

# SPECIFICATION FOR LCD MODULE

Model No. TM162ACA6

<b>Prepared by:</b>	<b>Date:</b>
<b>Checked by :</b>	<b>Date:</b>
<b>Verified by :</b>	<b>Date:</b>
<b>Approved by:</b>	<b>Date:</b>

**TIANMA MICROELECTRONICS CO., LTD**

**REVISION RECORD**

<b>Date</b>	<b>Ref. Page</b>	<b>Revision No.</b>	<b>Revision Items</b>	<b>Check &amp; Approval</b>

## 1 General Specifications:

1.1 Display type: STN

1.2 Display color\*:

Display color: Blue-Black

Background: White

1.3 Polarizer mode: Reflective/Positive

1.4 Viewing Angle: 6:00

1.5 Driving Method: 1/16 Duty 1/5 Bias

1.6 Backlight: None

\* Color tone is slightly changed by temperature and driving voltage.

1.7 Display Fonts: 5 x 7 dots+Cursor (1 Character)

1.8 Data Transfer: 8 Bit Parallel

1.9 Operating Temperature: 0----+50°C

Storage Temperature: -20----+60°C

1.10 Outline Dimensions: Refer to outline drawing on next page

1.11 Dot Matrix: 16 Characters X 2 Lines

1.12 Dot Size: 0.50X0.55(mm)

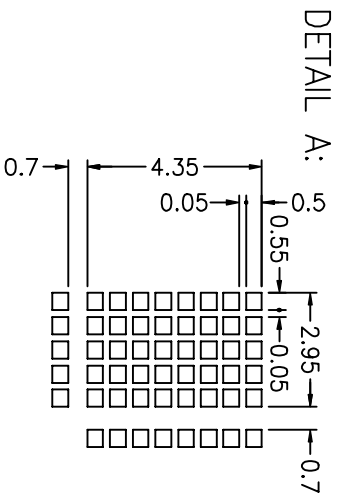
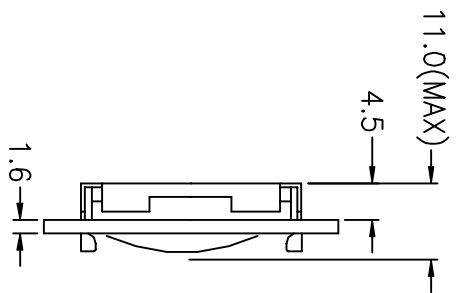
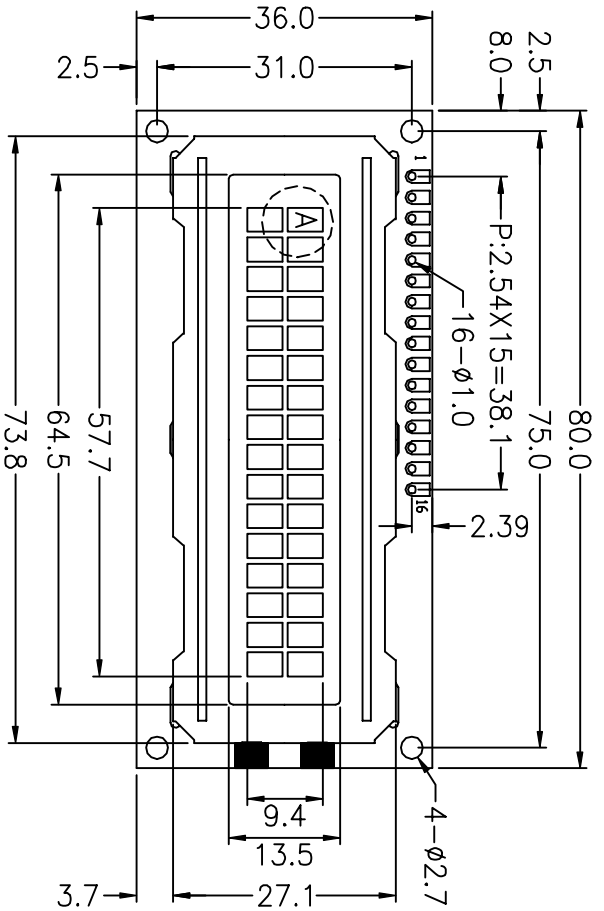
1.13 Dot Pitch: 0.55X0.60 (mm)

