SPECIFICATION

FOR LCD MODULE

Preliminary

CUSTOMER	:	F I N D L C D
CUSTOMER NO .	:	
PRODUCT TYPE	:	Character LCM
MODULEL NO.	:	TM128128B2CCWG

CUSTOMER APPROVED	

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REVISION RECORD

Version	Revision Items	Name	Date
1.0	**Preliminary**		2007.3.8

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1. LCD Module Part Numbering System

TM	128128	B2	C	C	W	G
①	②	③	④	⑤	⑥	⑦

NO.	Explanation	
①	**GEMINI module indicating**	
②	**Module type:** 128 columns×128 rows， 6 DIGITS	
③	**GEMINI module series (**A,B,C,D…**)**	
④	**LCD type**	
	C	Positive, FSTN
⑤	**Backlight type**	
	C	Transflective，LED backlight
⑥	**Temperature range**	
	W	Wide temperature
⑦	**Technology**	
	G	COG

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2. Basic specification

2.1 Display type: FSTN

2.2 Display color*:

Display color: White

Background: Blue-Black

2.3 Polarizer mode: Transflective/Positive

2.4 Viewing Angle: 6:00

2.5 Driving Method: 1/128 Duty 1/11 Bias

2.6 LCD Operating Voltage: 13.0V VDD: 3.0V

2.7 Backlight: LED Backlight

2.8 Controller: UC1617

2.9 Data Transfer: Parellel ---8bit Bus & SPI

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

Storage Temperature: -30----+80℃

2.11 Outline Dimensions: Refer to outline drawing on next page

2.12 Dot Matrix: 128 X 128Dots

2.13 Dot Size: 0.17X0.2(mm)

2.14 Dot Pitch: 0.185X0.215 (mm)

2.15 Weight: Approx 15g

2.16 Key Life: 50000h

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

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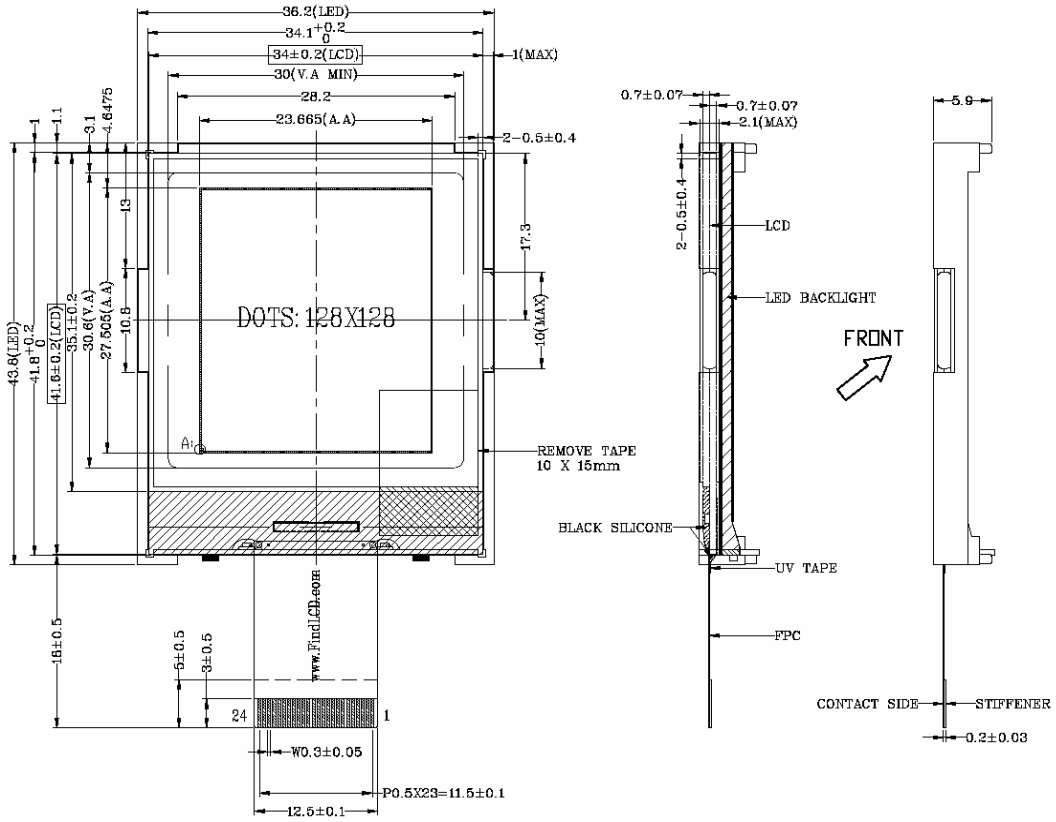
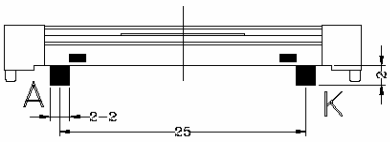
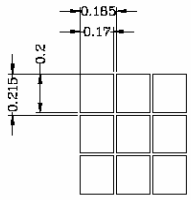
3. Outline Drawing



NO.	SYMBOLE
1	VSS
2	D0
3	D1
4	D2
5	D3
6	D4
7	D5
8	D6
9	D7
10	RST
11	CS0
12	CD
13	WR0
14	WR1
15	BM0
16	BM1
17	VSS
18	VDD
19	VB0+
20	VB1+
21	VB1-
22	VB0-
23	VLCD
24	VSS





