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What Are Embedded - Microcontrollers - Application Specific?

Application-specific microcontrollers are engineered to

Details	
Product Status	Active
Applications	USB Microcontroller
Core Processor	8051
Program Memory Type	ROMless
Controller Series	CY7C680xx
RAM Size	16K x 8
Interface	I²C, USB, USART
Number of I/O	24
Voltage - Supply	3V ~ 3.6V
Operating Temperature	0°C ~ 70°C
Mounting Type	Surface Mount
Package / Case	56-BSSOP (0.295", 7.50mm Width)
Supplier Device Package	56-SSOP
Purchase URL	https://www.e-xfl.com/product-detail/infineon-technologies/cy7c68013a-56pvxct

Contents

Applications

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

The “Reference Designs” section of the Cypress web site 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.

Functional Overview

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.

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.

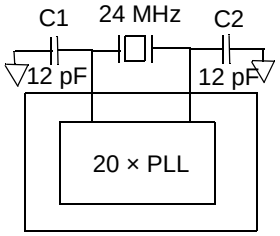
8051 Clock Frequency

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-µW 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; 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.

Figure 1. Crystal Configuration



12-pF capacitor values assume 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.

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 the 230-KBaud operation.[1]

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 6. Bold type indicates nonstandard, 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).

I^2C Bus

FX2LP supports the I^2C 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 3.3 V, even if no I^2C device is connected.

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.

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.

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 [3]
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 interrupt service routine (ISR).

Note
3. Errata: In Slave FIFO Asynchronous Word Wide mode, if a single word data is transferred from the USB host to EP2, configured as OUT Endpoint (EP) in the first transaction, then the Empty flag behaves incorrectly. This does not happen if the data size is more than one word in the first transaction. For more information, see the “Errata” on page 65.

Program/Data RAM

SizeThe FX2LP has 16 KB 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 appears in this space.

Two memory maps are shown in the following diagrams:

Figure 3 on page 10 shows the Internal Code Memory, EA = 0.

Figure 4 on page 11 shows the External Code Memory, EA = 1.

Internal Code Memory, EA = 0

This mode implements the internal 16 KB 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 KB memory without requiring address decodes to keep clear of internal memory spaces.

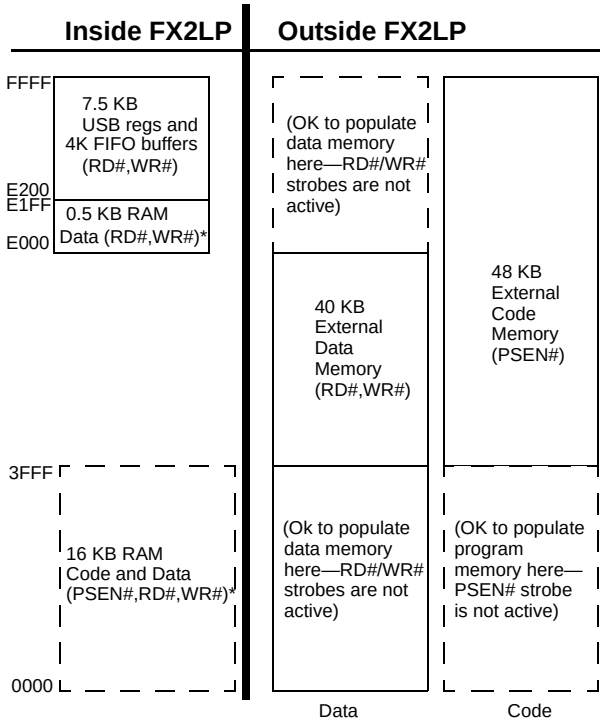
Only the internal 16 KB and scratch pad 0.5 KB RAM spaces have the following access:

- USB download
- USB upload
- Setup data pointer
- I^2C interface boot load

External Code Memory, EA = 1

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

Figure 3. Internal Code Memory, EA = 0



*SUDPTR, USB upload/download, I^2C interface boot access

Note
4. 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.

Default Full-Speed Alternate Settings

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

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×)

Default High Speed Alternate Settings

Table 7. Default Hi-Speed Alternate Settings[5, 6]

Alternate Setting	0	1	2	3
ep0	64	64	64	64
ep1out	0	512 bulk[7]	64 int	64 int
ep1in	0	512 bulk[7]	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×)

External FIFO Interface

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.

Master/Slave Control Signals

The FX2LP endpoint FIFOs are implemented as eight physically distinct 256×16 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.

