LIQUID CRYSTAL DISPLAY MODULE

Product Specification

DENSITRON	**STANDARD LCD MODULE**	
PRODUCT NUMBER	**LWM1602B-SERIES**	
DEFINITION	**2 Lines x 16 characters**	**19/12/07**

INTERNAL APPROVALS				
Quality Mgr	Product Mgr	Project Leader	Mech. Eng	Electr. Eng
Date:	Date:	Date:	Date:	Date:

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REVISION RECORD

Rev.	Date	Page	Chapt.	Comment	ECR no.
1	19/12/2007			Initial Specification	

1 PART NUMBERING SYSTEM

LWM1602B - BG - HNY *

Densitron mono module ① ② ③ ④ ⑤ ⑥

① Characters x Row format

② Model serials number

③ Display mode and backlight type :

A = Reflective (without backlight) =

B* = Transflective positive LEDS array type backlight (BG, BA, BW, BR, BT ...)

B*(E) = Transflective LEDS edge type backlight (BGE, BAE, BWE, BR…)

B = Transflective CFL

C* = Transflective positive EL backlight (CB, CW)

D* = Transmissive negative EL backlight (DB, DW)

E = CFL

E* = Transmissive negative LEDS array type backlight (EG, EA, EW, ER…)

E*(E) = Transmissive negative LEDS edge type backlight (EGE, EAE, EWE, ERE…)

(color LED or EL backlight = G/ yellow-green, A/ amber, W/ white, R/ red, B/blue ,T/ tricolour)*

④ Temperature range and power supply

D = Standard temperature range; negative supply voltage required (0°C~+50°C)

S = Standard temperature range; on board negative voltage generator (0°C~+50°C)

H= Wide temperature range; negative supply voltage required (-20°C ~+70°C)

W= Wide temperature range; on board negative voltage generator (-20°C ~+70°C)

⑤ Fluid type and compensation circuit option

NY = STN yellow-green glass, without temperature compensation circuit

CY = STN yellow green glass, with temperature compensation circuit on board

NG = STN gray glass without temperature compensation circuit

CG = STN gray glass with temperature compensation circuit

NB = STN blue glass, without temperature compensation circuit

CB = STN blue glass with temperature compensation circuit

NF = FSTN black and white glass without temperature compensation circuit

CF = FSTN black and white glass with temperature circuit on board

⑥ Special code for customized features

Please refer to our commercial office

Remarks and definitions :

1°) Display mode and backlight type :

- Reflective polarizer, no backlight, usable only in good ambient light conditions.
- Transflective polarizer uses a background backlight and a mirror reflector, usable in all lighting conditions.
- Transmissive polarizer needs the backlight switched on continuously, usable mostly in low ambient light conditions
- EL (electro-luminescent), uniform brightness, short life time (8000 hours max), needs EL inverter, low current consumption, low thickness.
- LED (light emitting diode), uniform brightness, long lifetime (100 000 hours), doesn't need inverter, reliable in vibration and shock environment, different colors available.

Array version is a direct lighting type, available in standard form, uniform and good brightness on all the active area.

Edge version is an edge lighting type providing a low consumption backlight, has a low thickness and brightness.

- Positive mode has dark pixels on a light background
- Negative mode has light pixels in a dark background and is normally used only with a transmissive polarizer as it needs a backlight on to be visible.

2°) Fluid type :

- STN yellow green or grey LCD has a yellow green or grey background with dark blue pixels and offers a good contrast.
- FSTN LCD is to produce very high contrast with black and white pixels using a film polarizer

2 MAIN FEATURES

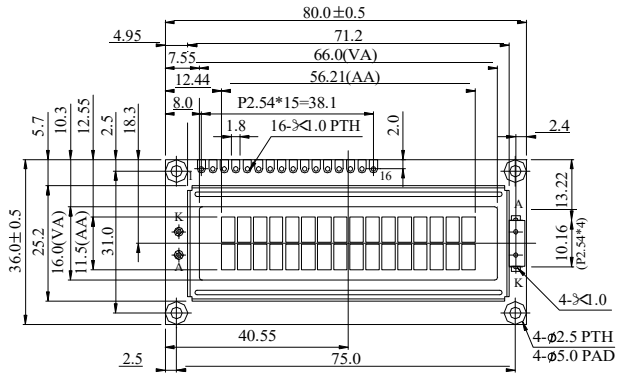
ITEM	CONTENTS
Display Format	16 characters x 2 Lines
Overall Dimensions	80.0 x 36.0 x 14.2(MAX)
Viewing Area	80.0 x 36.0 x 9.4(MAX)
LCD type	STN / FSTN
Mode	Avaible in Reflective / Transflective / Transmissive
Viewing Angle	6 o'clock
Duty ratio	1/16
Driver IC	Compatible HD44780
Backlight type	None / LED / EL
Backlight colour	YG / White / Tricolour / Amber / Red
DC/DC converter	None or Included
Operating temperature	From 0/+50°C to -20°/+70°C
Storage temperature	From -20°/+70°C to -30°/+80°C

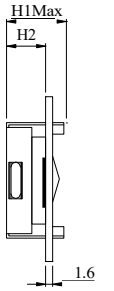
3 MECHANICAL SPECIFICATION

3.1 MECHANICAL CHARACTERISTICS

Item	Dimension	Unit
Number of Characters	16 characters x 2 Lines	–
Module dimension	80.0 x 36.0 x 14.2 (max)	mm
View area	66.0 x 16.0	mm
Active area	56.21 x 11.5	mm
Dot size	0.56 x 0.66	mm
Dot pitch	0.60 x 0.70	mm
Character size	2.96 x 5.56	mm
Character pitch	3.55 x 5.94	mm
Duty	1/16	
View direction	6 o'clock	
Backlight Type	N/A	

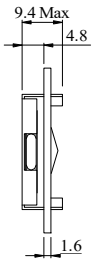
3.2 MECHANICAL DRAWING





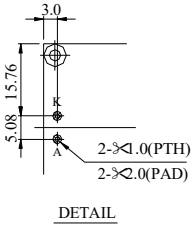
LED H/L B/L

	High	Low
H1	13.2	12.1
H2	8.6	7.5

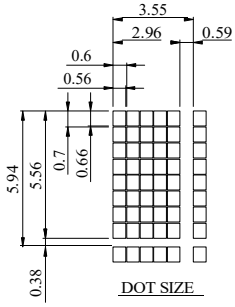


EL or NO B/L

PIN NO.	SYMBOL
1	Vss
2	Vdd
3	Vo
4	RS
5	R/$\overline{W}$
6	E
7	DB0
8	DB1
9	DB2
10	DB3
11	DB4
12	DB5
13	DB6
14	DB7
15	A
16	K



