

# POWERTIP TECH. CORP.

DISPLAY DEVICES FOR BETTER ELECTRONIC DESIGN

## Specification For Approval

Customer : \_\_\_\_\_

Model Type : LCD Module

Sample Code : PC2002ARS-BEA-A-SB

Mass Production Code : \_\_\_\_\_

Edition : B

Customer Sign	Sales Sign	Approved By	Prepared By

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# 1. SPECIFICATIONS

## 1.1 Features

- 20-characters, 2-lines liquid crystal display of 5\*7 dot matrix + cursor
- 1/16 Duty, 1/5 bias
- STN LCD, positive, gray
- Reflective LCD
- 6 o'clock viewing angle
- 8 bits parallel data input

## 1.2 Mechanical Specifications

- Outline dimension : 116.0mm(L)\* 37.0mm(W)\*13.8mm max.(H)
- Viewing area : 85.0mm \*18.5mm
- Active area : 73.5mm \*11.5mm
- Dot size : 0.6mm \*0.65mm
- Dot pitch : 0.6mm \*0.7mm
- Character Size : 3.2mm \*5.55mm

## 1.3 Absolute Maximum Ratings

Item	Symbol	Conditions	Min.	Max.	Unit
Power supply Voltage	$V_{DD}$	-	-0.3	7.0	V
LCD drive Supply voltage	$V_{DD}-V_O$	-	-	5.5	V
Input voltage	$V_{IN}$	-	-0.3	$V_{DD}+0.3$	V
Operating temperature	$T_{OPR}$	-	0	50	°C
Storage temperature	$T_{STG}$	-	-20	60	°C
Humidity	HD	-	-	90	%RH

## 1.4 DC Electrical Characteristics

$V_{DD}=+5V\pm 10\%$ ,  $V_{SS}=0V$ ,  $T_A=25^\circ C$

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Logic Supply voltage	$V_{DD}$	-	4.5	5	5.5	V
“H” input voltage	$V_{IH}$	-	2.2	-	$V_{DD}$	V
“L” input voltage	$V_{IL}$	-	$V_{SS}$	-	0.8	V
“H” output voltage	$V_{OH}$	-	2.4	-	-	V
“L” output voltage	$V_{OL}$	-	-	-	0.4	V
Supply current	$I_{DD}$	$V_{DD}=5V$	-	1.26	1.53	mA
LCD driving voltage	$V_{OP}$	$V_{DD}-V_O$	3.63	4.41	4.98	V



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## 1.5 Optical Characteristics

1/16 duty, 1/4 bias,  $V_{OPR}=4.1V$ ,  $T_a=25^{\circ}C$

Item	Symbol	Conditions	Min.	Typ.	Max	Reference
Viewing angle	$\theta$	$C \geq 2.0, \varnothing = 0^{\circ}$	$-30^{\circ}$	-	$30^{\circ}$	Notes 1 & 2
Contrast	C	$\theta = 5^{\circ}, \varnothing = 0^{\circ}$	-	3	-	Note 3
Response time(rise)	$T_r$	$\theta = 5^{\circ}, \varnothing = 0^{\circ}$	-	200ms	300ms	Note 4
Response time(fall)	$T_f$	$\theta = 5^{\circ}, \varnothing = 0^{\circ}$	-	200ms	300ms	Note 4

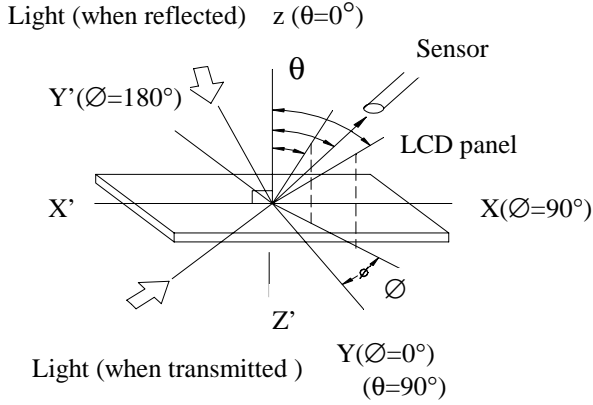
Parameter	Symbol	Temperature ( $^{\circ}C$ )	Standard			Unit
			Min	Typ	Max	
Driving voltage	$V_{OP}$	-20	-	-	-	V
		0	4.6	4.5	4.7	
		25	3.8	4.1	4.4	
		50	3.5	3.7	3.9	
		70	-	-	-	



