



# LCD Module

## Product Specification

**64128K FC BW-RGB**

128 x 64 DOTS Monochrome Display with RGB Backlight

June 8, 2018

Remark:

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**Displaytech Ltd.**

Tel: (852) 2311 2080 ; Fax: (852) 2722 6998 ; Email: [sales@displaytech.com.hk](mailto:sales@displaytech.com.hk)

Address: 31E Billion Plaza 2, No. 10 Cheung Yue Street, Cheung Sha Wan, Kowloon,  
Hong Kong.

Website: <http://www.displaytech.com.hk>

## Revision Record

REV	CHANGES	DATE
A0 (Ref. A00 20170407)	First release	Apr 7, 2017
A1 (Ref. A01 20180529)	Updated backlight pins location tolerance in section 2. Mechanical Drawing.	Jun 8, 2018

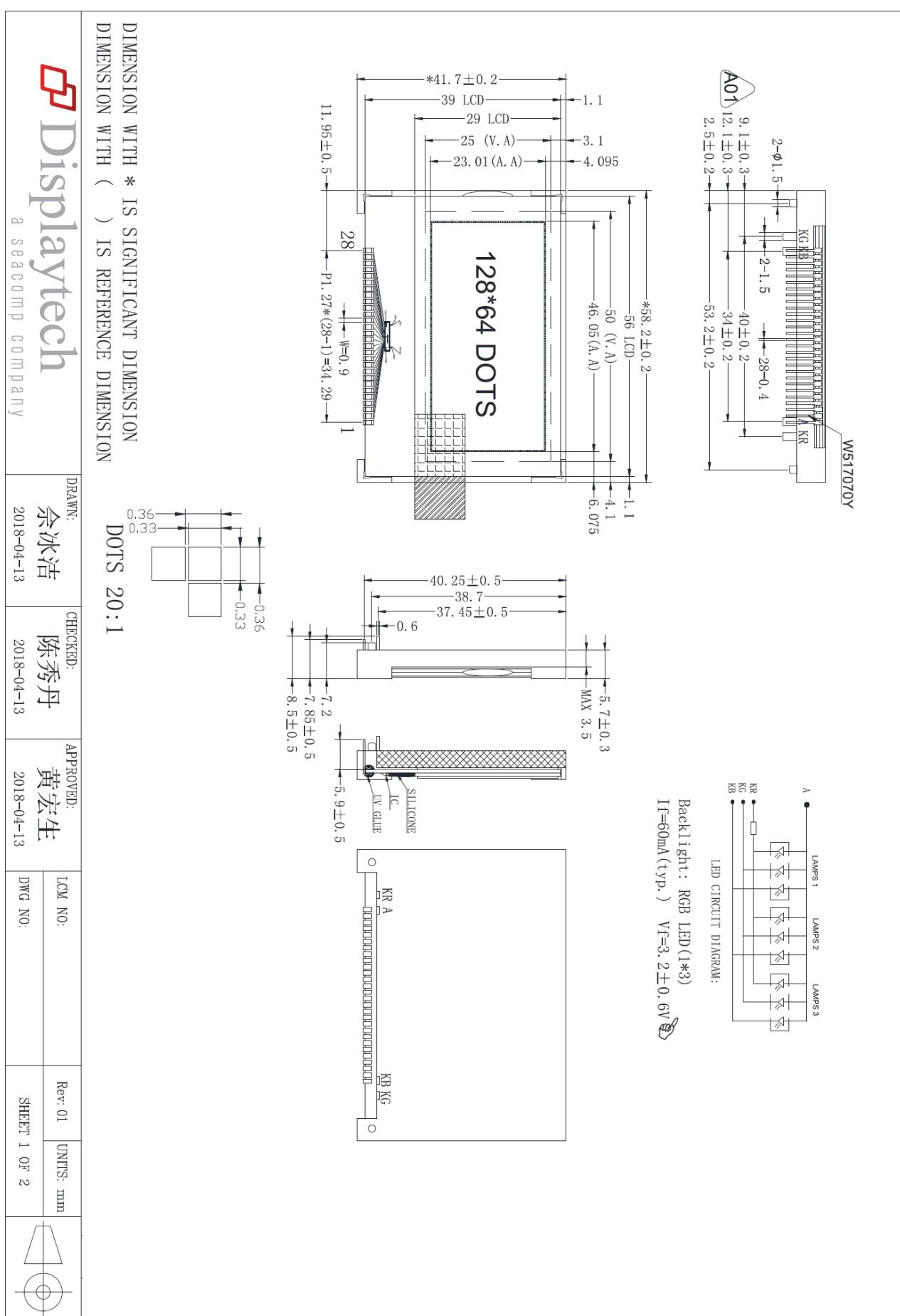
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## 1. General Specifications

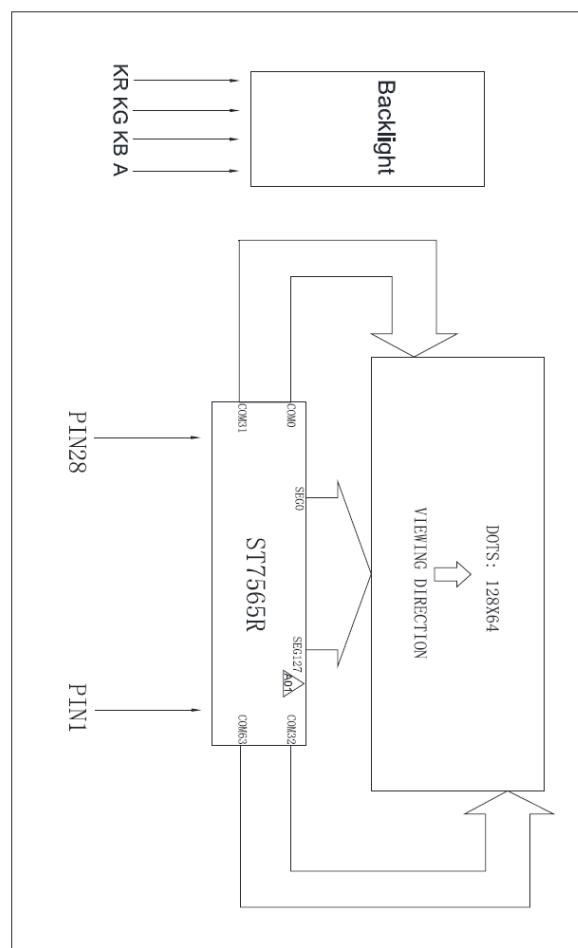
Item	Standard Value	Unit
Display Pattern	Graphic	
Color	Mono	
Resolution	128 x 64	DOTS
Module Dimension (W x H x T)	58.2 x 41.7 x 5.7	mm
Viewing Area (W x H)	50 x 25	mm
Active Area (W x H)	46.05 x 23.01	mm
DOT Size (W x H)	0.33 x 0.33	mm
DOT Pitch (W x H)	0.36 x 0.36	mm
LCD Type	FSTN, Positive	
Polarizer Type	Transflective	
View Direction	6 H	
LCD Controller & Driver	ST7565R	
LCD Driving Method	1/65 duty, 1/9 bias	
Interface Type	4-line SPI; Parallel 6800, 8080	
Backlight Type	LED	
Backlight Color	RGB	
DC-DC Converter	Build-in	
Operation Temperature	-20 ~ +70	°C
Storage Temperature	-30 ~ +80	°C

## 2. Mechanical Drawing



### 3. Interface I/O Terminal

Block Diagram:



Pin Description:	Pin	Symbol	Pin	Symbol
1 CS1	15	VSS		
2 /RES	16	VOUT		
3 A0	17	CAP3P		
4 /WR	18	CAP1N		
5 /RD	19	CAP1P		
6 D0	20	CAP2P		
7 D1	21	CAP2N		
8 D2	22	V4		
9 D3	23	V3		
10 D4	24	V2		
11 D5	25	V1		
12 D6	26	V0		
13 D7	27	C86		
14 VDD	28	P/S		

A01:Update LED-PCB pin tolerance
A00: Original Edition

Revision History:

	DRAWN: 陈维江 2018-04-13	CHECKED: 王彦添 2018-04-13	APPROVED: 黄宏生 2018-04-13

### 3.1 Pin Description

Pin	Symbol	Function Description
1	CS1	Chip select (Active low)
2	/RES	Reset input (Active low)
3	A0	Command/data select
4	/WR	Write execution control pin
5	/RD	Read execution control pin
6	D0	Bi-directional data
7	D1	Bi-directional data
8	D2	Bi-directional data
9	D3	Bi-directional data
10	D4	Bi-directional data
11	D5	Bi-directional data
12	D6	Bi-directional data
13	D7	Bi-directional data
14	VDD	Power supply
15	VSS	Power ground
16	VOUT	DC/DC voltage converter
17	CAP3P	DC/DC voltage converter
18	CAP1N	DC/DC voltage converter
19	CAP1P	DC/DC voltage converter
20	CAP2P	DC/DC voltage converter
21	CAP2N	DC/DC voltage converter
22	V4	Power supply for LCD
23	V3	Power supply for LCD
24	V2	Power supply for LCD
25	V1	Power supply for LCD
26	V0	Power supply for LCD
27	C86	MPU interface select
28	P/S	Parallel mode/serial mode select

## 4. Electro-Optical Specifications

### 4.1 Absolute Maximum Ratings

No	Item	Symbol	Min	Max	Unit
1	Power Supply Voltage	VDD	-0.3	3.6	V
2	Power Supply Voltage (VDD standard)	V0, VOUT	-0.3	13.5	V
3	Power Supply Voltage (VDD standard)	V1, V2, V3, V4	-0.3	V0	V

Note: Operating Temperature and Storage Temperature can be found in 1.General Specifications.

