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What is "Embedded - Microcontrollers"?

"Embedded - Microcontrollers" refer to small, integrated circuits designed to perform specific tasks within larger systems. These microcontrollers are essentially compact computers on a single chip, containing a processor core, memory, and programmable input/output peripherals. They are called "embedded" because they are embedded within electronic devices to control various functions, rather than serving as standalone computers. Microcontrollers are crucial in modern electronics, providing the intelligence and control needed for a wide range of applications.

Applications of "Embedded - Microcontrollers"

Details	
Product Status	Obsolete
Core Processor	Z8
Core Size	8-Bit
Speed	10MHz
Connectivity	-
Peripherals	PWM, WDT
Number of I/O	13
Program Memory Size	1KB (1K x 8)
Program Memory Type	OTP
EEPROM Size	-
RAM Size	64 x 8
Voltage - Supply (Vcc/Vdd)	4.5V ~ 5.5V
Data Converters	-
Oscillator Type	Internal
Operating Temperature	-40°C ~ 105°C (TA)
Mounting Type	Surface Mount
Package / Case	20-SSOP (0.209", 5.30mm Width)
Supplier Device Package	-
Purchase URL	https://www.e-xfl.com/product-detail/zilog/z8e00110hec

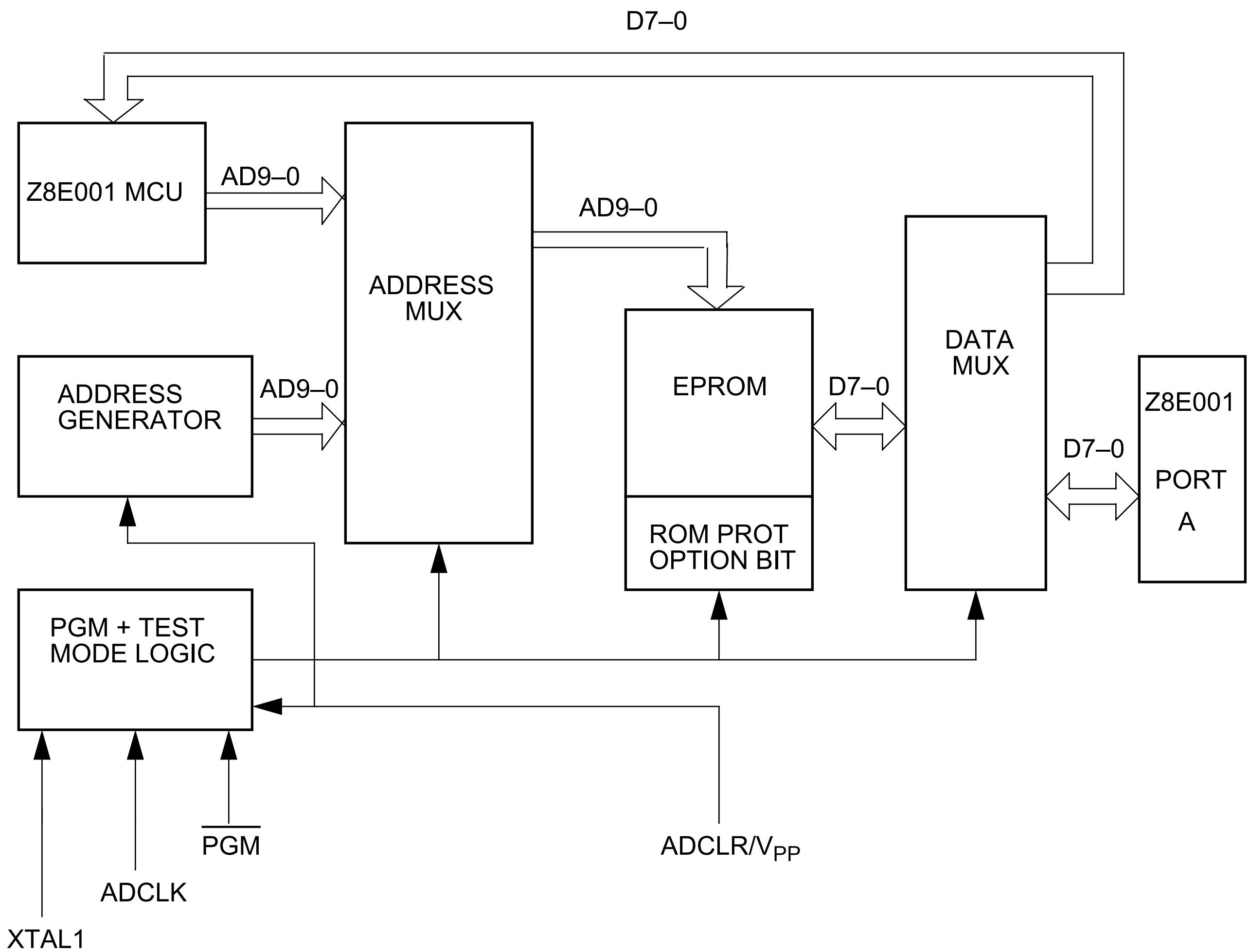


Figure 2. EPROM Programming Mode Block Diagram

PIN DESCRIPTION

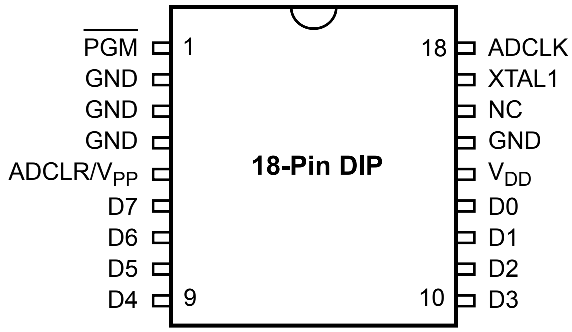


Figure 3. 18-Pin DIP/SOIC Pin Identification/EPROM Programming Mode

EPROM Programming Mode

Pin #	Symbol	Function	Direction
1	$\overline{PGM}$	Prog Mode	Input
2–4	GND	Ground	
5	ADCLR/V_{PP}	Clear Clk./Prog Volt.	Input
6-9	D7–D4	Data 7,6,5,4	Input/Output
10–13	D3–D0	Data 3,2,1,0	Input/Output
14	V_{DD}	Power Supply	
15	GND	Ground	
16	NC	No Connection	
17	XTAL1	1MHz Clock	Input
18	ADCLK	Address Clock	Input

PIN DESCRIPTION (Continued)

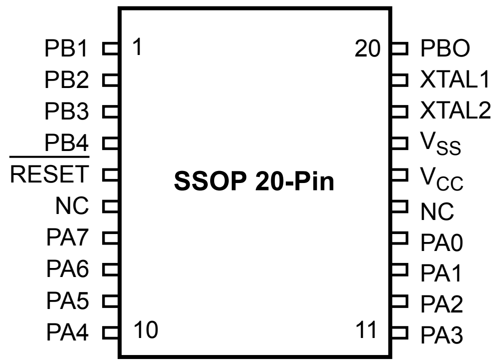


Figure 5. 20-Pin SSOP Pin Identification

Standard Mode

Pin #	Symbol	Function	Direction
1–4	PB1–PB4	Port B, Pins 1,2,3,4	Input/Output
5	RESET	Reset	Input
6	NC	No Connection	
7–10	PA7–PA4	Port A, Pins 7,6,5,4	Input/Output
11–14	PA3–PA0	Port A, Pins 3,2,1,0	Input/Output
15	NC	No Connection	
16	V_{CC}	Power Supply	
17	V_{SS}	Ground	
18	XTAL2	Crystal Osc. Clock	Output
19	XTAL1	Crystal Osc. Clock	Input
20	PB0	Port B, Pin 0	Input/Output

