

PROGRAMMABLE INTERVAL TIMER INTERFACE

BY
SUBATHRA S

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PROGRAMMABLE INTERVAL TIMER INTERFACE

OBJECTIVE

To write an assembly language program to interface programmable interval timer with 8085 microprocessor trainer kit and observe its various modes.

APPARATUS REQUIRED

- 8085 Microprocessor Trainer Kit
- Programmable interval timer interfacing kit
- Power Supply
- Flat Ribbon Cable

DESCRIPTION

The chip has a control register which stores the operational mode of each counter. This register can only be written into and no read operations of its contents are possible. Writing corresponding control word by simple I/O operation can individually program each counter of 8253.

CONTROL WORD FORMAT 8253

DATA BIT		DESCRIPTION			
D ₀	BCD	BINARY/BCD			
D ₁	M0	MODE			
		M2	M1	M0	MODE
D ₂	M1	0	0	0	0
		0	0	1	1
		0	1	0	2
D ₃	M2	0	1	1	3
		1	0	0	4
		1	0	1	5
D ₄	RL0	READ/LOAD			
		RL1	RL0		
		0	0	Latch	
D ₅	RL1	0	1	LSB	
		1	0	MSB	
		1	1	LSB/MSB	
D ₆	SC0	SELECT COUNTER			
		SC0	SC1	CH#	
		0	0	0	
D ₇	SC1	0	1	1	
		1	0	2	
		1	1	X	

MODE 0

INTERRUPT ON TERMINAL COUNT

ALGORITHM

- 1.The output will be low initially after mode set operation.
- 2.After loading the counter, the output will remain while counting.
- 3.On terminal count, output will go high until reloaded again.
- 4.After six clock pulses we can notice that the output goes high.

ASSEMBLY LANGUAGE PROGRAM

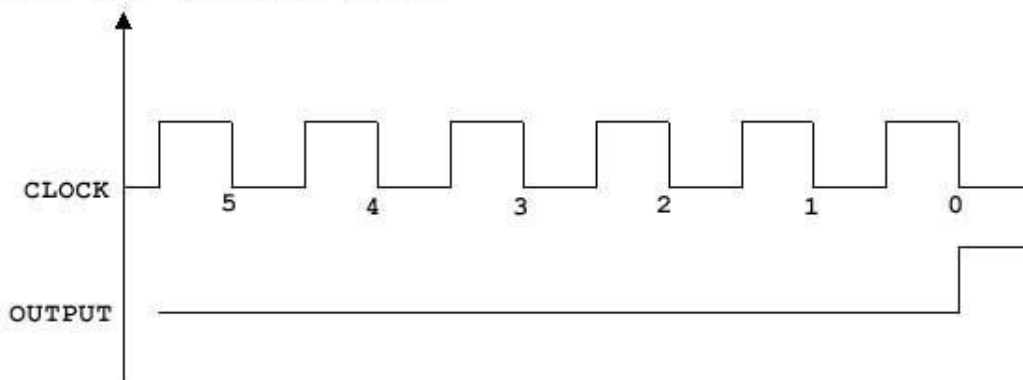
ADDRESS	LABEL	MNEMONICS	OPCODE/OPERAND
4100		MVI A, 30 _H	3E 30
4102		OUT CWR	D3 CE
4104		MVI A, 05 _H	3E 05
4106		OUT CNTO	D3 C8
4108		MVI A, 00 _H	3E 00
410A		OUT CNTO	D3 C8
410C		HLT	76

PROGRAM TRACE

LABEL	MNEMONICS	DESCRIPTION																																																												
	MVI A, 30 _H	<p>Initializing the COUNTER 0 of the PIT 8253 in MODE 0 by writing the control word as 30_H.</p> <table border="1" style="width: 100%; border-collapse: collapse; margin: 10px 0;"> <thead> <tr> <th rowspan="2" style="text-align: center;">COMMENT</th> <th colspan="2" style="text-align: center;">SELECT COUNTER</th> <th colspan="2" style="text-align: center;">READ/LOAD</th> <th colspan="3" style="text-align: center;">MODE</th> <th rowspan="2" style="text-align: center;">BCD/BINARY COUNT</th> </tr> <tr> <th style="text-align: center;">SC1</th> <th style="text-align: center;">SC0</th> <th style="text-align: center;">RL1</th> <th style="text-align: center;">RL0</th> <th style="text-align: center;">M2</th> <th style="text-align: center;">M1</th> <th style="text-align: center;">M0</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;"><i>DATA BITS</i></td> <td style="text-align: center;">D₇</td> <td style="text-align: center;">D₆</td> <td style="text-align: center;">D₅</td> <td style="text-align: center;">D₄</td> <td style="text-align: center;">D₃</td> <td style="text-align: center;">D₂</td> <td style="text-align: center;">D₁</td> <td style="text-align: center;">D₀</td> </tr> <tr> <td></td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;">1</td> <td style="text-align: center;">1</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> </tr> </tbody> </table> <table border="1" style="width: 100%; border-collapse: collapse; margin: 10px 0;"> <thead> <tr> <th style="text-align: center;">OBSERVE</th> <th style="text-align: center;">COUNTER 0</th> <th style="text-align: center;">LSB/MSB</th> <th style="text-align: center;">MODE 0</th> <th style="text-align: center;">BINARY COUNT</th> </tr> </thead> <tbody> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table> <p>30_H is moved to accumulator.</p> <p style="text-align: center;">REGISTERS</p> <table style="margin-left: 20px;"> <tr> <td style="padding-right: 5px;">A</td> <td style="border: 1px solid black; padding: 2px 5px;">30</td> <td style="border: 1px solid black; padding: 2px 5px;">XX</td> <td style="padding-left: 5px;">F</td> </tr> <tr> <td>B</td> <td style="border: 1px solid black; padding: 2px 5px;">XX</td> <td style="border: 1px solid black; padding: 2px 5px;">XX</td> <td>C</td> </tr> <tr> <td>D</td> <td style="border: 1px solid black; padding: 2px 5px;">XX</td> <td style="border: 1px solid black; padding: 2px 5px;">XX</td> <td>E</td> </tr> <tr> <td>H</td> <td style="border: 1px solid black; padding: 2px 5px;">XX</td> <td style="border: 1px solid black; padding: 2px 5px;">XX</td> <td>L</td> </tr> </table>	COMMENT	SELECT COUNTER		READ/LOAD		MODE			BCD/BINARY COUNT	SC1	SC0	RL1	RL0	M2	M1	M0	<i>DATA BITS</i>	D ₇	D ₆	D ₅	D ₄	D ₃	D ₂	D ₁	D ₀		0	0	1	1	0	0	0	0	OBSERVE	COUNTER 0	LSB/MSB	MODE 0	BINARY COUNT						A	30	XX	F	B	XX	XX	C	D	XX	XX	E	H	XX	XX	L
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	OUT CWR	<p>Write the control word in the control register.</p> <p><i>HINTS:</i></p> <ul style="list-style-type: none"> <input type="checkbox"/> Opcode used for CWR is CE_H. <input type="checkbox"/> The control register is not loaded until the count value is written (one or two bytes depending on the mode selected by the RL bits). 																																																												
	MVI A, 05 _H	Lower order byte of the count is loaded in to Accumulator as 05 _H .																																																												

