



SPECIFICATION

FOR LCD MODULE

Version 0.2

CUSTOMER :

CUSTOMER NO. :

PRODUCT TYPE : Graphics LCM

MODULEL NO. : TM12864NCCWVGYS

CUSTOMER APPROVED	
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1. LCD Module Part Numbering System

TM	12864	N	C	C	W	V	G	Y	S	C
①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪

NO.	Explanation
①	TIANMA module indicating
②	Module type: 128 columns × 64 rows
③	TIANMA module series (A,B,C,D...)
④	LCD type
	C Positive, FSTN
⑤	Backlight type
	C Transflective, LED
⑥	Temperature range
	W Wide temperature
⑦	Viewing Angle
	V Wide viewing direction
⑧	Technology
	G COG
⑨	The color of backlight
	Y Yellow-green
⑩	Module type
	S Standard
⑪	Function choice
	C Only DC-DC

2 Basic specification

Item	Contents			
LCD type	<input type="checkbox"/> TN	<input type="checkbox"/> STN	<input checked="" type="checkbox"/> FSTN	<input type="checkbox"/>
	<input checked="" type="checkbox"/> positive	<input type="checkbox"/> negative		
LCD Duty	<input checked="" type="checkbox"/> 65	<input type="checkbox"/> 128	<input type="checkbox"/> 240	<input type="checkbox"/> 16
LCD Bias	<input checked="" type="checkbox"/> 1/9	<input type="checkbox"/> 1/12	<input type="checkbox"/> 1/16	<input type="checkbox"/> 1/5
Polarizer	<input type="checkbox"/> reflective	<input checked="" type="checkbox"/> transfective	<input type="checkbox"/> transmissive	
LCD background color	<input type="checkbox"/> grey	<input checked="" type="checkbox"/> yellow/green	<input type="checkbox"/> blue-black	<input type="checkbox"/> without
Segment color	<input type="checkbox"/> white	<input checked="" type="checkbox"/> blue-black	<input type="checkbox"/>	
Backlighting	<input checked="" type="checkbox"/> LED	<input type="checkbox"/> EL	<input type="checkbox"/> CFL	<input type="checkbox"/> without
LED type	<input checked="" type="checkbox"/> edge	<input type="checkbox"/> area	<input type="checkbox"/>	<input type="checkbox"/>
Backlighting color	<input type="checkbox"/> white	<input checked="" type="checkbox"/> yellow/green	<input type="checkbox"/> blue	<input type="checkbox"/> without
View direction	<input checked="" type="checkbox"/> 6:00	<input type="checkbox"/> 12:00	<input type="checkbox"/> 9:00	<input type="checkbox"/> Wide View
Operating temperature	<input type="checkbox"/> 0°C~50°C	<input checked="" type="checkbox"/> -20°C~70°C	<input type="checkbox"/>	
Storage temperature	<input type="checkbox"/> -20°C~60°C	<input checked="" type="checkbox"/> -30°C~80°C		
Controller	<input type="checkbox"/> T6963C	<input type="checkbox"/> S1D13305	<input type="checkbox"/> S1D13700	<input checked="" type="checkbox"/> S6B0724
Frame	<input type="checkbox"/> SPCC(black)	<input type="checkbox"/> Zinc plated	<input type="checkbox"/> stainless steel	<input checked="" type="checkbox"/> without
Technology	<input type="checkbox"/> SMT	<input type="checkbox"/> COB	<input checked="" type="checkbox"/> COG	<input type="checkbox"/>
Power supply	<input type="checkbox"/> single +3.3V	<input checked="" type="checkbox"/> single +3.0V	<input type="checkbox"/> dual	<input type="checkbox"/> triplex
Data Transfer	<input checked="" type="checkbox"/> 8 Bit Parallel	<input type="checkbox"/> 4 Bit Parallel	<input type="checkbox"/> Serial	<input type="checkbox"/>

2.1 General

The TM12864NCCWG Graphics LCM unit consists of 128 columns×64 rows dot-matrix LCD panel, LCD driver, controller LSI on a single IC .

2.2 Features

- ◆ Wide viewing direction. Wide Operating temperature.
- ◆ Requirements on environmental protection: RoHS.

Notes:

- Color tone can slightly change with temperature and driving voltage.
- Color tone will be changed by backlight.

3 Mechanical data

Parameter	Standard Value	Unit
Display type	Dot-matrix module	--
Number of dots (W×H)	128×64	--
View area (W×H)	59.0 × 30.50	mm
Active Area (W×H)	55.0 × 27.48	mm
Dot Size (W×H)	0.39 × 0.39	mm
Dot Pitch (W×H)	0.43 × 0.43	mm
Module size(W×H×D)	70.0 × 43.0 × 8.8(MAX)	mm
Module outline dimensions	Refer to page 6-“Outline drawing”	--

