

PETAL ECOSYSTEM

# NM18040x

Petal Core with LoRa® Bluetooth® 5 Low Energy Module



## Overview

### LoRa®

- **Transceiver:** Semtech SX1262
- **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)
  - NM180400: Apollo3 Blue
  - NM180401: Apollo3 Blue Plus
- **Memory:**
  - Flash: 1 – 2 MB
  - RAM: 384 – 786 kB

### Power

- **Operating Voltage:** 1.8 – 3.6 V
- **Sleep Current:** 5uA (Typical)

### Peripherals

- **Digital I/O:** 42x GPIO, 4x I2C master, 3x SPI master, 1x Dual/Quad/Octal SPI master, 1x SPI/I2C slave, 2x UART with flow control, 1x PDM master, 1x I2S slave
- **Analog I/O:** 14-bit ADC, voltage comparator
- **Antenna Connectors:** U.FL, spring clips (optional)
- **Onboard Features:**
  - Push Buttons: RESET, user programmable
  - LED Indicators: LoRa and BLE transmit, user programmable

### Environmental

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

### Physical

- **Dimensions:** 30 mm x 30 mm x 6 mm (Stacking connector height: 3mm)

# 1 Features

| Category                         | Parameter             | NM180400  | NM180401  |
|----------------------------------|-----------------------|---|---|
| <b>Module</b>                    | Core Module           | NM180100  | NM180110  |
|                                  |                       | LoRa® Bluetooth® 5<br>Low Energy Module   | LoRa® Bluetooth® 5<br>Low Energy Module                             |
| <b>LoRa®</b>                     | Transceiver           | Semtech SX1262 Long Range Low Power LoRa® Transceiver +22dBm, global frequency coverage   |   |
|                                  | Frequency             | North America: 902 – 928 MHz<br>Europe: 863 – 870 MHz   |   |
|                                  | Max Transmit Power    | 21.7 dBm  |   |
|                                  | Receiver Sensitivity  | -147.6 dBm (BW=10.4kHz, SF=12)  |   |
| <b>Bluetooth®<br/>Low Energy</b> | Specification         | Bluetooth® 5 Low Energy   |   |
|                                  | Frequency             | 2.402 – 2.480 GHz   |   |
|                                  | Max Transmit Power    | 3 dBm   |   |
|                                  | Receiver Sensitivity  | -95 dBm   |   |
| <b>Processor</b>                 | Architecture          | Ambiq Apollo3 Blue<br>ARM® Cortex® M4 with<br>FPU, up to 96MHz  | Ambiq Apollo3 Blue Plus<br>ARM® Cortex® M4 with<br>FPU, up to 96MHz |
|                                  | Memory                | Flash: 1 MB<br>RAM: 384 kB  | Flash: 2 MB<br>RAM: 768 kB  |
|                                  | Security Features     | ISO 7816 Secure Interface, Secure Key Storage,<br>Secure Boot, Secure OTA, External Flash Inline<br>Encryption/Decryption                             |   |
| <b>Peripherals</b>               | Digital I/O           | 42x GPIO, 2x UART with flow control, 4x I2C master,<br>3x SPI master, 1x SPI/I2C slave, 1x Dual/Quad/Octal<br>SPI master, 1x I2S slave, 1x PDM master |   |
|                                  | Analog I/O            | 10-Channel 14-bit ADC at 1.2MS/s<br>Voltage Comparator  |   |
|                                  | Antenna Connectors    | U.FL, Spring clips (optional)   |   |
|                                  | User Interface        | Buttons: RESET, user programmable<br>LED: LoRa and BLE transmit, user programmable  |   |
| <b>Power</b>                     | Supply Voltage        | 1.8 – 3.6V  |   |
|                                  | Current Consumption   | Processor: 6uA / MHz<br>Sleep: 5uA (Typical)<br>BLE: 7 – 9 mA (Transmit)<br>LoRa: 41 – 143 mA (Transmit)  |   |
| <b>Environmental</b>             | Operating Temperature | -40° – 85°C   |   |
| <b>Physical</b>                  | Dimensions            | 30 mm x 30 mm x 6 mm (Stacked height: 3mm)  |   |