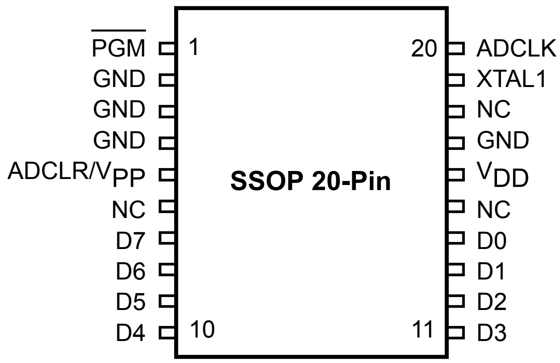


Figure 6. 20-Pin SSOP Pin Identification/EPROM Programming Mode

EPROM Programming Mode

Pin #	Symbol	Function	Direction
1	$\overline{PGM}$	Prog Mode	Input
2–4	GND	Ground	
5	ADCLR/V_{PP}	Clear Clk./Prog Volt.	Input
6	NC	No Connection	
7–10	D7–D4	Data 7,6,5,4	Input/Output
11–14	D3–D0	Data 3,2,1,0	Input/Output
15	NC	No Connection	
16	V_{DD}	Power Supply	
17	GND	Ground	
18	NC	No Connection	
19	XTAL1	1MHz Clock	Input
20	ADCLK	Address Clock	Input

Table 1. DC Electrical Characteristics (Continued)

Sym	Parameter	V_{CC}[1]	pF T_A = 0°C to +70°C Standard Temperatures Min	Max	Typical[2] @ 25°C	Units	Conditions	Notes
I_{CC}	Supply Current	3.5V		2.5	2.0	mA	@ 10 MHz	4,5
		5.5V		6.0	3.5	mA	@ 10 MHz	4,5
I_{CC1}	Standby Current	3.5V		2.0	1.0	mA	HALT Mode V_{IN} = 0V, V_{CC} @ 10 MHz	4,5
		5.5V		4.0	2.5	mA	HALT Mode V_{IN} = 0V, V_{CC} @ 10 MHz	4,5
I_{CC2}	Standby Current	3.5V		500	150	nA	STOP Mode V_{IN} = 0V, V_{CC}	6

Notes:
1. The V_{CC} voltage specification of 3.5V guarantees 3.5V and the V_{CC} voltage specification of 5.5 V guarantees 5.0 V ±0.5 V.
2. Typical values are measured at V_{CC} = 3.3V and V_{CC} = 5.0V; V_{SS} = 0V = GND.
3. For analog comparator input when analog comparator is enabled.
4. All outputs unloaded and all inputs are at V_{CC} or V_{SS} level.
5. CL1 = CL2 = 22 pF.
6. Same as note 4 except inputs at V_{CC}.

RESET PIN OPERATION (Continued)

Table 4. Control and Peripheral Registers (Continued)

		Bits								
Register (HEX)	**Register Name**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**	**Comments**
D7	Port B Special Function	0	0	0	0	0	0	0	0	Deactivates all port special functions after RESET
D6	Port B Directional Control	0	0	0	0	0	0	0	0	Defines all bits as inputs in PortB after RESET
D5	Port B Output	U	U	U	U	U	U	U	U	Output register not affected by RESET
D4	Port B Input	U	U	U	U	U	U	U	U	Current sample of the input pin following RESET
D3	Port A Special Function	0	0	0	0	0	0	0	0	Deactivates all port special functions after RESET
D2	Port A Directional Control	0	0	0	0	0	0	0	0	Defines all bits as inputs in PortA after RESET
D1	Port A Output	U	U	U	U	U	U	U	U	Output register not affected by RESET
D0	Port A Input	U	U	U	U	U	U	U	U	Current sample of the input pin following RESET
CF	Reserved									
CE	Reserved									
CD	T1VAL	U	U	U	U	U	U	U	U	
CC	T0VAL	U	U	U	U	U	U	U	U	
CB	T3VAL	U	U	U	U	U	U	U	U	
CA	T2VAL	U	U	U	U	U	U	U	U	
C9	T3AR	U	U	U	U	U	U	U	U	
C8	T2AR	U	U	U	U	U	U	U	U	
C7	T1ARHI	U	U	U	U	U	U	U	U	
C6	T0ARHI	U	U	U	U	U	U	U	U	
C5	T1ARLO	U	U	U	U	U	U	U	U	
C4	T0ARLO	U	U	U	U	U	U	U	U	
C3	WDTHI	1	1	1	1	1	1	1	1	
C2	WDTLO	1	1	1	1	1	1	1	1	
C1	TCTLHI	1	1	1	1	1	0	0	0	WDT Enabled in HALT Mode, WDT timeout at maximum value, STOP Mode disabled
C0	TCTLLO	0	0	0	0	0	0	0	0	All standard timers are disabled

Note: *The SMR and WDT flags are set indicating the source of the $\overline{\text{RESET}}$.

Note: The WDT can only be disabled via software if the first instruction out of RESET performs this function. Logic within the Z8E001 detects that it is in the process of executing the first instruction after the part leaves RESET. During the execution of this instruction, the upper five bits of the TCTLHI register can be written. After this first instruction, hardware does not allow the upper five bits of this register to be written.

The TCTLHI bits for control of the WDT are described below:

WDT Time Select (D6, D5, D4). Bits 6, 5, and 4 determine the time-out period. Table 6 indicates the range of timeout values that can be obtained. The default values of D6, D5, and D4 are all 1, thus setting the WDT to its maximum timeout period when coming out of RESET.

WDT During HALT (D7). This bit determines whether or not the WDT is active during HALT Mode. A 1 indicates active during HALT. A 0 prevents the WDT from resetting the part while halted.Coming out of reset, the WDT is enabled during HALT Mode.

STOP MODE (D3). Coming out of RESET, the Z8E001 STOP Mode is disabled. If an application requires use of STOP Mode, bit D3 must be cleared immediately upon leaving RESET. If bit D3 is set, the STOP instruction executes as a NOP. If bit D3 is cleared, the STOP instruction enters Stop Mode. Whenever the Z8E001 wakes up after having been in STOP Mode, the STOP Mode is again disabled.

Bits 2, 1 and 0. These bits are reserved and must be 0.

Table 6. WDT Time-Out

D6	D5	D4	Crystal Clocks* to Timeout	Time-Out Using a 10 MHZ Crystal
0	0	0	Disabled	Disabled
0	0	1	65,536 TpC	6.55 ms
0	1	0	131,072 TpC	13.11 ms
0	1	1	262,144 TpC	26.21 ms
1	0	0	524,288 TpC	52.43 ms
1	0	1	1,048,576 TpC	104.86 ms
1	1	0	2,097,152 TpC	209.72 ms
1	1	1	4,194,304 TpC	419.43 ms

Note:
*TpC=XTAL clock cycle. The default on reset is D6=D5=D4=1.

POWER-DOWN MODES

In addition to the standard RUN mode, the Z8E001 MCU supports two Power-Down modes to minimize device current consumption. The two modes supported are HALT and STOP.

HALT MODE OPERATION

The HALT Mode suspends instruction execution and turns off the internal CPU clock. The on-chip oscillator circuit remains active so the internal clock continues to run and is applied to the timers and interrupt logic.

To enter the HALT Mode, the Z8E001 only requires a HALT instruction. It is NOT necessary to execute a NOP instruction immediately before the HALT instruction.

```
7F      HALT            ; enter HALT Mode
```

The HALT Mode can be exited by servicing an interrupt (either externally or internally) generated. Upon completion of the interrupt service routine, the user program continues from the instruction after the HALT instruction.

The HALT Mode can also be exited via a RESET activation or a Watch-Dog Timer (WDT) timeout. In these cases, program execution restarts at the reset restart address 0020H.

STOP MODE OPERATION

The STOP Mode provides the lowest possible device stand-by current. This instruction turns off the on-chip oscillator and internal system clock.

