Z86C15

CMOS Z8® 8-BIT MCU
KEYBOARD CONTROLLER

FEATURES

ROM (Kbytes)	RAM* (Bytes)	I/O Lines	Speed (MHz)	Pin Count / Package
4	236	32	5	40 DIP 44 PLCC 44 QFP

* General-Purpose

n   4.5- to 5.5-Volt Operating Range

n   0°C to 70°C Operating Temperature Range

n   Expanded Register File

n   Low-Power Consumption: 30 mW @ 5 MHz Typical

n   Six Vectored, Priority Interrupts from Six Different Sources

n   Two Programmable 8-Bit Counter/Timers, Each with 6-Bit Programmable Prescaler

n   Power-On Reset (POR) Timer, Hardware Watch-Dog Timer (WDT)

n   Digital Inputs CMOS Levels with Internal Pull-Up Resistors

n   Four Direct Connect LED Drive Ports

n   On-Chip RC Oscillator, 4 MHz to 5 MHz

GENERAL DESCRIPTION

The Z86C15 Keyboard Controller is a full-featured member of the Z8® microcontroller family offering a unique register-to-register architecture that avoids accumulator bottlenecks and is more code efficient than RISC processors.

For applications demanding powerful I/O capabilities, the Z86C15 provides 32 pins dedicated to input and output. These lines are grouped into four ports, each port consisting of eight lines, and are configurable under software control to provide timing, status signals, and serial or parallel I/O ports.

Two on-chip counter/timers, with a large number of user-selectable modes, are available to relieve the system of administering real-time tasks, such as counting/timing and I/O datacommunications.

Six different internal or external interrupt sources are maskable and prioritized so a vectored address is provided for efficient interrupt subroutine handling and multitasking functions.

The Z86C15 achieves low-EMI by means of several modifications in the output drivers and clock circuitry of the device.

By means of an expanded register file, the designer has access to three additional system control registers that provide extra peripheral devices, I/O ports, and register addresses (see Functional Block Diagram).
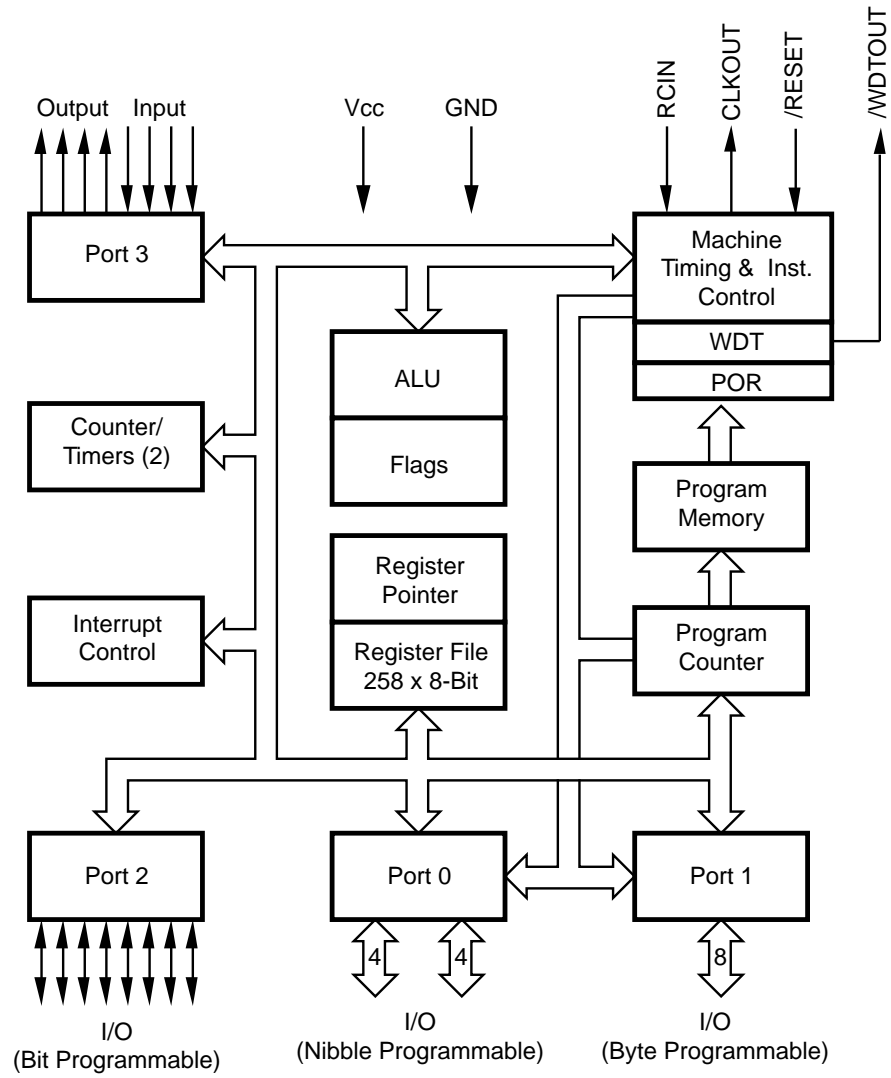
Notes:

All Signals with a preceding front slash, "/", are active Low, e.g., B//W (WORD is active Low); /B/W (BYTE is active Low, only).
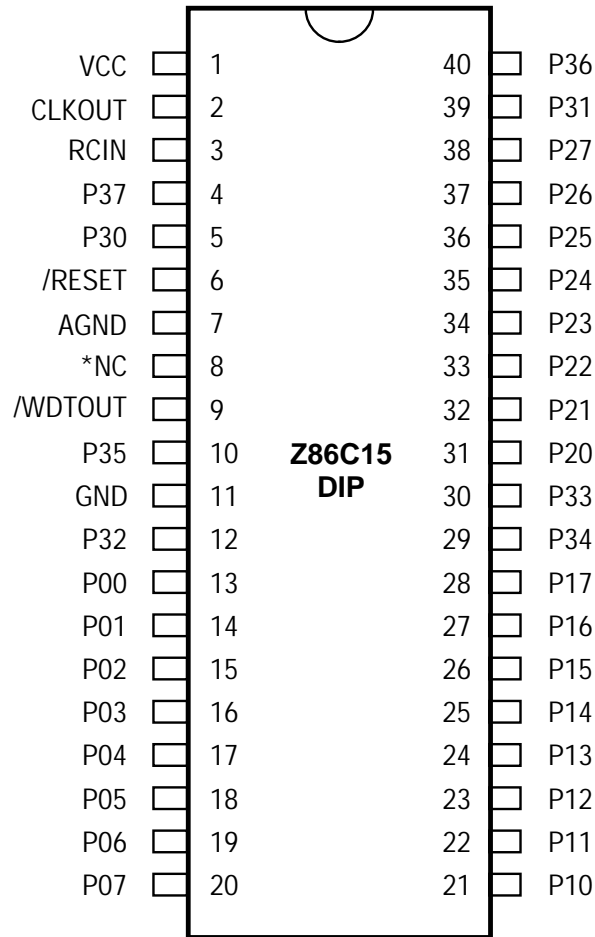
Power connections follow conventional descriptions below:

Connection	Circuit	Device
Power	V_{CC}	V_{DD}
Ground	GND	V_{SS}

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GENERAL DESCRIPTION (Continued)

