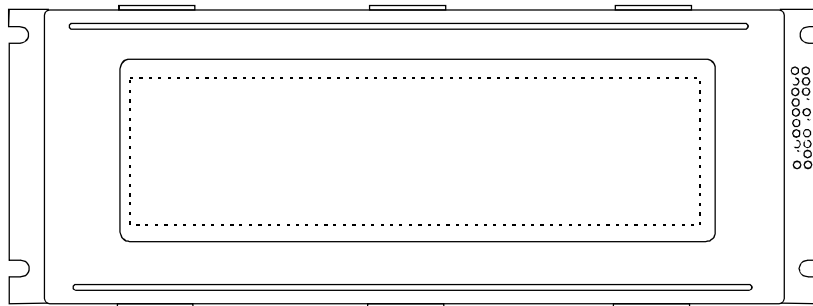


# PRODUCT SPECIFICATION

## TEG16991

240x64 GRAPHICS  
LCD DISPLAY MODULE



	Q.A.: JK	REV.: 1.2	TEG16991	SHEET 1 OF 22
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# 1. MECHANICAL DATA

(1) Part Name **TEG16991**

(2) Module Size 180.0(W)mm X 65.0(H)mm X MAX10.5(D)mm (W/O,EL B/L)  
 180.0(W)mm X 65.0(H)mm X MAX15.5(D)mm (LED B/L)  
 190.0(W)mm X 65.0(H)mm X MAX13.8(D)mm (CCFL B/L)

(3) Dot Size 0.49 (W)mm x 0.49 (H)mm

(4) Dot Pitch 0.53 (W)mm x 0.53 (H)mm

(5) Number of Dots 240 (W) x 64 (H)Dots

(6) Duty 1/64

(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

(8) Viewing Direction  6 O'clock  12 O'clock  \_\_\_ O'clock

(9) Backlight  W/O  EL B/L  LED B/L  CCFL B/L

(10) Weight W/O B/L: 128.5 g EL B/L: 135.5 g  
 LED B/L: 164.0 g CCFL B/L: 173.0 g

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## 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	20.0	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 2,4		Note 3,5		Note 4,5		Note 4,6	

Note 2  $T_a \leq 50^\circ\text{C}$  : 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 3  $T_a$  at  $-20^\circ\text{C}$  will be  $< 48\text{hrs}$ , at  $70^\circ\text{C}$  will be  $< 120\text{hrs}$

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


Note 5  $T_a \leq 70^\circ\text{C}$  : 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 6  $T_a$  at  $-30^\circ\text{C}$  will be  $< 48\text{hrs}$ , at  $80^\circ\text{C}$  will be  $< 120\text{hrs}$

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### 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-VEE	Duty= 1/64	0°C	13.1	13.5	13.9	V
			25°C	11.9	12.5	13.1	
		Bias= 1/9	50°C	10.8	11.4	11.8	
Recommended LC Driving Voltage (Wide Temp. LCM)	VDD-VEE	Duty= 1/64	-20°C	11.7	12.1	12.5	V
			0°C	11.6	12.0	12.4	
		Bias= 1/9	25°C	11.5	11.9	12.3	
			50°C	11.4	11.8	12.2	
			70°C	11.3	11.7	12.1	
Power Supply Current	IDD	FLM=72 Hz VDD=5.0 V VDD-VEE=11.6 V	6.5	7.2	10.6	mA	
	IEE	PATTERN : 	1.6	1.8	2.4		
LED Power Supply Current	I <sub>LED</sub>	V <sub>AK</sub> = 5.0 V R <sub>18</sub> = R <sub>19</sub> = 10Ω	-	220	-	mA	
EL Power Supply Current	I <sub>EL</sub>	V <sub>AK</sub> = 110 V <sub>rms</sub> 400HZ R <sub>18</sub> = R <sub>19</sub> = 0Ω	-	-	10.0	mA rms	
CCFL	Starting Voltage	V <sub>FLS</sub>	-	-	900	-	V <sub>rms</sub>
	Driving Voltage	V <sub>FLD</sub>	-	-	450	-	V <sub>rms</sub>
	Driving Current	I <sub>FLD</sub>	V <sub>FLD</sub> = 450V <sub>rms</sub> f <sub>FLD</sub> = 30KHZ	-	5.0	-	mA rms
	Driving Voltage	f <sub>FL</sub>	-	15	30	50	KHZ

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### 3. ELECTRICAL CHARACTERISTICS (White LED)

( VDD = 5V±10% )

ITEM	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT		
Input Voltage	V <sub>IH</sub>	H level	0.7VDD	-	VDD	V		
	V <sub>IO</sub>	L level	0	-	0.3VDD	V		
Recommended LC Driving Voltage (Normal Temp. LCM)	VDD-VEE	Duty= 1/64	0°C	-	13.3	13.8	V	
		Bias= 1/9	25°C	11.7	12.5	13.1		
			50°C	10.8	11.4	-		
Power Supply Current	I <sub>DD</sub>	FLM=72 Hz VDD=5.0 V VDD-VEE=12.5V	-	9.0	14.0	mA		
	I <sub>EE</sub>	PATTERN : 	-	2.0	3.5			
LED Power Supply Current Not Applicable	I <sub>LED</sub>	V <sub>BL</sub> = 5.0 V R <sub>BL</sub> = 7.5 Ω	-	200	300	mA		
LCM	Not Applicable Surface Luminance	LED	VDD=5.0V VDD-VO=12.5V ILED=200 mA	PATTERN: (Dots All Off)	-	6.6	-	cd/m <sup>2</sup>
				PATTERN: (Dots All ON)	-	27.1	-	cd/m <sup>2</sup>

# 4.OPTICAL CHARACTERISTICS

## 4-1 Optical Char. of Normal Temp. Mode

AT Vop

MODE	ITEM	Cr(Contrast Ratio)		$\theta$ (Viewing Angle)		$\phi$ (Viewing Angle)	
		25°C		25°C		25°C	
		MIN.	TYP.	MIN.	TYP.	MIN.	TYP.
R	A, B	3.5	4.5	50	75	20	30
	C, D	6.0	9.0	60	85	20	35
	J	4.5	7.5	55	80	20	35
S	A, B	3.0	4.2	50	75	20	30
	C, D	5.0	8.0	55	85	20	35
	J	4.0	7.0	50	75	20	35
T	A	2.0	2.5	40	60	18	25
	E, F	3.0	4.0	50	70	20	35
	J, K	3.0	4.0	50	70	20	35
note		NOTE6			NOTE5		

