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Note : For detailed information please refer to IC data sheet : [ST7066,KS0065B](#)

1. SPECIFICATIONS

1.1 Features

| Item | Standard Value |
|-------------------|--|
| Display Type | 12*2 Characters |
| LCD Type | STN Gray Positive Transflective Normal Temp. |
| Driver Condition | LCD Module : 1/16 Duty , 1/4 Bias |
| Viewing Direction | 6 O' clock |
| Backlight | YG LED B/L |
| Weight | 19 g |
| Interface | - |
| Other | - |

1.2 Mechanical Specifications

| Item | Standard Value | Unit |
|-------------------|-------------------------------------|------|
| Outline Dimension | 55.7 (L) * 32.0 (w) * 13.3 (H)(Max) | mm |
| Viewing Area | 46.7 (L) * 17.5 (w) | mm |
| Active Area | 37.85 (L) * 11.7 (w) | mm |
| Dot Size | 0.45 (L) * 0.6 (w) | mm |
| Dot Pitch | 0.55 (L) * 0.7 (w) | mm |

Note : For detailed information please refer to LCM drawing

1.3 Absolute Maximum Ratings

| Item | Symbol | Condition | Min. | Max. | Unit |
|---------------------------|------------------|---------------------|-----------------------|----------------------|------|
| Power Supply Voltage | V _{DD} | - | -0.3 | 7.0 | V |
| LCD Driver Supply Voltage | V _{LCD} | - | V _{DD} -10.0 | V _{DD} +0.3 | V |
| Input Voltage | V _{IN} | - | -0.3 | V _{DD} +0.3 | V |
| Operating Temperature | T _{OP} | Excluded B/L | 0 | 50 | |
| Storage Temperature | T _{ST} | Excluded B/L | -20 | 70 | |
| Storage Humidity | H _D | T _a < 40 | - | 90 | %RH |

1.4 DC Electrical Characteristics

$V_{DD} = 5.0 \text{ V} \pm 10\%$, $V_{SS} = 0\text{V}$, $T_a = 25$

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|----------------------|----------|---------------------------|--------------|------|----------|------|
| Logic Supply Voltage | V_{DD} | - | 4.5 | 5.0 | 5.5 | V |
| “H” Input Voltage | V_{IH} | - | $0.7 V_{DD}$ | - | V_{DD} | V |
| “L” Input Voltage | V_{IL} | - | -0.3 | - | 0.6 | V |
| “H” Output Voltage | V_{OH} | $I_{OH} = -0.1\text{mA}$ | 3.9 | - | V_{DD} | V |
| “L” Output Voltage | V_{OL} | $I_{OL} = 0.1\text{mA}$ | - | - | 0.4 | V |
| Supply Current | I_{DD} | $V_{DD} = 5.0 \text{ V}$ | - | 1.5 | - | mA |
| LCM Driver Voltage | V_{OP} | $V_{DD} - V_O (0^\circ)$ | - | - | - | V |
| | | $V_{DD} - V_O (25^\circ)$ | - | 4.0 | - | |
| | | $V_{DD} - V_O (50^\circ)$ | - | - | - | |

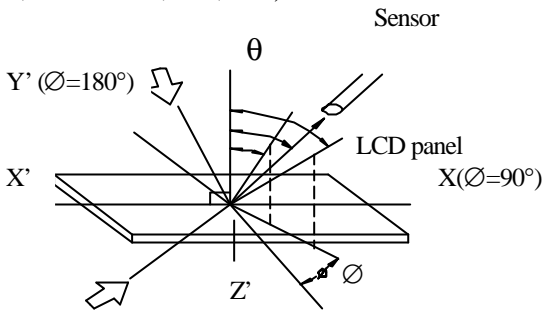
1.5 Optical Characteristics

LCD Panel : 1/16 Duty , 1/4 Bias , $V_{LCD} = 4.3 \text{ V}$, $T_a = 25$

| Item | Symbol | Conditions | Min. | Typ. | Max. | Reference |
|---------------------|----------|---|------------|--------|------|-------------|
| View Angle | θ | $C \geq 2.0, \varnothing = 0^\circ$ | 40° | - | - | Notes 1 & 2 |
| Contrast Ratio | C | $\theta = 5^\circ, \varnothing = 0^\circ$ | 5 | 7 | - | Note 3 |
| Response Time(rise) | t_r | $\theta = 5^\circ, \varnothing = 0^\circ$ | - | 150 ms | - | Note 4 |
| Response Time(fall) | t_f | $\theta = 5^\circ, \varnothing = 0^\circ$ | - | 300 ms | - | Note 4 |

