CY-RB4111 EZ-USB™ FX3 USB3 Vision solution demo kit guide

About this document

Scope and purpose

This document is a user guide for the CY-RB4111 EZ-USB™ USB3 Vision solution demo kit. This kit enables you to stream USB3 Vision video from an external HDMI source directly into a PC. Refer the relevant sections based on your requirements:

- **Introduction** – Provides basic information on the kit
- **Installing the kit software** – Explains the installation of software required to program the kit
- **Kit hardware** – Explains the kit architecture and system design details
- **Kit programming** – Describes the procedure to program the kit
- **Kit operation** – Explains the procedure to operate the kit

Intended audience

This document is intended for users of the EZ-USB™ FX3 USB3 Vision solution demo kit.

Table of contents

About this document **1**
Table of contents **2**
1 Introduction **3**
1.1 Kit contents 3
1.2 Download kit documents and hardware design files 3
1.3 Board details 4
1.4 Kit features 4
2 Installing the kit software **5**
2.1 Before you start 5
2.2 Install FX3 SDK 5
2.3 Install Pleora eBUS Player 5
3 EZ-USB™ FX3 USB3 Vision solution demo kit system design **6**
3.1 Top-level hardware design 6
3.2 CY-RB4111 design details 6
3.2.1 USB connector (J1) 6
3.2.2 Mode selection switch (SW1) 6
3.2.3 Power supply 7
3.2.4 EZ-USB™ FX3 (U6) 7
3.2.5 SPI flash (U11) 7
3.2.6 HDMI connector (J6) 7
3.2.7 Crystal (Y1, Y3) 7
3.2.8 LED (LED1) 7
3.2.9 HDMI receiver (U17) 7
3.2.10 Lattice ECP5 FPGA (U10) 8
3.2.11 DDR3 RAM (U12) 8
4 Programming the EZ-USB™ CY-RB4111 FX3 controller **9**
5 Kit operation **11**
5.1 Booting from the SPI flash 11
5.2 Video streaming from HDMI source 11
5.3 Streaming other resolutions 14
6 Troubleshooting **16**
6.1 Programming test 16
6.1.1 No bootloader device detected in USB Control Center 16
6.2 Video streaming test 16
6.2.1 FX3 not displayed in eBUS Player 16
6.2.2 Black screen detected in eBUS Player app 17
6.2.3 Configuring Windows host to support second display 18
6.2.4 Streaming stops responding 18
References **19**
Technical support **20**
Revision history **21**

1 Introduction

The CY-RB4111 EZ-USB™ FX3 USB3 Vision solution demo kit is based on the FX3 product family of Infineon's SuperSpeed USB controllers.

FX3 has a fully programmable General Programmable Interface (GPIF II) that can interface with any processor, ASIC, image sensor, or FPGA. It provides easy and effortless connectivity to popular industry interfaces such as synchronous slave FIFO and image sensor interfaces. The EZ-USB™ FX3 USB3 Vision solution demo kit combines hardware, software, and documentation that enable customers to stream USB3 Vision (U3V) video from an HDMI source directly into a PC. This user guide describes the steps to install the software required by the kit and to operate the development board provided with the kit.

This kit is intended to be a solution demo kit for U3V video streaming applications from an HDMI source to a PC via USB-C interface.

See the device datasheets **[4]** to understand and compare the various features supported by EZ-USB™ FX3 controllers.

The CY-RB4111 EZ-USB™ FX3 USB3 Vision solution demo kit supports the following key features:

- U3V Video streaming up to 4K (UHD) at 30 fps from an HDMI source
- USB bus-powered operation
- Onboard regulators

For FX3 controller details, see the **webpage**.

1.1 Kit contents

The CY-RB4111 EZ-USB™ FX3 USB3 Vision solution demo kit consists of the following:

Table 1 Kit contents

Item	Type	Comments
FX3 USB3 Vision kit	Hardware	-
SuperSpeed USB-C cable	Cable	-
HDMI-A male cable	Cable	-
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

The documents and the hardware design files for CY-RB4111 EZ-USB™ FX3 USB3 Vision solution demo kit can be downloaded from the kit webpage **[3]**. The documents include a QSG, kit user guide (this document) and release notes. The hardware design files include schematic, bill of materials (BOM), and layout files.

