LCD Module User Manual

YM320240-09

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REVISION RECORD		
REV. NO.	DATA	REVISION ITEMS
1.0	JAN 20, 2006	First Release Version

Contents

1.Scope

This manual defines general provisions as well as inspection standards for standard LCD module. If the event of unforeseen problem or unspecified items may occur, please contact the nearest supplier or our company.

2.Warranty

If module is not stored or used as specified in this manual, it will be void the 12- month warranty.

3.Features

3-1. Features

(1) Display mode: Transmissive/negative (optional)
STN LCD

(2) Display color: Display dots: Yellow-green (optional)
Background : Black (optional)

（3）Display Format: 320(w)×240(h) full dots

(4)Input data: 8-bit parallel data interfaced from a MPU
or Serial interface (optional)

(5) Multiplex ratio: 1/240 Duty, 1/16Bias

（6）Viewing direction: 6 O'clock

(7) Back light : LED Yellow-Green (optional)

(8) Controller: RA8835

3-2. Mechanical features

Item	Specifications	Unit
Outline dimensions	148.1(W)×103.3H) ×13.0Max.(T)	mm
Viewing Area	123.0(W)×93.0(H)	mm
Image Area	108.77(W)×81.57(H)	mm
Number of Dots	320 (W)×240(H)	---
Dot Size	0.31(W)×0.31(H)	mm
Dot Pitch	0.34(W)×0.34(H)	mm
Weight	---	g

3-3. Absolute maximum ratings

Item	Symbol	Condition	Min	Max	Units
Power supply for logic	Vdd-Vss	25℃	-0.3	7.0	V
Operating voltage for LCD	Vdd-V0	25℃	-0.3	28.0	V
Input voltage	Vin	25℃	-0.3	Vdd+0.3	V
Operating temperature	Top	---	- 20	70	℃
Storage temperature	Tstg	---	- 25	80	℃

Note:

1) The modules may be destroyed if they are used beyond absolute maximum ratings. In ordinary operation, it is desirable to use them within recommended operation conditions. Using the modules beyond these conditions may cause malfunction and poor reliability.
2) All voltage values are referenced to GND=0V.

3-4Electrical Characteristics

Item		Symbol	Conditions	Min.	Typ.	Max.	Unit
Supply Voltage		Vdd	—	4.5	5.0	5.5	V
Register data retention voltage		Voh	—	2.0	----	6.0	
Input leakage current		ILI	VI=Vdd	---	0.05	2.0	uA
Output leakage current		ILo	VI=Vdd	---	0.10	5.0	
Quiescent supply current		IQ	Sleep mode Vosc1=V/cs=V/rd=Vdd	---	0.05	20.0	uA
Oscillator frequency		Fosc	Measured at crystal 47.5% duty cycle	1.0	---	10.0	MHz
External clock frequency		Fcl		1.0	----	10.0	MHz
Oscillator feedback resistance		Rf		0.5	1.0	3.0	MΩ
TTL							
Input Voltage	"H" Level	Vih	Note 1	0.5Vdd	—	Vdd	V
	"L" Level	Vil	Note 1	Vss	—	0.2Vdd	
Output Voltage	"H" Level	Vih	IOH=-5.0mA, Note 1	2.4	—	—	
	"L" Level	Vil	IOL=5.0mA, Note 1	—	—	Vss+0.4	
COMS							
Input Voltage	"H" Level	Vih	Note 2	0.8Vdd	—	Vdd	V
	"L" Level	Vil	Note 2	Vss	—	0.2Vdd	
Output Voltage	"H" Level	Vih	IOH=-2.0mA, Note 2	Vdd-0.4	—	—	
	"L" Level	Vil	IOL=1.6mA ,Note 2	—	—	Vss+0.4	

Note: <1>D0 to D7,A0,/CS,/RD,/WR,VD0 to VD7,VA0 toVA15,/VRD,/VWRand/vce are ttl-level inputs

<2>SEL1 and NT/PL are CMOS-level inputs.YD,XD0toXD3,XSCL,XECL,LP,WF, YSCL,YDIS and CLO are CMOS-level outputs.

