



## PRODUCT SPECIFICATION

*Part Number*

PCOG12864P-O Series

CUSTOMER	
CUSTOMER PART NUMBER	
DESCRIPTION	
APPROVED BY	
DATE	

## Table of Contents

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## PAGE

SPEC ONLY

3

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	MODEL NO.		PAGE
	PCOG12864P-O series	SPEC ONLY	4

## 1. Part number breakdown

**P** \_ \_ - \_ \_ - \_ - \_ - \_  
 1 2 3 4 5 6 7 8 9

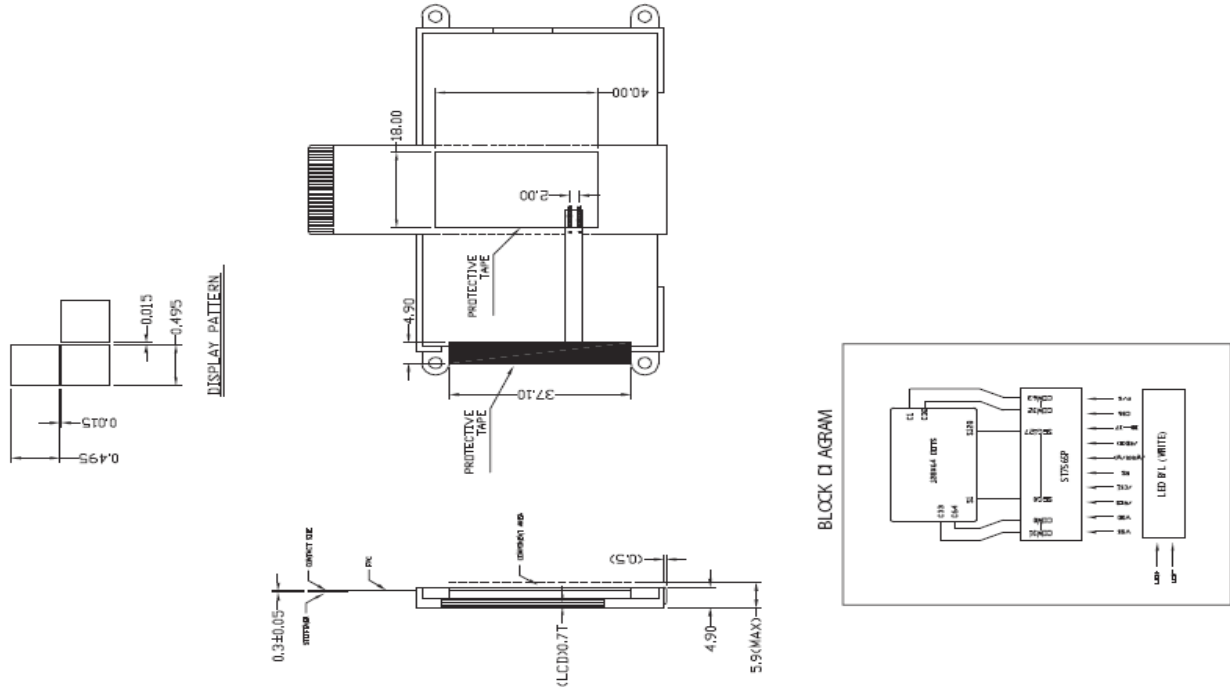
Replace each Space ( \_ ) with the following letters and or numbers

1. P-tec LCD Type	<b>C</b> = Character <b>G</b> = Graphic <b>COG</b> = Chip On Glass	<b>COF</b> = Chip On Flex <b>TAB</b> = Tape Automated Bonding <b>TFT</b> = Thin-film Transistor
2. LCD Model	Example for Character: <b>2002A</b> = 20 Characters x 2 Lines w/ Pins on Left side and 116mm x 37 x 12.7mm overall size Example for Graphic: <b>12864B</b> = 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	<b>T</b> = TN/ Grey <b>Y</b> = STN/ Yellow Green <b>G</b> = STN/ Grey	<b>B</b> = STN/ Blue <b>F</b> = FSTN/ White <b>N</b> = FSTN/ Black
4. Backlight/polorizer	<b>NF</b> = None/Transflective <b>NM</b> = None/Transmissive <b>NR</b> = None/Reflective <b>EF</b> = EL/Transflective <b>EM</b> = EL/Transmissive	<b>LF</b> = LED/Transflective <b>LM</b> = LED/Transmissive <b>CF</b> = CCFL/Transflective <b>CM</b> = CCFL=Transmissive
5. Backlight Color	(If no backlight provided move on to viewing angle [6.]) <b>B</b> = Blue/Green <b>Y</b> = Yellow <b>G</b> = Green	
6. Viewing Angle	<b>D</b> = 6:00 <b>U</b> = 12:00	<b>R</b> = 3:00 <b>L</b> = 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 General Specifications

Item	<input checked="" type="checkbox"/> Standard Value	Unit
Display Pattern	<input checked="" type="checkbox"/> Graphic <input type="checkbox"/> Character <input type="checkbox"/> Segment <input type="checkbox"/> _____ <input type="checkbox"/> with ICON	
Color	<input checked="" type="checkbox"/> Mono. <input type="checkbox"/> Grayscale <input type="checkbox"/> _____	
Module Dimension (W x H x T)	72.4(W)X87.6(H)X(5.9)(T)	mm
Viewing Area (W x H)	70(W)X37(H)	mm
Active Area (W x H)	65.265(W)X32.625(H)	mm
Character Size (W x H)	\	mm
Character Pitch (W x H)	\	mm
DOT Size (W x H)	0.495(W)• 0.495(H)	mm
DOT Pitch (W x H)	0.51(W)• 0.51(H)	mm
LCD Type	<input type="checkbox"/> TN, Positive <input type="checkbox"/> TN, Negative <input type="checkbox"/> HTN, Positive <input type="checkbox"/> HTN, Negative <input type="checkbox"/> STN, Yellow-Green <input type="checkbox"/> STN, Gray <input checked="" type="checkbox"/> STN, Blue <input type="checkbox"/> FSTN, Positive <input type="checkbox"/> FSTN, Negative <input type="checkbox"/> _____ <input type="checkbox"/> FM LCD <input type="checkbox"/> Color STN	
Polarizer Type	<input type="checkbox"/> Transflective <input checked="" type="checkbox"/> Transmissive <input type="checkbox"/> Reflective <input type="checkbox"/> Anti-Glare	
View Direction	<input type="checkbox"/> 6H <input checked="" type="checkbox"/> 12H <input type="checkbox"/> _____	
LCD Controller & Driver	ST7565P (or Equivalent)	
LCD Driving Method	1/65duty, 1/9bias	
Interface Type	Serial <input type="checkbox"/> I <sup>2</sup> C <input checked="" type="checkbox"/> 4-line SPI <input type="checkbox"/> 3-line SPI <input type="checkbox"/> _____ Parallel <input checked="" type="checkbox"/> 6800 <input checked="" type="checkbox"/> 8080 <input type="checkbox"/> 4-bit <input type="checkbox"/> _____	
Backlight Type	<input checked="" type="checkbox"/> LED <input type="checkbox"/> Bottom <input checked="" type="checkbox"/> Single Side <input type="checkbox"/> Dual Side <input type="checkbox"/> _____ <input type="checkbox"/> EL <input type="checkbox"/> CCFL	
Backlight Color	<input type="checkbox"/> Yellow-Green <input checked="" type="checkbox"/> White <input type="checkbox"/> Amber <input type="checkbox"/> Blue <input type="checkbox"/> Red <input type="checkbox"/> _____	
EL/CCFL Driver type	<input type="checkbox"/> Build-in <input type="checkbox"/> External	
DC-DC Converter	<input checked="" type="checkbox"/> Build-in <input type="checkbox"/> External	
Operation Temperature	T <sub>OPL</sub> = -20 T <sub>OPH</sub> = +70	• •
Storage Temperature	T <sub>STL</sub> = -30 T <sub>STH</sub> = +80	• •

