

POWERTIP TECH. CORP.

DISPLAY DEVICES FOR BETTER ELECTRONIC DESIGN

Specification For Approval

Customer : _____

Model Type : LCD MODULE

Sample Code : _____

Mass Production Code : PG9732LRF-CE3-H

Edition : 0

| Customer Sign | Sales Sign | Checked By (QA) | Approved By | Prepared By |
|---------------|------------|--------------------|-------------|-------------|
| | | | | |

Revision Record

| Date(y/m/d) | Rev. | Description | Note | Page |
|---------------------|-------------|--------------------|-------------|-------------|
| 2002/07/12 | 0 | Revised Contents | | |
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1. SPECIFICATIONS

1.1 Features

| Item | Standard Value |
|-------------------|--|
| Display Type | 97 * 32 dots |
| LCD Type | FSTN, White, Transflective, Positive, Extended Temp. |
| Driver Type | 1/33 Duty , 1/5 Bias |
| Viewing Direction | 6 O'clock |
| Backlight | Yellow-Green LED B/L |
| Weight | 10.2g |
| Other | - |

1.2 Mechanical Specifications

| Item | Standard Value | Unit |
|-------------------|---|------|
| Outline Dimension | 49.7mm(L) * 31.3mm (w) * 6.6mm (H)(Max) | mm |
| Viewing Area | 43.5mm(L) * 21.5mm (w) | mm |
| Active Area | 35.84mm(L) * 14.35mm (w) | mm |
| Dot Size | 0.32mm(L) * 0.40mm (w) | mm |
| Dot Pitch | 0.37mm(L) * 0.45mm (w) | mm |

1.3 Absolute Maximum Ratings

| Item | Symbol | Min. | Max. | Unit |
|--|--------------------|-------|----------------------|------|
| Supply voltage range | Triple boosting | -0.3 | 6.0 | V |
| | Quadruple boosting | -0.3 | 4.5 | |
| Supply voltage range (1) (V _{DD} Level) | V5, VOUT | -18.0 | 0.3 | V |
| Supply voltage range (2) (V _{DD} Level) | V1, V2, V3, V4 | V5 | 0.3 | V |
| Input voltage range | V _{IN} | -0.3 | V _{DD} +0.3 | V |
| Output voltage range | V _O | -0.3 | V _{DD} +0.3 | V |
| Operating temperature | T _{OPR} | -20 | 70 | |
| Storage temperature | T _{STR} | -30 | 80 | |
| Humidity | HD | - | 90 | %RH |



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1.4 DC Electrical Characteristics

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|----------------------|----------|-------------------------------|--------------|------|-------------|------|
| Logic Supply Voltage | V_{DD} | - | 2.4 | - | 6.0 | V |
| “H” Input Voltage | V_{IH} | - | $0.8 V_{DD}$ | - | V_{DD} | V |
| “L” Input Voltage | V_{IL} | - | V_{SS} | - | $0.2V_{DD}$ | V |
| “H” Output Voltage | V_{OH} | $I_{OH}=-0.5mA$ | $0.8 V_{DD}$ | - | V_{DD} | V |
| “L” Output Voltage | V_{OL} | $I_{OL}=0.5mA$ | V_{SS} | - | $0.2V_{DD}$ | V |
| Supply Current | I_{DD} | $V_{DD} = 5.0 V$ | - | 0.2 | 0.5 | mA |
| LCD Driver Voltage | V_{OP} | $V_{DD} - V_O (-20^{\circ}C)$ | - | - | - | V |
| | | $V_{DD} - V_O (25^{\circ}C)$ | - | 6.2 | - | |
| | | $V_{DD} - V_O (70^{\circ}C)$ | - | - | - | |

