U.S. MARKETING ARM:

MARK PRODUCTS CORPORATION
800 N. EDGEWOOD AVENUE
WOOD DALE, IL 60191
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SPECIFICATION OF
20x2 LCD MODULE
PRODUCT NO.: LM_B3_020_E

SPEC. NO.: LM020-0

APPROVED BY

EDITED ON : Sep. 15, 1997

SALES MANAGER	DESIGN MANAGER	PERSON IN CHARGE

1. MECHANICAL DATA

(1) Product No.	LM_B3_020__E
(2) Module Size	116.0 (W)mm x 37.0 (H)mm x MAX15.0 (D)mm (ARRAY TYPE LED B.L.) 116.0 (W)mm x 37.0 (H)mm x MAX12.5 (D)mm (EDGE TYPE LED B.L.) 116.0 (W)mm x 37.0 (H)mm x MAX9.5 (D)mm (W/O,EL B.L.)
(3) Dot Size	0.6 (W)mm x 0.65 (H)mm
(4) Dot Pitch	0.65 (W)mm x 0.7 (H)mm
(5) Number of Characters	20 (W) x 2 (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 ☐ EDGE TYPE LED
(11) Weight	W/O B/L: 40 g EL B/L: 45 g LED B/L: 55.5 g EDGE TYPE LED B/L: 50.5 g

Note :

LM_B3_020__E___

Backlight Type
- K : None
- M : LED
- N : EL

Polarizer Type
- R : Reflective
- S : Transflective
- T : Transmissive
- P : Transflective(High Transmissive)

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

Option
- C : Anti-Glare
- D : Wide Temp. Double Power.
- DL : Wide Temp. Single Power
- 6 : Edge Type LED Backlight
- 1 ~ 5, 7, 8, 9 : Version

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

(FRAME FREQUENCY : 70 Hz) (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 LCD Driving Voltage (NORMAL TEMP. LCM)	VDD–V0 (Vop)	0℃	–	4.8	5.4	V
		25℃	4.2	4.7	5.2	
		50℃	3.8	4.3	–	
Recommended LCD Driving Voltage (WIDE TEMP. and DOUBLE POWER LCM)	VDD–V0 (Vop)	–20°C	–	6.8	7.3	V
		0°C	–	6.6	–	
		25°C	5.9	6.4	7.3	
		50°C	–	6.1	–	
		70°C	5.3	5.7	–	
Recommended LCD Driving Voltage (WIDE TEMP. and SINGLE POWER LCM)	VDD–V0 (Vop)	–20°C	4.5	4.9	5.4	V
		0°C	4.2	4.7	5.1	
		25°C	4.1	4.6	5.0	
		50°C	–	–	–	
		70°C	3.6	4.0	4.5	
Power Supply Current	IDD	VDD = 5.0V	–	–	2.8	mA
LED Power Supply Current	ILED	V_{BL} = 5V_{DC} (R_{BL} = 5Ω)	–	210	–	mA
EL Power Supply Current	IEL	V_{BL} = 110V_{AC} 400Hz	–	–	5.0	mA
Edge Type LED Power Supply Current	ILED	V_{BL} = 5V (R_{BL} = 5Ω)	–	140	–	mA

4. OPTICAL CHARACTERISTICS

(FOR NORMAL TEMPERATURE MODE LCM)

AT V_{OP}

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	3.0	4.0	40	65	25	35
	C	5.0	8.0	50	70	28	38
	J						
S	A	3.0	4.0	35	60	20	32
	C	4.0	7.0	45	65	25	35
	J						
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 φ=0° θ=0°

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
G/H: NORMALLY BLACK
J/K: NORMALLY WHITE

4-1. OPTICAL CHARACTERISTICS

(FOR WIDE TEMPERATURE and DOUBLE POWER 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	5.5	45	–	30	–
	C	4	10	50	–	30	–
	J						
S	A	3.5	5	45	66	30	37
	C	4	10	50	–	30	40
	J						
T	E	2.5	3.2	45	60	30	40
	G						
NOTE		NOTE6		NOTE5			

AT φ=0° θ=0°

ITEM	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT	NOTE
Response Time (rise)	Tr	−20℃	–	1600	3200	ms	NOTE 2
		0℃	–	300	600		
		25℃	–	120	240		
		50℃	–	70	140		
		70℃	–	65	130		
Response Time (fall)	Tf	−20℃	–	1500	3000	ms	NOTE 2
		0℃	–	300	600		
		25℃	–	90	180		
		50℃	–	65	130		
		70℃	–	50	100		