To enter the STOP Mode, the Z8E001 only requires a STOP instruction. It is NOT necessary to execute a NOP instruction immediately before the STOP instruction.

```
6F    STOP    ;enter STOP Mode
```

The STOP Mode is exited by any one of the following resets: RESET pin or a STOP-Mode Recovery source. Upon reset generation, the processor always restarts the application program at address 0020H, and the STOP Mode Flag is set. Reading the STOP Mode Flag does not clear it. The user must clear the STOP Mode Flag with software.

Note: Failure to clear the STOP Mode Flag can result in undefined behavior.

The Z8E001 provides a dedicated STOP-Mode Recovery (SMR) circuit. In this case, a low-level applied to input pin PB0 triggers an SMR. To use this mode, pin PB0 (I/O Port B, bit 0) must be configured as an input before the STOP Mode is entered. The Low level on PB0 must be held for a minimum pulse width T_{WSM} plus any oscillator startup time. Program execution starts at address 20Hex after PB0 is raised back to a high level.

Notes: Use of the PB0 input for the stop mode recovery does not initialize the control registers.

The STOP Mode current (I_{CC2}) is minimized when:

- V_{CC} is at the low end of the devices operating range.
- Output current sourcing is minimized.
- All inputs (digital and analog) are at the Low or High rail voltages.

CLOCK

The Z8E001 MCU derives its timing from on-board clock circuitry connected to pins XTAL1 and XTAL2. The clock circuitry consists of an oscillator, a glitch filter, a divide-by-two shaping circuit, a divide-by-four shaping circuit, and a divide-by-eight shaping circuit. Figure 13 illustrates the clock circuitry. The oscillator's input is XTAL1 and its output is XTAL2. The clock can be driven by a crystal, a ceramic resonator, LC clock, or an external clock source.

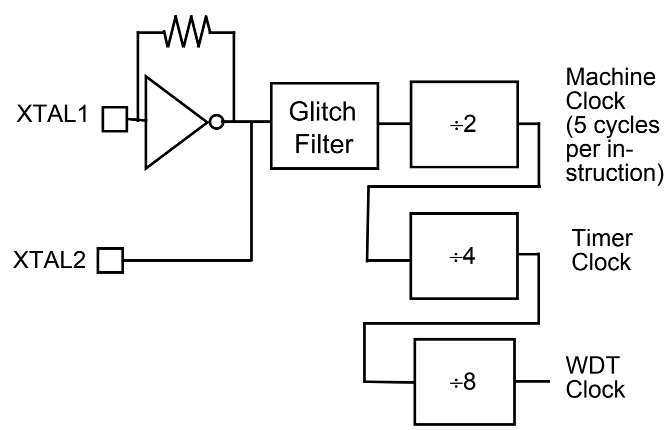


Figure 13. Z8E001 Clock Circuit

- V_{CC} power lines should be separated from the clock oscillator input circuitry.
- Resistivity between XTAL1 or XTAL2 (and the other pins) should be greater than 10 MΩ.

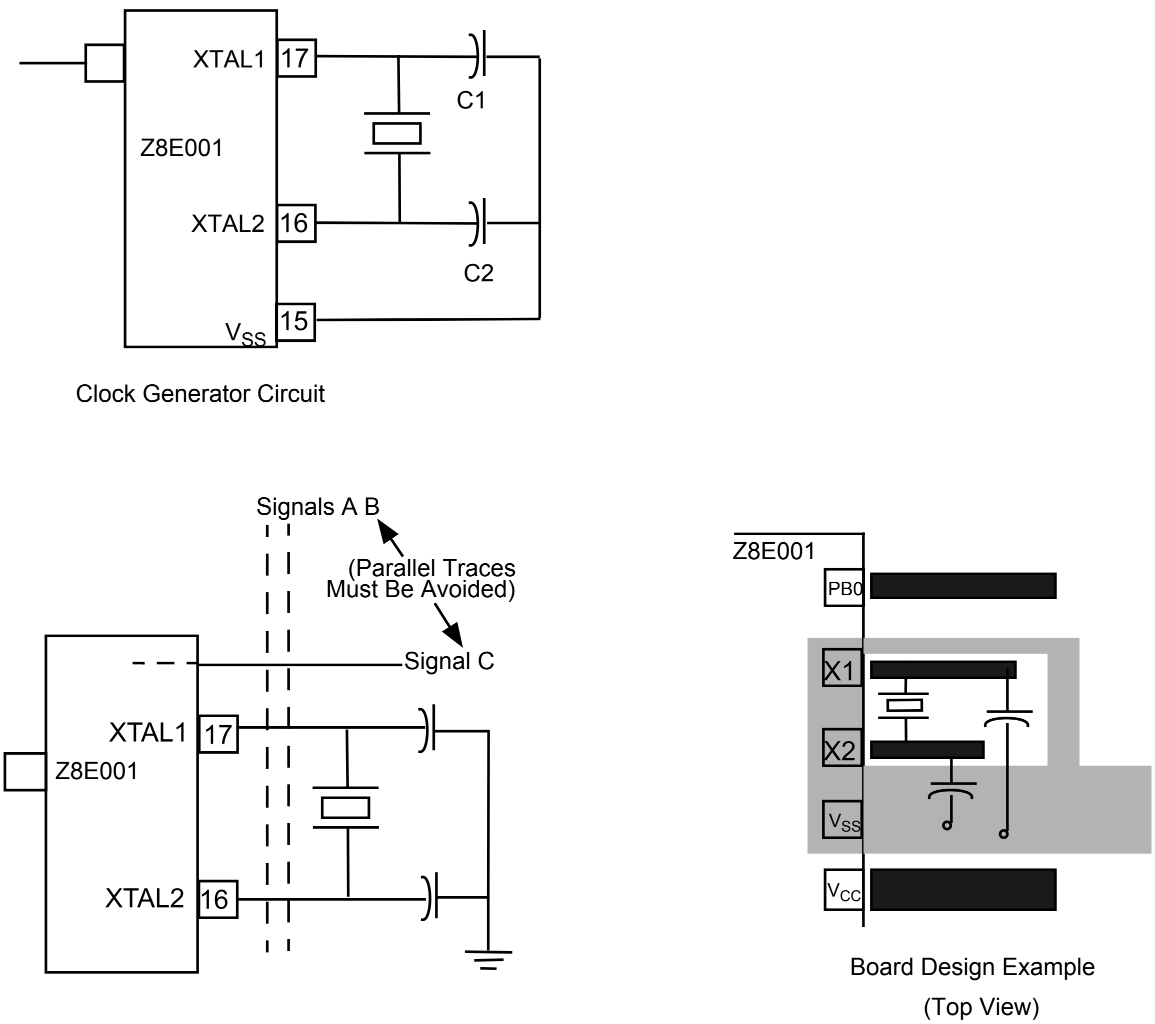


Figure 15. Circuit Board Design Rules

Crystals and Resonators

Crystals and ceramic resonators (Figure 16) should have the following characteristics to ensure proper oscillation:

Crystal Cut	AT (crystal only)
Mode	Parallel, Fundamental Mode
Crystal Capacitance	<7pF
Load Capacitance	10pF < CL < 220 pF,
	15 typical
Resistance	100 ohms max

Depending on the operation frequency, the oscillator can require additional capacitors, C1 and C2, as shown in Figure 16 and Figure 17. The capacitance values are dependent on the manufacturer's crystal specifications.

