Operating Manual for DualFlex V1 UI-CAVE (V0.05 PRELIMINARY)

1 Description

The heart of DualFlex is a Microcontroller (uC) that contains the user interface firmware. Features of this circuit/UI combination include:

- Choice of 4 different User Interfaces, UIC1 two switch optimized, UIC2W and UIC2C one switch optimized, and UIC3 2 switch optimized version of UIC2C.
- Dual channel linear regulator based current regulation (maximum drive current set in firmware).
- Dual or Single switch to select from various brightness levels, turn the unit on/off, select the operating modes and set menu options.
- Non-volatile (EEPROM) storage of operating modes and configurations, and maximum drive level (500mA, 1000mA, 1500mA, 2000mA, 2500mA, 3000mA or 3500mA).
- Voltage sensing with three user configurable trip points for ½ discharged and nearly fully discharged and forced off (or warn only). Warning display via the main LED or optional (user provided) status LED.
- Temperature sensing with user configurable trip point to limit output current to protect the driver and/or LEDs.

1.1 *Wiring the DualFlex V1*
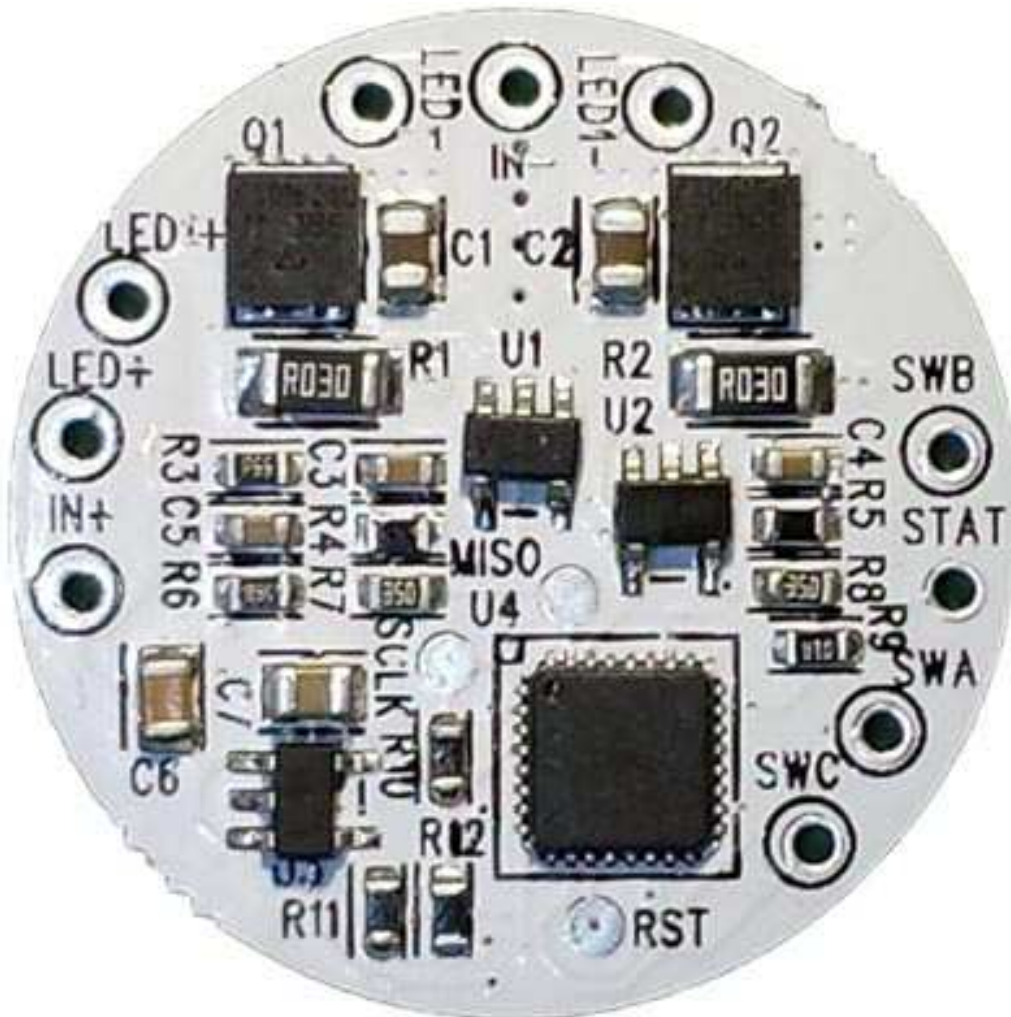
The picture shows the top of the DualFlex. The user provides DC power to the DualFlex (via battery, DC wallwart etc) via the IN+ (positive input voltage) and IN- (negative input voltage) pads.

The two independent LED channels outputs are LED+/LED- (Primary channel) and LED1+/LED1- (Secondary channel). The IN+, LED1+ and LED+ are electrically common.

The optional (user supplied) 3mm or 5mm status LED is wired to STAT (anode of status LED) and to IN- (cathode of status LED).

For UIC2W and UIC2C, DualFlex requires one momentary action (normally open) switch wired to SWA/SWB (see pictures below).

For UIC1 and UIC3, DualFlex requires either two momentary action switches or a single pole toggle switch type MOM-OFF-MOM, wired to SWA/SWB/SWC (see pictures below).

SWB is electrically the same as IN-, but the switch MUST be wired to SWB to minimize electrical interference to the switch signals.

UI MODE	Switch Type	SWA	SWB	SWC
UIC1	Momentary Toggle	Contact1	Center	Contact2
UIC1	Momentary Push (2)	Contact1	Contact2 Contact1	Contact2
UIC2	Momentary Push (1)	Contact1	Contact2	N/A
UIC3	Momentary Toggle	Contact1	Center	Contact2

