



SightLine

APPLICATIONS

EAN-Camera Switch

PN: EAN-Camera-Switch

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 **IMPORTANT:** Identifies crucial information that is important to setup and configuration procedures.

 *Used to emphasize points or reminds the user of something. Supplementary information that aids in the use or understanding of the equipment or subject that is not critical to system use.*



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1 Overview

The camera switch feature allows customers to externally switch multiple cameras connected to individual inputs on the 1500-OEM and 3000-OEM. An external customer designed FPGA is used for this process. The FPGA switches selected cameras and then outputs video to the camera inputs of the SightLine OEM systems. This document describes the requirements to achieve the best possible switching performance by coordinating the external camera switch with simultaneous updates to the camera acquisition settings.

1.1 Additional Support Documentation

Additional Engineering Application Notes (EANs) can be found on the [Documentation](#) page of the SightLine Applications website.

The [Panel Plus User Guide](#) provides a complete overview of settings and dialog windows located in the Help menu of the Panel Plus application.

The Interface Command and Control ([IDD](#)) describes the native communications protocol used by the SightLine Applications product line. The IDD is also available as a PDF download on the [Documentation](#) page under Software Support Documentation.


1.2 SightLine Software Requirements

This process requires Panel Plus software version 2.25.xx and higher. See the [EAN-Firmware Upgrade Utility](#) for more information how to upgrade the SightLine OEM hardware with the latest firmware.

1.3 1500-OEM FPGA Support

The correct FPGA version should be installed on the 1500-OEM to match the camera and digital video adapter. See the [EAN-Camera Compatibility](#) for FPGA camera compatibility information.

FPGA version information is located on the *Connect* tab under the *Video Output* section.



Firmware Ver: 3.0.3.9 [5], temp: 98°F [37°C]
SVN Revision: 50052, Build Date: 9/25/2019, Build Time: 4:48:51

Figure 1: FPGA Version Number Location

 *When the 3000-OEM starts, the 3-bits of the GPIO should be held as 000. This blocks the video processing board from sending any video signals.*

1.4 Integration Hardware Requirements

The camera switch feature combines camera acquisition and switching with an external customer FPGA. This can present difficult system debugging if issues are encountered. To help ensure a successful integration use the following guidelines:

- When designing the FPGA board, add test points for VSync, HSync, pixel clock and a few of the pixel bits that are output to the SightLine OEM boards. It also is helpful to add test points for the three GPIO outputs from the SightLine OEMs to the customer FPGA.



- Build an additional FPGA board that can be sent to Sightline Applications for debugging issues.
- Supply SightLine with the cameras used in the integration. If this is not possible, we recommend implementing simple camera simulator test patterns that mimic the camera timing for each camera in the system. This allows acquisition and camera switch validation without the camera hardware.
- Set *Camera Type* to *None* (number 0) to allow a reset of the customer FPGA and cameras.

2 Board ID (3000-OEM ONLY)

3000-OEM allows accessory boards to be quickly identified in the software. Board ID pins (ID0, ID1, ID2, ID3) are used to identify the type of board attached to this connector.

Table 1: 3000-OEM Board ID Pins

| CAM 0 (J3) | | CAM 2 (J4) | |
|------------|---------|------------|---------|
| PIN | NAME | PIN | NAME |
| 72 | GPIO 10 | 72 | GPIO 50 |
| 71 | GPIO 9 | 71 | GPIO 49 |
| 70 | GPIO 8 | 70 | GPIO 48 |
| 69 | GPIO 25 | 69 | GPIO 20 |

Set 3000-OEM board ID pins as shown in Table 2. This will configure the system to set the *Camera Type* to *Generic Digital* and allow for a more dynamic set of camera inputs as shown in the *Acquisition Settings* dialog in Panel Plus.

IMPORTANT: The board ID pins of an external FPGA connected to the SLA-3000 Hardware must be set to 0xD - Generic Adapter Board.

Table 2: 3000-OEM Board ID Pins - Generic Digital

| Board ID | 72 | 71 | 70 | 69 | Description |
|----------|----|----|----|----|-----------------------|
| 0xD | 1 | 1 | 0 | 1 | Generic Adapter Board |

IMPORTANT: *Generic Digital* requires firmware 2.25.xx and later.