DETAIL



DOT SIZE

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

4 ELECTRICAL SPECIFICATION

4.1 ABSOLUTE MAXIMUM RATINGS

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

Note 1: Background colour changes slightly depending on ambient temperature. This phenomenon is reversible. Ta≤70 °C: 75% RH max
Note 2: Ta≤80 °C: 75% RH max

4.2 ELECTRICAL CHARACTERISTICS

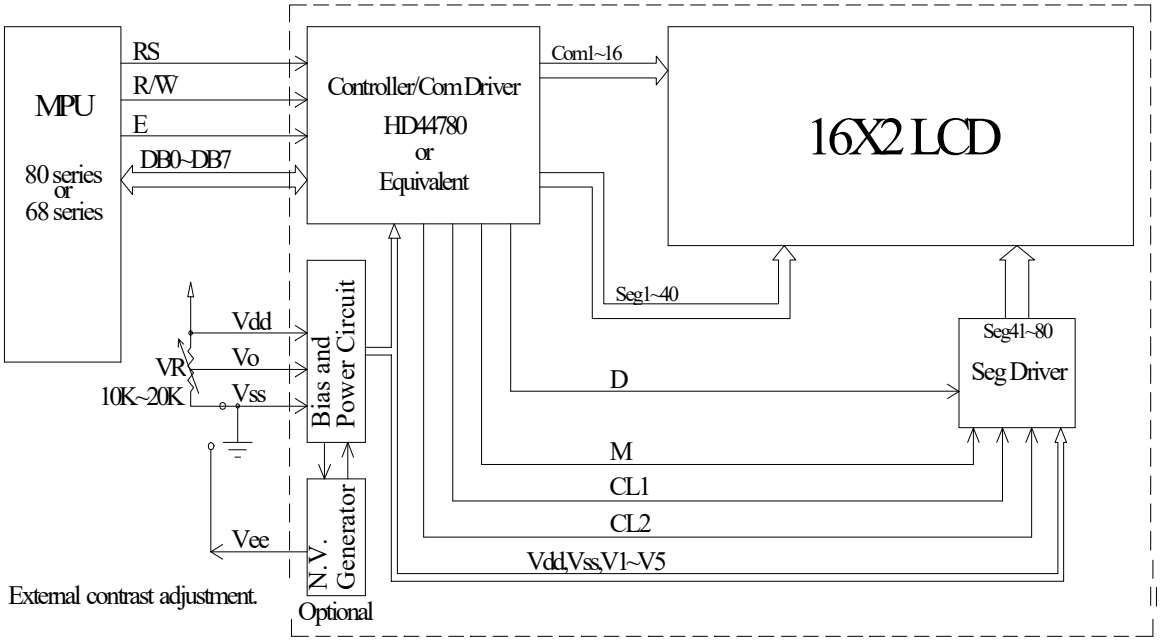
Item	Symbol	Condition	Min	Typ	Max	Unit
Supply Voltage For Logic	V_{DD}-V_{SS}	–	4.5	5.0	5.5	V
Supply Voltage For LCD	V_{DD}-V_0	Ta=-20°C Ta=25°C Ta=70°C	– – 3.2	– 3.7 –	5.2 – –	V V V
Input High Volt.	V_{IH}	–	0.7 V_{DD}	–	V_{DD}	V
Input Low Volt.	V_{IL}	–	V_{SS}	–	0.6	V
Output High Volt.	V_{OH}	–	3.9	–	–	V
Output Low Volt.	V_{OL}	–	–	–	0.4	V
Supply Current	I_{DD}	V_{DD}=5.0V	1.0	1.2	1.5	mA

* I_{DD} measurement condition is for all pattern ON

4.3 INTERFACE PIN ASSIGNMENT

Pin No.	Symbol	Level	Description
1	V_{SS}	0V	Ground
2	V_{DD}	5.0V (3V)	Supply Voltage for logic (3V option)
3	VO	(Variable)	Operating voltage for LCD
4	RS	H/L	H: DATA, L: Instruction code
5	R/W	H/L	H: Read(MPU→Module) L: Write(MPU→Module)
6	E	H,H→L	Chip enable signal
7	DB0	H/L	Data bus line
8	DB1	H/L	Data bus line
9	DB2	H/L	Data bus line
10	DB3	H/L	Data bus line
11	DB4	H/L	Data bus line
12	DB5	H/L	Data bus line
13	DB6	H/L	Data bus line
14	DB7	H/L	Data bus line
15	A		NC
16	K		NC

4.4 BLOCK DIAGRAM



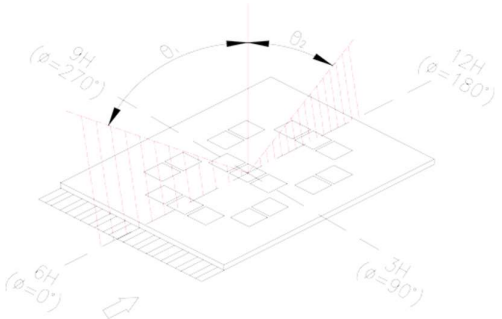
Character located	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
DDRAM address	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F
DDRAM address	40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F

5 OPTICAL SPECIFICATION

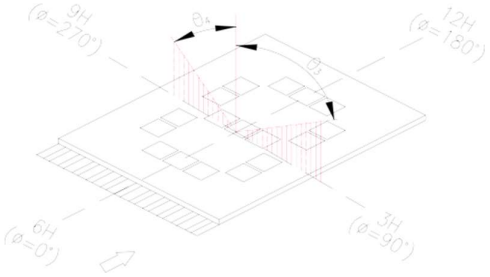
Ta = 25 °C

Item	Symbol	Condition	Min	Typ	Max	Unit	Note
Viewing Angle in STN	θ1	CR≥2	-	40	-	deg	1
	θ2	CR≥2	-	20	-	deg	1
	θ3	CR≥2	-	30	-	deg	2
	θ4	CR≥2	-	30	-	deg	2
Viewing Angle in FSTN	θ1	CR≥2	-	60	-	deg	1
	θ2	CR≥2	-	30	-	deg	1
	θ3	CR≥2	-	45	-	deg	2
	θ4	CR≥2	-	45	-	deg	2
Contrast Ratio	CR	Ta = 25 °C	-	5	-	-	3
Response Time	Tr	Ta = 25 °C	-	200	300	ms	4
	Tf	Ta = 25 °C	-	150	200		
Driving Method	Duty	1/16					
Viewing Direction	6 O'CLOCK						

