

**Get
mobile ...**



**... with
intelligent
battery packs**

Batteries Product Overview



Our distribution commitment for your battery support

As portable products are becoming more frequent in use and the need for reliable cost effective and safe portable power solution has increased Gleichmann Electronics have forged a partnership with BMZ (Batterie-Montage-Zentrum GmbH) in Karlstein/Germany.

Since 1994, BMZ have produced customised battery systems. Together with his team the owner of BMZ (Sven Bauer) are one of the today's leading European battery experts in design and manufacturing of intelligent battery solutions. With over 200 employees in Europe, BMZ is a proud European manufacturer focused in maintaining technical and production excellence. Additionally they have their own manufacturing site in Asia for appropriate projects.

From your initial concept to the end-customers hand Gleichmann Electronics and BMZ will provide support for your battery requirement, including any additional design work, generating drawings, functional samples, pre-production, UN-, UL- and CE approvals to full production.

As experts in customised battery pack manufacturing we look at all technologies for the best solution for your requirements. Today's market is particularly focused on the different lithium-ion technologies like cobalt, manganese and iron-phosphate but also nickel-cadmium and high current nickel-metal hydride are available.

You can be sure that the Gleichmann-BMZ-Team will provide you with the best fit solution for your power needs. You can be assured it has been professionally designed, manufactured and tested by the European battery pack leader and specialist.



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Useful things to know about ...

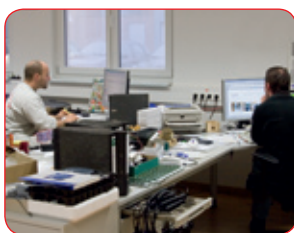
... typical battery types and sizes which are mentioned below (other cell sizes available as well).

Cylindrical cells

| | ∅ (mm) | height (mm) | A A A A | A A A | A A | A | C | D | N |
|--------------|-----------|----------------|------------------|-------------|--------|---|---|---|---|
| mini | 8.3 | 42.5 | x | | | | | | |
| micro | 10.5 | 44.5 | | x | | | | | |
| mignon | 14.7 | 50.5 | | | x | | | | |
| special size | 17.0 | 49.0 | | | | x | | | |
| baby | 25.8 | 50.0 | | | | | x | | |
| mono | 33.0 | 61.5 | | | | | | x | |
| lady | 12.0 | 30.0 | | | | | | | x |

... standard measurements for lithium-ion cells.

| ∅ (mm) | height (mm) | 14500 | 14650 | 18650 | 26650 |
|-----------|----------------|-------|-------|-------|-------|
| 14.0 | 50.0 | x | | | |
| 14.0 | 65.0 | | x | | |
| 18.0 | 65.0 | | | x | |
| 26.0 | 65.0 | | | | x |



Prismatic cells

- no specific standard measurements
- smallest cell = 032035, which is 3.0 mm x 20.0 mm x 35.0 mm (L x W x H)

| length (mm) | width (mm) | height (mm) | 033555 | 053048 | 103450 | 9-Volt | 344814 |
|----------------|---------------|----------------|--------|--------|--------|--------|--------|
| 3.0 | 35.0 | 55.0 | x | | | | |
| 5.0 | 30.0 | 48.0 | | x | | | |
| 10.0 | 34.0 | 50.0 | | | x | | |
| 26.0 | 48.0 | 17.0 | | | | x | |
| 34.0 | 48.0 | 14.0 | | | | | x |

Nickel-cadmium & nickel-metal-hydride

Nickel-cadmium (NiCd) and nickel-metal-hydride (NiMH) are similar types of technology which can replace each other in various applications.

Nickel-cadmium

Advantages

- high amount of charge and discharge cycles (up to 1,000)
- long shelf life (up to five years)
- good cost-performance ratio
- out-performances other technologies at lower temperatures

Disadvantages

- low energy density
- monthly care helps to avoid the memory effect
- toxic cadmium is environmentally unfriendly and forbidden in some countries like the Scandinavians

Useful things to know about NiCd ...

- to reach the full capacity of the cell, charge and discharge without usage for the first five times (formatting)
- best stored at a fully loaded state (formatting after a long storage can be helpful to get the whole capacity back)
- mainly produced in cylindrical cells

Nickel-metal-hydride

Advantages

- higher energy density than NiCd (30% and more)
- environmentally friendly, no constriction for particular countries

Disadvantages

- 50% more self discharge than NiCd
- temperature sensitive
- avoid overcharging and beware the cell warming while charging

Useful things to know about NiMH ...

