

SUMMARY

Electronic medical carts equipped with computing Systems are commonplace as more healthcare facilities utilized electronic medical record systems. These carts provide full computing functionality for clinical staff members when treating patients. They also support numerous periphery functions that require power, such as RFID, barcode scanners, and other bedside tools. Nearly all carts today rely on advanced batteries for operational portability to insure uptime and ease of use. In the past, lead acid batteries were used, but have been mostly replaced with lithium ion batteries due to their light weight, high energy density, and long service life.

KEY TRENDS

Medical carts are mostly used in a temperature controlled environment ~20 - 25 °C. During regular use they can power cycle the batteries 2 or 3 times over a 24 hour period, which generates approximately 700 - 1,000 cycles per year on the battery. Lead acid batteries under this use profile would reach end of life in 12 to 18 months, requiring replacement. The transition from lead-acid batteries to lithium ion batteries over the last few years has dramatically improved cart performance and reduced service costs.

Most medical cart suppliers specify the end of service life for a lithium ion battery when it drops to 60% - 70% of its original or beginning of life (BOL) capacity. Many lithium ion batteries will reach this end of life (EOL) point after <3,000 or 4,000 cycles. This means battery life is expected to be 3 to 5 years from the start of service.

The charging time for most lithium ion batteries used with AC line connected carts is 2 to 3 hours, which compares favorably with lead-acid batteries that can take up to 12 hours to fully charge. This is the recharge time from 0% to 100% state of charge (SOC). Depending on the number and deployment of carts in a healthcare facility, even 2 or 3 hours recharge time can impact equipment availability and logistics.



Carts that employ batteries that are hot swappable by healthcare personnel can insure system up time and readiness. However, these battery solutions tend to be more expensive than line connected carts and require the purchase and maintenance of charging stations and spare battery packs.

BACKUP POWER ATTRIBUTES & CHALLENGES

The main priority for electronic medical carts is they work “on demand” and at full utility. Healthcare facilities cannot afford unplanned system down time and work stoppage. Additionally, service and IT departments want to see operational savings from equipment that requires minimal or no service costs. Sidelining equipment for hours to accommodate battery charging or for frequent patient servicing directly impacts the cost and quality of patient care.

The ALM[®] 12V35 is a robust and light weight family of lithium ion batteries that have unmatched cycle and calendar life over a wide range of operating conditions (see figure 1). This enables a low Total Cost of Ownership (TCO) even with 3 full 100% Depth of Discharge (DOD) cycles per day (1 cycle per 8 hour work shift). Under these conditions, the expected service life is greater than 10 years. If the use profile is 2 cycles per day, then the service life is over 13 years. The ALM 12V35 can provided energy to 60% BOL before reaching its EOL point. This further increases the overall service life.

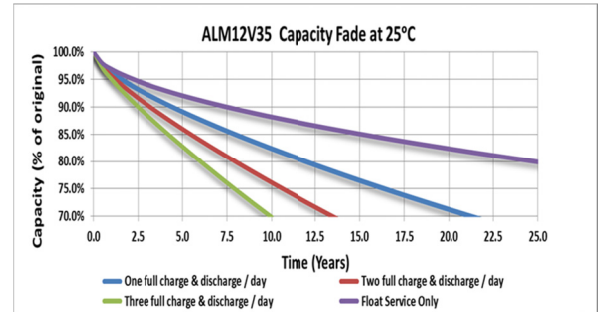


Figure 1

The ALM 12V35 high power design allows fast charge times from 0% to a 100% SOC in less than 20 minutes. Using a 70A charger, the ALM 12V35 can be recharged in ~30 minutes, reducing typical charge times by 4X – 6X. Under this scenario, a 30 minute charge delivers enough energy to support an 11.5 hour run time, assuming a 40W load. The potential is for a cart to spend less time under charging, and more time serving patients.

