1. Getting Started
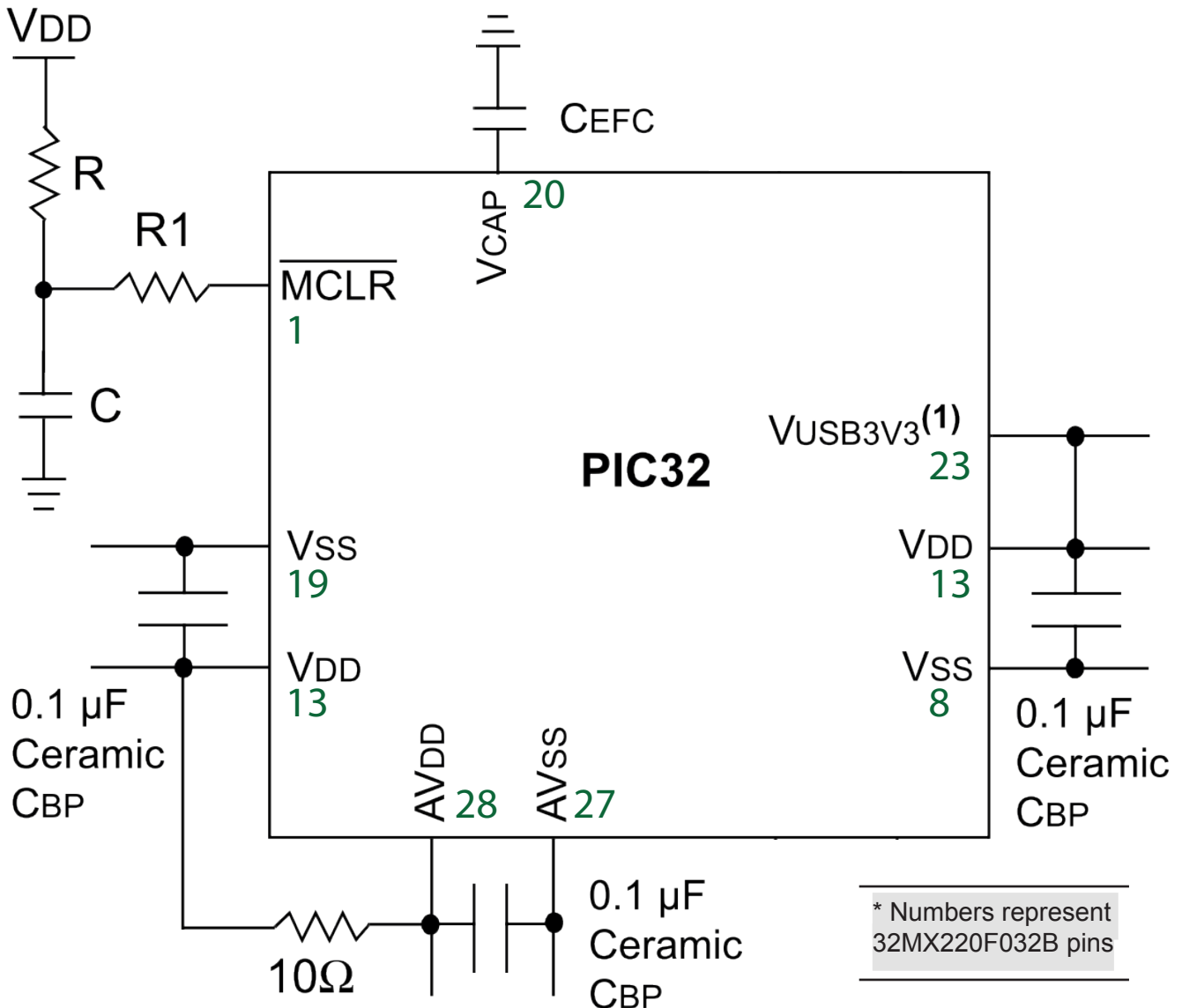
For details on the device, please refer to the PIC32MXXX/2XX Family Data Sheet.

1.1. Basic Connection Requirements

Getting started with the PIC32MX1XX/2XX family of 32-bit Microcontrollers (MCUs) requires attention to a minimal set of device pin connections before proceeding with development. The following is a

Note 1: If the USB module is not used, this pin must be connected to VDD.

