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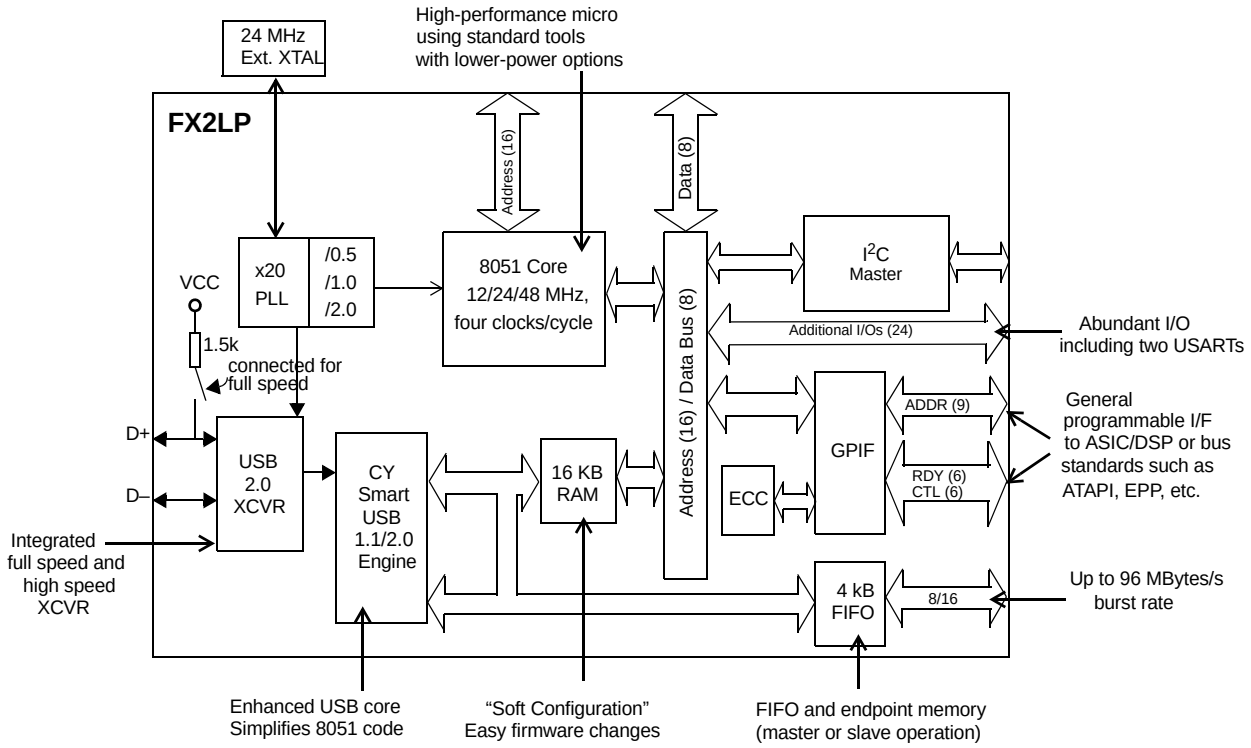
What Are Embedded - Microcontrollers - Application Specific?

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-56pvxc

Logic Block Diagram



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 a 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 the development time to ensure USB compatibility.

The general programmable interface (GPIF) and Master/Slave Endpoint FIFO (8-bit or 16-bit data bus) provide 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: 56 VFBGA, 56 SSOP, 56 QFN, 100 TQFP, and 128 TQFP.

Contents

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.

Endpoint RAM

Size

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

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 Hi-Speed endpoint configuration options, see Figure 5.

Setup Data Buffer

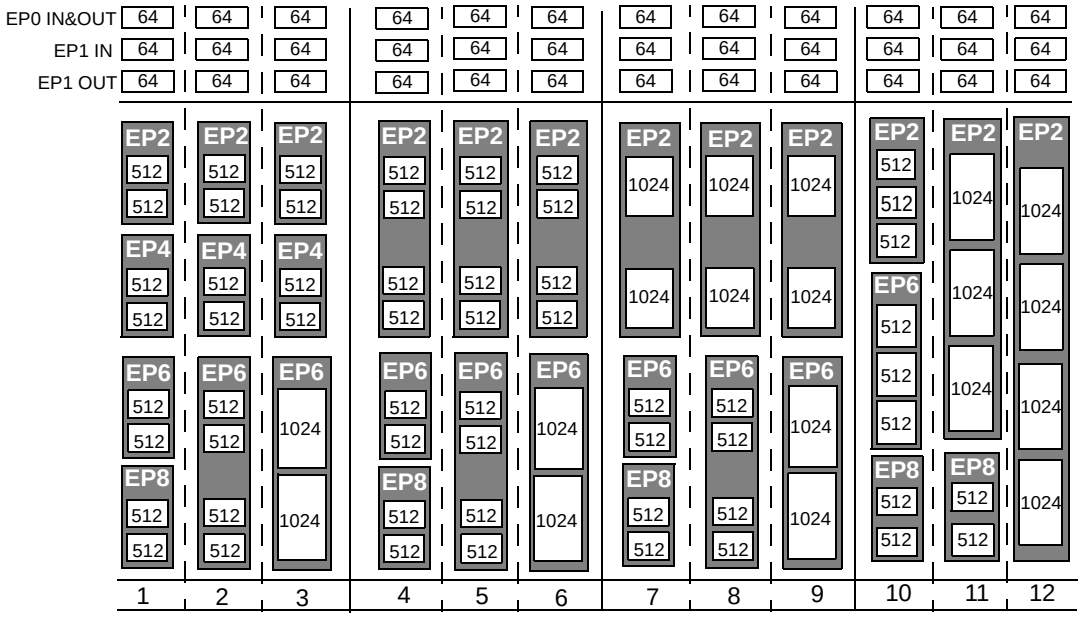
A separate 8-byte buffer at 0xE6B8-0xE6BF holds the setup data from a CONTROL transfer.

