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WINSTAR

WINSTAR Display Co.,Ltd.
華凌光電股份有限公司

SPECIFICATION

CUSTOMER :

MODULE NO.: WO240128B-TFH#

APPROVED BY:	
(FOR CUSTOMER USE ONLY)	PCB VERSION: DATA:

SALES BY	APPROVED BY	CHECKED BY	PREPARED BY

VERSION	DATE	REVISED PAGE NO.	SUMMARY
G	2024/11/14		Modify the recommended soldering temperature

Winstar Display Co.,

華凌光電股份有限公司

	RECORDS OF REVISION			DOC. FIRST ISSUE

VERSION	DATE	REVISED PAGE NO.	SUMMARY
0	2016/07/25		First issue
A	2016/11/04		Modify IDD.
B	2017/06/23		Correct FPC.
C	2019/08/27		Modify Material List of Components for RoHs
D	2019/12/17		Modify Precautions in use of LCD Modules
E	2021/01/04		Add Interface
F	2023/01/18		Modify Backlight Information(Note)
G	2024/11/14		Modify the recommended soldering temperature

Contents

1.Module Classification Information

W	O	240128	B	—	T	F	H	—	#
①	②	③	④		⑤	⑥	⑦		⑧

①　Brand：WINSTAR DISPLAY CORPORATION

②　Display Type：H→Character Type, G→Graphic Type , X→TAB Type, O→COG Type

③　Display Font： 240 * 128 dot

④　Model serials no.

⑤　Backlight Type：

N→Without backlight	T→LED, White	L→LED, Full color
B→EL, Blue green	A→LED, Amber	J→DIP LED,Blue
D→EL, Green	R→LED, Red	K→DIP LED,White
W→EL, White	O→LED, Orange	E→DIP LED, Yellow Green
M→EL, Yellow Green	G→LED, Green	H→DIP LED,Amber
F→CCFL, White	P→LED, Blue	I→DIP LED, Red
Y→LED, Yellow Green	X→LED, Dual color	
G→LED, Green	C→LED, Full color	

⑥　LCD Mode：

B→TN Positive, Gray	V→FSTN Negative, Blue
N→TN Negative,	T→FSTN Negative, Black
L→VA Negative	D→FSTN Negative (Double film)
H→ HTN Positive, Gray	F→FSTN Positive
I→HTN Negative, Black	K→FSC Negative
U→HTN Negative, Blue	S→FSC Positive
M→STN Negative, Blue	E→ISTN Negative, Black
G→STN Positive, Gray	C→CSTN Negative, Black
Y→STN Positive, Yellow Green	A→ASTN Negative, Black

⑦　LCD Polarize Type/ Temperature range/ View direction

A→Reflective, N.T, 6:00	H→Transflective, W.T,6:00
D→Reflective, N.T, 12:00	K→Transflective, W.T,12:00
G→Reflective, W. T, 6:00	C→Transmissive, N.T,6:00
J→Reflective, W. T, 12:00	F→Transmissive, N.T,12:00
B→Transflective, N.T,6:00	I→Transmissive, W. T, 6:00
E→Transflective, N.T.12:00	L→Transmissive, W.T,12:00

⑧　Special Code　#:Fit in with the ROHS Directions and regulations

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2.Precautions in use of LCD Modules

(1)Avoid applying excessive shocks to the module or making any alterations or modifications to it.

(2)Don't make extra holes on the printed circuit board, modify its shape or change the components of LCD module.

(3)Don't disassemble the LCM.

(4)Don't operate it above the absolute maximum rating.

(5)Don't drop, bend or twist LCM.

(6)Soldering: only to the I/O terminals.

(7)Storage: please storage in anti-static electricity container and clean environment.

(8) Winstar have the right to change the passive components, including R3,R6 & backlight adjust resistors. (Resistors,capacitors and other passive components will have different appearance and color caused by the different supplier.)

(9)Winstar have the right to change the PCB Rev. (In order to satisfy the supplying stability, management optimization and the best product performance...etc, under the premise of not affecting the electrical characteristics and external dimensions, Winstar have the right to modify the version.)

(10) To ensure the stability of the display screen, please apply screen saver after showing 30 mins of fixed display content.

(11)Please heat up a little the tape sticking on the components when removing it; otherwise the components might be damaged.

3.General Specification

Item	Dimension	Unit
Number of dots	240 x 128	—
Module dimension	122.2 x 79.8 x 6.5	mm
View area	114.0 x 64.0	mm
Active area	107.98 x 57.58	mm
Dot size	0.43 x 0.43	mm
Dot pitch	0.45 x 0.45	mm
LCD type	FSTN Positive Transflective (In LCD production, It will occur slightly color difference. We can only guarantee the same color in the same batch.)	
Drive Method	1/128D，1/12B	
View direction	6 o'clock	
Backlight Type	LED, White	
IC	ST7586S	
Interface	68 series /80 series /3 Line/4 Line	

4.Absolute Maximum Ratings

Item	Symbol	Min	Typ	Max	Unit
Operating Temperature	T_{OP}	-20	—	+70	℃
Storage Temperature	T_{ST}	-30	—	+80	℃
Digital Power Supply Voltage	VDDI	-0.3	—	3.6	V
Analog Power supply voltage	VDDA	-0.3	—	3.6	V
LCD Power supply voltage	V0-XV0	-0.3	—	19	V
LCD Power supply voltage	VG	-0.3	—	5.5	V

