NAN YA PLASTICS CORP. ELEC. MATERIALS DIV. LCD DEPARTMENT	SPECIFICATION	SPEC. NO. : LM014-0 DATE : Jun. 14, 1997 SHEET NO. : 1/21

U.S. MARKETING ARM:

MARK PRODUCTS CORPORATION
800 N. EDGEWOOD AVENUE
WOOD DALE, IL 60191
TEL: 630-787-9089
FAX: 630-787-9015

SPECIFICATION OF
240x128 LCD MODULE
PRODUCT NO.: LMBHA_014__

SPEC. NO.: LM014-0

APPROVED BY

SALES MANAGER	DESIGN MANAGER	PERSON IN CHARGE

REV/DATE	R0/ 06.14.97'					APP	CHK	BY

1. MECHANICAL DATA

(1) Product No.		LMBHA_014__
(2) Module Size		170.0 (W)mm x 102.0 (H)mm x MAX 14.0 (D)mm
(3) Dot Size		0.47 (W)mm x 0.47 (H)mm
(4) Dot Pitch		0.5 (W)mm x 0.5 (H)mm
(5) Number of Dots		240 (W) x 128 (H)Dots
(6) Duty		1/128
(7) LCD Display Mode	STN:	☐ Gray ☐ Yellow ☐ Blue
	FSTN:	☐ Black and White(Normal White/Positive Image)
		☐ Black and White(Normal Black/Negative Image)
	Rear Polarizer:	☐ Transflective ☐ Transmissive
(8) Viewing Direction		☐ 6 O'clock ☐ 12 O'clock ☐____O'clock
(9) Backlight		CCFT
(10) Weight		about 227 g

Note :

LMBHA_014_ _____

Backlight Type
- A : None
- B : CCFT
- C : LED
- D : EL

Polarizer Type
- R : Reflective
- S : Transflective
- T : Transmissive
- P : Transflective(High Transmissive)

Option
- C : Anti-Glare
- D : Wide Temperature
- 1 ~ 9 : Version

Mode/View Angle
- A : Gray , 6 Clock
- B : Gray , 12 Clock
- C : Yellow , 6 Clock
- D : Yellow , 12 Clock
- E : Blue , 6 Clock
- F : Blue , 12 Clock
- G : Normally Black , 6 Clock
- H : Normally Black , 12 Clock
- J : Normally White , 6 Clock
- K : Normally White , 12 Clock

2. ABSOLUTE MAXIMUM RATINGS

(1) ELECTRICAL ABSOLUTE RATINGS

GND=0V Standard

ITEM	SYMBOL	MIN	MAX	UNIT	COMMENT
Power Supply for Logic	VDD−GND	0	7.0	V	
Power Supply for LC Drive	VDD−VEE	0	24.0	V	
Input Voltage	VI	GND	VDD	V	
CCFL Driving Voltage	VFL	0	500	Vrms	
CCFL Input Current	IFL	−	7.0	mArms	
Static Electricity	−	−	−	−	Note 1

Note 1 LCM should be grounded during handling LCM.

(2) ENVIRONMENTAL ABSOLUTE MAXIMUM RATINGS

ITEM	NORMAL TEMP.				WIDE TEMP.			
	OPERATING		STORAGE		OPERATING		STORAGE	
	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.
Ambient Temperature	0	50	−20	70	−20	70	−30	80
Humidity (Without Condensation)	Note 1,3		Note 2,3		Note 3,4		Note 3,5	

Note 1 Ta ≦ 50°C : 85% RH max
Ta > 50°C : Absolute humidity must be lower than the humidity of 85%RH at 50°C

Note 2 Ta at −20°C will be < 48hrs, at 70°C will be < 120hrs

Note 3 Background color changes slightly depending on ambient temperature. This phenomenon is reversible.

Note 4 Ta ≦ 70°C : 75%RH max.
Ta > 70°C : Absolute humidity must be lower than the humidity of 75%RH at 70°C

Note 5 Ta at −30°C will be < 48hrs, at 80°C will be < 120hrs

3. ELECTRICAL CHARACTERISTICS

ITEM	SYMBOL	CONDITION		MIN.	TYP.	MAX.	UNIT
Logic Circuit Power Supply	VDD−GND	−		4.75	5.0	5.25	V
LCD Driver Power Supply (Normal Temp. LCM)	VDD−VEE	VDD=5.0V 1/13 Bias	0°C	−	19.9	21.1	V
			25°C	17.8	18.5	19.2	V
			50°C	16.6	17.0	−	V
LCD Driver Power Supply (Wide Temp. LCM)	VDD−VEE	VDD=5.0V 1/13 Bias	−20°C	−	20.8	21.6	V
			0°C	19.0	19.8	20.4	V
			25°C	18.9	19.7	20.3	V
			50°C	18.8	19.6	20.2	V
			70°C	18.1	18.9	−	V
Input Voltage	VIH	H level		0.7VDD	−	VDD	V
	VIL	L level		GND	−	0.3VDD	V
Power Consumption For LCD	Pd	VDD = 5.0V VEE = −13.5V		−	80	−	mW
Supply Current (LCD)	IDD	VDD = 5.0V VEE = −13.5V		−	8.6	−	mA
	IEE			−	2.7	−	
CCFL Staring Voltage	VFLS	−		−	900	−	Vrms
CCFL Driving Voltage	VFLD	−		−	450	−	Vrms
CCFL Driving Current	IFLD	VFLD = 450Vrms fFL = 30kHz		−	5.0	−	mArms
CCFL Driving Frequency	fFL	−		15	30	50	KHZ

4. OPTICAL CHARACTERISTICS

(FOR NORMAL TEMPERATURE MODE LCM)