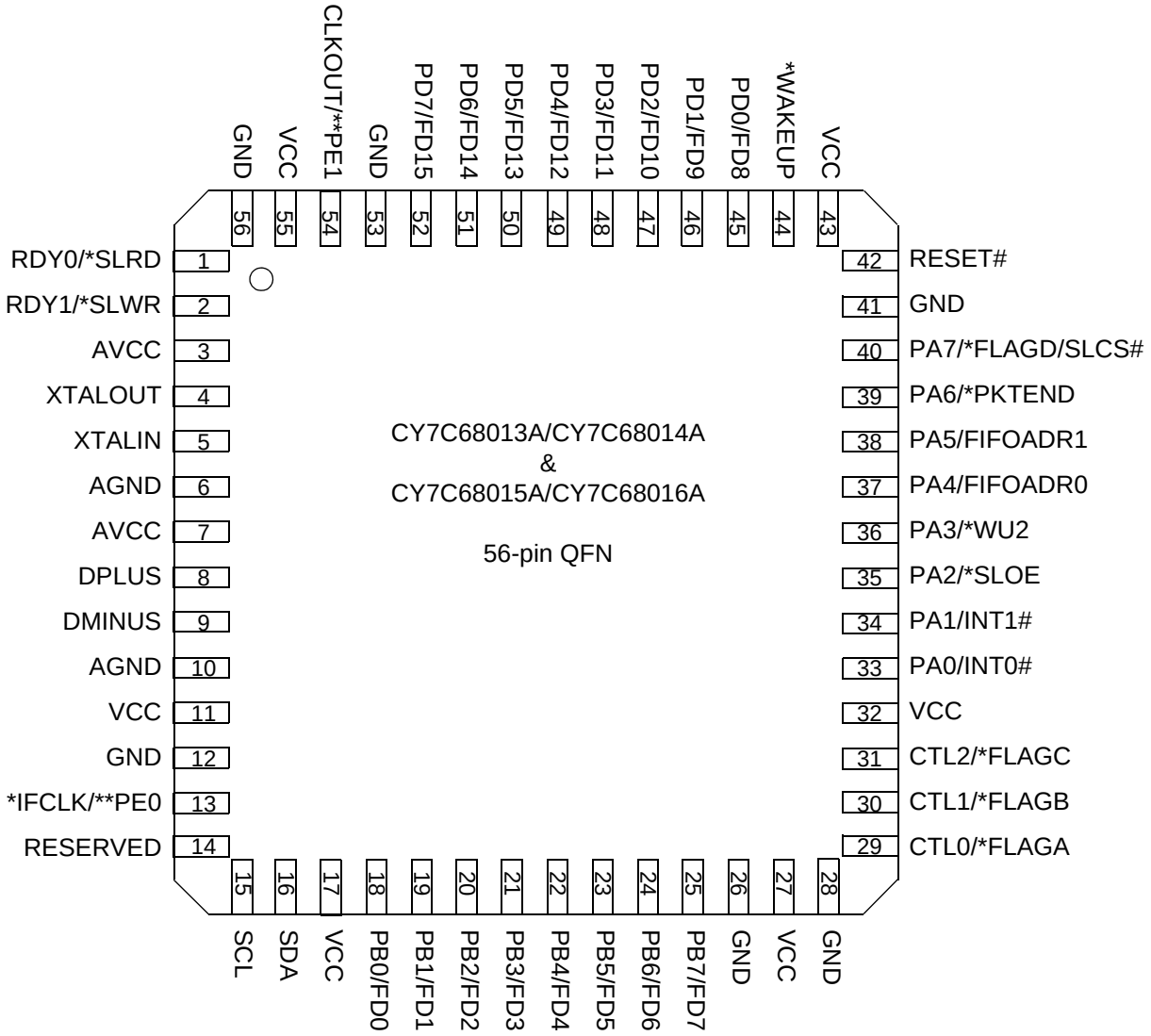
At any time, some RAM blocks are filling/emptying with the USB data under SIE control, while other RAM blocks are available to the 8051, the I/O control unit, or both. The RAM blocks operates as single-port in the USB domain, and dual-port in the 8051-I/O domain. The blocks can be configured as single-, 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 MBytes/s (48

Notes
5. "0" means "not implemented."
6. "2×" means "double buffered."
7. 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.

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



* denotes programmable polarity
** denotes CY7C68015A/CY7C68016A pinout

CY7C68013A/15A Pin Descriptions

Table 11. FX2LP Pin Descriptions[11]

128 TQFP	100 TQFP	56 SSOP	56 QFN	56 VFBGA	Name	Type	Default	Reset[12]	Description
10	9	10	3	2D	AVCC	Power	N/A	N/A	**Analog VCC**. Connect this pin to the 3.3 V power source. This signal provides power to the analog section of the chip.
17	16	14	7	1D	AVCC	Power	N/A	N/A	**Analog VCC**. Connect this pin to the 3.3 V power source. This signal provides power to the analog section of the chip.
13	12	13	6	2F	AGND	Ground	N/A	N/A	**Analog Ground**. Connect to ground with as short a path as possible.
20	19	17	10	1F	AGND	Ground	N/A	N/A	**Analog Ground**. Connect to ground with as short a path as possible.
19	18	16	9	1E	DMINUS	I/O/Z	Z	N/A	**USB D– Signal**. Connect to the USB D– signal.
18	17	15	8	2E	DPLUS	I/O/Z	Z	N/A	**USB D+ Signal**. Connect to the USB D+ signal.
94	–	–	–	–	A0	Output	L	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	L	
96	–	–	–	–	A2	Output	L	L	
97	–	–	–	–	A3	Output	L	L	
117	–	–	–	–	A4	Output	L	L	
118	–	–	–	–	A5	Output	L	L	
119	–	–	–	–	A6	Output	L	L	
120	–	–	–	–	A7	Output	L	L	
126	–	–	–	–	A8	Output	L	L	
127	–	–	–	–	A9	Output	L	L	
128	–	–	–	–	A10	Output	L	L	
21	–	–	–	–	A11	Output	L	L	
22	–	–	–	–	A12	Output	L	L	
23	–	–	–	–	A13	Output	L	L	
24	–	–	–	–	A14	Output	L	L	
25	–	–	–	–	A15	Output	L	L	
59	–	–	–	–	D0	I/O/Z	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	Z	
61	–	–	–	–	D2	I/O/Z	Z	Z	
62	–	–	–	–	D3	I/O/Z	Z	Z	
63	–	–	–	–	D4	I/O/Z	Z	Z	
86	–	–	–	–	D5	I/O/Z	Z	Z	
87	–	–	–	–	D6	I/O/Z	Z	Z	
88	–	–	–	–	D7	I/O/Z	Z	Z	
39	–	–	–	–	PSEN#	Output	H	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.

Notes
11. 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.
12. The Reset column indicates the state of signals during reset (RESET# asserted) or during Power on Reset (POR).

Table 11. FX2LP Pin Descriptions[11] (continued)

128 TQFP	100 TQFP	56 SSOP	56 QFN	56 VFBGA	Name	Type	Default	Reset[12]	Description
47	37	28	21	4G	PB3 or FD[3]	I/O/Z	I (PB3)	Z (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)	Z (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.
55	45	30	23	5G	PB5 or FD[5]	I/O/Z	I (PB5)	Z (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	I (PB6)	Z (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	I (PB7)	Z (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	I (PC0)	Z (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	I (PC1)	Z (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	I (PC2)	Z (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	I (PC3)	Z (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	I (PC4)	Z (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	I (PC5)	Z (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	I (PC6)	Z (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	I (PC7)	Z (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.

Table 11. FX2LP Pin Descriptions[11] (continued)

128 TQFP	100 TQFP	56 SSOP	56 QFN	56 VFBGA	Name	Type	Default	Reset[12]	Description
PORT D									
102	80	52	45	8A	PD0 or FD[8]	I/O/Z	I (PD0)	Z (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	I (PD1)	Z (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.
104	82	54	47	6B	PD2 or FD[10]	I/O/Z	I (PD2)	Z (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)	Z (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)	Z (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)	Z (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)	Z (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)	Z (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)	Z (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)	Z (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.

