

NCV53480 Quick Start Guide



ON Semiconductor®

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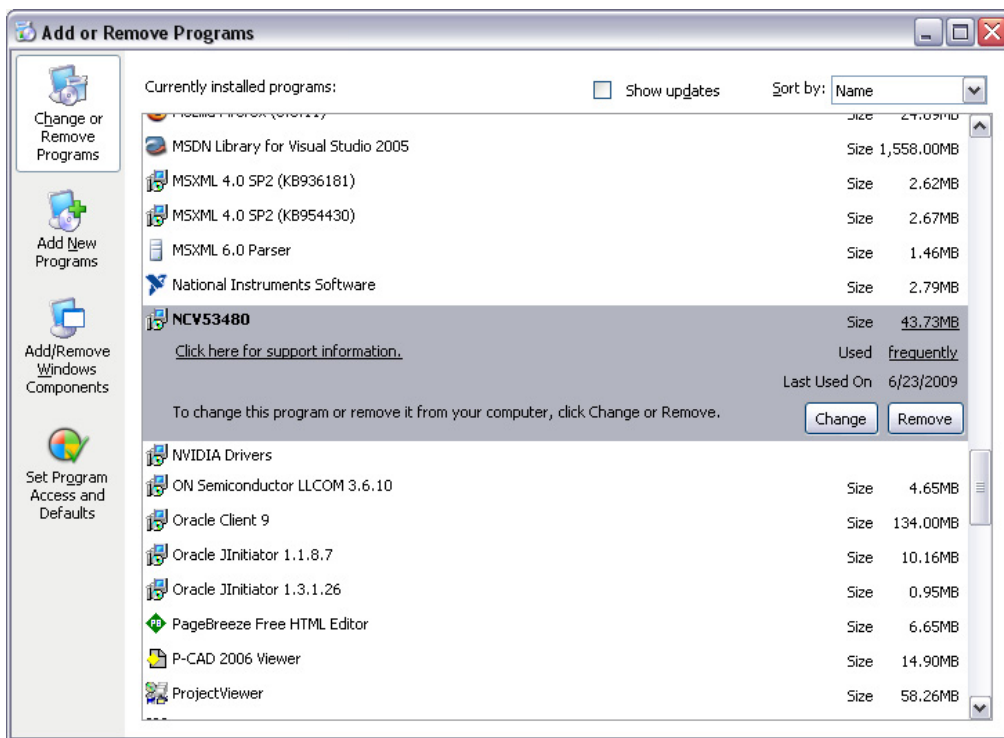
This quick start guide will guide you through the installation process of the NCV53480 evaluation software; the device driver installation process as well as an initial setup of the NCV53480 for different types of receive and transmit configurations.

The NCV53480 evaluation kit has only been tested using Microsoft Windows® XP operating system. This is the highly recommended operating system to use. If this operating system isn't available special considerations can be made.

1. Uninstall any previous version of the NCV53480 evaluation software.

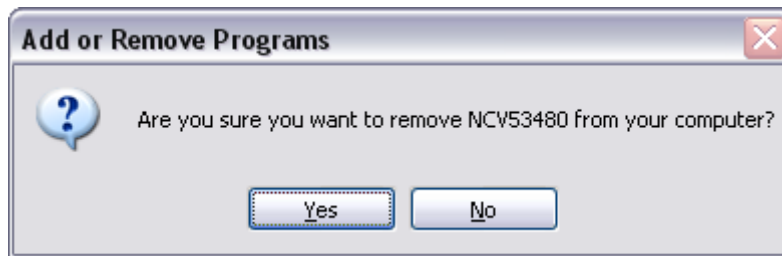
If a previous version of the NCV53480 evaluation software is installed you must first un-install the previous version before upgrading to the new version. If a previous version is NOT installed you may skip to **Step #2**.

- a. Go to "Start->Control Panel->Add or Remove Programs".
- b. Select "NCV53480" and press the "Remove" button.



NCV53480EVB/D

- c. When prompted if you're sure you want to remove the program select the "Yes" button.



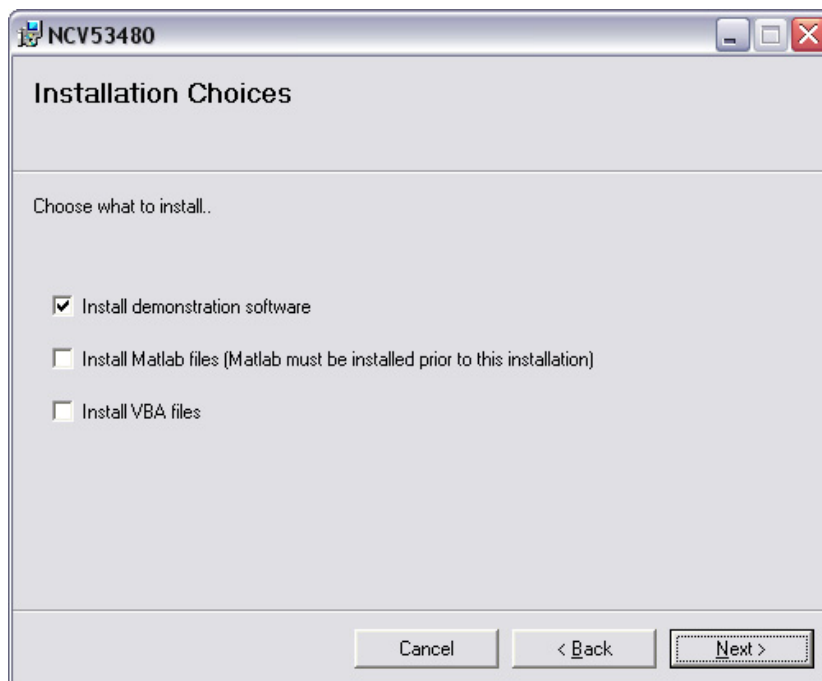
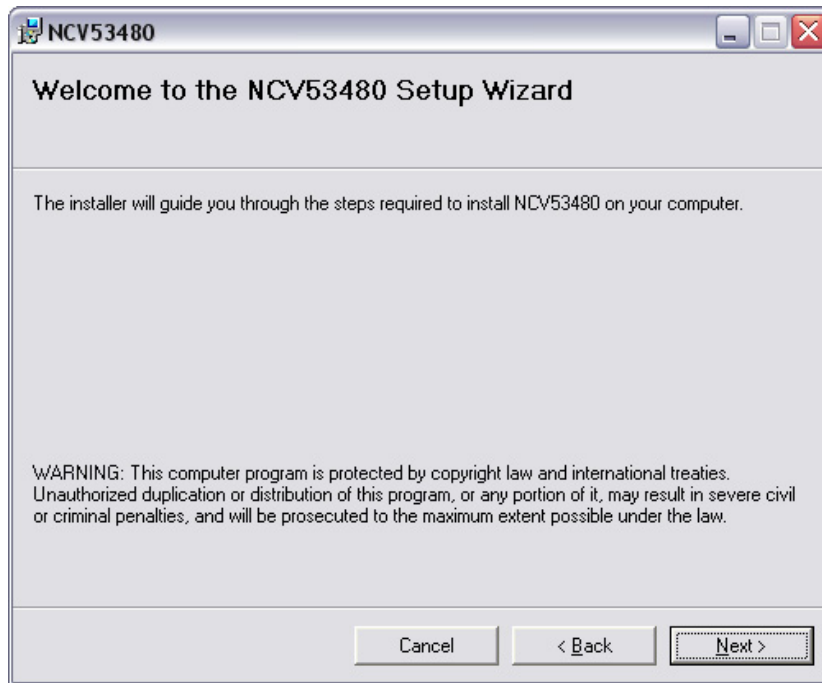
- d. The previous version of the NCV53480 evaluation software will be removed automatically for you.

