N5 ANT SoC Module Series

ANT Operation (when loaded with S210 SoftDevice)

- 79 selectable RF channels (2402 to 2480 MHz)
- Simple to complex network topologies: peer-to-peer, star, tree, star-to-star and more
- Broadcast, acknowledged, and burst data communication modes
- Supports up to 8 logical channels each with configurable channel periods (5.2ms – 2s)
- Built-in device search and pairing
- Built-in interference handling and radio coexistence management with application radio disable requests and application flash write/erase requests
- Enhanced ANT features
    - Advanced burst data transfer modes (up to 60kbps)
    - Optional single channel encryption mode (AES-128)
    - Supports up to 8 public, private and/or managed networks
    - Advanced power management features to optimize application power consumption including Event Filtering and Selective data updates
    - Asynchronous transmit channel
    - Fast channel initiation

ANT/BLUETOOTH® low energy peripheral Operation (when loaded with S310 SoftDevice)

- ANT operation functions as S210
- BLUETOOTH 4.0 compliant low energy single-mode protocol stack
    - Link Layer
    - L2GAP,ATT, and SM protocols
    - GATT,GAP, and L2GAP
    - Peripheral and Broadcaster roles
    - GATT Client and Server
    - Full SMP support including MITM and OOB pairing

Module Hardware

- Integrated PCB meander antenna
- Onboard 32kHz and 16MHz crystal clocks
- 1.8V to 3.6V supply voltage range
- -25°C to +75°C operating temperature
- 24 GPIOs (LGA package)
- Programmable output per channel from −20dBm up to +4dBm
- Excellent receiver sensitivity -90dBm
- RSSI reading (1dBm resolution)
- Total 256kB embedded flash memory and 16kB RAM
- SPI, I2C and UART interface
- ARM SWD interface
- 14.0x9.8x2.0mm (LGA package)
- Drop-in compatible package with AP2/C7 modules
- Radio regulatory approval for major markets
- BLUETOOTH SIG qualification
- RoHS compliant

FAMILY MEMBERS (N5xx Mxxx)
ANTN548 – pre-loaded with ANT Stack and network processor code
- M8CB: 14x9.8mm LGA
- M4CB: 20x20mm SMT
- M5CB: 20x20mm Molex connector

Table of Contents

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1. N5 System Module Series

The N5 module series uses Nordic Semiconductor's nRF51422, the industry's first System on Chip (SoC) solution that is able to support ANT standalone or ANT/BLUETOOTH low energy dual mode operation depending on the loaded protocol stack with advantages in power, size, cost, speed and security built directly into the protocol layer. The nRF51422 integrates a 32-bit ARM® Cortex™ M0 CPU with 256KB flash, 16KB RAM, and analog and digital peripherals. Benefits will reach consumers in the form of new products with even longer battery life, expanded functionality and security, further simplified operation and overall value.

Nordic Semiconductor protocol stacks are known as SoftDevices. SoftDevices are pre-compiled, pre-linked binary files, which can be programmed and are downloadable from the Nordic Semiconductor's web. The nRF51422 and N5 system module series support the S210, ANT 8-channel protocol stack, and the S310, ANT 8-channel / BLUETOOTH low energy peripheral protocol stack.

The N5 system module series starts with N548M8CB (or ANTN548M8CB) in a 14.0mm x 9.8mm x 2.0mm LGA (Land Array Grid) package. A compact design meeting the industrial requirement to go small, light and wearable, the N548M8CB is also a turnkey system hardware solution including antenna, onboard 32k and 16M crystal clock, DC-DC converter and 24 GPIOs with 6 analogue inputs.

The N548M8CB modules are pre-programmed with the S210 SoftDevice and reference ANT network processor application code in order to function as a generic ANT RF module when connected to an application controller. Both pre-programmed images can be easily replaced via the onboard SWD interface pins using off-the-shelf ARM programmers.

Pin compatible options to Dynastream's 20mm x 20mm AP2 or C7 modules are also available. In these options, N548M8CB modules are soldered on carrier boards that are pin compatible to the previous modules. Current AP2 or C7 module customers can easily use these models to evaluate the hardware and upgrade their final products.

The N5 module series if loaded with ANT and/or BLUETOOTH Low energy stack has been certified to comply with radio regulation or standards covering major markets include North America, Europe, Australia, New Zealand and Japan. The N5 modules series is also qualified by the BLUETOOTH SIG.

1.1   N5 Module Nomenclature

1.2   N5 System Module Offerings

The N5 module series are currently available in the following varieties.

