Petit Crouton (a.k.a. PC) v2.0
Entry Range Illuminated Saber Controller – User's manual

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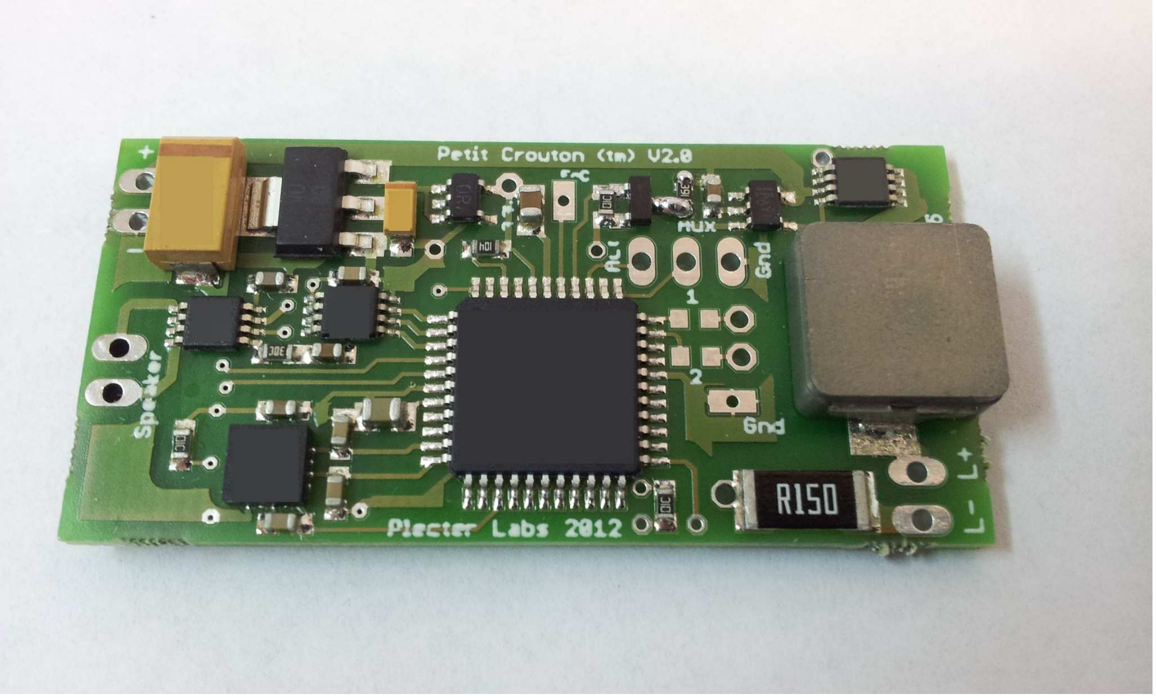

We spent a lot of time writing this manual to ensure all the important information is provided for proper use of that board. If you are new to saber building, to the use of Plecter Labs boards, or simply to electronics in general, we highly recommend you print a copy of that document and keep it with you during the whole process of installing PC in your hilt.

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Introduction

The Petit Crouton is the little brother of our Crystal Focus Board. It is very similar to the CF but has a single sound banks and two accent LEDs, making it a perfect midrange sound fx and high-power LED driver combo board.

Warning : You've just acquired an electronic board containing parts sensitive to ESD. Final wiring & assembly is under responsibility of the user with the appropriate tools and ESD protection.

If you're not familiar with ESD, please visit :

http://en.wikipedia.org/wiki/Electrostatic_discharge

Plecter Labs can not be held responsible for improper use or assembly of the Petit Crouton board.

Warning : High-power LEDs (such as the Luxeon brand LED, which is mentioned in this document) are *extremely bright*. They are considered "class 2 lasers"! You should neither look directly to the beam nor point someone with it when the blade is not attached to the hilt, just like a powerfull lamp or flashlight. Plecter Labs could not be held responsible for any bad use of high-power LEDs.

To avoid injuries and retina damage due to the high brightness of those high-power LEDs, simple "emitter plugs" can be built using a piece of blade tubing ended with some decorative greeblies.

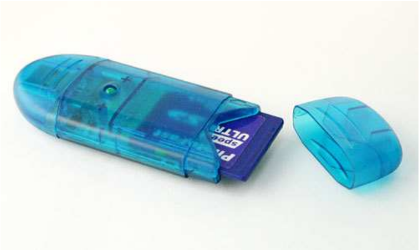
Sound section

The Plecter Labs sound board is unique. It has been developed in the purpose of improving the quality of DIY sabers sound FX in a significant way. During too many years, sound modules were obtained from sacrificed toys and remained low quality. Master Replica FX sabers broke the line with better sounds and good dynamics. However, the low resolution motion sensors used as well as closed electronics made those boards impossible to adjust in term of sensitivity or sound contents.

We have monitored several attempts for building an embedded sound module playing custom & changeable sounds, often based on chipcorders. Using bulky parts, those were often unreliable and hard to fit in a hilt. Not to add those chipcorders were designed for digital answering machines, and therefore feature a bad restitution quality (voice sample rate – 8 KHz).

Plecter Labs decided to process the internal motion sensors **and** the sound generation on the same board which requires some non-volatile memory. Second, we needed a simple way to upload or download sound contents or configuration of the saber through a simple and standard way.

To avoid any plugging problem with a small connector and an easy-to-loose cable, we opted for a high-end flash memory card in the SD format (now microSD).



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Inserted in a USB card reader like the one we sell, the card is seen as a USB storage key and it takes a few seconds only to transfer files to or from the card, on Mac or PC, without the need of any custom piece of software.

Petit Crouton V2.0 Features & Maximum Ratings

- Dimensions: 48x23.5x7.5 mm (with the microSD card).
- Power supply: 5.5 to 11 V / 2.5A (with the High-power LED). 2 li-ion cells (18650 or 14500) batteries recommended.
- Idle current consumption : 3 mA (deep sleep mode)
- 2 A high-power LED drive
- Speaker: 4 to 8 ohm.
- Audio output Power : 2W
- Accent LEDs: 2
- 32 stages sequence with stop and loop instructions (using either 0 or 65535 for the delay)
- Accent LEDs pad current source: 18 mA max per pad
- Handles momentary or latching for blade activation
- Blaster Blocking & Lockup Fx
- Blade Flickering Fx
- Blade Shimmering on Clash
- Anti Power Off technology (A-POP™)
- Foc™ Flash on Clash™
- WAV file support
- 12 bit sound
- SD card support: up to 2GB, FAT16 or FAT32 (beta). Sandisk and Kingston brands preferred.
- Hum resume: defines if you come back to where the hum has been interrupted or not. Interesting for certain hums. Not sample accurate but resumes the hum in a ballpark of 11ms from where it's been interrupted by a fx sound
- Anti power off delay (offd) : variant of our Anti Power Off technology (APOP) use an adjustable delay when cycling the the activation switch.
- Led current parameter now takes mA. To get 2A you would enter 2000, for 1.5A 1500 etc
- Motion sensing thresholds now go up to 1023 (ls, hs, lc) : multiply your former CF configurations by 4.
- General sensitivity (i) is now an integer between 0 and 99. Same kind of value than on CFv5. Previously entered as float number (0.65) but is now 65.
- Wiring is very similar to current CF, down to the accent LEDs location and FoC pad.
- Shorter than PC 1.6
- Mute on the go