2. Install the new version of the NCV53480

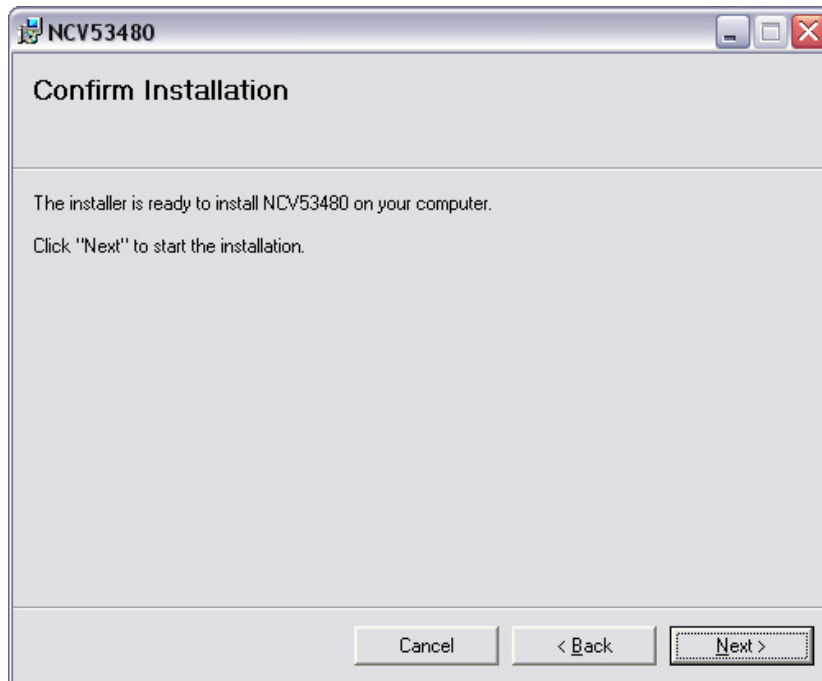
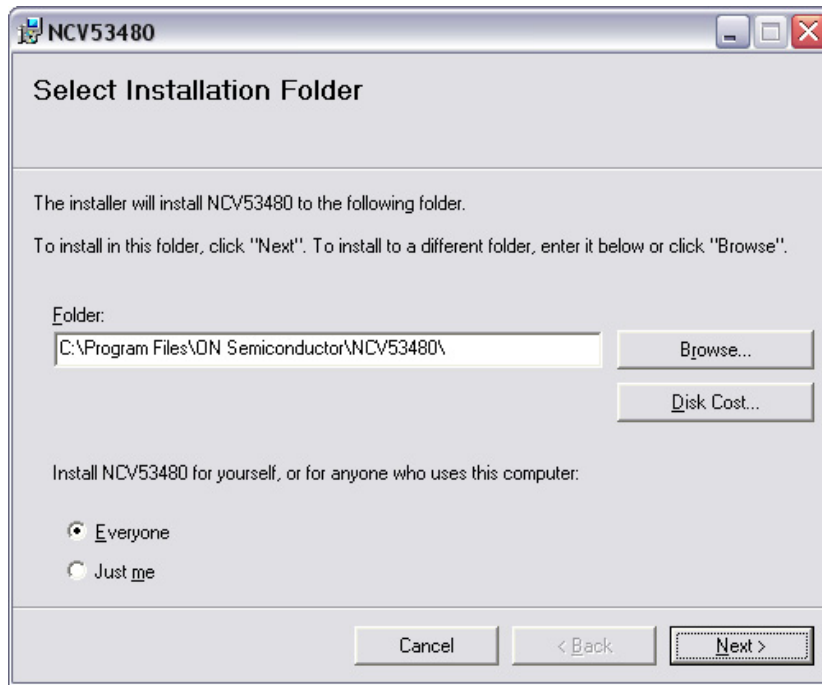
- a. On the CD provided double-click the "*setup.exe*" application. An installation wizard will start. Before running the *setup.exe* program ensure all evaluation boards are unplugged from the target PC.
- b. The defaults for the installation should be sufficient for most applications. The screen shots below walk you through the installation process.

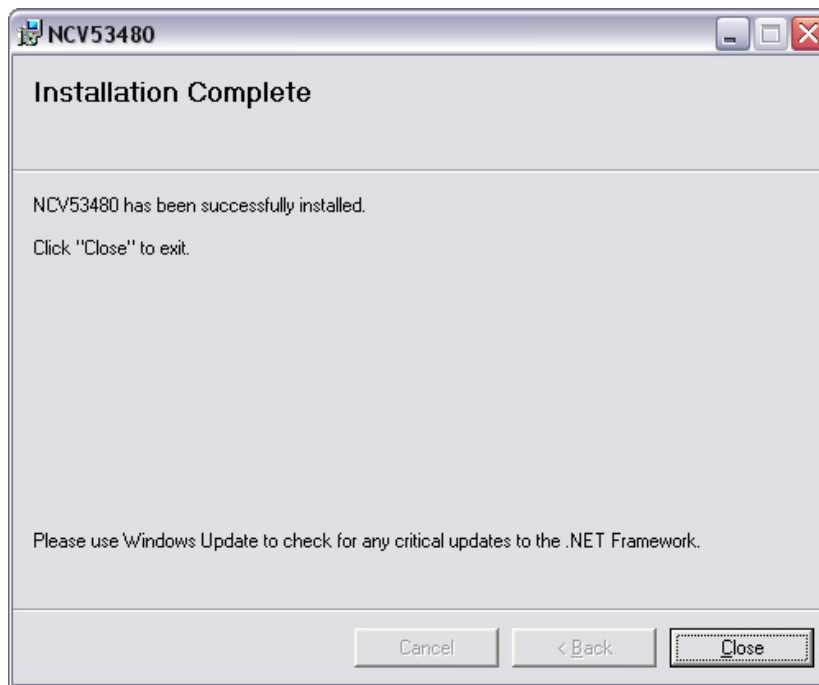


NCV53480EVB/D

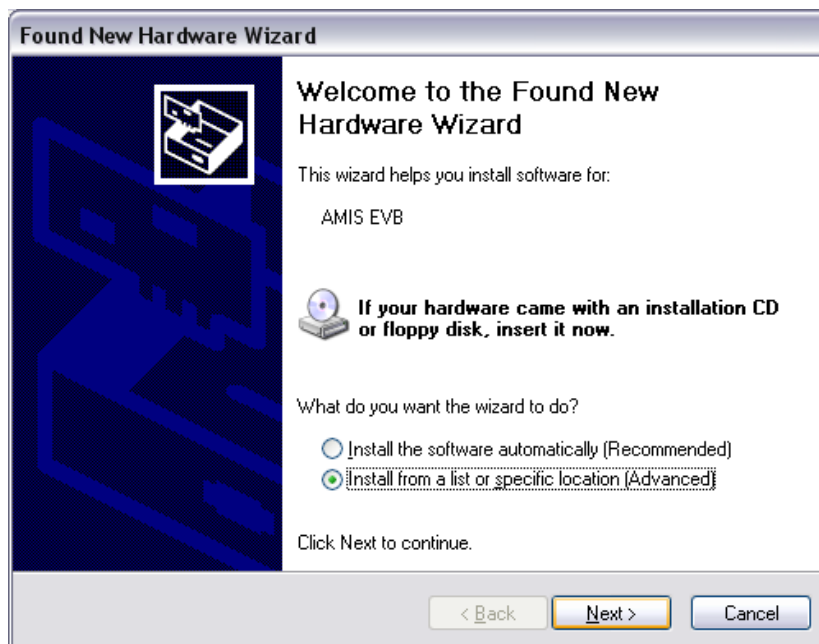


NCV53480EVB/D

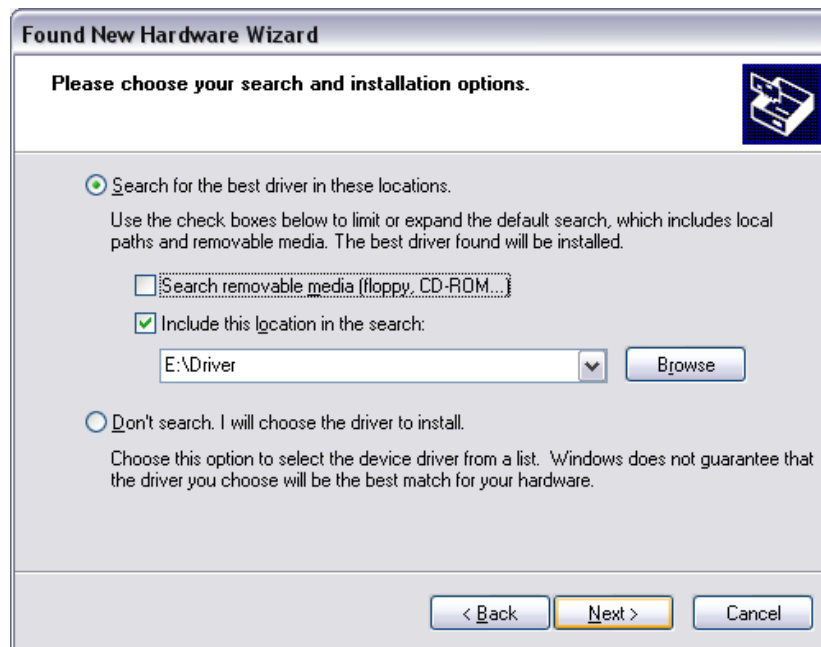




3. Install the device drivers for the NCV53480 evaluation board.
 - a. Plug-in one of the NCV53480 evaluation boards using the Mini-USB cable provided. Plug-in the other end of the USB cable into the target PC.
 - b. If Windows pops up a dialog stating it has found new hardware go to **Step #3.c** else go to **Step #3.h**.
 - c. Select *"Install from a list of specific location (Advanced)"* and press the *"Next"* button.



- d. Select *"Search for the best driver in these locations"*. Unselect *"Search removable media (floppy, CD-ROM...)"*. Select *"Include this location in the search"*. Select the *"Browse"* button and navigate to the CD-ROM drive and select the *"Driver"* directory. Press the *"Next"* button.



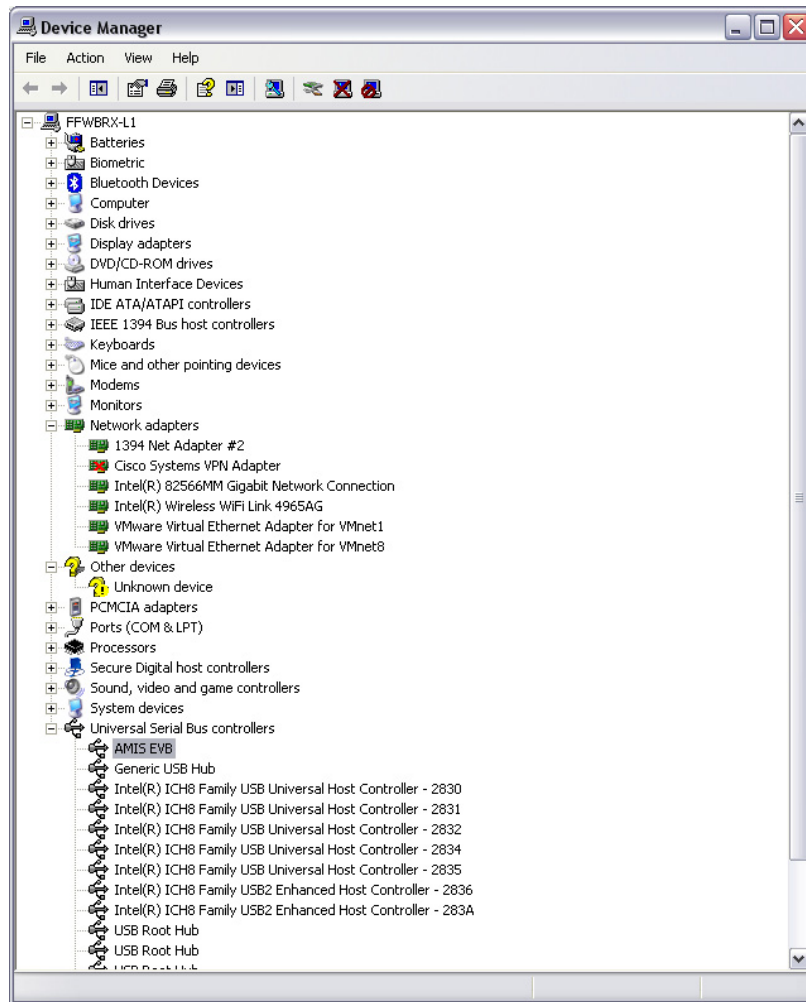
e. A dialog asking you to continue will be displayed. Press the “*Continue Anyway*” button.



