Winstar Display Co., LTD
華凌光電股份有限公司

SPECIFICATION

CUSTOMER　:

MODULE NO.:　　WH2002D-NGG-CT#

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

SALES BY	APPROVED BY	CHECKED BY	PREPARED BY

VERSION	DATE	REVISED PAGE NO.	SUMMARY
0	2012/11/27		First issue

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RECORDS OF REVISION			DOC. FIRST ISSUE	
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Contents

1.Module Classification Information

<u>W H</u>　　<u>2 0 0 2</u>　　<u>D</u>－<u>N</u> <u>G</u> <u>G</u>－　　<u>CT#</u>
① ②　　　　③　　　　④　　⑤ ⑥ ⑦　　　　⑧

① Brand：WINSTAR DISPLAY CORPORATION
② Display Type：H→Character Type, G→Graphic Type
③ Display Font：Character 20words, 2Lines.
④ Model serials no.
⑤ Backlight Type：　　N→Without backlight　　　　T→LED, White
　　　　　　　　　　　 B→EL, Blue green　　　　　　A→LED, Amber
　　　　　　　　　　　 D→EL, Green　　　　　　　　R→LED, Red
　　　　　　　　　　　 W→EL, White　　　　　　　　O→LED, Orange
　　　　　　　　　　　 F→CCFL, White　　　　　　　G→LED, Green
　　　　　　　　　　　 Y→LED, Yellow Green
⑥ LCD Mode：　　　　 B→TN Positive, Gray　　　　 T→FSTN Negative
　　　　　　　　　　　 N→TN Negative,
　　　　　　　　　　　 G→STN Positive, Gray
　　　　　　　　　　　 Y→STN Positive, Yellow Green
　　　　　　　　　　　 M→STN Negative, Blue
　　　　　　　　　　　 F→FSTN Positive
⑦ LCD Polarize　　　 A→Reflective, N.T, 6:00　　　H→Transflective, W.T,6:00
　Type/ Temperature　D→Reflective, N.T, 12:00　　K→Transflective, W.T,12:00
　range/ View　　　　 G→Reflective, W. T, 6:00　　C→Transmissive, N.T,6:00
　direction　　　　　 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　　　　CT : English and Cyrillic standard font;
　　　　　　　　　　　 #:Fit in with the ROHS Directions and regulations

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.)

3.General Specification

Item	Dimension	Unit
Number of Characters	20 characters x 2Lines	—
Module dimension	80.0 x 21.5 x 7.44(MAX)	mm
View area	75.0 x 15.0	mm
Active area	68.5x 10.7	mm
Dot size	0.55 x 0.60	mm
Dot pitch	0.60 x 0.65	mm
Character size	2.95 x 5.15	mm
Character pitch	3.45 x 5.55	mm
LCD type	STN Positive, Gray ,Reflective (In LCD production, It will occur slightly color difference. We can only guarantee the same color in the same batch.)	
Duty	1/16	
View direction	6 o'clock	
Backlight Type	Without backlight	

4.Absolute Maximum Ratings

Item	Symbol	Min	Typ	Max	Unit
Operating Temperature	T_{OP}	-20	—	+70	℃
Storage Temperature	T_{ST}	-30	—	+80	℃
Input Voltage	V_I	V_{SS}	—	V_{DD}	V
Supply Voltage For Logic	V_{DD}-V_{SS}	-0.3	—	7	V
Supply Voltage For LCD	V_{DD}-V_0	-0.3	—	13	V

5.Electrical Characteristics

5.1

Item	Symbol	Condition	Min	Typ	Max	Unit
Supply Voltage For Logic	V_{DD}-V_{SS}	—	4.5	5.0	5.5	V
Supply Voltage For LCD	V_{DD}-V_0	Ta=-20℃	—	—	5.2	V
		Ta=25℃	4.1	4.2	4.3	V
		Ta=70℃	3.6	—	—	V
Input High Volt.	V_{IH}	—	0.7 V_{DD}	—	V_{DD}	V
Input Low Volt.	V_{IL}	—	V_{SS}	—	0.6	V
Output High Volt.	V_{OH}	—	3.9	—	V_{DD}	V
Output Low Volt.	V_{OL}	—	0	—	0.4	V
Supply Current(NOTE 1)	I_{DD}	V_{DD}=5.0V	—	5.0	—	mA

NOTE1: With negative volt. DC-DC circuit.

5.2 Power supply

VDD=3V

L
C
D

VDD
Vo
VEE
VSS

VR

+3V

VDD=5V

L
C
D

VDD
Vo

VSS

VR

+5V
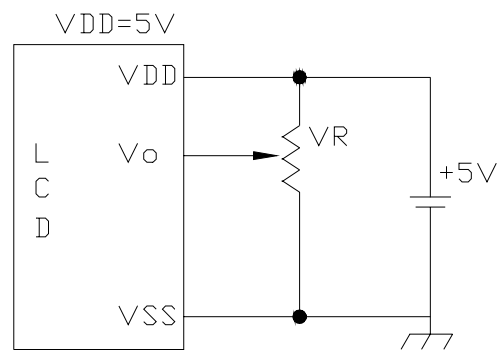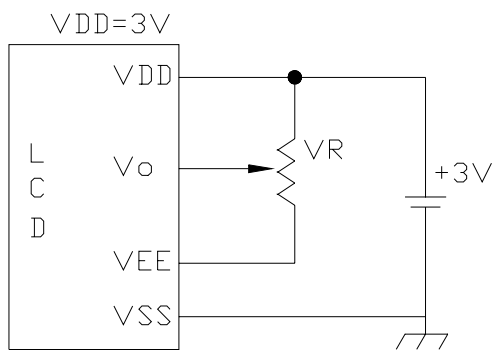
VR=10K ~ 20K ohm

