

### Description

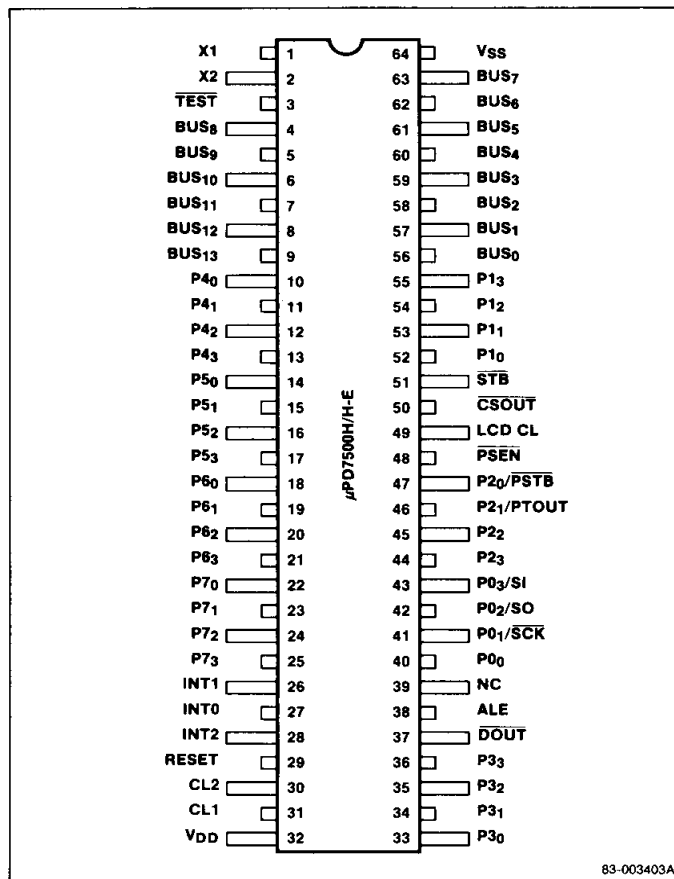
The μPD7500H and μPD7500H-E are single-chip microcomputers created as ROM-less evaluation chips for 4-bit single-chip microcomputers in the μPD7500 series. They are used with the appropriate Evakit development tool to emulate device operation of the μPD7500 series. The μPD7500H and μPD7500H-E incorporate a 4-bit parallel ALU, a data memory (RAM), a bus interface, I/O ports, an 8-bit serial interface, an 8-bit programmable timer/event counter, and vectored interrupt functions integrated into a single-chip design.

External memory may be a 2764 or any other type that interfaces an 8085-type bus.

### Features

- μPD7500 series evaluation chip
- 4-bit microcomputer
- Two instruction sets:
  - Set A: 110 instructions
  - Set B: 70 instructions
- Instruction cycles:
  - μPD7500H: RC oscillator = 5 μs/400 kHz  
External clock = 2.86 μs/700 kHz
  - μPD7500H-E: RC oscillator = 10 μs/200 kHz  
External clock = 10 μs/200 kHz
- External program memory: 8192 words x 8 bits
- Internal data memory (RAM): 256 words x 4 bits
- Three vectored interrupts (INT0, INT1, INT2)
- Two internal interrupts (INTS, INTT)
- 8-bit interval timer/event counter
- 8-bit serial interface
- Three types of serial clocks
- 8243 I/O expander interface
- Power-down functions using standby (STOP/HALT) mode
- Built-in RC oscillator for system clock (external drive also possible)
- Built-in crystal oscillator for count clock (external drive also possible)
- LCD regulating clock output (LCD CL)
- Low power consumption CMOS
- Single +5 V ±10% power supply

### Pin Configuration



83-003403A

### Ordering Information

Part Number	Package Type	Maximum Frequency of Operation
μPD7500HG-36	64-pin plastic QUIP	700 kHz
μPD7500H-EG-36	64-pin plastic QUIP	410 kHz

### Pin Identification

No.	Symbol	Function
1, 2	X2, X1	Crystal clock/external event input port n
3	$\overline{\text{TEST}}$	Factory test pin (connect to $V_{SS}$ )
4-9, 56-63	BUS <sub>0</sub> -BUS <sub>13</sub>	External data bus connected to external program memory
10-13	P <sub>40</sub> -P <sub>43</sub>	4-bit input/latched three-state output port 4
14-17	P <sub>50</sub> -P <sub>53</sub>	4-bit input/latched three-state output port 5
18-21	P <sub>60</sub> -P <sub>63</sub>	4-bit input/latched three-state output port 6
22-25	P <sub>70</sub> -P <sub>73</sub>	4-bit input/latched three-state output port 7
26	INT1	External interrupt INT1
27	INT0	External interrupt INT0
28	INT2	External interrupt INT2
29	RESET	RESET input
30, 31	CL1, CL2	System clock input
32	$V_{DD}$	Positive power supply
33-36	P <sub>30</sub> -P <sub>33</sub>	4-bit input/latched three-state output port 3
37	$\overline{\text{DOUT}}$	Data output
38	ALE	Address latch enable
39	NC	No connection
40-43	P <sub>00</sub> P <sub>01</sub> / $\overline{\text{SCK}}$ P <sub>02</sub> / $\overline{\text{SO}}$ P <sub>03</sub> / $\overline{\text{SI}}$	4-bit input port 0, serial I/O interface
44-47	P <sub>20</sub> / $\overline{\text{PSTB}}$ P <sub>21</sub> / $\overline{\text{PTOUT}}$ P <sub>22</sub> , P <sub>23</sub>	4-bit latched three-state output port 2
48	$\overline{\text{PSEN}}$	Program store enable
49	LCD CL	Display timing pulse
50	$\overline{\text{CSOUT}}$	Chip select output
51	$\overline{\text{STB}}$	Strobe output
52-55	P <sub>10</sub> -P <sub>13</sub>	4-bit input/three-state output port 1
64	$V_{SS}$	Ground

### Pin Functions

#### BUS<sub>0</sub>-BUS<sub>13</sub> [Data Bus]

External data bus connected to external program memory.

#### P<sub>00</sub>, P<sub>01</sub>/ $\overline{\text{SCK}}$ , P<sub>02</sub>/ $\overline{\text{SO}}$ , P<sub>03</sub>/ $\overline{\text{SI}}$ [Port 0/Serial Interface]

4-bit input port 0/serial I/O interface. This port can be configured as a 4-bit parallel input port or as the 8-bit serial I/O interface, under control of the serial mode select register. The serial input  $\overline{\text{SI}}$ , serial output  $\overline{\text{SO}}$ , and the serial clock  $\overline{\text{SCK}}$  (synchronizes data transfer) make up the 8-bit serial I/O interface.

#### P<sub>10</sub>-P<sub>13</sub> [Port 1]

4-bit input/three-state output port 1. Data output from port 1 is strobed in synchronization with a P<sub>20</sub>/ $\overline{\text{PSTB}}$  pulse.

#### P<sub>20</sub>/ $\overline{\text{PSTB}}$ , P<sub>21</sub>/ $\overline{\text{PTOUT}}$ , P<sub>22</sub>, P<sub>23</sub> [Port 2]

4-bit latched three-state output port 2. Line P<sub>20</sub> is shared with  $\overline{\text{PSTB}}$ , the port 1 output strobe pulse. Line P<sub>21</sub> is shared with  $\overline{\text{PTOUT}}$ , the timer-out F/F signal.