Table 11. FX2LP Pin Descriptions[11] (continued)

128 TQFP	100 TQFP	56 SSOP	56 QFN	56 VFBGA	Name	Type	Default	Reset[12]	Description
7	6	–	–	–	RDY3	Input	N/A	N/A	**RDY3** is a GPIF input signal.
8	7	–	–	–	RDY4	Input	N/A	N/A	**RDY4** is a GPIF input signal.
9	8	–	–	–	RDY5	Input	N/A	N/A	**RDY5** is a GPIF input signal.
69	54	36	29	7H	CTL0 or FLAGA	O/Z	H	L	Multiplexed pin whose function is selected by the following bits: IFCONFIG[1..0]. **CTL0** is a GPIF control output. **FLAGA** is a programmable slave-FIFO output status flag signal. Defaults to programmable for the FIFO selected by the FIFOADR[1:0] pins.
70	55	37	30	7G	CTL1 or FLAGB	O/Z	H	L	Multiplexed pin whose function is selected by the following bits: IFCONFIG[1..0]. **CTL1** is a GPIF control output. **FLAGB** is a programmable slave-FIFO output status flag signal. Defaults to FULL for the FIFO selected by the FIFOADR[1:0] pins.
71	56	38	31	8H	CTL2 or FLAGC	O/Z	H	L	Multiplexed pin whose function is selected by the following bits: IFCONFIG[1..0]. **CTL2** is a GPIF control output. **FLAGC** is a programmable slave-FIFO output status flag signal. Defaults to EMPTY for the FIFO selected by the FIFOADR[1:0] pins.
66	51	–	–	–	CTL3	O/Z	H	L	**CTL3** is a GPIF control output.
67	52	–	–	–	CTL4	Output	H	L	**CTL4** is a GPIF control output.
98	76	–	–	–	CTL5	Output	H	L	**CTL5** is a GPIF control output.
32	26	20	13	2G	IFCLK on CY7C68013A and CY7C68014A --- PE0 on CY7C68015A and CY7C68016A	I/O/Z --- - I/O/Z	Z --- I	Z --- Z	Interface Clock, used for synchronously clocking data into or out of the slave FIFOs. IFCLK also serves as a timing reference for all slave FIFO control signals and GPIF. When internal clocking is used (IFCONFIG.7 = 1) the IFCLK pin can be configured to output 30/48 MHz by bits IFCONFIG.5 and IFCONFIG.6. IFCLK may be inverted, whether internally or externally sourced, by setting the bit IFCONFIG.4 =1. --- **PE0** is a bidirectional I/O port pin.
28	22	–	–	–	INT4	Input	N/A	N/A	**INT4** is the 8051 INT4 interrupt request input signal. The INT4 pin is edge-sensitive, active HIGH.
106	84	–	–	–	INT5#	Input	N/A	N/A	**INT5#** is the 8051 INT5 interrupt request input signal. The INT5 pin is edge-sensitive, active LOW.
31	25	–	–	–	T2	Input	N/A	N/A	**T2** is the active HIGH T2 input signal to 8051 Timer2, which provides the input to Timer2 when C/T2 = 1. When C/T2 = 0, Timer2 does not use this pin.

Table 11. FX2LP Pin Descriptions[11] (continued)

128 TQFP	100 TQFP	56 SSOP	56 QFN	56 VFBGA	Name	Type	Default	Reset[12]	Description
30	24	–	–	–	T1	Input	N/A	N/A	**T1** is the active HIGH T1 signal for 8051 Timer1, which provides the input to Timer1 when C/T1 is 1. When C/T1 is 0, Timer1 does not use this bit.
29	23	–	–	–	T0	Input	N/A	N/A	**T0** is the active HIGH T0 signal for 8051 Timer0, which provides the input to Timer0 when C/T0 is 1. When C/T0 is 0, Timer0 does not use this bit.
53	43	–	–	–	RXD1	Input	N/A	N/A	**RXD1**is an active HIGH input signal for 8051 UART1, which provides data to the UART in all modes.
52	42	–	–	–	TXD1	Output	H	L	**TXD1**is an active HIGH output pin from 8051 UART1, which provides the output clock in sync mode, and the output data in async mode.
51	41	–	–	–	RXD0	Input	N/A	N/A	**RXD0** is the active HIGH RXD0 input to 8051 UART0, which provides data to the UART in all modes.
50	40	–	–	–	TXD0	Output	H	L	**TXD0** is the active HIGH TXD0 output from 8051 UART0, which provides the output clock in sync mode, and the output data in async mode.
42		–	–	–	CS#	Output	H	H	**CS#** is the active LOW chip select for external memory.
41	32	–	–	–	WR#	Output	H	H	**WR#** is the active LOW write strobe output for external memory.
40	31	–	–	–	RD#	Output	H	H	**RD#** is the active LOW read strobe output for external memory.
38		–	–	–	OE#	Output	H	H	**OE#** is the active LOW output enable for external memory.
33	27	21	14	2H	Reserved	Input	N/A	N/A	**Reserved**. Connect to ground.
101	79	51	44	7B	WAKEUP	Input	N/A	N/A	**USB Wakeup**. If the 8051 is in suspend, asserting this pin starts up the oscillator and interrupts the 8051 to enable it to exit the suspend mode. Holding WAKEUP asserted inhibits the EZ-USB chip from suspending. This pin has programmable polarity (WAKEUP.4).
36	29	22	15	3F	SCL	OD	Z	Z (if booting is done)	**Clock** for the I^2C interface. Connect to VCC with a 2.2-kΩ resistor, even if no I^2C peripheral is attached.
37	30	23	16	3G	SDA	OD	Z	Z (if booting is done)	**Data** for **I^2C compatible interface**. Connect to VCC with a 2.2-kΩ resistor, **even if no I^2C compatible peripheral is attached**.
2	1	6	55	5A	VCC	Power	N/A	N/A	**VCC**. Connect to the 3.3-V power source.
26	20	18	11	1G	VCC	Power	N/A	N/A	**VCC**. Connect to the 3.3-V power source.
43	33	24	17	7E	VCC	Power	N/A	N/A	**VCC**. Connect to the 3.3-V power source.
48	38	–	–	–	VCC	Power	N/A	N/A	**VCC**. Connect to 3.3-V power source.
64	49	34	27	8E	VCC	Power	N/A	N/A	**VCC**. Connect to the 3.3-V power source.
68	53	–	–	–	VCC	Power	N/A	N/A	**VCC**. Connect to the 3.3-V power source.
81	66	39	32	5C	VCC	Power	N/A	N/A	**VCC**. Connect to the 3.3-V power source.

