TIANMA

SPECIFICATION
FOR LCD MODULE

PRODUCT:	TM Standard LCM
PRODUCT NO.:	TM12232EBCWVBYA
PRODUCT TYPE:	Graphic Matrix STN
VERSION:	V1.0

☐Preliminary specification

■Final specification

CUSTOMER APPROVED	

PREPARED BY	CHECKED BY	VERIFIED BY QA DEPT.	APPROVED BY
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RoHS

REVISION RECORD

Version	Page	Revision Items	Name	Date
0.0	1	First release	Pu Tang	2006.03.14
0.1	24	Add power supply circuit, changed the naming of module	Pu Tang	2006.09.30
1.0	8 9-10 12,15	Update the format Update the pin description Update the instruction & timing Change the Optical and Reliability parameter	Lihong Zhou	2007.12.18

TABLE OF CONTENTS

1 Description

The TM12232EBCWVBYA, a graphic LCM unit consists of 122 ×32 dot-matrix LCD panel, LCD driver and controller, bias circuits on a single PCB. It is easy to display characters and graphics with a microcontroller

◆ Wide viewing angle
◆ Requirements on environmental protection: RoHS.

2 Features

Item	Contents
LCD type	STN
	Positive
LCD Duty	1/32
LCD Bias	1/6
Polarizer	Transflective
LCD background color	Yellow-Green
Segment color	Black
Backlighting	LED
Backlighting type	Bottom
Backlighting color	Yellow-Green
View direction	6:00 o'clock
Operating temperature	-10°C~70°C
Storage temperature	-30°C~80°C
LCD Controller	SBN1661
Frame	SPCC (black)
Technology	COB
Data Transfer	8 Bit parallel

3 Absolute maximum ratings

(VSS=0V, Ta=25°C)

Parameter	Symbol	Min	Max	Unit	Remark
Logic circuit supply voltage	V_{DD}	-0.3	+7.0	V	---
Input voltage of logic control or data pins	V_I	-0.3	$V_{DD}+0.3$	V	---
Voltage of V_0	V_0	-1.0	0	V	---
Voltage of V_{OUT}	V_{OUT}	-5.5	0	V	---
LCD driving voltage	V_{LCD}	-0.3	+6.5	V	Note [3-2]
Operating temperature range	T_{OP}	-10	+70	°C	Note [3-3]
Storage temperature range	T_{ST}	-30	+80	°C	Note [3-3]

Note [3-1]: No parameter is allowed to exceed these maximum ratings.

Note [3-2]: LCD operating voltage is calculated as $V_{LCD}=V_{DD} -V_o$

Note [3-3]: 95% RH MAX (40 °C ≥ Ta);

   Maximum wet-bulb temperature is 39°C or less. (Ta >40 °C) No dew condensation.

Note [3-4]: Only operation is guarantied at operating temperature. Contrast, response time and another display quality are evaluated at +25°C.
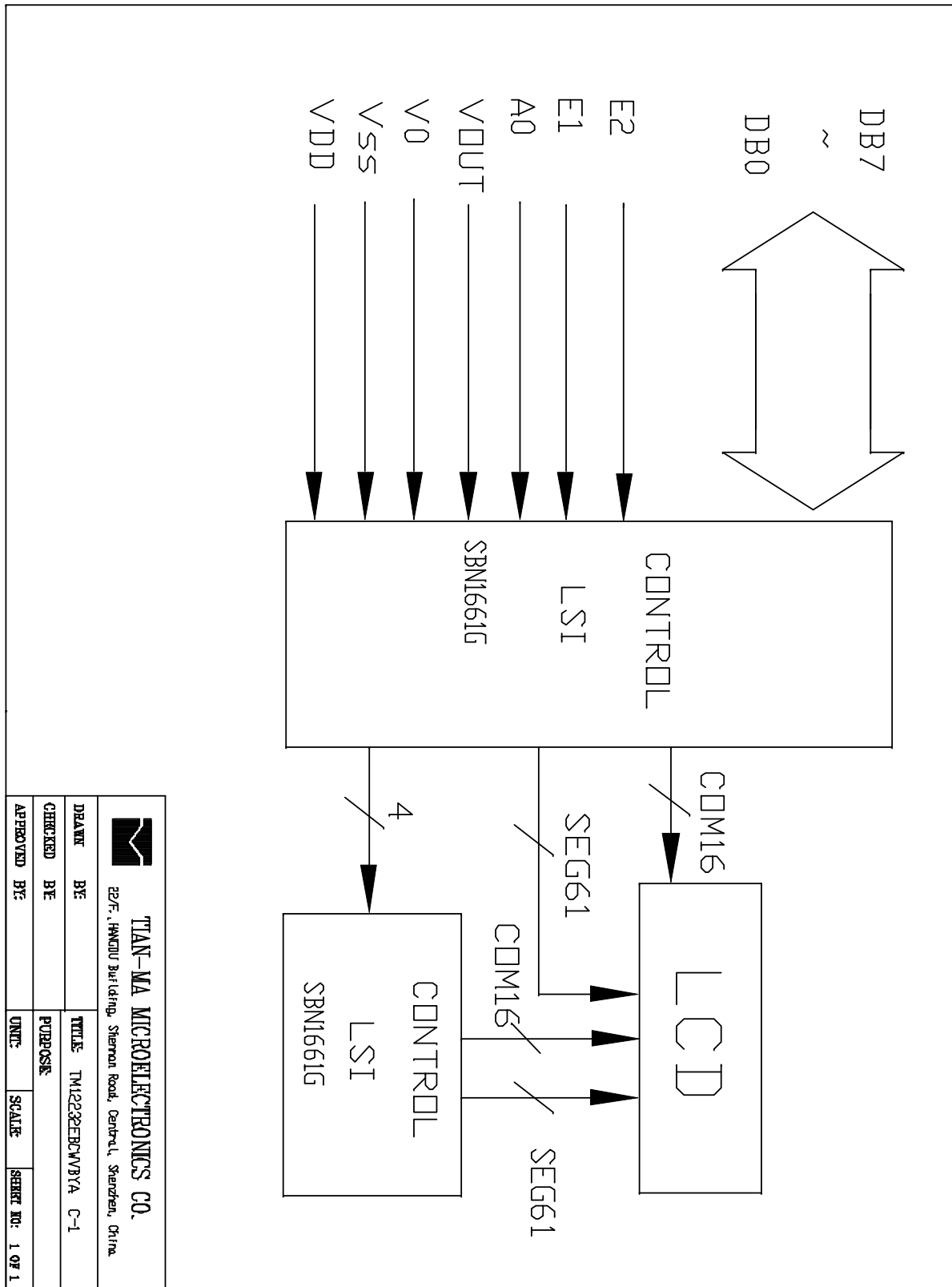
4 Mechanical Characteristics

