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SPECIFICATION FOR LCD MODULE

Model No. TM0236AKFW

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

TIANMA MICROELECTRONICS CO., LTD

Rev. 2.0

www.DataSheet4U.com

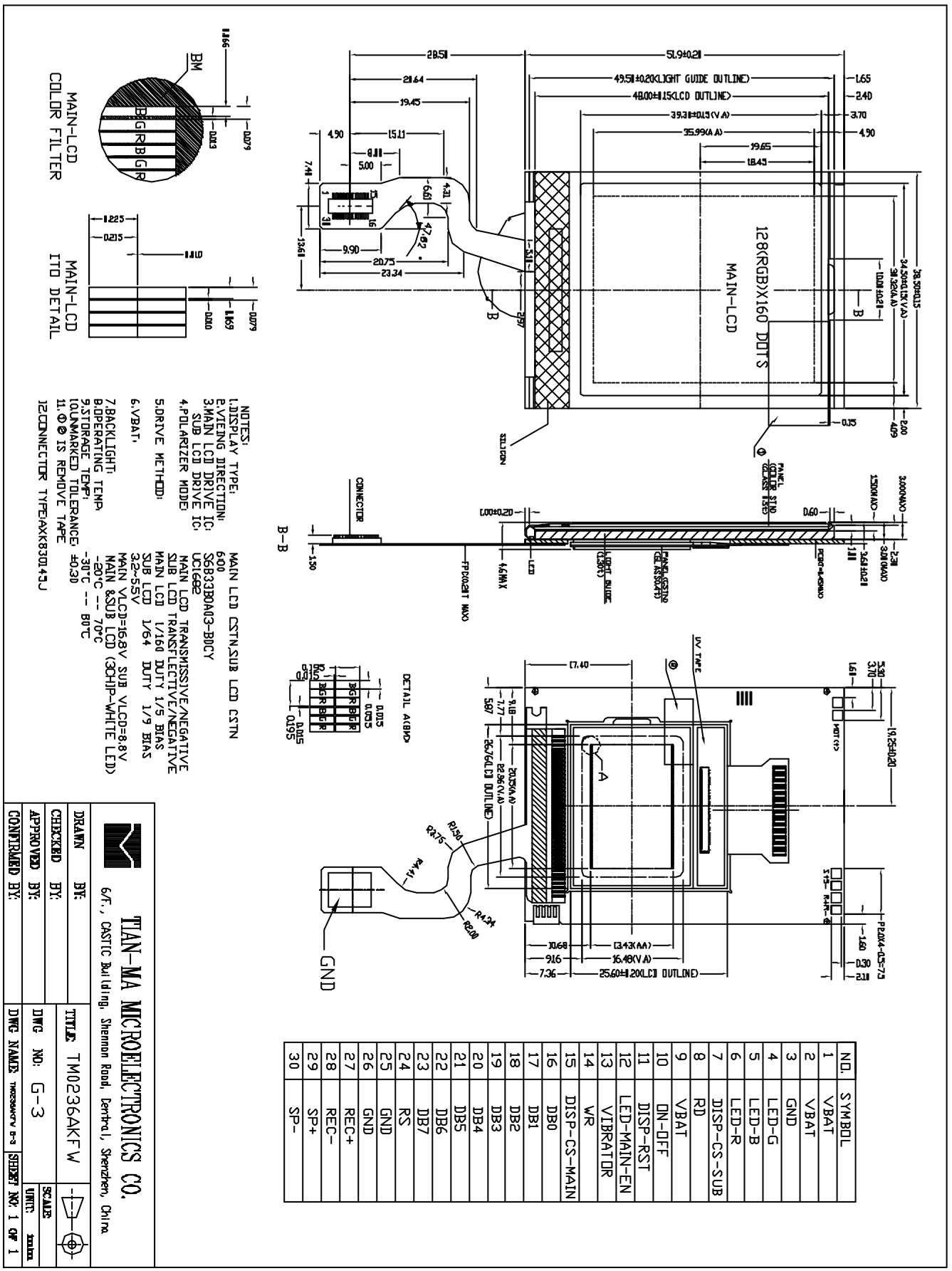
REVISION RECORD

Date	Ver.	Ref. Page	Revision No.	Revision Items

1 General Specifications:

ITEM	CONTENTS		UNIT
	MAIN LCD	SUB LCD	
LCD TYPE	COLOR STN	COLOR STN	---
LCD DUTY	1/160	1/64	---
LCD BIAS	1/5	1/9	---
VIEWING DIRECTION	6:00	6:00	O'CLOCK
GLASS AREA(WXH)	38.5X48. 0	26.76X25.6	MM
VIEWING AREA(WXH)	34. 5X39.3	22.96X16.48	MM
ACTIVE AREA(WXH)	30.32X35.99	20.15X13.43	MM
NUMBER OF DOTS	128(R+G+B)X160	96X64	
DOTS SIZE(WXH)	0.213X0.225	0.195X0.195	MM
DOT PITCH(WXH)	0.225X0.237	0.210X0.210	MM
CONTROLLER	S6B33B0A03-B0CY	UC1682xGAD-U0	---
VDD	3.0		V
LCD OPERATING VOLTAGE	16.8	8.8	V
OUTLINE DIMENSIONS	REFER TO OUTLINE DRAWING ON NEXT PAGE		
BACKLIGHT	LED(WHITE)	LED(WHITE)	---
OPERATING TEMPERAT	-20---+70℃	-20---+70℃	---
STORAGE TEMPERATURE	-30---+80℃	-30---+80℃	---
WEIGHT	TBD		---
DATA TRANSFER	8 BIT PARALLEL		---
POLARIZER MODE	TRANSMISSIVE /NEGATIVE	TRANSMISSIVE /NEGATIVE	---

