



# User Manual Development Kit

ANTDKT3  
ANTDKT3UP1  
ANTAP2DK1

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### About the User Manual

- This user manual is to facilitate the evaluation and prototyping of solutions based on the ANT Development Kit ANTDKT3 (with optional ANTDKT3UP1) or ANTAP2DK1
- This user manual is for design engineers who are using the ANT Development Kit to evaluate ANT as a wireless sensor network solution and develop applications based on ANT. The development kits are not intended as end products or for use by individuals who do not have a professional background in data communications. Refer to the Copyright Information and Usage Notice page for detailed information and usage restrictions.

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## Revision History

Revision	Effective Date	Description
1.5	Feb 12, 2008	Rewrite "Using ANTware". Add section 5.2 "Sample SensRcore scripts". Add reference design disclaimer
1.6	July 6, 2009	Add ANTDKT3UP1 and ANTAP2DK1 content, add dev zone and forum support, and modify doc structure. Correct 50000 and 57600 are the fixed rate connecting the UIF board. Change footer.
1.7	January 28, 2011	Minor content changes to abide with the new ANT license (open-source license)
1.8	May 18, 2011	Changed copy-write date. Changed address in footer. Added missing Application notes to section 1.2. Changed section 3 "Using ANTware II" so it is compatible with ANTware II. Changed all instances of ANTware to ANTware II. Updated screen shots of ANTware to ANTware II. Changed section 4.1 "SensRware Tutorial" to digital data rather than analog. Changed tables in this section to be consistent with digital data channels. Changed screenshots to be consistent with digital data channel. Changed the tutorial to be consistent with ANTware II. Changed 4.1.3 "Testing the SensRcore Script" so it is useable with a digital data channel. Added a short section at the end of section 4.1 to provide information on an analog data channel. Changed various typos throughout.
1.9	June 13, 2012	Added Section 4.1.4.

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## 1 Development Kit Overview

The ANT development kit offers a comprehensive set of hardware and software tools to help users to evaluate, design and prototype using ANT technology. The development kit features:

- detailed specifications, application notes, reference designs and basic processes for assessment and integration of the ANT wireless sensor network solution using ANT modules in both embedded and PC environments
- hardware configurations required for various operational modes of the modules
- tutorials on the *ANTware II* RF monitor and control PC application and the *SensRware* utility
- wireless sensor development and configuration based on SensRcore™ design platform
- PC application development using ANT products
- free access to the ANT developer's zone.

ANTAP2DK1 and ANTDKT3 are the two ANT development kits containing the same hardware, with the exception that ANTAP2DK1 features the latest AP2 modules in replacement for AP1 modules in ANTDKT3. Table 1 below shows the hardware content of the two development kits.

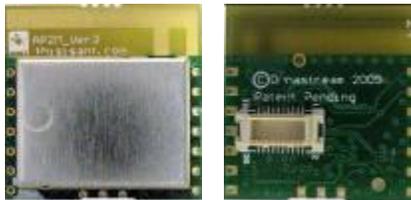
**Table 1. Development Kit Contents**

Component	ANTAP2DK1	ANTDKT3
ANTAP281M5IB module	2	0
ANT11TS33M5IB module	2	2
ANTAP1M5IB module	0	2
ANT battery board	2	2
ANT I/O interface board	2	2
USB interface board	2	2
CR2032 battery	2	2

ANTDKT3 kit can be upgraded to ANTAP2DK1 through the upgrade kit ANTDKT3UP1.

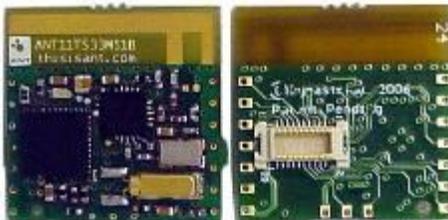
### 1.1 Hardware

1. ANTAP281M5IB module (a member of AP2 module family)



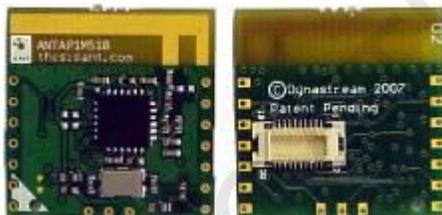
The 20 mm x 20 mm AP2 module uses the latest ANT system on chip offering from Nordic Semiconductor, the nRF24AP2-8ch chip. It is based on Nordic Semiconductor's new generation of ultra low power radio platform and incorporates many enhancements on the ANT core stack. The AP2 module is also the first of such that have received RF regulatory approval. For more detailed information, refer to the ANT AP2 Module datasheet.

2. ANT11TS33M5IB module (a member of AT3 module family)



The 20 mm x 20 mm AT3 module contains ANT technology with SensRcore™ in a dual-chip implementation using Nordic semiconductor's nRF24L01 radio and Texas Instruments' MSP430 MCU. The ANT SensRcore™ mode allows analog or digital sensors to be connected to the ANT microcontroller (MCU), eliminating the need for a HOST application controller. For more detailed information, refer to the AT3 RF Transceiver Module datasheet.

3. ANTAP1M5IB module (a member of AP1 module family)



The 20 mm x 20 mm AP1 module is designed around Nordic Semiconductor's nRF24AP1, the widely deployed and proven ANT single chip solution. For more detailed information, refer to the ANTAP1MxIB Module datasheet.

4. ANT battery board  
Refer to section 1.3 for details.
5. ANT I/O interface board  
Refer to section 1.4 for details.
6. USB interface board  
Refer to section 1.5 for details.
7. CR2032 battery

## 1.2 Technical Resource

Many documents, PC applications, drivers, reference designs and source codes are necessary to use the development kit. Some of the resources are not public, but offered only to development kit owners. The development kit may or may not come with a CD-ROM containing these resources. Regardless, users are encouraged to register their development kits in order to get access to the ANT developer's zone to obtain the complete resources and any updates. ANT developers are also welcomed to join the free and open ANT forum for any technical discussions.

ANT developer's zone: <http://www.thisisant.com/products/data-sheets-brochures>

ANT forum: <http://www.thisisant.com/antforum>

The technical resources for ANT development kit include the following (all items are available in developer's zone)

## User Manual

- ANT Development Kit User Manual
- ANT Reference Design User Manual

## Application Notes

- AN01 – Implementing a Receiver for Tx only Devices
- AN02 – Device Pairing
- AN03 – Dynamic Linking with ANT DLL
- AN04 – Burst Transfers
- AN05 – Using Epson S1C Series Microcontroller with the nRF24AP1
- AN06 – ANT SensRcore™ Mode
- AN07 – Auto Shared Channel – Master Example
- AN08 – nRF24AP1 RF Coupling Reduction Guidelines
- AN09 – ANT Module Hand Soldering Guidelines
- AN10 – ANT Frequency Agility
- AN11 – ANT Channel Search and Background Scanning Channel
- AN12 – Proximity Search
- AN13 – Power States
- AN14 – Continuous Scanning Mode for Asynchronous Topologies
- AN15 – Multi Channel Design Considerations

## Datasheets and Product Specifications

- nRF24AP2 Transceiver chip
- ANT AP2 RF Transceiver Module
- AT3 RF Transceiver Chipset
- AT3 RF Transceiver Module
- nRF24AP1 Transceiver chip
- ANTAP1MxIB RF Transceiver Module

## Interface and ANT Protocol Documents

- ANT Message Protocol and Usage
- Interfacing with ANT General Purpose Chipsets and Modules

- ANT SensRcore™ Messaging and Usage

### Applications

- *ANTware II* - A utility used for testing, debugging and configuring ANT applications
- *SensRware* - A utility used for creating SensRcore™ configuration files
- ANT\_ASC\_Demo – A utility for evaluating the Auto Shared channel capability of ANT
- ANT Windows Library Package, with source code

### Drivers and DLL

- ANT DLL – A library used to interface PC applications to ANT.
- DLLs from Silabs – Used by ANT DLL
- Drivers for the USB interface

### 1.3 ANT Battery Board

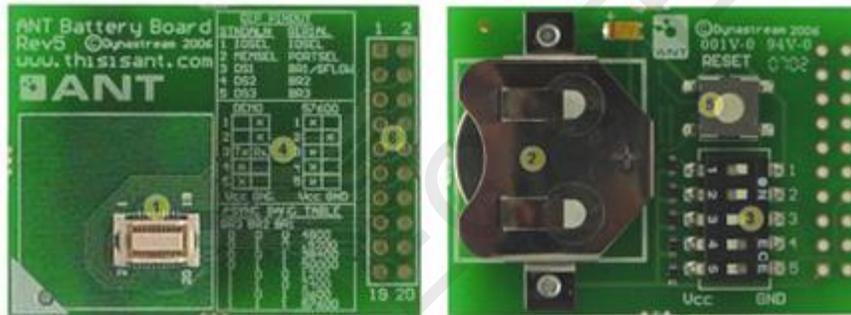


Figure 1. ANT Battery Board

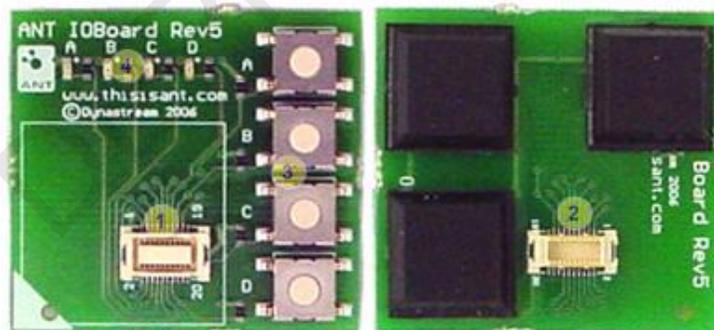
Table 2. Battery Board Description

Number	Component	Description
1	Module Socket	Used for plugging in an ANT module or an I/O interface board
2	Battery Slot	Used to power the demo mode setup (fits a 2032 coin cell)
3	Dipswitches	Used to select the state of the module's 5 configuration lines.
4	Dipswitch Instructions	Silkscreen instructions showing Dipswitch pin-out, Default Baud Rate configuration, and Baud Rate table
5	Reset Button	Resets the module
6	Interface Header	0.1" module interface header. See table below for the pin-out of this 20-pin header (not provided on board).