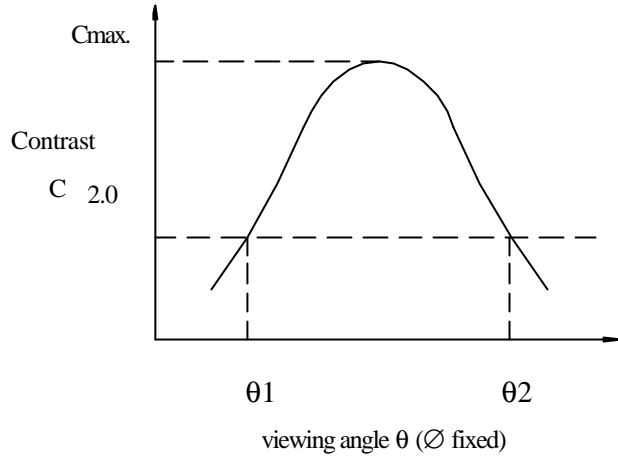
Note 1: Definition of angles θ and \varnothing

Light (when reflected) z ($\theta=0^\circ$)



Light (when transmitted) Y ($\varnothing=0^\circ$)
($\theta=90^\circ$)

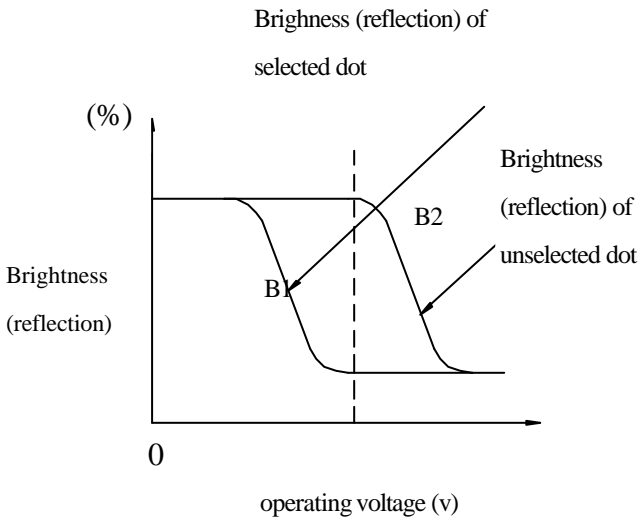
Note 2: Definition of viewing angles θ_1 and θ_2



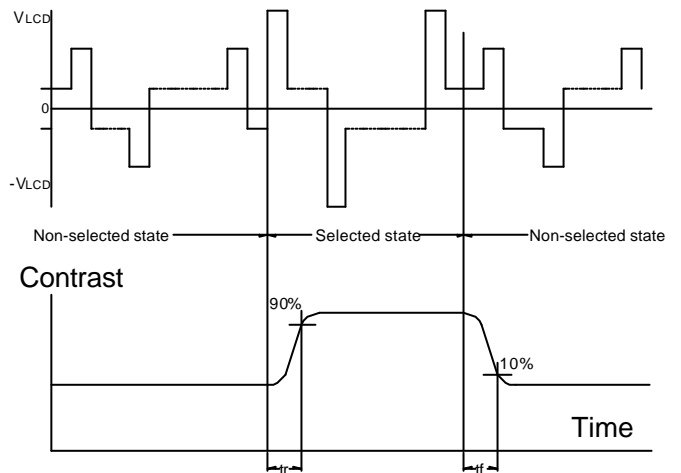
Note : Optimum viewing angle with the naked eye and viewing angle θ at C_{max} . Above are not always the same

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 cm^2

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

1.6 Backlight Characteristics

LCD Module with LED Backlight

Maximum Ratings

| Item | Symbol | Conditions | Min. | Max. | Unit |
|---------------------------|-----------------|------------|------|------|------|
| Forward Current | IF | Ta =25 | - | 200 | mA |
| Reverse Voltage | VR | Ta =25 | - | 8 | V |
| Power Dissipation | PO | Ta =25 | - | 0.92 | W |
| Operating Temperature | T _{OP} | - | -20 | 70 | |
| Storage Temperature | T _{ST} | - | -30 | 80 | |
| Solder Temp. for 3 Second | - | - | - | 260 | |

