RF Module instruction manual Tap Acquisition Inc, DBA TapDynamics

Model 348

FCC/IC notifications, OEM Labeling Requirements

The Original Equipment Manufacturer (OEM) must ensure that FCC and Industry Canada labeling requirements are met. The end product containing the RF Module must have a label or permanent marking for notification of the FCC and Industry Canada modular approval identification numbers. The label or notification must be located on the outside enclosure of the final product in a clearly visible location. It may not be placed on a removable part, i.e., not on a battery cover. The label or marking must display the following:

> *This device complies with part 15 of the FCC rules and Industry Canada license-exempt RSS standard(s). 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.*
> **Manufacturer: [YOUR MFGR NAME] Model: [END PRODUCT MODEL]**
> **Contains FCC ID: YUS348 Contains IC: 9306A-348**

If the end product is too small to affix a label containing all of the above information (smaller than 'hand-sized') the information in italics (non-bolded text) may be left off and placed solely in a conspicuous location in the user manual. Display of the manufacturer's name model and the registration numbers is mandatory. If the device containing the RF module is sold in Canada, the user manual must also contain the following information:

RF exposure compliance

To satisfy FCC RF exposure requirements for mobile transmitting devices, a separation distance of 20 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 is not recommended. The antenna used for this transmitter must not be co-located in conjunction with any other antenna or transmitter.

IMPORTANT: The integrator is responsible for its product to comply with IC ICES-003 & FCC Part 15, Sub. B – Unintentional Radiators. (These standards relate to the *unintentional* conducted and radiated emissions which include those of the parent or final device.) Final product must comply with unintentional radiators before declaring compliance of their final product to Part 15 of the FCC Rules and Industry Canada ICES-003. Also note that changes or modifications not expressly approved by TapDynamics could void the user's authority to operate the equipment.

FCC NOTE: 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. 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 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.

Industry Canada NOTES:

This device complies with Industry Canada licence-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.

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

Installation mechanical

The module is designed to fit a PCB land pattern as shown in figure 2 (see Appendix). Take note to reproduce the grounding plane as shown in Figure 1 to meet FCC and IC requirements. Avoid using metallic parts near the omni-directional antenna (small square blue device at the end of the module). Using metallic parts will have the effect of distorting the antenna radiation pattern, which is detrimental to optimum performance, for that reason it is also advisable to keep high-dielectric materials away from the antenna. Ideally, the case or enclosure of the host device should be transparent to radio frequency energy.

Software Interface

(Please see the programming section in the datasheet for the Nordic 24LO1.)

Configuring RF Channel selection and power levels

This module utilizes GFSK modulation and channel hopping. To meet the RF band edge requirements for FCC and IC approvals, only channels #2 through #76 (2.402GHz-2.476GHz) may be used. Pay close attention to the requirements listed in the Appendix regarding the pseudo-random channel selection and the maximum time dwelling and the proper time frame on each channel. FCC and IC requirements are very specific in this regard, and violation of the rules will make the end device non-compliant, and thus not legal for sale or use. The module is approved at full power output, which corresponds to a drive level of 0dBM at the Nordic Transceiver output, or +25.21 dBm at the antenna.

Specifications

Output Power: +25.21 dBm

Antenna*:* permanently fixed Fractus Fractal array, Omni-directional, 2.2 dBi peak gain.

