SPECIFICATIONS FOR
LCD MODULE

MODEL NO.
BO12864GBNHH$
VER.01

FOR MESSRS:

_____

ON DATE OF:

_____

APPROVED BY:

_____

BOLYMIN, INC.
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History of Version

Version	Contents	Date	Note
01	NEW VERSION	2010/03/23	SPEC.

CONTENTS

1. Numbering System

	B	O	12864	G	B	N	H	-	H	$
	0	1	2	3	4	5	6	7	8	9

0	Brand	Bolymin	
1	Module Type	C= character type G= graphic type P= TAB/TCP type	O= COG type F= COF type L=PLED/OLED
2	Format	2002=20 characters, 2 lines 12232= 122 x 32 dots	
3	Version No.	A type	
4	LCD Color	G=STN/gray Y=STN/yellow-green PLED/yellow-green C=color STN,OLED/RGB	B=STN/blue,OLED/blue F=FSTN T=TN D=OLED/blue+yellow A=OLED/blue+yellow+green
5	LCD Type	R=positive/reflective P=positive/transflective	M=positive/transmissive N=negative/transmissive
6	Backlight type/color	L=LED array/ yellow-green H=LED edge/white R=LED array/red G=LED edge/yellow-green F=RGB array I=RGB edge Q=LED edge/red N=No backlight	D=LED edge/blue E=EL/white B=EL/blue C=CCFL/white Y=LED Bottom/yellow O=LED array/orange K=LED edge/green A=LED edge/amber
7	CGRAM Font (applied only on character type)	J=English/Japanese Font E=English/European Font G=Chinese(simple) F=Chinese(traditional)	C=English/Cyrillic Font H=English/Hebrew Font A=English/Arabic Font
8	View Angle/ Operating Temperature	B=Bottom/Normal Temperature H=Bottom/Wide Temperature U=Bottom/Ultra wide Temperature	T=Top/Normal Temperature W=Top/Wide Temperature C=9H/Normal Temperature E=Top/ultra wide temperature
9	Special Code	3=3 volt logic power supply n=negative voltage for LCD c=cable/connector xxx=to be assigned on datasheet	t=temperature compensation for LCD p=touch panel $=RoHS

2. General Specification

(1) Mechanical Dimension

Item	Dimension	Unit
Number of Dots	128 x 64	dots
Module dimension (L x W x H)	76.0x 50.0 x 6.0 (MAX)	mm
View area	72.0x 39.0	mm
Active area	66.53 x 33.25	mm
Dot size	0.48x 0.48	mm
Dot pitch	0.52 x 0.52	mm

(2) Controller IC: ST7588T controller

(3) Temperature Range

	Wide
Operating	-20 ~+70℃
Storage	-30 ~+80℃

3. Absolute Maximum Ratings

Item	Symbol	Min	Typ	Max	Unit
Operating Temperature	T_{OP}	-20	-	+70	℃
Storage Temperature	T_{ST}	-30	-	+80	℃
Supply Voltage For Logic	Vdd-Vss	-0.3	-	+3.6	V

4. Electrical Characteristics

Item	Symbol	Condition	Min	Typ	Max	Unit
Supply Voltage For Logic	Vdd-Vss	—	2.4	3.0	3.3	V
Supply Voltage For LCD	Vo-Vss	＊Ta=-20℃ Ta=25℃ ＊Ta=+70℃	— — —	— 9.2 —	— — —	V
Input High Volt.	V_{IH}	—	0.7*Vdd	—	Vdd	V
Input Low Volt.	V_{IL}	—	Vss	—	0.3*Vdd	V
Output High Volt.	V_{OH}	—	0.8*Vdd	—	Vdd	V
Output Low Volt.	V_{OL}	—	Vss	—	0.2*Vdd	V
Supply Current	Idd	Vdd=3.3V	—	0.5	—	mA