1.14 Weight: 20g

## 2 Outline Drawing

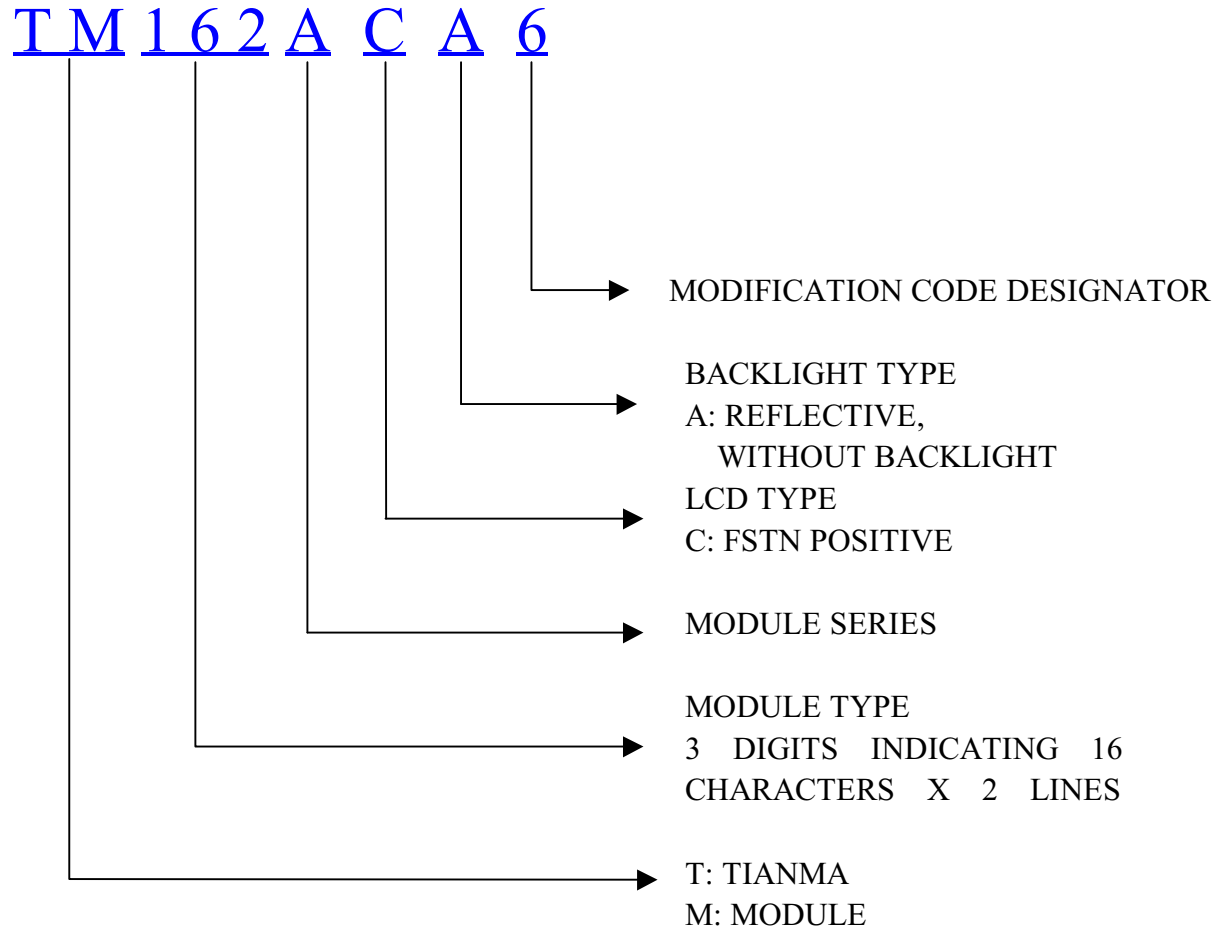
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Vss	Vcc	Vee	RS	R/W	E	DB0	DB1	DB2	DB3	DB4	DB5	DB6	DB7	NC	NC

- NOTES:
1. DISPLAY TYPE: FSTN
  2. VIEWING DIRECTION: 6:00
  3. POLARIZER MODE: REFLECTIVE/POSITIVE
  4. DRIVE METHOD: DUTY 1/16 BIAS 1/5
  5. OPERATING TEMP: 0°C~+50°C
  6. STORAGE TEMP: -20°C~+60°C
  7. CONTROLLER: NT3881DH-01
  8. WITHOUT BACKLIGHT
  9. LCD OPERATING VOLTAGE: 4.7V
  10. UNMARKED TOLERANCE: ±0.3mm
  11. BEZEL IS TO BE PAINTED BLACK

