

**ROHS****PRODUCT SPECIFICATION****MONO LCD MODULE**  
**MODEL: G2406C4FVR6B-A0 Ver:1.0**

&lt; ◇ &gt; Preliminary Specification

&lt; ◆ &gt; Finally Specification

CUSTOMER'S APPROVAL	
CUSTOMER :	
SIGNATURE:	DATE:

APPROVED BY	PM REVIEWED	PD REVIEWED	PREPARED BY



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## 1. Features

The features of LCD are as follows

- \* Display mode : FSTN/Transmissive/Negative
- \* Drive IC : RA6963C/SDN8080G
- \* Interface : 8080 8-Bit MPU Interface
- \* Driving Method : 1/64 Duty, 1/9 Bias
- \* Viewing Direction : 6 O'clock
- \* Backlight : LED Red(Side)
- \*Sample NO :

## 2. MECHANICAL SPECIFICATIONS

Item	Specification	Unit
Module Size	135.6(W) x 51.2(H) x 10.9MAX(T)	mm
Viewing Area	111(W) x 34 (H)	mm
Activity Area	105.56(W) x28.12(H)	mm
Number of Dots	240 X 64 Dots	-
Dot Size	0.4 (W) x 0.4 (H)	mm
Dot Pitch	0.44(W)x0.44(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	-	7.0	V
Supply Voltage For LCD Drive	$V_{LCD}$	0	-	32	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	$V_{DD} - V_{SS}$	$T_a = 25\text{ }^\circ\text{C}$ $V_{DD}=5V \pm 10\%$	4.5	5.0	5.5	V	
LCD Drive	$V_{LCD}$		12.2	12.5	12.8	V	
Input Voltage	"H" Level		$V_{IH}$	$V_{DD}-2.2$	-	$V_{DD}$	V
	"L" Level		$V_{IL}$	0	-	0.8	V
Frame Frequency	$f_{FLM}$		-	60	-	Hz	
Current Consumption	$I_{DD}$		-	23	-	mA	

**3-3. BACKLIGHT****3-3-1. Absolute Maximum Ratings**

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Forward Current	$I_F$	$T_a = 25\text{ }^\circ\text{C}$	40	50	60	mA
Reverse Voltage	$V_R$		-	-	4	V
Power Dissipation	$P_D$		-	-	162	mW

**3-3-2. Electrical-optical Characteristics**

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Forward Voltage	$V_F$	$I_F=50\text{mA}$ $T_a = 25\text{ }^\circ\text{C}$	-	2.7	-	V
Average Luminous Intensity	$I_v$		140	-	-	$\text{cd/m}^2$
Emission wavelength	$\lambda$		620	625	630	nm

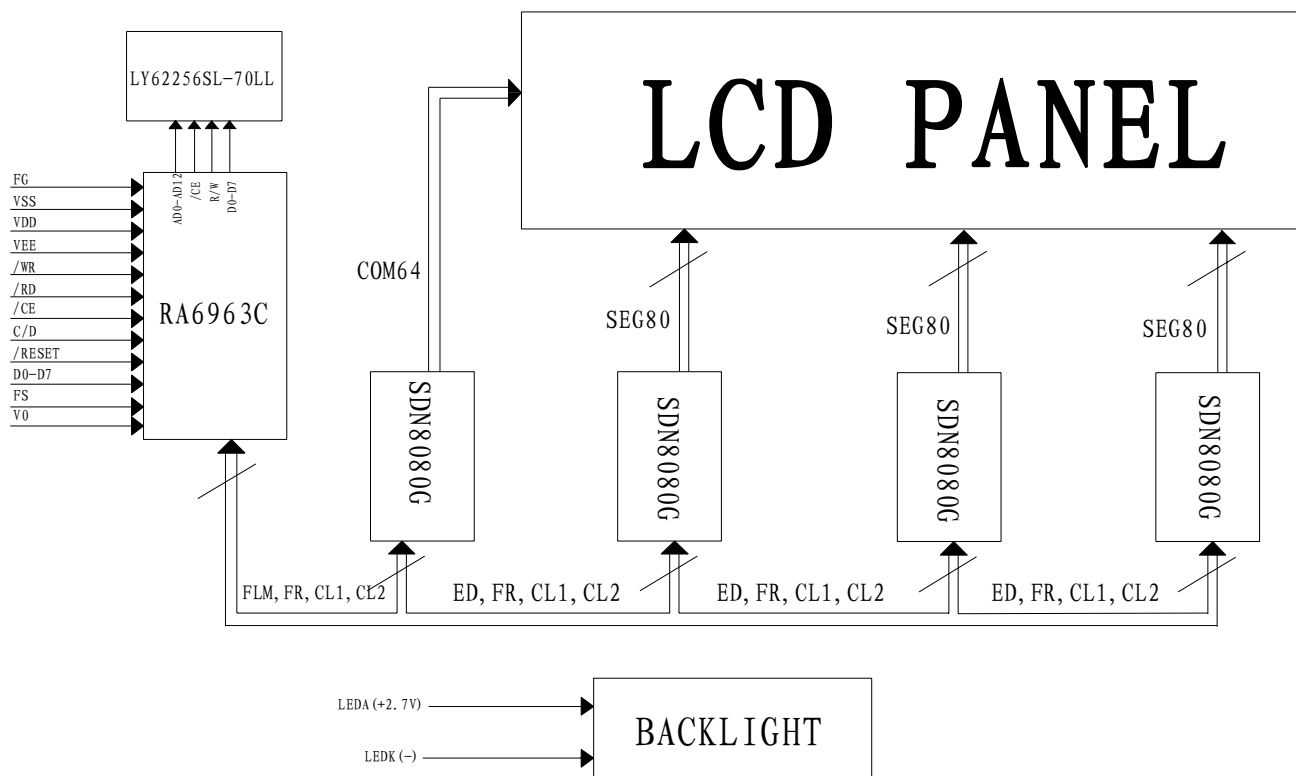
The brightness is measured without LCD panel

