Technical Note: FN-DC Battery Calibrating
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The Seven Steps to Highly Efficient
FLEXnet DC (FN-DC) Programming for the "Traditional Mate"

There are seven basic settings that, when properly entered, activate a powerful measurement tool!

1. The correct Amp Hours of your battery bank must be entered.
2. Enable the correct shunts.
3. The Return Amps must be entered.
4. The End of Charge Voltage must be entered
5. The Charge Parameters Met Time must be entered.
6. Battery Charge Factor (BCF) must be validated
7. Synchronization with the FN-DC & your fully charged battery bank

Prior to beginning these steps it's helpful to start from a known point that consists of charging up the batteries to the manufactures full charge parameters. The seven steps below basically set the parameters of what the FN-DC will detect as a full battery bank. You will be supervising the first FN-DC reconciliation to ensure the values reflect your battery bank, and then the FN-DC will perform the work and collect data for you.

These instructions are intended to support the Traditional Mate System Display, but we use the same nomenclature for our new Mate3. Thus new Mate3 users can to navigate the necessary screens The Flex Net Dc is called a "Battery Monitor", and adjust the respective values.

- Traditional Mate user instruction will begin from the MAIN menu, and you can press the bottom left 2 buttons simultaneously to return to the MAIN.
- Guidance about our Mate3 is found at the end of the frequently answered questions

Step # 1: The correct Amp Hours of your battery bank must be entered.

Traditional Mate: To enter Amp Hours go to **ADV/ (enter password 141)/ DC/** Press **BAT.**
Using the INC or the DEC buttons enter the amp-hours of your battery bank. This value is based on a 20 hour rate discharge capacity.

Mate 3: To enter Amp Hours go to **LOCK/USER/(enter password 141)/Settings/System.**
Using the INC or the DEC buttons enter the amp-hours of your battery bank. This value is based on your 20 hour rate discharge capacity.

Step # 2: Enable Shunt(s).

Only enable the respective shunts that will be active.
ADV/ (enter password 141)/ DC/ SHUNT.

You may confirm which shunt is active by going to Main screen and go to
STATUS/DC/METER. You should notice that when your batteries are charging they are receiving a positive number and a negative number when current is leaving your batteries. If the reverse is happening you need to switch the polarity on the sensing wires on either your shunt or FN-DC.

Step # 3: The Return Amps must be entered.

Return Amps, **ADV/ DC/CHARGE** This is the charge rate that is expected to be returned to your batteries when they are full or approaching full. This value is derived from a percentage of the total amp hours in your battery bank. This value can be obtained from your battery manufacturer. 2% of your total amp hours is a good default to establish our baseline. For example, a 250 Amp-hour battery bank @ 20hr discharge rate with a 2% value of return amps would be 250 x .02 = 5 amps.

Another more concrete method to find your return amps value would be to charge your batteries until they are full using the battery manufacturer charging values to include specific gravity readings if applicable. Then simply do another rebulk and absorb. If you are using an off grid inverter simply turn off the AC source for about 1 minute, and turn on the generator again or reconnect the AC source. If you are using a grid interactive inverter that can sell back to the grid start a RE-BULK (push AC IN button 4 times). Then monitor the current holding your absorb voltage by viewing the shunt activity (positive amps) returning to the battery bank with no loads on the batteries at **STATUS/DC/METER** . Set the return amps to this value.

> *FYI: This value will change as the batteries age. The return amps for brand new batteries could be as low as 1%. The return amps for older batteries may be as much as 3% perhaps more depending on their condition. Therefore, our suggested default value is 2%, and adjust the Battery Charge Factor (BCF) Step #5 if adjusting is needed.*

Step # 4:   **Battery End of Charge Voltage must be entered**,

ADV/ DC/CHARGE (select down – this parameter setting is beneath the "return amps").
The manual calls this the Battery End of Charge Voltage, but on the MATE this is labeled "battery voltage". Do not let this confuse you.
This value is based on your absorption voltage which can be found in the parameters you set with your battery manufacture's settings. **ADV/FX/CHARGER** (select down to you see this value and confirm each port too).
For a 12/24 volt system it should be set .2 of a volt less the absorption voltage.
For a 48 volt system it should be set .4 of a volt less the absorption voltage.