The following picture shows how 2 momentary action switches are wired for UIC1 or UIC3 operation.
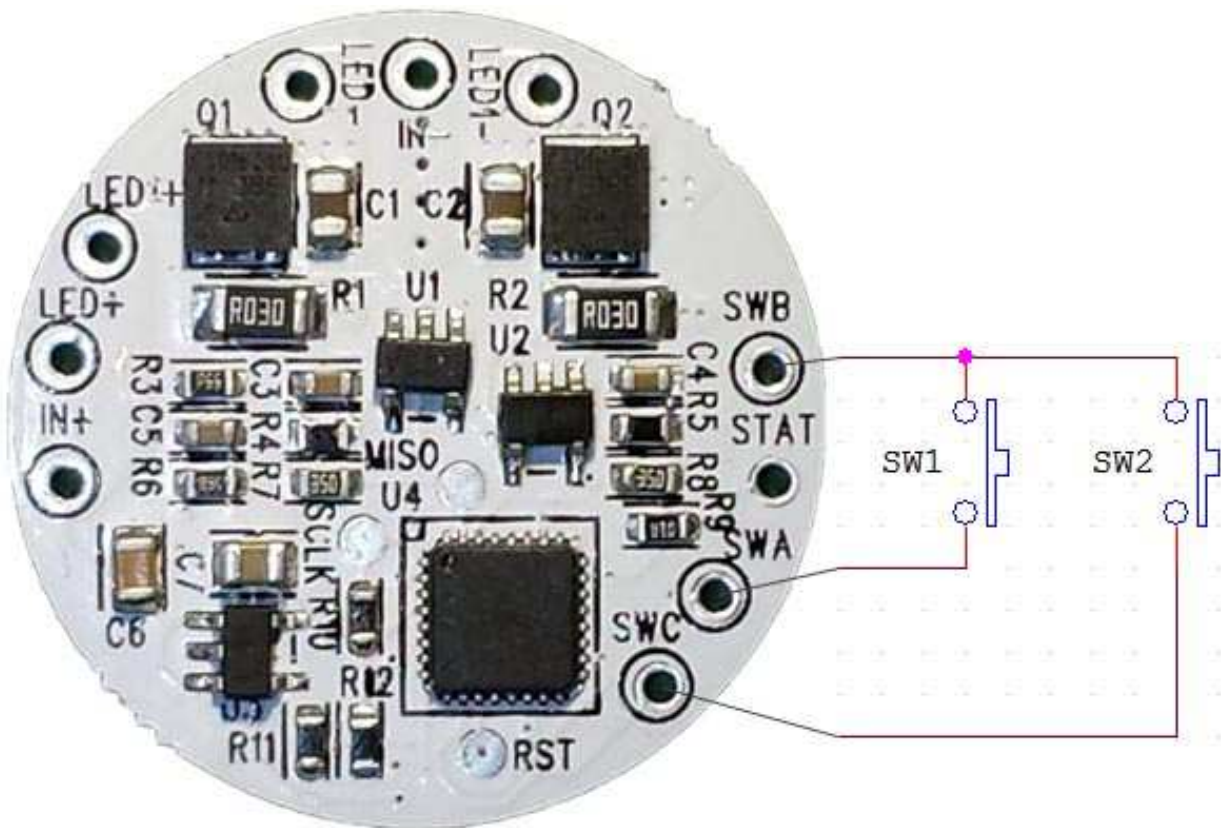
The following picture shows how a momentary action double position toggle switch is wired for UIC1 or UIC3 operation. This style of switch has a center (off) position and is spring loaded to either direction.
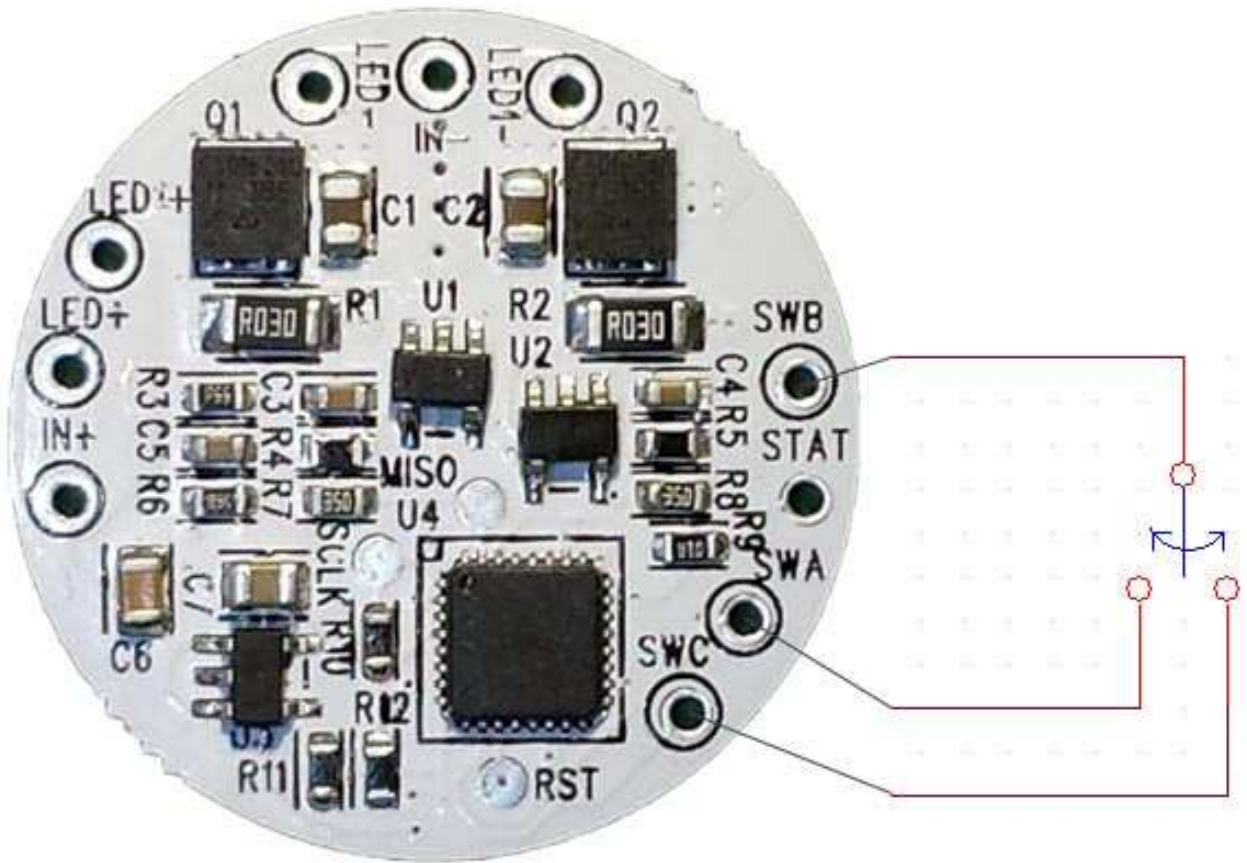
The following picture shows how a single momentary action switch is wired for UIC2W/UIC2C operation. For UIC2W/UIC2C operation, do not wire anything to the SWC pad.
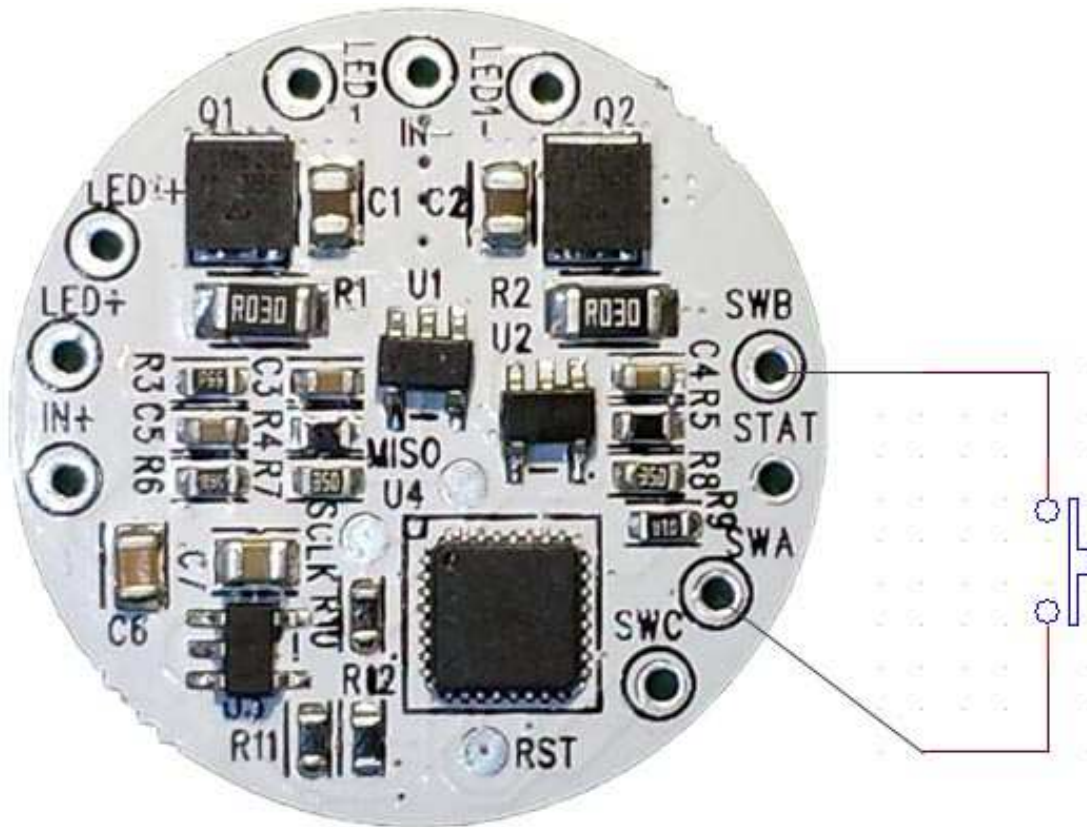
Do NOT connect the negative input power to SWB, power MUST connect to IN- only. SWB is ONLY to be used for the switches and can also be used for the optional status LED.

The LED load is connected to LED+ (positive LED) and LED- (negative LED).

An optional 3mm or 5mm colored LED can be connected between STAT (anode) and IN- (cathode) to be used as a battery status indicator. There is an onboard 100 ohm series resistor in the STAT connection to reduce and limit the current. Nominal drive voltage is 2.5V.

Temperature sensing is performed within the uController, the 32 pin IC (U4) in the lower center of the PCB in the picture above.

Below is the view of the bottom side of the DualFlex board.

