

24V Type Standard Battery Packs Using Large-Capacity Laminated Cells

ZAMA Koichi, SUZUKI Shin, KASAI Masakatsu, SHIOYA Taishi

Abstract

This paper introduces 24V type standard battery packs composed of large-capacity or high-power type laminated battery cells connected in series. These battery packs are used in combination with a dedicated battery charger and can be handled easily even by beginners who are not familiar with lithium ion batteries. The large-capacity type is designed mainly for power storage related applications, such as for UPS (Uninterrupted Power Supply), backup power supply for large equipment and natural energy storage (wind, solar, etc.) The high-power type is designed mainly for motor-drive related applications that require a momentary high current, such as for momentary power failure backup UPS, motorized bikes, motorized carts and robots.

Keywords

standard pack, laminated, lithium-manganate ion rechargeable battery, large capacity, high power

1. Introduction

At NEC TOKIN, we were aware that manganese was to be found in abundant deposits. Consequently by adopting lithium-manganate with its stable crystalline structure as the positive electrode material we have developed a lithium-manganate ion rechargeable battery that features excellent safety characteristics. We have thus been enabled to supply rectangular and compact laminate batteries to the market. In addition, we are also mass-producing large-capacity and high-power type laminated battery cells that adopt lithium manganate for a positive electrode material, laminate exterior and multilayer structure of electrodes.

On this occasion, we have developed 24V type standard battery packs composed of these laminated cells connected in series. These battery packs incorporate protection circuitry for the safe use of lithium-ion rechargeable batteries that may be used easily in combination with a dedicated battery charger.

With previous battery packs, the performance of each cell, the pack configuration and the functions had to be custom-designed according to the purposes of the applied equipment. However, the new products feature standardization of the 24V power supplies so that they may offer solutions that enable reduction of the design period, and application volumes and popularization of the use of the lithium-ion rechargeable battery. For example, their input/output specifications are held in common so that users who have never used the lithium-ion

battery may reliably use the battery packs. The standard battery packs also feature light weight and safety in use as laminated cells that do not have can-like structures and full use is made of our unique battery control and packaging technologies.

2. Marketability and Issues Related to the Large-Capacity Lithium Ion Battery

The large-capacity lithium-ion battery is attracting attention from the viewpoints of effective energy usage and environmental considerations and its market is expected to expand further in the future. Its fields of application are also expected to expand. These will include drive applications for power-assisted bicycles, powered wheelchairs and robots, storage applications for the storage of power generated by the natural energies of wind and solar light and features aimed at the equalization of power between daytime and nighttime, and the applications for consuming high energy such as automobiles (HEV, HV, etc.), motorized bikes and motorized carts.

On the other hand, in order to deal with the high capacity and large variety of market fields to which the battery will be applied, it is essential to secure safety standards that are strict enough to handle the large capacities that are envisaged. It will also be necessary to adopt extensive design redundancies in the fields of structural design, protection circuit design and equipment design as well as for the battery materials.

3. Purpose of Development

The newly developed large-capacity standard battery packs focus on 24V type applications such as for the already-proven power-assisted bicycles as the main targets and two models with energy capacities in the 100Wh and 200Wh classes are in preparation. When these are applied to motor drive, for example, they are assumed to be capable of driving a 50W class motor for 2 to 4 hours. They are also considered to be capable of providing solutions that are able to handle various scenarios and are assumed to be capable of parallel connection of multiple standard packs in cases for which higher energy inputs are required.

The specific usages considered for these battery packs include their use as backup power supply for various kinds of equipment and their incorporation in motor driven equipment, lighting equipment etc. They are equipped with safety protection circuits so that they can be introduced in their applications as they stand without further modifications. They also feature a power remaining indication facility for improving their ease of use.

4. Features of the Manganese Laminated Battery Cells

Table 1 shows the characteristics of the two kinds of laminated cells intended for use in the new standard battery packs, which are the large-capacity cell (IML05/82/150A) and the high-power type cell (IML05/82/150B). The large-capacity cell has an energy density per mass of 130Wh/kg and energy density per volume of 270Wh/l. It features slimness and light weight thanks to the use of aluminum-based laminated film for the exterior as shown in **Photo 1**.

The large-capacity cell of NEC TOKIN has the following four main features.

Table 1 Specifications for the laminated lithium-ion rechargeable batteries.