4.1 Mechanical features

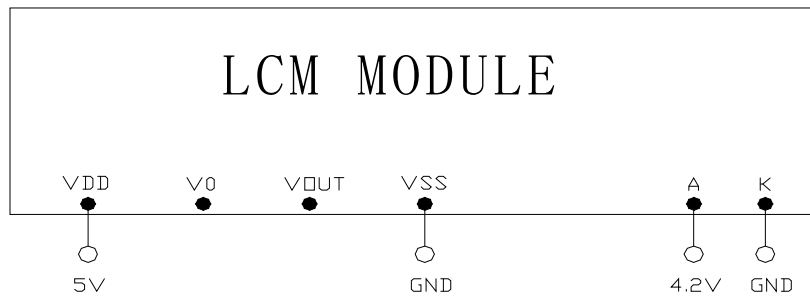| Parameter	Standard Value	Unit
Display type	Graphics Matrix LCM	--
Character size (W×H)	--	mm
Number of dots	122 × 32	--
View area (W×H)	57.20 × 17.20	mm
Active Area (W×H)	52.41 × 13.71	mm
Dot Size (W×H)	0.38 × 0.38	mm
Dot Pitch (W×H)	0.43 × 0.43	mm
Module size (W×H×D)	67.00 × 31.75 × 11.00 (MAX)	mm
Module total weight (approx)	24	g

4.2 Mechanical drawing

5 Circuit

5.1 Block Diagram

RoHS

5.2 Recommend power supply circuit

The first driving method

LCM MODULE

VDD   V0   VOUT   VSS   A   K

5V   GND   4.2V GND

The second driving method

LCM MODULE

VDD   V0   VOUT   VSS   A   K

5V   -0.9V   GND   4.2V GND
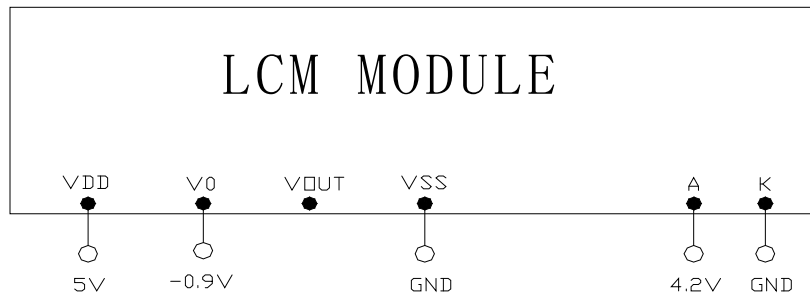
The third driving method

LCM MODULE

VDD   V0   VOUT   VSS   A   K

5V   10~20K   GND   4.2V GND
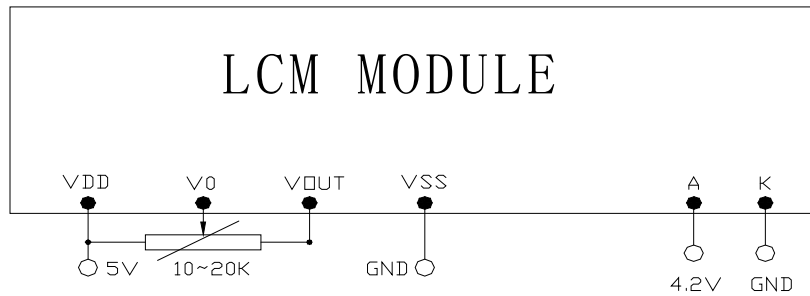
Note [5-1]: The V_{OUT} is generated form V_{DD}, with a DC-DC circuit. If you do not want to control the contrast of module outside, please don't add the VR.

Note [5-2]: If you want to input V_{EE} directly from external power and don't need the DC-DC circuit, please remove the resistance R28/R29 on the PCB.

