SPECIFICATION FOR LCD MODULE

Model No.　TM320240AKGWT

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

TIANMA MICROELECTRONICS CO., LTD

Ver. 1.2

REVISION RECORD

Date	Ver.	Ref. Page	Revision No.	Revision Items
2003.9.12	Ver.1.1	2	1	1.9
2003.9.12	Ver.1.1	6	2	5
2003.9.12	Ver.1.1	7	3	6.1
2003.9.12	Ver.1.1	12	4	7.2.3
2003.9.12	Ver.1.1	13	5	7.3
2003.9.12	Ver.1.1	14	6	8.1
2003.11.24	Ver.1.2	11	7	7.1
2003.11.24	Ver.1.2	12	8	7.2.2
2003.11.24	Ver.1.2	12	9	7.2.3
2003.11.24	Ver.1.2	13	10	7.3

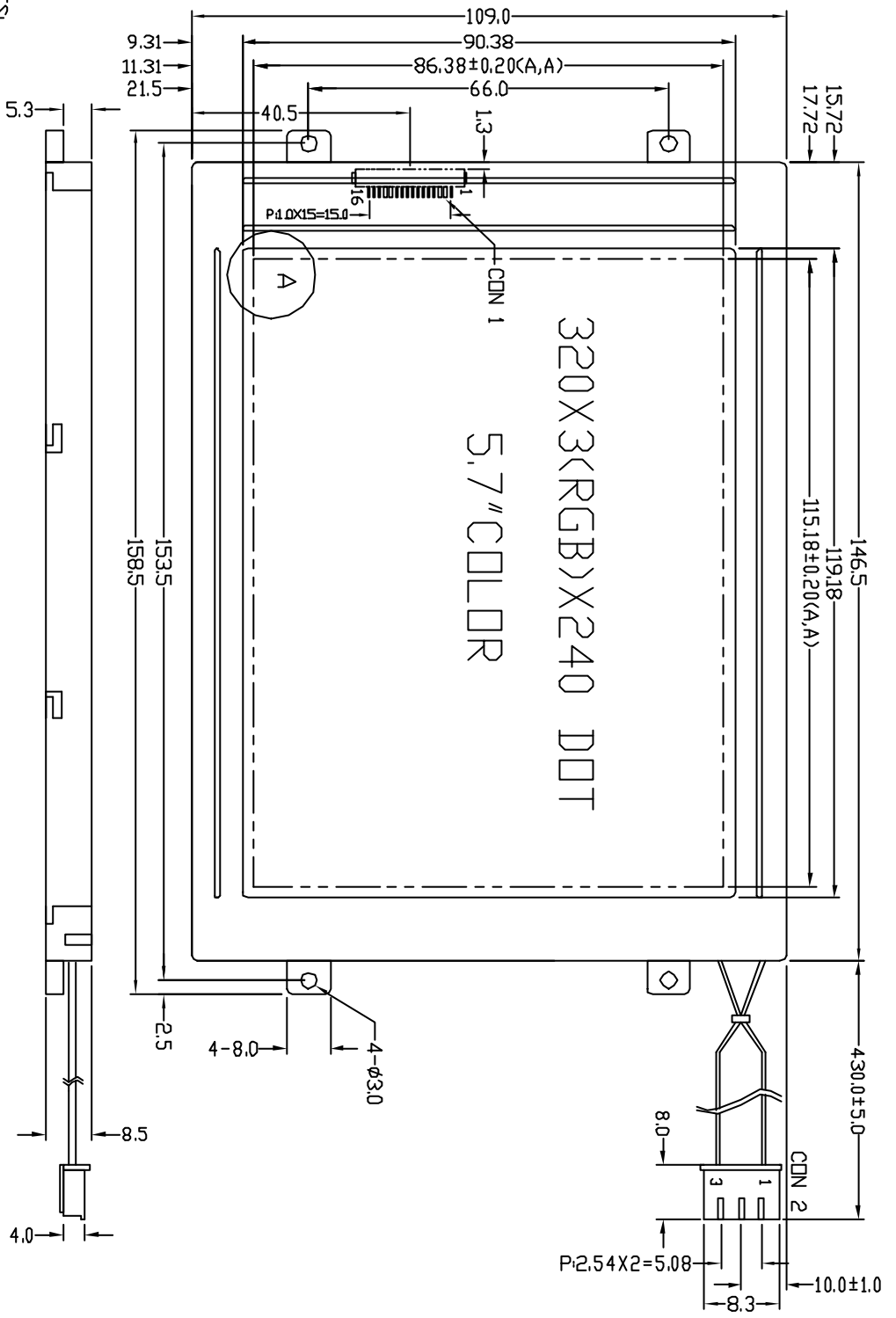# 1. General Specifications:

1.1 Display type: COLOR STN

1.2 Display color*[1]:

      Display color: Decided by the Controller

      Background*[2]:   Black (Red, Green, Blue dots are off state)

1.3 Polarizer mode: Transmissive/Negative

1.4 Viewing Angle: 6:00

1.5 Driving Method: 1/240 Duty   1/15 Bias

1.6 Backlight Type: CCFL

   Backlight Color: WHITE

   Backlight Life: 15000 hrs (Min.)

1.7 Driver: LH1562F4

1.8 Data Transfer: 8 Bit Parallel

1.9 Operating Temperature: -25----+55

   Storage Temperature: -35----+65

1.10 Power Supply Voltage: VDD=3.3V

1.11 LCD Operating Voltage: VLCD=21.6V

1.12 Outline Dimensions: Refer to outline drawing on next page

1.13 Dot Matrix: 320 X 3(RGB) X 240 Dots

1.14 Dot Size: $0.345(R+G+B) \times 0.345(mm^2)$

1.15 Dot Pitch: $0.36 \times 0.36 \ (mm^2)$

1.16 Weight: TBD*[3]

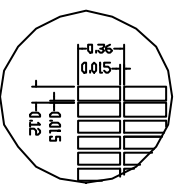   *[1] Color tone is slightly changed by temperature and driving voltage.
    *[2] Color tone will be changed by backlight.
    *[3] TBD: To Be Determined.
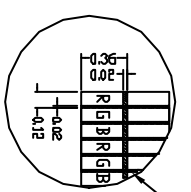
320X3(RGB)X240 DOT

5.7"COLOR

NOTES:
1. DISPLAY TYPE: COLOR STN
2. VIEWING DIRECTION: 6:00
3. POLARIZER MODE: TRANSMISSIVE/NEGATIVE
4. DRIVE METHOD: 1/240 DUTY 1/15 BIAS
5. VEE: 21.6V
6. VDD: 5.0V
7. OPERATING TEMP: -25°C~+55°C
8. STORAGE TEMP: -35°C~+65°C
9. DRIVER: LH1562F4
10. BACKLIGHT: CCFL(AC-270V WHITE)
11. BEZEL IS STAINLESS STEEL
12. ALL UNMARKED TOLERANCES: ±0.3mm

DETAIL A:

COLOR FILTER

BLACK MASK

DETAIL A:

CON 1		CON 2	
PIN	SYMBOL	PIN	SYMBOL
1	M	1	VFL1
2	YD	2	NC
3	LP	3	VFL2
4	XCK		
5	DISPOFF		
6	VDD		
7	VSS		
8	VEE		
9	D7		
10	D6		
11	D5		
12	D4		
13	D3		
14	D2		
15	D1		
16	D0		