#### P<sub>30</sub>-P<sub>33</sub> [Port 3]

4-bit input/latched three-state output port 3.

#### P<sub>40</sub>-P<sub>43</sub> [Port 4]

4-bit input/latched three-state output port 4. Also performs 8-bit parallel I/O with port 5.

#### P<sub>50</sub>-P<sub>53</sub> [Port 5]

4-bit input/latched three-state output port 5. Also performs 8-bit parallel I/O with port 4.

#### P<sub>60</sub>-P<sub>63</sub> [Port 6]

4-bit input/latched three-state output port 6. Individual lines can be configured as inputs or outputs under control of the port 6 mode select register.

#### P<sub>70</sub>-P<sub>73</sub> [Port 7]

4-bit input/latched three-state output port 7.

#### INT0 [Interrupt 0]

External interrupt INT0. This is a rising edge-triggered interrupt.

## INT1 [Interrupt 1]

External interrupt INT1. This is a rising edge-triggered interrupt.

## INT2 [Interrupt 2]

External interrupt INT2. This is a rising edge-triggered interrupt.

## CL1, CL2 [Clock Inputs]

System clock input. Connect 62-kΩ resistor across CL1 and CL2, and connect 33-pF capacitor from CL1 to V<sub>SS</sub>. Alternatively, you may connect an external clock source to CL1 and leave CL2 open.

## X2, X1 [Crystal Inputs]

Crystal clock/external event input port n. A crystal oscillator circuit is connected to input X1 and output X2 for crystal clock operation. Alternatively, external event pulses are connected to input X1 and output X2 is left open.

## $\overline{\text{DOU}}T$ [Data Output]

Data output.

## ALE [Address Latch Enable]

Address latch enable.

## $\overline{\text{PSEN}}$ [Program Store Enable]

Program store enable.

## LCD CL [Display Timing]

Display timing pulse.

## $\overline{\text{CSOUT}}$ [Chip Select Output]

Chip select output. Connected to μPD82C43.

## $\overline{\text{STB}}$ [Strobe Output]

Strobe output. Connected to μPD82C43.

## $\overline{\text{TEST}}$ [Test Pin]

Factory test pin (connect to V<sub>SS</sub>).

## RESET [Reset]

RESET input. RC circuit or pulse initializes μPD7500H after power up.

## NC [No Connection]

No connection.

## V<sub>DD</sub> [Power Supply]

Positive power supply. Apply single voltage in the range 4.5 to 6.0 V for proper operation.

## V<sub>SS</sub> [Ground]

Ground.

## Evaluation Chip Selection for Emulation

Table 1 lists which evaluation chip should be used with the Evakits to emulate the appropriate speed of each device in the μPD7500 series.

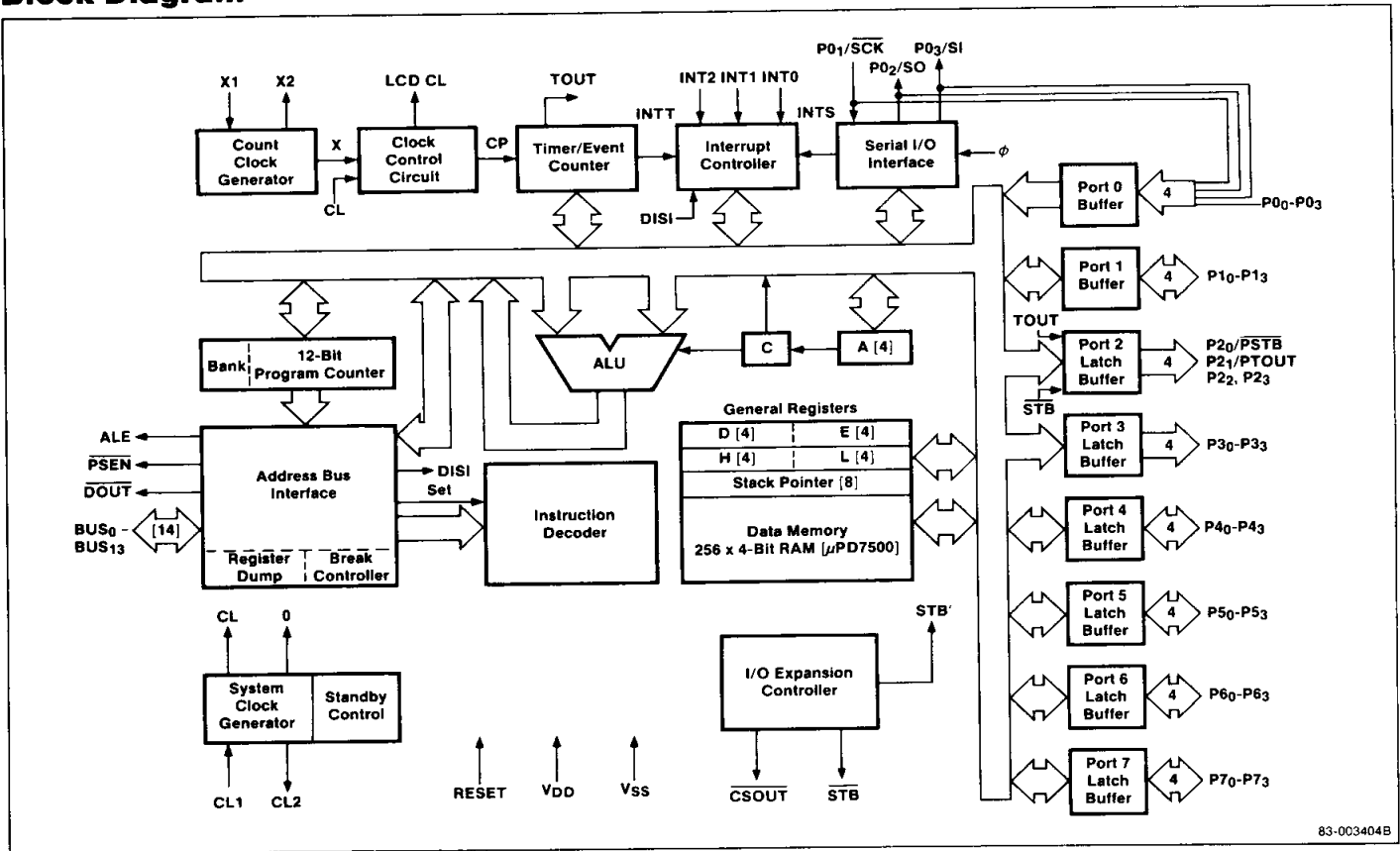
**Table 1. Evaluation Chip Selection**

μPD7500H	μPD7500H-E
μPD7507H	μPD7501
μPD7508H	μPD7502
μPD7514	μPD7503
μPD7516H (Note 1)	μPD7506
μPD7519H (Note 1)	μPD7507
μPD7527A	μPD7507S
μPD7528A	μPD7508
μPD7533	μPD7508A
μPD7537A	μPD7519
μPD7538A	
μPD7554	
μPD7556	
μPD7564	
μPD7566	

### Note:

(1) Up to 5.5 MHz during emulation.