TIMERS (Continued)

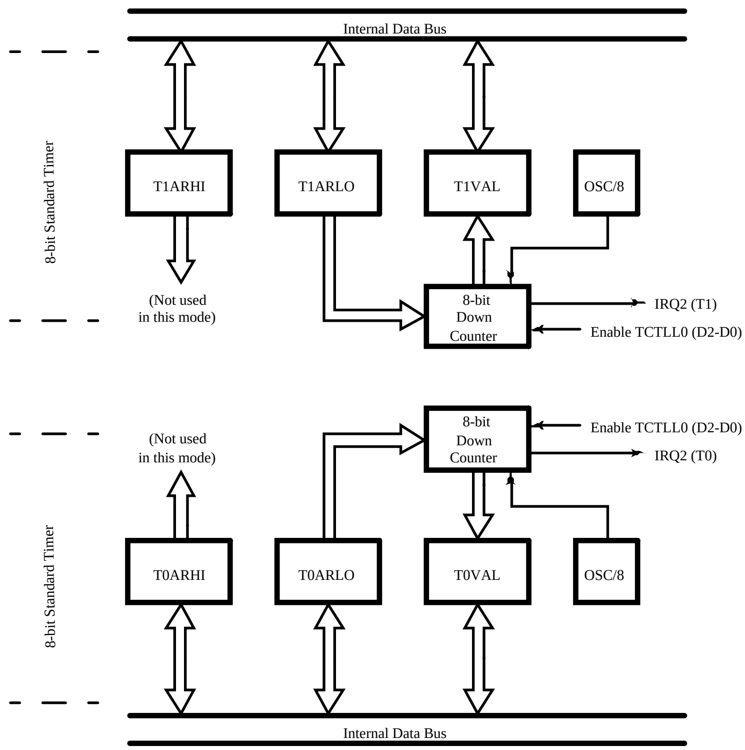


Figure 20. 8-Bit Standard Timers

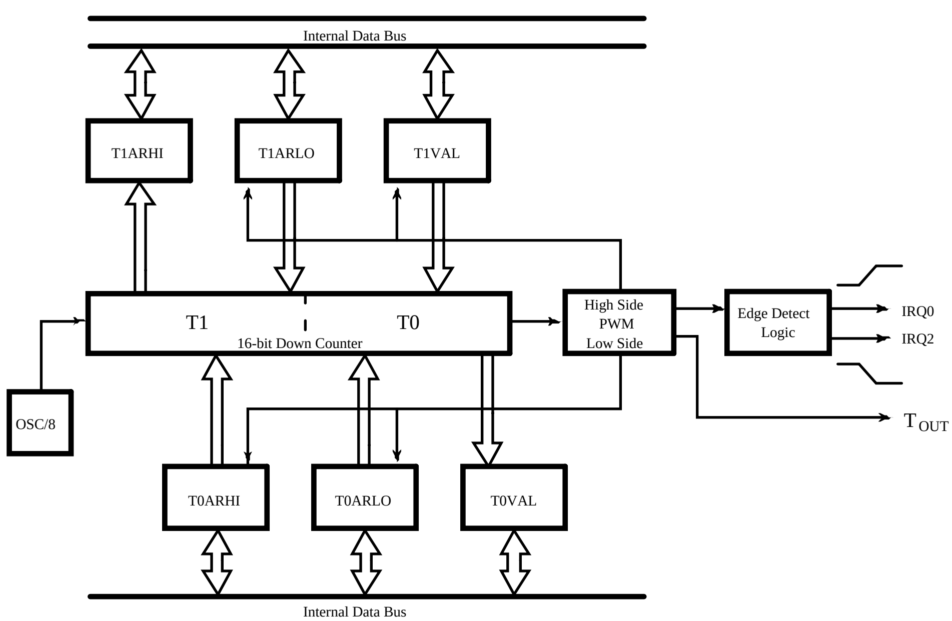


Figure 21. 16-bit Standard PWM Timer

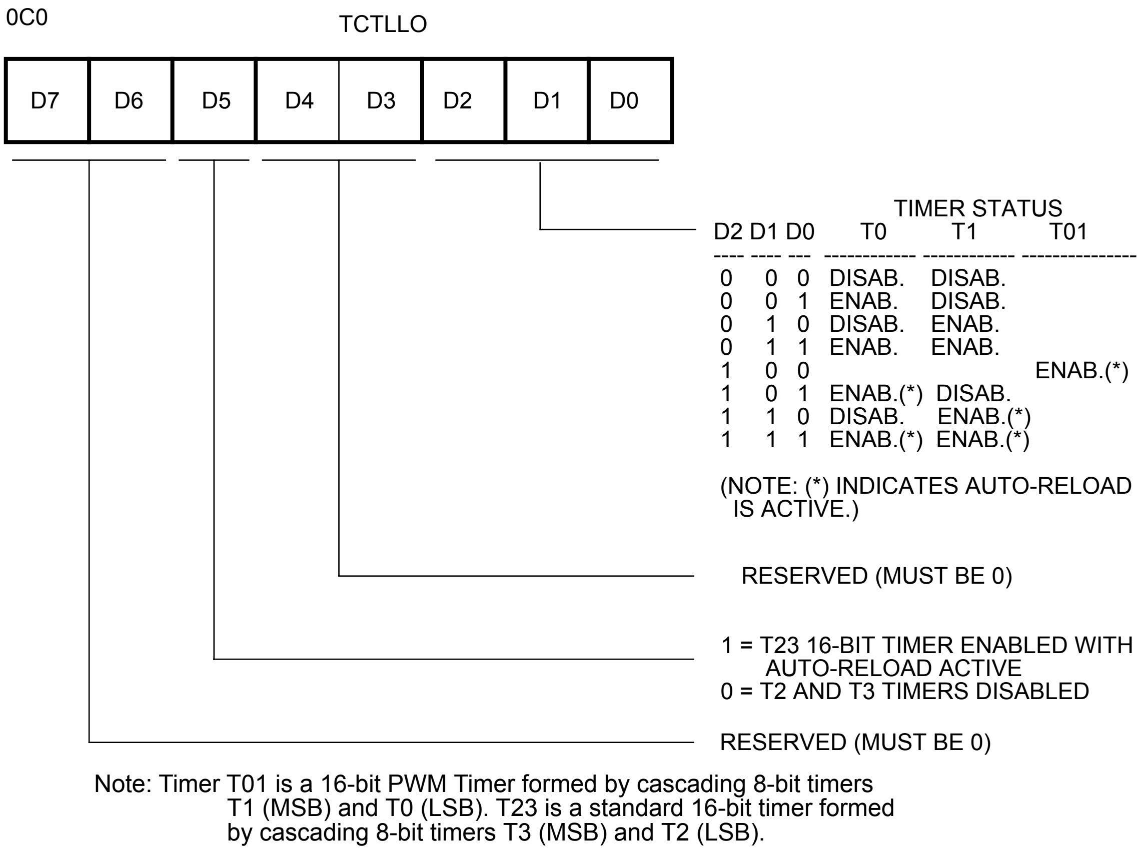


Figure 22. TCTLLO Register

Each 8-bit timer is provided a pair of registers, which are both readable and writable. One of the registers is defined to contain the auto-initialization value for the timer, while the second register contains the current value for the timer. When a timer is enabled, the timer decrements whatever value is currently held in its count register, and then continues decrementing until it reaches 0. At this time, an interrupt is generated and the contents of the auto-initialization register optionally copy into the count value register. If auto-initialization is not enabled, the timer stops counting upon reaching 0, and control logic clears the appropriate control register bit to disable the timer. This operation is referred to as “single-shot”. If auto-initialization is enabled, the timer continues counting from the initialization value. Software should not attempt to use registers that are defined as having timer functionality.

Software is allowed to write to any register at any time, but care should be taken if timer registers are updated while the timer is enabled. If software updates the count value while the timer is in operation, the timer continues counting based upon the software-updated value.

Note: Strange behavior can result if the software update occurred at exactly the point that the timer was reaching 0 to trigger an interrupt and/or reload.

Similarly, if software updates the initialization value register while the timer is active, the next time that the timer reaches 0, it initializes using the updated value.

Note: Strange behavior could result if the initialization value register is being written while the timer is in the process of being initialized.

