



## PRODUCT SPECIFICATION

*Part Number*

PG12232D-O Series

CUSTOMER	
CUSTOMER PART NUMBER	
DESCRIPTION	
APPROVED BY	
DATE	

## Table of Contents


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 <b>P-TEC</b>	<b>MODEL NO.</b>		<b>PAGE</b>
	PG12232D-O series	SPEC ONLY	4

## 1. Part number breakdown

**P** \_ \_ - \_ \_ - \_ - \_ - \_  
 1 2 3 4 5 6 7 8 9

Replace each Space ( \_ ) with the following letters and or numbers

1. P-tec LCD Type	<b>C</b> = Character <b>G</b> = Graphic <b>COG</b> = Chip On Glass	<b>COF</b> = Chip On Flex <b>TAB</b> = Tape Automated Bonding <b>TFT</b> = Thin-film Transistor
2. LCD Model	Example for Character: <b>2002A</b> = 20 Characters x 2 Lines w/ Pins on Left side and 116mm x 37 x 12.7mm overall size Example for Graphic: <b>12864B</b> = 128 Dots per row x 64 Dots per Column w/ Pins on lower side and 93mm x 70 x 8.8mm overall size	
3. Fluid Type	<b>T</b> = TN/ Grey <b>Y</b> = STN/ Yellow Green <b>G</b> = STN/ Grey	<b>B</b> = STN/ Blue <b>F</b> = FSTN/ White <b>N</b> = FSTN/ Black
4. Backlight/polorizer	<b>NF</b> = None/Transflective <b>NM</b> = None/Transmissive <b>NR</b> = None/Reflective <b>EF</b> = EL/Transflective <b>EM</b> = EL/Transmissive	<b>LF</b> = LED/Transflective <b>LM</b> = LED/Transmissive <b>CF</b> = CCFL/Transflective <b>CM</b> = CCFL=Transmissive
5. Backlight Color	(If no backlight provided move on to viewing angle [6.]) <b>B</b> = Blue/Green <b>Y</b> = Yellow <b>G</b> = Green	
6. Viewing Angle	<b>D</b> = 6:00 <b>U</b> = 12:00	<b>R</b> = 3:00 <b>L</b> = 9:00
7. Internal Number	Single Letter for internal purposes	
8. Extended Temperature	This space is blank if operating temperature is standard 0°C to 50°C An X will be visible if the LCD is Extended operating temperature	
9. Customer Specials or List of Value-added items	Usually blank unless customer requests some modifications. Can be several Letters long.	



## **2. Precautions in use of LCD Modules**

- (1) Avoid applying excessive shocks to the module or making any alterations or modifications to it.
- (2) Don't make extra holes on the printed circuit board, modify its shape or change the components of LCD module.
- (3) Don't disassemble the LCM.
- (4) Don't operate it above the absolute maximum rating.
- (5) Don't drop, bend or twist LCM.
- (6) Soldering: only to the I/O terminals.
- (7) Storage: please storage in anti-static electricity container and clean environment.

## **3. General Specification**

Item	Dimension	Unit
Number of Dots	122 x 32	—
Module dimension(With LED Backlight )	65.8 x 27.0 x 12.0 (MAX)	mm
View area	60.2 x 18.0	mm
Active area	53.64 x 14.04	mm
Dot size	0.45 x 0.40	mm
Dot pitch	0.49 x 0.44	mm
LCD type	STN	
Duty	1/32	
View direction	6 o'clock or 12 o'clock	
Backlight Type	WHITE BACKLIGHT	

## 4. Absolute Maximum Ratings

Item		Symbol	Min	Max	Unit
Input Voltage		$V_I$	-0.3	$V_{DD}+0.3$	V
Supply Voltage For Logic		$V_{DD}-V_{SS}$	-0.3	7.0	V
Supply Voltage For LCD		$V_{DD}-V_0$	$V_{dd}-13.5$	0	V
Standard Temperature LCM	Operating Temp.	$T_{op}$	0	50	°C
	Storage Temp.	$T_{str}$	-10	60	°C
Wide Temperature LCM	Operating Temp.	$T_{op}$	-20	70	°C
	Storage Temp.	$T_{str}$	-30	80	°C