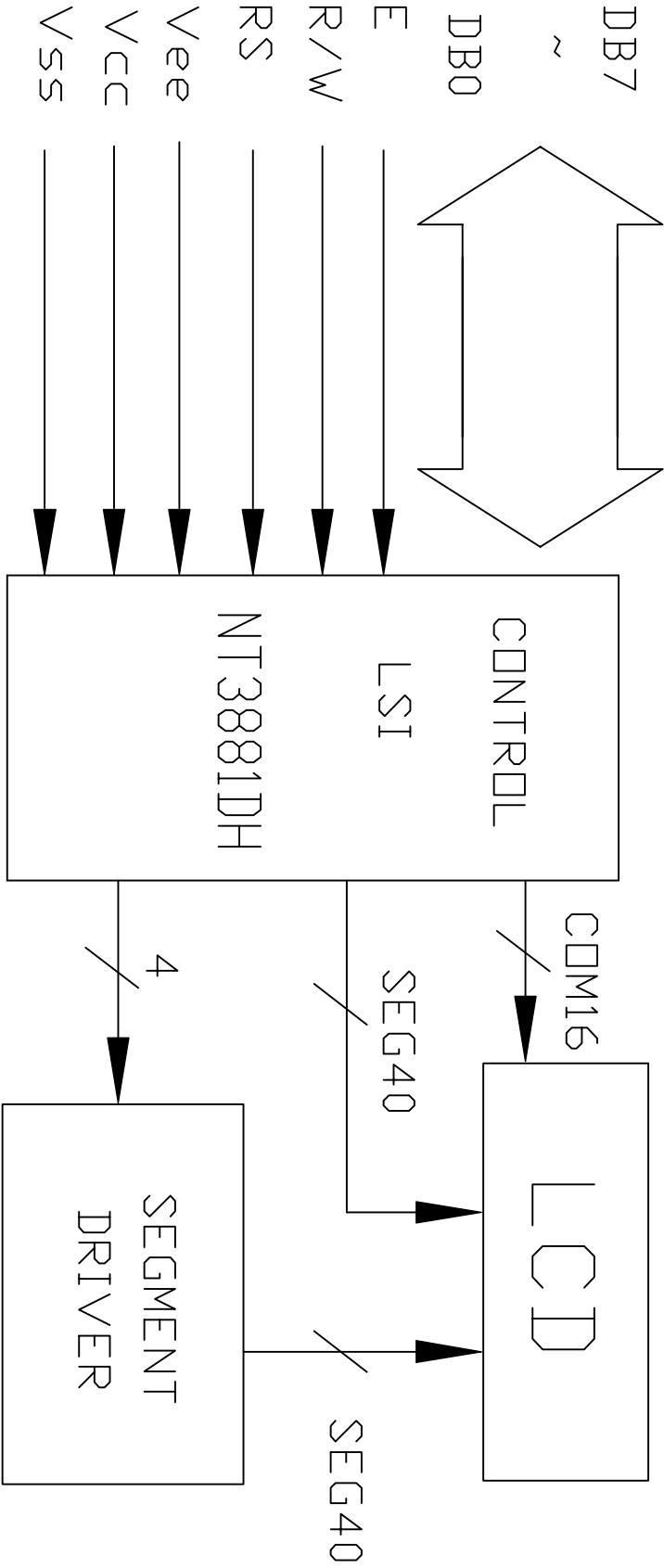


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DRAWN BY:		TITLE: TM162ACA6	SCALE: 1:1
CHECKED BY:		DWG NO: G-1	UNIT: mm
APPROVED BY:		DWG NAME: TM162ACA6-1	SHEET NO: 08
CONFIRMED BY:			

### 3 LCD Module Part Numbering System



**4 Circuit Block Diagram**



## 5 Absolute Maximum Ratings

Item	Symbol	Min.	Max.	Unit	Remark
Power Supply Voltage	$V_{DD}-V_{SS}$	-0.3	7.0	V	
LCD Driving Voltage	$V_{LCD}$	-0.3	13.0		
Operating Temperature Range	$T_{OP}$	0	+50	°C	No Condensation
Storage Temperature Range	$T_{ST}$	-20	+60		

## 6 Electrical Specifications and Instruction Code

### 6.1 Electrical characteristics

Item	Symbol	Min.	Typ.	Max.	Unit
Supply Voltage (Logic)	$V_{DD}-V_{SS}$	4.5	5.0	5.5	V
Supply Voltage (LCD Drive)	$V_{LCD}$	-	4.7	-	V
Input Signal Voltage	High $V_{IH}$ ( $V_{DD}=5.0$ )	$0.7V_{DD}$	-	$V_{DD}+0.3$	V
	Low $V_{IL}$ ( $V_{DD}=5.0$ )	-0.3	-	$0.2 V_{DD}$	V
Supply current (Logic)	$I_{DD}$ ( $V_{DD}-V_{SS}=5.0V$ )	-	1.6	-	mA
Supply current (LCD Drive)	$I_{EE}$	-	0.44	-	mA



## 6.2 Interface Signals

Pin No.	Symbol	Level	Description
1	Vss	0V	Ground
2	Vcc	5.0V	Power supply voltage for logic and LCD(+)
3	Vee	0.3V	Power supply voltage for LCD(-)
4	RS	H/L	Selects registers
5	R/ $\bar{W}$	H/L	Selects read or write
6	E	H/L	Starts data read/write
7	DB0	H/L	Data bit0
8	DB1	H/L	Data bit1
9	DB2	H/L	Data bit2
10	DB3	H/L	Data bit3
11	DB4	H/L	Data bit4
12	DB5	H/L	Data bit5
13	DB6	H/L	Data bit6
14	DB7	H/L	Data bit7
15	NC		
16	NC		

## 6.3 Interface Timing Chart

Read Cycle ( $V_{DD} = 5.0V$ ,  $GND = V_{EE} = 0V$ ,  $T_A = 25^\circ C$ )

