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.: LTBE9_159_K

SPEC. NO.: LM159-0

APPROVED BY

SALES MANAGER	DESIGN MANAGER	PERSON IN CHARGE

1. MECHANICAL DATA

(1) Product No.	LTBE9_159_K
(2) Module Size	142.6 (W)mm x 92.6 (H)mm x MAX 7.5 (D)mm (CCFT B.L.)
(3) Dot Size	0.285 (W)mm x 0.285 (H)mm
(4) Dot Pitch	0.30 (W)mm x 0.30 (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 120 g

Note :

LT_E9_159_ __K__

Backlight Type
- A : None
- B : CCFT
- C : LED
- D : EL

Polarizer Type
- R : Reflective
- S : Transflective (Normal)
- P : Transflective (Medium Transparency)
- H : Transflective (High Transparency)
- T : Transmissive

Option
- C : Anti-Glare
- K : High Contrast Ratio LC

1 … 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 STANDARD

ITEM	SYMBOL	MIN	MAX	UNIT	COMMENT
Power Supply for Logic	VDD−VSS	−0.3	6.5	V	
Power Supply for LCM	VDD−VEE	0	27.0	V	
Input Voltage	VI	−0.3	VDD+0.3	V	
Static Electricity	−	−	−	−	Note 1

Note 1 LCM should be grounded during handling LCM.

(2) ENVIRONMENTAL ABSOLUTE MAXIMUM RATINGS

ITEM	NORMAL TEMP.			
	OPERATING		STORAGE	
	MIN.	MAX.	MIN.	MAX.
Ambient Temperature	−20	70	−30	80
Humidity(Without Condensation)	Note 2, 4		Note 3, 4	

Note 2 Ta ≦ 70°C : 75%RH max
Ta > 70°C : Absolute humidity must be lower than the humidity of 75%RH at 70°C

Note 3 Ta at −30°C will be < 48hrs, at 80°C will be < 120hrs

Note 4 Background color changes slightly depending on ambient temperature. This phenomenon is reversible.

3. ELECTRICAL CHARACTERISTICS

ITEM		SYMBOL	CONDITION		MIN.	TYP.	MAX.	UNIT
Power Supply for Logic		VDD−VSS	−		4.5	5.0	5.5	V
					2.7	3.0	3.3	
Recommended LC Driving Voltage		VDD−VEE	Duty=1/240 Bias=1/13	−20°C	−	25.0	25.4	V
				0°C	−	23.6	24.0	
				25°C	−	22.9	23.3	
				50°C	−	21.5	21.9	
				70°C	−	20.9	21.3	
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 = −17.9 V		−	5.0	−	mA
		IEE	PATTERN : □ ■ □ ■ □ ■ ■ □ ■ □ ■ □		−	3.4	−	mA
CCFL LAMP	Starting Voltage	Vs			−	−	−	Vrms
	Lamp Voltage	V_L			−	280	−	Vrms
	Lamp Current	I_L			4	5	6	mArms
	Lamp Consumption	P_L			−	1.4	−	W
	Lamp Frequency	F_L			−	35	−	KHz
	Brightness	B			25000	28000	−	cd/m²
	Color Degree	X			0.298	0.313	0.328	−
		Y			0.329	0.344	0.359	
	Lamp Life Time	L_L			10000	−	−	hrs
LCM	Surface Luminance	L	Transmissive/Blue		−	186	−	cd/m²

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	–	–	–	5.5	–	6.0	–	4.5	–	–	–	60	–	56
	J	–	–	–	5.5	–	6.5	–	5.0	–	–	–	32	–	77
T	E,F	–	–	–	–	–	6.0	–	–	–	–	–	65	–	±20
	G,H	–	–	–	8.0	–	8.0	–	6.5	–	–	–	76	–	±62
note		NOTE6										NOTE5			

note:

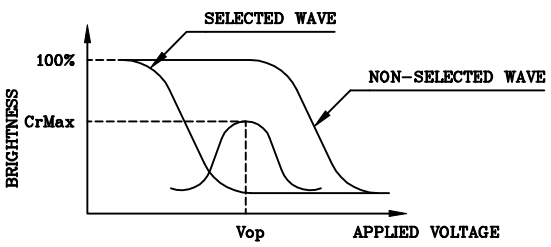
R: REFLECTIVE
S: TRANSFLECTIVE
T: TRANSMISSIVE
A: GRAY
C: YELLOW
E,F: BLUE
G,H: NORMALLY BLACK
J: NORMALLY WHITE