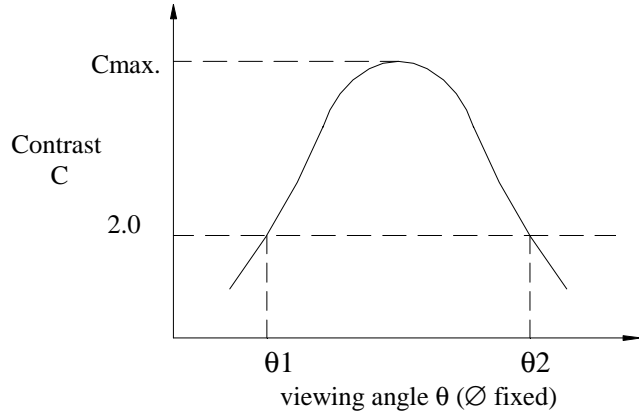
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Note 1: Definition of angles  $\theta$  and  $\varnothing$



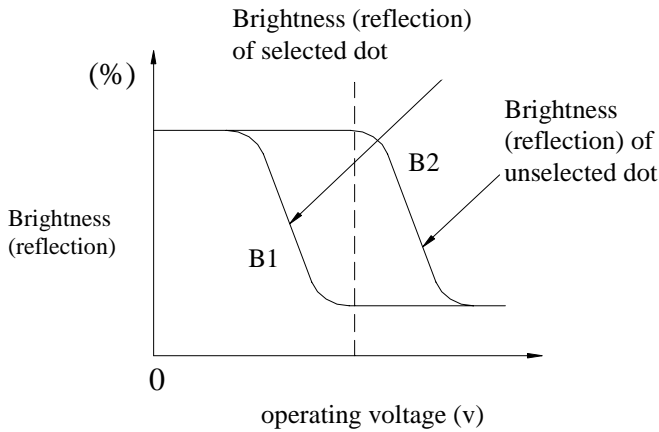
Note 2: Definition of viewing angles  $\theta_1$  and  $\theta_2$



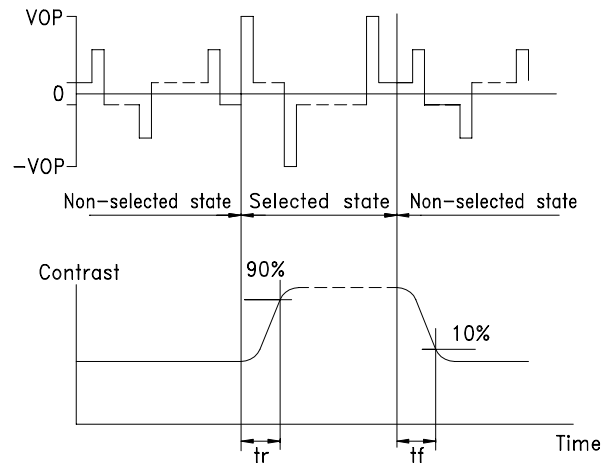
Note : Optimum viewing angle with the naked eye and viewing angle  $\theta$  at  $C_{max}$ . Above are not always the same

Note 3: Definition of contrast  $C$

$$C = \frac{\text{Brightness (reflection) of unselected dot (B2)}}{\text{Brightness (reflection) of selected dot (B1)}}$$



Note 4: Definition of response time



Note: Measured with a transmissive LCD panel which is displayed 1 cm<sup>2</sup>

$V_{OPR}$  : Operating voltage  
 $t_r$  : Response time (rise)

$f_{FRM}$  : Frame frequency  
 $t_f$  : Response time (fall)



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## 2. MODULE STRUCTURE

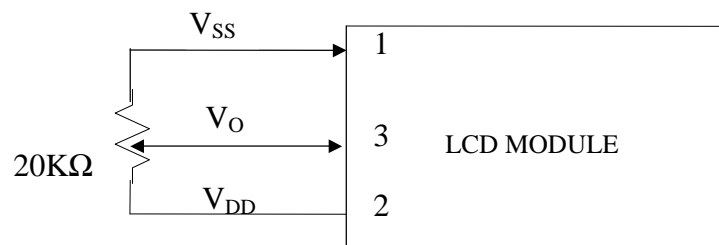
### 2.1 Counter Drawing

\*See Appendix

### 2.2 Interface Pin Description

Pin No.	Symbol	Signal Description
1	$V_{SS}$	Signal ground (GND)
2	$V_{DD}$	Power Supply (5 V)
3	$V_O$	Operating voltage (LCD Driver)
4	RS	Register Selection input High = Data register Low = Instruction register (for write) Busy flag address counter (for read)
5	R/W	Read/Write signal input is used to select the read/write mode High = Read mode, Low = Write mode
6	E	Start enable signal to read or write the data
7~10	DB0 ~ DB3	Four low order bi-directional three-state data bus lines. Use for data transfer between the MPU and the LCD module. These four are not used during 4-bit operation.
11~14	DB4 ~ DB7	For high order bi-directional three-state data bus lines. Used for data transfer between the MPU and the LCD module. DB7 can be used as a busy flag.
15	A	Power supply for LED B / L (+)
16	K	Power supply for LED B / L (-)

