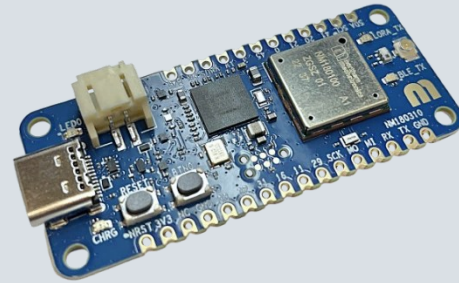


FEATHER BOARD

NM18031x

LoRa® Bluetooth® 5 Low Energy Feather



Overview

LoRa®

- **Max Transmit Power:** 22dBm
- **Frequency:**
 - North America: 902 – 928 MHz
 - Europe: 863 – 870 MHz

Bluetooth®

- **Specification:** Bluetooth® 5 Low Energy
- **Frequency:** 2.402 – 2.480 GHz

Processor

- **Architecture:** Ambiq Apollo3 series ARM® Cortex® M4 (FPU, max 96MHz)
 - NM180310: Apollo 3 Blue
 - NM180311: Apollo3 Blue Plus
- **Memory:**
 - Flash: 1 – 2 MB
 - RAM: 384 – 786 kB

Power

- **System Voltage:** 3.3 V

Host Interface Controller

- **Programming Tools:** License-free DAPLink debugging, VCOM and drag-and-drop programming over USB

Peripherals

- **Digital I/O:** 20x GPIO, 2x UART with flow control, 1x SPI master, 2x I2C master
- **Analog I/O:** 14-bit ADC, voltage comparator
- **Antenna Connector:** U.FL
- **Onboard Features:** Battery charger and power management, push buttons, LED indicators

Environmental

- **Operating Temperature:** -40° to 85°C

Physical

- **PCB Dimensions:** 54.8 mm x 22.9 mm (2.15 in x 0.9 in)

1 Features

Category	Parameter	NM180310	NM180311
Module	Core Module	NM180100 LoRa® Bluetooth® 5 Low Energy Module	NM180110 LoRa® Bluetooth® 5 Low Energy Module
LoRa®	Transceiver	Semtech SX1262 Long Range Low Power LoRa® Transceiver +22dBm, global frequency coverage	
	Frequency	North America: 902 – 928 MHz Europe: 863 – 870 MHz	
	Maximum Transmit Power	21.7 dBm	
	Receiver Sensitivity	-147.6 dBm (BW=10.4kHz, SF=12)	
Bluetooth® Low Energy	Specification	Bluetooth® 5 Low Energy	
	Frequency	2.402 – 2.480 GHz	
	Maximum Transmit Power	3 dBm	
	Receiver Sensitivity	-95 dBm	
Processor	Architecture	Ambiq Apollo3 Blue ARM® Cortex® M4 with FPU Up to 96MHz	Ambiq Apollo3 Blue Plus ARM® Cortex® M4 with FPU Up to 96MHz
	Memory	Flash: 1 MB RAM: 384 kB	Flash: 2 MB RAM: 768 kB
	Security Features	ISO 7816 Secure Interface, Secure Key Storage, Secure Boot, Secure OTA, External Flash Inline Encryption/Decryption	
Host Interface Controller	Programming Tools	License-free DAPLink debugging over USB, VCOM over USB, drag-and-drop programming via mass storage device emulation	
Peripherals	Digital I/O	20x GPIO, 1x SPI master, 2x I2C master, 2x UART with flow control	
	Analog I/O	14-bit ADC, voltage comparator	
	Antenna Connector	U.FL	
	Onboard Features	Battery charger, voltage regulation, power enable control, pushbuttons, LED indicators	
Power	Current Consumption	Processor: 6uA / MHz Sleep: 5uA (Typical) BLE: 7 – 9 mA (Transmit) LoRa: 41 – 143 mA (Transmit)	
Environmental	Operating Temperature	-40° – 85°C	
Physical	Dimensions	54.8 mm x 22.9 mm (2.15 in x 0.9 in)	

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5 Device Pinout

LEGEND

- PWR
- GND
- CTRL ~ PWM Capable (CTIMER)
- GPIO * High Side Power Switch
- UART ** Low Side Power Switch
- I2C
- SPI
- ADC
- SWD

