

LIQUID CRYSTAL DISPLAY MODULE

Product Specification

| | |
|---------------------------|----------------|
| PRODUCT NUMBER | LMR5407 |
|---------------------------|----------------|

| INTERNAL APPROVALS | | |
|--------------------|-------------|------------------|
| Product Manager | Engineering | Document Control |
| | | |

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REVISION RECORD

| Rev. | Date | Page | Par. | Comment | ECN no. |
|-------------|-------------|-------------|-------------|---|----------------|
| A | 11/21/08 | -- | -- | New DCA Specification – Combined all LMR5407 Versions | E3925 |
| B | 11/18/09 | 5,29 | -- | Transflective Positive mode added. | E4214 |
| C | 11/03/10 | 6,7 | -- | Added note on recommended FPC bend radius | E4366 |
| D | 1/18/11 | 35 | -- | Inspection standard updated | E4421 |
| | | | | | |
| | | | | | |
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| | | | | | |

1 PRODUCT SPECIFICATION

1.1 GENERAL SPECIFICATIONS

| ITEM | CONTENTS | UNIT |
|--------------------------|------------------------------------|---------|
| Outline Dimensions* | 35.0 (W) x 17.14 (H) x 4.8 Max (D) | mm |
| Display Format | 128 x 64 | Dots |
| Viewing Area | 28.0 (W) x 14.1 (H) | mm |
| Dot Size | 0.17 x 0.17 | mm |
| View Angle | 6:00 | O'clock |
| Duty Ratio | 1/65 | Duty |
| Bias | 1/9 | Bias |
| Module Operating Voltage | 3.0 | V |
| LCD Operating Voltage | 10.0 | V |
| Operating Temp. | -20~80 | °C |
| Storage Temp. | -30~80 | °C |
| LCD Driver | NT7534H | - |
| RoHS Complaint | Yes | - |

*Important Note: The outline dimensions for Sunburst Yellow backlight type will be 35.0 (W) x 17.14 (H) x 5.30 Max (D) mm due to the addition of Yellow filter.

1.2 AVAILABLE FLUID AND POLARIZER TYPES

| LCD TYPE | | STN | | FSTN | |
|---------------|----------|--------------|------------|--------------|------------|
| | | Normal Temp. | Wide Temp. | Normal Temp. | Wide Temp. |
| Transmissive | Negative | N/A | ✓ | N/A | ✓ |
| Transflective | Positive | N/A | N/A | N/A | ✓ |

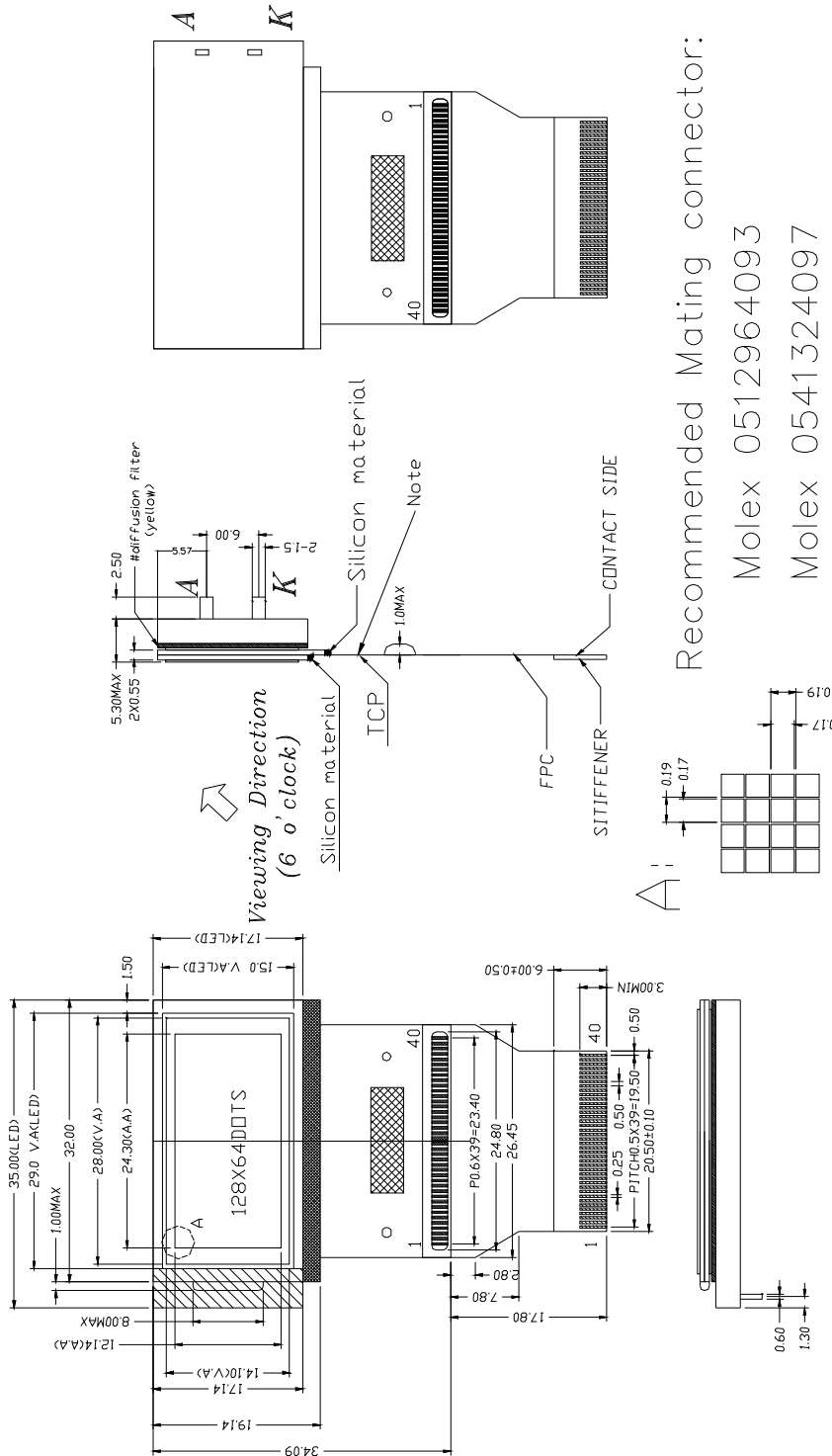
1.3 AVAILABLE BACKLIGHT TYPES AND COLORS

| BACKLIGHT COLOR | Jade Green | Arctic White | Warm Amber | Midnight Blue | Tangerine Orange | Sunburst Yellow |
|-----------------|------------|--------------|------------|---------------|------------------|-----------------|
| Edge LED | ✓ | ✓ | N/A | ✓ | ✓ | ✓ |

1.4 CHOICE OF BACKLIGHT COLORS AND LCD SURFACE LUMINOSITIES

| - | MIDNIGHT BLUE | JADE GREEN | TANGERINE ORANGE | SUNBURST YELLOW | ARCTIC WHITE | UNIT |
|------|---------------|------------|------------------|-----------------|--------------|-------------------|
| FSTN | 11.0 | 3.5 | 4.9 | 68.0 | 70.0 | Cd/m ² |
| STN | N/A | N/A | N/A | N/A | 83.0 | Cd/m ² |

2.2 FOR SUNBURST YELLOW BACKLIGHT TYPE



Recommended Mating connector:
Molex 0512964093
Molex 0541324097

Note: FPC/TCP recommended minimum bend radius is 2mm for a 90 degree bend,
a 180 degree bend requires a larger radius to prevent creasing.
Unspecified tolerance is +/-0.2mm

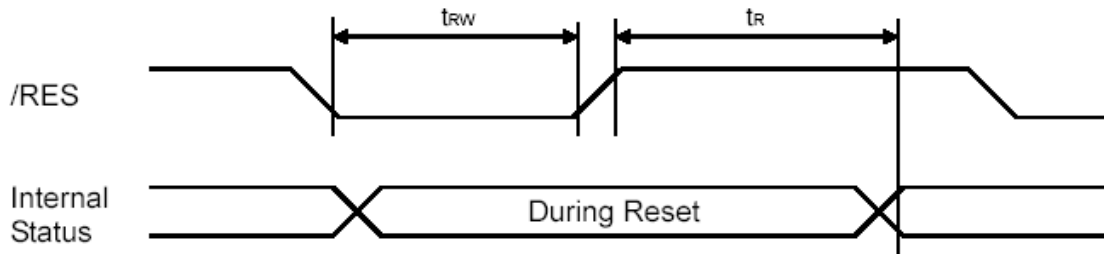
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3 ABSOLUTE MAXIMUM RATINGS

| Characteristics | Symbol | Ratings |
|---------------------|----------------------|-------------------|
| DC Supply Voltage | VDD, VDD2 | -0.3V to +3.6V |
| DC Supply Voltage | VOUT, V ₀ | -0.3V to +12V |
| Input Voltage Range | V _{IN} | -0.3V to VDD+0.3V |

4 RESET TIMING



(VDD = 2.7 ~ 3.6V, Ta = -40 ~ +85°C)

