A DIVISION OF HOFFMAN ENGINEERING

Hoffman Engineered Systems

Introduction of the

Series 301 Motive DC Controller

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Introduction

Hoffman Engineered Systems [HES] is a division of Hoffman Engineering Corporation [HEC] located just outside of New York City in the town of Stamford Connecticut. We are an independent business owned by a private U. K. company. We are located in the Riverbend Industrial park in a modern 30,000 square foot facility.

HES is a manufacturing company producing highly engineered products for the medical, aerospace, automotive and other industries. We have historically relied on our engineering capabilities to drive our success. We enjoy ISO accreditation along with a variety of quality awards including a Star Supplier Rating to Lockheed Martin.

We have been in business for over 50 years. HEC is most widely recognized for our light measurement products used in the automotive and aerospace industries. We design, develop and manufacture very unique instruments capable of measuring light and its physical characteristics more precisely and more accurately than any other company in the world.

We have leveraged this creative engineering talent and high quality, low cost manufacturing capability into the Medical Industry where we design, develop and manufacture a line of Power Management products called Motive DC Controllers.

Our Motive DC Controllers were designed to fit a very specific market request that we believe had not had an adequate response from industry. Using our abilities designing and manufacturing instruments requiring precise measurement and our understanding of power sources and this specific portable application, we have introduced a unique power management product.

Our Motive DC Controller was conceived to provide the Nursing community with a low maintenance, low cost method to power their Computers on Wheels [COWs] to fit their daily routine. This is the essence of the unique properties of the HES product; it is a sophisticated power system that provides a seamless integration of Mobile Carts into the Nurse's domain.

Market Need

Our introduction to this market was approximately 5 years ago. We became involved in the industry to help resolve the primary problems of insufficient run times, short battery life and battery out gassing experienced by various powered Mobile Point of Care [MPOC] carts in various hospitals and other medical facilities. The Nursing community was unhappy with the above problems and also the amount of the Nurses' involvement required to ensure the carts had adequate power remaining and to deal with the above issues.

At the time, the industry was experiencing the need to recharge carts within two to three hours. The Nursing community was focused on providing patient care and was not willing to care for the maintenance and upkeep of the battery conditions on the carts. In many situations the carts had been pushed aside and were not being used because the Nursing community was frustrated with the poor run times and the frequent recharges; especially the crisis "beeping" carts that were losing power during critical situations.

We found that the Nurses that *were* using carts had them plugged in virtually all of the time unless they were in use. This became problematic since the availability of common area AC power to keep the carts plugged in was not designed for the quantities required. Further, the Nurse's ability to know whether the cart to be used had adequate battery life was dependent on a very few lights providing just a very basic idea –green/yellow/red- of the state of the battery. This was inadequate information for the Nurse to make the basic decision whether or not the cart was going to remain powered for the duty to be performed.

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There was a variety of other problems that were also of issue such as the following.

Safety concerns

- Out gassing of batteries creating dangerous conditions
- Heating of batteries; Thermal runaway causing dangerous conditions
- Unattended carts

Security concerns

- Graceful shutdown of applications on power loss; loss of critical data

Cost concerns

- The logistics of when to replace batteries; keeping track of a high quantity of carts
- The life of the batteries; optimizing their use and therefore cost
- Over discharged batteries recovery; recovering a good battery and therefore saving the cost of purchasing new
- Battery Warranty disputes; misused or bad batteries

Performance and ease of use concerns

- Indicating the "time" left in a battery rather than a percentage; intuitive understanding of the timing for Nurse's use
- Fan noise used to cool power systems; annoying fan noise in a hospital environment

In essence, the industry had significant power problems; safety, security, cost and performance that were hampering the effective use of powered Mobile Carts. In our opinion, there was inadequate response to these issues from the existing suppliers to the market.

AC versus DC Comparison

The most critical aspect of the response to the market requirement was the fundamental type of power system to use as the basis of the design; AC power based or DC power based. The essential difference between the two approaches is in run times, safety and ease of use.

An AC system is essentially an Uninterruptible Power Supply [UPS] that is used in a variety of commercial applications to ensure power is not lost during an interrupt of the main power source. These are commonly used with Personal Computers [PC]. They provide a battery backed up function that gracefully shuts down a PC [or other device] after a given length of time. They are plugged into an AC wall outlet and provide a corresponding AC type plug for the supported device to be plugged into. The basic commercial product charges the batteries continuously at a very low current. Their intended commercial use expects very infrequent power interruptions with a relatively short time required to keep the device powered and an acceptable power down if it is accomplished without loss of data.