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	OUT CNT0	<p>Load COUNTER 0 with lower order byte.</p> <p><u>HINTS:</u></p> <ul style="list-style-type: none"> <input type="checkbox"/> Opcode used for CNT0 is C8_H, which is the memory address of the Counter 0 - Timer 8253. <input type="checkbox"/> Counter 0 of the 8253 has been used on card for the single step function. <p><u>TIPS:</u> I/O ADDRESS OF 8253</p> <table border="1"> <thead> <tr> <th></th> <th>A₇</th> <th>A₆</th> <th>A₅</th> <th>A₄</th> <th>A₃</th> <th>A₂</th> <th>A₁</th> <th>A₀</th> <th>HEX</th> </tr> </thead> <tbody> <tr> <td>CONTROL REG</td> <td>1</td> <td>1</td> <td>0</td> <td>0</td> <td>1</td> <td>1</td> <td>1</td> <td>0</td> <td>CE</td> </tr> <tr> <td>COUNTER 0</td> <td>1</td> <td>1</td> <td>0</td> <td>0</td> <td>1</td> <td>0</td> <td>0</td> <td>0</td> <td>C8</td> </tr> <tr> <td>COUNTER 1</td> <td>1</td> <td>1</td> <td>0</td> <td>0</td> <td>1</td> <td>0</td> <td>1</td> <td>0</td> <td>CA</td> </tr> <tr> <td>COUNTER 2</td> <td>1</td> <td>1</td> <td>0</td> <td>0</td> <td>1</td> <td>1</td> <td>0</td> <td>0</td> <td>CC</td> </tr> </tbody> </table>		A ₇	A ₆	A ₅	A ₄	A ₃	A ₂	A ₁	A ₀	HEX	CONTROL REG	1	1	0	0	1	1	1	0	CE	COUNTER 0	1	1	0	0	1	0	0	0	C8	COUNTER 1	1	1	0	0	1	0	1	0	CA	COUNTER 2	1	1	0	0	1	1	0	0	CC
	A ₇	A ₆	A ₅	A ₄	A ₃	A ₂	A ₁	A ₀	HEX																																											
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	MVI A,00_H	<p>Higher order byte of the count is loaded in to Accumulator as 00_H.</p> <p align="center">REGISTERS</p> <table border="1"> <tr> <td>A</td> <td>00</td> <td>XX</td> <td>F</td> </tr> <tr> <td>B</td> <td>XX</td> <td>XX</td> <td>C</td> </tr> <tr> <td>D</td> <td>XX</td> <td>XX</td> <td>E</td> </tr> <tr> <td>H</td> <td>XX</td> <td>XX</td> <td>L</td> </tr> </table>	A	00	XX	F	B	XX	XX	C	D	XX	XX	E	H	XX	XX	L																																		
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	OUT CNT0	<p>Load COUNTER 0 with higher order byte.</p> <p><u>OPERATION:</u></p> <p>Now the 16-bit count is loaded in to the counter and on command, counter begins to decrement the count until it reaches 0. At the end of the count, it generates a pulse that can be used to interrupt the microprocessor.</p>																																																		
	HLT	<p>The MPU finishes executing the current instruction and halts any further execution. The MPU enters the Halt Acknowledge machine cycle and Wait states are inserted in every clock period. The address and the data bus are placed in the high impedance state. The content of the registers are unaffected during the HLT state. An interrupt is necessary to exit from the Halt state.</p>																																																		

OUTPUT WAVEFORM



MODE 1	PROGRAMMABLE ONE SHOT
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ALGORITHM

1. After loading the counter, the output remains low following the rising edge of the gate input.
2. The output will go high on terminal count.
3. It is Re-triggerable, hence the output will remain low for the full count after any rising edge of the gate input.

