

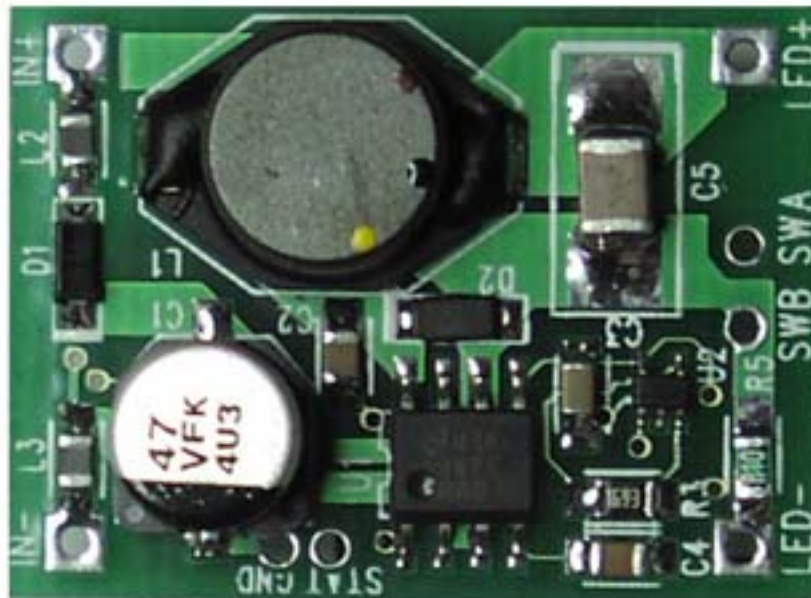
# Operating Manual for nFlex UIP (V1.01)

## 1 Description

The heart of the nFlex board is a Microcontroller (uC) that contains the firmware to implement the following features:

- High efficiency Buck mode (step down) switching regulator (maximum drive current set in firmware).
- Single switch to select from various brightness levels, turn the unit on/off and to select the operating mode.
- Non-volatile (EEPROM) storage of operating mode, last selected brightness level and maximum drive level (350mA, 500mA, 750mA or 1000mA).

### 1.1 Wiring the nFlex



The picture shows the connections to the nFlex. The user needs to provide DC power to the nFlex (e.g. battery, DC wallwart, vehicle/boat/RV 12V).

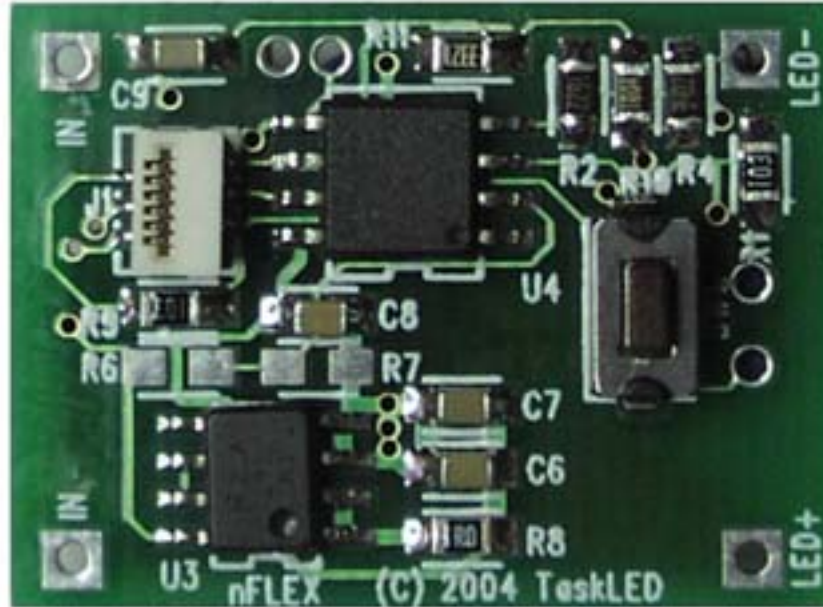
The nFlex is reverse polarity protected by a schottky diode in series with the +IN (D1 on the PCB). Ferrite beads in both the +IN and –IN help attenuate switching noise from feeding back into the input wiring that may interfere with radio communication equipment in a boat.

The nFlex has a switch soldered on the board; an additional switch may be connected via leads soldered to the holes SWA and SWB. The switch needs to be of a momentary action push to close type, i.e. normally open contacts.

Input power is connect via IN+ (positive input voltage) and IN- (negative input voltage).

The LED load is connected to LED+ (positive LED) and LED- (negative LED). NOTE: LED- is NOT the same as IN-.

Below is the view of the other side of the nFlex board. The switch is in the middle right side. The small white connector is the uController programming header.



