



**ON Semiconductor®**

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## NCS36510 Evaluation Kit User's Manual

### Introduction

This document explains how to use the ON Semiconductor NCS36510 evaluation kit (EVK).

The EVK comes pre-programmed with a demo application that allows customers easy access to the transceiver radio (805.15.4 PHY), ADC, and FLASH programming through a custom Graphical User Interface (GUI).

The EVK hardware also functions as a development platform when used in conjunction with the NCS36510 SDK. Access to the SDK can be requested through sales.

A command line interface (CLI) for the 802.15.4 MAC level access exists and can also be requested through sales. However this tool is not very popular with customers as most application developers proceed straight to the SDK.

This document does not cover the SDK or the MAC CLI interface.

### Evaluation Kit Contents

The evaluation kit contains the following items:

- 2 NCS36510 Evaluation Boards
- 2 USB-A to USB-mini Cables

### HW Requirements

The following items are necessary to use the EVK:

- 1 or 2 PC(s) Running Windows 7 or Higher (32 or 64 bit) with 2 Unused USB Ports
- 2 NCS36510 Evaluation Boards
- 2 USB-A to USB-mini Cables

### SW Requirements

The following software is required to use this evaluation kit:

- FTDI USB Driver for Virtual Com Port
- ON Semiconductor GUI

### USB Driver

The user can attempt to skip this USB driver installation as Windows should automatically download it the first time the GUI is invoked. *However if the user chooses this method they need to wait patiently for up to three minutes while Windows downloads and installs the proper driver.*

Most users choose the automatic method. But if you want to pre-install the USB driver see Table 1:

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**Table 1. USB DRIVER**

|               |   |
|---------------|---|
| Software Tool | FTDI drivers for the virtual COM port   |
| Source        | <a href="http://www.ftdichip.com/Drivers/VCP.htm">http://www.ftdichip.com/Drivers/VCP.htm</a>   |
| Instructions  | Download and install the FTDI drivers which will be needed to setup a COM port to communicate with the evaluation boards.<br><br>Most likely your PC already contains drivers for FTDI USB to RS232 transceiver. You could try to skip this download and only download and install the drivers when MS Windows was not capable of loading a driver. |

### Graphical User Interface

**Table 2. GUI**

|               |   |
|---------------|---|
| Software Tool | NCS36510 GUI to communicate with the NCS36510   |
| Source        | <a href="http://www.onsemi.com/PowerSolutions/product.do?id=NCS36510">http://www.onsemi.com/PowerSolutions/product.do?id=NCS36510</a>   |
| Instructions  | Double click the installer and the installer does all necessary step to fully enable the GUI. After the installer finishes a shortcut appears on the desktop.<br><br>If the user has chosen to let Windows install the USB driver, see the note above that discusses the delay that will occur the first time you invoke the GUI. |

### Hardware Overview

The evaluation kit contains two boards which are ready to use right out of the box. One evaluation board (EVB) consists of one NCS36510 RF module soldered to one mother board as shown in Figure 1.

Power and communication are handled by a USB virtual COM port.

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The motherboard provides two regulated voltages derived from the USB power supply to power the evaluation board. One is VDD which defaults to 3.0 V, and the other is for VDDIO which defaults to 3.3 V. On the evaluation board, the RF Power Amplifier (PA), is connected to the VDD supply.

To simplify active current measurements, a current sensor has been added to the motherboard. This is shown in Figure 1. An oscilloscope or digital multi-meter (DMM) can be used to measure the voltage on this test point (TP1). The voltage represents the active mode current through the following equation:

$$I_{VDD} = \left( \frac{V(TP1)}{A_{Sensor}} \right) = \left( \frac{V(TP1)}{9.1 \Omega} \right)$$

Some power supply current transients may be difficult to measure due to the finite bandwidth and slew rate capability of the current sensor amplifier.

Two header banks are provided to allow access to the on chip ADC inputs and available chip GPIO's. This is shown in Figure 1.

Serial Wire Debug (SWD) access is also provided as shown on the motherboard. Debugging is not required when using the EVK. The header is provided so the EVK hardware can also be used as a development platform when combined with the SDK and a suitable MCU debugger.

## EVK and GUI Setup

If this is the first time using the NCS36510 EVK the user will need to install the FTDI driver needed to open the virtual COM port to communicate with the evaluation boards. This must be done on both computers if two computers are used.

Windows should find and install the necessary USB drivers when the evaluation board (EVB) is plugged into the PC, however this may take several minutes. Once Windows confirms the device is ready to use, the user can start using the GUI (see following sections). If the drivers do not install automatically, or there are apparent driver issues, see Table 1 to manually download and install the drivers.

No additional hardware setup is needed. When the USB cable is plugged in to the PC(s), upon initializing the GUI it will automatically connect to the boards and be ready for use as shown in the following sections.

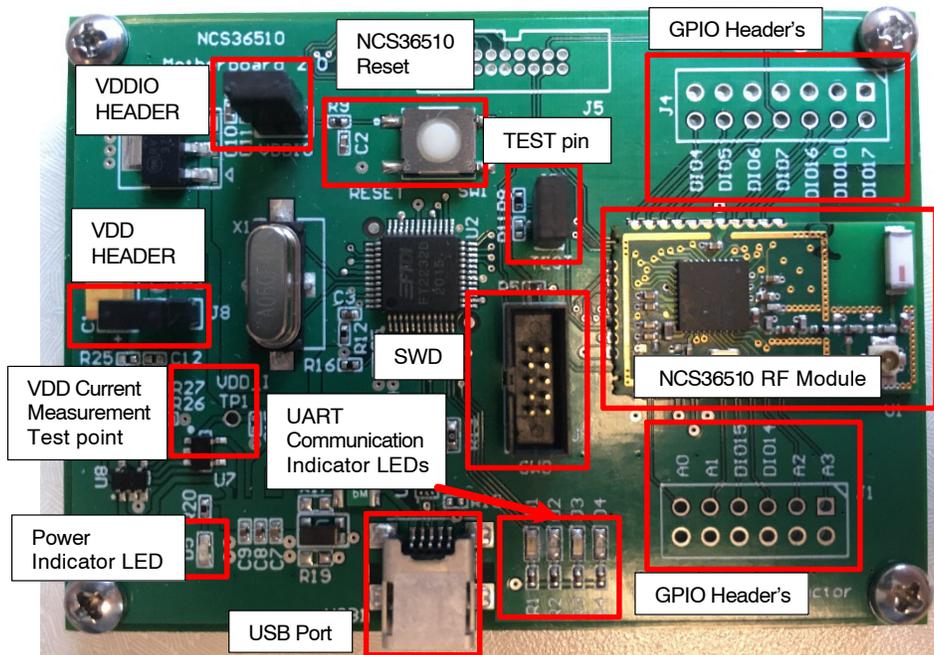


Figure 1. NCS36510 Evaluation Board

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## Graphical User Interface

The following sections provide examples of how to use the GUI with the NCS36510 EVK.