4 Absolute maximum ratings

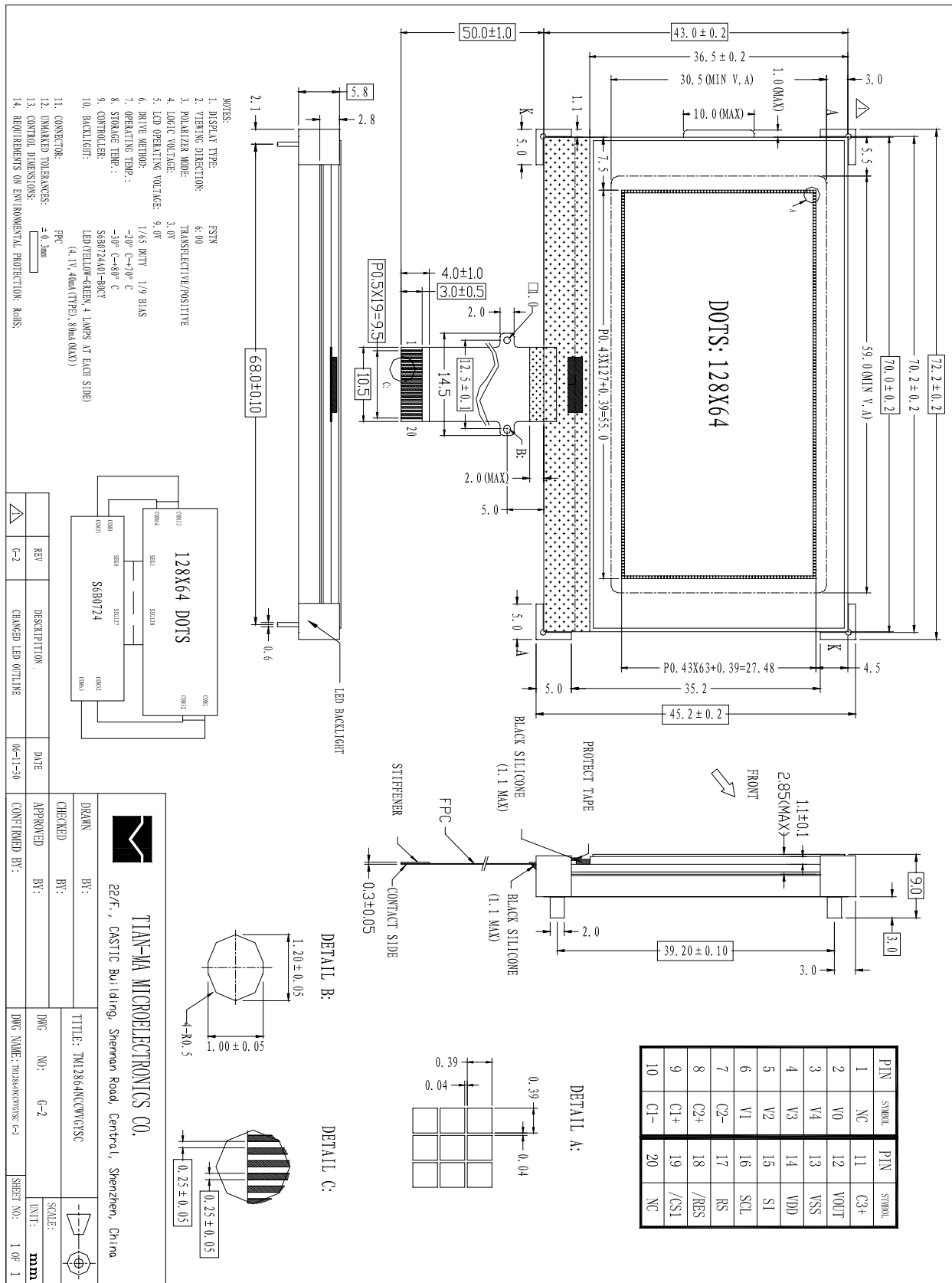
(Without LED backlighting ,Ta=25℃)

Parameter	Symbol	Min	Max	Unit	Remark
Logic circuit supply voltage	V _{DD}	-0.3	+3.0	V	
LCD driving voltage	V _{LCD}	-0.3	9.0	V	
Operating temperature range	T _{op}	-20	+70	℃	No Condensation
Storage temperature range	T _{st}	-30	+80	℃	

Notes:

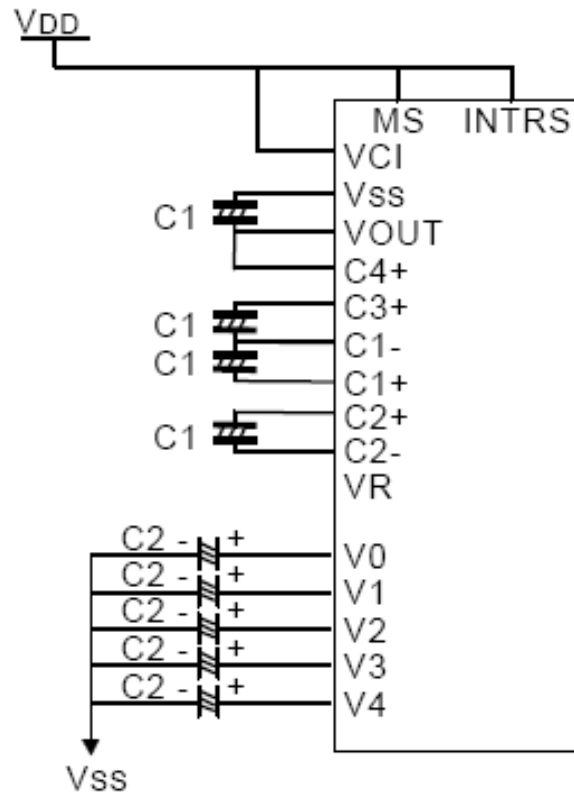
- LCD operating voltage $V_{LCD}=V_0-V_{SS}$.
- If the module is above these absolute maximum ratings. It may become permanently damaged. Using the module within the following electrical characteristic conditions are also exceeded, the module will malfunction and cause poor reliability, and its service life will reduce.
- $V_0 > V_{SS}$ must be maintained.

5. Outline Drawing



6.2 Recommend power supply circuit

Only for reference.



Value of external Capacitance

Item	Value	Unit
C1	1.0 to 4.7	μF
C2	0.47 to 1.0	

7 Pin connections

Pin No.	Symbol	Level	Description
1	NC	-	
2	V0	-	Power supply voltage for LCD $V0 \geq V1 \geq V2 \geq V3 \geq V4 \geq VSS$
3	V4	-	
4	V3	-	
5	V2	-	
6	V1	-	
7	C2-	-	Capacitor pin for voltage converter
8	C2+	-	Capacitor pin for voltage converter
9	C1+	-	Capacitor pin for voltage converter
10	C1-	-	Capacitor pin for voltage converter
11	C3+	-	Capacitor pin for voltage converter
12	VOUT	-	DC/DC voltage converter output
13	VSS	0V	Ground
14	VDD	3.0V	Power supply voltage for logic
15	SI	H/L	Serial input data
16	SCL	H/L	Serial input clock
17	RS	H/L	Register select input pin (H: Data, L: control)
18	/RES	H/L	Reset input pin (active at low)
19	/CS1	H/L	Chip select input pin (active at low)
20	NC	-	

