

NAN YA PLASTICS CORP.  
ELEC. MATERIALS DIV.  
LCD DEPARTMENT

# SPECIFICATION

SPEC. NO. : LM028-2  
DATE : NOV.18.1997  
SHEET NO. : 1/17

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  
40x4 LCD MODULE  
PRODUCT NO.: LM\_K5\_028\_2\_\_

SPEC. NO.: LM028-2

APPROVED BY

EDITED ON : NOV.18.1997

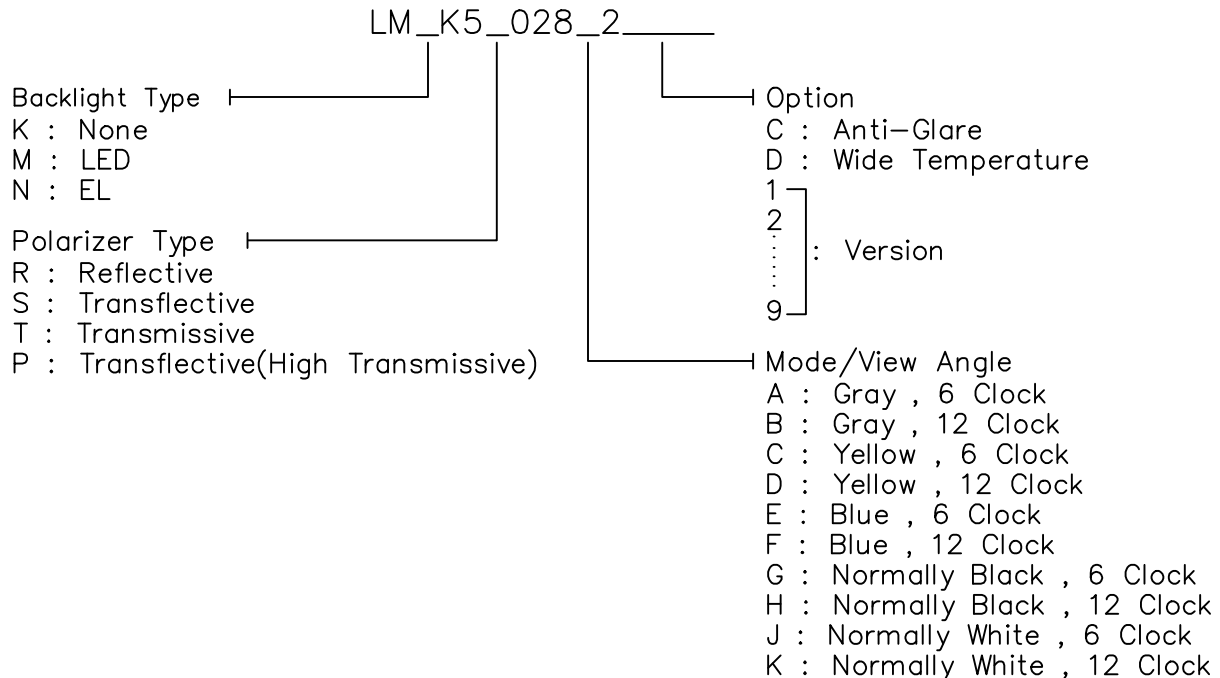
SALES MANAGER	DESIGN MANAGER	PERSON IN CHARGE

REV/DATE	R0/ 11.18.97'					APP	CHK	BY
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# 1. MECHANICAL DATA

- (1) Product No. LM\_K5\_028\_2\_\_\_\_\_
- (2) Module Size 190.0 (W)mm x 54.0 (H)mm x MAX14.5 (D)mm (LED B.L.)  
190.0 (W)mm x 54.0 (H)mm x MAX9.5 (D)mm (W/O,EL B.L.)
- (3) Dot Size 0.50 (W)mm x 0.55 (H)mm
- (4) Dot Pitch 0.57 (W)mm x 0.62 (H)mm
- (5) Number of Characters 40 (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: 95.0 g  
EL B/L: 101.0 g  
LED B/L: 131.0 g

Note :



REV/DATE	R0/ 11.18.97'					APP	CHK	BY
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## 2. ABSOLUTE MAXIMUM RATINGS

