LIQUID CRYSTAL DISPLAY MODULE

Product Specification

CUSTOMER	**Standard**	
PRODUCT NUMBER	**TSR4836**	
CUSTOMER APPROVAL		**Date**

INTERNAL APPROVALS		
Product Mgr	Doc Control	Electr. Eng
Bruno Recaldini	**Anthony Perkins**	**Bazile Peter**
Date: 20/09/2006	Date: 20/09/2006	Date: 20/09/2006

☐ **Approval for Specification only**

☐ **Approval for Specification and Sample**

TABLE OF CONTENTS

REVISION RECORD

Rev.	Date	Page	Chapt.	Comment	ECR no.
A	20/09/2006			Product release	

1 MAIN FEATURES

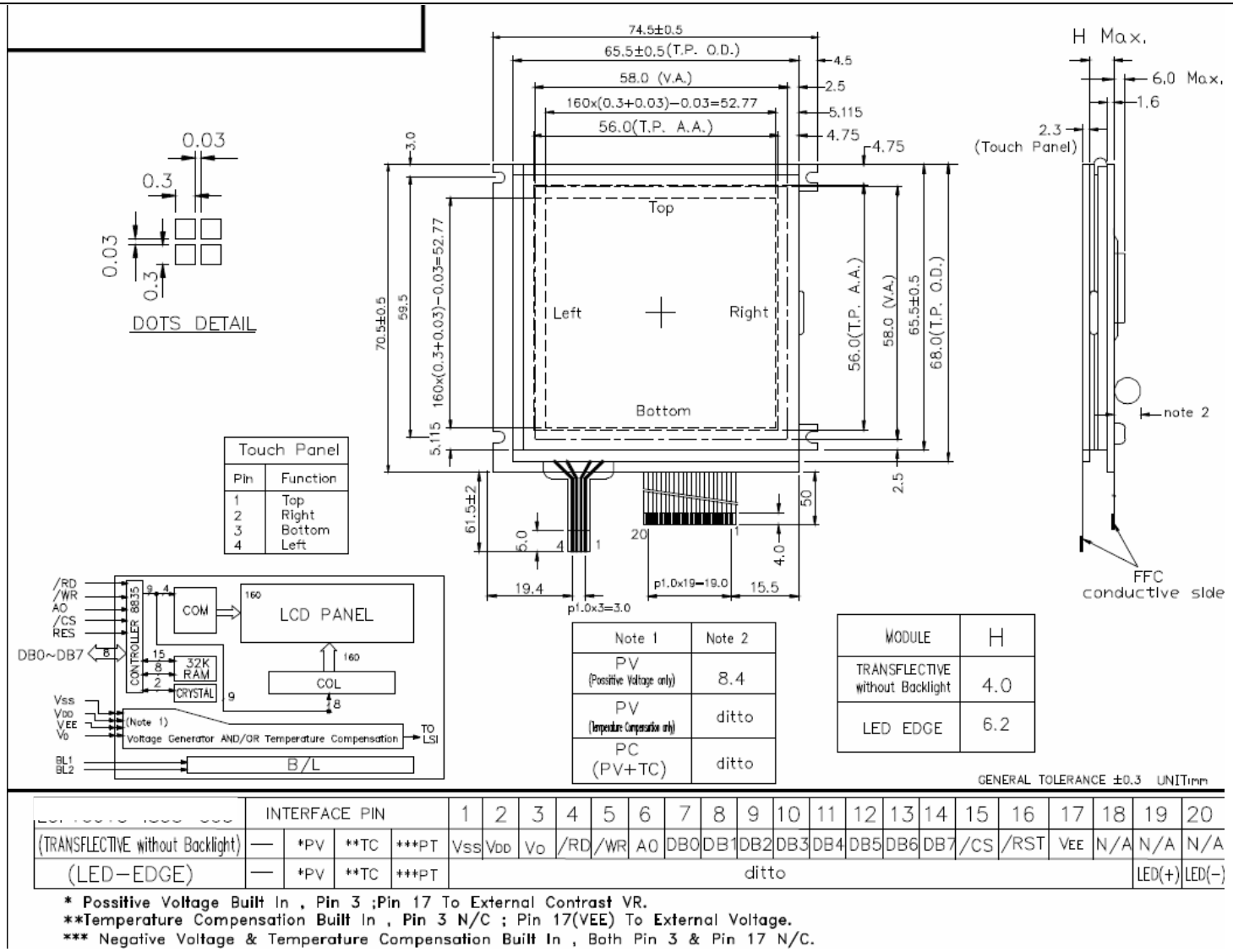
ITEM	CONTENTS
Display Format	160 x 160 dots
Overall Dimensions (excluding cable)	74.5 x 70.5 x 14.5 Without positive voltage and temp compensation. 74.5 x 70.5 x 16.9 With positive voltage and temp compensation
Viewing Area	58 x 58
LCD type	STN or FSTN
Mode	Transflective
Viewing Angle	6 O clock
Duty ratio	1 / 160
Driver IC	Raio RA8835
Backlight type	LED
Backlight colour	White
Temperature compensation	Optional
DC/DC converter	Optional
Operating temperature	-20 ~ +70˚C wide temp
Storage temperature	-30 ~ +80˚C
RoHS status	Compliant

2 MECHANICAL SPECIFICATION

2.1 MECHANICAL CHARACTERISTICS

ITEM	CHARACTERISTIC	UNIT
Display Format	160 x 160 dots	
Overall Dimensions (excluding cable)	74.5 x 70.5 x 14.5 Without positive voltage and temp compensation. 74.5 x 70.5 x 16.9 With positive voltage and temp compensation	mm
Viewing Area	58 x 58	mm
Active Area	56.0 x 56.0	mm
Dot Size	0.3 x 0.3	mm
Dot spacing	0.03	mm
IC Controller/Driver	Raio RA8835	

2.2 MECHANICAL DRAWING



Touch Panel	
Pin	Function
1	Top
2	Right
3	Bottom
4	Left

Note 1	Note 2
PV (Positive Voltage only)	8.4
PV (Temperature Compensation only)	ditto
PC (PV+TC)	ditto

MODULE	H
TRANSFLECTIVE without Backlight	4.0
LED EDGE	6.2

GENERAL TOLERANCE ±0.3 UNIT:mm

	INTERFACE PIN	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
(TRANSFLECTIVE without Backlight)	— *PV **TC ***PT	Vss	VDD	V0	/RD	/WR	A0	DB0	DB1	DB2	DB3	DB4	DB5	DB6	DB7	/CS	/RST	VEE	N/A	N/A	N/A
(LED−EDGE)	— *PV **TC ***PT	ditto																		LED(+)	LED(−)

* Possitive Voltage Built In , Pin 3 ;Pin 17 To External Contrast VR.
**Temperature Compensation Built In , Pin 3 N/C ; Pin 17(VEE) To External Voltage.
*** Negative Voltage & Temperature Compensation Built In , Both Pin 3 & Pin 17 N/C.