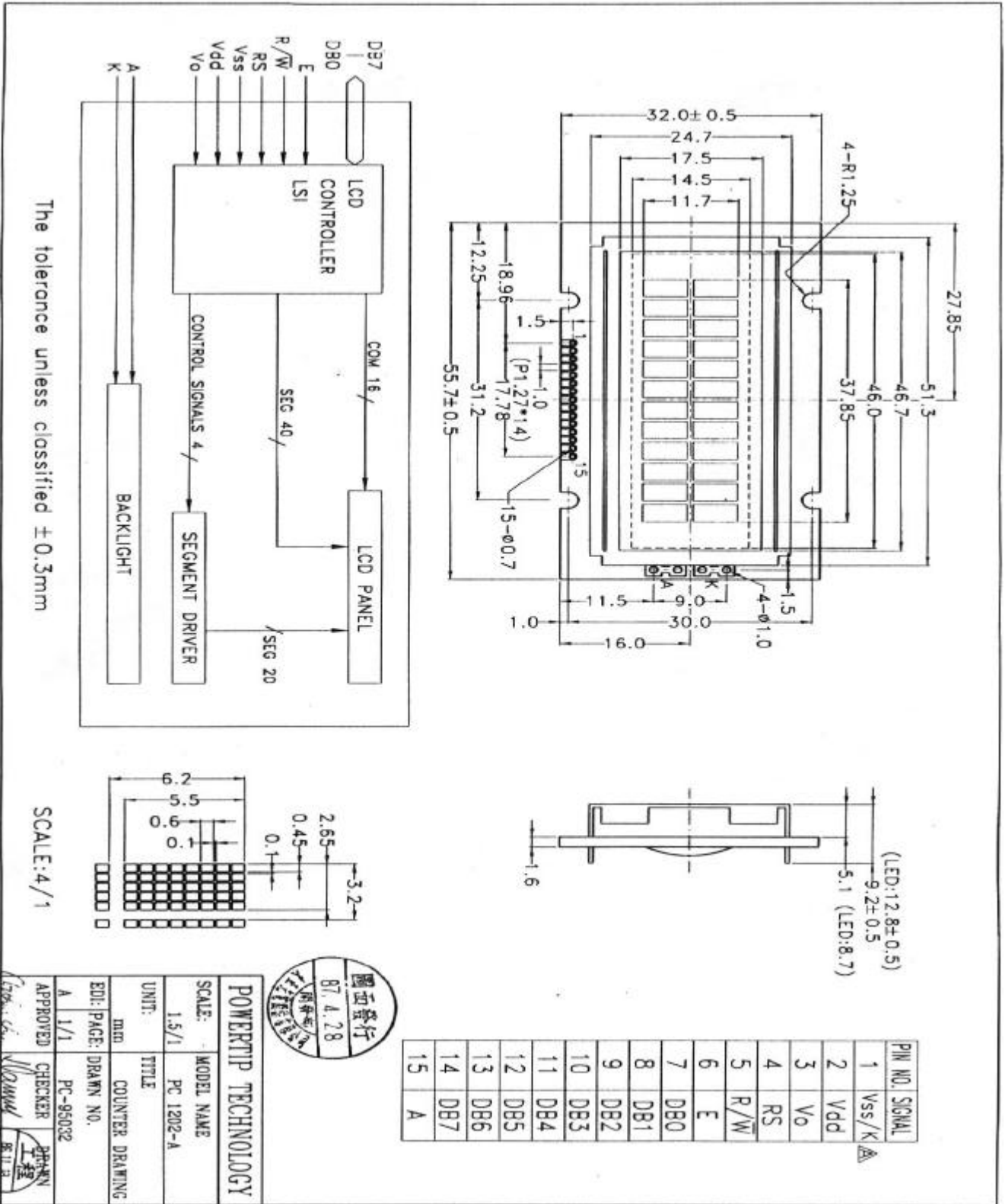
Electrical / Optical Characteristics

Ta =25

| Item | Symbol | Conditions | Min. | Typ. | Max. | Unit |
|-------------------------------------|--------------|------------|------|------|------|-------------------|
| Forward Voltage | VF | IF= 80 mA | - | 4.2 | 4.6 | V |
| Reverse Current | IR | VR= 8 V | - | - | 0.2 | mA |
| Average Brightness (with LCD) | IV | IF= 80 mA | - | - | - | cd/m ² |
| Wavelength | p | IF= 80 mA | 571 | - | 576 | nm |
| Luminous Intensity (without LCD) | IV | IF=80 mA | 150 | 190 | - | cd/m ² |
| Color | YELLOW-GREEN | | | | | |