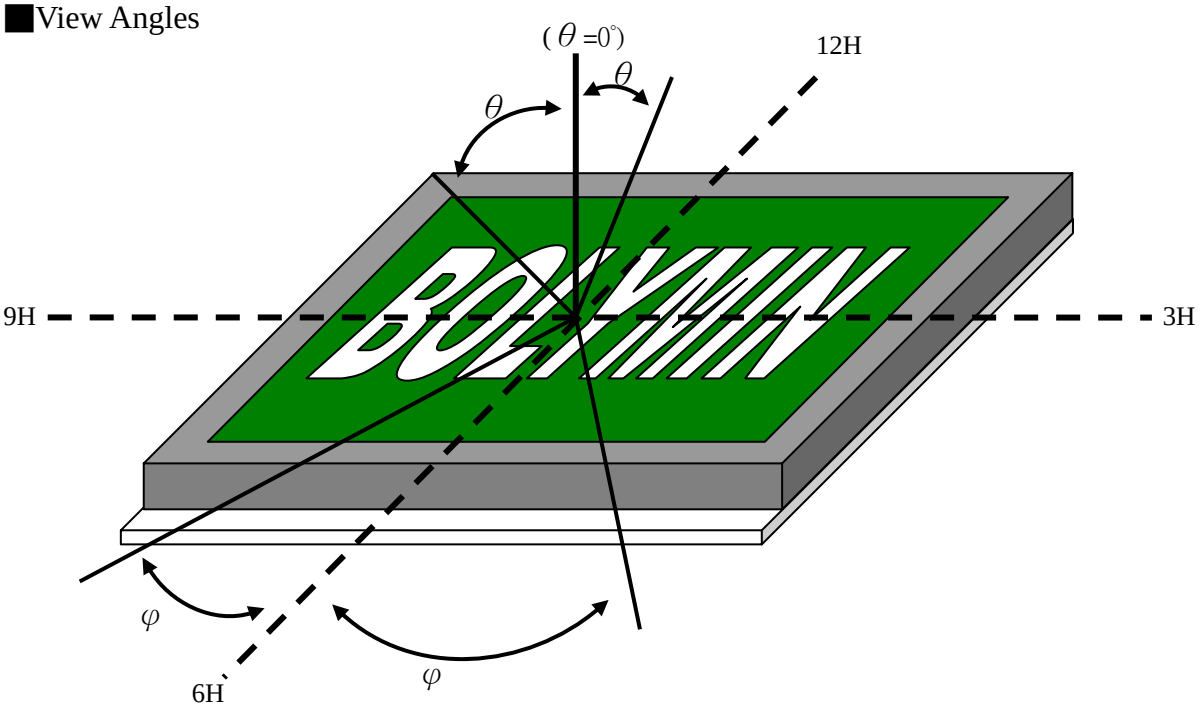
5. Optical Characteristics

a. STN

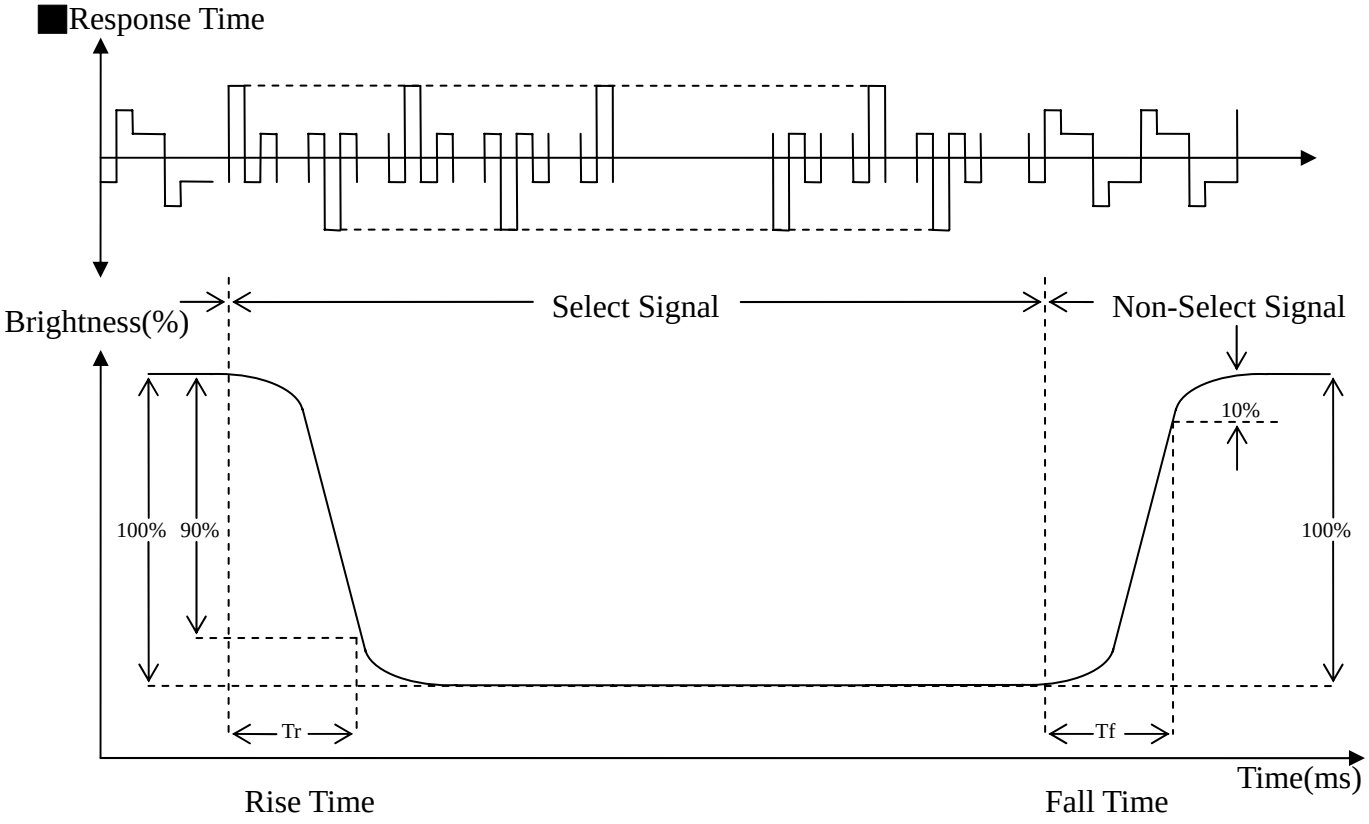
Item	Symbol	Condition	Min.	Typ.	Max.	Unit
View Angle	(V) θ	CR≧2	10	-	60	deg
	(H) φ	CR≧2	-45	-	45	deg
Contrast Ratio	CR	-	-	7.6	-	-
Response Time 25℃	T rise	-	-	28	400	ms
	T fall	-	-	330	400	ms