3 ELECTRICAL SPECIFICATION

3.1 ABSOLUTE MAXIMUM RATINGS

Ta = 25 °C

Item	Symbol	Min	Max	Unit	Note
Power Supply Voltage	V_{DD}	0	7	V	50±10%RH
Operating Temprature	Topr	-20	+70	°C	<65%RH (wide temp)
Storage Temperature	Tsg	-30	+80	°C	<65%RH (wide temp)
Humidity	H	20	+90	% RH	<48 Hrs
		20	+65		<1000 Hrs
Static Electricity	Be sure that you are grounded when handling displays.				

3.2 ELECTRICAL CHARACTERISTICS

VSS = 0 V, Ta = 25 °C

Item	Symbol	Condition	Min	Typ	Max	Unit
Operating voltage	V_{DD}		4.75	5	5.25	V
Input voltage High	V_{IHC}		0.8V_{DD}	-	V_{DD}	V
Input voltage Low	V_{ILC}		0	-	0.2V_{DD}	V
LCD driving voltage	V_{DD}-V_O		6	V	28	V

3.2.1 Current Consumption & Driving Voltage

	FSTN Temperature	STN Temperature
	Wide	Wide
Supply Current (I_{DD}) Typ mA	9	9
Supply Current (IEE) Typ mA	2	2
Supply Voltage (VEE) Typ	+24	+24

3.2.2 Recommended LCD drive voltage

		FSTN Temperature	STN Temperature
		Wide	Wide
LCD driving voltage	Ta=70ºC	20.6	18.6
	Ta=50 ºC	18.0	17.7
	Ta=25 ºC	16.5	17.0
	Ta=0 ºC	15.6	16.2
	Ta=-20 ºC	14.7	15.1

3.2.3 Single +5V Operation (with optional DC/DC converter not including B/L)

Negative voltage (NV) built in. I_{DD} = 120mA typ
Negative voltage (NV) and Temperature compensation (TC) built in. I_{DD} = 120mA typ.

3.3 INTERFACE PIN ASSIGNMENT

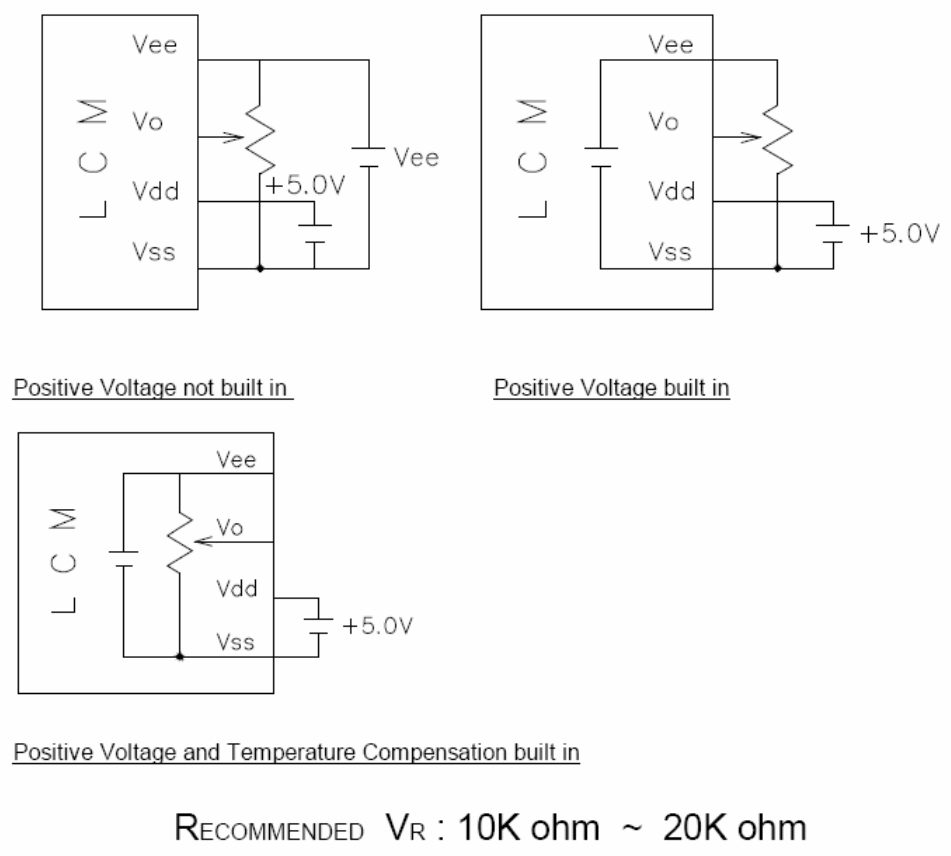
No.	Symbol	Level	Function
1	V_{SS}	-	Ground
2	V_{DD}	-	Power supply for logic
3	Vo	-	Voltage level for LCD Control adjustment
4	/RD	H/L	8080 family: Read signal 6800 family: Enable clock (E)
5	/WR	H/L	8080 family: Write signal 6800 family: R/W signal
6	A0	H/L	Data type select
7	DB0	H/L	Display data 0
8	DB1	H/L	Display data 1
9	DB2	H/L	Display data 2
10	DB3	H/L	Display data 3
11	DB4	H/L	Display data 4
12	DB5	H/L	Display data 5
13	DB6	H/L	Display data 6
14	DB7	H/L	Display data 7
15	/CS	H/L	Chip select
16	/RST	L	Reset signal
17	Vee	-	Alternative power supply
18	N/C	-	No connection
19	LED+	-	Anode of LED backlight
20	LED-	-	Cathode of LED backlight