Since AC systems pass through AC power directly when the source power is not interrupted, they require isolation from the source power. This is a safety and performance concern.

AC power systems tend to have reduced cycle times for various reasons.

First, they are designed to primarily run from wall power and to "survive" the movement between plugs, or primary power sources, rather than intentionally working while unplugged. The design typically is optimized to ensure the availability of power and the graceful operation during the removal of power and the power down. Operation during loss of primary power is through DC to AC inverters that are typically inefficient [70%] and require a quiescent current that slowly depletes energy from a battery even without loads. Also, many devices to be interfaced with the AC power then, again, convert it back to DC for use. This, again, creates a further inefficiency due to the conversion of power from AC to DC that may reduce its effective power by 70% again. This results in the "effective" available power from the battery potentially being reduced twice by 70%, or 49% total, of the original battery power. In essence, the time that the cart is mobile is intended to be short.

Secondly, the charge systems for typical commercially available UPS products are very low

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current, very slow chargers. In mobile applications, these chargers have been replaced with high current, fast charging devices. Fast charging does not provide the optimal charge for the battery. Further, fast charging can be dangerous if the charge method is not controlled with feedback. Batteries also require specific charge characteristics to ensure they are not *overcharged*, which can cause out gassing and other heat related dangers, and to ensure the battery is not faulty. In slow charge products, these issues are not significant concerns. As fast charging products replaced the slower chargers, these concerns were overlooked in consideration of the ability to reduce total charge times.

Third, charging of batteries to their maximum state charge and to ensure that the batteries life is optimized require the charge to be "managed" to the battery manufacturers requirements. Battery manufacturers have very specific guidelines to provide a full charge to the battery. Fast chargers frequently leave batteries undercharged or overcharged. Standard AC charge circuits do not provide the sophistication to manage the charge since the original intent is to survive unpowered events rather than to maximize the time available while unpowered. The fast chargers typically substituted in AC chargers are optimized for the speed of charge, not necessarily to optimize the charge available or to prolong the life of the batteries.

The most positive aspect of using AC power systems is that they provide standard power outlets that are commonly understood and are most easily interfaced to available devices. Standard PCs and displays, for example, typically are configured to plug into standard AC power. AC systems are easier to find compatible devices and are typically easier for users to plug and unplug devices.

DC systems, alternatively, are intended to provide maximum run times during mobility. Their design is constructed to provide the maximum charge to the battery and to always run devices directly from DC power; never directly to the wall. DC systems therefore have inherent isolation from wall power and are therefore inherently safer as well. The intention of a DC system is to fully charge, fully discharge and to utilize the full cycle of the battery.

DC systems are intended to "manage" charging of the batteries to optimize run times. This requires a rather sophisticated product since optimization requires feedback from the battery and the ability to set up and configure for the battery types used. The optimization must use the battery manufacturers' specifications and therefore must recognize, through feedback, the batteries' state at any given point since this parameter is critical to intelligent charging algorithms. This also provides the system the ability to recognize and respond to faulty batteries.

DC systems, however, are not as easily used as a source for commercial devices. Most devices are AC and those that are DC typically require a specific DC voltage beyond what the batteries naturally supply. This requires, in most cases, DC to DC regulation for each device attached. Due to the increasing popularity of mobile devices, more are coming to market that are designed for mobility and therefore have the DC to DC conversion embedded in the product. This is most frequently found in small mobile targeted PCs that are designed to run from standard car battery power. In most cases, however, using DC powered devices requires more up front planning and the use of dedicated DC to DC power converters.

HES selected the DC philosophy for the design of our product since we believed that the inherent advantages outweighed the limitations of DC device usage. We believed that the cart manufacturer would typically identify and advise, if not supply, the devices on the cart and therefore the ease of use issue would not impact the Nursing community. We further believed that the ease of use of AC receptacles could, at times, be a negative issue since vacuum cleaners and other unplanned instruments may be plugged into the available outlet; clearly not what the power system was designed for and potentially a dangerous problem with unlimited liability problems if critical instruments are powered by the cart. In the end, we decided that it would be much more straightforward to use a DC design rather than trying to force an AC design to operate as a DC designed system inherently operates.