## 4.2 Optical Characteristics

No	Item	Symbol	Condition	Min	Typ	Max	Unit
1	Contrast Ratio	Cr	Ta=23±3°C VLCD = Typ. <sup>(2)</sup>	-	4.3	-	-
2	Response Time	Tr	Ta=23±3°C	-	150	230	ms
		Tf		-	230	315	ms
3	Viewing Angle	3H	Cr = 2 Ta=23±3°C	22	28	-	Deg
		9H		43	42	-	Deg
		6H		37	40	-	Deg
		12H		38	40	-	Deg
4	R Brightness	Lv	Ta=23±3°C ILED = Typ.	-	55	-	cd/m²
	G Brightness			-	130	-	cd/m²
	B Brightness			-	22	-	cd/m²
5	Luminance Uniformity	ΔLv		75	-	-	%

Note:

(1) See Appendix Definition of Optical Characteristics for detail.

(2) VLCD can be found in 4.3 Electrical Characteristics.

## 4.3 Electrical Characteristics

No	Item	Symbol	Condition	Min	Typ	Max	Unit
1	Power Supply Voltage	VDD	-	2.7	3.0	3.3	V
2	Power Supply Voltage (LCD drive voltage)	V <sub>0</sub> (V <sub>LCD</sub> )	Ta=23±3°C	8.6	8.8	9.0	V
3	Current consumption for LCD	Idd	-	-	0.5	1.5	mA
4	Input High-level Voltage	V <sub>IH</sub>	-	0.8*VDD		VDD	V
5	Input Low-level Voltage	V <sub>IL</sub>	-	VSS		0.7*VDD	V
6	Output High-level Voltage	V <sub>OH</sub>	-	0.8*VDD		VDD	V
7	Output Low-level Voltage	V <sub>OL</sub>	-	VSS		0.2*VDD	V
8	Forward Current of Backlight	If	Ta=23±3°C		60		mA
9	Forward Voltage of Backlight	Vf	If= Typ. Ta=23±3°C	2.6	3.2	3.8	V
10	Luminous Uniformity of Backlight	△Lv		75	-	-	%
11	Emission Wavelength	R		620		635	-
		G		510		535	-
		B		460		480	-

## 4.4 Timing Characteristics

System Bus Read/Write Characteristics 1 (For the 8080 Series MPU)

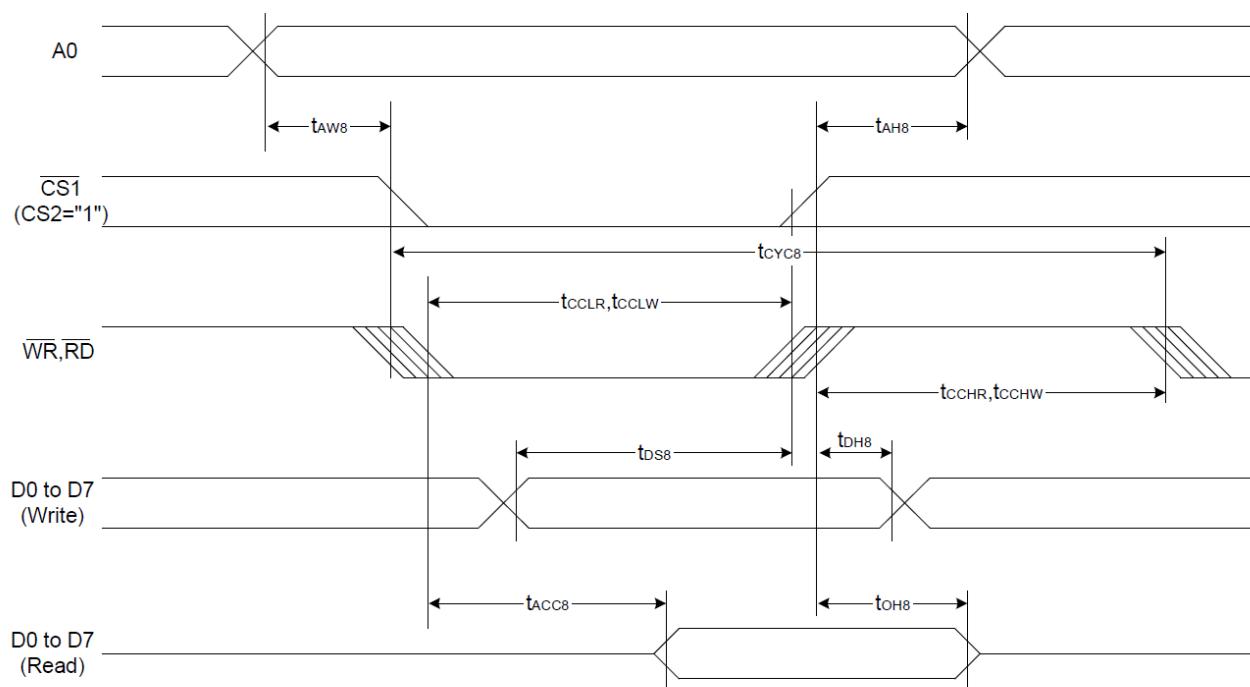


Figure 37

Table 24

(V<sub>DD</sub> = 3.3V, Ta = -30 to 85°C)

Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
Address hold time	A0	tAH8		0	—	Ns
Address setup time		tAW8		0	—	
System cycle time		tCYC8		240	—	
Enable L pulse width (WRITE)	WR	tCCLW		80	—	Ns
Enable H pulse width (WRITE)		tCCHW		80	—	
Enable L pulse width (READ)	RD	tCCLR		140	—	
Enable H pulse width (READ)		tCCHR		80	—	
WRITE Data setup time	D0 to D7	tDS8		40	—	Ns
WRITE Address hold time		tDH8		0	—	
READ access time		tACC8	CL = 100 pF	—	70	
READ Output disable time		tOH8	CL = 100 pF	5	50	

Table 25

(VDD = 2.7V, Ta = -30 to 85°C)

Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
Address hold time	A0	tAH8		0	—	ns
Address setup time		tAW8		0	—	
System cycle time		tcyc8		400	—	
Enable L pulse width (WRITE)	WR	tcclw		220	—	ns
Enable H pulse width (WRITE)		tcchw		180	—	
Enable L pulse width (READ)	RD	tcclr		220	—	
Enable H pulse width (READ)		tcchr		180	—	
WRITE Data setup time	D0 to D7	tds8		40	—	ns
WRITE Address hold time		tdh8		0	—	
READ access time		tacc8	CL = 100 pF	—	140	
READ Output disable time		toh8	CL = 100 pF	10	100	

\*1 The input signal rise time and fall time ( $t_r$ ,  $t_f$ ) is specified at 15 ns or less. When the system cycle time is extremely fast,  $(t_r + t_f) \leq (tcyc8 - tcclw - tcchw)$  for  $(t_r + t_f) \leq (tcyc8 - tcclr - tcchr)$  are specified.

\*2 All timing is specified using 20% and 80% of VDD as the reference.

\*3 tcclw and tcclr are specified as the overlap between /CS1 being "L" (CS2 = "H") and /WR and /RD being at the "L" level.

#### System Bus Read/Write Characteristics 2 (For the 6800 Series MPU)

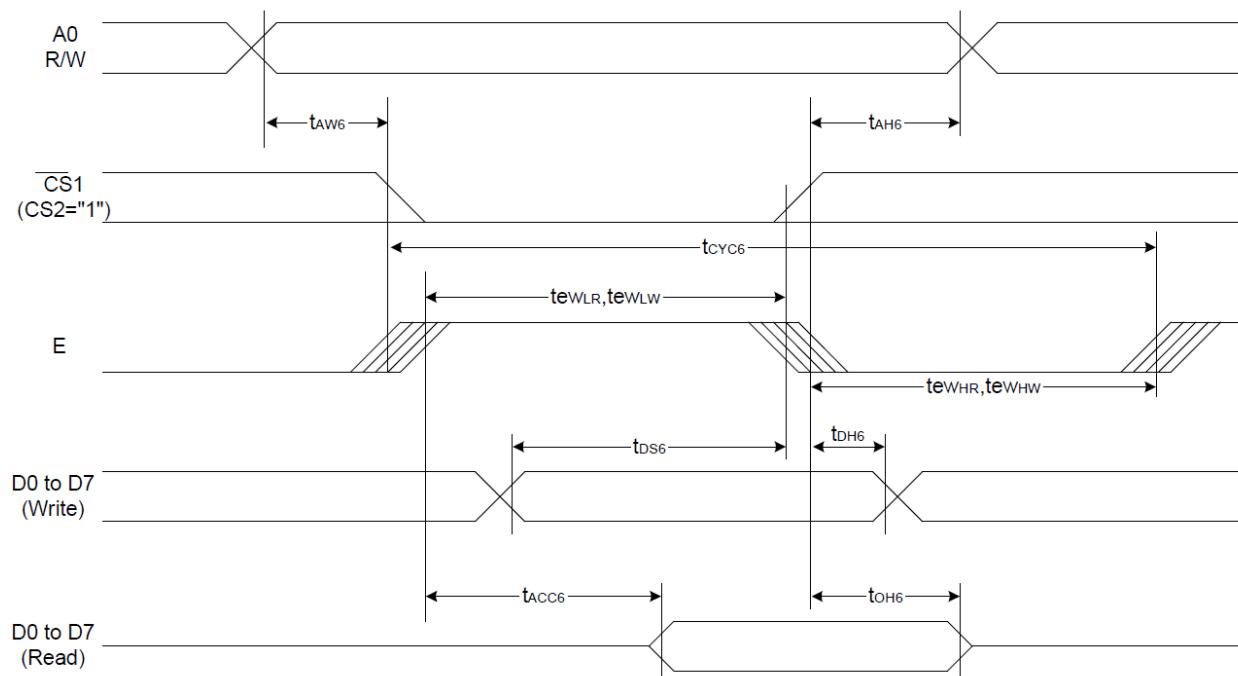


Figure 38

Table 26

(VDD = 3.3V, Ta = -30 to 85°C)

Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
Address hold time	A0	tAH6		0	—	ns
Address setup time		tAW6		0	—	
System cycle time		tcYC6		240	—	
Enable L pulse width (WRITE)	WR	tEWLW		80	—	ns
Enable H pulse width (WRITE)		tEWHW		80	—	
Enable L pulse width (READ)	RD	tEWLR		80	—	
Enable H pulse width (READ)		tEWHR		140	—	
WRITE Data setup time	D0 to D7	tDS6		40	—	
WRITE Address hold time		tDH6		0	—	
READ access time		tACC6	CL = 100 pF	—	70	
READ Output disable time		tOH6	CL = 100 pF	5	50	

Table 27

(VDD = 2.7V, Ta = -30 to 85°C)

Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
Address hold time	A0	tAH6		0	—	ns
Address setup time		tAW6		0	—	
System cycle time		tcYC6		400	—	
Enable L pulse width (WRITE)	WR	tEWLW		220	—	
Enable H pulse width (WRITE)		tEWHW		180	—	
Enable L pulse width (READ)	RD	tEWLR		220	—	
Enable H pulse width (READ)		tEWHR		180	—	
WRITE Data setup time	D0 to D7	tDS6		40	—	
WRITE Address hold time		tDH6		0	—	
READ access time		tACC6	CL = 100 pF	—	140	
READ Output disable time		tOH6	CL = 100 pF	10	100	

\*1 The input signal rise time and fall time (tr, tr) is specified at 15 ns or less. When the system cycle time is extremely fast, (tr + tr)  $\leq$  (tcyc6 – tEWLW – tEWHW) for (tr + tr)  $\leq$  (tcyc6 – tEWLR – tEWHR) are specified.