## 3 Mechanical Diagram



NO	SYMBOL
1	VSS
2	VDD
3	NC
4	/RES
5	/CS1
6	RS
7	/WR(R/W)
8	/RD(E)
9	D0
10	D1
11	D2
12	D3
13	D4
14	D5
15	D6
16	D7
17	C86
18	P/S
19	LED+
20	LED-

▲Display Type : BLUE/NEGATIVE

▲Display Mode : TRANSMISSIVE

▲Viewing Direction : 12:00

Driver IC : ST7565P

Logical Voltage (VDD) : 3.0V (3.5V MAX)

LCD Driver Voltage (Vlcd) : 10.3V

▲LED Driver Voltage (Vled) : 5.0V (5.2V MAX)(WHITE LED)

▲LED Current(I<sub>f</sub>) : I<sub>f</sub>=45mA (60mA MAX)

Driving Method : 1/65 DUTY 1/9 BIAS

Operating Temperature : -20°~ +70°C

Storage Temperature : -30°~ +80°C

Interface Connector : FPC

All unmarked tolerances ±0.2mm

▲ Circuit Diagram (LED 1x3-3) Color: WHITE

LED:SSW08T-P1

RANK:V11V12

b3±0.01

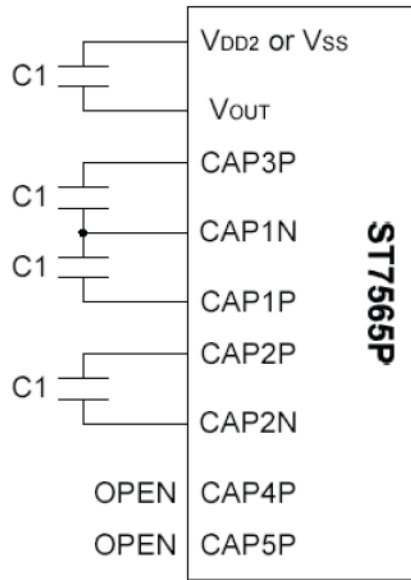
▲ The Luminosity of the Display 24cd/m2 (typical)

## 4 I/O Terminal

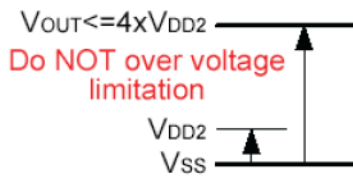
### 4.1 Pin Description

Pin NO.●●	Symbol●●	Function Description●●
1	VSS	Ground
2	VDD	Power supply.
3	NC	Not connect
4	/RES	When /RES is set to "L," the settings are initialized. The reset operation is performed by the /RES signal level.
5	/CS1	This is the chip select signal.
6	RS	This is connect to the least significant bit of the normal and it determines whether the data bits are data or a RS = "H": Indicates that D0 to D7 are display data. RS = "L": Indicates that D0 to D7 are control data.
7	R/W	<ul style="list-style-type: none"> <li>When connected to an 8080 MPU, this is active LOW. (R/W) This terminal connects to the 8080 MPU /WR signal. The signals on the data bus are latched at the rising edge of the /WR signal.</li> <li>When connected to a 6800 Series MPU: This is the read/write control signal input terminal. When R/W = "H": Read. When R/W = "L": Write.</li> </ul>
8	E	<ul style="list-style-type: none"> <li>When connected to a 6800 Series MPU, this is active HIGH. This is the 6800 Series MPU enable clock input terminal.</li> </ul>
9~16	D0~D7	This is an 8-bit bi-directional data bus that connects to an 8-bit or 16-bit standard MPU data bus.
17	C86	This is the MPU interface switch terminal. C86 = "H": 6800 Series MPU interface. C86 = "L": 8080 MPU interface.
18	P/S	<p>This is the parallel data input/serial data input switch terminal.</p> <p>P/S = "H": Parallel data input. P/S = "L": Serial data input.</p> <p>The following applies depending on the P/S status: When P/S = "L", D0 to D5 fixed "H". /RD (E) and /WR (R/W) are fixed to either "H" or "L". With serial data input, It is impossible read data from RAM . P/S Data/Command Data Read/Write Serial Clock "H" A0 D0 to D7 /RD, /WR X "L" A0 SI (D7) Write only SCL (D6)</p>
19	LED+	+5V
20	LED-	Ground

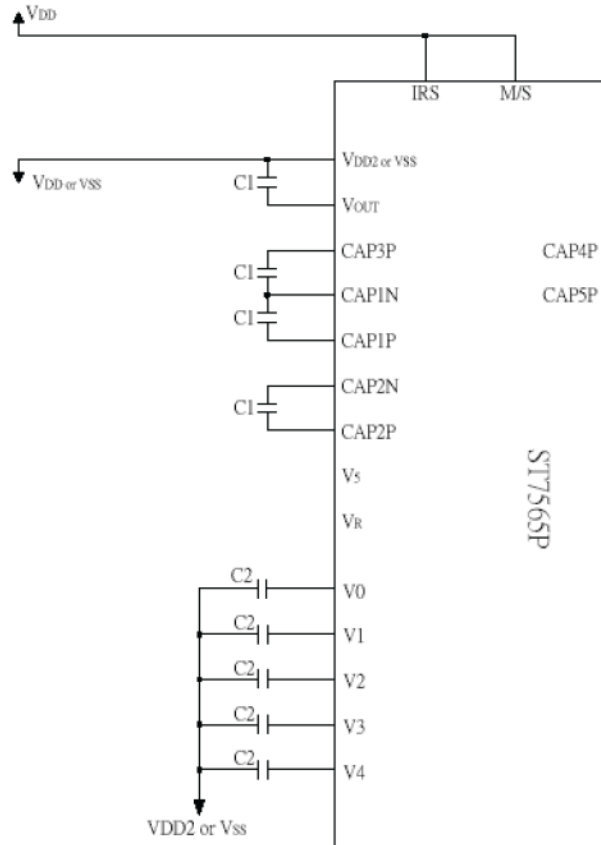
## 4.2 Block Diagram and Application Circuit



4x voltage booster circuit



4x boost voltage relationship





## 5 Electro-optical Specifications

### 5.1 Absolute Maximum Ratings

No	Item	Symbol	Min.	Max.	Unit
1	Supply Voltage For Logic	$V_{DD}-V_{SS}$	0.3	3.6	V
2	Supply Voltage For LCD Driver	$V_{LCD}$	0.3	14.5	V
3	Input Voltage	$V_{IN}$	0.3	3.6	V

Note: Operating Temperature and Storage Temperature can be found in 1. General Specifications.

### 5.2 Optical Characteristics<sup>(1)</sup>

No	Item		Symbol	Condition	Min.	Typ.	Max.	Unit
1	Contrast Ratio		Cr	Ta=23±3°C V <sub>LCD</sub> = Typ. <sup>(2)</sup>	8.4	9.08	-	-
2	Response time		T <sub>ON</sub>	Ta=23±3°C	-	223	330	ms
3	Response time		T <sub>OFF</sub>	Ta=23±3 °C	-	102	200	ms
4	Viewing Angle	3H	Θ1	Cr = 2 Ta=23±3 °C	43	48	-	Deg.
5		9H	Θ2		45	49	-	Deg.
6		6H	Θ3		39	44	-	Deg.
7		12H	Θ4		26	31	-	Deg.

Note:

(1) See Appendix Definition of Optical Characteristics for detail.

