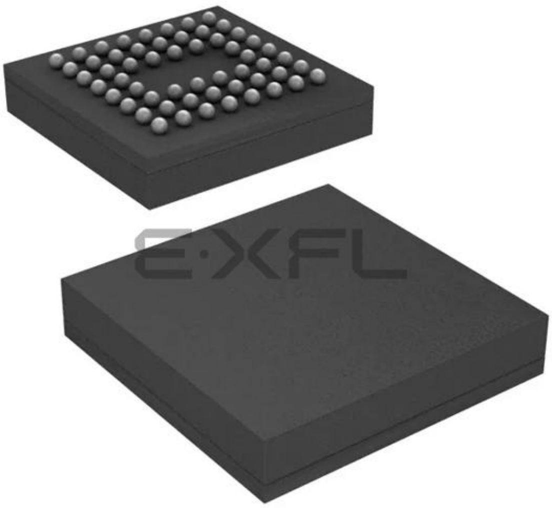

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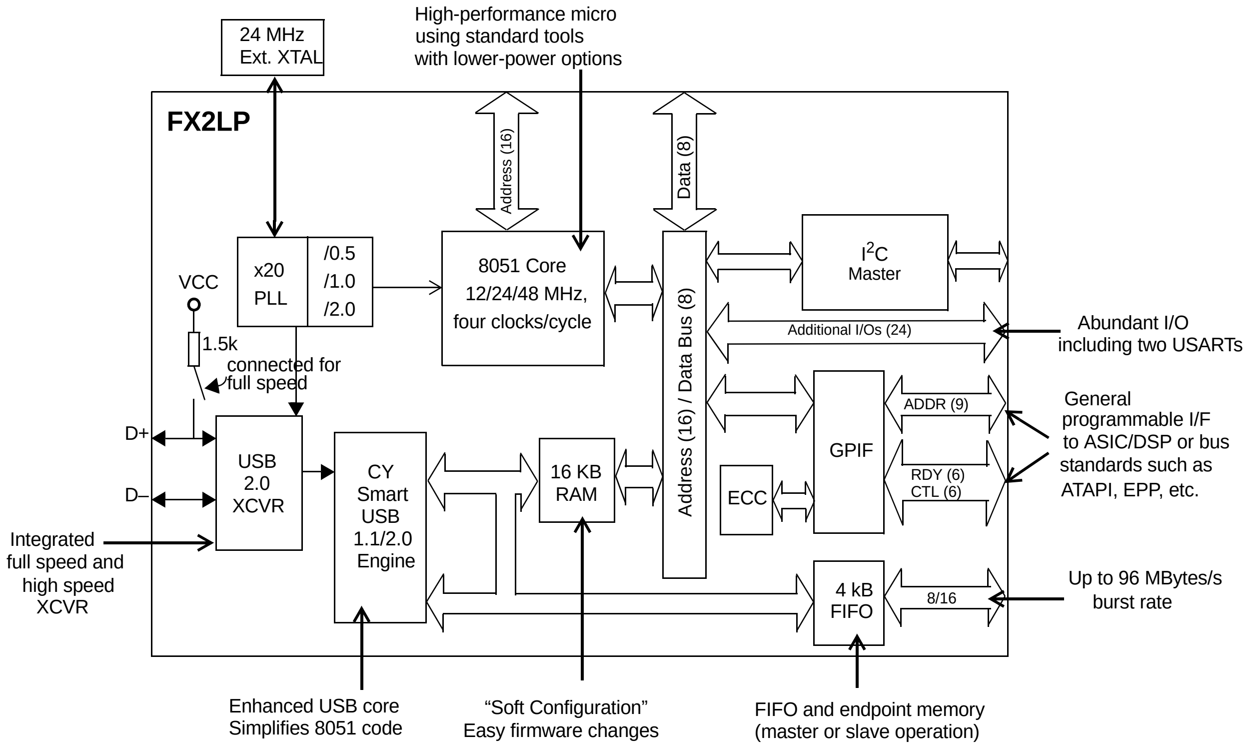
Embedded - Microcontrollers - Application Specific: Tailored Solutions for Precision and Performance

Embedded - Microcontrollers - Application Specific represents a category of microcontrollers designed with unique features and capabilities tailored to specific application needs. Unlike general-purpose microcontrollers, application-specific microcontrollers are optimized for particular tasks, offering enhanced performance, efficiency, and functionality to meet the demands of specialized applications.

What Are Embedded - Microcontrollers - Application Specific?

Details	
Product Status	Obsolete
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-VFBGA
Supplier Device Package	56-VFBGA (5x5)
Purchase URL	https://www.e-xfl.com/product-detail/infineon-technologies/cy7c68014a-56baxc

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.

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.

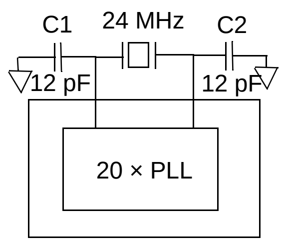
8051 Clock Frequency

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^{2}C Bus

FX2LP supports the I^{2}C 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^{2}C 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.

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.

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, similar to the USB Interrupt, can employ autovectoring.

Table 4 on page 8 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 [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.

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.

I^{2}C Controller

FX2LP has one I^{2}C 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 I^{2}C devices. The I^{2}C port operates in master mode only.

I^{2}C Port Pins

The I^{2}C 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

I^{2}C Interface Boot Load Access

At power-on reset, the I^{2}C 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. I^{2}C interface boot loads only occur after power-on reset.

I^{2}C Interface General-Purpose Access

The 8051 can control peripherals connected to the I^{2}C bus using the I2CTL and I2DAT registers. FX2LP provides I^{2}C master control only; it is never an I^{2}C 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.