\*2 All timing is specified using 20% and 80% of VDD as the reference.

\*3 tEWLW and tEWLR are specified as the overlap between CS1 being "L" (CS2 = "H") and E.

## The 4-line SPI Interface

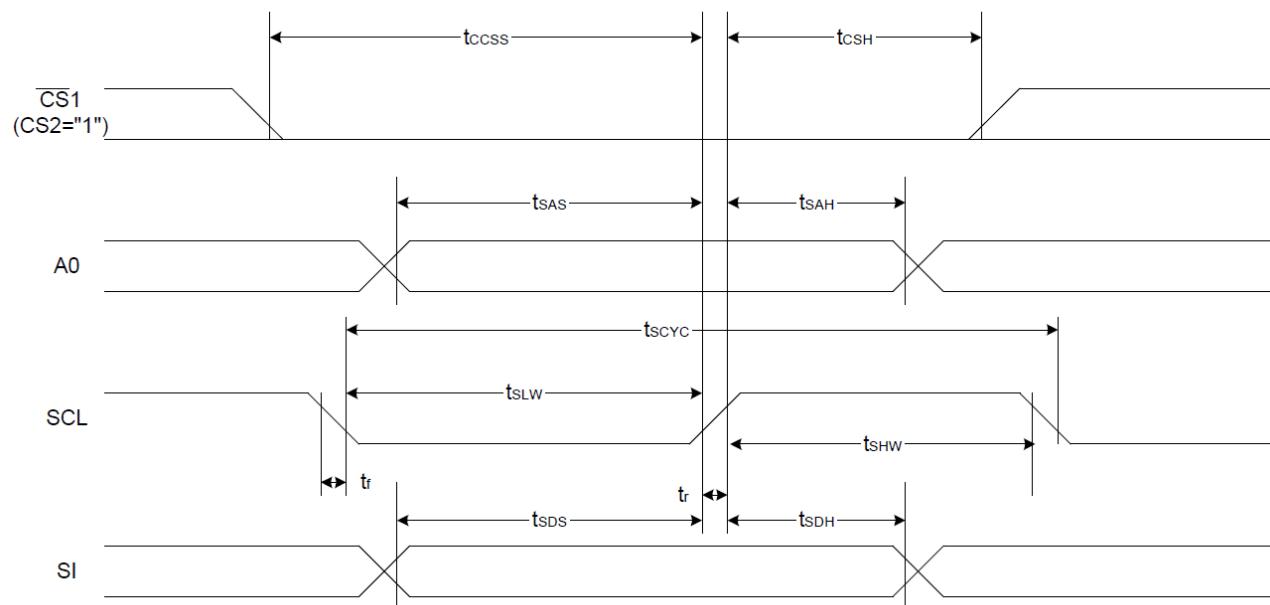


Figure 39

Table 28

(V<sub>DD</sub> = 3.3V, Ta = -30 to 85°C)

Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
4-line SPI Clock Period	SCL	T <sub>scyc</sub>		50	—	ns
SCL "H" pulse width		T <sub>shw</sub>		25	—	
SCL "L" pulse width		T <sub>slw</sub>		25	—	
Address setup time	A0	T <sub>sas</sub>		20	—	ns
Address hold time		T <sub>sah</sub>		10	—	
Data setup time	SI	T <sub>sd</sub> s		20	—	
Data hold time		T <sub>sd</sub> H		10	—	
CS-SCL time	CS	T <sub>cs</sub> s		20	—	
CS-SCL time		T <sub>cs</sub> H		40	—	

Table 29

(V<sub>DD</sub> = 2.7V, Ta = -30 to 85°C)

Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
4-line SPI Clock Period	SCL	T <sub>scyc</sub>		100	—	ns
SCL "H" pulse width		T <sub>shw</sub>		50	—	
SCL "L" pulse width		T <sub>slw</sub>		50	—	
Address setup time	A0	T <sub>sas</sub>		30	—	
Address hold time		T <sub>sah</sub>		20	—	
Data setup time	SI	T <sub>sd</sub> s		30	—	
Data hold time		T <sub>sd</sub> H		20	—	
CS-SCL time	CS	T <sub>cs</sub> s		30	—	
CS-SCL time		T <sub>cs</sub> H		60	—	

\*1 The input signal rise and fall time (tr, tf) are specified at 15 ns or less.

\*2 All timing is specified using 20% and 80% of V<sub>DD</sub> as the standard.

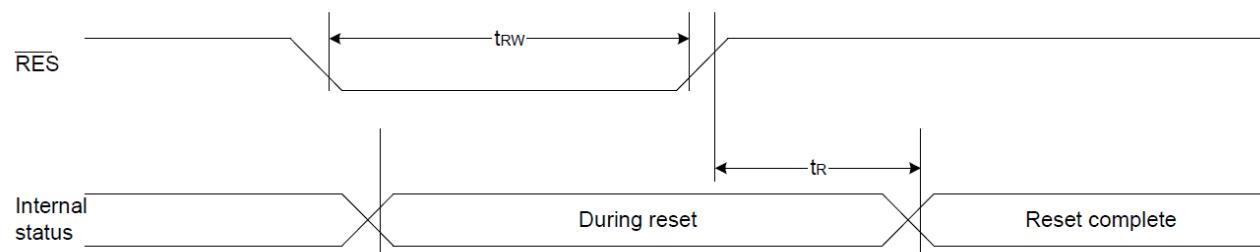
**Reset Timing**

Figure 41

**Table 30**(V<sub>DD</sub> = 3.3V, Ta = -30 to 85°C)

Item	Signal	Symbol	Condition	Rating			Units
				Min.	Typ.	Max.	
Reset time		t <sub>R</sub>		—	—	1.0	us
Reset "L" pulse width	/RES	t <sub>RW</sub>		1.0	—	—	us

**Table 31**(V<sub>DD</sub> = 2.7V, Ta = -30 to 85°C)

Item	Signal	Symbol	Condition	Rating			Units
				Min.	Typ.	Max.	
Reset time		t <sub>R</sub>		—	—	2.0	us
Reset "L" pulse width	/RES	t <sub>RW</sub>		2.0	—	—	us

\*1 All timing is specified with 20% and 80% of V<sub>DD</sub> as the standard.

## 5. Programming

### 5.1 Instruction Table

Table 16: Table of ST7565R Commands

(Note) \*: ignored data

Command	Command Code								Function			
	A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0	
(1) Display ON/OFF	0	1	0	1	0	1	1	1	1	0	1	LCD display ON/OFF 0: OFF, 1: ON
(2) Display start line set	0	1	0	0	1	Display start address					Sets the display RAM display start line address	
(3) Page address set	0	1	0	1	0	1	1	Page address			Sets the display RAM page address	
(4) Column address set upper bit Column address set lower bit	0	1	0	0	0	0	1	Most significant column address		Sets the most significant 4 bits of the display RAM column address.		
				0	0	0	0	Least significant column address		Sets the least significant 4 bits of the display RAM column address.		
(5) Status read	0	0	1	Status			0	0	0	0	Reads the status data	
(6) Display data write	1	1	0	Write data					Writes to the display RAM			
(7) Display data read	1	0	1	Read data					Reads from the display RAM			
(8) ADC select	0	1	0	1	0	0	0	0	0	0	Sets the display RAM address SEG output correspondence 0: normal, 1: reverse	
(9) Display normal/ reverse	0	1	0	1	0	0	0	1	1	0	Sets the LCD display normal/ reverse 0: normal, 1: reverse	
(10) Display all points ON/OFF	0	1	0	1	0	0	0	1	0	0	Display all points 0: normal display 1: all points ON	
(11) LCD bias set	0	1	0	1	0	0	0	0	1	0	Sets the LCD drive voltage bias ratio 0: 1/9 bias, 1: 1/7 bias (ST7565R)	
(12) Read-modify-write	0	1	0	1	1	1	0	0	0	0	Column address increment At write: +1 At read: 0	
(13) End	0	1	0	1	1	1	0	1	1	1	Clear read/modify/write	
(14) Reset	0	1	0	1	1	1	0	0	0	1	Internal reset	
(15) Common output mode select	0	1	0	1	1	0	0	0	*	*	Select COM output scan direction 0: normal direction 1: reverse direction	
(16) Power control set	0	1	0	0	0	1	Operating mode		Select internal power supply operating mode			
(17) V <sub>0</sub> voltage regulator internal resistor ratio set	0	1	0	0	0	1	0	0	Resistor ratio		Select internal resistor ratio(Rb/Ra) mode	
(18) Electronic volume mode set Electronic volume register set	0	1	0	1	0	0	0	0	0	1	Set the V <sub>0</sub> output voltage electronic volume register	
				0	0	Electronic volume value						
(19) Sleep mode set	0	1	0	1	0	1	1	1	0	0	0: Sleep mode, 1: Normal mode	
										1		
				*	*	*	*	*	*	0		
(20) Booster ratio set	0	1	0	1	1	1	1	0	0	0	select booster ratio 00: 2x,3x,4x 01: 5x 11: 6x	
				0	0	0	0	0	0	step-up value		
(21) NOP	0	1	0	1	1	0	0	0	1	1	Command for non-operation	
(22) Test	0	1	0	1	1	1	*	*	*	*	Command for IC test. Do not use this command	

Note: See Datasheet of LCD Driver for detail.

