

## LEADER TIME SRL

### PRODUCT SPECIFICATION

**160\*32 Graphic COB LCD MODULE**  
**MODEL: LT-16032E-201 Ver:1.1**

< ◇ > Finally Specification

CUSTOMER'S APPROVAL	
CUSTOMER :	
SIGNATURE:	DATE:

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- This specification is subject to change without notice. Please contact LT or its representative before designing your product based on this specification.

## Revision Status

[illegible]

## Table of Contents

No.	Contents	Page
1.	FEATURES .....	4
2.	MECHANICAL SPECIFICATIONS .....	4
3.	ELECTRICAL SPECIFICATIONS.....	4
4.	TERMINAL FUNCTIONS AND BLOCK DIAGRAM .....	6
5.	TIMING CHARACTERISTICS .....	7
6.	INSTRUCTION SET .....	8
7.	CHARACTER GENERATOR ROM. ....	11
8.	QUALITY SPECIFICATIONS .....	11
9.	RELIABILITY .....	16
10.	HANDLING PRECAUTION .....	17
11.	OUTLINE DIMENSION.....	18

# 1. FEATURES

The features of LCD are as follows

- \* Display mode : FSTN / Transflective/Positive
- \* Controller IC : ST7920 -0B & ST7921
- \* Interface Input Data : 6800 Parallel(8bit)
- \* Driving Method : 1/32Duty, 1/5Bias
- \* Viewing Direction : 6 O'clock
- \* Backlight : 3 LED/Side White
- \* Sample NO. : G1603A4FSW6B-B0\_01/20190117

# 2. MECHANICAL SPECIFICATIONS

Item	Specification	Unit
Module Size	122(W) x 44(H) x 13.5MAX(T)	mm
Viewing Area	99 (W) x 25 (H)	mm
Activity Area	94.36(W) x 19.16(H)	mm
Number of Dots	160 x 32 Dots	-
Dot Size	0.55(W) x 0.56(H)	mm
Dot Pitch	0.59(W) x 0.60(H)	mm

# 3. ELECTRICAL SPECIFICATIONS

## 3-1 ABSOLUTR MAZIMUM RATINGS (Ta = 25 °C)

Item	Symbol	Standard Value			Unit
		Min.	Typ.	Max.	
Supply Voltage For Logic	$V_{DD} - V_{SS}$	-0.3	-	5.5	V
Supply Voltage For LCD Drive	$V_{OP} = V_0 - V_{SS}$	-0.3	-	7	V
Input Voltage	$V_{in}$	-0.3	-	$V_{DD} + 0.3$	V
Operating Temp.	$T_{op}$	-20	-	+70	°C
Storage Temp.	$T_{st}$	-30	-	+80	°C

\*NOTE: The response time will be extremely slow when the operating temperature is around -20°C, and the back ground will become darker at high temperature operating.

### 3-2 ELECTRICAL CHARACTERISTICS

Item		Symbol	Test Condition	Min.	Typ.	Max.	Unit
Logic supply Voltage		$V_{DD} - V_{SS}$	$T_a = 25\text{ }^{\circ}\text{C}$ $V_{DD}=5.0\text{V} \pm 10\%$	-	5.0	-	V
LCD Drive		$V_{OP}=V_0-V_{SS}$		4.7	5.0	5.3	V
Input Voltage	“H” Level	$V_{IH}$		$0.7V_{DD}$	-	$V_{DD}$	V
	“L” Level	$V_{IL}$		0	-	$0.3 V_{DD}$	V
Frame Frequency		$f_{FLM}$		-	75	-	Hz
Current Consumption		$I_{DD}$		-	3.42	-	mA

### 3-3. BACKLIGHT

#### 3-3-1. Absolute Maximum Ratings

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Forward Current	IF	$T_a=25\text{ }^{\circ}\text{C}$	-	-	60	mA
Power Dissipation	PD		-	-	300	mW
Reverse Current	IR	$V_R=5\text{V}$	-	-	15	uA

#### 3-3-2. Electrical-optical Characteristics ( $T_a=25^{\circ}\text{C}$ )

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Forward Current	IF	$V_f=5\text{V}$ $T_a=25^{\circ}\text{C}$	-	45	-	mA
Luminance	$L_v$		-	120	-	cd/m <sup>2</sup>
Color Coordinate	X		0.25	0.28	0.32	-
	Y		0.25	0.28	0.32	

