# QuickFeather Low Power MCU Open Source Hardware Development Kit *User Guide*

This document serves as a guide for the user to getting started with the QuickFeather revision 1.2 board.

This guide provides users with functional descriptions, configuration options for the QuickFeather Low Power MCU Open Source Hardware Development Kit Rev 1.2.  It also serves as a "Getting Started" and "How To" guide.
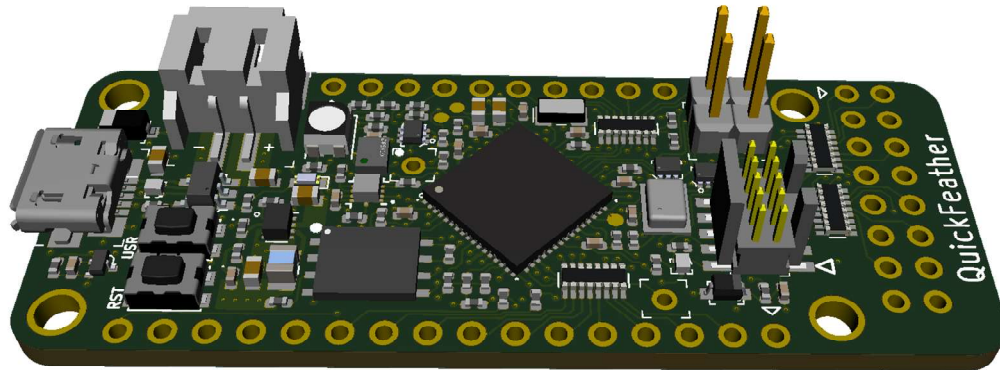


*Figure 1: QuickFeather Low Power MCU Open Source Hardware Development Kit*

## QuickFeather Low Power MCU Open Source Hardware Development Kit Overview

The QuickFeather Low Power MCU Open Source Hardware Development Kit (HDK) is a small form factor system ideal for enabling the next generation of low-power Machine Learning (ML) capable IoT devices. Unlike other development kits which are based on proprietary hardware and software tools, QuickFeather is based on 100% open source hardware, compatible with the Adafruit Feather form factor, and is built around 100% open source software (including the Symbiflow FPGA Tools).

The QuickFeather HDK is powered by QuickLogic's EOS™ S3 (https://www.quicklogic.com/products/eos-s3/), the first eFPGA-enabled Arm Cortex®-M4F MCU to be fully supported with Zephyr RTOS and FreeRTOS. Other functionality includes:

- QuickLogic EOS S3 MCU Platform
- mCube MC3635 accelerometer
- Infineon DPS310 pressure sensor
- Infineon IM69D130 MEMS microphone
- 16Mbit of on-board flash memory
- User button and RGB LED
- Powered from USB or a single Li-Po battery

- Integrated battery charger
- USB data signals tied to programmable logic
- IO signals break-routed into general purpose pinheads
- Compatible with standard 0.1" breadboards

## Benefits

- QuickFeather HDK is small, Feather compatible, inexpensive, and is 100% supported by open source tools.
- With a Cortex M4F MCU and integrated eFPGA, the EOS S3 lets you innovate with 100% open source hardware and software.

## Applications

- Tiny ML applications (such as with SensiML's AI Software Platform and Google's TensorFlow Lite)
- General purpose MCU applications

# Getting Started

## What You Need

- 1 × QuickFeather HDK Rev 1.2 development board
- 1 x Micro-USB 2.0 cable[1], Type A to Micro B for Power
- Laptop (Win10 OS[2] or Linux OS) running terminal program (such as PuTTY[3] or any UART console application)

Note[1, 2]:

[1] you will need to provide your own USB cable

[2] Windows 7 and Windows 8 are not supported

[3] PuTTY download & installation: https://www.putty.org/

## Running pre-loaded program from Flash

The purpose of the pre-loaded program is to make it very fast and straightforward for a new user to verify the board is functioning correctly.  While we do production testing of every QuickFeather HDK before we ship, sometimes things happen during shipping or storage.  Running this test takes less than a minute to do, requires no knowledge of the HDK, and will give you peace of mind the HDK is ready for you to start innovating freely.