	Module	Description	Packaging and Ordering Options
	N548M8CB Or ANTN548M8CB	14.0 x 9.8 x 2.0mm, LGA package, 31 pins, 24 GPIOs. Pre-loaded with S210 SoftDevice and ANT network processor code.	ANTN548M8CB-Tray: 40 modules on a tray N548M8CB-Reel: 1500 modules taped on a 13" reel
	N548M4CB Or ANTN548M4CB	20.0 x 20.0mm, 17 pins, 13 GPIOs. Pre-loaded with S210 SoftDevice and ANT network processor code.	ANTN548M4CB-Tray: 20 modules on a tray ANTN548M4CB-Reel: 800 modules taped on a 13" reel
	N548M5CB Or	20.0 x 20.0mm, 20 pin Molex connector. Onboard JTAG programming connector. 13	ANTN548M5CB-Tray: 20 modules on a tray

	ANTN548M5CB	GPIOs. Pre-loaded with S210 SoftDevice and ANT network processor code.	

Table 1 N5 Module Series Offerings

1.3 Production Code

For technical support and customer service purposes, a production code of three characters is laser marked on the RF shield as illustrated below.
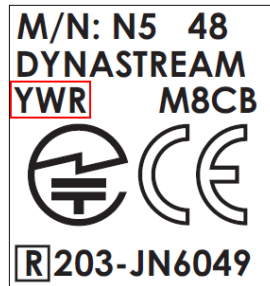

Figure 1 N5 Module Production Code

YW – Production date code

R – Product version

2. Product Overview

2.1 Block diagram
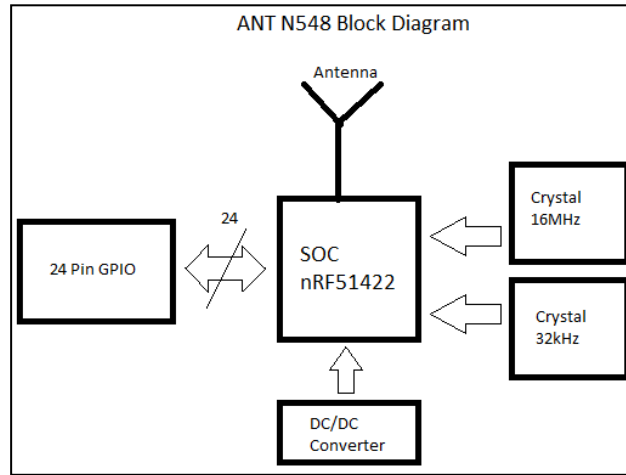
Figure 2 N5 Module Series Block Diagram

2.2 Generic Pin-outs
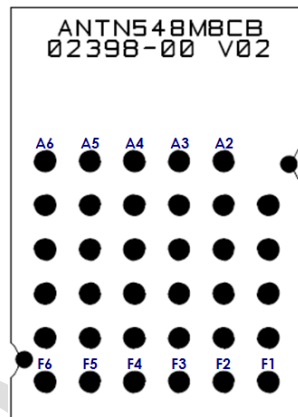
	6	5	4	3	2	1
A	GND	GND	GND	GND	GND	
B	VCC	VCC	P019	P020	P018	RST/SWDIO
C	VCC	VCC	P022	P016	P013	SWDCLK
D	P024	P021	P023	P025	P015	P012
E	P030	P000	P004	P006	P011	P009
F	P031	P002	P001	P003	P005	P008

Figure 3 N5xy M8__ Module LGA Bottom View

Figure 4 N5xy M4__ Bottom View
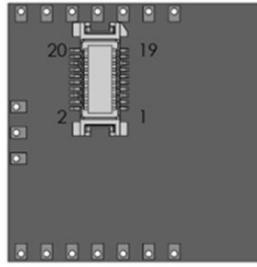
Figure 5 N5xy M5__ Bottom View