Endpoint Configurations (Hi-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 Hi-Speed mode, the max packet size is 512 bytes, but in Full-Speed mode, it is 64 bytes. Even though a buffer is configured to a 512-byte buffer, in Full-Speed mode, 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



In the Slave (S) mode, 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) that 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#.

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.

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.

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).

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.

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, then I/O port pins are used.

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 2^{32} 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.

ECC Generation[8]

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.

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.

USB Uploads and Downloads

The core has the ability to directly edit the data contents of the internal 16-KB RAM and of the internal 512-byte scratch pad RAM via a vendor-specific command. This capability is normally used when soft downloading the user code and is available only to and from the internal RAM, only when the 8051 is held in reset. The available RAM spaces are 16 KB from 0x0000–0x3FFF (code/data) and 512 bytes from 0xE000–0xE1FF (scratch pad data RAM)[9].

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

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. Autopointers are available in external FX2LP registers under the control of a mode bit (AUTOPTRSET-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, autopointers can point to any FX2LP register or endpoint buffer space. When the autopointer access to external memory is enabled, locations 0xE67B and 0xE67C in XDATA and code space cannot be used.

I²C Controller

FX2LP has one I²C port that is driven by two internal controllers, the 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.

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[10]	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

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 KB of program/data. The available RAM spaces are 16 KB from 0x0000–0x3FFF and 512 bytes from 0xE000–0xE1FF. The 8051 is in reset. I²C interface boot loads only occur after power-on reset.

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.

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.

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

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

Note
10. This EEPROM does not have address pins.

Pin Assignments

Figure 6 on page 17 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 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 the PORTCSTB bit in the CPUCS register.

PORTC Strobe Feature Timings displays the timing diagram of the read and write strobing function on accessing PORTC.

Figure 6. Signal

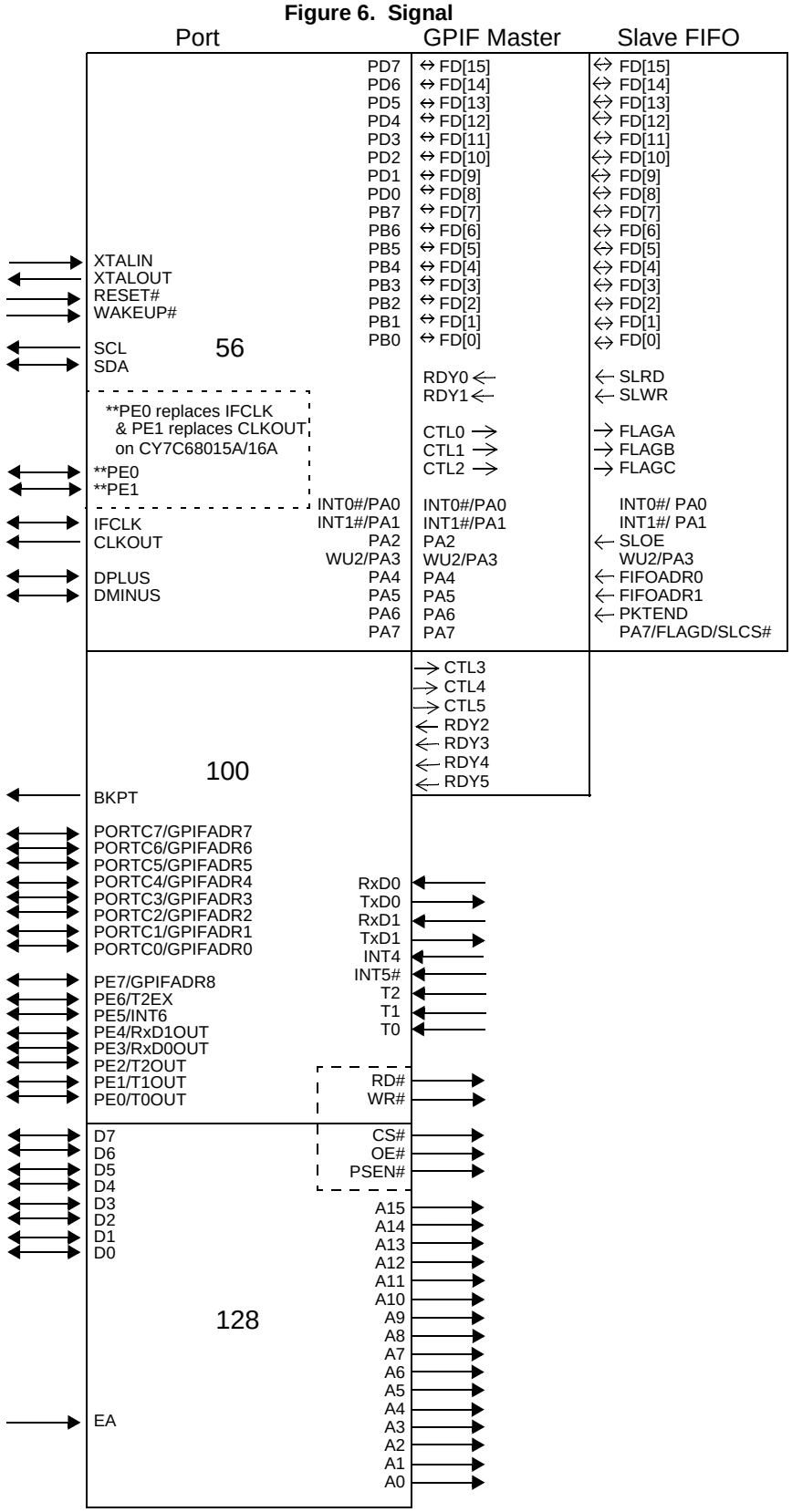


Table 11. FX2LP Pin Descriptions[11] (continued)

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 12. FX2LP Register Summary (continued)

