DG0702
Demo Guide
SmartFusion2 Imaging and Video Kit

Microsemi

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1 Revision History

The revision history describes the changes that were implemented in the document. The changes are listed by revision, starting with the most current publication.

1.1 Revision 3.0

The following is a summary of the changes in revision 3.0 of this document.

- Libero SoC and FlashPro design requirements were updated. For more information, see Table 1, page 4.
- Display resolution was updated from 1280x800 to standard 1280x720.

1.2 Revision 2.0

Updated the document based on SAR (80968). See Audio Demo, page 23.

1.3 Revision 1.0

Revision 1.0 was the first publication of this document.

2 SmartFusion2 Imaging and Video Demo Guide

The SmartFusion2 imaging and video demo is based on SmartFusion2 Advanced Development Kit and Imaging and Video daughter card. Microsemi's SmartFusion2 Advanced Development Kit offers a full featured 150K LE device, SmartFusion2 system-on-chip (SoC) FPGA. This 150K LE device, inherently integrates reliable flash-based FPGA fabric, a 166 MHz ARM Cortex-M3 processor, advanced data security features, digital signal processing (DSP) blocks, static random-access memory (SRAM), embedded non-volatile memory (eNVM), and industry-required high-performance communication interfaces-all on a single chip. This device also supports all the data security features available in SmartFusion2 devices. For more information about data security features, see http://www.microsemi.com/products/fpga-soc/design-resources/dev-kits/smartfusion2/smartfusion2-advanced-development-kit.

Video daughter board provides many interfaces for video and audio applications and the circuitry necessary for connection to an FPGA through a FMC connector, as shown in Figure 1, page 3.

Features

- HDMI Transmitter (ADV7511) and Receiver (ADV7611) chip sets and corresponding connectors
- LVDS 7:1 interface for connecting LCD
- Image sensor interface, which supports three difference sensor interfaces: Parallel, MIPI CSI-2, and HiSPi
- Microsemi Audio Processor (Timberwolf ZL38051)
- Analog mic connector
- Analog headphone and speaker connector
- Digital mics
- 100-pin FMC Connector

Figure 1 •   **Video Daughter Board**
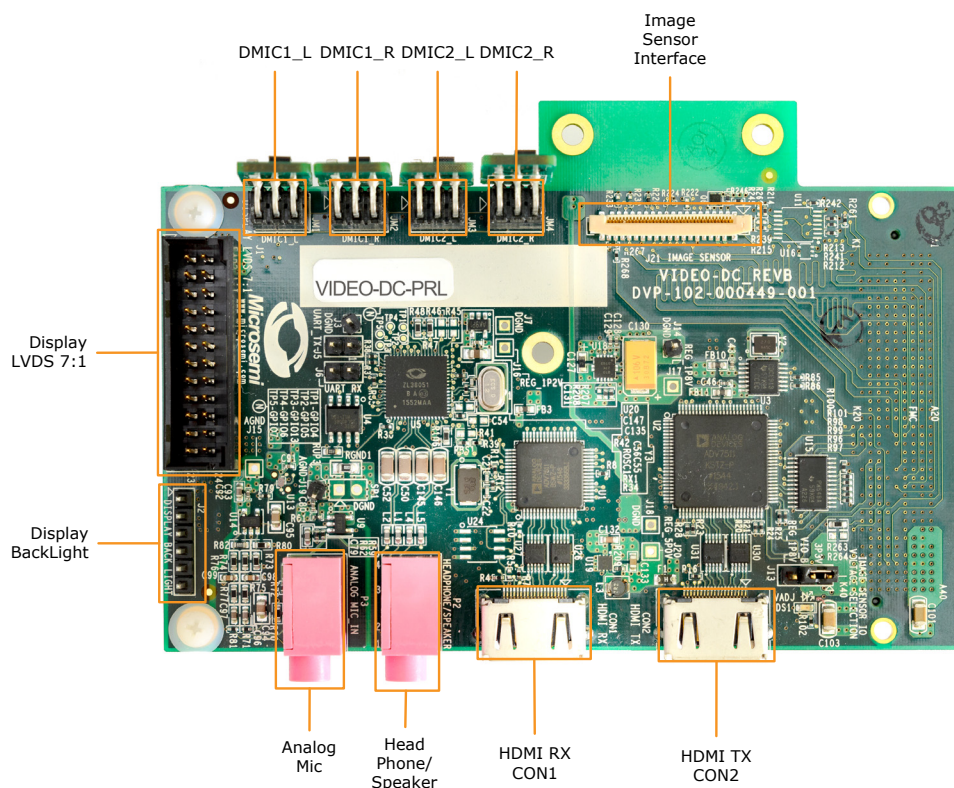
This demo guide provides the customers a foundation to set up an environment for the demonstration of video system, which includes hardware IP blocks and software. This demo guide provides details about the hardware setup and connections for running the demo design. A fully integrated solution along with an easy-to-use GUI is provided that enables customers to design the prototypes quickly. This video solution showcases various functions:

*   CFA to RGB Conversion
*   Display Timing Generator
*   Alpha Blending
*   Edge Detection
*   Image enhancements such as sharpening, brightness, contrast, hue, and saturation
*   Parallel reference design is configured for 1280x720 resolution

For more information about these features, goto
http://www.microsemi.com/products/fpgasoc/imaging#getting-started

2.1 Design Requirements

The following table lists the hardware and software design requirements for running the demo design.

Table 1 • **Design Requirements**

Design Requirements	Description
Hardware	
SmartFusion2 Imaging and Video Daughter Card	VIDEO-DC-PRL
SmartFusion2 Advanced Development Kit[1]	M2S150-ADV-DEV-KIT
Image Sensor	AR0330 Parallel Sensor 3.3 V
Image Sensor Ribbon Cable	–
Mini USB to Type A USB cable[2]	–
USB micro AB connector[2]	–
Power adapter (T1121-P5P-ND)[2]	–
Operating System	–
Software	
Libero® System-on-Chip (SoC) software	v11.7 SP2
SoftConsole	v3.4 SP1
USB drivers for GUI	Signed Windows USB drivers for USB communication between user interface and SmartFusion2 Advanced Development Kit.
FlashPro programming software	v11.7 SP2

1. SmartFusion2 Advanced Development Kit needs to be purchased separately and it is not shipped along with the SmartFusion2 Imaging and Video Daughter Card.
2. Mini USB to Type A USB cable and USB micro AB connector are included with SmartFusion2 Advanced Development Kit.

Figure 2 • **SmartFusion2 Advanced Dev Kit Board Setup**
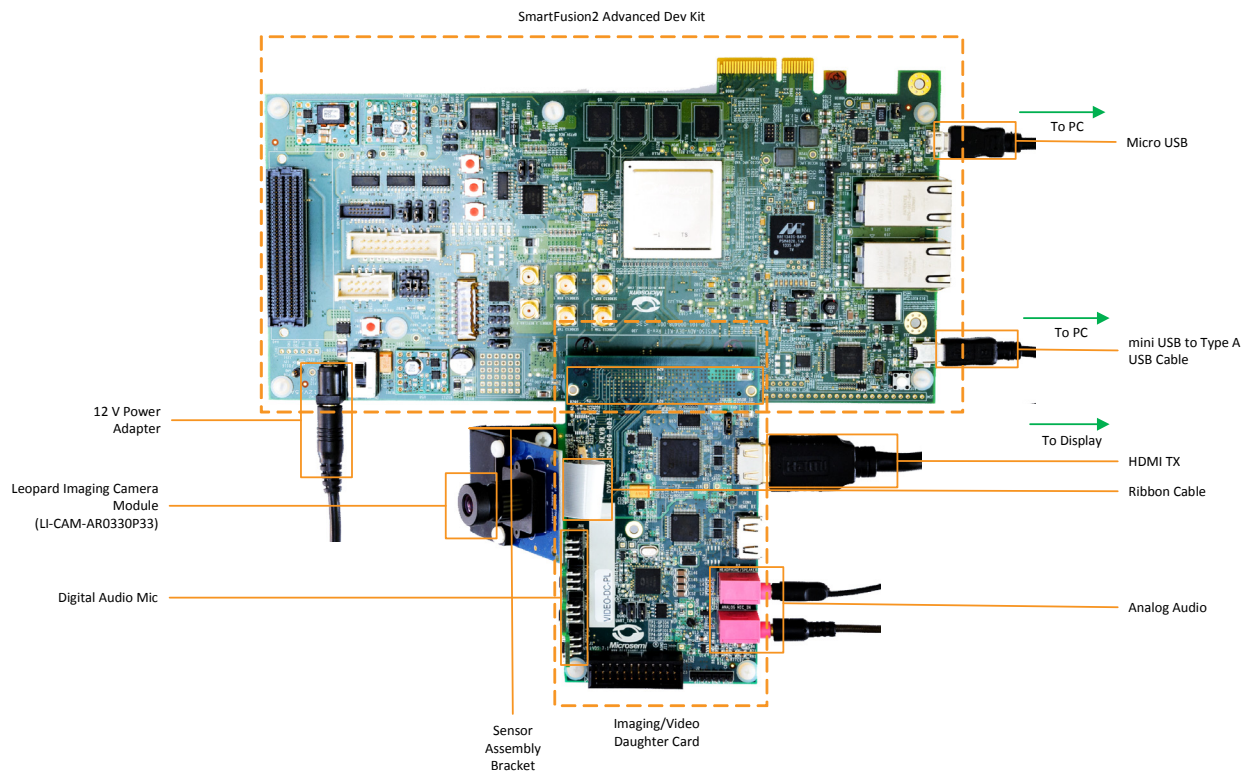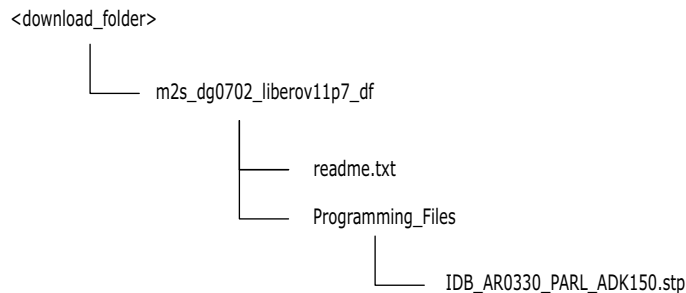

