

Turbo35 BL/SE LiPo Enhancement

Operating instruction Addendum

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Introduction

This enhancement makes it possible to charge 1 and 2 cell LiPo battery packs with the Turbo35 BL/SE. Now you can extend the useful life of your Turbo35 BL/SE chargers by adding LiPo capability.

Safety Considerations

WARNING: Please read before using your enhanced Turbo35 BL/SE LiPo charger/discharger:

IMPORTANT SAFETY INSTRUCTIONS AND WARNINGS

- You must read these safety instructions and warnings before using the Turbo35 BL/SE LiPo battery charger.
- **Lithium Polymer batteries are volatile.** Failure to read and follow the below instructions may result in fire, personal injury and damage to property if charged or used improperly.
- Competition Electronics, Inc, its distributors or retailers assume no liability for failures to comply with these warnings and safety guidelines.

General Guidelines and Warnings

- 1) **Use only the LiPo mode, never the NimH/NiCd mode, to charge and discharge LiPo batteries.** Failure to do so may cause a fire, which may result in personal injury and property damage. Likewise, do not attempt to work with NimH/NiCd packs in LiPo mode.
- 2) **Never charge batteries unattended.** When charging LiPo batteries you should always remain in constant observation to monitor the charging process and react to potential problems that may occur.
- 3) **If at any time you witness a battery starting to balloon or swell up, discontinue the charging process immediately, disconnect the battery and observe it in a safe place for approximately 15 minutes.** This may cause the battery to leak, and the reaction with air may cause the chemicals to ignite, resulting in fire.
- 4) Since delayed chemical reaction can occur, it is best to observe the battery as a safety precaution. Battery observation should occur in a safe area outside of any building or vehicle and away from any combustible material.
- 5) **Wire lead shorts can cause fire!** If you accidentally short the wires, the battery **must** be placed in a safe area for observation for approximately 15 minutes. Additionally, if a short occurs and contact is made with metal (such as rings on your hand), severe injuries may occur due to the LiPo pack's ability to supply massive amperage.
- 6) A battery can still ignite even after 10 minutes.
- 7) In the event of a crash, avoid any charging or discharging of a LiPo battery until you have placed it in a safe open area away from any combustible material and observed it for approximately 15 minutes.
- 8) Never store, charge or discharge battery pack inside your car in extreme temperatures, since extreme temperature could ignite fire.

- 9) Monitor the condition of your LiPo packs and discontinue use when performance degrades or changes significantly.
- 10) OBSERVE PROPER POLARITIES BETWEEN CHARGER AND PACK WITHOUT FAIL.

Charging Process

- 1) Never charge batteries unattended.
- 2) **Charge in an isolated area, away from other flammable materials.**
- 3) Let battery cool down to ambient temperature before charging.
- 4) **Do not charge batteries packs in series.** Charge each battery pack individually. Failure to do so may result in incorrect battery recognition and charging functions. Overcharging may occur and fire may be the result.
- 5) When selecting the cell count or voltage for charging purposes, select the cell count and voltage as it appears on the battery label. As a safety precaution, please confirm the information printed on the battery is correct.
- 6) Selecting a cell count other than the one printed on the battery (always confirm label is correct), can cause fire.
- 7) **You must check the pack voltage before charging.** It is not advisable to attempt to charge any pack if open voltage per cell is less than 3.3v. If you insist and the per cell voltage is greater than 2.3 volts, the Turbo35 BL/SE LiPo will charge the pack at a reduced current for 2 minutes in an attempt to reach at least 3V per cell. However, chances are the pack is damaged and will need replacement.
- 8) CEI recommends charging at **1C rate or less (one times the mAh capacity of the battery), unless the manufacturer specifically recommends otherwise.**

Caring for Battery

- 1) **Do not discharge battery to a level below 3V per cell under load.** Deep discharge below 3V per cell can deteriorate battery performance.
- 2) Use caution to avoid puncture of the cell. Puncture of cells may cause a fire.

Operating Temperature

Typical Charge temperatures:	32 to 113 degrees F
Typical Discharge temperatures:	32 to 140 degrees F

- 1) Consult the specific manufacturer's data sheet before charging or discharging a LiPo battery.
- 2) Let battery cool down to an ambient temperature before charging.
- 3) During discharge and handling of batteries, do not exceed 160 degrees F.

Navigating the LiPo mode screens is no different than navigating the original NimH/NiCd screens,

with this exception: not all the calculated and measured data produced with NimH/NiCd packs makes sense with LiPo packs, so certain data has been eliminated in the LiPo mode.

