NAN YA PLASTICS CORP. ELEC. MATERIALS DIV. LCD DEPARTMENT	SPECIFICATION	SPEC. NO. : LM027-0 DATE : Apr. 17, 1996 SHEET NO. : 1/16

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
16x4 LCD MODULE
PRODUCT NO.: LM_86_027_2E

SPEC. NO.: LM027-0

APPROVED BY

EDITED ON : Apr. 17, 1996

TECHNICAL MANAGER	DESIGN MANAGER	PERSON IN CHARGE

REV/DATE	R0/ 04.17.96'					APP	CHK	BY

1. MECHANICAL DATA

(1) Product No.	LM_86_027_2E
(2) Module Size	87.0 (W)mm x 60.0 (H)mm x MAX14.5 (D)mm (LED B.L.) 87.0 (W)mm x 60.0 (H)mm x MAX9.5 (D)mm (W/O,EL B.L.)
(3) Dot Size	0.55 (W)mm x 0.55 (H)mm
(4) Dot Pitch	0.60 (W)mm x 0.60 (H)mm
(5) Number of Characters	16 (W) x 4 (H)Characters
(6) Character Format	5 (W) x 8 (H)Dots
(7) Duty	1/16
(8) LCD Display Mode	STN: ☐ Gray Mode ☐ Yellow Mode ☐ Blue Mode FSTN: ☐ Black and White(Normal White/Positive Image) ☐ Black and White(Normal Black/Negative Image) Rear Polarizer: ☐ Reflective ☐ Transflective ☐ Transmissive
(9) Viewing Direction	☐ 6 O'clock ☐ 12 O'clock ☐ ____O'clock
(10) Backlight	☐ W/O ☐ LED ☐ EL
(11) Weight	W/O B/L: 46.8 g EL B/L: 48g LED B/L: 64g

Note :

LM_86_027_2E____

Back Light
K : None
M : LED Back Light
N : EL Back Light

Reflective/Transmissive
R : Reflective
S : Transflective
T : Transmissive
P : Transflective(High Transmissive)

Option
C : Anti-Glare
D : Wide Temperature
1
2
.
.
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

Vss=0V

	SYMBOL	MIN	MAX	UNIT	COMMENT
Power Supply for Logic	VDD−VSS	−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 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

(VDD = 5V±10%)

ITEM	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Input Voltage	VIH	H level	0.8VDD	–	VDD	V
	VIO	L level	0	–	0.2VDD	V
Recommended LC Driving Voltage (NORMAL TEMP. LCM)	VDD–V0	0°C	4.8	–	–	V
		25°C	4.3	4.8	–	
		50°C	3.9	4.2	4.8	
Recommended LC Driving Voltage (WIDE TEMP. LCM)	VDD–V0	–20°C	–	6.4	7.2	V
		0°C	–	6.4	–	
		25°C	–	6.1	–	
		50°C	–	5.9	–	
		70°C	5.2	5.5	–	
Power Supply Current	IDD	VDD = 5.0V	–	–	2.8	mA
LED Power Supply Current	ILED	V_{BL} = 5V_{DC} (R_{BL} = 5Ω) (R_{BL} =10Ω)	–	165 107	–	mA
EL Power Supply Current	IEL	V_{BL} = 110V_{AC} 400Hz	–	–	5.0	mA

4. OPTICAL CHARACTERISTICS

(FOR NORMAL TEMPERATURE MODE LCM)

AT Vop

ITEM / MODE		Cr(Contrast Ratio)		θ(Viewing Angle)		φ(Viewing Angle)	
		25℃		25℃		25℃	
		MIN.	TYP.	MIN.	TYP.	MIN.	TYP.
R	A	3	4.5	30	45	20	30
	C	3	5.5	30	60	20	35
	J						
S	A	3	4.5	30	45	20	30
	C	3	5.5	30	60	20	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℃	–	760	1400	ms	NOTE 2
		25℃	–	220	420		
		50℃	–	135	260		
Response Time (fall)	Tf	0℃	–	590	1100	ms	NOTE 2
		25℃	–	170	300		
		50℃	–	90	200		