1.3 Board details

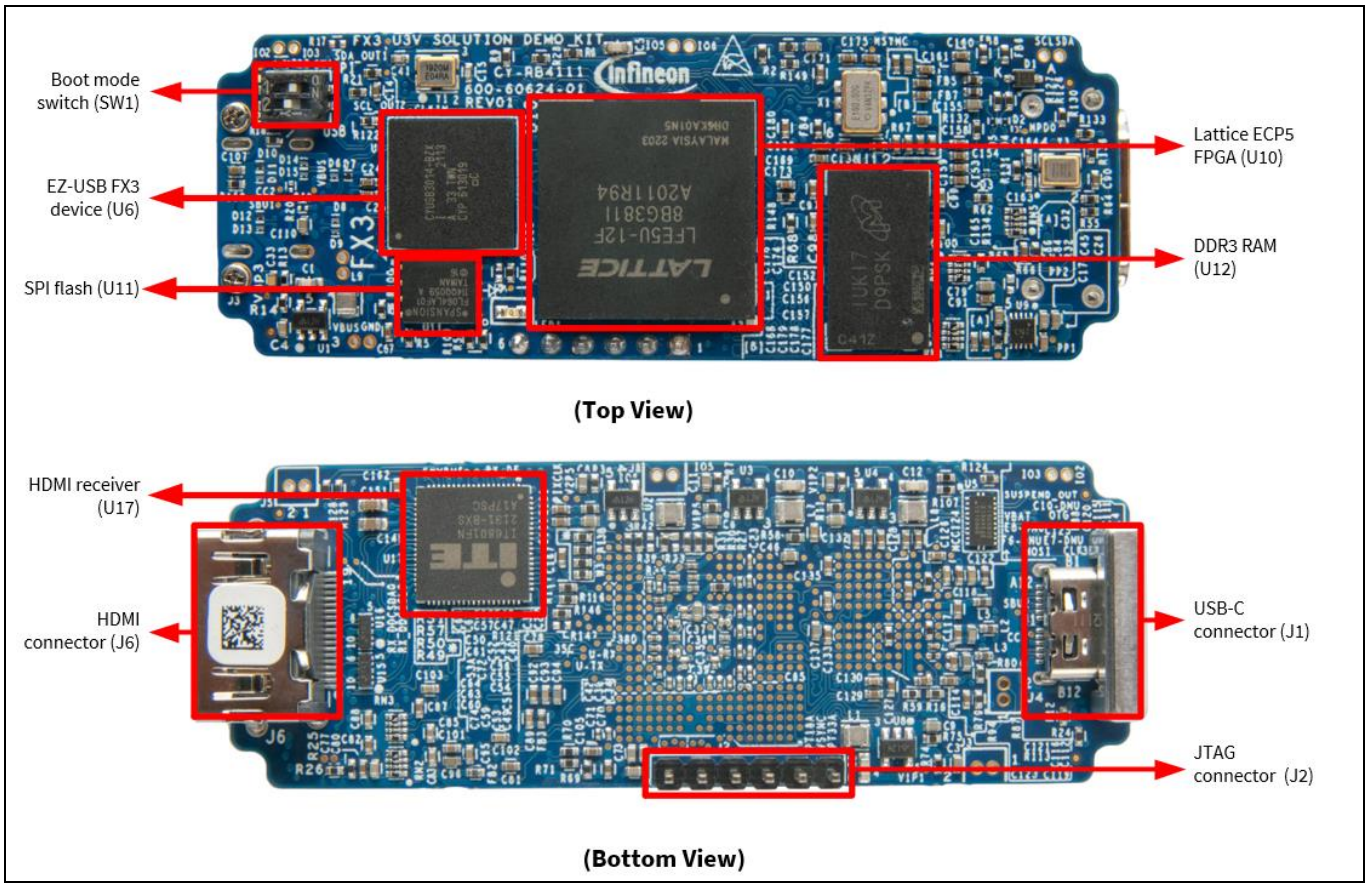

Figure 1 CY-RB4111 EZ-USB™ FX3 USB3 Vision solution demo kit

1.4 Kit features

The kit features an FX3 controller and ECP5 FPGA from Lattice Semiconductor that can be configured to stream U3V video from an external HDMI source directly into a PC. The onboard ITE HDMI receiver enables users to stream HDMI video up to 4K at 30 fps. See **Section 5** for more details.

2 Installing the kit software

2.1 Before you start

The installation of the FX3 SDK and other Infineon software may require administrator privileges. However, privileges are not required to run the software once it is installed.

2.2 Install FX3 SDK

Download and install **EZ-USB™ FX3 software development kit** to configure and evaluate the example templates on the CY-RB4111 kit.

Installable packages are available for Windows, Linux, and macOS.

After the installation is complete, the contents are available at *<Install Directory>\ EZ-USB FX3 SDK.*

Note:

1. *The default <Install Directory> is C:\Program Files(x86)\Cypress.*
2. *See **GettingStartedWithFX3SDK.pdf** available in the installation directory for more details.*

2.3 Install Pleora eBUS Player

Download and install Pleora eBUS Player:

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

3 EZ-USB™ FX3 USB3 Vision solution demo kit system design

The kit is bus-powered and supports a SuperSpeed USB-C cable to connect to the PC. To demonstrate the full functionality of the kit, an HDMI source must be connected to the onboard HDMI connector.

3.1 Top-level hardware design

The CY-RB4111 EZ-USB™ FX3 USB3 Vision solution demo kit consists of the FX3 device, the ECP5 FPGA from Lattice Semiconductor, an HDMI receiver, an external SPI flash module, the DDR3 SDRAM, onboard regulators and USB-C and HDMI connectors.

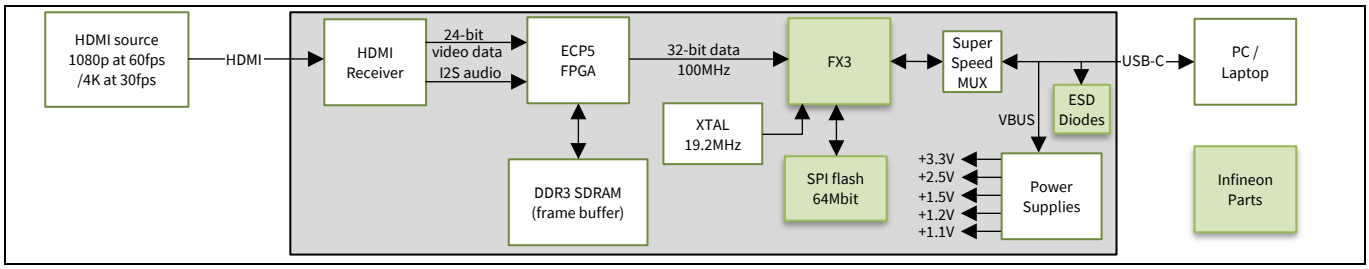

Figure 2 CY-RB4111 EZ-USB™ FX3 USB3 Vision solution demo kit architecture

3.2 CY-RB4111 design details

The CY-RB4111 board consists of the FX3 silicon (CYUSB3014-BZXI), SuperSpeed MUX, 64-Mbit SPI flash, HDMI receiver, ECP5 FPGA and DDR3 SDRAM. The kit is bus-powered and uses a 19.2 MHz crystal for operation. It provides HDMI and USB-C interface connectors to connect an external HDMI source and PC, respectively.

3.2.1 USB connector (J1)

An onboard certified USB-C receptacle (J1) allows FX3 to communicate with the PC via a SuperSpeed USB-C cable that is provided with the kit. Use this port to test FX3 applications. Using the Type-C interface allows access to the FX3 debug interface using serial terminal messages.

3.2.2 Mode selection switch (SW1)

This switch selects the mode in which FX3 must boot upon power-on. The kit can boot in two modes based on the position of this switch.

Table 2 Boot modes

Boot mode	PMODE1	PMODE2
USB	SW1.2 ON	SW1.1 OFF
SPI	SW2.2 OFF	SW1.1 ON

To program the device, set SW1 in USB mode. After programming, setting the mode switch in SPI mode and rebooting the device by power cycle allows FX3 to boot from the onboard SPI flash.

3.2.3 Power supply

The kit consists of five DC-DC step-down regulators with ratings as listed below. AP3428KTTR-G1 from Diodes Inc. is used due to its small form factor. All voltages listed below are generated from VBUS (i.e., 5 V ± 0.25 V).

- U1: 3.3 V ±5% at 1 A
- U2: 2.5 V ± 5% at 1 A
- U3: 1.5 V ± 5% at 1 A
- U4: 1.2 V ± 5% at 1 A
- U8: 1.1 V ± 5% at 1 A

The kit also uses a 2 A DDR termination controller (U9) to power the VTT bus terminations. It also provides the reference output to the DDR IC.

3.2.4 EZ-USB™ FX3 (U6)

This is a USB 3.1 Gen 1 SuperSpeed controller with a 32-bit ARM926EJ core CPU and 512-KB embedded SRAM. It supports UVC, UAC, U3V, and USB Vendor Class protocols. With a general programmable interface (GPIF II) of 8-, 16-, 24- and 32-bit data bus at 100 MHz, FX3 supports slave FIFO and parallel camera interface features. It has dedicated interfaces for SPI flash and I^2C. FX3 supports selectable clock input frequencies at 19.2, 26, 38.4, and 52 MHz. Additionally, a dedicated 19.2-MHz crystal input support is also available. It is a 121-ball, 10- × 10-mm, 0.8-mm pitch Pb-free ball grid array (BGA).

3.2.5 SPI flash (U11)

The kit firmware is stored on an Infineon 64-Mbit SPI flash. After power-on, FX3 fetches the required details from the firmware image, stores it in its RAM, and starts executing from it.

3.2.6 HDMI connector (J6)

The kit has an onboard HDMI connector that allows it to connect to an external HDMI source using an HDMI cable.

3.2.7 Crystal (Y1, Y3)

Y1 is a 19.2-MHz crystal used by FX3 to generate the clock for its operation. Y3 is a 27-MHz crystal used by HDMI RX.

