

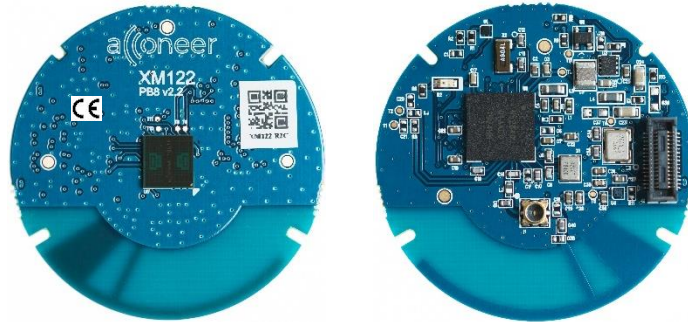


XM122 Connectivity Module  
Manual v1.1

## Abstract

The XM122 connectivity module is a reference module with optimized formfactor that can be used to support customer in their own design for commercial use, for evaluation and development purpose.

The XM122 connectivity module is built around the nRF52840 Bluetooth® 5 SoC (System on Chip) from Nordic Semiconductor and features an integrated antenna for Bluetooth connectivity.



*Figure 1. XM122 connectivity module Top view (left) and XM122 bottom view (right).*

# Table of Content

|       |                                                  |    |
|-------|--------------------------------------------------|----|
| 1     | Revision History .....                           | 4  |
| 2     | Functional description .....                     | 5  |
| 2.1   | Overview .....                                   | 5  |
| 2.2   | Product features.....                            | 5  |
| 2.3   | Block diagram.....                               | 5  |
| 2.4   | Module board connector and pin description ..... | 6  |
| 2.5   | Not mounted battery connector support.....       | 7  |
| 2.6   | MAC addresses.....                               | 8  |
| 3     | Interfaces .....                                 | 9  |
| 3.1   | Module supply input .....                        | 9  |
| 3.2   | System functions.....                            | 9  |
| 3.3   | Serial interfaces .....                          | 9  |
| 3.4   | Digital I/O interfaces .....                     | 9  |
| 3.5   | Analog I/O interfaces.....                       | 9  |
| 3.6   | Module reset.....                                | 9  |
| 3.7   | Debug interface.....                             | 9  |
| 4     | Electrical specifications.....                   | 10 |
| 4.1   | Absolute maximum ratings .....                   | 10 |
| 4.2   | Recommended operating conditions .....           | 10 |
| 4.3   | Power consumption summary .....                  | 11 |
| 4.4   | RF specification.....                            | 12 |
| 5     | Reference design description .....               | 13 |
| 5.1   | Schematics & BOM .....                           | 13 |
| 5.2   | Component Placement Drawing.....                 | 19 |
| 6     | Mechanical specifications.....                   | 21 |
| 7     | Regulatory Approval (In progress) .....          | 23 |
| 7.1   | FCC Approval (In progress) .....                 | 23 |
| 7.1.1 | FCC Regulatory Notes .....                       | 23 |
| 7.2   | Industry Canada Approval (In progress) .....     | 25 |
| 7.2.1 | Regulatory Information Canada .....              | 25 |
| 8     | Reference documents.....                         | 27 |
| 9     | Abbreviations.....                               | 28 |
|       | Disclaimer .....                                 | 29 |

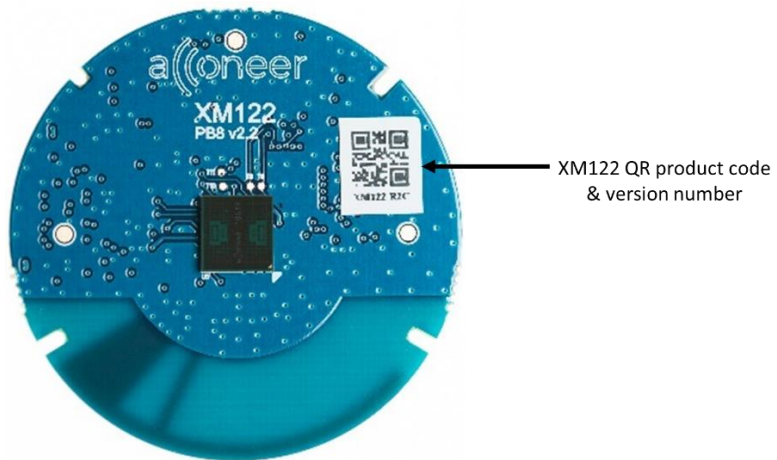
# 1 Revision History

| Revision | Comment          |
|----------|------------------|
| V1.1     | Released version |

This document applies to the following product:

| Product name              | Part number |
|---------------------------|-------------|
| XM122 connectivity module | XM122       |

**XM122 connectivity module marking:**



## 2 Functional description

### 2.1 Overview

The XM122 connectivity module comes with Nordic nRF52840 SoC, see ref [1]. The Nordic nRF52840 supports Bluetooth 5/Bluetooth Mesh/Thread/Zigbee/ 802.15.4/ANT/2.4 GHz.

### 2.2 Product features

The XM122 is an IoT Connectivity module based on the Nordic nRF52840 SoC.

XM122 connectivity module features:

- The nRF52840 protocol stack support for Bluetooth 5, Bluetooth mesh, and is built around the 64 MHz ARM® Cortex™-M4 CPU with 256 KB SRAM and 1 MB Flash.
- Integrated 2.4 GHz micro strip IFA (inverted F antenna).
- Optimized circular form factor with a diameter of 33 mm.
- Wide single supply operating voltage range 2.0 V to 5.5 V.
- Operating temperature -40° to 85°C.
- External I/F support - SPI, UART, I2C, GPIO