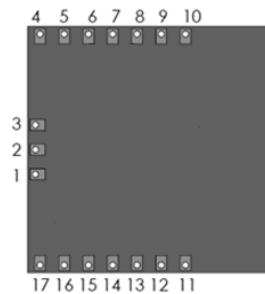| N5xy M8xx LGA Pad	N5xy M4xx Pin	N5xy M5xx Molex Connector	nRF51422 Pin Name	Description
A2-6	4	19	GND	Power supply ground
B1	2	10	$\overline{RST}$ /SWDIO	System reset. Also HW debug and flash programming I/O
B2			P018	GPIO
B3			P020	GPIO
B4			P019	GPIO
B5, B6	3	1	Vcc	Power supply source
C1	5	6	SWDCLK	HW debug and flash programming I/O
C2			P013	GPIO
C3			P016	GPIO
C4			P022	GPIO
C5, C6	3	1	Vcc	Power supply source
D1	12	3	P012	GPIO
D2	11	4	P015	GPIO
D3			P025	GPIO
D4	6	17	P023	GPIO
D5		16	P021	GPIO
D6	10	7	P024	GPIO
E1	14	9	P009	GPIO
E2	15	14	P011	GPIO
E3	13	5	P006	GPIO / ADC input 7/ ADC reference voltage 1
E4		20	P004	GPIO / ADC input 5
E5	9	11	P000	GPIO / ADC reference voltage 0
E6	8	13	P030	GPIO
F1	16	12	P008	GPIO
F2	17	2	P005	GPIO / ADC input 6
F3	1	8	P003	GPIO / ADC input 4
F4		18	P001	GPIO / ADC input 2
F5	7	15	P002	GPIO / ADC input 3
F6			P031	GPIO

Table 2 N5 Module Generic Pin-Outs

2.3 Writing the application code and programming

Please refer to nRF51422 S210 SoftDevice Specification or nRF51422 S310 SoftDevice Specification from Nordic Semiconductor.

2.4   Designs Consideration using the Module

The M8 module is designed to show the best RF performance in general with FR4 PCB attached. Typical radiation pattern is as follows,
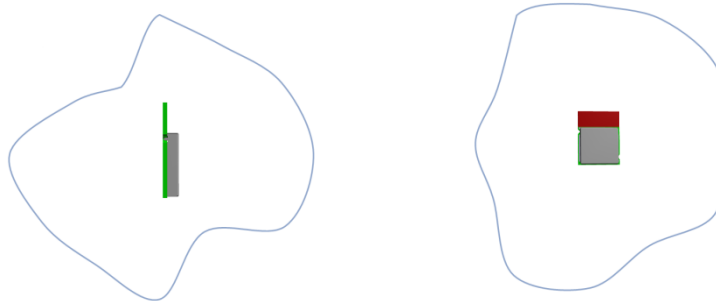
Figure 6 Typical Radiation Pattern

Please refer to the following drawing to mount the module.
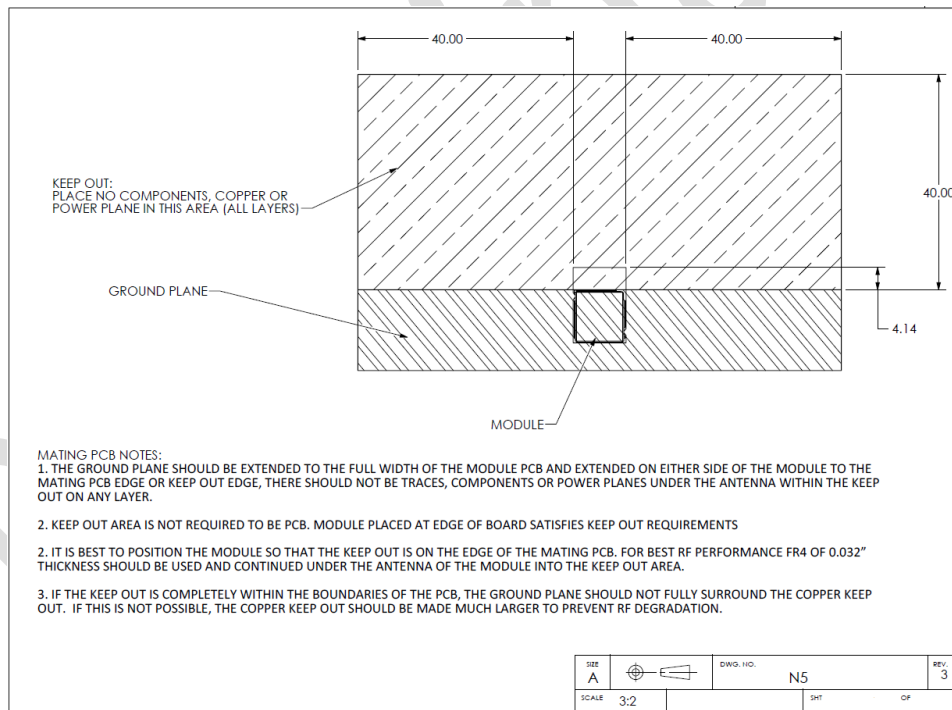
Figure 7 Antenna Keep Out and PCB note

2.5   Assembly Consideration

2.6   Moisture Control

The moisture control of the module is rated at level 1 defined by IPC/JEDEC J-STD-020. The modules do not require special storage conditions provided:

- They are maintained at conditions equal to or less than 30 °C/85 % RH, and

- They are solder reflowed at a peak body temperature which does not exceed 260 °C

To ensure good solderability of the PCB pads, it is highly recommended to always have the modules intended for reflow well sealed when in storage.