Note 1: A0, in conjuction with the /RD and /WR or R/W and E signals control the type of access to the RA8835. The description is below.
8080 family interface

A0	/RD	/WR	Function
0	0	1	Status flag read
1	0	1	Display data and cursor address read
0	1	0	Display data and parameter write
1	1	0	Command

This LCM is set to be controlled by 8080 family MPU

3.4 POWER SUPPLY CIRCUIT



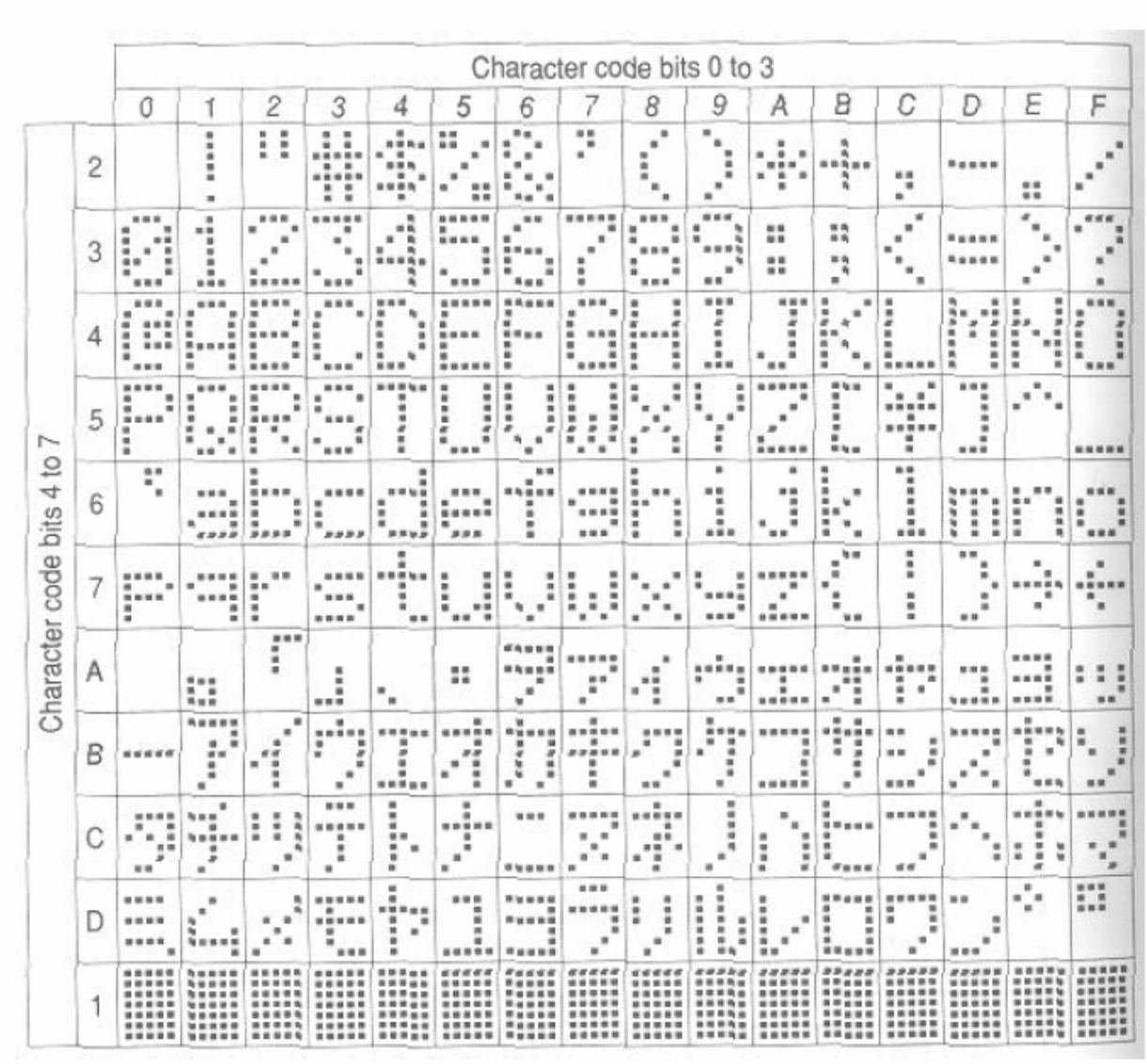
Positive Voltage not built in

Positive Voltage built in

Positive Voltage and Temperature Compensation built in

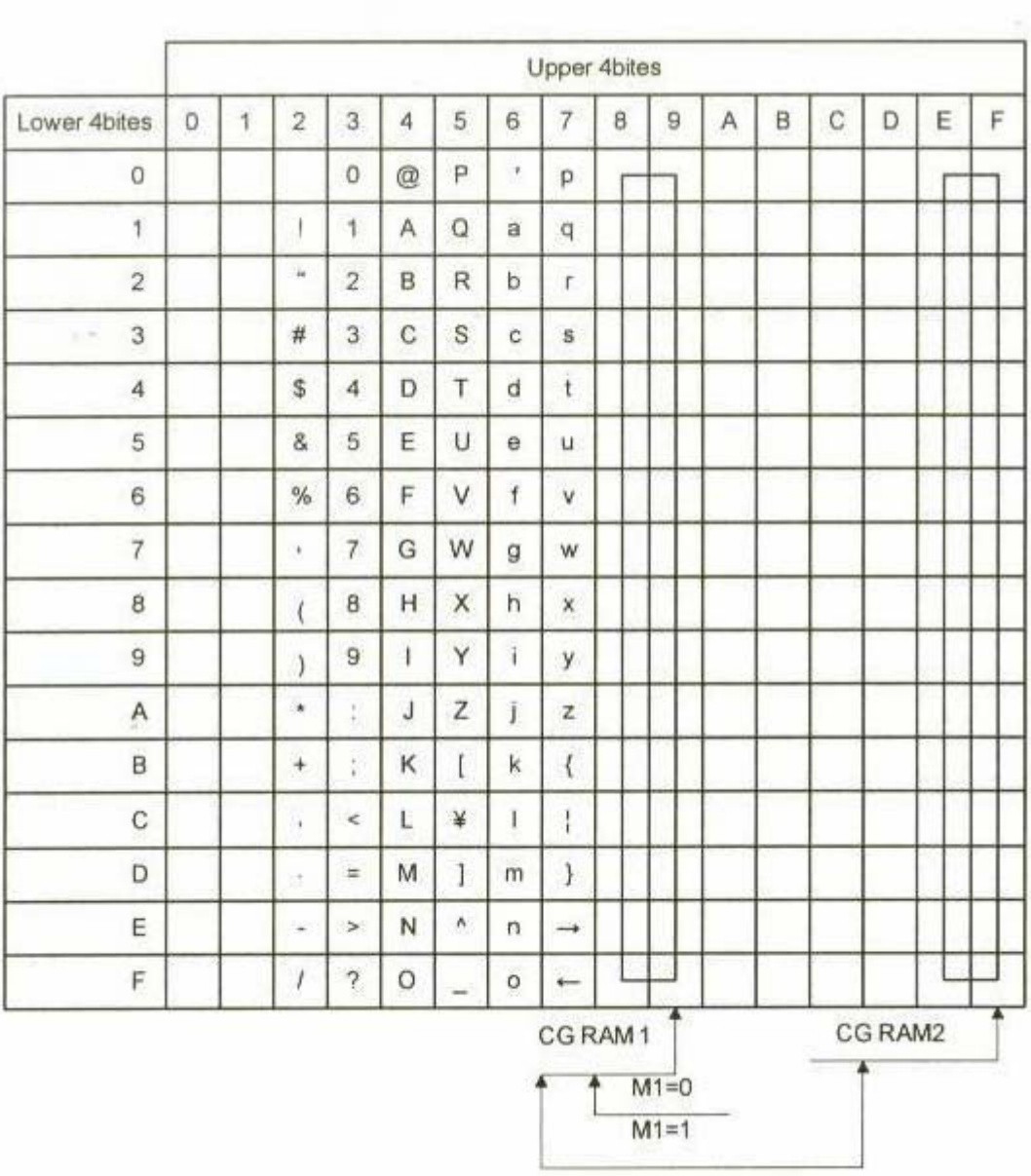
RECOMMENDED VR : 10K ohm ~ 20K ohm

3.5 CHARACTER GENERATOR ROM MAP



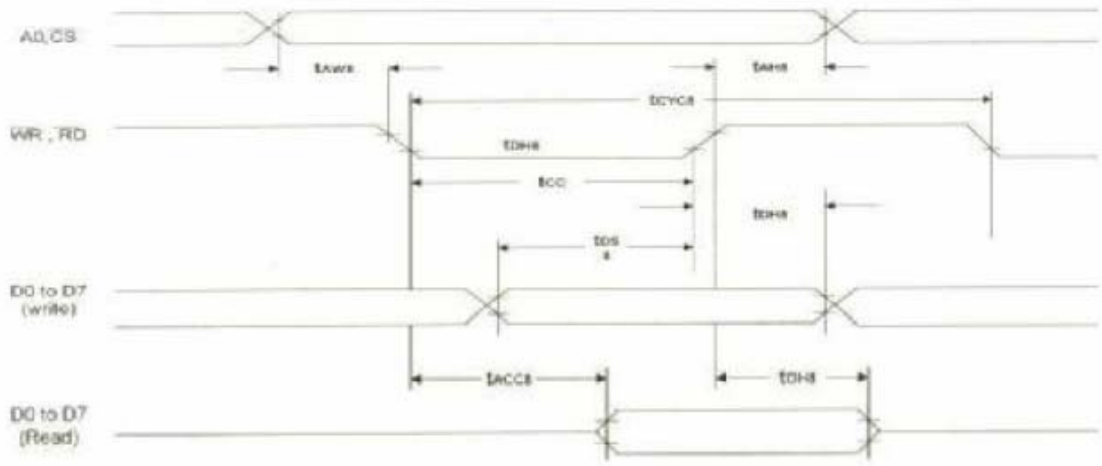
3.6 Character Codes

The following figure shows the character codes and the codes allocated to CG RAM. All codes can be used by the CG RAM if not using the internal ROM.



3.7 TIMING CHARECTERISTICS

3.7.1 8080 Family Interface timing



Ta = –20 to 75°C

Signal	Symbol	Parameter	V_{DD} = 4.5 to 5.5V		V_{DD} = 2.7 to 4.5V		Unit	Condition
			Min.	Max.	Min.	Max.		