To start the GUI:

1. Ensure the NCS36510 EVB is connected to the PC(s) with a USB cable, and the appropriate drivers are installed. See Table 1 for USB driver information.

2. Open the GUI by double clicking the NCS36510\_GUI.exe icon located on your desktop.

After opening the GUI please refer to sections “GUI Example – Receiver” through “GUI Example – FLASH Program” of this document for instructions on how to use the different operational modes of the NCS36510 supported by the GUI. The following figure depicts what to expect when the GUI starts.



Figure 2. GUI Main Page

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## GUI Example – Receiver

The purpose of this section is to display an example of how to configure the NCS36510 as an 802.15.4 receiver using the GUI.

1. From the “Main” tab, select the “Receive“ tab, the “Receive” page will look as shown in Figure 3.
2. Set the required parameters for the receiver. In this case the only required parameter is the desired channel. To do this select the channel from the

“Channel” drop down menu, and click “Set”.

Ensure that the receiving board’s channel matches that of the transmitting board.

3. Next the receiver must be turned on to start to receive packets. This is done by pressing the Receiver Mode “Start” button. This will leave the receiver on continuously and will receive any valid 802.15.4 data on the given channel.

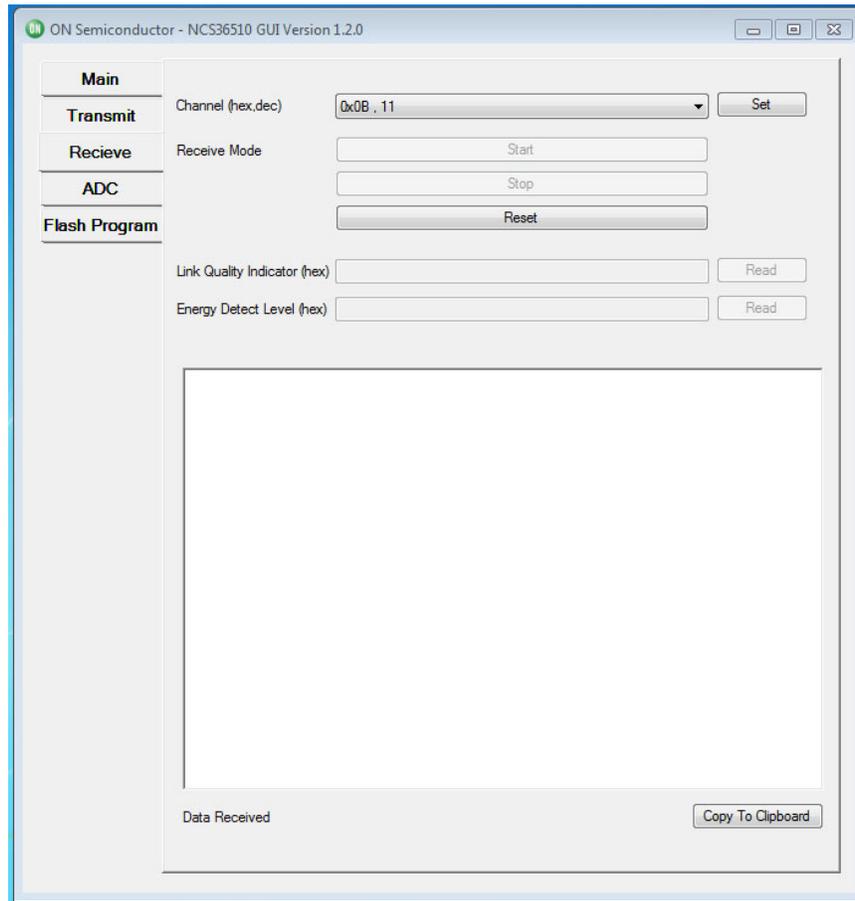


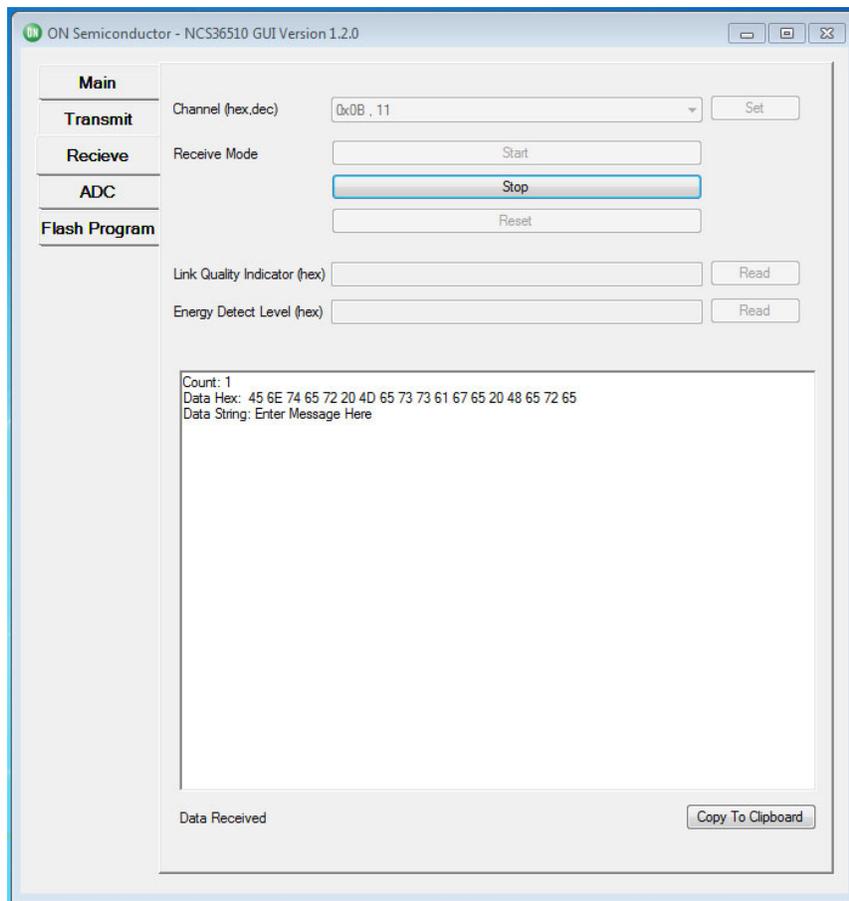
Figure 3. GUI–Receive–Interface

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4. Once all desired packets are received turn off the receiver by clicking the “Stop” button. At this point one can check the LQI for the last packet received by pressing the top “Read” button.

