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19-4572; Rev 0; 4/09

MAXIM

Crimzon® Infrared Microcontrollers

ZLF645 Series Flash MCUs

with Learning Amplification

Product Specification

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Revision History

Each instance in the revision history table reflects a change to this document from its previous revision. For more details, refer to the corresponding pages or appropriate links given in the table below.

Date	Version	Description	Page Number
December 2008	08	Updated formula in Flash Controller section. Updated V_{LVD} in Table 80 and V_{FLPE} in Table 82 in Electrical Characteristics section. Updated Table 56 through Table 59 in Timers section. Added Flash Programming through the ICP Interface in ICP Interface section. Added Using the Watchdog Timer As a Stop Mode Recovery Source in Reset and Power Management section. Updated Flash Frequency High and Low Byte Registers section and Table 83. Updated Port 1 pins in Figure 1.	67 165, 170 119 61 142 79, 172 4
April 2008	07	Updated Enabling The Flash Byte Programming Interface section.	82
April 2008	06	Deleted “Design Info” subsection and all of its associated text. Updated Flash Memory Overview section; updated Figure 19. Updated Flash Frequency High and Low Byte Registers section. Updated Icc and Icc1 in Table 80. Updated notes in Table 5 and Table 6. Removed “Preliminary” and “Precharacterization Product” notice. Added 20-pin QFN package to Pin Description, Table 3, Table 4, Packaging, Table 87, and Part Number Description. Change P31 to P32 at the beginning of Universal Asynchronous Receiver/Transmitter.	All 67, 68 79 165 9, 10 All 5, 6, 7, 176, 184, 186 85
January 2008	05	Updated Flash Code Protection Against External Access and Flash Frequency High and Low Byte Registers.	73, 79
January 2008	04	Chapter Reset and Power Management: Updated Table 68.	142

Table of Contents

Architectural Overview

Maxim's ZLF645 Series of Flash MCU's are members of the Crimzon® family of infrared microcontrollers. This series provides a directly-compatible code upgrade path to other Crimzon MCUs, offers a robust learning function, and features up to 64 KB Flash memory and 1K general-purpose Random Access Memory (RAM). Two timers allow the generation of complex signals while performing other counting operations.

A Universal Asynchronous Receiver/Transmitter (UART) allows the ZLF645 MCU to function as a slave/master database chip. When the UART is not in use, the Baud Rate Generator (BRG) can be used as a third timer. Enhanced Stop Mode Recovery features allow the ZLF645 MCU to recover from STOP mode on any change of logic and on any combination of the 12 SMR inputs. The SMR source can also be used as an interrupt source.

Many high-end remote control units offer a learning function. A learning function allows a replacement remote unit to learn infrared signals from the original remote unit and regenerate the signal. However, the amplifying circuits of many learning remotes are expensive and are not tuned well. The ZLF645 MCU is the first chip to offer a built-in tuned amplification circuit in a wide range of positions and battery voltages. The only external component required is a photodiode.

The ZLF645 MCU greatly reduces the system cost and improves learning function reliability. With all new features, the ZLF645 MCU is excellent for infrared remote control and other MCU applications.

Features

Table 1 lists the memory, I/O, and power features of the ZLF645 Flash MCU. Additional features are listed below the table.

Table 1. ZLF645 Flash MCU Features

Device	Flash (KB)	RAM*	I/O Lines	Voltage Range
ZLF645 Flash MCU	32 or 64	512 B or 1 K	16, 24, or 40	2.0 V–3.6 V

*General-purpose registers implemented as RAM.