Hex	Size	Name	Description	b7	b6	b5	b4	b3	b2	b1	b0	Default	Access
xxxx		I²C Configuration Byte		0	DISCON	0	0	0	0	0	400KHZ	xxxxxxxx [16]	n/a
		Special Function Registers (SFRs)											
80	1	IOA[15]	Port A (bit addressable)	D7	D6	D5	D4	D3	D2	D1	D0	xxxxxxxx	RW
81	1	SP	Stack Pointer	D7	D6	D5	D4	D3	D2	D1	D0	00000111	RW
82	1	DPL0	Data Pointer 0 L	A7	A6	A5	A4	A3	A2	A1	A0	00000000	RW
83	1	DPH0	Data Pointer 0 H	A15	A14	A13	A12	A11	A10	A9	A8	00000000	RW
84	1	DPL1[15]	Data Pointer 1 L	A7	A6	A5	A4	A3	A2	A1	A0	00000000	RW
85	1	DPH1[15]	Data Pointer 1 H	A15	A14	A13	A12	A11	A10	A9	A8	00000000	RW
86	1	DPS[15]	Data Pointer 0/1 select	0	0	0	0	0	0	0	SEL	00000000	RW
87	1	PCON	Power Control	SMOD0	x	1	1	x	x	x	IDLE	00110000	RW
88	1	TCON	Timer/Counter Control (bit addressable)	TF1	TR1	TF0	TR0	IE1	IT1	IE0	IT0	00000000	RW
89	1	TMOD	Timer/Counter Mode Control	GATE	CT	M1	M0	GATE	CT	M1	M0	00000000	RW
8A	1	TL0	Timer 0 reload L	D7	D6	D5	D4	D3	D2	D1	D0	00000000	RW
8B	1	TL1	Timer 1 reload L	D7	D6	D5	D4	D3	D2	D1	D0	00000000	RW
8C	1	TH0	Timer 0 reload H	D15	D14	D13	D12	D11	D10	D9	D8	00000000	RW
8D	1	TH1	Timer 1 reload H	D15	D14	D13	D12	D11	D10	D9	D8	00000000	RW
8E	1	CKCON[15]	Clock Control	x	x	T2M	T1M	T0M	MD2	MD1	MD0	00000001	RW
8F	1	reserved											
90	1	IOB[15]	Port B (bit addressable)	D7	D6	D5	D4	D3	D2	D1	D0	xxxxxxxx	RW
91	1	EXIF[15]	External Interrupt Flag(s)	IE5	IE4	I²CINT	USBNT	1	0	0	0	00001000	RW
92	1	MPAGE[15]	Upper Addr Byte of MOVX using @R0 / @R1	A15	A14	A13	A12	A11	A10	A9	A8	00000000	RW
93	5	reserved											
98	1	SCON0	Serial Port 0 Control (bit addressable)	SM0_0	SM1_0	SM2_0	REN_0	TB8_0	RB8_0	TI_0	RI_0	00000000	RW
99	1	SBUF0	Serial Port 0 Data Buffer	D7	D6	D5	D4	D3	D2	D1	D0	00000000	RW
9A	1	AUTOPTRH1[15]	Autopointer 1 Address H	A15	A14	A13	A12	A11	A10	A9	A8	00000000	RW
9B	1	AUTOPTRL1[15]	Autopointer 1 Address L	A7	A6	A5	A4	A3	A2	A1	A0	00000000	RW
9C	1	reserved											
9D	1	AUTOPTRH2[15]	Autopointer 2 Address H	A15	A14	A13	A12	A11	A10	A9	A8	00000000	RW
9E	1	AUTOPTRL2[15]	Autopointer 2 Address L	A7	A6	A5	A4	A3	A2	A1	A0	00000000	RW
9F	1	reserved											
A0	1	IOC[15]	Port C (bit addressable)	D7	D6	D5	D4	D3	D2	D1	D0	xxxxxxxx	RW
A1	1	INT2CLR[15]	Interrupt 2 clear	x	x	x	x	x	x	x	x	xxxxxxxx	W
A2	1	INT4CLR[15]	Interrupt 4 clear	x	x	x	x	x	x	x	x	xxxxxxxx	W
A3	5	reserved											
A8	1	IE	Interrupt Enable (bit addressable)	EA	ES1	ET2	ES0	ET1	EX1	ET0	EX0	00000000	RW
A9	1	reserved											
AA	1	EP2468STAT[15]	Endpoint 2,4,6,8 status flags	EP8F	EP8E	EP6F	EP6E	EP4F	EP4E	EP2F	EP2E	01011010	R
AB	1	EP24FIFOFLGS[15]	Endpoint 2,4 slave FIFO status flags	0	EP4PF	EP4EF	EP4FF	0	EP2PF	EP2EF	EP2FF	00100010	R
AC	1	EP68FIFOFLGS[15]	Endpoint 6,8 slave FIFO status flags	0	EP8PF	EP8EF	EP8FF	0	EP6PF	EP6EF	EP6FF	01100110	R
AD	2	reserved											
AF	1	AUTOPTRSETUP[15]	Autopointer 1&2 setup	0	0	0	0	0	APTR2INC	APTR1INC	APTREN	00000110	RW
B0	1	IOD[15]	Port D (bit addressable)	D7	D6	D5	D4	D3	D2	D1	D0	xxxxxxxx	RW
B1	1	IOE[15]	Port E (NOT bit addressable)	D7	D6	D5	D4	D3	D2	D1	D0	xxxxxxxx	RW
B2	1	OEA[15]	Port A Output Enable	D7	D6	D5	D4	D3	D2	D1	D0	00000000	RW
B3	1	OEB[15]	Port B Output Enable	D7	D6	D5	D4	D3	D2	D1	D0	00000000	RW
B4	1	OEC[15]	Port C Output Enable	D7	D6	D5	D4	D3	D2	D1	D0	00000000	RW
B5	1	OED[15]	Port D Output Enable	D7	D6	D5	D4	D3	D2	D1	D0	00000000	RW
B6	1	OEE[15]	Port E Output Enable	D7	D6	D5	D4	D3	D2	D1	D0	00000000	RW
B7	1	reserved											
B8	1	IP	Interrupt Priority (bit addressable)	1	PS1	PT2	PS0	PT1	PX1	PT0	PX0	10000000	RW
B9	1	reserved											
BA	1	EP01STAT[15]	Endpoint 0&1 Status	0	0	0	0	0	EP1INBSY	EP1OUTBSY	EP0BSY	00000000	R
BB	1	GPIFTRIG[15, 13]	Endpoint 2,4,6,8 GPIF slave FIFO Trigger	DONE	0	0	0	0	RW	EP1	EP0	10000xxx	brrrrbbb
BC	1	reserved											
BD	1	GPIFSGLDATH[15]	GPIF Data H (16-bit mode only)	D15	D14	D13	D12	D11	D10	D9	D8	xxxxxxxx	RW

Notes
15. SFRs not part of the standard 8051 architecture.
16. If no EEPROM is detected by the SIE then the default is 00000000.