### (1) ELECTRICAL ABSOLUTE RATINGS

V<sub>SS</sub>=0V

ITEM	SYMBOL	MIN	MAX	UNIT	COMMENT
Power Supply for Logic	VDD-VSS	-0.3	7.0	V	
Input Voltage	V <sub>I</sub>	-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	VIH	H level	0.7VDD	—	VDD	V
	VIO	L level	0	—	0.3VDD	V
Recommended LC Driving Voltage (Normal Temp. LCM)	VDD-V0	0℃	—	4.8	5.4	V
		25℃	4.2	4.7	5.2	
		50℃	3.8	4.3	—	
Recommended LC Driving Voltage (Wide Temp. LCM)	VDD-V0	-20℃	5.9	6.4	7.2	V
		0℃	5.7	6.4	7.2	
		25℃	5.7	6.2	6.8	
		50℃	5.5	5.9	6.5	
		70℃	5.3	5.5	6.1	
Power Supply Current	IDD	VDD = 5.0V	—	4.7	6.0	mA
LED Power Supply Current	I <sub>LED</sub>	V <sub>BL</sub> = 5V <sub>Dc</sub> (R <sub>BL</sub> = 5Ω)	—	200	—	mA
EL Power Supply Current	I <sub>EL</sub>	V <sub>BL</sub> = 110V <sub>Ac</sub> 400Hz	—	—	10.0	mA

## 4-1. OPTICAL CHARACTERISTICS

(FOR NORMAL TEMPERATURE MODE LCM)

AT Vop

MODE	ITEM	Cr(Contrast Ratio)		$\theta$ (Viewing Angle)		$\phi$ (Viewing Angle)	
		25℃		25℃		25℃	
		MIN.	TYP.	MIN.	TYP.	MIN.	TYP.
R	A/B	3.0	4.0	40	65	25	35
	C/D	5.0	8.0	50	70	28	38
	J/K						
S	A/B	3.0	4.0	35	60	20	32
	C/D	4.0	7.0	45	65	25	35
	J/K						
T	E/F	2.5	3.0	30	50	20	30
	C/D	2.5	5.0	30	50	20	30
NOTE		NOTE6		NOTE5			

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

ITEM	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT	NOTE
Response Time (rise)	Tr	0℃	-	460	900	ms	NOTE 2
		25℃	-	110	220		
		50℃	-	65	130		
Response Time (fall)	Tf	0℃	-	420	800	ms	NOTE 2
		25℃	-	140	250		
		50℃	-	90	155		

NOTE :

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

## 4-2.OPTICAL CHARACTERISTICS

(FOR WIDE TEMPERATURE MODE LCM)

AT Vop

MODE	ITEM	Cr(Contrast Ratio)		$\theta$ (Viewing Angle)		$\phi$ (Viewing Angle)	
		25 $\tau$		25 $\tau$		25 $\tau$	
		MIN.	TYP.	MIN.	TYP.	MIN.	TYP.
R	A/B	3.5	4.3	40	65	25	35
	C/D	5.5	9.0	50	70	28	38
	J/K						
S	A/B	3.2	4.1	35	60	20	32
	C/D	4.5	7.5	45	65	25	35
	J/K						
T	E/F	2.7	3.3	30	50	20	30
	C/D	3.0	5.5	30	50	20	30
NOTE		NOTE6		NOTE5			

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

ITEM	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT	NOTE
Response Time (rise)	Tr	-20 $\tau$	-	1500	3000	ms	NOTE 2
		0 $\tau$	-	270	540		
		25 $\tau$	-	120	240		
		50 $\tau$	-	70	140		
		70 $\tau$	-	65	130		
Response Time (fall)	Tf	-20 $\tau$	-	2000	3500	ms	NOTE 2
		0 $\tau$	-	310	580		
		25 $\tau$	-	100	220		
		50 $\tau$	-	50	120		
		70 $\tau$	-	40	105		

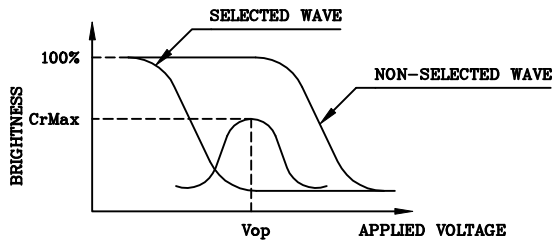
NOTE :