1. Make sure there is no shunt installed at J7 and J1; if there are shunts installed, remove the shunts; save the shunts for future firmware development
2. Provide power to the QuickFeather HDK using the micro USB cable; the power source can be either a PC or wall adapter. When there is power applied to the board, the LED flashes "white" for a short duration
3. Press the "reset" button
4. The LED flashes blue color for 5 seconds and then turns off
5. Wait for 5 seconds
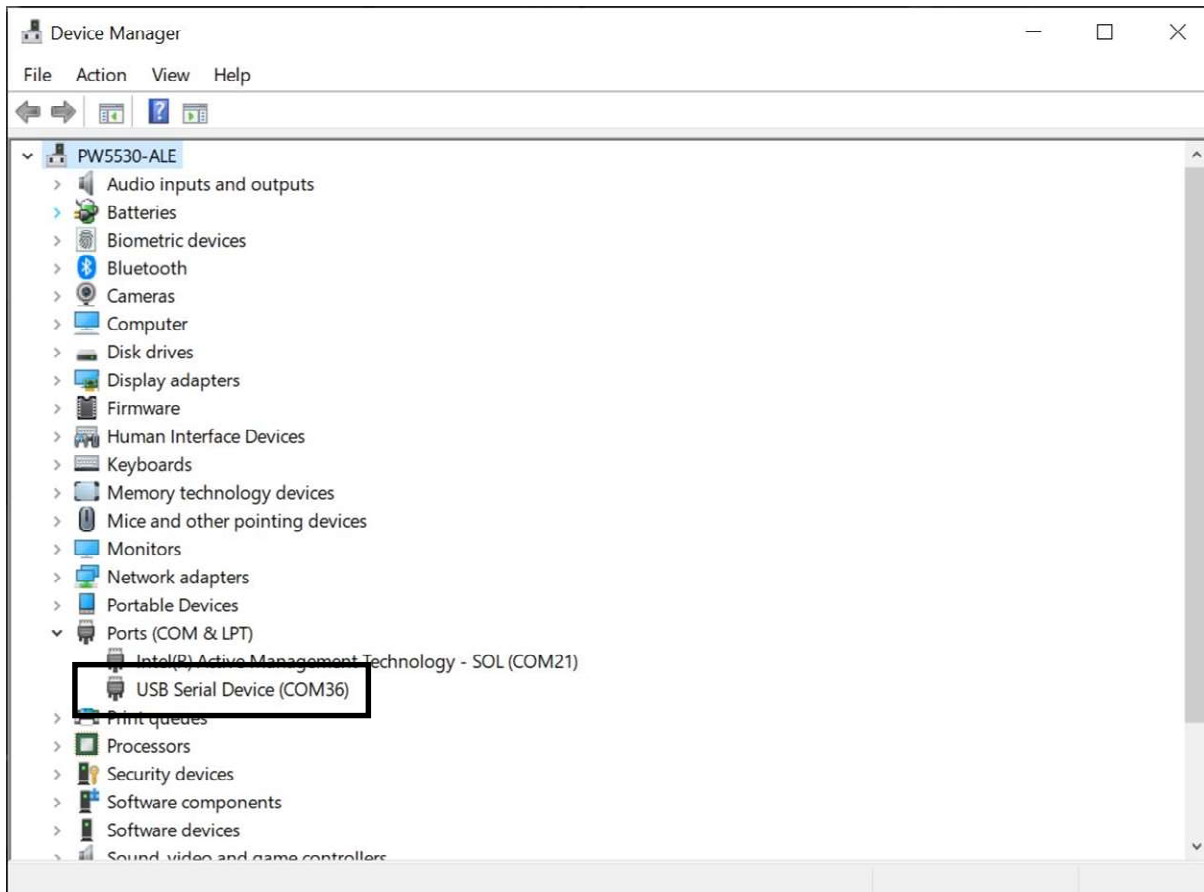6. On Windows 10 machine, open Device Manager to check for the assign COM port



*Figure 2: Checking COM Port with Device Manager*

Note: for Win10 system, the system device manager may not fully configure QuickFeather as COM port when install for the first time, repeat step (3) to (6).

