**DG0723**
**Demo Guide**
**SmartFusion2 Imaging and Video Kit MIPI CSI-2**

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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 1.0

Revision 1.0 is the first publication of this document.

# 2 SmartFusion2 Imaging and Video MIPI CSI-2

The SmartFusion®2 Imaging and Video MIPI CSI-2 demo is based on the SmartFusion2 Advanced Development Kit and SmartFusion2 Imaging and Video MIPI CSI-2 Daughter Card.

Microsemi SmartFusion2 Advanced Development Kit offers a full-featured 150K LE SmartFusion2 system-on-chip (SoC) FPGA. The device 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. It also supports all the data security features available in SmartFusion2 devices. For more information, see http://www.microsemi.com/products/fpga-soc/design-resources/dev-kits/smartfusion2/smartfusion2-advanced-development-kit.

The video daughter board provides several interfaces for video applications and the circuitry necessary to connect to an FPGA device through an FMC connector, as shown in the following figure.

*Figure 1* • **MIPI CSI-2 Daughter Card**
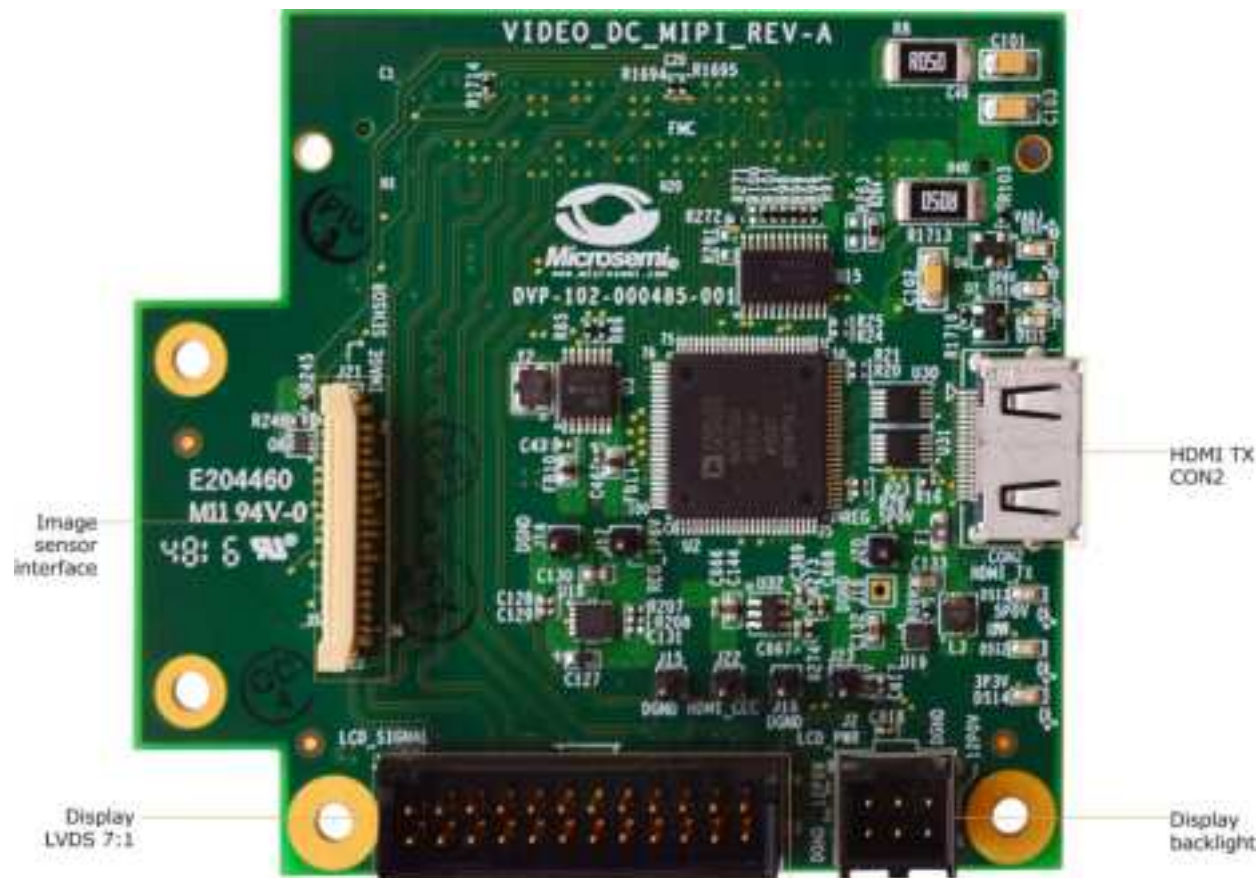