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

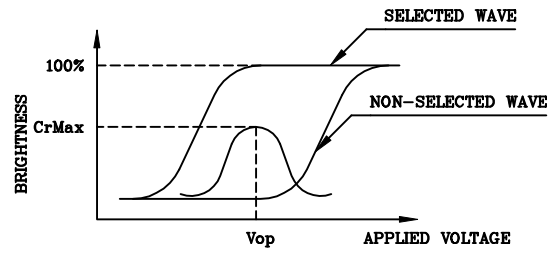
C/D: YELLOW  
E/F: BLUE  
J/K: NORMALLY WHITE

(NOTE 1)

Definition of Operation Voltage(Vop)



(positive type)



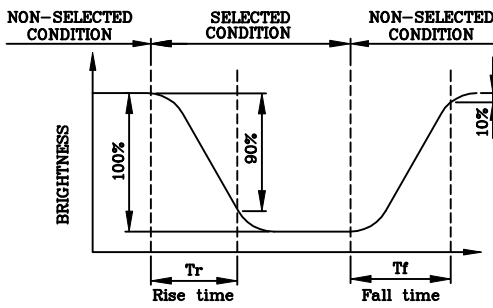
(negative type)

\*Conditions

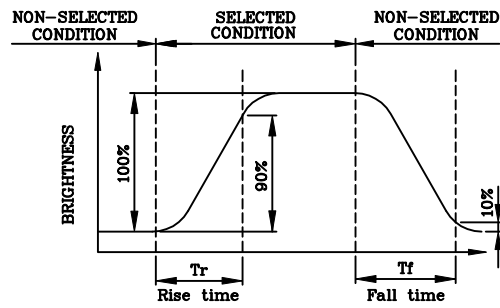
Viewing Angle : 0  
Frame Frequency : 70Hz  
Applied Waveform : 1/N duty, 1/a bias

(NOTE 2)

Definition of Response Time(Tr,Tf)



(positive type)



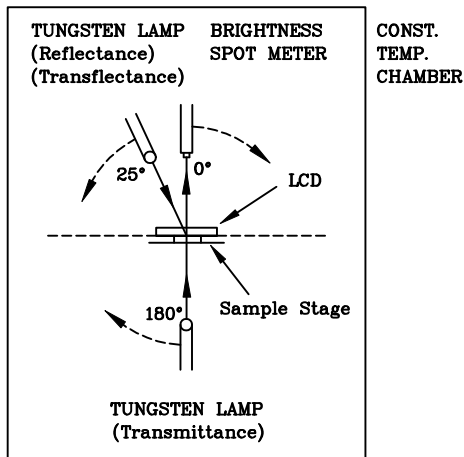
(negative type)

\*Conditions

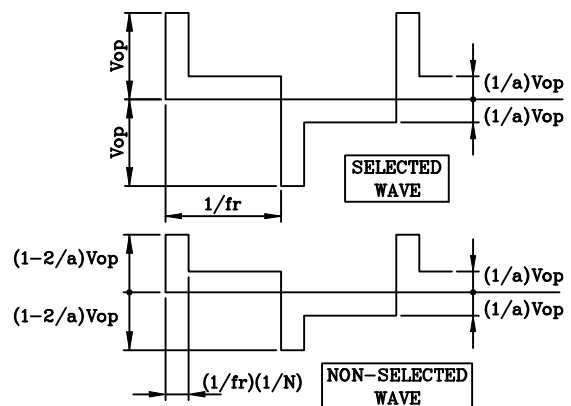
Operating Voltage : Vop  
Viewing Angle (θ,φ) : (0,0)  
Frame Frequency : 70Hz  
Applied Waveform : 1/N duty, 1/a bias

(NOTE 3)

Description of Measuring Equipment and Driving Waveforms

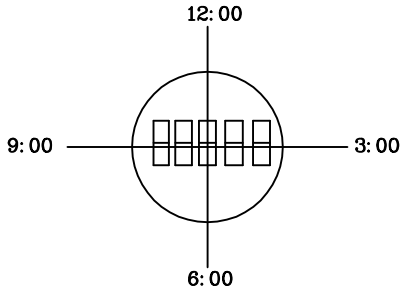


Multiplex Driving ( 1/N duty, 1/a bias )



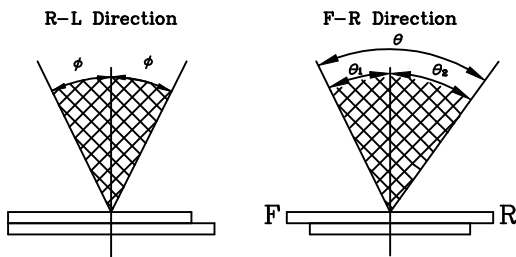
(NOTE 4)

