PRODUCT SPECIFICATION

Part Number

PCOG12864R2-O Series

CUSTOMER	
CUSTOMER PART NUMBER	
DESCRIPTION	
APPROVED BY	
DATE	

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Record of Revisions

Rev.	Comments	Page	Date
1	Preliminary Specification was first issued.	All	8/8’14

1. Part number breakdown

P_ ___ - _ __ _ _ - _ _ _

1 2 3 4 5 6 7 8 9

Replace each Space (_) with the following letters and or numbers

1. P-tec LCD Type	**C** = Character **G** = Graphic **COG** = Chip On Glass **COF** = Chip On Flex **TAB** = Tape Automated Bonding **TFT** = Thin-film Transistor
2. LCD Model	Example for Character: **2002A** = 20 Characters x 2 Lines w/ Pins on Left side and 116mm x 37 x 12.7mm overall size Example for Graphic: **12864B** = 128 Dots per row x 64 Dots per Column w/ Pins on lower side and 93mm x 70 x 8.8mm overall size
3. Fluid Type	**T** = TN/Grey **Y** = STN/Yellow Green **G** = STN/ Grey **B** = STN/ Blue **F** = FSTN/ White **N** = FSTN/ Black
4. Backlight/polorizer	**NF** = None/Transflective **NM**= None/Transmissive **NR**=None/Reflective **EF**= EL/Transflective **EM**= EL/Transmissive **LF**= LED/Transflective **LM**= LED/Transmissive **CF**= CCFL/Transflective **CM**=CCFL=Transmissive
5. Backlight Color	(If no backlight provided move on to viewing angle [6.]) **B** = Blue/Green **Y** = Yellow **G** = Green **S** = Yellow/Green **O** = Orange **W** = White
6. Viewing Angle	**D** = 6:00 **U** = 12:00 **R** = 3:00 **L** = 9:00
7. Internal Number	Single Letter for internal purposes
8. Extended Temperature	This space is blank if operating temperature is standard 0°C to 50°C An X will be visible if the LCD is Extended operating temperature
9. Customer Specials or List of Value-added items	Usually blank unless customer requests some modifications. Can be several Letters long.

2. FUNCTIONS & FEATURES

2.1. Format	: 128x64 Dots
2.2. LCD mode	: FSTN / Positive/ Transflective Mode
2.3. Viewing direction	: 6 o'clock
2.4. Driving scheme	: 1/65 Duty cycle, 1/9 Bias
2.5. Power supply voltage (V_{DD})	: 3.0V
2.6. LCD driving voltage (VLCD)	: 9.0V (Reference voltage)
2.7. Operation temp	: -20~70℃
2.8. Storage temp	: -30~80℃
2.9. Backlight color	: Edge White
2.10. RoHS compliant.	

3. MECHANICAL SPECIFICATIONS

3.1. Module size	: 45.0mm (L)*40.0+50.0(FPC)mm (W)*7.2mm (H)
3.2. Viewing area	: 37.0mm (L)*28.0mm (W)
3.3. Dot pitch	: 0.282mm (L)*0.36mm (W)
3.4. Dot size	: 0.252mm (L)*0.33mm (W)
3.5. Weight	: Approx.