Contrast Adjust

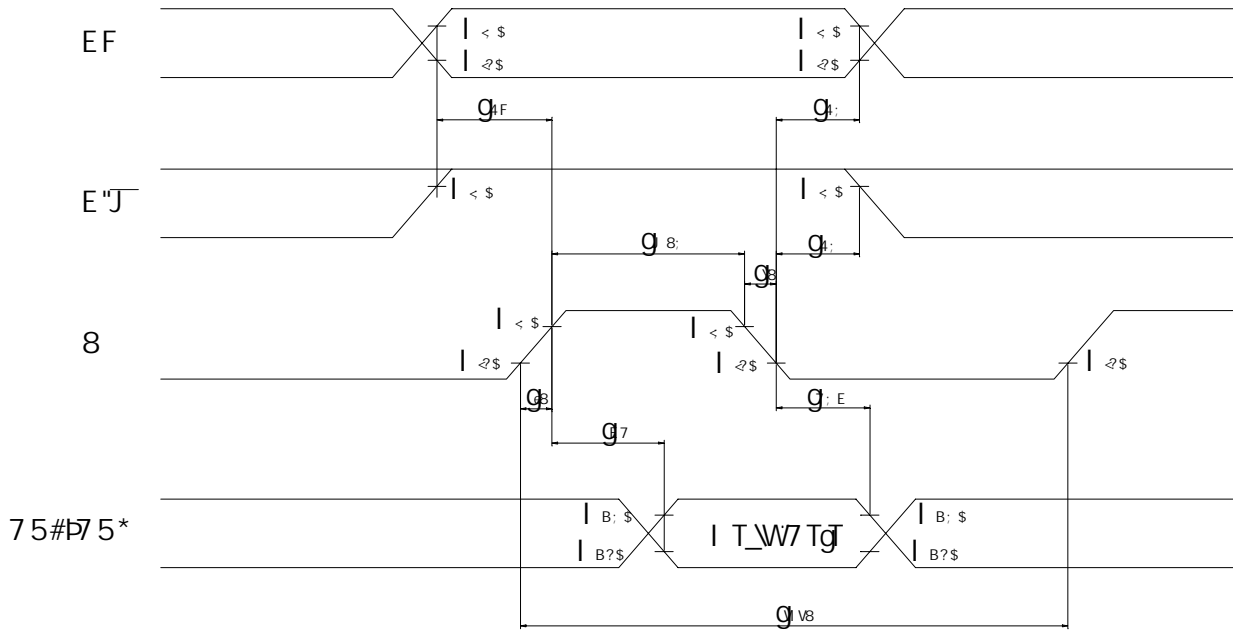


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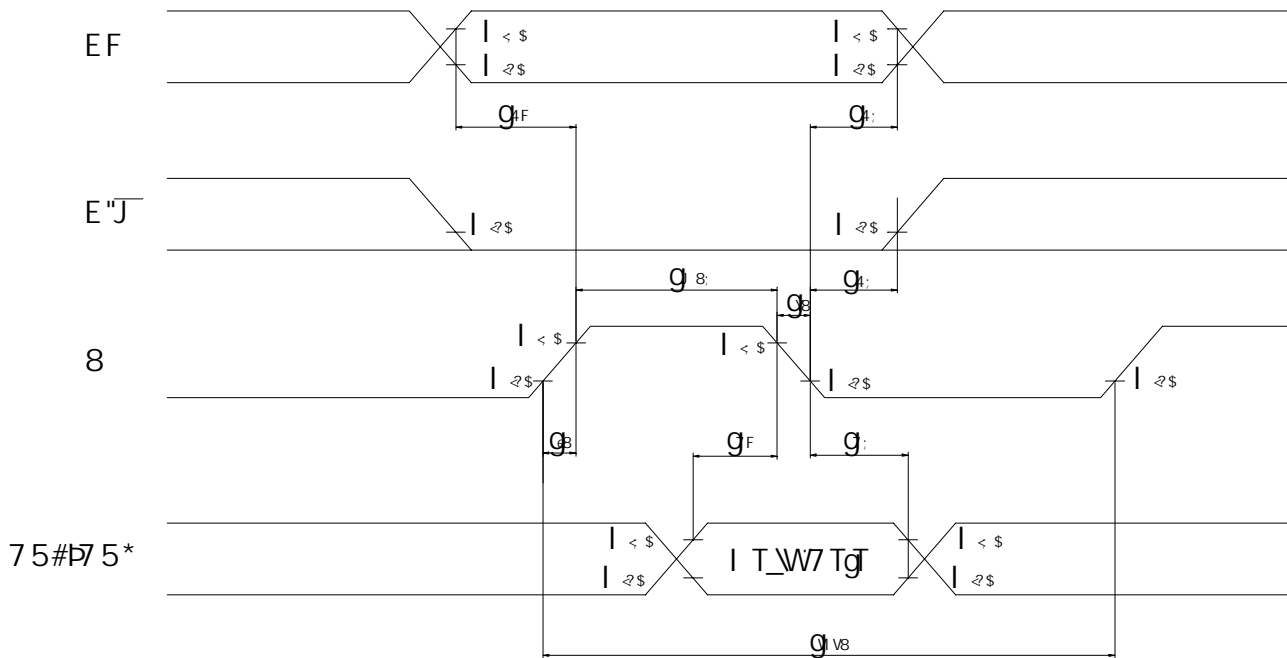
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### 2.3 Timing Characteristics