5.1 Definitions

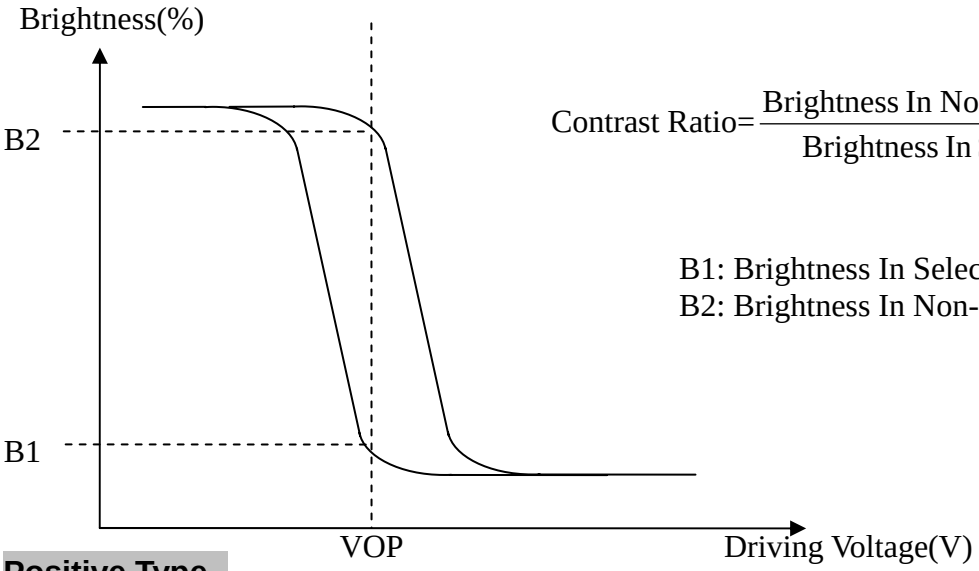
■View Angles



■Response Time



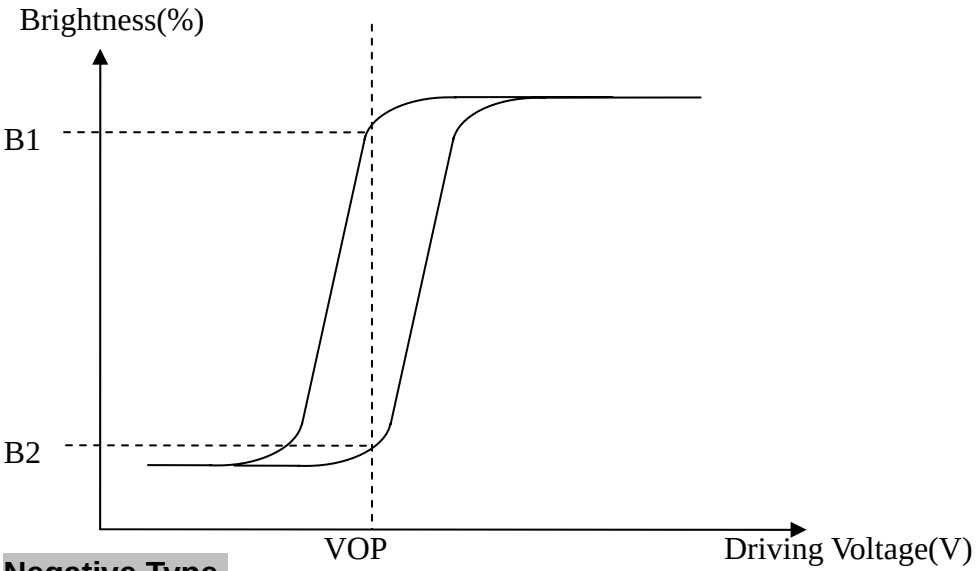
■Contrast Ratio



$$\text{Contrast Ratio} = \frac{\text{Brightness In Non - Select Singal}}{\text{Brightness In Select Singal}}$$