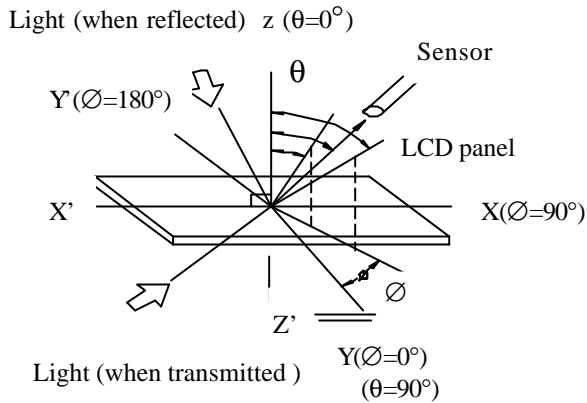
1.5 Optical Characteristics

1/33 duty, 1/5bias, $V_{OP}=6.2V$, $T_a=25^{\circ}C$

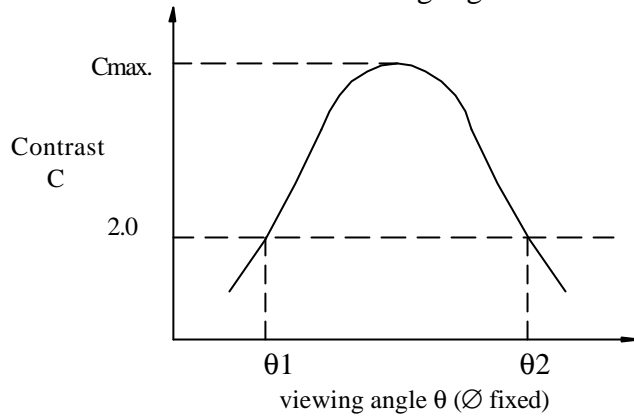
| Item | Symbol | Conditions | Min. | Typ. | Max | Reference |
|---------------------|----------|---|--------------|-------|-------|-------------|
| Viewing angle | θ | $C \geq 2.0, \varnothing = 0^{\circ}$ | 30° | - | - | Notes 1 & 2 |
| Contrast | C | $\theta = 5^{\circ}, \varnothing = 0^{\circ}$ | - | 3 | - | Note 3 |
| Response time(rise) | T_r | $\theta = 5^{\circ}, \varnothing = 0^{\circ}$ | - | 120ms | 180ms | Note 4 |
| Response time(fall) | T_f | $\theta = 5^{\circ}, \varnothing = 0^{\circ}$ | - | 150ms | 225ms | Note 4 |



Note 1: Definition of angles θ and \varnothing



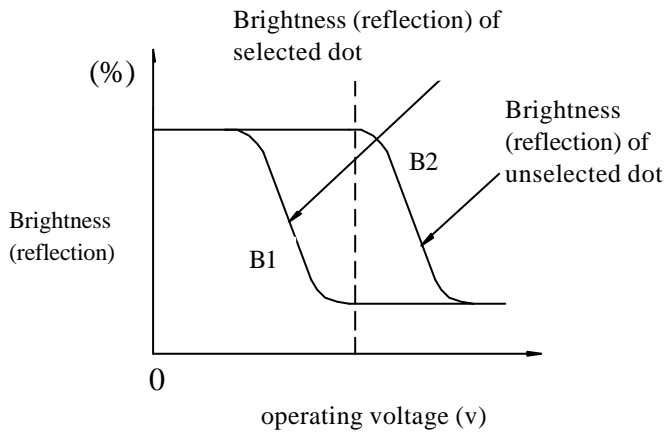
Note 2: Definition of viewing angles θ_1 and θ_2



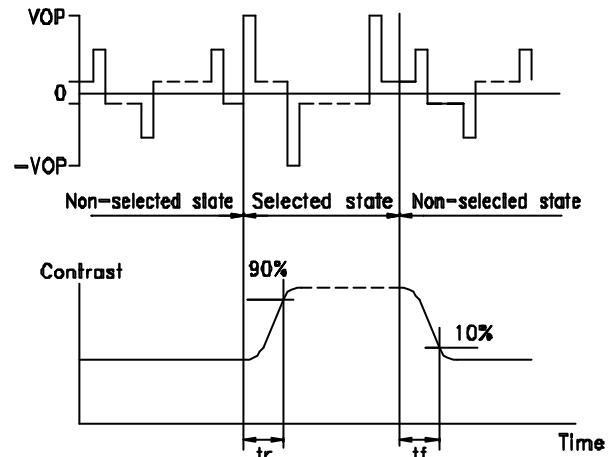
Note : Optimum viewing angle with the naked eye and viewing angle θ at C_{max} . Above are not always the same

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)



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1.6 Backlight Characteristics

LCD Module with LED Backlight

Maximum Ratings

| Item | Symbol | Conditions | Min. | Max. | Unit |
|-----------------------|-----------------|----------------------|------|------|------|
| Forward Current | I _F | T _a =25°C | - | 200 | mA |
| Reverse Voltage | V _R | T _a =25°C | - | 4 | V |
| Power Dissipation | P _O | T _a =25°C | - | 0.5 | W |
| Operating Temperature | T _{OP} | - | -20 | 70 | °C |
| Storage Temperature | T _{ST} | - | -40 | 80 | °C |

Electrical Ratings

T_a =25°C

| Item | Symbol | Conditions | Min. | Typ. | Max. | Unit |
|--|----------------|-----------------------|------|------|------|-------------------|
| Forward Voltage | V _F | I _F =80 mA | - | 2.1 | 2.5 | V |
| Reverse Current | I _R | V _R =4V | - | - | 0.2 | mA |
| Luminous Intensity (with LCD, Dots Off) | I _v | I _F =80 mA | 14 | 17 | - | cd/m ² |
| Wavelength | λ | I _F =80 mA | 569 | - | 576 | nm |
| Color | Yellow-Green | | | | | |

