POWERTIP TECH. CORP.
DISPLAY DEVICES FOR BETTER ELECTRONIC DESIGN

Specification For Approval

Customer _____

Model Type   LCD   MODULE

Sample Code

Mass Production Code   PC2402LRS-AWA-H

Edition   0

Customer Sign	Sales Sign	Checked By (QA)	Approved By	Prepared By
			Davy 2/22 Tom 2/22	李华明 2/21

Revision Record

Date(y/m/d)	Rev.	Description	Note	Page
2003/01/23	0	Revised Contents		

Total Page : 1 ~ 20

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1. SPECIFICATIONS

1.1 Features

Item	Standard Value
Display Type	24 * 2 Characters
LCD Type	STN,Gray, Transflective, Positive,Extended Temp.
Driver Type	1/16 Duty , 1/5Bias
Viewing Direction	6 O' clock
Backlight	Yellow-Green LED B/L
Weight	54.0g
Other	

1.2 Mechanical Specifications

Item	Standard Value	Unit
Outline Dimension	118.0 (L) * 36.0 (w) * 13.8 (H)(Max)	mm
Viewing Area	93.5 (L) * 15.8 (w)	mm
Active Area	88.3 (L) * 11.5 (w)	mm
Dot Size	0.6 (L) * 0.65 (w)	mm
Dot Pitch	0.65(L) * 0.7 (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}		-20	70	°C
Storage Temperature.	T_{ST}		-30	80	°C
Humidity	H_D			90	%RH

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1.4 DC Electrical Characteristics

$V_{DD} = 5.0$ V $\pm 10\%$ $V_{SS} = 0$V   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	2.5	mA
LCD Driver Voltage	V_{OP}	V_{DD} - V_{O} (-20°C)	-	-	-	V
		V_{DD} - V_{O} (25°C)	-	6.9	-	
		V_{DD} - V_{O} (70°C)	-	-	-	

1.5 Optical Characteristics

1/16 Duty   1/5 Bias   VOP $= 6.9$ V   Ta $= 25°$C

Item	Symbol	Conditions	Min.	Typ.	Max.	Reference
View Angle	θ	C$\geq$2.0,$\varnothing$= 0°	40°	-	-	Notes 1 & 2
Contrast Ratio	C	θ=25°, $\varnothing$= 0°	5	7	-	Note 3
Response Time(rise)	Tr	θ= 25°, $\varnothing$= 0°	-	150 ms	-	Note 4
Response Time(fall)	Tf	θ= 25°, $\varnothing$= 0°	-	300 ms	-	Note 4

Note 1: Definition of angles θ and ∅

Light (when reflected) z (θ=0°)

Sensor

Y'(∅=180°)

θ

LCD panel

X'

X(∅=90°)

∅

Z'

Light (when transmitted)

Y(∅=0°)
(θ=90°)
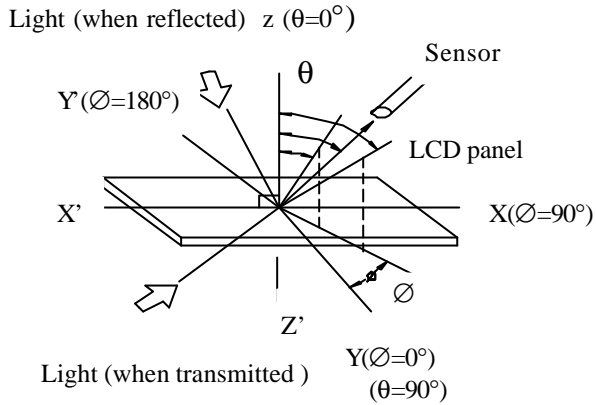
Note 2: Definition of viewing angles θ1 and θ2

Cmax.