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

ITEM	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT	NOTE
Response Time (rise)	Tr	0°C	-	600	1200	ms	NOTE 2
		25°C	-	110	220		
		50°C	-	50	100		
Response Time (fall)	Tf	0°C	-	900	1500	ms	NOTE 2
		25°C	-	250	360		
		50°C	-	100	150		

note:

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

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## 4-2 Optical Char. of Wide Temp. Mode

AT Vop

	ITEM	Cr(Contrast Ratio)		$\theta$ (Viewing Angle)		$\phi$ (Viewing Angle)	
		25°C		25°C		25°C	
		MIN.	TYP.	MIN.	TYP.	MIN.	TYP.
R	A	3.5	4.2	50	68	20	30
	C	5.0	-	50	-	30	35
	J	6.0	8.0	50	70	20	38
S	A	3.5	4.0	50	65	20	30
	C	5.0	-	50	-	25	35
	J	5.0	7.0	50	-	25	35
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°C	-	2100	3200	ms	NOTE 2
		0°C	-	450	680		
		25°C	-	150	250		
		50°C	-	110	170		
		70°C	-	70	90		
Response Time (fall)	Tf	-20°C	-	2100	3200	ms	NOTE 2
		0°C	-	400	600		
		25°C	-	120	180		
		50°C	-	60	100		
		70°C	-	30	50		

note:

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

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# 4.OPTICAL CHARACTERISTICS

AT Vop

ITEM		Cr(Contrast Ratio)		$\theta$ (Viewing Angle)		$\phi$ (Viewing Angle)	
		25°C		25°C		25°C	
MODE		MIN.	TYP.	MIN.	TYP.	MIN.	TYP.
T	G	-	10	-	70	-	60
note		NOTE6		NOTE5			

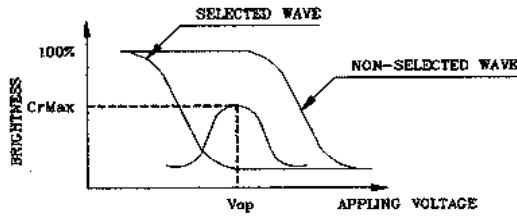
note:  
 T: TRANSMISSIVE  
 G: NORMALLY BLACK

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

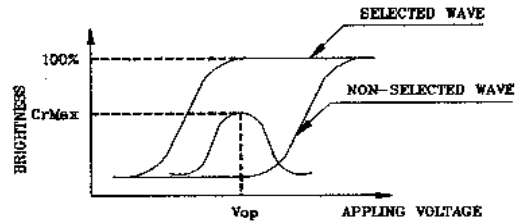
ITEM	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT	NOTE
Response Time (rise)	Tr	0°C	-	600	1200	ms	NOTE 2
		25°C	-	110	220		
		50°C	-	50	100		
Response Time (fall)	Tf	0°C	-	900	1500	ms	NOTE 2
		25°C	-	250	360		
		50°C	-	100	150		

(NOTE 1)

Definition of Operation Voltage(Vop)



(positive type)



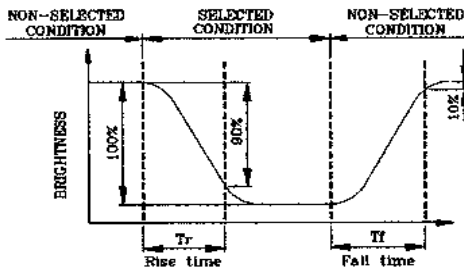
(negative type)

\*Conditions

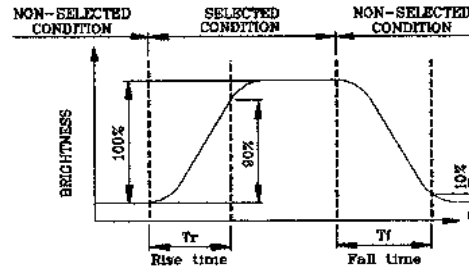
Viewing Angle : 0  
 Frame Frequency : 70Hz  
 Applying Waveform : 1/N duty 1/a bias

(NOTE 2)

Definition of Response Time(Tr,Tf)



(positive type)



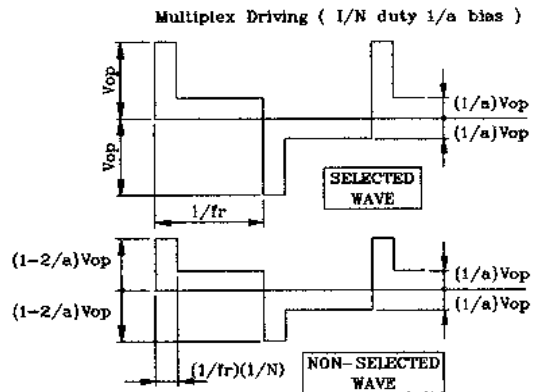
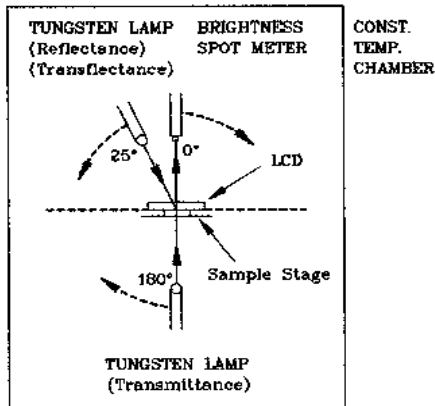
(negative type)

\*Conditions

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

(NOTE 3)