## 4. TERMINAL FUNCTIONS AND BLOCK DIAGRAM

### 4-1. INTERFACE PIN FUNCTION DESCRIPTION

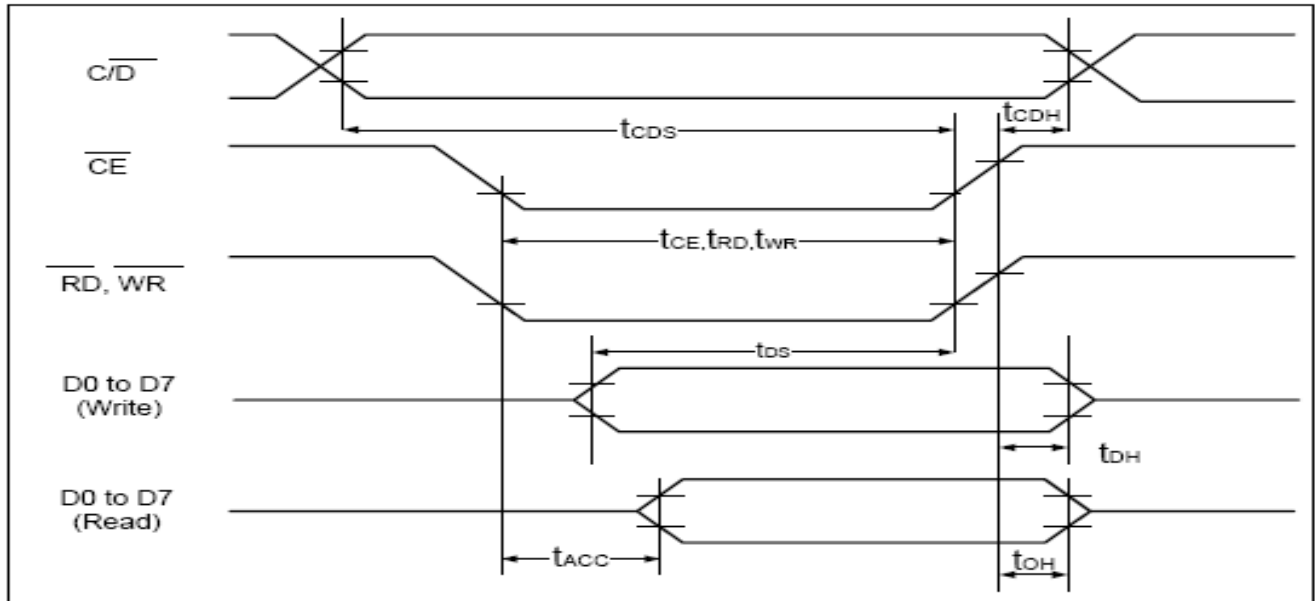
Pin No.	Pin Name	Function
1	FG	Frame Ground
2	VSS	Ground
3	VDD	Supple voltage for logic circuit
4	VEE	Supple voltage for LCD driving
5	/WR	Enable signal select read or write action
6	/RD	Enable signal
7	/CE	Chip enable pin for display momery of any address
8	C/D	A signal for selecting registers
9	NC	No connection
10	/RESET	Reset signal pin
11-18	D0-D7	8-bit data bus
19	FS	Font Selection
20	V0	Pin for negative voltage supple
21	LEDA	Backlight (+5.0V)
22	LEDK	Backlight (-)