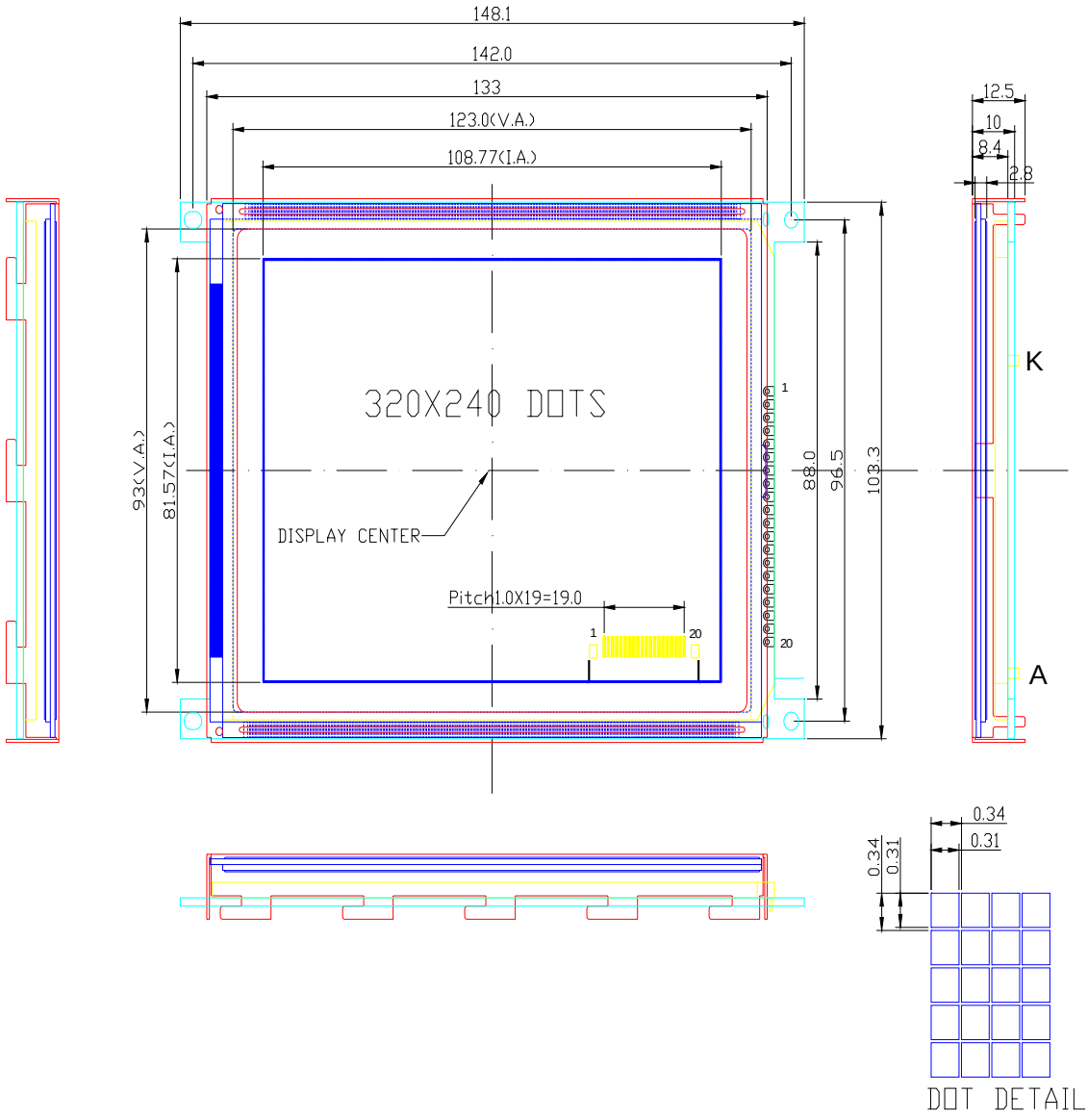
3-5 Electro-optical Characteristics

Item	Symbol	Conditions	Min.	Typ.	Max.	Unit
LCD Driving Voltage (Recommended voltage)	Vop	-20℃	---	---	---	V
		25℃	---	28.0	---	
		70℃	---	---	---	
Current consumption (No B/L)	Idd	----	—	20	---	mA
Power supply for logic	Vdd-Vss	25℃	2.7	—	5.5	V

3-6 LED back light specifications

Item	Unit	Standard Values			Condition
		Min.	Typ.	Max.	
Supply Voltage	V	—	4.2	---	—
Current	mA	---	650	---	---
Luminous Color	—	Yellow-Green			---
Operating Temp.	℃	-20 ~ +70			—
Storage Temp.	℃	-30 ~ +80			—