2.2 Demo Design

The demo programming files are available for download at:
http://soc.microsemi.com/download/rsc/?f=m2s_dg0702_liberov11p7sp2_pf

The demo programming files include:

- Readme
- STAPL programming file

The following figure shows the top-level structure of the demo design files.

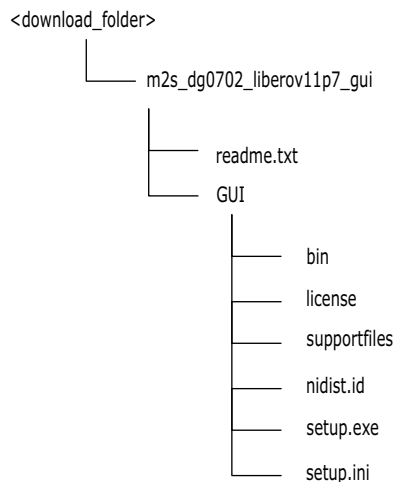*Figure 3 •* **Demo Programming Files Top-Level Structure**

The GUI installers are available for download at:
http://soc.microsemi.com/download/rsc/?f=m2s_dg0702_liberov11p7_gui

The GUI installer files include:

• GUI installer
• readme.txt

The following figure shows the top-level structure of the GUI installer.

Figure 4 • **GUI Installer Top-Level Structure**

The Libero reference design files are available for download at:
http://soc.microsemi.com/download/rsc/?f=parallel_cam_video_ref_design

Note: While loading the demo files, select **Save** instead of **Open**.

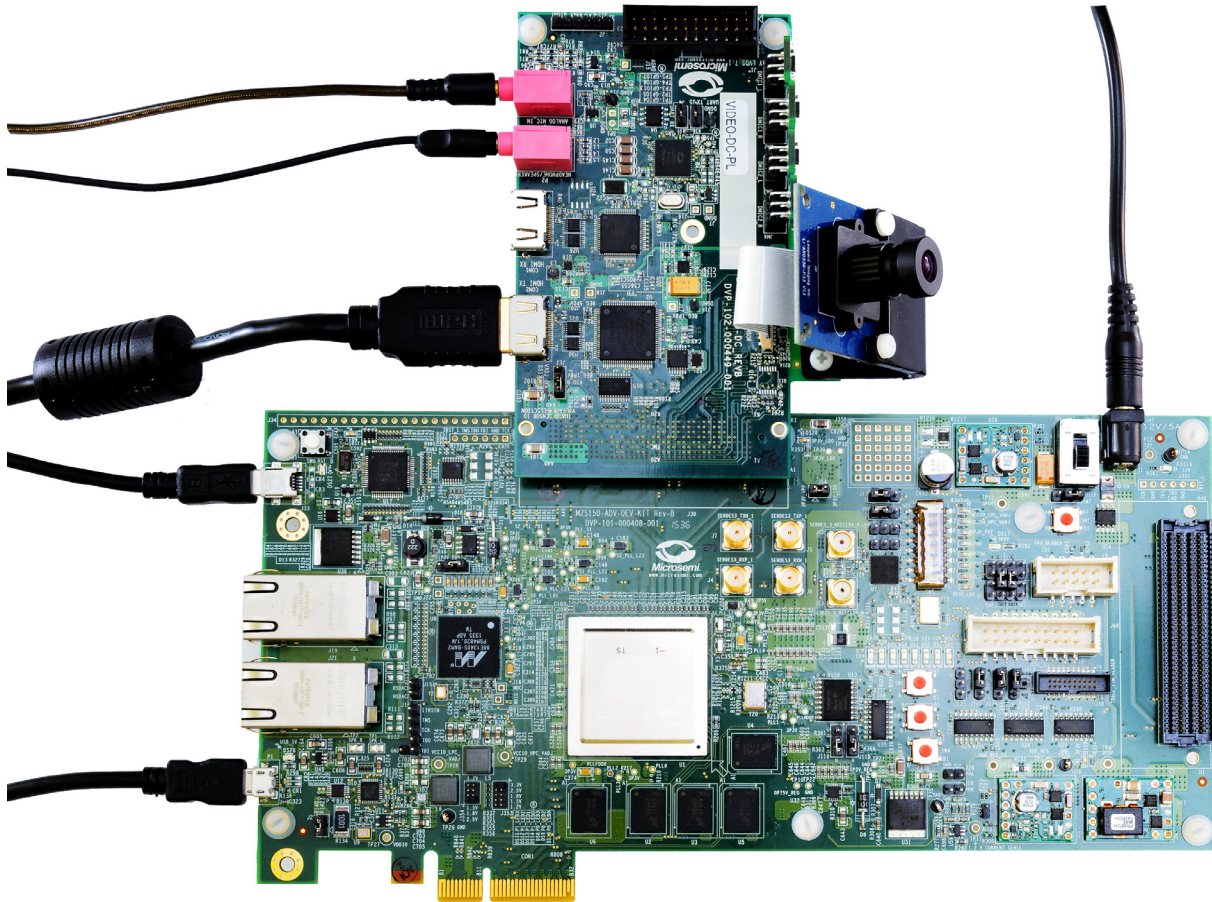## 2.3 Setting Up the Demo Design

This section has the following subsections:

• **Setting Up the Hardware**
• **Installing the Video Demo GUI**
• **GUI Driver Configuration**

2.3.1   Setting Up the Hardware

The following figure shows the hardware setup for imaging and video demo.

*Figure 5 •*   **SmartFusion2 Imaging and Video Demo Hardware Setup**

2.3.1.1 Video Daughter Board Settings

The following steps describe how to set the Video Daughter board.

1. Connect the video daughter board to HPC (J30) FMC connector of SmartFusion2 Advanced Development Kit.
2. Close the pins 1-2 of J13 of Video daughter board to select the core voltage 3.3 V.
3. Connect one end of the HDMI cable to HDMI Connector (**CON2**) of video daughter board and other end to the monitor.

Figure 6 • **SmartFusion2 Video Demo: Video Daughter Board settings**
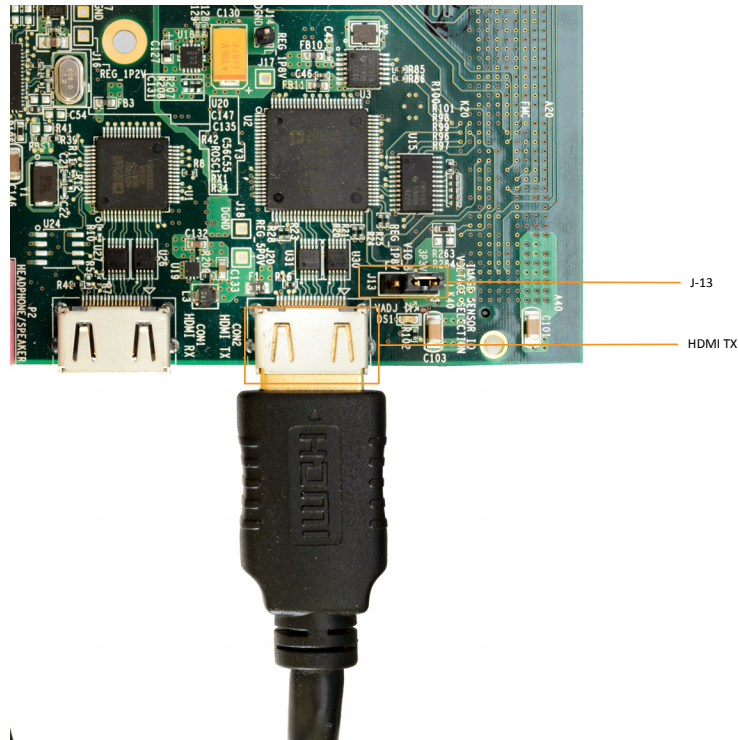
4. Connect one end of the image sensor ribbon cable to the image sensor interface (J21) on the video daughter board and the other end to the parallel sensor (AR0330). The following figure shows the correct way of connecting the cable.

