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SPECIFICATION FOR LCM MODULE

MODULE NO.: AMG19264BR-B-Y6WFDY
DOC.REVISION: 00

Customer Approval:

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	SIGNATURE	DATE
PREPARED BY (RD ENGINEER)		Sep-27-2006
PREPARED BY (QA ENGINEER)		
CHECKED BY		
APPROVED BY		

DOCUMENT REVISION HISTORY

Version	DATE	DESCRIPTION	CHANGED BY
00	Sep-27-2006	First issue	

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1. FUNCTIONS & FEATURES

1.1. Format	: 192x64 dots
1.2. LCD mode	: STN / Positive/Transflective/Y-G
1.3. Viewing direction	: 6 o'clock
1.4. Driving scheme	: 1/64 Duty , 1/9Bias
1.5. Power supply voltage (V_{DD})	: 5.0V
1.6. LCD driving voltage(V_{op})	: 9.0V
1.7. Operation temp	: -10~60°C
1.8. Storage temp	: -20~70°C
1.9. Backlight color	: Yellow-Green
1.10. RoHS	

2. MECHANICAL SPECIFICATIONS

2.1. Module size	: 130.0mm(L)*65.0mm(W)*12.8max mm(H)
2.2. Viewing area	: 104.0mm(L)*39.0mm(W)
2.3. Dot pitch	: 0.508mm(L)*0.508mm(W)
2.4. Dot size	: 0.458mm(L)*0.458mm(W)
2.5. Weight	: Approx.

