Please welcome Crystal Focus 9

- [NEW] iSaber Multitrack playing (track + saber Fx) with individual volume control
- [NEW] iSaber Fx swing clash stab and spin.
- [NEW] iSaber classic flicker + pulse or dynamic flicker (audio flicker)
- [NEW] iSaber specific font selection, or latest used (selected via the font menu prior entering iSaber)
- [NEW] Improved vocal menu audio real time mixing
- [NEW] Up to 16 color profiles
- [NEW] Spectrum™: a dynamic motion-based Color selection method
- [NEW] Improved color morphing between profiles
- [NEW] Mute-power-off (along with Mute-On-The-Go)
- [NEW] Specific start color profile (font specific)
- [NEW] Per Color Profile FoC mixing
- [NEW] Colder / More efficient power management
- [NEW] Omnisaber support
- [NEW] Accubolt & Multi bolt ported to CF (inherits from Prizm v5)
- [NEW] Deep Sleep & Deep Sleep pad (to power aux. electronics like a BT module, and accents)
- [NEW] New dimensions 50.77 x 22.13mm. Narrower PCB (< 7/8")
- [NEW] End of lockup sound slot for a smoother transition when returning to hum (ported from Blaster Core)
- [NEW] 16 bit motion sensing, larger motion dynamic range
- [NEW] Even faster motion sensing with improved (lower) motion-to-sound latency, now down to 4.74ms

Legacy features
- Tri digital motion sensor
- Magic Activation
- Saber ForceLock™
- Genuine 16 bit sound (no magic truncation, no design mistake)
- Sizable PLI 1 to 8 LED
- Glyph for PLI
- Dynamic Motion Flow
- Trident™ support for Cross-guard hilts
- Orientation based Mute-On-The-Boot™ & Mute-On-The-Go™
- Tangible, Accessory based on-the-fly sound font selection
- Crystal Chamber color profiles
- Spin Pitch Shifting
- 4 random boot sounds
- 4 channel color mixing
- StabFx™ (4 sounds)
- SpinFx™ (4 sounds)
- ComboFx™ (4 sounds)
- Dual digital sensor with Motion Fusion™
- Color configurable blade and Flash on Clash™
- Editable Glyph for the sound bank display in the menu (7 segment display + decimal point support)
- 8 accent LEDs
- Crystal Chamber specials
- Hum resume after fx
- Motion controlled sound bank selection (flick=next, bang=select)
- up to 12 sound fonts

**Why so long to get this release:**
I won’t extend much about my private life (not the place, not the goal) but I faced to major losses early this year. It clearly delayed a lot of things.
CFv9 firmware work was started in March but got postponed based on the amount of things we had to deal with and fix regarding the sad events and situation.
The hardware was sort of ready since then and we expected to have enough energy to get a release after the summer, around September. Now that we are beyond the storm, we could finalize some of the ideas that only got prototyped back in May and June, and get to the point.
We actually have more things to come but we decided to wrap up as much as we could in this one as a milestone, based on the fact the former CF8 motion sensor was discontinued, making hard the pursuit of the production of that version. On the brighter side (pun intended) the new motion sensor is even better, and faster.

**Availability & Pricing?**
Boards are already in production, we are wrapping up the default package (a couple of new sounds to make) and I need to finalize the user’s
manual, which I have spare time for... now! Everything should be ready for Christmas or early January worse case. No price change 😊

**No pixel love?**
We communicated several times about this: it makes no sense to sell a board with a current regulator for high-power leds, which both takes space and cost money for a feature that Pixel type blades don’t use. We do have a prototype of CF-LS but we think it deserves more work and experiments to be a nice & modular board. Also, it will inherits from a lot from CF9 and I wanted the code base to be mature before making a code port and avoid counter productive effort.

**Omnisabers:**
In the preparation of the upcoming Omnisaber dongle and software, we implemented all board events (like it was implemented for the Omnisaber firmware we designed for saberproject and their wireless system). All gestures, power on/off, color change etc are logged and sent out thru the RICE port.
We also added some remote control messages so that Omnisabers (or any remote device or program, via a Bluetooth dongle for instance). This way, you can remotely power the saber on and off, trigger the lockup and change color etc with just the ease of sending the saber some serial commands. It’s pretty neat when you want to control a saber as a decoration element in a home cinema room, when displayed on the wall, or on a mannequin.

**Color Profiles**
We did not just increase their number (now up to 16) we also added new and better ways to access / browse them.
We introduce Spectrum™: an saber orientation-based color profile selection menu, accessible on the fly while the saber is running. By triggering the safe and natural Aux+Act combination of switches, you get into the menu, then use the orientation of the hilt along with audio feedback to select your color profile, the exit with Aux.
It is configurable to use either the up/down axis of the hilt (referred as pitch axis) or the left/right (roll axis). Both give the feeling of a “dial-styled selector” and it allows for a fast and accurate browsing of the color profiles, which comes handy when you use 16. Using the pitch axis uses the blade as an “vu-meter needle” while the roll axis is reminiscent of a safe/vault combination dial knob.

So that you can still choose and combine, we added 4 modes to use either the legacy profile browsing or Spectrum. We also added a method to trigger the profile selection for those who use latching switches as Activator, combining the Aux with a rotation of the hilt.
Start / Forced Color Profiles
A good suggestion from Markus (Saberproject): remembering the latest used color profile in a font is useful sometimes, but for some users or sabers, you’d like to always start with a specific color when you boot the saber (kill key or reboot from deep sleep).