B1: Brightness In Select Signal
B2: Brightness In Non-Select Signal

Positive Type

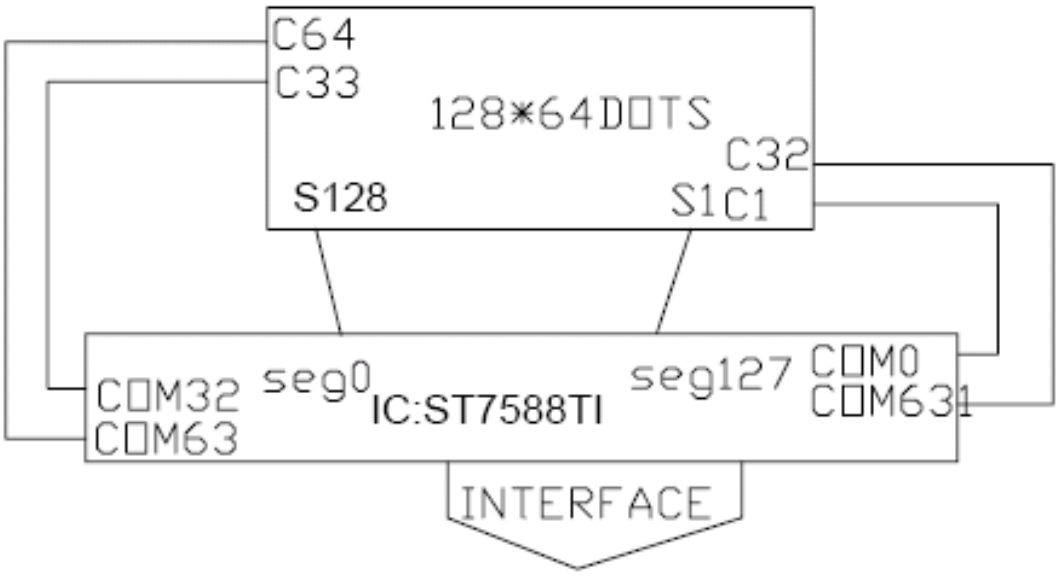


Negative Type

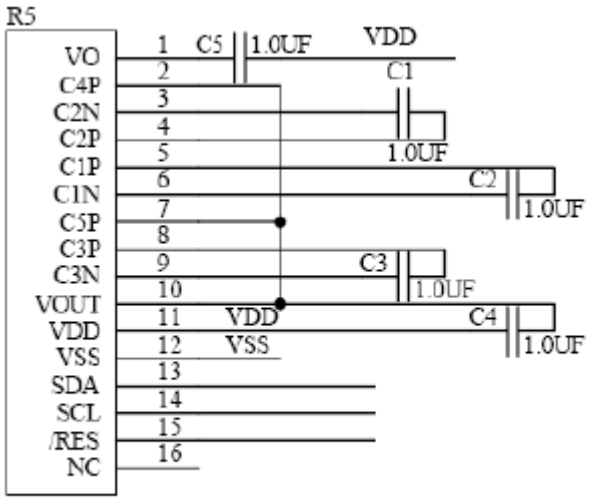
6. Interface Description

Pin No.	Symbol	Level	Description
1	Vo	-	LCD supply voltage
2	C4P	-	For voltage booster circuit capacitor connection pin for voltage converter
3	C2N	-	
4	C2P	-	
5	C1P	-	
6	C1N	-	
7	C5P	-	
8	C3P	-	
9	C3N	-	
10	VOUT	-	DC-DC voltage converter
11	VDD	3.0V	Power supply (+3.0V)
12	VSS	-	Ground
13	SDA	H/L	I2C input data
14	SCL	H/L	I2C input clock
15	/RESET	L	Reset : L=Enable H=Disable
16	NC	-	No connection

7. Block Diagram



8. Power Supply for LCD Module



9. Backlight Information

(1) LED edge/white

Parameter	Symbol	Min	Typ	Max	Unit	Test Condition
Supply Current	ILED	—	105	—	mA	V=3.1V
Supply Voltage	V	2.9	3.1	3.3	V	—
Reverse Voltage	VR	—	—	8	V	—
LCM Surface Luminous	IV	—	—	—	cd/m^2	ILED=105mA
Life Time	—	—	20000	—	Hr.	V≦3.1V
Color	White					

10. Timing Characteristics

10.1 Reset Timing

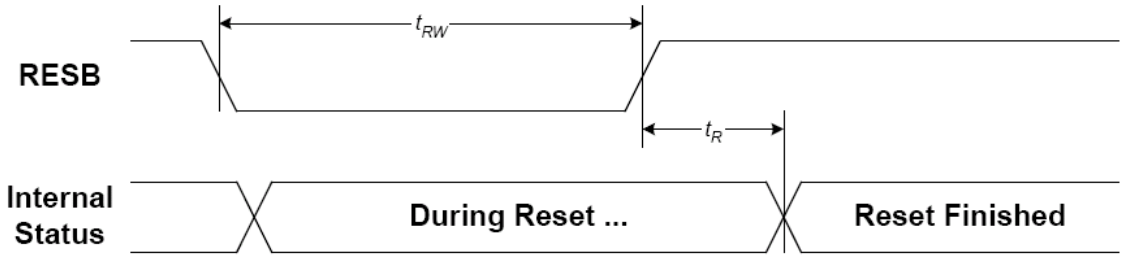


Figure 31

(V_{DD} = 3.3V, Ta = –30 to 85 °C)

Item	Signal	Symbol	Condition	Rating			Units
				Min.	Typ.	Max.	
Reset time		t_R		--	--	400	ns
Reset "L" pulse width	/RES	t_{RW}		1200	--	--	