Table 12. FX2LP Register Summary (continued)

Hex	Size	Name	Description	b7	b6	b5	b4	b3	b2	b1	b0	Default	Access
E6A0	1	EP0CS	Endpoint 0 Control and Status	HSNAK	0	0	0	0	0	BUSY	STALL	10000000	bbbbbbrb
E6A1	1	EP1OUTCS	Endpoint 1 OUT Control and Status	0	0	0	0	0	0	BUSY	STALL	00000000	bbbbbbrb
E6A2	1	EP1INCS	Endpoint 1 IN Control and Status	0	0	0	0	0	0	BUSY	STALL	00000000	bbbbbbrb
E6A3	1	EP2CS	Endpoint 2 Control and Status	0	NPAK2	NPAK1	NPAK0	FULL	EMPTY	0	STALL	00101000	rrrrrrrb
E6A4	1	EP4CS	Endpoint 4 Control and Status	0	0	NPAK1	NPAK0	FULL	EMPTY	0	STALL	00101000	rrrrrrrb
E6A5	1	EP6CS	Endpoint 6 Control and Status	0	NPAK2	NPAK1	NPAK0	FULL	EMPTY	0	STALL	00000100	rrrrrrrb
E6A6	1	EP8CS	Endpoint 8 Control and Status	0	0	NPAK1	NPAK0	FULL	EMPTY	0	STALL	00000100	rrrrrrrb
E6A7	1	EP2FIFOFLGS	Endpoint 2 slave FIFO Flags	0	0	0	0	0	PF	EF	FF	00000010	R
E6A8	1	EP4FIFOFLGS	Endpoint 4 slave FIFO Flags	0	0	0	0	0	PF	EF	FF	00000010	R
E6A9	1	EP6FIFOFLGS	Endpoint 6 slave FIFO Flags	0	0	0	0	0	PF	EF	FF	00000110	R
E6AA	1	EP8FIFOFLGS	Endpoint 8 slave FIFO Flags	0	0	0	0	0	PF	EF	FF	00000110	R
E6AB	1	EP2FIFOBCH	Endpoint 2 slave FIFO total byte count H	0	0	0	BC12	BC11	BC10	BC9	BC8	00000000	R
E6AC	1	EP2FIFOBCL	Endpoint 2 slave FIFO total byte count L	BC7	BC6	BC5	BC4	BC3	BC2	BC1	BC0	00000000	R
E6AD	1	EP4FIFOBCH	Endpoint 4 slave FIFO total byte count H	0	0	0	0	0	BC10	BC9	BC8	00000000	R
E6AE	1	EP4FIFOBCL	Endpoint 4 slave FIFO total byte count L	BC7	BC6	BC5	BC4	BC3	BC2	BC1	BC0	00000000	R
E6AF	1	EP6FIFOBCH	Endpoint 6 slave FIFO total byte count H	0	0	0	0	BC11	BC10	BC9	BC8	00000000	R
E6B0	1	EP6FIFOBCL	Endpoint 6 slave FIFO total byte count L	BC7	BC6	BC5	BC4	BC3	BC2	BC1	BC0	00000000	R
E6B1	1	EP8FIFOBCH	Endpoint 8 slave FIFO total byte count H	0	0	0	0	0	BC10	BC9	BC8	00000000	R
E6B2	1	EP8FIFOBCL	Endpoint 8 slave FIFO total byte count L	BC7	BC6	BC5	BC4	BC3	BC2	BC1	BC0	00000000	R
E6B3	1	SUDPTRH	Setup Data Pointer high address byte	A15	A14	A13	A12	A11	A10	A9	A8	xxxxxxxx	RW
E6B4	1	SUDPTRL	Setup Data Pointer low address byte	A7	A6	A5	A4	A3	A2	A1	0	xxxxxxx0	bbbbbbbr
E6B5	1	SUDPTRCTL	Setup Data Pointer Auto Mode	0	0	0	0	0	0	0	SDPAUTO	00000001	RW
	2	reserved											
E6B8	8	SET-UPDAT	8 bytes of setup data	D7	D6	D5	D4	D3	D2	D1	D0	xxxxxxxx	R
			SET-UPDAT[0] = bmRequestType										
			SET-UPDAT[1] = bmRequest										
			SET-UPDAT[2:3] = wValue										
			SET-UPDAT[4:5] = wIndex										
			SET-UPDAT[6:7] = wLength										
		GPIF											
E6C0	1	GPIFWFSELECT	Waveform Selector	SINGLEWR1	SINGLEWR0	SINGLERD1	SINGLERD0	FIFOWR1	FIFOWR0	FIFORD1	FIFORD0	11100100	RW
E6C1	1	GPIFIDLECS	GPIF Done, GPIF IDLE drive mode	DONE	0	0	0	0	0	0	IDLEDRV	10000000	RW
E6C2	1	GPIFIDLECTL	Inactive Bus, CTL states	0	0	CTL5	CTL4	CTL3	CTL2	CTL1	CTL0	11111111	RW
E6C3	1	GPIFCTLCFG	CTL Drive Type	TRICTL	0	CTL5	CTL4	CTL3	CTL2	CTL1	CTL0	00000000	RW
E6C4	1	GPIFADRH[13]	GPIF Address H	0	0	0	0	0	0	0	GPIFA8	00000000	RW
E6C5	1	GPIFADRL[13]	GPIF Address L	GPIFA7	GPIFA6	GPIFA5	GPIFA4	GPIFA3	GPIFA2	GPIFA1	GPIFA0	00000000	RW
		FLOWSTATE											
E6C6	1	FLOWSTATE	Flowstate Enable and Selector	FSE	0	0	0	0	FS2	FS1	FS0	00000000	brrrrbbb
E6C7	1	FLOWLOGIC	Flowstate Logic	LFUNC1	LFUNC0	TERMA2	TERMA1	TERMA0	TERMB2	TERMB1	TERMB0	00000000	RW
E6C8	1	FLOWEQ0CTL	CTL-Pin States in Flowstate (when Logic = 0)	CTL0E3	CTL0E2	CTL0E1/ CTL5	CTL0E0/ CTL4	CTL3	CTL2	CTL1	CTL0	00000000	RW
E6C9	1	FLOWEQ1CTL	CTL-Pin States in Flowstate (when Logic = 1)	CTL0E3	CTL0E2	CTL0E1/ CTL5	CTL0E0/ CTL4	CTL3	CTL2	CTL1	CTL0	00000000	RW
E6CA	1	FLOWHOLDOFF	Holdoff Configuration	HOPERIOD3	HOPERIOD2	HOPERIOD1	HOPERIOD0	HOSTATE	HOCTL2	HOCTL1	HOCTL0	00010010	RW
E6CB	1	FLOWSTB	Flowstate Strobe Configuration	SLAVE	RDYASYNC	CTLTOGL	SUSTAIN	0	MSTB2	MSTB1	MSTB0	00100000	RW
E6CC	1	FLOWSTBEDGE	Flowstate Rising/Falling Edge Configuration	0	0	0	0	0	0	FALLING	RISING	00000001	rrrrrrbb
E6CD	1	FLOWSTBPERIOD	Master-Strobe Half-Period	D7	D6	D5	D4	D3	D2	D1	D0	00000010	RW
E6CE	1	GPIFTCB3[13]	GPIF Transaction Count Byte 3	TC31	TC30	TC29	TC28	TC27	TC26	TC25	TC24	00000000	RW