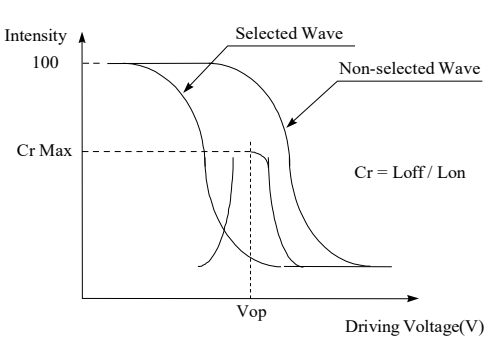
Note 1: definition of viewing angle θ1 & θ2



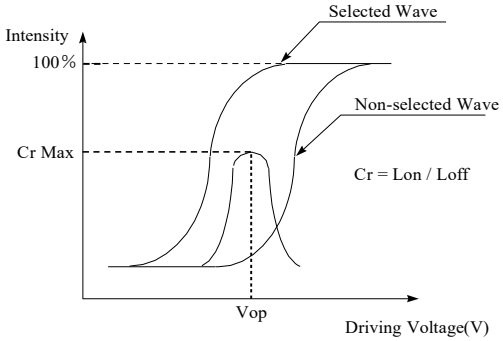
Note 2: definition of viewing angle θ3 & θ4



Note 3: definition of contrast ratio (CR)

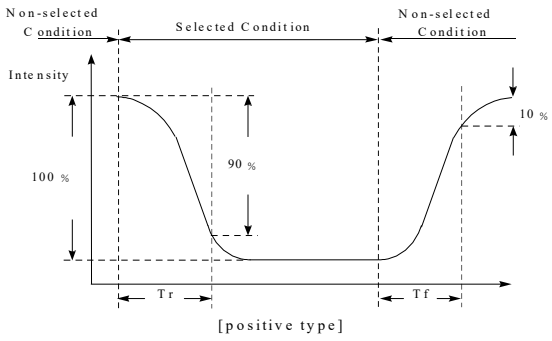


[positive type]

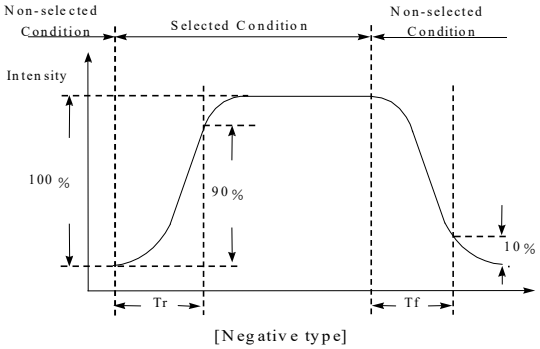


[Negative type]

Note 4: definition of response time



[positive type]



[Negative type]

6 BACKLIGHT SPECIFICATION

6.1 WHITE & YG LED EDGE BACKLIGHT CHARACTERISTICS

Item	Symbol	Condition	Min	Typ	Max	Unit
Supply Current	I	V = 3,5V	-	20	-	mA
Forward Voltage	V_F	I_F = 20mA	-	3,5	3,7	V
Reverse Voltage	V_R		-	-	5	V
Luminous Intensity before through LCD	I_V	I_F = 20mA	20	-	-	cd/m²
Life time		I_F = 20mA	-	50K	-	hrs
Colour	WHITE / YG					

6.2 YG LED BACKLIGHT CHARACTERISTICS

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITION
Supply Current	ILED	100	130	190	mA	V=4.2V
Supply Voltage	V	4.0	4.2	4.4	V	—
Reverse Voltage	VR	—	—	8	V	—
Luminous Intensity	IV	80	100	—	CD/M^2	ILED=130mA
Wave Length	λ p	565	575	585	nm	ILED=130mA
Life Time	—	—	100K	—	Hr.	ILED ≦ 130mA
Color	Yellow Green					

Note: The LED of B/L is drive by current only, drive voltage is for reference only. drive voltage can make driving current under safety area (current between minimum and maximum).

6.3 EL BACKLIGHT CHARACTERISTICS

Item	Symbol	Test Condition	Min	Typ	Max	Unit
Driving Voltage	V_{EL}	T=25℃	—	110	120	Vrms
Driving Frequency	Freq.	T=25℃	—	400	1000	Hz
Luminous Intensity	IV	V_{EL}=110Vrms, Freq=400Hz T=25℃	—	50	—	cd/m^2
CIE color coordinate	X		—	0.330	—	
	Y		—	0.365	—	
Power consumption	Id		—	0.133	—	mA/cm^2
	Wd			48.51		mW/cm^2
Life time				5000		Hr.
Color	White					

7 CONTROLLERS

7.1 Display Control Instruction

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

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

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

Busy Flag (BF)

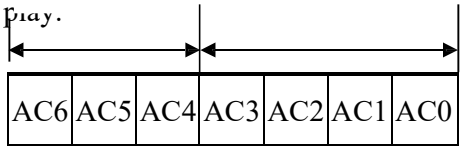
When the busy flag is 1, the controller LSI is in the internal operation mode, and the next instruction will not be accepted. When RS=0 and R/W=1, the busy flag is output to DB7. The next instruction must be written after ensuring that the busy flag is 0.

Address Counter (AC)

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

Display Data RAM (DDRAM)

This DDRAM is used to store the display data represented in 8-bit character codes. Its extended capacity is 80×8 bits or 80 charac High bits gure Low bits nships between DDRAM addresses and positions on the liquid crystal display.