2. MODULE STRUCTURE

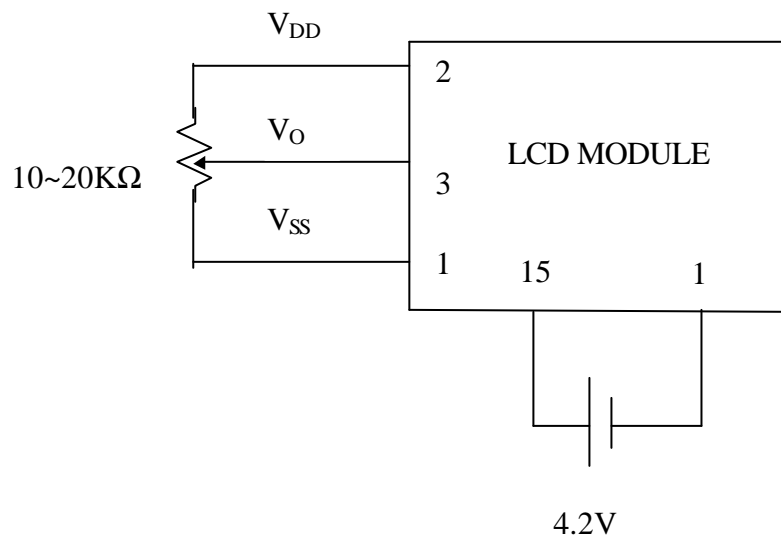
2.1 Counter Drawing



2.2 Interface Pin Description

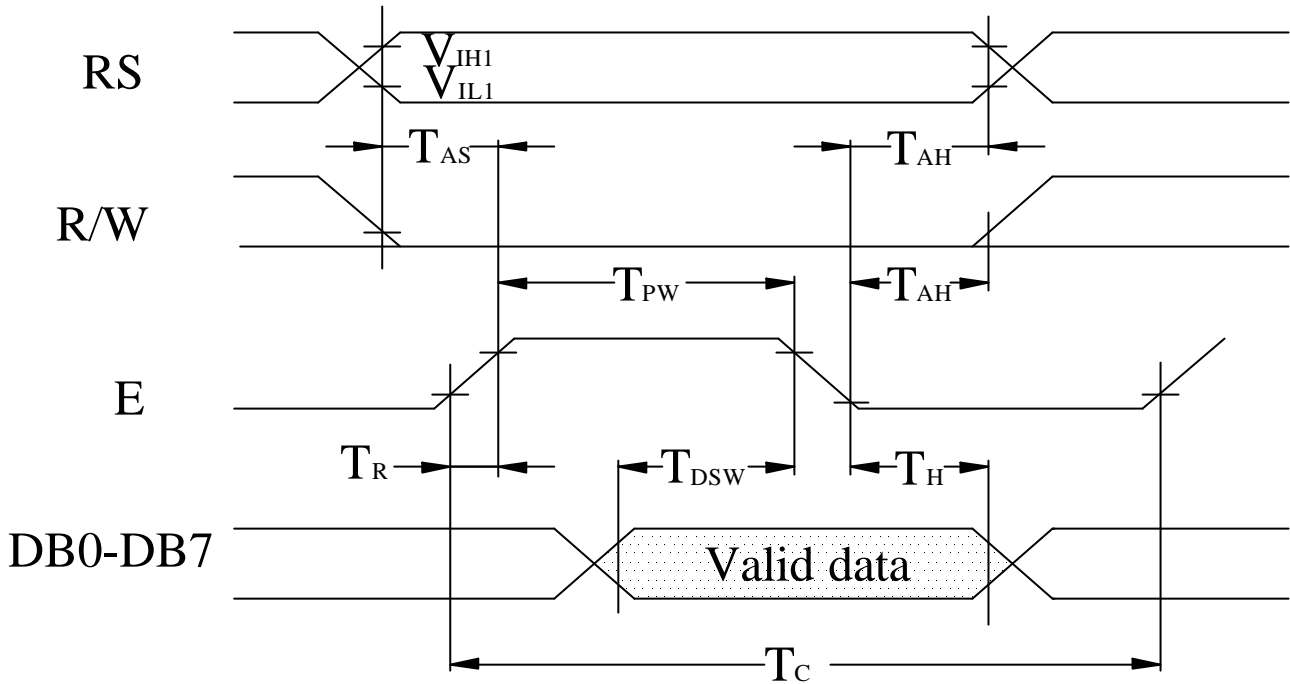
| Pin No. | Symbol | Signal Description |
|---------|------------------|--|
| 1 | VSS/K | Power Supply ($V_{SS}=0$)/ Power supply LED backlight (-) |
| 2 | VDD | Power Supply ($V_{DD}>V_{SS}$) |
| 3 | V _O | Operating voltage for LCD |
| 4 | RS | Register Selection input High = Data register Low = Instruction register (for write) Busy flag address counter (for read) |
| 5 | $\overline{R/W}$ | 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. Used 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 (+) |