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## 5 Device Pinout

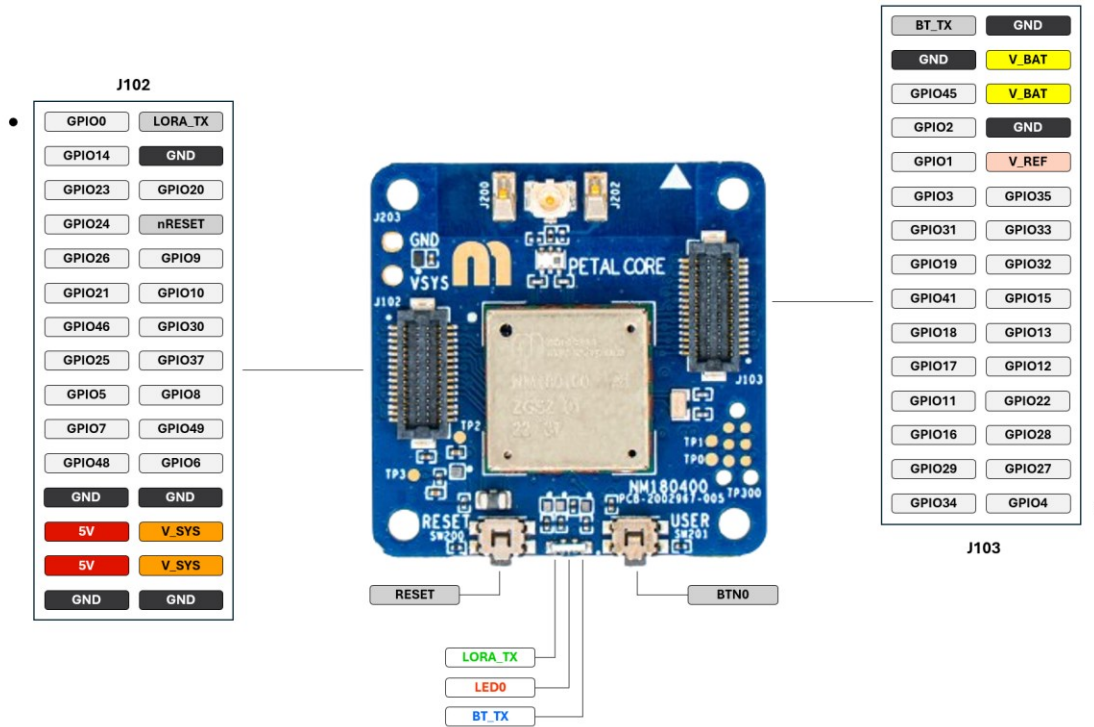


Figure 1: NM18040x Device Pinout - Top View

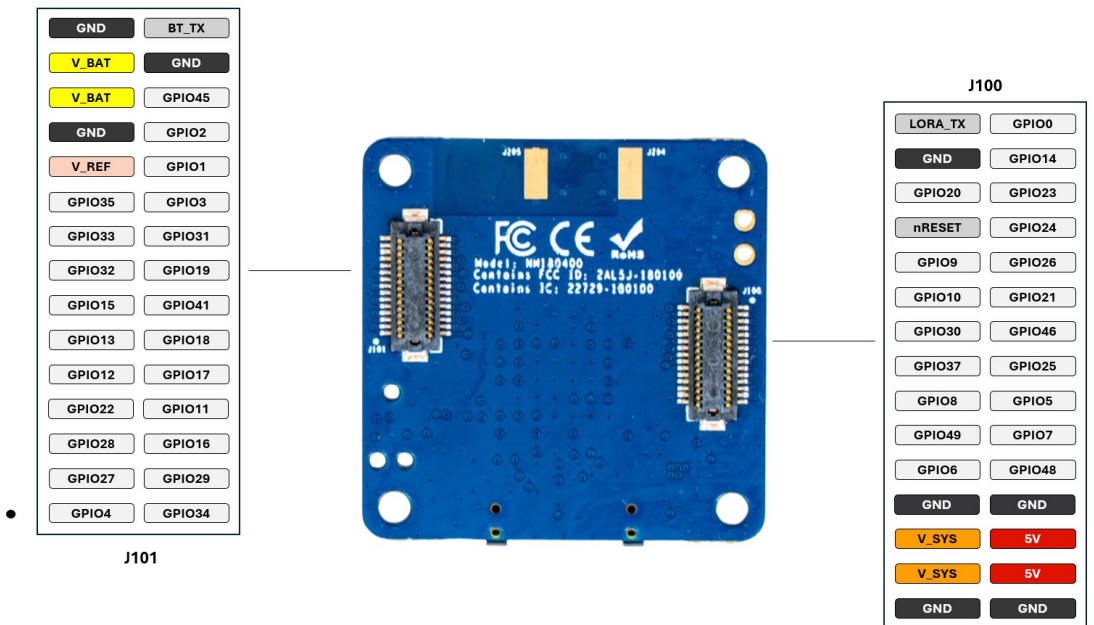


Figure 2: NM18040x Device Pinout - Bottom View

Table 1: NM18040x Pin Description – Connectors J100, J102

| Pin Number | Type | Function | Description   |
|------------|------|----------|---|
| 1          | I/O  | GPIO0    | General purpose I/O <sup>1</sup> .  |
| 2          | I/O  | GPIO14   | General purpose I/O.  |
| 3          | I/O  | GPIO23   | General purpose I/O.  |
| 4          | I/O  | GPIO24   | General purpose I/O.  |
| 5          | I/O  | GPIO26   | General purpose I/O.  |
| 6          | I/O  | GPIO21   | General purpose I/O.  |
| 7          | I/O  | GPIO46   | General purpose I/O.  |
| 8          | I/O  | GPIO25   | General purpose I/O.  |
| 9          | I/O  | GPIO5    | General purpose I/O.  |
| 10         | I/O  | GPIO7    | General purpose I/O.  |
| 11         | I/O  | GPIO48   | General purpose I/O.  |
| 12         | PWR  | GND      | Ground.   |
| 13         | PWR  | 5V       | 5V voltage rail.  |
| 14         | PWR  | 5V       | 5V voltage rail.  |
| 15         | PWR  | GND      | Ground.   |
| 16         | PWR  | GND      | Ground.   |
| 17         | PWR  | V_SYS    | System power.   |
| 18         | PWR  | V_SYS    | System power.   |
| 19         | PWR  | GND      | Ground.   |
| 20         | I/O  | GPIO6    | General purpose I/O.  |
| 21         | I/O  | GPIO49   | General purpose I/O.  |
| 22         | I/O  | GPIO8    | General purpose I/O.  |
| 23         | I/O  | GPIO37   | General purpose I/O.  |
| 24         | I/O  | GPIO30   | IO_EN, active high I/O enable for peripherals on other boards in Petal ecosystem. |
| 25         | I/O  | GPIO10   | nLORA_EN, active-low enable for LoRa radio power supply.                          |
| 26         | I/O  | GPIO9    | General purpose I/O.  |
| 27         | I/O  | nRESET   | NM1801xx active low chip reset.   |
| 28         | I/O  | GPIO20   | General purpose I/O.  |
| 29         | PWR  | GND      | Ground.   |
