

# Module Specification – User Guide

## Senceive F3N\_NF Radio Module

802.15.4 compliant

FlatMesh 2.4GHz Radio module

Revision	Description	Author
1	First Draft	D. Kerr
2	Radio Module Specific Changes	M. Ferris
3	Added further clarity around power supply. Added debug interface details.	M Ferris
4	J1,J2,J3 pinouts and uses	M Ferris

### CONFIDENTIAL:

This document describes the functionality and specification of the FlatMesh F3N\_NF Radio Module PCB only for FCC/ISED compliance, and is not meant for public viewing.

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## Introduction

Senceive is a company producing world leading wireless asset condition monitoring solutions for Civil and Rail use. The solutions entail a wireless mesh-networked, intelligent sensor system consisting of a collection of small easy to deploy devices, equipped with sensing, communication and computation capabilities. They work co-operatively and intelligently ("they talk to each other") to enable monitoring of complex layouts or challenging and difficult to access environments.

The nodes form an integrated system that can monitor over a wide area, or any convoluted physical/geographical environment. Working as a self-configuring wireless mesh, data moves from neighbour to neighbour through the network. This provides an extremely robust and flexible solution adaptable to many various and challenging situations.

The Senceive F3N\_NF Radio Module is an IEEE 802.15.4 compliant, 2.4GHz mesh radio (FlatMesh) and application processor combined module, solely intended for use within Senceive's range of Wireless Condition Monitoring Nodes. The Senceive F3N\_NF Radio Module PCB is **not sold** by Senceive to customers as a stand-alone OEM module, but only as part of a complete Senceive node.

**This document describes the functionality of the FlatMesh F3N\_NF Radio PCB only for FCC/ISED compliance.**

# F3N\_NF Radio Module PCB

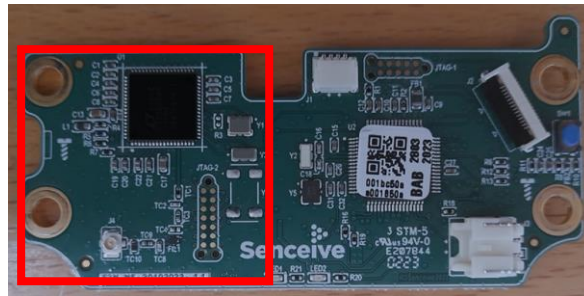


Figure 1 Top View (red = radio portion)

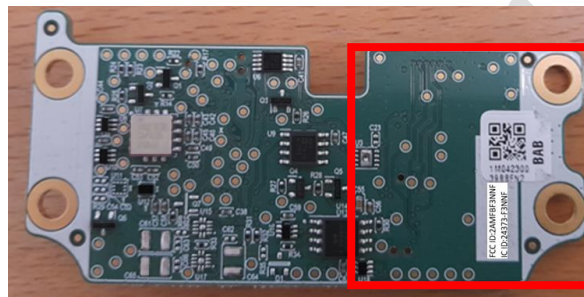


Figure 2 Bottom View (red = radio portion)

Module Name:	F3N_NF
Module Type:	802.15.4 compliant 2.4GHz Radio Module
Revision:	AAC

## Features

- F3N\_NF Radio Operating Frequencies: 2.4~2.480GHz, IEEE 802.15.4 compliant
- External Sensor Port Interface is via a single 14way FFC connector
- Application MCU: 32bit ARM Microcontroller, flash-512k, RAM-96k, 1.6V-5.5V (64LQFP)
- 2 x 3-Axis Accelerometers
- Temperature sensor,  $\pm 0.5^{\circ}\text{C}$  Accurate, 16-Bit resolution
- SPI Flash Memory
- Power Supply: 3–3.6V DC main power from internal battery in the host node
- UFL connector, SMD, 50Ohms, Jack (Pin) – to connect to external antenna on host node.