This demo guide provides the basic information required to set up an environment to demonstrate the video solution, which includes hardware IP blocks and software. It provides details about the hardware setup and the connections required to run the demo design. A fully integrated video solution with an easy-to-use GUI is provided to demonstrate the following functions and to design prototypes quickly:

- CFA to RGB conversion
- Display timing generator
- Alpha blending
- Edge detection

- Image enhancements (such as sharpening, brightness, contrast, hue, and saturation)

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

## 2.1    Features

- HDMI transmitter (ADV7511) chip set and corresponding connector
- LVDS 7:1 interface for connecting LCD
- Image sensor interface that supports MIPI CSI-2
- Low pin count (LPC) FMC connector

## 2.2    Design Requirements

The following table lists the design requirements.

*Table 1 •*    **Design Requirements**

| Design Requirement | Description |
|---|---|
| **Hardware** | |
| SmartFusion2 Imaging and Video MIPI-CSI2 Daughter Card | VIDEO-DC-MIPI |
| SmartFusion2 Advanced Development Kit[1] | M2S150-ADV-DEV-KIT |
| Image sensor module | ONSemi AR0330 Image Sensor from Leopard Imaging (LI-AR0330-MIPI v1.1) |
| Image sensor ribbon cable | |
| Mini USB to Type A USB cable[2] | |
| HDMI cable | HDMI A Male to Male Cable |
| HDMI monitor[3] | Any 21-inch display with HDMI input |
| USB micro AB connector[2] | |
| Power adapter (T1121-P5P-ND)[2] | |
| Operating system | Windows 7 or later |
| **Software** | |
| Libero® SoC | v11.8 |
| SoftConsole | v4.0 |
| USB drivers for the GUI | Signed Windows USB drivers for USB communication between user interface and SmartFusion2 Advanced Development Kit |
| FlashPro programming software | v11.8 |

1. Not shipped with SmartFusion2 Imaging and Video MIPI CSI-2 Daughter Card; must be purchased separately.
2. Included with SmartFusion2 Advanced Development Kit.
3. If the display does not support HDMI input, use an adapter that converts the HDMI out from the imaging card to a protocol supported by the display.

The following figure shows the complete setup of the SmartFusion2 Imaging and Video MIPI-CSI2 Daughter Card and the SmartFusion2 Advanced Development Kit.