6.Optical Characteristics

Item	Symbol	Condition	Min	Typ	Max	Unit
View Angle	(V) θ	CR≧2	20	—	40	deg
	(H) φ	CR≧2	-30	—	30	deg
Contrast Ratio	CR	—	—	3	—	—
Response Time	T rise	—	—	150	200	ms
	T fall	—	—	150	200	ms

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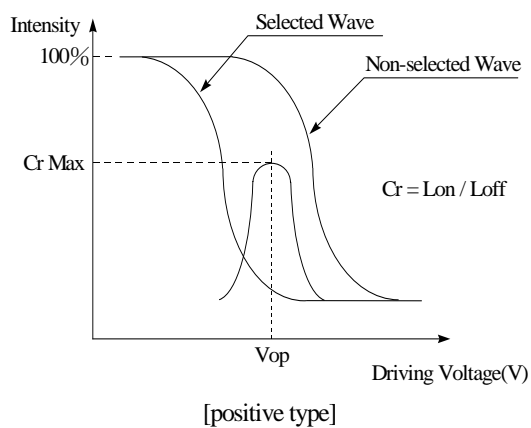
Intensity

100%

Selected Wave

Non-selected Wave

Cr Max

Cr = Lon / Loff

Vop

Driving Voltage(V)

[positive type]

Non-selected Conition   Selected Conition   Non-selected Conition

Intensity

100%   90%   10%

Tr   Tf

[positive type]
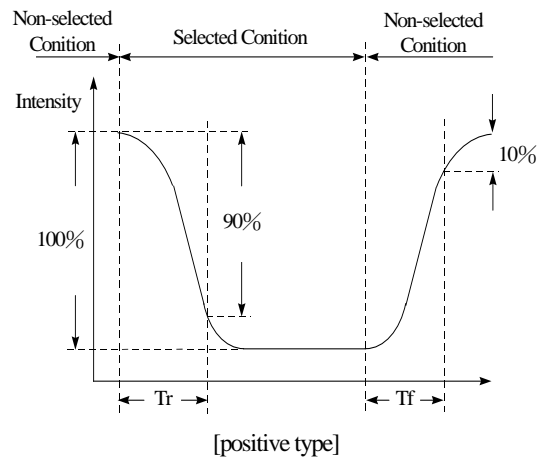
Conditions :

    Operating Voltage : Vop   Viewing Angle(θ , φ) : 0°, 0°

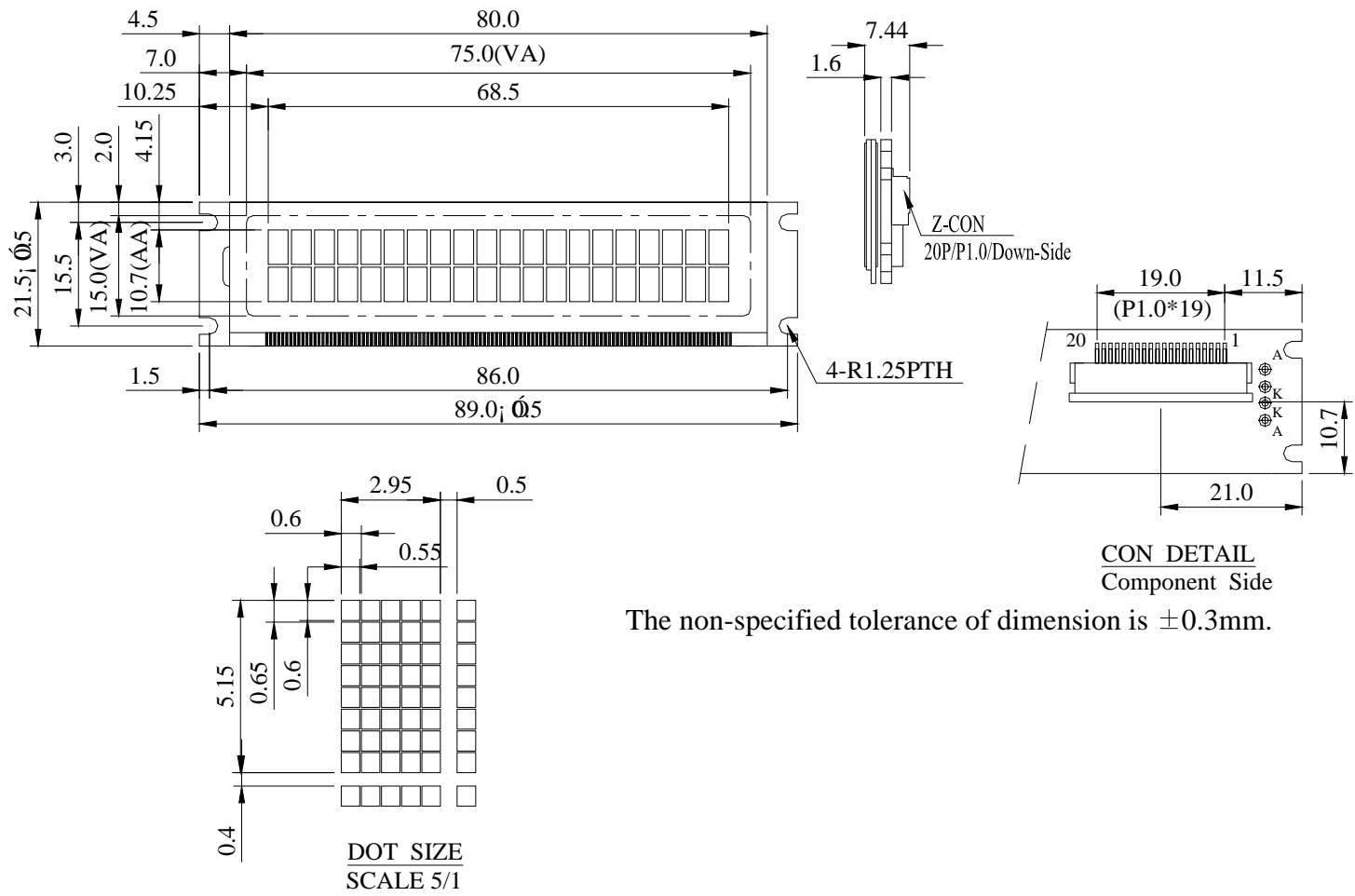   Frame Frequency : 64 HZ   Driving Waveform : 1/N duty , 1/a bias