ASSEMBLY LANGUAGE PROGRAM

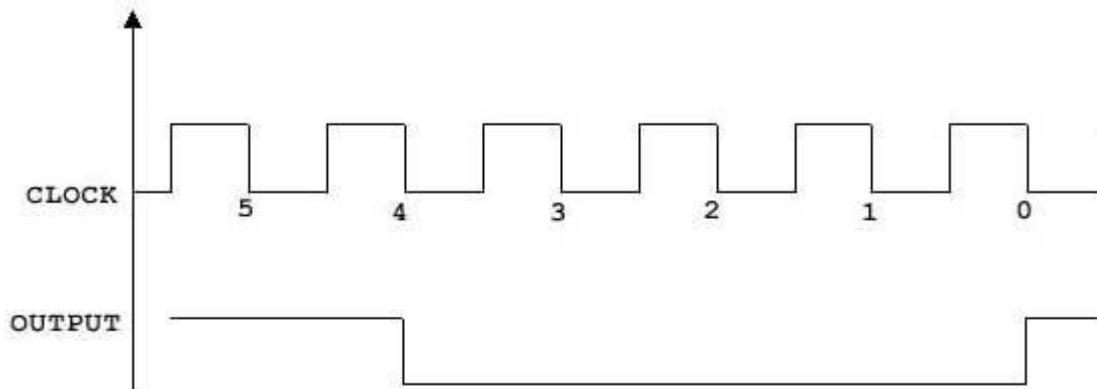
ADDRESS	LABEL	MNEMONICS	OPCODE/OPERAND
4200		MVI A, 32 _H	3E 32
4202		OUT CWR	D3 CE
4204		MVI A, 05 _H	3E 05
4206		OUT CNT0	D3 C8
4208		MVI A, 00 _H	3E 00
420A		OUT CNT0	D3 C8
420C		OUT D0	D3 D0
420E		HLT	76

PROGRAM TRACE

LABEL	MNEMONICS	DESCRIPTION																																																							
	MVI A, 32 _H	<p>Initializing the COUNTER 0 of the PIT 8253 in MODE 1 by writing the control word as 32_H.</p> <table border="1" style="width: 100%; border-collapse: collapse; margin: 10px 0;"> <tr> <th rowspan="2">COMMENT</th> <th colspan="2">SELECT COUNTER</th> <th colspan="2">READ/LOAD</th> <th colspan="3">MODE</th> <th rowspan="2">BCD/BINARY COUNT</th> </tr> <tr> <th>SC1</th> <th>SC0</th> <th>RL1</th> <th>RL0</th> <th>M2</th> <th>M1</th> <th>M0</th> </tr> <tr> <td>DATA BITS</td> <td>D₇</td> <td>D₆</td> <td>D₅</td> <td>D₄</td> <td>D₃</td> <td>D₂</td> <td>D₁</td> <td>D₀</td> </tr> <tr> <td></td> <td>0</td> <td>0</td> <td>1</td> <td>1</td> <td>0</td> <td>0</td> <td>1</td> <td>0</td> </tr> </table> <table border="1" style="width: 100%; border-collapse: collapse; margin: 10px 0;"> <tr> <td style="width: 20%;">OBSERVE</td> <td style="text-align: center;">COUNTER 0</td> <td style="width: 20%;">LSB/MSB</td> <td style="text-align: center;">MODE 1</td> <td style="width: 30%;">BINARY COUNT</td> </tr> </table> <p>32_H is moved to accumulator.</p> <p style="text-align: center;">REGISTERS</p> <table style="margin-left: 20px;"> <tr> <td style="padding-right: 5px;">A</td> <td style="border: 1px solid black; padding: 2px 5px;">32</td> <td style="border: 1px solid black; padding: 2px 5px;">XX</td> <td style="padding-left: 5px;">F</td> </tr> <tr> <td>B</td> <td style="border: 1px solid black; padding: 2px 5px;">XX</td> <td style="border: 1px solid black; padding: 2px 5px;">XX</td> <td>C</td> </tr> <tr> <td>D</td> <td style="border: 1px solid black; padding: 2px 5px;">XX</td> <td style="border: 1px solid black; padding: 2px 5px;">XX</td> <td>E</td> </tr> <tr> <td>H</td> <td style="border: 1px solid black; padding: 2px 5px;">XX</td> <td style="border: 1px solid black; padding: 2px 5px;">XX</td> <td>L</td> </tr> </table>	COMMENT	SELECT COUNTER		READ/LOAD		MODE			BCD/BINARY COUNT	SC1	SC0	RL1	RL0	M2	M1	M0	DATA BITS	D ₇	D ₆	D ₅	D ₄	D ₃	D ₂	D ₁	D ₀		0	0	1	1	0	0	1	0	OBSERVE	COUNTER 0	LSB/MSB	MODE 1	BINARY COUNT	A	32	XX	F	B	XX	XX	C	D	XX	XX	E	H	XX	XX	L
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	MVI A, 05 _H	<p>Lower order byte of the count is loaded in to Accumulator as 05_H.</p> <p style="text-align: center;">REGISTERS</p> <table style="margin-left: 20px;"> <tr> <td style="padding-right: 5px;">A</td> <td style="border: 1px solid black; padding: 2px 5px;">05</td> <td style="border: 1px solid black; padding: 2px 5px;">XX</td> <td style="padding-left: 5px;">F</td> </tr> <tr> <td>B</td> <td style="border: 1px solid black; padding: 2px 5px;">XX</td> <td style="border: 1px solid black; padding: 2px 5px;">XX</td> <td>C</td> </tr> <tr> <td>D</td> <td style="border: 1px solid black; padding: 2px 5px;">XX</td> <td style="border: 1px solid black; padding: 2px 5px;">XX</td> <td>E</td> </tr> <tr> <td>H</td> <td style="border: 1px solid black; padding: 2px 5px;">XX</td> <td style="border: 1px solid black; padding: 2px 5px;">XX</td> <td>L</td> </tr> </table>	A	05	XX	F	B	XX	XX	C	D	XX	XX	E	H	XX	XX	L																																							
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	OUT CNT0	Load COUNTER 0 with lower order byte. <i>HINT:</i> <ul style="list-style-type: none"> □ Opcode used for CNT0 is C8_H, which is the memory address of the Counter 0 - Timer 8253. 																
	MVI A,00_H	Higher order byte of the count is loaded in to Accumulator as 00 _H . REGISTERS <table border="1" style="margin-left: 20px;"> <tr> <td>A</td> <td>00</td> <td>XX</td> <td>F</td> </tr> <tr> <td>B</td> <td>XX</td> <td>XX</td> <td>C</td> </tr> <tr> <td>D</td> <td>XX</td> <td>XX</td> <td>E</td> </tr> <tr> <td>H</td> <td>XX</td> <td>XX</td> <td>L</td> </tr> </table>	A	00	XX	F	B	XX	XX	C	D	XX	XX	E	H	XX	XX	L
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B	XX	XX	C															
D	XX	XX	E															
H	XX	XX	L															
	OUT CNT0	Load COUNTER 0 with higher order byte.																
	OUT D0	To trigger GATE 0 of the Counter 0. The GATE inputs of 8253 are pulled high by 3.3k resistors. GATE 0 is also connected to pin 13 of 74LS138. This provision has been given to trigger the GATE <i>TIPS:</i> <ul style="list-style-type: none"> ➤ GATE signal is the input signal to the counter. ➤ GATE signal of the counter is used either to enable or disable counting. ➤ GATE SETTING OF A COUNTER <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>MODE</th> <th>LOW OR GOING LOW</th> <th>RISING</th> <th>HIGH</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>-</td> <td>(1)Initiates counting (2)Resets output after next clock</td> <td>-</td> </tr> </tbody> </table>	MODE	LOW OR GOING LOW	RISING	HIGH	1	-	(1)Initiates counting (2)Resets output after next clock	-								
MODE	LOW OR GOING LOW	RISING	HIGH															
1	-	(1)Initiates counting (2)Resets output after next clock	-															
	HLT	Execution of the processor is stopped.																