AT V_{OP}

ITEM / MODE		Cr(Contrast Ratio) 25℃ MIN.	Cr(Contrast Ratio) 25℃ TYP.	θ(Viewing Angle) 25℃ MIN.	θ(Viewing Angle) 25℃ TYP.	φ(Viewing Angle) 25℃ MIN.	φ(Viewing Angle) 25℃ TYP.
R	A	—	—	—	—	—	—
	C	—	—	—	—	—	—
	J	4	6	40	60	25	35
S	A	—	—	—	—	—	—
	C	—	—	—	—	—	—
	J	3.5	6	40	55	20	30
T	C	—	—	—	—	—	—
	E	3	6	35	65	25	40
	G	6	15	45	90	30	50
note		NOTE6		NOTE5			

AT $\phi=0^\circ$ $\theta=0^\circ$

ITEM	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT	NOTE
Response Time (rise)	Tr	0℃	—	500	1000	ms	NOTE 2
		25℃	—	120	240		
		50℃	—	70	140		
Response Time (fall)	Tf	0℃	—	700	1200	ms	NOTE 2
		25℃	—	140	260		
		50℃	—	80	150		

note:

R: REFLECTIVE
S: TRANSFLECTIVE
T: TRANSMISSIVE
A: GRAY
C: YELLOW
E: BLUE
G: NORMALLY BLACK
J: NORMALLY WHITE

(FOR WIDE TEMPERATURE MODE LCM)

AT V_{OP}

ITEM / MODE		Cr(Contrast Ratio) 25°C MIN.	Cr(Contrast Ratio) 25°C TYP.	θ(Viewing Angle) 25°C MIN.	θ(Viewing Angle) 25°C TYP.	φ(Viewing Angle) 25°C MIN.	φ(Viewing Angle) 25°C TYP.
R	C	3	4	40	60	28	35
	J	4	6.5	35	52	25	33
S	A	3	4	40	60	28	35
T	A	–	2.5	20	40	15	20
	E	3	4	40	60	15	25
	G	5	10	50	86	35	50
note		NOTE6		NOTE5			

AT φ=0° θ=0°

ITEM	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT	NOTE
Response Time (rise)	Tr	-20°C	—	2200	4400	ms	NOTE 2
		0°C	—	440	880		
		25°C	—	120	240		
		50°C	—	60	120		
		70°C	—	50	100		
Response Time (fall)	Tf	-20°C	—	3000	5000	ms	NOTE 2
		0°C	—	550	1100		
		25°C	—	180	350		
		50°C	—	80	150		
		70°C	—	70	130		

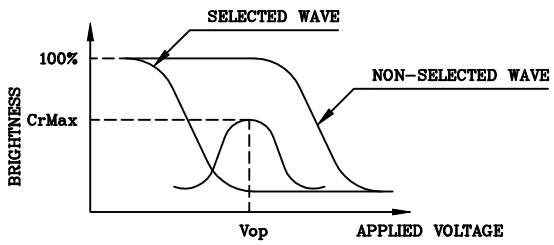
note:

R: REFLECTIVE
S: TRANSFLECTIVE
T: TRANSMISSIVE

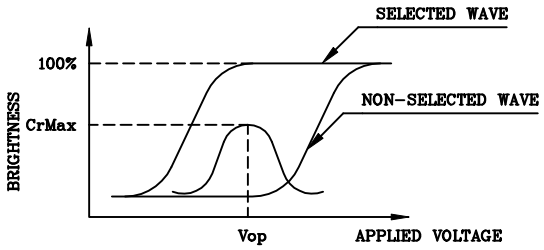
A: GRAY
G: NORMALLY BLACK
J: NORMALLY WHITE

(NOTE 1)

Definition of Operation Voltage(Vop)



(positive type)



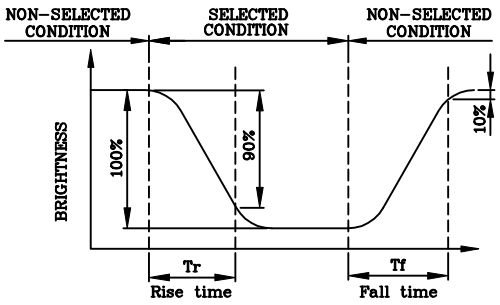
(negative type)

*Conditions

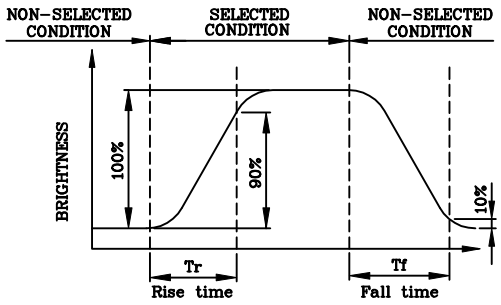
Viewing Angle : 0
Frame Frequency : 70Hz
Applied Waveform : 1/N duty, 1/a bias

(NOTE 2)

Definition of Response Time(Tr,Tf)



(positive type)



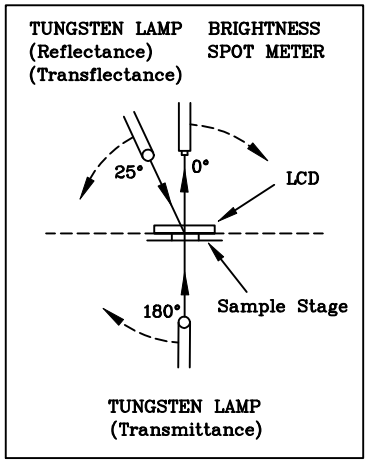
(negative type)