5. The Copy to Clipboard button can be used to copy the data that is received in the data box, to your Windows clipboard.

**NOTE:** After step 2 is completed, the user can read the energy level of the selected channel by pressing the second read button. Please note that the Energy Detect (ED) is a single sample of the energy in the air on the selected channel. The ED is not synchronized in any way to any data being sent from another EVB (or other packet generator), so it is difficult to get a valid reading for ED with asynchronously sent packet data. However when the transmitter is sending a tone in CW mode, the ED value will work for every sample as there is no timing involved.



**Figure 4. GUI-Receive-Packet Received Example**

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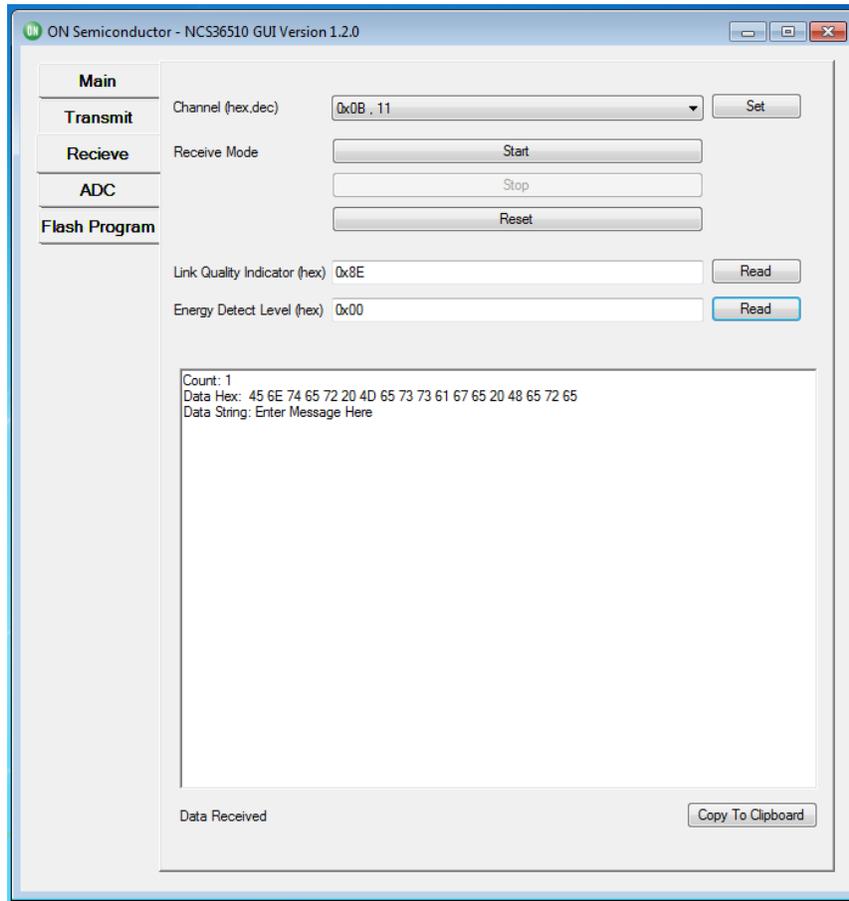


Figure 5. GUI-Receive-LQI/ED Example

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## GUI Example – Transmitter

The purpose of this section is to provide an example of how to use the NCS36510 as a transmitter using the GUI.

1. Ensure the NCS36510 EVB is physically connected and the GUI is opened as described in section “Graphical User Interface”.
2. From the default “Main” tab select the “Transmit” tab. The “Transmit” page will look as shown in Figure 6.
3. Set the following required parameters for the transmitter.
  - a.) Set the desired transmitter channel by selecting the channel from the “Channel” drop down menu, then press the respective “Set” button. Ensure that the transmitting board’s channel matches that of the receiving board.
  - b.) Set the desired output power by selecting the power level from the “Transmission Power” drop down menu, then press the respective “Set” button.
  - c.) Set the desired payload by entering a message into the “Set Payload to be Transmitted” text field. By default the payload is set to “Enter Message Here”.
4. Once all parameters are set, the user can begin to transmit packets. The GUI supports two transmission modes. The two available modes are:
  - a.) “Transmit periodically” which will transmit a finite number of packets with a given delay interval between transmission. To transmit in this mode one must set the number of packets to send in the “Number of Packets” text field as well as the delay interval in the “Delay between Packets (ms)” text field. It is important to note that one must enter a packet count greater than 0, and a delay that is greater than 200 milliseconds. Once these values are entered, press the “Tx” button to start the transmission.

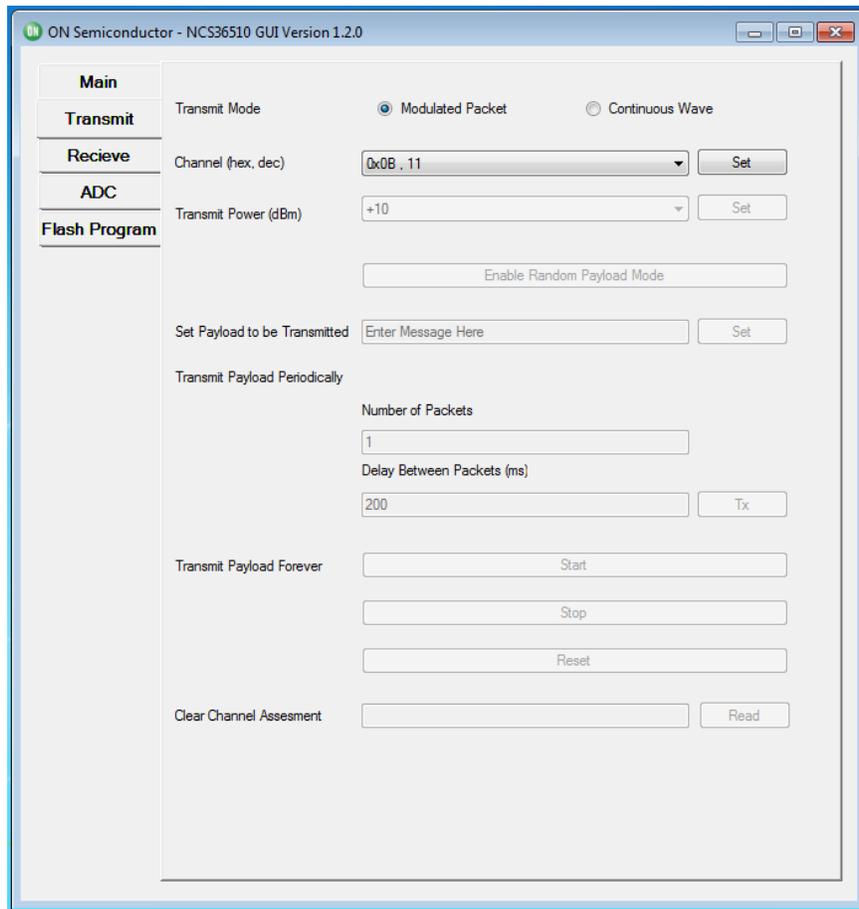


Figure 6. GUI–Transmitter–Interface

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b.) “Transmit Forever” which will continuously transmit packets until the transmitter is turned off (technically it will stop at 0xFFFF (65,535) packets). To transmit in this mode one must press the “Start”

button. It is important to note that once the “Start” button is pressed, one must press the “Stop” button to disable the transmitter before being able to do anything else with the NCS36510 EVB.