> *For example: Your battery manufacture suggested for you to set your FX charger absorb voltage to 58.2 volts for 3 hours since you typically do a 50% discharge of your batteries. Thus for the FN-DC Battery End Charge Voltage you must subtract .4 volts from your absorb voltage to have your "Battery End of Charge Voltage" which equals 57.8 volts.*

Step # 5: Charge Parameters Met Time must be entered.

 From the factory this is set to 1 minute. This is user adjustable but usually the default value is optimal.

Step # 6:   Charge Factor (BCF) must be validated.

From the factory this is set to 94%, and this would be the value that would require adjusting only after several battery charging and usage cycles. The BCF is defined as a compensation factor for losses in the recharging and discharging of the battery by discounting amp hours during the charging of the battery only. For example, the FN-DC doesn't count every amp hour used for recharging because during recharging it actually has losses related to gassing and heating – so for every 100 amp hours of charge only 94 are shown in the amp hour display (94% BCF). FYI: The amp hours removed from the battery are counted for 100%.

Step # 7: Synchronization with the FN-DC & your fully charged battery bank.

You are now done programming. You need to go through a few charge cycles to ensure your batteries are synchronized correctly with your programming. Some installers will charge the batteries prior to programming, and they simply calibrate the FNDC by unplugging the FNDC on the HUB and replugging it back in. The installer will also leave the absorb time to a long enough duration for the renewable energy resource is long enough for the FNDC parameters to meet 100% state of charge. Anytime you unplug the FNDC it resets to 100%.
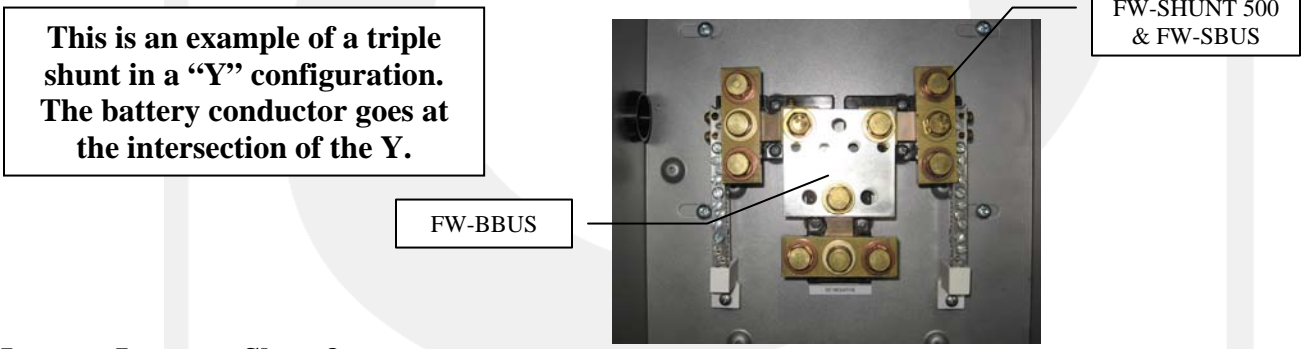
The FN-DC is a battery monitor or an elegant bean counter. It only knows what you tell it.

IF YOU LIE TO IT, IT WILL LIE TO YOU!

Frequently Asked Questions:

What type of shunt do I need?

OutBack recommends our FW-SHUNT250 (unit mounts on an FX) or FW-SHUNT500, with an FW-SBUS or FW-BBUS for multiple items to pass or to join gang multiple shunts. By adding our BUS bar you increase the capacity of our shunt for proper cooling. These shunts are rated to measure at 500 Amps / 50 mV. Any shunt can be used as long as it's a 10,000:1 amps/volts ratio, and this means a 1,000A/100mv shunt will work and this is our maximum input for the FN-DC.

