REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED

DV3 Displays Ltd
www.dv3displays.com
Europe: +44 1959 542000
USA: +1 562 941 5000
Asia: +81 33767 9701

1. **Specification subject to change without notice.**
2. **All dimensions and specifications apply to standard modules. This information may vary for modules with optional features.**
3. **All dimensions are in millimetres.**
4. **Precautions: These precautions apply equally to modules from all makers, not just Densitron. Violation of these guidelines may void the warranty and can cause problems ranging from erratic operation to catastrophic display failure.**

Handling precautions:

? ? This device is susceptible to Electro-Static Discharge (ESD) damage. Observe Anti-Static precautions.

Power supply precautions:

? ? Identify and, at all times, observe absolute maximum ratings for both logic and LC drivers. Note that there is some variance between models.
? ? Prevent the application of reverse polarity to VDD and VSS, however briefly.
? ? Use a clean power source free from transients. Power up conditions are occasionally “jolting” and may exceed the maximum ratings of the module.
? ? The +5V power of the module should also supply the power to all devices that may access the display. Don’t allow the data bus to be driven when the logic supply to the module is turned off.
? ? DO NOT install a capacitor between the VO (contrast) pin and ground. VDD must, at all times, exceed the VO voltage level. The capacitor combines with the contrast potentiometer to form an R-C network which “holds-up” VO, at power-down, possibly damaging the module.

Operating precautions:

? ? DO NOT plug or unplug the module when the system is powered up.
? ? Minimise the cable length between the module and host MPU. (Recommended max. length 30 cm).
? ? For models with EL backlights, do not disable the backlight by interrupting the HV line. Unloaded inverters produce voltage extremes that may arc within a cable or at the display.
? ? Operate the module within the limits of the modules temperature specifications.

Mechanical / Environmental precautions:

? ? Improper soldering is the major cause of module difficulty. Use of flux cleaner is not recommended as they may seep under the elastomeric connection and cause display failure. Densitron recommends the use of Kester “245” no-clean solder.
? ? Mount the module so that it is free from torque and mechanical stress.
? ? Surface of LCD panel should not be touched or scratched. The display front surface is an easily scratched, plastic polariser. Avoid contact and clean only when necessary with soft, absorbent cotton dampened with petroleum benzene.
? ? ALWAYS employ anti-static procedure while handling the module.
? ? Prevent moisture build-up upon the module and observe the environmental constraints for storage temperature and humidity.
? ? DO NOT store in direct sunlight.
? ? If leakage of the liquid crystal material should occur, avoid contact with this material, particularly ingestion. If the body or clothing becomes contaminated by the liquid crystal material, wash thoroughly with water and soap.

Notes: (unless otherwise specified)

Unless otherwise specified: Dimensions are mm Tolerances are: X = ? 3 0.X = ? 0.5 0.XX = ? 0.05	APPROVALS	DATE	DV3 Displays Ltd BIGGIN HILL, ENGLAND	
	DRAWN			
	CHECKED		TITLE: 2x16 LCD module with optional backlight	
	ISSUED		DWG.NO. **DV2230**	SHEET 1 of 8

GENERAL SPECIFICATION

ITEM	CONTENTS
Display Format	16charter(W) ×2line(H)
Character Size	4.84 ×9.66 mm
View Area	99.0 ×24.0 mm
General Dimensions	122.0 ×44.0 ×9.0 mm
LCD Type	☐ STN Gray ☑ STN Yellow Green ☐ STN Blue ☐ FSTN Positive ☐ FSTN Negative ☐ TN
Polarizer mode	☑ Reflective ☐ Transflective ☐ Transmissive
View Angle	☑ 6 O'clock ☐ 12 O'clock ☐ Others_____
Controller/Driver	NT3881 or KS0066U/NT3882 or KS0065B
Temperature Range	☑ 0℃~+50℃ ☐-20℃~+70℃ ☐ -30℃~+80℃
Character Font Table	☑English ☐European ☐Other_____
DC/DC Converter	Without

MECHANICAL SPECIFICATION

ITEM	CONTENTS
Module Size	122.0(W) ×44.0(H) ×9.0max(D)
View Area	99.0 ×24.0 mm
Character Size	4.84mm ×9.66mm
Character Pitch	6.0mm ×10.34mm
Dot Size	1.1mm ×0.92mm
Dot Pitch	1.16mm ×0.98mm
Duty Ratio	1/16 duty

ABSOLUTE MAXIMUN RATING(Ta=25℃ VSS=0V)

Item	Symbol	Min.	Type	Max.	Unit	Humidity
Power Supply for Logic	V_{DD}-V_{SS}	-0.3	-	7.1	Volt	
Power Supply for LCD	V_{DD}-Vo	0	-	10.0	Volt	
Input Voltage	V_{IN}	-0.3	-	V_{DD}+0.3	Volt	
Supply Current for LED backlight	I_{LED}	-	-	220	mA	
Operating Temperature	Top	0	-	+50	℃	Note1
Storage Temperature	Tst	-10	-	+60	℃	Note2

Note1: Background color changes slightly depending on ambient temperature. This phenomenon is reversible.

Ta≦50℃: 75RH max

Ta>50℃: absolute humidity must be lower than the humidity of 75%RH at 50℃

Note2: Ta at -10℃ will be <48hrs, at60 ℃ will be <120hrs when humidity is

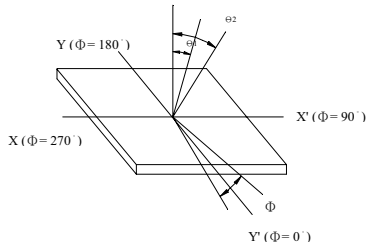
ELECTRICAL CHARACTERISTICS (Ta＝25℃)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Power Supply for Logic	V_{DD}-V_{SS}	-	4.7	5.0	5.3	Volt
Input Voltage	V_{IL}	L level	V_{SS}	0.2 V_{DD}	-	Volt
	V_{IH}	H level	0.7 V_{DD}	-	V_{DD}	Volt
LCD Module Driving Voltage	V_{DD}=5.0V V_{DD}-Vo= 4.2V	Ta＝-20℃	-	-	-	Volt
		Ta＝0℃	-	-	-	
		Ta＝25℃	3.9	4.2	4.5	
		Ta＝50℃	-	-	-	
Power Supply Current for LCM	I_{DD}	V_{DD}=5.0V	-	1.5	3.0	mA

