



PRODUCT SPECIFICATION

Part Number

PG12232D-O Series

CUSTOMER	
CUSTOMER PART NUMBER	
DESCRIPTION	
APPROVED BY	
DATE	



MODEL NO.

PAGE

PG12232D-O series

SPEC ONLY

2

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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	C = Character G = Graphic COG = Chip On Glass	COF = Chip On Flex TAB = Tape Automated Bonding TFT = Thin-film Transistor
2. LCD Model	Example for Character: 2002A = 20 Characters x 2 Lines w/ Pins on Left side and 116mm x 37 x 12.7mm overall size Example for Graphic: 12864B = 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	T = TN/Grey Y = STN/Yellow Green G = STN/ Grey	B = STN/ Blue F = FSTN/ White N = FSTN/ Black
4. Backlight/polorizer	NF = None/Transflective NM = None/Transmissive NR = None/Reflective EF = EL/Transflective EM = EL/Transmissive	LF = LED/Transflective LM = LED/Transmissive CF = CCFL/Transflective CM = CCFL=Transmissive
5. Backlight Color	(If no backlight provided move on to viewing angle [6.]) B = Blue/Green Y = Yellow G = Green	
6. Viewing Angle	D = 6:00 U = 12:00	R = 3:00 L = 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.	Top	0	50	°C
	Storage Temp.	Tstr	-10	60	°C
Wide Temperature LCM	Operating Temp.	Top	-20	70	°C
	Storage Temp.	Tstr	-30	80	°C

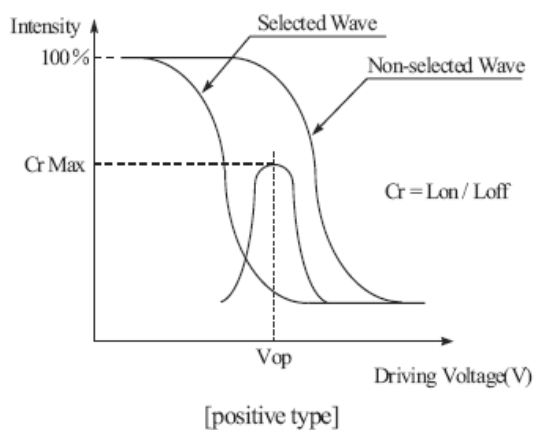
5. Electrical Characteristics

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}	$V_{DD}=5V$	-	1.0	2.0	mA
Supply Voltage of backlight	V_{LED}	Forward current =15 mA	-	3.2	-	V

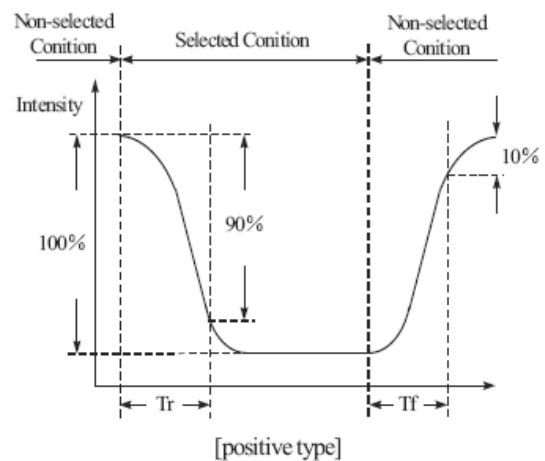
6. Optical Characteristics

Item	Symbol	Condition	Min	Typ	Max	Unit
View Angle	(V) θ	$CR \geq 2$	-20	—	35	deg
	(H) ϕ	$CR \geq 2$	-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 :

