



**SPECIFICATION**

**FOR**

**LCM MODULE**

**ORDER NO : D22-5003-03**

**MODULE NO.: D22-5003-W-G-LED03-YG**

**DOC.REVISION A00**

**Customer Approval:**

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	NAME	SIGNATURE	DATE
PREPARED BY	KOWK SHING FU		23 SEP 2003
CHECKED BY	FU SZE HOI		23 SEP 2003
APPROVED BY	FU SZE HOI		23 SEP 2003



**DOCUMENT REVISION HISTORY**

<b>Version</b>	<b>DATE</b>	<b>DESCRIPTION</b>	<b>CHANGED BY</b>
A00	23 SEP 2003	Firs Issue	

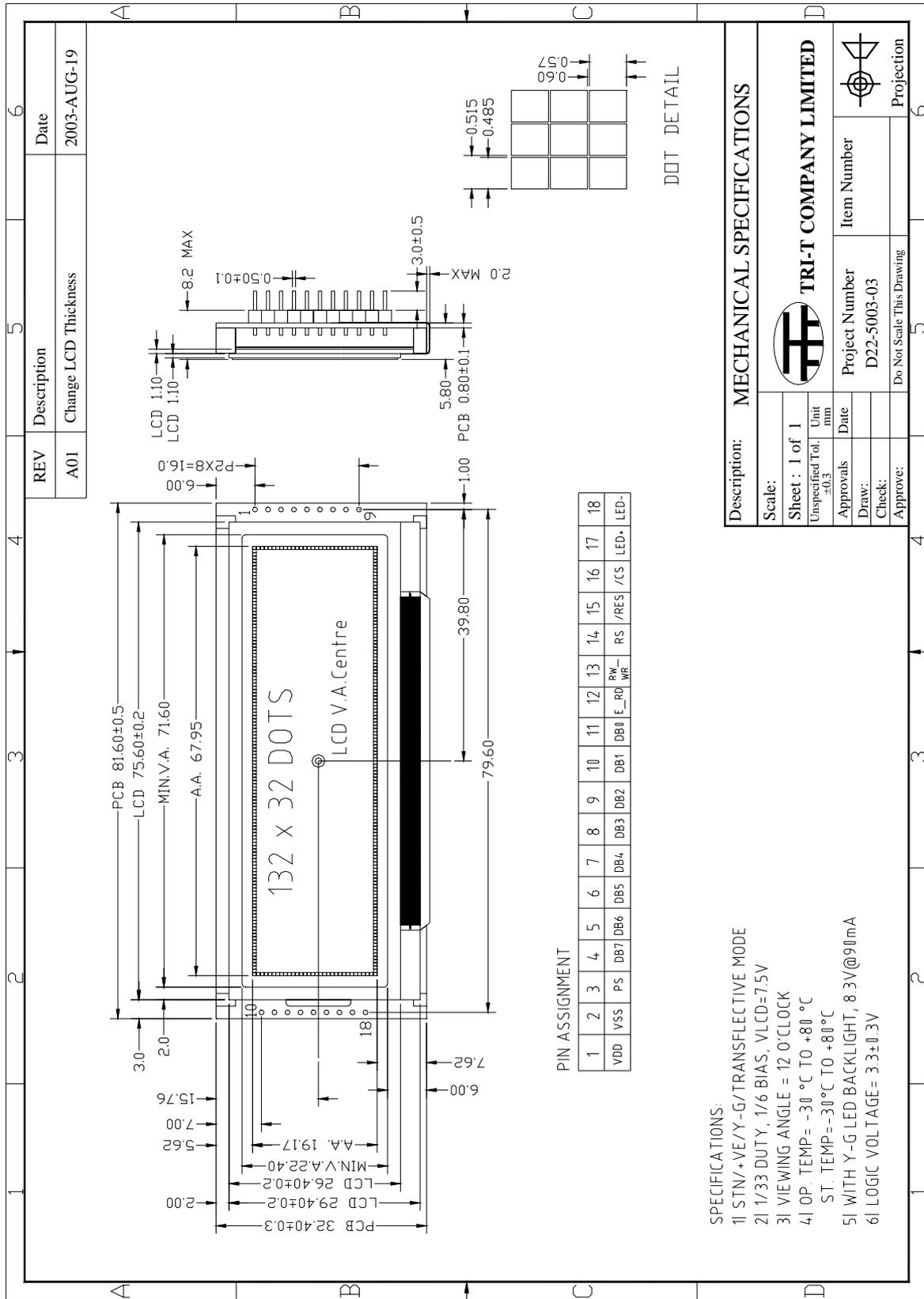


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# 1. DIMENSIONAL OUTLINE





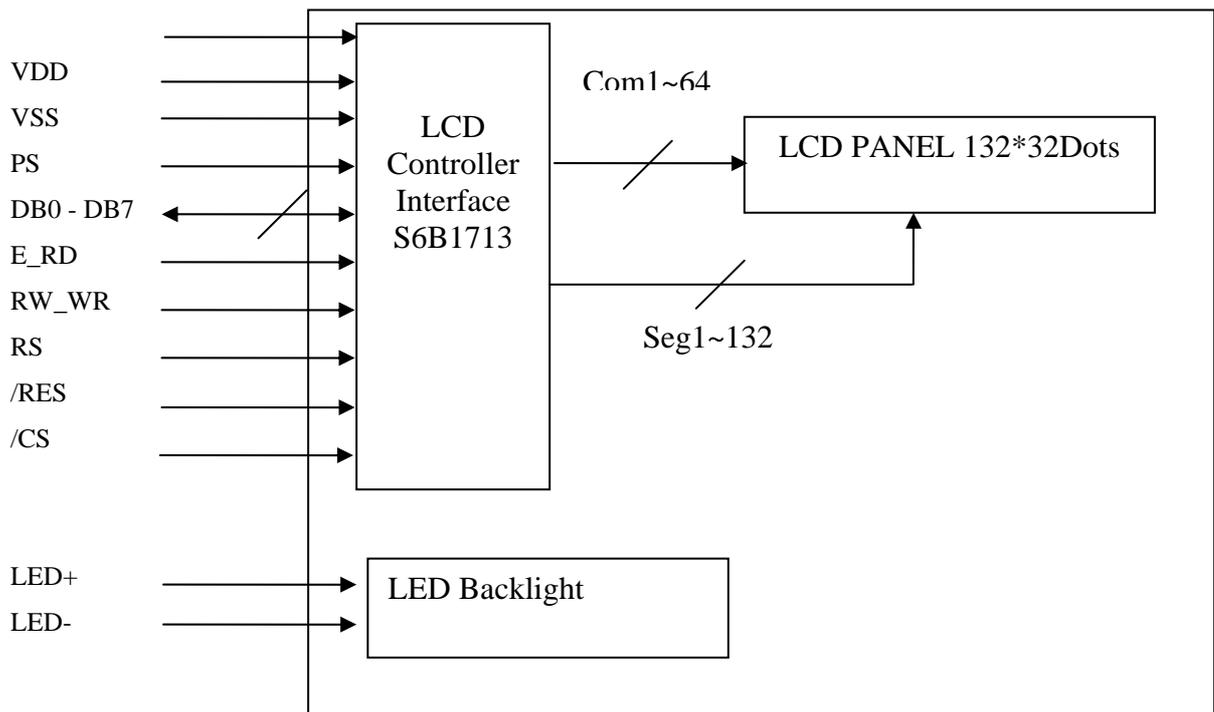
## 2.FUNCTIONS & FEATURES

- 2-1. Format : 132\*32dots
- 2-2. LCD Mode : STN, Positive, Y-G, Transflective Mode
- 2-3. Viewing Direction : 12 o'clock
- 2-4. Driving Scheme : 1/33 Duty cycle, 1/6 Bias
- 2-5. Single Supply Voltage : Power supply voltage range ( $V_{DD}$ ): 2.4~3.6V
- 2-6. Low current sleep mode
- 2-7. 64 level of Internal Contrast Control and External Contrast Control
- 2-8. 8-bit 68/80-series Parallel or Serial Interface
- 2-9. Vertical Scrolling, Display offset control and RAM Page blinking
- 2-10. On-chip DC-DC Converter

## 3.MECHANICAL SPECIFICATIONS

- 3-1. Module size : 81.60.0mm(L) x 32.40mm(W) x 8.2 mm (D)
- 3-2. Viewing area : 71.60mm(L) x 22.40mm(W)
- 3-3. Dot pitch : 0.515mm(L) x 0.60mm(W)