6 Interface description

| Pin No.	Symbol	I/O	Description
1	V_{SS}	I	Ground
2	V_{DD}	I	Power supply voltage for logic circuits and LCD (+5V)
3	V_0	I/O	Test pin for VOP (Between V_{DD} & V_0) or input for V_0
4	V_{OUT}	I/O	The output voltage of DC/DC converter or the Input for V_{EE}
5	A0	I	Command/data select control pin. When A0=0, it writes command to the internal register or reads the register status. When A0=1, it writes data to the display data memory or reads from it.
6	E1	I	Enable signal. When E1=1, the host SBN1661 is selected
7	E2	I	Enable signal. When E2=1, the slave SBN1661 is selected
8	D0	I/O	Data bus bit0 (LSB)
9	D1	I/O	Data bus bit1
10	NC	---	No connection
11	NC	---	No connection
12	D2	I/O	Data bus bit2
13	D3	I/O	Data bus bit3
14	D4	I/O	Data bus bit4
15	D5	I/O	Data bus bit5
16	D6	I/O	Data bus bit6
17	D7	I/O	Data bus bit7 (MSB)
18	NC	---	No connection
19	A	I	Power supply voltage for LED (+), 4.2V or 180mA
20	K	I	Power supply voltage for LED (-)

7 Instruction Code & Timing characteristics

7.1 Command and initial code

The module TM12232EBCWVBYA includes two SBN1661s as its driver. One is host and the other is slave. After reset, we have to use some commands to set up the display. And we may use this when we want to change the display type. We explain some commands below. For more details, please refer to the datasheet of SBN1661.

| Register Name	Description	States after RESET
Display ON/OFF Register	The Display ON/OFF Register is a 1-bit register. After RESET, its value is LOW and, therefore, the LCD display is turned OFF.	0xAE
Display Start Line Register	The Display Start Line Register is a 6-bit register. After RESET, its value is 0 0000 and Row0 of the Display Data Memory is mapped to COM0.	0xC0
Page Addres Register	The Page Address Register is a 3-bit register. After RESET, its value is 11 and, therefore, it points to Page 7 of the Display Data Memory.	0xBB
Column Address Register	The Column Address Register is a 7-bit register. After RESET, its value is 000 0000 and, therefore, it points to column 0 of the Display Data Memory.	0x00
Static Drive ON/OFF Register	The Static Drive ON/OFF Register is a 1-bit register. After RESET, its value is LOW and static display is turned OFF.	0xA5
Duty Select Register	The Duty Select Register is a 1-bit register. After RESET, its value is HIGH and 1/32 display duty is selected.	0xA9
Column/Segment Mapping Register	The Column/Segment Mapping Register is a 1-bit register. After RESET, its value is LOW and normal mapping is selected.	0xA0
Status Register	The Status Register shows the current state of the SBN1661G_X. It is a 4-bit register, with each bit showing the status of a programmed function.	

7.2 Interface Timing characteristics

Please refer to SBN1661 datasheet for more details.
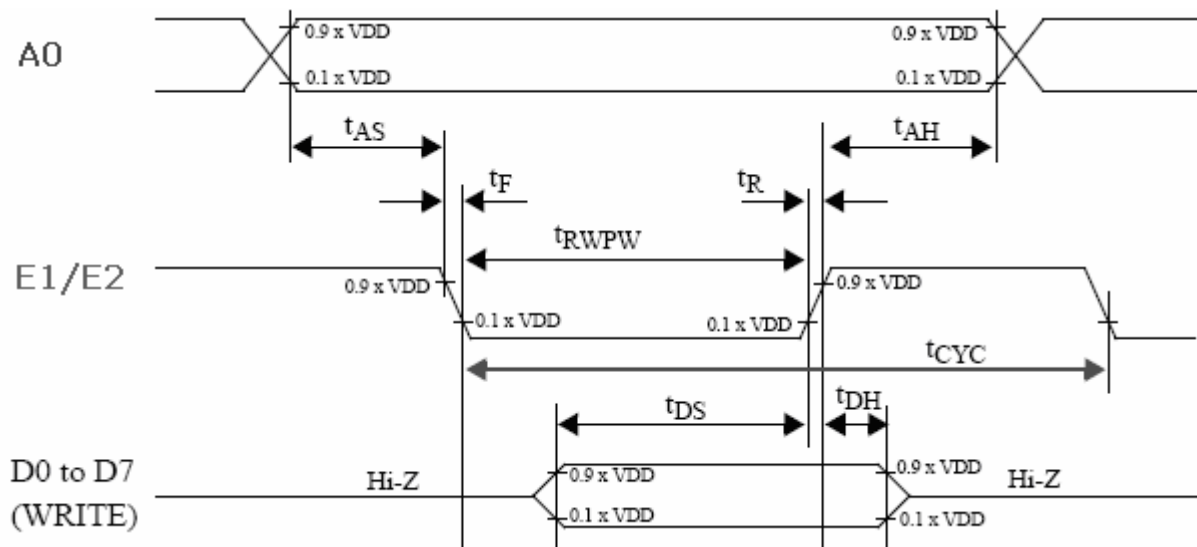
V_{DD} = 5 V ±10%; V_{SS} = 0 V; T_{amb} = -20 °C to +75°C.

symbol	parameter	min.	max.	test conditons	unit
t_{AS}	Address set-up time	20			ns
t_{AH}	Address hold time	10			ns
t_F, t_R	Read/Write pulse falling/rising time		15		ns
t_{RWPW}	Read/Write pulse width	200			ns
t_{CYC}	System cycle time	1000			ns
t_{DS}	Data setup time	80			ns
t_{DH}	Data hold time	10			ns
t_{ACC}	Data READ access time		90	CL= 100 pF.	ns
t_{OH}	Data READ output hold time	10	60	Refer to Fig. 23.	ns

The measurement is with the load circuit connected. The load circuit is shown in Fig. 23.