| 30         | OUT  | LORA_TX  | LoRa transmit indicator, active high output.                                      |

<sup>1</sup> See Apollo3 Pin Mapping - Petal Ecosystem for default functions, module datasheet for alternate functions.

Table 2: NM18040x Pin Description – Connectors J101, J103

| Pin Number | Type | Function | Description   |
|------------|------|----------|---|
| 1          | I/O  | GPIO4    | General purpose I/O <sup>2</sup> .  |
| 2          | I/O  | GPIO27   | General purpose I/O.  |
| 3          | I/O  | GPIO28   | General purpose I/O.  |
| 4          | I/O  | GPIO22   | General purpose I/O.  |
| 5          | I/O  | GPIO12   | General purpose I/O.  |
| 6          | I/O  | GPIO13   | General purpose I/O.  |
| 7          | I/O  | GPIO15   | General purpose I/O.  |
| 8          | I/O  | GPIO32   | General purpose I/O.  |
| 9          | I/O  | GPIO33   | General purpose I/O.  |
| 10         | I/O  | GPIO35   | USER_LED, onboard red LED indicator, also connected to LED0 on Petal Development Board. |
| 11         | PWR  | V_REF    | Reference voltage.  |
| 12         | PWR  | GND      | Ground.   |
| 13         | PWR  | V_BAT    | Battery voltage rail.   |
| 14         | PWR  | V_BAT    | Battery voltage rail.   |
| 15         | PWR  | GND      | Ground.   |
| 16         | OUT  | BT_TX    | BLE transmit indicator, active high output.   |
| 17         | PWR  | GND      | Ground.   |
| 18         | I/O  | GPIO45   | General purpose I/O.  |
| 19         | I/O  | GPIO2    | General purpose I/O.  |
| 20         | I/O  | GPIO1    | General purpose I/O.  |
| 21         | I/O  | GPIO3    | General purpose I/O.  |
| 22         | I/O  | GPIO31   | General purpose I/O.  |
| 23         | I/O  | GPIO19   | General purpose I/O.  |
| 24         | I/O  | GPIO41   | General purpose I/O.  |
| 25         | I/O  | GPIO18   | General purpose I/O.  |
| 26         | I/O  | GPIO17   | General purpose I/O.  |
| 27         | I/O  | GPIO11   | General purpose I/O.  |
| 28         | I/O  | GPIO16   | USER_BTN, onboard USER push button, also connected to BTN0 on Petal Development Board.  |
| 29         | I/O  | GPIO29   | General purpose I/O.  |
| 30         | I/O  | GPIO34   | General purpose I/O.  |