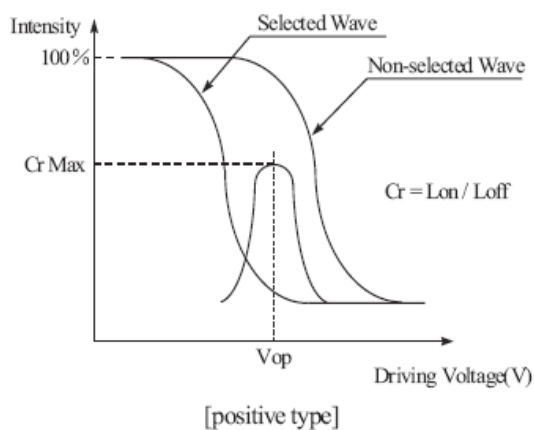
## 5. Electrical Characteristics

Item	Symbol	Condition	Min	Typ	Max	Unit
Supply Voltage For Logic	$V_{DD}-V_{SS}$	—	4.5	5.0	5.5	V
Supply Voltage For LCD	$V_{DD}-V_0$	$T_a=25^{\circ}\text{C}$	-	4.8	-	V
Input High Volt.	$V_{IH}$	—	$0.7 V_{DD}$	—	$V_{DD}$	V
Input Low Volt.	$V_{IL}$	—	$V_{SS}$	—	$0.3 V_{DD}$	V
Supply Current	$I_{DD}$	$V_{DD}=5\text{V}$	-	1.0	2.0	mA
Supply Voltage of backlight	$V_{LED}$	Forward current =15 mA	-	3.2	-	V

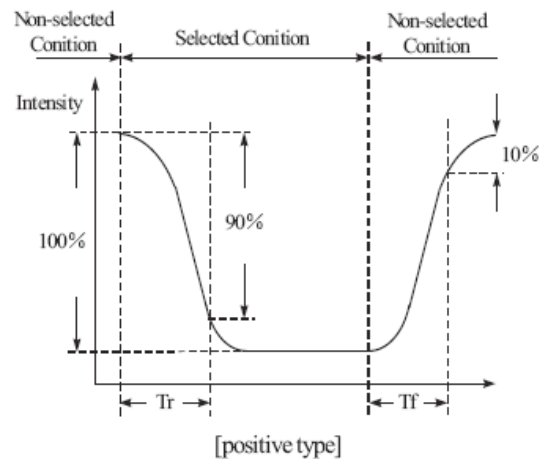
## 6. Optical Characteristics

Item	Symbol	Condition	Min	Typ	Max	Unit
View Angle	(V) $\theta$	$CR \geq 2$	-20	—	35	deg
	(H) $\phi$	$CR \geq 2$	-30	—	30	deg
Contrast Ratio	CR	—	—	3	—	—
Response Time	T rise	—	—	—	250	ms
	T fall	—	—	—	250	ms

