LIQUID CRYSTAL DISPLAY MODULE
MODEL: NMTB-S000363FYHSAY
Customer's No.:

Acceptance

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Approved and Checked by

Approved by	Checked by		Made by
微 端 2006/3/01 張秀美	微 端 2006/3/01 石國良	微 端 2006/3/01 連俊傑	微 端 2006/3/01 李守正

Revise Records

Rev.	Date	Contents	Written	Approved
A	2005/10/28	Initial Edition	David Ma	Debbie Chang
A	2005/11/2	See Note2	David Ma	Debbie Chang
A	2005/11/3	See Note3	David Ma	Debbie Chang
A	2006/3/01	See Note4	Kathy Lee	Debbie Chang

Special Notes

Note1.	LCD panel part no : 25A-16101XDF.
Note2.	With R9 =R10 =47 ohm and R3=5.6k ohm.
Note3.	Add Commands Description and Character Font Table (page 21~28)
Note4.	The LCD module is compliant with RoHS .
Note5.	

CONTENTS

The Microtips Customized LCD module, model: NMTB-S000363FYHSAY is compliant with RoHS.

1. General Specifications

Operating Temperature.	:	Min. -20°C ～ Max. 70°C
Storage Temperature.	:	Min. -30°C ～ Max. 80°C
Display Format	:	16 characters x 1 line
Display Fonts	:	5 x 8 dots (1 character)
Viewing Area	:	99.0 (W) x 13.0 (H) mm
Outline Dimensions	:	115.0* (W) x 35.0* (H) x 15.0 max. (D) mm * PCB Dimensions
Weight	:	N/A
LCD Type	:	STN / Positive, Yellow Green mode / Transflective
Viewing Direction	:	6:00
Backlight	:	Bottom Array type LED backlight
LCD LSI	:	SPLC780
Drawings	:	As attached drawings

2. Electrical Specifications

2.1 Absolute Maximum Ratings

V_{SS} = 0V

Parameter	Symbol	Conditions	Min.	Max.	Units
Supply Voltage (Logic)	V_{DD} - V_{SS}	–	- 0.3	7.0	V
Supply Voltage (LCD Drive)	V_{LCD}	–	V_{DD} –15.0	V_{DD} + 0.3	V
Input Voltage	V_I	–	- 0.3	V_{DD} + 0.3	V

2.2 DC Characteristics

Ta = 25°C, V_{SS} = 0V

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Supply Voltage (Logic)	V_{DD} - V_{SS}	–	4.5	–	5.5	V
Supply Voltage (LCD Drive)	V_{DD} – V_O	Shown in 3.1				V
High Level (Input Voltage)	V_{IH}	V_{DD} = 5.0V	2.2	–	V_{DD}	V
Low Level (Input Voltage)	V_{IL}	V_{DD} = 5.0V	-0.3	–	0.6	V
High Level (Output Voltage)	V_{OH}	I_{OH} =-0.205mA	2.4	–	V_{DD}	V
Low Level (Output Voltage)	V_{OL}	I_{OL}= 1.2mA	0	–	0.4	V
Supply Current	I_{DD}	V_{DD} - V_{SS} = 5.0V	–	1.5	5.0	mA

Ta = 25°C, V_{SS} = 0V

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Supply Voltage (Logic)	V_{DD} - V_{SS}	–	2.7	–	4.5	V
Supply Voltage (LCD Drive)	V_{DD} – V_O	Shown in 3.1				V
High Level(Input Voltage)	V_{IH}	V_{DD} = 3.0V	0.7 V_{DD}	–	V_{DD}	V
Low Level (Input Voltage)	V_{IL}	V_{DD} = 3.0V	-0.3	–	0.55	V
High Level (Output Voltage)	V_{OH}	I_{OH} = -0.1mA	0.75 V_{DD}	–	V_{DD}	V
Low Level (Output Voltage)	V_{OL}	I_{OL}= 0.1mA	0	–	0.2 V_{DD}	V
Supply Current	I_{DD}	V_{DD} - V_{SS} = 5.0V	–	1.5	5.0	mA

2.3 AC Characteristics

V_{DD} = 4.5V~5.5V

Parameter	Symbol	Conditions	Min.	Max.	Units
Enable Cycle Time	t_{CYC}	Fig.1, 2	500	--	ns
Enable Pulse Width	PW_{EH}	Fig.1, 2	230	--	ns
Enable Rise/Fall Time	t_{Er}, t_{Ef}	Fig.1, 2	--	20	ns
Address Setup Time	t_{AS}	Fig.1, 2	40	--	ns
Address Hold Time	t_{AH}	Fig.1, 2	10	--	ns
Write Data Setup Time	t_{DSW}	Fig.1	80	--	ns
Write Data Hold Time	t_{DHW}	Fig.1	10	--	ns
Read Data Delay Time	t_{DDR}	Fig.2	--	120	ns
Read Data Hold Time	t_{DHR}	Fig.2	5	--	ns

V_{DD} = 2.7V~4.5V

Parameter	Symbol	Conditions	Min.	Max.	Units
Enable Cycle Time	t_{CYC}	Fig.1, 2	1000	--	ns
Enable Pulse Width	PW_{EH}	Fig.1, 2	450	--	ns
Enable Rise/Fall Time	t_{Er}, t_{Ef}	Fig.1, 2	--	25	ns
Address Setup Time	t_{AS}	Fig.1, 2	60	--	ns
Address Hold Time	t_{AH}	Fig.1, 2	20	--	ns
Write Data Setup Time	t_{DSW}	Fig.1	195	--	ns
Write Data Hold Time	t_{DHW}	Fig.1	10	--	ns
Read Data Delay Time	t_{DDR}	Fig.2	--	360	ns
Read Data Hold Time	t_{DHR}	Fig.2	5	--	ns