NOTE :

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

4-1.OPTICAL CHARACTERISTICS

(FOR WIDE TEMPERATURE MODE LCM)

AT Vop

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	–	4.5	50	70	25	30
	C						
	J						
S	A	–	3.7	40	60	25	34
	C						
	J						
T	E						
	G						
NOTE		NOTE6		NOTE5			

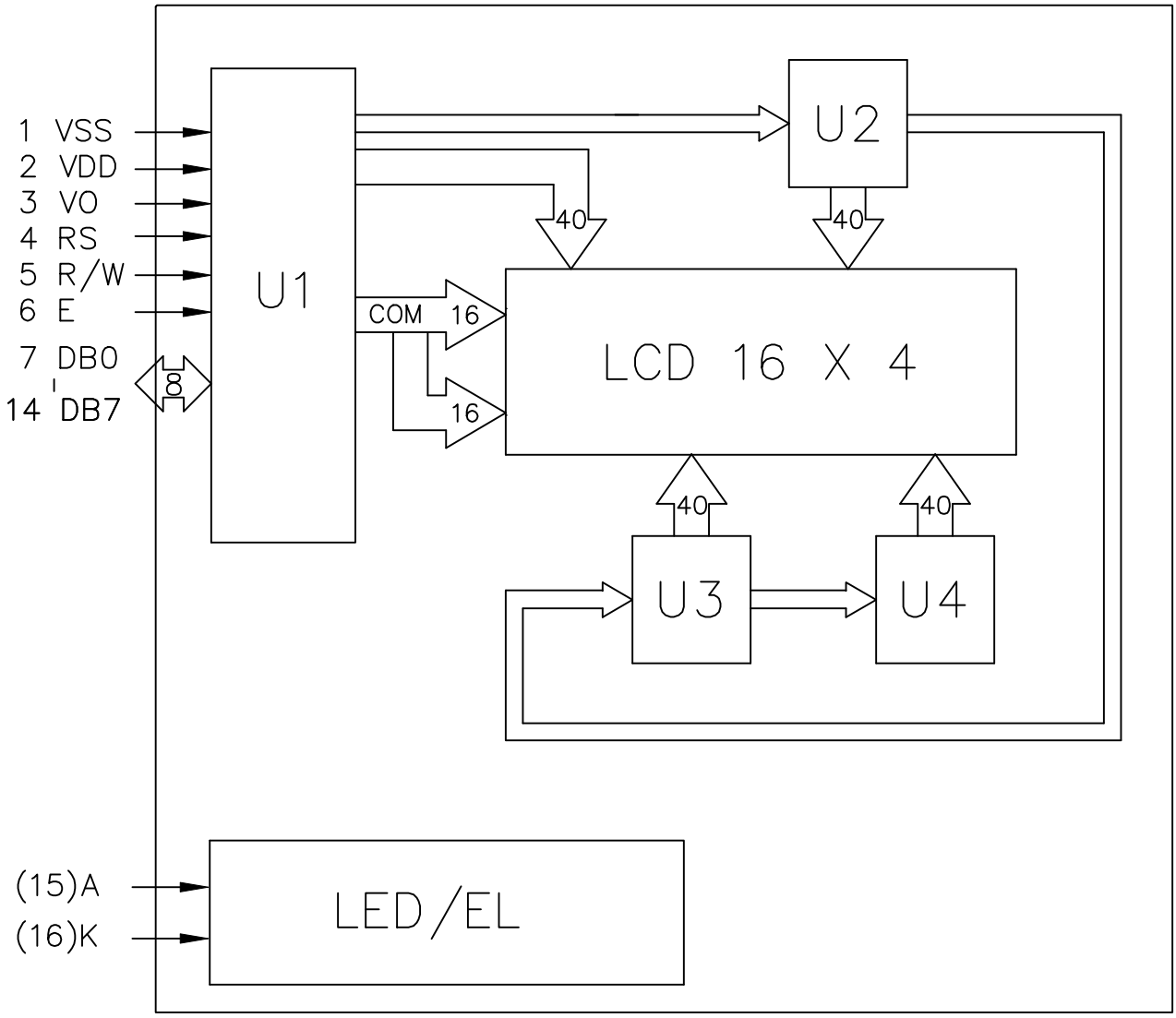
AT φ=0° θ=0°

ITEM	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT	NOTE
Response Time (rise)	Tr	-20℃	–	1530	3000	ms	NOTE 2
		0℃	–	270	540		
		25℃	–	130	260		
		50℃	–	70	140		
		70℃	–	65	130		
Response Time (fall)	Tf	-20℃	–	1490	3000	ms	NOTE 2
		0℃	–	310	600		
		25℃	–	90	180		
		50℃	–	48	100		
		70℃	–	40	80		

NOTE :