### 2.3 Block diagram

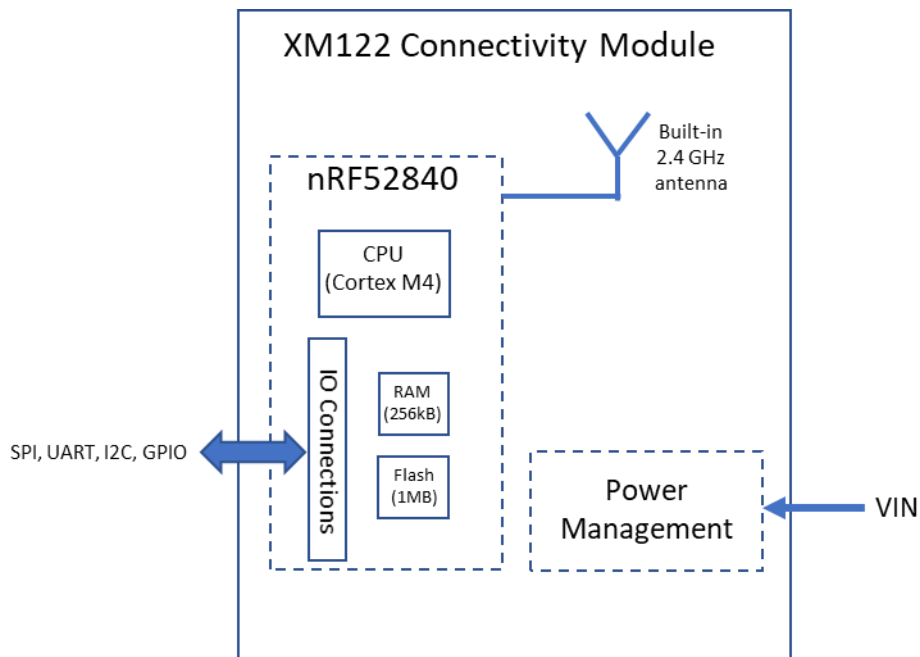


Figure 2.1. XM122 Connectivity module block diagram.

The XM122 connectivity module block diagram shows the nRF52840 microcontroller. The module provides a pin connector where the MCU external I/F are accessible including single voltage supply.

## 2.4 Module board connector and pin description

The board to board connector provides the external interface to the module. Figure 2.2 shows the connector footprint and Table 2.1 describes each signal.

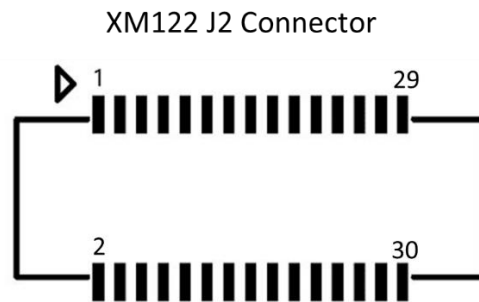


Figure 2.2. XM122 connectivity module J2 connector footprint.

| Pin Number | Signal          | Description                                                          | nRF52840*<br>pin    |
|------------|-----------------|----------------------------------------------------------------------|---------------------|
| 1          | GPIO            |                                                                      | P0.23               |
| 2          | GND             | Ground                                                               | -                   |
| 3          | GND             | Ground                                                               | -                   |
| 4          | VIN             | 2.0-5.5 V external power supply. Pin 4 and Pin 6 are interconnected. | -                   |
| 5          | GPIO            |                                                                      | P0.21               |
| 6          | VIN             | 2.0-5.5 V external power supply. Pin 4 and Pin 6 are interconnected. | -                   |
| 7          | GND             | Ground                                                               | -                   |
| 8          | GND             | Ground                                                               | -                   |
| 9          | GPIO            |                                                                      | P0.24               |
| 10         | GPIO            | Configurable as Analog Input.                                        | P0.04               |
| 11         | GND             | Ground                                                               | -                   |
| 12         | GPIO            | Configurable as JTAG Trace signal.                                   | P0.11<br>TRACEDATA2 |
| 13         | GPIO            |                                                                      | P0.22               |
| 14         | GPIO            | Configurable as JTAG Trace signal.                                   | P0.12<br>TRACEDATA1 |
| 15         | GND             | Ground                                                               | -                   |
| 16         | VDD             | Regulated 1.8 V output voltage.                                      | -                   |
| 17         | GPIO            |                                                                      | P0.06               |
| 18         | GPIO,<br>nRESET | nRF52840 reset pin.                                                  | P0.18<br>nRESET     |
| 19         | GPIO            |                                                                      | P0.16               |

|    |           |                                                                                                                   |                     |
|----|-----------|-------------------------------------------------------------------------------------------------------------------|---------------------|
| 20 | SWDIO     | SWD interface for flash and debug.                                                                                | SWDIO               |
| 21 | GND       | Ground                                                                                                            | -                   |
| 22 | GPIO, SWO | SWD interface for flash and debug. Configurable as JTAG Trace signal.                                             | P1.00<br>TRACEDATA0 |
| 23 | GPIO      | Configurable as JTAG Trace signal.                                                                                | P0.07<br>TRACECLK   |
| 24 | GND       | Ground                                                                                                            | -                   |
| 25 | GPIO      | Configurable as JTAG Trace signal.                                                                                | P1.09<br>TRACEDATA3 |
| 26 | SWDCLK    | SWD interface for flash and debug.                                                                                | SWDCLK              |
| 27 | GPIO      |                                                                                                                   | P0.20               |
| 28 | GND       | Ground                                                                                                            | -                   |
| 29 | GPIO      |                                                                                                                   | P0.19               |
| 30 | GPIO, DFU | Device Firmware Upgrade. Set low during reset to enter bootloader mode. Could also be used as miscellaneous GPIO. | P0.25               |

*Table 2.1. J2 connector pinout.*

## 2.5 Not mounted battery connector support

Not mounted battery connector (Reference Designator J3) supported on XM122 connectivity module PCB. See chapter 5 schematics for further information. Example of compatible battery connectors:

- Vertical Amphenol 10114828-10102LF
- Horizontal Amphenol 10114828-10102LF
- Horizontal Molex 532617002

## 2.6 MAC addresses

The XM122 connectivity module comes with a Static Random Bluetooth Address provided by the Nordic nRF52840 SoC. This address is assigned randomly during manufacturing. This static address can be used for evaluation.

## 3 Interfaces

### 3.1 Module supply input

The XM122 connectivity module support external single power supply for battery power applications, see table 4.2 recommended operating conditions.

Note that supply voltage conditions (E.g. slew rate) need to be taken into consideration according to nRF52840 product specification & manual, ref [1].

### 3.2 System functions

Module RESET is supported by activating NRST pin (active low).

Module ERASE is used to reinitialize the MCU Flash content and some of its NVM (Non-Volatile Memory) bits to an erased state. See nRF52840 product specification & manual, ref [1] for further information.

### 3.3 Serial interfaces

The XM122 connectivity module nRF52840 GPIO pins can be configured to support up to two UART, up to four SPI master or three SPI slave and up to two I2C compatible 2-wire master/slave external serial interfaces. See table 2.1 for HW configuration. See also nRF52840 product specification & manual, ref [1] for further information.