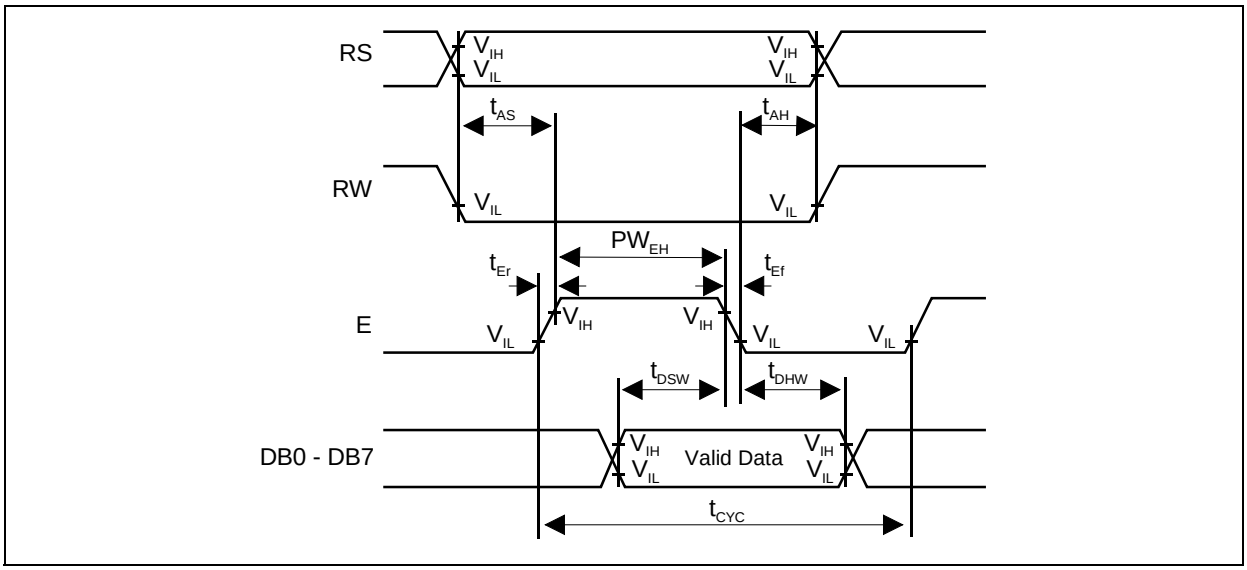


Fig.1 Write Operation Timing

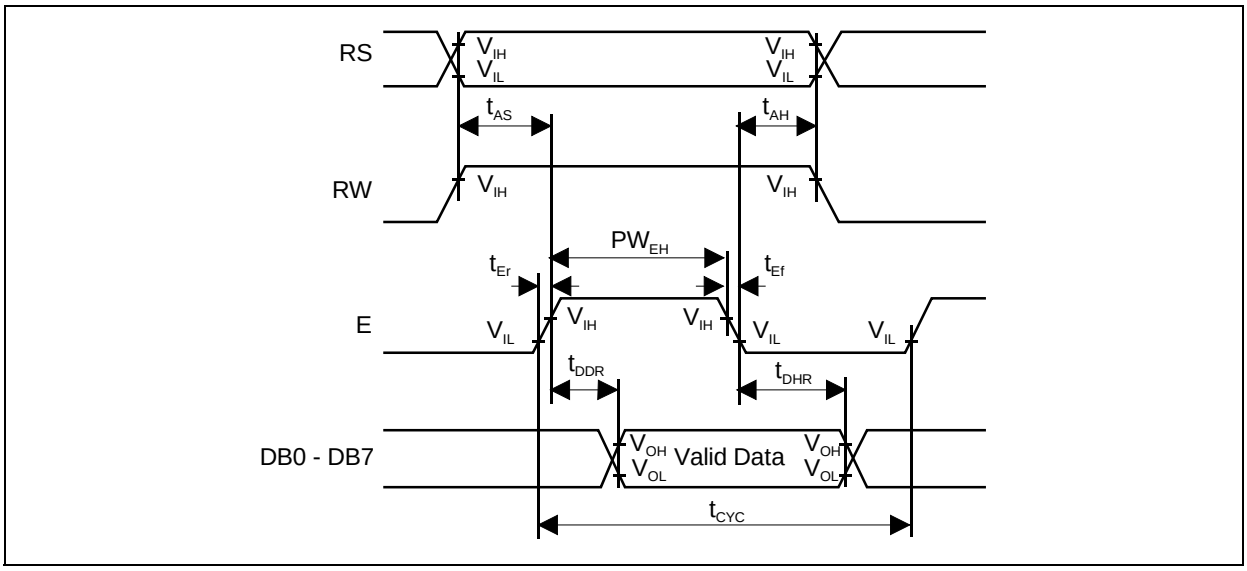


Fig.2 Read Operation Timing

2.4 Lighting Specifications

2.4.1 Absolute Maximum Ratings

Ta=25°C

Parameter	Symbol	Conditions	Max.	Units
Forward Current	I_F	--	320	mA
Reverse Voltage	V_R	--	10.0	V
LED Power Dissipation	P_D	--	1.536	W

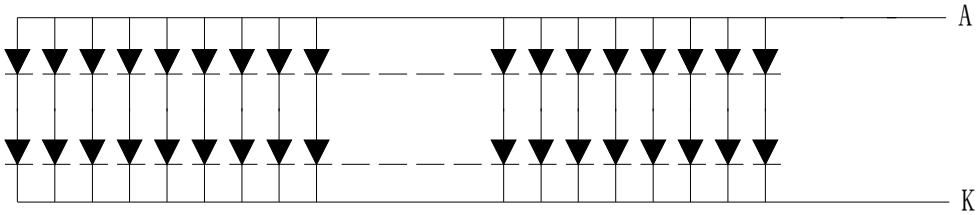
2.4.2 Operating Characteristics

Ta=25°C

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Forward Voltage	V_F	I_F=160mA	--	4.2	4.8	V
Peak Emission Wavelength (Note1)	λ_P		570	573	575	nm
Luminance of Backlight Surface	L		100	170	--	cd/m^2
Luminous Tolerance (Note 2)	--		--	30	--	%

Note 1: Source Color : Yellow Green
Note 2: Luminance tolerance = (Max. - Min. / Max.) x 100%.
Note 3: The driving condition above is based on Backlight A,K.

2.4.3 Schematics Related



2 x 16 = 32 (LED dice number)

3. Optical Specifications

3.1 LCD Driving Voltage

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Recommended LCD Driving Voltage Note 1	V_{DD}-V_O	Ta = -20 °C	--	4.61	--	V
		Ta = 25 °C	--	4.49	--	V
		Ta = 70 °C	--	4.19	--	V

Note 1 : Voltage (Applied actual waveform to LCD panel) for the best contrast. The range of minimum and maximum shows tolerance of the operating voltage. The specified contrast ratio and response time are not guaranteed over the entire range.

