

EZ-USB™ FX20 USB MIPI Camera Demo Kit guide

DEMO_FX20_MIPI_001

About this document

Scope and purpose

This document is a user guide for the DEMO_FX20_MIPI_001 EZ-USB™ FX20 USB MIPI Camera Demo Kit. This kit supports development of applications based on the EZ-USB™ FX20 USB 3.2 Gen 2x2 device controller (CYUSB402x) for streaming UVC video from an external MIPI source directly into a PC. Infineon's EZ-USB™ CYUSB402x devices are referred to as "FX20" in this document. Refer to 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
- [Run application](#) – Explains the procedure to operate the kit

Intended audience

This document is intended for the users of DEMO_FX20_MIPI_001 EZ-USB™ FX20 USB MIPI camera demo kit.

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Important notice

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Safety precautions

Safety precautions

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Table 1 Safety precautions

	<p>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.</p>
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Introduction

1 Introduction

The EZ-USB™ FX20 USB MIPI Camera Demo Kit (DEMO_FX20_MIPI_001) is based on the Infineon EZ-USB™ FX20 USB 20 Gbps peripheral controller, which is targeted at next-generation USB applications in camera, video, imaging, and data acquisition markets. EZ-USB™ FX20 consists of the following:

- Dual Arm® Cortex®-M4 and M0+ core CPUs
- 512 KB flash
- 128 KB SRAM
- 128 KB ROM
- Seven Serial Communication Blocks (SCBs)
- A cryptography accelerator
- A high-bandwidth data subsystem providing DMA data transfers between LVDS/LVCMOS and USB ports at speeds up to 20 Gbps

An additional 1 MB SRAM is included in the high-bandwidth data subsystem to provide buffering for USB data. EZ-USB™ FX20 also supports USB Type-C plug orientation detection and flip-mux function without the need for external logic. See the device datasheets to understand and compare the various features supported by EZ-USB™ FX20 controllers.

This kit is intended to be a solution demo kit for video streaming from up to four external MIPI sources directly into a PC. The DEMO_FX20_MIPI_001 kit supports the following key features:

- UVC video streaming up to
 - 8K 30 fps from a single MIPI camera
 - 4K 60fps from two MIPI cameras
 - 4K 30fps from four MIPI cameras
- USB bus-powered operation
- Onboard microphones

For the FX20 controller details, see the [webpage](#).

1.1 Kit contents

The DEMO_FX20_MIPI_001 kit consists of the following:

Table 2 Kit contents

Item	Type	Comments
DEMO_FX20_MIPI_001 board	Hardware	–
USB-C 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

EZ-USB™ FX20 USB MIPI Camera Demo Kit guide

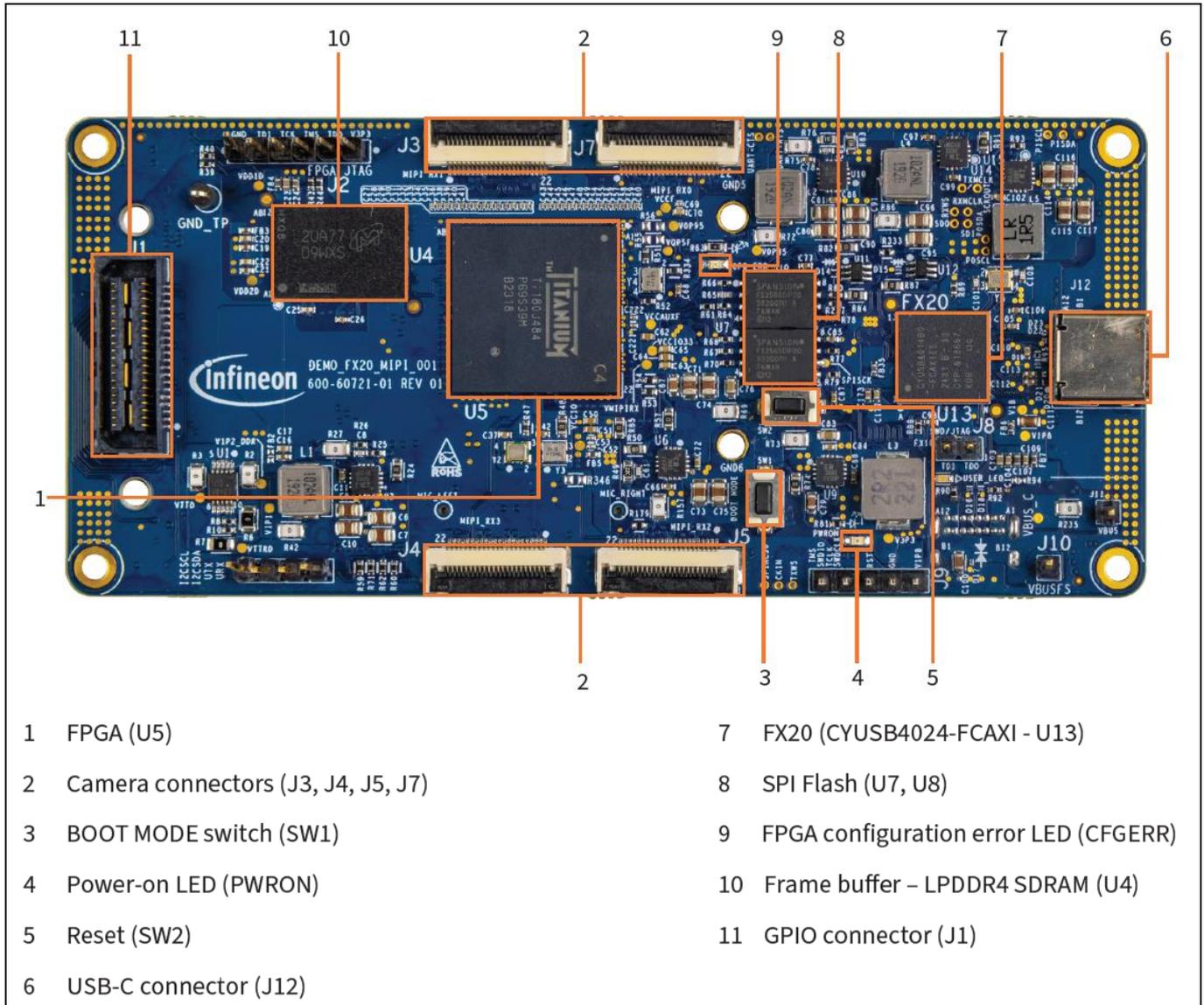
DEMO_FX20_MIPI_001

Introduction

1.2 Download kit documents and hardware design files

Download the documents and the hardware design files for the DEMO_FX20_MIPI_001 kit from the kit webpage. 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 Kit details



