What is the difference between general purpose registers segment registers in 8086 microprocessor?

General purpose registers

- There are 8 general purpose registers in the 8086 microprocessor: AX, BX, CX, DX, SP, BP, SI, and DI.
- They are 16-bit registers, but they can be divided into two 8-bit registers.
- They are used to store temporary data during the execution of a program.
- They can be used to store data, addresses, and results of arithmetic and logical operations.

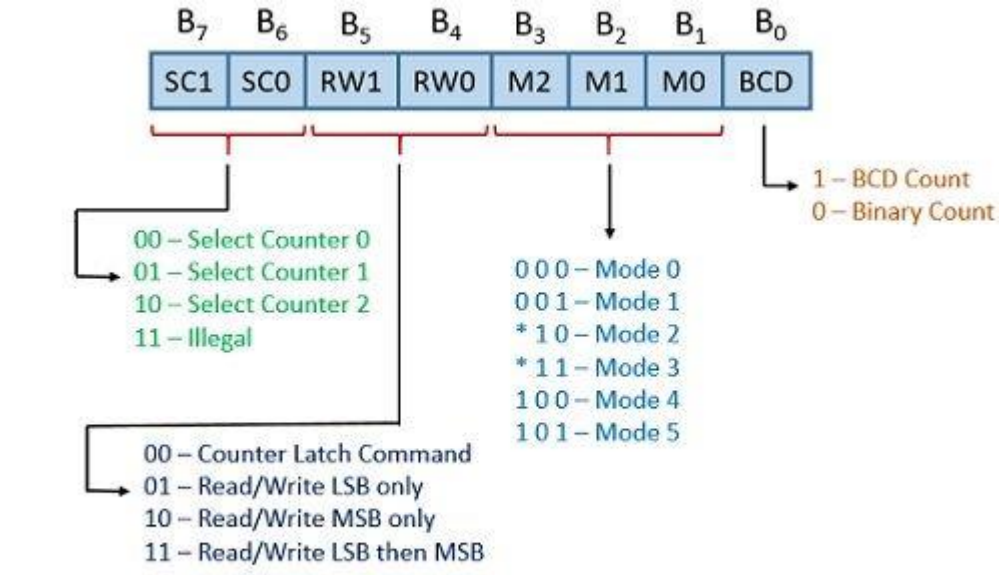
Segment registers

- There are 4 segment registers in the 8086 microprocessor: CS, DS, ES, and SS.
- They are 16-bit registers, but they only store the upper 16 bits of the starting addresses of memory segments.
- They are used to store the starting addresses of the code segment, data segment, extra segment, and stack segment.
- The starting address of a memory segment is multiplied by 16 to get the actual 20-bit address of the segment.

What is microcontroller?

A microcontroller is a small computer on a single integrated circuit (IC) chip. It contains one or more CPUs along with memory and programmable input/output (I/O) peripherals. Microcontrollers are designed for embedded applications. It has small size and low cost. It is programmable and requires less power.

Explain the 8254 control word format.



Format of Control Word of 8254 Timer

B_0 selects the BCD or binary count while B_1, B_2, and B_3 are used to select one of the modes of operation for the counter which bits B_6 and B_7 specify. For the operation to take place, the control word is needed to be sent for each separate counter at the same control address register. The identification of the control word of the particular counter is done using bits B_6 and B_7 of the control word format.
The read/ write operations are performed using bits B_4 and B_5.

Difference between instructions INT N and INTO.

INT n	INTO
Interrupt instruction with type number	Interrupt on overflow instruction
2 byte instruction	1 byte instruction
First byte provides the op-code	Opcode is CEH

Explain the 80286, Pentium Processors and microcontrollers.