- 3-4. Dot size : 0.485mm(L) x 0.57mm(W)

## 4.BLOCK DIAGRAM





## **5. PIN DESCRIPTION**

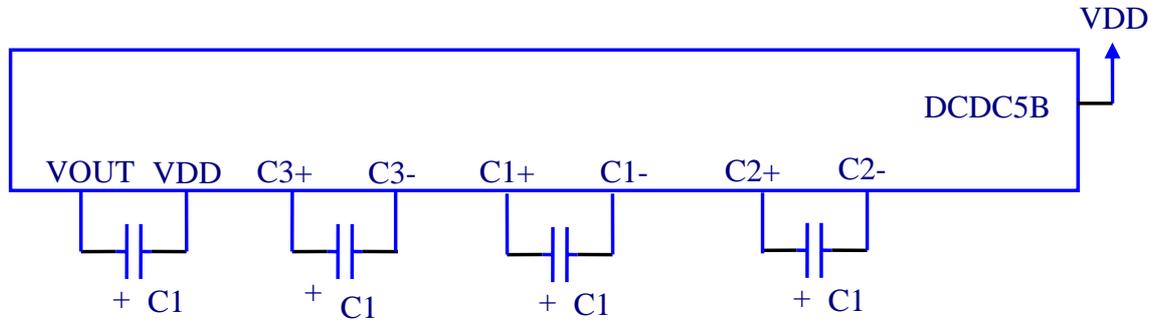
<b>Pin no.</b>	<b>Symbol</b>	<b>Function</b>
1	VDD	Positive power supply
2	VSS	Ground (0V)
3	PS	Parallel/Serial data input select pin PS='H': Parallel; PS='L': Serial When in serial mode, it is impossible to read the on-chip RAM. DB0 to DB5 are in high impedance, RW_WR and E_RD must be connected to 'H' or 'L'.
4	DB7/SID	8-bit bi-directional data bus. When in serial interface (PS='L') -DB0 to DB5 : high impedance. -DB6 : serial input clock (SCLK) -DB7: serial input data (SID) when chip select is not active, DB0 to DB7 maybe in high impedance.
5	DB6/SCLK	
6	DB5	
7	DB4	
8	DB3	
9	DB2	
10	DB1	
11	DB0	
12	E_RD	Read/Write execution control pin
		8080 series      /RD      Read enable clock input pin. When /RD='L': data on DB0 to DB7 are in an output status.
13	RW_WR	Read/Write execution control pin
		8080 series      /WR      Write enable clock input pin. The data on DB0 to DB7 are latched at the rising edge of the /WR signal
14	RS	Register select input pin. RS='H': DB0~DB7 are display data RS='L': DB0~DB7 are control data
15	/RES	Reset input pin
16	/CS	Chip select input pin, device active when /CS=low
17	LED+	LED backlight anode input pin
18	LED-	LED backlight cathode input pin