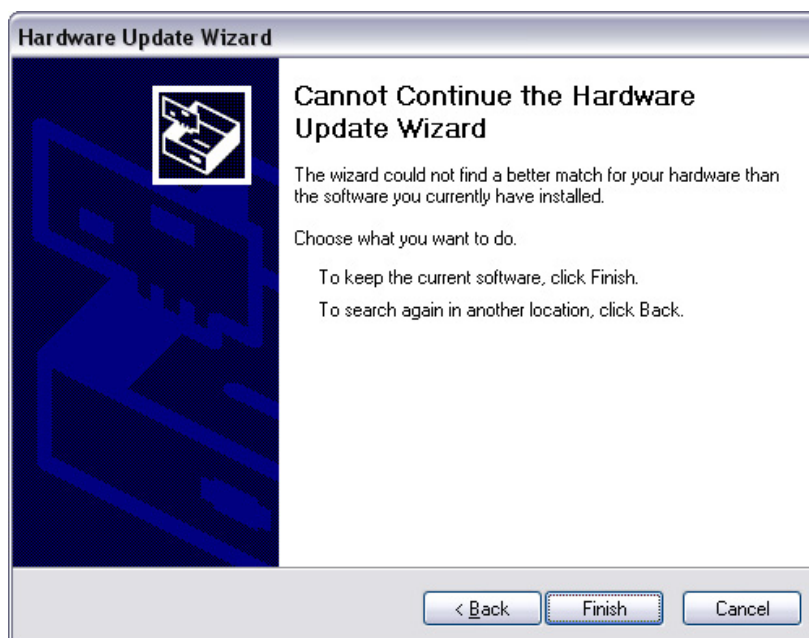
f. The driver will be automatically installed for you. Press the “*Finish*” button once the install has completed.



- g. At this point plug-in the second NCV53480 evaluation board and repeat **Step #3.c** through **Step #3.f**. Once the second install is complete you may proceed to **Step #4**.
- h. If Windows does NOT prompt you to install new hardware, then the device driver are probably already installed on the target PC.
- i. You must upgrade the device drivers manually. Go to “*Start->Control Panel->System->Hardware->Device Manager*”. Expand the “*Universal Serial Bus controllers*” tree and right click on “*AMIS EVB*”.



- j. Select “*Update Driver*” and perform **Step #3.c** through **Step #3.f**. If the driver is already installed, then the driver will be up to date and Windows will respond with the message below. This is fine and you may proceed to **Step #4**.



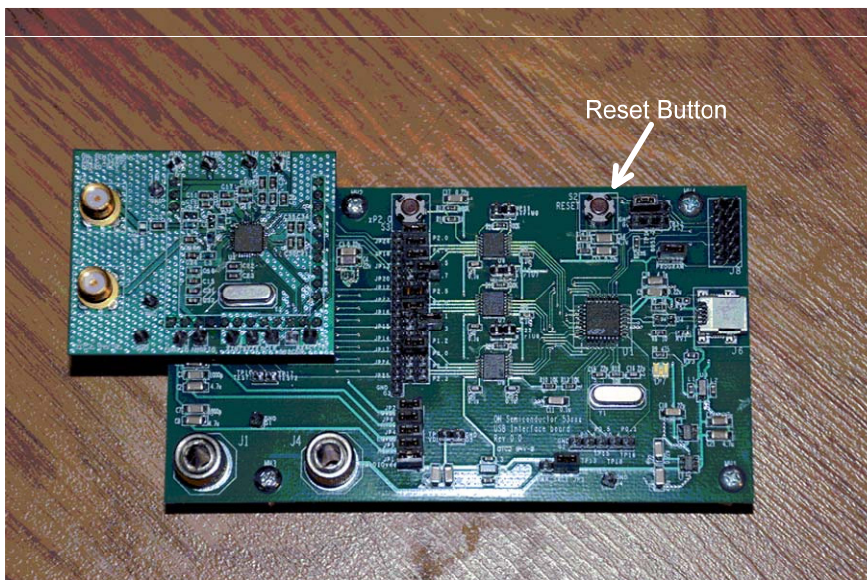
NCV53480EVB/D

- k. Plug-in the second NCV53480 evaluation board and repeat **Step #3.i** through **Step #3.h**.
4. At this point it is advisable to re-boot the target PC.
5. You may now start the NCV53480 evaluation software. If an evaluation board is not plugged in at this time, plug-in one of the boards using the provided Mini-USB cable. Go to “*Start->All Programs->ON Semiconductor->NCV53480.*”

If at any time when starting the NCV53480 evaluation software you receive the warning message:

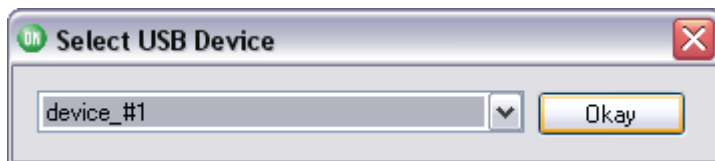


Ensure that the evaluation board is plugged in correctly and the device drivers were installed correctly. If the board is plugged in and the device drivers are installed, then press the “*Ok*” button, and close the application. Press the “*Reset*” button on the evaluation motherboard and try restarting the evaluation software. The picture below shows the location of the “*Reset*” button.



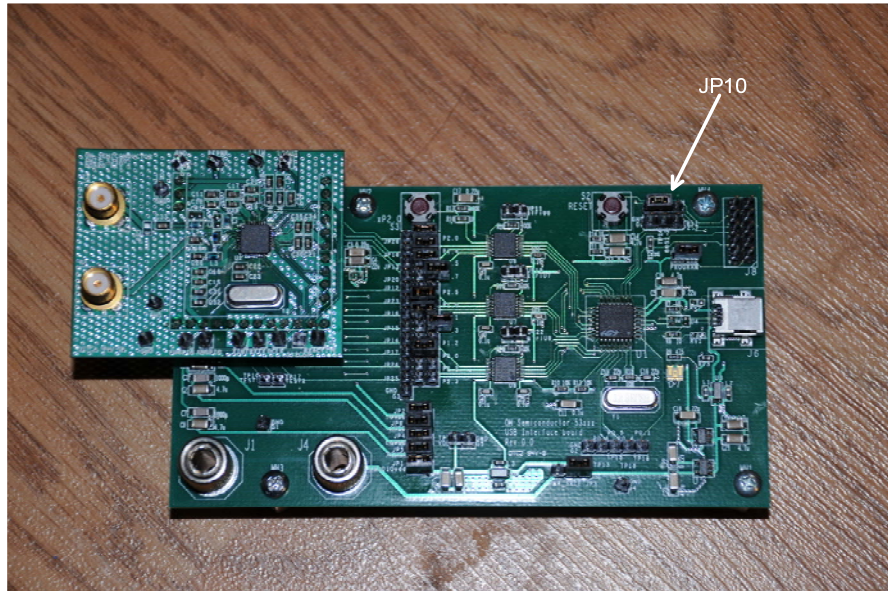
If you did NOT receive the warning message and if only one evaluation board is plugged into the target PC, then the software will startup without any intervention from the user. It is recommended for first time users to only have one evaluation board plugged in at a time, until the user is confident and comfortable with using the evaluation boards and software.

However, if two evaluation boards are plugged into the same target PC, the user will be prompted to select the USB device.



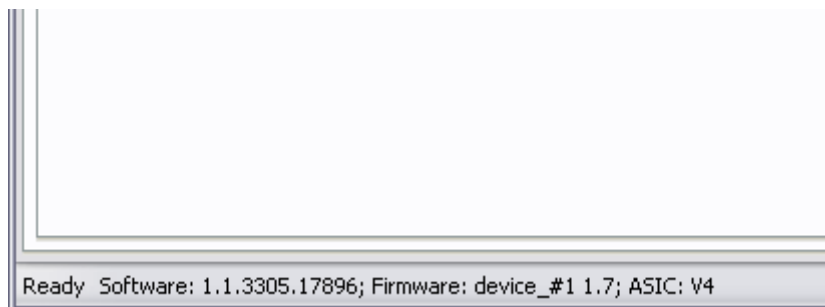
NCV53480EVB/D

Choose either device_#1 or device_#2. If JP10 is between pins 1 and 2 then the board is device_#1. If JP10 is between pins 2 and 3 then the board is device_#2. See the provided “Motherboard Schematic.pdf” for details. JP10 is located in the upper right portion of the motherboard.