**Table 3. Battery Board Pin-out**

Pin #	Signal Names
1	Vcc
2	GND
3	RXD/SIN/AIO2
4	TXD/SOUT/IO6
5	IOSELECT/RTS/ $\overline{\text{SEN}}$
6	RST
7	TIE_GND
8	GND
9	$\overline{\text{SUSPEND}}$ / $\overline{\text{SRDY}}$ / AIO0
10	SLEEP/MRDY/AIO1
11	RXD/SIN/AIO2
12	AIO3
13	AIO4
14	IO5
15	TXD/SOUT/IO6
16	IO7
17	PORTSEL
18	BR1/SFLOW/DevSel1
19	BR2/SCLK/DevSel2
20	BR3/DevSel3

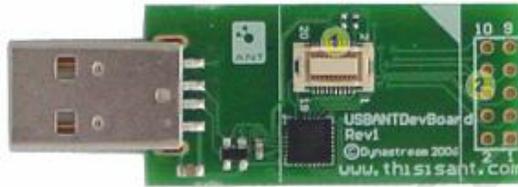
#### 1.4 I/O Interface Board

**Figure 2. I/O Interface Board**

**Table 4. I/O Interface Board Description**

Number	Component	Description
1	Module Socket	Used for plugging in an ANT module
2	Connector	Used to plug onto the battery board
3	Buttons	Used as inputs to 4 of the module's IO pins (AIO0, AIO1, AIO2, AIO3). When a button is released its IO line is pulled up with 1M $\Omega$ resistor. When a button is pressed its IO line is grounded.
4	LED's	Used as outputs of 4 of the module's IO pins (AIO4, IO5, IO6, IO7). A LED turns ON when its line is low and OFF when its line is high.

## 1.5 USB Interface Board

**Figure 3. USB Interface Board****Table 5. USB Interface Board Description**

Number	Component	Description
1	Module Socket	Used for plugging in an ANT module
2	Interface Header	0.1" module interface header. See table below for the pin-out of this 10-pin header (not provided on board).

**Table 6. 10-Pin 0.1" Header**

Pin #	Signal Names
1	Vcc
2	GND
3	RXD/SIN/AIO2
4	TXD/SOUT/IO6
5	IOSELECT/RTS/ $\overline{\text{SEN}}$
6	RST
7	TIE_GND
8	GND
9	$\overline{\text{SUSPEND}}$ / $\overline{\text{SRDY}}$ / AIO0
10	SLEEP/MRDY/AIO1

## 2 USB Driver Installation

Download the ANT USB Driver from [www.thisisant.com](http://www.thisisant.com) and copy the entire contents onto your hard drive.

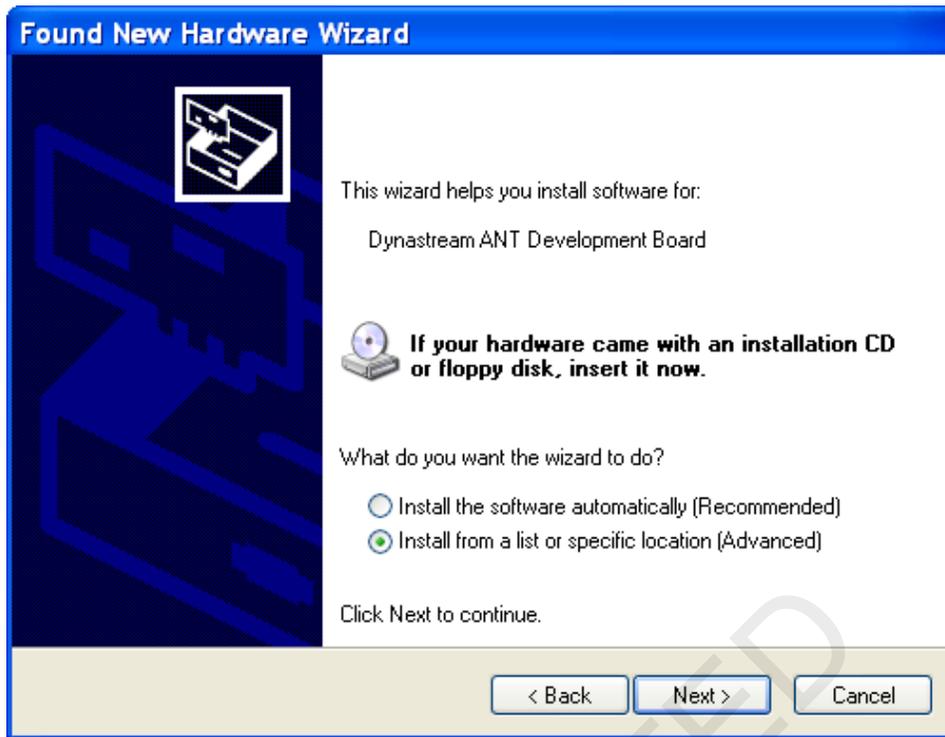
Connect an ANT module to one of the ANT Development Kit's USB interface boards



Plug the USB interface into one of your computer's USB ports. The Found New Hardware Wizard appears on your computer screen.



Select No, not this time and then click the Next > button to continue.



Select Install from a list of specific location (Advanced) and then click Next> to continue.



Select Search for the best driver in these locations. Browse to the Drivers folder in the directory on your hard drive (D:\Drivers in this case) and click Next>.



Click the Continue Anyway button.



Click the Finish button to complete installation of the ANT USB driver.

### 3 Using ANTware II

The *ANTware II* RF Control Application allows you to exercise the power of ANT through the USB port of your computer. *ANTware II* enables you to explore the functionality of ANT, as well as to leverage your ability to quickly design and develop your own embedded ANT applications.

This section walks you through a few basics of how to use *ANTware II*. From there you can explore ANT with the help of the tools and more detailed documentation provided. The ANT Message Protocol and Usage document is a useful companion to this section, as well as the *ANTware II* User Guide.

*ANTware II* can be used with either of the modules mounted onto the USB interface board. The serial communication speed is 50000 Baud if the AP1 module is mounted and 57600 Baud if the AP2 or AT3 module is used. Baud rate is automatically detected by the *ANTware II* application.

Download *ANTware II* from the ANT developer's zone (<http://www.thisisant.com/pages/developer-zone/software-tools>) and unzip all the files to your hard drive.

### 3.1 ANTware II Tutorial

*ANTware II* allows you to interface directly to an ANT module, giving you the ability to test and analyze all parameters of the ANT protocol. This includes setting channel parameters (channel type, RF frequency, message rate, pairing bit etc) to set up and monitor different types of ANT channels. The following step by step procedure presents a basic single channel setup using the default settings and the ANT modules provided in the development kit.

In the following example, a simple peer-to-peer network is setup. This requires setting up one ANT module with a SLAVE ANT channel and another ANT module with a MASTER ANT channel. Once the channel has been established, various data types may be exchanged, including broadcast, acknowledged and burst messages.



**Figure 4. Simple Peer-to-Peer Network**

Browse to the ANTware\_II folder and run ANTware\_II.exe. Only one instance of *ANTware II* is required to run both the Master and Slave channels.A

### Step 1. Connect to the USB devices

Select two ANT modules and mount each onto a USB interface board. Plug the USB sticks into a PC. If you have not done so already, install the driver as outlined in section 2.

After *ANTware II* is opened, you should see the two USB devices on the left-hand side of the window under the “Available Devices” section. If the connection is successful, the ANT modules’ configuration and capabilities should be listed in the text box. See below:

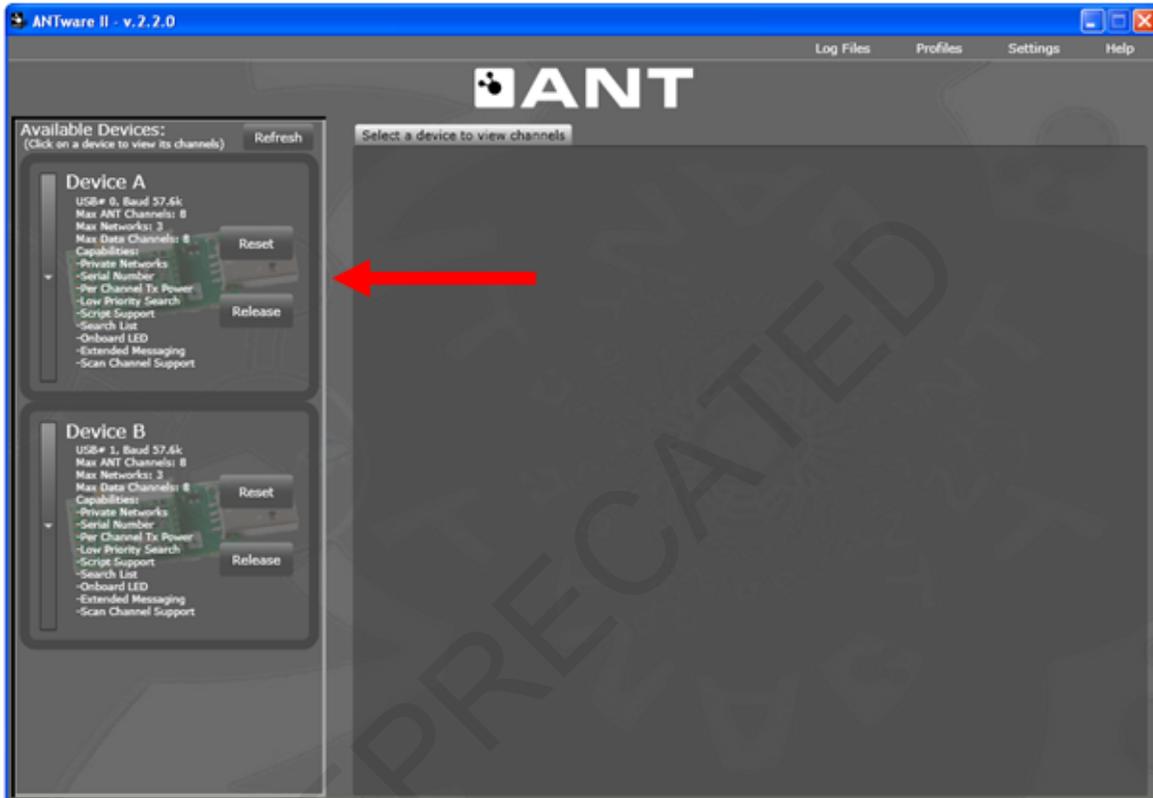
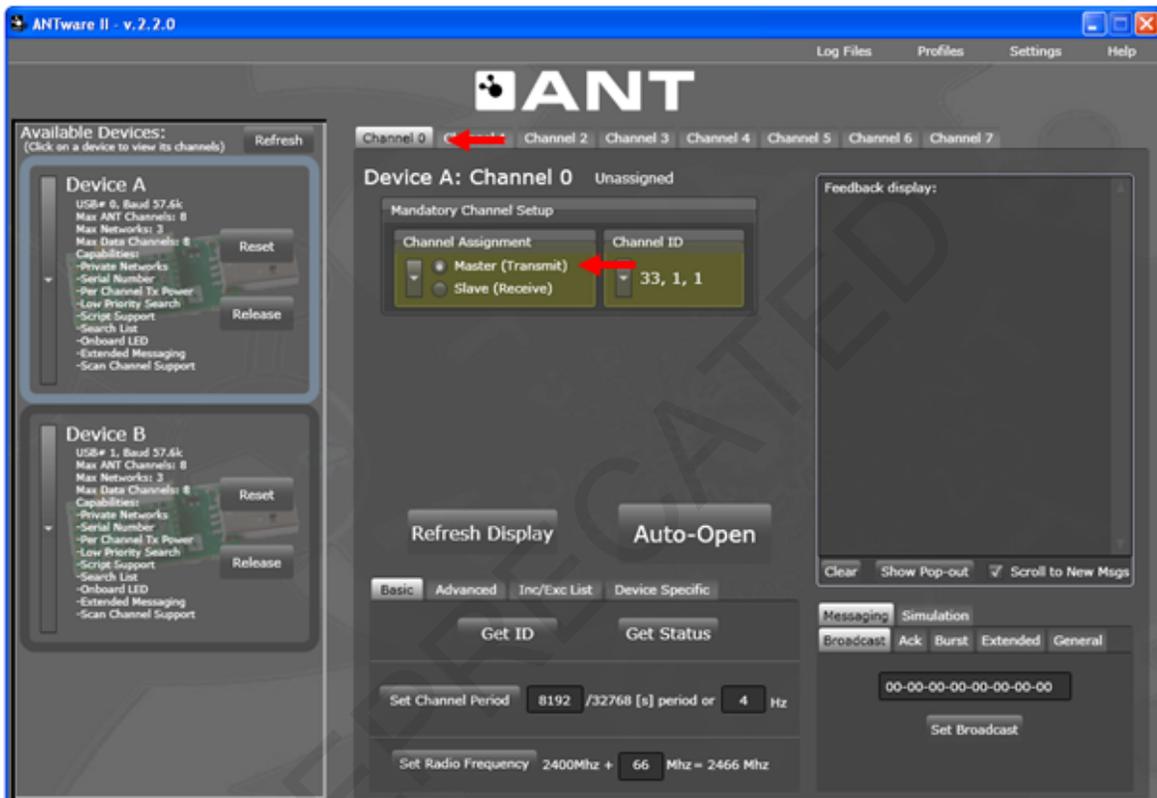


