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# SPECIFICATIONS

## SDO21605GGW06

Swissdis 108604

LCD Module 2x16 Characters, 5mm, I<sup>2</sup>C

Version April 2010

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## MODIFY RECORD

NO.	VER.	DATE	MODIFY REASON	MODIFY CONTENTS
1	A	2010/04/19	New issued	

## **1. Precaution in use of LCD Module**

- (1) Avoid applying excessive shocks to the module or making any alterations or modifications to it.
- (2) Don't make extra holes on the printed circuit board, modify its shape or change the components of LCD module.
- (3) Don't disassemble the LCM.
- (4) Don't operate it above the absolute maximum rating.
- (5) Don't drop, bend or twist LCM.
- (6) Soldering: only to the I/O terminals.
- (7) Storage: please storage in anti-static electricity container and clean environment.
- (8) Don't touch the elastomer connector, especially insert a backlight panel (EL or CCFL)

## **2. General Specification**

### 2.1 Mechanical Dimension

Item	Dimension	Unit
Number of Characters	16 characters x 2 Lines	—
Module dimension (L x W x H)	67.0 x 29.7 x 5.2	mm
View area	61.0 x 15.7	mm
Active area	56.2 x 11.04	mm
Character size (L x W)	2.95 x 5.22	mm
Character pitch (L x W)	3.55 x 5.82	mm
LCD TYPE	STN GRAY	
Backlight TYPE	LED WHITE	
Controller IC	ST7032i-0D-G controller	

### 3. Electrical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Voltage For Logic	Vdd-Vss	—	2.7	3.3	5.5	V
Supply Voltage For LCD	Vlcd	—	4.2	4.5	4.8	25°C
Input High Vol.	V <sub>IH</sub>	—	0.7Vdd	—	Vdd	V
Input Low Vol.	V <sub>IL</sub>	—	-0.3	—	0.8	V
Output High Vol.	V <sub>OH</sub>	I <sub>OH</sub> =0.1mA	0.75Vdd	—	—	V
Output Low Vol.	V <sub>OL</sub>	I <sub>OL</sub> =0.1mA	—	—	0.8	V
Supply Current(Logic)	I <sub>dd</sub>	V <sub>op</sub> =4.5±5% V <sub>DD</sub> -V <sub>SS</sub> =3.3V	—	1.13	3.0	mA

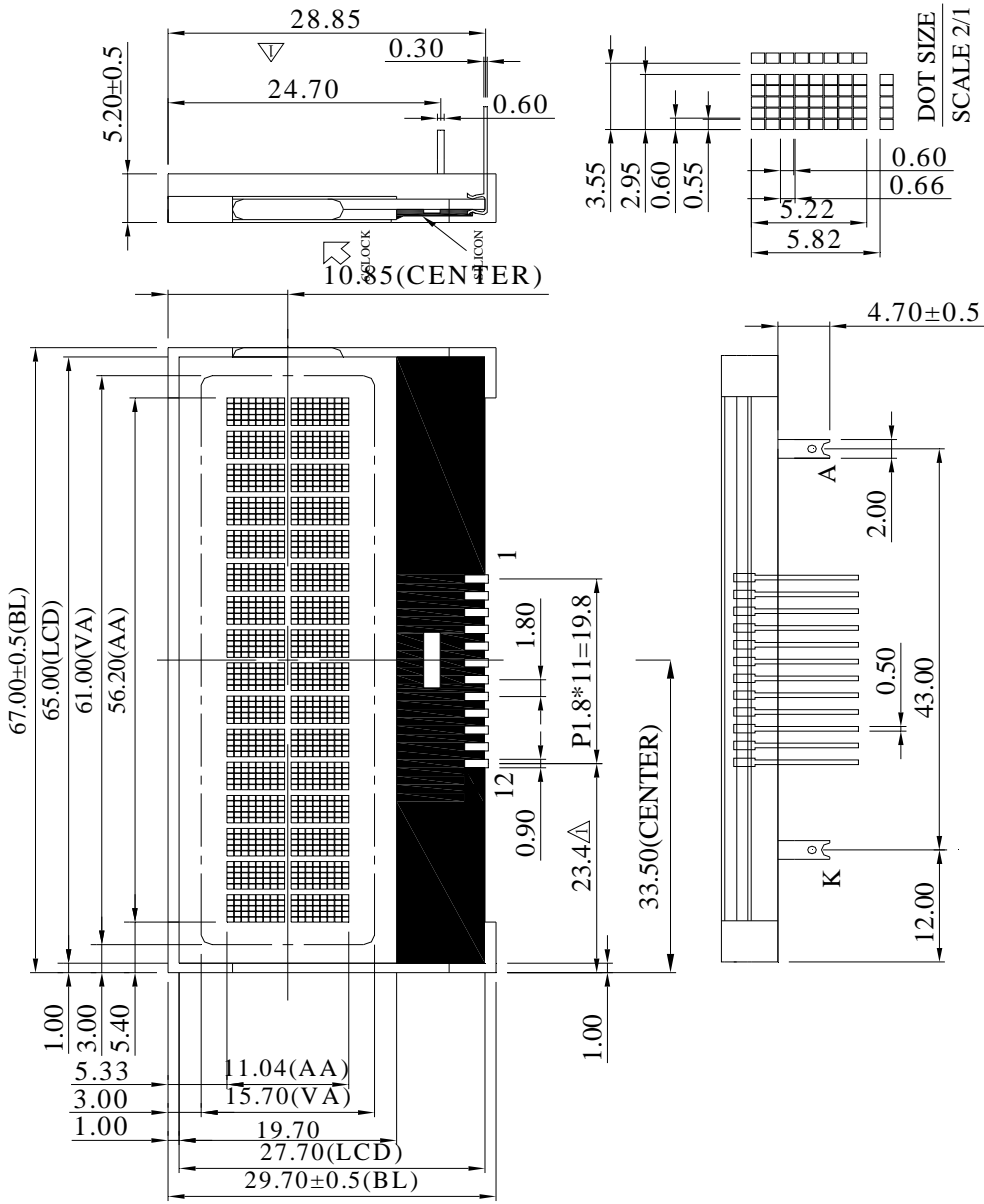
#### 3.1 Electrical Absolute Maximum Ratings