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

TITLE: TM320240AKGWT
DWG NO: G-4
DWG NAME: TM320240AKGWTG-4
SCALE
UNIT: mm
SHEET NO: 1 OF 1

3. LCD Module Part Numbering System

TM 320240 A K G W T

IC PACKAGE
T: TAB

TEMPRATURE RANGE
W: WIDE
TEMPERATURE RANGE

BACKLIGHT TYPE
G: TRANSMISSIVE,
CCFL BACKLIGHT

LCD TYPE
K: COLOR STN MODE
NEGATIVE

MODULE SERIES

MODULE TYPE
DIGITS INDICATING:
320 (RGB) COLUMNS X
240 ROWS

T: TIANMA
M: MODULE

4. Circuit Block Diagram

DC−AC ── CCFL

CONTROLLER
YD
LP
XCK
DOFF
D7
D6
D5
D4
D3
D2
D1
D0

40103
7474
LP
M

IC5 LH1562
M
YD
LP
DOFF
240

IC1 LH1562
M
LP
XCK
DOFF
D6
D4
D2
D0
240

IC3 LH1562
240

IC2 LH1562
240

IC4 LH1562
240
DOFF
XCK
LP
D1
D3
D5
D7
M

320 (RGB) X 240 DOTS
R G B

5. Absolute Maximum Ratings   Ta=25

Item	Symbol	Min.	Max.	Unit	Remark
Power Supply Voltage	V_{DD} V_{SS}	-0.3	+6.0	V	
LCD Driving Voltage	V_{LCD}	-0.3	+40.0		
Operating Temperature Range	T_{OP}	-25	+55		No Condensation
Storage Temperature Range	T_{ST}	-35	+65		

6. Electrical Specifications and Instruction Code

6.1 Electrical characteristics Vss=0V, Ta=25

Item		Symbol	Min.	Typ.	Max.	Unit
Supply Voltage (Logic)		V_{DD}-Vss	+3.0	+5.0	+5.5	V
Supply Voltage (LCD Drive)		V_{LCD}	-	21.6	-	V
Input Signal Voltage	High	V_{IH} V_{DD}=3.3	$0.8V_{DD}$	-	V_{DD}	V
	Low	V_{IL} V_{DD}=3.3	0	-	$0.2\,V_{DD}$	V
Supply current (Logic)		I_{DD} (V_{DD}- V_{SS}=3.3V)	-	1.5	-	mA
Supply current (LCD Drive)		I_{EE}	-	4.5	-	mA
Supply Voltage (CCFL Drive)		V_{CL} (I_{CL}=5.0mA)	-	270	350	Vrms
Supply current (CCFL Drive)		I_{CL}	-	5.0	6.3	mArms
Frequency (CCFL Drive)		f_{CL}	-	36.6	-	kHz

6.2 Interface Signals

6.2.1 CON1

Pin No.	Symbol	Level	Description
1	M	H/L	Input of signal to AC electrify the liquid crystal drive output
2	YD	H/L	Scan start pulse
3	LP	H/L	Display data latch pulse input
4	XCK	H/L	Display data shift clock input
5	**DISPOFF**	H/L	H: Display on, L: Display off
6	VDD	+3.3V	Supply voltage for logic
7	VSS	0V	Ground
8	VEE	+23V	LCD voltage input
9	D7	H/L	Data bit 7
10	D6	H/L	Data bit 6
11	D5	H/L	Data bit 5
12	D4	H/L	Data bit 4
13	D3	H/L	Data bit 3
14	D2	H/L	Data bit 2
15	D1	H/L	Data bit 1
16	D0	H/L	Data bit 0

6.2.2 CON2

Pin No.	Symbol	Level	Description
1	VFL1	AC	Supply voltage for CCFL
2	NC	-	No connection
3	VFL2	VSS	Supply voltage for CCFL

