# POWERTIP TECH. CORP.

DISPLAY DEVICES FOR BETTER ELECTRONIC DESIGN

## Specification For Approval

Customer : _____

Model Type : LCD MODULE

Sample Code : _____

Mass Production Code : PC2002ARS-AWA-A

Edition : 0

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

## Revision Record

| Date(y/m/d) | Rev. | Description | Note | Page |
|---|---|---|---|---|
| 2002/07/27 | 0 | Revised Contents | | |
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## Contents

# 1. SPECIFICATIONS

## 1.1 Features

| Item | Standard Value |
|---|---|
| Display Type | 20 * 2 Characters |
| LCD Type | STN, Gray, Reflective, Positive, Normal Temp. |
| Driver Type | 1/16 Duty , 1/5 Bias |
| Viewing Direction | 6 O'clock |
| Weight | 42.8g |
| Other | — |

## 1.2 Mechanical Specifications

| Item | Standard Value | Unit |
|---|---|---|
| Outline Dimension | 116.0mm(L) * 37.0mm(w) * 10.2mm(H)(Max) | mm |
| Viewing Area | 85.0mm(L) * 18.6mm(w) | mm |
| Active Area | 73.5mm(L) * 11.5mm(w) | mm |
| Dot Size | 0.6mm(L) * 0.65mm(w) | mm |
| Dot Pitch | 0.65mm(L) * 0.7mm(w) | mm |

## 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 | $V_{DD}$-$V_{EE}$ | — | $V_{DD}$-10.0 | $V_{DD}$+0.3 | V |
| Input Voltage | $V_{IN}$ | — | -0.3 | $V_{DD}$+0.3 | V |
| Operating Temperature | $T_{OP}$ | — | 0 | 50 | °C |
| Storage Temperature. | $T_{ST}$ | — | -20 | 70 | °C |
| Humidity | $H_D$ | — | | 90 | %RH |

## 1.4 DC Electrical Characteristics

$V_{DD}$ = 5.0 V ± 10%, $V_{SS}$ = 0V, Ta = 25°C

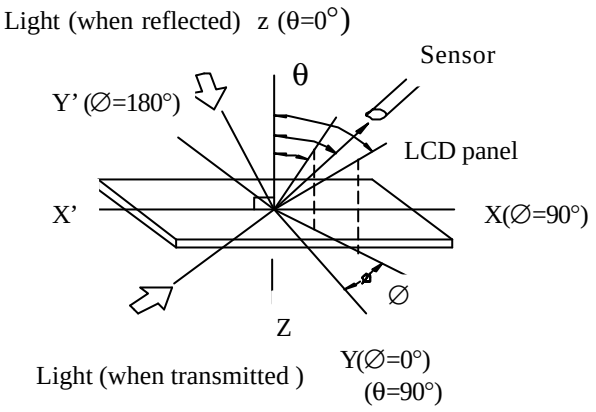
| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Logic Supply Voltage | $V_{DD}$ | — | 4.5 | 5.0 | 5.5 | V |
| "H" Input Voltage | $V_{IH}$ | — | 0.7 $V_{DD}$ | - | $V_{DD}$ | V |
| "L" Input Voltage | $V_{IL}$ | — | -0.3 | - | 0.6 | V |
| "H" Output Voltage | $V_{OH}$ | $I_{OH}$=-0.1mA | 3.9 | - | $V_{DD}$ | V |
| "L" Output Voltage | $V_{OL}$ | $I_{OL}$=0.1mA | - | - | 0.4 | V |
| Supply Current | $I_{DD}$ | $V_{DD}$ = 5.0 V | - | 2.0 | 3.0 | mA |
| LCD Driver Voltage | $V_{OP}$ | $V_{DD}$ - $V_O$ (0°C) | - | - | - | V |
| | | $V_{DD}$ - $V_O$ (25°C) | - | 4.8 | - | |
| | | $V_{DD}$ - $V_O$ (50°C) | - | - | - | |

