MULTI-INNO TECHNOLOGY CO., LTD.

LCD MODULE SPECIFICATION

Model : MI12864AB-G-1

Revision	
Engineering	
Date	
Our Reference	

REVISION RECORD

Date	Ver.	Ref. Page	Revision No.	Revision Items
2003-7-2	1.0		1	Preliminary specification

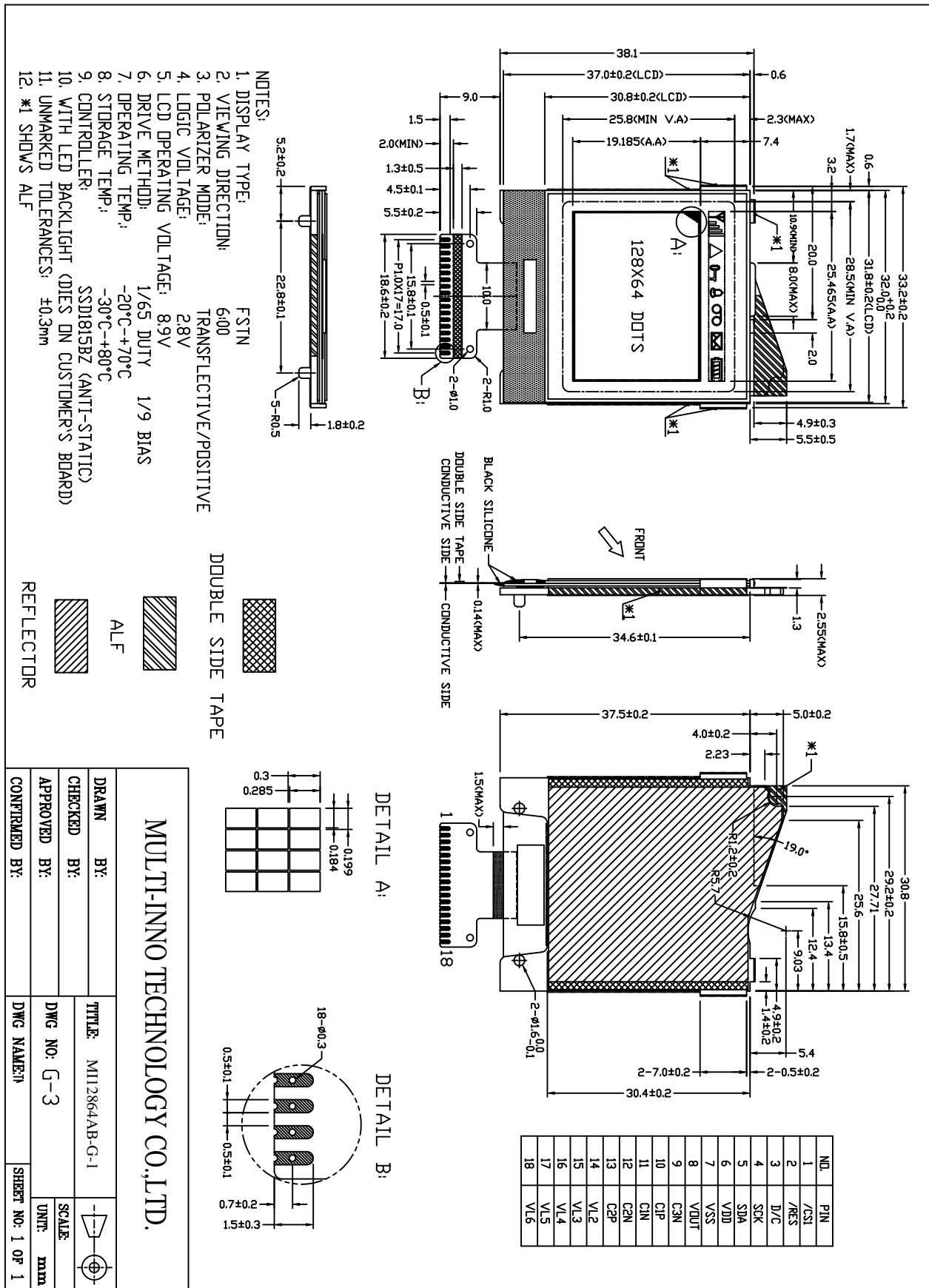## 1. General Specifications:

1.1 Display type: FSTN

1.2 Display color*[1]:

      Display color: Blue-Black

      Background*[2]:   White

1.3 Polarizer mode: Transflective/Positive

1.4 Viewing Angle: 6:00

1.5 Driving Method: 1/65 Duty   1/9 Bias

1.6 Backlight: LED (Dies on customer`s board)

1.7 Controller: SSD1815BZ

1.8 Data Transfer: Serial

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

    Storage Temperature: -30----+80℃

1.10 VDD: 2.8V

1.11 LCD Operating Voltage: 8.9V

1.12 Outline Dimensions: Refer to outline drawing on next page

1.13 Dot Matrix: 128 X 64 Dots

1.14 Dot Size: 0.184 X 0.285(mm)

1.15 Dot Pitch: 0.199 X 0.300(mm)

1.16 Weight: Approx   10g

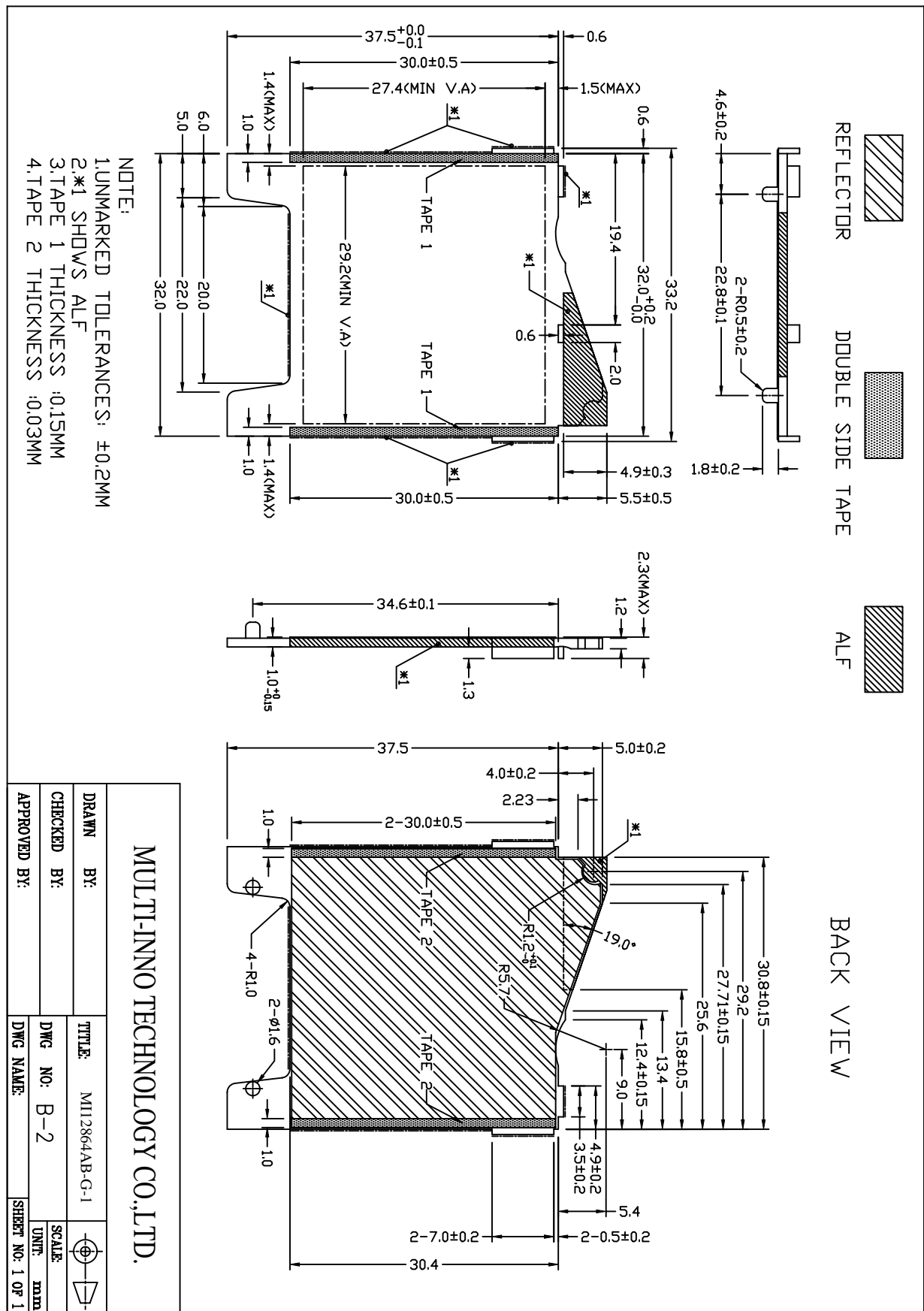   *[1] Color tone is slightly changed by temperature and driving voltage.