**Block Diagram**

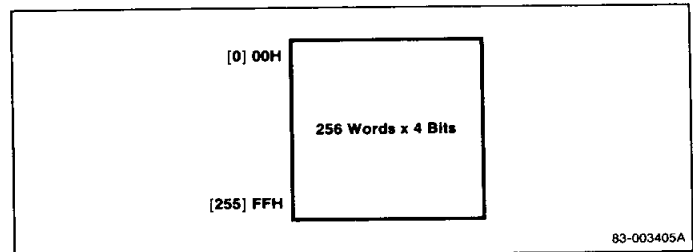


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See figures 1 through 7 for additional block diagram details.

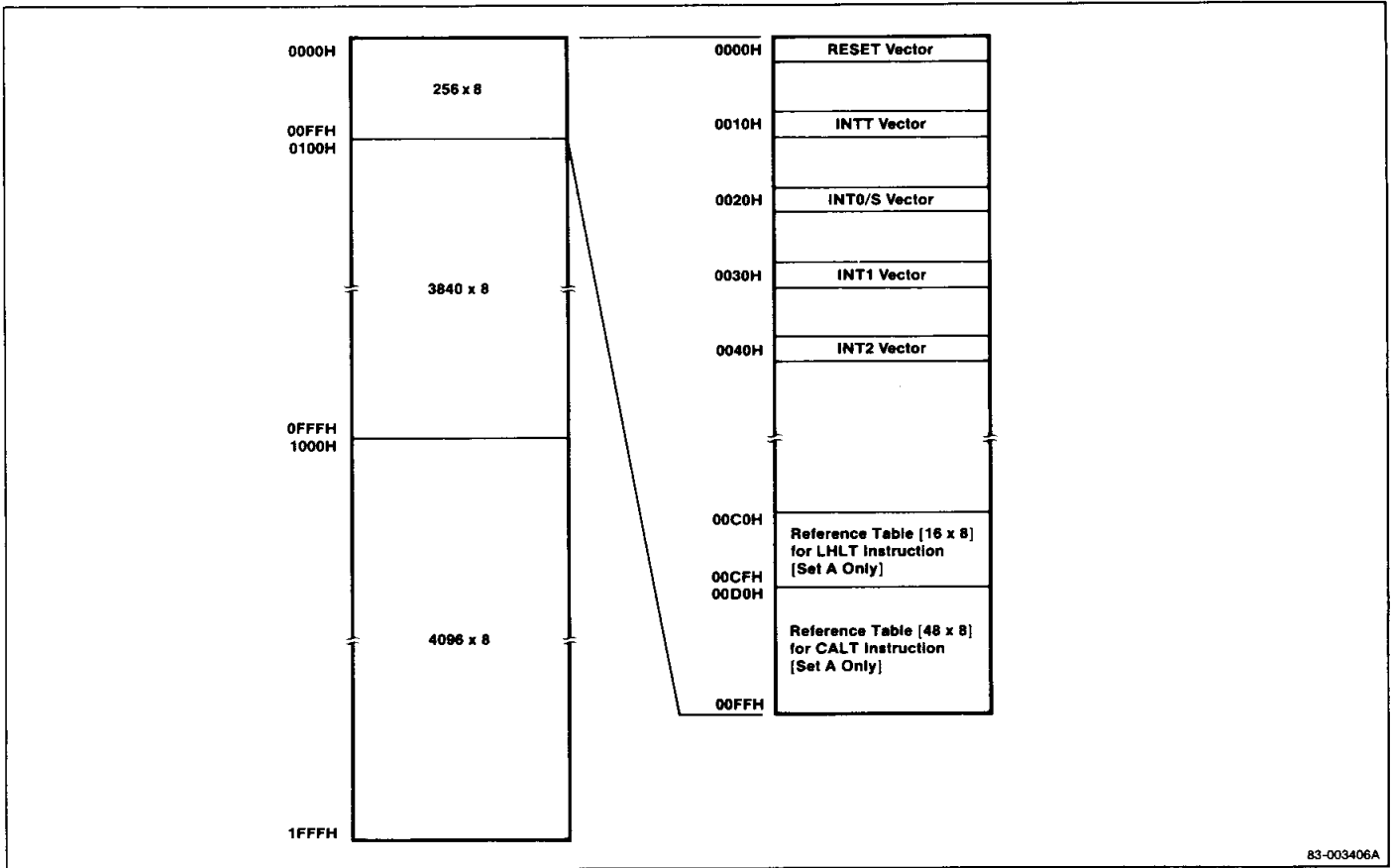
**Figure 1. Data Memory Map**

Figure	Title
1	Data Memory Map
2	Program Memory Map
3	Timer/Event Counter
4	Serial Interface
5	Interrupt Control
6	Clock Control
7	Interface at Input/Output Ports



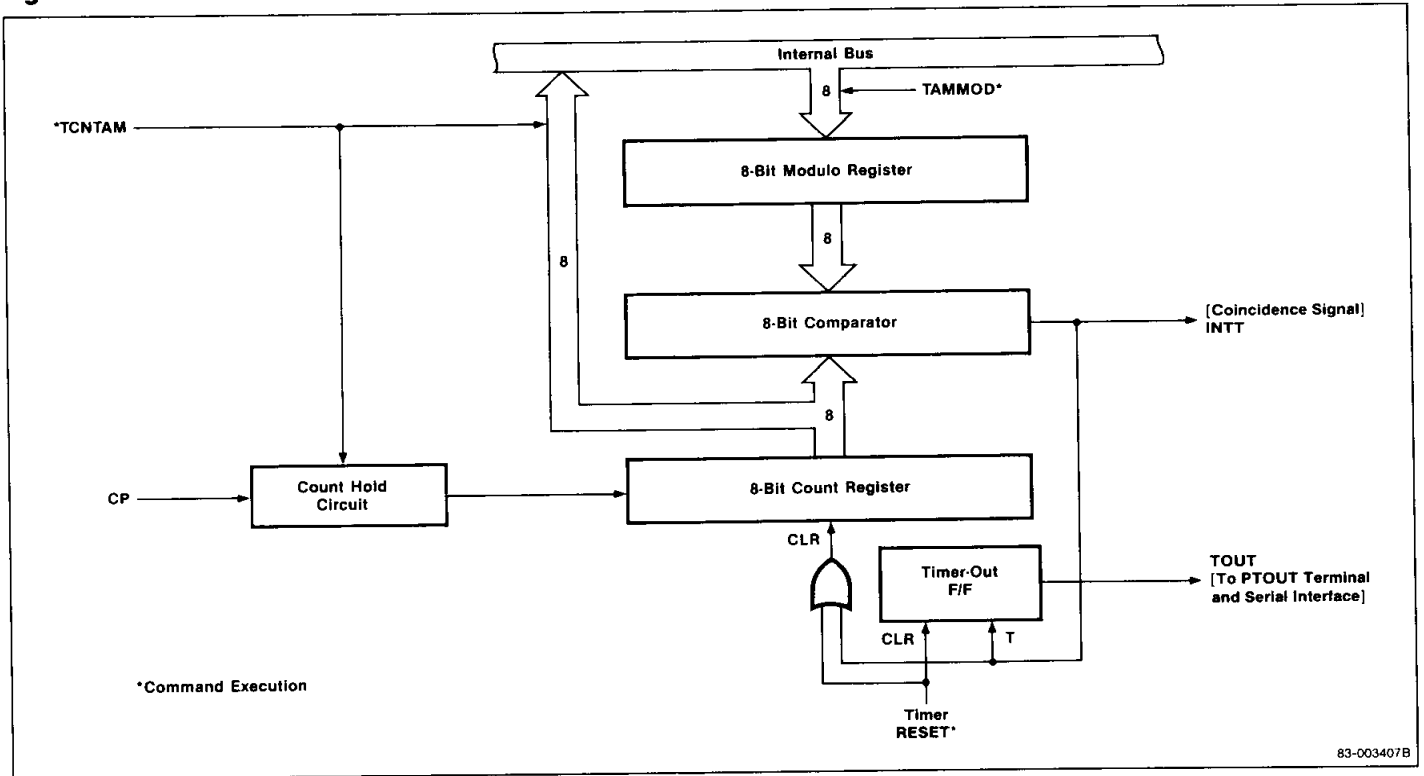
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**Figure 2. Program Memory Map**