### 3.4 Digital I/O interfaces

The XM122 connectivity module support General Purpose IOs (GPIOs), 16 GPIOs are available. The GPIO pins are configurable for different functions, only the debug and RESET pins are fixed to specific GPIOs. See table 2.1 for HW configuration. See also nRF52840 product specification & manual, ref [1] for further information.

### 3.5 Analog I/O interfaces

The XM122 connectivity module support one analog input (pin 10 on XM122 connector J2) and up to four individual PWM outputs which can be assigned to any of the GPIO pins. See table 2.1 for HW configuration.

### 3.6 Module reset

The XM122 connectivity module has an external reset option (Pin 18 on XM122 connector J2) that can be configured as a GPIO or RESET input.

### 3.7 Debug interface

The XM122 has 7 debug pins, SWDIO, SWDCLK and Trace signals. TRACE signals reuse GPIO pins. See table 2.1 for HW configuration.

## 4 Electrical specifications

### 4.1 Absolute maximum ratings

The below table shows the XM122 connectivity module absolute maximum ratings over operating temperature range, unless otherwise noted:

| Parameter        | Description                 | Min. | Max. | Unit |
|------------------|-----------------------------|------|------|------|
| VIN              | power supply                | -0.3 | 6.0  | V    |
| I/O              | Voltage on I/O pins         | -0.3 | 2.1  | V    |
| T <sub>OP</sub>  | Operating temperature range | -40  | 85   | °C   |
| T <sub>STG</sub> | High temperature storage    |      | 125  | °C   |

Table 4.1. Absolute maximum ratings.

Stresses beyond those listed in table 4.1 may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these conditions or at any other conditions beyond those indicated under Recommended Operating Conditions is not implied. Exposure to absolute-maximum-rated conditions for extended periods of time may affect device reliability.

### 4.2 Recommended operating conditions

The below table shows the XM122 connectivity module recommended operating conditions:

| Parameter                                         | Min. | Typ. | Max. | Unit |
|---------------------------------------------------|------|------|------|------|
| VIN, operating power supply voltage <sup>1)</sup> | 2.0  |      | 5.5  | V    |
| I/O operating range                               | 0    |      | 1.8  | V    |
| Operating temperature <sup>1)</sup>               | -40  |      | 85   | °C   |

Table 4.2. Recommended operating conditions.

<sup>1)</sup> Minimum battery voltage depends on battery internal resistance and temperature.

### 4.3 Power consumption summary

See nRF52840 product specification and manual, ref [1].

## 4.4 RF specification

The XM122 connectivity module support Bluetooth v5 including BLE, mesh, long range and advertising extensions.

The below table shows the XM122 connectivity module Bluetooth radio performance:

| Parameter                             | Min. | Typ. | Max. | Unit |
|---------------------------------------|------|------|------|------|
| Frequency (40 channels)               | 2.4  |      | 2.48 | GHz  |
| Data rate                             |      | 2    |      | Mbps |
| Total radiated power (TRP)            |      | 5.5  |      | dBm  |
| Conducted RX sensitivity (BLE)        |      | -97  |      | dBm  |
| Conducted RX sensitivity (Long range) |      | -101 |      | dBm  |
| Conducted total link budget           |      | -109 |      | dBm  |

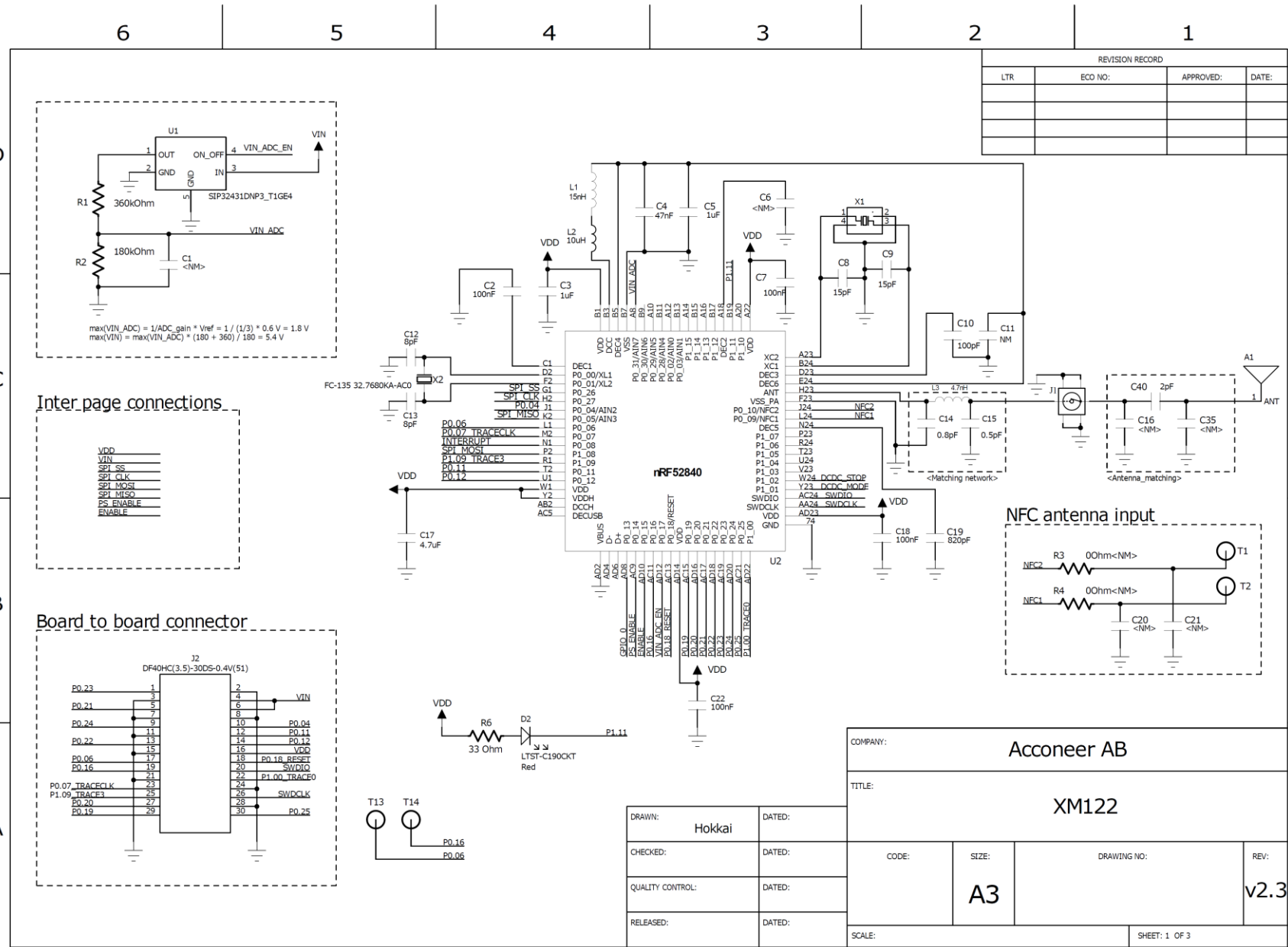
*Table 4.5. XM122 connectivity module Bluetooth radio performance.*