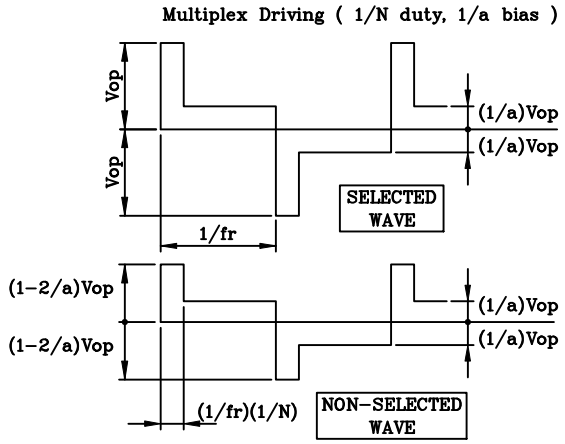
*Conditions

Operating Voltage : Vop
Viewing Angle (θ,ϕ) : (0,0)
Frame Frequency : 70Hz
Applied Waveform : 1/N duty, 1/a bias

(NOTE 3)

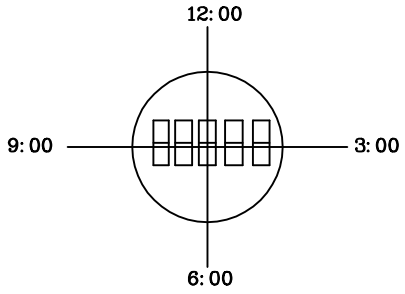
Description of Measuring Equipment and Driving Waveforms





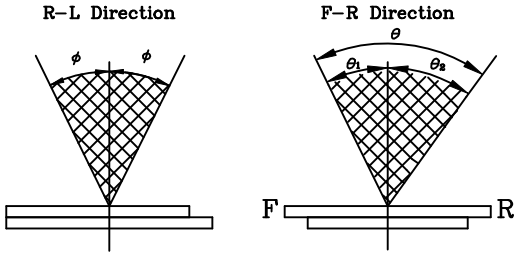
(NOTE 4)

Definition of Viewing Direction



(NOTE 5)

Definition of Viewing Angle



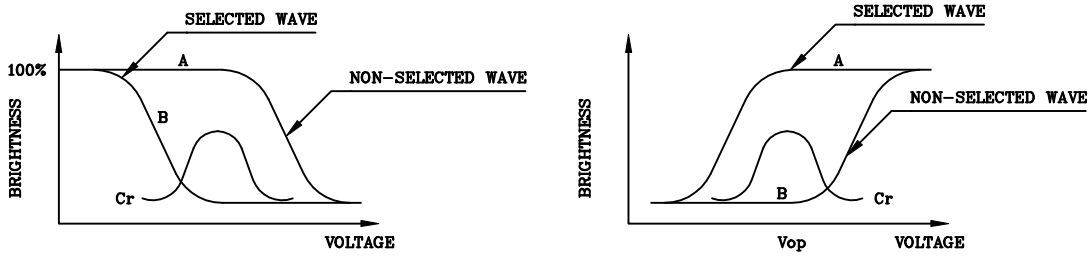
$\theta = \theta_1 + \theta_2$

*Conditions

Operating Voltage : Vop
Frame Frequency : 70Hz
Applied Waveform : 1/N duty, 1/a bias
Contrast Ratio : larger than 2

(NOTE 6)

Definition of Contrast Ratio (Cr)



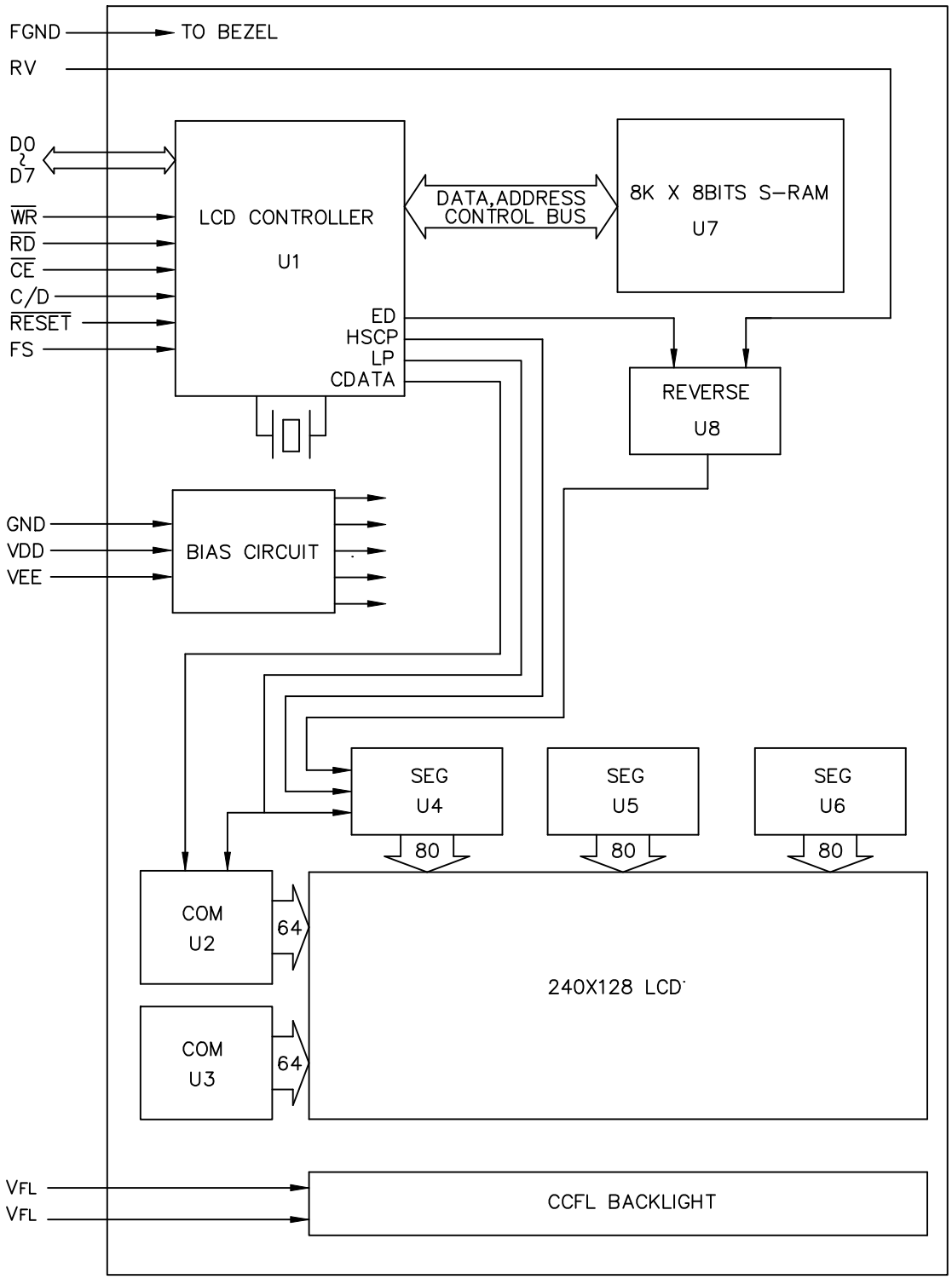
(positive type) (negative type)