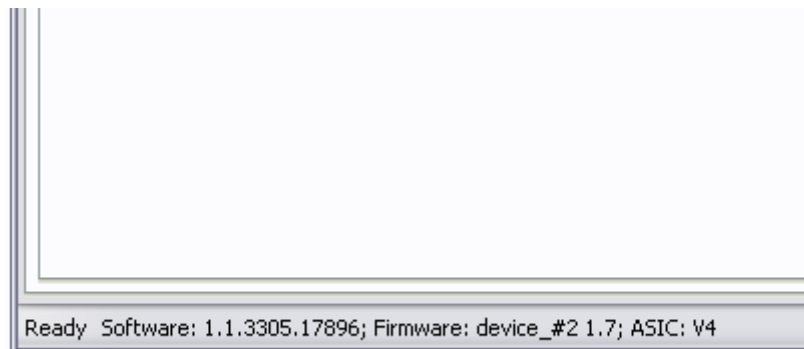


If you have two evaluation boards connected to the same target PC, you may start another instance of the NCV53480 evaluation software. This time selecting the other device number that was chosen when the previous application was started.

The user can determine which application talks to which evaluation board via the status bar.



The above figure shows the Software version, the board index as being device #1, the firmware version being 1.7 and the NCV53480 silicon version being 4.

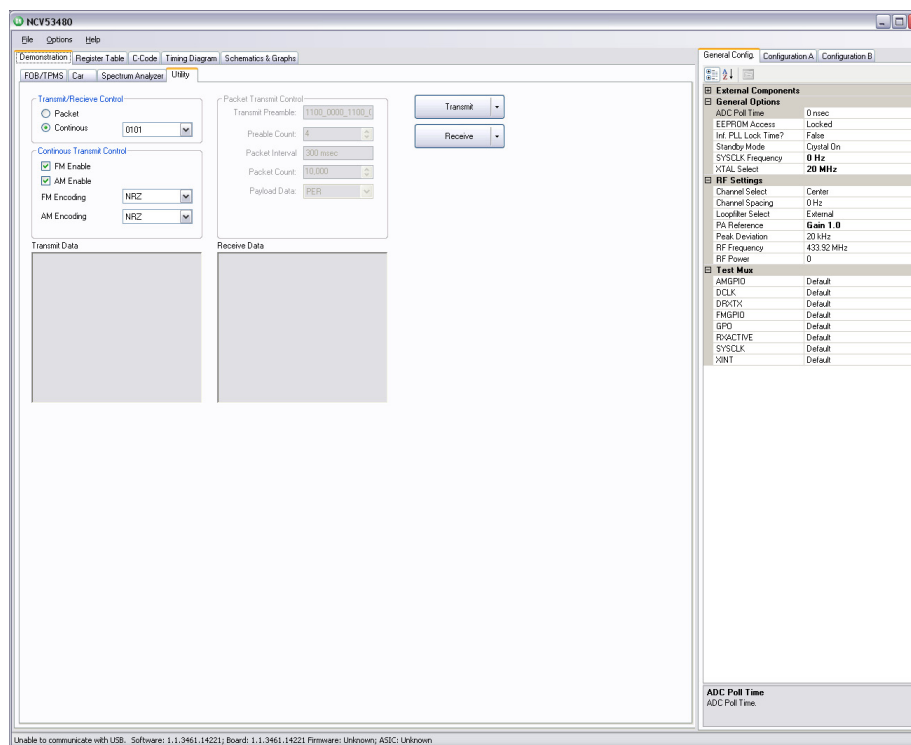


NCV53480EVb/D

The above figure shows the software version, the board index as being device #2, the firmware version being 1.7 and the NCV53480 silicon version being 4.

If using two boards simultaneously it is recommended you label the boards with some sort of “sticky” or other readable notifier to reduce confusion when dealing with two evaluation programs.

6. Familiarize self with evaluation software. If a evaluation board is not plugged in at this time, plug-in one of the evaluation boards. Re-start the NCV53480 evaluation software.
 - a. The default page displayed when starting the application is the “Utility” portion of the “Demonstration” page.



You will familiarize yourself with this page in the next step, so for now we will skip any explanation.

Note on the right side of the application there are three tabs with each having its own property window: “General Config”, “Configuration A”, and “Configuration B”. These property windows are always visible in the application and are the main interface to setting up the NCV53480 for its different modes of operation.

If the user clicks on a specific property in any of the property windows the window just below will give a short explanation as to the property’s function.

For example, if you click on “RF Frequency” in the “General Config” view the help window will look like the figure below. Much of the information in the help window is duplicated in the datasheet and/or design specification.

NCV53480EVB/D

RF Frequency

Setting the RF channel frequency is done through the RF Divider register, along with the RF Frequency[2:0] registers.

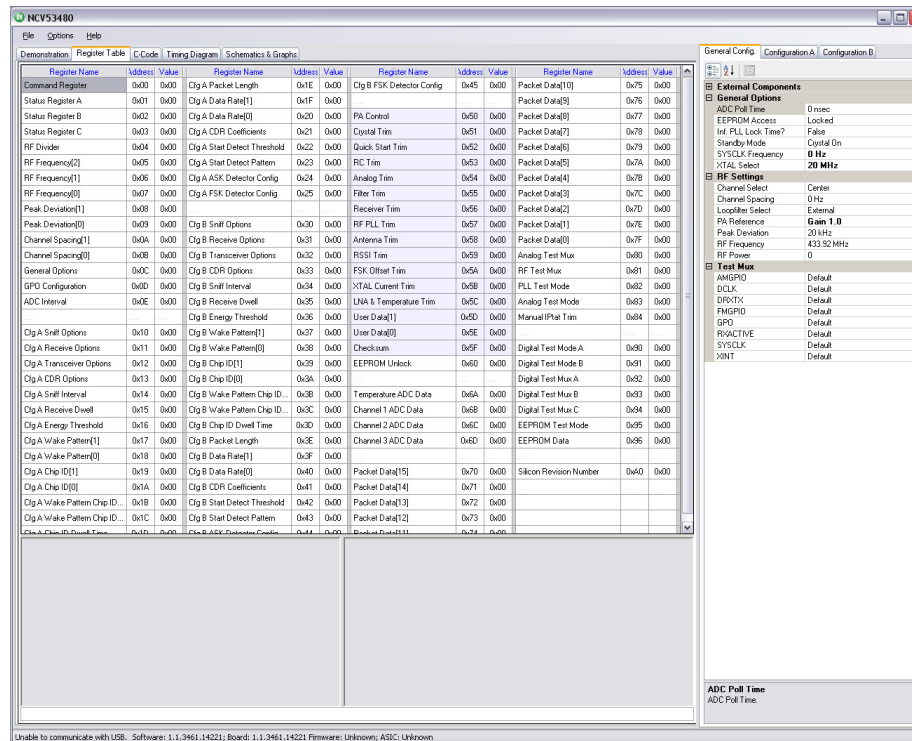
The RF Divider register is used to specify the integer portion of the divide value, and the RF Frequency[2:0] registers are used to specify the fraction.

The RF Divider register = round(RF Frequency / Crystal Frequency)

The RF Frequency registers = ((RF Frequency / Crystal Frequency) - RF Divider register) * 262147

The user is encouraged to examine several different properties in “*General Config*”, “*Configuration A*” and “*Configuration B*” and try changing some of them.

b. Next click on the “*Register Table*” tab to move to the register table interface.



While this register table isn't meant to be the main interface for setting up the NCV53480, it can be a useful guide. Both the register table and property windows are simultaneously updated.

NCV53480EVB/D

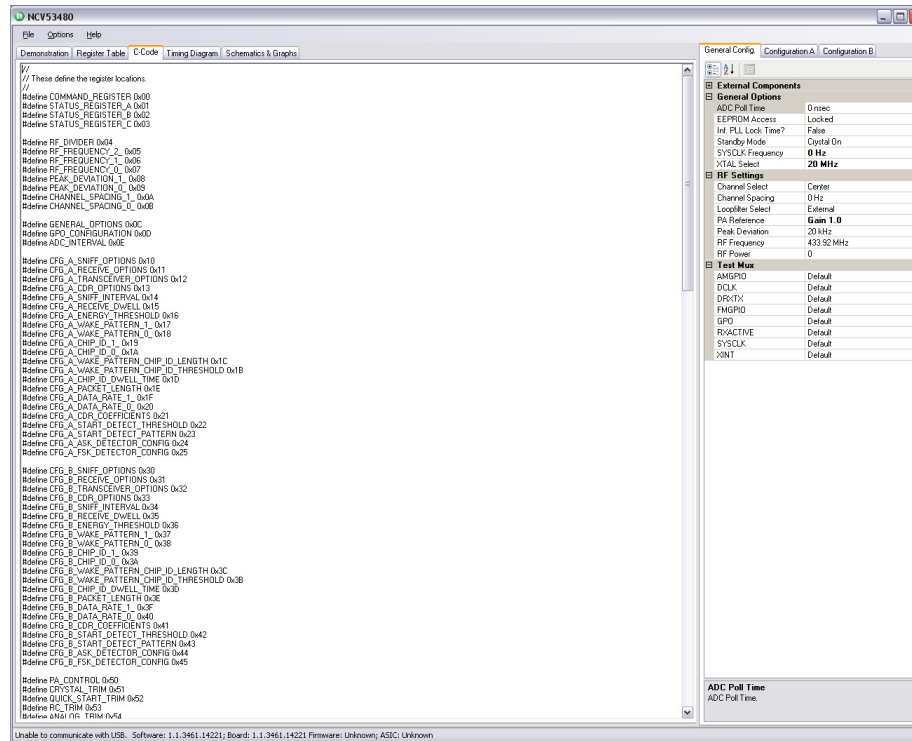
Try changing the “RF Frequency” in the “General Config” property window and note how registers 0x04 through 0x07 change. Also try changing the “Peak Deviation” in the “General Config” and note how registers 0x08 and 0x09 change.