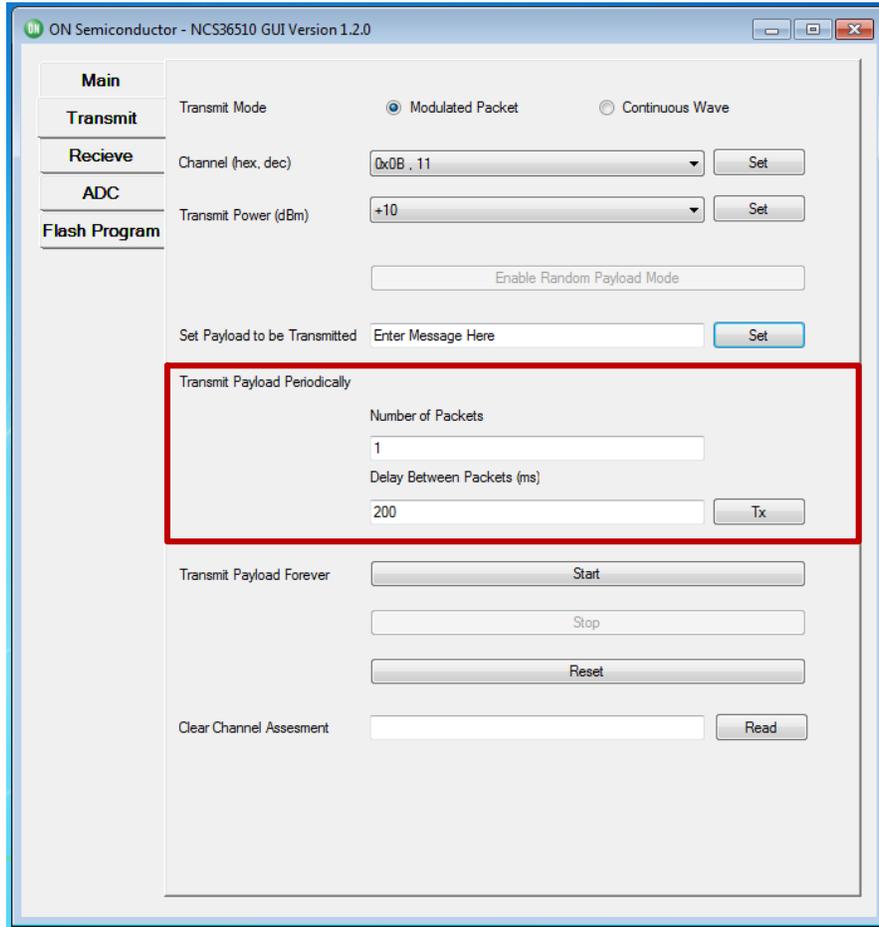


Figure 7. GUI-Transmit-Periodically

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NOTE: One can perform a clear channel assessment once the channel is set. This is done by pressing the “Read” button to the right of the “Clear Channel Assessment” text field.

Please note that the Clear Channel Assessment (CCA) is a single sample of the energy in the air on the selected channel. The CCA measurement is not synchronized in any way to any data being sent from another EVB (or other packet generator), so it is difficult to get a valid reading for CCA with asynchronously sent packet data. However when the transmitter is sending a tone in CW mode, the CCA value will work for every sample as there is no timing involved.

## GUI Example – Random Payload Mode

The purpose of this section is to provide an example of how to use the NCS36510 as a transmitter using the GUI while transmitting a continuous random payload.

1. Ensure the NCS36510 EVB is physically connected and the GUI is opened as described in section “Graphical User Interface”.
2. From the default “Main” tab select the “Transmit” tab. The “Transmit” page will look like section “GUI Example – Transmitter”, Figure 6.
3. Set the following required parameters for the transmitter.
  - a.) Set the desired transmitter channel by selecting the channel from the “Channel” drop down menu, then press the respective “Set” button. Ensure that the transmitting board’s channel matches that of the receiving board.
  - b.) Set the desired output power by selecting the power level from the “Transmission Power” drop down menu, then press the respective “Set” button.
4. Press the “Enable Random Payload Mode”, the “Transmit” tab will change and look as follows:

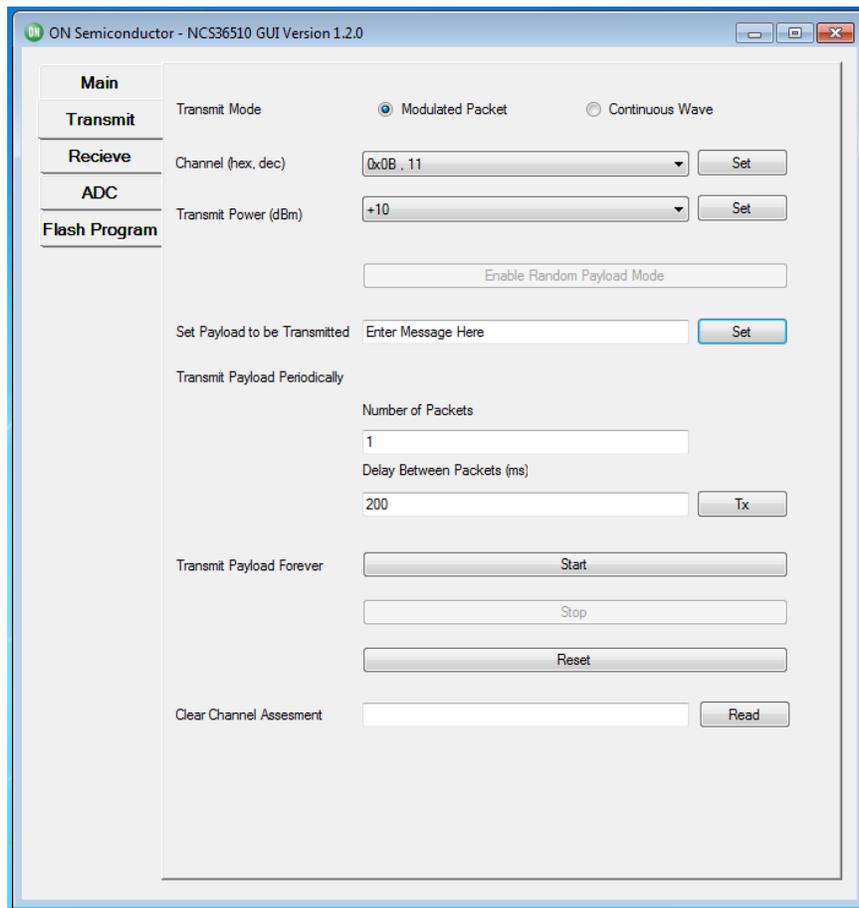


Figure 8. GUI–Transmit–Payload Forever

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5. Enter the length of the payload that you want to transmit in the appropriate field and then press the “Set” button.