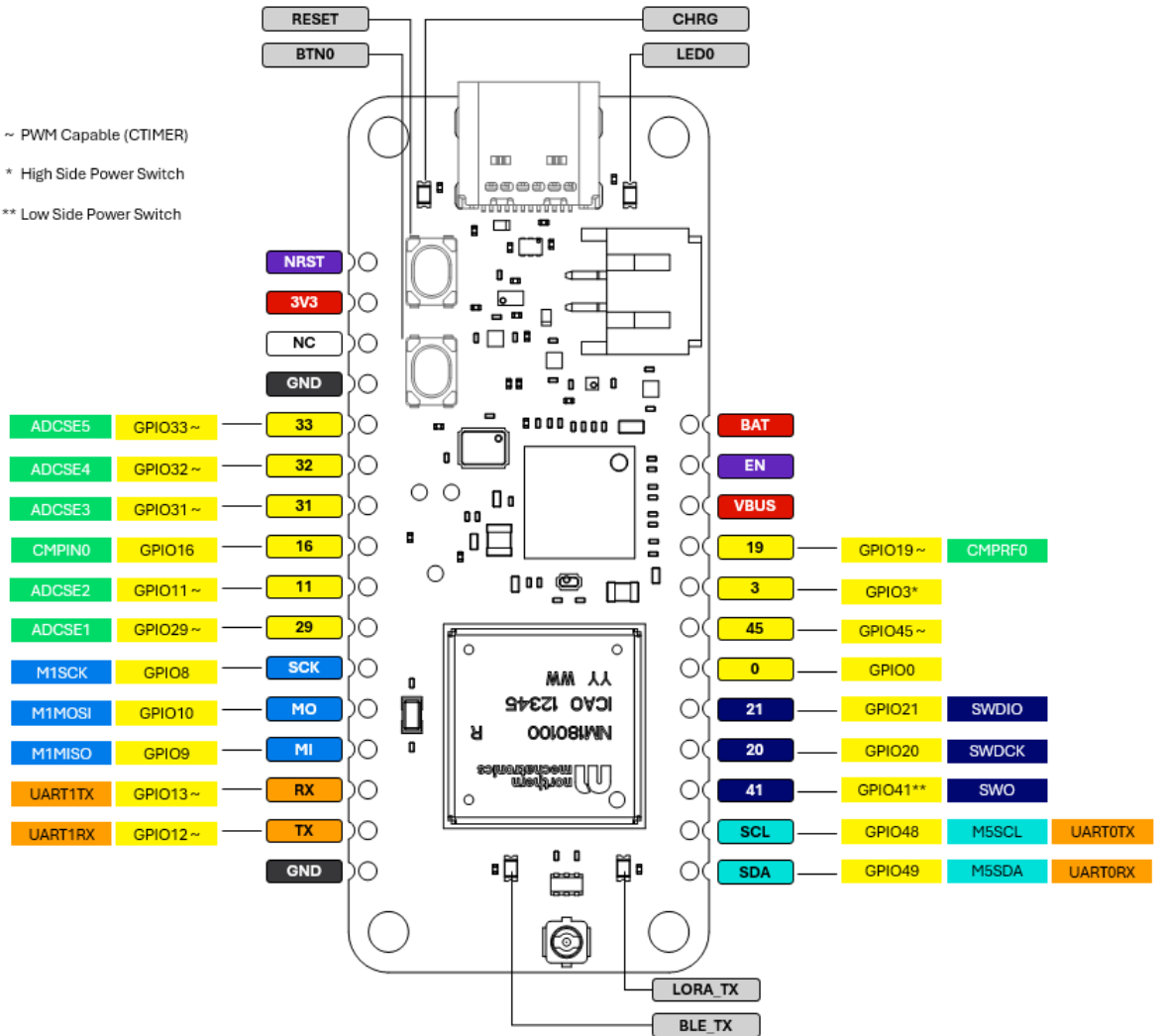


Figure 1: NM18031x Device Pinout

Table 1: NM18031x Header Pin Description

Pin Label	Type	Connector	Pin Number	NM1801xx Pin Name	Description
NRST	IN	J1100	1	-	NM1801xx active low chip reset.
3V3	OUT	J1100	2	-	3.3V output to peripherals.
NC	-	J1100	3	-	No connection.
GND	PWR	J1100	4	-	Ground.
33	I/O	J1100	5	GPIO33	General purpose I/O ¹ .
32	I/O	J1100	6	GPIO32	General purpose I/O.
31	I/O	J1100	7	GPIO31	General purpose I/O.
16	I/O	J1100	8	GPIO16	General purpose I/O.
11	I/O	J1100	9	GPIO11	General purpose I/O.
29	I/O	J1100	10	GPIO29	General purpose I/O.
SCK	I/O	J1100	11	GPIO8	SPI interface clock signal.
MO	I/O	J1100	12	GPIO10	SPI interface master out.
MI	I/O	J1100	13	GPIO9	SPI interface master in.
RX	I/O	J1100	14	GPIO13	UART receive input.
TX	I/O	J1100	15	GPIO12	UART transmit output.
GND	PWR	J1100	16	-	Ground.
BAT	PWR	J1101	1	-	Battery voltage rail.
EN	IN	J1101	2	-	Power enable. Pulled high onboard, pull low externally to disable onboard power supplies.
VBUS	PWR	J1101	3	-	5V supply from USB.
19	I/O	J1101	4	GPIO19	General purpose I/O.
3	I/O	J1101	5	GPIO3	General purpose I/O.
45	I/O	J1101	6	GPIO45	General purpose I/O.
0	I/O	J1101	7	GPIO0	General purpose I/O.
21	I/O	J1101	8	GPIO21	SWDIO, external debug interface.
20	I/O	J1101	9	GPIO20	SWDCK, external debug interface.
41	I/O	J1101	10	GPIO41	SWO, external debug interface.
SCL	I/O	J1101	11	GPIO48	I2C interface clock signal.
SDA	I/O	J1101	12	GPIO48	I2C interface data line.