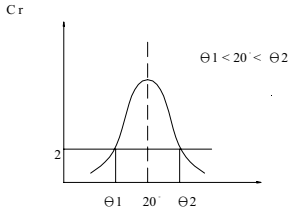
OPTICAL CHARACTERISTICS

Item	Symbol	Min.	Typ.	Max.	Unit	Condition	Note
Viewing Angle	Θ1-Θ2	-15	--	45	deg.		1.2
	Φ	-35	--	+35	deg.		
Contrast Ratio	Cr	--	10	15	--	Θ=20 ◦ Φ=0 ◦	3
Response Time (rise)	Tr	--	250	750	ms	Θ=20 ◦ Φ=0 ◦	4
Response Time (fall)	Tf	--	300	900	ms	Θ=20 ◦ Φ=0 ◦	4

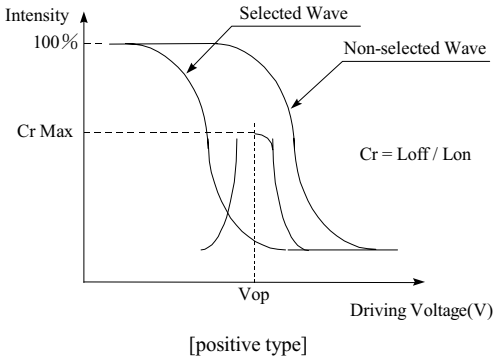
Note 1. Definition of angle Θ & Φ



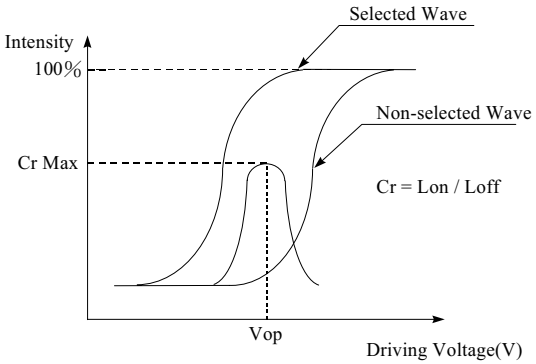
Note 2. Definition of viewing angle Θ1 & Θ2



Note 3. Definition of contrast ratio (Cr)

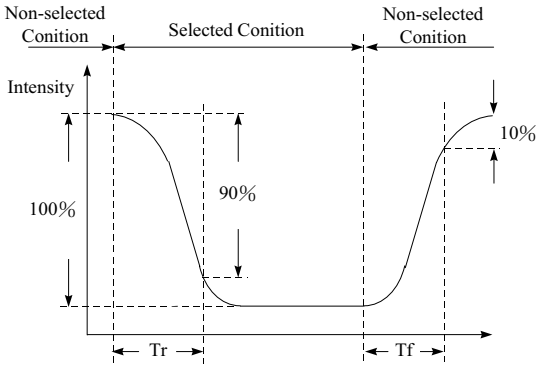


[positive type]

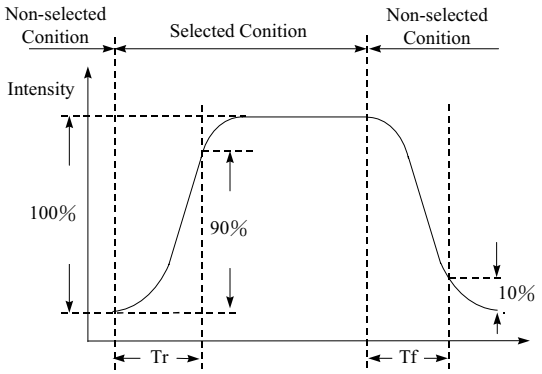


[Negative type]

Note 4. Definition of response time



[positive type]

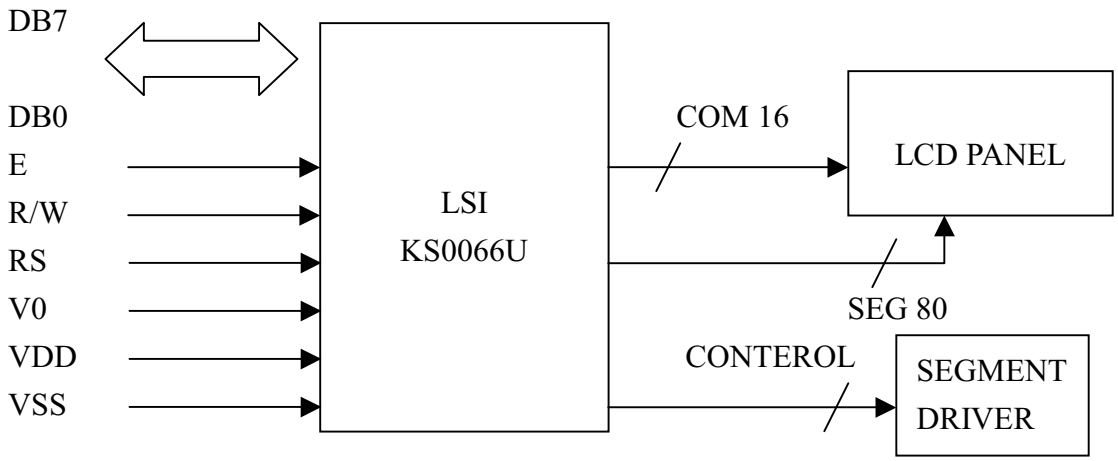


[Negative type]

