

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

APPROVED BY

EDITED ON : Apr. 17, 1996

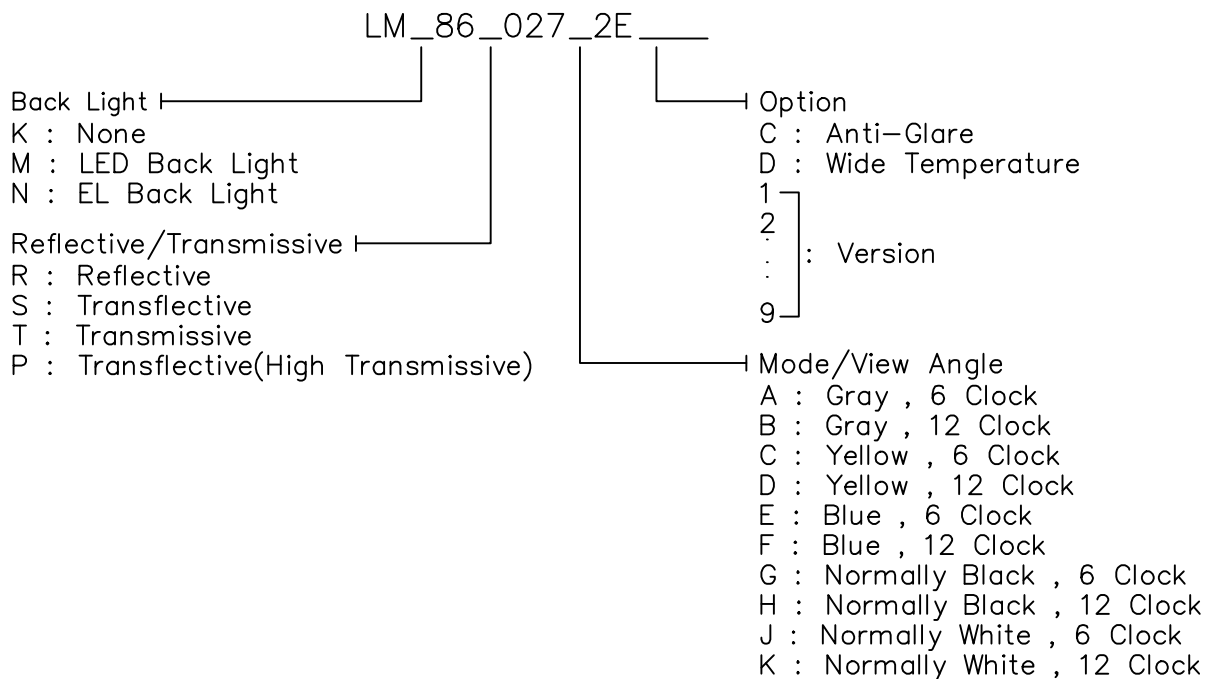
TECHNICAL MANAGER	DESIGN MANAGER	PERSON IN CHARGE

REV/DATE	RO/ 04.17.96'					APP	CHK	BY
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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 :



2. ABSOLUTE MAXIMUM RATINGS

(1) ELECTRICAL ABSOLUTE RATINGS

V_{SS}=0V

	SYMBOL	MIN	MAX	UNIT	COMMENT
Power Supply for Logic	VDD-VSS	-0.3	6.5	V	
Input Voltage	V _I	-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	VBL = 5Vdc (RBL = 5Ω) (RBL = 10Ω)	-	165 107	-	mA
EL Power Supply Current	IEL	VBL = 110Vac 400Hz	-	-	5.0	mA

4. OPTICAL CHARACTERISTICS

(FOR NORMAL TEMPERATURE MODE LCM)

AT Vop

MODE	ITEM	Cr(Contrast Ratio)		θ (Viewing Angle)		ϕ (Viewing Angle)	
		25 τ		25 τ		25 τ	
		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 τ	-	760	1400	ms	NOTE 2
		25 τ	-	220	420		
		50 τ	-	135	260		
Response Time (fall)	Tf	0 τ	-	590	1100	ms	NOTE 2
		25 τ	-	170	300		
		50 τ	-	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

MODE	ITEM	Cr(Contrast Ratio)		θ (Viewing Angle)		ϕ (Viewing Angle)	
		25℃		25℃		25℃	
		MIN.	TYP.	MIN.	TYP.	MIN.	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 $\phi=0^\circ$ $\theta=0^\circ$

