

POWERTIP TECH. CORP.

DISPLAY DEVICES FOR BETTER ELECTRONIC DESIGN

Specification For Approval

Customer : _____

Model Type : LCD Module

Sample Code : _____

Mass Production Code : PC1602LRU-CSO-K

Edit : 0

| Customer Sign | Sales Sign | Approved By | Prepared By |
|---------------|------------|-------------|-------------|
| | | | |

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1. SPECIFICATIONS

1.1 Features

- 16-characters, two-lines liquid crystal display of 5*7 dot matrix + cursor
- 1/16 Duty, 1/4 bias
- STN LCD, positive, yellow green
- Transflective LCD
- 12 o'clock viewing angle
- 8 bits parallel data input
- built-in LED backlight

1.2 Mechanical Specifications

- Outline dimension : 80.0mm(L)* 36.0mm(W)*14.2mm max.(H)
- Viewing area : 61.0mm *16.0mm
- Active area : 56.21mm *11.5mm
- Dot size : 0.56mm *0.66mm
- Dot pitch : 0.6mm *0.7mm
- Character Size : 2.96mm *5.56mm

1.3 Absolute Maximum Ratings

| Item | Symbol | Conditions | Min. | Max. | Unit |
|--------------------------|--------|------------|------|---------|------|
| Power supply Voltage | VDD | - | -0.3 | 7.0 | V |
| LCD drive Supply voltage | VDD-VO | - | 3.0 | 13 | V |
| Input voltage | VIN | - | -0.3 | VDD+0.3 | V |
| Operating temperature | TOPR | - | -20 | 70 | °C |
| Storage temperature | TSTG | - | -30 | 80 | °C |
| Humidity*1 | HD | - | - | 90 | %RH |

1.4 DC Electrical Characteristics

VDD=+5V±10%, VSS=0V, TA=25°C

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|----------------------|--------|-----------|------|------|------|------|
| Logic Supply voltage | VDD | - | 4.5 | 5 | 5.5 | V |
| “H” input voltage | VIH | - | 2.2 | - | VDD | V |
| “L” input voltage | VIL | - | -0.3 | - | 0.6 | V |
| “H” output voltage | VOH | - | 2.4 | - | - | V |
| “L” output voltage | VOL | - | - | - | 0.4 | V |
| Supply current | IDD | VDD=5V | - | 80 | - | mA |
| LCD driving voltage | VOP | VDD-VO | - | 4.6 | - | V |
| LCD driving voltage | VOP | -20°C | - | 4.8 | - | V |



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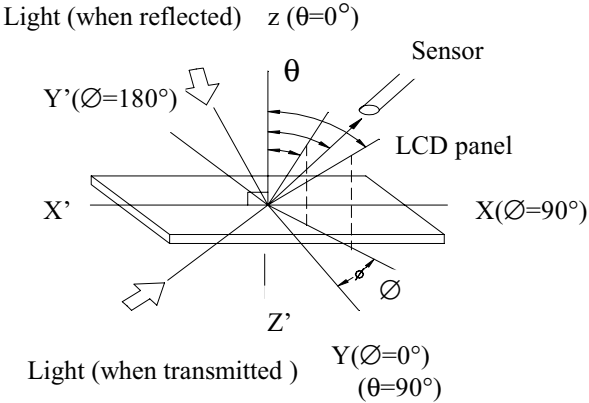
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1.5 Optical Characteristics