Symbol	Parameter	Min.	Typ.	Max.	Unit	Conditions
t <sub>CYCE</sub>	Enable Cycle Time	500	-	-	ns	Figure 1
t <sub>WHE</sub>	Enable "H" Level Pulse Width	300	-	-	ns	Figure 1
t <sub>RE</sub> , t <sub>FE</sub>	Enable Rise/Fall Time	-	-	25	ns	Figure 1
t <sub>AS</sub>	RS, R/W Setup Time	60 <sup>1</sup>	-	-	ns	Figure 1
		100 <sup>2</sup>				
t <sub>AH</sub>	RS, R/W Address Hold Time	10	-	-	ns	Figure 1
t <sub>RD</sub>	Read Data Output Delay	-	-	190	ns	Figure 1
t <sub>DHR</sub>	Read Data Hold Time	20	-	-	ns	Figure 1

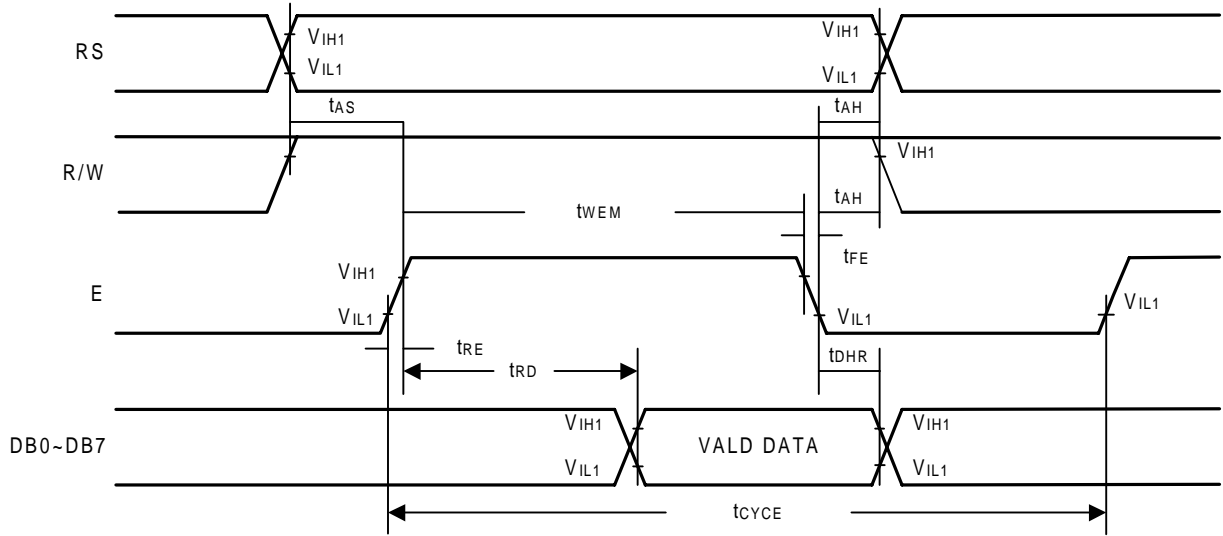
Write Cycle ( $V_{DD} = 5.0V$ ,  $GND = V_{EE} = 0V$ ,  $T_A = 25^\circ C$ )

Symbol	Parameter	Min.	Typ.	Max.	Unit	Conditions
t <sub>CYCE</sub>	Enable Cycle Time	500	-	-	ns	Figure 2
t <sub>WHE</sub>	Enable "H" Level Pulse Width	300	-	-	ns	Figure 2
t <sub>RE</sub> , t <sub>FE</sub>	Enable Rise/Fall Time	-	-	25	ns	Figure 2
t <sub>AS</sub>	RS, R/W Setup Time	60 <sup>1</sup>	-	-	ns	Figure 2
		100 <sup>2</sup>				
t <sub>AH</sub>	RS, R/W Address Hold Time	10	-	-	ns	Figure 2
t <sub>DS</sub>	Data Output Delay	100	-	-	ns	Figure 2
t <sub>DHR</sub>	Data Hold Time	10	-	-	ns	Figure 2