Interrupt Sources

The ZLF645 MCU supports 23 interrupt sources with 6 interrupt vectors, as given below:

- Three external interrupts.
- Two from T8, T16 time-out and capture.
- Three from UART Tx, UART Rx, and UART BRG.
- One from LVD.
- Fourteen from SMR source P20-P27, P30-P33, P00, and P07:
  - Any change in logic from P20-P27, P30-P33 can generate an interrupt or SMR

Additional Features

The additional features of ZLF645 MCU include:

- IR learning amplifier.
- Low power consumption—11 mW (typical).
- Three standby modes:
  - STOP—1.7 µA (typical)
  - HALT—0.6 mA (typical)
  - Low-voltage reset
- Intelligent counter/timer architecture to automate generation or reception and demodulation of complex waveform, and pulsed signals:
  - One programmable 8-bit counter/timer with two capture registers and two load registers
  - One programmable 16-bit counter/timer with one 16-bit capture register pair and one 16-bit load register pair
  - Programmable input glitch filter for pulse reception
  - The UART baud rate generator can be used as another 8-bit timer, when the UART is not in use
- Six priority interrupts:
  - Three external/UART interrupts
  - Two assigned to counter/timers
  - One low-voltage detection interrupt

- 8-bit UART:
  - R_X and T_X interrupts
  - 4800, 9600, 19200, and 38400 baud rates
  - Parity Odd/Even/None
  - Stop bits 1/2
- ICP (In-circuit Flash Programming) interface multiplexed with one of the GPIO's.
- Intelligent Power-On Reset (POR) to provide reduced POR time on detection of stable clock from external crystal oscillator or resonator.
- Low-voltage and high-voltage detection flags.
- Programmable Watchdog Timer (WDT)/POR circuits.
- Two on-board analog comparators with independent reference voltages and programmable interrupt polarity.
- User-selectable options through option bit Flash coding (ON/OFF):
  - Port 0 pins 0–3 pull-up transistors
  - Port 0 pins 4–7 pull-up transistors
  - Port 1 pins 0–3 pull-up transistors
  - Port 1 pins 4–7 pull-up transistors
  - Port 2 pins 0–7 pull-up transistors
  - Port 3 pins 0–3 pull-up transistors
  - Port 4 pins 0–7 pull-up transistors
  - WDT enabled at Power-On Reset
  - Flash lowest half main memory protect
  - Flash entire main memory protect
  - 16-bit addressability for stack pointer
  - No division, divide by 2, divide by 16, or divide by 32 of external clock to system clock

Note: *All signals with an overline, "‾", are active Low. For example, B/$\overline{W}$, in which WORD is active Low, and $\overline{B}$/W, in which BYTE is active Low.*

Power connections use the conventional descriptions listed in Table 2.

Table 2. Power Connections

Connection	Device
Power	V_{DD}
Ground	V_{SS}

Functional Block Diagram

Figure 1 displays the functional blocks of the ZLF645 Flash MCU.

