LCD Module

Product Specification

☐：APPROVAL FOR SPECIFICATION

For Customer：_____ ☐：APPROVAL FOR SAMPLE

Module No.：   __TSM160128B__

For Customer's Acceptance ：

Approved by	Comment

Team Source Display ：

Presented by	Reviewed by	Organized by

Revision history

revision	date	description	remark
A00	2010-06-01	First release	

Content

1. GENERAL SPECIFICATION

1.1 GENERAL SPECIFICATION
PLEASE REFER TO:

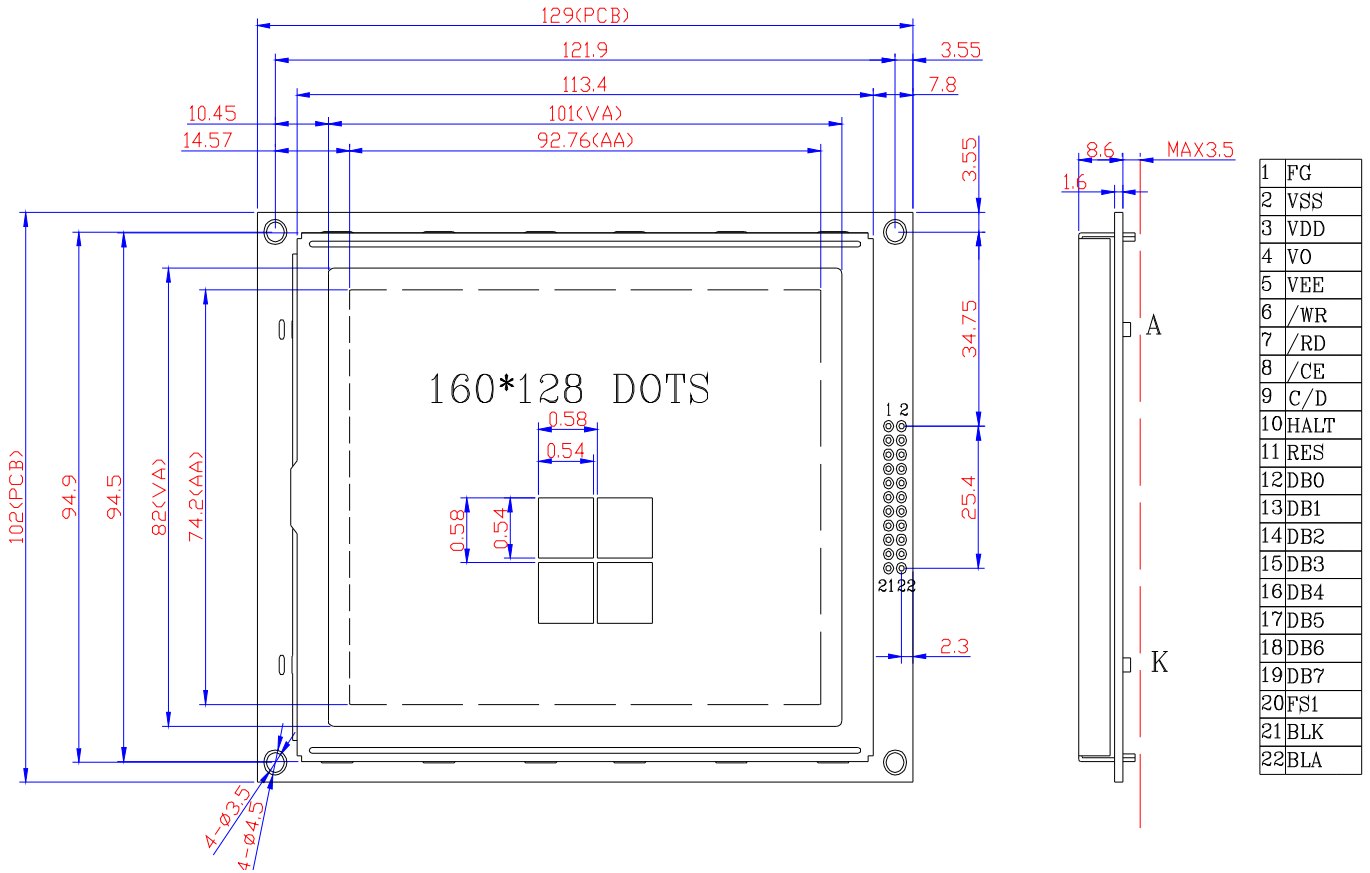a. "CUSTOMER ACCEPTANCE STANDARD SPECIFICATIONS（LCD MOUDLE QUALITY STANDARD）"