A0, $\overline{CS}$	t_{AH8}	Address hold time	10	—	10	—	ns	CL = 100pF
	t_{AW8}	Address setup time	0	—	0	—	ns	
$\overline{WR}$, $\overline{RD}$	t_{CYC8}	System cycle time	note.	—	note.	—	ns	
	t_{CC}	Strobe pulse width	120	—	150	—	ns	
D0 to D7	t_{DS8}	Data setup time	120	—	120	—	ns	
	t_{DH8}	Data hold time	5	—	5	—	ns	
	t_{ACC8}	$\overline{RD}$ access time	—	50	—	80	ns	
	t_{OH8}	Output disable time	10	50	10	55	ns	

Note: For memory control and system control commands:

$t_{CYC8} = 2t_C + t_{CC} + t_{CEA} + 75 > t_{ACV} + 245$

For all other commands:

$t_{CYC8} = 4t_C + t_{CC} + 30$

4 OPTICAL SPECIFICATION

4.1 OPTICAL CHARACTERISTICS

4.1.1 STN Type

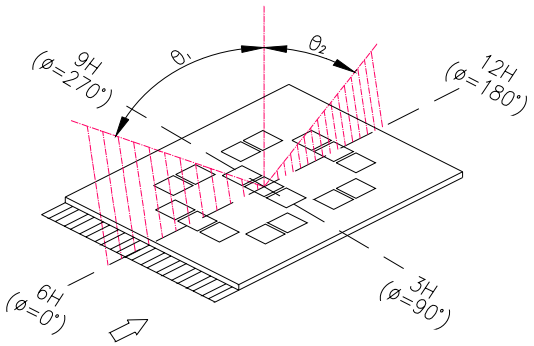
Ta = 25 °C

Item	Symbol	Condition	Min	Typ	Max	Unit	Note
Viewing Angle	θ1	CR≥2	-	40	-	deg	1
	θ2	CR≥2	-	35	-	deg	1
	θ3	CR≥2	-	35	-	deg	2
	θ4	CR≥2	-	35	-	deg	2
Contrast Ratio	CR	Ta = 25 °C	-	2.5	-	-	3
Response Time	Tr	Ta = 25 °C	-	220	-	ms	4
	Tf	Ta = 25 °C	-	300	-		
Driving Method	Duty	1/160					
	Bias	1/15					
LCD Type	STN						
Viewing Direction	6 O'CLOCK						