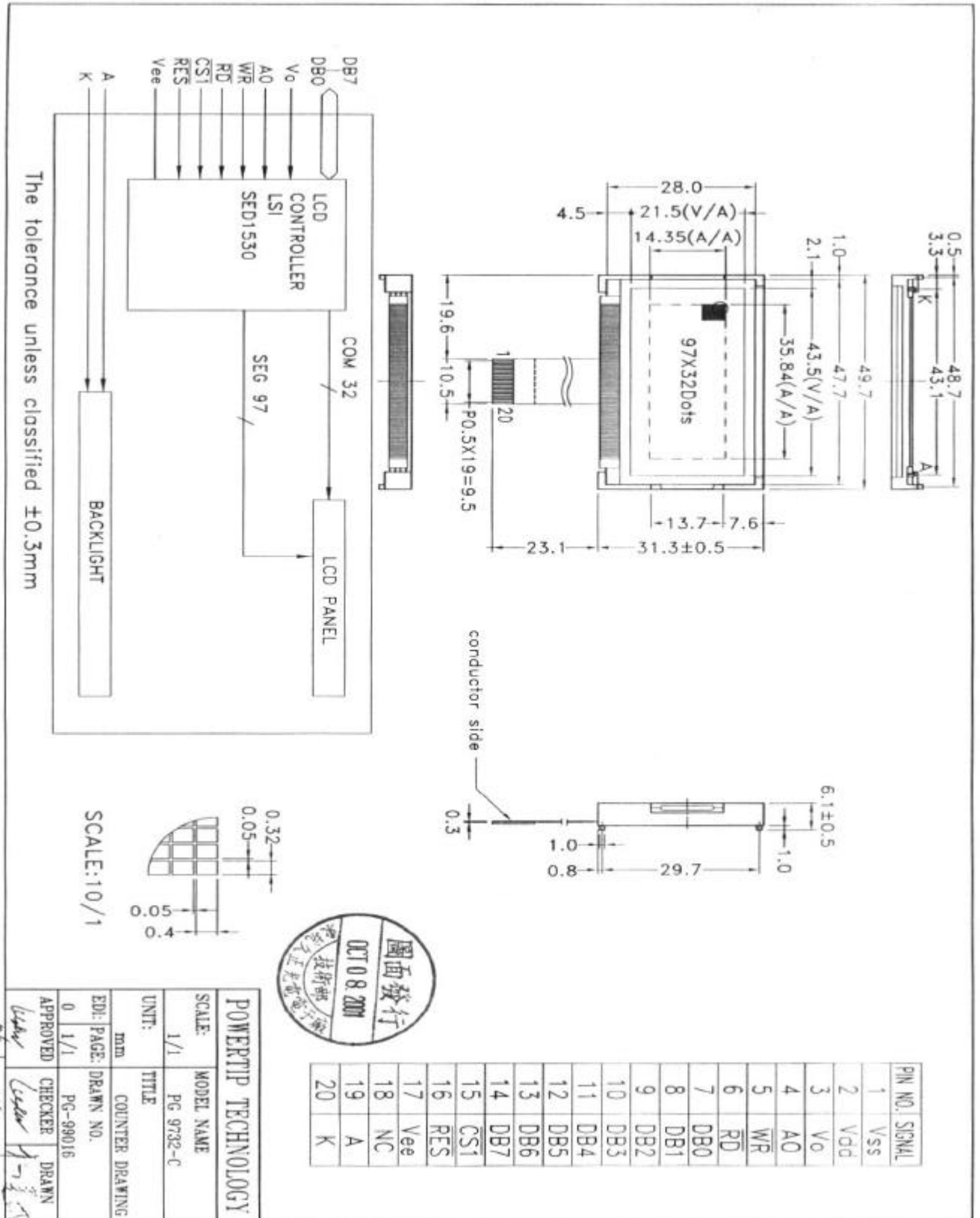


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2. MODULE STRUCTURE

2.1 Counter Drawing

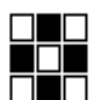
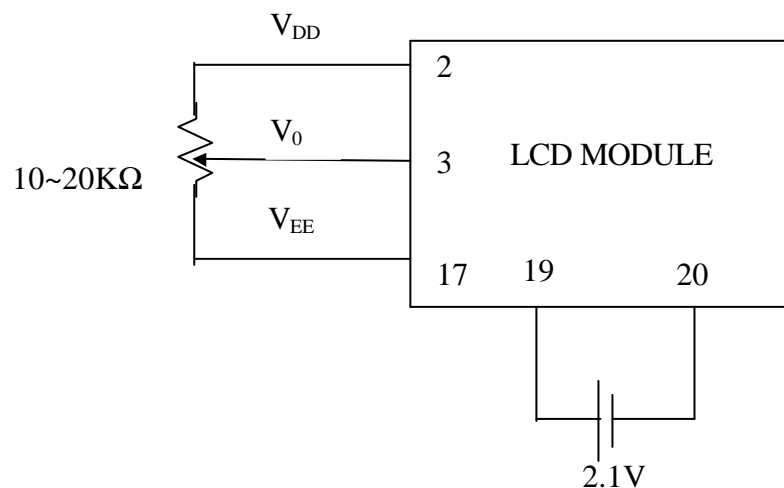


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2.2 Interface Pin Description

| Pin No. | Symbol | Function |
|---------|------------------|--|
| 1 | V_{SS} | Power Supply ($V_{SS}=0$) |
| 2 | V_{DD} | Power Supply ($V_{DD}>V_{SS}$) |
| 3 | V_O | Voltage adjust pin for s/w contrast |
| 4 | A_0 | Control/Display data flag input |
| 5 | \overline{WR} | Write enable input (write is active low) |
| 6 | \overline{RD} | Enable clock input (active high) |
| 7-14 | DB0~ DB7 | 8-bit bi-directional data bus to be connected to the standard 8-bit or 16-bit microprocessor data bus. When the serial interface selects; D7:Serial data input (SI) D6:Serial clock input (SCL) |
| 15 | $\overline{CS1}$ | Chip select input. |
| 16 | \overline{RES} | Reset signal |
| 17 | V_{EE} | DC/DC converter (booster) output |
| 18 | NC | No connection |
| 19 | A | Power supply for LED B / L (+) |
| 20 | K | Power supply for LED B / L (-) |