Whether initialization is done with the new or old value is a function of the exact timing of the write operation. In all cases, the Z8E001 prioritizes the software write above that of a decrementer writeback; however, when hardware clears a control register bit for a timer that is configured for single-shot operation, the clearing of the control bit overrides a software write. Reading either register can be done

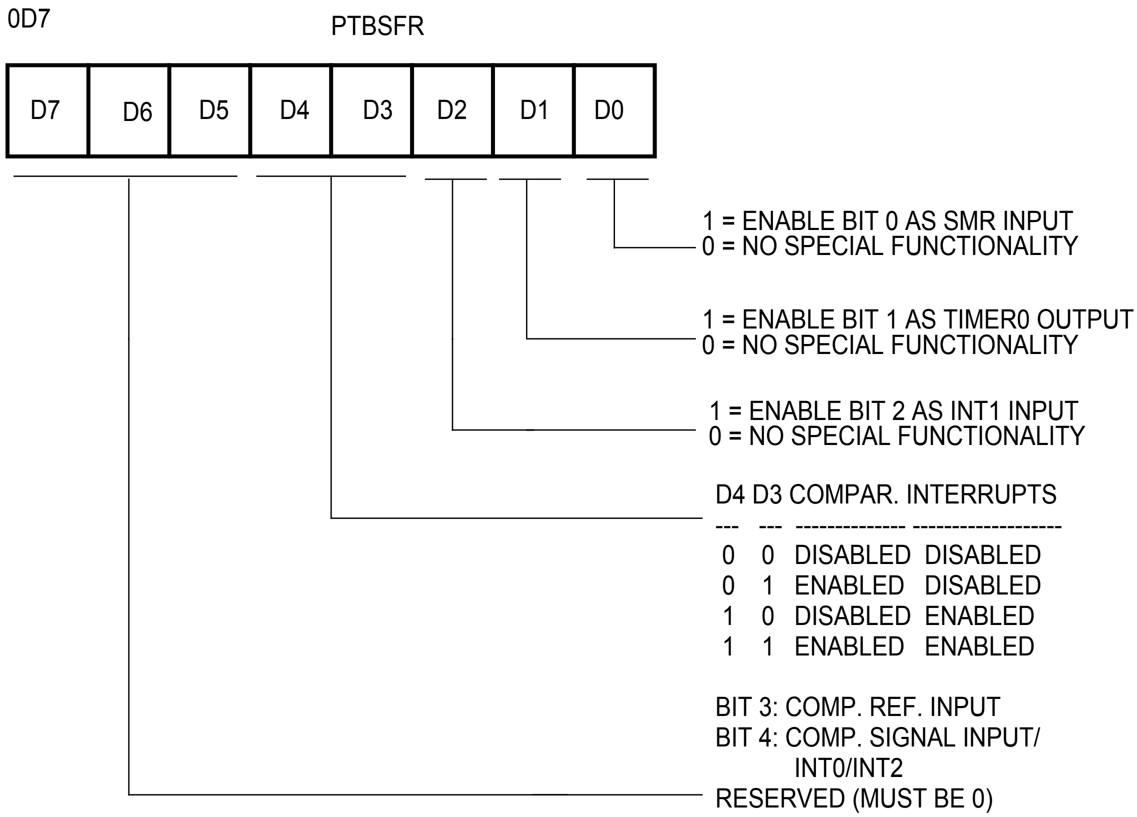


Figure 23. PortB Special Function Register (T_{out} Operation)

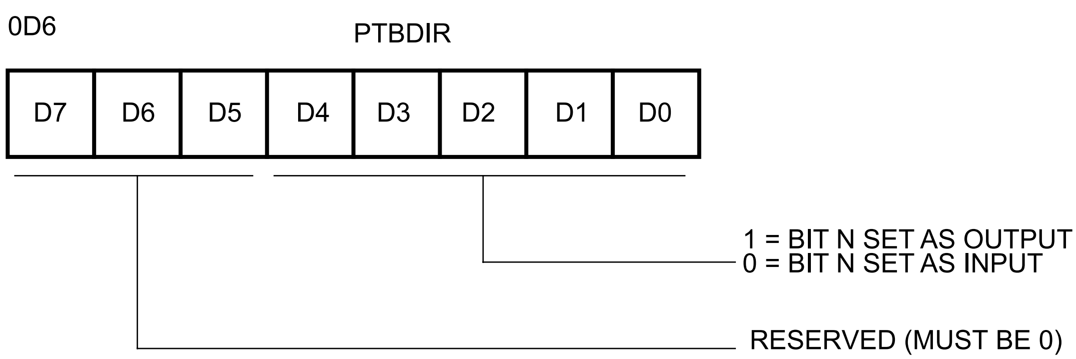


Figure 24. Port B Directional Control Register

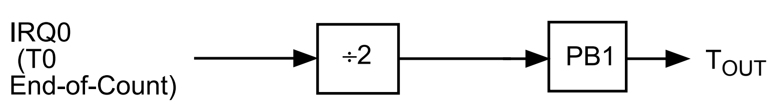


Figure 25. Timer T0 Output Through T_{OUT}

RESET CONDITIONS

After a hardware RESET, the timers are disabled. See Table 4 for timer control, value, and auto-initialization register status after RESET.

I/O PORTS

The Z8E001 has 13 lines dedicated to input and output. These lines are grouped into two ports known as Port A and Port B. Port A is an 8-bit port, bit programmable as either inputs or outputs. Port B can be programmed to provide standard input/output or the following special functions: timer0 output, comparator input, SMR input, and external interrupt inputs.

All ports have push-pull CMOS outputs. In addition, the outputs of Port A on a bit-wise basis can be configured for open-drain operation.The ports operate on a bit-wise basis. As such, the register values for/at a given bit position only affect the bit in question.

Each port is defined by a set of four control registers. See Figure 27.

Directional Control and Special Function Registers

Each port on the Z8E001 has a dedicated Directional Control Register that determines (on a bit-wise basis) whether a given port bit operates as either an input or an output.

Each port on the Z8E001 has a Special Function Register that, in conjunction with the Directional Control Register, implements (on a bit-wise basis), any special functionality that can be defined for each particular port bit.

Table 7. Z8E001 I/O Ports Registers

Register	Address	Identifier
Port B Special Function	OD7H	PTBSFR
Port B Directional Control	0D6H	PTBDIR
Port B Output Value	0D5H	PTBOUT
Port B Input Value	0D4H	PTBIN
Port A Special Function	0D3H	PTASFR
Port A Directional Control	0D2H	PTADIR
Port A Output Value	0D1H	PTAOUT
Port A Input Value	0D0H	PTAIN

Input and Output Value Registers

Each port has an Output Value Register and a pF Input Value Register. For port bits configured as an input by means of the Directional Control Register, the Input Value Register for that bit position contains the current synchronized input value.

For port bits configured as an output by means of the Directional Control Register, the value held in the corresponding bit of the Output Value Register is driven directly onto the output pin. The opposite register bit for a given pin (the output register bit for an input pin and the input register bit for an output pin) holds their previous value. These bits are not changed and don't have any effect on the hardware.

READ/WRITE OPERATIONS

The control for each port is done on a bit-wise basis. All bits are capable of operating as inputs or outputs, depending upon the setting of the port's Directional Control Register. If configured as an input, each bit is provided a Schmitt-trigger. The output of the Schmitt-trigger is latched twice to perform a synchronization function, and the output of the synchronizer is fed to the port input register, which can be read by software.

A write to a port input register has the effect of updating the contents of the input register, but subsequent reads do not necessarily return the same value that was written. If the bit in question is defined as an input, the input register for that bit position contains the current synchronized input value. Thus, writes to that bit position is overwritten on the next clock cycle with the newly sampled input data. However, if the particular port bit is programmed as an output, the input register for that bit retains the software-updated value. The port bits that are programmed as outputs do not sample the value being driven out.