## 5.2 Display Data RAM

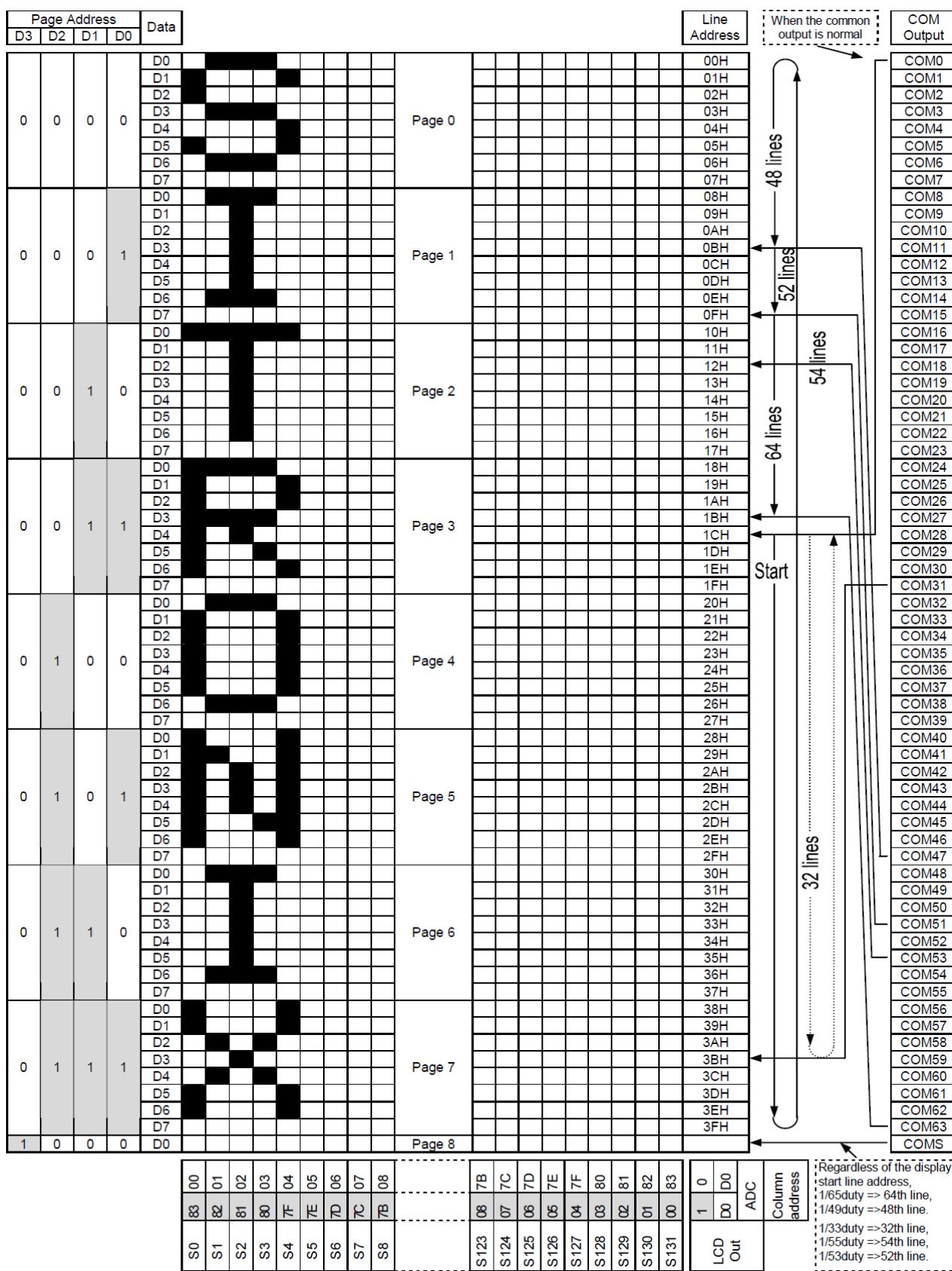
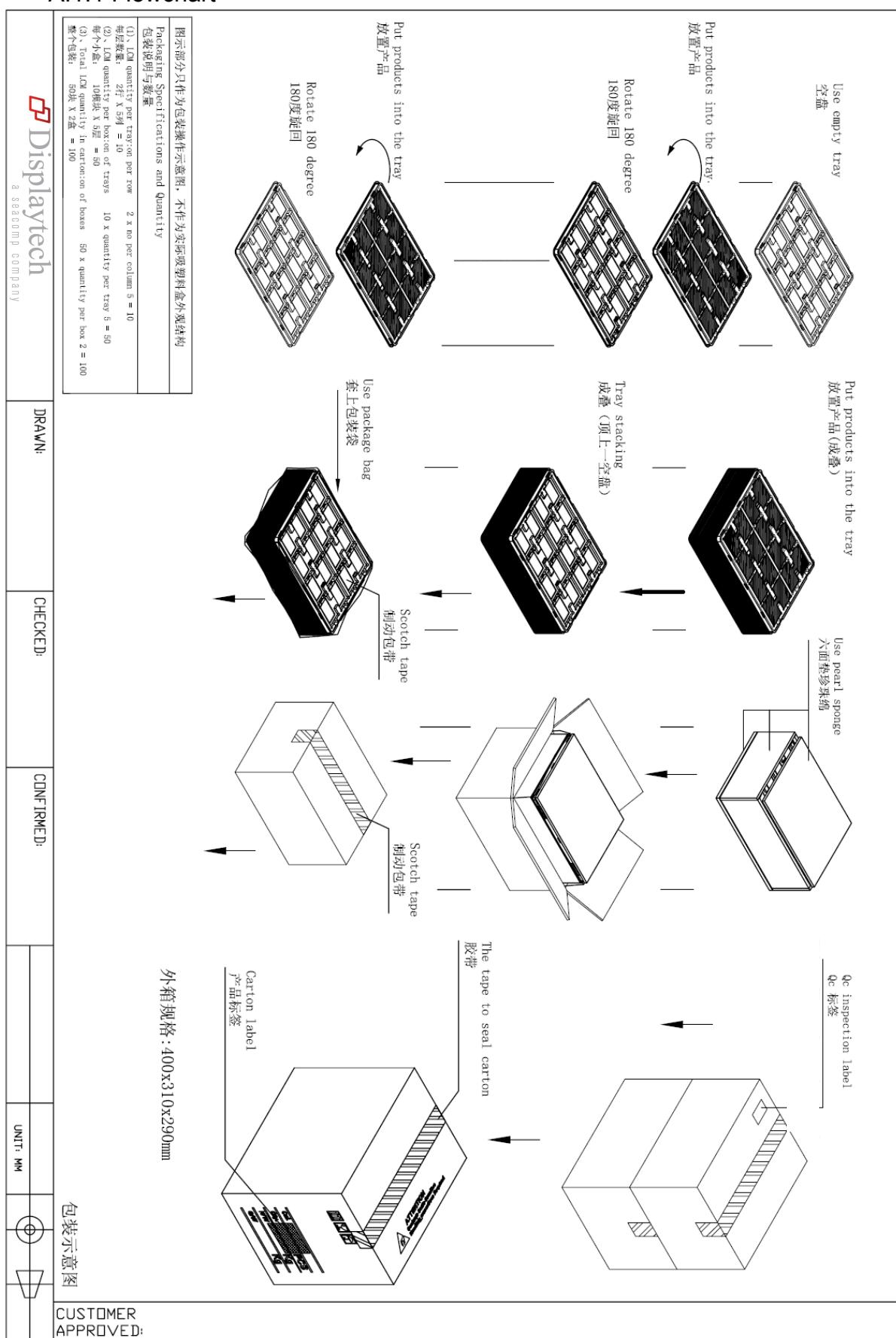


Figure 4

## Appendix A

### A.1 Packing Method

#### A.1.1 Flowchart



Note: Detail refer to goods label in mass production

### A.1.2 Carton Label

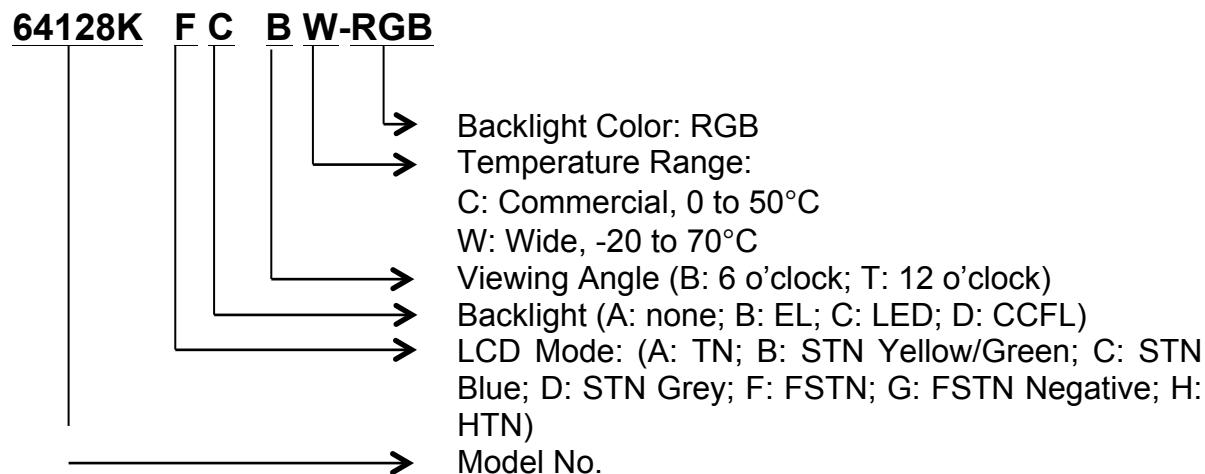
Carton label is printed with A4 paper.