6. To start transmitting the random payload press the “Start” button.

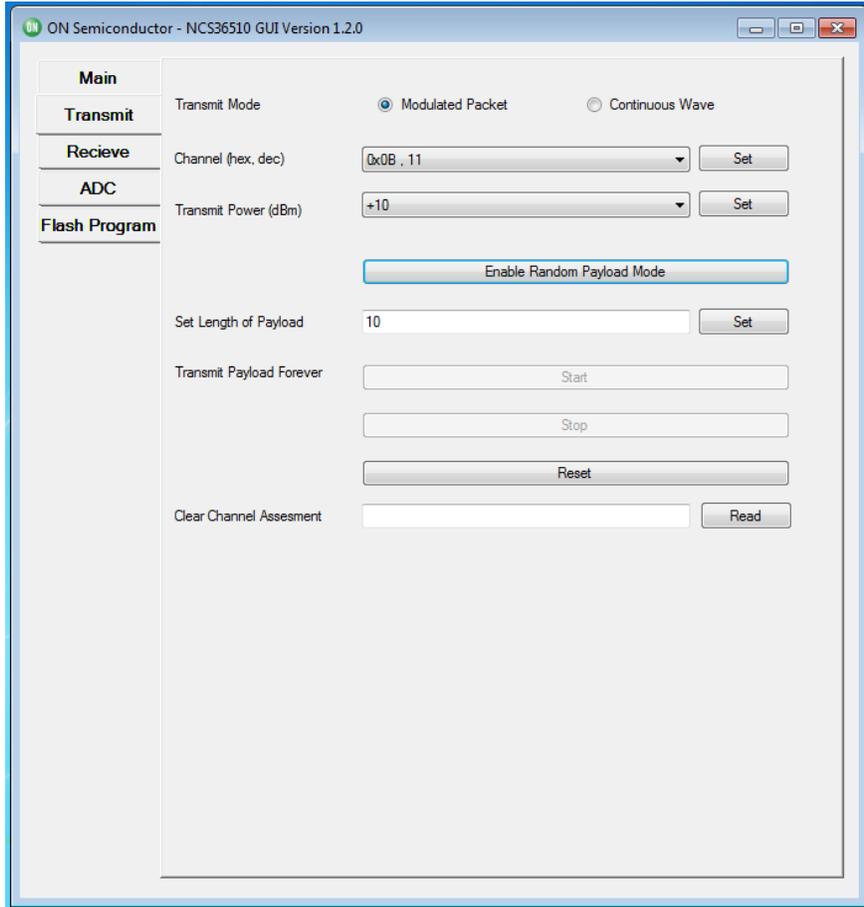


Figure 9. GUI-Transmit-Random Payload Mode

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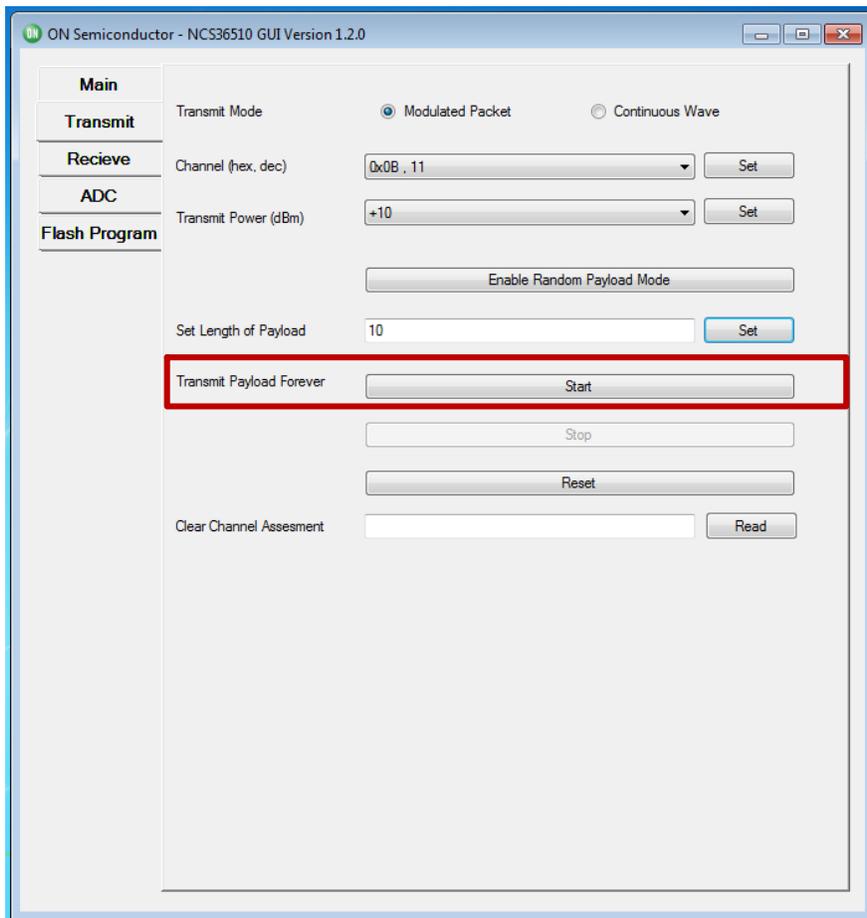


Figure 10. GUI-Transmit-Random Payload Mode Start

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### GUI Example – Transmitter Continuous Wave

The purpose of this section is to show how to use the Transmitter in Continuous wave mode using the GUI.

1. Ensure the NCS36510 EVB is physically connected and the GUI is opened as described in section “Graphical user Interface”.
2. From the default “Main” tab select the “Transmit” tab. The “Transmit” page will look like the one shown in Section: GUI Example – Transmitter, Figure 6.
3. In order to get to continuous wave mode press the “Continuous Wave” radio button that will result in the “Transmit Tab” to change and the “Transmit” page will look as shown in Figure 11.
4. Set the following required parameters for the transmitter.
  - a.) Set the desired transmitter channel by selecting the channel from the “Channel” drop down menu, then press the respective “Set” button.
  - b.) Set the desired output power by selecting the power level from the “Transmission Power” drop down menu, then press the respective “Set” button.
5. To transmit in this mode one must press the “Start” button. It is important to note that once the “Start” button is pressed, one must press the “Stop” button to disable the transmitter before being able to do anything else with the NCS36510 EVB.