## 6. POWER SUPPLY

### 6-1. On Board DC-DC Voltage Converter

The built in DC-DC voltage converter is used to generate large positive LCD driving voltage with reference to  $V_{SS}$  from the voltage input ( $V_{DD}$ ). For Module, it is possible to produce 4X boosting from the potential different between  $V_{DD}$ .  $V_{SS}$



4X Boosting Configuration

Remarks:

1.  $C1 = 0.47 \sim 1.0\mu F$
2. Boosting input from  $V_{DD}$
3. All voltage are referenced to  $V_{SS}$

### 6-2. Contrast Control (Voltages referenced to $V_{DD}$ )

Software control of the 64-contrast voltage levels at each voltage regulator feedback gain. The equation of calculating the LCD driving voltage is given as:

$$V_0 = \left(1 + \frac{R_b}{R_a}\right) \times V_{EV}$$

$$V_{EV} = \left(1 - \frac{(63-\alpha)}{300}\right) \times 2.0$$

Where  $\alpha=0,1,2,\dots,63$  and

Internal $R_b/R_a$ ratio setting	000	001	010	011	100	101	110	111
$1 + R_b/R_a$	1.90	2.19	2.55	3.02	3.61	4.35	5.29	6.48



## 7. MAXIMUM ABSOLUTE LIMIT (T=25°C)

Item	Symbol	Standard value	Unit
Power supply voltage for logic	V <sub>DD</sub>	-0.3~+4.0	V
	V <sub>LCD</sub>	-0.3 to 17.0	
Input voltage	V <sub>IN</sub>	V <sub>SS</sub> -0.3~V <sub>DD</sub> +0.3	V
Operating temperature	T <sub>opr</sub>	-30~+80	°C
Storage temperature	T <sub>stg</sub>	-30~+80	°C

Note: Voltage greater than above may damage the module

## 8. ELECTRICAL CHARACTERISTICS

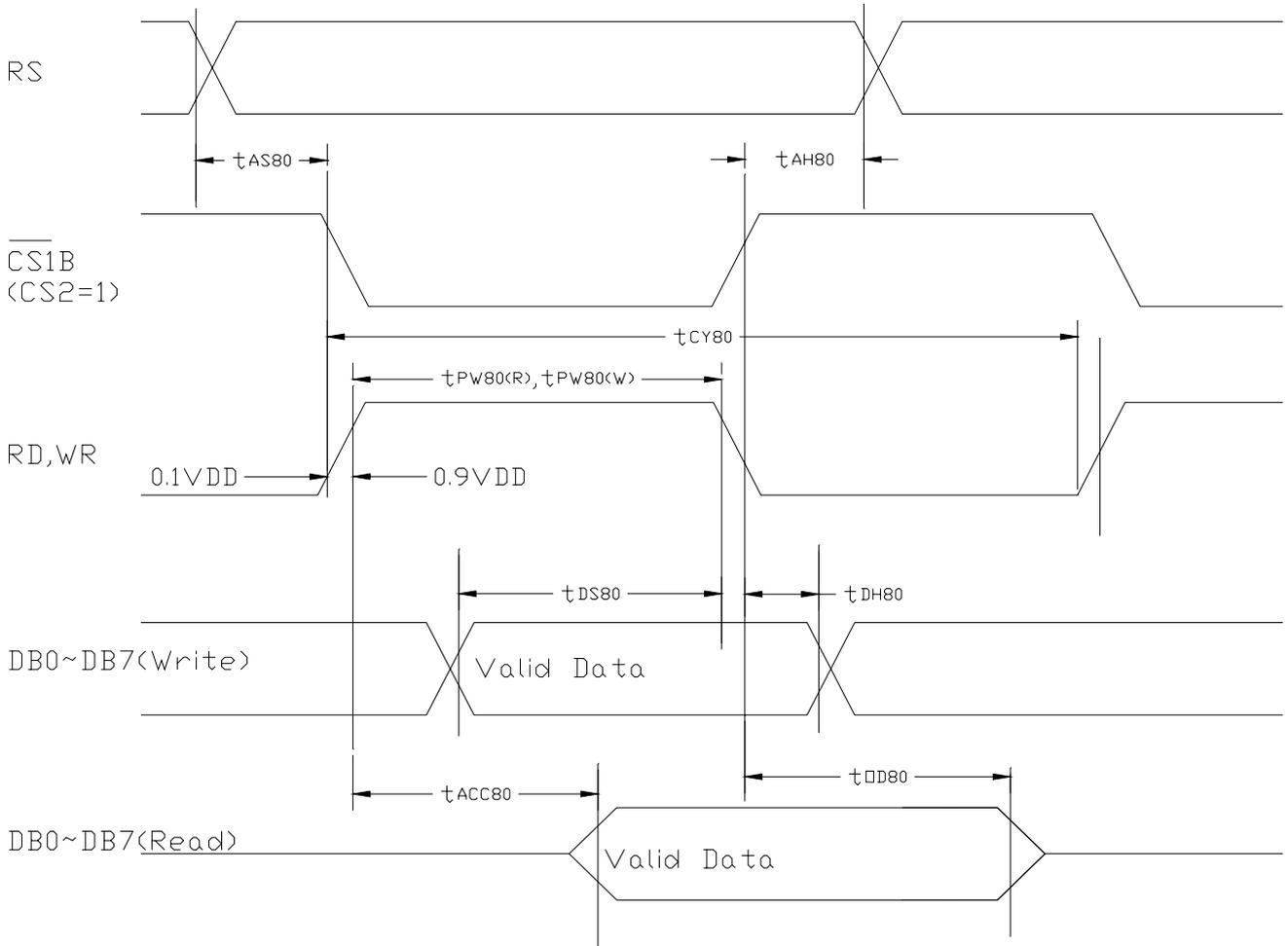
### 8-1. DC Characteristics (V<sub>DD</sub>=2.4~3.6, T<sub>a</sub>=-40~+85°C)