8 Instruction Code & Timing characteristics

8.1 COMMAND

		RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Description
Display ON / OFF	0	0	1	0	1	0	1	1	1	DON	Turn on/off LCD panel When DON = 0: display OFF When DON = 1: display ON
Initial display line	0	0	0	1	ST5	ST4	ST3	ST2	ST1	ST0	Specify DDRAM line for COM0
Set page address	0	0	1	0	1	1	P3	P2	P1	P0	Set page address
Set column address MSB	0	0	0	0	0	1	Y7	Y6	Y5	Y4	Set column address MSB
Set column address LSB	0	0	0	0	0	0	Y3	Y2	Y1	Y0	Set column address LSB
Read status	0	1	BUSY	ADC	ONOFF	FEFEB	0	0	0	0	Read the internal status
Write display data	1	0	Write data							Write data into DDRAM	
Read display data	1	1	Read data							Read data from DDRAM	
ADC select	0	0	1	0	1	0	0	0	0	ADC	Select SEG output direction When ADC = 0: normal direction (SEG0→SEG131) When ADC = 1: reverse direction (SEG131→SEG0)
Reverse display ON / OFF	0	0	1	0	1	0	0	1	1	REV	Select normal / reverse display When REV = 0: normal display When REV = 1: reverse display
Entire display ON / OFF	0	0	1	0	1	0	0	1	0	EON	Select normal/entire display ON When EON = 0: normal display. When EON = 1: entire display ON
LCD bias select	0	0	1	0	1	0	0	0	1	BIAS	Select LCD bias
Set modify-read	0	0	1	1	1	0	0	0	0	0	Set modify-read mode
Reset modify-read	0	0	1	1	1	0	1	1	1	0	release modify-read mode
Reset	0	0	1	1	1	0	0	0	1	0	Initialize the internal functions
SHL select	0	0	1	1	0	0	SHL	x	x	x	Select COM output direction When SHL = 0: normal direction (COM0→COM63) When SHL = 1: reverse direction (COM63→COM0)
Power control	0	0	0	0	1	0	1	VC	VR	VF	Control power circuit operation
Regulator resistor select	0	0	0	0	1	0	0	R2	R1	R0	Select internal resistance ratio of the regulator resistor
Set reference voltage mode	0	0	1	0	0	0	0	0	0	1	Set reference voltage mode
Set reference voltage register	0	0	x	x	SV5	SV4	SV3	SV2	SV1	SV0	Set reference voltage register
Set static indicator mode	0	0	1	0	1	0	1	1	0	SM	Set static indicator mode
Set static indicator register	0	0	x	x	x	x	x	x	S1	S0	Set static indicator register
Power save	-	-	-	-	-	-	-	-	-	-	Compound Instruction of display OFF and entire display ON
NOP	0	0	1	1	1	0	0	0	1	1	<i>Non-Operation command</i>
Test Instruction_1	0	0	1	1	1	1	x	x	x	x	<i>Don't use this instruction</i>
Test Instruction_2	0	0	1	0	0	1	x	x	x	x	<i>Don't use this instruction</i>

8.2 AC characteristics

Note: Please refer to IC: S6B0724 data sheet for more details.

Serial Interface Characteristics

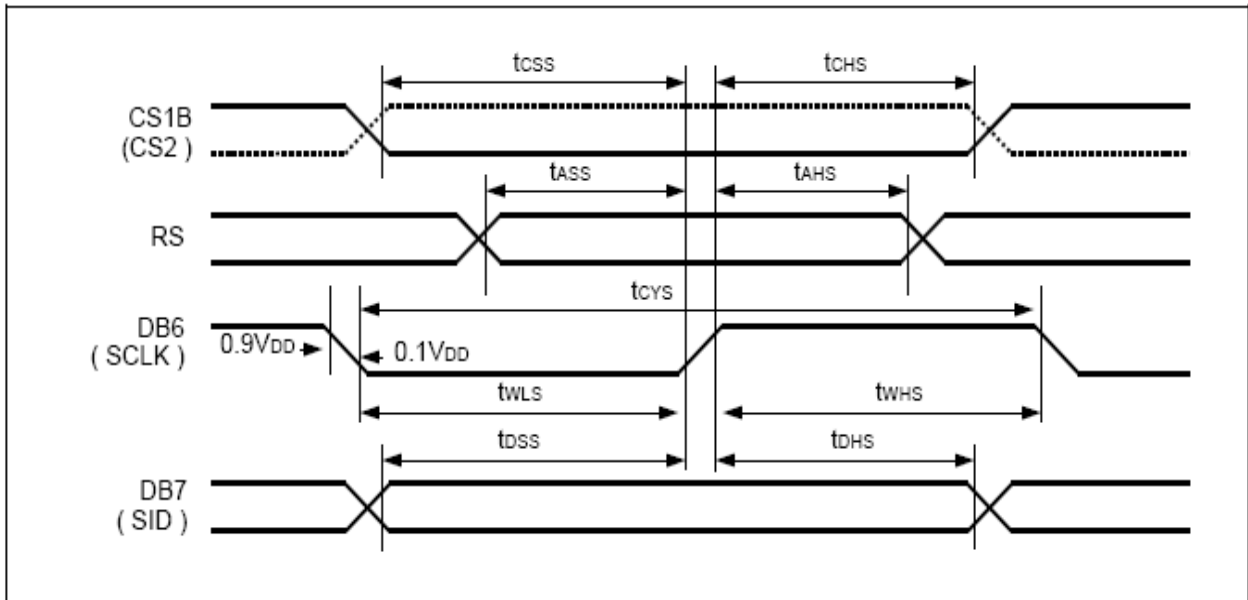
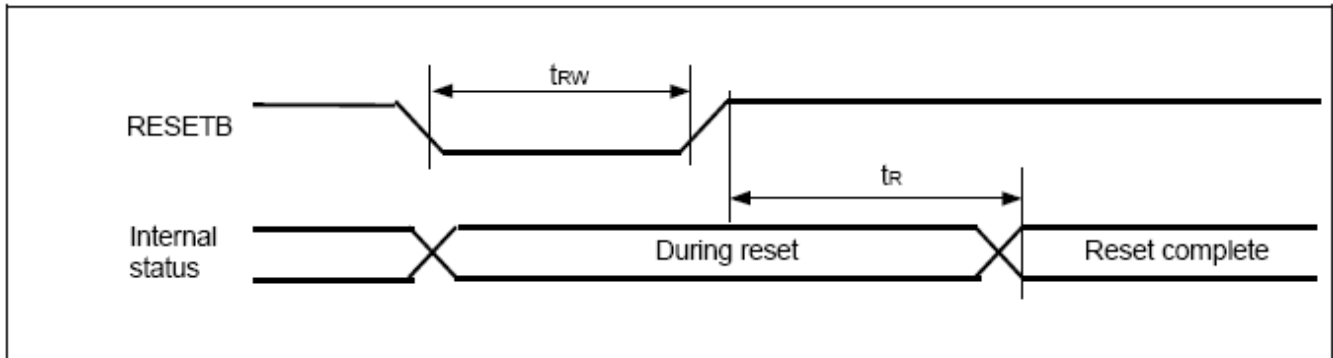