3.2.8 LED (LED1)

LED1 (user LED) is a green LED connected to GPIO_4 of FX3. By default, with power-on, this LED glows green, indicating the power to the kit. It can also be controlled by the application.

3.2.9 HDMI receiver (U17)

The kit uses a single-port HDMI receiver that supports HDMI 1.4b. It supports streaming of 4K videos with 24-bit RGB digital video standard and up to four channels of I^2S output.

3.2.10 Lattice ECP5 FPGA (U10)

The kit uses an ECP5 family FPGA from Lattice Semiconductor. It is a high-performance device with dedicated DDR3 RAM interfaces and supports high-speed signaling. This FPGA acts as a bridge between the HDMI receiver and the FX3 device. It receives 24-bit RGB video signals and I^2S audio signals from the HDMI receiver, processes and sends them to FX3 via the 32-bit slave FIFO interface at 100 MHz. This allows FX3 to directly communicate with an HDMI source.

3.2.11 DDR3 RAM (U12)

This kit has an onboard 2-Gb DDR3 SDRAM that is used by the FPGA to process the digital audio and video data received from the HDMI receiver and communicate it to FX3 via the 32-bit slave FIFO.

4 Programming the EZ-USB™ CY-RB4111 FX3 controller

The EZ-USB™ FX3 controller on the CY-RB4111 EZ-USB™ FX3 USB3 Vision solution demo kit is preprogrammed with the latest firmware at the time of manufacturing.

The CY-RB4111 kit is preprogrammed with the firmware to stream 4K U3V videos at 30 fps from an HDMI source. Use the USB Control Center application available in the FX3 SDK to change the firmware.

1. Set switch SW1 on the kit to boot in USB mode according to **Table 2**.
2. Connect the kit to PC using SuperSpeed USB-C cable.

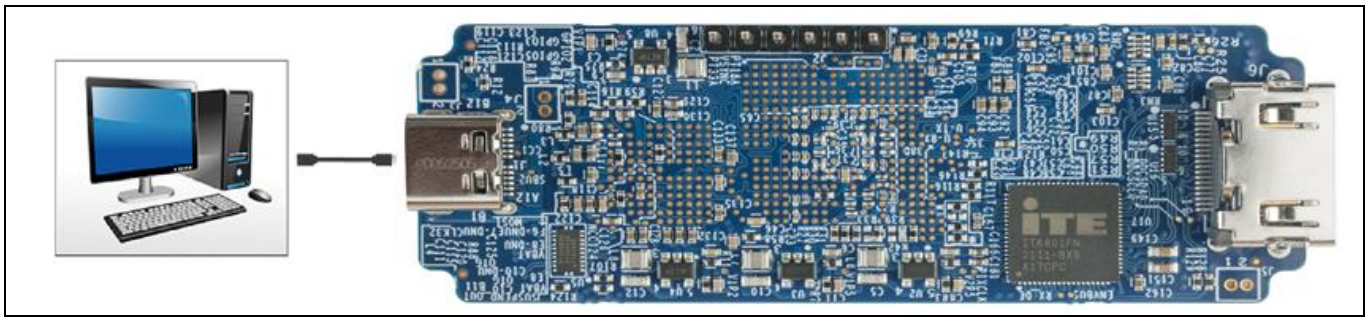

Figure 3 Connecting the kit with the PC

3. Open the EZ-USB™ Control Center application. If the application is not present on the desktop, browse to the FX3 SDK installation directory (*C:\Program Files (x86)\Cypress\EZ-USB FX3 SDK*).
   The board should appear as “Cypress USB Bootloader Device” in the left pane of the USB Control Center application.