Tools and Parts required to install/operate the module

- an ESD safe soldering station & soldering wire (60/40, 1mm OD or eq.)
- pliers (flat and cutting)
- a Digital Multimeter / DMM (strongly advised, so useful)
- a latching or momentary switch for the blade ignition, and a momentary switch for the auxiliary switch.
- wire & heat shrink
- rechargeable Batteries
- recharge port (canon 2.1mm socket)
- appropriate Battery charger
- a USB SD card reader accepting micro SD card or a regular SD card reader with a micro to regular SD card adapter.
- a computer
- a digital audio editor software handling WAV files if you wish to create your own sound fonts.

SD card contents, Sound Banks and Slots

Sounds are stored in the WAV format (16 bits, 22050 samples per second). Despite the module uses a 12 bit sound output, we kept the 16 bit format of the sound font, therefore ensuring immediate compatibility with CF sound fonts. You can now drop the contents of a CF sound bank directly onto the root directory of the SD card for the PC 2.0. It will only use the files necessary and ignore the rest.

WAV sound files must comply with the format above or they will be skipped during the boot, leading to sound gaps or board failure.

Petit Crouton has a single sound bank, with all the files (including configuration files) stored in the root directory of the SD card. The sound content of a bank is called a Sound Font.

A sound bank has 26 sound slots split as below:

- a boot sound (`boot.wav`)
- a power on sound (`poweron.wav`)
- a power off sound (`poweroff.wav`)
- continuous humming (`hum.wav`)
- 8 clash sounds (`clash1.wav` to `clash8.wav`)
- 8 swing sounds (`swing1.wav` to `swing8.wav`)
- 4 blaster blocking sound (`blaster1.wav to blaster4`)
- a blade lockup sound (`lockup.wav`)
- force sound (`force.wav`)

When the power supply voltage is applied to the board, our board "boots" and plays a little logo sound to notify the user, just like a digital camera. This little logo makes sure the Petit Crouton Saber Core started properly and it gives a special identity to the saber and to the loaded sound font. This sound can be of course customized. If the boot sound `boot.wav` is not on the SD card, a little beep is played instead. If you don't want any sound when powering the module, create a WAV sound file with 100 ms of silence.

The sounds **must** be all there on the SD card and be named properly (lower case) to have the module operating properly. Same thing for the configuration files (`.txt`). We advise the user to keep all its sound and configuration files in specific folders on the hard disk on the computer so that changing the saber's contents remains easy. Use some explicit naming of the folders so that you can easily remember what the sound font and configuration files are doing, for instance `[very_sensitive_dark_lord_saber]`.

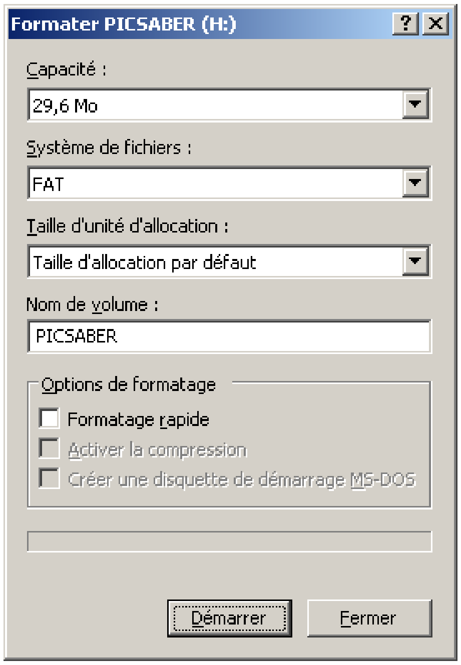
Creating Your Own Sounds

It's a great personal satisfaction to build up your own soundfont. However, it's not so easy. Please read our online tutorial about that particular topic.

Installing a Sound Font on the SD card

Although editing the configuration files (text files) can be done directly onto your microSD card, changing the SOUND FILES (.wav of ANY kind) requires you to format the microSD card! This is not a recommendation, it is A REQUIREMENT: YOU MUST FORMAT THE SD CARD prior to changing any sound files!

1. First thing: backup the SD card on the hard disk. Easy to do, however most people don't bother doing so and end losing their initial configuration.
2. Unzip the sound font archive in a directory of your hard disc.
3. Take all the WAV sounds. If the sound font zip archive comes configuration files that are supposed to match the theme of the sound font, you can take it as well, but make sure the settings won't harm anything (especially the high-power LED current).
4. Copy the files in desired sound bank and overwrite the files
5. Copy the whole SD card (Ctrl+a, Ctrl+c) to a temporary folder of the hard drive.
6. Format the SD card in FAT (FAT16 or FAT32)
7. Select the whole content of the temporary directory on the hard drive and copy it in one run to the SD card (Ctrl+a, Ctrl+c, Ctrl+v on the SD drive)