Figure 7 • **SmartFusion2 Video Demo: Camera Ribbon Cable Connection**
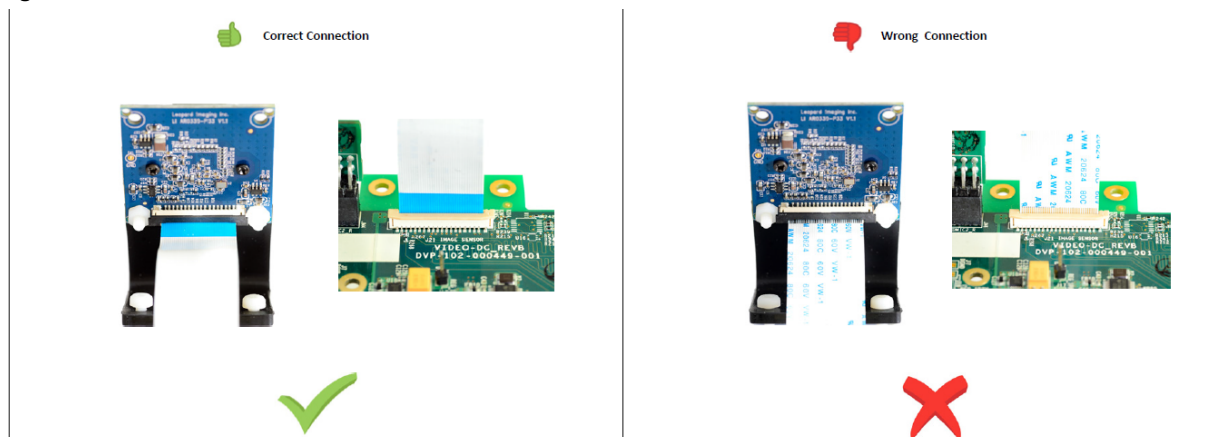
5. For testing audio application, connect the analog microphone to the analog microphone connector (port P3) and headphone or speaker to the connector (port P2). Digital microphones can also be used for testing.

6. Default jumper settings are:
   • Close pin 2 of J5 and J6.
   • Short jumper SP1

2.3.1.2 SmartFusion2 Advance Dev Kit Settings

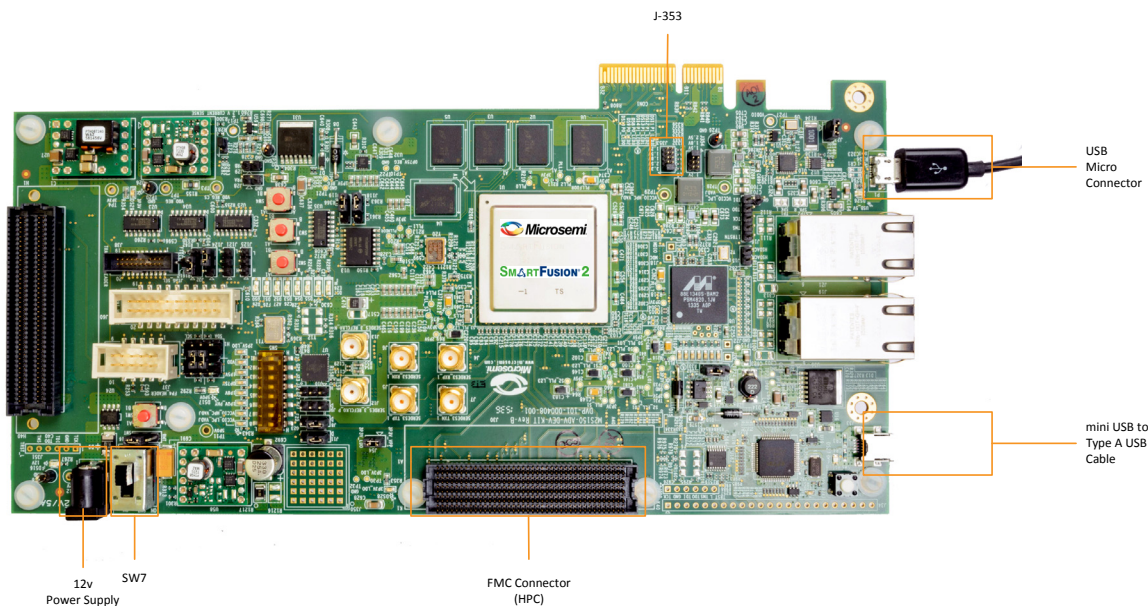The following steps describe how to set the SmartFusion2 Advance Dev Kit board.

1. Connect the 12 V power supply brick to J42 to supply power to the board, as shown in
2. Close the pins 1-2 of J353 to select the core voltage 3.3 V.
3. Close the pins 1-2 of J121 and J124.
4. Connect USB cable (mini USB to Type A USB cable) to J33 and the other end of the cable to USB port of the Host PC.Connect one end of USB micro connector to P1 and other end of the cable to the Host PC.
   For other default jumper settings, see the following table.
5. Switch **ON** the power supply switch, SW7.

Table 2 • **Jumper and Resistor settings M2S150 ADK**

Jumpers/Resistors	Settings
J116	Short 1-2
J123	Short 2-3
J354	Short 1-2 for 2.5 V
J54	Short 1-2
J32	Short 1-2
J14	Short 1-2
J23	Short 1-2
J11	Short 1-2
J8	Short 1-2
R1217	Mounted
R1216	Un-Mounted

6. Open FlashPro software and program the STAPL file (IDB_AR0330_PARL_ADK150.stp). For more information about how to program using FlashPro, see Manufacturing Test section from *UG0557: SmartFusion2 SoC FPGA Advanced Development Kit User Guide*.

Figure 8 • **SmartFusion2 Imaging and Video Demo: SmartFusion2 Advanced Development Kit Settings**


2.3.2 Installing the Video Demo GUI

The following steps describe how to install the Video Demo GUI:

1. From the downloaded folder, open the `\GUI\` folder and run **setup.exe**. Click **Yes** for any message from User Account Control. Setup window is displayed with the default locations.
2. Click **Next**.
   - Accept the license agreement and click **Next**.
   - Confirm the installation location in the installation dialog box and click **Next**.

   A progress bar appears that shows the progress of the installation. On successful installation, the following message is displayed: `Installation Complete`.
3. Click **Finish** to exit the installation wizard.
4. Restart the Host PC.

Check the device manager to see if the USB drivers are already configured on the Host machine. To check if the drivers are configured correctly, after ensuring that the hardware is powered ON and connected to the Host PC using USB cable (**P1** on board), see if NI-VISA USB devices appear in the device manager, as shown in the following figure. If they are configured, skip to Running the Demo Design, page 18.