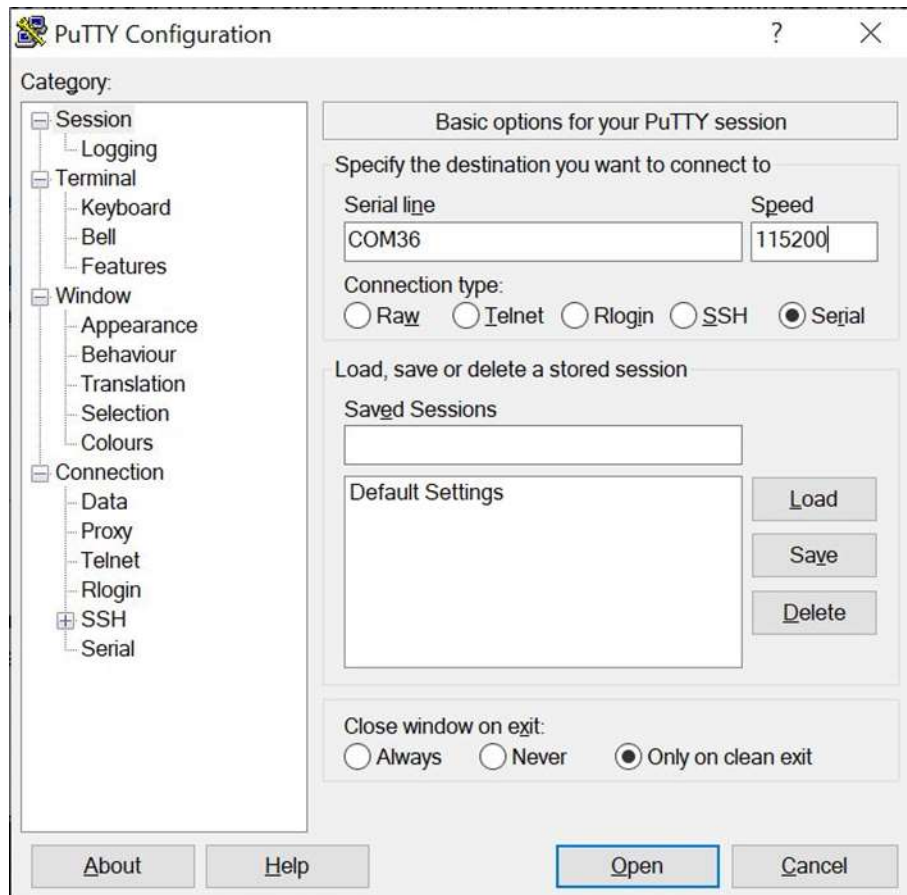7. Launch PuTTY application and configure for Serial access and select "Open"



*Figure 3: Checking COM Port with Device Manager*

8. Perform the followings in the PuTTY terminal:

   a) Type: "diag" to bring up QuickFeather diagnostic menu
   b) Type: "help" to bring up the menu of commands
   c) Type: "red"; the command shows red color for LED
   d) Type: "red"; the LED turns off the LED
   e) Try "green" and "blue" command

```
##########################
Quicklogic Open Platform 2.0
SW Version: OP2-QuickFeather-simple-app
May 18 2020 08:54:55
##########################

#********************
Command Line Interface
App SW Version: OP2-QuickFeather-simple-app
#********************
[0] > diag
[1] diag > help
help-path: diag
red            - toggle red led
green          - toggle green led
blue           - toggle blue led
userbutton     - show state of user button
exit           - exit/leave menu
help           - show help
?              - show help
help-end:
[1] diag > red
[1] diag > red
[1] diag >
```