DC Characteristics

Table 14. DC Characteristics

Parameter	Description	Conditions	Min	Typ	Max	Unit
VCC	Supply voltage	–	3.00	3.3	3.60	V
VCC Ramp Up	0 to 3.3 V	–	200	–	–	µs
V_{IH}	Input HIGH voltage	–	2	–	5.25	V
V_{IL}	Input LOW voltage	–	–0.5	–	0.8	V
V_{IH_X}	Crystal input HIGH voltage	–	2	–	5.25	V
V_{IL_X}	Crystal input LOW voltage	–	–0.5	–	0.8	V
I_I	Input leakage current	$0< V_{IN} < V_{CC}$	–	–	±10	µA
V_{OH}	Output voltage HIGH	I_{OUT} = 4 mA	2.4	–	–	V
V_{OL}	Output LOW voltage	I_{OUT} = –4 mA	–	–	0.4	V
I_{OH}	Output current HIGH	–	–	–	4	mA
I_{OL}	Output current LOW	–	–	–	4	mA
C_{IN}	Input pin capacitance	Except D+/D–	–	–	10	pF
		D+/D–	–	–	15	pF
I_{SUSP}	Suspend current CY7C68014/CY7C68016	Connected	–	300	380[18]	µA
		Disconnected	–	100	150[18]	µA
	Suspend current CY7C68013/CY7C68015	Connected	–	0.5	1.2[18]	mA
		Disconnected	–	0.3	1.0[18]	mA
I_{CC}	Supply current	8051 running, connected to USB HS	–	50	85	mA
		8051 running, connected to USB FS	–	35	65	mA
T_{RESET}	Reset time after valid power	V_{CC} min = 3.0 V	5.0	–	–	ms
	Pin reset after powered on		200	–	–	µs

USB Transceiver

USB 2.0 compliant in Full Speed and Hi-Speed modes.

Note
18. Measured at Max V_{CC}, 25 °C.

AC Electrical Characteristics

USB Transceiver

USB 2.0 compliant in Full-Speed and Hi-Speed modes.

Program Memory Read

Figure 12. Program Memory Read Timing Diagram

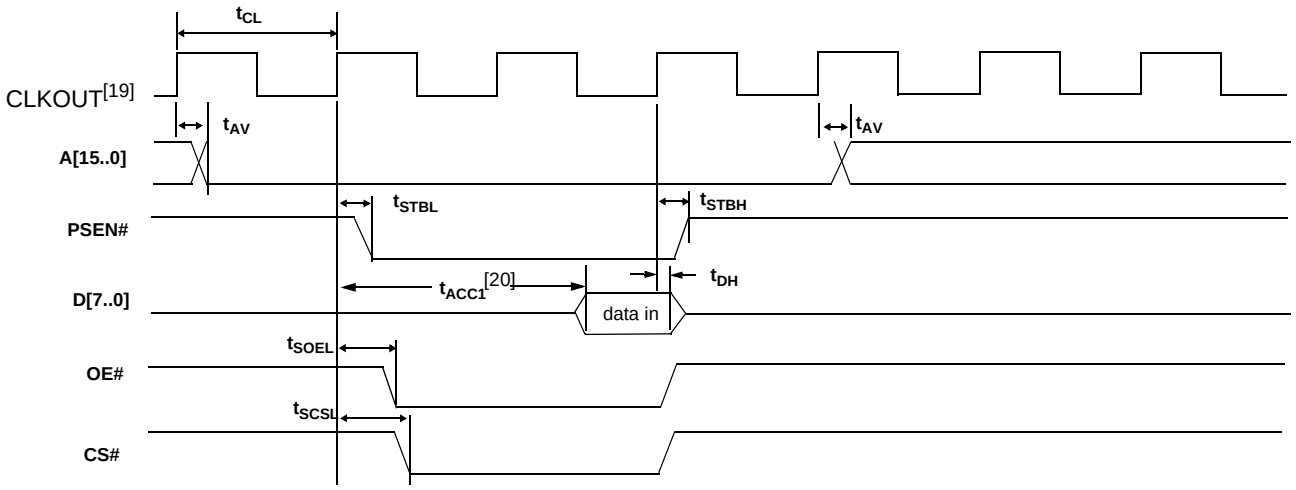


Table 15. Program Memory Read Parameters

Parameter	Description	Min	Typ	Max	Unit	Notes
t_{CL}	1/CLKOUT frequency	–	20.83	–	ns	48 MHz
		–	41.66	–	ns	24 MHz
		–	83.2	–	ns	12 MHz
t_{AV}	Delay from clock to valid address	0	–	10.7	ns	–
t_{STBL}	Clock to PSEN LOW	0	–	8	ns	–
t_{STBH}	Clock to PSEN HIGH	0	–	8	ns	–
t_{SOEL}	Clock to OE LOW	–	–	11.1	ns	–
t_{SCSL}	Clock to CS LOW	–	–	13	ns	–
t_{DSU}	Data setup to clock	9.6	–	–	ns	–
t_{DH}	Data hold time	0	–	–	ns	–

Notes
19. CLKOUT is shown with positive polarity.
20. t_{ACC1} is computed from these parameters as follows:
t_{ACC1}(24 MHz) = 3*t_{CL} – t_{AV} – t_{DSU} = 106 ns.
t_{ACC1}(48 MHz) = 3*t_{CL} – t_{AV} – t_{DSU} = 43 ns.

