BOLYMIN

SPECIFICATIONS FOR LCD MODULE

MODEL NO.
BO12864GGPHH$
VER.06

RoHS COMPLIANT

FOR MESSRS:

_____

ON DATE OF:

_____

APPROVED BY:

_____

History of Version

Version	Contents	Date	Note
01	**NEW VERSION**	**2010/01/08**	**SPEC.**
02	**Add Handling Instruction** **Update Quality Assurance and Reliability**	**2012/09/28**	**Page 5、13~15**
03	**Modify Handling Instruction、Electrical Characteristics**	**2013/03/06**	**Page 6、8**
04	**Modify Handling Instruction、Quality Assurance and Reliability**	**2013/08/30**	**Page 5、13~15**
05	**Modify Drawing**	**2013/12/24**	**Page 16**
06	**Modify Handling Precaution、Absolute Maximum Rating、Electrical Characteristics、Optical Characteristics、Quality Assurance and Reliability**	**2016/01/20**	**Page 5~10 15~17**

C O N T E N T S

1. Numbering System

B	O	12864	G	G	P	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
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=3.3 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. Handling Precaution
2.1 Precaution in use of LCD Module
2.1.1. LCD panel is made of glass. Avoid excessive mechanical shock or applying strong pressure and/or sharp tools on the surface of display area.

2.1.2. The polarizer placed on the display surface is easily scratched and damaged. Extreme care should be taken when handling it. To clean dust or dirt off the display surface, wipe gently with cotton, or other soft material soaked with isopropyl alcohol, ethyl alcohol, do not use water, ketone or aromatics to clear display surface, and never scrub it hard.

2.1.3. Keep LCD panels away from direct sunlight. The storage environment should be dust-free, clean, dry, temperature is 25℃±10℃ and the humidity is below 55% RH.

2.1.4. Do not input any signal before power is turned on.

2.1.5. 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.

2.1.6. It's important to control soldering temperature and time. RoHS compliant materials might need higher temperature and time, but try to keep temperature under 350℃ and time in 3-5 sec.

2.1.7. EL is manufactured from the organic film, and is easily affected by temperature, humidity and other environmental impact. Long time storage might cause low quality of the case. Therefore, please start production in 3 months after reception of the LCM. If in any case, long time storage over 3 months is necessary, please keep EL in vacuum package or at least in humidity < 35% RH, and temperature 25℃±10℃.
Note: 2.1.7. is applied to EL backlight only.

2.2 Static Electricity Precautions:
2.2.1. The LCD module contains a C-MOS LSI. People who operate the LCM should wear ESD protection equipment to prevent ESD hurt on products.

2.2.2. 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.

2.2.3. Do not touch the connection terminals of the display with bare hand; it will cause disconnection or defective insulation of terminals.

2.2.4. The modules should be kept in anti-static bags or trays for storage.

2.2.5. Only properly grounded soldering irons should be used.

2.2.6. If an electric screwdriver is used, it should be grounded and shielded to prevent sparks.

2.2.7. The normal static prevention measures should be observed for work clothes and working benches.

2.2.8. Since dry air(almost low RH) is inductive to static, a humidity of 50-60% RH is recommended in assembly line.

2.3 Operation Precautions:
2.3.1. DC voltage applied on LCM causes electrochemical reactions, which will deteriorate the display over time. The applied pulse waveform should be a symmetric waveform such that no DC component remains. Be sure to use the specified operating voltage.

2.3.2. LCD driving voltage should be kept within specified range; excess voltage will shorten display life, while less voltage may not turn on LCM.

2.3.3. LCM response time will be extremely delayed in low operating temperature(such as -20℃) than in room operating temperature. Therefore, higher LCD driving voltage is required in low operating temperature; On the other hand, in high operating temperature (such as +70℃) LCD shows dark background color, therefore lower LCD driving voltage is required. Be sure to use the specified LCD driving voltage in different operating temperature.

2.4 Safety:

2.4.1 If the LCD panel breaks, be careful not to get the liquid crystal to touch your skin. If the liquid crystal touches your skin or clothes, please wash it off immediately by using soap and water.

2.5 WARRANTY POLICY

Bolymin .Will provide one-year warranty for the products only if under specification operating conditions.

If there are functional defects found during the period of warranty, the defective products would be replaced on a one-to-one basis.

Bolymin would not be responsible for any direct/indirect liabilities consequential to any parties.

2.6 MTBF

2.6.1 .By specific test condition, MTBF based on 30℃ normal operation temperature is 50,000hours.