Contrast Ratio : Cr=A/B

*Conditions

Viewing Angle : 0
Frame Frequency : 70Hz
Applied Waveform : 1/N duty, 1/a bias

5. BLOCK DIAGRAM



REV/DATE	R0/ 06.14.97'					APP	CHK	BY

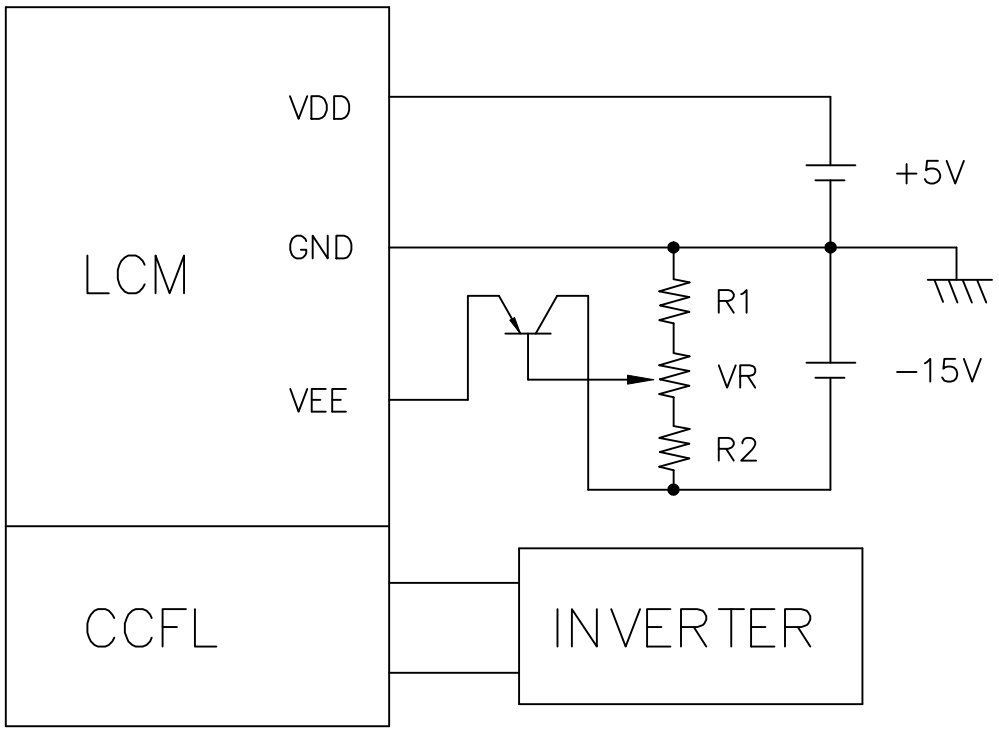
6. INTERNAL PIN CONNECTION

PIN NO.	SYMBOL	FUNCTION
1	FGND	FRAME GROUND (0V)
2	GND	GROUND
3	VDD	POWER SUPPLY FOR LOGIC (+5V)
4	VEE	POWER SUPPLY FOR LC DRIVING
5	$\overline{WR}$	DATA WRITE
6	$\overline{RD}$	DATA READ
7	$\overline{CE}$	CHIP ENABLE
8	C/D	$\overline{WR}$="L",C/D="H" :COMMAND WRITE $\overline{WR}$="L",C/D="L" :DATA WRITE $\overline{RD}$="L",C/D="H" :STATUS READ $\overline{RD}$="L".C/D="L" :DATA READ
9	NC	NO CONNECTION
10	$\overline{RESET}$	CONTROLLER RESET
11	D0	DATA INPUT/OUTPUT
12	D1	DATA INPUT/OUTPUT
13	D2	DATA INPUT/OUTPUT
14	D3	DATA INPUT/OUTPUT
15	D4	DATA INPUT/OUTPUT
16	D5	DATA INPUT/OUTPUT
17	D6	DATA INPUT/OUTPUT
18	D7	DATA INPUT/OUTPUT
19	FS	FONT SELECT CONNECT TO VDD : 6X8 PIXELS/CHARACTER CONNECT TO GND : 8X8 PIXELS/CHARACTER
20	RV	DISPLAY DATA REVERSE RV=H : REVERSE DISPLAY RV=L : NORMAL DISPLAY

FL CONNECTOR : J.A.E./IL-G-5S-S3C2

PIN NO.	SYMBOL	FUNCTION
1	V_{FL}	POWER SUPPLY FOR FL DRIVE
2	NC	NO CONNECTION
3	NC	NO CONNECTION
4	NC	NO CONNECTION
5	V_{FL}	POWER SUPPLY FOR FL DRIVE