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		

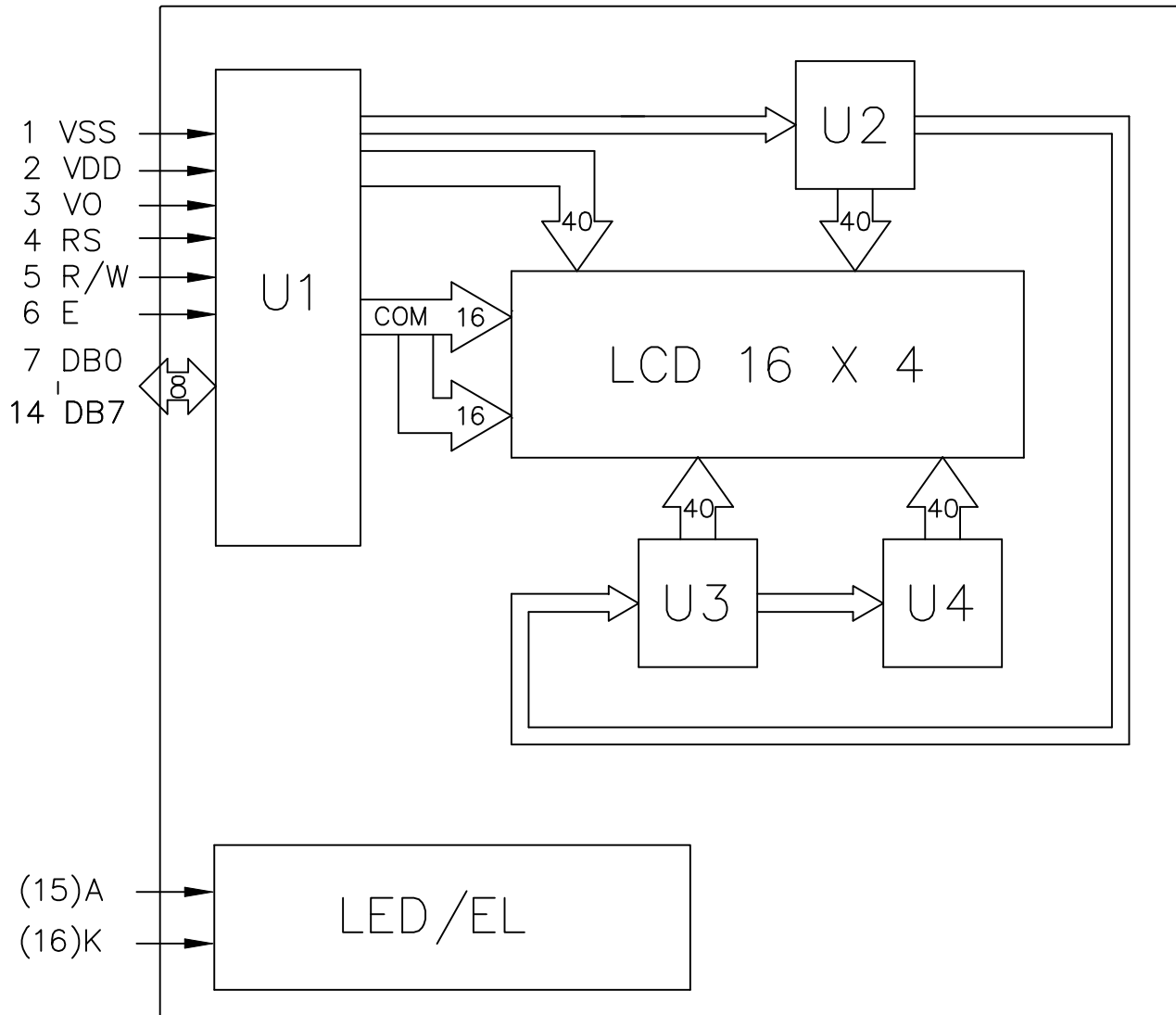
NOTE :