### Definition of Operation Voltage (Vop)



### Definition of Response Time (Tr , Tf)



### Conditions :

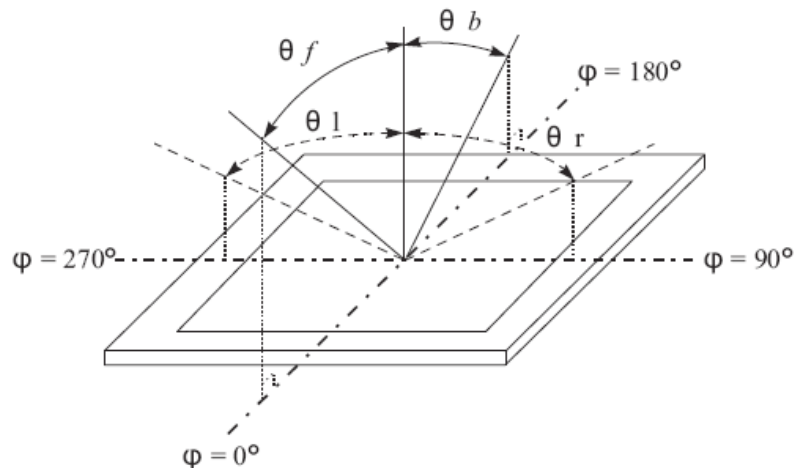
Operating Voltage : Vop

Viewing Angle( $\theta$  ,  $\phi$ ) :  $0^\circ$  ,  $0^\circ$ 

Frame Frequency : 64 HZ

Driving Waveform : 1/N duty , 1/a bias

### Definition of viewing angle( $CR \geq 2$ )



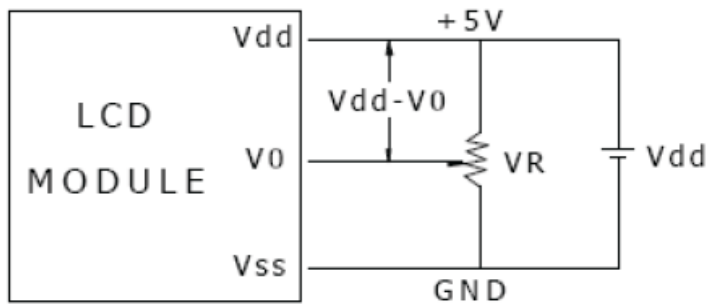
## **7. Interface Pin Function**

Pin No.	Symbol	Level	Description
1	RS	H/L	Register Select
2	E2	H/L	Enable For Chip2, Active High, Left Part
3	E1	H/L	Enable For Chip1, Active High, Left Part
4,5	NC	NC	NC
6	RW	H/L	Read/Write
7	V <sub>SS</sub>	0V	Ground
8	DB0	H/L	Data bit 0
9	DB1	H/L	Data bit 1
10	DB2	H/L	Data bit 2
11	DB3	H/L	Data bit 3
12	DB4	H/L	Data bit 4
13	DB5	H/L	Data bit 5
14	DB6	H/L	Data bit 6
15	DB7	H/L	Data bit 7
16	V <sub>DD</sub>	5.0V	Supply Voltage for logic
17	RSE	H/L	Reset Signal
18	V0		Operating voltage for LCD
19	NC	NC	NC
20	NC	NC	NC