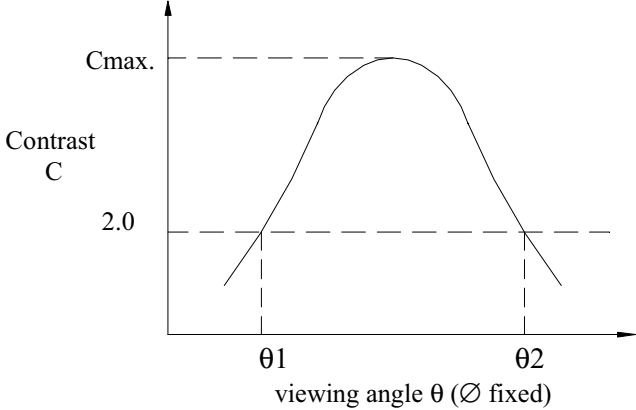
1/16 duty, 1/4 bias, Vopr=4.4V, Ta=25°C

| Item | Symbol | Conditions | Min. | Typ. | Max | Reference |
|---------------------|----------|---|-------------|-------|------------|-------------|
| Viewing angle | θ | $C \geq 2.0, \varnothing = 0^\circ C$ | -40° | - | 40° | Notes 1 & 2 |
| Contrast | C | $\theta = 5^\circ, \varnothing = 0^\circ$ | - | 3 | - | Note 3 |
| Response time(rise) | tr | $\theta = 5^\circ, \varnothing = 0^\circ$ | - | 100ms | 150ms | Note 4 |
| Response time(fall) | tf | $\theta = 5^\circ, \varnothing = 0^\circ$ | - | 450ms | 700ms | Note 4 |

Note 1: Definition of angles θ and \varnothing



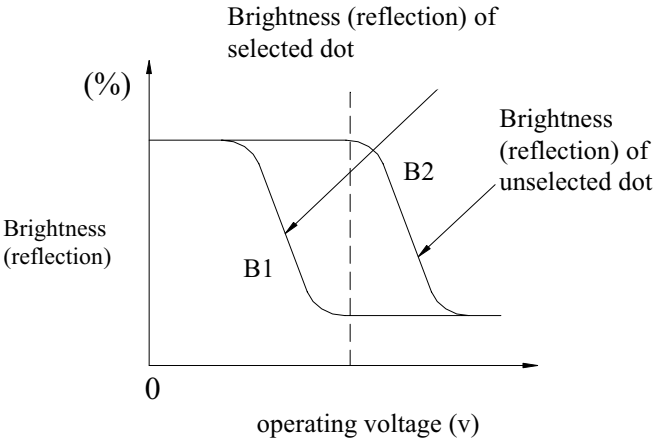
Note 2: Definition of viewing angles θ_1 and θ_2



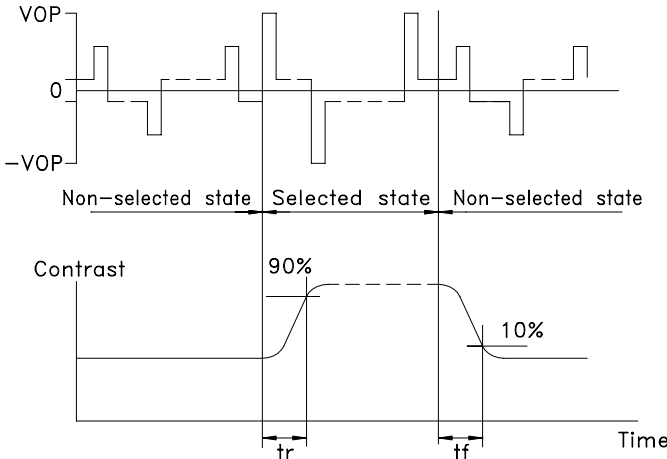
Note : Optimum viewing angle with the naked eye and viewing angle θ at Cmax. Above are not always the same

Note 3: Definition of contrast C

$$C = \frac{\text{Brightness (reflection) of unselected dot (B2)}}{\text{Brightness (reflection) of selected dot (B1)}}$$



Note 4: Definition of response time



Note: Measured with a transmissive LCD panel which is displayed 1 cm²

V_{OPR} : Operating voltage
 t_r : Response time (rise) f_{FRM} : Frame frequency
 t_f : Response time (fall)