(2)  $V_{LCD}$  can be found in 4.2 Electrical Characteristics *Supply Voltage for LCD Driver*

### 5.3 Electrical Characteristics

No	Item	Symbol	Condition	Min.	Typ.	Max.	Unit
1	Supply Voltage for Logic	$V_{DD}-V_{SS}$	-	2.9	3.0	3.1	V
2	Supply Voltage for LCD Driver	$V_{LCD}$	$T_a=25^{\circ}\text{C}$	10.1	10.3	10.5	V
3	Supply Current for Logic	$I_{DD}$	-....	-	-	1.0	mA
4	Frame Frequency	$f_M$	$T_a=25^{\circ}\text{C}$	17	20	24	KHz

5	Input High Voltage	$V_{IH}$	-	$0.8 V_{DD}$	-	$V_{DD}$	V
6	Input Low Voltage	$V_{IL}$	-	VSS	-	$0.2 V_{DD}$	V
7	Output High Voltage	$V_{OH}$	-	$0.8 V_{DD}$	-	$V_{DD}$	V
8	Output Low Voltage	$V_{OL}$	-	VSS	-	$0.2V_{DD}$	V

9	Supply Current for LED Backlight	$I_{LED}$	$V_{LED} = \text{Typ.}$ $T_a=23\pm 3^{\circ}\text{C}$	-	45	-	mA
10	Supply Voltage for LED Backlight	$V_{LED}$	$I_{LED} = \text{Typ.}$ $T_a=23\pm 3^{\circ}\text{C}$	4.8	5.0	5.2	V

## 5.4 Timing Characteristics

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

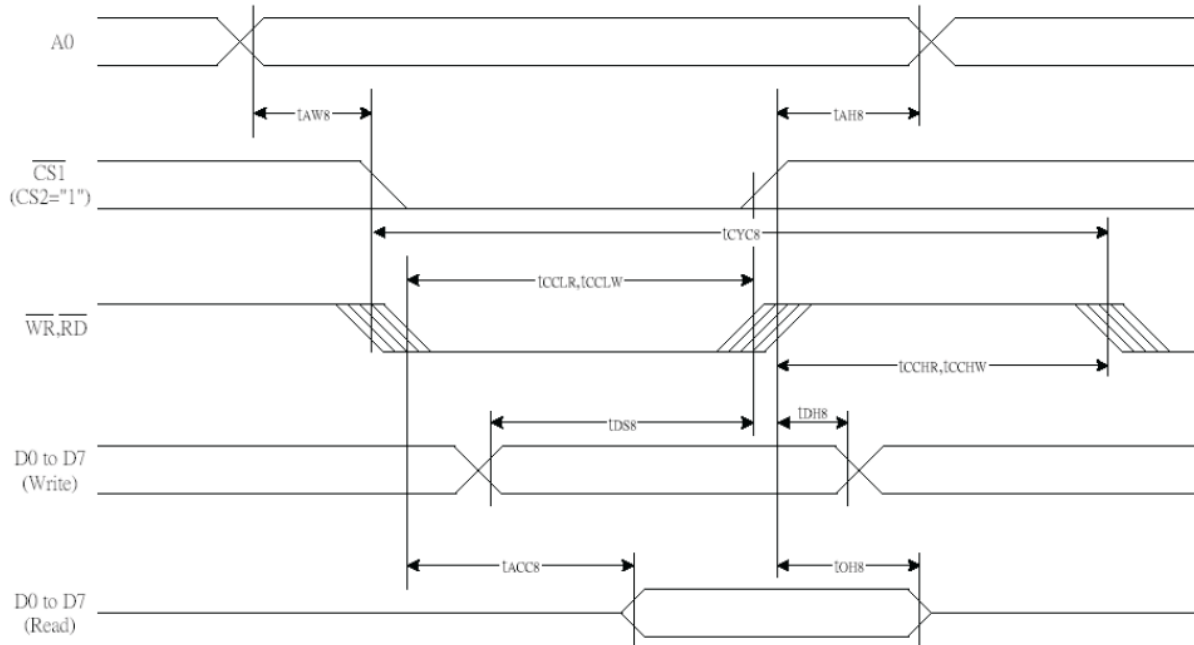


Figure 37

**Table 24**

(V<sub>DD</sub> = 3.3V, T<sub>a</sub> = -30 to 85°C)

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

(VDD = 2.7V, Ta = -30 to 85°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		400	—	
Enable L pulse width (WRITE)	WR	tCCLW		220	—	
Enable H pulse width (WRITE)		tCCHW		180	—	
Enable L pulse width (READ)	RD	tCCLR		220	—	
Enable H pulse width (READ)		tCCHR		180	—	
WRITE Data setup time	D0 to D7	tDS8		40	—	
WRITE Address hold time		tDH8		0	—	
READ access time		tACC8	CL = 100 pF	—	140	
READ Output disable time		tOH8	CL = 100 pF	10	100	

**Table 26**

(VDD = 1.8V, Ta = -30 to 85°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		640	—	
Enable L pulse width (WRITE)	WR	tCCLW		360	—	
Enable H pulse width (WRITE)		tCCHW		280	—	
Enable L pulse width (READ)	RD	tCCLR		360	—	
Enable H pulse width (READ)		tCCHR		280	—	
WRITE Data setup time	D0 to D7	tDS8		80	—	
WRITE Address hold time		tDH8		0	—	
READ access time		tACC8	CL = 100 pF	—	240	
READ Output disable time		tOH8	CL = 100 pF	10	200	

The input signal rise time and fall time ( $t_r$ ,  $t_f$ ) is specified at 15 ns or less. When the system cycle time is extremely fast,  $t_r + t_f \leq (t_{CYC8} - t_{CCLW} - t_{CCHW})$  for  $(t_r + t_f) \leq (t_{CYC8} - t_{CCLR} - t_{CCHR})$  are specified.

All timing is specified using 20% and 80% of VDD as the reference.

tCCLW and tCCLR are specified as the overlap between /CS1 being "L" (CS2 = "H") and /WR and /RD being at the "L" level.

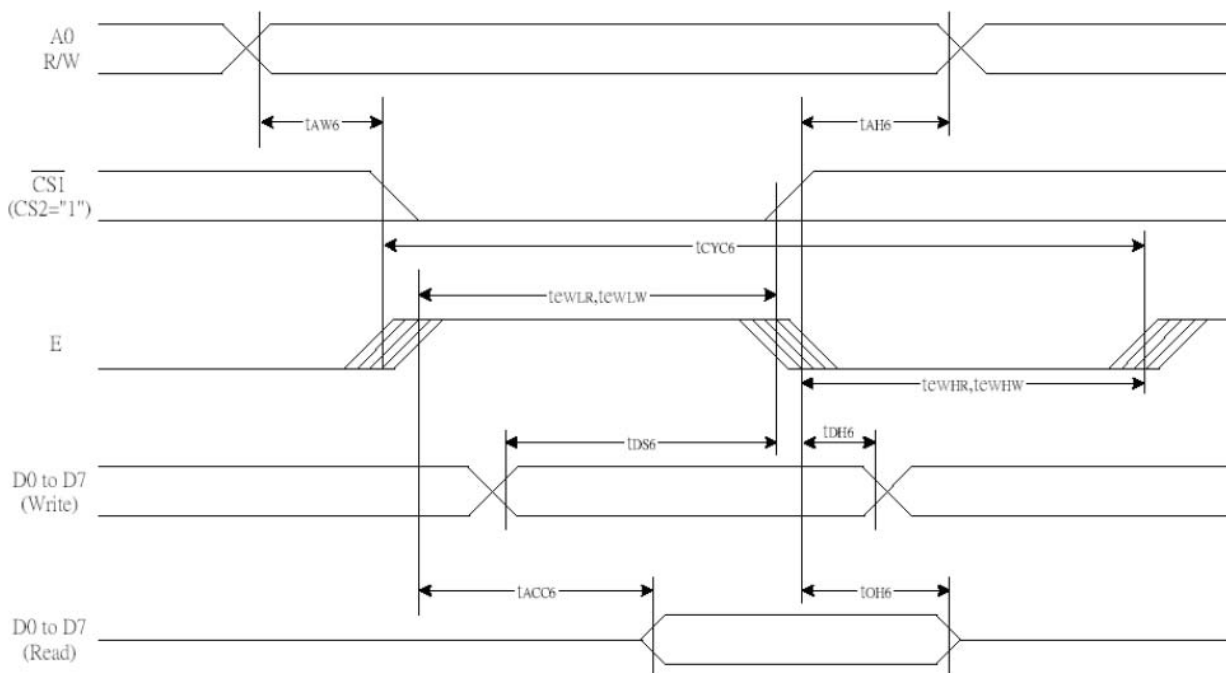

**System Bus Read/Write Characteristics 2 (For the 6800 Series MPU)**

Figure 38

**Table 27**

(VDD = 3.3V, Ta = -30 to 85°C)

Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
Address hold time	A0	tAH6		0	—	ns
Address setup time		tAW6		0	—	
System cycle time		tCYC6		240	—	
Enable L pulse width (WRITE)	WR	tEHLW		80	—	
Enable H pulse width (WRITE)		tEWHW		80	—	
Enable L pulse width (READ)	RD	tEHLR		80	—	
Enable H pulse width (READ)		tEWHR		140	—	
WRITE Data setup time	D0 to D7	tDS6		40	—	
WRITE Address hold time		tDH6		0	—	
READ access time		tACC6	CL = 100 pF	—	70	
READ Output disable time		tOH6	CL = 100 pF	5	50	

(VDD = 2.7V, Ta = -30 to 85°C)

Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
Address hold time	A0	tAH6		0	—	ns
Address setup time		tAW6		0	—	
System cycle time		tCYC6		400	—	
Enable L pulse width (WRITE)	WR	tEWLW		220	—	
Enable H pulse width (WRITE)		tEWHW		180	—	
Enable L pulse width (READ)	RD	tEWLR		220	—	
Enable H pulse width (READ)		tEWHR		180	—	
WRITE Data setup time	D0 to D7	tDS6		40	—	
WRITE Address hold time		tDH6		0	—	
READ access time		tACC6	CL = 100 pF	—	140	
READ Output disable time		tOH6	CL = 100 pF	10	100	

**Table 29**

(VDD = 1.8V, Ta = -30 to 85°C)

Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
Address hold time	A0	tAH6		0	—	ns
Address setup time		tAW6		0	—	
System cycle time		tCYC6		640	—	
Enable L pulse width (WRITE)	WR	tEWLW		360	—	
Enable H pulse width (WRITE)		tEWHW		280	—	
Enable L pulse width (READ)	RD	tEWLR		360	—	
Enable H pulse width (READ)		tEWHR		280	—	
WRITE Data setup time	D0 to D7	tDS6		80	—	
WRITE Address hold time		tDH6		0	—	
READ access time		tACC6	CL = 100 pF	—	240	
READ Output disable time		tOH6	CL = 100 pF	10	200	

1 The input signal rise time and fall time (tr, tr) is specified at 15 ns or less. When the system cycle time is extremely fast, (tr + tr) ≤ (tCYC6 - tEWLW - tEWHW) for (tr + tr) ≤ (tCYC6 - tEWLR - tEWHR) are specified.

2 All timing is specified using 20% and 80% of VDD as the reference.

3 tEWLW and tEWLR are specified as the overlap between CS1 being "L" (CS2 = "H") and E.

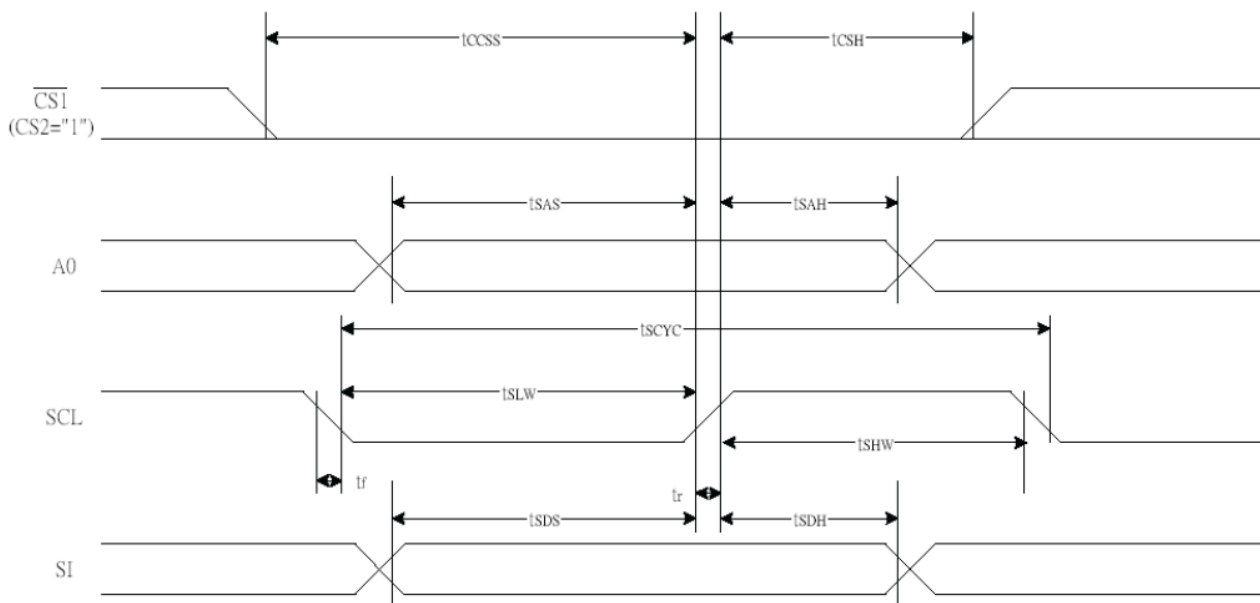
**The Serial Interface**


Figure 39

**Table 30**

(V<sub>DD</sub> = 3.3V, T<sub>a</sub> = -30 to 85°C)

Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
Serial Clock Period	SCL	T <sub>scyc</sub>		50	—	ns
SCL "H" pulse width		T <sub>shw</sub>		25	—	
SCL "L" pulse width		T <sub>slw</sub>		25	—	
Address setup time	A0	T <sub>sas</sub>		20	—	
Address hold time		T <sub>sah</sub>		10	—	
Data setup time	SI	T <sub>sds</sub>		20	—	
Data hold time		T <sub>sdh</sub>		10	—	
CS-SCL time	CS	T <sub>css</sub>		20	—	
CS-SCL time		T <sub>csh</sub>		40	—	

**Table 31**

(V<sub>DD</sub> = 2.7V, T<sub>a</sub> = -30 to 85°C)

Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
Serial Clock Period	SCL	T <sub>scyc</sub>		100	—	ns
SCL "H" pulse width		T <sub>shw</sub>		50	—	
SCL "L" pulse width		T <sub>slw</sub>		50	—	
Address setup time	A0	T <sub>sas</sub>		30	—	
Address hold time		T <sub>sah</sub>		20	—	
Data setup time	SI	T <sub>sds</sub>		30	—	
Data hold time		T <sub>sdh</sub>		20	—	
CS-SCL time	CS	T <sub>css</sub>		30	—	
CS-SCL time		T <sub>csh</sub>		60	—	

(VDD = 1.8V, Ta = -30 to 85°C)

Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
Serial Clock Period	SCL	TSCYC		200	—	ns
SCL "H" pulse width		TSHW		80	—	
SCL "L" pulse width		TSLW		80	—	
Address setup time	A0	TSAS		60	—	
Address hold time		TSAH		30	—	
Data setup time	SI	TSDS		60	—	
Data hold time		TS DH		30	—	
CS-SCL time	CS	TCSS		40	—	
CS-SCL time		TCSH		100	—	

\*1 The input signal rise and fall time (tr, tf) are specified at 15 ns or less.

\*2 All timing is specified using 20% and 80% of VDD as the standard.



