

Fema Part Number

FGM320200A-FWX1CCWR-Z

Description	LCD Display - Monochrome
	320X200 Resolution
	CCFL White Backlight (inverter required)
	ROHS Compliant

Customer Approval

Customer Approval Signature	
Approval Date	

Revision History

Revision	Date	Page	Comment

Fema Electronics Corporation:

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General Specification

(1) Mechanical Dimension

Item	Standard Value	Unit
Number of dots	320x200	dots
Outline dimension	166.0(W)x 134.0(H)x 15.1max(T)	mm
View area	128.0(W)x 110.0(H)	mm
Active area	121.56(W)x 103.0(H)	mm
Dot size	0.34(W)x 0.48(H)	mm
Dot pitch	0.38(W)x 0.52(H)	mm

(2) Controller IC: RAIO 8835 (equivalent to SED1335)

(3) Temperature Range

Normal	
Operating	0 ~+50°C
Storage	-10 ~+ 60°C

(4) Polarizer

FSTN / black / Negative: Anti-glare Polarizer

3. Absolute Maximum Ratings

Item	Symbol	Min	Typ	Max	Unit
Operating Temperature	T_{OP}	0	—	+50	°C
Storage Temperature	T_{ST}	-20	—	+70	°C
Input Voltage	V_I	0	—	V_{DD}	V
Supply Voltage For Logic	V_{DD}	0	—	6.5	V
Supply Voltage For LCD	$V_{DD}-V_{EE}$	0	—	32	V

4. Electrical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Logic Voltage	$V_{DD}-V_{SS}$	—	3.0	5.0	5.5	V
Supply Voltage For LCD	$V_{DD}-V_O$	$T_a=-20^{\circ}\text{C}$	—	24.0	—	V
		$T_a=25^{\circ}\text{C}$	—	22.0	—	V
		$T_a=+70^{\circ}\text{C}$	—	20.0	—	V
Input High Volt.	V_{IH}	—	$0.8V_{DD}$	—	V_{DD}	V
Input Low Volt.	V_{IL}	—	0	—	$0.2V_{DD}$	V
Output High Volt.	V_{OH}	—	$V_{DD}-0.4$	—	—	V
Output Low Volt.	V_{OL}	—	—	—	0.4	V
Supply Current	I_{DD}	—	—	—	110	mA
	I_O	—	—	—	3.0	mA

5. Optical Characteristics

FSTN

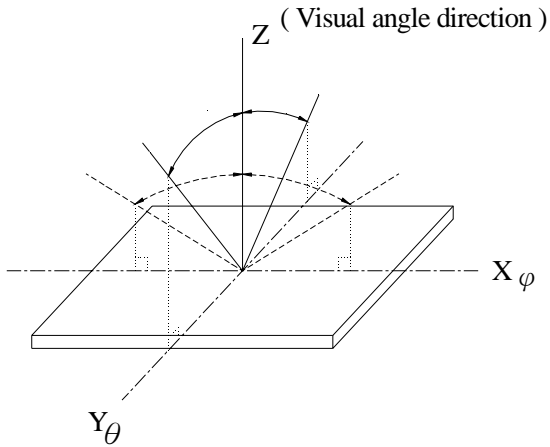
Item	Symbol	Condition	Min.	Typ.	Max.	Unit
View Angle	(V) θ	$CR \geq 3$	10		60	deg
	(H) φ	$CR \geq 3$	-45		45	deg
Contrast Ratio	CR	—		5	—	
Response Time 25°C	T rise	—		100	150	ms
	T fall	—		150	200	ms

Polarizer

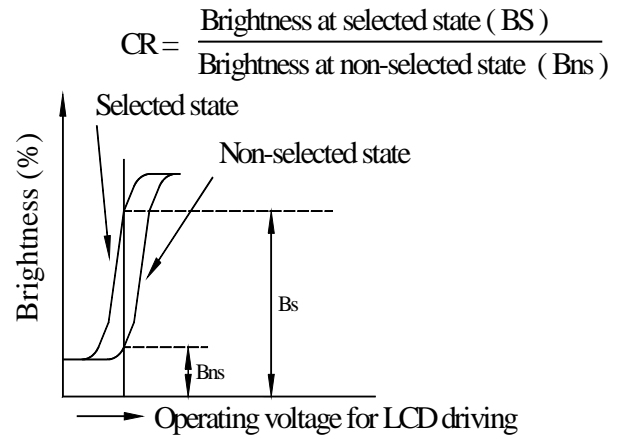
FSTN / black / Negative, STN / blue / Negative: Anti-glare Polarizer