b. "CUSTOMER ACCEPTANCE STANDARD SPECIFICATIONS (IC-T6963C+NT7086)"

1.2 This individual specification is prior to general specifications.

2. DISPLAY CONTENT AND MECHANICAL CHARACTERISTIC

ITEM	STANDARD VALUE	UNIT
Number of dots	160*128 DOTS	----
Module dimension	129.0(W)*102.0(H)*12.1(T)MAX	mm
View display area	101.0(W) x 82.0(H)	mm
Dot size	0.54(W) x 0.54(H)	mm
Dot pitch	0.58(W) x 0.58(H)	mm
Operating temp	-20~70	℃
Storage temp	-30~80	℃
Driving Method	1/ 128 DUTY，1/12　BIAS，VOP=15.0V	
Viewing direction	6　O'CLOCK	
Display mode	STN/(BLUE)	
Display type	TRANSMISSIVE　/　NEGATIVE	
Driver IC	T6963C+NT7086	
Backlight	WHITE	

3. Mechanical Specifications

1	FG
2	VSS
3	VDD
4	V0
5	VEE
6	/WR
7	/RD
8	/CE
9	C/D
10	HALT
11	RES
12	DB0
13	DB1
14	DB2
15	DB3
16	DB4
17	DB5
18	DB6
19	DB7
20	FS1
21	BLK
22	BLA