DETAIL A
SCALE 20:1

NOTES:
1. DISPLAY TYPE: FSTN
2. VIEWING DIRECTION: 6:00
3. POLARIZER MODE: TRANSFLECTIVE/POSITIVE
4. DRIVE METHOD: 1/128 DUTY 1/11 BIAS
5. OPERATION VOLTAGE: VOP=13.0V VDD=3.0V
6. OPERATING TEMP.: -20°C~70°C
7. STORAGE TEMP.: -30°C~80°C
8. CONTROLLER: UC1617
9. CONNECTION: FPC
10. BACKLIGHT: LED(WHITE,30mA,3.6~4.0V)
X=0.283~0.330 Y=0.276~0.339
11. UNMARKED TOLERANCE: ±0.3mm
12. CONTROL DIMENSION MASK TO BE:
13. REQUIREMENTS ON ENVIRONMENTAL PROTECTION: RoHS
14. 8-BIT PARALLEL BI-DIRECTIONAL INTERFACE & SPI

REV	DESCRIPTION	DATE

DRAWN BY:	TITLE: TM128128B2CCWG	
CHECKED BY:		SCALE:
APPROVED BY:	DWG NO: G-1	UNIT: mm
CONFIRMED BY:	DWG NAME: TM128128B2CCWG G-1	SHEET NO: 1 OF 1

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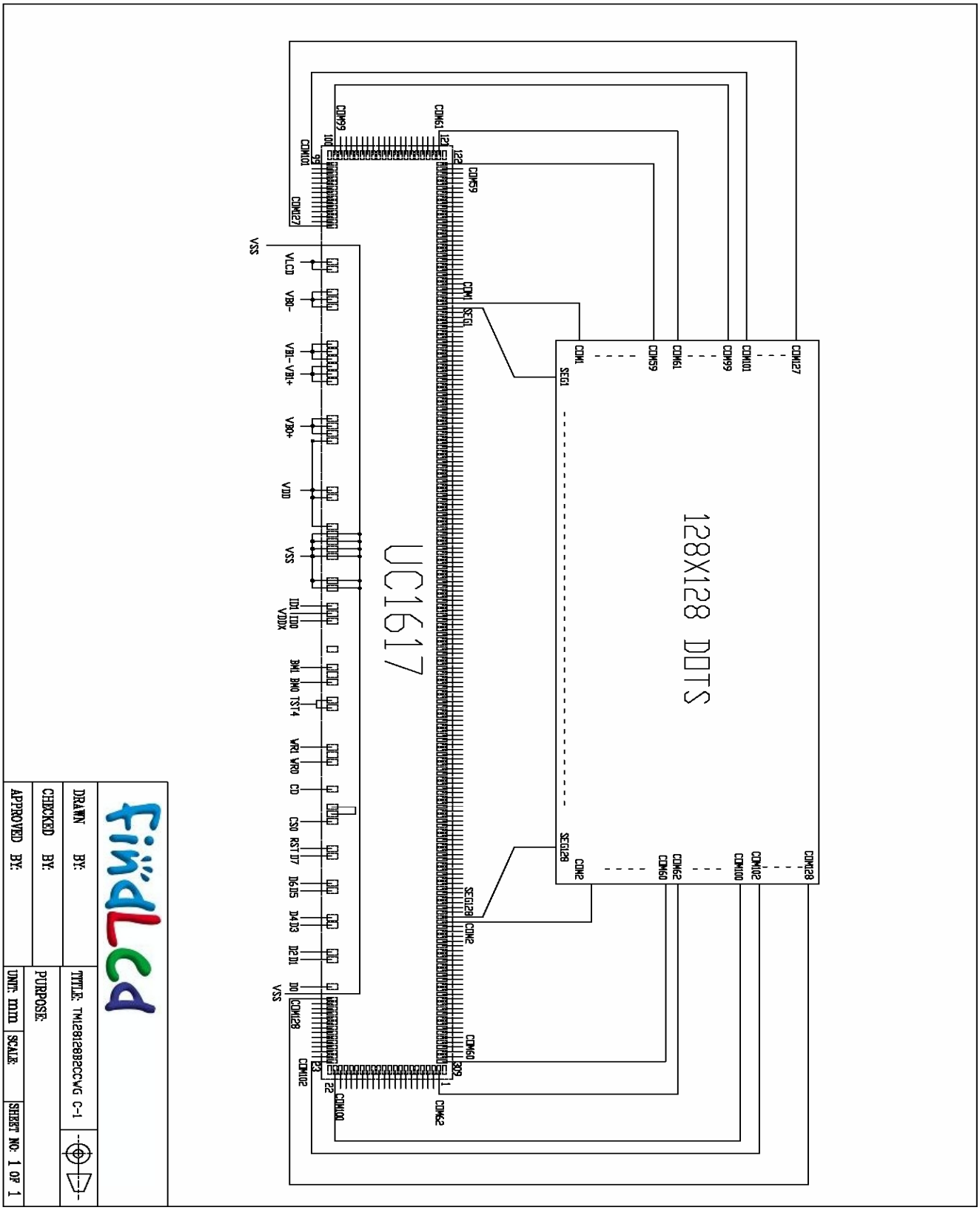
4. Circuit Block Diagram



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5. Absolute Maximum Ratings

Item	Symbol	Min.	Max.	Unit	Remark
Power Supply Voltage	$V_{DD}-V_{SS}$	0	3.6	V	
LCD Driving Voltage	V_{LCD}	0	15.0		
Operating Temperature Range	T_{OP}	-20	+70	℃	No Condensation
Storage Temperature Range	T_{ST}	-30	+80		

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6. Electrical Specifications and Instruction Code

6.1 Electrical characteristics

Item		Symbol	Min.	Typ.	Max.	Unit
Supply Voltage (Logic)		$V_{DD}-V_{SS}$	2.8	3.0	3.2	V
Supply Voltage (LCD Drive)		V_{LCD}	12.6	13.0	13.4	V
Input Signal Voltage	High	V_{IH} (V_{DD}=3.0)	0.8V_{DD}	-	V_{DD}+0.3	V
	Low	V_{IL} (V_{DD}=3.0)	-0.3	-	0.2 V_{DD}	V
Supply current (Logic) (Display Character)		I_{DD} ($V_{DD}-V_{SS}$ =3.0)	-	-	8.0	mA