This is an example of a triple shunt in a "Y" configuration. The battery conductor goes at the intersection of the Y.

FW-SHUNT 500 & FW-SBUS

FW-BBUS

How can I test my Shunt?

You can measure millivolts with your voltmeter across the terminals of the shunt. One millivolt equals ten amperes (+ probe goes on battery side). Observe the polarity when you are charging and discharging – it should reflect what you are seeing in Step 2 & 3 above.

Does a shunt come with the FN-DC kit?

No, unless you purchased the OutBack Power Systems FW500 or FW1000 DC enclosure, which comes with a shunt, you need to purchase one from your distributor.
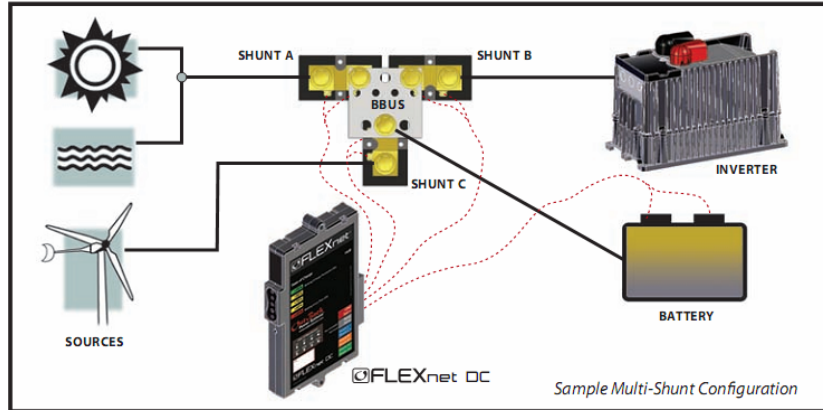
Frequently Asked Questions, Continued:

Can the FN-DC be connected to a positive grounded system?

No

My battery State of Charge (SOC) says 100% but my battery voltage or specific gravity isn't 100%?

Your FN-DC still needs some calibrating with your battery bank. Review your settings in Steps 1-7 above. If you have gone through multiple usage and full charge cycles with out adjusting any values, then, and only then, should you lower your Battery Charge Factor (BCF) See Step #6. Then go through multiple usage and full charge cycles prior to making any further adjustments to the BCF to fine tune your system.

How do I reset the FN-DC?

To reset the unit to factory defaults go to **ADV/DC/PG3** then select **RESET**.

I have no power at my FN-DC?

Your FN-DC is recommended to have an over current protection of less then 5 amps, and this device should be checked for open circuit. The FN-DC must be plugged into the HUB in one of the port numbers after the FX inverters. FYI: Unplugging the FN-DC and plugging it back in at the HUB re-synchronizes the SOC to be 100%– see Step #7.

How do I use the relay?

The relay is a 5 amp, 30 volts rated relay and needs over current protection. This dry contact relay has invert logic capabilities that can be used to control a generator. We recommend using it with the MATE's AGS feature by setting that port that the FN-DC is plugged into. The relay can also be use for other functions such as: alarm, light, or other low voltage devices. The FN-DC manual explains how to utilize this feature.
http://www.outbackpower.com/pdf/manuals/flexnet_dc.pdf page 16

Frequently Asked Questions, Continued:

What MATE software revision do I need to use the FN-DC?

You need at least 4.0.4. You can find your MATE code revision by going to **SETUP/MATE.** If you have a MATE that has older firmware you may contact OutBack Power Technologies to get free firmware upgrade on your device support@outbackpower.com or (360) 618-4363.

I want to sell energy back to the grid with my GTFX, but I want my batteries to receive a full charge first. Can the FN-DC help?

Yes, on the MATE (with MATE code firmware 4.1.6) we have "Advanced grid tie authority" that, when enabled, will tell the FN-DC to fully charge the batteries each morning prior to selling. This feature can be found at **ADV/MATE/PG4/MODE.**

When will my "Days Since Full" go back to zero?

