Battery Charger Sizing & Options

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Introduction

The purpose of this paper is to introduce, refresh, discuss and provide you with an understanding of battery charger sizing basics, as well as to familiarize you with some of the options that La Marche offers in our products.

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1. Battery Charger Sizing

In this section we will present and discuss the La Marche method for sizing a battery charger. There are a few pieces of information that must be gathered before the charger size can be calculated. The required information is as follows:

– What is the maximum load in amps?

– What is the battery backup time needed?

– What is the required recharge time?

– What is the battery type (Lead acid or Ni-Cad) and the number cells?

Once we have the required information we apply the following Battery Charger sizing formula:

A= (EF x AH/ H) + L

A = DC output rating of charger

EF = Efficiency Factor - used to return 100% of amp hours removed from a discharged battery. Recharging a battery is not a 100% efficient process. So it is necessary to put in more energy than we took out of the battery. This is the purpose of the efficiency factor in the charger sizing formula. La Marche uses the following efficiency factors:

1.15 - for lead acid batteries (Flooded and VRLA)

1.40 - for NiCad batteries

H = Recharge Time – Expressed in hours, this is the desired time to recharge and bring the battery back to full charge capacity and it varies by application. Typical values are 8, 12 or 24 hours. The battery manufacturer should be consulted recharge time faster than 8 hours or longer than 24 hours is required.

AH = Amp Hours Removed, calculated number of ampere hours removed from battery. Many people use the battery amp hour rating of the battery to size the charger. While you could use the actual battery amp hour size to calculate the charger, the proper method is to use the actual amp hours removed from the battery. You can either estimate the amp hours removed or it is calculated automatically when you use one of the many battery sizing programs provided by the various battery manufacturers for their batteries. For continuous loads, a quick way of calculating the amp hours removed is by using the following formula:

AH = L x BT

L = Continuous load - Many times the charger has to carry a continuous load while recharging the battery. In these situations this load is added to required amps to recharge the battery. Loads that are short in duration or transient are handled by the battery and not the charger.

BT = Backup Time - Expressed in hours, this is the time required for the batteries to support the load.

Charger sizing example:

We have a customer requiring a battery charger. He tells us that he has a piece of equipment he needs backed up with a battery and charger. The load is 25 Amps @ 24VDC and he needs it backed up for 5 hours. He also wants the system recharged in 8 hours. He plans to use a 12 cell lead acid battery.

First we need to figure out the estimated Amp Hours removed using the following formula:

AH = L x BT = 25 x 5 = 125AH

L = 25 Amps

BT = 5 Hours (Back up time)

Now that we know the estimated Amp Hours removed we can continue to calculate the charger size using the following formula.

A = (EF x AH/ H) + L = (1.15 x 125/8) +25 = 42.97

A = DC output rating of charger

EF = 1.15 for lead acid battery

AH = 125 amp hours removed

H = 8 hour recharge time

L = 75 amp Continuous load on system while recharging the battery

Round up to the next common size use a 50 Amp, 24VDC battery charger.

2. Battery Charger Options

2.1. Special Ground Bus

This is an appropriately sized ground bus bar mounted inside the battery charger to allow customers to tie ground connections inside the charger to the external system ground. The ground bus bar allows for several customer connections. (Option 38D)

2.2. Padlock Hasp

In those applications where the customer wants to control the access to the internal components of the battery charger, La Marche can provide a padlock hasp on the door of the enclosure. The customer can use their own lock to secure access to the charger from unauthorized personnel. (Option 08T)

2.3. Glyptol Dip

Used in areas where there is very high humidity to protect the transformers from moisture and salt air. It is also know as Tropicalization. This process treats the transformer with a fungus resistant dip after the transformers have been through the standard class H dip and bake process. (Option 092 for 1 Ph and 093 for 3 Ph)

2.4. Conformal Coating

A process applied to circuit boards to protect against moisture, dust and temperature extremes. The electrical insulation coating provides a level of protection to the electronics when they are used in a harsh environment such as a tropical location or mounted inside another outdoor enclosure. (Option 09P)

2.5. Equalize Fan Control Relay

Used to ensure the exhaust fan in a battery room is operating when the charger is in the equalize mode. Two sets of form C contacts are wired to a terminal strip inside the charger. The customer wires the exhaust fan control to the terminal strip. When the charger is placed in the equalize mode the contacts operate to signal the exhaust fan to start. (Option 20Q)

2.6. Temperature Compensation

The temperature compensation circuit is used to automatically adjust the charger's output voltage up or down based on the temperature read by the temperature probe. The standard probe is internally mounted inside the charger near the bottom of the enclosure near the air intake. This location means the charger and batteries need to be next to each other so the probe senses the same ambient air temperature. Internal temperature probe is a standard on A36D, A75D/E, A75R, ESCR and TPSD battery chargers. (Option 11V for A12B chargers)