<sup>2</sup> See Apollo3 Pin Mapping - Petal Ecosystem for default functions, module datasheet for alternate functions.

## 6 Electrical Characteristics

Table 3: Absolute Maximum Ratings

| Symbol  | Parameter                | Min | Max  | Unit |
|---------|--------------------------|-----|------|------|
| V_SYS   | System Voltage           |     | 3.63 | 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    |

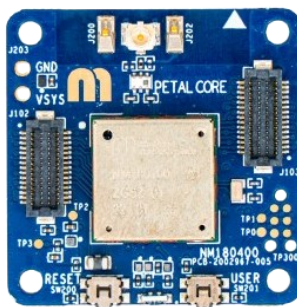
Table 4: Recommended Operating Conditions

| Symbol | Parameter      | Min | Typ | Max | Unit |
|--------|----------------|-----|-----|-----|------|
| V_SYS  | System Voltage | 1.8 | 3.3 | 3.6 | V    |



## 7 Functional Description

### 7.1 Introduction



*Figure 3: NM18040x Petal Core Board*

The Petal ecosystem is a series of modular, stackable development boards that can be combined and reused to quickly create prototype products for development, testing and rapid deployment using Northern Mechatronics' high performance NM1801xx modules.

The NM18040x Petal Core series function as the NM1801xx LoRa and BLE module carrier boards, and act as the core component in every Petal application. The NM18040x can be used with other plug-and-play elements of the ecosystem to quickly build and deploy a custom application.

The features onboard the NM18040x include two push buttons (RESET and USER), tri-colour LED indicator (blue for BLE transmit, green for LoRa transmit, and red user programmable), LoRa radio power control, exposed SWD programming port, and various antenna connector options.

### 7.2 LoRa® Radio

The NM1801xx module on the NM18040x 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 NM18040x includes a Bluetooth Low Energy (BLE) radio that is integrated into the Apollo3 Blue series 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 NM18040x is designed to use 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 all onboard antenna connector options, which are impedance matched to 50 Ohms.

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

The antenna connector options include U.FL and optional spring clips on the top side, and exposed RF pads on the bottom side of the Petal Core board. Multiple antenna connector options allow developers to connect any off-the-shelf or custom antenna that supports the 868MHz, 915MHz, and 2.4GHz frequency bands.

The NM18040x is designed to be completely plug-and-play, including RF connectivity. The Petal Core board can be easily snapped onto the Petal Development Board, making connection with the spring clips below to use the tri-band printed circuit antenna. The Petal Core can then be plugged into a prototype device, using the top-side connector to easily connect to an off-the-shelf U.FL antenna that remains mounted in the prototype housing.

Northern Mechatronics recommends the Molex 212570xxx series of flexible antennas as the default off-the-shelf option for U.FL antenna.

For developers who prefer to integrate a custom antenna using the spring-clip population option, contact Northern Mechatronics for more detailed information and ordering support.

## 7.5 Power Supply

### 7.5.1 System Voltage

The NM18040x Petal Core boards are designed to support the entire operating voltage range of the NM1801xx modules. System voltage, V\_SYS, supported range is from 1.8V to 3.6V. Typical system voltage is 3.3V.

**Note: For optimal LoRa RF performance, Northern Mechatronics recommends maintaining a minimum system voltage of 2.8V. Operating at voltages below 2.8V can potentially reduce transmit power.**

V\_SYS can be supplied to the NM18040x from another board, either the NM18043x Power Petal or NM18041x Petal Development Board, through the Petal stacking connectors. To provide power to a standalone NM18040x Petal Core, V\_SYS can be connected directly to an external power source via the pins of connector J203.

### 7.5.2 LoRa Power Control

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, labelled nLORA\_EN. The control is active low. The LoRa power rail is disabled by default through an onboard pull-up resistor and must be enabled by driving GPIO10 low before operating the LoRa radio.