Definition of Viewing Direction



(NOTE 5)

Definition of Viewing Angle

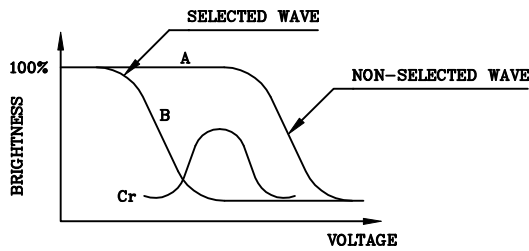


\*Conditions

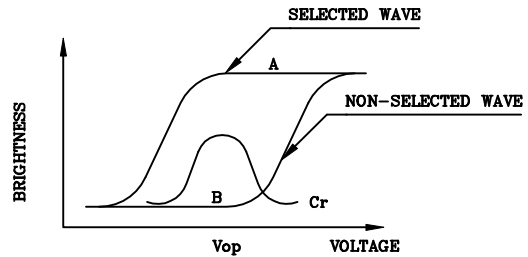
Operating Voltage :  $V_{op}$   
 Frame Frequency : 70Hz  
 Applied Waveform : 1/N duty, 1/a bias  
 Contrast Ratio : larger than 2

(NOTE 6)

Definition of Contrast Ratio (Cr)



(positive type)



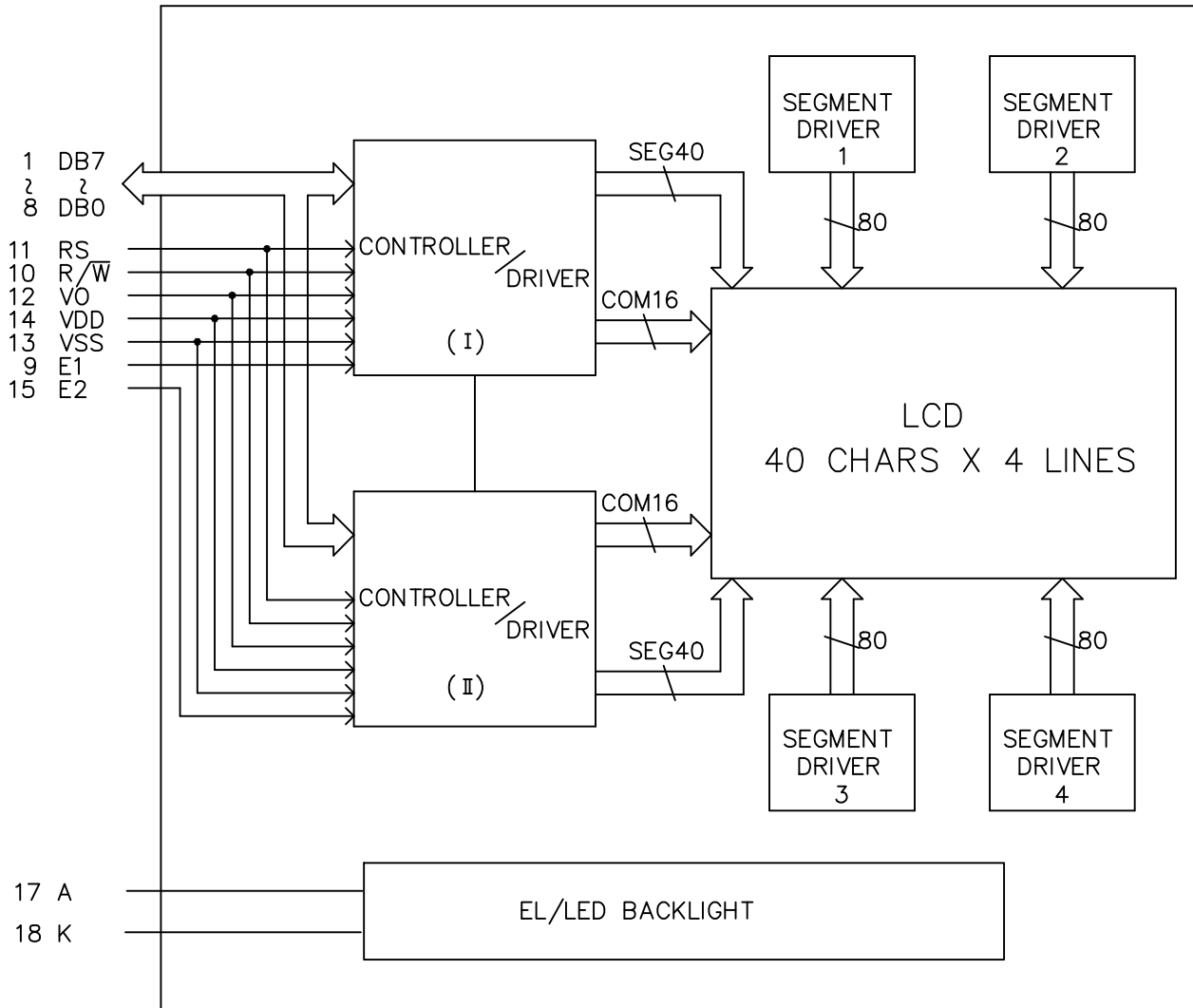
(negative type)