1.6 Backlight Characteristic

The LCD Module is backlight using a LED panel

- .Maximum Ratings

| Item | Symbol | Conditions | Min. | Max. | Unit |
|-----------------------|--------|------------|------|------|------|
| Forward current | IF | TA=25°C | - | 225 | mA |
| Reverse voltage | VR | TA=25°C | - | 8 | V |
| Power dissipation | PO | TA=25°C | - | 1.04 | W |
| Operating Temperature | TOPR | - | -20 | 70 | °C |
| Storage temperature | TSTG | - | -40 | 80 | °C |

- .Electrical Ratings

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|--------------------|--------------|-----------|------|------|------|-------------------|
| Forward voltage | VF | IF=90mA | - | 4.2 | 4.6 | V |
| Reverse current | IR | VR=8V | - | - | 0.2 | mA |
| Luminous intensity | IV | IF=90 mA | 160 | 200 | - | cd/m ² |
| Wavelength | HUE | IF=90mA | 571 | - | 576 | nm |
| Color | Yellow Green | | | | | |



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2. MODULE STRUCTURE

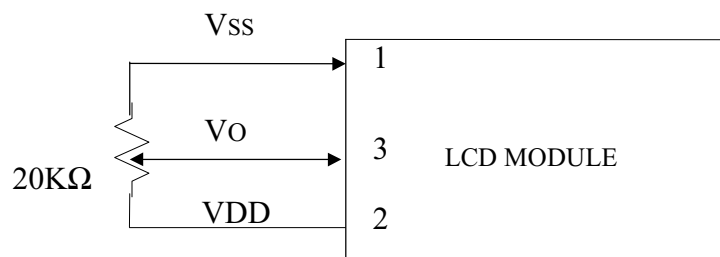
2.1 Counter Drawing

*See Appendix

2.2 Interface Pin Description

| Pin No. | Symbol | Signal Description |
|---------|-----------|---|
| 1 | VSS | Signal ground (GND) |
| 2 | VDD | Power Supply (5 V) |
| 3 | VO | Operating voltage (LCD Driver) |
| 4 | RS | Register Selection input High = Data register Low = Instruction register (for write) Busy flag address counter (for read) |
| 5 | R/W | Read/Write signal input is used to select the read/write mode High = Read mode, Low = Write mode |
| 6 | E | Start enable signal to read or write the data |
| 7~10 | DB0 ~ DB3 | Four low order bi-directional three-state data bus lines. Use for data transfer between the MPU and the LCD module. These four are not used during 4-bit operation. |
| 11~14 | DB4 ~ DB7 | Four high order bi-directional three-state data bus lines. Used for data transfer between the MPU and the LCD module. DB7 can be used as a busy flag. |
| 15 | A | Power supply LED backlight (+) |
| 16 | K | Power supply LED backlight (-) |