## 6 Programming

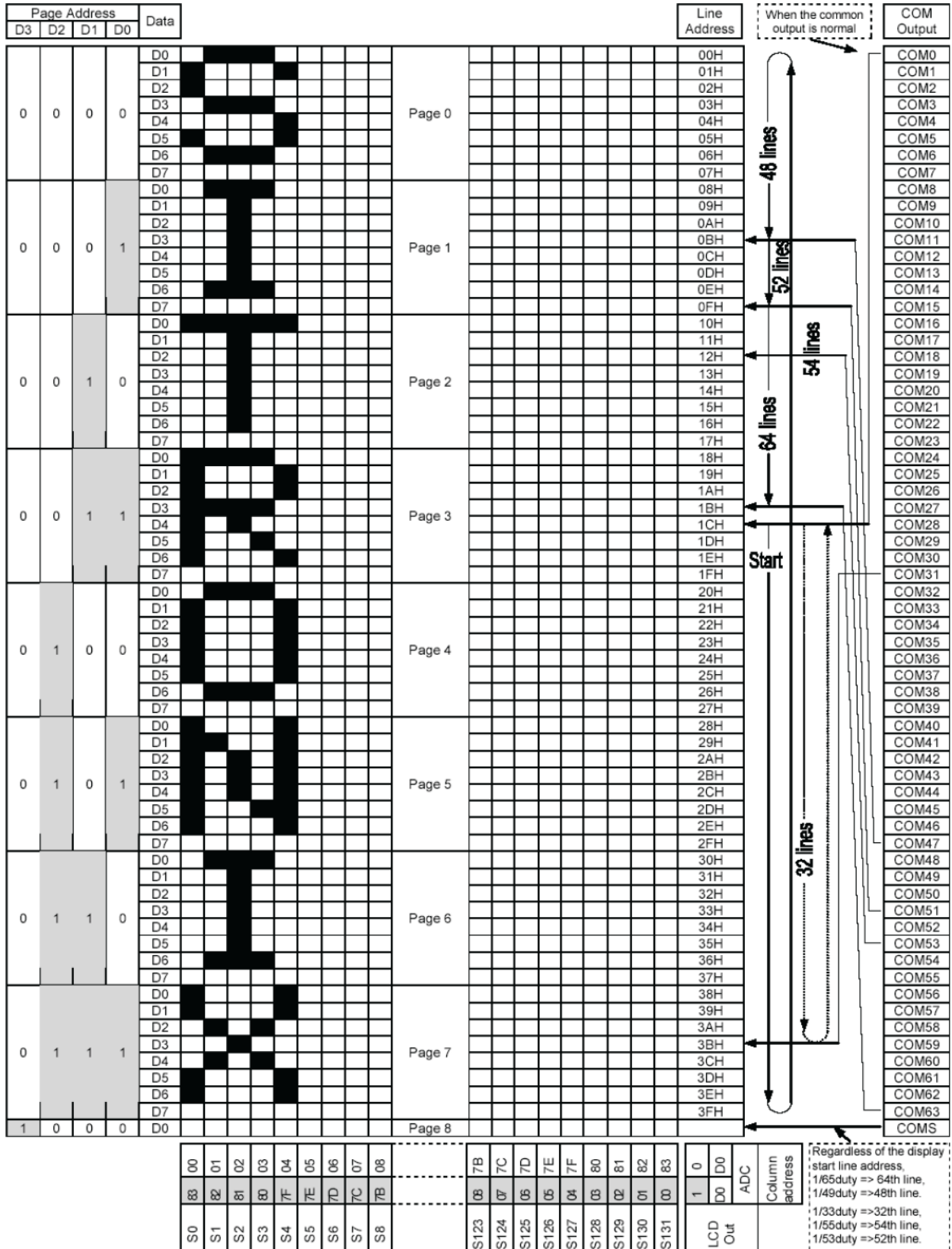
### 6.1 Instruction Table

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
(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) Vo 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 Vo output voltage electronic volume register
Electronic volume register set				0	0	Electronic volume value						
(19) Static indicator ON/OFF	0	1	0	1	0	1	0	1	1	0	0	0: OFF, 1: ON
Static indicator register set				0	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
(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



## 6.2 Display Data RAM

Relationship between display pattern and Display Data RAM show as below:



## Appendix

### 1 Packing Method

#### □Method 1

ESD Bag + Product Box + Plastic Bag + Carton

##### 1. Quantity

QUANTITY	UNIT
1	PCS / ESD Bag
108	PCS / Box
2	Box / Carton
216	PCS / Carton

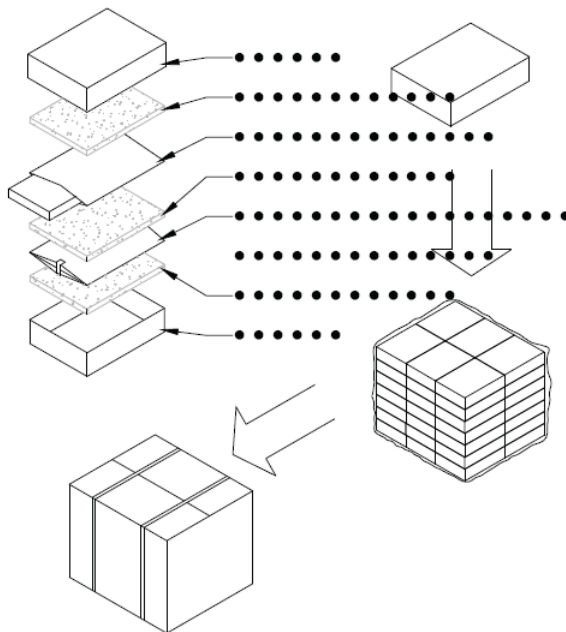
##### 2. Material

Material	Size (LXWXH) mm
ESD Bag	
Product Box	
Carton	

##### 3. Label

PRODUCT ID:  
PART NO:  
QUANTITY:  
GROSS WEIGHT:  
MEASUREMENTS:

#### 4. Packing Method



Note: see table 1. Quantity for detail.

#### □Method 2

ESD Tray + Plastic Bag + Carton

##### 1. Quantity

QUANTITY	UNIT
	PCS / Tray
	Tray / Carton
	PCS / Carton

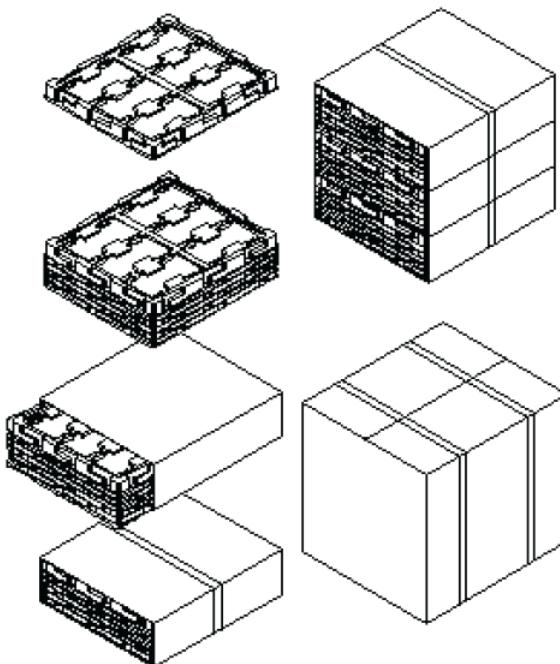
##### 2. Material

Material	Size (LXWXH) mm
ESD Tray	
Carton	

##### 3. Label

PRODUCT ID:  
PART NO:  
QUANTITY:  
GROSS WEIGHT:  
MEASUREMENTS:

#### 4. Packing Method



Note: see table 1. Quantity for detail.

## 2 Definitions of Optical Characteristic

### 2.1 Contrast Ratio Test

A) Contrast ratio is calculated by the following formula when the output voltage is obtained from the electro-optical test system.