(V<sub>SS</sub>=0V, T<sub>a</sub>=25°C)

Item		Symbol	Min	Max	Unit
Supply Voltage (Logic)		Vdd- Vss	-0.3	6.0	V
Supply Voltage(LCD driver)		VLCD	-0.3+VSS	7.0-VSS	V
Input Voltage		V <sub>I</sub>	-0.3	VDD+0.3	V
Normal Temp. Type	Operation Temp.	T <sub>OP</sub>	-20	60	°C
	Storage Temp.	T <sub>STG</sub>	-30	70	°C

# 4. Dimensional Outlines

PIN NO.	SYMBOL
1	RST
2	RS
3	CSB
4	DB6
5	DB7
6	VSS
7	VDD
8	PSB
9	PSI2B
10	CAP1P
11	CAP1N
12	VOUT



The tolerance of non-specified dimension is  $\pm 0.3mm$ .

<b>金宇科技股份有限公司</b> SDO21605GGW06	UNIT: mm	
	SCALE:	
APPROVE	MODEL 108604	REV : 0
CHECK	TITLE LCM DRAWING	
DRAW	Drawn: <i>Jane</i>	DWG NO. <i>2009/05/20</i>

## 5. Interface Pin Function

Pin No.	Symbol	I/O	Description												
1	RST	I	External reset pin. Only if the power on reset used, the XRESERT pin must be fixed to VDD. Low active.												
2	RS	I	Select registers.												
3	CSB	I	Chip select in parallel mode and serial interface(Low active)												
4	DB6	I/O	In serial interface mode: DB7 is SI (input data), DB6 is SCL (Serial clock).												
5	DB7		In I <sup>2</sup> C interface mode: DB7 is SDA (input data), DB6 is SCL (clock input).												
6	VSS	Supply	0V												
7	VDD	Supply	2.7V to 5.5V												
8	PSB	I	<table border="1"> <thead> <tr> <th>PSB</th> <th>PSI2B</th> <th>Interface</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>No use</td> </tr> <tr> <td>0</td> <td>1</td> <td>SI4</td> </tr> <tr> <td>1</td> <td>0</td> <td>SI2(I<sup>2</sup>C)</td> </tr> </tbody> </table>	PSB	PSI2B	Interface	0	0	No use	0	1	SI4	1	0	SI2(I <sup>2</sup> C)
PSB	PSI2B	Interface													
0	0	No use													
0	1	SI4													
1	0	SI2(I <sup>2</sup> C)													
9	PSI2B	I													
10	CAP1P	Supply	For voltage booster circuit(VDD-VSS). External capacitor about 0.1u~4.7uF												
11	CAP1N														
12	VOUT	Supply	DC/DC voltage converter. Connect a capacitor between this terminal and VIN when the built-in booster is used.												

## **6. Backlight Information**

### 6.1 Specification

LED WHITE

Parameter	Symbol	Min	Typ	Max	Unit	Test Condition
Supply Current	I <sub>LED</sub>		45		mA	V=3.0V
Supply Voltage	V		3.0	3.3	V	—
Luminous Intensity	I <sub>V</sub>		600	—	cd/m <sup>2</sup>	I <sub>LED</sub> =45mA
Life Time		—	20000	—	Hr.	V ≤ 3.3V
Color	White					

The brightness average lifetime is up 20,000 hours under these conditions:

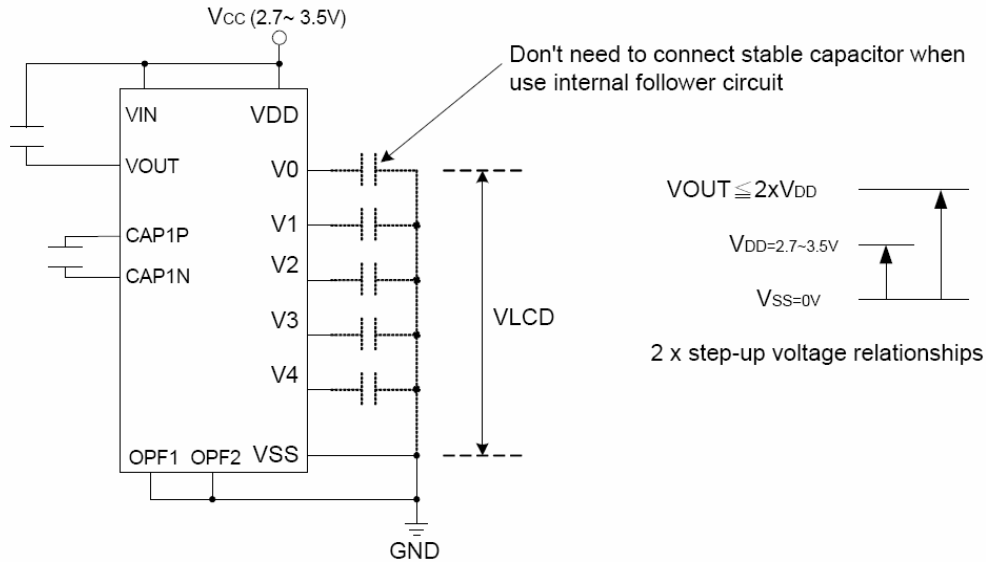
- (1) The environmental temperatures  $25 \pm 2^{\circ}\text{C}$
- (2)  $I_f = 45 \text{ mA}$ ,  $V_f = 3.0\text{V}$
- (3) The brightness is measured without LCD panel