¹ Multiple functions available for all GPIO pins, including those labelled for specific communication interface use by default, see NM1801xx datasheet for full list of alternate configuration options.

Table 2: NM18031x Onboard Peripheral Pin Mapping

Peripheral Name	NM1801xx Pin Name	Description
LED0	GPIO35	Onboard indicator LED.
BTN0	GPIO16	Onboard user push button.
nLORA_EN	GPIO10	LoRa power control. Pulled high by 100k onboard pull up resistor. Drive pin low to enable LoRa RF section power supply.
EN_3V3	GPIO30	3V3 output control. Pulled high by 100k onboard pull up resistor. Drive pin low to enable 3.3V output to header pin.

6 Electrical Characteristics

Table 3: Absolute Maximum Ratings

Symbol	Parameter	Min	Max	Unit
V_BUS	USB Supply Voltage		6	V
T_S	Storage Temperature	-55	125	°C
T_OP	Operating Temperature	-40	85	°C
ESD_LU	Latch-up		100	mA
ESD_HBM	ESD Human Body Model		2.0	kV
ESD_CDM	ESD Charged Device Model		250	V

Table 4: Recommended Operating Conditions

Symbol	Parameter	Min	Typ	Max	Unit
V_BUS	USB Supply Voltage	4.5	5	5.5	V
V_BAT	Battery Voltage	3.4	3.7	4.2	V

7 Functional Description

7.1 Introduction

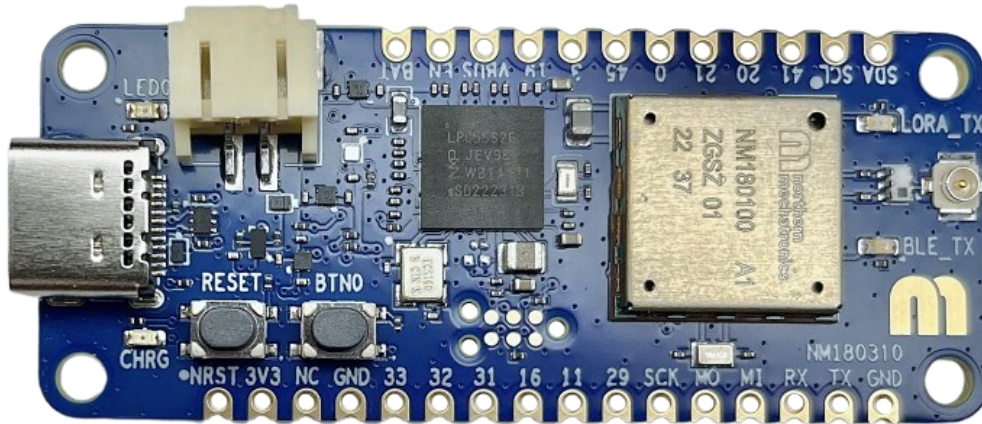


Figure 2: NM18031x Feather Board

The NM18031x Feather Board series allows developers to evaluate the high performance NM1801xx series of ultra-long range, ultra-low power RF modules, while utilizing the common feather form factor for compatibility with widely available prototyping components.

The NM18031x hardware features include power management and battery charging, LoRa and Bluetooth Low Energy (BLE) radios with complete onboard RF front end, and user pushbuttons and LED indicators.

