Charger Basics

This material is a compendium of information from Power Designers USA LLC

Charger Basics

Selecting the Right Charger

Selecting the correct Charger is critical to making sure the electrical gas tank (Battery) is able to store and release enough power to satisfy your application needs.

Before we get to selecting the charger we need to select the truck and the battery.

- What work am I going to do?
- How much of that work needs to be done?
- How often is the work being done?
- Are there breaks in the action?
    - Enough to recharge the battery?

This is charger basics right?
So what's the worrying over the truck and battery?

Briefly; if the truck is being overloaded or asked to do more work than possible with a single battery on a shift, no matter what charger is selected, you won't be happy. Most trucks allow you some freedom to select, different Ahr batteries (gas tanks) for the compartment size. If, I've got too small a tank, you'll need to fill (charge) it more frequently.

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Selecting the Right Charger

Let's look at a typical battery compartment size of 38.5" by 16.25" by 32.3"
How much gas can I put in that tank size?
Either of the following batteries will fit

12-85-13	510 Ahr	37.75" by 15.44" by 22.5"
12-125-13	750 Ahr	37.75" by 15.44" by 30.5"

Assuming the truck allows the heavier weight of the 750 Ahr battery the larger tank means about 32% more run time

So how does that affect the charger?
The charger, assuming you want to fill the battery in the same amount of time, will need to provide more current for the bigger battery, about 32% more current, so a more powerful charger is needed.

That's worth repeating, a bigger battery needs a bigger more powerful charger to fill that bigger battery in the same amount of time

So is a bigger battery always a better choice?
Depends on the application, how many shifts per day, average Ahr use per hour, and available charge time.

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Selecting the Right Charger

Don’t know what battery to select yet?

Power Designers offers products to help you answer the application questions to select the right battery and charger combination. Let us employ our PowerTracDT to study your application, and see exactly how much energy you need each day. These devices will record Ahr usage and duration for, discharge events (when the truck is being used), charge events (when the battery is being charged), and open events (when the battery/truck is resting). Based on this information we can recommend the right charger and right charging scheme to keep your trucks up and running

Charger Basics

Selecting the Right Charger

Most single shift operations that use less than a full battery each day are conventional charge applications.

Two and three shift a day operations using less or equal to a full battery per shift used to be conventional charge applications, but that meant a lot of extra space, and environmental and safety issues, due to the extra lead and acid of the spare batteries, plus the changing equipment.

Most 2 or 3 shift a day operations are good candidates for opportunity charging when the total battery use is between 1 and 2.5 full batteries per day, and there are “OPPORTUNITIES” to replace the energy into the battery throughout the 24 hour period, and there is time on the weekend to finish and equalize the battery, so only a 6 day a week operation, or a vehicle that can be out of service for 8 to 12 hours while the battery can go through a finish and equalize charge.

While Fast charging is a form of opportunity charging at a more aggressive rate, fast charging is falling out of favor for lead acid batteries due to the higher expense of the battery, the higher battery temperatures associated with fast charge, and increased charger costs.

Let Power Designers study your application’s needs, or let Power Designers teach you how to study and analyze your customer’s application’s needs.

Charger Basics

Selecting the Right Charger

Application General Requirements for charger and Type of Charge

Batteries per truck	Shifts per Day	Available Charge Time	Type of Charge
1 to 3	1 to 3	not applicable	Conventional
1 to 1.5	2 to 3	<6 hours	Hybrid
1	2 to 3	>6 hours	Opportunity
1	2 to 3	4-6 hours	Fast
Hybrid may require some battery changing if plug in time is less than 6 hours, or if weekend equalize time is not available. Difference in opportunity vs. fast charge is amp hours used in 24 hour period and available charge time to return those amps.			

