MODEL No: 24064FLW

Record of Revision

Date	Revision No.	Summary
2011-03-25	1.0	Rev 1.0 was issued

Record of Revision

1. Scope

The 24064FLW LCM unit consists of 240x64 dots-matrix LCD, and RA6963 which incorporates LCD controller and other common/segment driver.
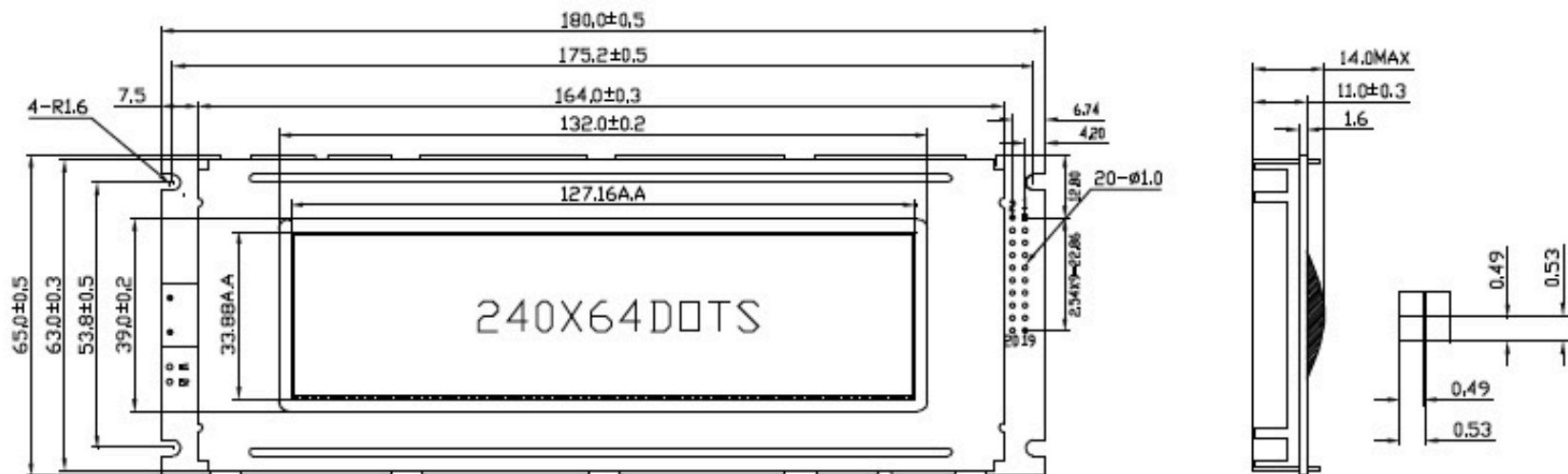
2. Application

Digital equipments which need display, instrumentation, remote control, electronic product.

3. General Information

Item	Contents	Unit
LCD Type	FSTN	
Polarizer Type	Transflective / Positive	
Viewing Direction	12:00	
Interface	8080 Parallel	
Number of Dots/ characters	240X 64 DOTS	
Dot size (W×H)	0.49X0.49	mm
Dot Pitch (W×H)	0.53X0.53	mm
Active Area	127.16×33.88	mm
Outline Dimension (W x H x D)	180.0×65.0×14.0	mm
LCD Controller & Driver	RA6963	
LCD Driving Method	1/128 Duty, 1/9 Bias	
Backlight Type	LED	
Backlight Color	White	
Operating Temperature	-20℃~+70℃	
Storage Temperature	-30℃~＋80℃	

180.0±0.5
175.2±0.5
164.0±0.3
132.0±0.2
127.16A.A

4-R1.6
7.5

14.0MAX
11.0±0.3
1.6
6.74
4.20
20-ø1.0

65.0±0.5
63.0±0.3
53.8±0.5
39.0±0.2
33.88A.A

240X64DOTS

2.54×9=22.86

0.49
0.53
0.49
0.53
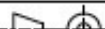
Pin no	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Symbol	FG	VSS	VDD	V0	/WR	/RD	/CE	C/D	NC	/RESET	DB0	DB1	DB2	DB3	DB4	DB5	DB6	DB7	FS	VEE

Notes:

1. Display Type : FSTN
2. Controller IC: TBD
3. Operating Temp:-20° C---+70° C
4. Storage Temp:-30° C---+80° C
5. Viewing Direction:12 clock
6. Polarizer: Transflective
7. Duty:1/128,Bias:1/9
8. BL Color:White

DRAWN BY:	TITLE: 24064FLW	
CHECKED BY:		SCALE:
APPROVED BY:	DWG NO:	UNIT: mm
CONFIRMED BY:	DWG NAME:	SHEET NO: 0F

5. Interface signals

Pin no	Symbol	Level	Function
1	FG	0V	Frame ground
2	VSS	0V	Ground
3	VDD	5.0V	Supply voltage for logic
4	V0	-	Operating voltage for LCD drive
5	/WR	L	Write signal
6	/RD	L	Read signal
7	/CE	L	Chip enable signal
8	C/D	H/L	H: Instruction code L: Data
9	NC	-	No connection
10	/RESET	L	Reset signal
11	DB0	H/L	Data bit 0
12	DB1	H/L	Data bit 1
13	DB2	H/L	Data bit 2
14	DB3	H/L	Data bit 3
15	DB4	H/L	Data bit 4
16	DB5	H/L	Data bit 5
17	DB6	H/L	Data bit 6
18	DB7	H/L	Data bit 7
19	FS	H/L	Font select signal (H:5X8 dots; L:8X8 dots)
20	VEE	-18V	
E11	BLK	0V	LED Backlight
E12	BLA	5.0V	LED Backlight

6. Absolute maximum Ratings

6.1. Electrical Absolute max. ratings

Parameter	Symbol	MIN	MAX	Unit	Remark
Supply Voltage For Logic	VDD - VSS	-0.3	7.0	V	
Input Voltage	VI	-0.3	VDD+0.3	V	

6.2. Environment Conditions

Item	Symbol	MIN	MAX	Unit	Remark
Operating Temperature	TOPR	-20	70	℃	
Storage Temperature	TSTG	-30	80	℃	

7. Electrical Specifications

7.1 Electrical characteristics

Item	Symbol	Standard Value			Unit	Remark
		min	typ	max		
Supply voltage(Logic)	VDD-VSS	4.75	5	5.25	V	
Supply current	IDD	14	17	19	mA	
	IO	-	3	5	mA	
Input high voltage	VIH	0.8VDD	-	VDD	V	
Input low voltage	VIL	0	-	0.2VDD	V	
Input Pull Up Resistance	RPU	50	100	300	KΩ	
Operating Frequency	fOSC	0.4	0.75	--	MHZ	

