

LCD MODULE

MODULE NO. :

KSEGG12864FWZ-130 SERIES**Customer:**

Approved by:

Approved by	Checked by	Prepared by

CONTENTS

1. MODULE CLASSIFICATION INFORMATION 4

2. FUNCTIONS & FEATURES 5

3. MECHANICAL SPECIFICATIONS 5

4. EXTERNAL DIMENSIONS 6

5. BLOC`K DIAGRAM 7

6. PIN ASSIGNMENT 8

7. BACKLIGHT ELECTRICAL/OPTICAL SPECIFICATIONS9

8. MAXIMUM ABSOLUTE POWER RATINGS9

9. ELECTRICAL CHARACTERISTICS10

10. INSTRUCTION TABLE 13

11. OPTICAL CHARACTERISTICS 14

12. MODULE ACCEPT QUALITY LEVEL (AQL) 16

13. RELIABILITY TEST 16

14. INSPECTION SPECIFICATION 17

15. LCD MODULES HANDLING PRECAUTIONS 20

16. OTHERS 20

1. MODULE CLASSIFICATION INFORMATION**KSE G G 12864 F W Z - 130**

① ② ③ ④ ⑤ ⑥ ⑦ ⑧

① KSE: KEEN SIDE electronics

② C: Character Type, G: Graphic Type

③ B: COB, G: COG

④ Display Font: 128 * 64

⑤ LCD Mode: B→ STN-Blue Negative F→ FSTN Positive
 G→ STN Gray Positive Y→ STN Yellow Green Positive⑥ Backlight Type: N→ Without backlight A→ Amber LED backlight
 B→ Blue LED backlight G→ Green LED backlight
 R→ Red LED backlight W→ Withe LED backlight
 Y→ Yellow-Green LED backlight

⑦ LCD Polarize Type/Temperature range/View direction :

D→ Transflective, W.T, 12:00 E→ Transmissive, W.T, 6:00
P→ Reflective, W. T, 6:00 Q→ Transmissive, W.T, 12:00
Z→ Transflective, W.T, 6:00

⑧ Model serials no. :

2. FUNCTIONS & FEATURES

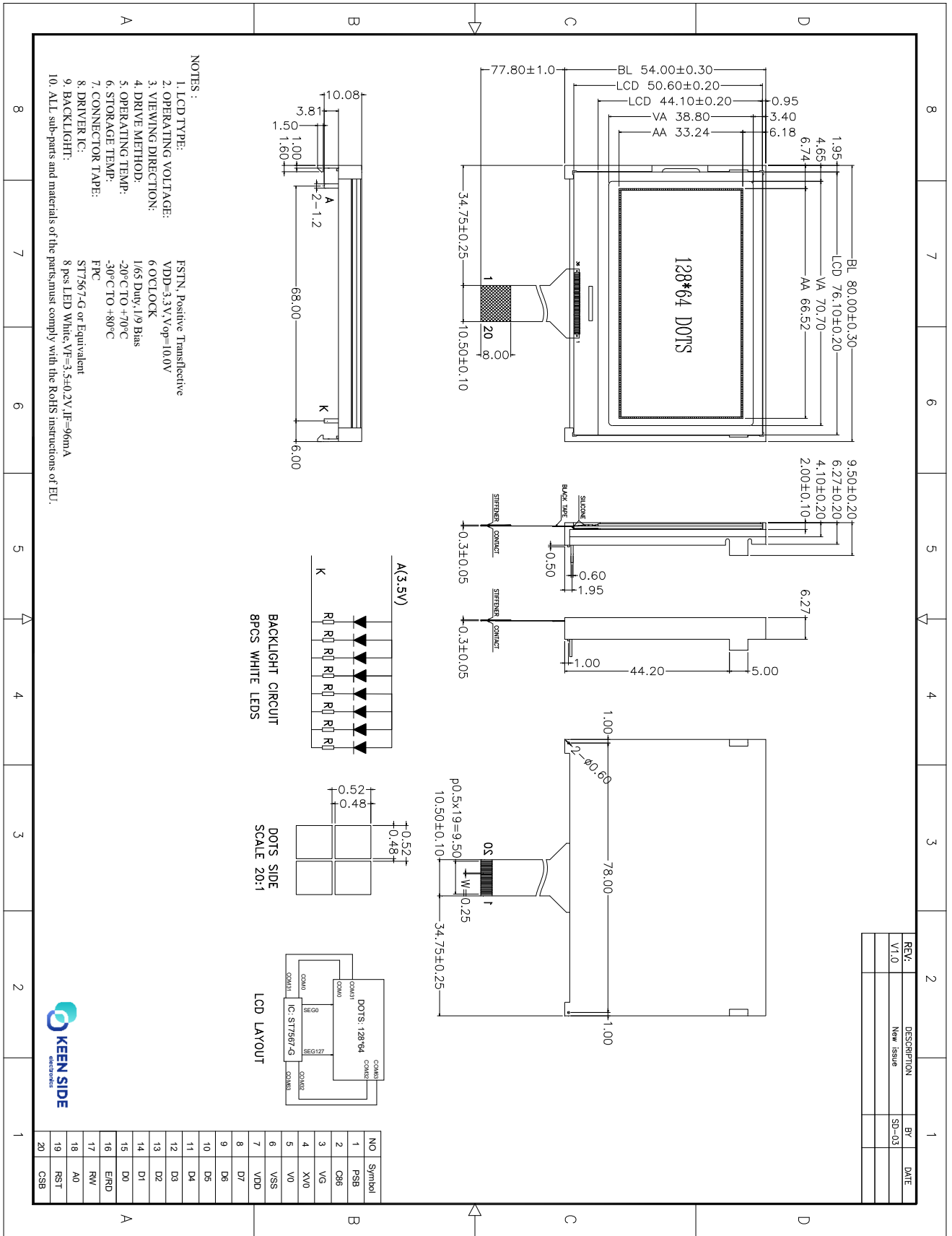
KSEGG12864FWZ-130 Series LCD type:

- Display Contents : 128 x 64 Dots
- Driving Scheme : 1/65Duty; 1/9Bias
- Viewing Direction : 6 O' clock
- Power Supply Voltage : 3.3V.
- VLCD : 10.0V.
- Driver IC : ST7567S-G
- Interface : Parallel/SPI
- Backlight : white
- Operating Temperature : -20°C - + 70°C
- Storage Temperature : -30°C - + 80°C
- RoHS Compliant

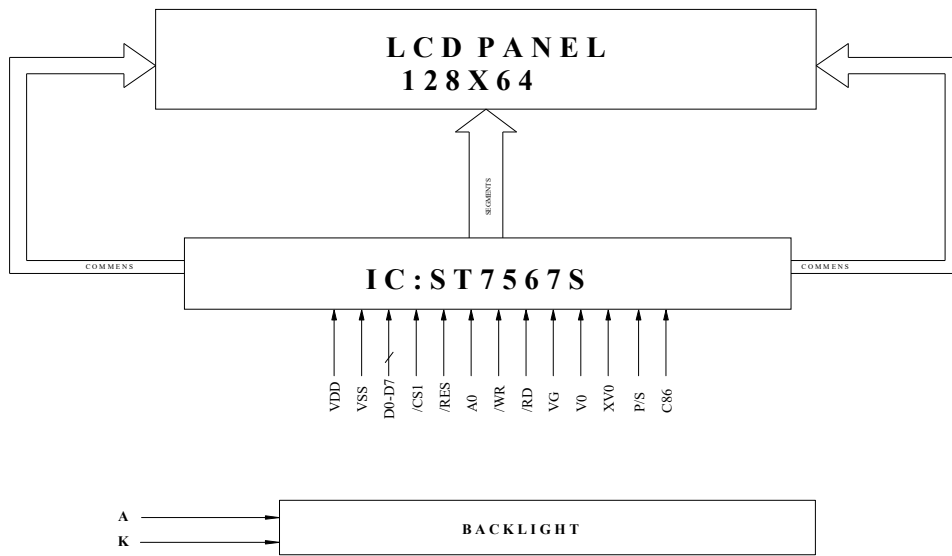
3. MECHANICAL SPECIFICATIONS

- Outline Dimensions : 80.00(W) x 54.00(L) x 9.50(H)(mm)
- Viewing Area : 70.70 (W) x 38.80(L)(mm)
- Active Area : 66.52 (W) x 33.24 (L)(mm)
- Dot Pitch : 0.52 (W) x 0.52 (L)(mm)
- Dot Size : 0.48 (W) x 0.48 (L)(mm)
- Weight : TBD

4. EXTERNAL DIMENSIONS



5. BLOC`K DIAGRAM



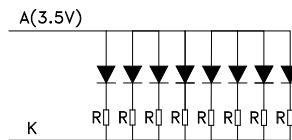
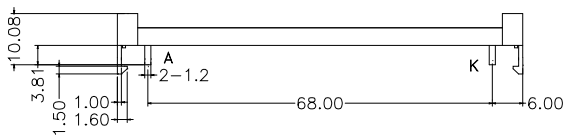
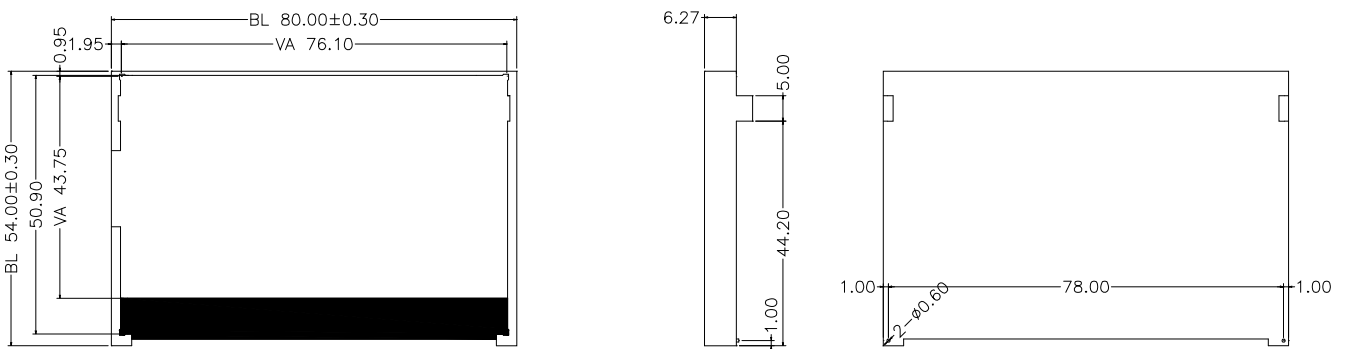
6. PIN ASSIGNMENT

