

The logo features a white diamond shape centered on a dark gray background. The background is filled with a complex, light gray circuit board pattern, including various lines, circles, and rectangular shapes representing electronic components. Inside the white diamond, the text "Isik's Tech" is written in a bold, black, sans-serif font, with "Isik's" on the top line and "Tech" on the bottom line.

**Isik's
Tech**

AFC-Lite

Manual

Doc Version: v0.2

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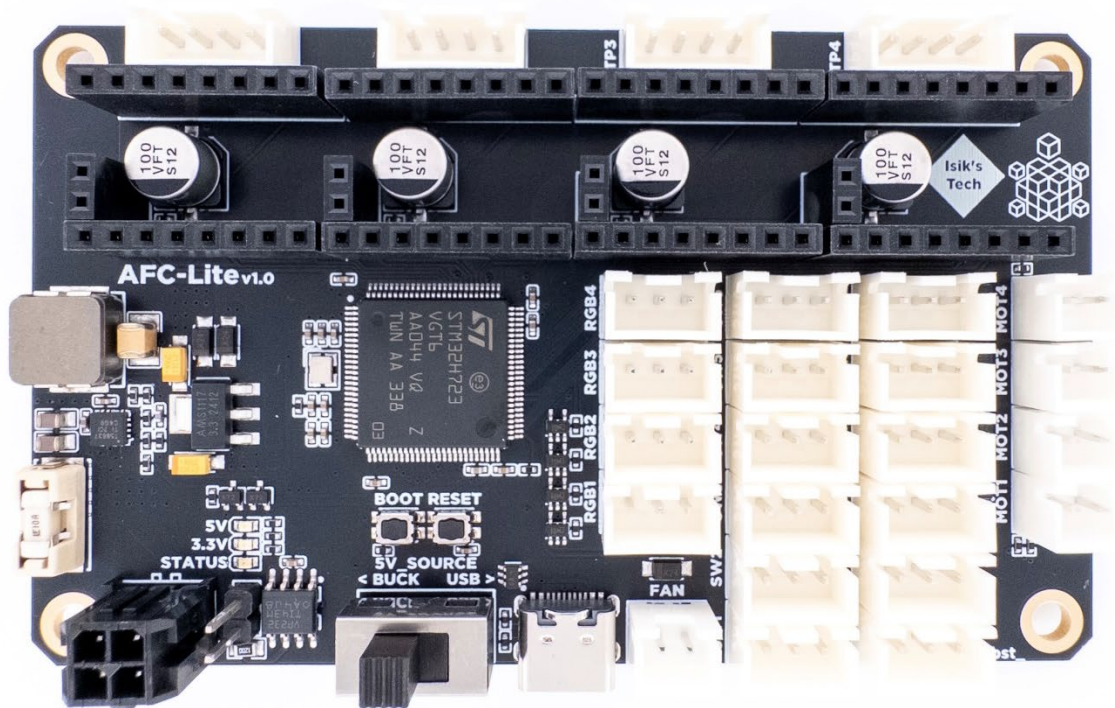
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AFC-Lite Features