5.Electrical Characteristics

Item	Symbol	Condition	Min	Typ	Max	Unit
Supply Voltage For Logic	V_{DD}-V_{SS}	—	3.0	3.3	3.6	V
Supply Voltage For LCM	VOP	Ta=-20℃	—	—	—	V
		Ta=25℃	14.8	15.0	15.2	V
		Ta=+70℃	—	—	—	V
Input High Volt.	V_{IH}	—	$0.7V_{DD}$	—	V_{DD}	V
Input Low Volt.	V_{IL}	—	Vss	—	$0.3V_{DD}$	V
Output High Volt.	V_{OH}	—	$0.8V_{DD}$	—	V_{DD}	V
Output Low Volt.	V_{OL}	—	Vss	—	$0.2V_{DD}$	V
Supply Current	I_{DD}	V_{DD}=3.3V	—	2.0	4.0	mA

Please kindly consider to design the Vop to be adjustable while programing the software to match LCD contrast tolerance.

6.Optical Characteristics

Item	Symbol	Condition	Min	Typ	Max	Unit
View Angle	θ	CR$\geqq$2	0	—	30	$\phi = 180°$
	θ	CR$\geqq$2	0	—	60	$\phi = 0°$
	θ	CR$\geqq$2	0	—	45	$\phi = 90°$
	θ	CR$\geqq$2	0	—	45	$\phi = 270°$
Contrast Ratio	CR	—	—	5	—	—
Response Time	T rise	—	—	200	300	ms
	T fall	—	—	250	350	ms

Definition of Operation Voltage (Vop)
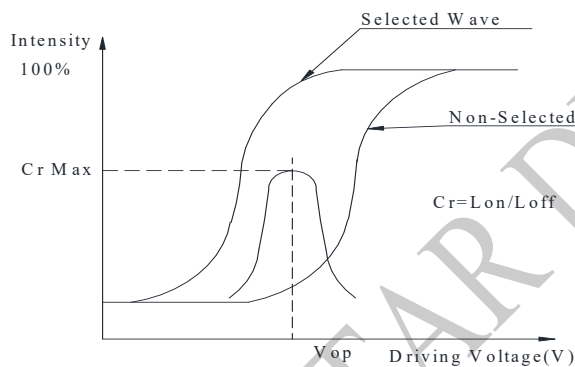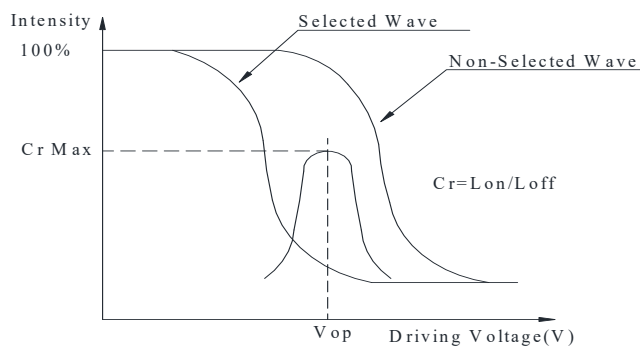
Definition of Response Time (Tr , Tf)

Intensity
100%
Selected Wave
Non-Selected Wave
Cr Max
Cr=Lon/Loff
Vop   Driving Voltage(V)

Non-selected Condition
Selected Condition
Non-selected Condition
Intensity
100%
90%
10%
Tr
Tf
【Positive type】

Intensity
100%
Selected Wave
Non-Selected Wave
Cr Max
Cr=Lon/Loff
Vop   Driving Voltage(V)

Non-selected Condition
Selected Condition
Non-selected Condition
Intensity
100%
90%
10%
Tr
Tf
【Negative type】

Conditions :

Operating Voltage : Vop   Viewing Angle(θ , φ) : 0° , 0°
Frame Frequency : 64 HZ   Driving Waveform : 1/N duty , 1/a bias

Definition of viewing angle(CR$\geqq$2)

θf
θb
$\varphi = 180°$
θl
θr
$\varphi = 270°$
$\varphi = 90°$
$\varphi = 0°$
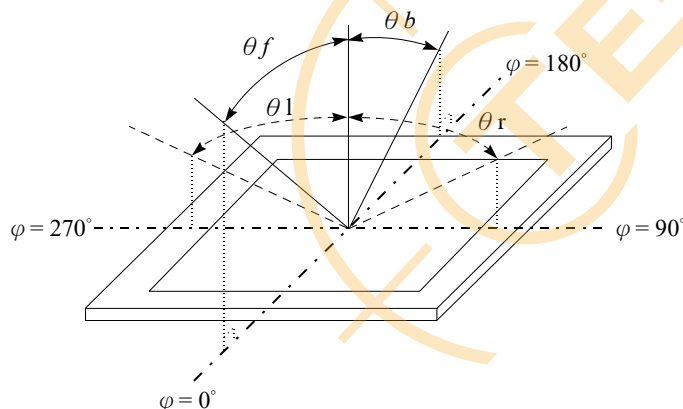
7.Interface Pin Function