4. Mechanical Diagram



5.I/O Terminal

5-1 CN1 I/O Connection

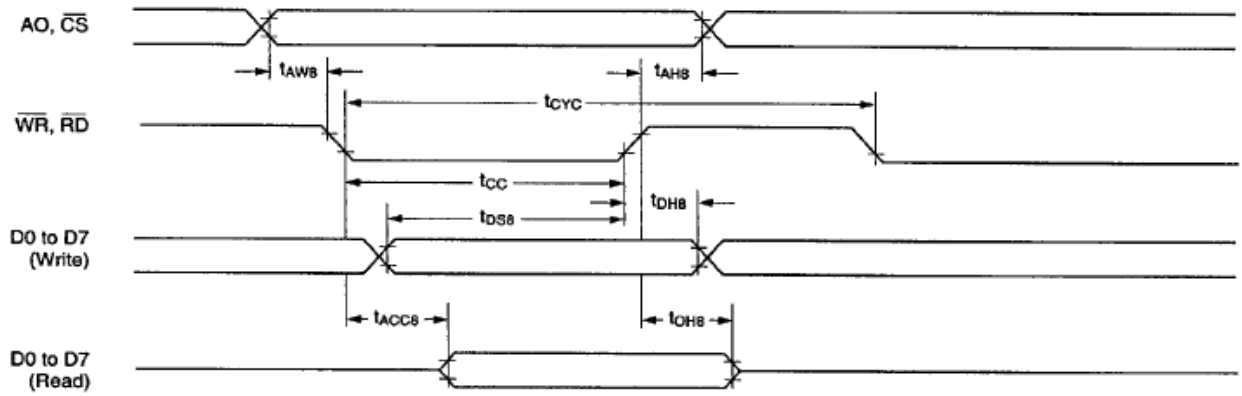
Pin No.	Symbol	Function
1	Vss	GND
2	Vdd	Power supply (+5.0V)
3	V0	Contrast adjust
4	A0	Register select signal A0=1, Instruction register ,A0=0, Data register
5	/WR	8080: Write signal; 6800: W/R signal
6	/RD	8080: Read signal; 6800: Enable signal
7-14	DB0-DB7	Data bus line
15	/CS	Chip select
16	/RES	Controller reset signal
17	VEE	Negative voltage output
18	SEL1	H:6800; L:8080
19	FG	Frame ground
20	LEDA	BL(+)（+5.0V）

CN2 I/O Connection (Optional)

Pin No.	Symbol	Function
1	Vss	GND
2	Vss	GND
3	Vss	GND
4	Vdd	Power supply (+5.0V)
5	Vss	GND
6	RXD	Receive Data
7	Vss	GND
8	TXD	Transmit Data
9	Vss	GND
10	VEE	Power supply voltage (Negative) Please ignore it if DC/DC converter built-in

5-2 Signal timing diagram

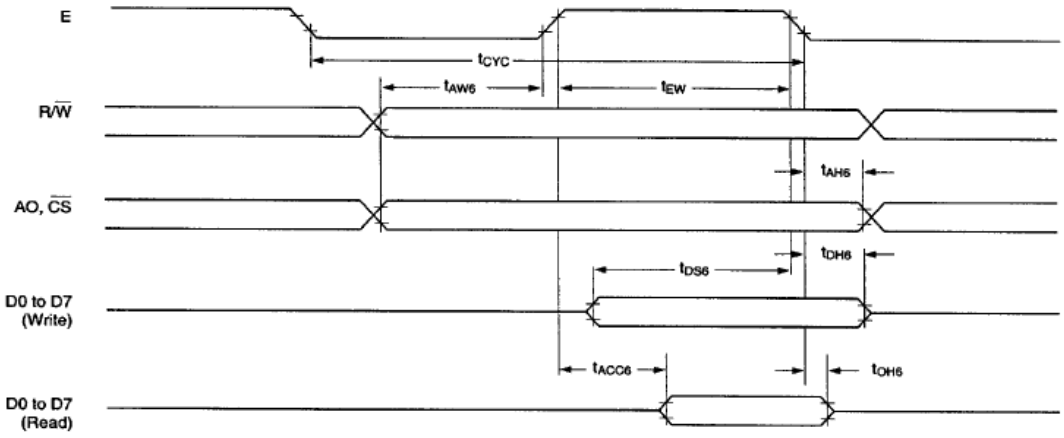
5-2-1 8080 family interface Timing



Ta = –20 to 75°C

Signal	Symbol	Parameter	VDD = 4.5 to 5.5V		VDD = 2.7 to 4.5V		Unit	Condition
			min	max	min	max		
A0, CS	tAH8	Address hold time	10	—	10	—	ns	CL = 100 pF
	tAW8	Address setup time	0	—	0	—	ns	
WR, RD	tCYC	System cycle time	See note	—	See note	—	ns	
	tCC	Strobe pulsewidth	120	—	150	—	ns	
D0 to D7	tDS8	Data setup time	120	—	120	—	ns	
	tDH8	Data hold time	5	—	5	—	ns	
	tACC8	RD access time	—	50	—	80	ns	
	tOH8	Output disable time	10	50	10	55	ns	

5-2-2 6800 family interface Timing



Note: tCYC6 indicates the interval during which CS is LOW and E is HIGH.