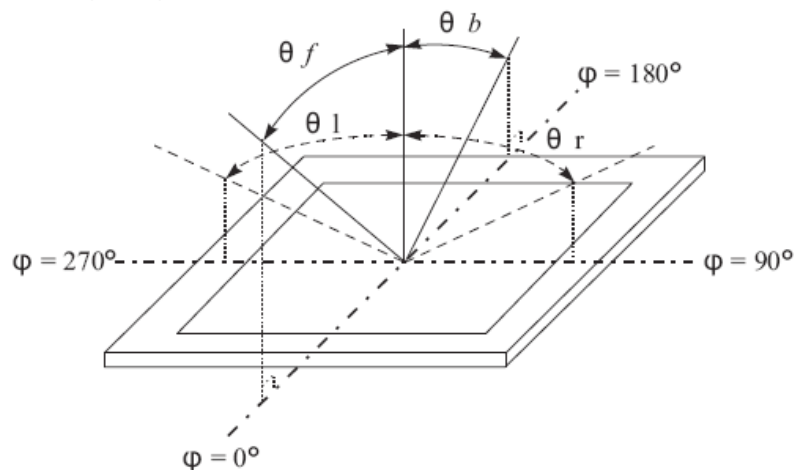
Operating Voltage : Vop

 Viewing Angle(θ , ϕ) : 0° , 0°

Frame Frequency : 64 HZ

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

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

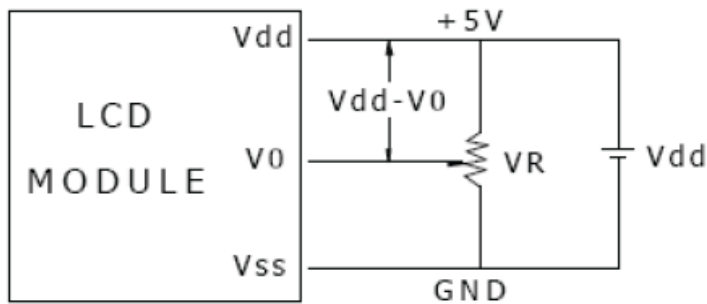


7. Interface Pin Function

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 _{SS}	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 _{DD}	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

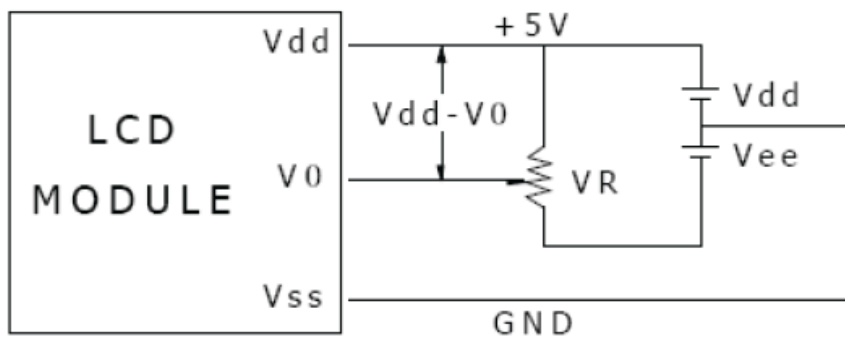
8. POWER SUPPLY

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



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

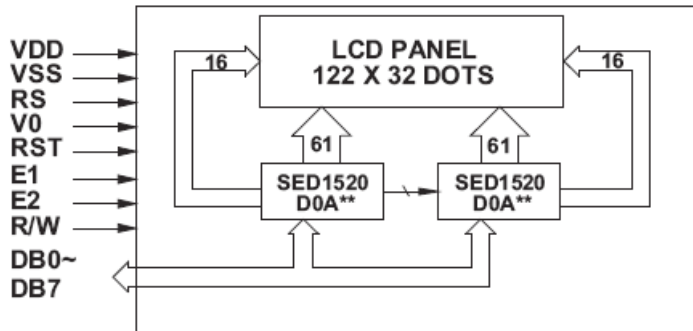
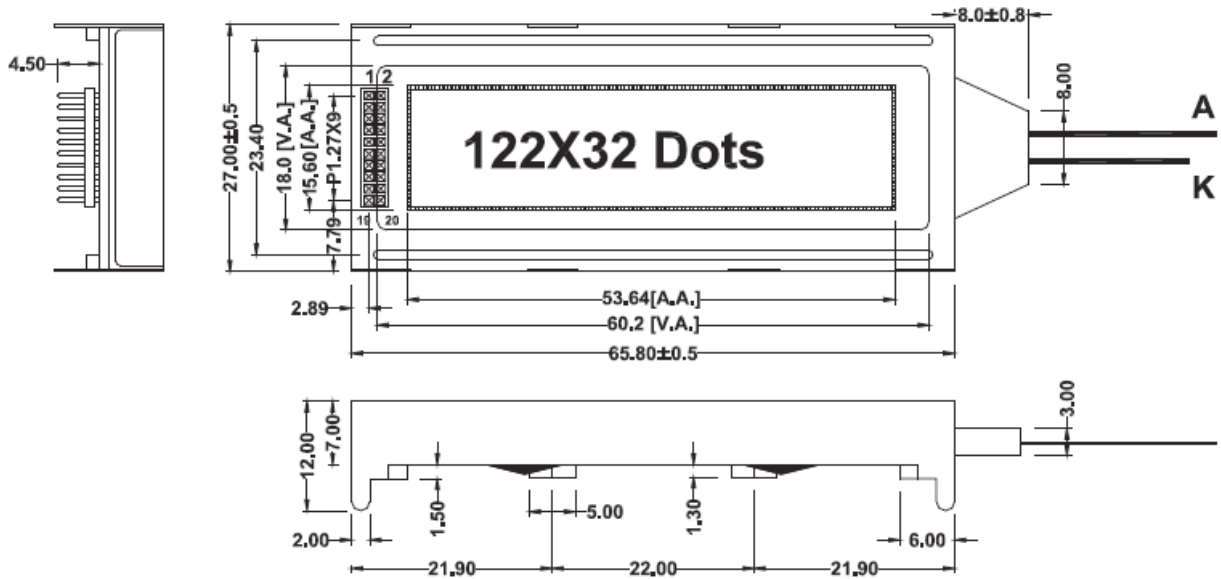
DUAL SUPPLY VOLTAGE TYPE (for LCM without Negative Power on PCB)