4. BLOCK DIAGRAM

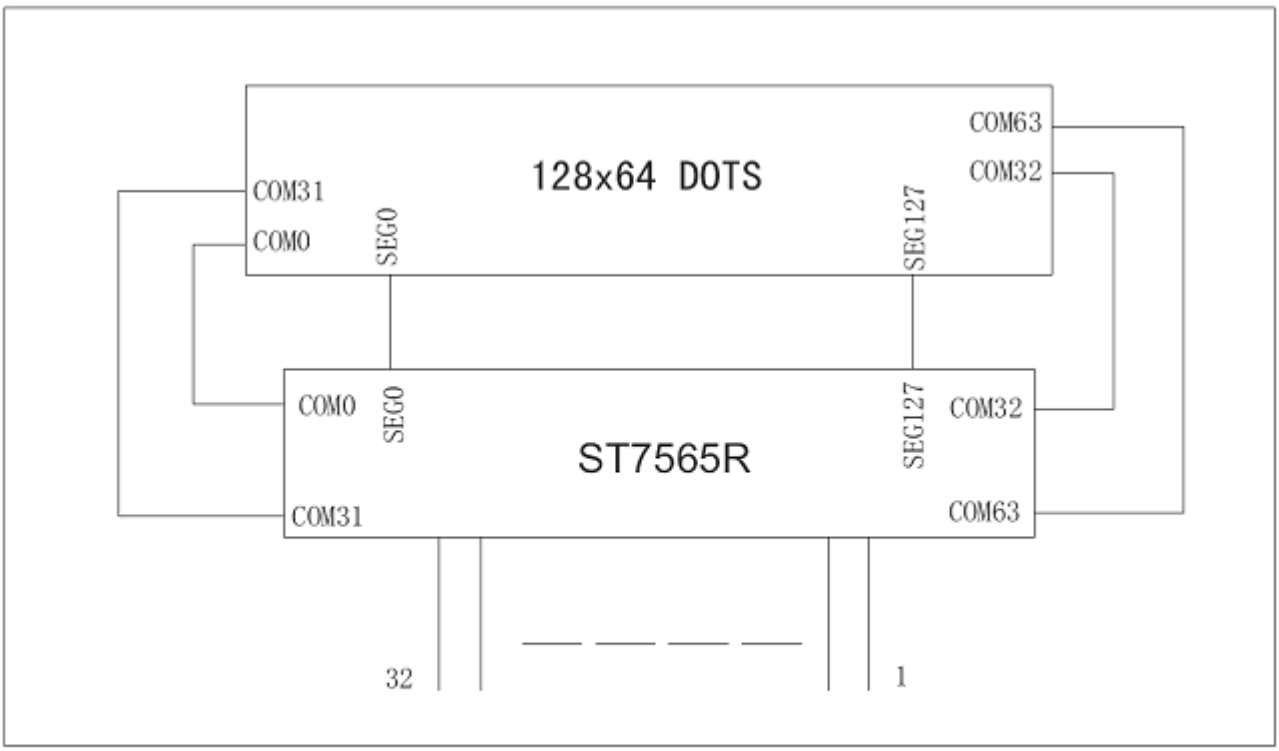
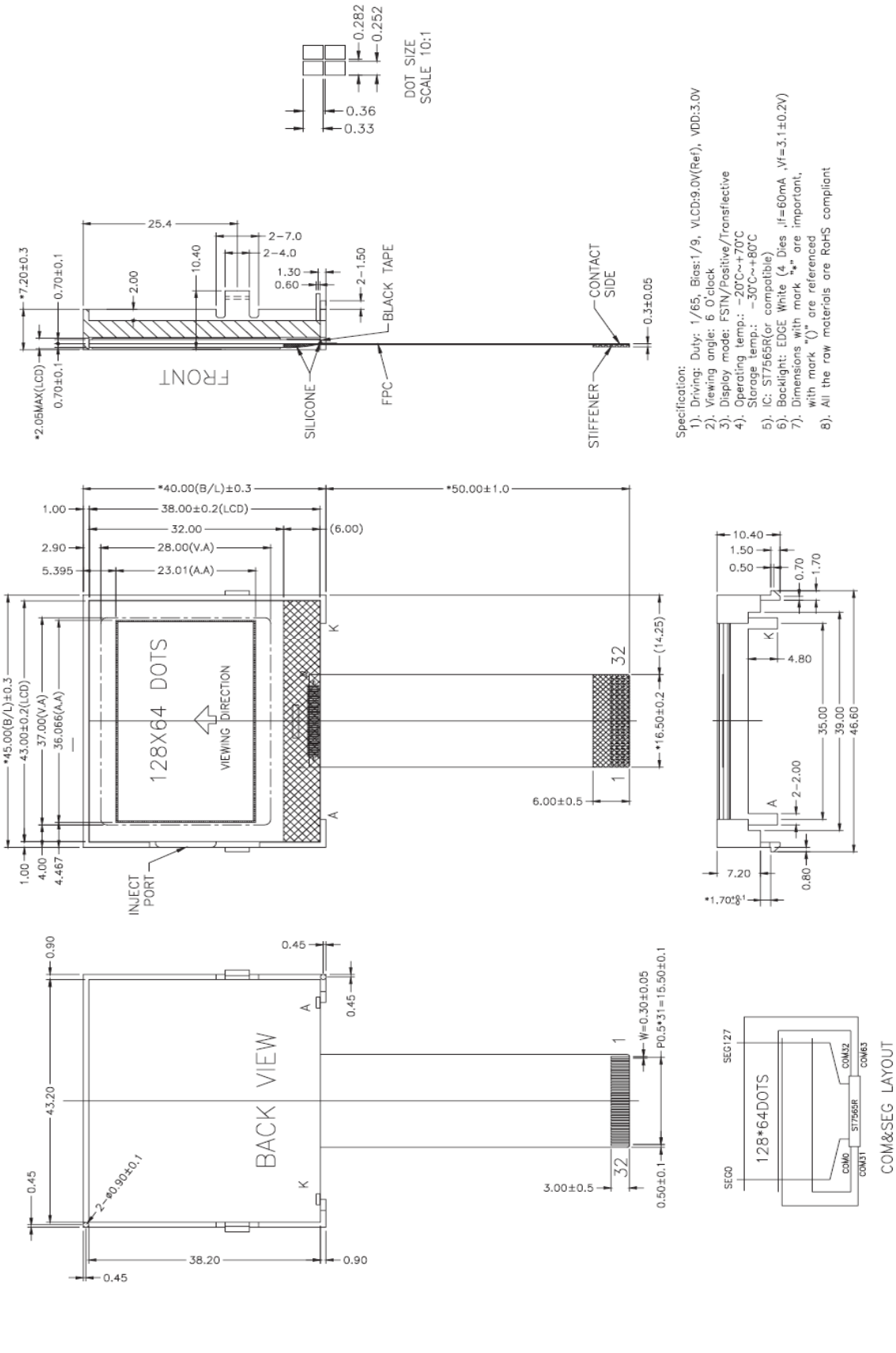