## 1.5 Optical Characteristics

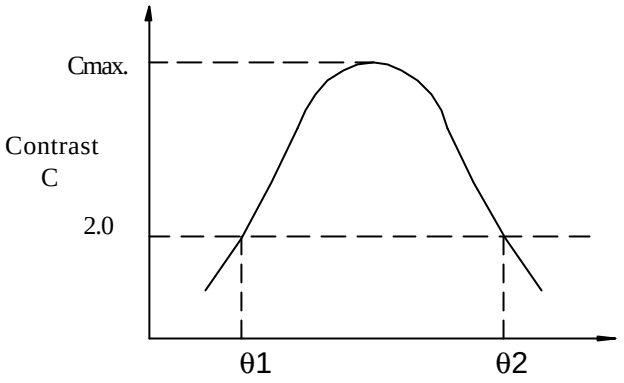
1/16Duty, 1/5Bias, VOP = 4.8V, Ta = 25°C

| Item | Symbol | Conditions | Min. | Typ. | Max. | Reference |
|---|---|---|---|---|---|---|
| View Angle | θ | C≥2.0,∅= 0° | 40° | - | - | Notes 1 & 2 |
| Contrast Ratio | C | θ=5°, ∅= 0° | 5 | 7 | - | Note 3 |
| Response Time(rise) | Tr | θ= 5°, ∅= 0° | - | 150 ms | - | Note 4 |
| Response Time(fall) | Tf | θ= 5°, ∅= 0° | - | 300 ms | - | Note 4 |

Note 1: Definition of angles θ and ∅



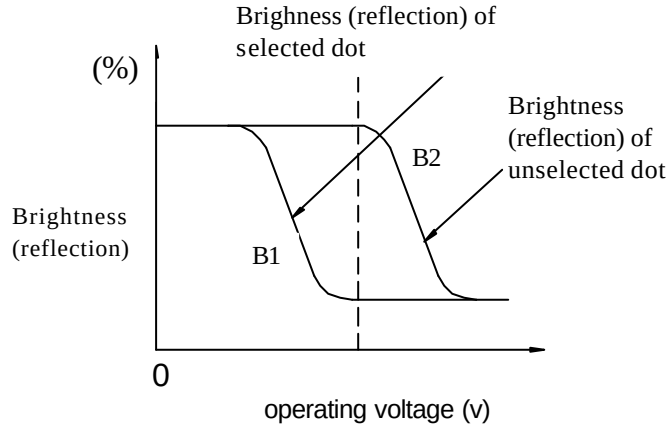

Note 2: Definition of viewing angles θ1 and θ2



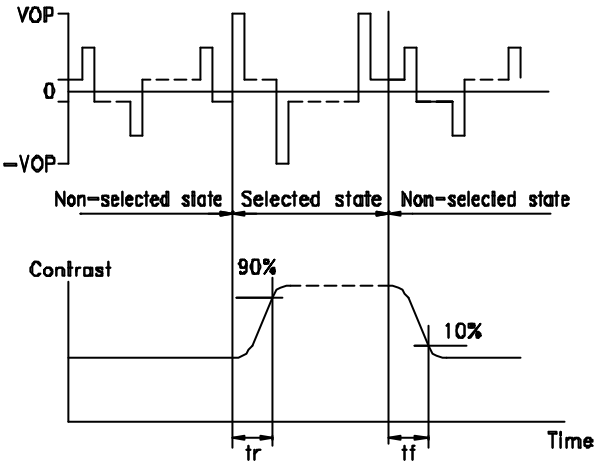

Note : Optimum viewing angle with the naked eye and viewing angle θ at Cmax. Above are not always the same