Item	Large capacity type IML05/82/150A	High-power type IML05/82/150B
Dimensions L × W × T (mm)	150 × 82 × 5.6	150 × 82 × 5.0
Weight (grams)	113	108
Discharge capacity (Ah) typ.	4.3	3.8
Z (mΩ)@1kHz	6.5	5.2
Max. continuous discharge current (A)	12.0	16.0



Photo 1 Appearance of IML05/82/150A.

- 1) High safety thanks to the manganese positive electrode.
- 2) Light weight, slim size and high heat radiation thanks to the laminated exterior.
- 3) Low impedance and reduced heat generation thanks to the stacked electrode structure.
- 4) High reliability thanks to the newly developed electrolyte.

5. 24V Type Standard Battery Packs

5.1 Summary of Standard Battery Packs

The standard packs are configured for use in 24V power supply systems using either of the large capacity type laminated cells described above. These devices implement an average supply voltage of 25.9V by the connection of 7 cells in series. Our commercialized products include those with the 7 series units in 1- parallel type configuration and the products with 7 series units in the 2- parallel type configuration (**Photo 2** and **Photo 3**).

Table 2 summarizes the characteristics of the large capacity type products. Each battery pack includes the protection

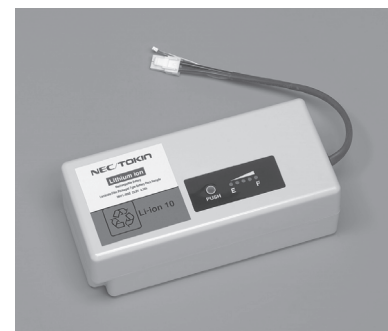


Photo 2 Appearance of 7-series, 1-parallel type standard battery pack.

24V Type Standard Battery Packs Using Large-Capacity Laminated Cells

circuitry and devices for safely achieving the characteristics shown in Table 2, and can be connected directly to the application target.

The standard battery packs are controlled by the protection circuitry that permanently monitors over-recharging, over-discharge, over-current, temperature, etc. in order to prevent incidents associated with heat generation or fire ignition of the pack before it occurs, even in the case of unexpected events. These products are additionally capable of battery situation management by means of discharge capacity and cycle count, thanks to the UART communication with the dedicated charger.

Each standard battery pack has an LED on its surface that can identify the remaining battery capacity accurately by comparing and computing data using a unique technology.



Photo 3 Appearance of 7-series, 2-parallel type standard battery pack.

Table 2 Characteristics of large-capacity type standard battery packs.

Item	7-series, 1-parallel (MH71-3002)	7-series, 2-parallel (MH71-3003)
Rated capacity	4.3Ah typ.	8.6Ah typ.
Nominal voltage	25.9V	25.9V
Max. charge voltage	29.6V	29.6V
Discharge cutoff voltage	17.5V	17.5V
Max. continuous charge current	4.5A	4.5A
Max. continuous discharge current	12A	12A
Max. pulse discharge current	30A/0.5 sec.	30A/0.5 sec.
Operating temperatures	Charging	0 to 40°C
	Discharging	-10 to +50°C
Storage temperatures	-20 to +40°C	-20 to +40°C
Dimensions (W × L × H, mm)	91 × 200 × 70	180 × 210 × 70
Weight	1.3kg typ.	2.5kg typ.

The provision of the dedicated battery charger as an accessory facilitates the evaluation and usage of the lithium-ion battery packs quickly, contributing thus to a quick commercialization of various applications.

5.2 Characteristics of Standard Battery Packs

Fig. 1 shows the discharge rate characteristic of the 1-parallel standard battery pack product using the large capacity type cells described above, Fig. 2 shows its temperature characteristic graph and Fig. 3 shows its cycle characteristic.

The large-capacity type battery packs are assumed to be used for long periods from 1 to 3 hours, and the discharge rate is optimized by using cells designed for up to about 3 C (coulomb) and by designing the circuit and current structures so that the pack can also discharge about 3 C. The 2-parallel battery pack also follows the same idea and achieves the same maximum discharge current as the 1-parallel product. The protection circuitry is of the minimum required scale so that the temperature and cycle characteristics of the cells are reflected in those of the battery packs.

