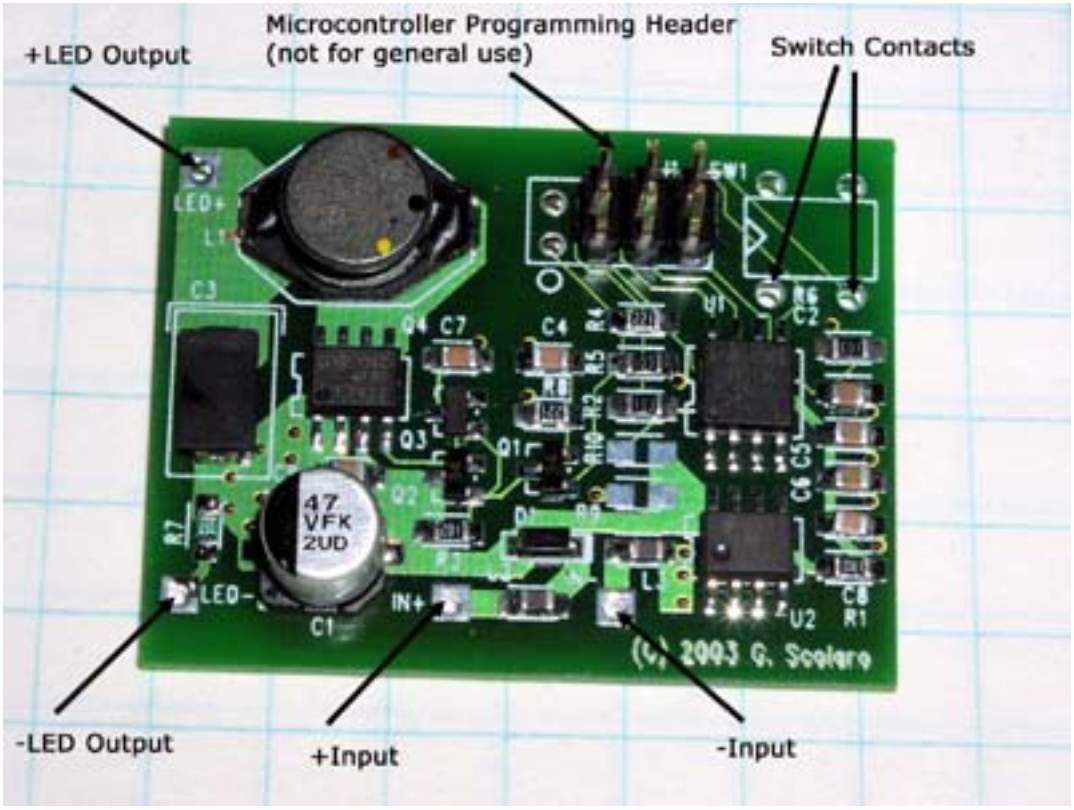
Operating Manual for uFlex (V2.00)

1 Introduction

The heart of the uFlex 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 1W or 5W configuration.

1.1 Wiring the uFlex



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

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

The switch should be of a push to close type, i.e. normally open contacts. A switch may be optionally soldered onto the board – the holes are compatible with common miniature tactile switches.

The uFlex is shipped configured for nominal 380mA drive or 750mA drive. This is a slight overdrive that was chosen to provide good battery life versus light output.

The following table shows the supported configurations of the uFlex.

Driver Configuration	Input voltage for regulation (min)*	Input voltage Operating (min)**	Input voltage (max)
1 1W Luxeon	Vf+0.6V	3V	20V
2 1W Luxeons (in series)	Vf1+Vf2+0.6V	3V	20V
1 Luxeon III	Vf+0.6V	3V	20V
2 Luxeon III (in series)	Vf1+Vf2+0.6V	3V	20V
1 5W Luxeon	Vf+0.6V	3V	20V

* Nominal Minimum input voltage to ensure current regulation is maintained. Below this voltage the uFlex may go into direct drive and the brightness will drop. If lower light levels are selected, the uFlex may be able to keep the Luxeon in current regulation due to lower Vf requirements at lower current.

Vf is the forward voltage of the Luxeon at the driven current.
Vf1 is the forward voltage of the first Luxeon.
Vf2 is the forward voltage of the second Luxeon.

** Minimum operating voltage for uFlex.

1.2 Turning the uFlex ON the first time

Do not apply power to the uFlex 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 uFlex.

The uFlex is shipped with the lowest light level as the default and with auto-sleep mode turned off. As soon as power is first applied the uFlex will drive the Luxeon(s) at the nightlight level. The nightlight level is somewhat related to input voltage, at lower voltages it will be quite dim and will get brighter with increasing input voltage. This is a byproduct of the implementation of the switching regulator control loop and is not a fault.

2 Operating Instructions

This section describes how to use the button to access the different features of the uFlex. A quick summary can be found in the following table.

0 – ½ second	½ - 1 ½ seconds	1 ½ - 5 seconds	5 – 10 seconds	>10 seconds
Normal on	On (nightlight)	On (Full bright)	On (auto-sleep on)	On (auto-sleep off)

2.1 Turning the uFlex ON

Pressing the button for less than ½ second will turn on the uFlex. The Luxeon(s) will not be illuminated until the button is released. This is a feature that enables the user to know if an alternate brightness level or mode change is occurring.
When the uFlex is turned on, by either applying power or pressing the button when in sleep mode, the previous brightness level will be automatically selected.

2.2 Turning the uFlex OFF

Pressing the button for less than ½ second will turn off the uFlex. In actuality the uFlex enters sleep mode (draws about 0.2mA). The uC disables the switching regulator control loop, the Luxeon(s) go off and the uC enters a low power sleep mode where it waits for a button press to wake it up again.