Contrast Ratio :  $Cr=A/B$

\*Conditions

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

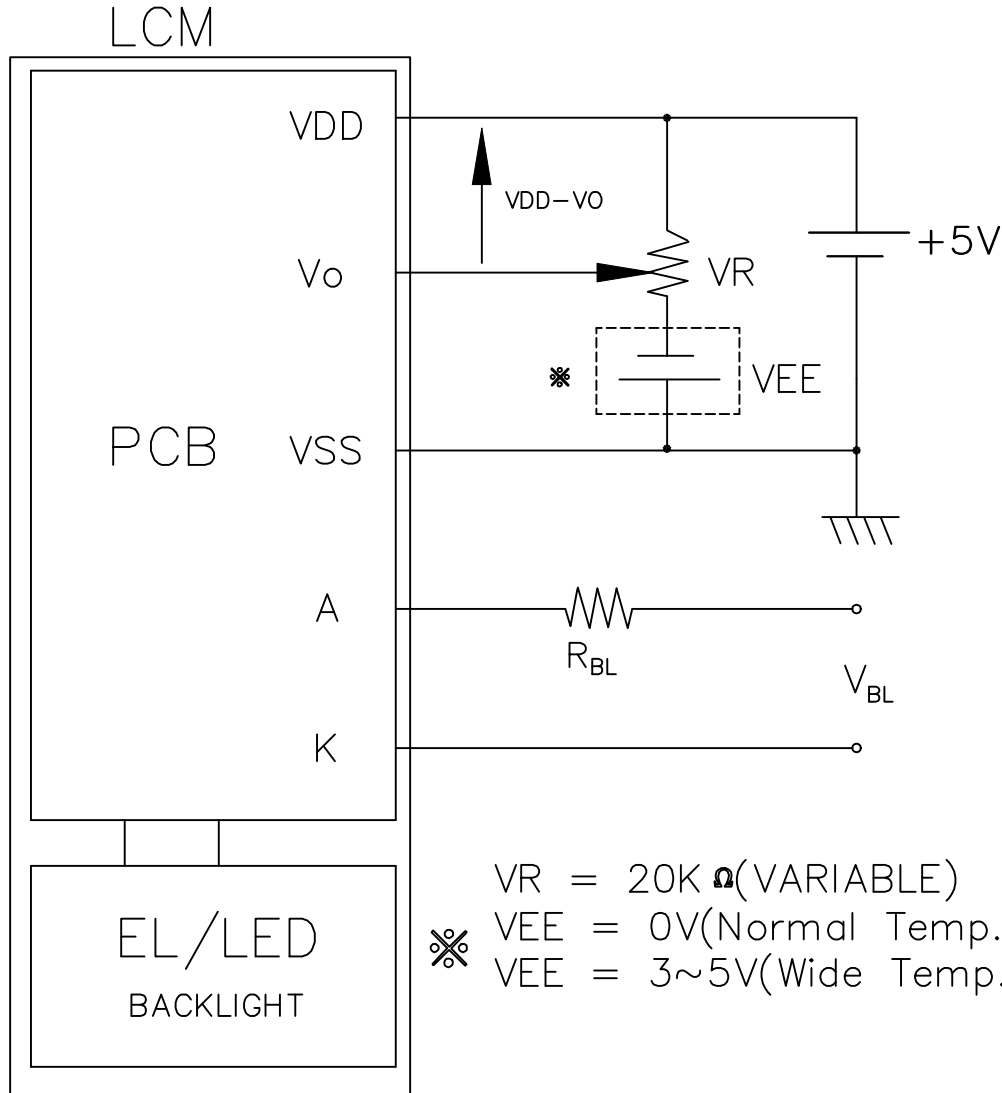
## 6. BLOCK DIAGRAM



## 6. INTERNAL PIN CONNECTION

PinNo.	Symbol	Function
1	DB7	Data Bus Line
2	DB6	
3	DB5	
4	DB4	
5	DB3	
6	DB2	
7	DB1	
8	DB0	
9	E1	Enable Signal (Lines 1 & 2)
10	R/ $\bar{W}$	H:Read L:Write
11	RS	H:Data L:Instruction
12	VO	Power Supply for LCD Driving
13	VSS	Power Supply (0V, GND)
14	VDD	Power Supply (+5V)
15	E2	Enable Signal (Lines 3 & 4)
16	NC	No Connection
(17)	A	Power Supply for EL/LED B/L
(18)	K	Power Supply for EL/LED B/L

## 7. POWER SUPPLY



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

ITEM Back Light Interface	R <sub>BL</sub>		V <sub>BL</sub>	
	LED	EL	LED	EL