Fig.23 Load circuit.
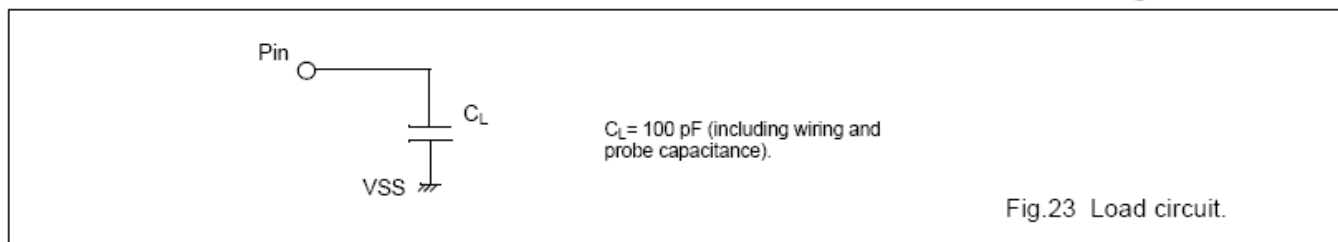
7.3 Data and picture mapping

SBN1661-Host   SBN1661-Slave
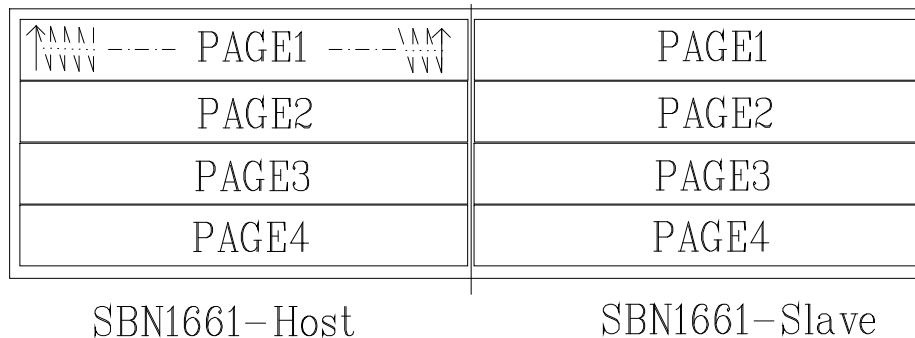
The screen is divided into two parts: the SBN1661-Host controls the left part and the SBN1661-Slave controls the right part. And each part is divided into four pages. We can select the data write to which page by write command 0xB8~0xB9 to the register. The code 0xB8~0xB9 indicate that we select Page1~Page3 correspondingly. When write data to SBN1661-host, we must assign E1 active. When write data to SBN1661-slave, we must assign E2 active.

In the mapping way shown above, you must follow these initial codes:
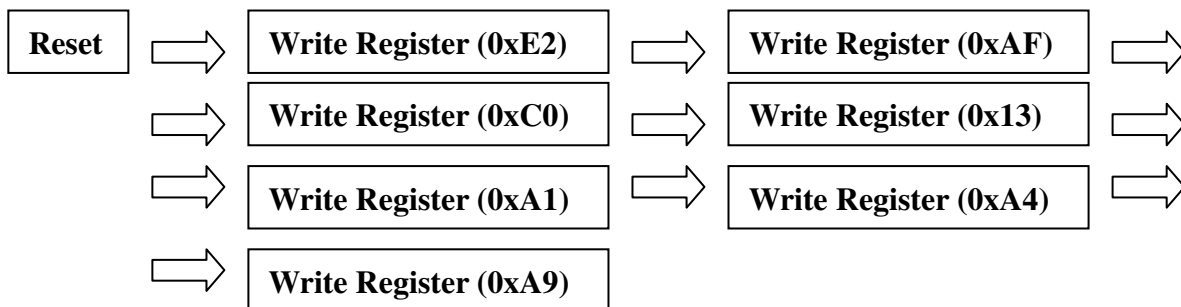
8 Electrical characteristics

Parameter		Symbol	Condition	MIN	TYP	MAX	UNIT
Logic circuit supply voltage		V_{DD}	---	4.8	5.0	5.2	V
Power supply LCD (-)		V_{OUT}	---	---	-5	---	
Power supply for V_O		V_O	---	---	5.9	---	
Input voltage for logic circuit	"H" level	V_{IH}	V_{DD}=5.0V	$0.8\,V_{DD}$	V_{DD}	V_{DD} +0.3	
	"L" level	V_{IL}		VSS-0.3	V_{SS}	0.2VDD	
Output voltage for logic circuit	"H" level	V_{OH}		---	V_{DD}	---	
	"L" level	V_{OL}		--	V_{SS}	---	
Logic power supply current (Without backlighting)		I_{DD}		---	7	---	mA
Used driver IC		SBN1661					

9 LED backlight characteristics
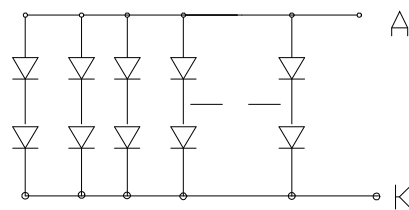
CIRCUIT DIAGRAM
2×18 LED'S

Item	Symbol	Condition	MIN.	TYP.	MAX.	Unit	Remark
Forward voltage	V_f	I_f=180mA	--	4.1	4.4	V	---
Forward current	I_f	V_f= 4.1V	--	180	200	mA	---
Wavelength	λ_P	I_f=180mA	567	572	577	nm	Note [9-1,2]
Lifetime	t	---	---	TBD	---	hour	Note [9-3]

Note [9-1]: The wavelength is measured with the bare LED backlight unit.
Note [9-2]: If the backlight is used above its' driving voltage or current for a long time, its lifetime will reduce or it will cause poor reliability.
Note [9-3]: The backlight lifetime lasts until the luminance reduces to 50% of its initial value.