## F3N\_NF PCB – Internal Block Diagram

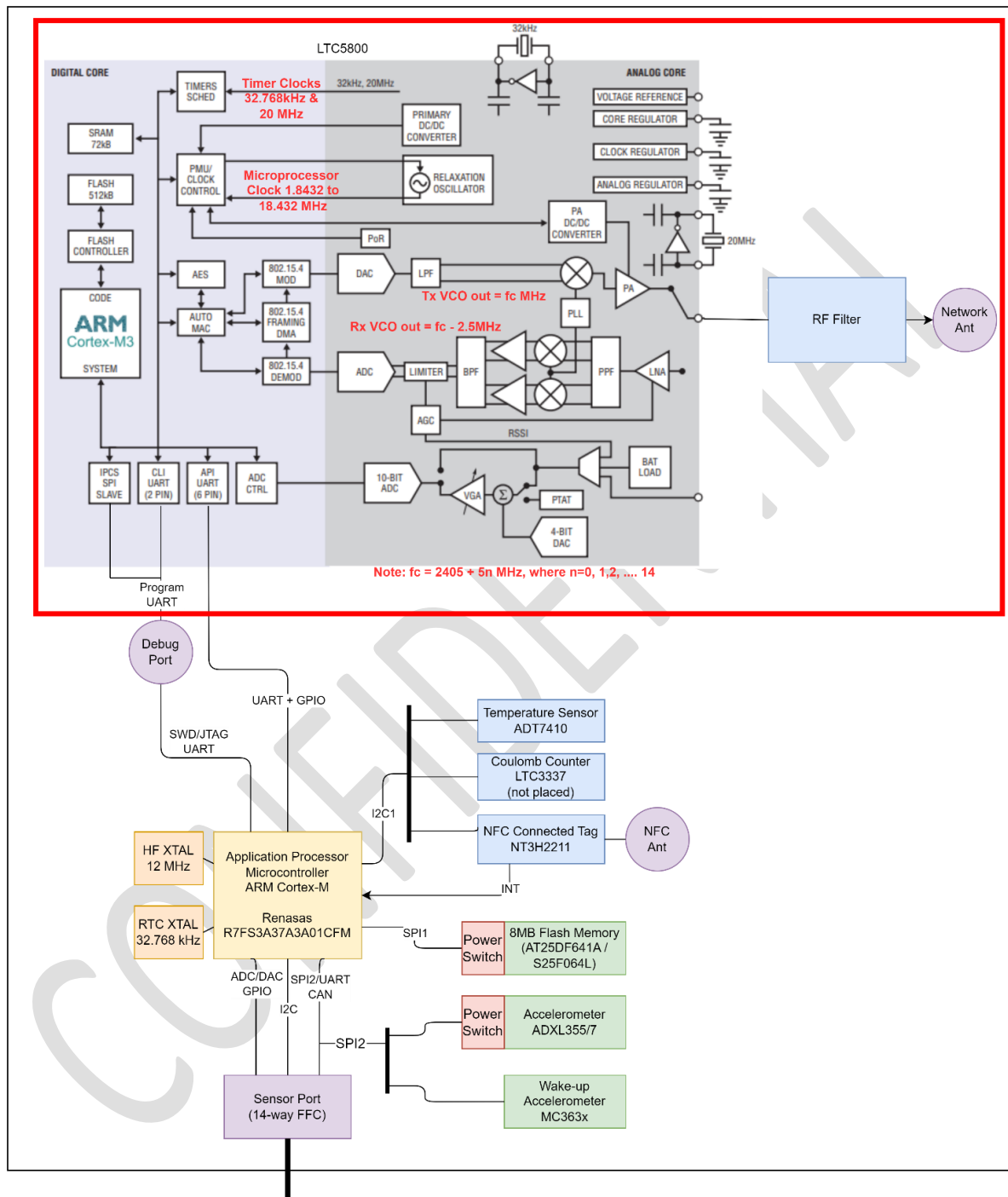


Figure 3 Block Diagram of F3N\_NF Radio Module (red = radio portion)