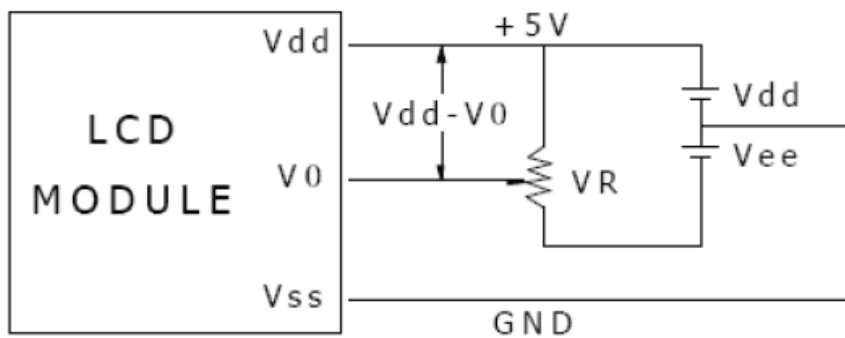
## 8. POWER SUPPLY

### SINGLE SUPPLY VOLTAGE TYPE (for LCM with Negative Power on PCB)



Vdd-V0: LCD Driving Voltage  
VR: 10K - 20K

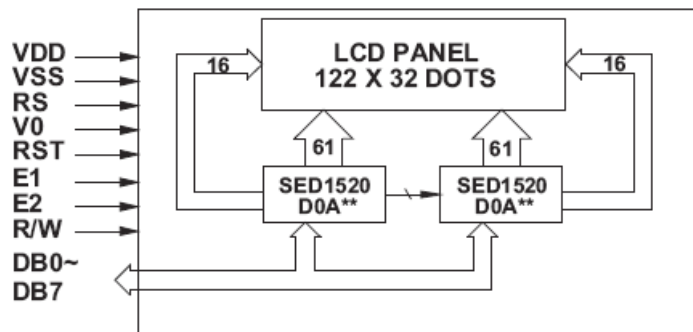
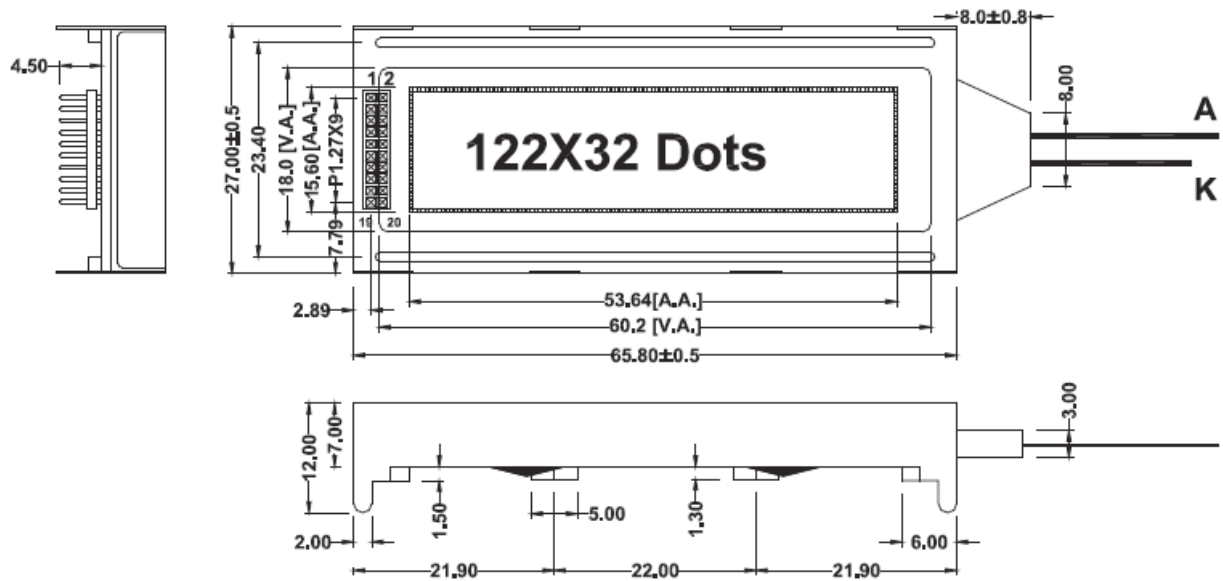
### DUAL SUPPLY VOLTAGE TYPE (for LCM without Negative Power on PCB)



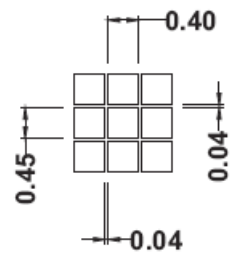
Vdd-V0: LCD Driving Voltage  
VR: 10K - 20K

## 9. Contour Drawing & Block Diagram

### LED B/L



\*\* OR EQUIVALENT



## 10. Timing Characteristics

### ● AC Characteristics

#### ○ Read/Write timing for the 80-port MPU

 $(T_a = -20 \text{ to } 75^\circ\text{C}, V_{ss} = -5.0\text{V} \pm 10\%)$ 

Parameter	Signal	Symbol	Condition	Rating			Unit
				Min	Typ	Max	
Address hold time	A0, $\overline{\text{CS}}$	tAHB		10	—	—	ns
Address set-up time		tAWB		20	—	—	ns
System cycle time	$\overline{\text{WR}}, \overline{\text{RD}}$	tcyc8		1000	—	—	ns
Control pulse width		tcc		200	—	—	ns
Data set-up time	D0 ~ D7	tDS8		80	—	—	ns
Data hold time		tDH8		10	—	—	ns
$\overline{\text{RD}}$ access time		tACC8	CL = 100pF	—	—	90	ns
Output disable time		tOH8		10	—	60	ns

\*2. The ratings when  $V_{ss} = -3.0\text{V}$  are approximately 100% higher than when  $V_{ss} = -5.0\text{V}$ .

#### ○ Read/Write timing for the 68-port MPU

 $(T_a = -20 \text{ to } 75^\circ\text{C}, V_{ss} = -5.0\text{V} \pm 10\%)$ 

Parameter		Signal	Symbol	Condition	Rating			Unit
					Min	Typ	Max	
System cycle time		A0, $\overline{\text{CS}}$ R/W	tcyc8 *3		1000	—	—	ns
Address set-up time			tAW8		20	—	—	ns
Address hold time			tAH8		10	—	—	ns
Data set-up time		D0 ~ D7	tDS8		80	—	—	ns
Data hold time			tDH8		10	—	—	ns
Output disable time			tOH8	CL = 100pF	10	—	60	ns
Access time			tACC8		—	—	90	ns
Enable pulse width	READ	E	tew		100	—	—	ns
	WRITE				80	—	—	ns

\*3. tcyc8 indicates the cycle during which  $\overline{\text{CS}}/\text{E}$  are HIGH; it does not indicate the cycle of the E signal.

