

Record of Version

Version	Modifications	Date
1.0	Generation first version	2001-10-8
2.0	Outline dimensions (HOLE) was changed from $\Phi 2.5\text{mm}$ to $\Phi 3.0\text{mm}$;	2009-4-13



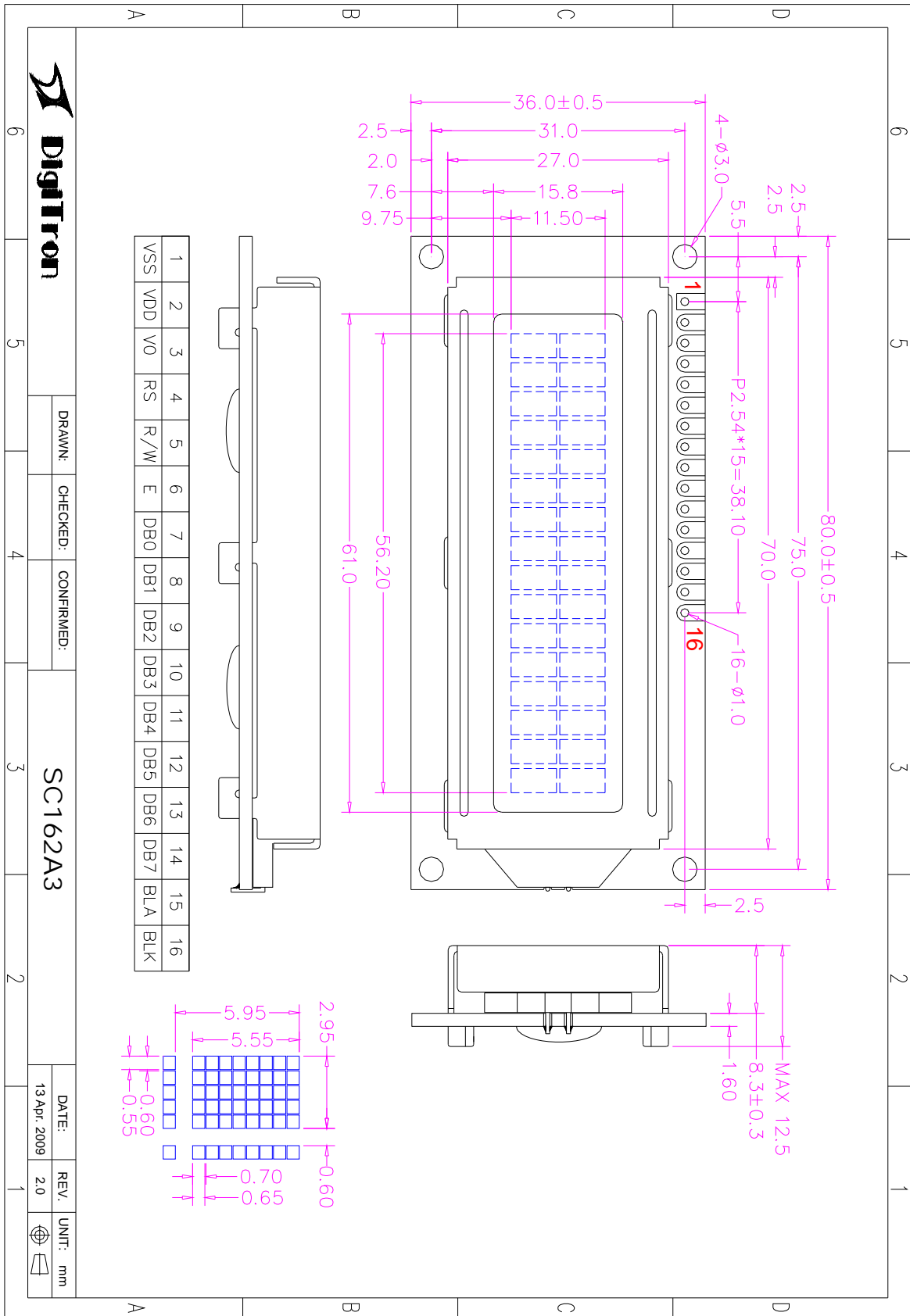
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1. General Specifications

Number of characters:	16 (W) × 2 (H)
Module Size:	80.0 (W)×36.0 (H)× 12.5 (D)
Viewing Area:	61.0 (W)× 15.8 (H)
Active Area:	56.20 (W)× 11.50 (H)
Characters Size:	2.95 (W)× 5.55 (H)
Characters Pith:	3.55 (W) × 5.95 (H)
LCD display type:	STN NEGATIVE (BLUE)
Drive method:	1/16 Duty 1/5 Bias
Viewing direction:	6 o'clock
Operating Temperature:	0~+50°C
Storage temperature:	-10~+60°C
Backlight:	White (LED)
Controller/driver:	S6A0069
Approx. weight:	36 g

2. External dimensions



3. Maximum absolute limit

Characteristics	Symbol	MIN.	MAX.	UNIT
Power Supply for Logic	VDD-VSS	-0.3	7.0	V
Power Supply for LCD	VDD-V0	0	17.0	V
Input Voltage	Vin	-0.3	VDD	V

Note: Stresses beyond those given in the Absolute Maximum Rating table may cause operational errors or damage to the device.