Remark:

- 1) PART NO = Displaytech part number
- 2) QTY = Quantity of products inside the box
- 3) P/O NO = Customer PO number
- 4) CARTON = Carton number

### A.2 Part Number Definition



### A.3 Definitions of Optical Characteristic

#### A.3.1 Contrast Ratio Test

A) Contrast ratio is calculated by the following formula when the output voltage is obtained from the electro-optical test system.

B) Test Condition: Accord to the LCD's driving method and operating voltage (VLCD).

C) Formula:

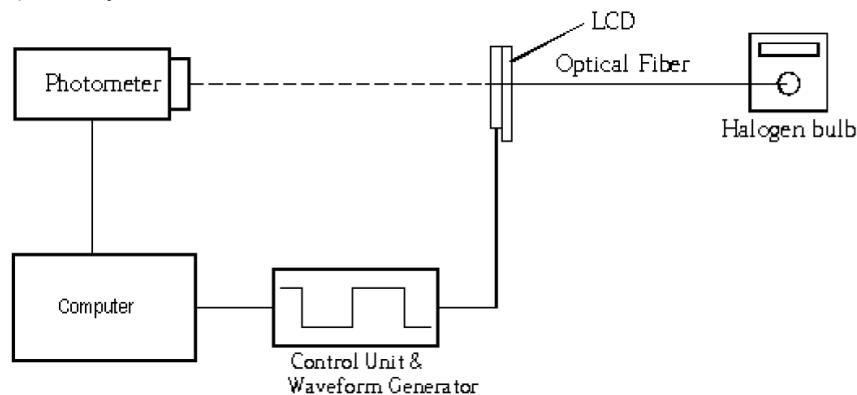
$$\text{Contrast Ratio} = \frac{\text{Photometer output voltage when non-select waveform is applying}}{\text{Photometer output voltage when select waveform is applying}}$$

(Positive type)

$$\text{Contrast Ratio} = \frac{\text{Photometer output voltage when select waveform is applying}}{\text{Photometer output voltage when non-select waveform is applying}}$$

(Negative type)

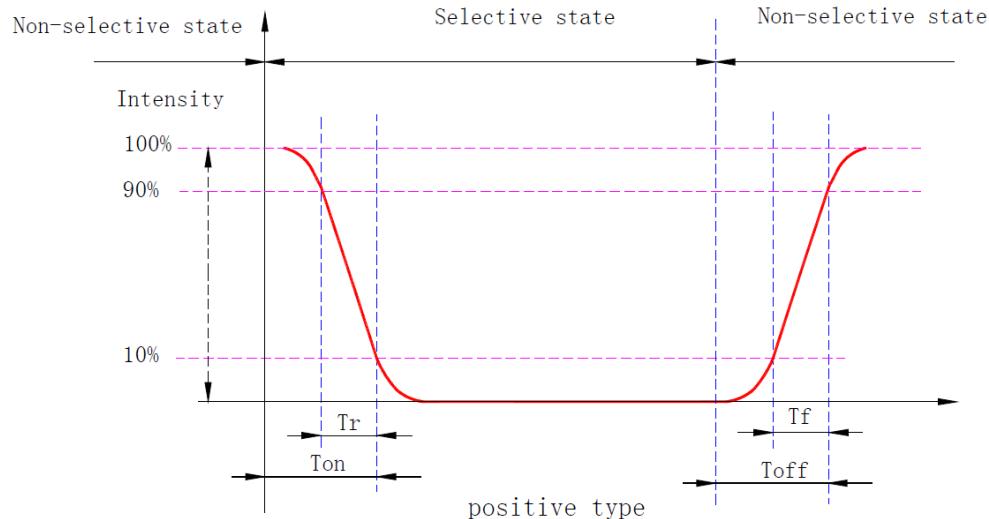
D) Test system:



### A.3.2 Response time

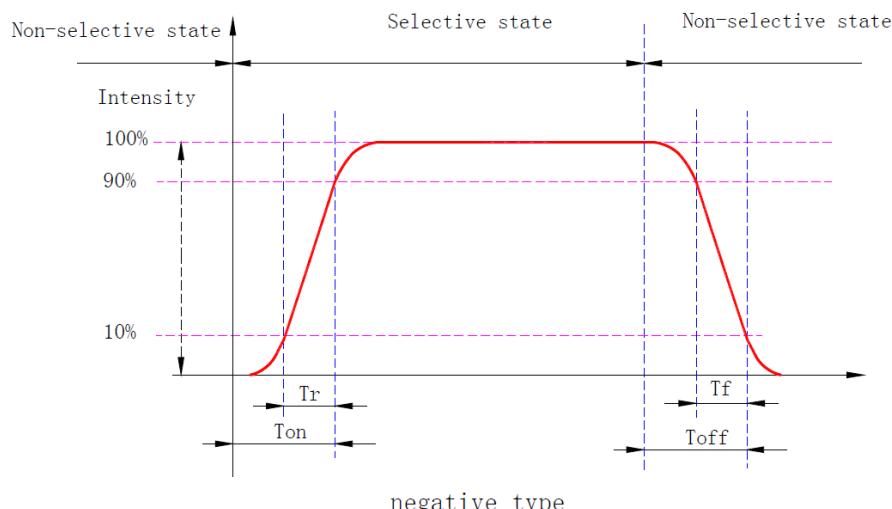
#### A.3.2.1 Positive type

- A) Rise time is defined as the time required for the transmission to change from 90% to 10%.
- B) Fall time is defined as the time required for the transmission to change from 10% to 90%.
- C) On time is defined as the time required for the transmission to change from 100% to 10%.
- D) Off time is defined as the time required for the transmission to change from 0% to 90%.



#### A.3.2.2 Negative type

- A) Rise time is defined as the time required for the transmission to change from 10% to 90%.
- B) Fall time is defined as the time required for the transmission to change from 90% to 10%.
- C) On time is defined as the time required for the transmission to change from 0% to 90%.
- D) Off time is defined as the time required for the transmission to change from 100% to 10%.



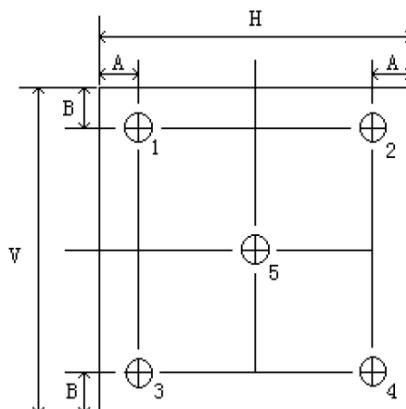
### A.3.3 Luminance Measurement

Luminance is a  $\text{cd}/\text{m}^2$  (nits) measurement of the display's white color (white screen).

All measurements are performed in a dark ambient.

Display luminance is defined as the average value of five (5) white screen measurements. The location of these 5 measurement points is shown in the drawing below.

$$\text{Display Luminance} = \frac{\text{Surface Luminance of all white screen (1+2+3+4+5)}}{5}$$



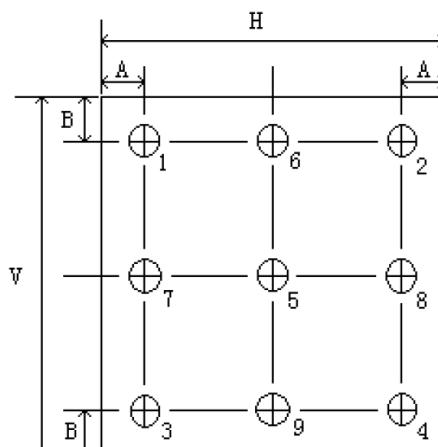
- Screen Luminance Measurement Points (5)**
- A: 5mm
  - B: 5mm
  - H / V: Active Area
  - Measuring Equipment: DMS505
  - Measurement point diameter: 3mm

### A.3.4 White Uniformity Measurement

White luminance uniformity is a  $\text{cd}/\text{m}^2$  (nits) measurement of the display's white color across the display screen.

All measurements are performed in a dark ambient.

Display luminance uniformity is defined as the percent (%) of luminance value variation over nine (9) white screen measurements. The location of these 9 measurement points is shown in the drawing below.

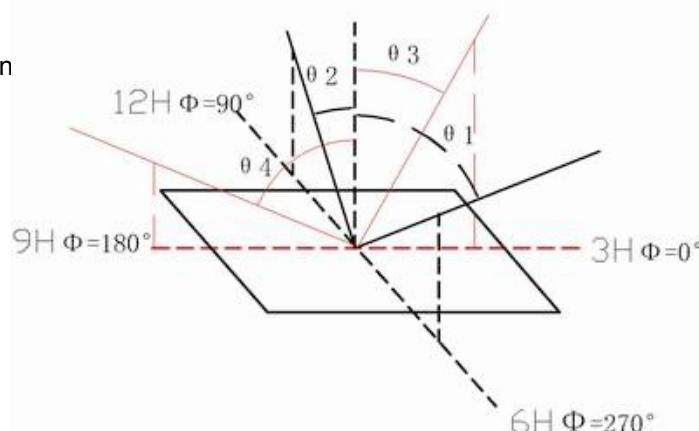


- A: 5mm
- B: 5mm
- H / V: Active Area
- Measuring Equipment: DMS505
- Measurement point diameter: 3mm

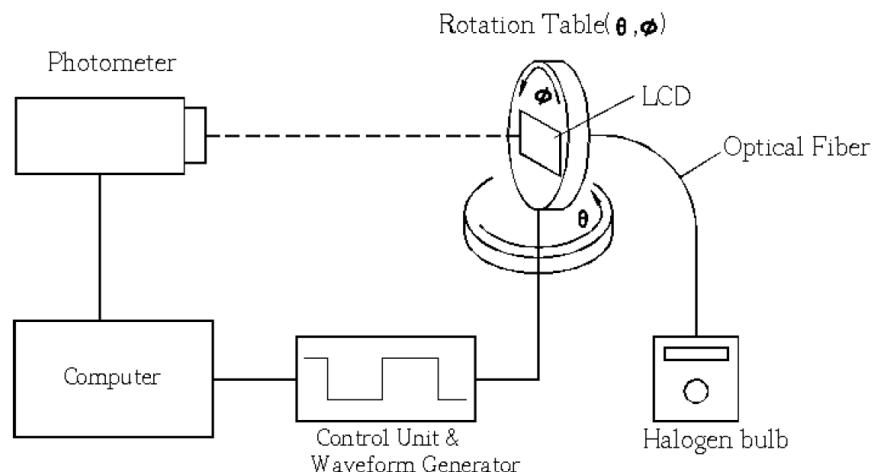
$$\text{Luminance Uniformity} = \frac{\text{Min Luminance (9 Pts.1- 9)}}{\text{Max Luminance (9 Pts.1- 9)}} \times 100\%$$