10 Optical Characteristics

1/32Duty,　1/6Bias,　Vo=5.9V　(Note　[10-2]),　f=70Hz

| Parameter		Symbol	Ratings			Unit	Measuring Temp.	Remark
			Min	Type	Max.			
Contrast ratio		Cr $(\theta=0°,\Phi=0°)$	---	3	---	---	25°C	Note[10-1,3]
Response time	Turn on	t_{on}	---	180	---	ms	25°C	Note[10-1,4]
			---	TBD	---		0°C	
	Turn off	t_{off}	---	220	---	ms	25°C	
			---	TBD	---		0°C	
Viewing angle (Cr≥2)	Up-down	$\theta1$ $(\Phi=0°)$	---	-40	---	deg	25°C	Note[10-1,5]
			---	+40	---			
	Left-right	$\theta2$ $(\theta=0°)$	---	-30	---	deg	25°C	
			---	+30	---			
Luminance		Y_L $(\theta=0°,\Phi=0°)$	---	30	---	cd/m^2	25°C	Note[10-1] (I_f=180mA)
Luminance Uniformity		L_U $(\theta=0°,\Phi=0°)$	70	---	---	%	25°C	Note[10-1,6]

Note [10-1]: Measuring equipments: DMS-501, PR-705.

Measuring condition:

- After stabilizing and leaving the panel alone at a given temperature for 30 min, the measurement should be executed,
- Measuring surroundings: a stable, windless and dark room,
- Measuring temperature: Ta=25°C,
- 30 min after lighting the back-light.
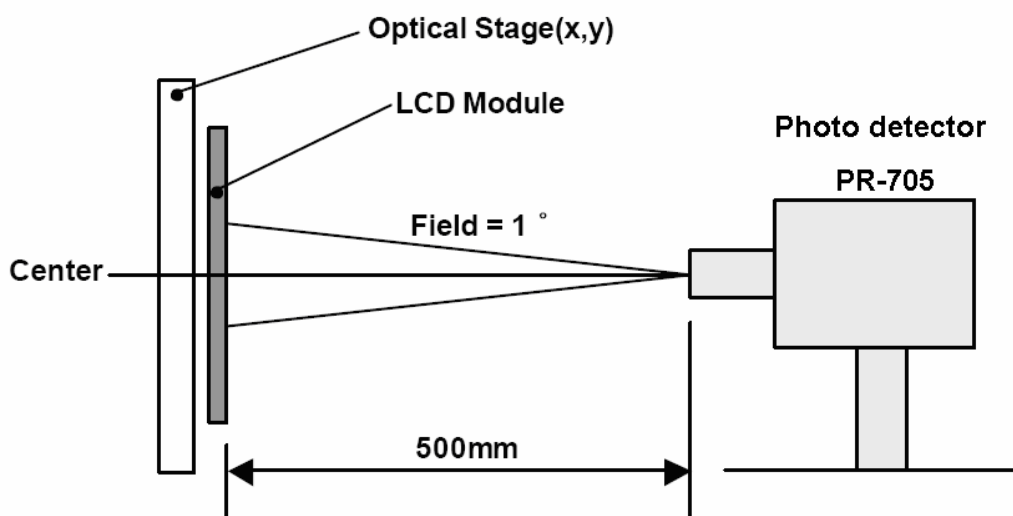
Note [10-2]: The maximum and minimum ratings don't mean the LCD works well in the whole range of Vo. Vo must be adjusted to optimize the viewing angle and contrast. Refer to the following definition of drive voltage:

Multiplex waveform   Static waveform
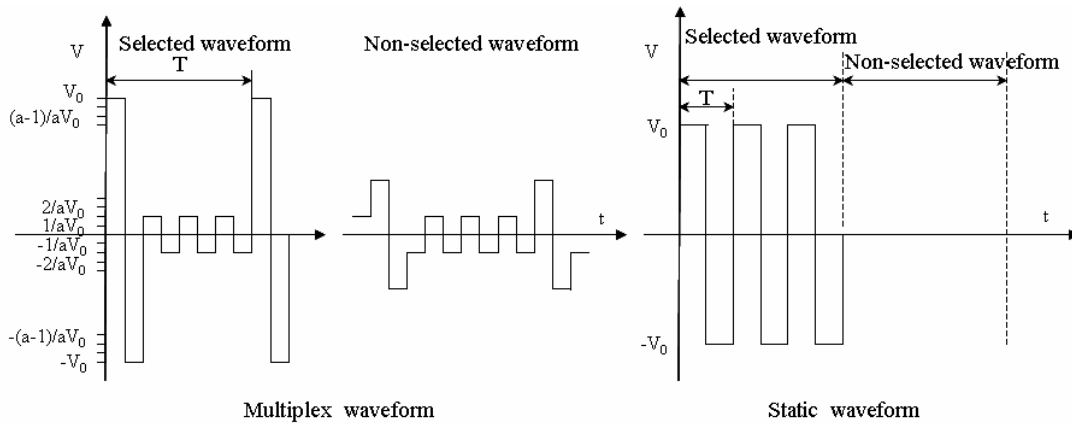
| Operating voltage：V$_o$	Frame frequency: f=1/T
Duty: 1/N	Bias: 1/a

Note [10-3]: Contrast ratio (CR) is defined as follows:

$$CR= \frac{L_{ON} \text{ (Luminance of the ON segments)}}{L_{OFF} \text{ (Luminance of the OFF segments)}}$$

Note [10-4]: Definition of response time:

Turn on time (rise time): $t_{on}= t_d + t_r$ (The time that the luminance level reaches 90% of the saturation level from 0% when ON signal is applied)