80286: The Intel 80286 is a 16-bit microprocessor that was introduced in 1982. It was the successor to the 8086 and 8088 microprocessors, and it offered a number of improvements, including:

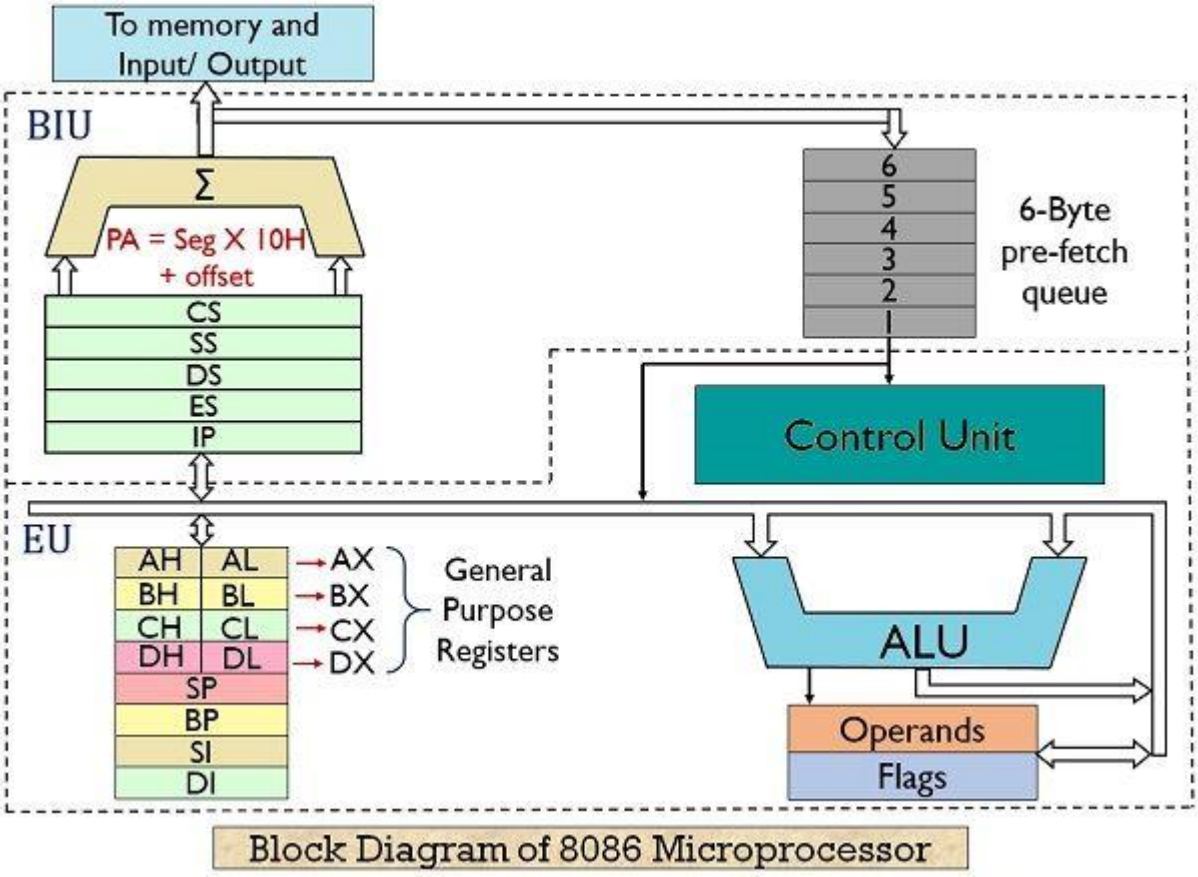
- A 24-bit address bus, which allowed it to address up to 16 MB of memory.
- A protected mode, which allowed multiple programs to run simultaneously and prevented one program from accessing the memory or data of another program.
- A faster clock speed, up to 12 MHz.

Pentium Processors: The Pentium microprocessors are a family of 32-bit microprocessors that were introduced by Intel in 1993. The Pentium processors offered a number of improvements over the 80286, including:

- A 32-bit address bus, which allowed them to address up to 4 GB of memory.
- A faster clock speed, up to 100 MHz.
- A more powerful instruction set.