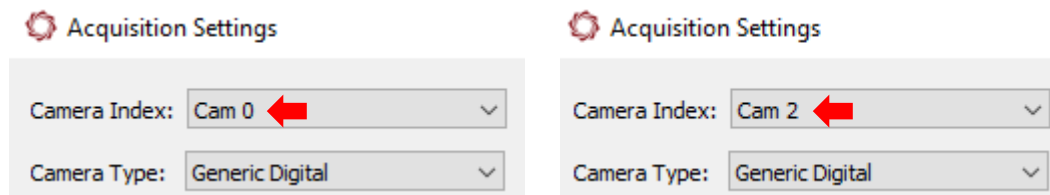


Figure 2: Camera Index and Type 3000-OEM - Acquisition Settings Dialog

The 1500-OEM does not have a board ID mechanism. The digital video acquisition parameters must be setup manually (see [EAN-Startup Guide 1500-OEM](#)).



3 Camera Type Select - GPIO

When a new camera number is selected by sending a camera switch SLA command, the 3000-OEM and 1500-OEM also change GPIOs to indicate the camera selection selected as shown in [Table 4](#).

Three GPIO pins are used to signal the FPGA that the camera has changed. This can be used by an external video switching FPGA to select which Camera to provide video from.

Using these GPIOs provides the fastest camera switch times. The camera switch SLA command message updates the acquisition parameters to match the new camera, and then immediately switches the GPIO values to simultaneously switch the camera in the external FPGA.

Table 3: GPIO Pins

| Bit | 1500-OEM (J4) | | 3000-OEM (J2) | | | |
|-------|---------------|----------|---------------|----------|-------|----------|
| | CAM 2 | | CAM 0 | | CAM 2 | |
| | PIN | NAME | PIN | NAME | PIN | NAME |
| Bit 2 | 13 | GPIO 174 | 51 | GPIO 22* | 54 | GPIO 28* |
| Bit 1 | 14 | GPIO 173 | 50 | GPIO 17* | 53 | GPIO 24* |
| Bit 0 | 40 | GPIO 172 | 49 | GPIO 16* | 52 | GPIO 23* |

*GPIOs are on the Vout (J2) connector. They will conflict with GPIOs used for configuration of output transmitters (HD-SDI OUT).

All GPIO default to inputs on startup. The GPIO are set as Outputs by VideoTrack when the digital camera type is set to Generic Digital (2.25.xx). The acquisition parameters shown below are default settings. They can be changed, saved, and persisted through subsequent restarts (See Camera Switch command description below).

The camera switch feature uses a table of acquisition parameters as shown in [Table 4](#). Position 0 in the table is reserved for cases when no cameras are present. Positions 1-7 can be configured by the user to match the camera inputs in acquisition parameters.

Table 4: Table of Camera Switch Acquisition Parameters

| GPIO | Camera Selection | High | Wide | Bits | | | VFP | HFP | Flags | Image Type |
|------|------------------|------|------|------|--|--|-----|-----|-------|------------|
| 000 | None | - | - | - | | | - | - | - | No camera |
| 001 | | | | | | | | | | |
| 010 | | | | | | | | | | |
| 011 | | | | | | | | | | |
| 100 | | | | | | | | | | |
| 101 | | | | | | | | | | |
| 110 | | | | | | | | | | |
| 111 | | | | | | | | | | |



4 Camera Switch (0x82) Command

The camera switch command can be used to switch cameras and to program new camera acquisition settings into the camera switch table.

Parameters:

| Switch Mode | Camera Index | Camera Selection |
|----------------|----------------|---|
| (16-bit value) | (16-bit value) | (16-bit value) |
| {0,1,2} | {0,2} | 0-5 (from camera selection tables in Camera Type Select - GPIO.) |

4.1 Switch Mode


Mode 0: *Restart Capture; No Camera Switch.* Restart the capture driver without switching camera or changing camera settings (not normally used).

Mode 1: *Switch the Camera; Apply Settings from the Table.* Apply the values that are in the table for a specific camera selection. This is used for normal camera switching.

Mode 2: *Switch the Camera; Update Camera Switch Table Settings.* Use the **Set Acquisition Parameters (FIP command 0x37)** to write these values to the camera selection entry in the above table using 0x82 command. When using Mode 1, these new values are now the defaults. The new table settings must be saved to the parameter file with the **Save Parameters (0x25)** command. These settings will then be reloaded on reboot. This is used only when programming new acquisitions parameters into a camera number in the table

4.2 Camera Index

For the 1500-OEM use Cam 2 (digital input). For the 3000-OEM use Cam 0 or Cam 2.