7. POWER SUPPLY



1. R1+VR+R2=10K~20K
2. Recommended CCFL Inverter : TDK CXA-L10L

8. TIMING CHARACTERISTICS

8-1 INTERFACE TIMING

@VDD = 5V±10%

ITEM	ITEM	CONDITION	MIN.	MAX.	UNIT
C/D SET UP TIME	t_{CDS}	Fig.	100	–	ns
C/D HOLD TIME	t_{CDH}	Fig.	10	–	ns
$\overline{CE}$,$\overline{RD}$,$\overline{WR}$ CLOCK WIDTH	t_{CP},t_{RP},t_{WP}	Fig.	80	–	ns
DATA SET UP TIME	t_{DS}	Fig.	80	–	ns
DATA HOLD TIME	t_{DH}	Fig.	40	–	ns
ACCESS TIME	t_{ACC}	Fig.	–	150	ns
DATA OUTPUT HOLD TIME	t_{OH}	Fig.	10	50	ns

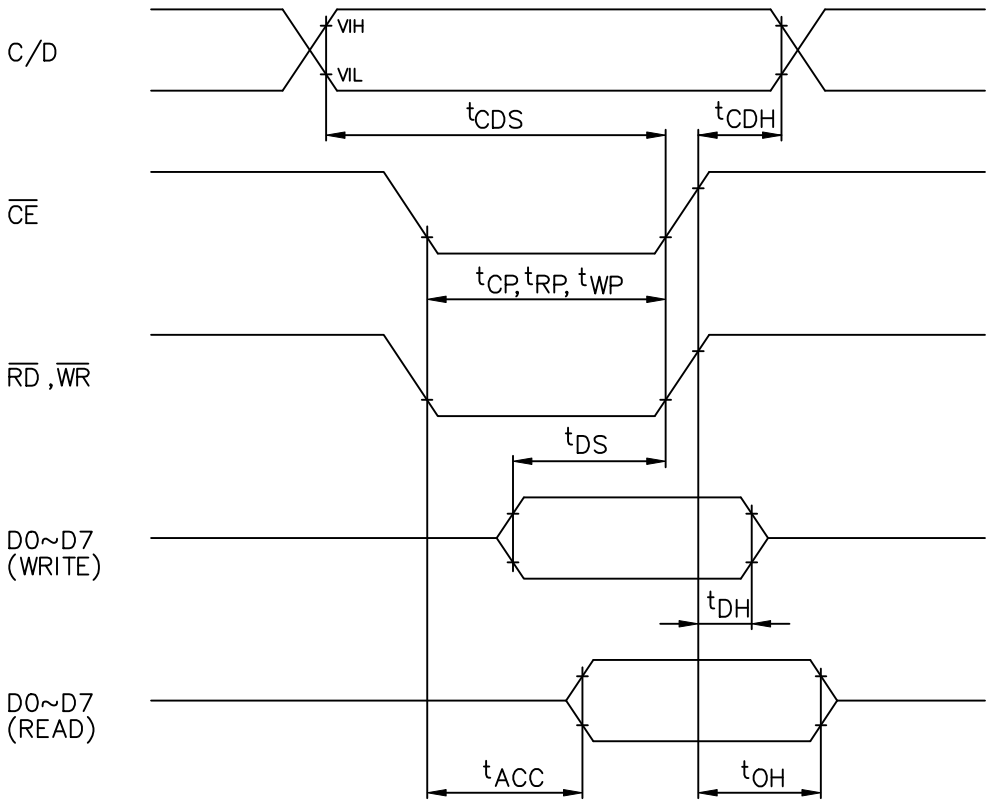
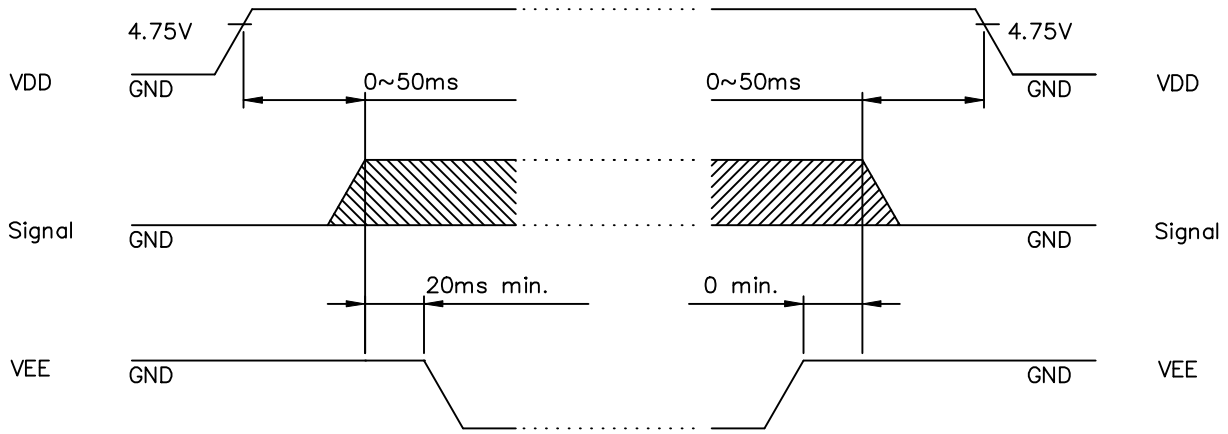