Definition of viewing angle(CR≧2)

θb

θf

$\varphi = 180°$

$\theta 1$

θ r

$\varphi = 270°$

$\varphi = 90°$

$\varphi = 0°$
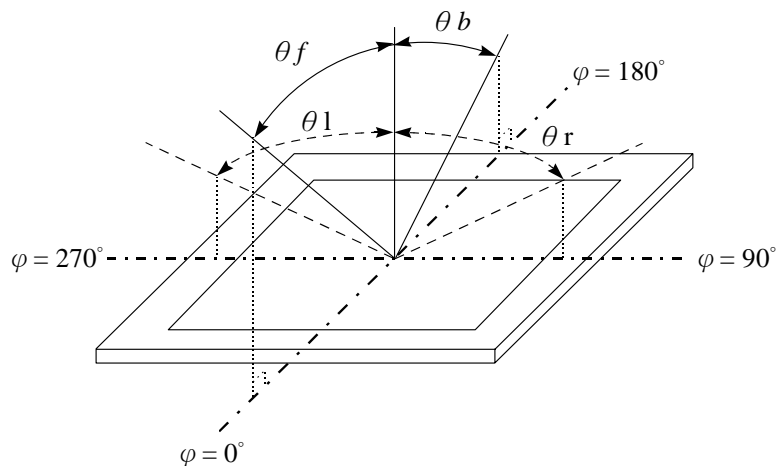
7.Interface Pin Function

Pin No.	Symbol	Level	Description
1	N/C		No connection
2	N/C		No connection
3	V_{SS}	0V	Ground
4	V_{DD}	3~5V	Supply Voltage for logic
5	VO	(Variable)	Operating voltage for LCD
6	RS	H/L	H: DATA, L: Instruction code
7	R/W	H/L	H: Read(MPU→Module) L: Write(MPU→Module)
8	E	H,H→L	Chip enable signal
9	DB0	H/L	Data bus line
10	DB1	H/L	Data bus line
11	DB2	H/L	Data bus line
12	DB3	H/L	Data bus line
13	DB4	H/L	Data bus line
14	DB5	H/L	Data bus line
15	DB6	H/L	Data bus line
16	DB7	H/L	Data bus line
17	LED+	—	No connection
18	LED-	—	No connection
19	VEE		No connection
20	NC		No connection

8.Contour Drawing &Block Diagram

PIN NO.	SYMBOL
1	N/C
2	N/C
3	Vss
4	Vdd
5	Vo
6	RS
7	R/W
8	E
9	DB0
10	DB1
11	DB2
12	DB3
13	DB4
14	DB5
15	DB6
16	DB7
17	V_{LED+}
18	V_{LED-}
19	Vee
20	N/C

