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
320x240 LCD MODULE
PRODUCT NO.: LM_GA_032_K_

SPEC. NO.: LM032-2

APPROVED BY

EDITED ON : Nov. 04, 1997

SALES MANAGER	DESIGN MANAGER	PERSON IN CHARGE

1. MECHANICAL DATA

(1) Product No.		LM_GA_032__K__
(2) Module Size		167.1 (W)mm x 109.0 (H)mm x MAX 11.0 (D)mm (CCFT B.L.)
(3) Dot Size		0.33 (W)mm x 0.33 (H)mm
(4) Dot Pitch		0.36 (W)mm x 0.36 (H)mm
(5) Number of Dots		320 (W) x 240 (H)Dots
(6) Duty		1/240
(7) 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
		☐ Transflective(High Transmissive)
(8) Viewing Direction		☐ 6 O'clock ☐ 12 O'clock ☐ ____O'clock
(9) Backlight		☐ W/O ☐ LED ☐ EL ☐ CCFT
(10) Recommended FL Inverter		TDK CORP. CXA-L10L
(11) Weight		CCFT : about 205 g

Note :

LM_GA_032__K__

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
K : High Contrast Ratio LC

1
2
⋮ : Version
9

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 STANDARD

ITEM	SYMBOL	MIN	MAX	UNIT	COMMENT
Power Supply for Logic	VDD−VSS	−0.3	7.0	V	
Power Supply for LCM	VDD−VEE	0	30.0	V	
Input Voltage	VI	−0.3	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	OPERATING		STORAGE	
	MIN.	MAX.	MIN.	MAX.
Ambient Temperature	−20	70	−30	80
Humidity(Without Condensation)	Note 1,3		Note 2,3	

Note 1 Ta ≦ 70°C : 75%RH max
Ta > 70°C : Absolute humidity must be lower than the humidity of 75%RH at 70°C

Note 2 Ta at −30°C will be < 48hrs, at 80°C will be < 120hrs

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

3. ELECTRICAL CHARACTERISTICS

(VDD = 5V±5%)

ITEM		SYMBOL	CONDITION		MIN.	TYP.	MAX.	UNIT
Power Supply for Logic		VDD−VSS	−		4.75	5.0	5.25	V
Recommended LC Driving Voltage		VDD−VO	Duty=1/240 Bias=1/13	−20°C	−	24.1	25.0	V
				0°C	−	22.7	23.6	
				25°C	21.3	22.0	22.8	
				50°C	20.3	20.8	−	
				70°C	20.1	20.9	−	
Input Voltage		VIH	H level		0.8VDD	−	VDD	V
		VIL	L level		0	−	0.2VDD	V
Power Supply Current		IDD	FLM = 70 Hz VDD = 5.0 V VEE = −24.0 V VDD−VO = 22.0 V PATTERN : □ ■ □ ■ □ ■ ■ □ ■ □ ■ □		−	7.7	−	mA
		IEE			−	3.9	−	mA
CCFL LAMP	Open Voltage	V_{Open}	Lamp Current = 5 mArms Frequency = 35 KHz		−	420	−	Vrms
	Lamp Voltage	V_L			−	260	−	Vrms
	Brightness	B			−	26000	−	cd/m²
	Color Degree	X			−	0.34	−	−
		Y			−	0.367	−	

4. OPTICAL CHARACTERISTICS

AT V_{OP}

ITEM / MODE		Cr(Contrast Ratio)										θ(Viewing Angle)		ϕ(Viewing Angle)	
		-20℃		0℃		25℃		50℃		70℃		25℃		25℃	
		MIN.	TYP.	MIN.	TYP.	MIN.	TYP.	MIN.	TYP.	MIN.	TYP.	MIN.	TYP.	MIN.	TYP.
R	A	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	C	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	J	–	–	–	–	–	–	–	–	–	–	–	–	–	–
S	A	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	C	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	J	–	–	–	–	–	–	–	–	–	–	–	–	–	–
T	E,F	–	3.8	–	6.4	9.2	10.8	–	8.5	–	7.3	35	65	20	30
	G,H	–	20.7	–	30.4	48	56	–	13.5	–	9.21	40	70	25	35
note		NOTE6										NOTE5			

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

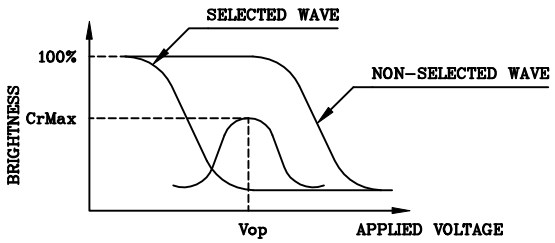
ITEM	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT	NOTE
Response Time (rise)	Tr	-20℃	–	1000	2000	ms	NOTE 2
		0℃	–	820	1640		
		25℃	–	200	400		
		50℃	–	160	320		
		70℃	–	80	160		
Response Time (fall)	Tf	-20℃	–	500	1000	ms	NOTE 2
		0℃	–	360	720		
		25℃	–	210	420		
		50℃	–	70	140		
		70℃	–	50	100		

note:

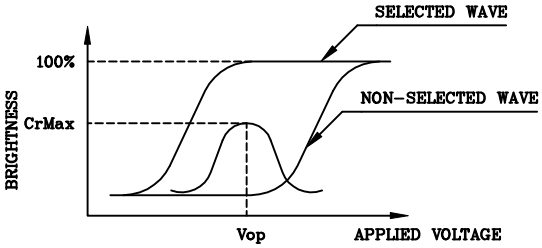
R: REFLECTIVE
S: TRANSFLECTIVE
T: TRANSMISSIVE
A: GRAY
C: YELLOW
E,F: BLUE
G,H: NORMALLY BLACK
J: NORMALLY WHITE

(NOTE 1)

Definition of Operation Voltage(Vop)



(positive type)



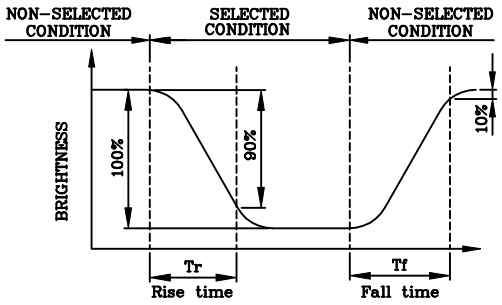
(negative type)

*Conditions

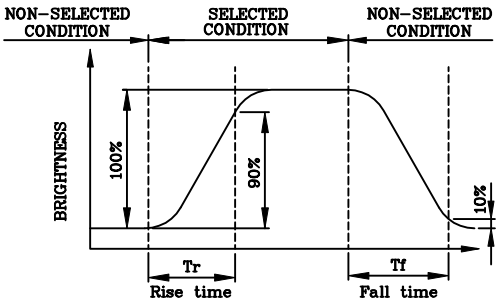
Viewing Angle : 0
Frame Frequency : 70Hz
Applied Waveform : 1/N duty, 1/a bias

(NOTE 2)

Definition of Response Time(Tr.Tf)



(positive type)



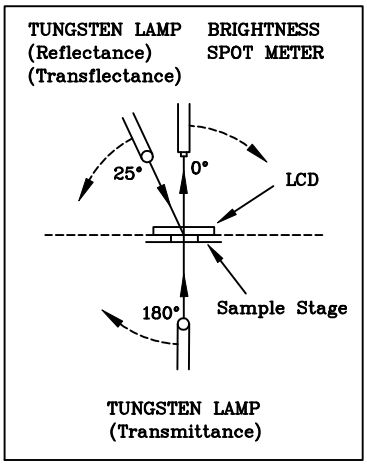
(negative type)

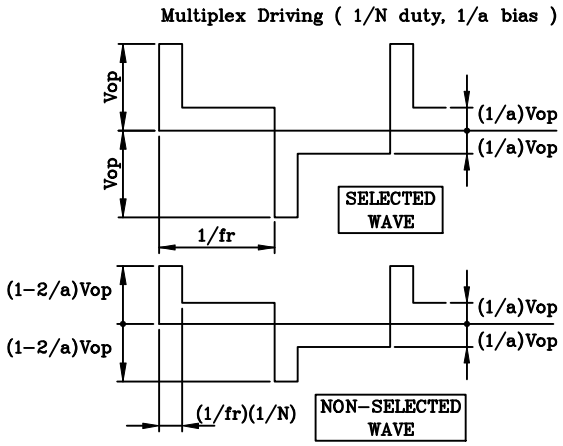
*Conditions

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

(NOTE 3)

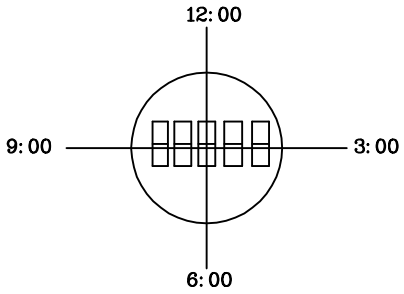
Description of Measuring Equipment and Driving Waveforms





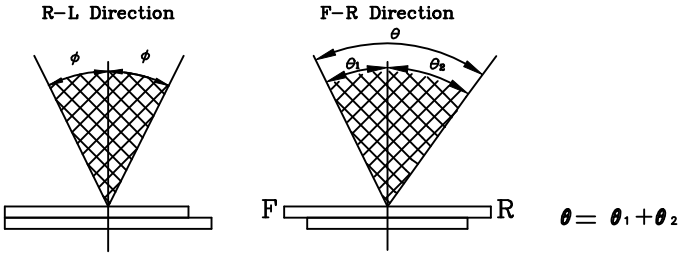
(NOTE 4)