Figure 1.Block diagram

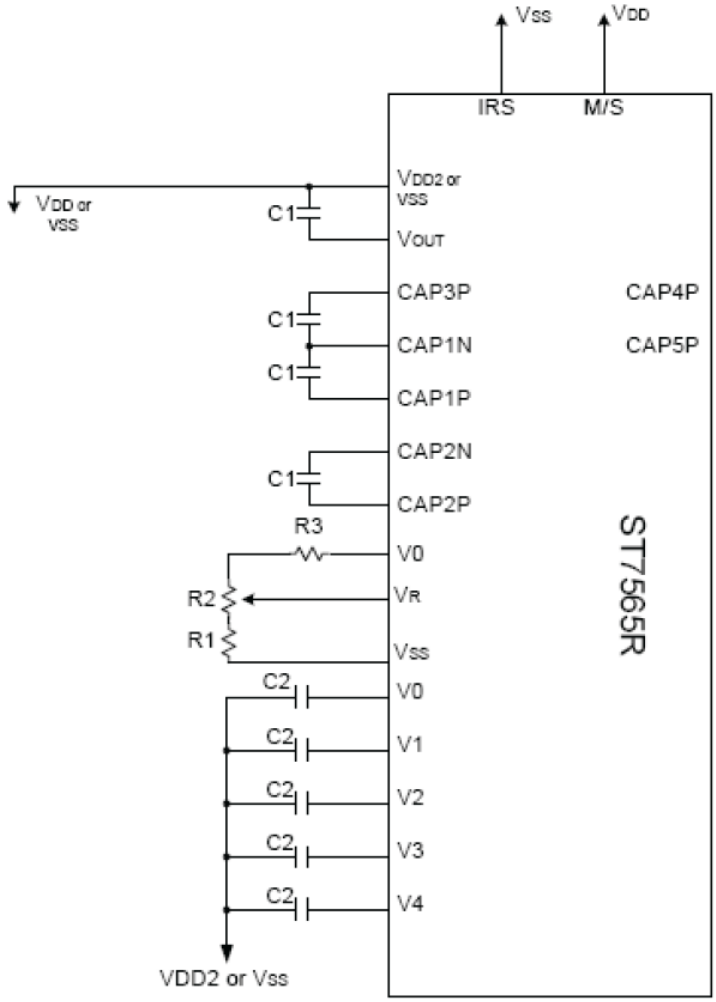
5. DIMENSIONAL OUTLINE



PIN	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
CONNECTOR	IRS	HPMB	PSB	C86	VR	V0	V1	V2	V3	V4	CAP4+	CAP2-	CAP2+	CAP1+	CAP1-	CAP3+
PIN	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
CONNECTOR	VOUT	VSS	VDD	D7	D6	D5	D4	D3	D2	D1	D0	RD(E)	WR(RW)	A0	/RES	/CS1

6. LCD Driving voltage generator and bias reference circuit

When the voltage regulator internal resistor is not used.
(Example where VDD2=VDD, with 4× step-up)



Item	Set value	units
c1	1.0 to 4.7	uF
c2	0.1 to 4.7	uF

C1 and C2 are determined by the size of the LCD being driven

* 1. Because the VR terminal input impedance is high, use short leads and shielded lines.
* 2. C1 and C2 are determined by the size of the LCD being driven. Select a value that will stabilize the liquid crystal drive voltage.