AT $\phi=0°$ $\theta=0°$

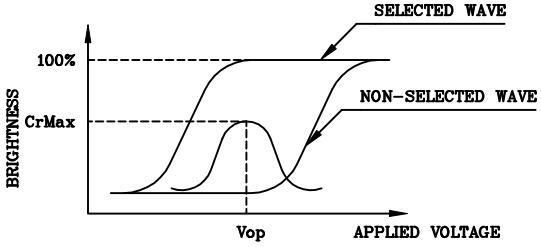
ITEM	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT	NOTE
Response Time (rise)	Tr	-20℃	–	3700	5500	ms	NOTE 2
		0℃	–	660	900		
		25℃	–	160	240		
		50℃	–	110	165		
		70℃	–	75	110		
Response Time (fall)	Tf	-20℃	–	2600	3900	ms	NOTE 2
		0℃	–	560	840		
		25℃	–	90	140		
		50℃	–	75	110		
		70℃	–	50	70		

(NOTE 1)

Definition of Operation Voltage(Vop)



(positive type)



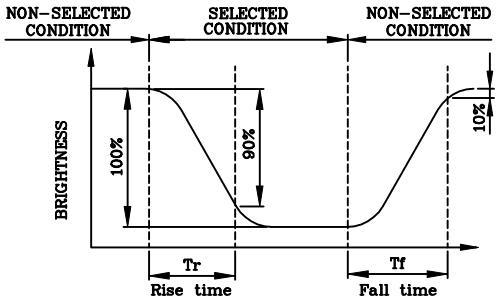
(negative type)

*Conditions

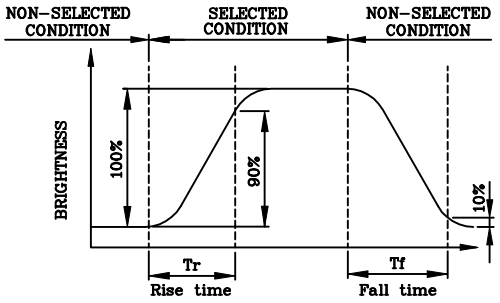
Viewing Angle : 0
Frame Frequency : 70Hz
Applied Waveform : 1/N duty, 1/a bias

(NOTE 2)

Definition of Response Time(Tr.Tf)



(positive type)



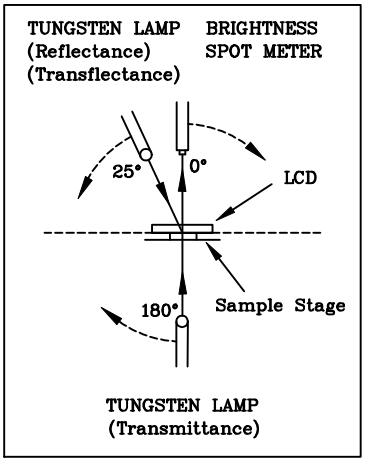
(negative type)

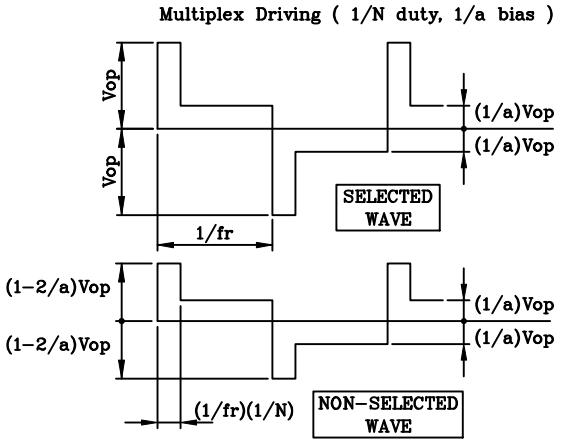
*Conditions

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

(NOTE 3)

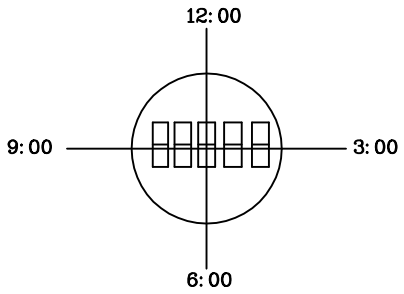
Description of Measuring Equipment and Driving Waveforms





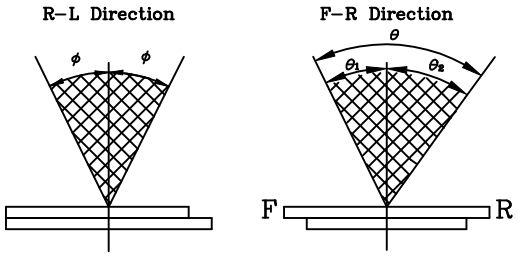
(NOTE 4)

Definition of Viewing Direction



(NOTE 5)

