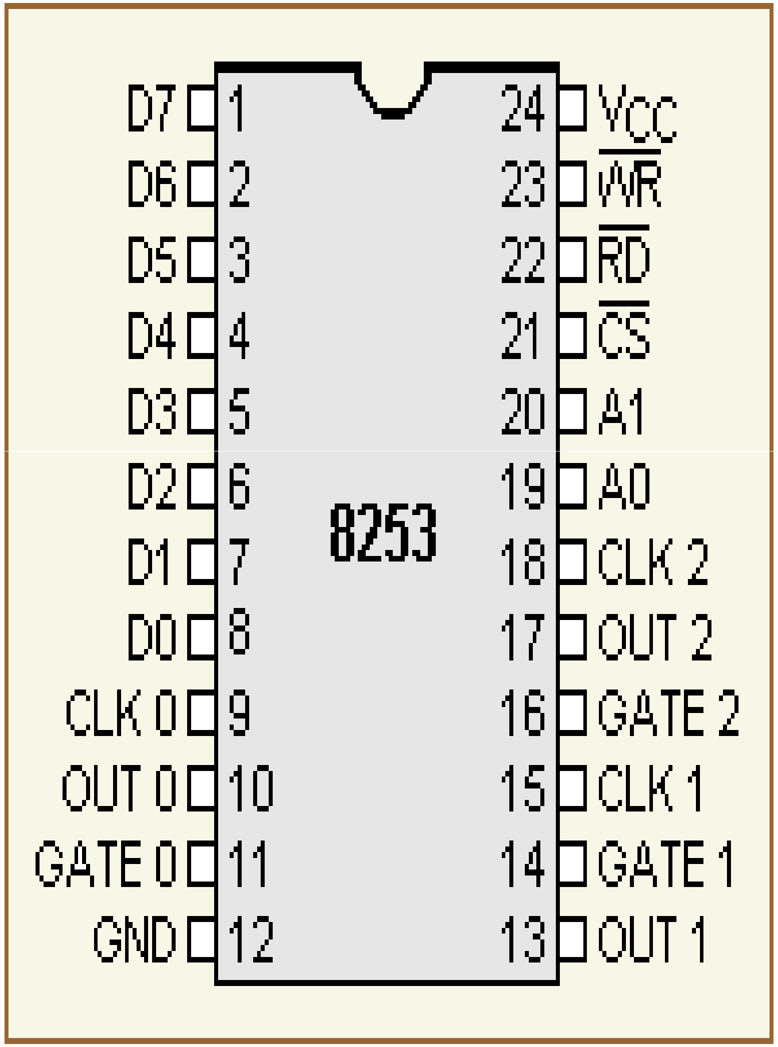
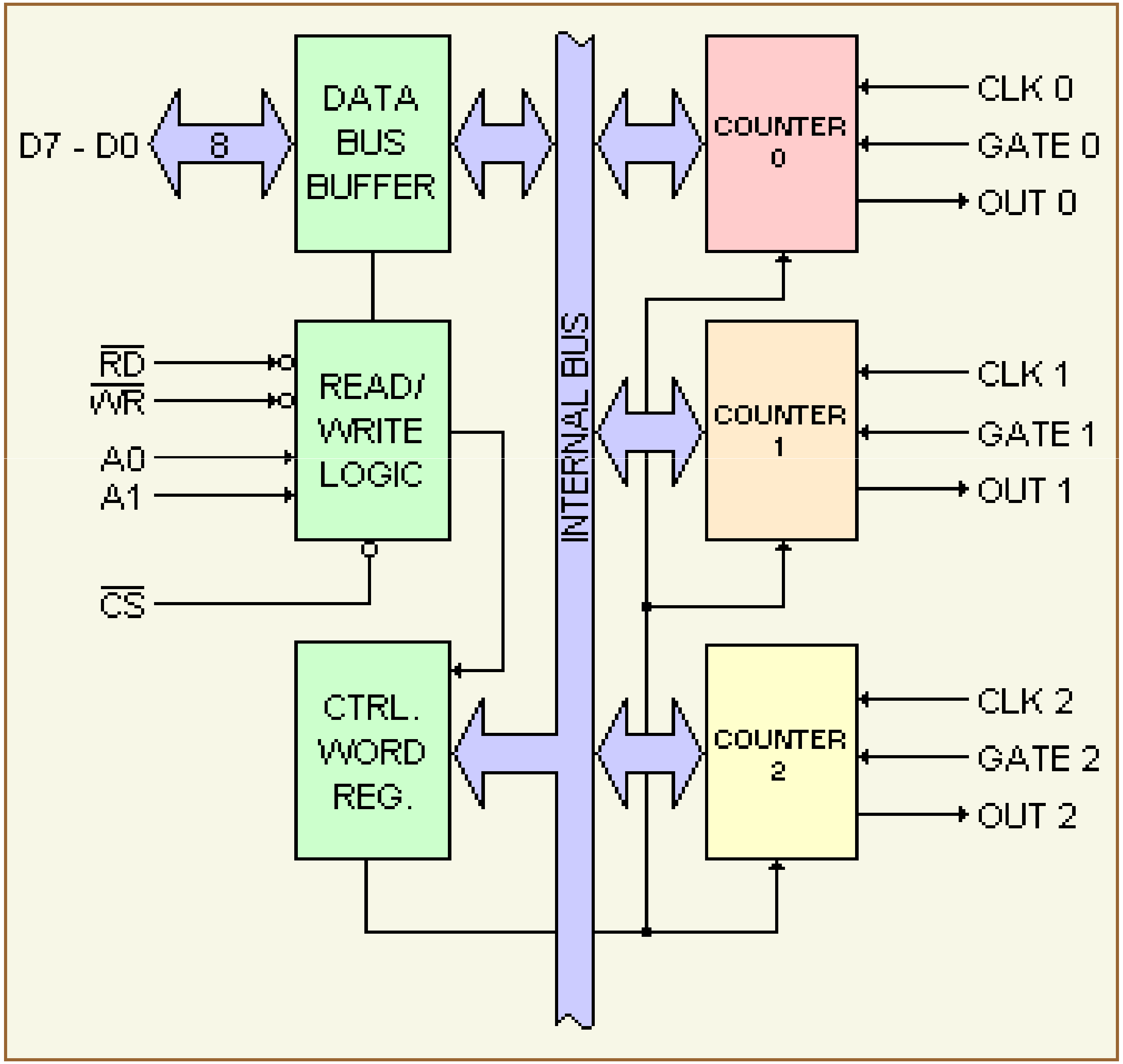
8253-Timer