*Figure 4: Example of diagnostic menu*

# Board Layout Overview

## Components on the Board

- QuickLogic EOS S3 MCU Platform

- mCube MC3635 accelerometer

- Infineon DPS310 pressure sensor

- Infineon IM69D130 MEMS microphone

- 16Mbit of on-board flash memory

- User button and RGB LED

- Hardware Reset button

- Powered from USB or a single Li-Po battery

- Integrated battery charger

- USB data signals tied to programmable logic
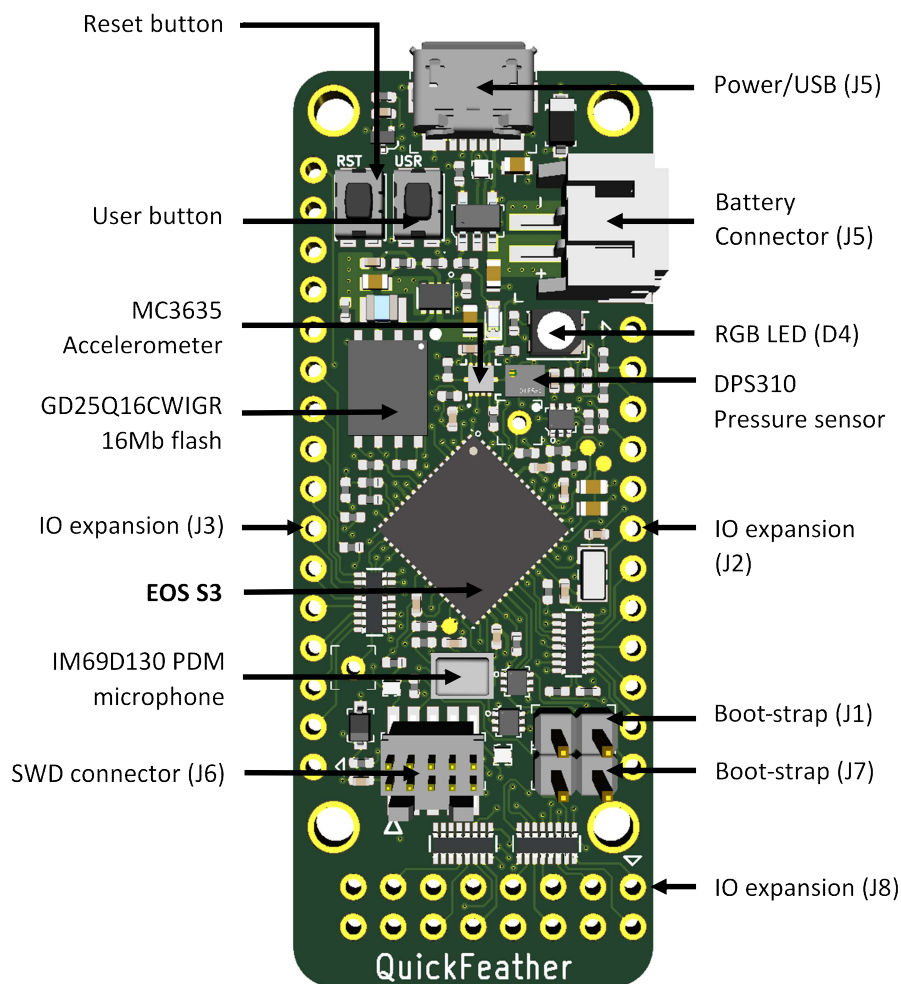
- IO signals break-routed into general purpose pinheads