2.6.2 Test Condition:

2.6.2.1 Supply Voltage for LCM: Typical Vdd

2.6.2.2 CC (Constant Current) mode and typical current is applied for LED.

2.6.2.3 Run-Patterns: by Bolymin's test program that has defined patterns and cyclic period.

2.6.2.4 Humidity: 60%RH

2.6.3 Test Criteria:

Attenuation of average brightness: $\leq$ 50%

Increasing of current consumption for LCM/Backlight: $\leq$ 20%

Display function at room temperature: Normal

Appearance: Normal

3. General Specification

(1) Mechanical Dimension

Item	Dimension	Unit
Number of Dots	128 x 64	dots
Module dimension (L x W x H)	88.3x 103.8 x 6.0 –LED B/L	mm
View area	72.0x 39.0	mm
Active area	66.53 x 33.25	mm
Dot size	0.49x 0.49	mm
Dot pitch	0.52 x 0.52	mm

(2) Controller IC: ST7588T controller

4. Absolute Maximum Ratings

4.1 Electrical Absolute Maximum Ratings

(Vss=0V, Ta=25℃)

Item	Symbol	Min	Typ	Max	Unit
Supply Voltage For Logic	Vdd-Vss	-0.3	-	3.6	V
Supply Voltage For LCD	Vo-Vss	-0.5	-	13.5	V
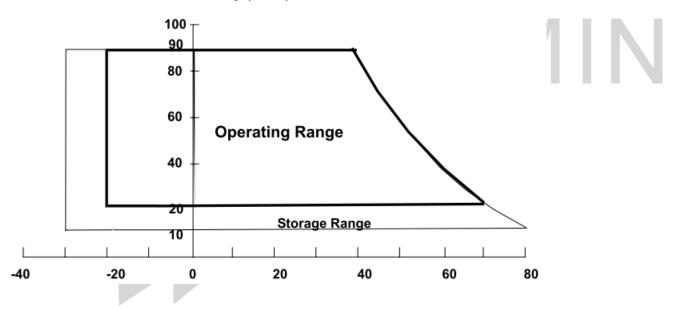
4.2 Environmental Absolute Maximum Ratings

Item	Symbol	Min	Max	Unit	Note
Operating Temperature	TOP	-20	70	℃	(1)
Storage Temperature	TST	-30	80	℃	(1)

Note (1)

(a) 90 %RH Max. (Ta <= 40 ºC).

(b) Wet-bulb temperature should be 39 ºC Max. (Ta > 40 ºC).

(c) No condensation.
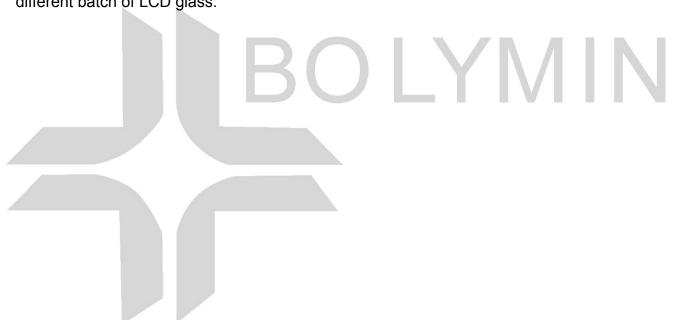
5. Electrical Characteristics

Item	Symbol	Condition	Min	Typ	Max	Unit
Supply Voltage For Logic	Vdd-Vss	—	1.8	—	3.3	V
Supply Voltage For LCD	Vo-Vss	Ta=25℃	8.9	9.2	9.5	V
Input High Volt.	V_{IH}	—	0.7*Vdd	—	0.3*Vdd	V
Input Low Volt.	V_{IL}	—	Vss	—	0.2*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
LCM Surface Luminance Ta=25℃	L	I_{LED}=105mA Display all OFF	55	82	—	cd/m^2