Competition

The fundamental competition to our product is the AC power systems that have been in the industry for years. There are quite a few manufacturers of AC

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power products; the most notable are Tripp Lite and TDI. AC power systems are not direct competitors on a product basis since the features and capabilities are significantly different. AC power is a competitor however for power systems *in this application* since they can be utilized as an alternative. The DC power system is unique in the market with little direct product competition.

As a further differentiation to this market we have approached the design with a significantly different approach in regard to the sharing of source power across charging and powering devices on the cart. In HES' design, we have decided to use two power supplies to generate DC power from the wall AC power source. By doing this, we can support both the charging of batteries as well as powering of devices simultaneously. This provides the user the added features of (1) having a known charge time regardless of the load devices being powered (2) isolation of the devices from the charging system (3) allowing the cart to continue "in service" if the battery system fails and (4) allowing the cart to continue "in service" during a deep discharge recovery of a battery.

We have incorporated the added capability to, if necessary; draw some additional power for the battery charger to support the added needs of the battery charge if the total current draw required exceeds the power supply capability. This would be apparent in the case of 75 Amp Hour batteries that require a relatively high charge current for optimized charge. If the load devices did not absorb all of the available current for the load power supply, some of the available power would be delivered to the charge supply. Sharing of power in *this situation* would be apparent to the user and the time to complete the charge would reflect the reduced charge time necessary in the display.

The converse is also true. If the load devices temporarily required more power than available from the load power supply, the charging power supply will help to supply the necessary current. This is most frequently associated with the surge current necessary when powering an actuator drive motor or other infrequently powered devices. Again, however, the user would be aware of the effect, if it was significant, and the modified charge time would be reflected on the display.

In a standard DC system without two DC power supplies, the load devices would use whatever power was required and the remainder would be used to charge the battery. This is typically termed power sharing. Using a power shared system, it is common to undercharge batteries since the user does not have an indication that this is happening. The user will plug in the cart, believe that it is being charged, and use the load devices on the cart simultaneously. Since the charger is sharing the current necessary for the devices, the current to the battery is often very low. This requires the charger to, at times, charge for much longer than typically required to fully charge the batteries. The user rarely understands this issue and therefore removes the charge far sooner than required.

This difference in system architecture is significant in our design philosophy. Although it is a somewhat more costly approach, it covers a significant problem that has been identified through the historic misuse of batteries in this application.

Features

The following features are incorporated in the standard HES power system. Each of these features addresses a particular failing of former systems or a specific need of the market that has yet to be addressed.

300 Watts of Power

HES' Series 301 provides a full 300 watts of power; 150 dedicated to battery charging and 150 dedicated to the load devices. This provides ample power to charge large batteries, up to 75 amp hours, at the optimal rate [in accordance with battery manufacturer specifications] and to also power typical devices with considerable margin available. A reasonable Laptop or PC may use 50-80 watts while a display may absorb 40 watts [conservative estimates]. This provides at least 30 watts to power additional devices. We also provide the ability to seamlessly route power from the battery charging supply so that the load devices may use more power if required without detrimentally affecting the charge function.

Dedicated Load and Charge Power

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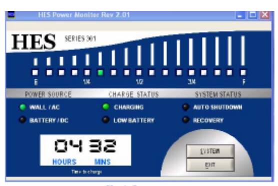
The 300 watts of power referenced above is supplied using two AC to DC power supplies. This provides the user the ability to charge the batteries while simultaneously using the cart without extending the charge time. The charge time will remain constant since the charging power supply is independent and does not share the power with the load devices. This ensures that users experience consistent charge times and ensures optimum charging of the battery.

This also allows the use of the cart if the batteries fail. The load power supply will still be available to run devices on the cart. If single power supply architecture was employed, a problem battery would either shut down the supply completely or absorb all of the current available; in either case it would render the cart unusable.

True State of Charge/Discharge

The HES power system can be used independently of the processor it may be charging; either laptop or PC, or it can be connected to the processor [preferred configuration]. If it is connected, it is through a standard USB port. The HES product is recognized by Microsoft operating systems as accepted through their formal certification program. The display indicating the state of charge information is provided both as a stand alone display and as a GUI pop up on the cart's processor's display; whether it is a laptop or PC.