Any bit in either port can be defined as an output by setting the appropriate bit in the directional control register. If such is the case, the value held in the appropriate bit of the port output register is driven directly onto the output pin.

Note: The preceding result does not necessarily reflect the actual output value. If an external error is holding an output pin either High or Low against the output driver, the software read returns the *required* value, not the actual state caused by the contention. When a bit is defined as an output, the Schmitt-trigger on the input is disabled to save power.

Updates to the output register takes effect based upon the timing of the internal instruction pipeline, but is referenced to the rising edge of the clock. The output register can be read at any time, and returns the current output value that is held. No restrictions are placed on the timing of reads and/or writes to any of the port registers with respect to the others; however, care should be taken when updating the directional control and special function registers.

When updating a Directional Control Register, the Special Function Register should first be disabled. If this precaution is not taken, spurious events could take place as a result of the change in port I/O status. This precaution is especially important when defining changes in Port B, as the spurious event referred to above could be one or more interrupts. Clearing of the SFR register should be the first step in configuring the port, while setting the SFR register should be the final step in the port configuration process. To ensure deterministic behavior, the SFR register should not be written until the pins are being driven appropriately, and all initialization has been completed.

PORT A

Port A is a general-purpose port. Figure 26 features a block diagram of Port A. Each of its lines can be independently programmed as input or output via the Port A Directional Control Register (PTADIR at 0D2H) as seen in Figure 27. A bit set to a 1 in PTADIR configures the corresponding bit in Port A as an output, while a bit cleared to 0 configures the corresponding bit in Port A as an input.

The input buffers are Schmitt-triggered. Bits programmed as outputs can be individually programmed as either push-pull or open drain by setting the corresponding bit in the Special Function Register (PTASFR, Figure 27).