※Optimum LCD driving voltage value, referring to above mentioned range, is changed due to different batch of LCD glass.
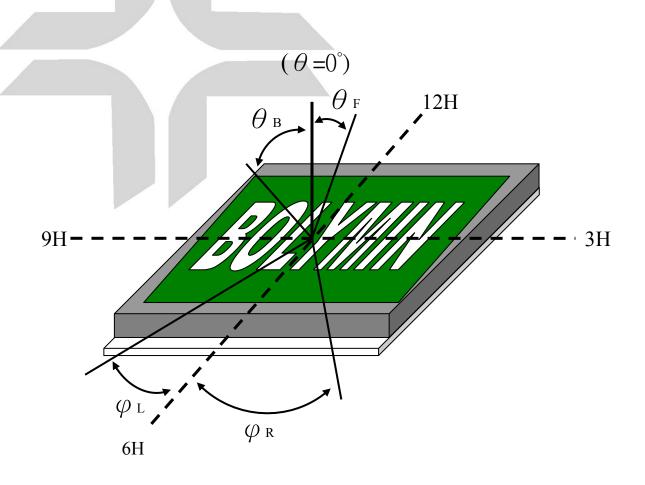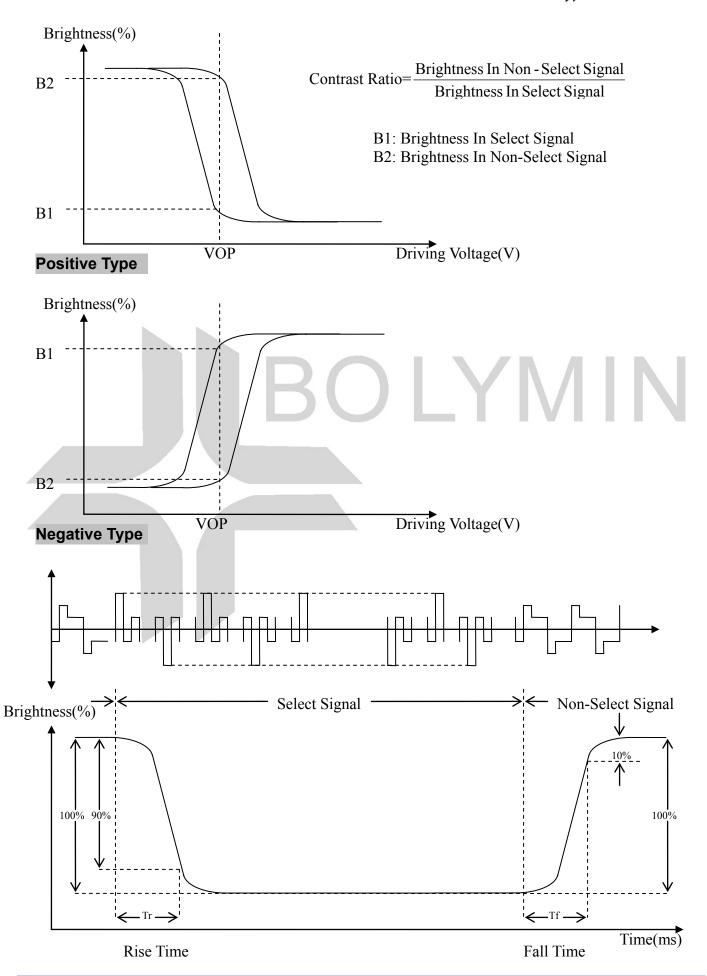
6. Optical Characteristics

a. STN   (Ta=25℃)

Item	Symbol	Min.	Typ.	Max.	Unit
View Angle (CR>=2)	θ_F	-	35	-	deg
	θ_B	-	50	-	deg
	φ_L	-	50	-	deg
	φ_R	-	50	-	deg
Contrast Ratio	CR	2	3	-	-
Response Time 25℃	T rise	-	200	350	ms
	T fall	-	200	400	ms

Brightness(%)

B2

B1

VOP
Driving Voltage(V)

Positive Type

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

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

Brightness(%)

B1

B2

VOP
Driving Voltage(V)

Negative Type

Select Signal — Non-Select Signal

Brightness(%)

100% 90%

10%

100%

Tr

Tf

Time(ms)

Rise Time

Fall Time
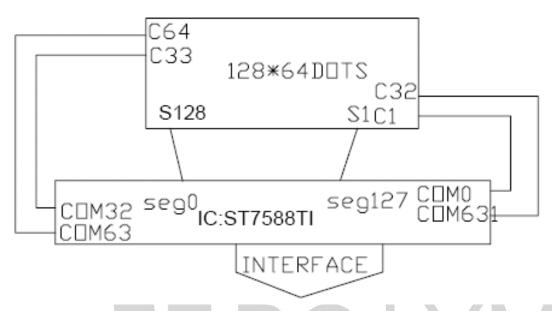
7.Interface Pin Function

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	3.3V	Power supply (+3.3V)
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
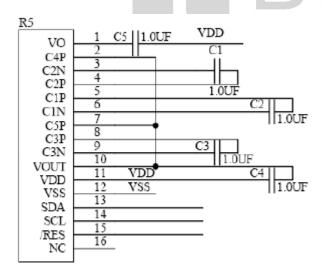
8. Block Diagram And Power Supply for LCD Module