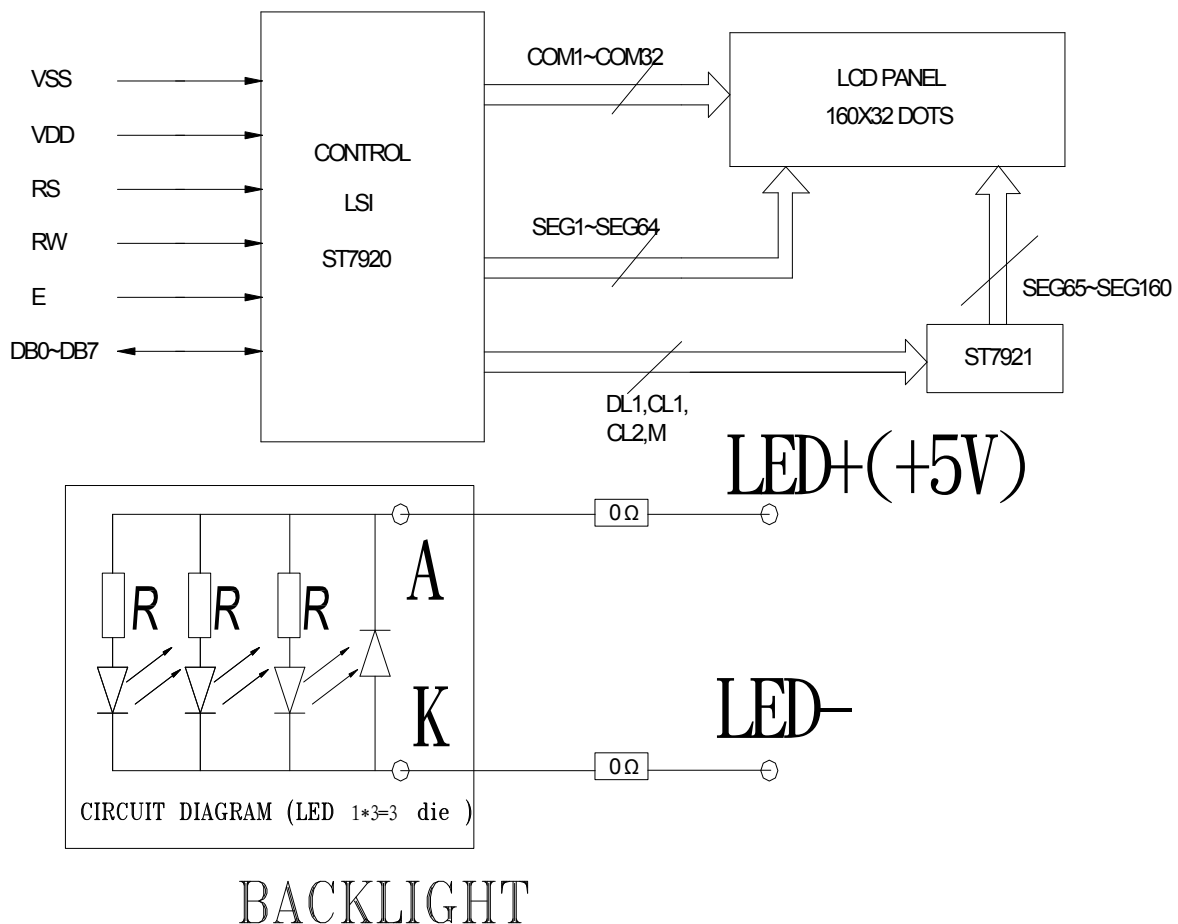
The brightness is measured without LCD panel.

## 4. TERMINAL FUNCTIONS AND BLOCK DIAGRAM

### 4-1. INTERFACE PIN FUNCTION DESCRIPTION

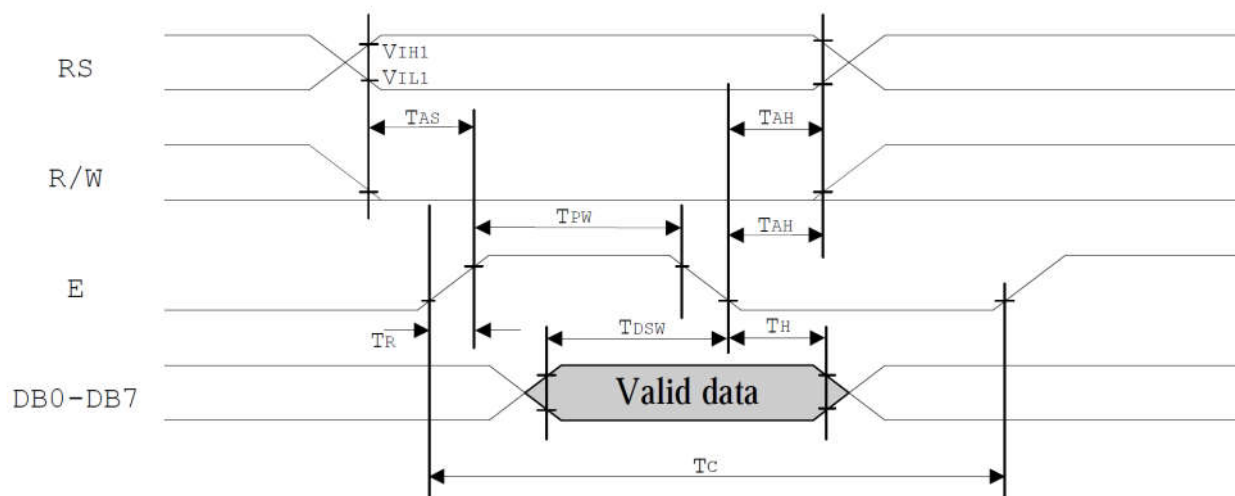
PIN NO.	SYMBOL	FUNCTIONS
1	VSS	Power Ground (0V).
2	VDD	Logic power supply voltage(+5.0V).
3	V0	No Connected
4	RS	Register select.
5	RW	Read/Write control
6	E	Enable trigger
7~10	DB0~DB3	Lower nibble data bus of 8-bit interface.
11~14	DB4~DB7	Higher nibble data bus of 8-bit interface
15	LED+	Backlight(+5V)
16	LED-	Backlight(-)