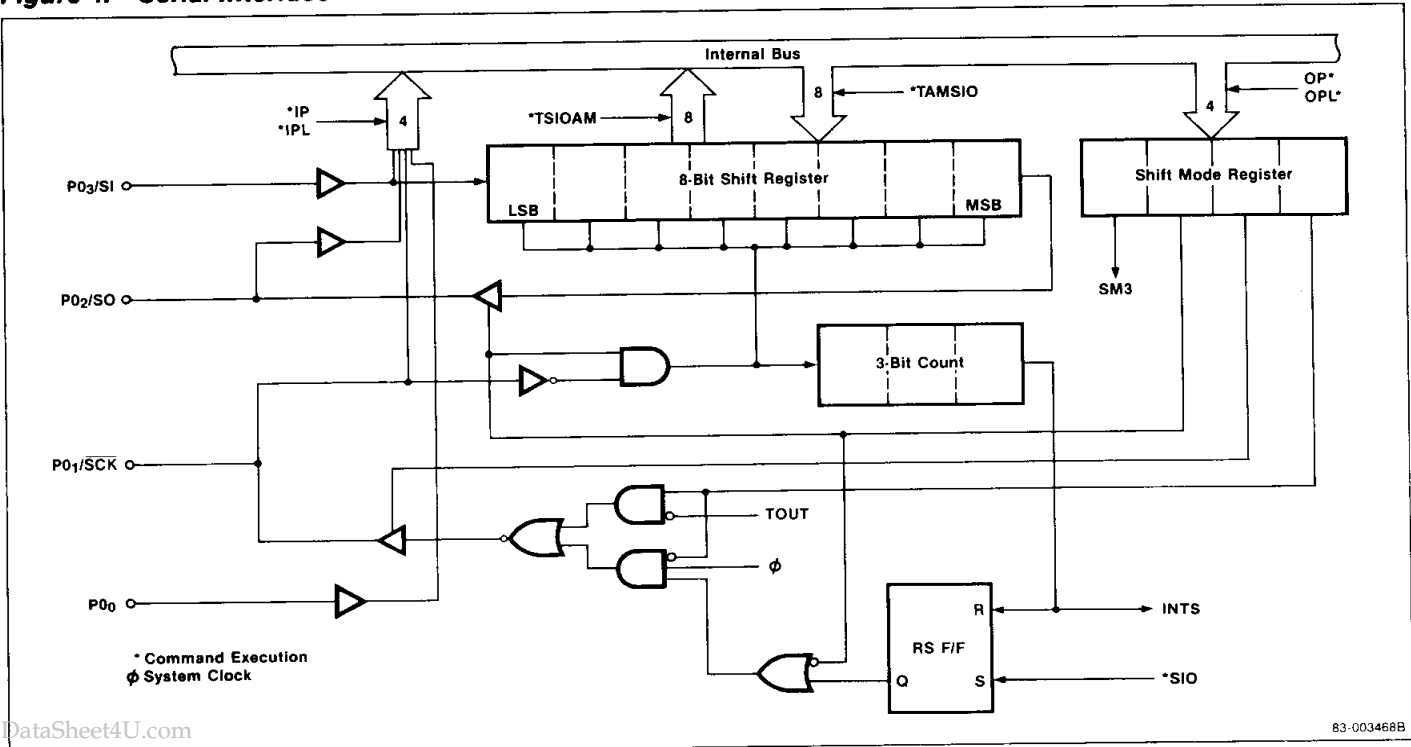
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Figure 3. Timer/Event Counter