Figure 1. `PIC32MX220F032B-Minimal.aiBlafasel`

list of pin names, which must always be connected:
- All VDD and VSS pins (see Section 2.2 "Decoupling Capacitors")
- All AVDD and AVSS pins, even if the ADC module is not used (see Section 2.2 "Decoupling Capacitors")

- VCAP pin (see Section 2.3 "Capacitor on Internal Voltage Regulator (VCAP)")
- MCLR pin (see Section 2.4 "Master Clear (MCLR) Pin")
- PGECx/PGEDx pins, used for In-Circuit Serial Programming (ICSP™) and debugging purposes (see Section 2.5 "ICSP Pins")
- OSC1 and OSC2 pins, when external oscillator source is used (see Section 2.7 "External Oscillator Pins")

The following pin may be required, as well:

VREF+/VREF- pins, used when external voltage reference for the ADC module is implemented.

The AVDD and AVSS pins must be connected, regardless of ADC use and the ADC voltage reference source.

Note: The AVDD and AVSS pins must be connected, regardless of ADC use and the ADC voltage reference source.

1.2. Decoupling Capacitors

The use of decoupling capacitors on power supply pins, such as VDD, VSS, AVDD and AVSS is required. See Figure 2-1.

Consider the following criteria when using decoupling capacitors:

- **Value and type of capacitor:** A value of 0.1 µF (100 nF), 10-20V is recommended. The capacitor should be a low Equivalent Series Resistance (low-ESR) capacitor and have resonance frequency in the range of 20 MHz and higher. It is further recommended that ceramic capacitors be used.
- **Placement on the printed circuit board:** The decoupling capacitors should be placed as close to the pins as possible. It is recommended that the capacitors be placed on the same side of the board as the device. If space is constricted, the capacitor can be placed on another layer on the PCB using a via; however, ensure that the trace length from the pin to the capacitor is within one-quarter inch (6 m) in length.
- **Handling high frequency noise:** If the board is experiencing high frequency noise, upward of tens of MHz, add a second ceramic-type capacitor in parallel to the above described decoupling capacitor. The value of the second capacitor can be in the range of 0.01 µF to 0.001 µF. Place this second capacitor next to the primary decoupling capacitor. In high-speed circuit designs, consider implementing a decade pair of capacitances as close to the power and ground pins as possible. For example, 0.1 µF in parallel with 0.001 µF.
- **Maximizing performance:** On the board layout from the power supply circuit, run the power and return traces to the decoupling capacitors first, and then to the device pins. This ensures that the decoupling capacitors are first in the power chain. Equally important is to keep the trace length between the capacitor and the power pins to a minimum thereby reducing PCB track inductance.

-- DELETEME --

Like the other pill boards, the design is closed source and the designer is unknown.

However, a File:Black Pill Schematic.pdf is available for this board (see Figure 2 on page 5).

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1.3. Comparison with the Blue Pill

The Black Pill is similar to the more popular Blue Pill.