Z-CON
20P/P1.0/Down-Side

4-R1.25PTH

CON DETAIL
Component Side

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

DOT SIZE
SCALE 5/1
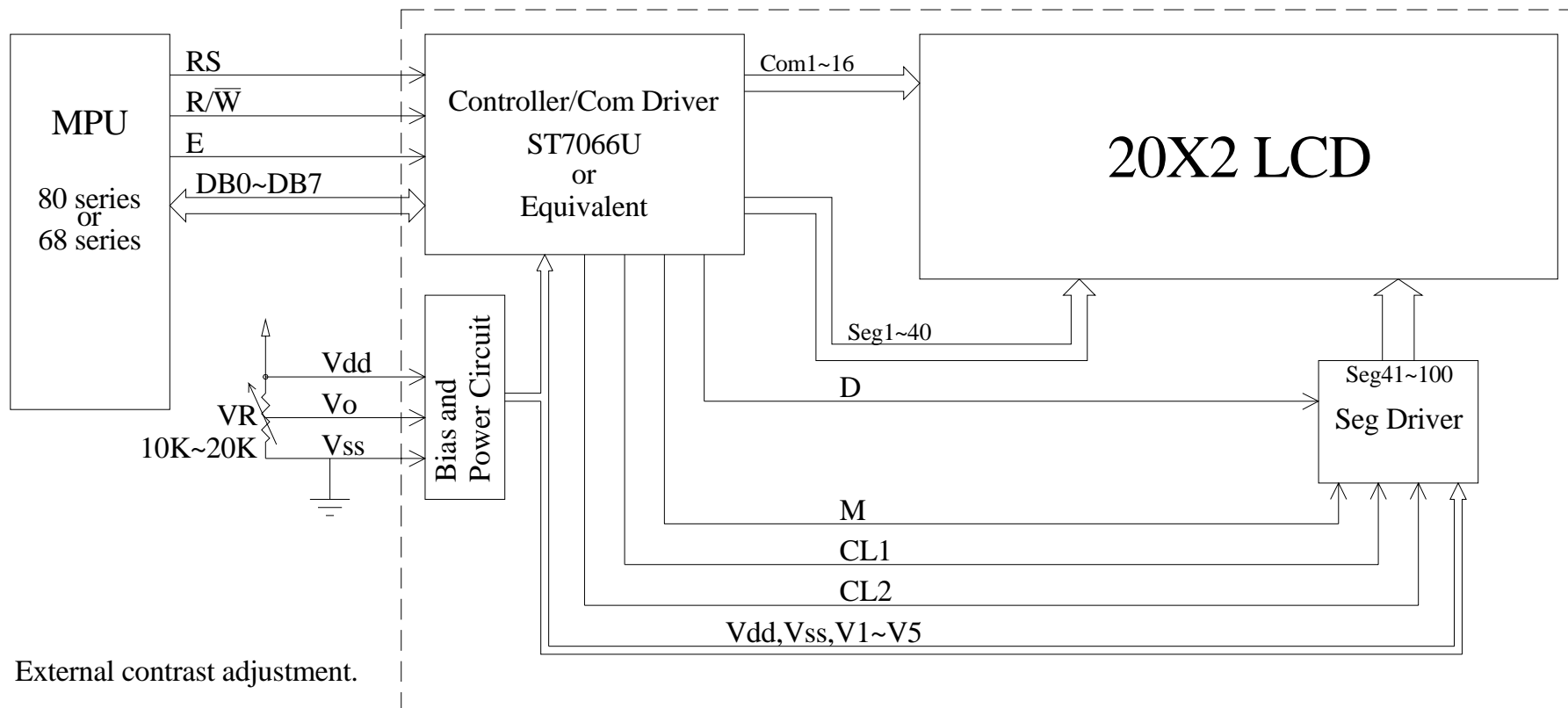
Character located	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
DDRAM address	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F	10	11	12	13
DDRAM address	40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F	50	51	52	53

9.Function Description

The LCD display Module is built in a LSI controller, the controller has two 8-bit registers, an instruction register (IR) and a data register (DR).

The IR stores instruction codes, such as display clear and cursor shift, and address information for display data RAM (DDRAM) and character generator (CGRAM). The IR can only be written from the MPU.   The DR temporarily stores data to be written or read from DDRAM or CGRAM.   When address information is written into the IR, then data is stored into the DR from DDRAM or CGRAM. By the register selector (RS) signal, these two registers can be selected.

| RS	R/W	Operation
0	0	IR write as an internal operation (display clear, etc.)
0	1	Read busy flag (DB7) and address counter (DB0 to DB7)
1	0	Write data to DDRAM or CGRAM (DR to DDRAM or CGRAM)
1	1	Read data from DDRAM or CGRAM (DDRAM or CGRAM to DR)

Busy Flag (BF)

When the busy flag is 1, the controller LSI is in the internal operation mode, and the next instruction will not be accepted.   When RS=0 and R/W=1, the busy flag is output to DB7.   The next instruction must be written after ensuring that the busy flag is 0.

Address Counter (AC)

The address counter (AC) assigns addresses to both DDRAM and CGRAM

Display Data RAM (DDRAM)

This DDRAM is used to store the display data represented in 8-bit character codes.   Its extended capacity is 80×8 bits or 80 characters.   Below figure is the relationships between DDRAM addresses and positions on the liquid crystal display.

High bits   Low bits

Example: DDRAM addresses 4E

AC (hexadecimal)	AC6	AC5	AC4	AC3	AC2	AC1	AC0		1	0	0	1	1	1	0
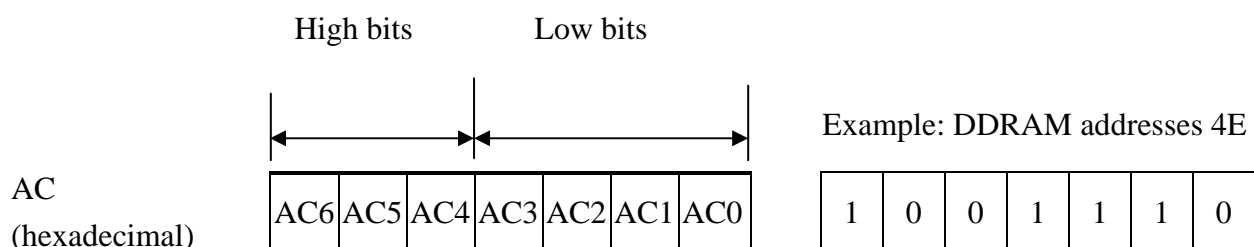
Display position DDRAM address

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F	10	11	12	13
40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F	50	51	52	53

2-Line by 20-Character Display

Character Generator ROM (CGROM)

The CGROM generate 5×8 dot or 5×10 dot character patterns from 8-bit character codes. See Table 2.

Character Generator RAM (CGRAM)

In CGRAM, the user can rewrite character by program.   For 5×8 dots, eight character patterns can be written, and for 5×10 dots, four character patterns can be written.