OUTPUT WAVEFORM



MODE 2	BAUD RATE GENERATOR
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ALGORITHM

- 1.It is a simple divide by N counter.
- 2.The output will be low for one period of clock input.
- 3.The period from one input pulse to the next equals the number of input counts in the count register.
- 4.If the count register is reloaded between output pulses, the present period will not be affected but the subsequent period will reflect the new value.

ASSEMBLY LANGUAGE PROGRAM

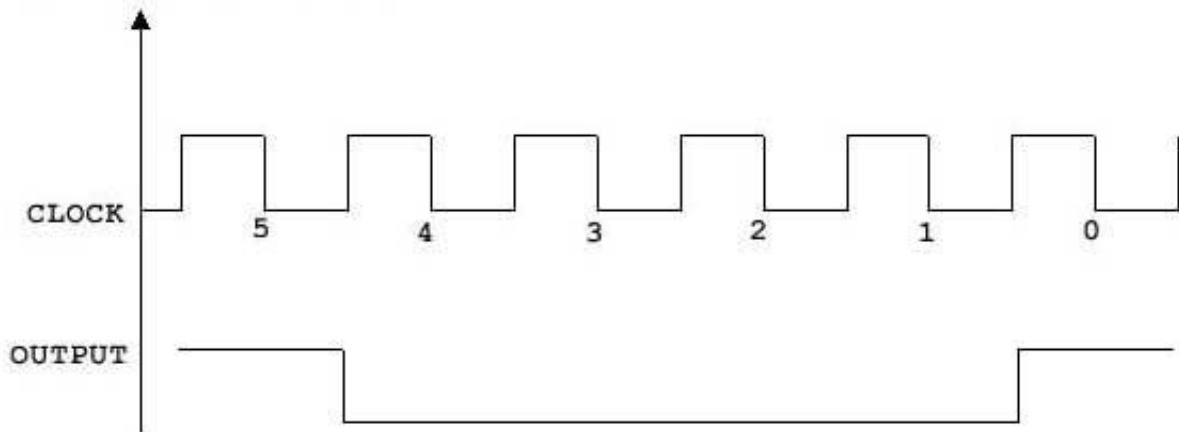
ADDRESS	LABEL	MNEMONICS	OPCODE/OPERAND
4300		MVI A,74 _H	3E 74
4302		OUT CWR	D3 CE
4304		MVI A,0A _H	3E 0A
4306		OUT CNT1	D3 CA
4308		MVI A,00 _H	3E 00
430A		OUT CNT1	D3 CA
430C		HLT	76