NOTE :

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

4-2. OPTICAL CHARACTERISTICS

(FOR WIDE TEMPERATURE and SINGLE POWER 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/B	3.5	4.5	40	60	25	40
	C						
	J						
S	A						
	C	5.0	8.0	45	70	25	40
	J						
T	E						
	G						
NOTE		NOTE6		NOTE5			

AT φ=0° θ=0°

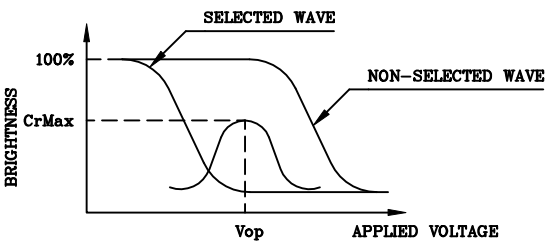
ITEM	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT	NOTE
Response Time (rise)	Tr	-20℃	-	1900	3800	ms	NOTE 2
		0℃	-	265	530		
		25℃	-	90	180		
		50℃	-	-	-		
		70℃	-	60	120		
Response Time (fall)	Tf	-20℃	-	2700	4500	ms	NOTE 2
		0℃	-	450	715		
		25℃	-	170	260		
		50℃	-	-	-		
		70℃	-	50	110		

NOTE :

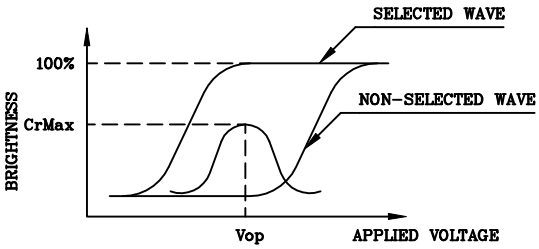
R: REFLECTIVE
S: TRANSFLECTIVE
T: TRANSMISSIVE
A/B: GRAY
C/D: YELLOW
E/F: BLUE
G/H: NORMALLY BLACK
J/K: NORMALLY WHITE

(NOTE 1)

Definition of Operation Voltage(Vop)



(positive type)



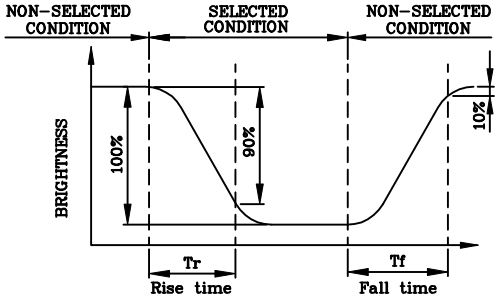
(negative type)

*Conditions

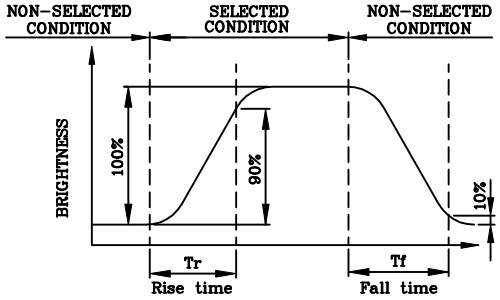
Viewing Angle : 0
Frame Frequency : 70Hz
Applied Waveform : 1/N duty, 1/a bias

(NOTE 2)

Definition of Response Time(Tr,Tf)



(positive type)



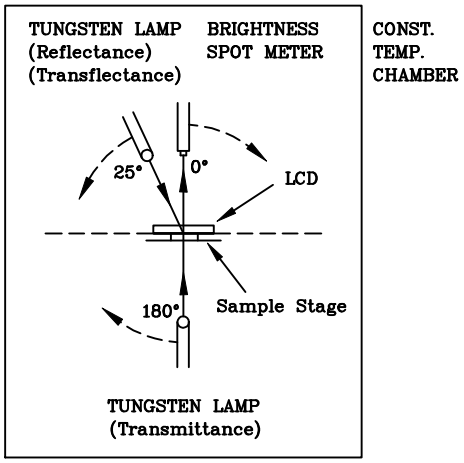
(negative type)