Figure 6. Signal

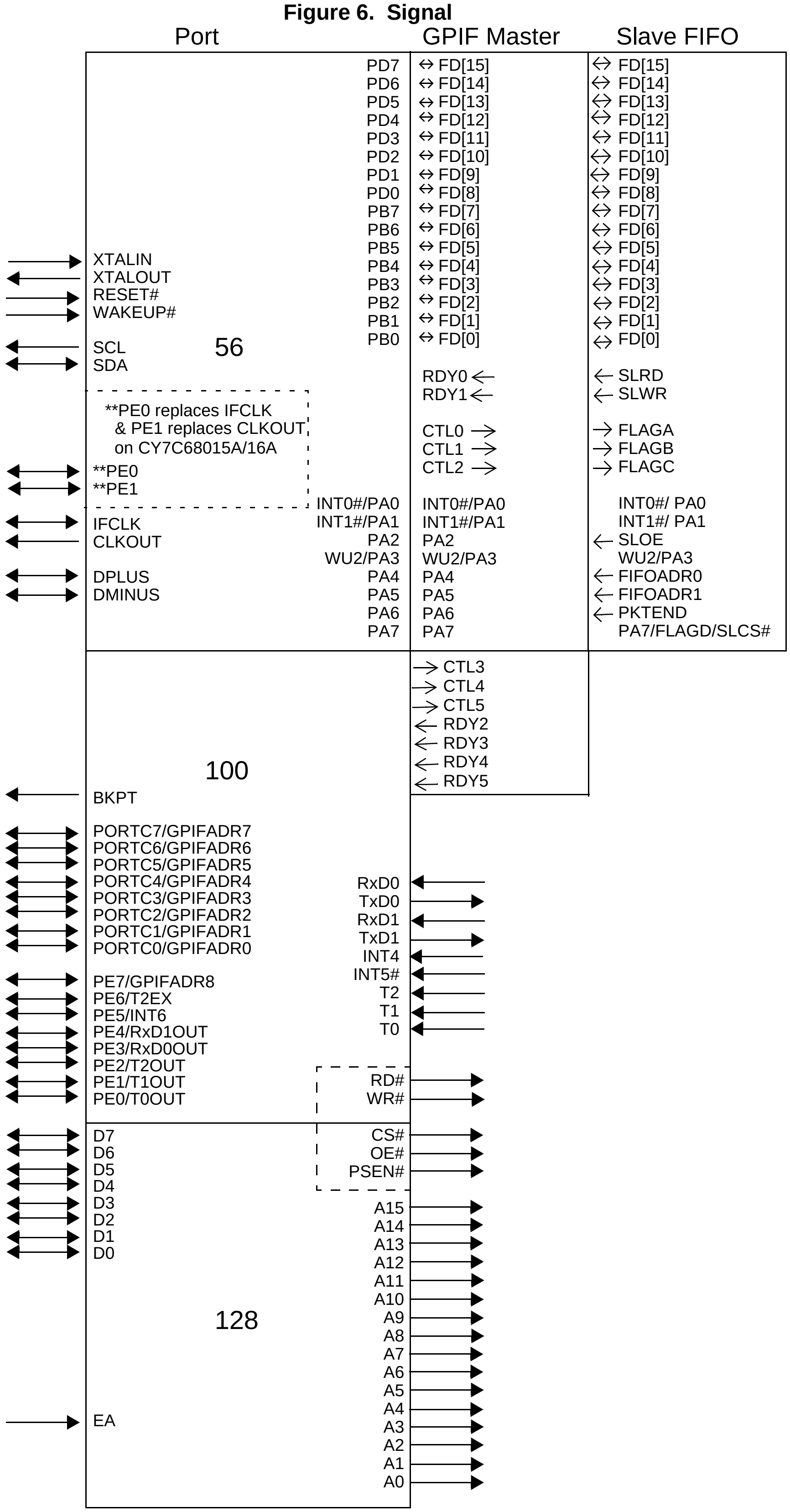
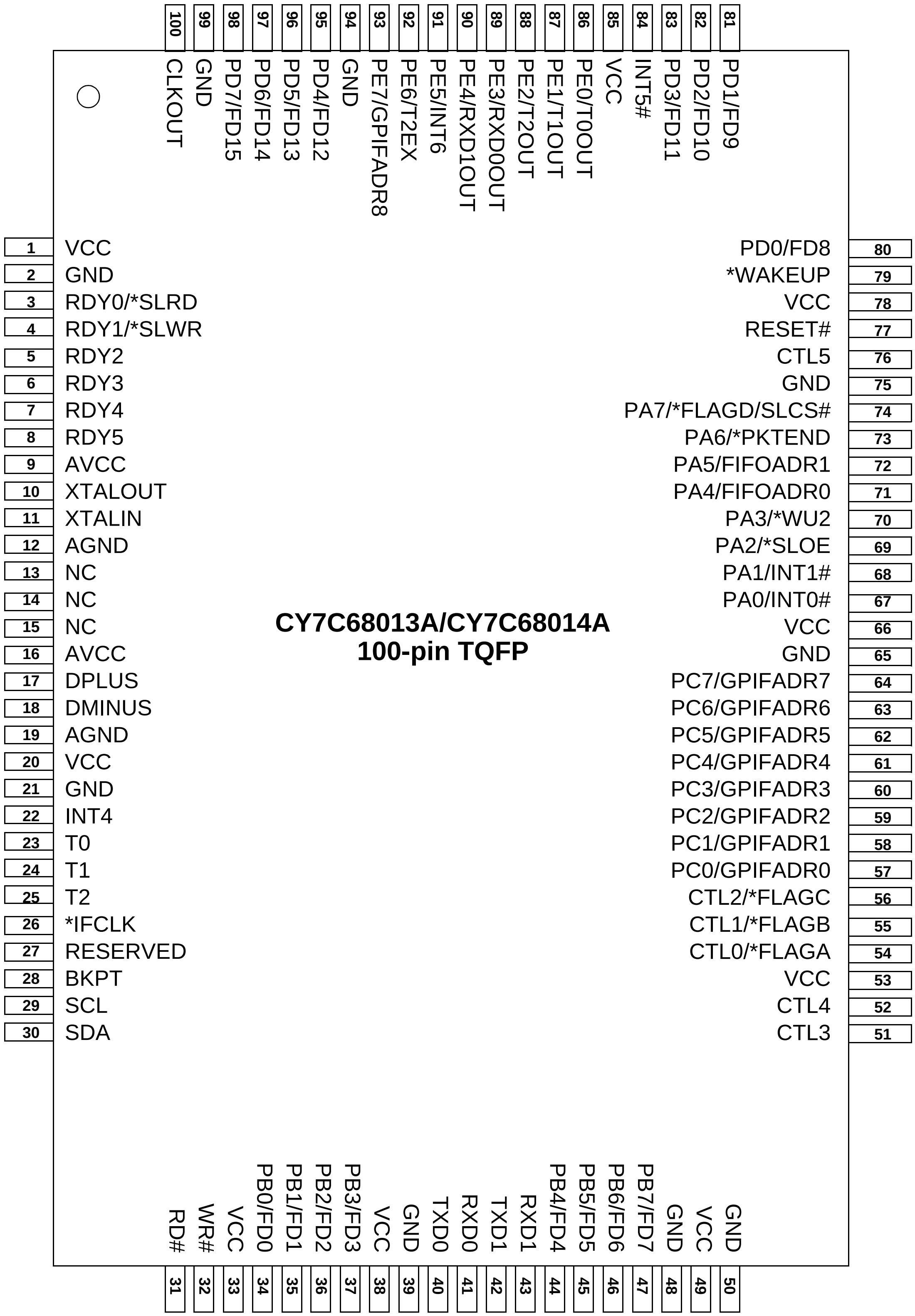
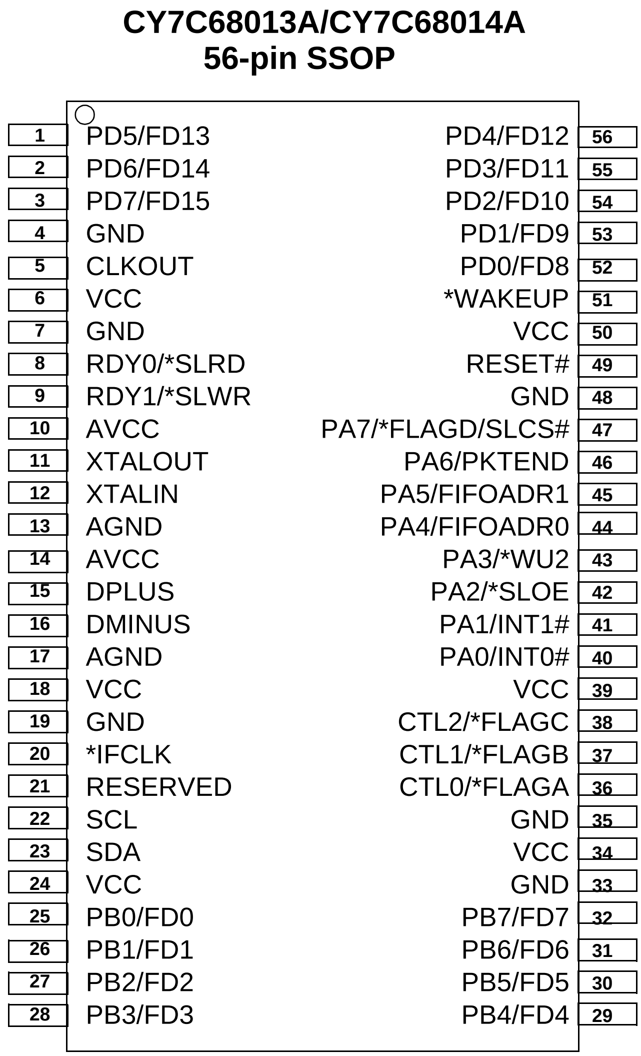