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

C: YELLOW
E: BLUE
G: NORMALLY BLACK
J: NORMALLY WHITE

REV/DATE	R0/ 04.17.96'					APP	CHK	BY
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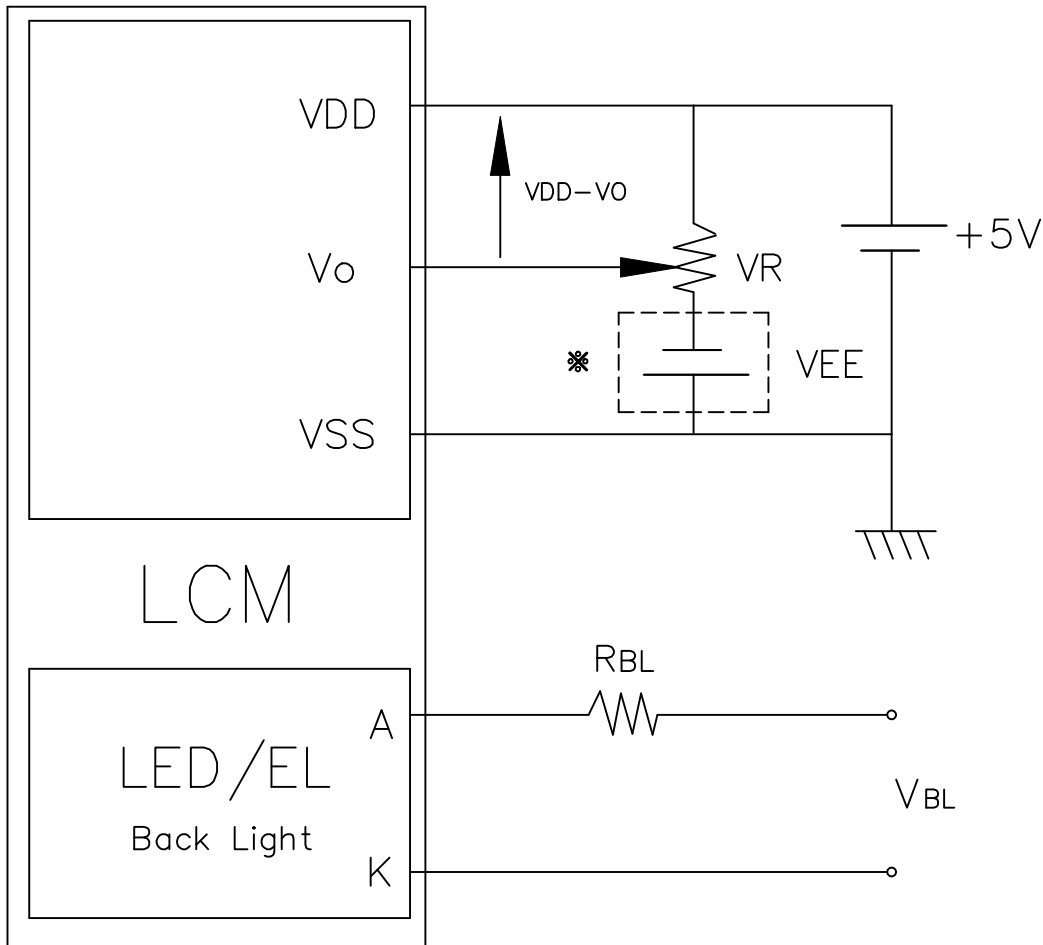
5. BLOCK DIAGRAM



6. INTERNAL PIN CONNECTION

PinNo.	Symbol	Level	Function
1	V _{SS}	—	0V
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



$VR = 20K\Omega$

$VEE = 0V$ (NORMAL TEMP. MODE LCM)

$VEE = 3\sim 5V$ (WIDE TEMP. MODE LCM)

Recommended Value for RBL and VBL

ITEM Back Light	RBL		VBL	
	LED	EL	LED	EL
Interface				
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

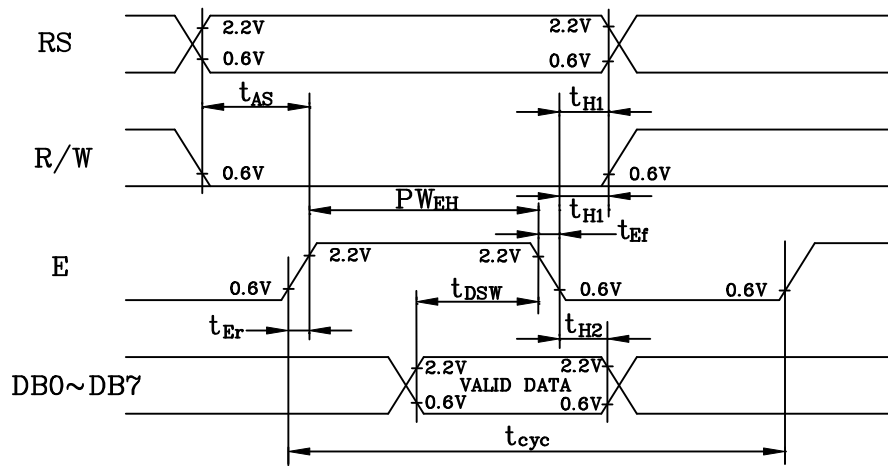


Fig.a Interface timing (data write)

