

NAN YA PLASTICS CORP. ELEC. MATERIALS DIV. LCD DEPARTMENT	SPECIFICATION	SPEC. NO. : LM120-0 DATE : Nov. 07, 1997 SHEET NO. : 1/16
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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 20x2 LCD MODULE PRODUCT NO.: LM_E4_120_
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SPEC. NO.: LM120-0

APPROVED BY

EDITED ON : Nov. 07, 1997

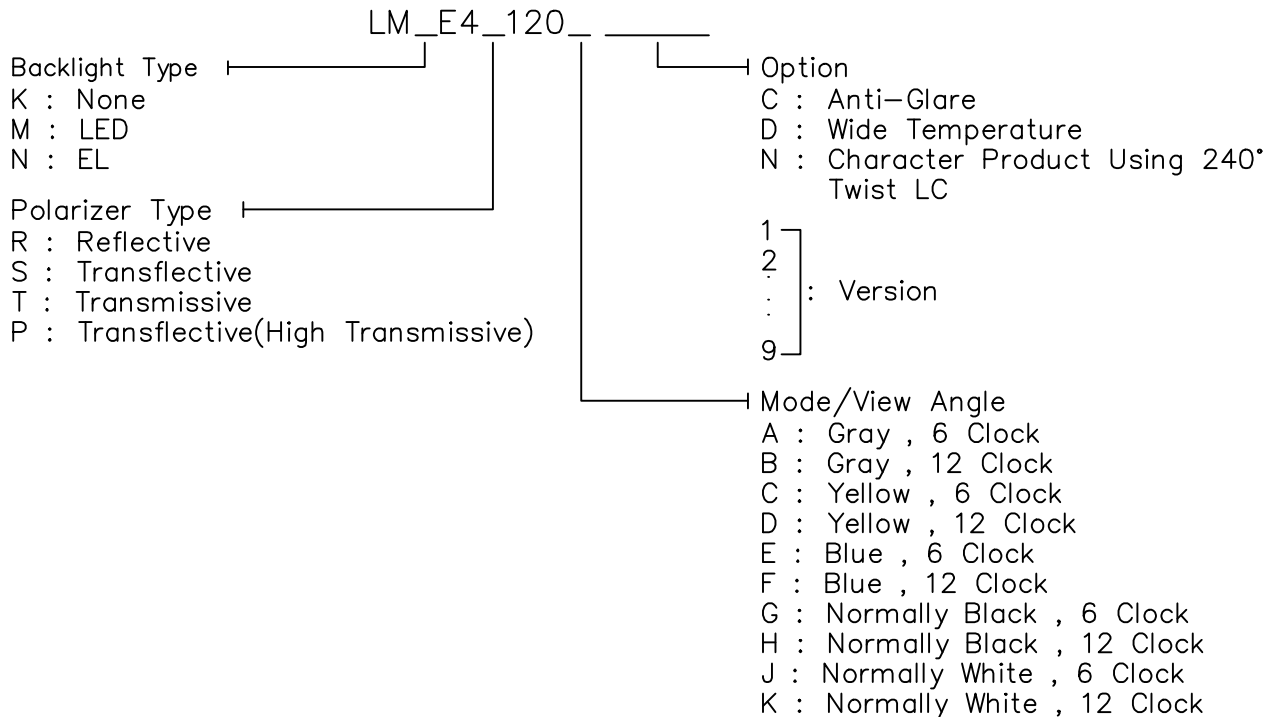
SALES MANAGER	DESIGN MANAGER	PERSON IN CHARGE

REV/DATE	R0/ 11.07.97'					APP	CHK	BY
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# 1. MECHANICAL DATA

