Maple Mini

This page is a general resource for information specific to the Maple Mini. The Maple Mini is a smaller version of the Maple that fits on a breadboard.

Contents

Technical Specifications

- MCU: *STM32F103RCBT6*, a 32-bit ARM Cortex M3 microprocessor
- Clock Speed: **72 MHz**
- **128 KB Flash** and **20 KB SRAM**
- 34 *digital I/ pins (GPIOs)*
- 12 *PWM* pins at 16 bit resolution
- 9 *analog input (ADC)* pins at 12 bit resolution
- 2 *SPI* peripherals
- 2 *I2C* peripherals
- 7 Channels of Direct Memory Access (**DMA**) (*dma.h*)
- 3 *USART (serial port)* peripherals
- 1 advanced and 3 general-purpose *timers*
- Dedicated *USB* port for programming and communications
- *JTAG*
- Nested Vectored Interrupt Controller (NVIC) (including *external interrupt* on GPIOs)
- Supplies up to 500 mA at 3.3 V, with *separate 250 mA digital and analog regulators* for low-noise analog performance
- *Open source, four layer design*

- Support for low power, sleep, and standby modes (<500 µA)
- Operating Voltage: 3.3 V
- Input Voltage (recommended): 3 V — 12 V
- Dimensions: 2.02″ × 0.72″

Powering the Maple Mini

You can power the Maple Mini via the USB plug or by powering Vin directly.

Warning: The silkscreen on the Maple Mini suggests it will accept an input voltage up to 16 V. We recommend applying **no greater than 12 V**, and potentially even lower depending upon the current draw requirements of the application. Please see *Power Regulation on the Maple Mini* for more information.

Power Regulation on the Maple Mini

Power regulation on the Maple is provided by two low dropout linear voltage regulators. (The part is the MCP1703 from Microchip, in the SOT-23A package. You can download the datasheet here). One of the regulators supplies power to the digital voltage plane; the other supplies power to the analog voltage plane.

These voltage regulators nominally take an input of up to 16V. In addition, while the maximum continuous output current for the board is 250mA, if you are powering the board off higher voltages the amount off current it can supply goes down, due to the regulators needing to dissipate the extra power. So if you are powering the board off 12V, the max current is about 40mA at room temperature. In general (again, at room temperature) the max power dissipation (PD) for the chip is about .37W, and output current = PD/(Vin-Vout). For exact max current calculations, please refer to the datasheet linked above.

If you are planning to draw a lot of current from the Maple board, it is necessary to provide input power as close to 3.3V as possible. Powering the microcontroller circuitry and LEDs on the board alone takes approximately 30mA, so if you are powering the board with 12V that leaves only 10mA (at best) available for powering any user circuitry. Attempting to draw more than 10mA runs the risk of shorting out the power regulators and bricking your board.

GPIO Information

The Maple Mini features 34 total input/output pins, numbered `D0` through `D33`. These numbers correspond to the numeric values next to each header on the Maple Mini's silkscreen. However, some of them have special uses by default [1].

Pin `D23` is the *USB* D+ line, and `D24` is the USB D- line. To use them as GPIOs, your program will need to *disable SerialUSB* first. Be aware, however, that disabling SerialUSB means that the *bootloader* won't work properly, and you'll need to use *Perpetual Bootloader Mode* to make your next upload.

Pin `D32` is the Mini's *button pin*. It is thus mainly useful as an *input*. The pin will *read* `HIGH` when the *button is pressed*.

Pin `D33` is the Mini's *LED pin*. It is thus mainly useful as an *output*. The LED will glow when `HIGH` is *written* to it. (It also supports *PWM*, for finer-grained brightness control).

Master Pin Map

This table shows a summary the available functionality on every GPIO pin, by peripheral type. The "5 V?" column documents whether or not the pin is *5 volt tolerant*.

Note that this table is not exhaustive; on some pins, more peripherals are available than are listed here.