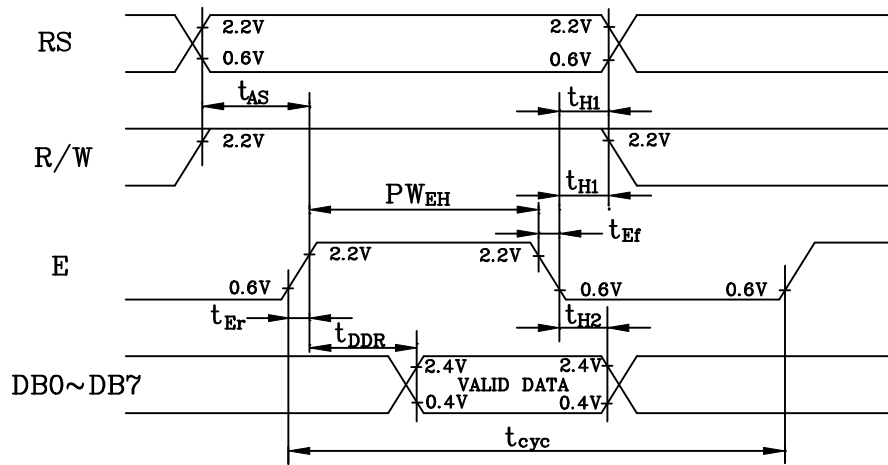


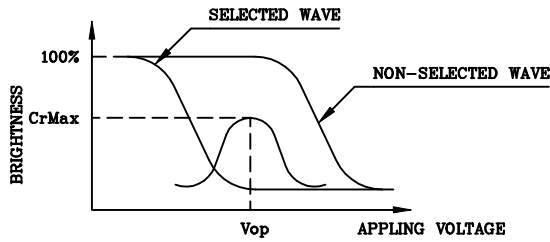
Fig.b Interface timing (data read)

9. RELIABILITY TEST

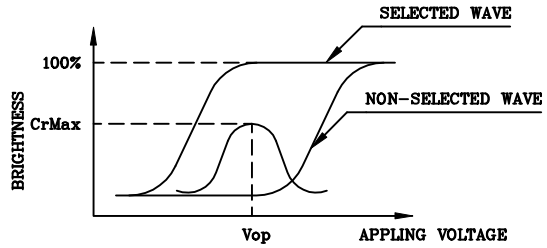
NO	ITEM	CONDITION			STANDARD	NOTE
1	High Temp. Leaving	70°C	120HR		Appearance without defect	
2	Low Temp. Leaving	-20°C	120HR		Appearance without defect	
3	High Temp. & High Humi. Leaving	40°C 90%RH	120HR		Appearance without defect	
4	Thermal Shock	-20°C,30min→25°C.5min →60°C,30min→25°C.5min (1cycle)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

(NOTE 1)

Definition of Operation Voltage(Vop)



(positive type)



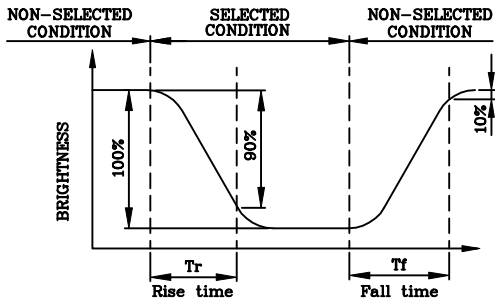
(negative type)

*Conditions

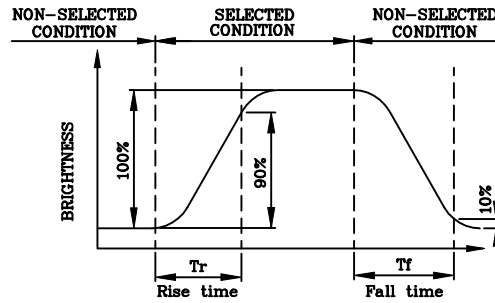
Viewing Angle : 0
 Frame Frequency : 70Hz
 Appling Waveform : 1/N duty 1/a bias