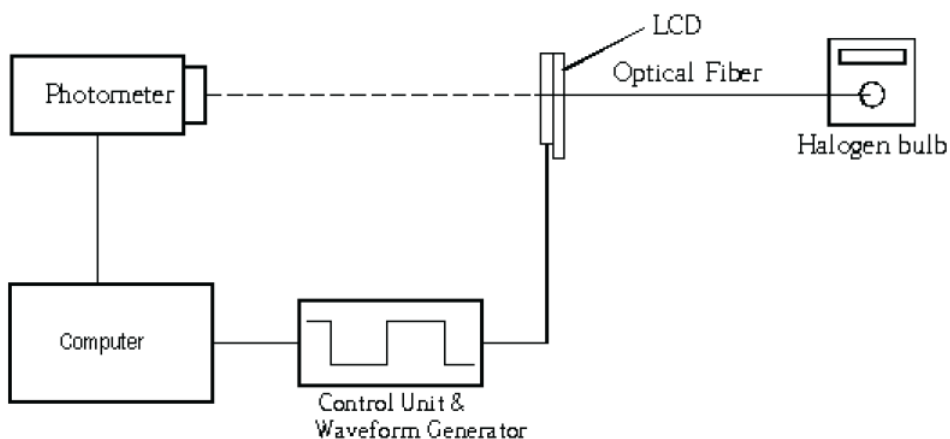
B) Test Condition: Accord to the LCD's driving method and operating voltage ( $V_{LCD}$ ).

C) Formula:

*Contrast Ratio (Positive type) =  $\frac{\text{Photometer output voltage when non-select waveform is applying}}{\text{Photometer output voltage when select waveform is applying}}$*

*Contrast Ratio (Negative type) =  $\frac{\text{Photometer output voltage when select waveform is applying}}{\text{Photometer output voltage when non-select waveform is applying}}$*

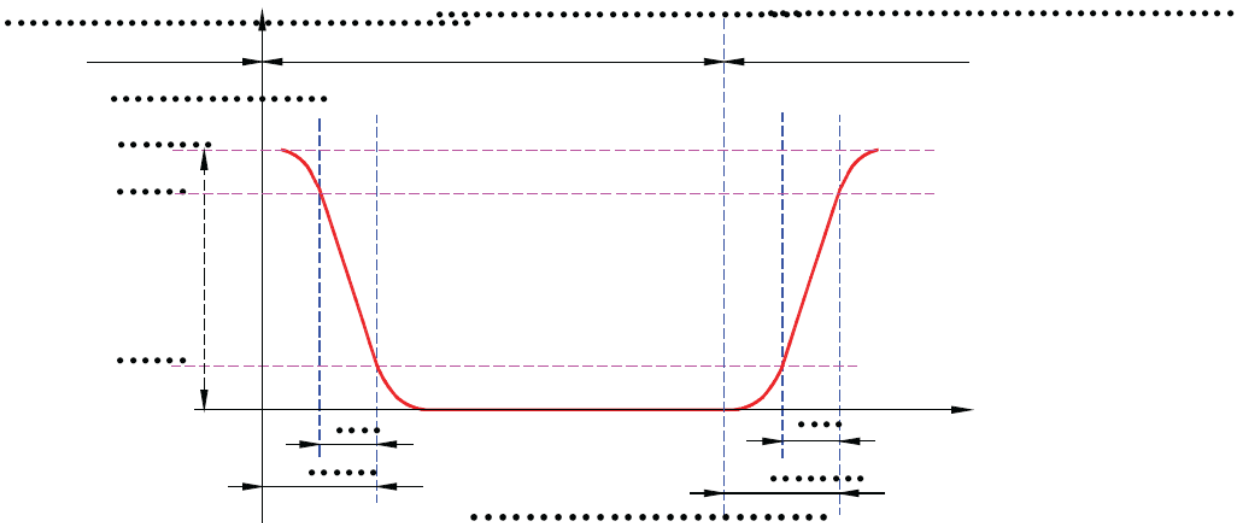
D) Test system:



## 2.2 Response time

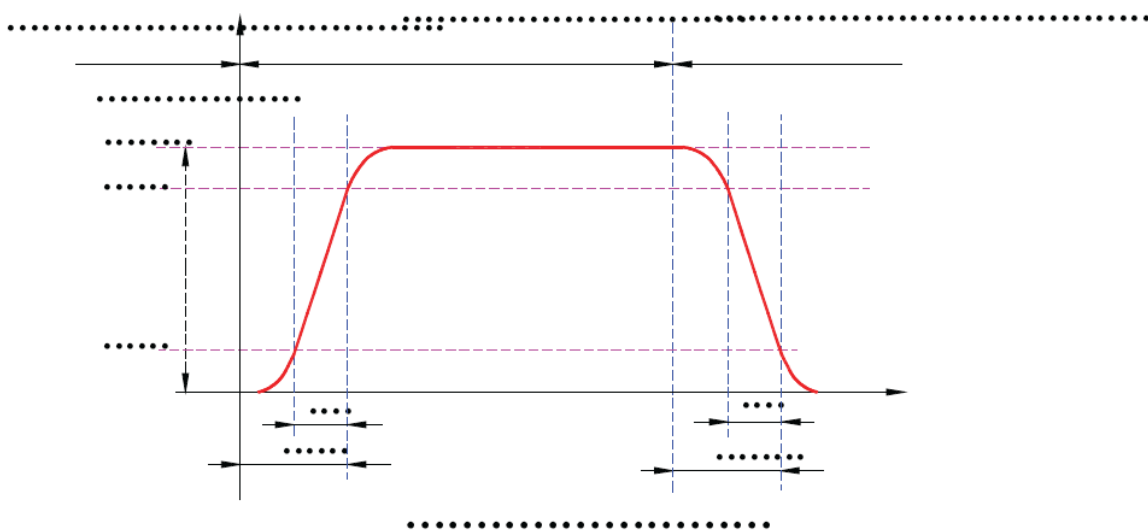
### 2.2.1 Positive type

- A) Rise time is defined as the time required for the transmission to change from 90% to 10%.
- B) Fall time is defined as the time required for the transmission to change from 10% to 90%.
- C) On time is defined as the time required for the transmission to change from 100% to 10%.
- D) Off time is defined as the time required for the transmission to change from 0% to 90%.



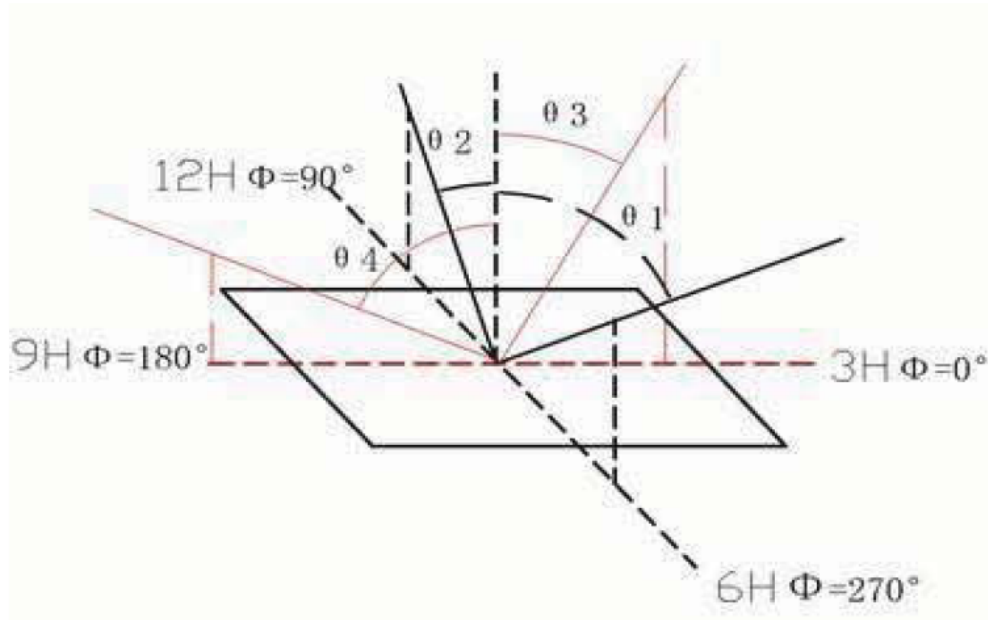
### 2.2.1 Negative type

- A) Rise time is defined as the time required for the transmission to change from 10% to 90%.
- B) Fall time is defined as the time required for the transmission to change from 90% to 10%.
- C) On time is defined as the time required for the transmission to change from 0% to 90%.
- D) Off time is defined as the time required for the transmission to change from 100% to 10%.