3.2 Optical Characteristics

Ta=25 °C, 1/16 Duty, 1/5 Bias, (Note 4), θ = 0°, ϕ = 270°

Parameter		Symbol	Conditions	Min.	Typ.	Max.	Units
Contrast Ratio Note 1		C	θ = 0°, ϕ = 0°	--	5	--	--
Viewing Angle (Shown in 3.3)		Front-Back	θ_f- θ_b, ϕ = 0°	+30	to	-10	deg.
		Left-Right	θ_l- θ_r, ϕ = 0°	+25	to	-25	deg.
Response Time	Rise Note 2	T_{ON}	Ta = -20 °C	--	6040	12080	msec
	Decay Note 3	T_{OFF}	Ta = -20 °C	--	4470	8940	msec
	Rise Note 2	T_{ON}	Ta = 25 °C	--	125	250	msec
	Decay Note 3	T_{OFF}	Ta = 25 °C	--	145	290	msec
	Rise Note 2	T_{ON}	Ta = 70 °C	--	--	--	msec
	Decay Note 3	T_{OFF}	Ta = 70 °C	--	--	--	msec

Note 1 : Contrast ratio is defined as follows.
CR = L_{OFF} / L_{ON}
L_{ON} : Luminance of the ON segments, L_{OFF} : Luminance of the OFF segments

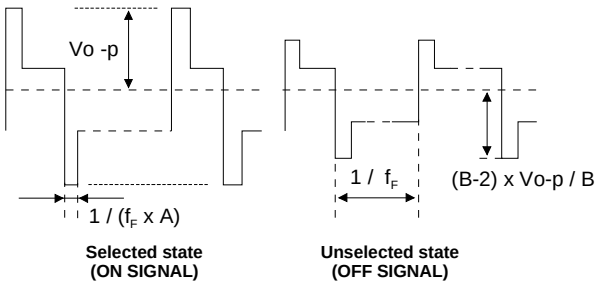
Note 2 : The time that the luminance level reaches 90% of the saturation level from 0% when ON signal is applied.

Note 3 : The time that the luminance level reaches 10% of the saturation level from 100% when OFF signal is applied.

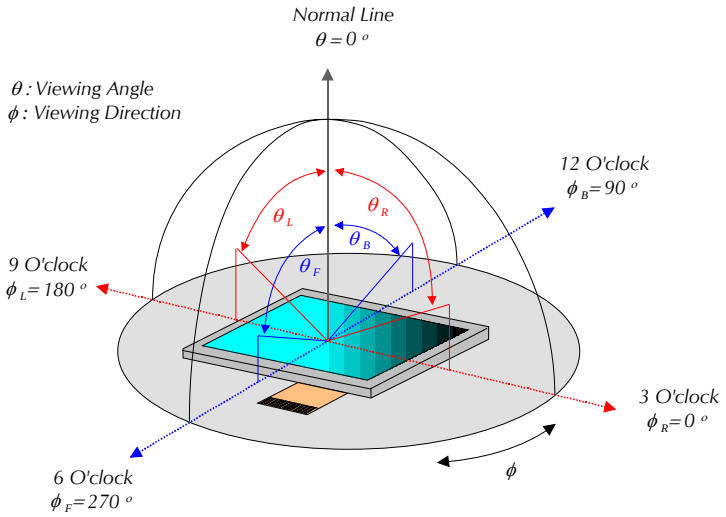
Note 4 : Definition of Driving Voltage V_D. Assuming that the typical driving waveforms shown below are applied to the LCD Panel at /A Duty - 1/B Bias (A : Duty Number, B : Bias Number). Driving voltage V_D is defined s follows: V_D = (Vth1+Vth2) / 2

Vth1 : The voltage VO-P that should provide 50% of the saturation level in the luminance at the segment which the ON signal is applied to.

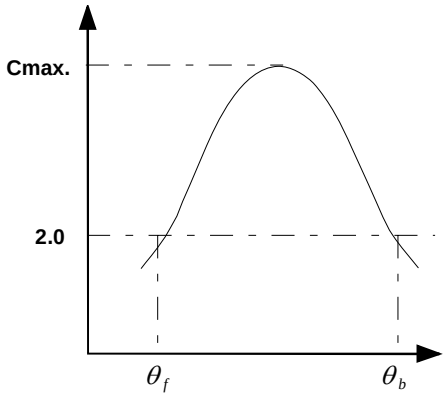
Vth2 : The voltage VO-P that should provide 50% of the saturation level in the luminance at the segment which the OFF signal is applied to.



3.3 Definition of Viewing Angle and Optimum Viewing Area



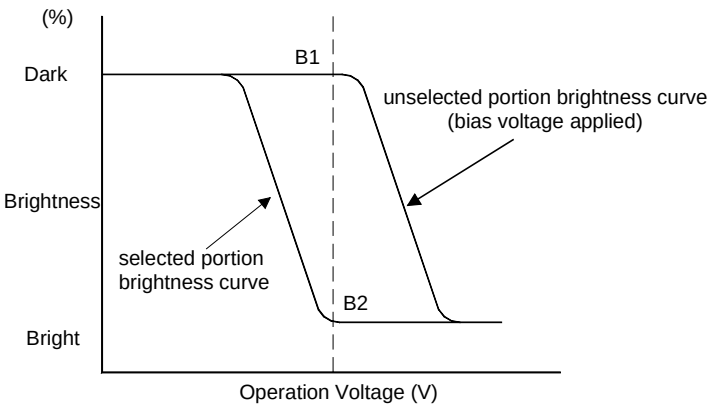
3.4 Definition of Viewing Angle θ_f and θ_b



Viewing angles θ (ϕ fixed)

Optimum viewing angle with the naked eye and viewing angle θ at Cmax.
Above are not always the same.