- best stored at a 40% loaded state (formatting after a long storage can be helpful to get the whole capacity back)
- does not get effected by the memory effect that much because it is repairable up to a certain degree (depend on the charger technology), quarterly care helps to avoid lost of energy potential

Nickel-cadmium

Nickel-metal-hydride

Cylindrical cells

| | Nickel-cadmium | Nickel-metal-hydride |
|-----------------|----------------------|----------------------|
| capacity | ● 110 to 20,000 mAh | ● 550 to 16,000 mAh |
| voltage | ● 1.2 V | ● 1.2 V |
| AAAA | | ● 550 to 650 mAh |
| AAA | ● 220 to 300 mAh | ● 280 to 1,000 mAh |
| AA | ● 170 to 300 mAh | ● 600 to 2,700 mAh |
| A | ● 660 to 1,650 mAh | ● 900 to 4,100 mAh |
| C | ● 1,320 to 3,000 mAh | ● 1,500 to 5,500 mAh |
| D | ● 1,320 to 5,500 mAh | ● 1,800 to 8,500 mAh |
| F | ● 1,320 to 8,000 mAh | ● to 15,000 mAh |
| N | ● 220 mAh | |

Prismatic cells

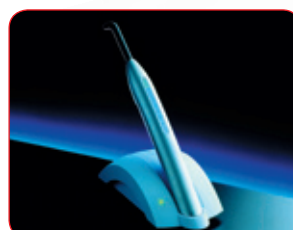
| | Nickel-cadmium | Nickel-metal-hydride |
|-----------------|--------------------|----------------------|
| capacity | ● 400 to 1,080 mAh | ● 650 to 1,350 mAh |
| voltage | ● 1.2 V | ● 1.2 V, 9V block |

Button cells

| | Nickel-cadmium | Nickel-metal-hydride |
|-----------------|-------------------|----------------------|
| capacity | ● 18 to 1,000 mAh | ● 60 to 600 mAh |
| voltage | ● 1.5 V, 3.0 V | ● 1.2 V |

Application & features

| | Nickel-cadmium | Nickel-metal-hydride |
|------------------------|--|---|
| general applic. | <ul style="list-style-type: none"> ● customer electronic ● measuring instrument ● medical equipment ● power tool ● emergency lighting ● PCB, memory, clock | <ul style="list-style-type: none"> ● cellular phone ● medical equipment ● safety system ● POS system ● barcode reader |
| features | <ul style="list-style-type: none"> ● fast charging cycle ● deep discharge ● ultra long shelf life ● high energy density | <ul style="list-style-type: none"> ● twice the energy density of NiCd batteries ● very small dimensions ● immerse in solder bath ● maintenance free |



Lithium

As the lightest material lithium owns the highest electrochemical potential and considers the highest energy density per weight. The aim of using this high energy potential for portable power solutions was the beginning of a new technology era which gets more and more important. As its high capacity of 3.86Ah/g is an advantage for portable products, it has its disadvantages as well:

- special transportation rules for all lithium pack solution over
 - > two grams (lithium primary)
 - > eight grams (lithium-ion)

Lithium primary

The correct choice of non-rechargeable batteries depends on your requirements, as the different chemical compounds used in this technology greatly change the cells performance. The main cell features and chemical compounds are ...

- Li-SO₂
 - > voltage ~3.0V with high continuous current
- Li-MnO₂
 - > voltage ~3.3V with higher nominal capacity
- Li-SOCl₂
 - > voltage ~3.6V with temperature up to +85°C
 - > huge nominal capacities (Ah) but low continuous current

Lithium-ion

To use high energy density on a rechargeable basis, battery manufacturers had to search for other chemical compounds and configurations. By using graphite as negative electrode and ionised lithium as a positive counterpart, lithium-ion technology was founded.

Advantages

- nominal capacity = 2 x NiMH
- nominal voltage = 3 x NiMH
- no need for formatting or periodical care for a long life time
- no memory effect

Disadvantages

- certain lithium-ion technologies need a protection circuit
- aging depend on storage conditions
- damages easy by over(dis)charge

Useful things to know about lithium-ion ...