Symbol	Parameter	Min	Typ	Max	Unit	Test condition
V <sub>DD</sub>	Logic Circuit supply voltage	2.3	3.3	3.6	V	Recommend operating voltage
I <sub>DD</sub>	Dynamic current consumption	200	300	500	uA	
I <sub>DD</sub> S1	Sleep mode current	-	-	2	uA	During sleep mode
I <sub>DD</sub> S2	Standby mode current	-	-	10	uA	During standby mode
V <sub>IH</sub>	Logic high input voltage	0.8V <sub>DD</sub>	-	V <sub>DD</sub>	V	
V <sub>IL</sub>	Logic low input voltage	V <sub>SS</sub>	-	0.2V <sub>DD</sub>	V	
V <sub>OH</sub>	Logic high output voltage	0.8V <sub>DD</sub>	-	V <sub>DD</sub>	V	I <sub>OH</sub> =-0.5mA
V <sub>OL</sub>	Logic low output voltage	V <sub>SS</sub>	-	0.2V <sub>DD</sub>	V	I <sub>OL</sub> =0.5mA
I <sub>IL</sub>	Input leakage current	-1		1	uA	V <sub>IN</sub> = V <sub>DD</sub> or V <sub>SS</sub>
I <sub>OZ</sub>	Output leakage current	-3		3	uA	V <sub>IN</sub> = V <sub>DD</sub> or V <sub>SS</sub>
V <sub>DD</sub>	Voltage converter input voltage	2.4	-	3.6	V	4 times boosting
V <sub>OUT</sub>	Voltage converter output voltage	95	99	-	%	4 times boosting, no load
V <sub>OUT</sub>	Voltage regulator output voltage	4	-	15	V	
V <sub>O</sub>	Voltage follower operating voltage	4	-	15	V	
V <sub>REF</sub>	Reference voltage	1.94	2.0	2.04-	V	T <sub>a</sub> =25°C
V <sub>LCD</sub>	LCD driving voltage	7.2	7.5	7.8	V	V <sub>LCD</sub> =V <sub>O</sub> -V <sub>DD</sub> , T <sub>a</sub> =25°C



8-2-1. Parallel Read/Write Characteristics (8080-series)

Characteristic	Signal	Symbol	Min	Typ	Max	Unit
Address setup time	RS	$T_{AS80}$	13	-	-	ns
Address hold time		$T_{AH80}$	17	-	-	
System cycle time		$T_{CY80}$	400	-	-	
Pulse width (WR)	RW_WR	$T_{PW80(W)}$	55	-	-	
Pulse width (RD)	E_RD	$T_{PW80(R)}$	125	-	-	
Data setup time	DB0 to DB7	$T_{DS80}$	35	-	-	
Data hold time		$T_{DH80}$	15	-	-	
Read access time		$T_{ACC80}$	-	-	125	
Output disable time		$T_{OD80}$	10	-	90	





## **9.BACKLIGHT SPECIFICATIONS**

### **9-1.Absolute maximum rating**

<b>Item</b>	<b>Symbol</b>	<b>Ratings</b>	<b>Unit</b>
Peak forward current	Ifp	60	mA
Reverse voltage	Vr	5	V
Power dissipation	Pd	600	mW

### **9-2.Electrical specifications**

<b>Item</b>	<b>Symbol</b>	<b>Min</b>	<b>Type</b>	<b>Max</b>	<b>Unit</b>	<b>Conditions</b>
Luminous intensity	Lv	30	-	-	cd/m <sup>2</sup>	IF=45mA Ta=25°C
Peak emission wavelength	$\lambda_p$	-	572	-	$\eta$ m	
Spectral line half width	$\Delta\lambda$	-	30	-	$\eta$ m	
Forward voltage	Vf	8.0	8.3	8.5	V	
Reverse current	Ir	-	-	100	$\mu$ A	VR=5V