Stand Alone Display

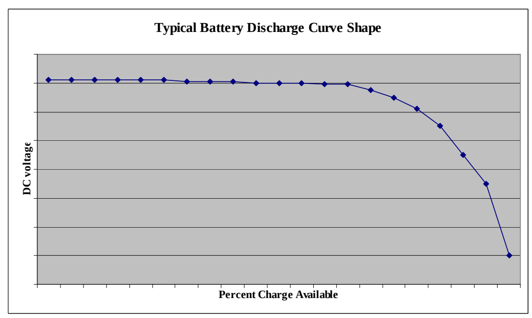


GUI Pop Up Display

The unique aspect of the displayed information is that it is the true state of charge of the battery. We use voltage decay curves from the battery type, the current sense of the load current, the temperature sensors at the battery posts, the time passed, the age of the battery, the number of cycles the battery has experienced as well as other data to perform an estimation of the time remaining. The estimation uses both the current state of the battery, its voltage, its temperature and the current passing through it as well as the total energy that the battery has used from its starting point. These estimates are used to get a very real estimate of the time remaining until it is necessary to charge the battery.

Competing systems use very simplistic estimates that provide just a basic estimate. The HES system provides, through the GUI pop up on the display, the <u>time</u> remaining in minutes and hours and, through both the pop up and the stand alone display, the percentage of charge remaining; we do not display the <u>voltage</u> remaining which is a very misleading metric.

The time remaining provides the user a very useful metric while the voltage level provides a misleading, and often misunderstood point of measurement. Battery voltage decays very little until it hits the "knee" of the charge curve where the voltage drops off very quickly and the battery is out of charge. The user would therefore see very little change until it was nearly dead and then would see a drastic and quick drop in voltage. This is very difficult to interpret to understand the "time" remaining [prior to the need for a recharge] for the user of the cart.



The true state of charge capability provides a second feature that also covers an issue that has been brought up repeatedly in the market; time remaining to reach full charge during the charging cycle. The user does not have to guess when the charge cycle will be complete. The HES system provides an accurate estimate of the time remaining of the charge cycle.

Managed Battery Charge

Most low cost chargers in commercial markets supply a flat high current rate that overwhelms the battery with power and provides a very quick charge. The unfortunate problem with this method is that the

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high current charge, if unmanaged can be quite dangerous due to overcharging or charging of a damaged battery, but more importantly, it provides a charge only to approximately 80% of the full battery charge [in the case of Sealed Lead Acid chemistries].

Batteries are most effectively charged through a three stage process as follows. All charging parameters (Current, Voltage, Time, and Temperature) are monitored and controlled by software.

Stage I: Bulk

Stage I is a constant current stage. The current level depends on battery type. Stage I is complete when the battery voltage reaches a predefined voltage based on the battery specification.

Stage II: Absorption

This stage is a constant voltage stage with a "taper" current profile. The voltage shall stay within a predefined range during this stage. The current shall fall from Stage I current levels to a trickle current, as specified by the battery manufacture, as the battery reaches a predefined charge threshold. Stage II is complete when the charge current falls to the trickle level.

Stage III: Float

The product will float charge [low current] with a constant predefined voltage. The charger shall remain in float charge mode until power is removed or cycled.

In any of the above stages, if the voltage, current, temperature or charge times are out of normal ranges [an indication of a problem with the battery], the charge cycle ends and the display indicates an error condition until AC power is removed or cycled. The error condition is also recorded in the Event Log.

A basic charger with one stage, a flat current, will charge to approximately 80% of the full charge of the battery. Flat high current charging also creates unnecessary heat in the battery. The added heat and the constant undercharged cycling reduce the life of the battery considerably.

Prior to commencing charge, there are two other relevant states that the HES product provides to further protect the user and to provide the fullest charge possible.

- Initialization

  This is a monitor mode in order to determine the integrity of the battery connection and the current state of charge.

- Over Discharge Recovery Mode:

  If the open circuit battery voltage has fallen below a predefined battery manufacturer specified voltage, the charger will enter a Battery Recovery Mode before entering stage 1. (The Recovery mode parameters are described by the Battery Manufacturer). This mode is covered in another section of this document.