- better cost-performance ratio for battery packs than for single cells
- chemical compounds within change frequently because of the new technology
- best stored at a 30% loaded state and at room temperature (25°C) or lower

Lithium primary

| | cylindrical cells | button cells |
|---------------------|--|--|
| capacity | ● 7 to 18,500 mAh | ● 5 to 1,600 mAh |
| voltage | ● 3.0 V, 3.3 V, 3.6 V | ● 1.5 V, 3.0 V |
| applications | <ul style="list-style-type: none"> ● radio equipment ● automatic camera ● emergency lighting ● water, gas, electricity meter ● memory backup power source | <ul style="list-style-type: none"> ● clock, memory ● power supply, PCB ● medical equipment ● memory backup power source ● electronic key fobs |
| features | <ul style="list-style-type: none"> ● ultra long shelf life ● high reliability ● wide operating temperature range ● extended operating life | <ul style="list-style-type: none"> ● ultra long shelf life ● high reliability ● wide operating temperature range ● extended operating life |

Lithium-ion cobalt

| | capacity | voltage |
|--------------------------|---|--|
| cylindrical cells | ● 150 to 40,000 mAh | ● 3.6 V, 3.7 V |
| prismatic cells | ● 190 to 5,900 mAh | ● 3.6 V, 3.7 V |
| polymer cells | ● 110 to 100,000 mAh | ● 3.6 V, 3.7 V |
| applications | <ul style="list-style-type: none"> ● cellular phone ● medical equipment ● power tool ● POS terminal ● PDA, Palmtop, Organizer ● solar device ● scanner | <ul style="list-style-type: none"> ● no memory effect ● light weight ● high cycles ● long shelf life ● good load performance <p>polymer:</p> <ul style="list-style-type: none"> ● slim design, flexible form factor |



Lithium-ion manganese

The lithium-ion manganese is the first advancement which fulfils the requirements of higher safety. Additionally it offers the use of cells without a protection circuit for several applications.

Our focused lithium-ion manganese cells for battery pack manufacturing are defined as follows:

| ∅ (mm) | height (mm) | voltage (V) | capacity [mAh] | weight [g] | |
|--------|-------------|-------------|----------------|------------|--------------------------------------|
| 14.15 | 49.3 | 3.7 | 680 | 16 | 60% of initial capacity (500 cycles) |
| 18.35 | 65.1 | 3.7 | 1,600 | 44 | 75% of initial capacity (500 cycles) |

The following cells are used in high current applications:

| ∅ (mm) | height (mm) | voltage (V) | capacity [mAh] | weight [g] | |
|--------|-------------|-------------|----------------|------------|--------------------------------------|
| 18.35 | 65.1 | 3.6 | 1,080 | 41 | 90% of initial capacity (500 cycles) |
| 26.45 | 65.6 | 3.6 | 2,500 | 90 | 90% of initial capacity (500 cycles) |

Applications

- POS terminal
- domestic equipment
- measuring instrument
- medical equipment
- power and gardening tool
- electric drive system

Lithium-ion nickel-cobalt-manganese = "tri-mix"

The "tri-mix" cell technology is a compromise between high energy density and safer usage.

| ∅ (mm) | height (mm) | voltage (V) | capacity [mAh] | weight [g] | |
|--------|-------------|-------------|----------------|------------|--------------------------------------|
| 18.1 | 64.8 | 3.6 | 2,000 | 44 | 60% of initial capacity (500 cycles) |
| 18.6 | 65.2 | 3.6 | 2,250 | 44 | 75% of initial capacity (500 cycles) |

The typical applications for this technology are the same as lithium-ion cobalt or lithium-ion manganese.

Lithium-ion phosphate

Its huge discharge rate is the main feature of this technology.

| ∅ (mm) | height (mm) | voltage (V) | capacity [mAh] | weight [g] | |
|--------|-------------|-------------|----------------|------------|---|
| 18.1 | 65.0 | 3.3 | 1,100 | 38 | 90% of initial capacity (1,000 cycles) |
| 26.15 | 65.5 | 3.3 | 2,300 | 70 | 80-90% of initial capacity (1,000 cycles) |

Applications

- hybrid electric vehicle
- electric drive system
- home appliance
- military equipment
- medical device
- robotics
- farming machine
- power and gardening tool
- power backup for communication station

Other single cells of this technology which are available by the end of 2006.

voltages: 3.3 V up to 12.0 V
 capacities: 5,000 mAh up to 250,000 mAh
 dimensions: cylindrical and prismatic

