GIVERNyLABS

Feather M4 Frequency Counter and RTC

DESCRIPTION (dual channel appliance)

You have always wanted an extremely accurate, programmable Feather M4 frequency counter and RTC?

It measures frequencies from 1 Hz up to 175 MHz using dedicated counters with a fantastic accuracy of ±5Hz at measurement frequency 1MHz (±5 ppm) and it provides a high-precision RTC clock. The frequency meter is available in two versions featuring 1 or 2 independent measuring channels. It is powered with the 120MHz ATSAMD51J19 Cortex M4 CPU with floating point support, 512KB Flash and 192KB RAM. There is therefore a lot of computing power available to process, analyze or compare measurement results with all possible applications at high speed.

And best of all, it's Feather M4 compatible. So you know it will work with all FeatherWings! You can use it with the Arduino IDE - and it's bonkers fast when you do. What a great way to quickly get up and running.

You can stack the FeatherWing 128*64 OLED display on top of it to display the frequency measuring. Or attach an external display like the Adafruit 3.5" 320x480 Color TFT Touchscreen by using the SPI ports. Or you can use it as an I2C appliance to front end any microcomputer e.g. the raspberry with frequency counter capabilities.

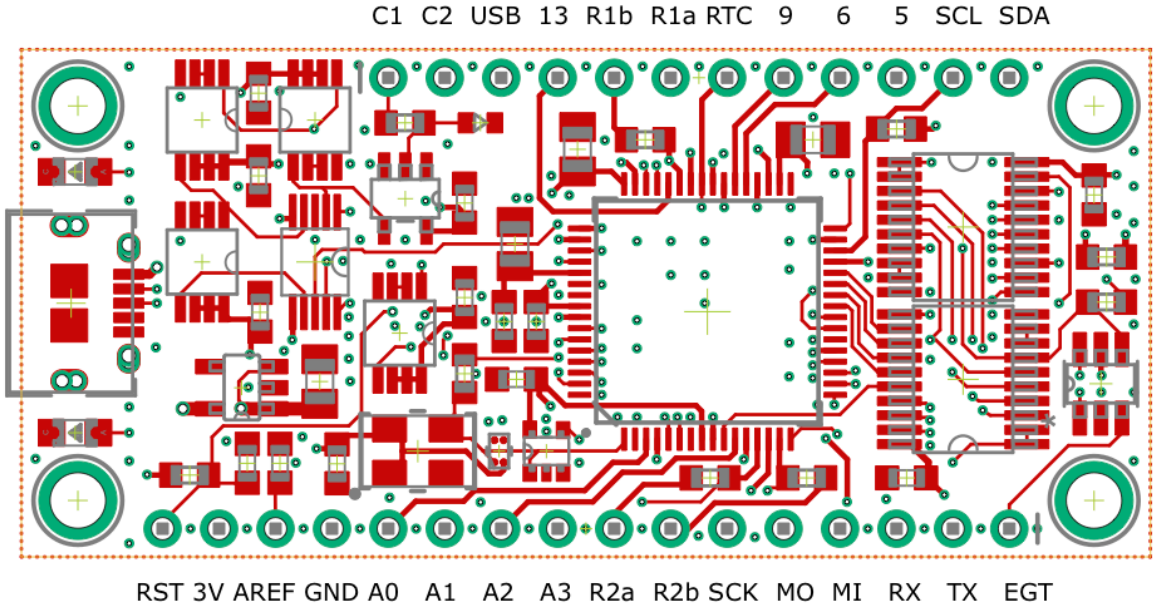
- 1 or 2 (depending on the version) independent frequency measuring channels up to 175Mhz with a accuracy of ±5 ppm and without glitches
- The board is using dedicated counters independent from the ATSAMD51J19 CPU
- The IO frequency measuring input ports support 3.3V and are 5V tolerable by using a Schmitt Trigger input buffer
- Any signal shape can be measured (rectangle, sine, sawtooth)
- 1 second standard gate time for the most precise measurement results
- Alternatively variable gate time by using the on board TXCO or any external timer, e.g. if you need shorter gate timing for faster measurement
- 1 Hz and 32.768 kHz extremely accurate real-time TXCO based reference clock (RTC)
- 32.768 kHz ±5 ppm all-inclusive frequency stability with a TCXO using an integrated temperature-compensated MEMS resonator
- The TCXO is factory calibrated (trimmed) over multiple temperature points to guarantee extremely tight frequency stability over temperature (-20°C to +70°C)
- First Year Frequency Aging only ±1 ppm
- Low integrated phase jitter (IPJ) suitable for multiplying up for portable audio: 2.5 nsRMS
- Measures 2.0" x 0.9" x 0.28" (50.8mm x 22.8mm x 7mm) without headers soldered in
- Light as a (large?) feather
- ATSAMD51 32-bit Cortex M4 core running at 120 MHz, 32-bit, 3.3V logic and power
- Floating point support with Cortex M4 DSP instructions

