

SPECIFICATION FOR LCD MODULE

Model No. [TM128160EKFWG1](#)

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

TIANMA MICROELECTRONICS CO., LTD

REVISION RECORD

Date	Ver.	Ref. Page	Revision No.	Revision Items

1. General Specifications:

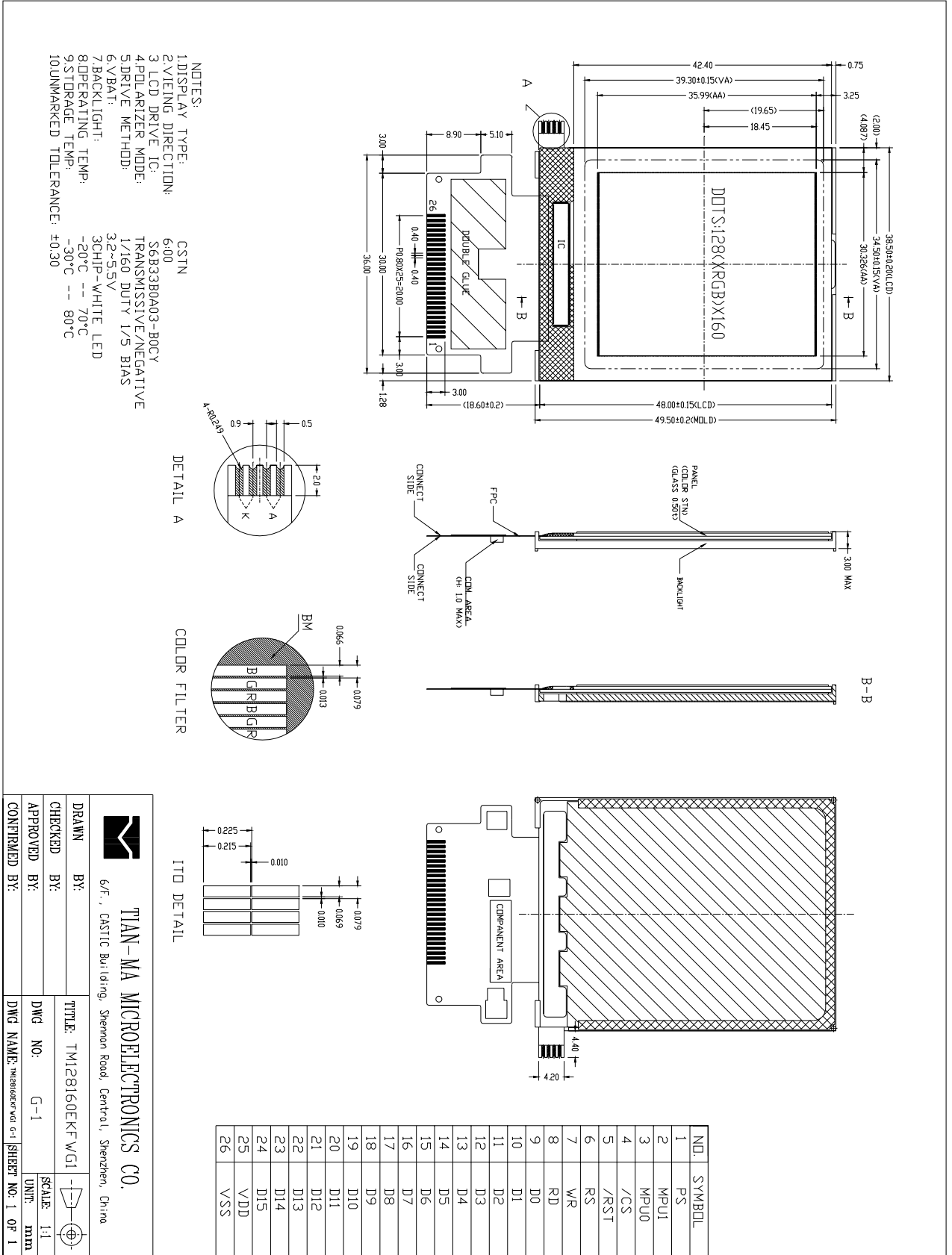
- 1.1 Display type: COLOR STN
- 1.2 Display color*¹:
 - Display color: 65K COLOR
 - Background*²: Black (Red, Green, Blue dots are off state)
- 1.3 Polarizer mode: Transmissive/Negative
- 1.4 Viewing Angle: 6:00
- 1.5 Driving Method: 1/160 Duty 1/5 Bias
- 1.6 Backlight Type: LED (3 LAMPS)
 - Backlight Color: WHITE
- 1.7 Controller: S6B33B0A03-B0CY
- 1.8 Data Transfer: 8/16 Bits Parallel or 3/4-PIN Serial Interface
- 1.9 Operating Temperature: -20~+70°C
 - Storage Temperature: -30~+80°C
- 1.10 Power Supply Voltage: VDD=3.0V
- 1.11 LCD Operating Voltage: VLCD=16.8V
- 1.12 Outline Dimensions: Refer to outline drawing on next page
- 1.13 Dot Matrix: 128×3 (RGB)×160 Dots
- 1.14 Dot Size: 0.227(R+G+B)×0.215(mm²)
- 1.15 Dot Pitch: 0.237×0.225 (mm²)
- 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.