2. Outline Drawing



NO.	SYMBOL
1	VBAT
2	VBAT
3	GND
4	LED-G
5	LED-B
6	LED-R
7	DISP-CS-SUB
8	RD
9	VBAT
10	ON-OFF
11	DISP-RST
12	LED-MAIN-EN
13	VIBRATOR
14	WR
15	DISP-CS-MAIN
16	DB0
17	DB1
18	DB2
19	DB3
20	DB4
21	DB5
22	DB6
23	DB7
24	RS
25	GND
26	GND
27	REC+
28	REC-
29	SP+
30	SP-

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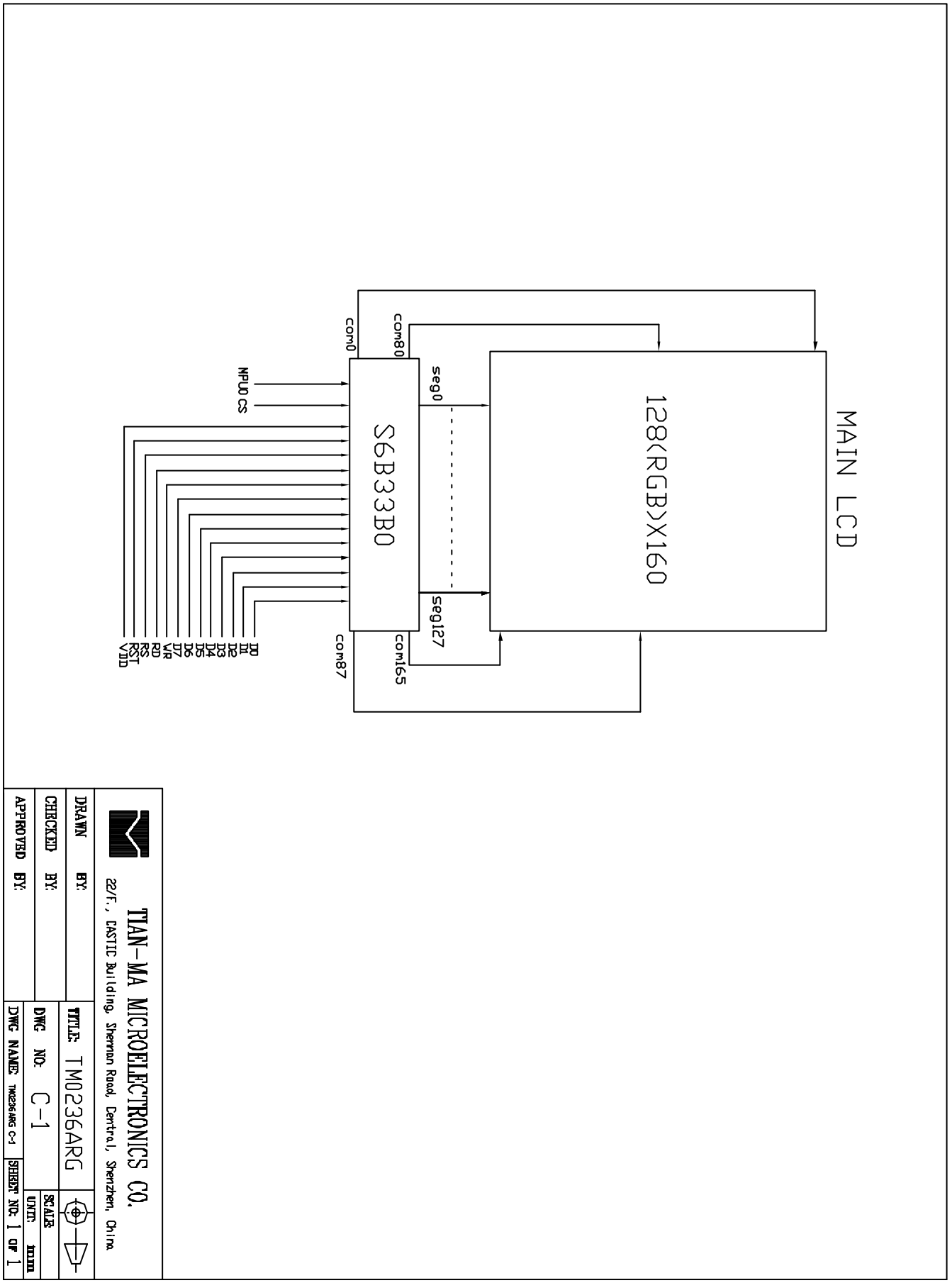
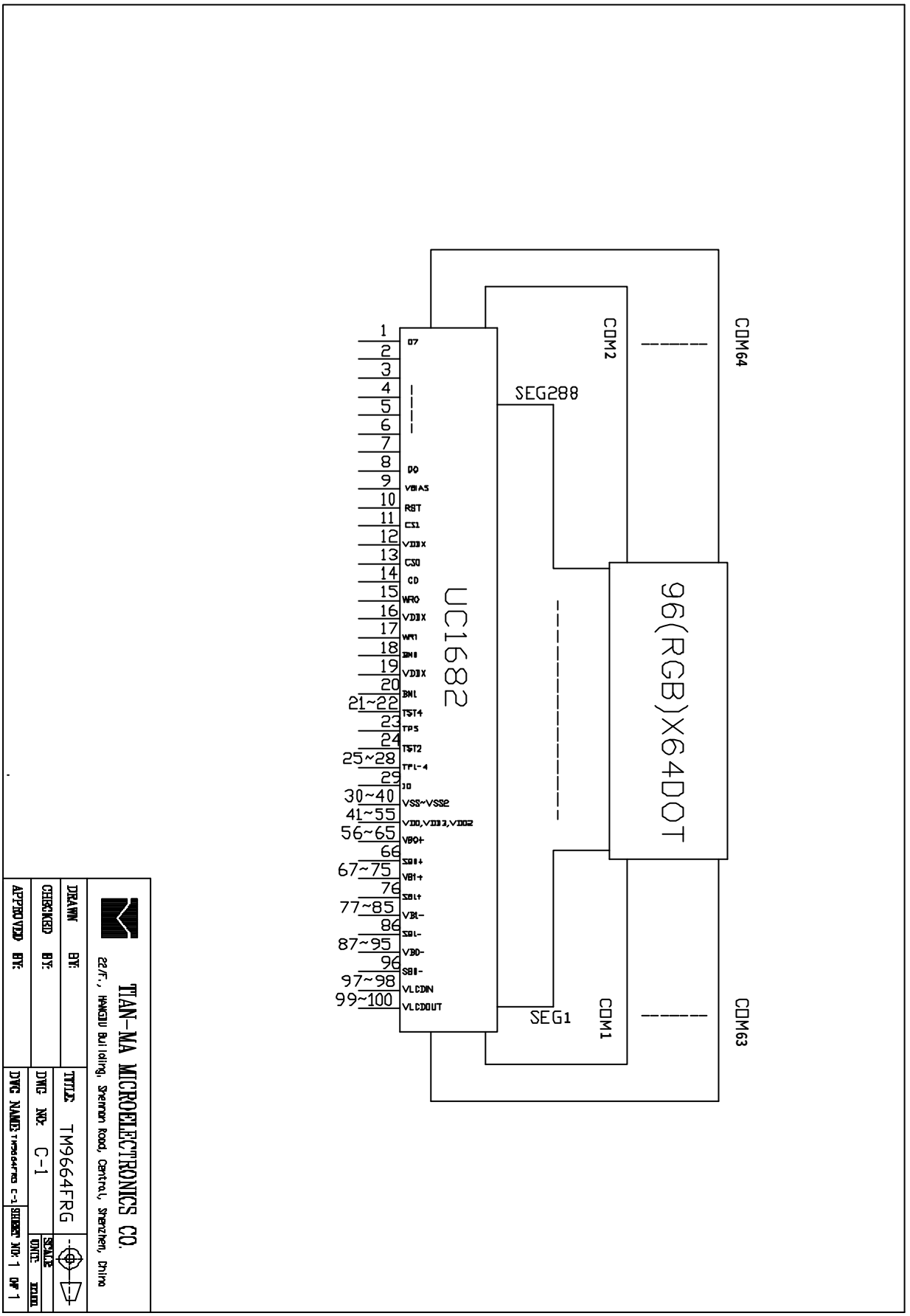
DRAWN BY:		TITLE: TM0236AKFW	
CHECKED BY:			
APPROVED BY:		DWG NO: G-3	SCALE:
CONFIRMED BY:		DWG NAME: TM0236AKFW G-3	UNIT: mm SHEET NO: 1 OF 1