Contrast Adjust

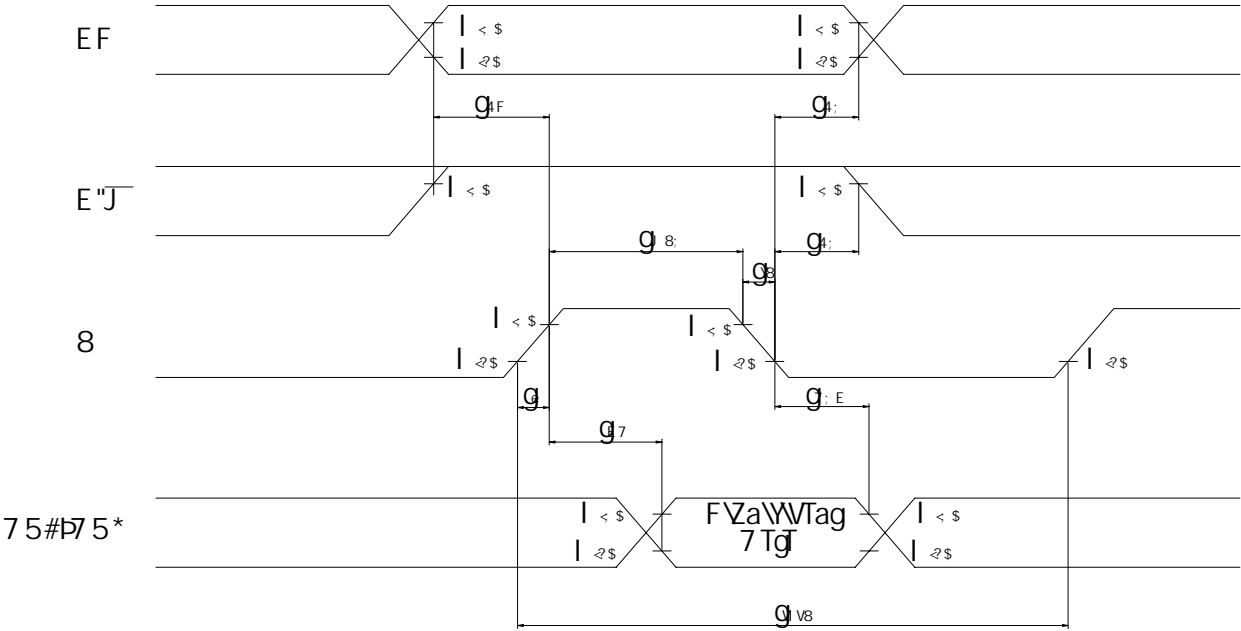


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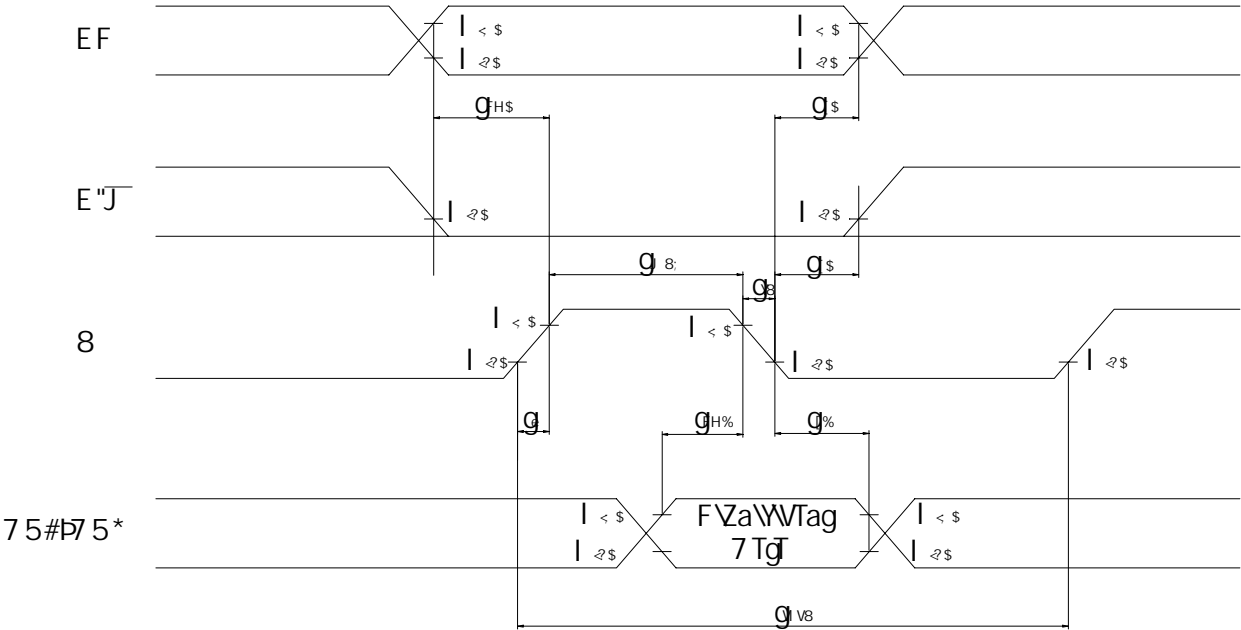
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2.3 Timing Characteristics