Microcontroller: A microcontroller is a small computer on a single integrated circuit (IC) chip. It contains one or more CPUs along with memory and programmable input/output (I/O) peripherals. Microcontrollers are designed for embedded applications. It has small size and low cost. It is programmable and requires less power.

Draw the architecture diagram of 8086. Explain the signals used to interrupt the activities of the microprocessor.

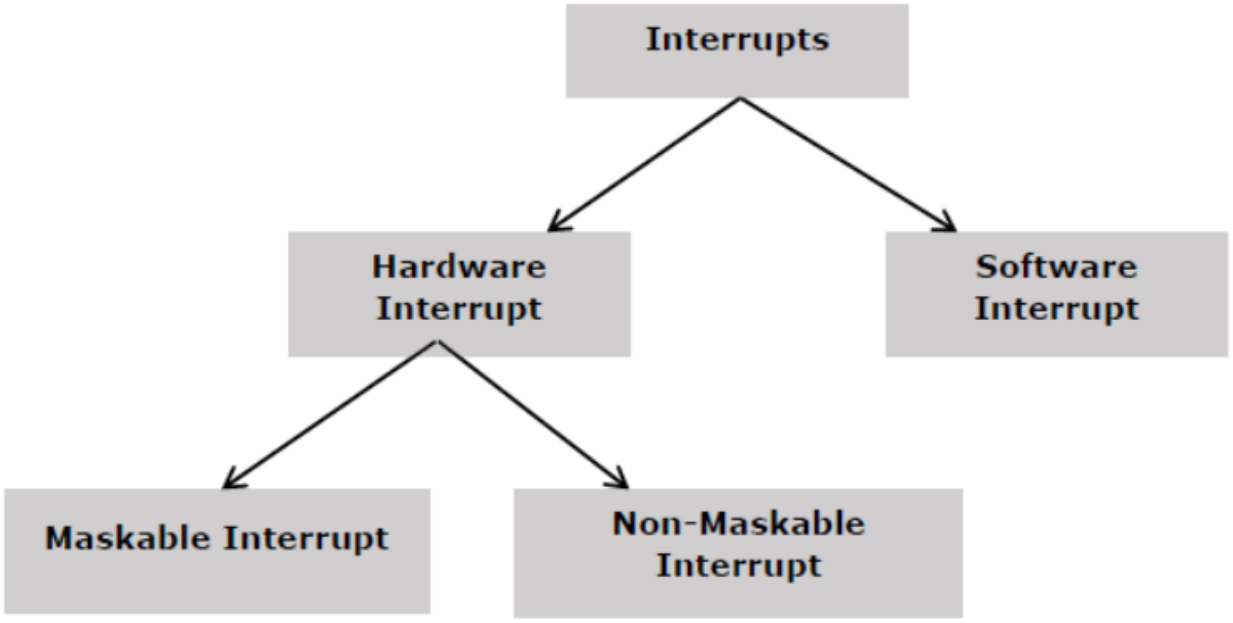


Block Diagram of 8086 Microprocessor

- **INTR:** This signal is used to signal an interrupt from an external device.
- **NMI:** This signal is used to signal a non-maskable interrupt, which is an interrupt that cannot be ignored by the microprocessor.

Explain different types of 8086 interrupt.

Interrupt is the method of creating a temporary halt during program execution and allows peripheral devices to access the microprocessor. The microprocessor responds to that interrupt with an **ISR (Interrupt Service Routine)**, which is a short program to instruct the microprocessor on how to handle the interrupt.



Hardware Interrupts

Hardware interrupt is caused by any peripheral device by sending a signal through a specified pin to the microprocessor.

The 8086 has two hardware interrupt pins, i.e. NMI and INTR. NMI is a non-maskable interrupt and INTR is a maskable interrupt having lower priority.

Software Interrupts

They interrupt instructions can be used to test the working of various interrupt handlers.

It includes −

INT- Interrupt instruction with type number

It is 2-byte instruction. First byte provides the op-code and the second byte provides the interrupt type number.