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

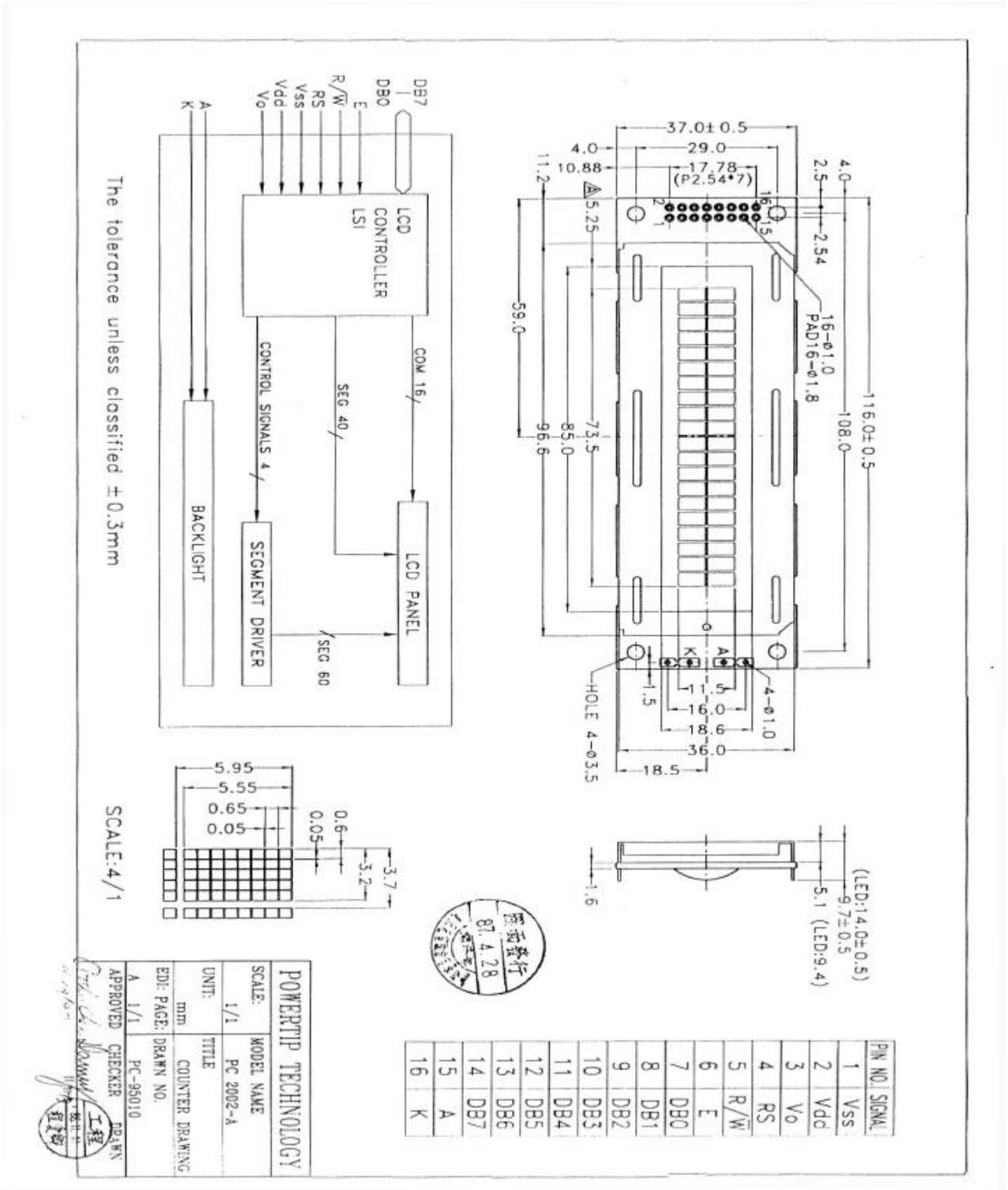



Note: Measured with a transmissive LCD panel which is displayed 1 $cm^2$

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

# 2. MODULE STRUCTURE

## 2.1 Counter Drawing

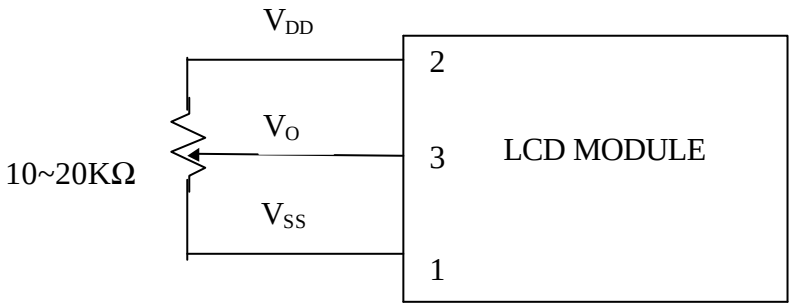



| PIN NO. | SIGNAL |
|---|---|
| 1 | Vss |
| 2 | Vdd |
| 3 | Vo |
| 4 | RS |
| 5 | R/W |
| 6 | E |
| 7 | DB0 |
| 8 | DB1 |
| 9 | DB2 |
| 10 | DB3 |
| 11 | DB4 |
| 12 | DB5 |
| 13 | DB6 |
| 14 | DB7 |
| 15 | A |
| 16 | K |