Description of Measuring Equipment and Driving Waveforms



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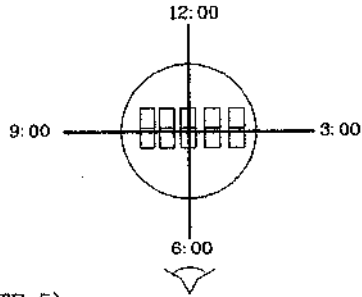
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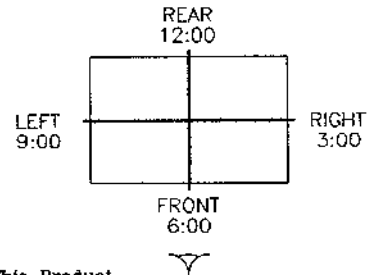
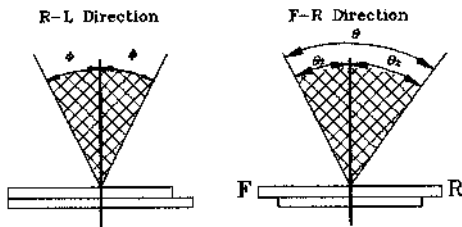
(NOTE 4)

Definition of Viewing Direction



(NOTE 5)

Definition of Viewing Angle



\*For This Product  
The Viewing Direction Is 6 O'clock  
So  $\theta_1 > \theta_2$

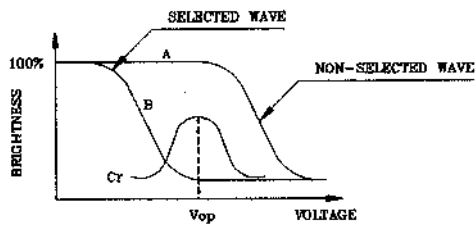
$$\theta = \theta_1 + \theta_2$$

\*Conditions

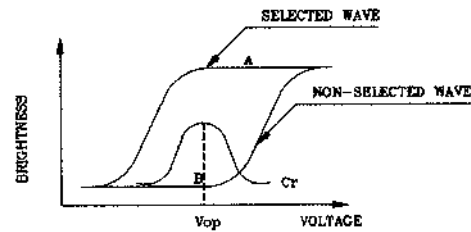
Operating Voltage : Vop  
Frame Frequency : 70Hz  
Applying Waveform : 1/N duty 1/a bias  
Contrast Ratio : larger than 2

(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

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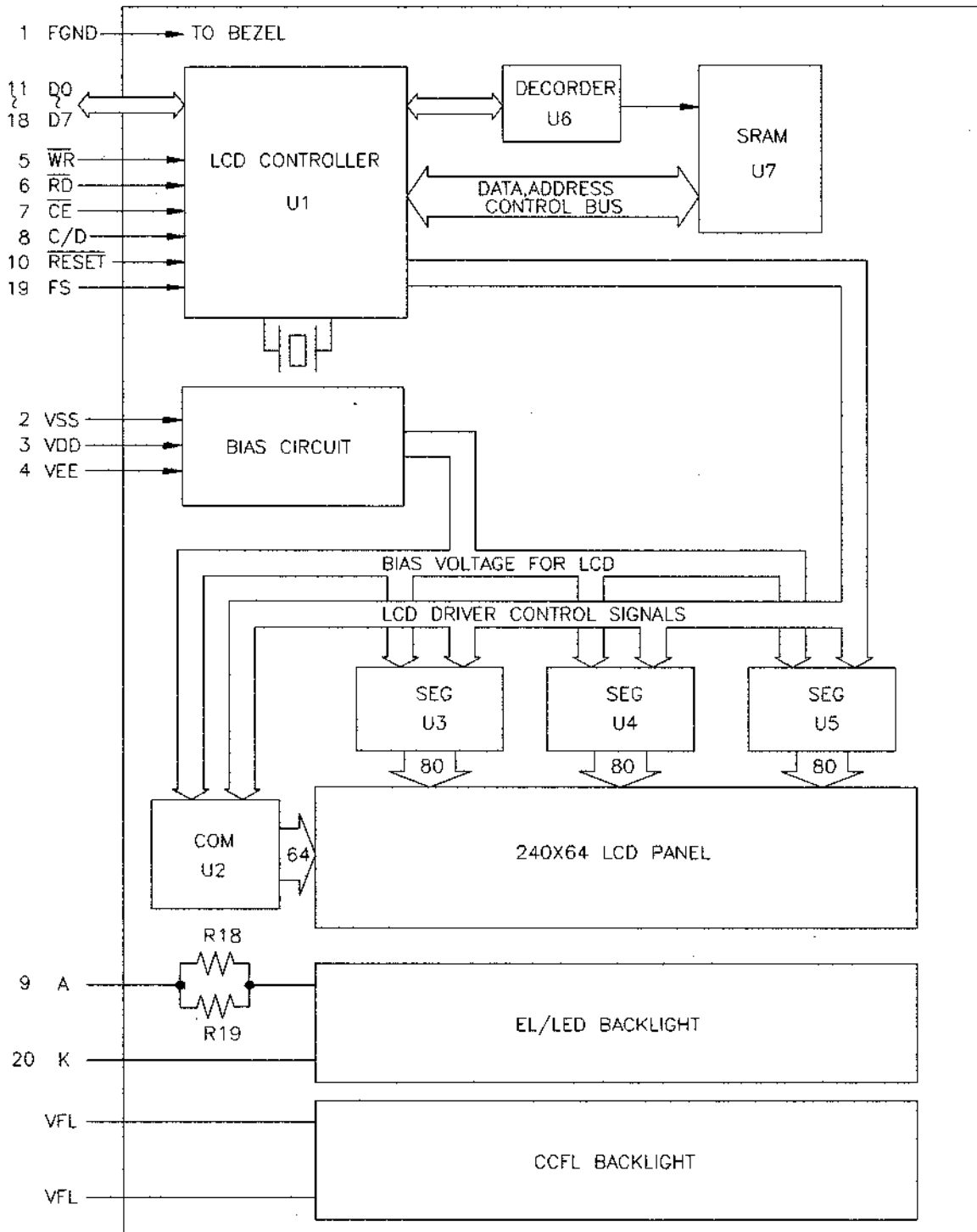
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# 5. BLOCK DIAGRAM



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## 6.INTERNAL PIN CONNECTION