Table 21. Slave FIFO Synchronous Read Parameters with Externally Sourced IFCLK[25]

Parameter	Description	Min	Max	Unit
t_{IFCLK}	IFCLK period	20.83	200	ns
t_{SRD}	SLRD to clock setup time	12.7	–	ns
t_{RDH}	Clock to SLRD hold time	3.7	–	ns
t_{OEon}	SLOE turn on to FIFO data valid	–	10.5	ns
t_{OEoff}	SLOE turn off to FIFO data hold	–	10.5	ns
t_{XFLG}	Clock to FLAGS output propagation delay	–	13.5	ns
t_{XFD}	Clock to FIFO data output propagation delay	–	15	ns

Slave FIFO Asynchronous Read

Figure 20. Slave FIFO Asynchronous Read Timing Diagram[24]

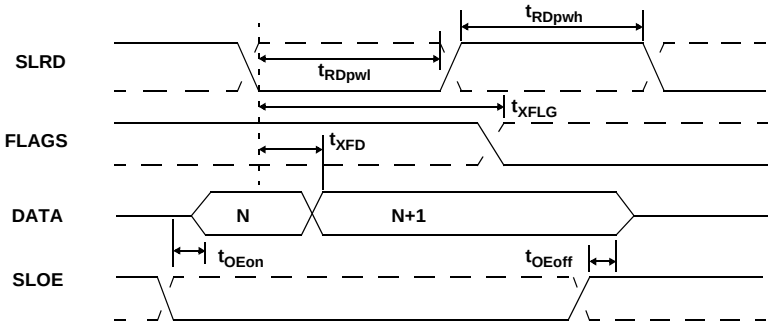


Table 22. Slave FIFO Asynchronous Read Parameters[27]

Parameter	Description	Min	Max	Unit
t_{RDpwl}	SLRD pulse width LOW	50	–	ns
t_{RDpwh}	SLRD pulse width HIGH	50	–	ns
t_{XFLG}	SLRD to FLAGS output propagation delay	–	70	ns
t_{XFD}	SLRD to FIFO data output propagation delay	–	15	ns
t_{OEon}	SLOE turn-on to FIFO data valid	–	10.5	ns
t_{OEoff}	SLOE turn-off to FIFO data hold	–	10.5	ns

Note
27. Slave FIFO asynchronous parameter values use internal IFCLK setting at 48 MHz.

Single and Burst Synchronous Write

Figure 32. Slave FIFO Synchronous Write Sequence and Timing Diagram[24]

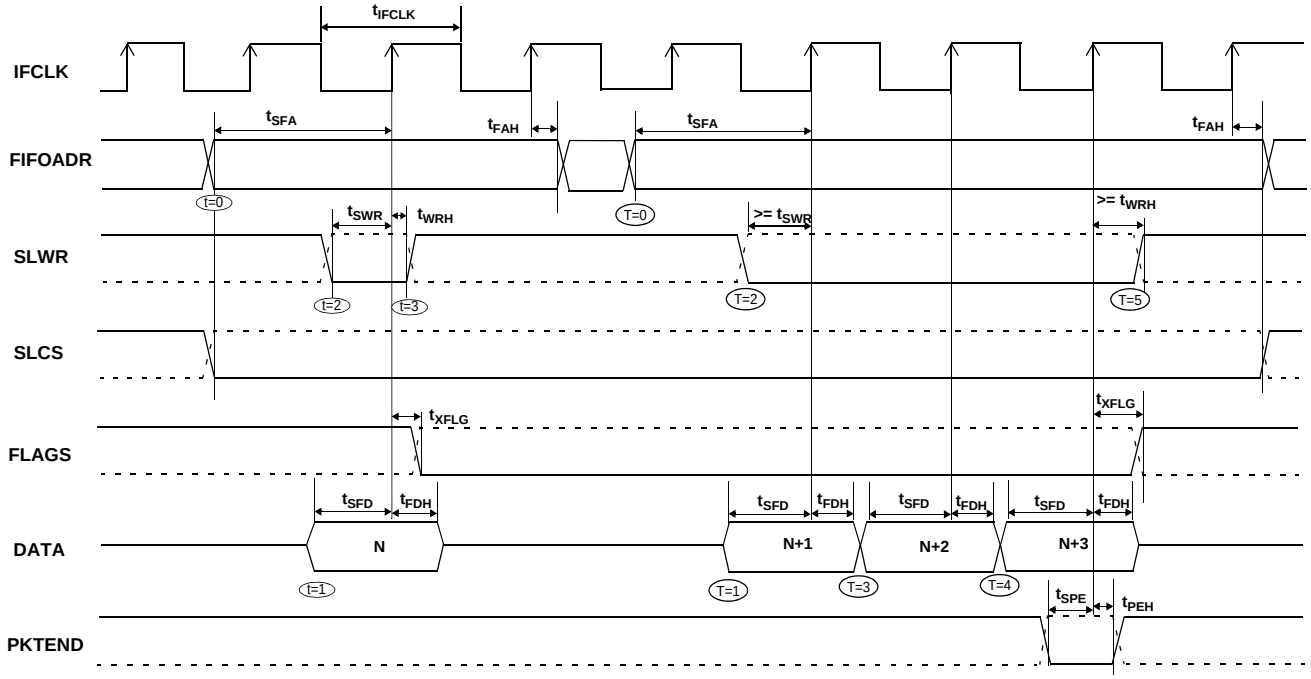


Figure 32 shows the timing relationship of the SLAVE FIFO signals during a synchronous write using IFCLK as the synchronizing clock. The diagram illustrates a single write followed by burst write of three bytes and committing all four bytes as a short packet using the PKTEND pin.