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

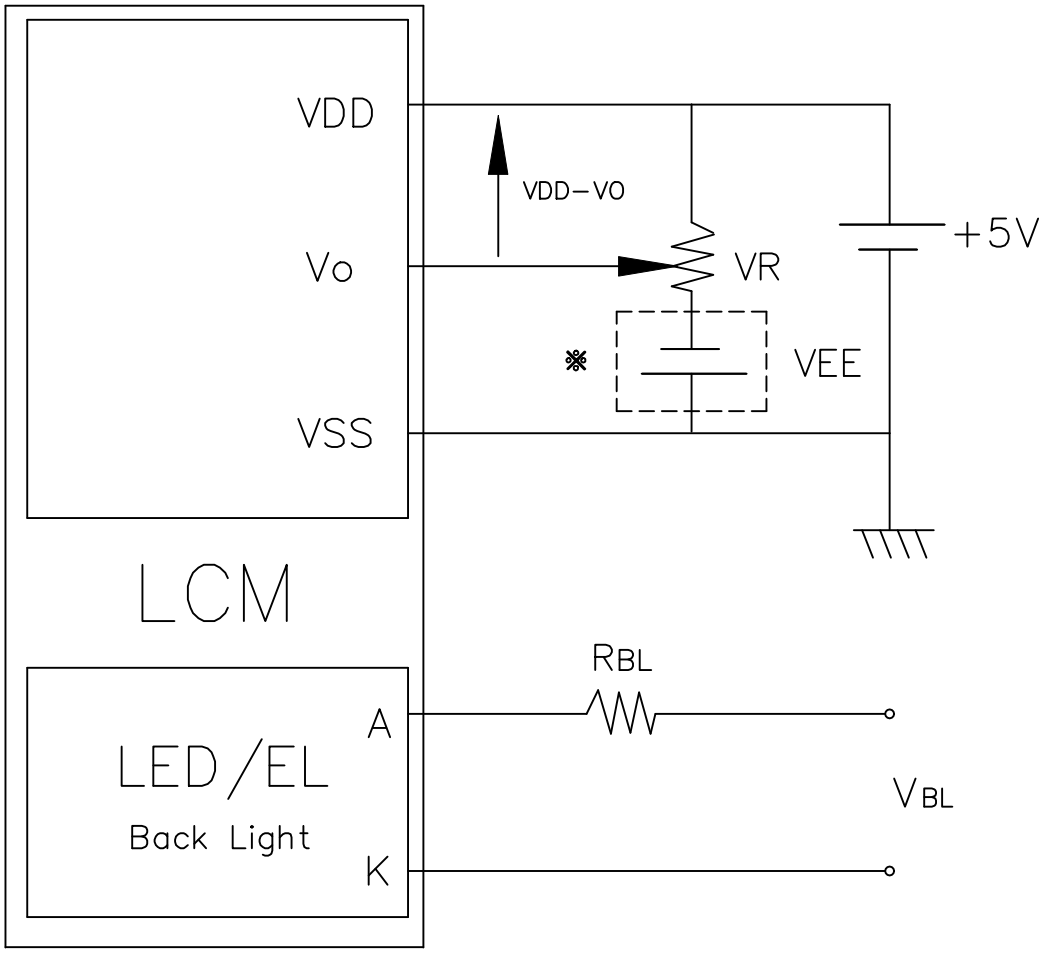
5. BLOCK DIAGRAM



6. INTERNAL PIN CONNECTION

Pin No.	Symbol	Level	Function	
1	V_{SS}	—	0V	POWER SUPPLY
2	V_{DD}	—	+5V	
3	V_O	—	—	
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)	A	—	POWER SUPPLY FOR LED,EL	
(16)	K	—		

7. POWER SUPPLY



VR = 20KΩ