Figure 8. CY7C68013A/CY7C68014A 100-Pin TQFP Pin Assignment



* denotes programmable polarity

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



* denotes programmable polarity

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

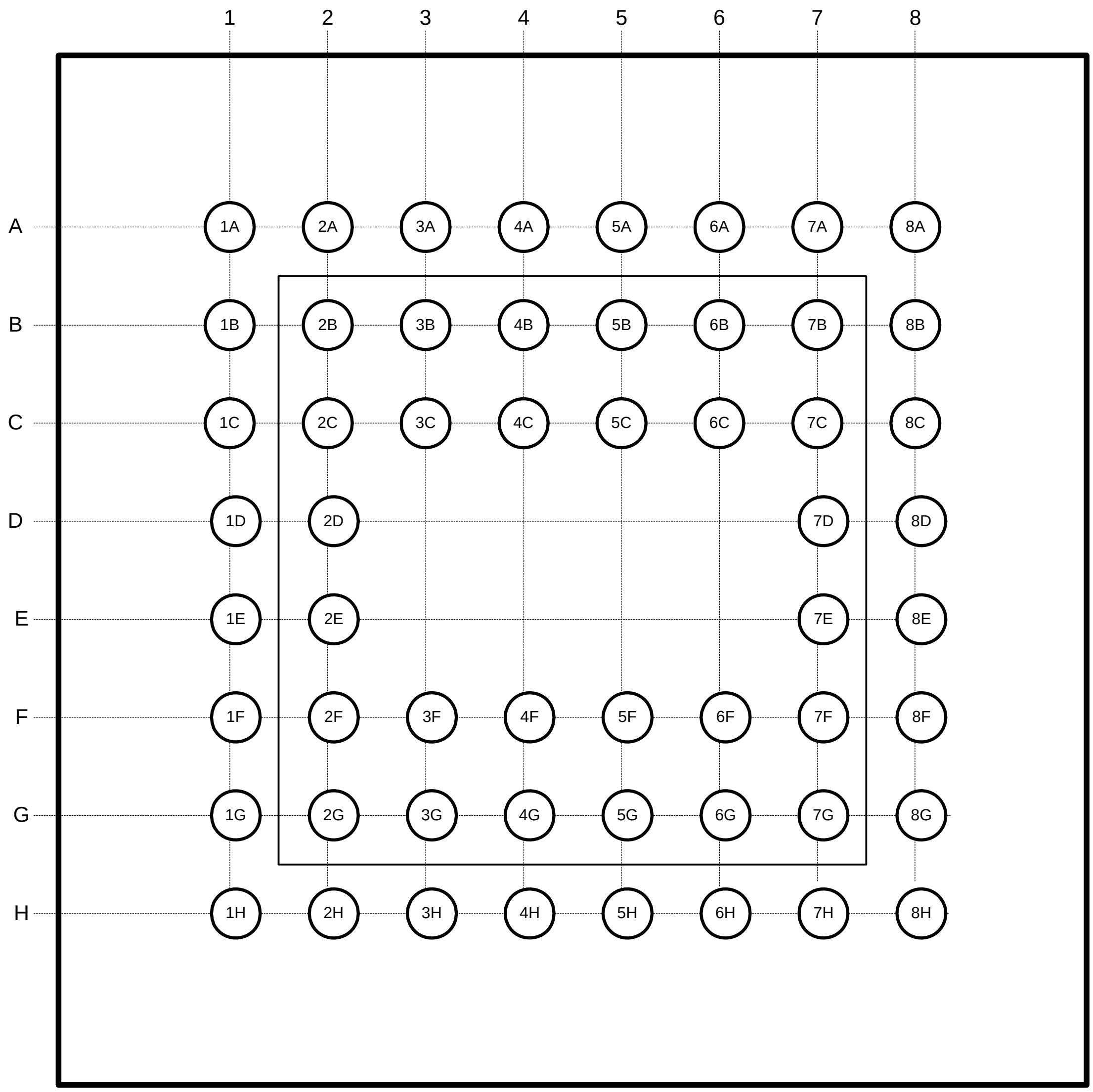


Table 11. FX2LP Pin Descriptions[11] (continued)