## General Specifications

Module Details	Description
F3N_NF PCB Dimensions	80mm x 38.8mm x 10.28mm (L x W x H)
Power Supply  NOTE: Designed to be directly powered (without regulator) via a 3.6V Li-SOCl2 battery.  There is no DC voltage regulator on the module, so should the module be installed in a system with a higher voltage power supply, the input voltage supply would require external regulation to within the range specified.	2.1 to 3.76V DC @ 200 mA (Max) (typically 3.6V, see note)
Operating Temperature	-40°C to +85°C

## Radio Specifications

Parameter	Description/Spec
Module Description	FlatMesh 2.4GHz Radio Module
Module Number	F3N_NF
Communication Type	Proprietary FlatMesh v3 Mesh Networking Protocols: IEEE 802.15.4 compliant
Operating Frequency Band	2400 - 2485 MHz ISM Band
Number of Channels	15
Channel Separation	5MHz
Channel Centre Frequency	2405 + 5*(k-11) MHz where k=11 to 25
Occupied Channel Bandwidth	2.7 MHz (At -20 dBc)
Modulation	OQPSK, IEEE 802.15.4 Direct Sequence Spread Spectrum (DSSS)
Raw Data Rate	250kbps
Maximum Antenna Gain	+3.4dBi
External Antenna connected directly to UFL connection on the F3N_NF module.	Tested with GTT Wireless Ltd / OS-ISMDB-0507-C0-WL (N-Type Dipole antenna)
Range	Up to 300m depending on the environment. Consult with Senceive for your application

## Radio Receiver Characteristics

Parameter	Typ
Receiver Sensitivity (PER = 1%)	-93 dBm
Receiver Sensitivity (PER = 50%)	-95 dBm
Saturation (max input level the receiver will properly receive packets)	0 dBm
Received Signal Strength Indicator (RSSI) Input Range	-90 to -10 dBm
RSSI Accuracy	+/-6 dBm
RSSI Resolution	1 dB

## Radio Transmitter Characteristics

Parameter	Typ
Maximum Transmit Power (EN 300 328 v2.2.2)	+5.6dBm (9dBi EIRP including antenna gain)

## Utilised Connector Interfaces

There are 3 connectors utilised on the F3N\_NF radio module.

### J1 – NFC Antenna PCB connector

- Only connects to a Senceive LR3\_NFC PCB – which is a Senceive passive NFC antenna with LED

### J2 – External Sensor Interface Connector (14way FFC connector)

- Provides optional (not always used) and configurable communication interfaces in order to communicate with additional interface PCBs in order to expand the interface node product range. For example, the **Senceive FlatMesh Digital Interface Node (F3N1-DIN)** PCB is plugged into J2, it utilises pins 4-5 as a UART, and configures the other pins as GPIOs for control.
- Pinout Description
  - Pin1 = VCC out (Vsupply)
  - Pin2 = I2C SCL (general purpose I2C)
  - Pin3 = I2C SDA (general purpose I2C)
  - Pin4 = SPI2\_MISO (GPIO/SPI/UART/CAN configurable)
  - Pin5 = SPI2\_MOSI (GPIO/SPI/UART/CAN configurable)
  - Pin6 = SPI\_CLK (GPIO/SPI/UART/CAN configurable)

- Pin7 = SPI2\_CS (GPIO/SPI/UART/CAN configurable)
- Pin8 = GND
- Pin9 = ADC\_A (GPIO or ADC input)
- Pin10 = ADC\_B (GPIO or ADC input)
- Pin11 = GND
- Pin12 = DAC\_A (GPIO or ADC input)
- Pin13 = Timer\_A (GPIO)
- Pin14 = Timer\_B (GPIO)

### J3 – Power Input Connector

- Typically a 3V6 Li-SOCL2 battery plugs into J3 to power the node
- Pinout Description
  - Pin1 = GND
  - Pin2 = Vsupply