Pin No.	Symbol	Description
1	ESD GND	Electro-Static discharge
2	VG	VG is the power of SEG-drivers
3	XV0	Negative operating voltage of COM-drivers
4	V0	Positive operating voltage of COM-drivers
5	VM	VM is the non-select voltage level of COM-drivers
6	VDDA	Power supply
7	VSS	Ground
8	VD1	Digital power source selection
9	VDDI	VDD1 is the power of interface I/O circuit
10	CSB	Chip select input pin CSB="L": This chip is selected and the MPU interface is active CSB="H": This chip is not selected and the MPU interface is disabled (D[7:0] are high impedance)
11	IF3	These pins select interface operation mode <table><tr><td>IF3</td><td>IF2</td><td>IF1</td><td>MPU interface type</td></tr><tr><td>H</td><td>H</td><td>L</td><td>80 series 8-bit parallel</td></tr><tr><td>H</td><td>L</td><td>L</td><td>68 series 8-bit parallel</td></tr><tr><td>L</td><td>H</td><td>H</td><td>8-bit serial (4-Line)</td></tr><tr><td>L</td><td>H</td><td>L</td><td>9-bit serial (3-Line)</td></tr></table>
12	IF2	
13	IF1	Note: Refer to "Interface Selection" for detailed information
14	RSTB	Reset input pin. When RSTB is "L", internal initialization procedure is executed
15	/RD(E)	Read / Write execution control pin. (This pin is only used in parallelinterface) <table><tr><td>MPU Type</td><td>ERD</td><td>Description</td></tr><tr><td>6800-series</td><td>E</td><td>Read / Write control input pin. R/W = "H": When E is "H", data bus is in output status. R/W = "L": The data are latched at the falling edge of the E signal.</td></tr><tr><td>8080-series</td><td>/RD</td><td>Read enable input pin. When /RD is "L", data bus is in output status.</td></tr></table> This pin is not used in serial interfaces and should be connected to VDD1

16~23	D7~D0	The bi-directional data bus of the MPU interface. When CSB is "H", they are high impedance If using serial interface: D0 is the SDA signal in 4-Line & 3-Line interface D1 is the A0 signal in 4-Line interface
24	/WR/(R/W)	Read / Write execution control pin. (This pin is only used in parallel interface) | MPU Type	RWR	Description
6800-series	R/W	Read / Write control input pin R/W = "H" : read R/W = "L" : write
8080-series	/WR	Write enable clock input pin. The data are latched at the rising edge of the /WR signal. | This pin is not used in serial interfaces and should be connected to VDD1
25	A0(SCL)	The function of this pin is different in parallel and serial interface In parallel interface: A0 is register selection input A0 = "H": inputs on data bus are display data A0 = "L": inputs on data bus are command In serial interface: this pad will be used as SCL (serial-clock) input
26	ESD GND	Electro-Static discharge

8.Contour Drawing & Block Diagram

PIN NO.	SIGNAL
1	ESD GND
2	VG
3	XV0
4	V0
5	VM
6	VDDA
7	VSS
8	VD1
9	VDDI
10	CSB
11	IF3
12	IF2
13	IF1
14	RSTB
15	/RD(E)
16	D7
17	D6
18	D5
19	D4
20	D3
21	D2
22	D1
23	D0
24	/WR/(R/W)
25	A0(SCL)
26	ESD GND

240*128 Dots

Pull tape

Supporting tape   Contact side

DETAIL B
SCALE 2/1

The non-specified tolerance of dimension is ±0.3mm.