Example: DDRAM addresses 4E

1	0	0	1	1	1	0

AC
(hexadecimal)

Display position DDRAM address

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

2-Line by 16-Character Display

Character Generator ROM (CGROM)

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

Character Generator RAM (CGRAM)

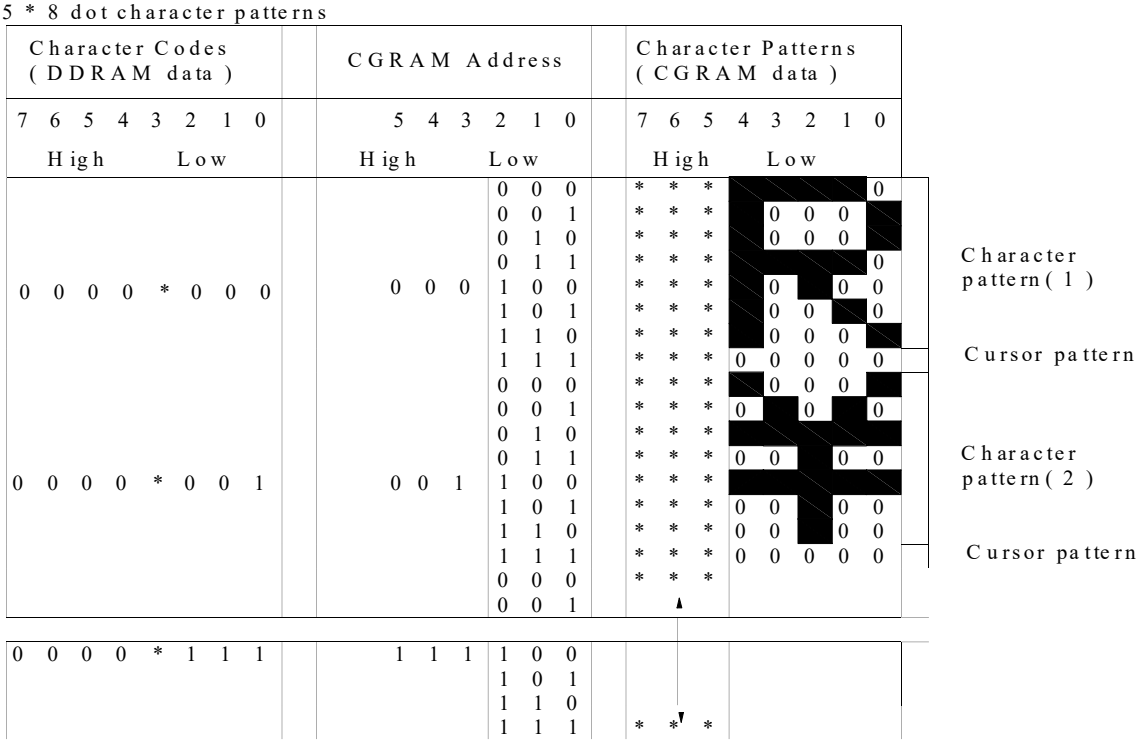
In CGRAM, the user can rewrite character by program. For 5×8 dots, eight character patterns can be written, and for 5×10 dots, four character patterns can be written.

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

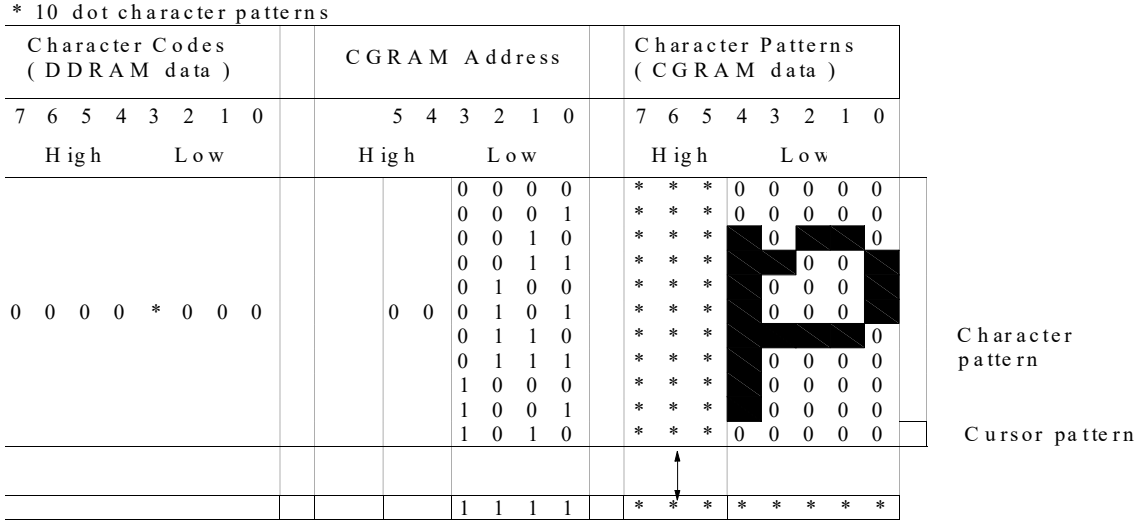
Relationship between CGRAM Addresses, Character Codes (DDRAM) and Character patterns

Table 1.

For 5 * 8 dot character patterns



For 5 * 10 dot character patterns



■ : " High "

7.2 Character generator ROM Pattern

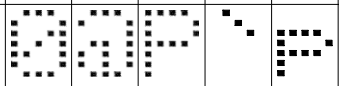
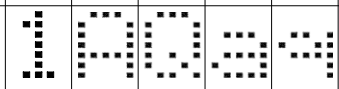
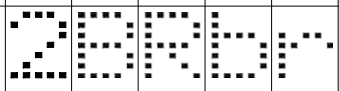
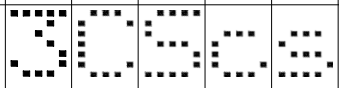
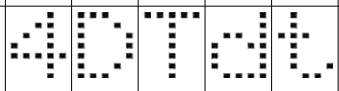
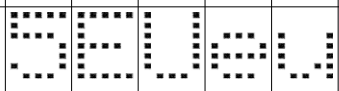
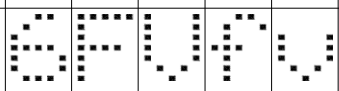
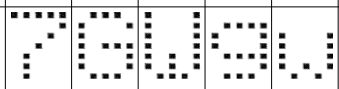
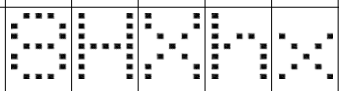
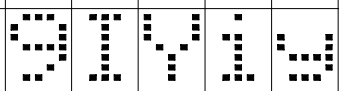
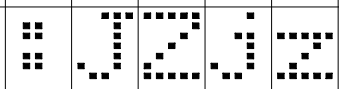
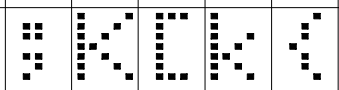
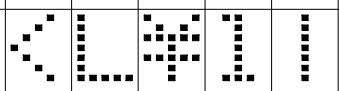
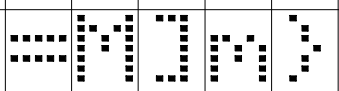
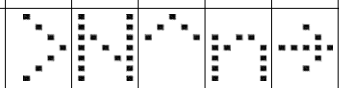
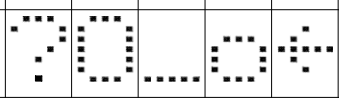
Upper 4 bit / Lower 4 bit	LLLL	LLLH	LLHL	LLHH	LHLL	LHLH	LHHL	LHHH	HLLL	HLLH	HLHL	HLHH	HHLL	HHLH	HHHL	HHHH
LLLL	CG RAM (1)															
LLLH	(2)															
LLHL	(3)															
LLHH	(4)															
LHLL	(5)															
LHLH	(6)															
LHHL	(7)															
LHHH	(8)											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