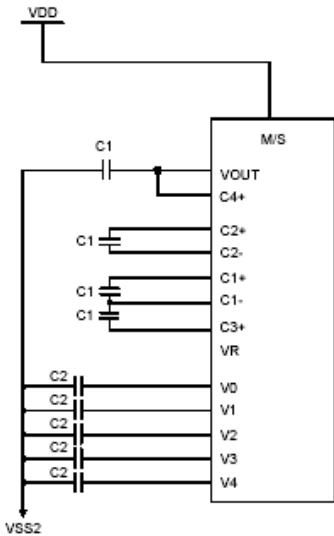
| Symbol | Parameter | Min. | Typ. | Max. | Unit | Condition |
|-----------------|-----------------------|------|------|------|------|-----------|
| t _R | Reset Time | - | - | 1.0 | μs | |
| t _{RW} | Reset low pulse width | 10 | - | - | μs | /RES |

5 PIN CONNECTIONS

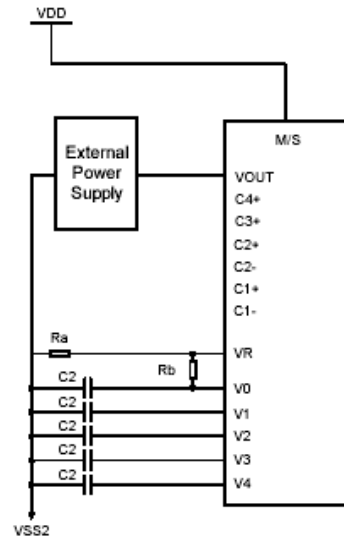
| Pin No. | Symbol | Function |
|---------|--------------------|---|
| 1 ~ 2 | NC | No connection |
| 3 | CL | This is the display clock input terminal |
| 4 | /CS1 | Chip Select signal |
| 5 | CS2 | Chip Select signal |
| 6 | RES | Reset Signal |
| 7 | A0 | This is connected to the least significant bit of the normal MPU address bus, and it determines whether the data bits are data or a command |
| 8 | /RW | Write Select |
| 9 | /RD | Read Select |
| 10~17 | D0~D7 | Data Bus Line |
| 18~19 | DUTY0-DUTY1 | Select the LCD driver duty |
| 20 | VDD | Logic Supply Voltage (+3.0V) |
| 21 | VSS | Ground (0V) |
| 22 | VOUT | DC/DC voltage converter output |
| 23 | CAP4+ | Capacitor 4+ pad for internal DC/DC voltage converter |
| 24 | CAP3+ | Capacitor 3+ pad for internal DC/DC voltage converter |
| 25 | CAP1- | Capacitor 1- pad for internal DC/DC voltage converter |
| 26 | CAP1+ | Capacitor 1+ pad for internal DC/DC voltage converter |
| 27 | CAP2+ | Capacitor 2+ pad for internal DC/DC voltage converter |
| 28 | CAP2- | Capacitor 2- pad for internal DC/DC voltage converter |
| 29~33 | V4, V3, V2, V1, V0 | LCD driving supply voltage. Connect to ground when internal power circuit is active |
| 34 | VR | Voltage adjustment pad |
| 35 | CLS | Terminal to select whether enable or disable the display clock internal oscillator circuit |
| 36 | C86 | This is the MPU interface switch terminal |
| 37 | P/S | This is the parallel data input/serial data input switch terminal |
| 38 | /HPM | This is the power control terminal for the power supply circuit for liquid crystal drive |
| 39 | IRS | This terminal selects the resistors for the Vo voltage level adjustment |
| 40 | NC | No connection |

6 THE STEP-UP VOLTAGE CIRCUITS

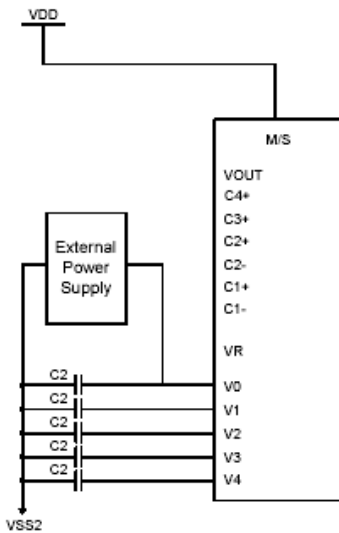
-When using all LCD power circuits
(Voltage booster, regulator and follower)
(In case of 4X boosting circuit and internal
regulator resistors, IRS=1)



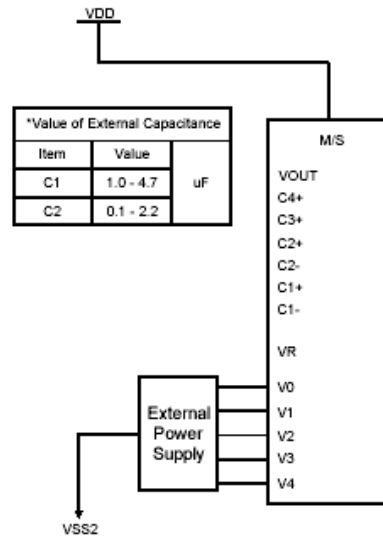
--When not using voltage booster circuits
(In case of external regulator resistors, IRS=0)



-When only using voltage follower

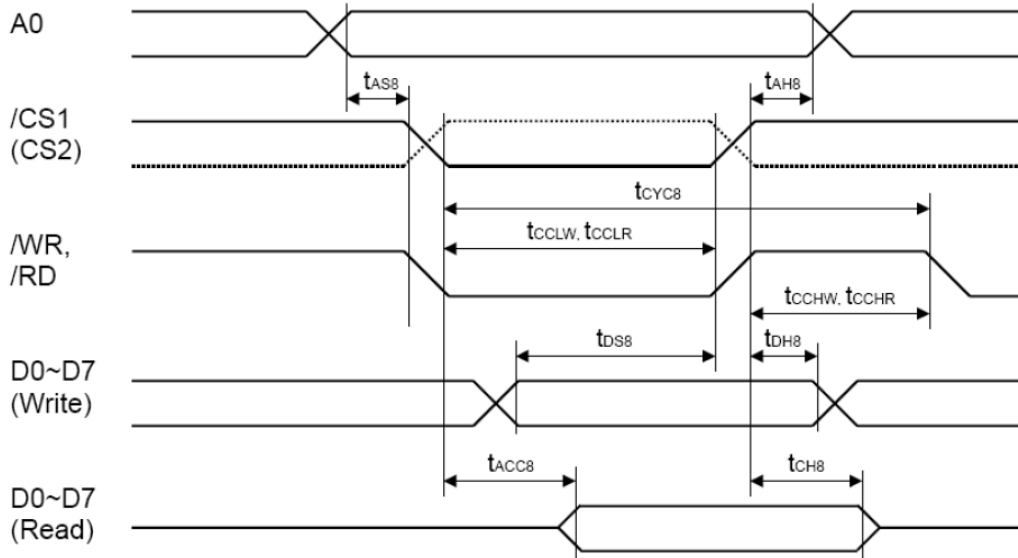


-When not using internal LCD power supply circuits



7 TIMING CHARACTERISTICS

System Buses Read/Write Characteristics (for 8080 Series MPU)



(VDD = 2.7 ~ 3.6V, Ta = -40 ~ +85°C)

| Symbol | Parameter | Min. | Typ. | Max. | Unit | Condition |
|-------------------|----------------------------------|------|------|------|------|-------------------|
| T _{AH8} | Address hold time | 0 | - | - | ns | A0 |
| T _{AS8} | Address setup time | 0 | - | - | ns | |
| t _{CYC8} | System cycle time | 240 | - | - | ns | |
| t _{CCLW} | Control low pulse width (write) | 90 | - | - | ns | /WR |
| t _{CCLR} | Control low pulse width (read) | 120 | - | - | ns | /RD |
| t _{CCHW} | Control high pulse width (write) | 100 | - | - | ns | /WR |
| t _{CCHR} | Control high pulse width (read) | 60 | - | - | ns | /RD |
| T _{DS8} | Data setup time | 40 | - | - | ns | D0~D7 |
| T _{DH8} | Data hold time | 10 | - | - | ns | |
| t _{ACC8} | /RD access time | - | - | 140 | ns | D0~D7, CL = 100pF |
| T _{CH8} | Output disable time | 5 | - | 50 | ns | |

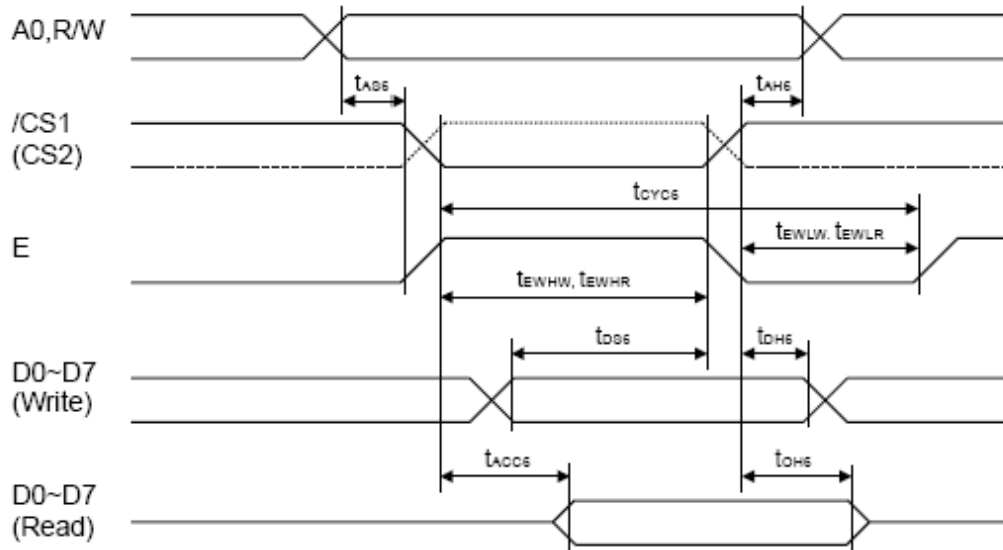
*1. The input signal rise time and fall time (t_r , t_f) is specified at 15ns or less.