26 PINS
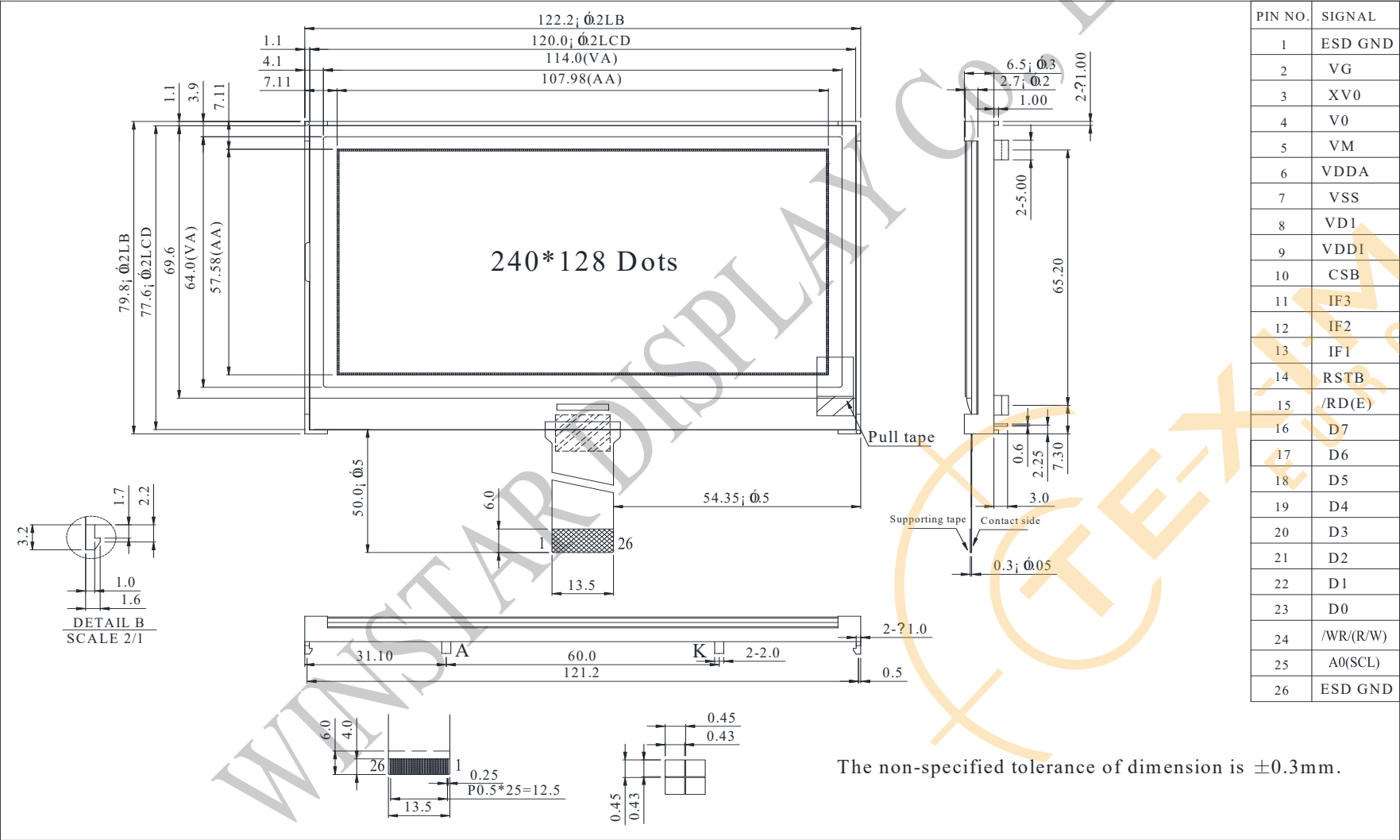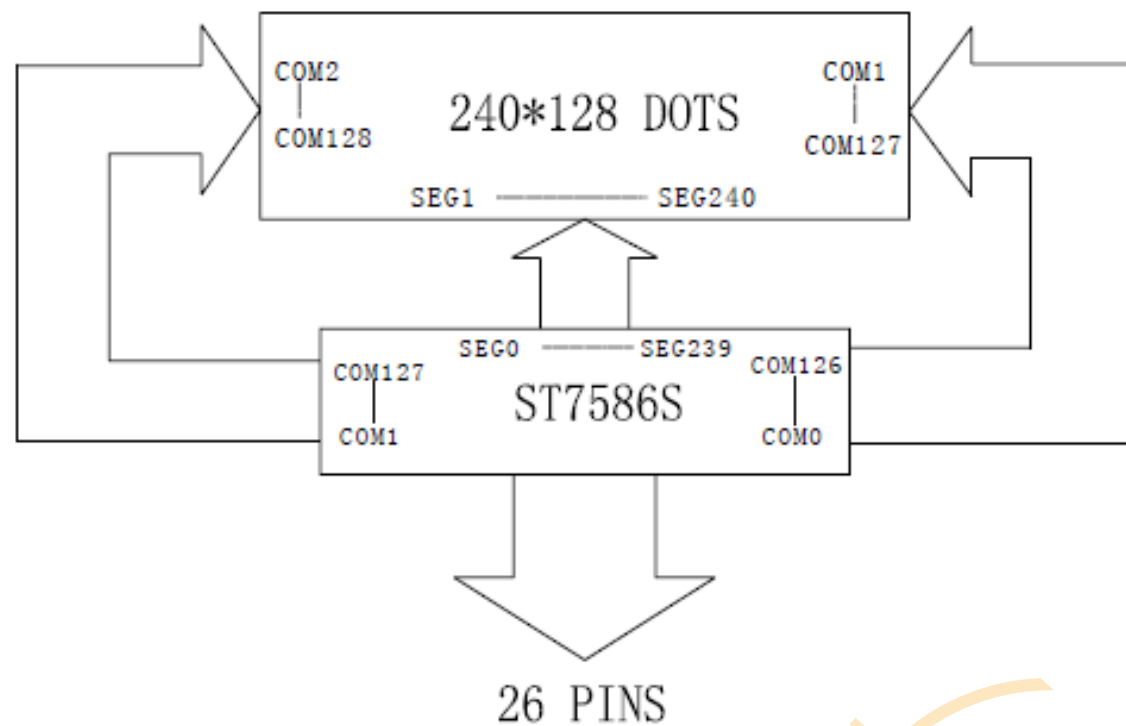
9.Reliability

Content of Reliability Test (Wide temperature, -20℃~70℃)

	Environmental Test		
Test Item	**Content of Test**	**Test Condition**	**Note**
High Temperature storage	Endurance test applying the high storage temperature for a long time.	80℃ 96hrs	2
Low Temperature storage	Endurance test applying the low storage temperature for a long time.	-30℃ 96hrs	1,2
High Temperature Operation	Endurance test applying the electric stress (Voltage & Current) and the thermal stress to the element for a long time.	70℃ 96hrs	— —
Low Temperature Operation	Endurance test applying the electric stress under low temperature for a long time.	-20℃ 96hrs	1
High Temperature/ Humidity storage	The module should be allowed to stand at 60℃,90%RH max For 96hrs under no-load condition excluding the polarizer, Then taking it out and drying it at normal temperature.	60℃,90%RH 96hrs	1,2
Thermal shock resistance	The sample should be allowed stand the following 10 cycles of operation -20℃ 25℃ 70℃　30min 5min 30min　1 cycle	-20℃/70℃ 10 cycles	— —
Vibration test	Endurance test applying the vibration during transportation and using.	Total fixed amplitude : 1.5mm Vibration Frequency : 10~55Hz One cycle 60 seconds to 3 directions of X,Y,Z for Each 15 minutes	3
Static electricity test	Endurance test applying the electric stress to the terminal.	VS=±600V(contact), ±800v(air), RS=330Ω CS=150pF 10 times	— —

Note1: No dew condensation to be observed.