4. Block Diagram & Power supply
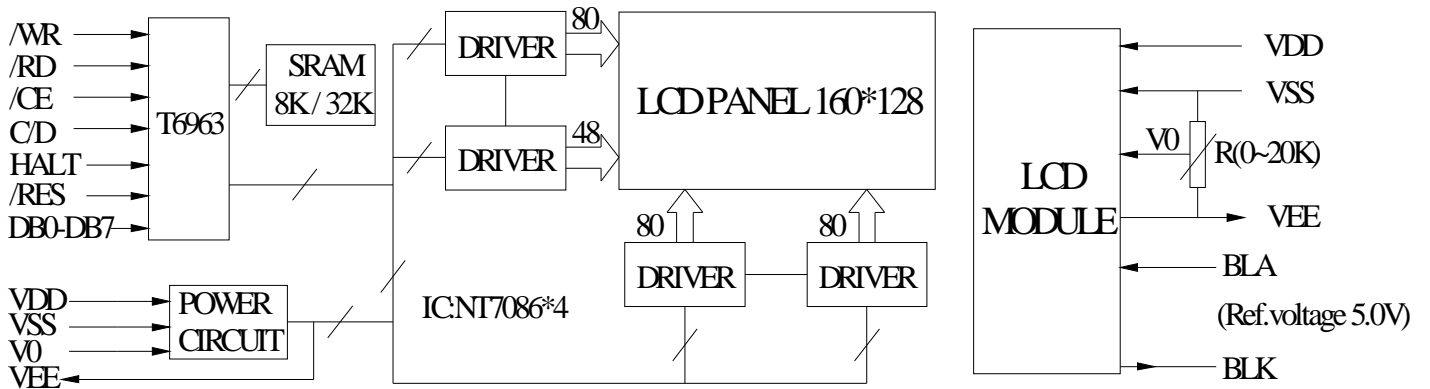
5. Pin description

Pin No.	Pin Name	Function
1	FG	Frame ground
2	VSS	Ground for logic
3	VDD	Power supply for logic
4	V0	Power supply for LCD driver (Vop=VDD-V0)
5	VEE	Negative voltage output
6	/WR	Write signal
7	/RD	Read signal
8	/CE	Chip enable
9	C/D	Command or data selection
10	HALT	Power-saving (H : Normal ; L : stop clock operating)
11	/RES	Reset signal (Low effective)
12~19	DB0~DB7	Read/write signal (H :read ; L : write)
20	FS1	Pins for selection of font
21	BLK	Power supply for backlight+
22	BLA	Power supply for backlight -

6. Absolute Maximum Ratings

Items	Symbol	MIN.	MAX.	Unit	Condition
Supply Voltage	V_{DD}	-0.3	+7.0	V	Vss = 0V
	Vlcd	-0.3	+20.0	V	Vss = 0V
Input Voltage	V_{IN}	-0.3	V_{DD}+0.3	V	Vss = 0V
LED forward current	If	0	100	mA	---
Operating Temperature	T_{OP}	-20	+70	℃	---
Storage Temperature	Tst	-30	+80	℃	---

7. Electrical Characteristics

7.1 DC Characteristics

(Vss = 0V, VDD = 5.0V ± 10%, Ta = -20~75°C)

Items	Symbol	MIN.	TYP.	MAX.	Unit
Operating Voltage	V_{DD}	4.5	5.0	5.5	V
Input High Voltage	V_{IH}	V_{DD}-2.2	-	V_{DD}	V
Input Low Voltage	V_{IL}	0	-	0.8	V
Output High Voltage	V_{OH}	V_{DD}-0.3	-	V_{DD}	V
Output Low Voltage	V_{OL}	0	-	0.3	V
Supply Current (BACKLIGHT)	I_{DD}	---	105	140	mA

7.2 AC Characteristics
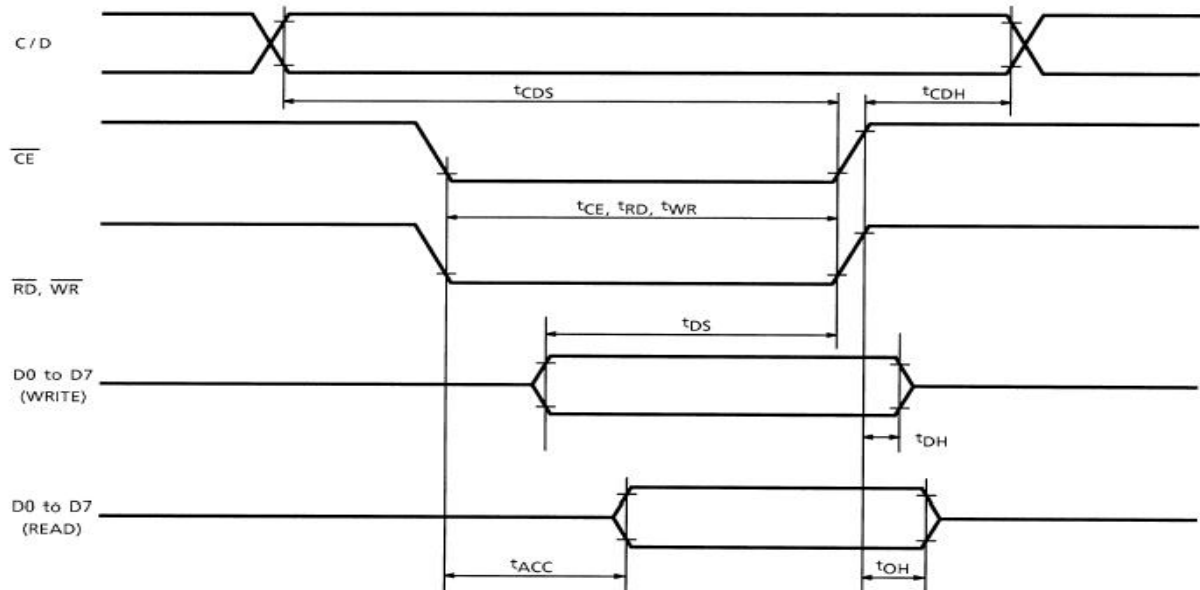
Test Conditions (Unless Otherwise Noted, V_{DD} = 5.0 V ± 10%, V_{SS} = 0 V, Ta = −20 to 75°C)