## 5 Reference design description

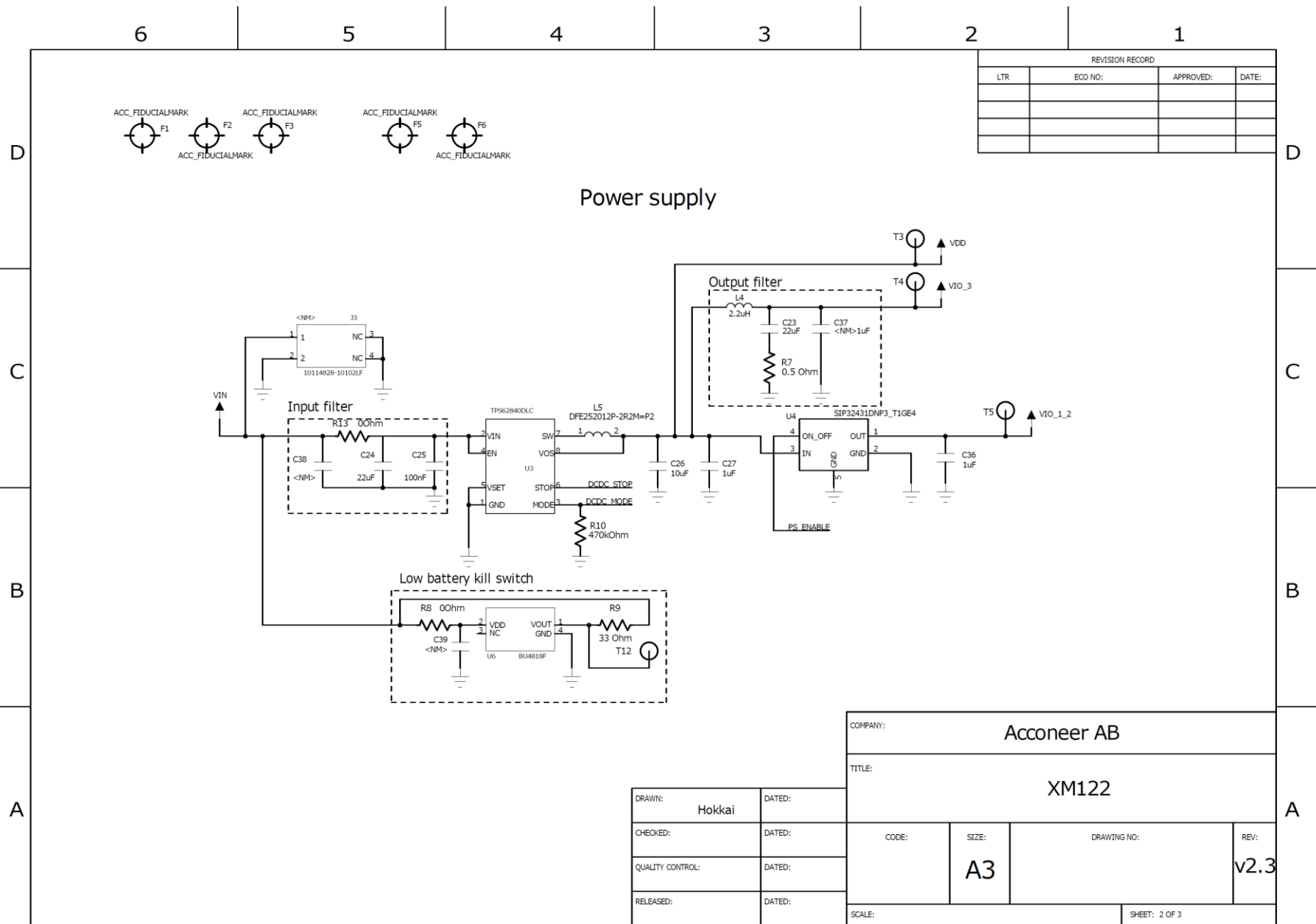
### 5.1 Schematics & BOM

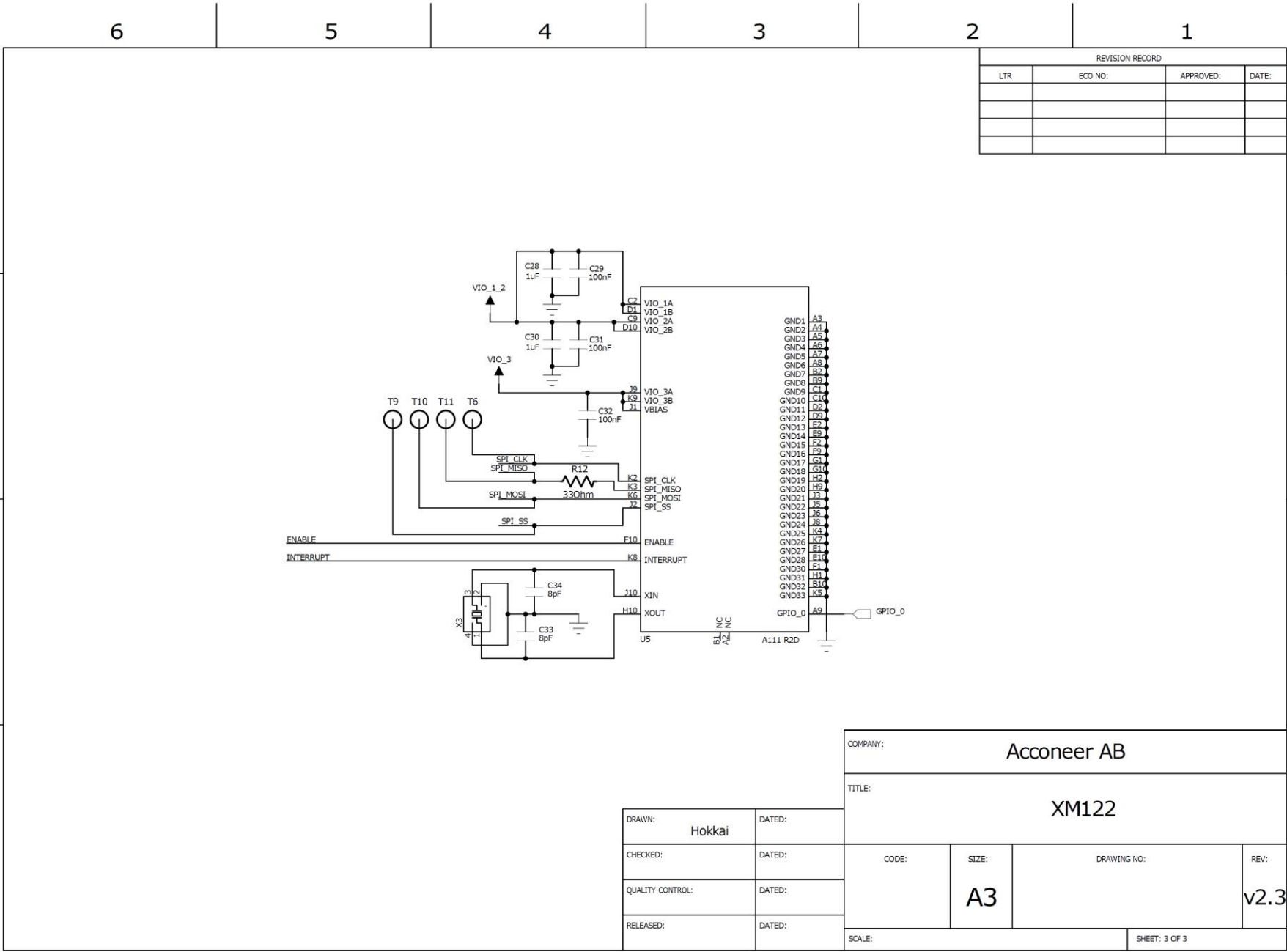
The following pages include the module schematics and bill of materials.

Note that Schematics and BOM includes example implementation with Acconeer A111 radar sensor.



|                  |        |        |  |
|------------------|--------|--------|--|
| DRAWN:           | Hokkai | DATED: |  |
| CHECKED:         |        | DATED: |  |
| QUALITY CONTROL: |        | DATED: |  |
| RELEASED:        |        | DATED: |  |







## Bill of Material

Table 6.1 shows the BOM for XM122 module.

| Component Ref.                | Specification             | QTY | Value  | Comment                                               |
|-------------------------------|---------------------------|-----|--------|-------------------------------------------------------|
| C2,C7,C18,C22,C25,C29,C31,C32 | 100/NF/K/50V/X7R/1005     | 8   | 100 nF |                                                       |
| C3,C5,C27,C28,C30,C36         | 1/UF/K/10V/X5R/1005       | 6   | 1uF    |                                                       |
| C4                            | 47/NF/K/50V/X5R/1005      | 1   | 47nF   |                                                       |
| C8,C9                         | 15/PF/J/50V/NP0/1005      | 2   | 15pF   |                                                       |
| C10                           | 100/PF/J/10V/NP0,C0G/1005 | 1   | 100pF  |                                                       |
| C12,C13,C33,C34               | 8/PF/C/50V/NP0,C0G/1005   | 4   | 8pF    |                                                       |
| C14                           | 0.75/PF/B/50V/C0G/1005    | 1   | 0.8pF  |                                                       |