5.1 Definitions

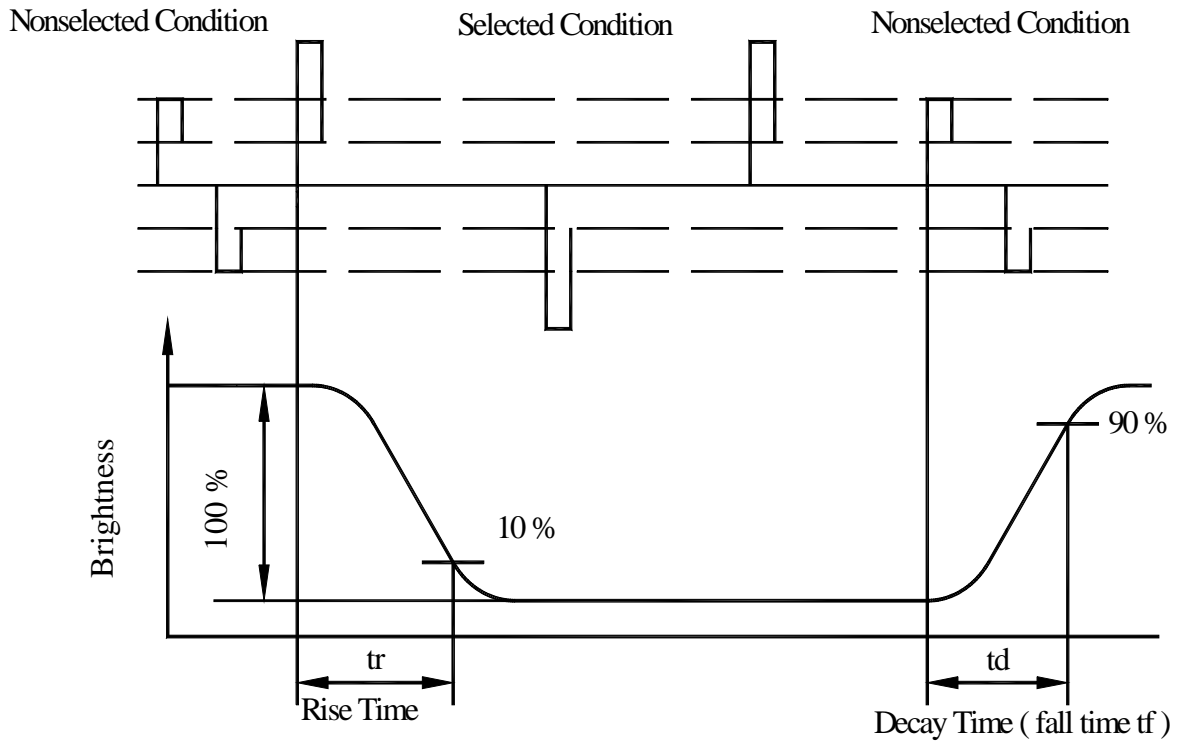
View Angles



Contrast Ratio



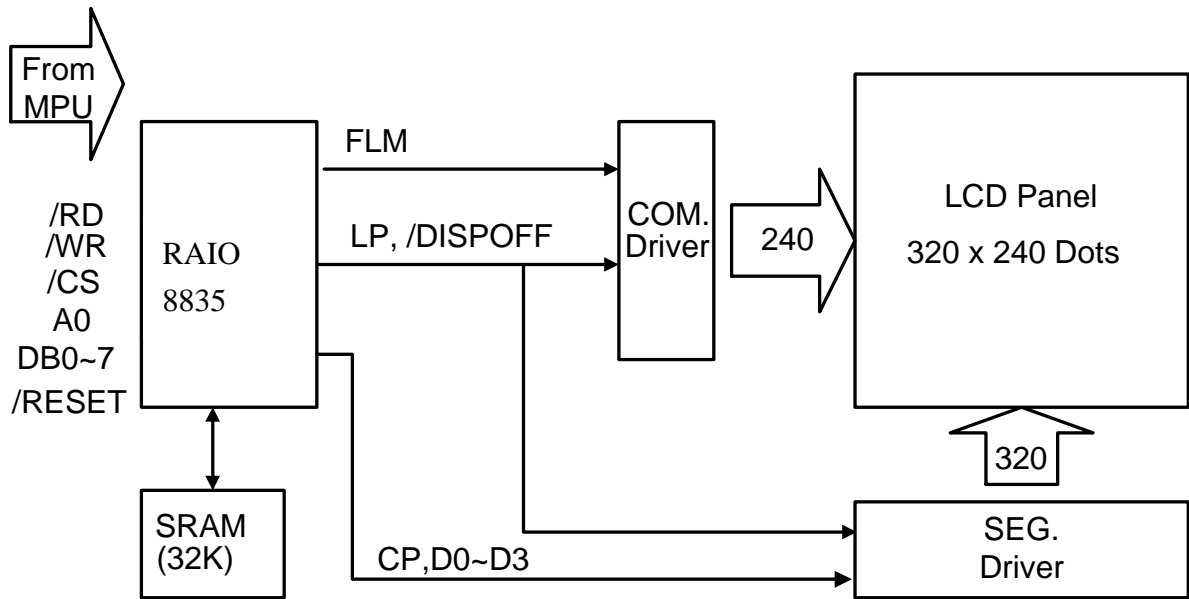
Response time



6. Interface Description

Pin No.	Symbol	Level	Description
1	/RES	H/L	Controller reset signal, Active L
2	/RD(E)	H/L	8080 family: Read signal, 6800 family: Enable clock
3	/WR	H/L	8080 family: Write signal, 6800 family: R/W signal
4	SEL2	H/L	SEL1=0 & SEL2=0 →8080 MPU interface
5	SEL1	H/L	SEL1=1 & SEL2=0 →6800 MPU interface
6	/CS	H/L	Chip select, Active “L”
7	A0	H/L	RD=L WR=H ,A0=L :Data Read AO=H :Status read RD=H WR=L ,A0=L :Data Write AO=H :Command write
8~15	DB0~7	H/L	Data Bus 0~7