Pin	***GPIO***	***ADC***	***Timer***	***I2C***	***UART***	***SPI***	**5 V?**
D0	PB11	•	•	2_SDA	3_RX	•	Yes
D1	PB10	•	•	2_SCL	3_TX	•	Yes
D2	PB2	•	•	•	•	•	Yes
D3	PB0	CH8	3_CH3	•	•	•	•
D4	PA7	CH7	3_CH2	•	•	1_MOSI	•
D5	PA6	CH6	3_CH1	•	•	1_MISO	•
D6	PA5	CH5	•	•	•	1_SCK	•
D7	PA4	CH4	•	•	2_CK	1_NSS	•
D8	PA3	CH3	2_CH4	•	2_RX	•	•

Pin	*GPIO*	*ADC*	*Timer*	*I2C*	*UART*	*SPI*	5 V?
D9	PA2	CH2	2_CH3	•	2_TX	•	•
D10	PA1	CH1	2_CH2	•	2_RTS	•	•
D11	PA0	CH0	2_CH1_ETR	•	2_CTS	•	•
D12	PC15	•	•	•	•	•	•
D13	PC14	•	•	•	•	•	•
D14	PC13	•	•	•	•	•	•
D15	PB7	•	4_CH2	1_SDA	•	•	Yes
D16	PB6	•	4_CH1	2_SCL	•	•	Yes
D17	PB5	•	•	1_SMBA	•	•	•
D18	PB4	•	•	•	•	•	Yes
D19	PB3	•	•	•	•	•	Yes
D20	PA15	•	•	•	•	•	Yes
D21	PA14	•	•	•	•	•	Yes
D22	PA13	•	•	•	•	•	Yes
D23	PA12	•	1_ETR	•	1_RTS	•	Yes
D24	PA11	•	1_CH4	•	1_CTS	•	Yes
D25	PA10	•	1_CH3	•	1_RX	•	Yes
D26	PA9	•	1_CH2	•	1_TX	•	Yes
D27	PA8	•	1_CH1	•	1_CK	•	Yes
D28	PB15	•	•	•	•	2_MOSI	Yes
D29	PB14	•	•	•	3_RTS	2_MISO	Yes
D30	PB13	•	•	•	3_CTS	2_SCK	Yes
D31	PB12	•	1_BKIN	2_SMBA	3_CK	2_NSS	Yes

Pin	*GPIO*	*ADC*	*Timer*	*I2C*	*UART*	*SPI*	5 V?
D32	PB8	•	4_CH3	•	•	•	Yes
D33	PB1	CH9	3_CH4	•	•	•	•

GPIO Port Pin Map

The following table shows what pins are associated with each *GPIO port*.

GPIOA	GPIOB	GPIOC
PA0: D11	PB0: D3	PC0: -
PA1: D10	PB1: D33	PC1: -
PA2: D9	PB2: D2	PC2: -
PA3: D8	PB3: D19	PC3: -
PA4: D7	PB4: D18	PC4: -
PA5: D6	PB5: D17	PC5: -
PA6: D5	PB6: D16	PC6: -
PA7: D4	PB7: D15	PC7: -
PA8: D27	PB8: D32	PC8: -
PA9: D26	PB9: -	PC9: -
PA10: D25	PB10: D1	PC10: -
PA11: D24	PB11: D0	PC11: -
PA12: D23	PB12: D31	PC12: -
PA13: D22	PB13: D30	PC13: D14
PA14: D21	PB14: D29	PC14: D13
PA15: D20	PB15: D28	PC15: D12

Timer Pin Map

The following table shows what pins are associated with a particular timer's capture/compare channels.

Timer	Ch. 1	Ch. 2	Ch. 3	Ch. 4
1	D27	D26	D25	D24
2	D11	D10	D9	D8
3	D5	D4	D3	*D33*
4	D16	D15	*D32*	

EXTI Line Pin Map

The following table shows which pins connect to which *EXTI lines*.

EXTI Line	Pins
EXTI0	D3, D11
EXTI1	D10, D33
EXTI2	D2, D9
EXTI3	D8, D19
EXTI4	D7, D18
EXTI5	D6, D17
EXTI6	D5, D16
EXTI7	D4, D15
EXTI8	D27, D32
EXTI9	D26
EXTI10	D1, D25
EXTI11	D0, D24
EXTI12	D23, D31
EXTI13	D14, D22, D30
EXTI14	D13, D21, D29
EXTI15	D12, D20, D28

USART Pin Map

The Maple Mini has three serial ports (also known as *USARTs*). They communicate using the pins given in the following table.

