SPECIFICATION FOR LCD MODULE

Model No. ___ **TM160128ACBW** ___

Prepared by:	Date:
Checked by :	Date:
Verified by :	Date:
Approved by:	Date:

TIANMA MICROELECTRONICS CO., LTD

REVISION RECORD

Date	Ref. Page	Revision No.	Revision Items	Check & Approval

1. General Specifications:

1.1 Display type: FSTN

1.2 Display color*:

      Display color: Black

      Background: White

1.3 Polarizer mode: Transflective/Positive

1.4 Viewing Angle: 6:00

1.5 Driving Method: 1/128 Duty 1/12 Bias

1.6 Backlight: EL

1.7 Controller: T6963C

1.8 Data Transfer: 8 Bit Parallel

1.9 Operating Temperature: -20----+70℃

    Storage Temperature: -30----+80℃

1.10 Outline Dimensions: Refer to outline drawing on next page

1.11 Dot Matrix: 160 X 128 Dots

1.12 Dot Size: 0.54 X 0.54 (mm)

1.13 Dot Pitch: 0.58 X 0.58 (mm)

1.14 Weight: 150g

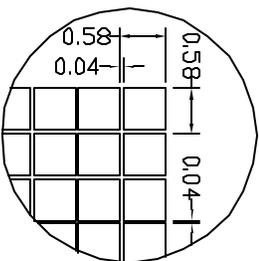   * Color tone is slightly changed by temperature and driving voltage.