10.2 I2C Interface Timing

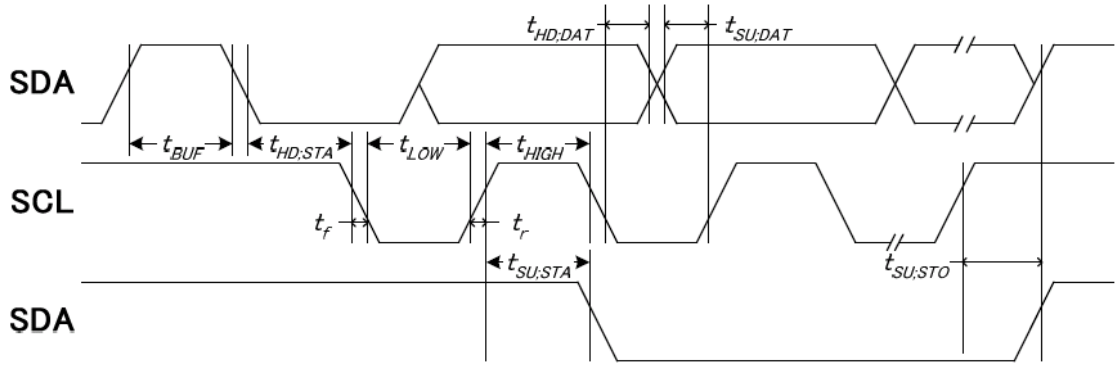
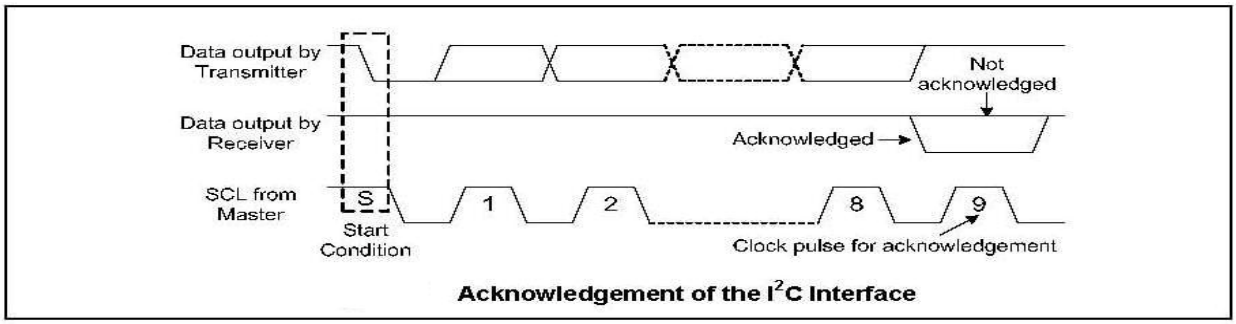


Figure 28

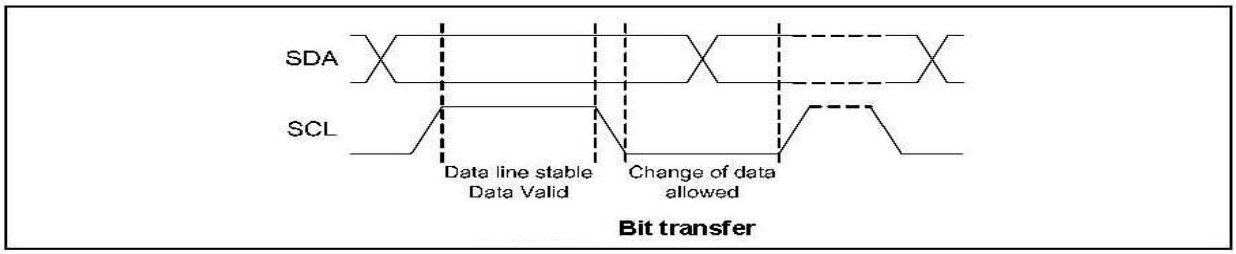
(V_{DD} = 3.3V, Ta = –30 to 85 °C)

Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
SCL clock frequency	SCL	f_{SCLK}		DC	400	kHz
SCL clock low period	SCL	t_{LOW}		150	--	ns
SCL clock high period	SCL	t_{HIGH}		100	--	
Data set-up time	SDA	$t_{SU;Dat}$		90	--	
Data hold time	SDA	$t_{HD;Dat}$		40	--	
Setup time for a repeated START condition	SDA	$t_{SU;STA}$		70	--	
Start condition hold time	SDA	$t_{HD;STA}$		170	--	
Setup time for STOP condition		$t_{SU;STO}$		90	--	
BUS free time between a STOP and START condition	SCL	t_{BUF}		70	--	