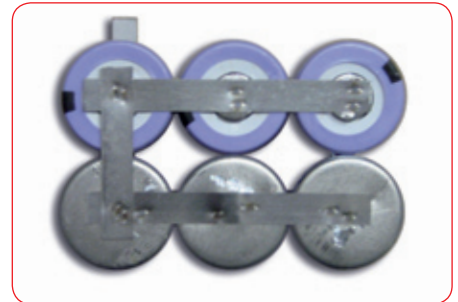
Comparison data of various lithium-ion technologies

| | cobalt | manganese | 'tri-mix' | phosphate |
|----------------------|---------|-----------|-----------|-----------|
| safety | -- | + | - | + |
| cycle life | + | + | + | + |
| power weight density | + | - | + | - |
| long term cost | + | + | - | - |
| temperature (°C) | -20/+60 | -20/+60 | -20/+60 | -45/+70 |

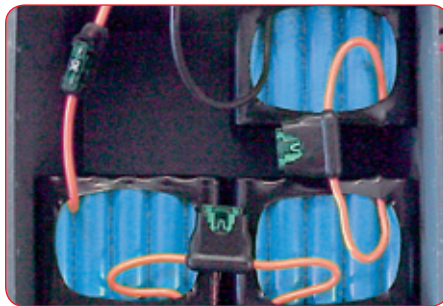
Customer applications – lithium-ion technology



3S3P – lithium-ion cobalt
>> 10.8 V and 6,300 mAh



3S2P – lithium-ion cobalt
>> 10.8 V and 4,200 mAh



3S30P – lithium-ion manganese
>> 10.8 V and 48,000 mAh

Lithium-ion standard battery packs

| | capacity | voltage | pack dimensions |
|------------|-----------|---------|-----------------|
| 1S1P 18650 | 2,000 mAh | 3.6 V | 22 x 22 x 70 |
| 2S1P 18650 | 2,000 mAh | 7.2 V | 44 x 22 x 70 |
| 3S1P 18650 | 2,000 mAh | 10.8 V | 60 x 22 x 70 |
| 4S1P 18650 | 2,000 mAh | 14.4 V | 75 x 22 x 70 |
| 1S2P 18650 | 4,000 mAh | 3.6 V | 44 x 22 x 70 |
| 2S2P 18650 | 4,000 mAh | 7.2 V | 75 x 22 x 70 |
| 1S4P 18650 | 8,000 mAh | 3.6 V | 75 x 22 x 70 |



Sealed lead batteries

High performance, long service life and a huge weight are known for lead-acid batteries. Gleichmann supports three different types of sealed lead technologies: lead-acid, lead-fleece and lead-gel.

Lead-acid as the oldest lead technology is mainly used for high current rates within a short time. Additionally to lead and acid it contains water to cool the battery whilst warming-up because of pulling high current rates and to avoid the inflammableness.

A similar structure to lead-acid has the **lead-fleece** technology: lead plates are separated by fleece plates. This type offers high current rates for a short while as well but its disadvantage is that the fleece gets dry and porous that is why the cycle life can be shorter with this type.

Lead-gel batteries are for non-portable products only. The gel desiccates slowly which supports a longer life time. By too much movement of the cell the gel creates air bubbles which are bad insulators. As a consequence they cause the warming-up inside the cell and make it useless for the long-term usage.

| | voltage | capacity |
|--------------|-------------|------------------|
| general type | 2 V to 24 V | 1.2 Ah to 200 Ah |

norm for emergency power: US = 6 V, EU = 12 V

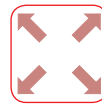
higher capacity rates for telecommunication available

| | voltage | capacity |
|-------------------------|--------------|------------------|
| high rate type | 12 V to 36 V | 5 Ah to 50 Ah |
| high power type | 12 V | 3 Ah to 135 Ah |
| special type | 4 V to 12 V | 0.5 Ah to 3.5 Ah |
| general type exit light | 4 V to 12 V | 2.5 Ah to 8 Ah |

Applications

- emergency power
- telecommunication
- medical device
- electric drive system
- solar system
- vending machine
- emergency lighting





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What will you do when you see **RED?**

2008 brings new changes in the manufacturing of products containing nickel-cadmium power cells.

Stop

Cylindrical cells:
20,000 mAh
vs. 40,000 mAh

Get ready

Prismatic cells:
1,080 mAh
vs. 5,900 mAh

Go!

Did you know?
A standard **24 V** battery pack requires either **20 nickel-cadmium** cells or **7 lithium-ion** cells



Lithium-ion cells

- have many advantages over nickel-cadmium.
- contain a higher voltage per cell than nickel-cadmium.
- out perform nickel-cadmium at lower temperatures.
- contain a higher energy density than nickel-cadmium.
- use simpler management and charging technology than nickel-cadmium.

Don't get stuck at the lights – our battery team is green to go and ready to support you!



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