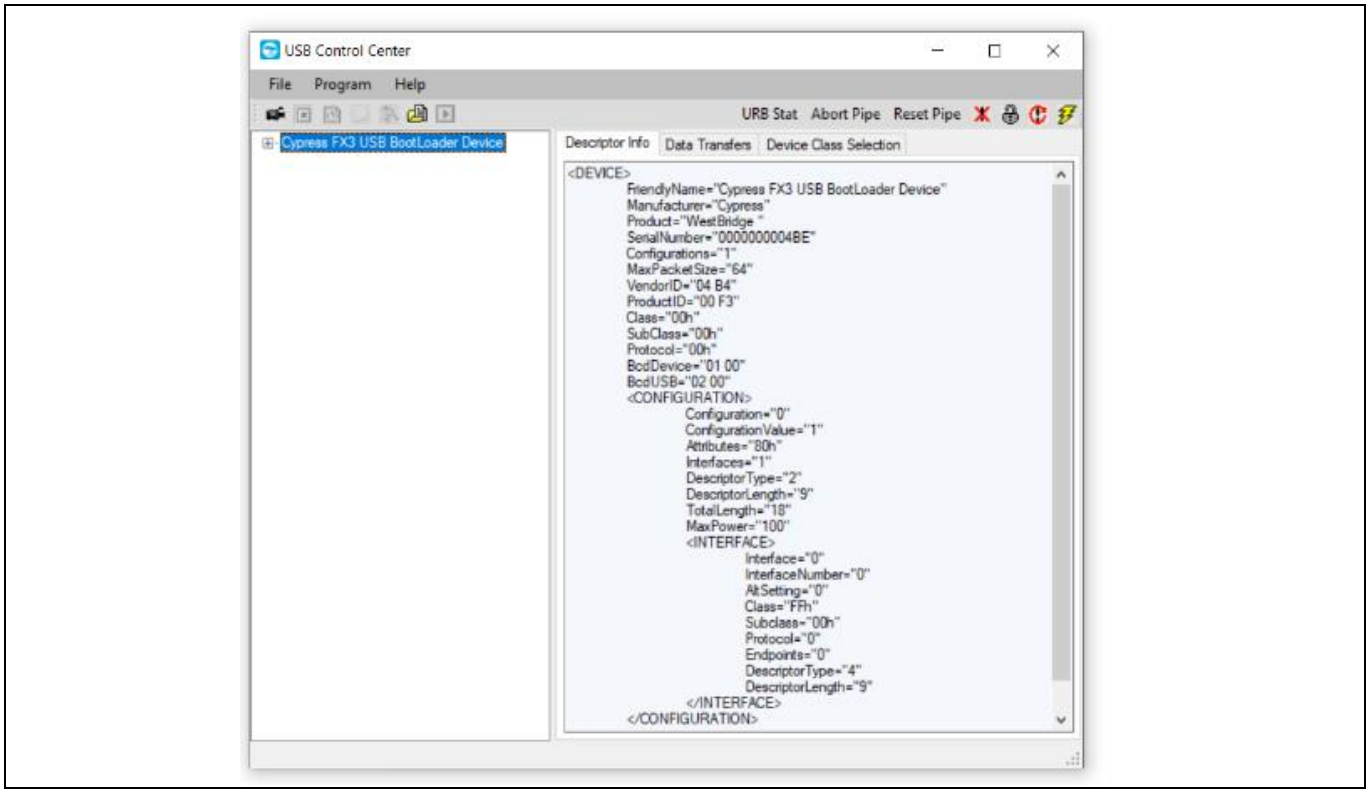

Figure 4 Device enumeration in control center application

4. Click **Program** > **FX3** > **SPI FLASH**

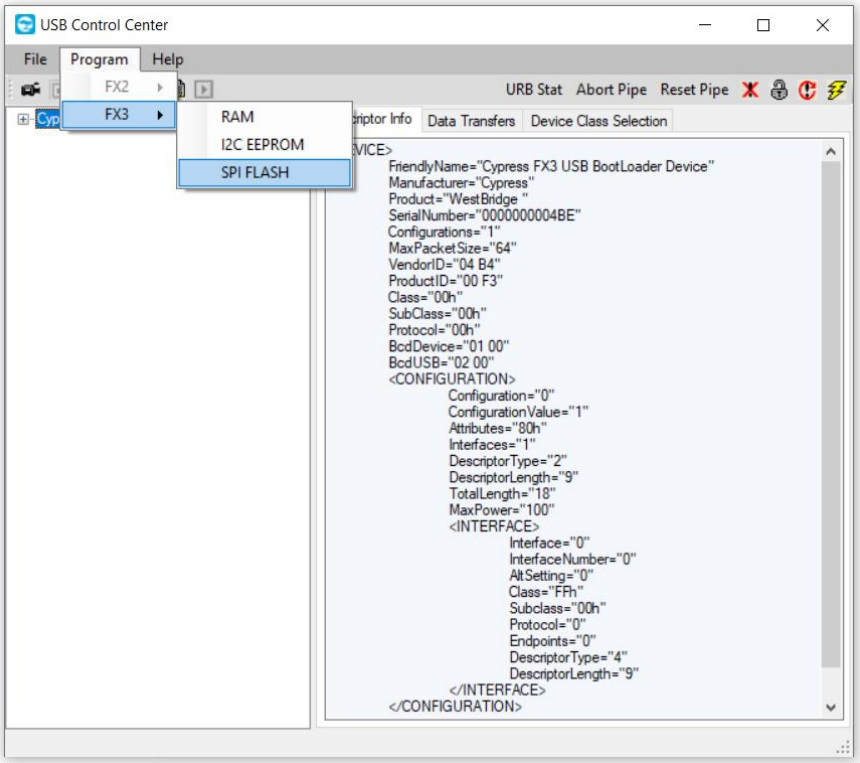

Figure 5 Programming the SPI FLASH

5. Browse to select the downloaded firmware file.

Table 3 Project files

S. No.	Firmware Image
1	*U3V_HDMI_FX3_4defa95_u3v_hdmi_fx3_4defa958_21Jun22_095740_MERGED.img*

6. Wait for programing to complete. Status can be seen on bottom left of the window.
7. Disconnect the kit power by removing the USB cable from the PC.

5 Kit operation

Important note: Before starting the demo, ensure the kit is loaded with the appropriate firmware as shown in **Table 3**.

5.1 Booting from the SPI flash

1. Set the switch SW1 setting to SPI position as below:
   Move SW1 pin 1 to ON position and pin 2 to OFF position.

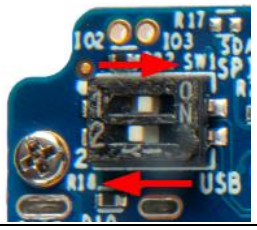

Figure 6 Boot mode switch in SPI mode

2. Connect the power back by plugging the USB-C cable to the PC.
3. Plug-in the HDMI cable to HDMI source such as laptop/set-top box/gaming console.



Figure 7 Connecting the kit to the HDMI port of laptop

5.2 Video streaming from HDMI source

1. Ensure that the steps in **Section 4** are followed and the firmware image is loaded.
2. Ensure that the steps in **Section 5.1** are followed to boot from SPI flash.
3. Open the eBUS Player app.
4. Click **Select/Connect** from the eBUS Player. Verify that FX3 is detected as shown in **Figure 8**.

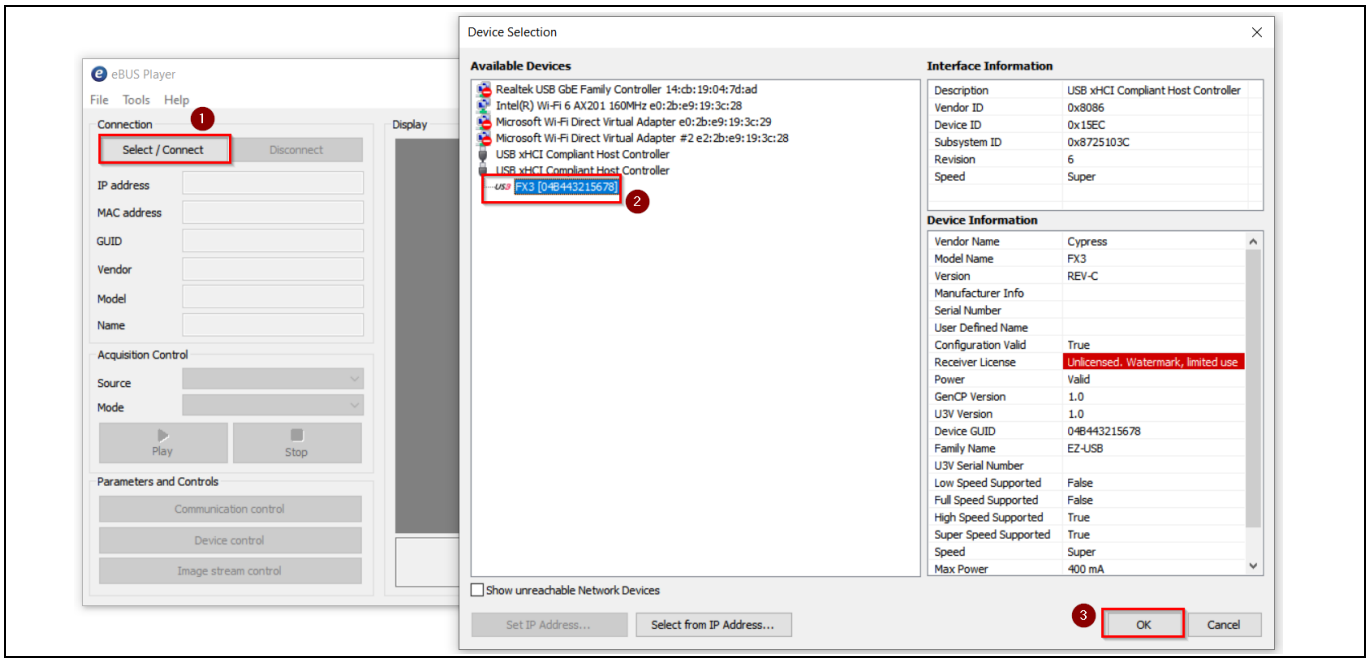

Figure 8 Selecting USB3 Vision device in eBUS Player application

5. If FX3 is not detected, go to *C:\Program Files\Common Files\Pleora\eBUS SDK\U3V\Certified* and install the U3V driver as shown in **Figure 9**.