6.3 Interface Timing Chart
6.3.1 Segment mode
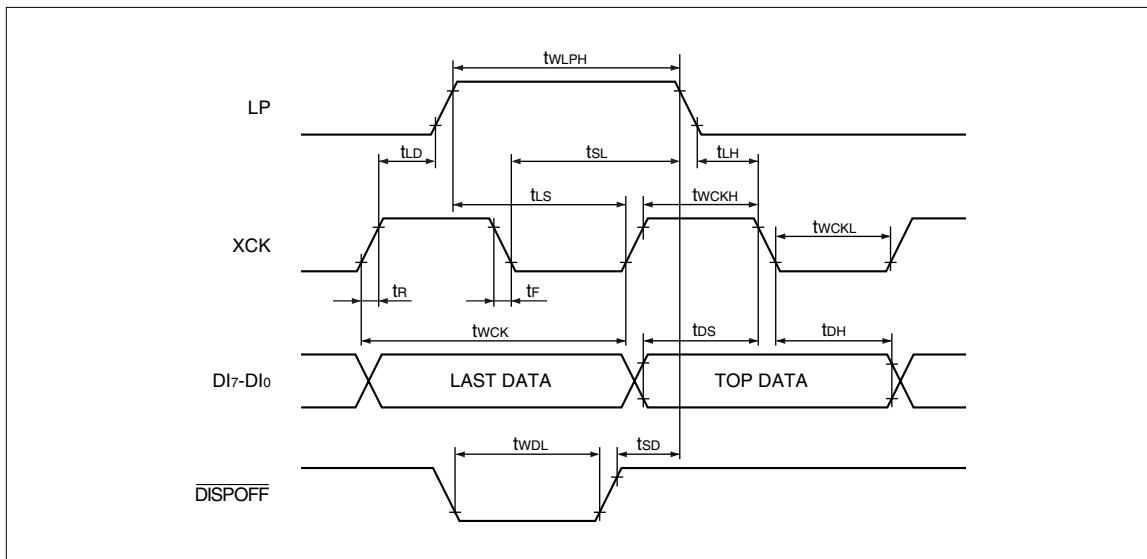
(Segment Mode 2)   ($V_{SS} = V_5 = 0$ V, $V_{DD} = +3.0$ to $+4.5$ V, $V_0 = +15.0$ to $+42.0$ V, $T_{OPR} = -20$ to $+85$ °C)

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT	NOTE
Shift clock period	t_{WCK}	t_R, $t_F \leq 10$ ns	66			ns	1
Shift clock "H" pulse width	t_{WCKH}		23			ns	
Shift clock "L" pulse width	t_{WCKL}		23			ns	
Data setup time	t_{DS}		15			ns	
Data hold time	t_{DH}		23			ns	
Latch pulse "H" pulse width	t_{WLPH}		30			ns	
Shift clock rise to latch pulse rise time	t_{LD}		0			ns	
Shift clock fall to latch pulse fall time	t_{SL}		50			ns	
Latch pulse rise to shift clock rise time	t_{LS}		30			ns	
Latch pulse fall to shift clock fall time	t_{LH}		30			ns	
Enable setup time	t_S		15			ns	
Input signal rise time	t_R				50	ns	2
Input signal fall time	t_F				50	ns	2
$\overline{DISPOFF}$ removal time	t_{SD}		100			ns	
$\overline{DISPOFF}$ "L" pulse width	t_{WDL}		1.2			µs	
Output delay time (1)	t_D	$C_L = 15$ pF			41	ns	
Output delay time (2)	t_{PD1}, t_{PD2}	$C_L = 15$ pF			1.2	µs	
Output delay time (3)	t_{PD3}	$C_L = 15$ pF			1.2	µs	

NOTES :
1. Takes the cascade connection into consideration.
2. ($t_{WCK} - t_{WCKH} - t_{WCKL}$)/2 is maximum in the case of high speed operation.