PROGRAM TRACE

LABEL	MNEMONICS	DESCRIPTION																																																							
	MVI A,74 _H	Initializing the COUNTER 1 of the PIT 8253 in MODE 2 by writing the control word as 74 _H . <table border="1" style="width: 100%; border-collapse: collapse; margin: 5px 0;"> <thead> <tr> <th rowspan="2">COMMENT</th> <th colspan="2">SELECT COUNTER</th> <th colspan="2">READ/LOAD</th> <th colspan="3">MODE</th> <th rowspan="2">BCD/BINARY COUNT</th> </tr> <tr> <th>SC1</th> <th>SC0</th> <th>RL1</th> <th>RL0</th> <th>M2</th> <th>M1</th> <th>M0</th> </tr> </thead> <tbody> <tr> <td>DATA BITS</td> <td>D₇</td> <td>D₆</td> <td>D₅</td> <td>D₄</td> <td>D₃</td> <td>D₂</td> <td>D₁</td> <td>D₀</td> </tr> <tr> <td></td> <td>0</td> <td>1</td> <td>1</td> <td>1</td> <td>0</td> <td>1</td> <td>0</td> <td>0</td> </tr> </tbody> </table> <table border="1" style="width: 100%; border-collapse: collapse; margin: 5px 0;"> <tr> <td style="width: 15%;">OBSERVE</td> <td style="width: 20%; text-align: center;">COUNTER 1</td> <td style="width: 20%;">LSB/MSB</td> <td style="width: 20%; text-align: center;">MODE 2</td> <td style="width: 25%;">BINARY COUNT</td> </tr> </table> 74 _H is moved to accumulator. REGISTERS <table style="margin-left: 20px;"> <tr> <td style="padding-right: 5px;">A</td> <td style="border: 1px solid black; padding: 2px 5px;">74</td> <td style="border: 1px solid black; padding: 2px 5px;">XX</td> <td style="padding-left: 5px;">F</td> </tr> <tr> <td>B</td> <td style="border: 1px solid black; padding: 2px 5px;">XX</td> <td style="border: 1px solid black; padding: 2px 5px;">XX</td> <td>C</td> </tr> <tr> <td>D</td> <td style="border: 1px solid black; padding: 2px 5px;">XX</td> <td style="border: 1px solid black; padding: 2px 5px;">XX</td> <td>E</td> </tr> <tr> <td>H</td> <td style="border: 1px solid black; padding: 2px 5px;">XX</td> <td style="border: 1px solid black; padding: 2px 5px;">XX</td> <td>L</td> </tr> </table>	COMMENT	SELECT COUNTER		READ/LOAD		MODE			BCD/BINARY COUNT	SC1	SC0	RL1	RL0	M2	M1	M0	DATA BITS	D ₇	D ₆	D ₅	D ₄	D ₃	D ₂	D ₁	D ₀		0	1	1	1	0	1	0	0	OBSERVE	COUNTER 1	LSB/MSB	MODE 2	BINARY COUNT	A	74	XX	F	B	XX	XX	C	D	XX	XX	E	H	XX	XX	L
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DATA BITS	D ₇	D ₆	D ₅	D ₄	D ₃	D ₂	D ₁	D ₀																																																	
	0	1	1	1	0	1	0	0																																																	
OBSERVE	COUNTER 1	LSB/MSB	MODE 2	BINARY COUNT																																																					
A	74	XX	F																																																						
B	XX	XX	C																																																						
D	XX	XX	E																																																						
H	XX	XX	L																																																						
	OUT CWR	Write the control word in the control register.																																																							
	MVI A,0A _H	Lower order byte of the count is loaded in to Accumulator as 0A _H . REGISTERS <table style="margin-left: 20px;"> <tr> <td style="padding-right: 5px;">A</td> <td style="border: 1px solid black; padding: 2px 5px;">0A</td> <td style="border: 1px solid black; padding: 2px 5px;">XX</td> <td style="padding-left: 5px;">F</td> </tr> <tr> <td>B</td> <td style="border: 1px solid black; padding: 2px 5px;">XX</td> <td style="border: 1px solid black; padding: 2px 5px;">XX</td> <td>C</td> </tr> <tr> <td>D</td> <td style="border: 1px solid black; padding: 2px 5px;">XX</td> <td style="border: 1px solid black; padding: 2px 5px;">XX</td> <td>E</td> </tr> <tr> <td>H</td> <td style="border: 1px solid black; padding: 2px 5px;">XX</td> <td style="border: 1px solid black; padding: 2px 5px;">XX</td> <td>L</td> </tr> </table>	A	0A	XX	F	B	XX	XX	C	D	XX	XX	E	H	XX	XX	L																																							
A	0A	XX	F																																																						
B	XX	XX	C																																																						
D	XX	XX	E																																																						
H	XX	XX	L																																																						
	OUT CNT1	Load COUNTER 1 with lower order byte.																																																							

		<p><i>HINT:</i></p> <ul style="list-style-type: none"> ➤ Opcode used for CNT1 is CA_H, which is the memory address of the Counter 1 - Timer 8253. ➤ Counter 1 of the 8253 has been used on card for generation of the TXD and RXD baud clock required by USART (8251A). 																
	MVI A,00_H	<p>Higher order byte of the count is loaded in to Accumulator as 00_H.</p> <p style="text-align: center;">REGISTERS</p> <table style="margin-left: auto; margin-right: auto;"> <tr> <td>A</td> <td>00</td> <td>XX</td> <td>F</td> </tr> <tr> <td>B</td> <td>XX</td> <td>XX</td> <td>C</td> </tr> <tr> <td>D</td> <td>XX</td> <td>XX</td> <td>E</td> </tr> <tr> <td>H</td> <td>XX</td> <td>XX</td> <td>L</td> </tr> </table>	A	00	XX	F	B	XX	XX	C	D	XX	XX	E	H	XX	XX	L
A	00	XX	F															
B	XX	XX	C															
D	XX	XX	E															
H	XX	XX	L															
	OUT CNT1	Load COUNTER 1 with higher order byte.																
	HLT	Execution of the processor is stopped.																

OUTPUT WAVEFORM



MODE 3	SQUARE WAVE GENERATOR
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ALGORITHM

1. It is similar to mode2 except that the output will remain high until one half of the count and go low for other half for even number count.
2. If the count is odd the output will be high for (count +1)/2 counts and low for (count -1)/2 counts.
3. This mode is the mode for generating baud rate for 8251A(USART).

ASSEMBLY LANGUAGE PROGRAM

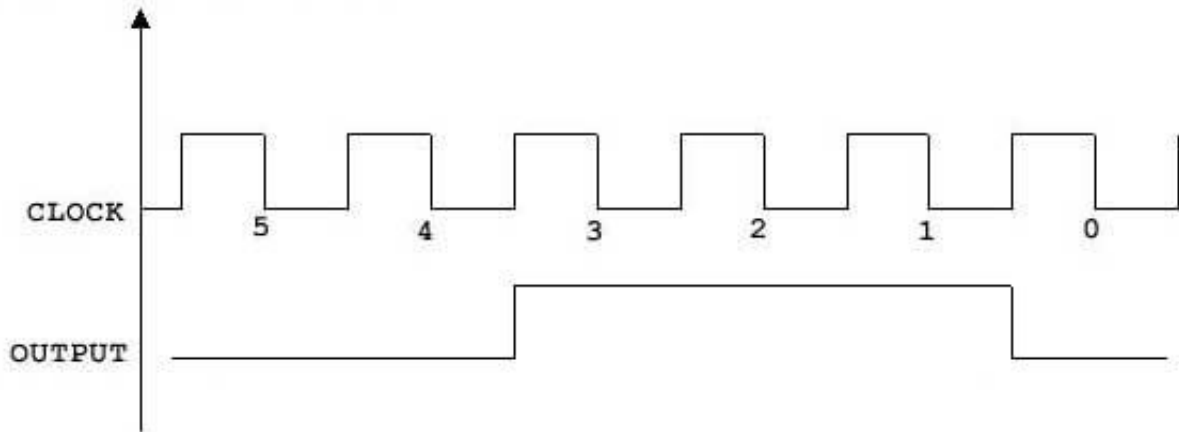
ADDRESS	LABEL	MNEMONICS	OPCODE/OPERAND
4400		MVI A, 36 _H	3E 36
4402		OUT CWR	D3 CE
4404		MVI A, 0A _H	3E 0A
4406		OUT CNT0	D3 C8
4408		MVI A, 00 _H	3E 00
440A		OUT CNT0	D3 C8
440C		HLT	76