Connecting the Turbo35 BL/SE Lipo to a LiPo Pack

The hazards to both the battery and operator associated with shorting out or reversing polarity to LiPo packs make it essential that care is taken with connections between the Turbo35 BL/SE LiPo and the pack. Smaller packs, such as transmitter packs or packs used for airplanes often come with a pin and socket type connector, or a Dean's connector already assembled to the pack. If the connector ampacity is sufficient for the discharge rate, it is suggested that you obtain a mating connector and affix it to the Turbo35 BL/SE contacts in such a way that no short or polarity reversal is possible.

Larger packs such as those intended for R/C cars, often have low resistance, gold-plated barrel-type connectors. In this case, CEI recommends obtaining the proper mating connectors and connecting them to the Turbo35 BL/SE LiPo output leads in such a way that shorting of the pack is not possible. In this case, it is recommended that similar proper mating connectors be directly attached to the Turbo35 BL/SE LiPo output leads. Do not expect balance connectors to carry the full ampacity that the main connectors do. This is especially important when charging/discharging individual cells on multiple cell LiPo packs. Make sure the amps drawn or sourced are reduced to within the smaller balance connector's capabilities.

For convenience, you can use suitable connectors, such as Dean's connectors, on the sense and power leads. Then, make plug-in harnesses for different pack types; terminate the NimH/NiCd harness with the usual large and small alligator clips. Terminate the LiPo harness with a pair of high quality barrel connectors specifically designed to mate with the LiPo pack.

CEI DOES NOT recommend using alligator clips or any dissimilar connector to directly connect to the LiPo pack's recessed terminals. In addition, avoid lots of floppy alligator-clipped connections with LiPo packs. Make the connections as simple as possible, and as short as practical.

Sense Leads

ALWAYS USE THE SENSE LEADS WITH LIPO PACKS.

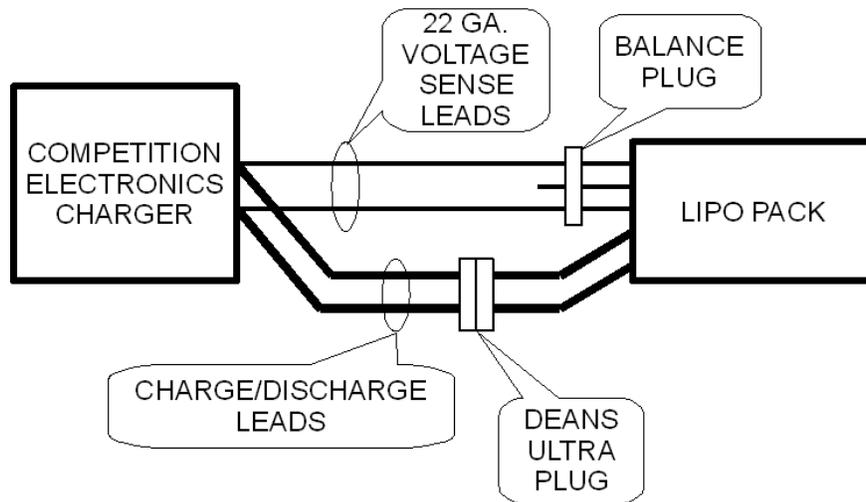
If your pack has high current barrel connectors such as those mentioned above, then it is best if you mate the sense leads with their respective polarity power leads directly at the barrel connector. Crimp or solder both power and sense lead directly into the mating barrel connector. Soldering is the most foolproof method; however, soldering is not always necessary, especially where the sense leads are concerned. In any case, always try to connect the sense leads as close to the actual cell contacts as possible, and try to assure that current through the sense leads does not travel through any more connections than is necessary.

Making the Proper Connections when Charging or Discharging a LiPo Pack

There are legitimate occasions when you may choose to forgo using a balancer during charging, for example, in order to charge at a higher rate.

In addition, you may be running a high current discharge on your LiPo pack. It is important to realize that improper use or connection of the sense leads during charge or discharge can result in damage to the pack or overcharge, leading to the unpleasant surprise of disqualification when the pack is inspected by technical personnel at a race. To avoid these unpleasant outcomes, you need to apply the principals outlined above.

Here is the best way to connect the sense leads when charging or discharging a LiPo pack configured with the separate balance connector.