3.5 Definition of Contrast C, *C= Brightness of selected dot (B1)/ Brightness of unselected dot (B2)*



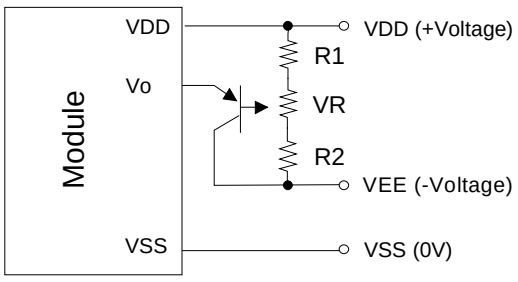
4. I/O Terminal

4.1 Pin Assignment

No.	Symbol	Level	Function
1	VSS	—	Power Supply (0V, GND)
2	VDD	—	Power Supply for Logic
3	VEE (Vo)	—	Power Supply for LCD Drive
4	RS	H / L	Register Select Signal
5	R/W	H / L	Read/Write Select Signal H : Read L : Write
6	E	H / L	Enable Signal (No pull-up Resister)
7	DB0	H / L	Data Bus Line / Non-connection at 4-bit operation
8	DB1	H / L	Data Bus Line / Non-connection at 4-bit operation
9	DB2	H / L	Data Bus Line / Non-connection at 4-bit operation
10	DB3	H / L	Data Bus Line / Non-connection at 4-bit operation
11	DB4	H / L	Data Bus Lin
12	DB5	H / L	Data Bus Line
13	DB6	H / L	Data Bus Line
14	DB7	H / L	Data Bus Line
15	LEDA	--	Power Supply for Backlight /LED Anode (+)
16	LEDK	--	Power Supply for Backlight /LED Cathode (-)

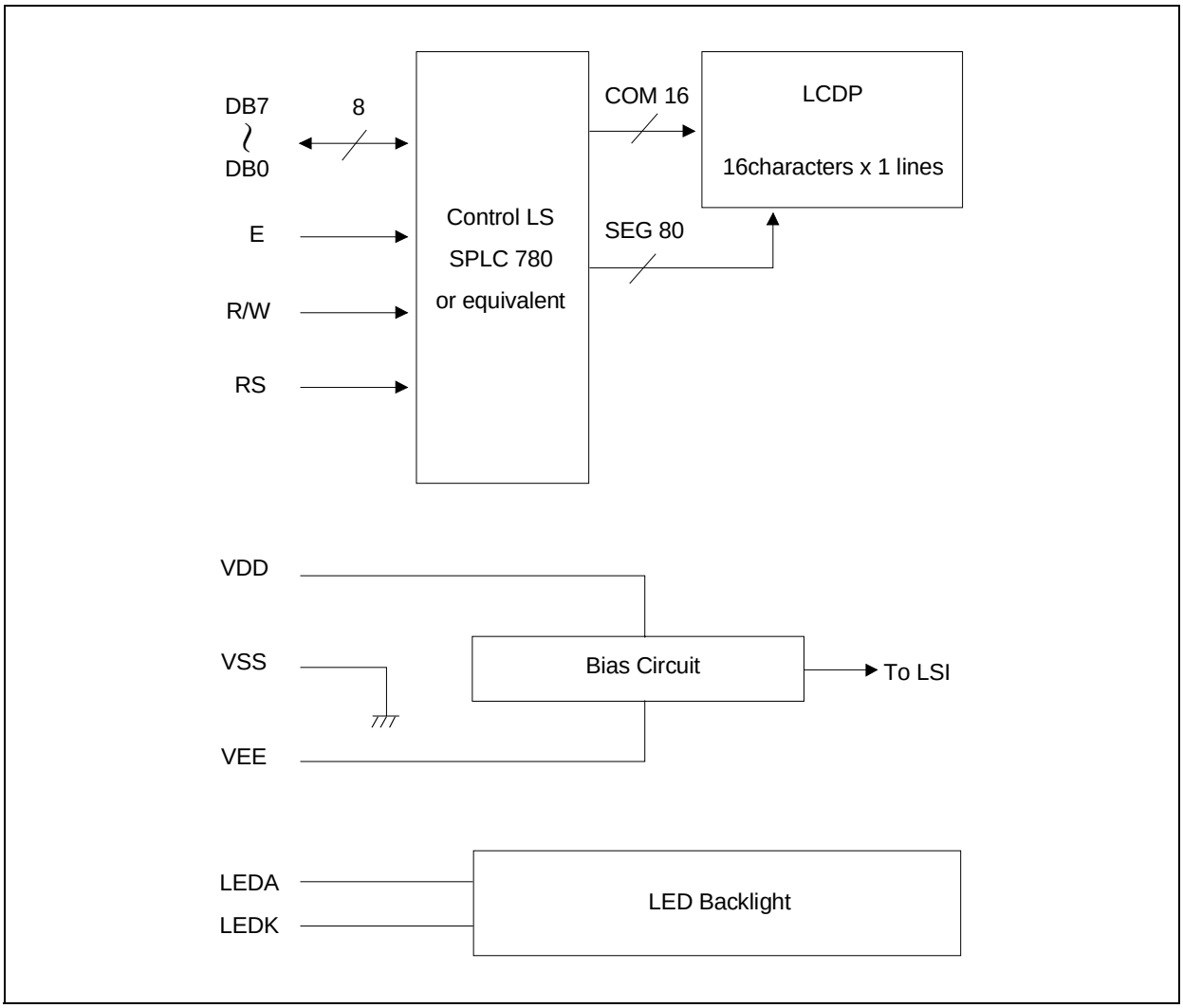
4.2 Example of Power Supply

It is recommended to apply a potentiometer for the contrast adjust due to the tolerance of the driving voltage and its temperature dependence.



R1+R2+VR=10 ～ 20KΩ
Tr=2SA1202 or equivalent

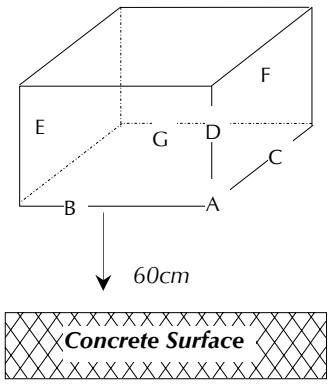
4.3 Block Diagram



5. Reliability Test

5.1 Test Item

No change on display and in operation under the following test condition.