Figure 5. Successful Connection to USB Stick

## Step 2. Assigning a Channel Type

After successfully connecting to the ANT modules, a channel type must be assigned for each module. Up to 8 channels can be configured for the AP2 and AT3 modules and up to 4 channels can be configured for the AP1 module. For this application we only utilize one channel per device. We will assume that Device A is the MASTER channel, and that Device B is the SLAVE channel.

Click on the Device A window. Make sure Channel 0 is selected. In the Mandatory Channel Setup window, select Master (Transmit) as the Channel Assignment.



**Figure 6. Assigning the Master Channel**

Similarly, click on the Device B window, and select Slave (Receive) under Channel Assignment. Ensure Channel 0 was selected.

### Step 3. Setting the Channel Parameters

Next, the channel ID must be set. The channel ID contains 3 parameters – Device No., Device Type and Transmission Type. The channel ID must be unique for each MASTER device in the network. The SLAVE channel ID must match that of the MASTER, or utilize wild cards to search for an unknown MASTER. Please note that, for the SLAVE, any of the three channel ID parameters may be wild carded. For this example we will set the MASTER and SLAVE channel IDs to be the same, ensuring the two devices would only ever connect to each other.

All other channel parameters in this example will be left at the default state. This includes message period (4Hz), channel search timeout (25s), RF frequency (2466MHz) and transmit power (0dBm).

To change the channel ID, click on the downward facing arrow. Set Device # to 33, Device Type to 1, and Transmission Type to 1.

Similar steps are taken for setting the SLAVE channel ID. Ensure the three parameters are the same for the SLAVE as they are for the MASTER.

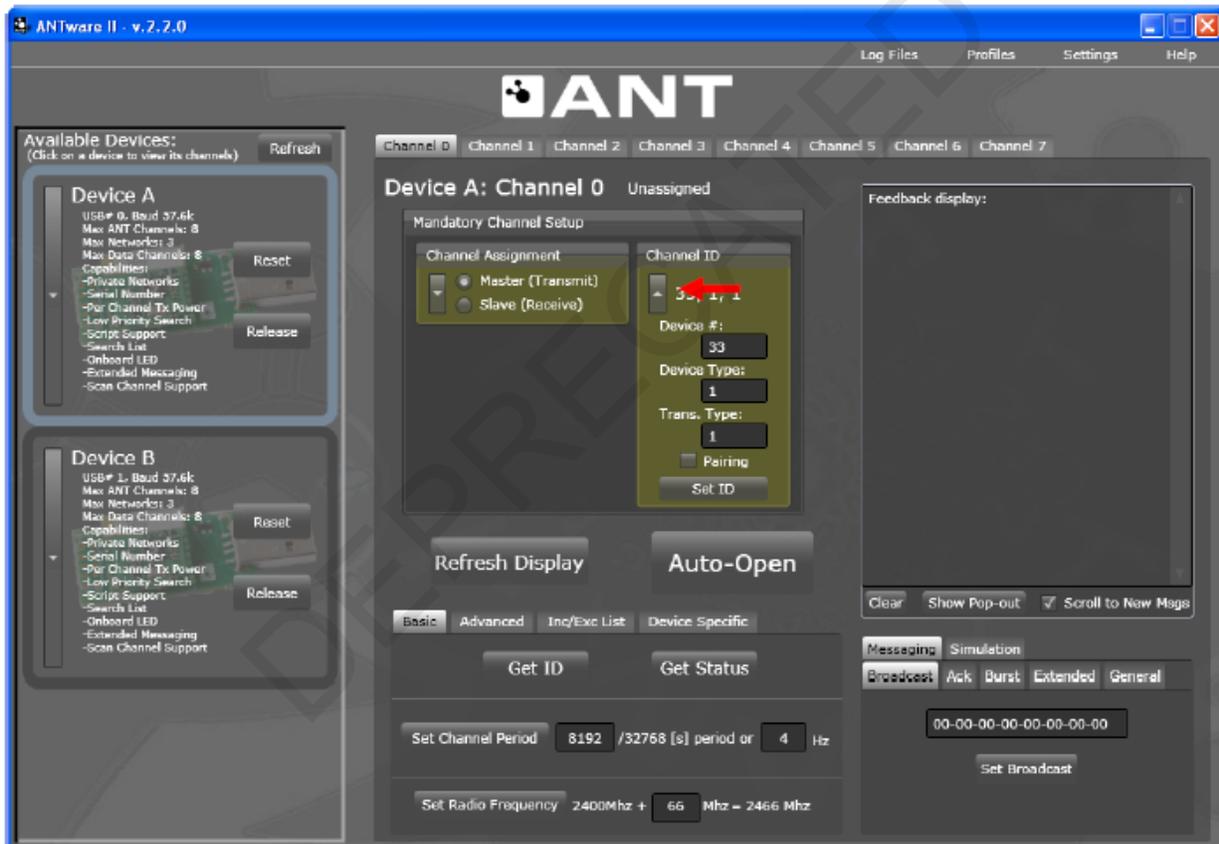


Figure 7. Setting the Channel ID

#### Step 4. Opening the Channel

The final step required to setup the ANT channel is to actually open it. Once a MASTER channel is open, it will start to transmit broadcast data at the specified message period (4Hz). Once the SLAVE channel is opened, it will search for a MASTER channel. Upon synchronization, it will start to receive messages from the MASTER device. At this point the ANT channel has been established and further communication can be initiated.

With Device A selected, click Auto-Open, and the connected ANT module will request Broadcast data from the application (*ANTware II*) at the default 4Hz data rate. The application automatically generates and feeds data. This data can be seen on the channel window on the right hand side of the application.

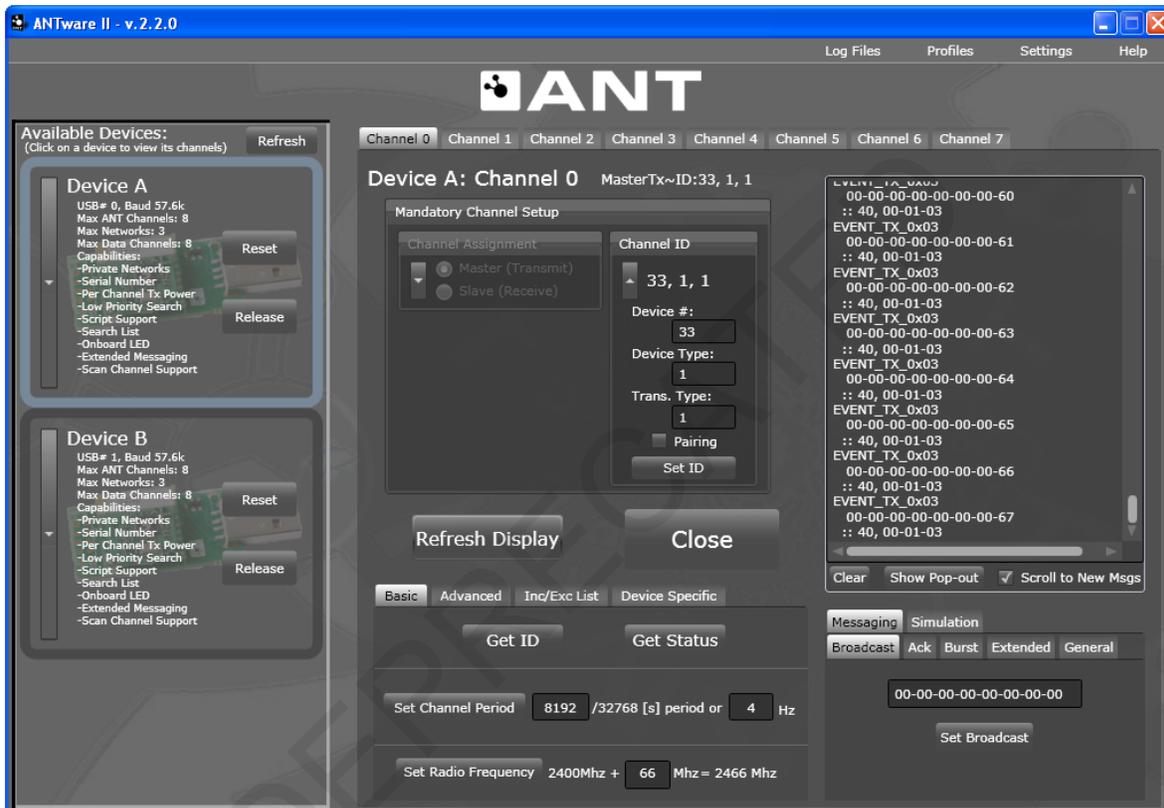


Figure 8. Opening the MASTER Channel

With Device B selected, click Auto-Open and the connected ANT module will initiate a search for the transmitting device. After finding the transmitter, it begins receiving data. An ANT channel is established. The two ANT modules should continue to operate in sync @4Hz message rate.