VEE = 0V(NORMAL TEMP. MODE LCM)
VEE = 3~5V(WIDE TEMP. MODE LCM)

Recommended Value for R_{BL} and V_{BL}

ITEM / Back Light / Interface	R_{BL}		V_{BL}	
	LED	EL	LED	EL
14 PIN	5Ω 10Ω	0Ω	5V	110V_{AC} 400Hz
16 PIN	0Ω			

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

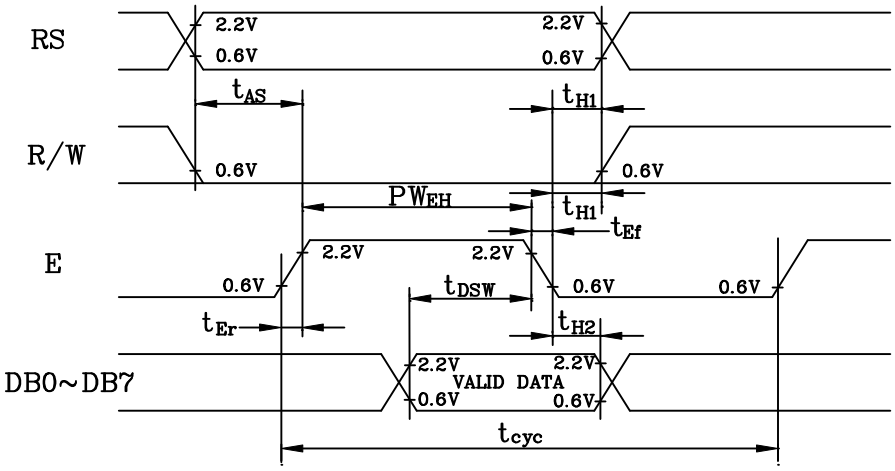


Fig.a Interface timing (data write)