- At t = 0 the FIFO address is stable and the signal SLCS is asserted. (SLCS may be tied LOW in some applications) Note that t_{SFA} has a minimum of 25 ns. This means when IFCLK is running at 48 MHz, the FIFO address setup time is more than one IFCLK cycle.
- At t = 1, the external master/peripheral must outputs the data value onto the data bus with a minimum set up time of t_{SFD} before the rising edge of IFCLK.
- At t = 2, SLWR is asserted. The SLWR must meet the setup time of t_{SWR} (time from asserting the SLWR signal to the rising edge of IFCLK) and maintain a minimum hold time of t_{WRH} (time from the IFCLK edge to the deassertion of the SLWR signal). If the SLCS signal is used, it must be asserted with SLWR or before SLWR is asserted (The SLCS and SLWR signals must both be asserted to start a valid write condition).
- While the SLWR is asserted, data is written to the FIFO and on the rising edge of the IFCLK, the FIFO pointer is incremented. The FIFO flag is also updated after a delay of t_{XFLG} from the rising edge of the clock.

The same sequence of events are also shown for a burst write and are marked with the time indicators of T = 0 through 5.

Note For the burst mode, SLWR and SLCS are left asserted for the entire duration of writing all the required data values. In this burst write mode, after the SLWR is asserted, the data on the FIFO data bus is written to the FIFO on every rising edge of IFCLK. The FIFO pointer is updated on each rising edge of IFCLK. In Figure 32, after the four bytes are written to the FIFO, SLWR is deasserted. The short 4 byte packet can be committed to the host by asserting the PKTEND signal.

There is no specific timing requirement that should be met for asserting PKTEND signal with regards to asserting the SLWR signal. PKTEND can be asserted with the last data value or thereafter. The only requirement is that the setup time t_{SPE} and the hold time t_{PEH} must be met. In the scenario of Figure 32, the number of data values committed includes the last value written to the FIFO. In this example, both the data value and the PKTEND signal are clocked on the same rising edge of IFCLK. PKTEND can also be asserted in subsequent clock cycles. The FIFOADDR lines should be held constant during the PKTEND assertion.

Although there are no specific timing requirement for the PKTEND assertion, there is a specific corner-case condition that needs attention while using the PKTEND to commit a one byte/word packet. Additional timing requirements exist when the FIFO is configured to operate in auto mode and it is desired to send two packets: a full packet (‘full’ defined as the number of bytes in the FIFO meeting the level set in the AUTOINLEN register) committed automatically followed by a short one byte or word packet committed manually using the PKTEND pin.

In this case, the external master must ensure to assert the PKTEND pin at least one clock cycle after the rising edge that caused the last byte or word that needs to be clocked into the previous auto committed packet (the packet with the number of bytes equal to what is set in the AUTOINLEN register). Refer to Figure 24 on page 50 for further details on this timing.

Sequence Diagram of a Single and Burst Asynchronous Read

Figure 33. Slave FIFO Asynchronous Read Sequence and Timing Diagram[24]

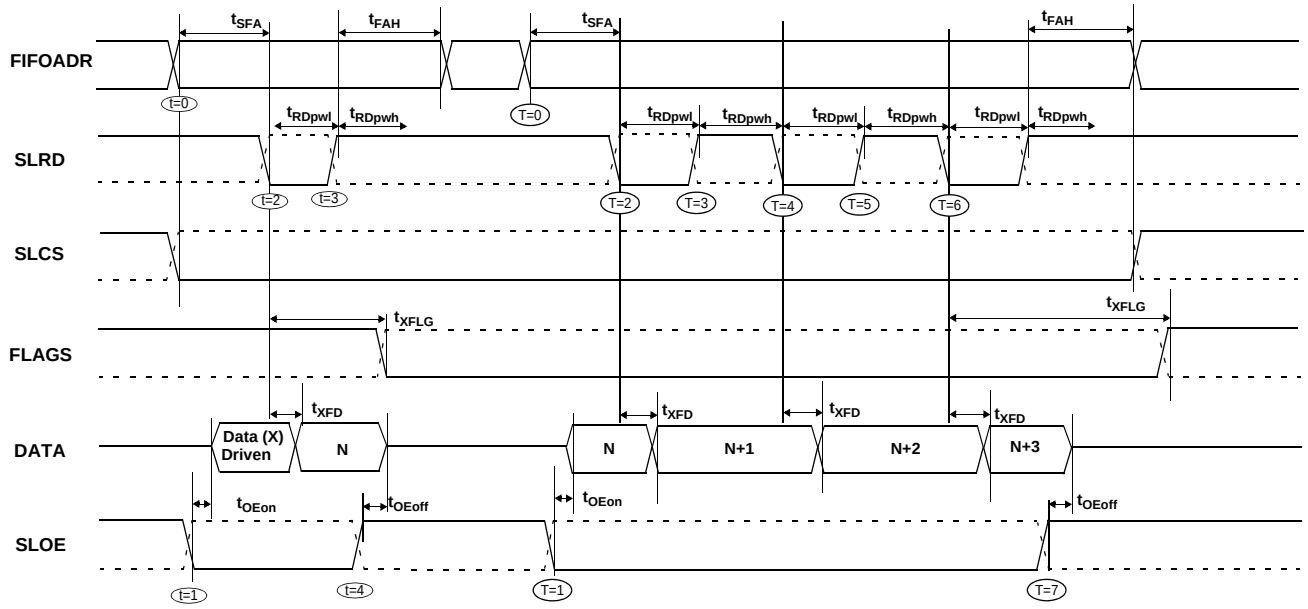


Figure 34. Slave FIFO Asynchronous Read Sequence of Events Diagram

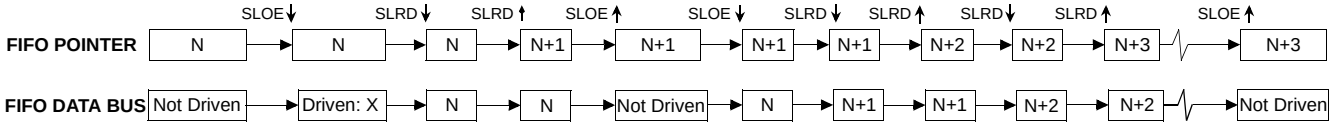


Figure 33 shows the timing relationship of the SLAVE FIFO signals during an asynchronous FIFO read. It shows a single read followed by a burst read.