($t_r + t_f$) < (t_{CYC8} - t_{CCLW} - t_{CCHW}) for write, ($t_r + t_f$) < (t_{CYC8} - t_{CCLR} - t_{CCHR}) for read.

*2. All timing is specified using 20% and 80% of VDD as the reference.

*3. t_{CCLW} and t_{CCLR} are specified as the overlap interval when /CS1 is low (CS2 is high) and /WR or /RD is low.

System Buses Read/Write Characteristics (for 6800 Series MPU)



(VDD = 2.7 ~ 3.6V, Ta = -40 ~ +85°C)

| Symbol | Parameter | Min. | Typ. | Max. | Unit | Condition |
|--------|----------------------------------|------|------|------|------|---------------------|
| tAHS | Address hold time | 0 | - | - | ns | A0, R/W |
| tAss | Address setup time | 0 | - | - | ns | |
| tCycs | System cycle time | 240 | - | - | ns | |
| tEWHW | Control high pulse width (write) | 90 | - | - | ns | E |
| tEWHR | Control high pulse width (read) | 120 | - | - | ns | E |
| tEWLW | Control low pulse width (write) | 100 | - | - | ns | E |
| tEWLR | Control low pulse width (read) | 60 | - | - | ns | E |
| tDss | Data setup time | 40 | - | - | ns | D0~D7 |
| tDHS | Data hold time | 10 | - | - | ns | |
| tAccs | /RD access time | - | - | 140 | ns | D0~D7 CL = 100pF |
| tOHS | Output disable time | 5 | - | 50 | ns | |

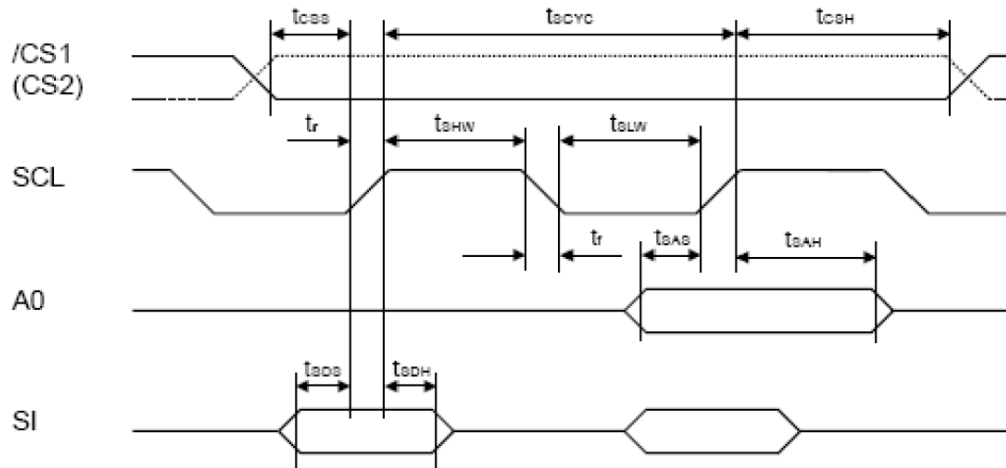
*1. The input signal rise time and fall time (t_r , t_f) is specified at 15ns or less.

($t_r + t_f$) < ($t_{Cycs} - t_{EWLW} - t_{EWHW}$) for write, ($t_r + t_f$) < ($t_{Cycs} - t_{EWLR} - t_{EWHR}$) for read.

*2. All timing is specified using 20% and 80% of VDD as the reference.

*3. t_{EWHW} and t_{EWHR} are specified as the overlap interval when /CS1 is low (CS2 is high) and E is high.

Serial Interface Timing



(VDD = 2.7 ~ 3.6V, Ta = -40 ~ +85°C)

| Symbol | Parameter | Min. | Typ. | Max. | Unit | Condition |
|--------|----------------------------|------|------|------|------|-----------|
| tscyc | Serial clock cycle | 120 | - | - | ns | SCL |
| tshw | Serial clock H pulse width | 60 | - | - | ns | SCL |
| tslw | Serial clock L pulse width | 60 | - | - | ns | SCL |
| tsas | Address setup time | 30 | - | - | ns | A0 |
| tsah | Address hold time | 20 | - | - | ns | A0 |
| tsds | Data setup time | 30 | - | - | ns | SI |
| tsdh | Data hold time | 20 | - | - | ns | SI |
| tcss | Chip select setup time | 20 | - | - | ns | /CS1, CS2 |
| tcsH | Chip select hold time | 40 | - | - | ns | /CS1, CS2 |

*1. The input signal rise time and fall time (t_r , t_f) is specified as 15ns or less.

*2. All timing is specified using 20% and 80% of VDD as the standard.

9 INSTRUCTION TABLE

| Command | A0 | /RD | /WR | Code | | | | | | | | Hex | Function | |
|--|----|-----|-----|------------|----|--------------------------|----|-----------------------|------------------|------|------------------|--|--|--|
| | | | | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | | | |
| (1) Display OFF | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | AEh AFh | Turn on LCD panel when high, and turn off when low |
| (2) Display Start Line Set | 0 | 1 | 0 | 0 | 1 | Display Start Address | | | | | 40h to 7Fh | Specifies RAM display line for COM0 | | |
| (3) Page Address Set | 0 | 1 | 0 | 1 | 0 | 1 | 1 | Page Address | | | | B0h to B8h | Set the display data RAM page in Page Address register | |
| (4) Column Address Set | 0 | 1 | 0 | 0 | 0 | 0 | 1 | Higher Column Address | | | 00h to 18h | Set 4 higher bits and 4 lower bits of column address of display data RAM in register | | |
| | 0 | 1 | 0 | 0 | 0 | 0 | 0 | Lower Column Address | | | | | | |
| (5) Read Status | 0 | 0 | 1 | Status | | | | 0 | 0 | 0 | 0 | XX | Reads the status information | |
| (6) Write Display Data | 1 | 1 | 0 | Write Data | | | | | | | | XX | Write data in display data RAM | |
| (7) Read Display Data | 1 | 0 | 1 | Read Data | | | | | | | | XX | Read data from display data RAM | |
| (8) ADC Select | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | A0h A1h | Set the display data RAM address SEG output correspondence |
| (9) Normal/Reverse Display | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | A6h A7h | Normal indication when low, but full indication when high |
| (10)Entire Display ON/OFF | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | A4h A5h | Select normal display (0) or entire display on |
| (11)LCD Bias Set | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | A2h A3h | Sets LCD driving voltage bias ratio |
| (12)Read-Modify-Write | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | E0h | Increments column address counter during each write |
| (13)End | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | EEh | Releases the Read-Modify-Write |
| (14)Reset | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | E2h | Resets internal functions |
| (15)Common Output Mode Select | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | * | * | * | C0h to CFh | Select COM output scan direction *: invalid data |
| (16)Power Control Set | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | Operation Status | | | 28h to 2Fh | Select the power circuit operation mode | |
| (17)V0 Voltage Regulator Internal Resistor ratio Set | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | Resistor Ratio | | | 20h to 27h | Select internal resistor ratio Rb/Ra mode | |
| (18)Electronic Volume mode Set | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 81h | |
| Electronic Volume Register Set | 0 | 1 | 0 | * | * | Electronic Control Value | | | | | XX | Sets the V0 output voltage electronic volume register | | |
| (19)Set Static indicator ON/OFF | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | ACH ADh | Sets static indicator ON/OFF 0: OFF, 1: ON |
| Set Static Indicator Register | 0 | 1 | 0 | * | * | * | * | * | * | Mode | | XX | Sets the flash mode | |
| (20)Power Save | 0 | 1 | 0 | - | - | - | - | - | - | - | - | - | - | Compound command of Display OFF and Entire Display ON |
| (21)NOP | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | E3h | Command for non-operation |