In this case, the sense leads are connected to the balance plug; you will want to connect them to the pins which correspond to the “outside” of the pack, that is, those pins across which the entire pack voltage appears. This gives the sense leads a direct and exclusive connection to the pack for the best voltage reading accuracy during charge and discharge. In almost every case this will be the two pins located at the outsides of the connector; you can check by measuring the voltage across the pins to see if it is the same as the voltage across the large current carrying leads.

Observe proper polarities.

In the case of a LiPo pack with bullet connectors, connect the sense leads directly at the main bullet connectors by stripping back a small bit of insulation at the bullet connector, then clipping the sense leads at these locations.

Important: Using an External Balancer with the Turbo35 BL/SE LiPo

The first thing to be aware of when using an external balancer with the Turbo35 BL/SE LiPo is that ***it is to be connected only during charging.*** You must completely disconnect the balancer during discharge, cycle, or motor operations.

As already mentioned, the Turbo35 BL/SE LiPo incorporates special voltage sense leads so that it can measure voltage with greater precision under all conditions. However, this does make achieving the proper connections more complex, especially when charging LiPo packs using external balancing devices. Because accurate voltage control is a must when working with LiPo packs, proper connection of the sense leads is critical.

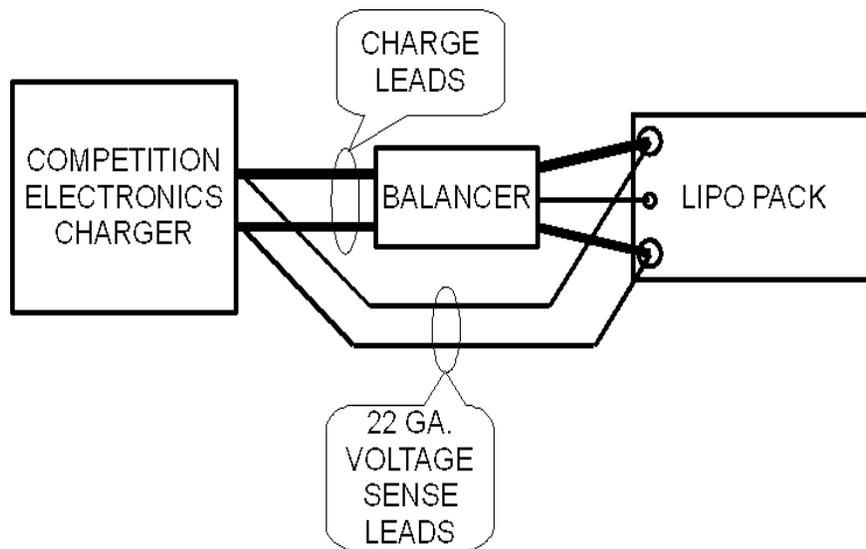
To reiterate: you must use the sense leads when working with LiPo packs!

In order to get good results when working with LiPo packs, it is important to understand these two principles:

- Connection of the sense leads should always be made as close as possible to the LiPo pack terminals, both electrically and physically.
- The more current there is flowing through a connection or wire, the more voltage drop will occur across that connection or wire, and the more error there will be in the voltage reading if that connection or wire is between the pack and the sense leads.

Now, with these two principles in mind, let's look at a couple of diagrams that show a hypothetical balancer used with the Turbo35 BL/SE LiPo to charge-balance 2C LiPo packs.

The first, below, is a diagram showing the connections for a LiPo pack with bullet connectors. Note that this pack has two high current bullet connectors which serve for both balance and charge functions, and a separate, smaller bullet connector in the center which is intended for balancing. (That does not mean that it could not be used for charging, but current limitations of the smaller connector must be observed.)



Note the following:

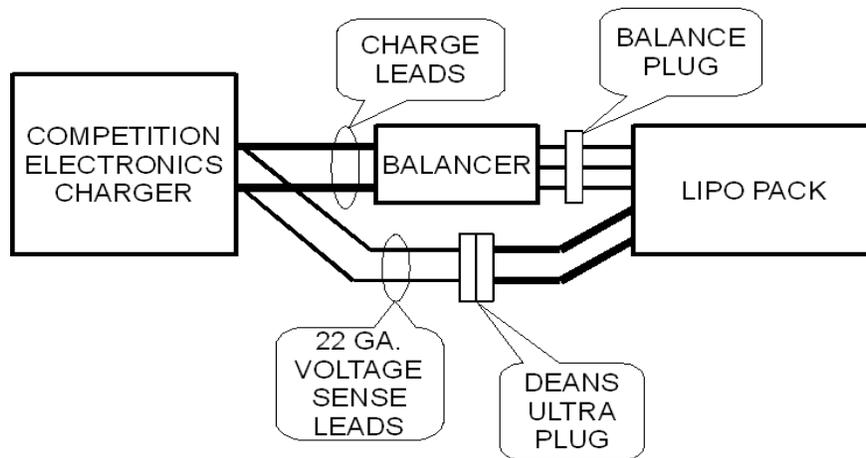
- The Turbo35 BL/SE LiPo's heavy current-carrying charge leads connect directly to the input of the balancer.
- The balancer's output leads, equipped with the proper harness, are connected to the LiPo pack per the balancer manufacturer's instructions.
- The Turbo35 BL/SE LiPo's sense leads are connected directly to the large bullet connectors on the LiPo pack.

A few things need to be said about this hookup:

- Do not charge at a higher rate than the balancer can endure.
- Observe all proper polarities.
- Observe the balancer manufacturer's directions.
- Make sure that the sense lead connections are made very close to the pack connectors.

In this case, we can be assured that under normal circumstances, the voltage drop across the bullet connectors will be very low, as they are high quality connectors designed for this purpose, so physically, the best you can do is to strip back the insulation right where the high current charge leads are soldered to the bullets and clip the sense leads at that point. There is a lot of current flowing through the power leads, but very little flowing through the sense leads, so in this case the only critical aspect of the connections of the sense leads is that they be made as close as possible to the bullet connectors.

Let's consider how to connect another popularly configured LiPo pack:



Here, the pack has a Dean's connector for the main power connections and a special pin and socket connector for the balance function.

The recommended connections for this pack are counterintuitive because in this case the charging occurs through the balance plug and the sense leads are connected to the Dean's plug. Inside a pack such as this, the balance and power connections go to exactly the same place, and as long as we don't exceed the current carrying capacity of the balance connector and it's smaller wires, this arrangement will work very well.

In this case the high current (whatever the connector and balancer will allow, since the Turbo35 BL/SE LiPo's charge rate capacity will almost certainly exceed the balancer's capability) flows through the balance plug, and that leaves the Dean's connector free to be used as a sense connection.

You should be aware of the fact that any connector/connection can fail and cause inaccuracies or hazardous conditions to occur.

If proper principles are followed, special harnesses can be constructed to make implementing these connections easy and convenient. Contact Competition Electronics for details.

Final Notes About Balancers

One should not assume that every balancer is compatible with the Turbo35 BL/SE LiPo. Be alert for possible errors induced by the balancer. It is possible, though unlikely, that some balancers will not work correctly, or at all with the Turbo35 BL/SE LiPo due to incompatibility issues.

Balancing with the Turbo35 BL/SE LiPo Alone

You can balance a pack using only the Turbo35 BL/SE LiPo, as follows:

- Set up the Turbo35 BL/SE LiPo for a 1C charge.
- Charge each cell of the pack individually, using the proper combination of balance and main charge connections on the LiPo pack.

Just make sure that

- You do not exceed the current rating of the balance connector.
- You follow the principles outlined above when connecting the voltage sensing leads.

Powering up the Turbo35 BL/SE LiPo: Selecting Cell Type

The first thing you will notice after the Turbo35 BL/SE LiPo shows the sign on screen is the Cell Type selection screen. Here, you can use the Up Arrow button to select either NimH/NiCd or LiPo chemistry. The unit defaults to NimH/NiCd but if you select LiPo and then store the setup, the next time it will default to LiPo mode. After selecting the chemistry type, press the Left Arrow button to enter the operational mode of your choice.

NimH/NiCd mode

The NimH/NiCd operation mode is unchanged from the previous version. Please consult the original manual, found at www.competitionelectronics.com under Turbo35 BL/SE in the retired products section if you have questions.

LiPo Mode

The Turbo35 BL/SE LiPo mode allows charging of LiPo packs consisting of 1 or 2 cells at up to 12000 mAhr rates.

LiPo packs require a constant current charge process when the voltage is below 4.2 volts per cell. After the voltage threshold of 4.2V per cell is reached, the charge mode will switch into a constant voltage mode and maintain the pack voltage at (4.2V times # of cells) until current drops to roughly 3% of the mAhr setpoint. At this point the charge is terminated. *Because of internal limitations of the Turbo35 BL/SE hardware, relatively low currents which occur when the charge rate approaches 3% of the charge mAhr setpoint may be displayed as “.**”. This is normal and does not indicate a malfunction of any kind.*

The Turbo35 BL/SE LiPo can discharge a LiPo pack at up to a 35 amp rate. The discharge is terminated when the pack voltage reaches (3V times # of cells) while under load.