3. BLOCK DIAGRAM

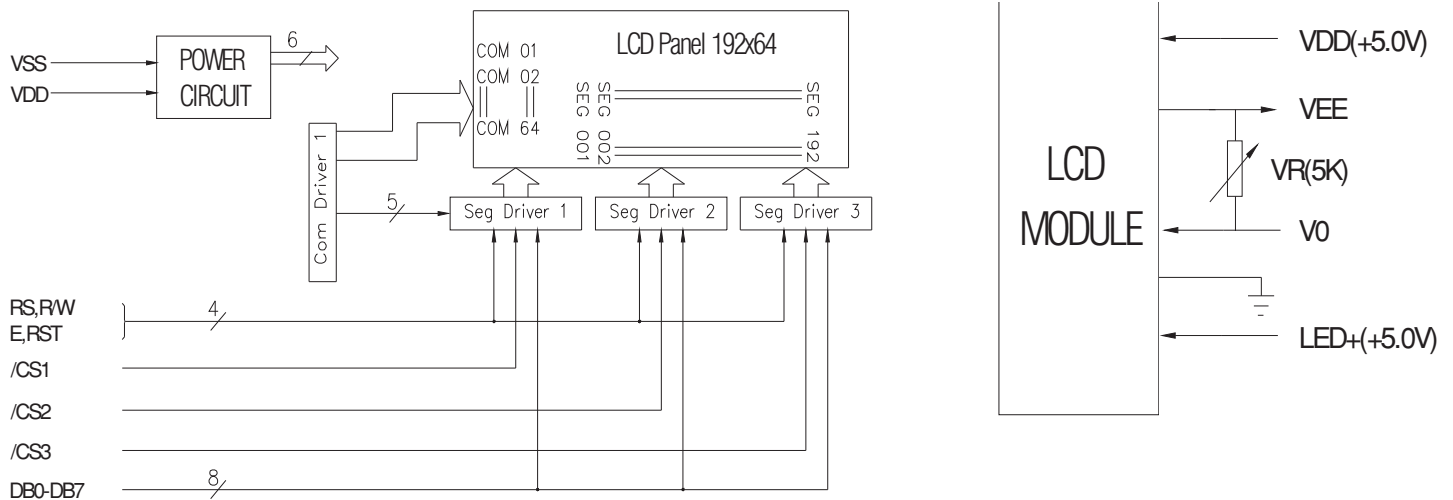


Figure1. Block diagram

4. DIMENSIONAL OUTLINE

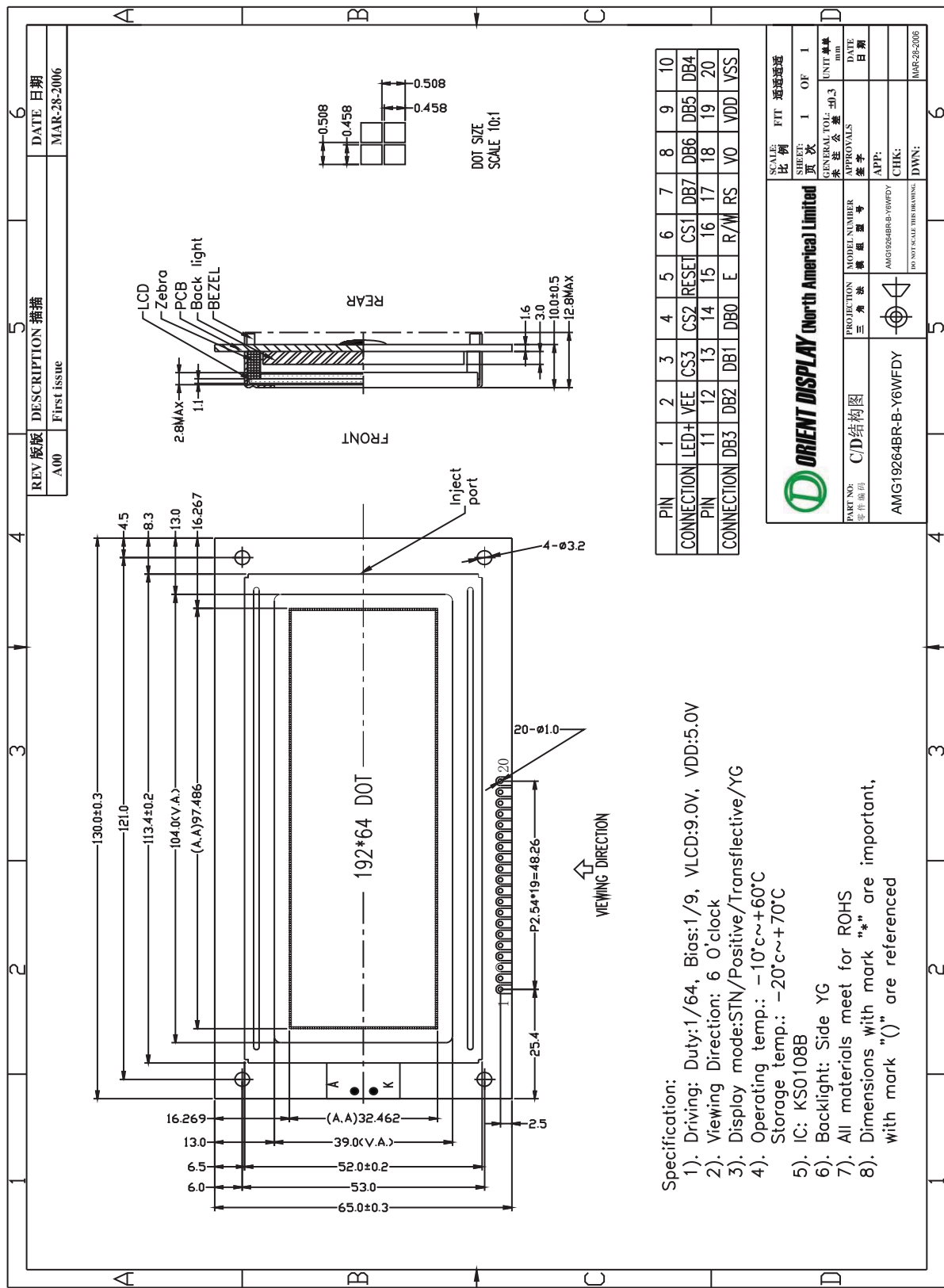


Figure 2. Dimensional outline

5. PIN DESCRIPTION

No.	Symbol	Function
1	LED+	Power supply for backlight (+5.0V)
2	VEE	Negative Power supply
3	/CS3	Chip selection , CS3=Low, Select for right screen.
4	/CS2	Chip selection, CS2=Low, Select for middle screen.
5	RST	Reset Signal, low level of RST is for reset and keep RST='h'.
6	/CS1	Chip selection, CS1=Low, Select for left screen
7-14	DB7-DB0	Data Bus line
15	E	Enable signal for LCM
16	R/W	Read/write selection (H:Read, L:Write)
17	RS	Register selection (H: Data register, L: Instruction register)
18	V0	Power supply for LCD drive
19	VDD	Power supply for Logic(+5.0V)
20	VSS	GND(0V)

6. MAXIMUM ABSOLUTE LIMIT

Item	Symbol	Value	Unit	Note
Supply voltage	V _{cc}	-0.3 to +7.0	V	2
	V _{EE1} V _{EE2}	V _{cc} -19.0 to V _{cc} + 0.3	V	3
Terminal voltage (1)	V _{T1}	V _{EE} - 0.3 to V _{cc} + 0.3	V	4
Terminla voltage (2)	V _{T2}	-0.3 to V _{cc} + 0.3	V	2, 5
Operating temperature	T _{opr}	-20 to + 75	°C	
Storage temperature	T _{stg}	-55 to + 125	°C	