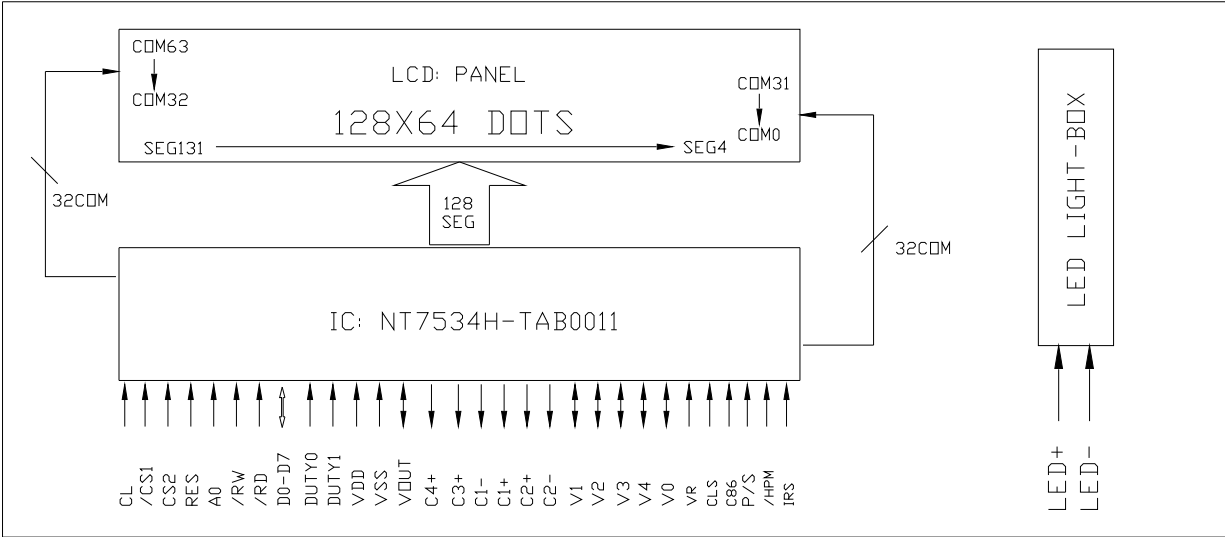
| Command | A0 | /RD | /WR | Code | | | | | | | | Hex | Function | |
|----------------------------------|----|-----|-----|------|----|--------------------|----------------|----------------|------------|----|----|---|--|--|
| | | | | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | | | |
| (22)Oscillation Frequency Select | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | E4h E5h | Select the oscillation frequency |
| (23)Partial Display mode Set | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 82h 83h | Enter/Release the partial display mode |
| (24)Partial Display Duty Set | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | Duty Ratio | | | 30h 37h | Sets the LCD duty ratio for partial display mode | |
| (25)Partial Display Bias Set | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | Bias Ratio | | | 38h 3Fh | Sets the LCD bias ratio for partial display mode | |
| (26)Partial Start Line Set | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | D3h | Enter Partial Start Line Set | |
| Partial Start Line Set | 0 | 1 | 0 | 1 | 1 | Partial Start Line | | | | | XX | Sets the LCD Number of partial display start line | | |
| (27)N-Line Inversion Set | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 85h | Enter N-Line inversion | |
| Number of Line Set | 0 | 1 | 0 | * | * | * | Number of Line | | | | XX | Sets the number of line used for N-Line inversion | | |
| (28)N-Line Inversion Release | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 84h | Exit N-Line Inversion | |
| (29)DC/DC Clock Set | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | E6h | Set DC/DC Clock Frequency | |
| DC/DC Clock Division Set | 0 | 1 | 0 | 1 | 1 | 0 | 0 | Clock Division | | | XX | Set the Division of DC/DC Clock Frequency | | |
| (30)Test Command | 0 | 1 | 0 | 1 | 1 | 1 | 1 | * | * | * | * | F1h to FFh | IC test command. Do not use! | |
| (31)Test Mode Reset | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | F0h | Command of test mode reset | |

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

10 ELECTRO-OPTICAL CHARACTERISTICS

| Item | | Symbol | Min | Typ. | Max | Unit | Condition | |
|------------------------------|-----------|--------------------|------|------|------|------|-----------|----------|
| Supply Voltage (Logic) | | Vdd-Vss | - | 3.0 | - | V | - | |
| LCD Operating Voltage | | Vdd-V ₀ | - | 10.4 | - | V | -20°C | |
| | | | - | 10.0 | - | V | 25°C | |
| | | | - | 9.5 | - | V | 80°C | |
| Response Time | FSTN Type | Ton | - | 65 | - | ms | - | |
| | | Toff | - | 323 | - | | | |
| | STN Type | Ton | - | 238 | - | | | |
| | | Toff | - | 214 | - | | | |
| Contrast Ratio | | CR | 2 | - | - | - | - | |
| Viewing Angle | FSTN Type | 12H | θ1 | - | 62 | - | Deg. | (CR≥2.0) |
| | | 6H | θ2 | - | 71 | - | | |
| | | 3H | θ3 | - | 65 | - | | |
| | | 9H | θ4 | - | 65 | - | | |
| | STN Type | 12H | θ1 | - | 45 | - | | |
| | | 6H | θ2 | - | 58 | - | | |
| | | 3H | θ3 | - | 50 | - | | |
| | | 9H | θ4 | - | 50 | - | | |
| LCD Threshold Voltage | FSTN Type | Vth | - | 8.4 | - | V | 25°C | |
| | STN Type | Vth | - | 8.3 | - | | | |
| Power consumption (LCD only) | | I _{dd} | 0.26 | -- | 0.63 | mA | 25°C | |

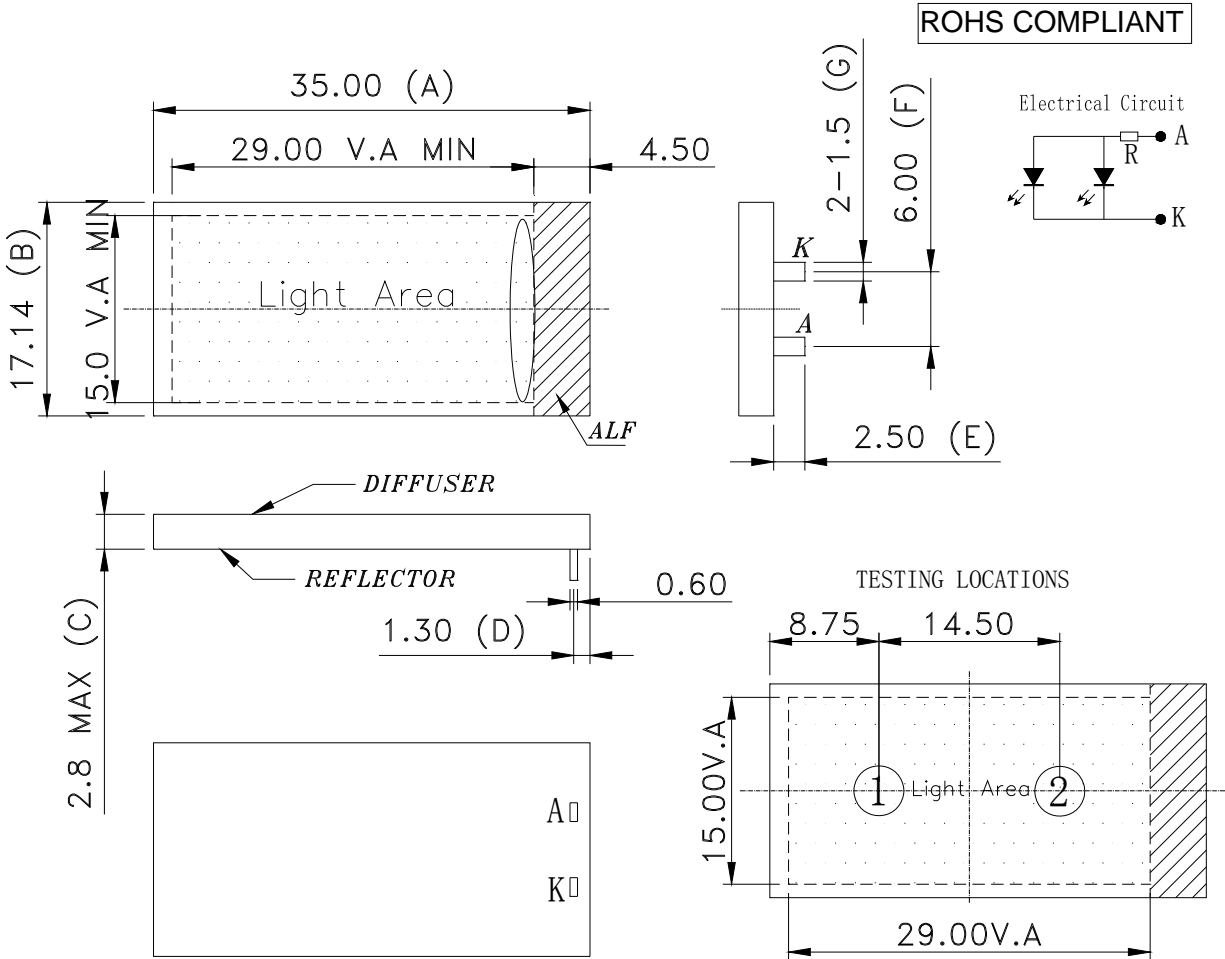
11 WIRING DIAGRAM



| | | | | | | | | | | | | | | | | | | | | |
|---------|-----|------|-----|------|-----|-----|-----|-----|-----|----|----|----|----|----|-----|-----|-----|-------|-------|-----|
| PIN NO. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| SYMBOL | NC | NC | CL | /CS1 | CS2 | RES | A0 | /RW | /RD | D0 | D1 | D2 | D3 | D4 | D5 | D6 | D7 | DUTY0 | DUTY1 | VDD |
| PIN NO. | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 |
| SYMBOL | VSS | VOUT | C4+ | C3+ | C1- | C1+ | C2+ | C2- | V1 | V2 | V3 | V4 | V0 | VR | CLS | C86 | P/S | /HPM | IRS | NC |

12 THE LED BACKLIGHT

12.1 MECHANICAL DRAWING



BM-7 FIELD=1.0ABS D=8.0mm @H=500mm

Note 1: LED Lifetime (Half Brightness) is estimated to be 30,000 hrs at 15 mA / LED (25°C).

