PRODUCT SPECIFICATION

Part Number

PG12232C-O Series

CUSTOMER	
CUSTOMER PART NUMBER	
DESCRIPTION	
APPROVED BY	
DATE	

Table of Contents

No.	Contents	Page
1	Functions & Features	4
2	Mechanical specifications	4
3	Block diagram	4
4	Dimensional Outline	5
5	Pin description	6
6	Absolute Maximum Ratings	6
7	Electrical Characteristics	6
8	Backlight Characteristics	7
9	Electro-Optical Characteristics	7
10	Timing Characteristics	8
11	Control and display command	9
12	Quality Specifications / Precautions	10-17

Record of Revisions

Rev.	Comments	Page	Date
1	Preliminary Specification was first issued.	All	8/8’14

1. FUNCTIONS & FEATURES

1.1. Format	: 122x32dots
1.2. LCD mode	: STN / Positive transflective mode / Yellow-Green
1.3. Viewing direction	: 6 o'clock
1.4. Driving scheme	: 1/32 Duty cycle, 1/5 Bias
1.5. Power supply voltage(V_{DD})	: 5.0V
1.6. LCD driving voltage	: 4.5V
1.7. Operation temp	: -20~70℃
1.8. Storage temp	: -30~80℃
1.9. Backlight color	: Yellow-Green
1.10.ROHS Standard	

2. MECHANICAL SPECIFICATIONS

2.1. Module size	: 65.4mm(L)*29.1mm(W)*6.0MAX mm(H)
2.2. Viewing area	: 54.8mm(L)*19.1mm(W)
2.3. Dot pitch	: 0.40mm(L)*0.45mm(W)
2.4. Dot size	: 0.36mm(L)*0.41mm(W)
2.5. Weight	: Approx.