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
E62B	1	ECC1B1	ECC1 Byte 1 Address	LINE7	LINE6	LINE5	LINE4	LINE3	LINE2	LINE1	LINE0	00000000	R
E62C	1	ECC1B2	ECC1 Byte 2 Address	COL5	COL4	COL3	COL2	COL1	COL0	LINE17	LINE16	00000000	R
E62D	1	ECC2B0	ECC2 Byte 0 Address	LINE15	LINE14	LINE13	LINE12	LINE11	LINE10	LINE9	LINE8	00000000	R
E62E	1	ECC2B1	ECC2 Byte 1 Address	LINE7	LINE6	LINE5	LINE4	LINE3	LINE2	LINE1	LINE0	00000000	R
E62F	1	ECC2B2	ECC2 Byte 2 Address	COL5	COL4	COL3	COL2	COL1	COL0	0	0	00000000	R
E630 H.S.	1	EP2FIFOPFH[13]	Endpoint 2 / slave FIFO Programmable Flag H	DECIS	PKTSTAT	IN:PKTS[2] OUT:PFC12	IN:PKTS[1] OUT:PFC11	IN:PKTS[0] OUT:PFC10	0	PFC9	PFC8	10001000	bbbbbrbb
E630 F.S.	1	EP2FIFOPFH[13]	Endpoint 2 / slave FIFO Programmable Flag H	DECIS	PKTSTAT	OUT:PFC12	OUT:PFC11	OUT:PFC10	0	PFC9	IN:PKTS[2] OUT:PFC8	10001000	bbbbbrbb
E631 H.S.	1	EP2FIFOPFL[13]	Endpoint 2 / slave FIFO Programmable Flag L	PFC7	PFC6	PFC5	PFC4	PFC3	PFC2	PFC1	PFC0	00000000	RW
E631 F.S	1	EP2FIFOPFL[13]	Endpoint 2 / slave FIFO Programmable Flag L	IN:PKTS[1] OUT:PFC7	IN:PKTS[0] OUT:PFC6	PFC5	PFC4	PFC3	PFC2	PFC1	PFC0	00000000	RW
E632 H.S.	1	EP4FIFOPFH[13]	Endpoint 4 / slave FIFO Programmable Flag H	DECIS	PKTSTAT	0	IN: PKTS[1] OUT:PFC10	IN: PKTS[0] OUT:PFC9	0	0	PFC8	10001000	bbrbbrrb
E632 F.S	1	EP4FIFOPFH[13]	Endpoint 4 / slave FIFO Programmable Flag H	DECIS	PKTSTAT	0	OUT:PFC10	OUT:PFC9	0	0	PFC8	10001000	bbrbbrrb
E633 H.S.	1	EP4FIFOPFL[13]	Endpoint 4 / slave FIFO Programmable Flag L	PFC7	PFC6	PFC5	PFC4	PFC3	PFC2	PFC1	PFC0	00000000	RW
E633 F.S	1	EP4FIFOPFL[13]	Endpoint 4 / slave FIFO Programmable Flag L	IN: PKTS[1] OUT:PFC7	IN: PKTS[0] OUT:PFC6	PFC5	PFC4	PFC3	PFC2	PFC1	PFC0	00000000	RW
E634 H.S.	1	EP6FIFOPFH[13]	Endpoint 6 / slave FIFO Programmable Flag H	DECIS	PKTSTAT	IN:PKTS[2] OUT:PFC12	IN:PKTS[1] OUT:PFC11	IN:PKTS[0] OUT:PFC10	0	PFC9	PFC8	00001000	bbbbbrbb
E634 F.S	1	EP6FIFOPFH[13]	Endpoint 6 / slave FIFO Programmable Flag H	DECIS	PKTSTAT	OUT:PFC12	OUT:PFC11	OUT:PFC10	0	PFC9	IN:PKTS[2] OUT:PFC8	00001000	bbbbbrbb
E635 H.S.	1	EP6FIFOPFL[13]	Endpoint 6 / slave FIFO Programmable Flag L	PFC7	PFC6	PFC5	PFC4	PFC3	PFC2	PFC1	PFC0	00000000	RW
E635 F.S	1	EP6FIFOPFL[13]	Endpoint 6 / slave FIFO Programmable Flag L	IN:PKTS[1] OUT:PFC7	IN:PKTS[0] OUT:PFC6	PFC5	PFC4	PFC3	PFC2	PFC1	PFC0	00000000	RW
E636 H.S.	1	EP8FIFOPFH[13]	Endpoint 8 / slave FIFO Programmable Flag H	DECIS	PKTSTAT	0	IN: PKTS[1] OUT:PFC10	IN: PKTS[0] OUT:PFC9	0	0	PFC8	00001000	bbrbbrrb
E636 F.S	1	EP8FIFOPFH[13]	Endpoint 8 / slave FIFO Programmable Flag H	DECIS	PKTSTAT	0	OUT:PFC10	OUT:PFC9	0	0	PFC8	00001000	bbrbbrrb
E637 H.S.	1	EP8FIFOPFL[13]	Endpoint 8 / slave FIFO Programmable Flag L	PFC7	PFC6	PFC5	PFC4	PFC3	PFC2	PFC1	PFC0	00000000	RW
E637 F.S	1	EP8FIFOPFL[13]	Endpoint 8 / slave FIFO Programmable Flag L	IN: PKTS[1] OUT:PFC7	IN: PKTS[0] OUT:PFC6	PFC5	PFC4	PFC3	PFC2	PFC1	PFC0	00000000	RW
	8	reserved											
E640	1	EP2ISOINPKTS	EP2 (if ISO) IN Packets per frame (1-3)	AADJ	0	0	0	0	0	INPPF1	INPPF0	00000001	brrrrrbb
E641	1	EP4ISOINPKTS	EP4 (if ISO) IN Packets per frame (1-3)	AADJ	0	0	0	0	0	INPPF1	INPPF0	00000001	brrrrrrr
E642	1	EP6ISOINPKTS	EP6 (if ISO) IN Packets per frame (1-3)	AADJ	0	0	0	0	0	INPPF1	INPPF0	00000001	brrrrrbb
E643	1	EP8ISOINPKTS	EP8 (if ISO) IN Packets per frame (1-3)	AADJ	0	0	0	0	0	INPPF1	INPPF0	00000001	brrrrrrr
E644	4	reserved											
E648	1	INPKTEND[13]	Force IN Packet End	Skip	0	0	0	EP3	EP2	EP1	EP0	xxxxxxxx	W
E649	7	OUTPKTEND[13]	Force OUT Packet End	Skip	0	0	0	EP3	EP2	EP1	EP0	xxxxxxxx	W
		INTERRUPTS											
E650	1	EP2FIFOIE[13]	Endpoint 2 slave FIFO Flag Interrupt Enable	0	0	0	0	EDGEPF	PF	EF	FF	00000000	RW
E651	1	EP2FIFOIRQ[13,14]	Endpoint 2 slave FIFO Flag Interrupt Request	0	0	0	0	0	PF	EF	FF	00000000	rrrrrbbb
E652	1	EP4FIFOIE[13]	Endpoint 4 slave FIFO Flag Interrupt Enable	0	0	0	0	EDGEPF	PF	EF	FF	00000000	RW
E653	1	EP4FIFOIRQ[13,14]	Endpoint 4 slave FIFO Flag Interrupt Request	0	0	0	0	0	PF	EF	FF	00000000	rrrrrbbb
E654	1	EP6FIFOIE[13]	Endpoint 6 slave FIFO Flag Interrupt Enable	0	0	0	0	EDGEPF	PF	EF	FF	00000000	RW
E655	1	EP6FIFOIRQ[13,14]	Endpoint 6 slave FIFO Flag Interrupt Request	0	0	0	0	0	PF	EF	FF	00000000	rrrrrbbb
E656	1	EP8FIFOIE[13]	Endpoint 8 slave FIFO Flag Interrupt Enable	0	0	0	0	EDGEPF	PF	EF	FF	00000000	RW
E657	1	EP8FIFOIRQ[13,14]	Endpoint 8 slave FIFO Flag Interrupt Request	0	0	0	0	0	PF	EF	FF	00000000	rrrrrbbb
E658	1	IBNIE	IN-BULK-NAK Interrupt Enable	0	0	EP8	EP6	EP4	EP2	EP1	EP0	00000000	RW
E659	1	IBNIRQ[14]	IN-BULK-NAK interrupt Request	0	0	EP8	EP6	EP4	EP2	EP1	EP0	00xxxxxx	rrbbbbbb
E65A	1	NAKIE	Endpoint Ping-NAK / IBN Interrupt Enable	EP8	EP6	EP4	EP2	EP1	EP0	0	IBN	00000000	RW
E65B	1	NAKIRQ[14]	Endpoint Ping-NAK / IBN Interrupt Request	EP8	EP6	EP4	EP2	EP1	EP0	0	IBN	xxxxxx0x	bbbbbbrb
E65C	1	USBIE	USB Int Enables	0	EP0ACK	HSGRANT	URES	SUSP	SUTOK	SOF	SUDAV	00000000	RW