- Notes : 1. LSI's may be destroyed if they are used beyond the absolute maximum ratings.
 In ordinary operation, it is desirable to use them within the recommended operation conditions.
 Using them beyond these conditons may cause malfunction and poor reliability.
2. All voltage values are referenced to GND = 0V.
 3. Apply the same supply voltage to V_{EE1} and V_{EE2}.
 4. Applies to V1L, V2L, V3L, V4L, V1R, V2R, V3R, and V4R.
 Maintain
 $V_{cc} \geq V1L = V1R \geq V3L \geq V3R \geq V4L = V4R \geq V2L = V2R \geq V_{EE}$
 5. Applies to M, FRM, CL, RST, ADC, ϕ 1, ϕ 2, CS1, CS2, CS3, E, R/W, D/I, and DB0 - DB7.

7. ELECTRICAL CHARACTERISTICS

7.1 DC CHARACTERISTICS

Item	Symbol	Limit			Unit	Test Condition	Note
		Min	Typ	Max			
Input “high” voltage	V_{IHC}	$0.7 \times V_{CC}$	--	V_{CC}	V		1
	V_{IHT}	2	--	V_{CC}	V		2
Input “low” voltage	V_{ILC}	0	--	$0.3 \times V_{CC}$	V		1
	V_{ILT}	0	--	0.8	V		2
Output “high” voltage	V_{OH}	2.4	--	--	V	$I_{OH} = -200 \mu A$	3
Output “low” voltage	V_{OL}	--	--	0.4	V	$I_{OL} = -1.6mA$	3
Input leakage current	I_{IL}	-1	--	1	μA	$V_{in} = GND - V_{CC}$	4
Three-state (off) input current	I_{TSL}	-5	--	5	μA	$V_{in} = GND - V_{CC}$	5
Liquid crystal supply leakage current	I_{LSL}	-2	--	2	μA	$V_{in} = V_{EE} - V_{CC}$	6
Driver on resistance	R_{ON}	--	--	7.5	$k\Omega$	$V_{CC} - V_{EE} = 15V$ $\pm I_{LOAD} = 0.1 mA$	8
Dissipation current	$I_{CC} (1)$	--	--	100	μA	During display	7
	$I_{CC} (2)$	--	--	500	μA	During access access cycle = 1MHz	7

- Notes :
1. Applies to $\overline{M}$, $\overline{FRM}$, $\overline{CL}$, $\overline{RST}$, $\phi 1$ and $\phi 2$.
 2. Applies to $\overline{CS1}$, $\overline{CS2}$, $\overline{CS3}$, $\overline{E}$, $\overline{R/W}$, $\overline{D/I}$, and $\overline{DB0} - \overline{DB7}$.
 3. Applies to $\overline{DB0} - \overline{DB7}$.
 4. Applies to terminals except for $\overline{DB0} - \overline{DB7}$.
 5. Applies to $\overline{DB0} - \overline{DB7}$ at high impedance.
 6. Applies to $V1L - V4L$ and $V1R - V4R$.
 7. Specified when liquid crystal display is in 1/64 duty cycle mode.
 Operation frequency $f_{CLK} = 250 kHz$ ($\phi 1$ and $\phi 2$ frequency)
 Frame frequency $f_M = 70 Hz$ (FRM frequency)
 Specified in the state of
 Output terminal : not loaded
 Input level : $V_{IH} = V_{CC} (V)$
 $V_{IL} = GND (V)$
 Measured at V_{CC} terminal

7.2 AC Characteristics

GND = 0 V, Vcc = 5 V, Ta = -20 to +75°C

Item	Symbol	Min	Typ	Max	Unit	Note
E cycle time	t_{CYC}	1,000	--	--	ns	1, 2
E high level width	P_{WEH}	400	--	--	ns	1, 2
E low level width	P_{WEL}	400	--	--	ns	1, 2
E rise time	t_r	--	--	25	ns	1, 2
E fall time	t_f	--	--	25	ns	1, 2
Address setup time	t_{AS}	200	--	--	ns	1, 2
Address hold time	t_{AH}	10	--	--	ns	1, 2
Data setup time	t_{DSW}	200	--	--	ns	1
Data delay time	t_{DDR}	--	--	320	ns	2, 3
Data hold time (Write)	t_{DHW}	10	--	--	ns	1
Data hold time (Read)	t_{DHR}	20	--	--	ns	2