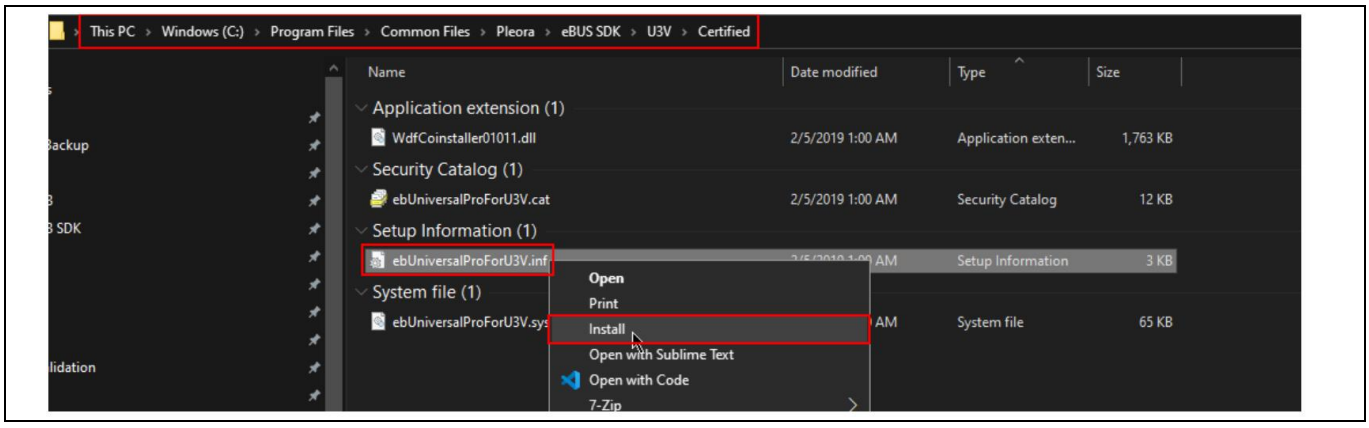

Figure 9 Installing the driver for USB3 Vision player (eBUS Player)

6. Click **Play** and observe the streaming video in the display pane.
   You can check the streaming statistics in the status pane below the display pane.

Kit operation

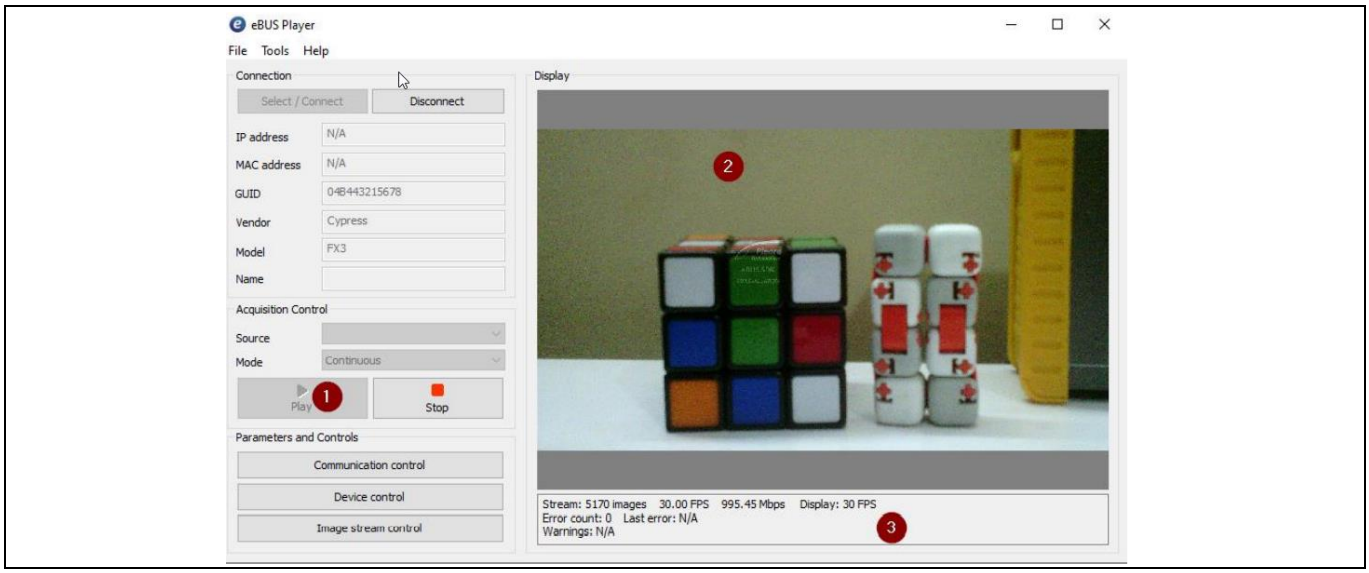

Figure 10 Check the streaming video in the display pane and its statistics in the status pane

7. Click **Device control** and verify the streaming resolution 3840 x 2160 indicating 4K streaming.

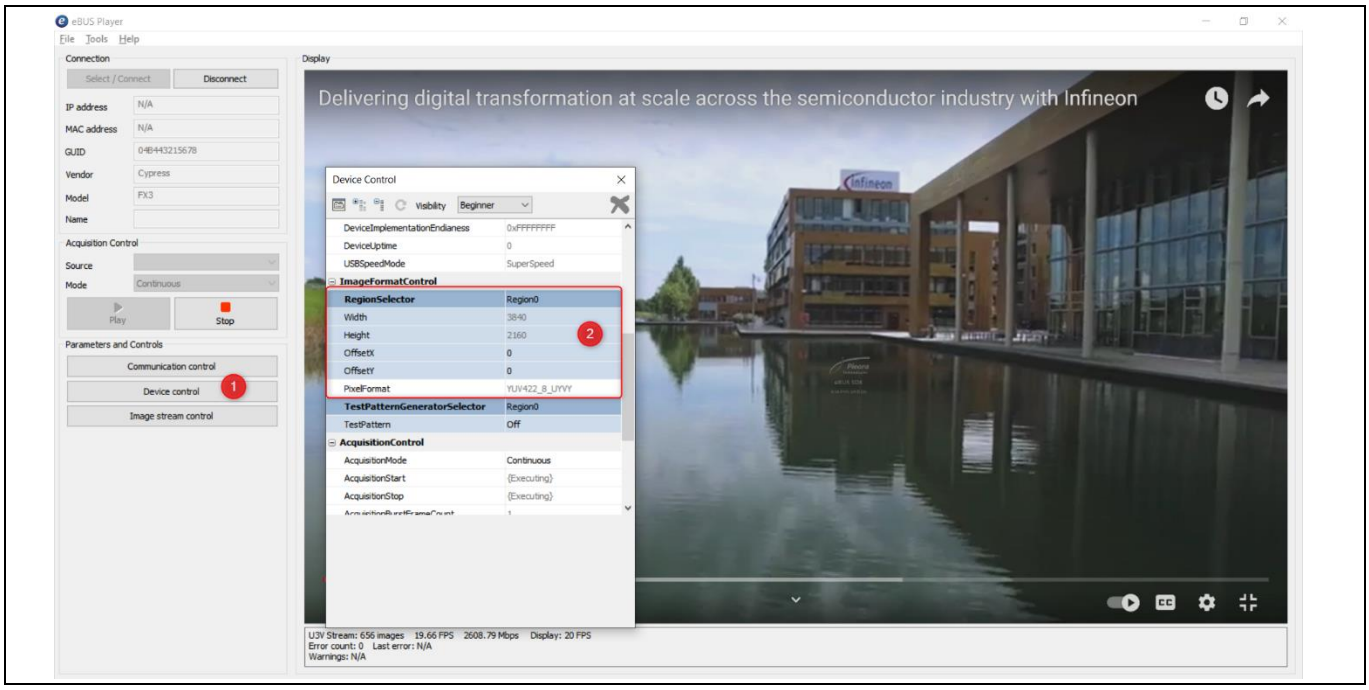

Figure 11 Device control settings

5.3 Streaming other resolutions

1. This kit supports the following resolutions:

Table 4 Resolutions supported by this kit

Video type	Resolution (Width x Height)	Frame rate (fps)
4K	3840 x 2160	30
1080p	1920 x 1080	60
720p	1280 x 720	60
VGA	640 x 480	60

Note: To view the video in the eBUS Player, the resolution setting of the HDMI source and eBUS Player must be the same.