3. Regulatory Approvals and Compliances

The N5 system module series has received regulatory approvals in the United States (FCC) and Canada (IC), and has been verified to conform to the appropriate regulations in Europe, Australia and New Zealand, and Japan. The module series has been qualified by BLUETOOTH SIG. Such approvals and qualification allow the user to place the module inside a finished product and, in most cases, not require regulatory testing for an intentional radiator, provided no changes or modifications are made to the module circuitry. This does not preclude the possibility that some other form of authorization or testing may be required for the finished product. Changes or modifications could void the user's authority to operate the equipment. The end user must comply with all of the instructions provided by the Grantee, which indicate installation and/or operating conditions necessary for compliance.

3.1   United States

The N5 system module series 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 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.

The N5 module series complies with 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.

The N5 module series does not contain any user-serviceable parts. Unauthorized repairs or modifications could result in permanent damage to the equipment, and void your warranty and your authority to operate this device under Part 15 regulations.

The N5 module series is labelled with its own FCC ID, O6R2398 (note: First Character is the letter O, not the # 0.) If the FCC ID is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. This exterior label can use wording such as the following: "Contains Transmitter Module FCC ID: O6R2398" or "Contains FCC ID: O6R2398". Any similar wording that expresses the same meaning may be used.

3.2   Industry Canada Compliance

The N5 system module series 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.)

To comply with Industry Canada regulations, it is required that product containing the N5 module series display a label referring to the enclosed module. This exterior label can use wording similar to the following: "Contains IC: 3797A-2398"

This information shall be affixed in such a manner as not to be removable except by destruction or defacement. The size of the lettering shall be legible without the aid of magnification but is not required to be larger than 8-point font size. If the device is too small to meet this condition, the information can be included in the user manual upon agreement with Industry Canada.

3.3   CE Declaration of Conformity

The N5 system module series is declared to be in conformance with the essential requirements and other relevant provisions of Directive 1999/5/EC and 2011/65/EU, as a low-powered unlicensed transmitter:

- EN 60950-1:2006+A11:2009+A1:2010+A12:2011 Information technology equipment - Safety - Part 1: General requirements
- EN 300 440-2 v1.4.1 Electromagnetic compatibility and Radio spectrum Matters (ERM); Short range devices; Radio equipment to be used in the 1 GHz to 40 GHz frequency range; Part 2: Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive
- EN 61000-6-1:2007 Electromagnetic compatibility (EMC) -- Part 6-1: Generic standards - Immunity for residential, commercial and light-industrial environments
- EN 301 489-3 V1.6.1 Electromagnetic compatibility and Radio spectrum Matters (ERM); Electromagnetic Compatibility (EMC); standard for radio equipment and services; Part 3: Specific conditions for Short-Range Devices (SRD) operating on frequencies between 9 kHz and 40 GHz

3.4   Australia & New Zealand

The N5 system module series has been tested and found to comply with

- AS/NZS 4268:2012 Radio equipment and systems – Short range devices
- AS/NZS CISPR 22:2009 Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement

The ACMA/MED supplier code number is N20233

3.5   Japan

The N5 system module series has been granted type certificate (mark number R203-JN6049). Standard applied:

Notification No. 88 of MIC 2004, 2.4GHz band wide-band low-power data communication system (item 19 of Article 2 paragraph 1)

3.6   BLUETOOTH Qualification

Contents to be added

4. Electrical Specifications

4.1 Absolute Maximum Ratings [1]

PARAMETER	TEST CONDITIONS	Min	Max	Unit
Supply voltage (VCC)	All supply pins must have the same voltage	-0.3	3.6	V
Voltage on any digital pin		-0.3	VCC+0.3, ≤ 3.9	V
Storage temperature range		-40	125	°C
ESD	All pads, according to human-body model, JEDEC STD 22, method A114		4	kV
	According to charged-device model, JEDEC STD 22, method C101		500	V

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

4.2 Recommended Operating Conditions

Over operating free-air temperature range (unless otherwise noted)

PARAMETER	Min	Max	Unit
Operating ambient temperature range, T_A	-25	+75	°C
Operating supply voltage	1.8	3.6	V