Capacité : 29,6 Mo

Système de fichiers : FAT

Taille d'unité d'allocation : Taille d'allocation par défaut

Nom de volume : PICSABER

Options de formatage

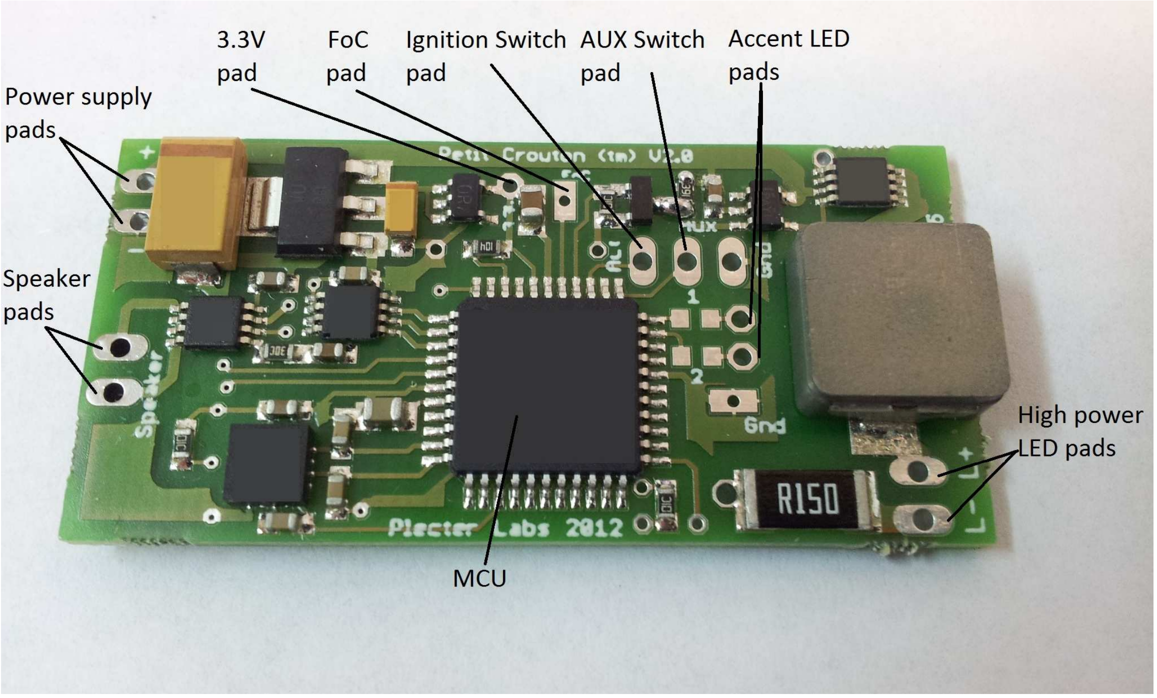
□ Formatage rapide

□ Activer la compression

□ Créer une disquette de démarrage MS-DOS

If you wish to try different sound fonts quickly, copying back and forth all the files will soon be boring and time consuming. Start by configuring your board to use `bank1`. Then make a temporary file structure of the SD card that has only the bank1 directory and nothing else. Use that directory to test the different sound fonts. This way you will transfer only a limited number of files. Once the fonts have been selected, you can store them in the different sound banks and start adjusting the parameters.

Board Overview



User's Notes

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Wiring and Operating the Module

The board must be powered with an appropriate battery pack. We highly recommend the use of good quality **li-ion battery** packs made of 14500 or 18650 cells **and including protection PCBs**. The AW brand makes superior quality batteries while the Ultrafire remains a cost effective solution.

Unless you have a convenient way to open the hilt and access the inside of the saber (Graflex base for instance), we strongly recommend the use of a directly connected battery pack (with a "recharge port") vs. removable cells. Moreover, for dueling sabers, directly wired battery packs have more reliable connections compared to spring action battery holders.

A 2-cell li-ion will provide a nominal voltage of 7.4V to the board. The board isn't compatible with a 3-cell solution without some modifications of the electronics.

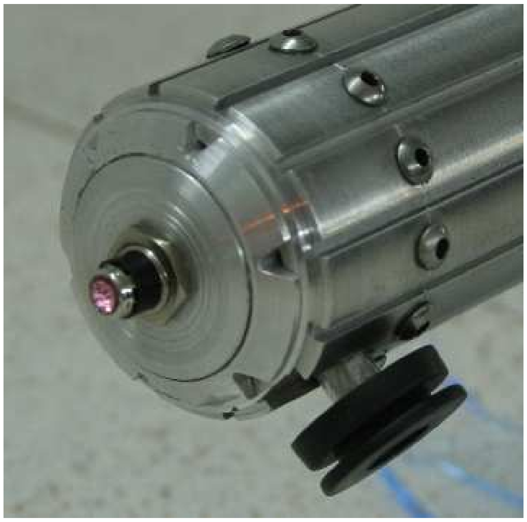
Ni-MH battery packs are simply not recommended since they have a bigger energy storage/volume ratio and cost of li-ion cells isn't an issue anymore.

General Power Switch & Recharge Port

Despite the PC board has a very low idle current use (3mA) when the blade is off and board is in deep sleep mode, long term storage of the hilt on a shelf or display case requires the electronics to be fully shut off. To avoid the use of an additional general power switch, we use the recharge port for that very purpose. A pin 2.1 mm "Canon" socket is a popular choice. Two of those pins are connected when nothing is inserted in the socket. Contact is disrupted when a plug is inserted.

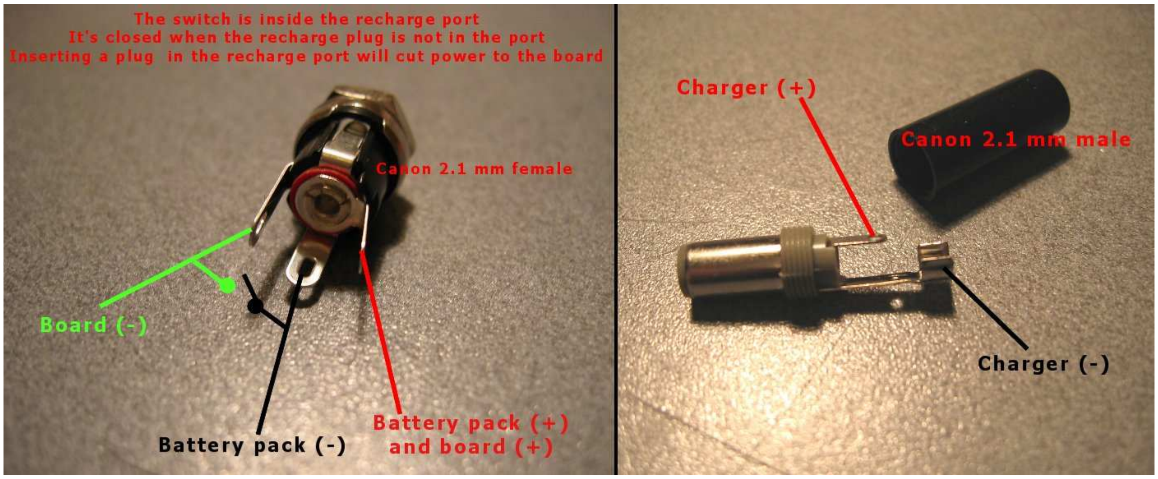
Along the years, the "kill key" technique has been developed: a fake plastic plug is decorated to look like an actual part of the hilt. When inserted, it cuts the power supply to the board in the recharge port. Of course, the port recharges the internal battery pack when an actual charger plug is inserted.