8253 Pin Diagram



8253 Block Diagram



Pin Description

- **Clock: This is the clock input for the counter. The counter is 16 bits.**
  - **The maximum clock frequency is 1 / 380 nanoseconds or 2.6 megahertz. The minimum clock frequency is DC or static operation.**

- **Out: This single output line is the signal that is the final programmed output of the device.**
  - **Actual operation of the out line depends on how the device has been programmed.**

- **Gate: This input can act as a gate for the clock input line, or it can act as a start pulse, depending on the programmed mode of the counter.**

Counter Features

- Each counter is **identical**, and each consists of a **16-bit**, pre-settable, **down** counter.
- Each is **fully independent** and can be easily read by the CPU.
- When the counter is read, the data within the counter **will not be disturbed**.
- This allows the system or your own program to **monitor** the counter's value at any time, without disrupting the overall function of the 8253.

Counter Selection

	$\overline{RD}$	$\overline{WR}$	A0	A1	function
COUNTER 0	1	0	0	0	Load counter 0
	0	1	0	0	Read counter 0
COUNTER 1	1	0	0	1	Load counter 1
	0	1	0	1	Read counter 1
COUNTER 2	1	0	1	0	Load counter 2
	0	1	1	0	Read counter 2
MODE WORD or CONTROL WORD	1	0	1	1	Write mode word
- -	0	1	1	1	No-operation

Control Word Register

- This internal register is used to write information to, **prior to using the device**.
- This register is addressed when **A0** and **A1** inputs are logical 1's.
- The data in the register **controls the operation mode** and the selection of either binary or BCD counting format.
- The register can **only** be written to.
- You **can't read** information from the register.

Control Word Format

CONTROL BYTE D7 - D0							
D7	D6	D5	D4	D3	D2	D1	D0
SC1	SC0	RL1	RL0	M2	M1	M0	BCP

D7 SC1	D6 SC0	
0	0	
0	1	
1	0	
1	1	il

D5 RL1	D4 RL0	R
0	0	Co th co lat
0	1	Re
1	0	Re
1	1	Re th

D3 M2	D2 M1	D1 M0	M
0	0	0	m … al count
0	0	1	mode 1: programmable one-shot
x	1	0	mode 2: rate generator
x	1	1	mode 3: square wave generator
1	0	0	mode 4: software triggered strobe
1	0	1	mode 5: hardware triggered strobe

D0	counts down in
0	binary
1	BCD

Once a counter is set up, it will remain that way until it is changed by another control word.