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6.2 Interface Signals

Pin No.	Symbol	Level	Description
1	VSS	0V	Ground
2	D0	H/L	Data bit 0
3	D1	H/L	Data bit 1
4	D2	H/L	Data bit 2
5	D3	H/L	Data bit 3
6	D4	H/L	Data bit 4
7	D5	H/L	Data bit 5
8	D6	H/L	Data bit 6
9	D7	H/L	Data bit 7
10	RST	H/L	Power on reset
11	CS0	H/L	Chip select
12	CD	H/L	Select control data or Display data for read/write operation
13	WR0	H/L	Read / Write execution control pin
14	WR1	H/L	
15	BM0	H/L	Bus mode
16	BM1	H/L	
17	VSS	0V	Ground
18	VDD	3.0V	Power supply voltage for logic
19	VB0+	-	LCD Bias voltages
20	VB1+	-	
21	VB1-	-	
22	VB0-	-	
23	VLCD	-	LCD Power supply voltage
24	VSS	0V	Ground

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6.3 Interface Timing Chart

AC CHARACTERISTICS

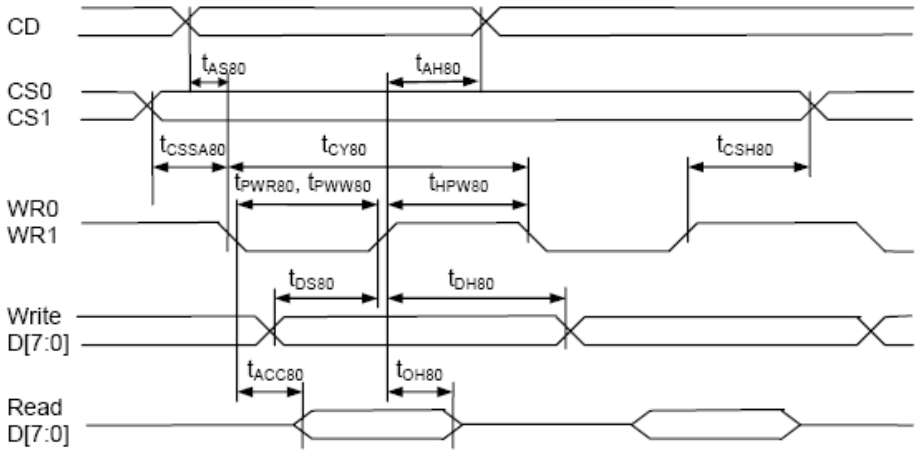

FIGURE 13: Parallel Bus Timing Characteristics (for 8080 MCU)

($2.5V \leqslant V_{DD} < 3.3V$, Ta= –30 to +85°C)

Symbol	Signal	Description	Condition	Min.	Max.	Units
t_{AS80} t_{AH80}	CD	Address setup time Address hold time		0 0	–	nS
t_{CY80}		System cycle time (read) (write)		170 130	–	nS
t_{PWR80}	WR1	Pulse width (read)		85	–	nS
t_{PWW80}	WR0	Pulse width (write)		65	–	nS
t_{HPW80}	WR0, WR1	High pulse width (read) (write)		85 65	–	nS
t_{DS80} t_{DH80}	D0~D7	Data setup time Data hold time		30 0	–	nS
t_{ACC80} t_{OH80}		Read access time Output disable time	C_L = 100pF	– –	65 30	nS
t_{CSSA80} t_{CSH80}	CS1/CS0	Chip select setup time Chip select hold time		5 5		nS

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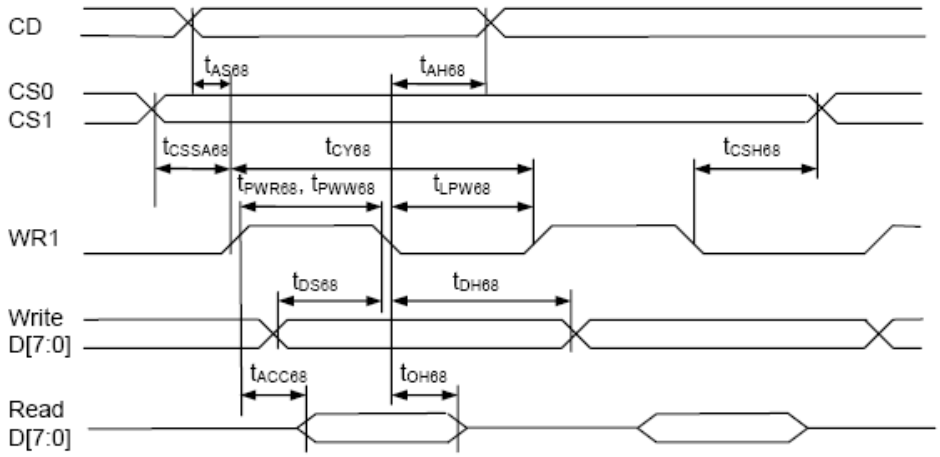

FIGURE 14: Parallel Bus Timing Characteristics (for 6800 MCU)

($2.5V \leqslant V_{DD} < 3.3V$, Ta= –30 to +85°C)

Symbol	Signal	Description	Condition	Min.	Max.	Units
t_{AS68} t_{AH68}	CD	Address setup time Address hold time		0 0	–	nS
t_{CY68}		System cycle time (read) (write)		170 130	–	nS
t_{PWR68}	WR1	Pulse width (read)		85	–	nS
t_{PWW68}		Pulse width (write)		65	–	nS
t_{LPW68}		Low pulse width (read) (write)		85 65	–	nS
t_{DS68} t_{DH68}	D0~D7	Data setup time Data hold time		30 0	–	nS
t_{ACC68} t_{OH68}		Read access time Output disable time	C_L = 100pF	– –	70 30	nS
t_{CSSA68} t_{CSH68}	CS1/CS0	Chip select setup time Chip select hold time		5 5		nS

