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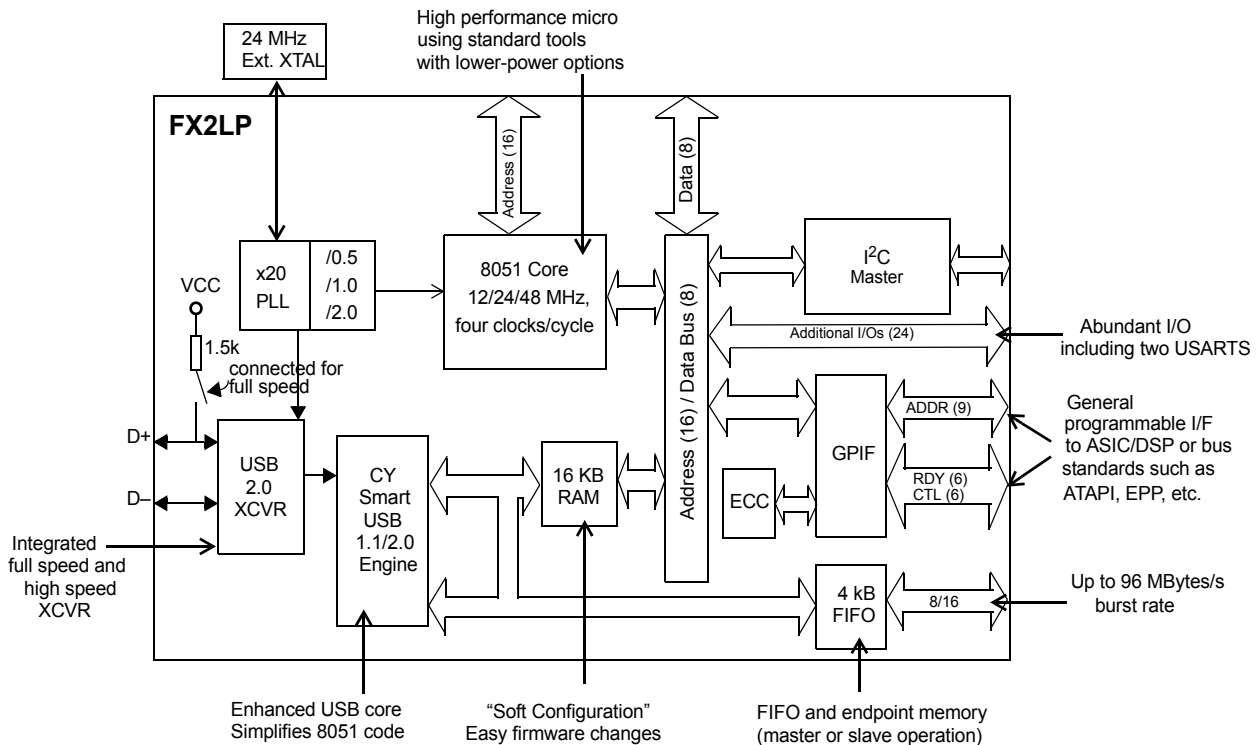
**CY7C68013A, CY7C68014A
CY7C68015A, CY7C68016A**

EZ-USB FX2LP™ USB Microcontroller High Speed USB Peripheral Controller

1. Features (CY7C68013A/14A/15A/16A)

- USB 2.0 USB IF High Speed Certified (TID # 40460272)
- Single Chip Integrated USB 2.0 Transceiver, Smart SIE, and Enhanced 8051 Microprocessor
- Fit, Form, and Function Compatible with the FX2
 - Pin compatible
 - Object-code-compatible
 - Functionally Compatible (FX2LP is a superset)
- Ultra Low Power: I_{CC} No More than 85 mA in any Mode
 - Ideal for bus and battery powered applications
- Software: 8051 Code Runs from:
 - Internal RAM, which is downloaded through USB
 - Internal RAM, which is loaded from EEPROM
 - External memory device (128 pin package)
- 16 KBytes of On-Chip Code/Data RAM
- Four Programmable BULK/INTERRUPT/ISOCRONOUS Endpoints
 - Buffering options: double, triple, and quad
- Additional Programmable (BULK/INTERRUPT) 64 Byte Endpoint
- 8-bit or 16-bit External Data Interface
- Smart Media Standard ECC Generation
- GPIF (General Programmable Interface)
 - Enables direct connection to most parallel interfaces
 - Programmable waveform descriptors and configuration registers to define waveforms
 - Supports multiple Ready (RDY) inputs and Control (CTL) outputs
- Integrated, Industry Standard Enhanced 8051
 - 48 MHz, 24 MHz, or 12 MHz CPU operation
 - Four clocks per instruction cycle
 - Two USARTS
 - Three counter/timers
 - Expanded interrupt system
 - Two data pointers
- 3.3V Operation with 5V Tolerant Inputs
- Vectored USB Interrupts and GPIF/FIFO Interrupts
- Separate Data Buffers for the Setup and Data Portions of a CONTROL Transfer
- Integrated I²C Controller, Runs at 100 or 400 kHz
- Four Integrated FIFOs
 - Integrated glue logic and FIFOs lower system cost
 - Automatic conversion to and from 16-bit buses
 - Master or slave operation
 - Uses external clock or asynchronous strobes
 - Easy interface to ASIC and DSP ICs
- Available in Commercial and Industrial Temperature Grade (all packages except VFBGA)

Logic Block Diagram



1.1 Features (CY7C68013A/14A only)

- CY7C68014A: Ideal for Battery Powered Applications
 - Suspend current: 100 μ A (typ)
- CY7C68013A: Ideal for Non-battery Powered Applications
 - Suspend current: 300 μ A (typ)
- Available in Five Pb-free Packages with Up to 40 GPIOs
 - 128-pin TQFP (40 GPIOs), 100-pin TQFP (40 GPIOs), 56-pin QFN (24 GPIOs), 56-pin SSOP (24 GPIOs), and 56-pin VFBGA (24 GPIOs)

1.2 Features (CY7C68015A/16A only)

- CY7C68016A: Ideal for Battery Powered Applications
 - Suspend current: 100 μ A (typ)
- CY7C68015A: Ideal for Non-battery Powered Applications
 - Suspend current: 300 μ A (typ)
- Available in Pb-free 56-pin QFN Package (26 GPIOs)
 - Two more GPIOs than CY7C68013A/14A enabling additional features in same footprint

Cypress's EZ-USB FX2LP™ (CY7C68013A/14A) is a low power version of the EZ-USB FX2™ (CY7C68013), which is a highly integrated, low power USB 2.0 microcontroller. By integrating the USB 2.0 transceiver, serial interface engine (SIE), enhanced 8051 microcontroller, and a programmable peripheral interface in a single chip,

Cypress has created a cost effective solution that provides superior time-to-market advantages with low power to enable bus powered applications.

The ingenious architecture of FX2LP results in data transfer rates of over 53 Mbytes per second, the maximum allowable USB 2.0 bandwidth, while still using a low cost 8051 microcontroller in a package as small as a 56 VFBGA (5 mm x 5 mm). Because it incorporates the USB 2.0 transceiver, the FX2LP is more economical, providing a smaller footprint solution than USB 2.0 SIE or external transceiver implementations. With EZ-USB FX2LP, the Cypress Smart SIE handles most of the USB 1.1 and 2.0 protocol in hardware, freeing the embedded microcontroller for application specific functions and decreasing development time to ensure USB compatibility.

The General Programmable Interface (GPIF) and Master/Slave Endpoint FIFO (8-bit or 16-bit data bus) provides an easy and glueless interface to popular interfaces such as ATA, UTOPIA, EPP, PCMCIA, and most DSP/processors.

The FX2LP draws less current than the FX2 (CY7C68013), has double the on-chip code/data RAM, and is fit, form and function compatible with the 56, 100, and 128 pin FX2.

Five packages are defined for the family: 56VFBGA, 56 SSOP, 56 QFN, 100 TQFP, and 128 TQFP.

2. Applications

- Portable video recorder
- MPEG/TV conversion
- DSL modems
- ATA interface
- Memory card readers
- Legacy conversion devices
- Cameras
- Scanners
- Home PNA
- Wireless LAN
- MP3 players
- Networking

The "Reference Designs" section of the [Cypress web site](http://www.cypress.com) provides additional tools for typical USB 2.0 applications. Each reference design comes complete with firmware source and object code, schematics, and documentation. Visit www.cypress.com for more information.

3. Functional Overview

3.1 USB Signaling Speed

FX2LP operates at two of the three rates defined in the USB Specification Revision 2.0, dated April 27, 2000:

- Full speed, with a signaling bit rate of 12 Mbps
- High speed, with a signaling bit rate of 480 Mbps.

FX2LP does not support the low speed signaling mode of 1.5 Mbps.

3.2 8051 Microprocessor

The 8051 microprocessor embedded in the FX2LP family has 256 bytes of register RAM, an expanded interrupt system, three timer/counters, and two USARTs.

3.2.1 8051 Clock Frequency

FX2LP has an on-chip oscillator circuit that uses an external 24 MHz (± 100 ppm) crystal with the following characteristics:

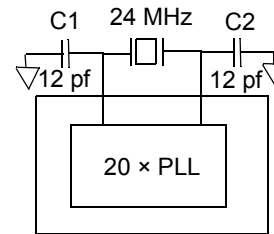
- Parallel resonant
- Fundamental mode
- 500 μ W drive level
- 12 pF (5% tolerance) load capacitors

An on-chip PLL multiplies the 24 MHz oscillator up to 480 MHz, as required by the transceiver/PHY and internal counters divide it down for use as the 8051 clock. The default 8051 clock frequency is 12 MHz. The clock frequency of the 8051 can be changed by the 8051 through the CPUCS register, dynamically.

Note

1. 115 Kbaud operation is also possible by programming the 8051 SMOD0 or SMOD1 bits to a "1" for UART0, UART1, or both respectively.