- At t = 0, the FIFO address is stable and the SLCS signal is asserted.
- At t = 1, SLOE is asserted. This results in the data bus being driven. The data that is driven on to the bus is the previous data, the data that was in the FIFO from anearlier read cycle.
- At t = 2, SLRD is asserted. The SLRD must meet the minimum active pulse of t_{RDpwl} and minimum de-active pulse width of t_{RDpwh}. If SLCS is used, then SLCS must be asserted before SLRD is asserted (The SLCS and SLRD signals must both be asserted to start a valid read condition.)
- The data that is driven, after asserting SLRD, is the updated data from the FIFO. This data is valid after a propagation delay of t_{XFD} from the activating edge of SLRD. In Figure 33, data N is the first valid data read from the FIFO. For data to appear on the data bus during the read cycle (SLRD is asserted), SLOE must be in an asserted state. SLRD and SLOE can also be tied together.

The same sequence of events is also shown for a burst read marked with T = 0 through 5.

Note In the burst read mode, during SLOE is asserted, the data bus is in a driven state and outputs the previous data. After SLRD is asserted, the data from the FIFO is driven on the data bus (SLOE must also be asserted) and then the FIFO pointer is incremented.

Package Diagrams

The FX2LP is available in five packages:

- 56-pin SSOP
- 56-pin QFN
- 100-pin TQFP
- 128-pin TQFP
- 56-ball VFBGA

Figure 36. 56-Pin Shrunk Small Outline Package O56 (51-85062)

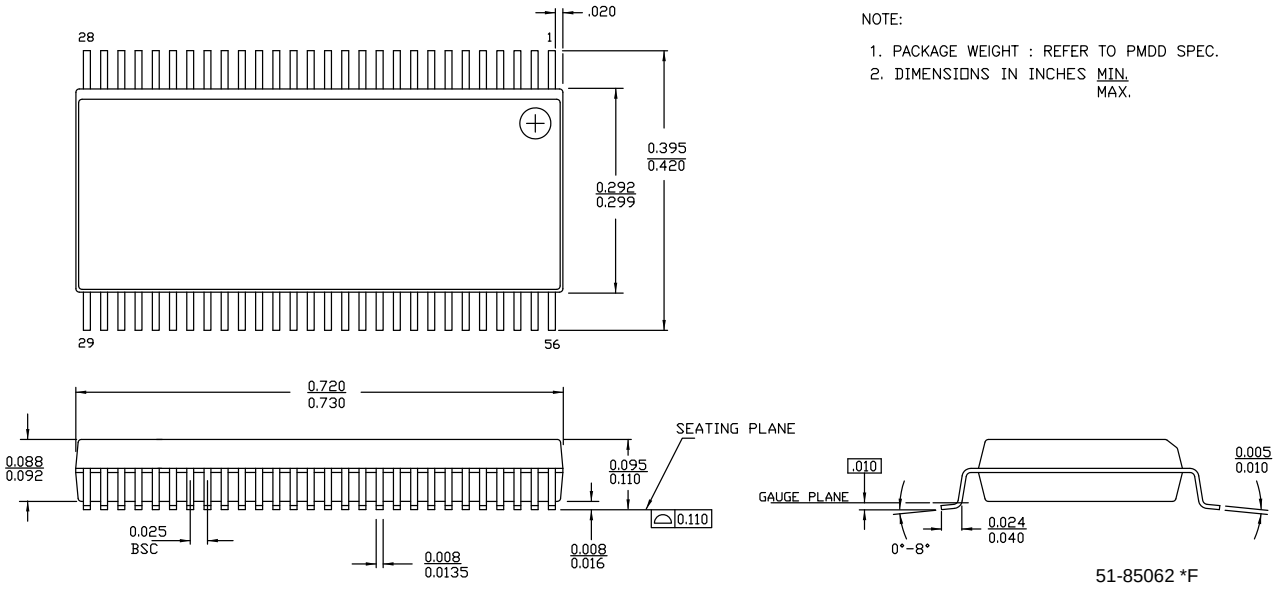
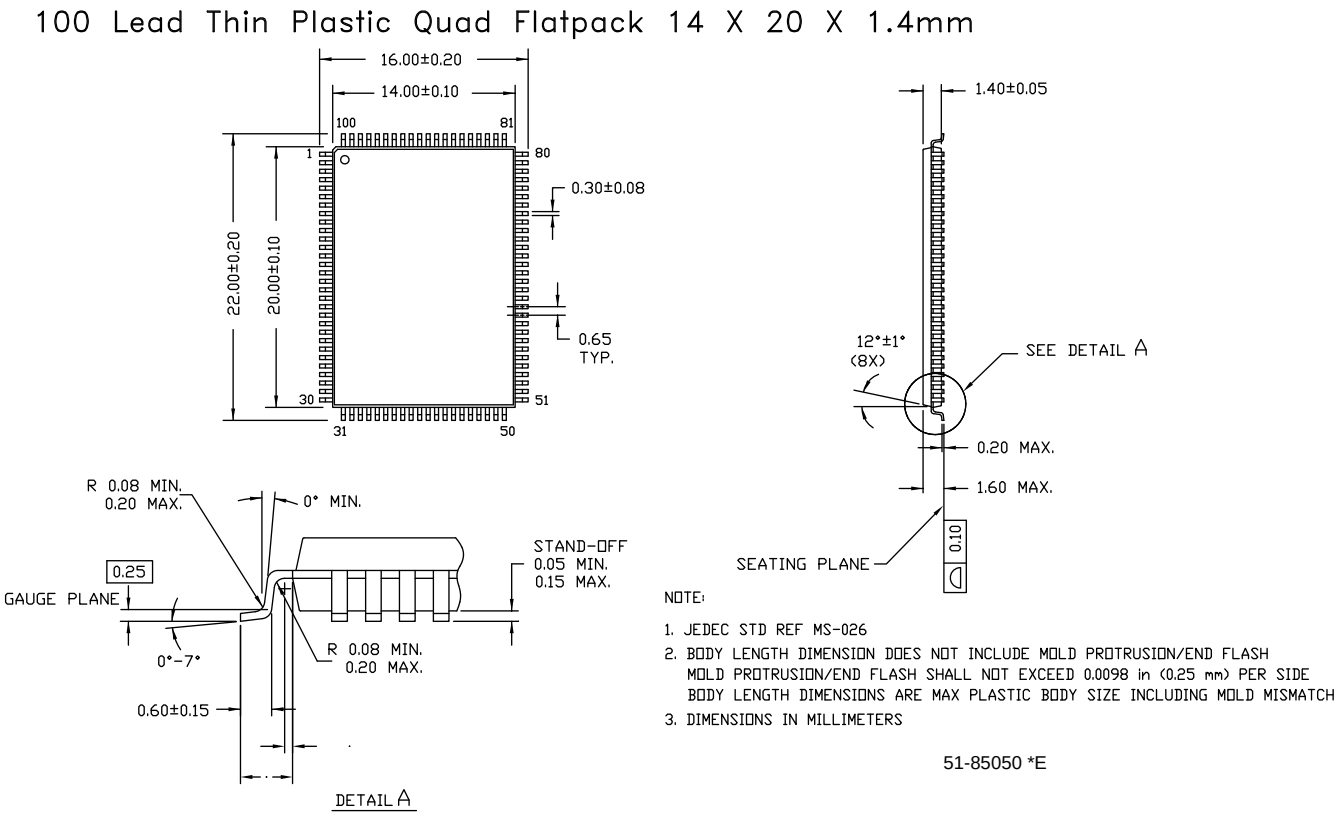