2. Outline Drawing



- NOTES:
- 1.DISPLAY TYPE: CSTN
 - 2.VIEWING DIRECTION: 6:00
 - 3.LCD DRIVE IC: S6B33B0A03-BOCY
 - 4.POLARIZER MODE: TRANSMISSIVE/NEGATIVE
 - 5.DRIVE METHOD: 1/160 DUTY 1/5 BIAS
 - 6.VBAT: 3.2~5.5V
 - 7.BACKLIGHT: CHIP-WHITE LED
 - 8.OPERATING TEMP: -20°C -- 70°C
 - 9.STORAGE TEMP: -30°C -- 80°C
 - 10.UNMARKED TOLERANCE: ±0.30

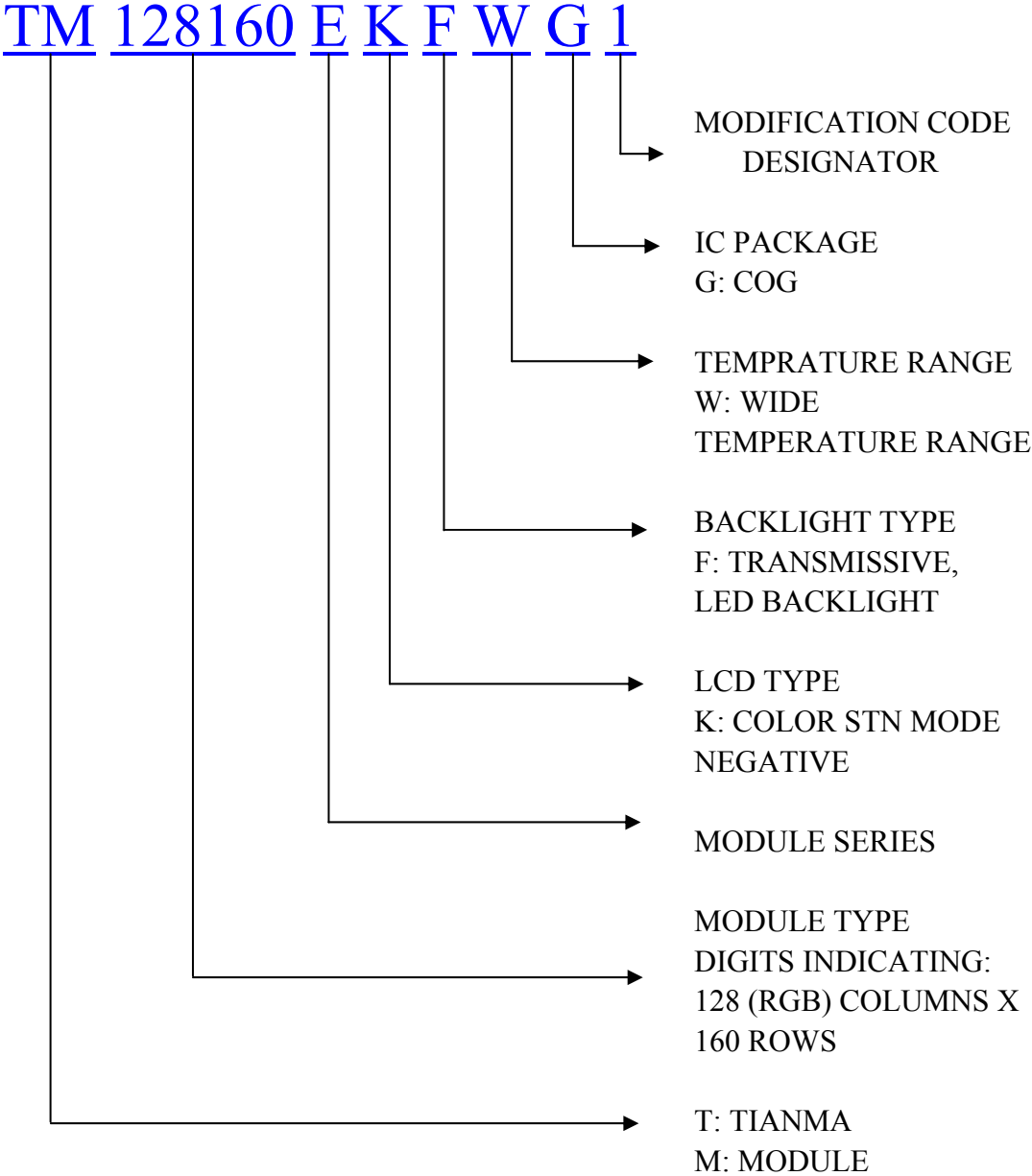
NO.	SYMBOL
1	PS
2	MPUI
3	MPU0
4	/CS
5	/RST
6	RS
7	WR
8	RD
9	D0
10	D1
11	D2
12	D3
13	D4
14	D5
15	D6
16	D7
17	D8
18	D9
19	D10
20	D11
21	D12
22	D13
23	D14
24	D15
25	VDD
26	VSS

