WILDERNESS LABS

Meadow F7v2

Datasheet

Draft: 2022 March 08

Description

The Meadow F7 is a workhorse Wi-Fi and Bluetooth enabled System-on-Module (SoM) microcontroller-based board designed for sophisticated IoT applications and is based on the STMicroelectronics STM32F7 microcontroller (MCU) with an Espressif ESP-32 coprocessor.

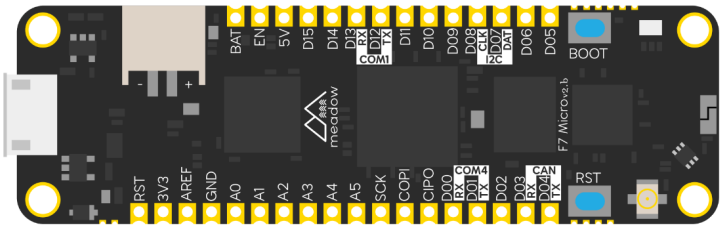
The Meadow F7 is provisioned with Meadow.OS which runs full .NET Standard v2.1 applications and can be managed remotely via Meadow.Cloud with secure, over-the-air (OtA) updates, reliable push messaging, and device and application health monitoring over a Wi-Fi or ethernet (F7 Production model only) network.

For complete Meadow documentation, please refer to our documentation site.

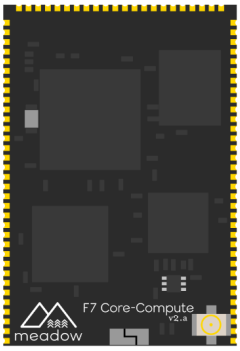
Models

The Meadow SoM is available in two models, based on two differing form factors:

- **Meadow F7v2 Feather Module** - An Adafruit Feather specification compatible design, intended for development, prototyping, and low-volume (1,000 or less) production.
- **Meadow F7v2 Core-Compute Module**- A surface mount device (SMD) intended for high-volume and industrial production, the F7 Production also adds Ethernet and SD card capabilities.



Dev Module



Core-Compute Module

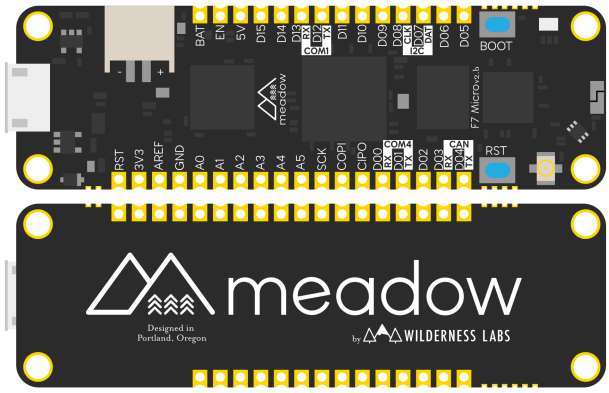
Features

- Fully Surface Mount Technology (SMT) compatible. Both modules can be used in SMD designs without the need for through-hole (PTH) soldering.
- STMicroelectronics STM32F7 32-bit ARM Cortex-M7 based core MCU at up to 216MHz
    - 2MB internal Flash memory
    - 412Kb internal RAM
    - 2D Graphics Acceleration (DMA2D) via *ST Chrom-ART Accelerator*
    - Internal, low-power realtime clock (RTC)
    - Cryptographic Hardware Acceleration for AES 128, 192, 256, triple DES, HASH (MD5, SHA-1, SHA-2), and HMAC
    - True random number generator
    - Floating point unit (FPU)
    - *Secure Boot* secure, encrypted firmware loader
- Espressif ESP32 (ESP-Pico-D4) Xtensa 32-bit dual-core LX6 up to 240MHz coprocessor.
    - 2.4GHz WiFi 802.11 b/g/n with WFA, WPA/WPA2 and WAPI
    - Bluetooth 4.2, 5.1
- 64MB external, onboard QSPI RAM
- 32MB external, onboard non-volatile Flash memory (~28MB available for user code)
- 25 Mixed Signal IO ports (6/8x Analog, 12x PWM, 3x UART, I2C, SPI, CAN, 2x DAC)

- On-board 2.4GHz ceramic chip antenna
- U.FL external antenna connector
- RoHS compliant (lead and hazardous materials-free)

Meadow F7 Micro Features

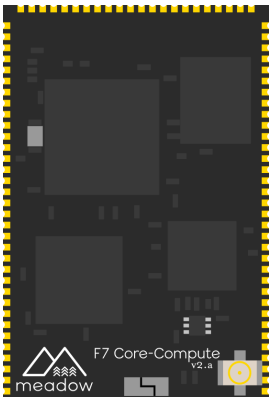
The Meadow F7 Micro model has additional onboard features designed to make developing and prototyping easier.



- Reset and Boot buttons
- Onboard user-accessible RGB LED
- Micro USB 3.0 with USB On-the-Go (OTG)
- Integrated 3.7V LiPo/LiIon battery charging and JST-PH 2-pin battery connector
- Can be powered via standard USB, or 5V/3V3 rails
- Integrated switching power supply capable of providing 800mA when powered from USB or 5V rail
- SMT and PTH compatible

Meadow F7 Core-Compute Features

The Meadow F7 Core-Compute model is designed to be an easy upgrade path to production volume solution, or for when Ethernet and an external SD card interface is required.



