

**Display Elektronik GmbH**

# DATA SHEET

**LCD MODULE**

**DEM 132038A FGH-PW**

**Product Specification**

**Version : 1**

**22.07.2011**

**DOCUMENT REVISION HISTORY**

<b>Version</b>	<b>DATE</b>	<b>DESCRIPTION</b>	<b>CHANGED BY</b>
0	Jul-19-2011	First issue	
1	Jul-22-2011	Update dimensional outline at p3	

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## 1. FUNCTIONS & FEATURES

Format	: 132 x 38 Dots
LCD mode	: FSTN / Positive/ Transflective Mode
Viewing direction	: 6 o'clock
Driving scheme	: 1/49 Duty cycle, 1/6 Bias
Power supply voltage (V <sub>DD</sub> )	: 3.3Volt (typ.)
LCD driving voltage (VLCD)	: 8.5Volt (typ.)
Operation temp	: -20 to +70°C
Storage temp	: -25 to +80°C
Backlight color	: LED, Lightguide, White

## 2. MECHANICAL SPECIFICATIONS

Module size	: 104.0 x 37.5 mm (without FPC)
Viewing area	: 91.5 x 26.5 mm

## 3. BLOCK DIAGRAM

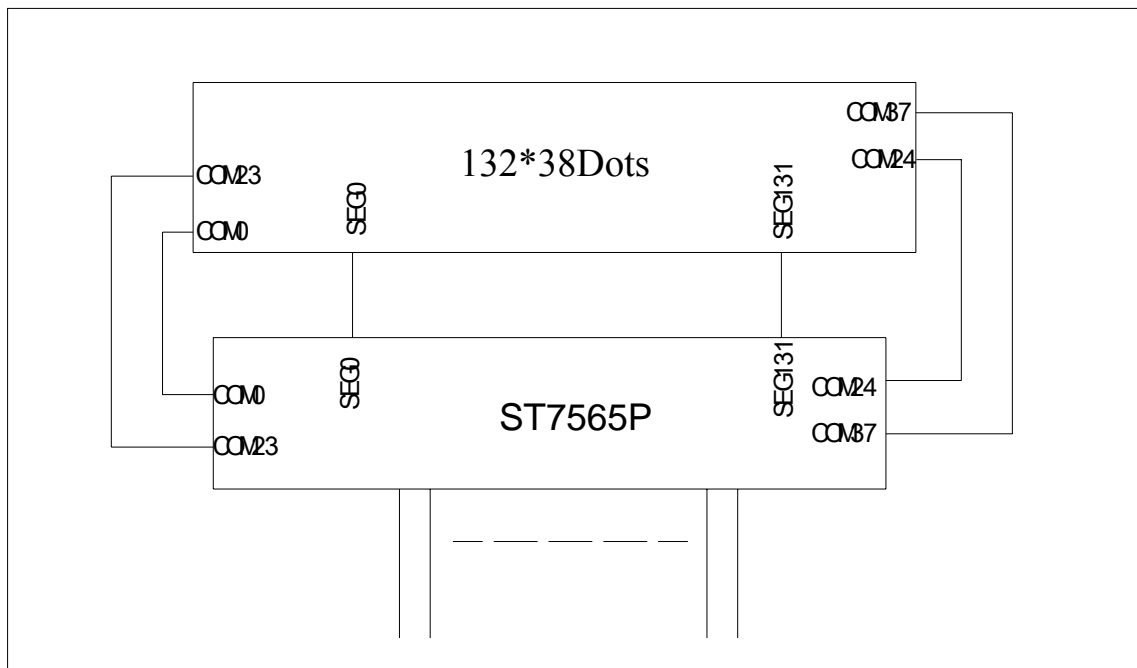


Figure 1. Block diagram

4. DIMENSIONAL OUTLINE

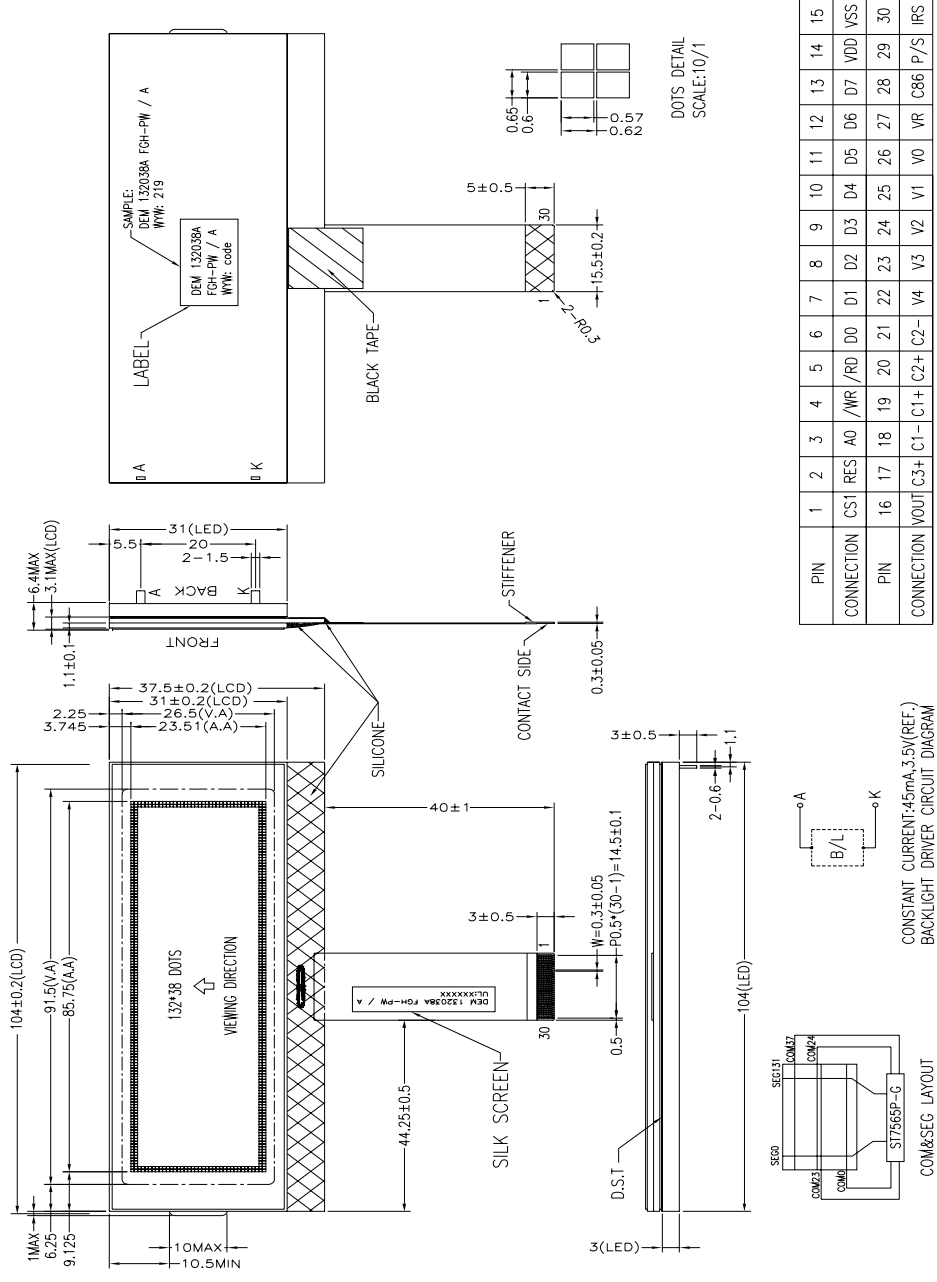


Figure 2. Dimensional outline

### 5. LCD Driving voltage generator and bias reference circuit

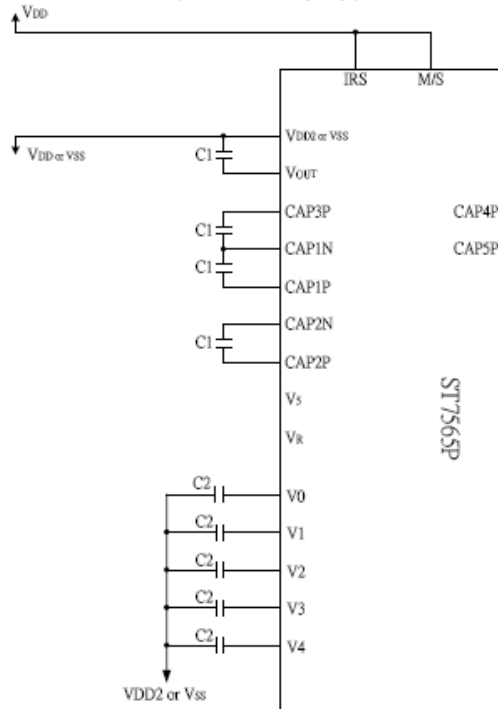
When the voltage regulator internal resistor is not used.