Definition of Viewing Angle



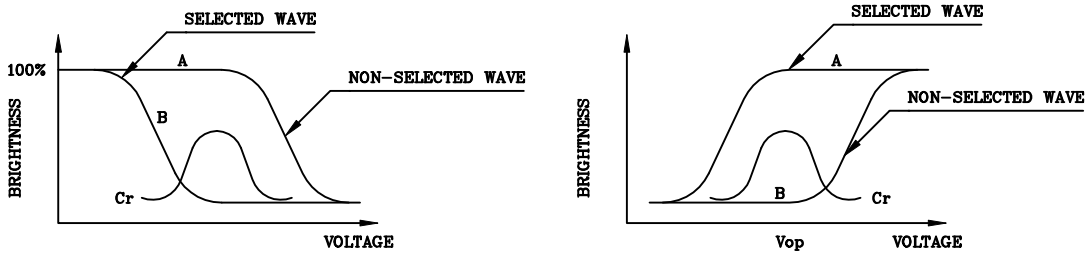
$\theta = \theta_1 + \theta_2$

*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)



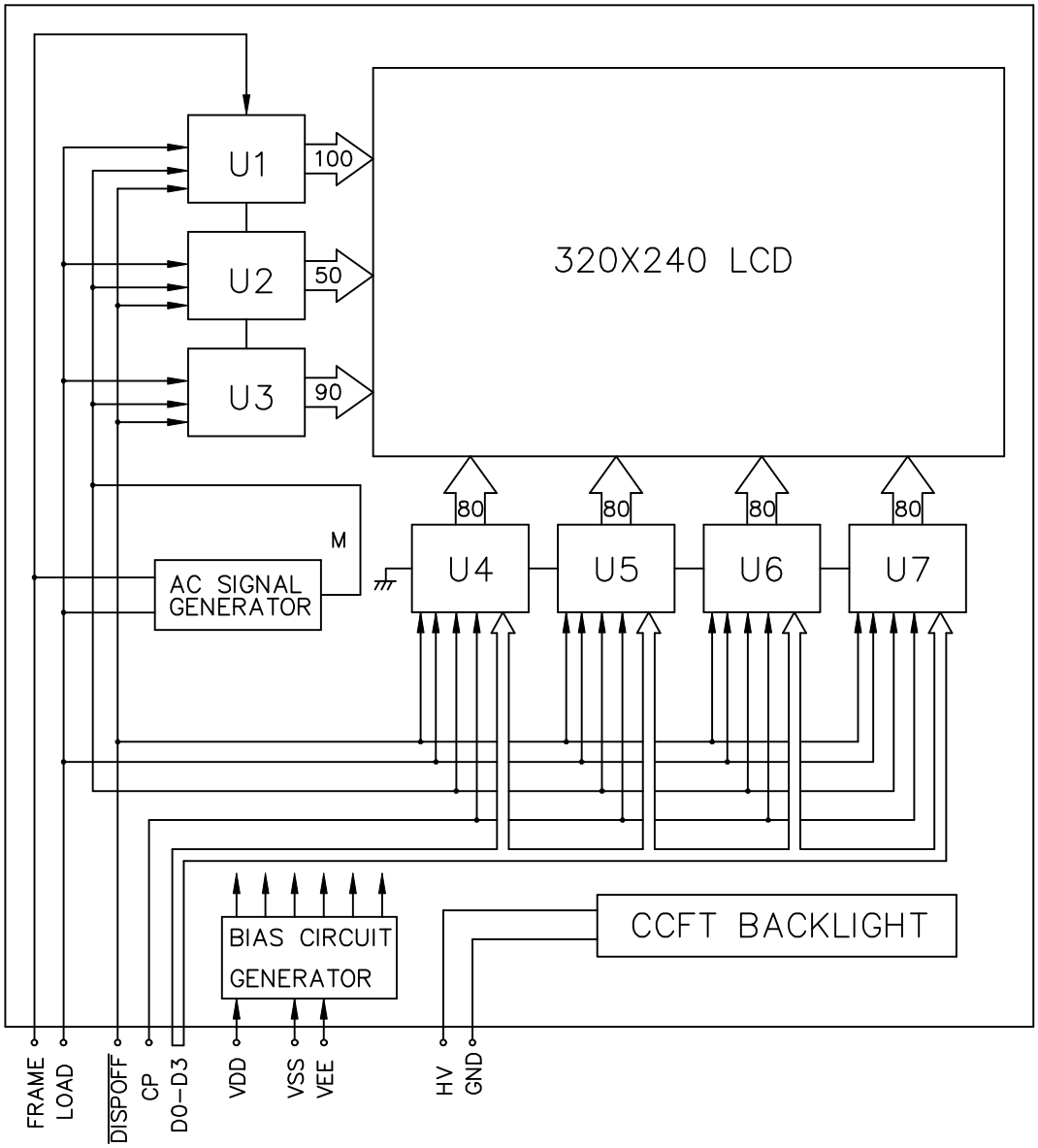
(positive type) (negative type)