### 4-2. BLOCK DIAGRAM

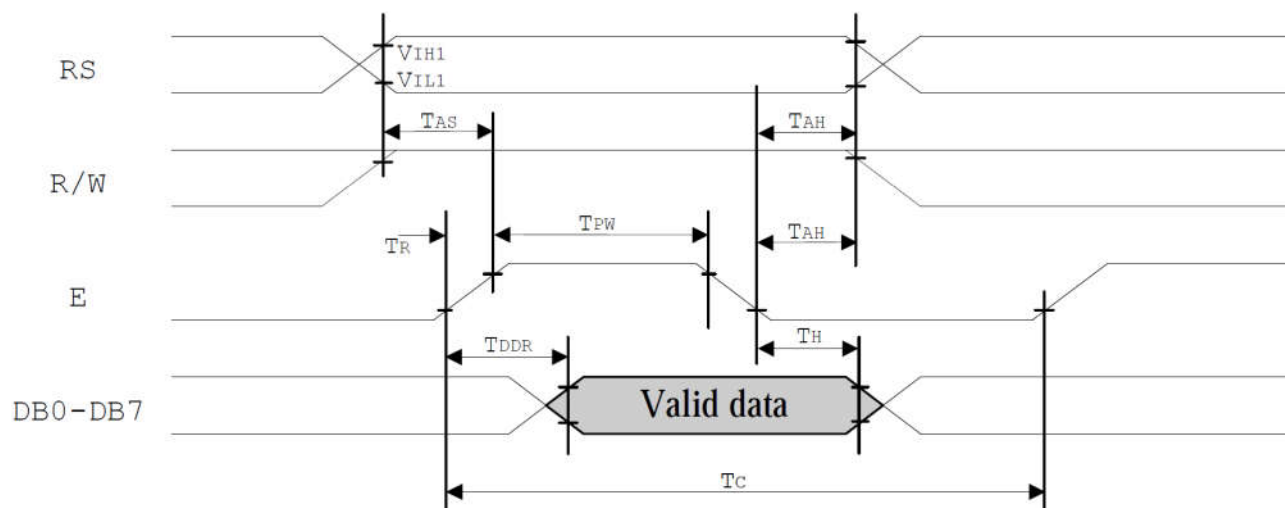


## 5. TIMING CHARACTERISTICS

### 5-1 Write data



### 5-2 Read data



## 6. INSTRUCTION SET

6-1 ST7920 offers basic instruction set and extended instruction set :

Instruction set 1: (RE=0: basic instruction)

Ins	code										Description	Exec time (540KHZ)
	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0		
CLEAR	0	0	0	0	0	0	0	0	0	1	Fill DDRAM with "20H", and set DDRAM address counter ( AC ) to "00H"	1.6 ms
HOME	0	0	0	0	0	0	0	0	1	X	Set DDRAM address counter ( AC ) to "00H", and put cursor to origin ; the content of DDRAM are not changed	72us
ENTRY MODE	0	0	0	0	0	0	0	1	I/D	S	Set cursor position and display shift when doing write or read operation	72us
DISPLAY ON/OFF	0	0	0	0	0	0	1	D	C	B	D=1: display ON C=1: cursor ON B=1: blink ON	72 us
CURSOR DISPLAY CONTROL	0	0	0	0	0	1	S/C	R/L	X	X	Cursor position and display shift control ; the content of DDRAM are not changed	72 us
FUNCTION SET	0	0	0	0	1	DL	X	0 RE	X	X	DL=1 8-BIT interface DL=0 4-BIT interface <u>RE=1: extended instruction</u> <u>RE=0: basic instruction</u>	72 us
SET CGRAM ADDR.	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0	Set CGRAM address to address counter ( AC ) <u>Make sure that in extended instruction SR=0 (scroll or RAM address select)</u>	72 us
SET DDRAM ADDR.	0	0	1	0 AC6	AC5	AC4	AC3	AC2	AC1	AC0	Set DDRAM address to address counter ( AC ) AC6 is fixed to 0	72 us
READ BUSY FLAG ( BF ) & ADDR.	0	1	BF	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Read busy flag ( BF ) for completion of internal operation, also Read out the value of address counter ( AC )	0 us
WRITE RAM	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Write data to internal RAM (DDRAM/CGRAM/IRAM/GDRAM)	72 us
READ RAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0	Read data from internal RAM (DDRAM/CGRAM/IRAM/GDRAM)	72 us