### 4-2. BLOCK DIAGRAM



## 5.TIMING CHARACTERISTICS

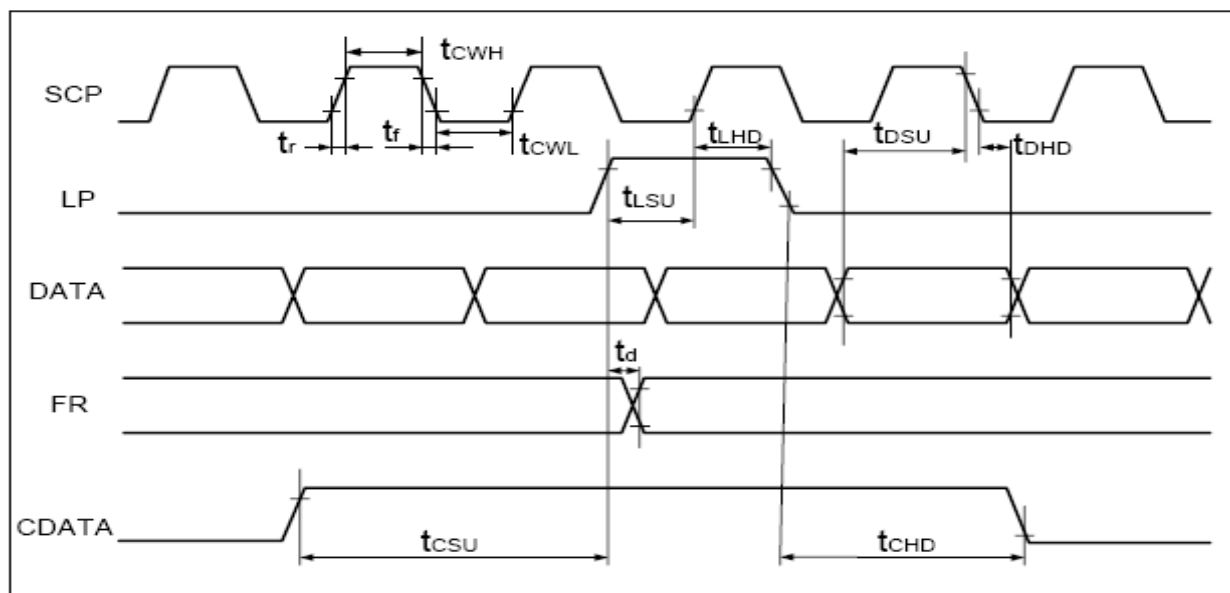
### 5-1 MPU Interface Timing



( $V_{DD}=+5V\pm 5\%$ ,  $GND=0V$ ,  $T_a = -20$  to  $+70^\circ C$ )

Item	Symbol	Test Conditions	Min.	Max.	Unit
$\overline{C/D}$ Set Up Time	$t_{CDS}$	--	100	--	ns
$\overline{C/D}$ Hold Time	$t_{CDH}$	--	10	--	ns
$\overline{CE}$ , $\overline{RD}$ , $\overline{WR}$ Pulse Width	$t_{CE}, t_{RD}, t_{WR}$	--	80	--	ns
Data Set Up Time	$t_{DS}$	--	80	--	ns
Data Hold Time	$t_{DH}$	--	40	--	ns
Access Time	$t_{ACC}$	--	--	150	ns
Output Hold Time	$t_{OH}$	--	10	50	ns