PROGRAM TRACE

LABEL	MNEMONICS	DESCRIPTION																																																		
	MVI A, 36 _H	Initializing the COUNTER 0 of the PIT 8253 in MODE 3 by writing the control word as 36 _H . <table border="1" style="width: 100%; margin-top: 10px; border-collapse: collapse; text-align: center;"> <thead> <tr> <th rowspan="2">COMMENT</th> <th colspan="2">SELECT COUNTER</th> <th colspan="2">READ/LOAD</th> <th colspan="3">MODE</th> <th rowspan="2">BCD/BINARY COUNT</th> </tr> <tr> <th>SC1</th> <th>SC0</th> <th>RL1</th> <th>RL0</th> <th>M2</th> <th>M1</th> <th>M0</th> </tr> </thead> <tbody> <tr> <td>DATA BITS</td> <td>D₇</td> <td>D₆</td> <td>D₅</td> <td>D₄</td> <td>D₃</td> <td>D₂</td> <td>D₁</td> <td>D₀</td> </tr> <tr> <td>OBSERVE</td> <td colspan="2">COUNTER 0</td> <td colspan="2">LSB/MSB</td> <td colspan="3">MODE 3</td> <td>BINARY COUNT</td> </tr> </tbody> </table> <p style="margin-top: 10px;">36_H is moved to accumulator.</p> <p style="margin-top: 5px;">REGISTERS</p> <table style="margin-top: 5px;"> <tr> <td style="padding-right: 5px;">A</td> <td style="border: 1px solid black; padding: 2px;">36</td> <td style="border: 1px solid black; padding: 2px;">XX</td> <td style="padding-left: 5px;">F</td> </tr> <tr> <td>B</td> <td style="border: 1px solid black; padding: 2px;">XX</td> <td style="border: 1px solid black; padding: 2px;">XX</td> <td>C</td> </tr> <tr> <td>D</td> <td style="border: 1px solid black; padding: 2px;">XX</td> <td style="border: 1px solid black; padding: 2px;">XX</td> <td>E</td> </tr> <tr> <td>H</td> <td style="border: 1px solid black; padding: 2px;">XX</td> <td style="border: 1px solid black; padding: 2px;">XX</td> <td>L</td> </tr> </table>	COMMENT	SELECT COUNTER		READ/LOAD		MODE			BCD/BINARY COUNT	SC1	SC0	RL1	RL0	M2	M1	M0	DATA BITS	D ₇	D ₆	D ₅	D ₄	D ₃	D ₂	D ₁	D ₀	OBSERVE	COUNTER 0		LSB/MSB		MODE 3			BINARY COUNT	A	36	XX	F	B	XX	XX	C	D	XX	XX	E	H	XX	XX	L
COMMENT	SELECT COUNTER			READ/LOAD		MODE			BCD/BINARY COUNT																																											
	SC1	SC0	RL1	RL0	M2	M1	M0																																													
DATA BITS	D ₇	D ₆	D ₅	D ₄	D ₃	D ₂	D ₁	D ₀																																												
OBSERVE	COUNTER 0		LSB/MSB		MODE 3			BINARY COUNT																																												
A	36	XX	F																																																	
B	XX	XX	C																																																	
D	XX	XX	E																																																	
H	XX	XX	L																																																	
	OUT CWR	Write the control word in to the control register and the count to channel0 so that you get an output frequency of 15KHz whose input clock is nearly 1.5MHz.																																																		
	MVI A, 0A _H	Lower order byte of the count is loaded in to Accumulator as 0A _H . <p style="margin-top: 5px;">REGISTERS</p> <table style="margin-top: 5px;"> <tr> <td style="padding-right: 5px;">A</td> <td style="border: 1px solid black; padding: 2px;">0A</td> <td style="border: 1px solid black; padding: 2px;">XX</td> <td style="padding-left: 5px;">F</td> </tr> <tr> <td>B</td> <td style="border: 1px solid black; padding: 2px;">XX</td> <td style="border: 1px solid black; padding: 2px;">XX</td> <td>C</td> </tr> <tr> <td>D</td> <td style="border: 1px solid black; padding: 2px;">XX</td> <td style="border: 1px solid black; padding: 2px;">XX</td> <td>E</td> </tr> <tr> <td>H</td> <td style="border: 1px solid black; padding: 2px;">XX</td> <td style="border: 1px solid black; padding: 2px;">XX</td> <td>L</td> </tr> </table>	A	0A	XX	F	B	XX	XX	C	D	XX	XX	E	H	XX	XX	L																																		
A	0A	XX	F																																																	
B	XX	XX	C																																																	
D	XX	XX	E																																																	
H	XX	XX	L																																																	