Low Battery Warnings and Auto Shutdown

As a general purpose UPS would provide, the HES power system provides the user both warnings that the battery is low, and the graceful shutdown if the user does not heed the warnings. This ensures the security of the data, prevents over discharge and provides the Nurse the failsafe use of the cart. The Nurse could literally use the cart to the last second and still not have a concern over lost data.

Auto Battery/Load Isolation

The HES system has no quiescent current flowing through the system if the load devices are powered down. The system senses this state and is able to isolate the loads from the battery such that no low current draw flows from the battery. This enables the battery to extend its life during times when the load devices are inactive.

The HES system has three operating states; Operate, Standby, and Sleep. When the battery has adequate charge remaining, the system is in Operate mode. In this mode the DC outputs are enabled so that the load(s) are powered on. If the battery becomes discharged, the system senses this state and enters Standby Mode. In this mode the DC Outputs are disabled in order to isolate the loads from the battery. In Standby Mode the system draws only a small (<50mA) current from the battery to operate the HES display and processor circuitry. This enables the battery to extend its life during times when the load devices are inactive. If the battery is left unattended and continues to discharge below a safe level, the HES system enters Sleep Mode. All display and processor functions are shut off, and current draw is extremely low (<1ma) to prevent further discharge. The system will wake up from sleep once AC power is on. The sleep function may also be invoked through the GUI software if the system will be stored for extended periods.

Battery Temperature Sensing

Assessing the temperature of the battery is important in managing the power system.

First, it provides the system the ability to identify a faulty battery that is responding to charging or discharging by overheating. Sensing this condition and taking appropriate action protects the user from a dangerous condition causing either out gassing, expansion of the battery [swelling of the housing] or in extreme cases explosion.

Second, the temperature of the battery is significant in assessing the status of the charge of the battery. One of the parameters used to assess the time left to either charge or discharge a battery is the ambient temperature the battery is experiencing.

Although the temperature "close" to the battery is helpful, the temperature at the battery is much more definitive. This is why the HES sensor is literally attached to the battery post rather than mounted in free space or on the HES enclosure. This provides, through the use of metal core board construction technology, an excellent reference to the battery internal temperature. We also provide a temperature sensor within the HES enclosure for reference and to ensure the system electronics is not generating unanticipated heat; a signal that a problem exists.

Over Discharge Recovery

During normal use of portable devices, the batteries are at times mistakenly left to discharge entirely. In normal circumstances the battery is still "good", but cannot be effectively charged since the charging mechanisms are designed to charge depleted batteries but not batteries totally without charge. The HES system senses the over discharge condition and can recover the battery, if it is still healthy. This can be a significant savings if batteries are routinely left in an unattended state while under load.

Since the recovery algorithm used to recover over discharged batteries takes significantly longer than a standard charge, the system provides an indicator on the display that informs the user that it is in the deep discharge recovery mode and not a standard charge mode. The difference in the time necessary could be significant; without this indicator the user may think that the battery is faulty and that the product is no longer charging.

The use of two power supplies is critical to the over discharge recovery function. If a single power supply is used, the cart must be out of service through the entire recovery process. With two supplies, the cart can be "in service" throughout the recovery.

Auto Email Notifications

The HES product provides email notifications that are set up at installation. The emails are typically sent to the IT person responsible for the health and maintenance of the carts. This alleviates the Nurses from this responsibility.

The email notifications that can be sent out are various. Each can be selected or not depending on the requirements of the individual receiving the emails. They are as follows.

- Auto shutdown Mode Activated; provides IT with an alert that a cart was automatically shut down
- Recovery Status Flag; provides IT an alert that a cart is in the deep discharge recovery process
- Battery Fault Detected; provides IT with an alert that there is a battery that should be immediately removed from service
- Battery Duration Reached; provides IT with an alert that the battery has reached the threshold that of time that was previously set up to take maintenance action

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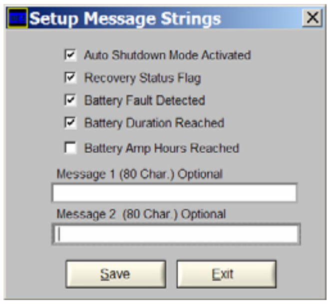
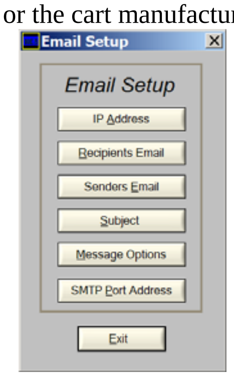
- Battery Amp Hours Reached; provides IT with an alert that the battery has reached the threshold of total amperes through the battery that was previously set up to take maintenance action
- Specific Messages are optional



The email alert function must be set up, one time, during the installation process. This is a password protected screen meant to be used by the responsible IT professional or the cart manufacturer.