   *[2] Color tone will be changed by backlight.
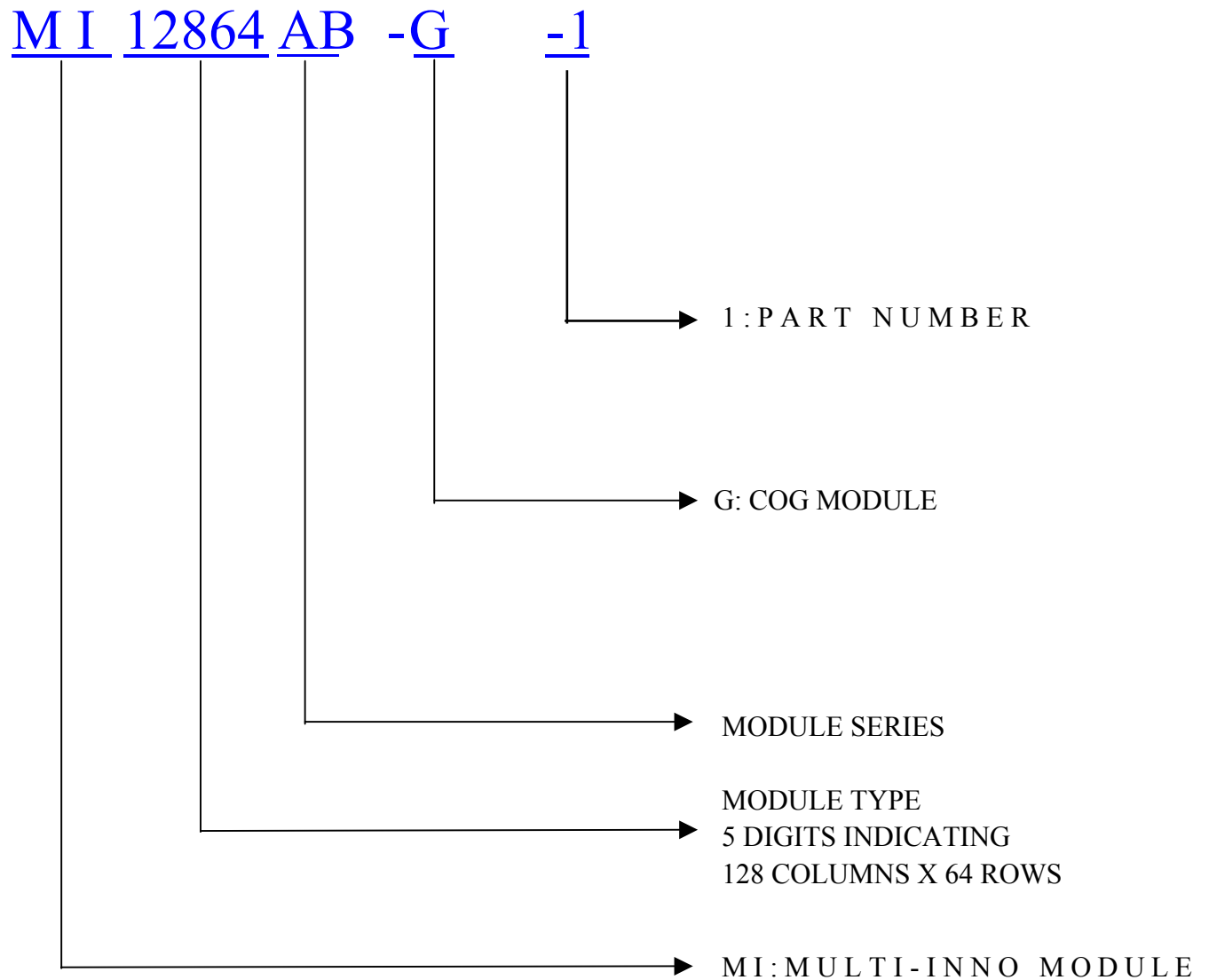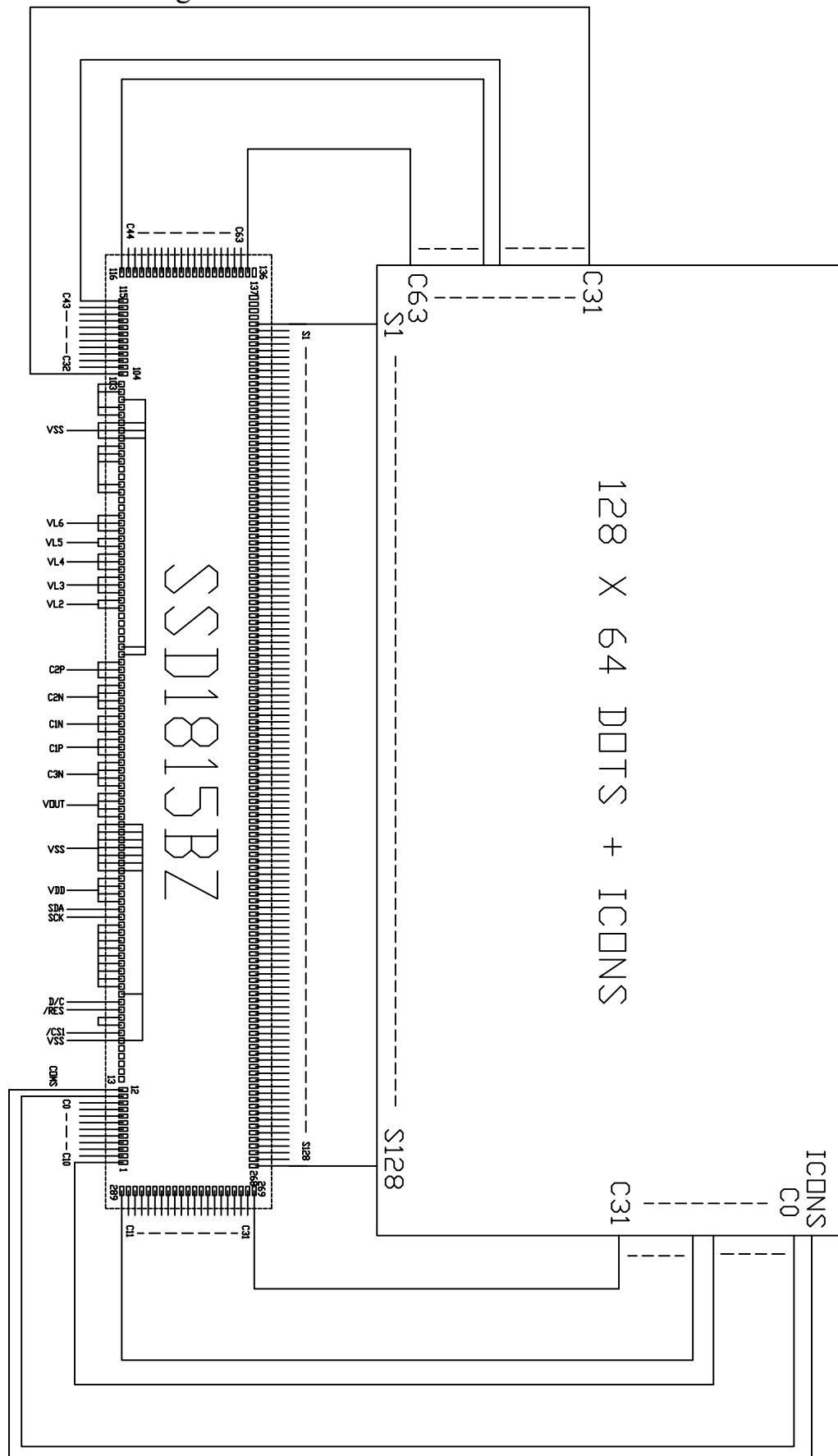
2. Outline Drawing