\*4. The ratings when  $V_{ss} = -3.0\text{V}$  are approximately 100% higher than when  $V_{ss} = -5.0\text{V}$ .

#### ○ Control timing for 80-port/68-port display

 $(T_a = -20 \text{ to } 75^\circ\text{C}, V_{ss} = -5.0\text{V} \pm 10\%)$ 

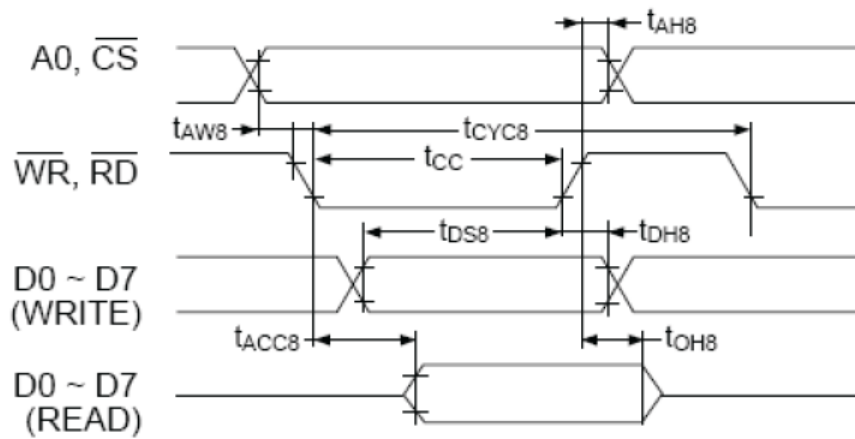
Parameter	Signal	Symbol	Condition	Rating			Unit
				Min	Typ	Max	
LOW pulse width	CL	twLCL		35	—	—	$\mu\text{s}$
HIGH pulse width		twHCL		35	—	—	$\mu\text{s}$
Rising time		tr		—	30	150	ns
Falling time		tf		—	30	150	ns
FR delay time	FR	tDFR	(Input timing)	-2.0	0.2	2.0	$\mu\text{s}$
			(Output timing), CL = 100pF	—	0.2	0.4	

\*5. The ratings when  $V_{ss} = -3.0\text{V}$  are approximately 100% higher than when  $V_{ss} = -5.0\text{V}$ .

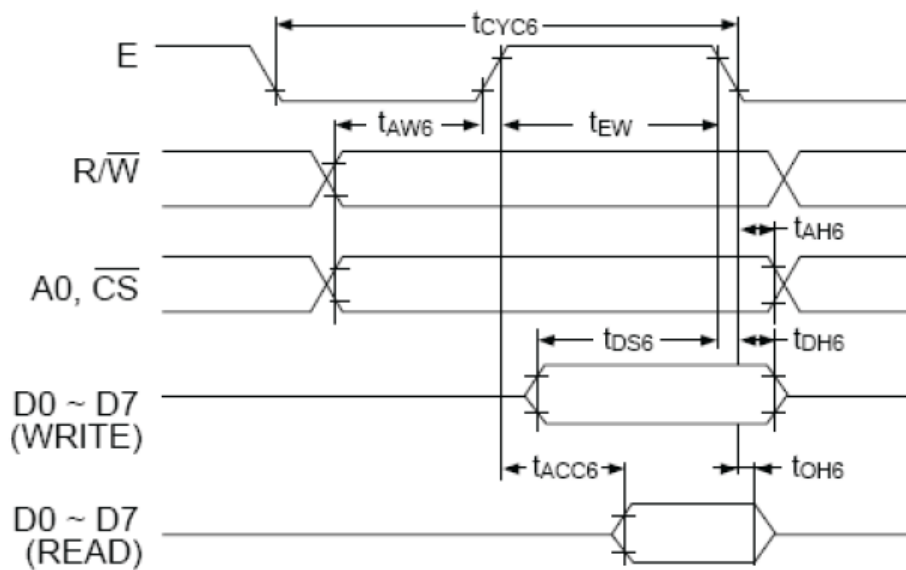
\*6. The input timing of the FR delay time is determined by the SED1520 (Slave).  
The output timing of the FR delay time is determined by the SED1520 (Master).