Figure1. Serial Interface Characteristics

($V_{DD} = 2.4$ to $3.6V$, $T_a = -40$ to $+85^{\circ}C$)

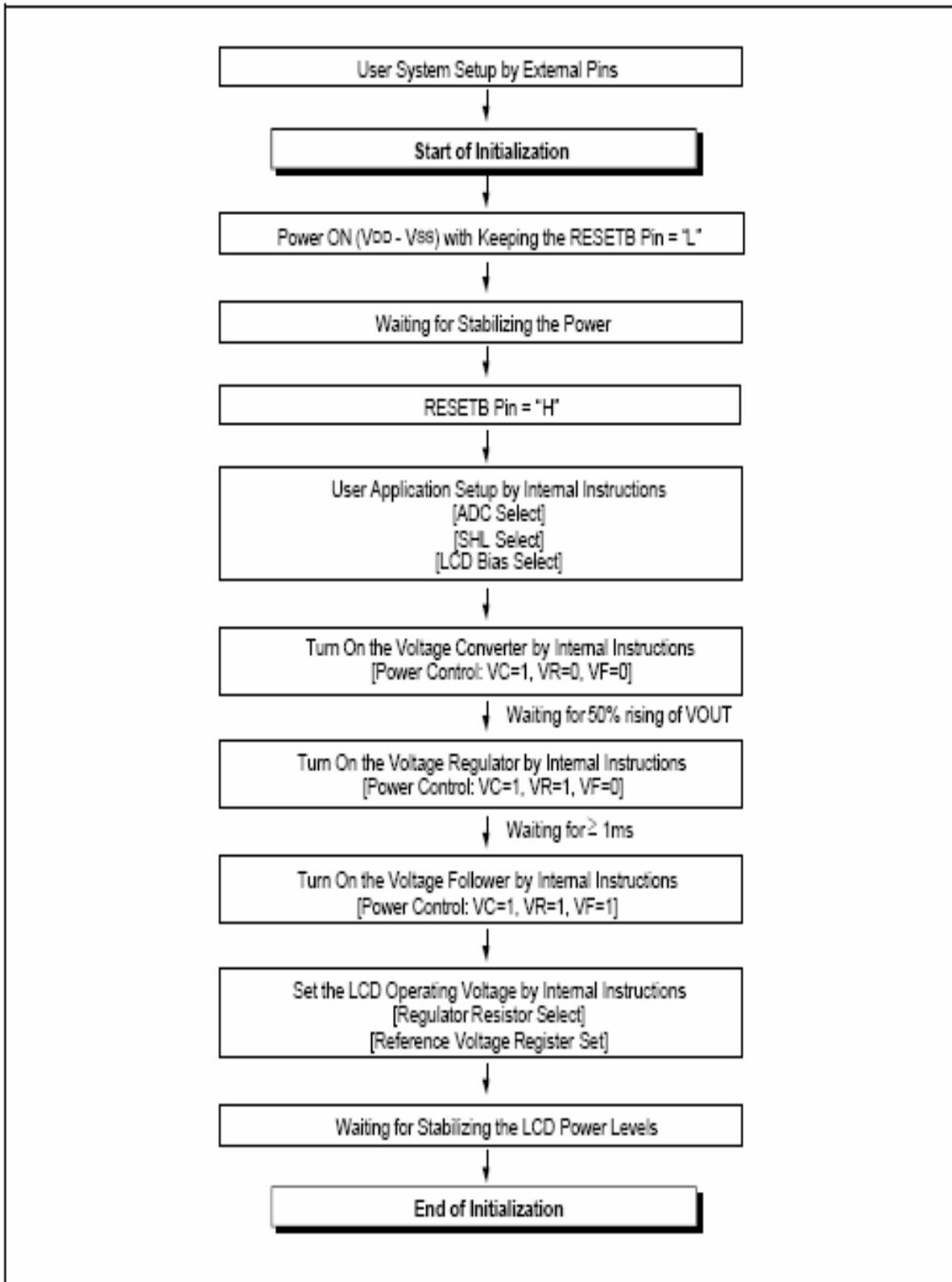
Item	Signal	Symbol	Min.	Typ.	Max.	Unit	Remark
Serial clock cycle	DB6 (SCLK)	t_{cYS}	250	-	-	ns	
SCLK high pulse width		t_{wHS}	100	-	-		
SCLK low pulse width		t_{wLS}	100	-	-		
Address setup time	RS	t_{ASS}	150	-	-	ns	
Address hold time		t_{AHS}	150	-	-		
Data setup time	DB7 (SID)	t_{dSS}	100	-	-	ns	
Data hold time		t_{dHS}	100	-	-		
CS1B setup time	CS1B	t_{cSS}	150	-	-	ns	
CS1B hold time		t_{cHS}	150	-	-		