6.3.2 Common Mode

[L/R = "L"]
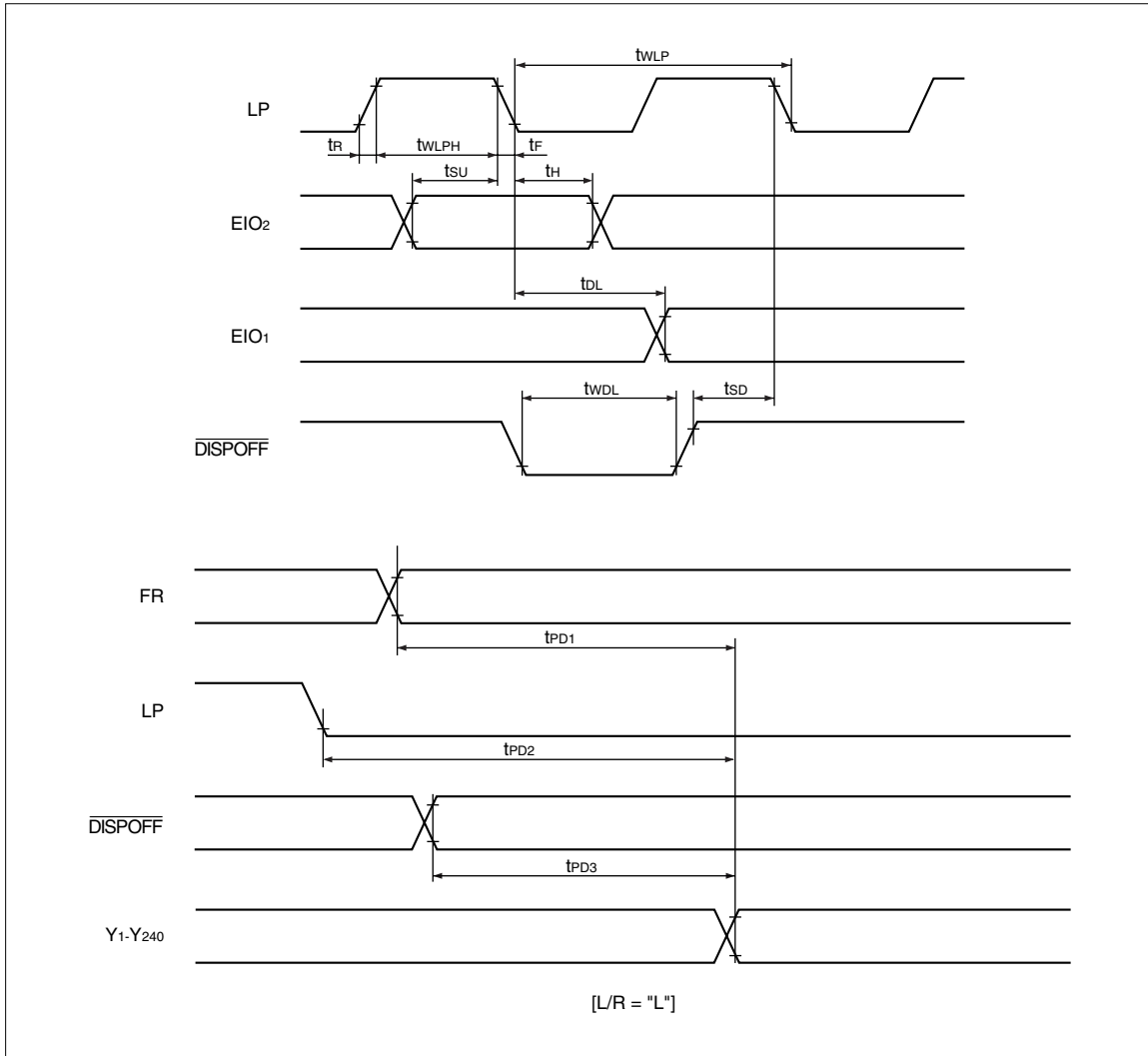
(V_{SS} = V_5 = 0 V, V_{DD} = +2.5 to +5.5 V, V_0 = +15.0 to +42.0 V, T_{OPR} = −20 to +85 ˚C)

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Shift clock period	t_{WLP}	t_R, t_F ≤ 20 ns	250			ns
Shift clock "H" pulse width	t_{WLPH}	V_{DD} = +5.0±0.5 V	15			ns
Data setup time	t_{SU}		30			ns
Data hold time	t_H		50			ns
Input signal rise time	t_R				50	ns
Input signal fall time	t_F				50	ns
$\overline{DISPOFF}$ removal time	t_{SD}		100			ns
$\overline{DISPOFF}$ "L" pulse width	t_{WDL}		1.2			μs
Output delay time (1)	t_{DL}	C_L = 15 pF			200	ns
Output delay time (2)	t_{PD1}, t_{PD2}	C_L = 15 pF			1.2	μs
Output delay time (3)	t_{PD3}	C_L = 15 pF			1.2	μs