(NOTE 2)

Definition of Response Time(Tr,Tf)



(positive type)



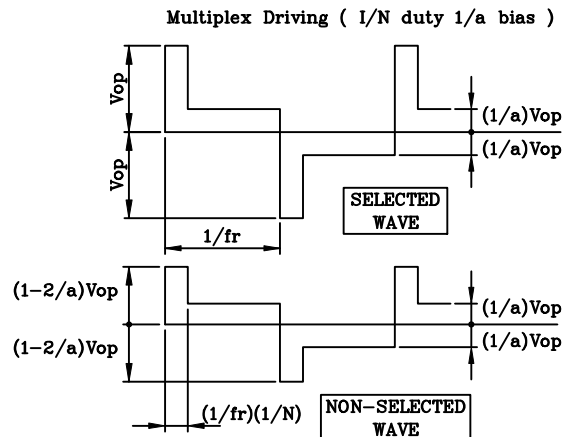
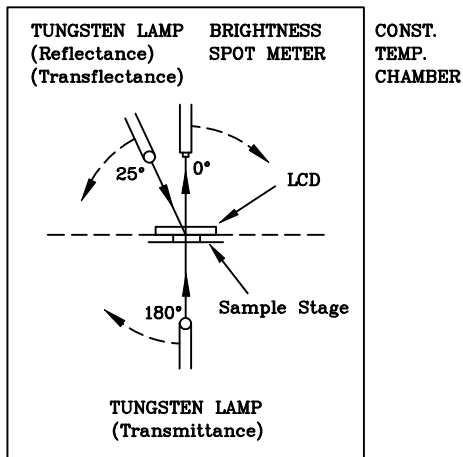
(negative type)

*Conditions

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

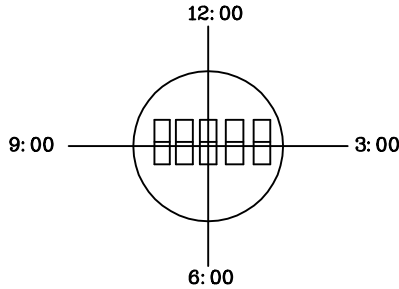
(NOTE 3)

Description of Measuring Equipment and Driving Waveforms



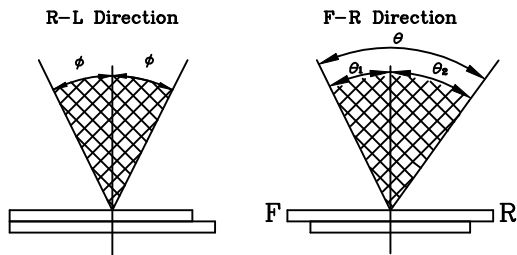
(NOTE 4)

Definition of Viewing Direction



(NOTE 5)

Definition of Viewing Angle



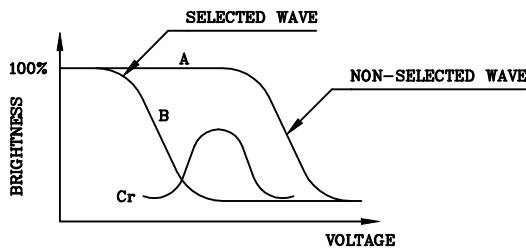
$$\theta = \theta_1 + \theta_2$$

*Conditions

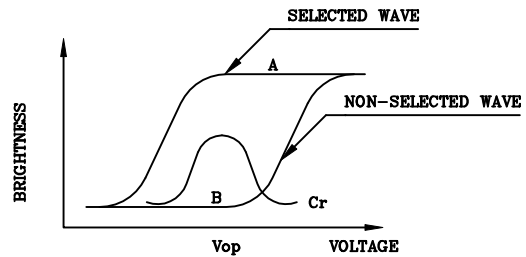
Operating Voltage : V_{op}
 Frame Frequency : 70Hz
 Applying Waveform : 1/N duty 1/a bias
 Contrast Ratio : larger than 2

(NOTE 6)

Definition of Contrast Ratio (Cr)



(positive type)



(negative type)