3. BLOCK DIAGRAM

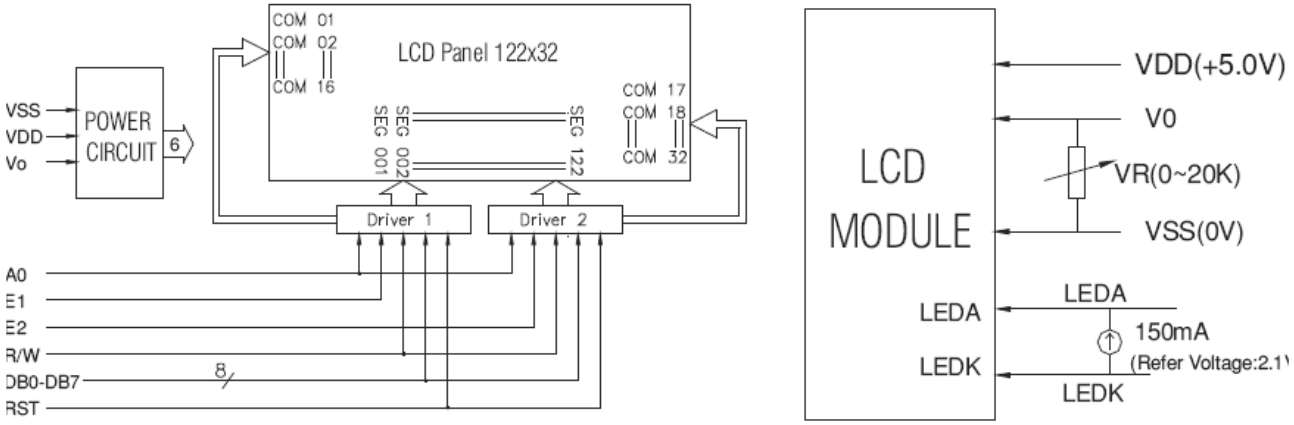
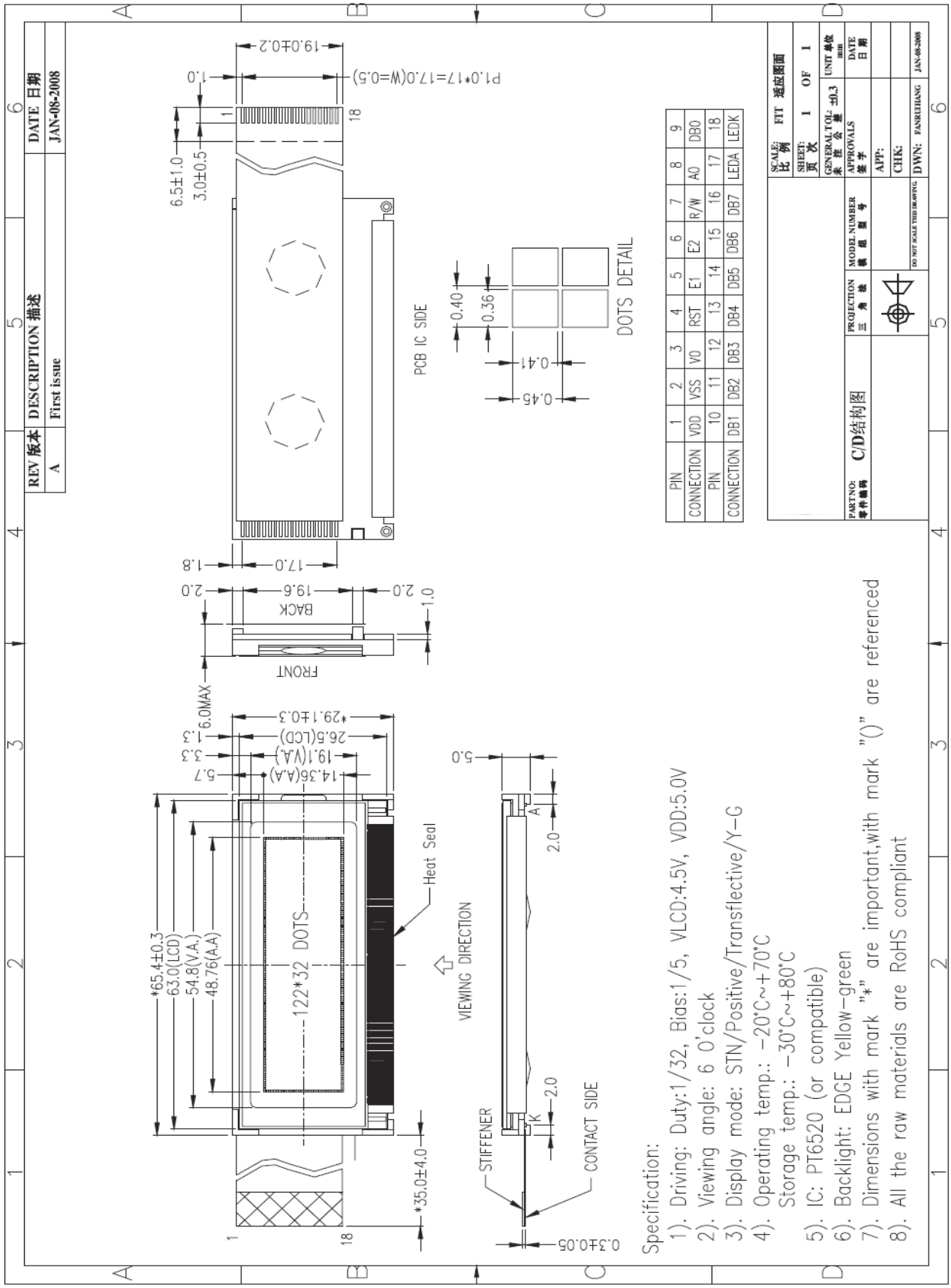


Figure 1. Block diagram

4. DIMENSIONAL OUTLINE



5. PIN DESCRIPTION

	Symbol	Function
1	VDD	Power supply(+5.0V)
2	VSS	GND(0V)
3	V0	Supply voltage for LCD drive
4	RST	Reset signal(The rise of the signal is for active and keep RST='h')
5	E1	Enable signal for IC1(left half of the panel)
6	E2	Enable signal for IC2(right half of the panel)
7	R/W	Read /write selection. (H: Read L: write)
8	A0	Register selection. (H: Data register L: Instruction register)
9~16	DB0~DB7	Data bus lines
17	LEDA	Power supply for backlight(+)
18	LEDK	Power supply for backlight(-)