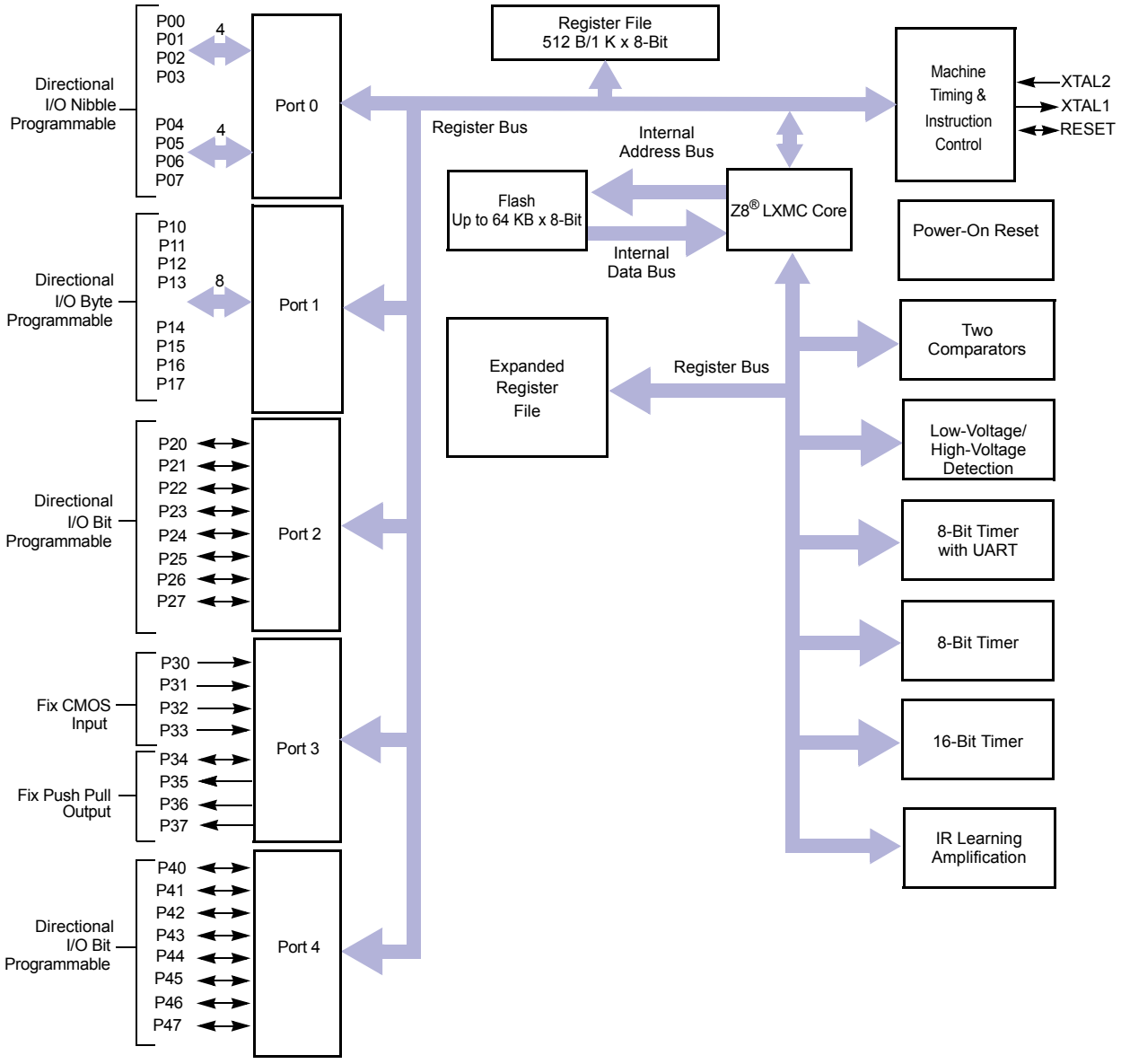

Figure 1. ZLF645 Flash MCU Functional Block Diagram

Pin Description

Figure 2 displays the pin configuration for ZLF645 MCU 20-pin QFN packages.

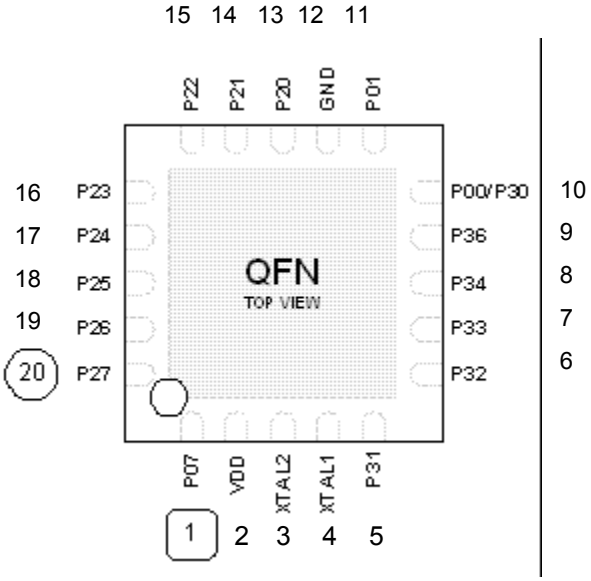

Figure 2. 20-Pin QFN Pin Configuration

Table 3 lists the function and signal directions of each pin within the 20-pin QFN package sequentially by pin number.