As shipped, the nFlex is configured for nominal 350mA drive. The user may reconfigure the nFlex drive level as described later in this document.

The following table shows the supported configurations of the nFlex.

Driver Configuration	Input voltage for regulation (min)*	Input voltage Operating (min)**	Input voltage (max)
1 1W Luxeon	$V_f+0.7V$	4V	24V
1 to 4 1W Luxeons (in series)	$\Sigma V_{fn}+0.7V$	4V	24V
1 Luxeon III	$V_f+1.1V$	4V	24V
1 to 4 Luxeon III (in series)	$\Sigma V_{fn}+1.1V$	4V	24V
1 to 2 5W Luxeon	$\Sigma V_{fn}+1.1V$	4V	24V

\* Nominal Minimum input voltage to ensure current regulation is maintained (350mA drive to 1W Luxeons, 1000mA drive to 3W or 5W Luxeons). Below this voltage the nFlex will enter direct drive and the brightness will drop. If lower light levels are selected, nFlex may be able to keep the Luxeon in current regulation due to lower  $V_f$  requirements at lower current. These dropout voltages assume that the input protection diode D1 and the ferrite beads L2 and L3 are shorted out.

$V_f$  is the forward voltage of the Luxeon at the driven current.

$\Sigma V_{fn}$  is the sum of the forward voltage of all the series connected Luxeons.

\*\* Minimum operating voltage for nFlex.

## **1.2 Turning the nFlex ON the first time**

**Do not apply power to the nFlex unless the Luxeon(s) is/are connected. This is to protect the output capacitor and to protect the Luxeon from voltage spikes if it is then connected to the nFlex.**

The nFlex is shipped with the lowest drive level (350mA) as the default and with auto-sleep mode turned off and Poweron mode turned on. When power is first applied, the nFlex will drive the Luxeon(s) at the nightlight level.

## **2 Definitions**

- Click – a short, less than 0.3 seconds press and release.
- Press – a longer, greater than 0.3 seconds press and hold.
- Force – an option to always have the light turn on at a specific user-selected level.
- UI – User Interface.
- EEPROM – non-volatile memory. Data stored here will remain even if the battery is disconnected.

## **3 Initial Power Application**

As shipped, when power is first applied, the nFlex will not light the LED. If Poweron Mode is active (it ships by default with it disabled) nFlex will power up and light the LED at the lowest level. If the switch is pressed when the electrical circuit is first made, nFlex will light up in the same way as if the switch had been pressed from off.

## **4 Initial Shipped Configuration**

nFlex is shipped preconfigured as follows:

- Autosleep OFF
- 350mA maximum drive
- Force OFF
- Autolockout OFF
- Poweron Mode OFF

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## **5 User Interface, 5 Discrete Levels**

There are 6 operating modes for the UI. They are described below.

### **5.1 On/Off Mode**

To turn on the light, click the switch. The light will turn on at the previous level or the Force level if Force is enabled.

To turn off the light, click the switch.

### **5.2 Adjustment Mode**

To adjust the brightness of the light start with the light off, then press the switch. The light will always turn on at Level 1 (dimmiest level) and in the brightening direction.

Release the switch at the desired level, and that new level will be stored in the EEPROM. Pressing the switch again (within 1.5 seconds) will start the light adjustment in the opposite direction (the direction toggles each time).

When the light reaches the dimmest or brightest level it will stay there until the switch is released. Once the switch is released for longer than 1.5 seconds no more brightness adjustment is possible without turning off the light and starting the sequence again.

### **5.3 Latched Full Brightness Mode**

With the light turned on, a press will latch to Level 5 (brightest). A second press will unlatch and return the light to the original brightness level.

To turn off the light, click the switch.

### **5.4 Lockout Mode**

To prevent accidental turn on or unintended use the light can be electronically locked out. Lockout can be manually selected each time prior to turning off the light or a menu option (see Sec 6.5) can auto-lockout every time the light is turned off.

To manually enter lockout, begin with the light on and ensure light is on for at least 1 second. Then click the switch rapidly three times, no more than 0.3 seconds apart. The light will cycle off/on/off and then flash once and then go dim for 2.5 seconds then flash three times. The light is now in lockout mode and can only be turned on again by three clicks spaced no more than 0.3 seconds apart.

### **5.5 Autosleep Mode**

If Autosleep is enabled (see Sec 6.1), the timer will reset and start counting whenever a switch click or press occurs. When 15 minutes goes by without a click or press, the Autosleep function will commence dimming the light. The brightness level will visibly drop after each subsequent minute until the lowest light level is reached. After a total of 60 minutes elapses from the last switch action the light will turn itself off.