- **TYPE 0** interrupt represents division by zero situation.
- **TYPE 1** interrupt represents single-step execution during the debugging of a program.
- **TYPE 2** interrupt represents non-maskable NMI interrupt.
- **TYPE 3** interrupt represents break-point interrupt.
- **TYPE 4** interrupt represents overflow interrupt.

INTO - Interrupt on overflow instruction

It is a 1-byte instruction. The op-code for this instruction is CEH. It is a conditional interrupt instruction.

Explain different modes of 8254 programmable peripheral device with example timing diagram.

- **Mode 0 (Interrupt on Terminal Count):** This mode is typically used for event counting. When the counter reaches 0, an interrupt is generated.

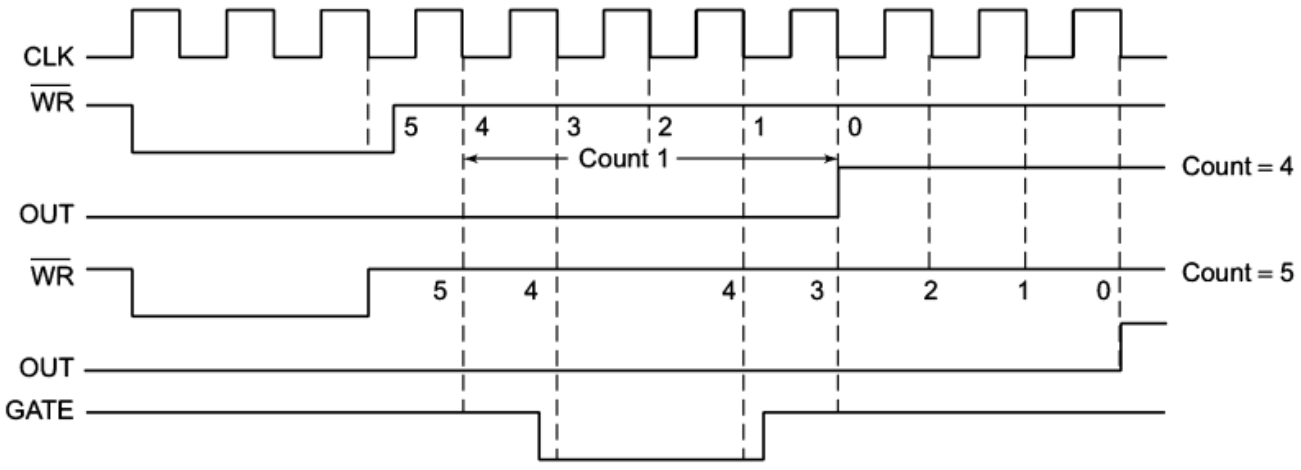


Fig. 6.3 *Waveforms of $\overline{WR}$, OUT and GATE in Mode 0*

- **Mode 1 (Programmable One Shot):** This mode is used to generate a one-shot pulse. When the counter reaches 0, the output goes low and remains low until the counter is reloaded with a new value.