A,K PAD	5 $\Omega$	0 $\Omega$	5V <sub>Dc</sub>	110 V <sub>Ac</sub> 400Hz

## 8-1. INTERFACE 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

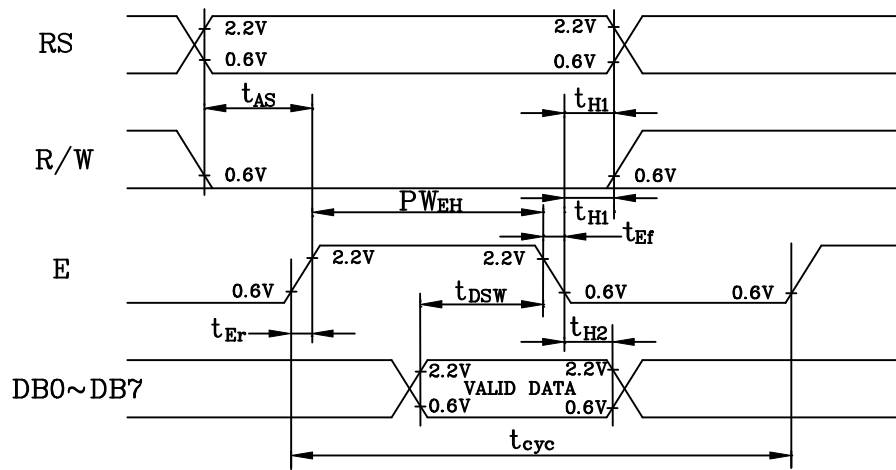


Fig.a Interface timing (data write)

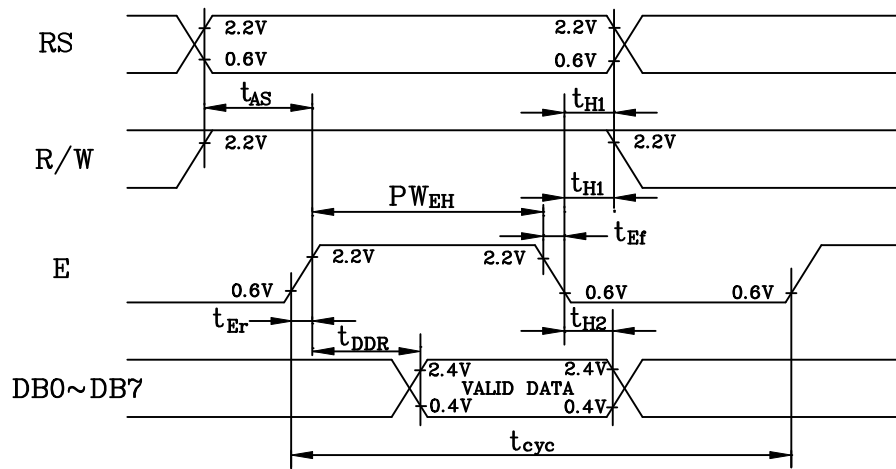


Fig.b Interface timing (data read)

## 8-2.DISPLAY PATTERN (40x4)

Display Data RAM Address  
 Versus Character Position

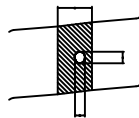
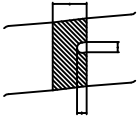
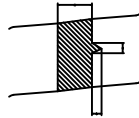
	1	2	.....	16	17	.....	32	33	.....	39	40
U1	00	01	.....	0F	10	.....	1F	20	.....	26	27
	40	41	.....	4F	50	.....	5F	60	.....	66	67
U2	00	01	.....	0F	10	.....	1F	20	.....	26	27
	40	41	.....	4F	50	.....	5F	60	.....	66	67