*Figure 2* • **Full Setup**
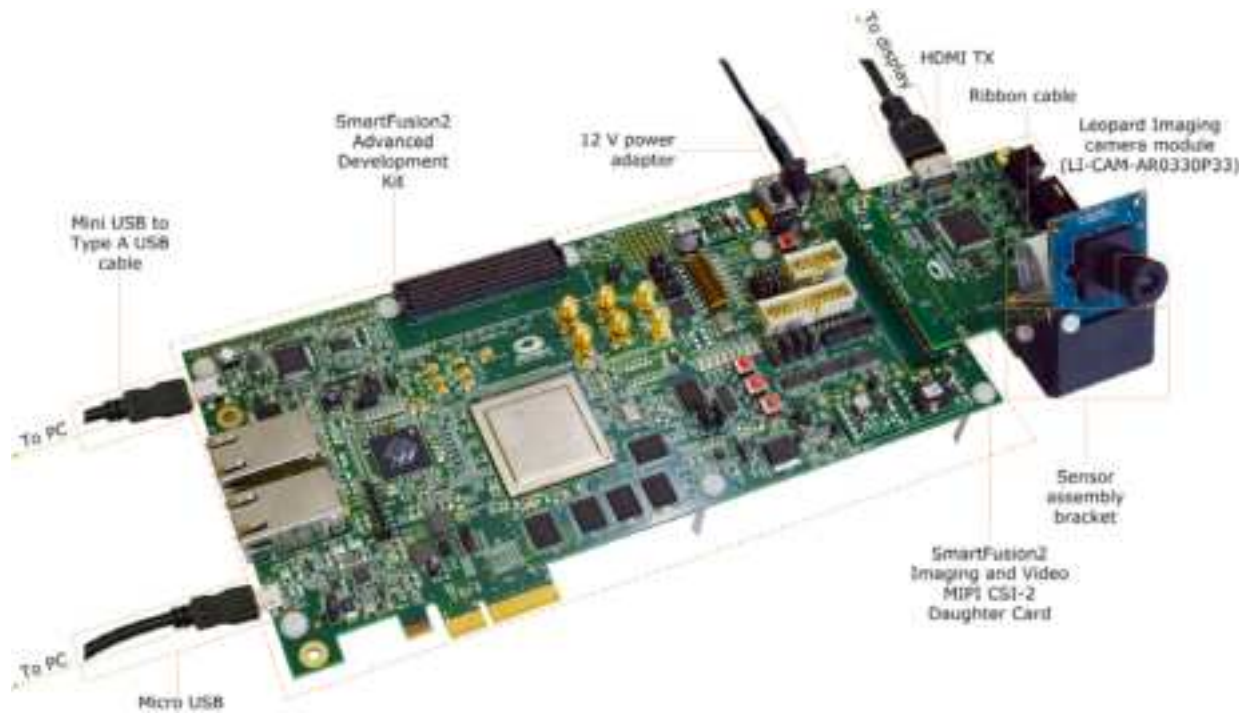


## 2.3　Demo Design
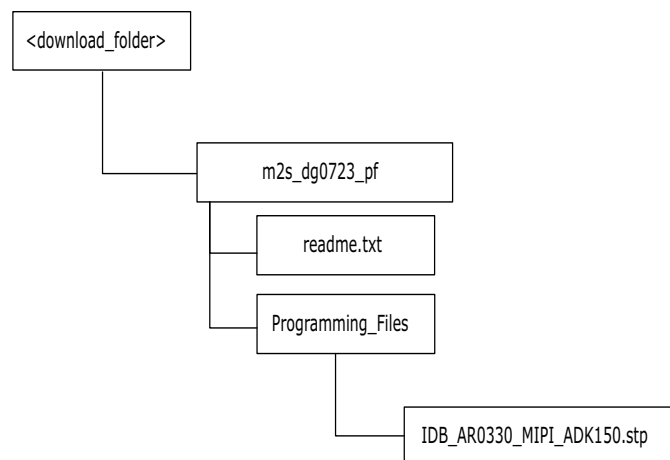
The demo programming files are available for download at:
*http://soc.microsemi.com/download/rsc/?f=m2s_dg0723_pf*

The programming files include:

- readme.txt file
- STAPL programming file

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

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

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

The GUI installer files include:

- GUI installer
- readme.txt file

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

*Figure 4 •*  **GUI Installer Top-Level Structure**
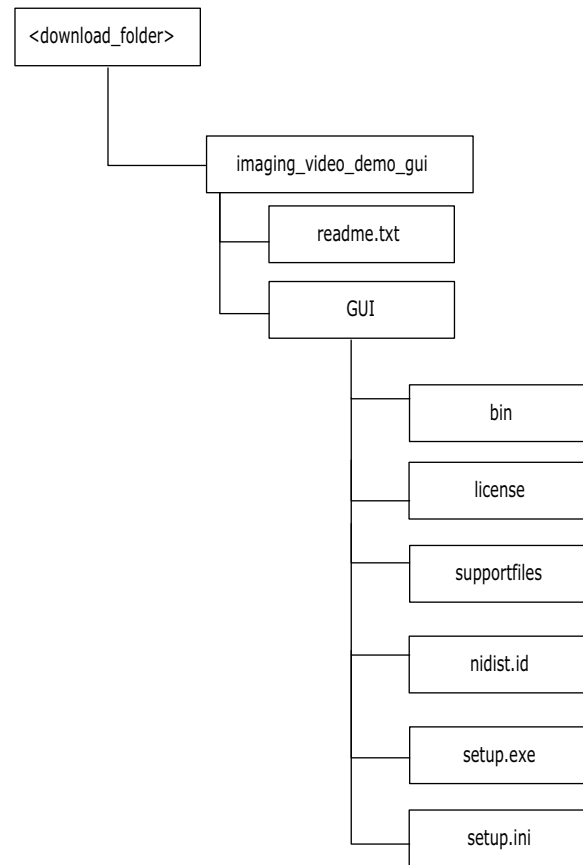
## 2.3.1    Setting Up the Demo Design

This section describes how to set up the hardware for running the demo design and how to install the demo GUI.