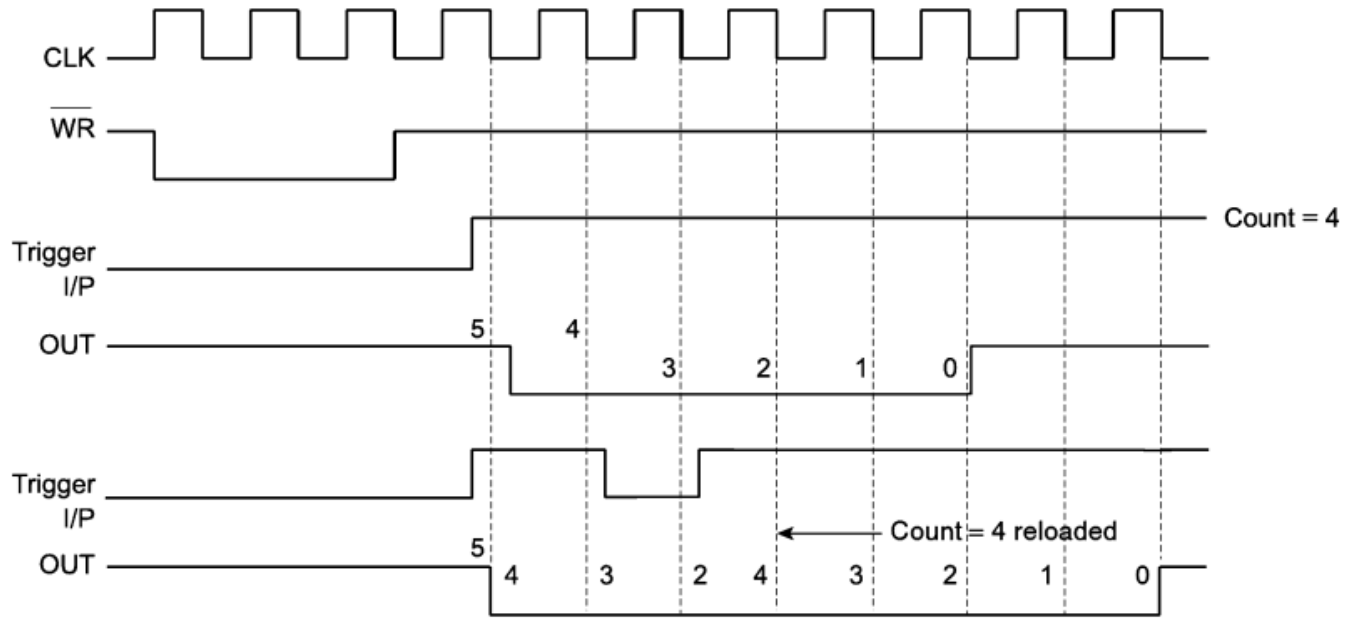


Fig. 6.4 *$\overline{WR}$, GATE and OUT Waveforms for Mode 1*

- **Mode 2 (Rate Generator):** This mode is used to generate a square wave with a period equal to the count value. The output goes high when the counter reaches 0 and goes low when the counter reaches the count value minus 1.

