# EZ-USB™ FX5N DVK (KIT_FX5N_FMC_001) kit guide

## About this document

### Scope and purpose

The EZ-USB™ FX5N DVK (KIT_FX5N_FMC_001) kit enables the development of applications based on EZ-USB™ FX5N USB 3.2 Gen 1x2 device controller (CYUSB3284-BZXI) for streaming video and audio seamlessly to the USB host using the off-the-shelf FPGA add-on board and camera modules.

### Intended audience

This document is intended for the EZ-USB™ FX5N DVK (KIT_FX5N_FMC_001) kit users.

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## Safety precautions

*Note:* *Please note the following warnings regarding the hazards associated with development systems.*

**Table 1 Safety precautions**

| | |
|---|---|
|  | **Caution:** *The evaluation or reference board contains parts and assemblies sensitive to electrostatic discharge (ESD). Electrostatic control precautions are required when installing, testing, servicing or repairing the assembly. Component damage may result if ESD control procedures are not followed. If you are not familiar with electrostatic control procedures, refer to the applicable ESD protection handbooks and guidelines.* |

# Table of contents

# 1 Introduction

The EZ-USB™ FX5N DVK (KIT_FX5N_FMC_001) kit is based on the EZ-USB™ FX5N product family of Infineon's USB 10 Gbps device controllers.

EZ-USB™ FX5N is a family of USB 10 Gbps peripheral controllers targeting the next-generation USB applications in camera, video, imaging, and data acquisition markets. EZ-USB™ FX5N consists of dual Arm® Cortex®-M4 and M0+ core CPUs, 512 KB flash, 128 KB SRAM, 128 KB ROM, seven Serial Communication Blocks (SCBs), cryptography accelerator, and high-bandwidth data subsystem providing DMA data transfers between LVDS and USB ports at speeds up to 10 Gbps. An additional 1 MB SRAM is included in the high-bandwidth data subsystem to provide buffering for the USB data. EZ-USB™ FX5N also supports USB Type-C plug orientation detection and flip-mux function without the need for external logic. This kit is intended to be a solution demo kit for video and audio streaming applications from block camera to a PC via USB-C interface.

See the device datasheet to understand and compare the various features supported by EZ-USB™ FX5N controllers.

The EZ-USB™ FX5N DVK (KIT_FX5N_FMC_001) supports the following key features:

- Stream video and audio seamlessly to a USB host
- USB bus-powered and self-powered operation
- Onboard regulators

For EZ-USB™ FX5N controller details, see the EZ-USB™ FX5N kit webpage.

## 1.1 DVK contents

Table 2 lists the EZ-USB™ FX5N DVK (KIT_FX5N_FMC_001) contents.

**Table 2 DVK contents**

| Item | Type | Comments |
|---|---|---|
| EZ-USB™ FX5N baseboard | Hardware | – |
| USB-C cable | Cable | This cable supports 10 Gbps in each lane. Hence it can be used for USB 3.2 Gen 1x2 applications |
| Hard copy of the quick-start guide (QSG) | Documentation | – |
| Kit casing | Package | – |
| Foam | Package | To protect and maintain proper placement in the kit container |

## 1.2 Download kit documents and hardware design files

Download the KIT_FX5N_FMC_001 kit documents and the hardware design files from the EZ-USB™ FX5N kit webpage. The documents include a quick start guide (QSG), kit user guide (this document), and release notes. The hardware design files include schematics, bill of materials (BOM), and layout files.