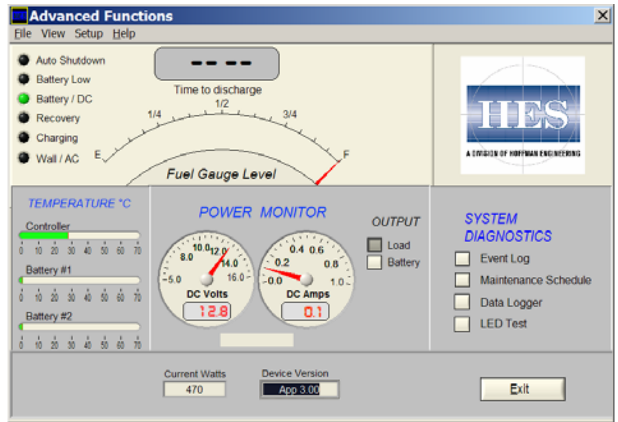


Controlled Fan Output

The fan used for cooling of the power system is controlled through the intelligence of the system to come on only when necessary due to rising heat. In normal circumstances this should be relatively infrequent and therefore the noise will not be as annoying as a full time fan might be. It will also extend the life of the fan considerably.

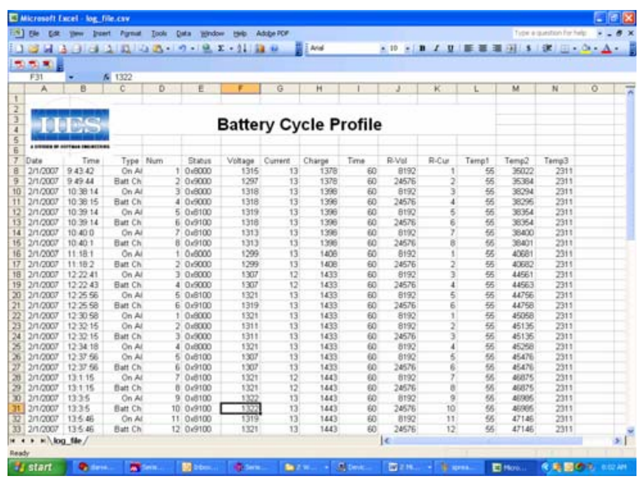
Field Diagnostics and Monitoring

The HES product has extensive monitoring and diagnostic capabilities to evaluate the batteries, the power system and the use of the system. This capability allows the evaluation of failed items as well as the evaluation of the usage of the product.



Diagnostic Screen

Included in the Diagnostic and Monitoring capability is an Event Logging function. This provides a historical accounting of the use of the system with time tags on events. Through this, the history of the use of the system can be monitored. Events depicted are items such as battery charge, low battery, shut down and a variety of others. The user has the ability to manipulate the file by clearing the data or the file, counting the total number of events experienced or saving the file to the host computer for manipulation by third party application software such as Excel.



Sample Event Log Screen

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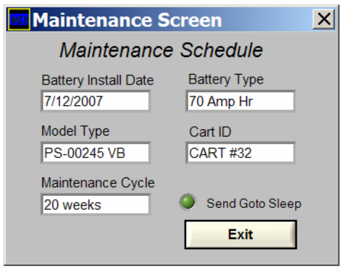
Maintenance [Battery Replacement] Scheduling

Within the password protected setup screen in the Series 301 software there is the ability to setup the threshold that creates the alert provided to the responsible IT individual identifying that battery maintenance is necessary.



This information is protected from manipulation by the user and provides an email alert to the email address of the individual responding. The user is not alerted to the requirement.

Battery Warranty Dispute Resolution Data

Since the Series 301 provides detailed event logs, the usage characteristics are readily available by the IT staff or by the cart manufacturer. In the event of a dispute over the short life of a battery, it can be reviewed to assess if charging was accomplished within the manufacturers established limits or whether there was a battery failure.