Z86C15 Functional Block Diagram

PIN IDENTIFICATION

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                    ┌──────────⌣──────────┐
           VCC ─┤ 1                    40 ├─ P36
        CLKOUT ─┤ 2                    39 ├─ P31
         RCIN  ─┤ 3                    38 ├─ P27
          P37  ─┤ 4                    37 ├─ P26
          P30  ─┤ 5                    36 ├─ P25
        /RESET ─┤ 6                    35 ├─ P24
          AGND ─┤ 7                    34 ├─ P23
          *NC  ─┤ 8                    33 ├─ P22
       /WDTOUT ─┤ 9                    32 ├─ P21
          P35  ─┤ 10    Z86C15        31 ├─ P20
          GND  ─┤ 11     DIP          30 ├─ P33
          P32  ─┤ 12                   29 ├─ P34
          P00  ─┤ 13                   28 ├─ P17
          P01  ─┤ 14                   27 ├─ P16
          P02  ─┤ 15                   26 ├─ P15
          P03  ─┤ 16                   25 ├─ P14
          P04  ─┤ 17                   24 ├─ P13
          P05  ─┤ 18                   23 ├─ P12
          P06  ─┤ 19                   22 ├─ P11
          P07  ─┤ 20                   21 ├─ P10
                    └─────────────────────┘
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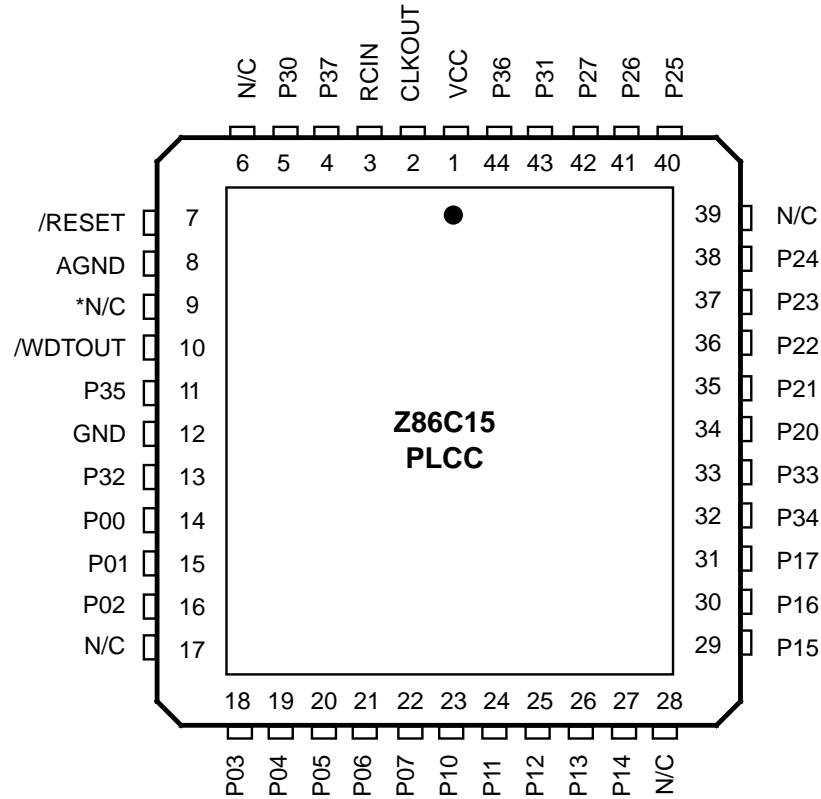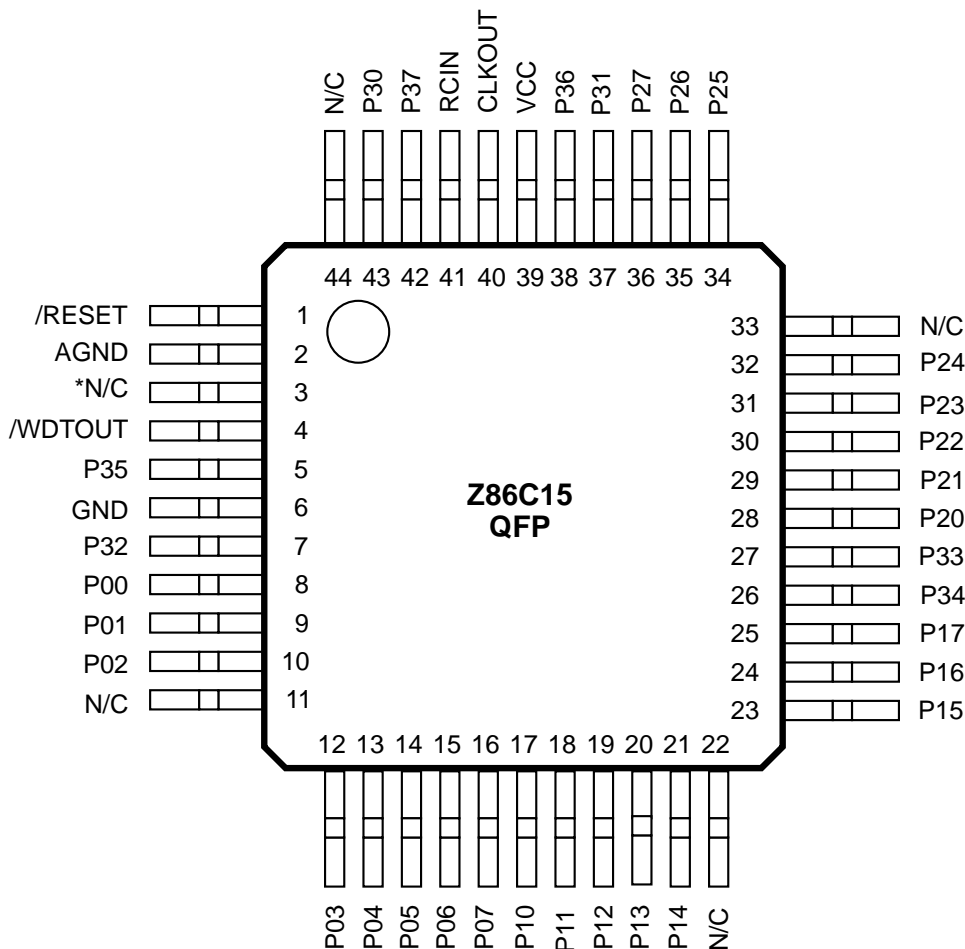
*Note: Pin 8 is connected to the chip, although it is used only for testing. This pin **must** float.