*Figure 5: QuickFeather HDK Board Layout Overview*

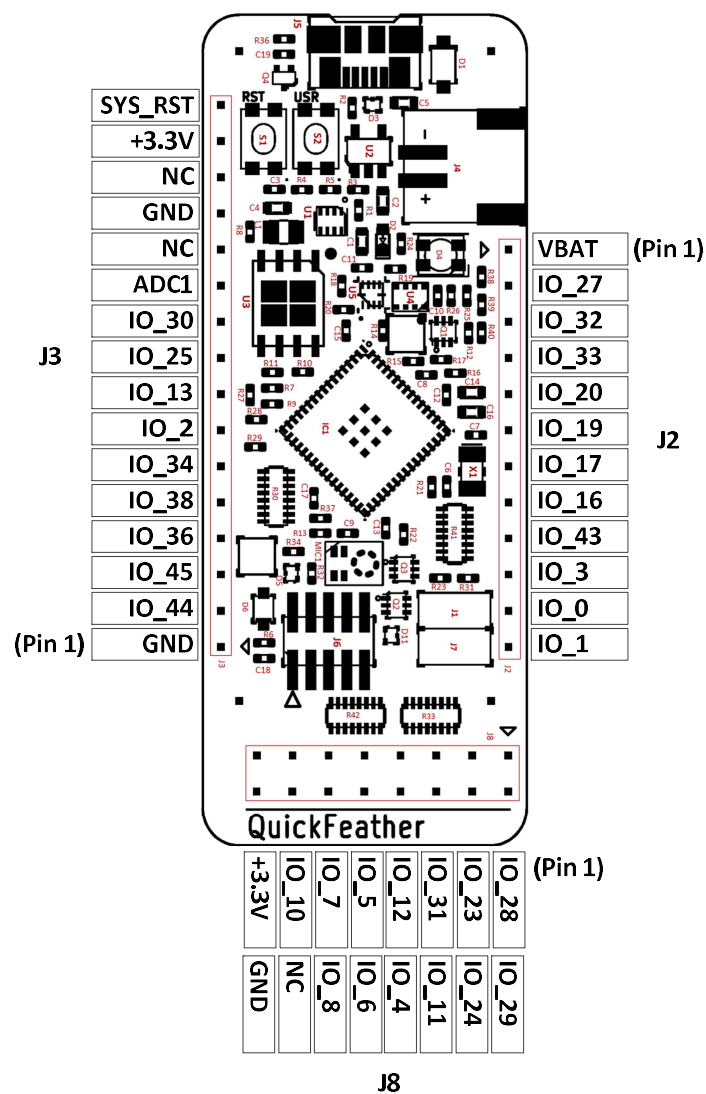# IO Expansion Connectors

## EOS S3 MCU IO Map



*Figure 6: QuickFeather HDK IO Expansion connectors*

| EOS S3 MCU IO | QuickFeather HDK Function | Additional Function | Expansion |
|---|---|---|---|
| IO_0 | I2C0 SCL | | J2.11 |
| IO_1 | I2C0 SDA | | J2.12 |
| IO_2 | IO | | J3.7 |
| IO_3 | Accelerometer MC3635 interrupt | | J2.10 |
| IO_4 | IO | | J8.8 |
| IO_5 | IO | | J8.9 |
| IO_6 | User Button input | | J8.10 |
| IO_7 | IO | | J8.11 |
| IO_8 | IO | | J8.12 |
| IO_10 | IO | | J8.13 |
| IO_11 | IO | | J8.6 |
| IO_12 | IO | | J8.7 |
| IO_13 | IO | | J3.8 |
| IO_14 | Serial Wire Debug CLK | | J6.4 |
| IO_15 | Serial Wire Debug DATA | | J6.2 |
| IO_16 | IO | SPI Slave CLK | J2.8 |
| IO_17 | IO | SPI Slave MISO (input) | J2.7 |
| IO_18 | Blue LED | | N/A |
| IO_19 | IO | SPI Slave MOSI | J2.6 |
| IO_20 | IO | SPI Slave CSn | J2.5 |
| IO_21 | Green LED | | N/A |
| IO_22 | Red LED | | N/A |
| IO_23 | IO | I2S Slave WCLK (frame) | J8.3 |
| IO_24 | IO | I2S Slave DATA (dout) | J8.4 |
| IO_25 | IO | | J3.9 |
| IO_27 | IO | SPI Master CS2 | J2.2 |
| IO_28 | PDM Data; to isolate, remove R13 | | J8.1 |
| IO_29 | PDM CKO | | J8.2 |
| IO_30 | IO | | J3.10 |
| IO_31 | IO | I2S Slave CLK (input) | J8.5 |
| IO_32 | IO | | J2.3 |
| IO_33 | IO | | J2.4 |
| IO_34 | SPI Master CLK | | J3.6 |
| IO_36 | SPI Master MISO | | J3.4 |
| IO_38 | SPI Master MOSI (flash) | | J3.5 |
| IO_40 | IO | | J8.14 |
| IO_43 | IO | Interrupt output to Host | J2.9 |
| IO_44 | IO | UART TX | J3.2 |
| IO_45 | IO | UART RX | J3.3 |