GPIF Synchronous Signals

Figure 18. GPIF Synchronous Signals Timing Diagram[24]

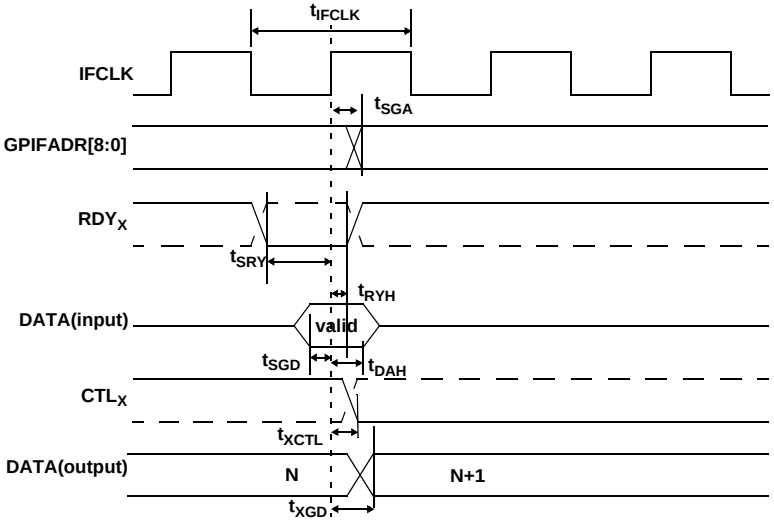


Table 18. GPIF Synchronous Signals Parameters with Internally Sourced IFCLK[24, 25]

Parameter	Description	Min	Max	Typ		Unit
				Min	Max	
t_{IFCLK}	IFCLK Period	20.83	–	–	–	ns
t_{SRY}	RDY_X to clock setup time	8.9	–	–	–	ns
t_{RYH}	Clock to RDY_X	0	–	–	–	ns
t_{SGD}	GPIF data to clock setup time	9.2	–	–	–	ns
t_{DAH}	GPIF data hold time	0	–	–	–	ns
t_{SGA}	Clock to GPIF address propagation delay	–	7.5	–	–	ns
t_{XGD}	Clock to GPIF data output propagation delay	–	11	–	–	ns
t_{XCTL}	Clock to CTL_X output propagation delay	–	6.7	–	–	ns
t_{IFCLKR}	IFCLK rise time	–	–	–	900	ps
t_{IFCLKF}	IFCLK fall time	–	–	–	900	ps
$t_{IFCLKOD}$	IFCLK output duty cycle	–	–	49	51	%
t_{IFCLKJ}	IFCLK jitter peak to peak	–	–	–	300	ps

Table 19. GPIF Synchronous Signals Parameters with Externally Sourced IFCLK[25]

Parameter	Description	Min	Max	Unit
t_{IFCLK}	IFCLK period[26]	20.83	200	ns
t_{SRY}	RDY_X to clock setup time	2.9	–	ns
t_{RYH}	Clock to RDY_X	3.7	–	ns
t_{SGD}	GPIF data to clock setup time	3.2	–	ns
t_{DAH}	GPIF data hold time	4.5	–	ns
t_{SGA}	Clock to GPIF address propagation delay	–	11.5	ns
t_{XGD}	Clock to GPIF data output propagation delay	–	15	ns
t_{XCTL}	Clock to CTL_X output propagation delay	–	10.7	ns

Notes
24. Dashed lines denote signals with programmable polarity.
25. GPIF asynchronous RDY_x signals have a minimum setup time of 50 ns when using the internal 48-MHz IFCLK.
26. IFCLK must not exceed 48 MHz.

Slave FIFO Synchronous Read

Figure 19. Slave FIFO Synchronous Read Timing Diagram[24]

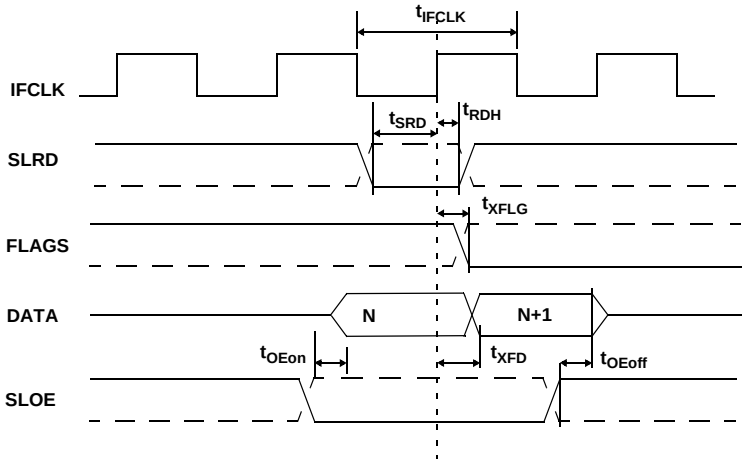


Table 20. Slave FIFO Synchronous Read Parameters with Internally Sourced IFCLK[25]

Parameter	Description	Min	Max	Typ		Unit
				Min	Max	
t_{IFCLK}	IFCLK period	20.83	–	–	–	ns
t_{SRD}	SLRD to clock setup time	18.7	–	–	–	ns
t_{RDH}	Clock to SLRD hold time	0	–	–	–	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	–	9.5	–	–	ns
t_{XFD}	Clock to FIFO data output propagation delay	–	11	–	–	ns
t_{IFCLKR}	IFCLK rise time	–	–	–	900	ps
t_{IFCLKF}	IFCLK fall time	–	–	–	900	ps
$t_{IFCLKOD}$	IFCLK output duty cycle	–	–	49	51	%
t_{IFCLKJ}	IFCLK jitter peak to peak	–	–	–	300	ps