*Conditions

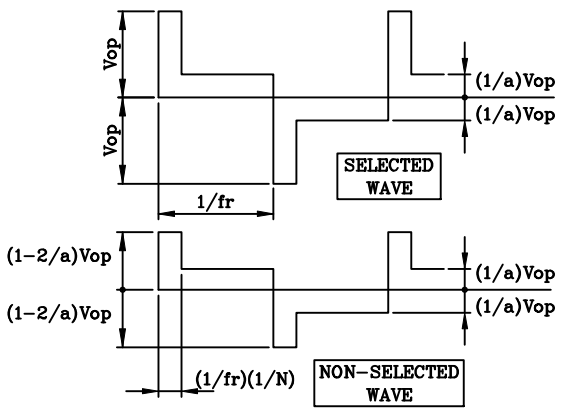
Operating Voltage : Vop
Viewing Angle (θ,ϕ) : (0,0)
Frame Frequency : 70Hz
Applied Waveform : 1/N duty, 1/a bias

(NOTE 3)

Description of Measuring Equipment and Driving Waveforms

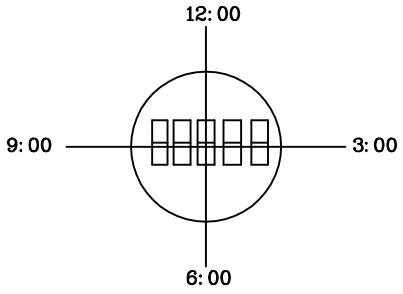


Multiplex Driving (1/N duty, 1/a bias)



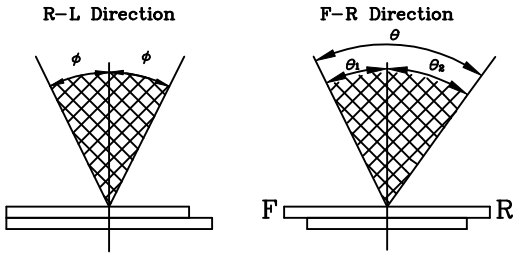
(NOTE 4)

Definition of Viewing Direction



(NOTE 5)

Definition of Viewing Angle



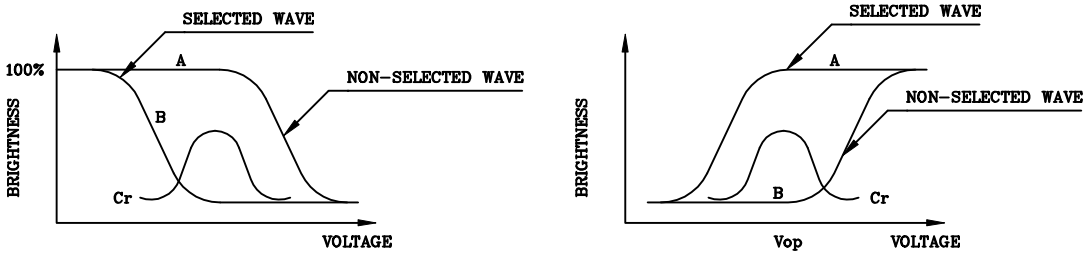
$\theta = \theta_1 + \theta_2$

*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)