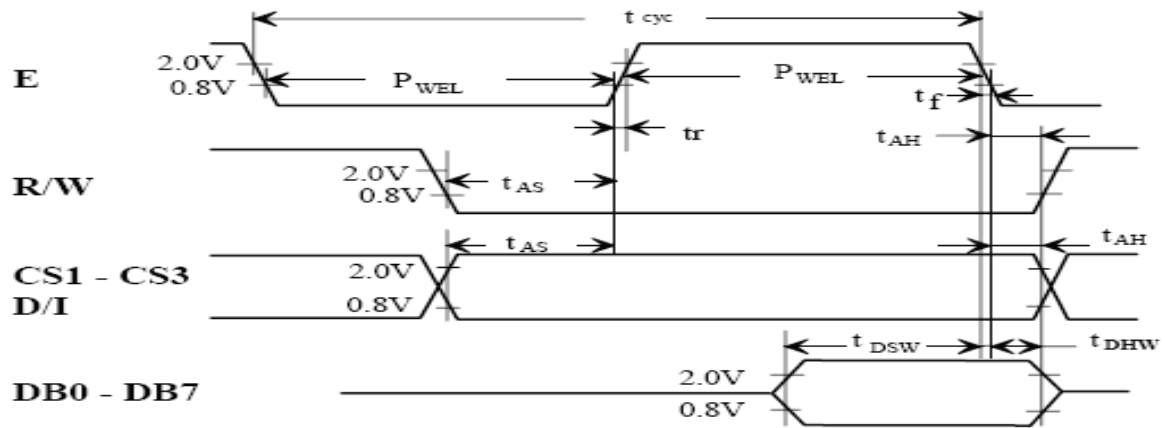


Figure 1 CPU Write Timing

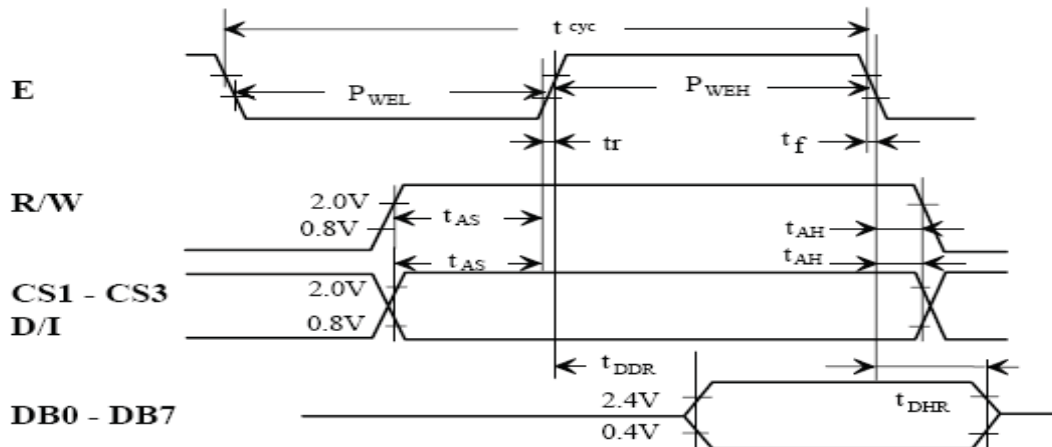


Figure 2 CPU Read Timing

(2) Clock Timing

(GND = 0 V, Vcc = 5 V, Ta = -20 to +75°C)

Limit						
Item	Symbol	Min	Typ	Max	Unit	Test Condition
$\phi 1$, $\phi 2$ cycle time	t_{CYC}	2.5	--	20	ns	Fig. 3
$\phi 1$ low level width	$t_{WL\phi 1}$	625	--	--	ns	Fig. 3
$\phi 2$ low level width	$t_{WL\phi 2}$	625	--	--	ns	Fig. 3
$\phi 1$ high level width	$t_{WH\phi 1}$	1,875	--	--	ns	Fig. 3
$\phi 2$ high level width	$t_{WH\phi 2}$	1,875	--	--	ns	Fig. 3
$\phi 1$ - $\phi 2$ phase difference	t_{D12}	625	--	--	ns	Fig. 3
$\phi 2$ - $\phi 1$ phase difference	t_{D21}	625	--	--	ns	Fig. 3
$\phi 1$ - $\phi 2$ rise time	t_r	--	--	150	ns	Fig. 3
$\phi 1$ - $\phi 2$ fall time	t_f	--	--	150	ns	Fig. 3