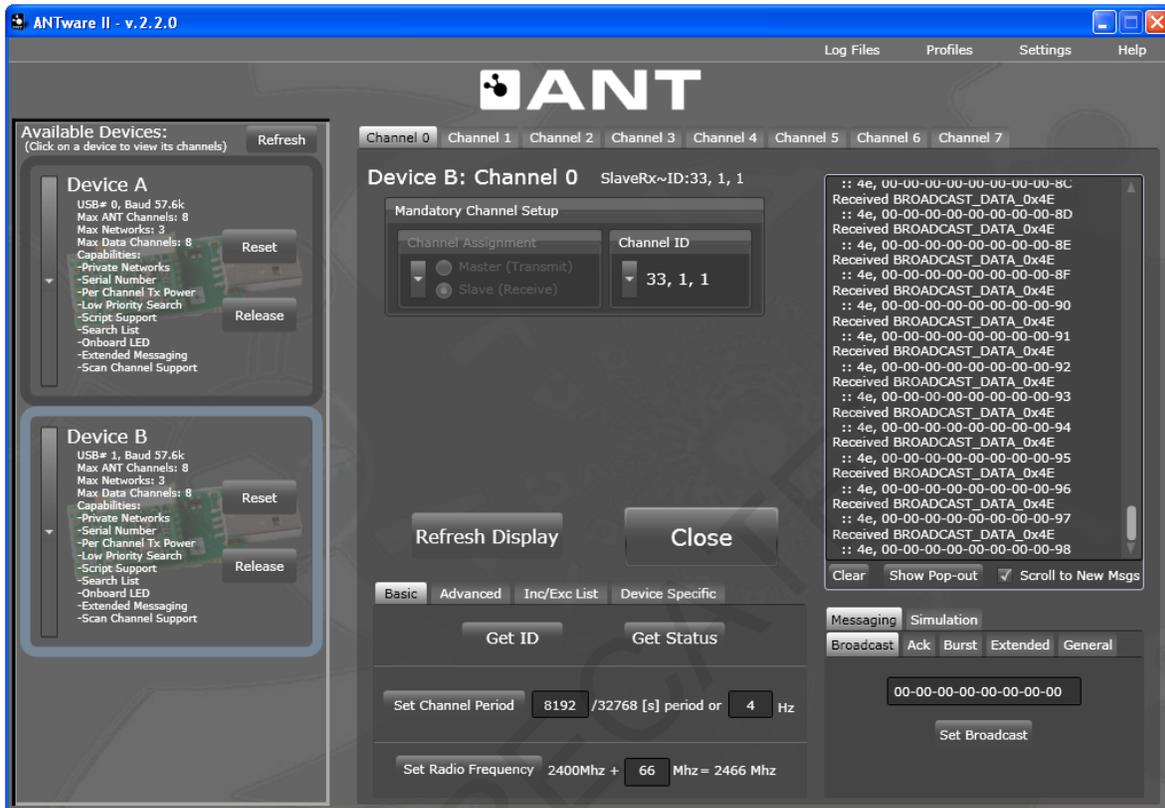


Figure 9. Opening the SLAVE Channel

## Step 5. Sending Data

Once the channel has been established, various data types may be exchange from the MASTER to the SLAVE and vice versa. The data types available are broadcast, acknowledged and burst.

User-defined data can be keyed in the Message Data field for transmission in RF messages. For example, type "21-22-23-24-25-26-27-28" in the data field on the lower right corner of the *ANTware II* window, and then click Set Broadcast. The data may also be sent as an acknowledge message by selecting the Ack tab. Please note that acknowledged messages are not automatically re-tried; however the status of the transmissions' success is reported. It is up to the application layer to perform re-tries as appropriate.

The ANT data channel is bi-directional. The same data types can be sent from the MASTER to the SLAVE as from the SLAVE to the MASTER.

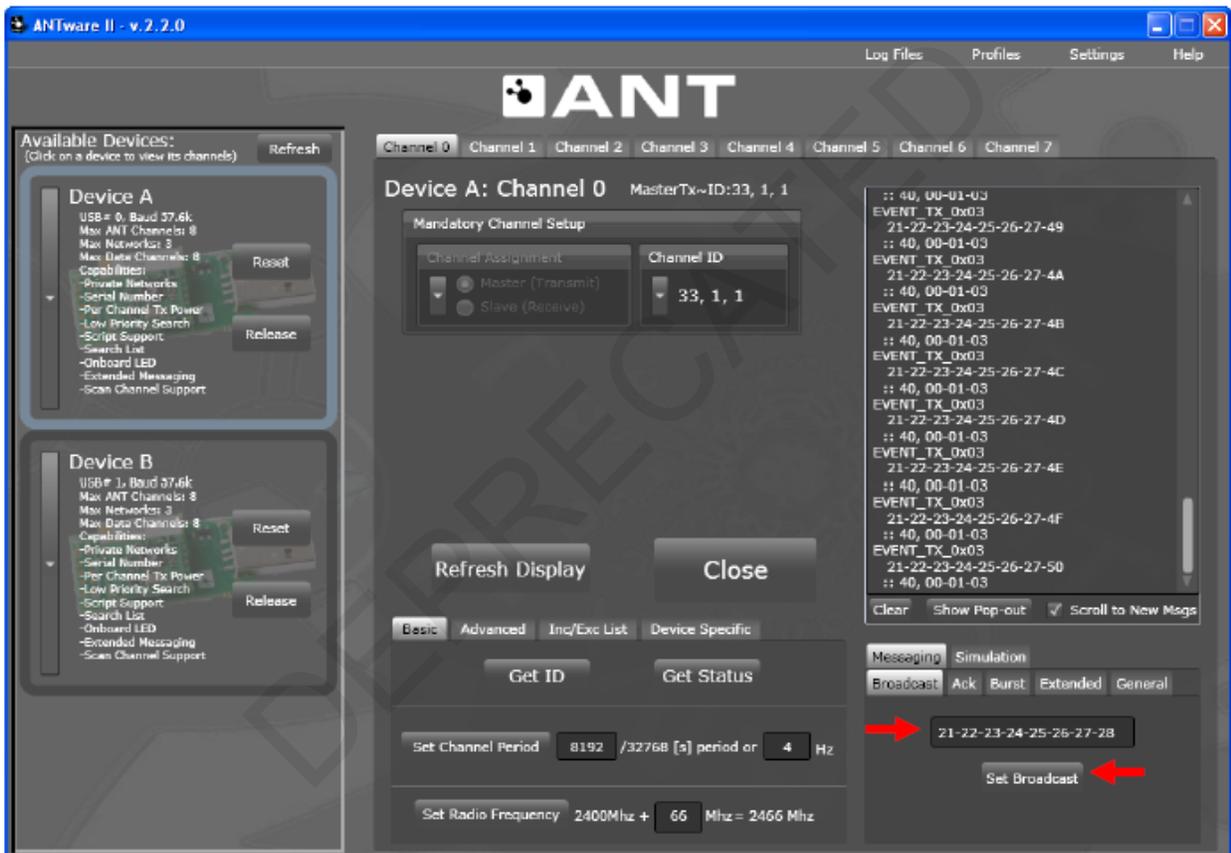


Figure 10. Sending Data Packets

Once a data packet is sent, it will be received and displayed in the *ANTware II* application. Figure 11 illustrates the reception of the data packet sent above.