External remote temperature probes are also available for those installations where the battery and charger are not next to each other. The remote probe is attached to the battery terminal and connected to the charger via terminal strip. Remote probes are available at 22 and 100 feet. (22ft option 11W and 100ft option 11Y)

Note: *Only one temperature probe option can be used at a time.*

2.7. High Interrupting AC and DC Breakers

In situations where the available short-circuit current is higher than the breaker's interrupting capacity rating, there may be a failure of the breaker to safely interrupt a

fault. This is a major concern in utility transmission and distribution along with oil exploration (offshore oil platforms). In these applications the battery charger specification may require high amperage interrupting capacity rated breakers. An alternative method is to use a fuse in series with a breaker to comply with the high interrupting fault requirements. The drawback to this design is that customers will need a spare fuse on hand to avoid substantial downtime. The La Marche high interrupting breaker option does not require a fuse. These breaker ratings are typically expressed in KAIC (Kilo-Amps Interrupting Capacity). These breakers are optional on A12B, A75D/E and TPSD product lines. One thing to note here is that many times there is a feeder breaker at the distribution source to the chargers that should already be rated for the higher KAIC and is already protecting the charger.

2.8. Alarm and Auxiliary Switches

Breakers can be equipped with either an Alarm Switch or an Auxiliary Switch. They allow the customer to remotely monitor the status of the breaker telling them if it is tripped or open/closed. The alarm switch indicates when the breaker electrically trips only, it does not indicate if someone manually opens the breaker. The auxiliary switch indicates when a breaker is either operated manually or electrically tripped. The breaker manufacturer must install these options at their factory.

2.9. Shunt Trip Coils

Circuit breakers can be provided with shunt trip coils which allow the customer to remotely trip the circuit breaker. The breaker manufacturer builds the shunt trip coil into additional pole on the breaker and provides two wires for connection to the coil. Typically La Marche wires the shunt trip wires to a terminal strip for the customer to connect to in the field. The breaker manufacturer must install this option at their factory.

2.10. Ground Detection Options

Ground detection alarms are installed on a battery charger to protect the cabling connected to the battery system and most importantly to ensure safety. Isolated or ungrounded battery systems need continuous monitoring for ground faults. Over time the battery system cable insulation level deteriorates, resulting in unacceptable and potentially damaging fault currents. Another reason to have ground detection on chargers is to be able to detect load failures to ground.

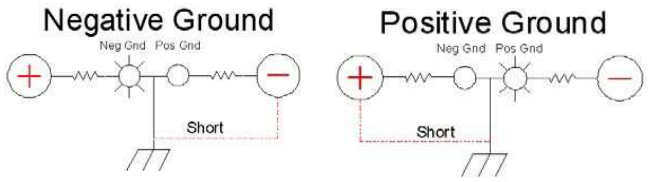
La Marche offers various types of ground detection alarms and indicators. Available on A12B series, our most popular C.A.P. (Combination Alarm Packages), such as the 16J or 46J, include ground detection. Our A75D/E and TPSD units are equipped with ground detection lights and relays standard. Some additional discrete ground detection options for the A12B chargers are as follows:

2.10.1 Ground Detection Switch Voltmeter Indication - This system uses the chargers analog DC voltmeter along with positive and negative switches. If a ground is present when the appropriate switch is operated, it will indicate on the chargers voltmeter. (Option 050)

2.10.2 Ground Detection Relays - Positive and negative ground detection relays are provided along with a reset switch. If a ground occurs, the appropriate relay automatically changes state to indicate the alarm via a set of form 'C' contacts for positive ground indication and a set of from 'C' contacts for negative ground indication. (Option 051)

2.10.3 Ground Detection Lights - This system consists of two lights, one marked positive and one marked negative. Under normal conditions, with no ground present, both lights are dimly lit. If a ground occurs, the light in the grounded circuit will glow brightly, the other light will diminish. (Option 052)

2.10.4 Ground Detection Lights and Switch - This system has two lights, one marked positive and one negative. The lights are not illuminated until the switch is thrown to the positive or negative position. If a ground is present, the appropriate light will illuminate to indicate the ground. (Option 053)

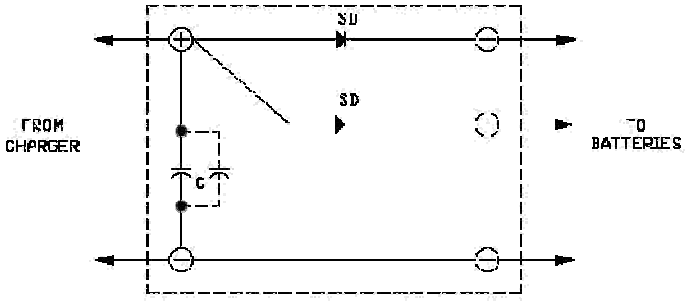


Typical (052) ground detection lights circuit in alarm condition

2.11. Charge Dividers

Our charge divider option adds series diodes to the output of our charger to isolate multiple banks of batteries. The battery banks, in effect, do not see each other, allowing each bank to be charged completely without feeding off each other. Typically, a charge divider is used in our A40 or A41 for marine applications, but they have also been provided in our A12B's for various applications.