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
H	L	L	H	H	L	L	L

6. INTERNAL PIN CONNECTION

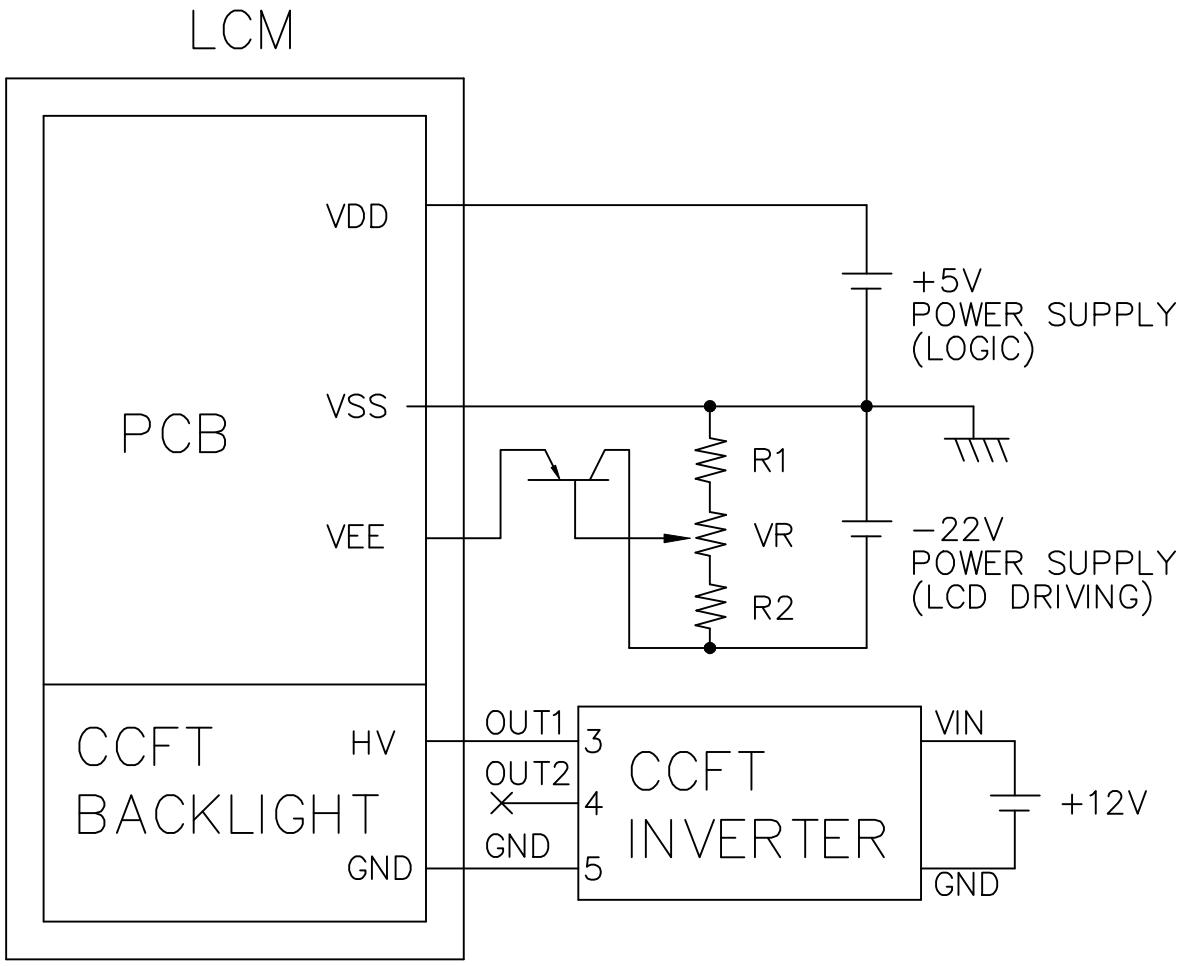
PIN CONNECTOR : ELCO 6224-12P-S-A OR EQUIVALENT

PIN NO.	SYMBOL	LEVEL	FUNCTION
1	FRAME	H	FIRST LINE MARKER
2	LOAD	H→L	DATA LATCH
3	CP	H→L	DATA SHIFT
4	VDD	–	POWER SUPPLY FOR LOGIC
5	VSS	–	GND
6	VEE	–	POWER SUPPLY FOR LC
7	D0	H/L	DISPLAY DATA
8	D1		
9	D2		
10	D3		
11	$\overline{\text{DISPOFF}}$	H/L	H: ON/L: OFF
12	NC	–	–