The red polygons enclose the minimum areas that must be thermally coupled to the heatsink with the provided thermal adhesive pad material. It is preferential to mount the entire bottom area of the DualFlex to a heatsink since the additional area will incrementally improve cooling.

Hint: When soldering leads to the thruhole pads, place the DualFlex on a flat surface to prevent solder or the leads from protruding below the level of the bottom side of the PCB. By ensure the bottom surface is flat you will minimize the risk of any shorts occurring through the thermal pad material.

When soldering wires to the through holes/pads on the PCB, be careful to not short or accidentally desolder components near where you are soldering.

The following table shows the supported configurations of DualFlex.

Driver Configuration	Input voltage Operating (min)*	Input voltage (max)**	Alternate Battery choice
1 LED (e.g. XM-L) (per channel)	2.7V	4.2V (1 x Li-Ion)	3 x NiMH
2 LED (e.g. XM-L) (per channel)	2.7V	8.4V (2 x Li-Ion)	7 x NiMH

* Nominal Minimum input voltage. Input voltage must be high enough to drive the LED at the required current. E.g. for a Cree XM-L with a Vf of 3V at 3A, minimum input voltage needs to be higher than 3V to enable the DualFlex to regulate at 3A

** Maximum operating voltage for DualFlex. To limit power dissipation it is recommended to match the battery voltage as closely as possible to the LED Vf. DualFlex is a linear regulator based driver, excess input voltage is dissipated in the power FET as heat (refer to the DualFlex technical section at www.taskled.com).

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. Stored data will remain even if battery is disconnected.
- LED – Light Emitting Diode. As used here, it typically refers to the light's main LED(s).

3 Turning the DualFlex ON the first time

Do not apply power to DualFlex unless the LEDs are connected. This is to protect the LEDs from voltage spikes if they are connected to DualFlex after power has been applied.

DualFlex is shipped with the lowest drive level (500 mA) selected for both channels, and Poweron mode turned on. When power is first applied, DualFlex will safely drive the LEDs at the lowest level.

3.1 Initial Power Application

Upon initial power application to the circuit, the light will turn on (because Power Mode is active by default) at the lowest level. The circuit is on and ready to use.

As shipped, the default operating UI is UIC2W and the driver will power up in normal mode 1 which will only light up the LEDs connected to LED+/LED-. The optional status LED will blink on momentarily as a self test.

The default UIC2W shipping configuration has 5 normal modes available and they are listed below along with their drive levels:

Mode Number	LED1	LED
Mode 1	OFF	L1
Mode 2	OFF	L3
Mode 3	L3	L3
Mode 4	OFF	L4
Mode 5	L5	L5

The 2 special modes by default has the following listed drive values:

Special Mode Number	LED1	LED
Special Mode 1	L1	OFF
Special Mode 2	L5	OFF

L1..L5 above refer to the 5 drive levels for the chosen current table. L5 is the current table value (500mA for the 500mA table, 1000mA for the 1000mA table etc.).

L1 is always set to a nominal minimum level of approximately 40mA. L2..L4 scale between L1 and L5. The scaling is fixed and not user configurable.

4 Turning the DualFlex OFF

To prevent turning off the DualFlex accidentally the use must click the button 2 or 3 times (depending on the UI) and also have met the guardband time. Below is a description of the sequence that must be used to turn off the driver in each UI.

4.1 Turning off in UIC1 mode

The first step to turning off the driver is to ensure the driver is either in normal mode 1 or special mode 1. The user then must wait the guardband time or longer (0.7 seconds shipping default, see Sec 6.12) before click 2 times quickly (0.3 seconds or faster, see Sec 6.12). If the sequence is performed correctly both LEDs will turn off and the driver will enter standby.

4.2 Turning off in UIC2W/UIC2C mode

The first step to turning off the driver is to ensure the driver is in the normal mode (any of them). The user then must wait the guardband time or longer (0.7 seconds shipping default, see Sec 6.12) before click 3 times quickly (0.3 seconds or faster, see Sec 6.12). If the sequence is performed correctly both LEDs will turn off and the driver will enter standby.

4.3 Turning off in UIC3 mode

The first step to turning off the driver is to ensure the driver is in normal mode 1. The user then must wait the guardband time or longer (0.7 seconds shipping default, see Sec 6.12) before click 2 times quickly (0.3 seconds or faster, see Sec 6.12). If the sequence is performed correctly both LEDs will turn off and the driver will enter standby.

5   Overview of the User Interfaces (UIs) and the Control Menu

For all the following UI flow diagrams the drawing below represents the two independent LED channels. Lx corresponds to the level or mode driving the LEDs wired to the LED+/LED- pads and Ly corresponds to the level or mode driving the LEDs wired to the LED1+/LED1- pads on the DualFlex driver. L0 means that the specified LED channel is off. When both channels show L0, that means the DualFlex is in standby (off). In standby, the DualFlex draws nominally 50uA which will cause minimal draw on the battery even after several months of non-use.
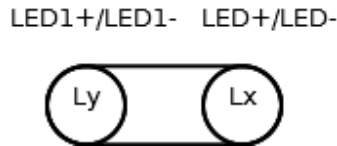
For all 4 UI's, when returning from special mode (1 or 2) back to normal mode (1, 2,.., 5) the driver will always return to the normal mode that was in use when the move was initially made to special mode.

The following diagrams may look complicated, but in operation the UI's are easy to use. It is advisable to be operating a DualFlex connected to LEDs and a battery while following the diagrams below.

5.1   UIC1

As seen in the UIC1 Flow Diagram for each mode and special mode, the levels (L1 - L5) are fixed and not user configurable. UIC1 requires 2 momentary action switches to operate.
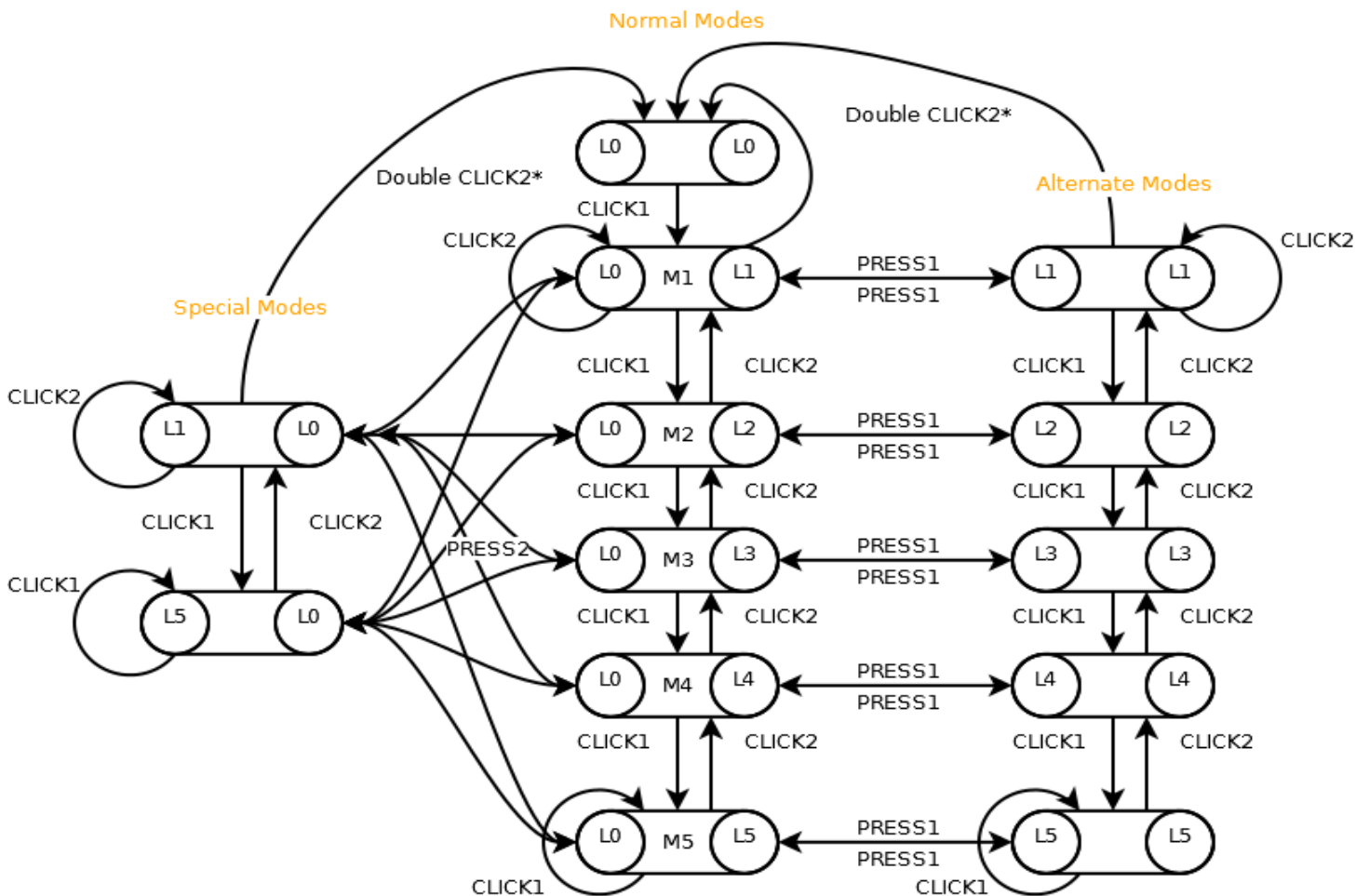
5.2 UIC2W