Now try doing the opposite. Change the RF Divider register by typing in “04 10” (without the quotes) and pressing enter in the command line at the bottom of the application. This will write 0x10 to register location 0x04. Note how the “RF Frequency” in the “General Config” property view has been changed.

Hover your mouse over any location in the register table and the register contents are shown in the tool tip window, which is located below and to the right of the register table. Try hovering over different register locations and see the tool-tip window update.

As stated before, this isn’t meant to be the main interface for setting up the NCV53480 but is useful for examining specific register contents. The user can also save or dump the register contents via “File->Save Register Contents”. This is valuable for remote debugging of silicon issues.

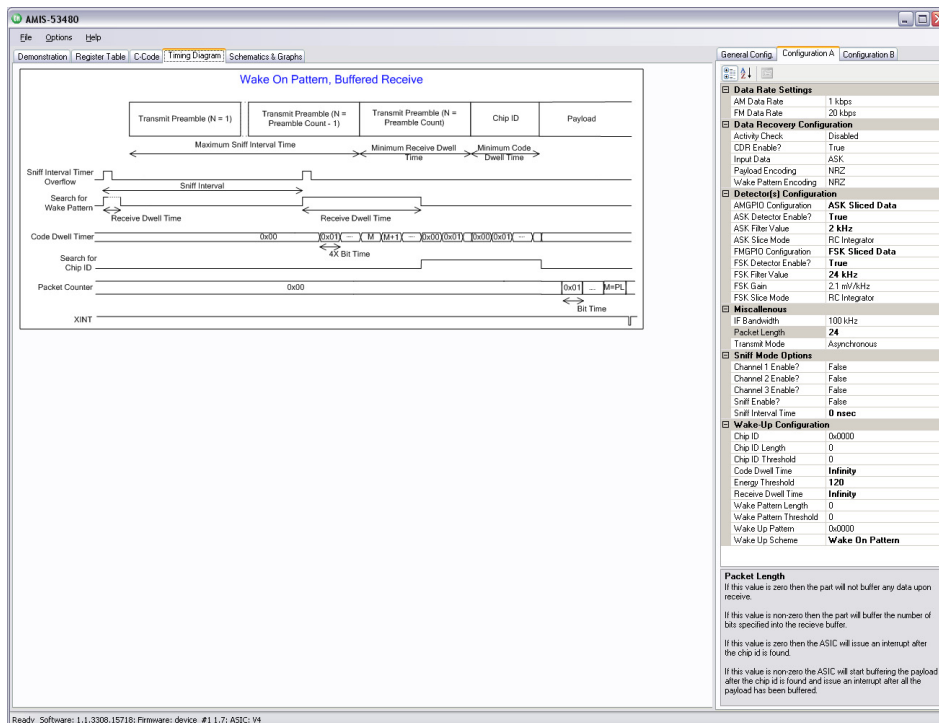
c. Now change to the “C-Code” tab page.



The C-Code tab page is for software developers to quickly setup the NCV53480 using their own specific micro-controller. The code can be saved to a C file via “File->Save C Code”.

The values in the C-Code text box are updated automatically any time a property changes and/or a register value is written.

- d. Change to the “Timing Diagram” tab and change to the “Configuration A” property window.

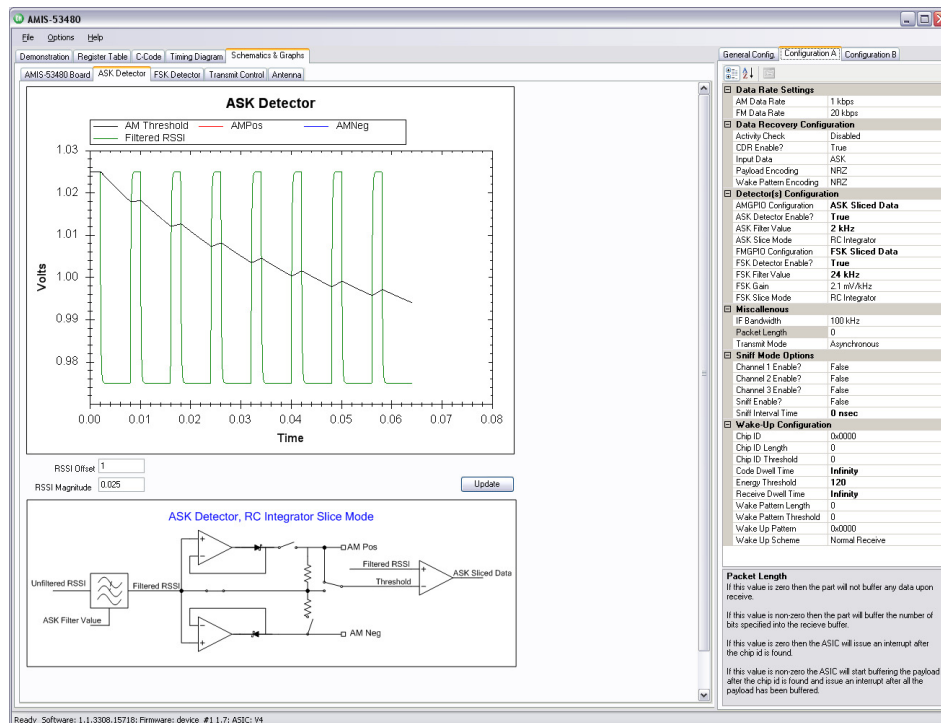


This dialog shows an indicative timing diagram for some key parameters when setting up the NCV53480 different receive modes of operation. You are encouraged to change the “Wake Up Scheme” and “Packet Length” and see how the timing diagrams are updated.

This document will not try to explain the different modes of receive operation. That is explained in detail in the datasheet and/or design specification. This is only meant to show how to access these timing diagrams for information purposes only.

- e. Change to the “Schematics & Graphs” tab page and then select the “NCV53480 Board” tab page. This shows an indicative schematic of the NCV53480 daughter board. The actual daughter board schematic can be found on the CD titled “Daughterboard Schematic.pdf” Note that the RF match shown in the schematic is for a single antenna, while that may not match the daughter boards you have, this will have no affect on the software and/or the hardware. This schematic is for information purposes only.

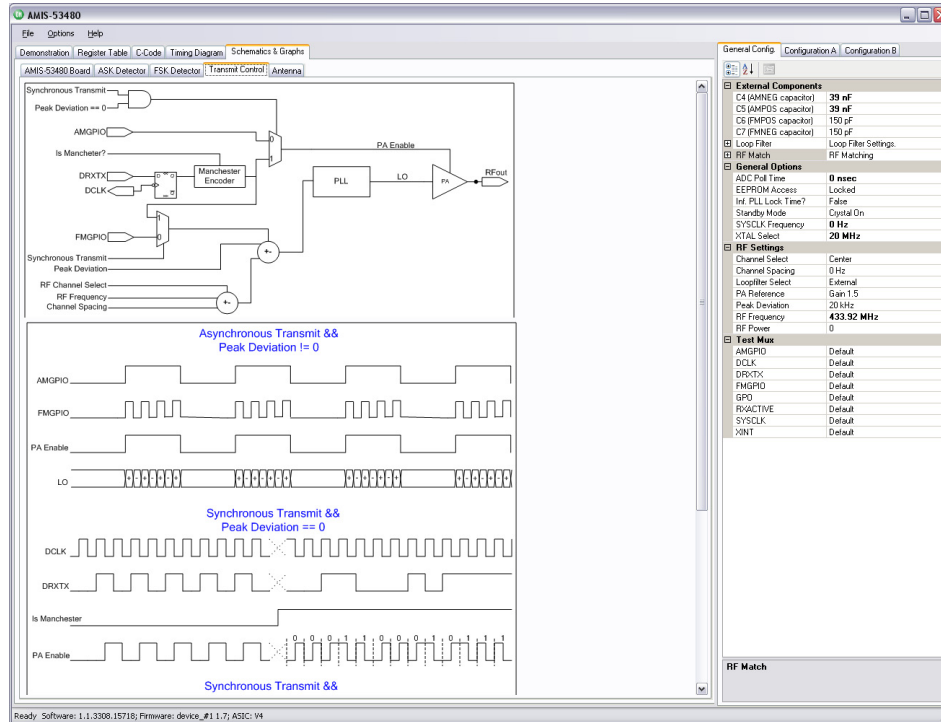
f. Change to the “Schematics & Graphs” tab page and then select the “ASK Detector” tab page.