83-003407B

Figure 4. Serial Interface



83-003468B

Figure 5. Interrupt Control

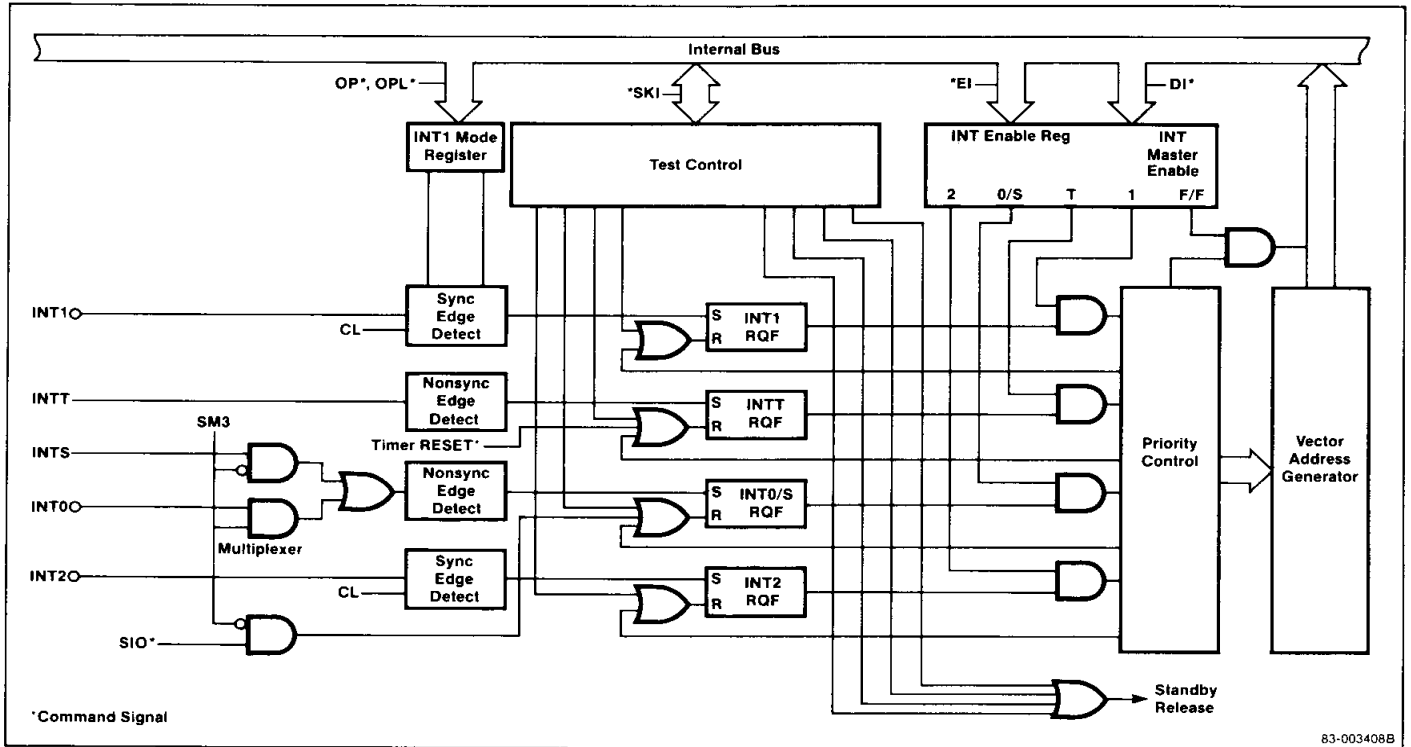
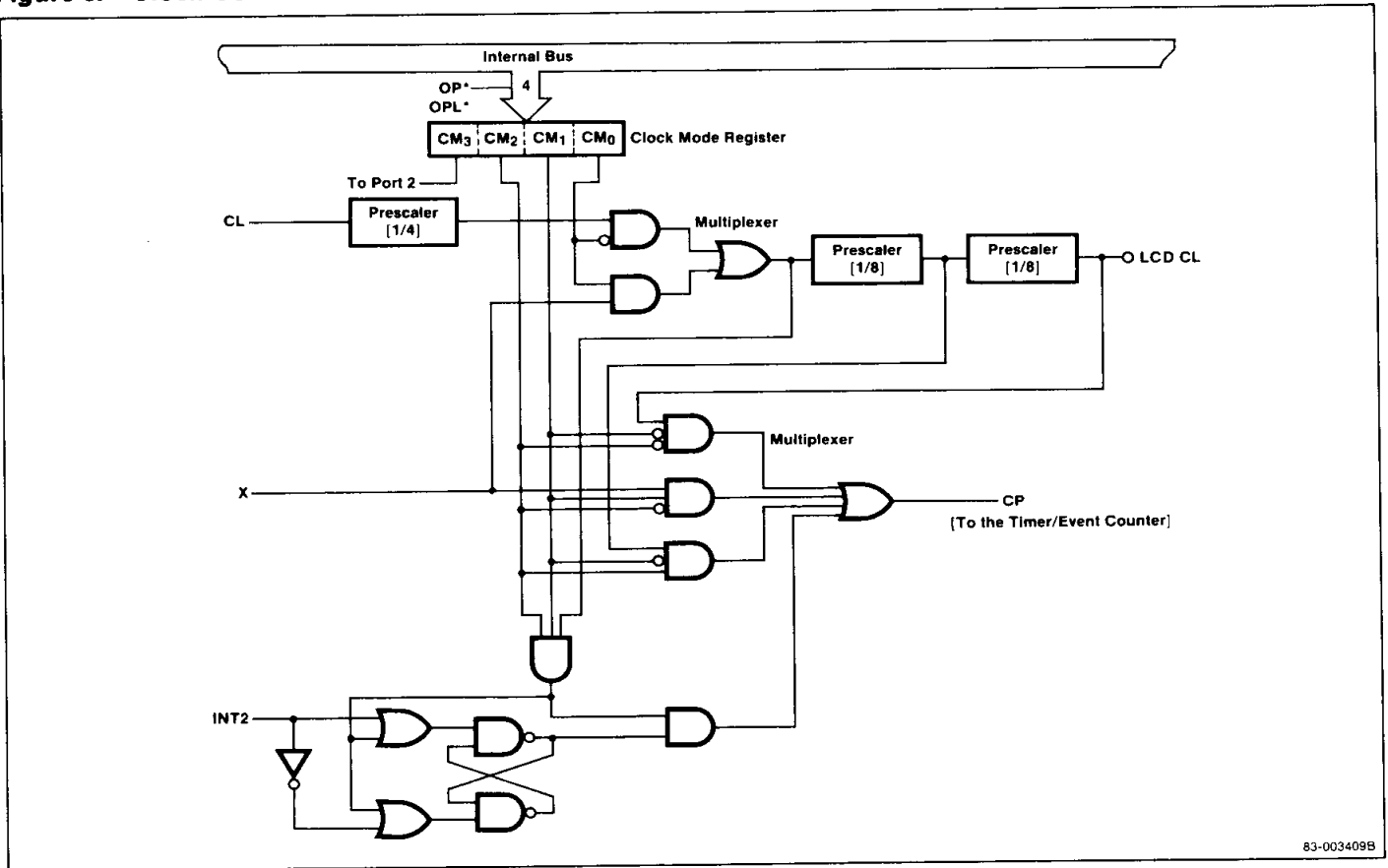