(Example where  $V_{DD2}=V_{DD}$ , with 4× step-up)

1. When used all of the step-up circuit, voltage regulating circuit and V/F circuit

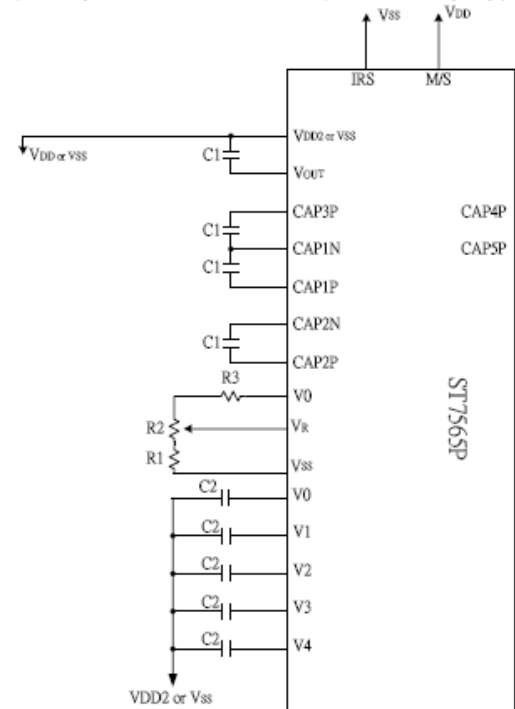
(1) When the voltage regulator internal resistor is used.

(Example where  $V_{DD2} = V_{DD}$ , with 4x step-up)



(2) When the voltage regulator internal resistor is not used.

(Example where  $V_{DD2} = V_{DD}$ , with 4x step-up)



NOTE: Reference circuit used 4 times booster circuit .

- Recommended component values: C1: 1.0 to 4.7uF ; C2: 0.47~1.0uF
- C1, C2 is determined by the size of the LCD being driven. Select a value that will stabilize the liquid crystal drive voltage.
- Ra and Rb may be changed in mass productions to keep the consistency of display contrast.

## 6. PIN DESCRIPTION

No.	Symbol	Function
1	CS1	This is the chip select signal. When /CS1 =“L”, then the chip select becomes active, and data/command I/O is enabled
2	RES	When /RES is set to “L”, the setting are initialized
3	A0	This is connected to the least significant bit of the normal MPU address bus, and it determines whether the data bits are data or a command
4	/WR(RW)	<ul style="list-style-type: none"> <li>• When connected to 8080 series MPU, this pin is treated as the “/WR” signal of the 8080 MPU and is LOW-active.</li> </ul> The signals on the data bus are latched at the rising edge of the /WR signal. <ul style="list-style-type: none"> <li>• When connected to 6800 series MPU, this pin is treated as the “R/W” signal of the 6800 MPU and decides the access type :                When R/W = “H”: Read.                When R/W = “L”: Write.</li> </ul>
5	/RD(E)	When connected to 8080 series MPU, this pin is treated as the “/RD” signal of the 8080 MPU and is LOW-active. The data bus is in an output status when this signal is “L”. <ul style="list-style-type: none"> <li>• When connected to 6800 series MPU, this pin is treated as the “E” signal of the 6800 MPU and is HIGH-active. This is the enable clock input terminal of the 6800 Series MPU.</li> </ul>
6-13	D0~D7	This is an 8-bit bi-directional data bus that connects to an 8-bit or 16-bit standard MPU data bus. When the serial interface (SPI-4) is selected (P/S = “L”) : D7 : serial data input (SI) ; D6 : the serial clock input (SCL). D0 to D5 should be connected to VDD or floating. When the chip select is not active, D0 to D7 are set to high impedance.
14	VDD	Power supply for logic(+3.0V)
15	VSS	Power ground
16	VOUT	DC/DC voltage converter.

17-21	C3+, C1-, C1+, C2+, C2-,	DC/DC voltage converter output
22-26	V4,V3,V2,V1, V0	The DC/DC voltage converter output is is a multi-level power supply for the liquid crystal drive.
27	VR	Output voltage regulator terminal. Provides the voltage between VSS and V0 through a resistive voltage divider. IRS = "L" : the V0 voltage regulator internal resistors are not used. IRS = "H" : the V0 voltage regulator internal resistors are used.
28	C86	This is the MPU interface selection pin. C86 = "H": 6800 Series MPU interface. C86 = "L": 8080 Series MPU interface.
29	P/S	This pin configures the interface to be parallel mode or serial mode. P/S = "H": Parallel data input/output. P/S = "L": Serial data input.
30	IRS	This terminal selects the resistors for the V0 voltage level adjustment. IRS = "H": Use the internal resistors IRS = "L": Do not use the internal resistors. The V0 voltage level is regulated by an external resistive voltage divider attached to the VR terminal

## **7. MAXIMUM ABSOLUTE LIMIT**

### **Maximum Ratings (Voltage Reference to VSS)**

<b>Item</b>	<b>Symbol</b>	<b>MIN</b>	<b>MAX</b>	<b>Unit</b>
Supply Voltage for Logic	V <sub>DD</sub>	-0.3	3.6	V
Supply Voltage for LCD	V <sub>0</sub>	0.3	14.5	V
Operating Temperature	Top	-20	70	°C
Storage Temperature	Tst	-25	80	°C