This page shows a simulation of the ASK slicer. It has several input parameters:

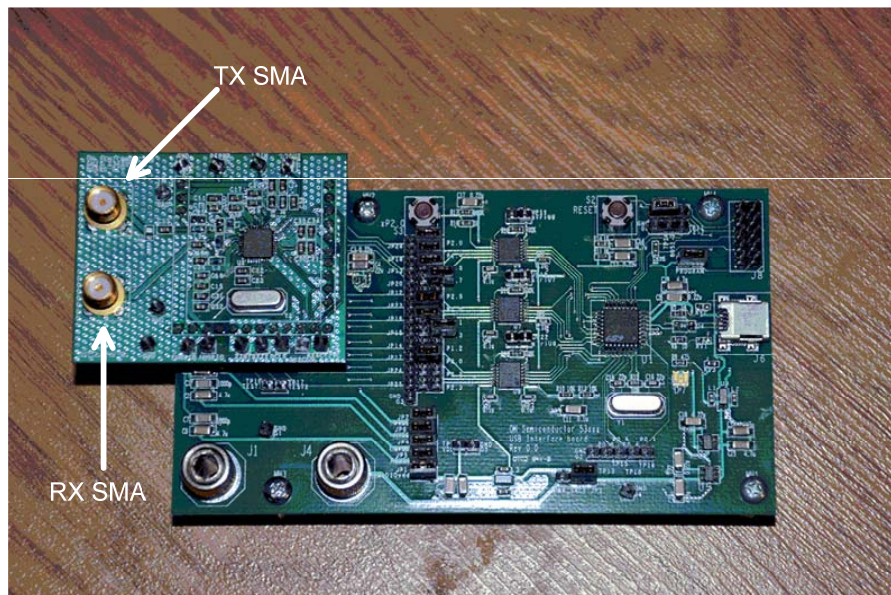
- The “ASK Slice Mode” in the “Configuration A” property window. Try changing this value and see how the simulation responds. Note how the indicative schematic changes when changing the slice mode.
 - The “C4” and “C5” capacitor values in the “General Config” property window. The user will need to expand the “External Components” category to see these values. If the “ASK Slice Mode” is either “RC Integrator” or “Dual Peak Detector” changing these capacitor values will change the simulation results.
 - The “Transmit Preamble” and “Preamble Count” in the “Demonstration” tab page. The simulation uses these values as the input stream. You will need to change the “Transmit/Receive Control” to “Packet”. To change these values. You can try changing these values and see the affect.
 - The “AM Data Rate” in the “Configuration A” property window.
- g. Change to the “Schematics & Graphs” tab page and then select the “FSK Detector” tab page. This is very similar to the “ASK Detector” tab page, only it uses the FSK detector.

h. Change to the “Schematics & Graphs” tab page and then select the “Transmit Control” tab page.



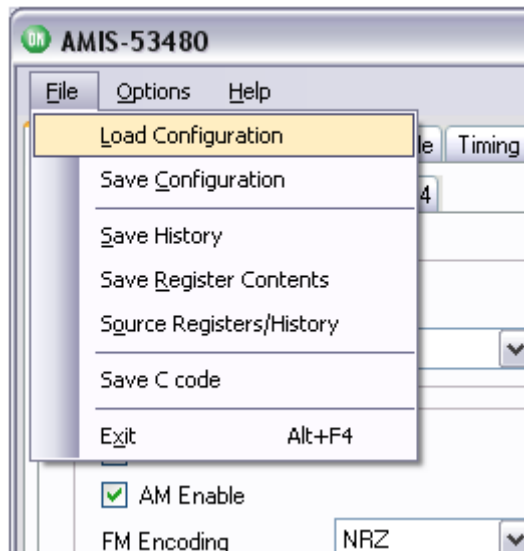
This page shows an indicative schematic and timing diagram for the different transmit modes of operation. More details can be found in the datasheet and/or design specification.

7. Running the Continuous Transmit and Receive configurations.
 - a. If the evaluation board and software are already running you may proceed to **Step #7.b** else plug-in one evaluation boards and start an instance of the NCV53480 evaluation software.
 - b. Connect the transmit SMA connection of the daughter board to a spectrum analyzer.

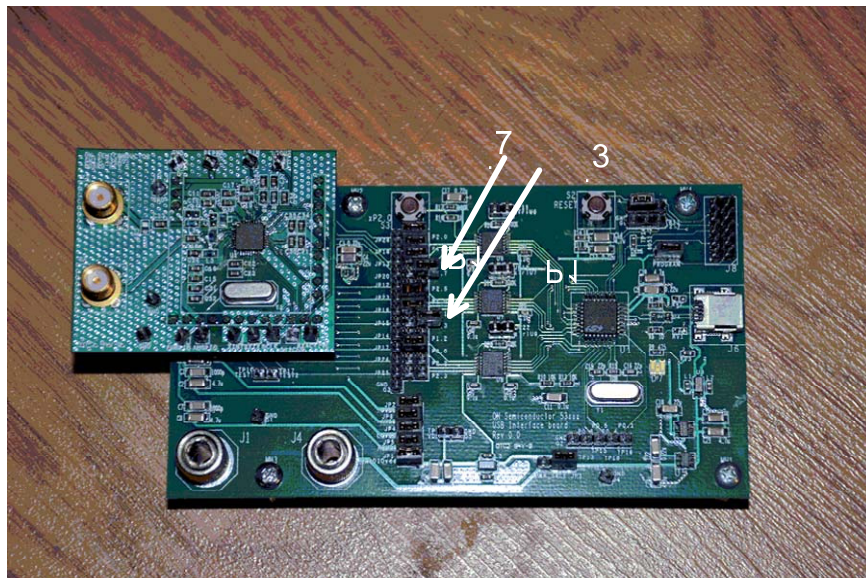


NCV53480EVB/D

- c. In the evaluation program select “File->Load Configuration”.

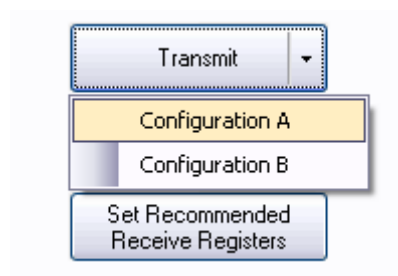


- d. This will bring up an Open File Dialog. Open the file “continuous.cfg” on the CD-ROM. This will setup the NCV53480 to receive/transmit both ASK and FSK data simultaneously.
- e. The jumpers on P1.7 and P1.3 NEED to be connected on the motherboard to utilize the continuous transmit functionality of the demonstration software. Connect these jumpers on the motherboard board. These jumpers should only be connected when utilizing the evaluation software for continuous transmit. If these jumpers are connected during receive it can severely affect the NCV53480’s sensitivity. See “Motherboard Errata.pdf” for details.

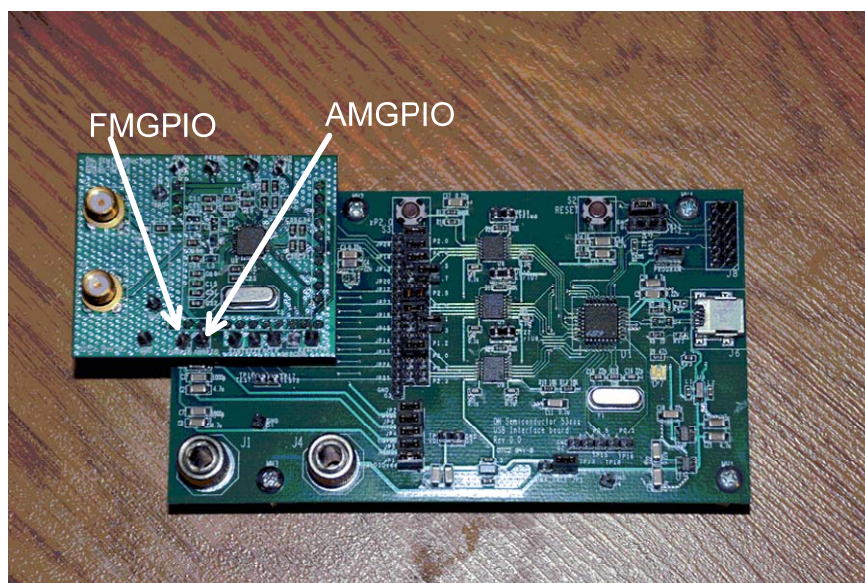


NCV53480EVB/D

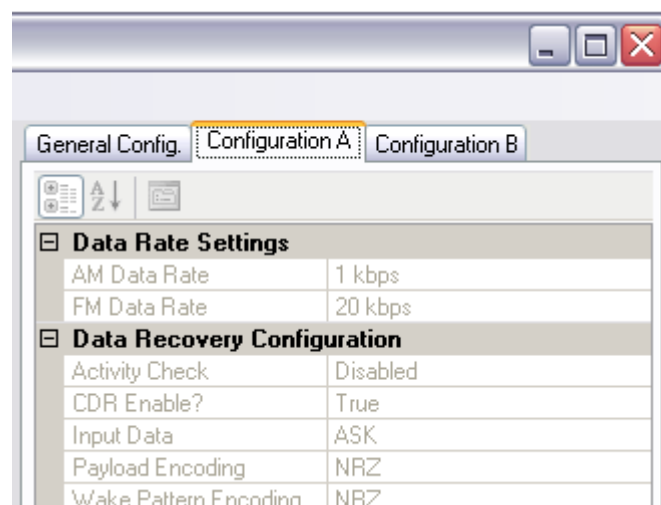
- f. You can then put the evaluation board into continuous transmit. Press the triangle on the right side of the “*Transmit*” button and press the “*Configuration A.*” button.



- g. You should then be able to probe the AMGPIO and FMGPIO test points on the daughter board, and observe a “010101...” bit pattern at 1 kbps and 20 kbps on these pins, respectively. The figure directly below shows the AMGPIO and FMGPIO locations on the daughter board.



Notice that in the “*Configuration B*” property window the “*AM Data Rate*” is set to 1 kbps and the “*FM Data Rate*” is set to 20 kbps.