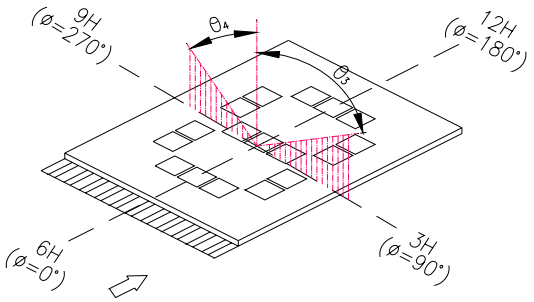
4.1.2 FSTN Type

Item	Symbol	Condition	Min	Typ	Max	Unit	Note
Viewing Angle	θ1	CR≥2	-	40	-	deg	1
	θ2	CR≥2	-	40	-	deg	1
	θ3	CR≥2	-	40	-	deg	2
	θ4	CR≥2	-	40	-	deg	2
Contrast Ratio	CR	Ta = 25 °C	-	3	-	-	3
Response Time	Tr	Ta = 25 °C	-	260	-	ms	4
	Tf	Ta = 25 °C	-	280	-		
Driving Method	Duty	1/160					
	Bias	1/15					
LCD Type	FSTN						
Viewing Direction	6 O'CLOCK						

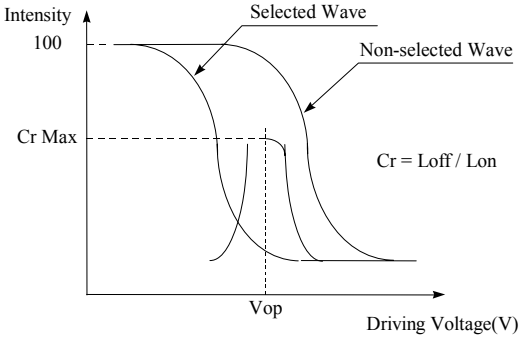
Note 1: definition of viewing angle θ1 & θ2



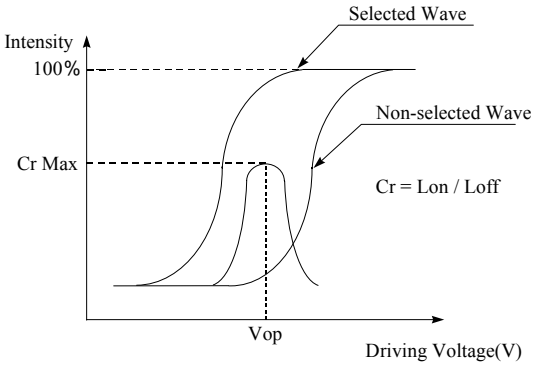
Note 2: definition of viewing angle θ3 & θ4



Note 3: definition of contrast ratio (CR)

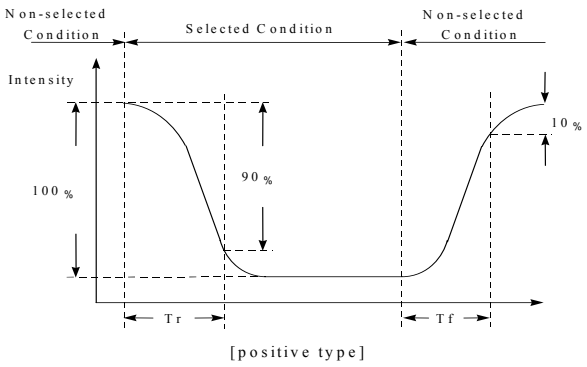


[positive type]

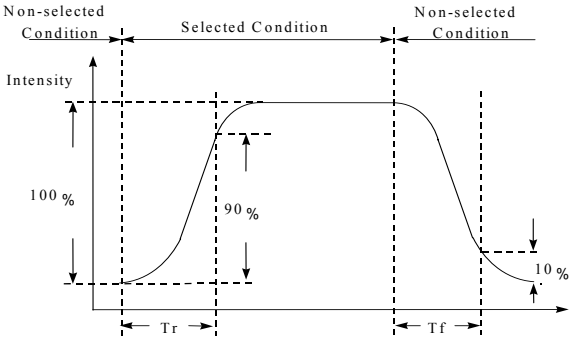


[Negative type]

Note 4: definition of response time



[positive type]



[Negative type]

5 Touch Panel Characteristics

Description	Specification	Condition
Transparency	>=80%	ASTM D1003 (wavelength = 550nm)
Linearity	<=1.5%	Material of pen: poly-acetal resin End shape: R0.8mm Test point: 100 points Test force: 80gf Note 1
Circuit Resistance X axis	300 ohm ~ 550 ohm	At connector
Circuit Resistance Y axis	250 ohm ~ 400 ohm	At connector
Insulation Resistance	>100M ohm	At DC 25V

Durability Test

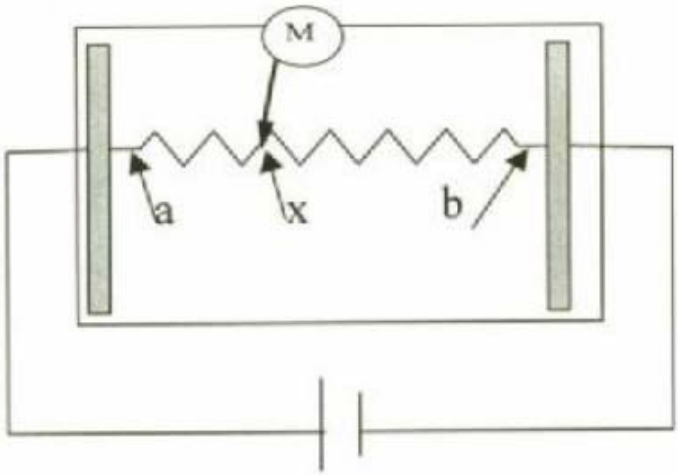
Description	Specification	Condition
Knocking test	>= 1 million times	End shape: R0.7mm (Hardness:50~60 degree) Load force: 150 gf Frequency: 2 times/sec (By silicon rubber tapping at same points)
Hardness of surface	3H	JIS K 5400