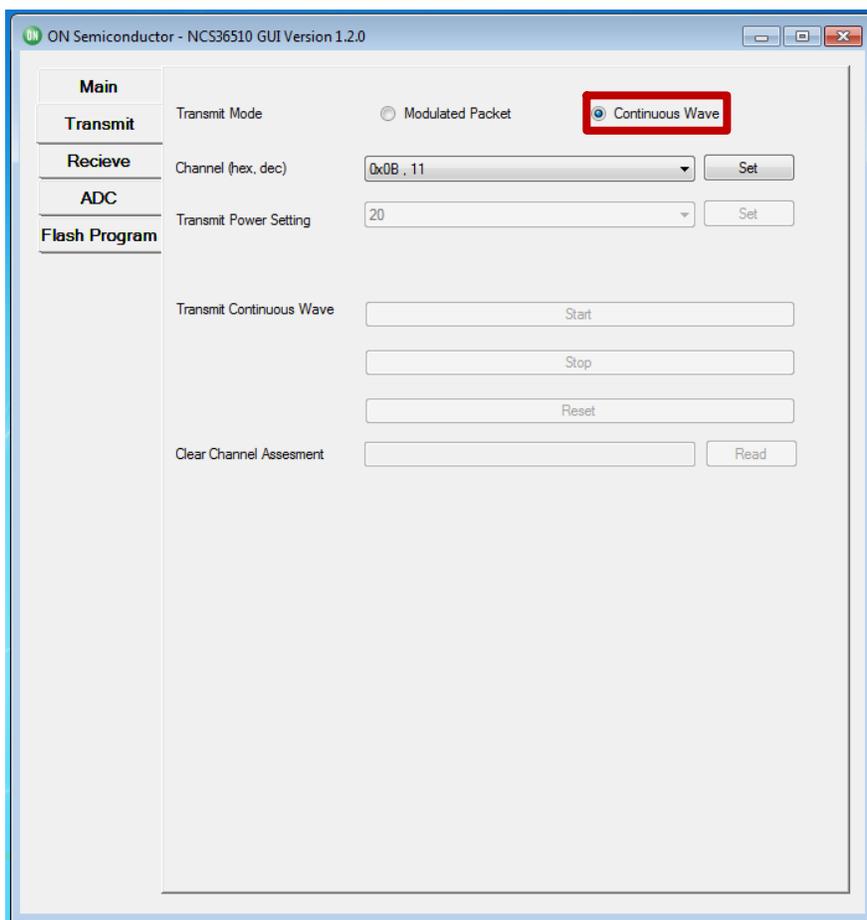


Figure 11. GUI–Transmit–Continuous Wave Transmit Mode

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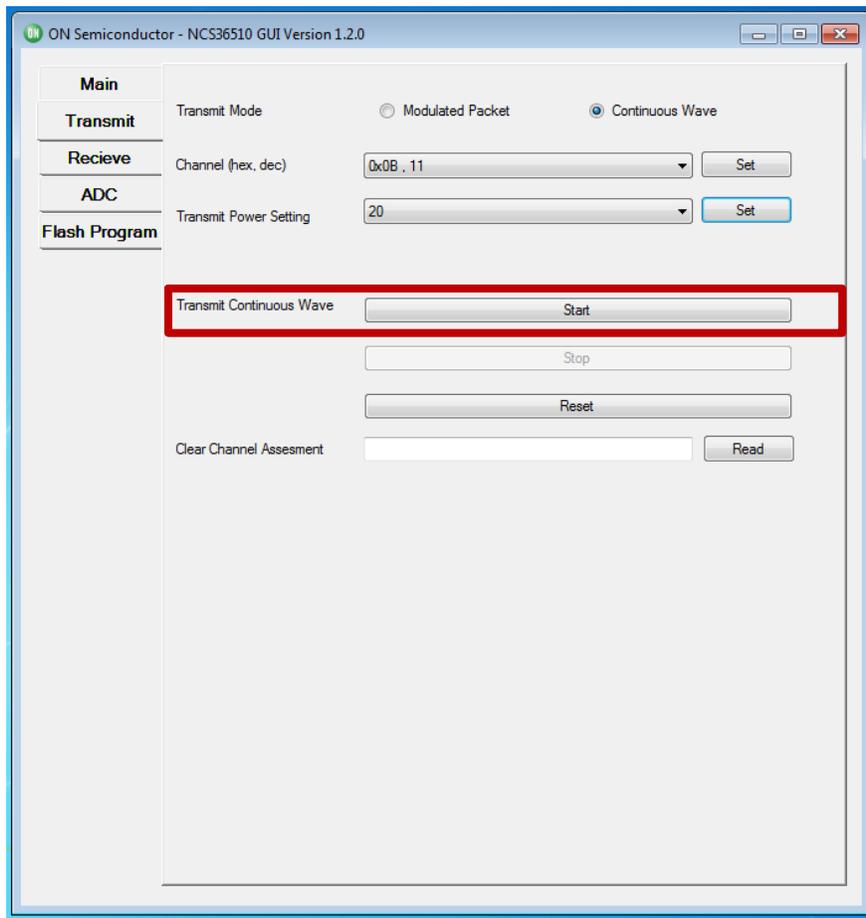


Figure 12. GUI-Transmit-Continuous Wave Transmit Mode Start

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NOTE: The proper functioning of the “Continuous Transmit Mode” can be checked using a new instance of the GUI for the NCS36510. In order to do this plug in another NCS36510 EVB and start another instance of the NCS36510 GUI. In this new instance, go to the receive mode tab and select the channel corresponding to the channel on which the Continuous wave is being transmitted; this can be done by following the instructions mentioned in section “GUI Example – Receiver”. After this press the “read” button next to the “Energy Detect Level” option, if the continuous wave mode is functioning properly then a non-zero energy should be detected on that specific channel as shown in Figure 13.