Contrast
C

2.0

θ1   θ2
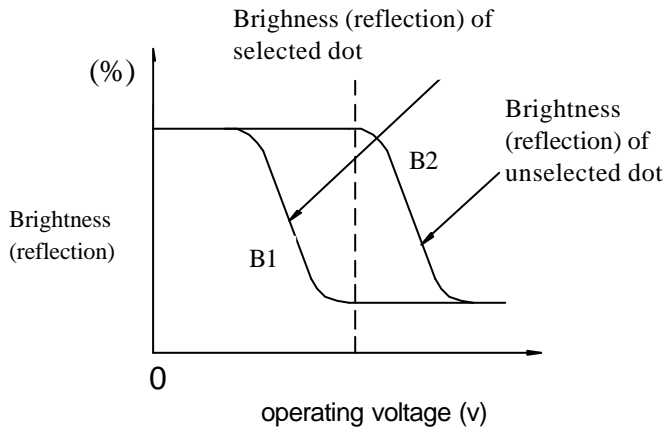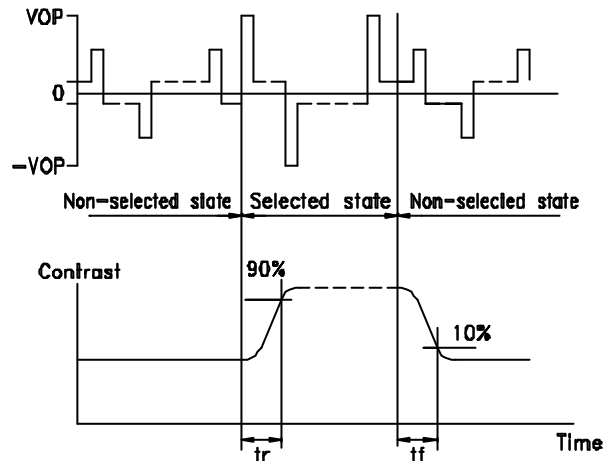
viewing angle θ (∅ fixed)
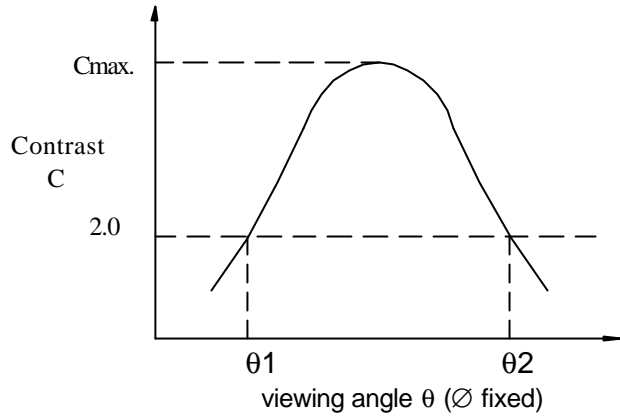
Note :   Optimum viewing angle with the
naked eye and viewing angle θ at
Cmax. Above are not always the same

Note 3: Definition of contrast C

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

(%)

Brighness (reflection) of
selected dot

Brightness
(reflection) of
unselected dot

B2

Brightness
(reflection)

B1

0

operating voltage (v)

Note 4: Definition of response time

VOP

0

−VOP

Non−selected state | Selected state | Non−selected state

Contrast

90%

10%

tr   tf

Time

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

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

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1.6 Backlight Characteristics

LCD Module with LED Backlight panel.

Maximum Ratings

Item	Symbol	Conditions	Min.	Max.	Unit
Forward Current	IF	Ta =25°C	-	375	mA
Reverse Voltage	VR	Ta =25°C	-	8	V
Power Dissipation	PO	Ta =25°C	-	1.72	W
Operating Temperature	T_{OP}	-	-20	70	°C
Storage Temperature	T_{ST}	-	-40	80	°C