2.1 Outline Drawing of LCM

NOTES:
1. DISPLAY TYPE: FSTN
2. VIEWING DIRECTION: 6:00
3. POLARIZER MODE: TRANSFLECTIVE/POSITIVE
4. LOGIC VOLTAGE: 2.8V
5. LCD OPERATING VOLTAGE: 8.9V
6. DRIVE METHOD: 1/65 DUTY   1/9 BIAS
7. OPERATING TEMP.: -20°C~+70°C
8. STORAGE TEMP.: -30°C~+80°C
9. CONTROLLER: SSD1815BZ (ANTI-STATIC)
10. WITH LED BACKLIGHT (DIES ON CUSTOMER'S BOARD)
11. UNMARKED TOLERANCES: ±0.3mm
12. ✳1 SHOWS ALF

MULTI-INNO TECHNOLOGY CO.,LTD.

TITLE: MI12864AB-G-1
DWG NO. G-3
DWG NAME:
SHEET NO. 1 OF 1
SCALE:
UNIT: mm

NO.	PIN
1	/CS1
2	/RES
3	D/C
4	SCK
5	SDA
6	VDD
7	VSS
8	VOUT
9	C3N
10	C3P
11	C2N
12	C2P
13	C1N
14	C1P
15	VL2
16	VL3
17	VL5
18	VL6