## 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>DIAMETER mm (a*)</th> <th>NO. OF DEFECT*</th> </tr> </thead> <tbody> <tr> <td><math>a \leq 0.20</math></td> <td>NEGLECT</td> </tr> <tr> <td><math>0.20 &lt; a \leq 0.35</math></td> <td>5 MAX</td> </tr> <tr> <td><math>0.35 &lt; a</math></td> <td>NONE</td> </tr> </tbody> </table>	DIAMETER mm (a*)	NO. OF DEFECT*	$a \leq 0.20$	NEGLECT	$0.20 < a \leq 0.35$	5 MAX	$0.35 < a$	NONE					
DIAMETER mm (a*)	NO. OF DEFECT*														
$a \leq 0.20$	NEGLECT														
$0.20 < a \leq 0.35$	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><math>W \leq 0.03</math></td> <td>NEGLECT</td> </tr> <tr> <td><math>L \leq 3</math></td> <td><math>0.03 &lt; W \leq 0.08</math></td> <td>6</td> </tr> <tr> <td><math>3 &lt; L</math></td> <td><math>0.08 &lt; W</math></td> <td>NONE</td> </tr> </tbody> </table>	LENGTH mm(L)	WIDTH mm(W)	NO. OF DEFECT	N A	$W \leq 0.03$	NEGLECT	$L \leq 3$	$0.03 < W \leq 0.08$	6	$3 < L$	$0.08 < W$	NONE	
LENGTH mm(L)	WIDTH mm(W)	NO. OF DEFECT													
N A	$W \leq 0.03$	NEGLECT													
$L \leq 3$	$0.03 < W \leq 0.08$	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>DIAMETER mm (a*)</th> <th>NO. OF DEFECT*</th> </tr> </thead> <tbody> <tr> <td><math>a \leq 0.15</math></td> <td>NEGLECT</td> </tr> <tr> <td><math>0.15 &lt; a \leq 0.20</math></td> <td>2 MAX</td> </tr> <tr> <td><math>0.20 &lt; a</math></td> <td>NONE</td> </tr> </tbody> </table>	DIAMETER mm (a*)	NO. OF DEFECT*	$a \leq 0.15$	NEGLECT	$0.15 < a \leq 0.20$	2 MAX	$0.20 < a$	NONE					
DIAMETER mm (a*)	NO. OF DEFECT*														
$a \leq 0.15$	NEGLECT														
$0.15 < a \leq 0.20$	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	$(a+b)/2 \leq 0.15$ mm MAXIMUM NUMBER: IGNORED $0.15 < (a+b)/2 \leq 0.20$ MAXIMUM NUMBER: 10													
6.	DOT DEFECT	$(a+b)/2 \leq 0.20$ mm MAXIMUM NUMBER: IGNORED $0.20 < (a+b)/2 \leq 0.30$ MAXIMUM NUMBER: 5 x = WIDTH	 												
7.	CONTRAST IRREGULARITY (SPOT)	DIAMETER SPEC. $a \leq 0.50$ mm $0.50 < a \leq 0.75$ $0.75 < a \leq 1.00$ $1.00 < a$	NO. OF DEFECT* NEGLECT 5 3 NONE												
8.	DOT WIDTH	DESIGN WIDTH ±15%													
9.	COLOR TONE AND UNIFORMITY	OBVIOUS UNEVEN COLOR IS NOT PERMITTED													

(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.