Electrical Ratings

Ta =25°C

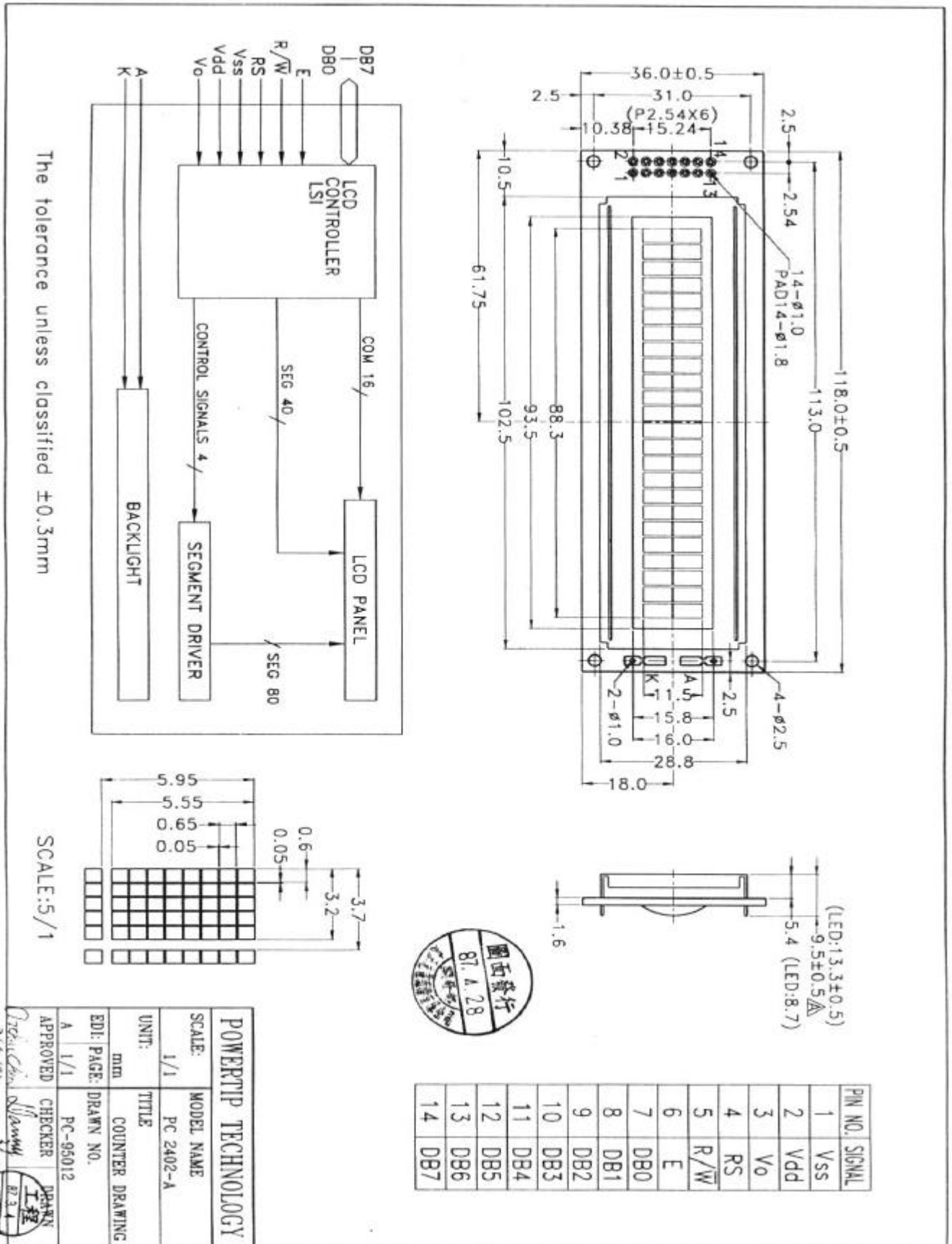| Item	Symbol	Conditions	Min.	Typ.	Max.	Unit
Forward Voltage	VF	IF=150 mA	3.8	4.2	4.6	V
Reverse Current	IR	VR=8V	-	-	0.2	mA
Luminous Intensity (without LCD)	IV	IF=150 mA	136	170	-	cd/m^2
Wavelength	Hue	IF=150 mA	569	-	576	nm
Color	Yellow-Green					