Item	Symbol	Test Conditions	Min	Max	Unit
C / D Set-up Time	t_{CDS}	—	100	—	ns
C / D Hold Time	t_{CDH}	—	10	—	ns
$\overline{CE}$, $\overline{RD}$, $\overline{WR}$ Pulse Width	t_{CE}, t_{RD}, t_{WR}	—	80	—	ns
Data Set-up Time	t_{DS}	—	80	—	ns
Data Hold Time	t_{DH}	—	40	—	ns
Access Time	t_{ACC}	—	—	150	ns
Output Hold Time	t_{OH}	—	10	50	ns

8.0Backlight Characteristics

Items	Symbol	MIN.	TYP.	MAX.	Unit	Condition
Forward current	If	-	105	-	mA	VF=3.1V
Forward Voltage	Vf	-	5.0	-	V	--
Reverse Voltage	Vr	---	---	8	V	--
Peak wave length	λ	--	--	--	nm	--
Luminance	Lv	150	200	---	Cd/m^2	If=105mA
Color	WHITE					

9. Electrical-Optical Characteristics

Items	Symbol	Condition	MIN.	TYP.	MAX.	Unit	NOTE
Operation Voltage	Vop	Ta= -20℃	15.2	15.5	15.8	V	1
		Ta= 25℃	14.7	15.0	15.3		
		Ta= 70℃	14.2	14.5	14.8		
Response time	Tr	Ta= 25℃	---	185	---	ms	2
	Tf		---	200	---		
Contrast ratio	Cr	Ta= 25℃	---	5	---		3
Viewing angle range	θ	Cr≥2	-40	---	40	degree	

Note1 Definition of Operation voltage
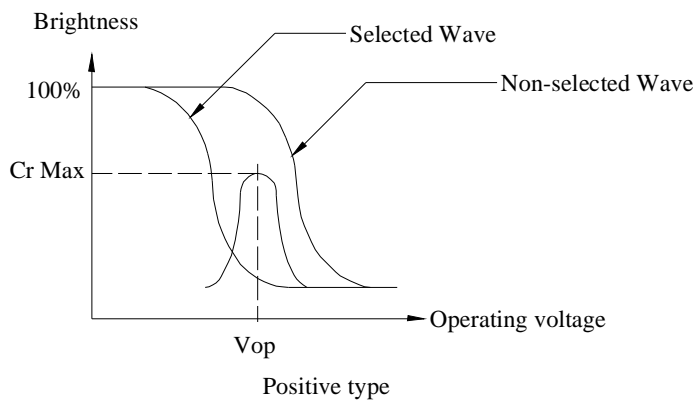
Note2 Definition of Response time

Brightness

100%

Cr Max

Selected Wave

Non-selected Wave

Operating voltage

Vop

Positive type

Non-selected condition

Selected condition

Non-selected condition

Brightness

100%

90%

10%

Tr

Tf

Time

Positive type
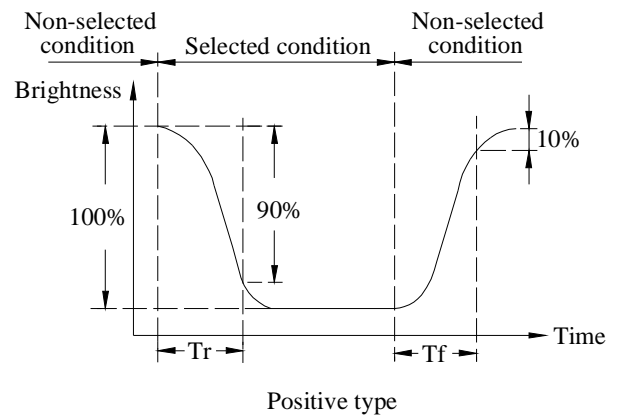
Note3 Definition of Contrast ratio、 Viewing angle and direction