Definition of Viewing Direction



(NOTE 5)

Definition of Viewing Angle



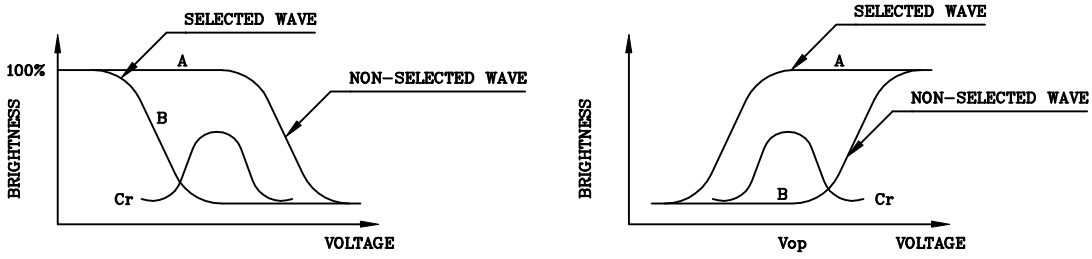
$\theta = \theta_1 + \theta_2$

*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)



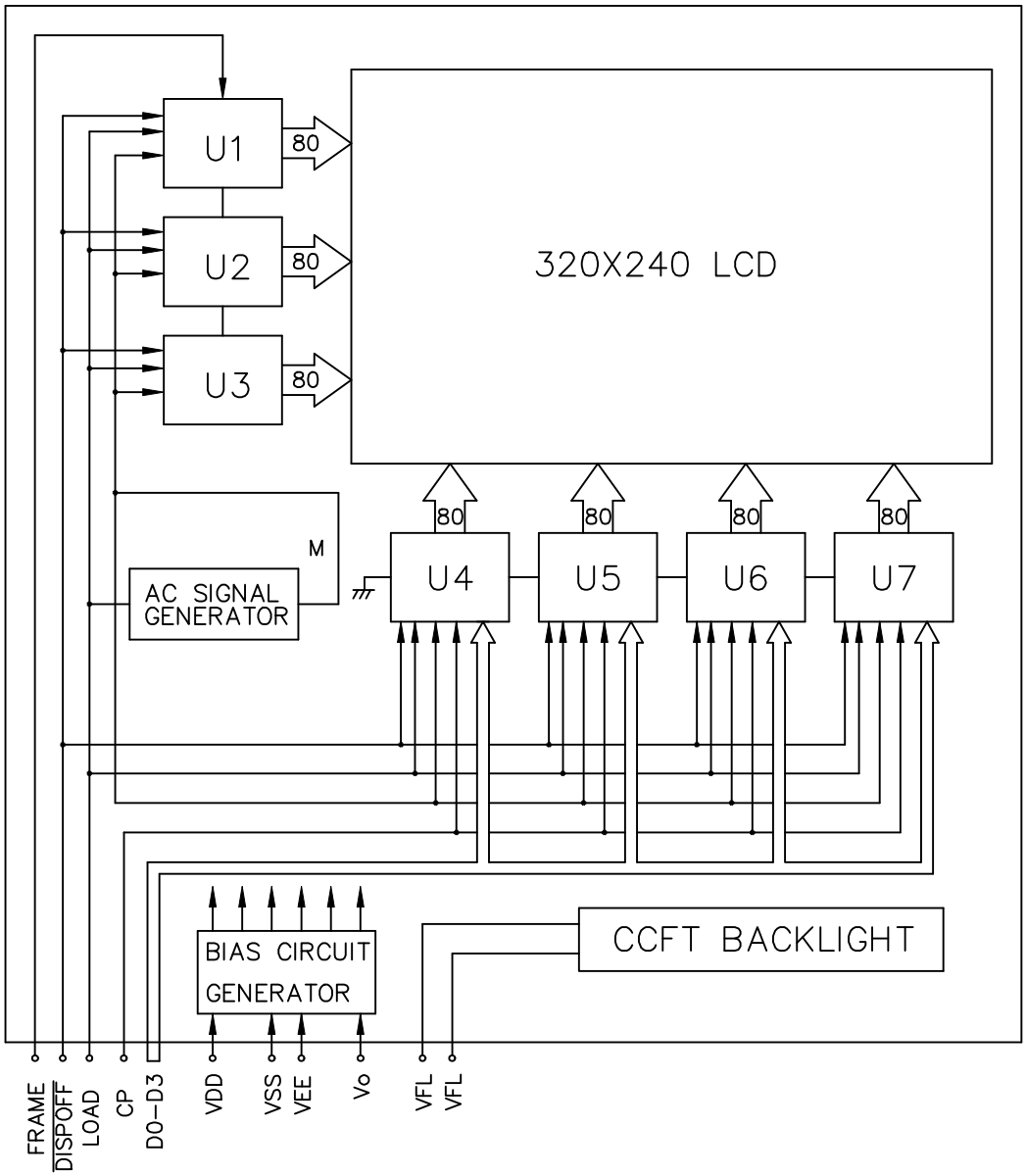
(positive type) (negative type)