## 10. CONTROL AND DISPLAY COMMAND

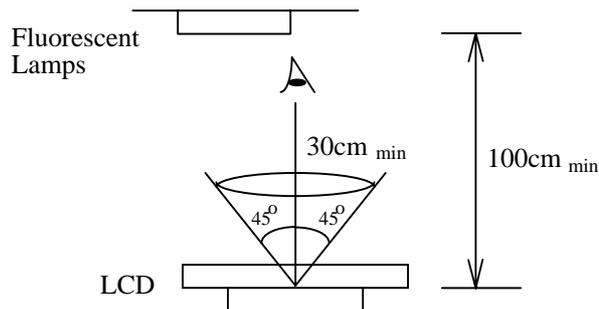
Write Command (RS=0, R/W=0)	Bit Pattern								Comment
	D7	D6	D5	D4	D3	D2	D1	D0	
Display On/Off	1	0	1	0	1	1	1	DON	DON=0: turns off LCD panel DON=1: turns on LCD panel
Initial display line	0	1	ST5	ST4	ST3	ST2	ST1	ST0	Specify DDRAM line for COM1; From 0-63.
Set reference voltage mode	1	0	0	0	0	0	0	1	Set reference voltage mode
Set reference voltage register	*	*	SV5	SV4	SV3	SV2	SV1	SV0	Set reference voltage register
Set page address	1	0	1	1	P3	P2	P1	P0	Set page Address (0-8) using P0 to P3
Set column address (MSB)	0	0	0	1	Y7	Y6	Y5	Y4	Set column address MSB
Set column address (LSB)	0	0	0	0	Y3	Y2	Y1	Y0	Set column address LSB
ADC Select	1	0	1	0	0	0	0	ADC	Select segment output direction: When ADC=0 : normal direction (SEG1 → SEG132) When ADC=1: reverse direction (SEG132→SEG1)
Reverse display ON/OFF	1	0	1	0	0	1	1	REV	REV=0: normal display REV=1: reverse display
Entire Display ON/OFF	1	0	1	0	0	1	0	EON	EON=0: normal display EON=1: entire display ON
LCD bias select	1	0	1	0	0	0	1	BIAS	BIAS=0: Select 1/7 bias BIAS=1: Select 1/9 bias
Set modify-read	1	1	1	0	0	0	0	0	Set modify-read mode
Reset modify-read	1	1	1	0	1	1	1	0	Reset modify-read mode
Reset	1	1	1	0	0	0	1	0	Initialize the internal functions
SHL	1	1	0	0	SHL	*	*	*	Select COM output direction When SHL=0 : normal direction (COM1 → COM64) When SHL=1: reverse direction (COM64→COM1)
Power control	0	0	1	0	1	VC	VR	VF	Control power circuit operation VF=0: internal voltage follower OFF VF=1: internal voltage follower ON VR=0: internal voltage regulator OFF VR=1: internal voltage regulator ON VC=0: internal voltage converter OFF VC=1: internal voltage converter ON
Regulator resistor select	0	0	1	0	0	R2	R1	R0	Select internal resistance ratio of the regulator resistor
Set static indicator mode	1	0	1	0	1	1	0	SM	Set static indicator mode SM=0: static indicator OFF SM=1: static indicator ON
Set static indicator register	*	*	*	*	*	*	S1	S0	Set static indicator register S1=0;S0=0: OFF S1=0;S0=1: ON (about 1 second blinking) S1=1;S0=0: ON (about 0.5 second blinking) S1=1;S0=1: ON (always ON)
Test instruction	1	1	1	1	*	*	*	*	<b>Don't use this instruction</b>
Power Save Mode	*	*	*	*	*	*	*	*	Standby or sleep mode will be entered with compound commands



## 11. Quality Specifications

### 11.1 Inspection Condition

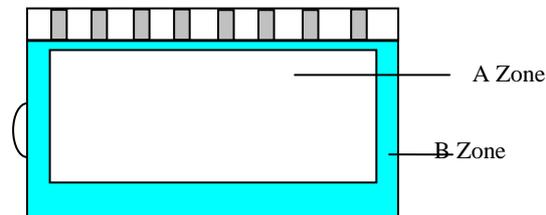
11.1.1 The inspection shall be performed by using 20W x 2 fluorescent lamps . Distance between LCD and fluorescent lamps should be 100 cm or more. Distance between LCD and inspector eyes should be 30 cm or more.



11.1.2 For transmissive displays a reflector (e.g. a white card) shall be placed behind the display.

11.1.3 Viewing direction for inspection is 45° from vertical against LCD.

### 11.2. Definition of Zone



A Zone: Active display area (minimum viewing area).

B Zone: Non-active display area (outside viewing area).



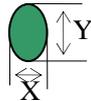
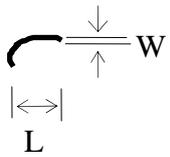
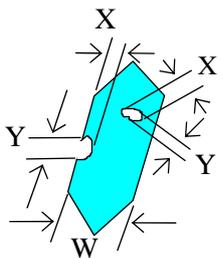
**11.3 Sampling Method: MIL-STD-105E.**

**11.4 Inspection level: Level II, Single Sampling.**

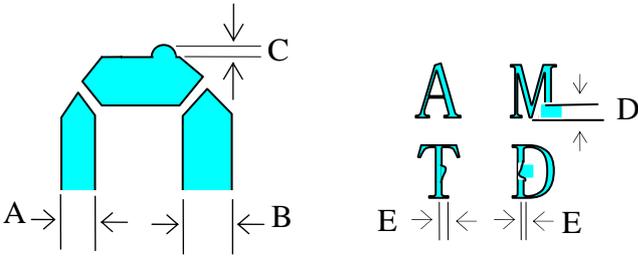
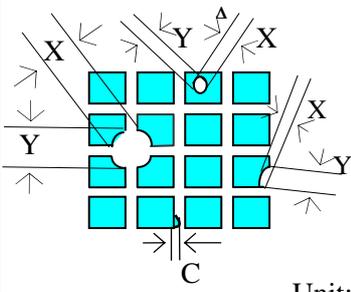
Rank	Item		Criterion	AQL
Major	1. Display state	1. Segment short circuit.	1	0.4
		2. Open circuit (missing segment)		
		3. Contrast defect (dim, ghosting)		
		4. Segment defect (Pin hole, etc.)	6	
	5. Leakage	/	Ac:0 Re: 1	
6. No display, polarizers reverse applied				
	2. Dimension	1. Dimension out of specification (incl. PIN)	2	0.4
Minor	1. Non-display state	1. Spot, foreign material, line defect	3, 4, 5	1.0
		2. Rainbow, background color		
	2. Polarizer	1. Scratch	3, 4, 7	
		2. Bubble		
		3. Foreign material	8	
	3. Glass substrate	1. Chipped	9	
		2. Protruded, burred	10	
	4. PIN	1. Positioning	11	
		2. Epoxy coverage		
	5. Silk screen	1. Positioning	12	
2. Color				
	3. Semblance defect (Refer spot, line Standards)	3, 4		
Total				1.0