### 2.3.1.1    Setting Up the Hardware

The hardware setup for the demo design involves establishing appropriate hardware connections for the SmartFusion2 Imaging and Video MIPI CSI-2 Daughter Card and the SmartFusion2 Advanced Development Kit.

The following figure shows the complete hardware setup for the demo. The following sections show the hardware setup for the Imaging and Video MIPI CSI-2 Daughter Card and the SmartFusion2 Advanced Development Kit separately.

*Figure 5* •    **Hardware Setup**

#### 2.3.1.1.1 Setting Up the Video Daughter Card

1. Connect the video daughter board to LPC (J60) FMC connector of SmartFusion2 Advanced Development Kit, as shown in the preceding figure.
2. Connect one end of the HDMI cable to HDMI Connector (**CON2**) of video daughter board and the other end to the monitor, as shown in the following figure.

*Figure 6 •* **Video Daughter Card Setup**



3. 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 MIPI sensor (AR0330), as shown in the following figure.

*Figure 7 •* **Camera Ribbon Cable Connection**



#### 2.3.1.1.2 Setting Up the SmartFusion2 Advance Development Kit

1. Connect the 12 V power supply brick to J42 to supply power to the board, as shown in Figure 8, page 8.
2. Close pins 1-2 of **J35**4 to select the core voltage 2.5 V.
3. Close pins 1-2 of **J121** and **J124**.
4. Connect a 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.

5. Make sure the default jumper settings shown in the following table are retained.

*Table 2 •* **Jumper and Resistor Settings for M2S150 ADK Device**

| Jumper/Resistor | Setting |
| --- | --- |
| J116 | Short 1-2 |
| J123 | Short 2-3 |
| J353 | Short 2-3 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 | Unmounted |

6. Switch **ON** the **SW7** power supply switch.
7. Open the FlashPro software, and program the STAPL file (`IDB_AR0330_MIPI_ADK150.stp`). For information about how to program using FlashPro, see *UG0557: SmartFusion2 SoC FPGA Advanced Development Kit User Guide.*

*Figure 8 •* **SmartFusion2 Advanced Development Kit Setup**

![Microsemi logo — Power Matters.]

## 2.3.1.2    Installing the Video Demo GUI

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

1.  Open the folder containing the GUI Installer files, and run **setup.exe**. Click **Yes** for any message from User Account Control.
    The Setup window is displayed with the default locations.
2.  Accept the license agreement, and click **Next**.
3.  Confirm the installation location in the installation dialog box, and click **Next**.
    A progress bar appears that shows the progress of the installation. Upon successful installation, a confirmation message is displayed.
4.  Click **Finish** to exit the installation wizard.
5.  Restart the host PC.

After installing the video demo GUI, check the Device Manager to see if the USB drivers are already configured on the host machine. To check if the drivers are configured, after ensuring that the hardware is powered ON and connected to the host PC using a USB cable (**P1** on the board), check whether NI-VISA USB devices appear in the Device Manager, as shown in Figure 12, page 10. If they appear, proceed to run the demo design (see Running the Demo Design, page 11).

### 2.3.1.2.1    Configuring the GUI Driver

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

1.  Connect the host PC to the **P1** connector on the SmartFusion2 Advanced Development Board using a USB A to mini-B USB cable.
2.  Connect the power adapter to the kit, and switch ON the **SW7** switch.
3.  Navigate to `C:\Windows\inf`, and right-click the `MSCC_UsbHID` file, as shown in the following figure.