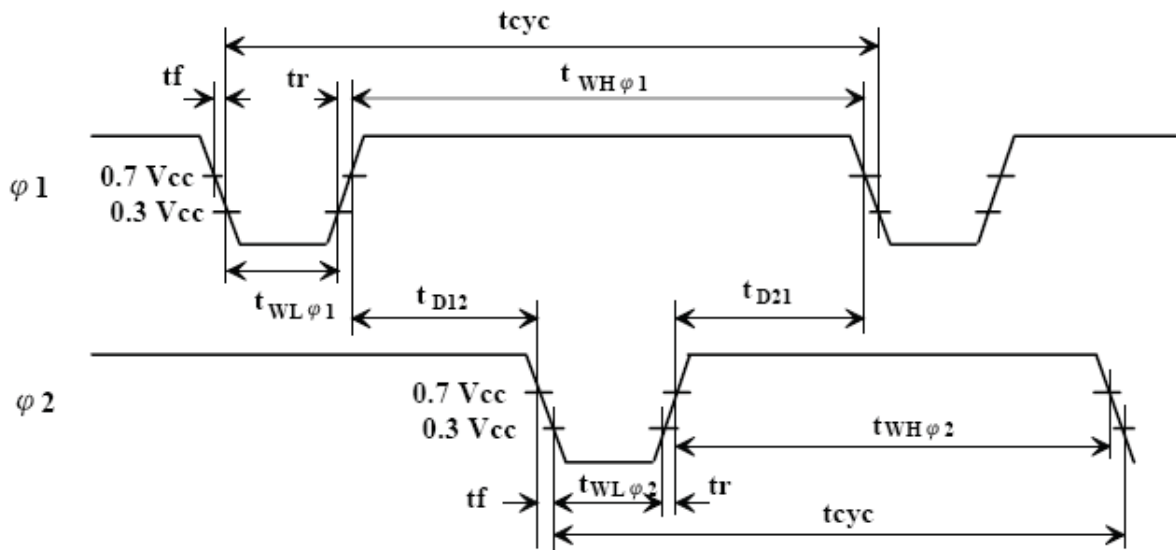


Figure 3 External Clock Waveform

(3) Display Control Timing

(GND = 0V, Vcc = 5 V, Ta = -20 to +75°C)

Limit						
Item	Symbol	Min	Typ	Max	Unit	Test Condition
FRM delay time	t_{DFRM}	-2	--	2	μs	Fig. 4
M delay time	t_{DM}	-2	--	2	μs	Fig. 4
CL “low” level width	t_{WLCL}	35	--	--	μs	Fig. 4
CL “high” level width	t_{WHCL}	35	--	--	μs	Fig. 4

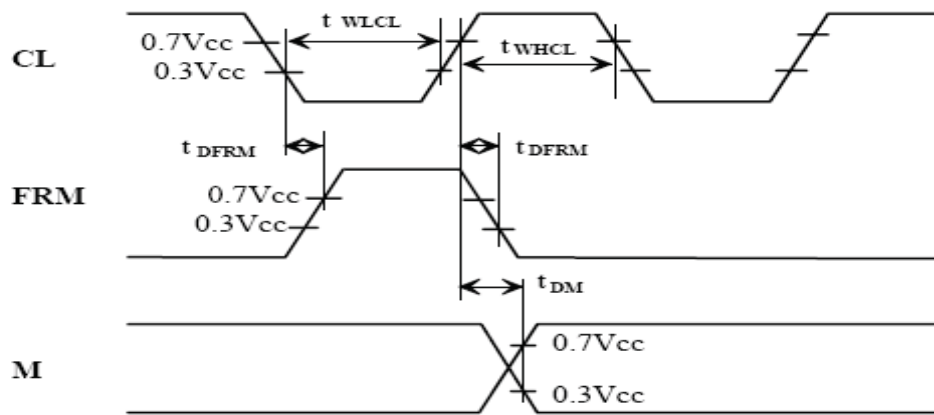


Figure 4 Display Control Signal Waveform

8. CONTROL AND DISPLAY INSTRUCTION

Instruction	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Function
Display on/off	L	L	L	L	H	H	H	H	H	L/H	Controls the display on or off. Internal status and display RAM data is not affected. L: OFF, H: ON
Set address (Y address)	L	L	L	H	Y address (0 - 63)						Sets the Y address in the Y address counter.
Set page (X address)	L	L	H	L	H	H	H	Page (0 - 7)			Sets the X address at the X address register.
Display start line (Z address)	L	L	H	H	Display start line (0 - 63)						Indicates the display data RAM displayed at the top of the screen.
Status read	L	H	Busy	L	On / Off	Reset	L	L	L	L	Read status. BUSY L: Ready H: In operation ON/OFF L: Display ON H: Display OFF RESET L: Normal H: Reset
Write display data	H	L	Write data								Writes data (DB0:7) into display data RAM. After writing instruction, Y address is increased by 1 automatically.
Read display data	H	H	Read data								Reads data (DB0: 7) from display data RAM to the data bus.