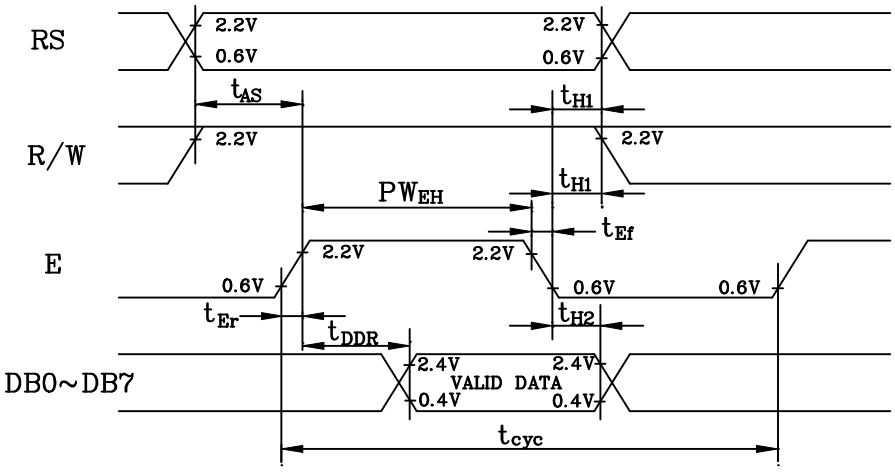


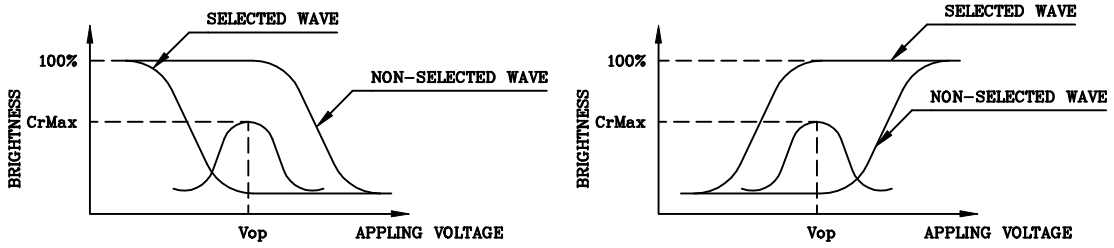
Fig.b Interface timing (data read)

9. RELIABILITY TEST

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

(NOTE 1)

Definition of Operation Voltage(Vop)



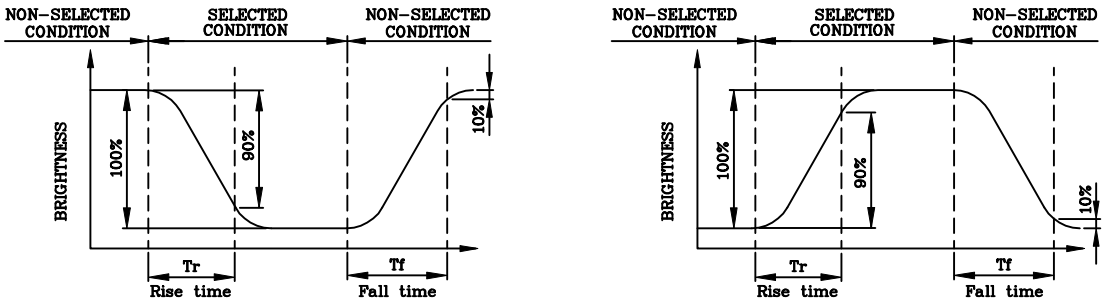
(positive type) (negative type)

*Conditions

Viewing Angle : 0
Frame Frequency : 70Hz
Appling Waveform : I/N duty 1/a bias

(NOTE 2)

Definition of Response Time(Tr.Tf)



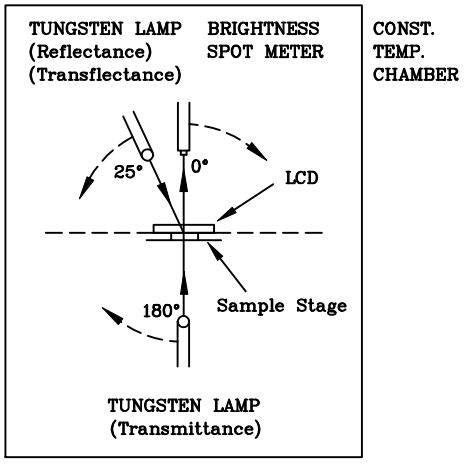
(positive type) (negative type)

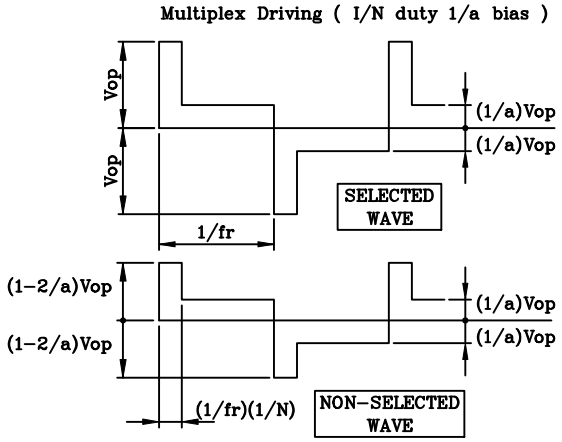
*Conditions

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

(NOTE 3)