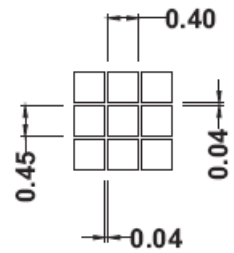
Vdd-V0: LCD Driving Voltage
VR: 10K - 20K

9. Contour Drawing & Block Diagram

LED B/L



** OR EQUIVALENT



10. Timing Characteristics

- AC Characteristics

- Read/Write timing for the 80-port MPU

(Ta = -20 to 75°C, Vss = -5.0V±10%)

Parameter	Signal	Symbol	Condition	Rating			Unit
				Min	Typ	Max	
Address hold time	A0, \overline{CS}	tAHB		10	—	—	ns
Address set-up time		tAWB		20	—	—	ns
System cycle time	\overline{WR} , \overline{RD}	tCYC8		1000	—	—	ns
Control pulse width		tCC		200	—	—	ns
Data set-up time	D0 ~ D7	tDS8	CL = 100pF	80	—	—	ns
Data hold time		tDH8		10	—	—	ns
\overline{RD} access time		tACC8		—	—	90	ns
Output disable time		tOH8		10	—	60	ns

*2. The ratings when Vss = -3.0V are approximately 100% higher than when Vss = -5.0V.

- Read/Write timing for the 68-port MPU

(Ta = -20 to 75°C, Vss = -5.0V±10%)

Parameter	Signal	Symbol	Condition	Rating			Unit
				Min	Typ	Max	
System cycle time	A0, \overline{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	CL = 100pF	80	—	—	ns
Data hold time		tDH8		10	—	—	ns
Output disable time		tOH8		10	—	60	ns
Access time		tACC8		—	—	90	ns
Enable pulse width	READ	E		100	—	—	ns
	WRITE			80	—	—	ns

*3. tCYC8 indicates the cycle during which $\overline{CS}/\overline{E}$ are HIGH; it does not indicate the cycle of the E signal.

*4. The ratings when Vss = -3.0V are approximately 100% higher than when Vss = -5.0V.

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

(Ta = -20 to 75°C, Vss = -5.0V±10%)

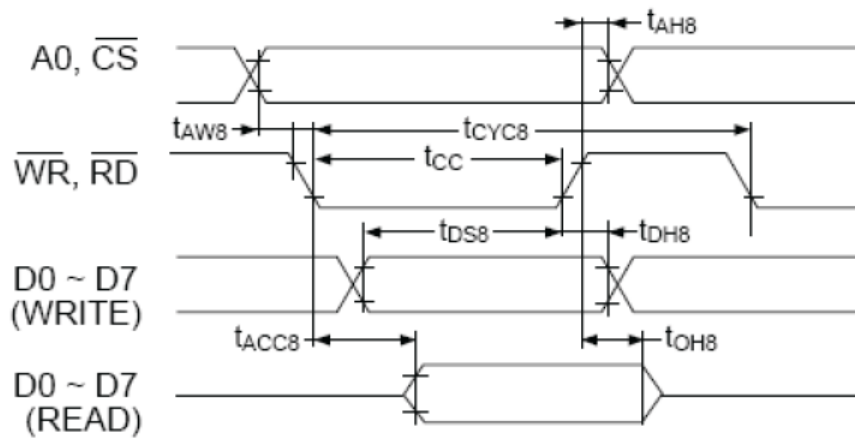
Parameter	Signal	Symbol	Condition	Rating			Unit
				Min	Typ	Max	
LOW pulse width	CL	twLCL		35	—	—	μs
HIGH pulse width		twHCL		35	—	—	μs
Rising time		tr		—	30	150	ns
Falling time		tr		—	30	150	ns
FR delay time	FR	tDFR	(Input timing)	-2.0	0.2	2.0	μs
			(Output timing), CL = 100pF	—	0.2	0.4	