Example of the Process by which to Determine the Settings:

- Turn the voltage regulator circuit and voltage follower circuit ON and supply a voltage to VOUT from the outside.
- Determine C2 by displaying an LCD pattern with a heavy load (such as horizontal stripes) and selecting a C2 that stabilizes the liquid crystal drive voltages (V_0 to V_4). Note that all C2 capacitors must have the same capacitance value.
- Next turn all the power supplies ON and determine C1.

7. PIN DESCRIPTION

1	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
2	HPMB	This is the power control terminal for the power supply circuit for liquid crystal drive. /HPM = "H": Normal mode /HPM = "L": High power mode (suggested)
3	PSB	This is the parallel data input/4-line SPI data input switch terminal. P/S = "H": Parallel data input. P/S = "L": 4-line SPI data input.
4	C86	This is the MPU interface switch terminal C86 = "H": 6800 Series MPU interface C86 = "L": 8080 Series MPU interface
5	VR	Voltage adjustment pad. Applies voltage between V0 and VSS using a resistive divider.
6~10	V0,V1,V2,V3,V4	LCD driver supplies voltages.
11~16	CAP4+, CAP2-, CAP2+, CAP1+, CAP1-, CAP3+	DC/DC voltage converter.
17	VOUT	DC/DC voltage converter. Connect a capacitor between this terminal and VSS or VDD
18	VSS	Power ground
19	VDD	Power supply for logic(+3.0V)
20~27	D7~D0	Data bus lines
28	RD(E)	Enable signal
29	WR(RW)	Write signal
30	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
31	/RES	The RESET signal
32	/CS1	This is the chip select signal

8. MAXIMUM ABSOUTE LIMIT

Maximum Ratings (Voltage Reference to VSS)(for IC)

Unless otherwise noted, V_{SS} = 0V

Table 17

Parameter		Symbol	Conditions	Unit
Power Supply Voltage		VDD	-0.3 ~ 3.6	V
Power supply voltage (VDD standard)		VDD2	-0.3 ~ 3.6	V
Power supply voltage (VDD standard)		V0, VOUT	-0.3 ~ 13.5	V
Power supply voltage (VDD standard)		V1, V2, V3, V4	-0.3 to V0	V
Operating temperature		TOPR	–30 to +85	°C
Storage temperature	Bare chip	TSTR	–65 to +150	°C