### 5-2 Driver Interface Timing

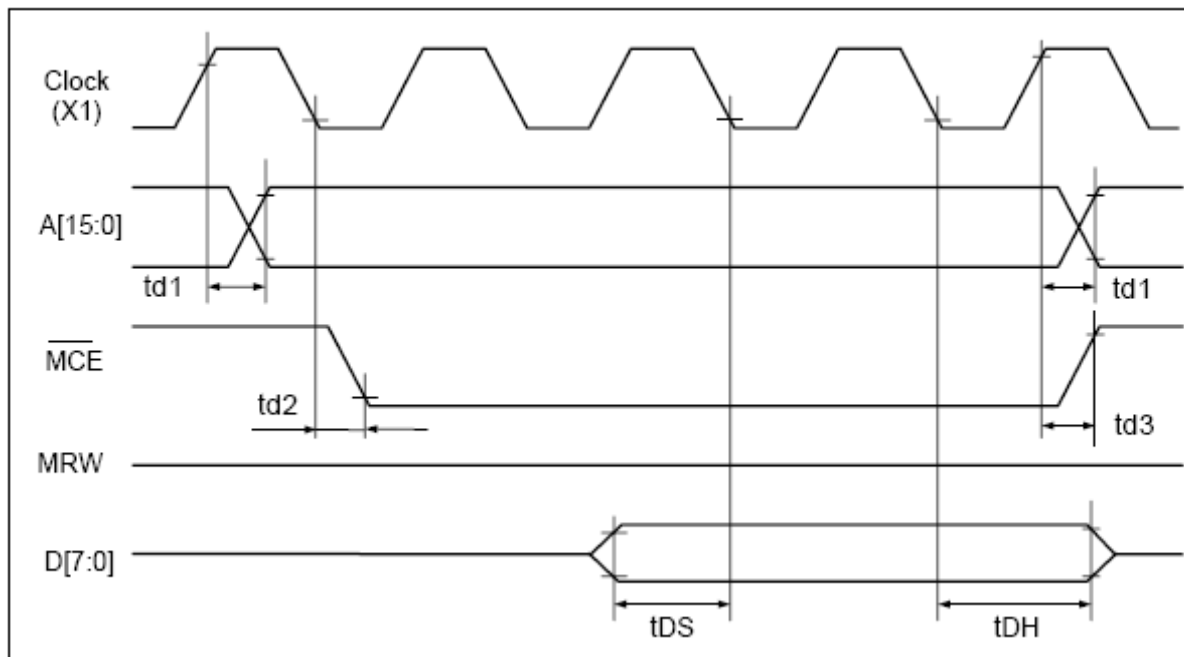


(  $V_{DD}=+5V\pm 5\%$ ,  $GND=0V$ ,  $T_a = -20$  to  $+70^\circ C$  )

Item	Symbol	Test Conditions	Min.	Max.	Unit
Operating Frequency	$f_{SCP}$	$T_a = -20\sim 70^\circ C$	--	2.75	MHz
SCP Pulse Width	$t_{CWH}, t_{CWL}$	--	150	--	ns
SCP Rise/Fall Time	$t_r, t_f$	--	--	30	ns
LP Setup Time	$t_{LSU}$	--	150	290	ns
LP Hold Time	$t_{LHD}$	--	5	40	ns
Data Setup Time	$t_{DSU}$	--	170	--	ns
Data Hold Time	$t_{DHD}$	--	80	--	ns
FR Delay Time	$t_d$	--	0	90	ns
CDATA Setup Time	$t_{CSU}$	--	450	850	ns
CDATA Hold Time	$t_{CHD}$	--	450	950	ns