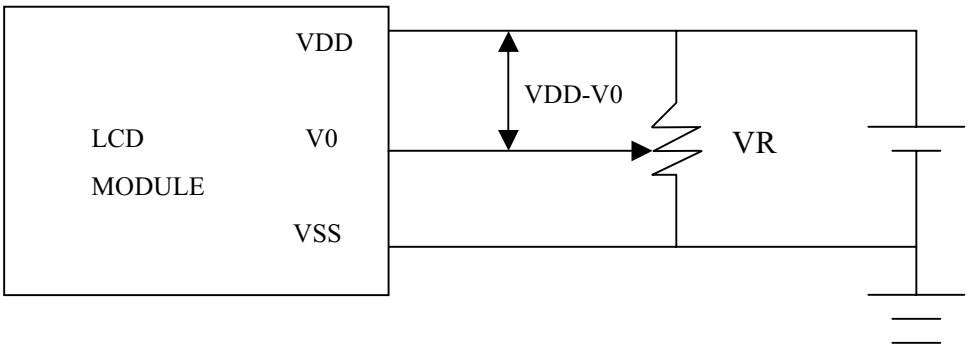
INTERFACE PIN ASSIGNMENT

PIN	SYMBOL	FUNCTIONS
1	VSS	GROUND (0V)
2	VDD	Powersupply for logic circuit (5V)
3	V0	Operating voltage for LCD driving (Variable)
4	RS	H：Data input ; L：Instruction code input
5	R/W	H：Data Read (LCM to MPU) ; L：Data Write (MPU to LCM)
6	E	Enable
7-14	DB0-DB7	Data bus line
15	NC	No connection
16	NC	No connection