3. Circuit Block Diagram

3.1 Circuit Block Diagram Of Main LCD



3.2 Circuit Block Diagram Of Sub LCD



4 Absolute Maximum Ratings(Ta=25℃)

ITEM	SYMBOL	MIN	MAX	UNIT
Power supply voltage(1)	VBAT	3.0	5.0	V
Power supply voltage(2)	LCD_VCC	-0.3	4.0	V
Power supply Voltage for main LCD	VLCD-GND	-0.3	20	V
Logic signal Input voltage	Vt	-0.3	LCD_VCC+0.3	V
Operating temperature	Topr	-20	+70℃	℃
Storage temperature	Tst	-30	+80℃	℃

Notes:

1. If the module is used above these absolute maximum ratings.It may become permanently damaged.Using the module within the following electrical characteristic conditions are also exceeded,the module will malfunction and cause poor reliability.
2. LCD_VCC>GND must be maintained.

5. Electrical Specifications and Instruction Code (Vss=0v, Ta=25℃)

5.1 Electrical characteristics

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Supply voltage for logic	VBATT	---	3.2	3.8	4.5	V
Operation voltage for main LCD	VLCD1	25		16.8		V
Operation voltage for SUB LCD	VLCD2	25		8.8		V
Input voltage'H' Level	V_{IH}	LCD_VCC=3.0V	0.8VDD	---	LCD_VCC	V
Input voltage'L' Level	V_{IL}	LCD_VCC=3.0V	0	---	0.2VDD	V
Output voltage'H'level	V_{OH}	VDD=3.0V VDD=2.75V	0.8LCD_VCC	---	LCD_VCC	V
Output voltage'L'level	V_{OL}	---	0	---	0.2LCD_VCC	V
Current consumption for MAIN LCD normal operation	IDD1	LCD-VCC-GND=3.0V 1/160DUTY	---	1.2	2.0	mA
Current consumption for SUB LCD normal operation	IDD2	LCD-VCC-GND=3.0V 1/64DUTY	---	0.15	0.35	mA
Supply Voltage (LED)	V_{LED}	---	---	5	---	V
Supply current (LED)	I_{LED}	---	---	45	60.0	mA