## 1.3 EZ-USB™ FX5N baseboard details

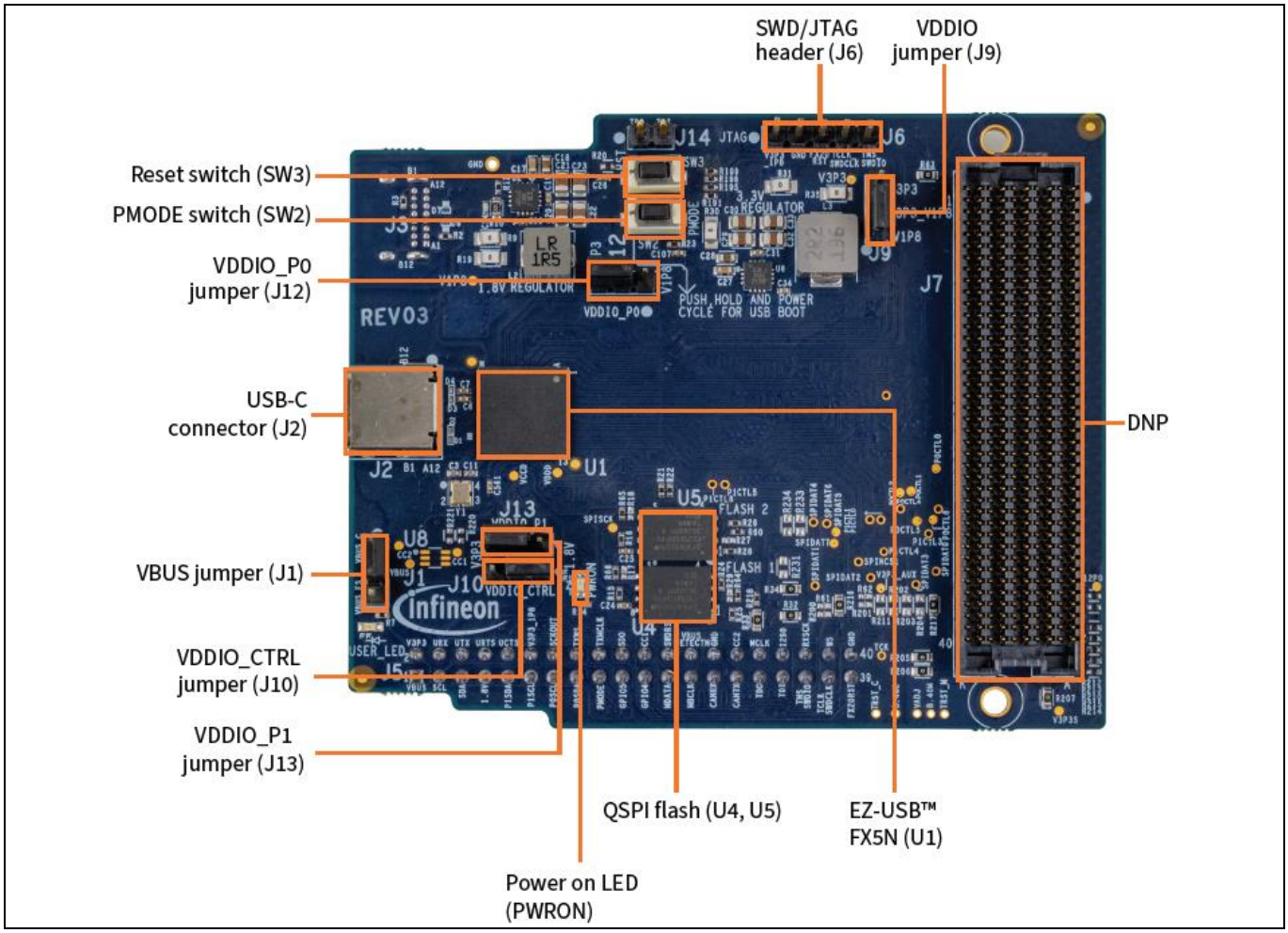


**Figure 1 EZ-USB™ FX5N baseboard – top view**

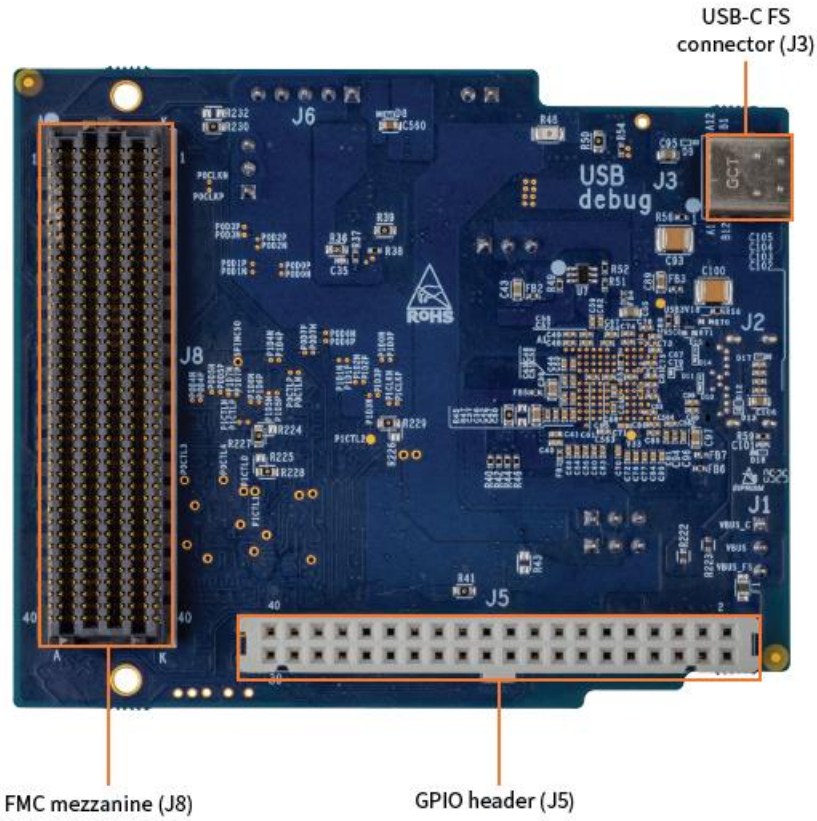


**Figure 2 EZ-USB™ FX5N baseboard – bottom view**

## 1.4 EZ-USB™ FX5N baseboard features

- EZ-USB™ FX5N controller
- Two QSPI SPI flash
- Onboard regulators: 1.8 V and 3.3 V DC-DC switching regulators
- Boot mode switch for selecting USB boot or SPI boot
- FMC-HPC mezzanine connector to interface EZ-USB™ FX5N DVK with FPGA boards
- 40-pin GPIO header for interfacing the GPIO accessory board (ASSY_GPIO_001)
- SS USB port for data transfers at speeds up to 10 Gbps
- FS USB port for data logging

# 2 Installing the kit software

Download the EZ-USB™ FX5N SDK from the EZ-USB™ FX5N kit webpage.

Install the following software. The installation of the following software may require administrator privileges.

### EZ-USB™ Control Center

Download and install the EZ-USB FX Control Center application from the webpage.

### Pleora eBUS Player

For USB3Vision (U3V) video streaming, download and install Pleora eBUS Player:

- For Windows 64-bit
- For Windows 32-bit

# 3 KIT_FX5N_FMC_001 system design

The EZ-USB™ FX5N baseboard is bus-powered and needs a USB-C cable to connect to the PC. To demonstrate the full functionality of the kit and FPGA, the add-on board must be connected to the EZ-USB™ FX5N DVK.