## Debug and Programming Interfaces

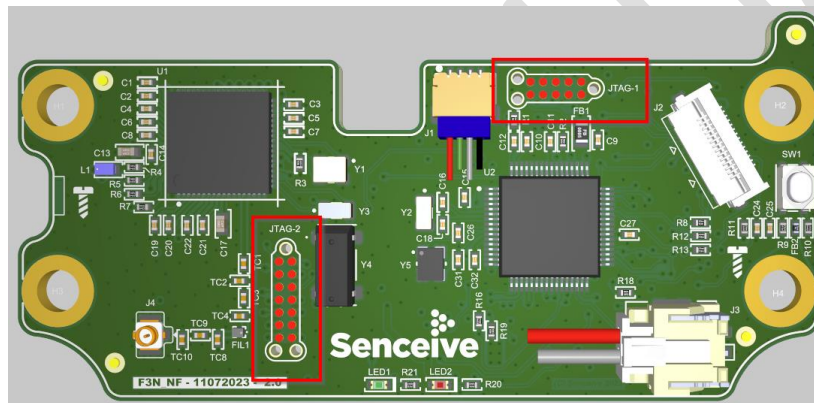


Figure 4 Module showing JTAG interfaces

There are two JTAG/debug interfaces on the module; JTAG-1, and JTAG-2. They are both accessed via Tag-Connect headers.

### JTAG-1

- SWD programming pins for the S3A3 Application MCU
  - Debug UART interface (9600 baud, 8-bit, no parity, 1 stop bit)
  - Access to the interactive console is intended for debug use only.

### JTAG-2

- In-circuit Programming Control System (IPCS) for the LTC5800 chip flash memory
- Command Line Interface (CLI) UART for the LTC5800.
  - This CLI interface is only accessible for radio certification purposes and requires the application MCU to be erased or held in reset
  - Operates at 9600 baud, 8-bit, no parity, 1 stop bit.