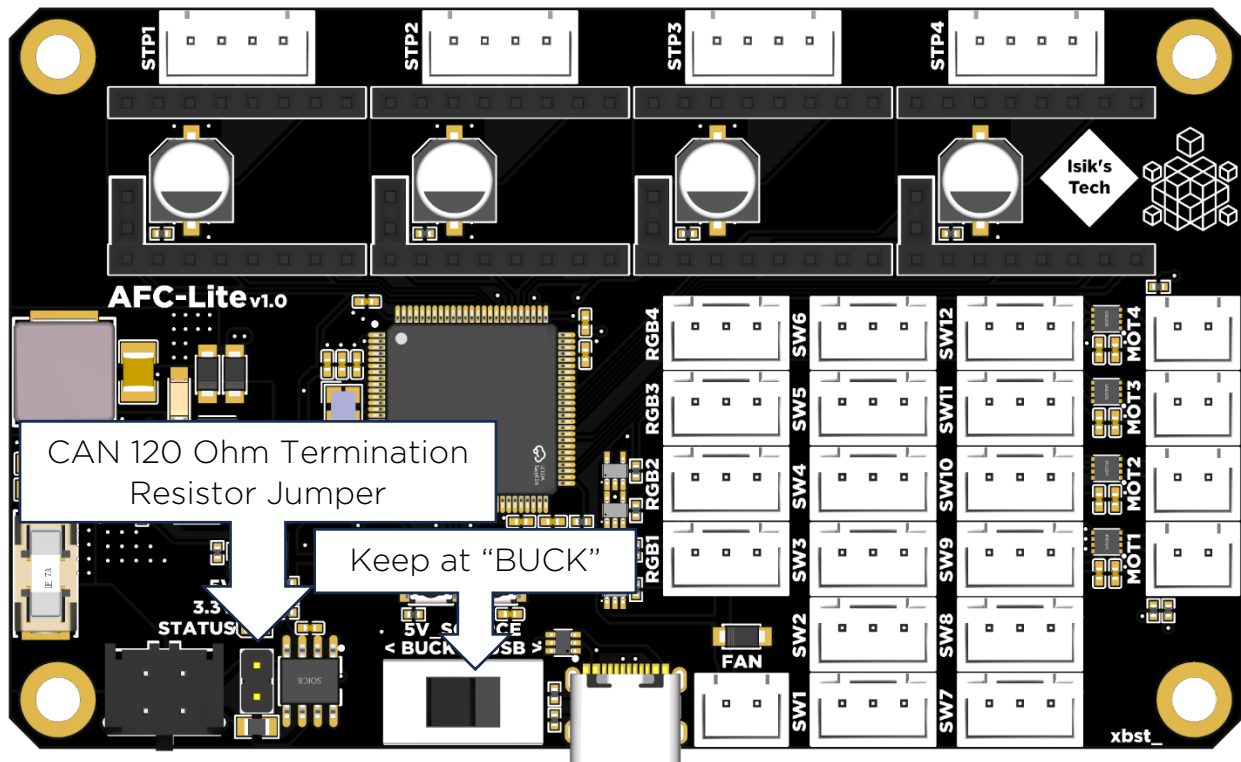
AFC-Lite is a controller PCB designed for Armored Turtle's Box Turtle multi-filament 3D printing system. It features:

- 4x Stepstick Slots for TMC2209-based Stepsticks
- 4x Brushed DC Motor Drivers
- 4x ARGB LED Connectors
- 12x Endstop Connectors
- 1x 5V Fan Connector (No Speed Control)
- STM32H723 MCU
- USB and CAN Support
- 5V Buck Converter

Pinout

Stepper Connectors			
BTT TMC2209 Stepsticks			
A	A	B	B
Standard Stepsticks			
B	A	A	B

Brushed Motor Connectors			
	SLP	IN1	IN2
MOT4	PD11	PD12	PD13
MOT3	PB13	PB14	PB15
MOT2	PA5	PA6	PA7
MOT1	PA2	PA0	PA1



MX3.0 Connector	
24V IN	GND
CAN H	CAN L

Fan Connector	
+5V	GND

ARGB LED Connectors			
Pinout			
GND	Data		+5V
Data Pins			
RGB1	RGB2	RGB3	RGB4
PE14	PE15	PB10	PB11

Switch Connectors			
Pinout			
Data	GND		+3.3V
Data Pins			
SW1	SW2	SW3	SW4
PC4	PC5	PB0	PB1
SW5	SW6	SW7	SW8
PB2	PE7	PE8	PE9
SW9	SW10	SW11	SW12
PE10	PE11	PE12	PE13

Firmware Flashing (CAN with Katapult)

First of all, make sure CAN is already set up on your printer. You can follow Esoterical's guide here: <https://canbus.esoterical.online/>

1. Connect the AFC-Lite to CAN, power and USB, turn it on.
2. SSH into Pi.
3. Install Katapult using `git clone https://github.com/Arksine/katapult.`
4. Go to `~/klipper`, do a `make clean`, then `make menuconfig`, use the Klipper settings in the beginning of the next page, then `make`.
5. Go to the Katapult directory `cd ~/katapult/`, do a `make clean`, then `make menuconfig`, use the Katapult settings below, then `make`.
6. On the AFC-Lite, hold the BOOT button. While holding it press and release the RESET button, then release the BOOT button.
7. Use `lsusb` to verify that your AFC-Lite is in DFU mode.
8. Flash Katapult using `sudo dfu-util -a 0 -d 0483:df11 --dfuse-address 0x08000000:leave -D out/canboot.bin`.
9. Use `~/klippy-env/bin/python ~/klipper/scripts/canbus_query.py can0` to find AFC-Lite's UUID. It'll say Canboot next to it.
10. Flash Klipper using `cd ~/katapult/scripts && python3 flashtool.py -i can0 -f ~/klipper/out/klipper.bin -u <uuid>`, replace `<uuid>` with your AFC-Lite's UUID.