Ta = –20 to 75°C

Signal	Symbol	Parameter	VDD = 4.5 to 5.5V		VDD = 2.7 to 4.5V		Unit	Condition
			min	max	min	max		
A0, $\overline{CS}$, R/$\overline{W}$	tCYC6	System cycle time	See note	—	See note	—	ns	CL = 100 pF
	tAW6	Address setup time	0	—	10	—	ns	
	tAH6	Address hold time	0	—	0	—	ns	
D0 to D7	tDS6	Data setup time	100	—	120	—	ns	
	tDH6	Data hold time	0	—	0	—	ns	
	tOH6	Output disable time	10	50	10	75	ns	
	tACC6	Access time	—	85	—	130	ns	
E	tEW	Enable pulsewidth	120	—	150	—	ns	

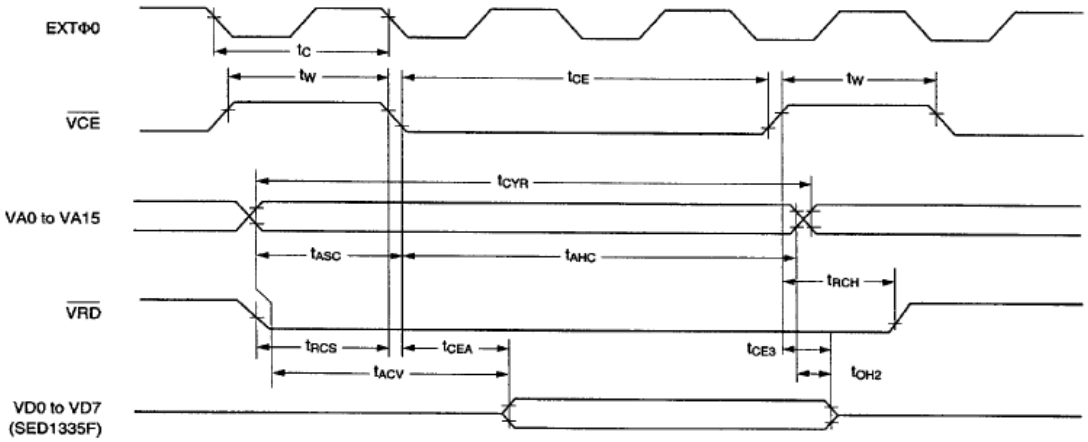
Note: For memory control and system control commands:

$t_{CYC6} = 2t_C + t_{EW} + t_{CEA} + 75 > t_{ACV} + 245$

For all other commands:

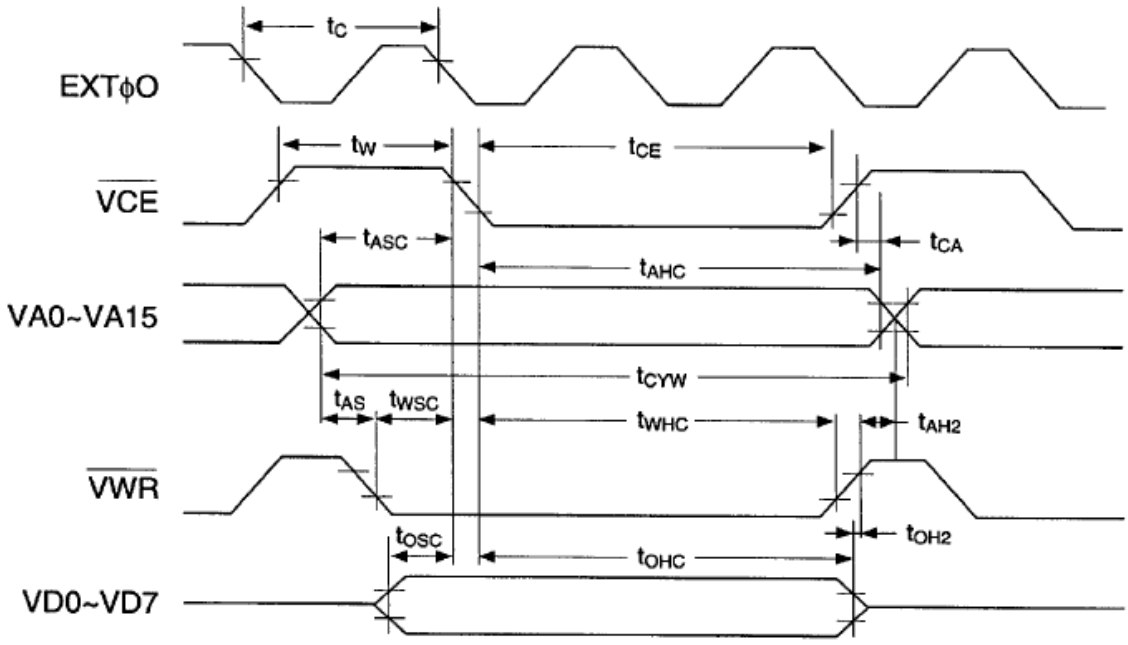
$t_{CYC6} = 4t_C + t_{EW} + 30$

5-2-3 Display Memory Read Timing



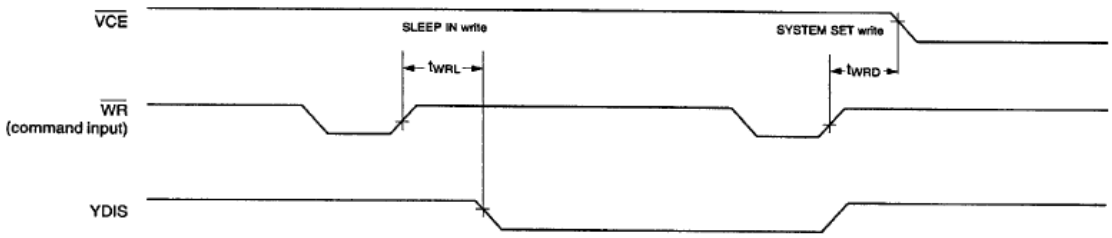
Signal	Symbol	Parameter	VDD = 4.5 to 5.5V		VDD = 2.7 to 4.5V		Unit	Condition
			min	max	min	max		
EXT ϕ0	tC	Clock period	100	—	125	—	ns	CL = 100 pF
$\overline{VCE}$	tW	$\overline{VCE}$ HIGH-level pulse-width	tC – 50	—	tC – 50	—	ns	
	tCE	$\overline{VCE}$ LOW-level pulse-width	2tC – 30	—	2tC – 30	—	ns	
VA0 to VA15	tCYR	Read cycle time	3tC	—	3tC	—	ns	
	tASC	Address setup time to falling edge of $\overline{VCE}$	tC – 70	—	tC – 100	—	ns	
	tAHC	Address hold time from falling edge of $\overline{VCE}$	2tC – 30	—	2tC – 40	—	ns	
$\overline{VRD}$	tRCS	Read cycle setup time to falling edge of $\overline{VCE}$	tC – 45	—	tC – 60	—	ns	
	tRCH	Read cycle hold time from rising edge of $\overline{VCE}$	0.5tC	—	0.5tC	—	ns	
VD0 to VD7	tACV	Address access time	—	3tC – 100	—	3tC – 115	ns	
	tCEA	$\overline{VCE}$ access time	—	2tC – 80	—	2tC – 90	ns	
	tOH2	Output data hold time	0	—	0	—	ns	
	tCE3	$\overline{VCE}$ to data off time	0	—	0	—	ns	

5-2-4 Display Memory Write Timing



Signal	Symbol	Parameter	VDD = 4.5 to 5.5V		VDD = 2.7 to 4.5V		Unit	Condition
			min	max	min	max		
EXT ϕ0	tC	Clock period	100	—	125	—	ns	CL = 100 pF
$\overline{VCE}$	tW	$\overline{VCE}$ HIGH-level pulse-width	tC – 50	—	tC – 50	—	ns	
	tCE	$\overline{VCE}$ LOW-level pulse-width	2tC – 30	—	2tC – 30	—	ns	
VA0 to VA15	tCYW	Write cycle time	3tC	—	3tC	—	ns	
	tAHC	Address hold time from falling edge of $\overline{VCE}$	2tC – 30	—	2tC – 40	—	ns	
	tASC	Address setup time to falling edge of $\overline{VCE}$	tC – 70	—	tC – 110	—	ns	
	tCA	Address hold time from rising edge of $\overline{VCE}$	0	—	0	—	ns	
	tAS	Address setup time to falling edge of $\overline{VWR}$	0	—	0	—	ns	
	tAH2	Address hold time from rising edge of $\overline{VWR}$	10	—	10	—	ns	
$\overline{VWR}$	tWSC	Write setup time to falling edge of $\overline{VCE}$	tC – 80	—	tC – 115	—	ns	
	tWHC	Write hold time from falling edge of $\overline{VCE}$	2tC – 20	—	2tC – 20	—	ns	
VD0 to VD7	tDSC	Data input setup time to falling edge of $\overline{VCE}$	tC – 85	—	tC – 125	—	ns	
	tDHC	Data input hold time from falling edge of $\overline{VCE}$	2tC – 30	—	2tC – 30	—	ns	
	tDH2	Data hold time from rising edge of $\overline{VWR}$	5	50	5	50	ns	

5-2-5 Sleep In Command Timing

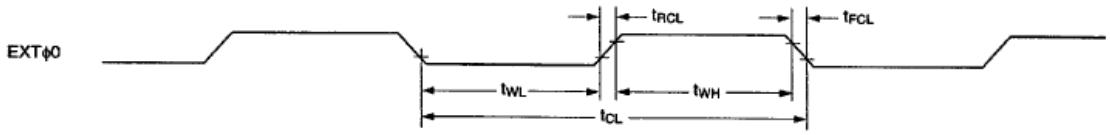


Signal	Symbol	Parameter	VDD = 4.5 to 5.5V		VDD = 2.7 to 4.5V		Unit	Condition
			min	max	min	max		
$\overline{WR}$	tWRD	$\overline{VCE}$ falling-edge delay time	See note 1	—	See note 1	—	ns	CL = 100 pF
	tWRL	YDIS falling-edge delay time	—	See note 2	—	See note 2	ns	

Notes:

1. $t_{WRD} = 18t_C + t_{OSS} + 40$ (t_{OSS} is the time delay from the sleep state until stable operation)
2. $t_{WRL} = 36t_C \times [TC/R] \times [L/F] + 70$