4. Electrical characteristics

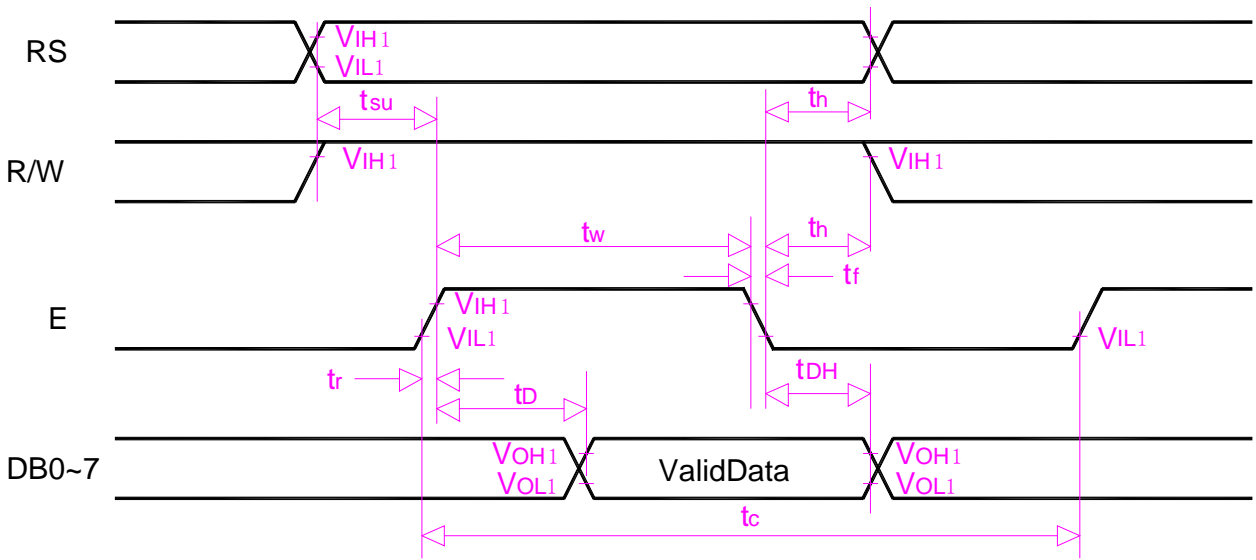
4.1) DC characteristics (ta = 25°C, VDD = 5.0 V)

Parameter	Sym.	Min.	Typ.	Max.	Unit	Condition
Operating Voltage	VDD		5.0		V	
Input high voltage	VIH	0.8 VDD	-	VDD	V	
Input low voltage	VIL	VSS	-	0.2 VDD	V	
Output high voltage	VOH	0.8 VDD	-	VDD	V	
Output low voltage	VOL	VSS	-	0.2 VDD	V	
Supply current for logic	IDD	-	1.0		mA	VDD =5.0V
Supply current for Backlight	IBLA		15		mA	BLA =5.0V

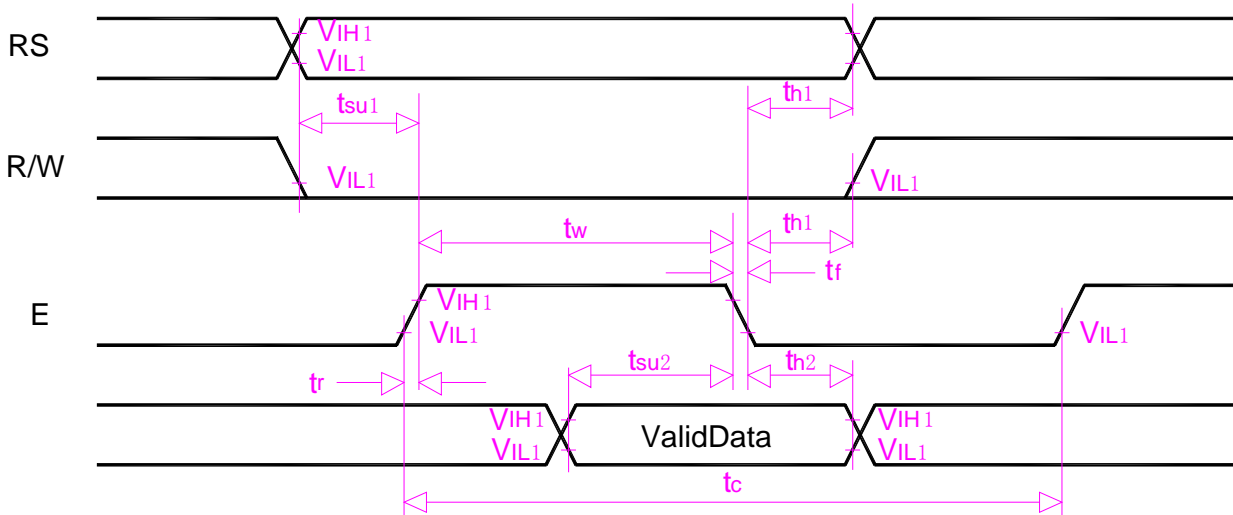
4.2) AC characteristics (TA = 25°C, VDD =5.0 V)

Read/Write Characteristics (6800-Series Microprocessor)

Mode	Characteristics	Symbol	Min	Typ	Max	Unit
Write Mode	E Cycle Time	tc	500	-	-	ns
	E Rise/Fall Time	tR, tF	-	-	20	
	E Pulse Width (High, Low)	tw	230	-	-	
	R/W and RS Setup Time	tsu1	40	-	-	
	R/W and RS Hold Time	tH1	10	-	-	
	Data Setup Time	tsu2	80	-	-	
	Data Hold Time	tH2	10	-	-	
Read Mode	E Cycle Time	tc	500	-	-	ns
	E Rise/Fall Time	tR, tF	-	-	20	
	E Pulse Width (High, Low)	tw	230	-	-	
	R/W and RS Setup Time	tsu	40	-	-	
	R/W and RS Hold Time	tH	10	-	-	
	Data Output Delay Time	tD	-	-	120	
	Data Hold Time	tDH	5	-	-	