 *3000-OEM: Since the Camera Switch function uses the entire port on VINO or VIN1, only Cam 0 or Cam 2 are supported.*

4.3 Camera Type Selection

See the [Camera Type Select - GPIO](#) section.

5 Camera Switching Process Overview

Each supported camera has a set of acquisition parameters. The following is an overview of the camera switching process:

1. Customer sends a camera switch command (0x82) to the SightLine OEM hardware indicating a switch to a new camera number.
2. The current camera acquisition is stopped.
3. A new set of acquisition parameters is applied to the new camera. Parameters are loaded from the camera switch table.
4. The new camera number is written to three GPIO output pins, which are used to signal the external customer FPGA that it should switch to the new camera.
5. Start acquisition for the new camera.



ⓘ IMPORTANT: For a comprehensive video that covers how to set up acquisition parameters, update the camera switch table, and verify camera switch table entries, see the [Camera Switch Setup](#) video on our [Support](#) channel before proceeding to the next sections.

5.1 Panel Plus - Camera Switch

The camera switch command options are shown in the *Camera Switch* dialog in Panel Plus (Figure 3). To open the dialog, go to main menu » *Configure* » *Camera Switch*. Use the *Send* button to send the command to the hardware.

This Camera Switch menu is only available if the currently configured camera uses Generic Digital ().

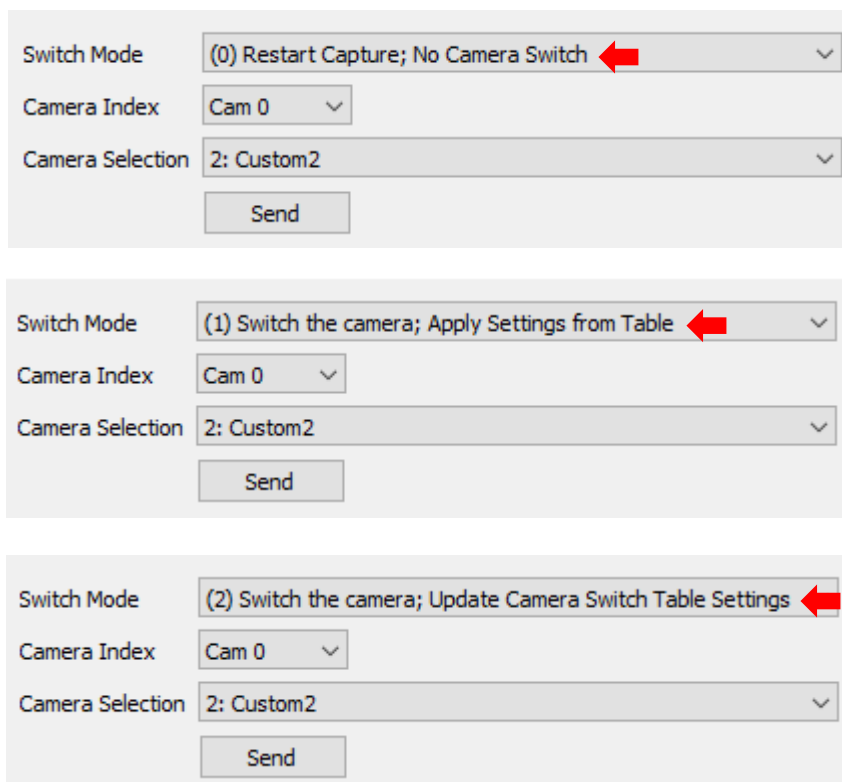


Figure 3: Camera Switch Menu Options

The resulting 0x82 command is shown in the command window of Panel Plus (Figure 4). This can be helpful in developing and debugging a camera switch interface.

```
23,37,00,02,38,04,80,07,08,00,00,00,00,01,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,DF
sent:GetAcquisitionParameters 51,AC,03,38,00,9F
received:CurrentAcquisitionParameters 51,AC,24,4F,
02,00,02,38,04,80,07,08,00,00,00,00,01,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,21
sent:CameraSwitch 51,AC,08,82,01,00,00,00,02,00,76
```

Figure 4: 0x82 Command in Panel Plus



5.2 Camera Switch Table Configuration

Use this process to configure the camera switch functionality for each camera. The default camera should be configured last. This will ensure that the acquisition parameters associated with the default camera are stored in the parameter file and in the camera switch table.