Slave FIFO Synchronous Write

Figure 21. Slave FIFO Synchronous Write Timing Diagram[24]

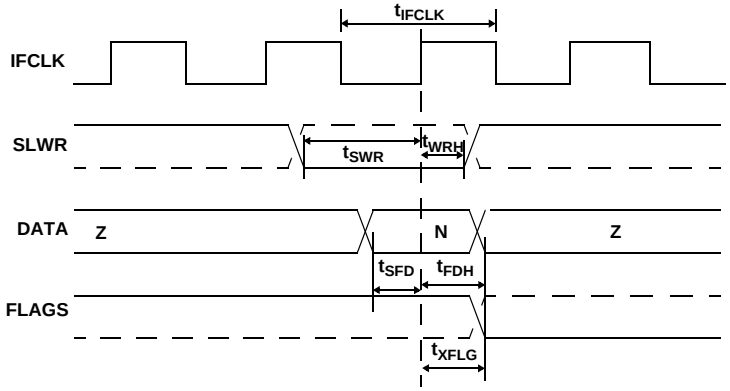


Table 23. Slave FIFO Synchronous Write Parameters with Internally Sourced IFCLK[25]

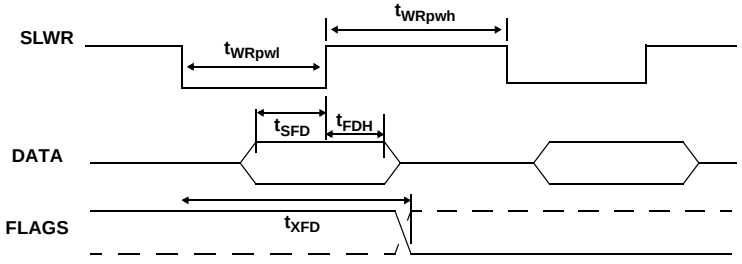
Parameter	Description	Min	Max	Unit
t_{IFCLK}	IFCLK period	20.83	–	ns
t_{SWR}	SLWR to clock setup time	10.4	–	ns
t_{WRH}	Clock to SLWR hold time	0	–	ns
t_{SFD}	FIFO data to clock setup time	9.2	–	ns
t_{FDH}	Clock to FIFO data hold time	0	–	ns
t_{XFLG}	Clock to FLAGS output propagation time	–	9.5	ns

Table 24. Slave FIFO Synchronous Write Parameters with Externally Sourced IFCLK[25]

Parameter	Description	Min	Max	Unit
t_{IFCLK}	IFCLK Period	20.83	200	ns
t_{SWR}	SLWR to clock setup time	12.1	–	ns
t_{WRH}	Clock to SLWR hold time	3.6	–	ns
t_{SFD}	FIFO data to clock setup time	3.2	–	ns
t_{FDH}	Clock to FIFO data hold time	4.5	–	ns
t_{XFLG}	Clock to FLAGS output propagation time	–	13.5	ns

Slave FIFO Asynchronous Write

Figure 22. Slave FIFO Asynchronous Write Timing Diagram[24]



Sequence Diagram

Single and Burst Synchronous Read Example

Figure 30. Slave FIFO Synchronous Read Sequence and Timing Diagram[24]