9. BACK LIGHT CHARACTERISTICS

LCD Module with side LED Backlight
ELECTRICAL RATINGS

Ta = 25°C

Item	Symbol	Condition	Min	Typ	Max	Unit
Forward Voltage	VF	IF=300mA	3.95	4.15	4.35	V
Reverse Current	IR	VR=8V	---	---	2000	uA
Luminous Intensity (With LCD dots off)	LV	IF=300mA	---	45	---	Cd/m ²
Wave length	λp	IF=300mA	---	568	---	nm
Use life	h	IF=300mA	20000	---	---	hour
Color	Yellow-Green					

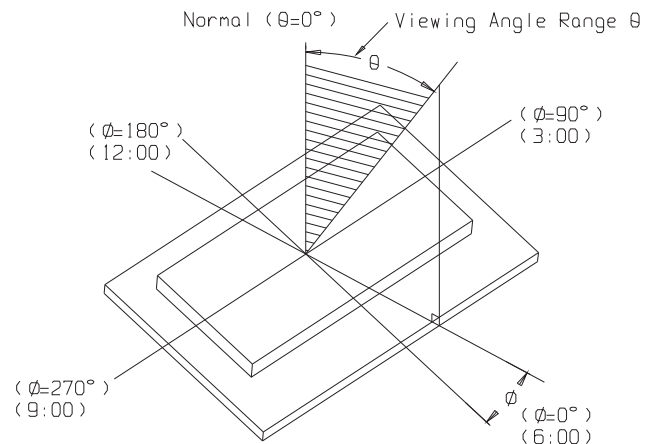
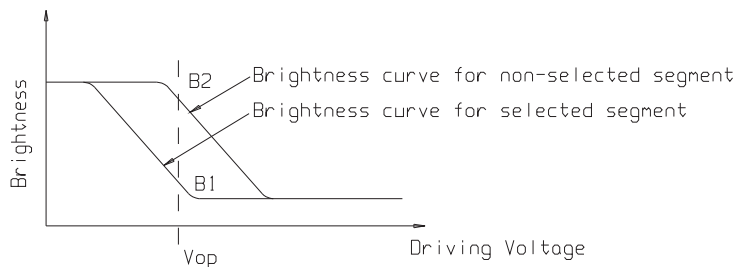
NOTE: lamp life time is defined as follows: the final brightness is at 50 % of original brightness

10. ELECTRO-OPTICAL CHARACTERISTICS

(V_{OP} =9.0V, Ta = 25°C)

Item	Symbol	Condition	Min	Typ	Max	Unit
Operating Voltage	Vop	Ta = -10°C	9.3	9.5	9.7	V
		Ta = 25°C	8.7	9.0	9.3	
		Ta = 60°C	8.2	8.4	8.6	
Response time	Tr	Ta = 25°C	---	185	---	ms
	Tf		---	200	---	ms
Contrast	Cr	Ta = 25°C	---	5	---	---
Viewing angle range	θ	Cr ≥ 2	-40	---	+40	deg
	Φ		-40	---	+40	deg

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

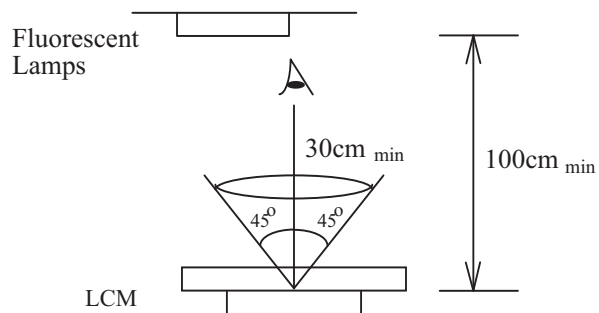


11.QUALITY SPECIFICATIONS

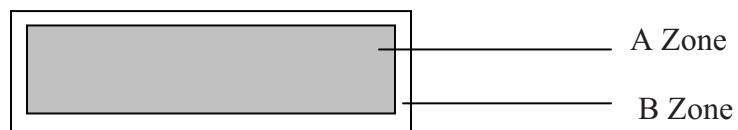
11.1 Standard of the product appearance test

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).