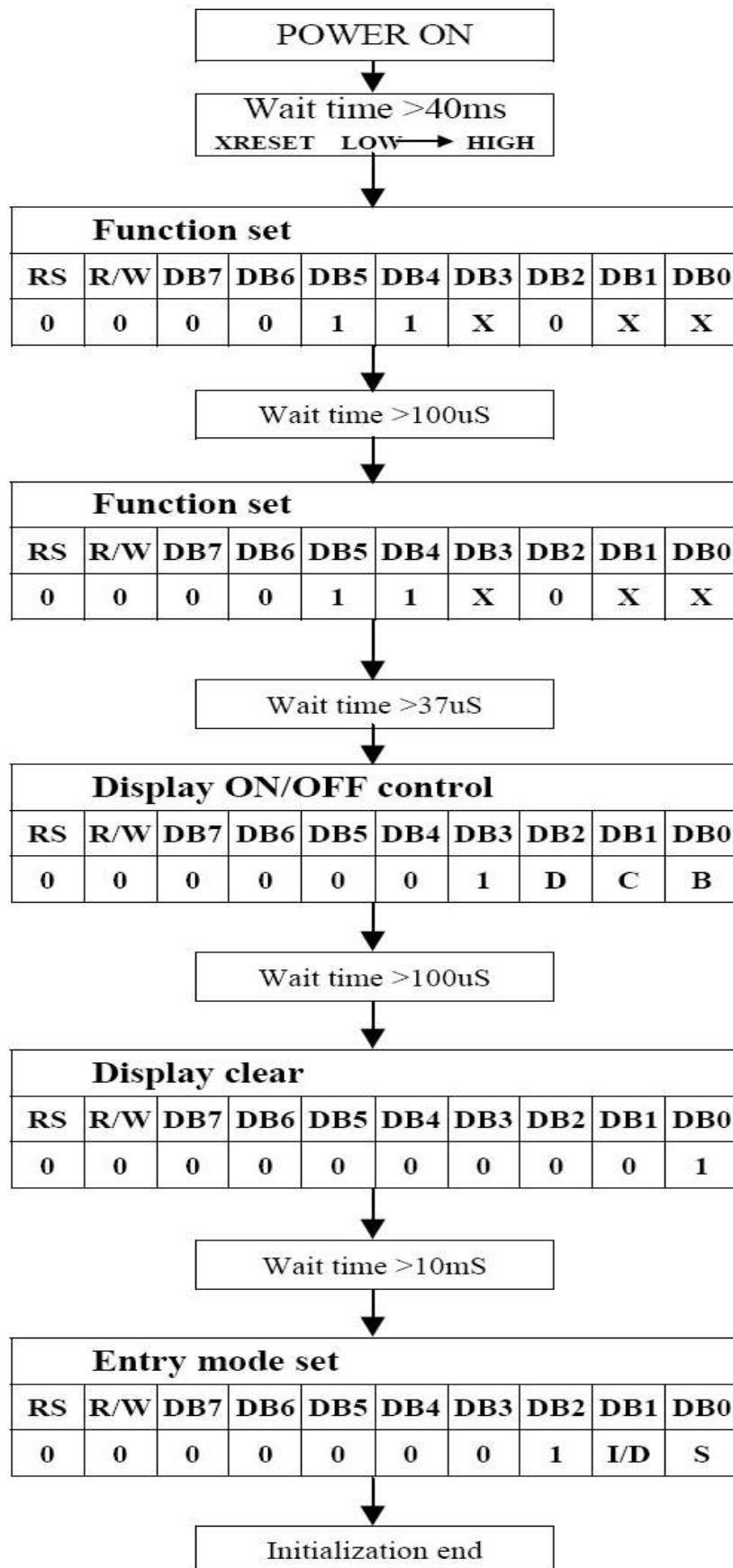
## Instruction set 2: (RE=1: extended instruction)