5-2-6 External Oscillator Signal Timing



Signal	Symbol	Parameter	VDD = 4.5 to 5.5V		VDD = 2.7 to 4.5V		Unit	Condition
			min	max	min	max		
EXT ϕ0	tRCL	External clock rise time	—	15	—	15	ns	
	tFCL	External clock fall time	—	15	—	15	ns	
	tWH	External clock HIGH-level pulsewidth	See note 1	See note 2	See note 1	See note 2	ns	
	tWL	External clock LOW-level pulsewidth	See note 1	See note 2	See note 1	See note 2	ns	
	tC	External clock period	100	—	125	—	ns	

Notes:

1. $(t_C - t_{RCL} - t_{FCL}) \times \frac{475}{1000} < t_{WH}, t_{WL}$
2. $(t_C - t_{RCL} - t_{FCL}) \times \frac{525}{1000} > t_{WH}, t_{WL}$

5-3 display command

Class	Command	Code											Hex	Command Description
		$\overline{RD}$	$\overline{WR}$	A0	D7	D6	D5	D4	D3	D2	D1	D0		
System control	SYSTEM SET	1	0	1	0	1	0	0	0	0	0	0	40	Initialize device and display
	SLEEP IN	1	0	1	0	1	0	1	0	0	1	1	53	Enter standby mode
Display control	DISP ON/OFF	1	0	1	0	1	0	1	1	0	0	D	58, 59	Enable and disable display and display flashing
	SCROLL	1	0	1	0	1	0	0	0	1	0	0	44	Set display start address and display regions
	CSRFORM	1	0	1	0	1	0	1	1	1	0	1	5D	Set cursor type
	CGRAM ADR	1	0	1	0	1	0	1	1	1	0	0	5C	Set start address of character generator RAM
	CSRDIR	1	0	1	0	1	0	0	1	1	CD 1	CD 0	4C to 4F	Set direction of cursor movement
	HDOT SCR	1	0	1	0	1	0	1	1	0	1	0	5A	Set horizontal scroll position
	OVLAY	1	0	1	0	1	0	1	1	0	1	1	5B	Set display overlay format
Drawing control	CSRW	1	0	1	0	1	0	0	0	1	1	0	46	Set cursor address
	CSRR	1	0	1	0	1	0	0	0	1	1	1	47	Read cursor address
Memory control	MWRITE	1	0	1	0	1	0	0	0	0	1	0	42	Write to display memory
	MREAD	1	0	1	0	1	0	0	0	0	1	1	43	Read from display memory

Notes:

1. In general, the internal registers of the SED1330F/1335F/1336F are modified as each command parameter is input. However, the microprocessor does not have to set all the parameters of a command and may send a new command before all parameters have been input. The internal registers for the parameters that have been input will have been changed but the remaining parameter registers are unchanged.

   2-byte parameters (where two bytes are treated as one data item) are handled as follows:

   a. CSRW, CSRR: Each byte is processed individually. The microprocessor may read or write just the low byte of the cursor address.

   b. SYSTEM SET, SCROLL, CGRAM ADR: Both parameter bytes are processed together. If the command is changed after half of the parameter has been input, the single byte is ignored.

2. APL and APH are 2-byte parameters, but are treated as two 1-byte parameters.

6. Quality Level

6-1 Inspection conditions

6-1-1The environmental conditions for inspection shall be as follows:

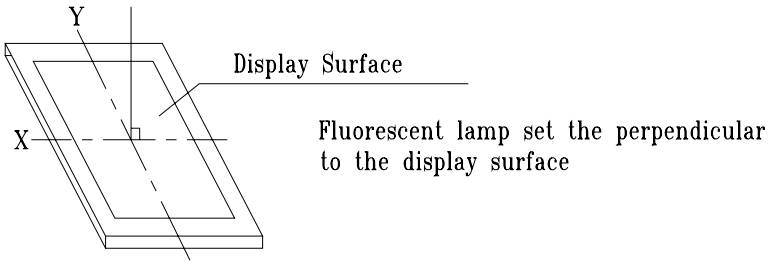
Room temperature: 20±3℃

Humidity: 65±20% RH

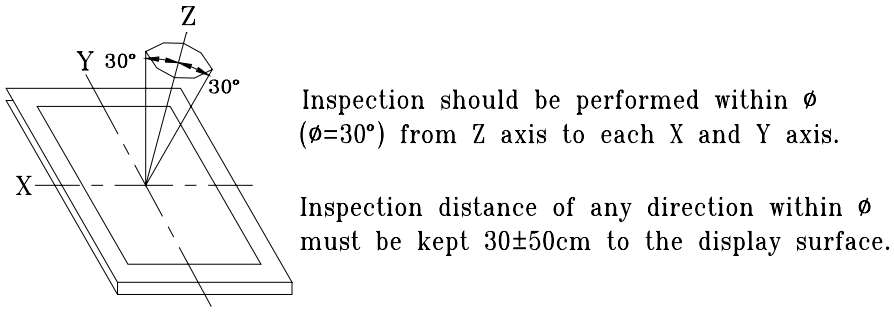
6-1-2 The external visual inspection:

The inspection shall be performed by using a 20W fluorescent lamp for illumination and the distance between LCD and the eyes of the inspector should be at least 30cm.