Table 3. 20-Pin QFN Sequential Pin Identification

Pin No	Symbol	Function	Signal Direction
1	P07	Port 0, bit 7	Input/Output
2	V_{DD}	Power Supply	Input
3	XTAL2	Crystal oscillator	Output
4	XTAL1	Crystal oscillator	Input
5	P31	Port 3, bit 1	Input
6	P32	Port 3, bit 2	Input
7	P33	Port 3, bit 3	Input
8	P34	Port 3, bit 4	Input/Output
9	P36	Port 3, bit 6	Output
10	P00	Port 0, bit 0	Input/Output
	P30	Port 3, bit 0	Input
11	P01	Port 0, bit 1	Input/Output
12	GND	Ground In	put
13	P20	Port 2, bit 0	Input/Output
14	P21	Port 2, bit 1	Input/Output
15	P22	Port 2, bit 2	Input/Output
16	P23	Port 2, bit 3	Input/Output
17	P24	Port 2, bit 4	Input/Output
18	P25	Port 2, bit 5	Input/Output
19	P26	Port 2, bit 6	Input/Output
20	P27	Port 2, bit 7	Input/Output

Note: When the Port 0 low-nibble pull-up option is enabled and the P30 input is Low, current flows through the pull-up to Ground.

Table 4 lists the function and signal direction of each pin within the 20-pin QFN package by function.

Table 4. 20-Pin QFN Functional Pin Identification

Pin No	Symbol	Function	Signal Direction
10	P00	Port 0, bit 0	Input/Output
	P30	Port 3, bit 0	Input
11	P01	Port 0, bit 1	Input/Output
1	P07	Port 0, bit 7	Input/Output
13	P20	Port 2, bit 0	Input/Output
14	P21	Port 2, bit 1	Input/Output
15	P22	Port 2, bit 2	Input/Output
16	P23	Port 2, bit 3	Input/Output
17	P24	Port 2, bit 4	Input/Output
18	P25	Port 2, bit 5	Input/Output
19	P26	Port 2, bit 6	Input/Output
20	P27	Port 2, bit 7	Input/Output
5	P31	Port 3, bit 1	Input
6	P32	Port 3, bit 2	Input
7	P33	Port 3, bit 3	Input
8	P34	Port 3, bit 4	Input/Output
9	P36	Port 3, bit 6	Output
2	V_{DD}	Power Supply	Input
12	GND	Ground In	put
4	XTAL1	Crystal oscillator	Input
3	XTAL2	Crystal oscillator	Output

Note: When the Port 0 low-nibble pull-up option is enabled and the P30 input is Low, current flows through the pull-up to Ground.

Figure 3 displays the pin configuration for ZLF645 MCU 20-pin PDIP, SOIC, and SSOP packages.

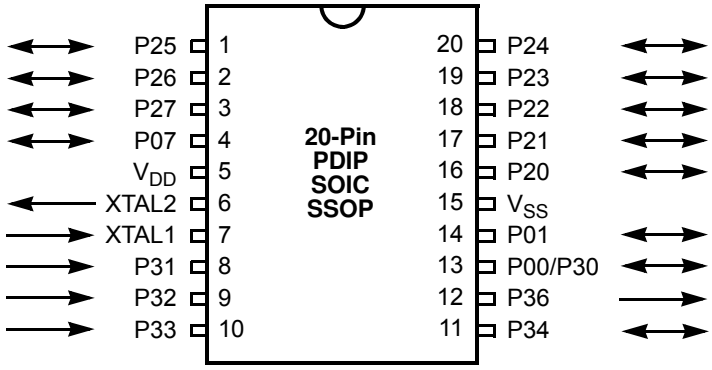

Figure 3. 20-Pin PDIP/SOIC/SSOP Pin Configuration

Table 5 lists the function and signal directions of each pin within the 20-pin PDIP, SOIC, and SSOP packages sequentially by pin number.