## 3.1 Top-level hardware design

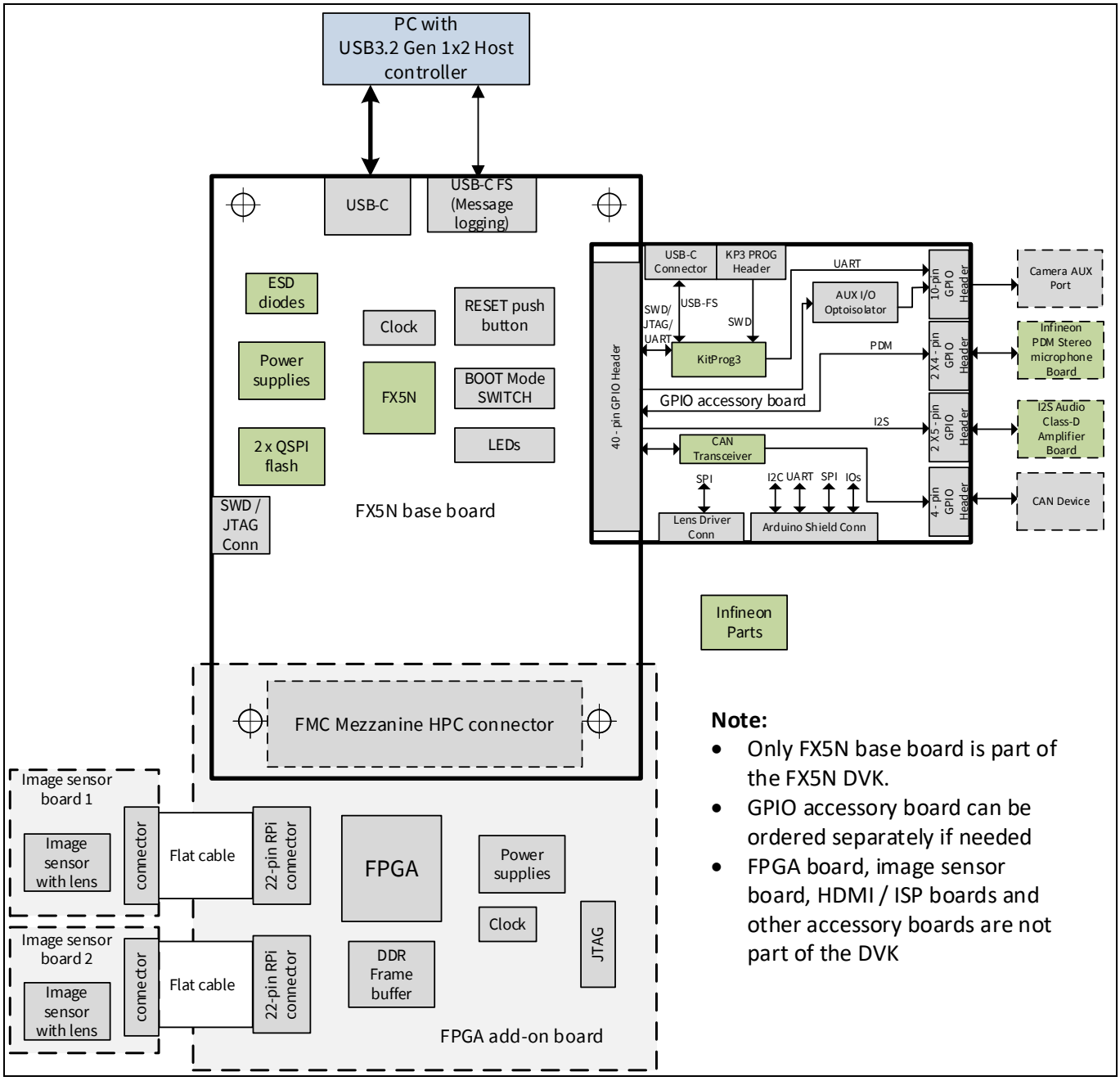


**Figure 3 EZ-USB™ FX5N DVK block diagram**

## 3.2 KIT_FX5N_FMC_001 EZ-USB™ FX5N DVK design details

The KIT_FX5N_FMC_001 EZ-USB™ FX5N DVK consists of the following:

- EZ-USB™ FX5N silicon (CYUSB3284-BZXI)
- Two external QSPI Flash modules
- Power supplies
- 24 MHz crystal
- USB-C SS connector
- USB-C FS connector
- FMC HPC mezzanine connector to connect with the add-on FPGA board
- GPIO interface connector for GPIO accessory board

### 3.2.1 EZ-USB™ FX5N DVK

#### 3.2.1.1 USB-C SS connector (J2)

The KIT_FX5N_FMC_001 kit is bus-powered and uses a USB-C SS connector to interface with the PC through the USB-C cable provided with the kit. The USB3 port of the PC will be able to source a maximum of 5 V at 3 A power through VBUS. The connector used in the DVK is USB-IF certified. This interface has TVS diodes for protection against ESD.

#### 3.2.1.2 Mode selection switch (SW2)

This switch selects the mode in which EZ-USB™ FX5N must boot upon power-on. The kit can boot in two modes based on the position of this switch.

**Table 3 Boot modes**

| Boot mode | SW2 | Description |
|---|---|---|
| USB | ON | Hold the push button (SW2) and power cycle the KIT either by pressing and releasing the RESET button (SW3) or removing and reconnecting the USB-C cable |
| Internal flash memory | OFF | Default |

### 3.2.1.3 Power supply

The kit is bus-powered. VBUS supply from the host PC can be disconnected from the kit by removing the jumper from connector J1 pin 1-2.

The board consists of two IR3883MTRPBF regulators from Infineon Technologies. It is a DC-DC buck switching regulator rated for 3 A. With a 16PQFN package, the regulator features overvoltage protection, overcurrent protection, and overtemperature protection. The following voltages are generated from VBUS (i.e., 5 V ± 0.25 V) and the rating of each regulator is:

- U6: 3.3 V ±5% at 3 A
- U2: 1.8 V ± 5% at 3 A

Jumpers J9, J10, J12, and J13 are 3-pin headers that can be used to switch the VDDIO supply between 1.8 V and 3.3 V. Shorting the pins 1-2 in these jumpers will set the voltage at respective supply pin to 1.8 V. Similarly, shorting the pins 2-3 in these jumpers will set the voltage at respective supply pin to 3.3 V.

**Table 4 DVK jumper settings**

| Name | Jumper | Short 1-2 | Short 2-3 |
|---|---|---|---|
| V3P3_1P8 | J9 | 1.8 V | 3.3 V |
| VDDIO_CTRL | J10 | 1.8 V | 3.3 V |
| VDDIO_P0 | J12 | 1.8 V | 3.3 V |
| VDDIO_P1 | J13 | 1.8 V | 3.3 V |

*Note: For LVDS operation, VDDIO_P0 and VDDIO_P1 must be kept at 3.3 V. VDDIO_P0_CTRL and VDDIO_P1_CTRL can be at either 1.8 V or 3.3 V depending on the desired CTRL signal logic level.*

### 3.2.1.4 EZ-USB™ FX5N (U1)

EZ-USB™ FX5N is a 10 Gbps device controller with a bandwidth to support USB 3.2 Gen 1x2 based host systems. It supports UVC, UAC, U3V, and USB Vendor Class protocols. The EZ-USB™ FX5N DVK is designed to stream video and audio seamlessly to USB host using off-the-shelf FPGA add-on boards and camera modules. It is a 169-ball, 10 mm × 10 mm × 1.2 mm, 13×13 ball array, 0.75 mm pitch FBGA. See the datasheet for more details on EZ-USB™ FX5N.

### 3.2.1.5 QSPI flash (U6, U7)

The kit has two Infineon S25FS256SDSNFI000 256 Mb QSPI flash devices. When the DVK is interface with an FPGA board, it is necessary to store the FPGA bin file in a flash memory. The DVK on-board flash modules can be used for this purpose.

### 3.2.1.6 FMC HPC mezzanine connector (J8)

The kit uses an ASP-134488-01 FMC-HPC mezzanine connector to interface with off-the-shelf FPGA boards. It is a 400-pin, 1.27 mm pitch connector that supports ANSI/VITA 57 standard. All the high bandwidth subsystem interfaces are brought to the FMC connector.

### 3.2.1.7 GPIO interface connector (J5)

The kit has a 2X10-pin GPIO connector to interface with GPIO accessory board. All the low-speed peripheral signals of EZ-USB™ FX5N are brought to this connector. Using the GPIO accessory board, you can interface with external add-on modules such as CAN transceivers, PDM microphones, UART devices, KitProg3 programmer for programming EZ-USB™ FX5N bootloader, Arduino shield boards, and I2S devices.

### 3.2.1.8 USB-C Full-Speed connector (J3)

EZ-USB™ FX5N has a debug access port (DAP) that acts as the interface for device programming and debugging. An external programmer or debugger (the “host”) communicates with the DAP through the device Serial Wire Debug (SWD) or JTAG interface pins through the USB-C Full-Speed connector.