Inst.	code										description	Exec. time (540KHZ)
	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0		
STAND BY	0	0	0	0	0	0	0	0	0	1	Enter stand by mode, any other instruction can terminate (Com1...32 halted, only Com33 ICON can display)	72 us
SCROLL or RAM ADDR. SELECT	0	0	0	0	0	0	0	0	1	SR	SR=1: enable vertical scroll position SR=0: enable IRAM address ( <b>extended instruction</b> ) SR=0: enable CGRAM address( <b>basic instruction</b> )	72 us
REVERSE	0	0	0	0	0	0	0	1	R1	R0	Select 1 out of 4 line ( in DDRAM) and decide whether to reverse the display by toggling this instruction <b>R1,R0 initial value is 00</b>	72 us
SLEEP	0	0	0	0	0	0	1	SL	X	X	SL=1: leave sleep mode SL=0: enter sleep mode	72 us
EXTENDED FUNCTION SET	0	0	0	0	1	DL	X	1 RE	G	0	DL=1 8-BIT interface DL=0 4-BIT interface <b>RE=1: extended instruction set</b> <b>RE=0: basic instruction set</b> G=1 :graphic display ON G=0 :graphic display OFF	72 us
SET IRAM or SCROLL ADDR	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0	SR=1: AC5~AC0 the address of vertical scroll SR=0: AC3~AC0 the address of ICON RAM	72 us
SET GRAPHIC RAM ADDR.	0	0	1	0 AC6	0 AC5	0 AC4	AC3 AC3	AC2 AC2	AC1 AC1	AC0 AC0	Set GDRAM address to address counter ( AC ) First set vertical address and the horizontal address by consecutive writing Vertical address range AC6...AC0 Horizontal address range AC3...AC0	72 us

### Note :

1. Make sure that ST7920 is not in busy state by reading the busy flag before sending instruction or data. If use delay loop instead please make sure the delay time is enough. Please refer to the instruction execution time.
2. "RE" is the selection bit of basic and extended instruction set. Each time when altering the value of RE it will remain. There is no need to set RE every time when using the same group of instruction set.

## 6-2 8- bit 6800 Initialization sequence



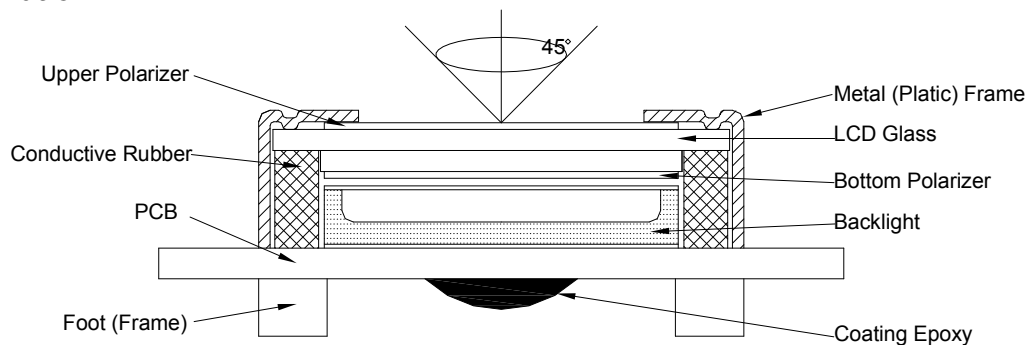
## 7. CHARACTER GENERATOR ROM

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
00		☺	☹	♥	♦	♣	♠	●	○	◐	◑	♂	♀	♂	♀	*
10	▶	◀	↑	!!	¶	§	—	‡	↑	↓	→	←	⊥	⊕	▲	▼
20		!	"	#	\$	%	&	'	(	)	*	+	,	-	.	/
30	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
40	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
50	P	Q	R	S	T	U	V	W	X	Y	Z	[	\	]	^	_
60	`	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
70	p	q	r	s	t	u	v	w	x	y	z	{		}	~	△

## 8 .QUALITY SPECIFICATIONS

### 8 - 1. LCM Appearance and Electric inspection Condition

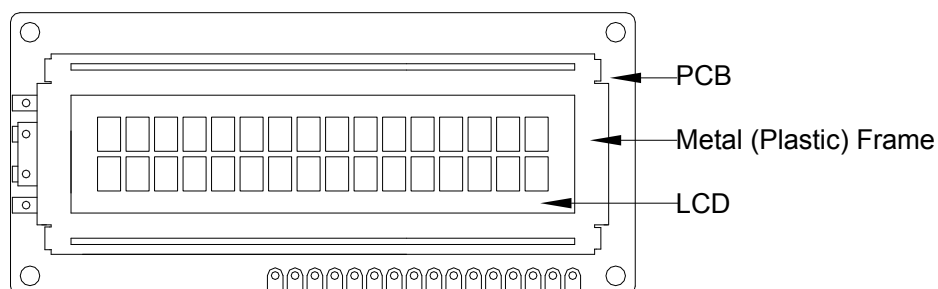
1. Inspection will be done by placing LCM 30cm away from inspector's eyeballs under normal illumination.