40-Pin DIP Pin Configuration

40-Pin DIP Pin Identification

Pin #	Symbol	Function	Direction	Pin #	Symbol	Function	Direction
1	V_{CC}	Power Supply	Input	11	GND	Ground	
2	CLKOUT	Z8 System Clock	Output	12	P32	Port 3, Pin 2	Input
3	RCIN	RC Oscillator Clock	Input	13-20	P00-P07	Port 0, Pins 0,1,2,3,4,5,6,7	In/Output
4	P37	Port 3, Pin 7	Output	21-28	P10-P17	Port 1, Pins 0,1,2,3,4,5,6,7	In/Output
5	P30	Port 3, Pin 0	Input	29	P34	Port 3, Pin 4	Output
6	/RESET	Reset	Input	30	P33	Port 3, Pin 3	Input
7	AGND	Analog Ground		31-38	P20-P27	Port 2, Pins 0,1,2,3,4,5,6,7	In/Output
*8	NC	Not Connected		39	P31	Port 3, Pin 1	Input
9	/WDTOUT	Watch-Dog Timer	Output	40	P36	Port 3, Pin 6	Output
10	P35	Port 3, Pin 5	Output				

PIN IDENTIFICATION (Continued)

44-Pin PLCC Pin Assignments

*Note: Pin 9 is connected to the chip, although it is used only for testing. This pin *must* float.

44-Pin PLCC Pin Identification

Pin #	Symbol	Function	Direction	Pin #	Symbol	Function	Direction
1	V_{CC}	Power Supply	Input	14-16	P00-P02	Port 0, Pins 0, 1, 2	In/Output
2	CLKOUT	Z8 System Clock	Output	17	N/C	Not Connected	
3	RCIN	RC Oscillator Clock	Input	18-22	P03-P07	Port 0, Pins 3, 4, 5, 6, 7	In/Output
4	P37	Port 3, Pin 7	Output	23-27	P10-P14	Port 1, Pins 0, 1, 2, 3, 4	In/Output
5	P30	Port 3, Pin 0	Input	28	N/C	Not Connected	
6	N/C	Not Connected		29-31	P15-P17	Port 1, Pins 5, 6, 7	In/Output
7	/RESET	Reset	Input	32	P34	Port 3, Pin 4	Output
8	AGND	Analog Ground		33	P33	Port 3, Pin 3	Input
*9	N/C	Not Connected		34-38	P20-P24	Port 2, Pins 0, 1, 2, 3, 4	In/Output
10	/WDTOUT	Watch-Dog Timer	Output	39	N/C	Not Connected	
11	P35	Port 3, Pin 5	Output	40-42	P25-P27	Port 2, Pins 5, 6, 7	In/Output
12	GND	Ground		43	P31	Port 3, Pin 1	Input
13	P32	Port 3, Pin 2	Input	44	P36	Port 3, Pin 6	Output

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44-Pin QFP Pin Assignments

*Note: Pin 3 is connected to the chip, although it is used only for testing. This pin *must* float.