Contrast Ratio : Cr=A/B

*Conditions

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

5. BLOCK DIAGRAM



* AC SIGNAL SETTING

J1	J2	J3	J4	J5	J6	J7	J8
L	H	H	L	L	L	L	L

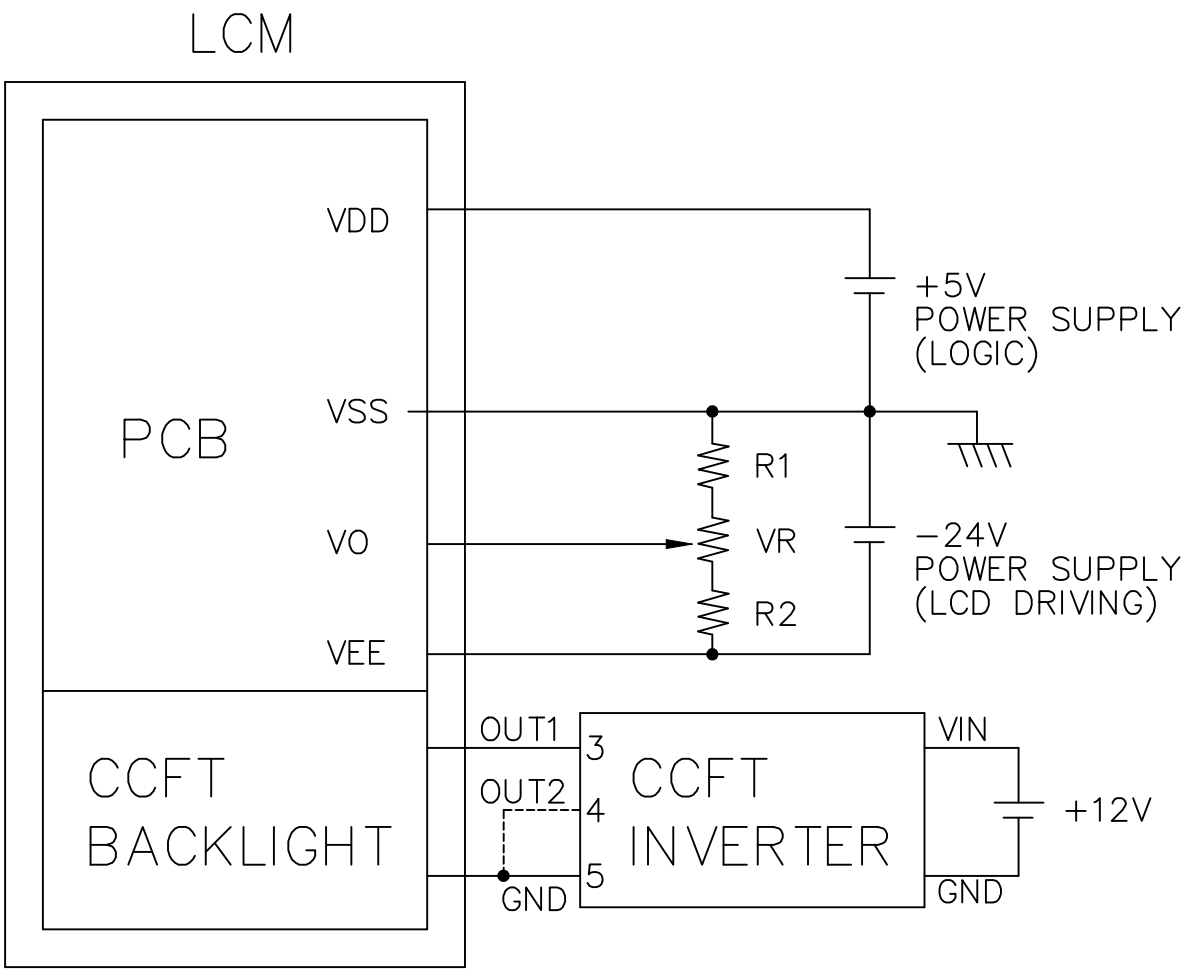
6. INTERNAL PIN CONNECTION

PIN NO.	SYMBOL	LEVEL	FUNCTION
1	D0	H/L	DISPLAY DATA SIGNAL
2	D1		
3	D2		
4	D3		
5	$\overline{\text{DISPOFF}}$	H/L	H: ON/L: OFF
6	FRAME	H	SCAN START-UP SIGNAL
7	NC	–	NO CONNECTION
8	LOAD	H→L	INPUT DATA LATCH SIGNAL
9	CP	H→L	DATA INPUT CLOCK SIGNAL
10	VDD	–	POWER SUPPLY FOR LOGIC(+5V)
11	VSS	–	SIGNAL GROUND(0V)
12	VEE	–	POWER SUPPLY FOR LCD
13	VO	–	LCD CONTRAST ADJUST VOLTAGE
14	FGND	–	FRONT PANEL GROUND