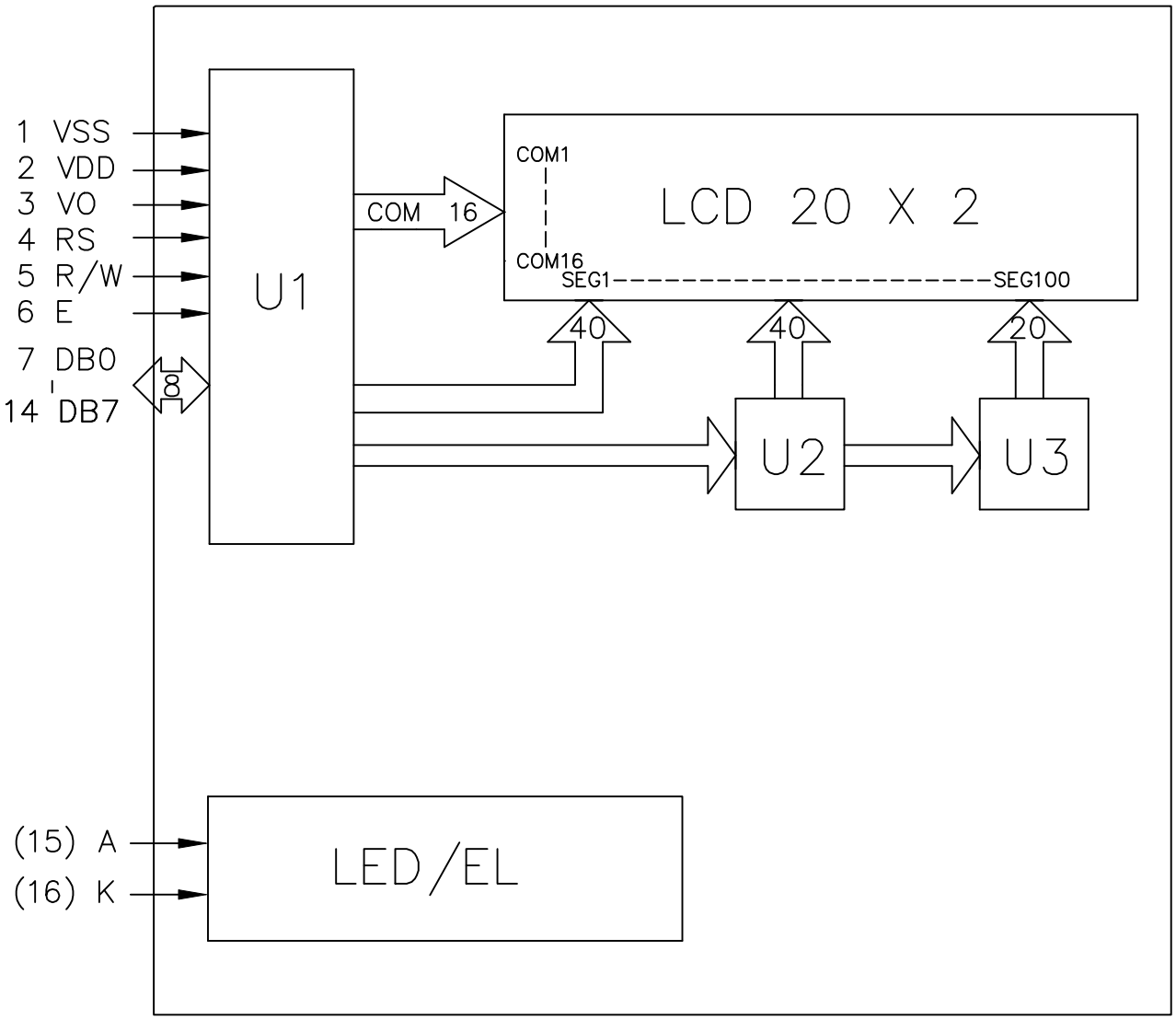
(positive type) (negative type)