Notes: 1: 8-bit operation mode  
2: 4-bit operation mode

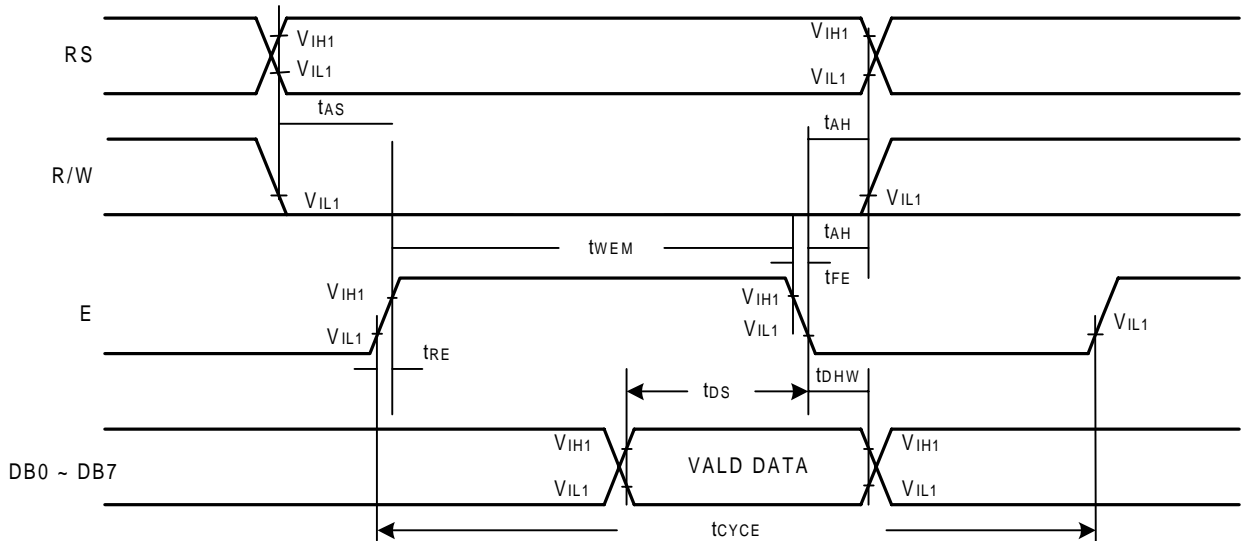
## Timing Waveforms

### Read Operation



**Figure 1. Bus Read Operation Sequence**  
(Reading out data from NT3881D to MPU)

### Write Operation



**Figure 2. Bus Write Operation Sequence**  
(Writing data from MPU to NT3881D)

## 6.4 Instruction Code

Instruction	Code										Function	Execution time (max) ( $f_{osc} = 250\text{kHz}$ )		
	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0				
Display Clear	0	0	0	0	0	0	0	0	0	0	1	Clear entire display area, restore display from shift, and load address counter with DD RAM address 00H.	1.64ms	
Display/ Cursor Home	0	0	0	0	0	0	0	0	0	1	*	Restore display from shift and load address counter with DD RAM address 00H.	1.64ms	
Entry Mode Set	0	0	0	0	0	0	0	0	1	I/D	S	Specify direction of cursor movement and display shift mode. This operation takes place after each data transfer (read/write).	40 $\mu$ s	
Display ON/OFF	0	0	0	0	0	0	0	1	D	C	B	Specify activation of display (D) cursor (C) and blinking of character at cursor position (B).	40 $\mu$ s	
Display/ Cursor Shift	0	0	0	0	0	0	1	S/C	R/L	*	*	Shift display or move cursor.	40 $\mu$ s	
Function Set	0	0	0	0	0	1	DL	N	F	*	*	Set interface data length (DL), number of display line (N), and character font (F).	40 $\mu$ s	
RAM Address Set	0	0	0	1	ACG						Load the address counter with a CG RAM address. Subsequent data access is for CG RAM data.	40 $\mu$ s		
DD RAM Address Set	0	0	1	ADD						Load the address counter with a DD RAM address. Subsequent data access is for DD RAM data.	40 $\mu$ s			
Busy Flag/ Address Counter Read	0	1	AC						Read Busy Flag (BF) and contents of Address Counter (AC).	40 $\mu$ s				
CG RAM/ DD RAM Data Write	1	0	Write data						Write data to CG RAM or DD RAM.	40 $\mu$ s				
CG RAM/ DD RAM Data Read	1	1	Read data						Read data from CG RAM or DD RAM.	40 $\mu$ s				
	I/D = 1 : Increment S = 1 : Display Shift On D = 1 : Display On C = 1 : Cursor Display On B = 1 : Cursor Blink On S/C = 1 : Shift Display R/L = 1 : Shift Right DL = 1 : 8-Bit N = 1 : Dual Line F = 1 : 5x10 dots BF = 1 : Internal Operation BF = 1 : Ready for Instruction										I/D = 0 : Decrement S/C = 0 : Move Cursor R/L = 0 : Shift Left DL = 0 : 4-Bit N = 0 : Signal Line F = 0 : 5x8 dots		DD RAM : Display Data RAM CG RAM : Character Generator RAM ACG : Character Generator RAM Address ADD : Display Data RAM Address AC : Address Counter	

Note 1: Symbol "\*" signifies an insignificant bit (disregard).

Note 2: Correct input value for "N" is predetermined for each model.