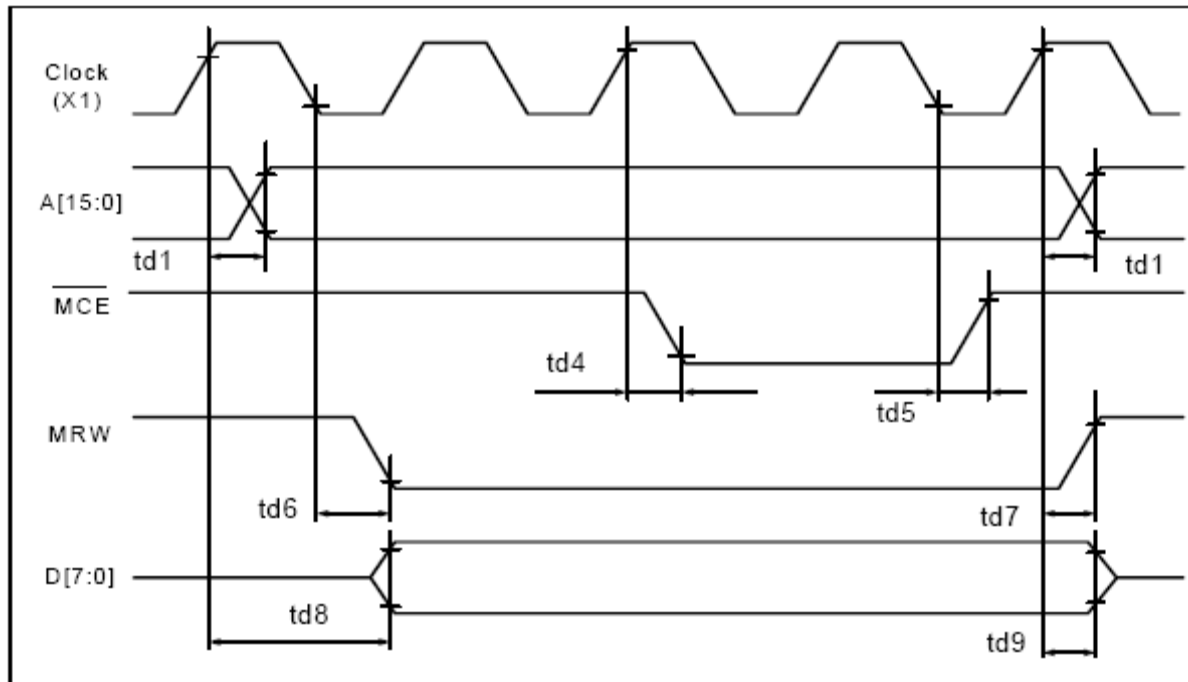
### 5-3 External Memory Interface

#### 5-3-1 External RAM Read





## 5-3-2 External RAM Write



( $V_{DD}=+5V\pm 5\%$ , GND=0V,  $T_a = -20$  to  $+70^\circ\text{C}$ )

Item	Symbol	Test Conditions	Min.	Max.	Unit
Address Delay Time	$t_{d1}$	--	--	250	ns
MCE Fall Delay Time(Read)	$t_{d2}$	--	--	180	ns
MCE Rise Delay Time(Read)	$t_{d3}$	--	--	180	ns
Data Setup Time	$t_{DS}$	--	--	--	ns
Data Hold Time	$t_{DH}$	--	--	--	ns
MCE Fall Delay Time(Write)	$t_{d4}$	--	--	200	ns
MCE Rise Delay Time(Write)	$t_{d5}$	--	--	200	ns
MRW Fall Delay Time	$t_{d6}$	--	--	180	ns
MRW Rise Delay Time	$t_{d7}$	--	--	180	ns
Data Stable Time	$t_{d8}$	--	--	450	ns
Data Hold Time	$t_{d9}$	--	--	200	ns

## 6. COMMAND LIST

Command	Code	D1	D2	Function
<b>Registers Setting</b>	00100001	X address	Y address	Set cursor pointer
	00100010	Data	00h	Set Offset Register
	00100100	Low address	High address	Set Address pointer
<b>Set Control Word</b>	01000000	Low address	High address	Set Text Home Address
	01000001	Columns	00h	Set Text Area
	01000010	Low address	High address	Set Graphic Home Address
	01000011	Columns	00h	Set Graphic Area
<b>Mode Set</b>	1000X000	--	--	OR mode
	1000X001	--	--	EXOR mode
	1000X011	--	--	AND mode
	1000X100	--	--	Text Attribute mode
	10000XXX	--	--	Internal CG ROM mode
	10001XXX	--	--	External CG RAM mode
<b>Display Mode</b>	10010000	--	--	Display off
	1001XX10	--	--	Cursor on, blink off
	1001XX11	--	--	Cursor on, blink on
	100101XX	--	--	Text on, graphic off
	100110XX	--	--	Text off, graphic on
	100111XX	--	--	Text on, graphic on
<b>Cursor Pattern Select</b>	10100000	--	--	1-line cursor
	10100001	--	--	2-line cursor
	10100010	--	--	3-line cursor
	10100011	--	--	4-line cursor
	10100100	--	--	5-line cursor
	10100101	--	--	6-line cursor
	10100110	--	--	7-line cursor
	10100111	--	--	8-line cursor
	<b>Data Read/Write</b>	11000000	Data	--
11000001		--	--	Data Read and Increment ADP
11000010		Data	--	Data Write and Decrement ADP
11000011		--	--	Data Read and Decrement ADP
11000100		Data	--	Data Write and Non-variable ADP
11000101		--	--	Data Read and Non-variable ADP
<b>Data auto Read/Write</b>		10110000	--	--
	10110001	--	--	Set Data Auto Read
	10110010	--	--	Auto Reset
<b>Screen Peek</b>	11100000	--	--	Screen Peek
<b>Screen Copy</b>	11101000			Screen Copy
<b>Bit Set/Reset</b>	11110XXX	--	--	Bit Reset
	11111XXX	--	--	Bit Set
	1111X000	--	--	Bit 0 (LSB)
	1111X001	--	--	Bit 1
	1111X010	--	--	Bit 2
	1111X011	--	--	Bit 3
	1111X100	--	--	Bit 4
	1111X101	--	--	Bit 5
	1111X110	--	--	Bit 6
	1111X111	--	--	Bit 7 (MSB)
<b>Screen Reverse</b>	11010000	Data	--	Whole screen reverse
				Data Bit 0 0 : Normal 1 : Reverse
<b>Blink Time</b>	01010000	Data	Don't care (Note)	If Frame = 60Hz Data Bit 2:0 000 : 0.066s 001 : 0.25s 010 : 0.5s (Default) 011 : 0.75s 100 : 1s 101 : 1.25s 110 : 1.5s 111 : 2s
<b>Cursor Auto Moving</b>	01100000	Data	Don't care (Note)	Data Bit 0 0 : Disable.(Default) 1 : Enable.
<b>CGROM Font Select</b>	01110000	Data	Don't care (Note)	Data Bit 1:0 00 : Do not care.(Default) 01 : Do not care. 10 : CGROM Font-01. 11 : CGROM Font-02.