Figure 9 • **Identifying the SmartFusion2 Video Demo USB Driver**
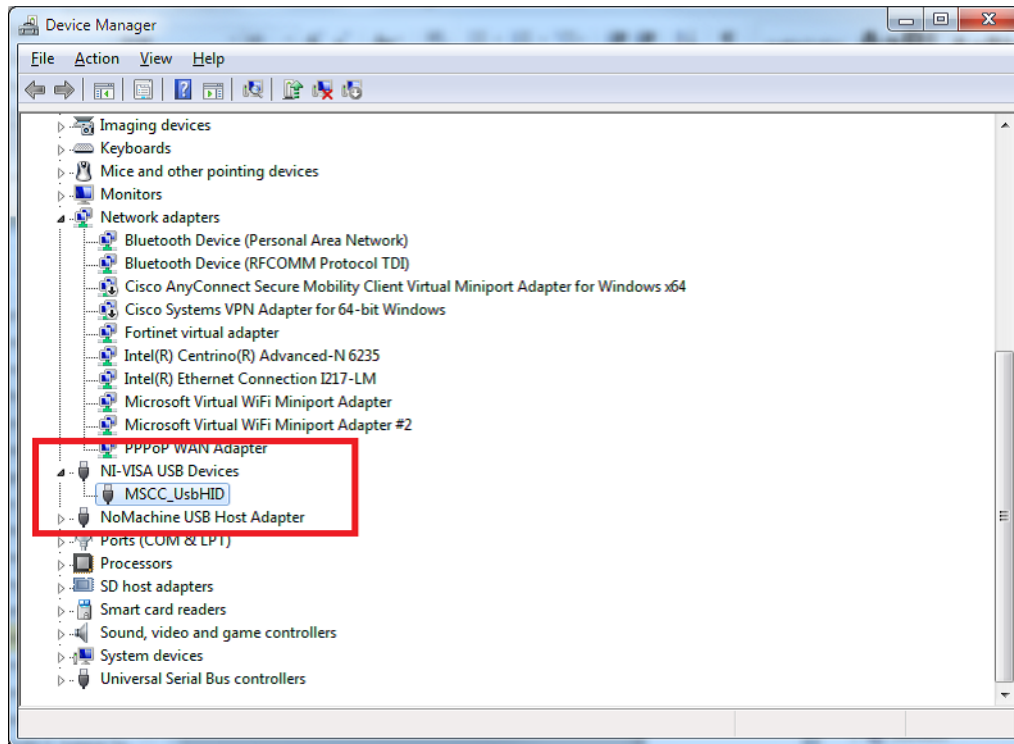
2.3.3   GUI Driver Configuration

The following steps describe how to install the GUI driver on the Host PC that has Windows 7 or higher version installed. The downloaded programming file must be programmed on the board before proceeding for driver installation.

1. Connect the Host PC to the P1 connector on the SmartFusion2 Video Demo Kit using the USB A to mini-B USB cable.
2. Connect the power adapter to the kit and switch ON **SW7** switch.
3. Open Device Manager of the Host PC and select **USB Input Device** under **Human Interface Devices,** as shown in the following figure.
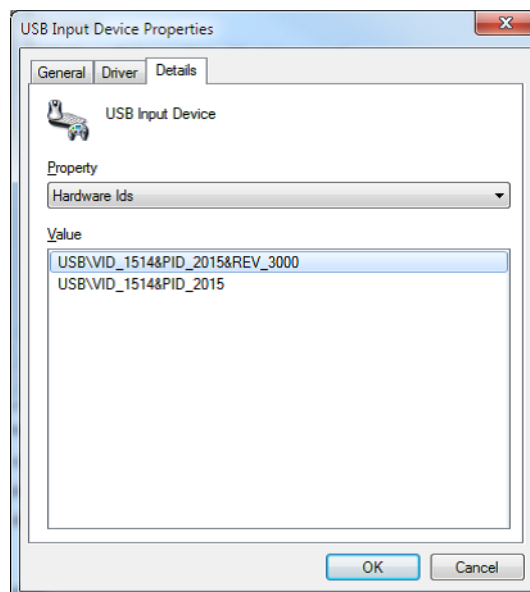
Figure 10 • **Device Manager**
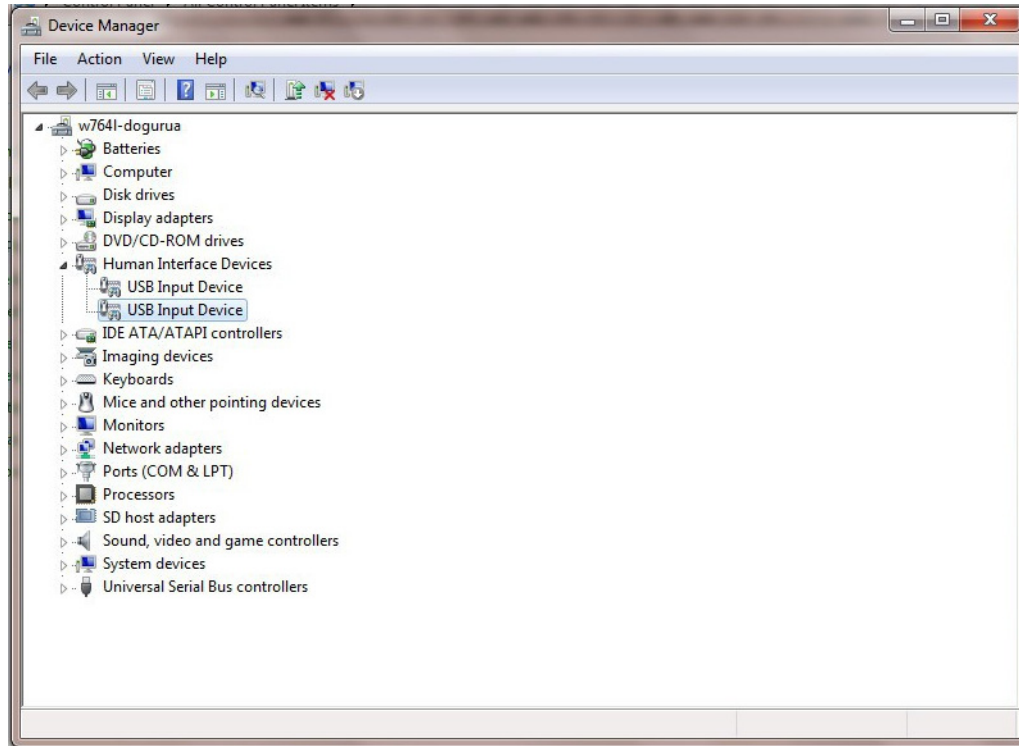
4. Right-click on the **USB Input Device** and select **Properties,** as shown in the following figure.

Figure 11 •   **Installing the USB Driver - Opening the Properties Window**
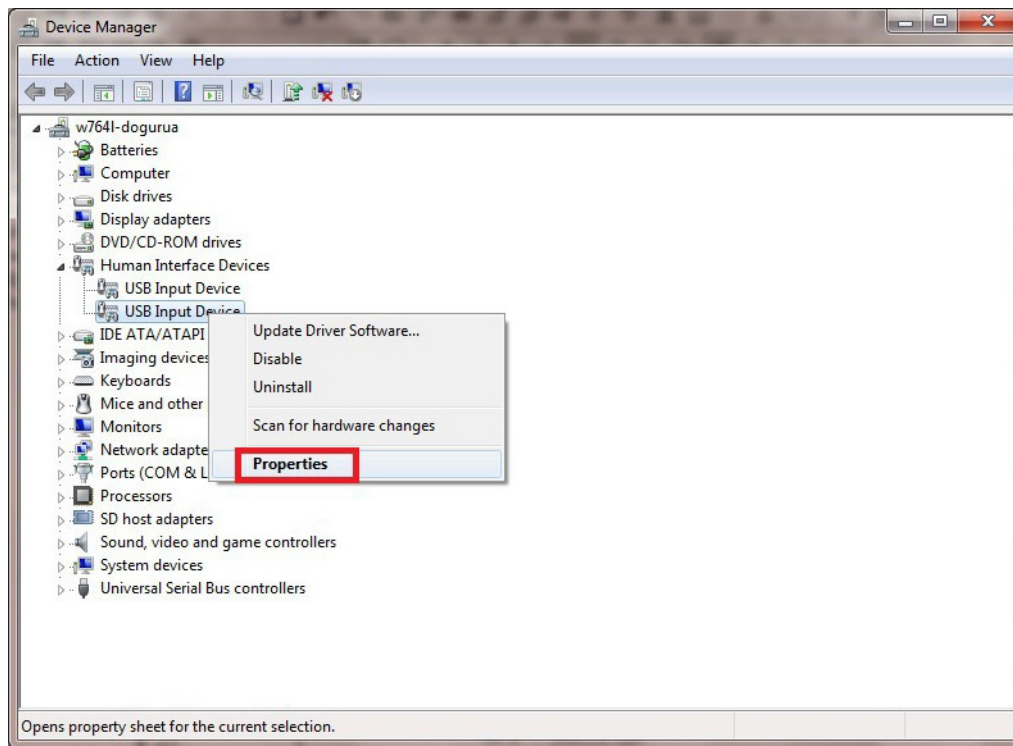
5. In the Details tab, select Hardware Ids under Property. The following figure shows the USB Input Device Properties window.
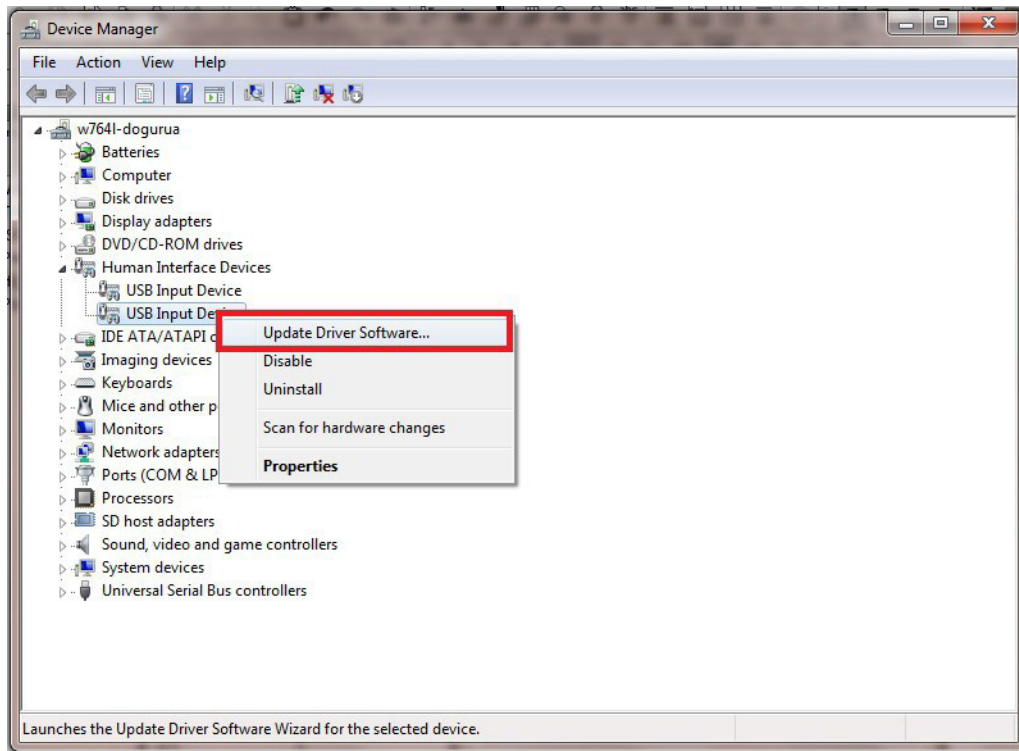
Figure 12 •   **Selecting the Right VID Number in the Properties Window**