1.4. Similarities

- STM32F103C8T6 32 bit ARM M3 microcontroller
- 4-pin ST-Link header
- Micro-USB
- No USB reset circuitry (reset over USB is still possible, though less reliable than the Maple Mini)
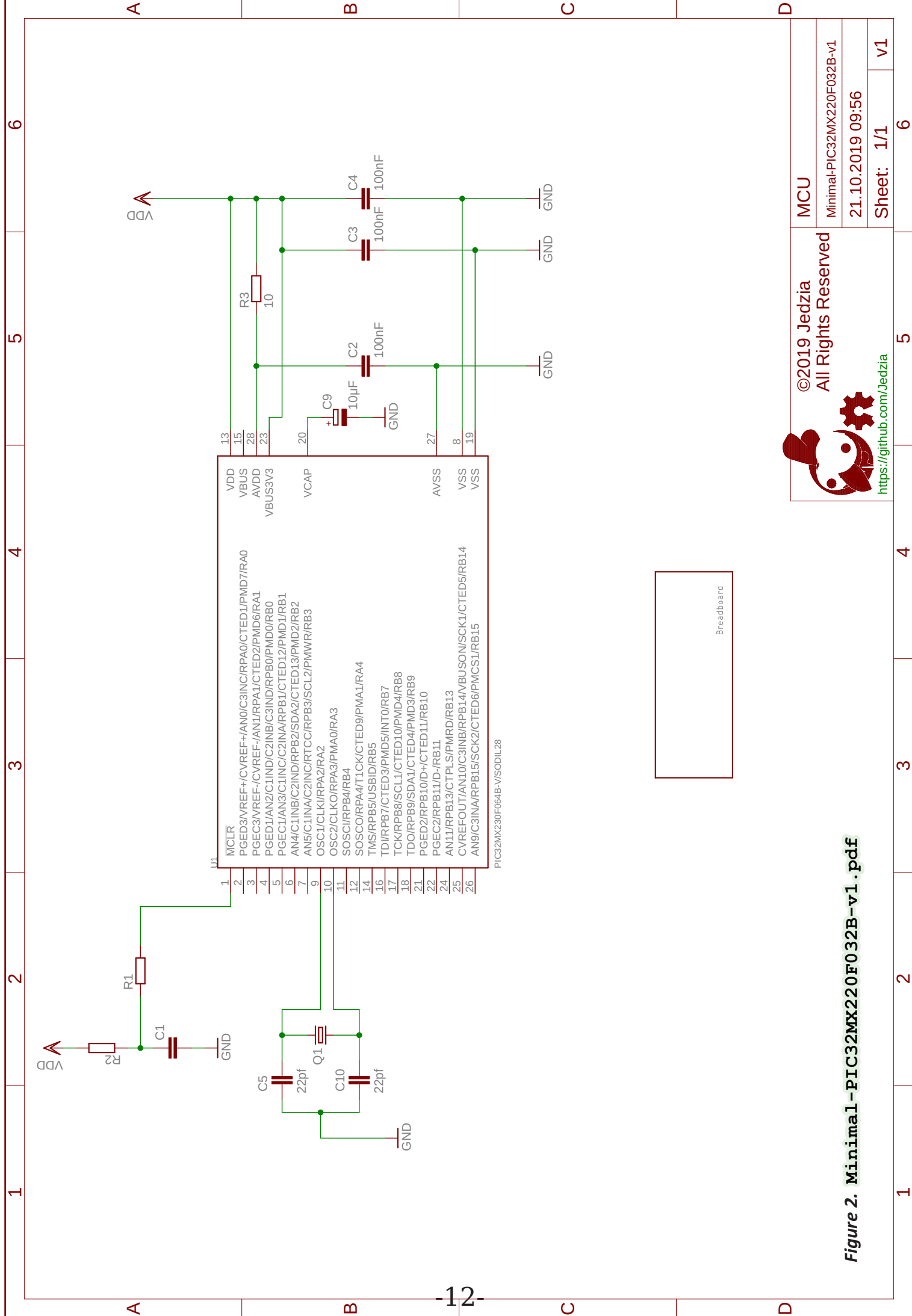
Figure 2. `Minimal-PIC32MX220F032B-v1.pdf`

Schematic component labels:

U1 — PIC32MX230F064B-V/SODIL28

Pin functions (left side of U1):
- 1 MCLR
- 2 PGED3/VREF+/CVREF+/AN0/C3INC/RPA0/CTED1/PMD7/RA0
- 3 PGEC3/VREF-/CVREF-/AN1/RPA1/CTED2/PMD6/RA1
- 4 PGED1/AN2/C1IND/C2INB/C3IND/RPB0/PMD0/RB0
- 5 PGEC1/AN3/C1INC/C2INA/RPB1/CTED12/PMD1/RB1
- 6 AN4/C1INB/C2IND/RPB2/SDA2/CTED13/PMD2/RB2
- 7 AN5/C1INA/C2INC/RTCC/RPB3/SCL2/PMWR/RB3
- 9 OSC1/CLKI/RPA2/RA2
- 10 OSC2/CLKO/RPA3/PMA0/RA3
- 11 SOSCI/RPB4/RB4
- 12 SOSCO/RPA4/T1CK/CTED9/PMA1/RA4
- 14 TMS/RPB5/USBID/RB5
- 16 TDI/RPB7/CTED3/PMD5/INT0/RB7
- 17 TCK/RPB8/SCL1/CTED10/PMD4/RB8
- 18 TDO/RPB9/SDA1/CTED4/PMD3/RB9
- 21 PGED2/RPB10/D+/CTED11/RB10
- 22 PGEC2/RPB11/D-/RB11
- 24 AN11/RPB13/CTPLS/PMRD/RB13
- 25 CVREFOUT/AN10/C3INB/RPB14/VBUSON/SCK1/CTED5/RB14
- 26 AN9/C3INA/RPB15/SCK2/CTED6/PMCS1/RB15

Pin functions (top side of U1):
- 13 VDD
- 15 VBUS
- 28 AVDD
- 23 VBUS3V3
- 20 VCAP
- 27 AVSS
- 8 VSS
- 19 VSS