PIN NO.	SYMBOL	FUNCTION
1	FGND	FRAME GROUND (0V)
2	VSS	GROUND
3	VDD	POWER SUPPLY FOR LOGIC (+5V)
4	VEE	POWER SUPPLY FOR LC DRIVING
5	$\overline{WR}$	DATA WRITE
6	$\overline{RD}$	DATA READ
7	$\overline{CE}$	CHIP ENABLE
8	C/D	$\overline{WR}="L",C/D="H"$ :COMMAND WRITE $\overline{WR}="L",C/D="L"$ :DATA WRITE $\overline{RD}="L",C/D="H"$ :STATUS READ $\overline{RD}="L",C/D="L"$ :DATA READ
9	A	Anode of LED B/L and EL B/L
10	$\overline{RESET}$	CONTROLLER RESET
11	D0	DATA INPUT/OUTPUT
12	D1	DATA INPUT/OUTPUT
13	D2	DATA INPUT/OUTPUT
14	D3	DATA INPUT/OUTPUT
15	D4	DATA INPUT/OUTPUT
16	D5	DATA INPUT/OUTPUT
17	D6	DATA INPUT/OUTPUT
18	D7	DATA INPUT/OUTPUT
19	FS	FONT SELECT    CONNECT TO VDD :6X8 PIXELS/CHARACTER CONNECT TO GND :8X8 PIXELS/CHARACTER
20	K	Cathode of LED B/L and EL B/L

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

PIN NO	SYMBOL	FUNCTION
1	VFL	POWER SUUPLY FOR CCFL DRIVE
2	NC	-
3	NC	-
4	VFL	POWER SUUPLY FOR CCFL DRIVE

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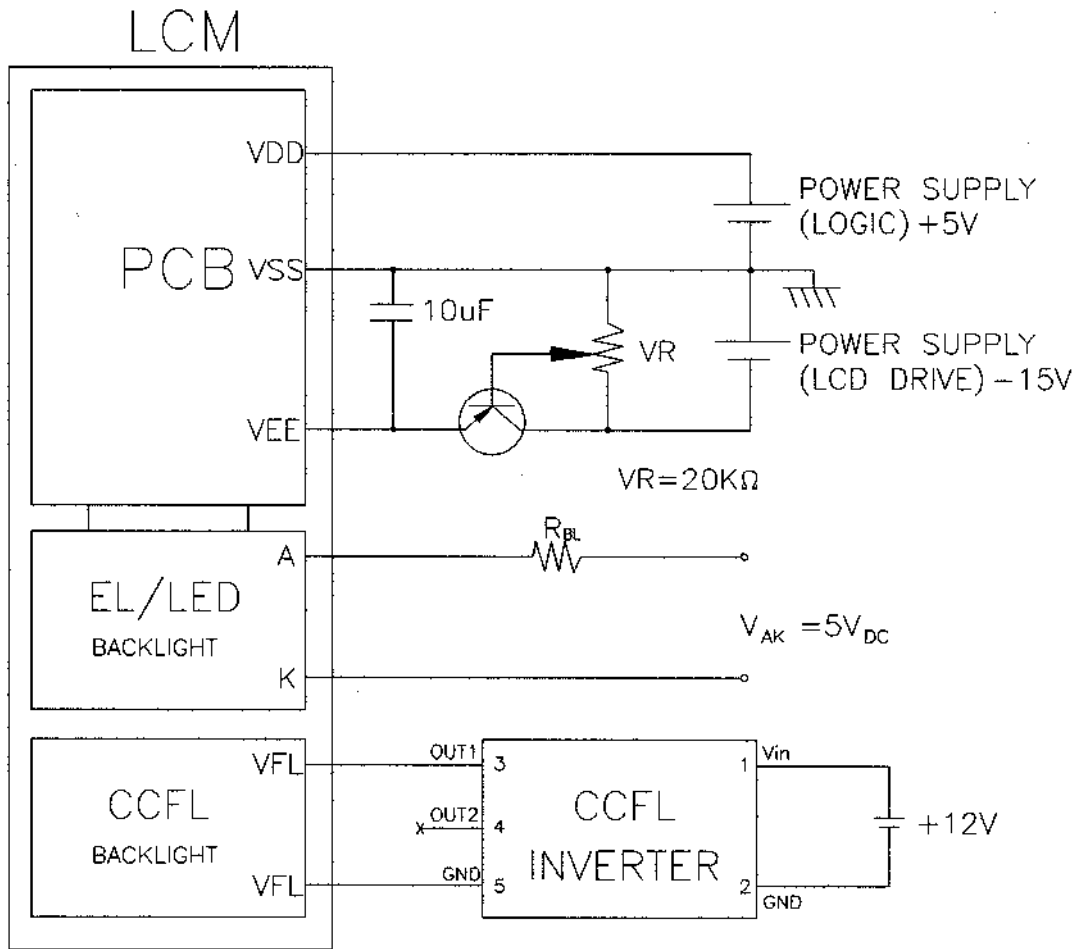
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# 7. POWER SUPPLY



Recommended Inverter : CXA-L10L (TDK)

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

item Back Light interface	$R_{BL}$		$V_{BL}$	
	EL	LED (White)	EL	LED (White)
A,K PIN	0Ω	5Ω 7.5Ω	110V <sub>ac</sub> 400HZ	5V <sub>dc</sub>

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# 8. TIMING CHARACTERISTICS

## 8-1 INTERFACE TIMING

ITEM	ITEM	CONDITION	MIN.	MAX.	UNIT
C/D SET UP TIME	$t_{CDS}$	Fig.	100	-	ns
C/D HOLD TIME	$t_{CDH}$	Fig.	10	-	ns
$\overline{CE}, \overline{RD}, \overline{WR}$ CLOCK WIDTH	$t_{CP}, t_{RP}, t_{WP}$	Fig.	80	-	ns
DATA SET UP TIME	$t_{DS}$	Fig.	80	-	ns
DATA HOLD TIME	$t_{DH}$	Fig.	40	-	ns
ACCESS TIME	$t_{ACC}$	Fig.	-	150	ns
DATA OUTPUT HOLD TIME	$t_{OH}$	Fig.	10	50	ns