EZ-USB™ FX20 USB MIPI Camera Demo Kit guide

DEMO_FX20_MIPI_001

Introduction

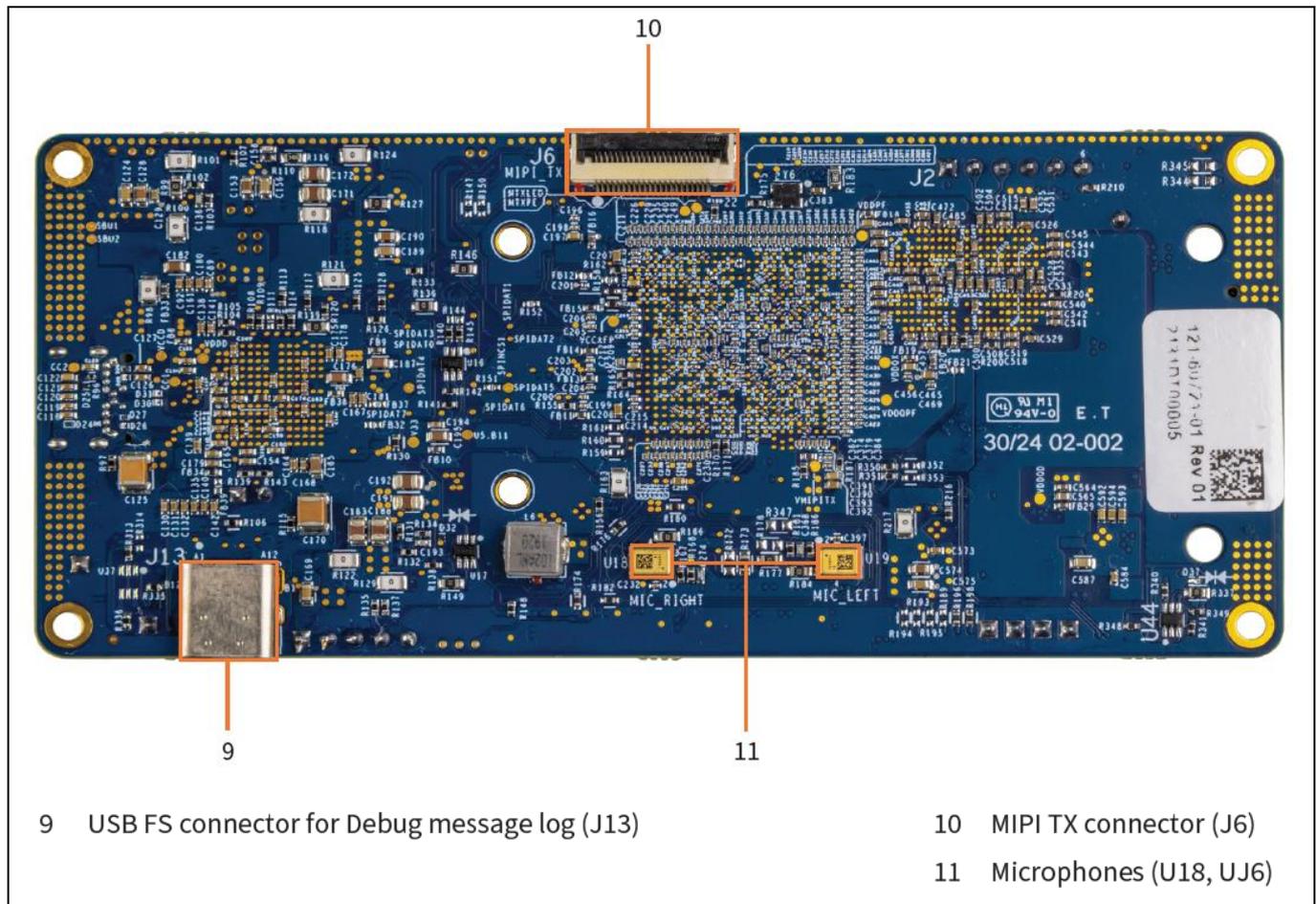


Figure 1 DEMO_FX20_MIPI_001 kit

1.4 Kit features

The kit features the FX20 USB 3.2 Gen2x2 controller and Trion T180 FPGA from Efinix Inc. that can be configured to stream UVC video from external MIPI camera sources directly into a PC.

Installing the kit software

2 Installing the kit software

2.1 Before you start

1. Download and extract the FX20 SDK from the kit webpage
2. Install the *EZ-USB_FX_Control_Center_Setup.exe* application
The installation may require administrator privileges. However, these privileges are not required to run the software once it is installed
3. Download the firmware *.hex* and FPGA *.bin* files available in the kit webpage

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System design

3.2.2 Boot Mode selection switch (SW1)

This switch selects the mode in which FX20 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	SW1
USB	ON - Hold the push button (SW1) and power cycle the kit either by pressing and releasing the RESET button (SW2) or removing and reconnecting the USB-C cable
SPI	OFF

To program the device, set the kit in USB mode. After programming, rebooting the device by power cycling or resetting by pressing and releasing the SW2 button allows FX20 to boot from the internal flash.

3.2.3 Power supply

The kit consists of six [IR3883MTRPBF](#) DC-DC buck switching regulators from Infineon. All these regulators provide protection against overvoltage, overcurrent, and overtemperature conditions.

The following voltages are generated from VBUS (that is, $5\text{ V} \pm 0.25\text{ V}$):

- U9: $3.3\text{ V} \pm 5\%$ at 3 A
- U15: $1.8\text{ V} \pm 5\%$ at 3 A
- U14: $1.2\text{ V} \pm 5\%$ at 3 A
- U2: $1.1\text{ V} \pm 5\%$ at 3 A
- U6: $0.95\text{ V} \pm 5\%$ at 3 A
- U10: $0.85\text{ V} \pm 5\%$ at 3 A

3.2.4 EZ-USB™ FX20 (U13)

This is a USB 3.2 Gen 2x2 device controller with the bandwidth to support USB output at speeds up to 20 Gbps for USB 3.2 Gen 2x2 based host systems. It supports USB Video Class (UVC), USB Audio Class (UAC), USB3 Vision (U3V), and USB Vendor Class protocols. The firmware is stored in the internal flash of FX20. The DEMO_FX20_MIPI_001 kit is pre-programmed to stream color bar video generated in the FPGA directly into a PC via USB-C interface. It is a 169-ball, $10 \times 10 \times 1.2\text{ mm}$, 13×13 ball array, 0.75 mm pitch FBGA.

3.2.5 QSPI flash (U7, U8)

The FPGA FW is stored in two Infineon 256-Mbit SPI flash devices. The kit executes the FW in passive mode. After power-on, FX20 fetches the firmware from the flash and sends it to the FPGA.

3.2.6 LPDDR4-SDRAM (U4)

This kit uses MT53E128M32D2DS-053 WT:A from Micron Technology Inc. for frame buffering. It is a 4 Gb, 32-bit LPDDR4 SDRAM used by the FPGA as the frame buffer to store the processed video data received from MIPI ports.

3.2.7 FPGA (U5)

The kit uses a Titanium family Ti180J484C4 FPGA from Efinix, Inc. It is a high-performance device with hard IP for LPDDR4 RAM interfaces and supports high-speed signaling. It has four MIPI Rx ports that are used to

System design

interface MIPI camera modules using 22-pin FPC connectors. This FPGA acts as a bridge between the MIPI receiver and the FX20 device. It receives RAW12 video from the MIPI source, processes it, and sends the data to FX20 via the LVDS interface.