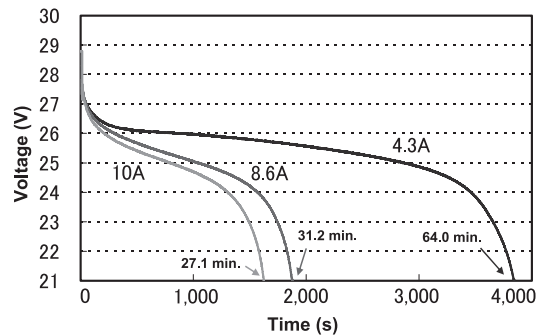


Fig. 1 Rate characteristic of the standard battery pack.

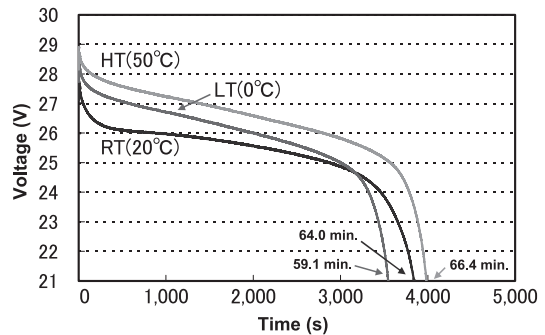


Fig. 2 Temperature characteristics of the standard battery packs.

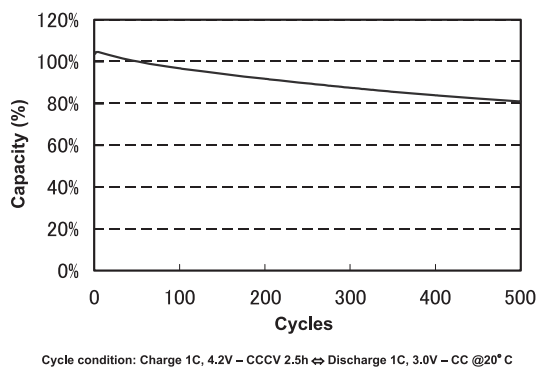


Fig. 3 Cycle characteristics of the standard battery packs.

In order to support their positioning as standard packs, the products clear all of the items in the air transport regulations recommended by the UN. The products can therefore be transported anywhere and are compatible with any means of transport inside as well as outside Japan.

5.3 Applications of Standard Battery Packs

The main applications of these products are classified into two types just as are the battery cell types used in them.

- 1) Large capacity type applications.
- 2) High-power type applications (under development)

The former applications refer to the power storage-related ones, such as the power type UPS (Uninterrupted Power Supply), the backup power supply for large equipment, the storage of the natural energy-generated power (wind, solar, etc.). The 1-parallel and 2-parallel products have the rated capacity of 4.3Ah (111Wh) and 8.6Ah (223Wh) respectively, enabling selection of the optimum product according to the properties required by each application.

The latter applications refer to the motor-drive related ones with which momentary high current is required, such as for momentary power failure backup UPS, motorized bicycles, motorized carts and robots. The high power type standard battery packs for use in these applications are under development.

6. Conclusion

At NEC TOKIN, we have developed standard battery packs that provide light weight, large capacity and high charge/discharge efficiency making use of the safety, long-term reliability and high power of the Lithium-manganate ion laminated

cells. For the present, we have started to supply the large capacity type products as the standard lithium-ion battery packs that are easily usable in various applications.

In the future, we intend to improve the performance of the large-capacity type products further in order to develop the standard battery packs incorporating the high-power type cells for use in large-current applications. This will be achieved by using our proven technologies that have been cultivated through long years of experience in the field of battery manufacture. The newly developed products will then be added to the product line-up in order to meet a broader range of market needs.

Authors' Profiles

ZAMA Koichi

Manager,
Storage & Drive Battery Group,
Laminate Battery Business Promotion Division,
NEC TOKIN Corporation

SUZUKI Shin

Assistant Manager,
Storage & Drive Battery Group,
Laminate Battery Business Promotion Division,
NEC TOKIN Corporation

KASAI Masakatsu

Assistant Manager,
Storage & Drive Battery Group,
Laminate Battery Business Promotion Division,
NEC TOKIN Corporation

SHIOYA Taishi

Assistant Manager,
Storage & Drive Battery Group,
Laminate Battery Business Promotion Division,
NEC TOKIN Corporation

The details about this paper can be seen at the following.

Related URL:

<http://www.nec-tokin.com/product/me/product/lineup-gaiyo.html>