Pin No.	Symbol	Function
1	P/S	This pin configures the interface to be parallel mode or serial mode. P/S = “H”: Parallel data input/output. P/S = “L”: Serial data input.
2	C86	This is the MPU interface selection pin. C86 = “H”: 6800 Series MPU interface. C86 = “L”: 8080 Series MPU interface.
3	VG	VG is the LCD driving voltage for segment circuits. Vgout is the output of VG regulator. VG is the feedback of VG regulator. Vgin is the VG input of segment circuits.
4	XV0	XV0 is the LCD driving voltage for common circuits at positive frame. XV0out is the output of XV0 regulator. XV0s is the feedback of XV0 regulator. XV0in is the V0 input of common circuits.
5	V0	V0 is the LCD driving voltage for common circuits at negative frame. V0out is the output of V0 regulator. V0s is the feedback of V0 regulator. V0in is the V0 input of common circuits.
6	VSS	Ground terminal of module.
7	VDD	Power terminal of module
8-15	D7-D0	This is an 8-bit bi-directional data bus that connects to an 8-bit or 16-bit standard MPU data bus. When the serial interface (SPI-4) is selected (P/S = “L”) : D7: serial data input (SI); D6: the serial clock input (SCL). D0 to D5 should be connected to VDD or floating. When the chip select is not active, D0 to D7 are set to high impedance.
16	/RD(E)	<ul style="list-style-type: none"> When connected to 8080 series MPU, this pin is treated as the “/RD” signal of the 8080 MPU and is LOW-active. The data bus is in an output status when this signal is “L”. When connected to 6800 series MPU, this pin is treated as the “E” signal of the 6800 MPU and is HIGH-active. This is the enable clock input terminal of the 6800 Series MPU.
17	/WR(R/W)	<ul style="list-style-type: none"> When connected to 8080 series MPU, this pin is treated as the “/WR” signal of the 8080 MPU and is LOW-active. The signals on the data bus are latched at the rising edge of the /WR signal. When connected to 6800 series MPU, this pin is treated as the “R/W” signal of the 6800 MPU and decides the access type : When R/W = “H”: Read. When R/W = “L”: Write.
18	RS	This is connecting to the least significant bit of the normal MPU address bus, and it determines whether the data bits are data or command. RS = “H”: Indicates that D0 to D7 are display data. RS = “L”: Indicates that D0 to D7 are control data.
19	/RES	When /RES is set to “L”, the register settings are initialized (cleared). The reset operation is performed by the /RES signal level.
20	/CS1	This is the chip select signal.
	LEDA	Anode of Backlight
	LEDK	Cathode of Backlight

7. BACKLIGHT ELECTRICAL/OPTICAL SPECIFICATIONS

Electrical/Optical Specifications

ITEM	SYMBOL	MIN.	TYP.	MAX.	UNIT	CONDITIONS
Forward Voltage	Vf	2.9	3.1	3.3	V	If= 15 x 8 mA
Reverse Current	Ir			120	mA	Vr=5.0 V
Power Dissipation	Pd			875	mW	If= 15 x 8 mA
Dominant wave length	X	0.24	--	0.26		If= 15 x 8 mA
	Y	0.24	--	0.26	-	
Luminous	LV	85			cd/m2	If= 15 x 8 mA
Luminous Uniformity	ΔLv	70			%	If= 15 x 8 mA



BACKLIGHT CIRCUIT
8PCS WHITE LEDS

8. MAXIMUM ABSOLUTE POWER RATINGS

Item	Symbol	Standard value	Unit
Power supply voltage(1)	VDD	-0.3~+3.6	V
Power supply voltage(2)	VOU, V0,	-0.3 ~ 13.5	V
Power supply voltage(3)	VIN	-0.3 ~ V0	V
Operating temperature	Topr	-20~+70	°C
Storage temperature	Tstg	-30~+80	°C

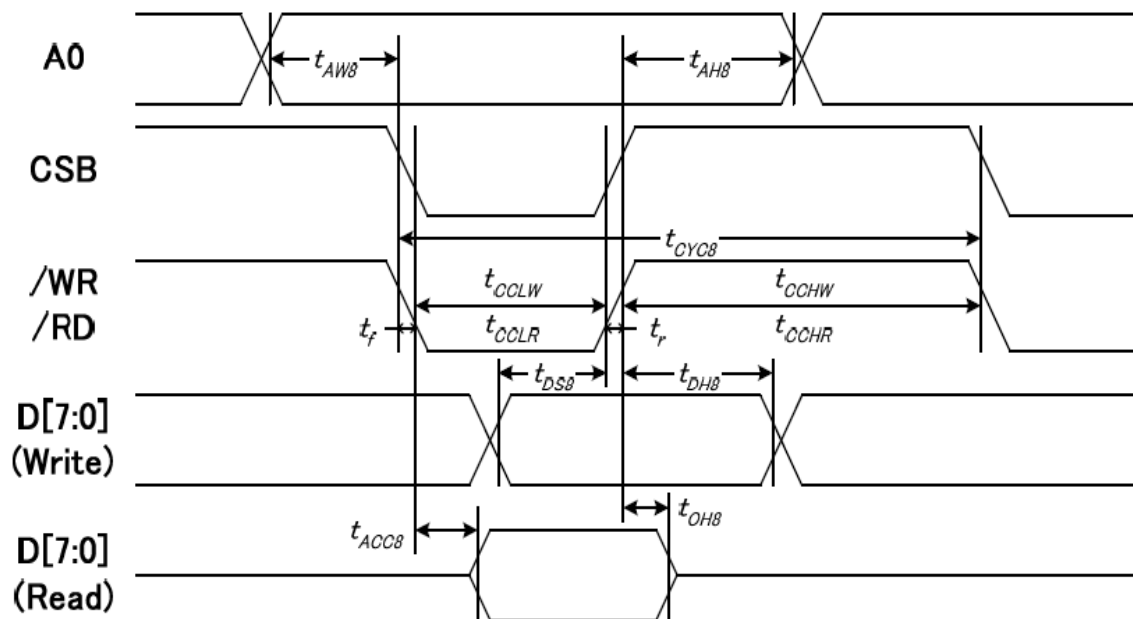
9. ELECTRICAL CHARACTERISTICS

9-1 DC Characteristics

Item	Symbol	Standard Value			Test Condition	Unit
		Min	Typ	Max		
Operating Voltage	$V_{DD} - V_{SS}$	2.8	3.3	3.6	TA=25°C	V
LCD Supply Current	I_{DD}	----	TBD	5.0	--	mA
LCD Driving Voltage	$V_0 - V_{SS}$	9.80	10.00	10.20	TA=25°C	V