NOTE:
1. DISPLAY TYPE: FSTN
2. VIEWING DIRECTION: 6:00
3. POLARIZER MODE: TRANSFLECTIVE/POSITIVE
4. DRIVE METHOD: 1/128 DUTY 1/12 BIAS
5. LCD OPERATING VOLTAGE: 15.0V
6. OPERATING TEMP: -20°C-+70°C
7. STORAGE TEMP: -30°C-+80°C
8. CONTROLLER: T6963C
9. BACKLIGHT: EL
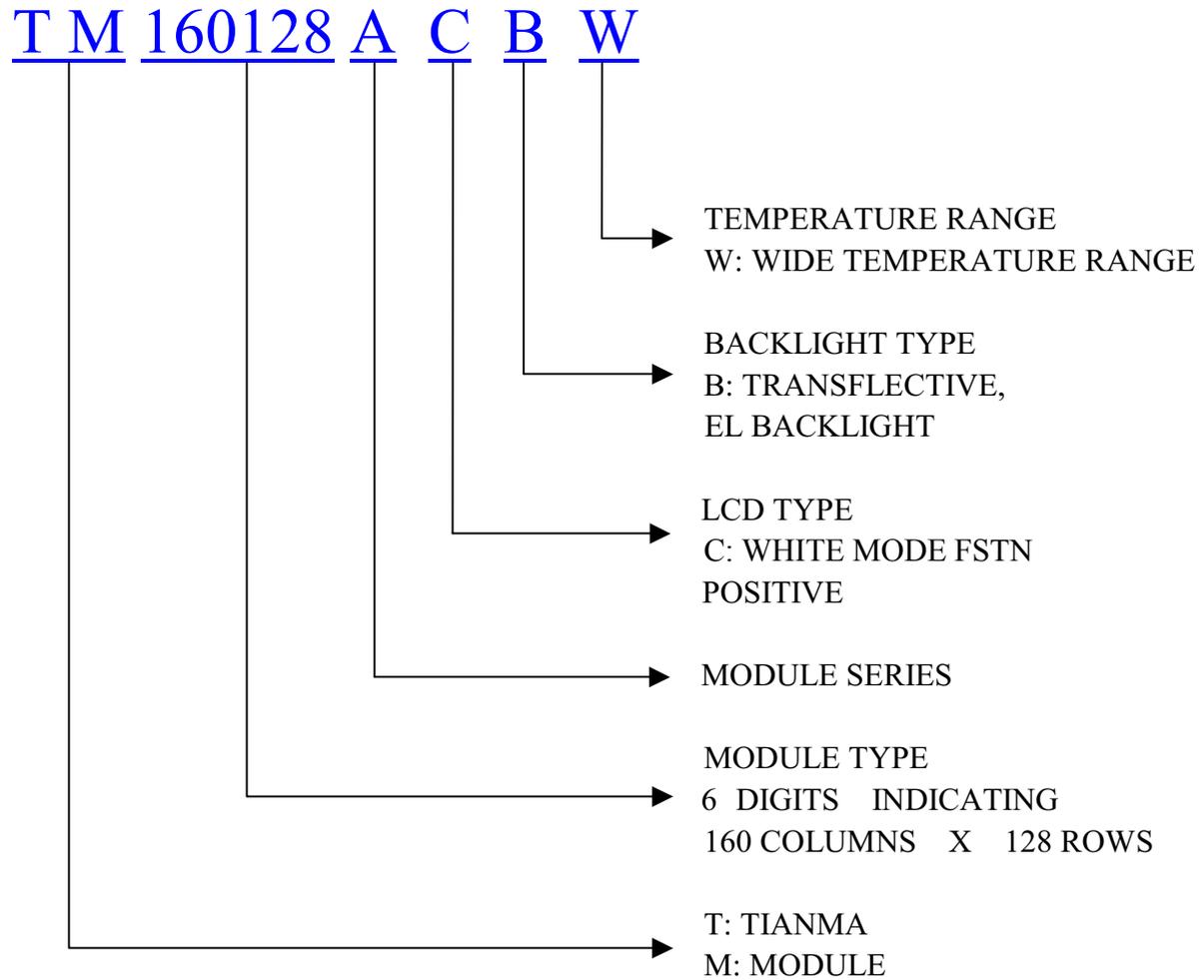10. BEZEL IS TO BE PAINTED BLACK
11. UNMARKED TOLERANCE: ±0.3MM
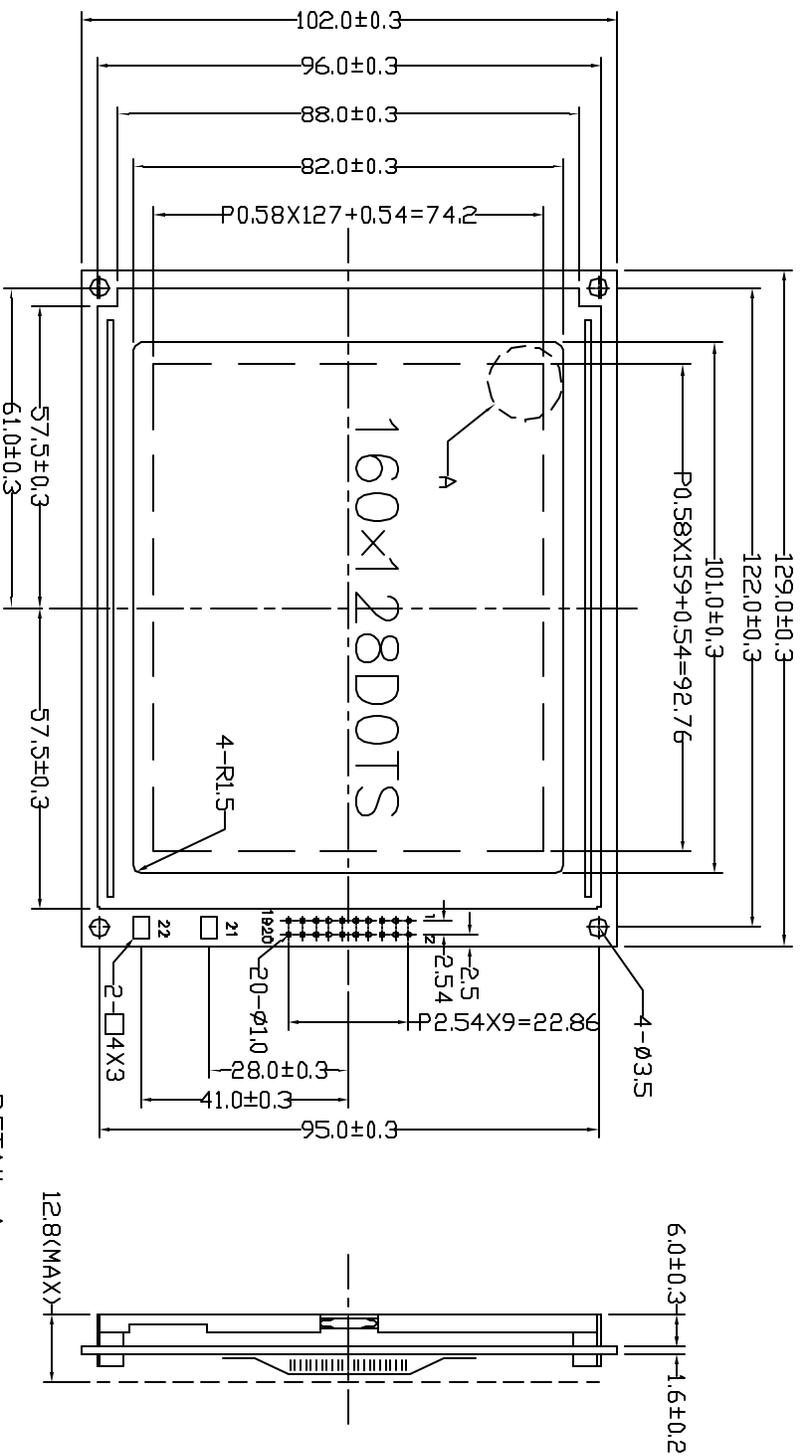
1	2	3	4	5	6	7	8	9	10	11
FG	VSS	VDD	VOUT	VEE	WR	RD	CE	C/D	HALT	RESET
12	13	14	15	16	17	18	19	20	21	22
D0	D1	D2	D3	D4	D5	D6	D7	NC	EL1	EL2