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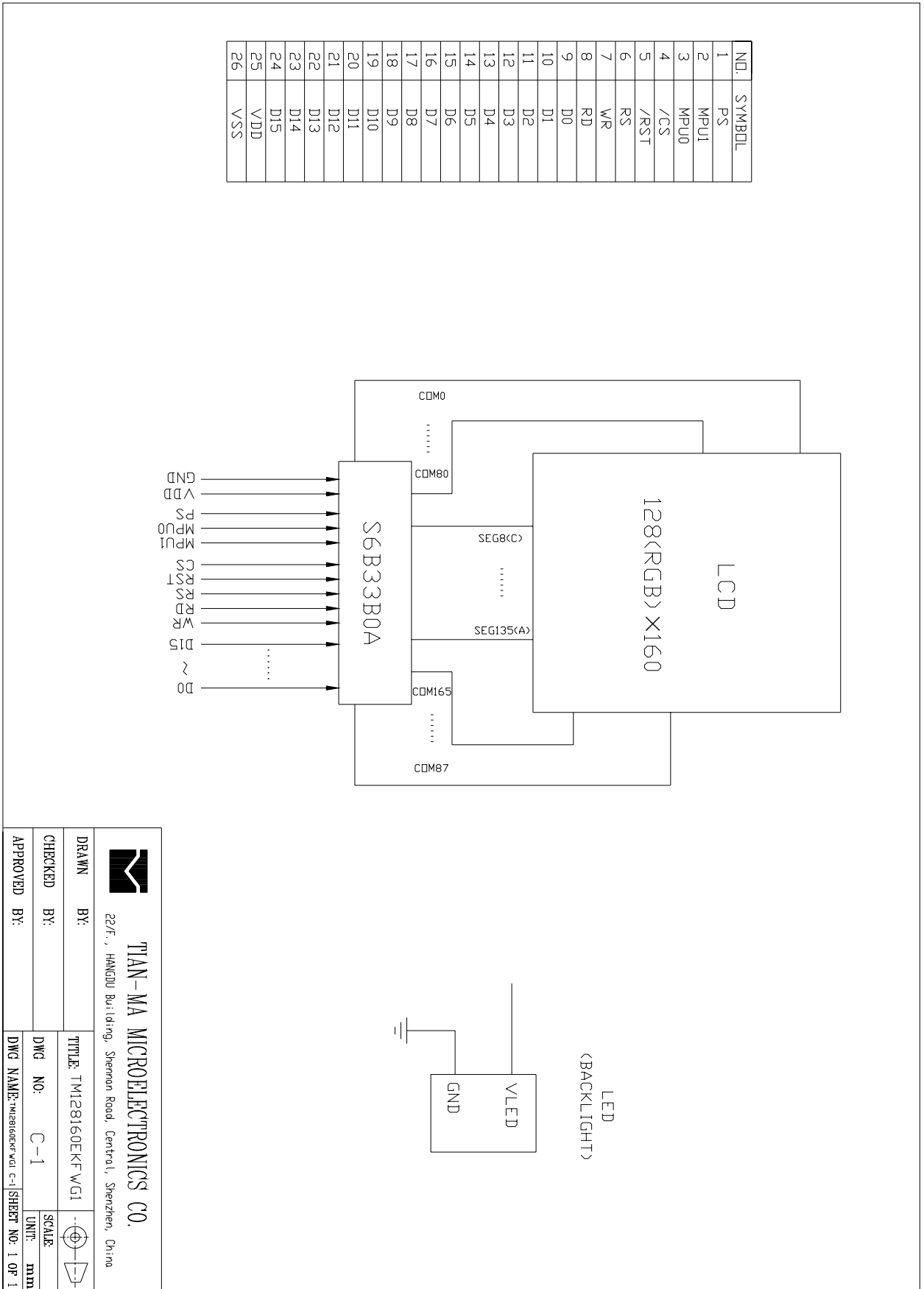
6/F., CASTIC Building, Sheppan Road, Central, Shenzhen, China

DRAWN BY:		TITLE: TM128160EKF W/G1	SCALE: 1:1
CHECKED BY:		DWG NO: G-1	UNIT: mm
APPROVED BY:		DWG NAME: tm128160e-kg1	SHEET NO: 1 OF 1
CONFIRMED BY:			

3. LCD Module Part Numbering System



4. Circuit Block Diagram



5. Absolute Maximum Ratings

Ta=25°C

Item	Symbol	Min.	Max.	Unit	Remark
Power Supply Voltage	V _{DD} -V _{SS}	-0.3	+4.6	V	
LCD Driving Voltage	V _{LCD}	-0.3	+20.0		
Operating Temperature Range	T _{OP}	-20	+70	°C	No Condensation
Storage Temperature Range	T _{ST}	-30	+80		

6. Electrical Specifications and Instruction Code

6.1 Electrical characteristics

$V_{SS}=0V$, $T_a=25^{\circ}C$

Item	Symbol	Min.	Typ.	Max.	Unit	
Supply Voltage (Logic)	$V_{DD}-V_{SS}$	+3.1	+3.6	+4.5	V	
Supply Voltage (LCD Drive)	V_{LCD}	-	16.8	-	V	
Input Signal Voltage	High	V_{IH} ($V_{DD}=3.0$)	$0.8V_{DD}$	-	V_{DD}	V
	Low	V_{IL} ($V_{DD}=3.0$)	0	-	$0.2V_{DD}$	V
Supply current (Logic)	I_{DD} ($V_{DD}-V_{SS}=3.0V$)	-	-	2.5	mA	
Oscillator frequency range	f_{osc}	220	-	330	KHz	
Supply Voltage (LED)	V_{LED}	-	10.0	-	V	
Supply current (LED)	I_{LED}		15.0	20.0	mA	

6.2 Interface Signals

6.2.1 CN1 (FPC)

Pin No.	Symbol	Level	Description			
1	PS	H/L	PS	MPU1	MPU0	MPU inter-face select
			H	L	L	8080-series 8bit interface
2	MPU1	H/L	H	L	H	8080-series 16bit interface
			H	H	L	6800-series 8bit interface
3	MPU0	H/L	H	H	H	6800-series 16bit interface
			L	L	X	3 pin SPI(Write only)
			L	H	X	4 pin SPI(Write only)
4	CS	H/L	Chip select: Low active			
5	RST	H/L	Reset pin: Low active			
6	RS	H/L	Index register / Data command select			
7	WR(R/W)	H/L	6800-series		ReadWRBite control input pin	
			8080-series		Write enable clock input pin	
8	RD(E)	H/L	6800-series		Read / Write control input pin	
			8080-series		Read enable clock input pin	
9	DB0	H/L	Data bus bit 0-7. Only DB[7:6] are valid in serial interface mode (DB[5:0]: high impedance, DB[6]: serial clock, DB[7]: serial data).			
10	DB1	H/L				
11	DB2	H/L				
12	DB3	H/L				
13	DB4	H/L				
14	DB5	H/L				
15	DB6	H/L				
16	DB7	H/L				
17	DB8	H/L	Data bus bit 8-15. Connect DB[15:8] “low” only in 8-series parallel interface mode.			
18	DB9	H/L				
19	DB10	H/L				
20	DB11	H/L				
21	DB12	H/L				
22	DB13	H/L				
23	DB14	H/L				
24	DB15	H/L				