Figure 1. Crystal Configuration



12-pF capacitor values assumes a trace capacitance of 3 pF per side on a four-layer FR4 PCA

The CLKOUT pin, which can be three-stated and inverted using internal control bits, outputs the 50% duty cycle 8051 clock, at the selected 8051 clock frequency: 48 MHz, 24 MHz, or 12 MHz.

3.2.2 USARTS

FX2LP contains two standard 8051 USARTs, addressed through Special Function Register (SFR) bits. The USART interface pins are available on separate I/O pins, and are not multiplexed with port pins.

UART0 and UART1 can operate using an internal clock at 230 Kbaud with no more than 1% baud rate error. 230 Kbaud operation is achieved by an internally derived clock source that generates overflow pulses at the appropriate time. The internal clock adjusts for the 8051 clock rate (48 MHz, 24 MHz, and 12 MHz) such that it always presents the correct frequency for 230 Kbaud operation.^[1]

3.2.3 Special Function Registers

Certain 8051 SFR addresses are populated to provide fast access to critical FX2LP functions. These SFR additions are shown in [Table 1](#) on page 4. Bold type indicates non standard, enhanced 8051 registers. The two SFR rows that end with "0" and "8" contain bit addressable registers. The four I/O ports A to D use the SFR addresses used in the standard 8051 for ports 0 to 3, which are not implemented in FX2LP. Because of the faster and more efficient SFR addressing, the FX2LP I/O ports are not addressable in external RAM space (using the MOVX instruction).

3.3 I²C Bus

FX2LP supports the I²C bus as a master only at 100/400 KHz. SCL and SDA pins have open-drain outputs and hysteresis inputs. These signals must be pulled up to 3.3V, even if no I²C device is connected.

3.4 Buses

All packages, 8-bit or 16-bit "FIFO" bidirectional data bus, multiplexed on I/O ports B and D. 128-pin package: adds 16-bit output-only 8051 address bus, 8-bit bidirectional data bus.

Table 1. Special Function Registers

x	8x	9x	Ax	Bx	Cx	Dx	Ex	Fx
0	IOA	IOB	IOC	IOD	SCON1	PSW	ACC	B
1	SP	EXIF	INT2CLR	IOE	SBUF1			
2	DPL0	MPAGE	INT4CLR	OEA				
3	DPH0			OEB				
4	DPL1			OEC				
5	DPH1			OED				
6	DPS			OEE				
7	PCON							
8	TCON	SCON0	IE	IP	T2CON	EICON	EIE	EIP
9	TMOD	SBUF0						
A	TL0	AUTOPTRH1	EP2468STAT	EP01STAT	RCAP2L			
B	TL1	AUTOPTRL1	EP24FIFOFLGS	GPIFTRIG	RCAP2H			
C	TH0	reserved	EP68FIFOFLGS		TL2			
D	TH1	AUTOPTRH2		GPIFSGLDATH	TH2			
E	CKCON	AUTOPTRL2		GPIFSGLDATLX				
F		reserved	AUTOPTRSET-UP	GPIFSGLDATLNOX				

3.5 USB Boot Methods

During the power up sequence, internal logic checks the I²C port for the connection of an EEPROM whose first byte is either 0xC0 or 0xC2. If found, it uses the VID/PID/DID values in the EEPROM in place of the internally stored values (0xC0), or it boot-loads the EEPROM contents into internal RAM (0xC2). If no EEPROM is detected, FX2LP enumerates using internally stored descriptors. The default ID values for FX2LP are VID/PID/DID (0x04B4, 0x8613, 0xAxxx where xxx = Chip revision).^[2]

Table 2. Default ID Values for FX2LP

Default VID/PID/DID		
Vendor ID	0x04B4	Cypress Semiconductor
Product ID	0x8613	EZ-USB FX2LP
Device release	0xAxxx	Depends on chip revision (nnn = chip revision where first silicon = 001)

3.6 ReNumeration

Because the FX2LP's configuration is soft, one chip can take on the identities of multiple distinct USB devices.

When first plugged into USB, the FX2LP enumerates automatically and downloads firmware and USB descriptor tables over the USB cable. Next, the FX2LP enumerates again, this time as a device defined by the downloaded information. This patented two step process called ReNumeration™ happens instantly when the device is plugged in, without a hint that the initial download step has occurred.

Note

2. The I²C bus SCL and SDA pins must be pulled up, even if an EEPROM is not connected. Otherwise this detection method does not work properly.

Two control bits in the USBCS (USB Control and Status) register, control the ReNumeration process: DISCON and RENUM. To simulate a USB disconnect, the firmware sets DISCON to 1. To reconnect, the firmware clears DISCON to 0.

Before reconnecting, the firmware sets or clears the RENUM bit to indicate whether the firmware or the Default USB Device handles device requests over endpoint zero: if RENUM = 0, the Default USB Device handles device requests; if RENUM = 1, the firmware services the requests.

3.7 Bus-Powered Applications

The FX2LP fully supports bus powered designs by enumerating with less than 100 mA as required by the USB 2.0 specification.

3.8 Interrupt System

3.8.1 INT2 Interrupt Request and Enable Registers

FX2LP implements an autovector feature for INT2 and INT4. There are 27 INT2 (USB) vectors, and 14 INT4 (FIFO/GPIF) vectors. See EZ-USB Technical Reference Manual (TRM) for more details.

3.8.2 USB Interrupt Autovectors

The main USB interrupt is shared by 27 interrupt sources. To save the code and processing time that is required to identify the individual USB interrupt source, the FX2LP provides a second level of interrupt vectoring, called Autovectoring. When a USB interrupt is asserted, the FX2LP pushes the program counter to its stack, and then jumps to the address 0x0043 where it expects to find a "jump" instruction to the USB Interrupt service routine.

The FX2LP jump instruction is encoded as follows:

Table 3. INT2 USB Interrupts

USB INTERRUPT TABLE FOR INT2			
Priority	INT2VEC Value	Source	Notes
1	00	SUDAV	Setup Data Available
2	04	SOF	Start of Frame (or microframe)
3	08	SUTOK	Setup Token Received
4	0C	SUSPEND	USB Suspend request
5	10	USB RESET	Bus reset
6	14	HISPEED	Entered high speed operation
7	18	EP0ACK	FX2LP ACK'd the CONTROL Handshake
8	1C		reserved
9	20	EP0-IN	EP0-IN ready to be loaded with data
10	24	EP0-OUT	EP0-OUT has USB data
11	28	EP1-IN	EP1-IN ready to be loaded with data
12	2C	EP1-OUT	EP1-OUT has USB data
13	30	EP2	IN: buffer available. OUT: buffer has data
14	34	EP4	IN: buffer available. OUT: buffer has data
15	38	EP6	IN: buffer available. OUT: buffer has data
16	3C	EP8	IN: buffer available. OUT: buffer has data
17	40	IBN	IN-Bulk-NAK (any IN endpoint)
18	44		reserved
19	48	EP0PING	EP0 OUT was Pinged and it NAK'd
20	4C	EP1PING	EP1 OUT was Pinged and it NAK'd
21	50	EP2PING	EP2 OUT was Pinged and it NAK'd
22	54	EP4PING	EP4 OUT was Pinged and it NAK'd
23	58	EP6PING	EP6 OUT was Pinged and it NAK'd
24	5C	EP8PING	EP8 OUT was Pinged and it NAK'd
25	60	ERRLIMIT	Bus errors exceeded the programmed limit
26	64		
27	68		reserved
28	6C		reserved
29	70	EP2ISOERR	ISO EP2 OUT PID sequence error
30	74	EP4ISOERR	ISO EP4 OUT PID sequence error
31	78	EP6ISOERR	ISO EP6 OUT PID sequence error
32	7C	EP8ISOERR	ISO EP8 OUT PID sequence error

If Autovectoring is enabled (AV2EN = 1 in the INTSET-UP register), the FX2LP substitutes its INT2VEC byte. Therefore, if the high byte (“page”) of a jump table address is preloaded at the location 0x0044, the automatically inserted INT2VEC byte at 0x0045 directs the jump to the correct address out of the 27 addresses within the page.

3.8.3 FIFO/GPIF Interrupt (INT4)

Just as the USB Interrupt is shared among 27 individual USB interrupt sources, the FIFO/GPIF interrupt is shared among 14 individual FIFO/GPIF sources. The FIFO/GPIF Interrupt, like the USB Interrupt, can employ autovectoring. [Table 4](#) on page 6 shows the priority and INT4VEC values for the 14 FIFO/GPIF interrupt sources.

Table 4. Individual FIFO/GPIF Interrupt Sources

Priority	INT4VEC Value	Source	Notes
1	80	EP2PF	Endpoint 2 Programmable Flag
2	84	EP4PF	Endpoint 4 Programmable Flag
3	88	EP6PF	Endpoint 6 Programmable Flag
4	8C	EP8PF	Endpoint 8 Programmable Flag
5	90	EP2EF	Endpoint 2 Empty Flag
6	94	EP4EF	Endpoint 4 Empty Flag
7	98	EP6EF	Endpoint 6 Empty Flag
8	9C	EP8EF	Endpoint 8 Empty Flag
9	A0	EP2FF	Endpoint 2 Full Flag
10	A4	EP4FF	Endpoint 4 Full Flag
11	A8	EP6FF	Endpoint 6 Full Flag
12	AC	EP8FF	Endpoint 8 Full Flag
13	B0	GPIFDONE	GPIF Operation Complete
14	B4	GPIFWF	GPIF Waveform

If Autovectoring is enabled (AV4EN = 1 in the INTSET-UP register), the FX 2LP substitutes its INT4VEC byte. Therefore, if the high byte (“page”) of a jump-table address is preloaded at location 0x0054, the automatically inserted INT4VEC byte at 0x0055 directs the jump to the correct address out of the 14 addresses within the page. When the ISR occurs, the FX2LP pushes the program counter to its stack then jumps to address 0x0053, where it expects to find a “jump” instruction to the ISR Interrupt service routine.

