DesignShine 11.1V-to-7.4V Reprogramming Guide

Battery Choice History

Before starting the reprogramming process, a small bit of history here would be appropriate. When I originally designed these lights, I really wanted to have a single power source for both the head and taillight. Just due to the nature of the light designs, the 11.1V pack ("3-cell" lithium-ion) seemed to be the perfect compromise…sort of. While ideal for the headlight, the taillight suffered a bit with the 11.1V standard since the lowest 2 power levels would not be visible until the battery had been partially discharged. Given that most folks would be using this light for daytime visibility, this seemed like a reasonable compromise. Fast-forward 3 years, and there are a number of factors that just make sense for converting the DS-500 over to 7.4V (2-cell) operation. The primary factor is that there are now a number of off-the-shelf packs that are plug-and-play compatible with the DS-500. In reality, the 7.4V solution is actually an ideal input voltage since all 5 power levels will always be available, regardless of the level of charge on the battery. There is NO detrimental effect on the performance of the light when using 7.4V. The power supply is a constant-current, boost-mode controller, and will accurately drive the LEDs at the same levels as with the 11.1V pack.

I've also done some extensive testing on the headlight, using a 7.4V pack, and found that it will actually run safely (without overheating the power supply inductor). The only drawback is that the headlight will require slightly more airflow to maintain constant level 5 operation before the thermal protection kicks in.

So Why Does the Light Need to be Reprogrammed?

The simple answer to this question is that the "brain" (microcontroller) on the power supply board needs to be able to correctly determine the remaining charge on the battery in order to inform the user of the remaining battery life. The light does this by detecting THREE distinct voltage levels as described in the Table 1 below. Note that the values in the 11.1V column are programmed into the firmware of the controller and will be restored upon performing a "factory" reset.

Table 1 - DesignShine Battery Detection Threshold Recommendations

Threshold Description	Value for 7.4V Packs (volts)	Value for 11.1V Packs (volts)
"Medium" warning	07.1	10.9
"Low" warning	06.7	10.4
Automatic shutdown (battery protection)	06.2	09.4

Through experimentation, I've determined values for each of these thresholds that make a good starting point for 7.4V packs. These values can certainly be "tweaked" as need be if you decide that the warning levels may not be adequate. The exact time remaining at each one of these threshold values is a direct function of battery capacity, power level being used, flash mode, etc. However, as a general rule of thumb, I was shooting for roughly 50% capacity remaining at the "medium" level, and 20% capacity remaining at the "low" warning. There are a LOT of variables that can affect this in practice, so the best method is to observe the light's behavior and try to take your own measurements (stopwatch, etc.) when the light indicates 20% capacity remaining. This will give you a better feel for how to manage the battery life.

How do I Actually Reprogram the Board for 7.4V Operation?

OK, now for the real reason you're here. Let's get down to it…
Grab the light and battery pack (preferably a 7.4V pack, but the 11.1V works fine as well) and follow this process:

FYI - Bail out procedure. If you ever get lost in the process or feel like you made a mistake, just unplug the battery and start over.

1. **Put the light into Programming mode.**
   Step 1: Hold down the power button WHILE connecting the battery. The light will now be ON at a fairly dim level.

2. **Move to Menu Item #6 (shutdown menu)**
   Step 1: Click SIX times. You want to do this fairly *slowly and deliberately* so that you always have time to observe the "acknowledge" flash after each click. After each acknowledge flash, the light will be OFF.

   Step 2: Press-and-hold till the light flashes and goes dim again. You have now successfully entered menu #6.

   Step 3: Press-and-hold until the light flashes once and goes dim again. You have now defined the behavior of the light once the cutoff voltage is reached. In this case you just selected "option 0," or, "Turn-off" (i.e. the light will flash 8 times and shut down automatically to protect the battery at this voltage level).

   TIP: Now it's time to enter the THREE digits that define the threshold voltage. Notice from Table-1 that the leading zeroes are NOT an accident. You must explicitly enter the number in the format XY.Z where X is the tens value, Y is the ones value, and Z is the tenths value.

   Step 4: Enter the "X" value of 0. This is a "zero-click" operation, so to ENTER the value, simply press-and-hold till the light flashes and goes dim again.

   Step 5: Enter the "Y" value of 6. Click SIX times, making sure that you wait long enough between clicks to observe the acknowledge flash.

   Step 6: Press-and-hold until the light flashes and goes dim, you have now entered the "Y" value.

   Step 7: Enter the "Z" value of 2. Click TWICE, then press-and-hold to enter. The light will flash twice and re-enter programming mode by going dim.

Menu #6 was unique in that there was the extra step of determining the behavior of the light when the shutdown threshold was reached. The "low" and "medium" thresholds, however, only involve entering the new numeric value via a similar process on the next page.

3. Move to Menu Item #7 (LOW voltage warning menu)

Step 1: Click SEVEN times, waiting for "acknowledge" flash after each click. Press-and-hold to ENTER menu #7. The light should be ON.

Enter the value "06.7" one digit at a time…

Step 2: Enter the "X" value of 0. This is a "zero-click" operation, so to ENTER the value, simply press-and-hold till the light flashes and goes dim again.

Step 3: Enter the "Y" value of 6. Click SIX times, making sure that you wait long enough between clicks to observe the acknowledge flash.

Step 4: Press-and-hold until the light flashes and goes dim, you have now entered the "Y" value.

Step 5: Enter the "Z" value of 7. Click SEVEN times, then press-and-hold to enter. The light will flash twice and re-enter programming mode by going dim.

4. Move to Menu Item #8 (MEDIUM voltage warning menu)

Step 1: Click EIGHT times, waiting for "acknowledge" flash after each click. Press-and-hold to ENTER menu #8. The light should be ON.

Enter the value "07.1" one digit at a time.

Step 2: Enter the "X" value of 0. This is a "zero-click" operation, so to ENTER the value, simply press-and-hold till the light flashes and goes dim again.

Step 3: Enter the "Y" value of 7. Click SEVEN times, making sure that you wait long enough between clicks to observe the acknowledge flash.

Step 4: Press-and-hold until the light flashes and goes dim, you have now entered the "Y" value.

Step 5: Enter the "Z" value of 1. Click ONE time, then press-and-hold to enter. The light will flash twice and re-enter programming mode by going dim.

5. Exit Programming Mode

Press and hold till the light flashes twice and goes OFF, or simply disconnect the battery. Congratulations! You're done.

Tweaking example: Let's say that you've determined you'd like to have a little more LOW battery warning time. In that case, you would go back to programming mode, enter menu #7 and adjust the threshold level UP by $1/10^{th}$ of a volt (i.e. change from 06.7 to 06.8). Similarly if you want to decrease the warning time, drop to 06.6.

Good 7.4V Battery Options

Any of the existing off-the-shelf batteries from Magicshine, Gloworm, or Gemini will work great with the DS lights with no connector modification. They are all 7.4V (2-cell) and use the same circular 2.1mm power connector. Dinotte and Lupine batteries will also work fine, but in that case, you'll need to either cut off the connector on the DS light and splice on a mating connector, or (better) build a short adapter cable. I've done this many times by purchasing an extension cable (from Dinotte for example), then cutting and mating as necessary.

A good source for the directly compatible batteries is:
www.Action-LED.com