102.0±0.3
96.0±0.3
88.0±0.3
82.0±0.3
P0.58X127+0.54=74.2
129.0±0.3
122.0±0.3
101.0±0.3
P0.58X159+0.54=92.76
57.5±0.3
61.0±0.3
57.5±0.3

160×128DOTS

4-R1.5
A

P2.54X9=22.86
2.5
2.54
20-Ø1.0
28.0±0.3
41.0±0.3
95.0±0.3
2-□4X3
4-Ø3.5

DETAIL A:
0.58
0.04
0.58
0.04

12.8(MAX)
6.0±0.3
1.6±0.2

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DRAWN BY:
CHECKED BY:
APPROVED BY:
CONFIRMED BY:

TITLE: TM160128ACBW
DWG NO: G-1
DWG NAME: TM160128ACBWG-1
SCALE
UNIT: mm
SHEET NO: 07

3. LCD Module Part Numbering System

T M 160128 A C B W

TEMPERATURE RANGE
W: WIDE TEMPERATURE RANGE

BACKLIGHT TYPE
B: TRANSFLECTIVE,
EL BACKLIGHT

LCD TYPE
C: WHITE MODE FSTN
POSITIVE

MODULE SERIES

MODULE TYPE
6 DIGITS INDICATING
160 COLUMNS X 128 ROWS

T: TIANMA
M: MODULE

4. Circuit Block Diagram

5. Absolute Maximum Ratings

Item	Symbol	Min.	Max.	Unit	Remark
Power Supply Voltage	$V_{DD}-V_{SS}$	-0.3	6.0	V	
LCD Driving Voltage	V_{LCD}	-	25.0		
Operating Temperature Range	T_{OP}	-20	+70	℃	No Condensation
Storage Temperature Range	T_{ST}	-30	+80		

6. Electrical Specifications and Instruction Code

6.1 Electrical characteristics

Item		Symbol	Min.	Typ.	Max.	Unit
Supply Voltage (Logic)		$V_{DD}-V_{SS}$	4.75	5.0	5.25	V
Supply Voltage (LCD Drive)		V_{LCD}	-	15.0	-	V
Input Signal Voltage	High	V_{IH} （V_{DD}=5.0）	$0.8V_{DD}$	-	$V_{DD}+0.3$	V
	Low	V_{IL} （V_{DD}=5.0）	0	-	$0.2V_{DD}$	V
Supply current (Logic)		I_{DD} (V_{DD}- V_{SS}=5.0V)	-	8.5	-	mA
Supply current (LCD Drive)		I_{EE}	-	3.5	-	mA
Supply current (EL)		I_{EL}			13.0	mA