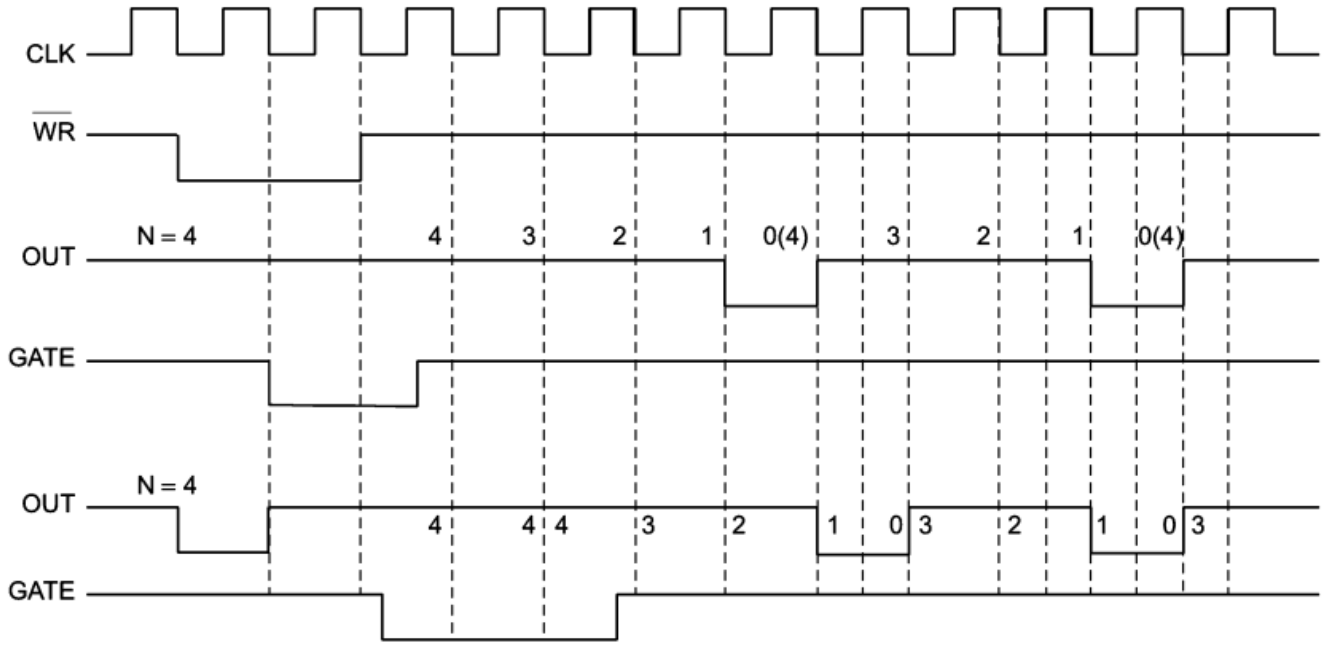


Fig. 6.5 *Waveforms at Pin $\overline{WR}$ and OUT In Mode 2*

- **Mode 3 (Square Wave Generator):** This mode is similar to mode 2, but the output is always high when the counter is counting down and goes low when the counter reaches 0.

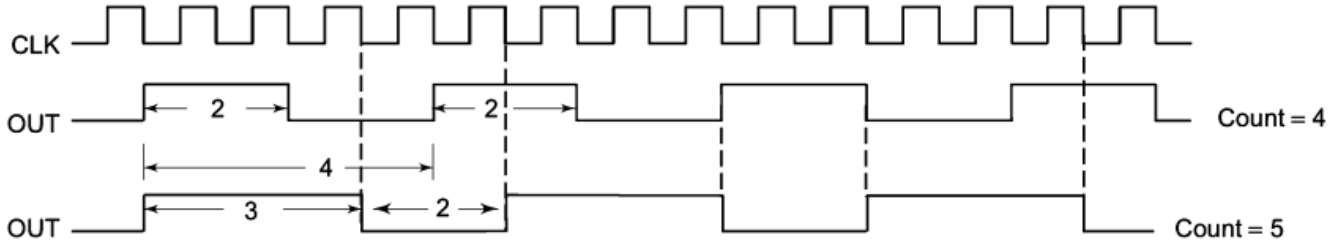


Fig. 6.6 *Waveforms for Mode 3*

- **Mode 4 (Software Triggered Strobe):** This mode is used to generate a strobe pulse. When the GATE input is asserted, the output goes high and remains high until the GATE input is de-asserted.