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6.4 Instruction Code

COMMAND SUMMARY

The following is a list of host commands supported by UC1617

C/D: 0: Control, 1: Data
W/R: 0: Write Cycle, 1: Read Cycle

\# Useful Data bits
– Don't Care

	Command	C/D	W/R	D7	D6	D5	D4	D3	D2	D1	D0	Action	Default
1	Write Data Byte	1	0	#	#	#	#	#	#	#	#	Write 1 byte	N/A
2	Read Data Byte	1	1	#	#	#	#	#	#	#	#	Read 1 byte	N/A
3	Get Status	0	1	1	MX	MY	WA	DE	WS	MD	MS	Get {Status, Ver, PMO, Product Code, PID, MID}	N/A
				Ver		PMO[5:0]							
				Product Code				PID		MID			
4	Set Page_C Address	0	0	0	0	0	#	#	#	#	#	Set CA[4:0]	0H
5	Set Temp. Compensation	0	0	0	0	1	0	0	1	#	#	Set TC[1:0]	00b
6	Set Panel Loading	0	0	0	0	1	0	1	0	#	#	Set PC[1:0]	10b
7	Set Pump Control	0	0	0	0	1	0	1	1	#	#	Set PC[3:2]	11b
8	Set Adv. Program Control (double-byte command)	0	0	0	0	1	1	0	0	R	R	Set APC[R][7:0], R = 0, 1 or 2	N/A
		0	0	#	#	#	#	#	#	#	#		
9	Set Scroll Line LSB	0	0	0	1	0	0	#	#	#	#	Set SL[3:0]	0H
	Set Scroll Line MSB	0	0	0	1	0	1	-	#	#	#	Set SL[6:4]	0H
10	Set Row Address LSB	0	0	0	1	1	0	#	#	#	#	Set RA[3:0]	00H
	Set Row Address MSB	0	0	0	1	1	1	-	#	#	#	Set RA[6:4]	00H
11	Set V_{BIAS} Potentiometer (double-byte command)	0 0	0 0	1 #	0 #	0 #	0 #	0 #	0 #	0 #	1 #	Set PM[7:0]	4EH
12	Set Partial Display Control	0	0	1	0	0	0	0	1	#	#	Set LC[9:8]	00b: Disable
13	Set RAM Address Control	0	0	1	0	0	0	1	#	#	#	Set AC[2:0]	001b
14	Set Fixed Lines	0	0	1 #	0 #	0 #	1 #	0 #	0 #	0 #	0 #	Set {FLT, FLB}	0
15	Set Line Rate	0	0	1	0	1	0	0	0	#	#	Set LC[4:3]	00b
16	Set All-Pixel-ON	0	0	1	0	1	0	0	1	0	#	Set DC[1]	0b
17	Set Inverse Display	0	0	1	0	1	0	0	1	1	#	Set DC[0]	0b
18	Set Display Enable	0	0	1	0	1	0	1	1	#	#	Set DC[3:2]	10b
19	Set LCD Mapping Control	0	0	1	1	0	0	0	#	#	#	Set LC[2:0]	000b
20	Set N-Line Inversion	0	0	1 -	1 -	0 -	0 -	1 #	0 #	0 #	0 #	Set NIV[3:0]	6H
21	Set LCD Gray Shade	0	0	1	1	0	1	0	#	#	#	Set LC[7:5]	001b
22	System Reset	0	0	1	1	1	0	0	0	1	0	System Reset	N/A
23	NOP	0	0	1	1	1	0	0	0	1	1	No operation	N/A
24	Set Test Control (double-byte command)	0	0	1	1	1	0	0	1	TT		For testing only. Do not use.	N/A
		0	0	#	#	#	#	#	#	#	#		
25	Set LCD Bias Ratio	0	0	1	1	1	0	1	0	#	#	Set BR[1:0]	11b: 11
26	Reset Cursor Update Mode	0	0	1	1	1	0	1	1	1	0	AC[3]=0, CA=CR	AC[3]=0
27	Set Cursor Update Mode	0	0	1	1	1	0	1	1	1	1	AC[3]=1, CR=CA	AC[3]=1
28	Set COM End	0 0	0 0	1 -	1 #	1 #	1 #	0 #	0 #	0 #	1 #	Set CEN[6:0]	127
29	Set Partial Display Start	0 0	0 0	1 -	1 #	1 #	1 #	0 #	0 #	1 #	0 #	Set DST[6:0]	0
30	Set Partial Display End	0 0	0 0	1 -	1 #	1 #	1 #	0 #	0 #	1 #	1 #	Set DEN[6:0]	127
31	Set Window Program Starting Page_C Address	0 0	0 0	1 -	1 -	1 -	1 #	0 #	1 #	0 #	0 #	Set WPC0[4:0]	0
32	Set Window Programming Starting Row Address	0 0	0 0	1 -	1 #	1 #	1 #	0 #	1 #	0 #	1 #	Set WPP0[6:0]	0
33	Set Window Programming Ending Page_C Address	0 0	0 0	1 -	1 -	1 -	1 #	0 #	1 #	1 #	0 #	Set WPC1[4:0]	31

