Hackaday link: <https://hackaday.com/2023/02/27/diy-stm32-scope-is-simple-cheap-and-featureful/>

Details found here: <https://github.com/tvlad1234/pillScopePlus/blob/main/README.md>

STM32 details: <https://stm32world.com/wiki/Black_Pill>

STM32 datasheet: <https://www.st.com/en/microcontrollers-microprocessors/stm32f103c8.html>

STM32 supplier: <https://www.st.com/en/microcontrollers-microprocessors/stm32-32-bit-arm-cortex-mcus.html>

Digikey link: <https://www.digikey.com/en/products/detail/dfrobot/DFR0864/14824968?utm_adgroup=&utm_source=google&utm_medium=cpc&utm_campaign=PMax%20Shopping_Product_Low%20ROAS%20Categories&utm_term=&utm_content=&utm_id=go_cmp-20243063506_adg-_ad-__dev-c_ext-_prd-14824968_sig-Cj0KCQiAmNeqBhD4ARIsADsYfTdYYcXOZ8Kv5Gb4WTHTx63hXoMCaEihIsbF92qegU7Zhxu1bXaAuSQaApotEALw_wcB&gad_source=1&gclid=Cj0KCQiAmNeqBhD4ARIsADsYfTdYYcXOZ8Kv5Gb4WTHTx63hXoMCaEihIsbF92qegU7Zhxu1bXaAuSQaApotEALw_wcB>

Flash SW: <https://www.youtube.com/watch?v=VlCYI2U-qyM>

Digital Storage Oscilloscope built with:

* Microcontroller: STM32F401 Black Pill
* Screen: TFT (thin-film-transistor) LCD (liquid-crystal display)

Specs

* Input range: -3.3 to 3.3V (increased if using attenuation probes
* Sampling rate: 1.6 MSamples/second

Captured waveforms communication to computer:

* UART (universal asynchronous receiver/transmitter) protocol for data transmission
* Data sent in csv format
* Data from ADC pulled into the memory buffer. DMA (direct memory access of microcontoller) transfer every time ADC is triggered.

Required Parts

* STM32F401CC Black Pill development board
* 128x160 ST7735-based TFT display
* 3 pushbuttons
* LM358 dual op-amp (rail-to-rail opamps should work better in this context, but this is what I had on hand)
* 2x 68kOhm resistors (to create a 1.65V offset voltage)
* 2x 500kOhm resistors (to create the input attenuator)

Optional Parts

* a 5V power supply
* an opto-isolated (an electronic component that transfers electrical signals between two isolated circuits by using light) USB UART adapter
* a BNC connector, for using proper oscilloscope probes

Flash tutorial: <https://diy.electromds.com/2021/11/how-to-update-dso138-oscilloscope.html>

Firmware: <https://jyetech.com/firmware-dso-138/>

YT tutorial: <https://www.youtube.com/watch?v=VlCYI2U-qyM>

A ton of resources from Jimmy 3/1:

* <https://www.instructables.com/HackerBox-0064-Scope/> Modded 138
* <https://jyetech.com/dso-138-oscilloscope-diy-kit/> JYE 138 resources
* <https://github.com/ardyesp/DLO-138> Github Firmware
* <https://jyetech.com/wp-content/uploads/2018/07/dso138-firmware-upgrade.pdf> JYE Firmware guide
* <https://foxbotindustries.com/how-to-use-a-simple-oscilloscope/> Simple button guide
* <https://jyetech.com/wp-content/uploads/2018/07/dso138-user-manual-13803k-13804k.pdf> digital manual
* <https://www.reddit.com/r/hackerboxes/comments/m19rp2/modded_the_dso_138_about_as_far_as_i_could_push/> Talks about the hacker box
* <https://github.com/ardyesp/DLO-138> Github Firmware
* <https://github.com/dpavlin/DLO-138> Github Firmware
* <https://tomeko.net/projects/dso138/index.php?lang=en> Awesome website describing above firmware

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* <https://github.com/ardyesp/DLO-138/blob/76747fe012a734dbeff00645211df16facb4e48f/>
  + This one has additional files for the compilation of STM32F103C8
* <https://github.com/tvlad1234/pillScope>

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* We purchased the bluepill ([STM32F103C8T6](https://www.st.com/en/microcontrollers-microprocessors/stm32f103c8.html))