Contrast Adjust

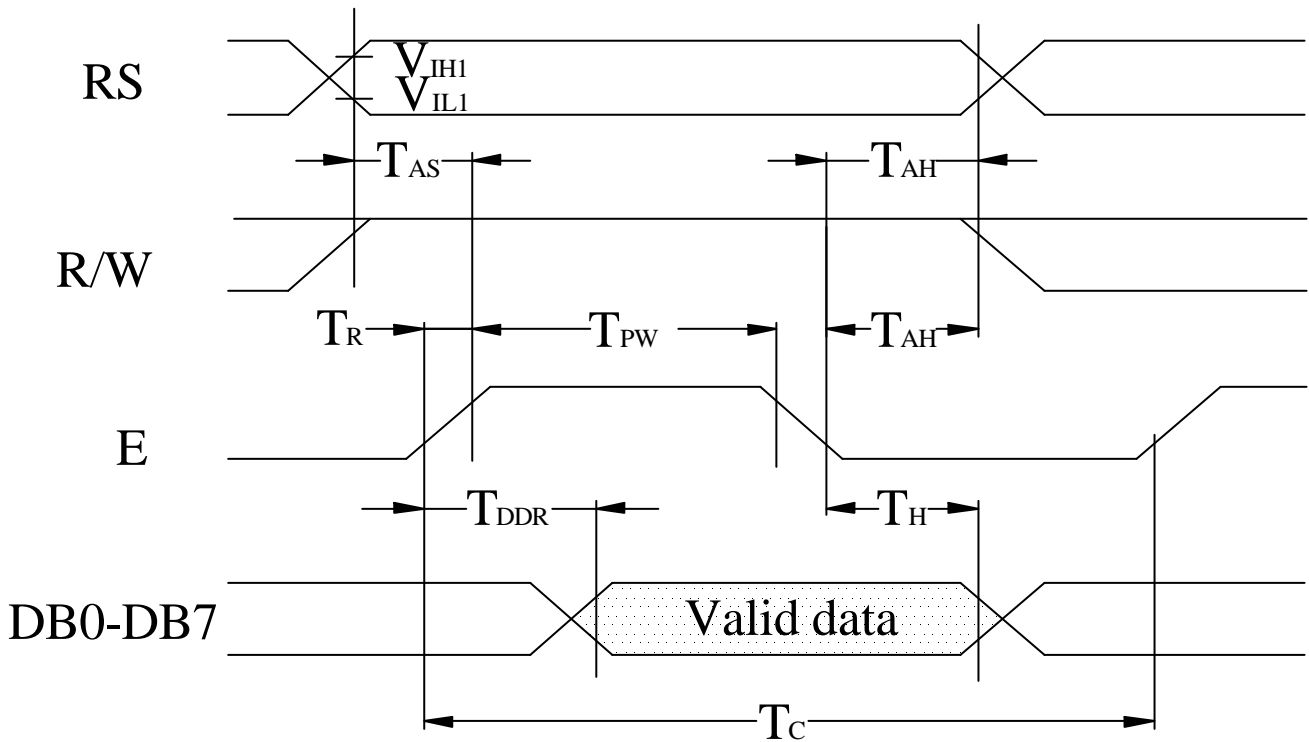


2.3 Timing Characteristics

- Writing data from MPU to ST7066U



Reading data from ST7066U to MPU



- Write Mode (Writing data from MPU to ST7066U)

(V_{cc} = +5V, Ta=25°C)

| Symbol | Characteristics | Test Condition | Min. | Typ. | Max. | Unit |
|---------------------------------|-------------------------|-----------------|------|------|------|------|
| T _C | Enable Cycle Time | Pin E | 1200 | - | - | ns |
| T _{PW} | Enable Pulse Width | Pin E | 140 | - | - | ns |
| T _R , T _F | Enable Rise / Fall Time | Pin E | - | - | 25 | ns |
| T _{AS} | Address Setup Time | Pins: RS , RW,E | 0 | - | - | ns |
| T _{AH} | Address Hold Time | Pins :RS,RW,E | 10 | - | - | ns |
| T _{DSW} | Data Setup Time | Pins:DB0~DB7 | 40 | - | - | ns |
| T _H | Data Hold Time | Pins:DB0~DB7 | 10 | - | - | ns |

- Read Mode (Reading data from ST7066U to MPU)

(V_{cc} = +5V, Ta=25°C)

| Symbol | Characteristics | Test Condition | Min. | Typ. | Max. | Unit |
|---------------------------------|-------------------------|-----------------|------|------|------|------|
| T _C | Enable Cycle Time | Pin E | 1200 | - | - | ns |
| T _{PW} | Enable Pulse Width | Pin E | 140 | - | - | ns |
| T _R , T _F | Enable Rise / Fall Time | Pin E | - | - | 25 | ns |
| T _{AS} | Address Setup Time | Pins: RS , RW,E | 0 | - | - | ns |
| T _{AH} | Address Hold Time | Pins :RS,RW,E | 10 | - | - | ns |
| T _{DDR} | Data Setup Time | Pins:DB0~DB7 | - | - | 100 | ns |
| T _H | Data Hold Time | Pins:DB0~DB7 | 10 | - | - | ns |

2.4 Display Command

| Instructions | Instruction Code | | | | | | | | | | Description | Description Time (270KHz) | |
|-------------------------|------------------|-----|---------|---------|---------|---------|---------|---------|---------|---------|-------------|---|--------|
| | RS | R/W | DB 7 | DB 6 | DB 5 | DB 4 | DB 3 | DB 2 | DB 1 | DB 0 | | | |
| Clear Display | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | Write "20H" to DDRAM. and set DDRAM address to "00H" from AC. | 1.52ms |
| Return Home | 0 | 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. | 1.52ms |
| Entry Mode Set | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | I/D | S | Sets cursor move direction and specifies display shift. These operations are performed during data write and read . | 37μs |
| Display ON/OFF | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | D | C | B | D=1 : entire display on C=1 : cursor on B=1 : cursor position on | 37μs |
| Cursor or Display Shift | 0 | 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. | 37μs |
| Function Set | 0 | 0 | 0 | 0 | 0 | 1 | DL | N | F | × | × | DL: interface data is 8/4 bits NL: number of line is 2/1 F: font size is 5×11/5×8 | 37μs |
| Set CGRAM Address | 0 | 0 | 0 | 1 | AC 5 | AC 4 | AC 3 | AC 2 | AC 1 | AC 0 | | Set CGRAM address in address counter. | 37μs |
| Set DDRAM Address | 0 | 0 | 1 | AC 6 | AC 5 | AC 4 | AC 3 | AC 2 | AC 1 | AC 0 | | Set DDRAM address in address counter. | 37μs |

| | | | | | | | | | | | | |
|----------------------------|---|---|----|------|------|------|------|------|------|------|--|------------|
| Read Busy Flag and Address | 0 | 1 | BF | AC 6 | AC 5 | AC 4 | AC 3 | AC 2 | AC 1 | AC 0 | Whether during internal operation or not can be known by reading BF. The contents of address counter can also be read. | 0 μ s |
| Write Data to RAM | 1 | 0 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Write data into internal RAM (DDRAM/CGRAM). | 37 μ s |
| Read Data from RAM | 1 | 1 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Read data from internal RAM (DDRAM/CGRAM). | 37 μ s |