4.3 Electrical Specifications
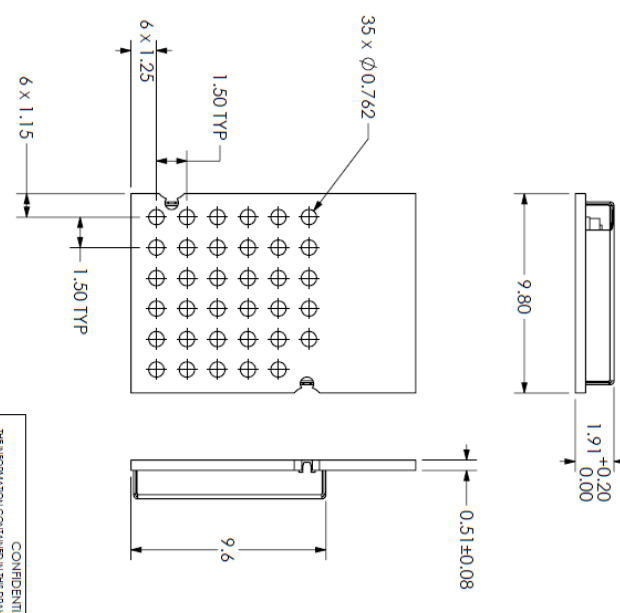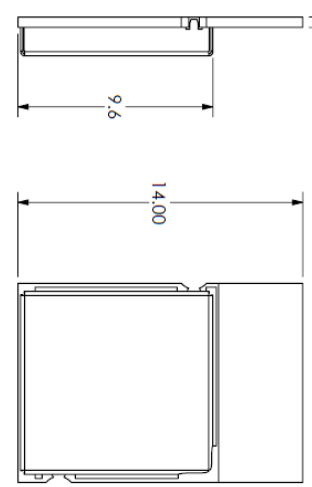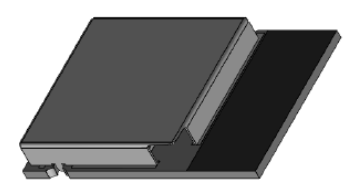
Please refer to the nRF51422 Product Specification of Nordic Semiconductor.

5. Mechanical Drawings

ANT N5 Module Mechanical Outline

6. Support

The N5 system module series uses nRF51422 from Nordic Semiconductor. Users can seek technical support, esp. about hardware, from Nordic Semiconductor, www.nordicsemi.com. Users can seek application support from Dynastream Innovations, www.thisisant.com.

6.1   One Year Limited Warranty

This product is warranted to be free from defects in materials or workmanship for 1 year from the date of purchase of the end customer. Within this period, Dynastream Innovations Inc. (Dynastream) will, at its sole option, replace any products that fail in normal use. Such replacement will be made at no charge to distributors or companies who purchase this product directly from Dynastream, provided the distributor or company shall be responsible for any transportation cost. This warranty does not apply to: (i) cosmetic damage, such as scratches, nicks and dents; (ii) damage caused by accident, abuse, misuse, water, flood, fire, or other acts of nature or external causes; (iii) damage caused by service performed by anyone who is not an authorized service provider of Dynastream; (iv) damage to a product that has been modified or altered without the written permission of Dynastream. In addition, Dynastream reserves the right to refuse warranty claims against products or services that are obtained and/or used in contravention of the laws of any country.

Replaced products have 1 year warranty as stipulated in this term.

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IN NO EVENT SHALL DYNASTREAM BE LIABLE FOR ANY INCIDENTAL, SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES, WHETHER RESULTING FROM THE USE, MISUSE, OR INABILITY TO USE THIS PRODUCT OR FROM DEFECTS IN THE PRODUCT.

Dynastream retains the exclusive right to replace (with a new or newly-overhauled replacement product) the device or software or offer a full refund of the purchase price at its sole discretion. SUCH REMEDY SHALL BE THE SOLE AND EXCLUSIVE REMEDY FOR ANY BREACH OF WARRANTY.

To obtain warranty service, the distributor or company shall contact Dynastream for shipping instructions and a return material authorization (RMA) tracking number. Securely pack the device and a copy of the original sales receipt, which is required as the proof of purchase for warranty claims. Write the tracking number clearly on the outside of the package. Send the device, freight charges prepaid, to Dynastream.

6.2   ANT Forum

Users are encouraged to participate in the ANT forum moderated by the application engineering team of Dynastream Innovations for any engineering discussions. Joining the ANT forum is free and open at http://www.thisisant.com/forum.