Below, 2 examples of decorative kill keys (February 2006 and July 2010)



The Kill Key must be made out of a non-conductive material (PVC, Nylon etc). The left picture above shows a kill key made out of a sacrificed male plug (metal) but it's

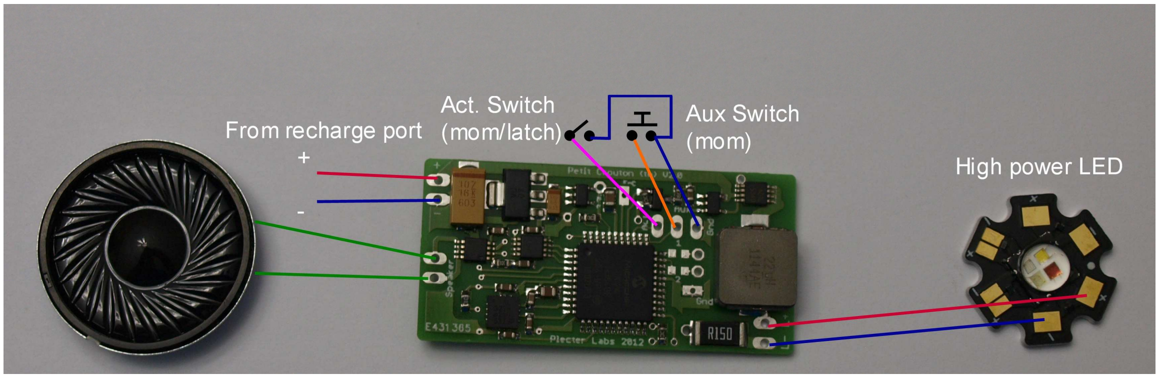
provided only as a reference picture and plastic should be used as a rule of the thumb.
Here's the usual wiring of the recharge port. Please note that not all recharge ports have the exact same pin out. User must understand the principle of wiring a recharge port and must be able to identify the different pins of a socket.
The idea is fairly simple: the positive of the battery pack goes to the recharge port central pin (referred as **tip**) and to the positive of the board. It's not affected by the kill key. The negative of the battery pack goes to the pin of the recharge port that is connected to the outer **sleeve of the socket**. The last pin, referred as **switched negative pin** and goes to the negative of the board.


The switch is inside the recharge port
It's closed when the recharge plug is not in the port
Inserting a plug in the recharge port will cut power to the board
Canon 2.1 mm female
Board (-)
Battery pack (-)
Battery pack (+)
and board (+)
Charger (+)
Canon 2.1 mm male
Charger (-)

When nothing is inserted in the port, the negative of the battery pack is internally connected to the switched negative tab, hence powering the board. When a Kill Key is inserted in the port, the negative of the board is no longer connected to the negative of the battery pack: the board is fully powered down. When a charger plug is inserted in the recharge port, the charging voltage is reaching both leads of the battery pack while the negative of the board is still unconnected from the circuit, preventing damages to the electronics and ensuring only the battery pack is connected to the charger for proper charge.
In the previous picture the green-black drawn switched doesn't need to be wired per say, it only illustrates the recharge socket internal switch.

General wiring

The board doesn't need so many connections for basic operation. Aside of the recharge port / power supply detailed above, only a pair of switches, the high power LED and the speaker are required to be soldered to get 90% of the features the PC board proposes.

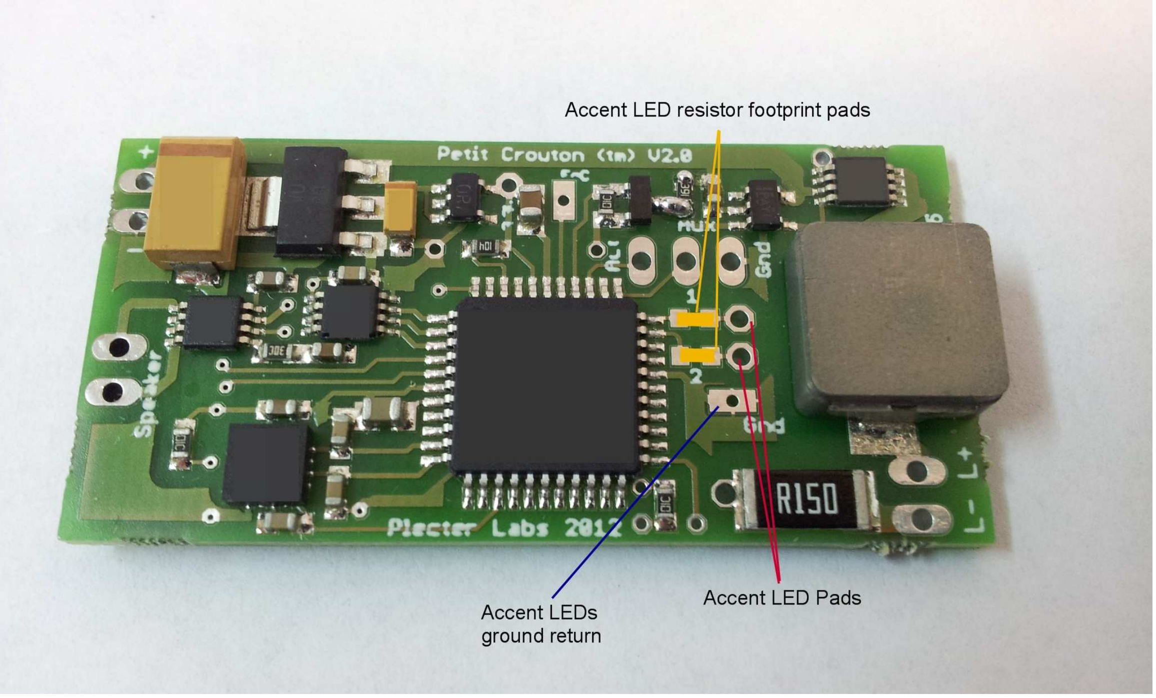


NEVER change the high-power LED while Petit Crouton Saber Core is in idle mode. If you need to install another high-power LED (changing the color for instance) you must totally power the saber off.

User's Notes

Animated Accent LEDs

There are many ways to “pimp” your saber hilt using additional small LEDs further referred in this document as **Accent LEDs**.
Petit Crouton features a 32 stage sequencer that allows the user to setup a blinking animated sequence for up to 2 LEDs. The board outputs 3.3V / 18mA max per accent LED pad. User must ensure the used accent LEDs have a forward voltage (Vf) lower or equal to 3.3V.



On the picture above, the red arrows point to the positive pads of the accent leds, use small gauge wire to send those signals to the positive of the LEDs. Flat/Ribbon cable can be very handy for that purpose. Then both negatives of the LEDs return to a single pad pointed by the blue arrow (ground return).

The resistor pads on the PC2 are pre-bridged. You will need to use an external resistor for the accent LEDs

Calculating resistors for LEDs

R = (Vsupply – Vled) / LedCurrent

In our case, Vsupply is the voltage the board provides to power the accent LEDs, ie 3.3V. The Vled is the forward voltage of the LED, usually referred as Vf in the datasheet. The led current has to be decided by the user, depending on the brightness and the maximum rating of the used LED. 5 to15 mA are fairly common for most accent LEDs.

As an example, let’s consider a 1.6 volt LED (red) at 10 mA
R = (3.3 – 1.6) / 0.01 = <u>170 ohm</u> (→ 150 ohm in the classic E12 resistor serie)

Be sure not to drive too much current in the LED (18 mA max). If you wish a good brightness with a low current, use high efficiency LED (generally coming in a transparent “crystal” coating).

Please see further in this document for the sequencing of the accent LEDs.

Main Configuration File

The `config.txt` configuration file is a simple text file to be edited with windows notepad.

It is composed of 26 parameters that **must all** be present in the file. Otherwise, the module will use default parameters.

The text file accepts comments on a stand alone line (not mixed with a parameter line). The comment symbol is the C language double slash '//' as the very first characters of the line.