Reset Input Timing

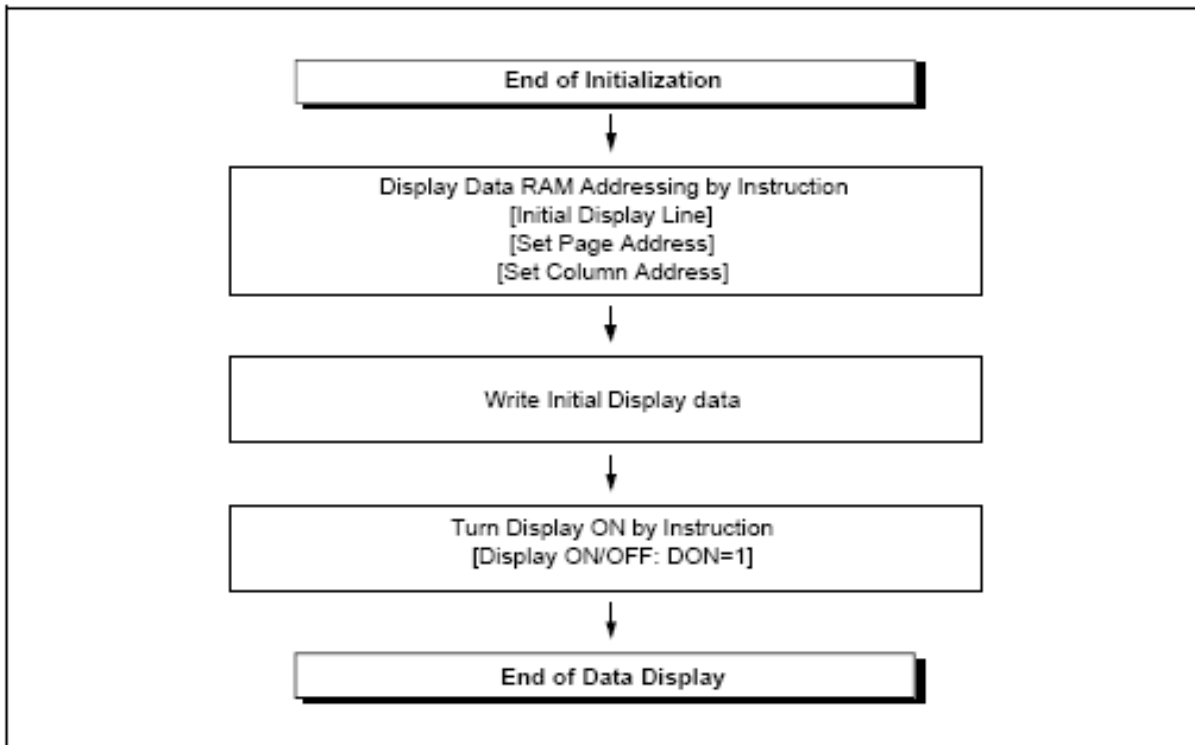

Figure2. Reset Input Timing Diagram

(VDD = 2.4 to 3.6V, Ta = -40 to +85°C)

Item	Signal	Symbol	Min.	Typ.	Max.	Unit	Remark
Reset low pulse width	RESETB	t_{rw}	1.0	-	-	μs	
Reset time	-	t_r	-	-	1.0	μs	

8.3 Instruction setup flow


Initialization with the built-in power supply circuits



Data displaying

9 DC characteristics

 (V_{SS} = 0V, V_{DD} = 2.4 to 5.5V, Ta = -40 to 85°C)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Pin used	
Operating voltage (1)	V _{DD}	Select by product code	2.4	-	3.6	V	V _{DD} *1	
			2.4	-	5.5			
Operating voltage (2)	V ₀		4.5	-	15.0	V	V ₀ *2	
Input voltage	High	V _{IH}	0.8V _{DD}	-	V _{DD}	V	*3	
	Low	V _{IL}	V _{SS}	-	0.2V _{DD}			
Output voltage	High	V _{OH}	I _{OH} = -0.5mA	0.8V _{DD}	-	V _{DD}	V	*4
	Low	V _{OL}	I _{OL} = 0.5mA	V _{SS}	-	0.2V _{DD}		
Input leakage current	I _{IL}	V _{DD} = 3.0V V _{IN} = V _{DD} or V _{SS}	- 1.0	-	+ 1.0	μA	*5	
Output leakage current	I _{OZ}	V _{IN} = V _{DD} or V _{SS}	- 3.0	-	+ 3.0	μA	*6	
LCD driver ON resistance	R _{ON}	Ta = 25°C, V ₀ = 8V	-	2.0	3.0	kΩ	SEGN COMn *7	
Oscillator frequency	Internal	f _{OSC}	V _{DD} = 3.0V Ta = 25°C Duty ratio = 1/65	32.7	43.6	54.5	kHz	CL *8
	External	f _{CL}		4.09	5.45	6.81		
Voltage converter input voltage	V _{CI}	× 2	2.4	-	5.5	V	V _{CI}	
		× 3	2.4	-	5.0			
		× 4	2.4	-	3.75			
		× 5	2.4	-	3.0			
Voltage converter output voltage	V _{OUT}	×2 / ×3 / ×4 / ×5 voltage conversion (no-load)	95	99	-	%	V _{OUT}	
Voltage regulator operating voltage	V _{OUT}		6.0	-	16.0	V	V _{OUT}	
Voltage follower operating voltage	V ₀		4.5	-	15.0	V	V ₀ *9	
Reference voltage	V _{REF}	V _{DD} = 3.0V Ta = 25°C	- 0.05%/°C	2.04	2.1	2.16	V	*10

10 LED backlight characteristics

Ta=25°C

Item	Symbol	Condition	MIN.	TYP.	MAX.	Unit
Forward voltage	V_f	$I_f=40\text{mA}$	4.0	4.2	4.4	V
Forward current	I_f	$V_f=4.1\text{V}$	--	80	100	mA
Reverse voltage	V_r	--	--	--	10	V
Peak Wave Length	λ_p		569	572	575	nm
Reverse Current	I_r	--	--	--	240	mA
Luminous intensity*	B_p	$I_f=80\text{mA}$	16	20	--	cd/m^2
Luminous Uniformity*	ΔB_p		75	--	--	%
Color coordinate*	X		--	--	--	--
	Y		--	--	--	--

Note:

- Measured at the bare LED backlight unit.
- If the backlight is above these maximum ratings for long time, the service life of the LED backlight will reduce or it will cause poor reliability.