5.2 Interface Signals

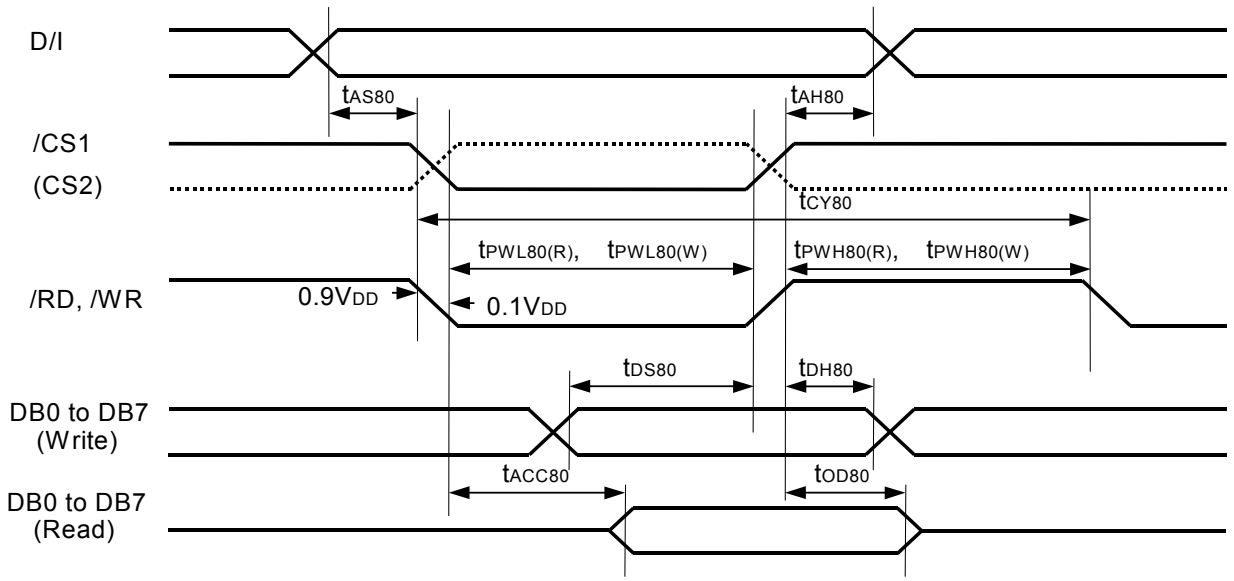
Pin NO.	Symbol	Function
1	VBAT	Power supply pin
2	VBAT	Power supply pin
3	GND	Ground pin
4	LED-G	Indication LED(GREEN)ON
5	LED-B	Indication LED(BLUE)ON
6	LED-R	Indication LED(RED)ON
7	DISP-CS-SUB	SUB chip selection input pin:Active”L”
8	RD	E is read enable clock input pin.When E=”L”,DB0~DB7 are in output status.
9	VBAT	Power supply pin.
10	ON-OFF	LDO ON/OFF
11	DISP-RST	Chip reset signal input pin:Active”L”
12	LED-MAIN-EN	LED backlight enable pin.when”H”the LED backlight is turn on.
13	VIBRTOR	Motor control pin.
14	WR	WR is write enabe clock input pin.DB0~DB7 are latched at the rising edge of the RW signal.
15	DISP-CS-MAIN	Main LCD(CSTN)chip selection input pin:Active”L”.
16	DB0	8bit Bi-directional data bus.
17	DB1	
18	DB2	
19	DB3	
20	DB4	
21	DB5	
22	DB6	
23	DB7	
24	RS	Command/data select input pin. RS=”L” input DB7~DB0 is control data;RS=”L” input DB7~DB0 is display data.
25	GND	Ground pin.
26	GND	Ground pin.
27	REC+	Connect to REC.
28	REC-	Connect to REC.
29	SP +	Connect to speaker.
30	SP -	Connect to speaker.

5.3 Interface Timing Chart

Note: Please refer to SAMSUNG S6B33B0A / ULTRACHIP UC1682 / ANALOGIC AAT3113 data sheet for more details.

SAMSUNG S6B33B0A INTERFACE PROTOCOL

Read / Write Characteristics (8080-series MPU)



** $t_{PWL80(W)}$ and $t_{PWL80(R)}$ is specified in the overlapped period when CS1B is low (CS2 is high) and /WR(/RD) is low.

Figure 25. Parallel Interface (8080-series MPU) Timing Diagram

Table 17. AC Characteristics (8080-series Parallel Mode)

(VDD3 = 1.8 to 3.3V, Ta = -30 to +70°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_{PWLR} t_{PWHR}		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
				tEWHR			

NOTE: *1. The input signal rise time and fall time (tr, tf) is specified at 10 ns or less.
(tr + tf) < (t_{CY80} - t_{PWLW} - t_{PWHW}) for write, (tr + tf) < (t_{CY80} - t_{PWLR} - t_{PWHR}) for read

INSTRUCTION DESCRIPTION (S6B33B0)

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
Driving current & 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.