- Read cycle



- Write cycle



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## • Read cycle

VDD=5.0V±10%,VSS=0V,Ta=-20 to 75°C

Characteristics	Symbol	Condition	Min.	Typ.	Max.	Unit
Enable cycle time	$t_{cycE}$	-	500	-	-	ns
Enable "H" level pulse width	$t_{WEH}$	-	220	-	-	ns
Enable rise/fall time	$t_{rE}, t_{fE}$	-	-	-	25	ns
RS,R/W setup time	$t_{AS}$	-	40	-	-	ns
RS,R/W address hold time	$t_{AH}$	-	10	-	-	ns
Read data output delay	$t_{RD}$	$C_L=100pF$	-	-	120	ns
Read data hold time	$t_{DHR}$		20	-	-	ns

## • Write cycle

Characteristics	Symbol	Condition	Min.	Typ.	Max.	Unit
Enable cycle time	$t_{cycE}$	-	500	-	-	ns
Enable "H" level pulse width	$t_{WEH}$	-	220	-	-	ns
Enable rise/fall time	$t_{rE}, t_{fE}$	-	-	-	25	ns
RS,R/W setup time	$t_{AS}$	-	40	-	-	ns
RS,R/W address hold time	$t_{AH}$	-	10	-	-	ns
Data setup time	$t_{DS}$	-	60	-	-	ns
Write data hold time	$t_{DH}$	-	10	-	-	ns

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## 2.4 Display Command

Instructions	Instruction Code										Description	Execution Time (fosc = 270KHZ)
	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0		
Clear Display	0	0	0	0	0	0	0	0	0	1	Write "20H" to DDRAM. and set DDRAM address to "00H" from AC.	1.52ms
Return Home	0	0	0	0	0	0	0	0	1	×	Set DDRAM address to "00H" from AC and return cursor to it's original position if shifted. The contents of DDRAM are not changed.	1.52ms
Entry Mode Set	0	0	0	0	0	0	0	1	I/D	SH	Assign cursor moving direction and make shift of entire display enable.	37μs
Display ON/OFF Control	0	0	0	0	0	0	1	D	C	B	Sets display (D), cursor(C), and blinking of cursor(B) on/off control bit.	37μs
Cursor or Display Shift	0	0	0	0	0	1	S/C	R/L	×	×	Set cursor moving and display shift control bit, and the direction, without changing of DDRAM data.	37μs
Function Set	0	0	0	0	1	DL	N	F	×	×	Set interface data length (DL:4-bit/8-bit), numbers of display line (N: 1-line/2-line), display font type(F:5*8 dots/5*11 dots)	37μs
Set CGRAM Address	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0	Set CGRAM address in address counter.	37μs
Set DDRAM Address	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Set DDRAM address in address counter.	37μs
Read Busy Flag and Address	0	1	BF	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Whether during internal operation or not can be known by reading BF. The contents of address counter can also be read.	0μs
Write Data to RAM	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Write data into internal RAM (DDRAM/CGRAM).	43μs
Read Data from RAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0	Read data from internal RAM (DDRAM/CGRAM).	43μs

※ "x":don't care



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## 2.5 Character Pattern

Upper 4bit Lower 4bit	LLLL	LLHL	LLHH	LHLL	LHLH	LHHL	LHHH	HLLL	HLLH	HLHL	HLHH	HHLL	HHLH	HHHL	HHHH
LLLL	CG RAM (1)														
LLLH	(2)														
LLHL	(3)														
LLHH	(4)														
LHLL	(5)														
LHLH	(6)														
LHHL	(7)														
LHHH	(8)														
HLLL	(1)														
HLLH	(2)														
HLHL	(3)														
HLHH	(4)														
HHLL	(5)														
HHLH	(6)														
HHHL	(7)														
HHHH	(8)														



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