12:00 φ=180

eye

θ

9:00 φ=270

3:00 φ=90

$$Cr = \frac{\text{Brightness at non-selected segment}}{\text{Brightness at selected segment}}$$

LCD Panel

φ

6:00 φ=0

90

25

6

4

2

φ=90

φ=0

—— Cr

– – θ
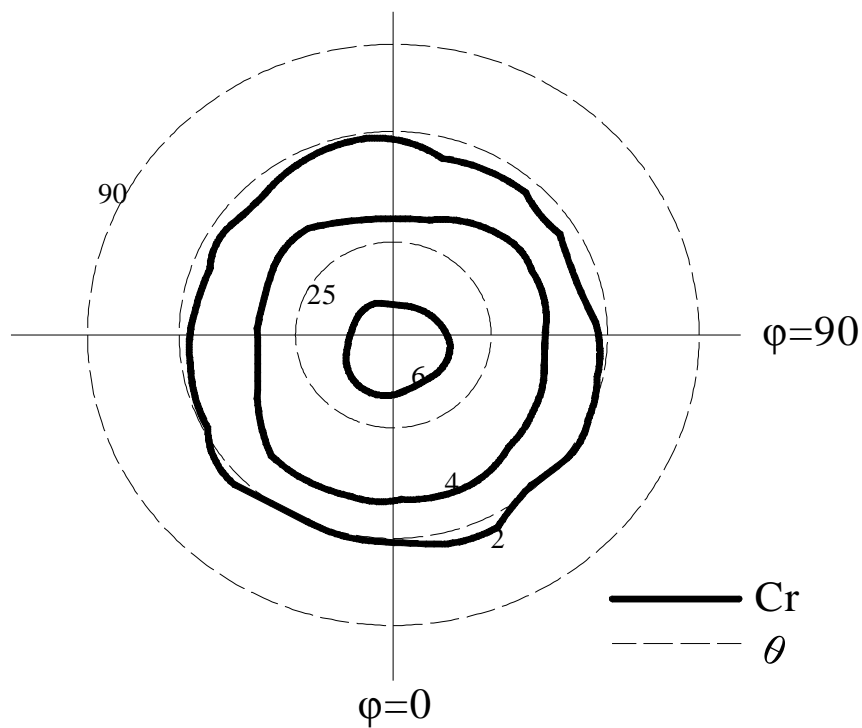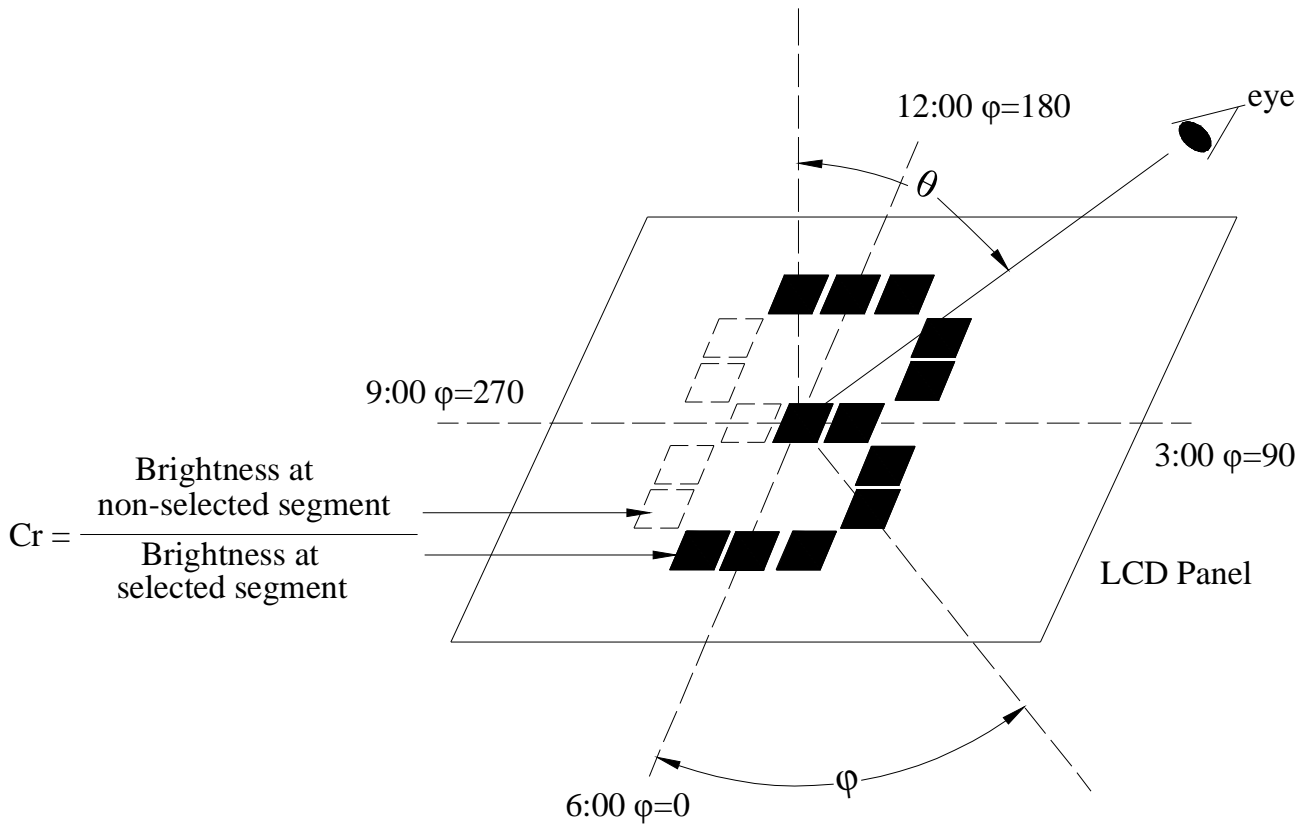
10. Control and display commands