## 6.5 Character generator ROM

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)															

## 7 Optical Characteristics

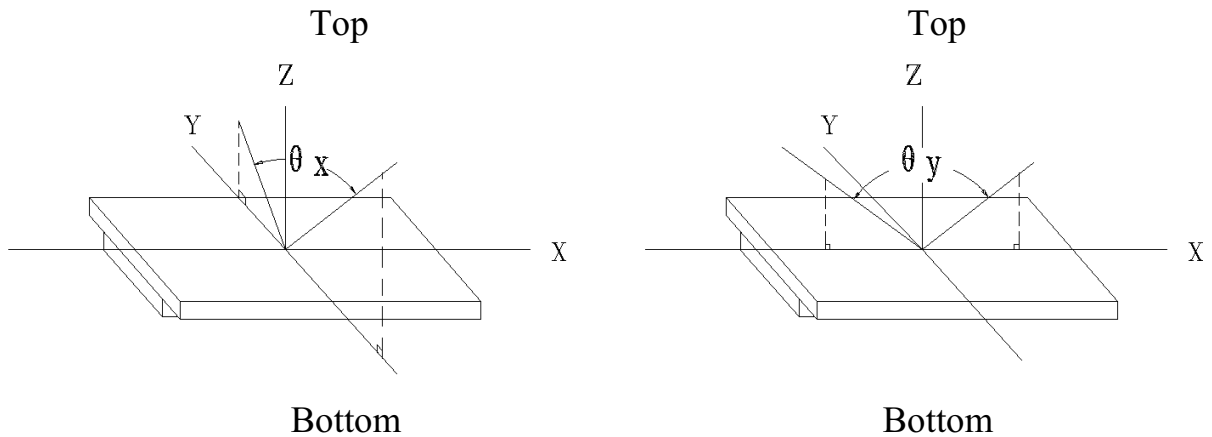
### 7.1 Optical Characteristics

Ta=25°C

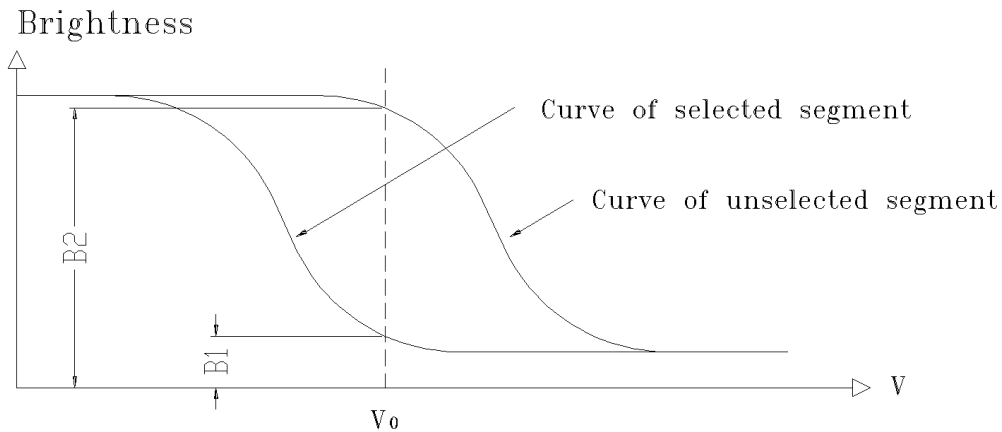
Item	Symbol	Condition	Min.	Typ.	Max.	Unit	
Viewing Angle	$\theta_x$	$C_r \geq 2$	$\theta_y = 0^\circ$	-35	--	20	Deg
	$\theta_y$			$\theta_x = 0^\circ$	-30	--	
Contrast Ratio	$C_r$	$\theta_x = 0^\circ$ $\theta_y = 0^\circ$	4.0		-	-	
Response Time	Turn on	$T_{on}$	$\theta_x = 0^\circ$ $\theta_y = 0^\circ$	-	-	250	ms
	Turn off	$T_{off}$		-	-	250	

## 7.2 Definition of Optical Characteristics

### 7.2.1 Definition of Viewing Angle



### 7.2.2 Definition of Contrast Ratio

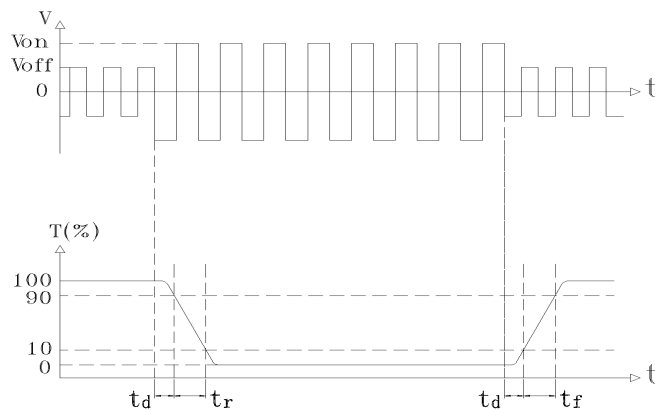


$$\text{Contrast Ratio} = B2/B1 = \frac{\text{unselected state brightness}}{\text{selected state brightness}}$$

Measuring Conditions:

- 1) Ambient Temperature: 25°C ;
- 2) Frame frequency: 64Hz

### 7.2.3 Definition of Response time



Turn on time:  $t_{on} = t_d + t_r$       Turn off time:  $t_{off} = t_d + t_f$

Measuring Condition:

- 1) Operating Voltage: 4.7V
- 2) Frame frequency: 64Hz

## 8 Reliability

### 8.1 Content of Reliability Test

Ta=25°C

No.	Test Item	Content of Test	Test condition
1	High Temperature Storage	Endurance test applying the high storage temperature for a long time	60°C 96H
2	Low Temperature Storage	Endurance test applying the low storage temperature for a long time	-20°C 96H
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 96H
4	Low Temperature Operation	Endurance test applying the electric stress under low temperature for a long time	0°C 96H
5	High Temperature /Humidity Storage	Endurance test applying the high temperature and high humidity storage for a long time	40°C 90%RH 96H
6	Temperature Cycle	Endurance test applying the low and high temperature cycle $  \begin{array}{ccccccc}  -20^{\circ}\text{C} & \longleftrightarrow & 25^{\circ}\text{C} & \longleftrightarrow & 60^{\circ}\text{C} & \longleftrightarrow & 25^{\circ}\text{C} \\  30\text{min} & & 5\text{min} & & 30\text{min} & & 5\text{min} \\  \longleftarrow & & & & & & \longrightarrow \\  & & & & & & \text{1 cycle}  \end{array}  $	-20°C/60°C 10 cycles
7	Vibration Test (package state)	Endurance test applying the vibration during transportation	10Hz~150Hz, 50m/s <sup>2</sup> , 40min
8	Shock Test (package state)	Endurance test applying the shock during transportation	Half- sine wave, 100m/s <sup>2</sup> , 11ms
9	Atmospheric Pressure Test	Endurance test applying the atmospheric pressure during transportation by air	40kPa 16H



## 8.2 Failure Judgment Criterion

Criterion Item	Test Item No.									Failure Judgement Criterion
	1	2	3	4	5	6	7	8	9	
Basic Specification	√	√	√	√	√	√	√	√	√	Out of the basic Specification
Electrical specification	√	√	√	√	√					Out of the electrical specification
Mechanical Specification							√	√		Out of the mechanical specification
Optical Characteristic	√	√	√	√	√	√			√	Out of the optical specification
Note	For test item refer to 8.1									
Remark	Basic specification = Optical specification + Mechanical specification									

## 9 QUALITY LEVEL

Examination or Test	At $T_a=25^\circ\text{C}$ (unless otherwise stated)	Inspection				
		Min.	Max.	Unit	IL	AQL
External Visual Inspection	Under normal illumination and eyesight condition, the distance between eyes and LCD is 25cm.	See Appendix A			II	Major 1.0 Minor 2.5
Display Defects	Under normal illumination and eyesight condition, display on inspection.	See Appendix B			II	Major 1.0 Minor 2.5
Note: Major defects: Open segment or common, Short, Serious damages, Leakage Miner defects: Others Sampling standard conforms to GB2828						

## **10 Precautions for Use of LCD Modules**

### 10.1 Handling Precautions

10.1.1 The display panel is made of glass. Do not subject it to a mechanical shock by dropping it from a high place, etc.

10.1.2 If the display panel is damaged and the liquid crystal substance inside it leaks out, be sure not to get any in your mouth, if the substance comes into contact with your skin or clothes, promptly wash it off using soap and water.

10.1.3 Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.

10.1.4 The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully.

10.1.5 If the display surface is contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If still not completely clear, moisten cloth with one of the following solvents:

- Isopropyl alcohol
- Ethyl alcohol

Solvents other than those mentioned above may damage the polarizer. Especially, do not use the following:

- Water
- Ketone
- Aromatic solvents

10.1.6 Do not attempt to disassemble the LCD Module.

10.1.7 If the logic circuit power is off, do not apply the input signals.

10.1.8 To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.

- a. Be sure to ground the body when handling the LCD Modules.
- b. Tools required for assembly, such as soldering irons, must be properly ground.
- c. To reduce the amount of static electricity generated, do not conduct assembly and other work under dry conditions.
- d. The LCD Module is coated with a film to protect the display surface. Be care when peeling off this protective film since static electricity may be generated.

## 10.2 Storage precautions

10.2.1 When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps.

10.2.2 The LCD modules should be stored under the storage temperature range. If the LCD modules will be stored for a long time, the recommend condition is:

Temperature :  $0^{\circ}\text{C} \sim 40^{\circ}\text{C}$

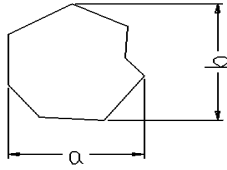
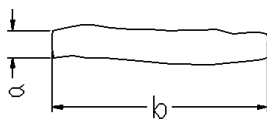
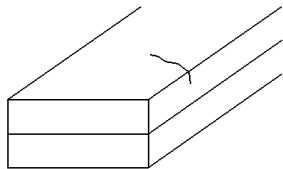
Relatively humidity:  $\leq 80\%$

10.2.3 The LCD modules should be stored in the room without acid, alkali and harmful gas.

10.3 The LCD modules should be no falling and violent shocking during transportation, and also should avoid excessive press, water, damp and sunshine.