I/O pin function (Touch Panel)

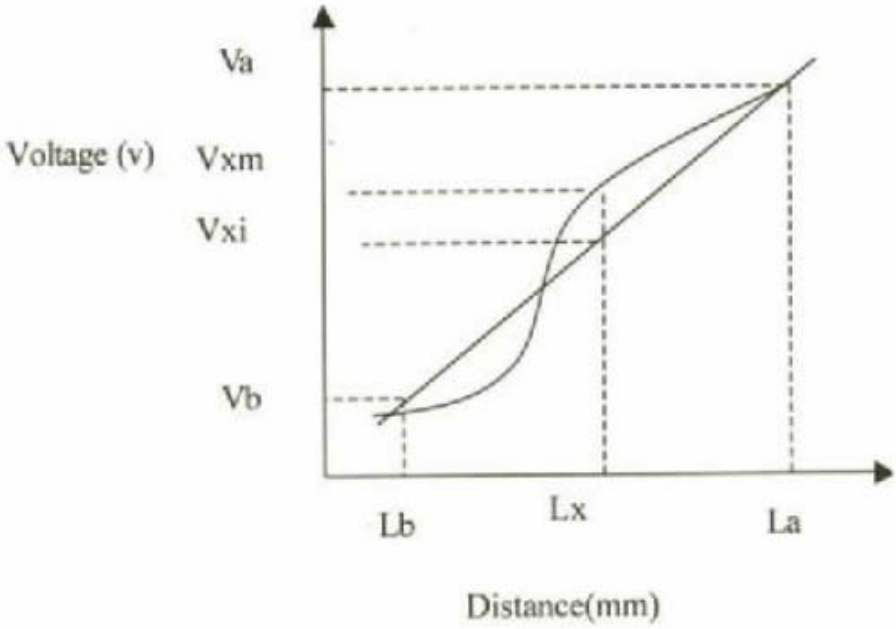
Pin No	Function
1	Top
2	Right
3	Botton
4	Left

Note 1: Measurement condition of Linearity

Linearity Definition



Va : maximum voltage in the active area of touch panel
Vb: minimum voltage in the active area of touch panel
X : random measuring point
Vxm: Actual voltage of Lx point
Vxi : Theoretical voltage of Lx point



Linearity : [| Vxi-Vxm | / (Va-Vb)]*100%

6 BACKLIGHT SPECIFICATION

6.1 BACKLIGHT CHARACTERISTICS

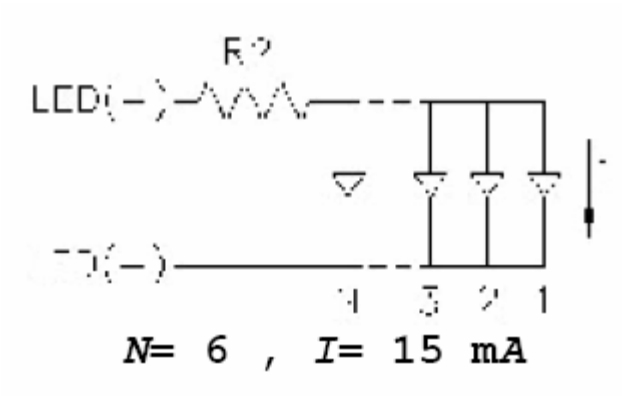
6.1.1 LED backlight

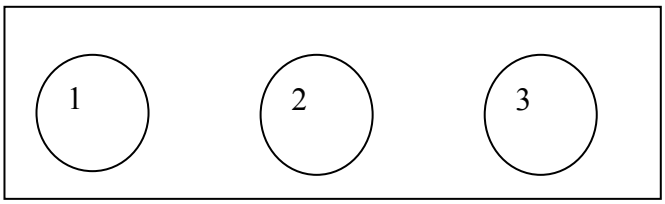
Ta=25˚C

Item	Symbol	Condition	Min	Typ	Max	Unit	Note
Input Voltage	V_{LED}		--	5	--	V DC	
Current consumption	I_{LED}		--	100	--	mA	
Average Brightness Ta=25˚C IL=100mA Backlight only	Test when connecting after 3min. (max contrast) Yellow green LED		10	--	--	cd/m²	2
Emission wave length	IL = 100mA		570	--	575		
Brightness Uniformity	IL = 100mA		75	--	--	%	3
Life time	IL = 100mA Humidity: 30%RH ~ 85%RH		--	40000	--	hrs	4
Operating Temp	Humidity: 30%RH ~85%RH		-20	-	70	˚C	
Storage Temp	Humidity: 30%RH ~85%RH		-30	-	80	˚C	
Limit resistor (R2)	Ta=25˚C		-	30	-	Ohm	1

Note:

1. SuggestedR2 current limit resistor not included - to be put on customer board
2. Average brightness of 3 points when B/L is used at the beginning
3. Brightness uniformity = (Min/Max) x 100%
4. Half of the original average brightness





7 LABELLING & MARKING

DENSITRON TSR4836 Taiwan YYMM

8 QUALITY ASSURANCE SPECIFICATION

8.1 CONFORMITY

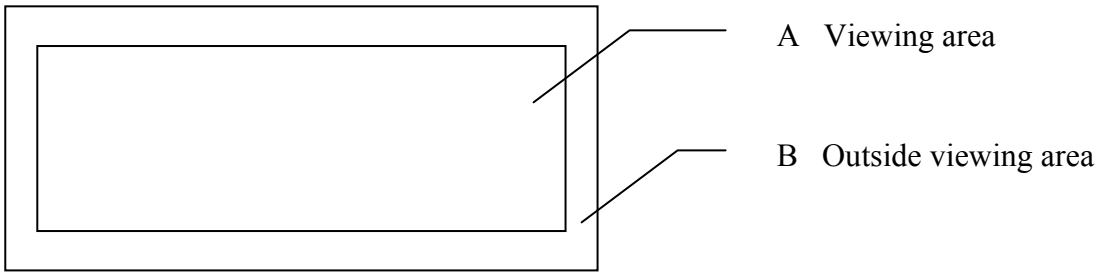
The performance, function and reliability of the shipped products conform to the Product Specification.