Charging with the Turbo35 BL/SE LiPo

Charge menu selections have been added to the Turbo35 BL/SE LiPo which are very much like the existing charge menus for NimH/NiCd packs. There are three significant settings for charging/discharging LiPo battery packs, as follows:

Max Charge Seconds

This is a user-settable safety time limit that will shut off the charge and signal an error if the charge time becomes equal to the setting. It is just another safety device which may be useful in the event of a malfunctioning LiPo pack. You should determine the typical charge time for a given LiPo pack at a given mAhr rate, and then set this just a bit longer.

It is also useful as a way to put a partial charge into a pack for the purpose of storage.

Maximum NimH/NiCd Charge mAhr Limit Removed

Earlier T35 models included a max charge mAhr limit. Over the years cell capacity has increased and so to avoid compatibility problems with today's higher capacity cells, this limit has been removed.

No of Cells

Always make sure the number of cells set into this setting agrees with the number of cells specified on the LiPo pack.

Charge mAhrs

Set this to the mAhr rating on your LiPo pack label. The Turbo35 BL/SE LiPo will charge at the ampere rate which will result in full mAhrs delivered in 1 hours time. For example if you have a 3200 mAhr pack, set the mAhr setpoint for 3200 and the Turbo35 BL/SE will charge at a rate of 3.2 amps.

Some manufacturers of LiPo packs specify the ability to charge at 2C, or even 3C rates. Check your manufacturer's pack data to determine if this is acceptable to your pack. At the time of this writing it is generally the case that charge rates higher than 1C can shorten the life of the LiPo pack.

NOTE: Unless specifically allowed by the manufacturer of the LiPo pack in question, never exceed a 1C charge rate.

Under and Overvoltage Considerations

LiPo charge will be disabled and an error message displayed if the pack voltage exceeds 4.3V per cell or if it is less than 2.3V per cell.

If the LiPo pack voltage is between 2.3V and 3V per cell, the Turbo35 BL/SE LiPo will try to charge the pack at approx. 10% of the mAhr rate setpoint for 2 minutes in an effort to restore the pack voltage

to 3V per cell. If the pack does not return to this level after 2 minutes, the charge cycle is terminated and an error message is displayed.

Discharging with the Turbo35 BL/SE

The Turbo35 BL/SE LiPo is capable of discharging continuously at up to 35 Amps. For some LiPo packs, this will cause the pack to exceed its maximum safe temperature. Usually, this is around 140 deg F. Exceeding the maximum temperature can cause fire or explosion. Consult the manufacturer's data sheet for details concerning the maximum temperature for your pack. Always observe maximum discharge rates specified by the manufacturer, as well. If in doubt contact them and ask them directly.

The Discharge display page contains three settable parameters:

Discharge Amps

Settable between .5 and 35 amps. Observe all precautions under “Discharging with the Turbo35 BL/SE LiPo,” above.

No of Cells

Always make sure the number of cells set into this setting agrees with the number of cells specified on the LiPo pack.

AIR

The Turbo35 BL/SE LiPo will measure actual internal resistance at 121 seconds into the discharge cycle. AIR measurement is disabled for discharge rates of 20 amps and below.

Under and Overvoltage Considerations

NOTE: As with charging, there are under and over voltage checks built in which will terminate discharge if it can be determined that there is an abnormality.

Cycling with the Turbo35 BL/SE LiPo

Cycling in LiPo mode works as you would expect; it first runs the LiPo charge and then the LiPo discharge functions.

Storing and Retrieving Program Setups

Storage and retrieval of setups works the same way as with the original Turbo35 BL/SE. The 3 available setups have been expanded to store the additional charge mAhr limit seconds, charge mAhr rate, cell count for LiPo packs. However, you only see the pertinent parameters that apply to the charge mode in use, ie, LiPo or NimH/NiCd.

Addendum Specifications

LiPo Charge Amps Range	0.5A-12A
LiPo Discharge Amps Range	0.5A-35A
LiPo Charge Seconds Range	0 seconds -9999 seconds
Max Power Limit for LiPo Charge	100 watts [(V power supply-V pack)*Charge Amps]

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