### 7.5.3 Petal Ecosystem I/O Enable

Though not used directly onboard the NM18040x, other boards in the Petal Ecosystem use a common control line, IO\_EN, to enable/disable peripherals, such as I/O level shifters and output power to external sensors. This is controlled directly by the NM1801xx module GPIO30. The control is active high. Peripherals are disabled by default through an onboard pull-down resistor and must be enabled by driving GPIO30 high.

### 7.5.4 Additional Voltage Rails

The 5V, V\_BAT, and V\_REF voltage rails are not used on the NM18040x Petal Core boards. They are included in the standardized Petal stacking connectors found on the NM18040x to act as a pass through, allowing the Petal boards to be stacked in any order.

## 7.6 Programming

The NM18040x is designed to be programmed over USB when plugged in to a Petal Development Board, using DAPLink. Programming tools available through this USB interface include step debugging, virtual communication port (VCOM), and flashing binary firmware files via drag-and-drop through USB mass storage device emulation.

For more detailed information on programming, see the NM18041x Petal Development Board datasheet, and Northern Mechatronics reference application Getting Started Guide in the public GitHub repository.

For developers who prefer to use a Segger J-Link debugger, the NM1801xx module onboard the NM18040x can be programmed via SWD using the exposed 6-pin needle pads, marked TP300. For more detailed information on SWD debugging, see the NM1801xx module datasheet.