Available configurations are: 2 Battery Bank Negative Common (Option 100), 2 Battery Bank Positive Common (Option 10U), 3 Battery Bank Negative Common (Option 101) and 3 Battery Bank Positive Common (Option 10V). We also offer external charge dividers, built in separate enclosures.



Typical 2-Battery Charge Divider-Negative Common

2.12. Lightning Arrestor

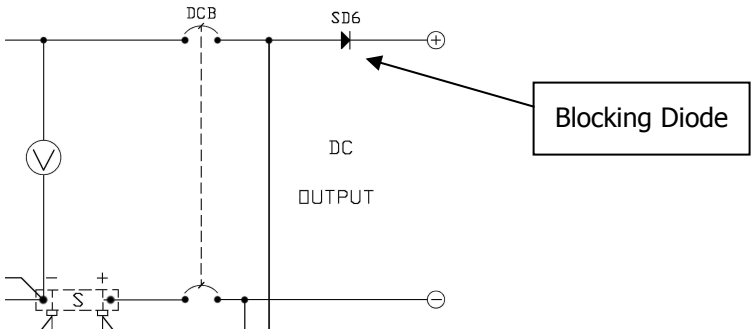
Not only do Lightning Arrestors protect a charger against lightning, they also provide protection against high voltage surges and spikes. During normal operation, the surge protector is not active; however, when the surge protective device detects a voltage above its design rating it activates by safely diverting the surge or spike away from the charger.

La Marche offers lightning arrestor for those applications requiring additional surge voltage suppression or to meet customer specifications. In recent years, there have been some major revisions to the standard that these devices are required to meet. This has prompted the redesign of the previous lightning arrestors. Due to the way they have

evolved, the name has changed to Surge Protective Devices (SPD). The SPD used by La Marche meet the current UL 1449 3rd Edition standard, and are classified as SPD Type 1. They are available on the A12B, TPSD and A75D/E models. (Option 11L)

2.13. Blocking Diode

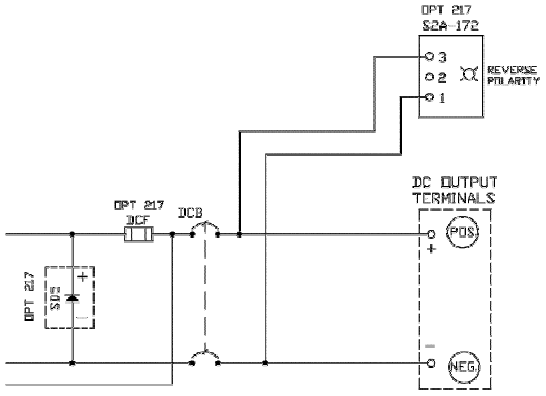
A blocking diode is wired in series with the chargers output to provide isolation. Today it is typically used in multi charger applications to isolate the chargers from each other should one of the chargers experience a problem. Contrary to popular belief they are not used to prevent the charger from draining the battery during a power failure. The charger output fuse or breaker prevents a charger failed component from discharging the battery. The charger alarm drain during an AC failure represents a very small load on the battery and is not enough to be considered. (Option 102)



Typical Blocking Diode arrangement

2.14. Reverse Polarity Protection and LED

This circuit protects against someone accidently reversing the battery terminal connections on the charger (i.e. connecting the battery positive to the charger negative or vise versa). The circuit consists of a diode and a fuse connected in series between the positive and negative output of the charger. If the battery connection is reversed, the diode conducts and the current opens the fuse thus protecting the DC system. The LED provides a visual indication that the polarity has been reversed. (Option 217)



Typical Reverse Polarity Protection and LED

2.15. DNP3.0 and ModBus Communication

Communication Options DNP3, MODBUS, IEC 61850 - La Marche is able to provide communication options to allow La Marche chargers to be monitored over a serial connection. La Marche battery chargers can be equipped with serial RS-485, RS-232 or TCP/IP ports for data communication over DNP3.0, ModBus, IEC 61850 and LAN. These different protocols cover the most popular protocols that customers are currently using with their SCADA systems.