### A.3.5 Viewing Angle

A) Viewing angle is definition



B) System Block Diagram



## Appendix B

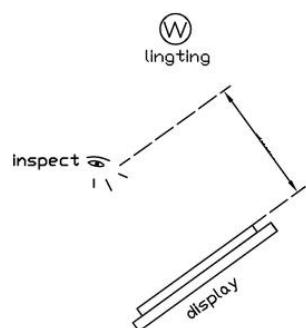
### B.1 Quality Units

#### B.1.1 Purpose & Scope

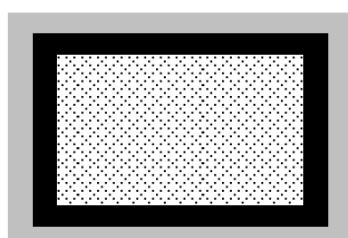
- This standard is applicable for mono STN products which were produced by our company. All mono STN products of our company should be subject to this standard;
- If some defect item was not defined exactly in this standard, there must be a negotiation between customer and our company;
- If customer had special requirements, there also must be a negotiation between customer and our company.

#### B.1.2 Inspection Conditions

- Inspection direction should be perpendicular to LCD surface;
- Inspection should be performed under the condition of 20~40W fluorescent lamp;
- The distance between inspector's eyes & product surface should be 30cm~50cm when inspection.



#### B.1.3 Definition of LCD area



A: Active Area



B: Viewing Area



C: Invisible Area (It is invisible after assembly; any defects in this area should be ignored.)

## B..4 Sampling Plan

### a. Sampling Method

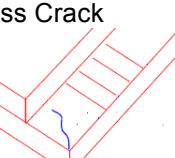
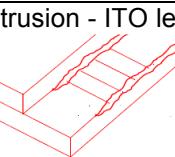
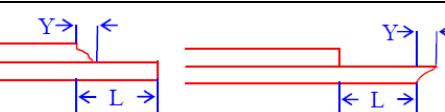
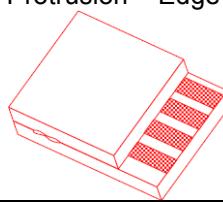
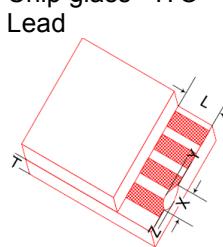
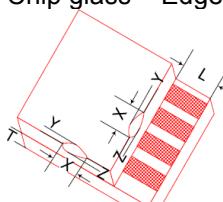
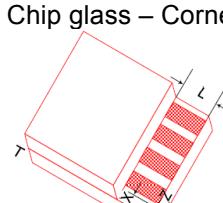
According to GB2828.1-2003 (Equivalent to MIL-STD-105/E) General inspection level II.

### b. AQL Definition

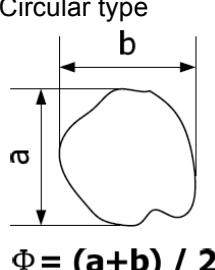
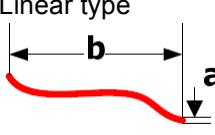
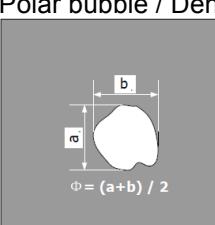
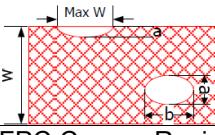
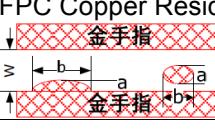
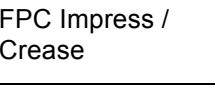
Major: AQL=0.65 (Please refer to the definition in "B.1.5 & B.1.6 Inspection Criteria")

Minor: AQL=1.0 (Please refer to the definition in "B.1.5 & B.1.6 Inspection Criteria")

## B.1.5 Inspection Criteria (Not energized)

No	Defect Name & Illustration	Criteria	Class																														
1.5.1	Light Leakage	Not allowed	Major																														
1.5.2	Vacuum Bubble	Not allowed	Major																														
1.5.3	Rainbow	According to limit sample	Minor																														
1.5.4	Glass Crack 	Not allowed	Minor																														
1.5.5	Protrusion - ITO lead 	 $Y \leq L/3$ , allowed quantity: 2	Minor																														
1.5.6	Protrusion – Edge 	Allowed if protrusion didn't affect dimension.	Minor																														
1.5.7	Chip glass - ITO Lead 	Unit: mm <table border="1"> <thead> <tr> <th>S (cm<sup>2</sup>)</th> <th>X</th> <th>Y</th> <th>Z</th> <th>Allowed Qty</th> </tr> </thead> <tbody> <tr> <td>50&lt;S</td> <td><math>\leq 6.0</math></td> <td><math>\leq L/3</math></td> <td><math>\leq T</math></td> <td>3</td> </tr> <tr> <td>12&lt;S≤50</td> <td><math>\leq 5.0</math></td> <td><math>\leq L/3</math></td> <td><math>\leq T</math></td> <td>3</td> </tr> <tr> <td>S≤12</td> <td><math>\leq 4.0</math></td> <td><math>\leq L/3</math></td> <td><math>\leq T</math></td> <td>3</td> </tr> <tr> <td>S random</td> <td>Random</td> <td><math>\leq 0.5</math>, if <math>L/3&gt;0.5</math></td> <td><math>\leq T/2</math></td> <td>NC (1)</td> </tr> </tbody> </table> Remark: S was the outline area (big glass area).	S (cm <sup>2</sup> )	X	Y	Z	Allowed Qty	50<S	$\leq 6.0$	$\leq L/3$	$\leq T$	3	12<S≤50	$\leq 5.0$	$\leq L/3$	$\leq T$	3	S≤12	$\leq 4.0$	$\leq L/3$	$\leq T$	3	S random	Random	$\leq 0.5$ , if $L/3>0.5$	$\leq T/2$	NC (1)	Minor					
S (cm <sup>2</sup> )	X	Y	Z	Allowed Qty																													
50<S	$\leq 6.0$	$\leq L/3$	$\leq T$	3																													
12<S≤50	$\leq 5.0$	$\leq L/3$	$\leq T$	3																													
S≤12	$\leq 4.0$	$\leq L/3$	$\leq T$	3																													
S random	Random	$\leq 0.5$ , if $L/3>0.5$	$\leq T/2$	NC (1)																													
1.5.8	Chip glass – Edge 	Unit: mm <table border="1"> <thead> <tr> <th>S (cm<sup>2</sup>)</th> <th>X</th> <th>Y*</th> <th>Z</th> <th>Extend width of seal line</th> <th>Allowed Qty</th> </tr> </thead> <tbody> <tr> <td>50&lt;S</td> <td><math>\leq 6.0</math></td> <td><math>\leq 2.0</math></td> <td><math>\leq T</math></td> <td><math>\leq 1/2</math></td> <td>NC</td> </tr> <tr> <td>12&lt;S≤50</td> <td><math>\leq 5.0</math></td> <td><math>\leq 1.5</math></td> <td><math>\leq T</math></td> <td><math>\leq 1/2</math></td> <td>NC</td> </tr> <tr> <td>S≤12</td> <td><math>\leq 4.0</math></td> <td><math>\leq 1.0</math></td> <td><math>\leq T</math></td> <td><math>\leq 1/3</math></td> <td>NC</td> </tr> <tr> <td>S random</td> <td>Random</td> <td><math>\leq 0.5</math></td> <td><math>\leq T/2</math></td> <td>-</td> <td>NC</td> </tr> </tbody> </table>	S (cm <sup>2</sup> )	X	Y*	Z	Extend width of seal line	Allowed Qty	50<S	$\leq 6.0$	$\leq 2.0$	$\leq T$	$\leq 1/2$	NC	12<S≤50	$\leq 5.0$	$\leq 1.5$	$\leq T$	$\leq 1/2$	NC	S≤12	$\leq 4.0$	$\leq 1.0$	$\leq T$	$\leq 1/3$	NC	S random	Random	$\leq 0.5$	$\leq T/2$	-	NC	Minor
S (cm <sup>2</sup> )	X	Y*	Z	Extend width of seal line	Allowed Qty																												
50<S	$\leq 6.0$	$\leq 2.0$	$\leq T$	$\leq 1/2$	NC																												
12<S≤50	$\leq 5.0$	$\leq 1.5$	$\leq T$	$\leq 1/2$	NC																												
S≤12	$\leq 4.0$	$\leq 1.0$	$\leq T$	$\leq 1/3$	NC																												
S random	Random	$\leq 0.5$	$\leq T/2$	-	NC																												
1.5.9	Chip glass – Corner 	Unit: mm <table border="1"> <thead> <tr> <th>S (cm<sup>2</sup>)</th> <th>X</th> <th>Y</th> <th>Z</th> <th>Allowed Qty</th> </tr> </thead> <tbody> <tr> <td>50&lt;S</td> <td><math>\leq 6.0</math></td> <td><math>\leq L</math></td> <td><math>\leq T</math></td> <td>2</td> </tr> <tr> <td>12&lt;S≤50</td> <td><math>\leq 5.0</math></td> <td><math>\leq L</math></td> <td><math>\leq T</math></td> <td>2</td> </tr> <tr> <td>S≤12</td> <td><math>\leq 4.0</math></td> <td><math>\leq L</math></td> <td><math>\leq T</math></td> <td>2</td> </tr> </tbody> </table> Remark: If X reach ITO lead, according to the criteria of "1.5.7".	S (cm <sup>2</sup> )	X	Y	Z	Allowed Qty	50<S	$\leq 6.0$	$\leq L$	$\leq T$	2	12<S≤50	$\leq 5.0$	$\leq L$	$\leq T$	2	S≤12	$\leq 4.0$	$\leq L$	$\leq T$	2	Minor										
S (cm <sup>2</sup> )	X	Y	Z	Allowed Qty																													
50<S	$\leq 6.0$	$\leq L$	$\leq T$	2																													
12<S≤50	$\leq 5.0$	$\leq L$	$\leq T$	2																													
S≤12	$\leq 4.0$	$\leq L$	$\leq T$	2																													