- Ultra-small Surface Mount Device (SMD) form factor.
- External SD Card interface
- Dual-Port External Ethernet interface

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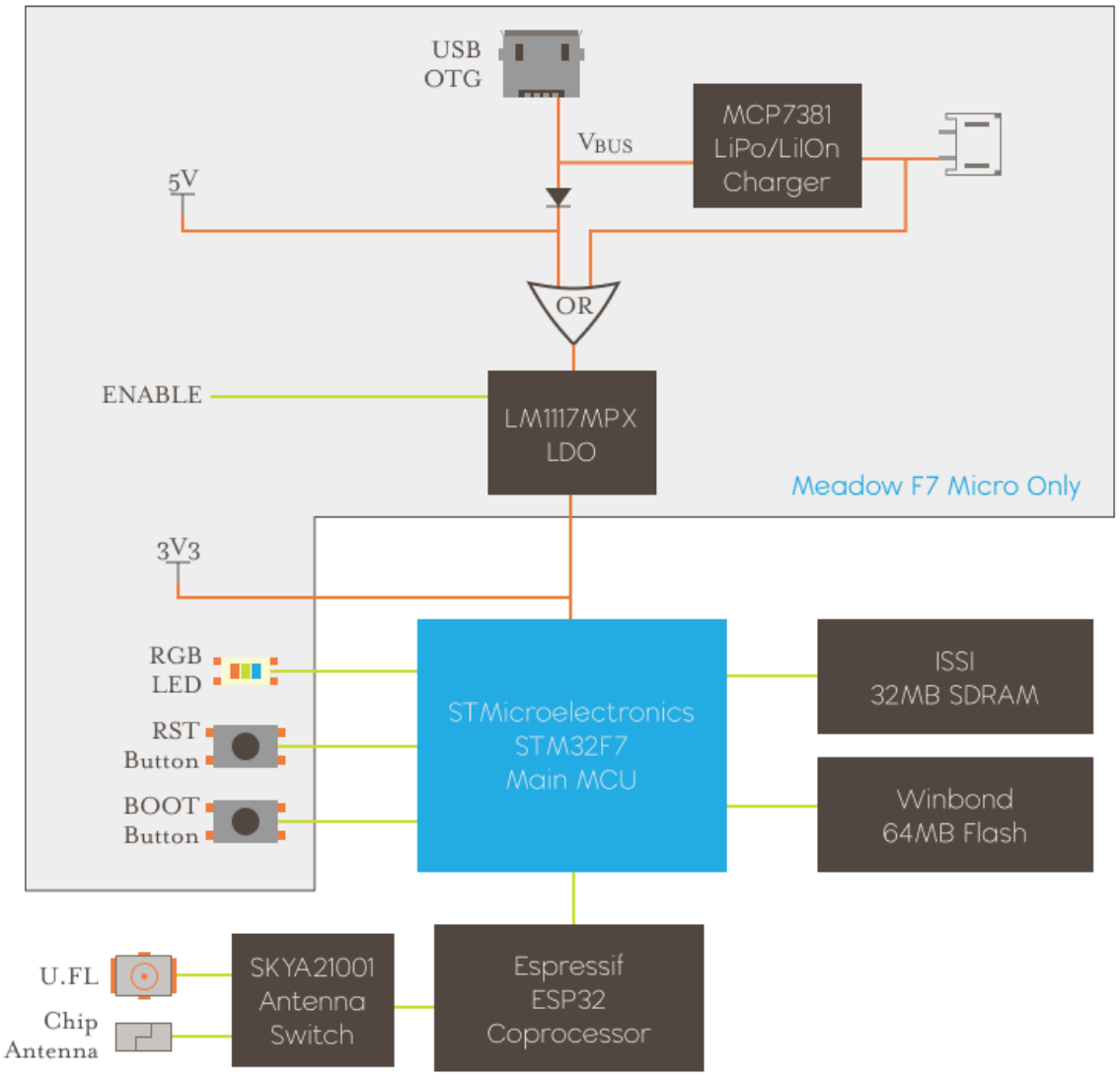
Hardware Interfaces

Meadow F7 Block Diagram



Power

The F7 Micro has onboard power features not present on the embedded version, including an LDA and battery charging circuit.

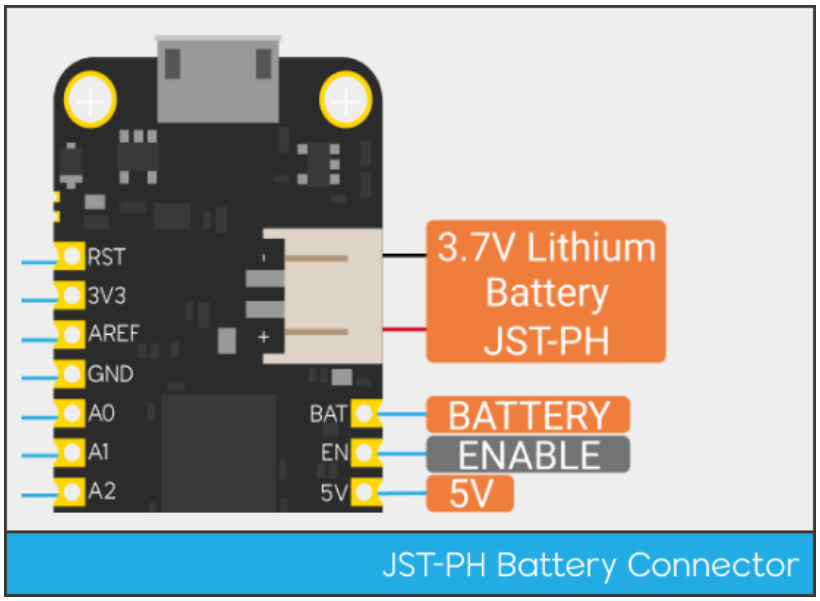
Meadow F7 Micro

The Meadow F7 Micro development board is designed such that it can be powered by supplying the appropriate voltage to either the USB connector, or the 5V or 3.3V power rails.

LiPo, LiIon Battery Charging

Supplying voltage via either the USB connector or 5V rail is effectively the same; it will output 3.3V on the 3V3 power rail, and enable the battery charging circuit, which will charge any standard 3.7V LiPo/LiIon battery.

To use a battery, you can either hook it to the JST-PH battery connector, or wire it directly to the VBAT and GND pins on the header. Both Adafruit and SparkFun have a good selection of LiPo/LiIon batteries that will work.



The battery charging circuit will supply a battery with up to 200mA of current (at up to 4.2V).

If you supply voltage only to the 3.3V power rail, the board will operate as expected, but the battery charging circuit will not be enabled and the 5V power rail will only be at 3.3V.

Charge Status LED

When charging, the yellow charge status LED next to the JST-PH connector will light up.