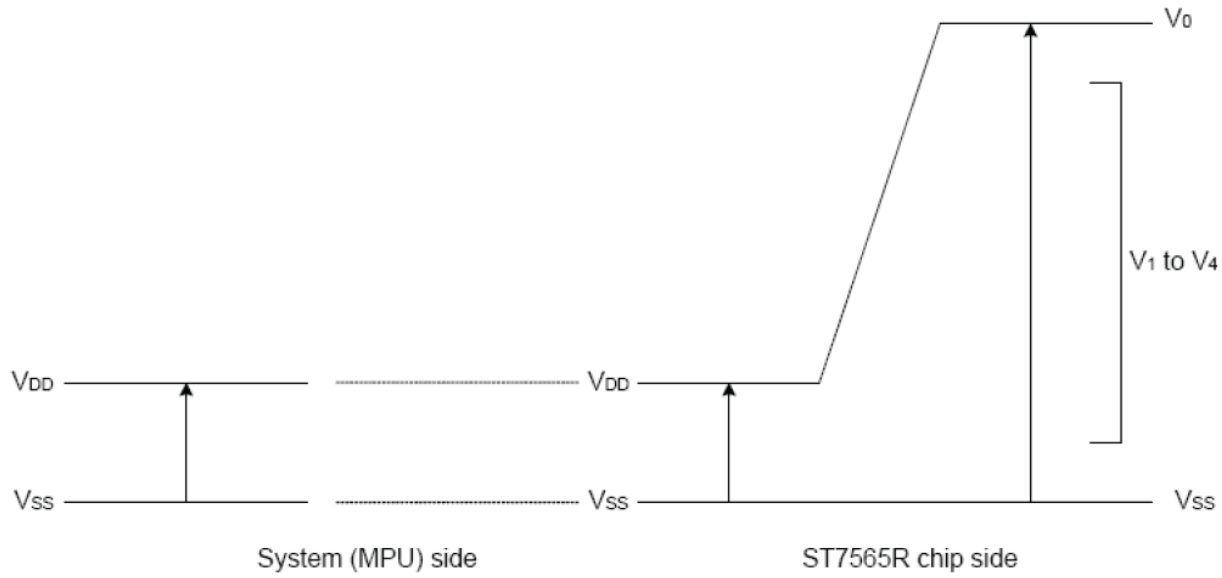


Figure 30

Notes and Cautions

1. The V_{DD2}, V_0 to V_4 and V_{OUT} are relative to the V_{SS} = 0V reference.
2. Insure that the voltage levels of V_1, V_2, V_3, and V_4 are always such that $V_{OUT} \geqq V_0 \geqq V_1 \geqq V_2 \geqq V_3 \geqq V_4$.
3. Permanent damage to the LSI may result if the LSI is used outside of the absolute maximum ratings. Moreover, it is recommended that in normal operation the chip be used at the electrical characteristic conditions, and use of the LSI outside of these conditions may not only result in malfunctions of the LSI, but may have a negative impact on the LSI