## Connector J2

| J2 | EOS S3 MCU IO | EOS S3 eFPGA IO | Function |
|---|---|---|---|
| 1 | | | VBAT |
| 2 | IO_27 | FBIO_27 | IO; SPI Master CS2n |
| 3 | IO_32 | FBIO_32 | IO; I2C bus 1 SDA |
| 4 | IO_33 | FBIO_33 | IO; I2C bus 1 SCL |
| 5 | IO_20 | FBIO_20 | SPI Slave SSn input; EOS S3 boot-strap |
| 6 | IO_19 | FBIO_19 | SPI Slave MOSI input; EOS S3 boot-strap |
| 7 | IO_17 | FBIO_17 | SPI Slave MISO output |
| 8 | IO_16 | FBIO_16 | SPI Slave CLK input |
| 9 | IO_43 | FBIO_43 | EOS S3 Interrupt output |
| 10 | IO_3 | FBIO_3 | MC3635 Interrupt input |
| 11 | IO_0 | FBIO_0 | I2C0 SCL |
| 12 | IO_1 | FBIO_1 | I2C0 SDA |

## Connector J3

| J3 | EOS S3 MCU IO | EOS S3 eFPGA IO | Function |
|---|---|---|---|
| 1 | | | Ground |
| 2 | IO_44 | FBIO_44 | S3 UART TX |
| 3 | IO_45 | FBIO_45 | S3 UART RX |
| 4 | IO_36 | FBIO_36 | SPI Master MISO input |
| 5 | IO_38 | FBIO_38 | SPI Master MOSI output |
| 6 | IO_34 | FBIO_34 | SPI Master CLK output |
| 7 | IO_2 | FBIO_2 | IO |
| 8 | IO_13 | FBIO_13 | IO |
| 9 | IO_25 | FBIO_25 | IO |
| 10 | IO_30 | FBIO_30 | IO |
| 11 | ADC1 | | ADC1 input |
| 12 | | | No Connect |
| 13 | | | Ground |
| 14 | | | No Connect |
| 15 | | | +3.3V |
| 16 | SYS_RSTn | | EOS S3 HW reset input |

## Connector J8

| J8 | EOS S3 MCU IO | EOS S3 eFPGA IO | Function |
|---|---|---|---|
| 1 | IO_28 | FBIO_28 | PDM microphone Data |
| 2 | IO_29 | FBIO_29 | PDM microphone CLK |
| 3 | IO_23 | FBIO_23 | I2S Slave WCLK input |
| 4 | IO_24 | FBIO_24 | I2S Slave DATA output |
| 5 | IO_31 | FBIO_31 | I2S Slave CLK input |
| 6 | IO_11 | FBIO_11 | IO |
| 7 | IO_12 | FBIO_12 | IO |
| 8 | IO_4 | FBIO_4 | IO |
| 9 | IO_5 | FBIO_5 | IO |
| 10 | IO_6 | FBIO_6 | User button input |
| 11 | IO_7 | FBIO_7 | IO |
| 12 | IO_8 | FBIO_8 | IO |
| 13 | IO_10 | FBIO_10 | IO |
| 14 | | | No Connect |
| 15 | | | +3.3V |
| 16 | | | Ground |

# Development connector

## EOS S3 MCU SWD connector

| J6 | EOS S3 MCU IO | Function |
|---|---|---|
| 1 | | +3.3V |
| 2 | IO_15 | SWD IO |
| 3 | | Ground |
| 4 | IO_14 | SWD CLK |
| 5 | | Ground |
| 6 | | No Connect |
| 7 | | No Connect |
| 8 | | No Connect |
| 9 | | Ground |
| 10 | SYS_RSTn | Hardware Reset |

## Boot-strap IO_19 & IO_20

- Install both shunts to use SWD Debugger for development
- Remove both shunts for boot-from-flash