Fig. INTERFACE TIMING CHART

8-2 POWER ON/OFF TIMING

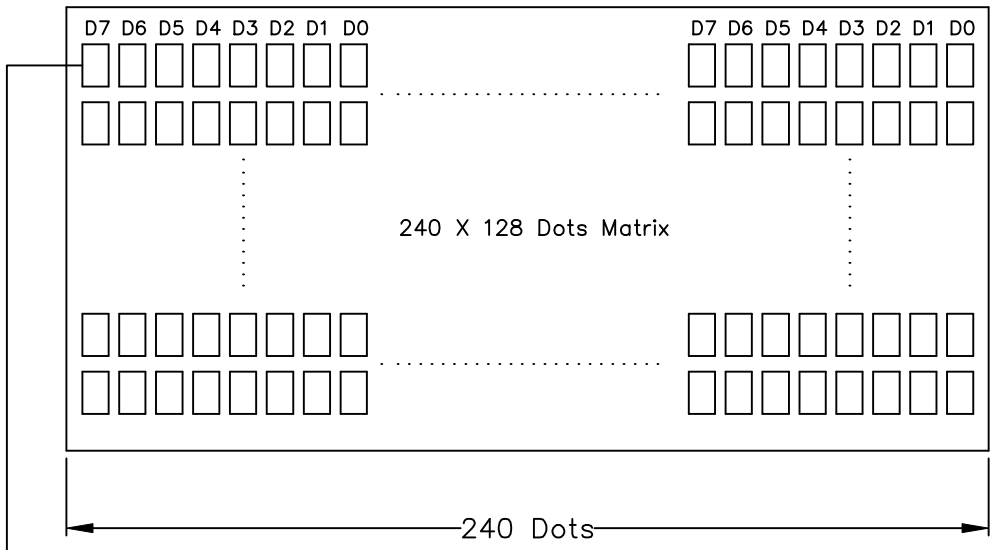


POWER ON

POWER OFF

The missing pixels may occur when the LCM is driven beyond above power interface timing sequence.

9. DISPLAY PATTERN



Startting dot for the startting address of display RAM.

D0~D7 are 8 bits transmitted data, where D0 is LSB and D7 is MSB.

9-2 COMMAND LIST

COMMAND	CODE	D1	D2	FUNCTION
REGISTER SET	00100001	X address	X address	Cursor pointer set
	00100010	Data	00H	Offset register set
	00100100	Low address	High address	Address pointer set
CONTROL WORD SET	01000000	Low address	High address	Text home address set
	01000001	Columns	00H	Text area set
	01000010	Low address	High address	Graphic home address set
	01000011	Columns	00H	Graphic area set
MODE SET	1000X000	—	—	"OR" mode
	1000X001	—	—	"EXOR" mode
	1000X011	—	—	"AND" mode
	1000X100	—	—	"Text attribute" mode
	10000XXX	—	—	Internal CG ROM mode
	10001XXX	—	—	External CG RAM mode
DISPLAY MODE	10010000	—	—	Display off
	1001XX10	—	—	Cursor on, blink off
	1001XX11	—	—	Cursor on, blink on
	100101XX	—	—	Text on, graphic off
	100110XX	—	—	Text off, graphic on
	100111XX	—	—	Text on, graphic on
CURSOR PATTERN SELECT	10100000	—	—	1 line cursor
	10100001	—	—	2 lines cursor
	10100010	—	—	3 lines cursor
	10100011	—	—	4 lines cursor
	10100100	—	—	5 lines cursor
	10100101	—	—	6 lines cursor
	10100110	—	—	7 lines cursor
	10100111	—	—	8 lines cursor
DATA AUTO READ/WRITE	10110000	—	—	Data auto write set
	10110001	—	—	Data auto read set
	10110010	—	—	Auto reset
DATA READ WRITE	11000000	Data	—	Data write and ADP increment
	11000001	—	—	Data read and ADP increment
	11000010	Data	—	Data write and ADP decrement
	11000011	—	—	Data read and ADP decrement
	11000100	Data	—	Data write and ADP nonvariable
	11000101	—	—	Data read and ADP nonvariable
SCREEN PEEK	11100000	—	—	Screen peek
SCREEN COPY	11101000			Screen copy
BIT SET/RESET	11110XXX	—	—	bit reset
	11111XXX	—	—	bit set
	1111X000	—	—	bit0(LSB)
	1111X001	—	—	bit1
	1111X010	—	—	bit2
	1111X011	—	—	bit3
	1111X100	—	—	bit4
	1111X101	—	—	bit5
	1111X110	—	—	bit6
	1111X111	—	—	bit7(MSB)

* STATUS READ

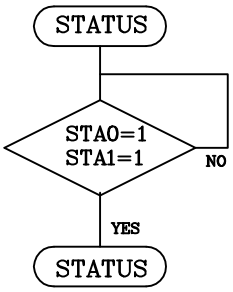
Before sending data (read/write), command it is necessary to check the status.

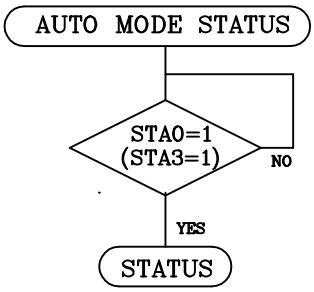
T6963C status word format is following :

LSB	D0	STA0	Check capability of command execution	0: Disable 1: Enable
	D1	STA1	Check capability of data read/write	0: Disable 1: Enable
	D2	STA2	Check capability of auto mode data read	0: Disable 1: Enable
	D3	STA3	Check capability of arto mode data write	0: Disable 1: Enable
	D4	STA4	Not use	
	D5	STA5	Check capability of controller operation	0: Disable 1: Enable
	D6	STA6	Error flag. Using screen peek/copy command	0: Disable 1: Enable
MSB	D7	STA7	Check the condition blink	0: Disable 1: Enable

Note 1: It is necessary to check STA0 and STA1 at the same time. The error is happened by sending data at executing command.
Note 2: The status check will be enough to check STA0/STA1.
Note 3: STA2/STA3 are valid in auto mode STA0/STA1 are invalid.