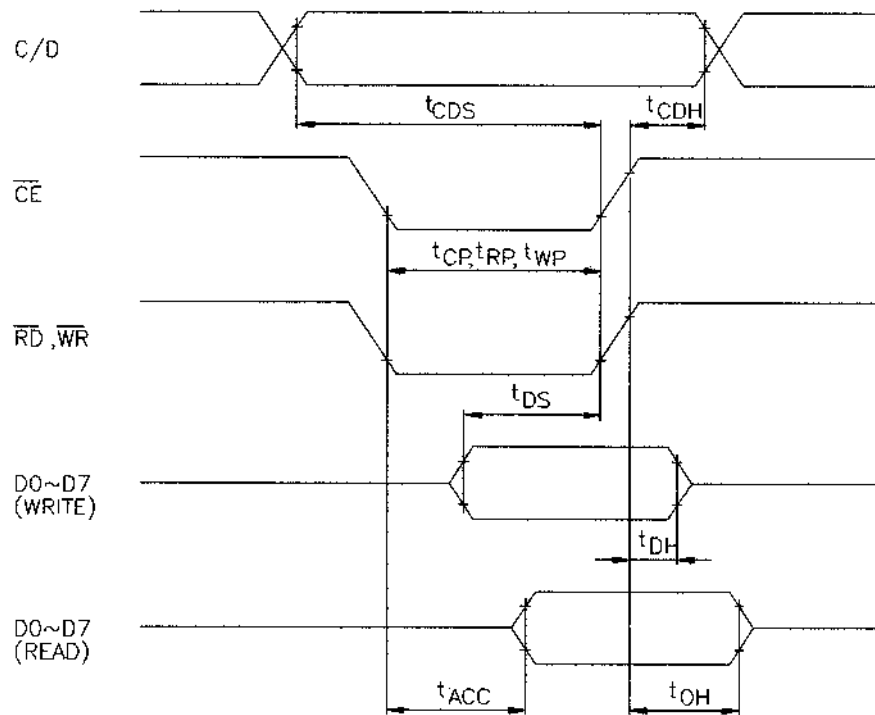
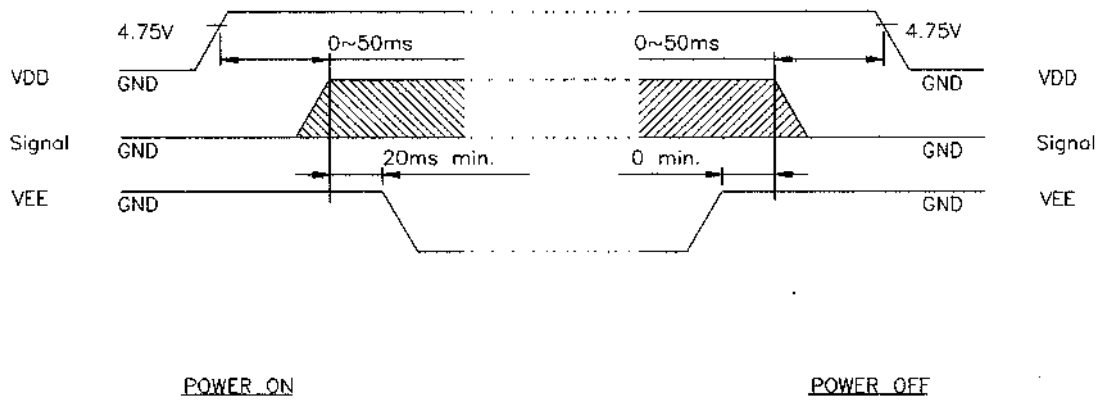


Fig. INTERFACE TIMING CHART

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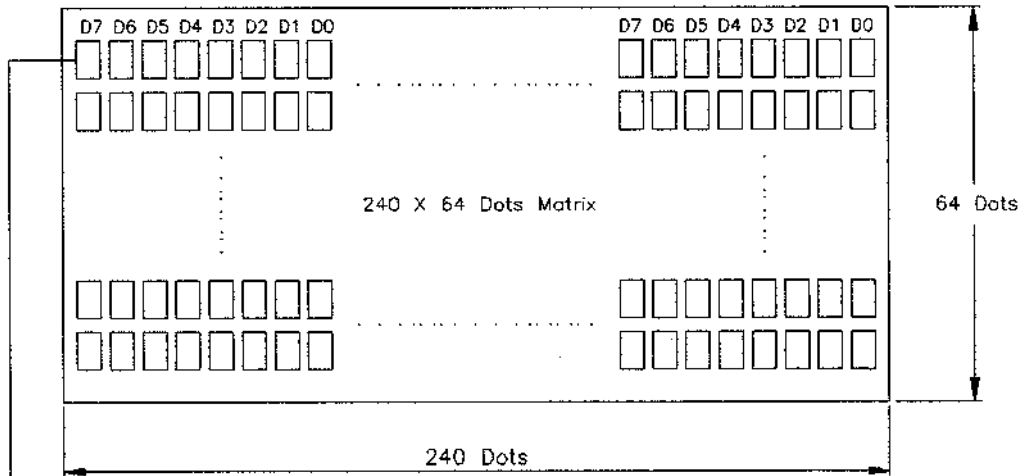
## 8-2 POWER ON/OFF TIMING



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

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# 8-3 DISPLAY PATTERN



Starting dot for the starting address of display RAM D0~D7 are 8 bits transmitted data ,where D0 is LSB and D7 is MSB.

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## 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 Humi. Storage	40°C 90%RH	120HR	Appearance without defect	
4	Thermal Shock	-20°C,30min → 25°C,5min → 70°C,30min → 25°C,5min (1cycle)		Appearance without defect	5 cycles

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NOTICE:

• 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

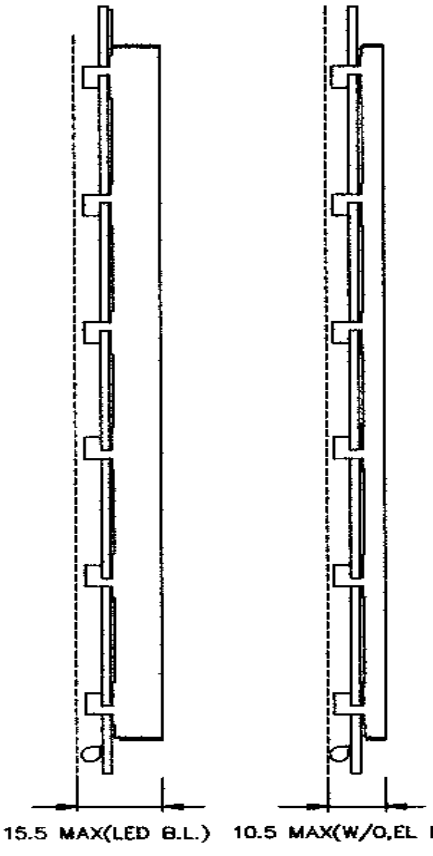
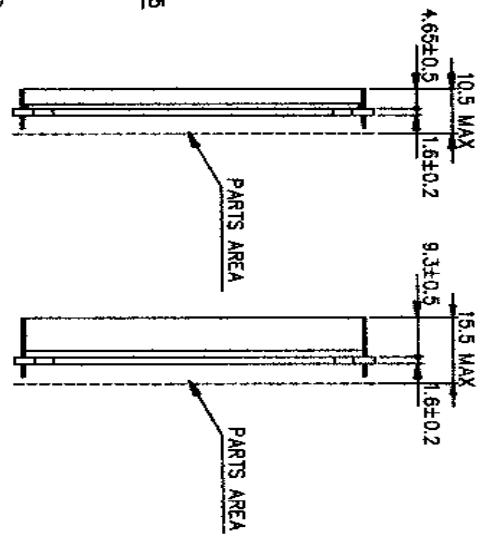
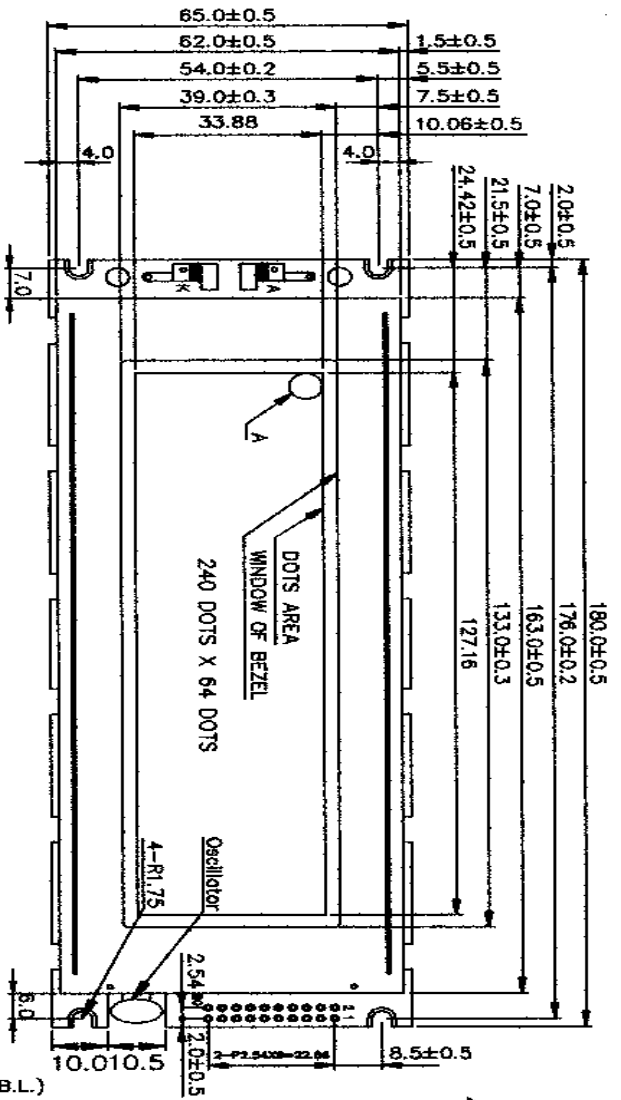
- 1.Acceptance inspection period  
The period is within one month after the arrival of contracted commodity at the buyer's factory site.
- 2.Applicable warrant period  
The period is within twelve months since the date of shipping out under normal using and storage conditions.

• THE OPERATING LIFE TIME OF BACK LIGHT

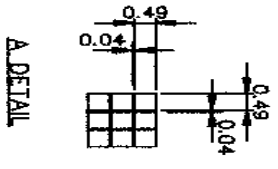
- EL : 5000hrs for AC 110Vrms, 400Hz, 20°C, 60%RH  
CCFT : 20,000hrs for lamp-current 5mA, 30KHz, 25°C  
White LED : 40,000hrs for ILED=200mA, 25°C  
LED : 50,000hrs for ILED=220mA, 25°C

(Operating life time is defined as follows : The final brightness is at 50% of original brightness.)