- Timing Chart

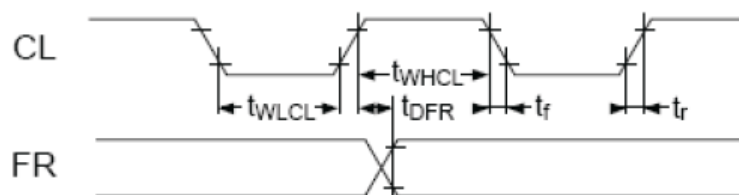
- Read/Write timing for the 80-port MPU



- Read/Write timing for the 68-port MPU



- Control timing for 80-port/68-port display



# 11. Instruction Table

## ■ DISPLAY COMMANDS

(Based on the 80-port MPU; the  $\overline{RD}$  and  $\overline{WR}$  commands differ for the 68-port MPU.)

Command	$\overline{RD}$ $\overline{WR}$ A0	D7 D6 D5 D4 D3 D2 D1 D0	Function
1 Display ON/OFF	1 0 0	1 0 1 0 1 1 1 0/1	Switches the entire display ON or OFF, regardless of the Display RAM's data or the internal status. *7
2 Display START Line	1 0 0	1 1 0	Display START address (0~31) Determines the line of RAM data to be displayed at the display's top line (COM0).
3 Page Address Set	1 0 0	1 0 1 1 1 0	Page address (0~3) Sets the page of the Display RAM in the page address register.
4 Column (Segment) Address Set	1 0 0	0	Column address (0~79) Sets the column address of the Display RAM in the column address register.
5 Status Read	0 1 0	BUSY ACC ON/OFF RESET 0 0 0 0	Reads the status. BUSY 1: Busy (internal processing) 0: READY status ADC 1: Rightward (forward) output 0: Leftward (reverse) output ON/OFF 1: Display OFF 0: Display ON RESET 1: Resetting 0: Normal
6 Write Display Data	1 0 1	Write Data	Writes the data on the data bus to RAM
7 Read Display Data	0 1 1	Read Data	Reads data from the Display RAM onto the data bus.
8 ADC Select	1 0 0	1 0 1 0 0 0 0 0/1	Used to reverse the correspondence between the Display RAM's column addresses and segment driver output ports 0: Rightward (forward) output 1: Leftward (reverse) output
9 Static Drive ON/OFF	1 0 0	1 0 1 0 0 1 0 0/1	Selects normal display operation or static all-lit drive display operation. 1: Static drive (Power Save) *7 0: Normal display operation
10 Duty Select	1 0 0	1 0 1 0 1 0 0 0/1	Selects the duty factor for driving LCD cells. 1: 1/32 duty 0: 1/16 duty
11 Read Modify Write	1 0 0	1 1 1 0 0 0 0 0	Increments the column address counter by one only when display data is written but not when it is read.
12 End	1 0 0	1 1 1 0 1 1 1 0	Cancels the Ready Modify Write mode.
13 Reset	1 0 0	1 1 1 0 0 0 1 0	Resets the Display START line to the 1st line in the register. Resets the column address counter to 0 and page address register to 3.

\*7. Power Save mode is entered by selecting static drive in Display OFF status.