Note: QuickFeather HDK board flash device must contain valid boot image for successful boot from flash.
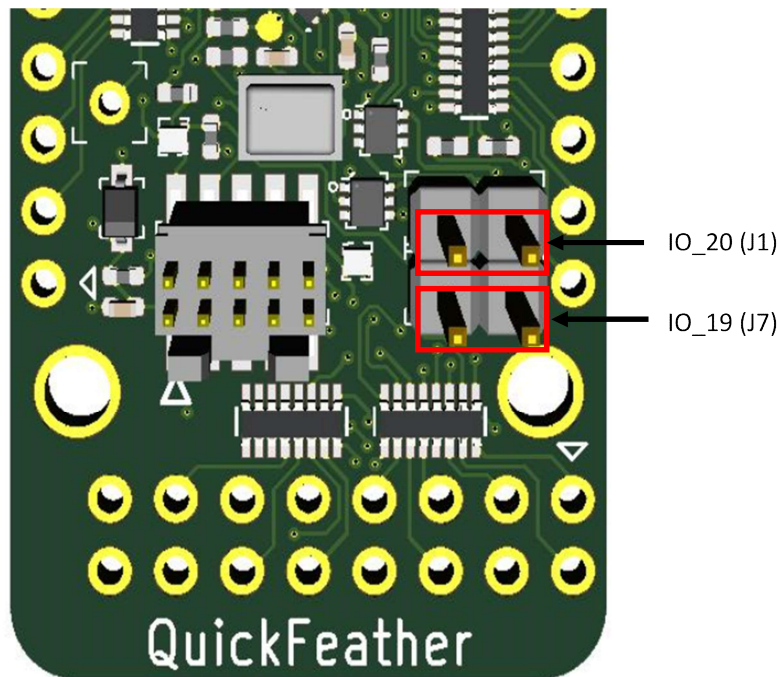
*Figure 7: Boot strap J1 and J7*

## QuickFeather HDK power supplies

There are two ways to provide power to the QuickFeather HDK: USB connector (J5) or Battery connector (J4).

When both ports are connected at the same time, the USB power activates the battery charging circuit that provide charging current to the battery.

When using a rechargeable battery, the minimum input voltage will determine the maximum currents that the system needs to support. This is important when connecting additional peripherals to the QuickFeather HDK that also requires connection to +3.3V for supplies.
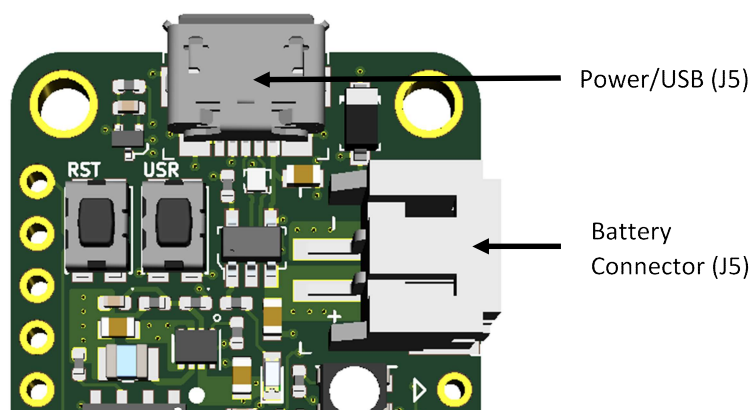


*Figure 8: QuickFeather HDK Power inputs*

# Connecting additional Peripherals to the QuickFeather HDK

QuickLogic's QuickFeather supports direct connection to FeatherWing module (providing that the FeatherWing module has Stack Headers installed) via expansion connector J2 and J3. Refer to Adafruit web site for additional information on available FeatherWing modules.

## Sensor with I2C port

QuickFeather board supports connecting to sensor module with I2C slave interface via expansion connectors J2. QuickFeather I2C supports I2C Standard mode (100KHz) and Fast mode (400KHz). There are two I2C buses available:

- I2C0 bus: J2 pin 12 (SDA) and J2 pin 11 (SCL); the signals (SCL and SDA) are connected to 4.7KΩ pull-up resistor. This bus is shared with onboard I2C sensors: Accelerometer MC3635 (address 0x44h) and Pressure DPS310 (address 0x77h).
- I2C1 bus: J2 pin 3 (SDA) and J2 pin 4 (SCL); there is no pull up resistor on the I2C1 bus.