Different uses of the 8253 gate input pin

Signal Status	Low or going low	Rising	High
Mode			
0	Disables counting	- -	Enables counting
1	- -	1) Initiates counting 2) Resets output after next clock	- -
2	1) Disables counting 2) Sets output immediately high	1) Reloads counter 2) Initiates counting	Enables counting
3	1) Disables counting 2) Sets output immediately high	Initiates counting	Enables counting
4	Disables counting	- -	Enables counting
5	- -	Initiates counting	- -

This table shows the different uses of the 8253 gate input pin.

Each mode of operation for the counter has a different use for the GATE input pin.

Timer Modes - Mode 0

- **Interrupt on Terminal Count**

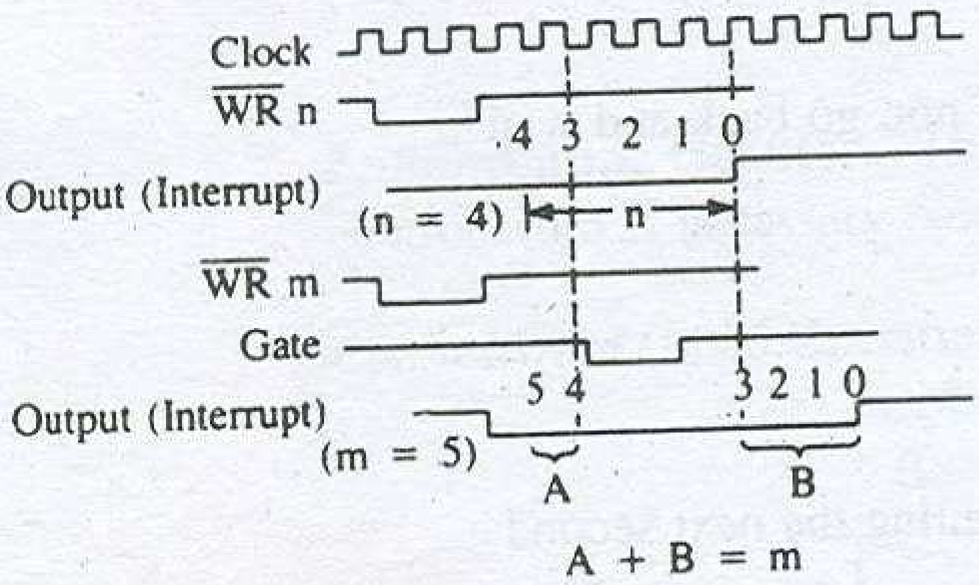
- The counter will be programmed to an initial value and afterwards **counts down** at a rate equal to the input clock frequency(8 MHz).

- When the count is equal to 0, the **OUT pin** will be a logical 1.

- The output will stay a logical 1 **until the counter is reloaded** with a new value or the same value or **until a mode word is written** to the device.

- Once the counter starts counting down, the **GATE input can disable the internal counting** by setting the GATE to a logical 0.

Mode 0: Interupt on Terminal Count



Timer Modes - Mode 1

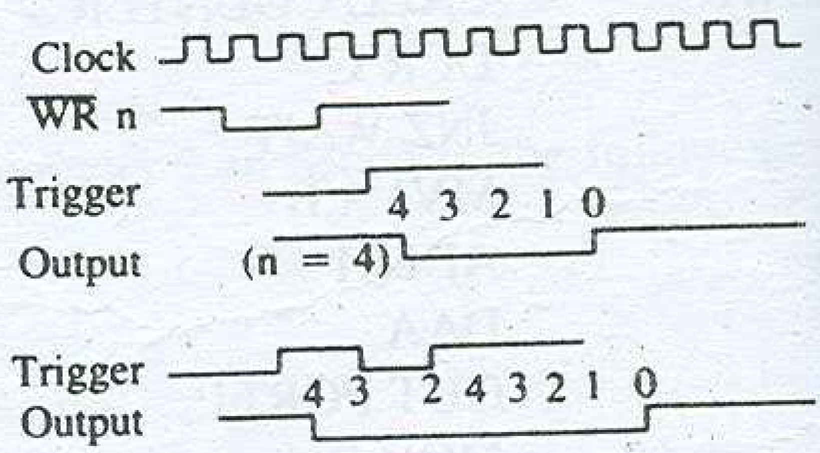
- **Programmable One-Shot**

- In mode 1, the device can be setup to give an **output pulse** that is an integer number of clock pulses.