3.2.8 USB-C Full Speed connector (J13)

EZ-USB™ FX20 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 JTAG interface pins through the USB-C Full Speed connector.

3.2.9 USB 3.2 Gen 2x2 connector (J13)

This kit is bus-powered and uses a USB-C connector to interface with the PC through a USB-C cable. The latter serves for both power and data transfer from the PC. The USB 3 port of the PC can source a maximum of 5 V @3 A power through VBUS. This interface has TVS diodes for protection against ESD.

3.2.10 Crystal (Y1)

FX20 requires a 24 MHz crystal to generate the clock for its operation having a tolerance of ± 10 ppm and a drive level of 100 μ W.

3.2.11 LEDs

This kit has three onboard LEDs:

- **POWER ON LED:** A green LED that turns ON when the kit is powered and stable power is available
- **CFG ERR LED:** A red LED that turns ON when the FPGA configuration fails
- **USER_LED:** A blue LED connected to GPIO4 of FX20. It can also be controlled by the application

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Kit programming

4 Kit programming

The DEMO_FX20_MIPI_001 kit is preprogrammed with the latest firmware to boot as four camera devices and stream 4K 30fps color bar video from each. Use the **EZ-USB™ FX Control Center** utility in the FX20 SDK to change the firmware.

4.1 Program FPGA

1. Open the **EZ-USB™ FX Control Center** utility
2. Connect the kit to the PC via the USB-C cable provided with the kit

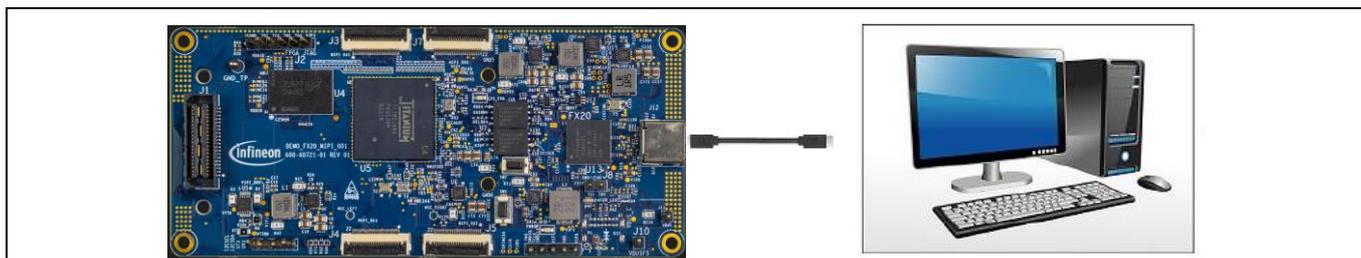


Figure 3 Connecting the kit with the PC

3. Press and hold the PMODE switch (SW1) and reset the device by pressing and releasing the RESET switch (SW2). Release the PMODE switch (SW1)
4. Wait for the **EZ-USB™ FX Control Center** utility to detect the FX20 bootloader

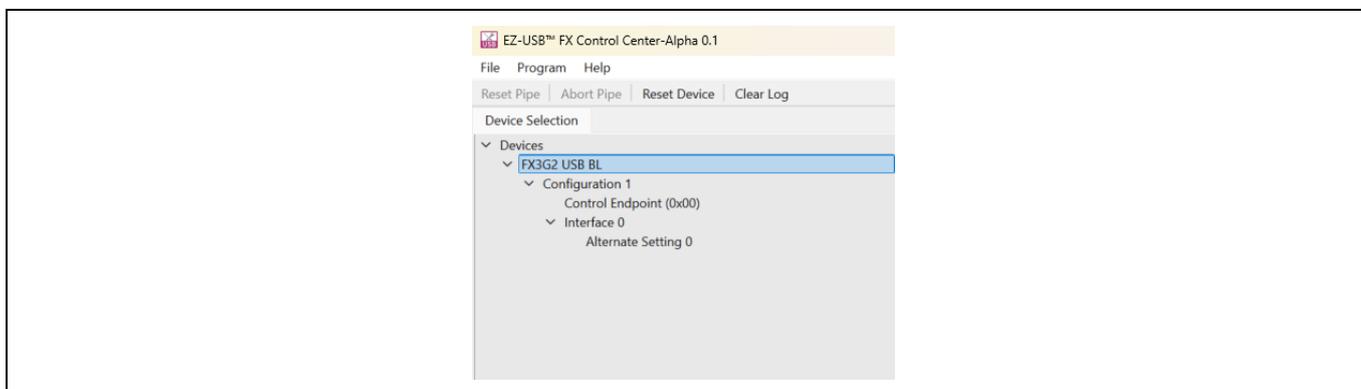


Figure 4 Device enumeration in the Control Center utility

5. Click **FX3G2 USB BL** > **Program** > **External SPI Flash**

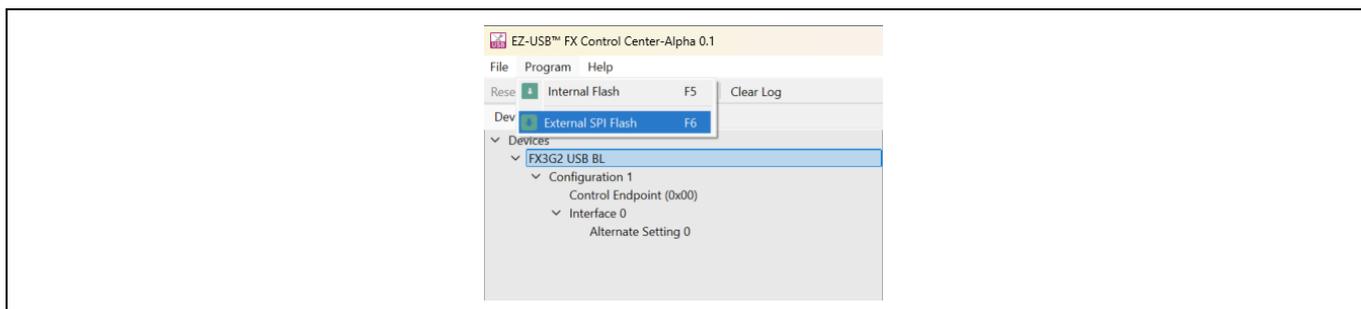


Figure 5 Programming the SPI flash

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Kit programming

- Go to the folder where the *.bin* file is downloaded and program the FPGA by selecting the appropriate *.bin* file. See the following table to select the *.bin* file depending on what you want to stream

Table 4 FPGA bin files

FPGA bin file	Streaming
<i>fxn_ti180_sdk_multi_cam_ref_des_lvds_wl_148m_clbr</i>	Color bar video from FPGA
<i>fxn_ti180_sdk_multi_cam_ref_des_sony_sensor_cis</i>	From Sony IMX715 camera