Maximum data rate: configurable 256k bps- 2M bps

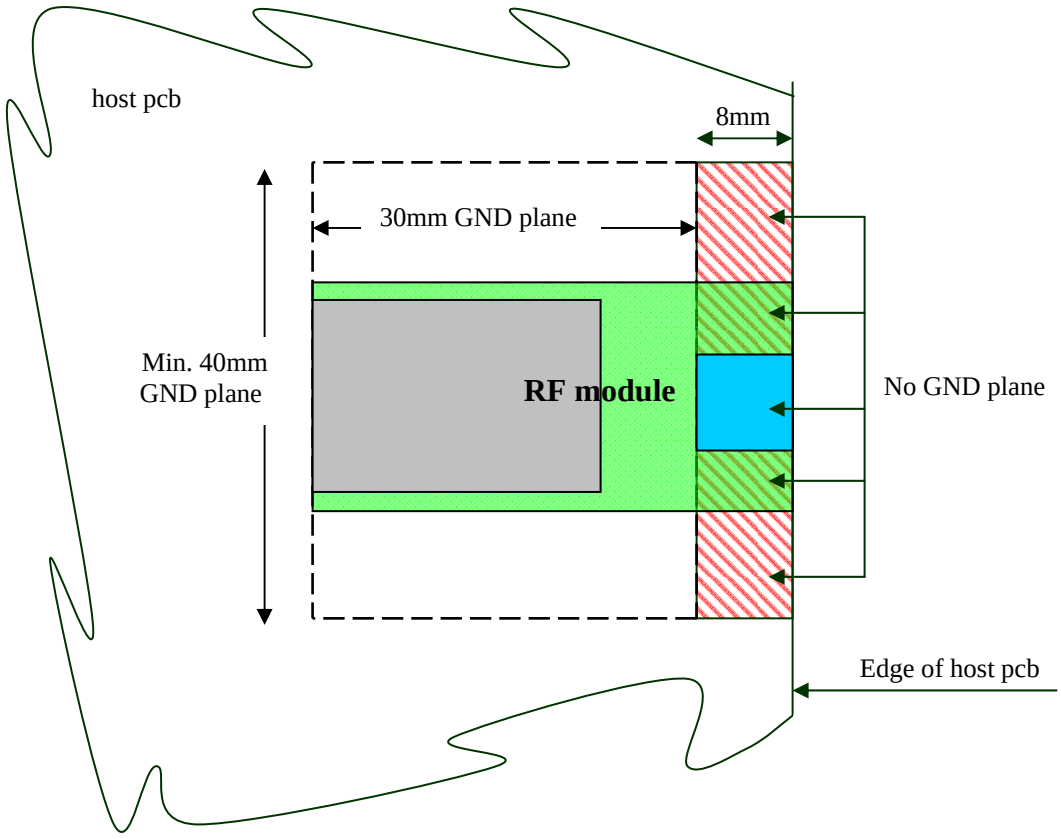
Supply requirements: +3.3VDC at 25mA avg., 4.2-5.0VDC at 250mA avg.

Appendix

Mechanical mounting of the RF module, host PCB requirements

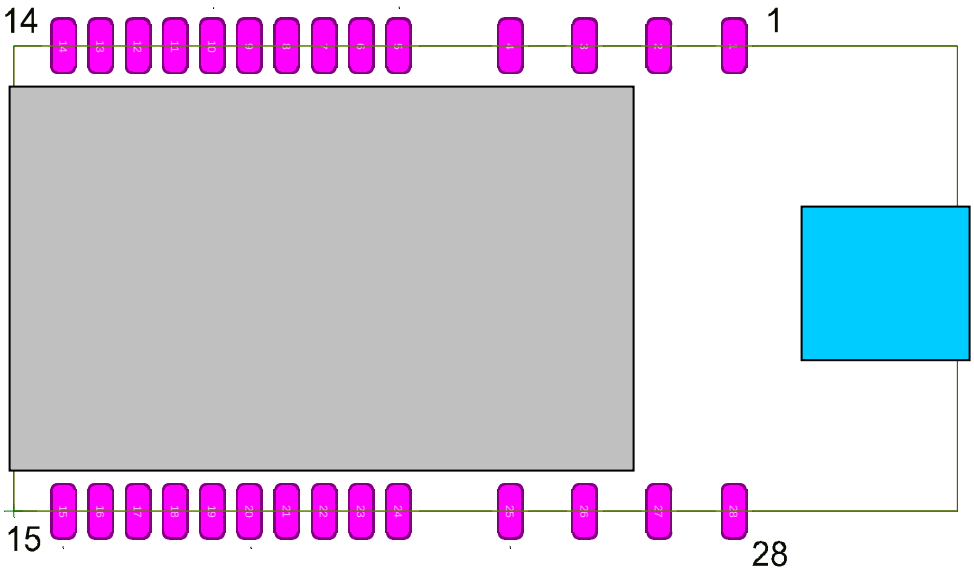
Below is the definition of the host requirements near the PCB footprint which will host the RF module. Carefully note the ground plane requirements shown below. The radiation pattern of the antenna is dependant on the GND plane being properly duplicated. Locate a ground plane preferably on both the top and bottom layers of the host pcb with coverage up to the area shown below which is 30mm from the left edge of the module. The bottom plane may be omitted at the mounting location if using only a 2 layer host pcb. The area under the blue Fractus antenna and along the 8mm wide strip shown in red stripes must NOT have ground plane beneath it on either layer. If in doubt, refer to the datasheet for the Fractus antenna, found at the end of the Appendix.

Figure 1: RF module mounting.



Electrical Interface

Figure 2: RF Module footprint.



The following table defines the geometry of the circuit board pad footprint layout required to mount the RF Module. Each pad is sized to be 0.85mm x 2mm square. The geometric coordinates of each pad and the electrical definition of each pad is listed below. The table also includes the pin function definition and direction of the signal flow with respect to the RF module.