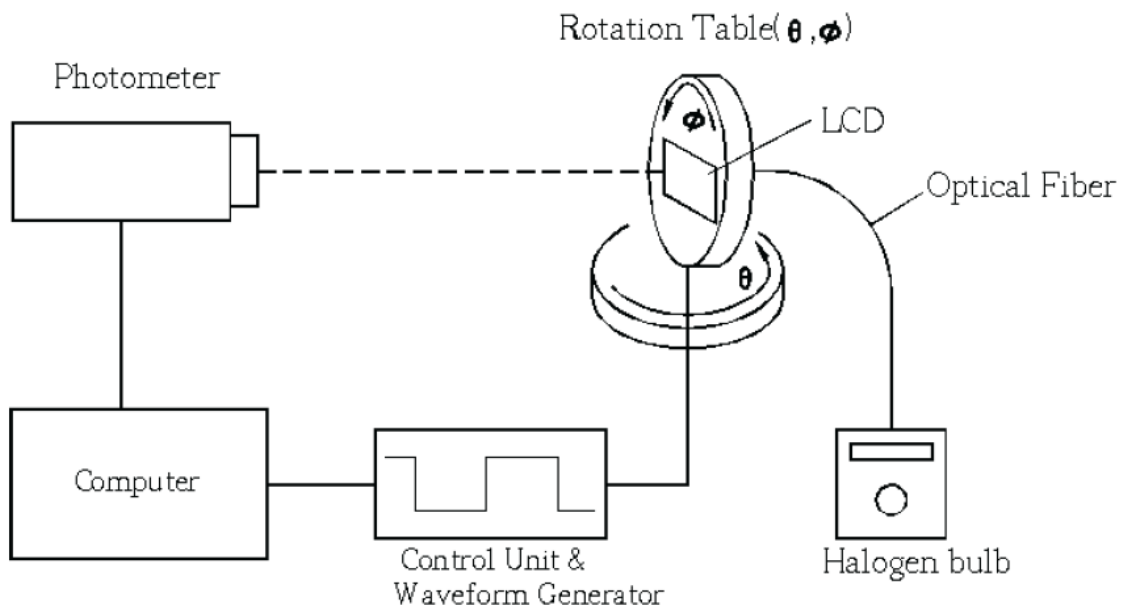


## 2.3 Viewing Angle

A) Viewing angle is definition



B) System Block Diagram

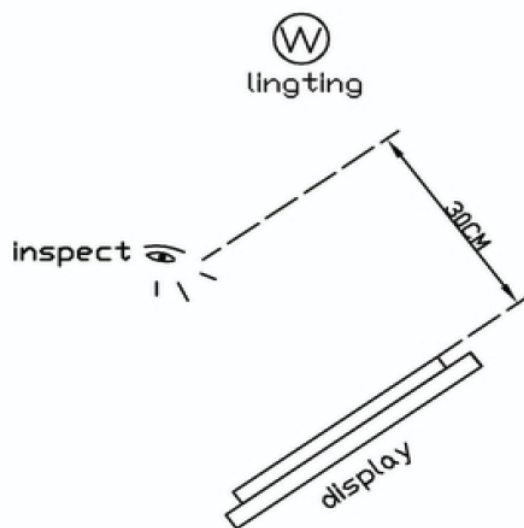


### 3 Quality Units

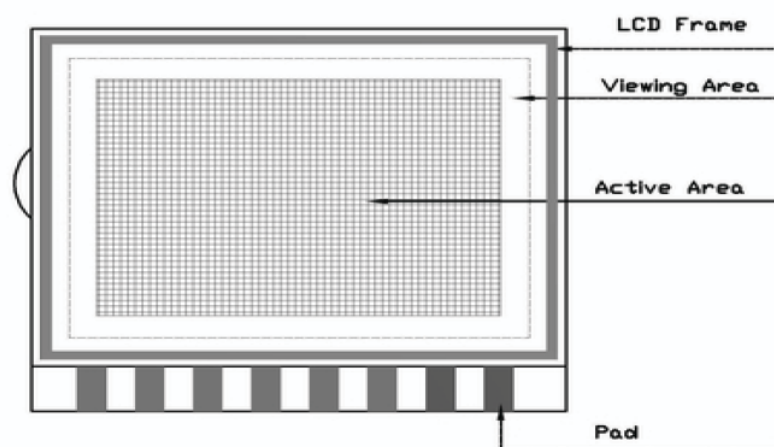
#### 3.1 Visual and Technological Inspection

- Visual inspection must be performed with naked eye on display.
- Distance between observer and display should be about 30 cm.
- Perform inspection at OFF state and ON state
- Ambient lighting should be 1000 lux
- Transmissive, transflective and negative type specimens should be inspected in backlight

(i) Inspecting method:



(ii) Definition of area:

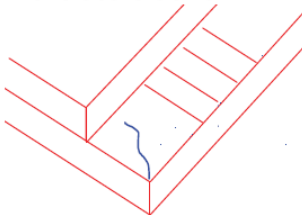
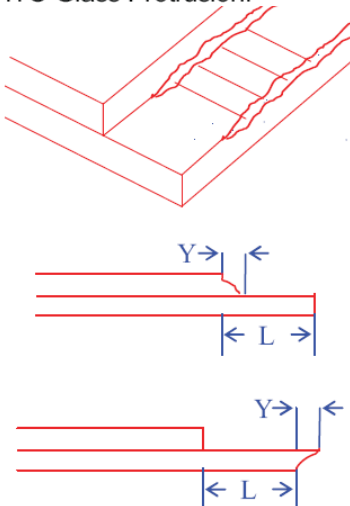
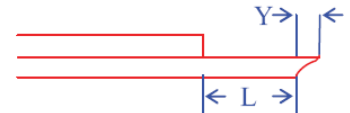


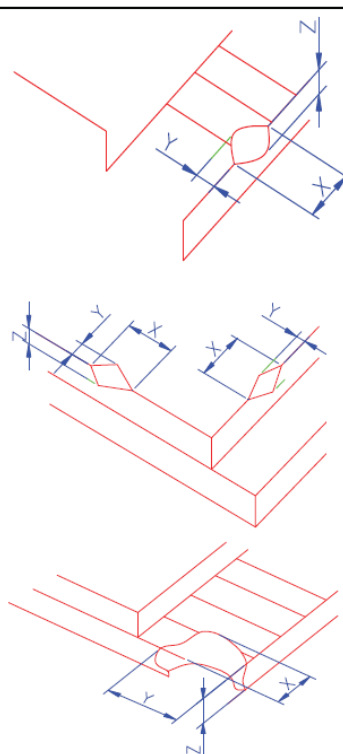
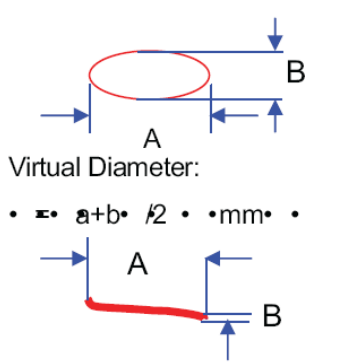
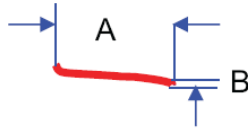
Note: The drawing is a general sketch map only. If want to see the product outline detail, please see the product outline drawing.