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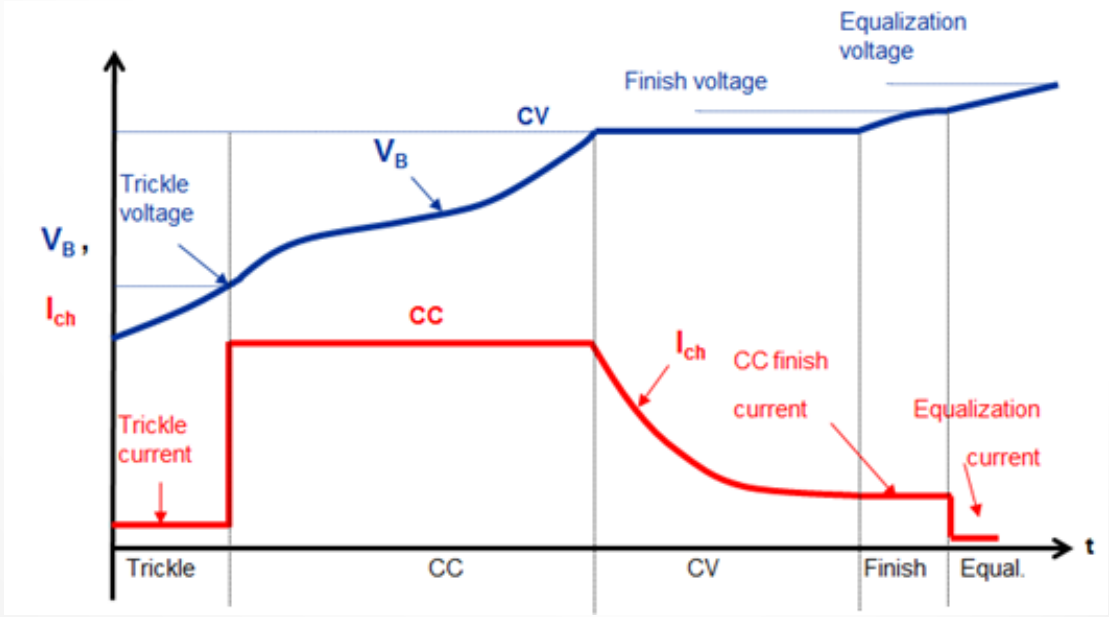
Charge Curve

Charging a battery consists of several modes.

Trickle is used when a battery is overly discharged, the output current is 3% of rated capacity, this restores the battery to the level where it can accept charge at a higher rate.

Constant Current is used to charge the battery from 20% of capacity to 80% of capacity. The output current is 16% to 17% of rated capacity for conventional charging, 25% for opportunity charging, and 40% for fast charging.



Constant Voltage is used to fill the battery from 80% of capacity to >95% of capacity. The desired voltage is set and current is allowed to decrease as the battery nears the full capacity state.

Finish has an output current of 3% to 5% of rated capacity to bring the battery to 100% of capacity.

Equalize has an output current of 3% of rated capacity and is used to force additional conversion of lead sulfate and lead oxide to sulfuric acid, raising gravity and insuring full capacity is available

Charger Basics

Recovery Charging Cycle a Power Designers Standard Feature

A unique feature of all Power Designers chargers is the **Battery Recovery / Desulfation Cycle.** While trickle charging allows an over discharged battery, in most cases, to charge to a state where further charging is possible, a more tailored approach is needed for soft sulfated batteries and batteries that are unable to reach full specific gravity when charged.

- **Battery Recovery / Desulfation Cycle** is an extended period of a constant low output current over a period of 6 to 18 hours
- The **Battery Recovery / Desulfation Cycle** is programmed from the front panel and can be run on demand as needed
- In general use of the **Battery Recovery / Desulfation Cycle** will increase specific gravity by 0.010 to 0.012, this is an increase of 5% to 10% in capacity over an unrecovered battery

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What is Conventional Charging

Conventional charging

+ more than one battery is available per truck, typically one battery for each shift of operation
+ constant current rate of 16% to 17% of rated battery capacity
+ always brings the battery to full capacity by providing a finish charge
+ requires weekly equalization
+ lowest temperature of the charging types
+ centralized charging with all chargers in a single location
+ requires the greatest labor of the charging types, it requires changing the battery in and out of the charging station; and in and out of the truck, taking up to 15 minutes per change
+ is the least environmentally friendly of the charging types, requiring the greatest number of batteries to be present. Each battery adds lead and acid to the facility both of which are considered to be environmental and health concerns

Charger Basics

What is Opportunity and Fast Charging

Opportunity and Fast charging

- are a variation on the same theme, higher constant current rate than conventional
  - Opportunity charging typically uses a constant current rate of 25% of battery nameplate capacity
  - Fast charging typically uses a constant current rate of 40% of battery nameplate capacity
- is used only when only one battery is available per truck.
- maintains the battery between 20% ad 80% state of charge by charging on every scheduled break
- is point of use charging, chargers are distributed throughout the facility
- requires analysis ahead of installation to determine
  - how much capacity is used per day relative to battery capacity
  - how much charging time is available, essentially can I replace what was removed
  - is time available during the week or weekend to finish and equalize
- results in higher battery temperature, as the increased current contributes to resistive heating
  - temperature feedback, for monitoring, is required for fast charging

Charger Basics

What is Opportunity and Fast Charging

Opportunity and Fast charging

- means fewer batteries, less lead and less acid, and is more environmentally friendly
- eliminates the labor to change batteries
- requires disciplined truck operators to make sure charging happens on every break
- requires down time once a week to finish and equalize charge, more on this in the next slide
- **Fast** charging requires a battery designed with thicker connectors between the cells to reduce resistance and heating

Charger Basics

What is Opportunity and Fast Charging Finish and Equalize

Opportunity and Fast charging require a finish charge once a week

Finish has an output current of 3% to 5% of rated capacity to bring the battery to 100% of capacity.