# 7. Controller data

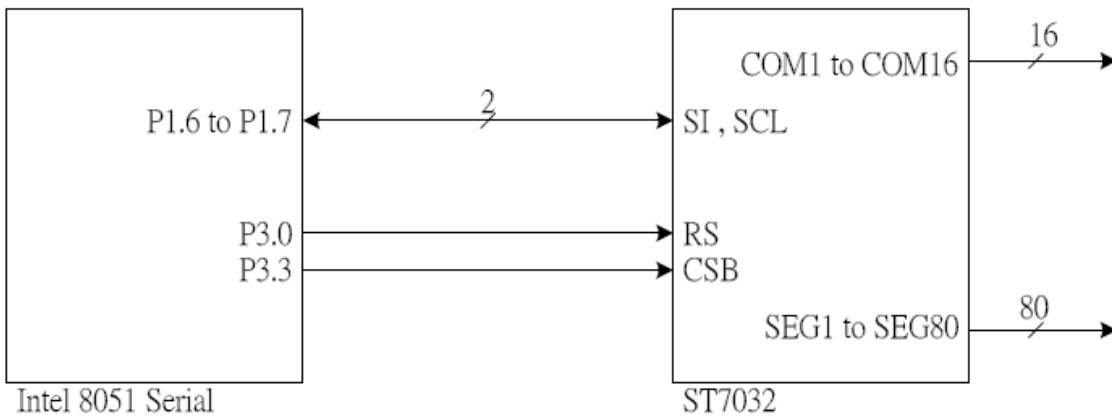
## 7.1 Power SUPPLY

- When built-in booster and voltage followers are used(OPF1=0,OPF2=0)

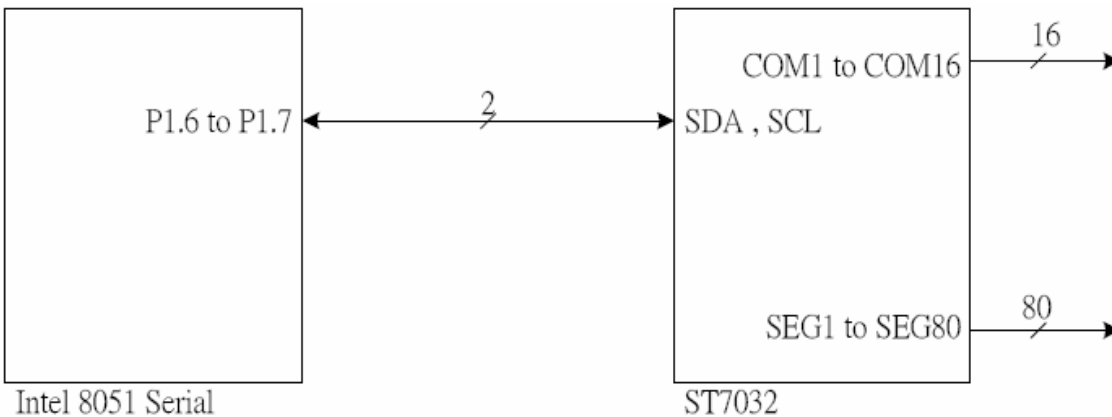


## 7.2 Block Diagram

### Intel 8051 Interface(Serial)



### Intel 8051 Interface(I<sup>2</sup>C)



7.3 C.G ROM table (table 2)

b7-b4	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111																
b3-b0	Replaced By CGRAM Pattern																															
0000																																
0001																																
0010																																
0011																																
0100																																
0101																																
0110																																
0111																																
1000																																
1001																																
1010																																
1011																																
1100																																
1101																																
1110																																
1111																																

## 7.4 A Instruction description

### ➤ instruction table at “Extension mode”

(when “EXT” option pin connect to Vss, the instruction set follow below table)