Note2: The function test shall be conducted after 4 hours storage at the normal
　　　Temperature and humidity after remove from the test chamber.

Note3: The packing have to including into the vibration testing.
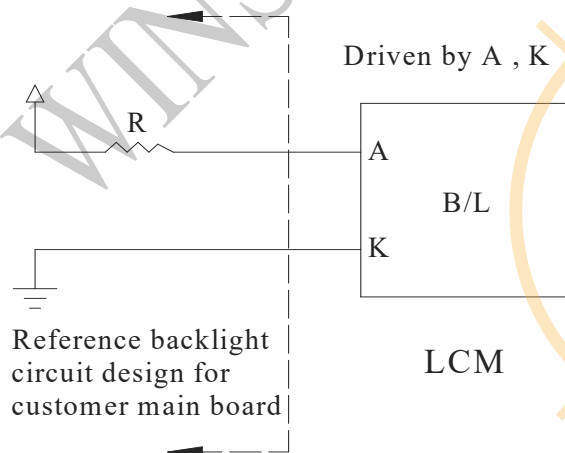
10.Backlight Information

Specification

Parameter	Symbol	Min	Typ	Max	Unit	Test Condition
Supply Current	ILED	─	144	180	mA	V=3.5V
Supply Voltage	V	3.4	3.5	3.6	V	─
Reverse Voltage	VR	─	─	5	V	─
Color coordinate	X	0.244	0.264	0.284		ILED=144mA
	Y	0.264	0.284	0.304		
Luminance (Without LCD)	IV	750	940	─	cd/m²	ILED=144mA
LED Life Time (For Reference only)	─	─	50K	─	Hr.	ILED=144mA 25℃,50-60%RH, (Note 1)
Color	White					
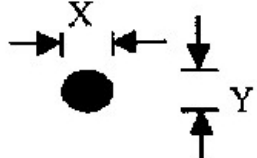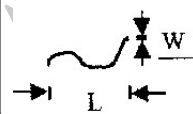
Note: A backlight driven by voltage will keep the drive current under the safe area (current between minimum and maximum).
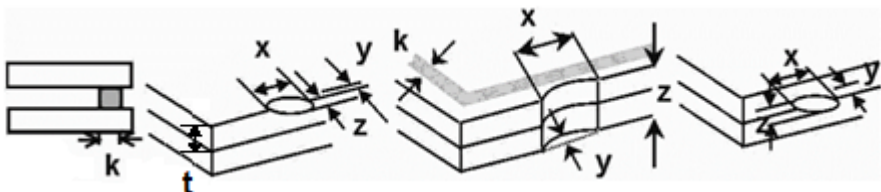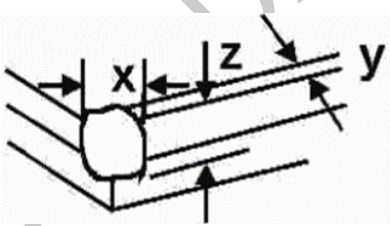
If the B/L LED is driven by current only, the drive voltage cannot be considered as a reference value.
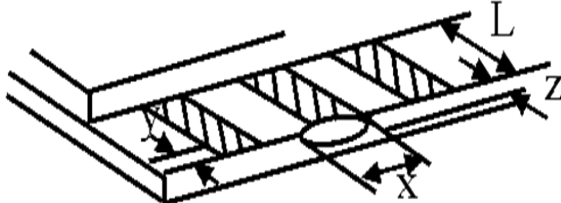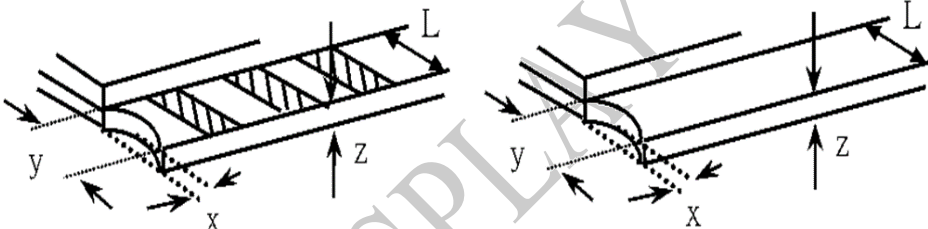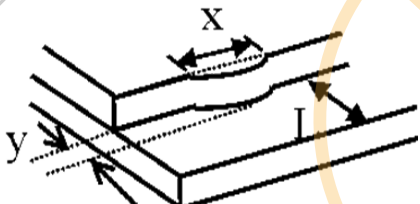
Note 1:50K hours is only an estimate for reference.

