MODES OF 8253

4.4.5 Modes

The following text describes all possible modes. The modes used in the MZ-700 and set by the monitor's startup are mode 0, mode 2, and mode 3.

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. 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 (see the table above).
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 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. I mean the time of the logical 1 pulse.

For example, suppose to get an output frequency of 1,000 Hz (Hertz), the period would be 1 / 1,000 s = 1 ms (millisecond) or 1,000 µs (microseconds). If an input clock of 1 MHz (Mega-Hertz) 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: **$n=f_i$ divided by f_{out}.**
f_i = input clock frequency, f_{out} = output frequency, n = value to be loaded.

My example: f_i = 1 MHz = 1 x 10^6 Hz, f_{out} = 1 kHz = 1 x 10^3 Hz.

n = 1 x 10^6 Hz / 1 x 10^3 Hz = 1 x 10^3 = 1,000. This is the decimal value to be loaded or the hexadecimal value $03E8. The following program example uses the decimal load count.

```
B000 3E35       LD      A,$35     ; load control word
                                  ; for counter 0 mode 2
B002 3207E0     LD      ($E007),A ; into port $E007
                  ; for BCD count
B005 2104E0     LD      HL,$E004  ; address to the port
                  ; of counter 0
B008 3E00       LD      A,$00
B00A 77         LD      (HL),A    ; load least significant
                  ; byte of 1000 first
B00B 3E10       LD      A,$10
B00D 77         LD      (HL),A    ; load most significant
                  ; byte of 1000 last
B00E 3E01       LD      A,1
B010 3208E0     LD      ($E008),A ; start counter 0 is only
                  ; necessary for the MZ-700.
                  ; Not necessary for
                  ; counter #1 and #2
;
; The counter is now initialized and the output frequency
; will be 1000 Hz if the input frequency is 1 MHz.
```

If the count is loaded between output pulses, the present period will not be affected. A new period will occur during the next count sequence.

<table>
<tr><td>Mode 3</td><td>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.

For example, I'll setup counter #0 for a square wave frequency of 10 kHz (kilo-Hertz), assuming the input frequency is 1 MHz.

Please refer to the formula described at mode 2.
$1 \times 10^6 / 10 \times 10^3 = 100$. This is the decimal value to be loaded or the hexadecimal value $0064. The following program example uses the binary load count.

<pre>
B000 3E35   LD   A,$36   ; load control word
                                    ; for counter 0 mode 3
B002 3207E0   LD   ($E007),A ; into port $E007
                    ; for binary count
B005 2104E0   LD   HL,$E004 ; address to the port
                ; of counter 0
B008 3E00   LD   A,$64   ; equals to
                    ; 100 microseconds
                    ; for 10,000 Hz
B00A 77   LD   (HL),A   ; load least significant
                    ; byte of $0064 first
B00B 3E10   LD   A,$00
B00D 77   LD   (HL),A   ; load most significant
                    ; nyte of $0064 last
B00E 3E01   LD   A,1
B010 3208E0   LD   ($E008),A ; start counter 0 is only
                                    ; necessary for the MZ-700.
            ; Not necessary for counter
                    ; #1 and #2
;
; The counter is now initialized and the output frequency
; will be 10 kHz if the input frequency is 1 MHz.
</pre></td></tr>
<tr><td>Mode 4</td><td>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. First the mode is set, the output will be a logical 1.</td></tr>
<tr><td>Mode 5</td><td>Hardware Triggered Strobe

In this mode the rising edge of the trigger input will start the counting of the counter. The</td></tr>
</table>

	output goes low for one clock at the terminal count. The counter is retriggerable, 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.

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