6. MAXIMUM ABSOLUTE LIMIT

Item	Symbol	MIN	MAX	Unit
Supply Voltage for Logic	V_{DD}	-0.3	8.0	V
Supply Voltage for LCD	V0	-0.3	16.5	V
Input Voltage	Vin	-0.3	V_{DD}+0.3	V
Supply Current for Backlight	I_F(Ta = 25°C)	---	160	mA
Reverse Voltage for Backlight	V_R(Ta = 25°C)	---	3	V
Operating Temperature	Top	-20	70	℃
Storage Temperature	Tst	-30	80	℃

7. ELECTRICAL CHARACTERISTICS

Item	Symbol	Condition	Min	Typ	Max	Unit
Supply Voltage for Logic	V_{DD}-V_{SS}	Ta = 25°C	4.5	5.0	5.5	V
Input High Voltage	V_{IH}	Ta = 25°C	V_{DD}-3.0	---	V_{DD}	V
Input Low Voltage	V_{IL}	Ta = 25°C	V_{ss}	---	V_{ss}+0.8	V
Output High Voltage	V_{OH}	Ta = 25°C	2.4	---	---	V
Output Low Voltage	V_{OL}	Ta = 25°C	---	---	0.4	V
Supply Current	I_{DD}	Ta = 25°C	---	3	5	mA

8.BACKLIGHT CHARACTERISTICS

Ta = 25°C

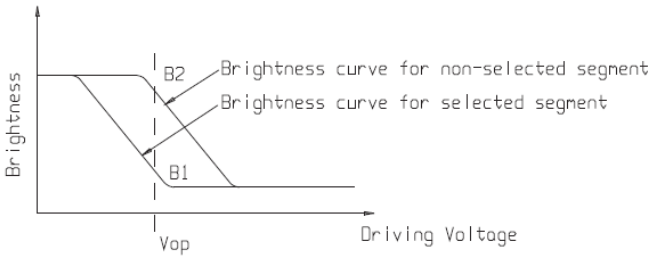
Item	Symbol	Condition	Min	Typ	Max	Unit
Forward Voltage	VF	IF=150mA	1.9	2.1	2.3	V
Reverse Current	IR	Vr=3V	---	---	10	uA
Luminous Intensity (Without LCD)	IV	IF=150mA	60	90	---	Cd/m^2
Wave length(Without LCD)	λρ		569	572	575	nm
Color	Yellow-green					

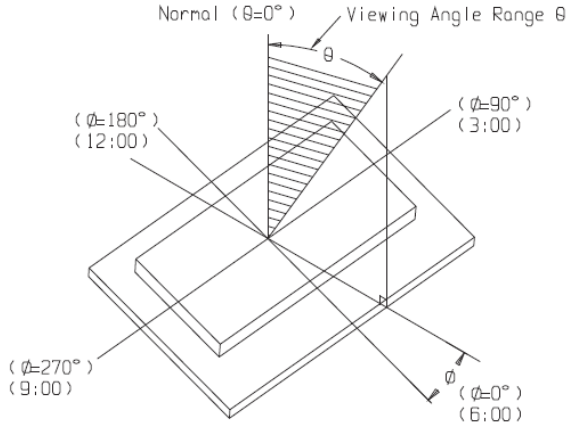
9. ELECTRO-OPTICAL CHARACTERISTICS

(VDD=5.0V, Ta = 25°C)

Item	Symbol	Condition	Min	Typ	Max	Unit
Operating Voltage	Vop	Ta = -20C	4.6	5.0	5.4	V
		Ta = 25°C	4.1	4.5	4.9	
		Ta = 70C	3.6	4.0	4.4	
Response time	Tr	Ta = 25°C	---	185	---	ms
	Tf		---	200	---	ms
Contrast	Cr	Ta = 25°C	---	4	---	---
Viewing angle range	θ	Cr≥2	-40	---	+40	deg
	Φ		-40	---	+40	deg

$$Cr = \frac{\text{Brightness of non-selected segment(B2)}}{\text{Brightness of selected segment(B1)}}$$