2.2 Light Guide Drawing

3. LCD Module Part Numbering System

M I 12864 AB -G   -1

1 : P A R T   N U M B E R

G: COG MODULE

MODULE SERIES

MODULE TYPE
5 DIGITS INDICATING
128 COLUMNS X 64 ROWS

M I : M U L T I - I N N O   M O D U L E

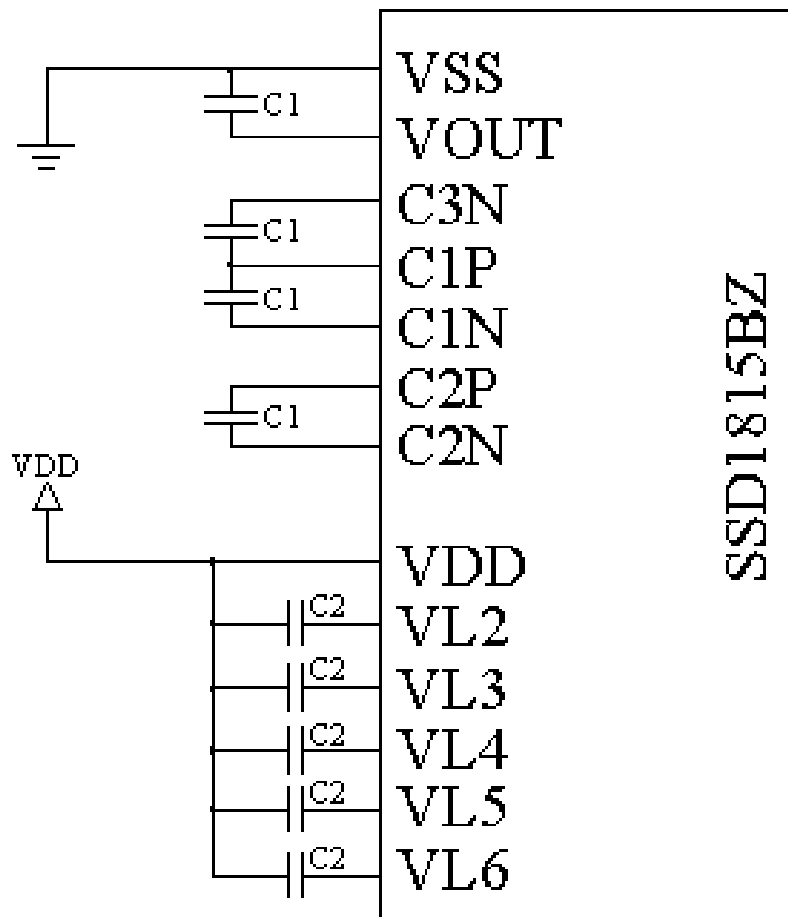## 4. Circuit Block Diagram

4.1 Circuit Block Diagram

4.2 Power Supply Circuit

Reference Value: VDD=2.8V
              C1=0.47∽1.0uF/25V
              C2=0.1∽0.47uF/25V

5. Absolute Maximum Ratings

Item	Symbol	Min.	Max.	Unit	Remark
Power Supply Voltage	$V_{DD}-V_{SS}$	-0.3	4.0	V	
LCD Driving Voltage	V_{LCD}	4.0	12.0		
Operating Temperature Range	T_{OP}	-20	+70	℃	No Condensation
Storage Temperature Range	T_{ST}	-30	+80		

6. Electrical Specifications and Instruction Code

6.1 Electrical characteristics

Item		Symbol	Min.	Typ.	Max.	Unit
Supply Voltage (Logic)		$V_{DD}-V_{SS}$	2.5	2.8	3.1	V
Supply Voltage (LCD Drive)		V_{LCD} $(V_{DD}-V_{L6})$	8.7	8.9	9.1	V
Input Signal Voltage	High	V_{IH} $(V_{DD}=2.8)$	$0.8V_{DD}$	-	V_{DD}	V
	Low	V_{IL} $(V_{DD}=2.8)$	0	-	$0.2\,V_{DD}$	V
Supply current (Logic) (Display Character)		I_{DD} $(V_{DD}-V_{SS}=2.8)$	-	-	300	uA

6.2 Interface Signals

Pin No.	Symbol	Level	Description
1	/CS1	H/L	Chip select signal." L" Active
2	/RES	H/L	Reset Signal." L" -The settings are initialized
3	D/C	H/ˆL	Data/Command control signal. "H"-Indicates that SDA are display data "L"-Indicates that SDA are control data
4	SCK	H/L	Serial Clock Input Signal
5	SDA	H/L	Serial Data Input Signal
6	VDD	2.8V	Power supply for logic
7	VSS	0V	Ground
8	VOUT	-	DC-DC voltage converter output
9	C3N	-	Capacitor pin for voltage converter
10	C1P	-	Capacitor pin for voltage converter
11	C1N	-	Capacitor pin for voltage converter
12	C2N	-	Capacitor pin for voltage converter
13	C2P	-	Capacitor pin for voltage converter
14	VL2	-	Power supply voltage for LCD
15	VL3	-	Power supply voltage for LCD
16	VL4	-	Power supply voltage for LCD
17	VL5	-	Power supply voltage for LCD
18	VL6	-	Power supply voltage for LCD

6.3 Interface Timing Chart

Serial Timing Characteristics (TA=25°C, DV_{DD}=2.7V, V_{SS}=0V)

Symbol	Parameter	Min	Typ	Max	Unit
t_{cycle}	Clock Cycle Time	400	-	-	ns
t_{AS}	Address Setup Time	250	-	-	ns
t_{AH}	Address Hold Time	250	-	-	ns
t_{CSS}	Chip Select Setup Time	250	-	-	ns
t_{CSH}	Chip Select Hold Time	250	-	-	ns
t_{DSW}	Write Data Setup Time	150	-	-	ns
t_{DHW}	Write Data Hold Time	150	-	-	ns
t_{CLKL}	Clock Low Time	150	-	-	ns
t_{CLKH}	Clock High Time	150	-	-	ns
t_R	Rise Time	-	-	15	ns
t_F	Fall Time	-	-	15	ns