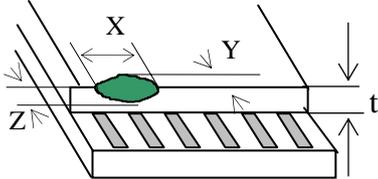
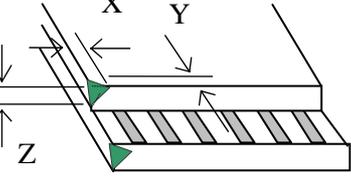
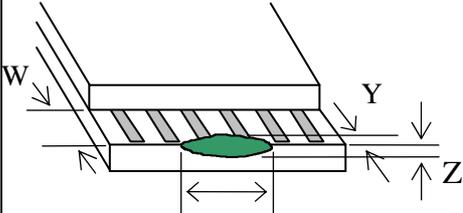
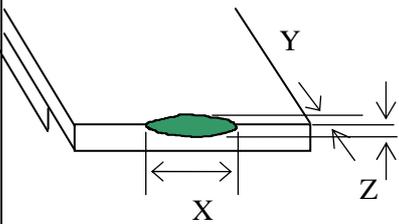
11.5 Inspection Items and Standards

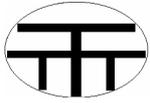
No	Item	Criterion																				
1	Segment short, missing	Not exist																				
	Contrast defect	Refer to approved sample																				
2	Outside defect、 Positioning Color	Not exceed tolerance Refer to approved sample																				
3	Point defect, Black spot, dust (incl. Polarizer)  $\phi = (X+Y)/2$	 <table border="1"> <thead> <tr> <th>Point Size</th> <th>Acceptable Qty.</th> </tr> </thead> <tbody> <tr> <td><math>\phi \leq 0.10</math></td> <td>2</td> </tr> <tr> <td><math>0.10 &lt; \phi \leq 0.20</math></td> <td>1</td> </tr> <tr> <td><math>0.20 &lt; \phi \leq 0.25</math></td> <td>0</td> </tr> <tr> <td><math>0.25 &lt; \phi \leq 0.30</math></td> <td>0</td> </tr> <tr> <td><math>\phi &gt; 0.30</math></td> <td>0</td> </tr> </tbody> </table> <p>Unit: mm</p>	Point Size	Acceptable Qty.	$\phi \leq 0.10$	2	$0.10 < \phi \leq 0.20$	1	$0.20 < \phi \leq 0.25$	0	$0.25 < \phi \leq 0.30$	0	$\phi > 0.30$	0								
Point Size	Acceptable Qty.																					
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$0.25 < \phi \leq 0.30$	0																					
$\phi > 0.30$	0																					
4	Line defect	 <table border="1"> <thead> <tr> <th colspan="2">Line</th> <th>Acceptable Qty.</th> </tr> <tr> <th>L</th> <th>W</th> <th></th> </tr> </thead> <tbody> <tr> <td>---</td> <td><math>0.015 \geq W</math></td> <td>Disregard</td> </tr> <tr> <td><math>3.0 \geq L</math></td> <td><math>0.03 \geq W</math></td> <td rowspan="2">1</td> </tr> <tr> <td><math>2.0 \geq L</math></td> <td><math>0.05 \geq W</math></td> </tr> <tr> <td><math>1.0 \geq L</math></td> <td><math>0.1 &gt; W</math></td> <td>0</td> </tr> <tr> <td>---</td> <td><math>0.05 &lt; W</math></td> <td>Applied as point defect</td> </tr> </tbody> </table> <p>Unit: mm</p>	Line		Acceptable Qty.	L	W		---	$0.015 \geq W$	Disregard	$3.0 \geq L$	$0.03 \geq W$	1	$2.0 \geq L$	$0.05 \geq W$	$1.0 \geq L$	$0.1 > W$	0	---	$0.05 < W$	Applied as point defect
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$1.0 \geq L$	$0.1 > W$	0																				
---	$0.05 < W$	Applied as point defect																				
5	Rainbow	Not more than two color changes across the viewing area. Background color should refer to approved sample .																				
6	Segment pattern W = Segment width  $\phi = (A+B)/2$	<p>1. Pin hole <math>\phi &lt; 0.10\text{mm}</math> is acceptable.</p>  <table border="1"> <thead> <tr> <th>Width</th> <th>Acceptable of defect</th> </tr> </thead> <tbody> <tr> <td><math>W &lt; 0.4</math></td> <td><math>\phi \leq 1/2W</math> and, <math>\phi \leq 0.2</math></td> </tr> <tr> <td><math>W \geq 0.4</math></td> <td><math>\phi \leq 1/3W</math> and, <math>\phi \leq 0.25</math></td> </tr> </tbody> </table> <p>Unit: mm</p>	Width	Acceptable of defect	$W < 0.4$	$\phi \leq 1/2W$ and, $\phi \leq 0.2$	$W \geq 0.4$	$\phi \leq 1/3W$ and, $\phi \leq 0.25$														
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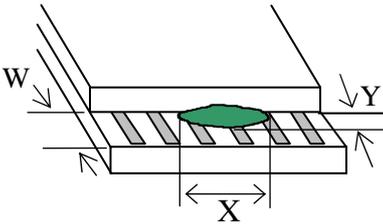
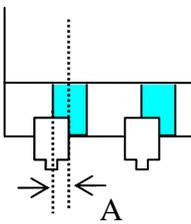
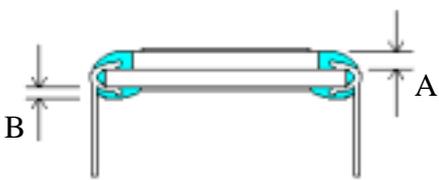