## Mechanical Specifications

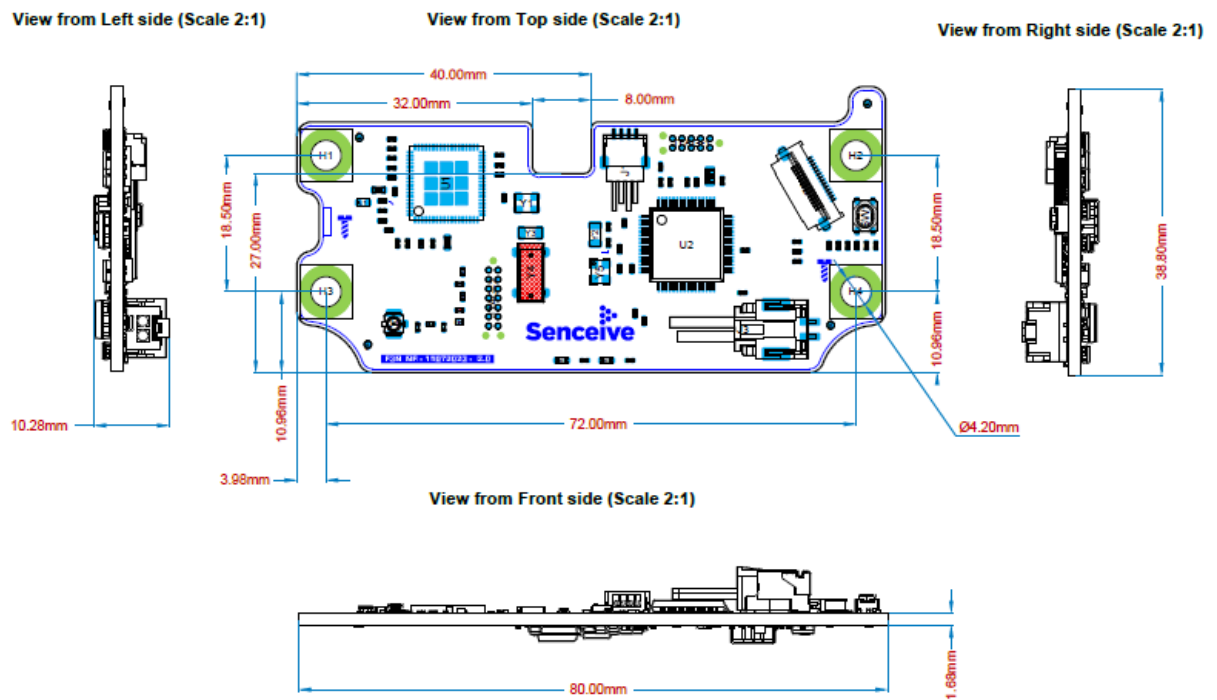


Figure 7: FlatMesh F3N\_NF Radio PCB Dimensions Drawings

## Typical Application Information

The Senceive F3N\_NF Radio Module is only intended to be used internally to Senceive node products.

It will be installed by Senceive inside a range of node products in order to collect monitoring data, and these nodes may or may not include an external interface for additional sensor integration (eg, crack sensors, mV/V sensors, VW sensors, RTD sensors, etc).

### Senceive FlatMesh Digital Interface Node (F3N1-DIN)

A typical node to illustrate suitable use for Senceive is the F3N1-DIN:

<https://www.senceive.com/sensor-interface-range/digital-interface-node>

The F3N\_NF module is both the radio and application processor for the product.



Figure 5 Front view F3N1-DIN



Figure 6 Rear view of F3N1-DIN



Figure 7 Internal view of F3N1-DIN showing F3N\_NF PCB connected to the Digital Node Interface board within the FlatMesh Digital Interface Node (F3N1-DIN)

### F3N1-DIN - FlatMesh Digital Interface Node

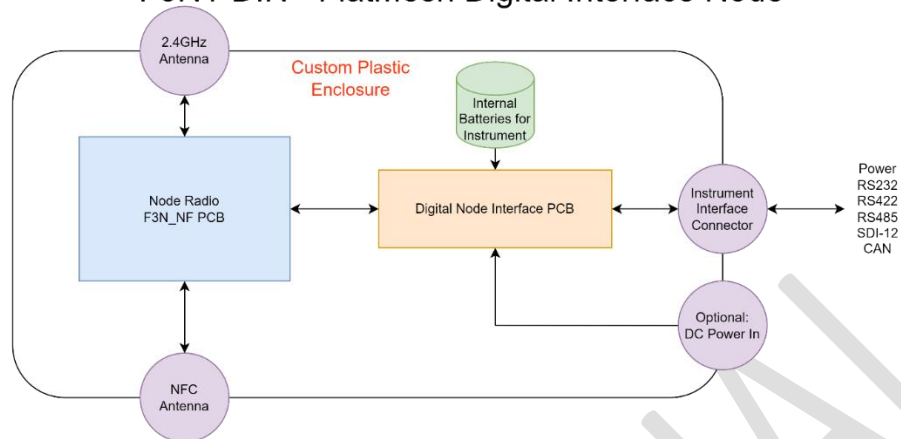


Figure 8 Block Diagram of F3N1-DIN showing modular connections

## USA – FCC

### FCC compliance statement for FCC ID: 2AMFBF3NNF

This device complies with Part 15 of the FCC rules.

Operation is subject to the following two conditions:

1. This device must accept any interference, and
2. This device must accept any interference received including interference that may cause undesired operation.

### FCC ID: 2AMFBF3NNF

#### Module Integration Instructions

- This module complies with Title 47 CFR 15.247
- FCC Modular Certification is subject to [KDB 996369](#) including 96369 D03 OEM Manual v01r01.
- This module has Limited Modular Approval, and only allows for integration into Senceive devices by Senceive and the module is not sold to 3<sup>rd</sup> parties
- The final product shall be labelled with “contains FCC ID: 2AMFBF3NNF”

#### General Information for FCC

Changes or modifications not expressly approved by Senceive Limited could void the user’s authority to operate the equipment.