(Please see the datasheet of T6963c for detail)

Command	Code	D1	D2	Function
REGISTERS SETTING	00100001 00100010 00100100	X address Data Low address	Y address 00H High address	Set Cursor Pointer Set Offset Register Set Address Pointer
SET CONTROL WORD	01000000 01000001 01000010 01000011	Low address Columns Low address Columns	High address 00H High address 00H	Set Text Home Address Set Text Area Set Graphic Home Address Set Graphic Area
MODE SET	1000X000 1000X001 1000X011 1000X100 10000XXX 10001XXX	— — — — — —	— — — — — —	OR mode EXOR mode AND mode Text Attribute mode Internal CG ROM mode External CG RAM mode
DISPLAY MODE	10010000 1001XX10 1001XX11 100101XX 100110XX 100111XX	— — — — — —	— — — — — —	Display off Cursor on, blink off Cursor on, blink on Text on, graphic off Text off, graphic on Text on, graphic on
CURSOR PATTERN SELECT	10100000 10100001 10100010 10100011 10100100 10100101 10100110 10100111	— — — — — — — —	— — — — — — — —	1-line cursor 2-line cursor 3-line cursor 4-line cursor 5-line cursor 6-line cursor 7-line cursor 8-line cursor
DATA AUTO READ / WRITE	10110000 10110001 10110010	— — —	— — —	Set Data Auto Write Set Data Auto Read Auto Reset
DATA READ / WRITE	11000000 11000001 11000010 11000011 11000100 11000101	Data — Data — Data —	— — — — — —	Data Write and Increment ADP Data Read and Increment ADP Data Write and Decrement ADP Data Read and Decrement ADP Data Write and Nonvariable ADP Data Read and Nonvariable ADP
SCREEN PEEK	11100000	—	—	Screen Peek
SCREEN COPY	11101000			Screen Copy
BIT SET / RESET	11110XXX 11111XXX 1111X000 1111X001 1111X010 1111X011 1111X100 1111X101 1111X110 1111X111	— — — — — — — — — —	— — — — — — — — — —	Bit Reset Bit Set Bit 0 (LSB) Bit 1 Bit 2 Bit 3 Bit 4 Bit 5 Bit 6 Bit 7 (MSB)