It is not necessary but recommend that the default camera is saved in position 1 in the camera switch table.

If each camera cannot be connected directly to the SightLine hardware the following steps can also be used without verifying the video. However, it is important to verify that the set of generic digital acquisition parameters is working with the selected camera to prevent confusion.

To configure the camera:

1. Connect the camera to the SightLine hardware (optional).
2. Enter the acquisition parameters for the camera in Panel Plus. Use *Generic Digital* for the camera type.

See the [Generic Digital Configuration - Panel Plus](#) section for setting up Generic Digital settings. If the Camera Type is not set to Generic Digital, the Camera Switch menu item will not be available in Panel Plus.
3. Click *Apply*.
4. Save and activate the settings:
 - a. Main menu » *Parameters* » *Save to Board*.
 - b. Main menu » *Reset* » *Board*.
 - c. Wait for the system to boot, and then reconnect to the board.
5. Verify video is streaming from the camera (optional).
6. Add the current camera using the *Camera Switch* menu that corresponds to the camera in the table index.
7. To persist the camera switch table entry through restarts, from the main menu » *Parameters* » *Save to Board*.

Since these are dynamic settings, a board restart is not necessary.

8. Repeat the above steps for each camera switch table entry.

The last camera entered should be the default camera.



5.3 Generic Digital Configuration - Panel Plus

In the example shown in [Figure 5](#) the *Camera Type* is set to *Generic Digital*. *Auto Fill* is set to HDMI 1080P.

ⓘ IMPORTANT: It is essential to the camera switching process to use *Generic Digital* and *Auto Fill* since these settings are stored in the camera switch table.

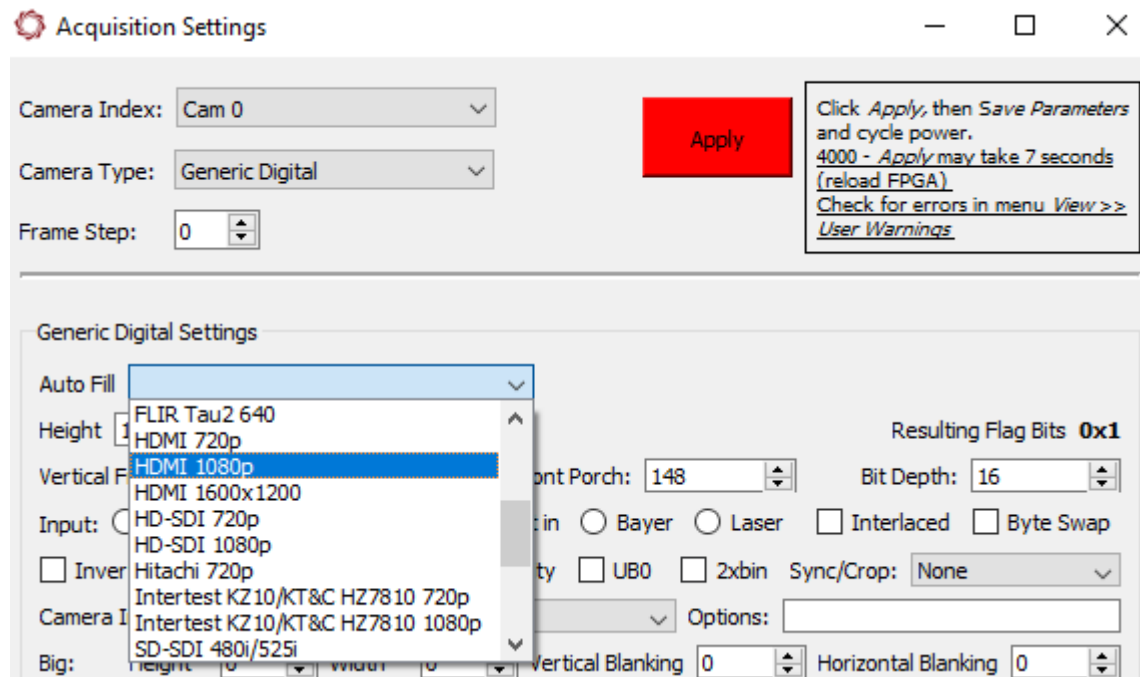


Figure 5: Generic Digital and Auto Fill Configuration

5.4 Camera Switch Menu - Table Entries

This section describes how to use the *Camera Switch* menu in Panel Plus to fill in the table entries.