## 8. ELECTRICAL CHARACTERISTICS

DC Electrical Characteristics (VDD=3.3V, VSS=0V, T<sub>A</sub>=25°C)

Item	Symbol	Condition	Rating			Units	Applicable Pin		
			Min.	Typ.	Max.				
Operating Voltage (1)	VDD		1.8	—	3.3	V	V <sub>SS</sub> *1		
Operating Voltage (2)	VDD2	(Relative to VSS)	2.4	—	3.3	V	V <sub>SS</sub>		
High-level Input Voltage	VIHC		0.8 x V <sub>DD</sub>	—	V <sub>DD</sub>	V	*3		
Low-level Input Voltage	VILC		V <sub>SS</sub>	—	0.2 x V <sub>DD</sub>	V	*3		
High-level Output Voltage	VOHC	I <sub>OH</sub> = -0.5 mA	0.8 x V <sub>DD</sub>	—	V <sub>DD</sub>	V	*4		
Low-level Output Voltage	VOLC	I <sub>OL</sub> = 0.5 mA	V <sub>SS</sub>	—	0.2 x V <sub>DD</sub>	V	*4		
Input leakage current	ILI	V <sub>IN</sub> = VDD or VSS	-1.0	—	1.0	μA	*5		
Output leakage current	ILO	V <sub>IN</sub> = VDD or VSS	-3.0	—	3.0	μA	*6		
Liquid Crystal Driver ON Resistance	R <sub>ON</sub>	Ta = 25°C (Relative to V <sub>SS</sub> )	V <sub>0</sub> = 13.0 V	—	2.0	3.5	KΩ	SEGn COMn *7	
			V <sub>0</sub> = 8.0 V	—	3.2	5.4			
Input Terminal Capacitance	C <sub>IN</sub>	Ta = 25°C, f = 1 MHz	—	5.0	8.0	pF			
Oscillator Frequency	Internal Oscillator	f <sub>OSC</sub>	1/65 duty 1/33 duty	Ta = 25°C	17	20	24	kHz	*8
	External Input	f <sub>CL</sub>			17	20	24	kHz	CL
	Internal Oscillator	f <sub>OSC</sub>	1/49 duty 1/53 duty	Ta = 25°C	25	30	35	kHz	*8
	External Input	f <sub>CL</sub>			1/55 duty	25	30	35	kHz

Item	Symbol	Condition	Rating			Units	Applicable Pin	
			Min.	Typ.	Max.			
Internal Power	Input voltage	VDD2	(Relative to VSS)	2.4	—	3.3	V	V <sub>SS</sub>
	Supply Step-up output voltage Circuit	V <sub>OUT</sub>	(Relative to VSS)	—	—	13.5	V	V <sub>OUT</sub>
	Voltage regulator Circuit Operating Voltage	V <sub>OUT</sub>	(Relative to VSS)	6.0	—	13.5	V	V <sub>OUT</sub>
	Voltage Follower Circuit Operating Voltage	V <sub>0</sub>	(Relative to VSS)	4.0	—	13.0	V	V <sub>0</sub> *9
	Base Voltage	V <sub>R</sub>	Ta = 25°C, (Relative to VSS) -0.05%/°C	2.07	2.10	2.13	V	*10

## 9. TIMING CHARACTERISTICS

System Bus Read/Write Characteristics 1 (For the 8080 Series MPU)

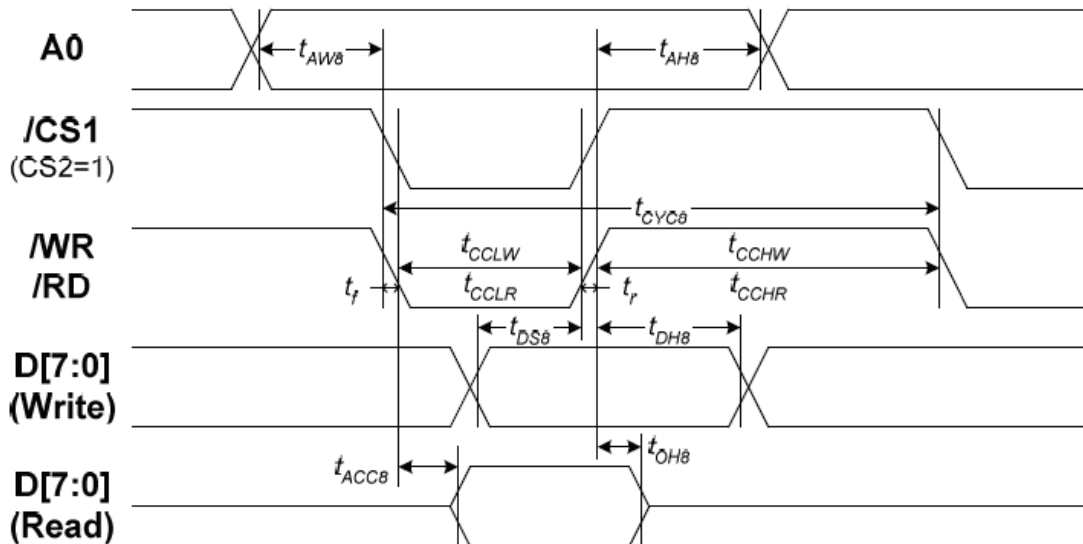


Figure 37

Table 24

(VDD =3.3V, Ta = -30 to 75°C)

Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
Address hold time	A0	tAH8		0	—	Ns
Address setup time		tAW8		0	—	
System cycle time		tCYC8		240	—	
Write L pulse width	/WR	tCCLW		80	—	
Write H pulse width		tCCHW		80	—	
Read L pulse width	/RD	tCCLR		140	—	
Read H pulse width		tCCHR		80	—	
Write Data setup time	D0 to D7	tDS8		40	—	
Write Address hold time		tDH8		0	—	
Read access time		tACC8	CL = 100 pF	—	70	
Read Output disable time		tOH8	CL = 100 pF	5	50	

System Bus Read/Write Characteristics 2 (For the 6800 Series MPU)

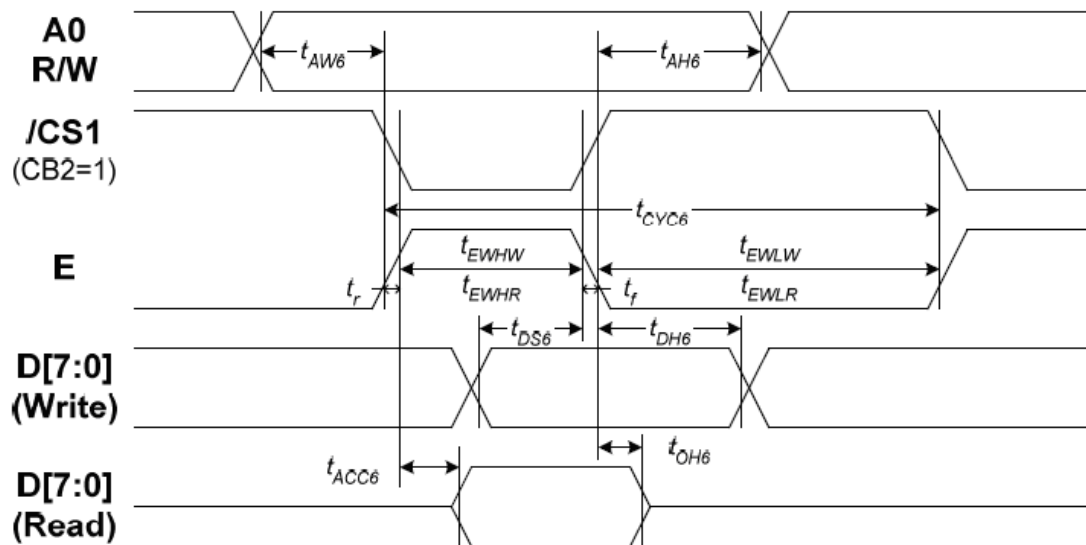


Figure 38

Table 27

(VDD = 3.3V, Ta = -30 to 75°C)

Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
Address hold time	A0	t <sub>AH6</sub>		0	—	ns
Address setup time		t <sub>AW6</sub>		0	—	
System cycle time		t <sub>CYC6</sub>		240	—	
Enable L pulse width (WRITE)	E	t <sub>EHLW</sub>		80	—	
Enable H pulse width (WRITE)		t <sub>EHWH</sub>		80	—	
Enable L pulse width (READ)		t <sub>EHLR</sub>		80	—	
Enable H pulse width (READ)		t <sub>EHWR</sub>		140	—	
WRITE Data setup time	D0 to D7	t <sub>DS6</sub>		40	—	
WRITE Address hold time		t <sub>DH6</sub>		0	—	
READ access time		t <sub>ACC6</sub>	CL = 100 pF	—	70	
READ Output disable time		t <sub>OH6</sub>	CL = 100 pF	5	50	