Removing input power will of course also turn the uFlex off.

2.3 Turning the uFlex ON to an alternate brightness level

Pressing the button for longer than ½ a second but less than 1½ seconds will select the nightlight illumination level. To aid the user in knowing this level is being selected, the Luxeon will illuminate at the nightlight level after ½ a second. This level is stored in the EEPROM as the current illumination level.

Pressing the button for longer than 1½ seconds but less than 5 seconds will select the full brightness illumination level. To aid the user in knowing this level is being selected, the Luxeon will switch to full brightness level after 1½ seconds. This level is stored in the EEPROM as the current illumination level.

2.4 Turning the uFlex ON and changing auto-sleep mode

Pressing the button for longer than 5 seconds but less than 10 seconds will select auto-sleep mode. To aid the user in knowing this mode is being selected, the Luxeon will illuminate at the nightlight level after 5 seconds. The nightlight illumination level along with the auto-sleep mode will be stored in the EEPROM.

Pressing the button for longer than 10 seconds will deselect auto-sleep mode. To aid the user in knowing this level is being selected, the Luxeon will switch to full brightness level after 10 seconds. The full brightness level along with the non auto-sleep mode will be stored in the EEPROM.

Auto-sleep is a feature than allows the uFlex to automatically enter sleep mode if no button press occurs within a fixed time period. The following is a description of auto-sleep in action.

- Turn unit on and set to any desired brightness level.
- 45 minutes after the last button press, one brightness level is automatically decreased every minute until nightlight level is reached
- The Luxeon remains at nightlight level until a total of 45 + 120 minutes elapses at which point the uFlex turns off and enters sleep mode (drawing 0.2mA).

If the button press occurs within 45 minutes, the auto-sleep timer is reset and the countdown starts again. If the button is pressed for longer than ½ second during the 120 minute countdown phase the brightness level will increase (until the button is released) and the auto-sleep timer is reset and the countdown starts again. Once the unit turns off if the user turns it back on it will return to the original brightness level that it was last set to prior to beginning the auto-sleep dimming sequence.

Note: The timer that measures the elapsed time is not highly accurate. The times can easily vary 10% between uFlex boards and over the operating temperature range. Do NOT use this device as a precision time-measurement tool. ☺

2.5 Turning the uFlex ON (examples)

Example 1: enable auto-sleep mode.

Press the button for longer than 5 seconds. The Luxeon will be off for the first ½ second, then it will light up at nightlight level, and after 2½ seconds will light up at full brightness and after 5 seconds will go back to nightlight level. Release the button and auto-sleep mode is now active. Auto-sleep will remain active until it is specifically reset.

Example 2: light up at nightlight level

Press the button for longer than ½ a second. The Luxeon will be off for the first ½ second, and then it will light up at nightlight level. Release the button and nightlight level will now be the current illumination level.

Example 3: disable auto-sleep mode.

Press the button for longer than 10 seconds. The Luxeon will be off for the first ½ second, then it will light up at nightlight level, and after 2½ seconds will light up at full brightness and after 5 seconds will go back to nightlight level and after 10 seconds will light up at full brightness again. Release the button and auto-sleep mode is now disabled.

2.6 Changing brightness levels

There are 7 equally spaced brightness levels (human eye model) in addition to the nightlight level. With the uFlex already switched on, the user can scroll through the brightness levels by pressing the button for longer than ½ a second. The brightness will either increase or decrease one level every 1/3 of a second. The uFlex will toggle from the bright or dim direction each time the button is released.

If the unit is turned on and the unit starts in nightlight mode, then the direction is initially set to increasing. If the unit it turned on and the unit starts in full bright mode, then the direction is initially set to decreasing. If the unit is turned on at any in between level then the direction is initially set to decreasing.

Each time the brightness level is changed the new level is stored in EEPROM ready to be retrieved next time the unit is turned back on.

2.7 Reconfiguring uFlex from 1W to 5W or back to 1W

Unless a custom current level has been ordered, uFlex ships configured for 1W or 5W Luxeons. The user can change a 1W uFlex to a 5W uFlex or a 5W uFlex to a 1W uFlex by using the following procedure.

1. To reconfigure a uFlex the power must be turned off by removing input power (disconnecting the battery etc).

2. While pressing the switch down and keeping it held down until Step 5, reapply power.

3. If uFlex is currently configured as a 1W driver:

    a. The LED will illuminate at the dimmest level and then cycle to full brightness (380mA max).

    b. Continue pressing the switch. After 1 minute the LED will go to the dimmest level (to confirm that the 5W level has been selected and then cycle to full brightness.

    c. You have successfully configured uFlex as a 5W driver.

4. If uFlex is currently configured as a 5W driver:

    a. The LED will illuminate at the brightest level (380mA max) and then cycle to the dimmest level.

    b. Continue pressing the switch. After 1 minute the LED will go to the brightest level (to confirm that the 1W level has been selected and then cycle to the dimmest level.

    c. You have successfully configured uFlex as a 1W driver.

5. Release the switch.

Note 1: During the entire configuration procedure no more than 380mA will be applied to the LED – this ensures that the driver can be reconfigured without applying excess current to a 1W Luxeon.

Note 2: Once uFlex is reconfigured, the new 1W or 5W configuration is stored in the EEPROM and the change is retained until the user performs the reconfiguration procedure again.

Note 3: Releasing the switch before the 1 minute elapses will not reconfigure uFlex.

Revision History

V2.00 New version of uFlex firmware and documentation released to reflect user Reconfiguration capability.