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2. MODULE STRUCTURE

2.1 Counter Drawing

2.2 Interface Pin Description

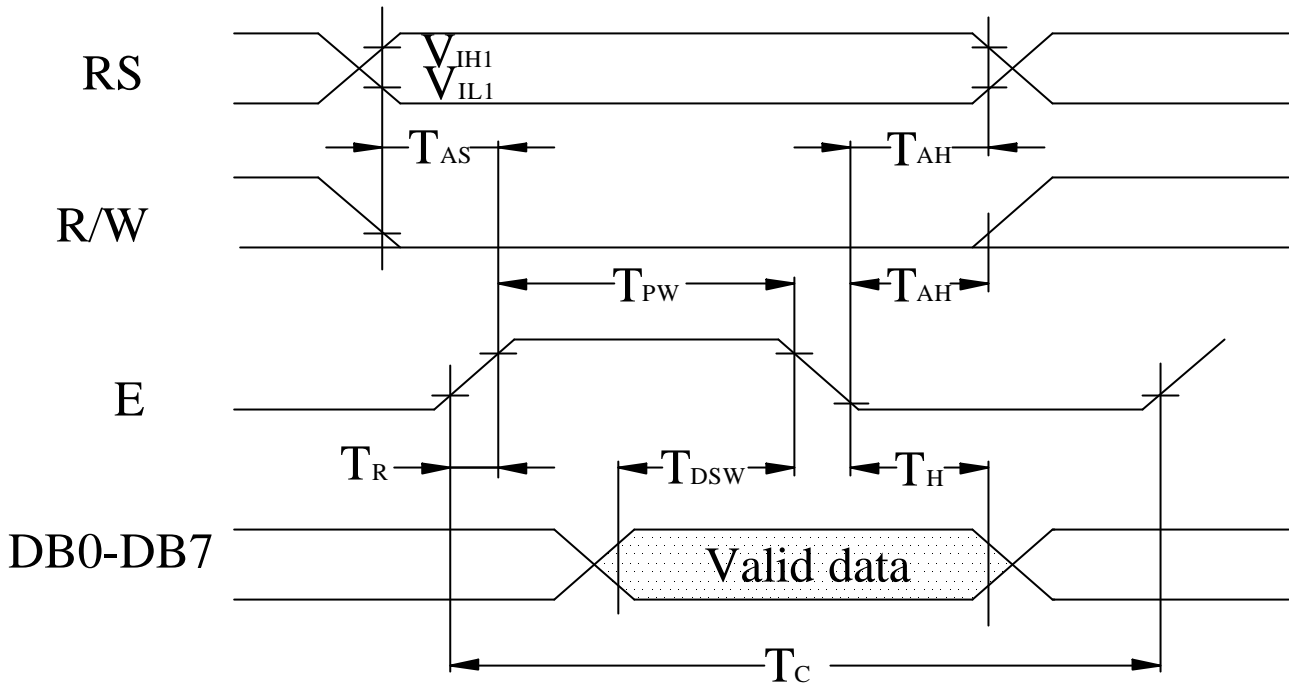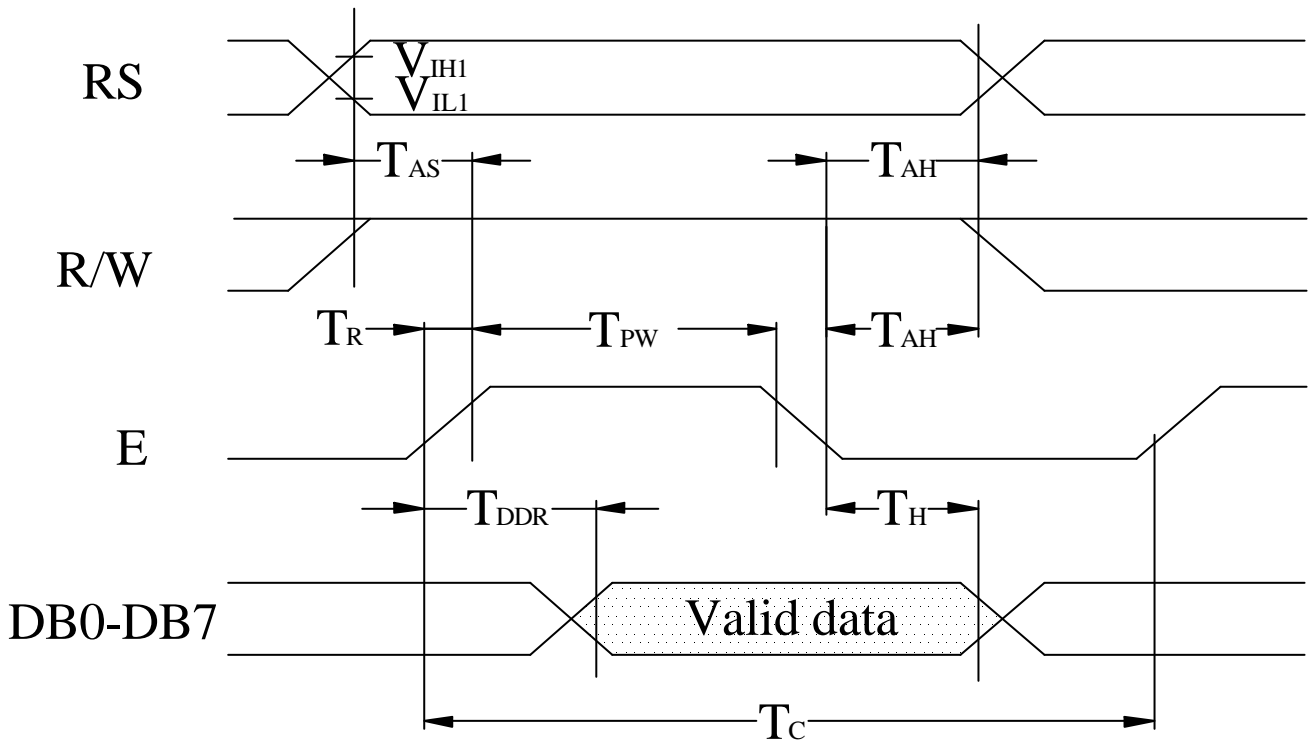| Pin No.	Symbol	Signal Description
1	V_{SS}	Power Supply (Vss=0)
2	V_{DD}	Power Supply ($V_{DD} > V_{SS}$)
3	V_O	Operating voltage for LCD
4	RS	Register Selection input High = Data register Low = Instruction register (for write) Busy flag address counter (for read)
5	$\overline{R/W}$	Read/Write signal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