The Serial Interface

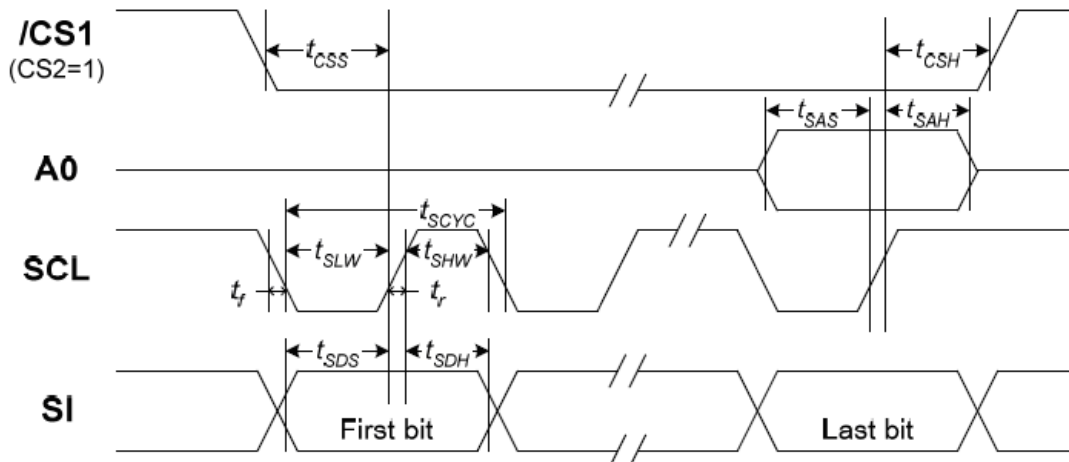


Figure 39

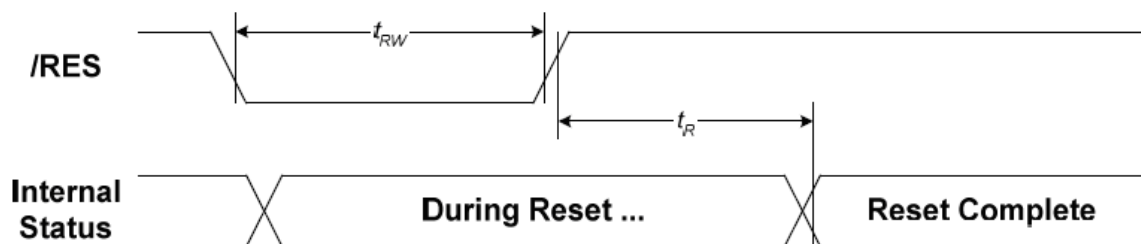
Table 30

(VDD = 3.3V, Ta = -30 to 75°C)

Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
Serial Clock Period	SCL	$t_{SCYC}$		50	—	ns
SCL "H" pulse width		$t_{SHW}$		25	—	
SCL "L" pulse width		$t_{SLW}$		25	—	
Address setup time	A0	$t_{SAS}$		20	—	
Address hold time		$t_{SAH}$		10	—	
Data setup time	SI	$t_{SDS}$		20	—	
Data hold time		$t_{SDH}$		10	—	
CS-SCL time	CS	$t_{CSS}$		20	—	
CS-SCL time		$t_{CSH}$		40	—	

## 10. Reset Timing

### Reset Timing



(VDD = 3.3V, Ta = -30 to 75°C)

Item	Signal	Symbol	Condition	Rating			Units
				Min.	Typ.	Max.	
Reset time	/RES	$t_R$		—	—	1.0	$\mu$ s
Reset "L" pulse width		$t_{RW}$		1.0	—	—	$\mu$ s