Note
14. The register can only be reset; it cannot be set.

Table 12. FX2LP Register Summary (continued)

Hex	Size	Name	Description	b7	b6	b5	b4	b3	b2	b1	b0	Default	Access
E6CF	1	GPIFTCB2[13]	GPIF Transaction Count Byte 2	TC23	TC22	TC21	TC20	TC19	TC18	TC17	TC16	00000000	RW
E6D0	1	GPIFTCB1[13]	GPIF Transaction Count Byte 1	TC15	TC14	TC13	TC12	TC11	TC10	TC9	TC8	00000000	RW
E6D1	1	GPIFTCB0[13]	GPIF Transaction Count Byte 0	TC7	TC6	TC5	TC4	TC3	TC2	TC1	TC0	00000001	RW
	2	reserved										00000000	RW
		reserved											
		reserved											
E6D2	1	EP2GPIFFLGSEL[13]	Endpoint 2 GPIF Flag select	0	0	0	0	0	0	FS1	FS0	00000000	RW
E6D3	1	EP2GPIFPFSTOP	Endpoint 2 GPIF stop transaction on prog. flag	0	0	0	0	0	0	0	FIFO2FLAG	00000000	RW
E6D4	1	EP2GPIFTRIG[13]	Endpoint 2 GPIF Trigger	x	x	x	x	x	x	x	x	xxxxxxxx	W
	3	reserved											
		reserved											
		reserved											
E6DA	1	EP4GPIFFLGSEL[13]	Endpoint 4 GPIF Flag select	0	0	0	0	0	0	FS1	FS0	00000000	RW
E6DB	1	EP4GPIFPFSTOP	Endpoint 4 GPIF stop transaction on GPIF Flag	0	0	0	0	0	0	0	FIFO4FLAG	00000000	RW
E6DC	1	EP4GPIFTRIG[13]	Endpoint 4 GPIF Trigger	x	x	x	x	x	x	x	x	xxxxxxxx	W
	3	reserved											
		reserved											
		reserved											
E6E2	1	EP6GPIFFLGSEL[13]	Endpoint 6 GPIF Flag select	0	0	0	0	0	0	FS1	FS0	00000000	RW
E6E3	1	EP6GPIFPFSTOP	Endpoint 6 GPIF stop transaction on prog. flag	0	0	0	0	0	0	0	FIFO6FLAG	00000000	RW
E6E4	1	EP6GPIFTRIG[13]	Endpoint 6 GPIF Trigger	x	x	x	x	x	x	x	x	xxxxxxxx	W
	3	reserved											
		reserved											
		reserved											
E6EA	1	EP8GPIFFLGSEL[13]	Endpoint 8 GPIF Flag select	0	0	0	0	0	0	FS1	FS0	00000000	RW
E6EB	1	EP8GPIFPFSTOP	Endpoint 8 GPIF stop transaction on prog. flag	0	0	0	0	0	0	0	FIFO8FLAG	00000000	RW
E6EC	1	EP8GPIFTRIG[13]	Endpoint 8 GPIF Trigger	x	x	x	x	x	x	x	x	xxxxxxxx	W
	3	reserved											
E6F0	1	XGPIFSGLDATH	GPIF Data H (16-bit mode only)	D15	D14	D13	D12	D11	D10	D9	D8	xxxxxxxx	RW
E6F1	1	XGPIFSGLDATLX	Read/Write GPIF Data L & trigger transaction	D7	D6	D5	D4	D3	D2	D1	D0	xxxxxxxx	RW
E6F2	1	XGPIFSGLDATLNOX	Read GPIF Data L, no transaction trigger	D7	D6	D5	D4	D3	D2	D1	D0	xxxxxxxx	R
E6F3	1	GPIFREADYCFG	Internal RDY, Sync/Async, RDY pin states	INTRDY	SAS	TCXRDY5	0	0	0	0	0	00000000	bbbrrrrr
E6F4	1	GPIFREADYSTAT	GPIF Ready Status	0	0	RDY5	RDY4	RDY3	RDY2	RDY1	RDY0	00xxxxxx	R
E6F5	1	GPIFABORT	Abort GPIF Waveforms	x	x	x	x	x	x	x	x	xxxxxxxx	W
E6F6	2	reserved											
		ENDPOINT BUFFERS											
E740	64	EP0BUF	EP0-IN/-OUT buffer	D7	D6	D5	D4	D3	D2	D1	D0	xxxxxxxx	RW
E780	64	EP10UTBUF	EP1-OUT buffer	D7	D6	D5	D4	D3	D2	D1	D0	xxxxxxxx	RW
E7C0	64	EP1INBUF	EP1-IN buffer	D7	D6	D5	D4	D3	D2	D1	D0	xxxxxxxx	RW
E800	2048	reserved											RW
F000	1024	EP2FIFOBUF	512/1024 byte EP 2 / slave FIFO buffer (IN or OUT)	D7	D6	D5	D4	D3	D2	D1	D0	xxxxxxxx	RW
F400	512	EP4FIFOBUF	512 byte EP 4 / slave FIFO buffer (IN or OUT)	D7	D6	D5	D4	D3	D2	D1	D0	xxxxxxxx	RW
F600	512	reserved											
F800	1024	EP6FIFOBUF	512/1024 byte EP 6 / slave FIFO buffer (IN or OUT)	D7	D6	D5	D4	D3	D2	D1	D0	xxxxxxxx	RW
FC00	512	EP8FIFOBUF	512 byte EP 8 / slave FIFO buffer (IN or OUT)	D7	D6	D5	D4	D3	D2	D1	D0	xxxxxxxx	RW
FE00	512	reserved											