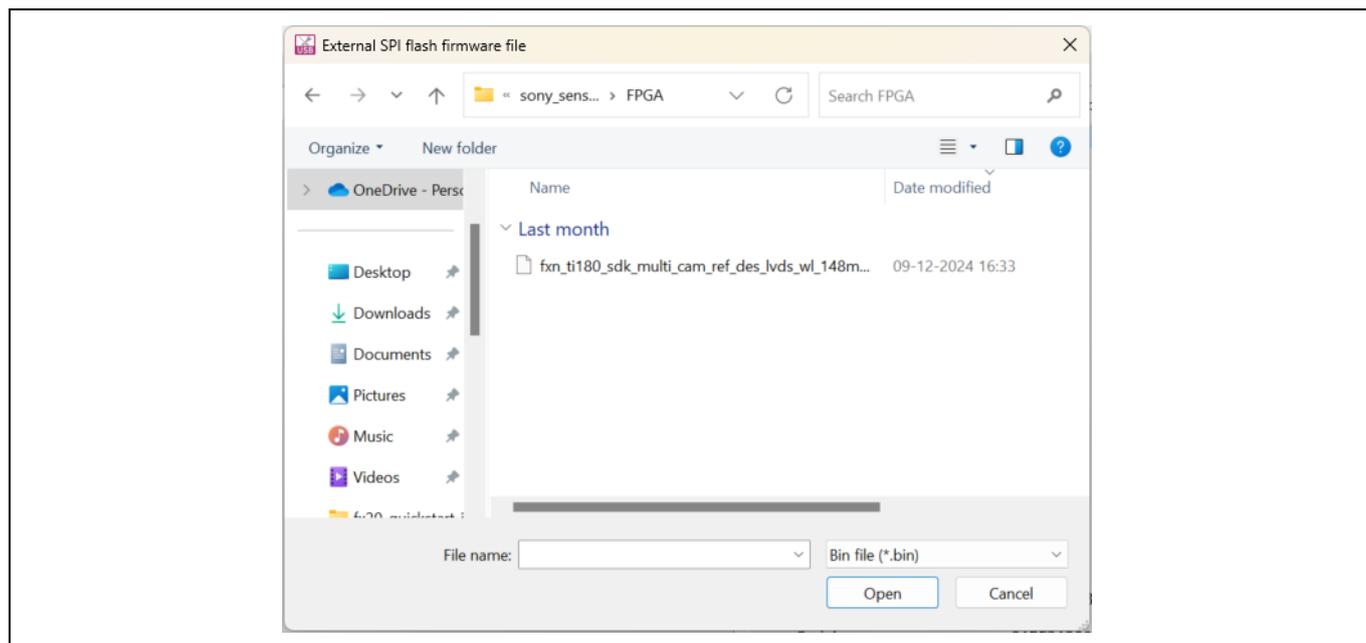


Figure 6 Programming FPGA example window

- Wait for programming to complete. The status at the bottom left of the window shows **Firmware Download Successful**. This indicates that programming is complete

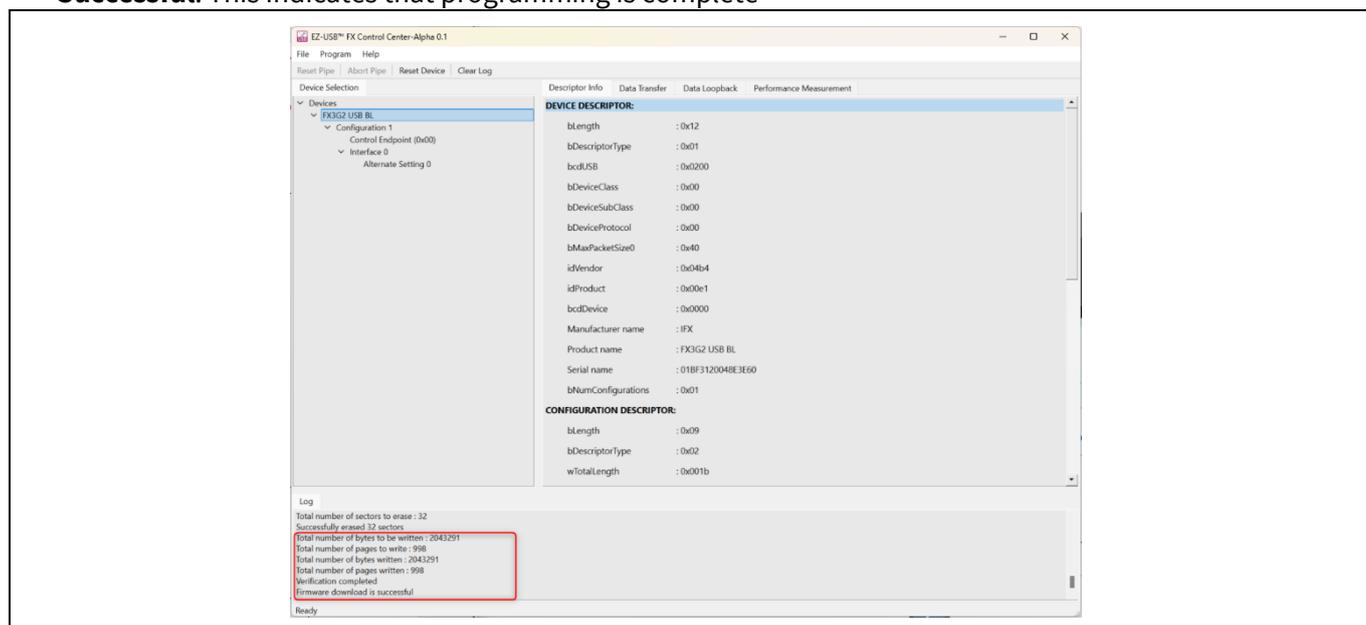


Figure 7 Programming successful log window

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Kit programming

4.2 Program FX20

1. After FPGA programming, in the **EZ-USB™ FX Control Center** utility, click **FX3G2 USB BL > Program > Internal Flash**

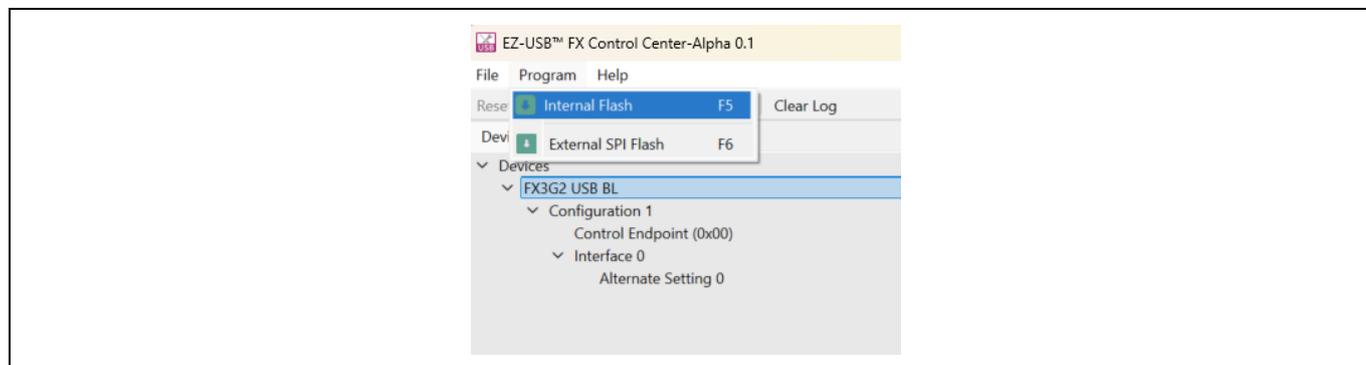


Figure 8 Programming the internal flash

2. Select the appropriate *.hex* file to program FX20 and click **Open**

Table 5 Firmware .hex files

FX20 .hex file	Streaming
<i>fx20_uvc_fw_lvds_wl_148m_clbr</i>	Color bar video from FPGA
<i>fx20_sony_sensor_cis</i>	From Sony IMX715 camera