- |                          |  |
|--------------------------|--|
| (1) Product No.          | LM_E4_120_   |
| (2) Module Size          | 146.0 (W)mm x 43.0 (H)mm x MAX9.5 (D)mm<br>(W/O B.L.)<br>146.0 (W)mm x 43.0 (H)mm x MAX14.5 (D)mm<br>(LED B.L.)  |
| (3) Dot Size             | 0.92 (W)mm x 1.1 (H)mm   |
| Dot Pitch                | 0.98 (W)mm x 1.16 (H)mm  |
| (4) Character Size       | 4.84 (W)mm x 9.22 (H)mm  |
| Character Pitch          | 6.0 (W)mm x 9.75 (H)mm   |
| (5) Number of Characters | 20 (W) x 2 (H)Characters   |
| (6) Character Format     | 5 (W) x 8 (H)Dots  |
| (7) Duty                 | 1/16   |
| (8) LCD Display Mode     | STN: <input type="checkbox"/> Gray Mode <input type="checkbox"/> Yellow Mode <input type="checkbox"/> Blue Mode<br>FSTN: <input type="checkbox"/> Black and White(Normal White/Positive Image)<br><input type="checkbox"/> Black and White(Normal Black/Negative Image)<br>Rear Polarizer: <input type="checkbox"/> Reflective <input type="checkbox"/> Transflective <input type="checkbox"/> Transmissive<br><input type="checkbox"/> Transflective(High Transmissive) |
| (9) Viewing Direction    |  |
| (10) Backlight           | <input type="checkbox"/> 6 O'clock <input type="checkbox"/> 12 O'clock <input type="checkbox"/> ____O'clock  |
| (11) Weight              | <input type="checkbox"/> W/O <input type="checkbox"/> EL <input type="checkbox"/> LED <input type="checkbox"/> CCFT<br>W/O B/L : about 50 g<br>LED B/L : about 81 g  |

Note :



## 2. ABSOLUTE MAXIMUM RATINGS

### (1) ELECTRICAL ABSOLUTE RATINGS

GND=0V

	SYMBOL	MIN	MAX	UNIT	COMMENT
Power Supply for Logic	VDD-GND	-0.3	6.5	V	
Input Voltage	VI	-0.3	VDD	V	
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  $T_a \leq 50^\circ\text{C}$  : 85%RH max  
 $T_a > 50^\circ\text{C}$  : Absolute humidity must be lower  
 than the humidity of 85%RH at  $50^\circ\text{C}$

Note 2  $T_a$  at  $-20^\circ\text{C}$  will be < 48hrs, at  $70^\circ\text{C}$  will be < 120hrs

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

Note 4  $T_a \leq 70^\circ\text{C}$  : 75%RH max  
 $T_a > 70^\circ\text{C}$  : Absolute humidity must be lower  
 than the humidity of 75%RH at  $70^\circ\text{C}$

Note 5  $T_a$  at  $-30^\circ\text{C}$  will be < 48hrs, at  $80^\circ\text{C}$  will be < 120hrs

### 3. ELECTRICAL CHARACTERISTICS

( VDD = 5V ± 10% )

ITEM	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Input Voltage	V <sub>IH</sub>	H level	0.8VDD	—	VDD	V
	V <sub>IO</sub>	L level	0	—	0.2VDD	V
Recommended LCD Driving Voltage (NORMAL TEMP. LCM)	VDD-V <sub>O</sub>	0℃	4.4	4.8	5.3	V
		25℃	4.3	4.7	5.1	
		50℃	4.0	4.4	4.7	
Recommended LCD Driving Voltage (WIDE TEMP. LCM)	VDD-V <sub>O</sub> 1/5 BIAS	-20℃	7.3	8.1	8.9	V
		0℃	7.3	8.1	8.9	
		25℃	7.3	8.1	8.9	
		50℃	7.2	7.8	8.6	
		70℃	7.1	7.6	8.3	
Power Supply Current	IDD	VDD = 5.0V	—	—	2.0	mA
LED Power Supply Current	I <sub>LED</sub>	V <sub>BL</sub> = 5V <sub>DC</sub> (R <sub>BL</sub> = 3.3Ω)	—	240	—	mA

## 4.OPTICAL CHARACTERISTICS

(FOR NORMAL TEMPERATURE MODE LCM)

AT V<sub>OP</sub>

ITEM MODE		Cr(Contrast Ratio)		$\theta$ (Viewing Angle)		$\phi$ (Viewing Angle)	
		25℃		25℃		25℃	
		MIN.	TYP.	MIN.	TYP.	MIN.	TYP.
R	A	4	5	40	60	20	30
	C	6	9	50	80	25	35
	J	-	-	-	-	-	-
S	A	3.5	4.5	40	55	20	25
	C	6	8	50	80	25	35
	J	-	-	-	-	-	-
T	E	-	-	-	-	-	-
	G	-	-	-	-	-	-
NOTE		NOTE6		NOTE5			