Component values:
- R1
- R2
- R3 10
- C1
- C2 100nF
- C3 100nF
- C4 100nF
- C5 22pf
- C9 10µF
- C10 22pf
- Q1

Nets: VDD, GND

Breadboard
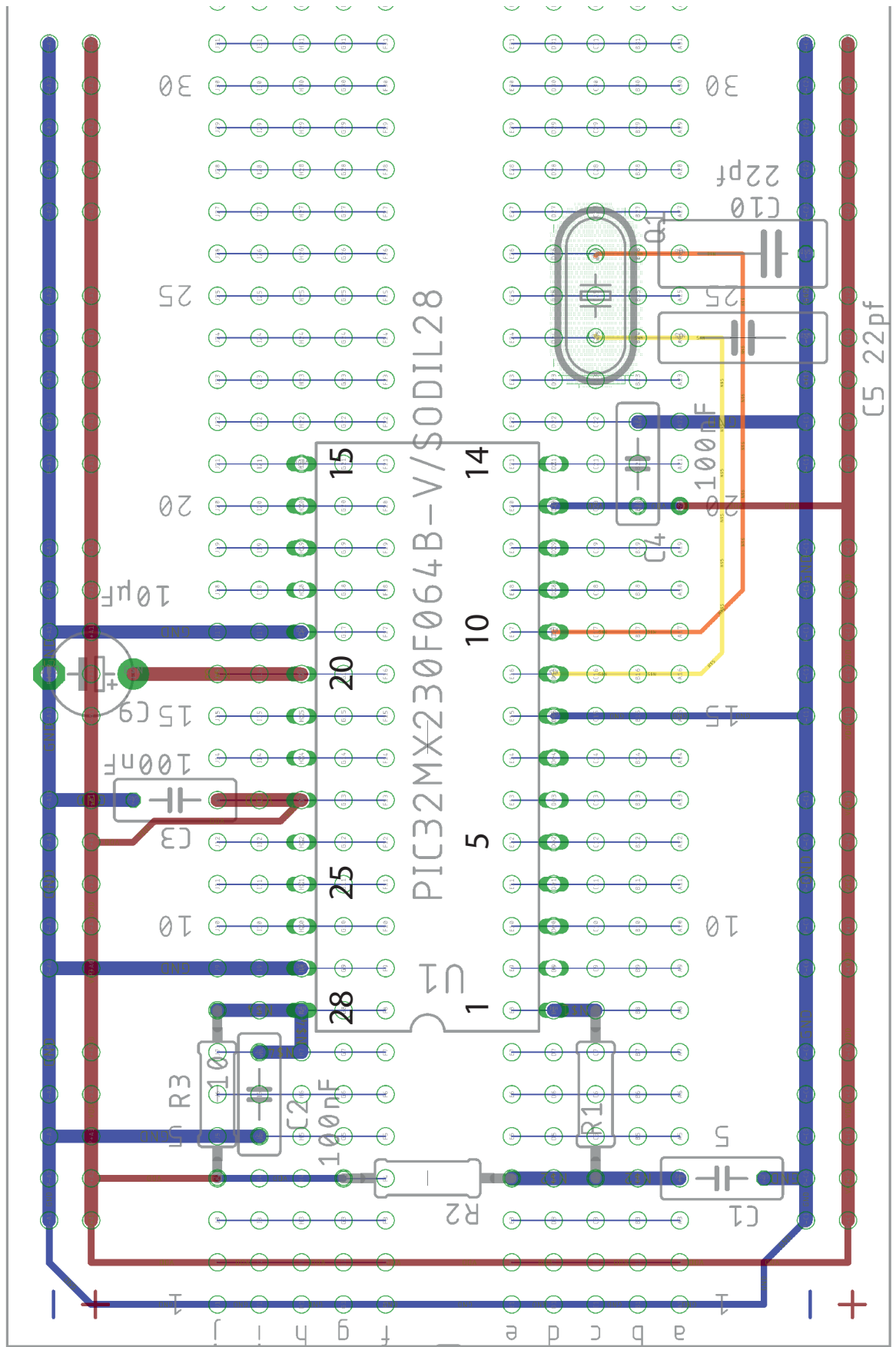
MCU
Minimal-PIC32MX220F032B-v1
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v1

Figure 3. `Minimal-PIC32MX220F032B-breadboard.ai`