Status checking flow





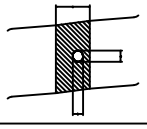
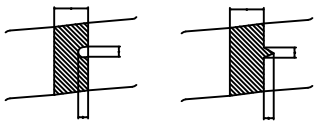
Note 4: It is impossible to save status check in the case of command of MSB0. To have the delay time cannot be save status check. The interrupt of hardware is happened at the end of lines. If command of MSB0 is sent in this period, the command executing is waited. The state of waiting doesn't disregarded or rewrites data of waiting command.

10. RELIABILITY TEST

NO	ITEM	CONDITION			STANDARD	NOTE
1	High Temp. Storage	70°C	120HR		Appearance without defect	
2	Low Temp. Storage	−20°C	120HR		Appearance without defect	
3	High Temp. & High Humidity Storage	40°C 90%RH	120HR		Appearance without defect	
4	Thermal Shock	−20°C,30min → 25°C,5min → 60°C,30min → 25°C,5min (= 1 cycle)			Appearance without defect	5 cycles

11. LCD PRODUCT QUALITY STANDARD

(1) DISPLAY APPEARANCE

<table>
<tr><th>NO</th><th>ITEM</th><th>C R I T E R I A</th></tr>
<tr><td>1.</td><td>INCLUSI-ONS (BLACK SPOT , WHITE SPOT , DUST)</td><td>(1) ROUND TYPE
<table>
<tr><th>DIAMETER mm (a*)</th><th>NO. OF DEFECT*</th></tr>
<tr><td>a ≦ 0.20
0.20 < a ≦ 0.35
0.35 < a</td><td>NEGLECT
5 MAX
NONE</td></tr>
</table>
(2) LINEAR TYPE
<table>
<tr><th>LENGTH mm(L)</th><th>WIDTH mm(W)</th><th>NO. OF DEFECT</th></tr>
<tr><td>N A
L ≦ 3
3 < L</td><td>W ≦ 0.03
0.03 < W ≦ 0.08
0.08 < W</td><td>NEGLECT
6
NONE</td></tr>
</table></td></tr>
<tr><td>2.</td><td>SCRATCH</td><td>1.SCRATCH ON PROTECTIVE FILM IS PERMITTED .
2.SCRATCH ON POLARIZER SHALL BE AS FOLLOW:
(1) ROUND TYPE
<table>
<tr><th>DIAMETER mm (a*)</th><th>NO. OF DEFECT*</th></tr>
<tr><td>a ≦ 0.15
0.15 < a ≦ 0.20
0.20 < a</td><td>NEGLECT
2 MAX
NONE</td></tr>
</table>
(2) LINEAR TYPE
BE JUDGED BY 1.-(2) LINEAR TYPE</td></tr>
<tr><td>3.</td><td>DENT</td><td>DIAMETER < 1.5mm</td></tr>
<tr><td>4.</td><td>BUBBLE</td><td>NOT EXCEEDING 0.5mm AVERAGE DIAMETER IS ACCEPTABLE BETWEEN GLASS AND POLARIZING FILM.</td></tr>
<tr><td>5.</td><td>PIN HOLE</td><td>(a+b)/2 ≦ 0.15 mm
MAXIMUM NUMBER: IGNORED
0.15 < (a+b)/2 ≦ 0.20
MAXIMUM NUMBER: 10
  </td></tr>
<tr><td>6.</td><td>DOT DEFECT</td><td>(a+b)/2 ≦ 0.20 mm
MAXIMUM NUMBER: IGNORED
0.20 < (a+b)/2 ≦ 0.30
MAXIMUM NUMBER: 5
x = WIDTH
  </td></tr>
<tr><td>7.</td><td>CONTRAST IRREGUL-ARITY (SPOT)</td><td>DIAMETER SPEC. — NO. OF DEFECT*
a ≦ 0.50 mm — NEGLECT
0.50 < a ≦ 0.75 — 5
0.75 < a ≦ 1.00 — 3
1.00 < a — NONE</td></tr>
<tr><td>8.</td><td>DOT WIDTH</td><td>DESIGN WIDTH±15%</td></tr>
<tr><td>9.</td><td>COLOR TONE AND UNIFOR-MITY</td><td>OBVIOUS UNEVEN COLOR IS NOT PERMITTED</td></tr>
</table>

(2) NOTE:

- SAFETY
  1. If the LCD panel breaks, be careful not to allow the liquid crystal to touch your skin.
  2. If the liquid crystal touches your skin or clothes, please wash it off immediately by using soap and water.

- HANDLING
  1. Prevent all contact with static electricity, which can damage the CMOS ICs. The module is packaged in a static-shielding bag to prevent damage during shipment, warehousing and removal from the shipping carton.
  2. Do not remove the panel or frame from the module.
  3. The polarizing plate on the front surface of the display is very fragile and easily scratched. The module is shipped with a protective liner which must be removed from the polarizing plate prior to assembly.
  4. Do not wipe the polarizing plate with a dry cloth, as it may easily scratch the surface of polarizing plate.
  5. Do not use ketonics solvent or aromatic solvent on the polarizing plate. Use a soft cloth soaked with plastic-lens cleaning solution.