Read Mode Timing Diagram

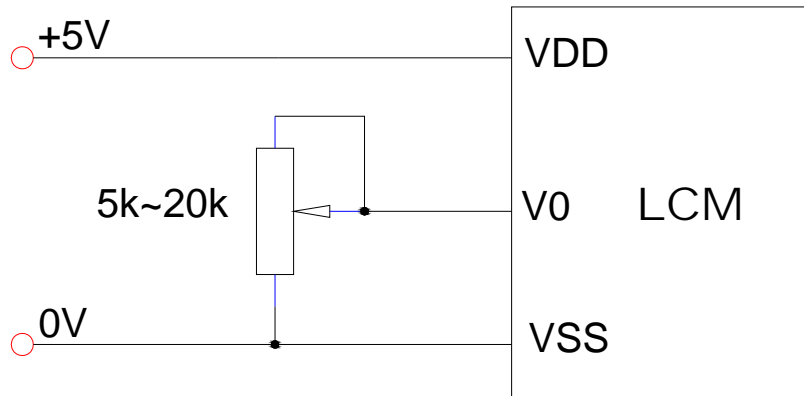


Write Mode Timing Diagram

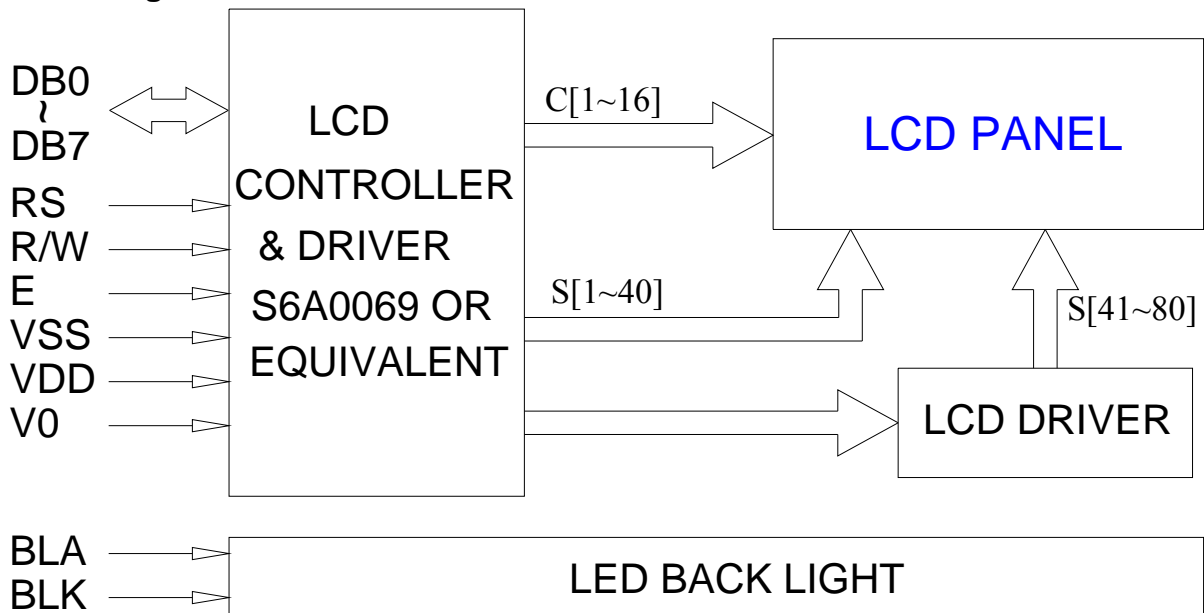
5. Operating Principles

Pin NO.	Symbol	LEVEL	Function
1	VSS	0V	GND
2	VDD	5V	Supply Power for logic
3	V0	-	VLCD voltage adjustment pin
4	RS	H/L	Data or Instruction select.
5	R/W	H/L	Read or Write
6	E	H, H→L	Read /Write enable signal.
7~10	DB0~DB3	H/L	Data BUS for 8-bit bus mode
11~14	DB4~DB7	H/L	Data BUS for 8-bit or 4bit bus mode
15	BLA	+5.0V	Supply Power for LED light
16	BLK	0V	Supply Power for LED light

5.2) Power supply for LCD Module



5.3) Block Diagram



6. Instruction Description

Instruction	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Description	Execution time (f _{soc} =270K)
Clear Display	0	0	0	0	0	0	0	0	0	1	Write "20H" to DDRAM. and set DDRAM address to "00H" from AC	1.53 mS
Return Home	0	0	0	0	0	0	0	0	1	X	Set DDRAM address to "00H" from AC and return cursor to its original position if shifted. The contents of DDRAM are not changed.	1.53 mS
Entry Mode Set	0	0	0	0	0	0	0	1	I/D	S H	Assign cursor moving direction and make shift of entire display enable.	39 uS
Display ON/OFF Control	0	0	0	0	0	0	1	D	C	B	Set display (D), cursor (C), and blinking of cursor (B) on/off control bit.	39 uS
Cursor or Display Shift	0	0	0	0	0	1	S / C	R / L	X	X	Set cursor moving and display shift control bit, and the direction, without changing DDRAM data.	39 uS
Function Set	0	0	0	0	1	DL	N	F	X	X	DL: Set interface Data Length DL =1: 8-bit; DL =0: 4-bit; N: Numbers of display line N =1: 2-line; N =0 1-line F: Display Font type F=0 : 5 × 8 dots; F=1: 5 × 11 dots	39 uS
Set CGRAM Address	0	0	0	1	A C 5	A C 4	A C 3	A C 2	A C 1	A C 0	Set CGRAM address in address counter.	39 uS
Set DDRAM Address	0	0	1	A C 6	A C 5	A C 4	A C 3	A C 2	A C 1	A C 0	Set DDRAM address in address counter.	39 uS
Read Busy Flag and Address	0	0	B F	A C 6	A C 5	A C 4	A C 3	A C 2	A C 1	A C 0	Whether during internal operation or not can be known by reading BF. The contents of address counter can also be read.	0uS
Write Data to RAM	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Write data into internal RAM (DDRAM/CGRAM).	43uS
Read Data From RAM	0	1	D7	D6	D5	D4	D3	D2	D1	D0	Read data from internal RAM (DDRAM/CGRAM).	43uS

NOTE: When an MPU program with checking the Busy Flag (DB7) is made, it must be necessary 1/2 f_{soc} is necessary for executing the next instruction by the falling edge of the 'E' signal after the Busy Flag (DB7) goes to "LOW".



