

Swish-Hoop Net Sensor Module

Integration Manual v1.2

1 Preface

The following guidelines must be followed when integrating the Swish-Hoop Net Sensor Module (SHNSM) into other devices. This manual describes the methods for integration of hardware, software and documentation.

2 Typical Use and Product Variants

The Swish-Hoop Net Sensor module (SHNSM) is intended to be used in a number of different electronic products manufactured by Shooter's Touch, LLC and others. The following is a subset of functions for some of the products:

- Swish-Hoop Shot Monitor – The SHNSM is connected to a CR2477 coin cell battery and housed in a plastic enclosure. The enclosed device is then hung on a basketball net that is attached to the goal and the system's function is to sense and record makes and misses. The vibration switch and tilt switch are used to sense interactions between the basketball and the rim, net or backboard and the radio on the SHNSM is used to transfer the data to a connected mobile device. The radio is also used to send status information and software updates back and forth.
- Swish-Hoop Personal Scoreboard – The SHNSM is connected to a main display board by soldering pins extending from the main display board to the through holes on the SHNSM. A rechargeable battery on the main display board delivers power to the SHNSM. The SHNSM microprocessor outputs are connected to a set of LED drivers on the main display board to create messages. The radio on the SHNSM is used to transfer message data from mobile device that is to be displayed. The radio is also used to send status information and software updates back and forth.
- Swish-Hoop Rim – The SHNSM is connected to a main motor board by soldering pins extending from the main motor board to the through holes on the SHNSM. A rechargeable battery on the main motor board delivers power to the SHNSM. The SHNSM microprocessor outputs are connected to a motor driver and sensors on the main motor board to actuate the rim. The radio on the SHNSM is used to transfer data from mobile device that drives the motor on the rim. The radio is also used to send status information and software updates back and forth.

3 Hardware

The SHNSM is designed for soldering either onto a battery or directly into another circuit board for the target application. Standard JEDEC-PCB-free reflow soldering temperature profiles apply. Detailed schematic layouts and other documents are available upon request. No antenna except the one integrated into the SHNSM circuit board shall be used.

3.1 Physical Description

The SHNSM is 25 X 25 X 5 mm including all components. The board thickness without components is 1 mm.

3.2 Components

The SHNSM uses a Nordic Semiconductor nRF51822 microprocessor with two clock inputs at 16 MHz and 32.768 KHz. The nRF microprocessor includes the drivers for a 2.4GHz radio transceiver. In addition to the microprocessor and its associate components, the SHNSM includes an omnidirectional vibration

switch and tilt switch, which is closed when the antenna end of the board is pointed down and open otherwise. Three pins on the SHNSM are supplied for Segger J-Link device connection to the microprocessor.

3.3 Operating Specifications

3.3.1 Input Power

- 3VDC, 10 microamps most of the time, 150 mA for 150mSec every 1 second

3.3.2 Operating temperature range of the equipment

- Outdoor commercial temp range - 0 to 70 degrees Celsius

3.3.3 Classification

- Portable

3.3.4 Number and types of i/o ports and associated cables

- 30 ports on CPU, no cables

3.3.5 RF Parameters

3.3.5.1 *Transmit frequency(s)*

- 2.4 GHz transceiver
- -90 dBm sensitivity in ANT mode
- -93 dBm sensitivity in Bluetooth low energy mode
- 250 kbps, 1 Mbps, 2 Mbps supported data rates
- TX Power -20 to +4 dBm in 4 dB steps
- TX Power -30 dBm Whisper mode
- 13 mA peak RX, 10.5 mA peak TX (0 dBm)
- 9.7 mA peak RX, 8 mA peak TX (0 dBm) with DC/DC
- RSSI (1 dB resolution)

3.3.5.2 *Number of Channels*

- 40 channels, 2MHz separation, 2402MHz - 2480MHz
- 3 Advertising channels, at 2402MHz (channel 37), 2426MHz (channel 38) and 2480MHz (channel 39)
- Remainder are Data channels (channels 0 - 36)

3.3.5.3 *Type of Transmit: Frequency hopping, spread spectrum / digital modulation system / fixed*

- To mitigate interference in such a crowded band, BLE uses frequency hopping. Three RF channels are dedicated for advertising functions that allow the discovery of devices available in the vicinity. Upon a connection request, the same channels are used for initial connection parameter exchanges.
- Once a device is discovered and connection is initiated, regular data channels are used for communication

3.3.5.4 *Transmitter Power output*

- 0 dB

3.3.5.5 *Antenna type*

- PCB trace
- No other antenna shall be used.