| C15                           | 0.5/PF/C/50V/C0G/1005     | 1   | 0.5pF  |                                                       |
| C17                           | 4.7/UF/M/10V/X5R/1005     | 1   | 4.7uF  |                                                       |
| C19                           | 820/PF/F/50V/NP0/1005     | 1   | 820pF  |                                                       |
| C23,C24                       | 22/UF/M/10V/X5R/1608      | 2   | 22uF   |                                                       |
| C26                           | 10/UF/M/10V/X5R/1005      | 1   | 10uF   |                                                       |
| C40                           | 2/PF/C/50V/N/A/1005       | 1   | 2pF    |                                                       |
| D2                            | LTST-C190CKT              | 1   |        | 638nm LED RED CLEAR CHIP SMD                          |
| J1                            | MM8130-2600               | 1   |        |                                                       |
| J2                            | DF40HC(3.5)-30DS-0.4V(51) | 1   |        | Manufacturer: Hirose                                  |
| L1                            | 15/NH/1005/J              | 1   | 15nH   | Manufacturer: Murata<br>Part number:<br>LQG15HS15NJ02 |
| L2                            | 10/UH/1608                | 1   | 10uH   | Manufacturer: TDK<br>Part number:<br>MLZ1608N100LT000 |
| L3                            | 4.7/nH/1005/+0.3nH        | 1   | 4.7nH  | Manufacturer: TDK<br>Part number:<br>MHQ1005P4N7ST000 |
| L4                            | 2.2/uH/1608/M             | 1   | 2.2uH  | Manufacturer: TDK<br>Part number:<br>MLZ1608N2R2LT000 |