CCFL CONNECTOR :MITSUMI/M63M83-04 OR EQUIVALENT

PIN NO.	SYMBOL	LEVEL	FUNCTION
1	GND	–	GND FOR CCFT BACKLIGHT
2	NC	–	–
3	NC	–	–
4	HV	–	POWER SUPPLY FOR CCFT BACKLIGHT

7. POWER SUPPLY



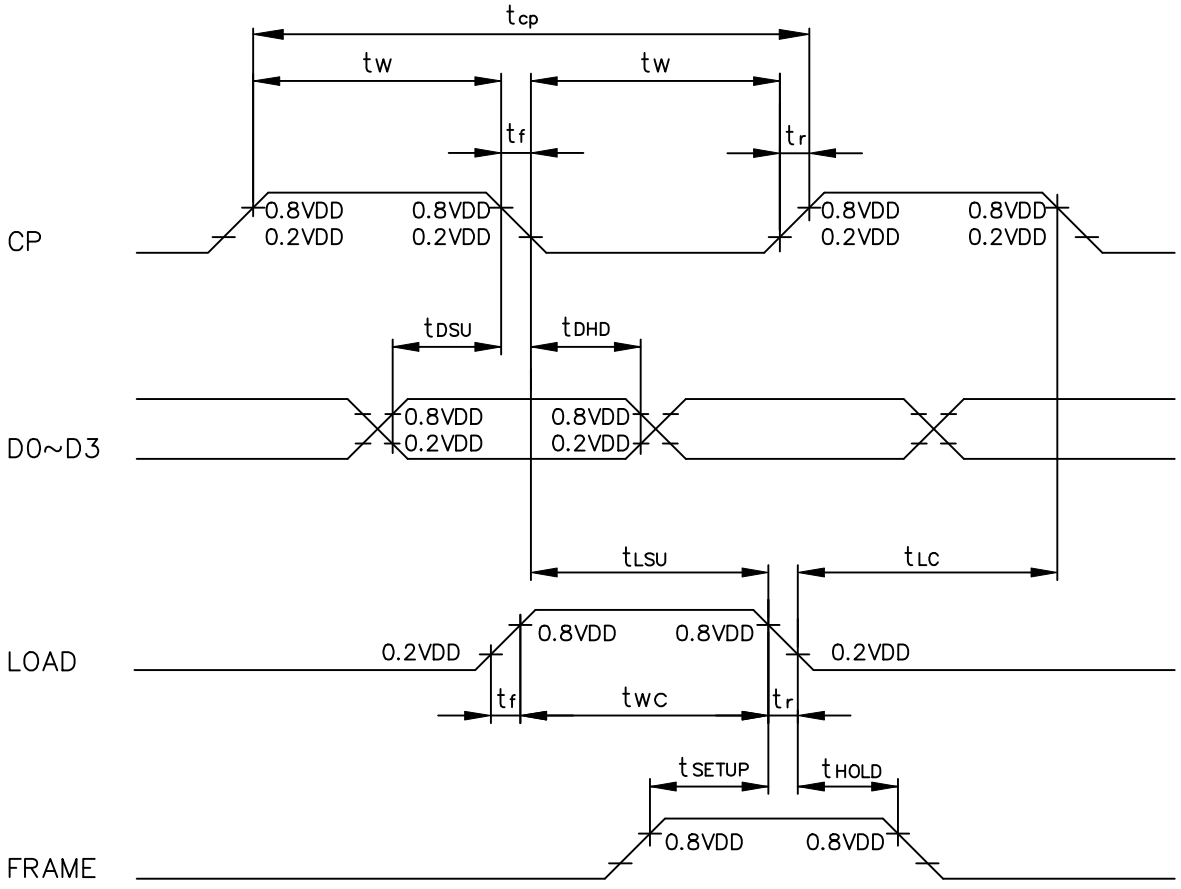
1. R1+VR+R2=10K~20KΩ
2. RECOMMENDED CCFT INVERTER : CXA-L10L(TDK)

