

# **SX1272LM1CEP NAMote-72**

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## **USER GUIDE**

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## 1 Introduction

This document describes how to use the SX1272LM1CEP North America LoRa Mote (NAMote-72) Device. This device represents a completely programmable LoRa end device solution with a built in mbed compatible programming interface and a LiOn battery and charger. This device provides the user with a number of built in sensors including a GPS receiver, pressure transducer, touch sensor, accelerometer, and thermometer. The intent is to provide the user with a platform to demonstrate the capabilities of LoRa and LoRaWAN in both private and public networks when used with a LoRaWAN concentrator. With mbed, users can easily download and install existing code examples as well as develop their own custom code.

The heart of the device is the SX1272 LoRa transceiver chip. It is configured to allow the user to select the PA\_Boost port output providing from approximately 0dBm to 19dBm transmit power at the antenna port, or to select an on board power amplifier output, driven from the SX1272's RFO port that can provide between 23 dBm to 30 dBm. A printed circuit board antenna is also included, as well as an RF connector that permits the use of an external antenna.

The NAMote-72 can operate over a wide frequency range, including the 868 MHz European and the 902-928 MHz North American ISM bands. An appropriate antenna must be used for the selected operating band. Although primarily intended for LoRa applications, the user can also enable FSK mode for conventional or legacy applications. Coupled with a link budget in excess of 135 dB in FSK and in excess of 155 dB in LoRa, the NAMote-72 really offers the possibility of two modems in one single package. The device can comply with both ETSI and FCC regulatory requirements.

An Arduino compatible interface is provided which enables the user to incorporate any of the widely available shields into their application.

The SX1272LM1CEP NAMote-72 requires only a PC with a USB interface for programming and a USB compatible charger to recharge the internal battery.

## 2 Getting Started

### 2.1 Evaluation Kit Contents

The SX1272LM1CEP evaluation kit consists of:

- SX1272LM1CEP - NAMote-72 NorAm LoRa Mote Device (shown below in Figure 1)
- USB type-A to USB micro-B cable



Figure 1 SX1272LM1CEP NorAm LoRa Mote Module

### 2.2 Ordering Information

Part #	Description
SX1272LM1CEP	NAMote-72 - 915MHz North America LoRa Mote w/o SMA

## 3 Connecting to the NorAm LoRa Mote (NAMote-72)

### 3.1 User Interface

The SX1272LM1CEP NorAm LoRa Mote is intended to enable a quick and easy range test of the SX1272 modules. Figure 2 below shows the Lora Mote endplate.

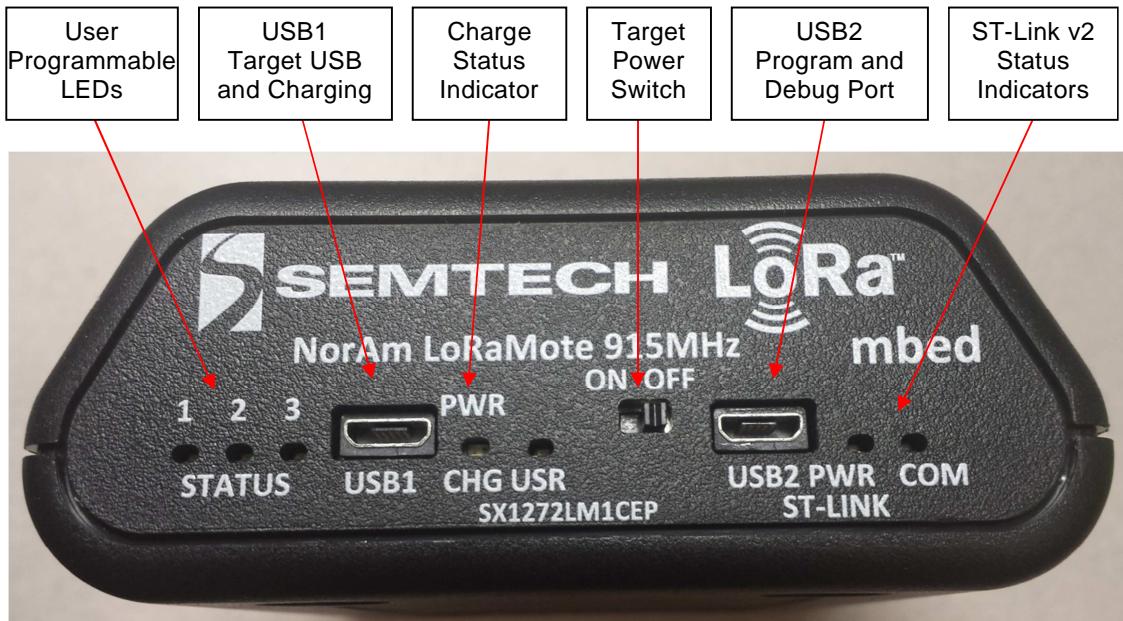


Figure 2 SX1272LM1CEP Endplate

#### 3.1.1 USB1 Charge Port

The USB1 Charger port connects to an external USB wall charger or host computer USB port. Under low battery conditions, the charger can supply up to 700mA to recharge the battery while also powering the module. This charge status indicator LED will illuminate orange when the battery is charging and green when fully charged.