Meadow F7 Production

Unlike the Meadow F7 Micro SoM, the F7 Production SoM doesn't include onboard power regulation or battery charging circuit. It must be supplied with at least 500mA of available current on the 3V3 pin.

Power Budget

The Meadow F7 and IOs are intended to operate on a combined maximum power budget of ~500mA with 400mA reserved for onboard functionality including both MCUs, RAM, and flash. This leaves, at a minimum, 100mA for peripherals, including anything drawing power from the IOs on the board.

Peripheral Usage

In addition to the overall power budget, the amount of power being delivered to peripherals via the IO pins must be considered. There is both an overall maximum that the MCU can drive, as well as a per pin maximum.

On the Meadow F7, there is a 25mA per IO maximum, and a total maximum of 120mA.

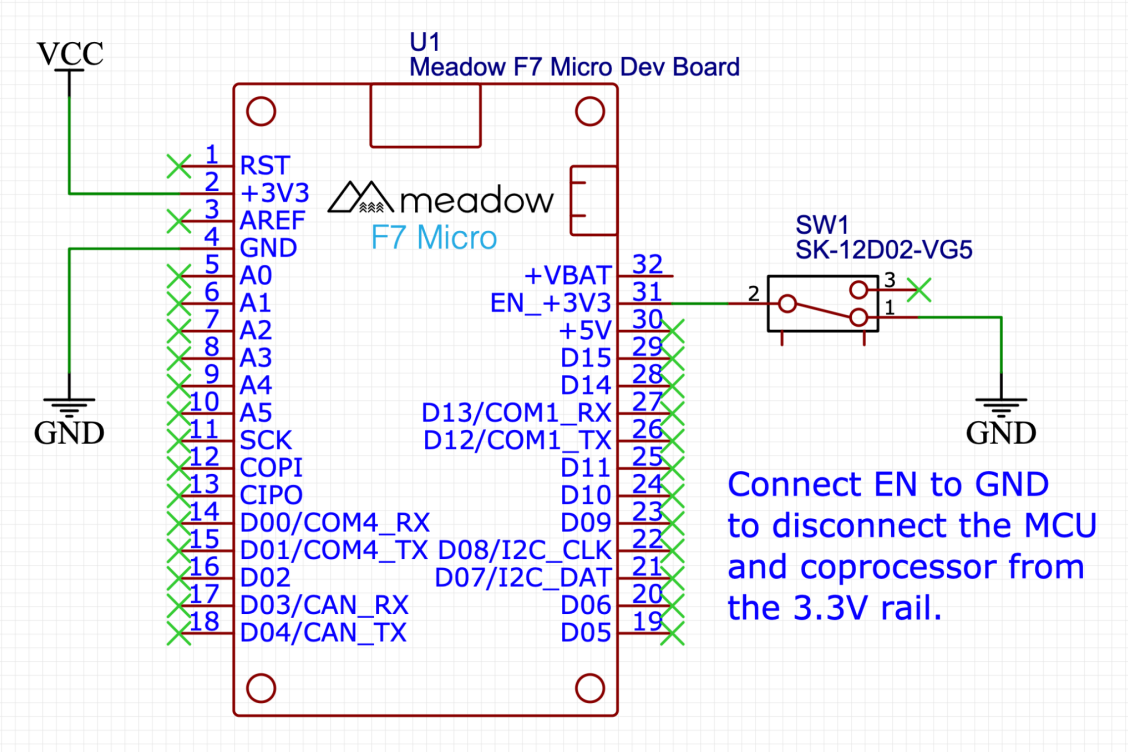
For additional information on supplying and using power on the Meadow F7 boards, including using solar panels, please refer to the Power guide on the Meadow documentation site.

Battery (BAT) Pin

The battery pin (BAT) provides an alternative positive terminal connection for an external battery or power source to the built-in JST-PH battery connector. If using the BAT pin, make sure to tie the negative terminal of the battery to the board ground (GND).

Enable (EN) Pin

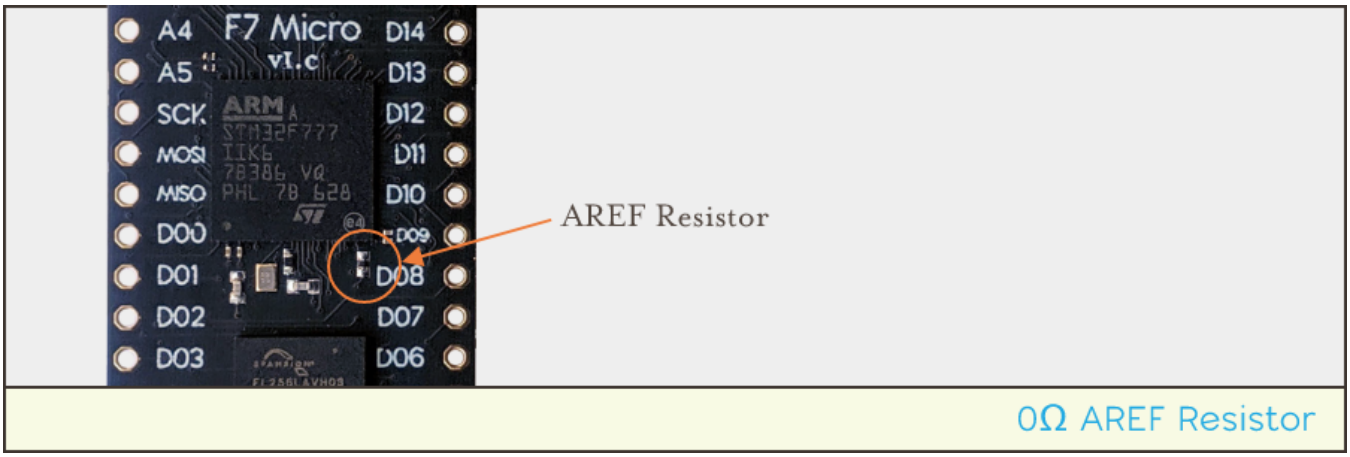
The enable pin (EN) serves as a power switch for the board. By default, it is pulled HIGH (3.3V), but when pulled LOW (0V), it will disconnect most of the power to the MCU. However, it will not disconnect backup power to the MCU, so that it will keep the RTC going and keeping time. The following schematic illustrates a sample application with a switch controlling the EN pin:



Analog Reference (AREF) Pin

The analog reference (AREF) pin provides a reference voltage for the Analog to Digital Converter (ADC) to compare against. Typically, this should be supplied with 3.3V, so as a

convenience, the AREF pin is actually connected to the 3.3V rail via 0Ω resistor that is located next to the D08 pin, just below the main MCU:



If you need to provide a different analog reference voltage, make sure to remove that resistor before hooking AREF to your voltage reference.