Turn off time (fall time): $t_{off}= t_d + t_r$ (The time that the luminance level reaches 10% of the saturation level from 100% when OFF signal is applied)
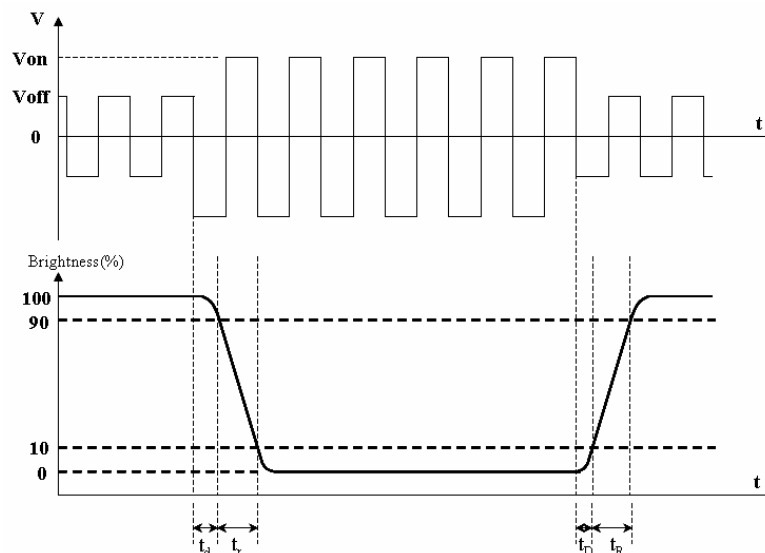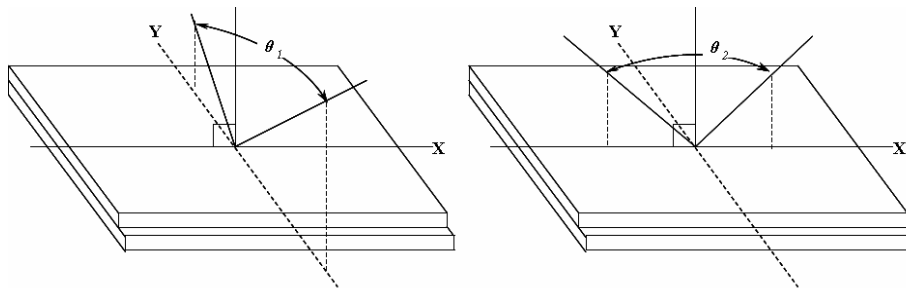

Note [10-5]: Definition of viewing direction

Refer to the picture below marked by θ and Φ
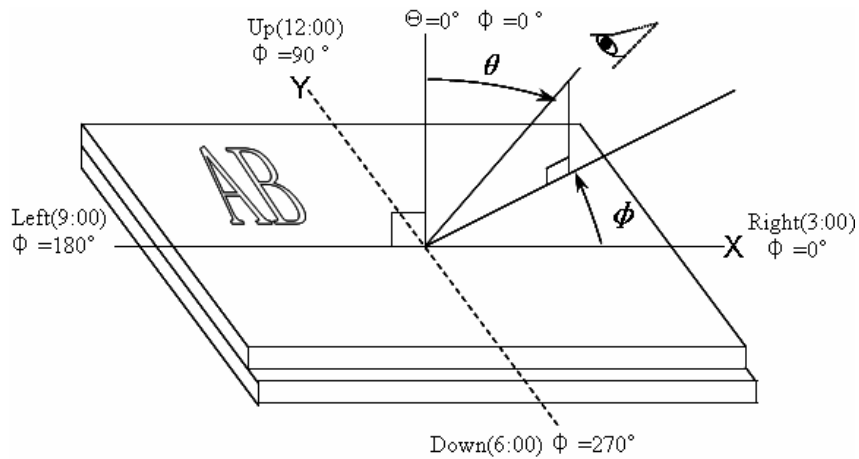
Definition of viewing angle

θ_1 ——range of viewing angle from up to down; θ_2 ——range of viewing angle from left to right.

Note [10-6]: The definition of luminance uniformity:

The luminance uniformity is calculated by using following formula.

$$\text{Luminance uniformity (Lu)} = \frac{\text{Minimum luminance from ① to ⑨}}{\text{Maximum luminance from ① to ⑨}}$$

The luminance is measured at near the 9 points shown below.

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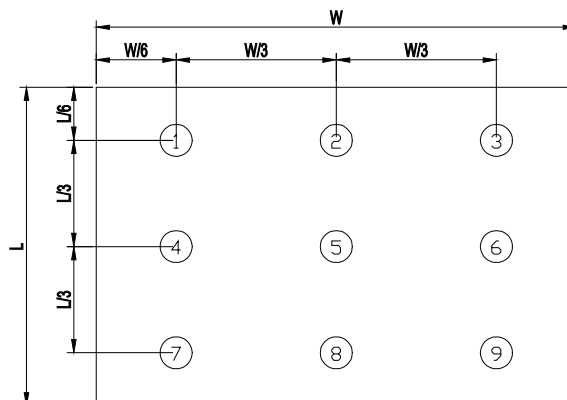
11 Reliability

11.1 Content of Reliability Test

No.	Test Item	Test condition	Remark	Criterion
1	High Temperature Storage	Ta=80°C, 120H		Remark1 Remark2 Remake3 Remake4
2	Low Temperature Storage	Ta=-30°C, 120H	Note[11-1]	
3	High Temperature Operation	Ta=70°C, 120H		
4	Low Temperature Operation	Ta=-10°C, 120H	Note[11-1]	
5	High Temperature & High Humidity Operation	Ta=60°C, 90%RH, 120H	Note[11-1]	
6	Temperature Cycle Test (Non-Operating)	-30°C↔+25°C↔+80°C, 100 cycles 30min 5min 30min	Note[11-1]	
7	Vibration Test	Frequency: 10 ~150 Hz, Stroke: 1.5mm Sweep time: 11 min Test Period: 6 cycles for each direction of X, Y, Z, 120 min every direction	Note[11-2]	Remark1 Remark5 Remark6
8	Shock Test	Waveform : Half Sinusoidal Wave Shock Level:50 G, Pulse Width:11 ms, Direction: ±X, ±Y, ±Z, Cycle:3 times	Note[11-2]	

Note [11-1]: No dew condensation to be observed.