9-2 AC Characteristics

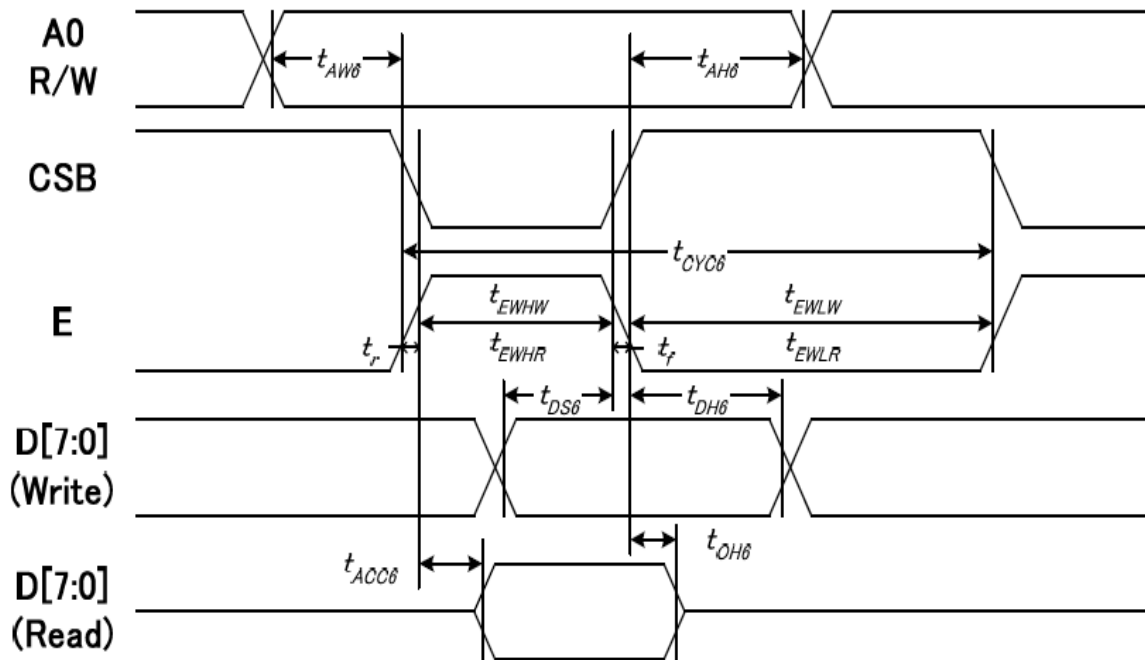
9.2.1 Read/Write mode for the 8080 Series MPU



(VDD1 = 3.3V, Ta = 25°C)

Item	Signal	Symbol	Condition	Min.	Max.	Unit
Address setup time	A0	tAW8		0	—	ns
Address hold time		tAH8		10	—	
System cycle time	/WR	tCYC8		240	—	
/WR L pulse width (WRITE)		tCCLW		80	—	
/WR H pulse width (WRITE)		tCCHW		80	—	
/RD L pulse width (READ)		RD	tCCLR		140	
/RD H pulse width (READ)	tCCHR			80	—	
WRITE Data setup time	D[7:0]	tDS8		40	—	
WRITE Data hold time		tDH8		20	—	
READ access time		tACC8	CL = 16 pF	—	70	
READ Output disable time		tOH8	CL = 16 pF	5	50	

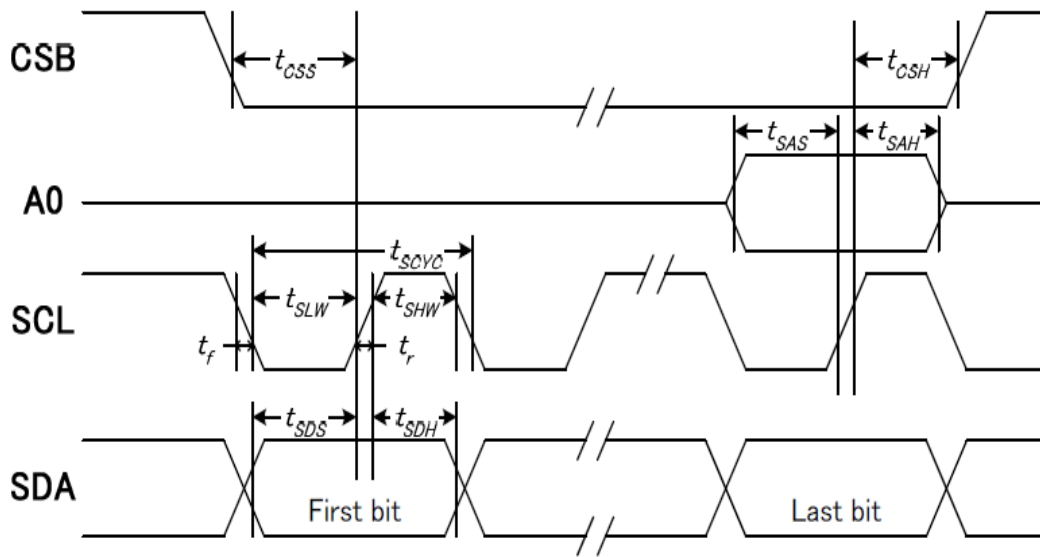
9.2.2 Read/Write mode for the 6800 Series MPU



(VDD1 = 3.3V , Ta =25°C)

Item	Signal	Symbol	Condition	Min.	Max.	Unit
Address setup time	A0	tAW6		0	—	ns
Address hold time		tAH6		10	—	
System cycle time	E	tCYC6		240	—	
Enable L pulse width (WRITE)		tEHLW		80	—	
Enable H pulse width (WRITE)		tEHWLW		80	—	
Enable L pulse width (READ)		tEHLR		80	—	
Enable H pulse width (READ)	tEHWHR		140	—		
Write data setup time	D[7:0]	tDS6		40	—	
Write data hold time		tDH6		10	—	
Read data access time		tACC6	CL = 16 pF	—	70	
Read data output disable time		tOH6	CL = 16 pF	5	50	

9.2.3 Read/Write mode for 4-SPI Series MPU



(VDD1 = 3.3V , Ta =25°C)

Item	Signal	Symbol	Condition	Min.	Max.	Unit
Serial clock period	SCLK	tSCYC		50	—	ns
SCLK "H" pulse width		tSHW		25	—	
SCLK "L" pulse width		tSLW		25	—	
Address setup time	A0	tSAS		20	—	
Address hold time		tSAH		10	—	
Data setup time	SDA	tSDS		20	—	
Data hold time		tSDH		10	—	
CSB-SCLK time	CSB	tCSS		20	—	
CSB-SCLK time		tCSh		40	—	