*Figure 9 •*    **MSCC_UsbHID File Installation**
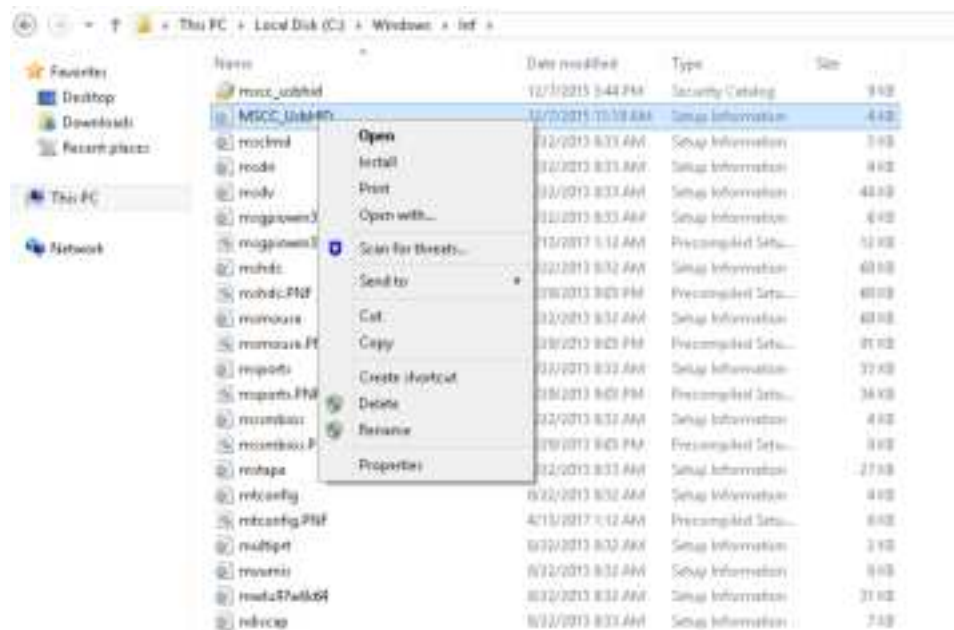
4.   Click **Install**, and in the dialog box that asks you to confirm if you want to install the software, click **Install** again, as shown in the following figure.

*Figure 10 •*   **Windows Security Dialog Box for MSCC_UsbHID File Installation**



The following message appears after the installation is completed.

*Figure 11 •*   **Confirmation Message after MSCC_UsbHID File Installation**
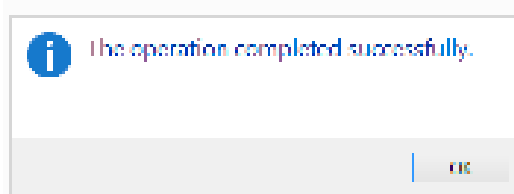


5.   In the **Device Manager**, under **Network Adapters**, check to confirm that **N1 Visa USB Devices** appears in the list, and that when expanded, it shows the **MSCC_UsbHID** driver, as shown in the following figure. If the driver does not appear, re-scan the Device Manager for hardware changes or reset the board.