3.3.5.6 *Transmission Duty cycle*

- While advertising, every second or so
- While in regular mode (after connection) whenever data needs to be sent

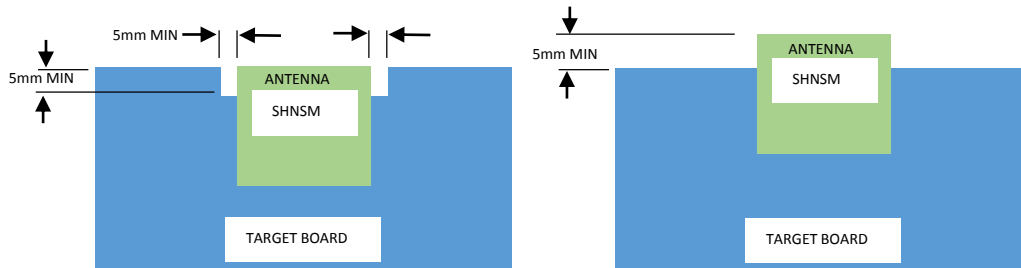
- Every second it sends out battery information (a few bytes of payload)

3.3.5.7 Device Duty cycle

- Sleeps most of the time
- Wakes up every 100mSec or so to keep BT connection alive
- Wakes up asynchronously when event(s) happen as part of device function

3.4 Mounting

For best RF performance, place the SHNSM at the edge of the target board with a margin beyond the target board as shown below.



Keep any metal parts at least 10mm from the antenna area of the SHNSM board.

4 Software

The SHNSM firmware consists of three portions: the Bootloader, the BLE SoftDevice and the application firmware. The Bootloader and the BLE SoftDevice are provided by the microprocessor chip producer, Nordic Semiconductor (www.nordicsemi.com). The application software is specific to the application. It monitors the sensor outputs on the SHNSM and sends and receives BLE messages using the SoftDevice. The Bootloader may be used for DFU OTA (Device Firmware Update Over The Air) application software updates using the nRF Toolbox app on a mobile device or custom software.

Firmware application software updates may also be performed using Segger J-Link device connected to the three pins on the SHNSM.

5 Regulatory Statements

5.1 FCC Statement

This device has been tested and found to comply with part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the receiver

- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Operation is subjected to the following two conditions: (1) This device may no cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation. Note: Modification to this product will void the user’s authority to operate this equipment.

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5.2 FCC Important Notes:

5.2.1 FCC Radiation Exposure Statement

This equipment complies with FCC RF radiation exposure limits set forth for an uncontrolled environment. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter. This equipment complies with Part 15 of the FCC Rules. Operation is subject the following two conditions:

- (1) This device may not cause harmful interference, and
- (2) This device must accept any interference received, including interference that may cause undesired operation.

The devices must be installed and used in strict accordance with the manufacturer’s instructions as described in this document.

Caution!

The manufacturer is not responsible for any radio or TV interference caused by unauthorized modifications to this equipment. Such modification could void the user authority to operate the equipment.

5.2.2 Co-location Warning:

This device and its antenna(s) must not be co-located or operating in conjunction with any other transmitter antenna.

5.2.3 Integration instructions

This device is intended only for integrators under the following conditions:

- (1) The antenna must be installed such that 25 cm is maintained between the antenna and users,
- (2) The transmitter module may not be co-located with any other transmitter or antenna.
- (3) The SHNSM was verified in the conformity testing. Radiated transmit power must be equal to or lower than that specified in the FCC/IC Grant of Equipment Authorization for FCC ID: 2AQMMSHNSM01 and IC: 24124-SHNSM01. A separate approval is required for all other antenna type, or higher gain antenna.

As long as the above conditions are met, further transmitter testing will not be required. However, the integrator is still responsible for testing their end-product for any additional compliance requirements with this module installed (for example, digital device emission, PC peripheral requirements, etc.)

In the event that these conditions cannot be met (for example certain laptop configuration or co-location with another transmitter), then the FCC authorization for this module in combination with the host equipment is no longer considered valid and the FCC ID of the module cannot be used on the final product. In these and circumstance, the OEM integrator will be responsible for re-evaluating. The end product (including the transmitter) and obtaining a separate FCC authorization.

Caution!

The integrator is still responsible for verifying compliance with FCC Part 15, subpart B limits for unintentional radiators through an accredited test facility.