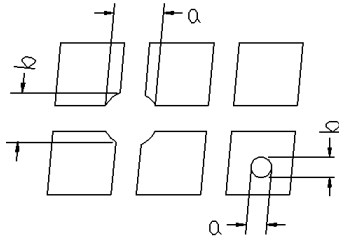
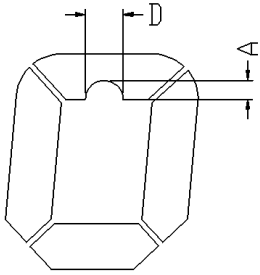
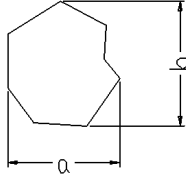
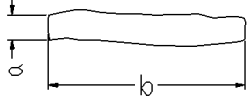
## Appendix A

### Inspection items and criteria for appearance defects

Items	Contents	Criteria		
Leakage		Not permitted		
Rainbow		According to the limit specimen		
Polarizer	Wrong polarizer attachment	Not permitted		
	Bubble between polarizer and glass	Not counted	Max. 3 defects allowed	
		$\phi < 0.3\text{mm}$	$0.3\text{mm} \leq \phi \leq 0.5\text{mm}$	
	Scratches of polarizer	According to the limit specimen		
Black spot (in viewing area)		Not counted	Max. 3 spots allowed	Max. 3 spots (lines) allowed
		$X < 0.2\text{mm}$	$0.2\text{mm} \leq X \leq 0.5\text{mm}$	
		$X = (a+b)/2$		
Black line (in viewing area)		Not counted	Max. 3 lines allowed	
		$a < 0.02\text{mm}$	$0.02\text{mm} \leq a \leq 0.05\text{mm}$ $b \leq 2.0\text{mm}$	
Progressive cracks		Not permitted		

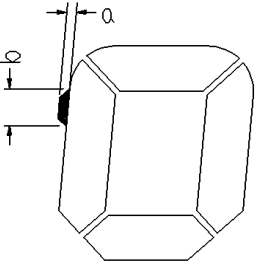
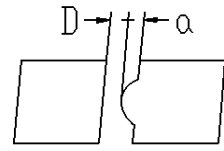
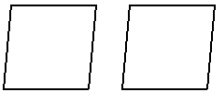
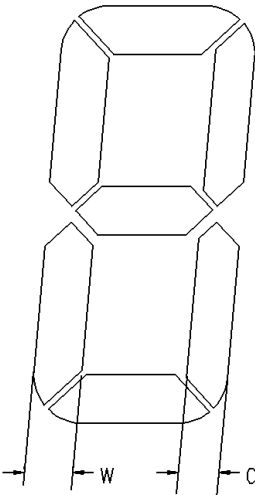
## Appendix B

### Inspection items and criteria for display defects

Items	Contents	Criteria		
Open segment or open common		Not permitted		
Short		Not permitted		
Wrong viewing angle		Not permitted		
Contrast radio uneven		According to the limit specimen		
Crosstalk		According to the limit specimen		
Pin holes and cracks in segment (DOT)		Not counted	Max.3 dots allowed	Max.3 dots allowed
		$X < 0.1\text{mm}$	$0.1\text{mm} \leq X \leq 0.2\text{mm}$	
		$X = (a+b)/2$		
		Not counted	Max.2 dots allowed	
$A < 0.1\text{mm}$		$0.1\text{mm} \leq A \leq 0.2\text{mm}$ $D < 0.25\text{mm}$		
Black spot (in viewing area)		Not counted	Max.3 spots allowed	Max.3 spots (lines) allowed
		$X < 0.1\text{mm}$	$0.1\text{mm} \leq X \leq 0.2\text{mm}$	
		$X = (a+b)/2$		
Black line (in viewing area)		Not counted	Max.3 lines allowed	
		$a < 0.02\text{mm}$	$0.02\text{mm} \leq a \leq 0.05\text{mm}$ $b \leq 0.5\text{mm}$	

## Appendix B

### Inspection items and criteria for display defects (continued)

Items	Content	Criteria			
Transformation of segment		Not counted	Max. 2 defects allowed	Max.3 defects allowed	
	$x < 0.1\text{mm}$	$0.1\text{mm} \leq x \leq 0.2\text{mm}$			
	$x = (a+b)/2$				
		Not counted	Max. 1 defects allowed		
		$a < 0.1\text{mm}$	$0.1\text{mm} \leq a \leq 0.2\text{mm}$ $D > 0$		
		Max.2 defects allowed $0.8W \leq a \leq 1.2W$  a=measured value of width W=nominal value of width			