## 11. CONTROL AND DISPLAY INSTRUCTION

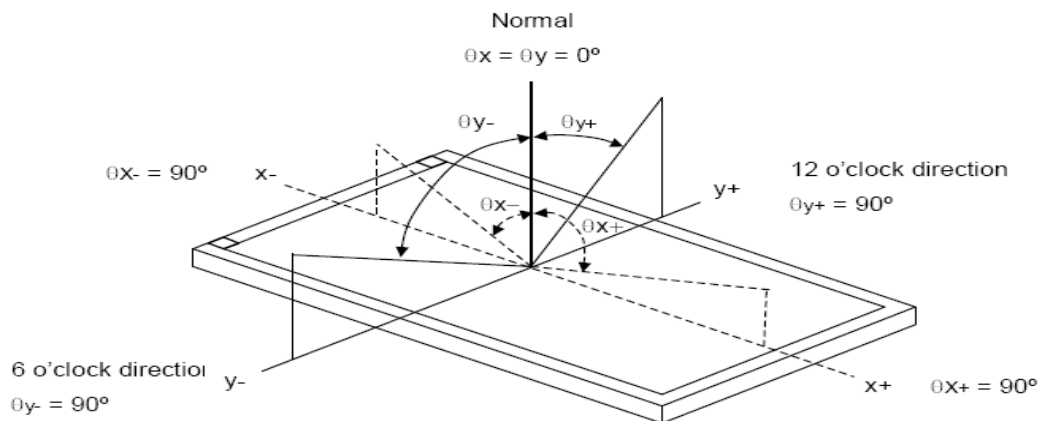
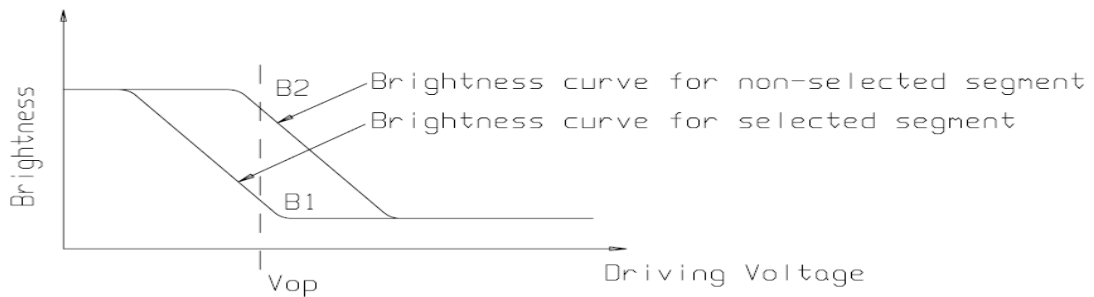
Command	Command Code										Function	
	A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1		D0
(1) Display ON/OFF	0	1	0	1	0	1	0	1	1	1	0	LCD display ON/OFF 0: OFF, 1: ON
(2) Display start line set	0	1	0	0	1	Display start address					Sets the display RAM display start line address	
(3) Page address set	0	1	0	1	0	1	1	Page address				Sets the display RAM page address
(4) Column address set upper bit	0	1	0	0	0	0	1	Most significant column address				Sets the most significant 4 bits of the display RAM column address.
Column address set lower bit	0	1	0	0	0	0	0	Least significant column address				Sets the least significant 4 bits of the display RAM column address.
(5) Status read	0	0	1	Status				0	0	0	0	Reads the status data
(6) Display data write	1	1	0	Write data							Writes to the display RAM	
(7) Display data read	1	0	1	Read data							Reads from the display RAM	
(8) ADC select	0	1	0	1	0	1	0	0	0	0	0	Sets the display RAM address SEG output correspondence 0: normal, 1: reverse
(9) Display normal/reverse	0	1	0	1	0	1	0	0	1	1	0	Sets the LCD display normal/reverse 0: normal, 1: reverse
(10) Display all points ON/OFF	0	1	0	1	0	1	0	0	1	0	0	Display all points 0: normal display 1: all points ON
(11) LCD bias set	0	1	0	1	0	1	0	0	0	1	0	Sets the LCD drive voltage bias ratio 0: 1/9 bias, 1: 1/7 bias (ST7565P)
(12) Read/modify/write	0	1	0	1	1	1	0	0	0	0	0	Column address increment At write: +1 At read: 0
(13) End	0	1	0	1	1	1	0	1	1	1	0	Clear read/modify/write
(14) Reset	0	1	0	1	1	1	0	0	0	1	0	Internal reset
(15) Common output mode select	0	1	0	1	1	0	0	0	*	*	*	Select COM output scan direction 0: normal direction 1: reverse direction
(16) Power control set	0	1	0	0	0	1	0	1	Operating mode		Select internal power supply operating mode	
(17) V <sub>0</sub> voltage regulator internal resistor ratio set	0	1	0	0	0	1	0	0	Resistor ratio		Select internal resistor ratio(Rb/Ra) mode	
(18) Electronic volume mode set	0	1	0	1	0	0	0	0	0	0	1	Set the V <sub>0</sub> output voltage electronic volume register
Electronic volume register set				0	0	Electronic volume value						
(20) Booster ratio set	0	1	0	1	1	1	1	1	0	0	0	select booster ratio 00: 2x,3x,4x 01: 5x 11: 6x
(21) Power saver												Display OFF and display all points ON compound command
(22) NOP	0	1	0	1	1	1	0	0	0	1	1	Command for non-operation
(23) Test	0	1	0	1	1	1	1	*	*	*	*	Command for IC test. Do not use this command

## 12. ELECTRO-OPTICAL CHARACTERISTICS

(VDD=3.3V, Ta = 25°C)

Item	Symbol	Condition	Min	Typ	Max	Unit
Operating Voltage for LCD	Vop	Ta = -20°C	-	-	-	V
		Ta = 25°C	-	8.5	-	
		Ta = 70°C	-	-	-	
Response time	Tr	Ta = 25°C	---	200	400	ms
	Tf		---	250	500	ms
Contrast	Cr	Ta = 25°C	---	5.0	---	---
Viewing angle range	Φ	Cr ≥ 2		90		deg
	θ			45		
	Φ	Cr ≥ 2		270		
	θ			45		
	Φ	Cr ≥ 2		0		
	θ			30		
	Φ	Cr ≥ 2		180		
	θ			45		

$$Cr = \frac{\text{Brightness of non-selected segment}(B2)}{\text{Brightness of selected segment}(B1)}$$