Clear Display

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	0	0	0	0	1

It clears the whole display and sets display data RAM's address 0 in address counter.

Return Home

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	0	0	0	1	X

X: Do not care (0 or 1)

It sets display data RAM's address 0 in address counter and display returns to its original position. The cursor or blink goes to the left edge of the display (to the 1st line if 2 lines are displayed). The contents of the Display Data RAM do not change.

Entry Mode Set

During writing and reading data, it sets cursor move direction and shifts the display.

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	0	0	1	I/D	SH

I / D = 1: Increment, I / D = 0: Decrement. S = 1: The display shift, S = 0: The display does not shift

SH= 1	I/D= 1	It shifts the display to the left
SH= 1	I/D=0	It shifts the display to the right

Display On/Off Control

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	0	1	D	C	B

D = 1: Display on, D = 0: Display off; C = 1: Cursor on , C = 0: Cursor off

B = 1: Blinks on, B= 0: Blinks off;

Cursor or Display Shift

Without changing DD RAM's dater, it can move cursor and shift display

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	1	S/C	R/L	X	X

S/C	R/L	Description	Address Counter
0	0	Shift cursor to the left	AC = AC - 1
0	1	Shift cursor to the right	AC = AC + 1
1	0	Shift display to the left. Cursor follows the display shift	AC=AC
1	1	Shift display to the right. Cursor follows the display shift	AC=AC

Function Set

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	1	DL	N	F	X	X

X: Do not care (0 or 1)

DL : It sets interface data length.

DL = 1: Datas are transferred with 8-bit lengths (DB7 - DB0).

DL = 0: Datas are transferred with 4-bit lengths (DB7 - DB4). (It needs two times to transfer datas)

N: It sets the number of the display line.

N = 0: One-line display.

N = 1: Two-line display.

F: It sets the character font

F = 0: 5 x 7 dots character font.

F = 1: 5 x 10 dots character font

N	F	No. of Display Lines	Character Font	Duty Factor
0	0	1	5X7 dots	1 /8
0	1	1	5x 10 dots	1 /11
1	X	2	5x7 dots	1 /16

Set Character Generator RAM Address

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0

It sets character generator RAM address AC[5:0] to the address counter. Character generator RAM data can read or write after this setting.

Set Display Data RAM Address

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0

It sets display data RAM address AC[6:0] to the address counter.

Display data RAM can read or write after this setting.

In one-line display (N = 0), AC[6:0]=00H~4FH;

In two-line display (N = 1), AC[6:0]= 00H~27H, for the first line,
AC[6:0]= 40H~67H, for the second line.

Read Busy Flag and Address

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	1	BF	AC6	AC5	AC4	AC3	AC2	AC1	AC0

When (BF = 1) indicates that the system is busy now, it will not accept any instruction until no Busy (BF = 0). At the same time, the address counter content's AC[6:0] is read out

Write Data to Character Generator RAM or Display Data RAM

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
1	0	D7	D6	D5	D4	D3	D2	D1	D0

It writes data D[7:0] to character generator RAM or display data RAM.

Read Data from Character Generator RAM or Display Data RAM

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
1	1	D7	D6	D5	D4	D3	D2	D1	D0

It reads data D[7:0] from character generator RAM or display data RAM. To get the correct data readout is shown below:

- Set the address of the character generator RAM or display data RAM or shift the cursor instruction.
- Send the "Read" instruction.

Display Character address code:

Display position		1	2	3	4	5~12	13	14	15	16
DDRAM Address (HEX)	1 Line	00	01	02	03	04~0B	0C	0D	0E	0F
	2 Line	40	41	42	43	44~4B	4C	4D	4E	4F

Relationship between Character Code (DDRAM) and character Pattern (CGRAM)

Character code DD RAM Data								CG RAM Address						Character Pattern CG RAM Data								Pattern Number
D7	D6	D5	D4	D3	D2	D1	D0	A5	A4	A3	A2	A1	A0	D7	D6	D5	D4	D3	D2	D1	D0	
0	0	0	0	X	0	0	0	0	0	0	0	0	0	X	X	X	0	1	1	1	0	Pattern 1
								0	0	0	0	0	1	X	X	X	1	0	0	0	1	
								0	0	0	0	1	0	X	X	X	1	0	0	0	1	
								0	0	0	0	1	1	X	X	X	1	1	1	1	1	
								0	0	0	1	0	0	X	X	X	1	0	0	0	1	
								0	0	0	1	0	1	X	X	X	1	0	0	0	1	
								0	0	0	1	1	0	X	X	X	1	0	0	0	1	
								0	0	0	1	1	1	X	X	X	0	0	0	0	0	
...	
0	0	0	0	X	1	1	1	1	1	1	0	0	0	X	X	X	0	0	0	0	0	Pattern 8
								1	1	1	0	0	1	X	X	X	1	0	0	0	1	
								1	1	1	0	1	0	X	X	X	1	0	0	0	1	
								1	1	1	0	1	1	X	X	X	1	1	1	1	1	
								1	1	1	1	0	0	X	X	X	1	0	0	0	1	
								1	1	1	1	0	1	X	X	X	1	0	0	0	1	
								1	1	1	1	1	0	X	X	X	1	0	0	0	1	
								1	1	1	1	1	1	X	X	X	0	0	0	0	0	