Contrast Adjust
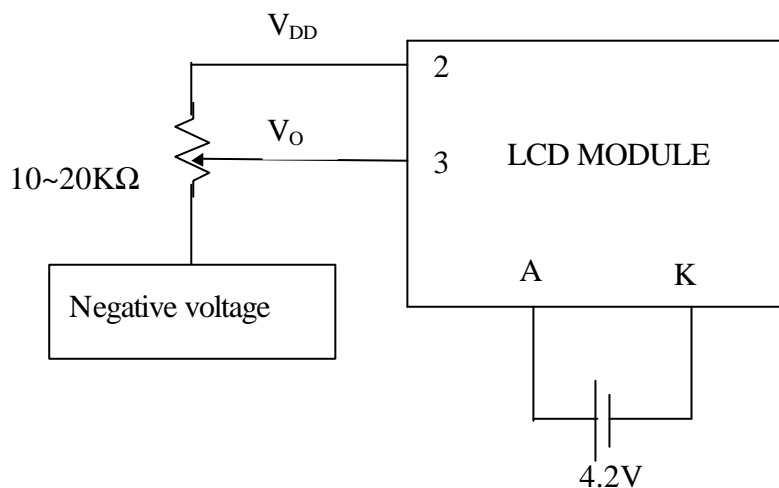
2.3 Timing Characteristics