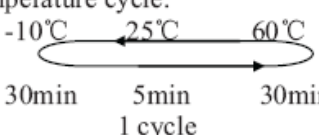
## **12.Quality Assurance**

### **Screen Cosmetic Criteria**

Item	Defect	Judgment Criterion	Partition																				
1	Spots	A)Clear <table><tr><td><u>Size: d mm</u></td><td><u>Acceptable Qty in active area</u></td></tr><tr><td><math>d \leq 0.1</math></td><td>Disregard</td></tr><tr><td><math>0.1 &lt; d \leq 0.2</math></td><td>6</td></tr><tr><td><math>0.2 &lt; d \leq 0.3</math></td><td>2</td></tr><tr><td><math>0.3 &lt; d</math></td><td>0</td></tr></table> Note: Including pin holes and defective dots which must be within one pixel size. B)Unclear <table><tr><td><u>Size: d mm</u></td><td><u>Acceptable Qty in active area</u></td></tr><tr><td><math>d \leq 0.2</math></td><td>Disregard</td></tr><tr><td><math>0.2 &lt; d \leq 0.5</math></td><td>6</td></tr><tr><td><math>0.5 &lt; d \leq 0.7</math></td><td>2</td></tr><tr><td><math>0.7 &lt; d</math></td><td>0</td></tr></table>	<u>Size: d mm</u>	<u>Acceptable Qty in active area</u>	$d \leq 0.1$	Disregard	$0.1 < d \leq 0.2$	6	$0.2 < d \leq 0.3$	2	$0.3 < d$	0	<u>Size: d mm</u>	<u>Acceptable Qty in active area</u>	$d \leq 0.2$	Disregard	$0.2 < d \leq 0.5$	6	$0.5 < d \leq 0.7$	2	$0.7 < d$	0	Minor
<u>Size: d mm</u>	<u>Acceptable Qty in active area</u>																						
$d \leq 0.1$	Disregard																						
$0.1 < d \leq 0.2$	6																						
$0.2 < d \leq 0.3$	2																						
$0.3 < d$	0																						
<u>Size: d mm</u>	<u>Acceptable Qty in active area</u>																						
$d \leq 0.2$	Disregard																						
$0.2 < d \leq 0.5$	6																						
$0.5 < d \leq 0.7$	2																						
$0.7 < d$	0																						
2	Bubbles in Polarizer	<table><tr><td><u>Size: d mm</u></td><td><u>Acceptable Qty in active area</u></td></tr><tr><td><math>d \leq 0.3</math></td><td>Disregard</td></tr><tr><td><math>0.3 &lt; d \leq 1.0</math></td><td>3</td></tr><tr><td><math>1.0 &lt; d \leq 1.5</math></td><td>1</td></tr><tr><td><math>1.5 &lt; d</math></td><td>0</td></tr></table>	<u>Size: d mm</u>	<u>Acceptable Qty in active area</u>	$d \leq 0.3$	Disregard	$0.3 < d \leq 1.0$	3	$1.0 < d \leq 1.5$	1	$1.5 < d$	0	Minor										
<u>Size: d mm</u>	<u>Acceptable Qty in active area</u>																						
$d \leq 0.3$	Disregard																						
$0.3 < d \leq 1.0$	3																						
$1.0 < d \leq 1.5$	1																						
$1.5 < d$	0																						
3	Scratch	In accordance with spots cosmetic criteria. When the light reflects on the panel surface, the scratches are not to be remarkable.	Minor																				
4	Allowable Density	Above defects should be separated more than 30mm each other.	Minor																				
5	Coloration	Not to be noticeable coloration in the viewing area of the LCD panels. Back-light type should be judged with back-light on state only.	Minor																				

## 13. Reliability

### Content of Reliability Test

Environmental Test			
Test Item	Content of Test	Test Condition	Applicable Standard
High Temperature storage	Endurance test applying the high storage temperature for a long time.	60℃ 96hrs	—
Low Temperature storage	Endurance test applying the high storage temperature for a long time.	-10℃ 96hrs	—
High Temperature Operation	Endurance test applying the electric stress (Voltage & Current) and the thermal stress to the element for a long time.	50℃ 96hrs	—
Low Temperature Operation	Endurance test applying the electric stress under low temperature for a long time.	0℃ 96hrs	—
High Temperature/ Humidity Storage	Endurance test applying the high temperature and high humidity storage for a long time.	60℃, 90%RH 96hrs	—
High Temperature/ Humidity Operation	Endurance test applying the electric stress (Voltage & Current) and temperature / humidity stress to the element for a long time.	50℃, 90%RH 96hrs	—
Temperature Cycle	Endurance test applying the low and high temperature cycle. <div style="text-align: center;">  <p>-10℃      25℃      60℃</p> <p>30min      5min      30min</p> <p>1 cycle</p> </div>	-10℃/60℃ 10 cycles	—
Mechanical Test			
Vibration test	Endurance test applying the vibration during transportation and using.	10~22Hz→1.5mmp-p 22~500Hz→1.5G Total 0.5hrs	—
Shock test	Constructional and mechanical endurance test applying the shock during transportation.	50G Half sign wave 11 msdc 3 times of each direction	—

\*\*\*Supply voltage for logic system=5V. Supply voltage for LCD system =Operating voltage at 25℃