Block Diagram

Power Supply for LCD Module
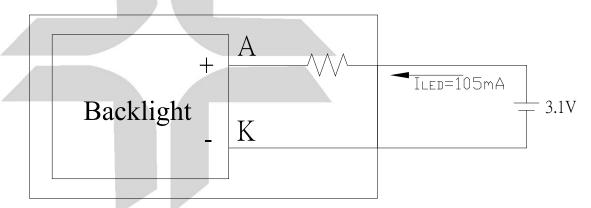
9. Backlight information

(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	ILED=105mA
Reverse Voltage	VR	—	—	5	V	—
CIE	X	0.26	—	0.32		ILED=105mA
	Y	0.26	—	0.32		
Color	White					

(2) Backlight driving methods

   a. LED B/L drive from A.K directly
       a.1 edge/white

10. Quality Assurance

10.1 Inspection conditions

1. The LCD shall be inspected under 20~40W white fluorescent light.

2. Checking Direction shall be in the 40 degree from perpendicular line of specimen surface.
3. Checker shall see over 30 cm.
4. Inspect about 5 seconds for each side.

5. Defect that is located at outside of VA and doesn't affect function is ignored.

10.2 Inspection Parameters

NO.	Parameter	Criteria			
1	Black or White spots (Particle)	Dimension \ Zone	Acceptable Number	Class Of Defects	Acceptable Level
		D≦0.10	Disregard	Minor	2.5
		0.10＜D≦0.2	4		
		0.2＜D≦0.3	2		
		0.3＜D	0		

D=(Long + Short)/2
Total defects should not exceed 5/module
Defect that is located at outside of AA and doesn't affect function is ignored.

NO.	Parameter	Zone		Acceptable Number	Class Of Defects	Acceptable Level
		X(mm)	Y(mm)			
2	Scratch, Substances	－	0.05≧W	Disregard	Minor	2.5
		4.0≧L	0.05≧W	4		
		3.0≧L	0.1≧W	2		
		－	0.1＜W	0		

X: Length   Y: Width
Total defects should not exceed 5/module
Defect that is located at outside of AA and doesn't affect function is ignored.

3	Air Bubbles (between glass & polarizer)				

Zone\nDimension	Acceptable Number	Class Of Defects	Acceptable Level
D≦0.2	Disregard		
0.2＜D≦0.5	3	Minor	2.5
0.5＜D	0		

Total defects shall not excess 3/module.
Defect that is located at outside of AA and doesn't affect function is ignored.
Bobble is sawn only under reflection light is disregarded.

4 — Displaying Pattern

1. Incomplete or broken line is not allowed.
2. Pinholes

Dimension Φ(mm)	Criteria	Class Of Defects	Acceptable Level
Φ＜0.1	Disregard		
0.1＜Φ≦0.2	2	Minor	2.5
0.2＜Φ≦0.25	1		
0.25＜Φ	0		

$$Ø=(X+Y)/2$$

3. Deformation

Dimension Φ(mm)	Criteria	Class Of Defects	Acceptable Level
Φ＜0.15	Disregard		
Φ≦0.25 and X≦1/2D	3	Minor	2.5
Φ＞0.25and X＞1/2D	0		

D：間距 $$Ø=(X+Y)/2$$

Other Inspection standard reference Bolymin standard.