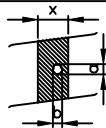
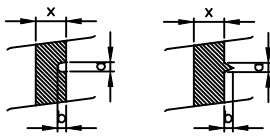
$$\text{Contrast Ratio : } Cr = A/B$$

*Conditions

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

LCD PRODUCT QUALITY STANDARD

(1) DISPLAY APPEARANCE

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

(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

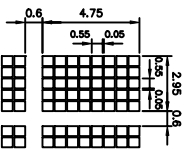
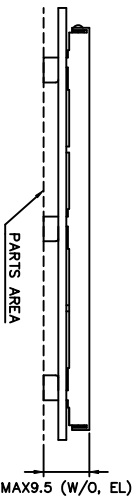
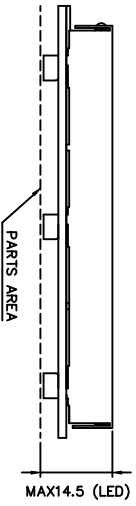
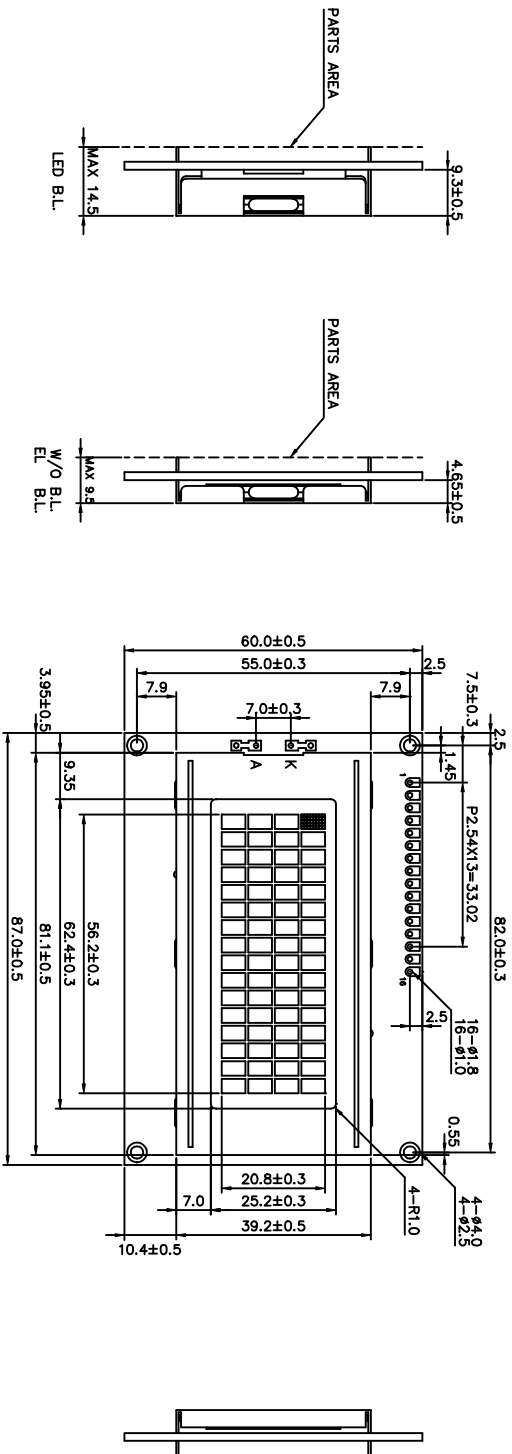
- 1.Store the panel or module in a dark place where the temperature is $25^{\circ}\text{C}\pm 5^{\circ}\text{C}$ and the humidity is below 65% RH.
- 2.Do not place the module near organics solvents or corrosive gases.
- 3.Do not crush, shake, or jolt the module.

• TERMS OF 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	VSS	-	OV
2	VDD	-	Power supply
3	V0	-	+5V
4	RS	H/L	INSTRUCTION CODE INPUT
5	R/W	H/L	HEAD DATA INPUT (FROM LED TO HEAD)
6	E	H, H->	HEAD DATA INPUT (FROM HEAD TO LED)
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	-	+5V
16	K	-	Power supply

產品編號	LM_86_027_2E	南亞塑膠工業股份有限公司
APPROVE		NAN YA PLASTICS CORPORATION
CHECK		
DESIGN		
DRAW	MAY PING	
	85.01.26	
TITLE	外觀尺寸圖	
DWG-NO	MXXB027X2X	
UNIT	mm	
SCALE	2/3	