Note : In these functions, it must be sent two data before sending the command, but the contents of the second datum (D2) can be any values.

## 7. CHARACTER GENERATOR ROM

CGROM Font - 01

LSB \ MSB	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	!	"	#	\$	%	&	'	(	)	*	+	,	-	.	/	
1	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
2	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	
3	P	Q	R	S	T	U	W	X	Y	Z	[	\	]	^	_	
4	~	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
5	p	q	r	s	t	u	v	w	x	y	z	{		}	~	
6	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
7	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E

CGROM Font - 02

LSB \ MSB	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	!	"	#	\$	%	&	'	(	)	*	+	,	-	.	/	
1	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
2	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	
3	P	Q	R	S	T	U	W	X	Y	Z	[	\	]	^	_	
4	千	万	月	夕	夕	■	ヲ	フ	イ	ウ	エ	オ	カ	ク	ケ	コ
5	一	ア	イ	ウ	エ	オ	カ	ク	ケ	コ	サ	シ	ス	セ	ソ	タ
6	タ	チ	ツ	テ	ト	ナ	ニ	ヌ	ネ	ノ	ヒ	フ	ホ	ヘ	ベ	バ
7	ミ	ム	メ	モ	ト	ユ	ヨ	ラ	リ	ル	レ	ロ	ワ	ウ	エ	オ

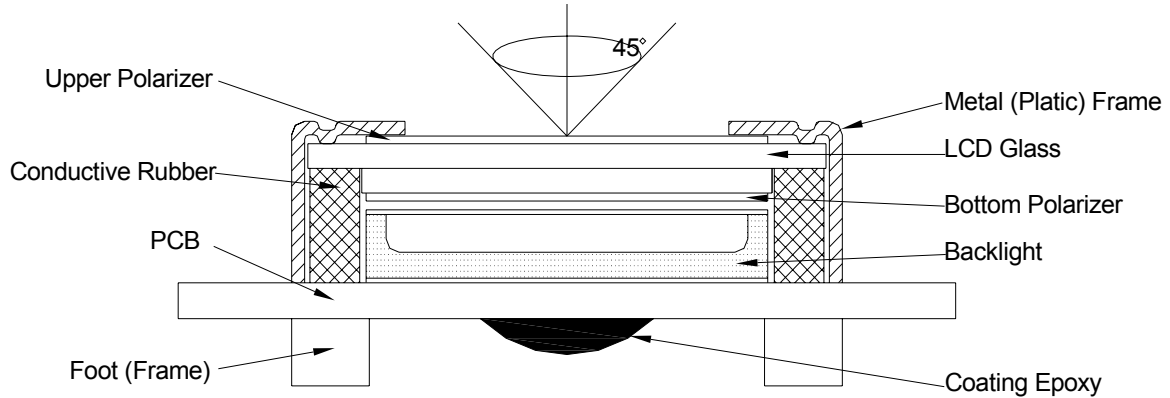
The RA6963 has two part number - RA6963L2NA and RA6963L2NB. The RA6963L2NA is compatible to T6963C(code 0101) and the default font is Figure 6-13 as above. The RA6963L2NB is compatible to T6963C(code 0201) and the default font is Figure 6-14 as above.