#### Antenna information

This module is only for integration into Senceive equipment that is professionally installed.

Only the following antenna are to be used with the equipment:

Order Code	Manufacturer / Part Number	Gain
C01967 – FA-FM-N	GTT Wireless Ltd / OS-ISMDB-0507-C0-WL	+3.4dBi

### Additional testing on final product integrating FCC ID: 2AMFBF3NNF

Continued compliance with FCC 47CFR15.247

- When integrating the module into intended host platforms additional testing is required to show that the module still complies with part 15.247:
  - Transmit power compliance is achieved by using the required antenna stated above
  - Radiated Spurious Emissions testing as detailed below:

#### Radiated Spurious Emissions of module installed in final host product

The highest transmit power was measured on top channel and this is the frequency with the most stringent band edge requirement, so testing will be performed on the following channel:

Frequency	2475 MHz
Modulation	OQPSK
Power	8dBm
Duty cycle	100 % in test mode (Senceive engineering mode not available to end customers)

The module is only authorised to FCC 47CFR15.247 and the host integrator is responsible for compliance with any of FCC rules that will apply, which will include part 15B for unintentional emissions

**RF Exposure**

The module has a maximum transmit power of 6.3 mW with a linear antenna gain of 2.18.

The module is only designed to be installed in fixed equipment and is not designed for portable use and meets FCC RF exposure requirements at 20 cm.

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## Canada – IC/ISED

This radio transmitter **IC:24373-F3NNF** has been approved by Innovation, Science and Economic Development Canada to operate with the antenna types listed below, with the maximum permissible gain indicated.

Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

Order Code	Manufacturer / Part Number	Gain
<b>C01967 – FA-FM-N</b>	GTT Wireless Ltd / OS-ISMDB-0507-C0-WL	+3.4dBi

Cet émetteur radio **24373-F3N-NF** a été approuvé par Innovation, Sciences et Développement économique Canada pour fonctionner avec les types d'antenne énumérés ci-dessous, avec le gain maximal autorisé indiqué.

Les types d'antenne non inclus dans cette liste qui ont un gain supérieur au gain maximum indiqué pour tout type répertorié sont strictement interdits pour l'utilisation avec cet appareil.

Order Code	Manufacturer / Part Number	Gain
<b>C01967 – FA-FM-N</b>	GTT Wireless Ltd / OS-ISMDB-0507-C0-WL	+3.4dBi

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

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

The safe distance for human exposure to electromagnetic field is 20cm.

Cet appareil contient des émetteurs/récepteurs exempts de licence qui sont conformes aux RSS exemptés de licence d'Innovation, Sciences et Développement économique Canada. L'exploitation est soumise aux deux conditions suivantes:

- Cet appareil ne doit pas provoquer d'interférences.
- Cet appareil doit accepter toute interférence, y compris les interférences susceptibles de provoquer un fonctionnement indésirable de l'appareil.

La distance de sécurité pour l'exposition humaine au champ électromagnétique est de 20cm.

### Additional testing on final product integrating IC ID: 24373-F3NNF

Continued compliance with RSS-247 Issue 3

- When integrating the module into intended host platforms additional testing is required to show that the module still complies with RSS-247 Issue 3:
  - Transmit power compliance is achieved by using the required antenna stated above
  - Radiated Spurious Emissions testing as detailed below:

Radiated Spurious Emissions of module installed in final host product

The highest transmit power was measured on top channel and this is the frequency with the most stringent band edge requirement, so testing will be performed on the following channel:

Frequency	2475 MHz
Modulation	OQPSK
Power	8dBm
Duty cycle	100 % in test mode (Senceive engineering mode not available to end customers)

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## Appendix A – Contact information

### Senceive Ltd

Phone: +44 (0) 800 033 7731

Email: [helpdesk@senceive.com](mailto:helpdesk@senceive.com)

Web: <https://www.senceive.com/support>

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