6. Select the appropriate VID number under **Value** and click **OK**. The VID number must have 1514, as shown in the following figure.

7. In the **Device Manager** window, right-click on the **USB Input Device** with the specified VID number and select **Update Driver Software**.

*Figure 13 •* **Updating Driver Software**

8. Select **Browse my computer for driver software** from the **Update Driver Software - USB Input Device** window, as shown in the following figure.

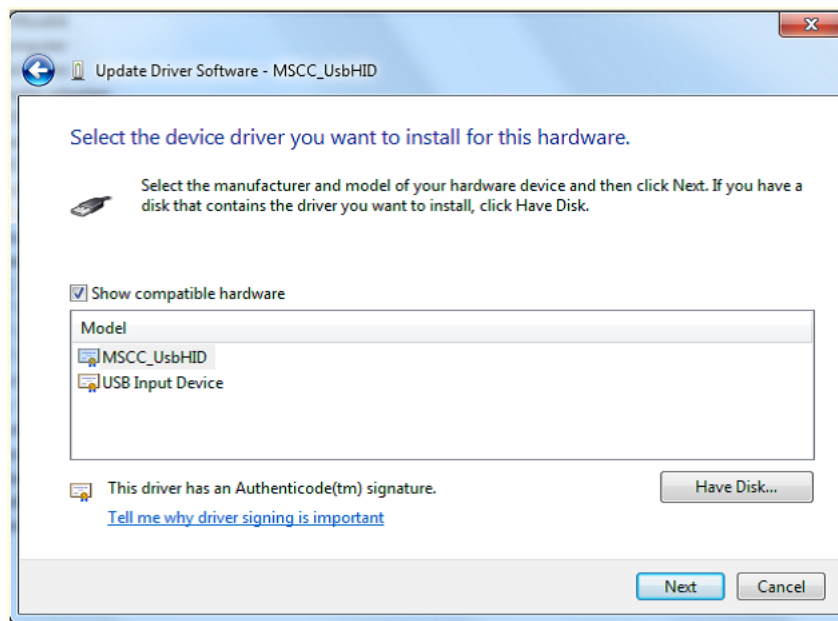*Figure 14 •* **Updating Driver Software - Locate and Install the Driver Software Manually**
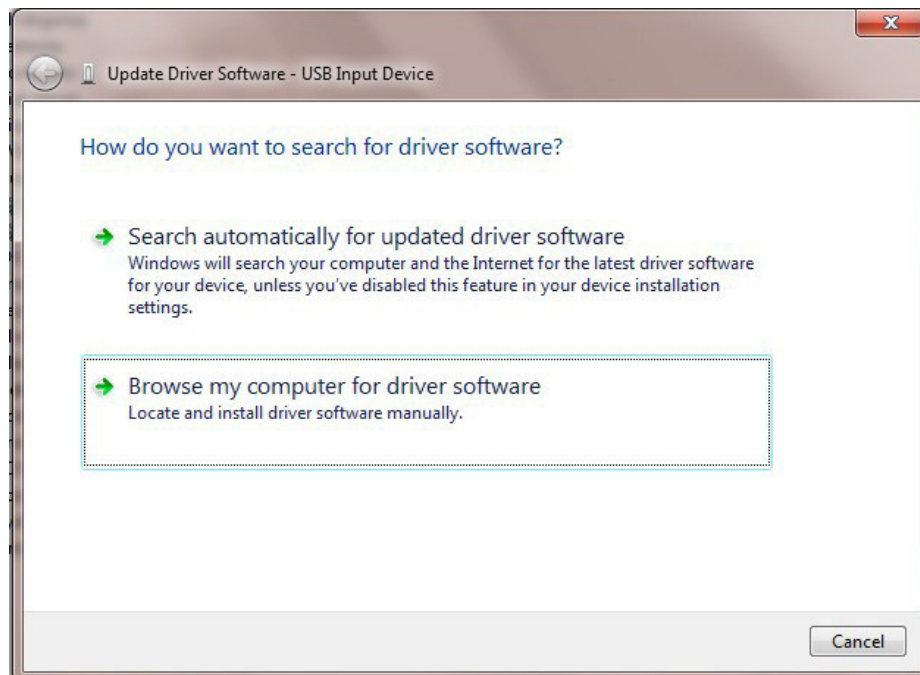
9.   Click **Let me pick from a list of device drivers on my compute**r and click **Next**, as shown in the following figure.

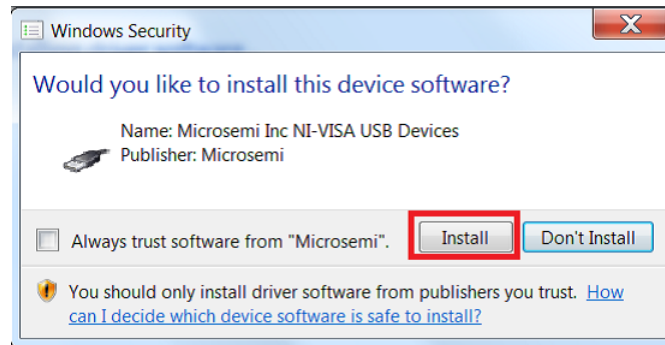*Figure 15 •*   **Updating Driver Software - Selecting the Driver Location**
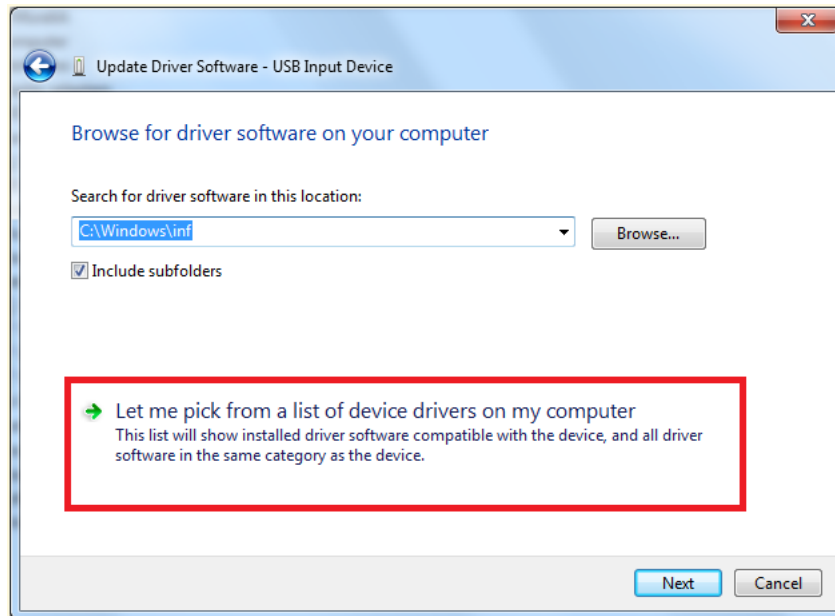
10. Ensure that MSCC_UsbHID is selected and click **Nex**t.