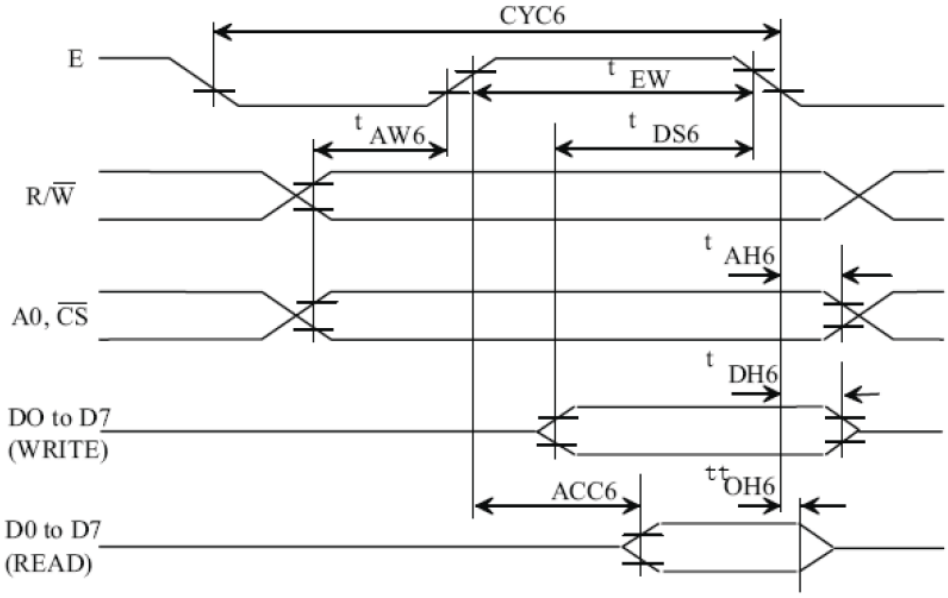




10. TIMING CHARACTERISTICS

(Please refer PT6520 DATASHEETS)

- **MPU Bus Read/Write II (68-family MPU)**



Ta= -20 to 75 deg. C. Vss= -5V ± 10 unless stated otherwise

Parameter		Symbol	Condition	Rating		Unit	Signal
				min	max		
System cycle time		tCYC6		1,000	--	ns	A0, CS, R/W
Address setup time		tAW6		20	--	ns	
Address hold time		tAH6		10	--	ns	
Data setup time		tDS6		80	--	ns	D0 to D7
Data hold time		tDH6		10	--	ns	
Output disable time		tOH6	CL= 100pF	10	60	ns	
Access time		tACC6		--	90	ns	
Enable pulsewidth	Read	tEW		100	--	ns	E
	Write			8	--	ns	

Notes : 1. tCYC6 is the cycle time of CS. E=H. not the cycle time of E.
2. Increase parameter values by 200% when Vss= -3.0V.
3. all inputs must have a rise and fall time of less than 15 ns.

11. CONTROL AND DISPLAY INSTRUCTION

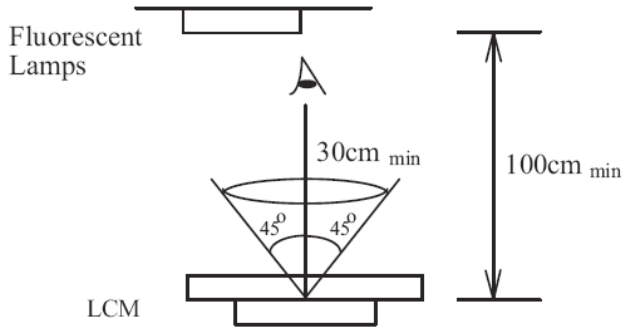
Command	Code											Function
	A0	RD	WR	D7	D6	D5	D4	D3	D2	D1	D0	
Display On/Off	0	1	0	1	0	1	0	1	1	1	0/1	Turns display on or off. 1 : ON, 0 : OFF
Display start line	0	1	0	1	1	0	Display start address (0 to 31)					Specifies RAM line corresponding to top line of display.
Set page address	0	1	0	1	0	1	1	1	0	Page (0 to 3)		Sets display RAM page in page address register.
Set column (segment) address	0	1	0	0	Column address (0 to 79)							Sets display RAM column address in column address registser.
Read status	0	0	1	Busy	ADC	ON/OFF	Reset	0	0	0	0	Reads the following status : BUSY 1 : Busy 0 : Ready ADC 1 : CW output 0 : CCW output ON/OFF 1 : Display off 0 : Display on RESET 1 : Being reset 0 : Normal
Write display data	1	1	0	Write data								Writes data from data bus into display RAM.
Read display data	1	0	1	Read data								Reads data from display RAM onto data bus.
Select ADC	0	1	0	1	0	1	0	0	0	0	0/1	0 : CW output, 1 : CCW output
Statis drive ON/OFF	0	1	0	1	0	1	0	0	1	0	0/1	Selects static driving operation. 1 : Static drive, 0 : Normal driving
Select duty	0	1	0	1	0	1	0	1	0	0	0/1	Selects LCD duty cycle 1 : 1/32, 0 : 1/16
Read-Modify -Write	0	1	0	1	1	1	0	0	0	0	0	Read-modify-write ON
End	0	1	0	1	1	1	0	1	1	1	0	Read-modify-write OFF
Reset	0	1	0	1	1	1	0	0	0	1	0	Software reset