16	Vdd	5V	Logic power +5V
17	Vss	0V	Logic GND
18	V _O	(Variable)	Driving voltage for LCD
19	VEE	-22V	(Option) Negative voltage output
20	FGND		Metal frame ground

7. Block Diagram



8. Timing Characteristics

8.1 8080 Family Interface Timing

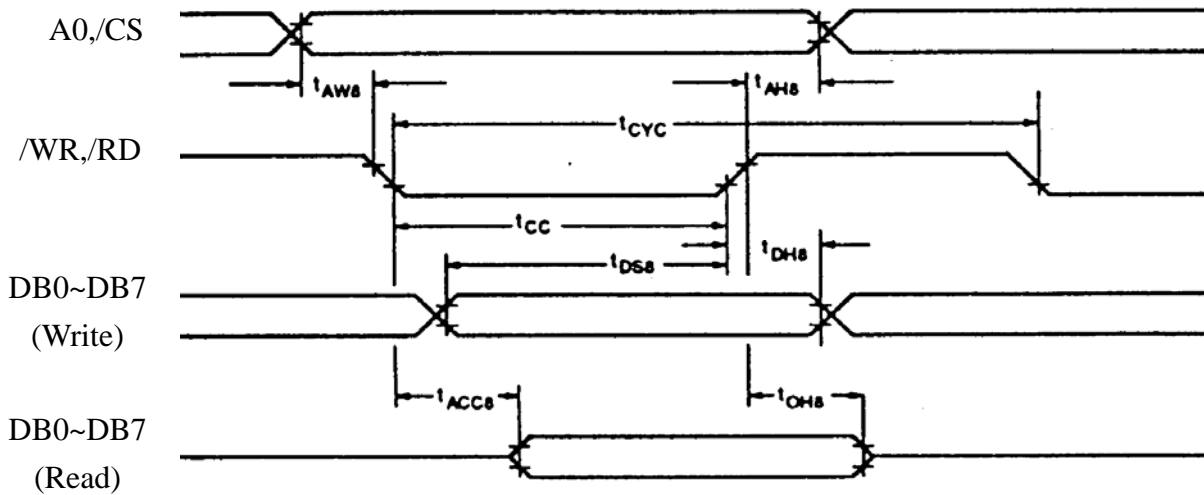
Parameter	Condition	Symbol	Min	Max	Unit	Remark
Address Hold Time	CL=100 pF VDD=2.7~4.5	tAH8		10		ns
Address Setup Time		tAW8		0		ns
System Cycle Time		tCYC		Note		ns
Strobe Pulse Width		tOC		150		ns
Data Setup Time		tDS8		120		ns
Data Hold Time		tDH8		5		ns
/RD Access Time		tACC8	-	80		ns
Output Disable Time		tOH8	10	55		ns