8.2 DELIVERY ASSURANCE

8.2.1 Delivery inspection standards

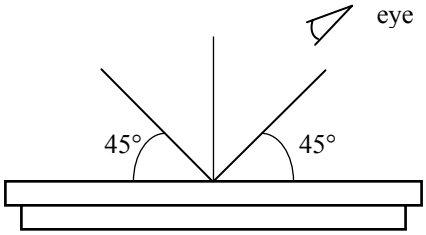
- IPC-AA610 class 2 electronic assemblies standard

8.2.2 Zone definition



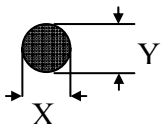
8.2.3 Visual inspection

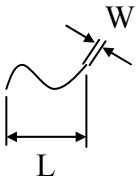
- Inspect under 2x20W or 40W fluorescent lamp (approximately 3000 lux) leaving 25 to 30 cm between the module and the lamp and 30 cm between the module and the eye (measuring position).
- Appearance is inspected at the best contrast voltage (best contrast is adjusted considering clearness and crosstalk on screen).
- Inspect the module at 45° right and left, top and bottom.
- Use the optimum viewing angle during the contrast inspection.

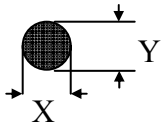


8.2.3.1 Standard of appearance inspection

Units: mm

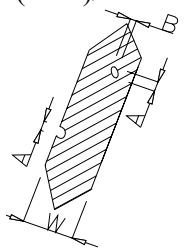
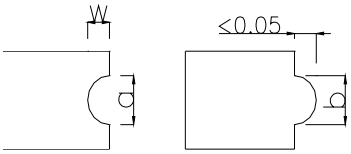
<table>
<tr><th>Class</th><th>Item</th><th>Criteria</th></tr>
<tr><td>Minor</td><td rowspan="2">Packing & Label</td><td>Outside & inside package | Presence of product no., lot no., quantity</td></tr>
<tr><td>Critical</td><td>Product must not be mixed with others and quantity must not be different from that indicated on the label</td></tr>
<tr><td>Major</td><td>Dimension</td><td>Product dimensions must be according to specification and drawing</td></tr>
<tr><td>Major</td><td>Electrical</td><td>Product electrical characteristics must be according to specification</td></tr>
<tr><td>Critical</td><td>LCD Display</td><td>Missing lines or wrong patterns on LCD display are not allowed</td></tr>
<tr><td>Minor</td><td>Black spot, white spot, dust</td><td>Round type: as per following drawing
∅ = (X+Y)/2
 

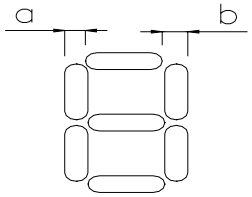
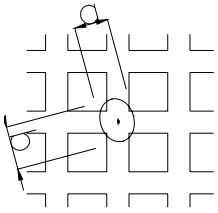
<table><tr><th colspan="3">Acceptable quantity</th></tr><tr><th>Size</th><th>Zone A</th><th>Zone B</th></tr><tr><td>∅<0.2</td><td>Any number</td><td rowspan="4">Any number</td></tr><tr><td>0.2<∅<0.25</td><td>2</td></tr><tr><td>0.25<∅</td><td>0</td></tr><tr><td></td><td></td></tr></table>
Line type: as per following drawing
 

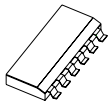
<table><tr><th colspan="4">Acceptable quantity</th></tr><tr><th>Length</th><th>Width</th><th>Zone A</th><th>Zone B</th></tr><tr><td>- -</td><td>W≤0.03</td><td>Any number</td><td rowspan="4">Any number</td></tr><tr><td>L≤3.0</td><td>0.03<W≤0.05</td><td rowspan="2">2</td></tr><tr><td>- -</td><td>0.05<W</td></tr><tr><td></td><td></td><td>As round type</td></tr></table>
Total acceptable quantity: 5</td></tr>
<tr><td>Minor</td><td>Polariser scratch</td><td>Scratch on protective film is permitted
Scratch on polariser: same as No. 1</td></tr>
<tr><td>Minor</td><td>Polariser bubble</td><td>∅ = (X+Y)/2
 

<table><tr><th colspan="3">Acceptable quantity</th></tr><tr><th>Size</th><th>Zone A</th><th>Zone B</th></tr><tr><td>∅<0.2</td><td>Any number</td><td rowspan="4">Any number</td></tr><tr><td>0.2<∅<0.5</td><td>3</td></tr><tr><td>0.5<∅<1.0</td><td>1</td></tr><tr><td>1.0<∅</td><td>0</td></tr></table>
Total acceptable quantity: 4</td></tr>
</table>

<table>
<tr><th>Class</th><th>Item</th><th>Criteria</th></tr>
<tr><td>Minor</td><td>Segment deformation</td><td>1.a. Pin hole on segmented display

W: segment width
∅ = (A+B)/2
 
<table><tr><td colspan="2">Acceptable quantity</td></tr><tr><td>Width</td><td>∅</td></tr><tr><td>W≤0.4</td><td>∅≤0.2 and ∅≤1/2W</td></tr><tr><td>W>0.4</td><td>∅≤0.25 and ∅≤1/3W</td></tr></table>Total acceptable quantity: 1 defect per segment
Pin holes with ∅ under 0.10 mm are acceptable</td></tr>
<tr><td>Minor</td><td>Segment deformation</td><td>1b. Pin hole on dot matrix display
 
<table><tr><td colspan="2">Acceptable quantity</td></tr><tr><td>Size</td><td></td></tr><tr><td>a,b<0.1</td><td>Any number</td></tr><tr><td>(a+b)/2≤0.1</td><td>Any number</td></tr><tr><td>0.5<∅<1.0</td><td>3</td></tr></table>Total acceptable quantity: 7

2. Segments / dots with different width
 
<table><tr><td colspan="2">Acceptable</td></tr><tr><td>a≥b</td><td>a/b≤4/3</td></tr><tr><td>a<b</td><td>a/b>4/3</td></tr></table>
3. Alignment layer defect
∅ = (a+b)/2
 
