

Lipo ESR Meter Mark II User Guide

Please read entire document before using this meter

Always test packs as close to 72F/23C as possible as IR changes with temperature
Always connect MAINS first

If the meter doesn't power up after mains are connected, DO NOT connect the balance cable, the cause is usually a totally dead pack, defective connector on the pack or reversed polarity.

If the XT-60 connector is not what you use on your packs a high-quality adapter is acceptable with minimal noticeable changes in IR readings. It is also advisable that if you use mostly Deans or APP or EC3 or EC5... then by all means, unsolder this supplied connector and solder on your connector of choice and be extra careful to not reverse polarity.

Once you power up and the LCD screen lights up, you can plug in the balance connector ensuring the pack's negative is mating to the balance extension cables first black wire. It will show the voltages of each cell on this HOME screen by posting voltage of Cell #1 to the left of V1. Cell #2 will be to the left of V2...and all the way to a maximum of V6 for 6 cells.

The pack size from the factory is set to 1300mAh. If you have a different size pack plugged in, push the left button for 1 second. When the button is released it will be in page 1 of 5 pages of pre-set pack sizes. **Page #1** is the most common sizes based on a survey of average users and will have 1300, 1800, 2200, 4000 and 5000 sizes available. If this list contains the pack size to be tested press the **SCROLL↓** button 5 times to select 5000 and then press the **Choose** button to select this pack size. From the screen you can either **Edit it** or **Use it** by pressing your desired button under these 2 options. Select **Use it** and your meter is ready for use for a 5000mAh pack from 1 cell to 6 cells.

If you do not see your pack size in Page 1, press the **LEFT** button to **SCROLL↓** and choose **>Next<** to search for your pack size. You can repeat as needed up to 4 times as the last page of presets is page #5.

Pack sizes are only available in 100mAh sizes so if you have a 1750 you will need to round up or round down. The end result is so minimal it will not matter if you round up or down.

If you decide to not change pack size AFTER you began the process press the **LEFT** button and hold it for at least 1 second and this will return you to the HOME screen.

How to change a pack size to a custom size.

If you have, for example, a 3300mAh pack, you can either edit a pre-existing size from Page 1 to Page 5. We left some slots open on page 5 for this if you don't want to change any pre-defined mAh sizes.

From this select **CHOOSE** and then edit the custom size as needed. In the case of this 3300 pack mentioned above, we press the **→** button 1 time. Now press the **+1** button 3 times to edit the thousands to get to 3000. This can go from 0000 to 9000. Now press the **→** button 1 time to edit hundreds and the left button 3 times to get 300. This now matches your pack size so press the **→** button and the screen will show

You close: 3300mAh and you can either **Edit it** or **Use it**. Select "Use it" and the screen will return to the HOME screen. That pack size is written and saved in the eprom and will always be there unless you change it.

From page 6 of presets, yes there is a page 6, there is an option of Reset. Doing this will reset all mAh values to the factory defaults.

Consider this: Use page 1 and page 2 for your packs and your buddies can use Page 3, or page 4 or page 5 and customize each page to match their most common used pack sizes. These can be overwritten over 10,000 times so don't worry about making changes, this function will outlast the meter AND you can always do a factory RESET to get rid of their custom sizes...but yours will be lost too.

Also, when changing pack sizes, if you decide not to change sizes and want to keep the last pack size used, just press and HOLD the left button 1 second and it will revert to the HOME screen.

Once you have the pack size selected and are at the HOME screen the meter will recall the last time used option for **ESR:mΩ** or **ESR: max A**. You can push the Left Button to toggle between **ESR:mΩ** and **ESR: max A**.

In **ESR: max A**, the top line will show the **FoM** (Figure of Merit) and C rating.

NOTE that the C rating is a very conservative C rating and should only be used as a reference but not the actual C rating the pack can deliver. This is done to protect you, the end user, from over stressing a lipo.

Line 2 will calculate the total pack voltage on the left and on the right will be the amps copied from the lowest performing cell in the pack.

The lines under that will be each cells voltage and max constant amps.

As designed, all voltages will update around 2 times per second and it is normal to bounce up and down a few thousandths of a volt.