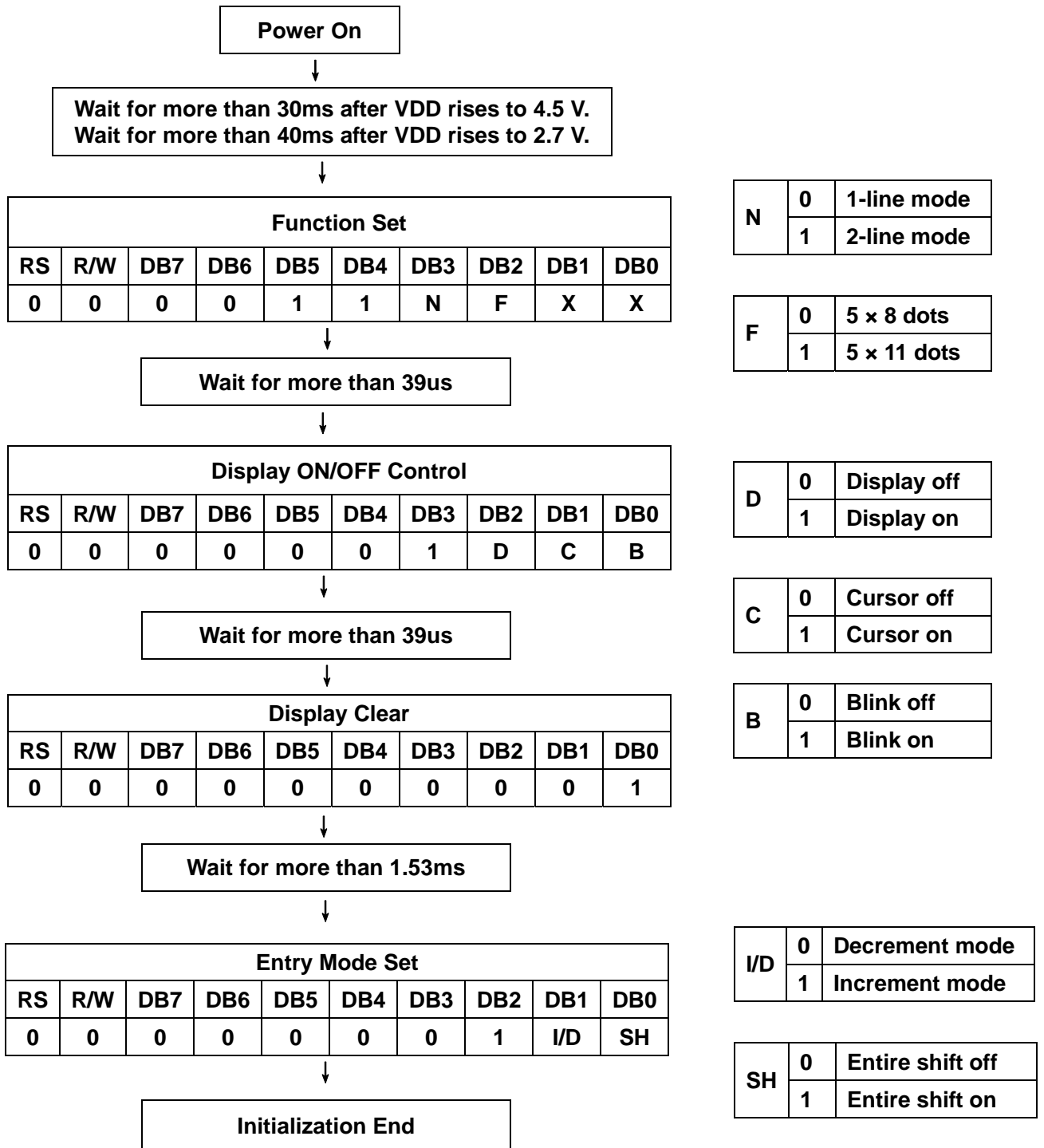
NOTES:

1. these areas are not used for display, but can be used for the general data RAM.
2. Character code bits D[2:0] correspond to CGRAM address A[5: 3] (3 bits: 8 types).
3. Character pattern row positions correspond to CGRAM data bits D[4:0] (D4 being at the left)..
4. " 1 ": Selected, " 0 ": No selected, " X": Do not care (0 or 1).
5. The 8th line is the cursor position and display is formed by logical OR with the cursor