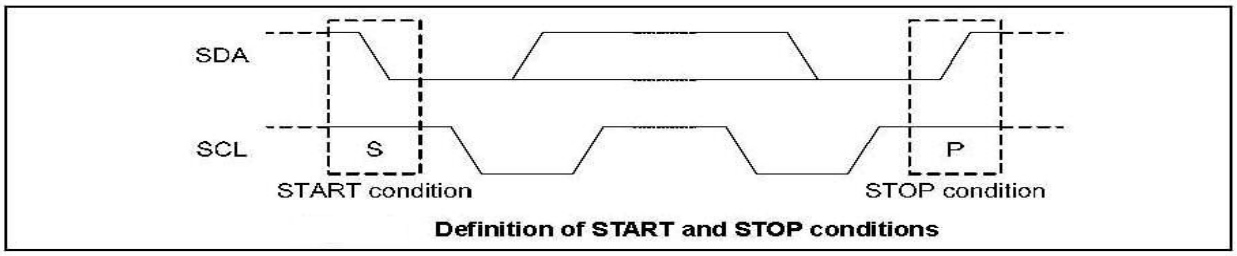
10.3 I2C Interface



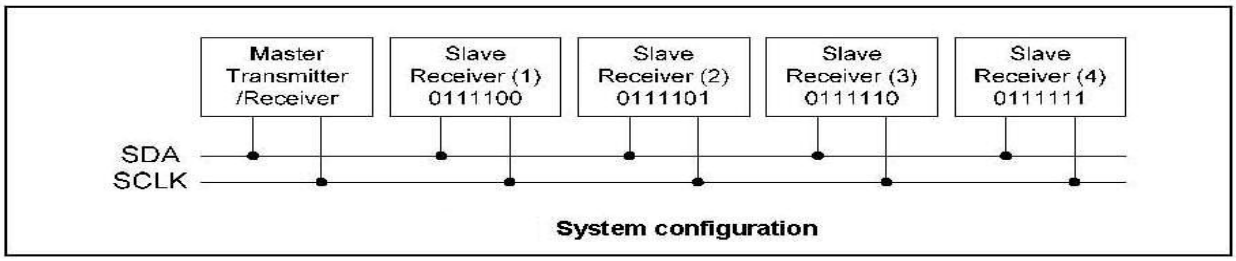
Acknowledgement of the I²C Interface



Bit transfer



Definition of START and STOP conditions



System configuration

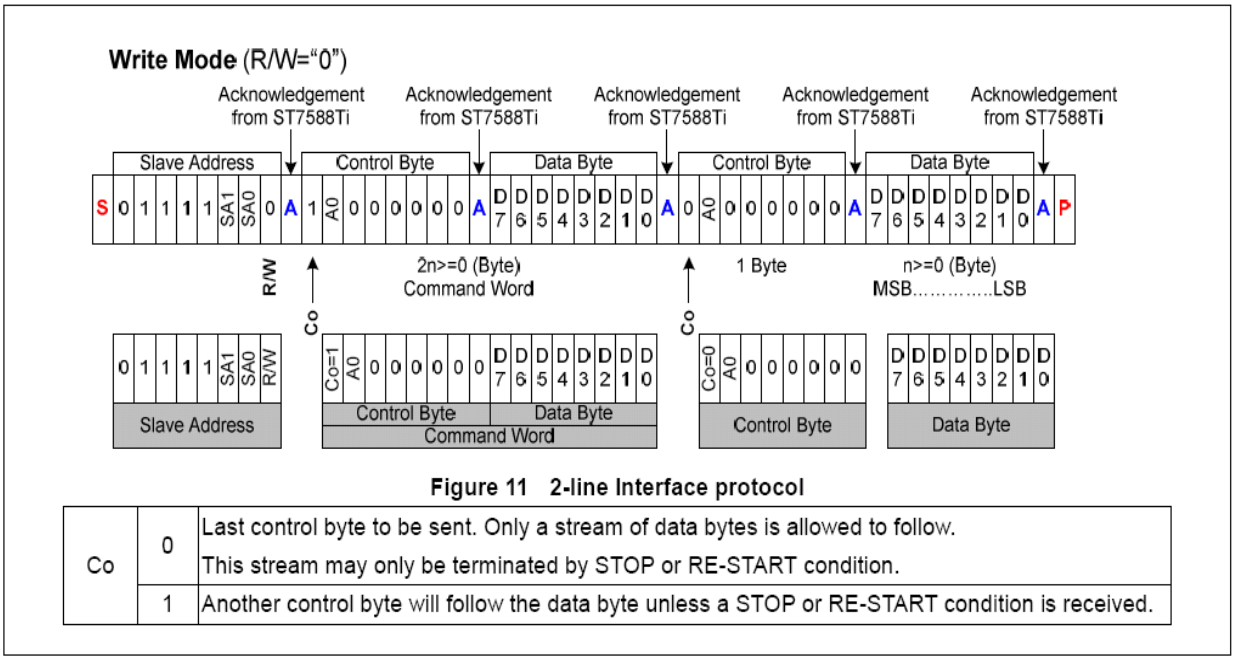


Figure 11 2-line Interface protocol

Co	0	Last control byte to be sent. Only a stream of data bytes is allowed to follow. This stream may only be terminated by STOP or RE-START condition.
	1	Another control byte will follow the data byte unless a STOP or RE-START condition is received.

11. Instruction Description

INSTRUCTION	A0	R/W (WR)	COMMAND BYTE								DESCRIPTION
			D7	D6	D5	D4	D3	D2	D1	D0	
H independent instruction											
Write data	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Write data to RAM
Read data	1	1	D7	D6	D5	D4	D3	D2	D1	D0	Read data to RAM
Read status byte	0	1	PD	0	V	D	E	MX	MY	DO	Read status byte
Function Set	0	0	0	0	1	MX	MY	PD	H1	H0	Mirror X, Mirror Y, Power Down, Extended table