1. Open the Camera Switch dialog window in Panel Plus. Main menu » *Configuration* » *Camera Switch*.

If this menu option is not available, setup the current camera to be *Generic Digital*.

2. In the example shown in [Figure 6](#) table entry 2 is set to the *Generic Digital* settings currently configured for *Cam 0* on the 3000-OEM.

3. Click *Send* to send this camera switch command to the 3000-OEM.

4. To persist the camera switch table entry through restarts, from the main menu » *Parameters* » *Save to Board*.

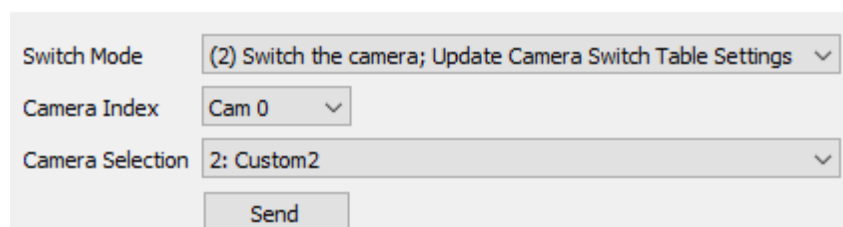


Figure 6: Camera Switch Menu - Fill in Table Entries



6 Questions and Additional Support

For questions and additional support, please contact [Technical Support](#). Additional support documentation and Engineering Application Notes (EANs) can be found on the [Documentation](#) page of the SightLine Applications website.

Appendix A: Testing Camera Switch without Customer Hardware

The Camera Switch feature requires an external FPGA to switch camera inputs, which makes testing this feature difficult. The following test procedure uses an SDI signal generator to test camera switch into the 3000-OEM.


Test equipment:

- 3000-OEM
- SLA-3000-HDSDI-IN adapter board
- QuestTel 3G/HD/SD-SDI Mini Pattern Generator - 1B-SDI-MN-PTG (cost ~ 285 USD)
- Coax cable

A1 Test Overview

The SDI Mini Pattern Generator can be used to switch video input format to the 3000-OEM. This can be used to test camera switch functionality and support of the formats provided on the pattern generator.

The pattern generator can be switched to a resolution that has been persisted in the camera switch table using the procedures shown in the previous sections. The camera switch can be complete and verified using Panel Plus.

 *If the formats in the pattern generator are switched between HD-SDI and SD-SDI resolutions, the following scripts must be executed to change the SDI receiver chip between HD and SD input format mode on the 3000-HDSDI-IN board.*

Scripts can be copy and pasted into an SSH connection (terminal) to the 3000-OEM hardware. This is necessary as camera switch does not change the SDI hardware resolution mode. This is not necessary when connected to a custom camera switch FPGA.

Scripts for CAM0(VIN0) and CAM2(VIN1) are as follows:

To change to **CAM0** HD-SDI mode (all except 625i/525i):

```
echo 1 > /sys/class/gpio/gpio14/value
echo 0 > /sys/class/gpio/gpio15/value
sleep 1
echo 1 > /sys/class/gpio/gpio8/value # 1== 20 bit HD
echo 0 > /sys/class/gpio/gpio9/value
echo 1 > /sys/class/gpio/gpio15/value
```

**To change to CAM0 SD-SDI mode (625i/525i):**

```
echo 1 > /sys/class/gpio/gpio14/value
echo 0 > /sys/class/gpio/gpio15/value
sleep 1
echo 0 > /sys/class/gpio/gpio8/value # 0== 10 bit SD
echo 0 > /sys/class/gpio/gpio9/value
echo 1 > /sys/class/gpio/gpio15/value
```

To change to CAM2 HD-SDI mode (all except 625i/525i):

```
echo 1 > /sys/class/gpio/gpio18/value
echo 0 > /sys/class/gpio/gpio19/value
sleep 1
echo 1 > /sys/class/gpio/gpio48/value # 1== 20 bit HD
echo 0 > /sys/class/gpio/gpio49/value
echo 1 > /sys/class/gpio/gpio19/value
```

To change to CAM2 SD-SDI mode (625i/525i):

```
echo 1 > /sys/class/gpio/gpio18/value
echo 0 > /sys/class/gpio/gpio19/value
sleep 1
echo 0 > /sys/class/gpio/gpio48/value # 0== 10 bit SD
echo 0 > /sys/class/gpio/gpio49/value
echo 1 > /sys/class/gpio/gpio19/value
```