Table.2

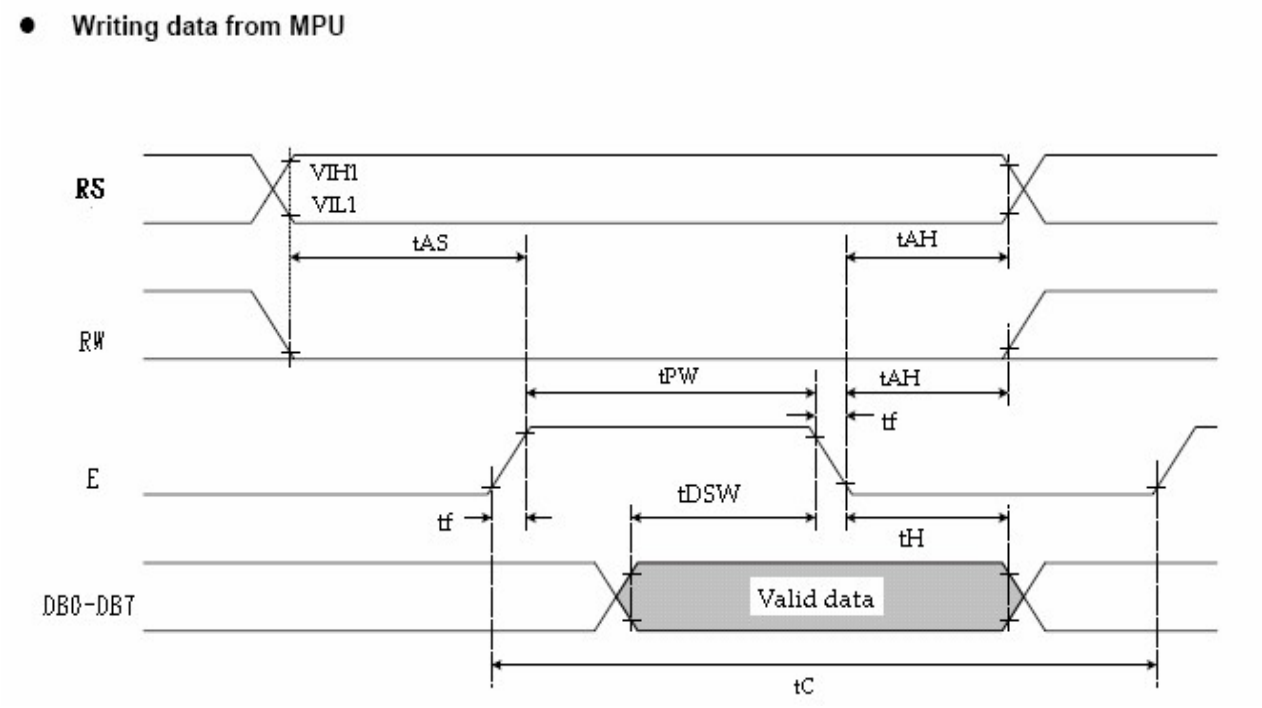
7.3. Instruction Table

Instruction	Instruction Code										Description	Execution time (fosc=270Khz)
	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0		
Clear Display	0	0	0	0	0	0	0	0	0	1	Write “00H” to DDRAM and set DDRAM address to “00H” from AC	1.53ms
Return Home	0	0	0	0	0	0	0	0	1	–	Set DDRAM address to “00H” from AC and return cursor to its original position if shifted. The contents of DDRAM are not changed.	1.53ms
Entry Mode Set	0	0	0	0	0	0	0	1	I/D	SH	Assign cursor moving direction and enable the shift of entire display.	39 μ s
Display ON/OFF Control	0	0	0	0	0	0	1	D	C	B	Set display (D), cursor (C), and blinking of cursor (B) on/off control bit.	39 μ s
Cursor or Display Shift	0	0	0	0	0	1	S/C	R/L	–	–	Set cursor moving and display shift control bit, and the direction, without changing of DDRAM data.	39 μ s
Function Set	0	0	0	0	1	DL	N	F	–	–	Set interface data length (DL:8-bit/4-bit), numbers of display line (N:2-line/1-line)and, display font type (F:5 × 11 dots/5 × 8 dots)	39 μ s
Set CGRAM Address	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0	Set CGRAM address in address counter.	39 μ s
Set DDRAM Address	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Set DDRAM address in address counter.	39 μ s
Read Busy Flag and Address	0	1	BF	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Whether during internal operation or not can be known by reading BF. The contents of address counter can also be read.	0 μ s
Write Data to RAM	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Write data into internal RAM (DDRAM/CGRAM).	43 μ s
Read Data from RAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0	Read data from internal RAM (DDRAM/CGRAM).	43 μ s