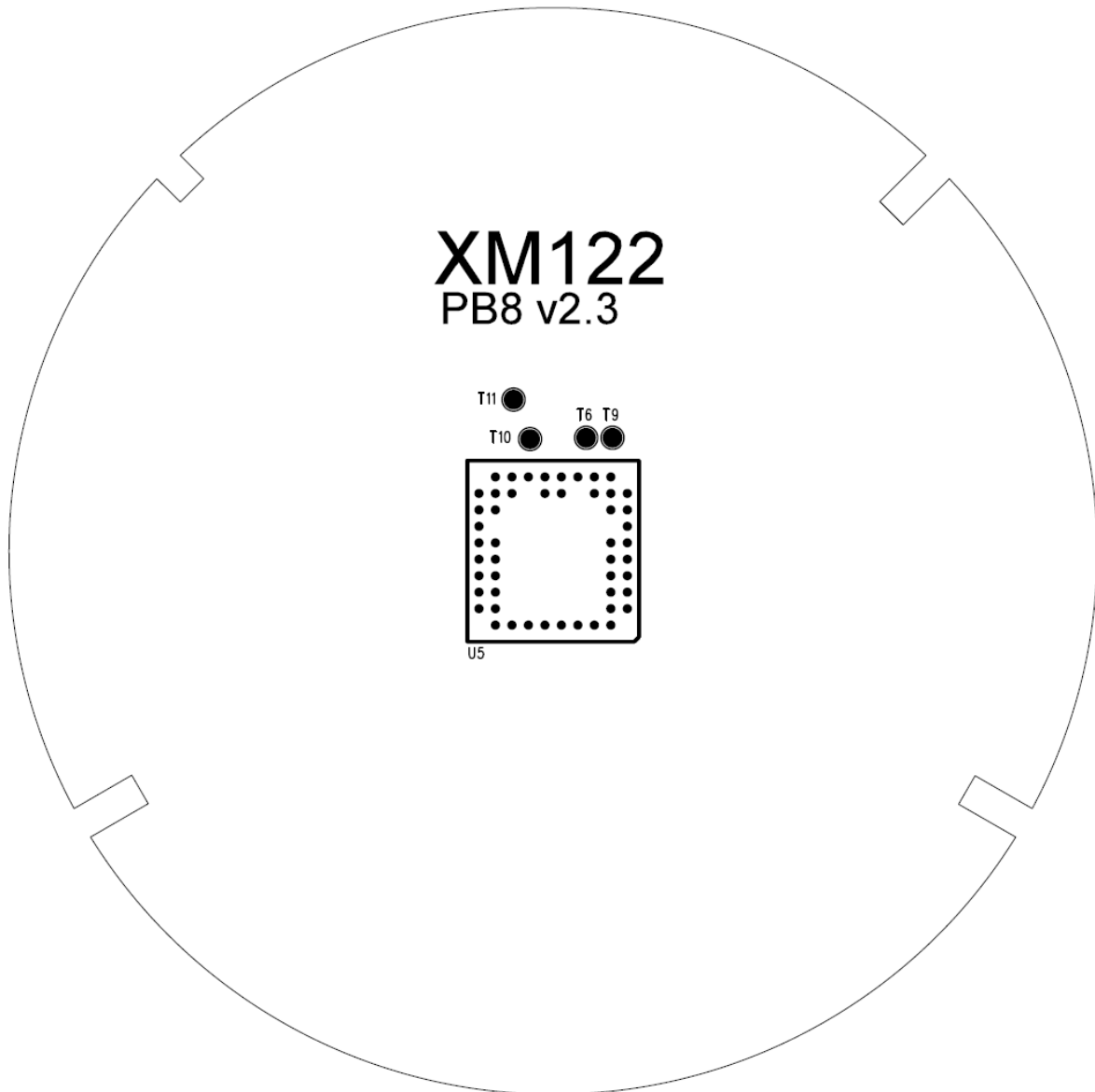
|             |                                 |   |          |                                                            |
|-------------|---------------------------------|---|----------|------------------------------------------------------------|
| L5          | 2.2/UH/2520/M                   | 1 | 2.2uH    | Manufacturer: Murata<br>Part number:<br>DFE252012P-2R2M=P2 |
| R1          | 360/Kohm/J/1005                 | 1 | 360 kOhm |                                                            |
| R2          | 180/KOHM/F/1005                 | 1 | 180kOhm  |                                                            |
| R6, R9, R12 | 33/OHM/F/1005                   | 3 | 33 Ohm   |                                                            |
| R7          | 0.5/OHM/J/1005                  | 1 | 0.5 Ohm  |                                                            |
| R8, R13     | 0/OHM/J/1005                    | 2 | 0 Ohm    |                                                            |
| R10         | 470/KOHM/F/1005                 | 1 | 470 kOhm |                                                            |
| U1, U4      | SIP32431DNP3_T1GE4              | 2 |          |                                                            |
| U2          | NORDIC_BT5.0_LONGRANGE_NRF52840 | 1 |          | NRF52840_QIAA                                              |
| U3          | TPS62840DLCR                    | 1 |          |                                                            |
| U5          | A111 R2D                        | 1 |          |                                                            |
| U6          | BU4818F-TR                      | 1 |          |                                                            |
| X1          | 32MHz/10ppm/10PF/50OHM/2520     | 1 |          |                                                            |
| X2          | 32.768kHz/20ppm/9.5PF/90KOHM/2  | 1 |          |                                                            |
| X3          | TSX-3225 24.0000MF20G-AC0/SMD   | 1 |          |                                                            |

Table 6.1. XM122 connectivity module BOM list.