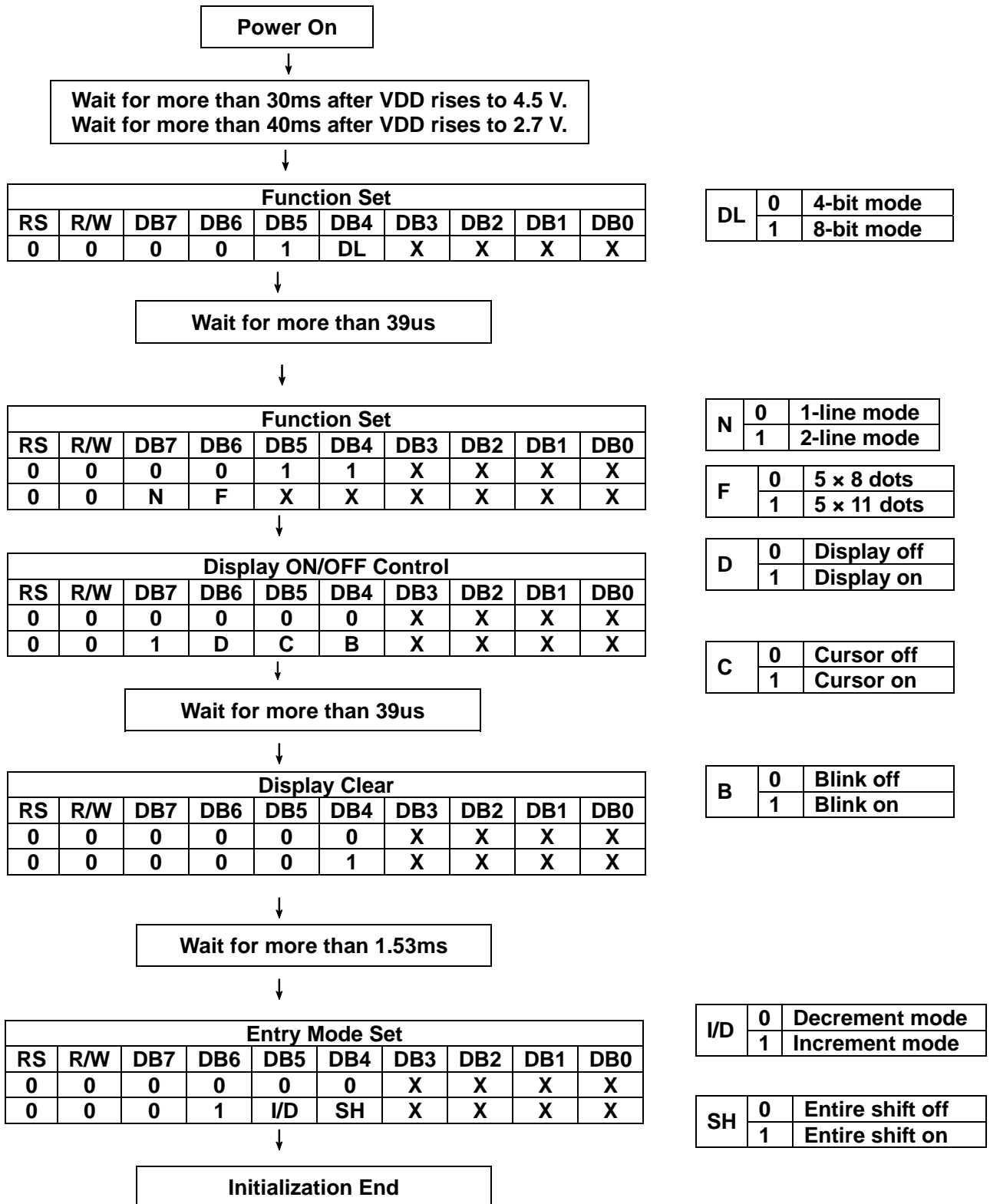
CGROM Character Code Table: (English & Japanese)

Upper 4bit Lower 4bit	LLLL	LLLH	LLHL	LLHH	LHLL	LHLH	LHHL	LHHH	HLLL	HLLH	HLHL	HLHH	HHLL	HHLH	HHHL	HHHH
LLLL	CG RAM (1)															
LLLH	(2)															
LLHL	(3)															
LLHH	(4)															
LHLL	(5)															
LHLH	(6)															
LHHL	(7)															
LHHH	(8)															
HLLL	(1)															
HLLH	(2)															
HLHL	(3)															
HLHH	(4)															
HHLL	(5)															
HHLH	(6)															
HHHL	(7)															
HHHH	(8)															

Initializing by Instruction (8-bit mode)



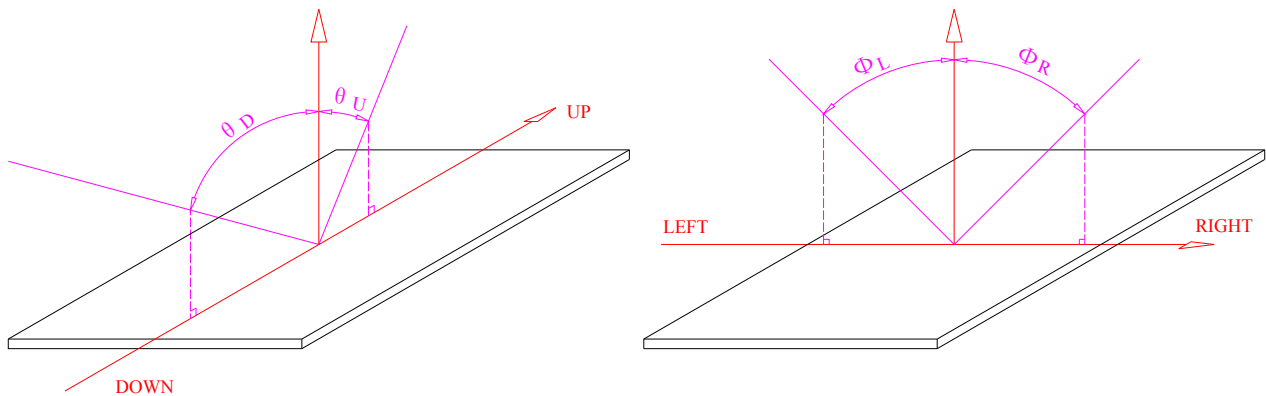
Initializing by Instruction (4-bit mode)