For UIC2W/UIC2C and UIC3 the user can configure the drive level for each mode and special mode. In the flow diagrams below, e.g., M1A indicates normal mode 1 and the user can configure L0-L5 (via menu #13) to be driven when M1A is selected. In the same way, SM1A indicates the special mode 1 and the user can configure L0-L5 (via menu #13) to be driven when SM1A is selected.

This provides the user considerable flexibility in configuring how the channels are driven for each selected mode or special mode. UIC2W/UIC2C and UIC3 also provide the user the ability to configure how many normal modes are present (3, 4 or 5).

UIC2W is designed to operate with a single momentary action switch. The primary difference between UIC2W (wrap) and UIC2C (cycle) is the behaviour at the last normal mode. With UIC2W if the user clicks at the last normal mode, the UI will wrap back to Mode 1 (the red arrows in the diagram below).

UIC2W Flow Diagram
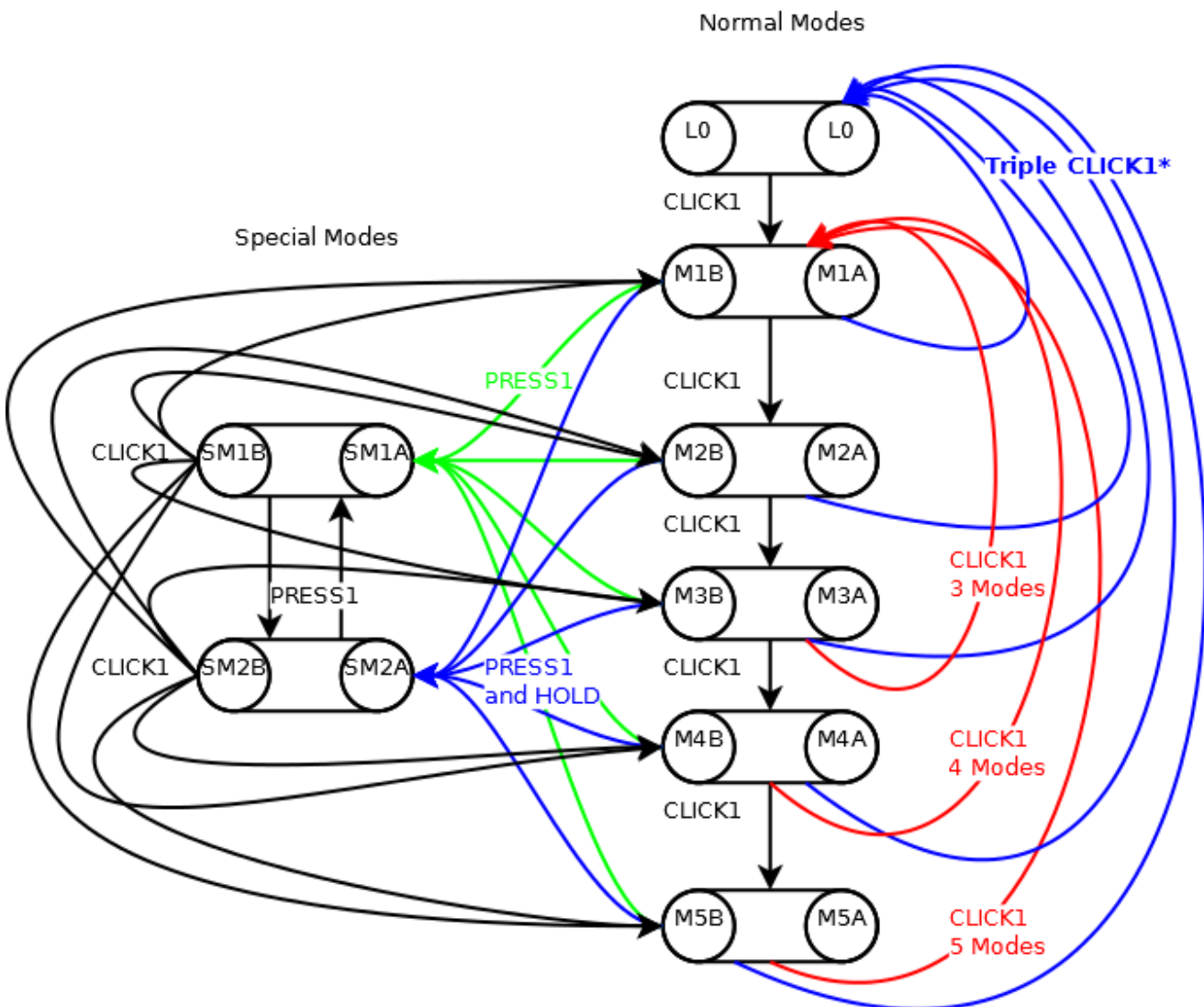
5.3 UIC2C

UIC2C is designed to operate with a single momentary action switch. With UIC2C if the user clicks at the last normal mode, the UI will decrement one mode (the red arrows in the diagram below).

UIC2C Flow Diagram

5.4 UIC3

UIC3 requires 2 momentary action switches to operate.