Further, the absolute life of the battery can be established in terms of charge cycles or duration in use.

Thermal Runaway Protection

The Series 301 has temperature sensors located at the post of the battery. If two batteries are used, both batteries have thermal sensors. The product monitors these sensors for a variety of reasons; one of which is to ensure that the batteries do not heat to dangerous levels. If the batteries heat to dangerous levels, for any reason, the power system shuts down and an alert is sent to the responsible IT individual and the GUI pop up declares that there is a failure. This happens quickly and far before any safety problems exist.

Out Gassing Protection

Using the same technology described above, out gassing is protected from occurring. Out gassing also results from high temperatures. The temperature sensing technology employed allows the HES system to monitor the temperature and preclude any harmful or unsafe events such as out gassing.

Elimination of Unintentional Under Charging

Unintentional under charging occurs when power systems share the power available to charge batteries and to support the load devices on the cart [laptop, display…etc.]. It is further exacerbated by the user not being informed of the specific time remaining for full charge.

The HES system provides two power supplies to accommodate both charging and running the load devices simultaneously. This allows the charge to be consistent without the time to charge being prolonged by reducing the charge current available due to the sharing attribute. This results in a predictable and consistent charge time for full charge of the battery.

We further provide a true time to charge metric that allows the user to view a very specific time necessary to reach full charge. This is much more effective than either a three or four LED display of green, yellow and red LEDs or a reference to the voltage level reached. In both cases these are poor estimates and can be very misleading.

User Selectable Battery Types

Since hospitals and cart manufacturers use different batteries for different applications we provide a selection process that will account for these variations and still provide accurate performance. This allows the use of various Amp Hour battery sizes with the same power system. This is a set up feature that is performed only once.

Customer Unique Graphics

The HES logo and HES pop up screens are standard on our product. If our customers want a unique look with their colors and logo, we will modify our graphics while retaining the same information for display. This allows our customers to have a

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consistent presentation of their product and to hide the HES name as necessary.

Benefits

The HES Series 301 Motive DC Controller provides a series of benefits to the Nursing community. Most of these benefits are in direct response to the problems described earlier.

Safety Benefits

- Eliminates thermal runaway and out gassing as safety concerns
- Auto notifications serve as an "auto attendant" providing continuous supervision of unattended carts. This is especially important during charging states.

Security Benefits

- Provides a graceful shutdown to protect critical data
- Provides email alerts showing cart usage, battery status, error conditions and other indications
- Provides password protected level of access to software setup and controls
- Provides logging functions providing insight to cart usage

Cost Benefits

- Prolongs battery life therefore reducing the need for frequent purchase of new batteries
- Provides recovery algorithms to reclaim the usage of an over discharged battery
- Provides detailed insight to ensure proper charge usage
- Provides comprehensive data to track battery usage and required intervals for battery maintenance
- Provides detailed insight to battery usage and therefore information resolving any warranty disputes
- Eliminates undercharging and battery capacity "walk down"

Usage Benefits

- Provides optimum charge of batteries thereby <u>increasing run times significantly</u>
- Provides 300 watts of available power thereby allowing the use of more devices or more powerful devices
- Provides true state of charge display allowing Nurse's to see the time left for usage and charge *directly*
- Provides the ability to use multiple battery types by simple setup parameter changes
- Minimizes annoying fan noise
- Uses readily available, easily replaceable low cost Sealed Lead Acid [SLA] batteries
- Eliminates carts having to be plugged in "all the time"; recharge can be scheduled for off shifts

The fundamental advantage in using HES' power system is that it is designed specifically for this application. It maximizes run times, eliminates Nurse's having to maintain it, eliminates safety hazards, displays information that is intuitive for the Nurses and reduces life cycle costs. The system eliminates inherent problems with designs taken from other industries and adds features necessary for this specific industry. In essence, this system is very unique and addresses all of the problems related to this industry and is the first product that allows Computers on Wheels to be truly mobile.

Certifications and Compliances

This system has been certified to UL 60601-2:2003 R6.03 and CAN/CSA-C22.2 No. 601.1-M90. The certification authority is TUV Rheinland of North America.