#### 3.1.2 User Configurable LEDs

There are four LEDs provided, which under user control can be used to provide module status. The MCU ports for these LEDs are shown in the appendix. LED1 is red, LED2 is yellow, LED 3 is green and LED USR is red. Additional details can be found in the Appendix.

#### 3.1.3 Power Switch

This switches on the battery to power the module. When this switch is in the OFF position, and a charger is connected to USB1, all charge current is directed to the battery. When a charger is connected and the switch is on, a portion of the charge current charges the battery and a portion helps power the module.

#### 3.1.4 USB2 Program and Debug port

This port serves two functions. When connected to the Host PC through the USB cable, a mbed mass storage device will appear on the Host PC, permitting the user to program the module. In addition, a virtual com port will also appear, enabling serial communication with user firmware. The ST-Link status indicators show programming status. Green indicates successful download.

### 3.2 SX1272LM1CEP Device Hardware

The SX1272LM1CEP major component location is shown in

Figure 3 SX1272LM1CEP Details. The schematics are shown in Figure 4 NorAm Mote RF Schematic to Figure 7 NorAm Mote Peripherals Schematic

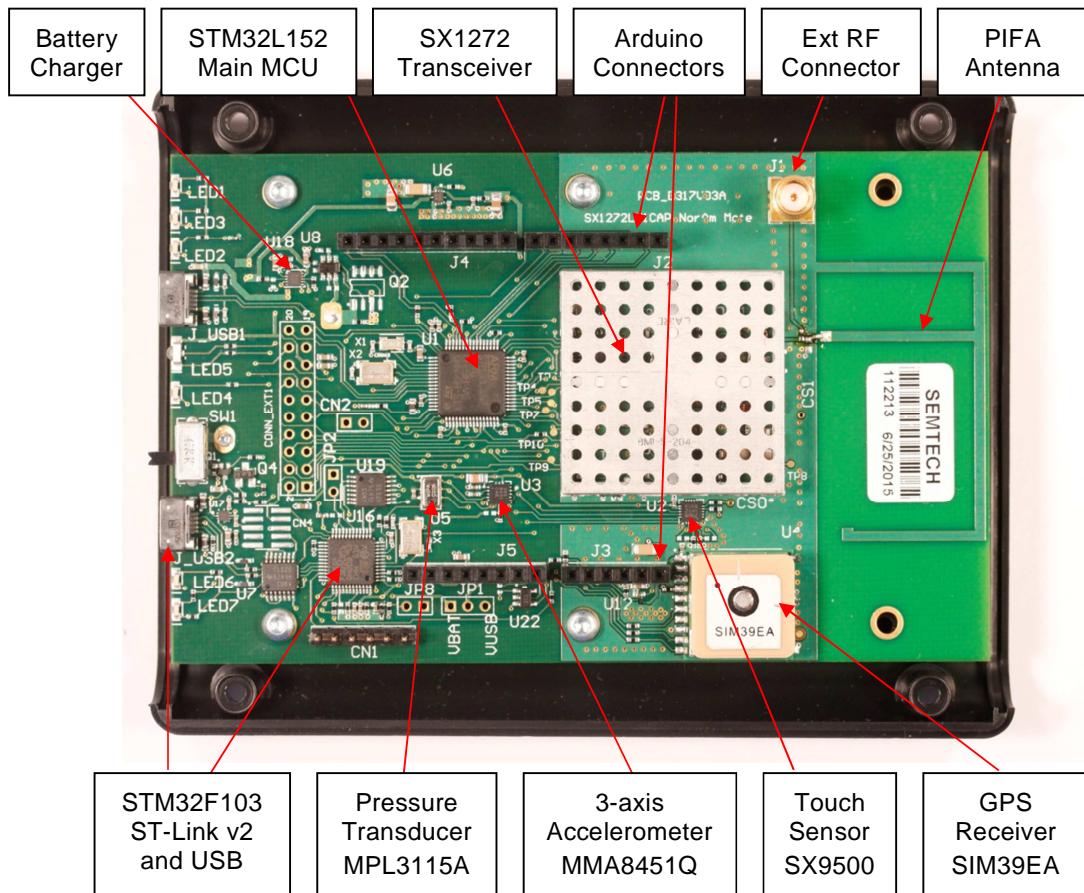


Figure 3 SX1272LM1CEP Details

### 3.2.1 NorAm Mote RF

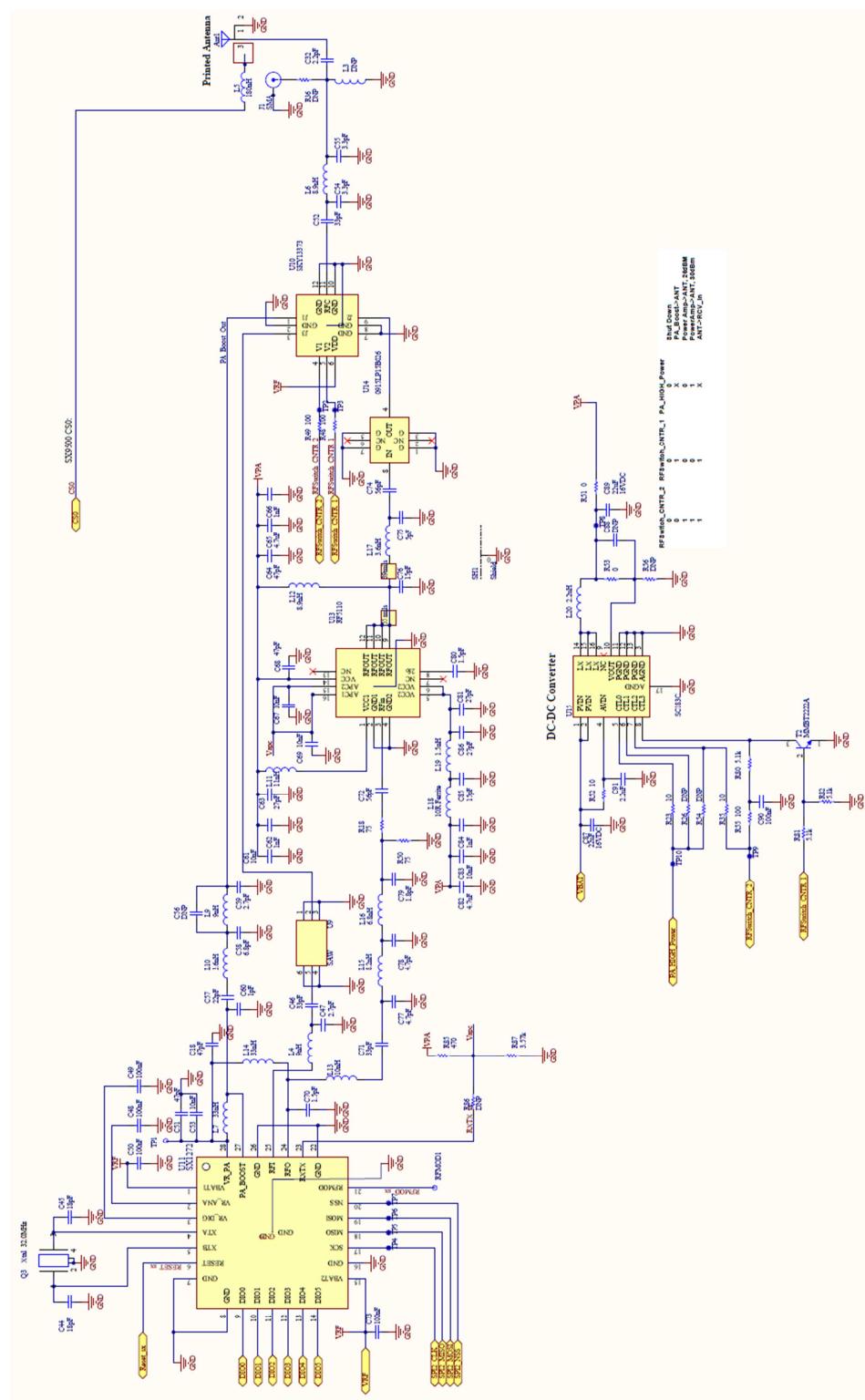


Figure 4 NorAm Mote RF Schematic

### 3.2.2 NorAm Mote MCU

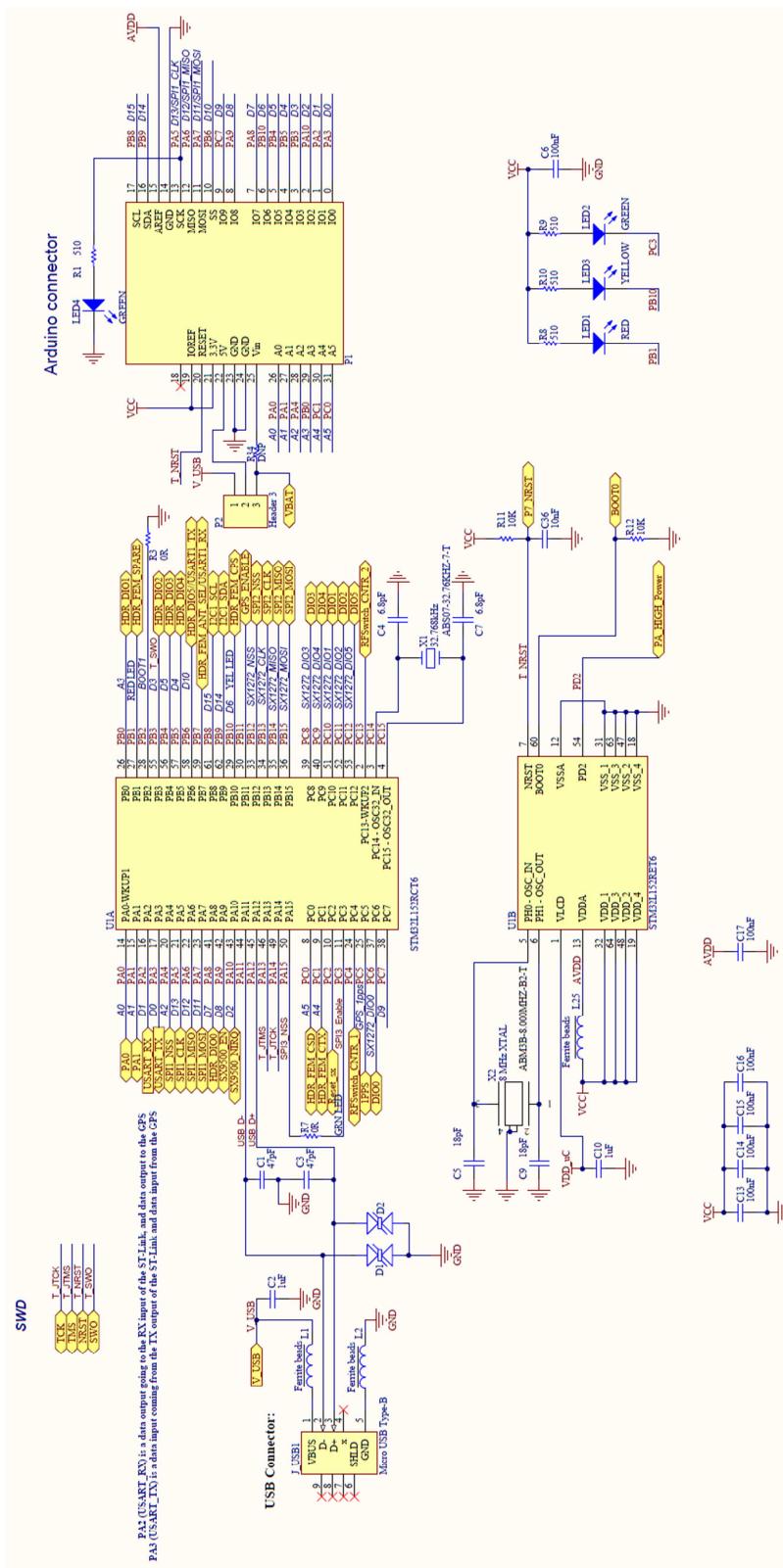


Figure 5 NorAm Mote Target Microcontroller Schematic

### 3.2.3 NorAm Mote ST-Link

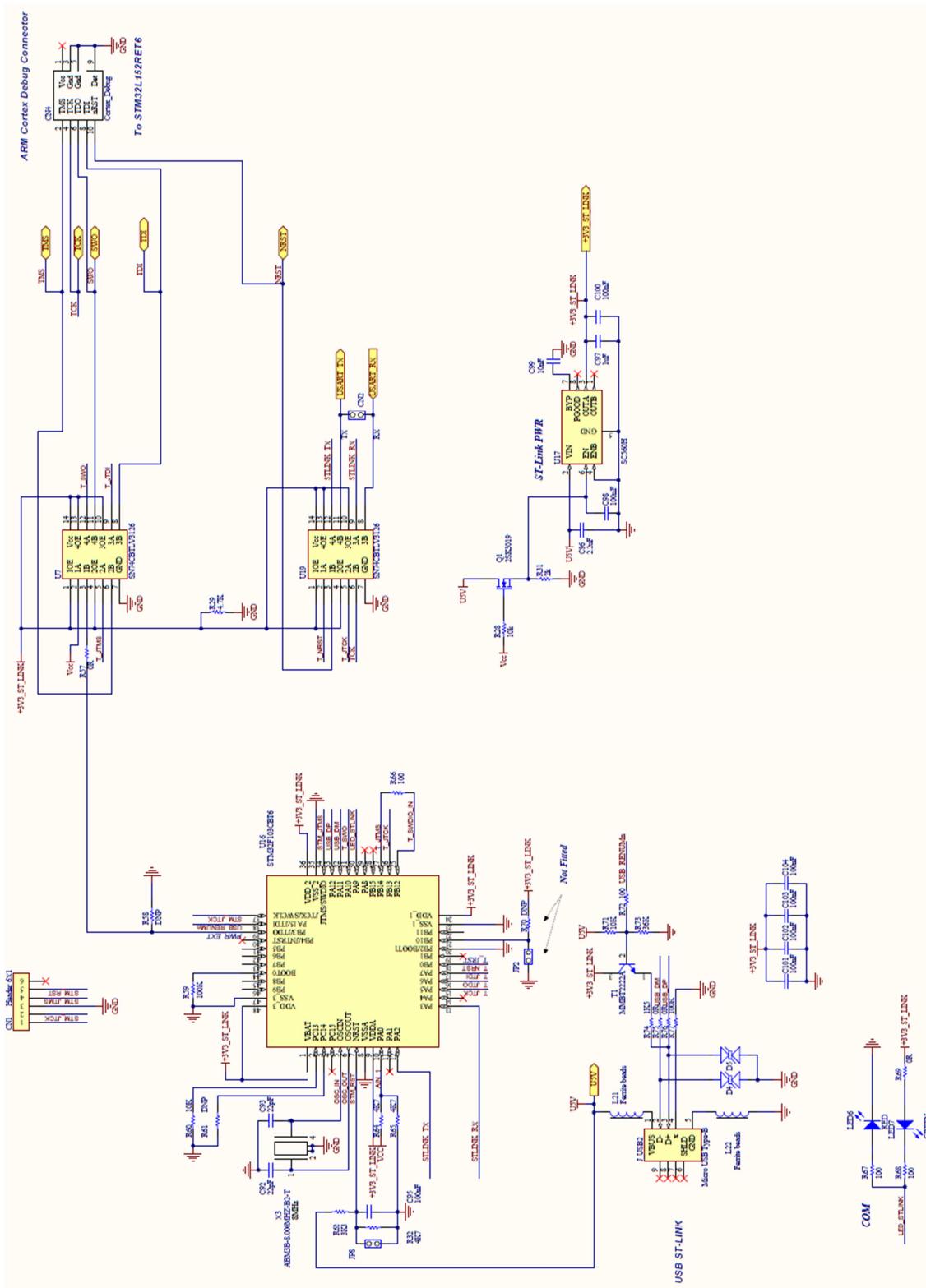
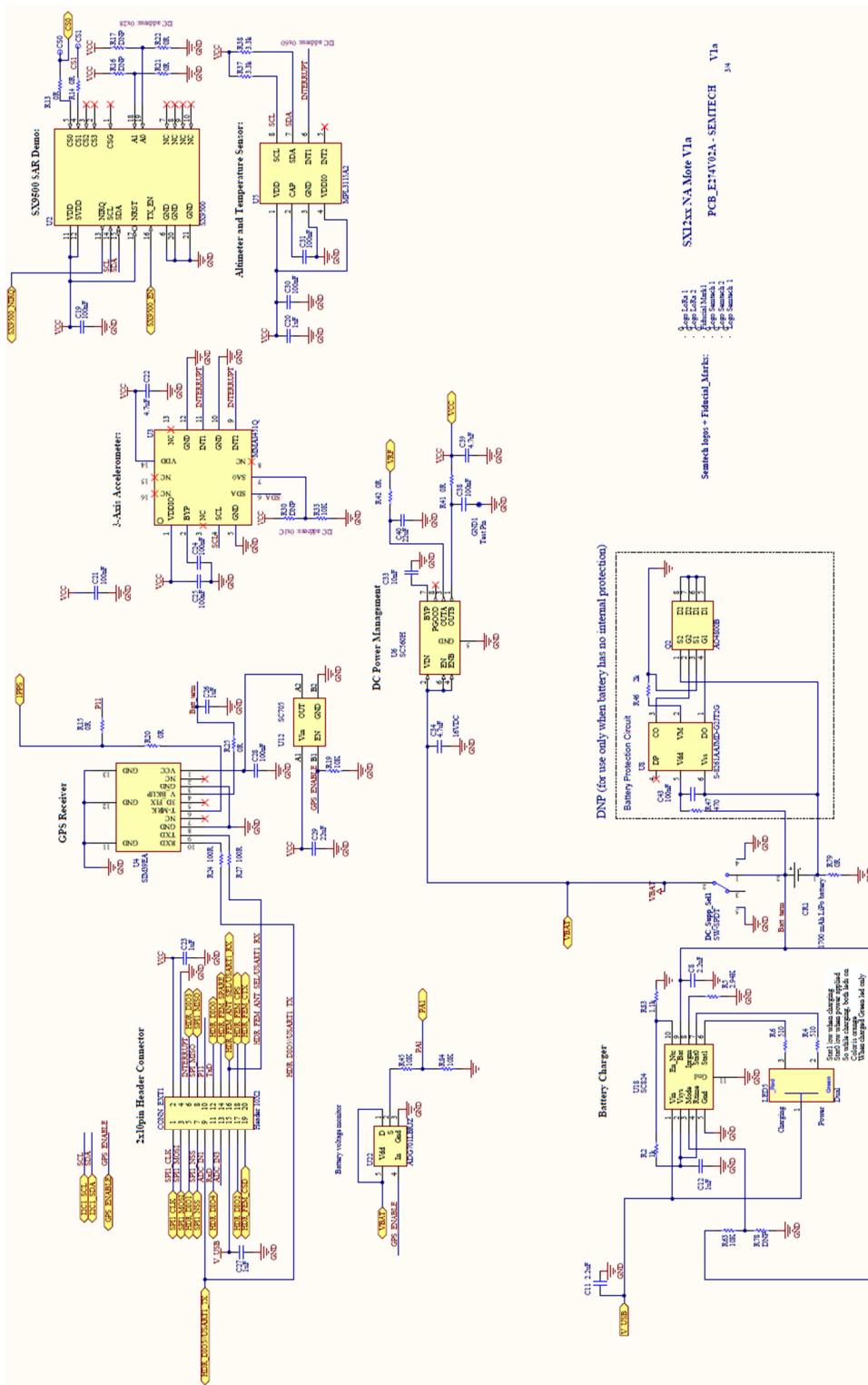