8. TIMING CHARACTERISTICS

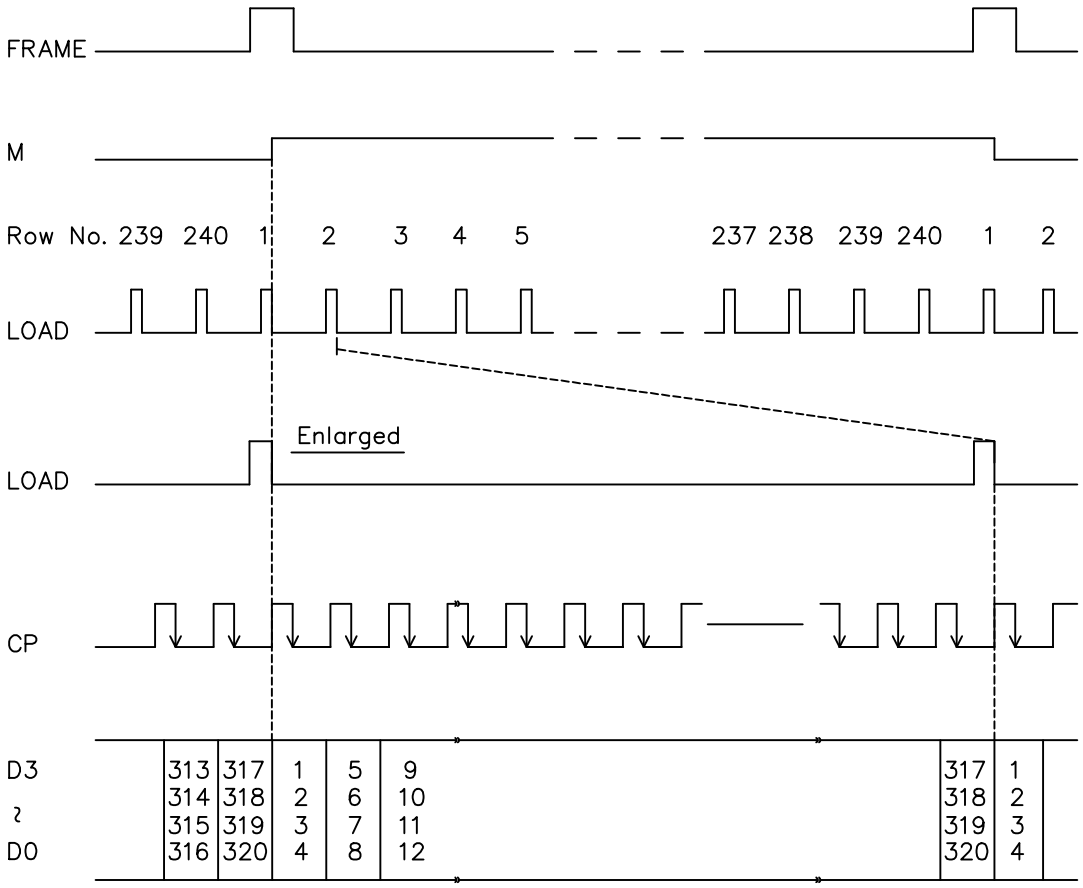
8-1. INTERFACE TIMING

@VDD=2.5~5.5V

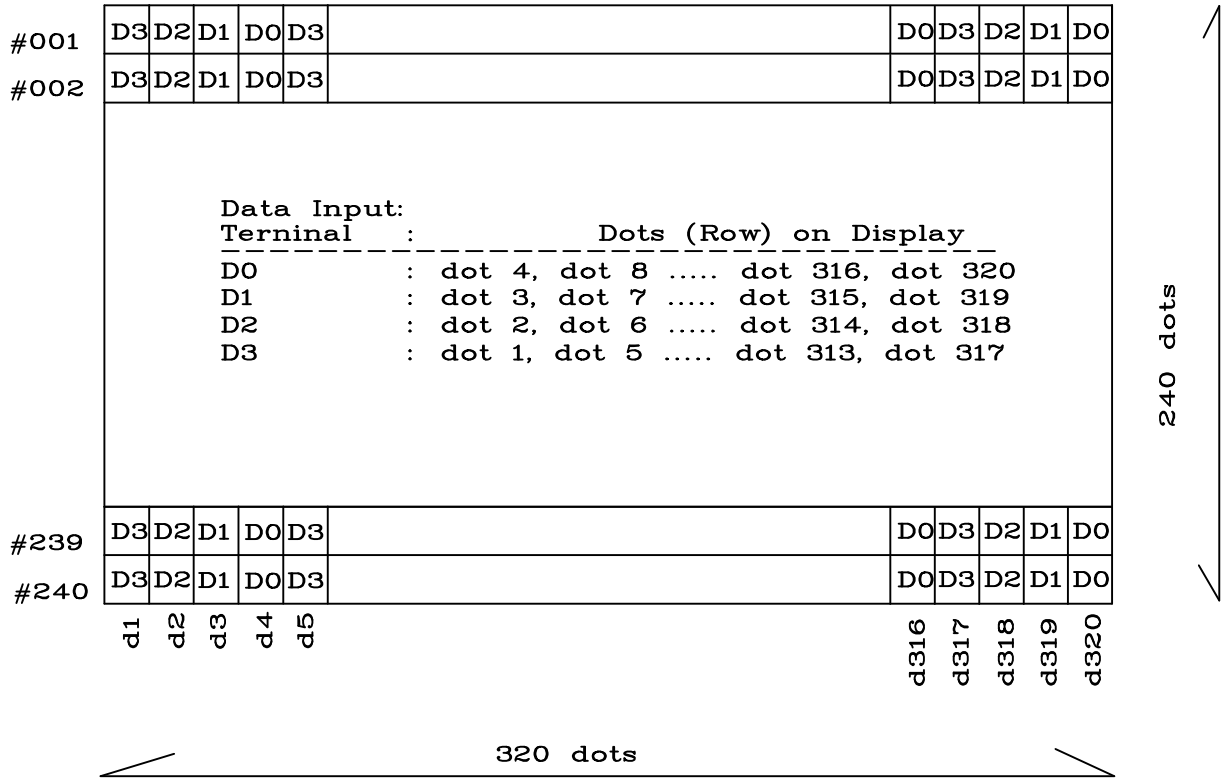
ITEM	SYMBOL	MIN.	TYP.	MAX.	UNIT
Shift Clock Period	t_{cp}	152	–	–	ns
"CP" PULSE WIDTH	t_W	65	–	–	ns
CLOCK RISE, FALL TIME	t_r , t_f	–	–	50	ns
DATA SETUP TIME	t_{DSU}	50	–	–	ns
DATA HOLD TIME	t_{DHD}	40	–	–	ns
"CP" → "LOAD" FALL TIME	t_{LSU}	65	–	–	ns
"LOAD" → "CP" FALL TIME	t_{LC}	65	–	–	ns
"FRAME" SETUP TIME	t_{SETUP}	100	–	–	ns
"FRAME" HOLD TIME	t_{HOLD}	100	–	–	ns
"LOAD" PULSE WIDTH	t_{WC}	65	–	–	ns