## 2.2 Interface Pin Description

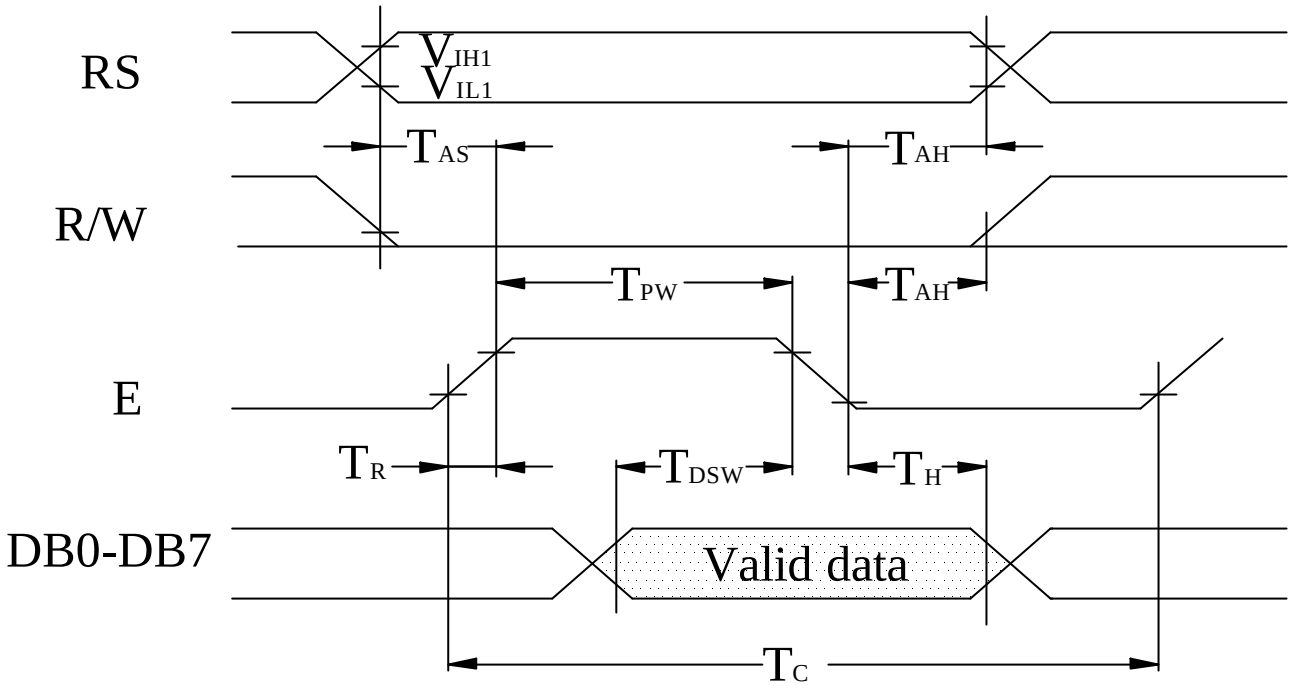
| Pin No. | Symbol | Signal Description |
|---|---|---|
| 1 | VSS | Power Supply ($V_{SS}$=0) |
| 2 | VDD | Power Supply ($V_{DD}$>$V_{SS}$) |
| 3 | VO | Operating voltage (LCD Driver) |
| 4 | RS | Register Selection input<br>High = Data register<br>Low = Instruction register (for write)<br>Busy flag address counter (for read) |
| 5 | R/W | Read/Write signal input is used to select the read/write mode<br>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.<br>Used for data transfer between the MPU and the LCD module.<br>These four are not used during 4-bit operation. |
| 11~14 | DB4 ~ DB7 | Four high order bi-directional three-state data bus lines.<br>Used for data transfer between the MPU and the LCD module.<br>DB7 can be used as a busy flag. |
| 15 | A | No connection |
| 16 | K | No connection |