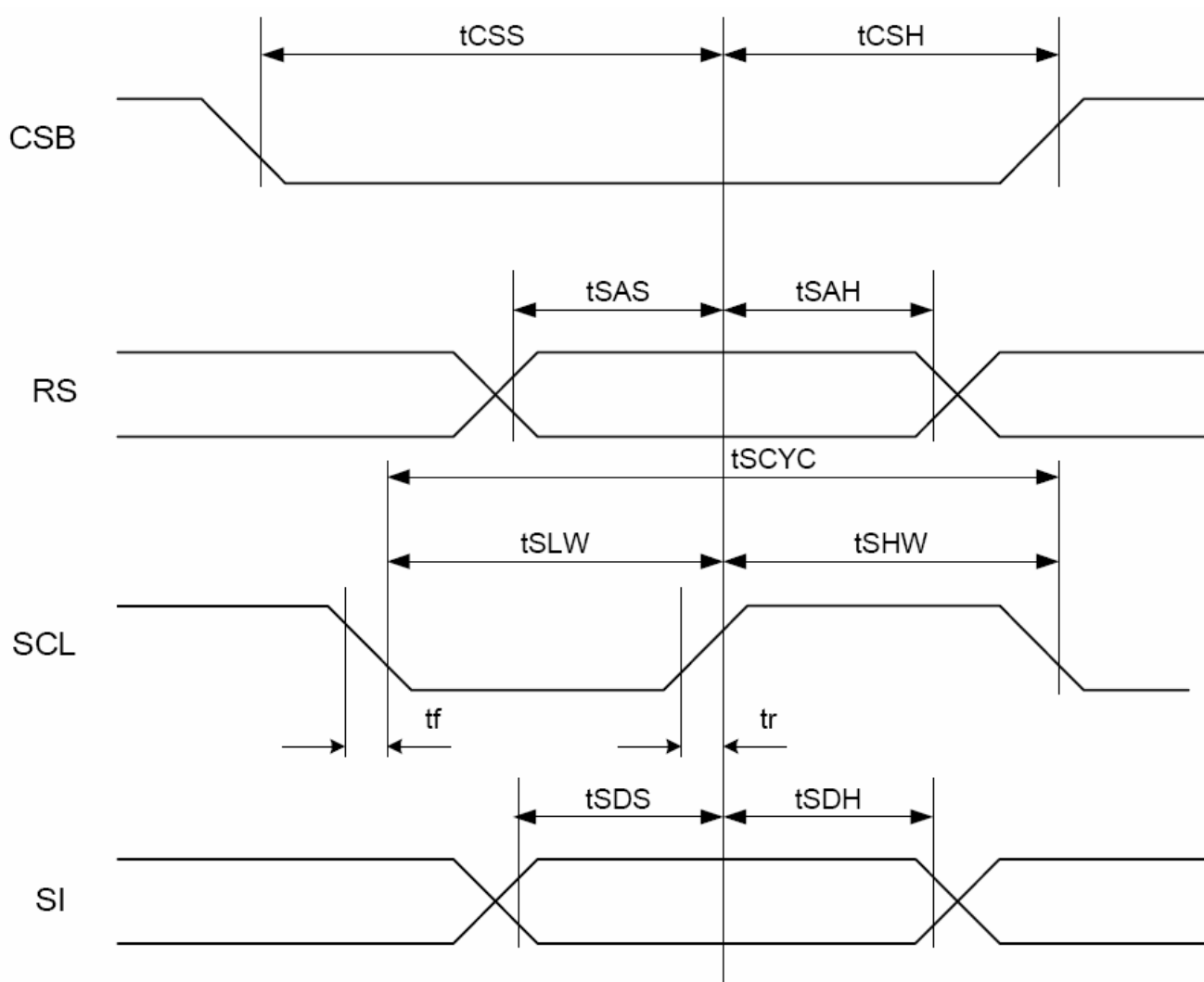
Instruction	Instruction Code										Description	Instruction Execution Time		
	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0		OSC=380KHz	OSC=540kHz	OSC=700KHz
Clear Display	0	0	0	0	0	0	0	0	0	1	Write "20H" to DDRAM. and set DDRAM address to "00H" from AC	1.08 ms	0.76 ms	0.59 ms
Return Home	0	0	0	0	0	0	0	0	1	x	Set DDRAM address to "00H" from AC and return cursor to its original position if shifted. The contents of DDRAM are not changed.	1.08 ms	0.76 ms	0.59 ms
Entry Mode Set	0	0	0	0	0	0	0	1	I/D	S	Sets cursor move direction and specifies display shift. These operations are performed during data write and read.	26.3 us	18.5 us	14.3 us
Display ON/OFF	0	0	0	0	0	0	1	D	C	B	D=1:entire display on C=1:cursor on B=1:cursor position on	26.3 us	18.5 us	14.3 us
Function Set	0	0	0	0	1	DL	N	DH	*0	IS	DL: interface data is 8/4 bits N: number of line is 2/1 DH: double height font IS: instruction table select	26.3 us	18.5 us	14.3 us
Set DDRAM address	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Set DDRAM address in address counter	26.3 us	18.5 us	14.3 us
Read Busy flag and address	0	1	BF	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Whether during internal operation or not can be known by reading BF. The contents of address counter can also be read.	0	0	0
Write data to RAM	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Write data into internal RAM (DDRAM/CGRAM/ICONRAM)	26.3 us	18.5 us	14.3 us
Read data from RAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0	Read data from internal RAM (DDRAM/CGRAM/ICONRAM)	26.3 us	18.5 us	14.3 us

**Note \*** : this bit is for test command , and must always set to “0”

Instruction table 1(IS=1)														
Internal OSC frequency	0	0	0	0	0	1	BS	F2	F1	F0	BS=1:1/4 bias BS=0:1/5 bias F2~0: adjust internal OSC frequency for FR frequency.	26.3 us	18.5 us	14.3 us
Set ICON address	0	0	0	1	0	0	AC3	AC2	AC1	AC0	Set ICON address in address counter.	26.3 us	18.5 us	14.3 us
Power/ICON control/Contrast set	0	0	0	1	0	1	Ion	Bon	C5	C4	Ion: ICON display on/off Bon: set booster circuit on/off C5,C4: Contrast set for internal follower mode.	26.3 us	18.5 us	14.3 us
Follower control	0	0	0	1	1	0	Fon	Rab2	Rab1	Rab0	Fon: set follower circuit on/off Rab2~0: select follower amplified ratio.	26.3 us	18.5 us	14.3 us
Contrast set	0	0	0	1	1	1	C3	C2	C1	C0	Contrast set for internal follower mode.	26.3 us	18.5 us	14.3 us