## 8 Mechanical Information

### 8.1 Mechanical Specifications

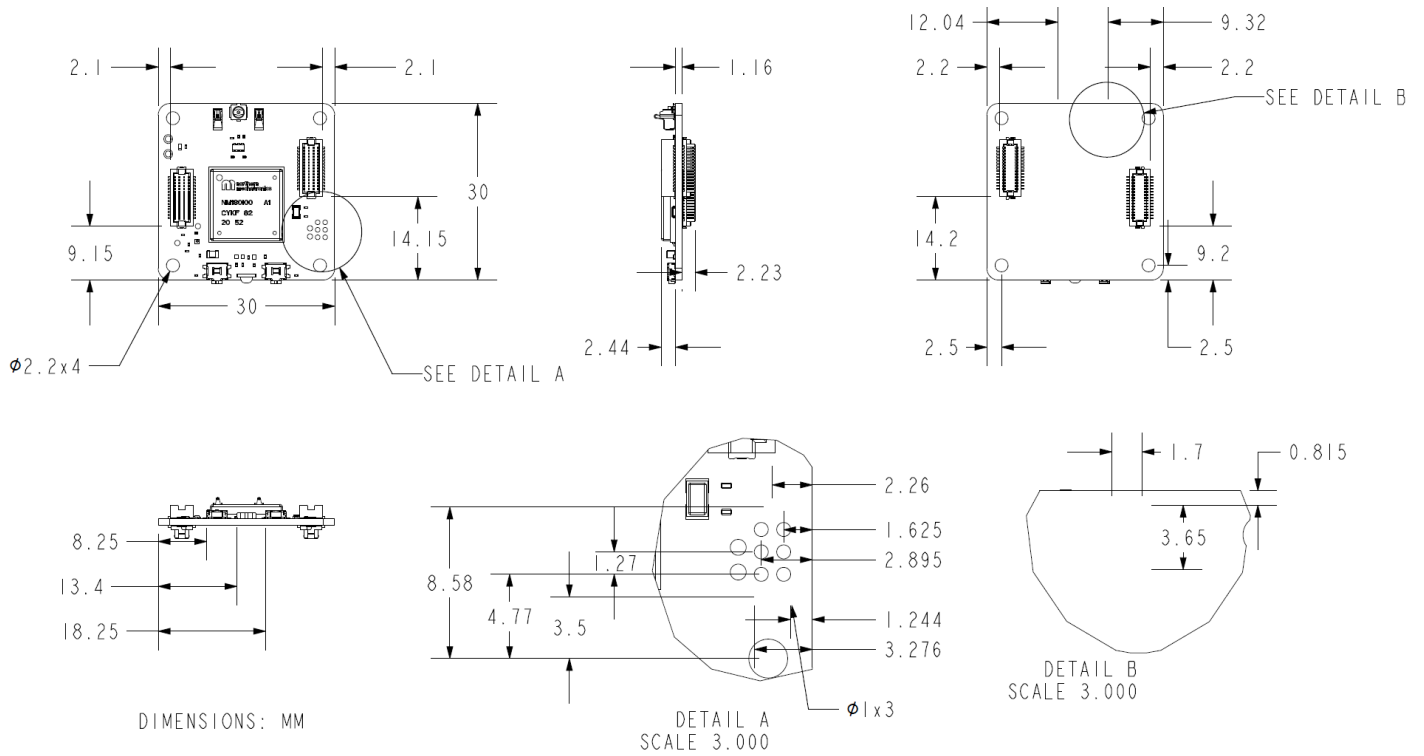


Figure 4: NM18040x Mechanical Specifications

## 8.2 Petal Stacking Connectors

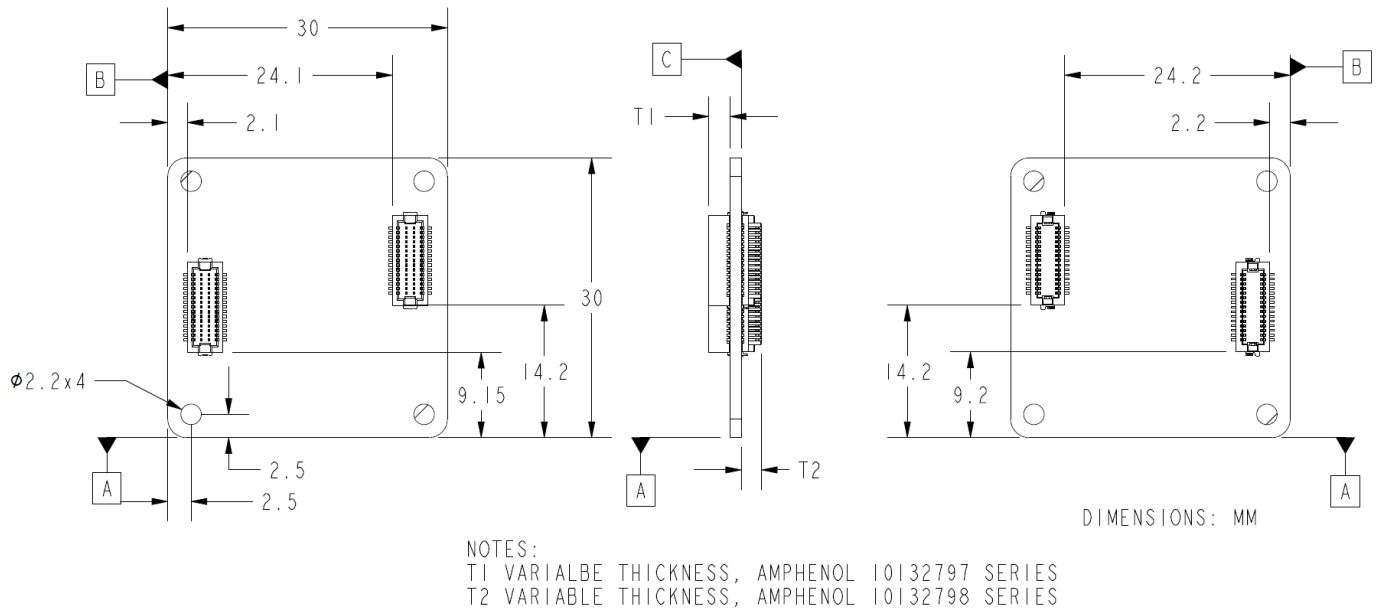


Figure 5: Petal Stacking Connectors Mechanical Specifications

## 8.3 Device Marking

The NM18040x 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.

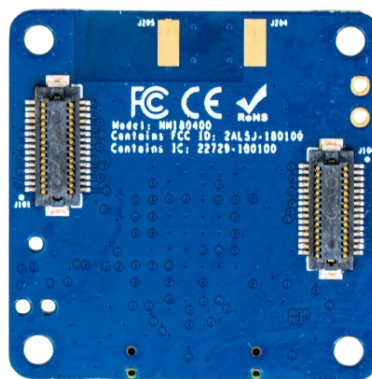


Figure 6: NM18040x Device Marking

## 9 Ordering Information

| Model    | Module   | Package Description   | Package Option |
|----------|----------|---|----------------|
| NM180400 | NM180100 | Petal Core with NM180100 LoRa® Bluetooth® 5 Low Energy Module | Bulk           |
| NM180401 | NM180110 | Petal Core with NM180110 LoRa® Bluetooth® 5 Low Energy Module | Bulk           |

## 10 Revision History

| Revision | Date             | Description      |
|----------|------------------|------------------|
| A.1      | December 5, 2024 | Initial release. |