To modify the file, insert the SD card in the USB card reader, and then browse the contents with windows file explorer (on **`E:`** for instance). Double-click on file `config.txt` : the notepad opens. You can directly save the file on the SD card. Once the configuration is over, simply remove the card from the reader after having it "ejected" (right click on the reader device in windows explorer, contextual menu, eject). Put the card back in the saber and test you new setup!

The configuration file **MUST BE LESS than 512 bytes**. If the size is bigger, the file will be skipped without further analysis and defaults parameters will be used. The basic configuration file of Petit Crouton is about 220 bytes, with a few comment lines for an easier reading. Make sure not to add too many comments in the file. If you are not sure of the file size, check it in Windows file Explorer, with a right click on the file, then "properties" in the contextual menu.

Make sure you have no space characters at the beginning of the line, or between the '=' sign and the value of a parameter.

Parameters and fine tuning the saber

The configuration file includes a set of parameters dedicated to the sound section of the controller and the gestural / motion detection (both being linked). A second set of parameters handles the behavior of the high-power LED. Some parameters influence both categories, since visual and sound effects are in tight relationship intrinsically. All parameters are lowercase.

Certain parameters involve time / duration / delay. We tried to normalize those parameters to a single unit: a multiple of 2ms. Unless otherwise indicated, that's what is used to define those timing parameters and it matches the internal clock of PC.

Motion & Gesture detection parameters :

Swings and clashes are separated using 3 thresholds. A swing motion must exceed **ls** (low swing) and must remain under **hs** (high swing). A clash must simply exceed **lc** (low clash).
It's important to maintain a dead-zone between **hs** and **lc** to maximize the quality of the motion detection.
Default parameters have been setup for you and usually, only the "i" parameter has to be touched up.
However, some special cases can be considered:
_ The saber is not sensitive enough to the swing (placement in the hilt too close to the spinning center, spinning style etc) : decrease parameter **ls** of one point of two. Don't decrease **ls** too much or undesired swing sounds will be triggered.
_ When the saber cuts the air too fast, the swing is not triggered (it's in the dead-zone). Increase a little bit parameter **hs**(or reduce the speed of your swings).
_ The saber often produces a clash sound when the user executes a swing: parameter **hs** is probably too high and too close to parameter **lc**. If the clash sensitivity is correct, decrease parameter **hs**.
_ The saber is not sensitive enough to clashes: decrease parameter **lc**.
_ The user wants the clash to happen **only** when blade is smacked very hard: increase **lc** (keep it under 1023).

Rule of the thumb for a proper configuration process: modify only a single parameter at once and work separately on clash and swing parameters. Fine tuning the module might take some time, but a good configuration will lead you to a very satisfying interaction with the saber.

Gesture flows & priorities :

Our gesture analysis is so fast that sounds could be chained one after the other at light speed! We therefore have to slow down the module because too many swing sounds played in a short time are not so realistic. For that reason we implement gesture flow limiters for swing and clash sounds.

Clash sounds generally have the priority over all other sounds except in the following cases:

- lockup is engaged : no other sound will be triggered until the aux. switch is released
- a blaster sound is triggered. Swings cannot interrupt it. A clash can interrupt it.

A clash sound can interrupt a swing sound even if the swing flow limiter is engaged (just after a swing was triggered).
A clash sound cannot interrupt a previously triggered clash sound if the clash flow limiter is still engaged (delay for triggering another one hasn't expired).
A swing sound cannot interrupt a previously triggered swing sound if the swing flow limiter is still engaged (delay for triggering another one hasn't expired).
A swing sound can never interrupt a clash sound **if the clash flow limiter is still engaged**, and whether or not the swing rate limiter is engaged.
If the clash flow limiter has expired, and even if the clash sound is still playing, a swing sound can interrupt it.

- **`swing [0-500]`**: swing rate flow limiter. Delay during which swings cannot be furthermore triggered.
- **`clash [0-500]`**: clash rate flow limiter. Delay during which clashes cannot be furthermore triggered.

Sound parameters :

- **`vol [0-4]`** : digital volume setup. 0 mutes the sound output, 4 is the maximum volume.
- **`shmrd [10-500]`**: duration of the shimmering effect of the high-power LED during a clash. Make sure this duration is not too much longer than the associated sound to keep a nice result.
- **`shmrp [5-25]`**: periodicity of the light bursts during the clash effect. A slow period will produce tight bursts.
- **`shmrr [0-25]`**: random value applied to the periodicity of the light burst during a clash effect. Allows having bursts that are not regularly spaced in time which increases the realism. For instance, a period **`shmrp`** of 20 and a random value **`shmrr`** of 10 will produce a period between two bursts varying between 20 and 30 (ie 40 and 60 ms).
- **`switch [0-2]`**: selects if the saber is activated by a normally-open or a normally-closed switch. Certain "push-on push-off" switches are more practical and more reliable when released for activating the saber. Other switches might simply have an "inverted" logic (normally closed contact). When **`switch`** is set to **1**, the saber lights up when the electrical contact of the switch is closed and conversely when **`switch`** is set to 0. If you wish to use a **momentary** switch for the blade activation, set **`switch`** to 2.
- **`offp [0-1]`**: Anti power off protection (A-POP). To avoid accidentally powering off the saber, especially when using a momentary button for activation, we added a power off protection. When this parameter is set to 1,

the user must press the activation button and confirm with the auxiliary button. It is not necessary to press both buttons at the same time, keep the activation switch pressed first, then press the auxiliary switch: the blade goes off.

- **qon [0-3000]**: "quick-on". Allows having the blade ignited in a specific amount of time rather than matching the duration of the power on sound. **This parameter is specified in milliseconds (ms)**, and should not exceed the duration of any power on sounds.
- **qoff [0-3000]**: same thing as above, but for the blade retractation. **Also in ms**.
- **lockup [0-1000]**: our module features an auxiliary switch to trigger additional sound/visual effects. A short pressure on the switch generates the blaster effect (the saber blade stops a blaster ray), plays one of the blaster sounds. A longer pressure (maintained) triggers a blade lockup effect: while the switch is pressed, the sound `lockup.wav` is played in loop with some shimmering applied to the high-power LED. The parameter **lockup** specifies the duration of the delay before triggering the lockup effect. A short value (50 to 100) will trigger the effect almost immediately: to trigger a blaster effect, the user will have to release the button quickly. Conversely, a higher value will leave more time to produce a blaster blocking feature.
- **focd [0-500]**: Flash on Clash™ (FoC™) duration. Used when an extra LED die is wired to the board with a Power Xtender™ circuit and the Flash on Clash™ Pad.
- **focp [5-25]**: periodicity of the light bursts during the Flash on Clash™ effect. A slow period will produce tight bursts. Similar to the **shmrp** parameter.
- **focr [0-25]**: random value applied to the periodicity of the light burst during a Flash on Clash™ effect. Similar to **shmrr** but applied to FoC™.
- **focfs [0-511]**: defines the overall strength of the FoC LED die
- offd [0-3000]: adds a delay to the power off when changing the state of the activation switch. Max value = 3000 = 6 seconds
- resume [0-1] hum resume : defines if you come back to where the hum has been interrupted or not. Interesting for certain hums. Not sample accurate but resumes the hum in a ballpark of 11ms from where it's been interrupted by a fx sound

High-power LED parameters :

- **led [0-2000]**: defines the current of the LED up to 2A. A value of 750 matches 750 mA, 1000 gives 1A. Calculation of the value is in actual milliamps
- **flks [0-20]**: speed of the energy variation / flickering effect of the blade. A high value produces a damaged saber effect while a small value generates subtile energy changes. The value 0 disables the effect (static blade).
- **flkd [0-100]**: depth (in %) of the energy fluctuation effect, i.e. the the range over which the LED brightness will be affected during the effect. A low value does not modify the energy very much while a high value « digs » big steps of light intensity. To be used with the parameter **flks**.