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

ITEM	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT	NOTE
Response Time (rise)	Tr	0℃	-	280	640	ms	NOTE 2
		25℃	-	65	170		
		50℃	-	45	75		
Response Time (fall)	Tf	0℃	-	995	1280	ms	NOTE 2
		25℃	-	280	345		
		50℃	-	100	145		

NOTE :

R: REFLECTIVE  
S: TRANSFLECTIVE  
T: TRANSMISSIVE  
A/B: GRAY  
C/D: YELLOW  
E/F: BLUE  
G/H: NORMALLY BLACK  
J/K: NORMALLY WHITE

REV/DATE	R0/ 11.07.97'	R1/ 03.24.98'				APP	CHK	BY
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# 4-1.OPTICAL CHARACTERISTICS

(FOR WIDE TEMPERATURE MODE LCM)

AT Vop

ITEM MODE		Cr(Contrast Ratio)		$\theta$ (Viewing Angle)		$\phi$ (Viewing Angle)	
		25℃		25℃		25℃	
		MIN.	TYP.	MIN.	TYP.	MIN.	TYP.
R	A						
	C						
	J						
S	A	3.5	6	50	95	25	40
	C						
	J						
T	E						
	G						
NOTE		NOTE6		NOTE5			

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

ITEM	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT	NOTE
Response Time (rise)	Tr	-20℃	-	1000	2000	ms	NOTE 2
		0℃	-	250	500		
		25℃	-	60	120		
		50℃	-	50	100		
		70℃	-	30	60		
Response Time (fall)	Tf	-20℃	-	1500	2500	ms	NOTE 2
		0℃	-	500	750		
		25℃	-	120	180		
		50℃	-	70	120		
		70℃	-	50	80		

NOTE :

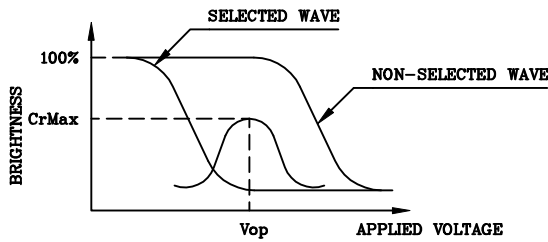
R: REFLECTIVE  
S: TRANSFLECTIVE  
T: TRANSMISSIVE  
A/B: GRAY

C/D: YELLOW  
E/F: BLUE  
G/H: NORMALLY BLACK  
J/K: NORMALLY WHITE

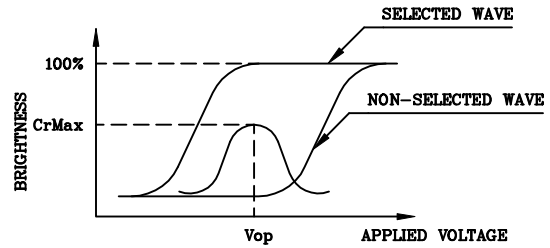
REV/DATE	R0/ 11.07.97'					APP	CHK	BY
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(NOTE 1)

Definition of Operation Voltage(Vop)



(positive type)



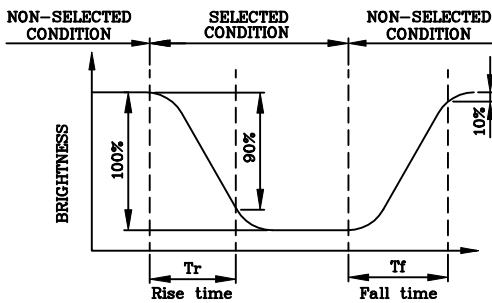
(negative type)

\*Conditions

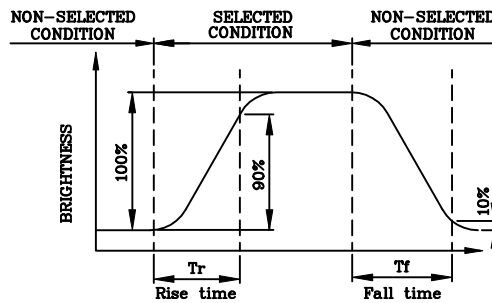
Viewing Angle : 0  
Frame Frequency : 70Hz  
Applied Waveform : 1/N duty, 1/a bias

(NOTE 2)

Definition of Response Time(Tr,Tf)