CCFL CONNECTOR : J.A.E./IL-G-4S-S3C2

PIN NO.	SYMBOL	LEVEL	FUNCTION
1	V_{FL}	–	POWER SUPPLY FOR CCFT BACKLIGHT
2	NC	–	–
3	NC	–	–
4	V_{FL}	–	POWER SUPPLY FOR CCFT BACKLIGHT

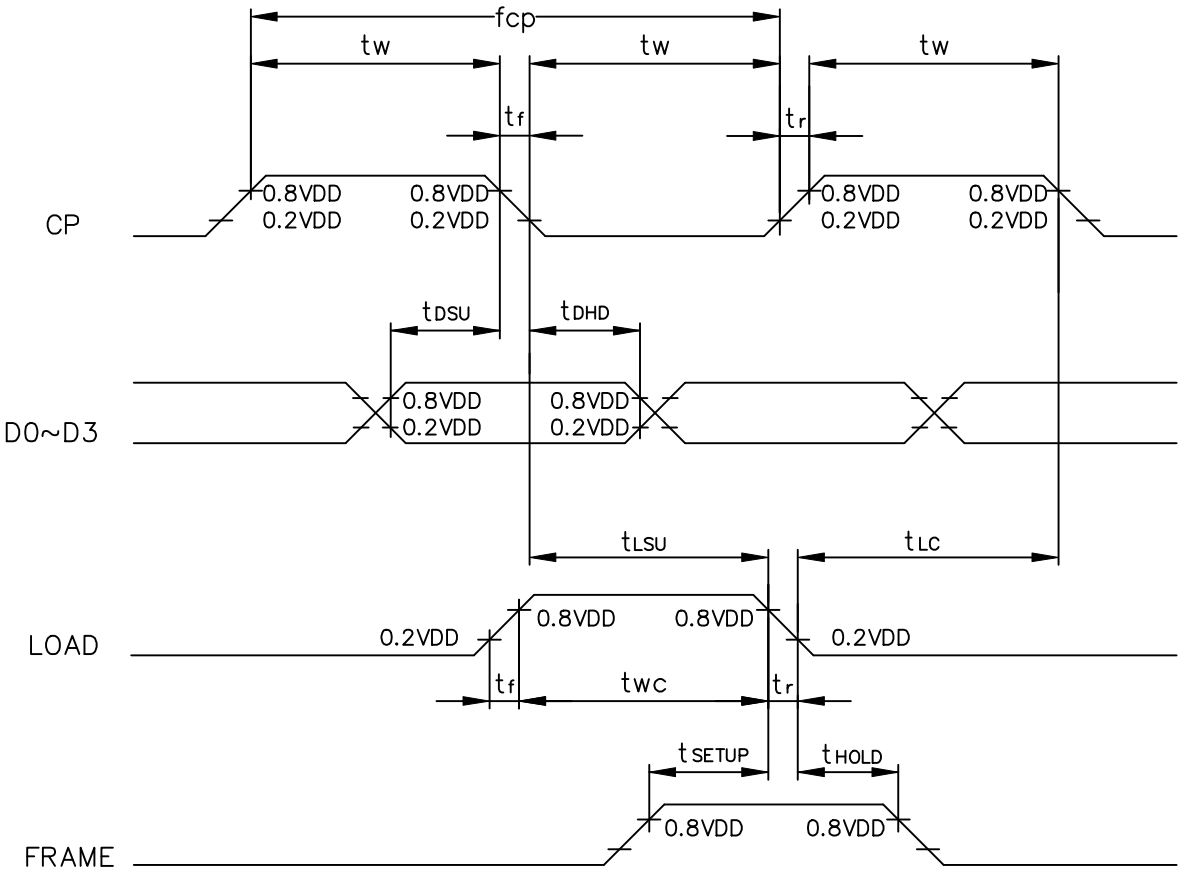
7. POWER SUPPLY



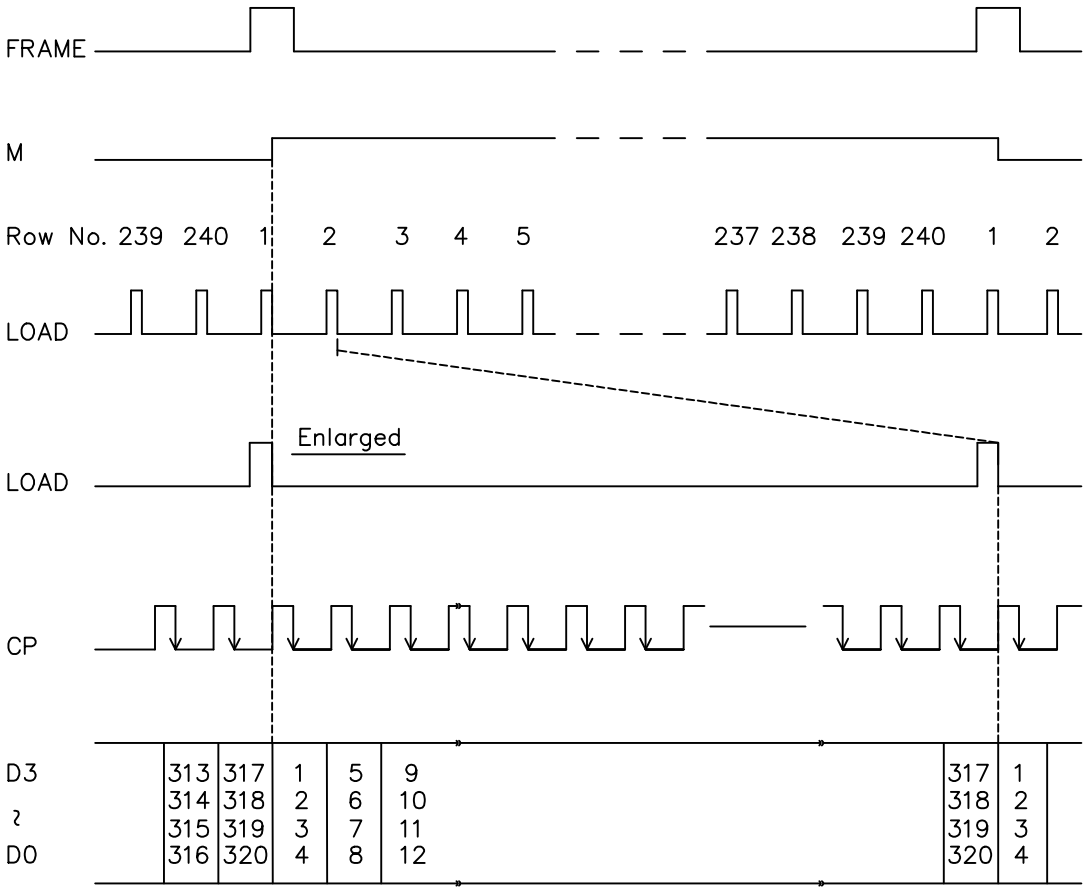
1. R1+VR+R2=10K~20KΩ
2. RECOMMENDED CCFT INVERTER : CXA-L10L(TDK)

8.1TIMING CHARACTERISTICS

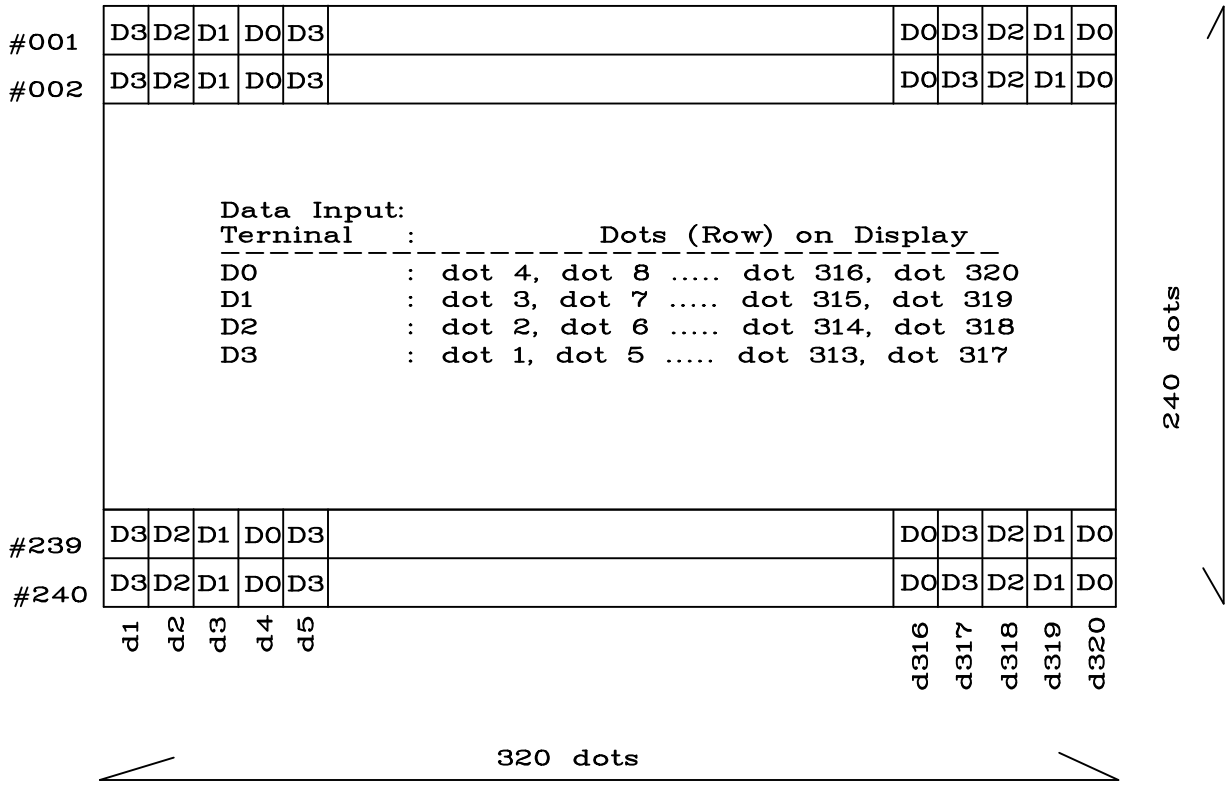
ITEM	SYMBOL	MIN.	TYP.	MAX.	UNIT
CLOCK FREQUENCY	fcp	–	–	6.5	MHZ
CLOCK PULSE WIDTH	tw	63	–	–	ns
CLOCK RISE,FALL TIME	t_r , t_f	–	–	20	ns
DATA SET UP TIME	t_{DSU}	50	–	–	ns
DATA HOLD TIME	t_{DHD}	50	–	–	ns
LOAD SET UP TIME	t_{LSU}	80	–	–	ns
LOAD → CLOCK TIME	t_{LC}	80	–	–	ns
"FRAME" SET UP TIME	t_{SETUP}	100	–	–	ns
"FRAME" HOLD TIME	t_{HOLD}	100	–	–	ns
"LOAD" PULSE WIDTH	twc	125	–	–	ns