Figure 6 NorAm Mote ST-Link v2 Schematic

### 3.2.4 NorAm Mote Peripherals



## 4 Arduino Connector

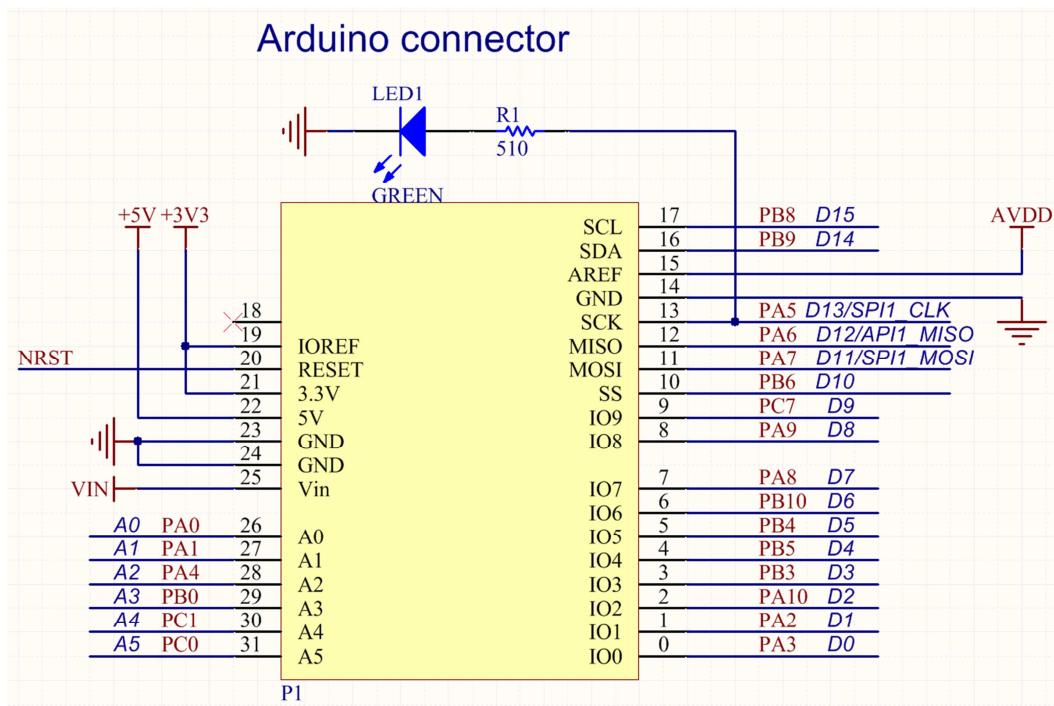


Figure 8 NorAmMote V2 Arduino Connector

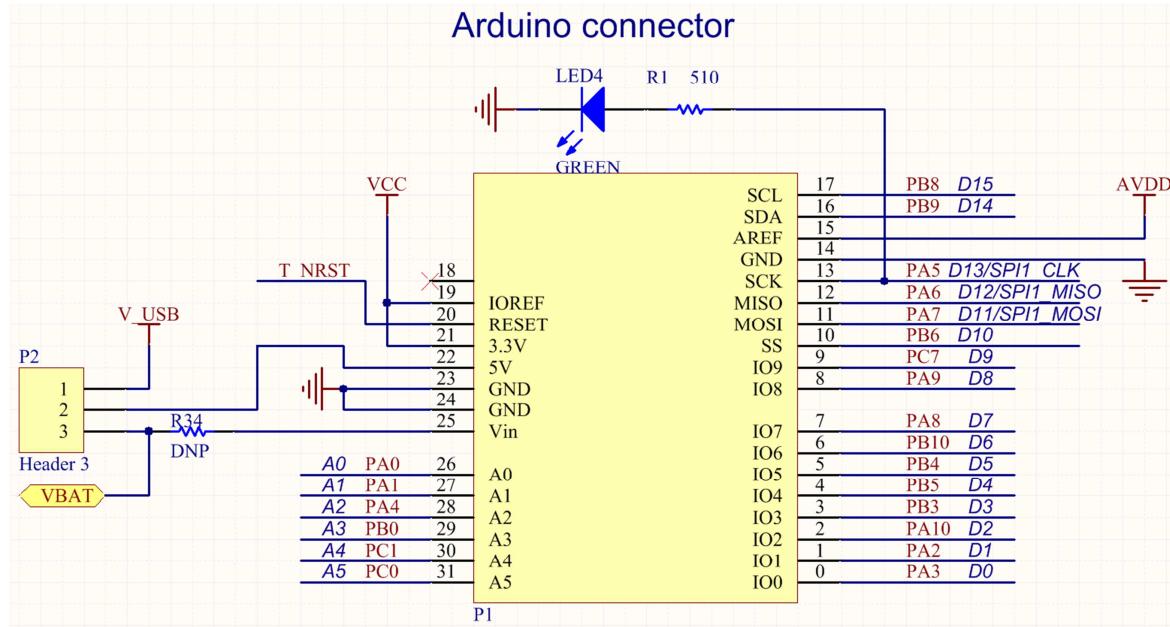


Figure 9 NorAmMote V3 Arduino Connector

## 5 Using mbed to program the NorAm Mote

With mbed capability, there is no need to install firmware development tools or purchase a programmer.

### 5.1 Connecting to PC

Before connecting the NorAm Mote to the Host PC, turn the power switch on. Then connect USB2, the ST-Link interface connector, to the PC. A new Removable Storage device, NAMote-72, will appear (see Figure 10 - NAMote-72 Virtual Removable Storage Device).



Figure 10 - NAMote-72 Virtual Removable Storage Device

### 5.2 Creating the program on mbed

For detailed mbed program development instructions, go to the mbed website: <http://mbed.org/>