12.QUALITY SPECIFICATIONS

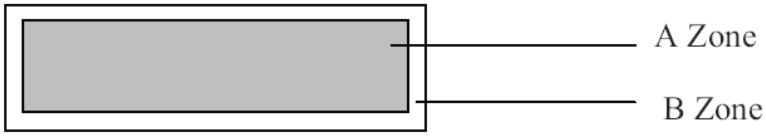
12.1 Standard of the product appearance test

Manner of appearance test: The inspection should be performed in using 20W x 2 fluorescent lamps. Distance between LCM and fluorescent lamps should be 100 cm or more. Distance between LCM and inspector eyes should be 30 cm or more.

Viewing direction for inspection is 45° from vertical against LCM.



Definition of zone:



A Zone: Active display area (minimum viewing area).
B Zone: Non-active display area (outside viewing area).

12.2 Specification of quality assurance

AQL inspection standard

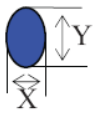
Sampling method: MIL-STD-105E, Level II, single sampling

Defect classification **(Note: * is not including)**

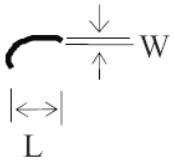
Classify	Item		Note	AQL
Major	Display state	Short or open circuit	1	0.65
		LC leakage		
		Flickering		
		No display		
		Wrong viewing direction		
		Contrast defect (dim, ghost)	2	
		Back-light	1,8	
	Non-display	Flat cable or pin reverse	10	
		Wrong or missing component	11	
Minor	Display state	Background color deviation	2	1.0
		Black spot and dust	3	
		Line defect, Scratch	4	
		Rainbow	5	
		Chip	6	
		Pin hole	7	
	Polarizer	Protruded	12	
		Bubble and foreign material	3	
	Soldering	Poor connection	9	
	Wire	Poor connection	10	
	TAB	Position, Bonding strength	13	

Note on defect classification

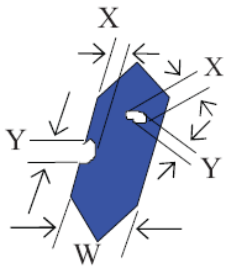
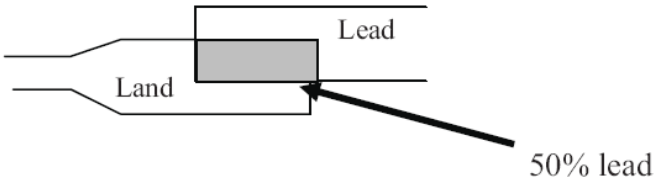
<table>
<tr><th>No.</th><th>Item</th><th>Criterion</th></tr>
<tr><td rowspan="6">1</td><td>Short or open circuit</td><td rowspan="6">Not allow</td></tr>
<tr><td>LC leakage</td></tr>
<tr><td>Flickering</td></tr>
<tr><td>No display</td></tr>
<tr><td>Wrong viewing direction</td></tr>
<tr><td>Wrong Back-light</td></tr>
<tr><td rowspan="2">2</td><td>Contrast defect</td><td rowspan="2">Refer to approval sample</td></tr>
<tr><td>Background color deviation</td></tr>
<tr><td>3</td><td>Point defect,
Black spot, dust
(including Polarizer)