No.	Test Item	Description	Condition	Note
1.	High Temperature (Operation)	Durability test under long time high temperature with electrical stress (voltage, current)	70°C ± 2°C 96hrs	
2.	High Temperature (Storage)	Durability test under long time high temperature storage	80°C ± 2°C 96hrs	4
3.	Low Temperature (Operation)	Durability test under long time low temperature with electrical stress (voltage, current)	-20°C ± 2°C, 96hrs	3
4.	Low Temperature (Storage)	Durability test under long time low temperature storage	-30°C ± 2°C, 96hrs	3, 4
5.	Damp Proof Test	Durability test under long time high temperature and high humidity	40°C± 2°C, 90～95% RH 96hrs	3 , 4
6.	Vibration Test	Total fixed amplitude: 1.5mm Vibration frequency: 10～55Hz One cycle 60 seconds to 3 directions of X, Y, Z for each 15 minutes	- -	5
7.	Drop Test	To be measured after dropping from 60cm high on the concrete surface in packing state.  *Dropping method corner dropping* *A corner: once* *Edge dropping* *B, C, D edge: once* *Face dropping* *E, F, G face: once*		

Note 1: Unless otherwise specified, tests will be conducted under the following condition,
Temperature : 25°C ± 2°C
Humidity : 65% ± 5%
Note 2: Unless otherwise specified, tests will be not conducted under functioning state.
Note 3: No dew condensation to be observed.
Note 4: The function test shall be conducted after 4 hours storage at the normal temperature and humidity after removed from the test chamber.
Note 5: Vibration test will be conducted to the product itself without putting it in a container.

5.2 Judgment Standard

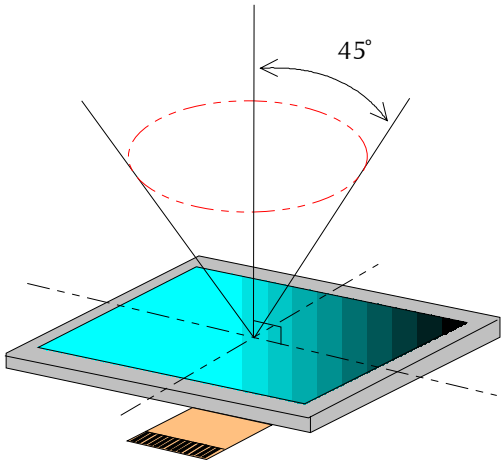
Failure Mode	Test Item							Judgment Standard
	1	2	3	4	5	6	7	
Orientation	*	*	*	*	*			No remarkable degradation of appearance under bias/ non-bias condition
Current Value (IAC)	*	*	*	*	*			No remarkable increase
Contrast	*		*	*	*			No remarkable poor contrast
Domain	*	*	*	*	*			Less than 20% of all dots have reverse tilt of more than on third of one dot area.
Bubble (Inside Cell)	*	*	*	*	*	*		As per "Appearance Standard" (Note. Including one which disappear after 25°C 2H)
Polarizer	*				*	*		As per "Appearance Standard" no remarkable appearance change
Glass Damage							*	As per "Appearance Standard"

Note.1. * is strong linkage between Failure Mode and Test Item.
2. Number of Test Item should be referred to former page.
3. Judgment and Standard value should be fixed by other inspection standard and criteria samples.

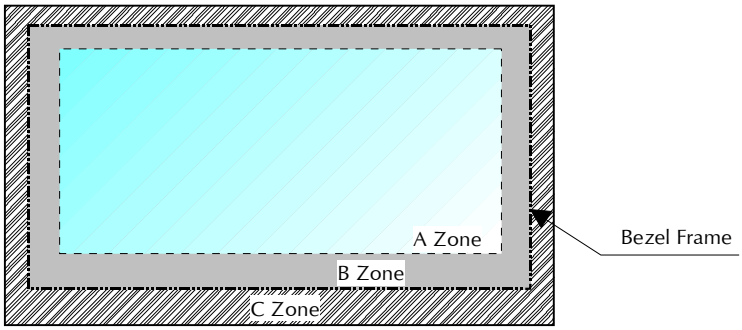
6. Appearance Standards

6.1 Inspection Conditions

The LCD shall be inspected under 40W white fluorescent light. The distance between the eyes and the sample shall be more than 30cm. All directions for inspecting the sample should be within 45° against perpendicular line.



6.2 Definition of Applicable Zones

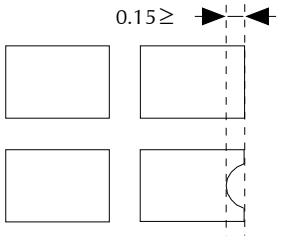
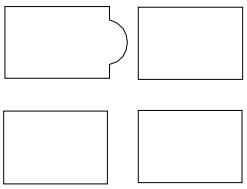
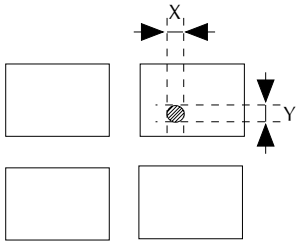
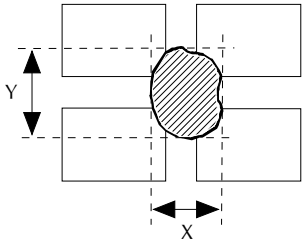


A Zone : Active display area
B Zone : Area from outside of "A Zone" to validity viewing area
C Zone : Rest parts
A Zone + B Zone = Validity viewing area