		<p>2. Segment width acceptable.</p> $ A - B  < 0.20 ; \quad D \leq 0.2$ $C \leq 0.1 \quad E \leq 0.15$  <p>3. Dot pattern</p>  <table border="1"> <thead> <tr> <th>Size</th> <th>Acceptable Qty.</th> </tr> </thead> <tbody> <tr> <td><math>\phi &lt; 0.1</math></td> <td>Disregard</td> </tr> <tr> <td><math>0.10 \leq \phi \leq 0.20</math></td> <td>1</td> </tr> <tr> <td><math>\phi &gt; 0.20</math></td> <td>0</td> </tr> </tbody> </table> <p>C: Shall not touch other dot(s). Unit: mm</p>	Size	Acceptable Qty.	$\phi < 0.1$	Disregard	$0.10 \leq \phi \leq 0.20$	1	$\phi > 0.20$	0				
Size	Acceptable Qty.													
$\phi < 0.1$	Disregard													
$0.10 \leq \phi \leq 0.20$	1													
$\phi > 0.20$	0													
7	Polarizer air bubble	<table border="1"> <thead> <tr> <th>Size</th> <th>Acceptable Qty.</th> </tr> </thead> <tbody> <tr> <td><math>\phi &lt; 0.10</math> or B Zone</td> <td>Disregard</td> </tr> <tr> <td><math>0.10 &lt; \phi \leq 0.20</math></td> <td>2</td> </tr> <tr> <td><math>0.20 &lt; \phi \leq 0.50</math></td> <td>1</td> </tr> <tr> <td><math>0.50 &lt; \phi</math></td> <td>0</td> </tr> <tr> <td>Total</td> <td>2</td> </tr> </tbody> </table> <p>Unit: mm</p>	Size	Acceptable Qty.	$\phi < 0.10$ or B Zone	Disregard	$0.10 < \phi \leq 0.20$	2	$0.20 < \phi \leq 0.50$	1	$0.50 < \phi$	0	Total	2
Size	Acceptable Qty.													
$\phi < 0.10$ or B Zone	Disregard													
$0.10 < \phi \leq 0.20$	2													
$0.20 < \phi \leq 0.50$	1													
$0.50 < \phi$	0													
Total	2													
8	Polarizer mis-placement	Polarizer should neither extends to glass edge nor extends into seal.												



No	Item	Criterion																								
9	<p>Crack and chip</p> <p>Remark:</p> <p>X: Length direction</p> <p>Y: Short direction</p> <p>Z: Thickness direction</p> <p>t: Glass thickness</p> <p>a: LCD length</p> <p>W: Terminal Width</p> <p>F: seal width</p>	<p>1. General</p>  <table border="1"> <caption>Acceptable criterion</caption> <thead> <tr> <th>X</th> <th>Y</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td><math>\leq 5\text{mm}</math></td> <td>shall not reach to <math>1F/3</math></td> <td><math>\leq t/2</math></td> </tr> </tbody> </table> <p>2. Corner</p>  <table border="1"> <caption>Acceptable criterion</caption> <thead> <tr> <th>X</th> <th>Y</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td><math>\leq 5\text{mm}</math></td> <td>shall not reach to <math>F/3</math></td> <td><math>\leq t</math></td> </tr> </tbody> </table> <p>3. Crack on terminal</p>  <table border="1"> <caption>Acceptable criterion</caption> <thead> <tr> <th>X</th> <th>Y</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td><math>\leq a/10</math></td> <td><math>\leq 0.4</math></td> <td><math>\leq t</math></td> </tr> </tbody> </table> <p>4. Other than terminal</p>  <table border="1"> <caption>Acceptable criterion</caption> <thead> <tr> <th>X</th> <th>Y</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td><math>\leq a/10</math></td> <td>shall not reach to <math>F/3</math></td> <td><math>\leq t/3</math></td> </tr> </tbody> </table>	X	Y	Z	$\leq 5\text{mm}$	shall not reach to $1F/3$	$\leq t/2$	X	Y	Z	$\leq 5\text{mm}$	shall not reach to $F/3$	$\leq t$	X	Y	Z	$\leq a/10$	$\leq 0.4$	$\leq t$	X	Y	Z	$\leq a/10$	shall not reach to $F/3$	$\leq t/3$
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No	Item	Criterion
10	Protruded W: Terminal Width	 <p>Acceptable criteria:  <math>Y \leq 1/5W</math></p>
11	Pin	<p>1. Positioning</p>  <p><math>A &lt; 0.3\text{mm}</math></p> <p>2 Epoxy coverage</p>  <p>A、 B Epoxy Maximum height shall extend above front rear polarizer surface 委</p> <p>3. No stain, rust nor discoloration of the insulating portion shall be allowed.</p>
12	Total no. of acceptable defect	<p>A. Zone</p> <p>Maximum 4 non-conformities per one unit.</p> <p>Defect distance: each point to be separated over 5mm</p> <p>B. Zone</p> <p>It is acceptable when it is no trouble for quality and assembly in customer's end product.</p>