5.3 Industry Canada (IC) Statement:

This device complies with Industry Canada license-exempt RSS standard(s). 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 warning: The equipment complies with RF exposure limits set forth for an uncontrolled environment. The antenna(s) used for this transmitter must not be co-located or operating in conjunction with any other antenna or transmitter. The device should be installed and operated with a minimum distance of 20cm between the radiator and your body.

Avertissement d'exposition RF: L'équipement est conforme aux limites d'exposition aux RF établies pour un incontrôlés environnement. L'antenne (s) utilisée pour ce transmetteur ne doit pas être co-localisés ou onctionner en conjonction avec toute autre antenne ou transmetteur. L'appareil doit être installé et utilisé avec une distance minimale de 20 cm entre le radiateur et votre corps.

6 Module Marking

The following text shall appear on the SHNSM:

Model SHNSM01 Shooter's Touch, LLC IC: 24124-SHNSM01 FCC ID: 2AQMMSHNSM01
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7 Final Product Marking and Documentation

The final product shall be compliant with applicable FCC, IC and R&TTE regulations and directives and marked for use in both North American and Europe as follows:

7.1 North America

The SHNSM complies with Part 15 of the FCC rules and regulations. Compliance with the labeling requirements, FCC notices and antenna usage guidelines is required. To fulfill FCC Certification, the final product must comply with the following regulations:

1. The required label is placed on the outside of the final product.
2. Modules may only be used with antennas that have been tested and approved for use with the modules. Only the antenna currently integrated into the SHNSM circuit board may be used.

The following statement must be printed on the end-use device or on the device's user manual in a conspicuous location.

This device complies with Industry Canada's license-exempt RSSs and part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Change or modifications that are not expressly approved by the manufacturer could void the user's authority to operate the equipment.

Cet appareil est conforme aux normes d'exemption de licence RSS d'Industrie Canada. Son utilisation est soumise aux deux conditions suivantes: 1. Cet appareil ne doit pas provoquer d'interférences, et 2. Cet appareil doit supporter toute interférence, y compris celles pouvant provoquer un fonctionnement non souhaité de l'appareil.

The following has to be put on an exterior label of the end device if the device is too small for the above text:

Contains FCC ID: 2AQMMSHNSM01

Contains IC: 24124-SHNSM01

If the device is sufficiently large, both the above identifiers and the text above will appear on the outside of the device.

The following Caution statement must be included in product manuals to alert users of FCC RF exposure compliance:



CAUTION! To satisfy FCC RF exposure requirements for mobile transmitting devices, a separation distance of 25 cm or more should be maintained between the antenna of this device and persons during device operation. To ensure compliance, operations at closer than this distance are not recommended. The antenna used for this transmitter must not be co-located in conjunction with any other antenna or transmitter.

Other information related to the final product

IMPORTANT: The final product to comply with unintentional radiators (FCC section 15.107 & 15.109) before declaring compliance of the final product to Part 15 of the FCC Rules.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions,

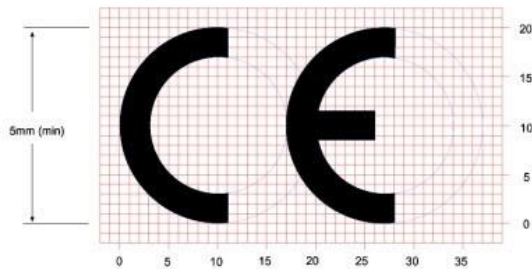
may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

7.2 Europe

The final product must be in compliance with articles 3.1a and 3.1b of the R&TTE Directive. A Declaration of Conformity must be issued for each of these standards and kept on file as described in the R&TTE Directive.

Furthermore, the manufacturer must maintain a copy of the product user manual documentation and ensure the final product does not exceed the specified power ratings, antenna specifications, and/or installation requirements as specified in the user guide.

The “CE” marking must be affixed to a visible location on the product. The following figure shows CE labeling requirements.



The CE mark shall consist of the initials “CE” taking the following form:

- If the CE marking is reduced or enlarged, the proportions given in the above graduated drawing must be respected.
- The CE marking must have a height of at least 5 mm except where this is not possible on account of the nature of the apparatus.
- The CE marking must be affixed visibly, legibly, and indelibly.

7.3 Other Approvals

A separate approval of the device into which the module is incorporated is only required when it cannot be insured that the conditions on the module grant will be met. The integrator must satisfy all relevant FCC, IC and CE Radio regulations which apply to the finished product.