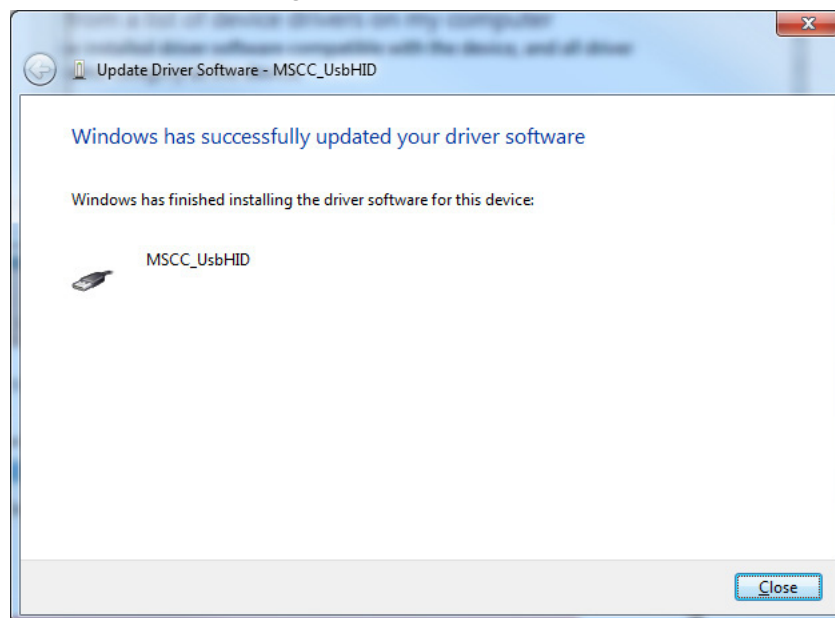*Figure 16 •*   **Selecting the Device Driver**

11. A pop up window appears, as shown in the following figure. Click **Install**.

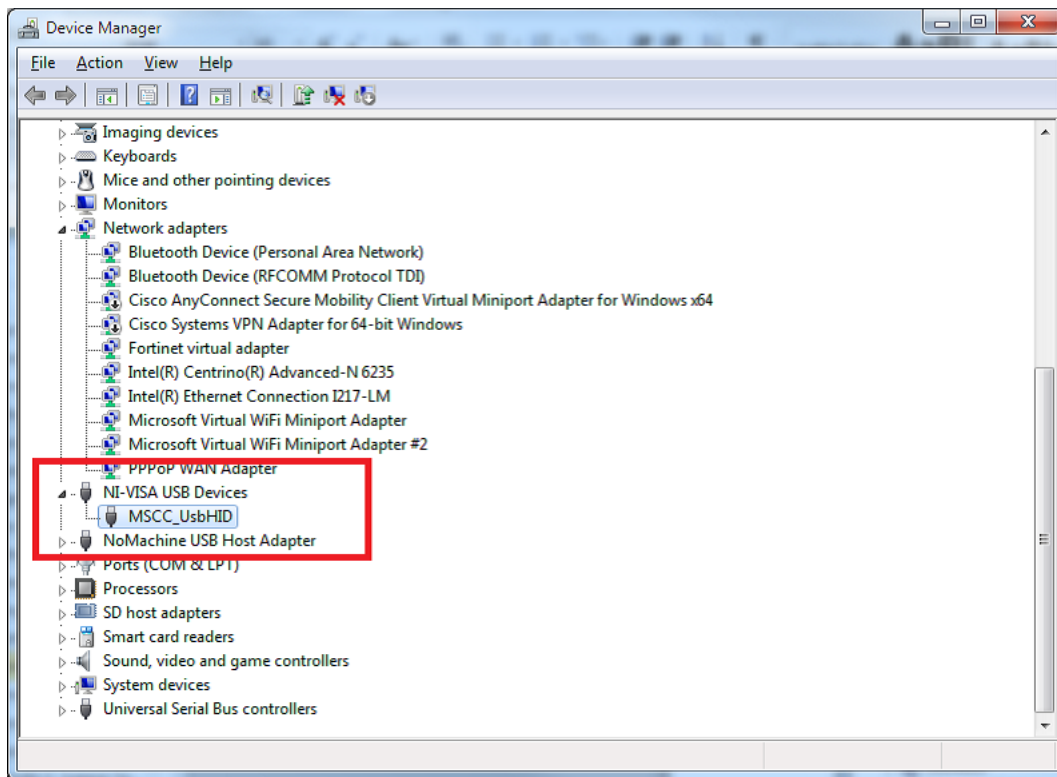*Figure 17 •* **Locating the Device Driver**

The following window appears on successful installation.

Figure 18 • **Successful Installation Message**

12. Check for **NI-VISA-USB Devices** in the **Device Manager** window to ensure that the driver is installed successfully, as shown in the following figure.

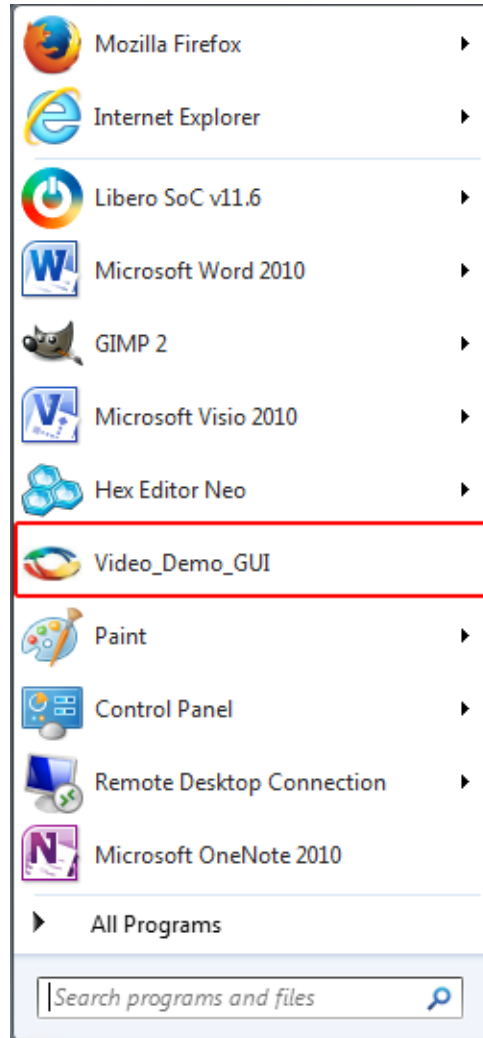*Figure 19 •* **Verifying the Installed Driver Software**

2.4 Running the Demo Design

The following steps describe how to run the demo design.

1. After installing the GUI, go to **Start** menu and select **Video_ Demo _GUI** to open the GUI, as shown in the following figure.

Figure 20 • **Launching the SmartFusion2 Video Demo GUI**

2. In the SmartFusion2 Video Demo GUI, select the **USB device** with VID 0x1514 and PID 0x2015 (USB0::0x1514::0x2015..) from the **USB DEVICE** drop-down list.

Figure 21 • **SmartFusion2 Video Demo GUI – Launch Window**
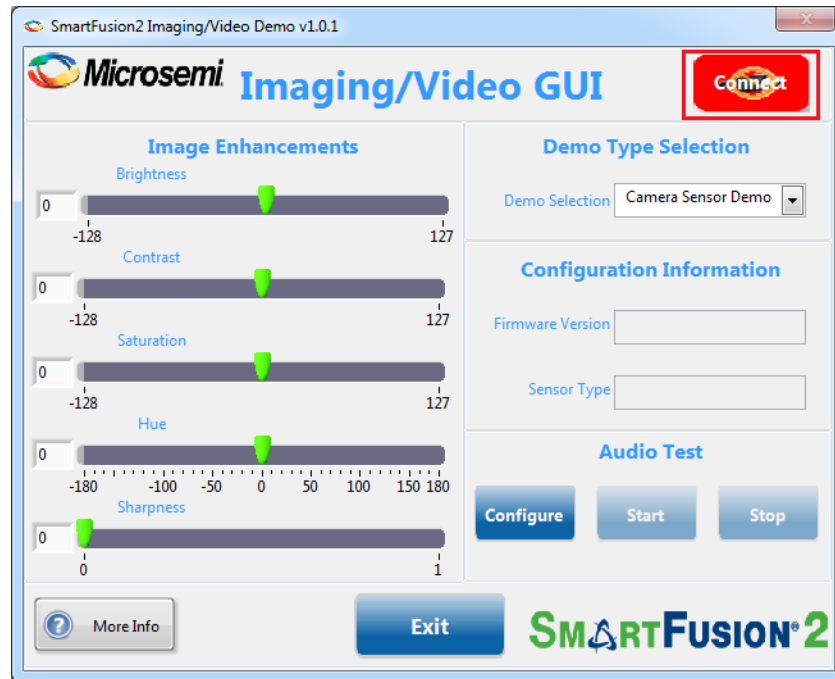
3. Click **Connect**.
    On successful connection, the connection LED on the right-side of the window is highlighted in green.