6.3 Standards

<table>
<tr><th>No.</th><th>Parameter</th><th>Criteria</th></tr>
<tr><td>1.</td><td>Black and White Spots, Foreign Substances</td><td>
(1) Round Shape
<table>
<tr><th rowspan="2">Dimension (mm) \ Zone</th><th colspan="3">Acceptable Number</th></tr>
<tr><th>A</th><th>B</th><th>C</th></tr>
<tr><td>D ≤ 0.1</td><td>*</td><td>*</td><td>*</td></tr>
<tr><td>0.1 < D ≤ 0.2</td><td>3</td><td>5</td><td>*</td></tr>
<tr><td>0.2 < D ≤ 0.25</td><td>2</td><td>3</td><td>*</td></tr>
<tr><td>0.25 < D ≤ 0.3</td><td>0</td><td>1</td><td>*</td></tr>
<tr><td>0.3 < D</td><td>0</td><td>0</td><td>*</td></tr>
</table>
D = (Long + Short)/2 *: Disregard
(2) Line Shape
<table>
<tr><th rowspan="2">X (mm) \ Zone</th><th rowspan="2">Y (mm) \ Zone</th><th colspan="3">Acceptable Number</th></tr>
<tr><th>A</th><th>B</th><th>C</th></tr>
<tr><td>--</td><td>0.03 ≥ W</td><td>*</td><td>*</td><td>*</td></tr>
<tr><td>2.0 ≥ L</td><td>0.05 ≥ W</td><td>3</td><td>3</td><td>*</td></tr>
<tr><td>1.0 ≥ L</td><td>0.1 ≥ W</td><td>3</td><td>3</td><td>*</td></tr>
<tr><td>--</td><td>0.1 < W</td><td colspan="3">In the same way (1)</td></tr>
</table>
X : Length Y: Width *: Disregard
Total defects shall not exceed 5.
</td></tr>
<tr><td>2.</td><td>Air Bubbles (between glass & polarizer)</td><td>
<table>
<tr><th rowspan="2">Dimension (mm) \ Zone</th><th colspan="3">Acceptable Number</th></tr>
<tr><th>A</th><th>B</th><th>C</th></tr>
<tr><td>D ≤ 0.3</td><td>*</td><td>*</td><td>*</td></tr>
<tr><td>0.3 < D ≤ 0.4</td><td>3</td><td>*</td><td>*</td></tr>
<tr><td>0.4 < D ≤ 0.6</td><td>2</td><td>3</td><td>*</td></tr>
<tr><td>0.6 < D</td><td>0</td><td>0</td><td>*</td></tr>
</table>
*: Disregard
Total defects shall not exceed 3.
</td></tr>
</table>

To be continued.....

No.	Parameter	Criteria
3.	The Shape of Dot	(1) Dot Shape (with Dent)  As per the sketch of left hand. (2) Dot Shape (with Projection)  Should not be connected to next dot. (3) Pin Hole  (X+Y)/2 ≤ 0.2mm (Less than 0.1mm is no counted.) (4) Deformation  (X+Y)/2 ≤ 0.2mm Total acceptable number: 1/dot, 5/cell (Defect number of (4): 1pc.)
4.	Polarizer Scratches	Not to be conspicuous defects.
5.	Polarizer Dirts	I f the stains are removed easily from LCDP surface, the module is not defective.
6.	Complex Foreign Substance Defects	Black spots, line shaped foreign substance or air bubbles between glass & polarizer should be 5pcs maximum in total.
7.	Distance between different Foreign Substance defects	D ≤ 0.2 : 20mm or more 0.2 < D : 40mm or more

7. Handling and Precautions

The Following precautions will guide you in handling our product correctly.

1 Liquid crystal display devices

1.1 The liquid crystal display device panel used in the liquid crystal display module is made of plate glass. Avoid any strong mechanical shock. Should the glass break handle it with care.
1.2 The polarizer adhering to the surface of the LCD is made of a soft material. Guard against scratching it.

2 Care of the liquid crystal display module against static electricity discharge.

2.1 When working with the module, be sure to ground your body and any electrical equipment you may be using. We strongly recommend the use of anti static mats (made of rubber), to protect work tables against the hazards of electrical shock.
2.2 Avoid the use of work clothing made of synthetic fibers. We recommend cotton clothing or other conductivity-treated fibers.
2.3 Slowly and carefully remove the protective film from the LCD module, since this operation can generate static electricity.

3 When the LCD module alone must be stored for long periods of time:

3.1 Protect the modules from high temperature and humidity.
3.2 Keep the modules out of direct sunlight or direct exposure to ultra-violet rays.
3.3 Protect the modules from excessive external forces.

4 Use the module with a power supply that is equipped with an over current protector circuit, since the module is not provided with this protective feature.

5 Do not ingest the LCD fluid itself should it leak out of a damaged LCD module. Should hands or clothing come in contact with LCD fluid, wash immediately with soap.

6 Conductivity is not guaranteed for models that use metal holders where solder connections between the metal holder and the PCB are not used. Please contact us to discuss appropriate ways to assure conductivity.

8. Warranty:

This product has been manufactured to your company's specifications as a part for use in your company's general electronic products. It is guaranteed to perform according to delivery specifications. For any other use apart from general electronic equipment, we cannot take responsibility if the product is used in medical devices, nuclear power control equipment, aerospace equipment, fire and security systems, or any other applications in which there is a direct risk to human life and where extremely high levels of reliability are required. If the product is to be used in any of the above applications, we will need to enter into a separate product liability agreement.

1 We cannot accept responsibility for any defect, which may arise from additional manufacturing of the product (including disassembly and reassembly), after product delivery.