3.9 Reset and Wakeup

3.9.1 Reset Pin

The input pin, RESET#, resets the FX2LP when asserted. This pin has hysteresis and is active LOW. When a crystal is used with the CY7C680xxA the reset period must enable stabilization of the crystal and the PLL. This reset period must be approximately

5 ms after VCC reaches 3.0V. If the crystal input pin is driven by a clock signal the internal PLL stabilizes in 200 μs after VCC has reached 3.0V.^[3]

Figure 2 on page 7 shows a power on reset condition and a reset applied during operation. A power on reset is defined as the time reset that is asserted while power is being applied to the circuit. A powered reset is when the FX2LP powered on and operating and the RESET# pin is asserted.

Cypress provides an application note which describes and recommends power on reset implementation. For more information about reset implementation for the FX2 family of products visit <http://www.cypress.com>.

Note

3. If the external clock is powered at the same time as the CY7C680xxA and has a stabilization wait period, it must be added to the 200 μs.

Figure 2. Reset Timing Plots

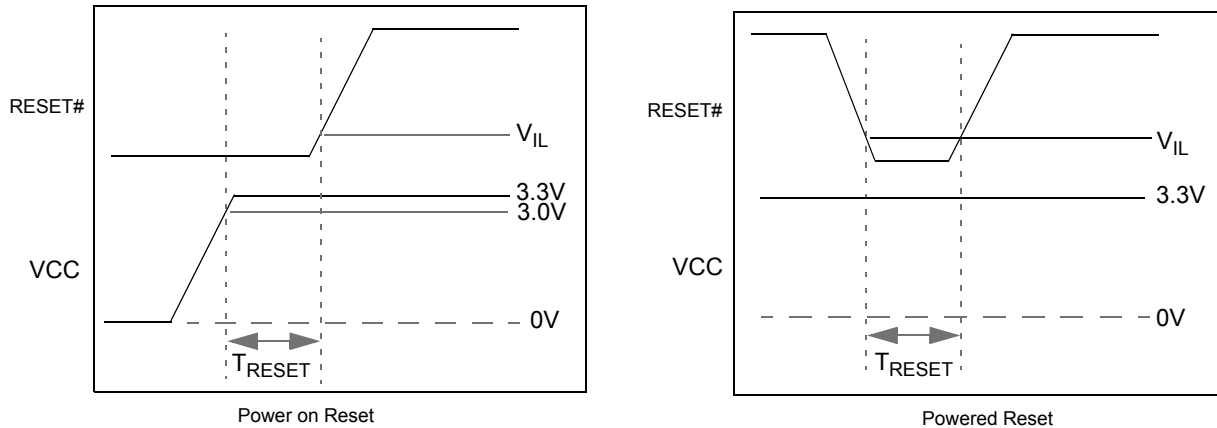


Table 5. Reset Timing Values

Condition	T_{RESET}
Power on Reset with Crystal	5 ms
Power on Reset with External Clock	200 μ s + Clock stability time
Powered Reset	200 μ s

3.9.2 Wakeup Pins

The 8051 puts itself and the rest of the chip into a power down mode by setting PCON.0 = 1. This stops the oscillator and PLL. When WAKEUP is asserted by external logic the oscillator restarts after the PLL stabilizes, and the 8051 receives a wakeup interrupt. This applies whether or not FX2LP is connected to the USB.

The FX2LP exits the power down (USB suspend) state using one of the following methods:

- USB bus activity (if D+/D- lines are left floating, noise on these lines may indicate activity to the FX2LP and initiate a wakeup)
- External logic asserts the WAKEUP pin
- External logic asserts the PA3/WU2 pin

The second wakeup pin, WU2, can also be configured as a general purpose I/O pin. This enables a simple external R-C network to be used as a periodic wakeup source. WAKEUP is by default active LOW.

3.10 Program/Data RAM

3.10.1 Size

The FX2LP has 16 KBytes of internal program/data RAM, where PSEN#/RD# signals are internally ORed to enable the 8051 to access it as both program and data memory. No USB control registers appear in this space.

Two memory maps are shown in the following diagrams:

Figure 3 on page 8 shows the Internal Code Memory, EA = 0

Figure 4 on page 9 shows the External Code Memory, EA = 1.

3.10.2 Internal Code Memory, EA = 0

This mode implements the internal 16 KByte block of RAM (starting at 0) as combined code and data memory. When external RAM or ROM is added, the external read and write strobes are suppressed for memory spaces that exist inside the chip. This enables the user to connect a 64 KByte memory without requiring address decodes to keep clear of internal memory spaces.

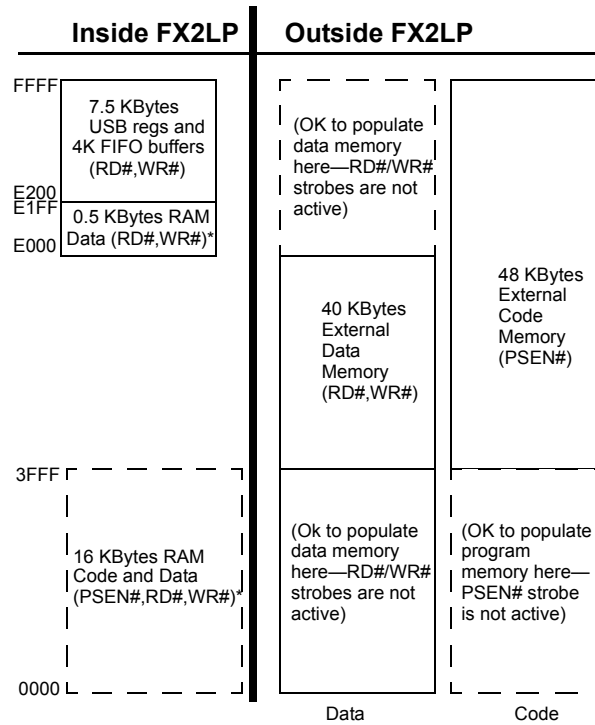
Only the internal 16 KBytes and scratch pad 0.5 KBytes RAM spaces have the following access:

- USB download
- USB upload
- Setup data pointer
- I²C interface boot load.

3.10.3 External Code Memory, EA = 1

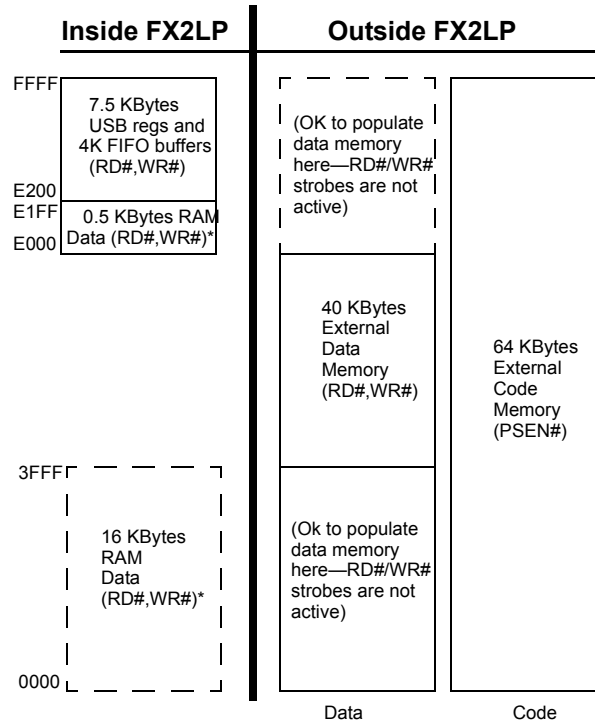
The bottom 16 KBytes of program memory is external and therefore the bottom 16 KBytes of internal RAM is accessible only as a data memory.

Figure 3. Internal Code Memory, EA = 0



*SUDPTR, USB upload/download, I²C interface boot access

Figure 4. External Code Memory, EA = 1



*SUDPTR, USB upload/download, I²C interface boot access

3.11 Register Addresses

FFFF	4 KBytes EP2-EP8 buffers (8 x 512)
F000	2 KBytes RESERVED
EFFF	
E800	64 Bytes EP1IN
E7FF	
E7C0	64 Bytes EP1OUT
E7BF	
E780	64 Bytes EP0 IN/OUT
E77F	
E740	64 Bytes RESERVED
E73F	
E700	8051 Addressable Registers (512)
E6FF	
E500	Reserved (128)
E4FF	
E480	128 bytes GPIF Waveforms
E47F	
E400	Reserved (512)
E3FF	
E200	512 bytes 8051 xdata RAM
E1FF	
E000	

3.12 Endpoint RAM

3.12.1 Size

- 3 × 64 bytes (Endpoints 0 and 1)
- 8 × 512 bytes (Endpoints 2, 4, 6, 8)

3.12.2 Organization

- EP0
- Bidirectional endpoint zero, 64 byte buffer
- EP1IN, EP1OUT
- 64 byte buffers, bulk or interrupt
- EP2, 4, 6, 8
- Eight 512 byte buffers, bulk, interrupt, or isochronous. EP4 and EP8 can be double buffered; EP2 and 6 can be either double, triple, or quad buffered. For high speed endpoint configuration options, see [Figure 5](#).