### 3.2 Visual Inspection Standard:

Table1

(Unit: mm)

No	Defect Item			Criterion	
	Defect describe	Position	classify	Section	Acceptable Number(N)(*3)
1	Liquid Crystal Leakage				Not acceptable
2	Bubble in Liquid Crystal				Not acceptable
3	Rainbow		Slight • *1 • •		Acceptable
			Obvious • *2 • •		Not acceptable
4	ITO Glass Crackle  Pic 1		Slight	Pic 1: Enter into the glass	Not acceptable
			Slight	Pic 2: not Enter into the glass	2
5 • *4 •	ITO Glass Protrusion: 		Slight	1 • smaller glass edge: Y • $L/6$ , X ignore, Z • $t$ 2: larger glass edge: no influence upon no influence upon outline dimension • assemble, display function	1
6 • *4 •	Chipped Glass: 	pad Edge	Slight	X • 1.5, Y • $1/3L$ , Z • $t$ • or chip don't touch one third of Pad width.	2

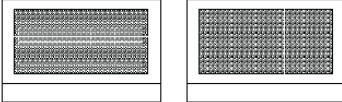
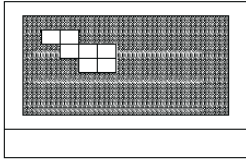
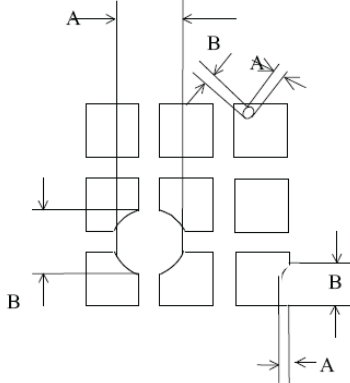
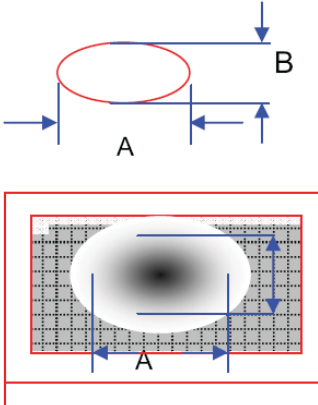
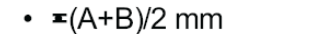
		Non-Pad Edge	Slight	X• 2, Y• 1, Z• 1, Y can't t enter into active area and can't touch the sealant	2
		Comer	Slight	X• 1.5, Y• 1.5 , Z• 1	2
7	Black/White Spots (Include LCD and Backlight):  Virtual Diameter: • $\frac{a+b}{2}$ • mm • 	Circular Type	Slight	• • 0.1 0.10<• • 0.2 0.2<• • 0.25	Acceptable 2 1
		Linear Type	Slight	B • 0.05 A • 2	Acceptable
				0.05<B• 0.1 A• 2	2
				B>0.1	According to the spot's standard
8	Polarizer Bubble			• • 0.2 0.2• • • 0.3 • 0.3• • • 0.5 •	Acceptable 2 1
Note	1. Slight rainbow: rainbow outside of Viewing Area, or concolorous rainbow inside of ViewingArea but don't go beyond the limited sample which affirmed by purchaser. 2. Obvious rainbow: double color rainbow in Viewing area and go beyond the limited sample which affirmed by purchaser. 3. Acceptable Number(N) is the defects number in the LCD that will be defined according to the defects distributing density. In this table,the acceptable number is • 1/1(cm) <sup>2</sup> . If purchaser has different suggest, please discuss with GW.				

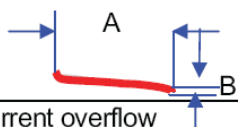
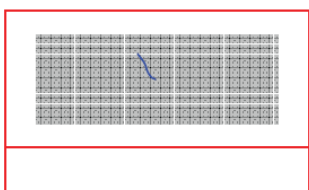


### 3.3 Display Inspection Standard:

Table2

(Unit: mm)

No	Defect Item	Criterion	
		Section	Acceptable Number(N) (*1)
1	Non display		Not acceptable
2	Display missing 		Not acceptable
3	Short Circuit		Not acceptable
4	Abnormal display 		Not acceptable
5	Pin Hole & Gap in displaying segment or Dot Matrix: 	• • 0.1	Acceptable
		0.1 • • • 0.2 •	2
		0.2 • • • 0.25 •	1
		• ≥0.25	Not acceptable
6	Display Black/White Spots 	The spot's dimension and color don't alter with the voltage alteration	
		• • 0.10	acceptable
		0.10 < • • 0.2	3
		0.2 < • • 0.25	1
		• ≥0.25	Not acceptable
		The spot's dimension and color alter with the voltage alteration	
		• • 0.3	acceptable
		0.3 < • • 0.5	3
7	Display Black/White lines 	The Line's dimension and color don't alter with the voltage alteration	
		B • 0.05 A • 2	acceptable
		0.05 < B • 0.1 A • 2	3
		B > 0.1	According to the spot's standard



The Line's dimension and color alter with the voltage alteration

$B \cdot 0.07 \quad A \cdot 5$	acceptable
$0.07 < B \cdot 0.15 \quad A \cdot 5$	3
$0.15 < B \cdot 0.3 \quad A \cdot 5$	1
$B > 0.3$	According to the spot's standard

8	The current overflow	Not acceptable
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Note  
1. when the width value of Segment or Dot Matrix is less than 3.0 mm, no default is acceptable  
2. No more than 5 defaults are acceptable in  $1\text{cm}^2$  area.


## 4 Reliability-TEST

### 4.1. Standard Specifications for Reliability

#### 4.1-1 Test method

There should be no existing conspicuous failure of functions and appearance in LCD after the following tests.

NO	Item	Description
1	Low Temperature Operating	The sample should be allowed to stand at $(-20 \pm 2)^\circ\text{C}$ for 96 Hours under driving condition.
2	High Temperature Operating	The sample should be allowed to stand at $(+70 \pm 2)^\circ\text{C}$ for 96 Hours under driving condition.
3	Low Temperature Storage	The sample should be allowed to stand at $(-30 \pm 3)^\circ\text{C}$ for 96 Hours under no-load condition, and then returning it to normal temperature condition, and allowing it stand for 24 hours
4	High Temperature Storage	The sample should be allowed to stand at $(+80 \pm 2)^\circ\text{C}$ for 96 Hours under no-load condition, and then returning it to normal temperature condition, and allowing it stand for 24 hours
5	Moisture resistance	The sample should be allowed to stand at $(40 \pm 2)^\circ\text{C}$ ; $(95 \pm 2)\% \text{RH}$ for 96 Hours under no-load condition excluding the polarizer, then taking it out and drying it at normal temperature, and allowing it stand for 24 hours
6	Thermal Shock Resistance	The sample should be allowed to stand the following 5 cycles of operation: $T_{\text{STL}}$ * for 30 minutes -> normal temperature for 5 minutes -> $T_{\text{STH}}$ * for 30 minutes -> normal temperature for 5 minutes, as one cycle, then taking it out and drying it at normal temperature, and allowing it stand for 24 hours

 <b>P-TEC</b>	<b>MODEL NO.</b>		<b>PAGE</b>
	PCOG12864P-O series	SPEC ONLY	27

#### 4.1-2 Testing Conditions and Inspection Criteria:

For the final test, the testing sample must be stored at room temperature for 24 hours, after the tests listed above; Standard specifications for Reliability have been executed in order to ensure stability.

NO	Item	Inspection Criteria
1	Current Consumption	The current consumption should be under double of initial test.
2	Contrast	The contrast must be larger than half of initial test.
3	Appearance	Appearance defects should not happen.

#### 4.2 Life Time:

Functions, performance, appearance, etc. shall be free from remarkable deterioration within 50,000 hours under ordinary operating and storage conditions room temperature ( $25\pm 10^{\circ}\text{C}$ ), normal humidity ( $45\pm 20\%\text{RH}$ ), and in area not exposed to direct sunlight.