### 3.2.1.9 SWD header (J6)

This DVK provides a SWD header interface that can be used to program the EZ-USB™ FX5N device. J6 along with J14 can used for JTAG operation. This interface can also be used for boundary scan operations.

### 3.2.1.10 Crystal (Y1)

EZ-USB™ FX5N needs a 24 MHz crystal to generate the clock for its operation having tolerance ±10 ppm and drive level 100 µW.

### 3.2.1.11 LED (USER_LED, PWRON)

- LED1 (user LED): Green LED connected to GPIO5 of EZ-USB™ FX5N. It is an application/firmware-controlled LED used for the FW debug purpose
- LED2 (PWR ON): With power-on, this LED glows green, indicating the 3.3 V power supply is ON

# 4 Programming the kit

The KIT_FX5N_FMC_001 kit is preprogrammed with the internal colorbar firmware to stream 4K UVC color bar video generated internally inside EZ-USB™ FX5N. This allows you to stream the color bar video without the need of an FPGA board. Do the following steps if you need to change the firmware.

## 4.1 Program the user application

1. Following the SDK user guide, build the code example project which you want to program on the kit
2. Open EZ-USB™ FX Control Center application from the installed directory

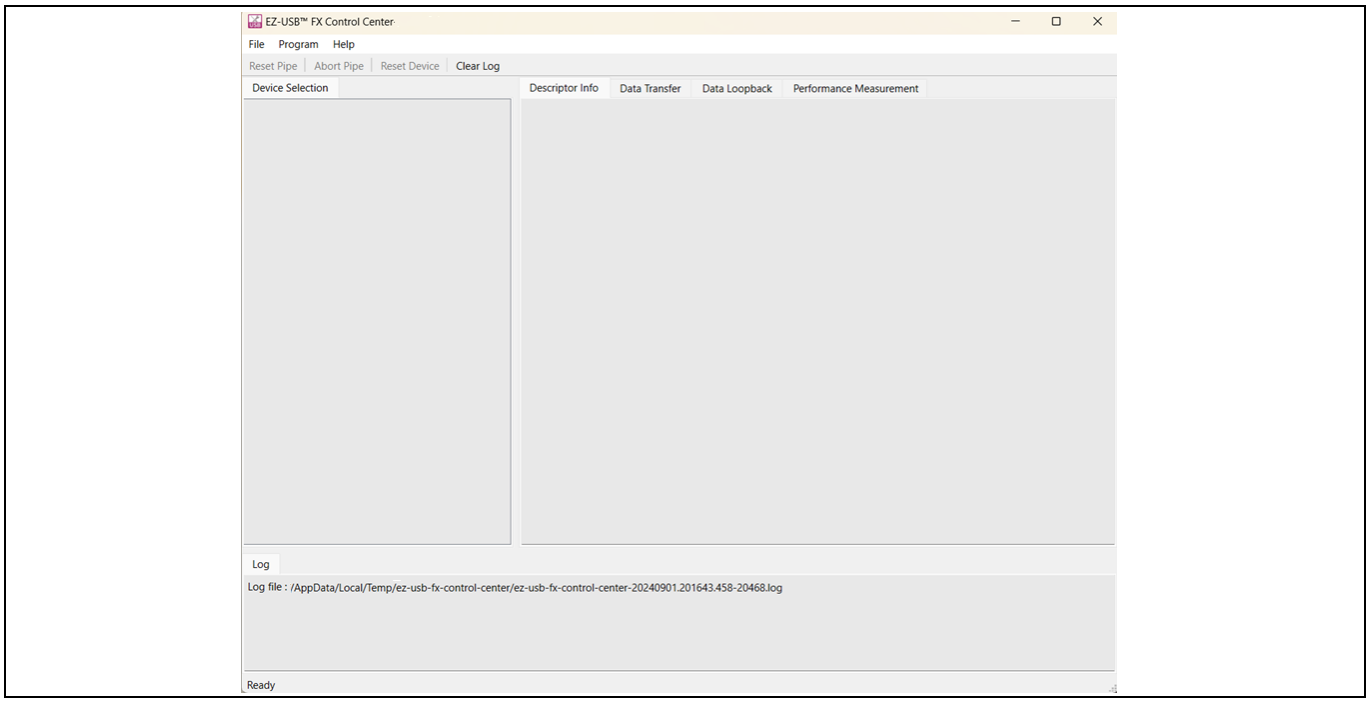


**Figure 4 EZ-USB™ FX Control Center**

3. Connect the EZ-USB™ FX5N DVK to the PC via the USB-C cable provided with the kit
4. Press and hold the PMODE switch (SW2) and reset the device by pressing the RESET switch (SW3). Release the PMODE switch (SW2)
5. Wait for the **EZ-USB™ FX Control Center utility** tool to detect the bootloader