7.2 Backlight

Item	Symbol	MIN	TYP	MAX	Unit	Remark
Forward Current	IF	-	100	-	mA	

7.3 Block Diagram
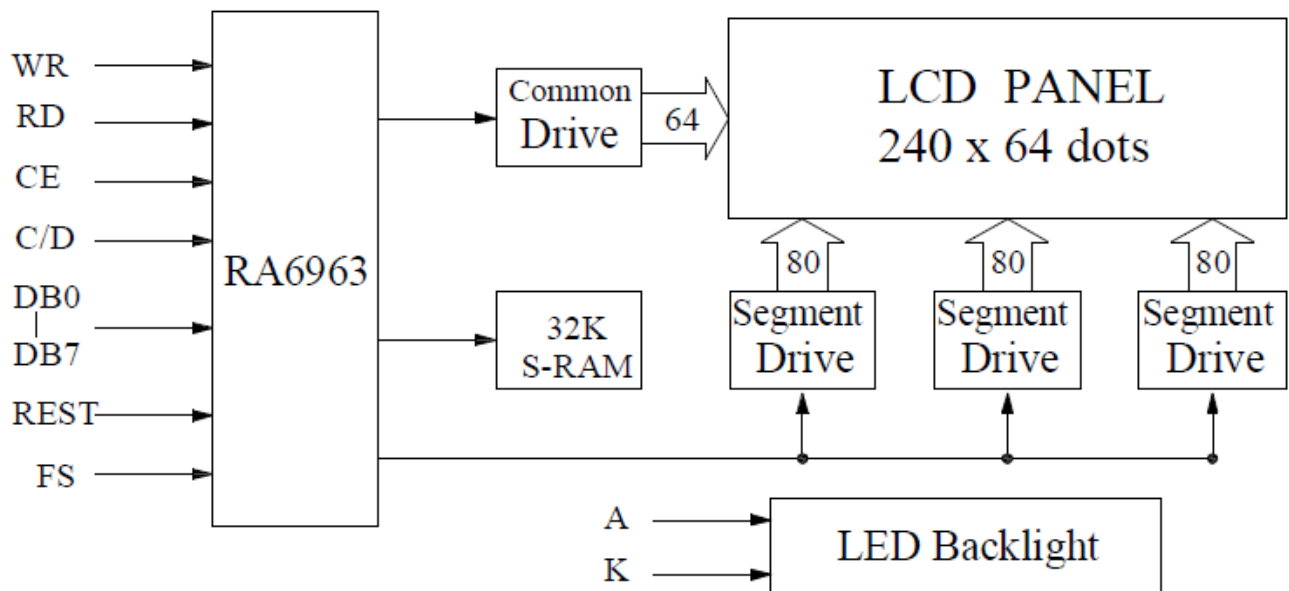
# 8. Command/AC Timing

8.1 IC instruction and Command

RA6963 is LCD controller designed to be used for control LCD driver LCD driver LSIs and display data Memory, It has an 8 bit parallel data bus and control lines for reading or writing through a MPU I/F. It has 128 words character generator ROM with the capability to control External display RAM of up to 128K bytes. Allocation of text, graphics and external generator RAM can be easily made and the display window can be freely moved within the allocated memory range. It supports a very board range of LCD formats by selecting different combinations on a set of programmable inputs. It can be used in text, graphic Modes and has various attribute functions.

COMMAND	CODE	D1	D2	FUNCTION
Register Set	00100001	X address	Y address	Cursor pointer set
	00100010	Data	00H	Off register
	00100100	Low address	High address	Address pointer set
Control Word set	01000000	Low address	High address	Text home address set
	01000001	Columns	00H	Text area set
	01000010	Low address	High address	Graphic home address set
	01000011	Columns	00H	Graphic area set
Mode set	1000x000	−	−	"OR" mode
	1000x001	−	−	"EXOR" mode
	1000x011	−	−	"AND" mode
	1000x100	−	−	"Text attribute" mode
	10000xxx	−	−	Internal CGROM mode
	10001xxx	−	−	External CGRAM mode
Display Mode	10010000	−	−	Display off
	1001xx10	−	−	Cursor on, blink off
	1001xx11	−	−	Cursor on, blink on
	100101xx	−	−	Text on, graphic off
	100110xx	−	−	Text off, graphic on
	100111xx	−	−	Text on, graphic on
Cursor Pattern Select	10100000	−	−	1 line cursor
	10100001	−	−	2 line cursor
	10100010	−	−	3 line cursor
	10100011	−	−	4 line cursor
	10100100	−	−	5 line cursor
	10100101	−	−	6 line cursor
	10100110	−	−	7 line cursor
	10100111	−	−	8 line cursor
Data auto Read/write	10110000	−	−	Data auto write set
	10110001	−	−	Data auto read set
	10110010	−	−	Auto reset
Data read Write	11000000	Data	−	Data write and ADP increment
	11000001	−	−	Data read and ADP increment
	11000010	Data	−	Data write and ADP decrement
	11000011	−	−	Data read and ADP decrement
	11000100	Data	−	Data write and ADP no variable
	11000101	−	−	Data read and ADP no variable
Screen peek	11100000	−	−	Screen peek
Screen copy	11101000	−	−	Screen copy
Bit Set/Reset	11110XX	−	−	Bit reset
	11111XXX	−	−	Bit set
	1111X000	−	−	Bit 0（LSB）
	1111X001	−	−	Bit 1
	1111X010	−	−	Bit 2
	1111X011	−	−	Bit 3
	1111X100	−	−	Bit 4
	1111X101	−	−	Bit 5
	1111X110	−	−	Bit 6
	1111X111	−	−	Bit 7（MSB）

8.2 TIMING CHARACTERISICS

Condition: VDD=+5.0V±10%, Ta=-10°C +70°C)