Reset (RST) Pin

The reset pin is used to do an MCU system reset. If you pull this pin LOW (to GND) momentarily, the MCU will reboot, clearing out it's volatile registers. The RST button on the board does exactly this.

Note that as long as the board still has power, the RTC will continue to keep time without resetting.

Real-Time Clock (RTC)

The STM32F7 is equipped with a real-time clock (RTC), which, when set, will retain the system time as long as the board has power. If the board will have intermittent power, as when powered by a solar panel, having a battery hooked up to the board will ensure the RTC will not lose the time.

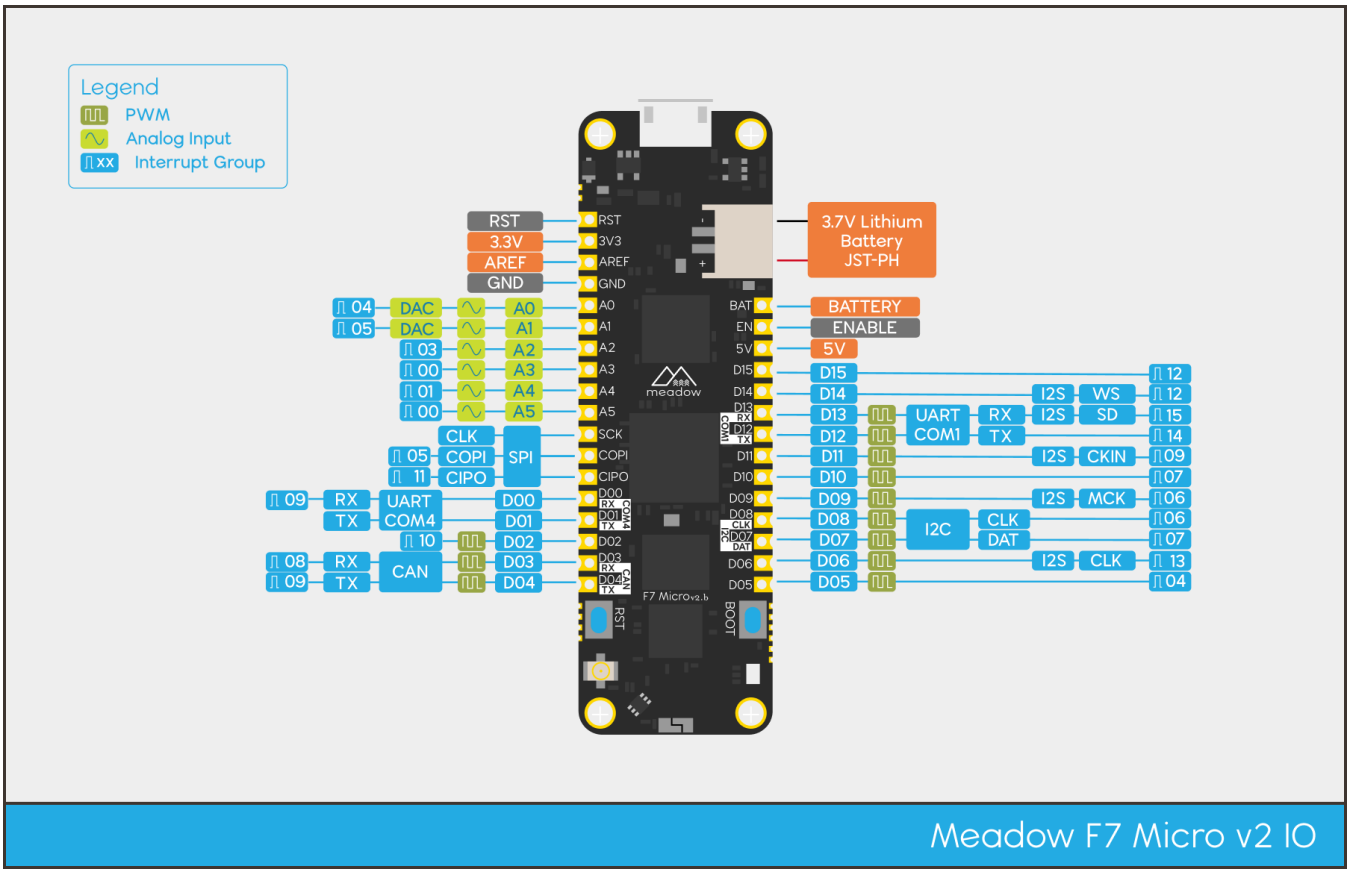
Antenna

There is an onboard ceramic chip antenna and a U.FL connector for an external antenna for the 2.4GHz WiFi and Bluetooth radio. Additionally, there is a [SKY] antenna switch for switching between the two; by default, the chip antenna is selected, and you must use the Meadow.OS device API to switch to the external antenna.

For more information, see the Antenna guide.

Peripherals and IO Pinout

Both Meadow F7v2 Feather and F7 Core-Compute share a nearly identical pinout which provides an easy upgrade path from low volume to high volume production - an application built on the F7 Feature can easily be upgraded to run on a Core-Compute module.