Serial Timing Characteristics

6.4 Instruction Code

| Bit Pattern	Command	Description
$0000X_3X_2X_1X_0$	Set Lower Column Address	Set the lower nibble of the column address register using $X_3X_2X_1X_0$ as data bits. The lower nibble of column address register is reset to 0000b after POR.
$0001X_3X_2X_1X_0$	Set Higher Column Address	Set the higher nibble of the column address register using $X_3X_2X_1X_0$ as data bits. The higher nibble of column address is reset to 0000b after POR.
$00100X_2X_1X_0$	Set Internal Regulator Resistor Ratio	Feedback gain of the internal regulator generating V_{L6} increases as $X_2X_1X_0$ increased from 000b to 111b. After POR, $X_2X_1X_0$ = 100b.
$00101X_2X_1X_0$	Set Power Control Register	X_0=0: turns off the output op-amp buffer (POR) X_0=1: turns on the output op-amp buffer X_1=0: turns off the internal regulator (POR) X_1=1: turns on the internal regulator X_2=0: turns off the internal voltage booster (POR) X_2=1: turns on the internal voltage booster
$01X_5X_4X_3X_2X_1X_0$	Set Display Start Line	Set GDDRAM display start line register from 0-63 using $X_5X_4X_3X_2X_1X_0$. Display start line register is reset to 000000 after POR.
10000001 $* * X_5X_4X_3X_2X_1X_0$	Set Contrast Control Register	Select contrast level from 64 contrast steps. Contrast increases (V_{L6} decreases) as $X_5X_4X_3X_2X_1X_0$ is increased from 000000b to 111111b. $X_5X_4X_3X_2X_1X_0$ = 100000b after POR
$1010000X_0$	Set Segment Re-map	X_0=0: column address 00h is mapped to SEG0 (POR) X_0=1: column address 83h is mapped to SEG0 Refer to Figure 8 on page 15 for example.
$1010001X_0$	Set LCD Bias	X_0=0: POR default bias: 1/9 X_0=1: alternate bias: 1/7 For other bias ratio settings, see "Set 1/4 Bias Ratio" and "Set Bias Ratio" in Extended Command Set.
$1010010X_0$	Set Entire Display On/Off	X_0=0: normal display (POR) X_0=1: entire display on
$1010011X_0$	Set Normal/Reverse Display	X_0=0: normal display (POR) X_0=1: reverse display
$1010111X_0$	Set Display On/Off	X_0=0: turns off LCD panel (POR) X_0=1: turns on LCD panel
$1011X_3X_2X_1X_0$	Set Page Address	Set GDDRAM Page Address (0-8) for read/write using $X_3X_2X_1X_0$
$1100X_3 * * *$	Set COM Output Scan Direction	X_3=0: normal mode (POR) X_3=1: remapped mode, COM0 to COM[N-1] becomes COM[N-1] to COM0 when Multiplex ratio is equal to N. See Figure 8 on page 15 for detail mapping.
11100000	Set Read-Modify-Write Mode	Read-Modify-Write mode will be entered in which the column address will not be increased during display data read. After POR, Read-modify-write mode is turned OFF.
11100010	Software Reset	Initialize internal status registers.
11101110	Set End of Read-Modify-Write Mode	Exit Read-Modify-Write mode. RAM Column address before entering the mode will be restored. After POR, Read-modify-write mode is OFF.

7. Optical Characteristics
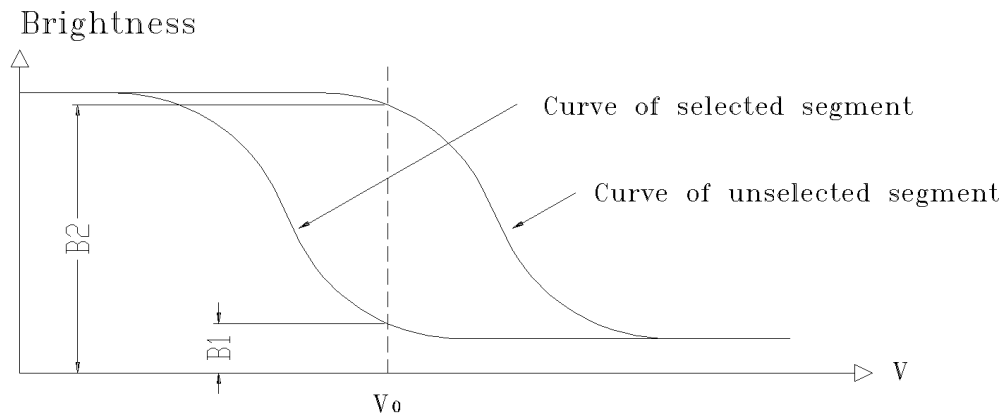
7.1 Optical Characteristics　　　　　　　　　　　　　　Ta=25℃

Item		Symbol	Condition		Min.	Typ.	Max.	Unit
Viewing Angle		θ_x	Cr≥2	$\theta_y=0°$	-30	--	20	Deg
		θ_y		$\theta_x=0°$	-30	--	30	
Contrast Ratio		Cr	$\theta_x=0°$ $\theta_y=0°$		3.0	-	-	
Response Time	Turn on	Ton	$\theta_x=0°$ $\theta_y=0°$		-	-	300	ms
	Turn off	Toff			-	-	300	