Item	Symbol	Min	Max	Unit
Operating frequency	Fscp	-	9	MHZ
SCP pulse width	Tcwh, Tcwl	150		ns
SCP rise/fall time	Tr	-	30	ns
LP set up time	Tlsu	150	290	ns
LP hold time	Tlhd	5	40	ns
Data set up time	Tdsu	170	-	ns
Data hold time	Tdhd	80	-	ns
FR delay time	Td	0	90	ns
CDATA set up time	Tcsu	450	850	ns
CDATA hold time	Tchd	450	950	ns
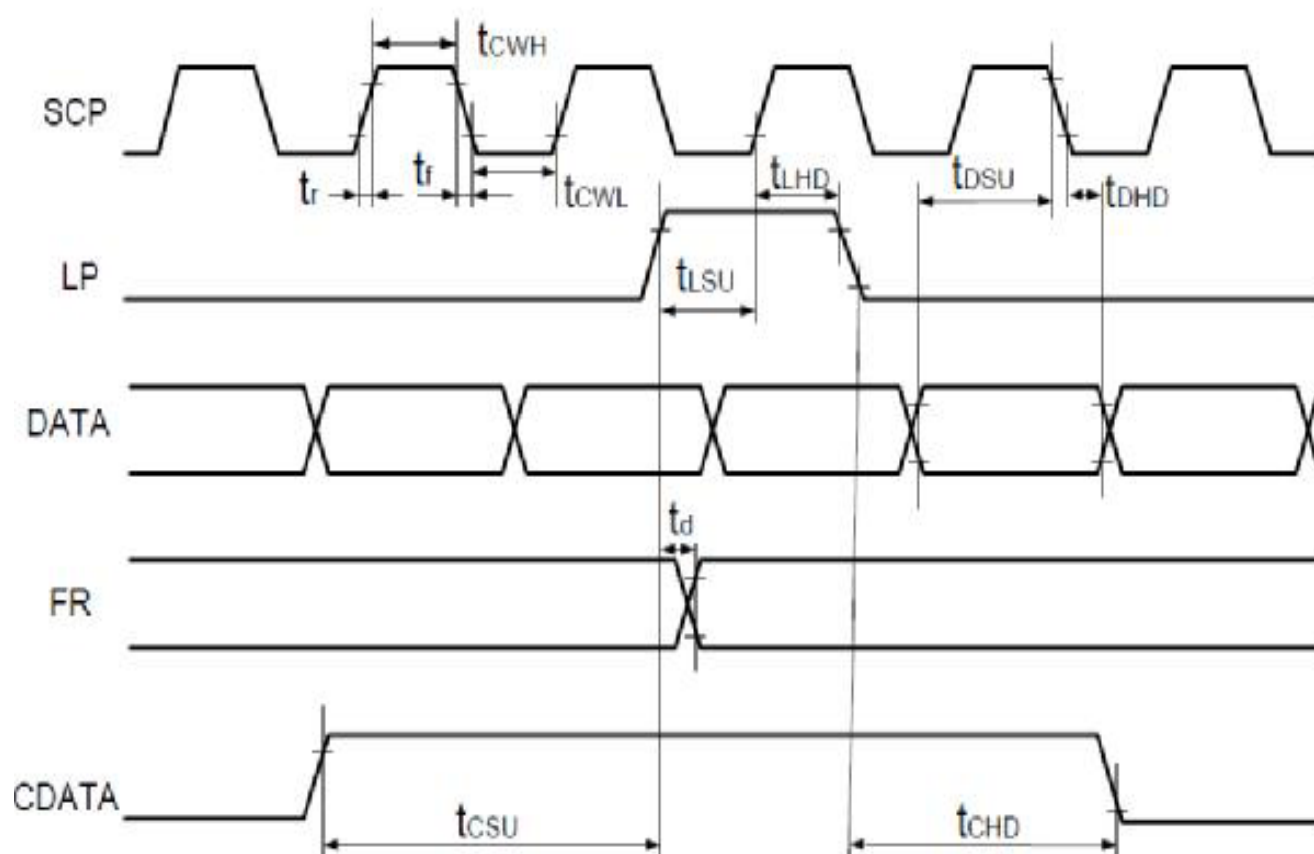
8.3 INTERFACE TIMING

Item	Symbol	Min	Max	Unit
C/D set up time	Tcds	100	-	ns
C/D hold time	Tcdh	10	-	ns
CE,RD,WR pulse width	Tce,Trd,Twr	80	-	ns
DATA set up time	Tds	80	-	ns
DATA hold time	Tdh	40	-	ns
Access time	Tacc	-	150	ns
Output hold time	Toh	10	50	ns
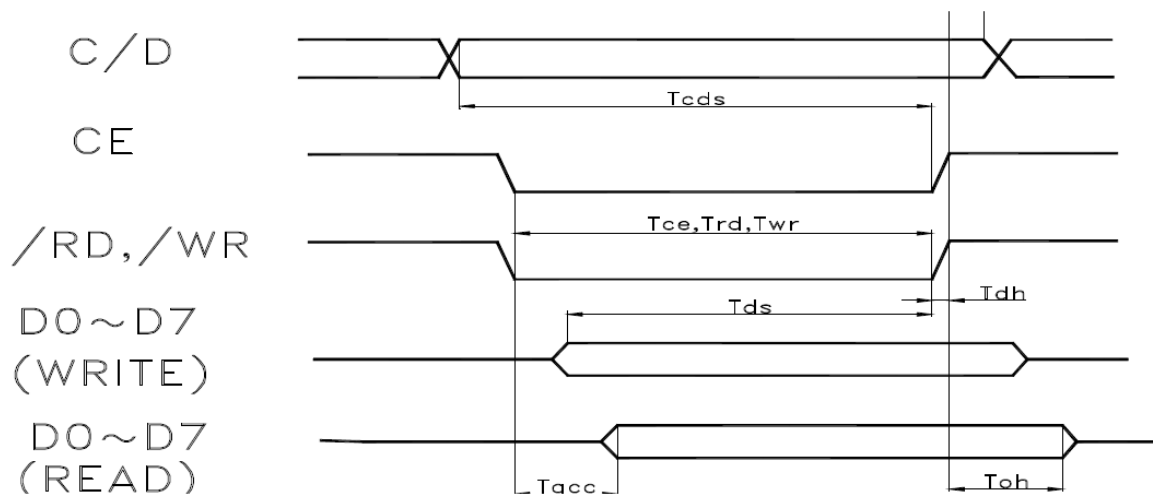
8.4 STATUS READ

Before sending data (read/write), command, it is necessary to check the Status.
Status check

Status of T6963c can read from data lines.