Contrast Adjust

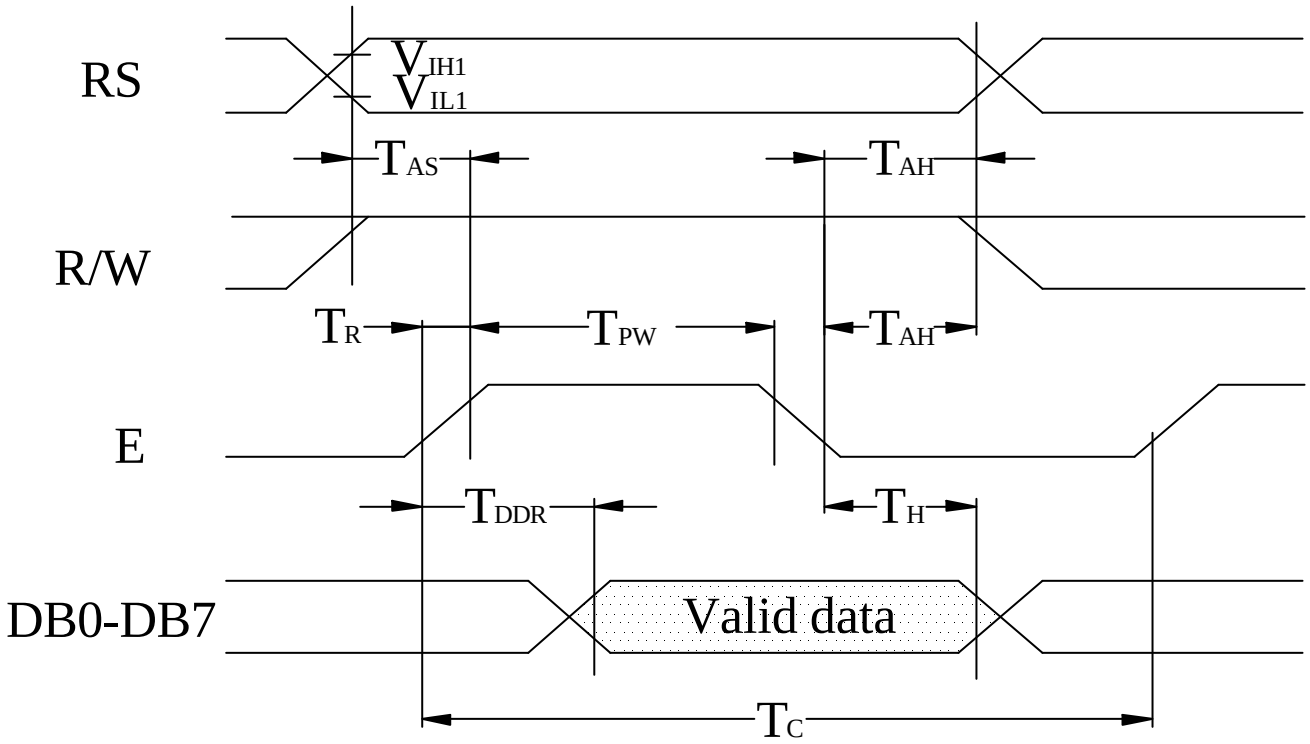


## 2.3 Timing Characteristics

- Writing data from MPU to ST7066U




- Reading data from ST7066U to MPU



- Write Mode (Writing data from MPU to ST7066)

($V_{DD}$ = +5V±10%,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 ST7066 to MPU)

($V_{DD}$ = +5V±10%,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 | 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 | 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 | 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 | 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 | 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 | 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. | 0μs |
| Write Data to RAM | 1 | 0 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Write data into internal RAM (DDRAM/CGRAM). | 37μs |
| Read Data from RAM | 1 | 1 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Read data from internal RAM (DDRAM/CGRAM). | 37μs |

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 .