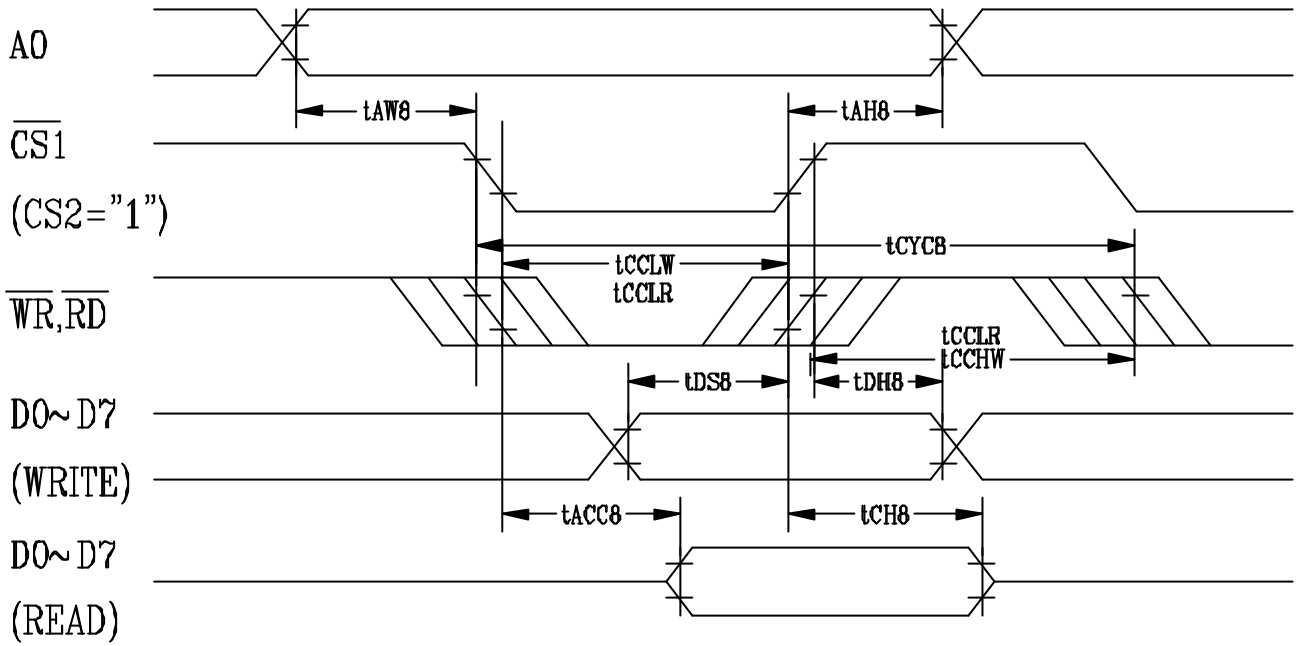
Contrast Adjust



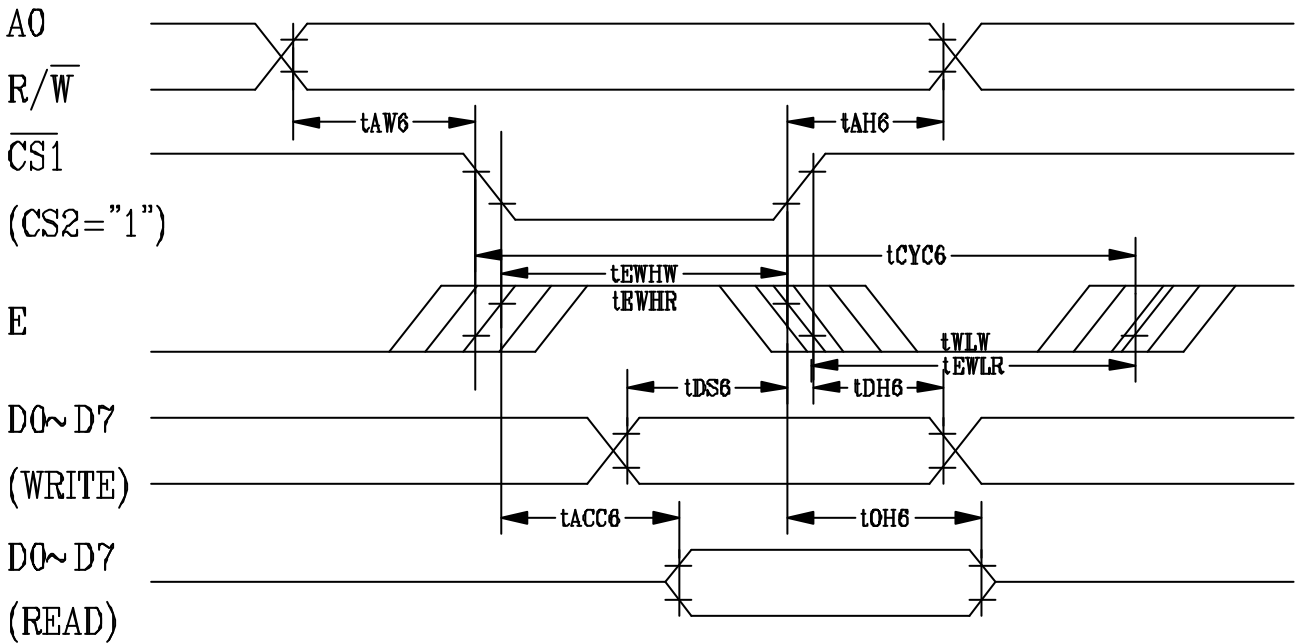
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2.3 Timing Characteristics