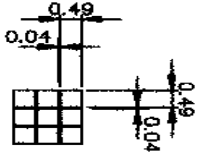
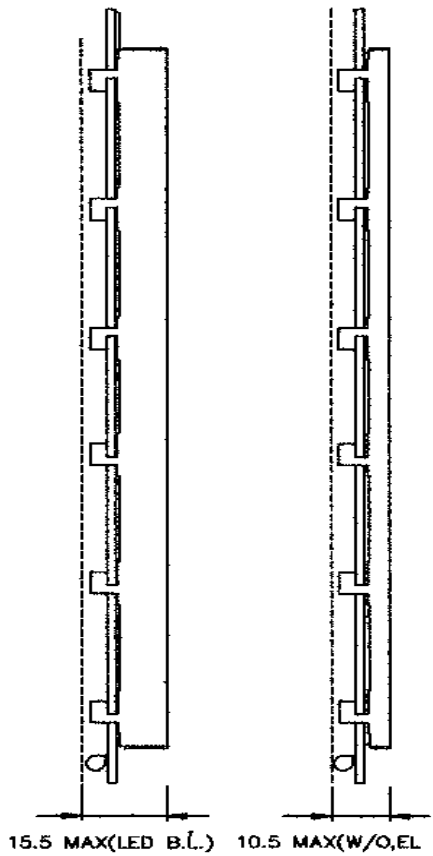
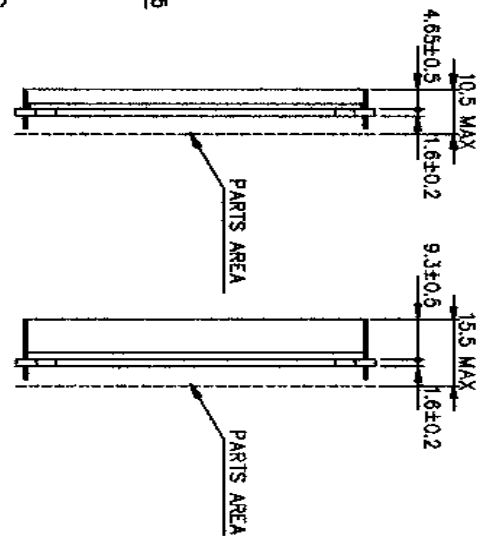
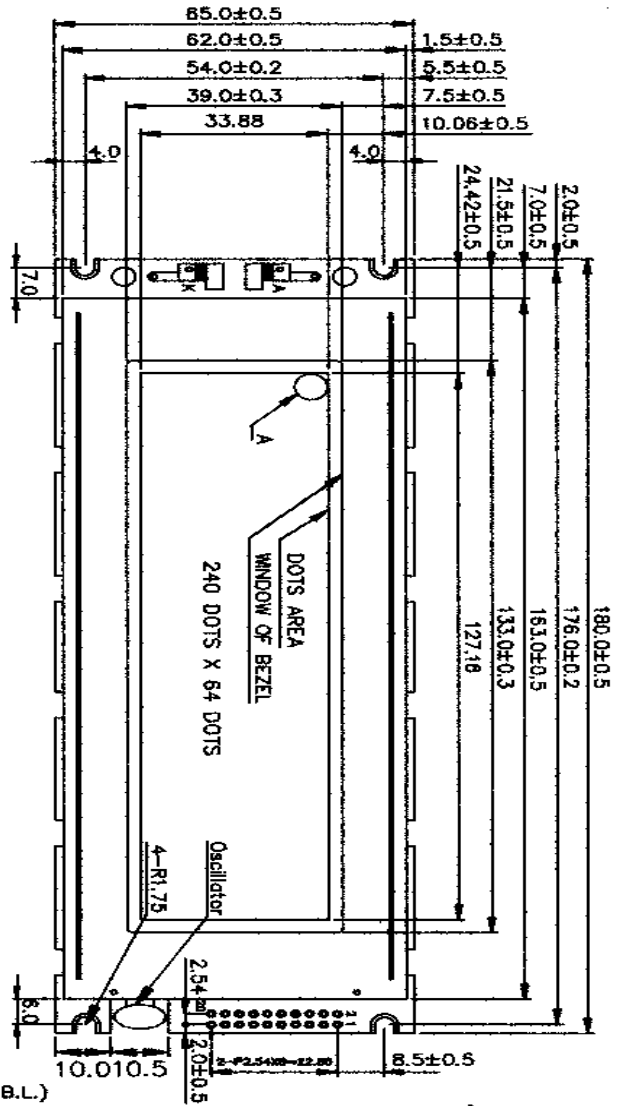
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PIN NO.	1	2	3	4	5	6	7	8	9	10
SYMBOL	FGND	VSS	VDD	VEE	WR	RD	OE	C/D	A	RESET
PIN NO.	11	12	13	14	15	16	17	18	19	20
SYMBOL	D0	D1	D2	D3	D4	D5	D6	D7	FS	K



- NOTES:
1. Resolution: 240 x 64 Dots
  2. Controller: Built-in
  3. DC/DC Converter: Without



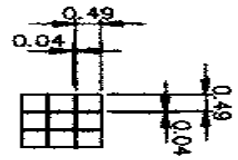
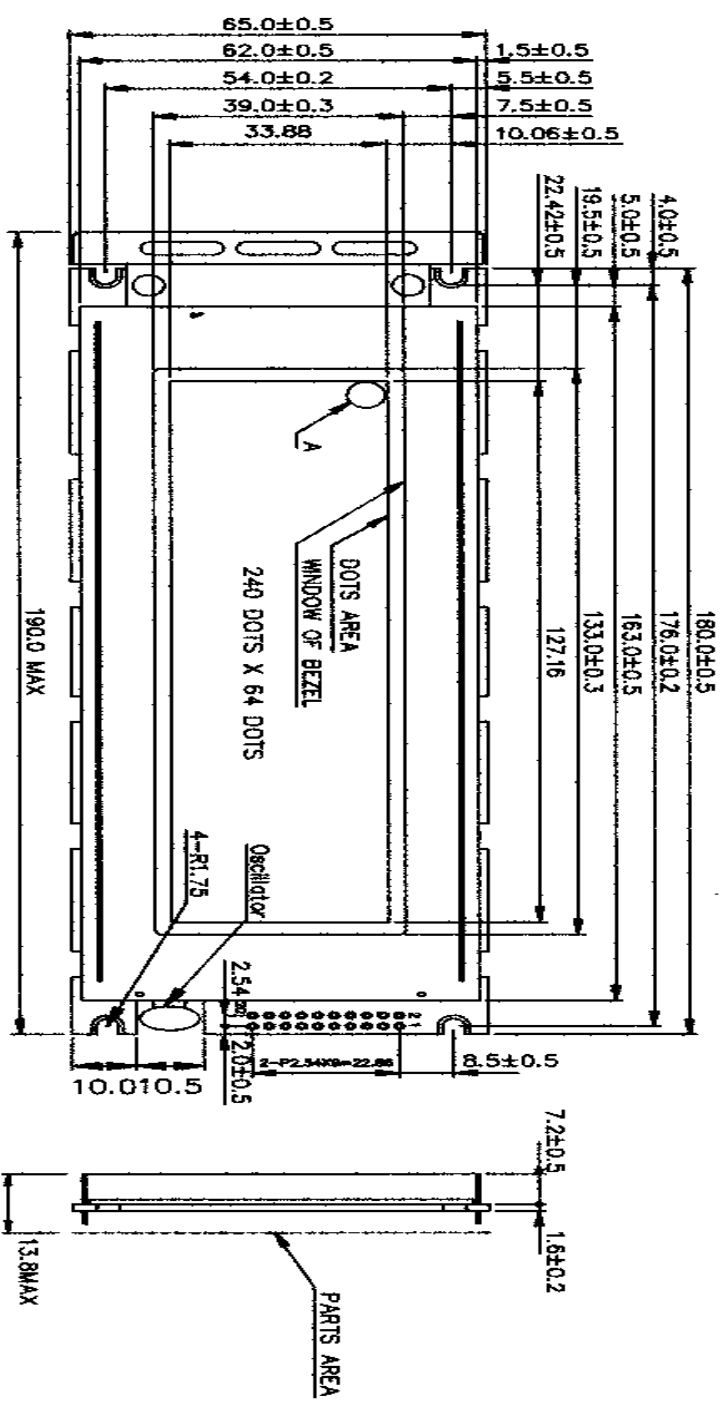
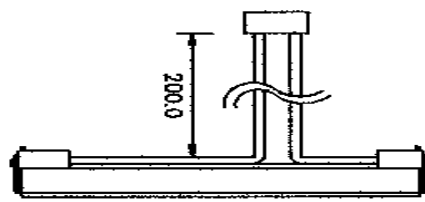
A DETAIL