Note: For memory control and system control commands:

$$t_{CYC8} = 2t_C + t_{OC} + t_{CEA} + 75 > t_{ACV} + 245$$

For all other commands:

$$t_{CYC8} = 4t_C + t_{OC} + 30$$



8.2 6800 Family Interface Timing

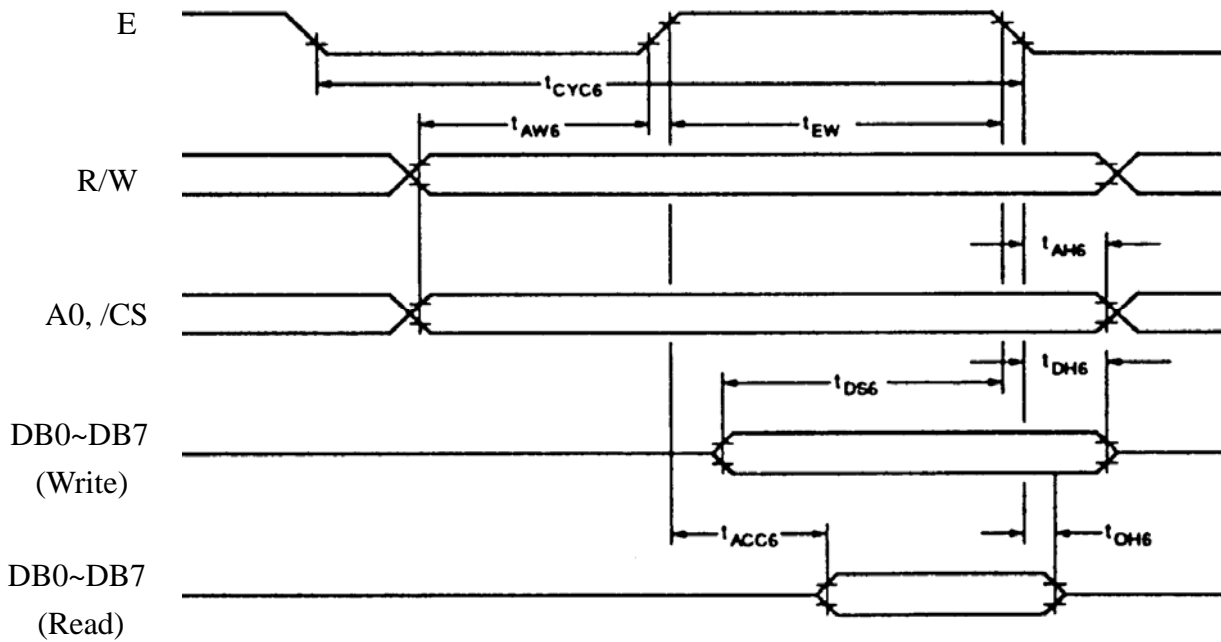
Parameter	Condition	Symbol	Min	Max	Unit	Remark	
System Cycle Time	CL=100 pF VDD=2.7~4.5	tCYC6			Note		ns
Address Setup Time		tAW6		10			ns
Address Hold Time		tAH6		0			ns
Data Setup Time		tDS6		120			ns
Data Hold Time		tDH6		0			ns
Output Disable Time		tOH6		10	75		ns
Access Time		tACC6		-	130		ns
Enable Pulsewidth		tEW		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:

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



AC Electrical Characteristics

9 Instruction Set

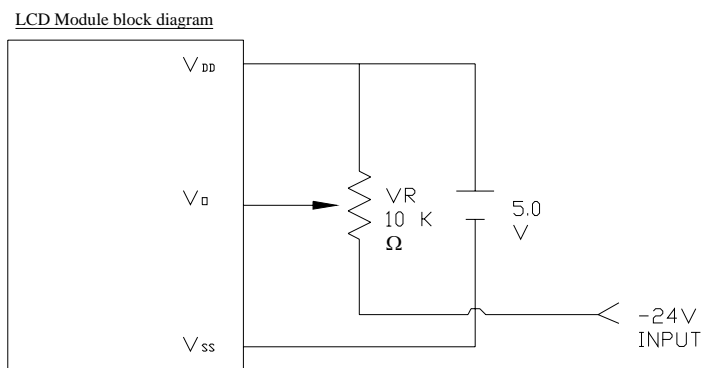
Class	Command	Code											Hex	Command Description	Command read parameters	
		/RD	/WR	A0	D7	D6	D5	D4	D3	D2	D1	D0			Number of byters	Section
System	SYSTEM	1	0	1	0	1	0	0	0	0	0	0	40	Initialized Device and display	8	8.2.1
Control	SLEEP IN	1	0	1	0	1	0	1	0	0	1	1	53	Enter Standby mode	0	8.2.2
Display Control	DISP	1	0	1	0	1	0	1	1	0	0	D	58,	Enable and disable display and	1	8.3.1
	SCROLL	1	0	1	0	1	0	0	0	1	0	0	44	set Display start address and	10	8.3.2
	CSRFORM	1	0	1	0	1	0	1	1	1	0	1	5D	Set cursor byte	2	8.3.3
	CGRAM	1	0	1	0	1	0	1	1	1	0	0	5C	Set start address of character	2	8.3.6
	CSRDIR	1	0	1	0	1	0	0	1	1	CD 1	CD 0	4C to 4F	Set direction of cursor movement	0	8.3.4
	HDOT SCR	1	0	1	0	1	0	1	1		1	0	5A	set horizontal scroll position	1	8.3.7
	OVLAY	1	0	1	0	1	0	1	1	0	1	1	5B	set display overlay format	1	8.3.5
Drawing	CSRW	1	0	1	0	1	0	0	0	1	1	0	46	set cursor address	2	8.4.1
Control	CSRR	1	0	1	0	1	0	0	0	1	1	1	47	read cursor address	2	8.4.2
Memory	MWRITE	1	0	1	0	1	0	0	0	0	1	0	42	write to display memory	-	8.5.1
Control	MREAD	1	0	1	0	1	0	0	0	0	1	1	43	read from display memory	-	8.5.2

Note:

- In general, the internal registers of the RAIO 8835 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 bytes parameters(where two bytes are treated as 1 data item) are handled as following:
 - CSRW, CSRR: Each byte is processed individually. The microprocessor may read or write just the low byte of the cursor address.
 - 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.
- APL and APH are 2-byte parameters, but are treated as two 1-byte parameters.
- Please refer to RAIO 8835 LCD Controller Data Book for detail.

10. Power Supply for LCD Module and LCD Operating Voltage a Adjustment

(Optional) LCM operating on " DC 3V or 5V " input with external negative voltage.



11. Backlight Information

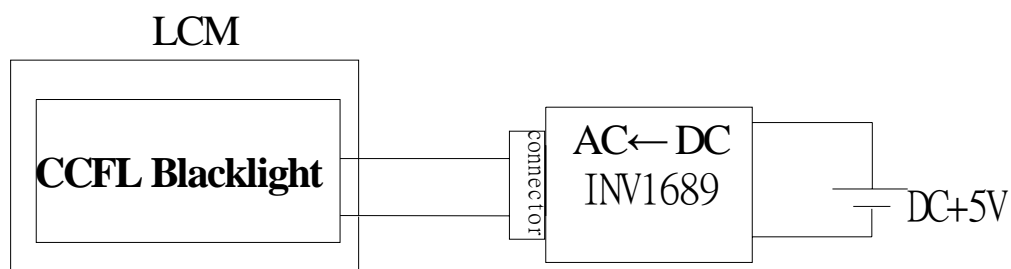
(1) CCFL / white

(Ta=25)

Item	Symbol	Specification			Unit	Condition
		Min	Typ	Max		
Driving Voltage	V_{FL}	—	350	—	Vrms	—
Input current	I_{FL}	3.0	5.0	6.0	mArms	—
Power consumption	W	—	1.35	—	W	—
Starting Voltage	V_{FLS}	—	530	—	Vrms	—
Luminance	L	—	550	—	Cd/m ²	$\varphi, \theta = 0 \text{ deg}, I_{FL} = 5.0 \text{ mArms}$
Chromaticity	x	—	0.340	—	—	—
	y	—	0.370	—	—	—
Luminance Uniformity (Testing 9 point)	—	75%	—	—	%	$\varphi, \theta = 0 \text{ deg}, I_{FL} = 5.0 \text{ mArms}$
Life time	—	15000	—	—	hrs	
Color	White					