Note 2: Please refer to the PWM white paper at http://www.densitron.com/displays/lcd_support.aspx for background on extending LED backlight lifetimes.

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12.2 BACKLIGHT ELECTRO-OPTICAL CHARACTERISTICS

12.2.1 MIDNIGHT BLUE

| - | SYMBOL | MIN. | TYP. | MAX. | UNIT | CONDITIONS |
|---------------------|--------------|------|------|------|-------------------|---------------------------------|
| Input Voltage | V_{IN} | 3.0 | 3.2 | 3.5 | V | If = 30 mA |
| Forward Current | If | -- | 30 | 40 | mA | -- |
| Power Dissipation | Pd | -- | -- | 0.14 | W | If = 30 mA |
| Reverse Voltage | V_R | -- | -- | 5.0 | V | -- |
| Reverse Current | I_R | -- | -- | 0.2 | mA | Vr = 5.0 V |
| Luminous Intensity | I_v | 80 | -- | -- | Cd/m ² | If = 30 mA |
| Luminous Uniformity | ΔI_v | 70 | -- | -- | % | If = 30 mA |
| Emission Wavelength | λ_P | 465 | -- | 475 | -- | If = 15 mA, Ta = 25°C Each Chip |

12.2.2 JADE GREEN

| - | SYMBOL | MIN. | TYP. | MAX. | UNIT | CONDITIONS |
|---------------------|--------------|------|------|-------|-------------------|---------------------------------|
| Input Voltage | V_{IN} | 3.0 | 3.2 | 3.5 | V | If = 20 mA |
| Forward Current | If | -- | 20 | 30 | mA | -- |
| Power Dissipation | Pd | -- | -- | 0.069 | W | If = 20 mA |
| Reverse Voltage | V_R | -- | -- | 5.0 | V | -- |
| Reverse Current | I_R | -- | -- | 0.2 | mA | Vr = 5.0 V |
| Luminous Intensity | I_v | 45 | -- | -- | Cd/m ² | If = 20 mA |
| Luminous Uniformity | ΔI_v | 70 | -- | -- | % | If = 20 mA |
| Emission Wavelength | λ_P | 569 | -- | 575 | -- | If = 15 mA, Ta = 25°C Each Chip |

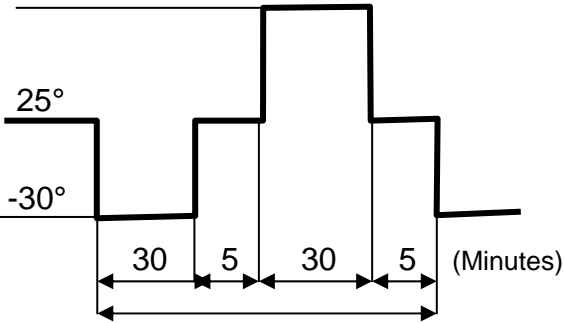
12.2.3 TANGERINE ORANGE

| - | SYMBOL | MIN. | TYP. | MAX. | UNIT | CONDITIONS |
|---------------------|--------------|------|------|-------|-------------------|---------------------------------|
| Input Voltage | V_{IN} | 3.0 | 3.2 | 3.5 | V | If = 20 mA |
| Forward Current | If | -- | 20 | 30 | mA | -- |
| Power Dissipation | Pd | -- | -- | 0.069 | W | If = 20 mA |
| Reverse Voltage | V_R | -- | -- | 5.0 | V | -- |
| Reverse Current | I_R | -- | -- | 0.2 | mA | Vr = 5.0 V |
| Luminous Intensity | I_V | 70 | -- | -- | Cd/m ² | If = 20 mA |
| Luminous Uniformity | ΔI_V | 70 | -- | -- | % | If = 20 mA |
| Emission Wavelength | λ_P | 600 | -- | 610 | -- | If = 15 mA, Ta = 25°C Each Chip |

12.2.4 SUNBURST YELLOW AND ARCTIC WHITE

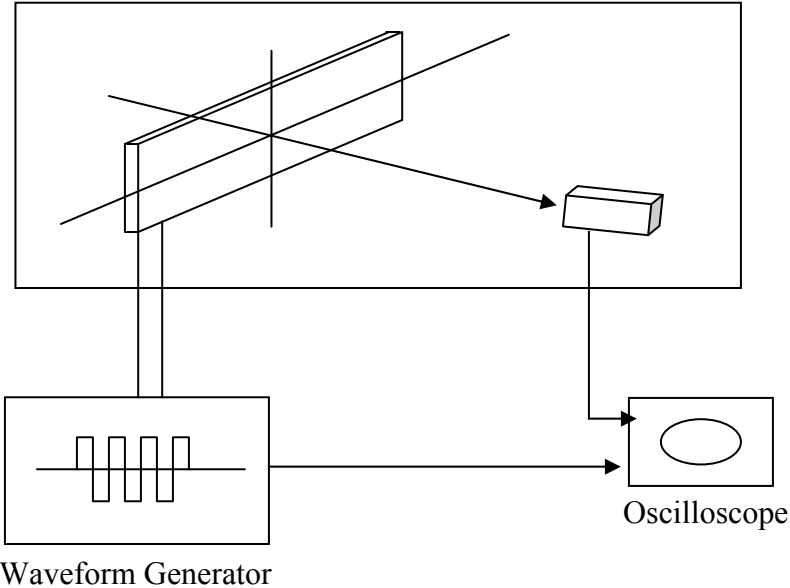
| - | SYMBOL | MIN. | TYP. | MAX. | UNIT | CONDITIONS |
|---------------------|--------------|------|------|------|-------------------|---------------------------------|
| Input Voltage | V_{IN} | 3.0 | 3.2 | 3.5 | V | If = 30 mA |
| Forward Current | If | -- | 30 | 40 | mA | -- |
| Power Dissipation | Pd | -- | -- | 0.14 | W | If = 30 mA |
| Reverse Voltage | V_R | -- | -- | 5.0 | V | -- |
| Reverse Current | I_R | -- | -- | 0.2 | mA | Vr = 5.0 V |
| Luminous Intensity | I_V | 1000 | -- | -- | Cd/m ² | If = 30 mA |
| Luminous Uniformity | ΔI_V | 70 | -- | -- | % | If = 30 mA |
| Color Chromaticity | X | 0.27 | -- | 0.33 | -- | If = 15 mA, Ta = 25°C Each Chip |
| | Y | 0.27 | -- | 0.33 | -- | |

13 RELIABILITY TEST

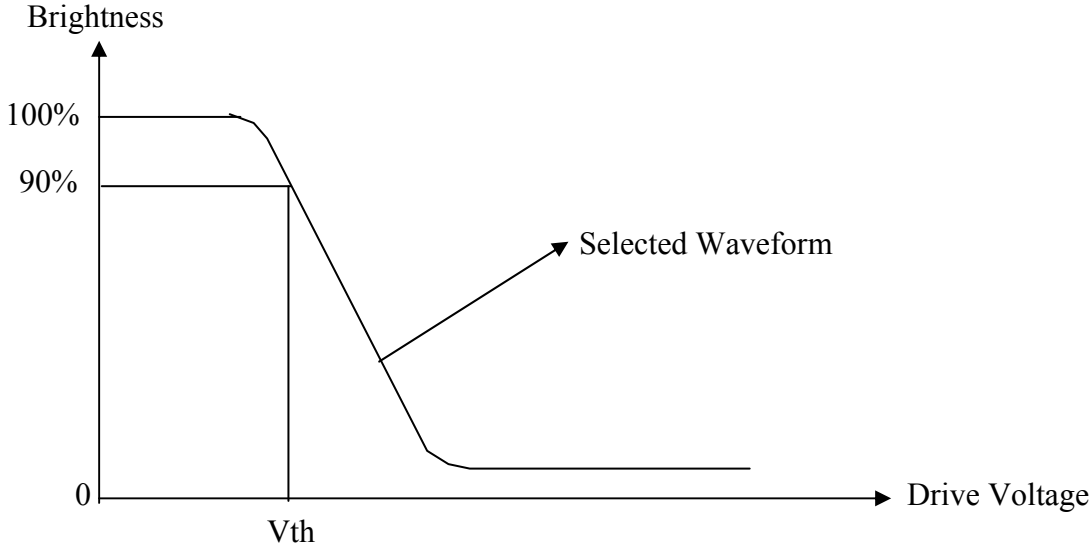
| Items | Test Condition | Equipment | Test Result |
|----------------------------|---|-----------|-------------|
| High TEMP Storage | TEMP:80±2°C Time: 96h Restore:24h | Tenny | Passed |
| Low TEMP Storage | TEMP: -30±3°C Time: 96h Restore:24h | Tenny | Passed |
| High TEMP Operating | TEMP: 80±2°C Vop: 3.3V Timp: 24h Restore:24h | Tenny | Passed |
| Low TEMP Operating | TEMP: -20±2°C Vop: 3.3V Timp: 24h Restore:24h | Tenny | Passed |
| High TEMP High Hum Storage | TEMP:40±2°C Hum: 95%Rh Time: 96h Restore:24h | Tenny | Passed |
| Thermal Shock | TEMP:(°C) 80°C  5 Cycles Restore:24h | Tenny | Passed |