(positive type)



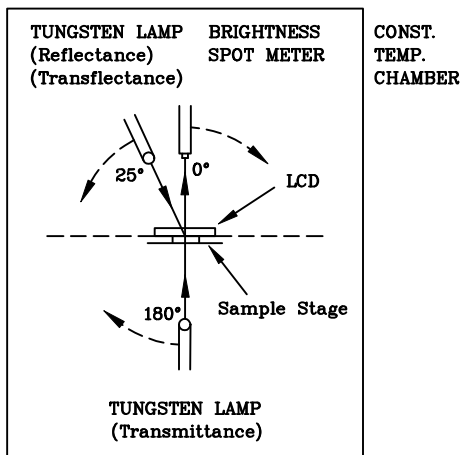
(negative type)

\*Conditions

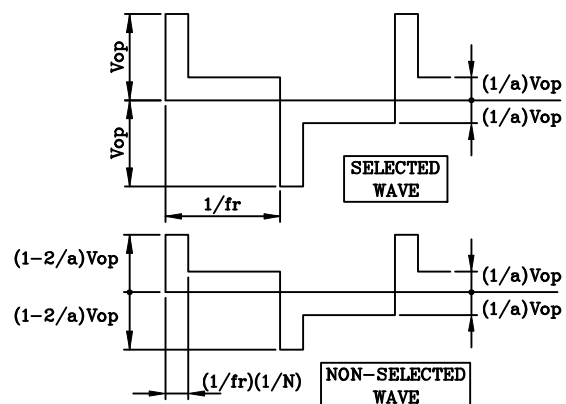
Operating Voltage : Vop  
Viewing Angle (θ,φ) : (0,0)  
Frame Frequency : 70Hz  
Applied Waveform : 1/N duty, 1/a bias

(NOTE 3)

Description of Measuring Equipment and Driving Waveforms

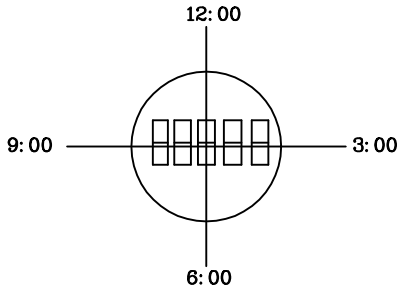


Multiplex Driving ( 1/N duty, 1/a bias )



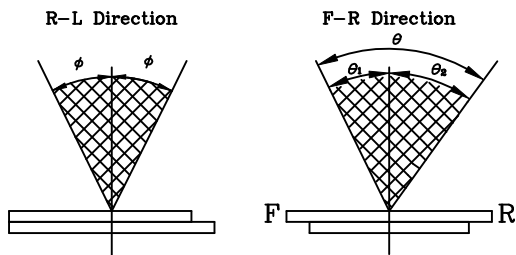
(NOTE 4)

Definition of Viewing Direction



(NOTE 5)

Definition of Viewing Angle



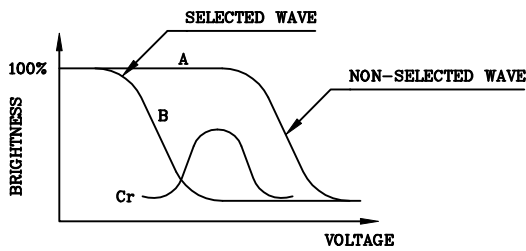
$$\theta = \theta_1 + \theta_2$$

\*Conditions

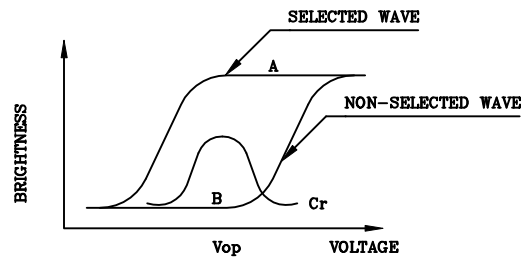
- Operating Voltage :  $V_{op}$
- Frame Frequency : 70Hz
- Applied Waveform : 1/N duty, 1/a bias
- Contrast Ratio : larger than 2

(NOTE 6)

Definition of Contrast Ratio (Cr)



(positive type)



(negative type)