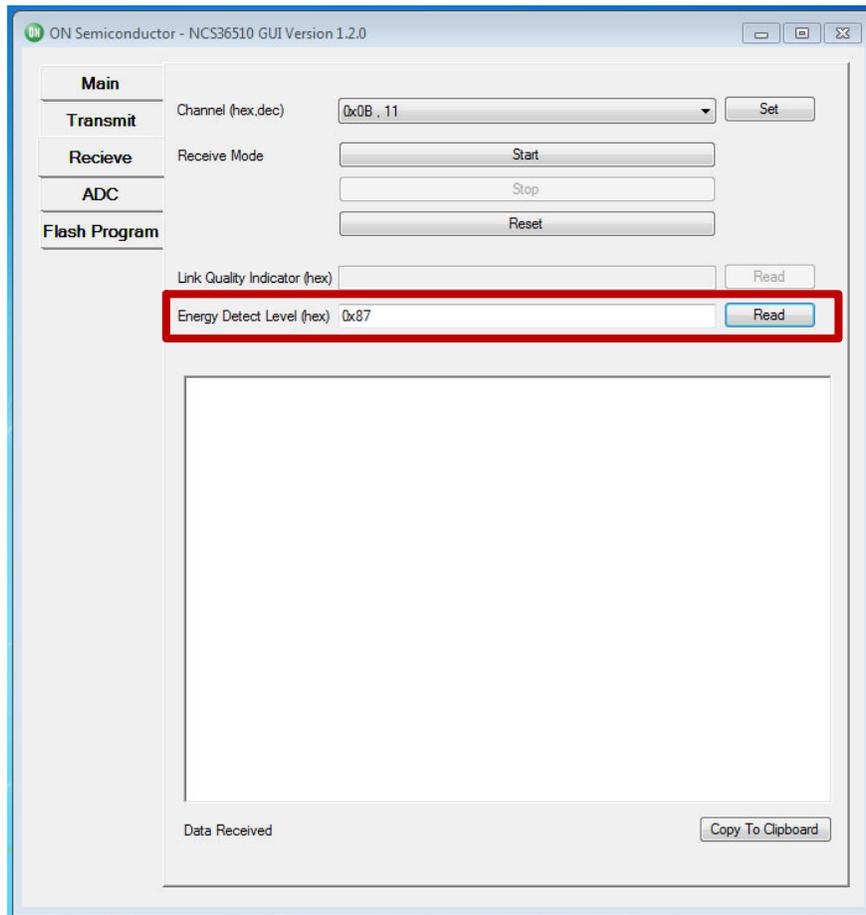


Figure 13. GUI-Receive-Continuous Wave Energy Detect Level

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## GUI Example – ADC

The purpose of this section is to provide an example of how to use the ADC on the NCS36510 using the GUI.

1. Ensure the NCS36510 is physically connected as described in Section “EVK and GUI Setup” above.
2. Open the GUI by double clicking the NCS36510\_GUI.exe icon located on your desktop.
3. Select the “ADC” tab as shown in Figure 2, the “ADC” page will look as shown in Figure 14.
4. Set the following required parameters for the ADC.
  - a.) Set the scale factor by selecting the desired factor from the “Scale Factor” drop down menu.

- b.) Set the ADC input channel by selecting the desired channel from the “ADC Input” drop down menu.
5. Once the required parameters are selected, press the “Set” button.
  6. The next step is to enter the number of samples desired in the “Number of Samples” text field. It is important to note that the number of samples must be greater than zero.
  7. The last step is to perform the ADC read. This is done by pressing the ADC Sample “Start” button. The following is an example of an ADC read.