Write into DDRAM the character code at the addresses shown as the left column of table 1. To show the character patterns stored in CGRAM.

Relationship between CGRAM Addresses, Character Codes (DDRAM) and Character patterns

Table 1.

For 5 * 8 dot character patterns

Character Codes (DDRAM data)		CGRAM Address		Character Patterns (CGRAM data)		
7 6 5 4 3 2 1 0		5 4 3 2 1 0		7 6 5 4 3 2 1 0		
High Low		High Low		High Low		
			0 0 0	* * *	■ ■ ■ ■	0	
			0 0 1	* * *	■ 0 0 0	■	
			0 1 0	* * *	■ 0 0 0	■	
			0 1 1	* * *	■ ■ ■	0	Character pattern (1)
0 0 0 0 * 0 0 0		0 0 0	1 0 0	* * *	0 ■ 0	0	
			1 0 1	* * *	0 0 ■	0	
			1 1 0	* * *	0 0 0	■	
			1 1 1	* * *	0 0 0 0 0		Cursor pattern
			0 0 0	* * *	0 0 0	■	
			0 0 1	* * *	0 ■ 0	■	
			0 1 0	* * *			
			0 1 1	* * *	0 0 0 0		Character pattern (2)
0 0 0 0 * 0 0 1		0 0 1	1 0 0	* * *	■ ■ ■ ■		
			1 0 1	* * *	0 0 0 0		
			1 1 0	* * *	0 0 ■ 0 0		
			1 1 1	* * *	0 0 0 0 0		Cursor pattern
			0 0 0	* * *			
			0 0 1				
0 0 0 0 * 1 1 1		1 1 1	1 0 0				
			1 0 1				
			1 1 0				
			1 1 1	* * *			

For 5 * 10 dot character patterns

Character Codes (DDRAM data)		CGRAM Address		Character Patterns (CGRAM data)		
7 6 5 4 3 2 1 0		5 4 3 2 1 0		7 6 5 4 3 2 1 0		
High Low		High Low		High Low		
			0 0 0 0	* * *	0 0 0 0 0		
			0 0 0 1	* * *	0 0 0 0 0		
			0 0 1 0	* * *	■ 0 0	0	
			0 0 1 1	* * *	■ 0 0	■	
			0 1 0 0	* * *	■ 0 0 0		
0 0 0 0 * 0 0 0		0 0	0 1 0 1	* * *	■ 0 0 0		
			0 1 1 0	* * *	■	0	Character pattern
			0 1 1 1	* * *	■ 0 0 0	0	
			1 0 0 0	* * *	■ 0 0 0	0	
			1 0 0 1	* * *	■ 0 0 0	0	
			1 0 1 0	* * *	0 0 0 0 0		Cursor pattern
			1 1 1 1	* * *	* * * * *		

■ : " High "

10.Character Generator ROM Pattern

Table.2

Upper 4 bit / Lower 4 bit	LLLL	LLLH	LLHL	LLHH	LHLL	LHLH	LHHL	LHHH	HLLL	HLLH	HLHL	HLHH	HHLL	HHLH	HHHL	HHHH
LLLL	CG RAM (1)															
LLLH	CG RAM (2)															
LLHL	CG RAM (3)															
LLHH	CG RAM (4)															
LHLL	CG RAM (5)															
LHLH	CG RAM (6)															
LHHL	CG RAM (7)															
LHHH	CG RAM (8)															
HLLL	CG RAM (1)															
HLLH	CG RAM (2)															
HLHL	CG RAM (3)															
HLHH	CG RAM (4)															
HHLL	CG RAM (5)															
HHLH	CG RAM (6)															
HHHL	CG RAM (7)															
HHHH	CG RAM (8)															

11.Instruction Table

Instruction	Instruction Code										Description	Execution time (fosc=270Khz)
	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0		
Clear Display	0	0	0	0	0	0	0	0	0	1	Write "20H" to DDRAM. and set DDRAM address to "00H" from AC	1.52ms
Return Home	0	0	0	0	0	0	0	0	1	—	Set DDRAM address to "00H" from AC and return cursor to its original position if shifted. The contents of DDRAM are not changed.	1.52ms
Entry Mode Set	0	0	0	0	0	0	0	1	I/D	SH	Sets cursor move direction and specifies display shift. These operations are performed during data write and read.	$37 \mu s$
Display ON/OFF Control	0	0	0	0	0	0	1	D	C	B	D=1:entire display on C=1:cursor on B=1:cursor position on	$37 \mu s$
Cursor or Display Shift	0	0	0	0	0	1	S/C	R/L	—	—	Set cursor moving and display shift control bit, and the direction, without changing DDRAM data.	$37 \mu s$
Function Set	0	0	0	0	1	DL	N	F	—	—	DL:interface data is 8/4 bits N:number of line is 2/1 F:font size is 5x11/5x8	$37 \mu s$
Set CGRAM Address	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0	Set CGRAM address in address counter	$37 \mu s$
Set DDRAM Address	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Set DDRAM address in address counter	$37 \mu s$
Read Busy Flag and Address	0	1	BF	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Whether during internal operation or not can be known by reading BF. The contents of address counter can also be read.	$0 \mu s$
Write Data to RAM	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Write data into internal RAM (DDRAM/CGRAM)	$37 \mu s$
Read Data from RAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0	Read data from internal RAM (DDRAM/CGRAM)	$37 \mu s$