- Read/Write characteristics I (8080-series microprocessor)



- Read/Write characteristics II (6800-series microprocessor)



•Read/Write characteristics I (8080-series microprocessor)

V_{DD}=5.0V±10%, T_a=25°C

| Item | Symbol | Conditions | Min. | Max. | Unit | Signal |
|-----------------------|--------------------------------|------------|------|------|------|------------------------|
| Address hold time | t _{AH8} | - | 10 | - | ns | A0 |
| Address setup time | t _{AW8} | - | 10 | - | ns | |
| System cycle time | t _{CYC8} | - | 166 | - | ns | |
| Control L pulse width | t _{CCLW} | - | 30 | - | ns | $\overline{\text{WR}}$ |
| Control L pulse width | t _{CCLR} | - | 70 | - | ns | $\overline{\text{RD}}$ |
| Control H pulse width | t _{CCHW} | - | 100 | - | ns | $\overline{\text{WR}}$ |
| Control H pulse width | t _{CCHR} | - | 70 | - | ns | $\overline{\text{RD}}$ |
| Data setup time | t _{DS8} | - | 20 | - | ns | D0 to D7 |
| Data hold time | t _{DH8} | - | 10 | - | ns | |
| RD access time | t _{ACC8} | CL=100 PF | - | 70 | ns | |
| Output disable time | t _{CH8} | | 10 | 50 | ns | |
| Rise and fall time | t _r ,t _f | - | - | 15 | ns | |

V_{DD}=2.7V to 4.5V, T_a=25°C

| Item | Symbol | Conditions | Min. | Max. | Unit | Signal |
|-----------------------|--------------------------------|------------|------|------|------|------------------------|
| Address hold time | t _{AH8} | - | 19 | - | ns | A0 |
| Address setup time | t _{AW8} | - | 15 | - | ns | |
| System cycle time | t _{CYC8} | - | 450 | - | ns | |
| Control L pulse width | t _{CCLW} | - | 60 | - | ns | $\overline{\text{WR}}$ |
| Control L pulse width | t _{CCLR} | - | 140 | - | ns | $\overline{\text{RD}}$ |
| Control H pulse width | t _{CCHW} | - | 200 | - | ns | $\overline{\text{WR}}$ |
| Control H pulse width | t _{CCHR} | - | 140 | - | ns | $\overline{\text{RD}}$ |
| Data setup time | t _{DS8} | - | 40 | - | ns | D0 to D7 |
| Data hold time | t _{DH8} | - | 15 | - | ns | |
| RD access time | t _{ACC8} | CL=100 PF | - | 140 | ns | |
| Output disable time | t _{CH8} | | 10 | 100 | ns | |
| Rise and fall time | t _r ,t _f | - | - | 15 | ns | |



• Read/Write characteristics II (6800-series microprocessor)

VDD=5.0V±10%, Ta=25°C

| Item | Symbol | Conditions | Min. | Max. | Unit | Signal | |
|----------------------|--------------------------------|-------------------|------|------|------|----------|---|
| System cycle time | t _{CYC6} | - | 166 | - | ns | | |
| Address setup time | t _{AW6} | - | 10 | - | ns | A0 | |
| Address hold time | t _{AH6} | - | 10 | - | ns | W/R | |
| Data hold time | t _{DS6} | - | 20 | - | ns | D0 to D7 | |
| Data hold time | t _{DH6} | - | 10 | - | ns | | |
| Output disable time | t _{OH6} | CL=100 PF | 10 | 50 | ns | | |
| Access time | t _{ACC6} | | - | 70 | ns | | |
| Enable L pulse width | Read | t _{EWHR} | - | 70 | - | ns | E |
| | Write | t _{EWHW} | - | 30 | - | ns | |
| Enable H pulse width | Read | t _{EWLR} | - | 70 | - | ns | E |
| | Write | t _{EWLW} | - | 100 | - | ns | |
| Rise and fall time | t _r ,t _f | - | - | 15 | ns | - | |

VDD=2.7V to 4.5V, Ta=25°C

| Item | Symbol | Conditions | Min. | Max. | Unit | Signal | |
|----------------------|--------------------------------|-------------------|------|------|------|----------|---|
| System cycle time | t _{CYC6} | - | 450 | - | ns | | |
| Address setup time | t _{AW6} | - | 15 | - | ns | A0 | |
| Address hold time | t _{AH6} | - | 19 | - | ns | W/R | |
| Data hold time | t _{DS6} | - | 40 | - | ns | D0 to D7 | |
| Data hold time | t _{DH6} | - | 15 | - | ns | | |
| Output disable time | t _{OH6} | CL=100 PF | 10 | 100 | ns | | |
| Access time | t _{ACC6} | | - | 140 | ns | | |
| Enable L pulse width | Read | t _{EWHR} | - | 140 | - | ns | E |
| | Write | t _{EWHW} | - | 60 | - | ns | |
| Enable H pulse width | Read | t _{EWLR} | - | 140 | - | ns | E |
| | Write | t _{EWLW} | - | 200 | - | ns | |
| Rise and fall time | t _r ,t _f | - | - | 15 | ns | - | |