X: invalid

note:

1. After power on, it is necessary to reset. RESET is kept L between 5 clocks up (oscillation clock).
2. The column / line counter and display register are cleared by RESET. (Other registers are not cleared.)
3. The T6963C can only handle one byte per machine cycle (16 clocks). It is impossible to send more than two data in a machine cycle.
4. When using a command with operand data, it important to send the data first, and then execute the command.
5. The character codes used by the T6963C are different from ASCII codes.
6. The status must be checked before data or commands are sent.

The Status of T6963C can be read from the data lines.

$\overline{RD}$	L
$\overline{WR}$	H
$\overline{CE}$	L
C / D	H
D0 to D7	Status word

The T6963C status word format is as follows:

MSB							LSB
STA7 D7	STA6 D6	STA5 D5	STA4 D4	STA3 D3	STA2 D2	STA1 D1	STA0 D0

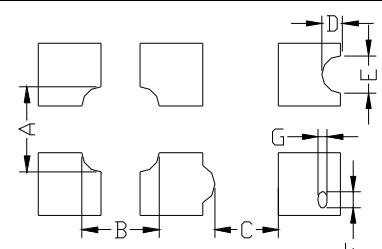|		
STA0	Check command execution capability	0: Disable 1: Enable
STA1	Check data read / write capability	0: Disable 1: Enable
STA2	Check Auto mode data read capability	0: Disable 1: Enable
STA3	Check Auto mode data write capability	0: Disable 1: Enable
STA4	Not used	
STA5	Check controller operation capability	0: Disable 1: Enable
STA6	Error flag. Used for Screen Peek and Screen copy commands.	0: No error 1: Error
STA7	Check the blink condition	0: Display off 1: Normal display

Note 1: It is necessary to check STA0 and STA1 at the same time.
There is a possibility of erroneous operation due to a hardware interrupt.
Note 2: For most modes STA0 / STA1 are used as a status check.
Note 3: STA2 and STA3 are valid in Auto mode; STA0 and STA1 are invalid.