Note:

Be sure the ST7066U is not in the busy state (BF=0) before sending an instruction from the MPU to the ST7066.

If an instruction is sent without checking the busy flag , the time between the first instruction and next instruction will take much longer than the instruction time itself.

Refer to Instruction Table for the list of each instruction execution time .

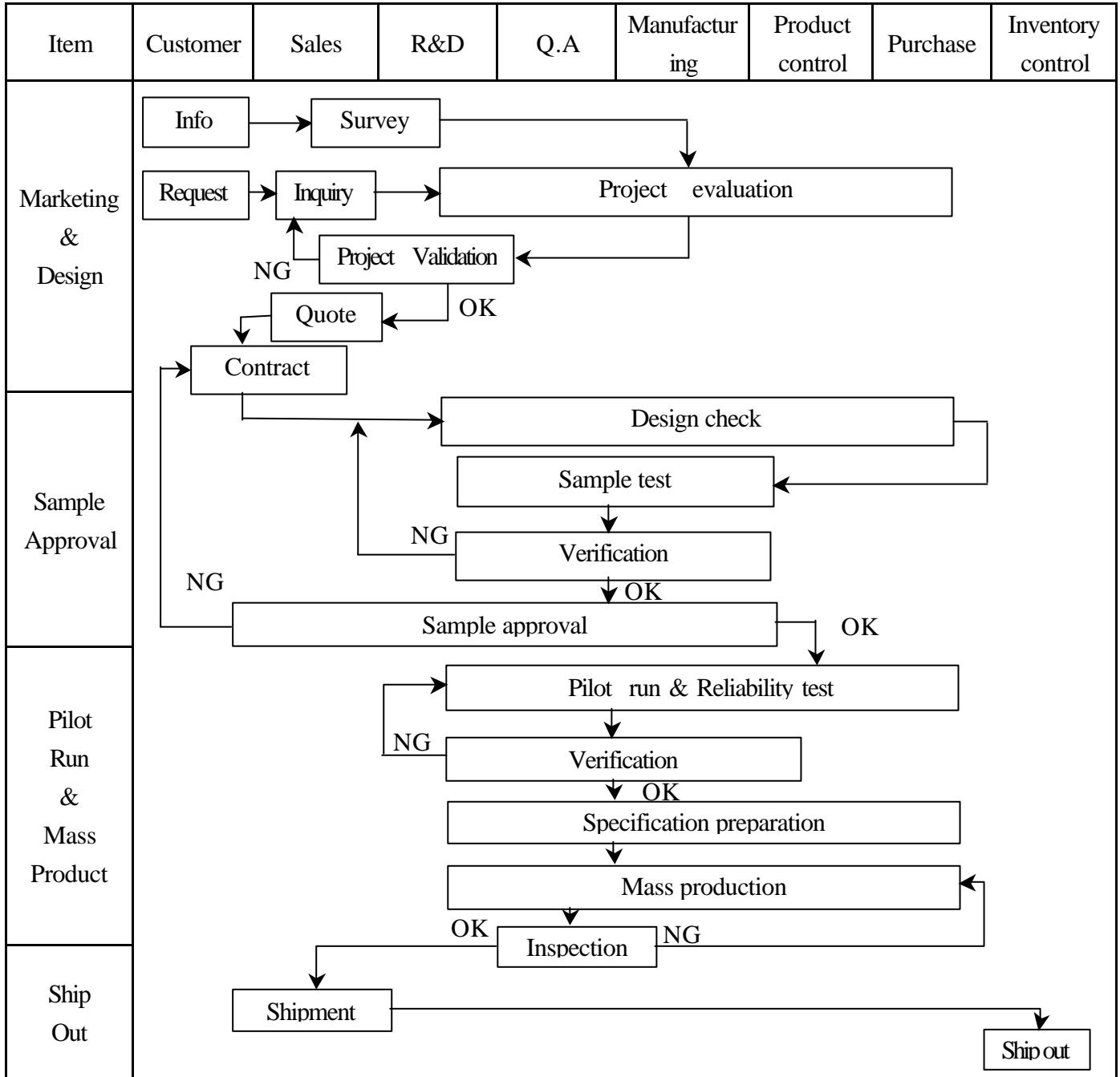
2.5 Character Pattern

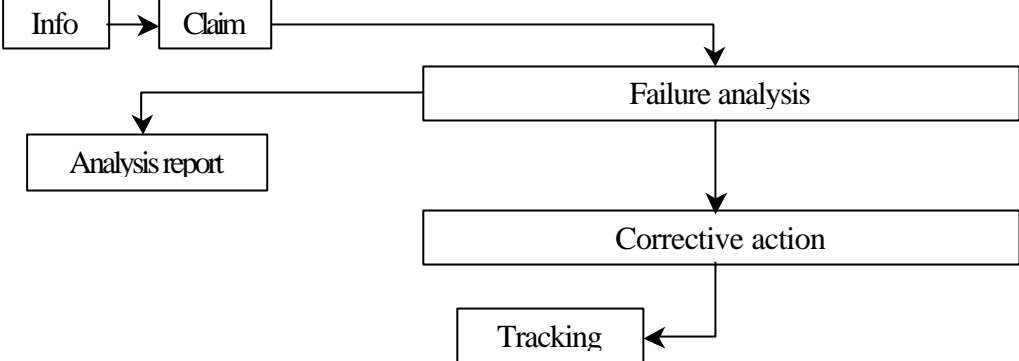
CHARACTER PATTERN(SO/HO/EA,WA)

| Lower 4 Bits \ Upper 4 Bits | 0000 | 0001 | 0010 | 0011 | 0100 | 0101 | 0110 | 0111 | 1000 | 1001 | 1010 | 1011 | 1100 | 1101 | 1110 | 1111 |
|-----------------------------|------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| xxxx0000 | CG RAM (1) | | | 0 | 1 | 2 | 3 | 4 | | | | 5 | 6 | 7 | 8 | 9 |
| xxxx0001 | (2) | ! | 1 | A | Q | a | q | | = | 7 | * | 4 | 3 | 9 | | |
| xxxx0010 | (3) | " | 2 | B | R | b | r | | + | 8 | 5 | 6 | 0 | 1 | 7 | |
| xxxx0011 | (4) | # | 3 | C | S | c | s | | ^ | 9 | 6 | 7 | 2 | 3 | 4 | 5 |
| xxxx0100 | (5) | * | 4 | D | T | d | t | | ~ | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| xxxx0101 | (6) | % | 5 | E | U | e | u | | ~ | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| xxxx0110 | (7) | & | 6 | F | V | f | v | | ~ | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| xxxx0111 | (8) | ' | 7 | G | W | g | w | | ~ | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| xxxx1000 | (1) | (| 8 | H | X | h | x | | ~ | 4 | 5 | 6 | 7 | 8 | 9 | 0 |