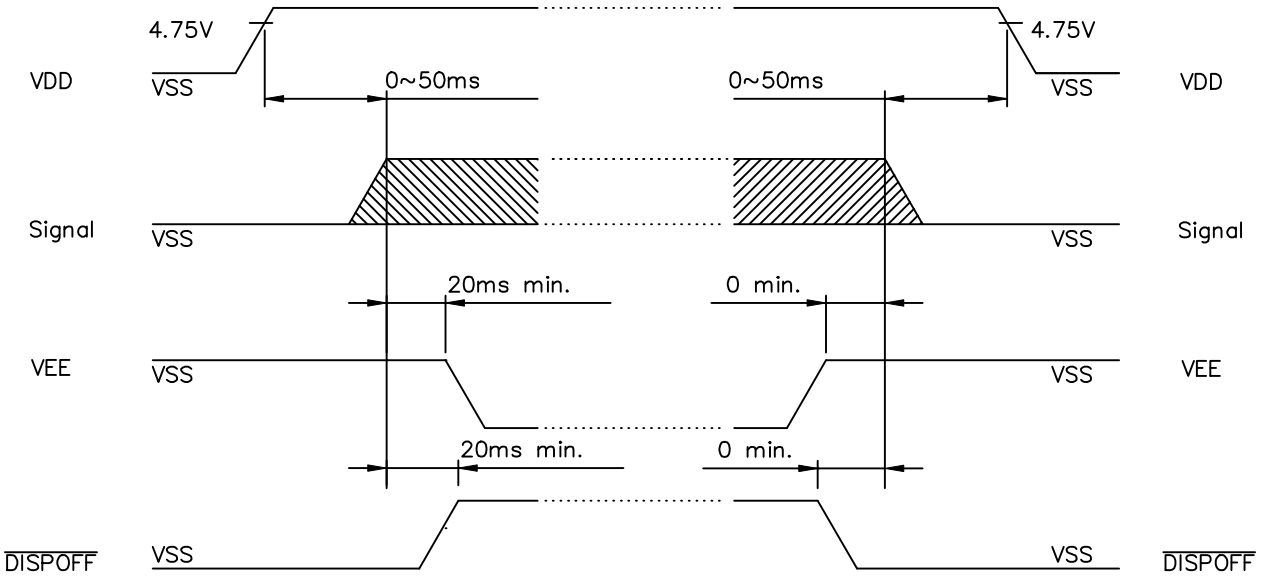
8.2TIMING CHART OF INPUT SIGNALS



8.3DISPLAY PATTERN



8.4POWER ON/OFF TIMING



POWER ON

POWER OFF

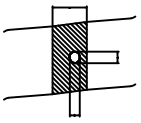
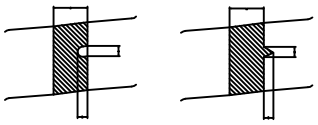
The missing pixels may occur when the LCM is driven beyond above power interface timing sequence.