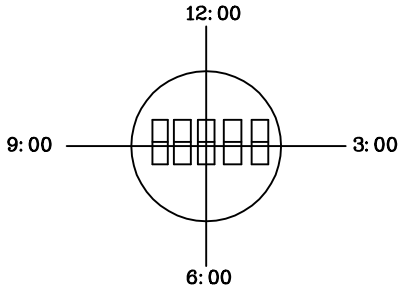
Description of Measuring Equipment and Driving Waveforms





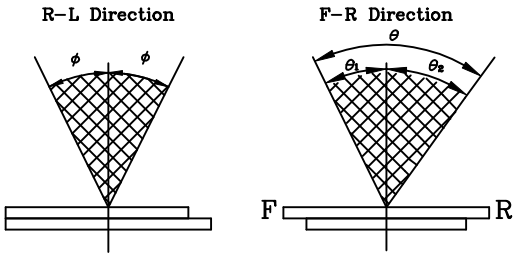
(NOTE 4)

Definition of Viewing Direction



(NOTE 5)

Definition of Viewing Angle



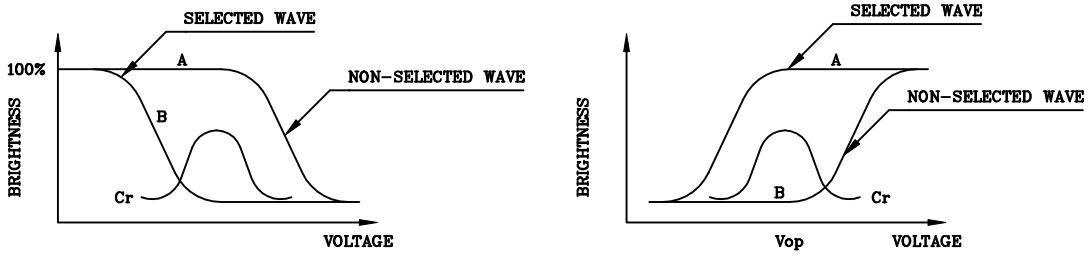
$\theta = \theta_1 + \theta_2$

*Conditions

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

(NOTE 6)

Definition of Contrast Ratio (Cr)



(positive type) (negative type)

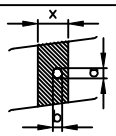
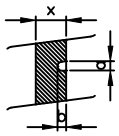
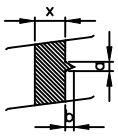
Contrast Ratio : Cr=A/B

*Conditions

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

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:

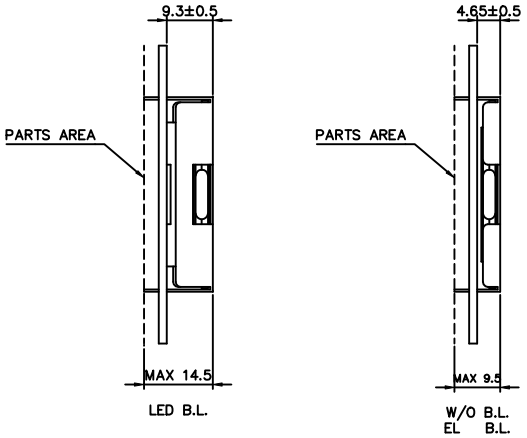
- SAFETY
  1. If the LCD panel breaks, be careful not to get the liquid crystal to touch your skin.
  2. If the liquid crystal touches your skin or clothes, please wash it off immediately by using soap and water.