● Writing data from MPU to ST7066U

RS

R/W

E

DB0-DB7

T_{AS} T_{AH} T_{PW} T_{AH} T_R T_{DSW} T_H V_{IH1} V_{IL1}

Valid data

T_C

● Reading data from ST7066U to MPU

RS

R/W

E

DB0-DB7

T_{AS} T_{AH} T_R T_{PW} T_{AH} T_{DDR} T_H V_{IH1} V_{IL1}

Valid data

T_C

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• Write Mode (Writing data from MPU to ST7066U)

(Vcc = +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)

(Vcc = +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

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2.4 Display Command

Instructions	Instruction Code										Description	Description Time (270KHz)
	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0		
Clear Display	0	0	0	0	0	0	0	0	0	1	Write "20H" to DDRAM. and set DDRAM address to "00H" from AC.	1.52ms
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	AC5	AC4	AC3	AC2	AC1	AC0	Set CGRAM address in address counter.	37µs
Set DDRAM Address	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Set DDRAM address in address counter.	37µs
Read Busy Flag and Address	0	1	BF	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Whether during internal operation or not can be known by reading BF. The contents of address counter can also be read.	0µs
Write Data to RAM	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Write data into internal RAM (DDRAM/CGRAM).	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 .

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2.5 Character Pattern
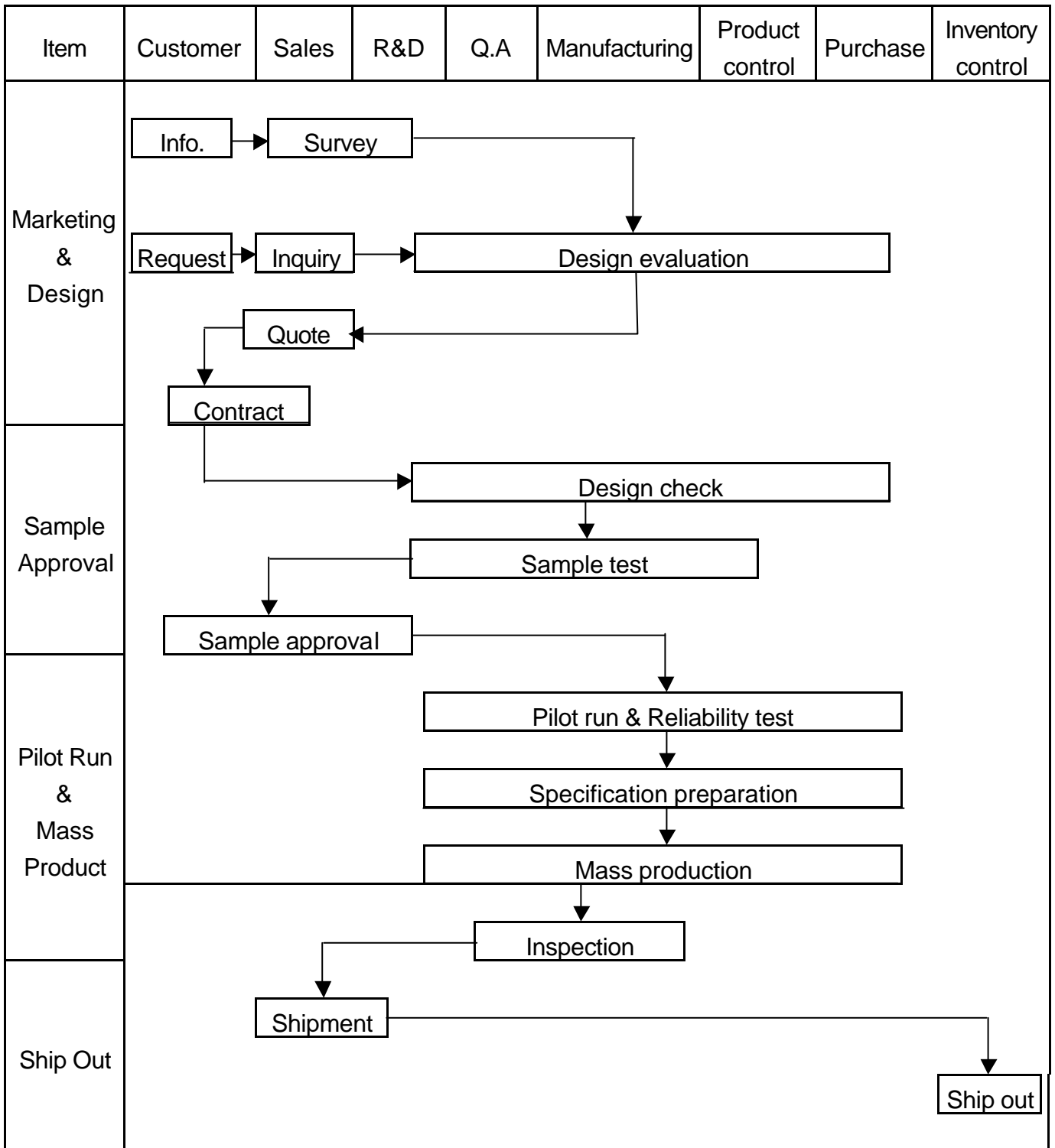
■ CHARACTER PATTERN(SO/HO/EA,WA)