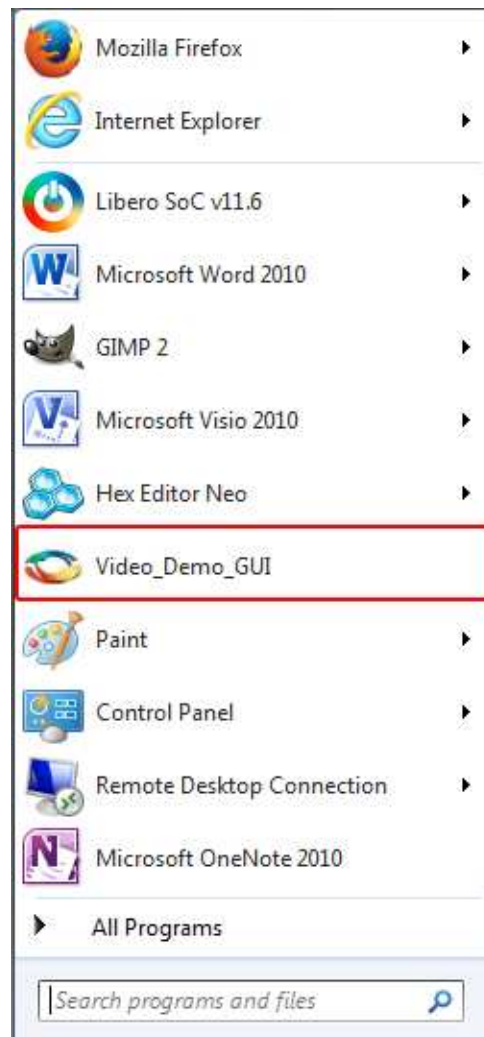*Figure 12 •*   **MSCC_UsbHID File in Device Manager**
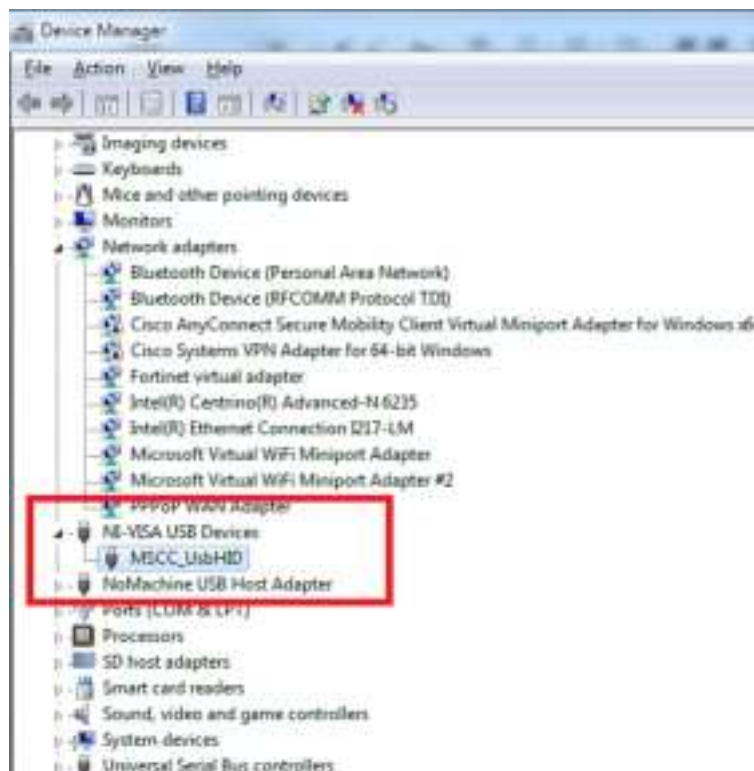
## 2.3.2 Running the Demo Design

The following steps describe how to run the demo design using the Video Demo GUI.

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

*Figure 13 •* **SmartFusion2 Video Demo GUI in Windows Start Menu**

2.  Click the **Connect** button on the top right side of the window, as shown in the following figure.
    Upon successful connection, the **Connect** button turns green and the text changes to **Connected**.

*Figure 14 •* **SmartFusion2 Video Demo GUI Launch Window**



The following sections describe the two demos available in the Video Demo GUI:

*   Camera Sensor Demo
*   Edge Detection Demo

### 2.3.2.1 Camera Sensor Demo

To run the Camera Sensor Demo:

- Select the **Camera Sensor Demo** from the **Demo Type Selection** drop-down list, as shown in the following figure. The video is displayed on the monitor with the Microsemi logo on it, thus demonstrating the alpha blending feature.