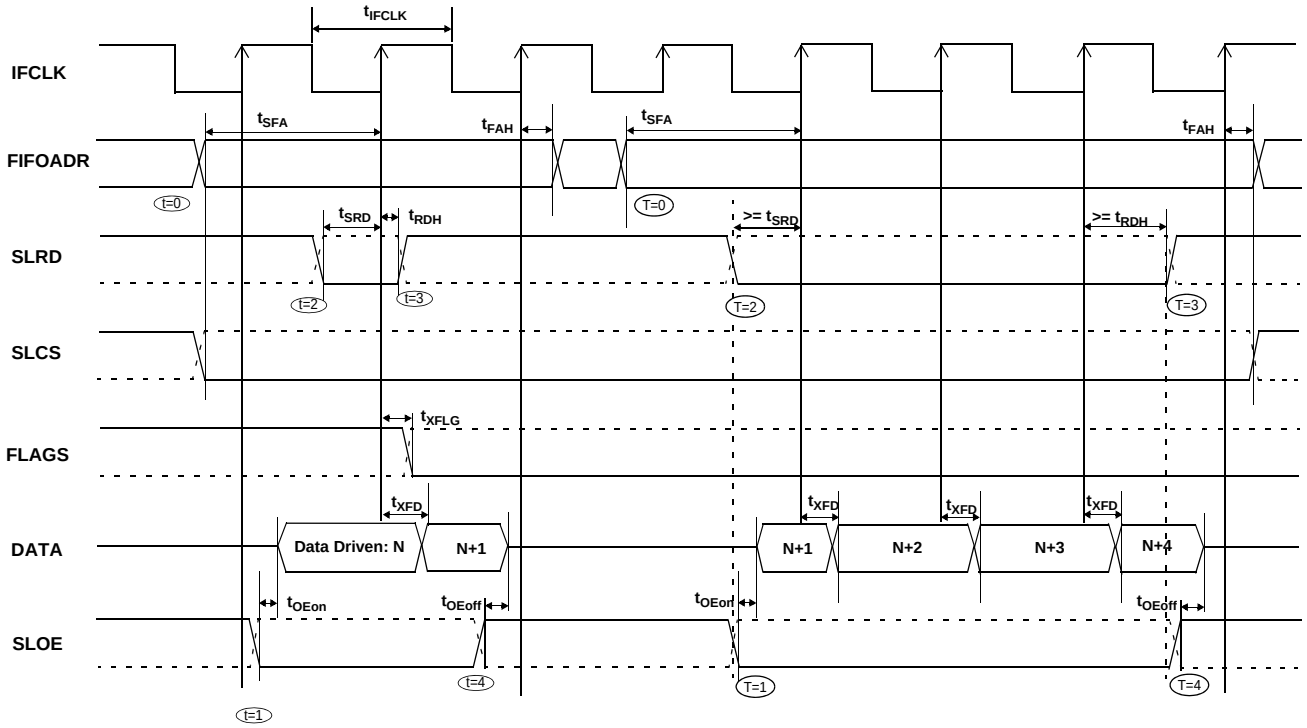


Figure 31. Slave FIFO Synchronous Sequence of Events Diagram

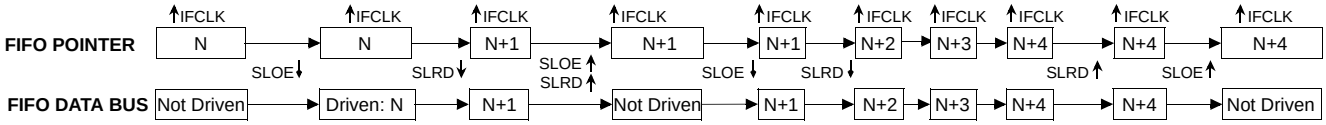


Figure 30 on page 52 shows the timing relationship of the SLAVE FIFO signals during a synchronous FIFO read using IFCLK as the synchronizing clock. The diagram illustrates a single read followed by a burst read.

- 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 that when IFCLK is running at 48 MHz, the FIFO address setup time is more than one IFCLK cycle.
- At t = 1, SLOE is asserted. SLOE is an output enable only, whose sole function is to drive the data bus. The data that is driven on the bus is the data that the internal FIFO pointer is currently pointing to. In this example it is the first data value in the FIFO. **Note**: the data is prefetched and is driven on the bus when SLOE is asserted.
- At t = 2, SLRD is asserted. SLRD must meet the setup time of t_{SRD} (time from asserting the SLRD signal to the rising edge of the IFCLK) and maintain a minimum hold time of t_{RDH} (time from the IFCLK edge to the deassertion of the SLRD signal). If the SLCS signal is used, it must be asserted before SLRD is asserted (The SLCS and SLRD signals must both be asserted to start a valid read condition).
- The FIFO pointer is updated on the rising edge of the IFCLK, while SLRD is asserted. This starts the propagation of data from the newly addressed location to the data bus. After a propagation delay of t_{XFD} (measured from the rising edge of IFCLK) the new data value is present. N is the first data value read from the FIFO. To have data on the FIFO data bus, SLOE MUST also be asserted.

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

Note For the burst mode, the SLRD and SLOE are left asserted during the entire duration of the read. In the burst read mode, when SLOE is asserted, data indexed by the FIFO pointer is on the data bus. During the first read cycle, on the rising edge of the clock, the FIFO pointer is updated and incremented to point to address N+1. For each subsequent rising edge of IFCLK, while the SLRD is asserted, the FIFO pointer is incremented and the next data value is placed on the data bus.

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)

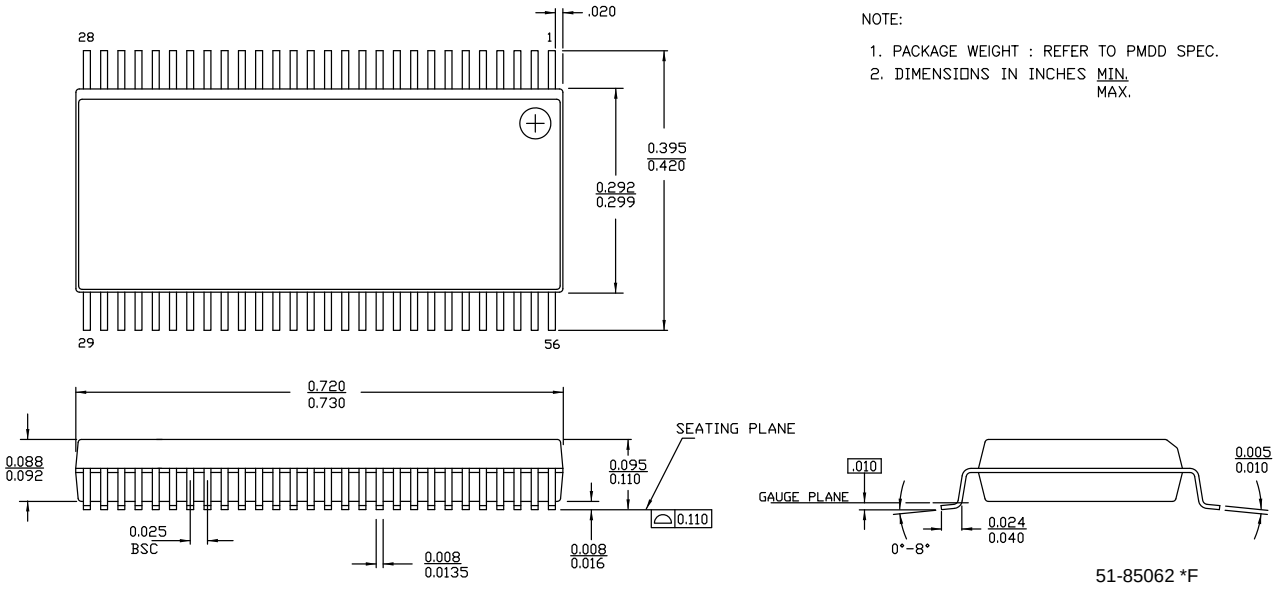
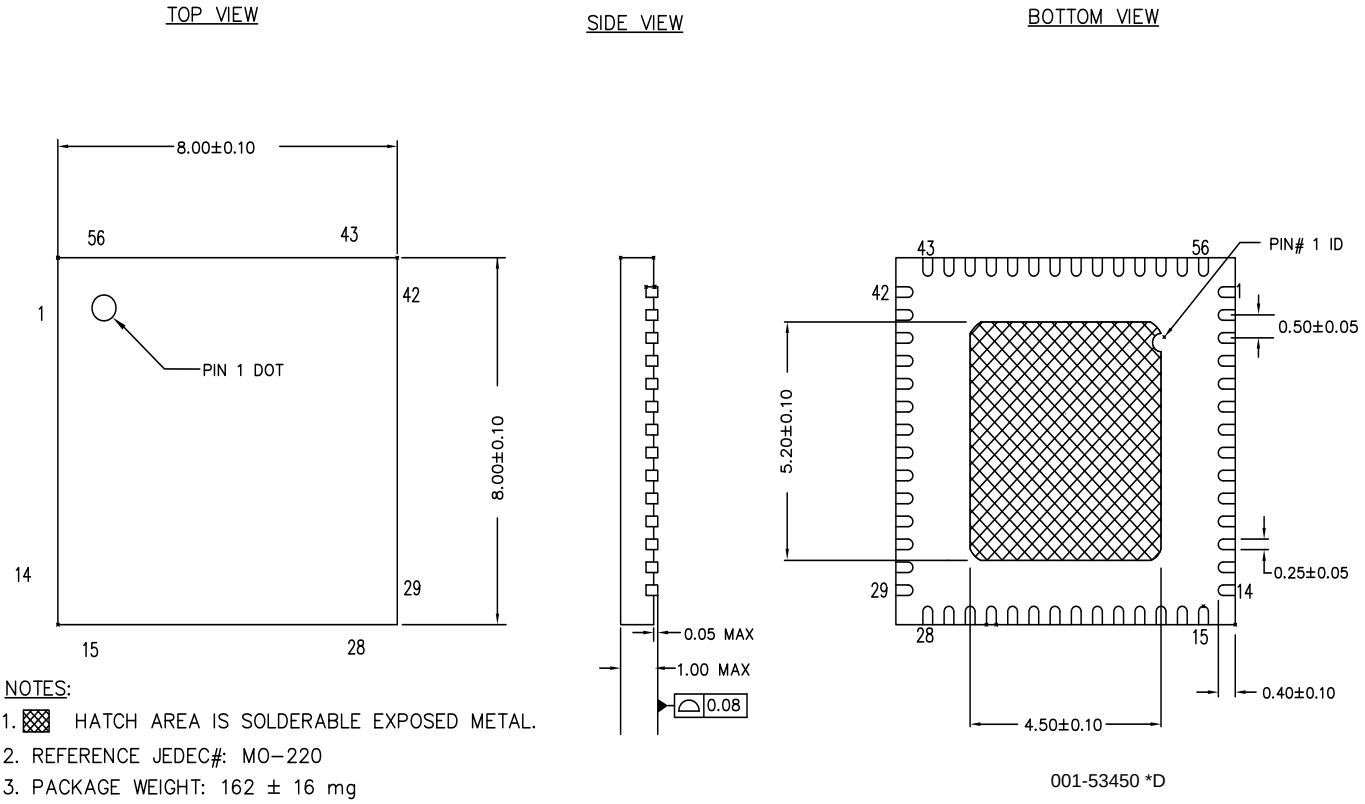