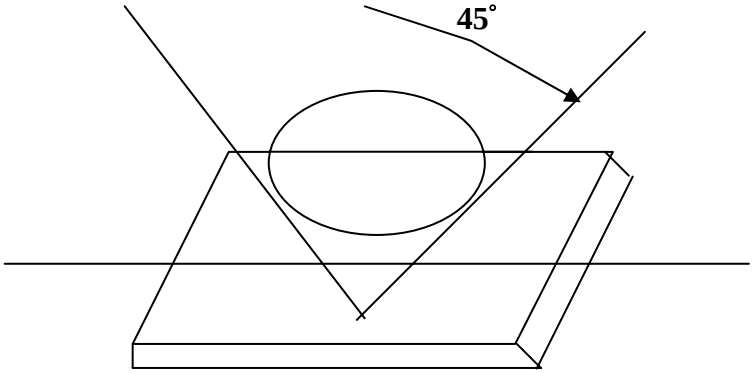
INSTRUCTION	A0	R/W (WR)	COMMAND BYTE								DESCRIPTION
			D7	D6	D5	D4	D3	D2	D1	D0	
H[1:0]=[0:0]											
Set V0 (V_{OP}) range	0	0	0	0	0	0	0	1	0	PRS	V0 (V_{OP}) range L/H select
END	0	0	0	0	0	0	0	1	1	0	Release read/modify/write
Read/modify/write	0	0	0	0	0	0	0	1	1	1	RAM address at R:+0 , W:+1
Display control	0	0	0	0	0	0	1	D	0	E	Sets display configuration
SI3-8bit data (L)&start	0	0	0	1	0	1	DA3	DA2	DA1	DA0	Set the number of data bytes, Low-bit (8 bit 3-line SPI)
SI3-8bit data (M)	0	0	0	1	1	0	DA7	DA6	DA5	DA4	Set the number of data bytes, Middle-bit (8 bit 3-line SPI)
SI3-8bit data (H)	0	0	0	1	1	1	0	DA10	DA9	DA8	Set the number of data bytes, High-bit (8 bit 3-line SPI)
Set Y address	0	0	0	1	0	0	Y3	Y2	Y1	Y0	Set Y address of RAM $0 \leqq Y \leqq 9$
Set X Address (L)	0	0	1	1	1	0	X3	X2	X1	X0	Set X address of RAM, Low-bit. $0 \leqq X \leqq 131$
Set X Address (H)	0	0	1	1	1	1	X7	X6	X5	X4	Set X address of RAM, High-bit. $0 \leqq X \leqq 131$
H[1:0]=[0:1]											
Display configuration	0	0	0	0	0	0	1	DO	0	V	Top/bottom row mode set data order
Bias system	0	0	0	0	0	1	0	BS2	BS1	BS0	Sets bias system (BSx)
Set V0 (V_{OP})	0	0	1	V_{OP6}	V_{OP5}	V_{OP4}	V_{OP3}	V_{OP2}	V_{OP1}	V_{OP0}	Write V0 (V_{OP}) to register

INSTRUCTION	A0	R/W (WR)	COMMAND BYTE								DESCRIPTION
			D7	D6	D5	D4	D3	D2	D1	D0	
H[1:0]=[1:0]											
Set Partial screen mode	0	0	0	0	0	0	0	1	0	PS	PS=1: Enable Partial screen mode.
Partial Display	0	0	0	0	0	0	1	0	0	WS	Set partial screen size
Set Partial Display part	0	0	0	0	0	1	DP3	DP2	DP1	DP0	Set display area for partial screen mode
Set Start line	0	0	1	S6	S5	S4	S3	S2	S1	S0	Specify the initial display line to realize vertical scrolling
H[1:0]=[1:1]											
RESET	0	0	0	0	0	0	0	0	1	1	Software reset
High Power Mode	0	0	1	0	1	1	0	HP	0	0	High Power Mode SET
Frame	0	0	0	0	0	0	1	FR2	FR1	FR0	Frame rate control
N line inversion	0	0	0	1	0	NL4	NL3	NL2	NL1	NL0	Sets N line inversion

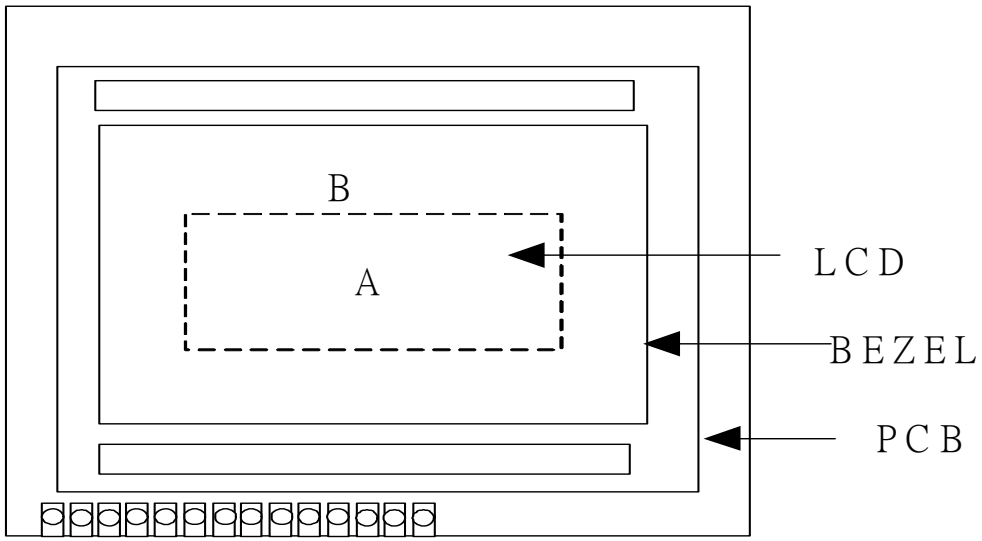
12. Quality Assurance

12.1 Inspection conditions

The LCD shall be inspected under 40W white fluorescent light.