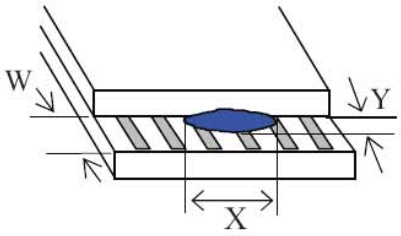
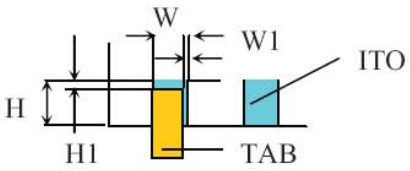
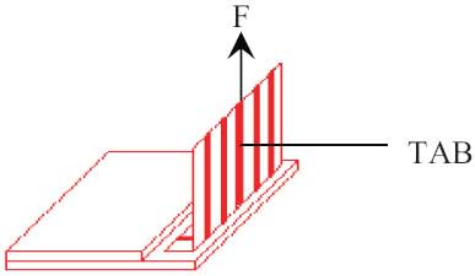
$\phi = (X+Y)/2$</td><td> 

<table>
<tr><th>Point Size</th><th>Acceptable Qty.</th></tr>
<tr><td>$\phi \leq 0.10$</td><td>Disregard</td></tr>
<tr><td>$0.10 < \phi \leq 0.20$</td><td>3</td></tr>
<tr><td>$0.20 < \phi \leq 0.25$</td><td>2</td></tr>
<tr><td>$0.25 < \phi \leq 0.30$</td><td>1</td></tr>
<tr><td>$\phi > 0.30$</td><td>0</td></tr>
</table>
Unit： mm</td></tr>
<tr><td>4</td><td>Line defect,

Scratch</td><td> 

<table>
<tr><th colspan="2">Line</th><th>Acceptable Qty.</th></tr>
<tr><td>L</td><td>W</td><td></td></tr>
<tr><td>---</td><td>0.015≥W</td><td>Disregard</td></tr>
<tr><td>3.0≥L</td><td>0.03≥W</td><td rowspan="2">2</td></tr>
<tr><td>2.0≥L</td><td>0.05≥W</td></tr>
<tr><td>1.0≥L</td><td>0.1＞W</td><td>1</td></tr>
<tr><td>---</td><td>0.05<W</td><td>Applied as point defect</td></tr>
</table>
Unit: mm</td></tr>
<tr><td>5</td><td>Rainbow</td><td>Not more than two color changes across the viewing area.</td></tr>
</table>

No.	Item	Criterion
7	Segment pattern W = Segment width ϕ = (X+Y)/2	(1) Pin hole ϕ < 0.10mm is acceptable.  Point Size / Acceptable Qty ϕ≤1/4W — Disregard 1/4W<ϕ≤1/2W — 1 ϕ>1/2W — 0 Unit: mm
8	Back-light	(1) The color of backlight should correspond its specification. (2) Not allow flickering
9	Soldering	(1) Not allow heavy dirty and solder ball on PCB. (The size of dirty refer to point and dust defect) (2) Over 50% of lead should be soldered on Land. 
10	Wire	(1) Copper wire should not be rusted (2) Not allow crack on copper wire connection. (3) Not allow reversing the position of the flat cable. (4) Not allow exposed copper wire inside the flat cable.
11*	PCB	(1) Not allow screw rust or damage. (2) Not allow missing or wrong putting of component.

No	Item	Criterion
12	Protruded W: Terminal Width	 Acceptable criteria: Y ≤ 0.4
13	TAB	1. Position  W1≤1/3W H1≤1/3H 2 TAB bonding strength test  P (=F/TAB bonding width) ≥650gf/cm ,(speed rate: 1mm/min) 5pcs per SOA (shipment)
14	Total no. of acceptable Defect	A. Zone Maximum 2 minor non-conformities per one unit. Defect distance: each point to be separated over 10mm B. Zone It is acceptable when it is no trouble for quality and assembly in customer's end product.

12.3 Reliability of LCM

Reliability test condition:

Item	Condition	Time (hrs)	Assessment
High temp. Storage	80°C	48	No abnormalities in functions and appearance
High temp. Operating	70°C	48	
Low temp. Storage	-30°C	48	
Low temp. Operating	-20°C	48	
Humidity	40°C/ 90%RH	48	
Temp. Cycle	0°C ← 25°C →50°C (30 min ← 5 min → 30min)	10cycles	

Recovery time should be 24 hours minimum. Moreover, functions, performance and appearance ,etc. shall be free from remarkable deterioration within 50,000 hours under ordinary operating and storage conditions room temperature (20±8°C), normal humidity (below 45±20% RH), and in the area not exposed to direct sun light. The life time is not content the life time of the LED (for the life time of LED which decay only 50%,in the industry the experience value is 50000 hours, but there are not any experimentation data to support this).