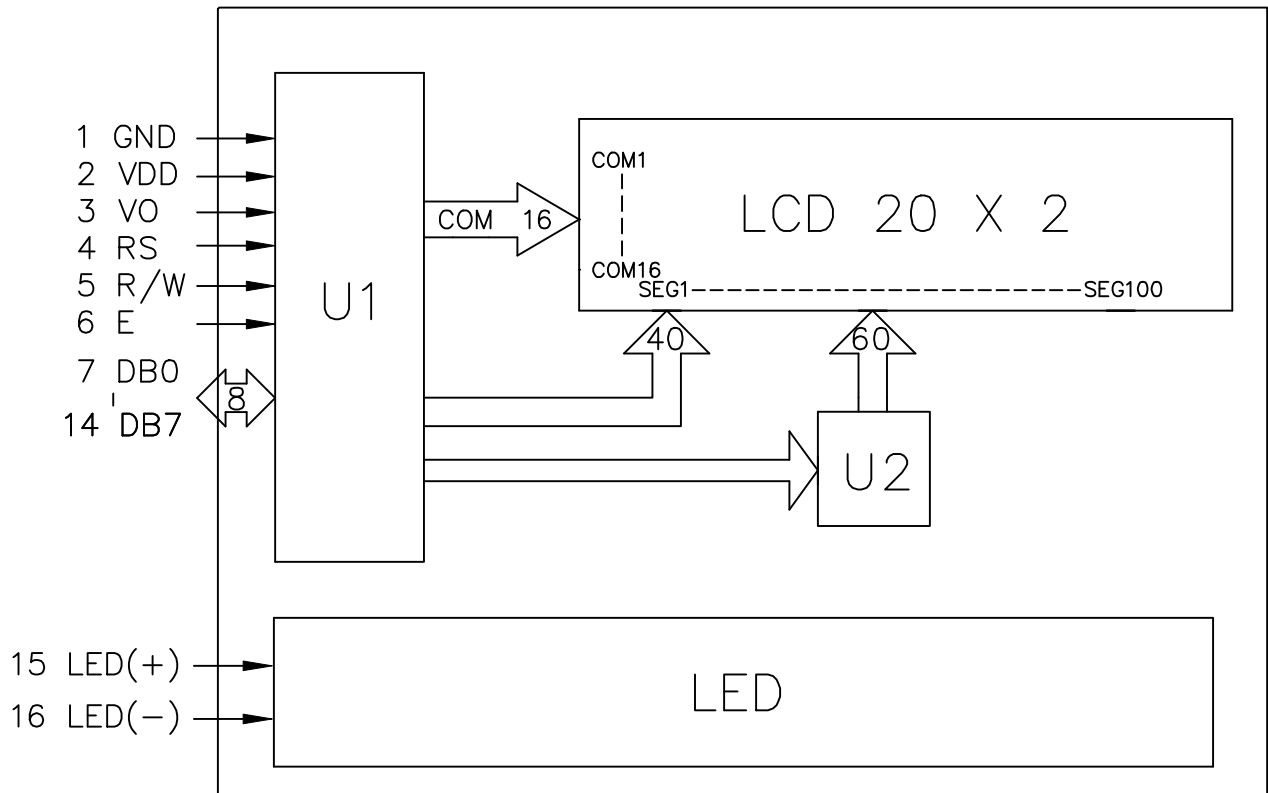
$$\text{Contrast Ratio} : Cr = A/B$$

\*Conditions

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

REV/DATE	R0/ 11.07.97'					APP	CHK	BY
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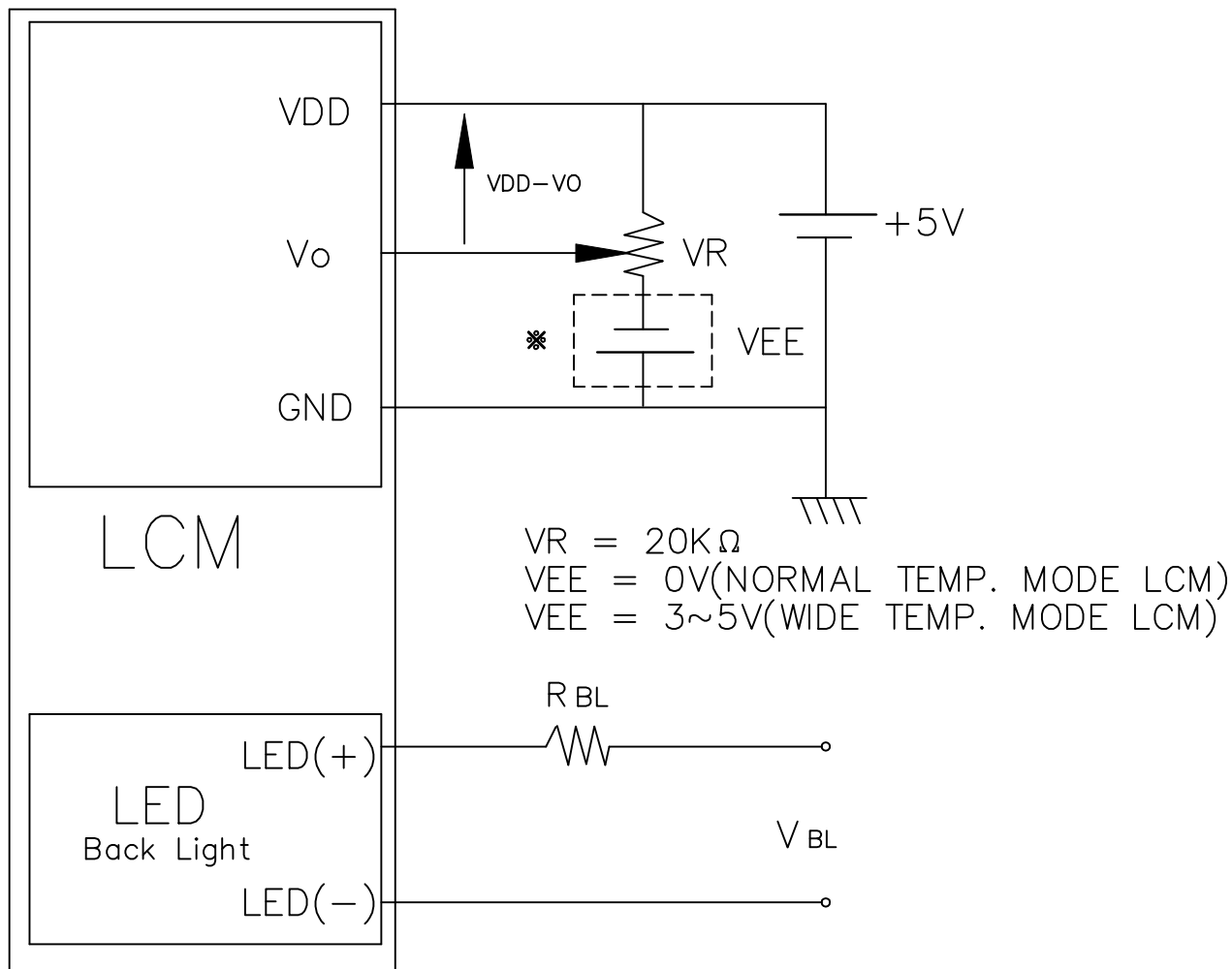
## 5. BLOCK DIAGRAM



## 6. INTERNAL PIN CONNECTION

PinNo.	Symbol	Level	Function
1	GND	—	0V
2	VDD	—	+5V
3	V <sub>0</sub>	—	—
4	RS	H/L	L: INSTRUCTION CODE INPUT H: DATA INPUT
5	R/W	H/L	H: DATA READ (FROM LCM TO MPU) L: DATA WRITE (FROM MPU TO LCM)
6	E	H, H->L	ENABLE SIGNAL
7	DB0	H/L	DATA BUS LINE
8	DB1	H/L	
9	DB2	H/L	
10	DB3	H/L	
11	DB4	H/L	
12	DB5	H/L	
13	DB6	H/L	
14	DB7	H/L	
15	LED(+)	—	POWER SUPPLY FOR LED/EL
16	LED(-)	—	

## 7. POWER SUPPLY



Recommended Value for R<sub>BL</sub> and V<sub>BL</sub>

ITEM	R <sub>BL</sub>	V <sub>BL</sub>
Back Light	LED	LED
Interface		
16 PIN	3.3 $\Omega$	5V <sub>dc</sub>