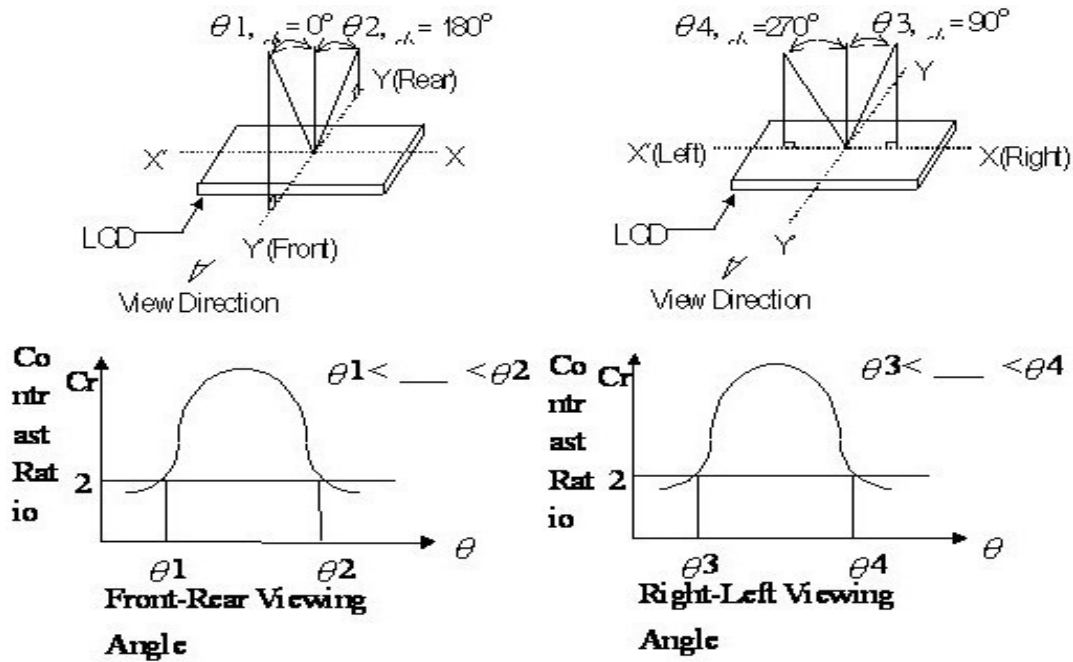
10. INSTRUCTION TABLE

INSTRUCTION	A0	R/W (RWR)	COMMAND BYTE								DESCRIPTION
			D7	D6	D5	D4	D3	D2	D1	D0	
(1) Display ON/OFF	0	0	1	0	1	0	1	1	1	D	D=1, display ON D=0, display OFF
(2) Set Start Line	0	0	0	1	S5	S4	S3	S2	S1	S0	Set display start line
(3) Set Page Address	0	0	1	0	1	1	Y3	Y2	Y1	Y0	Set page address
(4) Set Column Address	0	0	0	0	0	1	X7	X6	X5	X4	Set column address (MSB)
	0	0	0	0	0	0	X3	X2	X1	X0	Set column address (LSB)
(5) Read Status	0	1	0	MX	D	RST	0	0	0	0	Read IC Status
(6) Write Data	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Write display data to RAM
(7) Read Data	1	1	D7	D6	D5	D4	D3	D2	D1	D0	Read display data from RAM
(8) SEG Direction	0	0	1	0	1	0	0	0	0	MX	Set scan direction of SEG MX=1, reverse direction MX=0, normal direction
(9) Inverse Display	0	0	1	0	1	0	0	1	1	INV	INV =1, inverse display INV =0, normal display
(10) All Pixel ON	0	0	1	0	1	0	0	1	0	AP	AP=1, set all pixel ON AP=0, normal display
(11) Bias Select	0	0	1	0	1	0	0	0	1	BS	Select bias setting 0=1/9; 1=1/7 (at 1/65 duty)
(12) Read-modify-Write	0	0	1	1	1	0	0	0	0	0	Column address increment: Read:+0 , Write:+1
(13) END	0	0	1	1	1	0	1	1	1	0	Exit Read-modify-Write mode
(14) RESET	0	0	1	1	1	0	0	0	1	0	Software reset
(15) COM Direction	0	0	1	1	0	0	MY	-	-	-	Set output direction of COM MY=1, reverse direction MY=0, normal direction
(16) Power Control	0	0	0	0	1	0	1	VB	VR	VF	Control built-in power circuit ON/OFF
(17) Regulation Ratio	0	0	0	0	1	0	0	RR2	RR1	RR0	Select regulation resistor ratio
(18) Set EV	0	0	1	0	0	0	0	0	0	1	Double command!! Set electronic volume (EV) level
	0	0	0	0	EV5	EV4	EV3	EV2	EV1	EV0	
(19) Set Booster	0	0	1	1	1	1	1	1	0	0	Double command!! Set booster level: BL=0: 4X BL=1: 5X
	0	0	0	0	0	0	0	0	0	0	
(20) Power Save	0	0	Compound Command								Display OFF + All Pixel ON
(21) NOP	0	0	1	1	1	0	0	0	1	1	No operation
(22) Test	0	0	1	1	1	1	1	1	1	-	Do NOT use. Reserved for testing.

Note: Symbol "-" means this bit can be "H" or "L".