44-Pin QFP Pin Identification

Pin #	Symbol	Function	Direction	Pin #	Symbol	Function	Direction
1	/RESET	Reset	Input	26	P34	Port 3, Pin 4	Output
2	AGND	Analog Ground		27	P33	Port 3, Pin 3	Input
*3	N/C	Not Connected		28-32	P20-P24	Port 2, Pins 0, 1, 2, 3, 4	In/Output
4	/WDTOUT	Watch-Dog Timer	Output	33	N/C	Not Connected	
5	P35	Port 3, Pin 5	Output	34-36	P25-P27	Port 2, Pins 5, 6, 7	In/Output
6	GND	Ground		37	P31	Port 3, Pin 1	Input
7	P32	Port 3, Pin 2	Input	38	P36	Port 36	Output
8-10	P00-P02	Port 0, Pins 0, 1, 2	In/Output	39	V_{cc}	Power Supply	
11	N/C	Not Connected	Input	40	CLKOUT	Z8 System Clock	Output
12-16	P03-P07	Port 0, Pins 3,4,5,6,7	In/Output	41	RCIN	RC Oscillator Clock	Input
17-21	P10-P14	Port 1, Pins 0,1,2,3,4	In/Output	42	P37	Port 3, Pin 7	Output
22	N/C	Not Connected		43	P30	Port 3, Pin 0	Input
23-25	P15-P17	Port 1, Pins 5, 6,7	In/Output	44	N/C	Not Connected	

ABSOLUTE MAXIMUM RATINGS

| Symbol	Description	Min	Max	Units
V_{CC}	Supply Voltage*	−0.3	+7.0	V
T_{STG}	Storage Temp	−65	+150	°C
T_A	Oper Ambient Temp	0	+105	°C

Notes:
* Voltage on all pins with respect to GND.

Stresses greater than those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only; operation of the device at any condition above those indicated in the operational sections of these specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

STANDARD TEST CONDITIONS

Standard Test Conditions. The characteristics listed here apply for standard test conditions as noted. All voltages are referenced to GND. Positive current flows into the referenced pin (Test Load).
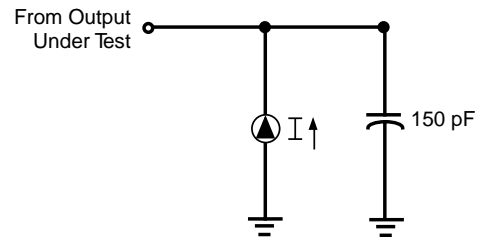
Test Load Diagram

CAPACITANCE

T_A = 25°C; V_{CC} = GND = 0V; f = 1.0 MHz; unmeasured pins returned to GND.

Parameter	Max
Input Capacitance	12 pF
Output Capacitance	12 pF
I/O Capacitance	12 pF

FREQUENCY

Frequency 4 MHz – 5 MHz
Tolerance ±10%

Frequency tolerance limit only applies to the packaged device and not die or wafer.