## 8. TIMING CHARACTERISTICS

Item	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Enable cycle time	$t_{cyc}$	Fig.a, Fig.b	500	-	-	ns
Enable pulse width	$PW_{EH}$	Fig.a, Fig.b	230	-	-	ns
Enable rise/fall time	$t_{Er}, t_{Ef}$	Fig.a, Fig.b	-	-	20	ns
RS, R/W set up time	$t_{AS}$	Fig.a, Fig.b	40	-	-	ns
RS, R/W hold time	$t_{H1}$	Fig.a, Fig.b	10	-	-	ns
Data set up time	$t_{DSW}$	Fig.a	60	-	-	ns
Data output delay time	$t_{DDR}$	Fig.b	-	-	120	ns
Data write hold time	$t_{H2}$	Fig.a	10	-	-	ns
Data read hold time	$t_{H2}$	Fig.b	5	-	-	ns

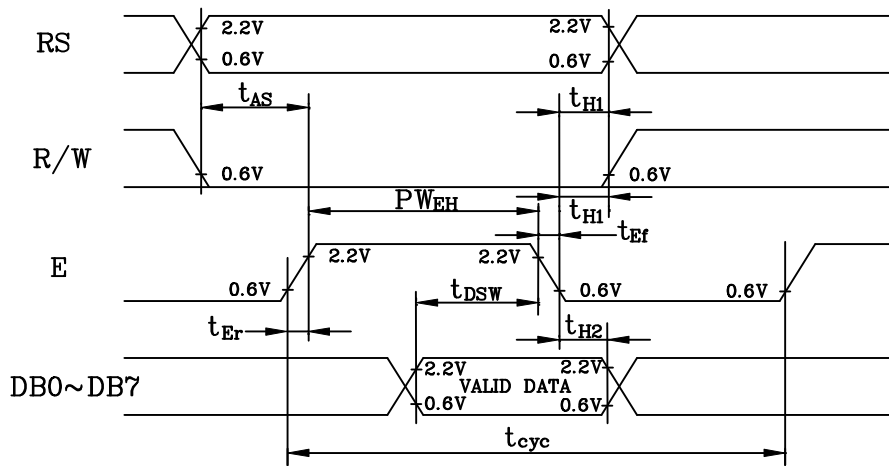


Fig.a Interface timing (data write)

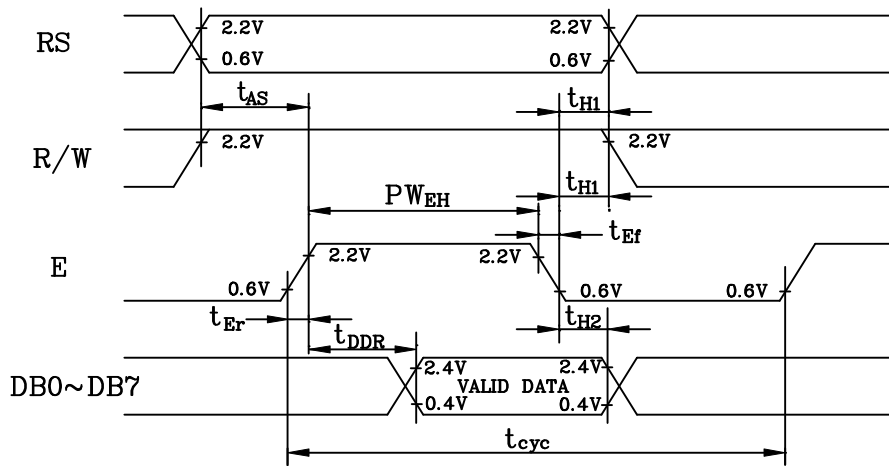


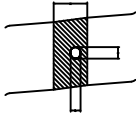
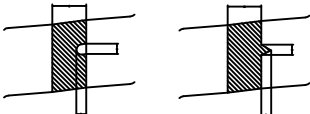
Fig.b Interface timing (data read)

## 9. 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

# 10.LCD PRODUCT QUALITY STANDARD

## (1) DISPLAY APPEARANCE

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

NAN YA PLASTICS CORP. ELEC. MATERIALS DIV. LCD DEPARTMENT	SPECIFICATION	SPEC. NO. : LM120-0 DATE : Nov. 07, 1997 SHEET NO. : 15/16
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(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  $25^{\circ}\text{C}\pm 5^{\circ}\text{C}$  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.