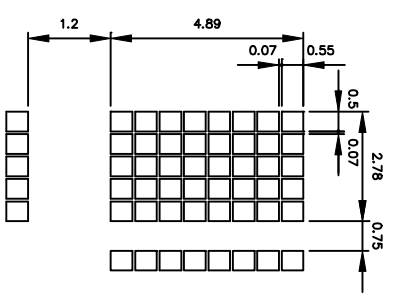
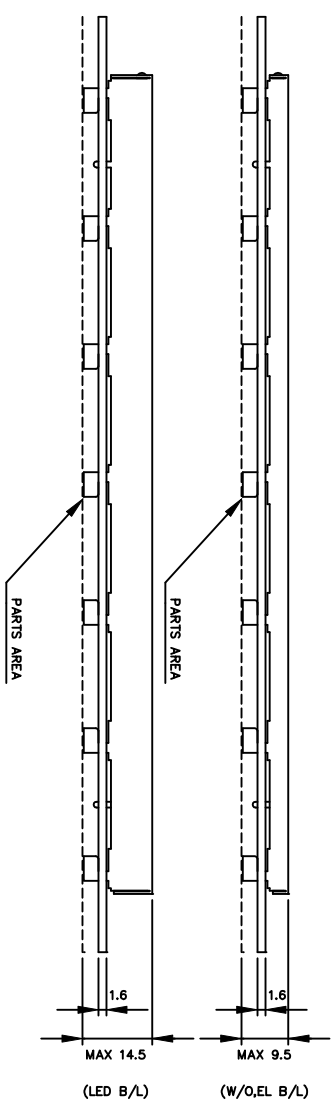
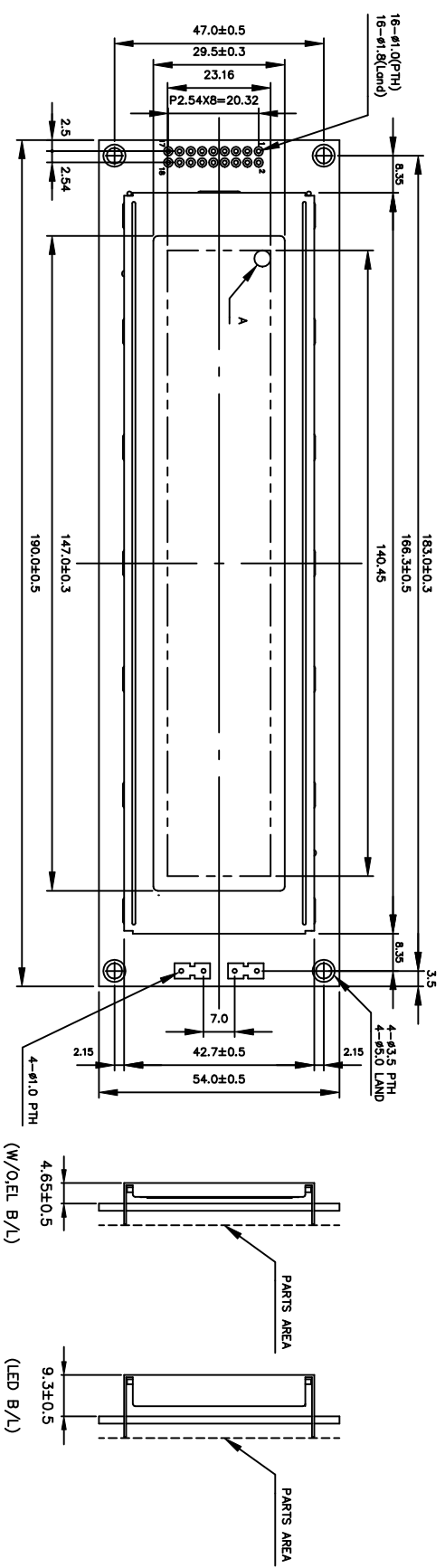
• TERMS OF WARRANTY

- 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/ 11.18.97'					APP	CHK	BY
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PinNo.	Symbol	Function
1	DB7	Data Bus Line
2	DB6	
3	DB5	
4	DB4	
5	DB3	
6	DB2	
7	DB1	
8	DB0	
9	EU	Enable Signal (Up panel)
10	R/W	Hi/Read L/Write
11	RS	Hi/Data L/Instruction
12	VO	Power Supply for LCD Driving
13	VSS	Power Supply (OV, GND)
14	VDD	Power Supply (+5V)
15	ED	Enable Signal (Down panel)
16	NC	No Connection
17	A	Power Supply for EL/LED B/L
18	K	Power Supply for EL/LED B/L

NOTES :  
1. RESOLUTION: 40 CHARACTERS X 4 LINES

產品編號	LM_K5_028_2	南亞塑膠工業股份有限公司
APPROVE	NAME	NAN YA PLASTICS CORPORATION
CHECK	DATE	
DESIGN		
DRAW	MAY PING	86.11.18
	TITLE	外觀尺寸圖
	DWG-NO	MXCX028X2 Rev.A
	UNIT	mm
	SCALE	1/1
	THIRD ANGLE PROJECT	