Driven by A , K

R

A

B/L

K

LCM

Reference backlight circuit design for customer main board

11.Inspection specification

No	Item	Criterion	AQL
01	Electrical Testing	Missing vertical, horizontal segment, segment contrast defect. Missing character , dot or icon. Display malfunction. No function or no display. Current consumption exceeds product specifications. LCD viewing angle defect. Mixed product types. Contrast defect.	0.65
02	Black or white spots on LCD (display only)	2.1 White and black spots on display $\leqq$0.25mm, no more than three white or black spots present. 2.2 Densely spaced: No more than two spots or lines within 3mm	2.5

No	Item	Criterion	AQL
03	LCD black spots, white spots, contamination (non-display)	3.1 Round type : As following drawing $\Phi=(x + y) / 2$	2.5

Size	Acceptable QTY
$\Phi\leqq0.10$	Accept no dense
$0.10<\Phi\leqq0.20$	2
$0.20<\Phi\leqq0.25$	1
$0.25<\Phi$	0

3.2 Line type : (As following drawing)

Length	Width	Acceptable Q TY
---	$W\leqq0.02$	Accept no dense
$L\leqq3.0$	$0.02<W\leqq0.03$	2
$L\leqq2.5$	$0.03<W\leqq0.05$	
---	$0.05<W$	As round type

AQL 2.5

No	Item	Criterion	AQL
04	Polarizer bubbles	If bubbles are visible, judge using black spot specifications, not easy to find, must check in specify direction.	2.5

Size Φ	Acceptable Q TY
$\Phi\leqq0.20$	Accept no dense
$0.20<\Phi\leqq0.50$	3
$0.50<\Phi\leqq1.00$	2
$1.00<\Phi$	0
Total Q TY	3

No	Item	Criterion	AQL
05	Scratches	Follow NO.3 LCD black spots, white spots, contamination	
06	Chipped glass	Symbols Define: x: Chip length y: Chip width z: Chip thickness k: Seal width t: Glass thickness a: LCD side length L: Electrode pad length: 6.1 General glass chip : 6.1.1 Chip on panel surface and crack between panels: *table below* 6.1.2 Corner crack: 	2.5

Detail tables for No. 06:

6.1.1

z: Chip thickness	y: Chip width	x: Chip length
$Z \leqq 1/2t$	Not over viewing area	$x \leqq 1/8a$
$1/2t < z \leqq 2t$	Not exceed 1/3k	$x \leqq 1/8a$

⊙If there are 2 or more chips, x is total length of each chip.

6.1.2 Corner crack:

z: Chip thickness	y: Chip width	x: Chip length
$Z \leqq 1/2t$	Not over viewing area	$x \leqq 1/8a$
$1/2t < z \leqq 2t$	Not exceed 1/3k	$x \leqq 1/8a$

⊙If there are 2 or more chips, x is the total length of each chip.

No	Item	Criterion	AQL
06	Glass crack	Symbols : x: Chip length y: Chip width z: Chip thickness k: Seal width t: Glass thickness a: LCD side length L: Electrode pad length 6.2 Protrusion over terminal : 6.2.1 Chip on electrode pad : 	2.5

6.2.1 table:

y: Chip width	x: Chip length	z: Chip thickness
$y \leqq 0.5mm$	$x \leqq 1/8a$	$0 < z \leqq t$

6.2.2 Non-conductive portion:

y: Chip width	x: Chip length	z: Chip thickness
$y \leqq L$	$x \leqq 1/8a$	$0 < z \leqq t$

⊙If the chipped area touches the ITO terminal, over 2/3 of the ITO must remain and be inspected according to electrode terminal specifications.

⊙If the product will be heat sealed by the customer, the alignment mark not be damaged.

6.2.3 Substrate protuberance and internal crack.

y: width	x: length
$y \leqq 1/3L$	$x \leqq a$

No	Item	Criterion	AQL
07	Cracked glass	The LCD with extensive crack is not acceptable.	2.5
08	Backlight elements	8.1 Illumination source flickers when lit.	0.65
		8.2 Spots or scratched that appear when lit must be judged. Using LCD spot, lines and contamination standards.	2.5
		8.3 Backlight doesn't light or color wrong.	0.65
09	Bezel	9.1 Bezel may not have rust, be deformed or have fingerprints, stains or other contamination.	2.5
		9.2 Bezel must comply with job specifications.	0.65
10	PCB、COB	10.1 COB seal may not have pinholes larger than 0.2mm or contamination.	2.5
		10.2 COB seal surface may not have pinholes through to the IC.	2.5
		10.3 The height of the COB should not exceed the height indicated in the assembly diagram.	0.65
		10.4 There may not be more than 2mm of sealant outside the seal area on the PCB. And there should be no more than three places.	2.5
		10.5 No oxidation or contamination PCB terminals.	
		10.6 Parts on PCB must be the same as on the production characteristic chart. There should be no wrong parts, missing parts or excess parts.	2.5
			0.65
		10.7 The jumper on the PCB should conform to the product characteristic chart.	0.65
		10.8 If solder gets on bezel tab pads, LED pad, zebra pad or screw hold pad, make sure it is smoothed down.	2.5
		10.9 The Scraping testing standard for Copper Coating of PCB $X * Y <= 2mm^2$	2.5
11	Soldering	11.1 No un-melted solder paste may be present on the PCB.	2.5
		11.2 No cold solder joints, missing solder connections, oxidation or icicle.	2.5
		11.3 No residue or solder balls on PCB.	2.5
		11.4 No short circuits in components on PCB.	0.65