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

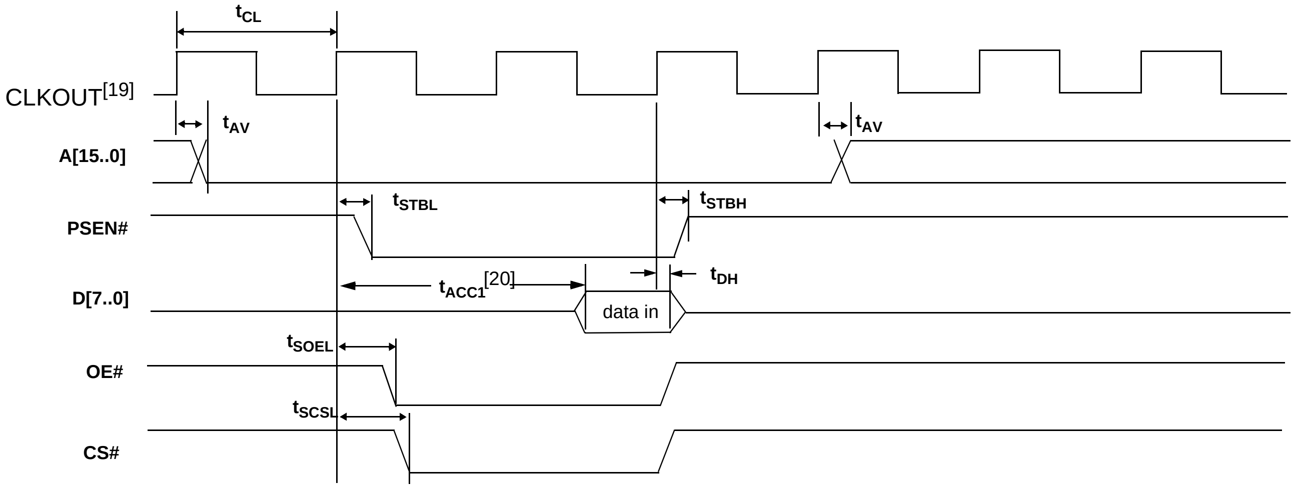


Table 15. Program Memory Read Parameters

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.

Data Memory Write[23]