＊ ”－”：don't care

12.Timing Characteristics

12.1 Writing data from MPU to ST7066U
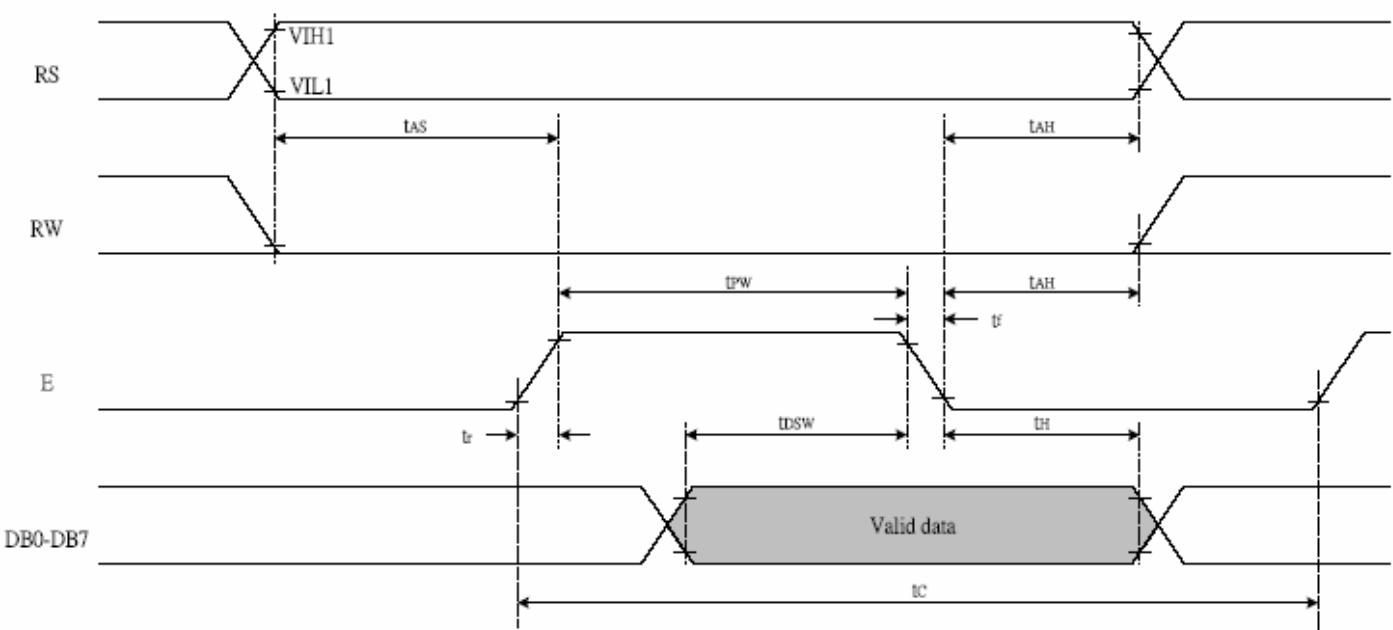
Ta=-30~+85℃, VDD=5.0± 0.5V

TC	Enable Cycle Time	Pin E	1200	-	-	ns
TPW	Enable Pulse Width	Pin E	140	-	-	ns
TR,TF	Enable Rise/Fall Time	Pin E	-	-	25	ns
TAS	Address Setup Time	Pins: RS,RW,E	0	-	-	ns
TAH	Address Hold Time	Pins: RS,RW,E	10	-	-	ns
TDSW	Data Setup Time	Pins: DB0 - DB7	40	-	-	ns
TH	Data Hold Time	Pins: DB0 - DB7	10	-	-	ns

12.2Reading data from ST7066U to MPU
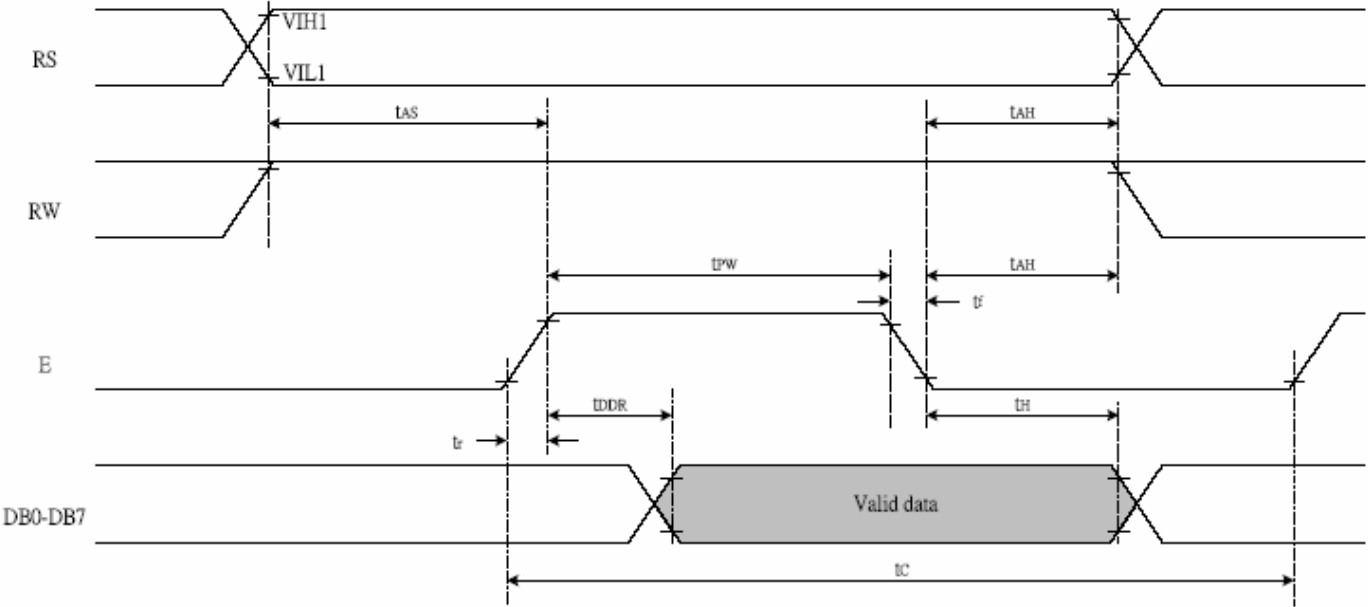
Ta=-30~+85℃, VDD=5.0± 0.5V