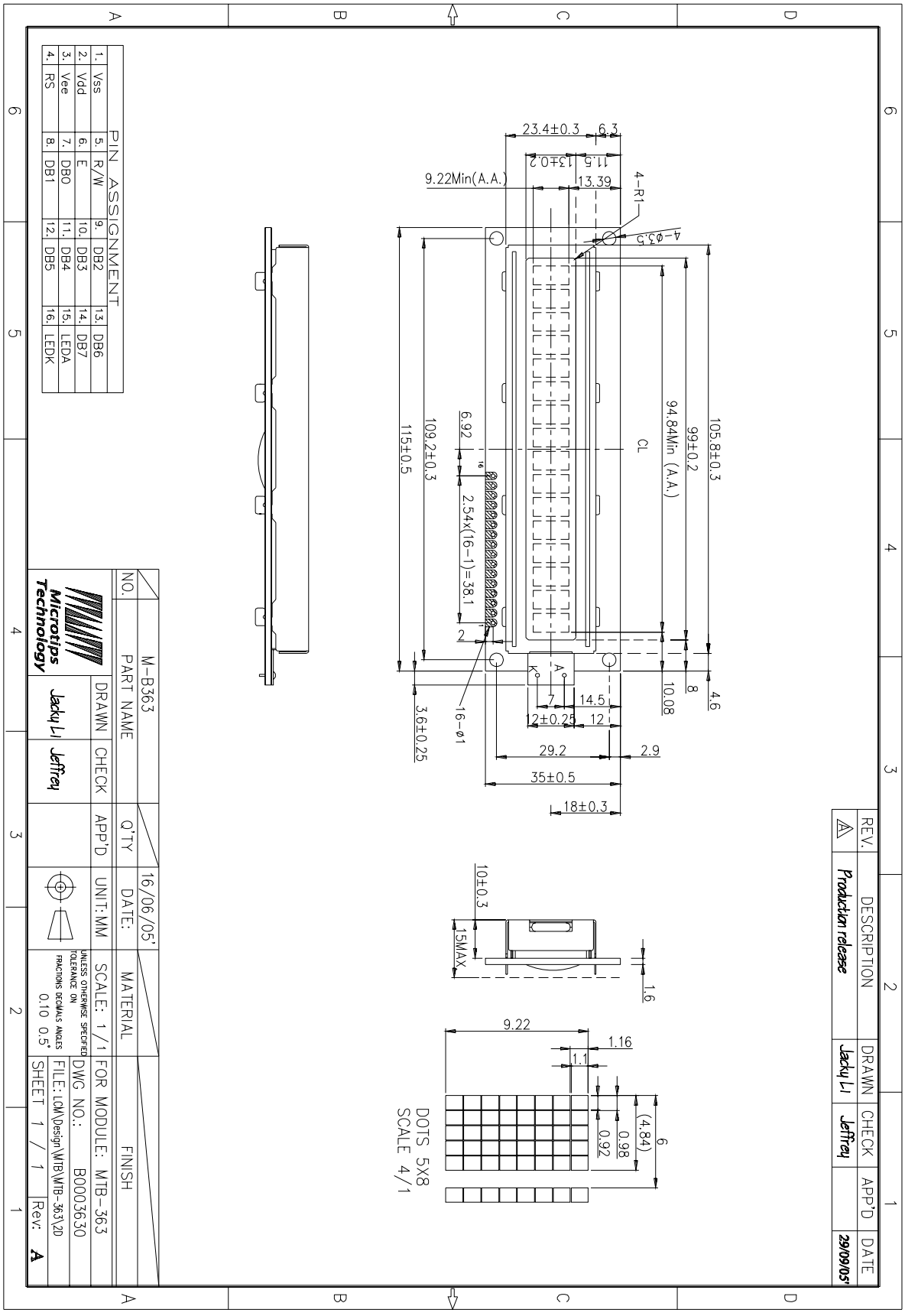
2 We cannot accept responsibility for any defect, which may arise after the application of strong external force to the product.

3 We cannot accept responsibility for any defect, which may arise due to the application of static electricity after the product has passed your company's acceptance inspection procedures.

4 We cannot accept responsibility for industrial property, which may arise through the use of your product, with exception to those issues relating directly to the structure or method of manufacturing of our product. Microtips-origin longer than one year from Microtips production.

9. Dimensional Outlines

- See the next page.....


PIN ASSIGNMENT
1. Vss
2. Vdd
3. Vee
4. RS
5. R/W
6. E
7. DB0
8. DB1
9. DB2
10. DB3
11. DB4
12. DB5
13. DB6
14. DB7
15. LEDA
16. LEDK
23.4±0.3
6.3
13±0.2
11.5
9.22Min(A.A.)
13.39
4-R1
4-Ø3.5
105.8±0.3
99±0.2
94.84Min (A.A.)
CL
109.2±0.3
115±0.5
6.92
2.54x(16-1)=38.1
16-Ø1
3.6±0.25
10.08
8
4.6
14.5
12±0.25
12
29.2
2.9
35±0.5
18±0.3
10±0.3
15MAX.
1.6
9.22
1.16
1.1
0.98
0.92
(4.84)
6
DOTS 5X8
SCALE 4/1
REV.
DESCRIPTION
DRAWN
CHECK
APP'D
DATE
Production release
Jacky Li
Jeffrey
29/09/05'
M-B363
PART NAME
DRAWN
CHECK
APP'D
Q'TY
DATE:
16/06/05'
UNIT: MM
SCALE: 1/1
MATERIAL
FINISH
FOR MODULE: MTB-363
DWG NO.: B000363O
FILE: LCM\Design\MTB\MTB-363\2D
SHEET 1 / 1
Rev: A
Microtips Technology

10. Commands Description

Clear Display

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	0	0	0	0	1

Clear all the display data by writing "20H" (space code) to all DDRAM address, and set DDRAM address to "00H" into AC (address counter). Return cursor to the original status. namely, bring the cursor to the left edge on first line of the display. Make entry mode increment (I/D = "1").

Return Home

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	0	0	0	1	*

Return Home is cursor return home instruction. Set DDRAM address to "00H" into the address counter. Return cursor to its original site and return display to its original status, if shifted. Content of DDRAM is not changed.

Entry Mode Set

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	0	0	1	I/D	SH

Set the moving direction of cursor and display.

I/D : Increment / decrement of DDRAM address (cursor or blink)

When I/D = "High", cursor/blink moves to right and DDRAM address is increased by 1.
When I/D = "Low", cursor/blink moves to left and DDRAM address is decreased by 1.
* CGRAM operates the same as DDRAM, when read from or write to CGRAM.

SH: Shift of entire display

When DDRAM read (CGRAM read/write) operation or SH = "Low", shift of entire display is not performed. If SH = "High" and DDRAM write operation, shift of entire display is performed according to I/D value (I/D = "1" , shift left, I/D = "0" : shift right).

Display ON/OFF Control

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	0	1	D	C	B

Control display/cursor/blink ON/OFF 1 bit register.

D : Display ON/OFF control bit

When D = "High", entire display is turned on.

When D = "Low", display is turned off, but display data is remained in DDRAM.

C : Cursor ON/OFF control bit

When C = "High", cursor is turned on.

When C = "Low", cursor is disappeared in current display, but I/D register remains its data.

B : Cursor Blink ON/OFF control bit

When B = "High", cursor blink is on, that performs alternate between all the high data and display character at the cursor position.

When B = "Low", blink is off.

Cursor or Display Shift

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	1	S/C	R/L	*	*

Without writing or reading of display data, shift right/left cursor position or display.

This instruction is used to correct or search display data. (Refer to Table 4)

During 2-line mode display, cursor moves to the 2nd line after 40th digit of 1st line.

Note that display shift is performed simultaneously in all the line.

When displayed data is shifted repeatedly, each line shifted individually.

When display shift is performed, the contents of address counter are not changed.

S/C	R/L	Operation
0	0	Shift cursor to the left, AC is decreased by 1.
0	1	Shift cursor to the right, AC is increased by 1.
1	0	Shift all of the display to the left, cursor moves according to the display.
1	1	Shift all of the display to the right, cursor moves according to the display.