## 7.5 AC Characteristics

### Serial interface



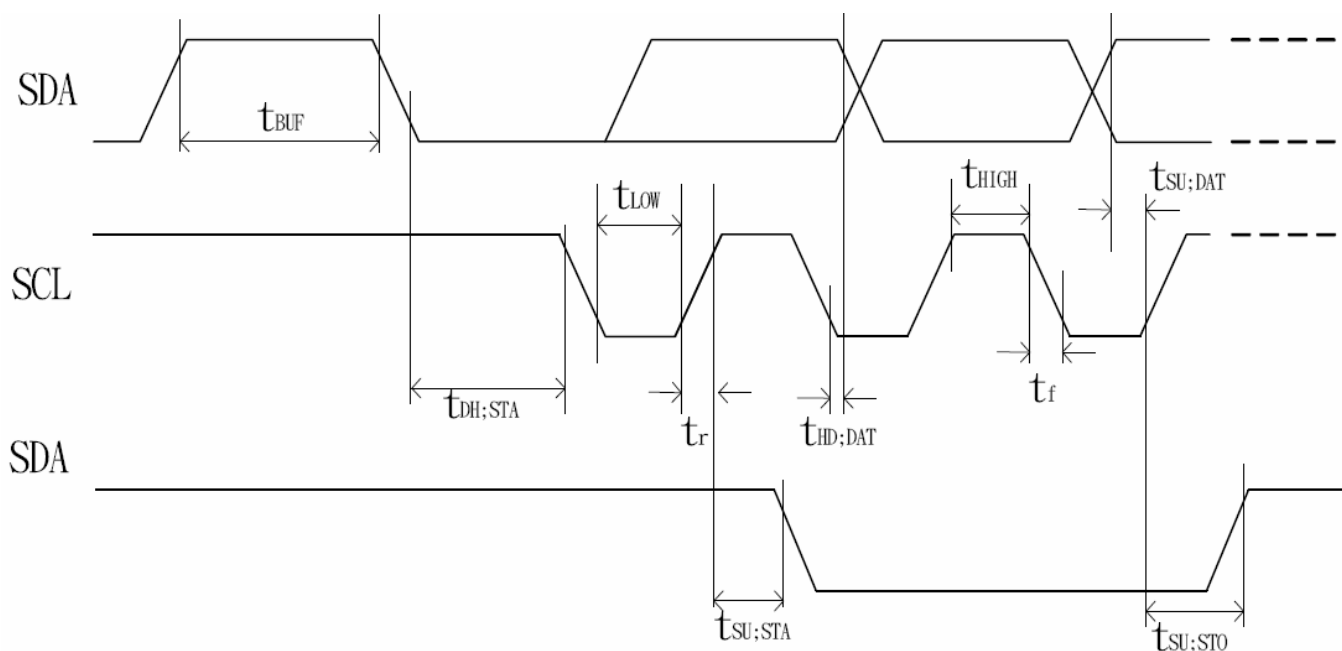
( $T_a = 25^\circ\text{C}$ )

Item	Signal	Symbol	Condition	VDD=2.7 to 4.5V Rating		VDD=4.5 to 5.5V Rating		Units
				Min.	Max.	Min.	Max.	
Serial Clock Period	SCL	$t_{SCYC}$	—	200	-	100	-	ns
SCL "H" pulse width		$t_{SHW}$		20	-	20	-	
SCL "L" pulse width		$t_{SLW}$		160	-	120	-	
SCL Rise/Fall time	SCL	$t_r, t_f$	—	-	20	-	20	ns
Address setup time	RS	$t_{SAS}$	—	10	-	10	-	ns
Address hold time		$t_{SAH}$		250	-	150	-	
Data setup time	SI	$t_{SDS}$	—	10	-	10	-	ns
Data hold time		$t_{SDH}$		10	-	20	-	
CS-SCL time	CS	$t_{CSS}$	—	20	-	20	-	ns
		$t_{CSH}$		350	-	200	-	

\*1 All timing is specified using 20% and 80% of VDD as the standard.

## 7.6 AC Characteristics(Continued)

### I<sup>2</sup>C interface



( $T_a = 25^\circ\text{C}$ )

Item	Signal	Symbol	Condition	VDD=2.7 to 4.5V Rating		VDD=4.5 to 5.5V Rating		Units
				Min.	Max.	Min.	Max.	
SCL clock frequency	SCL	$f_{SCLK}$	—	DC	400	DC	400	KHz
SCL clock low period		$t_{LOW}$	—	1.3	—	1.3	—	us
SCL clock high period		$t_{HIGH}$	—	0.6	—	0.6	—	us
Data set-up time	SI	$t_{SU:DAT}$	—	<b>180</b>	—	100	—	ns
Data hold time		$t_{HD:DAT}$	—	0	0.9	0	0.9	us
SCL,SDA rise time	SCL, SDA	$t_r$	—	$20+0.1C_b$	300	$20+0.1C_b$	300	ns
SCL,SDA fall time		$t_f$	—	$20+0.1C_b$	300	$20+0.1C_b$	300	
Capacitive load represent by each bus line		$C_b$	—	—	400	—	400	pf
Setup time for a repeated START condition	SI	$t_{SU:STA}$	—	0.6	—	0.6	—	us
Start condition hold time		$t_{HD:STA}$	—	0.6	—	0.6	—	us
Setup time for STOP condition		$t_{SU:STO}$	—	0.6	—	0.6	—	us
Bus free time between a Stop and START condition	SCL	$t_{BUF}$	—	1.3	—	1.3	—	us

# 8. Optical Characteristics

## 8.1 OPTICAL CHARACTERISTICS

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
View Angle	(V) $\theta$	$CR \geq 2$	10		45	deg
	(H) $\varphi$	$CR \geq 2$	-30		30	deg
Contrast Ratio	CR	—	2			—
Response Time 25°C	T rise	—		96	250	ms
	T fall	—		108	250	ms