Clashes & Swings Selection Modes

The Petit Crouton boards have a single random method for selecting the clash and swing sounds. It's the same as mode **3** on a CF board: this is an improved random mode referred as RandomX mode or "Bubble Sort" random. The idea is to avoid triggering twice the same sound in a sequence. This new algorithm will make sure a sequence (8 swings / 8 clashes) does not have any duplicate, but you might still get a double between 2 sequences, in rare cases.

Advanced Wiring & Usage

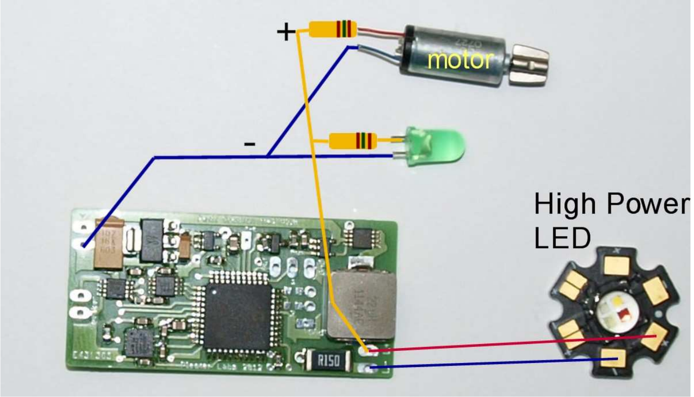
Wiring a tactile feedback motor and a progressive power On LED

It is possible to wire additional peripherals on our controller and make them follow the fluctuations applied to the high power LED.

Therefore, a little force feedback motor (like the ones used in cellphones) and a power on LED can be added. Those peripherals will behave the same way as the high-power LED does: progressive fade in and out during power on/off and perturbation during a clash, blaster blocking or blade lockup effects. The peripherals are connected on the output of the high-power LED current regulator **but return to ground** instead of the high-power LED negative (L-).

Please note that due to the mechanical nature of the motion sensor used (made out of small steel balls moving with motion) the use of a rumbling motor is not always recommended. It can work; however, the installer must insure the motor is as mechanically decoupled as possible from the board, otherwise the vibration generated by the motor will permanently activate the motion sensors, leading to undesired swing fx sounds.

No extra wiring pad has been provided for wiring those additional peripherals, just solder the positive wires (in yellow on the wiring diagram below) on the high-power LED positive pad (L+) or on the side of the coil.



Calculation of the power-on LED resistor

The power-on LED is not current regulated, it just takes the voltage applied to the high-power LED running at its nominal current. We therefore need to limit the current in the power on LED, as well as in the force-feedback motor.

The calculation of the resistor depends on the forward voltage of the high-power LED, which varies with the current used and the LED color, the forward voltage of the accent LED and the current flowing in it.

Example

A classic 3 or 5 mm LED (red, green or yellow) has a forward voltage of 1.6 to 1.8 volts and can take up to 20 mA.

- For a red, red-orange or amber luxeon III LED the forward voltage is about 2.9V. Let’s take for instance a red power-on LED (1.6V) at 15 mA.
  $R_{\text{Power-on LED}} = (V_{\text{luxeon}} – V_{\text{Power-on LED}}) / I_{\text{Power-on LED}}$
  $R_{\text{Power-on LED}} = (2.9 – 1.6) / 0.015 = 86\ \Omega$
  Which leads to 82Ω or 91Ω in the E12 resistor serie.

- For a white, blue, green or cyan luxeon the forward voltage is about 3.7 V. Let’s take for example a green LED (1.8V) at 15 mA.
  $R_{\text{Power-on LED}} = (V_{\text{luxeon}} – V_{\text{Power-on LED}}) / I_{\text{Power-on LED}}$
  $R_{\text{Power-on LED}} = (3.7 – 1.8) / 0.015 = 95\ \Omega$
  Which leads to 91Ω or 100Ω in the E12 serie.

Calculation of the force-feedback motor resistor

There are too many various sorts of motors to determine a specific resistor. The motors we sell are designed to work in the 1V to 2V range and the current they take increases very quickly when the power supply voltage increases due to the non-centered weight that produces the rumbling effect.

We can however take 1.5V as a base voltage with a 100 mA maximum current to avoid too much current flowing in the high-power LED driver and limit heating.

For a red, red-orange or amber luxeon LED the forward voltage is about 2.5V.
$R_{\text{motor}} = (V_{\text{luxeon}} – V_{\text{motor}}) / I_{\text{motor}}$
$R_{\text{motor}} = (2.5 – 1.5) / 0.1 = 10\ \Omega$ - ½ watt

- For a white, blue, green or cyan luxeon the forward voltage is about 3.7 V.
  $R_{\text{motor}} = (V_{\text{luxeon}} – V_{\text{motor}}) / I_{\text{motor}}$
  $R_{\text{motor}} = (3.7 – 1.5) / 0.1 = 22\ \Omega$ - ½ watt

For an unknown motor, experimentation is the key, starting for instance with a ½ watt 100 or 150Ω resistor and an amp-meter to find out the supply voltage of the motor within the limit of the max current used (100 mA max). The best solution is to power the motor with a regulated power supply and to increase slowly the voltage while monitoring the current and when the current and voltage are found, you can go back to the above formula. Be sure to use at least a ½ watt resistor in all cases.