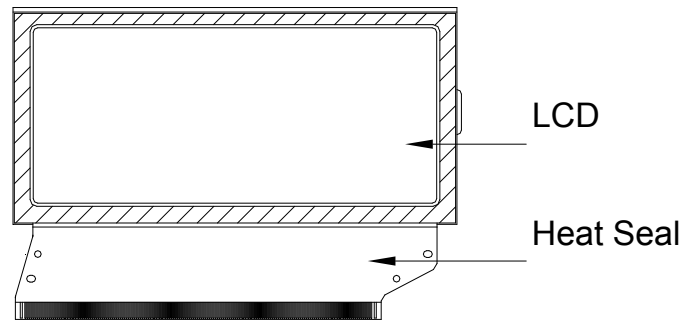
2. View Angle: with in 45° around perpendicular line.

### 8 - 2. Definition

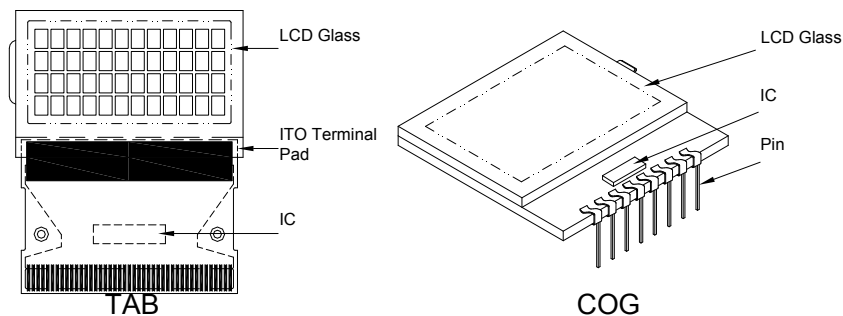
#### 1. COB



## 2. Heat Seal



## 3. TAB and COG



### 8-3. Sampling Plan and Acceptance

#### 1. Sampling Plan

MIL - STD - 105E ( || ) ordinary single inspection is used.

#### 2. Acceptance

Major defect: AQL = 0.65%

Minor defect: AQL = 1.5%

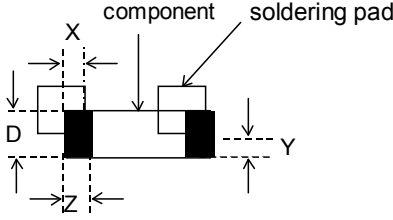
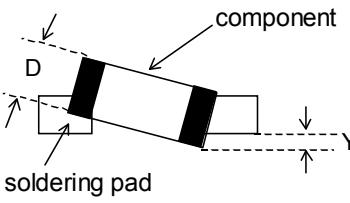
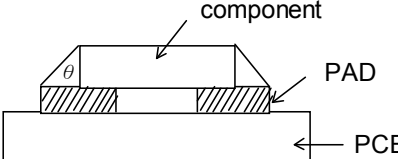
### 8-4. Criteria

#### 1. COB

Defect	Inspection Item	Inspection Standards	
Major	PCB copper flakes peeling off	Any copper flake in viewing Area should be greater than 1.0mm <sup>2</sup>	Reject
Major	Height of coating epoxy	Exceed the dimension of drawing	Reject
Major	Void or hole of coating epoxy	Expose bonding wire or IC	Reject
Major	PCB cutting defect	Exceed the dimension of drawing	Reject

#### 2. SMT

Defect	Inspection Item	Inspection Standards	
Minor	Component marking not readable		Reject
Minor	Component height	Exceed the dimension Of drawing	Reject
Major	Component solder defect (missing , extra, wrong component or wrong orientation		Reject
Minor	Component position shift	X < 3/4Z Y > 1/3D	Reject Reject

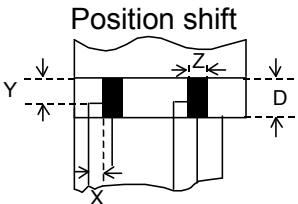
			
Minor		$Y > 1/3D$	Reject
Minor		$\theta \leq 20^\circ$	Reject

### 3. Metal (Plastic) Frame

Defect	Inspection Item	Inspection Standards		
Major	Crack / breakage	Anywhere		Reject
Minor	Frame Scratch	W	L	Acceptable of Scratch
		$w < 0.1\text{mm}$	Any	Ignore
		$0.1 \leq w < 0.2\text{mm}$	$L \leq 5.0\text{mm}$	2
		$0.2 \leq w < 0.3\text{mm}$	$L \leq 3.0\text{mm}$	1
		$w > 0.3\text{mm}$	Any	0
		Note : 1. Above criteria applicable to scratch lines with distance greater than 5mm. 2. Scratch on the back side of frame (not visible) can be ignored .		
Minor	Frame Dent , Prick $\Phi = \frac{L + W}{2}$			Acceptable of Dents / Pricks
		$\Phi \leq 1.0\text{mm}$		2
		$1.0 < \Phi \leq 1.5\text{mm}$		1
		$1.5\text{mm} < \Phi$		0
		Note : 1. Above criteria applicable to any two dents / pricks with distance greater than 5mm 2. Dent / prick on the back side of frame (not visible) can be ignored		
Minor	Frame Deformation	Exceed the dimension of drawing		
Minor	Metal Frame Oxidation	Any rust		