UC1682 AC CHARACTERISTICS

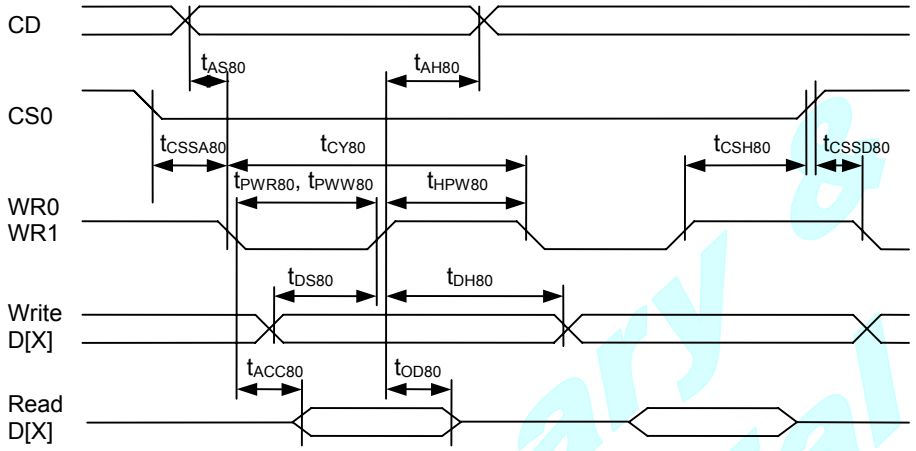


FIGURE 15: Parallel Bus Timing Characteristics (for 8080 MCU)

(V_{DD}=2.5V to 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 10	–	ns
t_{CY80}		System cycle time 8 bits bus (read) (write) 4 bits bus (read) (write)		 140 128 128 128	–	ns
t_{PWR80}	WR1	Pulse width 8 bits (read) 4 bits		65 35	–	ns
t_{PWW80}	WR0	Pulse width 8 bits (write) 4 bits		35 35	–	ns
t_{HPW80}	WR0, WR1	High pulse width 8 bits bus (read) (write) 4 bits bus (read) (write)		 65 35 35 35	–	ns
t_{DS80} t_{DH80}	D0~D7	Data setup time Data hold time		30 10	–	ns
t_{ACC80} t_{OD80}		Read access time Output disable time	C_L = 100pF	– 10	50 50	ns
t_{SSA80} t_{CSSD80} t_{CSH80}	CS1/CS0	Chip select setup time		10 10 20		ns

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COMMAND TABLE

The following is a list of host commands supported by UC1680

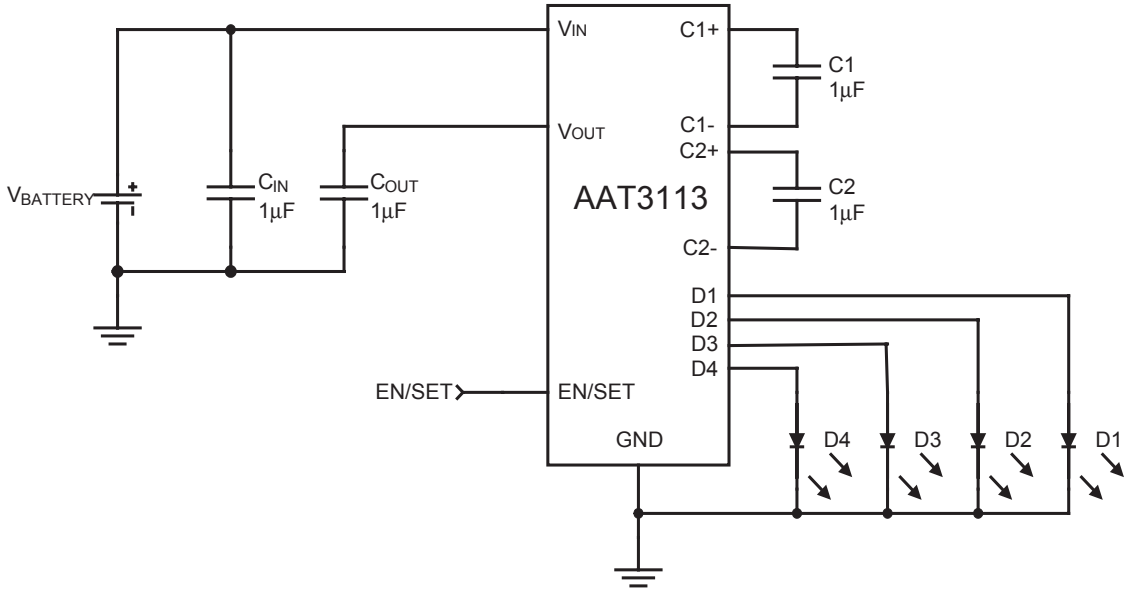
C/D: 0: Control, 1: Data
W/R: 0: Write Cycle, 1: Read Cycle