NO	Item	Criterion	AQL
12	General appearance	12.1 No oxidation, contamination, curves or, bends on interface Pin (OLB) of TCP.	2.5
		12.2 No cracks on interface pin (OLB) of TCP.	0.65
		12.3 No contamination, solder residue or solder balls on product.	2.5
		12.4 The IC on the TCP may not be damaged, circuits.	2.5
		12.5 The uppermost edge of the protective strip on the interface pin must be present or look as if it cause the interface pin to sever.	2.5
		12.6 The residual rosin or tin oil of soldering (component or chip component) is not burned into brown or black color.	2.5
		12.7 Sealant on top of the ITO circuit has not hardened.	2.5
		12.8 Pin type must match type in specification sheet.	0.65
		12.9 LCD pin loose or missing pins.	0.65
		12.10 Product packaging must the same as specified on packaging specification sheet.	0.65
		12.11 Product dimension and structure must conform to product specification sheet.	0.65
		12.12 Visual defect outside of VA is not considered to be rejection.	0.65

12.Material List of Components for RoHs

1. WINSTAR Display Co., Ltd hereby declares that all of or part of products (with the mark "#"in code), including, but not limited to, the LCM, accessories or packages, manufactured and/or delivered to your company (including your subsidiaries and affiliated company) directly or indirectly by our company (including our subsidiaries or affiliated companies) do not intentionally contain any of the substances listed in all applicable EU directives and regulations, including the following substances.

Exhibit A：The Harmful Material List

Material	Cd	Pb	Hg	Cr6+	PBB	PBDE	DEHP	BBP	DBP	DIBP
Limited Value	**100 ppm**	**1000 ppm**	**1000 ppm**	**1000 ppm**	**1000 ppm**	**1000 ppm**	**1000 ppm**	**1000 ppm**	**1000 ppm**	**1000 ppm**
Above limited value is set up according to RoHS.										

2. For RoHS compliance, the recommended soldering temperatures for different components are as follows:

(1) FPC：300℃, 1-3 seconds

(2) Backlight AK and metal pin glass: 330℃, 1-5 seconds

Note: Customers should adjust the temperature and duration based on the actual materials used in their soldering process, including the soldering iron, solder paste, and any other components involved.

13.Recommendable Storage

1. Place the panel or module in the temperature 25°C±5°C and the humidity below 65% RH
2. Do not place the module near organics solvents or corrosive gases.
3. Do not crush, shake, or jolt the module.