11.Reliability
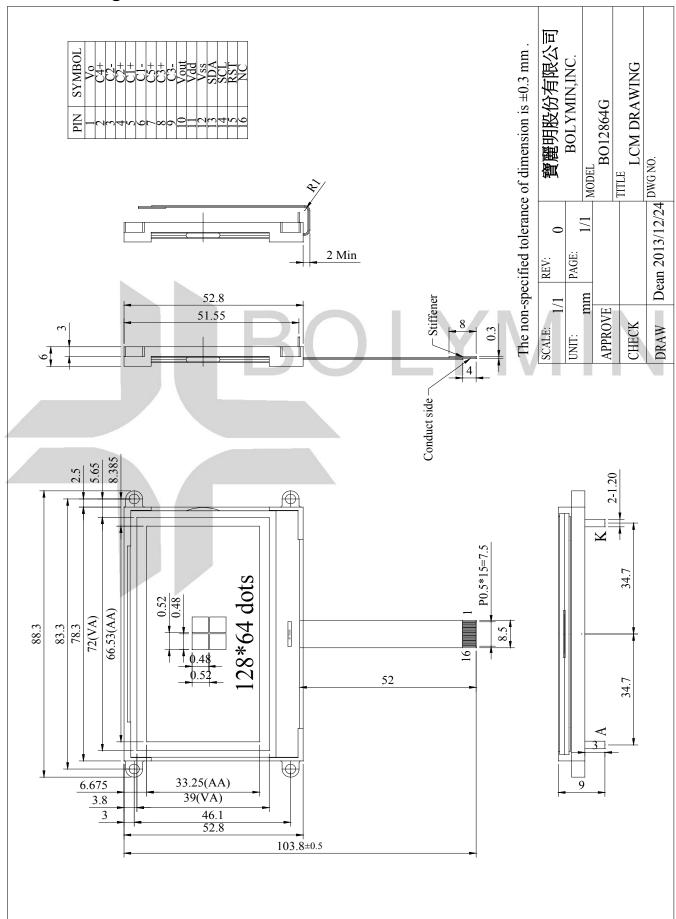
■Content of Reliability Test

No	Test Item	Content of Test	Test Condition	Applicable Standard
Environmental Test				
1	High Temperature storage	Endurance test applying the high storage temperature for a long time.	80℃ 96 hrs	――
2	Low Temperature storage	Endurance test applying the high storage temperature for a long time.	-30℃ 96 hrs	――
3	High Temperature Operation	Endurance test applying the electric stress (Voltage & Current) and the thermal stress to the element for a long time.	70℃ 96 hrs	――
4	Low Temperature Operation	Endurance test applying the electric stress under low temperature for a long time.	-20℃ 96 hrs	――
5	Humidity Test	Endurance test applying the high humidity storage for a long time.	40℃,90%RH 96hrs	――
6	Temperature cycle (Non-operation)	Endurance test applying the low and high temperature cycle. -30℃　　　　　　　　80℃ ←――――――――――→ 30min　　　　　30min 1 cycle	-30℃/80℃ 10　cycles	――
7	Vibration test (Packaged)	Endurance test applying the vibration.	Total Fixed Amplitude:1.5mm Vibration Frequency :10~55Hz One cycle 60 seconds to 3 direction of X,Y,Z for each 15minutes	――

※Assess after placing at normal temperature and humidity for 4 hour。No abnormalities in

functions and appearance。

12.Appendix (Drawing , ST7588T controller data)
12.1 Drawing

12.2 ST7588T controller data

12.2.1. Instruction table

INSTRUCTION	A0	R/W (WR)	D7	D6	D5	D4	D3	D2	D1	D0	DESCRIPTION
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)	D7	D6	D5	D4	D3	D2	D1	D0	DESCRIPTION
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 $0 \leq Y \leq 9$
Set X Address (L)	0	0	1	1	1	0	X3	X2	X1	X0	Set X address of RAM, Low-bit. $0 \leq X \leq 131$
Set X Address (H)	0	0	1	1	1	1	X7	X6	X5	X4	Set X address of RAM, High-bit. $0 \leq X \leq 131$
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)	D7	D6	D5	D4	D3	D2	D1	D0	DESCRIPTION
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

12.2.2 . Timing characteristics
Reset Timing
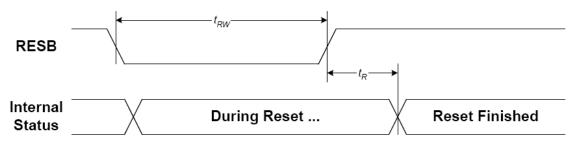
Figure 31

(V$_{DD}$ = 3.3V, Ta = –30 to 85 °C)

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

I2C Interface Timing
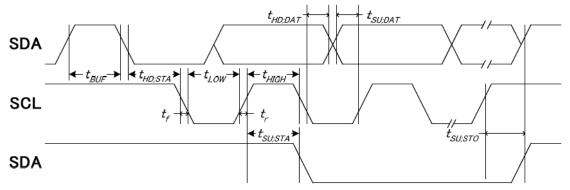
Figure 28

(V$_{DD}$ = 3.3V, Ta = –30 to 85 °C)

Item	Signal	Symbol	Condition	Min.	Max.	Units
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	--	

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.