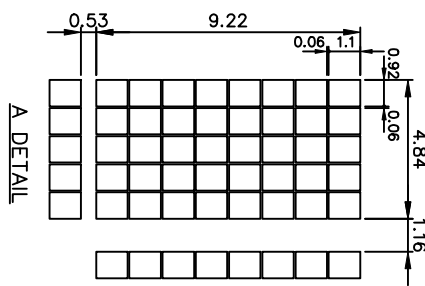
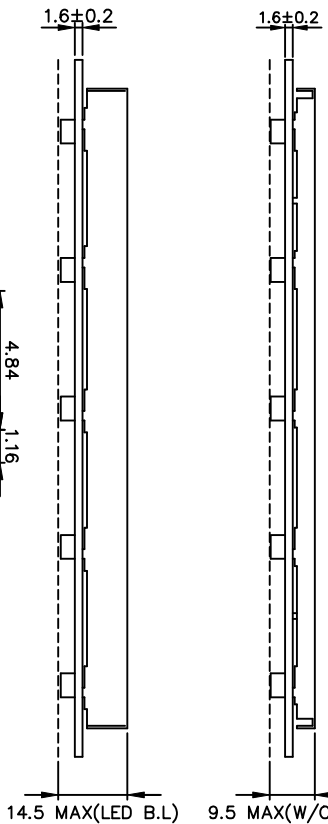
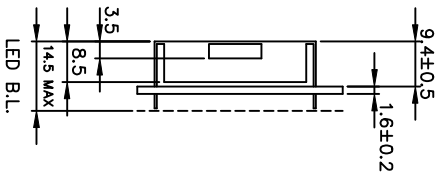
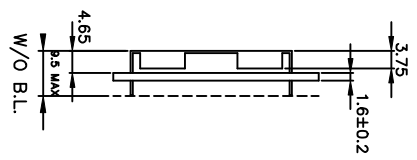
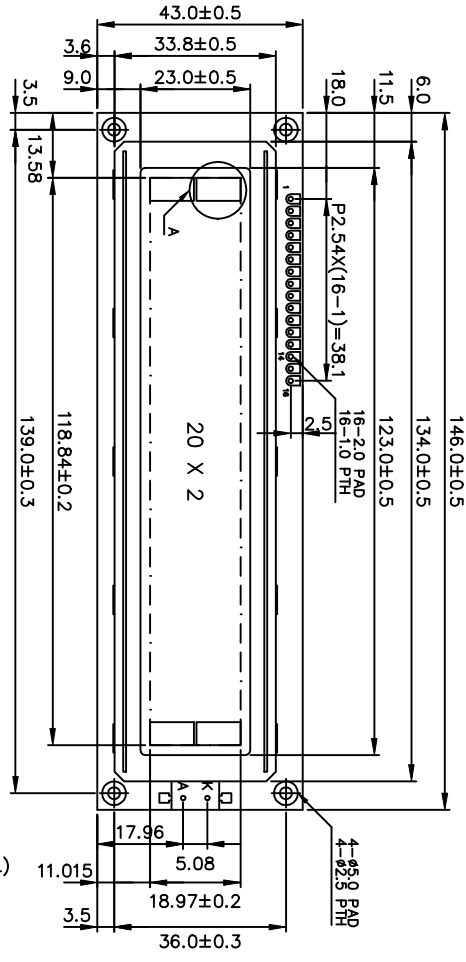
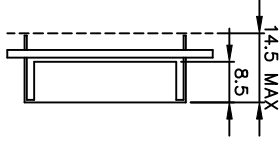
- TERMS OF WARRANTY

- 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

REV/DATE	R0/ 11.07.97'					APP	CHK	BY
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PinNo.	Symbol
1	GND
2	VDD
3	V0
4	RS
5	R/W
6	E
7	DB0
8	DB1
9	DB2
10	DB3
11	DB4
12	DB5
13	DB6
14	DB7
15	LED(+)
16	LED(-)

產品編號	LM_E4_120_
NAME	
DATE	
南亞塑膠工業股份有限公司 NAN YA PLASTICS CORPORATION	
TITLE	製圖
DWG-NO	MX-X120XXN
Rev	B
APPROVE	
CHECK	
DESIGN	
DRAW	
MAY PING	86.01.31
UNIT	mm
SCALE	2/3