11 Optical Characteristics

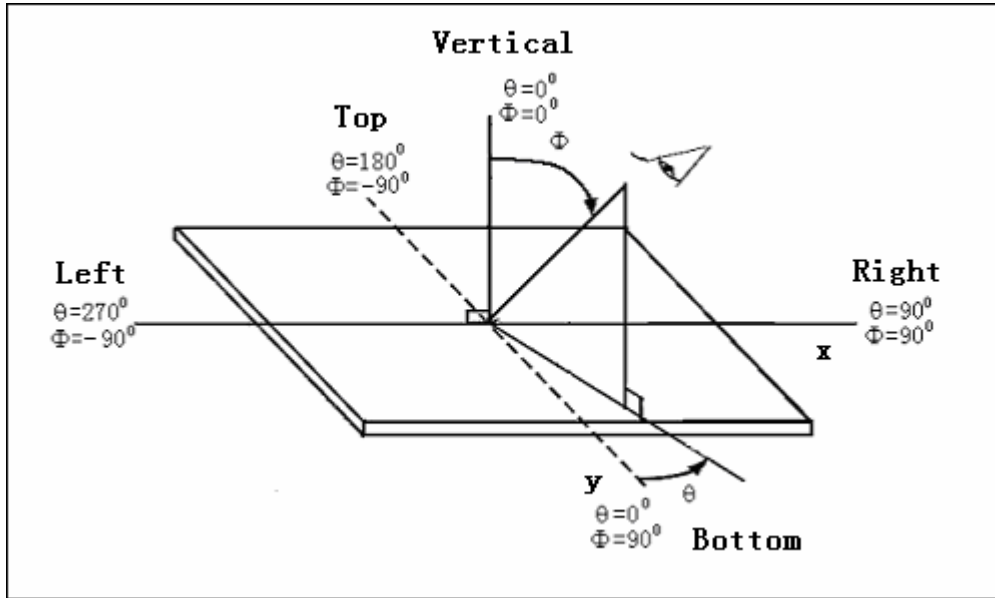
11.1 Optical Characteristics

Ta=25°C

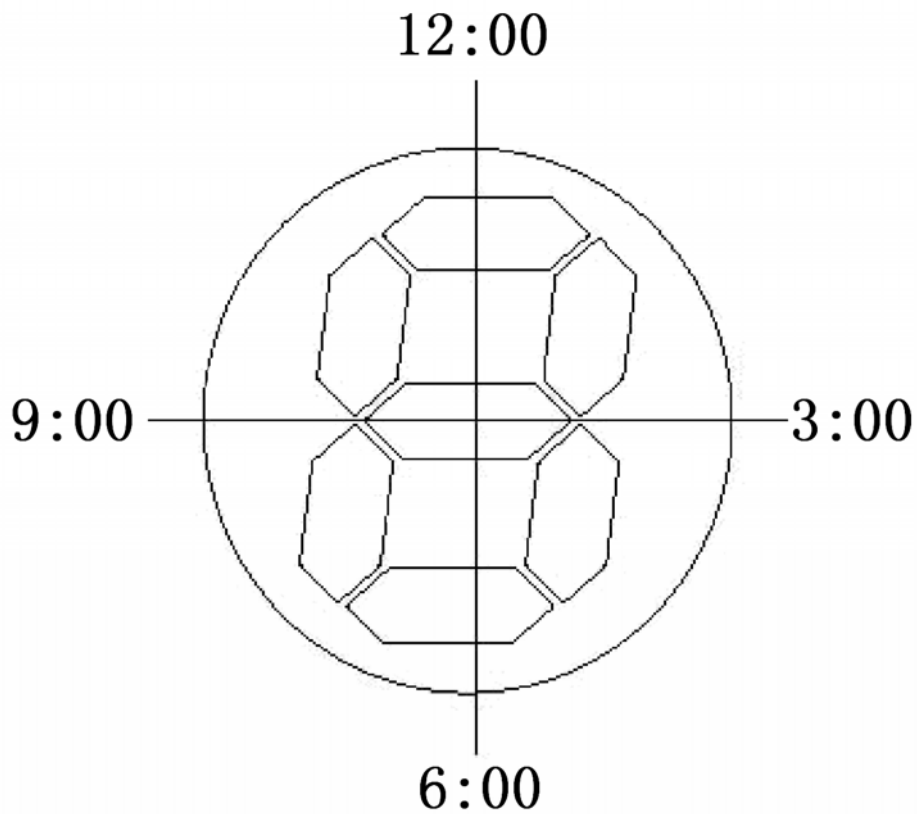
Item		Symbol	Condition	Min.	Typ.	Max.	Unit
Transmission		T	--	10%	16%	--	--
Viewing Angle		θ_x	Cr \geq 2 $\theta_y = 0^\circ$	-45 -- 60			Deg
		θ_y		-30 -- 30			
Viewing Angle		θ_x	Cr \geq 5 $\theta_y = 0^\circ$	--			Deg
		θ_y		--			
Contrast Ratio		Cr	$\theta_x = 0^\circ$ $\theta_y = 0^\circ$	--	10.0	--	
Response Time	Turn on	Ton	$\theta_x = 0^\circ$ $\theta_y = 0^\circ$ Tamb= +22°C 0°C -10°C -20°C A wave, f=70Hz	--	--	250	ms
				--	--	--	
				--	--	--	
				--	--	--	
	Turn off	Toff		--	--	200	
				--	--	--	
				--	--	--	
				--	--	--	