### Conditions :

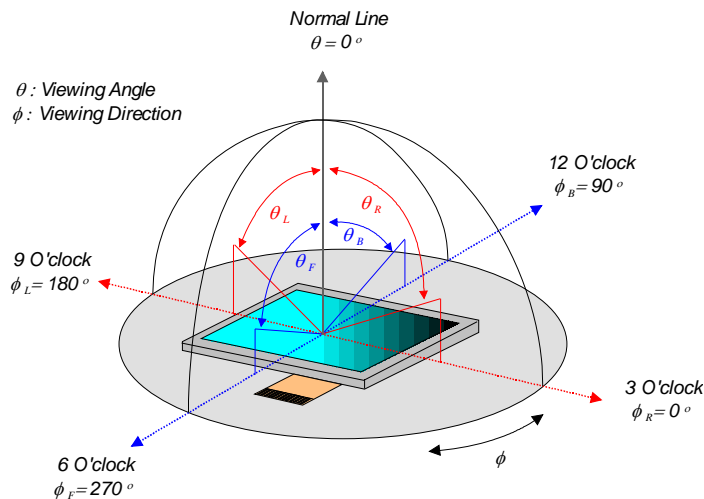
Operating Voltage : Vop

Viewing Angle( $\theta$  ,  $\varphi$ ) :  $0^\circ$  ,  $0^\circ$

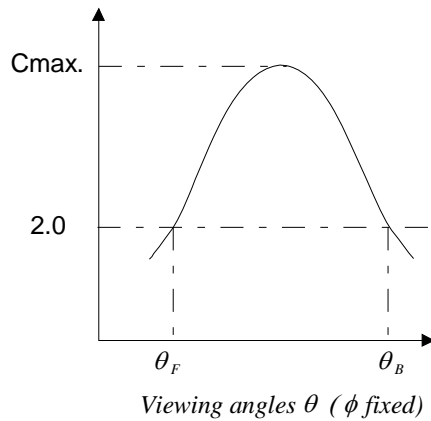
Frame Frequency : 64 HZ

Driving Waveform : 1/N duty , 1/a bias

## 8.2 Definition of Viewing Angle and Optimum Viewing Area



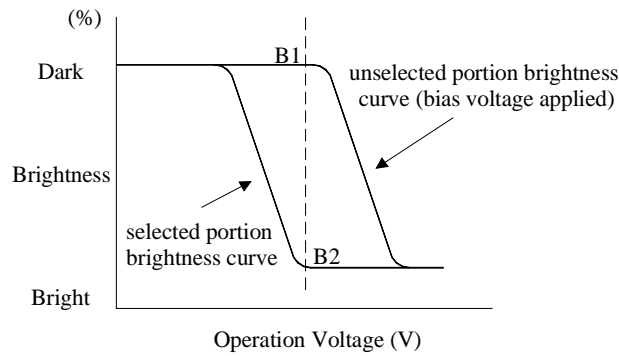
### 8.3 Definition of Viewing Angle $\theta_F$ and $\theta_B$



Optimum viewing angle with the naked eye and viewing angle  $\theta$  at  $C_{max}$ .  
Above are not always the same.

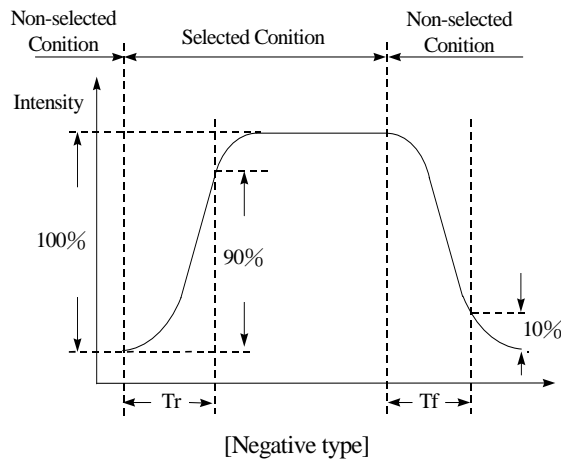
### 8.4 Definition of Contrast CR

$CR = \text{Brightness of selected dot (B1)} / \text{Brightness of unselected dot (B2)}$



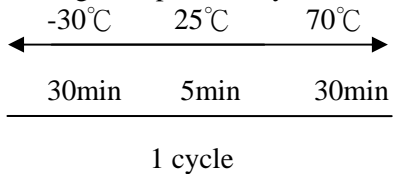
### 8.5 Definition of Response Time

(  $T_r$  ,  $T_f$  )



## 9. Reliability

### 9.1 Content of Reliability Test

Environmental Test				
No.	Test Item	Content of Test	Test Condition	Applicable Standard
1	High Temperature storage	Endurance test applying the high storage temperature for a long time.	70°C / 96hrs	—
2	Low Temperature storage	Endurance test applying the high storage temperature for a long time.	-30°C 96hrs	—
3	High Temperature Operation	Endurance test applying the electric stress (Voltage & Current) and the thermal stress to the element for a long time.	60°C 96hrs	—
4	Low Temperature Operation	Endurance test applying the electric stress under low temperature for a long time.	-20°C 96hrs	—
5	High Temperature/Humidity Storage	Endurance test applying the high temperature and high humidity storage for a long time.	60°C,90%RH 96hrs	—
6	High Temperature/Humidity Operation	Endurance test applying the electric stress (Voltage & Current) and temperature / humidity stress to the element for a long time.	40°C,90%RH 96hrs	—
7	Temperature Cycle	Endurance test applying the low and high temperature cycle. 	-30°C/70°C 5 cycles	—
Mechanical Test				
8	Vibration test	Endurance test applying the vibration during transportation and using.	Total fixed amplitude : 1.5mm Vibration Frequency :10~55Hz One cycle 60 seconds to 3 directions of X,Y,Z for Each 15 minutes	—
Others				
9	Static electricity test	Endurance test applying the electric stress to the terminal.	VS=800V,RS=1.5kΩ CS=100pF 1 time	—