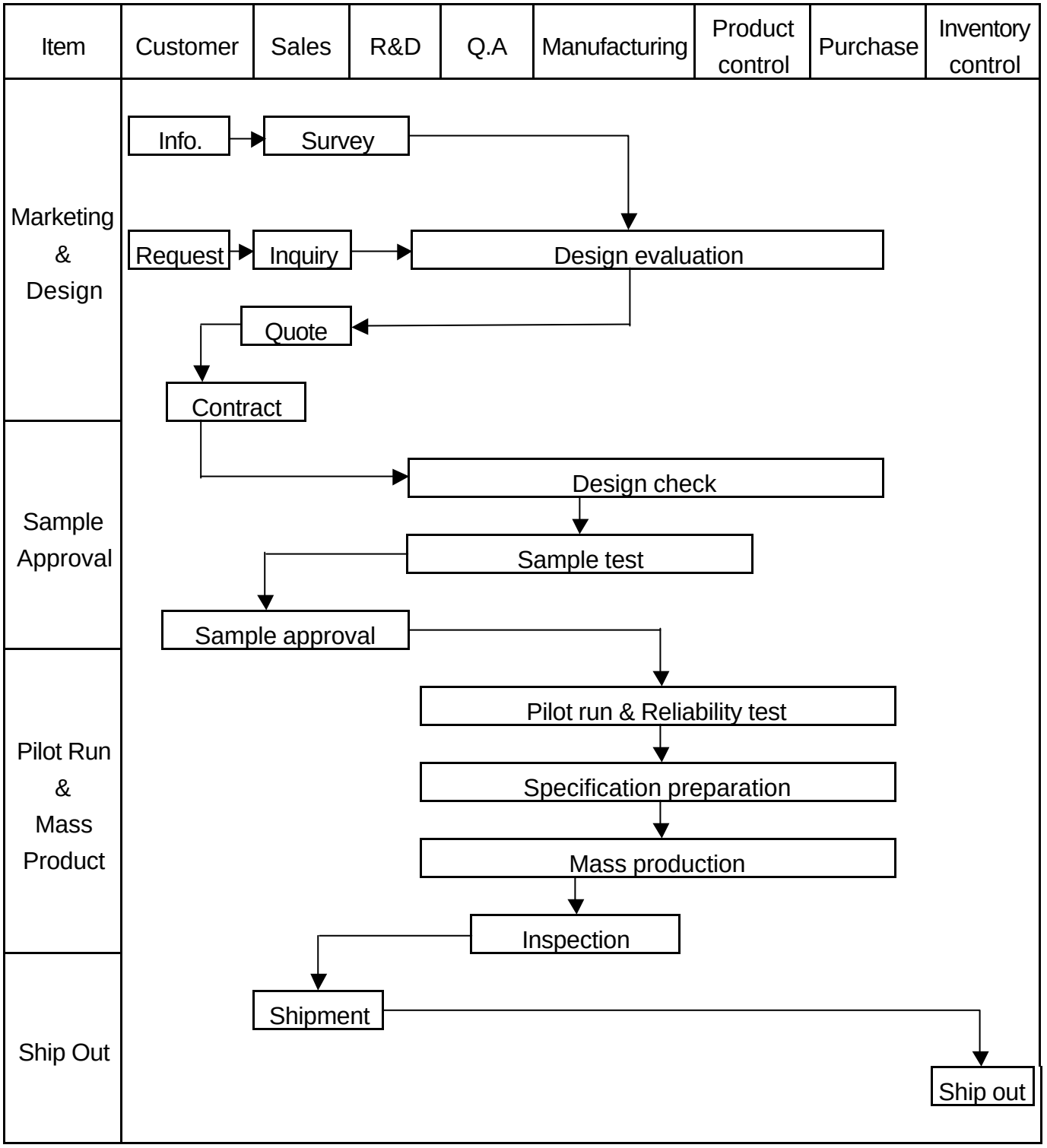
## 2.5 Character Pattern

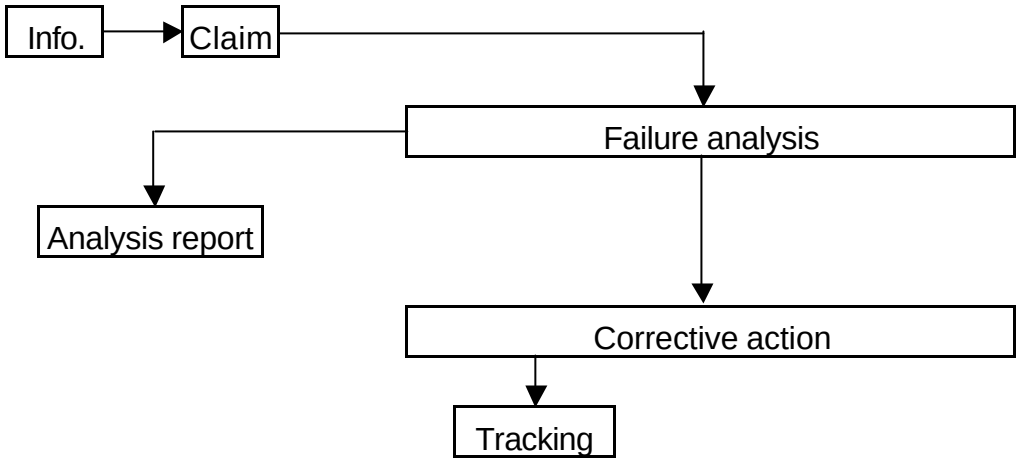
■ CHARACTER PATTERN(SO/HO/EA,WA)