7. Optical Characteristics

7.1 Optical Characteristics

V_{LCD}=21.6V   Ta=25

Item		Symbol	Condition		Min.	Typ.	Max.	Unit
Viewing Angle		x	Cr≥2	y=0°	+30	--	-40	Deg
		y		x=0°	+30	--	-30	
Contrast Ratio		Cr	x=0° y=0°		-	20	-	
Response Time	Turn on	Ton	x=0° y=0°		-	200	-	ms
	Turn off	Toff			-	100	-	
	Red	x	x=0° y=0°		-	0.440	-	
		y			-	0.340	-	
	Green	x	x=0° y=0°		-	0.300	-	
		y			-	0.434	-	
	Blue	x	x=0° y=0°		-	0.215	-	
		y			-	0.300	-	

7.2 Definition of Optical Characteristics
7.2.1 Definition of Viewing Angle

Top   Top

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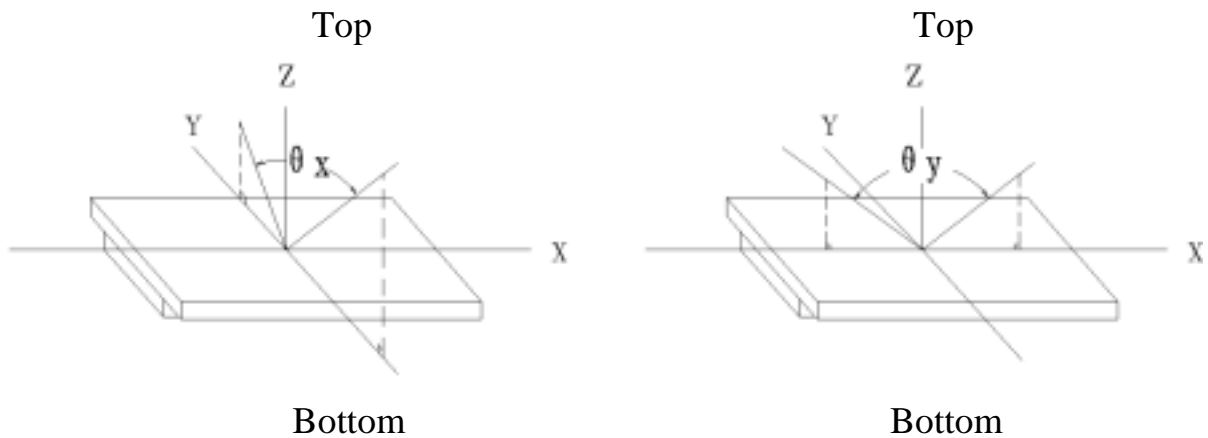
7.2.2 Definition of Contrast Ratio
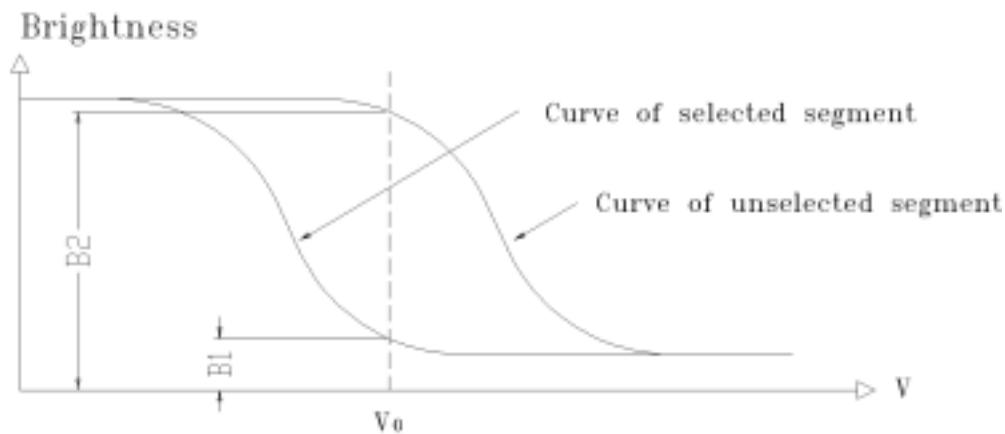
$$\text{Contrast Ratio} = B2/B1 = \frac{\text{unselected state brightness}}{\text{selected state brightness}}$$