6.3   Public Technical References

Documents:

1. nRF51422 Product Specification, Nordic semiconductor
2. nRF51822 and nRF51422 Product Anomaly Notification (PAN-028), Nordic Semiconductor
3. nRF51422 S210 SoftDevice Specification, Nordic Semiconductor
4. nRF51422 S310 SoftDevice Specification, Nordic Semiconductor
5. ANT Message Protocol and Usage, Dynastream Innovations
6. Interfacing with ANT General Purpose Chipsets and Modules, Dynastream Innovations

Software:

7. S210 nRF51422 SoftDevice

8. S310 nRF51422 SoftDevice
9. ANT network processor reference code
10. ANTwareII – a system testing and debugging tool

The above documents and software are available at www.thisisant.com and/or ww.nordicsemi.com.

6.4   ANT Developer's Zone

ANT development software tools, application notes, reference designs and other public resources are found in the ANT developer's zone at http://www.thisisant.com/developer.

To begin development with the ANT+ interoperability, please become an ANT+ Adopter or ANT+ Alliance member to obtain the access to the ANT+ Adopter Zone. ANT+ documents and design tools contained in the ANT+ Adopter zone include the ANT+ Device Profiles, ANT-FS specification, ANT software (PC/Mac) libraries with source code, and embedded reference designs with source code.

6.5   ANT Social Media

ANT is on the following social media sites,

YouTube: http://www.youtube.com/user/ANTAlliance

Twitter: http://twitter.com/ANTPlus

Facebook: https://www.facebook.com/thisisant

LinkedIn: http://www.linkedin.com/groups?gid=1379137

Appendix: Using the ANT Network Processor Configuration

N548 modules are preloaded with a default ANT network processor reference code image in the application code space of the NRF51422. Using this configuration is similar to other ANT generic chips or modules, as illustrated in the diagram below. This reference code is accessible the downloading area of www.thisisant.com
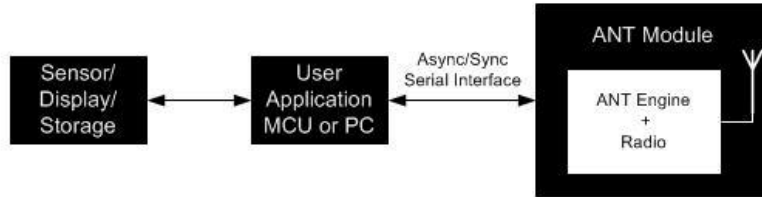

Figure 8 Using ANT Network Processor

Pin Assignments in the ANT Network Processor Configuration

In the pre-loaded ANT network processor configuration, specific functions are assigned to the module pins. The details are as the following.

N548M8xx LGA Pad	N548M4xx Pin	N548M5xx Molex Connector	nRF51422 Pin Name	Default Reference Code ANT Network Processor Pin Assignments			
				Pin Name	Async Mode	Sync Mode	Function
A2-6	4	19	GND	GND	GND	GND	Power supply ground
B1	2	10	$\overline{RST}$ /SWDIO	$\overline{RST}$	$\overline{RST}$	$\overline{RST}$	Reset the device
B2			P018	NC	NC	NC	No connection
B3			P020	NC	NC	NC	No connection
B4			P019	NC	NC	NC	No connection
B5, B6	3	1	Vcc	Vcc	Vcc	Vcc	Power supply source
C1	5	6	SWDCLK	NC	NC	NC	No connection
C2			P013	NC	NC	NC	No connection
C3			P016	NC	NC	NC	No connection
C4			P022	NC	NC	NC	No connection
C5, C6	3	1	Vcc	Vcc	Vcc	Vcc	Power supply source
D1	12	3	P012	RXD0/SIN	RXD0	SIN	Async -> Receive data signal Sync -> Data input
D2	11	4	P015	TXD0/SOUT	TXD0	SOUT	Async -> Transmit data signal Sync -> Data output
D3			P025	$\overline{NC}$	NC	NC	No connection
D4	6	17	P023	$\overline{SUSPEND}$ / $\overline{SRDY}$	$\overline{SUSPEND}$	$\overline{SRDY}$	Async -> Suspend control Sync -> Serial port ready
D5		16	P021	Unused	Unused	Unused	Not used, tie to ground
D6	10	7	P024	BR2/SCLK	BR2	SCLK	Async -> Baud rate selection