	OUT CNT0	Load COUNTER 0 with lower order byte.																
	MVI A,00_H	Higher order byte of the count is loaded in to Accumulator as 00 _H . <div style="text-align: center;"> REGISTERS <table style="display: inline-table; border-collapse: collapse;"> <tr> <td style="padding-right: 5px;">A</td> <td style="border: 1px solid black; padding: 2px 5px;">00</td> <td style="border: 1px solid black; padding: 2px 5px;">XX</td> <td style="padding-left: 5px;">F</td> </tr> <tr> <td>B</td> <td style="border: 1px solid black; padding: 2px 5px;">XX</td> <td style="border: 1px solid black; padding: 2px 5px;">XX</td> <td>C</td> </tr> <tr> <td>D</td> <td style="border: 1px solid black; padding: 2px 5px;">XX</td> <td style="border: 1px solid black; padding: 2px 5px;">XX</td> <td>E</td> </tr> <tr> <td>H</td> <td style="border: 1px solid black; padding: 2px 5px;">XX</td> <td style="border: 1px solid black; padding: 2px 5px;">XX</td> <td>L</td> </tr> </table> </div>	A	00	XX	F	B	XX	XX	C	D	XX	XX	E	H	XX	XX	L
A	00	XX	F															
B	XX	XX	C															
D	XX	XX	E															
H	XX	XX	L															
	OUT CNT0	Load COUNTER 0 with higher order byte. <i>OPERATION:</i> Now the 16-bit count is loaded in to the counter and on command, counter begins to decrement the count until it reaches 0. At the end of the count, it generates a pulse that can be used to interrupt the microprocessor.																
	HLT	Execution of the processor is stopped.																

OUTPUT WAVEFORM



MODE 5	HARDWARE TRIGGERED MODE
---------------	--------------------------------

ALGORITHM

1. The counter starts counting after rising edge of trigger input and output goes low for one clock period when terminal count is reached.
2. Counter is Re-triggerable.
3. After 6th pulse, initially high output goes low and half on next pulse.

ASSEMBLY LANGUAGE PROGRAM

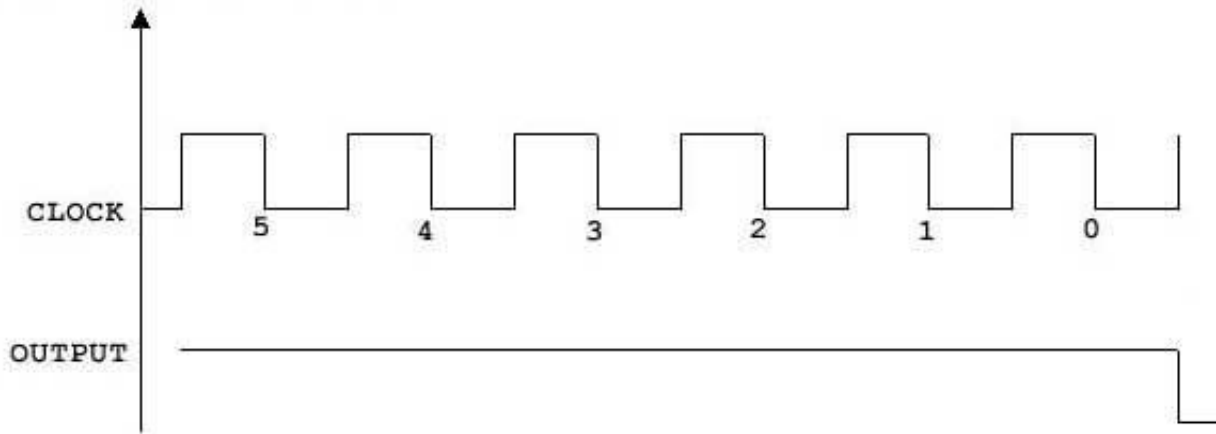
ADDRESS	LABEL	MNEMONICS	OPCODE/OPERAND
4500		MVI A, 1A _H	3E 1A
4502		OUT CWR	D3 CE
4504		MVI A, 05 _H	3E 05
4506		OUT CNT0	D3 C8
4508		OUT D0	D3 D0
450A		HLT	76