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	Command	C/D	W/R	D7	D6	D5	D4	D3	D2	D1	D0	Action	Default
34	Set Window Programming Ending Row Address	0 0	0 0	1 -	1 #	1 #	1 #	0 #	1 #	1 #	1 #	Set WPP1[6:0]	127
35	Enable window program	0	0	1	1	1	1	1	0	0	#	Set AC[4]	0: Disable
36	Set MTP Operation control	0 0	0 0	1 -	0 -	1 #	1 #	1 #	0 #	0 #	0 #	Set MTPC[5:0]	10H
37	Set MTP Write Mask	0 0	0 0	1 #	0 #	1 #	1 #	1 #	0 #	0 #	1 #	Set MTPM[7:0]	0
38	Set V_{MTP1} Potentiometer	0 0	0 0	1 #	1 #	1 #	1 #	0 #	1 #	0 #	0 #	Shared with Window Programming commands	N/A
39	Set V_{MTP2} Potentiometer	0 0	0 0	1 #	1 #	1 #	1 #	0 #	1 #	0 #	1 #		
40	Set MTP Write Timer	0 0	0 0	1 #	1 #	1 #	1 #	0 #	1 #	1 #	0 #		
41	Set MTP Read Timer	0 0	0 0	1 #	1 #	1 #	1 #	0 #	1 #	1 #	1 #		

Notes:

- Any other bit patterns other than the commands listed above may result in undefined behavior.
- The interpretation of commands (37)~(41) depends on register MTPC[3].
- Commands (38)~(41) are shared with commands (31)~(34) and have exactly the same code.
  When MTPC[3]=0, commands (38)~(41) are interpreted as *Window Programming* commands.
  When MTPC[3]=1, they are the *MTP Control* commands.
- MTPM and PM are actually the same register. Only one of the commands (37 or 11) is valid at any time, and it is determined by MTPC[3].
- After MTP-ERASE or MTP-PROGRAM operation, before resuming normal operation, please always
  a) Remove TST4 power source,
  b) Do a full V_{DD} ON-OFF-ON cycle.

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7. Optical Characteristics

7.1 Optical Characteristics Ta=25℃

Item		Symbol	Condition		Min.	Typ.	Max.	Unit
Viewing Angle		θ_x	Cr≥2	$\theta_y=0°$	-35 -- 20			**Deg**
		θ_y		$\theta_x=0°$	-30 -- 30			
Contrast Ratio		Cr	$\theta_x=0°$ $\theta_y=0°$		3.0	-	-	
Response Time	Turn on	Ton	$\theta_x=0°$ $\theta_y=0°$		-	-	350	ms
	Turn off	Toff			-	-	350	

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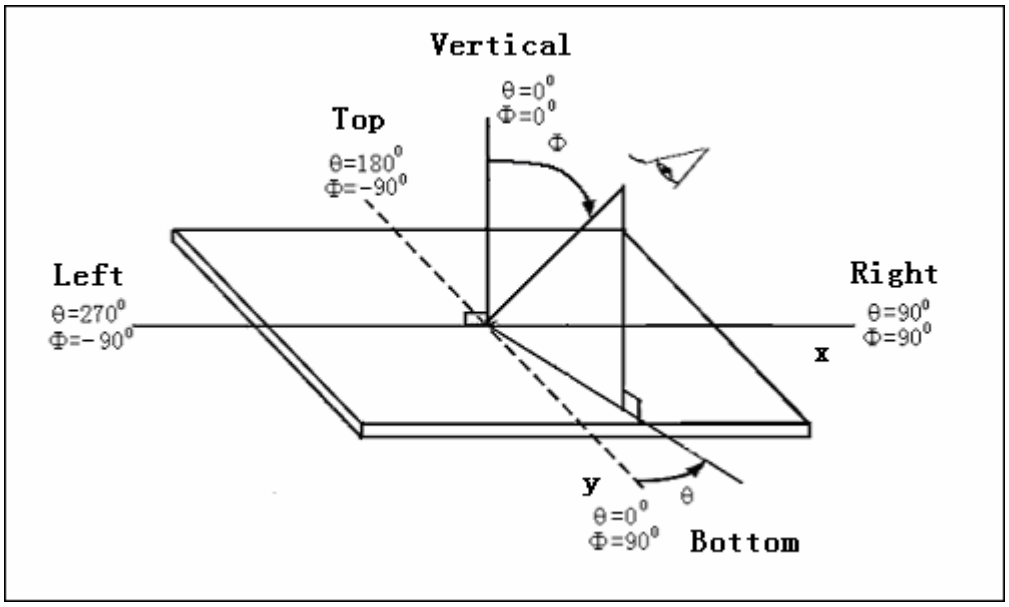
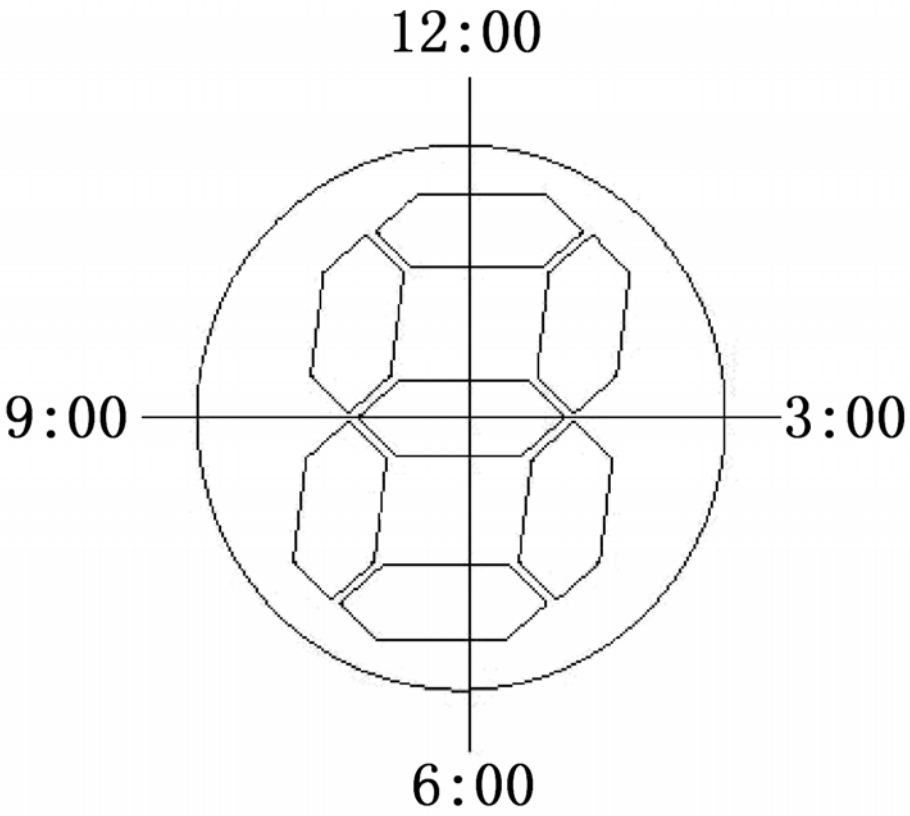
7.2 Definition of Optical Characteristics