Contrast Ratio : Cr=A/B

*Conditions

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

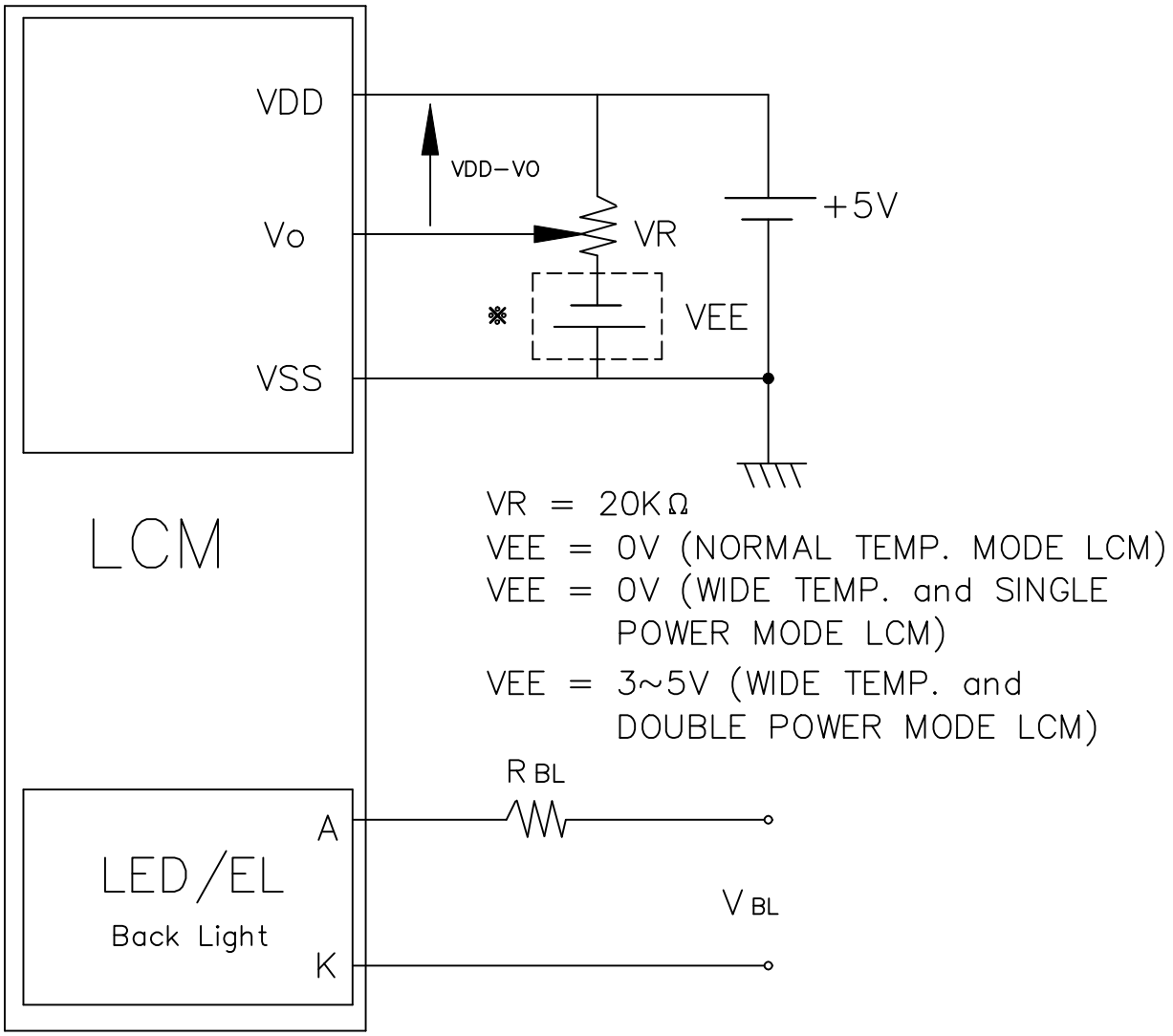
5. BLOCK DIAGRAM



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



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

ITEM / Back Light / Interface	R_{BL}		V_{BL}	
	LED	EL	LED	EL
14 PIN (A,K)	5Ω	0Ω	5V_{DC}	110 V_{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

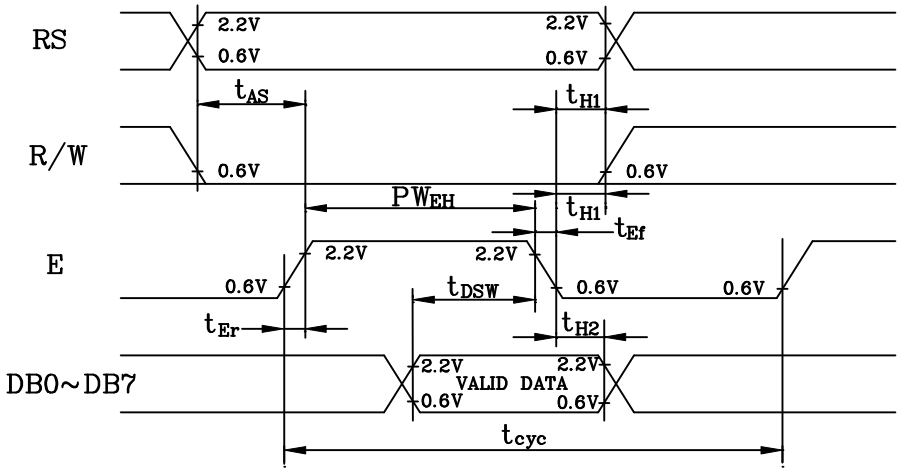


Fig.a Interface timing (data write)

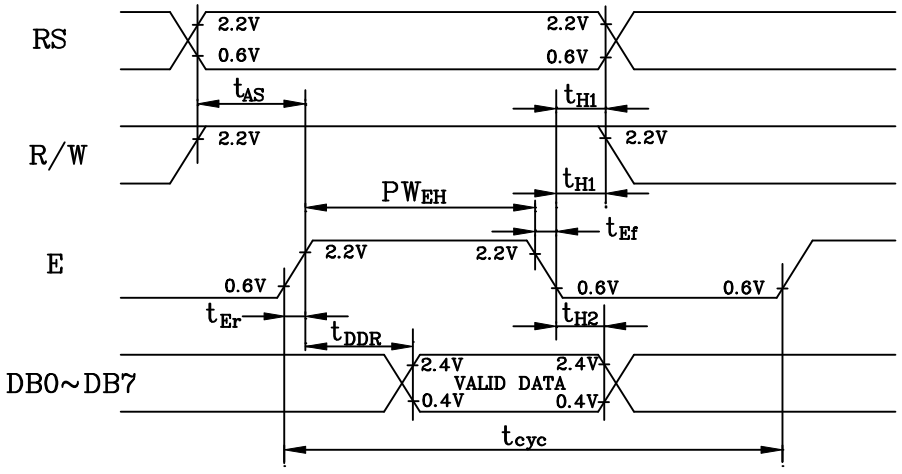


Fig.b Interface timing (data read)