### 4. Flexible Film Connector (FFC)

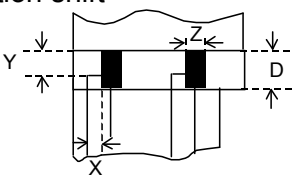
Defect	Inspection Item	Inspection Standards	
Minor	Tilted soldering	Within the angle $+5^\circ$	Acceptable
Minor	Uneven solder joint /bump		Reject

Minor	Hole $\Phi = \frac{L + W}{2}$	Expose the conductive line	Reject
		$\Phi > 1.0\text{mm}$	Reject
Minor		$Y > 1/3D$	Reject
		$X > 1/2Z$	Reject

## 5. Screw

Defect	Inspection Item	Inspection Standards	
Major	Screw missing/loosen		Reject
Minor	Screw oxidation	Any rust	Reject
Minor	Screw deformation	Difficult to accept screw driver	Reject

## 6. Heatseal 、TCP 、FPC

Defect	Inspection Item		Inspection Standards	
Major	Scratch expose conductive layer			Reject
Minor	HS Hole	$\Phi = \frac{L + W}{2}$	$\Phi > 0.5\text{mm}$	Reject
Major	Adhesion strength		Less than the specification	Reject
Minor			$Y > 1/3D$	Reject
			$X > 1/2Z$	Reject
Major	Conductive line break			Reject

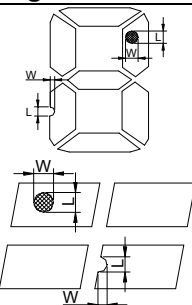
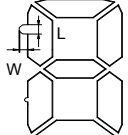
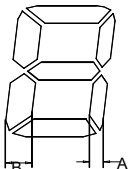
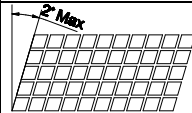
## 7. LED Backing Protective Film and Others

Defect	Inspection Item	Inspection Standards	
Minor	LED dirty, prick	Acceptable number of units	
		$\Phi \leq 0.10\text{mm}$	Ignore
		$0.10 < \Phi \leq 0.15\text{mm}$	2
		$0.15 < \Phi \leq 0.2\text{mm}$	1
		$\Phi > 0.2\text{mm}$	0
		The distance between any two spots should be $\geq 5\text{mm}$ Any spot/dot/void outside of viewing area is acceptable	
Minor	Protective film tilt	Not fully cover LCD	Reject
Major	COG coating	Not fully cover ITO circuit	Reject

## 8. Electric Inspection

Defect	Inspection Item	Inspection Standards	
Major	Short		Reject
Major	Open		Reject

## 9. Inspection Specification of LCD

Defect	Inspect Item		Inspection Standards			
Minor	Linear Defect	* Glass Scratch * Polarizer Scratch * Fiber and Linear material	W	$W \leq 0.03$	$0.03 < W \leq 0.05$	$W > 0.05$
			L	$L < 5$	$L < 3$	Any
			ACC. NO.	1	1	Reject
			Note	L is the length and W is the width of the defect		
Minor	Black Spot and Polarizer Pricked	* Foreign material between glass and polarizer or glass and glass * Polarizer hole or protuberance by external force	$\Phi$	$\Phi \leq 0.1$	$0.1 < \Phi \leq 0.15$	$0.15 < \Phi \leq 0.2$
			ACC. NO.	3EA / 100mm <sup>2</sup>	2	1
			Note	$\Phi$ is the average diameter of the defect. Distance between two defects > 10mm.		
Minor	White Spot and Bubble in polarizer	* Unobvious transparant foreign material between glass and glass or glass and polarizer * Air protuberance between polarizer and glass	$\Phi$	$\Phi \leq 0.3$	$0.3 < \Phi \leq 0.5$	$0.5 < \Phi$
			ACC. NO.	3EA / 100mm <sup>2</sup>	1	0
			Note	$\Phi$ is the average diameter of the defect. Distance between two defects > 10mm.		
Minor	Segment Defect		$\Phi$	$\Phi \leq 0.10$	$0.10 < \Phi \leq 0.20$	$0.20 < \Phi \leq 0.25$
			ACC. NO.	3EA / 100mm <sup>2</sup>	2	1
			Note	W is more than 1/2 segment width		Reject
			Note	$\Phi = \frac{L + W}{2}$ Distance between two defect is 10mm		
Minor	Protuberant Segment	 $\Phi = (L + W) / 2$	$\Phi$	$\Phi \leq 0.10$	$0.10 < \Phi \leq 0.20$	$0.20 < \Phi \leq 0.25$
			W	Glue	$W \leq 1/2 \text{ Seg}$ $W \leq 0.2$	$W \leq 1/2 \text{ Seg}$ $W \leq 0.2$
			ACC. NO.	3EA / 100mm <sup>2</sup>	2	1
						0
Minor	Assembly Mis-alignment		1. Segment			
			B	$B \leq 0.4\text{mm}$	$0.4 < B \leq 1.0\text{mm}$	$B > 1.0\text{mm}$
			B-A	$B-A < 1/2B$	$B-A < 0.2$	$B-A < 0.25$
			Judge	Acceptable	Acceptable	Acceptable
			2. Dot Matrix			
Minor	Stain on LCD Panel Surface		Deformation > 2°			
			Reject			
Minor	Stain on LCD Panel Surface		Accept when stains can be wiped lightly with a soft cloth or a similar one. Otherwise, judged according to the above items: "Black spot" and "White Spot"			