The chargers output voltage, current and alarms can be monitored and the float/equalize selection can be selected. (Options 21P – DNP3, 21Q – ModBus and 21J – IEC 61850)

2.16. Heat Shrinkable Wire Markers

Some customers require the individual wiring inside the equipment to be identified or numbered on each end with wire markers. La Marche uses the heat shrinkable type, which fit snuggly around the wire ends and are permanent. The electrical schematic is marked accordingly. This greatly helps someone in the field to quickly and easily identify components and wiring for troubleshooting purposes. (Option 09W)

2.17. SIS Wiring and Wire Markers

Many specifications call for SIS wire. It is also known as switchboard wire. Typically it consists of a stranded copper conductor that is usually tin coated with cross-linked polyethylene (XLP) insulation. The insulation can withstand temperature extremes and meets VM-1 flame rating. The majority of SIS is gray so wire markers are required in order to properly identify and wire the units. Also, SIS wire is only provided on wire 16 AWG and larger. This is because SIS wire has a thicker insulation jacket and will not fit properly in the insulation displacement connections used in some of the wiring assemblies. (Option 097)

2.18. Zero Center Ammeter with Battery and Load Terminals

DC Ammeter, which reads both charge and discharge current to the battery. Two sets of output terminals are provided, one for the load connection and one for the battery connection. The zero center ammeter is wired in the battery terminal. There is also an option for just the battery and load terminal connections without the zero center ammeter. (Option 06G)

2.19. AC Ammeter

Measures the input current consumed by the charger. On chargers with a three phase input, a selector switch is wired to each phase and indicates on a single AC ammeter. (Option 06L for 1 Ph units and option 14W for 3 Ph units)

2.20. AC Voltmeter

Measures the AC input voltage to the charger. On chargers with a three phase input, a selector switch is wired to each phase and indicates on a single AC voltmeter. (Option 06M for 1 Ph units and option 14V for 3 Ph units)

2.21. Drip Shield

The Drip Shield provides a cover to protect those La Marche chargers with top ventilation openings from dripping water and falling dust particles in applications where those hazards are present. It meets IP 21 requirements. Drip shield can be ordered as a separate line item and installed on existing units in the field, they standard on A41 units and included with the USCG option 10B.

2.22. Combination Alarm Packages

La Marche offers two series of digital Combination Alarm Packages, they are known as the 16 and 46 series CAP. These alarm packages provide a variety of alarm indications and relay contacts for remote annunciation for alarm conditions such as, AC Failure, Low DC Current, Low DC Voltage, High DC Voltage, High DC Voltage Shutdown and Ground Detection. Another feature provided by the CAP system is a multi-mode Equalize timer adjustable from 1 to 144 hours with five selectable modes. Some of these CAP systems also provide LVLD or LVBD with battery and load terminals included.

The 16 series provides a selectable Volts/Amp digital LED display with LED's for each of the alarm conditions. The 46 series provided a two line LCD display, one LED for Float, one LED for Equalize and one alarm LED. During an alarm condition the alarm LED is lit and a text description of the fault is displayed on the display. For those cases where the specifications require light indicators for the alarms La Marche provides an additional LED board option.

2.23. ABS (American Bureau of Shipping)

ABS (American Bureau of Shipping) - ABS is a marine and offshore classification society. ABS develops standards, which are called ABS rules, for products that are used in marine and offshore applications.

Certain applications such as offshore oil platforms and work boats may require the charger to carry an ABS listing or type approval. La Marche can provide chargers which meet the ABS regulations and carry the ABS type approval listing.

To comply with ABS, the chargers need to be equipped with the follow features:

1. Device for disconnecting AC power source

   AC Breaker 2 pole on single phase units

   AC Breaker 3 pole on three phase units

2. DC Breaker 2 pole
3. AC pilot light

The ABS option is available on models A12B, A46 and TPSD. The ABS pricing contains a choice on how you get the AC pilot light. If the customer does require any additional alarms then use the ABS pricing with the AC pilot light. If the customer requires alarms and lights such as low voltage, low current etc., then use the ABS pricing with the CAP package. Depending on the site, a drip shield may be required by local ABS inspector.

Note: *The selection of the ABS options with AC pilot light or CAP does not apply to the TPSD chargers.*

2.24. USCG (United States Coast Guard)

USCG (United States Coast Guard) accessories - This option consists of a group of accessories or features that are normally required by the US Coast Guard in order to pass the onboard inspection. It is typically required on ships and offshore applications. This option is offered on models A12B and A46 which are built in the following enclosures: 1, 2, 3, 7, 6, 70 and 72. (Option 10B)

The USCG accessory package includes:

Drip Shield

Water tight input/ output connectors

AC breaker or AC switch (depending on AC input current)

Note: *The ABS and USCG options are frequently used together.*