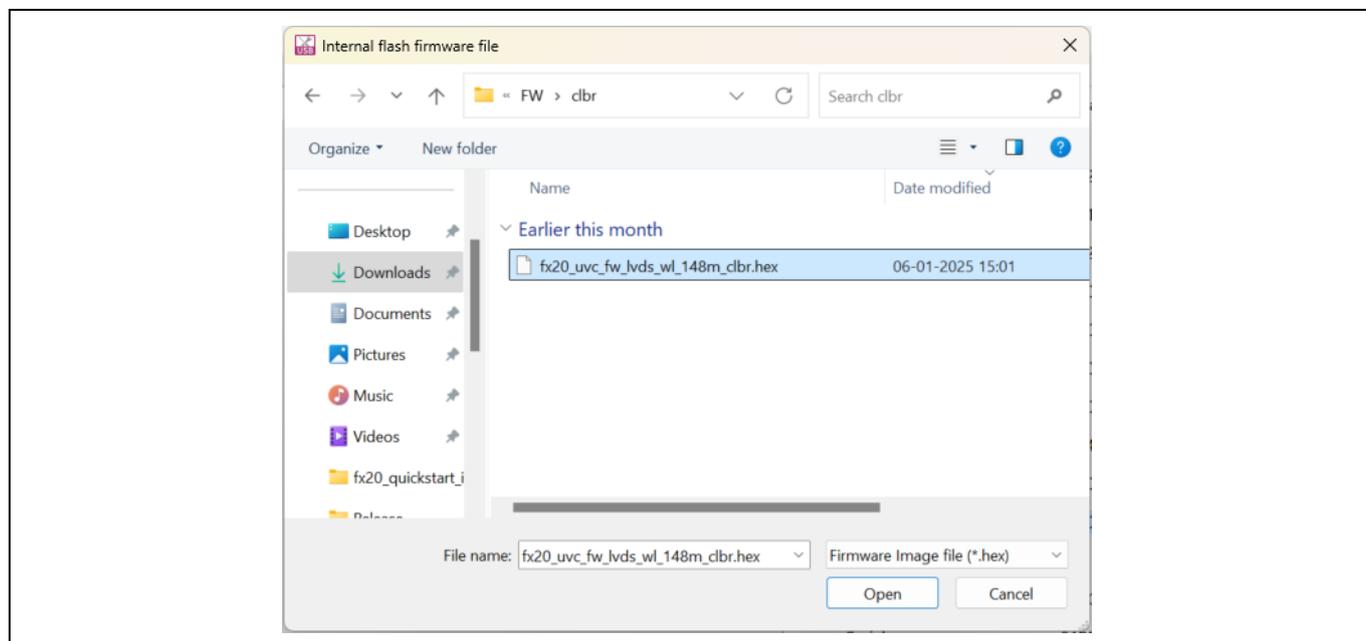


Figure 9 Programming FX20

3. Wait for programming to complete. The status at the bottom left of the window shows **Device detached**. This indicates that programming is complete

Kit programming

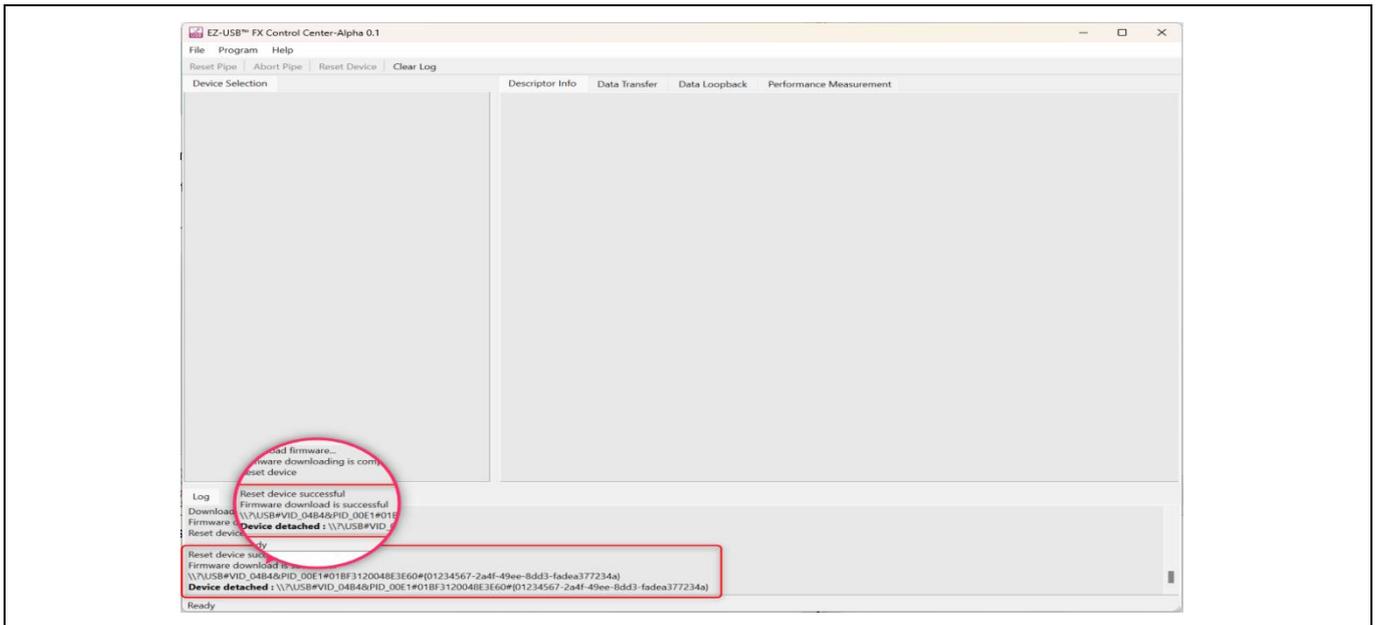


Figure 10 Programming successful log window

5 Streaming UVC video

5.1 Streaming from an external MIPI camera module (Sony IMX715)

The kit can stream 8K 30fps video from a single MIPI camera source. When four cameras are connected, the kit can stream 4K 30fps video from each camera source. The Sony IMX715 can stream video up to 4K 90 fps. Do the following to stream from four Sony IMX715 MIPI camera modules:

1. Ensure that the steps in Section 4.1 are completed and the external flash is programmed with the *fxn_ti180_sdk_multi_cam_ref_des_sony_sensor_cis.bin* file as provided in Table 3
2. Follow the steps in Section 4.2 and ensure that the FX20 internal flash is programmed with *fx20_sony_sensor_cis.hex* as provided in Table 4
3. Ensure that the addresses of Sony IMX715 camera modules are changed per Table 5 and the cameras are connected to their respective ports as shown in Figure 11

Table 6 Sony IMX715 camera address setting and connection to the kit

Camera address	Resistors populated on camera	Resistors not populated	Port connection
0x10	R19, R15	R26, R14	J7
0X36	R26, R14	R19, R15	J3
0X37	R19, R14	R26, R15	J4
0X1A	R26, R15	R19, R14	J5

Streaming UVC video

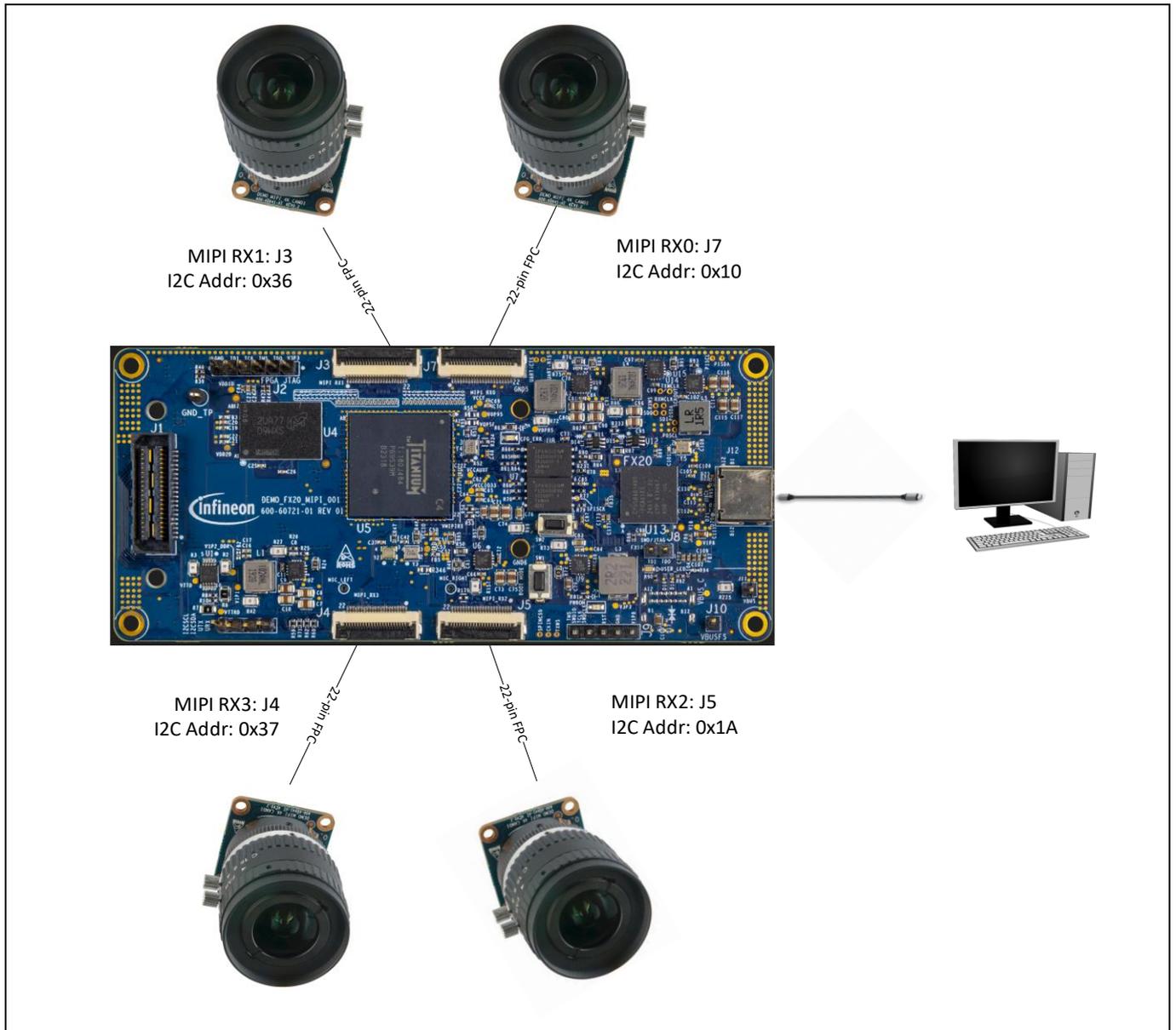


Figure 11 Connecting an external camera module to the kit

4. Open the **Windows Camera** application. Click on the flip camera icon at the top right corner of the window as shown in [Figure 12](#)