7.2.1 Definition of Viewing Angle



7.2.2 Indication of Viewing Angle



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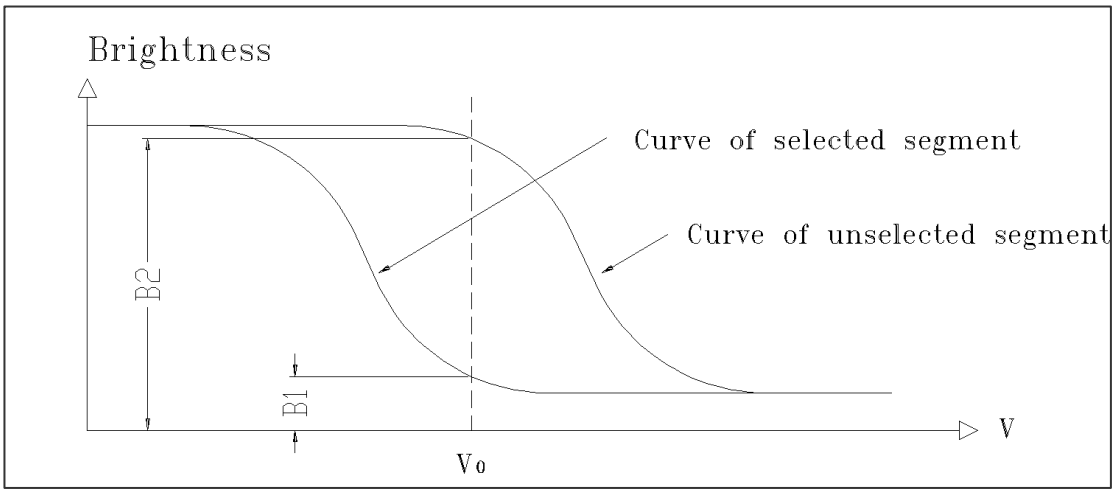
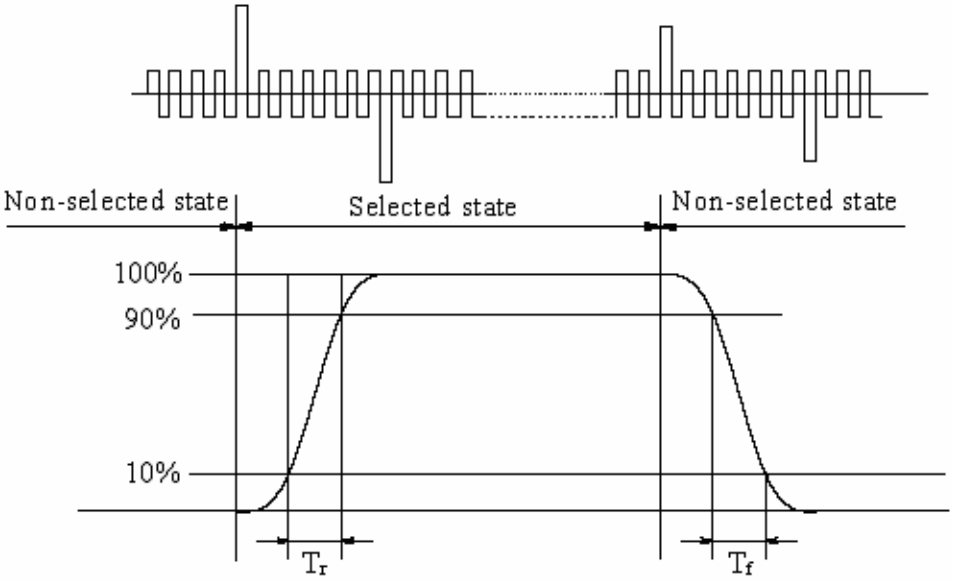
7.2.3 Definition of Contrast Ratio



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

Measuring Conditions:
1) Ambient Temperature: 25℃
2) Frame frequency: 70Hz
3) Operating voltage: Vop＝13.0V
4) Appling waveform: 1/128 duty 1/11 bias
5) View angle (θ , ϕ): (0^o, 0^o)

7.2.4 Definition of Response time Test (LCD using DMS501)



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

Measuring Condition:
1) Operating Voltage: Vop=13.0V
2) Frame frequency: 70Hz
3) Appling waveform: 1/128 duty 1/11 bias
4) View angle (θ , ϕ): (0^o, 0^o)

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8. Reliability

8.1 Content of Reliability Test

Ta=25℃

No.	Test Item	Content of Test	Test condition	Criterion
1	High Temperature Storage	Endurance test applying the high storage temperature for a long time	80℃ 240H	Remark1 Remark2 Remake3 Remake4
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 and 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	40℃ 90%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~150Hz, 100m/s^2, 120min	Remark1 Remark5 Remark6
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	

Notes:

1. Each test item applies for a test sample only once, The test sample can not be used again in any other test item.
2. The test sample is inspected after 2 hours or more storing at room temperature and room humidity after each test item is finished.
3. The criteria refer to 8.2.