11.2 Specification of quality assurance

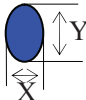
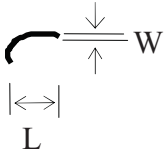
AQL inspection standard

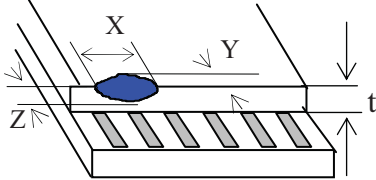
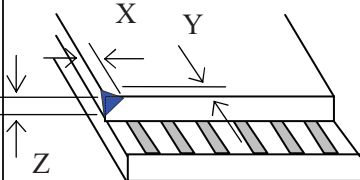
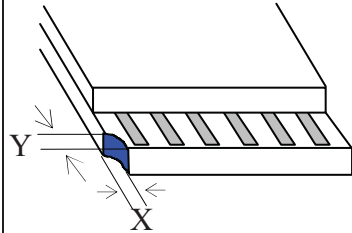
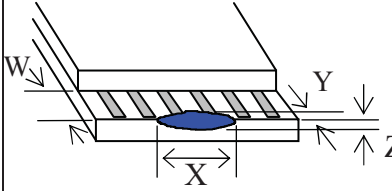
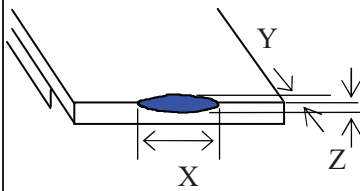
Sampling method: MIL-STD-105E, Level II, single sampling

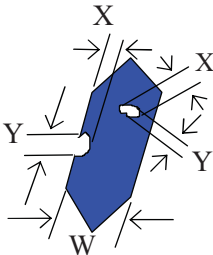
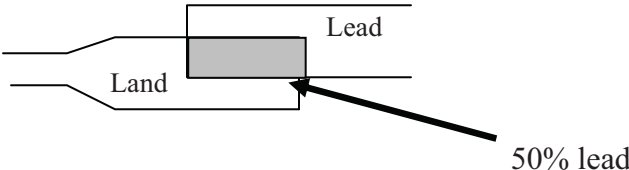
Defect classification (Note: * is not including)

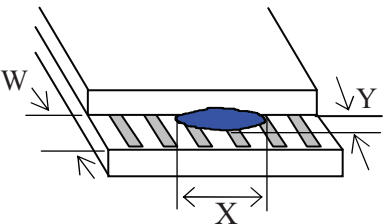
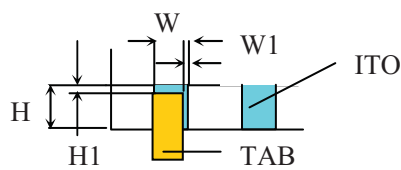
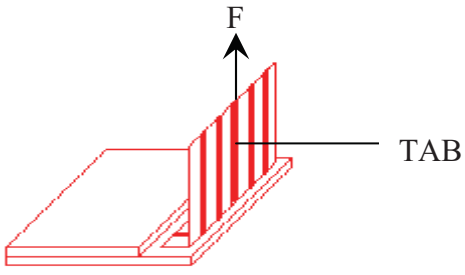
Classify	Item		Note	AQL
Major	Display state	Short or open circuit	1	0.65
		LC leakage		
		Flickering		
		No display		
		Wrong viewing direction		
		Contrast defect (dim, ghost)	2	
		Back-light	1,8	
	Non-display	Flat cable or pin reverse	10	
		Wrong or missing component	11	
Minor	Display State	Background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

Note on defect classification

No.	Item	Criterion																				
1	Short or open circuit	Not allow																				
	LC leakage																					
	Flickering																					
	No display																					
	Wrong viewing direction																					
	Wrong Back-light																					
2	Contrast defect	Refer to approval sample																				
	Background color deviation																					
3	Point defect, Black spot, dust (including Polarizer) $\phi = (X+Y)/2$	 <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	Point Size	Acceptable Qty.	$\phi \leq 0.10$	Disregard	$0.10 < \phi \leq 0.20$	3	$0.20 < \phi \leq 0.25$	2	$0.25 < \phi \leq 0.30$	1	$\phi > 0.30$	0								
Point Size	Acceptable Qty.																					
$\phi \leq 0.10$	Disregard																					
$0.10 < \phi \leq 0.20$	3																					
$0.20 < \phi \leq 0.25$	2																					
$0.25 < \phi \leq 0.30$	1																					
$\phi > 0.30$	0																					
4	Line defect, Scratch	 <table><tr><th colspan="2">Line</th><th>Acceptable Qty.</th></tr><tr><th>L</th><th>W</th><th></th></tr><tr><td>---</td><td>$0.015 \geq W$</td><td>Disregard</td></tr><tr><td>$3.0 \geq L$</td><td>$0.03 \geq W$</td><td rowspan="2">2</td></tr><tr><td>$2.0 \geq L$</td><td>$0.05 \geq W$</td></tr><tr><td>$1.0 \geq L$</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	Line		Acceptable Qty.	L	W		---	$0.015 \geq W$	Disregard	$3.0 \geq L$	$0.03 \geq W$	2	$2.0 \geq L$	$0.05 \geq W$	$1.0 \geq L$	$0.1 > W$	1	---	$0.05 < W$	Applied as point defect
Line		Acceptable Qty.																				
L	W																					
---	$0.015 \geq W$	Disregard																				
$3.0 \geq L$	$0.03 \geq W$	2																				
$2.0 \geq L$	$0.05 \geq W$																					
$1.0 \geq L$	$0.1 > W$	1																				
---	$0.05 < W$	Applied as point defect																				
5	Rainbow	Not more than two color changes across the viewing area.																				