PROGRAM TRACE

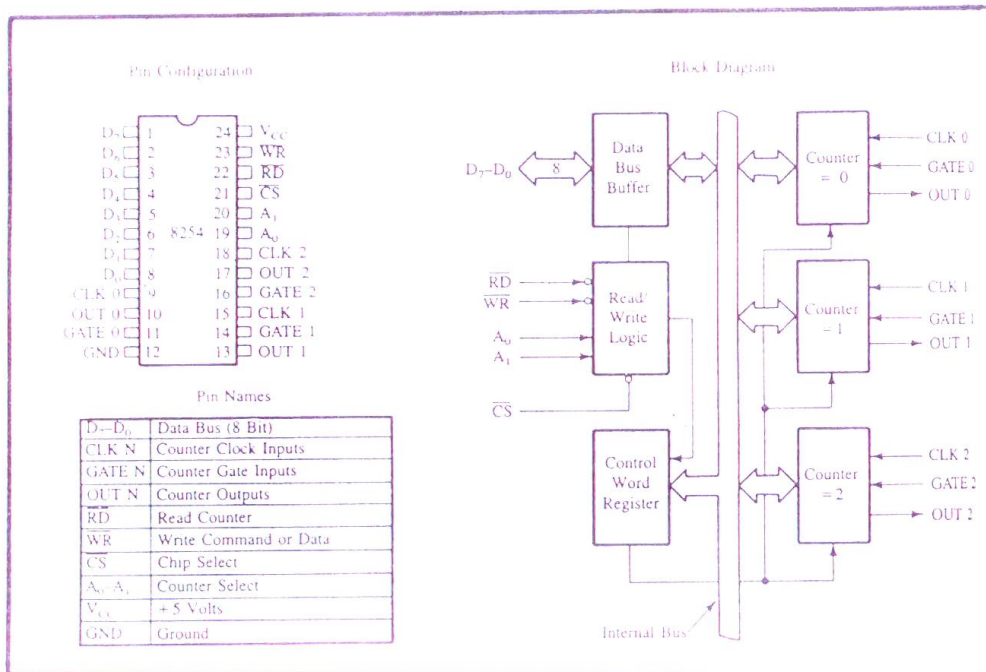
LABEL	MNEMONICS	DESCRIPTION																																																													
	MVI A, 1A _H	Initializing the COUNTER 0 of the PIT 8253 in MODE 5 by writing the control word as 1A _H . <table border="1" style="width: 100%; margin-top: 10px; border-collapse: collapse;"> <thead> <tr> <th style="width: 15%;">COMMENT</th> <th colspan="2">SELECT COUNTER</th> <th colspan="2">READ/LOAD</th> <th colspan="3">MODE</th> <th>BCD/BINARY COUNT</th> </tr> <tr> <td></td> <th>SC1</th> <th>SC0</th> <th>RL1</th> <th>RL0</th> <th>M2</th> <th>M1</th> <th>M0</th> <th></th> </tr> </thead> <tbody> <tr> <td>DATA</td> <td>D₇</td> <td>D₆</td> <td>D₅</td> <td>D₄</td> <td>D₃</td> <td>D₂</td> <td>D₁</td> <td>D₀</td> </tr> <tr> <td>BITS</td> <td>0</td> <td>0</td> <td>0</td> <td>1</td> <td>1</td> <td>0</td> <td>1</td> <td>0</td> </tr> <tr> <td>OBSERVE</td> <td colspan="2" style="text-align: center;">COUNTER 0</td> <td colspan="2" style="text-align: center;">LSB</td> <td colspan="3" style="text-align: center;">MODE 5</td> <td>BINARY COUNT</td> </tr> </tbody> </table> <p>1A_H is moved to accumulator.</p> <p style="text-align: center;">REGISTERS</p> <table style="margin-left: auto; margin-right: auto;"> <tr> <td style="padding-right: 5px;">A</td> <td style="border: 1px solid black; padding: 2px;">1A</td> <td style="border: 1px solid black; padding: 2px;">XX</td> <td style="padding-left: 5px;">F</td> </tr> <tr> <td>B</td> <td style="border: 1px solid black; padding: 2px;">XX</td> <td style="border: 1px solid black; padding: 2px;">XX</td> <td>C</td> </tr> <tr> <td>D</td> <td style="border: 1px solid black; padding: 2px;">XX</td> <td style="border: 1px solid black; padding: 2px;">XX</td> <td>E</td> </tr> <tr> <td>H</td> <td style="border: 1px solid black; padding: 2px;">XX</td> <td style="border: 1px solid black; padding: 2px;">XX</td> <td>L</td> </tr> </table>	COMMENT	SELECT COUNTER		READ/LOAD		MODE			BCD/BINARY COUNT		SC1	SC0	RL1	RL0	M2	M1	M0		DATA	D ₇	D ₆	D ₅	D ₄	D ₃	D ₂	D ₁	D ₀	BITS	0	0	0	1	1	0	1	0	OBSERVE	COUNTER 0		LSB		MODE 5			BINARY COUNT	A	1A	XX	F	B	XX	XX	C	D	XX	XX	E	H	XX	XX	L
COMMENT	SELECT COUNTER		READ/LOAD		MODE			BCD/BINARY COUNT																																																							
	SC1	SC0	RL1	RL0	M2	M1	M0																																																								
DATA	D ₇	D ₆	D ₅	D ₄	D ₃	D ₂	D ₁	D ₀																																																							
BITS	0	0	0	1	1	0	1	0																																																							
OBSERVE	COUNTER 0		LSB		MODE 5			BINARY COUNT																																																							
A	1A	XX	F																																																												
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D	XX	XX	E																																																												
H	XX	XX	L																																																												
	OUT CWR	Write the control word in the control register.																																																													
	MVI A, 05 _H	Lower order byte of the count is loaded in to Accumulator as 05 _H . <p style="text-align: center;">REGISTERS</p> <table style="margin-left: auto; margin-right: auto;"> <tr> <td style="padding-right: 5px;">A</td> <td style="border: 1px solid black; padding: 2px;">05</td> <td style="border: 1px solid black; padding: 2px;">XX</td> <td style="padding-left: 5px;">F</td> </tr> <tr> <td>B</td> <td style="border: 1px solid black; padding: 2px;">XX</td> <td style="border: 1px solid black; padding: 2px;">XX</td> <td>C</td> </tr> <tr> <td>D</td> <td style="border: 1px solid black; padding: 2px;">XX</td> <td style="border: 1px solid black; padding: 2px;">XX</td> <td>E</td> </tr> <tr> <td>H</td> <td style="border: 1px solid black; padding: 2px;">XX</td> <td style="border: 1px solid black; padding: 2px;">XX</td> <td>L</td> </tr> </table>	A	05	XX	F	B	XX	XX	C	D	XX	XX	E	H	XX	XX	L																																													
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D	XX	XX	E																																																												
H	XX	XX	L																																																												
	OUT CNT0	Load COUNTER 0 with lower order byte.																																																													
	OUT D0	To trigger GATE 0 of the Counter 0.																																																													

	<p>TIPS:</p> <ul style="list-style-type: none"> ➤ GATE signal of the counter is used either to enable or disable counting. ➤ GATE SETTING OF A COUNTER <table border="1"> <thead> <tr> <th>MODE</th> <th>LOW OR GOING LOW</th> <th>RISING</th> <th>HIGH</th> </tr> </thead> <tbody> <tr> <td>5</td> <td>-</td> <td>Initiates counting</td> <td>-</td> </tr> </tbody> </table>	MODE	LOW OR GOING LOW	RISING	HIGH	5	-	Initiates counting	-
MODE	LOW OR GOING LOW	RISING	HIGH						
5	-	Initiates counting	-						
HLT	Execution of the processor is stopped.								

OUTPUT WAVEFORM



8254 BLOCK DIAGRAM, PIN CONFIGURATION



REFERENCE

1. Ramesh S.Gaonkar, Microprocessor Architecture, Programming, and Applications, Fourth Edition, Penram International Publishing (India), 2000.
2. S.Subathra, "Advanced Microprocessor Laboratory", Record work, Adhiparashakthi Engineering College, Melmaruvathur, October 2002
3. S.Subathra, "Programming in 8085 Microprocessor and its applications – An Innovative Analysis", Technical Report, March 2003
4. Micro-85 EB, User Manual, Version – 3.0, CAT #M85 EB-002, VI Microsystems Pvt. Ltd., Chennai.