Measuring Conditions:

1) Ambient Temperature: 25   ;   2) Frame frequency: 70Hz

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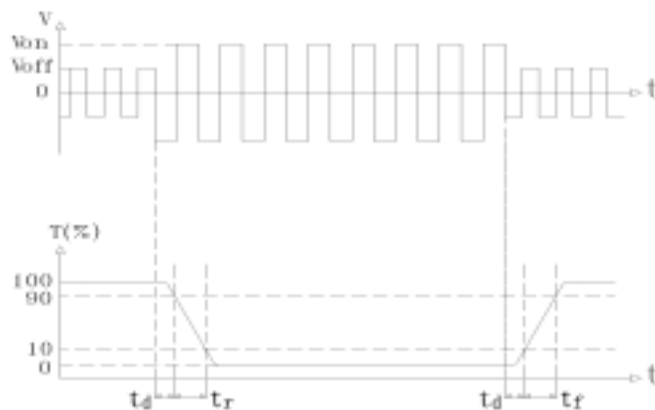
Turn on time: $t_{on} = t_d + t_r$ Turn off time: $t_{off} = t_d + t_f$

Measuring Condition:

1) Operating Voltage:21.6V   2) Frame frequency: 70Hz

7.3 Brightness Characteristic

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Brightness	Bp	Ta=25 ±3	-	120	-	cd/m^2
Uniformity	Bp	30-80%RH	-	80	-	%

Note:
1. The data is measured after CCFLs are turned on for 5 minutes.
2. Testing conditions   CCFL: I_{CL} = 5mA (AC)
                                        LCD: All dots are on (White color)
3. Brightness in the center of the LCD panel.
4. Definition of Uniformity (Bp)
    Bp = Bp (Min.) / Bp (Max.) X 100 (%)
   Bp (Max.) = Maximum brightness in 9 measurement spots
   Bp (Min.) = Minimum brightness in 9 measurement spots

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	65 ±2 240H Restore 4H at 25
2	Low Temperature Storage	Endurance test applying the low storage temperature for a long time	-35 ±2 240H Restore 4H at 25
3	High Temperature Operation	Endurance test applying the electric stress (voltage current) and the thermal stress to the element for a long time	55 ±2 240H Restore 4H at 25
4	Low Temperature Operation	Endurance test applying the electric stress under low temperature for a long time	-25 ±2 240H Restore 4H at 25
5	High Temperature /Humidity Storage	Endurance test applying the high temperature and high humidity storage for a long time	60 ±2 90%RH 240H Restore 4H at 25
6	Temperature Cycle	Endurance test applying the low and high temperature cycle -35 25 65 25 30min 5min 30min 5min 1 cycle	-35 /65 10 cycles Restore 4H at 25
7	Vibration Test (package state)	Endurance test applying the vibration during transportation	10Hz~150Hz, 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 Restore 2H

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 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:
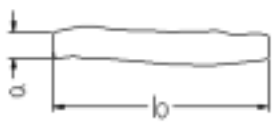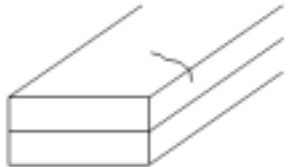
      Temperature :   0   40