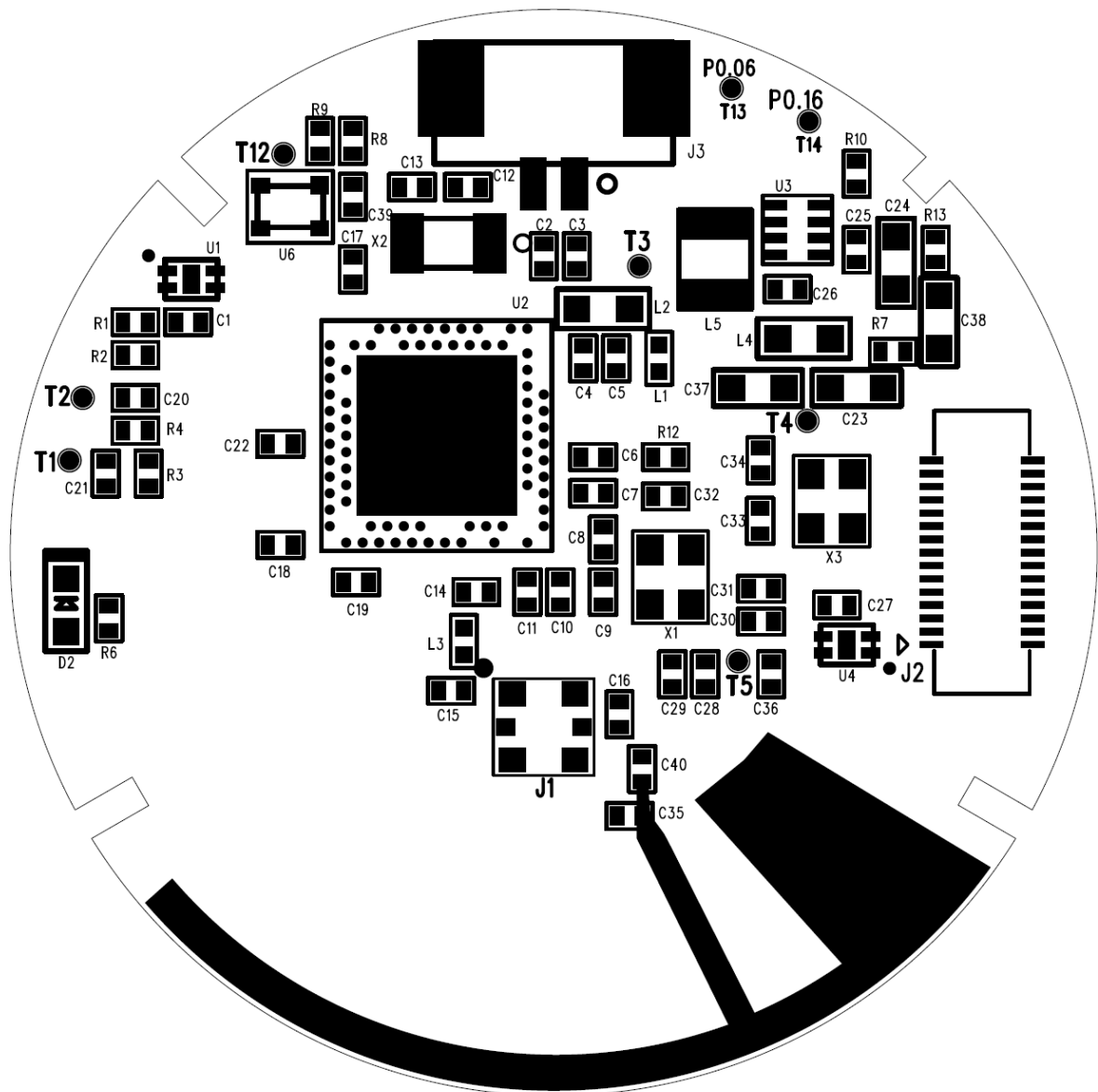
## 5.2 Component Placement Drawing

The component placement drawing of XM122 connectivity module is found below:

Top side

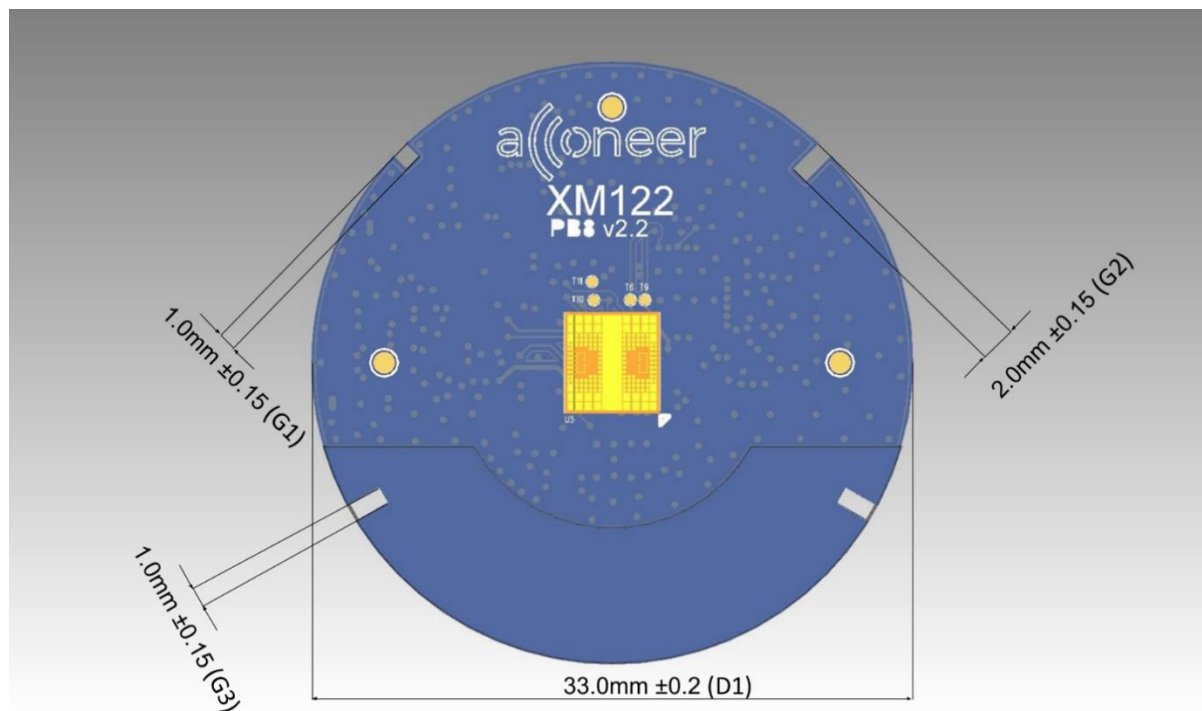


Bottom side:

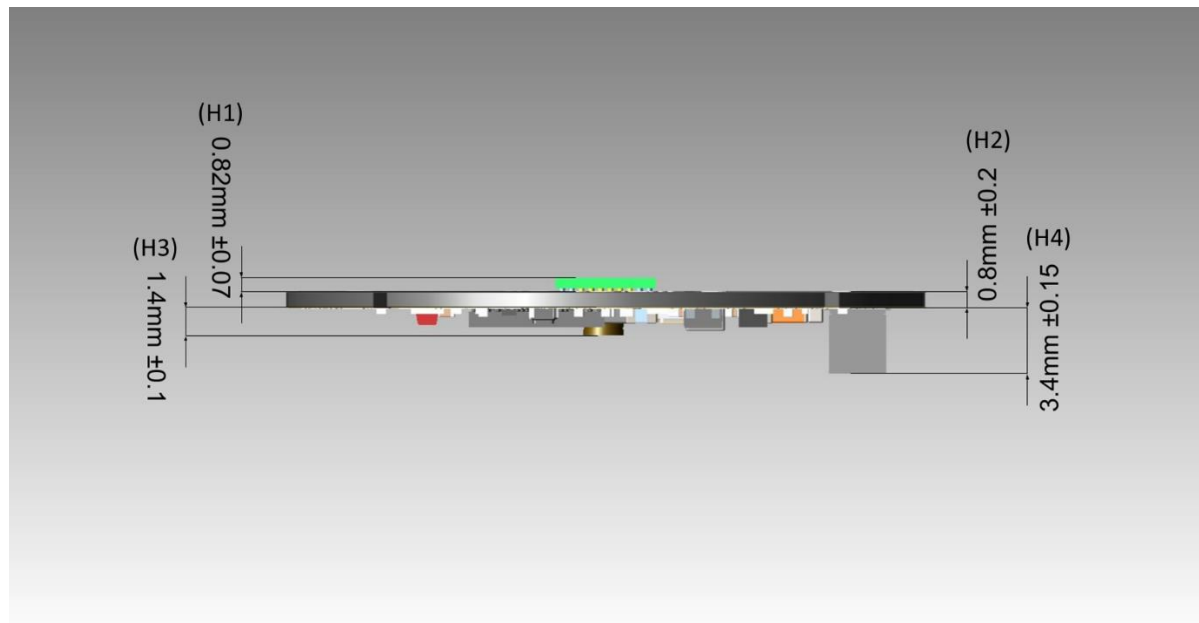


## 6 Mechanical specifications

### XM122 connectivity module outline – Top view



### XM122 connectivity module outline – Side view



| Distance | Value   | Tolerance  |
|----------|---------|------------|
| D1       | 33.0 mm | +/-0.2 mm  |
| H1       | 0.82 mm | +/-0.07 mm |
| H2       | 0.8 mm  | +/-0.2 mm  |
| H3       | 1.4 mm  | +/-0.1 mm  |
| H4       | 3.4 mm  | +/-0.15 mm |
| G1       | 1.0 mm  | +/-0.15 mm |
| G2       | 2.0 mm  | +/-0.15 mm |
| G3       | 1.0 mm  | +/-0.15 mm |

## 7 Regulatory Approval (In progress)

### 7.1 FCC Approval (In progress)

Hereby, Acconeer declares that the XM122 Connectivity module has limited modular approval granted by FCC.

The XM122 Connectivity module meets the title 47 of the Code of Federal Regulations, part 15C.

FCC ID: 2AQ6KXM001

The host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the limited modular transmitter grant of certification.

#### 7.1.1 FCC Regulatory Notes

This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s) and complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference.
2. This device must accept any interference received, including interference that may cause undesired operation of the device.

#### Applicable FCC rules

The XM122 Connectivity module transmitter complies with FCC part 15 rules. The XM122 Connectivity module transmitter is only FCC authorized for the specific rule parts listed in the grant. The host product manufacturer is responsible for compliance to any other FCC rule that apply to the host not covered by the modular transmitter grant of certification.

The XM122 Connectivity module has limited modular approval granted by FCC. The approval is limited as shielding is not included and this must be considered by the host manufacturer when demonstrating compliance with FCC part 15 rules.

#### Modifications

Acconeer has not approved any changes to this device. Any changes or modifications to this device could invalid the FCC approval.

#### Interference statement

This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

#### RF exposure

This device complies with the FCC radiation exposure limits set forth for an uncontrolled environment. Co-location of this module with other transmitters that operate simultaneously are required to be evaluated using the FCC multi-transmitter procedures.

The RF exposure has been calculated with a 20 cm separation distance I.e. Mobile devices.

#### Labelling requirements for the host device

The host device shall be labelled to identify the modules within the host device, which means that the host device shall be labelled to display the FCC ID of the module preceded by words "Contains transmitter module" or "Contains", E.g.

*Contains FCC ID: 2AQ6KXM001*



## 7.2 Industry Canada Approval (In progress)

The XM122 Connectivity Module meets the ISED's Radio Standards Specifications for unlicensed equipment according to RSS-247.

IC certification number: 24388-XM122

*Le module de connectivité XM122 répond aux spécifications des normes radio de l'ISED pour les équipements sans licence selon RSS-247.*

*Numéro d'identification IC: 24388-XM122*

### 7.2.1 Regulatory Information Canada

Acconeer has not approved any changes to this device. Any changes or modifications to this device could invalid the usage of the module.

*Acconeer n'a pas approuvé aucun changement de ce dispositif. Tout changement ou toute modification de ce dispositif pourrait invalider l'usage du module.*

This device complies with Industry Canada's licence-exempt RSSs. Operation is subject to the following two conditions: (1) This device may not cause interference; and (2) This device must accept any interference, including interference that may cause undesired operation of the device.

*Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.*

#### RF Exposure

Radiation Exposure Statement This equipment complies with Canada radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

*Déclaration d'exposition aux radiations*

*Cet équipement est conforme Canada limites d'exposition aux radiations dans un environnement non contrôlé. Cet équipement doit être installé et utilisé à distance minimum de 20cm entre le radiateur et votre corps.*

### Labelling requirements for the host device

The host device should be labelled to identify the modules within the host device, which means that the host device shall be labelled to display the IC of the module preceded by words "Contains transmitter module" or "Contains", or similar wording expressing the same meaning, as follows

*Contains IC: 24388-A111*

*Le dispositif hôte doit être étiqueté afin d'identifier les modules du dispositif hôte, ce qui veut dire que le dispositif hôte doit être étiqueté pour exposer le IC du module précédé par les mots "Contient module émetteur" ou "Contient", ou des termes similaires exprimant le même sens, comme suit:*

*Contient IC: 24388-A111*

## 8 Reference documents

- [1] Nordic nRF52840 product specification & manual:  
[Nordic Semiconductor](#)

## 9 Abbreviations

|      |                                             |
|------|---------------------------------------------|
| BLE  | Bluetooth Low Energy                        |
| BOM  | Bill of Materials                           |
| GND  | Ground                                      |
| GPIO | General Purpose Input/Output                |
| HW   | HardWare                                    |
| I2C  | Inter-Integrated Circuit                    |
| MAC  | Media Access Control                        |
| MCU  | MicroController Unit                        |
| RF   | Radio Frequency                             |
| SoC  | System on Chip                              |
| SPI  | Serial Peripheral Interface                 |
| SW   | SoftWare                                    |
| SWD  | Serial Wire Debug                           |
| UART | Universal Asynchronous Receiver/Transmitter |

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