8.2TIMING CHART OF INPUT SIGNALS



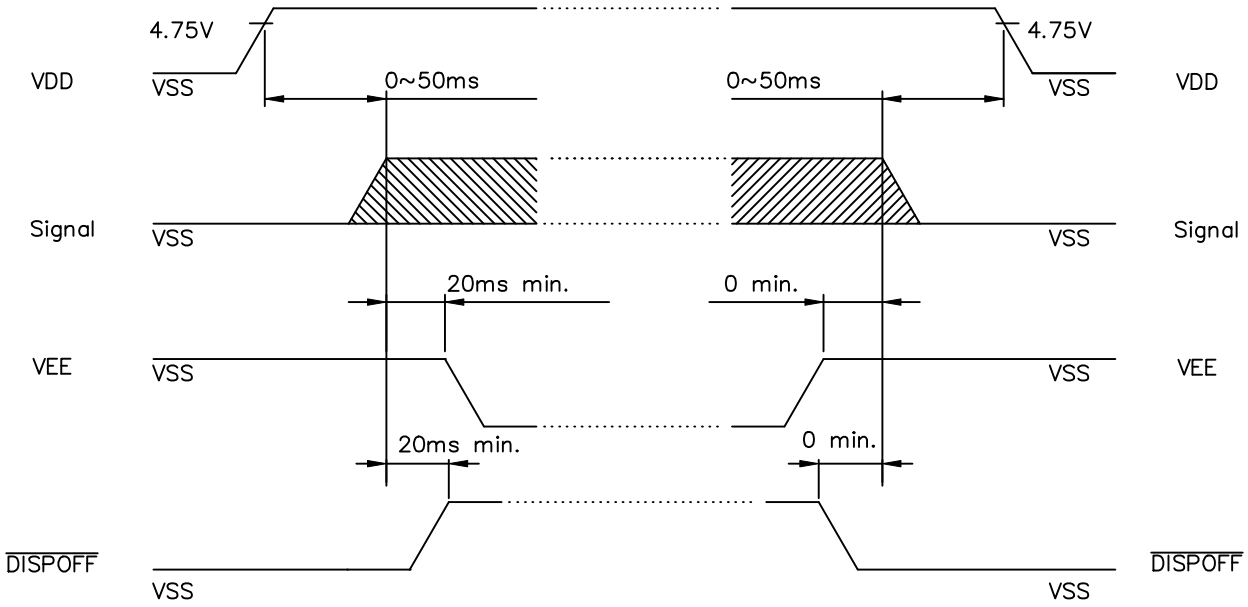
8.3DISPLAY PATTERN



Data Input:

Terninal	: Dots (Row) on Display
D0	: dot 4, dot 8 ..... dot 316, dot 320
D1	: dot 3, dot 7 ..... dot 315, dot 319
D2	: dot 2, dot 6 ..... dot 314, dot 318
D3	: dot 1, dot 5 ..... dot 313, dot 317

8.4POWER ON/OFF TIMING



POWER ON　　POWER OFF

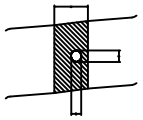
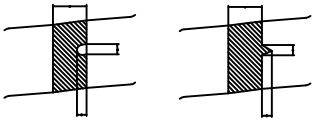
The missing pixels may occur when the LCM is driven beyond above power interface timing sequence.