11. Inspection Standards

Item	Criterion for defects	Defect type
1) Display on inspection	(1) Non display (2) Vertical line is deficient (3) Horizontal line is deficient (4) Cross line is deficient	Major
2) Black／White spot	Size Φ(mm) Acceptable number $\Phi \leq 0.3$ Ignore (note) $0.3 < \Phi \leq 0.45$ 3 $0.45 < \Phi \leq 0.6$ 1 $0.6 < \Phi$ 0	Minor
3) Black／White line	Length (mm) Width (mm) Acceptable number L≤10 W≤0.03 Ignore 5.0≤L≤10 0.03<W≤0.04 3 5.0≤L≤10 0.04<W≤0.05 2 1.0≤L≤10 0.05<W≤0.06 2 1.0≤L≤10 0.06<W≤0.08 1 L≤10 0.08<W follows 2) point defect Defects separate with each other at an interval of more than 20mm	Minor
4) Display pattern	 $\dfrac{A+B}{2} \leq 0.28$ $0 < C$ $\dfrac{D+E}{2} \leq 0.25$ $\dfrac{F+G}{2} \leq 0.25$ Note: 1) Up to 3 damages acceptable 2) Not allowed if there are two or more pinholes every three-fourth inch.	Minor
5) Spot-like contrast irregularity	Size Φ(mm) Acceptable Number $\Phi \leq 0.7$ Ignore (note) $0.7 < \Phi \leq 1.0$ 3 $1.0 < \Phi \leq 1.5$ 1 $1.5 < \Phi$ 0 Note: 1) Conformed to limit samples. 2) Intervals of defects are more than 30mm.	Minor
6) Bubbles in polarizer	Size Φ(mm) Acceptable Number $\Phi \leq 0.4$ Ignore (note) $0.4 < \Phi \leq 0.65$ 2 $0.65 < \Phi \leq 1.2$ 1 $1.2 < \Phi$ 0	Minor
7) Scratches and dent on the polarizer	Scratches and dent on the polarizer shall be in the accordance with "2) Black/white spot", and "3) Black/White line".	Minor
8) Stains on the surface of LCD panel	Stains which cannot be removed even when wiped lightly with a soft cloth or similar cleaning.	Minor
9) Rainbow color	No rainbow color is allowed in the optimum contrast on state within the active area.	Minor
10) Viewing area encroachment	Polarizer edge or line is visible in the opening viewing area due to polarizer shortness or sealing line.	Minor
11) Bezel appearance	Rust and deep damages that are visible in the bezel are rejected.	Minor
12) Defect of land surface contact	Evident crevices that are visible are rejected.	Minor
13) Parts mounting	(1) Failure to mount parts (2) Parts not in the specifications are mounted (3) For example: Polarity is reversed, HSC or TCP falls off.	Minor
14) Part alignment	(1) LSI, IC lead width is more than 50% beyond pad outline. (2) More than 50% of LSI, IC leads is off the pad outline.	Minor
15) Conductive foreign matter (solder ball, solder hips)	(1) $0.45 < \Phi$, N≥1 (2) $0.3 < \Phi \leq 0.45$, N≥1, Φ: Average diameter of solder ball (unit: mm) (3) $0.5 < L$, N≥1, L: Average length of solder chip (unit: mm)	Minor
16) Bezel flaw	Bezel claw missing or not bent	Minor
17) Indication on name plate (sampling indication label)	(1) Failure to stamp or label error, or not legible.(all acceptable if legible) (2) The separation is more than 1/3 for indication discoloration, in which the characters can be checked.	Minor

12. Reliability test

item	condition	criterion
High temp. operation	80℃　24hrs	No abnormity in function and appearance
High temp. storage	70℃　24hrs	
Low temp. operation	-20℃　24hrs	
Low temp. storage	-30℃　24hrs	
Humidity	40℃　90%RH　24hrs	
Thermal shock	0℃(30min)ß à50℃(30min) 10cycles	
Vibration	Frequency :10~55HZ Duration : 3times , 3min/time Amplitude : 0.75mm	-

13. Handling precautions

1. Refrain from strong mechanical shock and forces to the module. It may cause improper operating or damage to the module.
2. The polarizer used on the display surface is easily scratched and damaged. Extreme care should be taken when handling. When cleaning the display surface, use soft cloth with a solvent recommended : ethyl alcohol , isopropyl or hexane) and wipe gently, do not use the following solvents : water, ketone or aromatics .
3. Wipe off water or oil drop immediately If you leave drop for a long time, stain and discoloration may occur.
4. Do not touch pads or pins of interface directly with bare hands. When handling the LCD module, put on a soft glover like finger-glover.
5. Protect the module from static electricity, it may cause damage to CMOS LSI.
6. To prevent LCD panels from degradation, do not operate or store them exposed directly to sunlight or high temperature/humidity.
7. If the liquid crystal leaks from the panel it should be kept away from the eyes and mouths. In case of contact with skins, wash away thoroughly with soap and water.
8. Soldering should be only performed on the I/O terminals within the temperature of 280±20℃ and soldering time should be less than 4 seconds.
9. Supply voltage within the specified voltage limit, the maximum rating, higher voltage cause the shorter LCD life or damaged.
10. Do not input any signals before power is turned on. Do not connect or disconnect the module on the state of Power-ON.