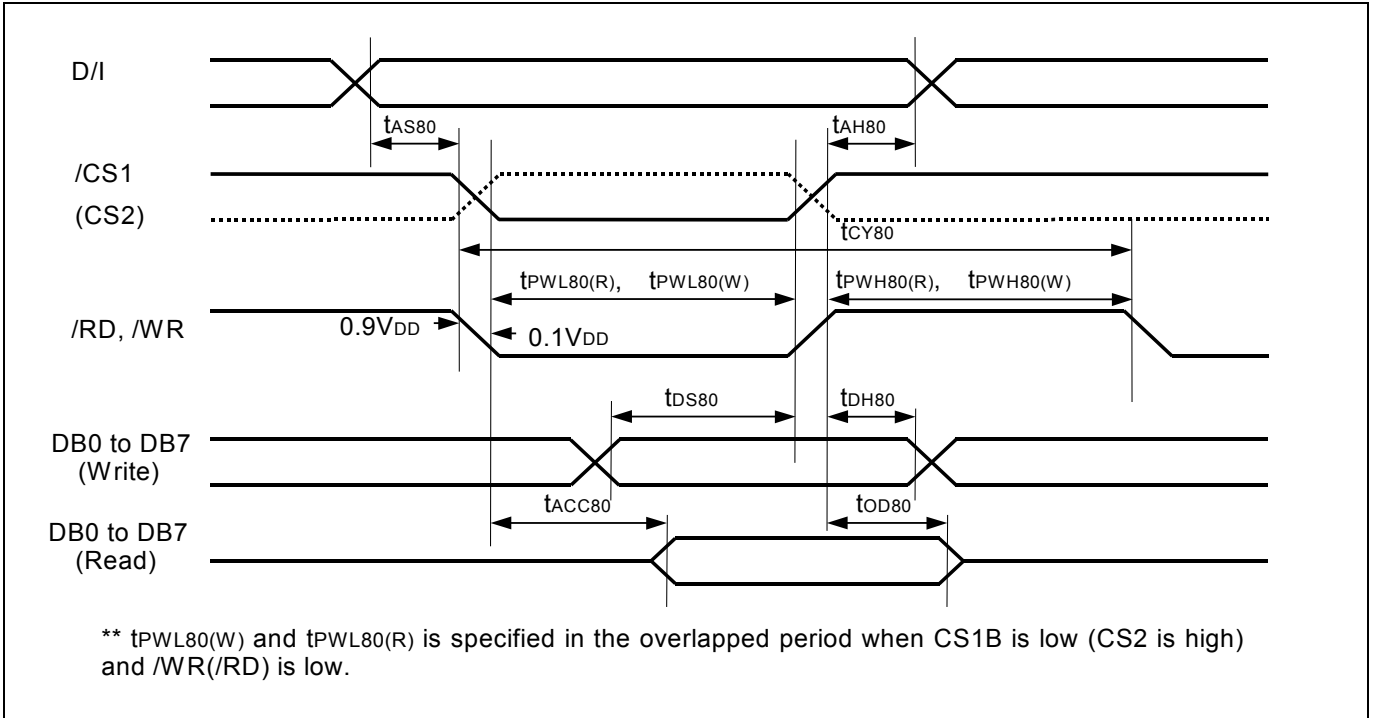
25	VDD	3.0V	Main power supply, 3VDC
26	VSS	0V	Ground

6.2.2 CN2 (LED)

Pin No.	Symbol	Level	Description
1, 2	CATHODE	0V	LED CATHODE
3, 4	ANODE	10.0V	LED ANODE

6.3 Interface Timing Chart

Read / Write Characteristics (8080-series MPU)



Parallel Interface (8080-series MPU) Timing Diagram

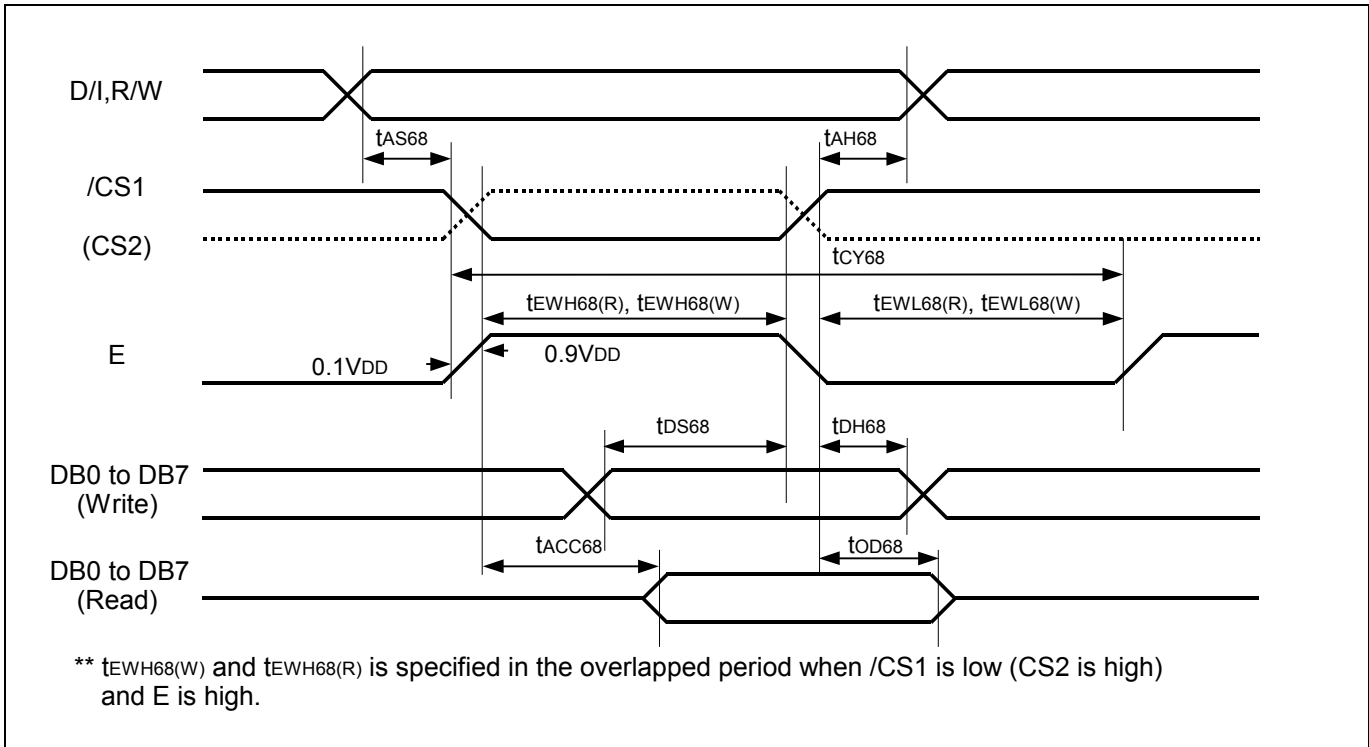
AC Characteristics (8080-series Parallel Mode)