Pinout Definitions

Meadow Pin Name	MCU Pin Name	Analog Channel	PWM Timer Channel	Interrupt Group
A00	PA4	AC1_IN4		4
A01	PA5	ADC1_IN5		5
A02	PA3	ADC1_IN3		3
A03	PB0	ADC1_IN8		0
A04	PB1	ADC1_IN9		1
A05	PC0	ADC1_IN10		0
SCK	PC10			10

MOSI	PB5			5
MISO	PC11			11
D00	PI9			9
D01	PH13			13
D02	PH10		1	10
D03	PB8		3	8
D04	PB9		4	9
D05	PB4		1	4
D06	PB13		1	13
D07	PB7		2	7
D08	PB6		1	6
D09	PC6		1	6
D10	PC7		2	7
D11	PC9		4	
D12	PB14		1	14
D13	PB15		2	15
D14	PB12			12
D15	PG12			12
OnboardLedRed	PA2		3	2

OnboardLedGreen	PA1		2	1
OnboardLedBlue	PA0		1	0

IO Voltage Tolerance

IOs all operate nominally within 0V and 3.3V, but pins configured for digital IO are 5V tolerant while configured.

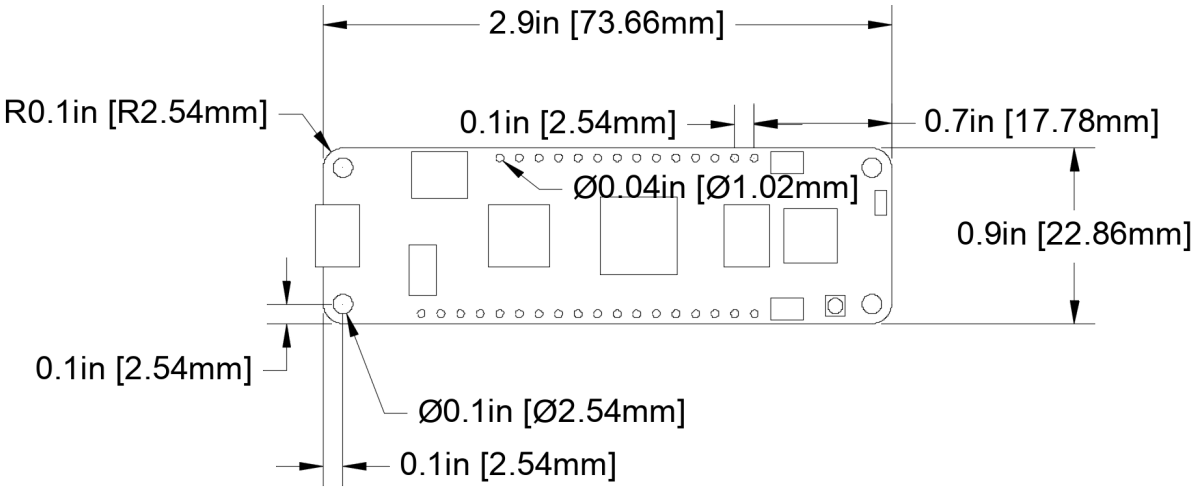
Mechanical Specifications

Please note that symbols and footprints for EDA tools can be found in the Meadow EDA Parts repo.

F7v2 Feather

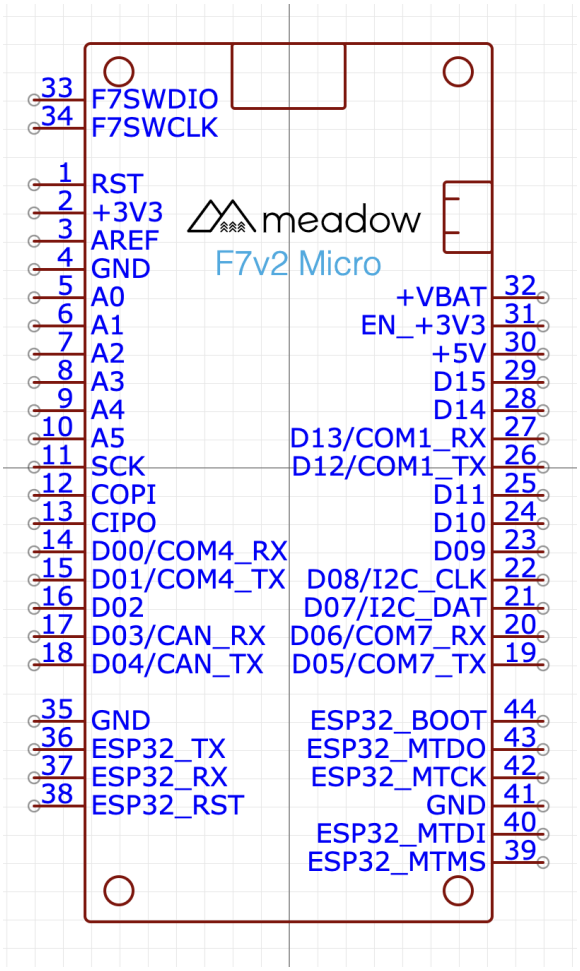
Dimensions and Weight

Basic dimensions are as follows. For 3D CAD models and extended dimensional information, please see the Wilderness Labs 3D Designs git repository.