Figure 37. 56-Pin QFN 8 × 8 mm Sawn Version (001-53450)



NOTES:
1. HATCH AREA IS SOLDERABLE EXPOSED METAL.
2. REFERENCE JEDEC#: MO–220
3. PACKAGE WEIGHT: 162 ± 16 mg
4. ALL DIMENSIONS ARE IN MILLIMETERS

Document History Page

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**
**	124316	VCS	03/17/03	New datasheet
*A	128461	VCS	09/02/03	Added PN CY7C68015A throughout datasheet Modified Figure 1 to add ECC block and fix errors Removed word “compatible” where associated with I^2C Corrected grammar and formatting in various locations Updated Sections 3.2.1, 3.9, 3.11, Table 9, Section 5.0 Added Sections 3.15, 3.18.4, 3.20 Modified Figure 5 for clarity Updated Figure 37 to match current spec revision
*B	130335	KKV	10/09/03	Restored PRELIMINARY to header (had been removed in error from rev. *A)
*C	131673	KKU	02/12/04	Section 8.1 changed “certified” to “compliant” Table 14 added parameter V_{IH_X} and V_{IL_X} Added Sequence diagrams Section 9.16 Updated Ordering information with lead-free parts Updated Registry Summary Section 3.12.4:example changed to column 8 from column 9 Updated Figure 14 memory write timing Diagram Updated section 3.9 (reset) Updated section 3.15 ECC Generation
*D	230713	KKU	See ECN	Changed Lead free Marketing part numbers in Table 33 as per spec change in 28-00054.
*E	242398	TMD	See ECN	Minor Change: datasheet posted to the web,
*F	271169	MON	See ECN	Added USB-IF Test ID number Added USB 2.0 logo Added values for Isusp, Icc, Power Dissipation, Vih_x, Vil_x Changed VCC from ± 10% to ± 5% Changed PKTEND to FLAGS output propagation delay (asynchronous interface) in Table 28 from a max value of 70 ns to 115 ns
*G	316313	MON	See ECN	Removed CY7C68013A-56PVXCT part availability Added parts ideal for battery powered applications: CY7C68014A, CY7C68016A Provided additional timing restrictions and requirement about the use of PKETEND pin to commit a short one byte/word packet subsequent to committing a packet automatically (when in auto mode). Added Min Vcc Ramp Up time (0 to 3.3v)
*H	338901	MON	See ECN	Added information about the AUTOPTR1/AUTOPTR2 address timing with regards to data memory read/write timing diagram. Removed TBD for Min value of Clock to FIFO Data Output Propagation Delay (t_{XFD}) for Slave FIFO Synchronous Read Changed Table 33 to include part CY7C68016A-56LFXC in the part listed for battery powered applications Added register GPCR2 in register summary
*I	371097	MON	See ECN	Added timing for strobing RD#/WR# signals when using PortC strobe feature (Section)
*J	397239	MON	See ECN	Removed XTALINSRC register from register summary. Changed Vcc margins to ±10% Added 56-pin VFBGA Pin Package Diagram Added 56-pin VFBGA definition in pin listing Added RDK part number to the Ordering Information table