Once the program has been compiled, a binary file will be created and placed in your download directory. You can then copy and paste the file to the NAMote-72 storage device or use the Send command to directly load the file.

**Note:** The selected platform for the NorAm Mote on mbed IDE is NAMote-72 at <http://developer.mbed.org/platforms/NAMote-72/>

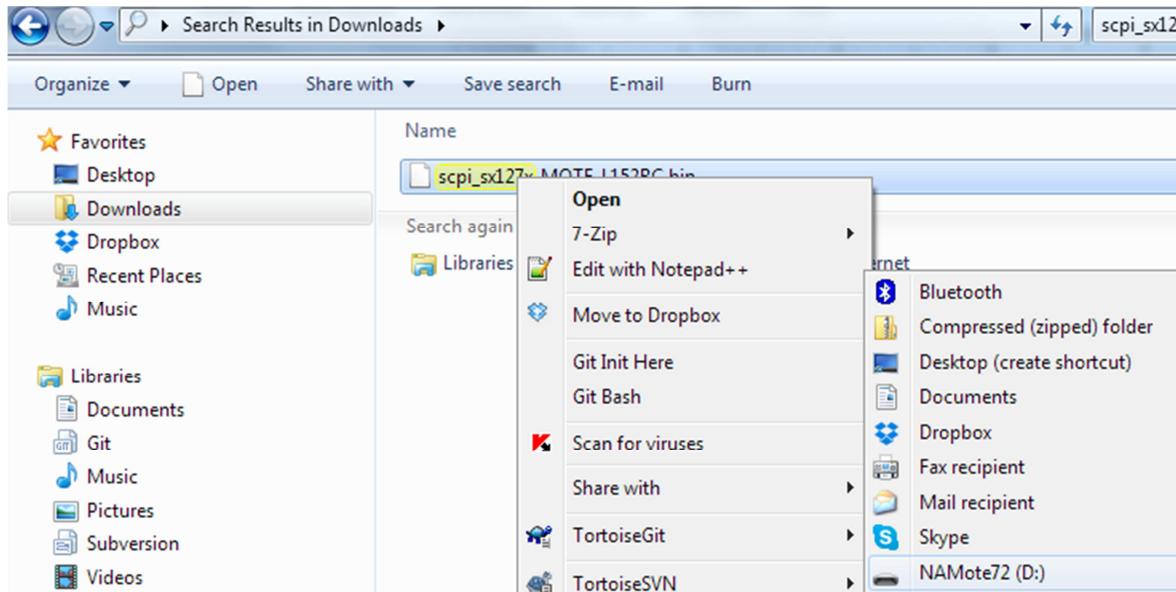


Figure 11 Windows Send to NAMote-72

## 5.3 Reference code examples

### 5.3.1 NorAm Mote Test program

This program implements a SCPI command parser. When connected via the debug port, you can command the radio and peripherals to perform specific tasks or to set specific parameters. The serial port defaults to 9600bps N-8-1. This project includes libraries for interfacing with the peripherals.

[https://developer.mbed.org/teams/Semtech/code/scpi\\_sx127x/](https://developer.mbed.org/teams/Semtech/code/scpi_sx127x/)

### 5.3.2 LoraWAN Location Monitoring

LMIC transmit example for NAmote-72 with GPS.