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

<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:

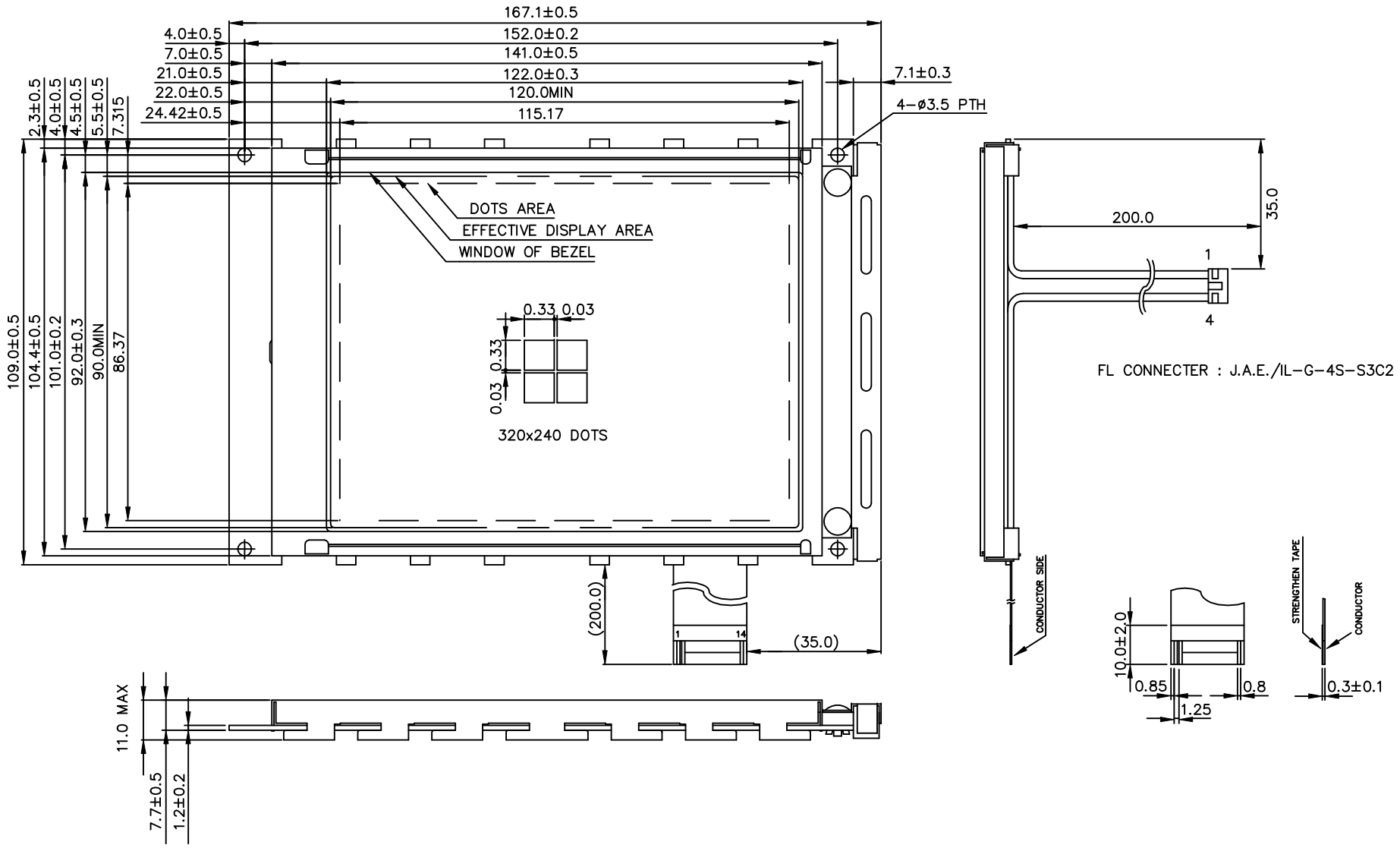
- SAFETY
  1. If the LCD panel breaks, be careful not to allow the liquid crystal to touch your skin.
  2. If the liquid crystal touches your skin or clothes, please wash it off immediately by using soap and water.

- 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



PIN NO.	1	2	3	4	5	6	7
SYMBOL	D0	D1	D2	D3	DISPOFF	FRAME	NC
PIN NO.	8	9	10	11	12	13	14
SYMBOL	LOAD	CP	VDD	VSS	VEE	VO	FGND

NOTES :

1.RESOLUTION : 320 X 240 Dots
2.CONTROLLER : WITHOUT
3.DC/DC : WITHOUT
4.BACKLIGHT: CCFL

產品編號	LMBGA_032_K		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-X032XK
DESIGN			UNIT : mm
DRAW	MAY PING	86.10.29	THIRD ANGLE PROJECT / SCALE : 1/1