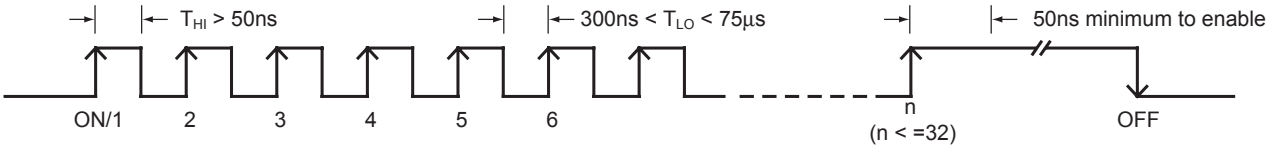
\# Useful Data bits
– Don't Care

	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	-	MX	MY	WA	DE	WS	OD	OS	Get Status	N/A
4	Set Column Address LSB	0	0	0	0	0	0	#	#	#	#	Set CA[3:0]	0
	Set Column Address MSB	0	0	0	0	0	1	-	#	#	#	Set CA[6:4]	0
5	Set Temp. Compensation	0	0	0	0	1	0	0	1	#	#	Set TC[1:0]	0
6	Set Panel Loading	0	0	0	0	1	0	1	0	#	#	Set PC[1:0]	01b
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	0	R	Set APC[R][7:0], R = 0, or 1	N/A
		0	0	#	#	#	#	#	#	#	#		
9	Set Scroll Line LSB	0	0	0	1	0	0	#	#	#	#	Set SL[3:0]	0
	Set Scroll Line MSB	0	0	0	1	0	1	#	#	#	#	Set SL[7:4]	0
10	Set Row Address LSB	0	0	0	1	1	0	#	#	#	#	Set RA[3:0]	0
	Set Row Address MSB	0	0	0	1	1	1	#	#	#	#	Set RA[7:4]	0
11	Set V_{BIAS} Potentiometer (double-byte command)	0	0	1	0	0	0	0	0	0	1	Set PM[7:0]	83H
		0	0	#	#	#	#	#	#	#	#		
12	Set Partial Display Control	0	0	1	0	0	0	0	1	#	#	Set LC[9:8]	0: 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	#	#	#	#	Set FL[3:0]	0
15	Set Line Rate	0	0	1	0	1	0	0	0	#	#	Set LC[4:3]	10b
16	Set All-Pixel-ON	0	0	1	0	1	0	0	1	0	#	Set DC[1]	0
17	Set Inverse Display	0	0	1	0	1	0	0	1	1	#	Set DC[0]	0
18	Set Display Enable	0	0	1	0	1	0	1	1	#	#	Set DC[3:2]	10b
19	Set Color Mask	0	0	1	0	1	1	0	#	#	#	Set MSK[2:0]	0
20	Set LCD Mapping Control	0	0	1	1	0	0	0	#	#	#	Set LC[2:0]	0
21	Set Color Pattern	0	0	1	1	0	1	0	0	0	#	Set LC[5]	0 (BGR)
22	Set Color Mode	0	0	1	1	0	1	0	1	#	#	Set LC[7:6]	10b (65K)
23	System Reset	0	0	1	1	1	0	0	0	1	0	System Reset	N/A
24	NOP	0	0	1	1	1	0	0	0	1	1	No operation	N/A
25	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	#	#	#	#	#	#	#	#		
26	Set LCD Bias Ratio	0	0	1	1	1	0	1	0	#	#	Set BR[1:0]	11b (12)
27	Reset Cursor Update Mode	0	0	1	1	1	0	1	1	1	0	AC[3]=0, CA=CR	AC[3]=0
28	Set Cursor Update Mode	0	0	1	1	1	0	1	1	1	1	AC[3]=1, CR=CA	AC[3]=1
29	Set COM End	0	0	1	1	1	1	0	0	0	1	Set CEN[7:0]	159
		0	0	#	#	#	#	#	#	#	#		
30	Set Partial Display Start	0	0	1	1	1	1	0	0	1	0	Set DST[7:0]	0
		0	0	#	#	#	#	#	#	#	#		
31	Set Partial Display End	0	0	1	1	1	1	0	0	1	1	Set DEN[7:0]	159
		0	0	#	#	#	#	#	#	#	#		

Application Circuits

Typical AAT3113 Application Circuit:





Enable / Disable / LED Brightness Level Set Data Input

Current Levels (mA)

Code	20 mA max
1	0.549
2	0.627
3	0.706
4	0.784
5	0.863
6	1.020
7	1.098
8	1.255
9	1.412
10	1.569
11	1.804
12	1.961
13	2.275
14	2.510
15	2.824
16	3.137

Code	20 mA max
17	3.529
18	4.000
19	4.471
20	5.020
21	5.647
22	6.353
23	7.059
24	7.922
25	8.941
26	10.039
27	11.216
28	12.627
29	14.118
30	15.843
31	17.804
32	20.000