Streaming UVC video

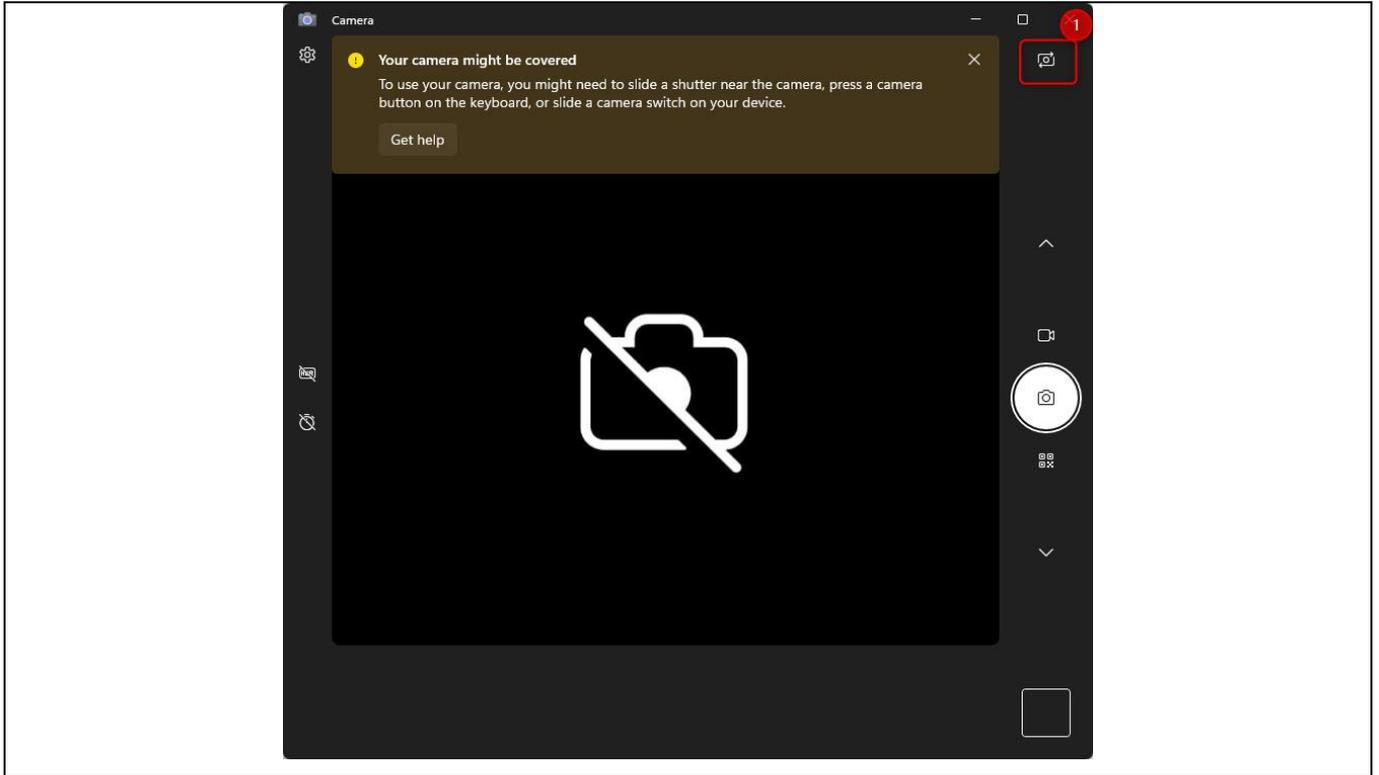


Figure 12 Windows Camera application

- 5. Observe that the video starts streaming from Camera 1 on the **Windows Camera** application. You can check the resolution as 3840 x 2160 in the **Settings** menu

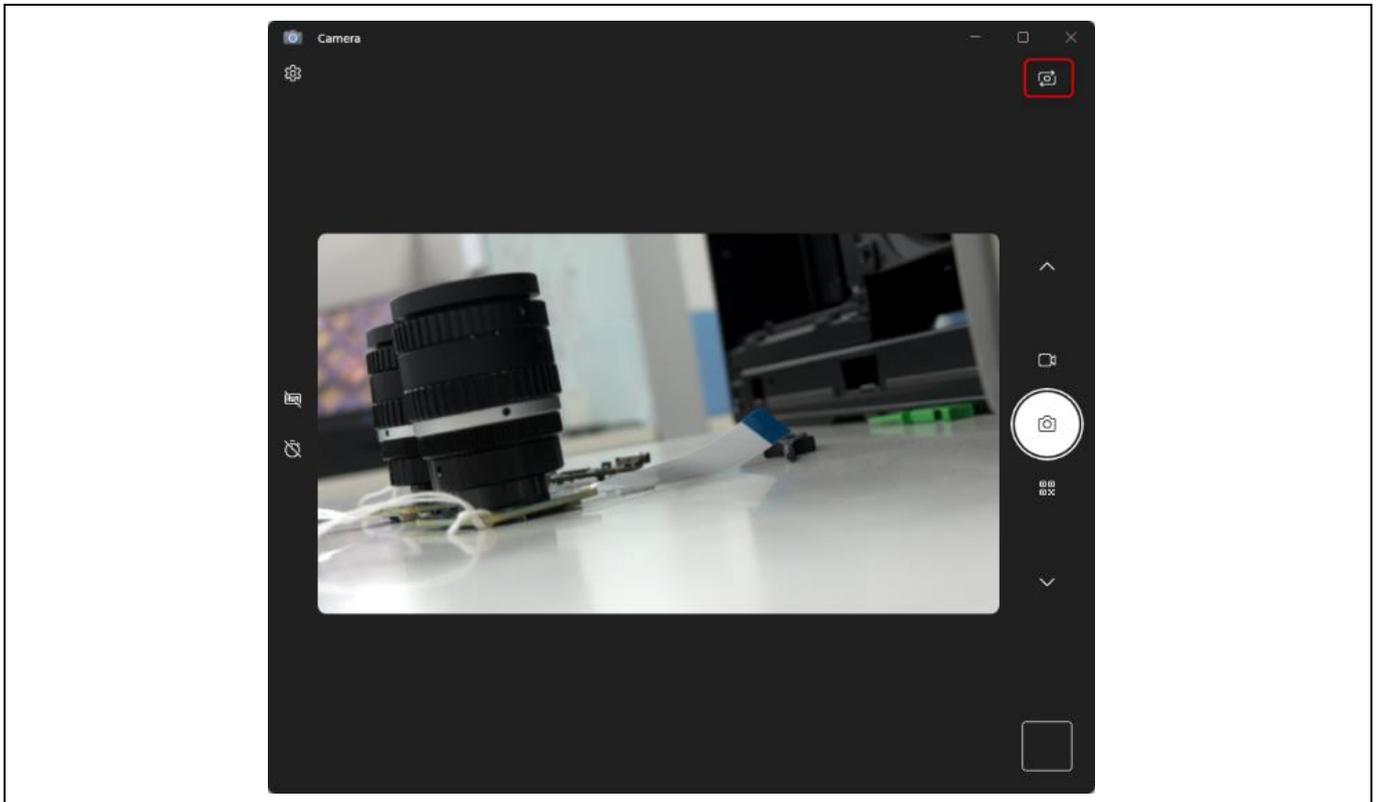


Figure 13 FX20 camera streaming in Windows Camera application

Streaming UVC video

6. Click the flip camera icon at the top right corner of the window again to start streaming from the second camera
7. Flip the camera again to stream from Camera 3 and Camera 4

5.2 Streaming from color bar generated from the FPGA

The kit can stream 4K 60fps video from the color bar source from the FPGA.

1. Follow the steps in Section 4.1 to ensure that the external flash is programmed with the *fxn_ti180_sdk_multi_cam_ref_des_lvds_wl_148m_clbr.bin* file as provided in Table 3
2. Follow the steps in Section 4.2 and load the *fx20_uvc_fw_lvds_wl_148m_clbr.hex* file to the internal flash as provided in Table 4
3. Open the **Windows Camera** application. Click the flip camera icon at the top right corner of the window as shown below