9.CONTROL and DISPLAY COMMAND

COMMAND	RS	R/W	DB_7	DB_6	DB_5	DB_4	DB_3	DB_2	DB_1	DB_0	EXCUTION TIME (FOSC=250kHz)	REMARK
DISPLAY CLEAR	L	L	L	L	L	L	L	L	L	H	1.64ms	
RETURN HOME	L	L	L	L	L	L	L	L	H	X	1.64ms	CURSOR MOVE TO FIRST DIGIT
ENTRY MODE SET	L	L	L	L	L	L	L	H	I/D	SH	40μS	•I/D: SET CURSOR MOVE DIRECTION I/D: H = INCREASE; L = DECREASE •SH: SPECIFIES SHIFT OF DISPLAY SH: H = DISPLAY IS SHIFTED; L = DISPLAY IS NOT SHIFTED
DISPLAY ON/OFF	L	L	L	L	L	L	H	D	C	B	40μS	•DISPLAY D: H = DISPLAY ON; L = DISPLAY OFF •CURSOR C: H = CURSOR ON; L = CURSOR OFF •BLINKING B: H = BLINKING ON; L = BLINKING OFF
SHIFT	L	L	L	L	L	H	S/C	R/L	X	X	40μS	SC: H = DISPLAY SHIFT; L = CURSOR MOVE R/L: H = RIGHT SHIFT; L = LEFT SHIFT
SET FUNCTION	L	L	L	L	H	DL	N	F	X	X	40μS	DL: H = 8 DITS INTERFACE; L = 4 BITS INTERFACE N: H = 2 LINE DISPLAY; L = 1 LINE DISPLAY F: H = 5 X 10 DOTS; L = 5 X 7 DOTS
SET CG RAM ADDRESS	L	L	L	H	CG RAM address (corresponds to cursor address)						40μS	CG RAM Data is sent and received after this setting
SET DD RAM ADDRESS	L	L	H	DD RAM address							40μS	DD RAM Data is sent and received after this setting
READ BUSY FLAG & ADDRESS	L	H	BF	Address Counter used for Both DD & CG RAM address							0μS	BF: H = Busy; L = Ready –Reads BF indication internal operating is being performed. –reads address counter contents
WRITE DATA	H	L	Write Data								46μS	Write data into DD or CG RAM
READ DATA	H	H	Read Data								46μS	Read data form DD or CGRAM