This user interface supports three features for the demo:

- Camera Sensor Demo
- Edge Detection Demo
- Audio Test

2.4.1 Camera Sensor Demo

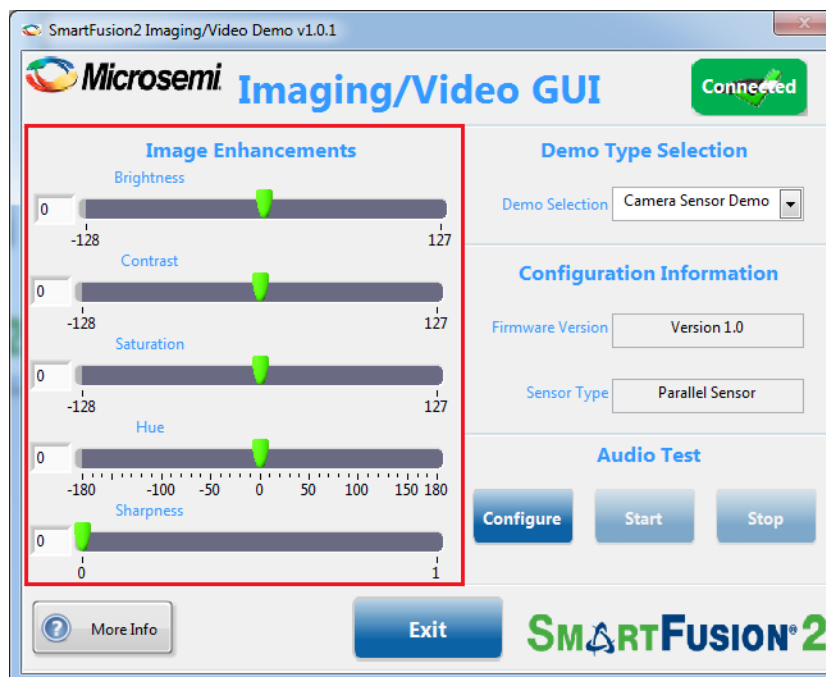The following steps describe how to run camera sensor demo design.

1. Select the **Camera Sensor Demo** from the demo selection block, as shown in the following figure. Video is displayed on the monitor with Microsemi logo on it (which represents alpha blending feature)

Figure 22 • **SmartFusion2 Video Demo GUI – Demo Selection**
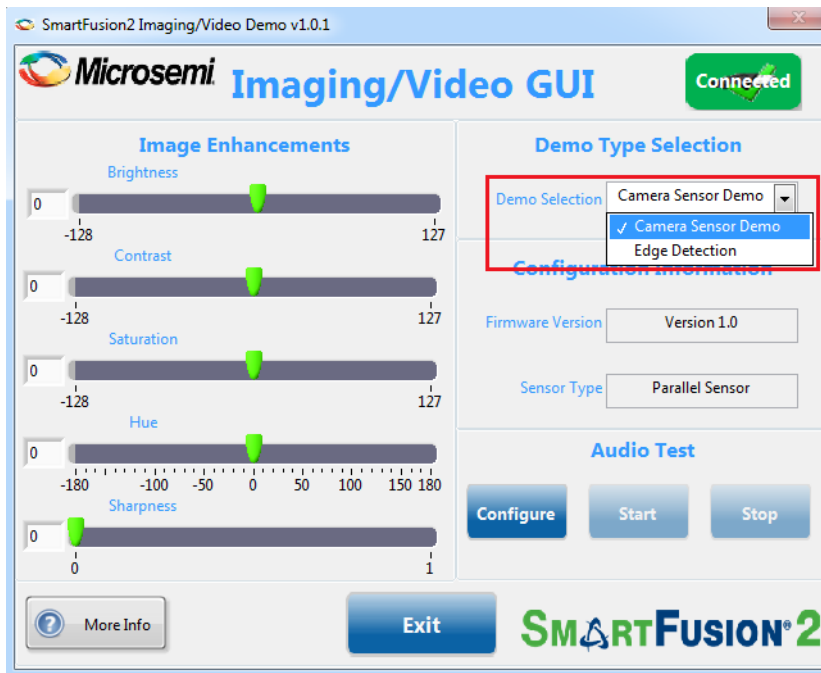
Different features such as brightness, contrast, saturation, hue, and sharpness can be adjusted, as shown in the following figure to enhance the image.

Figure 23 • **SmartFusion2 Video Demo GUI – Image Enhancement Features**
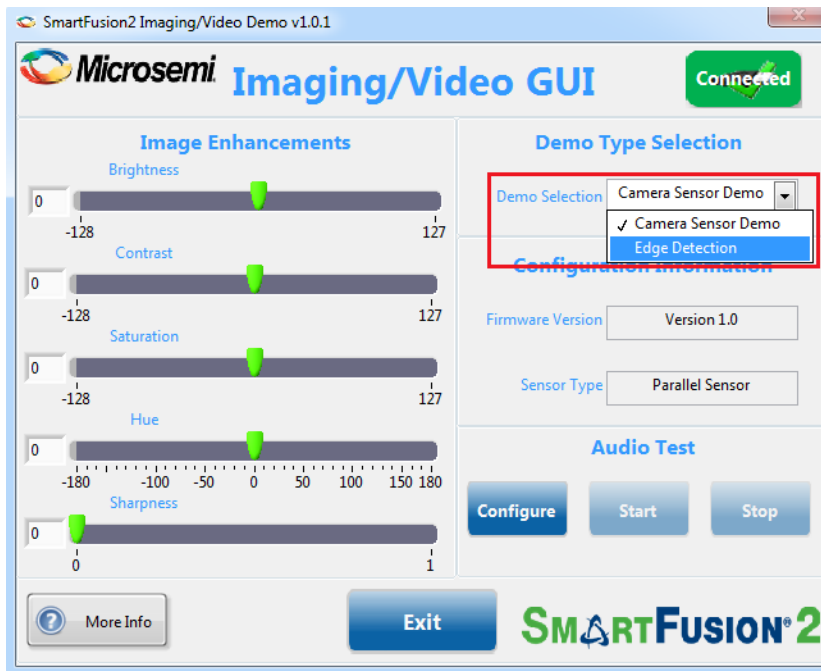
2.4.2 Edge Detection Demo

The following steps describe how to run edge detection demo design.

1. Select the **Edge Detection** option from demo selection, as shown in the following figure. On the monitor, only edges of the scene under view can be seen.

Figure 24 • **SmartFusion2 Video Demo GUI – Edge Detection Demo**

The following figures show the difference between normal images and the edge detected images.

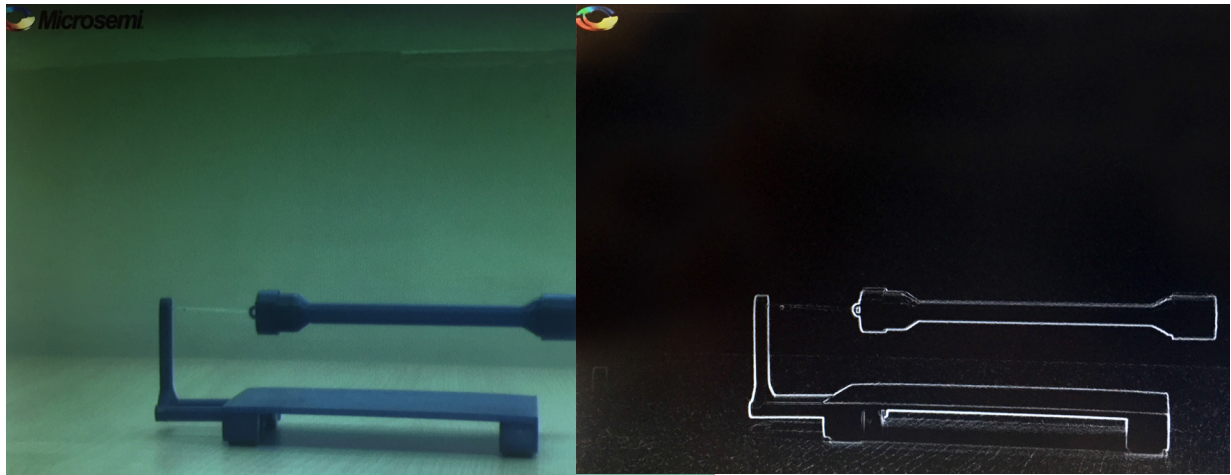*Figure 25 •* **Difference between Normal Image and the Edge Detected Image 1**