Definition of applicable Zones

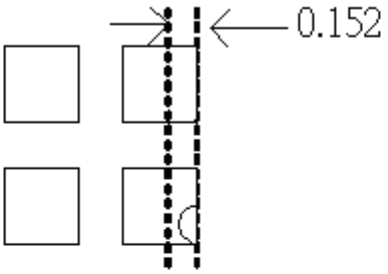
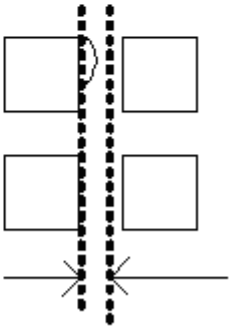
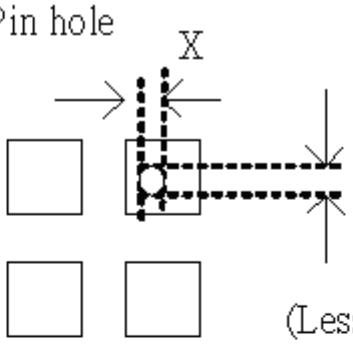
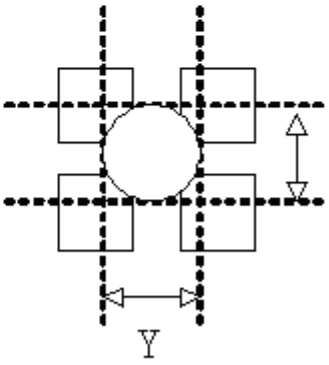


A ：Display Area

B ：Non-Display Area

12.2 Inspection Parameters

<table>
<tr><th>NO.</th><th>Parameter</th><th>Criteria</th></tr>
<tr><td>1</td><td>Black or White spots</td><td>
<table>
<tr><th>Zone / Dimension</th><th colspan="2">Acceptable Number</th><th>Class Of Defects</th><th>Acceptable Level</th></tr>
<tr><td></td><td>A</td><td>B</td><td></td><td></td></tr>
<tr><td>D＜0.15</td><td>*</td><td>*</td><td rowspan="4">Minor</td><td rowspan="4">2.5</td></tr>
<tr><td>0.15≦D≦0.2</td><td>4</td><td>4</td></tr>
<tr><td>0.2≦D≦0.25</td><td>2</td><td>2</td></tr>
<tr><td>D≦0.3</td><td>0</td><td>1</td></tr>
</table>
D=(Long + Short)/2 *: Disregard
</td></tr>
<tr><td>2</td><td>Scratch, Substances</td><td>
<table>
<tr><th colspan="2">Zone
X(mm) Y(mm)</th><th colspan="2">Acceptable Number</th><th>Class Of Defects</th><th>Acceptable Level</th></tr>
<tr><td></td><td></td><td>A</td><td>B</td><td></td><td></td></tr>
<tr><td>*</td><td>0.04≧W</td><td>*</td><td>*</td><td rowspan="4">Minor</td><td rowspan="4">2.5</td></tr>
<tr><td>3.0≧L</td><td>0.06≧W</td><td>4</td><td>4</td></tr>
<tr><td>2.0≧L</td><td>0.08≧W</td><td>2</td><td>3</td></tr>
<tr><td>—</td><td>0.1＜W</td><td>0</td><td>1</td></tr>
</table>
X: Length Y: Width *: Disregard
Total defects should not exceed 4/module
</td></tr>
<tr><td>3</td><td>Air Bubbles (between glass & polarizer)</td><td>
<table>
<tr><th>Zone / Dimension</th><th colspan="2">Acceptable Number</th><th>Class Of Defects</th><th>Acceptable Level</th></tr>
<tr><td></td><td>A</td><td>B</td><td></td><td></td></tr>
<tr><td>D≦0.2</td><td>*</td><td>*</td><td rowspan="3">Minor</td><td rowspan="3">2.5</td></tr>
<tr><td>0.2＜D≦0.5</td><td>2</td><td>*</td></tr>
<tr><td>0.5＜D</td><td>0</td><td>1</td></tr>
</table>
*: Disregard
Total defects shall not excess 3/module.
</td></tr>
</table>

4	Uniformity	(1) Pixel shape (with Dent)  (2) Pixel shape (With Projection)  (3) Pin hole  (Less than 0.1mm is no counted) (4)Deformation  Total acceptable number : 1/pixel,5/cell

13. Reliability

■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℃ 96hrs	——
2	Low Temperature storage	Endurance test applying the high storage temperature for a long time.	-20℃ 96hrs	——
3	High Temperature Operation	Endurance test applying the electric stress (Voltage & Current) and the thermal stress to the element for a long time.	80℃ 96hrs	——
4	Low Temperature Operation	Endurance test applying the electric stress under low temperature for a long time.	-30℃ 96hrs	——
5	Humidity Test	Endurance test applying the high humidity storage for a long time.	40℃,90%RH 96hrs	——
6	Thermal Shock Test	Endurance test applying the low and high temperature cycle. -30℃ 25℃ 80℃ 30min 5min 30min 1 cycle	-30℃/ 80℃ 5 cycles	——
7	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 direction of X,Y,Z for each 15minutes	——

***Supply voltage for logic system=5V. Supply voltage for LCD system = Operating voltage at 25℃

14. Appendix (Drawing)