7.4. Timing Characteristics

Write Operation

- Writing data from MPU

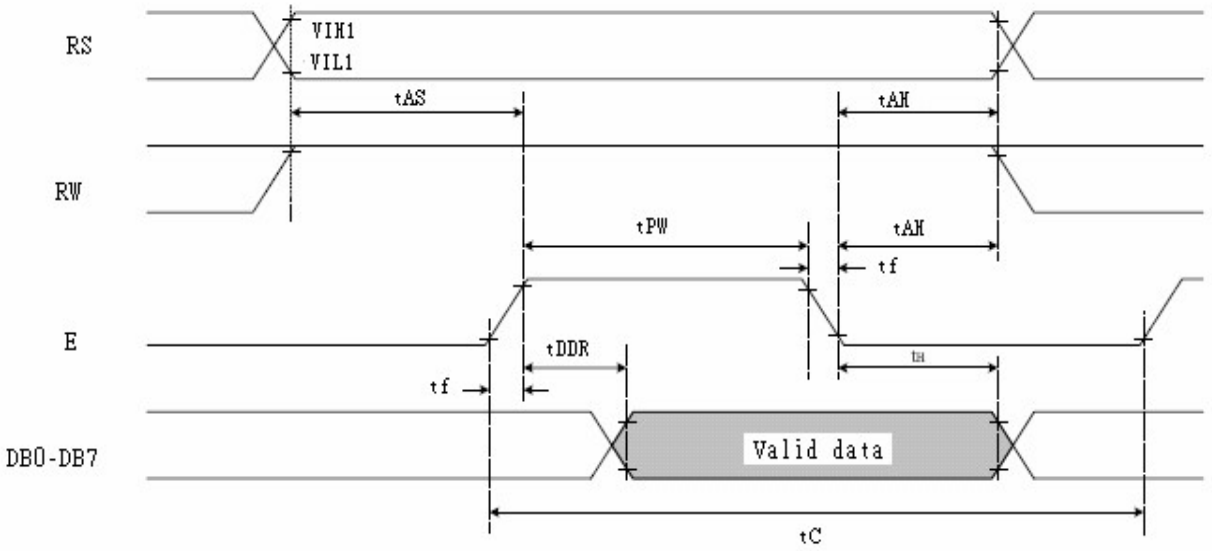


Ta=25°C, VDD=5.0V

Item	Symbol	Min	Typ	Max	Unit
Enable cycle time	T_C	1200	–	–	ns
Enable pulse width	T_{PW}	140	–	–	ns
Enable rise/fall time	T_R,T_F	–	–	25	ns
Address set-up time (RS, R/W to E)	t_{AS}	0	–	–	ns
Address hold time	t_{AH}	10	–	–	ns
Data set-up time	t_{DSW}	40	–	–	ns
Data hold time	t_H	10	–	–	ns