**13.BACKLIGHT CHARACTERISTICS**

LCD Module with Edge White LED Backlight

**ELECTRICAL RATINGS**

Ta = 25°C

Item	Symbol	Condition	Min	Typ	Max	Unit
Forward Voltage	VF	IF= 45mA		3.5		V
Reverse Current	IR	VR=V	---	---	---	uA
Luminance (Without LCD)	Lv	IF=45 mA	-	-	-	Cd/m <sup>2</sup>
wave length (Without LCD)	λp	IF=45 mA	-	-	-	nm
Color	White					

When the temperature exceed 2°C the approved current decrease rate for backlight change as the temperature increase is:  $-0.36 \times 3 \text{mA}/^\circ\text{C}$  (below 25°C, the current refer to constant, which would not change with temperature ).

## **14. PRECAUTION FOR USING LCD/LCM**

LCD/LCM is assembled and adjusted with a high degree of precision. Do not attempt to make any alteration or modification. The followings should be noted.

### **General Precautions:**

1. LCD panel is made of glass. Avoid excessive mechanical shock or applying strong pressure onto the surface of display area.
2. The polarizer used on the display surface is easily scratched and damaged. Extreme care should be taken when handling. To clean dust or dirt off the display surface, wipe gently with cotton, or other soft material soaked with isopropyl alcohol, ethyl alcohol or trichlorotrifluoroethane, do not use water, ketone or aromatics and never scrub hard.
3. Do not tamper in any way with the tabs on the metal frame.
4. Do not make any modification on the PCB without consulting DISPLAY.
5. When mounting a LCM, make sure that the PCB is not under any stress such as bending or twisting. Elastomer contacts are very delicate and missing pixels could result from slight dislocation of any of the elements.
6. 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.
7. Be careful not to touch or swallow liquid crystal that might leak from a damaged cell. Any liquid crystal adheres to skin or clothes, wash it off immediately with soap and water.

### **Static Electricity Precautions:**

1. CMOS-LSI is used for the module circuit; therefore operators should be grounded whenever he/she comes into contact with the module.
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.
3. Do not touch the connection terminals of the display with bare hand; it will cause disconnection or defective insulation of terminals.
4. The modules should be kept in anti-static bags or other containers resistant to static for storage.
5. Only properly grounded soldering irons should be used.
6. If an electric screwdriver is used, it should be grounded and shielded to prevent sparks.
7. The normal static prevention measures should be observed for work clothes and working benches.
8. Since dry air is inductive to static, a relative humidity of 50-60% is recommended.

### **Soldering Precautions:**

1. Soldering should be performed only on the I/O terminals.
2. Use soldering irons with proper grounding and no leakage.
3. Soldering temperature:  $350^{\circ}\text{C} \pm 10^{\circ}\text{C}$
4. Soldering time: 3 to 4 second.
5. Use eutectic solder with resin flux filling.
6. If flux is used, the LCD surface should be protected to avoid spattering flux.
7. Flux residue should be removed.



**Operation Precautions:**

1. The viewing angle can be adjusted by varying the LCD driving voltage  $V_o$ .
2. Since applied DC voltage causes electro-chemical reactions, which deteriorate the display, the applied pulse waveform should be a symmetric waveform such that no DC component remains. Be sure to use the specified operating voltage.
3. Driving voltage should be kept within specified range; excess voltage will shorten display life.
4. Response time increases with decrease in temperature.
5. Display color may be affected at temperatures above its operational range.
6. Keep the temperature within the specified range usage and storage. Excessive temperature and humidity could cause polarization degradation, polarizer peel-off or generate bubbles.
7. For long-term storage over 40°C is required, the relative humidity should be kept below 60%, and avoid direct sunlight.

**Limited Warranty**

DISPLAY LCDs and modules are not consumer products, but may be incorporated by DISPLAY's customers into consumer products or components thereof; DISPLAY does not warrant that its LCDs and components are fit for any such particular purpose.

1. The liability of DISPLAY is limited to repair or replacement on the terms set forth below. DISPLAY will not be responsible for any subsequent or consequential events or injury or damage to any personnel or user including third party personnel and/or user. Unless otherwise agreed in writing between DISPLAY and the customer, DISPLAY will only replace or repair any of its LCD which is found defective electrically or visually when inspected in accordance with DISPLAY general LCD inspection standard . (Copies available on request)
2. No warranty can be granted if any of the precautions state in handling liquid crystal display above has been disregarded. Broken glass, scratches on polarizer mechanical damages as well as defects that are caused accelerated environment tests are excluded from warranty.
3. In returning the LCD/LCM, they must be properly packaged; there should be detailed description of the failures or defect.