Figure 14. Data Memory Write Timing Diagram

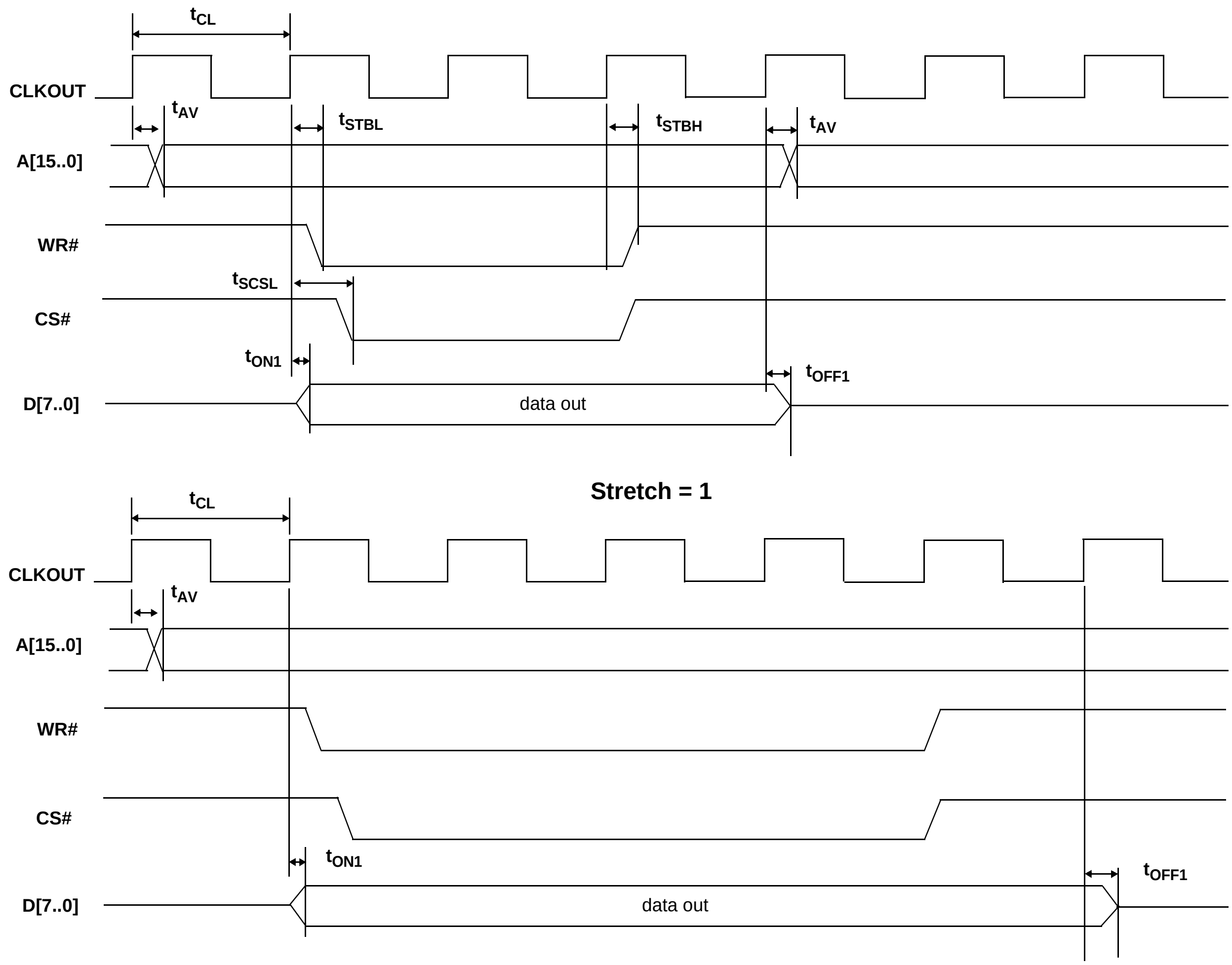


Table 17. Data Memory Write Parameters

Parameter	Description	Min	Max	Unit	Notes
t_{AV}	Delay from clock to valid address	0	10.7	ns	–
t_{STBL}	Clock to WR pulse LOW	0	11.2	ns	–
t_{STBH}	Clock to WR pulse HIGH	0	11.2	ns	–
t_{SCSL}	Clock to CS pulse LOW	–	13.0	ns	–
t_{ON1}	Clock to data turn-on	0	13.1	ns	–
t_{OFF1}	Clock to data hold time	0	13.1	ns	–

When using the AUTPOPTR1 or AUTOPTR2 to address external memory, the address of AUTOPTR1 is only active while either RD# or WR# are active. The address of AUTOPTR2 is active throughout the cycle and meets the address valid time for which is based on the stretch value.

Note

23. The stretch memory cycle feature enables EZ-USB firmware to adjust the speed of data memory accesses not the program memory accesses. Details including typical strobe width timings can be found in the section 12.1.2 of the Technical Reference Manual. The address cycle width can be interpreted from these.

Slave FIFO Address to Flags/Data

Figure 27. Slave FIFO Address to Flags/Data Timing Diagram[24]

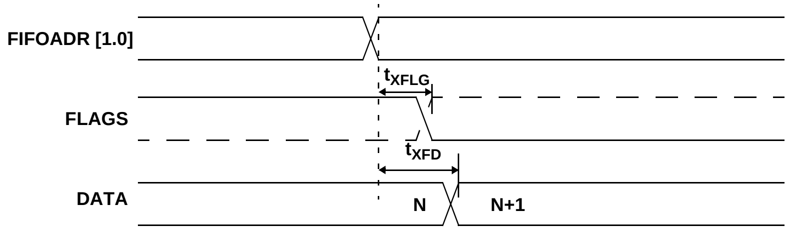


Table 30. Slave FIFO Address to Flags/Data Parameters

Parameter	Description	Min	Max	Unit
t_{XFLG}	FIFOADR[1:0] to FLAGS output propagation delay	–	10.7	ns
t_{XFD}	FIFOADR[1:0] to FIFODATA output propagation delay	–	14.3	ns

Slave FIFO Synchronous Address

Figure 28. Slave FIFO Synchronous Address Timing Diagram[24]

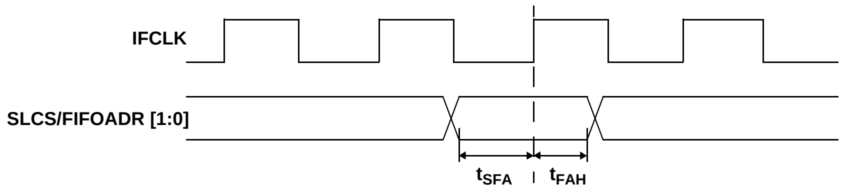


Table 31. Slave FIFO Synchronous Address Parameters[25]

Parameter	Description	Min	Max	Unit
t_{IFCLK}	Interface clock period	20.83	200	ns
t_{SFA}	FIFOADR[1:0] to clock setup time	25	–	ns
t_{FAH}	Clock to FIFOADR[1:0] hold time	10	–	ns

Slave FIFO Asynchronous Address

Figure 29. Slave FIFO Asynchronous Address Timing Diagram[24]