BLOCK DIAGRAM

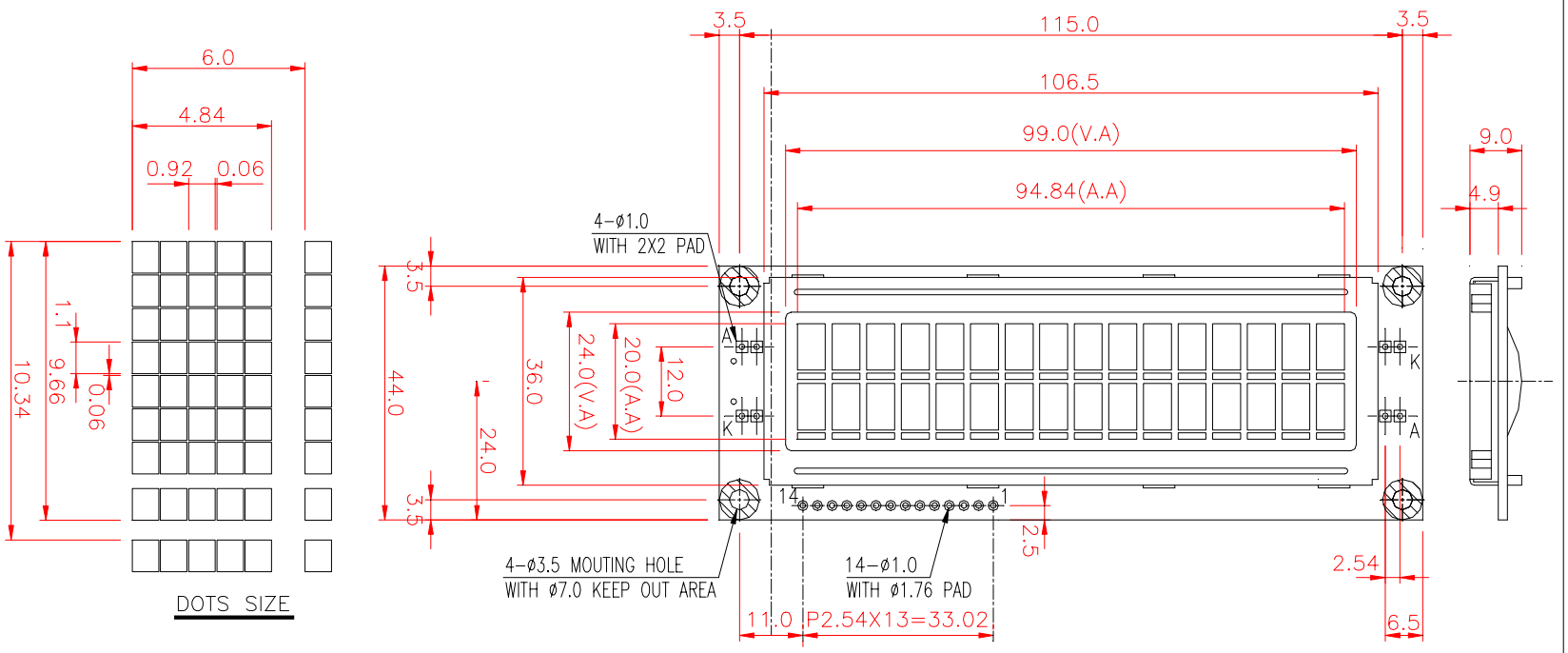


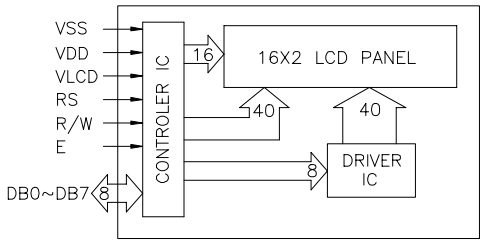
POWER SUPPLY



* VDD-V0 = Operating voltage for LCD
* VR = 10 Kohm to 20 Kohm

VCM-16200B





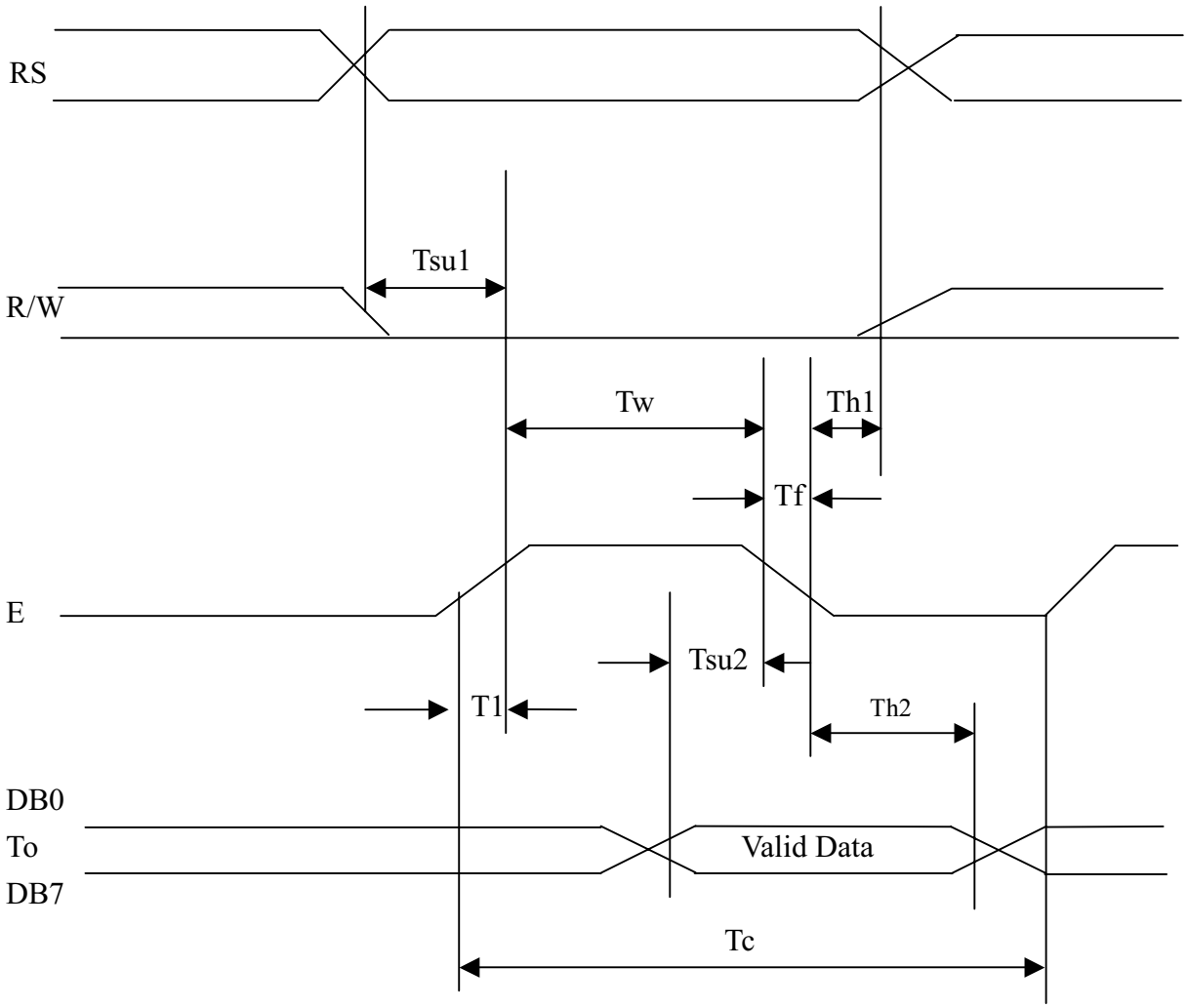
INTERFACE PIN / B/L TYPE	1	2	3	4	5	6	7	8	9	10	11	12	13	14
REFLECTIVE	VSS	VDD	VLCD	RS	R/W	E	DB0	DB1	DB2	DB3	DB4	DB5	DB6	DB7

APPROVED BY	/ /	勁佳光電股份有限公司
CHECK BY	/ /	
CHECK BY	/ /	SHEET : 1/1 / TOLERANCE: ±0.2 / UNIT: MM
DRAWING BY JACKY	2001/4/18	SIZE : A4 / ANGLES: ±0.5° / SCALE: 1/1