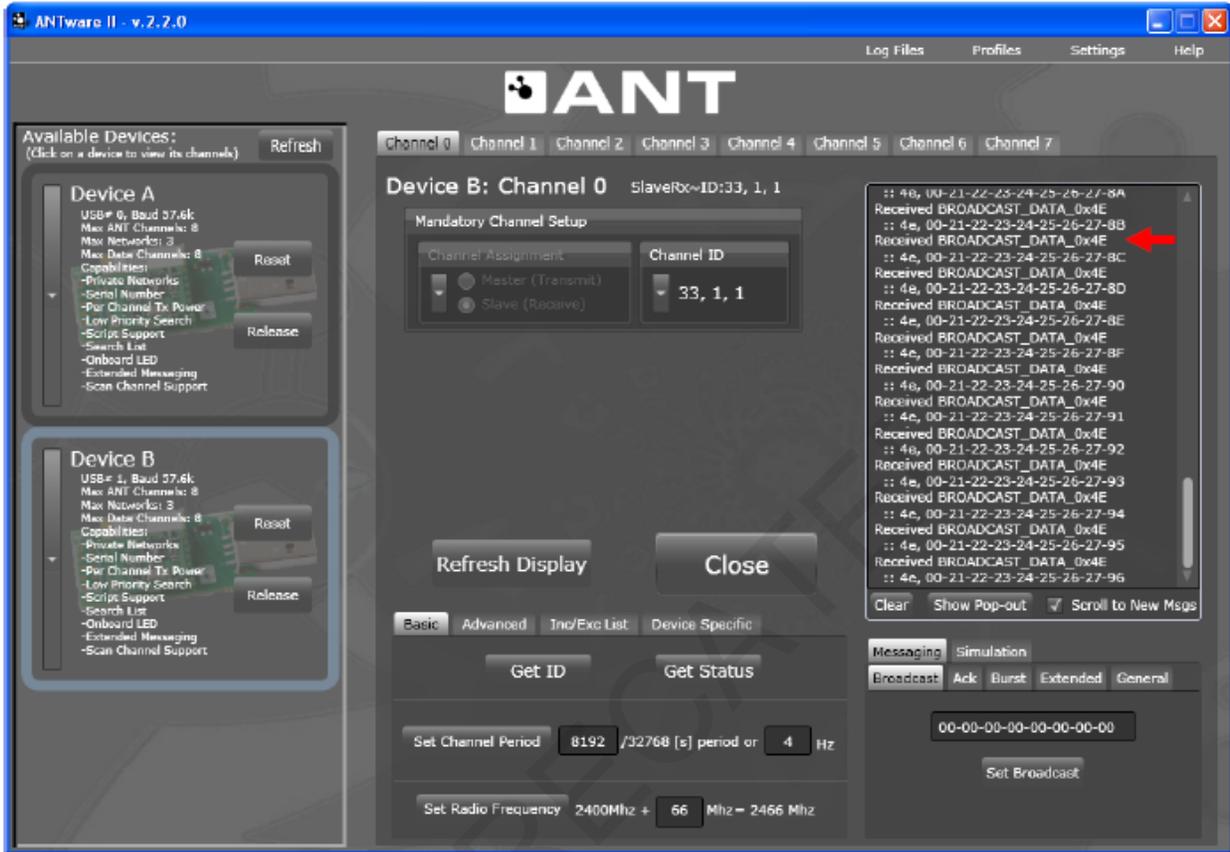


Figure 11. Receiving a Broadcast Message

Bursting may also be tested using *ANTware II*. The user may specify the message length of the burst and subsequently *ANTware II* will generate the packets and the associated data. To burst data across the channel, specify the length of the burst message (default is 256 bytes) under the Burst tab in the MASTER device. Ensure both the SLAVE and MASTER channels are open. Click start transfer on the lower right hand corner of the window under the Burst tab. In the SLAVE channel window, you will notice that the received data will change from 'Received BROADCAST\_DATA' to 'Received BURST\_DATA'. An example of a successful burst from both the MASTER and SLAVE channels is shown below. Note that the length of a packet of data is 8 bytes, so with the message length of 256 bytes, 32 packets are being sent. In Figure 12, the MASTER display is on the left, while the SLAVE display is on the right.

```

21-22-23-24-25-26-27-72
:: 40, 00-01-03
EVENT_TX_0x03
21-22-23-24-25-26-27-73
:: 40, 00-01-03
Sending burst by counter: 256 bytes ← Burst data transmitted
EVENT_TX_0x03
21-22-23-24-25-26-27-74
:: 40, 00-01-03
EVENT_TRANSFER_TX_START_0x0A
:: 40, 00-01-0A
Burst Result: Pass
Time in burst: 479ms
EVENT_TRANSFER_TX_COMPLETED_0x05
:: 40, 00-01-05
EVENT_TX_0x03
21-22-23-24-25-26-27-75
:: 40, 00-01-03
EVENT_TX_0x03
21-22-23-24-25-26-27-76
:: 40, 00-01-03
EVENT_TX_0x03
21-22-23-24-25-26-27-77
:: 40, 00-01-03
EVENT_TX_0x03

:: 4e, 00-21-22-23-24-25-26-27-6D
Received BROADCAST_DATA_0x4E
:: 4e, 00-21-22-23-24-25-26-27-6E
Received BROADCAST_DATA_0x4E
:: 4e, 00-21-22-23-24-25-26-27-6F
Received BROADCAST_DATA_0x4E
:: 4e, 00-21-22-23-24-25-26-27-70
Received BROADCAST_DATA_0x4E
:: 4e, 00-21-22-23-24-25-26-27-71
Received BROADCAST_DATA_0x4E
:: 4e, 00-21-22-23-24-25-26-27-72
Received BROADCAST_DATA_0x4E
:: 4e, 00-21-22-23-24-25-26-27-73
Received BURST_DATA_0x50 ← Burst data received
:: 50, 00-00-01-02-03-04-05-06-07
Received BURST_DATA_0x50
:: 50, 20-08-09-0A-0B-0C-0D-0E-0F
Received BURST_DATA_0x50
:: 50, 40-10-11-12-13-14-15-16-17
Received BURST_DATA_0x50
:: 50, 60-18-19-1A-1B-1C-1D-1E-1F
Received BURST_DATA_0x50
:: 50, 20-20-21-22-23-24-25-26-27
Received BURST_DATA_0x50
.. 50, 40-28-29-2A-2B-2C-2D-2E-2F

```

Figure 12. Receiving a Burst Transfer

## 4 Using SensRware

ANT SensRcore™ mode, available on AT3 modules and chipsets, provides simple analog and digital sensor data inputs and outputs to be transmitted and received across an ANT wireless network without the need for an external HOST microcontroller. Configuration commands are loaded into the ANT device's flash memory and executed on startup. The *SensRware* application allows the user to save SensRcore™ configuration commands to a text file. This text file can then be loaded at a later time using ANTware.

It is important to read and understand the ANT SensRcore™ Messaging and Usage document for descriptions of all SensRcore™ configuration messages in order to exercise the full power of SensRcore™.

Download *SensRware* from the ANT developer's zone (<http://www.thisisant.com/products/data-sheets-brochures>) and unzip all the files to your hard drive

### 4.1 SensRware Tutorial

The *SensRware* PC application provides a point and click interface for creating SensRcore™ scripts. The script created in the following example will enable an AT3 module to sample data from one of its digital I/O lines and to send the data over-the-air for processing. The following sections provide a step-by-step procedure describing how to create the SensRcore™ script, how to load the SensRcore™ script onto an AT3 module, and how to setup the hardware to run the example in SensRcore™ mode using components in the development kit.

For this example, a single digital data channel will be configured and assigned to an ANT channel. The parameters for the data channel and the ANT channel are listed below. Following are step-by-step instructions of how to configure these parameters using *SensRware*.

**Table 7. SensRcore™ Digital Data Channel Parameters**

Parameter	Value
Data Channel	0
Data Type	Digital Input
Timer Chain	4Hz
ANT Channel Number	5
Pin Enable Mask/Number	15
Message Ratio	1
Message Ratio Offset	0

**Table 8. SensRcore™ ANT Channel Setup**

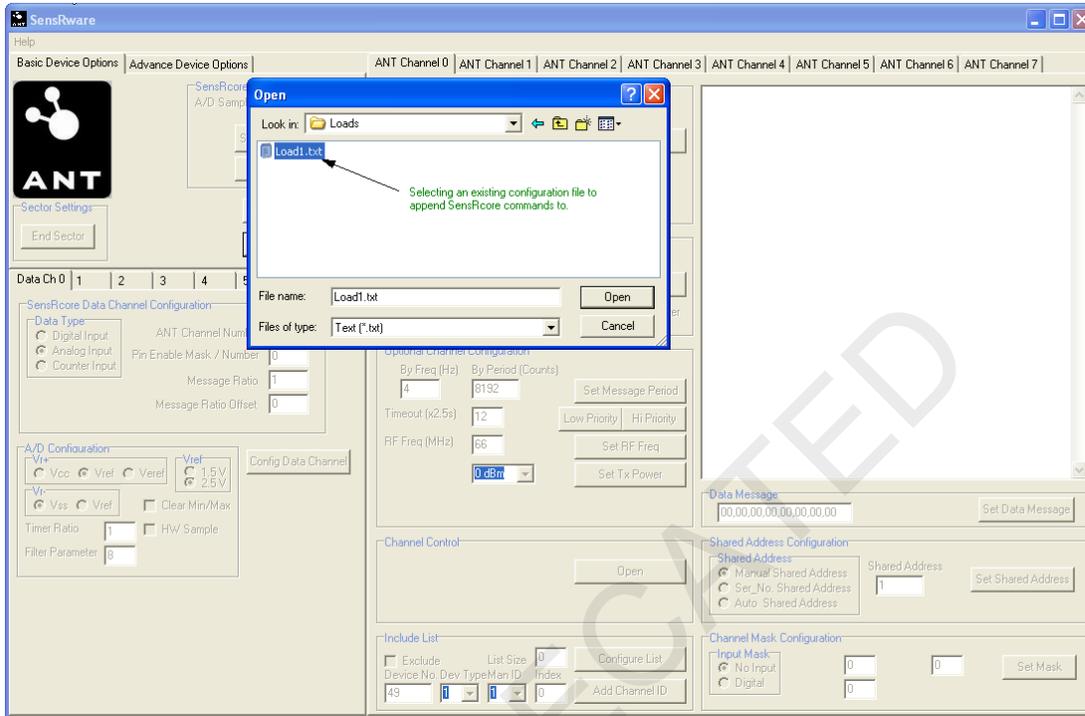
Parameter	Value
Channel Type	Master
Device Number	54
Device Type	1
Transmission Type	5
RF Frequency	66
Period	4Hz

#### 4.1.1 Creating SensRcore™ Scripts

This section describes how to create a SensRcore™ script file. A script file contains specific SensRcore™ commands. A script may be created manually if desired (without using *SensRware*) or edited manually following creation using *SensRware*.

## Step 1. Specifying a file

The first step is to specify the name of the file to be written to. A new file may be selected, or an existing file may be chosen and appended to. In this example a new file is created. Click the Open SensRcore File button and type the file name "Load1.txt" for the text file. Click Open. The SensRcore™ configuration commands will be saved to this file.



**Figure 13. Specifying a SensRcore™ Script Filename**

Alternatively, append configurations to an existing configuration text file by selecting the file in the Open dialog. In the example above, the Load1.txt file contains configuration commands. Select and open it to append an additional set of SensRcore™ commands.

## Step 2. Configuring the Data Channel

The Data Channel describes how the physical resources of the ANT MCU will be utilized for the application. Data channels may describe digital I/O behavior, analog channel behavior or counter behavior. A total of 8 data channels may be configured per device. Each data channel must be assigned to a specific ANT channel. There is no restriction as to which ANT channel a data channel is assigned to. For example, all data channels may be assigned to a single ANT channel if desired.

To configure the data channel: Select the Data Ch 0 tab. Set the data type to Digital. Select the ANT Channel Number 5 from the drop down list. Set Pin Enable Mask/Number to 15 (1111) so that all 4 pushbuttons on the I/O interface board can be utilized. Click the Config Data Channel button. You should see [91][05][00][40][0F][01][00] appear in the script box. Refer to Figure 14 for details.