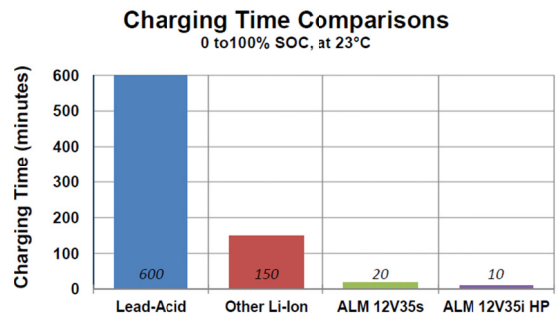


Figure 2

SOLUTION

The ALM[®] 12V35i HP battery takes medical cart operation to a higher level of reliability, safety, and service life. The battery is available in a group U-1 form factor. It can be safely charged and discharged across 100% of its capacity and at rates as high as 6C or 10 minutes. The ALM 12V35i HP comes with SMBus functions to communicate with electronic medical cart systems to intelligently manage battery state of charge based on operational demands. This optimizes the battery's performance out of each charge and discharge cycle.

The ALM 12V35 maximizes the value of modern medical carts in the following areas.

1.) Reliability & Safety

The ALM[®] 12V35 uses lithium iron phosphate (LiFePO₄) cells that provide excellent deep cycling capabilities, extended temperature, long service life and exceptional power and energy performance. The ALM 12V35 includes EverSafe™ protection technology as part of the Battery Management System (BMS) in each battery. This technology delivers fully redundant protection from internal failures or external abuse. It provides system-level protections for battery and power system operation, with automatic adjustments and recovery from system level faults or abusive application.

2.) Agency Compliance

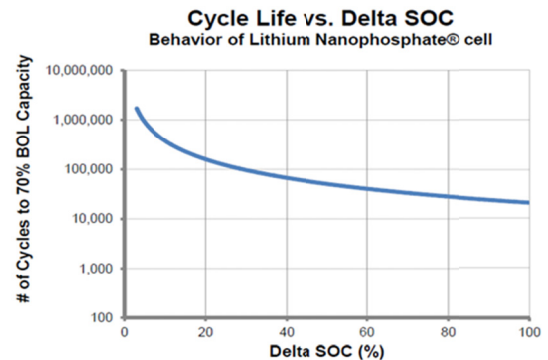
The ALM 12V35 family of lithium-ion batteries undergoes engineering construction, evaluation, and extensive testing to ensure international product safety conformity, as well as application specific certifications. These standards include.

- IEC62133; UL 1973, UL1642
- REACH, RoHS and Battery Directive (2006/66/EC)
- Meets FCC 47CFR 15 Class B, IEC61000-6-1, -2, -3, -4, ICES-003
- UN Manual of Tests and Criteria Part III, subsection 38.3

3.) Service Life, Total Cost of Ownership

The ALM 12V35 when operated at three full 100% DOD power cycles at a 24/7/365 rate has a cycle life in excess of 10,000 cycles to 70% BOL. This provides a service life of over 10 years. The cost savings from this level of reliability and cycle efficiency are substantial. Using the ALM 12V35 will match or exceed the service life of the cart. Also, there is no need to invest in highly specialized carts that use customized, hot swappable batteries.

Figure 3 shows the results of the LiFePO₄ cells used in the ALM 12V35 and shows substantial cycle life over a 0% - 100% delta SOC range. This performance adds an extra level of reliability as some lithium ion chemistries suffer reduced cycle life as a result of partial state of charge operation.



Number of cycles is dependent upon average SOC, charge/discharge rates, temperature and calendar time. Actual results will depend on specific use cases. Contact NEC Energy Solutions for more details.

Figure 3

4.) Smart Battery Functions and Communications

The ALM12V35 is available in an intelligent (i) series with integrated CAN bus or SMBus communications. The ALM 12V35i HP SMBus can be integrated with medical cart management systems. The data is compatible with Smart Battery System (SBS) specifications, with NEC extensions. The ALM 12V35i provides remote monitoring and control of critical battery status and usage tracking.

Capabilities include:

- Battery voltage and current
- Relative state of charge (SOC)
- Cell voltage and temperatures
- Programmable thresholds for remaining capacity, time, charging
- Alarm and fault monitoring



Details on design, safety, and compliance can be found in the NEC Energy Solutions white paper: [Lithium-Ion Battery Design for Safety](#)

Visit www.neces.com for the latest information and data sheets.

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