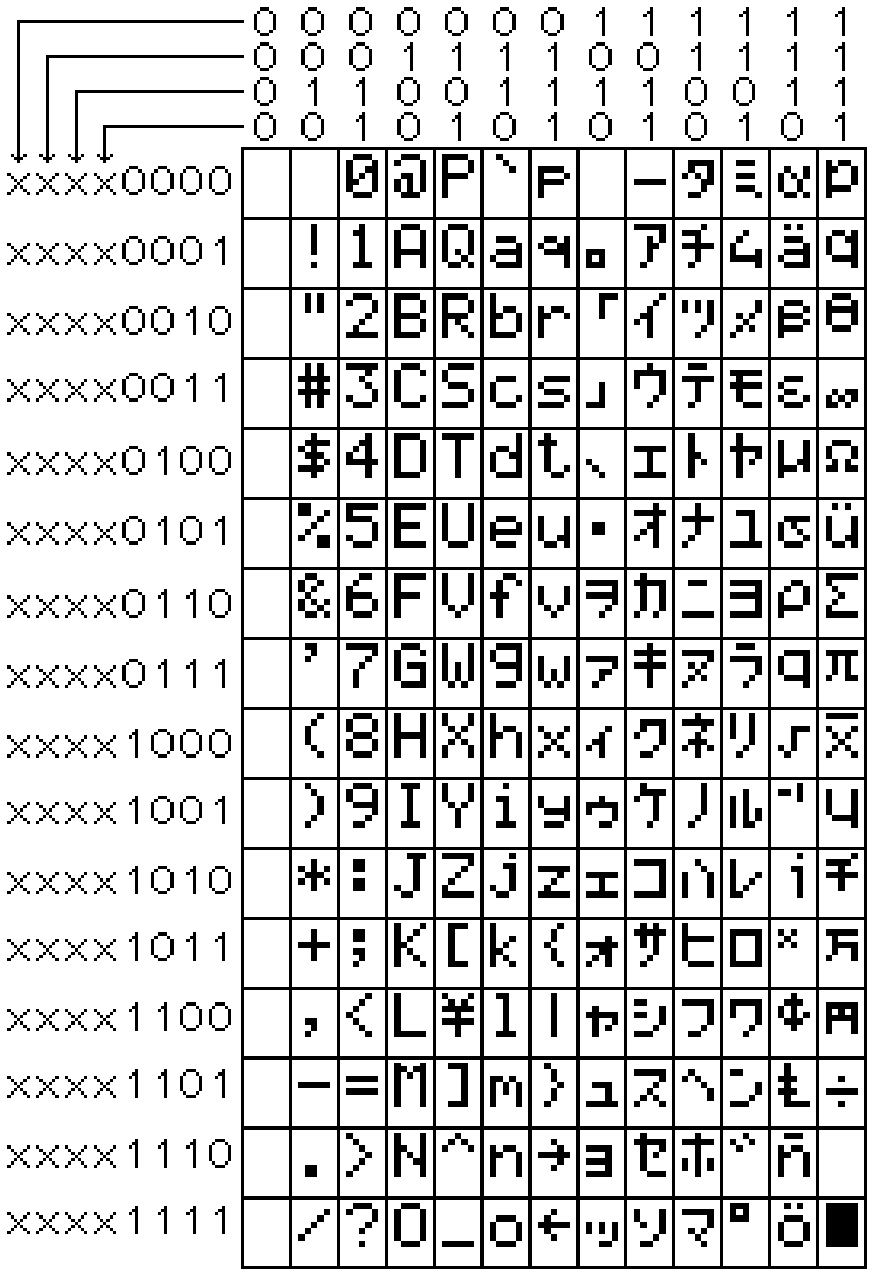
X : Don't care

10. DISPLAY PATTERN (20X2)

Display Data RAM Address
Versus Character Position

	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20
	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F	10	11	12	13
	40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F	50	51	52	53

11.CHARACTER FONT TABLE

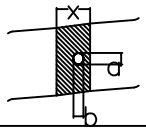
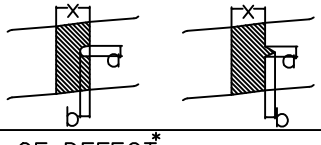


12. RELIABILITY TEST

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

13. 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:

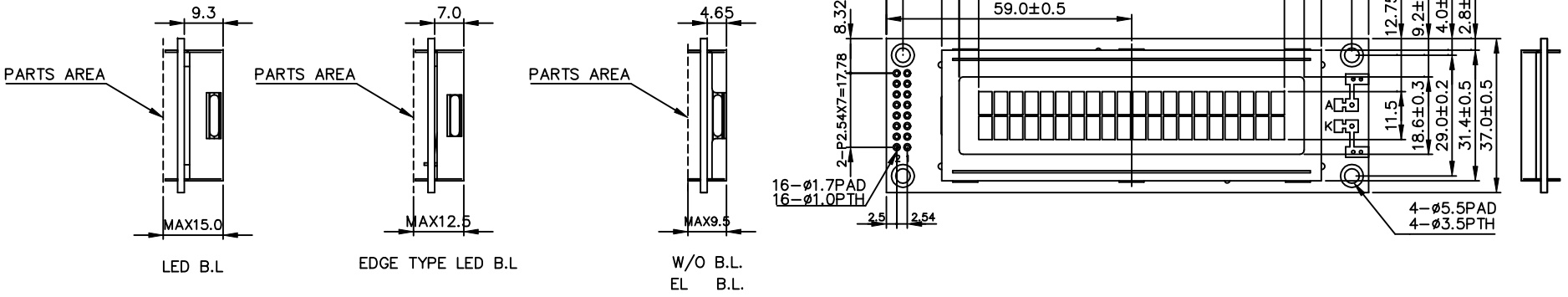
- SAFETY
  1. If the LCD panel breaks, be careful not to allow the liquid crystal to touch your skin.
  2. If the liquid crystal touches your skin or clothes, please wash it off immediately by using soap and water.