- The one-shot is **triggered** on the rising edge of the GATE input.

- If the trigger occurs during the pulse output, the 8253 will be **retriggered** again.

Mode 1: Programmable One-Shot



Timer Modes - Mode 2

- **Rate Generator**
- The counter that is programmed for mode 2 becomes a **"divide by n" counter**.
- The **OUT pin** of the counter goes to low for one input clock period.
- The time between the pulses of going low is dependent on the **present count in the counter's register**.

Timer Modes - Mode 2

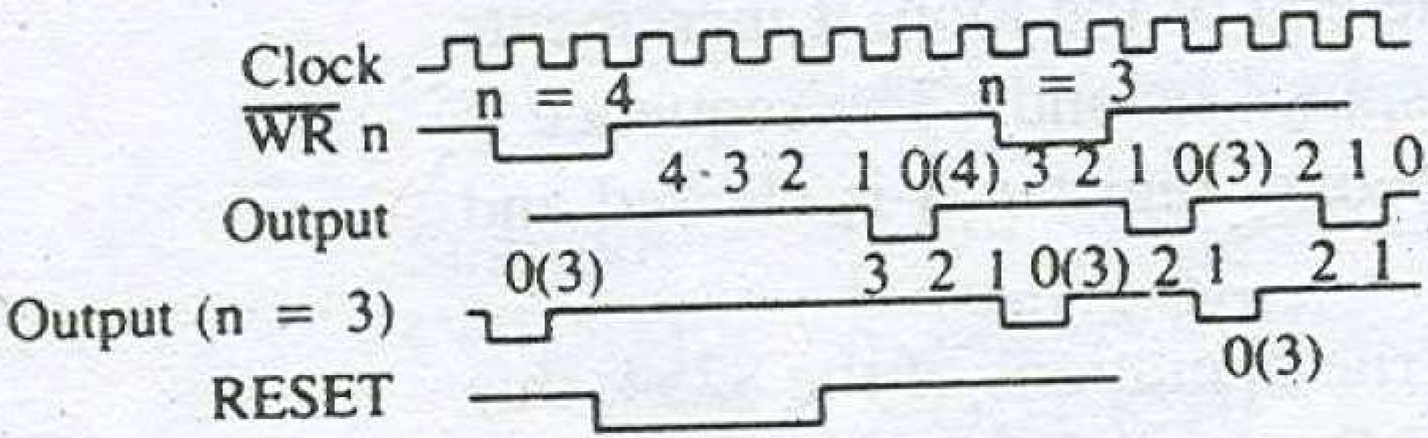
- For example, suppose to get an output frequency of **1,000 Hz**, the period would be **1 / 1,000 s = 1 ms or 1,000 µs**.

- If an input clock of **1 MHz** were applied to the clock input of the counter #0, then the counter #0 would need to be programmed to 1000 µs.

- This could be done in **decimal or in BCD**. (The period of an input clock of 1 MHz is 1 / 1,000,000 = 1 µs.)

- The formula is: **n=fi/fout**, where fi = input clock frequency, fout = output frequency, n = value to be loaded.