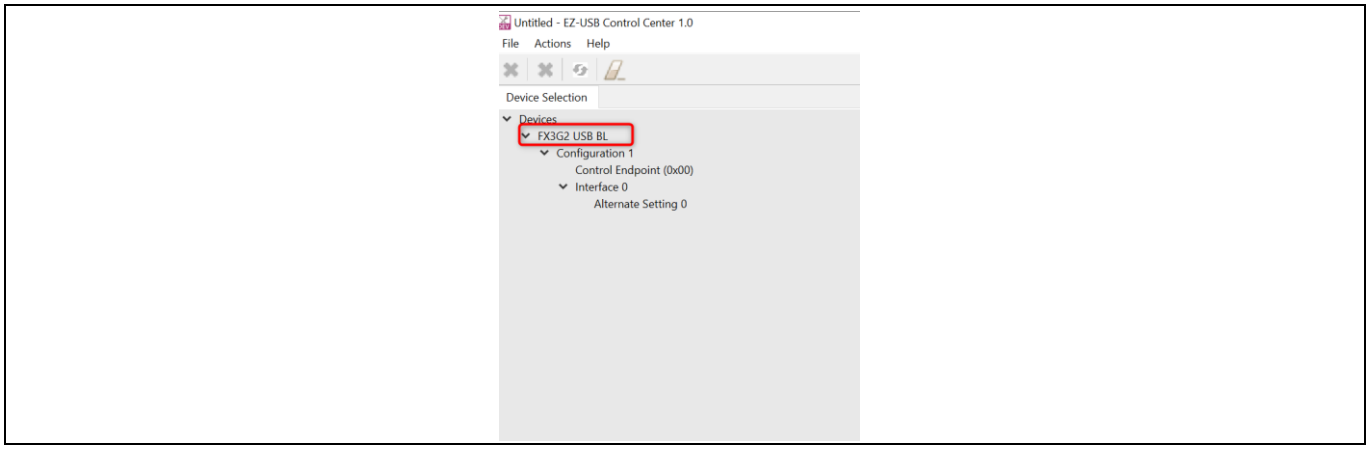


**Figure 5 Bootloader detection in EZ-USB™ FX Control Center application**

## Programming the kit

6. Do the following to program the device:

   Click **FX3G2 USB BL** > Click **Program** > Click **Internal Flash**

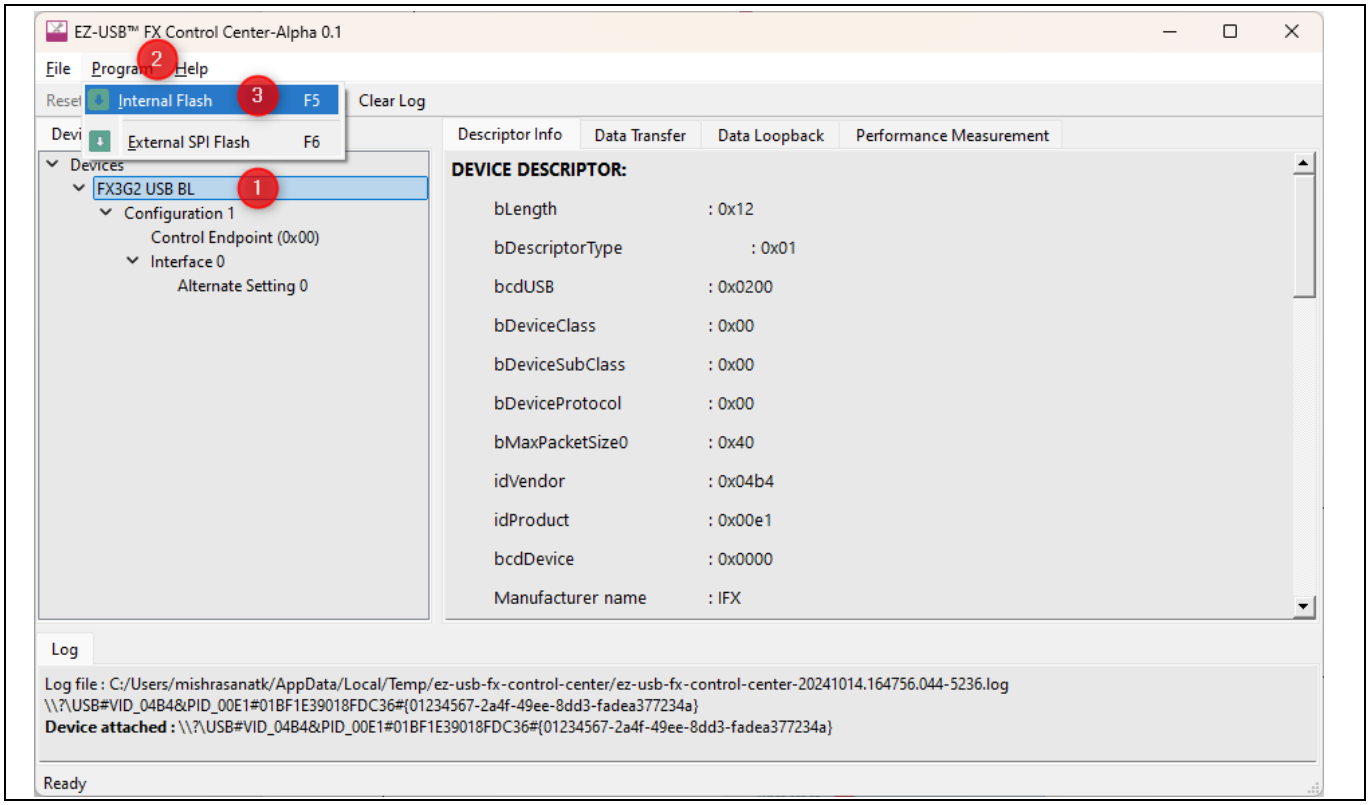


**Figure 6 Program in Control Center application**

7. Navigate to the *<Drive>\EZ-USB FX5N Release Package\SDK\<project folder>\out* folder based on the code example project. Select the hex file to program and click **Open**

