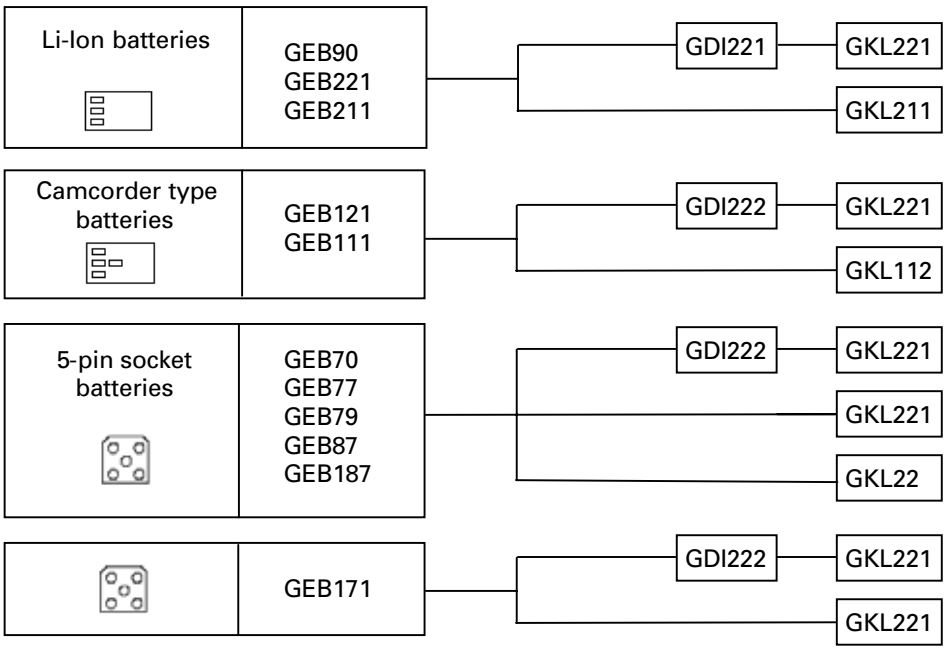
4. Customer benefits on the usage of Leica Geosystems accessories

The batteries available from Leica Geosystems are of the highest quality in respect of temperature tolerance, recharging capability, operating time and cycle behaviour. If the recommendations given in this document are followed and Leica Geosystems chargers are used, there exist the following significant advantages for the user:
- Long battery life.
- Reliable supply of power in the field.
- Batteries and chargers compatibly matched.
- Quick charging of batteries.
- Prevention of the memory effect in batteries.
- Trickle charging after completion of charging.
- Microprocessor controlled and monitored charging.
- Discharging with regeneration charging of the batteries
- using GKL221 Charging Station.

GEV71

Appendix

System overview



General comparison of cell types

	NiCd	NiMH	Li-Ion
Nominal voltage	1.2 V	1.2 V	3.6 V
Charge cycles	< 1000	< 800	> 500
Energy density per unit weight	45–80	60–120	110–160
Memory effect	yes	yes	no
Self-discharging at 0 °C (+32 °F) (% per month) +20 °C (+88 °F) +40 °C (+104 °F)	7 15 30	10 30 90	3 5 8
Recommended charge when stored	Any	100%	10%–50%
Environmental implications	Contains heavy metals, must be collected	Unhazardous in accordance with EU directives, recycle	Unhazardous in accordance with EU directives, recycle
Power cost of cells (NiCd = 1)	1	1.2	1.4

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