*5. The ratings when Vss = -3.0V are approximately 100% higher than when Vss = -5.0V.

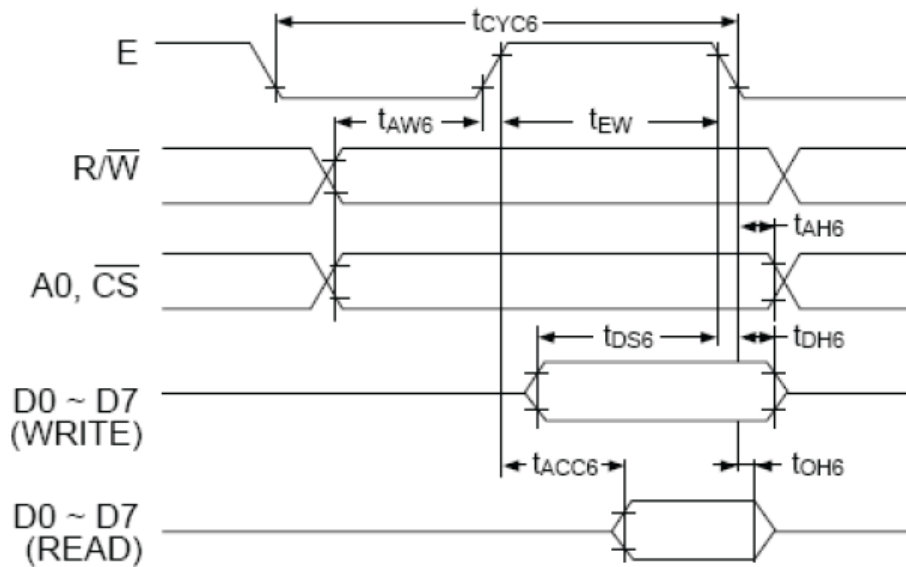
*6. The input timing of the FR delay time is determined by the SED1520 (Slave).
The output timing of the FR delay time is determined by the SED1520 (Master).

- **Timing Chart**

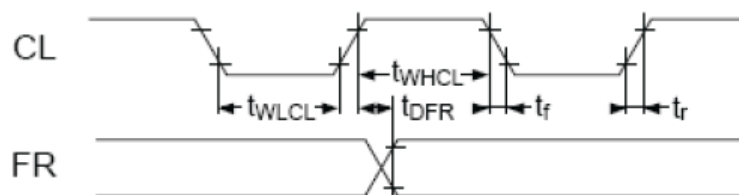
- **Read/Write timing for the 80-port MPU**



- **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	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 (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	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	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	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.

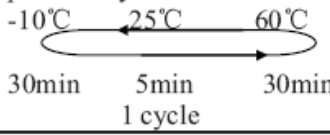
12. Quality Assurance

Screen Cosmetic Criteria

Item	Defect	Judgment Criterion	Partition
1	Spots	A)Clear <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 Note: Including pin holes and defective dots which must be within one pixel size. B)Unclear <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
2	Bubbles in Polarizer	<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
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°C 96hrs	—
Low Temperature storage	Endurance test applying the high storage temperature for a long time.	-10°C 96hrs	—
High Temperature Operation	Endurance test applying the electric stress (Voltage & Current) and the thermal stress to the element for a long time.	50°C 96hrs	—
Low Temperature Operation	Endurance test applying the electric stress under low temperature for a long time.	0°C 96hrs	—
High Temperature/ Humidity Storage	Endurance test applying the high temperature and high humidity storage for a long time.	60°C, 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°C, 90%RH 96hrs	—
Temperature Cycle	Endurance test applying the low and high temperature cycle. 	-10°C/60°C 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°C