Note [11-2]: Vibration test will be conducted to the product itself without putting it in a container.

Note [11-3]: The test sample is inspected after 2 hours or more storing at room temperature and room humidity after each test item is finished.

Note [11-4]: The criteria refer to 11.2.

11.2 Inspection of criteria

Remark No.	Content
1	Function test is OK. Missing Segment, shorts, unclear segment, non-display, display abnormally, liquid crystal leak are unallowable.
2	After testing, cosmetic defects should not happen, no low temperature bubbles, seal loose and fall, frame rainbow, ACF bubble growing are unallowable in the appearance test.
3	Total current consumption should not be over 10% of initial value.
4	After tests, the contrast ratio must be larger than 70% of its value before.
5	No glass crack, chipped glass, end seal loose frame crack and so on.
6	No structure looseness.

12 Package

TBD

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13 Quality level

Examination or Test	At T_a=25°C (Unless otherwise stated)	Inspection				
		Min	**Max**	**Unit**	**IL**	**AQL**
External Visual Inspection	Under normal illumination and eyesight condition, the distance between eyes and LCD is 25cm.	Refer to appendix A			II	Major 1.0 Minor 2.5
Display Defects	Under normal illumination and eyesight condition, display on inspection.	Refer to appendix B			II	Major 1.0 Minor 2.5
Note: Major defects: Open segment or common, Short, Serious damages, Leakage Miner defects: Others Sampling standard conforms to GB2828						

14 Precautions for Use of LCD Modules

14.1 Handling Precautions

14.1.1 The display panel is made of glass. Do not subject it to a mechanical shock by dropping it from a high place, etc.

14.1.2 Liquid in LCD is hazardous substance, if the display panel is damaged and the liquid crystal substance inside it leaks out, be sure not to get any in your mouth, if the substance comes into contact with your skin or clothes, thoroughly and promptly wash it off using soap and water.

14.1.3 Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.

14.1.4 Don't touch, push or rub the exposed polarizer covering the display surface of the LCD module with anything harder than an HB pencil lead, the polarizer is soft and easily scratched, handle it carefully.

14.1.5 Don't put or attach anything on the display area to avoid leaving any marks on.

14.1.6 If the display surface is contaminated or becomes dusty, breathe on the surface and gently wipe it with a soft dry cloth. Do not scrub hard to avoid damage the surface. If still not completely clear, moisten cloth with one of the following solvents:
  — Isopropyl alcohol
  — Ethyl alcohol
  Solvents other than those mentioned above may damage the polarizer. Especially, do not use the following:
  — Water
  — Ketone
  — Aromatic solvents

14.1.7 Do not attempt to disassemble the LCD Module.

14.1.8 If the logic circuit power is off, do not apply the input signals.

14.1.9 Avoid using the same display pattern long time (continuous ON segment).Software must be prepared so that the pattern will be changed

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14.1.10 To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.

    a. Be sure to ground the body and electric appliances when handling the LCD Modules. It is preferable to use conductive mat on table and wear cotton clothes or conductive processed fiber. Synthetic fiber is not recommended.

    b. Tools required for assembly, such as soldering irons, must be properly ground.

    c. To reduce the amount of static electricity generated, do not conduct assembly and other work under dry conditions.

    d. The LCD Module is coated with a film to protect the display surface. Be careful and slow when peeling off this protective film since static electricity may be generated. It is recommended to use ionic fan or machine when operating. It is recommended to remove the protection foil slowly (> 3 sec.).

    e. It is preferable to wear gloves etc, to avoid damaging the LCD. Please do not touch electrodes with bare hands or avoid any other contamination.

14.2 Storage precautions

14.2.1 When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps.

14.2.2 The LCD modules should be stored under the storage temperature range. If the LCD modules will be stored for a long time, the recommend condition is:

        Temperature :   5°C $\sim$ 40°C

        Relatively humidity: ≤80%

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

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

14.3 Transportation precautions

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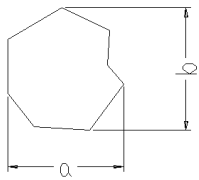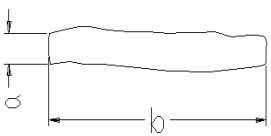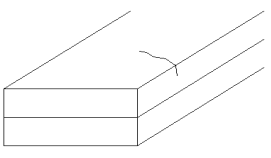
14.4 Soldering

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

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

14.4.3 Rewiring: no more than 3 times.

14.4.4 When you remove connector or cable soldered to I/O terminals, please confirm that solder is fully melted. If you remove by force, electrodes at I/O terminals may be damaged (or stripped off). It is recommended to use solder suction machine.
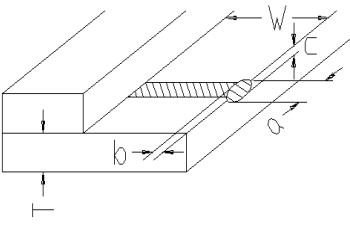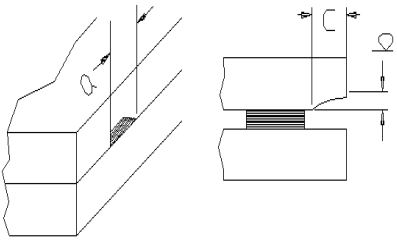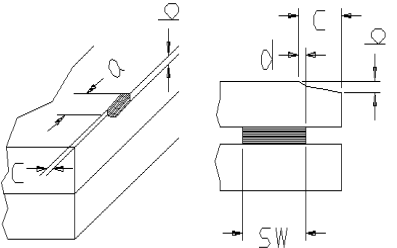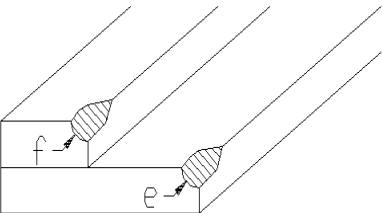
15. LCD Module Part Numbering System