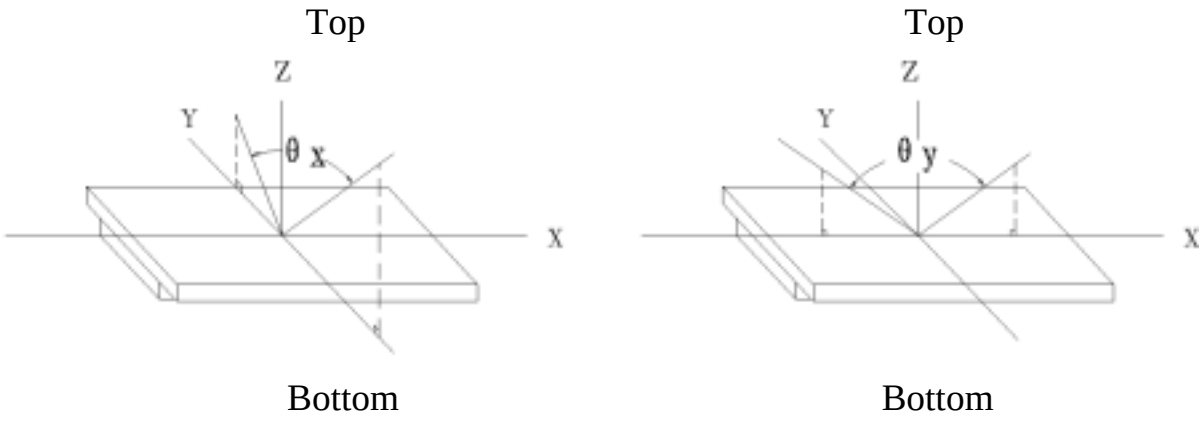
6. Optical Characteristics

6.1 Optical Characteristics V_{LCD}=16.8V Ta=25℃

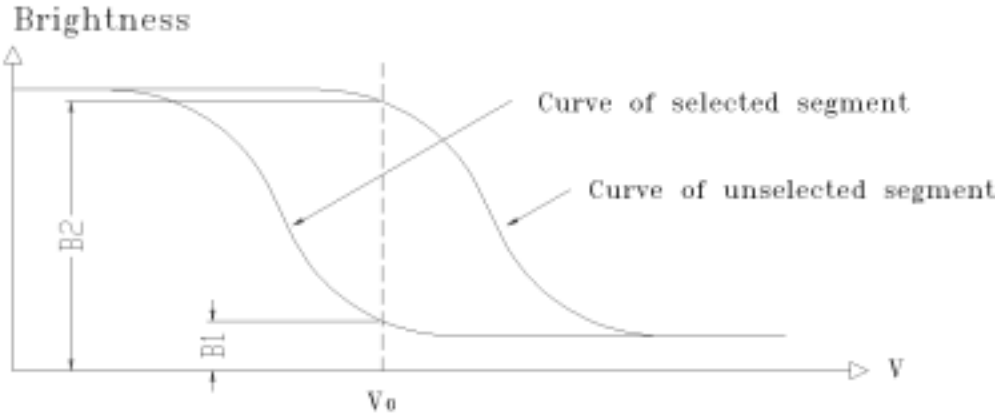
Item		Symbol	Condition			Min.	Typ.	Max.	Unit
Viewing Angle		θ_x	$C_r \geq 2$	θ_y=0 °	MAIN	-50--+50			Deg
					SUB	-60--36			
		θ_y		θ_x=0 °	MAIN	-30--+45			
					SUB	-42--40			
Contrast Ratio		C_r	θ_x=0 ° θ_y=0 °			30	40	60	--
Response Time	Turn on	T_{on}	θ_x=0 ° θ_y=0 °			-	-	180	ms
	Turn off	T_{off}				70	-	90	
Color Of CIE Coord-Inate	White	x	θ_x=0 ° θ_y=0 °			-	0.30	-	-
		y				-	0.36	-	-
	Red	x	θ_x=0 ° θ_y=0 °			-	0.53	-	-
		y				-	0.37	-	-
	Green	x	θ_x=0 ° θ_y=0 °			-	0.31	-	-
		y				-	0.51	-	-
	Blue	x	θ_x=0 ° θ_y=0 °			-	0.16	-	-
		y				-	0.18	-	-

6.2 Definition of Optical Characteristics

6.2.1 Definition of Viewing Angle



6.2.2 Definition of Contrast Ratio

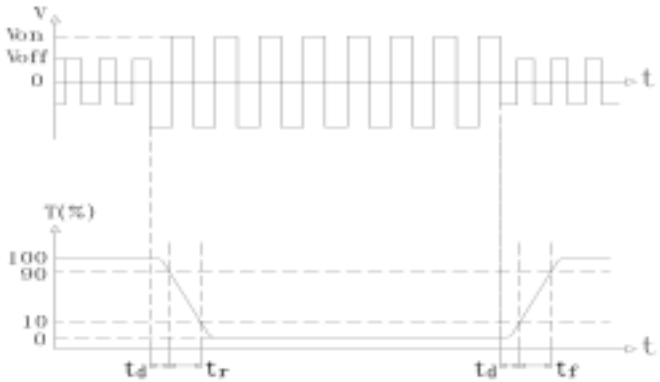


$$\text{Contrast Ratio} = B2/B1 = \frac{\text{unselected state brightness}}{\text{selected state brightness}}$$

Measuring Conditions:

1) Ambient Temperature: 25℃ ; 2) Frame frequency: 70.0Hz

6.2.3 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:MAIN-LCD 16.8V SUB-LCD 8 . 8 V

2) Frame frequency: 70.0Hz

6.3 Brightness Characteristic

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Brightness	Bp	Ta=25℃±3℃ 30-80%RH	100	-	-	cd/m^2
Uniformity	△Bp		7 5	-	-	%

Note:

1. The data is measured after LED are turned on for 5 minutes.
2. Testing conditions LED: VLED =5.0 V (DC)
   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

7. Reliability

7.1 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℃±2℃ 240H Restore 4H at 25℃
2	Low Temperature Storage	Endurance test applying the low storage temperature for a long time	-30℃±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	70℃±2℃ 240H Restore 4H at 25℃
4	Low Temperature Operation	Endurance test applying the electric stress under low temperature for a long time	-20℃±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 -30℃⟷25℃⟷80℃⟷25℃ 30min 5min 30min 5min ←——————————→ 1 cycle	-30℃/80℃ 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

7.2 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									

8. 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						

9. Precautions for Use of LCD Modules

9.1 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.

9.1.2 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.

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

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

9.1.5 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

9.1.6 Do not attempt to disassemble the LCD Module.

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

9.1.8 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.