| xxxx1001 | (2) |) | 9 | I | Y | i | y | | ~ | 5 | 6 | 7 | 8 | 9 | 0 | 1 |
| xxxx1010 | (3) | * | 0 | J | Z | j | z | | ~ | 6 | 7 | 8 | 9 | 0 | 1 | 2 |
| xxxx1011 | (4) | + | 1 | K | 3 | k | 3 | | ~ | 7 | 8 | 9 | 0 | 1 | 2 | 3 |
| xxxx1100 | (5) | , | 2 | L | 4 | l | 4 | | ~ | 8 | 9 | 0 | 1 | 2 | 3 | 4 |
| xxxx1101 | (6) | - | 3 | M | 5 | m | 5 | | ~ | 9 | 0 | 1 | 2 | 3 | 4 | 5 |
| xxxx1110 | (7) | . | 4 | N | 6 | n | 6 | | ~ | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| xxxx1111 | (8) | / | 5 | O | 7 | o | 7 | | ~ | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

3. QUALITY ASSURANCE SYSTEM

3.1 Quality Assurance Flow Chart



| Item | Customer | Sales | R&D | Q.A | Manufacturing | Product control | Purchase | Inventory control |
|---------------|---|-------|-----|-----|---|-----------------|----------|-------------------|
| Sales Service |  <pre> graph TD Info[Info] --> Claim[Claim] Claim --> Failure[Failure analysis] Failure --> Report[Analysis report] Failure --> Action[Corrective action] Action --> Tracking[Tracking] </pre> | | | | | | | |
| Q.A Activity | 1. ISO 9001 Maintenance Activities 3. Equipment calibration 5. Standardization Management | | | | 2. Process improvement proposal 4. Education And Training Activities | | | |

3.2 Inspection Specification

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

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

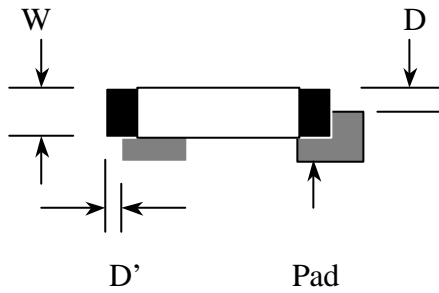
IQC Defect Level : Major Defect AQL 0.4; Minor Defect AQL 1.5.

FQC Defect Level : 100% Inspection.

OUT Going Defect Level : Sampling.