/RD   L
/WR   H
/CE   L
C/D   H
D0~D7   Status word

T6963C status word format is following

MSB   LSB

STA7	STA6	STA5	STA4	STA3	STA2	STA1	STA0
D7	D6	D5	D4	D3	D2	D1	D0

STA0	Check capability of command execution	0:Disable	1:Enable
STA1	Check capability of data read/write	0:Disable	1:Enable
STA2	Check capability of auto mode data read	0:Disable	1:Enable
STA3	Check capability of auto mode data write	0:Disable	1:Enable
STA4	Not use		
STA5	Check capability of controller operation	0:Disable	1:Enable
STA6	Error flag. Using screen peek/copy command	0:No error	1:error
STA7	Check the condition blink	0:Disable	1:Enable

Note 1: It is necessary to check STA0 and STA1 at the same time, the error Is happened by sending data at executing command.
2: The status check will be enough to check STA0/STA1.
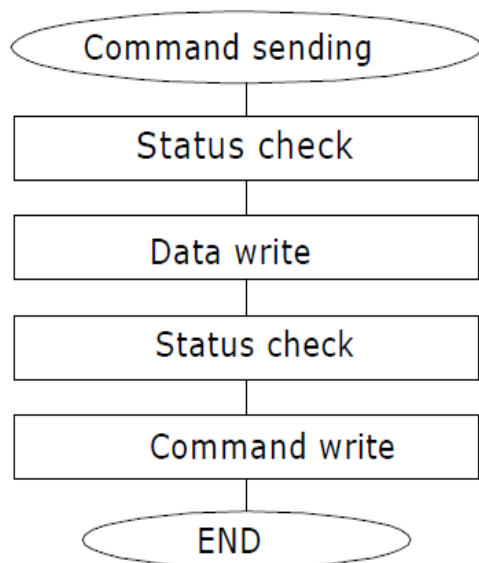3:STA2/STA3 are valid in auto mode STA0/STA1 are invalid.
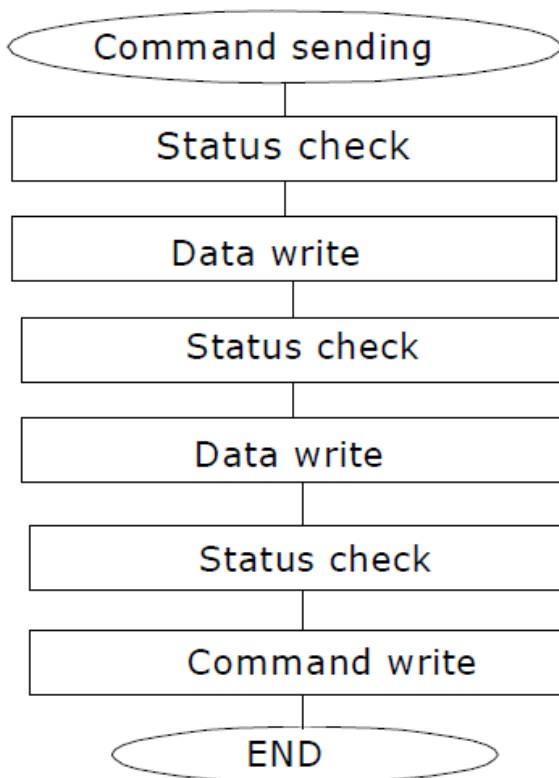
Status checking flow:
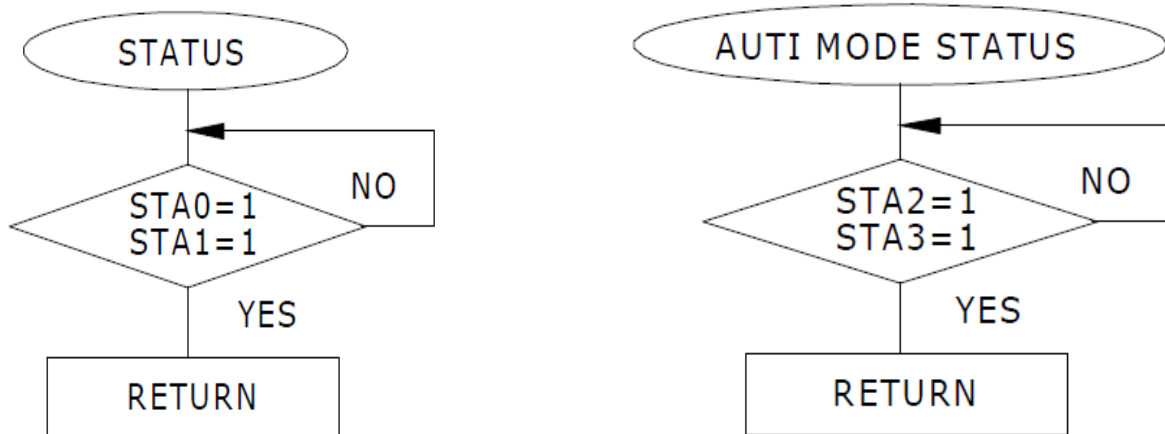
8.5 DATA SET

In T6963C, the data have been set and command executes.

The order of procedure of command sending

Note:In case of over 2 data sending,

valid).

8.6 Description of command

Register set

CODE	HEX	FUNCTION	D1	D2
00100001	21H	Cursor pointer set	X address	Y address
00100010	22H	Offset register set	Data	00H
00100100	24H	Address pointer set	Low address	High address

(1) Cursor pointer set
The position of cursor is specified by X address. The cursor position is moved only by this command. The cursor pointer doesn't have the function of increment and decrement. The shift of cursor set by this command. X address, Y address are specified following.
X address 00H - - - - 4FH (Low 7bits are valid)
Y address 00H - - - - 1FH (Low 5bits are valid)
1 Screen drive
X address 00H - - - - 4FH
Y address 00H - - - - 0FH
(2) Offset register set
The offset register is used to determine external character generator
RAM area.

T6963C has 16 bits address lines as follow:

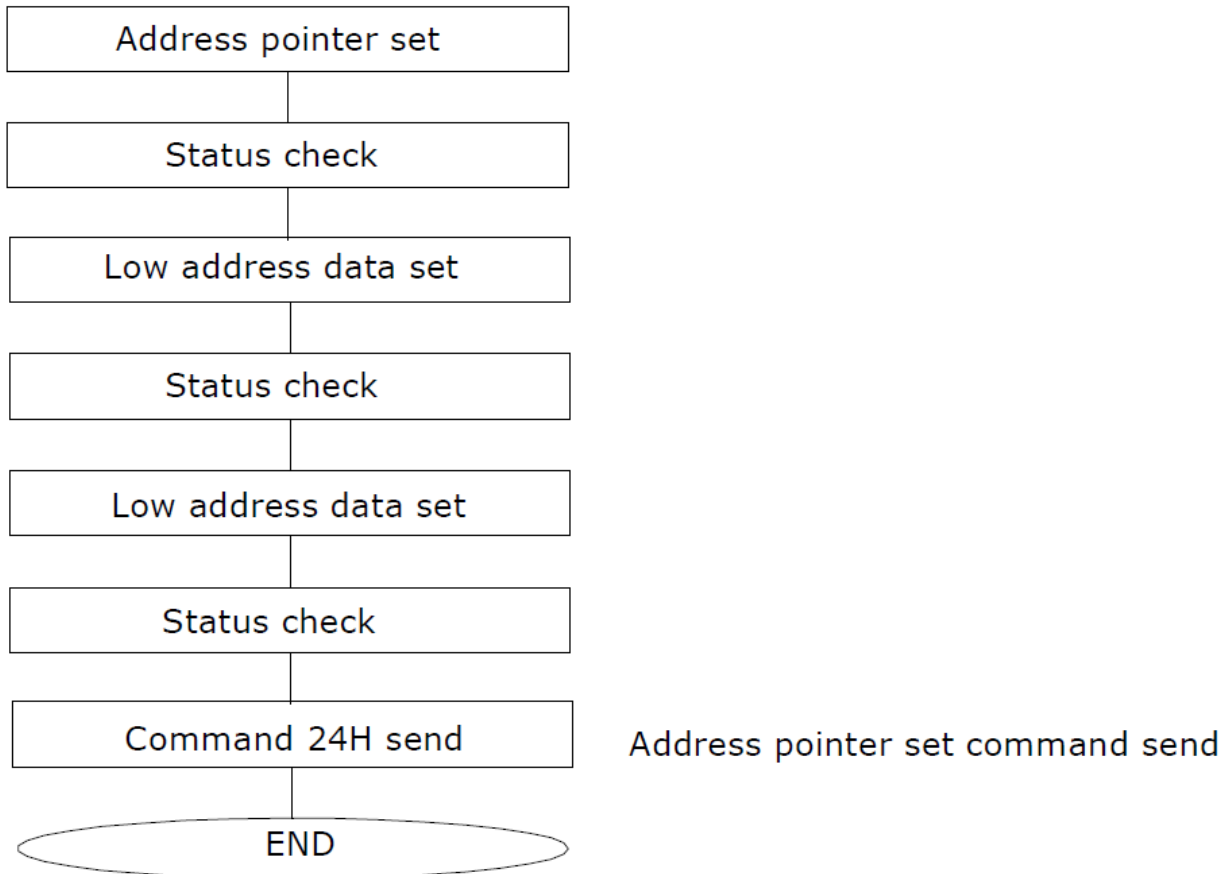MSB   LSB

| Ad15 | Ad14 | Ad13 | Ad12 | Ad11 | Ad10 | Ad9 | Ad8 | Ad7 | Ad6 | Ad5 | Ad4 | Ad3 | Ad2 | Ad1 | Ad0 |

The upper 5 bits (ad15 - ad11) are determined by offset register. The Middle 8 bits (ad10 - ad3) are determined by character code. The Lower 3 bit (ad2 - ad10) are determined by vertical counter. The Lower 5 bit of D1 (data) are valid. The data format of external character Generator RAM.

(3) Address pointer set

The address pointer set command is used to indication the start address for writing (or reading) to external RAM.

The flow chart address pointer set command

```
┌─────────────────────────────┐
│     Address pointer set      │
└─────────────────────────────┘
               │
┌─────────────────────────────┐
│        Status check          │
└─────────────────────────────┘
               │
┌─────────────────────────────┐
│     Low address data set     │
└─────────────────────────────┘
               │
┌─────────────────────────────┐
│        Status check          │
└─────────────────────────────┘
               │
┌─────────────────────────────┐
│     Low address data set     │
└─────────────────────────────┘
               │
┌─────────────────────────────┐
│        Status check          │
└─────────────────────────────┘
               │
┌─────────────────────────────┐
│      Command 24H send        │   Address pointer set command send
└─────────────────────────────┘
               │
         (     END     )
```

8.7 Control word set

CODE	HEX	FUNCTION	D1	D2
01000000	40H	Text home address set	Low address	High address
01000001	41H	Text area set	Columns	00H
01000010	42H	Graphic home address set	Low address	High address
01000011	43H	Graphic area set	Columns	00H

The home address and column size are defined by this command

(1) Text home address and area set

The starting address of external display RAM for text display is defined by this command. The text home address shows the left end and most upper position.

The relationship of external display RAM address and display position.

Example:

Text home address: 0000H
Text area: 00A0H
MD2=0, MD3=0:   80 COLUMN
DUAL=0, MDS=1, MD0=1, MD1=0:   28 LINES

Display plane:

0000H	0001H	- - - - -	004EH	004FH	1 Line
00A0H	00A1H	- - - - -	00EEH	00EFH	2 Line
: : :	: : :	: : :	: : :	: : :	
10E0H	10E1H	- - - - -	112EH	112FH	28 Lines

(2) Graphic home address and area set

The starting address of external display RAM for Graphic display is defined by this command. The graphic home address shows the left end most Upper line.

The relationship of external display RAM address and display position.

Example:

Graphic home address:	0000H
Graphic area:	0020H
MD2=H, MD3=H:	32 COLUMNS
DUAL=H, MDS=L, MD0=H, MD1=H:	2 LINES

Example:

Display plane:

0000H	0001H	- - - - -	001EH	001FH
0020H	0021H	- - - - -	003EH	003FH
: : :	: : :	: : :	: : :	: : :
01E0H	01E1H		01FEH	01FFH

8.8 MODE SET

The display mode is defined by this command. The display mode don't have changed until to send next this command. Logically "OR","EXOR',"AND" of text and graphic display can be displayed.

When internal character generator mode is selected, character code 00H - 7FH are selected from built-in character generator ROM. The character code 80H-FFH are automatically selected external character generator RAM.

NOTE: Only text display is attributed, because attributed data is located.