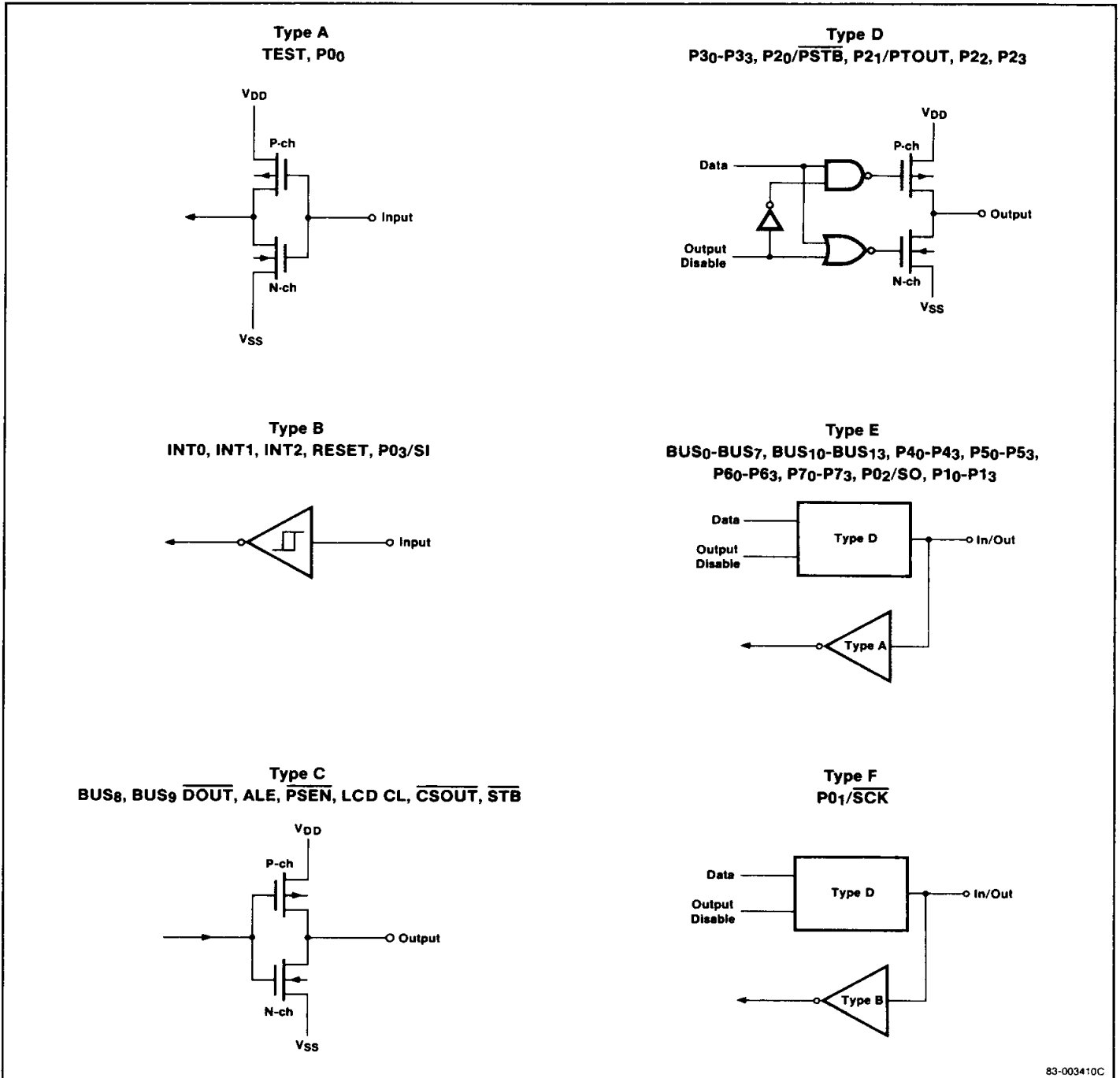
Figure 6. Clock Control



83-003409B



Figure 7. Interface at Input/Output Ports



## μPD7500H/H-E

### Absolute Maximum Ratings

$T_A = 25^\circ\text{C}$

Operating temperature, $T_{OPT}$	0 to $+40^\circ\text{C}$ $\mu\text{PD7500H}$ $\mu\text{PD7500H-E}$
Storage temperature, $T_{STG}$	$-65$ to $+150^\circ\text{C}$
Power supply voltage, $V_{DD}$	$-0.3$ to $+7.0$ V
All input and output voltages	$-0.3$ to $V_{DD} + 0.3$ V
Output current (total, all output ports)	$-20$ mA
$I_{OH}$	$50$ mA
$I_{OL}$	

**Comment:** Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

### DC Characteristics

$\mu\text{PD7500H}$ :  $T_A = 0$  to  $+40^\circ\text{C}$ ,  $V_{DD} = 5$  V  $\pm 5\%$

$\mu\text{PD7500H-E}$ :  $T_A = -10$  to  $+70^\circ\text{C}$ ,  $V_{DD} = 5$  V  $\pm 10\%$

Parameter	Symbol	Limits						Unit	Test Conditions
		$\mu\text{PD7500H}$			$\mu\text{PD7500H-E}$				
		Min	Typ	Max	Min	Typ	Max		
Input high voltage	$V_{IH1}$	$0.7 V_{DD}$		$V_{DD}$	$0.7 V_{DD}$		$V_{DD}$	V	All inputs other than CL1, X1
	$V_{IH2}$	$V_{DD} - 0.5$		$V_{DD}$	$V_{DD} - 0.5$		$V_{DD}$	V	CL1, X1
Input low voltage	$V_{IL1}$	0		$0.3 V_{DD}$	0		$0.3 V_{DD}$	V	All inputs other than CL1, X1
	$V_{IL2}$	0		0.5	0		0.5	V	CL1, X1
Input leakage current, high	$I_{LIH1}$			3			3	$\mu\text{A}$	All inputs other than CL1, X1
	$I_{LIH2}$			10			10	$\mu\text{A}$	CL1, X1
Input leakage current, low	$I_{LIL1}$			-3			-3	$\mu\text{A}$	All inputs other than CL1, X1
	$I_{LIL2}$			-10			-10	$\mu\text{A}$	CL1, X1
Output voltage, high	$V_{OH}$	$V_{DD} - 1.0$			$V_{DD} - 1.0$			V	$I_{OH} = 1.0$ mA
Output voltage, low	$V_{OL}$			0.4			0.4	V	$I_{OL} = 1.6$ mA
Output leakage current, high	$I_{LOH}$			3			3	$\mu\text{A}$	$V_O = V_{DD}$
Output leakage current, low	$I_{LOL}$			-3			-3	$\mu\text{A}$	$V_O = 0$ V
Supply current	$I_{DD1}$			4			3	mA	Normal operation, all output pins open, no BUS conflicts
	$I_{DD2}$	2	20		2	20		$\mu\text{A}$	Stop mode, X1 = 0 V

### Capacitance

$T_A = 25^\circ\text{C}$ ,  $V_{DD} = 0$  V,  $f = 1$  MHz

Parameter	Symbol	Limits						Unit	Test Conditions
		$\mu\text{PD7500H}$			$\mu\text{PD7500H-E}$				
		Min	Typ	Max	Min	Typ	Max		
Input capacitance	$C_I$			15			15	pF	Unmeasured pins returned to $V_{SS}$
Output capacitance	$C_O$			15			15	pF	
I/O capacitance	$C_{IO}$			15			15	pF	

### AC Characteristics

μPD7500H: T<sub>A</sub> = 0 to 40°C, V<sub>DD</sub> = 5 V ±5%

μPD7500H-E: T<sub>A</sub> = -10 to +70°C, V<sub>DD</sub> = 5 V ±10%

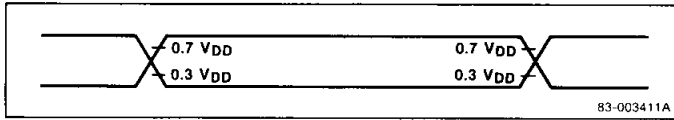
Parameter	Symbol	Limits						Unit	Test Conditions
		μPD7500H			μPD7500H-E				
		Min	Typ	Max	Min	Typ	Max		
<b>Clock Operation</b>									
System clock oscillation frequency	f <sub>φ</sub>	300	400	500	160	200	250	kHz	C = 33 pF ±5%; μPD7500H: R = 33 kΩ ±2%; μPD7500H-E: R = 62 kΩ ±2%
		10		700	10		410		
CL1 input rise time	t <sub>CR</sub>			0.2			0.2	μs	
CL1 input fall time	t <sub>CF</sub>			0.2			0.2	μs	
CL1 input clock width (high)	t <sub>CH</sub>	0.7			1.2			μs	
CL1 input clock width (low)	t <sub>CL</sub>	0.7			1.2			μs	
Count clock oscillation frequency (X1, X2)	f <sub>XX</sub>	25	32	50	25	32	50	kHz	Crystal oscillation
Count clock input frequency (X1)	f <sub>X</sub>	0		700	0		410	kHz	
X1 input rise time	t <sub>XR</sub>			0.2			0.2	μs	
X1 input fall time	t <sub>XF</sub>			0.2			0.2	μs	
X1 input clock width (high)	t <sub>XH</sub>	0.7			1.2			μs	
X1 input clock width (low)	t <sub>XL</sub>	0.7			1.2			μs	
<b>Bus I/O Operation</b>									
ALE pulse width (high)	t <sub>LH</sub>	400			600			ns	
Address setup time to ALE ↓	t <sub>AL</sub>	100			200			ns	
Address hold time to ALE ↓	t <sub>LA</sub>	80			80			ns	
Output data setup time to $\overline{\text{DOUT}}$ ↑	t <sub>DDO</sub>	200			200			ns	
Output data hold time after $\overline{\text{DOUT}}$ ↑	t <sub>DOD</sub>	80			80			ns	
DOUT pulse width (low)	t <sub>DOL</sub>	400			600			ns	
ALE → data input valid time	t <sub>LDV</sub>			600			700	ns	
Address → data input valid time	t <sub>ADV</sub>			700			900	ns	
PSEN pulse width (low)	t <sub>PSL</sub>	700			1000			ns	
PSEN → data input valid time	t <sub>PSDV</sub>			300			600	ns	
PSEN → data float	t <sub>PSDF</sub>	0			0			ns	