($V_{DD3} = 1.8$ to $3.3V$, $T_a = -30$ to $+70^\circ C$)

Item	Signal	Symbol	Condition	Min.		Max. (3.3V/1.8V)	Unit
				3.3V	1.8V		
Address setup time Address hold time	D/I	t_{AS80} t_{AH80}		0 0	0 0	- -	ns
System cycle time		t_{CY80}		150	360	-	ns
Pulse width low for write Pulse width High for write	WRB (WRB)	t_{PWLW} t_{PWHW}		50 30	100 75	- -	ns
Pulse width low for read Pulse width high for read	RDB (RDB)	$t_{PWL R}$ $t_{PWH R}$		50 30	100 75	- -	ns
Data setup time Data hold time	DB0 to DB15	t_{DS80} t_{DH80}		5 8	10 14	- -	ns
Read access time Output disable time		t_{ACC80} t_{OD80}	CL = 100 pF	-	60 / 120		ns
				t_{EWHR}			

NOTE: *1. The input signal rise time and fall time (t_r , t_f) is specified at 10 ns or less.
 $(t_r + t_f) < (t_{CY80} - t_{PWLW} - t_{PWHW})$ for write, $(t_r + t_f) < (t_{CY80} - t_{PWL R} - t_{PWH R})$ for read

Read / Write Characteristics (6800-series Microprocessor)



Parallel Interface (6800-series MPU) Timing Diagram

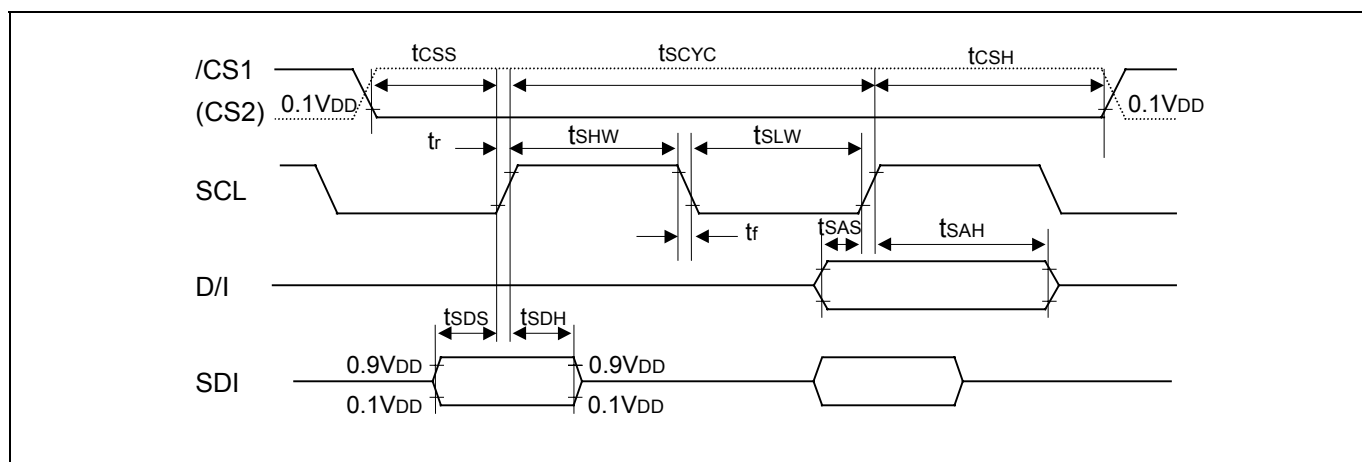
AC Characteristics (6800-series Parallel Mode)

(V_{DD3} = 1.8 to 3.3V, T_a = -30 to +70°C)

Item	Signal	Symbol	Condition	Min.		Max. (3.3V/1.8V)	Unit
				3.3V	1.8V		
Address setup time	D/I	t_{AS68}		0	0	-	ns
Address hold time	R/W	t_{AH68}		0	0	-	ns
System cycle time		t_{CY68}		150	360	-	ns
Enable width high for write	RDB	t_{EWHW}		50	100	-	ns
Enable width low for write	(E)	t_{EWLW}		30	75	-	ns
Enable width high for read	RDB	t_{EWHR}		50	100	-	ns
Enable width low for read	(E)	t_{EWLR}		30	75	-	ns
Data setup time	DB0 to DB15	t_{DS68}		5	10	-	ns
Data hold time		t_{DH68}		8	14	-	ns
Read access time	DB0 to DB15	t_{ACC68}	C _L = 100 pF	-		60 / 120	ns
Output disable time		t_{OD68}		t_{EWLR}			