2. Set the HDMI source resolution as shown in **Table 4**.
3. Streaming resolution in the eBUS Player can be changed in Device Control setting in Image Format Control.

Note: Ensure to stop the streaming before changing the resolution.

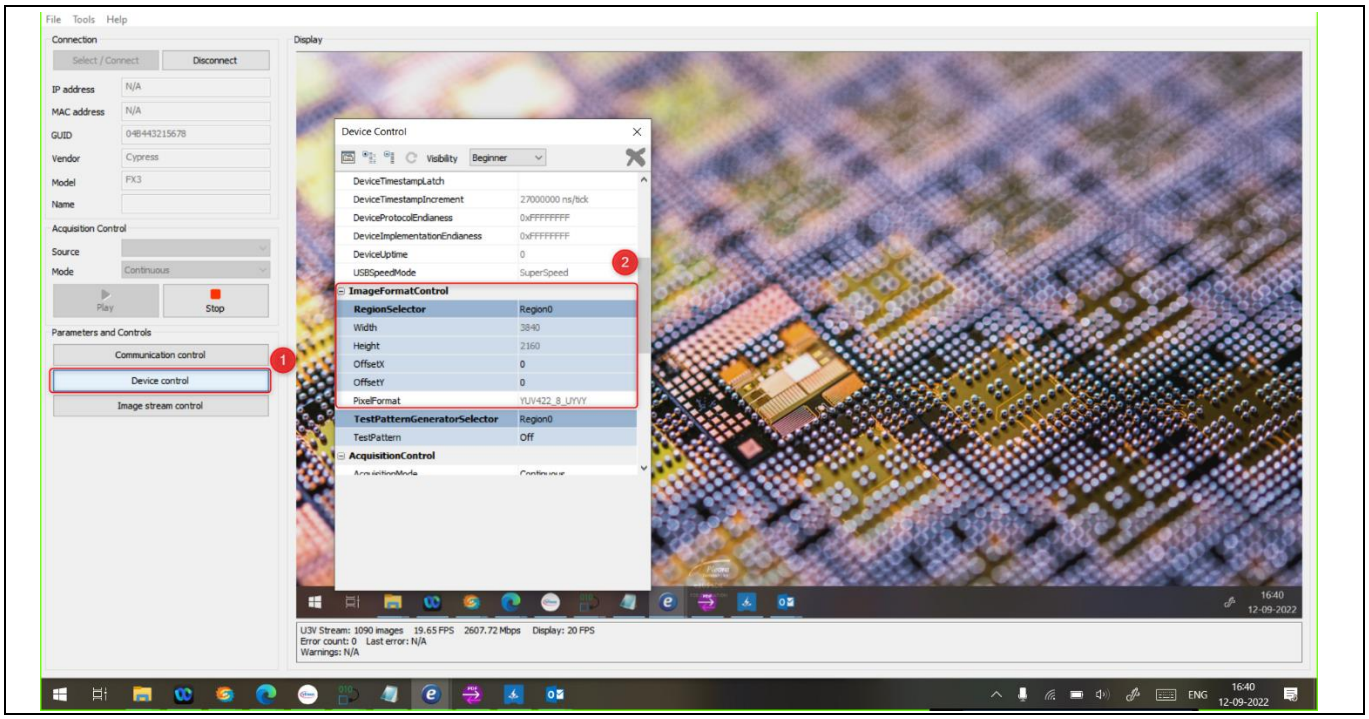

Figure 12 Device control settings

4. Enter the required resolution in the Width and Height fields as shown in **Figure 13** according to **Table 4** and close the window.