3.12.3 Setup Data Buffer

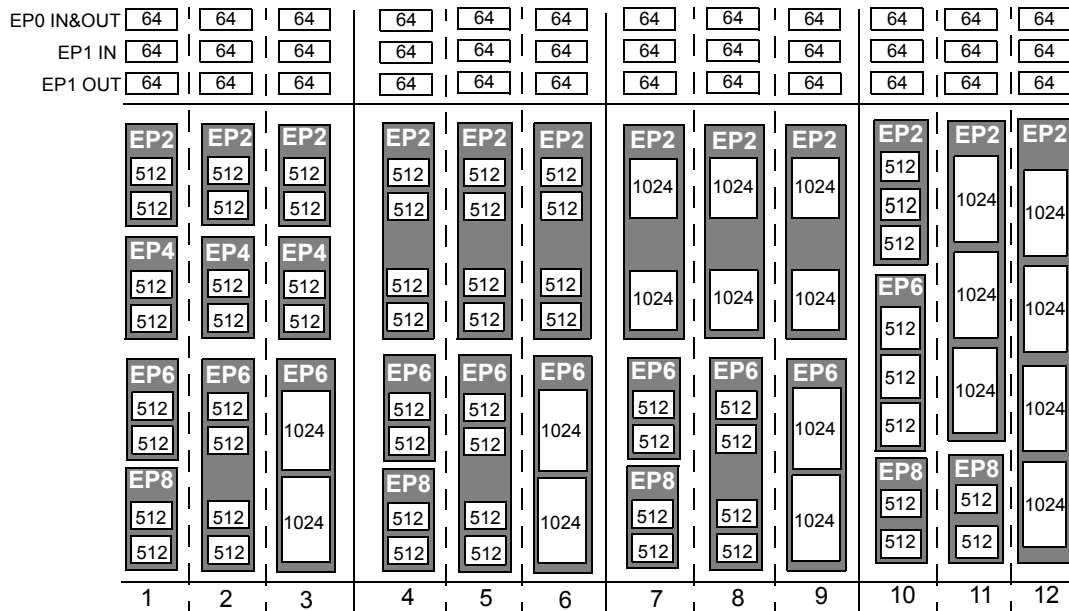
A separate 8 byte buffer at 0xE6B8-0xE6BF holds the setup data from a CONTROL transfer.

3.12.4 Endpoint Configurations (High Speed Mode)

Endpoints 0 and 1 are the same for every configuration. Endpoint 0 is the only CONTROL endpoint, and endpoint 1 can be either BULK or INTERRUPT.

The endpoint buffers can be configured in any 1 of the 12 configurations shown in the vertical columns. When operating in the full speed BULK mode only the first 64 bytes of each buffer are used. For example, in high speed, the max packet size is 512 bytes but in full speed it is 64 bytes. Even though a buffer is configured to a 512 byte buffer, in full speed only the first 64 bytes are used. The unused endpoint buffer space is not available for other operations. An example endpoint configuration is the EP2–1024 double buffered; EP6–512 quad buffered (column 8).

Figure 5. Endpoint Configuration



3.12.5 Default Full Speed Alternate Settings

Table 6. Default Full Speed Alternate Settings^[4, 5]

Alternate Setting	0	1	2	3
ep0	64	64	64	64
ep1out	0	64 bulk	64 int	64 int
ep1in	0	64 bulk	64 int	64 int
ep2	0	64 bulk out (2×)	64 int out (2×)	64 iso out (2×)
ep4	0	64 bulk out (2×)	64 bulk out (2×)	64 bulk out (2×)
ep6	0	64 bulk in (2×)	64 int in (2×)	64 iso in (2×)
ep8	0	64 bulk in (2×)	64 bulk in (2×)	64 bulk in (2×)

3.12.6 Default High Speed Alternate Settings

Table 7. Default High Speed Alternate Settings^[4, 5]

Alternate Setting	0	1	2	3
ep0	64	64	64	64
ep1out	0	512 bulk ^[6]	64 int	64 int
ep1in	0	512 bulk ^[6]	64 int	64 int
ep2	0	512 bulk out (2×)	512 int out (2×)	512 iso out (2×)
ep4	0	512 bulk out (2×)	512 bulk out (2×)	512 bulk out (2×)
ep6	0	512 bulk in (2×)	512 int in (2×)	512 iso in (2×)
ep8	0	512 bulk in (2×)	512 bulk in (2×)	512 bulk in (2×)

3.13 External FIFO Interface

3.13.1 Architecture

The FX2LP slave FIFO architecture has eight 512 byte blocks in the endpoint RAM that directly serve as FIFO memories and are controlled by FIFO control signals (such as IFCLK, SLCS#, SLRD, SLWR, SLOE, PKTEND, and flags).

In operation, some of the eight RAM blocks fill or empty from the SIE, while the others are connected to the I/O transfer logic. The transfer logic takes two forms, the GPIF for internally generated control signals and the slave FIFO interface for externally controlled transfers.

3.13.2 Master/Slave Control Signals

The FX2LP endpoint FIFOS are implemented as eight physically distinct 256x16 RAM blocks. The 8051/SIE can switch any of the RAM blocks between two domains, the USB (SIE) domain and the 8051-I/O Unit domain. This switching is done virtually instantaneously, giving essentially zero transfer time between “USB FIFOS” and “Slave FIFOS.” Because they are physically the same memory no bytes are actually transferred between buffers.

At any given time, some RAM blocks are filling/emptying with USB data under SIE control, while other RAM blocks are available to the 8051, the I/O control unit or both. The RAM blocks operate as single port in the USB domain, and dual port

in the 8051-I/O domain. The blocks can be configured as single, double, triple, or quad buffered as previously shown.

The I/O control unit implements either an internal master (M for master) or external master (S for Slave) interface.

In Master (M) mode, the GPIF internally controls FIFOADR[1..0] to select a FIFO. The RDY pins (two in the 56-pin package, six in the 100-pin and 128-pin packages) can be used as flag inputs from an external FIFO or other logic if desired. The GPIF can be run from either an internally derived clock or externally supplied clock (IFCLK), at a rate that transfers data up to 96 Megabytes/s (48-MHz IFCLK with 16-bit interface).

In Slave (S) mode, the FX2LP accepts either an internally derived clock or externally supplied clock (IFCLK, max frequency 48 MHz) and SLCS#, SLRD, SLWR, SLOE, PKTEND signals from external logic. When using an external IFCLK, the external clock must be present before switching to the external clock with the IFCLKSRC bit. Each endpoint can individually be selected for byte or word operation by an internal configuration bit and a Slave FIFO Output Enable signal SLOE enables data of the selected width. External logic must ensure that the output enable signal is inactive when writing data to a slave FIFO. The slave interface can also operate asynchronously, where the SLRD and SLWR signals act directly as strobes, rather than a clock qualifier as in synchronous mode. The signals SLRD, SLWR, SLOE and PKTEND are gated by the signal SLCS#.

Notes

4. “0” means “not implemented.”

5. “2×” means “double buffered.”

6. Even though these buffers are 64 bytes, they are reported as 512 for USB 2.0 compliance. The user must never transfer packets larger than 64 bytes to EP1.

3.13.3 GPIF and FIFO Clock Rates

An 8051 register bit selects one of two frequencies for the internally supplied interface clock: 30 MHz and 48 MHz. Alternatively, an externally supplied clock of 5 MHz–48 MHz feeding the IFCLK pin can be used as the interface clock. IFCLK can be configured to function as an output clock when the GPIF and FIFOs are internally clocked. An output enable bit in the IFCONFIG register turns this clock output off, if desired. Another bit within the IFCONFIG register inverts the IFCLK signal whether internally or externally sourced.

3.14 GPIF

The GPIF is a flexible 8-bit or 16-bit parallel interface driven by a user programmable finite state machine. It enables the CY7C68013A/15A to perform local bus mastering and can implement a wide variety of protocols such as ATA interface, printer parallel port, and Utopia.

The GPIF has six programmable control outputs (CTL), nine address outputs (GPIFADRx), and six general-purpose ready inputs (RDY). The data bus width can be 8 or 16 bits. Each GPIF vector defines the state of the control outputs, and determines what state a ready input (or multiple inputs) must be before proceeding. The GPIF vector can be programmed to advance a FIFO to the next data value, advance an address, etc. A sequence of the GPIF vectors make up a single waveform that is executed to perform the desired data move between the FX2LP and the external device.

3.14.1 Six Control OUT Signals

The 100-pin and 128-pin packages bring out all six Control Output pins (CTL0–CTL5). The 8051 programs the GPIF unit to define the CTL waveforms. The 56-pin package brings out three of these signals, CTL0–CTL2. CTLx waveform edges can be programmed to make transitions as fast as once per clock (20.8 ns using a 48-MHz clock).

3.14.2 Six Ready IN Signals

The 100-pin and 128-pin packages bring out all six Ready inputs (RDY0–RDY5). The 8051 programs the GPIF unit to test the RDY pins for GPIF branching. The 56-pin package brings out two of these signals, RDY0–1.

3.14.3 Nine GPIF Address OUT Signals

Nine GPIF address lines are available in the 100-pin and 128-pin packages, GPIFADR[8..0]. The GPIF address lines enable indexing through up to a 512 byte block of RAM. If more address lines are needed I/O port pins are used.

3.14.4 Long Transfer Mode

In the master mode, the 8051 appropriately sets GPIF transaction count registers (GPIFTCB3, GPIFTCB2, GPIFTCB1, or GPIFTCB0) for unattended transfers of up to 2³² transactions. The GPIF automatically throttles data flow to prevent under or overflow until the full number of requested transactions complete. The GPIF decrements the value in these registers to represent the current status of the transaction.

3.15 ECC Generation^[7]

The EZ-USB can calculate ECCs (Error Correcting Codes) on data that passes across its GPIF or Slave FIFO interfaces. There are two ECC configurations: Two ECCs, each calculated over 256 bytes (SmartMedia Standard); and one ECC calculated over 512 bytes.

The ECC can correct any one-bit error or detect any two-bit error.

3.15.1 ECC Implementation

The two ECC configurations are selected by the ECCM bit:

ECCM = 0

Two 3 byte ECCs, each calculated over a 256 byte block of data. This configuration conforms to the SmartMedia Standard.

Write any value to ECCRESET, then pass data across the GPIF or Slave FIFO interface. The ECC for the first 256 bytes of data is calculated and stored in ECC1. The ECC for the next 256 bytes is stored in ECC2. After the second ECC is calculated, the values in the ECCx registers do not change until ECCRESET is written again, even if more data is subsequently passed across the interface.

ECCM = 1

One 3 byte ECC calculated over a 512 byte block of data.

Write any value to ECCRESET then pass data across the GPIF or Slave FIFO interface. The ECC for the first 512 bytes of data is calculated and stored in ECC1; ECC2 is unused. After the ECC is calculated, the values in ECC1 do not change even if more data is subsequently passed across the interface, till ECCRESET is written again.