NOTE: *1. The input signal rise time and fall time (t_r , t_f) is specified at 10 ns or less.
 $(t_r + t_f) < (t_{CY68} - t_{EWHW} - t_{EWLW})$ for write, $(t_r + t_f) < (t_{CY68} - t_{EWHR} - t_{EWLR})$ for read

Serial Data Interface Timing



Serial Data Interface Timing

(VDD3 = 1.8 to 3.3V, Ta = -30 to +70°C)

Item	Signal	Symbol	Condition	Min.	Max.	Unit
SCL Cycle Time	SCL	t_{csc}		50	-	ns
SCL High Pulse Width	SCL	t_{shw}		20	-	ns
SCL Low Pulse Width	SCL	t_{slw}		20	-	ns
SDI Setup time	SDI	t_{sds}		20	-	ns
SDI Hold time	SDI	t_{sdh}		20	-	ns
D/I Setup time	D/I	t_{sas}		20	-	ns
D/I Hold time	D/I	t_{sah}		20	-	ns
Chip Select Setup time	CS1B(CS2)	t_{css}		20	-	ns
Chip Select Hold time	CS1B(CS2)	t_{chs}		20	-	ns

6.4 Instruction code

Instruction Table

Instruction Name	D/I	WRB	RDB	DB15 ~ DB8	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Hex.	Parameter
Non Operation	0	0	1	*	0	0	0	0	0	0	0	0	00	
Oscillation Mode Set	0	0	1	*	0	0	0	0	0	0	1	0	02	1Byte
Driver Output Mode Set	0	0	1	*	0	0	0	1	0	0	0	0	10	1Byte
DC-DC Select	0	0	1	*	0	0	1	0	0	0	0	0	20	1Byte
Bias Set	0	0	1	*	0	0	1	0	0	0	1	0	22	1Byte
DCDC Clock Division Set	0	0	1	*	0	0	1	0	0	1	0	0	24	1Byte
DCDC and AMP ON/OFF set	0	0	1	*	0	0	1	0	0	1	1	0	26	1Byte
Temperature Compensation Set	0	0	1	*	0	0	1	0	1	0	0	0	28	1Byte
Contrast Control(1)	0	0	1	*	0	0	1	0	1	0	1	0	2A	1Byte
Contrast Control(2)	0	0	1	*	0	0	1	0	1	0	1	1	2B	1Byte
Standby Mode OFF	0	0	1	*	0	0	1	0	1	1	0	0	2C	-
Standby Mode ON	0	0	1	*	0	0	1	0	1	1	0	1	2D	-
DDRAM Burst Mode OFF	0	0	1	*	0	0	1	0	1	1	1	0	2E	-
DDRAM Burst Mode ON	0	0	1	*	0	0	1	0	1	1	1	1	2F	-
Addressing Mode Set	0	0	1	*	0	0	1	1	0	0	0	0	30	1Byte
ROW Vector Mode Set	0	0	1	*	0	0	1	1	0	0	1	0	32	1Byte
N-line Inversion Set	0	0	1	*	0	0	1	1	0	1	0	0	34	1Byte
Entry Mode Set	0	0	1	*	0	1	0	0	0	0	0	0	40	1Byte
X-address Area Set	0	0	1	*	0	1	0	0	0	0	1	0	42	2Byte
Y-address Area Set	0	0	1	*	0	1	0	0	0	0	1	1	43	2Byte
RAM Skip Area Set	0	0	1	*	0	1	0	0	0	1	0	1	45	1Byte
Display OFF	0	0	1	*	0	1	0	1	0	0	0	0	50	-
Display ON	0	0	1	*	0	1	0	1	0	0	0	1	51	-
Specified Display Pattern Set	0	0	1	*	0	1	0	1	0	0	1	1	53	1Byte
Partial Display Mode Set	0	0	1	*	0	1	0	1	0	1	0	1	55	1Byte
Partial Display Start Line Set	0	0	1	*	0	1	0	1	0	1	1	0	56	1Byte
Partial Display End Line Set	0	0	1	*	0	1	0	1	0	1	1	1	57	1Byte
Area Scroll Mode Set	0	0	1	*	0	1	0	1	1	0	0	1	59	4Byte
Scroll Start Line Set	0	0	1	*	0	1	0	1	1	0	1	0	5A	1Byte
Set Display Data Length	X	X	X	*	1	1	1	1	1	1	0	0	FC	1Byte
Display Data Write	1	0	1	Display Data Write									-	-
Display Data Read	1	1	0	Display Data Read									-	-
Status Read	0	1	0	0	Status Data Read								-	-
Test Mode1	0	0	1	*	1	1	1	1	1	1	1	1	FF	-
Test Mode2	0	0	1	*	1	1	1	1	1	1	1	0	FE	-
Test Mode3	0	0	1	*	1	1	1	1	1	1	0	1	FD	-
Test Mode4	0	0	1	*	1	1	1	1	1	0	1	1	FB	-
Test Mode5	0	0	1	*	1	1	1	1	1	0	1	0	FA	-
Test Mode6	0	0	1	*	1	1	1	1	1	0	0	1	F9	-

*: Don't care

Parameter: The number of parameter bytes that follows instruction data.