| 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) | | | | | | | | | | | | | | | |
| xxxx0001 | (2) | | | | | | | | | | | | | | | |
| xxxx0010 | (3) | | | | | | | | | | | | | | | |
| xxxx0011 | (4) | | | | | | | | | | | | | | | |
| xxxx0100 | (5) | | | | | | | | | | | | | | | |
| xxxx0101 | (6) | | | | | | | | | | | | | | | |
| xxxx0110 | (7) | | | | | | | | | | | | | | | |
| xxxx0111 | (8) | | | | | | | | | | | | | | | |
| xxxx1000 | (1) | | | | | | | | | | | | | | | |
| xxxx1001 | (2) | | | | | | | | | | | | | | | |
| xxxx1010 | (3) | | | | | | | | | | | | | | | |
| xxxx1011 | (4) | | | | | | | | | | | | | | | |
| xxxx1100 | (5) | | | | | | | | | | | | | | | |
| xxxx1101 | (6) | | | | | | | | | | | | | | | |
| xxxx1110 | (7) | | | | | | | | | | | | | | | |
| xxxx1111 | (8) | | | | | | | | | | | | | | | |

# 3. QUALITY ASSURANCE SYSTEM

## 3.1 Quality Assurance Flow Chart

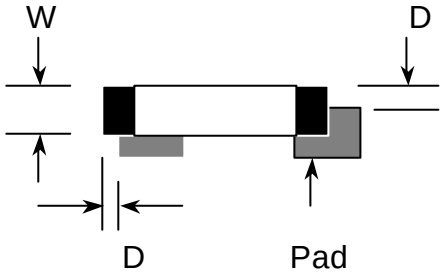


| | |
|---|---|
| Sales Service |  |
| Q.A Activity | 1. ISO 9001 Maintenance Activities 2. Process improvement proposal<br>3. Equipment calibration 4. Education And Training Activities<br>5. Standardization Management |

## 3.2 Inspection Specification

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

| N O | 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<br>A=( L + W )÷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<br>A=( L + W )÷2<br>Dirty particle ( Include scratch、bubble ) | 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 length ＞3.0mm<br>And 0.01mm＜ Width ≦ 0.05mm ( Width＞ 0.05mm Measure by area ) | N.G. | Minor |
| | | Without protective film | N.G. | Minor |
| | | Conductive rubber over bezel | N.G. | Minor |
| 5 | PCB Appearance<br>A=( L + W )÷2 | Burned PCB | N.G. | Major |
| | | Green paint stripped & visible circuit A＞1.0mm ( 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 |
| | | 0.2mm＜Tin ball area A≦0.4mm<br>And Q'TY＞4 Pieces | N.G | Minor |
| | | Tin ball area A＞0.4mm | N.G | Minor |

| N O | Item | Specification | Judge | Level |
|---|---|---|---|---|
| 6 | Molding appearance A=( L + W )÷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 )÷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 )÷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 )÷2 | Polarize rise over V/A | N.G. | Minor |
| 10 | Assembly parts A=( L + W )÷2 | Components mark unclearly | N.G. | Minor |
| | | Components' distance more than 0.7mm firm 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<br>Surrounding Temperature, Then Storage<br>At Normal Condition 4hrs. | | MIL-202E |
| 2 | Low Temperature Storage | Storage At -30 ±2℃ 96~100 hrs<br>Surrounding Temperature, Then Storage<br>At Normal Condition 4hrs. | | MIL-202E |
| 3 | High Temperature<br>Humidity Storage | 1.Storage 96~100 hrs 60 ±2℃, 90~95%RH<br>Surrounding Temperature, Then Storage<br>At Normal Condition 4hrs .(Polarizer may fail in this environment).<br>or<br>2.Storage 96~100 hrs 40 ±2℃, 90~95%RH<br>Surrounding Temperature, Then Storage<br>At Normal Condition 4 hrs. | | MIL-202E |
| 4 | Temperature Cycling | -20℃ → 25℃ → 70℃ → 25℃<br>(30Mins) (5Mins) (30Mins) (5Mins)<br>10 Cycle | | MIL-202E |
| 5 | Vibration | 10~55Hz ( 1 Minute ) 1.5mm<br>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 | |

# 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°C ±5°C 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.