TIMING CHARACTERISTICS

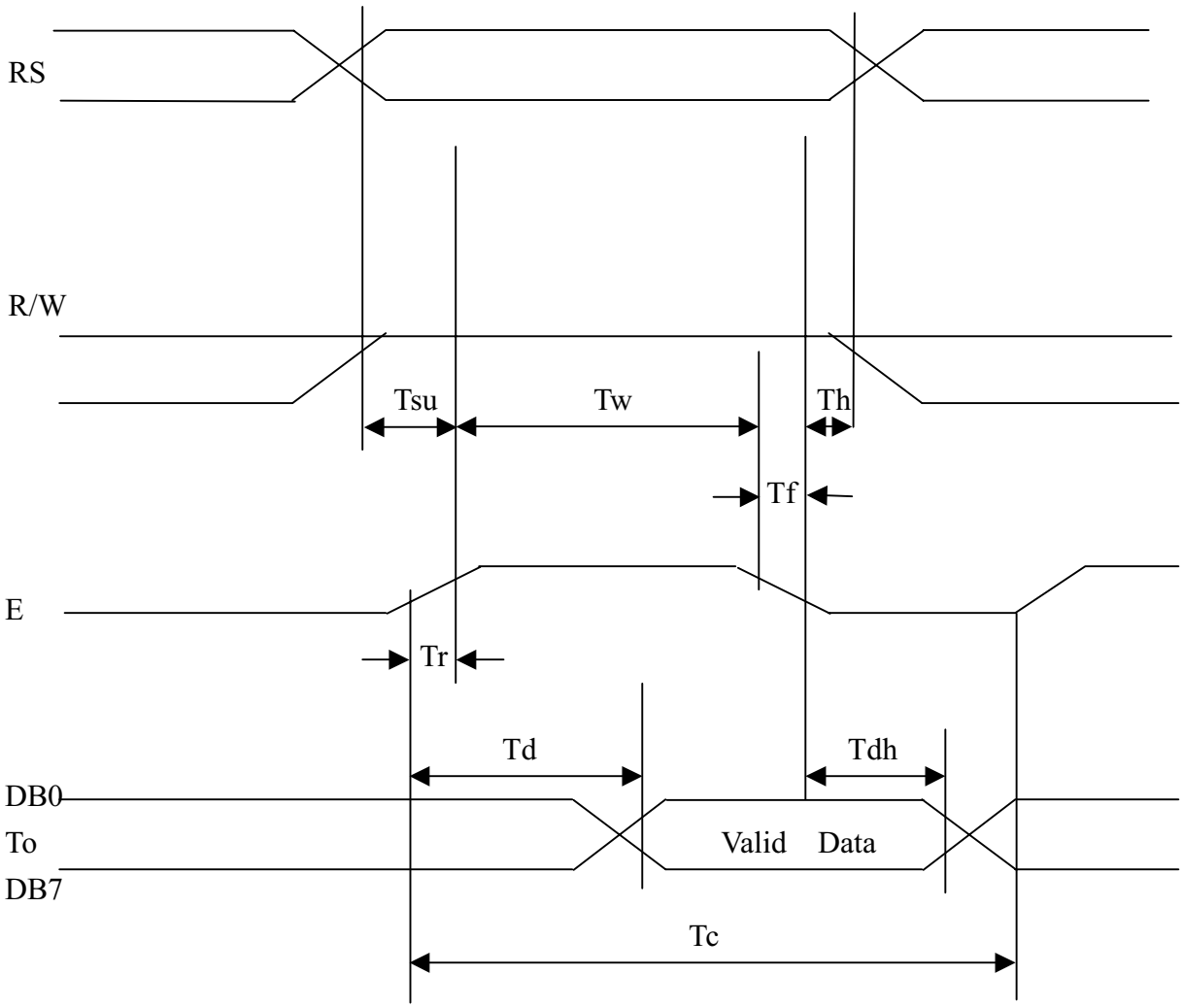
1-1. WRITE TIMING

Characteristic	Symbol	Min	Type	Max	Unit	Testpin
E Cycle Time	Tc	500	--	--	ns	E
E Rise Time	Tr	--	--	20	ns	E
E Fall Time	Tf	--	--	20	ns	E
E Pulse Width(High,Low)	Tw	230	--	--	ns	E
R/W and RS Set-up Time	Tsu1	40	--	--	ns	R/W,RS
R/W and RS Hold Time	Th1	10	--	--	ns	R/W,RS
Data Set-Up Time	Tsu2	80	--	--	ns	DB0-DB7
Data Hold Time	Tdh2	10	--	--	ns	DB0-DB7



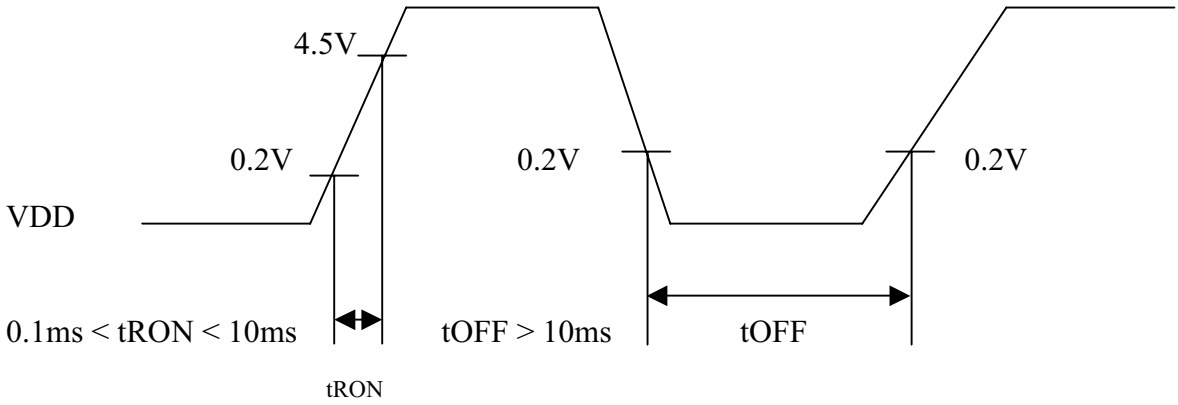
1-2. READ TIMING

Characteristic	Symbol	Min	Type	Max	Unit	Testpin
E Cycle Time	Tc	500	--	--	ns	E
E Rise Time	Tr	--	--	20	ns	E
E Fall Time	Tf	--	--	20	ns	E
E Pulse Width(High,Low)	Tw	230	--	--	ns	E
R/W and RS Set-up Time	Tsu	40	--	--	ns	R/W,RS
R/W and RS Hold Time	Th	10	--	--	ns	R/W,RS
Data Set-Up Time	Td	--	--	120	ns	DB0-DB7
Data Hold Time	Tdh	5	--	--	ns	DB0-DB7



POWER SUPPLY CONDITION USING INTERNAL RESET CIRCUIT

Characteristic	Symbol	Test Condition	Min.	Typ.	Max.	Unit	Test Pin
Power supply Rise Time	tRON	Below FIG	0.1	--	10	ms	
Power Supply Off Time	tOFF	Below FIG	10	--	--	ms	



Note：tOFF Stipulates the time of power off for power supply instantaneous dip or when power supply repeats on and off

INSTRUCTION SET

1-1. Abstracts

There are four type of instructions

Type	Used to
1	Designate LCD functions such as Display Form at, Data Length,etc.
2	Give internal RAM Addresses
3	Perform Data Transfer with internal RAM
4	Control (other than type 1-3 above)

In normal display usage”3” instructions are most frequently used.

When an instructions is executing in the LCD no instruction other than the Busy Flage/ Address Read instruction is recognized.

The Busy Flage bit will be set at “1” while the LCD is excuting the instruction.

The valid instructions for the LCD are shown in the Table following.