- 512 KB flash, 192 KB RAM
- Arduino IDE but no CircuitPython support in contrast to the standard Feather M4
- No EEPROM, QSPI Flash and NeoPixel in contrast to the standard Feather M4
- 3.3V regulator with 400mA peak current output
- USB native support, comes with Feather M4 USB bootloader and serial port debugging
- Built in crypto engines with AES (256 bit), true RNG, Pubkey controller
- Tons of GPIO! 16 x GPIO pins with following capabilities:
    - Dual 1 MSPS 12 bit true analog DAC (A0 and A1)
    - Dual 1 MSPS 12 bit ADC (6 analog pins some on ADC1 and some on ADC2)
    - 6 x hardware SERCOM - Native hardware SPI, I2C and Serial all available
    - 11 x PWM outputs - for servos, LEDs, etc
    - Pin #13 red LED for general purpose blinking
    - 4 mounting holes

When measuring high frequencies in the MHz range, it is important to use suitable cables with the correct termination in order to avoid reflections and crosstalk. This board is using the PIN Header Connector for the frequency measuring input. Please note that at high frequencies in the MHz range, pin connectors (especially in connection with breadboards) provide less protection than SMA connectors with regard to reflections, parasitic capacitances and crosstalk. For this reason, we recommend that you do not measure frequencies above 50 MHz when using both counters at the same time.

USB cable not included.

PINOUTS



Power Pins

- **GND** - this is the common ground for all power and logic
- **USB** - this is the positive voltage to/from the micro USB jack if connected
- **3.3V** - this is the output from the 3.3V regulator, it can supply 400mA peak (cannot be disabled)

Logic Pins

This is the general purpose I/O pin set for the microcontroller. All logic is 3.3V. Nearly all pins can do PWM output. All pins can be interrupt inputs. Please note that some Logic PINs are reserved for the frequency counter capabilities and are only available to a limited extent for general purpose I/O. For your convenience these ports with a different characteristic compared to the standard Feather M4 Express board are colored blue. Different to the standard Feather M4 the I/O ports do not support I2S (Inter-IC Sound) and Parallel Capture Peripheral.

- #0 / RX - GPIO #0, also receive (input) pin for Serial1 (hardware UART). Also PWM out
- #1 / TX - GPIO #1, also transmit (output) pin for Serial1. Also PWM out
- SDA - the I2C (Wire) data pin. There's a 10K pull up resistor on this pin by default. When using with I2C, you may need down to 2.2K pull up. Also GPIO #21. Also PWM out
- SCL - the I2C (Wire) clock pin. There's a 10K pull up resistor on this pin by default. When using with I2C, you may need down to 2.2K pull up. Also GPIO #22. Also PWM out
- #4 / EGT - GPIO #4, PWM out. This pin can be alternatively used if the frequency counter is to be controlled with an external gate time.
- #5 - GPIO #5, PWM out
- #6 - GPIO #6, PWM out
- #9 - GPIO #9, PWM out
- #10 / RTC - TXCO 32.768 kHz clock output. Cannot be used for general purpose I/O (because this port is not standard Feather M4 it is short protected through a 2.2k series resistor).
- #11 / FR1 - Selection of the frequency range (because this port is not standard Feather M4 it is short protected through a 470 Ohm series resistor).
- #12 / FR2 - Selection of the frequency range (because this port is not standard Feather M4 it is short protected through a 470 Ohm series resistor).
- #13 - GPIO #13, PWM out and is connected to the red LED next to the USB jack
- SCK/MOSI/MISO - These are the hardware SPI pins, you can use them as everyday GPIO #25/#24/#23 pins (but recommend keeping them free as they are best used for hardware SPI connections for high speed.)