6.2 Interface Signals

Pin No.	Symbol	Level	Description
1	FG	0V	Frame Ground
2	Vss	0V	Ground
3	V$_{DD}$	5.0V	Power supply voltage for logic and LCD(+)
4	V$_{COUT}$	H/L	Font Selection
5	V$_{EE}$	-10.0V	Operating Voltage for LCD(-)(variable)
6	$\overline{WR}$	L	Write Enable Signal
7	$\overline{RD}$	L	Read Enable Signal
8	$\overline{CE}$	L	Chip Enable Signal
9	$\overline{C/D}$	H/L	Data type (H:Instruction;L:Data)
10	$\overline{HALT}$	L	Clock operating stop Signal
11	$\overline{RESET}$	L	Reset Signal
12	D0	H/L	Data bit0
13	D1	H/L	Data bit1
14	D2	H/L	Data bit2
15	D3	H/L	Data bit3
16	D4	H/L	Data bit4
17	D5	H/L	Data bit5
18	D6	H/L	Data bit6
19	D7	H/L	Data bit7
20	NC	--	No Signal
21	EL1	--	Backlight Power Supply
22	EL2	--	Backlight Power Supply

6.3 Interface Timing Chart

AC CHARACTERISTICS
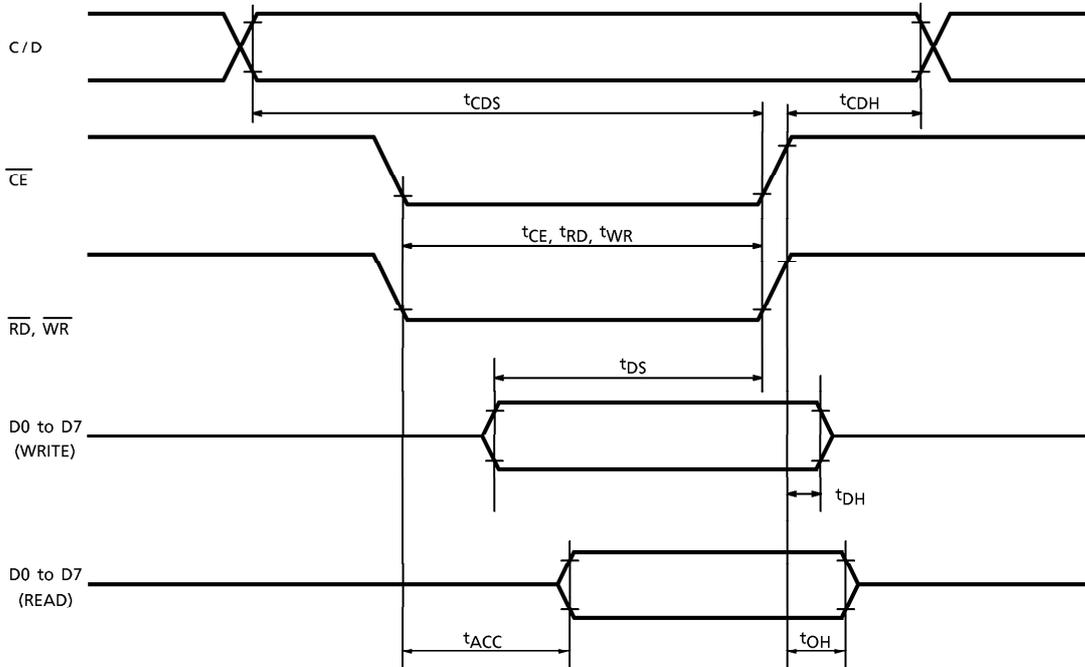
- Switching Characteristics (1)
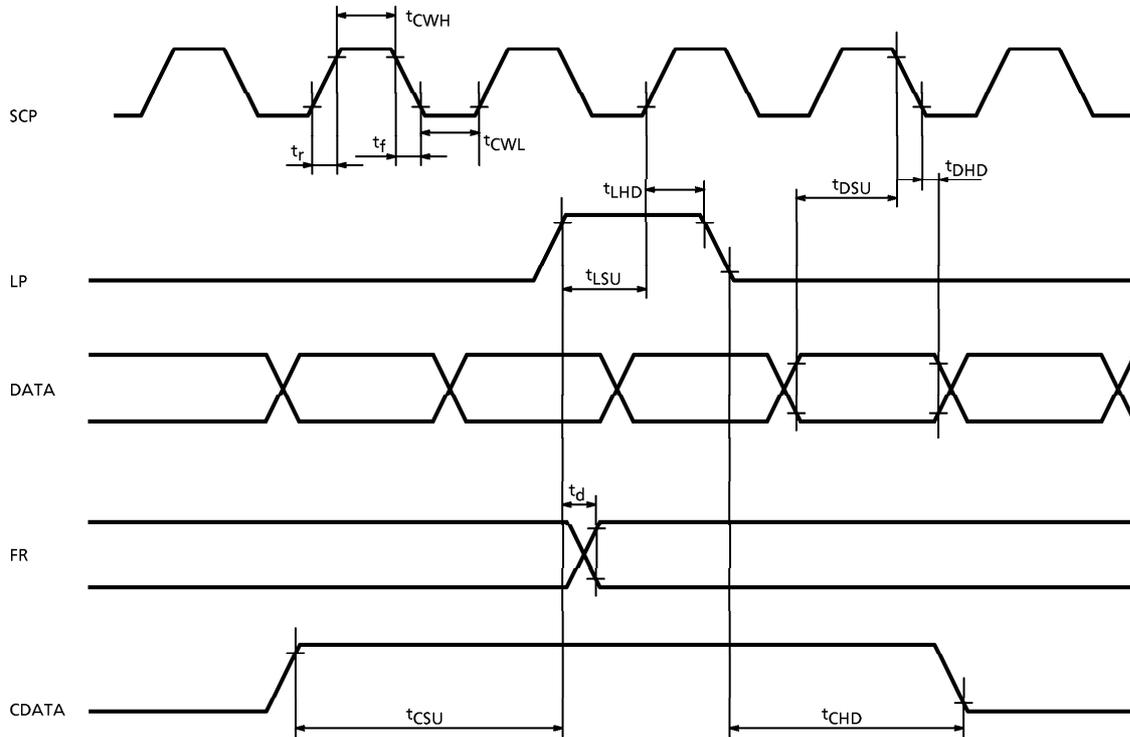
TEST CONDITIONS (Unless otherwise noted, $V_{DD} = 5.0V \pm 10\%$, $V_{SS} = 0V$, Ta = -20 to $70°C$)