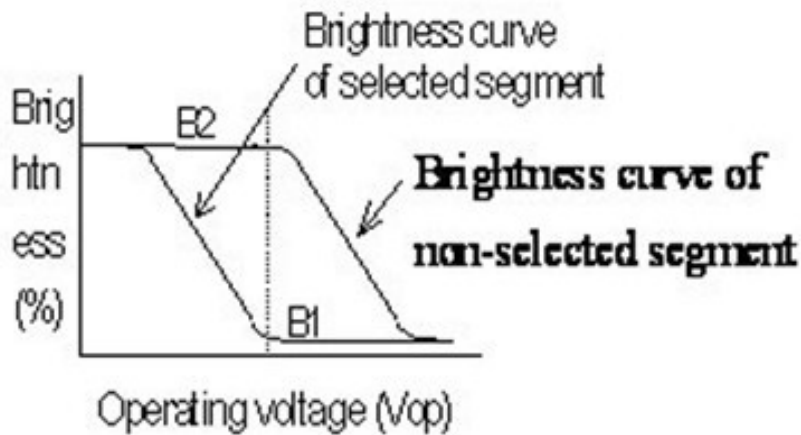
11. Optical Characteristics

11.1 Definition of Viewing Angle

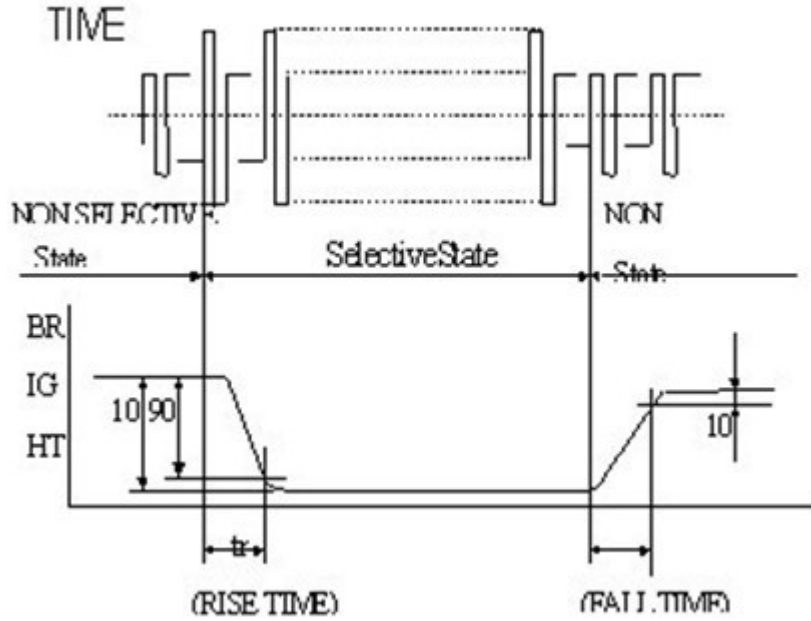


11.2 Definition of Contrast

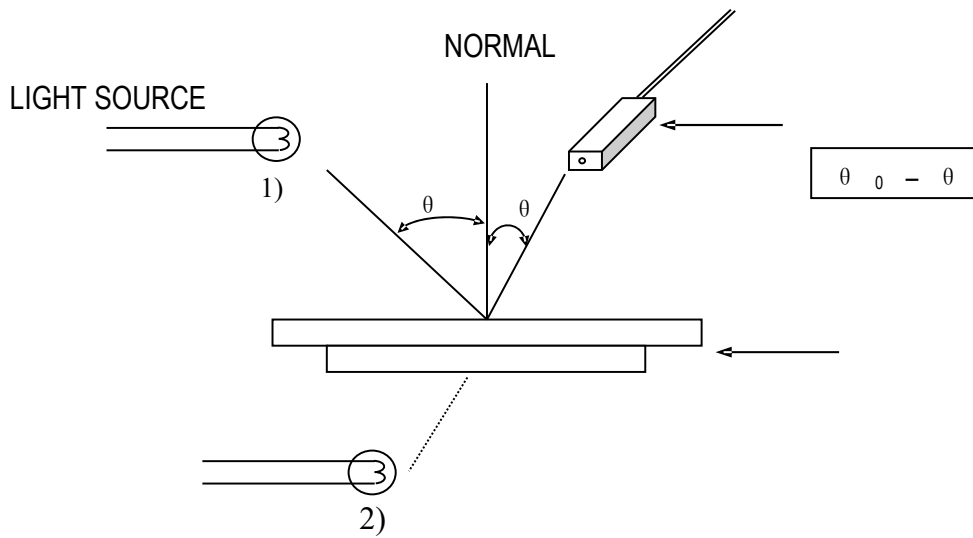
$$C.R = \frac{\text{Brightness of nonselected segment (E2)}}{\text{Brightness of selected segment}}$$



11.3 Definition of Response



11.4 Measuring Instruments For Elector-optical Characteristics



*** Note:**

- 1) Light source position for measuring the reflective type of LCD panel;
- 2) Light source position for measuring the transfective / transmissive types of LCD panel.

12. MODULE ACCEPT QUALITY LEVEL (AQL)

12.1 AQL Standard Value: Critical Defect =0.1, Major Defect=0.65; Minor Defect =2.5.

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

13. RELIABILITY TEST

Operating life time: Longer than 75,000 hours

(at room temperature without direct irradiation of sunlight)

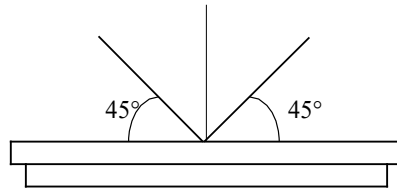
Reliability characteristics shall meet following requirements.

No.	Test Item	Content of Test	Test Condition
1	High Temperature Storage	Endurance test applying the high temperature for a long time storage	+80°C 96H
2	Low Temperature Storage	Endurance test applying the low temperature for a long time storage	-30°C 96H
3	High Temperature Operation	Endurance test applying the electric stress (voltage & current) and the thermal stress to the element for a long time	+70°C 96H
4	Low Temperature Operation	Endurance test applying the electric stress under low temperature for a long time	-20°C 96H
5	High Temperature/ Humidity Storage	Endurance test applying the high temperature and humidity storage for a long time	60°C 90%RH 96H
6	Temperature Cycle	Endurance test applying the low and high temperature cycle $-20^{\circ}\text{C} \longleftrightarrow 25^{\circ}\text{C} \longleftrightarrow 70^{\circ}\text{C} \longleftrightarrow 25^{\circ}\text{C}$ $30\text{min} \quad 5\text{min} \quad 30\text{min} \quad 5\text{min}$ $\longleftarrow \text{1 cycle} \longrightarrow$	-20°C/70°C 5 cycles
7	Vibration Test (Package State)	Endurance test applying the vibration during transportation	10Hz - 55Hz, 50m/s, 15min
8	Shock Test (Package State)	Endurance test applying the shock during transportation	Half-sinewave, 100m/s, 11ms
9	Atmospheric Pressure Test	Endurance test applying the atmospheric pressure during transportation by air	40 kPa 16 H