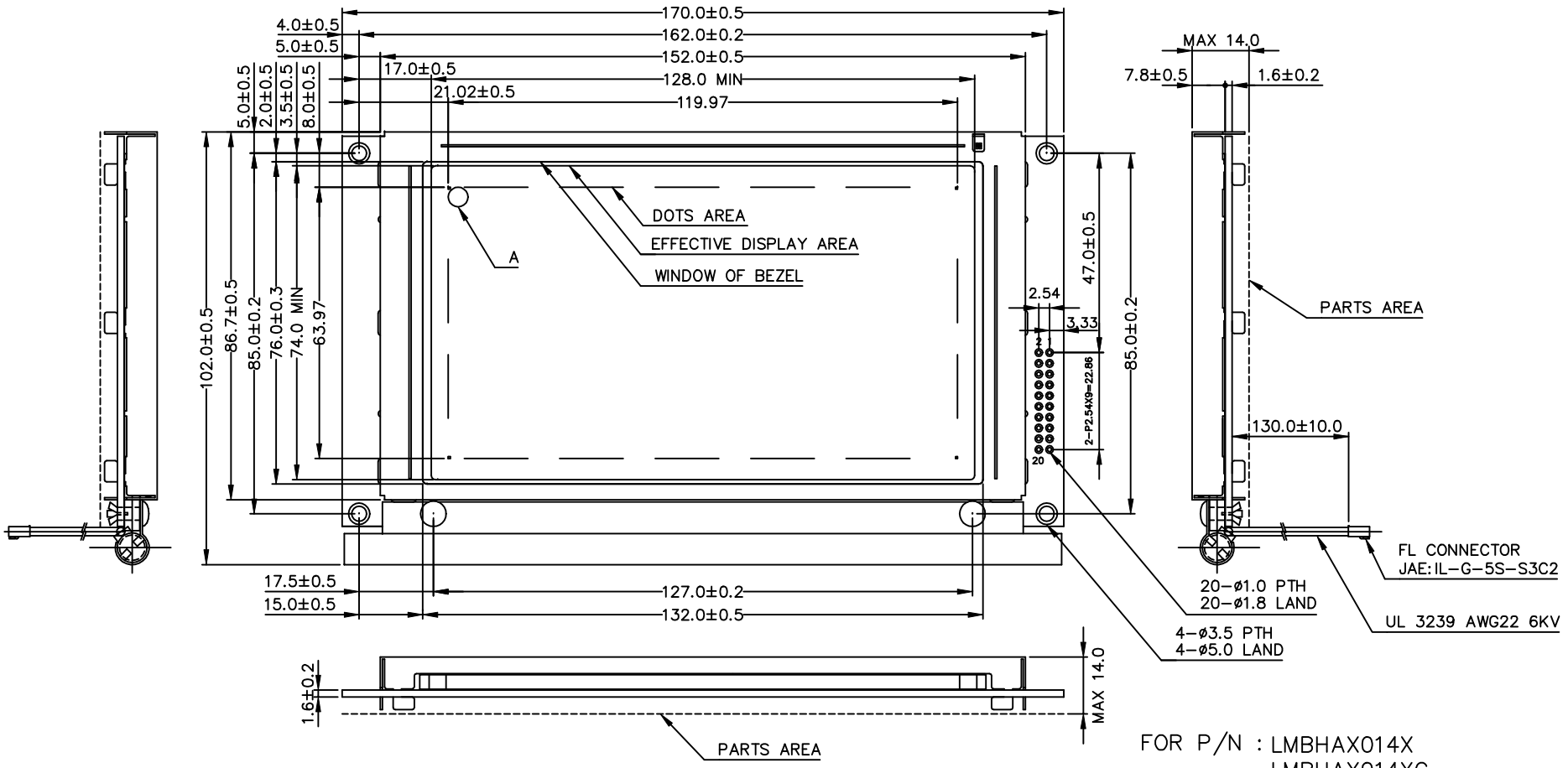
- STORAGE
  1. Store the panel or module in a dark place where the temperature is 25°C±5°C and the humidity is below 65% RH.
  2. Do not place the module near organics solvents or corrosive gases.
  3. Do not crush, shake, or jolt the module.

- TERMS OF WARRANTY
  1. Acceptance inspection period
     The inspection period is within one month after the arrival of the contracted goods at the buyer's factory site.
  2. Applicable warranty period
     The warranty period is within twelve months from the date of invoice under normal usage and storage conditions.

- TYPICAL OPERATING LIFETIME OF BACKLIGHT
  LED : 50,000HR
  EL : 5,000HR
  CCFT : 10,000HR

11.LCD VIBRATION & DROP TEST

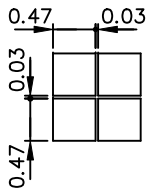
NO	ITEM	CONDITIONS			Sample	RESULT
1.	Vibration Test	a. Frequency	5 ⟶ 13.95Hz 13.95 ⟶ 33Hz 33 ⟶ 51Hz 51 ⟶ 500Hz	Displacement: 0.2inch Acceleration: 2G Displacement: 0.036inch Acceleration: 5G	18 pcs	OK
		b. Time Total Time	20 min. ± 1 min. X.Y.Z 3 Direction 60 min. ± 3 min.			
2.	Drop Test	Three-time free drop In X.Y.Z direction & One conner from a height of 70cm about ground			18 pcs	OK



FOR P/N : LMBHAX014X
LMBHAX014XC
LMBHAX014XCZ
LMBHAX014XCD
LMBHAX014XD
LMBHAX014XCD
LMBHAX014X4C

NOTES :

1. RESOLUTION : 240 X 128 Dots
2. CONTROLLER : T6963C(Toshiba)
3. DC/DC : Without
4. GENERAL TOLERANCE : ±0.5 mm



240X128 DOTS

A DEITAIL

PIN NO.	1	2	3	4	5	6	7	8	9	10
SYMBOL	FGND	GND	VDD	VEE	$\overline{WR}$	$\overline{RD}$	$\overline{CE}$	C/D	NC	$\overline{RESET}$
PIN NO.	11	12	13	14	15	16	17	18	19	20
SYMBOL	D0	D1	D2	D3	D4	D5	D6	D7	FS	RV

產品編號	LMBHA_014__		南亞塑膠工業股份有限公司 NAN YA PLASTICS CORPORATION
	NAME	DATE	
APPROVE			TITLE 製品圖
CHECK			DWG-NO MB-X014XXX Rev.C
DESIGN			
DRAW	MAY PING	87.01.22	THIRD ANGLE PROJECT UNIT : mm SCALE :