Specification :

| NO | Item | Specification | Judge | Level |
|--|---|--|-------|-------|
| 1 | Part Number | The part number is inconsistent with work order of production | N.G. | Major |
| 2 | Quantity | The quantity is inconsistent with work order of production | N.G. | Major |
| 3 | Electronic characteristics of LCM $A = (L + W) \div 2$ | The display lacks of some patterns. | N.G. | Major |
| | | Missing line. | N.G. | Major |
| | | The size of missing dot, A is $> 1/2$ Dot size | N.G. | Major |
| | | There is no function. | N.G. | Major |
| | | Output data is error | N.G. | Major |
| 4 | Appearance of LCD $A = (L + W) \div 2$ Dirty particle (Including scratch, bubble) | Material is different with work order of production | N.G. | Major |
| | | LCD is assembled in inverse direction | N.G. | Major |
| | | Bezel is assembled in inverse direction | N.G. | Major |
| | | Shadow is within LCD viewing area + 0.5 mm | N.G. | Major |
| | | The diameter of dirty particle, A is > 0.4 mm | N.G. | Minor |
| | | Dirty particle length is > 3.0 mm, and 0.01 mm $<$ width 0.05mm | N.G. | Minor |
| | | Display is without protective film | N.G. | Minor |
| | | Conductive rubber is over bezel 1mm | N.G. | Minor |
| | | Polarizer exceeds over viewing area of LCD | N.G. | Minor |
| | | Area of bubble in polarizer, A > 1.0 mm, the number of bubble is > 1 piece. | N.G. | Minor |
| | | 0.4 mm $<$ Area of bubble in polarizer, A < 1.0 mm, the number of bubble is > 4 pieces. | N.G. | Minor |
| 5 | Appearance of PCB $A = (L + W) \div 2$ | Burned area or wrong part number is on PCB | N.G. | Major |
| | | The symbol, character, and mark of PCB are unidentifiable. | N.G. | Minor |
| | | The stripped solder mask, A is > 1.0 mm | N.G. | Minor |
| | | 0.3 mm $<$ stripped solder mask or visible circuit, A < 1.0 mm, and the number is 4 pieces | N.G. | Minor |
| | | There is particle between the circuits in solder mask | N.G. | Minor |
| | | The circuit is peeled off or cracked | N.G. | Minor |
| | | There is any circuits risen or exposed. | N.G. | Minor |
| | | 0.2 mm $<$ Area of solder ball, A is 0.4mm | N.G. | Minor |
| | | The number of solder ball is 3 pieces | N.G. | Minor |
| The magnitude of solder ball, A is > 0.4 mm. | N.G. | Minor | | |

| NO | Item | Specification | Judge | Level |
|----|--|--|-------|-------|
| 6 | Appearance of molding $A=(L+W) \div 2$ | The shape of modeling is deformed by touching. | N.G. | Major |
| | | Insufficient epoxy: Circuit or pad of IC is visible | N.G. | Minor |
| | | Excessive epoxy: Diameter of modeling is $> 20\text{mm}$ or height is $> 2.5\text{mm}$ | N.G. | Minor |
| | | The diameter of pinhole in modeling, A is $> 0.2\text{mm}$. | N.G. | Minor |
| 7 | Appearance of frame $A=(L+W) \div 2$ | The folding angle of frame must be $> 45 +10$ | N.G. | Minor |
| | | The area of stripped electroplate in top-view of frame, A is $> 1.0\text{mm}$. | N.G. | Minor |
| | | Rust or crack is (Top view only) | N.G. | Minor |
| | | The scratched width of frame is $> 0.06\text{mm}$. (Top view only) | N.G. | Minor |
| 8 | Electrical characteristic of backlight $A=(L+W) \div 2$ | The color of backlight is nonconforming | N.G. | Major |
| | | Backlight can't work normally. | N.G. | Major |
| | | The LED lamp can't work normally | N.G. | Major |
| | | The unsoldering area of pin for backlight, A is $> 1/2$ solder joint area. | N.G. | Minor |
| | | The height of solder pin for backlight is $> 2.0\text{mm}$ | N.G. | Minor |
| 10 | Assembly parts $A=(L+W) \div 2$ | The mark or polarity of component is unidentifiable. | N.G. | Minor |
| | | The height between bottom of component and surface of the PCB is floating $> 0.7\text{mm}$ | N.G. | Minor |
| | | $D > 1/4W$  | N.G. | Minor |
| | | End solder joint width, D' is $> 50\%$ width of component termination or width of pad | N.G. | Minor |
| | | Side overhang, D is $> 25\%$ width of component termination. | N.G. | Minor |
| | | Component is cracked, deformed, and burned, etc. | N.G. | Minor |
| | | The polarity of component is placed in inverse direction. | N.G. | Minor |
| | | Maximum fillet height of solder extends onto the component body or minimum fillet height is $< 0.5\text{mm}$. | N.G. | Minor |

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.
- 5.2.8 To control temperature and time of soldering is 280 ± 10 and 3-5 sec.
- 5.2.9 To avoid liquid (include organic solvent) stained on LCM .

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 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.