**AC Characteristics (cont)**

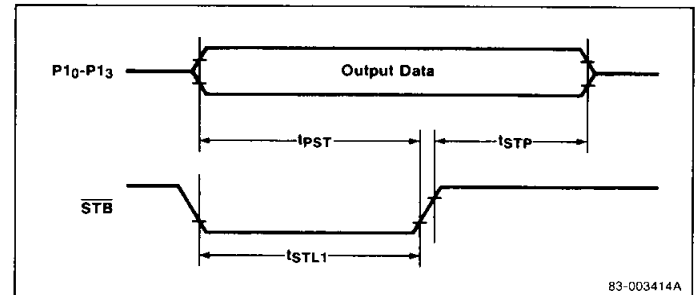
Parameter	Symbol	Limits						Unit	Test Conditions
		μPD7500H			μPD7500H-E				
		Min	Typ	Max	Min	Typ	Max		
<b>Port I/O Operation</b>									
Port 1 output setup time to $\overline{STB}\uparrow$	t <sub>PST</sub>	200			200			ns	Port output mode
Port 1 output hold time after $\overline{STB}\uparrow$	t <sub>STP</sub>	80			80			ns	
$\overline{STB}$ pulse width (low)	t <sub>STL1</sub>	400			600			ns	
Output data setup time to $\overline{STB}\uparrow$	t <sub>DST</sub>	300			300			ns	I/O expander mode
Output data hold time after $\overline{STB}\uparrow$	t <sub>STD</sub>	80			80			ns	
$\overline{STB}\downarrow \rightarrow$ input data valid time	t <sub>STDV</sub>			850			850	ns	
$\overline{STB}\downarrow \rightarrow$ input data float time	t <sub>STDF</sub>	0			0			ns	
Control setup time to $\overline{STB}\downarrow$	t <sub>CST</sub>	200			200			ns	
Control hold time after $\overline{STB}\downarrow$	t <sub>STC</sub>	80			80			ns	
$\overline{STB}$ pulse width (low)	t <sub>STL2</sub>	700			1000			ns	
$\overline{CSOUT}$ setup time to $\overline{STB}\downarrow$	t <sub>CSST</sub>	200			200			ns	
$\overline{CSOUT}$ hold time after $\overline{STB}\downarrow$	t <sub>STCS</sub>	80			80			ns	
<b>Serial Interface Operation</b>									
SCK cycle time	t <sub>KCY</sub>	2.5			3.0			μs	Input
		2.86			4.9			μs	Output
SCK pulse width, high	t <sub>KH</sub>	1.1			1.3			μs	Input
		1.3			2.2			μs	Output
SCK pulse width, low	t <sub>KL</sub>	1.1			1.3			μs	Input
		1.3			2.2			μs	Output
SI setup time to $\overline{SCK}\uparrow$	t <sub>SIK</sub>	300			300			ns	
SI hold time after $\overline{SCK}\uparrow$	t <sub>KSI</sub>	450			450			ns	
SO output delay after $\overline{SCK}\uparrow$	t <sub>SKO</sub>			500			850	ns	
<b>Other Operations</b>									
INT0 pulse width, high	t <sub>I0H</sub>	10			10			μs	
INT0 pulse width, low	t <sub>I0L</sub>	10			10			μs	
INT1 pulse width, high	t <sub>I1H</sub>	2/t <sub>φ</sub>			2/t <sub>φ</sub>			μs	
INT1 pulse width, low	t <sub>I1L</sub>	2/t <sub>φ</sub>			2/t <sub>φ</sub>			μs	
INT2 pulse width, high	t <sub>I2H</sub>	2/t <sub>φ</sub>			2/t <sub>φ</sub>			μs	
INT2 pulse width, low	t <sub>I2L</sub>	2/t <sub>φ</sub>			2/t <sub>φ</sub>			μs	
RESET pulse width, high	t <sub>RSH</sub>	10			10			μs	
RESET pulse width, low	t <sub>RSL</sub>	10			10			μs	