3.16 USB Uploads and Downloads

The core has the ability to directly edit the data contents of the internal 16 KByte RAM and of the internal 512 byte scratch pad RAM via a vendor specific command. This capability is normally used when soft downloading user code and is available only to and from internal RAM, only when the 8051 is held in reset. The available RAM spaces are 16 KBytes from 0x0000–0x3FFF (code/data) and 512 bytes from 0xE000–0xE1FF (scratch pad data RAM).^[8]

3.17 Autopointer Access

FX2LP provides two identical autopointers. They are similar to the internal 8051 data pointers but with an additional feature: they can optionally increment after every memory access. This capability is available to and from both internal and external RAM. The autopointers are available in external FX2LP registers under control of a mode bit (AUTOPTRESET-UP.0). Using the external FX2LP autopointer access (at 0xE67B – 0xE67C) enables the autopointer to access all internal and external RAM to the part.

Also, the autopointers can point to any FX2LP register or endpoint buffer space. When autopointer access to external memory is enabled, location 0xE67B and 0xE67C in XDATA and code space cannot be used.

Notes

7. To use the ECC logic, the GPIF or Slave FIFO interface must be configured for byte-wide operation.
8. After the data has been downloaded from the host, a “loader” can execute from internal RAM to transfer downloaded data to external memory.

3.18 I²C Controller

FX2LP has one I²C port that is driven by two internal controllers, one that automatically operates at boot time to load VID/PID/DID and configuration information, and another that the 8051 uses when running to control external I²C devices. The I²C port operates in master mode only.

3.18.1 I²C Port Pins

The I²C pins SCL and SDA must have external 2.2 kΩ pull up resistors even if no EEPROM is connected to the FX2LP. External EEPROM device address pins must be configured properly. See [Table 8](#) for configuring the device address pins.

Table 8. Strap Boot EEPROM Address Lines to These Values

Bytes	Example EEPROM	A2	A1	A0
16	24LC00 ^[9]	N/A	N/A	N/A
128	24LC01	0	0	0
256	24LC02	0	0	0
4K	24LC32	0	0	1
8K	24LC64	0	0	1
16K	24LC128	0	0	1

Table 9. Part Number Conversion Table

EZ-USB FX2 Part Number	EZ-USB FX2LP Part Number	Package Description
CY7C68013-56PVC	CY7C68013A-56PVXC or CY7C68014A-56PVXC	56-pin SSOP
CY7C68013-56PVCT	CY7C68013A-56PVXCT or CY7C68014A-56PVXCT	56-pin SSOP – Tape and Reel
CY7C68013-56LFC	CY7C68013A-56LFXC or CY7C68014A-56LFXC	56-pin QFN
CY7C68013-100AC	CY7C68013A-100AXC or CY7C68014A-100AXC	100-pin TQFP
CY7C68013-128AC	CY7C68013A-128AXC or CY7C68014A-128AXC	128-pin TQFP

Note

9. This EEPROM does not have address pins.

3.18.2 I²C Interface Boot Load Access

At power on reset the I²C interface boot loader loads the VID/PID/DID configuration bytes and up to 16 KBytes of program/data. The available RAM spaces are 16 KBytes from 0x0000–0x3FFF and 512 bytes from 0xE000–0xE1FF. The 8051 is in reset. I²C interface boot loads only occur after power on reset.

3.18.3 I²C Interface General-Purpose Access

The 8051 can control peripherals connected to the I²C bus using the I²CTL and I2DAT registers. FX2LP provides I²C master control only, it is never an I²C slave.

3.19 Compatible with Previous Generation EZ-USB FX2

The EZ-USB FX2LP is form, fit and with minor exceptions functionally compatible with its predecessor, the EZ-USB FX2. This makes for an easy transition for designers wanting to upgrade their systems from the FX2 to the FX2LP. The pinout and package selection are identical and a vast majority of firmware previously developed for the FX2 functions in the FX2LP.

For designers migrating from the FX2 to the FX2LP a change in the bill of material and review of the memory allocation (due to increased internal memory) is required. For more information about migrating from EZ-USB FX2 to EZ-USB FX2LP, see the application note titled *Migrating from EZ-USB FX2 to EZ-USB FX2LP* available in the [Cypress web site](#).

3.20 CY7C68013A/14A and CY7C68015A/16A Differences

CY7C68013A is identical to CY7C68014A in form, fit, and functionality. CY7C68015A is identical to CY7C68016A in form, fit, and functionality. CY7C68014A and CY7C68016A have a lower suspend current than CY7C68013A and CY7C68015A respectively and are ideal for power sensitive battery applications.

CY7C68015A and CY7C68016A are available in 56-pin QFN package only. Two additional GPIO signals are available on the CY7C68015A and CY7C68016A to provide more flexibility when neither IFCLK or CLKOUT are needed in the 56-pin package.

USB developers wanting to convert their FX2 56-pin application to a bus-powered system directly benefit from these additional signals. The two GPIOs give developers the signals they need for the power control circuitry of their bus-powered application without pushing them to a high pincount version of FX2LP.

The CY7C68015A is only available in the 56-pin QFN package

Table 10. CY7C68013A/14A and CY7C68015A/16A Pin Differences

CY7C68013A/CY7C68014A	CY7C68015A/CY7C68016A
IFCLK	PE0
CLKOUT	PE1

4. Pin Assignments

Figure 6 on page 15 identifies all signals for the five package types. The following pages illustrate the individual pin diagrams, plus a combination diagram showing which of the full set of signals are available in the 128-pin, 100-pin, and 56-pin packages.

The signals on the left edge of the 56-pin package in Figure 6 on page 15 are common to all versions in the FX2LP family with the noted differences between the CY7C68013A/14A and the CY7C68015A/16A.

Three modes are available in all package versions: Port, GPIF master, and Slave FIFO. These modes define the signals on the right edge of the diagram. The 8051 selects the interface mode using the IFCONFIG[1:0] register bits. Port mode is the power on default configuration.

The 100-pin package adds functionality to the 56-pin package by adding these pins:

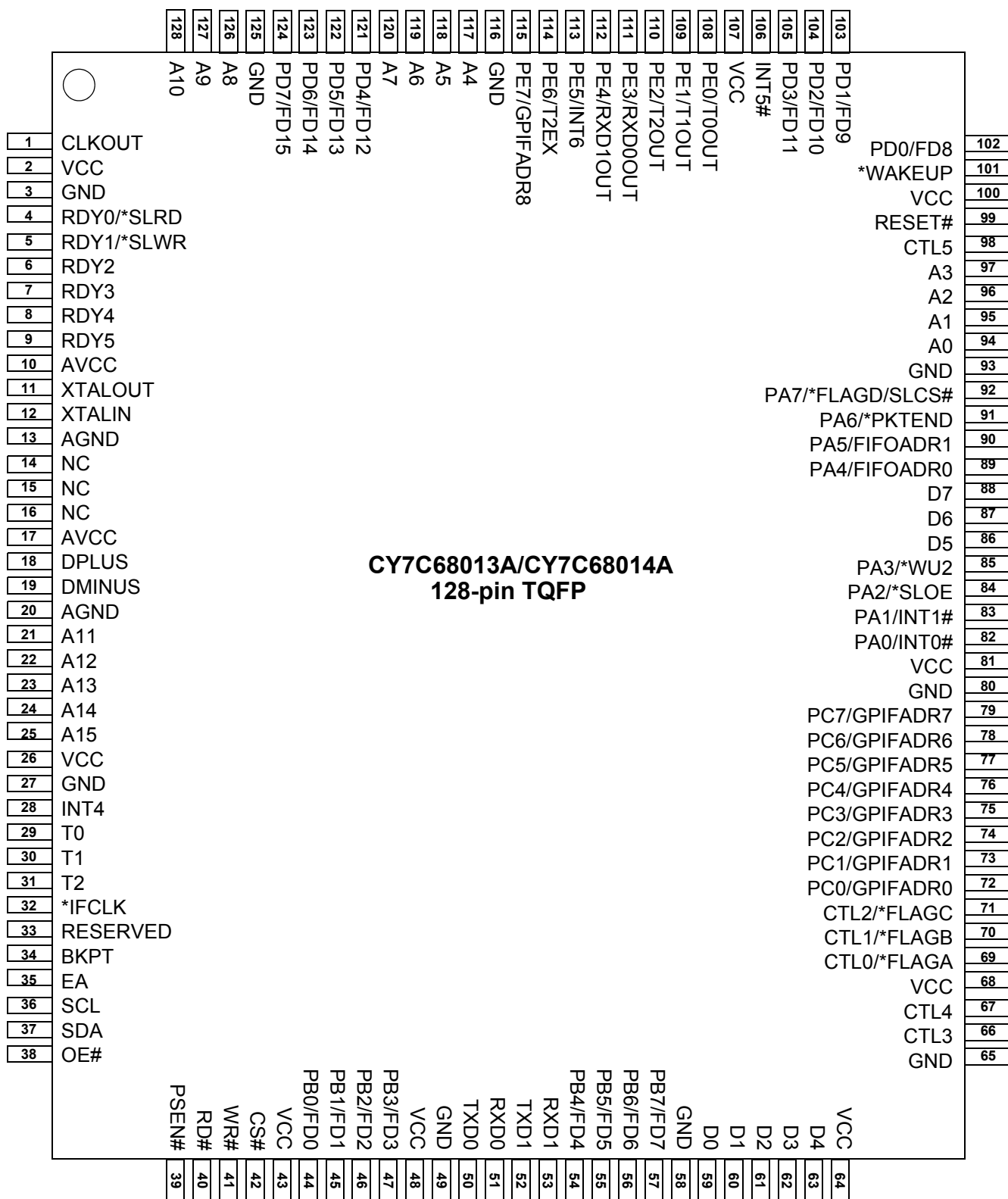
- PORTC or alternate GPIFADR[7:0] address signals
- PORTE or alternate GPIFADR[8] address signal and seven additional 8051 signals
- Three GPIF Control signals
- Four GPIF Ready signals
- Nine 8051 signals (two USARTs, three timer inputs, INT4, and INT5#)
- BKPT, RD#, WR#.