Table 5. 20-Pin PDIP/SOIC/SSOP Sequential Pin Identification

Pin No	Symbol	Function	Signal Direction
1	P25	Port 2, bit 5	Input/Output
2	P26	Port 2, bit 6	Input/Output
3	P27	Port 2, bit 7	Input/Output
4	P07	Port 0, bit 7	Input/Output
5	V_{DD}	Power Supply	Input
6	XTAL2	Crystal oscillator	Output
7	XTAL1	Crystal oscillator	Input
8	P31	Port 3, bit 1	Input
9	P32	Port 3, bit 2	Input
10	P33	Port 3, bit 3	Input
11	P34	Port 3, bit 4	Input/Output
12	P36	Port 3, bit 6	Output
13	P00	Port 0, bit 0	Input/Output
	P30	Port 3, bit 0	Input
14	P01	Port 0, bit 1	Input/Output
15	V_{SS}	Ground In	put
16	P20	Port 2, bit 0	Input/Output
17	P21	Port 2, bit 1	Input/Output
18	P22	Port 2, bit 2	Input/Output
19	P23	Port 2, bit 3	Input/Output
20	P24	Port 2, bit 4	Input/Output

Note: When the Port 0 low-nibble pull-up option is enabled and the P30 input is Low, current flows through the pull-up to Ground.

Table 6 lists the function and signal direction of each pin within the 20-pin PDIP, SOIC, and SSOP packages by function.

Table 6. 20-Pin PDIP/SOIC/SSOP Functional Pin Identification

Pin No	Symbol	Function	Signal Direction
13	P00	Port 0, bit 0	Input/Output
	P30	Port 3, bit 0	Input
14	P01	Port 0, bit 1	Input/Output
4	P07	Port 0, bit 7	Input/Output
16	P20	Port 2, bit 0	Input/Output
17	P21	Port 2, bit 1	Input/Output
18	P22	Port 2, bit 2	Input/Output
19	P23	Port 2, bit 3	Input/Output
20	P24	Port 2, bit 4	Input/Output
1	P25	Port 2, bit 5	Input/Output
2	P26	Port 2, bit 6	Input/Output
3	P27	Port 2, bit 7	Input/Output
8	P31	Port 3, bit 1	Input
9	P32	Port 3, bit 2	Input
10	P33	Port 3, bit 3	Input
11	P34	Port 3, bit 4	Input/Output
12	P36	Port 3, bit 6	Output
5	V_{DD}	Power Supply	Input
15	V_{SS}	Ground In	put
7	XTAL1	Crystal oscillator	Input
6	XTAL2	Crystal oscillator	Output

Note: When the Port 0 low-nibble pull-up option is enabled and the P30 input is Low, current flows through the pull-up to Ground.

Figure 4 displays the pin configuration of the ZLF645 MCU within the 28-pin PDIP, SOIC, and SSOP packages.

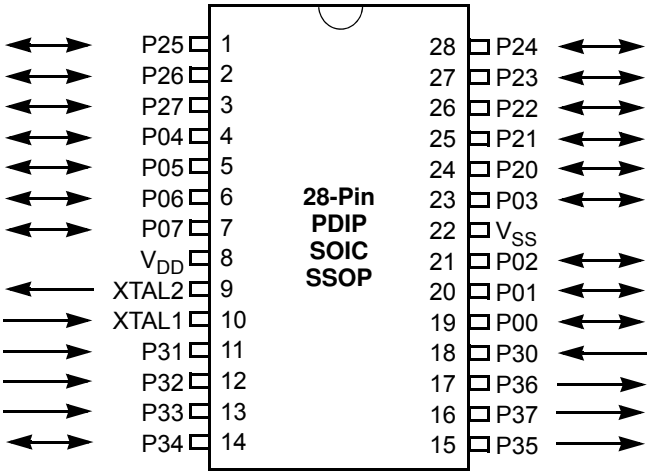

Figure 4. 28-Pin PDIP/SOIC/SSOP Pin Configuration

Table 7 lists the function and signal directions of each pin within the 28-pin PDIP, SOIC, and SSOP packages sequentially by pin number.