Pin #	**X** (mm)	**Y** (mm)	**Function**	**FLOW Direction**		**Pin #**	**X** (mm)	**Y** (mm)	**Function**	**FLOW Direction**
1	29	18.0	GND	I		**28**	29	0.0	GND	I
2	26	18.0	GND	I		**27**	26	0.0	GND	I
3	23	18.0	GND	I		**26**	23	0.0	GND	I
4	20	18.0	GND	I		**25**	20	0.0	GND	I
5	15.5	18.0	GND	I		**24**	15.5	0.0	GND	I
6	14	18.0	GND	I		**23**	14	0.0	LDO_EN	I
7	12.5	18.0	GND	I		**22**	12.5	0.0	RF_IRQ	I
8	11	18.0	VCC_AMP	O		**21**	11	0.0	VCC5.0	I
9	9.5	18.0	GND	I		**20**	9.5	0.0	SPI_MISO	O
10	8	18.0	GND	I		**19**	8	0.0	GND	I
11	6.5	18.0	GND	I		**18**	6.5	0.0	SPI_MOSI	I
12	5	18.0	VCC3.3	I		**17**	5	0.0	SPI_SCK	I
13	3.5	18.0	RF_ENA	I		**16**	3.5	0.0	SPI_CS	I
14	2	18.0	GND	I		**15**	2	0.0	GND	I

The RF module is essentially an SPI interface, with additional I/O required for enable and control.

RF PIN DESCRIPTIONS

RF_ENA	Input to RF module. This pin is active high. It is used to activate the Nordic Device in RX or TX mode.
VCC_AMP	Output from RF module. Used during manufacturing test only. A reference voltage used to verify operation of LDO.
RF_IRQ	Output from RF module. This pin is active low and is controlled by three maskable interrupt sources.
LDO_EN	Input to RF module. Driving this pin high (3.3V) turns on the regulator which powers the RF amplifier. This pin should be static, and ON during all RF operation.
VCC3.3	Input to RF module. 3.3V supply voltage.
VCC5.0	Input to RF module. 4.2- 5.0V supply voltage/ 250mA max.

STANDARD SPI INTERFACE to RF module's Nordic device.

SPI_CS	Input to RF module. SPI chip select.
SPI_CLK	Input to RF module. SPI clock.
SPI_MISO	Output from RF module. SPI Master in, slave out. Nordic is slave.
SPI_MOSI	Input to RF module. SPI Master out, slave in. Nordic is slave.

Please refer to the Nordic nRF24L01+ RF transceiver for
more detailed strobe data.

Resource info

links to datasheets for components of interest on this module:

RE: Nordic Transceiver:
http://www.nordicsemi.com/eng/Products/2.4GHz-RF/nRF24L01P

RE: Fractus FR05-S1-N-0-001 chip antenna:
http://www.fractus.com/main/fractus/documentation/#row1

The following requirements are given by the FCC for unlicensed operators of FHSS systems in the 2.4GHz band, and must be addressed:

15.247(a)	Description of how the EUT meets the definition of a frequency hopping spread spectrum, found in Section 2.1. Based on the technical description.
15.247(a)	Pseudo Frequency Hopping Sequence: Describe how the hopping sequence is generated. Provide an example of the hopping sequence channels, in order to demonstrate that the sequence meets the requirements specified in the definition of a frequency hopping spread spectrum system, found in Section 2.1
15.247(a)	Equal Hopping Frequency Use: Describe how each individual EUT meets the requirement that each of its hopping channels is used equally on average (e.g. that each new transmission event begins on the next channel in the hopping sequence after final channel used in the previous transmission events).
Public Notice DA 00-705	System Receiver Input Bandwidth: Describe how the associated receiver(s) complies with the requirement that its input bandwidth (either RF or IF) matches the bandwidth of the transmitted signal.
Public Notice DA 00-705	System Receiver Hopping Capability: Describe how the associated receiver(s) has the ability to shift frequencies in synchronization with the transmitted signals
15.247(g)	Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section.
15.247(h)	Describe how the EUT complies with the requirement that it not have the ability to coordinated with other FHSS is an effort to avoid the simultaneous occupancy of individual hopping frequencies by multiple transmitters

Section 2.1 Definition:

Frequency Hopping Systems. A spread spectrum system in which the carrier is modulated with the coded information in a conventional manner causing a conventional spreading of the RF energy about the frequency carrier. The frequency of the carrier is not fixed but changes at fixed intervals under the direction of a coded sequence. The wide RF bandwidth needed by such a system is not required by spreading of the RF energy about the carrier but rather to accommodate the range of frequencies to which the carrier frequency can hop. The test of a frequency hopping system is that the near term distribution of hops appears random, the long term distribution appears evenly distributed over the hop set, and sequential hops are randomly distributed in both direction and magnitude of change in the hop set.