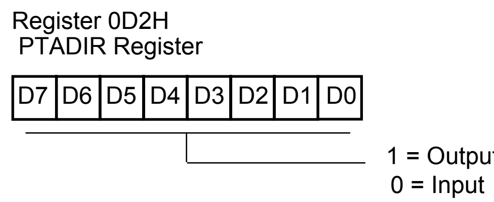


Figure 26. Port A Directional Control Register

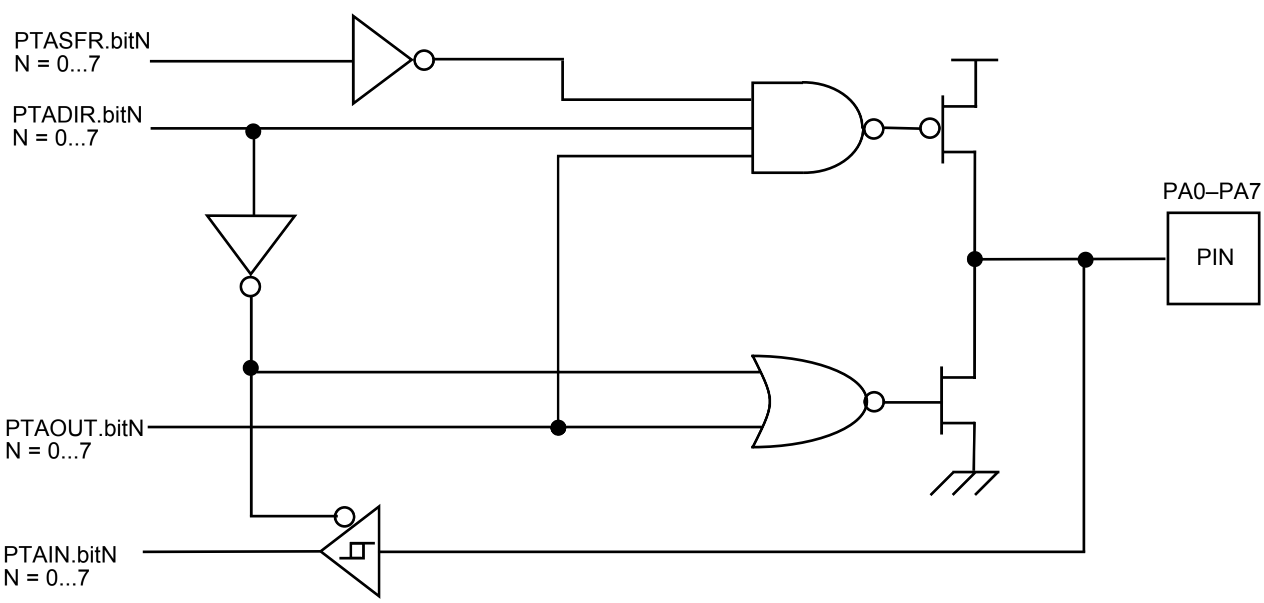


Figure 27. Port A Configuration with Open-Drain Capability and Schmitt-Trigger

PORT A REGISTER DIAGRAMS

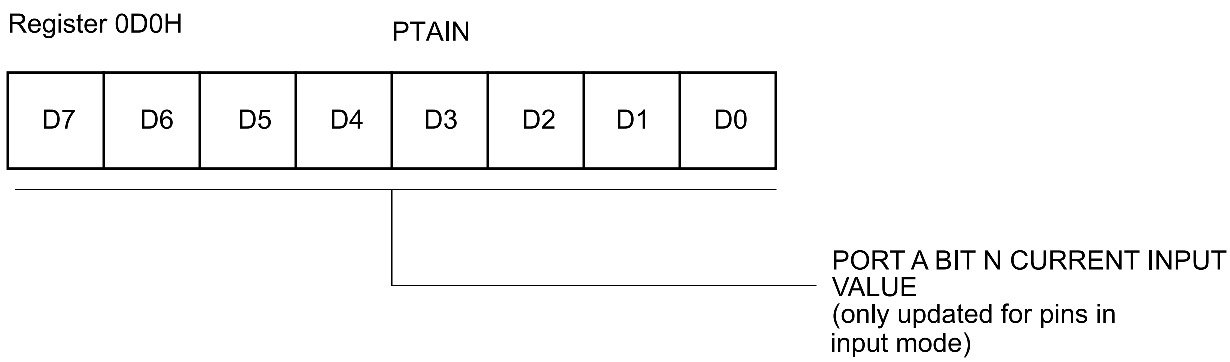


Figure 28. Port A Input Value Register

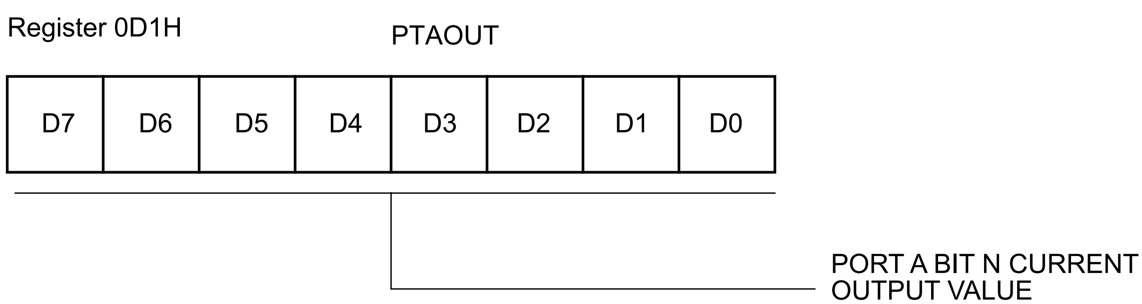


Figure 29. Port A Output Value Register

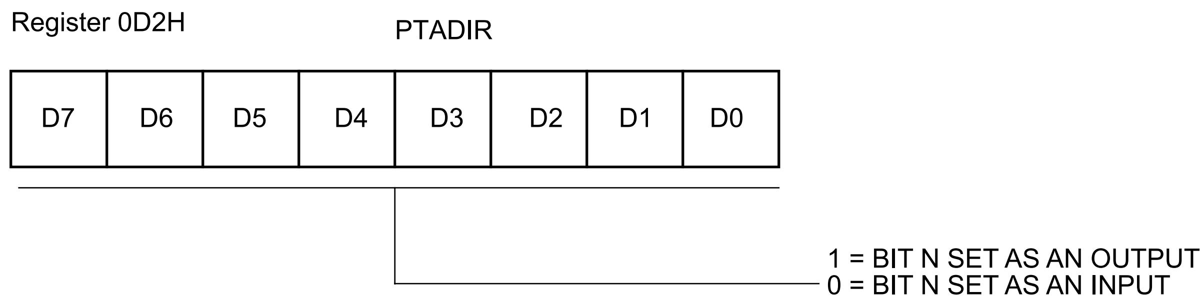


Figure 30. Port A Directional Control Register

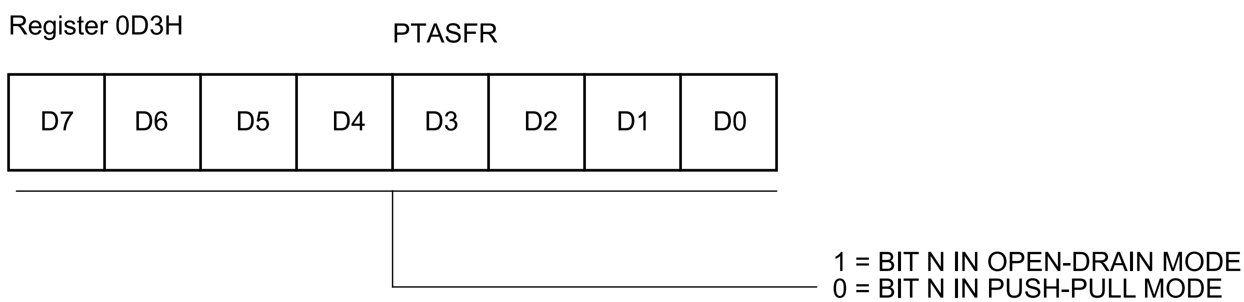


Figure 31. Port A Special Function Register

PORT B

Port B Description

Port B is a 5-bit (bidirectional), CMOS-compatible I/O port. These five I/O lines can be configured under software control to be an input or output, independently. Input buffers are Schmitt-triggered. See Figure 33 through Figure 36 for diagrams of all five Port B pins.

In addition to standard input/output capability on all five pins of Port B, each pin provides special functionality as shown in the following table:

Special functionality is invoked via the Port B Special Function Register. See Figure 32 for the arrangement and control conventions of this register.

Table 8. Port B Special Functions

Port Pin	Input Special Function	Output Special Function
PB0	Stop Mode Recovery Input	None
PB1	None	Timer0 Output
PB2	IRQ3	None
PB3	Comparator Reference Input	None
PB4	Comparator Signal Input/IRQ1/IRQ4	None