UIC3 Flow Diagram
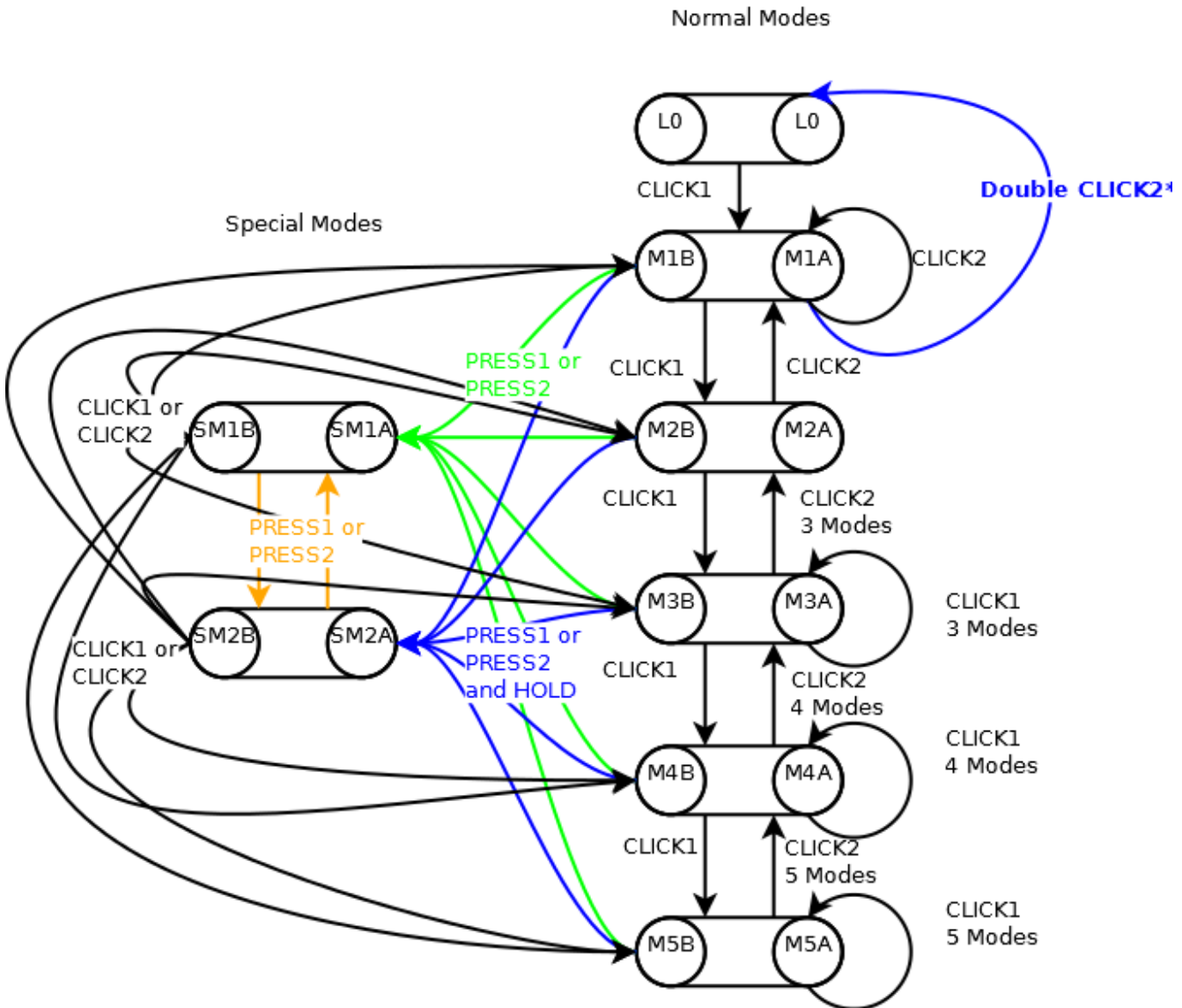
5.5 Menu features/choices of all UIs

Bold is factory shipping default.

1. <u>Force Level</u> (choose level for initial on, or **disable**)
2. <u>Current Drive Level</u> (**500ma**, 1000 mA, 1500 mA, 2000 mA,2500mA, 3000mA or 3500mA - all intermediate brightness levels scale to this max level)
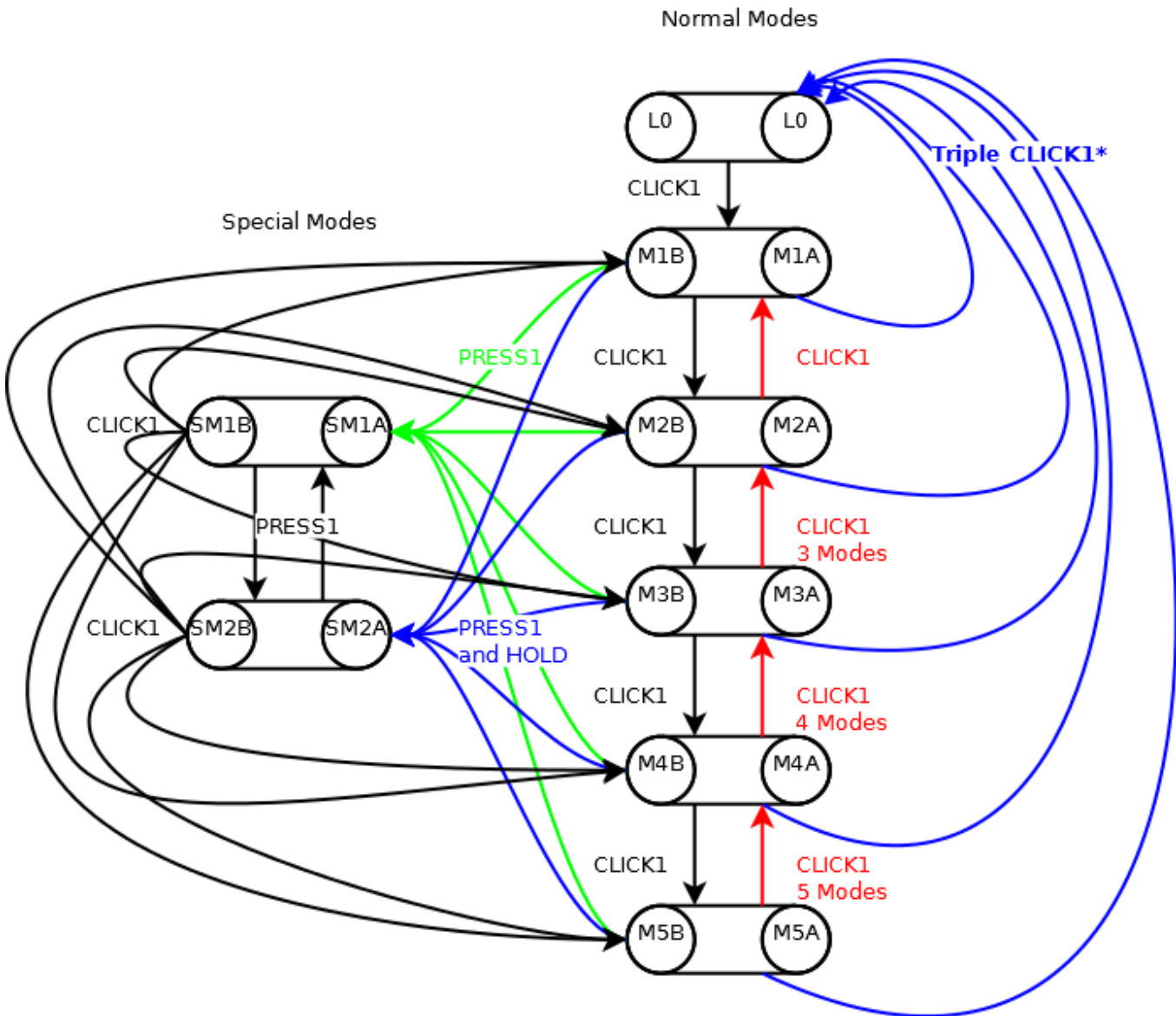3. <u>UI Selection</u> (UIC1, **UIC2W**, UIC2C, UIC3)
4. <u>SuperLock</u> (**disable,** enable)
5. <u>V Stat</u> (how often the LED warns that V Low and V Med levels have been reached. Flash sequence per 5, 10, 30, 60 seconds, or **disabled** - STAT pin only). Threshold (**0**/1/2 for **0.2V**/0.4V/0.6V).
6. <u>V Cut</u> (protect rechargeable batteries by shutting off or warning at a chosen Voltage level). Enter in form xy.z) Default **Cutoff** and Default: **3.0 V** (configured for 1 cell 3.7V Li-Ion battery)
7. <u>V Low</u> (Warn of battery nearly discharged. Enter in form xy.z) Default: No override and **3.2 V** (configured for 1 cell 3.7V Li-Ion battery)
8. <u>V Med</u> (Warn of battery half discharged. Enter in form xy.z) Default: **3.6 V** (configured for 1 cell 3.7V Li-Ion battery)
9. <u>Power On</u> (disable, **enable** "on" function when power is applied)
10. <u>Reset</u> (Menu selections reset to shipping defaults)
11. <u>Thermal Protection</u> (trip point that reduces power to L3 if the system is at risk of overheating. 50°C, 60°C, 70°C, 80°C, 90°C, **disable**)
12. <u>Click and Guardband timing</u> (0.2, **0.3**, 0.4, 0.5 and guardband 0.5, 0.7, **1.0**, 1.3)
13. <u>Number of normal Modes and Driver level configuration</u>

HINT: Snip and save the above Menu table for quick reference.

6 Menu Selection (Configuring operation)

This section describes how to enter the Menu system and how to change operating options. All changes are stored in the EEPROM.

To access the menu system you must remove power (disconnect the battery) from the circuit and then re-apply power WHILE keeping the switch pressed down. The LED will flash brightly 2 times, then stay steady dim to indicate that the Menu system has been entered.

Note: While in the Menu system, voltage sensing and temperature sensing is disabled, again to enable access even if an over temperature or under voltage condition exists.