No	Item	Criterion																																
6	Chip Remark: X: Length direction Y: Short direction Z: Thickness direction t: Glass thickness W: Terminal Width	 Acceptable criterion <table><tr><th>X</th><th>Y</th><th>Z</th></tr><tr><td>≤ 2</td><td>0.5mm</td><td>$\leq t/2$</td></tr></table>  Acceptable criterion <table><tr><th>X</th><th>Y</th><th>Z</th></tr><tr><td>≤ 2</td><td>0.5mm</td><td>$\leq t$</td></tr></table>  Acceptable criterion <table><tr><th>X</th><th>Y</th><th>Z</th></tr><tr><td>≤ 3</td><td>≤ 2</td><td rowspan="2">$\leq t$</td></tr><tr><td colspan="2">shall not reach to ITO</td></tr></table>  Acceptable criterion <table><tr><th>X</th><th>Y</th><th>Z</th></tr><tr><td>Disregard</td><td>≤ 0.2</td><td>$\leq t$</td></tr></table>  Acceptable criterion <table><tr><th>X</th><th>Y</th><th>Z</th></tr><tr><td>≤ 5</td><td>≤ 2</td><td>$\leq t/3$</td></tr></table>	X	Y	Z	≤ 2	0.5mm	$\leq t/2$	X	Y	Z	≤ 2	0.5mm	$\leq t$	X	Y	Z	≤ 3	≤ 2	$\leq t$	shall not reach to ITO		X	Y	Z	Disregard	≤ 0.2	$\leq t$	X	Y	Z	≤ 5	≤ 2	$\leq t/3$
X	Y	Z																																
≤ 2	0.5mm	$\leq t/2$																																
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Disregard	≤ 0.2	$\leq t$																																
X	Y	Z																																
≤ 5	≤ 2	$\leq t/3$																																

No.	Item	Criterion								
7	Segment pattern W = Segment width $\phi = (X+Y)/2$	(1) Pin hole $\phi < 0.10\text{mm}$ is acceptable. <table><tr><th>Point Size</th><th>Acceptable Qty</th></tr><tr><td>$\phi \leq 1/4W$</td><td>Disregard</td></tr><tr><td>$1/4W < \phi \leq 1/2W$</td><td>1</td></tr><tr><td>$\phi > 1/2W$</td><td>0</td></tr></table> Unit: mm	Point Size	Acceptable Qty	$\phi \leq 1/4W$	Disregard	$1/4W < \phi \leq 1/2W$	1	$\phi > 1/2W$	0
Point Size	Acceptable Qty									
$\phi \leq 1/4W$	Disregard									
$1/4W < \phi \leq 1/2W$	1									
$\phi > 1/2W$	0									
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: $Y \leq 0.4$
13	TAB	1. Position  $W1 \leq 1/3 W$ $H1 \leq 1/3 H$ 2 TAB bonding strength test  $P (=F/TAB \text{ bonding width}) \geq 650gf/cm$,(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.

11.3 Reliability of LCM

Reliability test condition:

Item	Condition	Time (hrs)	Assessment
High temp. Storage	70°C	120	No abnormalities in functions and appearance
High temp. Operating	60°C	120	
Low temp. Storage	-20°C	120	
Low temp. Operating	-10°C	120	
Humidity	40°C/ 90%RH	120	
Temp. Cycle	-20°C ← 25°C → 70°C (30 min ← 5 min → 30min)	10cycles	

Recovery time should be 24 hours minimum. Moreover, functions, performance and appearance shall be free from remarkable deterioration within 50,000 hours under ordinary operating and storage conditions room temperature (20±8°C), normal humidity (below 65% RH), and in the area not exposed to direct sun light.

11.4 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 isopropyl alcohol, ethyl alcohol or trichlorotrifluoroethane, 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 Orient Display.
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 whenever 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 working 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: $280^{\circ}\text{C} \pm 10^{\circ}\text{C}$
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 V_o .
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

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

1. The liability of Orient Display is limited to repair or replacement on the terms set forth below. Orient Display 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 Orient Display and the customer, Orient Display will only replace or repair any of its LCD which is found defective electrically or visually when inspected in accordance with Orient Display 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.