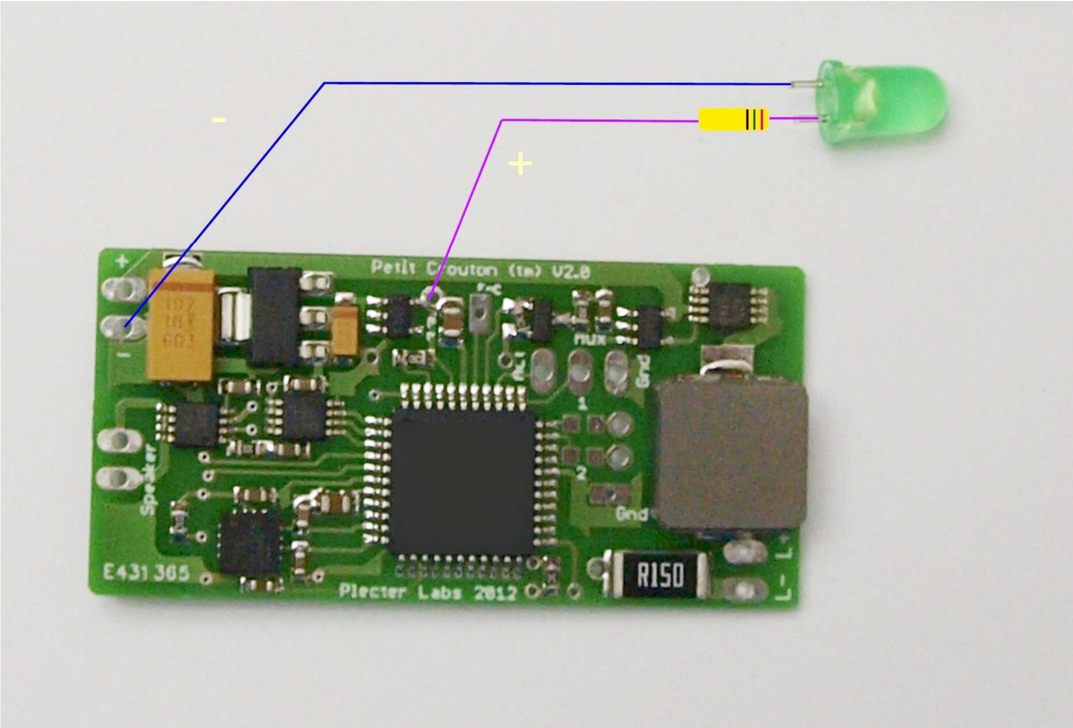
An easy workaround is to use a multiturn trimming potentiometer of 100Ω or 1kΩ. This makes possible to adjust the speed with accuracy.

User's Notes

Wiring a general Power-On Indicator / Accent LED

It's is sometimes useful (or good looking) to have a LED lighting up as soon as the kill key is removed. Of course, 1 of the 2 accent LEDs could still blink as idle mode indicator, but a permanently on LED could be nice to simply indicate the battery pack is working properly. This is also very nice to have indicator lighting up the internal ring of a chromed anti-vandal switch.

The PC board provides a regulated 3.3V pad for that purpose, shown in purple in the illustration below.



Wiring a Flash on Clash™ (FoC™) LED / Die

PC v2.0 features an additional pad to drive a Flash on Clash™ effect. With the emerging technology of multi-die high-power LEDs, certain dice can be used to light up the blade, while a remaining die can add some more light (possibly with a different color) when a clash is triggered. Depending on the configuration file, the FoC™ can also be triggered when blaster blocking, and lockup events are registered.
The FoC™ pad is only a 3.3V remote control pad and cannot drive any power. Hence, it controls a Power Xtender™ micro board in order to drive an additional LED die.
Moreover, the FoC™ isn't static but has also its own shimmer parameters in the configuration files, which allows the generation of very vivid Flash on Clash effects (**focp**, **focr** and **focs** parameters).

The drive of the LED die involved in the FoC™ isn't current regulated, so the appropriate resistor must be included in the Power Xtender™ circuit to limit the current. Also, user must be concerned about the current used by the FoC™ die, the overall current used by the complete setup, and the current the battery pack can provide. Exceeding the capacity of the battery pack, or its discharge rate could lead to battery deterioration or explosion.

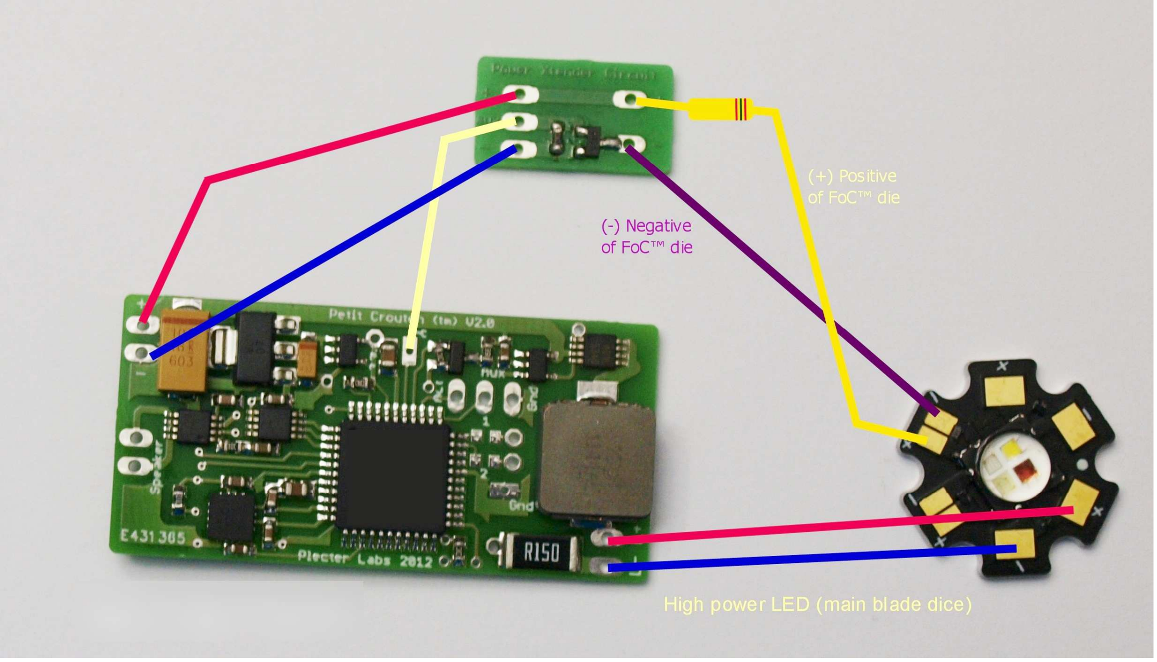
Example of use :
Let's consider the drive an extra white die at 1A for the FoC. Forward voltage of that die is around 3.7V.
Required resistor for the FoC circuit :
R = (Vpack – Vf die) / FoC current
R = (7.4 – 3.7) / 1 = 3.7 ohm

Wattage of the resistor :
P = RxI^2 = 3.7 watt.

Since the FoC circuit is only active for a short time (maximum 10 seconds during a lockup), it's acceptable to use a 3W resistor in the example above.

If the user wants to drive an accent LED out of the FoC pad (and not a high-power LED die), this can be of course achieved without a Power Xtender board, just like any accent LED. The pad outputs 3.3V and 18 mA maximum.