N548M8xx LGA Pad	N548M4xx Pin	N548M5xx Molex Connector	nRF51422 Pin Name	Default Reference Code ANT Network Processor Pin Assignments			
				Pin Name	Async Mode	Sync Mode	Function
							Sync -> Clock output signal
E1	14	9	P009	BR3	BR3	Tie to GND	Async -> Baud rate selection Sync -> Not used, tie to ground
E2	15	14	P011	Unused	Tie to GND	Tie to GND	Not used, tie to ground
E3	13	5	P006	BR1	BR1	Tie to GND	Async -> Baud rate selection Sync -> Not used, tie to ground
E4		20	P004	Unused	Unused	Unused	Not used, tie to ground
E5	9	11	P000	PORTSEL	Tie to GND	Tie to VCC	Asynchronous or synchronous port select
E6	8	13	P030	Unused	Tie to GND	Tie to GND	Tie to GND
F1	16	12	P008	Unused	Tie to GND	Tie to GND	Tie to GND
F2	17	2	P005	RTS/SEN	RTS	SEN	Async -> Request to send Sync -> Serial enable signal
F3	1	8	P003	Unused	Unused	Unused	Not used, tie to ground
F4		18	P001	Unused	Unused	Unused	Not used, tie to ground
F5	7	15	P002	SLEEP/$\overline{\text{MRDY}}$	SLEEP	$\overline{\text{MRDY}}$	Async -> Sleep mode enable Sync -> Message ready indication
F6			P031	NC	NC	NC	No connection

Table 3 Pin Assignments in ANT Network Processor Configuration
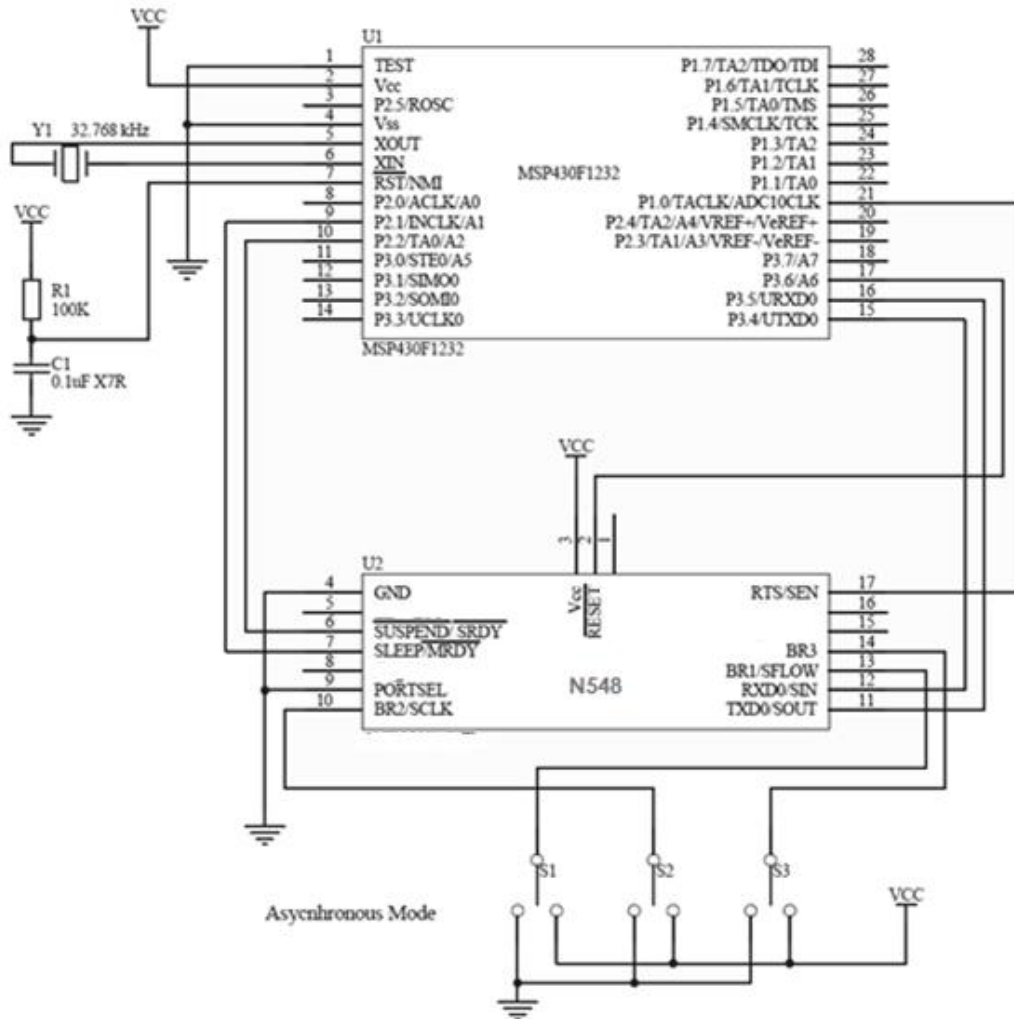
Async Mode Baud Rate Select

The baud rate of the asynchronous communication is controlled by the speed select signals BR1, BR2 and BR3. Please refer to the table below.