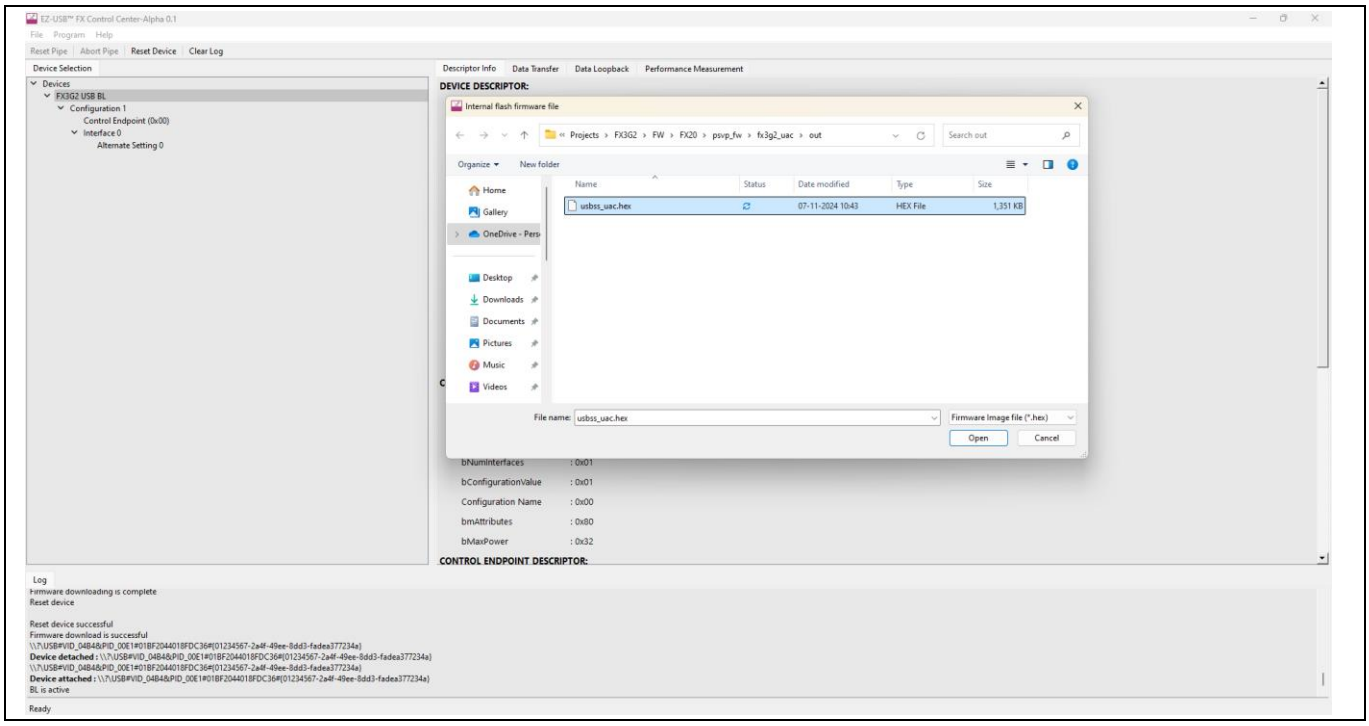

**Figure 7 Programming EZ-USB™ FX5N**

## Programming the kit

8. Wait for programming to complete. Observe the EZ-USB™ FX5N device detach message in the **Log** window

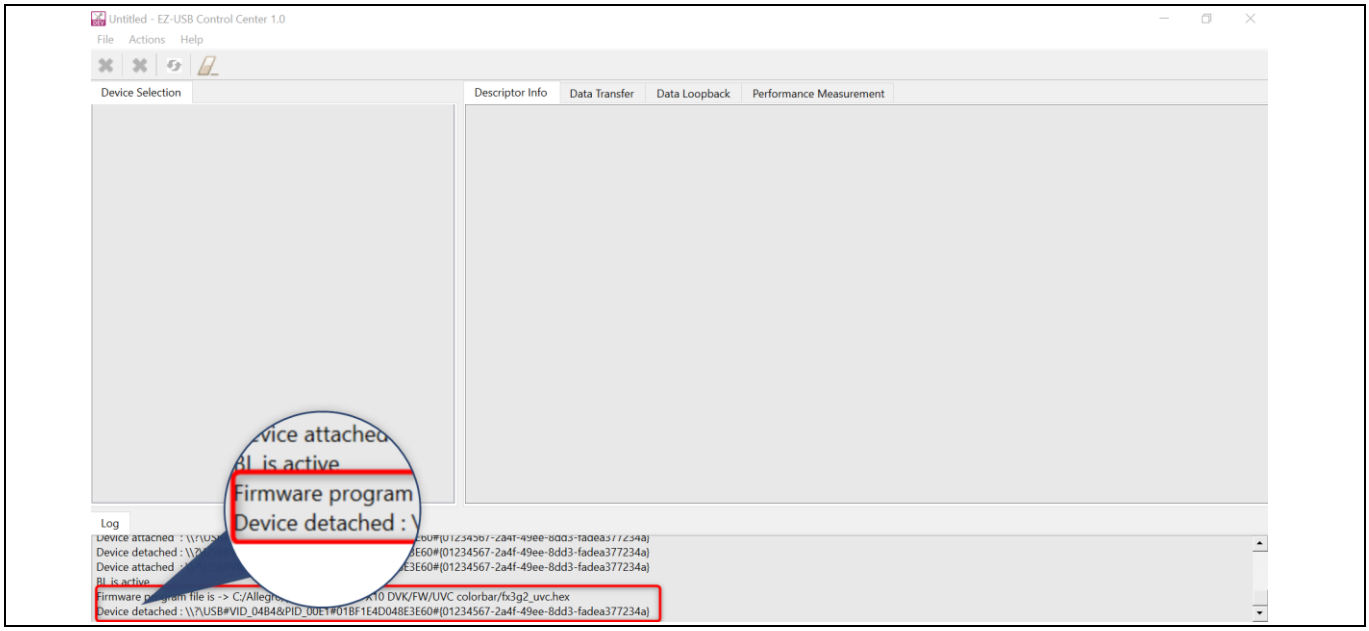


**Figure 8 Programming successful Log window**

# 5 Run the application (internal color bar)

## 5.1 Viewing the UVC output using windows camera application

1. Follow the instructions in the SDK user guide to build the *uvc_inmem* project
2. Program EZ-USB™ FX5N with the generated *.hex* file by following the steps mentioned in the Program the user application section
3. Open Windows **Device Manager** and verify that the EZ-USB™ FX5N camera is listed


**Figure 9 Board enumerated as FX3G2 device in Windows Device Manager**

*Note: The enumeration name can vary based on the latest FW available.*

4. Open the Windows Camera application and click the flip camera option. Ensure the resolution selected is 3840X2160 in the settings window. Observe the video streaming