Table 7. 28-Pin PDIP/SOIC/SSOP Sequential Pin Identification

Pin No	Symbol	Function	Signal Direction
1	P25	Port 2, bit 5	Input/Output
2	P26	Port 2, bit 6	Input/Output
3	P27	Port 2, bit 7	Input/Output
4	P04	Port 0, bit 4	Input/Output
5	P05	Port 0, bit 5	Input/Output
6	P06	Port 0, bit 6	Input/Output
7	P07	Port 0, bit 7	Input/Output
8	V_{DD}	Power supply	Input
9	XTAL2	Crystal oscillator	Output
10	XTAL1	Crystal oscillator	Input
11	P31	Port 3, bit 1	Input
12	P32	Port 3, bit 2	Input
13	P33	Port 3, bit 3	Input
14	P34	Port 3, bit 4	Input/Output
15	P35	Port 3, bit 5	Output
16	P37	Port 3, bit 7	Output
17	P36	Port 3, bit 6	Output
18	P30	Port 3, bit 0; connect to VDD if not used	Input
19	P00	Port 0, bit 0	Input/Output
20	P01	Port 0, bit 1	Input/Output
21	P02	Port 0, bit 2	Input/Output
22	V_{SS}	Ground	Input
23	P03	Port 0, bit 3	Input/Output
24	P20	Port 2, bit 0	Input/Output
25	P21	Port 2, bit 1	Input/Output
26	P22	Port 2, bit 2	Input/Output
27	P23	Port 2, bit 3	Input/Output
28	P24	Port 2, bit 4	Input/Output

Table 8 lists the functions and signal directions of each pin within the 28-pin PDIP, SOIC, and SSOP packages by function.

Table 8. 28-Pin PDIP/SOIC/SSOP Functional Pin Identification

Pin No	Symbol	Function	Signal Direction
19	P00	Port 0, bit 0	Input/Output
20	P01	Port 0, bit 1	Input/Output
21	P02	Port 0, bit 2	Input/Output
23	P03	Port 0, bit 3	Input/Output
4	P04	Port 0, bit 4	Input/Output
5	P05	Port 0, bit 5	Input/Output
6	P06	Port 0, bit 6	Input/Output
7	P07	Port 0, bit 7	Input/Output
24	P20	Port 2, bit 0	Input/Output
25	P21	Port 2, bit 1	Input/Output
26	P22	Port 2, bit 2	Input/Output
27	P23	Port 2, bit 3	Input/Output
28	P24	Port 2, bit 4	Input/Output
1	P25	Port 2, bit 5	Input/Output
2	P26	Port 2, bit 6	Input/Output
3	P27	Port 2, bit 7	Input/Output
18	P30	Port 3, bit 0; connect to VDD if not used	Input
11	P31	Port 3, bit 1	Input
12	P32	Port 3, bit 2	Input
13	P33	Port 3, bit 3	Input
14	P34	Port 3, bit 4	Input/Output
15	P35	Port 3, bit 5	Output
17	P36	Port 3, bit 6	Output
16	P37	Port 3, bit 7	Output
8	V_{DD}	Power supply	Input
22	V_{SS}	Ground	Input
10	XTAL1	Crystal oscillator	Input
9	XTAL2	Crystal oscillator	Output

Figure 5 displays the pin configuration of the ZLF645 MCU within the 48-pin SSOP package.

