

PWM

- ① PWM stands for Pulse width modulation
- ② PWM is a technique in which the width of the pulse is varied while keeping the frequency constant.
width of Pulse T_1 \downarrow freq const.
 T_2 \downarrow
Vary
- ③ Each PWM signal has two parts
 - ON time (High)
 - OFF time (low)
- ④ The fraction for which the signal is ON over a period is known as duty cycle.

$$\text{Duty Cycle} = \frac{T_{on}}{T_{on} + T_{off}} \times 100$$

- ⑤ PWM is used to control power to loads, such as DC motors, LEDs, heaters, etc.

T6LPC2148 supports two types
of controlled PWM outputs.

① Single Edge Controlled PWM

- rising edge is fixed at the start of PWM cycle.
- only the falling edge is adjustable.
- used to generate 6 PWM outputs.

② Double Edge Controlled PWM

- Both rising edge and falling edge can be controlled.
- offers more precise control of pulse width.
- supports 13 PWM outputs.

- D) PWM module is based on 32 bit timer counter
- D) C8051F020 provides 7 matched register:
- PWM MMR0 — controls frequency
 - PWM R~~R0~~ — PWM R6 — controls duty cycle or pulse width.

LPC 2148 Timer / Counter

- ① Timer is a specific type of clock which is used to measure the time intervals.
- ② Works by counting input clock pulses.
- ③ If clock frequency is known
$$\text{time period} = \frac{1}{\text{frequency}}$$
- ④ Using this, any delay can be generated.

Counter

- ① Similar to timer, but counts external events instead of internal clock.
- ② Used to measure frequency of external signals.

- ① LPC 2148 Contains two 32-bit timer / counter units.
- Timer 0 / Counter 0
 - Timer 1 / Counter 1
- ② Important Timer 0 Registers
- ③ TOIR - Interrupt Register
 - ④ TOTER - Timer Control Register
 - ⑤ TOCTCR - Counter Control Register
 - ⑥ TOTC - Timer Counter
 - ⑦ TORR - Prescale Register
 - ⑧ TOPC - Prescale Counter
 - ⑨ TOMR0 to TOMR3 - Match Registers
 - ⑩ TOMCR - Match Control Register

LCD 16x2

Pin No. Symbol

- | | |
|----|----------------------------|
| 1 | GND |
| 2 | VCC |
| 3 | CONT (Contrast) |
| 4 | RS (Reset) Register select |
| 5 | R/W (read / write) |
| 6 | EN (enable) |
| 7 | |
| 8 | |
| 9 | |
| 10 | Data pins
D7 to D14 |
| 11 | |
| 12 | |
| 13 | |
| 14 | |
| 15 | BL |



Data pins

D7 to D14

COH

CFH

LCD 16x2 Features

① Character Format

- 5x7 dots per character
- 5x10 dots optional

② Interface Modes

- 4 bit - D7-D4 are used as data bus.
- 8 bit - D7-D0 are used as data bus.

③ Display Data RAM (DDRAM)

- 80x8 bit memory to store
- More 80 character

④ Character Generator ROM (CGRAM)

- 160 characters in 5x7 format
- 32 characters in 5x10 format
- Stores built in characters.

⑤ Read / Write Support

- Both DRAM and CG RAM can be read & written by MPU

⑥ CG RAM Character Generator RAM

- used to generate custom characters
- size : 64×8 bits

Supports : 8 custom (8×8)

and 4 custom (8×10)

⑦ Instruction Set

- Clear Display
- Cursor Home
- Display ON/OFF
- Cursor Blink ON/OFF
- Cursor Shift / Display Shift
- Function Set