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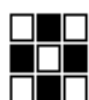
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2.4 Display Command

Reference SED 1530 technical Manual

| Command | Code | | | | | | | | | | | Function | |
|-------------------------------------|------|----|------------------------|------------------------|----|-----------------------|--------------------------|-----------------------|------------------|----|----|--|---|
| | A0 | RD | $\overline{\text{WR}}$ | $\overline{\text{D7}}$ | D6 | D5 | D4 | D3 | D2 | D1 | D0 | | |
| Display ON/OFF | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | Turns on LCD panel when goes high, and turns off when goes low. |
| Initial Display Line | 0 | 1 | 0 | 0 | 1 | Start display address | | | | | 1 | Specifies RAM display line for COM0. | |
| Set Page Address | 0 | 1 | 0 | 1 | 0 | 1 | 1 | Page address | | | | 1 | Sets the display RAM page in Page Address register. |
| Set Column Address 4 higher bits | 0 | 1 | 0 | 0 | 0 | 0 | 1 | Higher column address | | | | 1 | Sets 4 higher bits of column address of display RAM in register |
| Set Column Address 4 lower bits | 0 | 1 | 0 | 0 | 0 | 0 | 0 | Lower column address | | | | 1 | Sets 4 lower bits of column address of display RAM in register |
| Read Status | 0 | 0 | 1 | Status | | | | 0 | 0 | 0 | 0 | 0 | Reads the status information. |
| Write Display Data | 1 | 1 | 0 | Write data | | | | | | | | 0 | Writes data in display RAM. |
| Read Display Data | 1 | 0 | 1 | Read data | | | | | | | | 0 | Reads data from display RAM. |
| ADC Select | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | Sets normal relationship between RAM column address and segment driver when low, but reverses the relationship when high. |
| Normal/Reverse Display | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | Normal indication when low, but full indication when high. |
| Entire Display ON/OFF | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | Selects normal display (0) or Entire display ON (1). |
| Set LCD Bias | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | Sets LCD drive voltage bias ratio. |
| Read-Modify- Write | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | Increments Column Address counter during each write when high and during each read when low. |
| End | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | Releases the Read-Modify-Write. |
| Reset | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | Resets internal functions. |
| Set Output Status Register | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | * | * | * | * | Selects COM output scan direction. * Invalid data |
| Set Power Control | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | Operation status | | 0 | 0 | Selects the power circuit operation mode. |
| Set Electronic Control Register | 0 | 1 | 0 | 1 | 0 | 0 | Electronic control value | | | | 0 | Sets V5 output voltage to Electronic Control register. | |
| Set Standby | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | Selects standby status. 0: OFF 1:ON |
| Power Save | - | - | - | - | - | - | - | - | - | - | - | - | Compound command of display OFF and entire display ON |
| Test Command | 0 | 1 | 0 | 1 | 1 | 1 | 1 | * | * | * | * | * | IC Test command. Do not use! |