14 THE LCD MEASURING METHOD AND EQUIPMENT

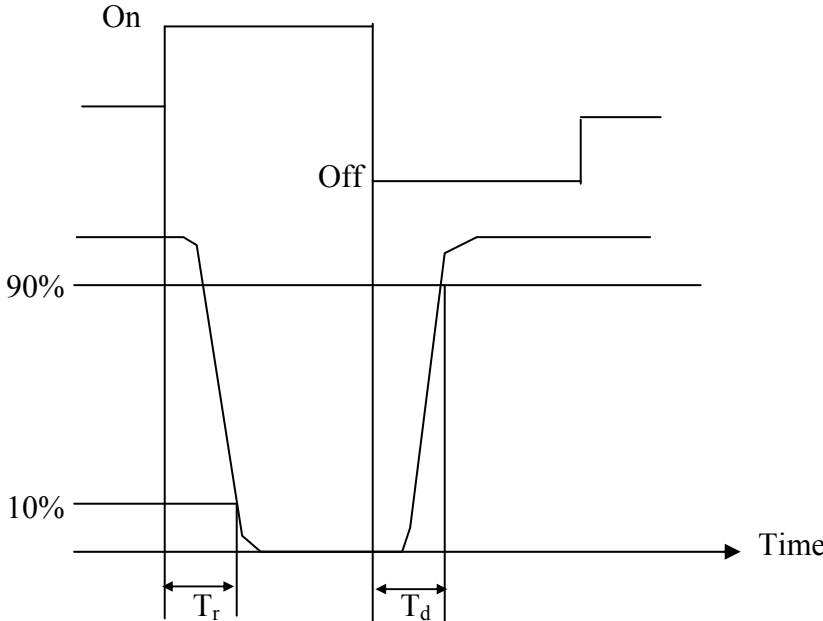
- 1. Threshold Voltage and Response Time Measuring:
 - (1) Equipment



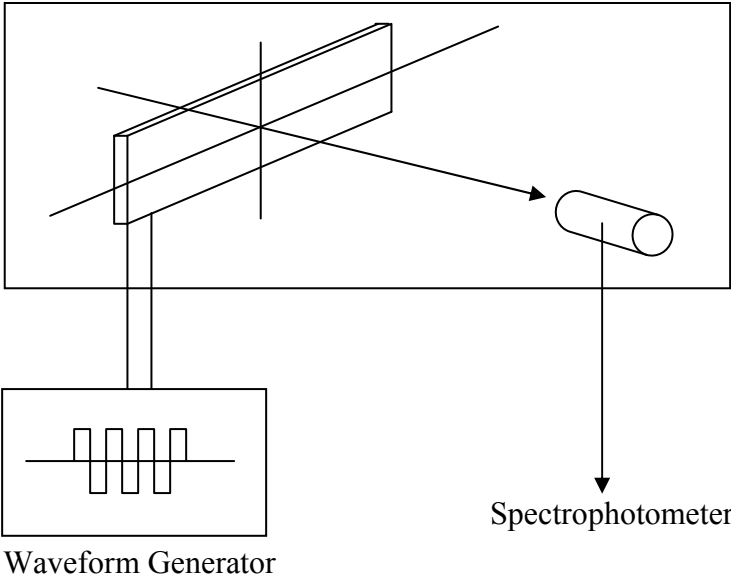
- (2) Definition
 - A. Threshold Voltage (V_{th}):



B. Response Time:

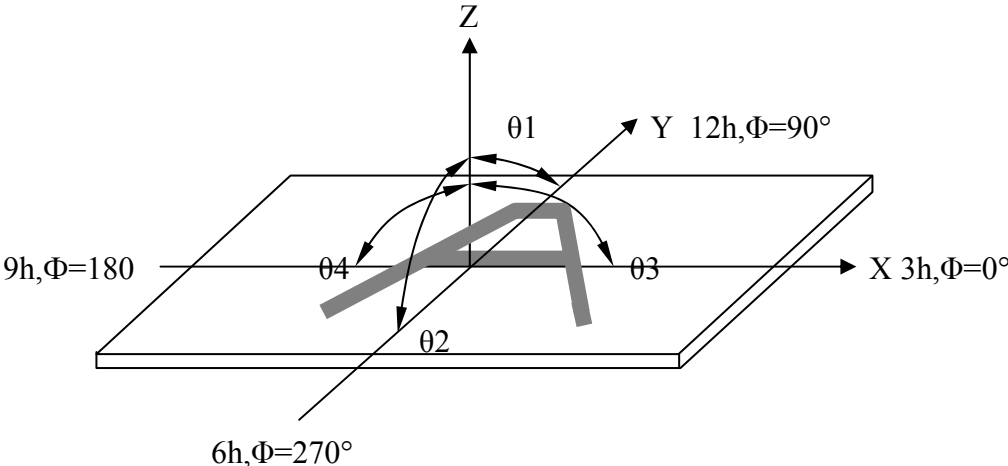


1. Contrast Measuring
(1) Equipment



(2) Definition

A. Viewing angle:



B. Contrast Ratio (Positive)

$$CR = \frac{\text{Brightness of non-selected wave-form}}{\text{Brightness of selected wave-form}}$$

15 SAMPLE CODE

```

#include <Reg52.h>          /* special function register declarations */
                           /* for the intended 8051 derivative */

#include <Intrins.h>
#include <Absacc.h>
#define com P1
#define dat P1
#define delay_valve 6

sbit cs =P3^5;
sbit reset =P3^3;
sbit rs =P3^2;
sbit wr =P3^0;
sbit e =P3^1;

code unsigned int C[]={
0xFF,0x01,0x01,0x01,0x01,0x01,0x01,0x01,0x01,0x01,0x01,0x01,0x01,0x01,0x01,
0x09,0x05,0x03,0x01,0x01,0x01,0x81,0x01,0x01,0x01,0x01,0x01,0x01,0x01,0x01,
0x01,0x01,0x01,0x01,0x01,0x09,0x05,0x01,0x01,0x01,0x01,0x21,0x11,0x09,0x01,0x01,
0x01,0x01,0x01,0x05,0x07,0x0B,0x1B,0x79,0xA9,0x51,0xB1,0x61,0xA1,0x61,0xA1,0x11,
0x11,0x11,0x11,0x09,0x09,0x09,0x0B,0x13,0x13,0x95,0x95,0xA9,0xA9,0x71,0x71,0x61,
0x41,0xC1,0x61,0x81,0x81,0x41,0x21,0x11,0x11,0x09,0x01,0x01,0x01,0x01,0x01,0x01,
0x01,0x01,0x01,0x01,0x01,0x01,0x01,0x01,0x01,0x01,0x01,0x01,0x01,0x01,0x01,
0x01,0x01,0x01,0x01,0x01,0x01,0x01,0x01,0x01,0x01,0x01,0x01,0x01,0x01,0x01,
0xFF,0xFF,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,
0x40,0x20,0x10,0x08,0x08,0x04,0x02,0x01,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,
0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,
0x40,0x20,0x20,0x10,0x08,0x04,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,
0x10,0x08,0x04,0x02,0x01,0x00,0x00,0x04,0x07,0x0D,0x1A,0x35,0x6A,0xD5,0xAA,0x55,
0xAA,0x54,0xA8,0x58,0xA8,0xD4,0x72,0x22,0xA1,0x40,0x80,0x00,0x00,0x00,0x00,0x00,
0xC0,0x3F,0x07,0x3A,0xC4,0x18,0x60,0x80,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,
0x00,0x00,0x00,0x80,0x40,0x20,0x10,0x08,0x04,0x02,0x00,0x00,0x00,0x00,0x00,0x00,
0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,
0xFF,0xFF,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,
0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,
0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x80,0x40,0x20,0x20,0x11,0x08,
0x08,0x08,0x08,0x04,0x04,0x02,0x02,0x02,0x02,0x02,0x01,0x01,0x01,0x01,0x01,
0x01,0x01,0x02,0x02,0x02,0x02,0x02,0x04,0x04,0x08,0x08,0x10,0x10,0x30,0x49,0x87,
0x66,0x13,0xCA,0x67,0x92,0x09,0x06,0x03,0x06,0x0D,0x1A,0xF5,0xAA,0x54,0xBC,0x63,
0xC0,0x80,0x80,0x00,0x00,0xFF,0x00,0x01,0x0E,0xF0,0x00,0x00,0x00,0x00,0x00,0x00,
0x00,0x00,0x01,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,
0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,
0xFF,0xFF,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,
0x02,0x02,0x01,0xC1,0x21,0x11,0x11,0x91,0x72,0x0C,0x02,0xC1,0xE0,0x60,0xF0,0x30,0x10,0x10,
0x20,0xC0,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,