Read Mode		(Reading Data from ST7066U to MPU)					
TC	Enable Cycle Time	Pin E	1200	-	-	ns
TPW	Enable Pulse Width	Pin E	140	-	-	ns
TR,TF	Enable Rise/Fall Time	Pin E	-	-	25	ns
TAS	Address Setup Time	Pins: RS,RW,E	0	-	-	ns
TAH	Address Hold Time	Pins: RS,RW,E	10	-	-	ns
TDDR	Data Setup Time	Pins: DB0 - DB7	-	-	100	ns
TH	Data Hold Time	Pins: DB0 - DB7	10	-	-	ns

13.Initializing of LCM

● **4-bit Interface (fosc=270KHz)**

POWER ON

↓

Wait time >40mS
After Vcc >4.5V

↓

Function set

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	1	1	X	X	X	X

◄ ---- BF cannot be checked before this instruction.

↓

Wait time >37uS

↓

Function set

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	1	0	X	X	X	X
0	0	N	F	X	X	X	X	X	X

◄ ---- BF cannot be checked before this instruction.

↓

Wait time >37uS

↓

Function set

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	1	0	X	X	X	X
0	0	N	F	X	X	X	X	X	X

◄ ---- BF cannot be checked before this instruction.

↓

Wait time >37uS

↓

Display ON/OFF control

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	0	X	X	X	X
0	0	1	D	C	B	X	X	X	X

↓

Wait time >37uS

↓

Display clear

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	0	X	X	X	X
0	0	0	0	0	1	X	X	X	X

↓

Wait time >1.52mS

↓

Entry mode set

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	0	X	X	X	X
0	0	0	1	I/D	S	X	X	X	X

↓

Initialization end

- **8-bit Interface (fosc=270KHz)**

POWER ON

↓

Wait time >40mS
After Vcc >4.5V

↓

Function set

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	1	1	N	F	X	X

←------ BF cannot be checked before this instruction.

↓

Wait time >37uS

↓

Function set

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	1	1	N	F	X	X

←------ BF cannot be checked before this instruction.

↓

Wait time >37uS

↓

Display ON/OFF control

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	0	1	D	C	B

↓

Wait time >37uS

↓

Display clear

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	0	0	0	0	1

↓

Wait time >1.52mS

↓

Entry mode set

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	0	0	1	I/D	S

↓

Initialization end

14.Reliability

Content of Reliability Test (wide temperature, -20℃~70℃)
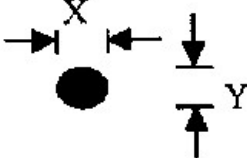
Environmental Test			
Test Item	**Content of Test**	**Test Condition**	**Note**
High Temperature storage	Endurance test applying the high storage temperature for a long time.	80℃ 200hrs	2
Low Temperature storage	Endurance test applying the low storage temperature for a long time.	-30℃ 200hrs	1,2
High Temperature Operation	Endurance test applying the electric stress (Voltage & Current) and the thermal stress to the element for a long time.	70℃ 200hrs	____
Low Temperature Operation	Endurance test applying the electric stress under low temperature for a long time.	-20℃ 200hrs	1
High Temperature/ Humidity Operation	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=800V,RS=1.5kΩ CS=100pF 1 time	____
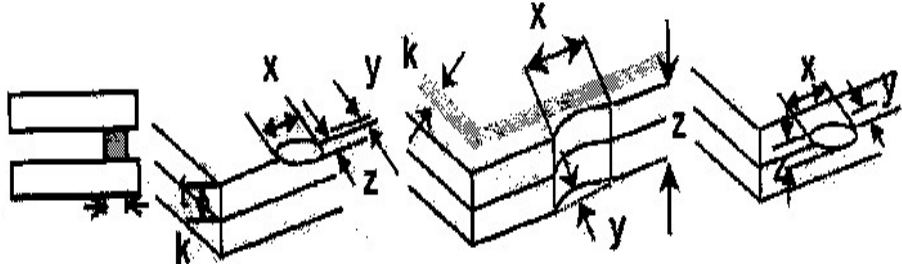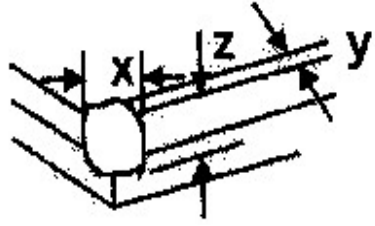
Note1: No dew condensation to be observed.
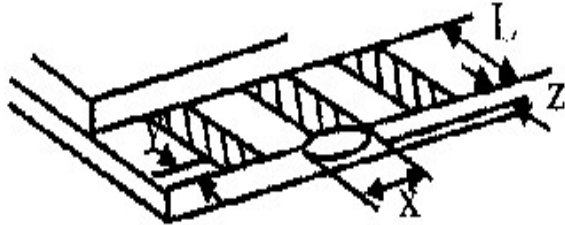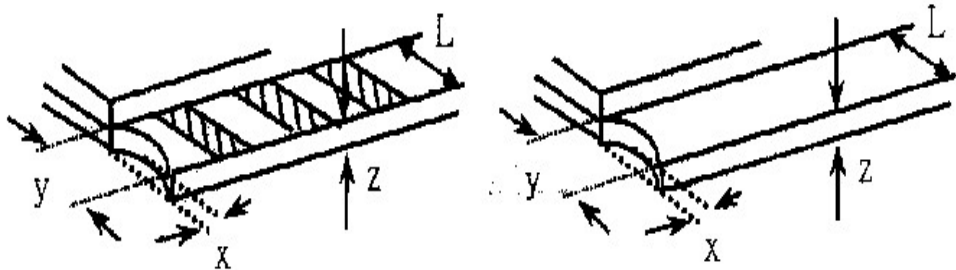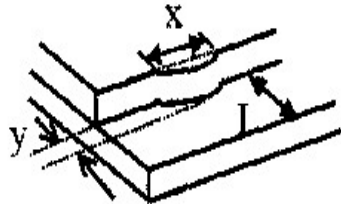
Note2: The function test shall be conducted after 4 hours storage at the normal