Read Operation

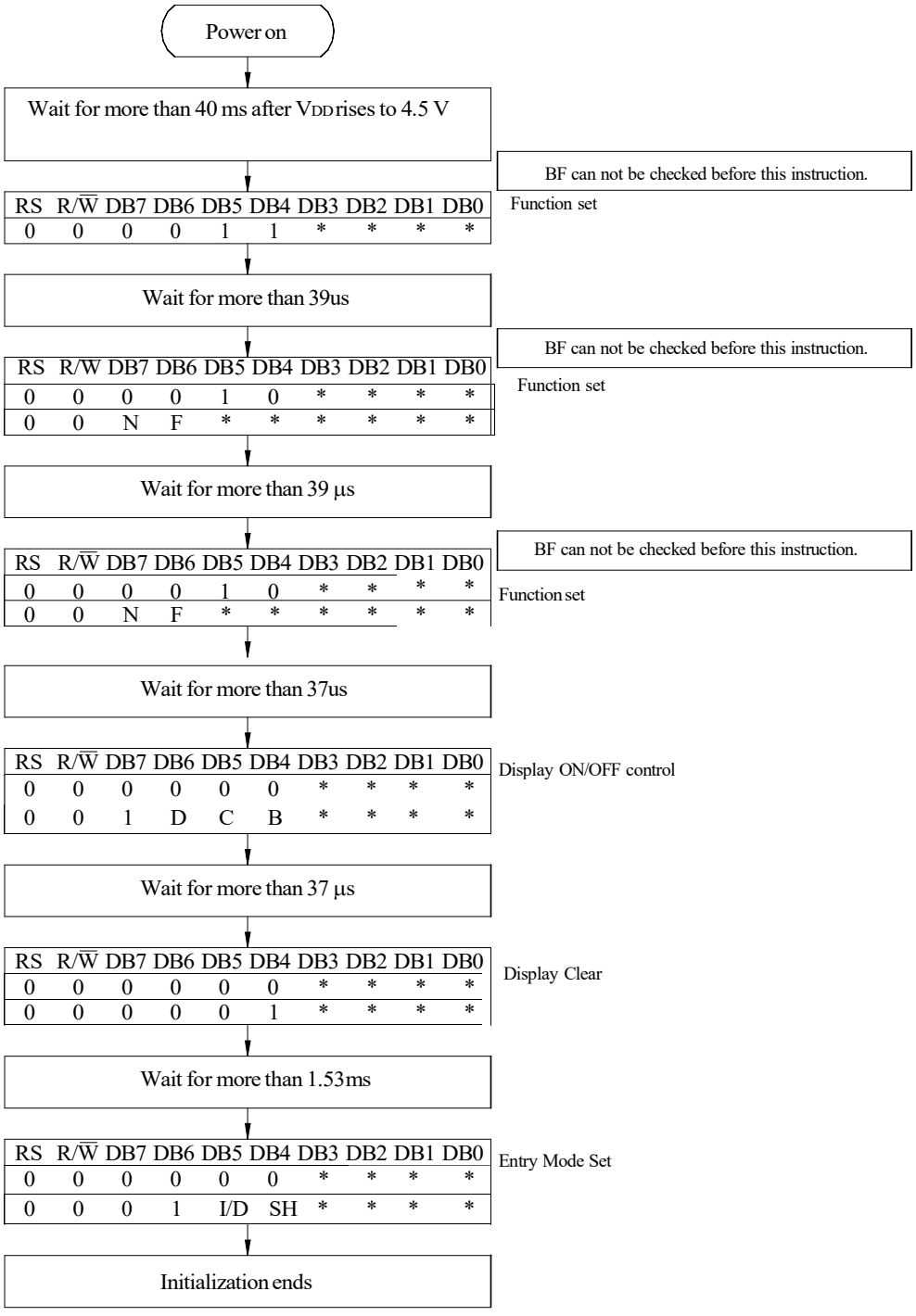
- Reading data from ST7066U



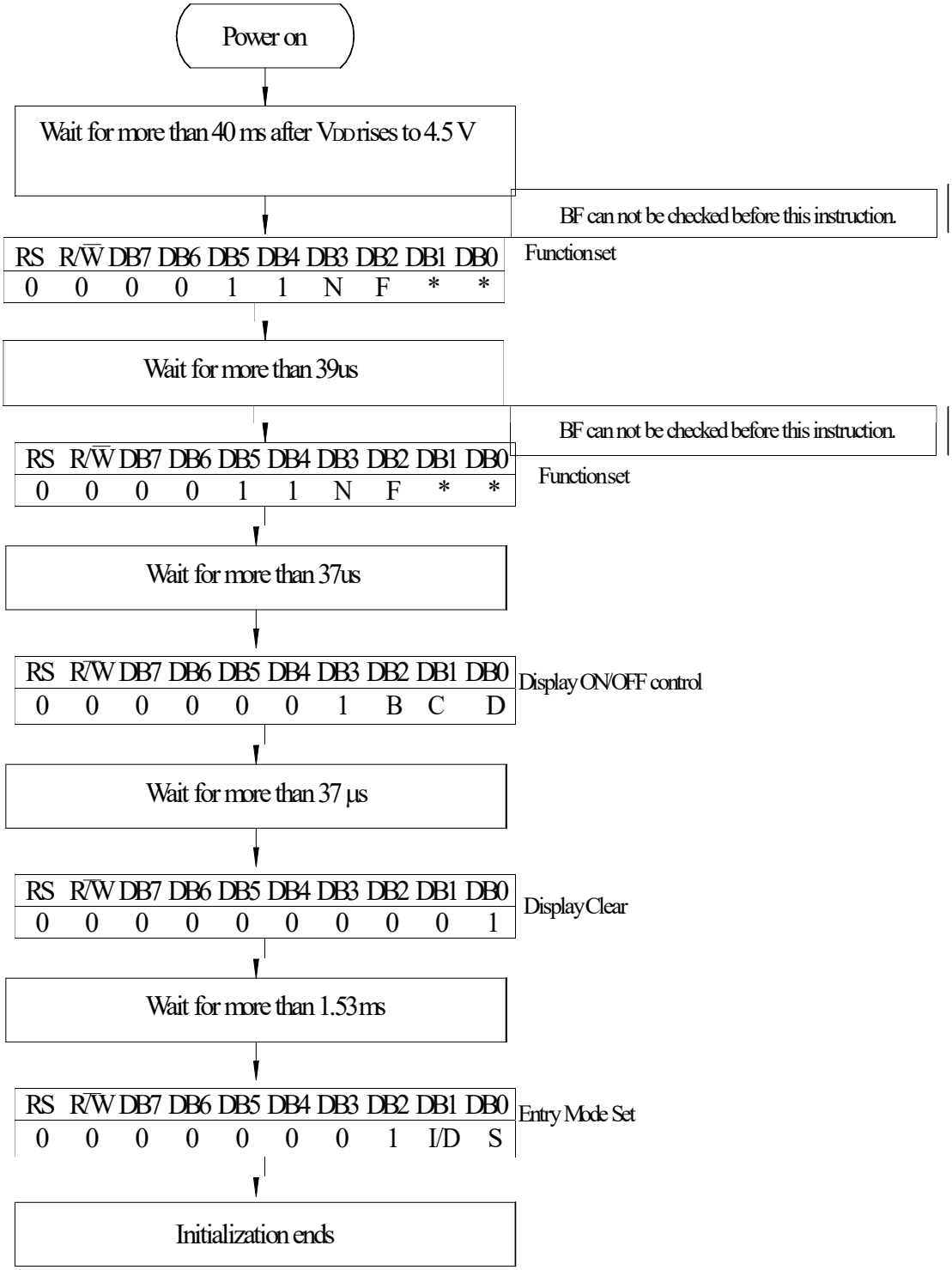
Ta=25℃, VDD=5V

Item	Symbol	Min	Typ	Max	Unit
Enable cycle time	T_C	1200	–	–	ns
Enable pulse width (high level)	T_{PW}	140	–	–	ns
Enable rise/fall time	T_R,T_F	–	–	25	ns
Address set-up time (RS, R/W to E)	t_{AS}	0	–	–	ns
Address hold time	t_{AH}	10	–	–	ns
Data delay time	t_{DDR}	–	–	100	ns
Data hold time	t_H	10	–	–	ns

7.4 Initialing of LCM



4-Bit Ineterface



8-Bit Ineterface

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

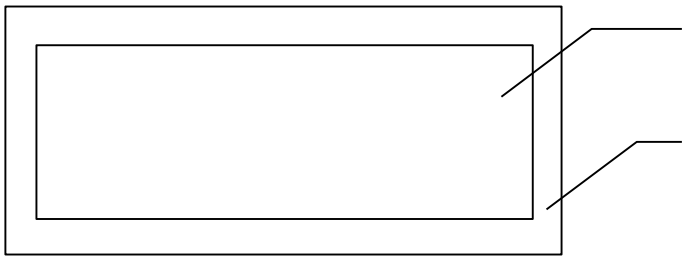
8.2.1 Delivery inspection standards.

- MIL-STD-105E, general inspection level II, single sampling level;
- IPC-AA610 rev. C, class 2 electronic assemblies standard

The quality assurance levels are shown below:

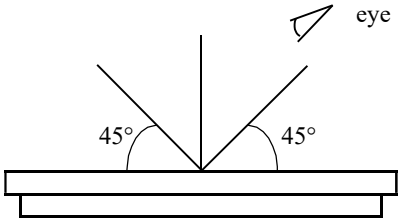
Rank	Item Inspected	Defect type	AQL	Remark
Critical defect	Display	Non display	0.65%	Display malfunction
		Over current		
		Missing segment		
		Wrong viewing direction		
		Backlight OFF		
	Dimension	PCB and bezel out of specification	0.65%	Assembly failure
Major defect	Display	Incorrect operating	1.0%	
	Backlight	Flashing, dust		
		Wrong colour		
Minor defect	LCD	Black and white spot	2.5%	Appearance defect
		Black and white lines		
		Polariser scratch		
		Bubbles in polariser		
		Segment deformation, pin hole		
		Colour uniformity		
		Glass chip		
	COB	Wire bond pad exposed		
		Insufficient covering with resin (wire bond line exposed)		
		Bubble, dust on COB		
	PCB	Dust, solder ball on PCB		
		Pad scratch		
		Total	2.5%	