Although RA6963 provide a extra internal command for MCU to select both font of above, but you do not need to change the software to select the font that if you chose the right part number.

## 8. QUALITY SPECIFICATIONS

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

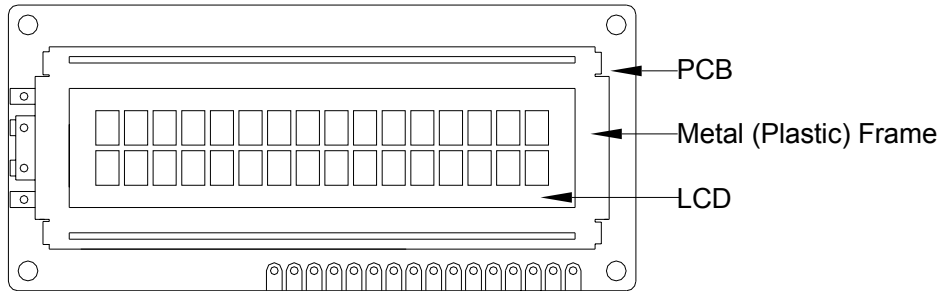
1. Inspection will be done by placing LCM 30cm away from inspector's eyeballs under normal illumination.



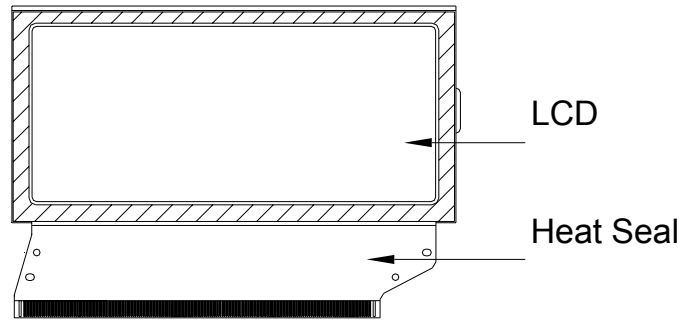
2. View Angle: with in 45° around perpendicular line.

### 8 - 2. Definition

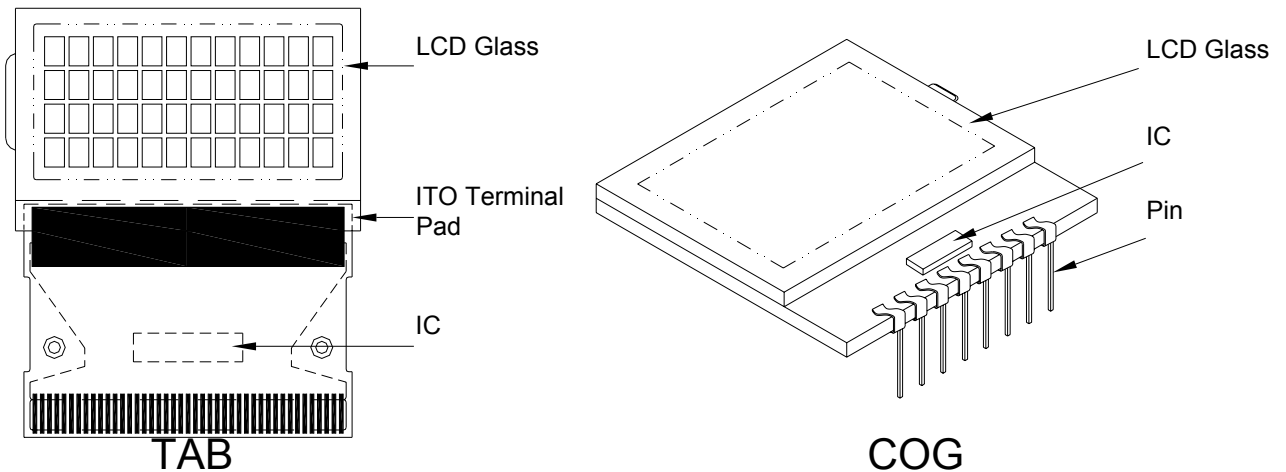
#### 1. COB



#### 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

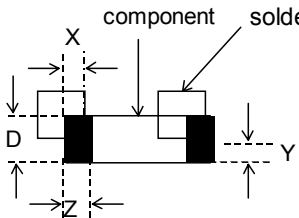
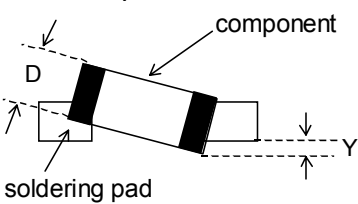
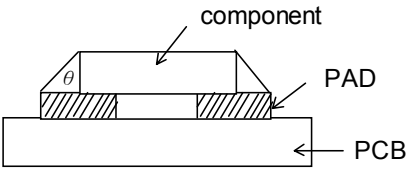
Major defect: AQL = 0.65%

