CYPRESS SEMICONDUCTOR CORPORATION
Internal Correspondence

TITLE: EZ-USB® FX3™—USB 3.0 Peripheral Controller NPI
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Frequently Asked Questions

Contents

Product Family Features ........................................................................................................2
System Implementation/BOM .................................................................................................3
Solution Capability ..................................................................................................................4
Applications ............................................................................................................................5
Software/Tools/Drivers ...........................................................................................................5
Competition/Positioning .........................................................................................................6
Portfolio/Roadmap ..................................................................................................................7
Support ...................................................................................................................................7
PRODUCT FAMILY FEATURES

Q1. What is FX3?
A: FX3 is a programmable USB 3.0 peripheral controller.

Q2. What are the key features of EZ-USB FX3?
A: These are the key features of EZ-USB FX3:
- USB 3.0 peripheral controller with full backward compatibility to USB 2.0
- 32-bit General Programmable Interface (GPIF™ II) operating at 100 MHz
- Fully accessible 32-bit ARM926EJ-S CPU core with 200-MHz operation
- 512KB embedded SRAM
- I²C master controller – support 100 kHz, 400 kHz and 1 MHz
- I²S master (transmitter only)
- UART support up to 4 Mbps
- SPI master – support up to 33 MHz
- 12 GPIOs

Q3. What packages are available for FX3?
A: FX3 is available in a 121-pin BGA (10 x 10 x 1.7-mm, 0.8-mm pitch) package as well as a 131-ball WLCSP (5.1 x 4.7 x 0.6-mm, 0.4-mm pitch).

Q4. Is this product available in both commercial and industrial temperature grades?
A: Yes, FX3 is available in both commercial and industrial temperature grades.

Q5. Are there lower-cost alternatives to FX3?
A: Yes, there are multiple lower-cost FX3 parts segmented based on the amount of SRAM (256KB or 512KB) and width of the GPIF II (16-bit or 32-bit). There are also parts that support only USB 2.0 (CYUSB201X).
SYSTEM IMPLEMENTATION / BOM

Q6. What are the major external components generally required to design an FX3-based product?
A: An FX3-based product requires the following major external components:
   • FPGA or image sensor (the data source)
   • 19.2-MHz clock oscillator
   • 1.2-V, 1.8-V/2.5-V or 3.3-V I/O power supply
   • I²C EEPROM or SPI flash (not required if FX3 boots over USB).

Q7. Can FX3 connect to devices with a serial interface?
A: No. FX3 can interface only with devices that have a parallel output; it cannot interface directly with products that have serial interfaces (such as CSI-2, LVDS and PCIe). To do this, a bridge chip is required to convert the serial input into parallel e.g., Lattice X02/03 FPGAs. Contact usb3@cypress.com for more information.

Q8. What debugging features does FX3 provide?
A: FX3 has JTAG and UART ports, which can be used to debug the firmware.

Q9. Is it possible to connect two image sensors with one FX3?
A: Yes, you can connect multiple image sensors to FX3. If the image streams need to be in sync, then all the image sensors must have a single clock source. To accomplish this, use an FPGA in between FX3 and the image sensors. Although this would increase the BOM cost, it reduces complexity because the FPGA can handle the data streams and send them to FX3 over the GPIF II in a simple format. Contact usb3@cypress.com for more information.

Q10. Does FX3 have a way to control LEDs (in an imaging system) using PWM? Will it need an additional microcontroller for this?
A: Yes, FX3 has GPIOs that can provide PWM output. The built-in ARM9 microcontroller can be used to control the LED using PWM output.
SOLUTION CAPABILITY

Q11. Does FX3 support USB Video Class (UVC) implementations?
A: Yes, FX3 supports UVC. For more information, please refer to AN75779 – How to Implement an Image Sensor Interface with EZ-USB FX3 in a USB Video Class (UVC) Framework.

Q12. What throughput does FX3 support?
A: The GPIF II interface is a 32-bit-wide interface running at 100 MHz, providing a theoretical maximum throughput of 400 MB/s. We have measured GPIF II-to-USB throughput with an integrated Intel USB 3.0 host clock ~370 MB/s. For more information, refer to AN86947 – Optimizing USB 3.0 Throughput with EZ-USB FX3.

Q13. Can FX3 boot without an external EEPROM?
A: Yes, FX3 can boot from the USB port or the GPIF II port. For more information, refer to AN76405 – EZ-USB FX3 Boot Options.

Q14. Can the ARM9 MCU in FX3 be used for digital signal processing (DSP) or image signal processing (ISP) functions?
A: No, the ARM9 is not powerful enough to do DSP or ISP. The ARM9 MCU can only do very light data processing (such as inserting a UVC header). Any significant data processing would negatively impact the USB throughput.

Q15. Can the entire 512KB SRAM be used for custom firmware?
A: No, the 512KB SRAM is shared between code space and buffers for USB transfers.