1、 <u>**Panel Specification**</u>：

    1.   Panel Type：   ☐ Pass   ☐ NG ,_____

    2.   View Direction：   ☐ Pass   ☐ NG ,_____

    3.   Numbers of Dots：   ☐ Pass   ☐ NG ,_____

    4.   View Area：   ☐ Pass   ☐ NG ,_____

    5.   Active Area：   ☐ Pass   ☐ NG ,_____

    6.   Operating Temperature： ☐ Pass   ☐ NG ,_____

    7.   Storage Temperature： ☐ Pass   ☐ NG ,_____

    8.   Others：_____

2、 <u>**Mechanical Specification**</u>：

    1.   PCB Size：   ☐ Pass   ☐ NG ,_____

    2.   Frame Size：   ☐ Pass   ☐ NG ,_____

    3.   Materal of Frame： ☐ Pass   ☐ NG ,_____

    4.   Connector Position： ☐ Pass   ☐ NG ,_____

    5.   Fix Hole Position： ☐ Pass   ☐ NG ,_____

    6.   Backlight Position： ☐ Pass   ☐ NG ,_____

    7.   Thickness of PCB： ☐ Pass   ☐ NG ,_____

    8.   Height of Frame to PCB： ☐ Pass   ☐ NG ,_____

    9.   Height of Module： ☐ Pass   ☐ NG ,_____

    10. Others：   ☐ Pass   ☐ NG ,_____

3、 <u>**Relative Hole Size**</u>：

    1.   Pitch of Connector： ☐ Pass   ☐ NG ,_____

    2.   Hole size of Connector： ☐ Pass   ☐ NG ,_____

    3.   Mounting Hole size： ☐ Pass   ☐ NG ,_____

    4.   Mounting Hole Type： ☐ Pass   ☐ NG ,_____

    5.   Others：   ☐ Pass   ☐ NG ,_____

4、 <u>**Backlight Specification**</u>：

    1. B/L Type：   ☐ Pass   ☐ NG ,_____

    2. B/L Color：   ☐ Pass   ☐ NG ,_____

    3. B/L Driving Voltage (Reference for LED Type)： ☐ Pass   ☐ NG ,_____

    4. B/L Driving Current： ☐ Pass   ☐ NG ,_____

    5. Brightness of B/L： ☐ Pass   ☐ NG ,_____

    6. B/L Solder Method： ☐ Pass   ☐ NG ,_____

    7. Others：   ☐ Pass   ☐ NG ,_____

＞＞ **Go to page 2** ＜＜

5、<u>Electronic Characteristics of Module</u>：

1. Input Voltage：　　　　　☐ Pass　　　☐ NG ,_____

2. Supply Current：　　　　　☐ Pass　　　☐ NG ,_____

3. Driving Voltage for LCD：　☐ Pass　　　☐ NG ,_____

4. Contrast for LCD：　　　　☐ Pass　　　☐ NG ,_____

5. B/L Driving Method：　　　☐ Pass　　　☐ NG ,_____

6. Negative Voltage Output：　☐ Pass　　　☐ NG ,_____

7. Interface Function：　　　　☐ Pass　　　☐ NG ,_____

8. LCD Uniformity：　　　　　☐ Pass　　　☐ NG ,_____

9. ESD test：　　　　　　　　☐ Pass　　　☐ NG ,_____

10. Others：　　　　　　　　　☐ Pass　　　☐ NG ,_____

6、<u>Summary</u>：

Sales signature：_____

Customer Signature：_____   **Date**：___/___/___

14.Initial code

//WO240128B 2016.06.17 Winstar
//For FSTN White

```c
void initial()
{

    RES=1;
    delay(200);
    RES=0;
    delay(200);
    RES=1;
    delay(200);

    write_com(0xD7);        // Disable Auto Read
    write_dat(0x9F);
    write_com(0xE0);        // Enable OTP Read
    write_dat(0x00);
    delay(20);
    write_com(0xE3);        // OTP Up-Load
    delay(20);
    write_com(0xE1);        // OTP Control Out
    write_com(0x11);        // Sleep Out
    write_com(0x28);        // Display OFF
    delay(50);

    write_com(0xC0);        //----- Vop = 0X11Dh -----
    write_dat(0x1D);        //
    write_dat(0x01);        //

    write_com(0xC3);        // BIAS = 1/12 ----------
    write_dat(0x02);        //

    write_com(0xC4);        // Set Booster
    write_dat(0x07);

    write_com(0xD0);        // Enable Analog Circuit
    write_dat(0x1D);
```

```
write_com(0xB5);        // N-Line = 0 ; Frame inversion
write_dat(0x00);


write_com(0x39);        //Display Mode : Monochrome mode(B/W Mode)


//------------------      FSTN White Temperature Compensation
write_com(0xF1);        // Frame Rate (Monochrome Mode)
write_dat(0x06);        //
write_dat(0x0B);        //
write_dat(0x0D);
write_dat(0x12);        //
//-----------------       FSTN White Temperature Compensation
write_com(0xF4);        //Temperature Gradient Compensation
write_dat(0x7F);        //MT1 , MT0
write_dat(0x22);        //MT3 , MT2
write_dat(0x11);        //MT5 , MT4
write_dat(0x02);        //MT7 , MT6
write_dat(0x00);        //MT9 , MT8
write_dat(0x32);        //MTB , MTA
write_dat(0x82);        //MTD , MTC
write_dat(0xB6);        //MTF , MTE
//-----------------


write_com(0x3A);        // Enable DDRAM Interface
write_dat(0x02);


write_com(0x36);        // Scan Direction Setting/Display Control
write_dat(0x00);



write_com(0xB0);        // Duty Setting--------------------
write_dat(0x7F);        // 1/128Duty
///////////////////////
write_com(0x20);        // Normal display


write_com(0x37);        // Start Line
write_dat(0x00);        //


write_com(0xB1);        // First Output COM
write_dat(0x00);        //
```

//////////////////////

```
    write_com(0xB3);        //FOSC Divider
    write_dat(0x00);        //

    write_com(0x2A);        // Column Address Setting
    write_dat(0x00);
    write_dat(0x00);
    write_dat(0x00);
    write_dat(79);          //

    write_com(0x2B);        // Row Address Setting
    write_dat(0x00);
    write_dat(0x00);
    write_dat(0x00);
    write_dat(127);         //


    write_com(0x29);        // Display ON
}
```

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Headquarters & Warehouse

Elektrostraat 17
NL-7483 PG Haaksbergen
The Netherlands

T: +31 (0)53 573 33 33
E: info@texim-europe.com
Homepage: www.texim-europe.com

The Netherlands

Elektrostraat 17
NL-7483 PG Haaksbergen

T: +31 (0)53 573 33 33
E: nl@texim-europe.com

Belgium

Zuiderlaan 14, box 10
B-1731 Zellik

T: +32 (0)2 462 01 00
E: belgium@texim-europe.com

UK & Ireland

St Mary's House, Church Lane
Carlton Le Moorland
Lincoln LN5 9HS

T: +44 (0)1522 789 555
E: uk@texim-europe.com

Germany

Bahnhofstrasse 92
D-25451 Quickborn

T: +49 (0)4106 627 07-0
E: germany@texim-europe.com

Germany

Martin-Kollar-Strasse 9
D-81829 München

T: +49 (0)89 436 086-0
E: muenchen@texim-europe.com

Austria

Warwitzstrasse 9
A-5020 Salzburg

T: +43 (0)662 216 026
E: austria@texim-europe.com

Nordic

Stockholmsgade 45
2100 Copenhagen

T: +45 88 20 26 30
E: nordic@texim-europe.com

Italy

Martin-Kollar-Strasse 9
D-81829 München

T: +49 (0)89 436 086-0
E: italy@texim-europe.com