1-2 INSTRUCTIONS SET

Instruction	CODE										DESCRIPTION	Executed Time(max) Focs=250K Hz
	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0		
Clear Display	0	0	0	0	0	0	0	0	0	1	Clear Entire display	1.64mS
Return Home	0	0	0	0	0	0	0	0	1	*	Return display being shifted to the original position	1.64mS
Entry Mode Set	0	0	0	0	0	0	0	1	I/D	SH	Sets the crusor move direction and specifies shift of display.	40μS
Display On/Off Control	0	0	0	0	0	0	1	D	C	B	Sets the ON/OFF of all display(D) cursor ON/OFF(C), and blink of cursor position character(B)	40μS
Cursor/Display Shift	0	0	0	0	0	1	S/C	R/L	*	*	Moves the cursor and shifs the display.	40μS
Function Set	0	0	0	0	1	DL	N	F	*	*	Sets interface data length(DL), number of display lines(N) and character font (F).	40μS

Instruction	CODE										DESCRIPTION	Executed Time(max) Focs=250KHz
	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0		
CGRAM Address Set	0	0	0	1	A_{CG}						Sets the CGRAM Address.	40μS
DDRAM Address Set	0	0	1	A_{DD}							Sets the DDRAM Address.	40μS
Busy Flag/Address Read	0	1	BF	AC							BF: Busy flag Read AC Contents	0μS
CGRAM/DDRAM Data Write	1	0	W_{RITE} D_{ATA}								Writes data into DDRAM or CGRAM	40μS
CGRAM/DDRAM Data Read	1	1	R_{EAD} D_{ATA}								Reads data into DDRAM or CGRAM	40μS

Reliability

Test item	Test condition	Evaluation and assessment
Operation at high temperature and humidity	40℃±2℃ 90%RH for 240 hours	No abnormalities in functions* and appearance**
Operation at high temperature	60℃±2℃ for 240 hours	No abnormalities in functions* and appearance**
Heat shock	-20~+60℃ Left for 1 hour at each temperature，transition time 5min，repeated 10times	No abnormalities in functions* and appearance**
Low temperature	-20±2℃ for 240 hours	No abnormalities in functions* and appearance**
Vibration	Sweep for 1 min at 10Hz， 55Hz，10Hz，amplitude 1.5 mm 2hrs each in the X，Y and Z directions	No abnormalities in functions* and appearance**
Drop shock	Drop shock	No abnormalities in functions* and appearance**

* Dissipation current，contrast and display functions

** Polarizing filter deterioration，other appearance defects

Liquid crystal panel service life

100,000 hours minimum at 25℃±10℃

definition of panel service life

Contrast becomes 30% of initial value

Current consumption becomes three times higher then initial value

Remarkable alignment deterioration occurs in LCK cell layer

Unusual operation occurs in display functions

1.Specification of quality assurance

1.1 Purpose

This standard for quality assurance should affirm the quality of LCD module products to supply to _____（Pruchaser） by VBSET ELECTRONIC LTD.（Supplier）

1.2 Standard for Quality Test

1.2.1 Test method :According to MIL-STD-105D,General Inspection Level II take a single time.

1.2.2 The defects classify of AQL as following list.

Classify	Inspect item	Nonconforming status	AQL	Remark
Critical defect	1.Display damage	（1）Non-Display	AQL=0.65	Product no function
		（2）Occur high current		
		（3）Segment missing		
		（4）LCD with wrong viewing direction		
		（5）Back light unlighten		
	2.Dimension not correct	（1）PCB and bezel out of specification	AQL=0.65	Can not assembly
Major defect	1.Display	（1）Display scanned Disorder	AQL=1.0	
		（2）display defect		
	2.Back-light	（1）Flash，duct		
		（2）Wong color		
Minor defect	1.LCD	（1）Dust（Black spot，white spot）	AQL=2.50	Appearance defect
		（2）Polarizer scratch		
		（3）Reflective polarizer with bubble		
		（4）Display segment transfigure		
		（5）Color out of the renge of sample color		
	2.COB	（1）The PAD of wire bond exposed		
		（2）Resin not enough (line of wire boding exposure)		
		（3）Bubble,dust on the COB		
	3.PCB	（1）Dust,solder ball on the PCB		
		（2）PAD scratch		
Total			AQL=2.50	

1.3 NONCONFORMING ANALYSIS&DEAL WITH MANNERS

1.3.1 Nonconforming analysis:

· Purchaser should supply the detail data of non-conforming sample and the improper state.
· After accepting the detail data from purchaser，the analysis of Nonconforming should be finished in two weeks.
· If supplier can not finish analysis on time，must announce puchaser.

1.3.2 Dispositttion of nonconforming :

· If the customer will fine any defected product during assembly time，supplier will replace the good product for every defect after.
· Both supplier and customer should analytsis the reason and discuss the disposition of nonconforming when the reason of nonconforming is not sure.

1.4 Agreement items

Both sides should discuss together when the following problems happen.

1.4.1 There is anyproblem of standard of quality assurance，and both sides Think that must be modified.

1.4.2 There is any argument item which does not recored in the standard of quality assurance.

1.4.3 Any other special problem.

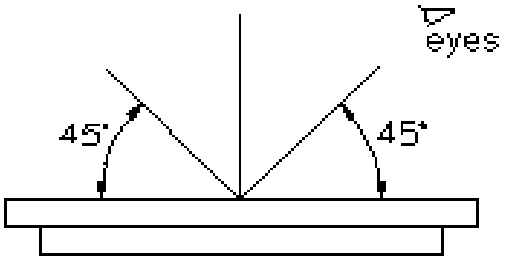
1.5 Standard of the product appearance test

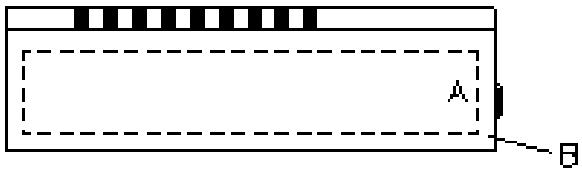
1.5.1 Manner of appearance test

· The test must be under 20W×2 or 40W fluorescent light，and the distance of view must be at 30cm.

· When test the model of transmissive productn must add the reflective plate.

· The test direction is base on about 45º of vertical line.