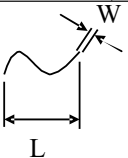
14. Inspection specification


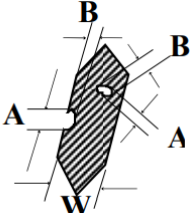
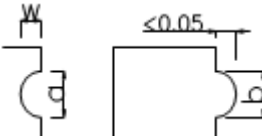
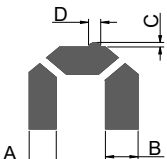
14.1 Visual Inspection

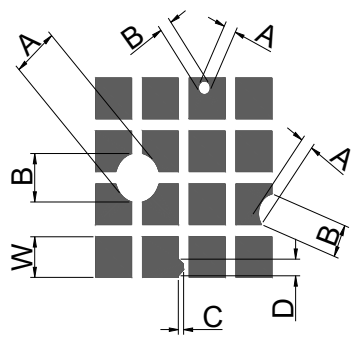
- 1) Inspect under 2x20W or 40W fluorescent lamp (approximately 3000 lux) leaving 25 to 30 cm between the module and the lamp and 30 cm between the module and the eye (measuring position).
- 2) Appearance is inspected at the best contrast voltage (best contrast is adjusted considering clearness and crosstalk on screen).
- 3) Inspect the module at 45° right and left, top and bottom.
- 4) Use the optimum viewing angle during the contrast inspection.



14.2 Standard of Appearance Inspection

No.	Item	Criteria																				
1	Black spot White spot Dust	Round type: as per following drawing $\Phi = (X+Y)/2$ 																				
		<table border="1"> <thead> <tr> <th colspan="3">Acceptable quantity</th> </tr> <tr> <th>Size</th> <th>Zone A</th> <th>Zone B</th> </tr> </thead> <tbody> <tr> <td>$\Phi < 0.1$</td> <td>Any number</td> <td rowspan="4">Any number</td> </tr> <tr> <td>$0.1 < \Phi < 0.2$</td> <td>2</td> </tr> <tr> <td>$0.2 < \Phi < 0.25$</td> <td>1</td> </tr> <tr> <td>$0.25 < \Phi$</td> <td>0</td> </tr> </tbody> </table>	Acceptable quantity			Size	Zone A	Zone B	$\Phi < 0.1$	Any number	Any number	$0.1 < \Phi < 0.2$	2	$0.2 < \Phi < 0.25$	1	$0.25 < \Phi$	0					
Acceptable quantity																						
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$0.25 < \Phi$	0																					
		Line type: as per following drawing <table border="1"> <thead> <tr> <th colspan="4">Acceptable quantity</th> </tr> <tr> <th>Length</th> <th>Width</th> <th>Zone A</th> <th>Zone B</th> </tr> </thead> <tbody> <tr> <td>—</td> <td>$W \leq 0.02$</td> <td>Any number</td> <td rowspan="4">Any number</td> </tr> <tr> <td>$L \leq 3.0$</td> <td>$0.02 < W \leq 0.03$</td> <td rowspan="2">2</td> </tr> <tr> <td>$L \leq 2.5$</td> <td>$0.03 < W \leq 0.05$</td> </tr> <tr> <td>—</td> <td>$0.05 < W$</td> <td>As round type</td> </tr> </tbody> </table> 	Acceptable quantity				Length	Width	Zone A	Zone B	—	$W \leq 0.02$	Any number	Any number	$L \leq 3.0$	$0.02 < W \leq 0.03$	2	$L \leq 2.5$	$0.03 < W \leq 0.05$	—	$0.05 < W$	As round type
Acceptable quantity																						
Length	Width	Zone A	Zone B																			
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$L \leq 3.0$	$0.02 < W \leq 0.03$	2																				
$L \leq 2.5$	$0.03 < W \leq 0.05$																					
—	$0.05 < W$	As round type																				
		Total acceptable quantity: 3																				
2	Polariser scratch	Scratch on protective film is permitted Scratch on polariser: same as No. 1																				
3	Polariser bubble	$\Phi = (X+Y)/2$																				