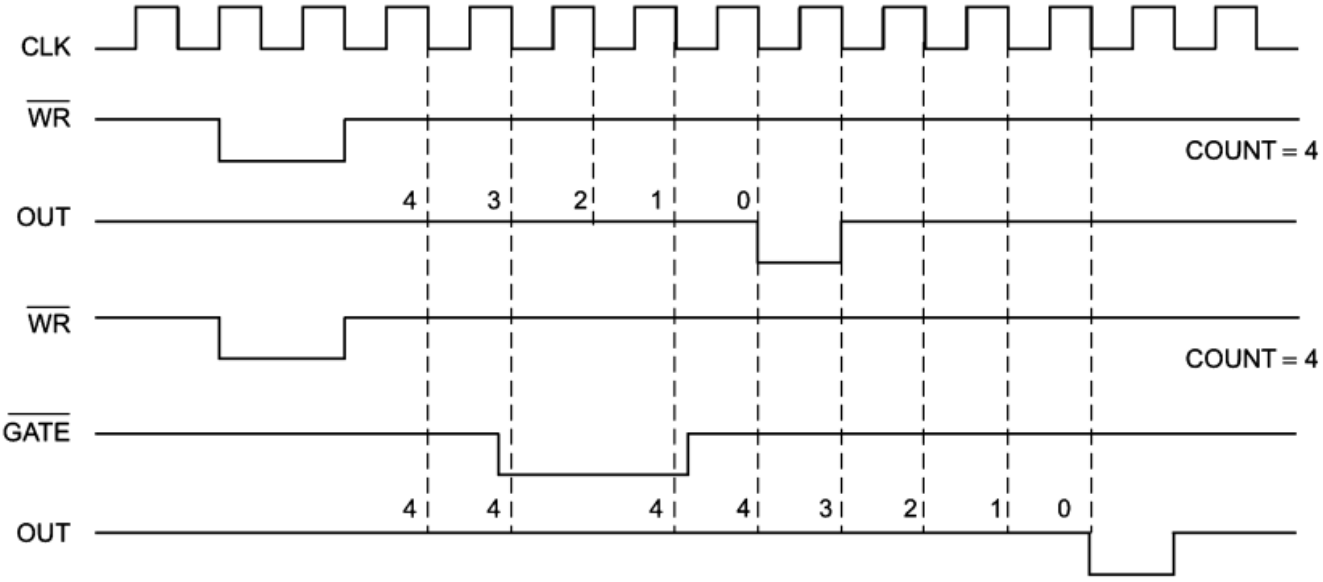


Fig. 6.7 $\overline{WR}$, *GATE and OUT Waveforms for Mode 4*

- **Mode 5 (Hardware Triggered Strobe):** This mode is similar to mode 4, but the strobe pulse is generated when the GATE input is asserted by an external signal.

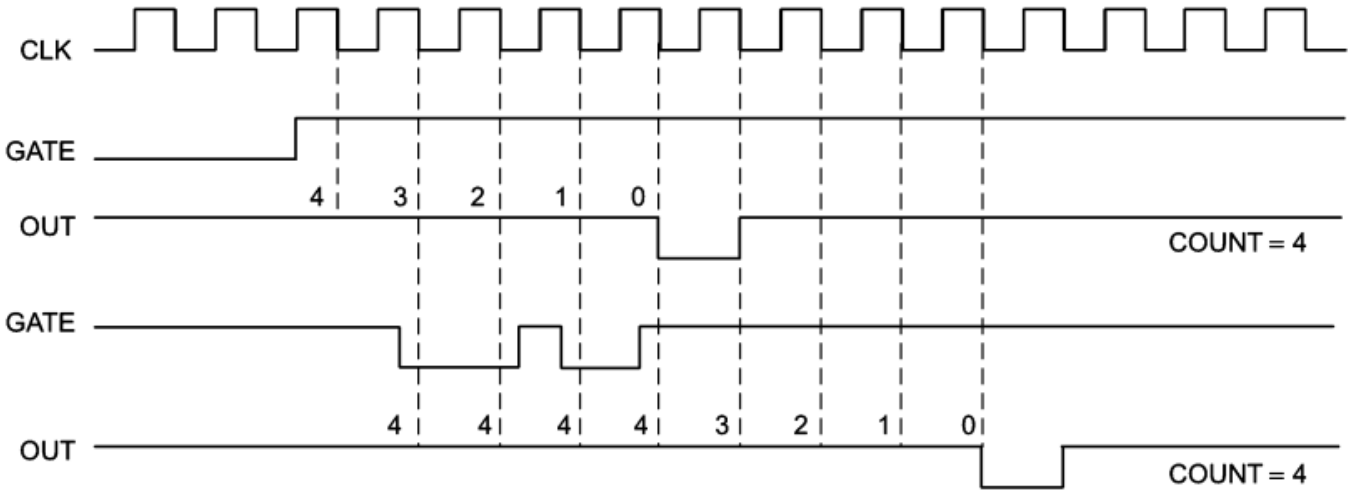


Fig. 6.8 *Waveforms in Mode 5*

Explain the Architecture and signal descriptions for 8253 chip. Also, explain the different operating modes of programmable timer device (8253).

Same as that of 8254