12.4 Precaution for using LCD/LCM

LCD/LCM is assembled and adjusted with a high degree of precision. Do not attempt to make any alteration or modification. The followings should be noted.

General Precautions:

1. LCD panel is made of glass. Avoid excessive mechanical shock or applying strong pressure onto the surface of display area.
2. The polarizer used on the display surface is easily scratched and damaged. Extreme care should be taken when handling. To clean dust or dirt off the display surface, wipe gently with cotton, or other soft material soaked with isoproply alcohol, ethyl alcohol or trichlorotriflorothane, do not use water, ketone or aromatics and never scrub hard.
3. Do not tamper in any way with the tabs on the metal frame.
4. Do not make any modification on the PCB without consulting P-tec Corp
5. When mounting a LCM, make sure that the PCB is not under any stress such as bending or twisting. Elastomer contacts are very delicate and missing pixels could result from slight dislocation of any of the elements.
6. Avoid pressing on the metal bezel, otherwise the elastomer connector could be deformed and lose contact, resulting in missing pixels and also cause rainbow on the display.
7. Be careful not to touch or swallow liquid crystal that might leak from a damaged cell. Any liquid crystal adheres to skin or clothes, wash it off immediately with soap and water.

Static Electricity Precautions:

1. CMOS-LSI is used for the module circuit; therefore operators should be grounded when ever he/she comes into contact with the module.
2. Do not touch any of the conductive parts such as the LSI pads; the copper leads on the PCB and the interface terminals with any parts of the human body.
3. Do not touch the connection terminals of the display with bare hand; it will cause disconnection or defective insulation of terminals.
4. The modules should be kept in anti-static bags or other containers resistant to static for storage.
5. Only properly grounded soldering irons should be used.
6. If an electric screwdriver is used, it should be grounded and shielded to prevent sparks.
7. The normal static prevention measures should be observed for work clothes and work benches.
8. Since dry air is inductive to static, a relative humidity of 50-60% is recommended.

Soldering Precautions:

1. Soldering should be performed only on the I/O terminals.
2. Use soldering irons with proper grounding and no leakage.
3. Soldering temperature: 280°C$\pm$10°C
4. Soldering time: 3 to 4 second.
5. Use eutectic solder with resin flux filling.
6. If flux is used, the LCD surface should be protected to avoid spattering flux.
7. Flux residue should be removed.

Operation Precautions:

1. The viewing angle can be adjusted by varying the LCD driving voltage Vo.
2. Since applied DC voltage causes electro-chemical reactions, which deteriorate the display, the applied pulse waveform should be a symmetric waveform such that no DC component remains. Be sure to use the specified operating voltage.
3. Driving voltage should be kept within specified range; excess voltage will shorten display life.
4. Response time increases with decrease in temperature.
5. Display color may be affected at temperatures above its operational range.
6. Keep the temperature within the specified range usage and storage. Excessive temperature and humidity could cause polarization degradation, polarizer peel-off or generate bubbles.
7. For long-term storage over 40°C is required, the relative humidity should be kept below 60% and avoid direct sunlight.

Limited Warranty

P-tec LCDs and modules are not consumer products, but may be incorporated by P-tec's customers into consumer products or components thereof, P-tec does not warrant that its LCDs and components are fit for any such particular purpose.

1. The liability of P-tec is limited to repair or replacement on the terms set forth below. P-tec will not be responsible for any subsequent or consequential events or injury or damage to any personnel or user including third party personnel and/or user. Unless otherwise agreed in writing between P-tec and the customer, P-tec will only replace or repair any of its LCD which is found defective electrically or visually when inspected in accordance with P-tec general LCD inspection standard . (Copies available on request)
2. No warranty can be granted if any of the precautions state in handling liquid crystal display above has been disregarded. Broken glass, scratches on polarizer mechanical damages as well as defects that are caused accelerated environment tests are excluded from warranty.
3. In returning the LCD/LCM, they must be properly packaged; there should be detailed description of the failures or defect.