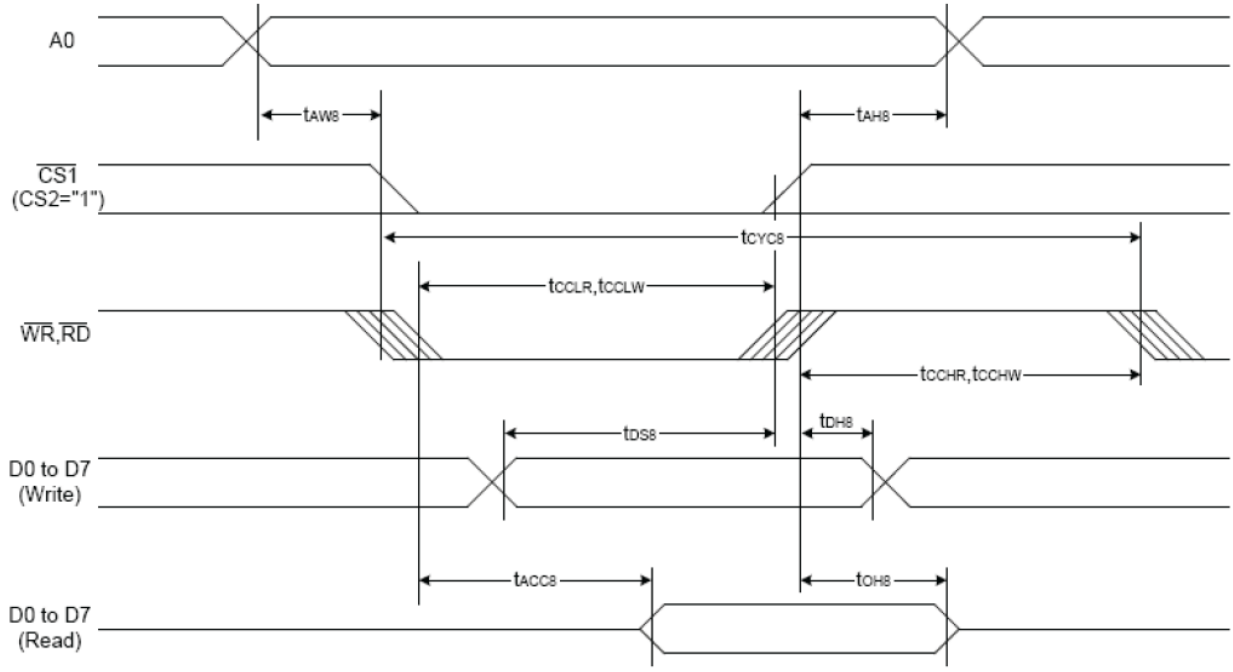
9. ELECTRICAL CHARACTERISTICS

Item		Symbol	Condition		Rating Min.	Rating Typ.	Rating Max.	Units	Applicable Pin
Operating Voltage (1)		V_{DD}			1.8	—	3.3	V	Vss*1
Operating Voltage (2)		V_{DD2}	(Relative to V_{SS})		2.4	—	3.3	V	V_{SS}
High-level Input Voltage		V_{IHC}			0.8 x V_{DD}	—	V_{DD}	V	*3
Low-level Input Voltage		V_{ILC}			V_{SS}	—	0.2 x V_{DD}	V	*3
High-level Output Voltage		V_{OHC}	I_{OH} = –0.5 mA		0.8 x V_{DD}	—	V_{DD}	V	*4
Low-level Output Voltage		V_{OLC}	I_{OL} = 0.5 mA		V_{SS}	—	0.2 x V_{DD}	V	*4
Input leakage current		I_{LI}	V_{IN} = V_{DD} or V_{SS}		–1.0	—	1.0	µA	*5
Output leakage current		I_{LO}	V_{IN} = V_{DD} or V_{SS}		–3.0	—	3.0	µA	*6
Liquid Crystal Driver ON Resistance		R_{ON}	Ta = 25°C (Relative To V_{DD})	V_0 = 13.0 V	—	2.0	3.5	KΩ	SEGn COMn *7
				V_0 = 8.0 V	—	3.2	5.4		
Static Consumption Current		I_{SSQ}	V_0 = 13.0 V (Relative To V_{DD})		—	0.01	2	µA	V_{DD}, V_{DD2}
Output Leakage Current		I_{5Q}			—	0.01	10	µA	V0
Input Terminal Capacitance		C_{IN}	Ta = 25°C, f = 1 MHz		—	5.0	8.0	pF	
Oscillator Frequency	Internal Oscillator	f_{OSC}	1/65 duty 1/33 duty	Ta = 25°C	17	20	24	kHz	*8
	External Input	f_{CL}			17	20	24	kHz	CL
	Internal Oscillator	f_{OSC}	1/49 duty 1/53 duty 1/55 duty	Ta = 25°C	25	30	35	kHz	*8
	External Input	f_{CL}			25	30	35	kHz	CL

Item		Symbol	Condition	Rating Min.	Rating Typ.	Rating Max.	Units	Applicable Pin
Internal Power	Input voltage	V_{DD2}	(Relative To V_{SS})	2.4	—	3.3	V	V_{SS}
	Supply Step-up output voltage Circuit	V_{OUT}	(Relative To V_{SS})	—	—	13.5	V	V_{OUT}
	Voltage regulator Circuit Operating Voltage	V_{OUT}	(Relative To V_{SS})	6.0	—	13.5	V	V_{OUT}
	Voltage Follower Circuit Operating Voltage	V0	(Relative To V_{SS})	4.0	—	13.5	V	V0 * 9
	Base Voltage	VRS	Ta = 25°C, (Relative To V_{SS}) –0.05%/°C	2.07	2.10	2.13	V	*10

10. TIMING CHARACTERISTICS

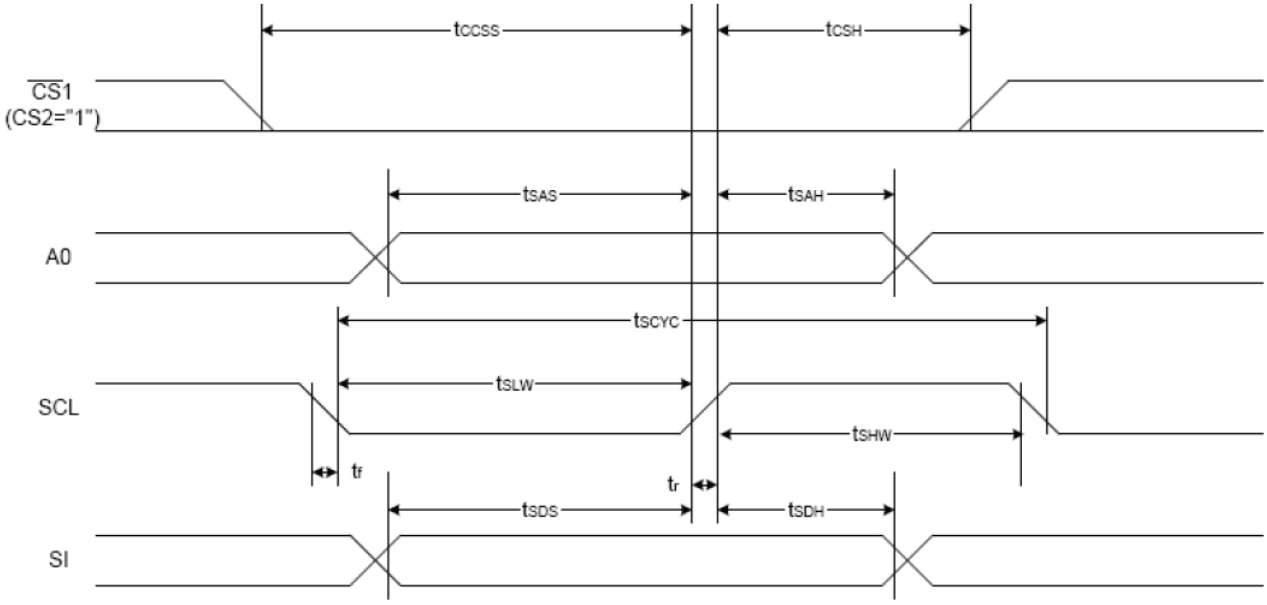
System Bus Read/Write Characteristics 1 (For the 8080 Series MPU)