　　　　Temperature and humidity after remove from the test chamber.
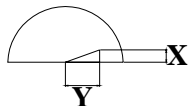
Note3: The packing have to including into the vibration testing.

15. Inspection specification

NO	Item	Criterion	AQL
01	Electrical Testing	1.1 Missing vertical, horizontal segment, segment contrast defect. 1.2 Missing character , dot or icon. 1.3 Display malfunction. 1.4 No function or no display. 1.5 Current consumption exceeds product specifications. 1.6 LCD viewing angle defect. 1.7 Mixed product types. 1.8 Contrast defect.	0.65
02	Black or white spots on LCD (display only)	2.1 White and black spots on display $\leqq0.25$mm, no more than three white or black spots present. 2.2 Densely spaced: No more than two spots or lines within 3mm	2.5
03	LCD black spots, white spots, contamination (non-display)	3.1 Round type : As following drawing $\Phi=(x + y)/2$ See table below	2.5

3.1 Round type : As following drawing

$\Phi=(x + y)/2$

SIZE	Acceptable Q TY
$\Phi\leqq0.10$	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

| 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: 	2.5

Within row 06:

6.1.1 table:

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

⊙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
$Z \leq 1/2t$	Not over viewing area	$x \leq 1/8a$
$1/2t < z \leq 2t$	Not exceed $1/3k$	$x \leq 1/8a$

⊙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 : _(see table below)_ 6.2.2 Non-conductive portion: _(see table below)_ ⊙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. 	2.5

6.2.1 Chip on electrode pad 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 table:

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

6.2.3 Substrate protuberance and internal crack table:

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. 8.2 Spots or scratched that appear when lit must be judged. Using LCD spot, lines and contamination standards. 8.3 Backlight doesn't light or color wrong.	0.65 2.5 0.65
09	Bezel	9.1 Bezel may not have rust, be deformed or have fingerprints, stains or other contamination. 9.2 Bezel must comply with job specifications.	2.5 0.65
10	PCB、COB	10.1 COB seal may not have pinholes larger than 0.2mm or contamination. 10.2 COB seal surface may not have pinholes through to the IC. 10.3 The height of the COB should not exceed the height indicated in the assembly diagram. 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. 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. 10.7 The jumper on the PCB should conform to the product characteristic chart. 10.8 If solder gets on bezel tab pads, LED pad, zebra pad or screw hold pad, make sure it is smoothed down. 10.9 The Scraping testing standard for Copper Coating of PCB X * Y<=2mm^2	2.5 2.5 0.65 2.5 2.5 0.65 0.65 2.5 2.5
11	Soldering	11.1 No un-melted solder paste may be present on the PCB. 11.2 No cold solder joints, missing solder connections, oxidation or icicle. 11.3 No residue or solder balls on PCB. 11.4 No short circuits in components on PCB.	2.5 2.5 2.5 0.65

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

16. 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

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Material	(Cd)	(Pb)	(Hg)	(Cr6+)	PBBs	PBDEs
Limited Value	100 ppm	1000 ppm	1000 ppm	1000 ppm	1000 ppm	1000 ppm
Above limited value is set up according to RoHS.						

2.Process for RoHS requirement：

(1) Use the Sn/Ag/Cu soldering surface；the surface of Pb-free solder is rougher than we used before.

(2) Heat-resistance temp.：

Reflow：250℃,30 seconds Max.；

Connector soldering wave or hand soldering：320℃, 10 seconds max.

(3) Temp. curve of reflow, max. Temp.：235±5℃；

Recommended customer's soldering temp. of connector：280℃, 3 seconds.

17. 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、Panel Specification：

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、Mechanical Specification：

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、Relative Hole Size：

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、Backlight Specification：

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** ＜＜

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5、Electronic Characteristics of Module：

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、Summary：

Sales signature： _____

Customer Signature： _____   **Date**： __ / __ / __