- Finish charging more than once a week can increase gas production and loss of electrolyte
- Chargers can be programmed to finish charge at the end of the last shift of the day, the battery is fully charged and cool by morning

Opportunity and Fast charging require an equalize cycle once a week

Equalize has an output current of 3% of rated capacity and is used to force additional conversion of lead sulfate and lead oxide to sulfuric acid, raising gravity and insuring full capacity is available

- Equalize cycling more than once a week increase gas production and loss of electrolyte
- **Equalize cycling is needed to restore capacity and gravity**
- Water levels should always be checked after an equalize cycle and water added if low

Charger Basics

Choosing a Charger

We have chosen our battery based on;

- truck type (model), truck voltage,
- battery compartment size,
- charging time available

It's the moment of truth let's play what's my charger?

- Am I charging in a conventional mode, an opportunity mode, or a fast mode?
  - For conventional mode the charger must supply 16% to 17% of the battery rated Ahr as the charging current (for example the 510 Ahr battery needs 82A, while the 750 Ahr needs 120A)
  - For opportunity mode the charger must supply 25% of the battery rated Ahr as the charging current (for example the 510 Ahr battery needs 128A, while the 750 Ahr needs 188A)
  - For fast mode the charger must supply 40% of the battery rated Ahr as the charging current (for example the 510 Ahr battery needs 204A, while the 750 Ahr needs 300A)
- A BIGGER BATTERY MEANS A MORE POWERFUL HIGHER CURRENT CHARGER
- FASTER REFILL = SHORTER CHARGING TIME = A MORE POWERFUL HIGHER CURRENT CHARGER

Charger Basics

Revolution Charger Breakdown

The Revolution series chargers offers two types of chargers to better suite the charging needs of your battery.

48V version

- 1.3kW modules
- A maximum output current of 25A
- At least 22.5A at voltages above 2.17VPC

36V version

- 1.3kW modules
- A maximum output current of 30A

Charger Basics

Choosing a Charger 12-125-13 Battery Conventional Charge Example

For this 24 volt 750 Ahr battery in an **conventional** charging mode a 16% to 17% rate means a charger that produces 120 Amps to 128 Amps of output current, therefore the correct charger is

RV05-6kW-36V-SB

RV Revolution Series

05 Five Module Chassis

6kW Five modules rated at 1.3kW each 30 amps per module, times 5 modules 150 Amp output

36V Using the 36 volt module suitable for 24 and 36 volt batteries with no reduction in rating

SB Common connector type, SB175 or SB350 are the most common connectors for conventional charging

Charger Basics

Choosing a Charger 18-125-13 Battery Opportunity Charge Example

For this 36 volt 750 Ahr battery in an **opportunity** charging mode a 25% rate means a charger that produces 188 Amps of output current, therefore the correct charger is

RV08-9kW-36V-SB

RV Revolution Series
08 Eight Module Chassis
9kW Seven modules rated at 1.3kW each 30 amps per module, times 7 modules 210 Amp output
36V Using the 36 volt module suitable for 24 and 36 volt batteries with no reduction in rating
SB Connector type, SB350 is the most common connector for opportunity charging

Note most opportunity charging does not require temperature feedback
If temperature feedback is desired then SBX or Euro connectors are appropriate for the charger, battery and truck

Charger Basics

Choosing a Charger 18-125-13 Battery Fast Charge Example

For this 36 volt 750 Ahr battery in a **fast** charging mode a 40% rate means a charger that produces 300 Amps of output current, therefore the correct charger is

RV12-13kW-36V-SBX*

RV	Revolution Series
12	Twelve Module Chassis
13kW	Ten modules rated at 1.3kW each 30 amps per module, times 10 modules 300 Amp output
36V	Using the 36 volt module suitable for 24 and 36 volt batteries with no reduction in rating
***SBX**	Connector type, SBX350 is the most common connector for charging

Note fast charge requires temperature feedback

*SBX or Euro connectors are appropriate for the charger, battery and truck; for temperature feedback