11.2 Backlight driving methods

1. CCFL B/L driven from A.K cable directly



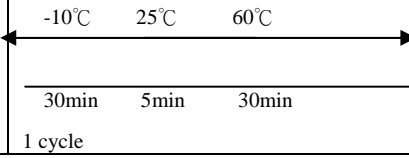
12. Quality Assurance

Screen Cosmetic Criteria

No.	Defect	Judgement Criterion	Partition																				
1	Spots	<p>A)Clear</p> <table border="1"> <thead> <tr> <th>Size: d mm</th> <th>Acceptable Qty in active area</th> </tr> </thead> <tbody> <tr> <td>$d \leq 0.1$</td> <td>Disregard</td> </tr> <tr> <td>$0.1 < d \leq 0.2$</td> <td>6</td> </tr> <tr> <td>$0.2 < d \leq 0.3$</td> <td>2</td> </tr> <tr> <td>$0.3 < d$</td> <td>0</td> </tr> </tbody> </table> <p>Note: Including pin holes and defective dots which must be within one pixel size.</p> <p>B)Unclear</p> <table border="1"> <thead> <tr> <th>Size: d mm</th> <th>Acceptable Qty in active area</th> </tr> </thead> <tbody> <tr> <td>$d \leq 0.2$</td> <td>Disregard</td> </tr> <tr> <td>$0.2 < d \leq 0.5$</td> <td>6</td> </tr> <tr> <td>$0.5 < d \leq 0.7$</td> <td>2</td> </tr> <tr> <td>$0.7 < d$</td> <td>0</td> </tr> </tbody> </table>	Size: d mm	Acceptable Qty in active area	$d \leq 0.1$	Disregard	$0.1 < d \leq 0.2$	6	$0.2 < d \leq 0.3$	2	$0.3 < d$	0	Size: d mm	Acceptable Qty in active area	$d \leq 0.2$	Disregard	$0.2 < d \leq 0.5$	6	$0.5 < d \leq 0.7$	2	$0.7 < d$	0	Minor
Size: d mm	Acceptable Qty in active area																						
$d \leq 0.1$	Disregard																						
$0.1 < d \leq 0.2$	6																						
$0.2 < d \leq 0.3$	2																						
$0.3 < d$	0																						
Size: d mm	Acceptable Qty in active area																						
$d \leq 0.2$	Disregard																						
$0.2 < d \leq 0.5$	6																						
$0.5 < d \leq 0.7$	2																						
$0.7 < d$	0																						
2	Bubbles Polarize	<table border="1"> <thead> <tr> <th>Size: d mm</th> <th>Acceptable Qty in active area</th> </tr> </thead> <tbody> <tr> <td>$d \leq 0.3$</td> <td>Disregard</td> </tr> <tr> <td>$0.3 < d \leq 1.0$</td> <td>3</td> </tr> <tr> <td>$1.0 < d \leq 1.5$</td> <td>1</td> </tr> <tr> <td>$1.5 < d$</td> <td>0</td> </tr> </tbody> </table>	Size: d mm	Acceptable Qty in active area	$d \leq 0.3$	Disregard	$0.3 < d \leq 1.0$	3	$1.0 < d \leq 1.5$	1	$1.5 < d$	0	Minor										
Size: d mm	Acceptable Qty in active area																						
$d \leq 0.3$	Disregard																						
$0.3 < d \leq 1.0$	3																						
$1.0 < d \leq 1.5$	1																						
$1.5 < d$	0																						
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