## 9. RELIABILITY

No	Item	Condition	Quantity	Criteria
1	High Temperature Operating	70℃, 96Hrs	2	GB/T2423.2-2008
2	Low Temperature Operating	-20℃, 96Hrs	2	GB/T2423.1-2008
3	High Humidity	50℃, 90%RH, 96Hrs	2	GB/T2423.3-2006
4	High Temperature Storage	80℃, 96Hrs	2	GB/T2423.2-2008
5	Low Temperature Storage	-30℃, 96Hrs	2	GB/T2423.1-2008
6	Thermal Cycling Test	-20℃, 60min~70℃, 60min, 20 cycles.	2	GB/T2423.2-2012
7	Packing vibration	Frequency range:10Hz~50Hz Acceleration of gravity:5G X,Y,Z 30 min for each direction.	2	GB/T5170.1-2009
8	Electrical Static Discharge	Air: ± 8KV 150pF/330 Ω 5 times Contact: ± 4KV 150pF/330 Ω 5 times	2	GB/T17626.2-2006
9	Drop Test(Packaged)	Height:80 cm,1 corner, 3 edges, 6 surfaces.	2	GB/T2423.8-1995

Note: 1) Above conditions are suitable for our company standard products.  
2) For restrict products, the test conditions listed as above must be revised.



## 10. HANDLING PRECAUTION

### (1) Mounting Method

The panel of the LCD Module consists of two thin glass plates with polarizers which easily get damaged since the Module is fixed by utilizing fitting holes in the printed circuit board. Extreme care should be taken when handling the LCD Modules.

### (2) Caution of LCD handling & cleaning

When cleaning the display surface, use soft cloth with solvent (recommended below) and wipe lightly.

- Isopropyl alcohol
- Ethyl alcohol
- Trichloro triflurothane

Do not wipe the display surface with dry or hard materials that will damage the polarizer surface.

Do not use the following solvent:

- Water
- Ketone
- Aromatics

### (3) Caution against static charge

The LCD Module use C-MOS LSI drivers, so we recommend that you connect any unused input terminal to VDD or VSS, do not input any signals before power is turned on. And ground your body, Work/assembly table. And assembly equipment to protect against static electricity.

### (4) Packaging

- Modules use LCD elements, and must be treated as such. Avoid intense shock and falls from a height.
- To prevent modules from degradation. Do not operate or store them exposed directly to sunshine or high temperature/humidity.

### (5) Caution for operation

- It is indispensable to drive LCD's within the specified voltage limit since the higher voltage than the limit shorten LCD life. An electrochemical reaction due to direct current causes LCD deterioration, Avoid the use of direct current drive.
- Response time will be extremely delayed at lower temperature than the operating temperature range and on the other hand at higher temperature LCD's show dark color in them. However those phenomena do not mean malfunction or out of order with LCD's. Which will come back in the specified operating temperature range.
- If the display area is pushed hard during operation, some font will be abnormally displayed but it resumes normal condition after turning off once.
- A slight dew depositing on terminals is a cause for electro-chemical reaction resulting in terminal open circuit.

Usage under the relative condition of 40°C, 50%RH or less is reequired.

### (6) Storage

In the case of storing for a long period of time (for instance.) For years) for the purpose or replacement use, The following ways are recommended.

- Storage in a polyethylene bag with sealed so as not to enter fresh air outside in it, And with no desiccant.
- Placing in a dark place where neither exposure to direct sunlight nor light is. Keeping temperature in the specified storage temperature range.
- Storing with no touch on polarizer surface by the anything else. (It is recommended to store them as they have been contained in the inner container at the time of delivery)

### (7) Safety

- It is recommendable to crash damaged or unnecessary LCD into pieces and wash off liquid crystal by using solvents such as acetone and ethanol.

Which should be burned up later.

When any liquid crystal leaked out of a damaged glass cell comes in contact with your hands, please wash it off well with soap and water.

### (8) Other

- After the product shipped, any product quality issues must be feedback within three months, otherwise, we will not be responsible for the subsequent or consequential events.

## 11. OUTLINE DIMENSION