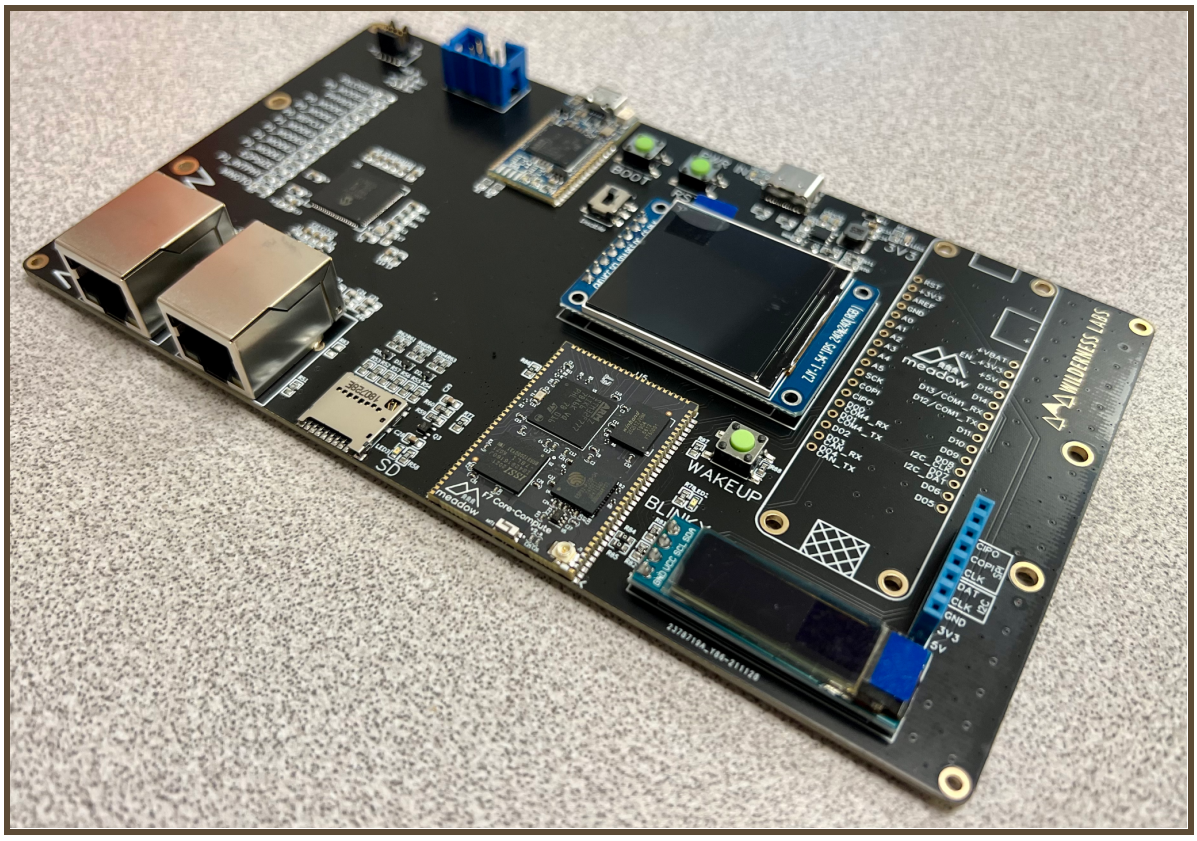


- Width = 0.9” [22.86mm]
- Length = 2.9” [73.66mm]
- Weight = 0.3oz [7.0 grams]

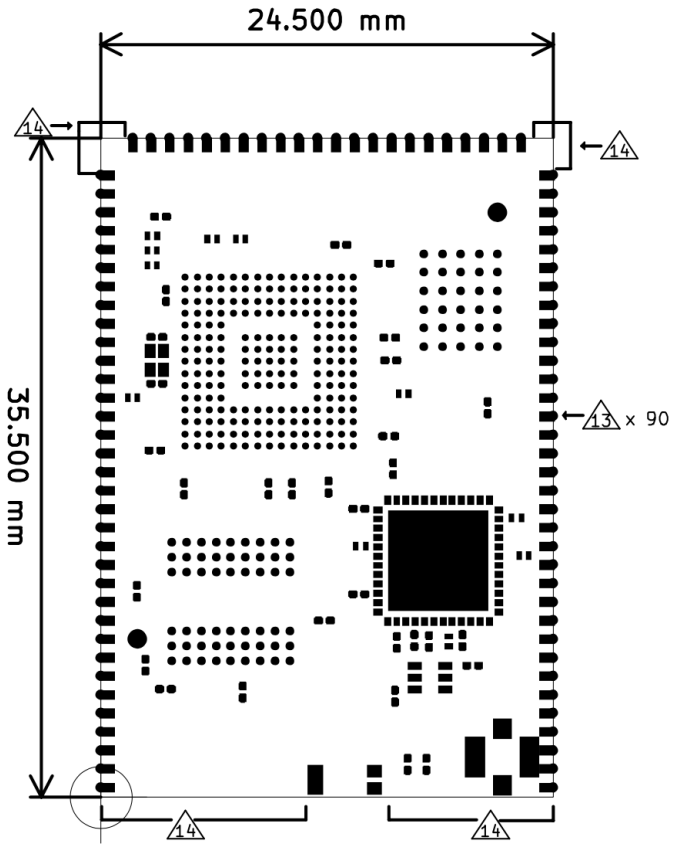
Schematic Symbol



F7v2 Core Compute



Dimensions and Weight



- Width = 24.5mm
- Length = 35.5mm
- Height = 1.6mm to top of PCB, 3mm total height clearance required
- Weight = 0.1oz [3.0 grams]