11.2 Definition of Optical Characteristics

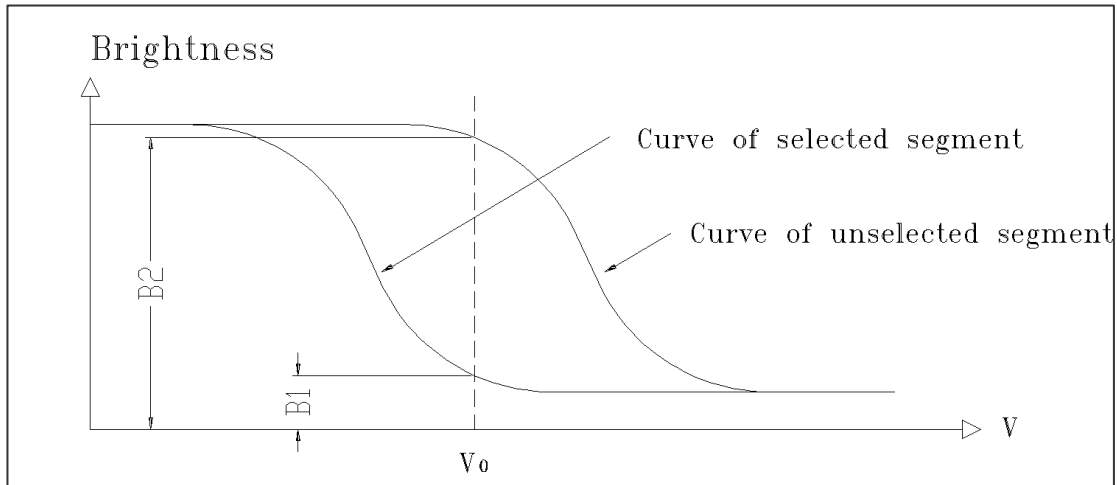
11.2.1 Definition of Viewing Angle



11.2.2 Indication of Viewing Angle



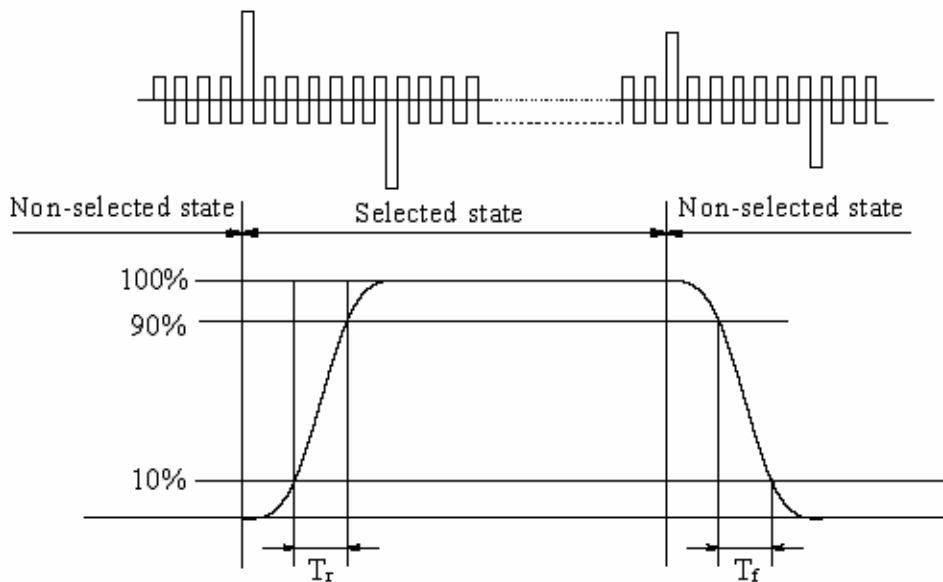
11.2.2 Definition of Contrast Ratio



$$\text{Contrast Ratio} = B_2/B_1 = \frac{\text{unselected state brightness}}{\text{selected state brightness}}$$

- Measuring Conditions:
- 1) Ambient Temperature: 25°C
 - 2) Frame frequency: 70Hz
 - 3) Operating voltage: $V_{op}=9.0V$
 - 4) Applying waveform: 1/65 duty 1/9 bias
 - 5) View angle (θ , ϕ): (0°, 0°)

11.2.3 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: $V_{op}=9.0V$
 - 2) Frame frequency: 70Hz
 - 3) Applying waveform: 1/65 duty 1/9 bias
 - 4) View angle (θ , ϕ): (0°, 0°)

12 Reliability

12.1 Content of Reliability Test

Ta=25°C

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°C 240H	Remark1 Remark2 Remake3 Remake4
2	Low Temperature Storage	Endurance test applying the low storage temperature for a long time	-30°C 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°C 240H	
4	Low Temperature Operation	Endurance test applying the electric stress under low temperature for a long time	-20°C 240H	
5	High Temperature /Humidity Storage	Endurance test applying the high temperature and high humidity storage for a long time	40°C 90%RH 240H	
6	Temperature Cycle	Endurance test applying the low and high temperature cycle $ \begin{array}{c} -30^{\circ}\text{C} \longleftrightarrow 25^{\circ}\text{C} \longleftrightarrow 80^{\circ}\text{C} \longleftrightarrow 25^{\circ}\text{C} \\ \begin{array}{cccc} 30\text{min} & 5\text{min} & 30\text{min} & 5\text{min} \end{array} \\ \longleftarrow \hspace{10em} \longrightarrow \\ \text{1 cycle} \end{array} $	-30°C/80°C 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:

- Each test item applies for a test sample only once, The test sample can not be used again in any other test item.
- The test sample is inspected after 2 hours or more storing at room temperature and room humidity after each test item is finished.
- The criteria refer to 11.2.

12.2 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.

12.3 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 ($25^{\circ}\text{C} \pm 10^{\circ}\text{C}$).