Click the switch from 0 to 13 times (the LED will flash a response for each click, do NOT try to beat the flash) to select one of the Menu options to change as listed below. To exit the Menu system instead of choosing an option, press the switch before clicking (Sec 6.0). The LED will flash 2 times and then the light will turn off. To reenter the Menu system you will need to perform the proper sequence as described above.

If any errors occur in selecting a Menu option (e.g. clicking more than 13 times or making an invalid selection), the LED will flash quickly 5 times to indicate an error and the user will be returned to the top of the Menu system as if it had just been entered.

If at any time you lose track or get confused about where you are in the Menu system, you can always remove power and only the settings that have been altered (if any) will have been written to the EEPROM.

After clicking from 0 to 13 times to select the Menu entry, press the switch to choose that menu option.

Example – set drive current to 1500 mA:

1. Disconnect and reconnect power to the circuit WHILE keeping the switch pressed down (the switch wired to SWA/SWB).
2. The LED will flash brightly two times and stay steady dim. You are in the Menu system.
3. Click twice to choose the Current Drive Selection (wait for flash response after each click).
4. Press to select this option. The LED will light steady dim. You are in the *Current Drive Selection* at the lowest option, 500 mA.
5. Clicking once will make the LED brighter, indicating 1000 mA. Clicking a second time brightens the LED again, indicating 1500 mA.
6. Press to save your selection. The LED will flash twice and stay steady. You have now saved the 1500 mA Current Drive Selection, and are back to the top of the Menu.

If that is all you would like to set, press one more time to exit the Menu. Two flashes later, you are out of the Menu and into the normal operation mode. If instead you would like to set another Menu option, do not press, and go back to step 3 and click the proper number of times for your next selection.

6.0 Zero clicks – Nothing

This option changes nothing and allows the user to exit the Menu system.

Initially the LED will be dim to indicate that the Menu system has been entered. If no (further) Menu changes are needed, a press will exit the Menu system (2 flashes). The driver returns to the normal operating mode.

6.1 One click - Force Mode Enable/Adjust/Disable

This mode chooses the initial mode (M1 - M5) for UIC1. Force Mode is ignored when UIC2W/UIC2C or UIC3 are enabled.

Initially the LED will be dim to indicate that M1 (dimmest) will be selected (i.e. if you don't click, Force will become active and set to M1). Each click will cycle to the next Force setting. The sequence is:

- 0 click (actual L1)   → Mode Level 1 select
- 1 click (actual L2)   → Mode Level 2 select
- 2 click (actual L3)   → Mode Level 3 select
- 3 click (actual L4)   → Mode Level 4 select
- 4 click (actual L5)   → Mode Level 5 select
- 5 click (off)   → Force Disabled (M1 selected when clicked on) - shipping default

When you are satisfied with the choice, press to save the setting. The LED will flash twice to indicate that the selection has been made and then go dim to indicate that it has returned to the Menu mode for the next selection.

6.2 Two clicks – Current Drive Selection (For Channel 1 and Channel 2)

The circuit can be set to one of seven maximum current drive levels independently for each channel. This selection will be L5 or "high" for all modes. The brightness scales of all other levels are determined by this setting.

Initially the LED will be dim to indicate that 500 mA max current will be active for Channel 1. Each click will cycle to the next current drive level and wrap back to the beginning. The sequence is:

- 0 click (dim)   → 500 mA select (shipping default)
- 1 click (brighter)   →1000 mA select
- 2 click (brighter)   →1500 mA select
- 3 click (brighter)   → 2000 mA select
- 4 click (brighter)   → 2500 mA select
- 5 click (brightest)   → 3000 mA select
- 6 click (brightest)   → 3500 mA select

When you are satisfied with the choice, press to save the setting for Channel 1. The LED will flash once and go dim to indicate that the selection has been made, and that the Menu mode has been reentered.

Initially the LED will be dim to indicate that 500 mA max current will be active for Channel 2. Each click will cycle to the next current drive level and wrap back to the beginning. The sequence is:

- 0 click (dim)   → 500 mA select (shipping default)
- 1 click (brighter)   →1000 mA select
- 2 click (brighter)   →1500 mA select
- 3 click (brighter)   → 2000 mA select
- 4 click (brighter)   → 2500 mA select
- 5 click (brightest)   → 3000 mA select
- 6 click (brightest)   → 3500 mA select

When you are satisfied with the choice, press to save the setting for Channel 2. The LED will flash twice to indicate that the selection has been made and then go dim to indicate that it has returned to the Menu mode for the next selection

6.3 Three clicks – UIC1/UIC2W/UIC2C/UIC3 select

This menu option allows the user to select their chosen UI based on their preference and whether one or two switches will be used.

Initially the LED will be dim to indicate that UIC1 is chosen. Each click will cycle to the next choice and wrap back to the beginning.

- 0 click → UIC1 (default)
- 1 click → UIC2W
- 2 click → UIC2C
- 3 click → UIC3

When you are satisfied with the choice, press to save the setting. The LED will flash twice to indicate that the selection has been made and then go dim to indicate that it has returned to the Menu mode for the next selection

6.4 Four clicks – Superlock Enable/Disable

To prevent accidental turn on or unintended use, the light can be electronically locked off.

With Superlock enabled, each time the user wants to turn the light on, 3 clicks spaced no more than 0.3 seconds apart must occur.

Initially the LED will be dim to indicate that Superlock Mode will be disabled (i.e. if you don't click, Superlock Mode will be disabled). A click will brighten the LED to indicate that Superlock Mode will be enabled. Each click will cycle between enabled and disabled.

- 0 click (dim)   → Superlock disabled (shipping default)
- 1 click (brighter)   → Superlock enabled

When you are satisfied with the choice, press to save the setting. The LED will flash twice and go dim to indicate that the selection has been made, and that the Menu mode has been reentered.

6.5 Five Clicks – Voltage Warning Status & Threshold Setting

How (and how often) the circuit reports the low and medium voltage conditions is configured using this Menu option. You can also set the threshold or hysteresis of the voltage sensing (see below).

The circuit reports the low voltage condition via the STAT pin on the PCB. STAT will drive high (~2.5V) to light the status LED and drive back to 0V to turn the status LED off. The STAT pin can drive a single 3mm or 5mm (at approximately 20 mA). If this feature is used, wire the 3mm or 5mm LED between STAT and IN-. A red or amber LED is recommended for this use.

Note: The STAT pin will light the status LED (if affixed) if the input voltage is greater than the V Low Setting but less than the V Med Setting. The STAT pin will pulse (flash the status LED) once per second when the input voltage is less than the V Low Setting. The STAT pin will double pulse (flash the status LED) once per second if the input voltage is less than the V Cut Off Setting.

The STAT pin is pulsed once every time the light is turned on as a self-check that the status LED is functioning correctly. If the user does not want to wire a status LED to the STAT pin but still wants an indication of low voltage occurring, then the main LED can be set to flash at a specific interval to give a visual warning.

If the input voltage is greater than the V Low Setting but less than the V Med Setting, the main LED will briefly flash off once at the flash rate chosen with this Menu option (5 sec, 10 sec, 30 sec or 60 sec).This warning will time-out after five sequences so the remaining battery capacity can be used without annoyance. As a reminder, the V Med warning sequence will repeat if the light is turned off/on, or if a higher level is chosen. The STAT pin will remain active with no time-out.

If the input voltage is less than the Low Setting the main LED will flash off twice at the flash rate. If the user has configured the Low Voltage Over-ride in menu #7 to be L1..L4 then this warning will time-out after five sequences. If the user does not set the Low Voltage Over-ride (leaves it off) then this V Low warning sequence will continue indefinitely until the Cut Off Setting is reached or recharged to above the V Med Setting.

If the input voltage is less than the Cut Off Setting the main LED will flash off three times at the flash rate. This Cut Off warning sequence will continue until the light turns off (Cut Off enabled) or indefinitely (Warn Only enabled), see Sec 6.6. These sequences were chosen to give an obvious indication of battery status while still allowing use of the light for navigation.

Threshold/Hysteresis Selection: The voltage monitoring/warning system uses hysteresis to prevent the warning system triggering and resetting again when hovering around a trip point.