A press during any time prior to 60 minutes elapsing will return the light to its starting brightness level prior to dimming having started.

To turn off the light, click the switch.

### **5.6 Force Mode**

This mode is selected from the power-on menu (see Sec 6). Force mode overrides the initial turn on brightness level that was set via the Adjustment Mode on the previous turn off. The user can always set a new temporary light level by using the Adjustment mode during turn on. but it will be overridden the next time the light is turned off and back on.

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## 6 Menu Selection (Configuring nFlex)

This section describes how to enter the Menu system and how to change operating options. The changes will be stored in the EEPROM.

To access the Menu, begin with the light on and ensure light is on for at least 1 second. Then click the switch rapidly three times, no more than 0.3 seconds apart. The light will cycle off/on/off and then flash once and then light up dim. The Menu Mode is now active and you can select the Menu you wish to access.

Click the switch from 1 to 5 times (the LED will flash for each click) to select one of the five menu options to change as listed below. If no click occurs within 2.5 seconds lockout is set. If more than 5 clicks are entered, the menu mode is exited, the LED flashes quickly 5 times to indicate a selection error and normal operation of the light commences.

After clicking from 1 to 5 times wait for the LED to light up dim (unless your choice is zero clicks). Then continue as below.

### **6.1 Zero clicks – times out to Lockout**

If no menu is selected (zero clicks), after 2.5 seconds the LED flashes quickly 3 times to indicate Lockout has been set. The LED then turns off and the unit is locked out. To turn it back on requires following the lockout release sequence of three quick clicks as outlined in Sec 5.4.

### **6.2 One click - Autosleep Enable/Disable**

Initially the LED will be dim to indicate Autosleep will be active (i.e. if you don't click to toggle this option, Autosleep will become active). A click will brighten the LED to indicate Autosleep will be inactive. Each click will toggle from active to inactive. When you are happy with the choice, wait 2.5 seconds and the LED will flash once to indicate the selection has been made and the light will then turn off.

### **6.3 Two clicks – Current Drive Selection**

Initially the LED will light up dim to indicate the 350mA current drive will be active. Each click will cycle to the next current drive level. The sequence is:

- 350ma (LED dim)
- 500mA (LED brighter)
- 750mA (LED brighter)
- 1000mA (LED brightest)

The sequence will cycle through all 4 choices. The LED brightness increases at each click. When you are happy with the choice, wait 2.5 seconds. The LED will flash once to indicate the selection has been made and the light will then turn off.

## **6.4 Three clicks - Force Mode Enable/Adjust/Disable**

Initially the LED will dim to indicate Force Level 1 (dimmiest) will be active (i.e. if you don't click, Force will become active and set to Level 1). Each click will cycle to the next Force setting. The sequence is:

- Force Level 1 (LED dim)
- Force Level 2 (LED med/low)
- Force Level 3 (LED medium)
- Force Level 4 (LED med/high)
- Force Level 5 (LED brightest)
- Force Disabled (LED is off)

The sequence will cycle through all 6 choices. The LED brightness matches the 5 operating levels of User Interface 1. When you are happy with the choice, wait 2.5 seconds. The LED will flash once to indicate the selection has been made and the light will then turn off.

## **6.5 Four clicks – Auto-lockout Enable/Disable**

To prevent accidental turn on or unintended use, the light can be electronically locked out. Auto-lockout can be enabled so that each time the light is turned off it enters Lockout and requires 3 quick clicks or 2 quick clicks and a press to turn the light back on.

Initially the LED will be dim to indicate Auto-lockout will be active (i.e. if you don't click, Auto-lockout will become active). A click will brighten the LED to indicate Auto-lockout will be inactive. Each click will cycle from active to inactive. When you are happy with the choice, wait 2.5 seconds and the LED will flash once to indicate the selection has been made and the light will then turn off.

## **6.6 Five clicks – Poweron Mode Enable/Disable**

nFlex can be configured to either power-up with the LED lit or unlit when power is first applied. E.g. In a light that has a power switch in series with nFlex and the battery the user may want nFlex to light up the LED as soon as the power switch is turned on. In this case the user would Enable Poweron Mode.

Initially the LED will be dim to indicate Poweron Mode will be enabled (i.e. if you don't click, Poweron Mode will be enabled). A click will brighten the LED to indicate Poweron Mode will be disabled. Each click will cycle from enabled to disabled. When you are happy with the choice, wait 2.5 seconds and the LED will flash once to indicate the selection has been made and the light will then turn off.

## **6.7 Menu Selection Complete**

Once the above menu procedure is complete and the light turns off the new menu selection is immediately active. nFlex is ready to be used.

Only one menu item can be changed per Menu Selection sequence, i.e. nFlex turns off after one sequence.