The NM18031x has an onboard host interface controller that supports a wide range programming features over USB including license-free DAPLink debugging, virtual COM port emulation, and drag-and-drop firmware updates via USB mass storage device emulation.

7.2 LoRa® Radio

The NM1801xx module on the NM18031x utilizes the Semtech SX1262 transceiver for LoRa communications, which supports the 868MHz and 915MHz ISM bands. The module achieves a maximum transmit power of 22dBm. The module also contains an integrated LoRa RF front end, consisting of a transmit and a receive path. For a more detailed description of the LoRa radio operation, see the NM1801xx module datasheet.

7.3 Bluetooth® Low Energy Radio

The NM1801xx module on the NM18031x includes a Bluetooth Low Energy (BLE) radio that is integrated into the Apollo3 Blue series module processor. The BLE controller supports up to eight simultaneous connections. The BLE presents to the host as a Host Controller Interface, and supports extended PDU length and enhanced security.

7.4 Antenna

The NM18031x utilizes a single antenna interface for both LoRa and BLE radio communications. The LoRa and BLE RF paths are combined through an onboard RF diplexer to minimize intermodulation, with the single output routed to the onboard U.FL antenna connector, impedance matched to 50 Ohms. This allows developers to connect any off-the-shelf antenna that supports the 868MHz, 915MHz, and 2.4GHz frequency bands. Northern Mechatronics recommends the Molex 212570xxx series of flexible antennas as a default option.

The NM1801xx module onboard is certified for simultaneous LoRa and BLE transmit. This allows developers to operate both radios simultaneously without compromising RF performance.

7.5 Power Management

The NM18031x contains onboard voltage regulators and battery charger for power management. The NM18031x can be powered via USB or battery power. The battery connector supports standard lithium-ion rechargeable batteries, with charging over USB.

The onboard system voltage is fixed at 3.3 V, and as with all feather boards the NM18031x is compatible with 3.3 V I/O. When enabled, the 3V3 pin provides a 3.3 V output voltage rail that can be used to power external sensors and other peripherals. The control line that enables the 3V3 output is connected to the EN pin. There is an onboard 100k Ohm pull-up to enable the 3V3 output by default, but it can be disabled by pulling the EN pin voltage low. The enable is also connected to the onboard NM1801xx module GPIO30, allowing for software control.

The VBUS pin provides a direct connection to the USB bus voltage rail. While the VBUS pin can be used directly for power purposes, it is not recommended due to the lack of circuit protection.

To reduce power consumption, the power for the LoRa radio section, V_LORA, can be turned off. This is controlled directly by the NM1801xx module GPIO10. The LoRa power rail is disabled by default through an onboard pull up resistor and must be enabled by setting GPIO10 low before operating the LoRa radio.

7.6 Programming

The NM18031x is programmed over USB using DAPLink. Northern Mechatronics' software guide and comprehensive reference code examples utilize VSCode as the programming IDE and C as the programming language. For more detailed information on programming, see the Northern Mechatronics reference application Getting Started Guide in the public GitHub repository.

The NM18031x is also compatible with Arduino IDE and can be programmed with Arduino code. For more detailed documentation on using Northern Mechatronics' Arduino core, see the Arduino reference projects in the public GitHub repository.

The NM18031x can also be programmed by flashing binary firmware files via drag-and-drop. When the NM18031x USB cable is connected to a PC, it emulates a USB mass storage device named "NMI". By copying a firmware binary file to the NMI drive, it will automatically flash the new binary file to update the program. Any programming errors will be flagged by an error message text file shown on the NMI drive.

For developers who prefer to use a Segger J-Link debugger, the NM1801xx module onboard the NM18031x can be programmed via the exposed SWD pins on the J1101 header connector. For more detailed information on SWD debugging, see the NM1801xx module datasheet.

7.7 Debugging

7.7.1 Step Debugging

One of the differentiating features offered by the NM18031x is the ability to step debug over a USB connection. The onboard host interface controller utilizes DAPLink, a license-free debugger. This enables developers to step debug code in VS Code or Arduino IDE without connecting an external debugger.

For developers who prefer to use a Segger J-Link debugger to interface, the SWD port pins to interface with the NM1801xx module directly are exposed on the J1101 header connector.

7.7.2 Virtual Communication Port (VCOM)

Another feature that can be used for debugging is the virtual communication port (VCOM) over USB. This allows a user to interact with the NM18031x through a standard serial terminal, and can be used for printf style debugging, device logging, or implementing a basic command line interface (CLI).