```

| | | | | |
|-------------|---------|--------|------|---------|
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|-------------|---------|--------|------|---------|

```

0x00,0x00,0x00,0x00,0x1C,0x2E,0x46,0xEF,0xF3,0x61,0x21,0x92,0x4C,0x32,0x09,0x04,
0xC6,0x39,0x00,0x00,0x01,0x3E,0xC0,0x00,0x00,0x00,0x00,0x00,0x3F,0xD5,0x6A,0x35,
0x2A,0x35,0x2A,0x55,0x6A,0xD7,0xB8,0x60,0x80,0xFF,0x00,0x00,0x08,0x04,0x02,0x00,
0x00,0x00,0x00,0x80,0x40,0x20,0x10,0x08,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,
0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,
0xFF,0xFF,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,
0x00,0xFF,0x00,0x00,0x00,0x07,0x38,0x40,0x80,0x01,0x02,0x04,0x4E,0xAF,0x46,0xA6,
0x53,0x23,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x02,0x07,0x87,0x82,0x00,0x00,
0x00,0x00,0x00,0xE0,0x10,0x18,0x24,0xB3,0xC8,0x86,0x41,0x40,0x20,0x10,0x08,0x04,
0x03,0x00,0x00,0x00,0x00,0x00,0x0F,0x70,0x80,0x00,0x00,0x00,0x00,0x07,0xF8,0x00,
0x00,0x00,0x00,0x00,0x00,0x01,0x03,0x06,0x07,0x00,0x00,0x00,0x00,0x00,0x10,
0x08,0x04,0x02,0x01,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,
0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0xFF,
0xFF,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,
0x00,0x01,0xFE,0x00,0x00,0x00,0x00,0x00,0x00,0x01,0x02,0x04,0x04,0x08,0x08,0x08,
0x08,0x10,0x10,0x10,0x10,0x10,0x78,0xA4,0xD2,0xA1,0xC3,0x8D,0xD0,0x60,0xA1,0x12,
0x0C,0x04,0x52,0x27,0x5A,0xE2,0xA9,0x40,0x54,0x2A,0x1F,0x00,0x00,0x00,0x00,0x00,
0x10,0x08,0x04,0x00,0x00,0x00,0x00,0x00,0x00,0x01,0x02,0x02,0x02,0x01,0x00,0x00,
0x80,0x40,0x20,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,
0x40,0x20,0x10,0x10,0x08,0x04,0x02,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,
0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0xFF,
0xFF,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x04,0x04,
0x04,0x03,0x00,0x80,0x40,0x40,0x20,0x10,0x08,0x08,0x04,0x02,0x00,0x00,0x00,0x00,
0x00,0x00,0x00,0x00,0x60,0xD8,0xAE,0x55,0xFE,0x35,0xD7,0x01,0xD7,0xB6,0xFF,0x03,
0xAA,0xAA,0xAA,0xAA,0x03,0xFE,0x55,0xFE,0x60,0xB8,0x0F,0xF1,0xBF,0xCF,0xE1,0xAF,
0xE8,0x0C,0xEA,0xE8,0xA8,0xC8,0x78,0x00,0x38,0xEC,0x74,0x74,0xB4,0xCE,0x7A,0xF1,
0x18,0x6C,0xB4,0xB4,0x74,0xD4,0x9C,0x00,0xFC,0x84,0xB4,0xB4,0x74,0xD4,0x9C,0x00,
0x00,0xFE,0x02,0x7A,0x4A,0x4A,0x4A,0x6A,0x5A,0x4A,0x7B,0x01,0xFB,0x00,0x00,0x00,
0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0xFF,
0xFF,0x80,0x80,0x80,0x80,0x80,0x80,0x80,0x80,0x80,0x80,0x80,0x80,0x80,0x80,0x80,
0x80,0x80,0x80,0x80,0x80,0x80,0x80,0x80,0x80,0x80,0x80,0x80,0x80,0x80,0x80,0x80,
0x80,0x80,0x80,0x80,0x80,0x80,0x81,0x9F,0xB9,0xEF,0xF3,0xFE,0xC3,0xBE,0xBB,0xBA,
0xB6,0xBE,0x86,0xFA,0xF6,0xCF,0xF9,0x81,0x81,0xFF,0x80,0xFF,0xAE,0xB3,0xFC,0xD7,
0xBF,0xC0,0xFF,0x8E,0xB9,0xA7,0xBC,0xB8,0xE8,0xD9,0xD1,0xDB,0xEE,0xB1,0x9F,0x9F,
0xB0,0xEF,0xD9,0xD9,0xEF,0xB0,0x9F,0xB8,0xE8,0xD8,0xD0,0xD9,0xEF,0xB0,0x9F,0x80,
0x84,0xFF,0x80,0xDF,0xD1,0xD1,0xD1,0xD1,0xD1,0xD1,0xDF,0x80,0xFF,0x80,0x80,0x80,
0x80,0x80,0x80,0x80,0x80,0x80,0x80,0x80,0x80,0x80,0x80,0x80,0x80,0x80,0xFF

```

```
};
```

```

void delay(long tt)
{while(tt>0)
  {tt--;}
}

```

| | | |
|-------------|---------|--------|
| Product No. | LMR5407 | REV. D |
|-------------|---------|--------|

| | |
|------|---------|
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|------|---------|

```

wr_com(unsigned char byte)
{
//   unsigned char i;
    cs=0;
    rs=0;
/*   wr=1;
    com=0xff;
    do
    {
        i=com;
        e=1;
        e=0;
    }while(i&0x80);*/
    wr=0;
    com=byte;
    e=1;
    e=0;
}

```

```

wr_dat(unsigned char byte)
{
//   unsigned char i;
    cs=0;
/*   rs=0;
    wr=1;
    com=0xff;
    do
    {
        i=com;
        e=1;
        e=0;
    }while(i&0x80);*/
    rs=1;
    wr=0;
    dat=byte;
    e=1;
    e=0;
}

```

```

void lcd_line()
{
    unsigned char i,j;
    for (i=0xb0;i<0xb8;i++)
    {

```

```

        wr_com(0x10);

```

| | | |
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| | |
|------|---------|
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|------|---------|

```

        wr_com(0x00);
        wr_com(i);
        for (j=0;j<128;j++)
            {
                wr_dat(0x88);
            }
    }
}

```

```

void lcd_vertical(unsigned char byte1,unsigned char byte2,unsigned char byte3,unsigned char
byte4)

```

```

{
    unsigned char i,j;
    for (i=0xb0;i<0xb8;i++)
    {
        wr_com(0x10);
        wr_com(0x00);
        wr_com(i);
        for (j=0;j<128/4;j++)
            {
                wr_dat(byte1);
                wr_dat(byte2);
                wr_dat(byte3);
                wr_dat(byte4);
            }
    }
}

```

/*

```

void lcd_clear()

```

```

{
    unsigned char i,j;
    for (i=0xb0;i<0xb8;i++)
    {
        wr_com(i);
        wr_com(0x10);
        wr_com(0x04);
        for (j=0;j<128;j++)
            {
                wr_dat(0x00);
            }
    }
}
*/

```

```

void main (void)

```

| | | |
|-------------|---------|--------|
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|-------------|---------|--------|

| | |
|------|---------|
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|------|---------|

```

{
  unsigned char i,j;
  unsigned int image;
  delay(500);
  while (1)
    {

    reset=0;
    delay(2000);
    reset=1;

    wr_com(0xa2);/*set BIAS 1/9 */
    wr_com(0xa1);/*set ADC=0 s1-s128*/
    wr_com(0xc8);/*set SHL=1 c0-c63*/

    wr_com(0x2f);/*set VC=VR=VF=1*/

    wr_com(0x25);/*SET (1+Ra/Rb)=.0*/
    wr_com(0x81);/*SET V0 volume register*/
    wr_com(0x2A);/*set V0=35 */
    wr_com(0xaf);/*set display on*/

    wr_com(0xa5);/*set entire display on*/
    delay(20000);
    wr_com(0xa4);/*set normal display*/

    wr_com(0x40);
    image=0;
    for (i=0xb0;i<0xb8;i++)
      {
        wr_com(i);
        wr_com(0x10);
        wr_com(0x00);
        for (j=0;j<128;j++)
          {
            wr_dat(C[image++]);
          }
      }
    delay(20000);

    wr_com(0x43);
    lcd_line();
    delay(20000);
    wr_com(0x42);
    delay(20000);

```

```
    wr_com(0x41);  
    delay(20000);  
    wr_com(0x40);  
    delay(20000);  
  
    lcd_vertical(0xff,0x00,0x00,0x00);  
    delay(20000);  
    lcd_vertical(0x00,0xff,0x00,0x00);  
    delay(20000);  
    lcd_vertical(0x00,0x00,0xff,0x00);  
    delay(20000);  
    lcd_vertical(0x00,0x00,0x00,0xff);  
    delay(20000);  
  
    }  
}
```

16 PART NUMBER DESCRIPTION FOR AVAILABLE OPTIONS

LMR5407①②128G64③④⑤

①

Polarizer Type

B= Transflective Positive Mode

E = Transmissive Negative Mode

②

Backlight Color

G = Jade Green

B = Midnight Blue

W = Arctic White

O = Tangerine Orange

Y = Sunburst Yellow

③

Fluid Type and Temperature Range

W = Wide temp. range

④

Fluid Type and Temperature Compensation

N = STN

F = FSTN

⑤

Background Color

B = Blue mode STN (Ocean Blue)

17 STANDARD SPECIFICATIONS FOR PRODUCT QUALITY

1. Manner of Test:

- 1.1- The Test must be under 40w Fluorescent Light and The Distance of View Must Be At 30cm.
- 1.2- The Test Direction Is Based On Around 15°- 45° of Vertical Line.