"Days Since Full" may be labeled "Days since Parameters Met". The FN-DC will be content to reset "Days Since Full" when it observes the parameters programmed on steps 3 through 5 are satisfied, and then when it confirms current has begun leaving the battery. *Tip: If you have inaccurate parameters you will have an invalid state of battery charge displayed that is capable to be enabled to be controlling selling, charging, etc.*

How can I have my FN-DC stop my absorb charge if my battery bank has met parameters?

As a default the Mate will stop an absorb charge if it sees the parameters met. Using the Mate, go to the following screen: ADV/(Password)/MATE/PG3/FN-DC. Ensure "enable charge termination" is set to "yes". This will stop the absorb cycle on our Out Back gear once parameters are met.

Why does my Charge Efficiency (STATUS/DC/BAT) say a different value then my Battery Charge Factor I programmed into the FN-DC parameters?

Charging Efficiency is revealing how effective you are at charging your battery bank. Did you make it to 100% SOC when you last charged your system, or where you passing too much energy to your AC loads? Battery Charge Factor is a different value all together, but it could be relevant. (See our explanation in Step #6). Consulting the battery manufacture would be ideal to inquire their efficiency percentage for the actual amount of energy entering the battery and actually being stored for your use versus lost to heat and other losses.

Frequently Asked Questions, Continued:

"DC NOW" displays zero volts. What is going on?

You may have a blown fuse or tripped a circuit breaker that is protecting the conductor that goes to the BAT+ on the back of the FN-DC. Check the over current protection and check the back the FN-DC terminal block, to see if proper battery voltage is present at the screws.

How do I know my battery is full?

This answer is critical to a battery owner who desires to have long lasting batteries. The best answer is to consult with the battery manufacture by asking them to answer this question. Methods to measure typically involve the utilization of:

- temperature compensated hydrometers
- refractometers,
- digital multi-testers that go to the hundredth decimal
- load testing,
- end amps or good old fashioned return amps (to include a combination of voltage & time).

Further information about best practice for confirming how a battery is full, can be found by searching Out Back Power Forum http://www.outbackpower.com/forum/index.php   .

My slave FX says a lower battery voltage than my FN-DC. What should I do?

The FN-DC is the most accurate device and all other devices should be calibrated to that voltage, after being confirmed with a quality digital multi-tester on the terminal lugs of each device. This will help reduce conflicts between devices.

I have a Mate 3 what is different for me to program?

The Mate 3 doesn't require users to go through several different screen paths to modify and calibrate a battery monitor system (Flex Net DC). The Mate's remote monitoring and graphing will be very helpful for ensuring your system stays healthy. The status screen used in this document can be found on the pushing the battery icon button (#2 soft button) and the "next" screens it offers to examine closely "status" & "statistics". The modifications to values or enabling shunts for the FN-DC are found and adjustments made from the Lock Button, (user-password 141), Settings, Battery Monitor.

Further Reading:

Alpha Technologies, http://www.alpha.com/ Has experienced designers, installers, and products to support battery based inverter and charger systems. They have training and white papers to help answer questions such as predicting the life of your battery bank. For example this link: http://www.alpha.com/Media/Documents/ConductanceTesting.pdf

Home Power Magazine, http://homepower.com/home/ Has a lot of brain power from reputable industry representatives to help you gain insights with new techniques or best practices. For example, **Managing Your Batteries** by Dan Fink Apr/May 2011 (#142) pp. 62-66

Misco Refractometers, http://www.misco.com/   Has refractometers that measure how dense battery acid is by how many degrees it bends light. This is very easy to utilize, uses only a drop of acid, temperature compensated automatically, and very reliable. The hand held model #7084VP is a worthy investment to an installer or off grid user.

Rolls Surrette, http://www.rollsbattery.com/ A durable battery manufacture with resources to help you succeed. For example, this link: http://www.rollsbattery.com/content/preventive-maintenance-charging-and-equalization-605

Trojan Battery, http://www.trojanbattery.com/ A helpful battery company that produces a variety of batteries. For example, this link: http://www.trojanbattery.com/BatteryMaintenance/Testing.aspx