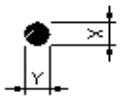




· Definition of area :

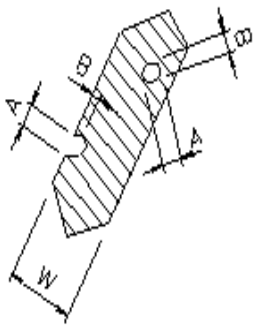
A area: viewing area

1.5.2 Standard of appearance inspection : (Unit:mm)

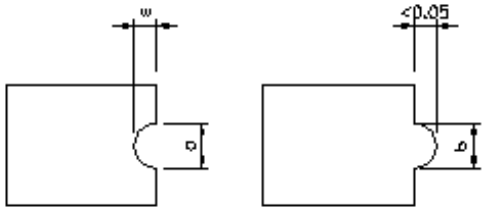
<table>
<tr><td>Name:LCM</td><td>Inspection Specification</td></tr>
<tr><td>Scope</td><td>LCM</td></tr>
<tr><td>Item</td><td>Criterion</td></tr>
<tr><td>1.Electronic</td><td>(1)Display scanned must be complete.
(2)Can not non-display
(3)The consumer current can not over the specification
(4)Test result as the following must be reject:
1.Display incomplete
2.Occur high current
3.Display defect</td></tr>
<tr><td>2.Black spot , white spot , dust in LCD</td><td>(1)Round type : As following drawing
Ψ=(X+Y) / 2
 
<table><tr><td>Size</td><td colspan="2">Acceptable Q'TY</td></tr><tr><td>Area</td><td>A</td><td>B</td></tr><tr><td>Ψ<0.1</td><td>Accep no dense</td><td rowspan="4">Accept
No
Dense</td></tr><tr><td>0.1<Ψ<0.2</td><td>2</td></tr><tr><td>0.2<Ψ<0.25</td><td>1</td></tr><tr><td>0.25<Ψ</td><td>0</td></tr></table>
(2)Line type : (As following drawing)
 
<table><tr><td>Length</td><td>Width</td><td colspan="2">Acceptable</td></tr><tr><td colspan="2">Area</td><td>A</td><td>B</td></tr><tr><td>Accept</td><td>0.02≧L</td><td>Accept no dense</td><td rowspan="4">Accept
No
Dense</td></tr><tr><td>3.0≧L</td><td>0.03≧L</td><td rowspan="2">2</td></tr><tr><td>2.5≧L</td><td>0.05≧L</td></tr><tr><td>---</td><td>0.05≧L</td><td>As round type</td></tr></table>
Total acceptable Q'TY (1) + (2) ≦ 3</td></tr>
</table>

<table>
<tr><td>Name:LCM</td><td>Inspection Specification</td></tr>
<tr><td>Scope</td><td>LCM</td></tr>
<tr><td>Item</td><td>Criterion</td></tr>
<tr><td>1.Polarizer scratch</td><td>Following the dust specification of time type.</td></tr>
<tr><td>2.Polarizer bubble</td><td>(1)Bubble could be seen by eyes exidently to be judged
According to black spot specification.
(2)Not allow polarize jutting glass outside.

<table>
<tr><td>Size</td><td colspan="2">Acceptable Q'TY</td></tr>
<tr><td>Area</td><td>A</td><td>B</td></tr>
<tr><td>Ψ<0.2</td><td>Accept no dense</td><td rowspan="5">Accept
No
Dense</td></tr>
<tr><td>0.2<Ψ<0.5</td><td>3</td></tr>
<tr><td>0.5<Ψ<1.0</td><td>2</td></tr>
<tr><td>1.0<Ψ</td><td>0</td></tr>
<tr><td>Total acceptable Q'TY</td><td>3</td></tr>
</table></td></tr>
<tr><td>3.Segmenter transfigure(Digit, word , sign)</td><td>(1)PIN hole , transfigure : (See below)
a. Segment display:

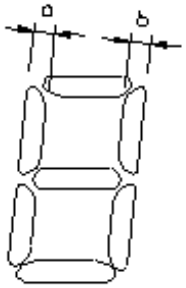
 

<table>
<tr><td>Width</td><td>Acceptable</td></tr>
<tr><td>W≦0.4</td><td>Ψ≦0.2 and Ψ≦1/2w</td></tr>
<tr><td>W≧0.4</td><td>Ψ≦0.25 and Ψ≦1/3w</td></tr>
</table>
Note:
W : Segment width
Ψ : (AB)/2
Only allow one defect in one segment.
Ψ under 0.10mm is acceptable.</td></tr>
</table>

Name:LCM	Inspection Specification
Scope	LCM
Item	Criterion
3.Segmenter transfigure(Digit, word , sign)	b.dot Matrix display: 

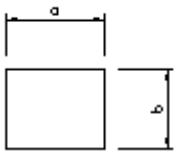
Size	Acceptable Q'TY
a , b ≦ 0.1	Accept no dense
(a + b) / 2 ≦ 0.1	Accept no dense
0.5 < Ψ < 1.0	3
Total acceptable Q'TY	7

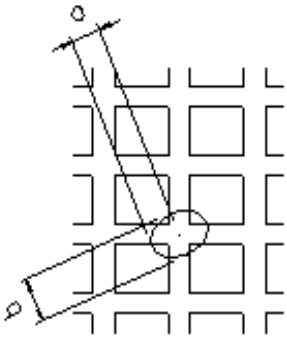
(2)a.Segment are not same width

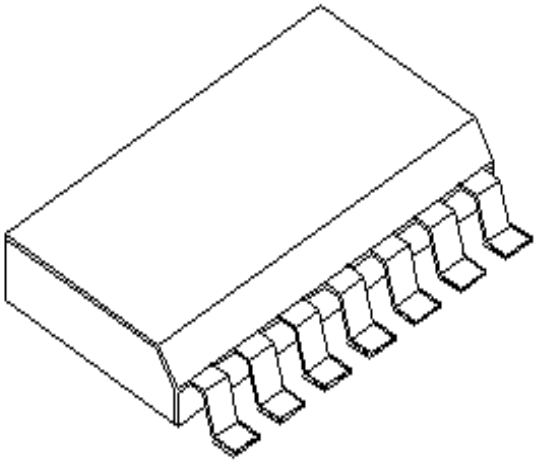


a ≧ b	a / b ≦ 4 / 3
a < b	a / b > 4 / 3

b.Segment are not equal no length and size within ±15% of production specification.