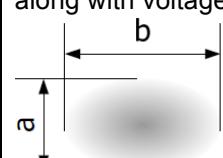
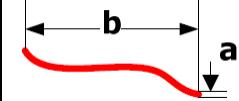
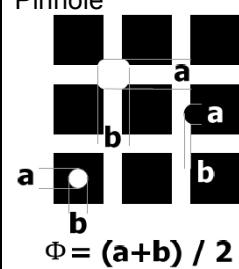
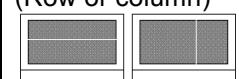
Note (1): NC = Not Count

No	Defect Name & Illustration	Criteria					Class																																					
1.5.10	 <p>Circular type  <math>b</math>  <math>a</math>  <math>\Phi = (a+b) / 2</math></p>	<p>Suppose <math>S^{(2)}</math> = The area of A, the criteria in A&amp;B is as below,</p> <table border="1"> <thead> <tr> <th><math>S \text{ (cm}^2)</math></th> <th><math>S \leq 4</math></th> <th><math>4 &lt; S \leq 12</math></th> <th><math>12 &lt; S \leq 50</math></th> <th><math>50 &lt; S \leq 150</math></th> <th><math>S &gt; 150</math></th> </tr> </thead> <tbody> <tr> <td><math>\Phi \text{ (mm)}</math></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td><math>\Phi \leq 0.10</math></td> <td>NC</td> <td>NC</td> <td>NC</td> <td>NC</td> <td>NC</td> </tr> <tr> <td><math>0.10 &lt; \Phi \leq 0.20</math></td> <td>1</td> <td>2</td> <td>2</td> <td>3</td> <td>3</td> </tr> <tr> <td><math>0.20 &lt; \Phi \leq 0.30</math></td> <td>1</td> <td>1</td> <td>2</td> <td>2</td> <td>3</td> </tr> <tr> <td><math>\Phi &gt; 0.30</math></td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> </tr> </tbody> </table> <p>Remark: Bubble, dirt spot, concavo-convex spot &amp; stab spot should be regarded as circular defect.  Maximum defect number in <math>1\text{cm}^2</math> is 1.  Please refer to footnote for the conversion between <math>S</math> &amp; Diagonal.</p>	$S \text{ (cm}^2)$	$S \leq 4$	$4 < S \leq 12$	$12 < S \leq 50$	$50 < S \leq 150$	$S > 150$	$\Phi \text{ (mm)}$						$\Phi \leq 0.10$	NC	NC	NC	NC	NC	$0.10 < \Phi \leq 0.20$	1	2	2	3	3	$0.20 < \Phi \leq 0.30$	1	1	2	2	3	$\Phi > 0.30$	0	0	0	0	0						Minor
$S \text{ (cm}^2)$	$S \leq 4$	$4 < S \leq 12$	$12 < S \leq 50$	$50 < S \leq 150$	$S > 150$																																							
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$\Phi \leq 0.10$	NC	NC	NC	NC	NC																																							
$0.10 < \Phi \leq 0.20$	1	2	2	3	3																																							
$0.20 < \Phi \leq 0.30$	1	1	2	2	3																																							
$\Phi > 0.30$	0	0	0	0	0																																							
1.5.11	 <p>Linear type  <math>b</math>  <math>a</math></p>	<p>Suppose <math>S</math> = The area of A, the criteria in a&amp;b is as below,</p> <table border="1"> <thead> <tr> <th><math>S \text{ (cm}^2)</math></th> <th><math>S \leq 4</math></th> <th><math>4 &lt; S \leq 12</math></th> <th><math>12 &lt; S \leq 50</math></th> <th><math>50 &lt; S \leq 150</math></th> <th><math>S &gt; 150</math></th> </tr> </thead> <tbody> <tr> <td><math>a \&amp; b \Phi \text{ (mm)}</math></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td><math>a \leq 0.03</math></td> <td>NC</td> <td>NC</td> <td>NC</td> <td>NC</td> <td>NC</td> </tr> <tr> <td><math>0.03 &lt; a \leq 0.05, b \leq 3</math></td> <td>2</td> <td>3</td> <td>4</td> <td>5</td> <td>6</td> </tr> <tr> <td><math>a &gt; 0.05</math></td> <td colspan="5">According to the criteria of &lt;1.5.10&gt;</td><td></td></tr> </tbody> </table> <p>Remark: Linear scratch, dirt line should be regarded as linear defect.  Maximum defect number in <math>1\text{cm}^2</math> is 1.</p>	$S \text{ (cm}^2)$	$S \leq 4$	$4 < S \leq 12$	$12 < S \leq 50$	$50 < S \leq 150$	$S > 150$	$a \& b \Phi \text{ (mm)}$						$a \leq 0.03$	NC	NC	NC	NC	NC	$0.03 < a \leq 0.05, b \leq 3$	2	3	4	5	6	$a > 0.05$	According to the criteria of <1.5.10>											Minor					
$S \text{ (cm}^2)$	$S \leq 4$	$4 < S \leq 12$	$12 < S \leq 50$	$50 < S \leq 150$	$S > 150$																																							
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$a \leq 0.03$	NC	NC	NC	NC	NC																																							
$0.03 < a \leq 0.05, b \leq 3$	2	3	4	5	6																																							
$a > 0.05$	According to the criteria of <1.5.10>																																											
1.5.12	 <p>Polar bubble / Dent  <math>b</math>  <math>a</math>  <math>\Phi = (a+b) / 2</math></p>	<p>Suppose <math>S</math> = The area of A, the criteria in A&amp;B is as below,</p> <table border="1"> <thead> <tr> <th><math>S \text{ (cm}^2)</math></th> <th><math>S \leq 4</math></th> <th><math>4 &lt; S \leq 12</math></th> <th><math>12 &lt; S \leq 50</math></th> <th><math>50 &lt; S \leq 150</math></th> <th><math>S &gt; 150</math></th> </tr> </thead> <tbody> <tr> <td><math>\Phi \text{ (mm)}</math></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td><math>\Phi \leq 0.15</math></td> <td>NC</td> <td>NC</td> <td>NC</td> <td>NC</td> <td>NC</td> </tr> <tr> <td><math>0.15 &lt; \Phi \leq 0.25</math></td> <td>1</td> <td>2</td> <td>2</td> <td>3</td> <td>3</td> </tr> <tr> <td><math>0.25 &lt; \Phi \leq 0.35</math></td> <td>1</td> <td>1</td> <td>2</td> <td>2</td> <td>3</td> </tr> <tr> <td><math>\Phi &gt; 0.35</math></td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> </tr> </tbody> </table> <p>Remark: Maximum defect number in <math>1\text{cm}^2</math> is 1.  Ignore the dent if it can't be seen in positive angle.</p>	$S \text{ (cm}^2)$	$S \leq 4$	$4 < S \leq 12$	$12 < S \leq 50$	$50 < S \leq 150$	$S > 150$	$\Phi \text{ (mm)}$						$\Phi \leq 0.15$	NC	NC	NC	NC	NC	$0.15 < \Phi \leq 0.25$	1	2	2	3	3	$0.25 < \Phi \leq 0.35$	1	1	2	2	3	$\Phi > 0.35$	0	0	0	0	0						Minor
$S \text{ (cm}^2)$	$S \leq 4$	$4 < S \leq 12$	$12 < S \leq 50$	$50 < S \leq 150$	$S > 150$																																							
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$\Phi \leq 0.15$	NC	NC	NC	NC	NC																																							
$0.15 < \Phi \leq 0.25$	1	2	2	3	3																																							
$0.25 < \Phi \leq 0.35$	1	1	2	2	3																																							
$\Phi > 0.35$	0	0	0	0	0																																							
1.5.13	Polarizer Stab	According to the criteria of <1.5.10>						Minor																																				
1.5.14	Polarizer Scratch	According to the criteria of <1.5.11>						Minor																																				
1.5.15	 <p>FPC Pinhole  <math>w</math>  <math>a</math>  <math>b</math></p>	<table border="1"> <thead> <tr> <th>a</th> <th>b</th> <th>Allowed Qty</th> </tr> </thead> <tbody> <tr> <td><math>\leq W/3</math></td> <td><math>\leq W</math></td> <td>NC</td> </tr> <tr> <td><math>&gt; W/3</math></td> <td><math>&gt; W</math></td> <td>Not allowed</td> </tr> </tbody> </table>			a	b	Allowed Qty	$\leq W/3$	$\leq W$	NC	$> W/3$	$> W$	Not allowed				Minor																											
a	b	Allowed Qty																																										
$\leq W/3$	$\leq W$	NC																																										
$> W/3$	$> W$	Not allowed																																										
1.5.16	 <p>FPC Copper Residue  <math>w</math>  <math>a</math>  <math>b</math></p>	<table border="1"> <thead> <tr> <th>a</th> <th>b</th> <th>Allowed Qty</th> </tr> </thead> <tbody> <tr> <td><math>\leq W/3</math></td> <td><math>\leq W</math></td> <td>NC</td> </tr> <tr> <td><math>&gt; W/3</math></td> <td><math>&gt; W</math></td> <td>Not allowed</td> </tr> </tbody> </table>			a	b	Allowed Qty	$\leq W/3$	$\leq W$	NC	$> W/3$	$> W$	Not allowed				Minor																											
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$\leq W/3$	$\leq W$	NC																																										
$> W/3$	$> W$	Not allowed																																										
1.5.17	 <p>FPC Impress / Crease</p>	<table border="1"> <thead> <tr> <th>Shape</th> <th>Allowed Qty</th> </tr> </thead> <tbody> <tr> <td>Moulage / Impress</td> <td>NC</td> </tr> <tr> <td>Crease with a sharp angle</td> <td>Note allowed</td> </tr> </tbody> </table>		Shape	Allowed Qty	Moulage / Impress	NC	Crease with a sharp angle	Note allowed					Minor																														
Shape	Allowed Qty																																											
Moulage / Impress	NC																																											
Crease with a sharp angle	Note allowed																																											
1.5.18	Soldering defect	According to the criteria of IPC-A-610C						Minor																																				