8.2.2 Zone definition



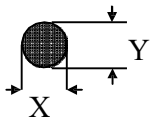
8.2.3 Visual inspection

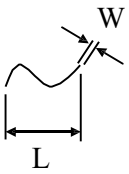
- Inspect under 2x20W or 40W fluorescent lamp (approximately 3000 lux) leaving 25 to 30 cm between the module and the lamp and 30 cm between the module and the eye (measuring position).
- Appearance is inspected at the best contrast voltage (best contrast is adjusted considering clearness and crosstalk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

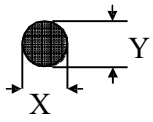


8.2.4 Standard of appearance inspection

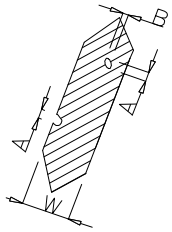
Units: mm

<table>
<tr><th>No</th><th>Item</th><th>Criteria</th></tr>
<tr><td>1</td><td>Black spot, white spot, dust</td><td>
Round type: as per following drawing
∅ = (X+Y)/2


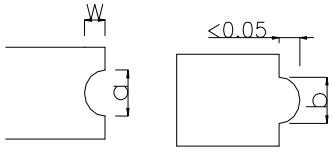
<table>
<tr><th colspan="3">Acceptable quantity</th></tr>
<tr><th>Size</th><th>Zone A</th><th>Zone B</th></tr>
<tr><td>∅<0.1</td><td>Any number</td><td rowspan="4">Any number</td></tr>
<tr><td>0.1<∅<0.2</td><td>6</td></tr>
<tr><td>0.2<∅<0.3</td><td>2</td></tr>
<tr><td>0.3<∅</td><td>0</td></tr>
</table>
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≤0.02</td><td>Any number</td><td rowspan="4">Any number</td></tr>
<tr><td>L≤3.0</td><td>0.02<W≤0.03</td><td rowspan="2">2</td></tr>
<tr><td>L≤2.5</td><td>0.03<W≤0.05</td></tr>
<tr><td>- -</td><td>0.05<W</td><td>As round type</td></tr>
</table>
Total acceptable quantity: 3
</td></tr>
<tr><td>2</td><td>Polariser scratch</td><td>Scratch on protective film is permitted
Scratch on polariser: same as No. 1</td></tr>
<tr><td>3</td><td>Polariser bubble</td><td>
∅ = (X+Y)/2


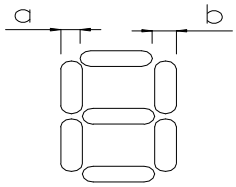
<table>
<tr><th colspan="3">Acceptable quantity</th></tr>
<tr><th>Size</th><th>Zone A</th><th>Zone B</th></tr>
<tr><td>∅<0.3</td><td>Any number</td><td rowspan="4">Any number</td></tr>
<tr><td>0.3<∅<1.0</td><td>3</td></tr>
<tr><td>1.0<∅<1.5</td><td>1</td></tr>
<tr><td>1.5<∅</td><td>0</td></tr>
</table>
Total acceptable quantity: 4
</td></tr>
<tr><td>4</td><td>Segment deformation</td><td>
1.a. Pin hole on segmented display

W: segment width
∅ = (A+B)/2


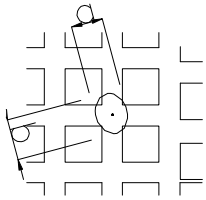
<table>
<tr><th colspan="2">Acceptable quantity</th></tr>
<tr><th>Width</th><th>∅</th></tr>
<tr><td>W≤0.4</td><td>∅≤0.2 and ∅≤1/2W</td></tr>
<tr><td>W>0.4</td><td>∅≤0.25 and ∅≤1/3W</td></tr>
</table>
Total acceptable quantity: 1 defect per segment
Pin holes with ∅ under 0.10 mm are acceptable
</td></tr>
</table>

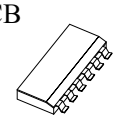
<table>
<tr><th>No</th><th>Item</th><th>Criteria</th></tr>
<tr><td>4</td><td>Segment deformation</td><td>
1b. Pin hole on dot matrix display


<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>5</td><td>Colour uniformity</td><td>Level of sample for approval set as limit sample</td></tr>
<tr><td>6</td><td>Backlight</td><td>The backlight colour should correspond to the product specification
Flashing and or unlit backlight is not allowed
Dust larger than 0.25 mm is not allowed</td></tr>
<tr><td>7</td><td>COB</td><td>Exposed wire bond pad is not allowed
Insufficient covering with resin is not allowed (wire bond line exposed)
Dust or bubble on the resin are not allowed</td></tr>
<tr><td>8</td><td>PCB
  </td><td>No unmelted solder paste should be present on PCB
Cold solder joints, missing solder connections, or oxidation are not allowed
No residue or solder balls on PCB are allowed
Short circuits on components are not allowed</td></tr>
</table>

9 RELIABILITY SPECIFICATION

Test Item	Test Condition	Description
High Temperature Operation	50°C or 70°C 200hrs	Endurance test applying the electric stress (Voltage & Current) and the thermal stress to the element for a long time.
Low Temperature Operation	0°C or -20°C 200hrs	Endurance test applying the electric stress under low temperature for a long time.
High Temperature Storage	70°C or 80°C 200hrs	Endurance test applying the high storage temperature for a long time.
Low Temperature Storage	-20°C or -30°C 200hrs	Endurance test applying the high storage temperature for a long time.
High Temperature & High Humidity Storage	80°C,90%RH 96hrs	Endurance test applying the high temperature and high humidity storage for a long time.
Thermal Shock Test	-30°C 25°C 80°C 30min 5min 30min For 10 cycles	Endurance test applying the low and high temperature cycle. Burn In Test.
Vibration	10~22Hz→1.5mmp-p 22~500Hz→1.5G Total 0.5hrs	Endurance test applying the vibration during transportation and using.
ESD	VS=800V,RS=1.5kΩ CS=100pF	Endurance test applying the electric stress to the terminal.
Shock Test	50G Half sign wave 11 msed 3 times of each direction	Constructional and mechanical endurance test applying the shock during transportation.

10 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).