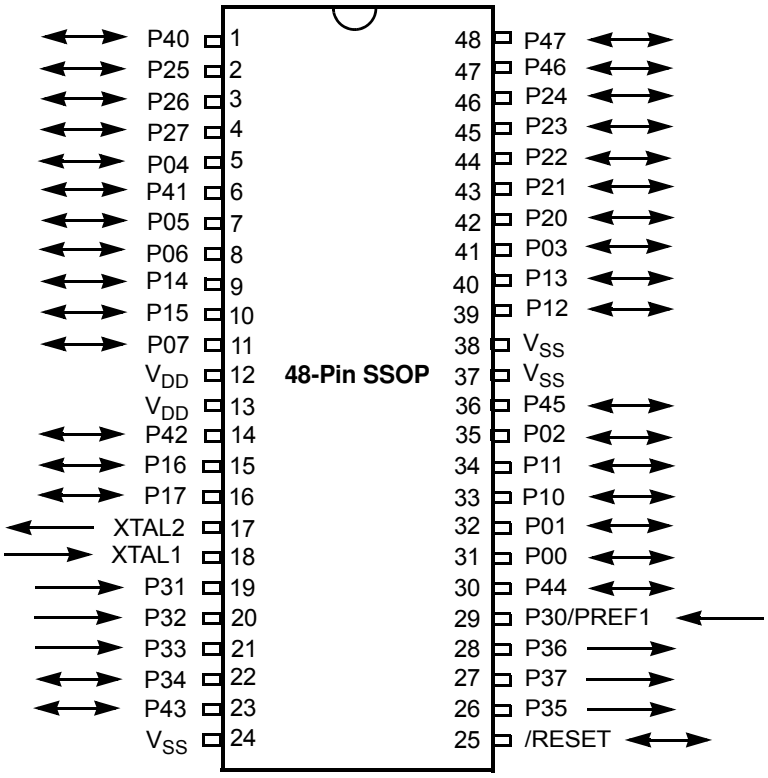

Figure 5. 48-Pin SSOP Pin Configuration

Table 9 lists the functions and signal directions of each pin within the 48-pin SSOP package sequentially by pin number.

Table 9. 48-Pin SSOP Sequential Pin Identification

Pin No	Symbol	Function	Signal Direction
1	P40	Port 4, bit 0	Input/Output
2	P25	Port 2, bit 5	Input/Output
3	P26	Port 2, bit 6	Input/Output
4	P27	Port 2, bit 7	Input/Output
5	P04	Port 0, bit 4	Input/Output
6	P41	Port 4, bit 1	Input/Output
7	P05	Port 0, bit 5	Input/Output

Table 9. 48-Pin SSOP Sequential Pin Identification (Continued)

Pin No	Symbol	Function	Signal Direction
8	P06	Port 0, bit 6	Input/Output
9	P14	Port 1, bit 4	Input/Output
10	P15	Port 1, bit 5	Input/Output
11	P07	Port 0, bit 7	Input/Output
12	V_{DD}	Power Supply	Input
13	V_{DD}	Power Supply	Input
14	P42	Port 4, bit 2	Input/Output
15	P16	Port 1, bit 6	Input/Output
16	P17	Port 1, bit 7	Input/Output
17	XTAL2	Crystal oscillator	Output
18	XTAL1	Crystal oscillator	Input
19	P31	Port 3, bit 1	Input
20	P32	Port 3, bit 2	Input
21	P33	Port 3, bit 3	Input
22	P34	Port 3, bit 4	Input/Output
23	P43	Port 4, bit 3	Input/Output
24	V_{SS}	Ground	Input
25	/RESET	Bidirectional reset signal	Input/Output
26	P35	Port 3, bit 5	Output
27	P37	Port 3, bit 7	Output
28	P36	Port 3, bit 6	Output
29	P30/PREF1	Port 3, bit 0	Input
30	P44	Port 4, bit 4	Input/Output
31	P00	Port 0, bit 0	Input/Output
32	P01	Port 0, bit 1	Input/Output
33	P10	Port 1, bit 0	Input/Output
34	P11	Port 1, bit 1	Input/Output
35	P02	Port 0, bit 2	Input/Output
36	P45	Port 4, bit 5	Input/Output
37	V_{SS}	Ground	Input
38	V_{SS}	Ground	Input
39	P12	Port 1, bit 2	Input/Output
40	P13	Port 1, bit 3	Input/Output