Steps to connect external I2C sensors to QuickFeather board:

- Ground connection
- Power connection (+3.3V supplies); check supply voltage level meeting connecting module requirement
- Connect SCL and SDA signals; check IO level (> +3.0V IO only)
- Keep connecting wires as short as possible
- Configure the I2C address to avoid address 0x44h (on-board ACCEL MC3635) and address 0x77h (on-board Pressure sensor DPS310)
- Check SCL and SDA rise time (< 1000 ns for Standard mode and < 300 ns for Fast mode)

  Note: refer to I2C- bus specification for details (UM10204)

## Sensor with SPI Slave port

QuickFeather board supports connecting to sensor module with SPI slave interface via expansion connectors J2 and J3: SPI MASTER CLK (J3 pin 6), SPI MASTER MISO (J3 pin 4), SPI MASTER MOSI (J3 pin 5) and SPI MASTER SS2 (J2 pin 2). The maximum supported SPI clock frequency is 10MHz.

Steps to connect external SPI sensor to QuickFeather board:

- Ground connection
- Power connection (+3.3V supplies check supply voltage level meeting connecting module requirement
- Connect SPI MASTER signals; check IO level (> +3.0V IO only)
- Keep connecting wires as short as possible
- Check signal quality using scope

## PDM Microphones

## Single PDM microphone

The on-board PDM microphone (Infineon IM69D130) is configured as left channel output (driving active data on falling edge of PDM CLK). QuickFeather supports external PDM microphone connection via expansion connector J8: PDM CLK (J8 pin 2) and PDM DATA (J8 pin 1).

Steps to connect one external PDM microphone to QuickFeather board:

- Ground connection
- Power connection (+3.3V supplies check supply voltage level meeting connecting module requirement
- Connect PDM CLK and PDM DATA signals; check IO level (> +3.0V IO only)
- Keep connecting wires as short as possible
- PDM microphone is configured as right channel microphone; the L/R signal or Channel signal is connected to VDD
- Check signal quality using scope

## Two PDM microphones

To support two external PDM microphones configuration, it is required to disable the connection of the on-board PDM microphone.

QuickFeather supports external PDM microphone connection via expansion connector J8: PDM CLK (J8 pin 2) and PDM DATA (J8 pin 1).

Steps to connect two external PDM microphones to QuickFeather board:

- Ground connection
- Power connection (+3.3V supplies check supply voltage level meeting connecting module requirement
- **Remove R13 (100Ω resistor)**
- Connect PDM CLK and PDM DATA signals; check IO level (> +3.0V IO only)
- Keep connecting wires as short as possible; avoid star connection scheme (see figure below)
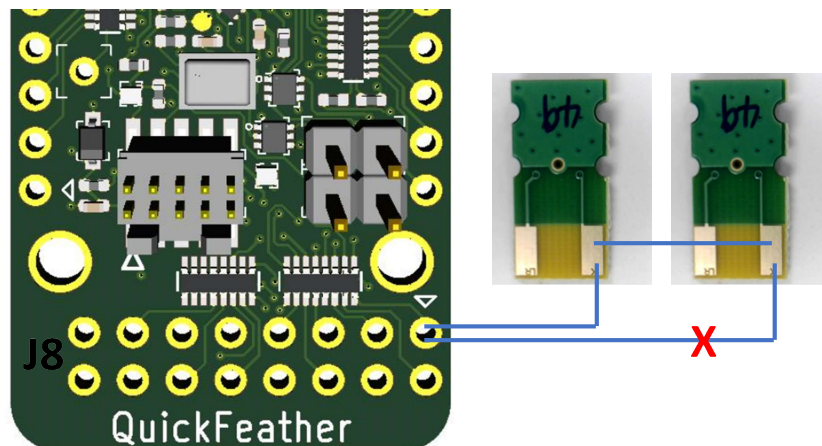- Configure one PDM microphone as left channel and one PDM microphone as right channel
- Check signal quality using scope



*Figure 9: Microphones Wiring recommendation*