Note: Do not use any other command, or the system malfunction may result

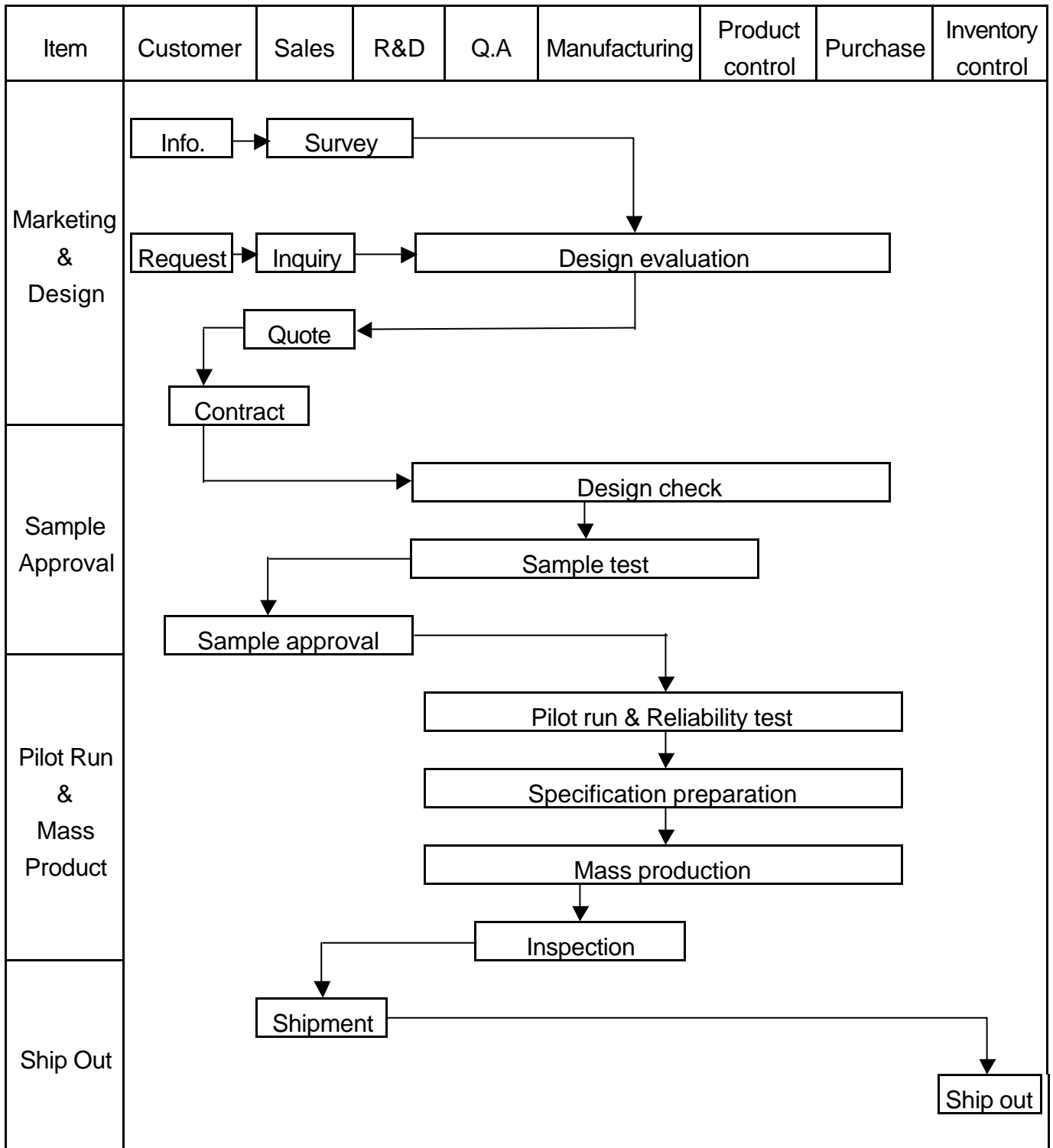


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3. QUALITY ASSURANCE SYSTEM

3.1 Quality Assurance Flow Chart



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| | |
|----------------------|--|
| <p>Sales Service</p> | <pre> graph TD Info[Info.] --> Claim[Claim] Claim --> FA[Failure analysis] FA --> AR[Analysis report] FA --> CA[Corrective action] CA --> Tracking[Tracking] </pre> |
| <p>Q.A Activity</p> | <ol style="list-style-type: none"> 1. ISO 9001 Maintenance Activities 2. Process improvement proposal 3. Equipment calibration 4. Education And Training Activities 5. Standardization Management |



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3.2 Inspection Specification

Inspection Standard : MIL-STD-105E Table Normal Inspection Single Sampling Level

Equipment : Gauge, MIL-STD, Powertip Tester, Sample.

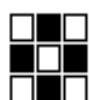
IQC Defect Level : Major Defect AQL 0.65; Minor Defect AQL 1.0.

FQC Defect Level : 100% Inspection.

OUT Going Defect Level : Sampling.

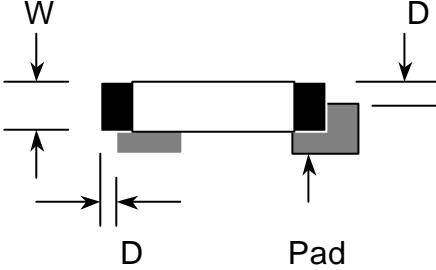
Specification :

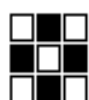
| NO | Item | Specification | Judge | Level |
|----|--|--|-------|-------|
| 1 | Part Number | Inconsistent with the P/N on the flow chart of production | N.G. | Major |
| 2 | Quantity | Inconsistent Q'TY with the flow chart of production | N.G. | Major |
| 3 | Electronic characteristics $A = (L + W) \div 2$ | Display short | N.G. | Major |
| | | Missing line | N.G. | Major |
| | | Dot missing $A > 1/2$ Dot size | N.G. | Major |
| | | No function | N.G. | Major |
| | | Out put data error | N.G. | Major |
| 4 | Appearance $A = (L + W) \div 2$ | Material difference with flow chart | N.G. | Major |
| | | LCD Assembled in opposite direction | N.G. | Major |
| | | Bezel assembled in opposite direction | N.G. | Major |
| | | Shadow within LCD $V./A + 1.0$ mm | N.G. | Major |
| | | Dirty particle $A > 0.4$ mm | N.G. | Minor |
| | Dirty particle (Include scratch, bubble) | Dirty particle length > 3.0 mm And 0.01 mm $<$ Width 0.05 mm (Width $>$ 0.05 mm Measure by area) | N.G. | Minor |
| | | Without protective film | N.G. | Minor |
| | | Conductive rubber over bezel | N.G. | Minor |
| 5 | PCB Appearance $A = (L + W) \div 2$ | Burned PCB | N.G. | Major |
| | | Green paint stripped & visible circuit $A > 1.0$ mm (Finish coat not counted in) | N.G. | Minor |
| | | A particle across the circuit | N.G. | Minor |
| | | Circuit split $> 1/2$ Circuit width | N.G. | Minor |
| | | Any circuit risen | N.G. | Minor |
| | | 0.2 mm $<$ Tin ball area $A \leq 0.4$ mm And Q'TY $>$ 4 Pieces | N.G. | Minor |
| | | Tin ball area $A > 0.4$ mm | N.G. | Minor |