Mode 2: Rate Generator Clock



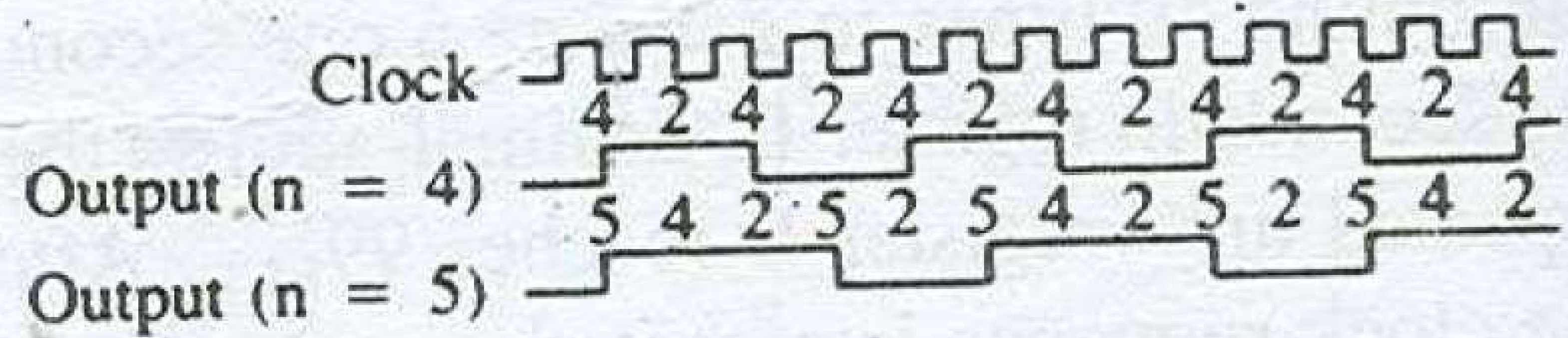
Timer Modes - Mode 3

- **Square Wave Generator**

- Mode 3 is similar to the mode 2 except that the output will be high **for half the period and low for half**.

- **If the count is odd**, the output will be high for **(n+1)/2** and low for **(n-1)/2** counts.

Mode 3: Square Wave Generator



Timer Modes - Mode 4

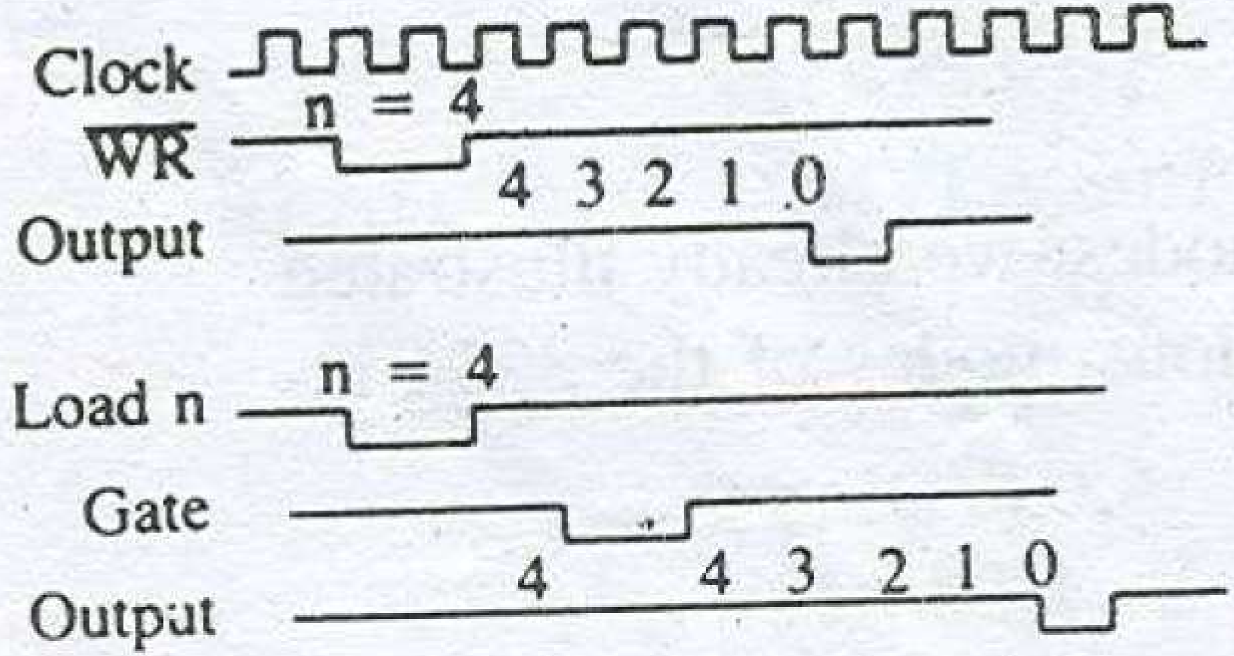
- **Software Triggered Strobe**

- In this mode the programmer can set up the counter to give an **output timeout** starting when the register is loaded.

- **On the terminal count**, when the counter equals to 0, the output will go to a logical 0 for one clock period and then returns to a logical 1.

- Firstly, when the mode is set, the **output will be a logical 1.**

Mode 4: Software Triggered Strobe



Timer Modes - Mode 5

- **Hardware Triggered Strobe**
- In this mode **the rising edge of the trigger input** will start the counting of the counter.
- The **output goes low for one clock** at the terminal count.
- The counter is **re triggerable**, thus meaning that if the trigger input is taken low and then high during a count sequence, the sequence will start over.
- When the external trigger input goes to a logical 1, **the timer will start to time out.**
- If the **external trigger occurs again**, prior to the time completing a full timeout, the timer will retrigger.

Mode 5: Hardware Triggered Strobe