The 128-pin package adds the 8051 address and data buses plus control signals. Note that two of the required signals, RD# and WR#, are present in the 100-pin version.

In the 100-pin and 128-pin versions, an 8051 control bit can be set to pulse the RD# and WR# pins when the 8051 reads from/writes to PORTC. This feature is enabled by setting PORTCSTB bit in CPUCS register.

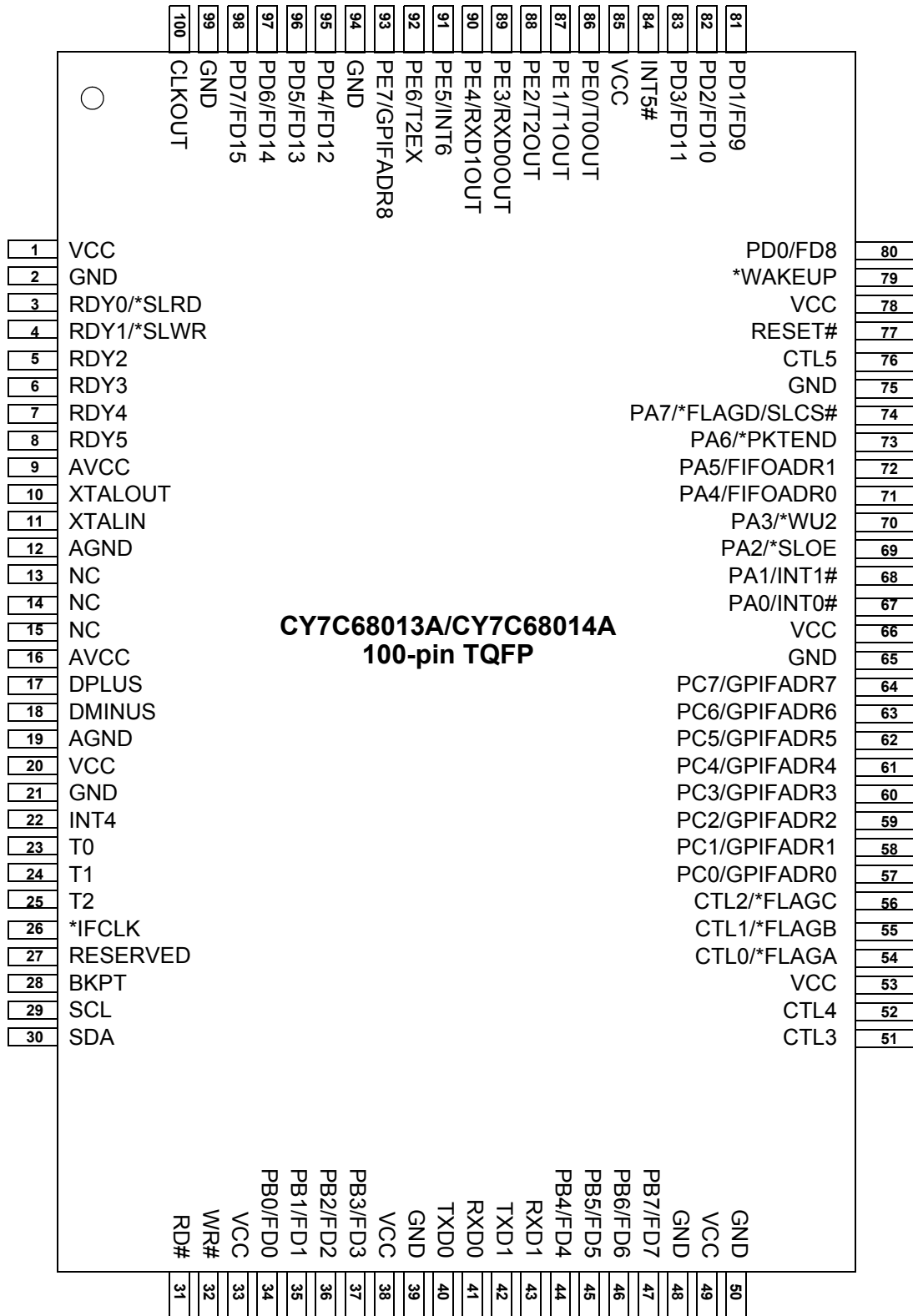
Section 10.5 displays the timing diagram of the read and write strobing function on accessing PORTC.

Figure 7. CY7C68013A/CY7C68014A 128-pin TQFP Pin Assignment



* denotes programmable polarity

Figure 8. CY7C68013A/CY7C68014A 100-pin TQFP Pin Assignment



* denotes programmable polarity

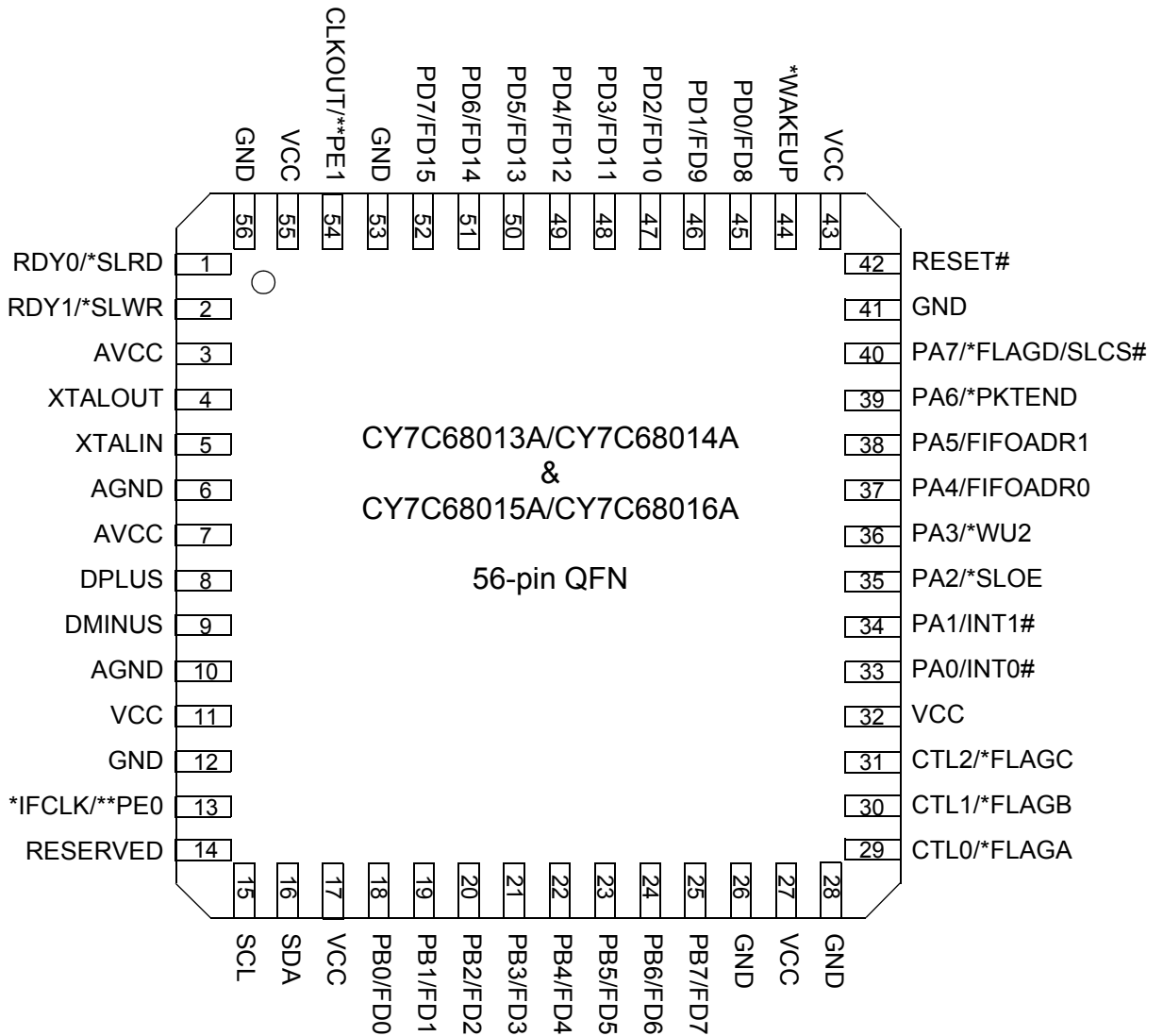
Figure 9. CY7C68013A/CY7C68014A 56-pin SSOP Pin Assignment

**CY7C68013A/CY7C68014A
56-pin SSOP**

1	PD5/FD13	PD4/FD12	56
2	PD6/FD14	PD3/FD11	55
3	PD7/FD15	PD2/FD10	54
4	GND	PD1/FD9	53
5	CLKOUT	PD0/FD8	52
6	VCC	*WAKEUP	51
7	GND	VCC	50
8	RDY0/*SLRD	RESET#	49
9	RDY1/*SLWR	GND	48
10	AVCC	PA7/*FLAGD/SLCS#	47
11	XTALOUT	PA6/PKTEND	46
12	XTALIN	PA5/FIFOADR1	45
13	AGND	PA4/FIFOADR0	44
14	AVCC	PA3/*WU2	43
15	DPLUS	PA2/*SLOE	42
16	DMINUS	PA1/INT1#	41
17	AGND	PA0/INT0#	40
18	VCC	VCC	39
19	GND	CTL2/*FLAGC	38
20	*IFCLK	CTL1/*FLAGB	37
21	RESERVED	CTL0/*FLAGA	36
22	SCL	GND	35
23	SDA	VCC	34
24	VCC	GND	33
25	PB0/FD0	PB7/FD7	32
26	PB1/FD1	PB6/FD6	31
27	PB2/FD2	PB5/FD5	30
28	PB3/FD3	PB4/FD4	29