The C ratings are generated from extensive work by John Julian, Wayne Giles and Mark Forsyth as they were gathering information over many months from users like you and came up with a calculation to estimate the maximum “safe” amps a pack can be discharged for the full 80% discharge without damaging any cells. This meter uses that calculation and an on-line version can be found here: <http://jj604.com/LiPoTool/>

This worked great until Hobby King came out with the Turnigy Graphene line and these performed unlike any lipo I have ever tested in the past. Since then many other companies have come up with much better performing cells and each, in their own way, may be equal or better based on weight, max amps or energy density and all are considered top of the line lipo's.

It is my opinion and **MY OPINION ONLY** that a lipo displaying 30C or higher at 72F on this meter is a true 45C battery but don't expect many cycles out of it if you push it to its limits.

If you press the left button the screen will toggle to **ESR:mΩ** and the top line will show **FoM** on the left and max amps on the right based on a reading copied from the lowest performing cell in the pack from

ESR: max A .

On line #2 the meter will display total pack voltage on the left and pack mΩ on the right. You will notice the pack mΩ is not the same as if you add all cells and get a total mΩ value. This is due to the meter taking a 2 wire IR reading for pack mΩ and, like so many chargers and other IR testers, it must add the resistance of the main discharge wires from the meter to the pack including the connectors of choice.

On line 3 and beyond, each cell's voltage will be displayed on the left and ESR in mΩ on the right.

As designed, all voltages will update around 2 times per second and it is normal to bounce up and down a few thousandths of a volt.

If a cell's reading is blank the balance tap may be plugged in improperly or voltage for that cell has fallen below 0.8 volts If a cell reads **Over_V** it is showing you that either the mains are not plugged in and/or the balance cable is not plugged in correctly or a balance tap wire is broken (OPEN). Any OPEN will cause the meter to not read correctly for 1 cell or more as the meter must have a common (negative) for each cell.

If you try to take a reading faster than 1 second, the buzzer inside will give a longer and LOUDER buzz and that is reminding you to not press the button faster than once per second. This is to protect the power FET from burning up if a button happy person tries to read, read, read... too fast and too long.

Some facts

A pack will ALWAYS show higher resistance if you only test through the discharge lead. If you take an ESR reading with the balance connector and add the total mΩ of each cell. Why? This is because you are performing a Kelvin (4-wire) method of measuring cell voltage separately through the balance leads and adds

the resistance of the battery leads and connectors. This is the reason many chargers and most hand-held IR meters are not very accurate and why the Wayne Giles original ESR meter and this Mark II ESR meter are considered the Golden Standard of lipo IR measuring devices.

Bored? Press and HOLD the right button when you plug in the main leads. Credits go to the first 3 gentlemen mentioned for all their hard work shared on RCGroups.com in the battery forum and their dedication early on to try to make sense of what is a “True C” rating and calling out manufacturers C rating hype. Hopefully you know by now most lipo's sold today have grossly overstated C ratings but, unfortunately, if a seller doesn't exaggerate C ratings their sales will drop so they live in a vicious world. Presently (early 2019) the highest true C ratings that Wayne and John have found hovers around 45-50C. Do we need 50C? No, but in my testing for several of the largest lipo sellers in the USA and abroad, I have found that as the true C of a pack increases so does the potential cycle life. I have tested one pack that has over 1,900 30C discharge cycles and it is still testing at 25C on these meters which makes it about as good as an average new pack.

Still bored? Press and HOLD the left button when you plug in the main leads. That is me and I am NOT an engineer but the one with deep pockets to pay Greg for his hundreds of hours of work and his buddy Robert to do the PCB layout and my friend Carl White to do initial pre-release technical testing (no credits shown, sorry Robert and Carl)

The Firmware and hardware was done by Greg Guerin who helped me accomplish my dream of manufacturing an affordable ESR meter that will read and display up to 6 cells at a time. Most of the other enhancements were his ideas to incorporate into this meter as I had no idea some of this could happen.

If you have a dream and want to make it a reality like I did, Greg may be your man. He knows hardware AND software and is very good at both.