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

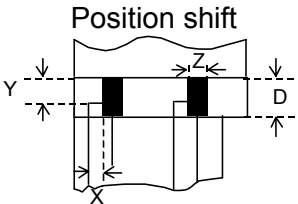
**2. SMT**

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	Component tilt 	$Y > 1/3D$	Reject
Minor	Insufficient solder 	$\theta \leq 20^\circ$	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
		$w \geq 0.3\text{mm}$	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		

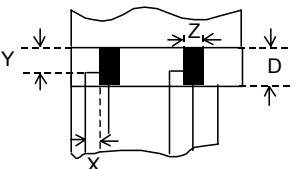
**4. Flexible Film Connector (FFC)**

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	Position shift 	$Y > 1/3D$	Reject
		$X > 1/2Z$	Reject
Major	Conductive line break		Reject

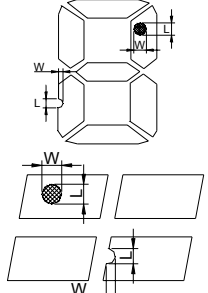
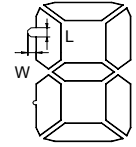
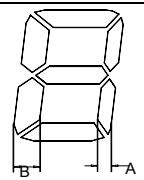
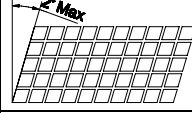
**7. LED Backing Protective Film and Others**

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				
		W	$W \leq 0.03$	$0.03 < W \leq 0.05$	$W > 0.05$	
Minor	Linear Defect * Glass Scratch * Polarizer Scratch * Fiber and Linear material	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	$\Phi$	$\Phi \leq 0.1$	$0.1 < \Phi \leq 0.15$	$0.15 < \Phi \leq 0.2$	$\Phi > 0.2$
		ACC. NO.	3EA / 100mm <sup>2</sup>	2	1	0
		Note	$\Phi$ is the average diameter of the defect. Distance between two defects > 10mm.			
Minor	White Spot and Bubble in polarizer * Unobvious transparent 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 	$\Phi$	$\Phi \leq 0.10$	$0.10 < \Phi \leq 0.20$	$0.20 < \Phi \leq 0.25$	$\Phi > 0.25$
		ACC. NO.	3EA / 100mm <sup>2</sup>	2	1	0
		Note	W is more than 1/2 segment width			Reject
			$\Phi = \frac{L + W}{2}$ Distance between two defect is 10mm			
Minor	Protuberant Segment  $\Phi = (L + W) / 2$	$\Phi$	$\Phi \leq 0.10$	$0.10 < \Phi \leq 0.20$	$0.20 < \Phi \leq 0.25$	$\Phi > 0.25$
		W	Glue	$W \leq 1/2$ Seg $W \leq 0.2$	$W \leq 1/2$ Seg $W \leq 0.2$	Ignore
		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				
		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	Criterion
1	High Temperature Operating	70°C, 96Hrs	No defect in cosmetic and operational function allowable. Total current Consumption should be below double of initial value.
2	Low Temperature Operating	-20°C, 96Hrs	
3	High Humidity	50°C, 90%RH, 96Hrs	
4	High Temperature Storage	80°C, 96Hrs	
5	Low Temperature Storage	-30°C, 96Hrs	
6	Vibration	Random wave 10 ~ 100Hz Acceleration: 2g 2 Hrs per direction(X,Y,Z)	
7	Thermal Shock	-20°C to 25°C to 70°C (60Min) (5Min) (60Min) 16Cycles	
8	ESD Testing	Contract Discharge Voltage: +1 ~ 5kV and -1 ~ -5kV Air Discharge Voltage: +1 ~ 8kV and -1 ~ -8kV	

Note: 1) Above conditions are suitable for 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 trifluro thane

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.

# 11. OUTLINE DIMENSION