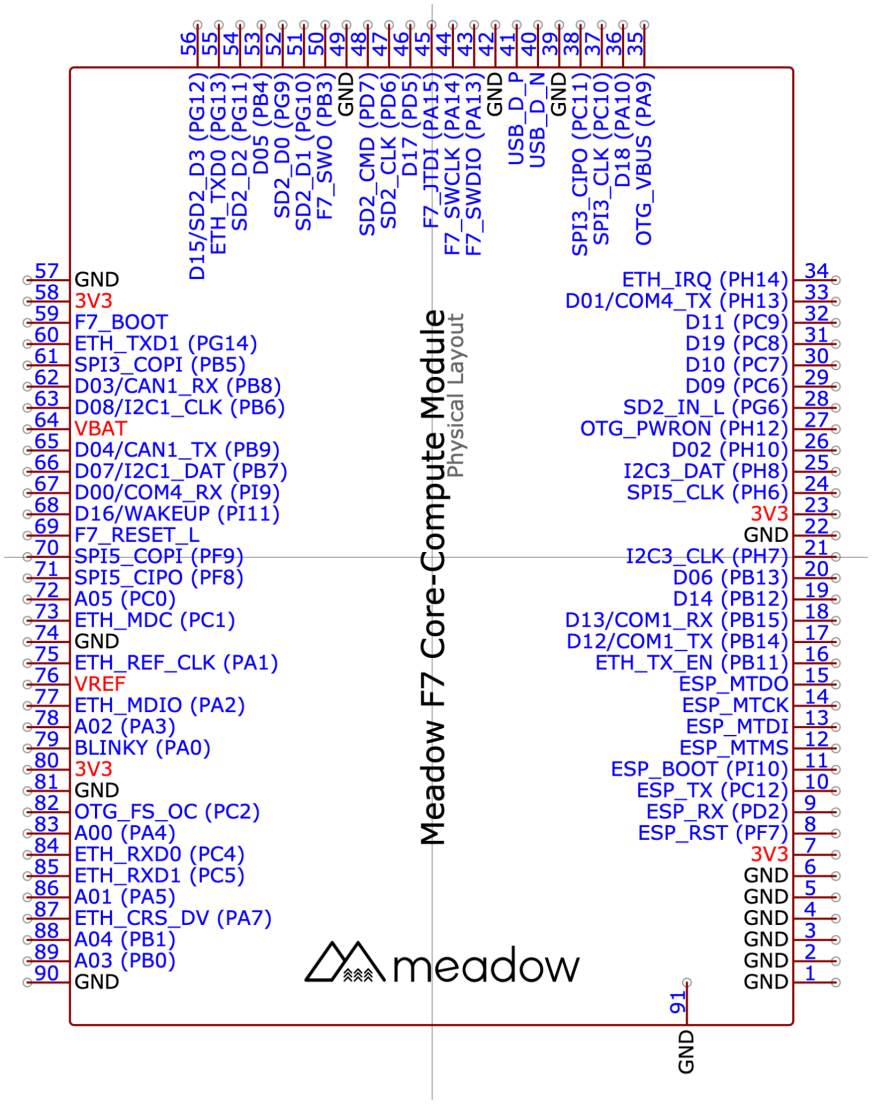
Schematic Symbols and Footprints

Schematic symbols and footprints for popular EDA tools can be found in the [Wilderness Labs Meadow EDA Parts github repository](#).

EasyEDA symbols and footprints for a variety of use cases can be found online [here](#).

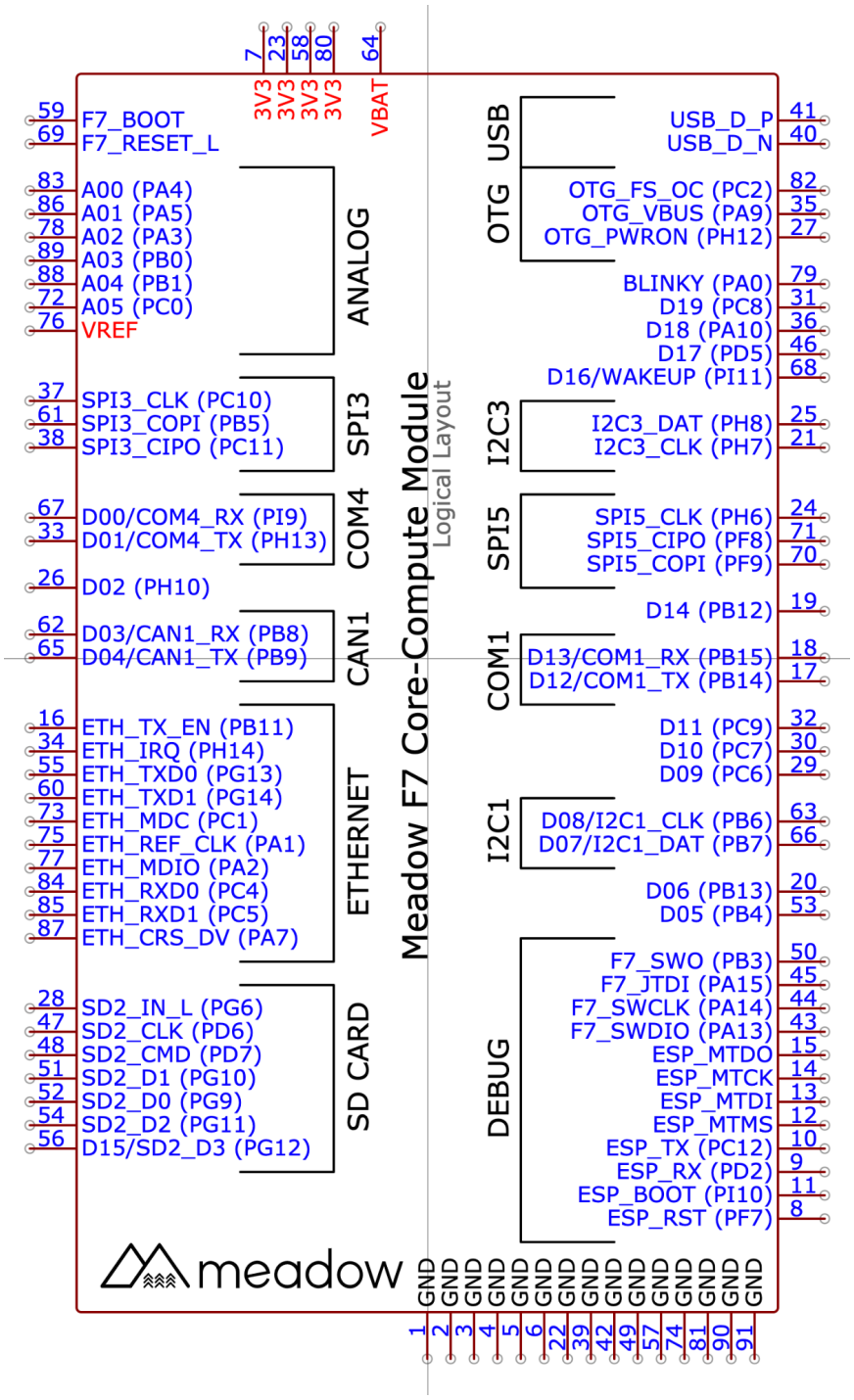
Physical Layout

The following schematic symbol represents the physical pin layout:

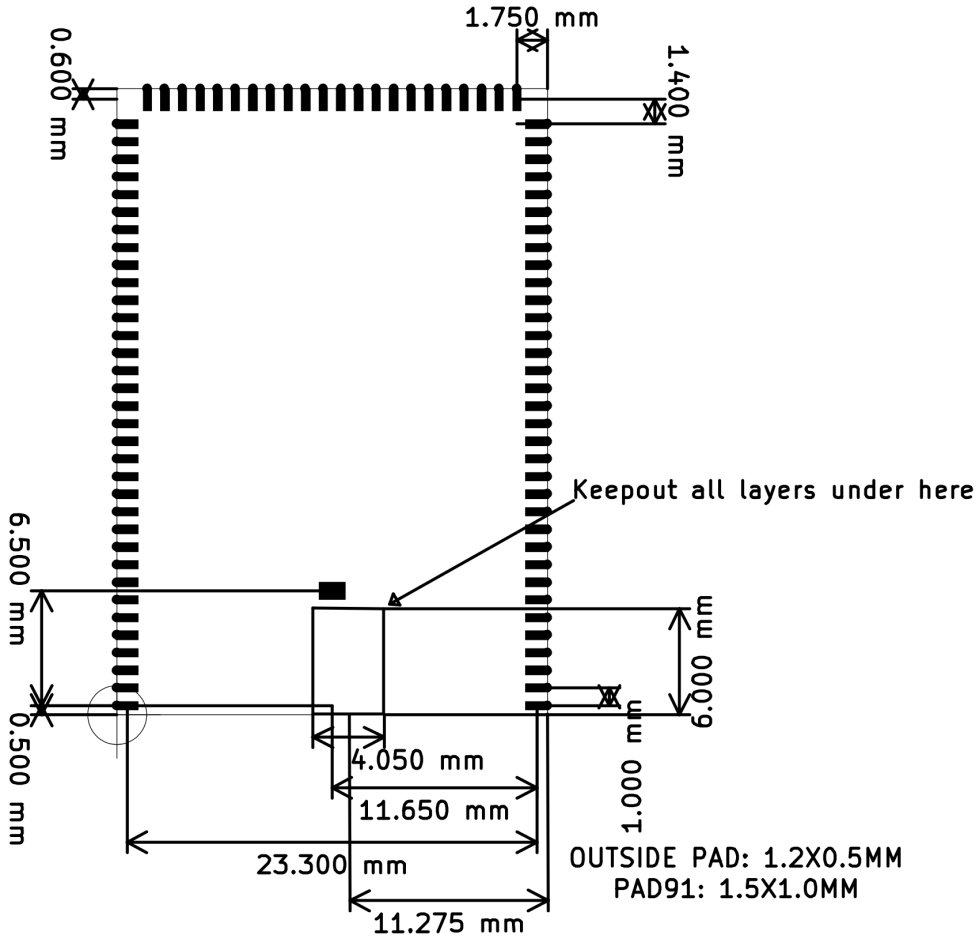


Logical Layout

The following schematic symbol provides a suggested logical layout of pins based on primary function:


Meadow F7 Core-Compute Module
Logical Layout
meadow
3V3
VBAT
GND
F7_BOOT
F7_RESET_L
ANALOG
A00 (PA4)
A01 (PA5)
A02 (PA3)
A03 (PB0)
A04 (PB1)
A05 (PC0)
VREF
SPI3
SPI3_CLK (PC10)
SPI3_COPI (PB5)
SPI3_CIPO (PC11)
COM4
D00/COM4_RX (PI9)
D01/COM4_TX (PH13)
D02 (PH10)
CAN1
D03/CAN1_RX (PB8)
D04/CAN1_TX (PB9)
ETHERNET
ETH_TX_EN (PB11)
ETH_IRQ (PH14)
ETH_TXD0 (PG13)
ETH_TXD1 (PG14)
ETH_MDC (PC1)
ETH_REF_CLK (PA1)
ETH_MDIO (PA2)
ETH_RXD0 (PC4)
ETH_RXD1 (PC5)
ETH_CRS_DV (PA7)
SD CARD
SD2_IN_L (PG6)
SD2_CLK (PD6)
SD2_CMD (PD7)
SD2_D1 (PG10)
SD2_D0 (PG9)
SD2_D2 (PG11)
D15/SD2_D3 (PG12)
USB
USB_D_P
USB_D_N
OTG
OTG_FS_OC (PC2)
OTG_VBUS (PA9)
OTG_PWRON (PH12)
BLINKY (PA0)
D19 (PC8)
D18 (PA10)
D17 (PD5)
D16/WAKEUP (PI11)
I2C3
I2C3_DAT (PH8)
I2C3_CLK (PH7)
SPI5
SPI5_CLK (PH6)
SPI5_CIPO (PF8)
SPI5_COPI (PF9)
D14 (PB12)
COM1
D13/COM1_RX (PB15)
D12/COM1_TX (PB14)
D11 (PC9)
D10 (PC7)
D09 (PC6)
I2C1
D08/I2C1_CLK (PB6)
D07/I2C1_DAT (PB7)
D06 (PB13)
D05 (PB4)
DEBUG
F7_SWO (PB3)
F7_JTDI (PA15)
F7_SWCLK (PA14)
F7_SWDIO (PA13)
ESP_MTDO
ESP_MTCK
ESP_MTDI
ESP_MTMS
ESP_TX (PC12)
ESP_RX (PD2)
ESP_BOOT (PI10)
ESP_RST (PF7)

Recommended PCB Footprint



Technical Specifications

Absolute Maximum Ratings

Parameter	Symbol	Min	Typ	Max	Unit
Supply Input Voltage	V_{IN-MAX}			+9	V

Battery Input Voltage	V_{LiPo}			+6.5	V
Supply Output Current	$I_{3V3\text{-}MAX\text{-}L}$			800	mA
Storage Temperature	T_{stg}	-30		+75	°C
ESD Susceptibility HBM (Human Body Mode)	V_{ESD}			2	kV

Recommended Operating Conditions

Parameter	**Symbol**	**Min**	**Typ**	**Max**	**Unit**
LiPo Battery Voltage	V_{LiPo}	+3.3		+4.4	V
Supply Input Voltage	V_{3V3}	+3.0	+3.3	+3.6	V
Supply Output Voltage	V_{3V3}		+3.3		V
Operating Temperature	T_{op}	-20		+60	°C
Humidity Range Non-condensing, relative humidity.				95	%

Schematics

All of the Meadow F7 hardware designs are open source and available in the Meadow Hardware Designs repo. The following are direct links to specific schematics:

- Meadow F7v2 Feather Schematic
- Meadow F7v2 Core-Compute Schematic
- Meadow F7v2 Core-Compute Debug Breakout Schematic

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