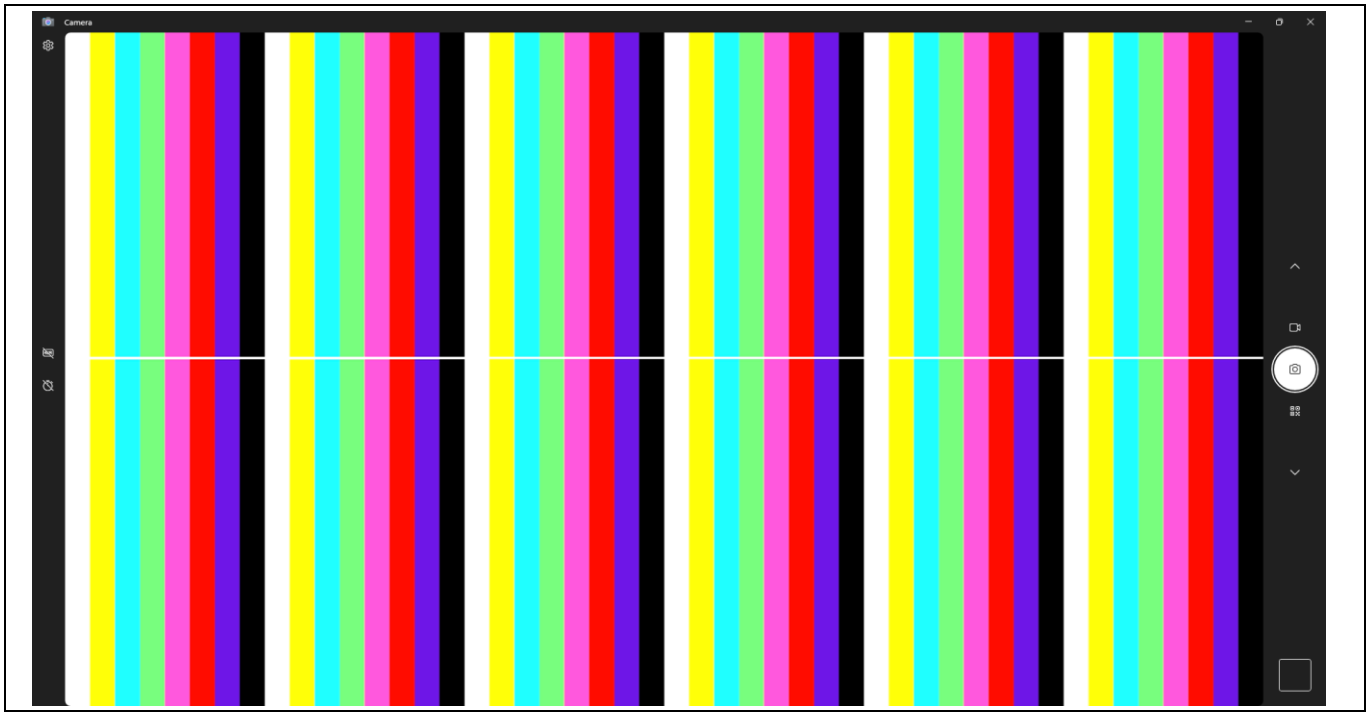

**Figure 10 Streaming on Windows Camera application**

5. On a USB 3.2 Gen 1x2 host, the frame rate will be ~60 fps. This can be viewed on the serial terminal such as Tera Term. Take a USB-C FS cable and connect its one end to J3 and the other end to a PC. Open any serial terminal application such as Tera Term. Select the correct COM port and you see the debug logs printing ~60 fps.

## 5.2 Viewing the U3V output using eBus Player application

1. Follow the instructions in the SDK user guide to build the *u3v_inmem* project
2. Program EZ-USB™ FX5N with the generated *.hex* file by following the steps mentioned in the Program the user application section
3. Check the **Device Manager** for USB enumeration

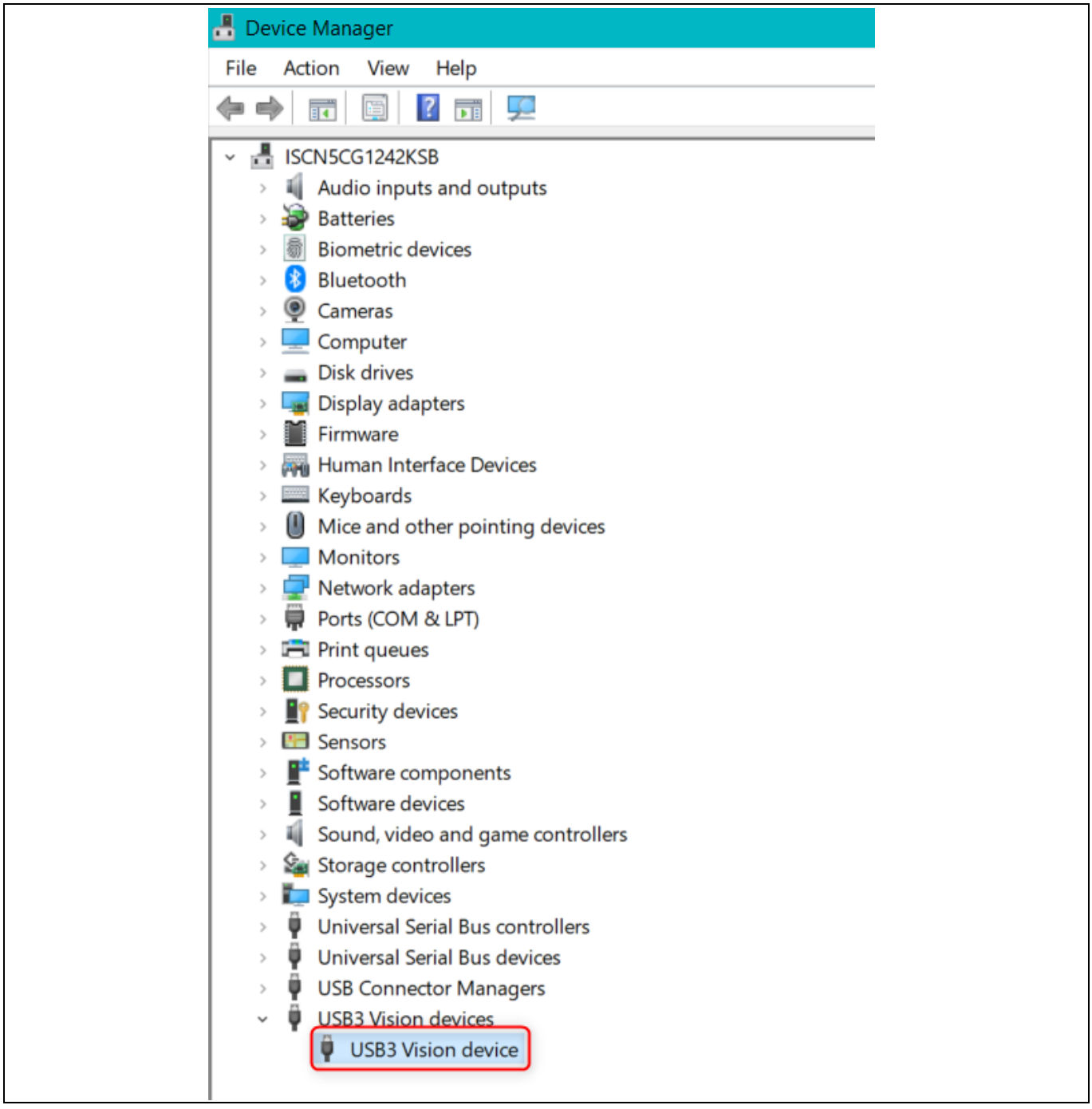


**Figure 11 U3V device enumeration**

## Run the application (internal color bar)

4. Open eBus Player application and do the following:
   a) Go to **Select/Connect**
   b) Select the available device. For example, **FX3G2**
   c) Press **OK**