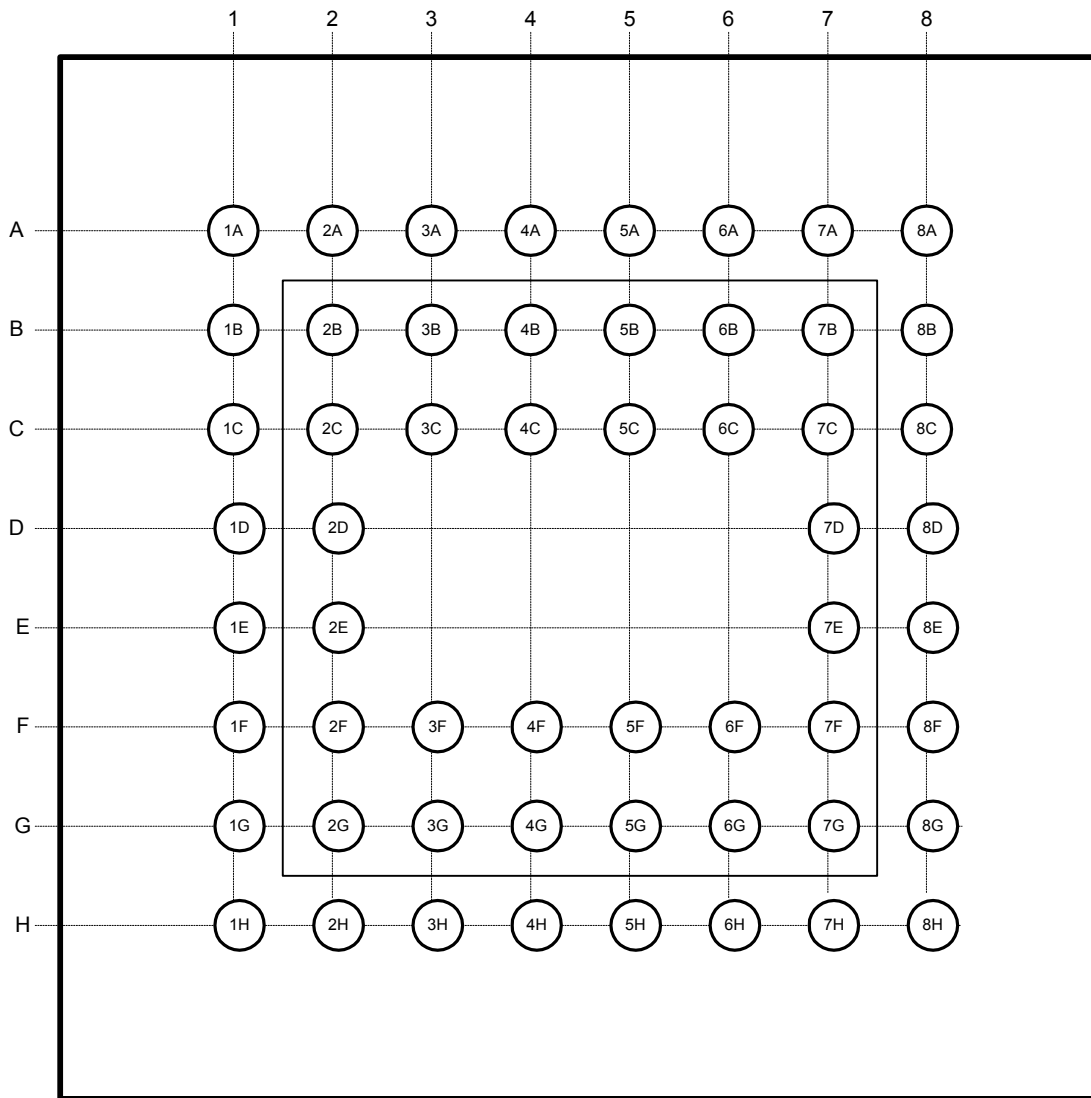
* denotes programmable polarity

Figure 10. CY7C68013A/14A/15A/16A 56-pin QFN Pin Assignment



* denotes programmable polarity
** denotes CY7C68015A/CY7C68016A pinout

Figure 11. CY7C68013A 56-pin VFBGA Pin Assignment - Top View



4.1 CY7C68013A/15A Pin Descriptions

The FX2LP Pin Descriptions follows.^[10]

Table 11. FX2LP Pin Descriptions

128 TQFP	100 TQFP	56 SSOP	56 QFN	56 VF-BGA	Name	Type	Default	Description
10	9	10	3	2D	AVCC	Power	N/A	Analog VCC. Connect this pin to 3.3V power source. This signal provides power to the analog section of the chip.
17	16	14	7	1D	AVCC	Power	N/A	Analog VCC. Connect this pin to 3.3V power source. This signal provides power to the analog section of the chip.
13	12	13	6	2F	AGND	Ground	N/A	Analog Ground. Connect to ground with as short a path as possible.
20	19	17	10	1F	AGND	Ground	N/A	Analog Ground. Connect to ground with as short a path as possible.
19	18	16	9	1E	DMINUS	I/O/Z	Z	USB D- Signal. Connect to the USB D- signal.
18	17	15	8	2E	DPLUS	I/O/Z	Z	USB D+ Signal. Connect to the USB D+ signal.
94					A0	Output	L	8051 Address Bus. This bus is driven at all times. When the 8051 is addressing internal RAM it reflects the internal address.
95					A1	Output	L	
96					A2	Output	L	
97					A3	Output	L	
117					A4	Output	L	
118					A5	Output	L	
119					A6	Output	L	
120					A7	Output	L	
126					A8	Output	L	
127					A9	Output	L	
128					A10	Output	L	
21					A11	Output	L	
22					A12	Output	L	
23					A13	Output	L	
24					A14	Output	L	
25					A15	Output	L	
59					D0	I/O/Z	Z	8051 Data Bus. This bidirectional bus is high impedance when inactive, input for bus reads, and output for bus writes. The data bus is used for external 8051 program and data memory. The data bus is active only for external bus accesses, and is driven LOW in suspend.
60					D1	I/O/Z	Z	
61					D2	I/O/Z	Z	
62					D3	I/O/Z	Z	
63					D4	I/O/Z	Z	
86					D5	I/O/Z	Z	
87					D6	I/O/Z	Z	
88					D7	I/O/Z	Z	
39					PSEN#	Output	H	Program Store Enable. This active-LOW signal indicates an 8051 code fetch from external memory. It is active for program memory fetches from 0x4000–0xFFFF when the EA pin is LOW, or from 0x0000–0xFFFF when the EA pin is HIGH.

Note

10. Unused inputs must not be left floating. Tie either HIGH or LOW as appropriate. Outputs should only be pulled up or down to ensure signals at power up and in standby. Note also that no pins should be driven while the device is powered down.

Table 11. FX2LP Pin Descriptions (continued)

128 TQFP	100 TQFP	56 SSOP	56 QFN	56 VF-BGA	Name	Type	Default	Description
34	28				BKPT	Output	L	Breakpoint. This pin goes active (HIGH) when the 8051 address bus matches the BPADDRH/L registers and breakpoints are enabled in the BREAKPT register (BPEN = 1). If the BPPULSE bit in the BREAKPT register is HIGH, this signal pulses HIGH for eight 12-/24-/48-MHz clocks. If the BPPULSE bit is LOW, the signal remains HIGH until the 8051 clears the BREAK bit (by writing 1 to it) in the BREAKPT register.
99	77	49	42	8B	RESET#	Input	N/A	Active LOW Reset. Resets the entire chip. See section 3.9 "Reset and Wakeup" on page 6 for more details.
35					EA	Input	N/A	External Access. This pin determines where the 8051 fetches code between addresses 0x0000 and 0x3FFF. If EA = 0 the 8051 fetches this code from its internal RAM. If EA = 1 the 8051 fetches this code from external memory.
12	11	12	5	1C	XTALIN	Input	N/A	Crystal Input. Connect this signal to a 24-MHz parallel-resonant, fundamental mode crystal and load capacitor to GND. It is also correct to drive XTALIN with an external 24-MHz square wave derived from another clock source. When driving from an external source, the driving signal should be a 3.3V square wave.
11	10	11	4	2C	XTALOUT	Output	N/A	Crystal Output. Connect this signal to a 24-MHz parallel-resonant, fundamental mode crystal and load capacitor to GND. If an external clock is used to drive XTALIN, leave this pin open.
1	100	5	54	2B	CLKOUT on CY7C68013A and CY7C68014A	O/Z	12 MHz	CLKOUT: 12-, 24- or 48-MHz clock, phase locked to the 24-MHz input clock. The 8051 defaults to 12-MHz operation. The 8051 may three-state this output by setting CPUCS.1 = 1.
					PE1 on CY7C68015A and CY7C68016A	I/O/Z	I	PE1 is a bidirectional I/O port pin.
Port A								
82	67	40	33	8G	PA0 or INT0#	I/O/Z	I (PA0)	Multiplexed pin whose function is selected by PORTACFG.0 PA0 is a bidirectional I/O port pin. INT0# is the active-LOW 8051 INT0 interrupt input signal, which is either edge triggered (IT0 = 1) or level triggered (IT0 = 0).
83	68	41	34	6G	PA1 or INT1#	I/O/Z	I (PA1)	Multiplexed pin whose function is selected by: PORTACFG.1 PA1 is a bidirectional I/O port pin. INT1# is the active-LOW 8051 INT1 interrupt input signal, which is either edge triggered (IT1 = 1) or level triggered (IT1 = 0).
84	69	42	35	8F	PA2 or SLOE or	I/O/Z	I (PA2)	Multiplexed pin whose function is selected by two bits: IFCONFIG[1:0]. PA2 is a bidirectional I/O port pin. SLOE is an input-only output enable with programmable polarity (FIFOPINPOLAR.4) for the slave FIFOs connected to FD[7..0] or FD[15..0].