Function Set

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
00	0	0	0	1	DL	N	F	*	*

DL : Interface data length control bit

When DL = "High", it means 8-bit bus mode with MPU.

When DL = "Low", it means 4-bit bus mode with MPU. So to speak, DL is a signal to select 8-bit or 4-bit bus mode. When 4-bit bus mode, it needs to transfer 4-bit data by two times.

N : Display line number control bit

When N = "Low", it means 1-line display mode.

When N = "High", 2-line display mode is set.

F : Display font type control bit

When F = "Low", it means 5 X 8 dots format display mode

When F = "High", 5 x11 dots format display mode.

Set CG RAM Address

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0

Set CGRAM address to AC.

This instruction makes CGRAM data available from MPU.

Set DD RAM Address

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0

Set DDRAM address to AC.

This instruction makes DDRAM data available from MPU.

When 1-line display mode (N = 0), DDRAM address is from "00H" to "4FH".

In 2-line display mode (N = 1), DDRAM address in the 1st line is from "00H" to "27H", and DDRAM address in the 2nd line is from "40H" to "67H".

Read Busy Flag and Address

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	1	BF	AC6	AC5	AC4	AC3	AC2	AC1	AC0

This instruction shows whether KS0066U is in internal operation or not. If the resultant BF is High, it means the internal operation is in progress and you have to wait until BF to be Low, and then the next instruction can be performed. In this instruction you can read also the value of address counter.

Write Data to RAM

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
1	0	D7	D6	D5	D4	D3	D2	D1	D0

Write binary 8-bit data to DDRAM/CGRAM.

The selection of RAM from DDRAM, CGRAM, is set by the previous address set instruction : DDRAM address set,

CGRAM address set. RAM set instruction can also determine the AC direction to RAM. After write operation, the address

is automatically increased/decreased by 1, according to the entry mode.

Read Data to RAM

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
1	0	D7	D6	D5	D4	D3	D2	D1	D0

Read binary 8-bit data from DDRAM/CGRAM.

The selection of RAM is set by the previous address set instruction. If address set instruction of RAM is not performed before this instruction, the data that read first is invalid, because the direction of AC is not determined. If you read RAM data several times without RAM address set instruction before read operation, you can get correct RAM data from the second, but the first data would be incorrect, because there is no time margin to transfer RAM data.

In case of DDRAM read operation, cursor shift instruction plays the same role as DDRAM address set instruction : it also transfers RAM data to output data register. After read operation address counter is automatically increased/decreased by 1 according to the entry mode. After CGRAM read operation, display shift may not be executed correctly.

NOTE: In case of RAM write operation, after this AC is increased/decreased by 1 like read operation. In this time, AC indicates the next address position, but you can read only the previous data by read instruction.

DD RAM ADDRESSING

For 16×1 or 8×1 Display

Character	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
DD RAM Address	00	01	02	03	04	05	06	07	40	41	42	43	44	45	46	47

For 16×2 or 8×2 Display

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

For 16×4 Display

Character	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
DD RAM Address	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
	10	11	12	13	14	15	16	17	18	19	1A	1B	1C	1D	1E	1F
	50	51	52	53	54	55	56	57	58	59	5A	5B	5C	5D	5E	5F

For 20×2 Display

Character	1	2	3	4	5	6	7	8	9	10	...	...	17	18	19	20
DD RAM Address	00	01	02	03	04	05	06	07	08	09	...	...	10	11	12	13
	40	41	42	43	44	45	46	47	48	49	...	...	50	51	52	53

For 20×4 Display

Character	1	2	3	4	5	6	7	8	9	10	...	...	17	18	19	20
DD RAM Address	00	01	02	03	04	05	06	07	08	09	...	...	10	11	12	13
	40	41	42	43	44	45	46	47	48	49	...	...	50	51	52	53
	14	15	16	17	18	19	1A	1B	1C	1D	...	...	24	25	26	27
	54	55	56	57	58	59	5A	5B	5C	5D	...	...	64	65	66	67

For 40×2 Display

Character	1	2	3	4	5	6	7	8	9	10	...	...	37	38	39	40
DD RAM Address	00	01	02	03	04	05	06	07	08	09	...	...	24	25	26	27
	40	41	42	43	44	45	46	47	48	49	...	...	64	65	66	67

For 40×4 Display

Character	E	1	2	3	4	5	6	7	8	9	10	...	...	37	38	39	40
DD RAM Address	E1	00	01	02	03	04	05	06	07	08	09	...	...	24	25	26	27
		40	41	42	43	44	45	46	47	48	49	...	...	64	65	66	67
	E2	00	01	02	03	04	05	06	07	08	09	...	...	24	25	26	27
		40	41	42	43	44	45	46	47	48	49	...	...	64	65	66	67

CG RAM MAPPING

Character Code (DD RAM data)								CG RAM Address						Character Patterns (CG RAM data)								
7	6	5	4	3	2	1	0	5	4	3	2	1	0	7	6	5	4	3	2	1	0	
High							Low	High					Low	High							Low	
0	0	0	0	*	0	0	0	0	0	0	0	0	0	*	*	*	0	1	1	0	0	←Character Pattern
											0	0	1				1	0	0	1	0	
											0	1	0				0	0	1	0	0	
											0	1	1				0	1	0	0	0	
											1	0	0				1	1	1	1	0	
											1	0	1				0	0	0	0	0	
											1	1	0				0	0	0	0	0	
											1	1	1				0	0	0	0	0	←Cursor
0	0	0	0	*	0	0	1	0	0	1	0	0	0	*	*	*	1	1	1	1	1	←Character Pattern
											0	0	1				1	0	0	0	1	
											0	1	0				1	0	1	0	1	
											0	1	1				1	0	1	1	1	
											1	0	0				1	0	1	0	1	
											1	0	1				1	0	0	0	1	
											1	1	0				1	1	1	1	1	
											1	1	1				0	0	0	0	0	←Cursor
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	
0	0	0	0	*	1	1	1	1	1	1	0	0	0	*	*	*	1	1	1	1	1	←Character Pattern
											0	0	1				1	0	0	0	1	
											0	1	0				1	1	1	0	1	
											0	1	1				1	0	0	0	1	
											1	0	0				1	0	1	1	1	
											1	0	1				1	0	0	0	1	
											1	1	0				1	1	1	1	1	
											1	1	1				0	0	0	0	0	←Cursor

11. Character Font Table