<table><tr><td colspan="2">Acceptable quantity</td></tr><tr><td>Size</td><td></td></tr><tr><td>∅≤0.4</td><td>Any number</td></tr><tr><td>0.4<∅≤1.0</td><td>5</td></tr><tr><td>1.0<∅≤1.5</td><td>3</td></tr><tr><td>1.5<∅≤2.0</td><td>2</td></tr></table>Total acceptable quantity: 7</td></tr>
<tr><td>Minor</td><td>Colour uniformity</td><td>Level of sample for approval set as limit sample</td></tr>
<tr><td>Critical</td><td rowspan="3">Backlight</td><td>The backlight colour should correspond to the product specification</td></tr>
<tr><td>Critical</td><td>Flashing and or unlit backlight is not allowed</td></tr>
<tr><td>Minor</td><td>Dust larger than 0.25 mm is not allowed</td></tr>
<tr><td>Major</td><td rowspan="3">COB</td><td>Exposed wire bond pad is not allowed</td></tr>
<tr><td>Major</td><td>Insufficient covering with resin is not allowed (wire bond line exposed)</td></tr>
<tr><td>Minor</td><td>Dust or bubble on the resin are not allowed</td></tr>
</table>

Class	Item	Criteria
Major	PCB 	No unmelted solder paste should be present on PCB
Critical		Cold solder joints, missing solder connections, or oxidation are not allowed
Minor		No residue or solder balls on PCB are allowed
Critical		Short circuits on components are not allowed

8.3 DEALING WITH CUSTOMER COMPLAINTS

8.3.1 Non-conforming analysis

Purchaser should supply Densitron with detailed data of non-conforming sample.
After accepting it, Densitron should complete the analysis in two weeks from receiving the sample.
If the analysis cannot be completed on time, Densitron must inform the purchaser.

8.3.2 Handling of non-conforming displays

If any non-conforming displays are found during customer acceptance inspection which Densitron is clearly responsible for, return them to Densitron.
Both Densitron and customer should analyse the reason and discuss the handling of non-conforming displays when the reason is not clear.
Equally, both sides should discuss and come to agreement for issues pertaining to modification of Densitron quality assurance standard.

9 RELIABILITY SPECIFICATION

9.1 RELIABILITY TESTS

Wide Temp

Test Item	Test Condition	Evaluation and assessment
High Temperature Operation	70˚C ±2˚C for 240 hours	No abnormalities in function* and appearance
Low Temperature Operation	-20˚C ±2˚C for 240 hours	No abnormalities in function* and appearance
Thermal Shock Storage	-30˚C (30 min) ->25˚C (5 min) ->80˚C (30 min) - >25˚C (5 min) 5 cycles	No abnormalities in function* and appearance
Vibration	10Hz ~ 55Hz 0.3mm / 1 Octave 55Hz ~ 500Hz 3g / 1 Octave 20 cycle / per axis	No abnormalities in function* and appearance

If any of the following occurs after the MTBF test the LCD is deemed to have failed.

* Current consumption 3 times initial value
* Contrast > ½ initial value
* Non-operational display

9.2 LIFE TIME

Item	Description
1	Function, performance, appearance, etc. shall be free from remarkable deterioration within 50,000 hours under ordinary operating and storage conditions of room temperature (25±10 °C), normal humidity (45±20% RH), and in area not exposed to direct sunlight.

10 PART NUMBER DESCRIPTIONS FOR AVAILABLE OPTIONS

TSR4836①②160G160③④⑤

① **POLARIZER TYPE**
B = Transflective: light background with LED backlight

② **BACKLIGHT COLOUR**
G = Yellow Green

③ **FLUID TYPE AND POWER SUPPLY**
W = Wide Temperature Range; on-board negative supply voltage generator
H = Wide Temperature Range

④ **TEMPERATURE COMPENSATION**
C = with on board temperature compensation circuitry
N = No on board temperature compensation and NTN Fluid

⑤ **FLUID TYPE**
F = FSTN
Y = Yellow mode STN
G = Grey mode STN

11 HANDLING PRECAUTIONS

Safety
If the LCD panel breaks, be careful not to get the liquid crystal fluid in your mouth or in your eyes. If the liquid crystal touches your skin or clothes, wash it off immediately using soap and plenty of water.

Mounting and Design
Place a transparent plate (e.g. acrylic, polycarbonate or glass) on the display surface to protect the display from external pressure. Leave a small gap between the transparent plate and the display surface.
When assembling with a zebra connector, clean the surface of the pads with alcohol and keep the surrounding air very clean.
Design the system so that no input signal is given unless the power supply voltage is applied.

Caution during LCD cleaning
Lightly wipe the display surface with a soft cloth soaked with Isopropyl alcohol, Ethyl alcohol or Trichlorotriflorothane.
Do not wipe the display surface with dry or hard materials that will damage the polariser surface.
Do not use aromatic solvents (toluene and xylene), or ketonic solvents (ketone and acetone).

Caution against static charge
As the display uses C-MOS LSI drivers, connect any unused input terminal to VDD or VSS. Do not input any signals before power is turned on.
Also, ground your body, work/assembly table and assembly equipment to protect against static electricity.

Packaging
Displays use LCD elements, and must be treated as such. Avoid strong shock and drop from a height.
To prevent displays from degradation, do not operate or store them exposed directly to sunshine or high temperature/humidity.

Caution during operation
It is indispensable to drive the display within the specified voltage limit since excessive voltage shortens its life.
Direct current causes an electrochemical reaction with remarkable deterioration of the display quality.
Give careful consideration to prevent direct current during ON/OFF timing and during operation.
Response time is extremely delayed at temperatures lower than the operating temperature range while, at high temperatures, displays become dark. However, this phenomenon is reversible and does not mean a malfunction or a display that has been permanently damaged.
If the display area is pushed on hard during operation, some graphics will be abnormally displayed but returns to a normal condition after turning off the display once.
Even a small amount of condensation on the contact pads (terminals) can cause an electro-chemical reaction which causes missing rows and columns. Give careful attention to avoid condensation.

Storage
Store the display in a dark place where the temperature is 25°C ± 10°C and the humidity below 50%RH.
Store the display in a clean environment, free from dust, organic solvents and corrosive gases.
Do not crash, shake or jolt the display (including accessories).