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Policy Issues

The Healthcare Interpretation Task Force [HITF] recently addressed a topic addressing portable devices/equipment in corridors [reference following interpretation document]. They had concerns regarding the clarification of the National Fire Protection Association [NFPA] and Joint Commission on Accreditation of Healthcare Organizations [JCAHO] interpretation of NFPA 101 (2000). The interpretation clarifies the position regarding allowances for Mobile Carts and the acceptance of their being charged in acceptable locations. They specifically require that the battery and charging systems meet the following design requirements to ensure safe operation:

- Sealed Lead-Acid Batteries:
  - Absorbed Glass Mat design and
  - Sealed Case (Sealed Lead-Acid)
- All Battery Systems [SLA, NiMH, Li+Ion, Li+Ion Polymer];
  - Smart Charging system with overcharge protection and
  - Shorted cell protection that shuts down upon detecting a shorted cell

The HES charging system meets these requirements. Our design has the prerequisite sensing capability that allows the detection of overcharge and shorted cells. Again, this differentiates our product from others in the industry. We provide a compliant solution within our standard product offering.

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A DIVISION OF HOFFMAN ENGINEERING

HITF INTERPRETATION
DECEMBER 2007 NO. 1

Document to be interpreted: NFPA 101 (2000)

Edition: 2000

Background Information (optional):

PORTABLE DEVICES/EQUIPMENT IN CORRIDORS

Background:

Healthcare occupancies are prone to having more and different types of equipment in them. While NFPA 101: Sections 18.2.3.4. and 19.2.3.4 work to address the importance of maintaining minimum corridor widths, portable devices / equipment invariably find their way into these corridor spaces. Computers on wheels (COWs) are a particular concern.

NOTE: Because the size, geometry, and combustibility of mattresses and bed furnishings can vary to a great degree, and the possibility of other items being "stored" on the mattress surface, beds should not be considered portable devices / equipment for the purposes of this interpretation.

Questions:

Q1. How long should portable devices / equipment on wheels (such as COWs, portable x-ray machines (i.e. C-arms), EKG / EEG or other diagnostic equipment or other equipment with electrical connections) located in a corridor be permitted to be inactive before they are considered to be in storage? In this context, inactive is the amount of time that passes between users accessing the equipment.

A1. -Although the code does not address a specific time limit (See NFPA 101:A.18.2.3.4/A.19.2.3.4), recent interpretations by the Joint Commission and Centers for Medicare/Medicaid Services have established a time of 30 minutes as a maximum limit on the amount of time that portable devices/equipment on wheels can be considered to be in use. The HITF agrees that this is a reasonable time frame for an AHJ to consider.

Note: This limitation should not be applied to crash carts or isolation carts.

Q2. Based on the answer to Q1, if the portable devices / equipment on wheels do not compromise the required egress width, can they be stored in the egress corridors, i.e. alcoves or spaces?

A2. YES. Alcoves or spaces being used for such purposes are not considered to be hazardous areas as defined by NFPA 101:18.3.2.1/19.3.2.1, nor should they be subject to the requirements for areas open to the corridor (See NFPA 101:18.3.6.1/19.3.6.1).

Q3. If the answer to Q2 is yes, can the portable devices / equipment on wheels be charging in these acceptable locations or while in use?

A3. YES, provided that the battery and charging systems meet the following design requirements to ensure safe operation:
-Sealed Lead-Acid Batteries:
    -Absorbed Glass Mat design and
    -Sealed Case (Sealed Lead-Acid)
-All Battery Systems (SLA, NiMH, Li+ Ion, Li+ Ion Polymer):
    -Smart Charging system with overcharge protection and
    -Shorted cell protection that shuts down upon detecting a shorted cell

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Summary

HES invested into an industry that we believe was overdue for a new power solution. Our experience was that the Nursing community was not satisfied with the mobility of powered carts and the basis was power system problems. The Nursing community has routines and priorities that lend themselves to optimizing the care provided. The early power solutions did not correspond to their routine; rather, they created more work and demanded priority attention.

The solution we offer here is a combination of requirements with the priority given to the Nursing community. We also addressed concerns voiced by cart manufacturers as well as the purchasing arm of the hospitals. The underlying concept however, is that Nurse's will not use products that don't fit their priorities or work environment. The product described in this document meets the Nurse's requirements and satisfies the various issues with the prior products in the industry.

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