      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.
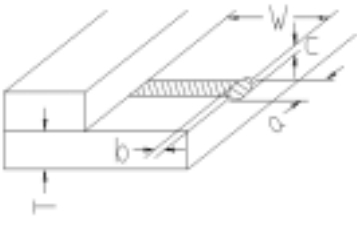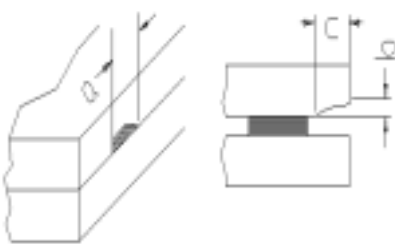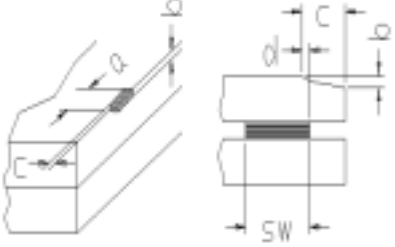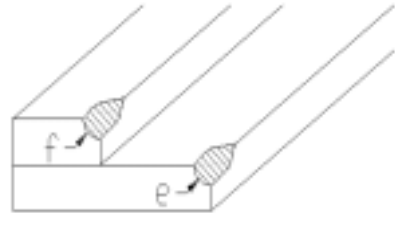
Appendix A

Inspection items and criteria for appearance defects

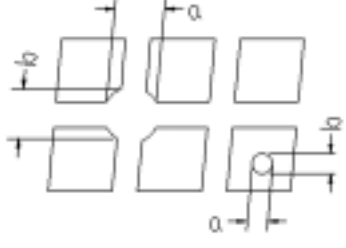| Items	Contents	Criteria		
Leakage		Not permitted		
Rainbow		According to the limit specimen		
Polarizer	Wrong polarizer attachment	Not permitted		
	Bubble between polarizer and glass	Not counted	Max. 3 defects allowed	
		$\phi<0.3$mm	0.3mm ϕ 0.5mm	
	Scratches of polarizer	According to the limit specimen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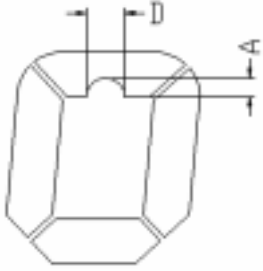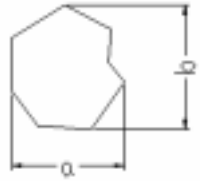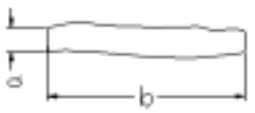
Appendix A

Inspection item and criteria for appearance defects (continued)

Items	Contents	Criteria				
Glass Cracks	Cracks on pads 	a	b	c	Max. 2 cracks allowed	Max. 5 cracks allowed
		3mm	W/5	T/2		
		2mm	W/5	T/2<C<T		
	Cracks on contact side 	a		b	Max. 2 cracks allowed	
		3mm		T/2		
		2mm		T/2<b<T		
		C shall be not reach the seal area				
	Cracks on non-contact side 	a		b		
		3mm		T/2		
		2mm		T/2<b<T		
		C 0.5mm				
		d SW/3				
	Corner cracks 	e<2.0mm^2 f<2.0mm^2			Max. 3 cracks allowed	
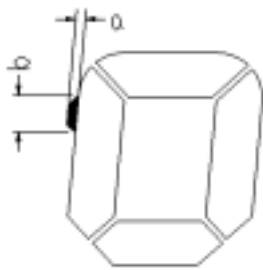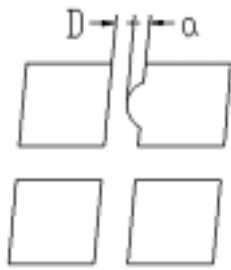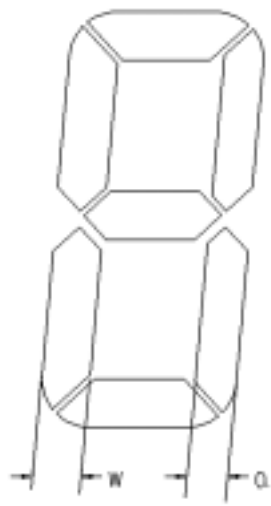
Appendix B
Inspection items and criteria for display defects

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		