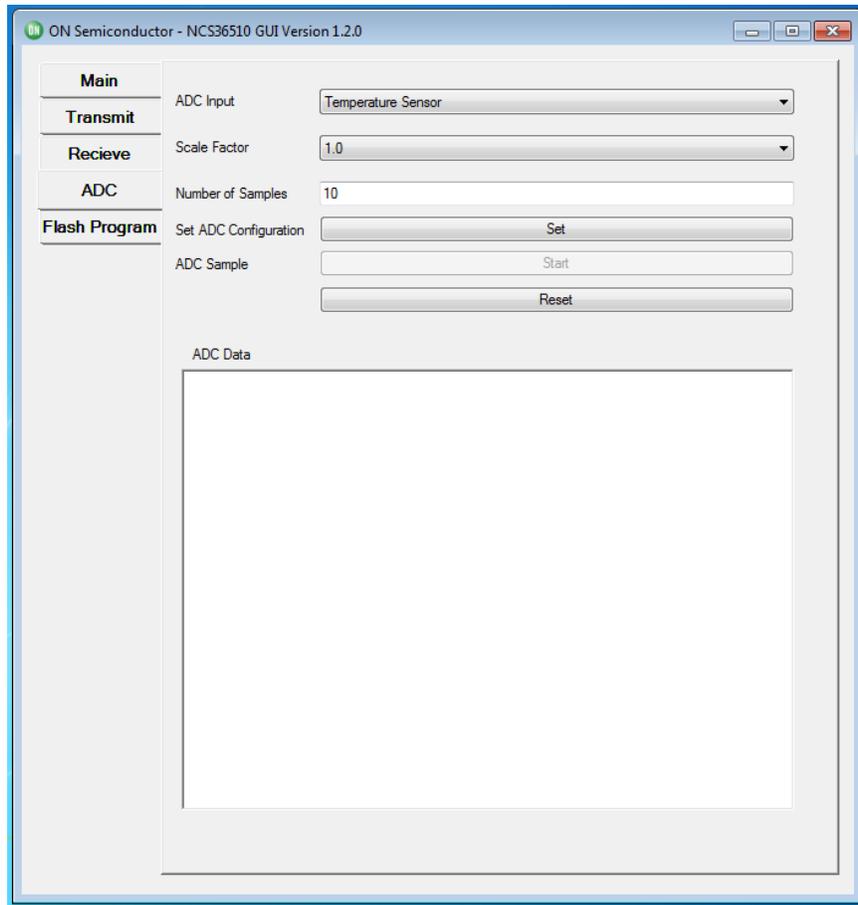


Figure 14. GUI-ADC-Interface

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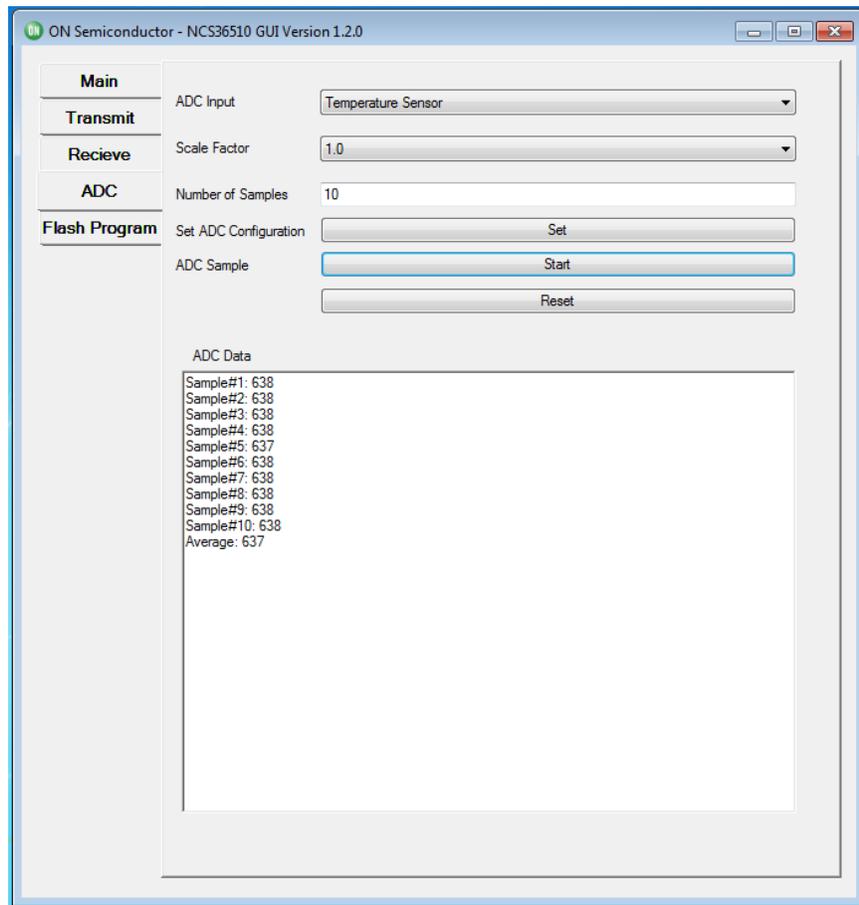


Figure 15. GUI-ADC-Reading Example

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## GUI Example – FLASH Program

The purpose of this section is to provide an example of how to program an application onto the NCS36510 using the GUI.

NOTE: It is recommended that you **only connect one board** while using the functionality.

1. Ensure the NCS36510 is physically connected as described in Section “EVK and GUI Setup” above.
2. Open the GUI by double clicking the NCS36510\_GUI.exe icon located on your desktop.
3. Select the “FLASH Program” tab as shown in Figure 2, the “FLASH Program” page will look as shown in Figure 16.
4. On this page the GUI provides the user the capability to program the connected board. Press the “Browse” button next to the “File Path to Bin” and navigate to the binary file. This binary file should have an extension type of “.bin”. If an invalid file extension is selected the user will be prompted with an error.
5. Press the “Browse” button next to the “File Path to Fib” and navigate to the FIB (Firmware Information Block) file. This fib file should have

an extension type of “.txt”. The FIB file should have been included with the binary. Both files are required to update the firmware.

6. Press the “FLASH” button and wait for the installation process to conclude. Once the process has concluded the following pop up should emerge.
7. Disconnect and reconnect the USB cable from the board being programmed. This is done in order to power on reset the board to trigger a reboot. Then press the “OK” button and wait for the following pop up to emerge.
8. Press the “OK” button and the program will restart in order to provide the user with the initial GUI interface as shown in Figure 2.

NOTE: If after step 7 the program prompts you that the programming was unsuccessful, follow the instructions on the screen in order to re-program the board to a default version which should allow you to continue using the board with a known good firmware image. If this also fails, please contact sales for support.

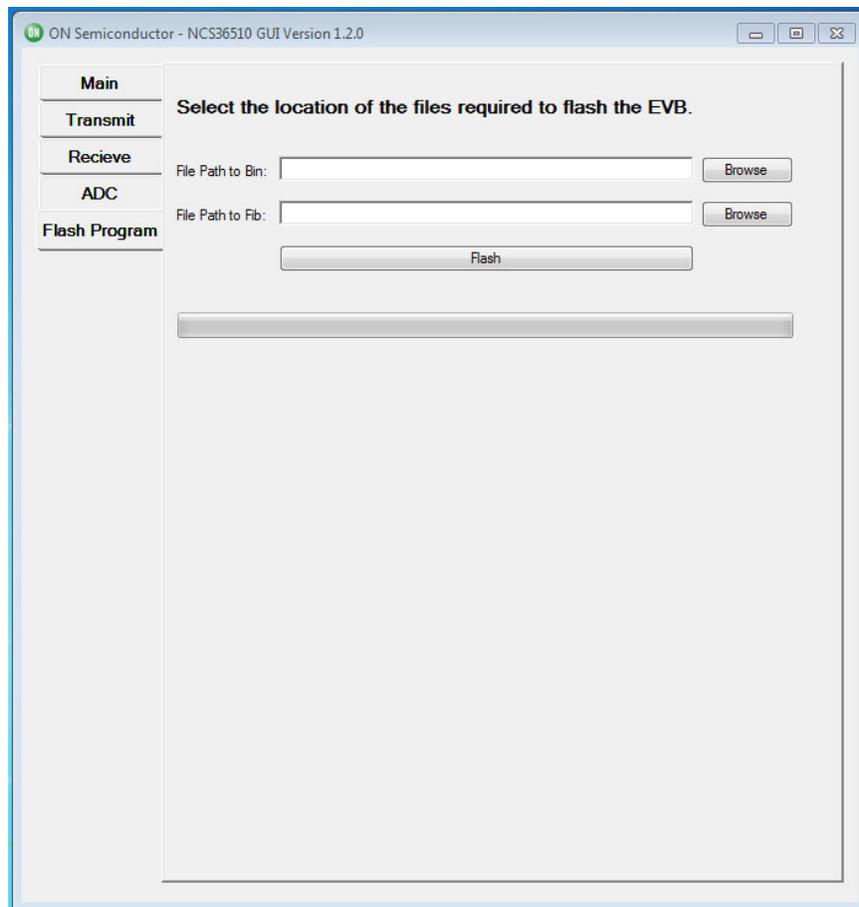
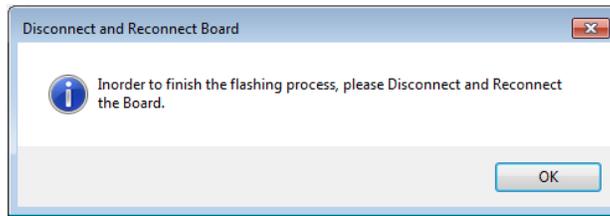
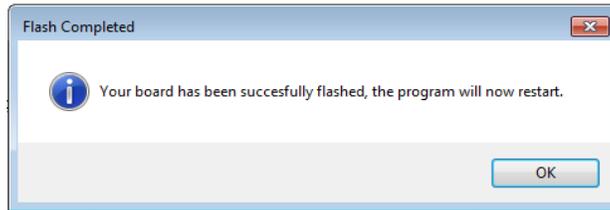


Figure 16. GUI–FLASH Program–Interface

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**Figure 17. GUI-FLASH Program-Power Cycle Board Popup**



**Figure 18. GUI-FLASH Program-Successful**

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