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:

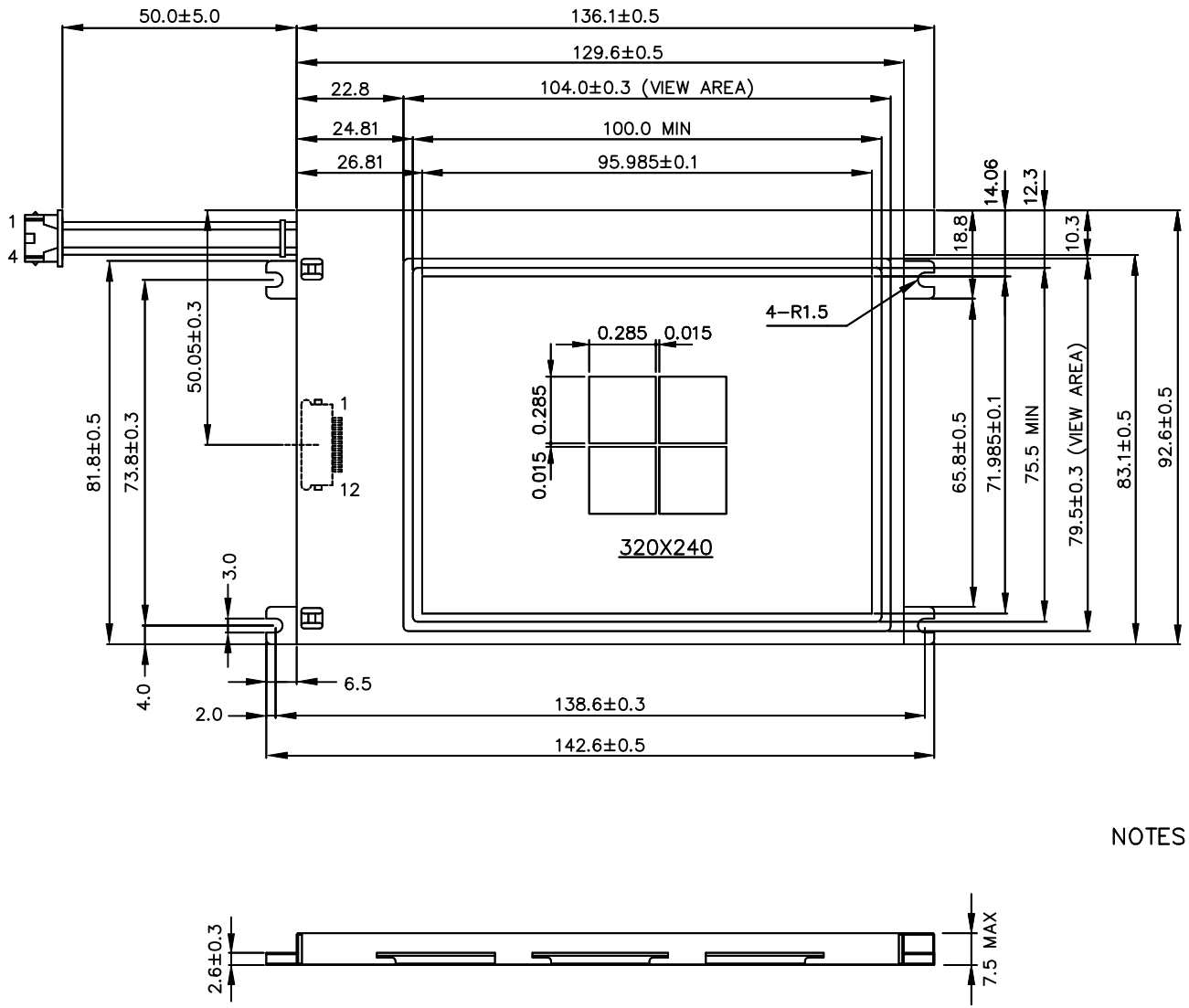
- SAFETY
  1. If the LCD panel breaks, be careful not to allow the liquid crystal to touch your skin.
  2. If the liquid crystal touches your skin or clothes, please wash it off immediately by using soap and water.

- 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



INTERFACE CONNECTOR: ELCO/6224-12P-S-A or equivalent

Pin NO.	SIGNAL	LEVEL	FUNCTION
1	FRAME	H	FIRST LINE MARKER
2	LOAD	H→L	DATA LATCH
3	CP	H→L	DATA SHIFT
4	VDD	–	POWER SUPPLY FOR LOGIC
5	VSS	–	GND
6	VEE	–	POWER SUPPLY FOR LC
7	D0	H/L	DISPLAY DATA
8	D1		
9	D2		
10	D3		
11	$\overline{\text{DISPOFF}}$	H/L	H: ON/L: OFF
12	NC	–	–

CCFL CONNECTOR: MITSUMI/M63M83-04 or equivalent

1	2	3	4
GND	NC	NC	HV

NOTES :

1. RESOLUTION : 320 X 240 Dots
2. CONTROLLER : WITHOUT
3. DC/DC : WITHOUT
4. BACKLIGHT : CCFT
5. GENERAL TOLERANCE : ±0.2mm

產品編號	LTBE9_159_K		南亞塑膠工業股份有限公司 NAN YA PLASTICS CORPORATION	
	NAME	DATE	TITLE	外觀尺寸圖
APPROVE			DWG-NO	LTBE9X159XK
CHECK				
DESIGN			UNIT : mm	
DRAW	MAY PING	87.07.10	THIRD ANGLE PROJECT	SCALE : 1/1