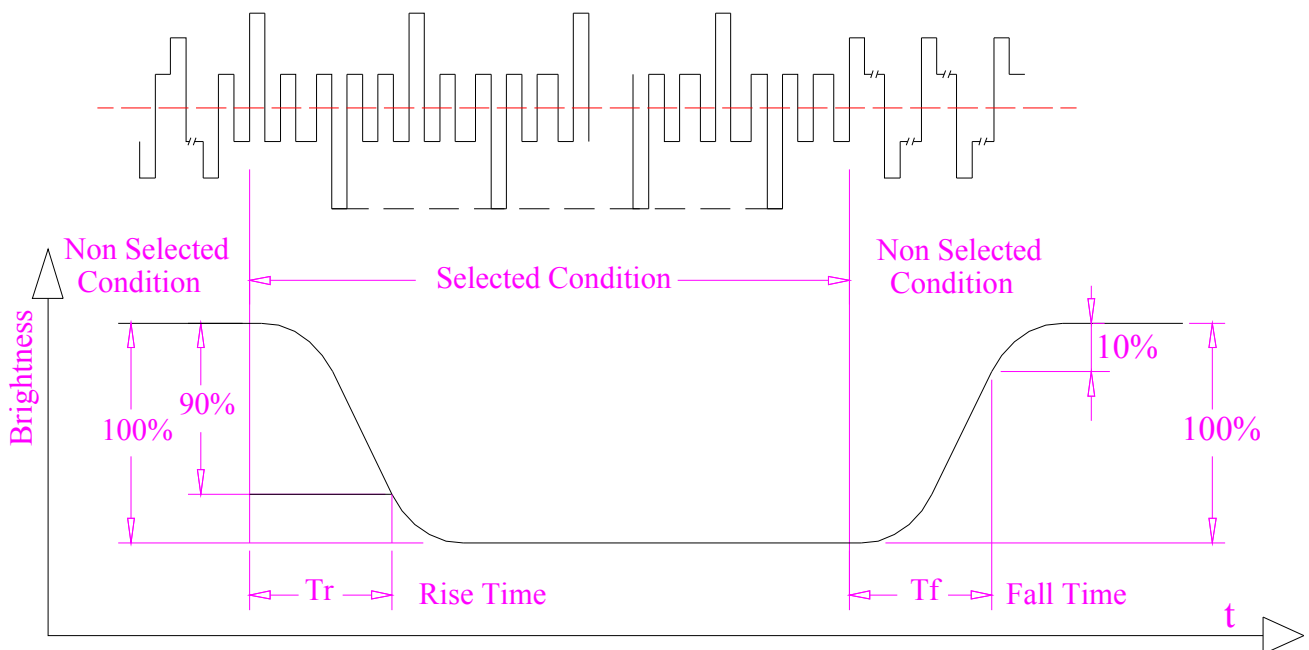
7. Electro-optical Units

Electro-optical Characteristics

Item	Symbol	Test Condition	Standard Value			Unit
			Min.	Typ.	Max.	
Viewing Angle	θU	CR=2		10		degree
	θD			40		degree
	ΦL			30		degree
	ΦR			30		degree
Response Time (rise)	Tr	Ta=25°C	-		300	ms
Response Time (fall)	Tf	Ta=25°C	-		300	ms



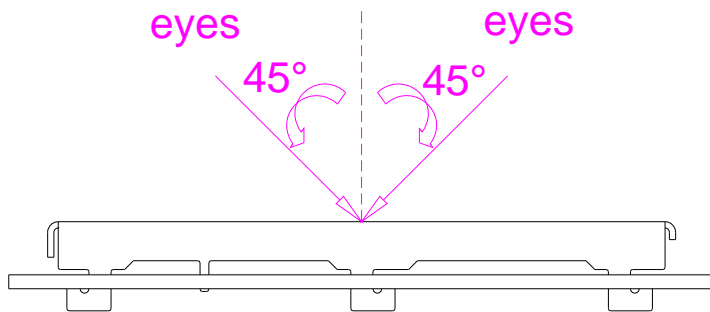
Viewing Angle



$$CR = \frac{\text{Brightness of Non-selected Segment}}{\text{Brightness of Selected Segment}}$$

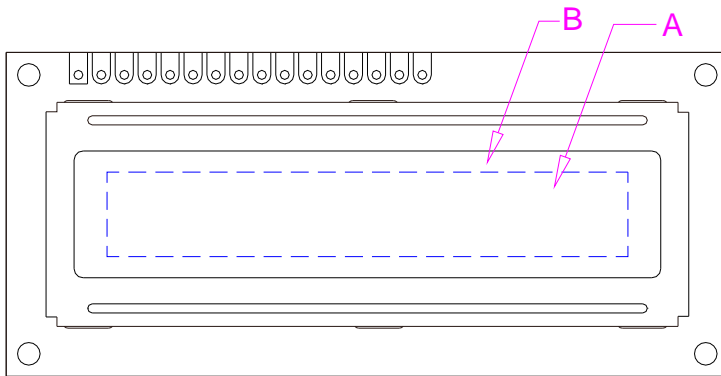
8. Inspection criteria

8.1. Inspection conditions



The LCD shall be inspected under 40W white fluorescent light.
 The distance between the eyes and the sample shall be more than 30cm.
 The test direction is based on about around 45 degree of vertical line

Definition of applicable Zones



A: Active display area

B: Area from outside of "A Zone" to validity viewing area

A + B = Validity viewing area

b). Sampling procedures for each item's acceptance level table

Defect type	Sampling procedures	AQL
Major defect	M1L-STD-105D inspection level I Normal inspection single sample inspection	1,0
Minor defect	M1L-STD-105D Inspection level I Normal inspection single sample inspection	2.5

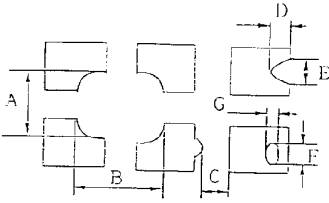
c) ①. Major defect

A major defect refers to a defect which is not considered to substantially degrade usability for product applications.