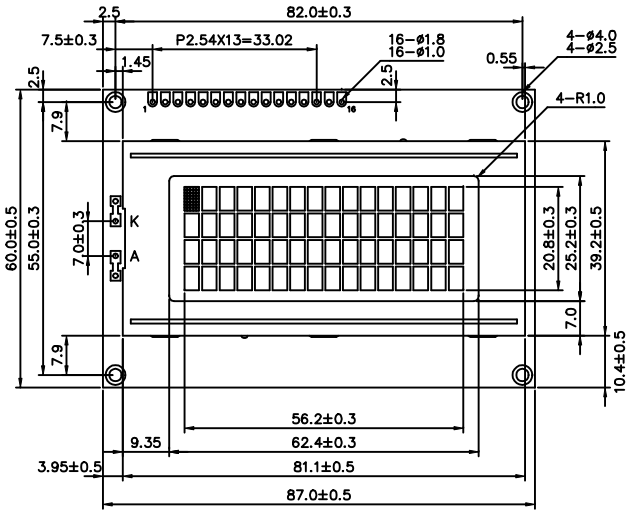
- HANDLING
  1. Avoid static electricity which can damage the CMOS LSI.
  2. Do not remove the panel or frame from the module.
  3. The polarizing plate of the display is very fragile. So, please handle it very carefully.
  4. Do not wipe the polarizing plate with a dry cloth, as it may easily scratch the surface of plate.
  5. Do not use ketonics solvent & Aromatic solvent, use with a soft cloth soaked with a cleaning naphtha solvent.

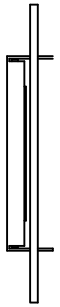
- STORAGE
  1. Store the panel or module in a dark place where the temperature is 25°C±5°C and the humidity is below 65% RH.
  2. Do not place the module near organics solvents or corrosive gases.
  3. Do not crush, shake, or jolt the module.

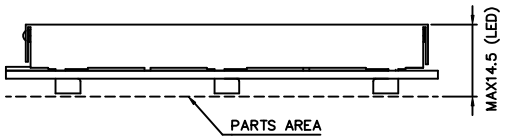
- TERMS OF WARRANT
  1. Acceptance inspection period
     The period is within one month after the arrival of contracted commodity at the buyer's factory site.
  2. Applicable warrant period
     The period is within twelve months since the date of shipping out under normal using and storage conditions.

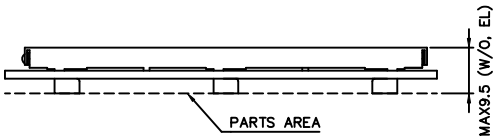
- THE OPERATING LIFE TIME OF BACK LIGHT
  LED : 50,000HR
  EL : 5,000HR
  CCFT : 10,000HR



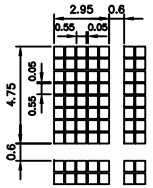








PinNo.	Symbol	Level	Function	
1	V_{SS}	—	0V	Power supply
2	V_{DD}	—	+5V	
3	V_O	—	—	
4	RS	H/L	L:INSTRUCTION CODE INPUT H:DATA INPUT	
5	R/W	H/L	H:DATA READ (FROM LCM TO MPU) L:DATA WRITE (FROM MPU TO LCM)	
6	E	H,H->L	ENABLE SIGNAL	
7	DB0	H/L	DATA BUS LINE	
8	DB1	H/L		
9	DB2	H/L		
10	DB3	H/L		
11	DB4	H/L		
12	DB5	H/L		
13	DB6	H/L		
14	DB7	H/L		
15	A	—	+5V	Power supply
16	K	—	0V	



產品編號	LM_86_027_2E		南亞塑膠工業股份有限公司 NAN YA PLASTICS CORPORATION
			TITLE: 外觀尺寸圖
APPROVE			DWG-NO: MXBX027X2X Rev.A
CHECK			
DESIGN			UNIT : mm
DRAW	MAY PING	85.01.26	SCALE : 2/3

SHEET NO. : 16/16