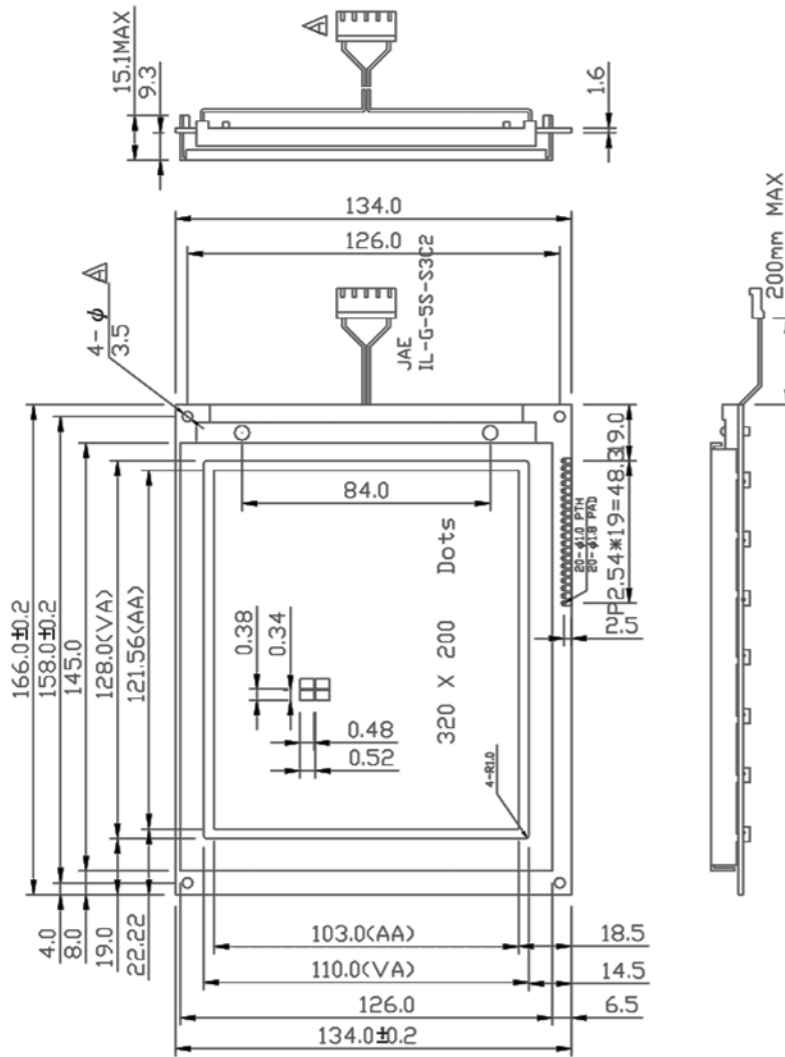
Content of Reliability Test

Environmental Test				
No.	Test Item	Content of Test	Test Condition	Applicable Standard
1	High Temperature storage	Endurance test applying the high storage temperature for a long time.	60°C 200hrs	—
2	Low Temperature storage	Endurance test applying the high storage temperature for a long time.	-10°C 200hrs	—
3	High Temperature Operation	Endurance test applying the electric stress (Voltage & Current) and the thermal stress to the element for a long time.	50°C 200hrs	—
4	Low Temperature Operation	Endurance test applying the electric stress under low temperature for a long time.	0°C 200hrs	—
5	High Temperature/ Humidity Storage	Endurance test applying the high temperature and high humidity storage for a long time.	60°C, 90%RH 96hrs	—
6	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	—
7	Temperature Cycle	Endurance test applying the low and high temperature cycle. 	-10°C/60°C 10 cycles	—
Mechanical Test				
8	Vibration test	Endurance test applying the vibration during transportation and using.	10~22Hz→1.5mmp-p 22~500Hz→1.5G Total 0.5hrs	—
9	Shock test	Constructional and mechanical endurance test applying the shock during transportation.	50G Half sign wave 11 msecd 3 times of each direction	—
10	Atmospheric pressure test	Endurance test applying the atmospheric pressure during transportation by air.	115mbar 40hrs	—
Others				
11	Static electricity test	Endurance test applying the electric stress to the terminal.	VS=800V, RS=1.5kΩ CS=100pF 1 time	—

***Supply voltage for logic system=5V. Supply voltage for LCD system =Operating voltage at 25°C

14. Outline Drawing

PIN NO	SYMBOL
1	/RES
2	/RD
3	/WR
4	A SEL2
5	A SEL1
6	CS
7	A0
8	DB0
9	DB1
10	DB2
11	DB3
12	DB4
13	DB5
14	DB6
15	DB7
16	VDD
17	VSS
18	V0
19	A VEE
20	FGND



SCALE:	1/2	REV:	C
UNIT:	mm	PAGE:	1/1
APPROVE	CHEN	MODEL	FGM320200A-FWX1CCWR-Z
CHECK	DAVIDY	TITLE	LCM DRAWING
DRAW	Keven 12/22/04	DWGNO.	