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8.2 Inspection of criteria

Remark NO.	Content
1	Functional test is OK. Missing Segment, shorts, unclear segment, nondisplay, display abnormally, liquid crystal leak are unallowable.
2	After testing, cosmetic defects should not happen, no low temperature bubbles, seal loose and fall, frame rainbow, ACF bubble growing are unallowable in the appearance test.
3	Total current consumption should not be over 10% of initial value.
4	After tests being executed, Contrast must be larger than 70% of its initial value prior to the tests.
5	No glass crack, chipped glass, end seal loose frame crack and so on.
6	No structure loose and fall.

8.3 LCD module service life

Functions, performance, appearance, etc. shall be free from remarkable deterioration within 100,000 hours under ordinary operating and storage conditions room temperature (25℃±10℃).

8.4 Definition of module service life

- Contrast becomes 30% of initial value.
- Current consumption becomes threes times higher than initial value.
- Remarkable alignment deterioration occurs in LCD cell layer.
- Unusual operation occurs in display functions

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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 annex A			II	Major 1.0 Minor 2.5
Display Defects	Under normal illumination and eyesight condition, display on inspection.	See annex 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**						

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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 Liquid in LCD is hazardous substance, 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, thoroughly and 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 Don't touch, push or rub the exposed polarizer covering the display surface of the LCD module with anything harder than an HB pencil lead, the polarizer is soft and easily scratched, handle it carefully.

10.1.5 Don't put or attach anything on the display area to avoid leaving any marks on.

10.1.6 If the display surface is contaminated or becomes dusty, breathe on the surface and gently wipe it with a soft dry cloth. do not scrub hard to avoid damage the surface. 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

10.1.7 Do not attempt to disassemble the LCD Module.

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

10.1.9 Avoid using the same display pattern long time (continous ON segment).Software must be prepared so that the pattern will be changed

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

a. Be sure to ground the body and electric appliances when handling the LCD Modules. It is preferable to use conductive mat on table and wear cotton clothes or conductive processed fibre. Synthetic fibre is not recommended.

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 careful and slow when peeling off this protective film since static electricity may be generated. It is recommended to use ionic fan or machine when operating. It is recommended to remove the protection foil slowly (> 3 sec.).

e. It is preferable to wear gloves etc, to avoid damaging the LCD. Please do not touch electrodes with bare hands or avoid any other contamination.

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:

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Temperature : 5℃ ～ 40℃
Relatively humidity: ≤80%

10.2.3 The LCD modules should be stored in a clean environment or room, free from acid, alkali and harmful gas.

10.2.4 Store the module in anti-static electricity container and without any physical load.

10.3 Transportation precautions

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

10.4 Soldering

10.4.1 Use the high quality solders, only solder the I/O terminals.

10.4.2 No higher than 280℃ and time less than 3-4 second during soldering.

10.4.3 Rewiring: no more than 3 times.

10.4.4 when you remove connector or cable soldered to I/O terminals, please confirm that solder is fully melted. If you remove by force, electrodes at I/O terminals may be damaged (or stripped off). It is recommended to use solder suction machine.

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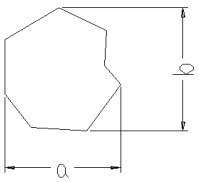
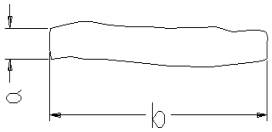
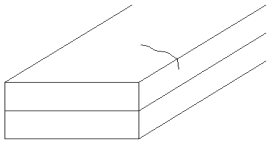
Appendix A

Inspection items and criteria for appearance defects

Items	Contents	Criteria		
Protective Glue		No clear defects		
Cover Tape		Covering all of the chip and no clear crimple		
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	
		ϕ<0.3mm	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<0.20mm	0.20mm≤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		

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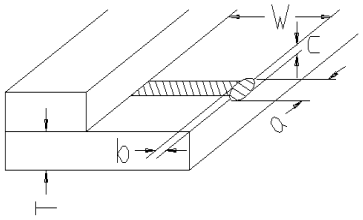
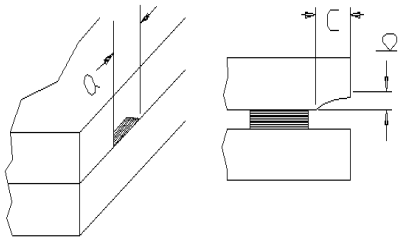
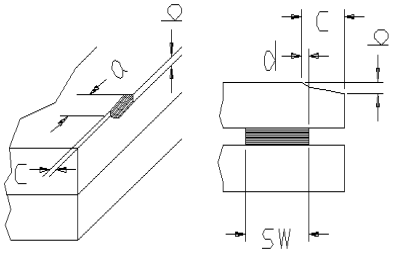
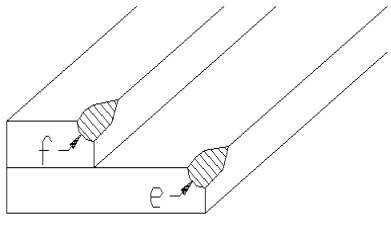
Appendix A (continued)

<table>
<tr><th>Item</th><th>Contents</th><th colspan="5">Criteria</th></tr>
<tr><td rowspan="4">Glass Cracks</td><td>Cracks on pads
 
</td><td>a</td><td>b</td><td>c</td><td>Max. 2 Cracks allowed</td><td rowspan="4">Max. 5 cracks allowed</td></tr>
<tr><td></td><td>≤3mm</td><td>≤W/5</td><td>≤T/2</td><td></td></tr>
<tr><td></td><td>≤2mm</td><td>≤W/5</td><td>T/2<C<T</td><td></td></tr>
<tr><td>Cracks on contact side
 