(V_{DD} = 3.3V, Ta = –30 to 85°C)

Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
Address hold time	A0	t_{AH8}		0	—	Ns
Address setup time		t_{AW8}		0	—	
System cycle time		t_{CYC8}		240	—	
Enable L pulse width (WRITE)	WR	t_{CCLW}		80	—	
Enable H pulse width (WRITE)		t_{CCHW}		80	—	
Enable L pulse width (READ)	RD	t_{CCLR}		140	—	
Enable H pulse width (READ)		t_{CCHR}		80		
WRITE Data setup time	D0 to D7	t_{DS8}		40	—	
WRITE Address hold time		t_{DH8}		0	—	
READ access time		t_{ACC8}	C_L = 100 pF	—	70	
READ Output disable time		t_{OH8}	C_L = 100 pF	5	50	

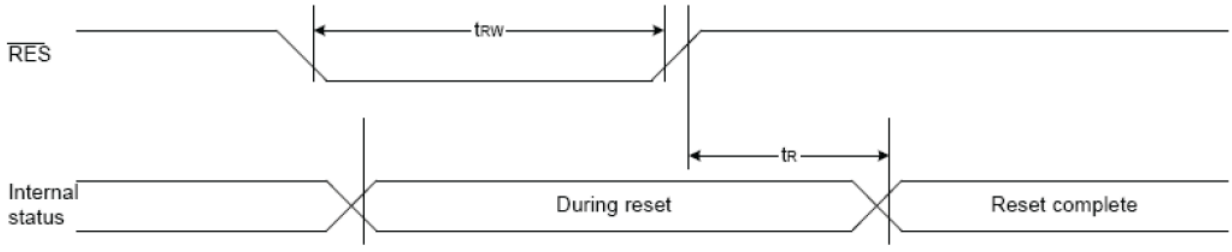
The 4-line SPI Interface



(VDD = 3.3V,Ta = –30 to 85°C)

Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
4-line SPI Clock Period	SCL	Tscyc		50	—	ns
SCL "H" pulse width		Tshw		25	—	
SCL "L" pulse width		TSLW		25	—	
Address setup time	A0	TSAS		20	—	
Address hold time		Tsah		10	—	
Data setup time	SI	Tsds		20	—	
Data hold time		TSDH		10	—	
CS-SCL time	CS	Tcss		20	—	
CS-SCL time		Tcsh		40	—	

11. Reset Timing



(VDD = 3.3V,Ta = –30 to 85°C)

Item	Signal	Symbol	Condition	Rating			Units
				Min.	Typ.	Max.	
Reset time		tR		—	—	1.0	us
Reset "L" pulse width	/RES	tRW		1.0	—	—	us