(1) Light method



(2) Inspection distance and angle



6-2 Sampling procedures for each item's acceptance level table

Defect type	Sampling procedure	AQL
Major defect	MIL-STD-105D Inspection Level I Normal inspection Single sample inspection	Q/GD-07-2006(1)
Minor defect	MIL-STD-105D Inspection Level I Normal inspection Single sample inspection	Q/GD-07-2006(1)

6-3 Classification of defects

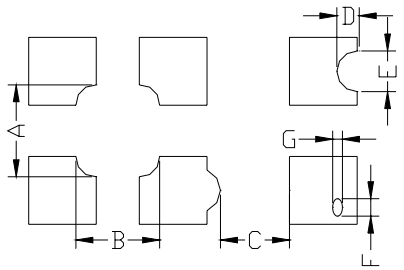
6-3-1 Major defect

A major defect refers to a defect that may substantially degrade usability for product applications.

6-3-2 Minor defect

A minor defect refers to a defect that deviates from existing standards almost unrelated to the effective use of the product or its operation.

6-4 Inspection standar

<table>
<tr><th>Item</th><th>Criterion for defects</th><th>Defect type</th></tr>
<tr><td>1) Display on inspection</td><td>(1) Non display (2) Vertical line is deficient
(3) Horizontal line is deficient (4) Cross line is deficient</td><td>Major</td></tr>
<tr><td>2) Black / White spot</td><td><table><tr><th>Size Φ(mm)</th><th>Acceptable number</th></tr><tr><td>Φ≤0.3</td><td>Ignore (note)</td></tr><tr><td>0.3<Φ≤0.45</td><td>3</td></tr><tr><td>0.45<Φ≤0.6</td><td>1</td></tr><tr><td>0.3<Φ</td><td>0</td></tr></table>(Note) Not allowed if four more spots crowd together</td><td>Minor</td></tr>
<tr><td>3) Black / White line</td><td><table><tr><th>Length (mm)</th><th>Width (mm)</th><th>Acceptable number</th></tr><tr><td>L≤10</td><td>W≤0.03</td><td>Ignore</td></tr><tr><td>5.0≤L≤10</td><td>0.03<W≤0.04</td><td>3</td></tr><tr><td>5.0≤L≤10</td><td>0.04<W≤0.05</td><td>2</td></tr><tr><td>1.0≤L≤10</td><td>0.05<W≤0.06</td><td>2</td></tr><tr><td>1.0≤L≤10</td><td>0.06<W≤0.08</td><td>1</td></tr><tr><td>L≤10</td><td>0.08<W</td><td>follows 2) point defect</td></tr></table>Defects separate with each other at an interval of more than 20mm.</td><td>Minor</td></tr>
<tr><td>4) Display pattern</td><td> 

[Unit: mm]</td><td>Minor</td></tr>
</table>

	$\frac{A+B}{2} \leqslant 0.45$ | $0<C$ | $D+E \leqslant 0.35$ | $F+G \leqslant 0.35$ Note: 1) Up to 3 damages acceptable 2) Not allowed if there are two or more pinholes every 3 of fourths inch.	
5) Spot-like contrast irregularity	Size Φ(mm) / Acceptable Number Φ≤0.7 / Ignore (note) 0.7<Φ≤1.0 / 3 1.0<Φ≤1.5 / 1 1.5<Φ / 0 Note: 1) Conformed to limit samples. 2)Intervals of defects are more than 30mm.	Minor

Item	Criterion for defects	Defect type
6) Bubbles in polarizer	Size Φ(mm) / Acceptable Number Φ≤0.4 / Ignore (note) 0.4<Φ≤0.65 / 2 0.65<Φ≤1.2 / 1 1.2<Φ / 0	Minor
7) Scratches and dent on the polarizer	Scratches and dent on the polarizer shall be in the accordance with “2) Black/white spot”, and “3) Black/White line”.	Minor
8) Stains on the surface of LCD panel	Stains which cannot be removed even when wiped lightly with a soft cloth or similar cleaning.	Minor
9) Rainbow color	No rainbow color is allowed in the optimum contrast on state within the active area.	Minor
10) Viewing area encroachment	Polarizer edge or line is visible in the opening viewing area due to polarizer shortness or sealing line.	Minor
11) Bezel appearance	Rust and deep damages that are visible in the bezel are rejected.	Minor
12) Defect of land surface contact	Evident crevices that are visible are rejected.	Minor
13) Parts mounting	(1) Failure to mount parts (2) Parts not in the specifications are mounted (3) For example: Polarity is reversed, HSC or TCP falls off.	Major
14) Part alignment	(1) LSI, IC lead width is more than 50% beyond pad outline. (2) More than 50% of LSI, IC leads is off the pad outline.	Minor
15) Conductive foreign matter (solder ball, solder hips)	(1) 0.45<Φ, N≥1 (2) 0.3<Φ≤0.45, N≥1 Φ: Average diameter of solder ball (unit: mm) (3) 0.5<L, N≥1 L: Average length of solder chip (unit: mm)	Major Minor Minor
16) PCB pattern damage	(1) Deep damage is found on copper foil and the pattern is nearly broken. (2) Damage on copper foil other than 1) above	Major Minor