[https://developer.mbed.org/teams/Semtech/code/lmic\\_NAmote\\_GPS/](https://developer.mbed.org/teams/Semtech/code/lmic_NAmote_GPS/)

## 6 Appendix

### 6.1.1 MCU Port Assignments

PORT	NA MOTE (MBED)	PORT	STM32L152C
PA0	Arduino_A0, BATT_Sense	PB9	Arduino_D14/I2C1-SDA
PA1	Arduino_A1	PB10	Arduino_D6/YELLOW LED, HDR_FEM_CPS (Header)
PA2	Arduino_D1/USART_RX/to GPS Data Input	PB11	GPS_ENABLE, battery voltage monitor (activehigh)
PA3	Arduino_D0/USART_TX/from GPS Data Output	PB12	SPI2_NSS->SPI_NSS (on board SX1272)
PA4	Arduino_A2/SPI1_NSS, SX12xx NSS (Header)	PB13	SPI2_CLK->SPI_CLK (on board SX1272)
PA5	Arduino_D13/SPI1_CLK, SX12xx SCK (Header)	PB14	SPI2_MISO->SPI_MISO (on board SX1272)
PA6	Arduino_D12/SPI1_MISO, SX12xx SCK (Header)	PB15	SPI2_MOSI->SPI_MOSI (on board SX1272)
PA7	Arduino_D11/SPI1_MOSI, SX12xx SCK (Header)	PC0	Arduino_A5, HDR_FEM_CSD (Header)
PA8	Arduino_D7, SX12xx DIO0(Header)	PC1	Arduino_A4, HDR_FEM_CTX (Header)
PA9	Arduino_D8/SX9500_EN	PC2	Reset_sx (on board SX1272)
PA10	Arduino_D2/SX9500_NIRQ	PC3	GREEN LED, SPI3_Enable (WISUN)
PA11	USART1_CTS->USB_D-	PC4	RFSwitch_CNTR_1
PA12	USART1_RTS->USB_D+	PC5	from 1pps GPS out
PA13	T_JTMS	PC6	DIO0 (on board SX1272)
PA14	T_JTCK	PC7	Arduino_D9
PA15	SPI3_NSS	PC8	DIO3 (SX1272_DIO3 on board SX1272)
PB0	Arduino_A3, HDR_DIO1 (Header)	PC9	DIO4 (SX1272_DIO4 on board SX1272)
PB1	RED LED, HDR_FEM_SPARE (Header)	PC10	DIO1 (SX1272_DIO1 on board SX1272)
PB2	BOOT1(GND)	PC11	DIO2 (SX1272_DIO2 on board SX1272)
PB3	Arduino_D3, HDR_DIO2 (Header)	PC12	DIO5 (SX1272_DIO5 on board SX1272)
PB4	Arduino_D5, HDR_DIO3 (Header)	PC13	WKUP2/RFSwitch_CNTR_2
PB5	Arduino_D4, HDR_DIO4 (Header)	PC14	OSC32_IN
PB6	Arduino_D10, HDR_DIO5 (Header)/USART1_RX	PC15	OSC32_OUT
PB7	HDR_FEM_ANT_SEL(Header)/USART1_RX	PD2	PA_HIGH_Power
PB8	Arduino_D15/I2C1_SCL	BOOT	10k to GND

### 6.1.2 LED Settings

LED	On State	Off State
Status 1, Red	PB1 = 0	PB1 = 1
Status 2, Yellow	PB10 = 0	PB10 = 1
Status 3, Green	PC3 = 0	PC3 = 1
USR, Green	PA5 = 1	PA5 = 0

### 6.1.1 GPS/battery voltage monitor Settings

LED	On State	Off State
GPS/Batt Mon Enable,	PB11 = 1	PB11 = 0

### 6.1.2 TR Switch/PA Power Settings

RFSwitch_CNTR_2	RFSwitch_CNTR_1	PA_HIGH_Power	Operating Mode
0	0	0	Shut Down
0	1	0	PA_Boost to ANT
1	0	0	Power Amp to ANT Low
1	0	1	Power Amp to ANT High
1	1	0	ANT to RCV_in

### 6.1.3 Output Power Level Settings +/- 1dB

RegPaConfig 3-0	Output Power, PA_HIGH_Power = 0	Output Power, PA_HIGH_Power = 1
0	17.00dBm*	24.50dBm
1	18.00dBm*	25.75dBm
2	21.40dBm	26.90dBm
3	23.30dBm	28.00dBm
4	24.75dBm	28.60dBm
5	25.80dBm	29.40dBm
6	26.80dBm	30.00dBm
7	27.75dBm	30.70dBm
8	28.00dBm	30.90dBm
9	29.00dBm	31.60dBm
10	29.42dBm	32.00dBm
11	29.90dBm	32.50dBm
12	30.15dBm	32.75dBm
13	30.20dBm	32.78dBm
14	30.25dBm	32.80dBm
15	30.30dBm	33.00dBm

\*Use PA\_Boost for power 18dBm or lower.

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