BR3	BR2	BR1	Baud Rate
0	0	0	4800
1	0	1	9600
0	1	0	19200
0	0	1	38400
1	1	1	57600

Table 4 Async Mode Baud Rate Select

Async Mode Baud Connection Example

Asycnhronous Mode
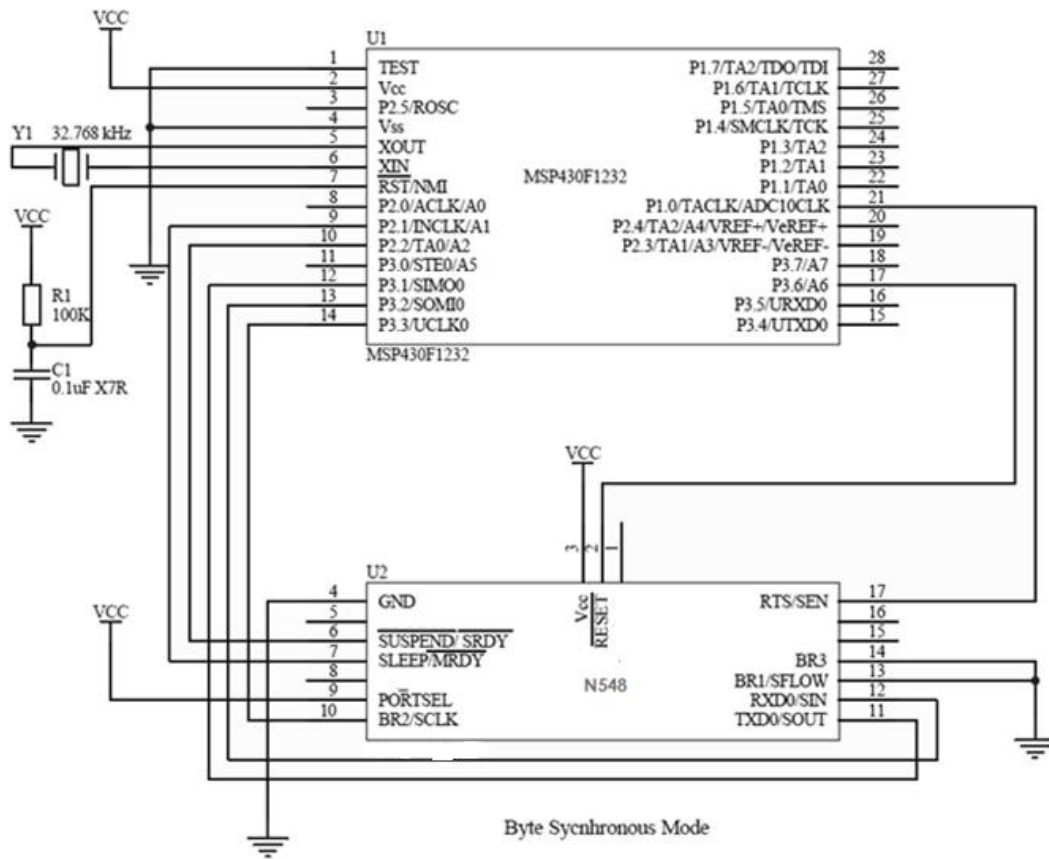
Notes:

- Module RXD and TXD connected directly to hardware USART of microcontroller.
- Switches on baud rate selection pins (BR1, BR2 and BR3) are for ease of use only. They can be connected directly to the logic level of interest.
- RTS is hardware controlled on the N548 and will toggle on a per byte level. If HW flow control is not available on MCU, the software implemented flow control must be able to manage serial communication flow control on a per byte level.

Byte Sync Mode Connection Example

Byte Sycnhronous Mode

Notes:

- Module SOUT, SIN, and SCLK connected directly to hardware USART of microcontroller.
- $\overline{\text{SEN}}$ needs to be on an interrupt capable I/O pin on the microcontroller. (Interrupt pins located on Port 1&2 on the MSP430F1232)