## Timing Waveforms

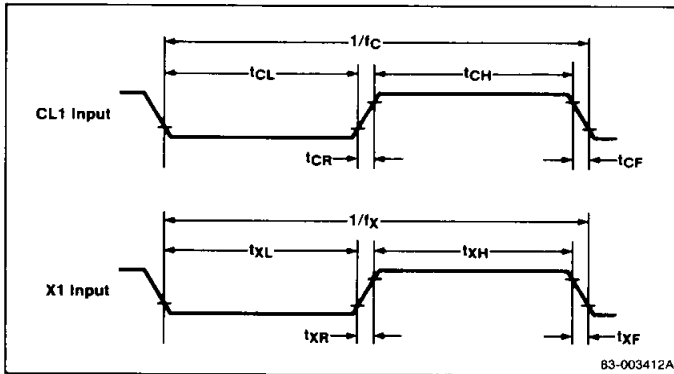
### AC Test Input



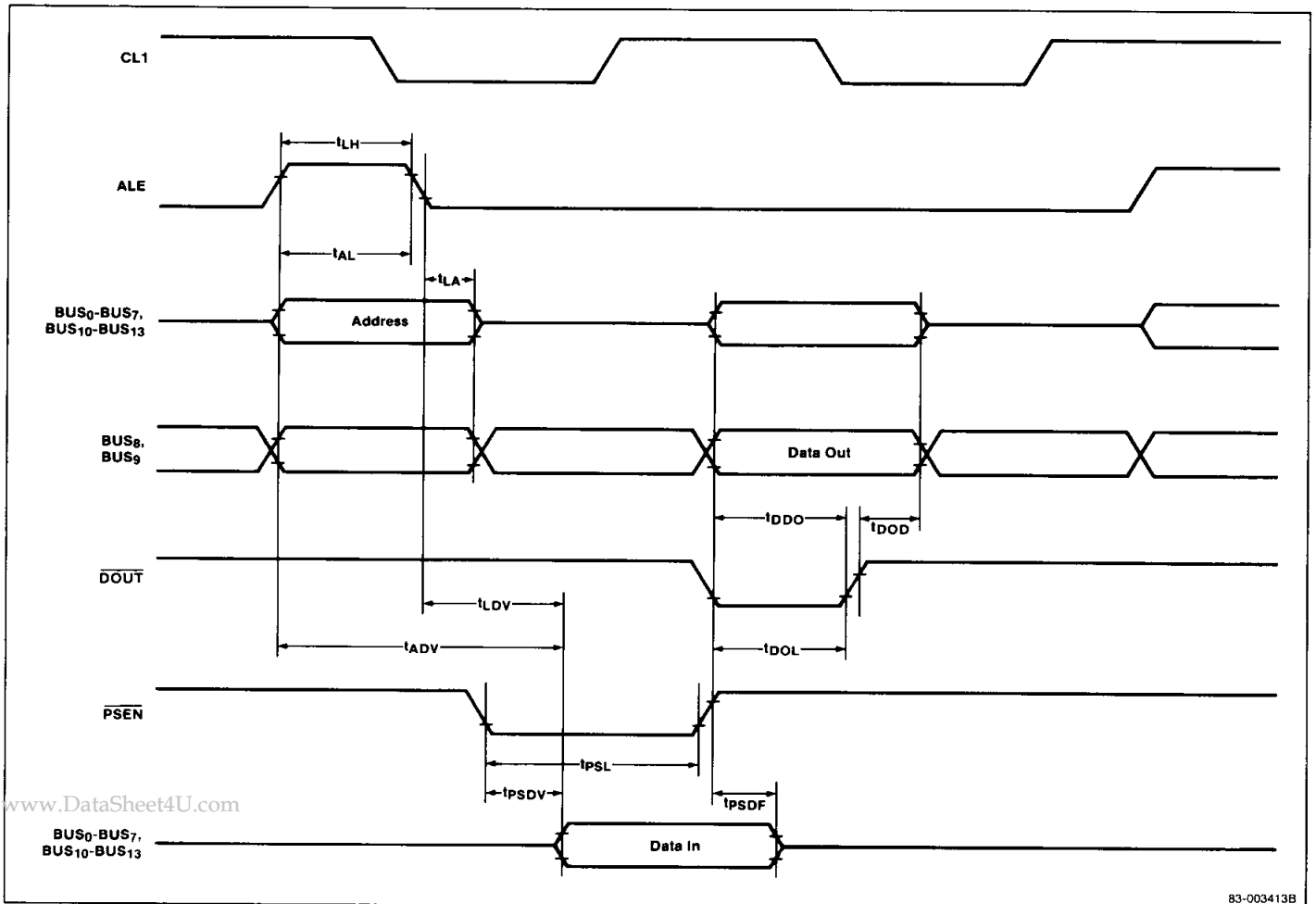
### Strobe Output Timing



### Clock Timing



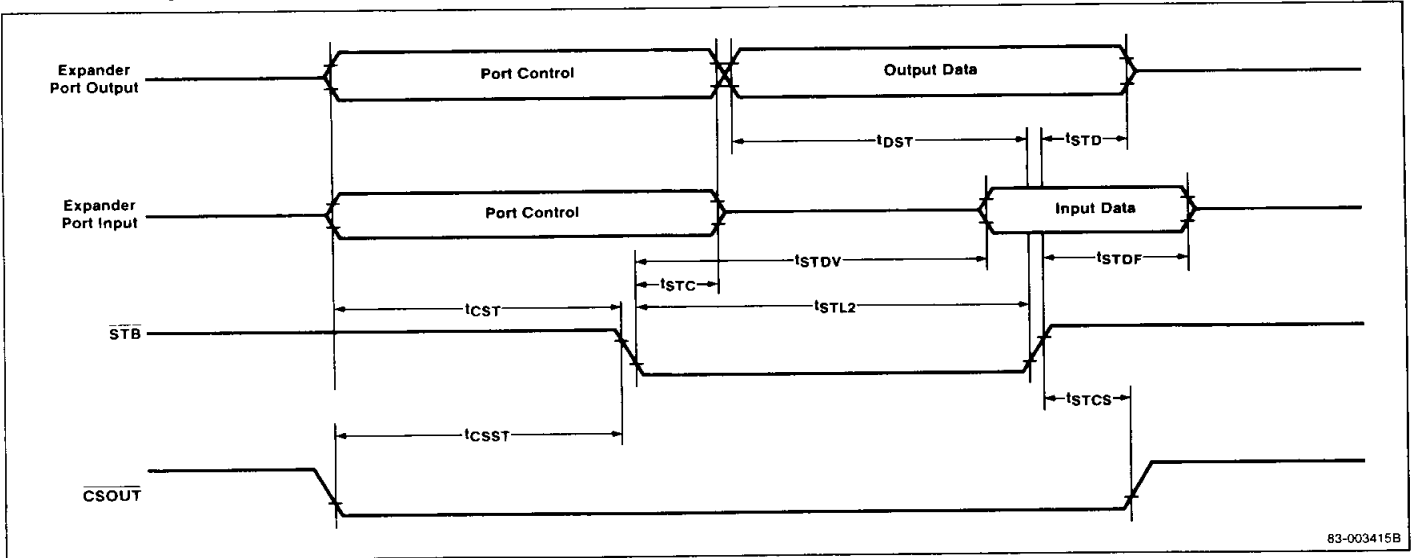
### Bus I/O Timing



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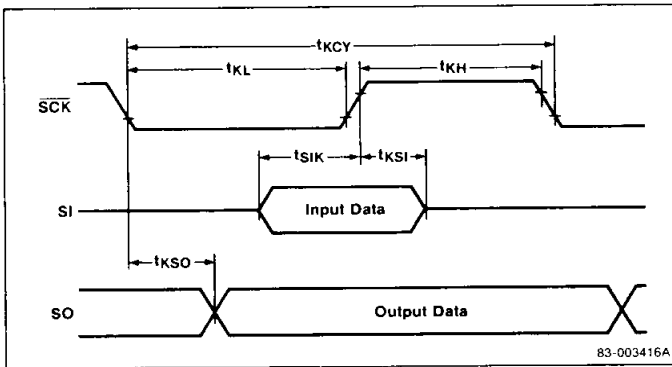
**Timing Waveforms (cont)**

**Port 1 I/O Expander Port Timing**



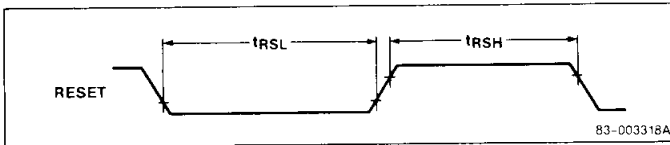
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**Serial Interface Timing**



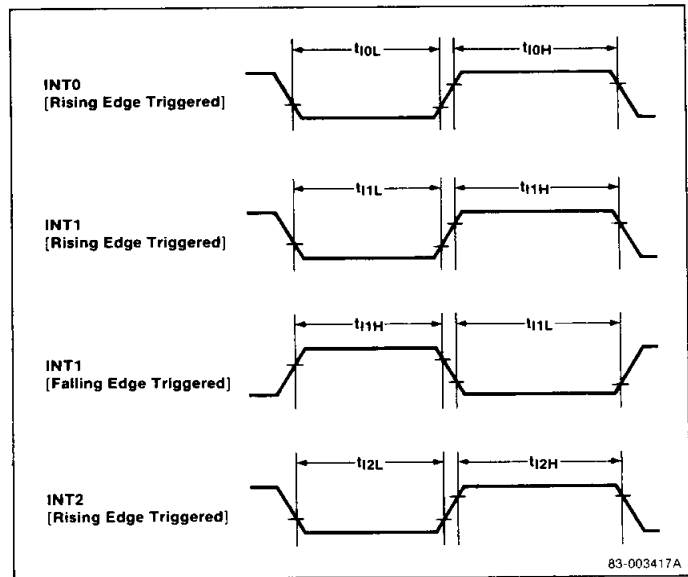
83-003416A

**RESET Input Timing**



83-003318A

**Interrupt Input Timing**



83-003417A