7.2 Definition of Optical Characteristics

7.2.1 Definition of Viewing Angle

Top　　　　　　　　　　　Top

Bottom　　　　　　　　　Bottom
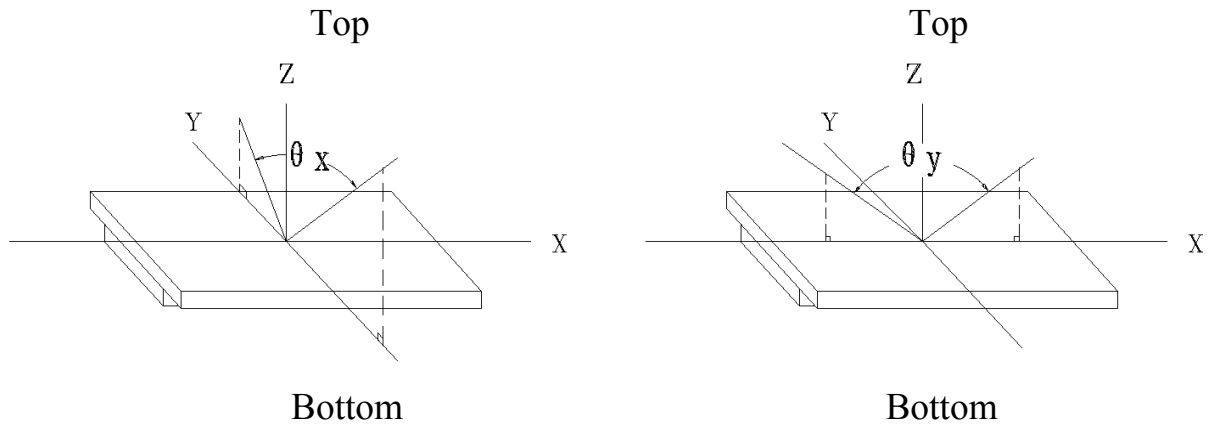
7.2.2 Definition of Contrast Ratio

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

Measuring Conditions:

1) Ambient Temperature: 25℃ ;　　2) Frame frequency: 84.0Hz

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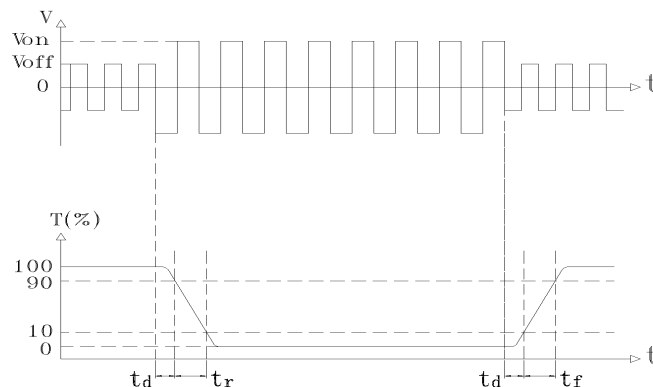
Turn on time: $t_{on} = t_d + t_r$　　Turn off time: $t_{off} = t_d + t_f$

Measuring Condition:

1) Operating Voltage: 8.9V ;　　2) Frame frequency: 84.0Hz

8. Reliability

8.1 Content of Reliability Test　　　　　　　　　　　　　Ta=25℃

No.	Test Item	Content of Test	Test condition
1	High Temperature Storage	Endurance test applying the high storage temperature for a long time	80℃ 240H Restore 4H at 25℃
2	Low Temperature Storage	Endurance test applying the low storage temperature for a long time	-30℃ 240H Restore 4H at 25℃
3	High Temperature /Humidity Storage	Endurance test applying the high temperature and high humidity storage for a long time	60℃ 90%RH 240H Restore 4H at 25℃
4	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℃
5	Vibration Test (package state)	Endurance test applying the vibration during transportation	10Hz~500Hz, 100m/s^2, 120min
6	Shock Test (package state)	Endurance test applying the shock during transportation	Half- sine wave, 300m/s^2, 18ms
7	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	
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 0.65 Minor 1.5
Display Defects	Under normal illumination and eyesight condition, display on inspection.	See Appendix B			II	Major 0.65 Minor 1.5
Note: Major defects: Open segment or common, Short, Serious damages, Leakage 　　　Miner defects: Others 　　　Sampling standard conforms to GB2828						

10. Precautions for Use of LCD Modules

10.1 Handling Precautions

10.1.1 The display panel is made of glass. Do not subject it to a mechanical shock by dropping it from a high place, etc.

10.1.2 If the display panel is damaged and the liquid crystal substance inside it leaks out, be sure not to get any in your mouth, if the substance comes into contact with your skin or clothes, promptly wash it off using soap and water.

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

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

10.1.5 If the display surface is contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If still not completely clear, moisten cloth with one of the following solvents:

　　　― Isopropyl alcohol
　　　― Ethyl alcohol

Solvents other than those mentioned above may damage the polarizer. Especially, do not use the following:

　　　― Water
　　　― Ketone
　　　― Aromatic solvents

10.1.6 Do not attempt to disassemble the LCD Module.

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

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

　a. Be sure to ground the body when handling the LCD Modules.

　b. Tools required for assembly, such as soldering irons, must be properly ground.

　c. To reduce the amount of static electricity generated, do not conduct assembly and other work under dry conditions.

　d. The LCD Module is coated with a film to protect the display surface. Be care when peeling off this protective film since static electricity may be generated.