DC CHARACTERISTICS (Z86C15)

V_{CC} = 5.0V ±10% @ 0°C to +70°C

Sym	Parameter	Min	Max	Typical @ 25°C	Unit	Condition
V_{CH}	Clock Input High Voltage	0.7 V_{CC}	V_{CC} to +0.3V	2.5	V	Driven by External Clock Generator
V_{CL}	Clock Input Low Voltage	GND −0.3	0.2 V_{CC}	1.5	V	Driven by External Clock Generator
V_{IH}	Input High Voltage	0.7 V_{CC}	V_{CC} + 0.3	2.5	V	
V_{IL}	Input Low Voltage	GND −0.3	0.2V_{CC}	1.5	V	
V_{RH}	Reset Input High Voltage	0.8 V_{CC}	V_{CC}	2.1	V	
V_{RL}	Reset Input Low Voltage	GND −0.3	0.2 V_{CC}	1.7	V	
V_{OH}	Output High Voltage	V_{CC} −0.4		3.1	V	I_{OH} = −2.0 mA
V_{OH}	Output High Voltage	V_{CC} 0.6			V	I_{OH} = −2.0 mA (See note [1] below.)
V_{OL}	Output Low Voltage		0.8		V	I_{OL} = 4 mA (See note [1] below.)
V_{OL}	Output Low Voltage		.4		V	I_{OL}= 4 mA
I_{OL}	Output Low	8	20		mA	V_{OL}= V_{CC} −2.2 V (See note [1] below.)
I_{IL}	Input Leakage	−1	1	<1	µA	V_{IN} = 0V, 5.25V (See note [2] beow.)
I_{OL}	Output Leakage	−1	1	<1	µA	V_{IN} = 0V, 5.25V
I_{CC}	V_{CC} Supply Current		12	6	mA	@ 5.0 MHz
POR	Power On Reset	84	196	140	m s	
I_{CC1}	Standby Current		4	2.0	mA	HALT mode V_{IN} = 0V, V_{CC} @ 5 MHz
I_{CC2}	Standby Current		20		µA	STOP mode V_{IN} = 0V
R_P	Pull Up Resistor	6.76	14.04	10.4	Kohm	
R_P	Pull Up Resistor (P26-P27)	1.8	3	2.4	Kohm	
R_P	Pull Up Resistor (Reset)	40	80	60	Kohm	

Note:

[1] Ports P37-P34. These may be used for LEDs or as general-purpose outputs requiring high sink current.

[2] Input pin without pull-up resistor.

AC ELECTRICAL CHARACTERISTICS (Z86C15)
Additional Timing Table

No	Symbol	Parameter	V_{CC} Note [4]	$T_A = 0°C$ to $+70°C$ 5 MHz		Units	Notes
				Min	Max		
1	TpC	Input Clock Period	5.0V	125	100000	ns	[1]
2	TrC,TfC	Clock Input Rise & Fall Times	5.0V		25	ns	[1]
3	TwC	Input Clock Width	5.0V	37		ns	[1]
4	TwTinL	Timer Input Low Width	5.0V	70		ns	[1]
5	TwTinH	Timer Input High Width	5.0V	2.5TpC			[1]
6	TpTin	Timer Input Period	5.0V	4TpC			[1]
7	TrTin	Timer Input Rise & Fall Timer	5.0V		100	ns	[1]
8A	TwIL	Int. Request Low Time	5.0V	70		ns	[1,2]
8B	TwIL	Int. Request Low Time	5.0V	3TpC			[1,3]
9	TwIH	Int. Request Input High Time	5.0V	3TpC			[1,2]
10	Twsm	STOP Mode Recovery Width Spec	5.0V	20		ns	Reg. SMR - D5=0
			5.0V	5TpC			Reg. SMR - D5=1
11	Tost	Oscillator Startup Time	5.0V		5TpC		[4]
12	Twdt	Watch-Dog Timer Delay Time	5.0V	2		ms	[5]
			5.0V	4		ms	[6]
			5.0V	8		ms	[7]
			5.0V	32		ms	[8]

Notes:

[1] Timing Reference uses 0.7 V_{CC} for a logic 1 and 0.2 V_{CC} for a logic 0.

[2] Interrupt request via Port 3 (P31-P33).

[3] Interrupt request via Port 3 (P30).

[4] SMR-D5 = 0.

[5] D1 = 0, D0 = 0.{Reg. WDTMR)

[6] D1 = 0, D0 = 1.{Reg. WDTMR)

[7] D1 = 1, D0 = 0.{Reg. WDTMR)

[8] D1 = 1, D0 = 1.{Reg. WDTMR)

AC ELECTRICAL CHARACTERISTICS
Additional Timing Diagram