Serial Port	TX	RX	CK	CTS	RTS
`Serial1`	D26	D25	D27	D24	D23
`Serial2`	D9	D8	D7	D11	D10
`Serial3`	D1	D0	D31	D30	D29

Low-Noise ADC Pins

Maple Mini has an electrically isolated analog power plane with its own regulator, and a geometrically isolated ground plane, connected to the digital plane by an inductor. Its analog input pins, D3 — D11, are laid out to correspond with these analog planes, and our measurements indicate that they generally offer low noise ADC performance. However, analog performance may vary depending upon the activity of the other GPIOs. Consult the *Maple Mini hardware design files* for more details.

Board-Specific Values

This section lists the Maple Mini's *board-specific values*.

- `CYCLES_PER_MICROSECOND`: 72
- `BOARD_BUTTON_PIN`: 32
- `BOARD_LED_PIN`: 33
- `BOARD_NR_GPIO_PINS`: 34
- `BOARD_NR_PWM_PINS`: 12
- `boardPWMPins`: 3, 4, 5, 8, 9, 10, 11, 15, 16, 25, 26, 27
- `BOARD_NR_ADC_PINS`: 9
- `boardADCPins`: 3, 4, 5, 6, 7, 8, 9, 10, 11
- `BOARD_NR_USED_PINS`: 4
- `boardUsedPins`: `BOARD_LED_PIN`, `BOARD_BUTTON_PIN`, 23, 24 (23 and 24 are used by *USB*)
- `BOARD_NR_USARTS`: 3
- `BOARD_USART1_TX_PIN`: 26
- `BOARD_USART1_RX_PIN`: 25
- `BOARD_USART2_TX_PIN`: 9
- `BOARD_USART2_RX_PIN`: 8
- `BOARD_USART3_TX_PIN`: 1
- `BOARD_USART3_RX_PIN`: 0
- `BOARD_NR_SPI`: 2
- `BOARD_SPI1_NSS_PIN`: 7
- `BOARD_SPI1_MOSI_PIN`: 4
- `BOARD_SPI1_MISO_PIN`: 5
- `BOARD_SPI1_SCK_PIN`: 6
- `BOARD_SPI2_NSS_PIN`: 31
- `BOARD_SPI2_MOSI_PIN`: 28
- `BOARD_SPI2_MISO_PIN`: 29
- `BOARD_SPI2_SCK_PIN`: 30
- `BOARD_JTMS_SWDIO_PIN`: 22
- `BOARD_JTCK_SWCLK_PIN`: 21
- `BOARD_JTDI_PIN`: 20
- `BOARD_JTDO_PIN`: 19
- `BOARD_NJTRST_PIN`: 18

Hardware Design Files

The hardware schematics and board layout files are available in the Maple Mini GitHub repository.

From the GitHub repository main page, you can download the entire repository by clicking the “Download” button. If you are familiar with Git, you can also clone the repository at the command line with

```
$ git clone git://github.com/leaflabs/maplemini.git
```

Failure Modes

The following known failure modes apply to all Maple boards. The failure modes aren't design errors, but are easy ways to break or damage your board permanently.

- **High voltage on non-tolerant pins**: not all header pins are 5 V compatible; so e.g. connecting certain serial devices in the wrong way could over-voltage the pins. The *pin-mapping master table* details which pins are *5 V-tolerant*.

Errata

This section lists known issues and warnings for the Maple Mini Rev 2 (the first Rev sold to the public).

- **Silkscreen Vin voltage mistake**: The silkscreen on the Maple Mini falsely indicates that Vin may be supplied with up to 16V. We recommend an input voltage **no greater than 12V**, and potentially even lower depending upon the current draw requirements of the application. Please see *Power Regulation on the Maple Mini* for more information.

Recommended Reading

STMicro documentation for STM32F103CB microcontroller:

- Datasheet (PDF); covers STM32F103x8, STM32F103xB.
- Reference Manual RM0008 (PDF); definitive resource for peripherals on the STM32F1 line.
- Programming Manual PM0056 (PDF); assembly language and register reference.
- STM32F103CB overview page with links to further references.

Footnotes

[1] See *boardUsedPins* for more information.