**11.6 Reliability Standards**

Reliability test condition:

Item	Condition	Time (hrs)	Assessment
High temp. Storage	80°C	240	No abnormalities in functions and appearance
High temp. Operating	80°C	240	
Low temp. Storage	-30°C	240	
Low temp. Operating	-3°C	240	
Humidity	40°C/ 90%RH	240	
Temp. Cycle	-30°C ← 25°C →80°C (30 min ← 5 min → 30min)	10cycles	

Recovery time should be 24 hours minimum. Moreover, functions, performance and appearance shall be free from remarkable deterioration within 50,000 hours under ordinary operating and storage conditions room temperature (20±8°C), normal humidity (below 65% RH), and in the area not exposed to direct sun light.



### **11-7. Precaution for using LCM**

LCM is assembled and adjusted with a high degree of precision. Do not attempt to make any alteration or modification. The followings should be noted.

#### **General Precautions:**

1. LCD panel is made of glass. Avoid excessive mechanical shock or applying strong pressure onto the surface of display area.
2. The polarizer used on the display surface is easily scratched and damaged. Extreme care should be taken when handling. To clean dust or dirt off the display surface, wipe gently with cotton, or other soft material soaked with isopropyl alcohol, ethyl alcohol or trichlorotrifluoroethane, do not use water, ketone or aromatics and never scrub hard.
3. Do not tamper in any way with the tabs on the metal frame.
4. Do not make any modification on the PCB without consulting TRI-T.
5. When mounting a LCM, make sure that the PCB is not under any stress such as bending or twisting. Elastomer contacts are very delicate and missing pixels could result from slight dislocation of any of the elements.
6. Avoid pressing on the metal bezel, otherwise the elastomer connector could be deformed and lose contact, resulting in missing pixels and also cause rainbow on the display.
7. Be careful not to touch or swallow liquid crystal that might leak from a damaged cell. Any liquid crystal adheres to skin or clothes, wash it off immediately with soap and water.

#### **Static Electricity Precautions:**

1. CMOS-LSI is used for the module circuit; therefore operators should be grounded whenever he/she comes into contact with the module.
2. Do not touch any of the conductive parts such as the LSI pads; the copper leads on the PCB and the interface terminals with any parts of the human body.
3. Do not touch the connection terminals of the display with bare hand; it will cause disconnection or defective insulation of terminals.
4. The modules should be kept in anti-static bags or other containers resistant to static for storage.
5. Only properly grounded soldering irons should be used.
6. If an electric screwdriver is used, it should be grounded and shielded to prevent sparks.
7. The normal static prevention measures should be observed for work clothes and working benches.
8. Since dry air is inductive to static, a relative humidity of 50-60% is recommended.

#### **Soldering Precautions:**

1. Soldering should be performed only on the I/O terminals.
2. Use soldering irons with proper grounding and no leakage.
3. Soldering temperature:  $280^{\circ}\text{C} \pm 10^{\circ}\text{C}$
4. Soldering time: 3 to 4 second.
5. Use eutectic solder with resin flux filling.
6. If flux is used, the LCD surface should be protected to avoid spattering flux.
7. Flux residue should be removed.



**Operation Precautions:**

1. The viewing angle can be adjusted by varying the LCD driving voltage  $V_o$ .
2. Since applied DC voltage causes electro-chemical reactions, which deteriorate the display, the applied pulse waveform should be a symmetric waveform such that no DC component remains. Be sure to use the specified operating voltage.
3. Driving voltage should be kept within specified range; excess voltage will shorten display life.
4. Response time increases with decrease in temperature.
5. Display color may be affected at temperatures above its operational range.
6. Keep the temperature within the specified range usage and storage. Excessive temperature and humidity could cause polarization degradation, polarizer peel-off or generate bubbles.
7. For long-term storage over 40°C is required, the relative humidity should be kept below 60%. Avoid direct sunlight.

**Limited Warranty**

TRI-T modules are not consumer products, but may be incorporated by TRI-T's customers into consumer products or components thereof, TRI-T does not warrant that its modules and components are fit for any such particular purpose.

1. The liability of TRI-T is limited to repair or replacement on the terms set forth below. TRI-T will not be responsible for any subsequent or consequential events or injury or damage to any personnel or user including third party personnel and/or user. Unless otherwise agreed in writing between TRI-T and the customer, TRI-T will only replace or repair any of its LCD which is found defective electrically or visually when inspected in accordance with TRI-T QUALITY INSPECTION STANDARD.
2. No warranty can be granted if any of the precautions state in handling liquid crystal display above has been disregarded. Broken glass, scratches on polarizer mechanical damages as well as defects that are caused accelerated environment tests are excluded from warranty.
3. In returning the LCM, they must be properly packaged; there should be detailed description of the failures or defect.