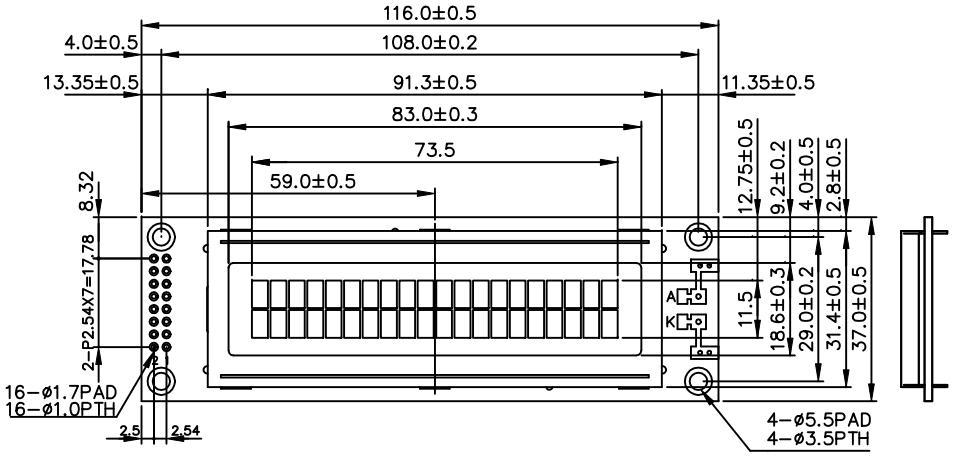
- HANDLING
  1. Prevent all contact with static electricity, which can damage the CMOS ICs. The module is packaged in a static-shielding bag to prevent damage during shipment, warehousing and removal from the shipping carton.
  2. Do not remove the panel or frame from the module.
  3. The polarizing 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.

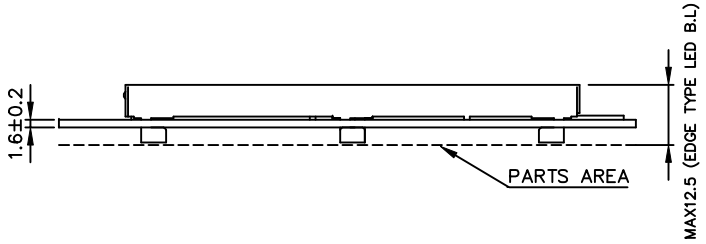
- STORAGE
  1. Store the panel or module in a dark place where the temperature is 25°C±5°C and the humidity is below 65% RH.
  2. Do not place the module near organics solvents or corrosive gases.
  3. Do not crush, shake, or jolt the module.

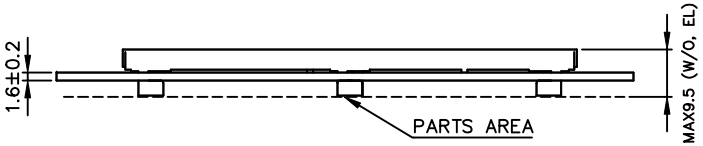
- TERMS OF WARRANTY
  1. Acceptance inspection period
     The inspection period is within one month after the arrival of the contracted goods at the buyer's factory site.
  2. Applicable warranty period
     The warranty period is within twelve months from the date of invoice under normal usage and storage conditions.

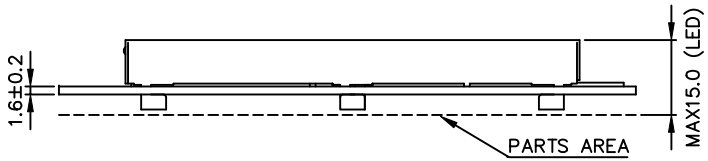
- TYPICAL OPERATING LIFETIME OF BACKLIGHT
  LED : 50,000HR
  EL : 5,000HR
  CCFT : 10,000HR







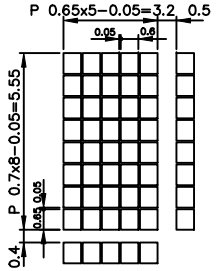




PIN NO.	SYMBOL
1	Vss
2	VDD
3	VO
4	RS
5	R/W
6	E
7	DB0
8	DB1
9	DB2
10	DB3
11	DB4
12	DB5
13	DB6
14	DB7
15	A
16	K

Note :

1.Resolution : 20X2 Characters
2.Character Format : 5X8 Dots
3.General Tolerance : ±0.5mm.



FOR P/N:

LMXB3X020X ┐
LMXB3X020X2┘ have 14 pins only.
LMXB3X020X2E
LMXB3X020X2DE
LMXB3X020X5E
LMXB3X020X6E
LMXB3X020X7E
LMXB3X020X8E
LMXB3X020X12E

產品編號	LM_B3_020__E		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	MXCX020XA	Rev.A
DESIGN			THIRD ANGLE PROJECT	UNIT : mm	
DRAW	MAY PING	85.11.14		SCALE :	