②. Minor defect

A minor defect refers to a defect which is not considered to substantially degrade product application, or a defect which deviates from existing Standards almost unrelated to the effective use of the product or its operation.

d). Incoming Inspection standards

ITEM	Criterion for defects	Defect type
1.Display inspection on	(1) Non display (2) Vertical Line is deficient (3) Horizontal line is deficient (4) Cross line is deficient	Minor
2.Black/White spot	Size ϕ (mm) Acceptable number $\phi \leq 0.25$ Ignore (note) $0.25 < \phi \leq 0.35$ 3 $0.35 < \phi$ 0 Note: NG is four or more spot crowd together	Minor
3.Black/White line	Length (mm) width (mm) : Acceptable number $L < 10$ $w < 0.05$ Ignore $L < 10$ $0.05 < w < 0.10$ 1 $L < 10$ $0.10 \leq W$ 0 $L > 10$ $w < 0.05$ 0 Defects separate at interval if 30mm each other	Minor
4.Display inspection on	 <p> $(A+B)/2 \leq 0.3$ $0 < C$ $(D+E)/2 \leq 0.15$ $(F+G)/2 \leq 0.15$ </p> <p>NOTE: 1) Up to 5 damages acceptable 2) NG if there're two or more pinholes</p>	Minor
5) Spot-like contrast irregularity	Size ϕ (mm) Acceptable number $\phi \leq 0.2$ Ignore (note) $0.2 < \phi \leq 0.4$ 3 $0.4 < \phi \leq 0.6$ 2 $0.6 < \phi$ 0 NOTE: 1) conformed to limit samples 2) Defects separate at intervals of 50mm each other	Minor
6) Bubble in polarizer	Size ϕ (mm) Acceptable number $\phi \leq 0.2$ Ignore (note) $0.2 < \phi \leq 0.4$ 3 $0.4 < \phi \leq 0.6$ 2 $0.6 < \phi$ 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 3).Black/White line	Minor
8.) Stains on LCD panel surface	Stains which cannot be removed even when wiped lightly with a soft cloth or similar cleaning too.	Minor
9) Rainbow color	No rainbow color is allowed in the optimum contrast on Stale within the active area	Minor
10) Threshold	Non-uniform brightness at optimum contrast is not allowed and the criterion abides by standard samples	Minor
11) Viewing area encroachment	Polarizer edge or line is visible in the opening viewing area due to polarizer shortness or sealing line.	Minor
12) Bezel appearance	Rust and deep damage which are visible in the bezel is reject able	Minor
13) Defect of land surface contact (Poor soldering)	Evident crevices which is visible are reject able	Minor

ITEM	Criterion for defects	Defect type
14) Parts mounting	(1) Failure to mount parts (2) Parts not in the specifications are mounted (3) Polarity, for example, is reversed	Major
15) Parts alignment	(1) LSI. IC lead width is more than 50% beyond pad outline. (2) Chip component is off center and more than 50% of the leads s off the pad outline	Minor Minor
16) Conductive foreign matter	(1) $0.45 < \varnothing, N \geq 1$ (2) $0.30 < \varnothing \leq 0.45, N \geq 1$ \varnothing : Average diameter of solder ball (unit: mm) (3) $0.50 < L, N \geq 1$ L: Average length of solder chip (unit: mm)	Major Minor Minor
17) PWB 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
18) Faulty PWB correction	(1) Due to PWB copper foil pattern burnout, the pattern is connected, using a jumper wire for repair; 2 or more places are corrected per PWB. (2) Short circuited part is cut, and no resist coating has been performed.	Minor Minor
19) Bezel claw	Bezel claw missing or not bent	Minor
20) Indication of 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

9. Precautions for using LCD modules

a) Handling of LCM

- (1) The LCD screen is made of glass. Don't give excessive external shock, or drop from a high place.
- (2) If the LCD screen is damaged and the liquid crystal leaks out, do not lick and swallow. When the liquid is attach to your hand, skin, cloth etc, wash it off by using soap and water thoroughly and immediately.
- (3) Don't apply excessive force on the surface of the LCM.
- (4) If the surface is contaminated ,clean it with soft cloth. If the LCM is severely contaminated , use Isopropyl alcohol/Ethyl alcohol to clean. Other solvents may damage the polarizer . The following solvents is especially prohibited: water , ketone Aromatic solvents etc.
- (5) Exercise care to minimize corrosion of the electrode. Corrosion of the electrodes is accelerated by water droplets, moisture condensation or a current flow in a high-humidity environment.
- (6) Install the LCD Module by using the mounting holes. When mounting the LCD module make sure it is free of twisting, warping and distortion. In particular, do not forcibly pull or bend the I/O cable or the backlight cable.
- (7) Don't disassemble the LCM.
- (8) 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 modules.
 - Tools required for assembling, such as soldering irons, must be properly grounded.
 - To reduce the amount of static electricity generated, do not conduct assembling 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.
- (9) Do not alter, modify or change the the shape of the tab on the metal frame.
- (10) Do not make extra holes on the printed circuit board, modify its shape or change the positions of components to be attached.
- (11) Do not damage or modify the pattern writing on the printed circuit board.
- (12) Absolutely do not modify the zebra rubber strip (conductive rubber) or heat seal connector
- (13) Except for soldering the interface, do not make any alterations or modifications with a soldering iron.
- (14) Do not drop, bend or twist LCM.

b) Storage

- (1) Store in an ambient temperature of 5 to 45 °C, and in a relative humidity of 40% to 60%. Don't expose to sunlight or fluorescent light.
- (2) Storage in a clean environment, free from dust, active gas, and solvent.
- (3) Store in antistatic container.