2. Definition of Defects:

2.1- Major Defects

Non-Display, Segment Missing, Over Current, Segment Short, Sealant Softens, Wrong Polarizer Direction

2.2- Minor Defects: The Others.

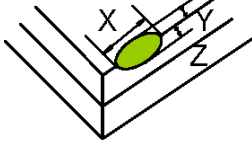
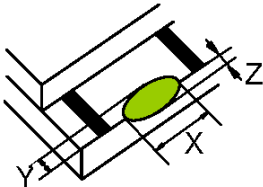
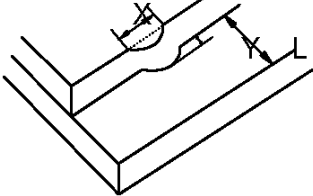
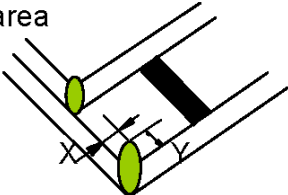

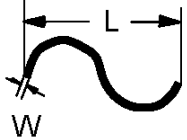
3. Major Defects Should Be In AQL 0.25, and The Minor In AQL 1.00.

4. Inspection Item and Standards

| Item | The standard of quality inspection | Checking Manner | Quality Ratio |
|--|---|--|---------------|
| Frame | Smooth and even surface, no crack, no scratch, no rust, and not be bent out of shape. The range between convex and concave is: $d \leq 0.35\text{mm}$ and the frame must be connected to the ground. | Checking With Eyes And Using Vernier Caliper, Multimeter | 100% |
| LCD | 1. The major defects would be rejected. 2. No scratch and no dust on the LCD glass surface. 3. $D \leq 0.15\text{mm}$ $n \leq 2$ diameter of bubble: $d \leq 0.5$ $n \leq 2$ damaged size of polarizer: $d \leq 0.15\text{mm}$, $n \leq 2$. 4. No scratch and dust between the LCD and LED. | Check It When Displaying | 100% |
| The Relative Position of LCD and Frame | 1. The LCD should not be twisted. 2. The LCD graphic should be in the middle position of the frame. | Checking With Eyes | 100% |
| The Relative Position of PCB Panel and Frame | 1. The frame installing direction must be correct. 2. The twisted angle of the pin is from 45° to 60°. 3. The pin is vertical to PCB panel and it should be in the middle position of the installing holes. | Checking With Eyes | 100% |
| LED | 1. The led would be yellow-green. 2. The led would be uniform. | Checking With Eyes | 100% |
| Function Test | 1. The major defects must be reject. 2. Test flow chart (see attached chart) 3. Background changes evenly and no disorderly displaying phenomenon. 4. Display no shortage. | Check It When Displaying | 100% |

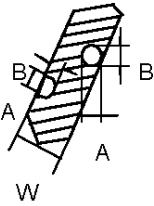
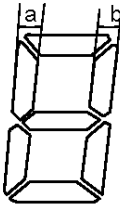
Note: D = Diameter, N = Quantity, Unit = mm

Standard of appearance test:

| No | Items | Criterion | Checking manner |
|----|---|---|---|
| 1 | <p>Substrate crack</p> <p>X: defect Length</p> <p>Y: defect Width</p> <p>Z: defect Depth</p> <p>T: glass Thickness</p> <p>N: defect QTY</p> <p>L: Connector Width</p> | <p>(1) A area</p>  <p>$X \leq 2.0$ $Y \leq 0.5$ $Z \geq T/2$ $N \leq 3$ $X \leq 2.0$ $Y \leq 1.0$ $Z \leq T/2$ $N \leq 3$ $X \leq 0.5$ $Y \leq 0.5$ $Z \leq T/3$ No check</p> <p>(2) G area</p>  <p>$X \leq 2.0$ $Y \leq 0.5$ $Z \leq T/2$ $N \leq 2$</p>  <p>$X \leq 2.0$ $Y \leq 1/4$ or $X \leq 2.0$ $Y \leq 1.0$ $N \leq 2$</p> <p>(1) F area</p>  <p>$X \leq 2.0$ $Y \leq 2$ $Z \leq T$ $N \leq 3$</p> | <p>checking with eyes</p> |
| 2 | <p>Black spot</p> <p>white spot</p> <p>dust</p> <p>polarizer scratch,</p> <p>$D = (X+Y)/2$</p> | <p>(1)</p>  <p>$0.15 < D \leq 0.2$ $N \leq 1$ $0.1 < D \leq 0.15$ $N \leq 2$ $D \leq 0.1$ No check</p> <p>(2)</p>  <p>$L \leq 2.0$ $W \leq 0.03$ $N \leq 1$</p> | <p>Checking on the table with light and polarizer, and checking with eyes directly.</p> |

| No | Items | Criterion | Checking manner |
|----|-----------------------------|--|--|
| 3 | Polarizer Bubble | $D \leq 0.15$ No check $0.15 < D \leq 0.4$ $N \leq 2$ | Checking on the table with light and polarizer, and checking with eyes directly |
| 4 | Rainbow Color | Allow tiny rainbow Allow 5% color contrast | Checking on the table with light and polarizer, And checking with eyes directly |
| 5 | Sealant | 1. Dimension accord design require 2. Immerge depth (d): $1/5D \leq d \leq D$ (D: seal design depth) | Checking with eyes |
| 6 | Polarizer or pad appearance | No dirty | Checking with eyes |

Standard of display test:

| No | Items | Criterion | Checking manner |
|----|---|--|-------------------------------|
| 1 | Pin hole $D = (A+B)/2$ W: segment width |  $W \leq 0.4$ $D \leq 0.20$ And $D \leq 1/2W$ $N \leq 1$ $W > 0.4$ $D \leq 0.25$ And $D \leq 1/3W$ $N \leq 2$ $D \leq 0.05$ No check | Checking at the display state |
| 2 | Different width of segment |  $ a-b < 0.25$ or $ a-b \leq 1/4W$ No check | Checking at the display state |

18 HANDLING PRECAUTIONS

Safety

If the LCD panel breaks, be careful not to get the liquid crystal fluid in your mouth or in your eyes.
If the liquid crystal touches your skin or clothes, wash it off immediately using soap and plenty of water.

Mounting and Design

Place a transparent plate (e.g. acrylic, polycarbonate or glass) on the display surface to protect the display from external pressure. Leave a small gap between the transparent plate and the display surface.
When assembling with a zebra connector, clean the surface of the pads with alcohol and keep the surrounding air very clean. Design the system so that no input signal is given unless the power supply voltage is applied.

Caution during LCD cleaning

Lightly wipe the display surface with a soft cloth soaked with Isopropyl alcohol, Ethyl alcohol or Trichlorotrifluoroethane. Do not wipe the display surface with dry or hard materials that will damage the polariser surface. Do not use aromatic solvents (toluene and xylene), or ketonic solvents (ketone and acetone).

Caution against static charge

As the display uses C-MOS LSI drivers, connect any unused input terminal to VDD or VSS. Do not input any signals before power is turned on. Also, ground your body, work/assembly table and assembly equipment to protect against static electricity.

Packaging

Displays use LCD elements, and must be treated as such. Avoid strong shock and drop from a height.
To prevent displays from degradation, do not operate or store them exposed directly to sunshine or high temperature/humidity.

Caution during operation

It is indispensable to drive the display within the specified voltage limit since excessive voltage shortens its life. Direct current causes an electrochemical reaction with remarkable deterioration of the display quality. Give careful consideration to prevent direct current during ON/OFF timing and during operation.
Response time is extremely delayed at temperatures lower than the operating temperature range while, at high temperatures, displays become dark. However, this phenomenon is reversible and does not mean a malfunction or a display that has been permanently damaged. If the display area is pushed on hard during operation, some graphics will be abnormally displayed but returns to a normal condition after turning off the display once. Even a small amount of condensation on the contact pads (terminals) can cause an electrochemical reaction which causes missing rows and columns. Give careful attention to avoid condensation.

Storage

Store the display in a dark place where the temperature is 25°C ± 10°C and the humidity below 50%RH.
Store the display in a clean environment, free from dust, organic solvents and corrosive gases.
Do not crash, shake or jolt the display (including accessories).

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