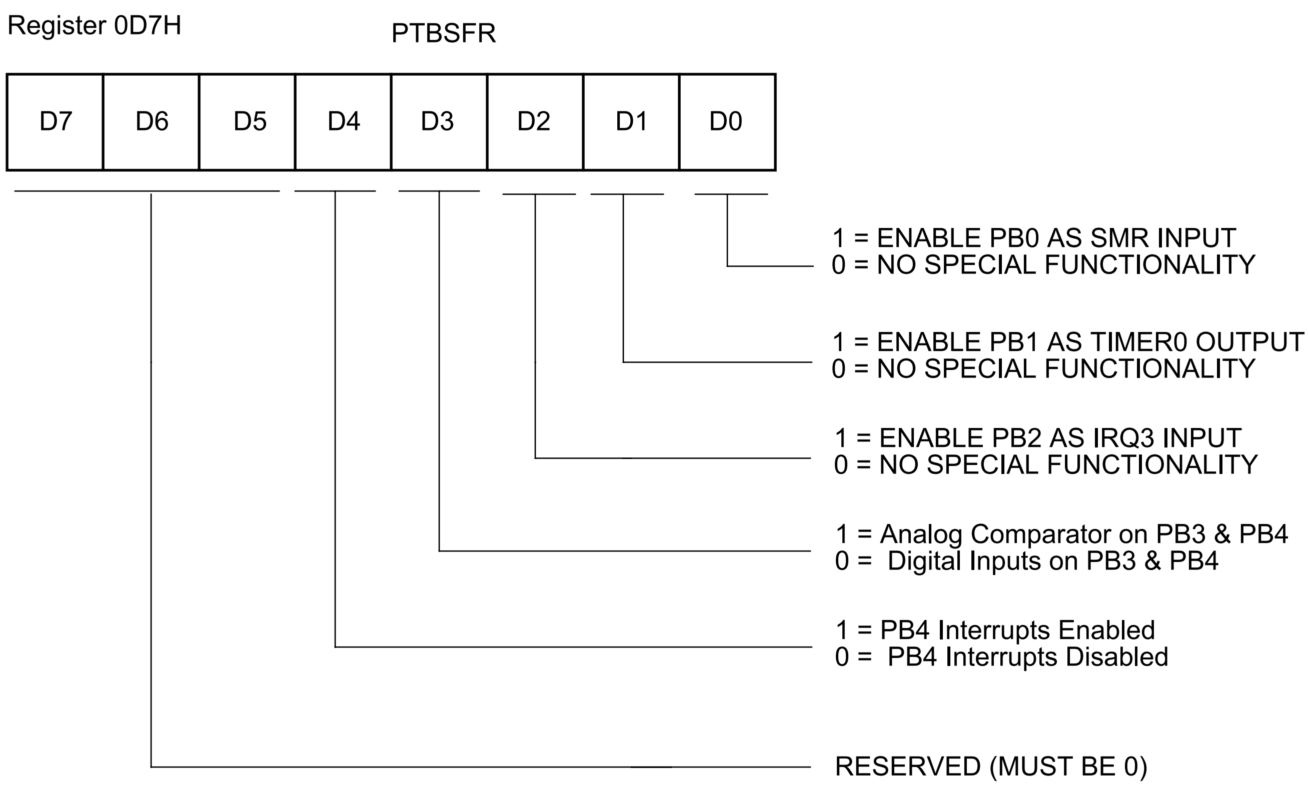


Figure 32. Port B Special Function Register

PORT B—PINS 3 AND 4 CONFIGURATION

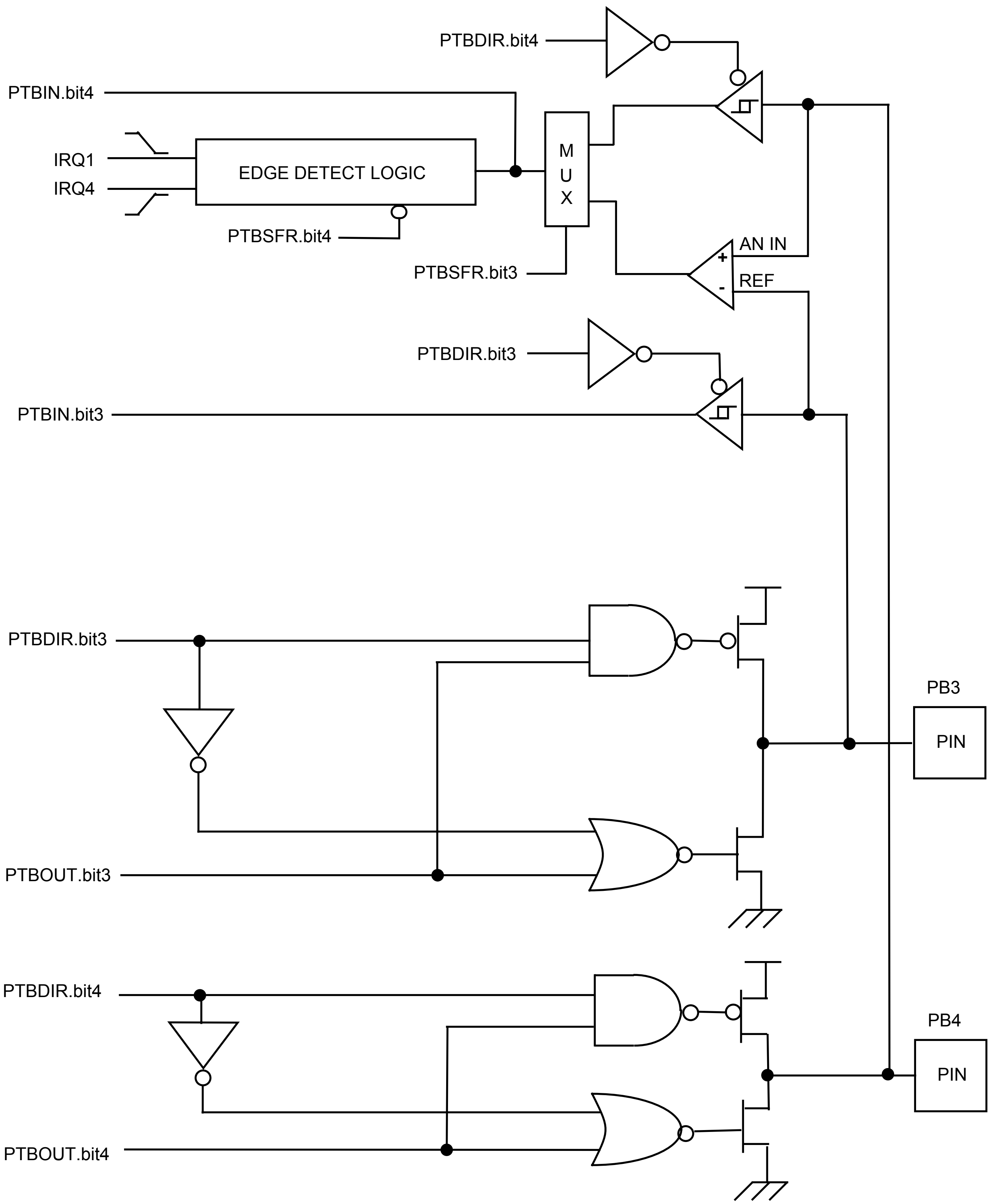
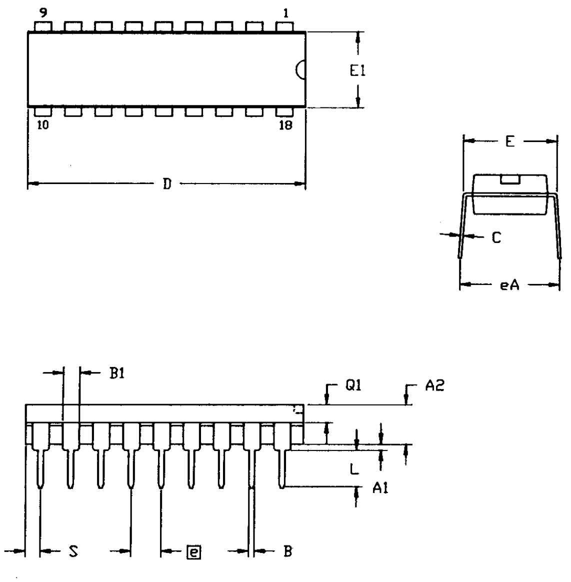


Figure 36. Port B Pins 3 and 4 Diagram

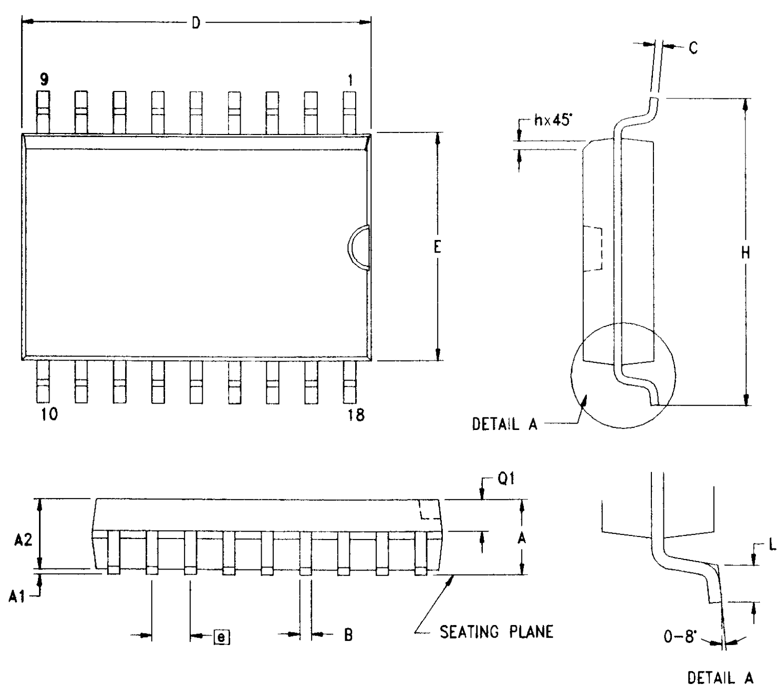
PACKAGE INFORMATION



SYMBOL	MILLIMETER		INCH	
	MIN	MAX	MIN	MAX
A1	0.51	0.81	.020	.032
A2	3.25	3.43	.128	.135
B	0.38	0.53	.015	.021
B1	1.14	1.65	.045	.065
C	0.23	0.38	.009	.015
D	22.35	23.37	.880	.920
E	7.62	8.13	.300	.320
E1	6.22	6.48	.245	.255
e	2.54 TYP		.100 TYP	
eA	7.87	8.89	.310	.350
L	3.18	3.81	.125	.150
Q1	1.52	1.65	.060	.065
S	0.89	1.65	.035	.065

CONTROLLING DIMENSIONS : INCH

Figure 43. 18-Pin DIP Package Diagram



SYMBOL	MILLIMETER		INCH	
	MIN	MAX	MIN	MAX
A	2.40	2.65	0.094	0.104
A1	0.10	0.30	0.004	0.012
A2	2.24	2.44	0.088	0.096
B	0.36	0.46	0.014	0.018
C	0.23	0.30	0.009	0.012
D	11.40	11.75	0.449	0.463
E	7.40	7.60	0.291	0.299
e	1.27 TYP		0.050 TYP	
H	10.00	10.65	0.394	0.419
h	0.30	0.50	0.012	0.020
L	0.60	1.00	0.024	0.039
Q1	0.97	1.07	0.038	0.042

CONTROLLING DIMENSIONS : MM
LEADS ARE COPLANAR WITHIN .004 INCH.

Figure 44. 18-Pin SOIC Package Diagram

Pre-Characterization Product:

The product represented by this document is newly introduced and ZiLOG has not completed the full characterization of the product. The document states what ZiLOG knows about this product at this time, but additional features or non-conformance with some aspects of the document may be found, either by ZiLOG or its customers in the course of further application and characterization work. In addition, ZiLOG cautions that delivery may be uncertain at times, due to start-up yield issues.

Development Projects:

Customer is cautioned that while reasonable efforts will be employed to meet performance objectives and milestone dates, development is subject to unanticipated problems and delays. No production release is authorized or committed until the Customer and ZiLOG have agreed upon a Product Specification for this project.

Low Margin:

Customer is advised that this product does not meet ZiLOG's internal guardbanded test policies for the specification requested and is supplied on an exception basis. Customer is cautioned that delivery may be uncertain and that, in addition to all other limitations on ZiLOG liability stated on the front and back of the acknowledgement, ZiLOG makes no claim as to quality and reliability under the document. The product remains subject to standard warranty for replacement due to defects in materials and workmanship.

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