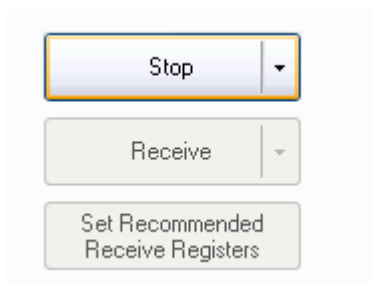


NCV53480EVB/D

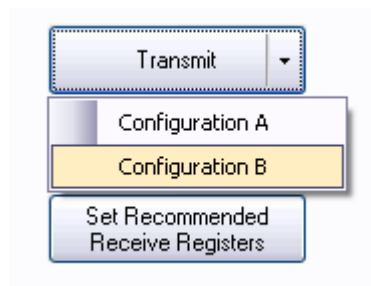
In the asynchronous transmit mode of operation the AMGPIO controls the PA enable and the FMGPIO controls the LO. Note that the FMGPIO doesn't toggle when the AMGPIO is a '0', since the PA will be disabled when AMGPIO is a '0'.

The user can examine an indicative schematic and timing diagrams for the transmit control in the evaluation software by selecting the “*Schematics & Graphs*” tab then the “*Transmit Control*” tab.

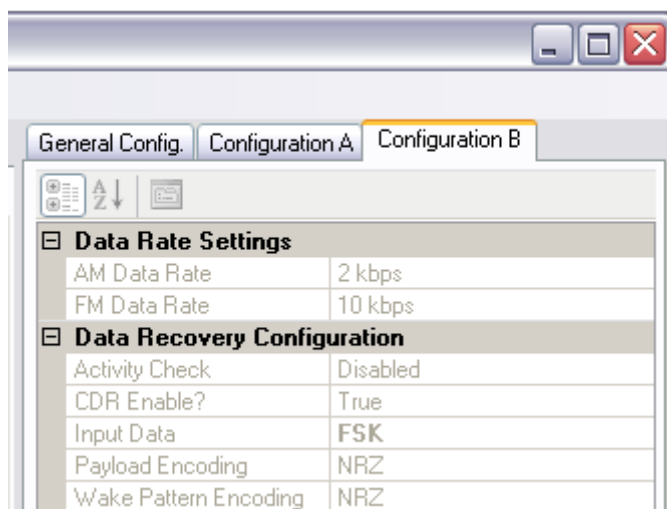
- h. The user can then press the “*Stop*” button and note that the transmitter shuts down.



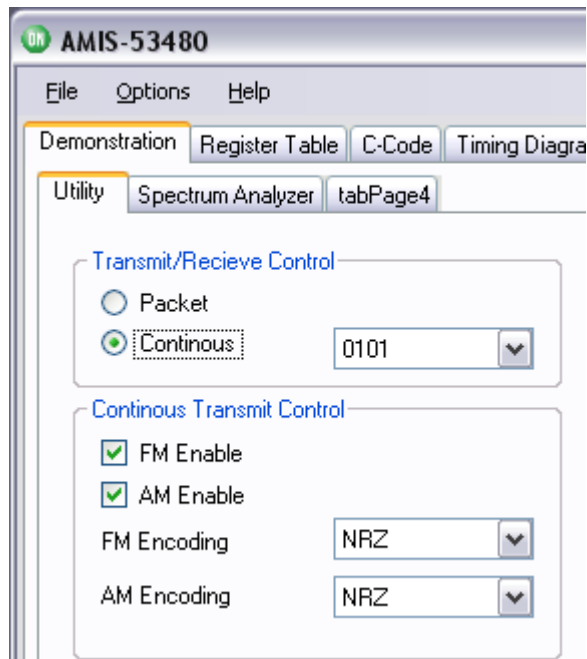
- i. The user can then put the board into continuous transmit using configuration B. Press the “*Transmit*” button and select “*Configuration B*.”



- j. Now probe the AMPGIO and FMGPIO test points on the daughter board, and observe a “010101...” bit pattern at 2 kbps and 10 kbps on these pins, respectively. Notice that in the “*Configuration B*” property window the “*AM Data Rate*” is set to 2 kbps and the “*FM Data Rate*” is set to 10 kbps.



- k. The user can start/stop the transmitter as much as they would like. It is recommended the user changes the transmit data and encoding data and trying several different transmit options and seeing the affect of these changes on the AMGPIO and FMGPIO.



- l. This continuous transmit mode of operation can be used to measure different aspects of the transmitter of the NCV53480 for different configurations, i.e. “*RF Power*”, “*PA Reference*”, “*Peak Deviation*”, “*RF Frequency*”, etc.

For instance if you wanted to measure the NCV53480 current draw at maximum output power, you would

- i. Place a current meter across JP1 on the motherboard. See the figure below for the location of JP1. If you disconnect JP1 and add a current meter you have disconnected the supply from the NCV53480. It is advised after you connect the current meter to shut down the evaluation software; reset the motherboard via the reset push button; and re-start the evaluation software.

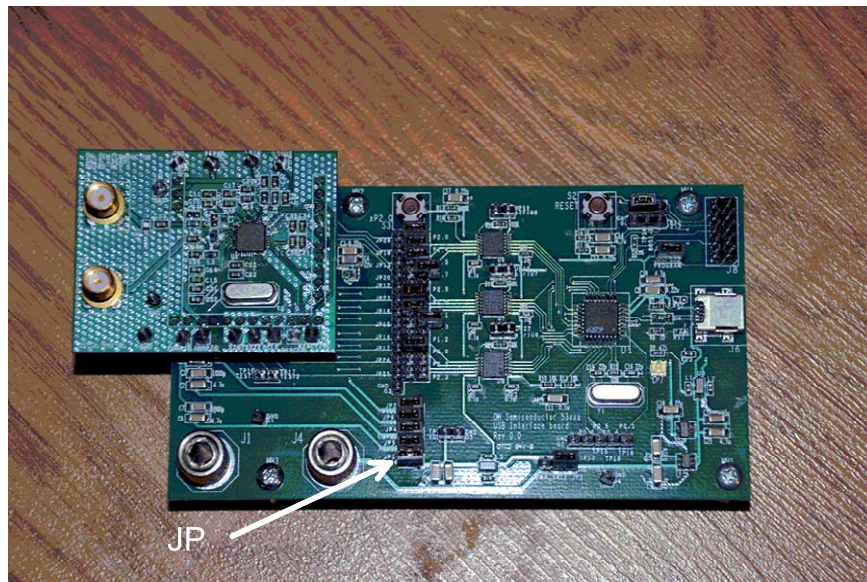
- ii. Change the “*RF Power*” property in “*General Config*” property window to 255.

- iii. Change the “*PA Reference*” property to “*Gain 2.0*”.

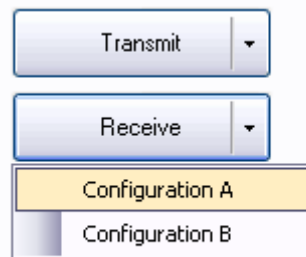
- iv. Change the continuous transmit data to “*1111*” and “*AM Encoding*” to “*NRZ*” such that we transmit CW.

The current meter will display the current draw of the NCV53480 and the spectrum analyzer should show ~10 dBm output power.

Currently the daughter boards should be setup to run off of the USB power. It is possible to run the daughter board (i.e. the NCV53480) at a different supply. See **Step #9** for details on running the NCV53480 off of a DC supply.

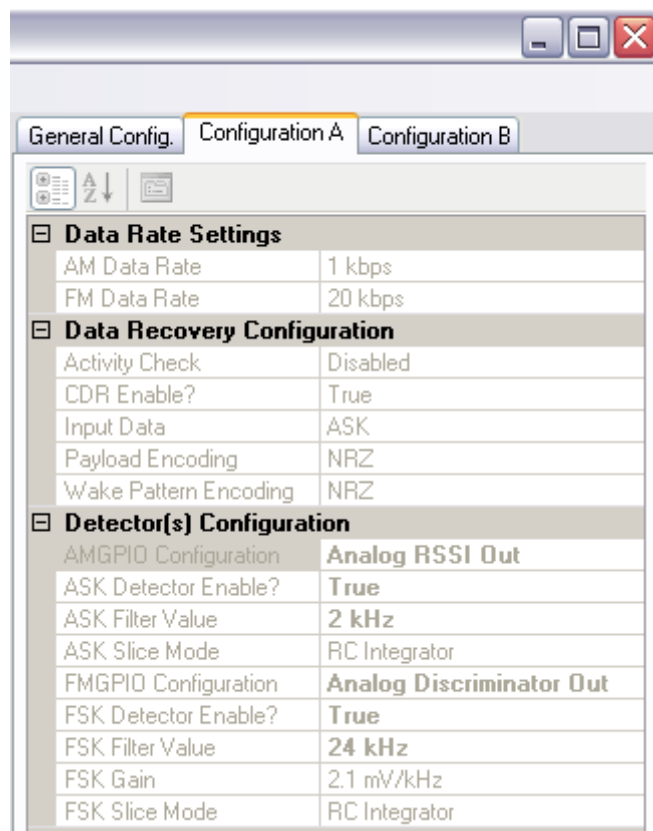


- m. For the remaining section we'll refer to the current evaluation board as the "Transmitter". You can now connect the second evaluation board & start another instance of the evaluation program. We'll call this second board the "Receiver". It is useful to put the evaluation software that corresponds to the board that is physically on the "right" on the right side of the screen. And place the evaluation software that corresponds to the board that is physically on the "left" on the left side of the screen.
Connect the TX SMA of the "Transmitter" to the RX SMA of the "Receiver". It is advised that a 20dB attenuator is used between the TX SMA and RX SMA, this is because at even the minimum output power it is possible to saturate portions of the receive chain.
- n. Load the "continuous.cfg" in the "Receiver" evaluation program like you did in **Step #7.c**. If you've made any changes to the "Transmitter" configuration you should re-load the "continuous.cfg" in the "Transmitter" application.
- o. Place the "Transmitter" board in Transmit configuration A, like in **Step #7.f** Place the "Receiver" board in receive mode using configuration A, by pressing the "Receive" button and the "Configuration A".