Figure 26 • **Difference between Normal Image and the Edge Detected Image 2**
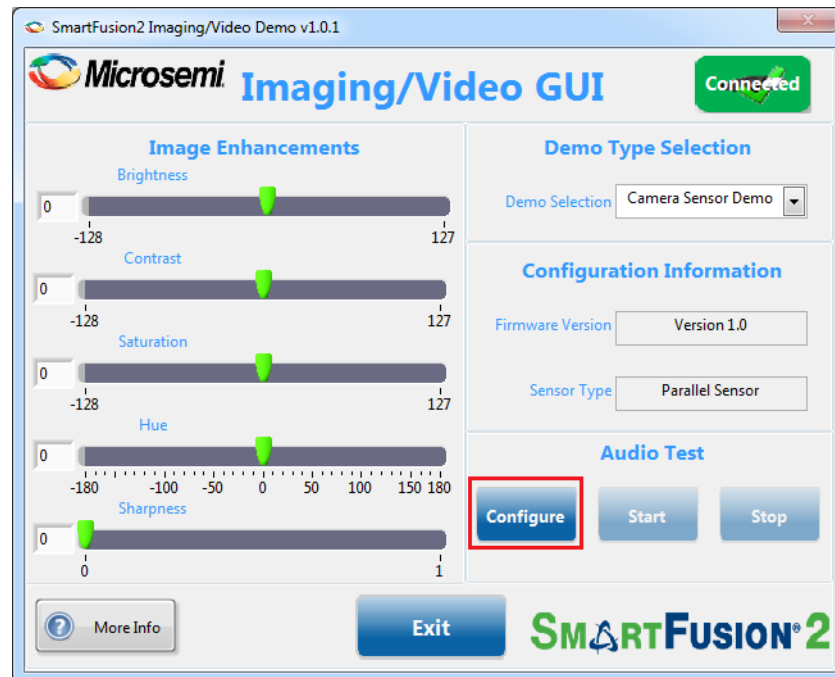
2.4.3 Audio Demo

The following steps describe how to run audio demo design.

1. For testing the audio application, click **Configure**. The **Start** and **Stop** buttons are disabled until the configuration is done.

Note: Whenever the board is reset, audio test has to be reconfigured.

Figure 27 • **SmartFusion2 Video Demo GUI – Configure Audio Test**

2. Then, click **OK** for the prompt message, as shown in the following figure. It will take few seconds to configure the audio test.

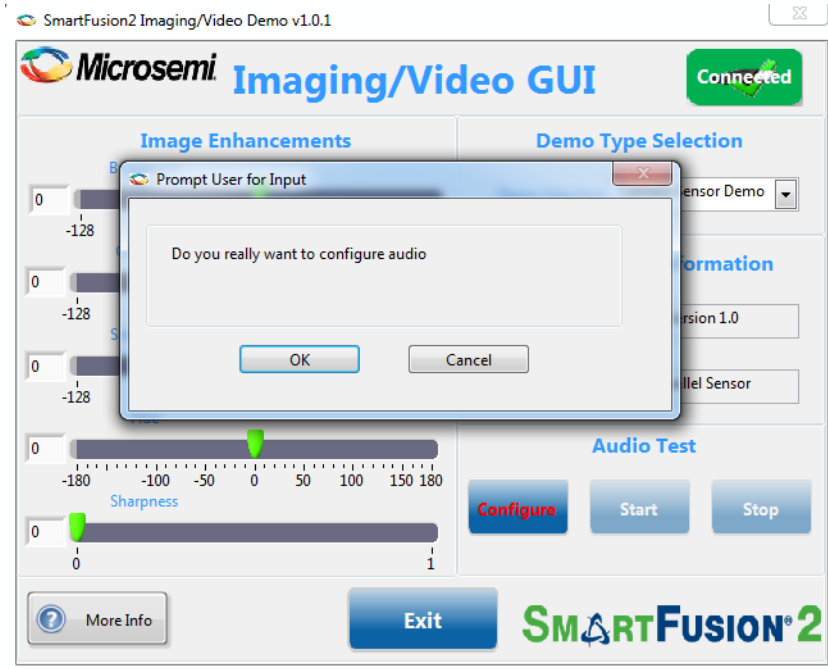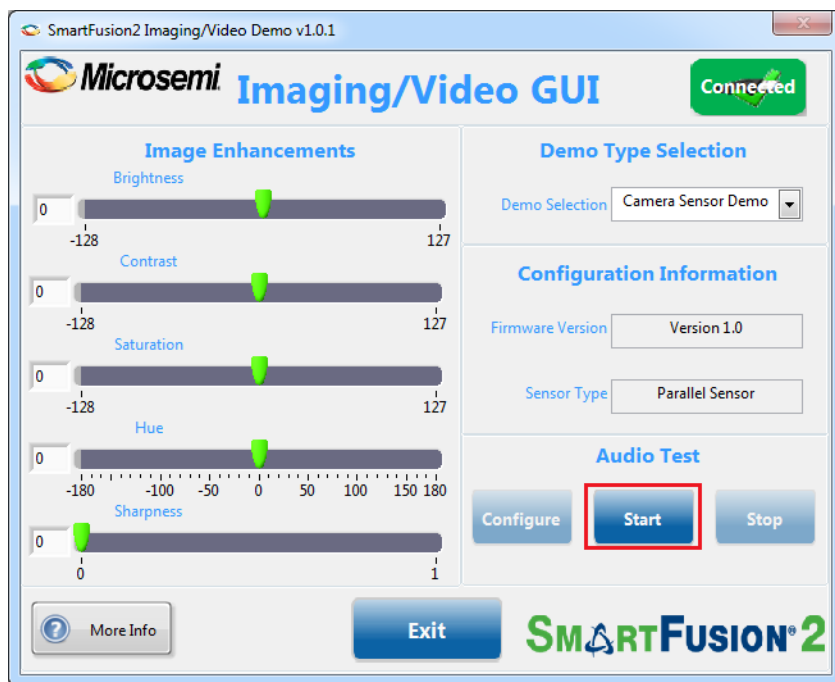*Figure 28 •* **SmartFusion2 Video Demo GUI – Prompt message**

Figure 29 • **SmartFusion2 Video Demo GUI – Start Audio Test**

3. **Start** button is enabled after the audio test is configured, as highlighted in preceding figure. Click **Start** and speak closer to the digital microphone port DMIC1_L and DMIC1_R. You will hear the sound through the Head Phone / Speaker port (see Figure 1, page 3) until you click **Stop**.

Figure 30 • **Imaging and Video Kit – Digital Microphone**
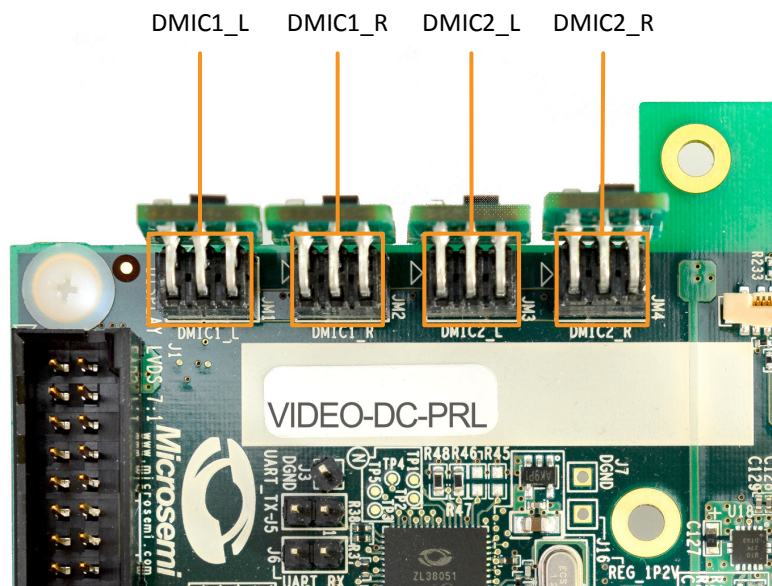
4. To use analog microphone, connect the microphone to Analog MIC port (see Figure 1, page 3), configure the user interface as instructed above to perform the audio test.

Note: Microphone is not shipped along with this kit.