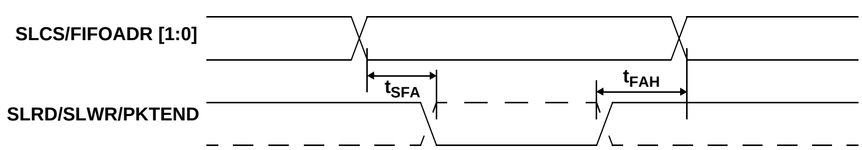
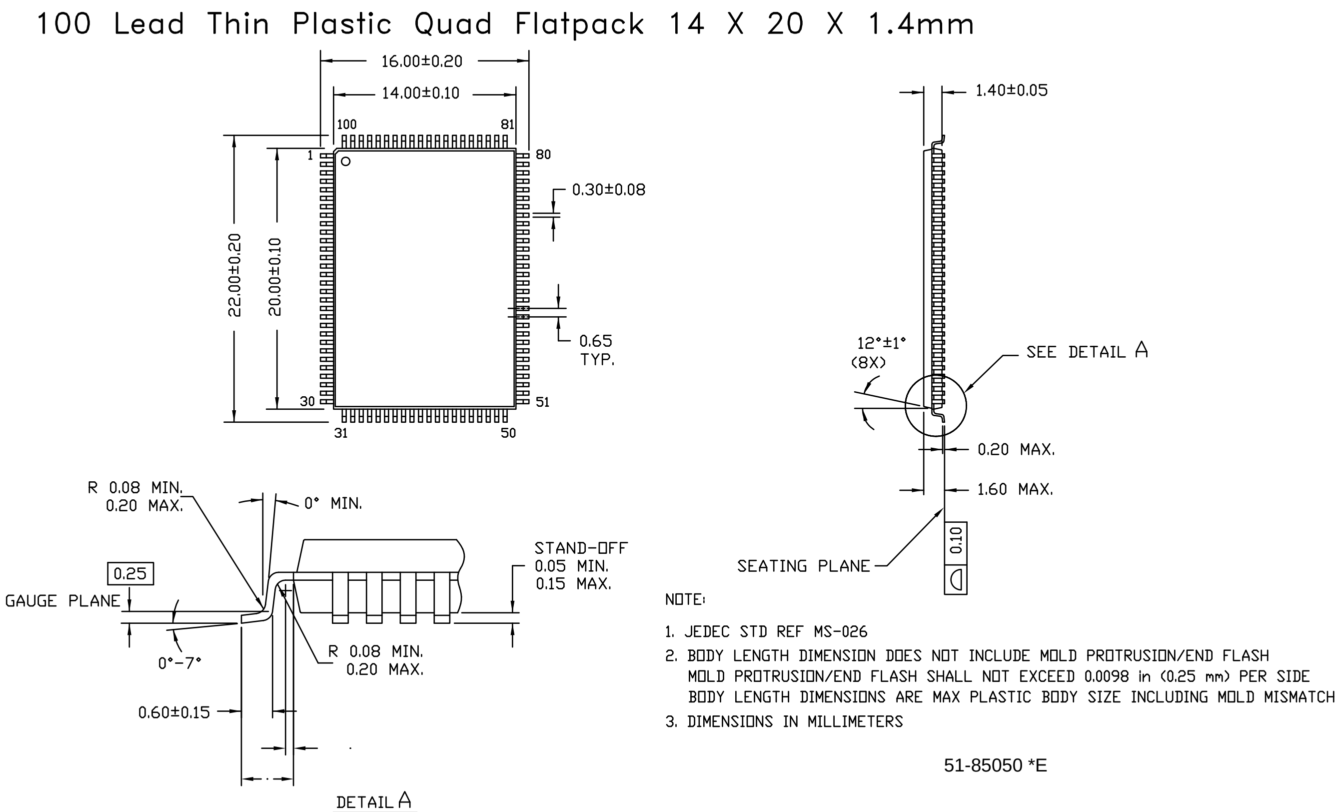


Table 32. Slave FIFO Asynchronous Address Parameters[27]

Parameter	Description	Min	Max	Unit
t_{SFA}	FIFOADR[1:0] to SLRD/SLWR/PKTEND setup time	10	–	ns
t_{FAH}	RD/WR/PKTEND to FIFOADR[1:0] hold time	10	–	ns

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



Quad Flat Package No Leads (QFN) Package Design Notes

Electrical contact of the part to the PCB is made by soldering the leads on the bottom surface of the package to the PCB. Therefore, special attention is required to the heat transfer area below the package to provide a good thermal bond to the circuit board. Design a copper (Cu) fill in the PCB as a thermal pad under the package. Heat is transferred from the FX2LP through the device's metal paddle on the bottom side of the package. Heat from here is conducted to the PCB at the thermal pad. It is then conducted from the thermal pad to the PCB inner ground plane by a 5 × 5 array of via. A via is a plated-through hole in the PCB with a finished diameter of 13 mil. The QFN's metal die paddle must be soldered to the PCB's thermal pad. Solder mask is placed on the board top side over each via to resist solder flow into the via. The mask on the top side also minimizes outgassing during the solder reflow process.

For further information on this package design, refer to application notes for Surface Mount Assembly of Amkor's MicroLeadFrame (MLF) Packages. You can find this on Amkor's website http://www.amkor.com.

This application note provides detailed information about board mounting guidelines, soldering flow, rework process, etc.

Figure 41 shows a cross-sectional area underneath the package. The cross section is of only one via. The solder paste template should be designed to allow at least 50% solder coverage. The thickness of the solder paste template should be 5 mil. Use the No Clean type 3 solder paste for mounting the part. Nitrogen purge is recommended during reflow.

Figure 42 is a plot of the solder mask pattern and Figure 43 displays an X-Ray image of the assembly (darker areas indicate solder).

Figure 41. Cross-section of the Area Underneath the QFN Package

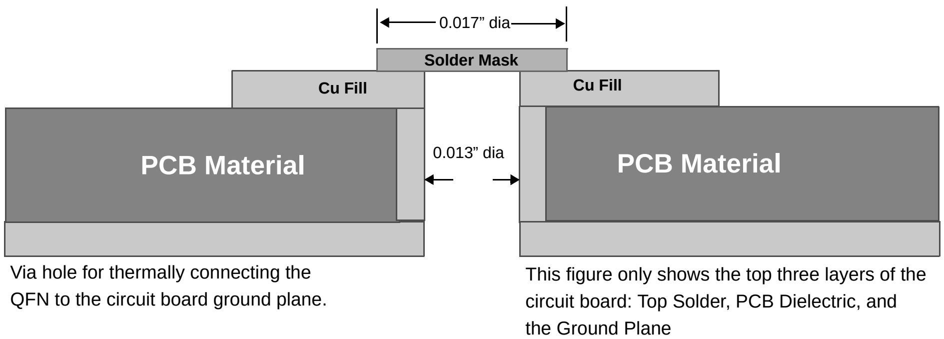


Figure 42. Plot of the Solder Mask (White Area)

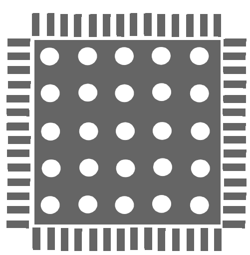
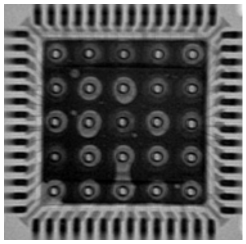


Figure 43. X-ray Image of the Assembly



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