17) Faulty PCB correction	(1) Due to PCB copper foil pattern burnout, the pattern is connected, using a jumper wire for repair;2 or more places are corrected per PCB. (2) Short-circuited part is cut, and no resist coating has been performed.	Minor
18) Bezel flaw	Bezel claw missing or not bent	Minor
19) Indication on name plate (sampling indication label)	(1) Failure to stamp or label error, or not legible.(all acceptable if legible) (2) The separation is more than 1/3 for indication discoloration, in which the characters can be checked.	Minor

7.Reliability

7-1 Lifetime

50,000 hours (25℃ in the room without ray of sun)

7-2 Items of reliability

Item	Condition	Criterion
1) High Temperature Operating	60℃ 96hrs	No cosmetic failure is allowable. Contrast ratio should be between initial value ± 10%. Total current consumption should be below double of initial value.
2) Low Temperature Operation	-20℃ 96hrs	
3) Humidity	40℃, 90%RH, 96hrs	No cosmetic failure is allowable. Contrast ratio should be between initial value ± 20%. Total current consumption should be below double of initial value.
4) High Temperature	70℃ 96hrs	
5) Low Temperature	-30℃ 96hrs	
6) Thermal shock	25℃→30℃→25℃→70℃ 5(min) 30(min) 5(min) 30(min) 5 cycle, 55~60%RH	
7) Vibration	10~55~10hz amplitude: 1.5mm 2hrs for each direction (X,Y,Z)	No defects in cosmetic and operational function are allowable. Total current consumption should be below double of initial value.

8.Handling Precautions

8-1 Mounting method

A panel of LCD module consists of two thin glass plates with polarizers that easily get damaged.

And since the module in so constructed as to be fixed by utilizing fitting holes in the printed circuit board (PCB).

Extreme care should be used when handling the LCD modules.

8-2 Cautions of LCD handling and cleaning

When cleaning the display surface, use soft cloth with solvent (recommended below)

and wipe lightly.

- □ Isopropyl alcohol
- □ Ethyl alcohol
- □ Trichlorotriflorothane

Do not wipe the display surface with dry or hard materials that will damage the polarizer surface.

Do not use the following solvent:

- □ Water
- □ Ketone
- □ Aromatics

8-3 Caution against static charge

The LCD module use C-MOS LSI drivers. So we recommend you:

Connect any unused input terminal to V_{dd} or V_{ss}. Do not input any signals before power is turned on, and ground your body, work/assembly areas, assembly equipment to protect against static electricity.

8-4 Packaging

- Module employs LCD elements, and must be treated as such.
  Avoid intense shock and falls from a height.
  To prevent modules from degradation, do not operate or store them exposed direct to sunshine or high temperature/humidity.

8-5 Caution for operation

- It is an indispensable condition to drive LCD module within the limits of the specified voltage since the higher voltage over the limits may cause the shorter life of LCD module.
  An electrochemical reaction due to DC (direct current) causes LCD undesirable deterioration so that the uses of DC (direct current) drive should be avoided.
- Response time will be extremely delayed at lower temperature than the operating temperature range and on the other hand at higher temperature LCD module may show dark color in them. However those phenomena do not mean malfunction or out of order of LCD module, which will come back in the specified operating temperature.

8-6 Storage

In the case of storing for a long period of time, the following ways are recommended:

- Storage in polyethylene bag with the opening sealed so as not to enter fresh air outside in it. And with not desiccant.
- Placing in a dark place where neither exposure to direct sunlight nor light is. Keeping the storage temperature range.
- Storing with no touch on polarizer surface by any thing else.

8-7 Safety

- It is recommendable to crash damaged or unnecessary LCD into pieces and to wash off liquid crystal by either of solvents such as acetone and ethanol, which should be burned up later.
- When any liquid leaked out of a damaged glass cell comes in contact with your hands, please wash it off well at once with soap and water.

9.Precautions for Use

9-1 Both parties should provide a limit sample on an occasion when both parties agree its necessity.
The judgement by a limit sample shall take effect after the limit sample has been established and confirmed by both parties

9-2 On the following occasions, the handling of problem should be decided through discussion and agreement between responsible of the both parties.

-When a question is arisen in this manual.

-When a new problem is arisen which is not specified in this manual.

-Some problem is arisen due to the change of inspection and operating conditions in users.

-When a new problem is arisen at the customer's operating set for sample evaluation in the customer site.