• Read cycle



• Write cycle



• Read cycle

VDD=5.0V± 10%, VSS=0V, Ta=-20 to 75°C

| Characteristics | Symbol | Condition | Min. | Typ. | Max. | Unit |
|------------------------------|------------------|-------------|------|------|------|------|
| Enable cycle time | t_{cycE} | - | 500 | - | - | ns |
| Enable "H" level pulse width | t_{WEH} | - | 230 | - | - | ns |
| Enable rise/fall time | t_{rE}, t_{fE} | - | - | - | 20 | ns |
| RS,R/W setup time | t_{AS} | - | 40 | - | - | ns |
| RS,R/W address hold time | t_{AH} | - | 10 | - | - | ns |
| Read data output delay | t_{RD} | $C_L=100pF$ | - | - | 120 | ns |
| Read data hold time | t_{DHR} | | 5 | - | - | ns |

• Write cycle

| Characteristics | Symbol | Condition | Min. | Typ. | Max. | Unit |
|------------------------------|------------------|-----------|------|------|------|------|
| Enable cycle time | t_{cycE} | - | 500 | - | - | ns |
| Enable "H" level pulse width | t_{WEH} | - | 230 | - | - | ns |
| Enable rise/fall time | t_{rE}, t_{fE} | - | - | - | 20 | ns |
| RS,R/W setup time | t_{AS} | - | 40 | - | - | ns |
| RS,R/W address hold time | t_{AH} | - | 10 | - | - | ns |
| Data setup time | t_{DS} | - | 80 | - | - | ns |
| Write data hold time | t_{DH} | - | 10 | - | - | ns |



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2.4 Display Command

| Instructions | Instruction Code | | | | | | | | | | Description | Execution Time (fosc=270KHZ) |
|----------------------------|------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|---|---------------------------------|
| | RS | R/W | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 | | |
| Clear Display | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | Write "20H" to DDRAM. and set DDRAM address to "00H" from AC. | 1.53ms |
| Return Home | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | × | Set DDRAM address to "00H" from AC and return cursor to it's original position if shifted. The contents of DDRAM are not changed. | 1.53ms |
| Entry Mode Set | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | I/D | SH | Assign cursor moving direction and make shift of entire display enable. | 39μs |
| Display ON/OFF Control | 0 | 0 | 0 | 0 | 0 | 0 | 1 | D | C | B | Sets display (D), cursor(C), and blinking of cursor(B) on/off control bit. | 39μs |
| Cursor or Display Shift | 0 | 0 | 0 | 0 | 0 | 1 | S/C | R/L | × | × | Set cursor moving and display shift control bit, and the direction, without changing of DDRAM data. | 39μs |
| Function Set | 0 | 0 | 0 | 0 | 1 | DL | N | F | × | × | Set interface data length (DL:4 - bit/8-bit), numbers of display line (N: 1-line/2-line), display font type(F:5*8 dots/5*11 dots) | 39μs |
| Set CGRAM Address | 0 | 0 | 0 | 1 | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 | Set CGRAM address in address counter. | 39μs |
| Set DDRAM Address | 0 | 0 | 1 | AC6 | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 | Set DDRAM address in address counter. | 39μs |
| Read Busy Flag and Address | 0 | 1 | BF | AC6 | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 | Whether during internal operation or not can be known by reading BF. The contents of address counter can also be read. | 0μs |
| Write Data to RAM | 1 | 0 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Write data into internal RAM (DDRAM/CGRAM). | 43μs |
| Read Data from RAM | 1 | 1 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Read data from internal RAM (DDRAM/CGRAM). | 43μs |

※ "× ":don't care



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