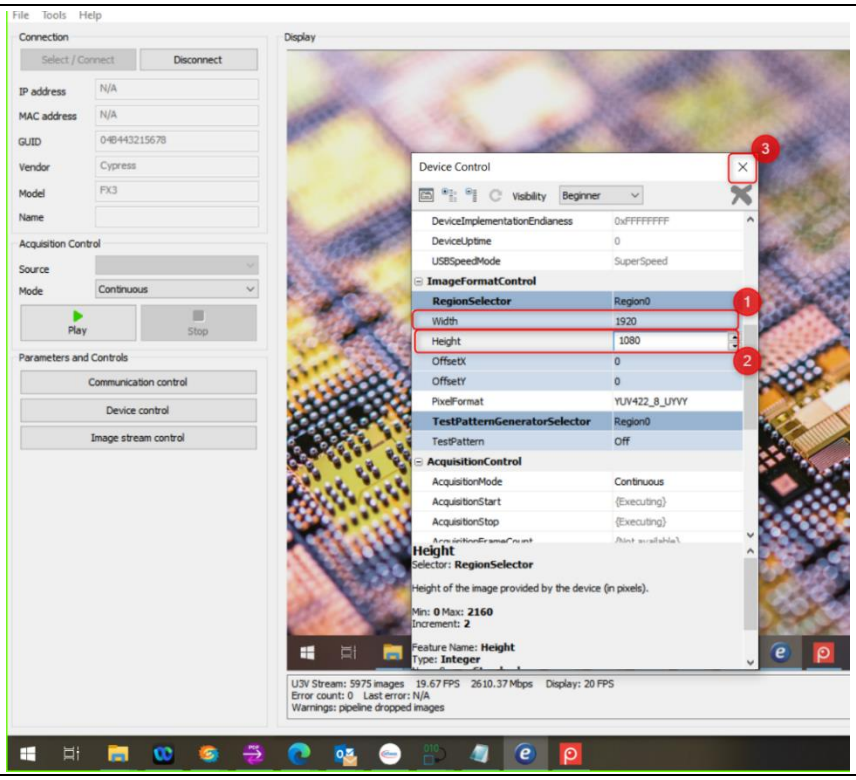

Figure 13 Display resolution changed to 1080p

5. Click **Play** to stream the video.

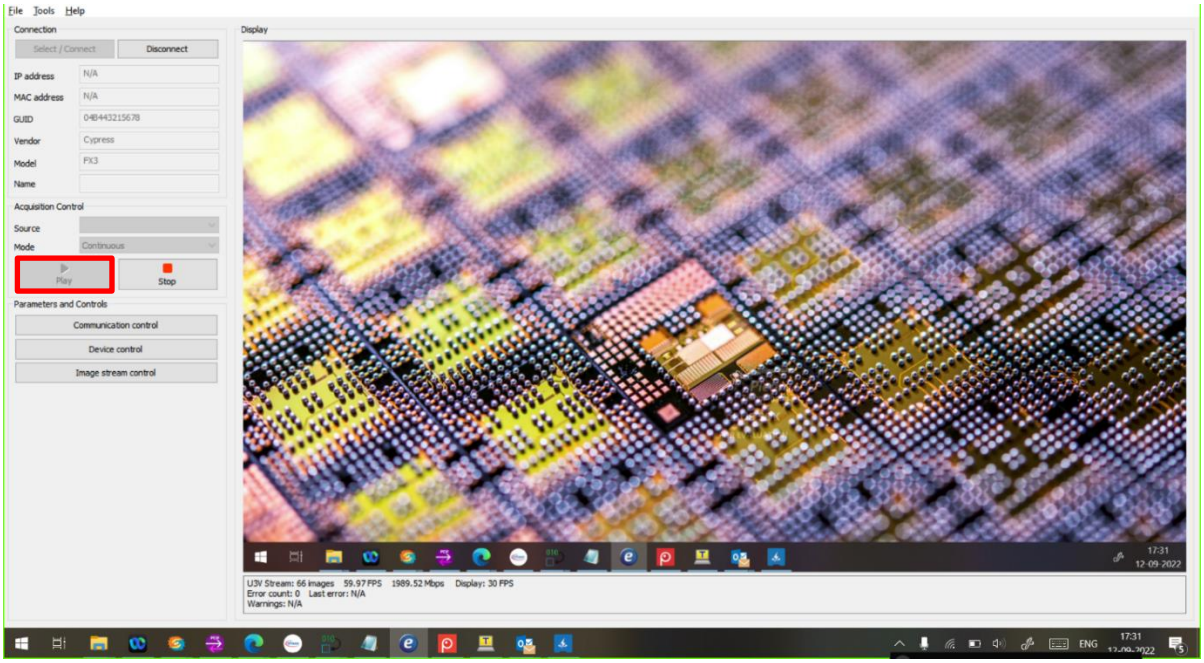

Figure 14 Video streaming at 1080p

6 Troubleshooting

6.1 Programming test

6.1.1 No bootloader device detected in USB Control Center

If “Cypress FX3 USB Bootloader device” is not visible in the USB Control Center application, verify that the PMODE switch (SW1) is in the “USB” state.

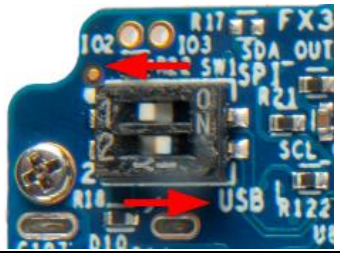

Figure 15 Mode switch setting for USB mode

6.2 Video streaming test

6.2.1 FX3 not displayed in eBUS Player

Verify that the PMODE switch (SW1) is in the SPI position.

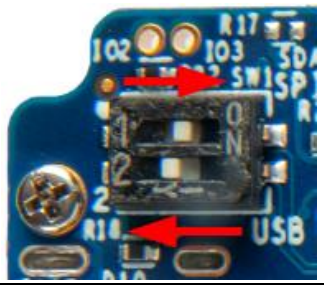

Figure 16 Boot mode switch in SPI mode

6.2.2 Black screen detected in eBUS Player app

1. Check the HDMI input source resolution.

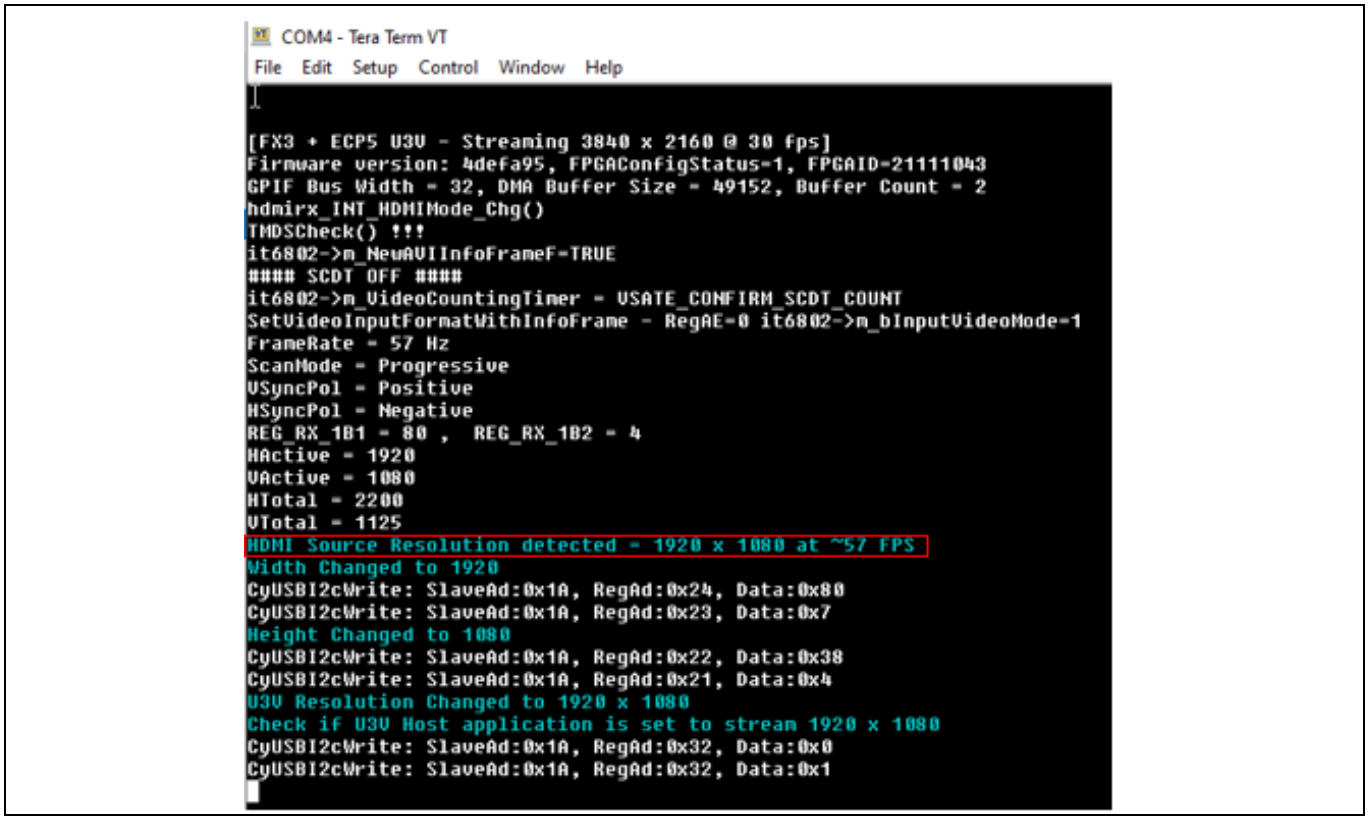

Figure 17 HDMI source resolution display in Tera Term window

2. Change in eBUS Player to receive the appropriate HDMI input source resolution. In the example shown, it is set for 1920 x 1080.