		 <table border="1" data-bbox="766 235 1428 548"> <thead> <tr> <th colspan="3">Acceptable quantity</th> </tr> <tr> <th>Size</th> <th>Zone A</th> <th>Zone B</th> </tr> </thead> <tbody> <tr> <td>$\Phi < 0.2$</td> <td>Any number</td> <td rowspan="3">Any number</td> </tr> <tr> <td>$0.2 < \Phi < 0.5$</td> <td>2</td> </tr> <tr> <td>$0.5 < \Phi < 1.0$</td> <td>1</td> </tr> <tr> <td>$1.0 < \Phi$</td> <td>0</td> <td></td> </tr> </tbody> </table> <p>Total acceptable quantity: 3</p>	Acceptable quantity			Size	Zone A	Zone B	$\Phi < 0.2$	Any number	Any number	$0.2 < \Phi < 0.5$	2	$0.5 < \Phi < 1.0$	1	$1.0 < \Phi$	0									
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$1.0 < \Phi$	0																									
4	Segment deformation	<p>4.1 Pin hole on segmented display W: segment width $\Phi = (A+B)/2$</p>  <table border="1" data-bbox="837 784 1428 1019"> <thead> <tr> <th colspan="2">Acceptable quantity</th> </tr> <tr> <th>Width</th> <th>Quantity</th> </tr> </thead> <tbody> <tr> <td>$W \leq 0.4$</td> <td>$\Phi \leq 0.2$ and $\Phi \leq 1/2W$</td> </tr> <tr> <td>$W > 0.4$</td> <td>$\Phi \leq 0.25$ and $\Phi \leq 1/3W$</td> </tr> </tbody> </table> <p>Total acceptable quantity: 1 defect per segment Pin holes with Φ under 0.10 mm are acceptable</p> <p>4.2 Pin hole on dot matrix display</p>  <table border="1" data-bbox="981 1209 1428 1444"> <thead> <tr> <th colspan="2">Acceptable quantity</th> </tr> <tr> <th>Size</th> <th>Quantity</th> </tr> </thead> <tbody> <tr> <td>$a, b < 0.1$</td> <td>Any number</td> </tr> <tr> <td>$(a+b)/2 \leq 0.1$</td> <td>Any number</td> </tr> <tr> <td>$0.5 < \Phi < 1.0$</td> <td>3</td> </tr> </tbody> </table> <p>Total acceptable quantity: 7</p> <p>4.3 Segments / dots with different width</p>  <table border="1" data-bbox="981 1612 1340 1736"> <thead> <tr> <th colspan="2">Acceptable</th> </tr> </thead> <tbody> <tr> <td>$a \geq b$</td> <td>$a/b \leq 4/3$</td> </tr> <tr> <td>$a < b$</td> <td>$a/b > 4/3$</td> </tr> </tbody> </table> <p>4.4 Alignment layer defect $\Phi = (A+B)/2$</p>	Acceptable quantity		Width	Quantity	$W \leq 0.4$	$\Phi \leq 0.2$ and $\Phi \leq 1/2W$	$W > 0.4$	$\Phi \leq 0.25$ and $\Phi \leq 1/3W$	Acceptable quantity		Size	Quantity	$a, b < 0.1$	Any number	$(a+b)/2 \leq 0.1$	Any number	$0.5 < \Phi < 1.0$	3	Acceptable		$a \geq b$	$a/b \leq 4/3$	$a < b$	$a/b > 4/3$
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		 <p>Total acceptable quantity: 7</p> <table border="1" data-bbox="989 257 1428 616"> <thead> <tr> <th colspan="2">Acceptable quantity</th> </tr> <tr> <th>Size</th> <th>Quantity</th> </tr> </thead> <tbody> <tr> <td>$\Phi \leq 0.4$</td> <td>Any number</td> </tr> <tr> <td>$0.4 < \Phi \leq 1.0$</td> <td>5</td> </tr> <tr> <td>$1.0 < \Phi \leq 1.5$</td> <td>3</td> </tr> <tr> <td>$1.5 < \Phi \leq 2.0$</td> <td>2</td> </tr> </tbody> </table>	Acceptable quantity		Size	Quantity	$\Phi \leq 0.4$	Any number	$0.4 < \Phi \leq 1.0$	5	$1.0 < \Phi \leq 1.5$	3	$1.5 < \Phi \leq 2.0$	2				
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$1.5 < \Phi \leq 2.0$	2																	
5	Colour uniformity	Level of sample for approval set as limit sample																
6	Backlight	The backlight colour should correspond to the product specification Flashing and or unlit backlight is not allowed Dust larger than 0.25 mm is not allowed																
7	COB	Exposed wire bond pad is not allowed Insufficient covering with resin is not allowed (wire bond line exposed) Dust or bubble on the resin are not allowed																
8	PCB	No unmelted solder paste should be present on PCB Cold solder joints, missing solder connections, or oxidation are not allowed No residue or solder balls on PCB are allowed Short circuits on components are not allowed																
9	Tray particles	<table border="1" data-bbox="670 1176 1324 1411"> <thead> <tr> <th colspan="3">Acceptable quantity</th> </tr> <tr> <th></th> <th>Size</th> <th>Quantity</th> </tr> </thead> <tbody> <tr> <td rowspan="2">On tray</td> <td>$\Phi < 0.2$</td> <td>Any number</td> </tr> <tr> <td>$\Phi > 0.25$</td> <td>4</td> </tr> <tr> <td rowspan="2">On display</td> <td>$\Phi \geq 0.25$</td> <td>2</td> </tr> <tr> <td>$L = 3$</td> <td>1</td> </tr> </tbody> </table>	Acceptable quantity				Size	Quantity	On tray	$\Phi < 0.2$	Any number	$\Phi > 0.25$	4	On display	$\Phi \geq 0.25$	2	$L = 3$	1
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15. LCD MODULES HANDLING PRECAUTIONS

- Please remove the protection foil of polarizer before using.
- The display panel is made of glass. Do not subject it to a mechanical shock by dropping it from a high place, etc.
- If the display panel is damaged and the liquid crystal substance inside it leaks out, do not get any in your mouth. If the substance come into contact with your skin or clothes promptly wash it off using soap and water.
- Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.
- The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarize carefully.
- To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.
 - Be sure to ground the body when handling the LCD module.
 - Tools required for assembly, such as soldering irons, must be properly grounded.
 - To reduce the amount of static electricity generated, do not conduct assembly and other work under dry conditions.
 - The LCD module is coated with a film to protect the display surface. Exercise care when peeling off this protective film since static electricity may be generated.
- Storage precautions
When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps. Keep the modules in bags designed to prevent static electricity charging under low temperature / normal humidity conditions (avoid high temperature / high humidity and low temperatures below 0 °C). Whenever possible, the LCD modules should be stored in the same conditions in which they were shipped from our company.

16. OTHERS

- Liquid crystals solidify at low temperature (below the storage temperature range) leading to defective orientation of liquid crystal or the generation of air bubbles (black or white). Air bubbles may also be generated if the module is subjected to a strong shock at a low temperature.
- If the LCD modules have been operating for a long time showing the same display patterns may remain on the screen as ghost images and a slight contrast irregularity may also appear. Abnormal operating status can be resumed to be normal condition by suspending use for some time. It should be noted that this phenomena does not adversely affect performance reliability.
- To minimize the performance degradation of the LCD modules resulting from caused by static electricity, etc. exercise care to avoid holding the following sections when handling the modules:
 - Exposed area of the printed circuit board
 - Terminal electrode sections