12.4 Definition of module service life

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

13 Quality level

Examination or Test	At T _a =25°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 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 Minor defects: Others Sampling standard conforms to GB2828						

14 Precautions for Use of LCD Modules

14.1 Handling Precautions

- 14.1.1 The display panel is made of glass. Do not subject it to a mechanical shock by dropping it from a high place, etc.
- 14.1.2 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.
- 14.1.3 Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.
- 14.1.4 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.
- 14.1.5 Don't put or attach anything on the display area to avoid leaving any marks on.
- 14.1.6 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
- 14.1.7 Do not attempt to disassemble the LCD Module.
- 14.1.8 If the logic circuit power is off, do not apply the input signals.
- 14.1.9 Avoid using the same display pattern long time (continuous ON segment).Software must be prepared so that the pattern will be changed
- 14.1.10 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.

14.2 Storage precautions

- 14.2.1 When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps.
- 14.2.2 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 : 5°C ~ 40°C

Relatively humidity: ≤80%

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

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

14.3 Transportation precautions

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

14.4 Soldering

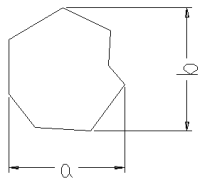
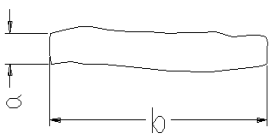
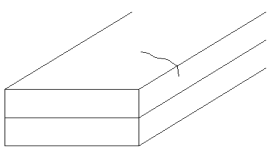
14.4.1 Use the high quality solders, only solder the I/O terminals.

14.4.2 No higher than 280°C and time less than 3-4 second during soldering.

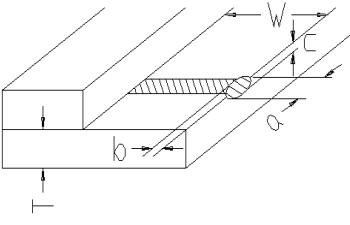
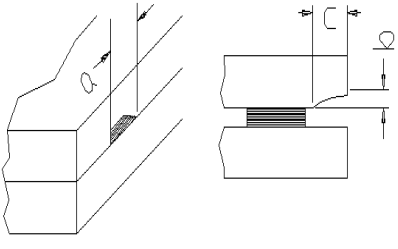
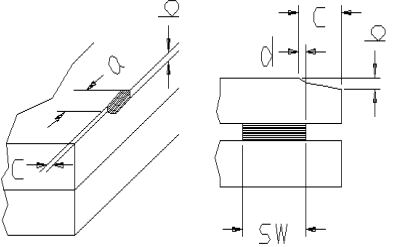
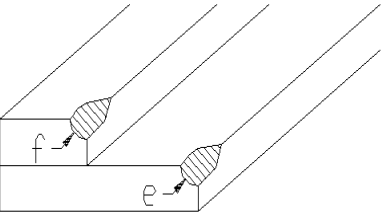
14.4.3 Rewiring: no more than 3 times.

14.4.4 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.

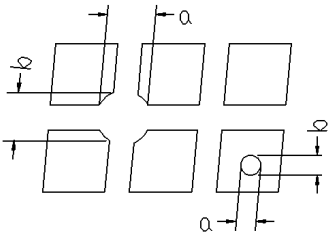
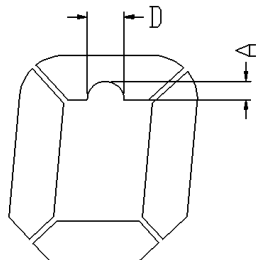
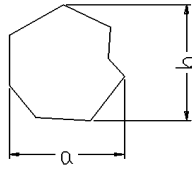
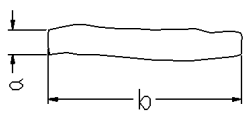
Appendix A
Inspection items and criteria for appearance defects

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
		$\phi < 0.3\text{mm}$	$0.3\text{mm} \leq \phi \leq 0.5\text{mm}$
Scratches of polarizer	According to the limit specimen		
Black spot (in viewing area)		Not counted	Max. 3 spots allowed
		$X < 0.20\text{mm}$	$0.20\text{mm} \leq X \leq 0.5\text{mm}$
		$X = (a+b)/2$	
Black line (in viewing area)		Not counted	Max. 3 lines allowed
		$a < 0.02\text{mm}$	$0.02\text{mm} \leq a \leq 0.05\text{mm}$ $b \leq 2.0\text{mm}$
Progressive cracks		Not permitted	

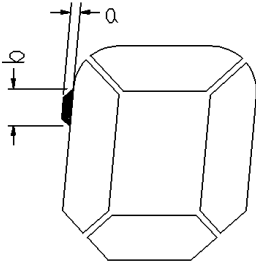
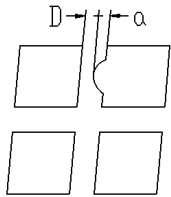
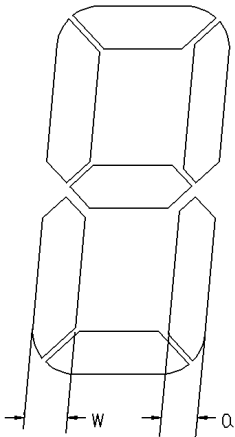
Appendix A (continued)

Item	Contents	Criteria				
Glass Cracks	Cracks on pads 	a	b	c	Max. 2 Cracks allowed	Max. 5 cracks allowed
	$\leq 3\text{mm}$	$\leq W/5$	$\leq T/2$			
	$\leq 2\text{mm}$	$\leq W/5$	$T/2 < C < T$			
	Cracks on contact side 	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					
	Cracks on non-contact side 	a	b	Max. 2 cracks allowed		
	$\leq 3\text{mm}$	$\leq T/2$				
	$\leq 2\text{mm}$	$T/2 < b < T$				
$C \leq 0.5\text{mm}$						
$d \leq SW/3$						
Corner cracks 	$e < 2.0\text{mm}^2$ $f < 2.0\text{mm}^2$			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 (continued)

Items	Content	Criteria	
Transformation of segment		Not counted	Max. 2 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 = measured value of width W = nominal value of width	