End of Lockup sound slot
Discussed formerly with Lord Blako, it’s a nice way to end the lockup no matter when you release it. Up to 4 sounds can be integrated; they are automatically played if part of the font, otherwise, the legacy system is used (return to hum). The idea behind it was to port the Blaster Core “End Shot” used in full-auto mode. The sound slot can be made of a specific part of the lockup, an energy glitch artefact or anything that suggest the blade contact removal (leading to the end of the lockup).

Power management & size:
We selected a new regulator is more efficient and allows for an even lower cut-off voltage of the board. While we still recommend to hack it to single cell (remove the regulator), the board runs until 3.7V (vs around 5V previously).
We also phased the new, lower ESR capacitors we started using with prizm to both reduce the size of the board which now fits in a 7/8” width.

Deep sleep
We ported the same deep sleep system as on the NB and Prizm. However, the additional components of the current driver cannot be powered down, so the deep sleep current is slightly higher than on a PZ or NB. We do reach however 0.3mA, estimated to 11 to 12 months of shelf time.

Power Saving modes
We preserved the legacy sleep mode of CF. Now the board uses 3 modes of power saving.

- 1) IDLE: this is when the blade is off. The board plays the accent sequence defined in the idle.txt file. The board uses about 50mA
- 2) After the sleep delay (in multiple of 20ms allowing now up to 994 days) elapses, the board will leave IDLE to go in the SLEEP mode. Accents will be turned off except the one that blinks here and there (font specific settings). The board still computes in that mode, detect motions and moves and will eventually revert the board back to IDLE when using the Wakeup feature. Aux and Act will also wake it up back to IDLE. In that mode the board uses about 10mA
- 3) After the deep sleep delay, the board will move from SLEEP to DEEP SLEEP and will stop computing. It can be started again by either the kill key or pressing the activator switch (not the aux, to
avoid jumping in the font selection menu right away). The board will then reboot from scratch. In this mode, it uses about 0.3mA.

**iSaber and Multitrack**

We actually introduced multitrack playback on CF back on v7 (2014) in the sound font selection menu (aka “Vocal Menu”) and it got added easily to iSaber (growing demand) as all the software infrastructure was already in place.

**So why not mixing everything on the fly?**

I get that question sometimes, but less than one would imagine. The answer is that my customer base is extremely attached to the realism of a lightsaber replica. This includes how it “feels” when you move it and when the sound comes out. My day job workplace (IRCAM) deals with real-time audio since the late 70’s, and when you play a digital musical instrument, you expect it to react and play the sound immediately. The time between the action and the resulting sound is called the latency, and the average accepted audio latency is around 10ms; not just in the state of the art literature. Personally, if I pick a guitar and process its sounds in a computer with more than 6-8ms of latency, I start feeling the bad sensation of having my notes off tempo, or on a delay effect.

For impact sensitive instruments like drums, it’s rather around 4-5ms, so you get really sensitive to what’s happening with your saber especially with clash (impact) sounds if the latency is too long.

Playing multitrack on the type of embedded hardware most of us use generates a lot of additional latency which leads to unwanted delay from the motion to the resulting sound. It’s both unrealistic and non-pleasing to the ear.

Latency is easy to measure (at least to have a ballpark): knock the hilt on the table facing a microphone that you record on the computer (just ensure the microphone is at the same distance between the board and the speaker to avoid propagation delay error). Then measure the time between the impact and the clash sound in the recorded audio using your favourite audio editor.

I used to do that on pretty much all my CF releases (and some of the other boards) then the latest measurements showed the 2 sounds were so close that I couldn’t have an accurate measurement (I got about 6ms with the method above).

So I brought the oscilloscope to the rescue, sent a trigger message when the motion is detected and looked at the sound signal, then measured the delay. I’ve used clash sound made of a 1 KHz square wave to visually “see” when the clash sound playback starts. I got a stunning 4.74ms.
I also ran the same measurements on iSaber multitrack playback and got 25ms, which exceed the real-time limit. Still it’s cool to have that feature implemented, but for the normal use of the saber (outside of the audio player), we prefer to preserve and ensure a smooth flow of motion and sounds versus high, unrealistic latency added to the saber experience and interaction.

But wait! Others do that! Maybe your board (or programming skills) isn’t capable of doing that properly!? Good question, I’m glad you ask, Paul Taylor! (It could be a catch 22…)

Also, one could tell me that their knobs go to 11, right? #spinaltap

Well, I did measure “others”, obviously. Older generation of boards from 2011 ranged around 60ms latency (6 times the real-time limit) while CF (v0.1 aka the “sound module”) was 8-10ms back in March 2006.
An old saber “actor” (recent comeback) showed a whooping 90ms in a teaser of his board. Then, in a very recent update, I measured 176ms delay on another board which is amazing and like being in a car accident while still having the time to get out of the car.

Such a latency is actually above the *visual* latency accepted in virtual reality, which is around 100ms (just above 2 frames, 80ms @25fps). So you actually “see” the latency, not just hear it. I wonder what would happen if people would play Doom-likes or CoD with such a latency and an Oculus Rift.

So yes, we (Plecterlabs) can do multitrack, and fast enough to minimize latency. Still, it’s not good enough to us when you can do better with another method which preserves the saber experience. We will use multitrack playback in applications / situations where latency isn’t critical for the interaction with the saber, like in the font selection menu, in the Spectrum™ color profile menu, or when it can be “tolerated” like in the Audio Player.
Future plans
We unfortunately didn’t have the time to include the iSaber configuration via RICE in this release but it’s planned for the next milestone.