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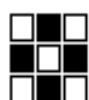
| NO | Item | Specification | Judge | Level |
|----|--|--|-------|-------|
| 6 | Molding appearance $A=(L+W) \div 2$ | Too soft : Shape by touch changed | N.G. | Major |
| | | Insufficient epoxy : IC circuit or IC pad visible | N.G. | Minor |
| | | Excessive epoxy : Diameter > 20mm Or High > 2.5mm | N.G. | Minor |
| | | Pin hole through to IC and A > 0.2mm | N.G. | Minor |
| 7 | Bezel appearance $A=(L+W) \div 2$ | Angle between frame and TAB > 45 +10 | N.G. | Minor |
| | | Electroplate strip A > 1.0mm (Top view only) | N.G. | Minor |
| | | Rust (Top view only) | N.G. | Minor |
| | | Crack | N.G. | Minor |
| 8 | Backlight electric characteristics $A=(L+W) \div 2$ | Error backlight color | N.G. | Major |
| | | No function | N.G. | Major |
| | | Any LED dot no function | N.G. | Major |
| | | PIN soldering without tin A > 1/2 solder pad | N.G. | Minor |
| | | Solder PIN high > 1.5mm | N.G. | Minor |
| 9 | LCD Appearance $A=(L+W) \div 2$ | Polarize rise over V/A | N.G. | Minor |
| 10 | Assembly parts $A=(L+W) \div 2$ | Components mark unclearly | N.G. | Minor |
| | | Components' distance more than 0.7mm from the PCB | N.G. | Minor |
| | | Error position ,not in center $D > 1/4W$ | N.G. | Minor |
| | |  | | |
| | | Non- solder area > Twice solder area | N.G. | Minor |
| | | Flux area A > 1/4 solder area | N.G. | Minor |
| | | Component broken | N.G. | Minor |



4. RELIABILITY TEST

4.1 Reliability Test Condition

| NO | Item | Test Condition | | Applicable Standard |
|----|-----------------------------------|---|----------------|---------------------|
| 1 | High Temperature Storage | Storage At 80 ± 2 96~100 hrs Surrounding Temperature , Then Storage At Normal Condition 4hrs. | | MIL-202E |
| 2 | Low Temperature Storage | Storage At -30 ± 2 96~100 hrs Surrounding Temperature, Then Storage At Normal Condition 4hrs. | | MIL-202E |
| 3 | High Temperature Humidity Storage | 1.Storage 96~100 hrs 60 ± 2 , 90~95%RH Surrounding Temperature, Then Storage At Normal Condition 4hrs .(Polarizer may fail in this environment). or 2.Storage 96~100 hrs 40 ± 2 , 90~95%RH Surrounding Temperature, Then Storage At Normal Condition 4 hrs. | | MIL-202E |
| 4 | Temperature Cycling | -20 25 70 25 (30Mins) (5Mins) (30Mins) (5Mins) 10 Cycle | | MIL-202E |
| 5 | Vibration | 10~55Hz (1 Minute) 1.5mm X,Y And Z Direction * (Each 2hrs) | | MIL-202E |
| 6 | Drop Test | Packing Weight (Kg) | Drop High (Cm) | MIL-810E |
| | | 0 ~ 45.4 | 122 | |
| | | 45.4 ~ 90.8 | 76 | |
| | | 90.8 ~ 454 | 61 | |
| | | Over 454 | 46 | |



POWERTIP TECHNOLOGY CORPORATION

DISPLAY DEVICES FOR BETTER ELECTRONIC DESIGN

5. PRECAUTION RELATING PRODUCT HANDLING

5.1 SAFETY

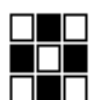
- 5.1.1 If the LCD panel breaks , be careful not to get the liquid crystal to touch your skin.
- 5.1.2 If the liquid crystal touches your skin or clothes , please wash it off immediately by using soap and water.

5.2 HANDLING

- 5.2.1 Avoid any strong mechanical shock which can break the glass.
- 5.2.2 Avoid static electricity which can damage the CMOS LSI—When working with the module , be sure to ground your body and any electrical equipment you may be using.
- 5.2.3 Do not remove the panel or frame from the module.
- 5.2.4 The polarizing plate of the display is very fragile. So , please handle it very carefully , do not touch , push or rub the exposed polarizing with anything harder than an HB pencil lead (glass , tweezers , etc.)
- 5.2.5 Do not wipe the polarizing plate with a dry cloth , as it may easily scratch the surface of plate.
- 5.2.6 Do not touch the display area with bare hands , this will stain the display area.
- 5.2.7 Do not use ketonics solvent & aromatic solvent. Use with a soft cloth soaked with a cleaning naphtha solvent.

5.3 STORAGE

- 5.3.1 Store the panel or module in a dark place where the temperature is 25 ± 5 and the humidity is below 65% RH.
- 5.3.2 Do not place the module near organics solvents or corrosive gases.
- 5.3.3 Do not crush , shake , or jolt the module.



5.4 TERMS OF WARRANTY

5.4.1 Applicable warrant period

The period is within thirteen months since the date of shipping out under normal using and storage conditions.

5.4.2 Unaccepted responsibility

This product has been manufactured to your company's specification as a part for use in your company's general electronic products. It is guaranteed to perform according to delivery specifications. For any other use apart from general electronic equipment , we cannot take responsibility if the product is used in medical devices , nuclear power control equipment , aerospace equipment , fire and security systems or any other applications in which there is a direct risk to human life and where extremely high levels of reliability are required.