Figure 38. 100-Pin Thin Plastic Quad Flatpack (14 × 20 × 1.4 mm) A100RA (51-85050)



Errata

This section describes the errata for the EZ-USB® FX2LP™ CY7C68013A/14A/15A/16A Rev. B silicon. Details include errata trigger conditions, scope of impact, available workaround, and silicon revision applicability.

Contact your local Cypress Sales Representative if you have questions.

Part Numbers Affected

Part Number	Package Type	Operating Range
CY7C68013A	All	Commercial
CY7C68014A	All	Commercial
CY7C68015A	All	Commercial
CY7C68016A	All	Commercial

CY7C68013A/14A/15A/16A Qualification Status

In production

CY7C68013A/14A/15A/16A Errata Summary

This table defines the errata for available CY7C68013A/14A/15A/16A family devices. An "X" indicates that the errata pertain to the selected device.

Items	CY7C68013A/14A/15A/16A	Silicon Revision	Fix Status
[1.]. Empty Flag Assertion	X	B	No silicon fix planned currently. Use the workaround.

1. Empty Flag Assertion

■ Problem Definition

In Slave FIFO Asynchronous Word Wide mode, if a single word data is transferred from the USB host to EP2, configured as OUT Endpoint (EP) in the first transaction, then the Empty flag behaves incorrectly. This does not happen if the data size is more than one word in the first transaction.

■ Parameters Affected

NA

■ Trigger Condition(S)

In Slave FIFO Asynchronous Word Wide Mode, after firmware boot and initialization, EP2 OUT endpoint empty flag indicates the status as ‘Empty’. When data is received in EP2, the status changes to ‘Not-Empty’. However, if data transferred to EP2 is a single word, then asserting SLRD with FIFOADR pointing to any other endpoint changes ‘Not-Empty’ status to ‘Empty’ for EP2 even though there is a word data (or it is untouched). This is noticed only when the single word is sent as the first transaction and not if it follows a multi-word packet as the first transaction.

■ Scope of Impact

External interface does not see data available in EP2 OUT endpoint and can end up waiting for data to be read.

■ Workaround

One of the following workarounds can be used:

- Send a pulse signal to the SLWR pin, with FIFOADR pins pointing to an endpoint other than EP2, after firmware initialization and before or after transferring the data to EP2 from the host
- Set the length of the first data to EP2 to be more than a word
- Prioritize EP2 read from the Master for multiple OUT EPs and single word write to EP2
- Write to an IN EP, if any, from the Master before reading from other OUT EPs (other than EP2) from the Master.

■ Fix Status

There is no silicon fix planned for this currently; use the workarounds provided.

Document History Page (continued)

Document Title: CY7C68013A, CY7C68014A, CY7C68015A, CY7C68016A, EZ-USB® FX2LP™ USB Microcontroller High-Speed USB Peripheral Controller Document Number: 38-08032				
Rev.	**ECN No.**	**Orig. of Change**	**Submission Date**	**Description of Change**
*K	420505	MON	See ECN	Remove SLCS from figure in Section . Removed indications that SLRD can be asserted simultaneously with SLCS in Section and Section Added Absolute Maximum Temperature Rating for industrial packages in Section Changed number of packages stated in the description in Section to five. Added Table 13 on Thermal Coefficients for various packages
*L	2064406	CMCC/PYRS	See ECN	Changed TID number Removed T0OUT and T1OUT from CY7C68015A/16A Updated t_{SWR} Min value in Figure 21 Updated 56-lead QFN package diagram
*M	2710327	DPT	05/22/2009	Added 56-Pin QFN (8 X 8 mm) package diagram Updated ordering information for CY7C68013A-56LTXC, CY7C68013A-56LTXI, CY7C68014A-56LTXC, CY7C68015A-56LTXC, and CY7C68016A-56LTXC parts.
*N	2727334	ODC	07/01/09	Removed sentence on E-Pad size change from *F revision in the Document History Page Updated 56-Pin Sawn Package Diagram
*O	2756202	ODC	08/26/2009	Updated Ordering Information table and added note 24.
*P	2785207	ODC	10/12/2009	Added information on Pb-free parts in the Ordering information table.
*Q	2811890	ODC	11/20/2009	Updated Program I/Os for the CY7C68016A-56LTXC and CY7C68016A-56LTXCT parts in "Ordering Information" on page 56.
*R	2896281	ODC	03/19/10	Removed inactive parts from the ordering information table. Updated package diagrams.Updated links in Sales, Solutions and Legal Information.
*S	3035980	ODC	09/22/10	Updated template. Changed PPM requirement for the external crystal from +/- 10 ppm to +/- 100 ppm under Electrical specifications. Added table of contents, ordering code definitions, acronym table, and units of measure.
*T	3161410	AAE	02/03/2011	Replaced 56-Pin QFN 8 × 8 mm Punch Version Package Diagram (Figure 11.2) and 56-Pin QFN 8 × 8 mm Sawn Version Package Diagram (Figure 11.3). Updated Package Diagrams (Figure 11.4, Figure 11.5).
*U	3195232	ODC	03/14/2011	Updated table numbering. Added typical values to Table 18 on page 45 and Table 20 on page 46 based on data obtained from SHAK-63 and SHAK 69. Updated Table 13, "Thermal Characteristics," on page 39 (CDT 89510) Updated package diagram 001-03901 to *D.
*V	3512313	GAYA	02/01/2012	Removed obsolete part CY7C68014A-56BAXC Removed pruned part CY7C68016A-56LFXC Added parts CY7C68013A-56BAXCT and CY7C68013A-56PVXCT Updated Package Diagrams

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