Attribute function

"Reverse display", "Character blink" and "Inhibit" are called "Attribute".The attribute data is written in the graphic area defined by control word set command. The mode set command selects text display only and graphic the mode set command selects text display only and graphic display cannot be displayed. The attribute data of the 1ST character in text area Is written at the IST 1 byte in graphic area, and attribute data of n-th 1byte in graphic area. Attribute function is defined as follow.
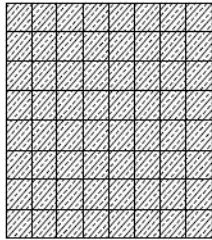
Attribute RAM 1byte

| X | X | X | X | D3 | D2 | D1 | D0 |

X: don't care

D3	D2	D1	D0	FUNCTION
0	0	0	0	Normal display
0	1	0	1	Reverse display

0	0	1	1	Inhibit display
1	0	0	0	Blink of normal display
1	1	0	0	Blink of reverse display
1	0	1	1	Blink of inhibit display
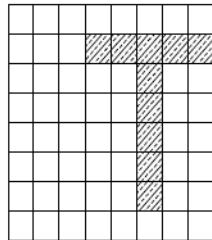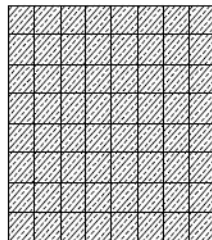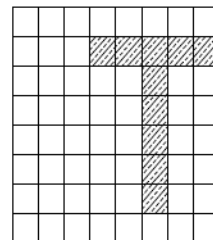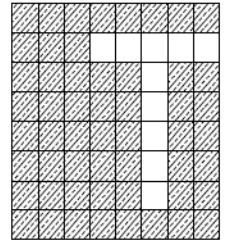
GRAPHIC   TEXT   "OR"   "AND"   "EXOR"

8.9 DATA AUTO READ/WRITE

CODE	HEX	FUNCTION	OPERAND
10110000	B0H	Data auto write set	-
10110001	B1H	Data auto read set	-
10110010	B2H	Auto reset	-

This command is convenient to send full screen data from external display RAM. After setting auto mode , "Data write(or read)" command is not necessary between each data. "Data auto write (or read)" command should follow the "Address pointer set" and address pointer is automatically increment by + 1 after each data. After sending (or receiving) all data "Auto reset" is necessary to return normal operation because all data is regarded "Display data" and no command can be accepted in the auto mode.

Note: status check for auto mode (STA2,STA3 should be checked between each Data. Auto reset should be performed after checking (STA3=1 STA2=1)
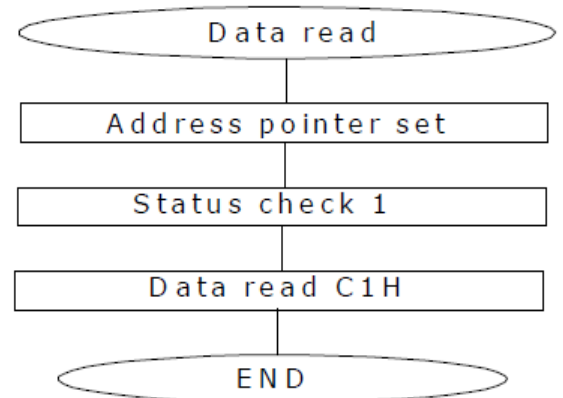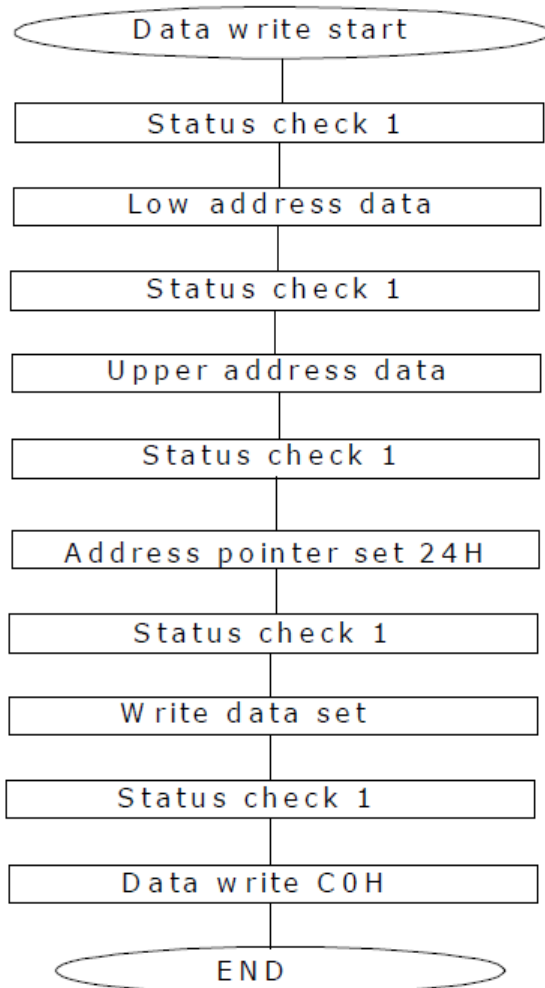
Auto mode start
Status check 1
Low address data
Status check 1
Address pointer set 24H
Status check 1

Data auto write B0H
Status check 2
Display data send
Status check 2
Display data send
Status check 2
Auto reset B2H
END
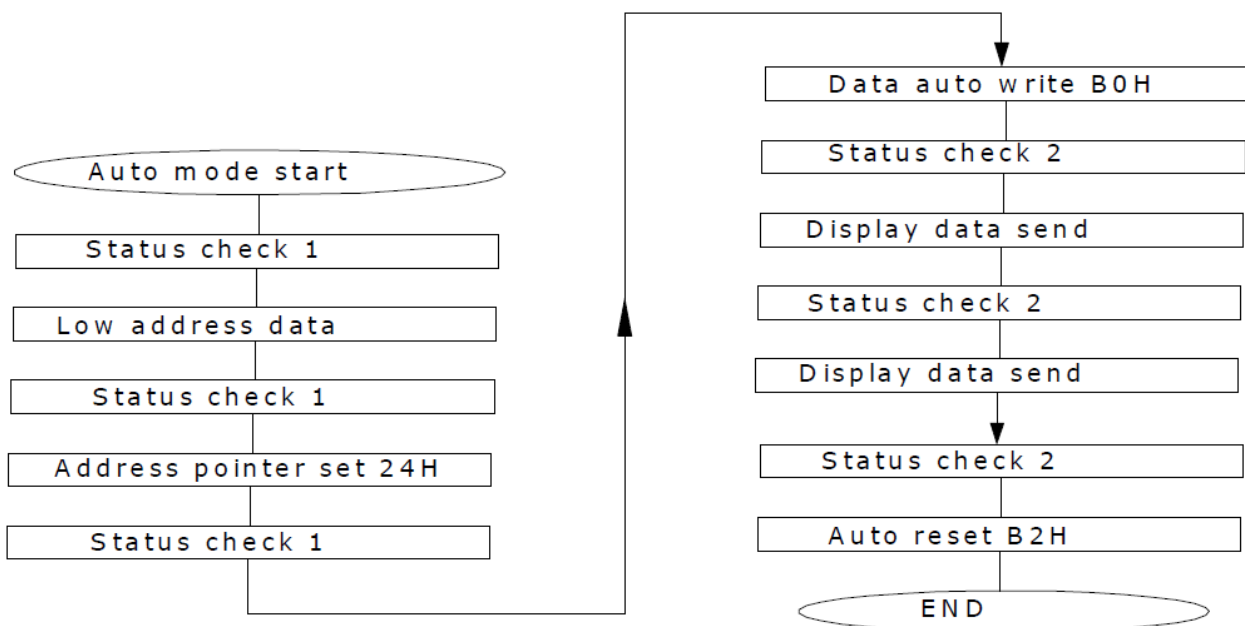
8.10 DATA READ WRITE