PIN NO.	1	2	3	4	5	6	7	8	9	10
SYMBOL	F/GND	VSS	VDD	VEE	WR	RD	OE	C/D	A	RESET
PIN NO.	11	12	13	14	15	16	17	18	19	20
SYMBOL	D0	D1	D2	D3	D4	D5	D6	D7	FS	K

NOTES:

1. Resolution : 240 x 64 Dots
2. Controller : T6963C(Compatible)
3. DC/DC Converter : Without
4. J1 didn't add 09, Disconnect Pin1(F/GND) and Pin2(GND)
5. General Tolerance : ±0.5 mm

W/O,EL B/L LED B/L

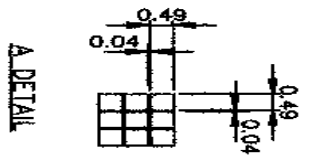
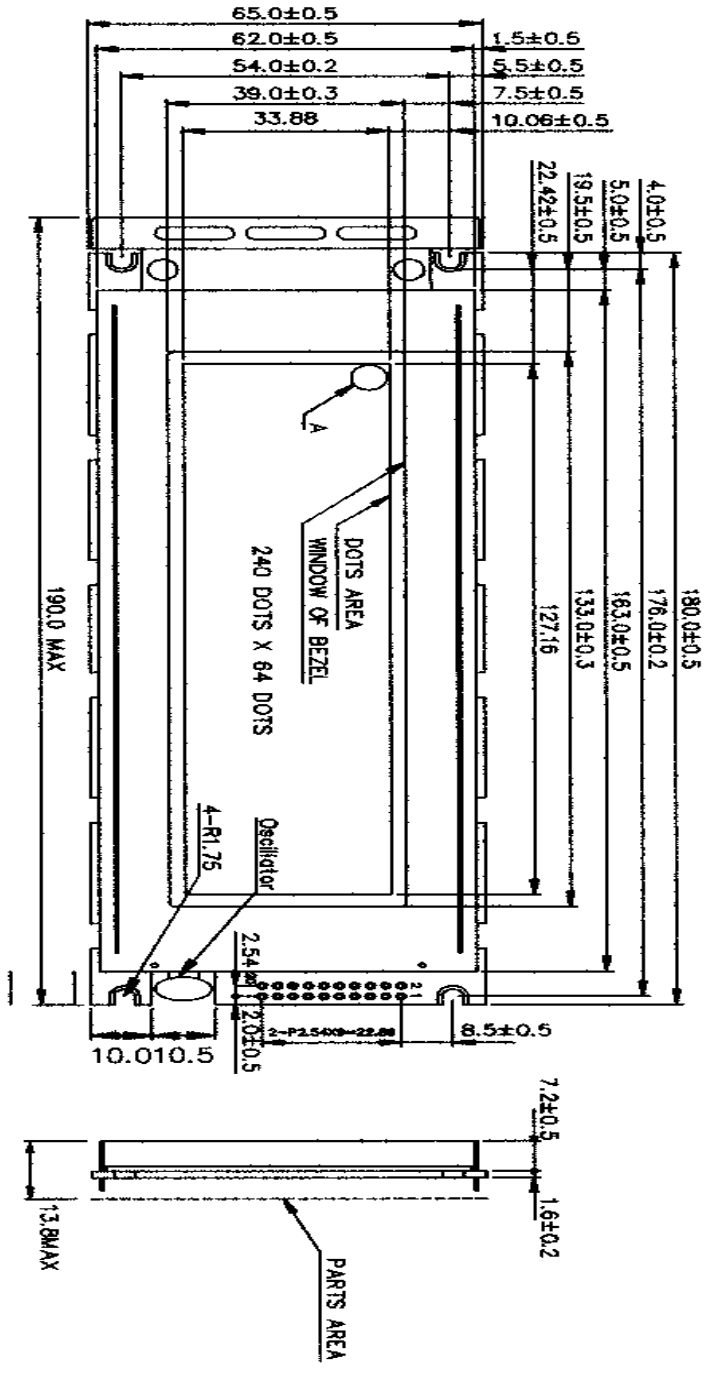
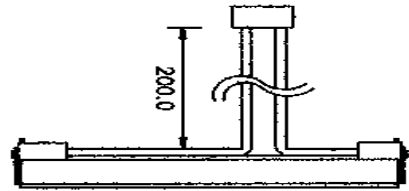


A DETAIL

PIN NO.	1	2	3	4	5	6	7	8	9	10
SYMBOL	FGND	VSS	VDD	VEE	WR	RD	CE	C/D	A	RESET
PIN NO.	11	12	13	14	15	16	17	18	19	20
SYMBOL	D0	D1	D2	D3	D4	D5	D6	D7	FS	K

NOTES:

1. Resolution: 240 x 64 Dots
2. Controller: Built-in
3. DC/DC Converter: Without



PN NO.	1	2	3	4	5	6	7	8	9	10
SYMBOL	FGND	VSS	VDD	VEE	WR	RD	CE	C/D	A	RESET
PN NO.	11	12	13	14	15	16	17	18	19	20
SYMBOL	D0	D1	D2	D3	D4	D5	D6	D7	FS	K

- NOTES:
1. Resolution : 240 x 64 Dots
  2. Controller : T6963C(Compatible)
  3. DC/DC Converter : Without
  4. Bezel Material : SPCC
  5. General Tolerance : ±0.5 mm

Q.A.: JK	REV.: 1.2	TEG16991	SHEET 22 OF 22
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