Katapult settings:

```
Micro-controller Architecture (STMicroelectronics STM32) --->
Processor model (STM32H723) --->
Build Katapult deployment application (Do not build) --->
Clock Reference (25 MHz crystal) --->
Communication interface (CAN bus (on PB8/PB9)) --->
Application start offset (128KiB offset) --->
(1000000) CAN bus speed
() GPIO pins to set on bootloader entry
[*] Support bootloader entry on rapid double click of reset button
[ ] Enable bootloader entry on button (or gpio) state
[ ] Enable Status LED
```

Klipper settings:

```
[*] Enable extra low-level configuration options
    Micro-controller Architecture (STMicroelectronics STM32) --->
    Processor model (STM32H723) --->
    Bootloader offset (128KiB bootloader) --->
    Clock Reference (25 MHz crystal) --->
    Communication interface (CAN bus (on PB8/PB9)) --->
(1000000) CAN bus speed
() GPIO pins to set at micro-controller startup
```

Firmware Flashing (USB)

1. Make sure 5V_SOURCE switch is flipped to “BUCK”.
2. Connect the AFC-Lite to power and USB, turn it on.
3. SSH into Pi.
4. Go to `~/klipper`, do a `make clean`, then `make menuconfig`, use the settings below, then `make`.
5. On the AFC-Lite, hold the BOOT button. While holding it press and release the RESET button, then release the BOOT button.
6. Use `lsusb` to verify that your AFC-Lite is in DFU mode.
7. Flash Klipper using `make flash FLASH_DEVICE=0483:df11`.
8. Use `ls /dev/serial/by-id/*` to find your AFC-Lite’s serial address.

```
[*] Enable extra low-level configuration options
    Micro-controller Architecture (STMicroelectronics STM32) --->
    Processor model (STM32H723) --->
    Bootloader offset (No bootloader) --->
    Clock Reference (25 MHz crystal) --->
    Communication interface (USB (on PA11/PA12)) --->
    USB ids --->
() GPIO pins to set at micro-controller startup
```

5V_SOURCE Switch

This switch should be kept at the “BUCK” position during regular operation. Flipping this switch to “USB” makes MCU draw its power from the USB C cable, which can be useful for firmware flashing in certain scenarios (when there isn’t a convenient 24V source). In this mode, the PCB won’t be fully functional. Brushed motors and ARGB LEDs are wired to only draw power from the 5V buck converter on the PCB to not draw too much power from the USB C cable.

Klipper Config

Klipper config and other software needed can be found on Armored Turtle’s AFC Klipper Add-on GitHub repository:

<https://github.com/ArmoredTurtle/AFC-Klipper-Add-On/>

Troubleshooting

1. Do I need to connect 24V and GND to the MX3.0 connector if I’m using USB?

Yes. The USB C connector is only used for data. You need to connect 24V power and GND to the MX3.0 connector even if you’re not using CAN. Also, make sure the 5V_SOURCE switch is flipped to “BUCK”.

2. I’m able to connect to the PCB with USB but brushed motors and RGB LEDs aren’t working.

Make sure to flip the 5V_SOURCE switch to “BUCK”. If still not working, make sure 24V power and GND are connected to the MX3.0 connector and pins under the 5V_SOURCE switch aren’t shorted.

3. Klipper can’t communicate with my SPI-based stepsticks.

AFC-Lite only fully supports UART stepsticks, like TMC2209s. You can use other stepsticks too, but only in STEP/DIR mode.

4. [Insert CAN-related issue here]

Esoterical has a great CAN bus guide, I recommend checking it out for more information: <https://canbus.esoterical.online/>

5. Do I need to use Katapult if using CAN?

No. However it makes firmware flashing much easier. To avoid confusion, this manual only covers CAN with Katapult.

Debugging

The SWDIO and SWCLK pads on the back side of the PCB can be used for debugging purposes, with an ST-Link. You will likely also need to use the 3.3V, GND and NRST pads, located next to each other.

Specs

Connectors	MX3.0 CAN/VIN XH for the rest
VIN	24V 10A Fused
5V Buck Converter	Texas Instruments TPS56637 5V@6A
Brushed Motor Driver	Texas Instruments DRV8837 Max 1.8A Peak
MCU	STM32H723 550 MHz 1M Flash
Stepstick Slots	4
Brushed Motor Drivers	4
ARGB LED Ports	4
Endstop Ports	12
Fan Ports	1 (No Speed Control)

Schematic

Schematic can be found on the GitHub repo:

https://github.com/xbst/AFC-Lite/blob/master/Docs/AFC-Lite_Schematic.pdf



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