9.2 Storage precautions

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

9.2.2 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℃

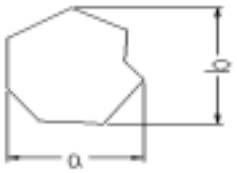
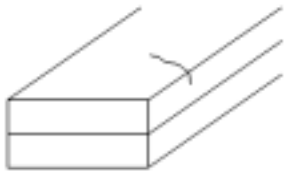
Relatively humidity: ≤80%

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

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

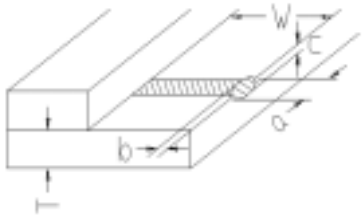
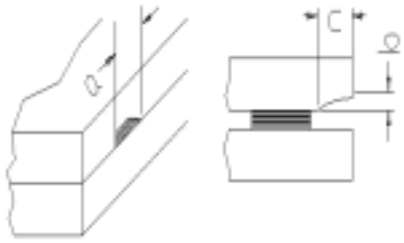
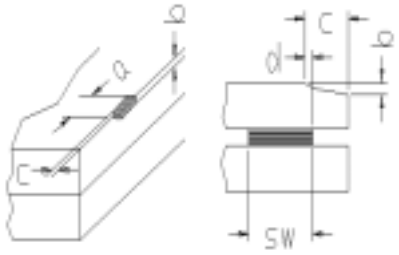
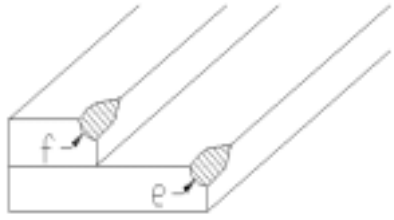
Appendix A

Inspection items and criteria for appearance defects

<table>
<tr><td>Items</td><td>Contents</td><td colspan="3">Criteria</td></tr>
<tr><td>Leakage</td><td></td><td colspan="3">Not permitted</td></tr>
<tr><td>Rainbow</td><td></td><td colspan="3">According to the limit specimen</td></tr>
<tr><td rowspan="3">Polarizer</td><td>Wrong polarizer attachment</td><td colspan="3">Not permitted</td></tr>
<tr><td rowspan="2">Bubble between polarizer and glass</td><td>Not counted</td><td colspan="2">Max. 3 defects allowed</td></tr>
<tr><td>ϕ<0.3mm</td><td colspan="2">0.3mm≤ϕ≤0.5mm</td></tr>
<tr><td>Scratches of polarizer</td><td colspan="3">According to the limit specimen</td></tr>
<tr><td rowspan="3">Black spot (in viewing area)</td><td rowspan="3">  </td><td>Not counted</td><td>Max. 3 spots allowed</td><td rowspan="4">Max. 3 spots (lines) allowed</td></tr>
<tr><td>X<0.2mm</td><td>0.2mm≤X≤0.5mm</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>Not counted</td><td>Max. 3 lines allowed</td></tr>
<tr><td>a<0.02mm</td><td>0.02mm≤a≤0.05mm
b≤2.0mm</td></tr>
<tr><td>Progressive cracks</td><td>  </td><td colspan="3">Not permitted</td></tr>
</table>

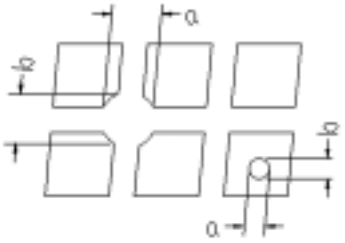
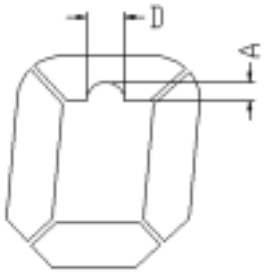
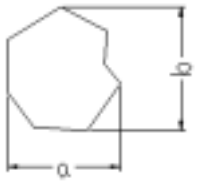
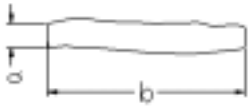
Appendix A

Inspection item and criteria for appearance defects (continued)

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

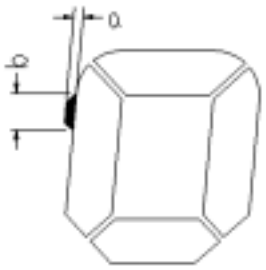
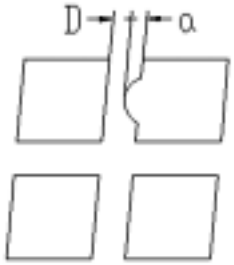
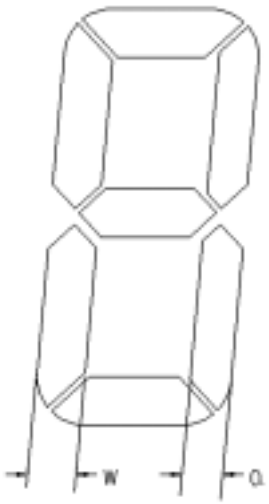
Appendix B

Inspection items and criteria for display defects

<table>
<tr><td colspan="2">Items</td><td>Contents</td><td colspan="3">Criteria</td></tr>
<tr><td colspan="3">Open segment or open common</td><td colspan="3">Not permitted</td></tr>
<tr><td colspan="3">Short</td><td colspan="3">Not permitted</td></tr>
<tr><td colspan="3">Wrong viewing angle</td><td colspan="3">Not permitted</td></tr>
<tr><td colspan="3">Contrast radio uneven</td><td colspan="3">According to the limit specimen</td></tr>
<tr><td colspan="3">Crosstalk</td><td colspan="3">According to the limit specimen</td></tr>
<tr><td rowspan="4">Pin holes and cracks in segment (DOT)</td><td rowspan="2">  </td><td>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 rowspan="2">  </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>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>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>

Appendix B

Inspection items and criteria for display defects (continued)

<table>
<tr><th>Items</th><th>Content</th><th colspan="3">Criteria</th></tr>
<tr><td rowspan="4">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
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">  </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><td></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>