Analog Pins

- A0 - This pin is analog input A0 but is also an analog output due to having a DAC (digital-to-analog converter). You can set the raw voltage to anything from 0 to 3.3V, unlike PWM outputs this is a true analog output
- A1 - This pin is analog input A1 but is also an analog output due to having a DAC (digital-to-analog converter). This is the second DAC, and is 'independent' of A0. You can set the raw voltage to anything from 0 to 3.3V, unlike PWM outputs this is a true analog output. Also can do PWM.
- A2 thru A3 - These are each analog input as well as digital I/O pins. These pins can also do PWM.
- A4 / FR3 - Selection of the frequency range (because this port is not standard Feather M4 it is short protected through a 470 Ohm series resistor).
- A5 / FR4 - Selection of the frequency range (because this port is not standard Feather M4 it is short protected through a 470 Ohm series resistor).

Frequency Counter Pins

- C1 – (the standard Feather BAT pin) the frequency measuring input pin for Frequency Counter 1. It supports 3.3V and is 5V tolerable. Frequency measuring up to 175Mhz for any signal shape (rectangle, sine, sawtooth) by using a Schmitt Trigger input buffer.
- C2 – (the standard Feather En pin) the frequency measuring input pin for Frequency Counter 2. It supports 3.3V and is 5V tolerable. Frequency measuring up to 175Mhz for any signal shape (rectangle, sine, sawtooth) by using a Schmitt Trigger input buffer.
- R1a (the standard Feather M4 GPIO #11 pin) - Selection of the frequency range for Frequency Counter 1.
- R1b (the standard Feather M4 GPIO #12 pin) - Selection of the frequency range Frequency Counter 1.
- R2a (the standard Feather M4 A4 pin) - Selection of the frequency range Frequency Counter 2.
- R2b (the standard Feather M4 A5 pin) - Selection of the frequency range Frequency Counter 2.
- EGT (the standard Feather M4 GPIO #4) - This input pin can be used if the frequency counter is to be controlled with an external gate time.
- RTC (the standard Feather M4 GPIO #10 pin) - TXCO 32.768 kHz RTC output.

Other Pins

- RST - this is the Reset pin, tie to ground to manually reset the ATSAMD51, as well as launch the bootloader manually
- AREF - the analog reference pin. Normally the reference voltage is the same as the chip logic voltage (3.3V) but if you need an alternative analog reference, connect it to this pin and select the external AREF in your firmware. Can't go higher than 3.3V!

DEBUGGING INTERFACE

If you'd like to do more advanced development, trace-debugging, or not use the bootloader, we have the SWD interface exposed. You'll have to solder to the two SWD/SWCLK pads on the bottom.

ASSEMBLY

We ship the Feather M4 frequency counter and RTC fully tested but without headers attached - this gives you the most flexibility on choosing how to use and configure your Feather. For the header options and how to assemble the header please note the Feather M4 Express product brief.

ARDUINO IDE SETUP AND USING WITH ARDUINO IDE

At this point we refer to the Feather M4 Express product brief too.

ARDUINO CODE

The Feather M4 frequency counter and RTC is well supported by dedicated software including a library and example code.

The Feather M4 frequency counter and RTC with Arduino sketches requires one library to be installed: Giverny_Feather_M4_FC, which handles the frequency counter. Libraries can be found at: giverny-labs.com/downloads

Run Example Code
We have basic demos that works with the Feather M4 frequency counter and RTC. So please download/compile/upload a sketch. Demo sketches can be found at: giverny-labs.com/downloads

CONSULTING SERVICES

Based on your wishes and requirements, we will be happy to advise you on the configuration and programming of the Frequency Synthesizer & Jitter Cleaner Board or create customer-specific hardware and software solutions.

We look forward to hearing from you at:

GIVERNyLabs
Schindellegistrasse 73
8808 Pfäffikon (SZ)
Switzerland
office@Givernylabs.com