Charger Basics

Choosing a Charger 24-125-13 Battery Charge Examples

For this 48 volt 750 Ahr battery in an **conventional** charging mode a 16% to 17% rate means a charger that produces 120 Amps to 128 Amps of output current, therefore the correct charger is

RV08-8kW-48V-SB

RV Revolution Series
08 Eight Module Chassis
8kW Six modules rated at 1.3kW each 22.5 amps per module, times 6 modules 135 Amp output
48V Using the 48 volt module suitable for 24, 36, and 48 volt batteries
SB Connector type, SB350 is the most common connector for conventional charging

Charger Basics

Choosing a Charger 24-125-13 Battery Charge Examples

For this 48 volt 750 Ahr battery in an **opportunity** charging mode a 25% rate means a charger that produces 188 Amps of output current, therefore the correct charger is

RV12-12kW-48V-SB

RV Revolution Series
12 Twelve Module Chassis
12kW Nine modules rated at 1.3kW each 22.5 amps per module, times 9 modules 203 Amp output
48V Using the 48volt module suitable for 24, 36, and 48 volt batteries
SB Connector type, SB350 is the most common connector for opportunity charging

Note most opportunity charging does not require temperature feedback
If temperature feedback is desired then SBX or Euro connectors are appropriate for the charger, battery and truck

Charger Basics

Choosing a Charger 24-125-13 Battery Charge Examples

For this 48 volt 750 Ahr battery in a **fast** charging mode a 40% rate means a charger that produces 300 Amps of output current, therefore the correct charger is

RV16-18kW-48V-SBX*

RV Revolution Series
16 Sixteen Module Chassis
18kW Fourteen modules rated at 1.3kW each 22.5 amps per module, times 14 modules 315 Amp output
48V Using the 48volt module suitable for 24, 36, and 48 volt batteries
***SBX** the most common connector for this battery type, dual and single output cable options

Note fast charge requires temperature feedback
*SBX or Euro connectors are appropriate for the charger, battery and truck; for temperature feedback

Charger Basics

The Charger With Batteries of Same Capacity Different Voltages

As a standard feature all Power Designers chargers have the capability to charge batteries of the **same capacity** but different voltages by enabling the Battery Voltage Auto select Function through the PowerChargeDataLink program.
This function measures the battery voltage at time of connection to the charger, and will automatically adjust the charger to the appropriate 24, 36 or 48 volt battery
NOTE the -36V models **will not** charge 48 V batteries

Power Designers will preset this function to be enabled at time of shipment on request

Charger Basics

The Charger With Batteries of Different Capacities Different Voltages

Power Designers chargers have the capability to charge batteries **differing capacities and voltages** when used with a Power Designers PowerTrac SP+ (PTSP+) battery monitor
In addition to installing the PTSP+ on the battery, a cable with auxiliary wires is required, and connectors must be of the SBX, Euro, or SLV500 types

The Revolution charger must have the RS485 communication option installed.
Use PowerTracParameters (PT Params) must be enabled through the PowerChargeDataLink program.

The charger communicates with the PTSP+ to determine, battery voltage, capacity and desired charging parameters.

Power Designers will preset this function to be enabled at time of shipment on request, when the RS485 option is ordered.

Charger Basics

The Charger With Batteries of Different Capacities Different Voltages

Power Designers will be introducing our next generation PowerTrac 3 which is being designed to wirelessly communicate with the Revolution charger eliminating the need for the RS485 option and the auxiliary cable.

- Does everything the PTM does and adds the ability to communicate with, and control the charger
- Measures current using the intercell connector like the PTM, but allows for an optional Hall Effect current sensor or metering shunt to be substituted
- Optional electrolyte level sensing is available

Stay tuned for more news and release of this PowerTrac

Charger Basics

Quiz Time with Answers

Conventional charging rate is?

16% to 17%

Most 2 to 3 shift a day operations should be evaluated for opportunity charging true or false?

True

Name a feature unique to Power Designers chargers

Recovery Cycle

Which charge cycle allows for the lowest current output charger to be used; conventional, opportunity, or fast?

Conventional

In the Revolution charger series the numbers after the RV, indicate what?

Chassis Size

The -36V revolution chargers can charge 48 volt batteries True of False

False the -48V is needed when a 48 volt battery is present, the -36V will charge 24 and 36 volt batteries

Fast charging is becoming more or less prevalent, why?

Less prevalent, due to the cost of the batteries and the higher operating temperatures

The Revolution chargers have finish and equalize automatic operation for all charging types Yes or No?

Yes

Thank You
On Behalf of
Power Designers
For Your
Participation