| TM | 12232 | E | B | C | W | V | B | Y | A |

① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩
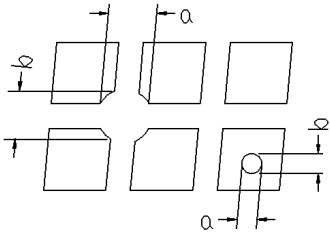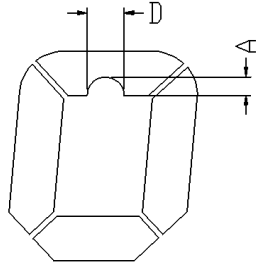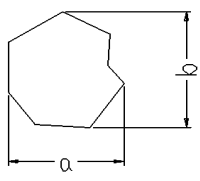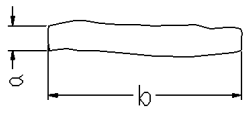
NO.	Explanation
①	**TIANMA module indicating**
②	**Module type: 122 columns×32 rows**
③	**TIANMA module series**
④	**LCD type**
	B — Positive, Yellow-Green mode, STN
⑤	**Backlight type**
	C — Transflective, LED
⑥	**Temperature range**
	W — Wide temperature
⑦	**Viewing Angle**
	V — Wide viewing direction
⑧	**Technology**
	B — COB (including SMT)
⑨	**The color of backlight**
	Y — Yellow-green
⑩	**Module type**
	A — Basic function

Appendix A

Inspection items and criteria for appearance defects
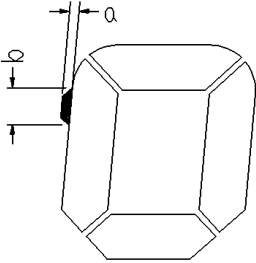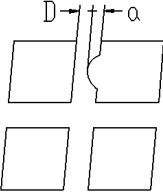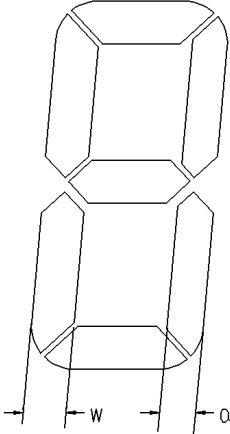
Items	Contents	Criteria		
Protective Glue		No clear defects		
Cover Tape		Covering all of the chip and no clear crimple		
Leakage		Not permitted		
Rainbow		According to the limit specimen		
Polarizer	Wrong polarizer attachment	Not permitted		
	Bubble between polarizer and glass	Not counted	Max. 3 defects allowed	
		$\phi<0.3mm$	$0.3mm\leq\phi\leq0.5mm$	
	Scratches of polarizer	According to the limit specimen		
Black spot (in viewing area)		Not counted	Max. 3 spots allowed	Max. 3 spots (lines) allowed
		X<0.20mm	0.20mm≤X≤0.5mm	
		X=(a+b)/2		
Black line (in viewing area)		Not counted	Max. 3 lines allowed	
		a<0.02mm	0.02mm≤a≤0.05mm b≤2.0mm	
Progressive cracks		Not permitted		

Item	Contents	Criteria				
Glass Cracks	Cracks on pads	a	b	c	Max. 2 Cracks allowed	Max. 5 cracks allowed
		≤3mm	≤W/5	≤T/2		
		≤2mm	≤W/5	T/2<C<T		
	Cracks on contact side	a		b	Max. 2 cracks allowed	
		≤3mm		≤T/2		
		≤2mm		T/2<b<T		
		C shall be not reach the seal area				
	Cracks on non-contact side	a		b		
		≤3mm		≤T/2		
		≤2mm		T/2<b<T		
		C≤0.5mm				
		d≤SW/3				
	Corner cracks	e<2.0mm² f<2.0mm²			Max. 3 cracks allowed	

RoHS

Appendix B

Inspection items and criteria for display defects

Items	Contents	Criteria		
Open segment or open common		Not permitted		
Short		Not permitted		
Wrong viewing angle		Not permitted		
Contrast radio uneven		According to the limit specimen		
Crosstalk		According to the limit specimen		
Pin holes and cracks in segment (DOT)		Not counted	Max.3 dots allowed	Max.3 dots allowed
		X<0.1mm	0.1mm≤X≤0.2mm	
		X=(a+b)/2		
		Not counted	Max.2 dots allowed	
		A<0.1mm	0.1mm≤A≤0.2mm D<0.25mm	
Black spot (in viewing area)		Not counted	Max.3 spots allowed	Max.3 spots (lines) allowed
		X<0.1mm	0.1mm≤X≤0.2mm	
		X=(a+b)/2		
Black line (in viewing area)		Not counted	Max.3 lines allowed	
		a<0.02mm	0.02mm≤a≤0.05mm b≤0.5mm	

Items	Content	Criteria		
Transfor-mation of segment		Not counted	Max. 2 defects allowed	Max.3 defects allowed
		$x < 0.1mm$	$0.1mm \leq x \leq 0.2mm$	
		$x=(a+b)/2$		
		Not counted	Max. 1 defects allowed	
		$a < 0.1mm$	$0.1mm \leq a \leq 0.2mm$ $D > 0$	
		Max.2 defects allowed $0.8W \leq a \leq 1.2W$ a = measured value of width W = nominal value of width		