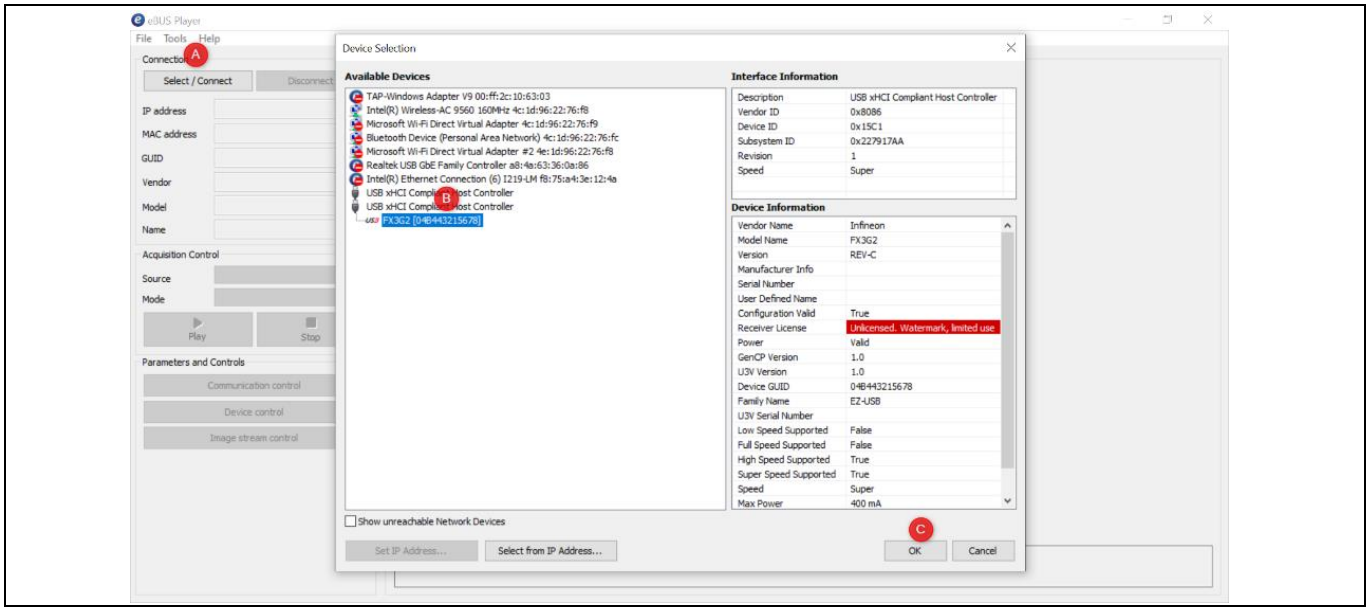


**Figure 12 eBus Player settings**

5. Click on **Play** button and observe the video streaming

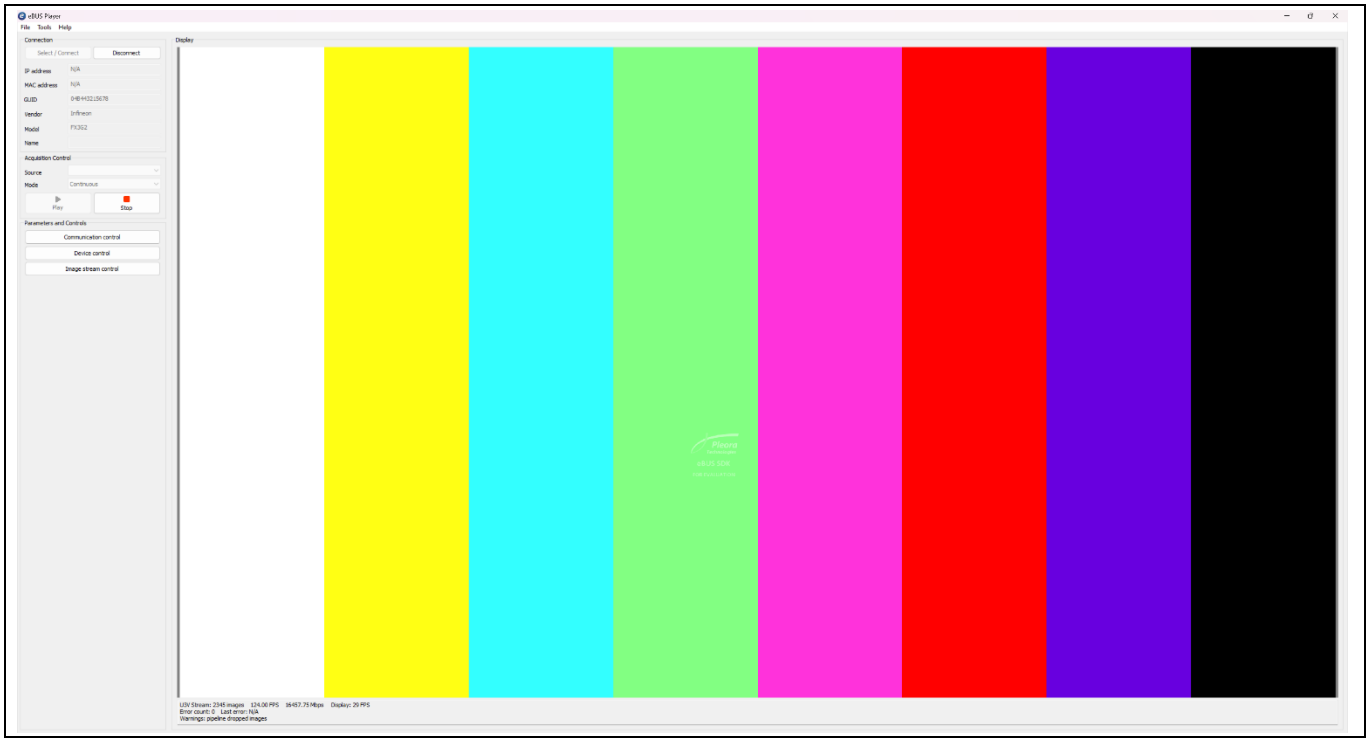

**Figure 13 U3V colorbar streaming**

*Note: Internal color bar can stream at up to ~60 fps.*

# 6 Troubleshooting

## 6.1 EZ-USB™ FX5N programming test

1. If EZ-FX™ Control Center is not detecting the EZ-USB™ FX5N device:
   a) Press and hold the PMODE switch (SW2)
   b) RESET EZ-USB™ FX5N: (Either press the RESET switch SW1 and release or power cycle the kit)
   c) Release the PMODE switch after a delay

If you have any questions, create a support request on the Infineon Technical Support page.

# References

[1] Infineon Technologies AG: *EZ-USB™ FX5N kit webpage*; Available online

[2] Infineon Technologies AG: *EZ-USB™ FX5N datasheet;* Available online

# Glossary

**DMA**
*active authenticat*ion (AA)

**DAP**

debug access port

**EMC**

Electromagnetic Compatibility

**ESD**

Electrostatic discharge

**FW**

Firmware

**JTAG**

Joint test action group

**LVDS**

Low-voltage differential signaling

**PDM**

Pulse density modulation

**QSPI**

Quad serial peripheral interface

**SDK**

Software development kit

**SPI**

Serial peripheral interface

**SWD**

Serial Wire Debug

## Revision history

| Document revision | Date | Description of changes |
|---|---|---|
| ** | 2025-02-27 | Initial release |
| *A | 2025-03-21 | Updated FX5N webpage url |
| *B | 2025-03-25 | Released to Web |

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