Wiring Diagram for Flash on Clash™ (FoC™)



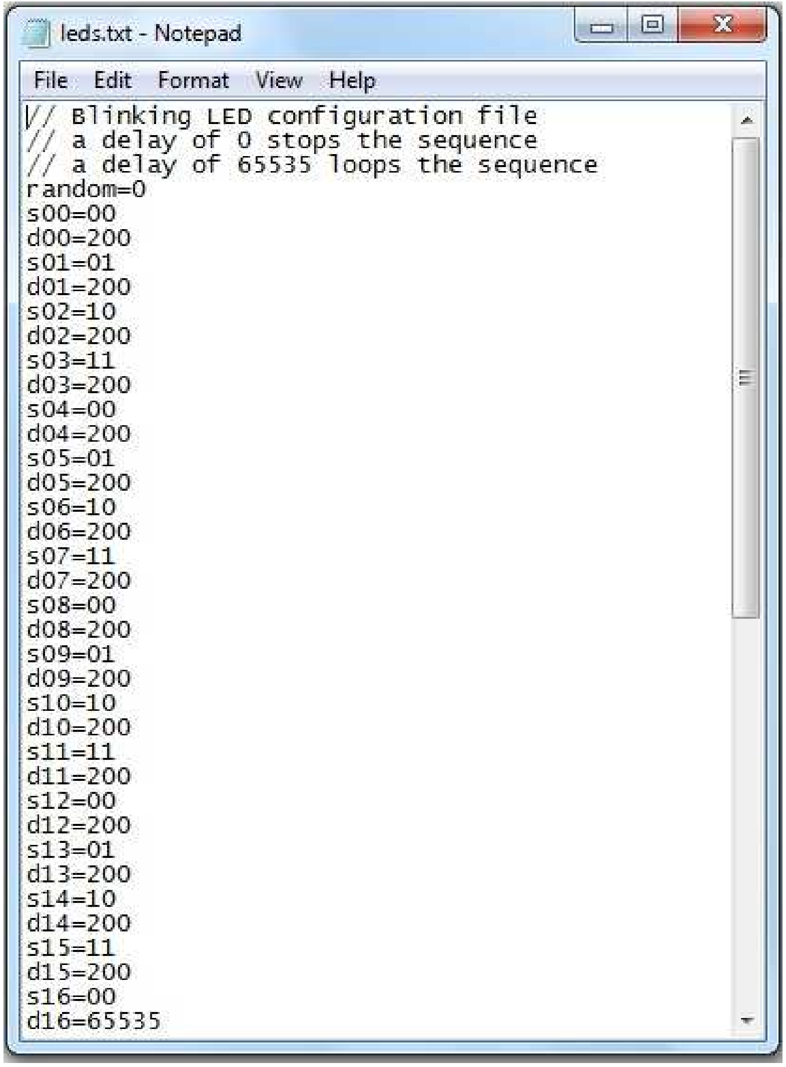
Flash on Clash™ (FoC™)

User's Notes

Accent LEDs sequencer

2 accent LEDs can produce 4 patterns; we limited the sequencer to 32 stages.
The working principle of the sequencer is to put the LEDs in a given pattern/state during a certain time (delay). Once the delay is over, a new pattern is output and so on for the 32 stages before looping to the first one.
The main LED sequence is described for each sound bank in the `leds.txt` text file. Simply open the file with window notepad to modify it, directly on the SD card or on the hard disk.

Here is an example of an actual `leds.txt` file.



```
// Blinking LED configuration file
// a delay of 0 stops the sequence
// a delay of 65535 loops the sequence
random=0
s00=00
d00=200
s01=01
d01=200
s02=10
d02=200
s03=11
d03=200
s04=00
d04=200
s05=01
d05=200
s06=10
d06=200
s07=11
d07=200
s08=00
d08=200
s09=01
d09=200
s10=10
d10=200
s11=11
d11=200
s12=00
d12=200
s13=01
d13=200
s14=10
d14=200
s15=11
d15=200
s16=00
d16=65535
```

Stages & Delays

The delay between each state can be different for each "state" line, it's not necessary to have a pattern evolution with a constant timing. A value of 0 for a "delay" line will stop the sequencer. Hence, it's possible to have an accent LED animation when the

saber starts, and the animation stop at the end of the 32 stages (or before) when a 0 delay is found in the file.
When setting **random** to 1 the sequencer will generate a random pattern at each stage of the sequence, ideal for a changing or non conventional animation. The delays will remain the ones specified in the sequence.
A delay of 65535 will loop the sequence. It's of course possible to use a LED output to drive an accent LED **AND** the remote control wire of a power xtender board to drive an additional peripheral requiring more power than what the accent LED pads can offer.

Deep Sleep flashing LED

It’s also possible to use one of the 2 accent LEDs to indicate the saber is in deep sleep mode when the blade is off. For that purpose, 2 parameters have been added to the configuration file `config.txt`.

- **`idleled [0-1]`**: selection of the LED used as idle indicator. **0** indicates accent LED pad #1. **1** indicates accent LED pad #2.
- **`idlepulsing [0-30]`**: duration of the the idle flash of the selected LED. In multiple of 1/30th of second. **0** disable the effect. With **1** we get a really short flash. With **28**, the idle LED stays on all the time except during a brief moment, and with **30**, the idle LED remains always on.

Mute On The Go™

Proposed / requested by Novastar for the specific situation of teaching saber classes and interacting with students. We all enjoy our saber to be loud when playing with it, however, it’s hard to show saber moves and interact with the students with the saber sound in the background.

We therefore tweaked the firmware so that, pressing the aux. switch prior pressing the activator switch will mute the saber until powering the blade off (the power-off sound will be played). Further “regular” ignition (without pressing the aux. switch prior ignition) will have the normal sound volume as setup in the configuration file.

Troubleshooting & FAQ

Q : I've updated the sounds on the SD card and now the module does not work anymore. It generates some beeps when it starts.
A : You must format the SD card (in FAT16 / FAT32) before updating the sounds, while it's not necessary to do so for the configuration files that can be edited in place on the SD card. To simplify the update process, put the new sounds on the SD, overwrite the old ones. Then select the whole contents of the SD card, and copy it in a temporary directory/folder on the hard disk. Format then the card, and next copy the files back to the SD card in one run.

Q : what's the meaning of the beeps when the module starts.
A : it means that a file is missing or hasn't been found. It can be the boot sound, or the configuration files. Three beeps generally mean that many important files haven't been found (`boot.wav`, `config.txt`, `leds.txt`)

Q : can I rename the sounds on the SD card ?
A : no, except the force.wav file. This file is usually provided with the sound font and is meant to provide an alternative to blaster blocking when using the aux. switch (ie producing a force fx sound instead of a blaster blocking fx).

Q : I wired a rumbling motor in my hilt and now I have swings triggered while the hilt rests on a flat surface.
A : The motor makes the board vibrating enough so that it's interpreted as a swing. Reduce the speed of the motor and/or mechanically isolate the board from the motor. Increasing **ls** can also help, but it will make swings more difficult to execute.