The Arduino IDE built in Serial Monitor functions as read-only, however other serial terminal software (e.g. PuTTY, RealTerm, etc.) have bi-directional serial communication capabilities, which enables developers to use the features in Northern Mechatronics' reference application CLI. For more detailed information on using command line features, see the reference application example in the public GitHub repository.

8 Mechanical Information

8.1 Mechanical Specifications

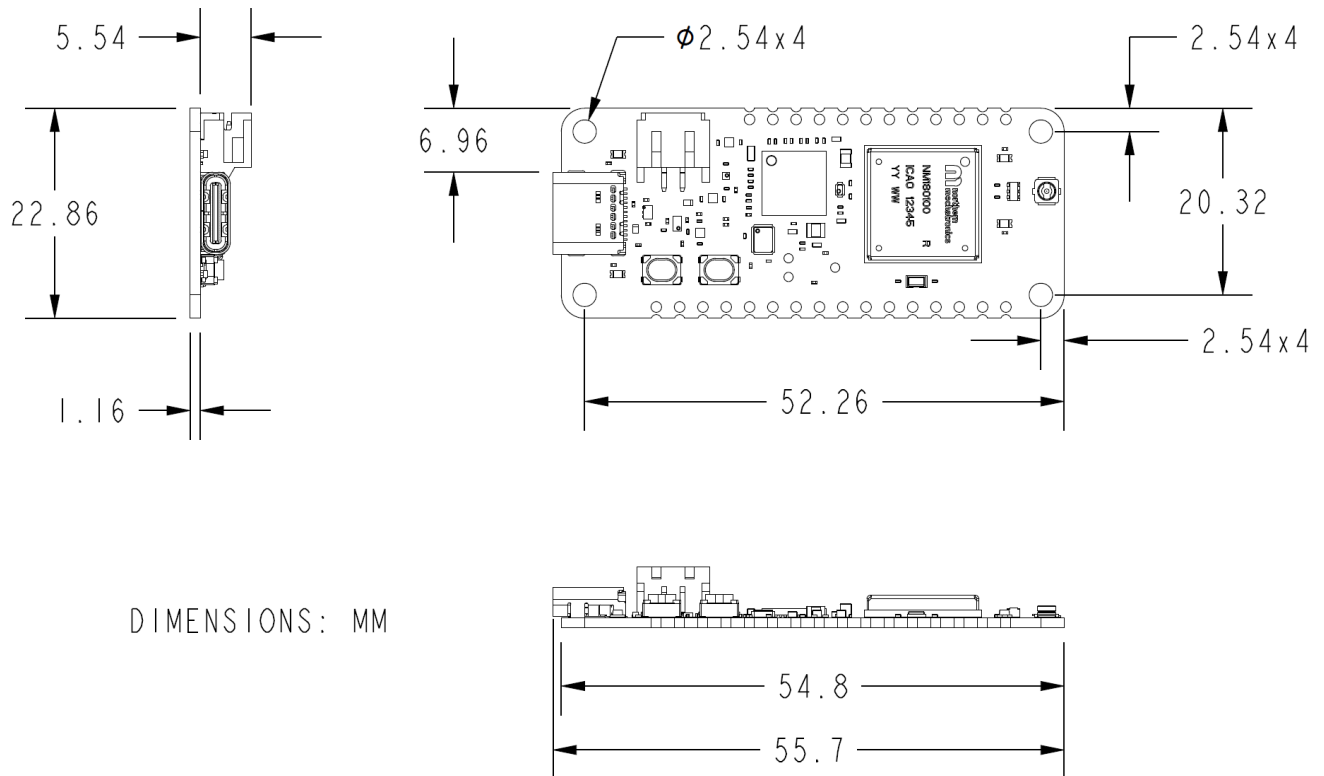


Figure 3: NM18031x Mechanical Specifications

8.2 Device Marking

The NM18031x series boards have the product number displayed on the top side silkscreen and all other device information on the bottom side silkscreen, as shown in the reference image below.



Figure 4: NM18031x Device Marking

9 Ordering Information

Model	Module	Package Description	Package Option
NM180310	NM180100	Feather with NM180100 LoRa® Bluetooth® 5 Low Energy Module	Bulk
NM180311	NM180110	Feather with NM180110 LoRa® Bluetooth® 5 Low Energy Module	Bulk

10 Revision History

Revision	Date	Description
A.1	November 19, 2024	Initial release.
A.2	December 2, 2024	Updated with minor corrections, formatting updates.
A.3	December 5, 2024	Updated mechanical drawings.