Q16. Can you use 32-bit GPIF II mode and UART at the same time?
A: No, you cannot have a 32-bit GPIF II and UART active at the same time, because the pins are multiplexed between GPIF II and UART. FX3 can support software UART by bit-banging a GPIO, but this UART implementation is suitable only for low-throughput transfers.
APPLICATIONS

Q17. What are the target applications for FX3?
A: The following are target applications for FX3:
- HD (720p), FHD (1080p), UHD (4K x 2K) webcams
- USB 3.0 industrial cameras
- USB 3.0 surveillance cameras
- USB 3.0 video conference cameras
- Printers and scanners
- Test and measurement equipment
- Medical imaging devices
- Data acquisition devices
- Gesture-recognition peripherals

SOFTWARE / TOOLS / DRIVERS

Q18. What development kits are available for FX3?
A: There are two development kits available for FX3:
- The FX3 SuperSpeed Explorer Kit (CYUSB3KIT-003) - $49
- The FX3 Development Kit (CYUSB3KIT-001) - $397

Q19. Is there any reason to choose the $397 FX3 Development Kit over the $49 FX3 SuperSpeed Explorer Kit?
A: The FX3 SuperSpeed Explorer Kit is sufficient for ~90% of design requirements. However, the FX3 Development Kit is required for the following features:
- USB 2.0 On-The-Go (OTG) mode
- Battery-power or external power supply operation
- SPI, GPIF II boot modes

Q20. What software tools are required for FX3?
A: All the tools required can be found in the FX3 Software Development Kit (SDK).

Q21. Can you develop FX3 products without using the Cypress-provided software development kit?
A: Yes, you can create products using FX3 without using the Cypress-provided software development kit with the help of the EZ-USB FX3 Technical Reference Manual (TRM), which provides access to all of FX3's low-level registers.
Q22. What firmware examples does Cypress provide for FX3?
A: Cypress provides more than 50 firmware examples covering a full range of applications in the FX3 SDK. For a full list of firmware examples provided, please visit http://www.cypress.com/?rID=101781.

Q23. Does FX3 support Linux or Mac OS X?
A: Yes, the FX3 SDK (v1.3.3) supports both Linux and Mac OS X operating systems.

Q24. Does FX3 have an RTOS running on it?
A: Yes, FX3 is running the ThreadX RTOS.

Q25. What USB drivers are supported by FX3?
A: FX3 firmware examples provided with the FX3 SDK support the standard USB Video Class (UVC) driver that comes with the OS. If the application requires a custom driver, please contact Cypress technical support by creating a support case. Cypress has firmware examples using the Cypress CYUSB3.sys driver. Tech support can help the customer customize this firmware example to specific requirements.

COMPETITION/POSITIONING

Q26. What products can compete with FX3?
A: The following products can compete with FX3
  • PLX Tech USB3380 – Fixed-function USB 3.0 to PCIe peripheral controller
  • FTDI FT600 – 16-bit or 32-bit FIFO to USB bridge controller
  • Any FPGA with a TI TUSB1310A – USB 3.0 transceiver

PLX solutions are generally fixed-function and are used only when there is a PCIe interface available.

FT600 is a bridge controller most similar to FX3 but it has product limitations. For example, the FT600 only offers 16KB of RAM for buffers, compared to FX3’s 512KB of SRAM. The interface is also limited to a FIFO interface with limited configurability compared to FX3’s programmable GPIF II.

The FPGA-based, two-chip USB 3.0 solution is more expensive and requires more design effort than the FX3-based single-chip solution.
PORTFOLIO/ROADMAP

Q27. Does Cypress have any other USB 3.0 controllers?
A: Yes, Cypress has a family of USB 3.0 controllers for different applications, including CX3 – USB 3.0 to MIPI CSI-2 Camera Controller and FX3S – USB 3.0 Storage Controller. For more information, see the USB Roadmap.

Q28. Does Cypress have plans for FX3 with Type-C or USB 3.1 support?
A: Currently, we only have tentative plans to launch an “FX3+” with Type-C and USB 3.1 support. This product is forecasted to sample in 2017.

SUPPORT

Q29. How can I place sample orders for FX3?
A: FX3 can be ordered through the Oracle CRM system. Cypress employees will be able to request samples by going to my.cypress.com > MyApps > MySamples and requesting samples of the desired FX3 MPN: CYUSB301x.

Q30. Does Cypress provide reference schematics to help customers develop their own camera?
A: Yes, Cypress FX3 has a Reference Design Kit developed for use with an Aptina image sensor. To get the source code of the firmware, email usb3@cypress.com.

Q31. Does Cypress provide hardware design guidelines for customers building PCBs with FX3?
A: Yes, Cypress provides hardware design guidelines for FX3 as part of the AN70707 – EZ-USB FX3/FX3S Hardware Design Guidelines and Schematic Checklist application note.

Q32. Where can I get information about “SuperSpeed Device Design By Example,” by John Hyde?

Q33. Where can I find knowledge base articles about FX3?
A: All FX3 knowledge base articles can be found here. A couple of important FX3 knowledge base articles are highlighted below:

- KBA87889 – How to Design with EZ-USB FX3 and FX3S
- KBA84133 – UVC Support in FX3 SDK
### Document History Page

<table>
<thead>
<tr>
<th>Rev.</th>
<th>ECN No.</th>
<th>Orig. of Change</th>
<th>Description of Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>**</td>
<td>4684503</td>
<td>ANOP</td>
<td>EZ-USB FX3 NPI FAQ</td>
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</tbody>
</table>