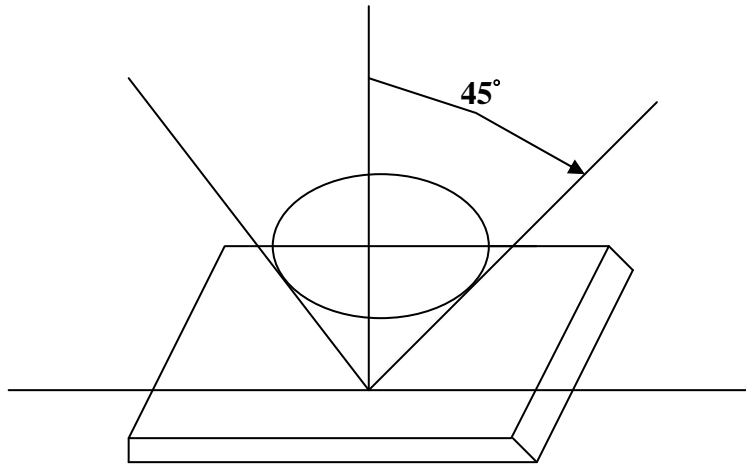
\*\*\*Supply voltage for logic system=5V. Supply voltage for LCD system =Operating voltage at 25°C



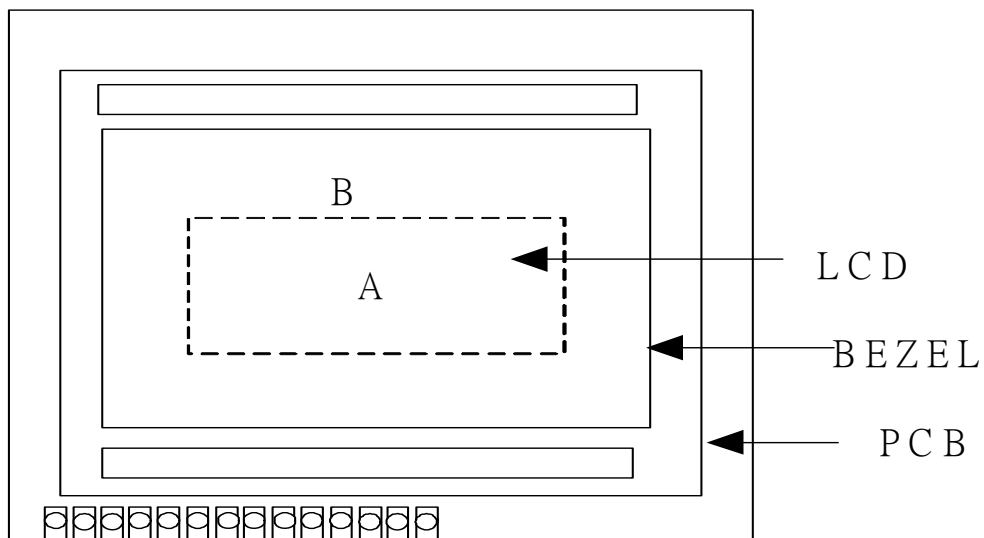
## 10. Quality Assurance

### 10.1 Inspection conditions

The LCD shall be inspected under 40W white fluorescent light. The distance between the eyes and the sample shall be more than 30cm. All directions for inspecting the sample should be within 45° against perpendicular line.