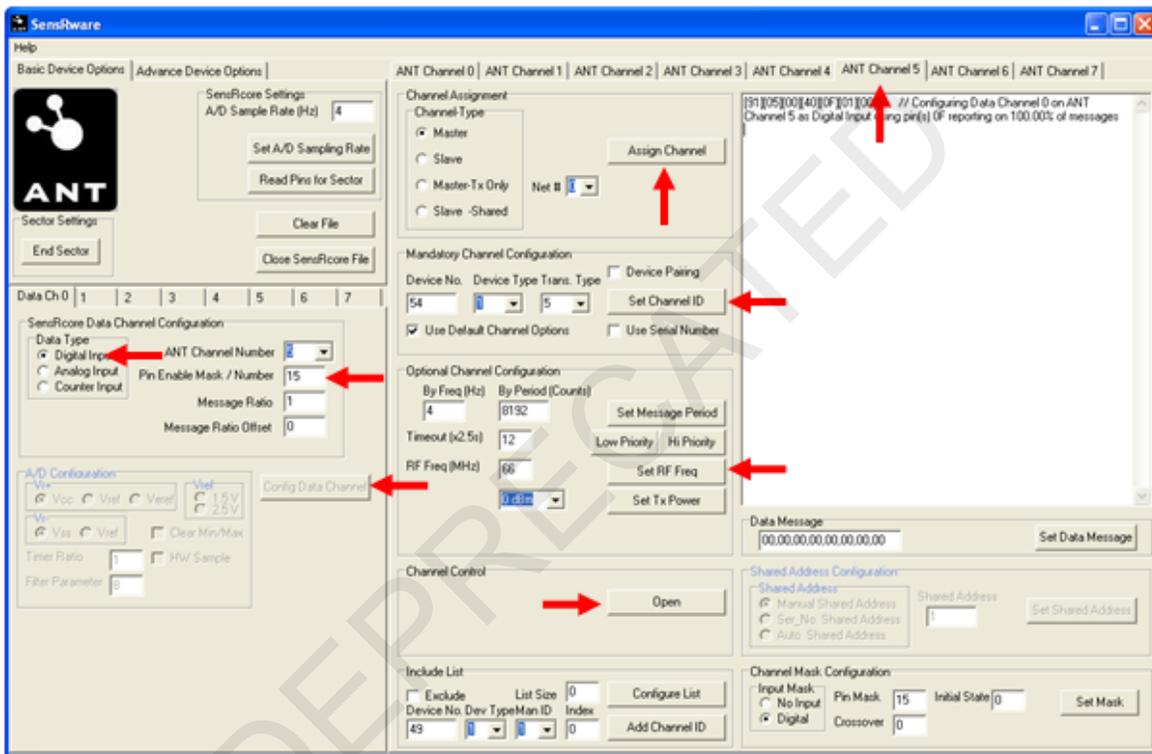


Figure 14. Configuring a SensRcore™ Script with SensRware

## Step 3. Configuring the ANT Channel

Once the data channel has been configured, the ANT channel assigned to the data channels must be configured. The channel type, channel ID and other channel parameters must be specified. It is important to also open the channel before completing this step.

To configure the ANT channel: Select the ANT channel by clicking on the ANT Channel 5 tab. Configure the ANT channel as a Master with Device Number 54, Device Type 1, and Transmission Type 5. Click Assign Channel, then Set Channel ID. All other parameters should be left with the default values. Click Set Message Period, Set RF Freq and Set Tx Power. Click the Open button so that the channel is opened when the SensRcore™ script is run. Refer to Figure 14 for details.

#### Step 4. Verifying and Closing the Script

If all steps were followed correctly, the text area in *SensRware* should appear as in Figure 15 below. Note that a summary of all input commands is displayed and can be verified before the script is loaded onto the module. If satisfied with the script, click on the Close SensRcore File button and the commands will be written to the text file. The script file is now ready to be loaded onto the ANT module using the *ANTware II* PC application. If not satisfied, click Clear File to erase the configuration and start again.

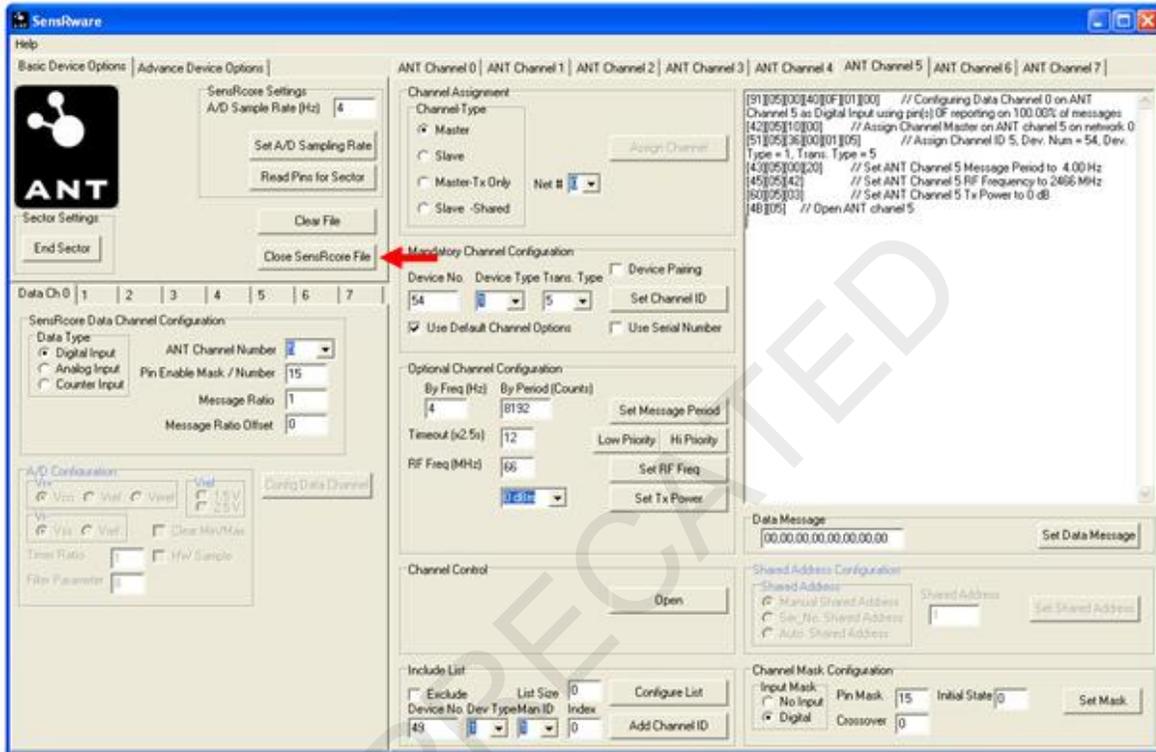


Figure 15. Completing SensRcore™ Script

#### 4.1.2 Loading the SensRcore™ Script

Once the configuration file 'Load1.txt' has been created and saved, it needs to be loaded into the flash of the SensRcore™ module (AT3).

##### Step 1. Connect to the Device.

Ensure the SensRcore™ module (AT3) is plugged into the USB development board and follow the instructions for connecting to the module using *ANTware II* as outlined in section 3.1.

##### Step 2. Clear the NVM

SensRcore™ scripts are stored in the Non-Volatile memory of the ANT device. Any scripts written to the NVM will be appended to the existing scripts in the NVM. Hence, to load a new configuration, it is recommended that the NVM first be cleared to erase any existing configurations that might have been previously loaded. In the *ANTware II* application window, expand the options available for the device you wish to load the SensRcore™ script onto. Click on the Clear Script button under the Script tab. This erases any scripts previously stored on the device's NVM.

### Step 3. Load the Script

To load the script, press the Load Script button under the Script tab. This will open up a dialog box requesting that you select a file to upload. Navigate to where the file you created in the previous is stored. Select this file and click Open. The file will be uploaded to the module. Once the file has been uploaded, click Release to complete the procedure.

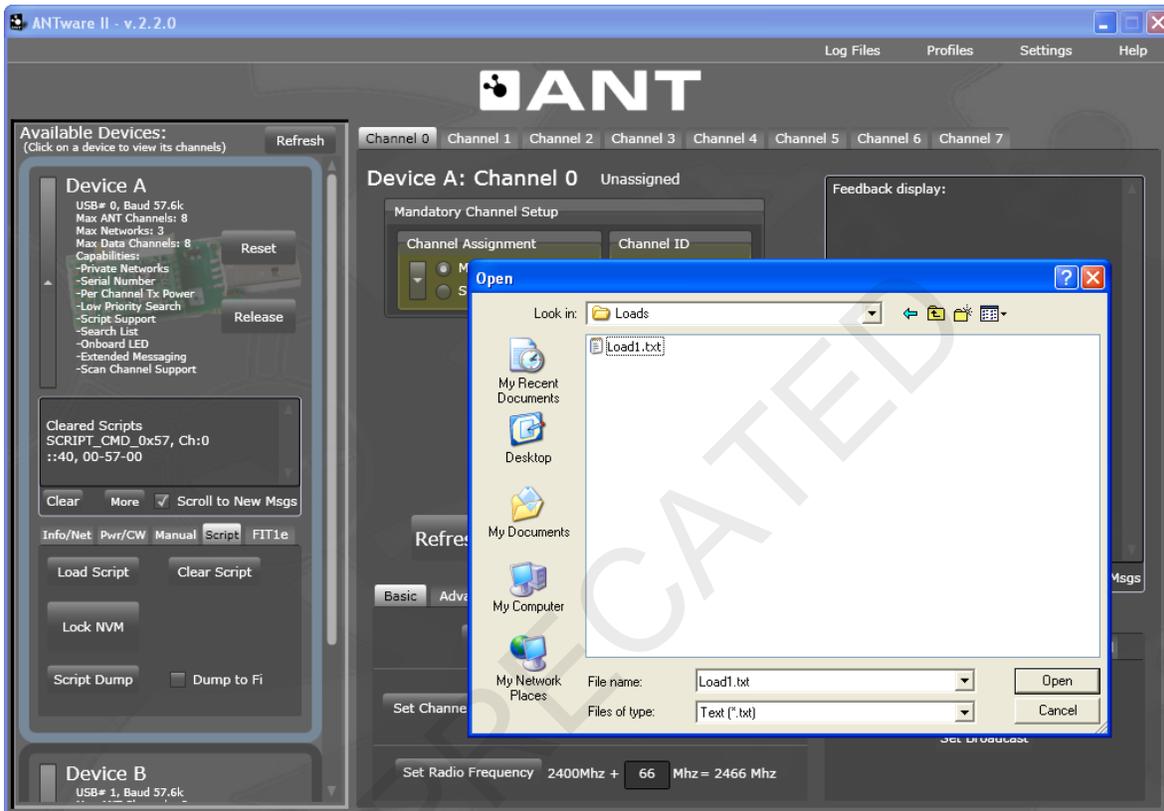


Figure 16. Loading a SensRcore™ Script

This completes the procedure for loading the commands into the NVM of a SensRcore™ module. The SensRcore™ script generated in this example is as follows:

```
C [91] [05] [00] [40] [0F] [01] [00]
C [42] [05] [10] [00]
C [51] [05] [36] [00] [01] [05]
C [43] [05] [00] [20]
C [45] [05] [42]
C [60] [05] [03]
C [4B] [05]
```

#### 4.1.3 Testing the SensRcore™ Script

Once the SensRcore™ module has been properly loaded with a configuration file, it may be tested using *ANTware II*, an ANT enabled USB stick and a Battery pack development board stack.