Table 9. 48-Pin SSOP Sequential Pin Identification (Continued)

Pin No	Symbol	Function	Signal Direction
41	P03	Port 0, bit 3	Input/Output
42	P20	Port 2, bit 0	Input/Output
43	P21	Port 2, bit 1	Input/Output
44	P22	Port 2, bit 2	Input/Output
45	P23	Port 2, bit 3	Input/Output
46	P24	Port 2, bit 4	Input/Output
47	P46	Port 4, bit 6	Input/Output
48	P47	Port 4, bit 7	Input/Output

Table 10 lists the functions and signal directions of each pin within the 48-pin SSOP package by function.

Table 10. 48-Pin SSOP Functional Pin Identification

Pin No	Symbol	Function	Signal Direction
31	P00	Port 0, bit 0	Input/Output
32	P01	Port 0, bit 1	Input/Output
35	P02	Port 0, bit 2	Input/Output
41	P03	Port 0, bit 3	Input/Output
5	P04	Port 0, bit 4	Input/Output
7	P05	Port 0, bit 5	Input/Output
8	P06	Port 0, bit 6	Input/Output
11	P07	Port 0, bit 7	Input/Output
33	P10	Port 1, bit 0	Input/Output
34	P11	Port 1, bit 1	Input/Output
39	P12	Port 1, bit 2	Input/Output
40	P13	Port 1, bit 3	Input/Output
9	P14	Port 1, bit 4	Input/Output
10	P15	Port 1, bit 5	Input/Output
15	P16	Port 1, bit 6	Input/Output
16	P17	Port 1, bit 7	Input/Output
42	P20	Port 2, bit 0	Input/Output
43	P21	Port 2, bit 1	Input/Output
44	P22	Port 2, bit 2	Input/Output

Table 10. 48-Pin SSOP Functional Pin Identification (Continued)

Pin No	Symbol	Function	Signal Direction
45	P23	Port 2, bit 3	Input/Output
46	P24	Port 2, bit 4	Input/Output
2	P25	Port 2, bit 5	Input/Output
3	P26	Port 2, bit 6	Input/Output
4	P27	Port 2, bit 7	Input/Output
29	P30	Port 3, bit 0; connect to VDD if not used	Input
19	P31	Port 3, bit 1	Input
20	P32	Port 3, bit 2	Input
21	P33	Port 3, bit 3	Input
22	P34	Port 3, bit 4	Input/Output
26	P35	Port 3, bit 5	Output
28	P36	Port 3, bit 6	Output
27	P37	Port 3, bit 7	Output
1	P40	Port 4, bit 0	Input/Output
6	P41	Port 4, bit 1	Input/Output
14	P42	Port 4, bit 2	Input/Output
23	P43	Port 4, bit 3	Input/Output
30	P44	Port 4, bit 4	Input/Output
36	P45	Port 4, bit 5	Input/Output
47	P46	Port 4, bit 6	Input/Output
48	P47	Port 4, bit 7	Input/Output
12	V_{DD}	Power Supply	Input
13	V_{DD}	Power Supply	Input
24	V_{SS}	Ground	Input
37	V_{SS}	Ground	Input
38	V_{SS}	Ground	Input
18	XTAL1	Crystal oscillator	Input
17	XTAL2	Crystal oscillator	Output
25	/RESET	Bidirectional reset signal	Input/Output