3. QUALITY ASSURANCE SYSTEM

3.1 Quality Assurance Flow Chart

Item	Customer	Sales	R&D	Q.A	Manufacturing	Product control	Purchase	Inventory control
Marketing & Design	Info. → Survey Request → Inquiry				Design evaluation			
	Quote Contract							
Sample Approval	Sample approval				Design check Sample test			
Pilot Run & Mass Product					Pilot run & Reliability test Specification preparation Mass production Inspection			
Ship Out	Shipment							Ship out

Sales Service	Info. → Claim → Failure analysis → Analysis report → Corrective action → Tracking
Q.A Activity	1. ISO 9001 Maintenance Activities 2. Process improvement proposal 3. Equipment calibration 4. Education And Training Activities 5. Standardization Management

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
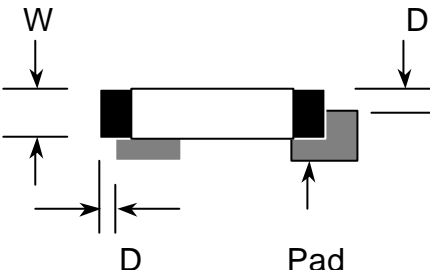FQC Defect Level   100% Inspection
OUT Going Defect Level   Sampling
Specification

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 $A=(L + W)\div 2$	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 $A=(L + W)\div 2$ 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 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 $A=(L + W)\div 2$	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 And Q'TY 4 Pieces	N.G	Minor
		Tin ball area A 0.4mm	N.G	Minor

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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 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	<table><tr><td>Packing Weight (Kg)</td><td>Drop High (Cm)</td></tr><tr><td>0 ~ 45.4</td><td>122</td></tr><tr><td>45.4 ~ 90.8</td><td>76</td></tr><tr><td>90.8 ~ 454</td><td>61</td></tr><tr><td>Over 454</td><td>46</td></tr></table>	MIL-810E

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.

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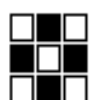DISPLAY DEVICES FOR BETTER ELECTRONIC DESIGN
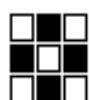
5.4 TERMS OF WARRANTY

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.

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