Note (2): Suppose Length:Width = 4:3, The conversion between  $S$  & diagonal length is as below table,

$S \text{ (cm}^2)$	Diagonal Length (Inch)
4	1.13
12	1.95
50	3.99
150	6.91

## B.1.6 Inspection Criteria (Energized)

No	Defect Name & Illustration	Criteria	Class																																				
1.6.1	Circular type when display (Not change along with voltage)	According to the criteria of <1.5.10>	Minor																																				
1.6.2	Circular type when display (Change along with voltage)  $\Phi = (a+b) / 2$	Suppose S= The area of A, the criteria in a&b is as below, <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <th>S (cm<sup>2</sup>)</th> <th>S≤4</th> <th>4&lt;S≤12</th> <th>12&lt;S≤50</th> <th>50&lt;S≤150</th> <th>S&gt;150</th> </tr> <tr> <th>Φ (mm)</th> <th></th> <th></th> <th></th> <th></th> <th></th> </tr> <tr> <td>Φ≤0.30</td> <td>NC</td> <td>NC</td> <td>NC</td> <td>NC</td> <td>NC</td> </tr> <tr> <td>0.30&lt;Φ≤0.50</td> <td>1</td> <td>2</td> <td>2</td> <td>3</td> <td>3</td> </tr> <tr> <td>0.50&lt;Φ≤0.80</td> <td>1</td> <td>1</td> <td>2</td> <td>2</td> <td>3</td> </tr> <tr> <td>Φ&gt;0.80</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> </tr> </table> Remark: Maximum defect number in 1cm <sup>2</sup> is 1.	S (cm <sup>2</sup> )	S≤4	4<S≤12	12<S≤50	50<S≤150	S>150	Φ (mm)						Φ≤0.30	NC	NC	NC	NC	NC	0.30<Φ≤0.50	1	2	2	3	3	0.50<Φ≤0.80	1	1	2	2	3	Φ>0.80	0	0	0	0	0	Minor
S (cm <sup>2</sup> )	S≤4	4<S≤12	12<S≤50	50<S≤150	S>150																																		
Φ (mm)																																							
Φ≤0.30	NC	NC	NC	NC	NC																																		
0.30<Φ≤0.50	1	2	2	3	3																																		
0.50<Φ≤0.80	1	1	2	2	3																																		
Φ>0.80	0	0	0	0	0																																		
1.6.3	Linear type when display (Not change along with voltage)	According to the criteria of <5.1.11>	Minor																																				
1.6.4	Linear type when display (Change along with voltage)  $\Phi = (a+b) / 2$	Suppose S= The area of A, the criteria in a&b is as below, <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <th>S (cm<sup>2</sup>)</th> <th>S≤4</th> <th>4&lt;S≤12</th> <th>12&lt;S≤50</th> <th>50&lt;S≤150</th> <th>S&gt;150</th> </tr> <tr> <th>a&amp;b Φ (mm)</th> <th></th> <th></th> <th></th> <th></th> <th></th> </tr> <tr> <td>a≤0.05</td> <td>NC</td> <td>NC</td> <td>NC</td> <td>NC</td> <td>NC</td> </tr> <tr> <td>0.05&lt;a≤0.10, b≤5</td> <td>2</td> <td>3</td> <td>4</td> <td>5</td> <td>6</td> </tr> <tr> <td>a&gt;0.10</td> <td colspan="5" style="text-align: center;">According to the criteria of &lt;1.6.2&gt;</td></tr> </table> Remark: Maximum defect number in 1cm <sup>2</sup> is 1.	S (cm <sup>2</sup> )	S≤4	4<S≤12	12<S≤50	50<S≤150	S>150	a&b Φ (mm)						a≤0.05	NC	NC	NC	NC	NC	0.05<a≤0.10, b≤5	2	3	4	5	6	a>0.10	According to the criteria of <1.6.2>					Minor						
S (cm <sup>2</sup> )	S≤4	4<S≤12	12<S≤50	50<S≤150	S>150																																		
a&b Φ (mm)																																							
a≤0.05	NC	NC	NC	NC	NC																																		
0.05<a≤0.10, b≤5	2	3	4	5	6																																		
a>0.10	According to the criteria of <1.6.2>																																						
1.6.5	Pinhole  $\Phi = (a+b) / 2$	Suppose S= The area of A, the criteria in a&b is as below, <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <th>S (cm<sup>2</sup>)</th> <th>S≤4</th> <th>4&lt;S≤12</th> <th>12&lt;S≤50</th> <th>50&lt;S≤150</th> <th>S&gt;150</th> </tr> <tr> <th>Φ (mm)</th> <th></th> <th></th> <th></th> <th></th> <th></th> </tr> <tr> <td>Φ≤0.10</td> <td>NC</td> <td>NC</td> <td>NC</td> <td>NC</td> <td>NC</td> </tr> <tr> <td>0.10&lt;Φ≤0.15</td> <td>1</td> <td>2</td> <td>2</td> <td>3</td> <td>3</td> </tr> <tr> <td>0.15&lt;Φ≤0.25</td> <td>1</td> <td>1</td> <td>2</td> <td>2</td> <td>3</td> </tr> <tr> <td>Φ&gt;0.25</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> </tr> </table> Remark: Maximum defect number in 1cm <sup>2</sup> is 1.	S (cm <sup>2</sup> )	S≤4	4<S≤12	12<S≤50	50<S≤150	S>150	Φ (mm)						Φ≤0.10	NC	NC	NC	NC	NC	0.10<Φ≤0.15	1	2	2	3	3	0.15<Φ≤0.25	1	1	2	2	3	Φ>0.25	0	0	0	0	0	Major
S (cm <sup>2</sup> )	S≤4	4<S≤12	12<S≤50	50<S≤150	S>150																																		
Φ (mm)																																							
Φ≤0.10	NC	NC	NC	NC	NC																																		
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0.15<Φ≤0.25	1	1	2	2	3																																		
Φ>0.25	0	0	0	0	0																																		
1.6.6	Segment Distortion	More than 1/5 size in spec is not allowed.	Major																																				
1.6.7	Missing Segment (Row or column) 	Not allowed.	Major																																				
1.6.8	Abnormal Display	Not allowed.	Major																																				
1.6.9	Display inhomogeneity / CR inhomogeneity	According to the approved sample by both sides	Minor																																				
1.6.10	Too much current	Not allowed.	Major																																				
1.6.11	No display	Not allowed.	Major																																				
1.6.12	No backlight / flicking	Not allowed.	Major																																				

## B.2 Reliability Test

### B.2.1 Standard Specifications for Reliability

#### B.2.1.1 Test method

There should be no existing conspicuous failure of functions and appearance in LCD after the following tests.

No	Item	Description
1	Low Temperature Operating	The sample should be allowed to stand at $(-20\pm 2)^\circ\text{C}$ for 96 Hours under driving condition.
2	High Temperature Operating	The sample should be allowed to stand at $(70\pm 2)^\circ\text{C}$ for 96 Hours under driving condition.
3	Low Temperature Storage	The sample should be allowed to stand at $(-30\pm 3)^\circ\text{C}$ for 96 Hours under no-load condition, and then returning it to normal temperature condition, and allowing it stand for 24 hours
4	High Temperature Storage	The sample should be allowed to stand at $(80\pm 2)^\circ\text{C}$ for 96 Hours under no-load condition, and then returning it to normal temperature condition, and allowing it stand for 24 hours
5	Moisture resistance	The sample should be allowed to stand at $(40\pm 2)^\circ\text{C}$ , $(95\pm 2)\%$ RH for 96 Hours under no-load condition excluding the polarizer, then taking it out and drying it at normal temperature, and allowing it stand for 24 hours
6	Thermal Shock Resistance	The sample should be allowed to stand the following 5 cycles of operation: $T_{STL}^*$ for 30 minutes -> normal temperature for 5 minutes -> $T_{STH}^*$ for 30 minutes -> normal temperature for 5 minutes, as one cycle, then taking it out and drying it at normal temperature, and allowing it stand for 24 hours

Note:

- $T_{STL}$ : Lowest Storage Temperature.
- $T_{STH}$ : Highest Storage Temperature.

#### B.2.1.2 Testing Conditions and Inspection Criteria:

For the final test, the testing sample must be stored at room temperature for 24 hours, after the tests listed above; Standard specifications for Reliability have been executed in order to ensure stability.

No	Item	Description
1	Current Consumption	The current consumption should be under double of initial test.
2	Contrast	The contrast must be larger than half of initial test.
3	Appearance	Appearance defects should not happen.

## B.2.2 Life Time

Functions, performance, appearance, etc. shall be free from remarkable deterioration within 50,000 hours under ordinary operating and storage conditions room temperature ( $25\pm 10^\circ\text{C}$ ), normal humidity ( $45\pm 20\%$ RH), and in area not exposed to direct sunlight.

## B.3 Caution for Using

1. Recommended storage condition:  $50\sim 60\%$ RH,  $25\pm 5^\circ\text{C}$ ;
2. Avoid direct sunlight. Avoid operating or storage under the temperature which exceeds the standard for a long time;
3. Avoid driving LCD with DC (Direct Current);
4. LCD was made of glass, please avoid any impact or pressure on surface;
5. If the skin contact with liquid crystal inadvertently, wash with water for more than 15 minutes. If you feel uncomfortable, please see the doctor immediately;
6. It is prohibited to clean polarizer by ethanol or acetone. Clean polarizer by pure water is recommended;

7. The products should be used within 6 month. Otherwise, the ITO pad and FPC pad maybe be oxidized and cause poor contact, etc.;
8. ESD: TFT module or COG module is sensitive to ESD, effective action should be taken before you touch the products;
9. Avoid contacting the ITO pad by hand and pressing the surface of the LCD. Please take the both sides when you fetch the LCD.

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