ITEM	SYMBOL	TEST CONDITIONS	MIN	MAX	UNIT
Operating Frequency	f_{scp}	Ta = $-10 \sim 70°C$	—	2.75	MHz
SCP Pulse Width	t_{CWH}, t_{CWL}	—	150	—	ns
SCP Rise / Fall Time	t_r, t_f	—	—	30	ns
LP Set-up Time	t_{LSU}	—	150	290	ns
LP Hold Time	t_{LHD}	—	5	40	ns
Data Set-up Time	t_{DSU}	—	170	—	ns
Data Hold Time	t_{DHD}	—	80	—	ns
FR Delay Time	t_d	—	0	90	ns
CDATA Set-up Time	t_{CSU}	—	450	850	ns
CDATA Hold Time	t_{CHD}	—	450	950	ns

● Switching Characteristics (2)

Bus Timing

TEST CONDITIONS (Unless otherwise noted, V_{DD} = 5.0V ± 10%, V_{SS} = 0V, Ta = − 20 to 75°C)

ITEM	SYMBOL	TEST CONDITIONS	MIN	MAX	UNIT
C / D Set-up Time	t_{CDS}	—	100	—	ns
C / D Hold Time	t_{CDH}	—	10	—	ns
$\overline{CE}$, $\overline{RD}$, $\overline{WR}$ Pulse Width	t_{CE}, t_{RD}, t_{WR}	—	80	—	ns
Data Set-up Time	t_{DS}	—	80	—	ns
Data Hold Time	t_{DH}	—	40	—	ns
Access Time	t_{ACC}	—	—	150	ns
Output Hold Time	t_{OH}	—	10	50	ns