10.2 Storage precautions

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

10.2.2 The LCD modules should be stored under the storage temperature range. If the LCD modules will be stored for a long time, the recommend condition is:
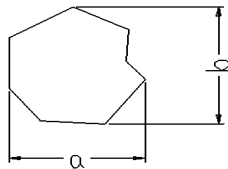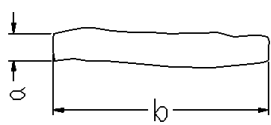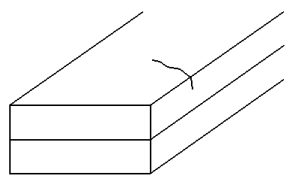
Temperature :   0℃ ～ 40℃

Relatively humidity: ≤80%

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

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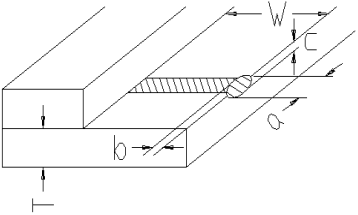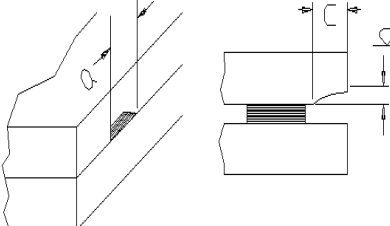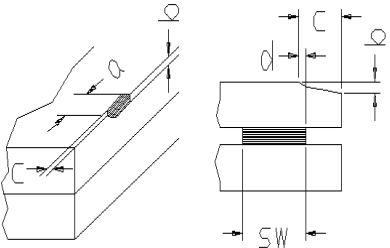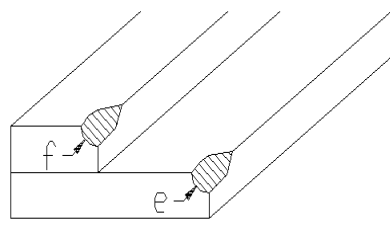
Appendix A

Inspection items and criteria for appearance defects

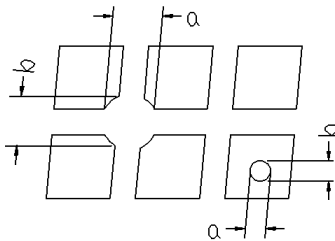| Items	Contents	Criteria		
Leakage		Not permitted		
Rainbow		According to the limit specimen		
Polarizer	Wrong polarizer attachment	Not permitted		
	Bubble between polarizer and glass	Not counted	Max. 3 defects allowed	
		$\phi<0.3mm$	$0.3mm\leqslant\phi\leqslant0.5mm$	
	Scratches of polarizer	According to the limit specimen		
Black spot (in viewing area)		Not counted	Max. 3 spots allowed	Max. 3 spots (lines) allowed
		$X<0.2mm$	$0.2mm\leqslant X\leqslant0.5mm$	
		$X=(a+b)/2$		
Black line (in viewing area)		Not counted	Max. 3 lines allowed	
		$a<0.02mm$	$0.02mm\leqslant a\leqslant0.05mm$ $b\leqslant2.0mm$	
Progressive cracks		Not permitted		
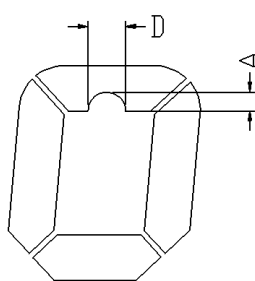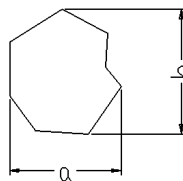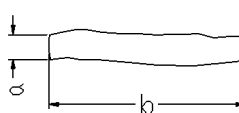
Appendix A

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		
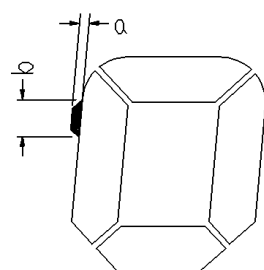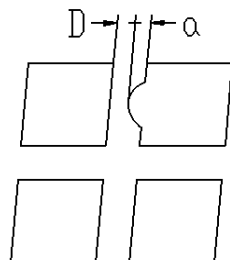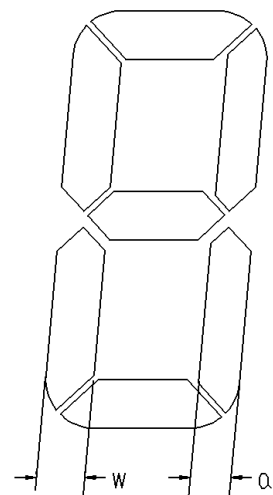
Appendix B

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		