### Step 1: Configure SensRcore™ Device

Plug the ANT11TS33M5IB module into the I/O interface board provided in the ANT Development Kit. Then attach the interface board, with the ANT module mounted on top of it, to the battery board. Set the dipswitches on the reverse side of the battery board according to the following table to ensure SensRcore™ mode is active.

**Table 9. Dip Switch Settings for SensRcore™ Mode**

Dipswitch	Vcc	Gnd
1 (IOSEL)		X
2 (MEMSEL)	X	
3 (DEVSEL)		X
4 (DEVSEL)		X
5 (DEVSEL)		X

### Step 2: Setup *ANTware II* to Receive from SensRcore™ Module

Next, *ANTware II* must be configured to receive data from the SensRcore™ device. The data will be displayed in the box on the right hand side. Connect a different ANT11TS33M5IB module to an ANT enabled USB stick using the *ANTware II* PC tool (as described in section 3.1). Ensure that ANT Channel 5 is selected from the tabs across the top. Please note that any ANT channel could have been used, but channel 5 was used in this particular example. The ANT channel should be configured with the following parameters:

**Table 10. Slave Settings to Receive from SensRcore™**

Parameter	Value
Channel Type	Slave
Device Number	54
Device Type	1
Transmission Type	5
RF Frequency	66
Period	4Hz

Open the ANT channel. *ANTware II* should find the SensRcore™ ANT channel and start to display data. If data is not displayed immediately, pressing the reset button on the battery board may help. Pushing any of the buttons on the I/O interface board causes a change in the messages sent by the SensRcore™ module. This may be observed in the messages received in *ANTware II*.

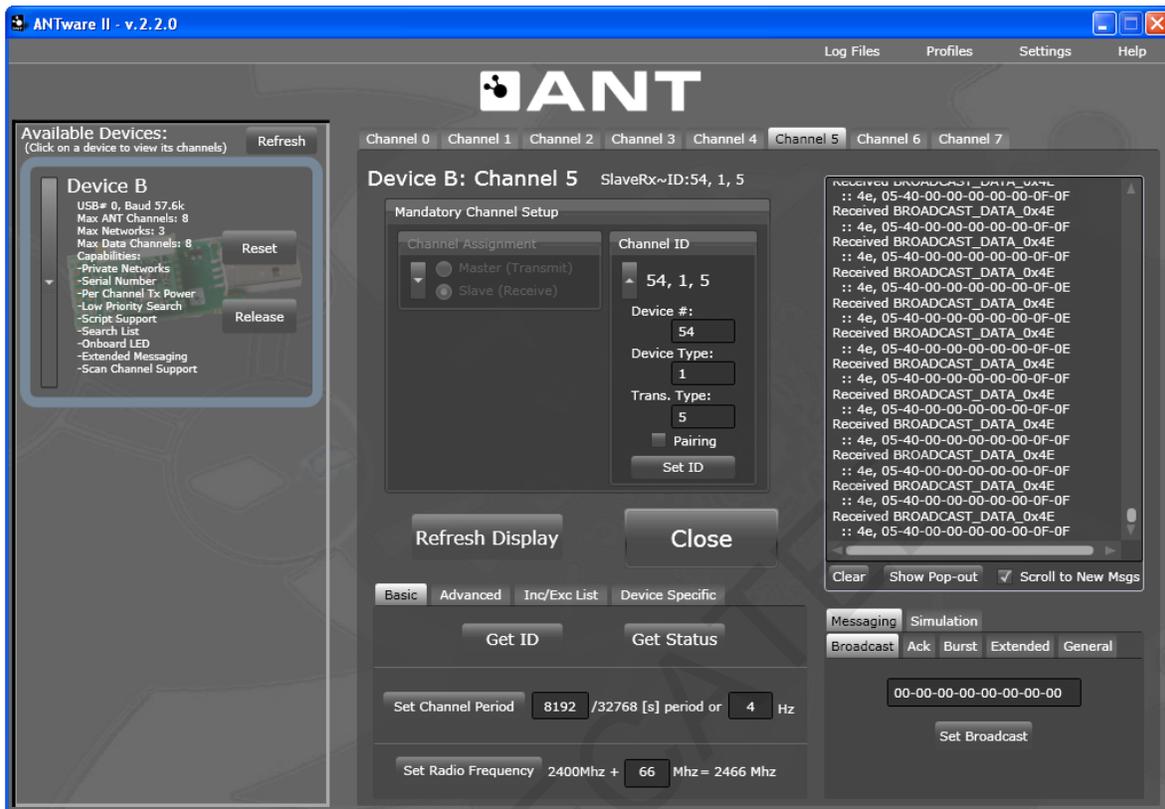


Figure 17. ANTware II Receiving Digital Data from SensRcore™

#### 4.1.4 Analog Data Exercise

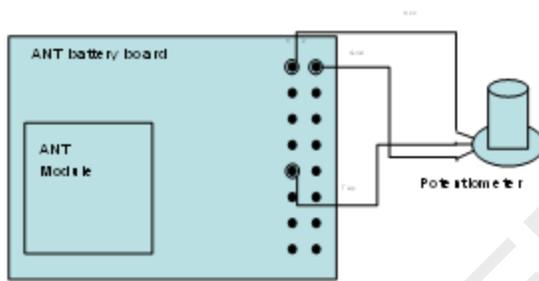
If analog data was used, both the A/D Sample Rate and A/D Configuration would have to be set in the *SensRware* application as in the table below. The procedures for configuring the ANT channel, verifying the SensRcore™ script, and loading the script onto the module are the same as the procedure outlined above for digital data.

Table 11. SensRcore Analog Data Channel Parameters

Parameter	Value
Data Channel	0
Data Type	Analog Input
Timer Chain	4Hz
ANT Channel Number	5
Pin Enable Mask/Number	0
Message Ratio	1
A/D Configuration	Vref
Vref	2.5V
Vr-	Vss
Clear Min/Max	No
HW Sample	No
Timer Ratio	1
Filter Parameter	8

To test SensRcore™ functionality with analog data, the battery board may be interfaced to a potentiometer as illustrated in Figure 18 below. The script itself is not provided in this manual, however the information given in Table 11 is sufficient to construct a script using SensRware.

The potentiometer is connected to specific pins (Vcc, GND, and AIO0) on the battery board. Plug the ANT11TS33M5IB module into the battery board. Attach the sensor to specific pins (Pin 1-Vcc, Pin 2-GND, Pin 9-AIO0) on the 20-pin header of the battery board. Set the dipswitches the same as in Table 9. Ensure that *ANTware II* is configured to receive data from the SensRcore™ device, as outlined for digital data above. To note a change in the received data in the *ANTware II* application, the potentiometer knob should be turned.



**Figure 18. Test Hardware Setup**

## 4.2 Sample SensRcore™ Scripts

Some sample scripts have been provided to show the ease of use in creating low power wireless sensor nodes using ANT SensRcore™ technology. These scripts have been created using *SensRware*.

Simply load these sample scripts into the module through *ANTware II* and watch the data come in. These scripts can be downloaded from the ANT developer's zone.

### 4.2.1 Auto Shared Channel with Digital I/O

The ANT protocol allows for self forming networks using the auto shared channel. This SensRcore™ sample script, "ANT\_ASC\_Demo.txt", shows how a sensor node can be easily added to a self forming ad hoc network without the need for complicated application code. The script is loaded into the module and the protocol will allow for the auto joining of this node to a network.

Download Auto Shared Channel demonstration from ANT developer's zone and run ANT\_ASC\_Demo.exe. Connect an ANT module to the USB stick and connect the USB stick to the PC. Once connected to a module, this PC application will display the following screen:

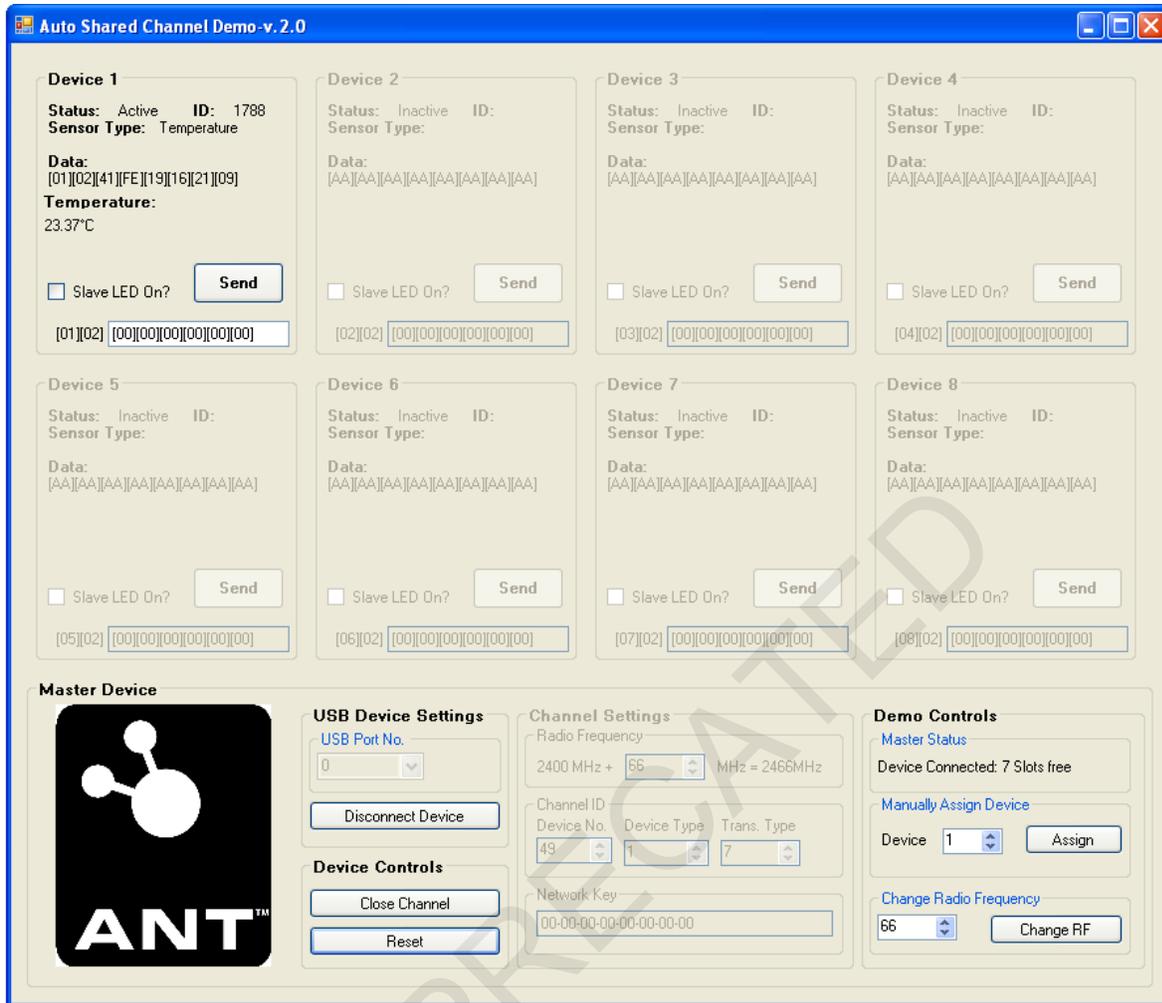


Figure 19. Auto Shared Channel Demo

When the AT3 module is activated using this script, the device will be shown in the top left hand corner of the application window. The status and the serial number of the device will be displayed as well as an alternating message that gives temperature information as well as the state of the digital I/O pins. More modules will be added to this application as they are turned on and brought within receiving range of the USB stick, demonstrating the ability of ANT to automatically form ad hoc star networks.

The auto shared channel script is explained below. All of the information presented can be found in detail in the SensRcore™ Messaging and Usage document and the ANT Message Protocol and Usage document. The contents of the script are as follows:

```

C [93][00][00][08] // Setting A/D Sample Rate at 16 Hz

C [90][00][01][F0][01][F0] // Set ANT Channel 0 Input Mask to Digital, using input mask 0F
with Crossover Mode Enabled

C [91][00][00][41][FE][02][00] // Configuring Data Channel 0 on ANT Channel 0 as Analog Input
using pin(s) FE reporting on 50.00% of messages

C [94][00][00][01][01][08][00][00] // Configuring Data Channel 0 A/D with reference setting of
1, sampling at 1.00 of sample rate, filter N value of 8

C [91][00][01][40][0F][02][01] // Configuring Data Channel 1 on ANT Channel 0 as Digital Input
using pin(s) 0F reporting on 50.00% of messages

C [42][00][20][00] // Assign Shared Channel Slave on ANT channel 0 on network 0

C [51][00][31][00][01][07] // Assign Channel ID 0, Dev. Num = 49, Dev. Type = 1, Trans. Type
= 7

C [45][00][42] // Set ANT Channel 0 RF Frequency to 2466 MHz

C [43][00][00][10] // Set ANT Channel 0 Message Period to 8.00 Hz

C [44][00][18] // Set ANT Channel 0 Search Timeout to 60.0 s

C [95][00][02][00][00] // Set ANT Channel 0 Shared Address to Auto Shared Address

C [4B][00] // Open ANT channel 0

```

**Figure 20. Auto Shared SensRcore™ Sample Script**

**[93] [00] [00] [08]**

The 0x93 command is defined as the timer period select command. It sets the base timer for all of the A/D sampling rates.

Parameters	Type	Value	Description
Reserved	UCHAR	0x00	Reserved for future use
Timer Period	USHORT (Little Endian)	0x800	0x800 = 2048 2048 = Timer Period * 32678 Timer Period = 2048/32678 Timer Period = 0.0625 s = 16Hz

**[90] [00] [01] [F0] [01] [F0]**

The 0x90 command is defined to set the ANT channel input mask and sets what pins will be used as digital I/O.

Parameters	Type	Value	Description
ANT Channel Number	UCHAR	0x00	ANT channel 0 is in use
8Input Type	UCHAR	0x01	0x00 – No input (default) 0x01 – Digital
Data 1	UCHAR	0xF0	Pins AIO 1 - 4 are used as digital I/O
Data 2	UCHAR	0x01	Value 1 indicates Output Crossover Mode Enabled, so incoming digital data is nibble reversed (most significant 4 bits and least significant 4 bits are swapped). Cross over mode is enabled to allow the LED to light up as they are connected to IO4 – IO7.
Data 3	UCHAR	0xF0	Default state of enabled outputs

**[91] [00] [00] [41] [FE] [02] [00]**

The 0x91 command is used to set the ANT channel data source.

Parameters	Type	Value	Description
ANT Channel Number	UCHAR	0x00	ANT channel 0 is being used
Data Channel Number	UCHAR	0x00	Data channel 0 is being used
Data Type	UCHAR	0x41	0x41 – Analog Input
Pin Number	UCHAR	0xFE	0xFE – Temperature
Message Ratio	UCHAR	0x02	Sends this data out on every second ANT message
Message Ratio Offset	UCHAR	0x00	Sends the data message on the first ANT message and every second one after that.

**[94] [00] [00] [01] [01] [08] [00] [00]**

The 0x94 command is for setting the A/D parameters.

Parameters	Type	Value	Description
Reserved	UCHAR	0x00	Reserved byte
Data Channel Number	UCHAR	0x00	Data channel 0 is being used
A/D Configuration	UCHAR	0x01	Using 1.5V internal reference, keeps the min and max value since power up
Timer Ratio	UCHAR	0x01	Decimation of the originally set A/D Sample rate, in this case 16Hz /1 = 16Hz
Filter Parameter N	UCHAR	0x08	Will take the average of the last 8 samples
Reserved	USHORT	0x0000	Reserved bytes

**[91] [00] [01] [40] [0F] [02] [01]**

The 0x91 command is used to set an ANT data channel.

Parameters	Type	Value	Description
ANT Channel Number	UCHAR	0x00	ANT Channel 0 is being used
Data Channel Number	UCHAR	0x01	Data Channel 1 is being used
Data Type	UCHAR	0x40	0x40 – Digital Input
Pin Number	UCHAR	0x0F	Enabling pins IO0 – IO3.
Message Ratio	UCHAR	0x02	Sends this data out on every second ANT message
Message Ratio Offset	UCHAR	0x01	Sends the data message on the second ANT message and every second one after that.

**[42] [00] [20] [00]**

The 0x42 command is used to assign the channel.

Parameters	Type	Value	Description
ANT Channel Number	UCHAR	0x00	Using ANT channel 0
Channel Type	UCHAR	0x20	Shared Receive channel
Network Number	UCHAR	0x00	Using network number 0

**[51] [00] [31] [00] [01] [07]**

The 0x51 command is used to set the channel id.

Parameters	Type	Value	Description
ANT Channel Number	UCHAR	0x00	Using ANT channel 0
Device Number	USHORT (Little Endian)	0x31	The device number of 49
Pairing Request	UCHAR (1bit)	0	Pairing request is not set
Device Type ID	UCHAR (7bits)	0x01	The device type is set to 1
Transmission Type	UCHAR	0x07	Transmission type is set to 7

**[45] [00] [42]**

The 0x45 command is used to set the RF frequency of the channel.

Parameters	Type	Value	Description
ANT Channel Number	UCHAR	0x00	Using ANT channel 0
Channel RF Frequency	UCHAR	0x42	Channel frequency of 2442MHz

**[43] [00] [00] [10]**

The 0x43 command is used to set the channel messaging period.

Parameters	Type	Value	Description
ANT Channel Number	UCHAR	0x00	The channel number
Messaging Period	USHORT (Little Endian)	0x1000	The channel messaging period count is 0x1000 = 4096 4096 = Messaging Period * 32768 Messaging Period = 4096 / 32768 Messaging Period = 0.125 s = 8Hz

**[44] [00] [18]**

The 0x44 command is used to set the time out period.

Parameters	Type	Value	Description
ANT Channel Number	UCHAR	0x00	Using ANT channel 0
Search Timeout	UCHAR	0x18	This is 0x18 = 24 2.5 second segments = 60 seconds

**[95] [00] [02] [00] [00]**

The 0x95 command is used to set the shared channel address.

Parameters	Type	Value	Description
ANT Channel Number	UCHAR	0x00	Using ANT channel 0
Shared Address Mode	UCHAR	0x02	Indicates auto shared channel address acquisition – see ANT Message Protocol and Usage documentation for more details
Shared Address	USHORT (Little Endian)	0x0000	To be assigned when channel is acquired

**[4B] [00]**

The 0x4B command is used to open the ANT channel

Parameters	Type	Value	Description
ANT Channel Number	UCHAR	0x00	Open ANT Channel 0

**4.2.2 Temperature Sensor**

The temperature sensor script, "temperature.txt", enables one of the A/D pins to collect the temperature sensor information from the baseband processor. The description of the data format can be found in the SensRcore™ Messaging and Usage document.

In order to receive the temperature sensor data, set the channel parameters in ANTware to:

Channel Type	Network Number	Device Number	Device Type	Transmission Type	Message Period	RF Frequency
Slave	0	49	1	5	4Hz	66 (2466 MHz)

**4.2.3 Digital Input**

The digital input sensor script, "digital input.txt", enables all 8 pins to collect the digital sensor information input pins. The description of the data format can be found in the SensRcore™ Messaging and Usage document. By using the stack up boards, pressing one of the four buttons on the ANT IO board will show the correlating I/O pin to go high.

In order to receive the digital sensor data, set the channel parameters in *ANTware II* to:

Channel Type	Network Number	Device Number	Device Type	Transmission Type	Message Period	RF Frequency
Slave	0	49	1	5	4Hz	66 (2466 MHz)