CODE	HEX	FUNCTION	OPERAND
11000000	C0H	Data write and ADP increment	Data
11000001	C1H	Data read and ADP increment	Data
11000010	C2H	Data write and ADP decrement	Data
11000011	C3H	Data read and ADP decrement	Data
11000100	C4H	Data write and ADP nonvariable	Data
11000101	C5H	Data read and ADP nonvariable	Data

This command is used for data write from MPU to external display RAM, AND data read external display RAM to MPU. Data write/data read should be executed after setting address by address pointer set command. Address Pointer can be automatically increment by setting this command.

Note: this command is necessary for each 1 byte data.

Please refer following flow chart.

```
Data write start                          Data read

Status check 1                            Address pointer set

Low address data                          Status check 1

Status check 1                            Data read C1H

Upper address data                        END

Status check 1

Address pointer set 24H

Status check 1

Write data set

Status check 1

Data write C0H

END
```

NOTE:
(1) After power on, it is necessary to reset. /RESET is kept "L" between 5 CLOCK up (oscillation clock).
(2) When /HALT has been "L", the oscillation is stopped. It is necessary to turn off power supply for LCD, because LCD goes down by DC bias.
(3) The HALF function contains the RESET function.
(4) After state of RESET/HALT.

TERMINAL	HALT	RESET
D0-D7	F	F
D0-d7	F	F
R/w	H	H
/ce	H (NOTE 1)	H (NOTE 1)
Ad0-ad15	H (NOTE 2)	H (NOTE 2)
/ce0,/ce1	H (NOTE 1)	H (NOTE 1)
ED,HOD	Final Data	Final Data
HSCP	L	L
LP	L	L
CDATA	H	H
FR	H	H
CH1	L	K0
CH2	L	VEND
DSPON	L	L
XO	H	OSC CLOCK

H: Level H
L: Level L
F: Floating (High impedance)
KO: Internal state (TEXT data access) normally open,
VEND: End signal of V-counter (Line count) if MDS=H, T2=L,
HEND: (end signal of H-count) normally open.
Note 1: In Attribute mode, H or L by state of Graphic pointer.
Note 2: In Attribute mode, DATA of Graphic pointer.
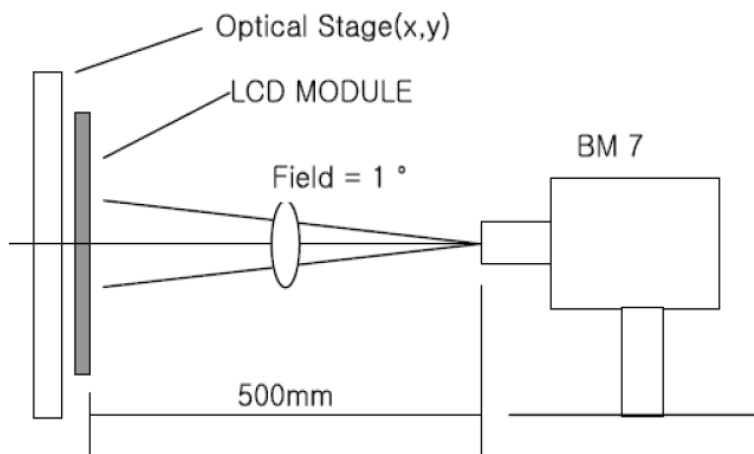
9. Optical Specification

Item	Symbol	Condition	Min	Typ.	Max.	Unit	Remark
Contrast Ratio	CR	θ=0°	--	12	--		Note1 Note2
Response Time	Tr		--	200	--	ms	Note1 Note3
	Tf		--	260	--		
View Angles	ΘT	CR≧2	--	60	--	Degree	Note 4
	ΘB		--	45	--		
	ΘL		--	40	--		
	ΘR		--	40	--		

Note 1: Definition of optical measurement system.

Temperature = 25℃(±3℃)

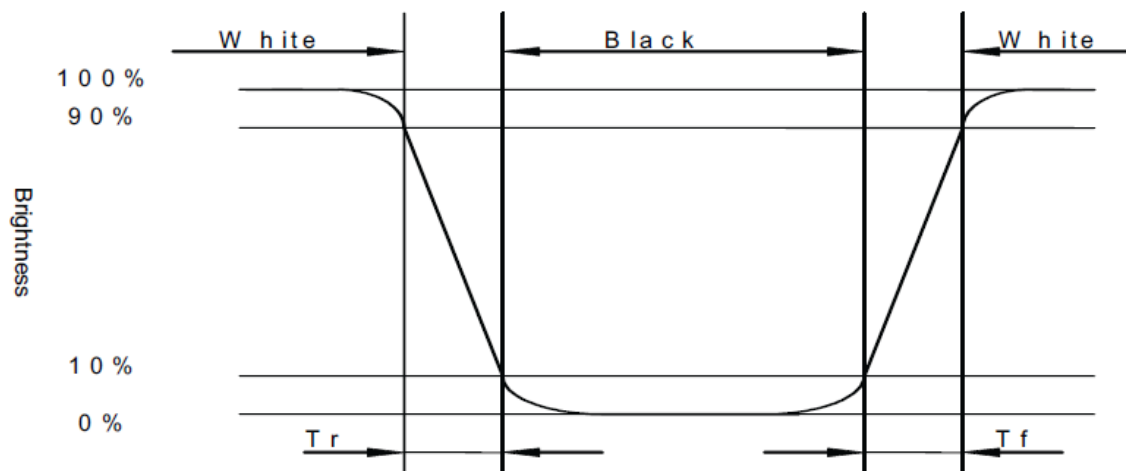LED back-light: ON, Environment brightness < 150 lx