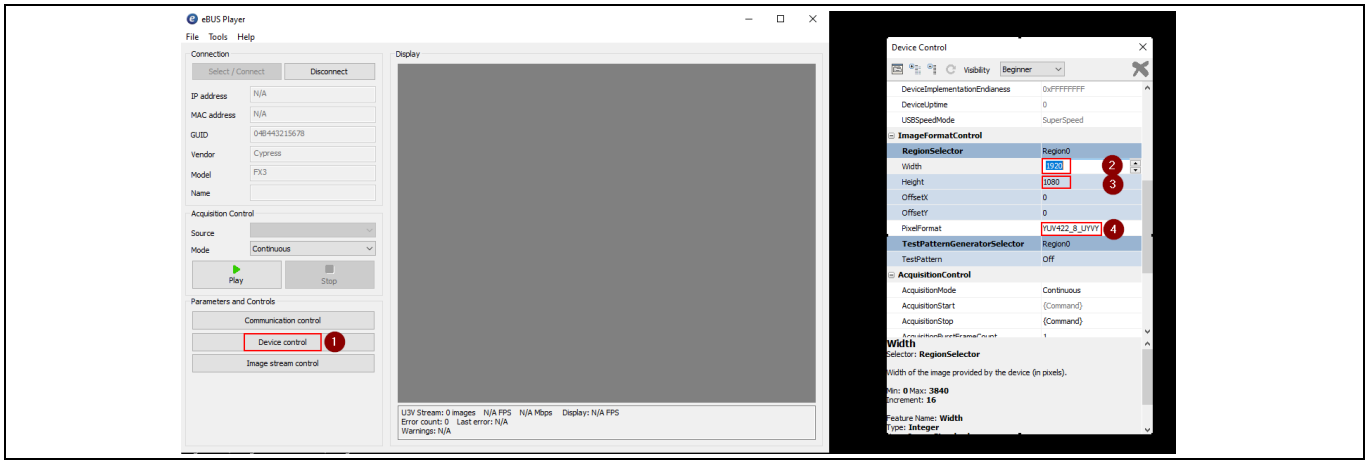

Figure 18 Resolution change window in eBUS Player

3. Check the debug logs:
   - Open Tera Term and connect to the COM port associated with the FX3 device.
   - Check if any error messages are displayed.

6.2.3 Configuring Windows host to support second display

1. Search for “extend” and select “Duplicate or extend to a connected display”.

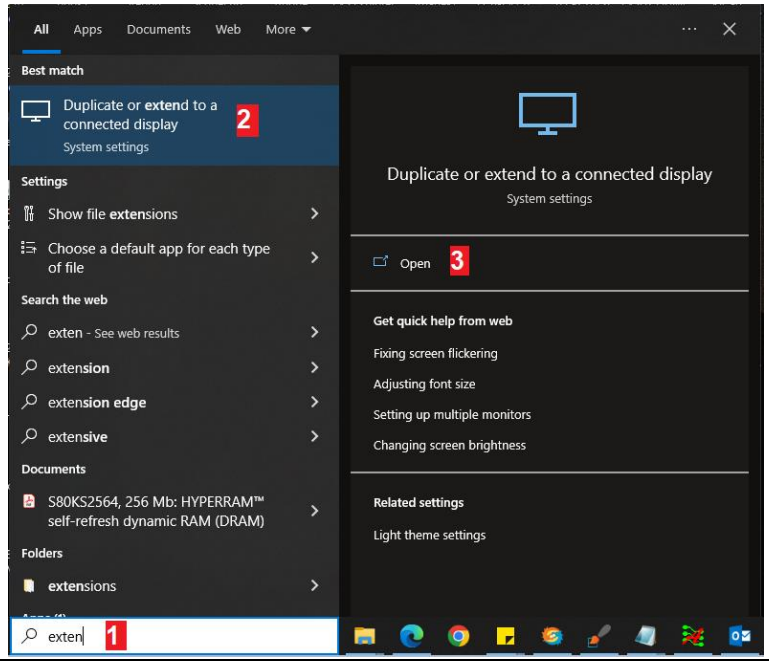

Figure 19 Display extension setting in Windows PC

2. Scroll down to “Multiple displays”. Select “Extend these displays”.

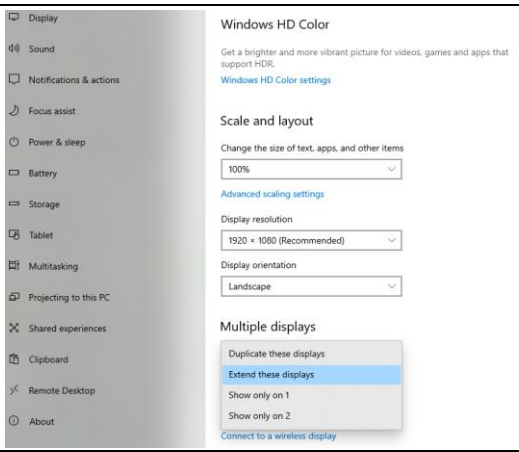

Figure 20 Select extend display

*Note: If the above troubleshooting steps do not resolve the problem, visit the Infineon **Technical Support** page.*

6.2.4 Streaming stops responding

While changing the display resolution in the eBUS Player, if streaming becomes unresponsive in a single frame, check the system display setting for fps is set according to **Table 4**.

References

[1] Overview: **Infineon USB controller roadmap**

[2] Product webpage: **EZ-USB™ FX3 webpage**

[3] Kit webpages: **CY-RB4111 webpage**

[4] Datasheets: **EZ-USB™ FX3 datasheet**

Technical support

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

Revision history

Date	Version	Description
2022-08-25	**	Initial release
2022-09-14	*A	Added **Streaming other resolutions** and **Streaming stops responding** sections

Trademarks
All referenced product or service names and trademarks are the property of their respective owners.

Edition 2022-09-14
Published by
Infineon Technologies AG
81726 Munich, Germany

©2022 Infineon Technologies AG.
All Rights Reserved.

Do you have a question about this document?
Go to: www.infineon.com/support

Document reference
002-36168 Rev. *A

IMPORTANT NOTICE
The information given in this document shall in no event be regarded as a guarantee of conditions or characteristics ("Beschaffenheitsgarantie").

With respect to any examples, hints or any typical values stated herein and/or any information regarding the application of the product, Infineon Technologies hereby disclaims any and all warranties and liabilities of any kind, including without limitation warranties of non-infringement of intellectual property rights of any third party.

In addition, any information given in this document is subject to customer's compliance with its obligations stated in this document and any applicable legal requirements, norms and standards concerning customer's products and any use of the product of Infineon Technologies in customer's applications.

The data contained in this document is exclusively intended for technically trained staff. It is the responsibility of customer's technical departments to evaluate the suitability of the product for the intended application and the completeness of the product information given in this document with respect to such application.

For further information on the product, technology, delivery terms and conditions and prices please contact your nearest Infineon Technologies office (**www.infineon.com**).

WARNINGS
Due to technical requirements products may contain dangerous substances. For information on the types in question please contact your nearest Infineon Technologies office.

Except as otherwise explicitly approved by Infineon Technologies in a written document signed by authorized representatives of Infineon Technologies, Infineon Technologies' products may not be used in any applications where a failure of the product or any consequences of the use thereof can reasonably be expected to result in personal injury.