6.4 Instruction Code

COMMAND	CODE	D1	D2	FUNCTION
REGISTERS SETTING	00100001 00100010 00100100	X address Data Low address	Y address 00H High address	Set Cursor Pointer Set Offset Register Set Address Pointer
SET CONTROL WORD	01000000 01000001 01000010 01000011	Low address Columns Low address Columns	High address 00H High address 00H	Set Text Home Address Set Text Area Set Graphic Home Address SetGraphic Area
MODE SET	1000X000 1000X001 1000X011 1000X100 10000XXX 10001XXX	-- -- -- -- -- --	-- -- -- -- -- --	OR mode EXOR mode AND mode Text Attribute mode Internal CG ROM mode External CG RAM mode
DISPLAY MODE	10010000 1001XX10 1001XX11 100101XX 100110XX 100111XX	-- -- -- -- -- --	-- -- -- -- -- --	Display off Cursor on, blink off Cursor on, blink on Text on, graphic off Text off, graphic on Text on, graphic on
CURSOR PATTERN SELECT	10100000 10100001 10100010 10100011 10100100 10100101 10100110 10100111	-- -- -- -- -- -- -- --	-- -- -- -- -- -- -- --	1-line cursor 2-line cursor 3-line cursor 4-line cursor 5-line cursor 6-line cursor 7-line cursor 8-line cursor
DATAAUTO READ/WRITE	10110000 10110001 10110010	-- -- --	-- -- --	Set Data Auto Write Set Data Auto Read Set Reset
DATA READ/WRITE	11000000 11000001 11000010 11000011 11000100 11000101	Data -- Data -- Data --	-- -- -- -- -- --	Data Write and increment ADP Data Read and increment ADP Data Write and Decrement ADP Data Read and Decrement ADP Data Write and Nonvariable ADP Data Read and Nonvariable ADP
SCREEN PEEK	11100000	--	--	Screen Peek
SCREEN COPY	11101000			Screen Copy
BIT SET/RESET	11110XXX 11111XXX 1111X000 1111X001 1111X010 1111X011 1111X100 1111X101 1111X110 1111X111	-- -- -- -- -- -- -- -- -- --	-- -- -- -- -- -- -- -- -- --	bit reset bit set bit0(LSB) bit1 bit2 bit3 bit4 bit5 bit6 bit7(MSB)

X:invalid

6.5 Character generator ROM code 0101

LSB MSB	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0		!	"	#	$	%	&	'	(	)	*	+	,	-	.	/
1	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
2	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
3	P	Q	R	S	T	U	V	W	X	Y	Z	[	\	]	^	_
4	`	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
5	p	q	r	s	t	u	v	w	x	y	z	{	|	}	~	
6	Ç	ü	é	â	ä	à	å	ç	ê	ë	è	ï	î	ì	Ä	Å
7	É	æ	Æ	ô	ö	ò	û	ù	ÿ	Ö	Ü	¢	£	¥	₧	ƒ

7. Optical Characteristics

7.1 Optical Characteristics   Ta=25℃

Item		Symbol	Condition		Min.	Typ.	Max.	Unit
Viewing Angle		θ_x	$Cr\geq2$	$\theta_y=0°$	-30	--	20	Deg
		θ_y		$\theta_x=0°$	-30	--	30	
Contrast Ratio		Cr	$\theta_x=0°$ $\theta_y=0°$		3.0	-	-	
Response Time	Turn on	T_{on}	$\theta_x=0°$ $\theta_y=0°$		-	-	300	ms
	Turn off	T_{off}			-	-	300	