Note 2: Contrast ratio is defined as follow:

$$\text{Contrast Ratio} = \frac{\text{Surface Luminance with all white pixels}}{\text{Surface Luminance with all black pixels}}$$
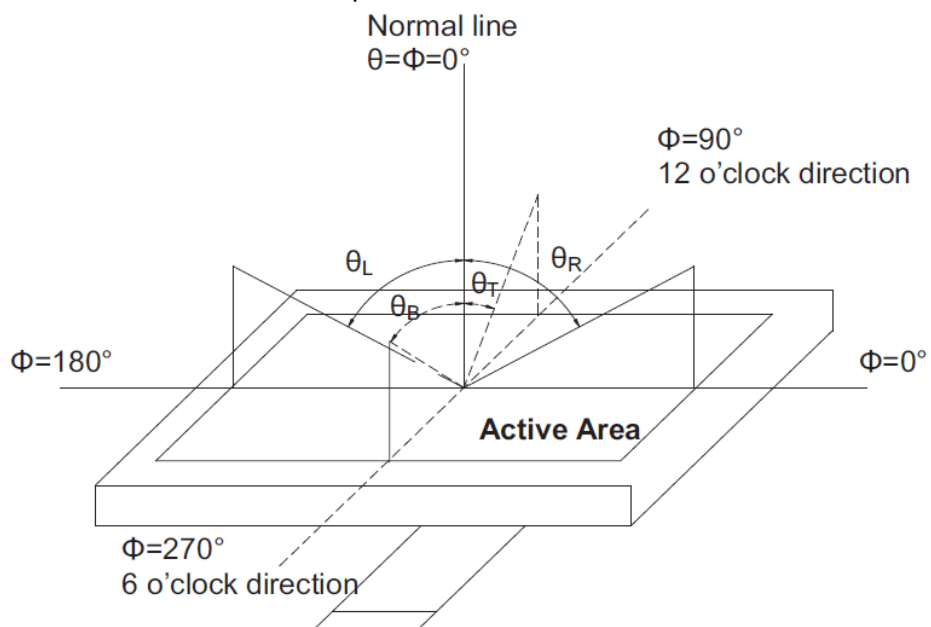
Note 3: Response time is defined as follow:

Response time is the time required for the display to transition from black to white (Rise Time, Tr) and from white to black (Decay Time, Tf).

Note 4: Viewing angle range is defined as follow:

Viewing angle is measured at the center point of the LCD.

Normal line
θ=Φ=0°

Φ=90°
12 o'clock direction

θ_L

θ_R

θ_T

θ_B

Φ=180°

Φ=0°

Active Area

Φ=270°
6 o'clock direction

10. Environmental / Reliability Tests

No	Test Item	Condition	Judgment criteria
1	High Temp Operation	Ts=+70℃, 240hrs	Per table in below
2	Low Temp Operation	Ta=-20℃, 240hrs	Per table in below
3	High Temp Storage	Ta=+80℃, 240hrs	Per table in below
4	Low Temp Storage	Ta=-30℃, 240hrs	Per table in below
5	High Temp & High Humidity Storage	Ta=+40℃, 90% RH 120 hours	Per table in below (polarizer discoloration is excluded)
6	Thermal Shock (Non-operation)	-30℃ 30 min~+80℃ 30 min, Change time:5min, 10 Cycles	Per table in below
7	ESD (Operation)	C=150pF, R=330Ω，5points/panel Air:±8KV, 5times; Contact:±4KV, 5 times;	Per table in below
8	Vibration (Non-operation)	Frequency range:10~55Hz, Stroke:1.5mm Sweep:10Hz~55Hz~10Hz 2 hours for each direction of X.Y.Z.	Per table in below
9	Shock (Non-operation)	60G 6ms, ±X,±Y,±Z 3times, for each direction	Per table in below
10	Package Drop Test	Height:80 cm, 1 corner, 3 edges, 6 surfaces	Per table in below

INSPECTION	CRITERION(after test)
Appearance	No Crack on the FPC, on the LCD Panel
Alignment of LCD Panel	No Bubbles in the LCD Panel No other Defects of Alignment in Active area
Electrical current	Within device specifications
Function / Display	No Broken Circuit, No Short Circuit or No Black line No Other Defects of Display

11. Precautions for Use of LCD Modules

11.1 Safety

The liquid crystal in the LCD is poisonous. Do not put it in your mouth. If the liquid crystal touches your skin or clothes, wash it off immediately using soap and water.

11.2 Handling

A. The LCD and touch panel is made of plate glass. Do not subject the panel to mechanical shock or to excessive force on its surface.

B. Do not handle the product by holding the flexible pattern portion in order to assure the reliability

C. Transparency is an important factor for the touch panel. Please wear clear finger sacks, gloves and mask to protect the touch panel from finger print or stain and also hold the portion outside the view area when handling the touch panel.

D. Provide a space so that the panel does not come into contact with other components.

E. To protect the product from external force, put a covering lens (acrylic board or similar board) and keep an appropriate gap between them.

F. Transparent electrodes may be disconnected if the panel is used under environmental conditions where dew condensation occurs.

G. Property of semiconductor devices may be affected when they are exposed to light, possibly resulting in IC malfunctions.

H. To prevent such IC malfunctions, your design and mounting layout shall be done in the way that the IC is not exposed to light in actual use.

11.3 Static Electricity

A. Ground soldering iron tips, tools and testers when they are in operation.

B. Ground your body when handling the products.

C. Power on the LCD module before applying the voltage to the input terminals.

D. Do not apply voltage which exceeds the absolute maximum rating.

E. Store the products in an anti-electrostatic bag or container.

11.4 Storage

A. Store the products in a dark place at $+25℃\pm10℃$ with low humidity (40% RH to 60% RH).

Don't expose to sunlight or fluorescent light.

B. Storage in a clean environment, free from dust, active gas, and solvent.

11.5 Cleaning

A. Do not wipe the touch panel with dry cloth, as it may cause scratch.

B. Wipe off the stain on the product by using soft cloth moistened with ethanol. Do not allow ethanol to get in between the upper film and the bottom glass. It may cause peeling issue or defective operation. Do not use any organic solvent or detergent other than ethanol.

11.6 Cautions for installing and assembling

Bezel edge must be positioned in the area between the Active area and View area. The bezel may press the touch screen and cause activation if the edge touches the active area.

A gap of approximately 0.5mm is needed between the bezel and the top electrode. It may cause unexpected activation if the gap is too narrow. There is a tolerance of 0.2 to 0.3mm for the outside dimensions of the touch panel and tail. A gap must be made to absorb the tolerance in the case and connector.