For example, if the medium warning is set to 7.2V the voltage warning will trip when the input voltage drops below 7.2V. The voltage is required to go at least 7.2V + Hysteresis to reset the medium warning. By default the hysteresis is set to 0.2V which for this example means the voltage would need to rise above 7.4V to reset the medium level. The 0.2V hysteresis works well for most applications, but if the battery pack is also being used to power other devices that may have large cycle current the input voltage to the driver may fluctuate enough to trip and reset the voltage monitoring over and over again. Increasing the hysteresis to 0.4V or 0.6V can prevent this warning cycle.

Configuring the settings:

Initially the LED will be Dim to indicate that one flash per 5 seconds will be chosen. See the table below for all available settings.

- 0 click (dim)   → Main LED flash once per 5 sec (undervoltage)
- 1 click (brighter)   → Main LED flash once per 10 sec (undervoltage)
- 2 click (brighter)   → Main LED flash once per 30 sec (undervoltage)
- 3 click (brighter)   → Main LED flash once per 60 sec (undervoltage)
- 4 click (off)   → No Main LED flash for undervoltage (shipping default)

When you are satisfied with the choice, press to save the setting. The LED will flash once and go dim again and wait for entry of the threshold/hysteresis value.

- 0 click (dim)   → Hysteresis set to 0.2V - default
- 1 click (brighter)   → Hysteresis set to 0.4V
- 2 click (brighter)   → Hysteresis set to 0.6V

When you are satisfied with the choice, press to save the setting. The LED will flash twice and go dim to indicate that the selection has been made, and that the Menu mode has been reentered.

Note: regardless of the selection for this Menu, the STAT pin will always report the battery status.

6.6 Six Clicks – Voltage Cut Off Setting

The circuit can be configured to turn off OR warn when the cut off input voltage occurs. The user can set the cut off voltage to any value between 0V – 12.6V. The voltage value is entered by setting a number in the format: xy.z (e.g. 06.8V).

The V Cut Off setting is the value that the user chooses to protect the battery pack from over discharge. When the Cut Off voltage is sensed, and Cutoff is selected, see below, the circuit will wait 1 minute prior to turning off the main LED (short flash sequence warning before it turns off). The user can turn the light on again and after 1 minute the circuit will again turn off the main LED. This 1 minute cycle provides the user a last ditch ability to continue using the light for short periods of time. If Cutoff is set to Warn Only, see below, then the Main LED or STAT LED (as selected in Sec 6.5) will continue to warn indefinitely.

Initially the LED will be dim to indicate that Cutoff (turn off) will be chosen (i.e. if you don't click, Cutoff will be chosen). A click will brighten the LED to indicate that only a warning will be chosen. Each click will cycle between Cutoff and Warning.

- 0 click (dim)   → Cutoff (driver will turn off) - shipping default
- 1 click (brighter)   → Warn Only (driver will continue to flash the LED after 1 minute)

When you are satisfied with the choice, press to save the setting. The LED will flash once to confirm the saving of the new selection.

The LED will dim again and wait for entry of the 'x' (tens). Click 0 to 2 times (If you don't click, 0 will be selected for the tens digit).

When you are satisfied with the choice, press to save the setting. The LED will flash once to acknowledge the Press.

The LED will dim again and wait for entry of the 'y' (units). Click 0 to 9 times (If you don't click, 0 will be selected for the units digit

When you are satisfied with the choice, press to save the setting. The LED will flash once to acknowledge the Press.

The LED will dim again and wait for entry of the 'z' (tenths). Click 0 to 9 times (If you don't click, 0 will be selected for the tenths digit

When you are satisfied with the choice, press to save the setting. The LED will flash twice and go dim to indicate that the selection has been made, and that the Menu mode has been reentered.

The xy.z value is stored in the EEPROM and can be changed by following the above procedure as often as necessary.

Note: the circuit senses the input voltage across IN+ and IN- connection points. This means if there is a voltage drop across the wires from the battery and any connectors in use the battery voltage could be higher than the voltage at the IN+/IN- connection points.

6.7 Seven Clicks – Voltage Warning Low Setting

The circuit can be configured to warn the user when low input voltage occurs. The user can set the voltage warning to any value between 0V – 12.6V. The voltage value is entered by setting a number in the format: xy.z (e.g. 06.8V).

The V Low setting is the value that the user chooses to provide a warning prior to reaching the cut off voltage. Of course the warning can be ignored if necessary (emergency), though the warning will never time out and at some point the Cut Off voltage will be reached and the light will turn off.

The user can specify what level the driver should use as the upper limit when the low voltage setting is detected. This forces the driver to drop to a lower level that the user can not exceed unless the user turns the driver off and back on and the low voltage setting is no longer occurring (e.g. the battery has been recharged). This feature allows the light to still operate, but the runtime will be extended since the higher levels are no longer available.

Initially the LED will be dim to indicate L1 will be chosen (i.e. if you don't click, L1 will be chosen). A click will brighten the LED to indicate that only a warning will be chosen.

- 0 click (dim) $\rightarrow$ L1
- 1 click (brighter) $\rightarrow$ L2
- 2 click (brighter) $\rightarrow$ L3
- 3 click (brighter) $\rightarrow$ L4
- 4 click (off) $\rightarrow$ Low Voltage over-ride disabled (shipping default)

When you are satisfied with the choice, press to save the setting. The LED will flash once to confirm the saving of the new selection.

The LED will dim again and wait for entry of the 'x' (tens). Click 0 to 2 times (If you don't click, 0 will be selected for the tens digit).

When you are satisfied with the choice, press to save the setting. The LED will flash once to acknowledge the Press.

The LED will dim again and wait for entry of the 'y' (units). Click 0 to 9 times (If you don't click, 0 will be selected for the units digit

When you are satisfied with the choice, press to save the setting. The LED will flash once to acknowledge the Press.

The LED will dim again and wait for entry of the 'z' (tenths). Click 0 to 9 times (If you don't click, 0 will be selected for the tenths digit

When you are satisfied with the choice, press to save the setting. The LED will flash twice and go dim to indicate that the selection has been made, and that the Menu mode has been reentered.

The xy.z value is stored in the EEPROM and can be changed by following the above procedure as often as necessary.

6.8 Eight Clicks – Voltage Warning Medium Setting

The circuit can be configured to warn the user when medium input voltage occurs. The user can set the voltage warning to any value between 0V – 12.6V. The voltage value is entered by setting a number in the format: xy.z (e.g. 06.8V).

The V Med setting is the value that the user chooses to indicate that the battery is around half discharged (recommendation). Of course the user can set this to whatever value he/she chooses. This warning will time out after five sequences so the remaining battery capacity can be used without annoyance. As a reminder, the V Med warning sequence will repeat if the light is turned off/on, or if a higher level is chosen. The STAT pin will remain active with no timeout.

Initially the LED will be dim, waiting for entry of the 'x' (tens). Click 0 to 2 times (If you don't click, 0 will be selected for the tens digit).

When you are satisfied with the choice, press to save the setting. The LED will flash once to acknowledge the Press.

The LED will dim again and wait for entry of the 'y' (units). Click 0 to 9 times (If you don't click, 0 will be selected for the units digit

When you are satisfied with the choice, press to save the setting. The LED will flash once to acknowledge the Press.

The LED will dim again and wait for entry of the 'z' (tenths). Click 0 to 9 times (If you don't click, 0 will be selected for the tenths digit

When you are satisfied with the choice, press to save the setting. The LED will flash twice and go dim to indicate that the selection has been made, and that the Menu mode has been reentered.

The xy.z value is stored in the EEPROM and can be changed by following the above procedure as often as necessary.

6.9 Nine clicks – Poweron Mode Enable/Disable

The circuit can be configured to either power-up with the LED lit or unlit when power is first applied. E.g. In a light fixture that has an auxiliary power switch in series with the battery and the circuit, the user can choose to have the circuit illuminate 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 that Poweron Mode will be disabled (i.e. if you don't click, Poweron Mode will be disabled). A click will brighten the LED to indicate that Poweron Mode will be enabled. Each click will cycle between enabled and disabled.

- 0 click (dim)   → Poweron disabled
- 1 click (brighter)   → Poweron enabled (shipping default)

When you are satisfied with the choice, press to save the setting. The LED will flash twice and go dim to indicate that the selection has been made, and that the Menu mode has been reentered.