7. Optical Characteristics

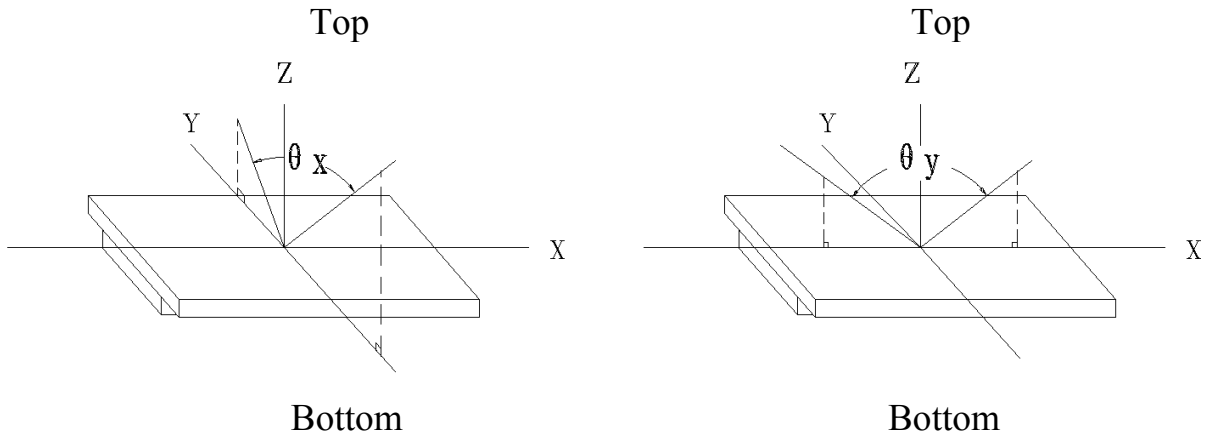
7.1 Optical Characteristics

V_{LCD}=16.8V Ta=25°C

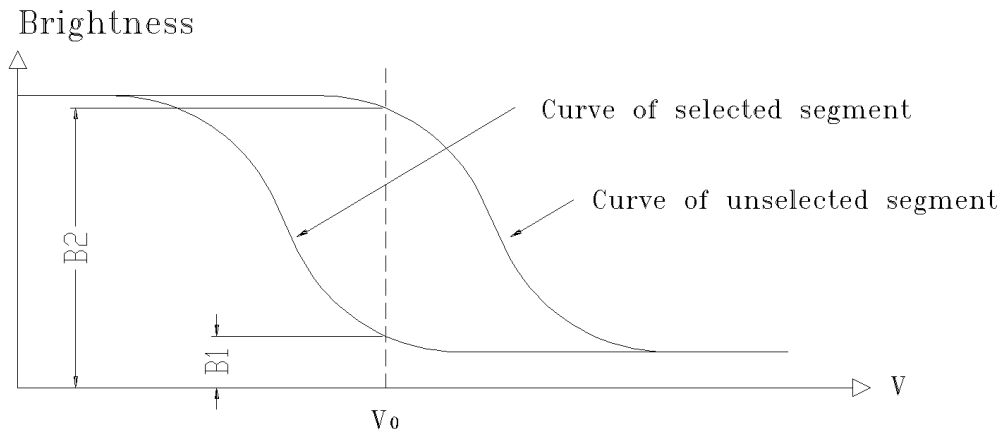
Item		Symbol	Condition	Min.	Typ.	Max.	Unit
Viewing Angle		θ_x	$C_r \geq 2$	$\theta_y = 0^\circ$		-45 -- +30	Deg
		θ_y		$\theta_x = 0^\circ$		-50 -- +50	
Contrast Ratio		C_r	$\theta_x = 0^\circ$ $\theta_y = 0^\circ$	-	30	-	
Response Time	Turn on	T_{on}	$\theta_x = 0^\circ$ $\theta_y = 0^\circ$	-	-	300	ms
	Turn off	T_{off}		-	-	200	
Color Of CIE Coord-Inate	Red	x	$\theta_x = 0^\circ$	-	0.53	-	cd/m ²
		y	$\theta_y = 0^\circ$	-	0.37	-	
	Green	x	$\theta_x = 0^\circ$	-	0.31	-	cd/m ²
		y	$\theta_y = 0^\circ$	-	0.51	-	
	Blue	x	$\theta_x = 0^\circ$	-	0.16	-	cd/m ²
		y	$\theta_y = 0^\circ$	-	0.18	-	

7.2 Definition of Optical Characteristics

7.2.1 Definition of Viewing Angle



7.2.2 Definition of Contrast Ratio

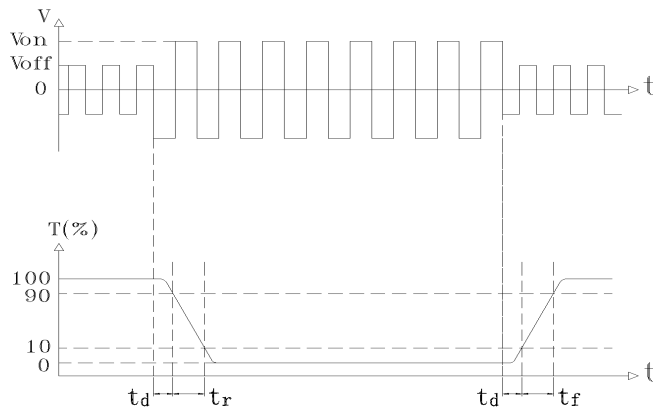


$$\text{Contrast Ratio} = B2/B1 = \frac{\text{unselected state brightness}}{\text{selected state brightness}}$$

Measuring Conditions:

- 1) Ambient Temperature: 25°C ;
- 2) Frame frequency: 70.0Hz

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: 16.8V
- 2) Frame frequency: 70.0Hz

7.3 Brightness Characteristic

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Brightness	Bp	Ta=25°C±3°C	100	150	-	cd/m ²
Uniformity	ΔBp	30-80%RH	70	-	-	%

Note:

1. The data is measured after LEDs are turned on for 5 minutes.
2. Testing conditions LED: V_{LED} = 10.0 V (DC)
 LCD: All dots are on (White color)
3. Brightness in the center of the LCD panel.
4. Definition of Uniformity (ΔBp)

$$\Delta Bp = Bp (\text{Min.}) / Bp (\text{Max.}) \times 100 (\%)$$

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°C

No.	Test Item	Content of Test	Test condition
1	High Temperature Storage	Endurance test applying the high storage temperature for a long time	80°C ± 2°C 240H Restore 4H at 25°C
2	Low Temperature Storage	Endurance test applying the low storage temperature for a long time	-30°C ± 2°C 240H Restore 4H at 25°C
3	High Temperature Operation	Endurance test applying the electric stress (voltage & current) and the thermal stress to the element for a long time	70°C ± 2°C 240H Restore 4H at 25°C
4	Low Temperature Operation	Endurance test applying the electric stress under low temperature for a long time	-20°C ± 2°C Restore 4H at 25°C
5	High Temperature /Humidity Storage	Endurance test applying the high temperature and high humidity storage for a long time	70°C ± 2°C 90%RH 240H Restore 4H at 25°C
6	Temperature Cycle	Endurance test applying the low and high temperature cycle $ \begin{array}{ccccccc} -30^{\circ}\text{C} & \longleftrightarrow & 25^{\circ}\text{C} & \longleftrightarrow & 80^{\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} $	-30°C/80°C 10 cycles Restore 4H at 25°C
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 Judgment 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 Minor 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 : $0^{\circ}\text{C} \sim 40^{\circ}\text{C}$

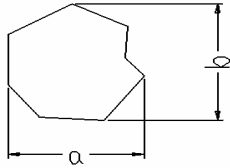
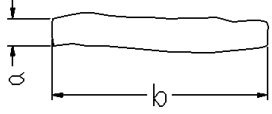
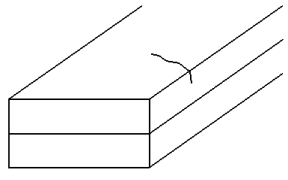
Relatively humidity: $\leq 80\%$

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.

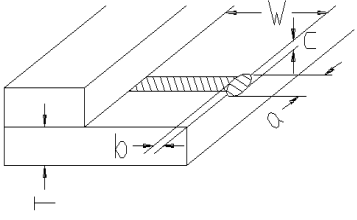
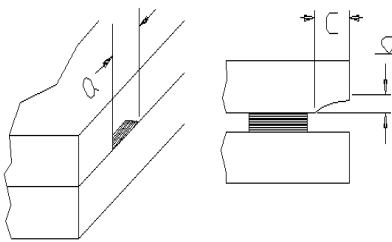
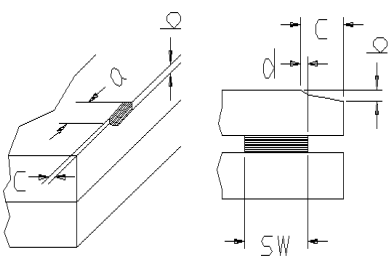
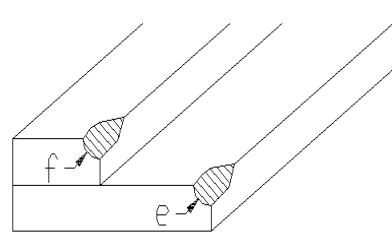
Appendix A

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	Max. 3 spots (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		

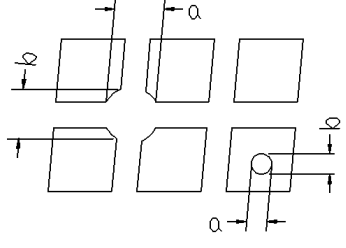
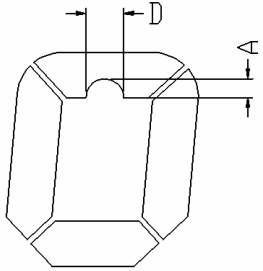
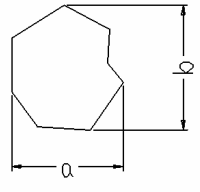
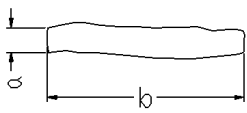
Appendix A

Inspection item and criteria for appearance defects (continued)

Items	Contents	Criteria				
Glass Cracks	<p>Cracks on pads</p> 	a	b	c	Max. 2 cracks allowed	Max. 5 cracks allowed
		$\leq 3\text{mm}$	$\leq W/5$	$\leq T/2$		
		$\leq 2\text{mm}$	$\leq W/5$	$T/2 < C < T$		
	<p>Cracks on contact side</p> 	a	b		Max. 2 cracks allowed	
		$\leq 3\text{mm}$	$\leq T/2$			
		$\leq 2\text{mm}$	$T/2 < b < T$			
		C shall be not reach the seal area				
	<p>Cracks on non-contact side</p> 	a	b		Max. 2 cracks allowed	
		$\leq 3\text{mm}$	$\leq T/2$			
		$\leq 2\text{mm}$	$T/2 < b < T$			
	$C \leq 0.5\text{mm}$					
<p>Corner cracks</p> 	$e < 2.0\text{mm}^2$ $f < 2.0\text{mm}^2$			Max. 3 cracks allowed		

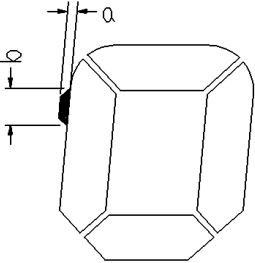
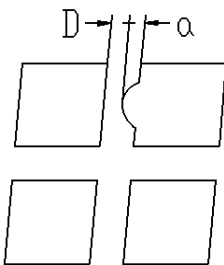
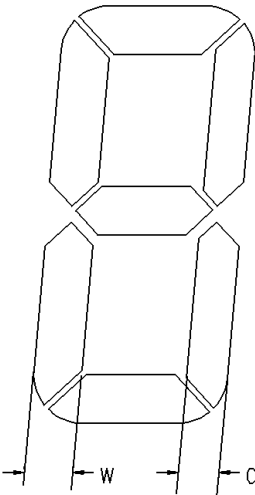
Appendix B

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 ratio 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 $0.8W \leq a \leq 1.2W$ $a = \text{measured value of width}$ $W = \text{nominal value of width}$			