Definition of applicable Zones



A : Display Area

B : Non-Display Area

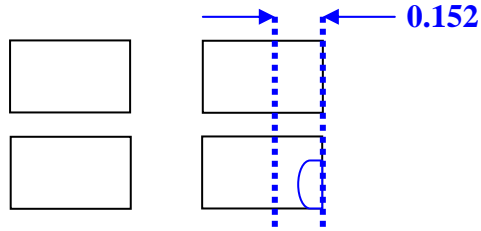
## 10.2 Inspection Parameters

NO.	Parameter	Criteria																												
1	Black or White spots	<table border="1" data-bbox="580 418 1310 745"> <thead> <tr> <th rowspan="2">Zone Dimension</th> <th colspan="2">Acceptable Number</th> <th rowspan="2">Class Of Defects</th> <th rowspan="2">Acceptable Level</th> </tr> <tr> <th>A</th> <th>B</th> </tr> </thead> <tbody> <tr> <td><math>D &lt; 0.15</math></td> <td>*</td> <td>*</td> <td rowspan="4">Minor</td> <td rowspan="4">2.5</td> </tr> <tr> <td><math>0.15 \leq D \leq 0.2</math></td> <td>4</td> <td>4</td> </tr> <tr> <td><math>0.2 \leq D \leq 0.25</math></td> <td>2</td> <td>2</td> </tr> <tr> <td><math>D \leq 0.3</math></td> <td>0</td> <td>1</td> </tr> </tbody> </table> <p data-bbox="580 752 1059 786"><math>D = (\text{Long} + \text{Short})/2</math>      *: Disregard</p>	Zone Dimension	Acceptable Number		Class Of Defects	Acceptable Level	A	B	$D < 0.15$	*	*	Minor	2.5	$0.15 \leq D \leq 0.2$	4	4	$0.2 \leq D \leq 0.25$	2	2	$D \leq 0.3$	0	1							
Zone Dimension	Acceptable Number			Class Of Defects	Acceptable Level																									
	A	B																												
$D < 0.15$	*	*	Minor	2.5																										
$0.15 \leq D \leq 0.2$	4	4																												
$0.2 \leq D \leq 0.25$	2	2																												
$D \leq 0.3$	0	1																												
2	Scratch, Substances	<table border="1" data-bbox="580 871 1310 1328"> <thead> <tr> <th colspan="2">Zone</th> <th colspan="2">Acceptable Number</th> <th rowspan="2">Class Of Defects</th> <th rowspan="2">Acceptable Level</th> </tr> <tr> <th>X(mm)</th> <th>Y(mm)</th> <th>A</th> <th>B</th> </tr> </thead> <tbody> <tr> <td>*</td> <td><math>0.04 \geq W</math></td> <td>*</td> <td>*</td> <td rowspan="4">Minor</td> <td rowspan="4">2.5</td> </tr> <tr> <td><math>3.0 \geq L</math></td> <td><math>0.06 \geq W</math></td> <td>4</td> <td>4</td> </tr> <tr> <td><math>2.0 \geq L</math></td> <td><math>0.08 \geq W</math></td> <td>2</td> <td>3</td> </tr> <tr> <td>—</td> <td><math>0.1 &lt; W</math></td> <td>0</td> <td>1</td> </tr> </tbody> </table> <p data-bbox="580 1335 1059 1368">X: Length    Y: Width    *: Disregard</p> <p data-bbox="580 1375 1091 1408">Total defects should not exceed 4/module</p>	Zone		Acceptable Number		Class Of Defects	Acceptable Level	X(mm)	Y(mm)	A	B	*	$0.04 \geq W$	*	*	Minor	2.5	$3.0 \geq L$	$0.06 \geq W$	4	4	$2.0 \geq L$	$0.08 \geq W$	2	3	—	$0.1 < W$	0	1
Zone		Acceptable Number		Class Of Defects	Acceptable Level																									
X(mm)	Y(mm)	A	B																											
*	$0.04 \geq W$	*	*	Minor	2.5																									
$3.0 \geq L$	$0.06 \geq W$	4	4																											
$2.0 \geq L$	$0.08 \geq W$	2	3																											
—	$0.1 < W$	0	1																											
3	Air Bubbles ( between glass & polarizer)	<table border="1" data-bbox="580 1458 1310 1731"> <thead> <tr> <th rowspan="2">Zone Dimension</th> <th colspan="2">Acceptable Number</th> <th rowspan="2">Class Of Defects</th> <th rowspan="2">Acceptable Level</th> </tr> <tr> <th>A</th> <th>B</th> </tr> </thead> <tbody> <tr> <td><math>D \leq 0.15</math></td> <td>*</td> <td>*</td> <td rowspan="3">Minor</td> <td rowspan="3">2.5</td> </tr> <tr> <td><math>0.15 &lt; D \leq 0.25</math></td> <td>2</td> <td>*</td> </tr> <tr> <td><math>0.25 &lt; D</math></td> <td>0</td> <td>1</td> </tr> </tbody> </table> <p data-bbox="580 1738 751 1771">*: Disregard</p> <p data-bbox="580 1778 1070 1812">Total defects shall not excess 3/module.</p>	Zone Dimension	Acceptable Number		Class Of Defects	Acceptable Level	A	B	$D \leq 0.15$	*	*	Minor	2.5	$0.15 < D \leq 0.25$	2	*	$0.25 < D$	0	1										
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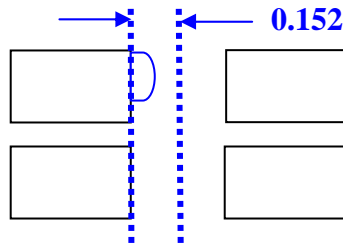
4.

Uniformity

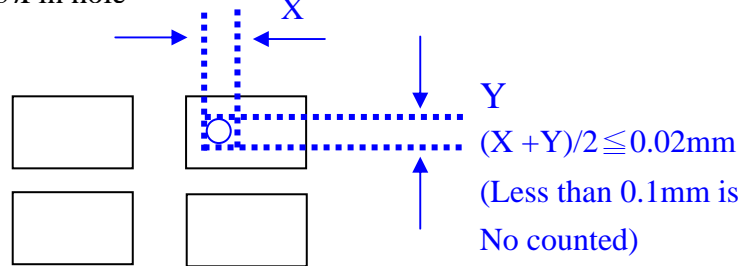
(1) Pixel shape (with Dent)



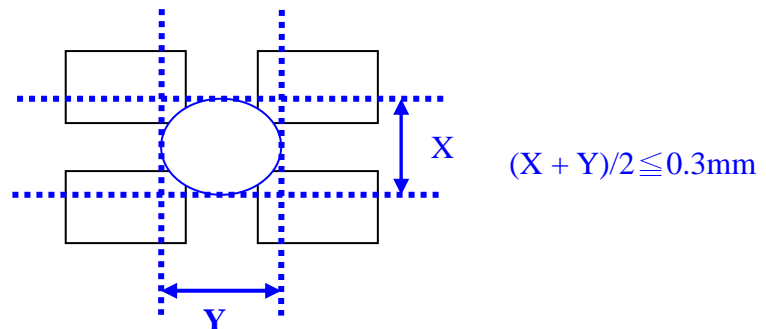
(2) Pixel shape (with Projection)



(3) Pin hole



(4) Deformation



Total acceptable number: 1/pixel ;.5/cell

## LCD Numbering system

SD	C	116	05	G	F	W	JC	
①	②	③	④	⑤	⑥	⑦	⑧	⑨

### ① Brand Name

SD	Swissdis AG
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### ② Display Type

C	Character Type	O	COG	C	Character Type
G	Graphic Type	S	Segment Type	G	Graphic Type

### ③ Number of Pixels

Character Module	Lines x Characters per line
Graphic Module	Row Dots x Column Dots

### ④ Character Size

05	~ 5 mm
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### ⑤ LCD Polarize

	Normal Temperature		Wide Temperature	
	6:00	12:00	6:00	12:00
Reflective	A	B	C	D
Transflective	E	F	G	H
Transmissive	I	J	K	L

### ⑥ LCD Mode

	TN	STN	FSTN	DFSTN
Positive	P	G (Gray)	F	
		Y (Yellow/Green)		
Negative	N	B (Blue)	W	D

### ⑦ Backlight

None	N	None						
EL	I	White	U	Blue Green				
LED	A	Amber	B	Blue	G	Green	E	Yellow/Green, edge
	R	Red	W	White	Y	Yellow/Green		
CCFL	C	White						

### ⑧ IC Font Character

Cyrillic / English	CC
Japanese / English	JC
European / English	RC, EC

### ⑨ Special Code

O6	I2C