The following shows how Poweron mode affects the operation of the driver when power is first applied (battery first connected or power turned on via a switch in series with the battery):

```
If poweron is ON, and DualFlex turns on.
If poweron is OFF, and DualFlex goes off (standby).
```

By standby, what is meant is that DualFlex turns electronically off and waits to be turned on via the momentary action switch.

6.10 Ten Clicks – Configuration Reset (to initial shipping defaults)

This Menu option allows a reset of all options to their initial shipping defaults (Sec 5.5) and/or to display the firmware version number.

Initially the LED will be dim to indicate that a Configuration Reset will _not_ occur (i.e. if you don't click to toggle this option). A click will brighten the LED to indicate that a Configuration Reset _will_ occur. Each click will toggle from active to inactive.

- 0 click (dim)   → Reset will not occur (shipping default)
- 1 click (brighter)   → Reset will occur

When you are satisfied with the choice, press to save the setting. The LED will flash M times then a pause and then flash N times and then go off (M.N = version number of the firmware). After the Reset version number display is complete, the light will remain **off** until turned back on by the user.

6.11 Eleven Clicks – Thermal Protection

To protect the light from over-heating, a thermal trigger point can be set with this option. Obviously the temperature sensing will not be of any use in a light that has the LED heatsink/case far from the driver.

When the internal thermal sensor detects the configured temperature, the light level is dropped to L3 (corresponds to less than 1/3 of the selected maximum current of L5). When the temperature protection is active (over-temperature), the user can still change modes and choose from any of the normal modes and special modes, but the LED drive current will be limited to L3 even if that mode requires L4 or L5 on either one of the two channels.

The user will not be able to access levels above L3 until the temperature has dropped a minimum of 5°C. At that time, full operation of the light is restored. Note: The sensor determines the temperature of the uController IC, not of the light case or the LED junction, etc.

Initially the LED will be dim to indicate that 50°C is chosen. Each click will cycle to the next temperature option and wrap back to the beginning. The sequence is:

- 0 click (dim)   → 50°C
- 1 click (brighter)   → 60°C
- 2 click (brighter)   → 70°C
- 3 click (brighter)   → 80°C
- 4 click (brightest) → 90°C
- 5 click (off)   → disabled (shipping default)

When you are satisfied with the choice, press to save the setting. The LED will flash twice and go dim to indicate that the selection has been made, and that the Menu mode has been reentered.

HINT: Choosing the appropriate temperature for a particular light will require some trial and error if temperature measurements of the case and thermal sensing IC aren't possible, e.g. due to lack of equipment. With DualFlex it is important to utilize the thermal sensing to protect the driver, versus the LEDs or housing. If possible the DualFlex driver should utilize a heatsink that is not common to LED heatsink to minimize heating of the driver from external sources.

6.12 Twelve clicks – Select click timing

This menu allows selection of the click timing (how quickly a click must occur subsequent to a previous click) and also the guardband time (how long no click/press activity must occur, prior to the double or triple click to turn off the driver).

These two timing values are user configurable to enable the user to choose values that work best with the particular type of switch that is being used, e.g. momentary action push button, momentary toggle button, piezo switches etc.

This configuration is used to set the double or triple click timing used to turn off the driver. Using UIC1 as an example:

To turn off the driver, the user must first click the driver to mode 1 or special mode 1 (the 'lowest' levels). Then at least guardband during of time must elapse (by default 0.7 seconds) BEFORE the user then clicks quickly (by default less than 0.3 seconds between clicks) to turn off the light. If either the guardband time has elapsed or the user clicks too slowly, the driver will not turn off. Setting the parameters in this menu correctly allows the driver to operate well with the chosen switch type and also prevent accidental turn off during normal use.

Initially the LED will be dim to indicate that 0.2 seconds will be the click to click timing. Click the switch to choose a different value. The sequence is:

- 0 click (dim)   → 0.2 seconds click timing
- 1 click (brighter)   → 0.3 seconds click timing (shipping default)
- 2 click (brighter)   → 0.4 seconds click timing
- 3 click (brighter)   → 0.5 seconds click timing

When you are satisfied with the choice, press to save the setting. The LED will flash once and then go dim to indicate the guardband submenu choice needs to be made.

Initially the LED will be dim to indicate that 0.5 seconds will be the guardband timing. Click the switch to choose a different value. The sequence is:

- 0 click (dim)   → 0.5 seconds guardband timing
- 1 click (brighter)   → 0.7 seconds guardband timing (shipping default)
- 2 click (brighter)   → 1.0 seconds guardband timing
- 3 click (brighter)   → 1.3 seconds guardband timing

When you are satisfied with the choice, press to save the setting. The LED will flash twice and go dim to indicate that the selection has been made, and that the Menu mode has been reentered.

6.13 Thirteen clicks –Number of main modes and levels for UIC2W/UIC2C or UIC3

This menu allows selecting the number of main modes (3, 4 or 5) that are available in UIC2W/UIC2C or UIC3. It also allows the user to configure all 3, 4 or 5 drive levels (for each channel) and the drive levels of the two special modes.

This menu has no effect when UIC1 is in use since the levels are predefined (L1 through L5) for each of the 5 normal modes.

STEP1:

Initially the LED will be dim to indicate that 3 modes will be selected. Click the switch to choose a different value. The sequence is:

- 0 click (dim) $\rightarrow$ 3 modes
- 1 click (brighter) $\rightarrow$ 4 modes
- 2 click (brighter) $\rightarrow$ 5 modes (default)

When you are satisfied with the choice, press to save the setting. The LED will flash once and then go dim to indicate the drive level submenu is active.

STEP2:

This submenu allows configuration of the drive level for each mode (3, 4 or 5) and both channels.

First the LED will light up dim to indicate L1 for the LED1+/LED1- channel. Click to choose your required level.

- 0 click (dim) $\rightarrow$ L1
- 1 click (brighter) $\rightarrow$ L2
- 2 click (brighter) $\rightarrow$ L3
- 3 click (brighter) $\rightarrow$ L4
- 4 click (brightest) $\rightarrow$ L5
- 5 click (off) $\rightarrow$ L0 (LED channel is off)

When you are satisfied with the choice, press to save the setting. The LED will flash once and then go dim to indicate the second channel drive level is waiting to be configured.

STEP3:

The LED will light up dim to indicate L1 for the LED+/LED- channel. Click to choose your required level.

- 0 click (dim) $\rightarrow$ L1
- 1 click (brighter) $\rightarrow$ L2
- 2 click (brighter) $\rightarrow$ L3
- 3 click (brighter) $\rightarrow$ L4
- 4 click (brightest) $\rightarrow$ L5
- 5 click (off) $\rightarrow$ L0 (LED channel is off)

When you are satisfied with the choice, press to save the setting. The LED will flash once and then go dim to. Repeat Steps 2 - 3 for the number of normal modes (3, 4 or 5) that you selected in Step 1.

STEP4:

This submenu allows configuration of the drive level for each of the 2 special modes for both channels.

First the LED will light up dim to indicate L1 for the LED1+/LED1- channel. Click to choose your required level.

- 0 click (dim) → L1
- 1 click (brighter) → L2
- 2 click (brighter) → L3
- 3 click (brighter) → L4
- 4 click (brightest) → L5
- 5 click (off) → L0 (LED channel is off)

When you are satisfied with the choice, press to save the setting. The LED will flash once and then go dim to indicate the second channel drive level is waiting to be configured.

STEP5:

The LED will light up dim to indicate L1 for the LED+/LED- channel. Click to choose your required level.

- 0 click (dim) → L1
- 1 click (brighter) → L2
- 2 click (brighter) → L3
- 3 click (brighter) → L4
- 4 click (brightest) → L5
- 5 click (off) → L0 (LED channel is off)

When you are satisfied with the choice, press to save the setting. If you have only configured the first of the 2 special modes, then the LED will flash once and then go dim. Repeat Steps 4 - 5 for the second of the special modes. If you have configured both of the special modes, then instead the LED will flash twice and go dim to indicate that all the selections have been made, and that the Menu mode has been reentered.

6.14 Menu Selection Complete

Once the above Menu procedure is complete and the driver exits the new Menu system. The driver is ready to be used in normal mode.