Table 11. FX2LP Pin Descriptions (continued)

128 TQFP	100 TQFP	56 SSOP	56 QFN	56 VF-BGA	Name	Type	Default	Description
85	70	43	36	7F	PA3 or WU2	I/O/Z	I (PA3)	Multiplexed pin whose function is selected by: WAKEUP.7 and OEA.3 PA3 is a bidirectional I/O port pin. WU2 is an alternate source for USB Wakeup , enabled by WU2EN bit (WAKEUP.1) and polarity set by WU2POL (WAKEUP.4). If the 8051 is in suspend and WU2EN = 1, a transition on this pin starts up the oscillator and interrupts the 8051 to enable it to exit the suspend mode. Asserting this pin inhibits the chip from suspending, if WU2EN = 1.
89	71	44	37	6F	PA4 or FIFOADR0	I/O/Z	I (PA4)	Multiplexed pin whose function is selected by: IFCONFIG[1..0]. PA4 is a bidirectional I/O port pin. FIFOADR0 is an input-only address select for the slave FIFOs connected to FD[7..0] or FD[15..0].
90	72	45	38	8C	PA5 or FIFOADR1	I/O/Z	I (PA5)	Multiplexed pin whose function is selected by: IFCONFIG[1..0]. PA5 is a bidirectional I/O port pin. FIFOADR1 is an input-only address select for the slave FIFOs connected to FD[7..0] or FD[15..0].
91	73	46	39	7C	PA6 or PKTEND	I/O/Z	I (PA6)	Multiplexed pin whose function is selected by the IFCONFIG[1:0] bits. PA6 is a bidirectional I/O port pin. PKTEND is an input used to commit the FIFO packet data to the endpoint and whose polarity is programmable via FIFOPINPOLAR.5.
92	74	47	40	6C	PA7 or FLAGD or SLCS#	I/O/Z	I (PA7)	Multiplexed pin whose function is selected by the IFCONFIG[1:0] and PORTACFG.7 bits. PA7 is a bidirectional I/O port pin. FLAGD is a programmable slave-FIFO output status flag signal. SLCS# gates all other slave FIFO enable/strobes
Port B								
44	34	25	18	3H	PB0 or FD[0]	I/O/Z	I (PB0)	Multiplexed pin whose function is selected by the following bits: IFCONFIG[1..0]. PB0 is a bidirectional I/O port pin. FD[0] is the bidirectional FIFO/GPIF data bus.
45	35	26	19	4F	PB1 or FD[1]	I/O/Z	I (PB1)	Multiplexed pin whose function is selected by the following bits: IFCONFIG[1..0]. PB1 is a bidirectional I/O port pin. FD[1] is the bidirectional FIFO/GPIF data bus.
46	36	27	20	4H	PB2 or FD[2]	I/O/Z	I (PB2)	Multiplexed pin whose function is selected by the following bits: IFCONFIG[1..0]. PB2 is a bidirectional I/O port pin. FD[2] is the bidirectional FIFO/GPIF data bus.
47	37	28	21	4G	PB3 or FD[3]	I/O/Z	I (PB3)	Multiplexed pin whose function is selected by the following bits: IFCONFIG[1..0]. PB3 is a bidirectional I/O port pin. FD[3] is the bidirectional FIFO/GPIF data bus.
54	44	29	22	5H	PB4 or FD[4]	I/O/Z	I (PB4)	Multiplexed pin whose function is selected by the following bits: IFCONFIG[1..0]. PB4 is a bidirectional I/O port pin. FD[4] is the bidirectional FIFO/GPIF data bus.

Table 11. FX2LP Pin Descriptions (continued)

128 TQFP	100 TQFP	56 SSOP	56 QFN	56 VF-BGA	Name	Type	Default	Description
55	45	30	23	5G	PB5 or FD[5]	I/O/Z	1 (PB5)	Multiplexed pin whose function is selected by the following bits: IFCONFIG[1..0]. PB5 is a bidirectional I/O port pin. FD[5] is the bidirectional FIFO/GPIF data bus.
56	46	31	24	5F	PB6 or FD[6]	I/O/Z	1 (PB6)	Multiplexed pin whose function is selected by the following bits: IFCONFIG[1..0]. PB6 is a bidirectional I/O port pin. FD[6] is the bidirectional FIFO/GPIF data bus.
57	47	32	25	6H	PB7 or FD[7]	I/O/Z	1 (PB7)	Multiplexed pin whose function is selected by the following bits: IFCONFIG[1..0]. PB7 is a bidirectional I/O port pin. FD[7] is the bidirectional FIFO/GPIF data bus.
PORT C								
72	57				PC0 or GPIFADR0	I/O/Z	1 (PC0)	Multiplexed pin whose function is selected by PORTCCFG.0 PC0 is a bidirectional I/O port pin. GPIFADR0 is a GPIF address output pin.
73	58				PC1 or GPIFADR1	I/O/Z	1 (PC1)	Multiplexed pin whose function is selected by PORTCCFG.1 PC1 is a bidirectional I/O port pin. GPIFADR1 is a GPIF address output pin.
74	59				PC2 or GPIFADR2	I/O/Z	1 (PC2)	Multiplexed pin whose function is selected by PORTCCFG.2 PC2 is a bidirectional I/O port pin. GPIFADR2 is a GPIF address output pin.
75	60				PC3 or GPIFADR3	I/O/Z	1 (PC3)	Multiplexed pin whose function is selected by PORTCCFG.3 PC3 is a bidirectional I/O port pin. GPIFADR3 is a GPIF address output pin.
76	61				PC4 or GPIFADR4	I/O/Z	1 (PC4)	Multiplexed pin whose function is selected by PORTCCFG.4 PC4 is a bidirectional I/O port pin. GPIFADR4 is a GPIF address output pin.
77	62				PC5 or GPIFADR5	I/O/Z	1 (PC5)	Multiplexed pin whose function is selected by PORTCCFG.5 PC5 is a bidirectional I/O port pin. GPIFADR5 is a GPIF address output pin.
78	63				PC6 or GPIFADR6	I/O/Z	1 (PC6)	Multiplexed pin whose function is selected by PORTCCFG.6 PC6 is a bidirectional I/O port pin. GPIFADR6 is a GPIF address output pin.
79	64				PC7 or GPIFADR7	I/O/Z	1 (PC7)	Multiplexed pin whose function is selected by PORTCCFG.7 PC7 is a bidirectional I/O port pin. GPIFADR7 is a GPIF address output pin.
PORT D								
102	80	52	45	8A	PD0 or FD[8]	I/O/Z	1 (PD0)	Multiplexed pin whose function is selected by the IFCONFIG[1..0] and EPxFIFOCFG.0 (wordwide) bits. FD[8] is the bidirectional FIFO/GPIF data bus.
103	81	53	46	7A	PD1 or FD[9]	I/O/Z	1 (PD1)	Multiplexed pin whose function is selected by the IFCONFIG[1..0] and EPxFIFOCFG.0 (wordwide) bits. FD[9] is the bidirectional FIFO/GPIF data bus.

Table 11. FX2LP Pin Descriptions (continued)

128 TQFP	100 TQFP	56 SSOP	56 QFN	56 VF-BGA	Name	Type	Default	Description
104	82	54	47	6B	PD2 or FD[10]	I/O/Z	I (PD2)	Multiplexed pin whose function is selected by the IFCONFIG[1..0] and EPxFIFOCFG.0 (wordwide) bits. FD[10] is the bidirectional FIFO/GPIF data bus.
105	83	55	48	6A	PD3 or FD[11]	I/O/Z	I (PD3)	Multiplexed pin whose function is selected by the IFCONFIG[1..0] and EPxFIFOCFG.0 (wordwide) bits. FD[11] is the bidirectional FIFO/GPIF data bus.
121	95	56	49	3B	PD4 or FD[12]	I/O/Z	I (PD4)	Multiplexed pin whose function is selected by the IFCONFIG[1..0] and EPxFIFOCFG.0 (wordwide) bits. FD[12] is the bidirectional FIFO/GPIF data bus.
122	96	1	50	3A	PD5 or FD[13]	I/O/Z	I (PD5)	Multiplexed pin whose function is selected by the IFCONFIG[1..0] and EPxFIFOCFG.0 (wordwide) bits. FD[13] is the bidirectional FIFO/GPIF data bus.
123	97	2	51	3C	PD6 or FD[14]	I/O/Z	I (PD6)	Multiplexed pin whose function is selected by the IFCONFIG[1..0] and EPxFIFOCFG.0 (wordwide) bits. FD[14] is the bidirectional FIFO/GPIF data bus.
124	98	3	52	2A	PD7 or FD[15]	I/O/Z	I (PD7)	Multiplexed pin whose function is selected by the IFCONFIG[1..0] and EPxFIFOCFG.0 (wordwide) bits. FD[15] is the bidirectional FIFO/GPIF data bus.
Port E								
108	86				PE0 or T0OUT	I/O/Z	I (PE0)	Multiplexed pin whose function is selected by the PORTECFG.0 bit. PE0 is a bidirectional I/O port pin. T0OUT is an active-HIGH signal from 8051 Timer-counter0. T0OUT outputs a high level for one CLKOUT clock cycle when Timer0 overflows. If Timer0 is operated in Mode 3 (two separate timer/counters), T0OUT is active when the low byte timer/counter overflows.
109	87				PE1 or T1OUT	I/O/Z	I (PE1)	Multiplexed pin whose function is selected by the PORTECFG.1 bit. PE1 is a bidirectional I/O port pin. T1OUT is an active-HIGH signal from 8051 Timer-counter1. T1OUT outputs a high level for one CLKOUT clock cycle when Timer1 overflows. If Timer1 is operated in Mode 3 (two separate timer/counters), T1OUT is active when the low byte timer/counter overflows.
110	88				PE2 or T2OUT	I/O/Z	I (PE2)	Multiplexed pin whose function is selected by the PORTECFG.2 bit. PE2 is a bidirectional I/O port pin. T2OUT is the active-HIGH output signal from 8051 Timer2. T2OUT is active (HIGH) for one clock cycle when Timer/Counter 2 overflows.
111	89				PE3 or RXD0OUT	I/O/Z	I (PE3)	Multiplexed pin whose function is selected by the PORTECFG.3 bit. PE3 is a bidirectional I/O port pin. RXD0OUT is an active-HIGH signal from 8051 UART0. If RXD0OUT is selected and UART0 is in Mode 0, this pin provides the output data for UART0 only when it is in sync mode. Otherwise it is a 1.