<table>
<tr><td>Name:LCM</td><td>Inspection Specification</td></tr>
<tr><td>Scope</td><td>LCM</td></tr>
<tr><td>Item</td><td>Criterion</td></tr>
<tr><td>3.Segmenter
transfigure(Digit,
word , sign)</td><td>c.Alignment layer defect :
Ψ=(a+b) / 2
 
<table><tr><td>Size Ψ</td><td>Acceptable Q'TY</td></tr><tr><td>Ψ≦0.4</td><td>Accept no dense</td></tr><tr><td>0.4 < Ψ ≦ 1.0</td><td>5</td></tr><tr><td>1.0 < Ψ ≦ 1.5</td><td>3</td></tr><tr><td>1.5 < Ψ ≦ 2.0</td><td>2</td></tr><tr><td>Total acceptable Q'TY</td><td>7</td></tr></table></td></tr>
<tr><td>4.Color</td><td>Sample of the lowest acceptable quality level.</td></tr>
<tr><td>5.Back-light</td><td>(1)The color of backlight should correspond its specification.
(2)Not allow flash and unlighten on backlight.
(3)Not allow larger than 0.25mm dust on backlight.</td></tr>
<tr><td>6.COB</td><td>(1)Not allow the PAD of wire bond exposed.
(2)Not allow the line type of wire bond on resin.
(3)Not allow bubble and dust on resin.</td></tr>
</table>

Name:LCM	Inspection Specification
Scope	LCM
Item	Criterion
7.PCB	(1)Not allow dirty and reminded solder on PCB.  (2)Not allow scratch on pin PAD.

HANDLING PRECAUTION

1.Mounting Method

The panel of the LCD Module consists of two thin glass plates with polarizes which easily get damaged since the Module is fixed by utilizing fitting holes in the printed circuit board. Extreme care should be taken when handling the LCD Modules.

2.Caution of LCD handling & cleaning

When cleaning the display surface, use soft cloth with solvent (recommended below) and Wipe lightly.

-Isopropyl alcohol

-Ethyl alcohol

-Trichlorotriflorothane

Do not wipe the display surface with dry or hard materials that will damage the polarize surface.

Do not use the following solvent：

-Water

-Kettle

-Aromatics

3.Caution against static charge

The LCD Module use C-MOSLSI drivers, so we recommend end that you connect any unused input terminal to VDD or VSS, do not input any signals before power is turned on. And ground your body, Work/assembly table. And assembly equipment to protect against static electricity.

4.Packaging

-Modules use LCD elements, and must be treated as such. Avoid in tense shock and falls from a height.

-To prevent modules from degradation. Do not operate or store them exposed directly to sunshine or high temperature/humidity.

5.Caution for operation

-It is indispensable to drive LCD’s with in the specified voltage limit since the higher voltage than the limit shorten LCD life.

An electrochemical reaction due to direct current causes LCD deterioration, Avoid the use of direct current drive.

-Response time will be extremely delayed at lower temperature than the operating temperature range and on the other hand at higher temperature LCD's show dark color in them.

However those phenomena do not mean malfunction or out of order with LCD's. Which will come back in the specified operating temperature range.

- If the display area is pushed hard during operation, some font will be abnormally displayed but it resumes normal condition after turning off once.

- A slight dew depositing on terminals is a cause for electro-chemical reaction resulting in terminal

open circuit.

Usage under the relative condition of 40 ℃, 50%RH or less is required.

6. Storage

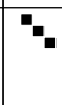
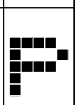
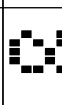
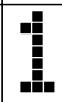
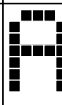
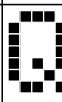
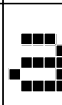
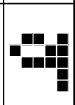
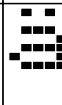
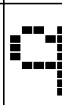
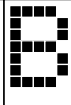
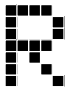
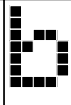
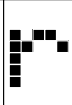
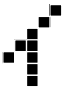
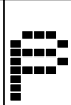
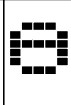
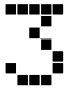
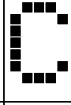
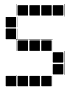
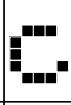
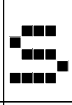
In the case of storing for a long period of time (for instance. For years) for the purpose or replacement use, The following ways are recommended.

- Storage in a polyethylene bag with sealed so as not to enter fresh air outside in it, And with no desiccant.
- Placing in a dark place where neither exposure to direct sunlight nor light is. Keeping temperature in the specified storage temperature range.
-Storing with no touch on polarizer surface by the anything else. (It is recommended to store them as they have been contained in the inner container at the time of delivery)

7. Safety

- It is recommendable to crash damaged or unnecessary LCD into pieces and wash off liquid crystal by using solvents such as acetone and ethanol. Which should be burned up later.
- When any liquid crystal leaked out of a damaged glass cell comes in contact with your hands, please wash it off well with soap and water.

CHARACTER FONT TABLE

Upper 4 bits / Lower 4 bits	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
0000	**CG RAM (1)**															
0001	**CG RAM (2)**															
0010	**CG RAM (3)**															
0011	**CG RAM (4)**															
0100	**CG RAM (5)**															
0101	**CG RAM (6)**															
0110	**CG RAM (7)**															
0111	**CG RAM (8)**															
1000	**CG RAM (1)**															
1001	**CG RAM (2)**															
1010	**CG RAM (3)**															
1011	**CG RAM (4)**															
1100	**CG RAM (5)**															
1101	**CG RAM (6)**															
1110	**CG RAM (7)**															
1111	**CG RAM (8)**															