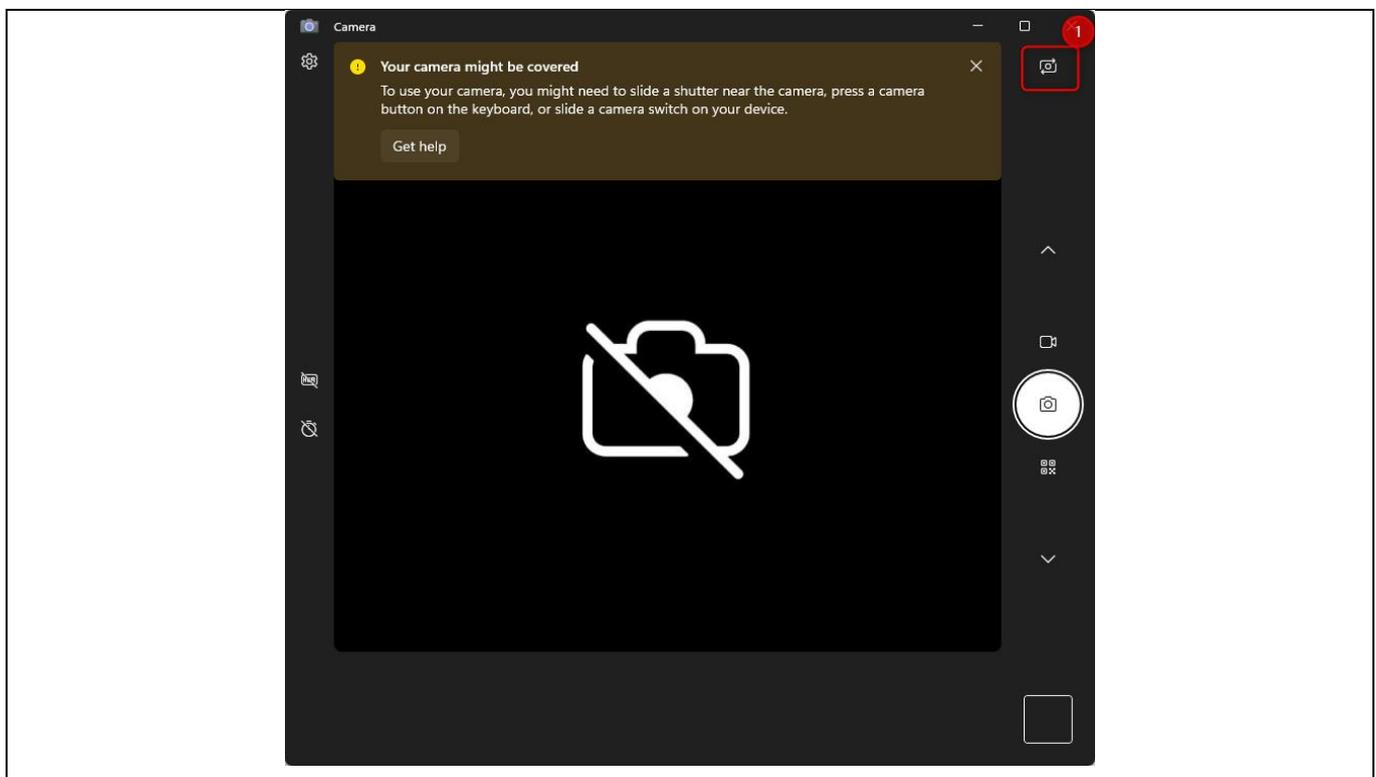


Figure 14 Windows Camera application

4. Observe that the color bar video starts streaming from Camera 1

Streaming UVC video

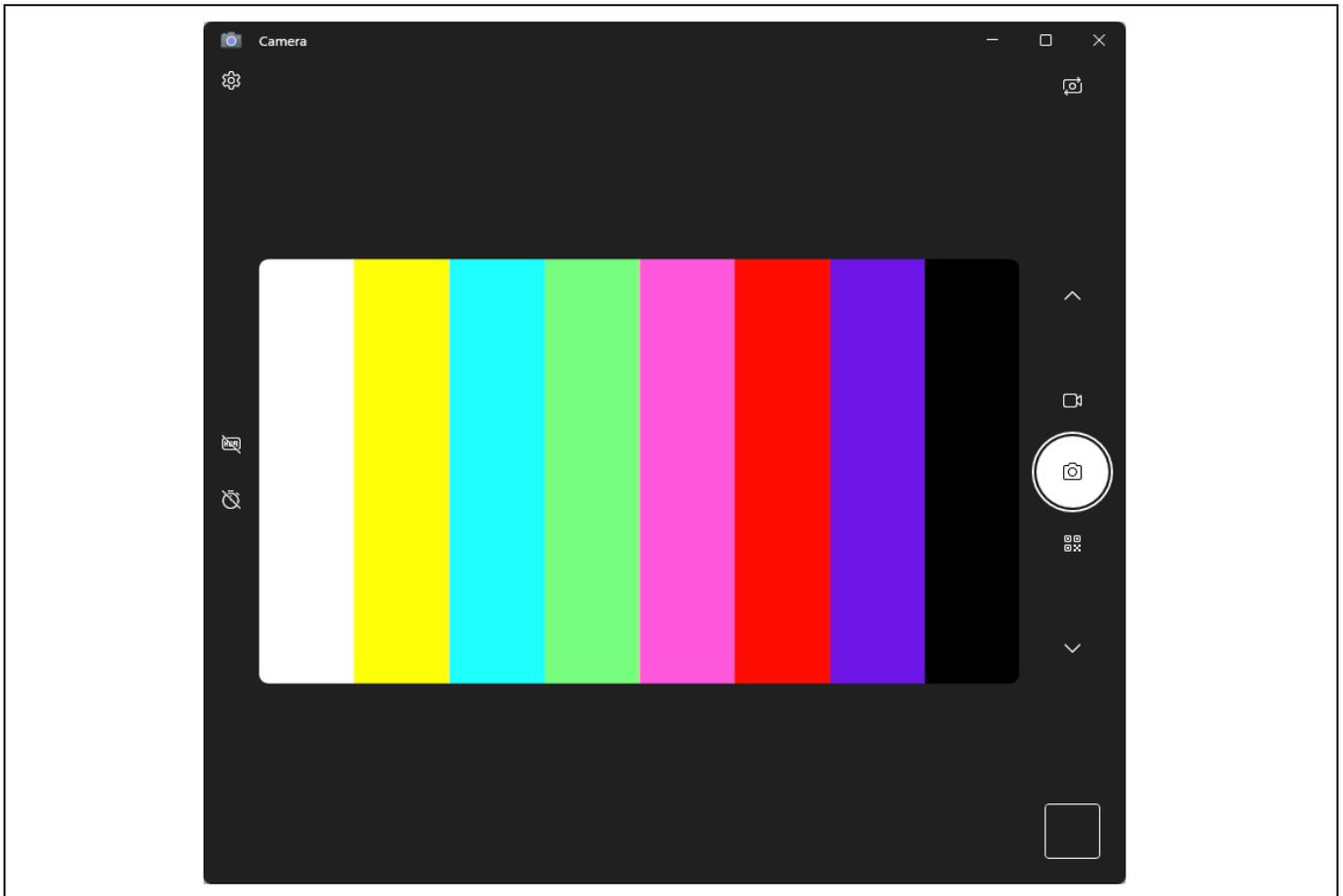


Figure 15 FX20 color bar video streaming in Windows Camera application

5. Click the flip camera icon at the top right corner of the window again to start streaming from the second camera
Flip the camera again to stream from Camera 3 and Camera 4

References

References

For queries, contact [Infineon support](#).

- [1] Infineon Technologies AG: *EZ-USB™ FX20 datasheet*
- [2] Infineon Technologies AG: *AN38689 Implementing a USB Video and Audio composite device using EZ-USB™ FX20*
- [3] Infineon Technologies AG: *AN37841 Getting started with EZ-USB™ FX20/FX10/FX5N/FX5*
- [4] Infineon Technologies AG: *EZ-USB™ FX family promo page*; [Available online](#)

Revision history

Revision history

Document revision	Date	Description of changes
**	2025-02-12	Initial release
*A	2025-05-15	Publish to web

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