12. 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 1	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 Column address set lower bit	0	1	0	0	0	0	1	Most significant column address				Sets the most significant 4 bits of the display RAM column address. Sets the least significant 4 bits of the display RAM column address.
				0	0	0	0	Least significant 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 1	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 1	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 1	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 1	Sets the LCD drive voltage bias ratio 0: 1/9 bias, 1: 1/7 bias (ST7565R)
(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 1	*	*	*	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_0 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 Electronic volume register set	0	1	0	1	0	0	0	0	0	0	1	Set the V_0 output voltage electronic volume register
				0	0	Electronic volume value						
(19) Static indicator ON/OFF Static indicator register set	0	1	0	1	0	1	0	1	1	0	0 1	0: OFF, 1: ON Set the flashing mode
				0	0	0	0	0	0	0	Mode	
(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
				0	0	0	0	0	0	step-up value		
(21) Power save	0	1	0									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

13. BACK LIGHT CHARACTERISTICS

LCD Module with Side LED Backlight

ELECTRICAL RATINGS

Ta = 25°C

Item	Symbol	Condition	Min	Typ	Max	Unit
Forward Voltage	VF	IF=60mA	2.9	3.1	3.3	V
Reverse Current	IR	VR=0.8V	---	15	---	mA
Luminance(without LCD)	Lv	IF=60mA	420	500	---	Cd/㎡
Color coordinate(without LCD)	λp	IF=60mA	X=0.26 Y=0.27	---	X=0.30 Y=0.31	
Color	white					

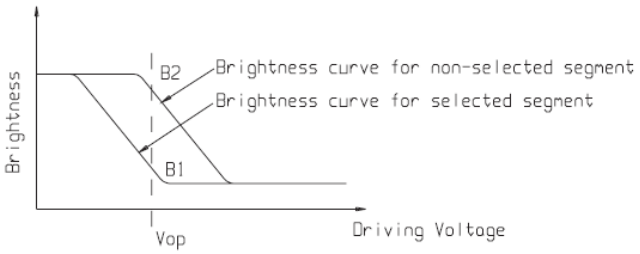
Note:
when the temperature exceed 25℃, the approved current decrease rate for Backlight change as the temperature increase is: -0.36mA/℃(below 25℃, the current refer to constant, which would not change with temperature).

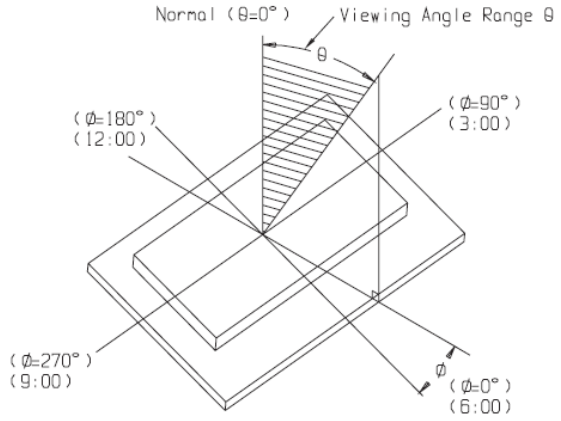
14. ELECTRO-OPTICAL CHARACTERISTICS

(VDD=3.0V,Ta = 25°C)

Item	Symbol	Condition	Min	Typ	Max	Unit
Operating Voltage for LCD	Vop	Ta =-20°C	9.2	9.5	9.8	V
		Ta = 25°C	8.7	9.0	9.2	
		Ta = 70°C	8.2	8.5	8.8	
Response time	Tr	Ta = 25°C	---	200	400	ms
	Tf		---	250	500	ms
Contrast	Cr	Ta = 25°C	---	4.0	---	---
Viewing angle range	θ	Cr≥2	-40	---	+40	deg
	?		-40	---	+40	deg

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





15. PRECAUTION FOR USING LCD/LCM

After reliability test, recovery time should be 24 hours minimum. Moreover, functions, performance and appearance shall be free from remarkable deterioration within 50,000 hours(average) under ordinary operating and storage conditions room temperature (20±8?C), normal humidity (below 65% RH), and in the area not exposed to direct sun light. Using LCM beyond these conditions will shorten the life time.

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 isoproply alcohol, ethyl alcohol or trichlorotriflorothane, 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 made any modification on the PCB without consulting P-tec Corp.
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?C±10?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 Vo.
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

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

1. The liability of P-tec Corp is limited to repair or replacement on the terms set forth below. be responsible for any subsequent or consequential events or injury or damage to any personnel P-tec Corp will not or user including third party personnel and/or user. Unless otherwise agreed in writing between P-tec Corp and the customer, P-tec Corp will only replace or repair any of its LCD which is found defective electrically or visually when inspected in accordance with P-tec Corp 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.