- p. The user can now probe the AMGPIO and the FMGPIO on the "Receiver" board. The user should notice the AMGPIO is the ASK sliced data and the FMGPIO is the FSK sliced data. The AMGPIO and FMGPIO should be a "101010" bit pattern at a 500 bps rate and 10 kbps data rate, respectively. Note the FMGPIO will "chatter" when the AMGPIO is a '0', since no signal is being received at this time.

The user should now shut down the receiver via the "Stop" button. Change the configuration A "AMGPIO Configuration" to "Analog RSSI Out" and the "FMGPIO Configuration" to "Analog discriminator out".



Put the part back into Receive mode. The user should notice AMGPI0 and FMGPI0 are RSSI and the discriminator output, respectively.

Now probe the DCLK and DRXTX probe points. These are the recovered baud clock and data, respectively. Note that the DRXTX pin is the ASK recovered data & not the FSK recovered data. This is because the "Input Data" is "ASK" and not "FSK", shown in the figure directly above. In **Step #7.q** the user will utilize configuration B which recovers the FSK sliced data.

- q. It is recommended the user repeats **Step #7.p** and **Step #7.o** utilizing configuration B in both the "Transmitter" and "Receiver". Remember to stop transmitting in the "Transmitter" evaluation software and re-start it using Configuration B.
- r. This continuous receive functionality can be used to measure certain receive characteristics of the NCV53480, such as sensitivity, receive current, etc. You are encouraged to connect a signal generator to the "Receiver" board and place it in receive mode configuration A. You can then measure the sensitivity by examining the DRXTX pin and measure the receive current by placing a current meter across JP1 on the motherboard.
8. Running the Packet Transmit and Sniff configurations. The previous example is meant to show the functionality and performance of the RF and Analog portions of the NCV53480. This section will show some of the functionality of the digital portion, such as Sniff Mode, Wake-On-Energy, Wake-On-Pattern, dual configurations, etc.
 - a. If an evaluation board is already plugged in and the software already started proceed to **Step #8.b** else plug-in one evaluation boards and start an instance of the NCV53480 evaluation software.
 - b. In the evaluation program load the "WakeOnEnergy.cfg" on the CD-ROM drive file via "File->Load Configuration".
 - c. At this point the jumpers on P1.7 and P1.3 should be removed from both motherboards.
 - d. The user should then put the NCV53480 into Transmit Configuration A mode as in **Step #7.f**. Probe the AMGPI0 pin and DRXTX pins to examine the PA Enable and transmit data, respectively.
 - e. In this example the transmitter will periodically burst every 300 msec a defined packet. The packet will include...
 - i. A preamble specified by the "Transmit Preamble" text box for N times, where N is specified by the "Preamble Count" box.
 - ii. A Start-Of-Frame (SOF)
 - iii. The Chip-ID, specified by the "Chip ID" property in the "Configuration A" property window

- iv. 3 bytes (24 bits) of random data specified by the “*Packet Length*” property in the “*Configuration A*” property window.

This “*Transmit Data*” window will display the values current being transmitted.

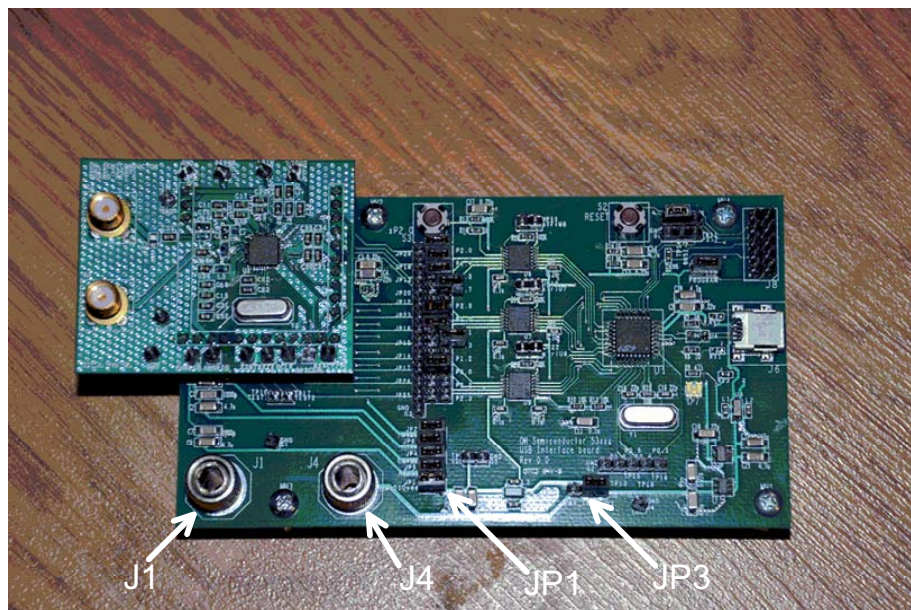
The screenshot shows the software interface for the NCV53480EVb/D evaluation board. The interface is organized into several functional areas:

- Transmit/Receive Control:** Includes radio buttons for 'Packet' (selected) and 'Continuous'. A 'Continuous' section has checkboxes for 'FM Enable' and 'AM Enable', and dropdown menus for 'FM Encoding' and 'AM Encoding' (both set to 'NRZ').
- Packet Transmit Control:** Contains fields for 'Transmit Preamble' (set to '1_1111_1111_1111'), 'Preamble Count' (4), 'Packet Interval' (300 msec), 'Packet Count' (10,000), and 'Payload Data' (Random).
- Transmit Data:** A text area displaying the current transmitted data: '0x80 0x5B 0xD0'.
- Receive Data:** A large, empty text area for displaying received data.
- Control Buttons:** On the right side, there are buttons for 'Stop', 'Receive', and 'Set Recommended Receive Registers'.


- You should see the transmitted data on the DRXTX line via an oscilloscope.
- If a second board isn't plugged in you should plug-in the second evaluation board; start another instance of the evaluation software and load the “*WakeOnEnergy.cfg*” file. For future reference we'll call the first board the “*Transmitter*” and the second board the “*Receiver*.” Hook the TX SMA of the “*Transmitter*” to the RX SMA of the “*Receiver*.”
- Put the “*Receiver*” board into Receive Configuration A, much like in **Step #7.o**.
- Notice the “*Receive Data*” text box being updated periodically with 3 bytes of random data.
- You are encouraged to stop both the “*Transmitter*” and “*Receiver*” and change the “*Payload Data*” to “*PER*” and restart both the “*Transmitter*” and “*Receiver*”. At this time the user should notice the “*Receive Data*” text box being updated with the results of the Packet-Error-Rate tester.
- Change the “*Payload Data*” back to “*Random*”. The user can now try changing several different settings & seeing the affect it has on both the receiver and transmitter.
 - Change the “*Packet Length*” in “*Configuration A*” property window of both the “*Transmitter*” and “*Receiver*”. This value can be from 0 to 128.
 - Change the “*Chip ID*” and “*Chip ID Length*” in “*Configuration A*” property window of both the “*Transmitter*” and “*Receiver*”. Refer to the datasheet and/or design specification on details of the Chip ID and Chip ID Length in Wake-On-Energy mode.
 - Change the “*Transmit Preamble*” and “*Preamble Count*” in the “*Transmitter*” and the “*Sniff interval Time*” in the “*Receiver*”. The maximum Sniff Interval Time is the length of the preamble. In this mode of operation the length of the preamble is the “*Preamble Count*” * Length(“*Tranmit Premable*”) / AM data rate. You are encouraged to examine how the Sniff Interval has an effect on the Receive current.
 - Change the “*Payload Encoding*” in “*Configuration A*” property window of both the “*Transmitter*” and “*Receiver*” from “*NRZ*” to “*Manchester*” to encode/decode the payload using Manchester encoding.
 - The user is welcome to “play” around with ASK detector configurations; data rates; code dwell timers; receive dwell timers; encoding schemes, etc.
- Stop both the “*Transmitter*” and the “*Receiver*”. Load the “*WakeOnPattern.cfg*” file from the CD-ROM.

NCV53480EVb/D

- m. Enable the “Transmitter” to Transmit using Configuration B, like in **Step #7.i** and enable the “Receiver” to receive using configuration B. This will demonstrate the Wake-On-Pattern functionality using Configuration B. The user is encouraged to change several options affecting the receiver and/or transmitter in “*Configuration B*” and seeing the effect this has.
9. There is a lot of functionality of the NCV53480 that isn’t shown in this Quick Start Guide. The functionality not covered includes, but is not limited to.
 - a. Sniff Mode with both Configuration A and Configuration B active. This is not shown because it would require two transmitters.
 - b. Channel assessment to determine which channel has the lowest noise floor.
 - c. Temperature sensor functionality.
 - d. IF Filter bandwidth performance
 - e. Various wake-up parameters, encoding styles, detector configurations, filter settings, etc.
 - f. Wake-On-Energy and Wake-On-Pattern using recovered FSK data.
10. Running the NCV53480 daughter board off of a DC supply.
 - a. Connect JP3 between pins 2 and 3 to run the NCV53480 off of a DC supply. Connect JP3 between pins 1 and 2 to run the NCV53480 off of USB Power. Pin 1 is on the right side and pin 3 is on the left side in the orientation shown in the figure below.
 - b. Connect the DC power supply to the banana jacks J1 and J4. J4 is the positive supply and J1 is the negative supply.
 - c. You may remove JP1 to measure the current draw of the NCV53480 in certain modes of operation such as Sniff, Standby, Receive and/or Transmit



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