7.2 Definition of Optical Characteristics
7.2.1 Definition of Viewing Angle
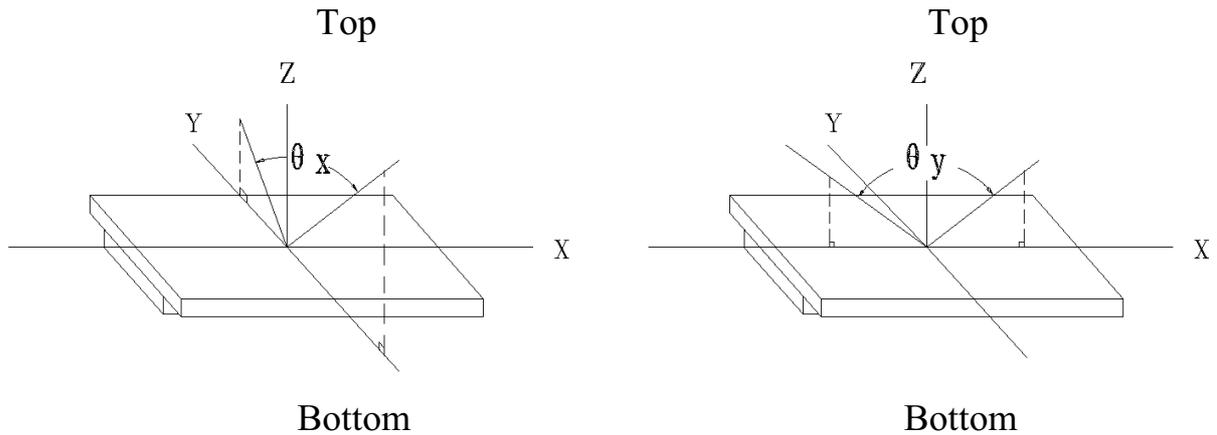
7.2.2 Definition of Contrast Ratio
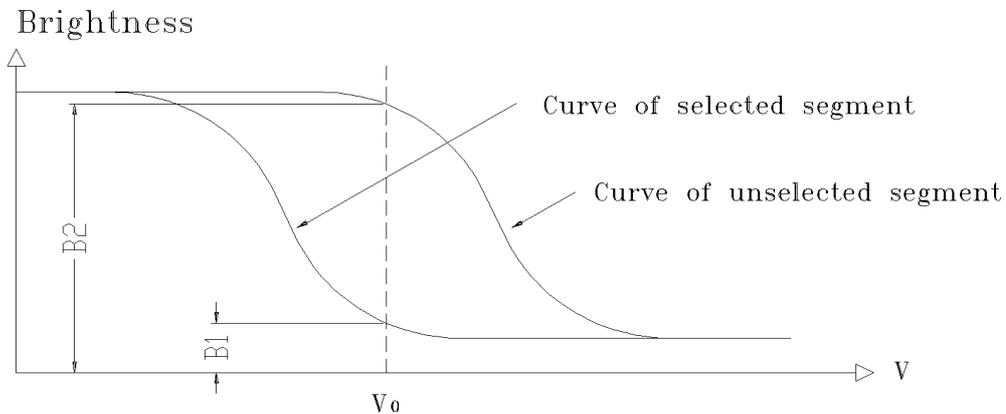
$$\text{Contrast Ratio} = B2/B1 = \frac{\text{unselected state brightness}}{\text{selected state brightness}}$$

Measuring Conditions:

    1) Ambient Temperature: 25℃ ;   2) Frame frequency: 64Hz

7.2.3 Definition of Response time
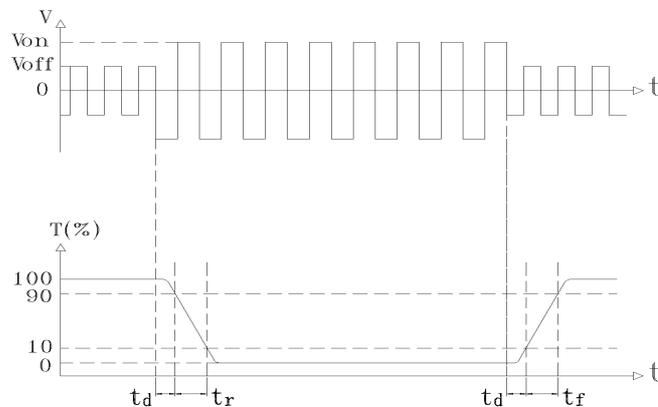
Turn on time: $t_{on} = t_d + t_r$ Turn off time: $t_{off} = t_d + t_f$

Measuring Condition:

    1) Operating Voltage: 15.0V   2) Frame frequency: 64Hz

8. Reliability

8.1 Content of Reliability Test Ta=25℃

No.	Test Item	Content of Test	Test condition
1	High Temperature Storage	Endurance test applying the high storage temperature for a long time	80℃ 240H
2	Low Temperature Storage	Endurance test applying the low storage temperature for a long time	-30℃ 240H
3	High Temperature Operation	Endurance test applying the electric stress (voltage ＆ current) and the thermal stress to the element for a long time	70℃ 240H
4	Low Temperature Operation	Endurance test applying the electric stress under low temperature for a long time	-20℃ 240H
5	High Temperature /Humidity Storage	Endurance test applying the high temperature and high humidity storage for a long time	60℃ 95%RH 240H
6	Temperature Cycle	Endurance test applying the low and high temperature cycle -30℃⟷25℃⟷80℃⟷25℃ 30min 5min 30min 5min ⟵ 1 cycle ⟶	-30℃/80℃ 10 cycles
7	Vibration Test (package state)	Endurance test applying the vibration during transportation	10Hz~500Hz, 100m/s^2, 120min
8	Shock Test (package state)	Endurance test applying the shock during transportation	Half- sine wave, 300m/s^2, 18ms
9	Atmospheric Pressure Test	Endurance test applying the atmospheric pressure during transportation by air	25kPa 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℃ (unless otherwise stated)	Inspection				
		Min.	Max.	Unit	IL	AQL
External Visual Inspection	Under normal illumi-nation and eyesight condition, the dis-tance between eyes and LCD is 25cm.	See Appendix A			II	Major 1.0 Minor 2.5
Display Defects	Under normal illumi-nation 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:
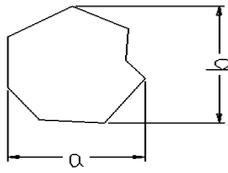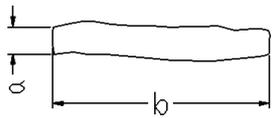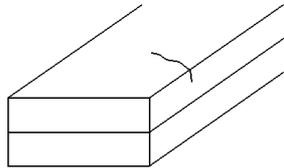
Temperature : 0℃ ～ 40℃

Relatively humidity: ≤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	
		$\phi<0.3mm$	$0.3mm\leqslant\phi\leqslant0.5mm$	
	Scratches of polarizer	According to the limit specimen		
Black spot (in viewing area)		Not counted	Max. 3 spots allowed	Max. 3 spots (lines) allowed
		$X<0.2mm$	$0.2mm\leqslant X\leqslant0.5mm$	
		$X=(a+b)/2$		
Black line (in viewing area)		Not counted	Max. 3 lines allowed	
		$a<0.02mm$	$0.02mm\leqslant a\leqslant0.05mm$ $b\leqslant2.0mm$	
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<0.1mm	0.1mm≤X≤0.2mm	
			X=(a+b)/2		
			Not counted	Max.2 dots allowed	
			A<0.1mm	0.1mm≤A≤0.2mm D<0.25mm	
Black spot (in viewing area)			Not counted	Max.3 spots allowed	Max.3 spots (lines) allowed
			X<0.1mm	0.1mm≤X≤0.2mm	
			X=(a+b)/2		
Black line (in viewing area)			Not counted	Max.3 lines allowed	
			a<0.02mm	0.02mm≤a≤0.05mm b≤0.5mm	

Appendix B

Inspection items and criteria for display defects (continued)
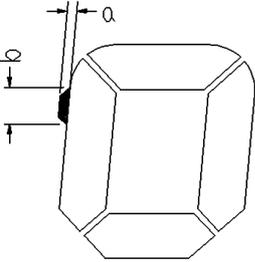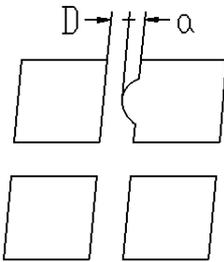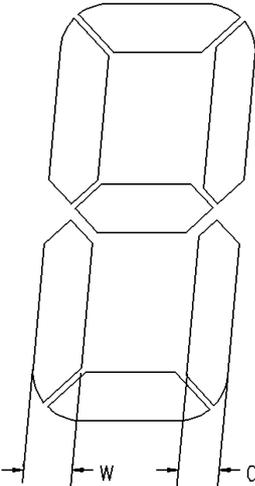
Items	Content	Criteria		
Transfor-mation of segment		Not counted	Max. 2 defects allowed	Max.3 defects allowed
		x＜0.1mm	0.1mm≤x≤0.2mm	
		x=(a+b)/2		
		Not counted	Max. 1 defects allowed	
		a＜0.1mm	0.1mm≤a≤0.2mm D＞0	
		Max.2 defects allowed 0.8W≤a≤1.2W a=measured value of width W=nominal value of width		