*Figure 15 •* **Camera Sensor Demo Selection**
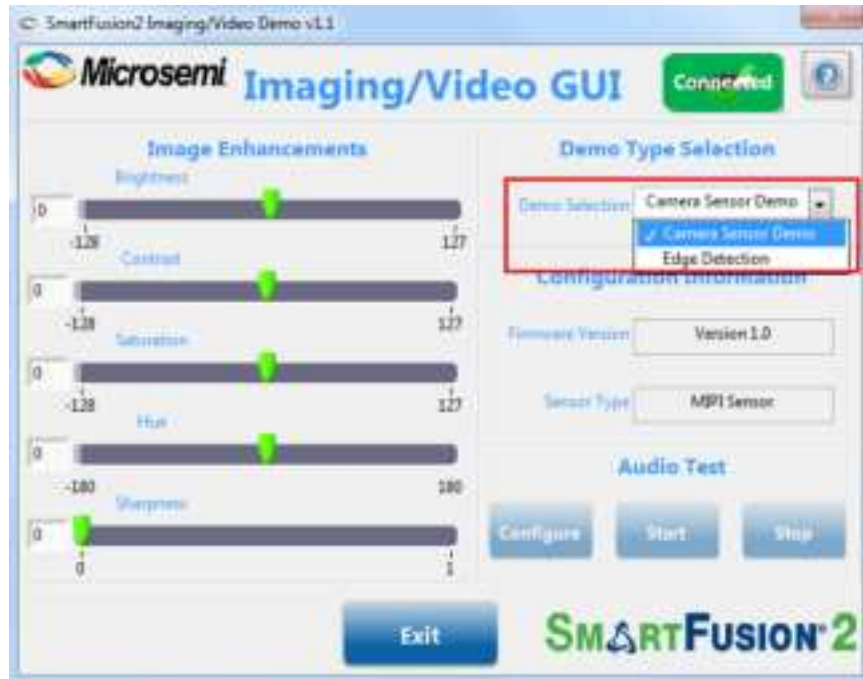


Properties such as brightness, contrast, saturation, hue, and sharpness can be adjusted to enhance the clarity of the video, as shown in the following figure.
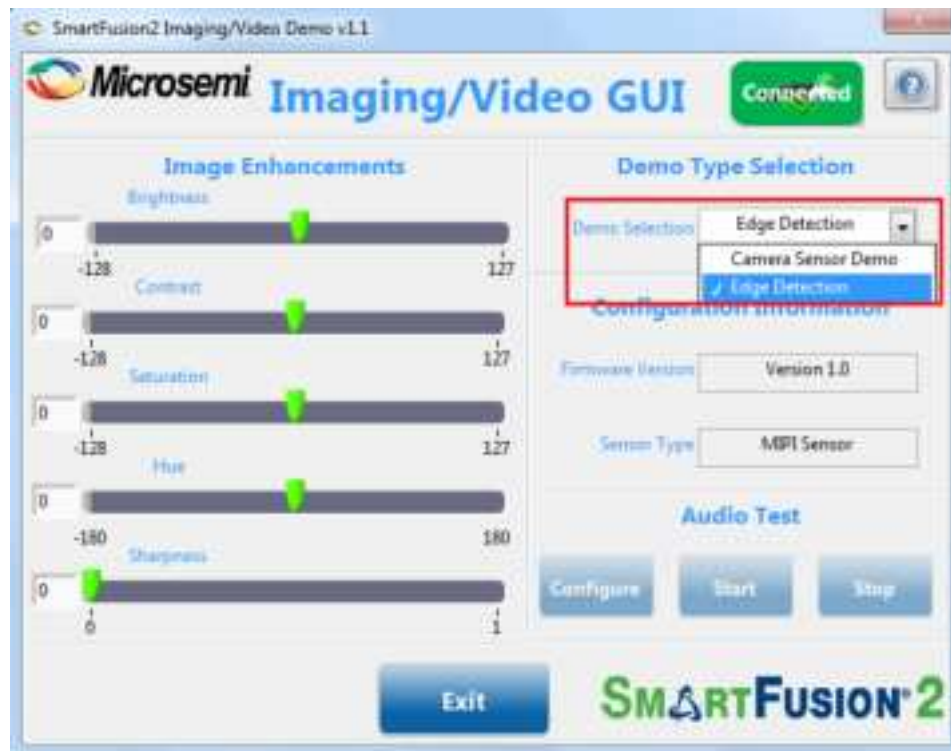
*Figure 16 •* **Image Enhancement Features**

### 2.3.2.2 Edge Detection Demo

To run the Edge Detection Demo:

• Select the **Edge Detection** option from **Demo Type Selection** drop-down list, as shown in the following figure.

*Figure 17 •* **Edge Detection Demo Selection**



The edges of the image currently appearing on the monitor are highlighted.

The following figures show two regular images and the corresponding edge-detected images.

*Figure 18 •* **Normal Image vs. Edge-Detected Image—Example 1**



*Figure 19 •* **Normal Image vs. Edge-Detected Image—Example 2**