</td><td colspan="2">a</td><td colspan="2">b</td><td rowspan="3">Max. 2 cracks allowed</td></tr>
<tr><td colspan="2">≤3mm</td><td colspan="2">≤T/2</td></tr>
<tr><td colspan="2">≤2mm</td><td colspan="2">T/2<b<T</td></tr>
<tr><td>Cracks on non-contact side
 
</td><td colspan="4">C shall be not reach the seal area</td></tr>
<tr><td></td><td colspan="2">a</td><td colspan="2">b</td><td rowspan="4">Max. 2 cracks allowed</td></tr>
<tr><td></td><td colspan="2">≤3mm</td><td colspan="2">≤T/2</td></tr>
<tr><td></td><td colspan="2">≤2mm</td><td colspan="2">T/2<b<T</td></tr>
<tr><td></td><td colspan="4">C≤0.5mm
d≤SW/3</td></tr>
<tr><td>Corner cracks
 
</td><td colspan="4">e<2.0mm^2
f<2.0mm^2</td><td>Max. 3 cracks allowed</td></tr>
</table>

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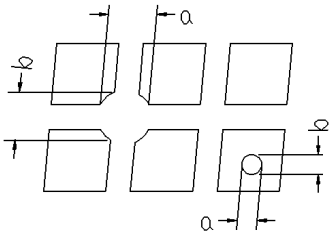
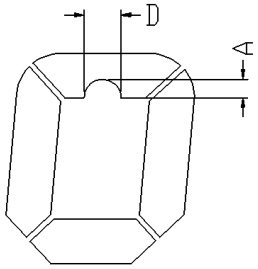
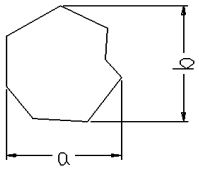
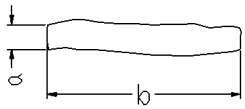
Appendix B

Inspection items and criteria for display defects

<table>
<tr><th colspan="2">Items</th><th colspan="3">Contents</th><th>Critera</th></tr>
<tr><td colspan="2">Open segment or open common</td><td colspan="3"></td><td>Not permitted</td></tr>
<tr><td colspan="2">Short</td><td colspan="3"></td><td>Not permitted</td></tr>
<tr><td colspan="2">Wrong viewing angle</td><td colspan="3"></td><td>Not permitted</td></tr>
<tr><td colspan="2">Contrast radio uneven</td><td colspan="3"></td><td>According to the limit specimen</td></tr>
<tr><td colspan="2">Crosstalk</td><td colspan="3"></td><td>According to the limit specimen</td></tr>
<tr><td rowspan="4">Pin holes and cracks in segment (DOT)</td><td rowspan="3">  </td><td colspan="2">Not counted</td><td>Max.3 dots allowed</td><td rowspan="4">Max.3 dots allowed</td></tr>
<tr><td>X<0.1mm</td><td>0.1mm≤X≤0.2mm</td></tr>
<tr><td colspan="2">X=(a+b)/2</td></tr>
<tr><td>  </td><td>Not counted</td><td>Max.2 dots allowed</td></tr>
<tr><td>A<0.1mm</td><td>0.1mm≤A≤0.2mm
D<0.25mm</td></tr>
<tr><td rowspan="3">Black spot (in viewing area)</td><td rowspan="3">  </td><td colspan="2">Not counted</td><td>Max.3 spots allowed</td><td rowspan="4">Max.3 spots (lines) allowed</td></tr>
<tr><td>X<0.1mm</td><td>0.1mm≤X≤0.2mm</td></tr>
<tr><td colspan="2">X=(a+b)/2</td></tr>
<tr><td rowspan="2">Black line (in viewing area)</td><td rowspan="2">  </td><td colspan="2">Not counted</td><td>Max.3 lines allowed</td></tr>
<tr><td>a<0.02mm</td><td>0.02mm≤a≤0.05mm
b≤0.5mm</td></tr>
</table>

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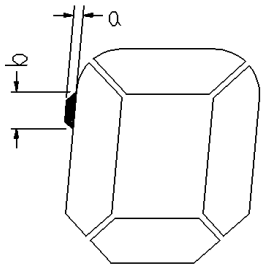
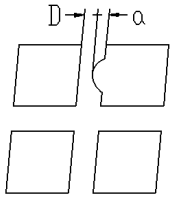
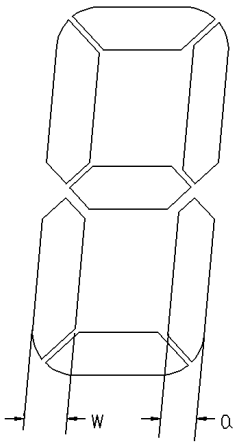
Appendix B (continued)

<table>
<tr><th>Items</th><th>Content</th><th colspan="3">Critera</th></tr>
<tr><td rowspan="3">Transfor-
mation
of segment</td><td rowspan="2">  </td><td>Not counted</td><td>Max. 2 defects allowed</td><td rowspan="3">Max.3
defects
allowe
d</td></tr>
<tr><td>x＜0.1mm</td><td>0.1mm≤x≤0.2mm</td></tr>
<tr><td colspan="2">x=(a+b)/2</td></tr>
<tr><td rowspan="2">  </td><td>Not counted</td><td>Max. 1 defects allowed</td></tr>
<tr><td>a＜0.1mm</td><td>0.1mm≤a≤0.2mm
D>0</td></tr>
<tr><td>  </td><td colspan="3">Max.2 defects allowed
0.8W≤a≤1.2W

a = measured value of width
W = nominal value of width</td></tr>
</table>

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