PRODUCT SPECIFICATION

Part Number

PCOG240160Q-O Series

CUSTOMER	
CUSTOMER PART NUMBER	
DESCRIPTION	
APPROVED BY	
DATE	

Table of Contents

Record of Revisions

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

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.

1. FUNCTIONS & FEATURES

1.1. Format	: 240x160 Dots
1.2. LCD mode	: STN /Positive Mode /Transflective/Y-G
1.3. Viewing direction	: 6 o'clock
1.4. Driving scheme	: 1/160 Duty cycle, 1/12 Bias
1.5. Power supply voltage (V_{DD})	: 3.3V
1.6. LCD driving voltage (VLCD)	: 16.0V (Reference voltage)
1.7. Operation temp	: -20~+70℃
1.8. Storage temp	: -30~+80℃
1.9. Back light	: none
1.10. RoHS compliant.	

2. MECHANICAL SPECIFICATIONS

2.1. Module size	: 102mm(L)*67.2+58.0mm(FPC length)mm(W)*2.9mm(H)
2.2. Viewing area	: 99.0mm(L)*57.5mm(W)
2.3. Dot pitch	: 0.35mm(L)*0.32mm(W)
2.4. Dot size	: 0.33mm(L)*0.30mm(W)
2.5. Weight	: Approx.

3. BLOCK DIAGRAM

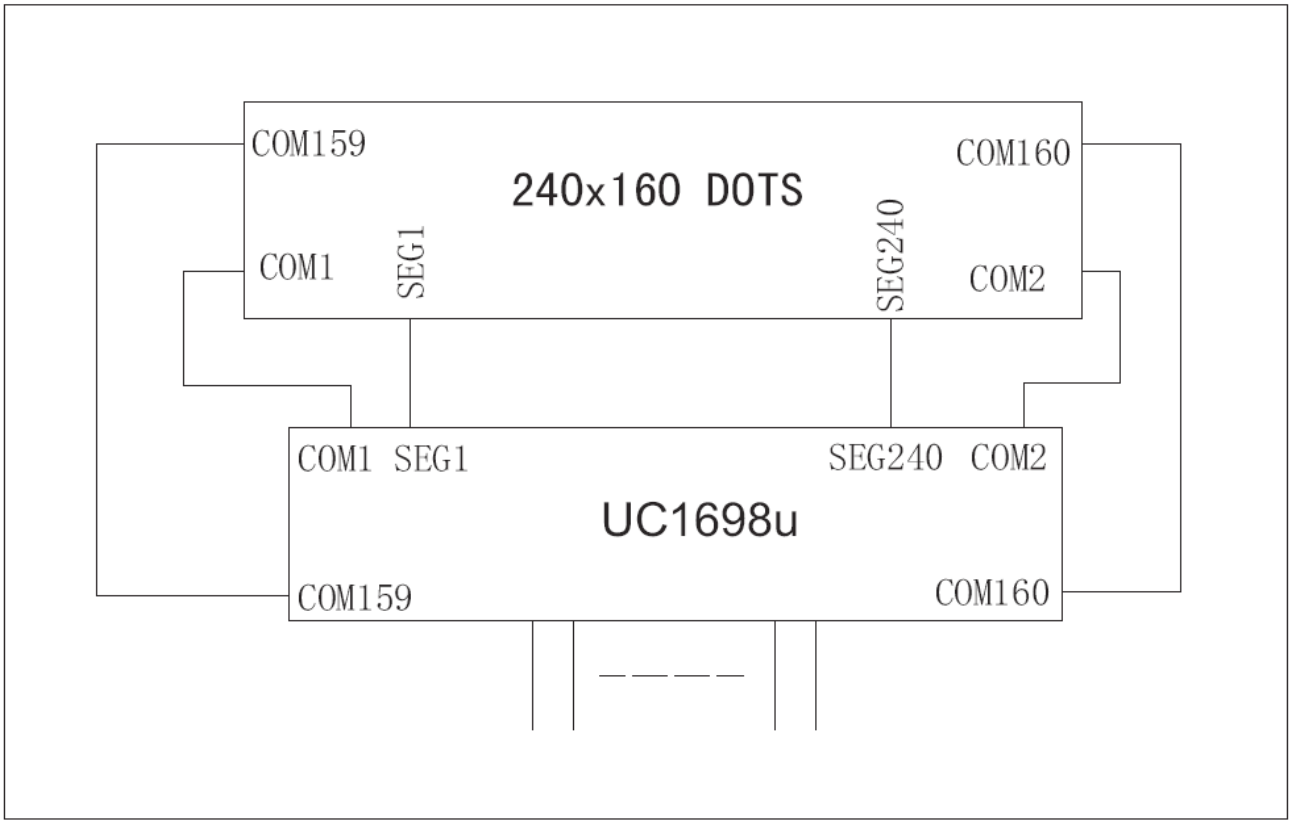
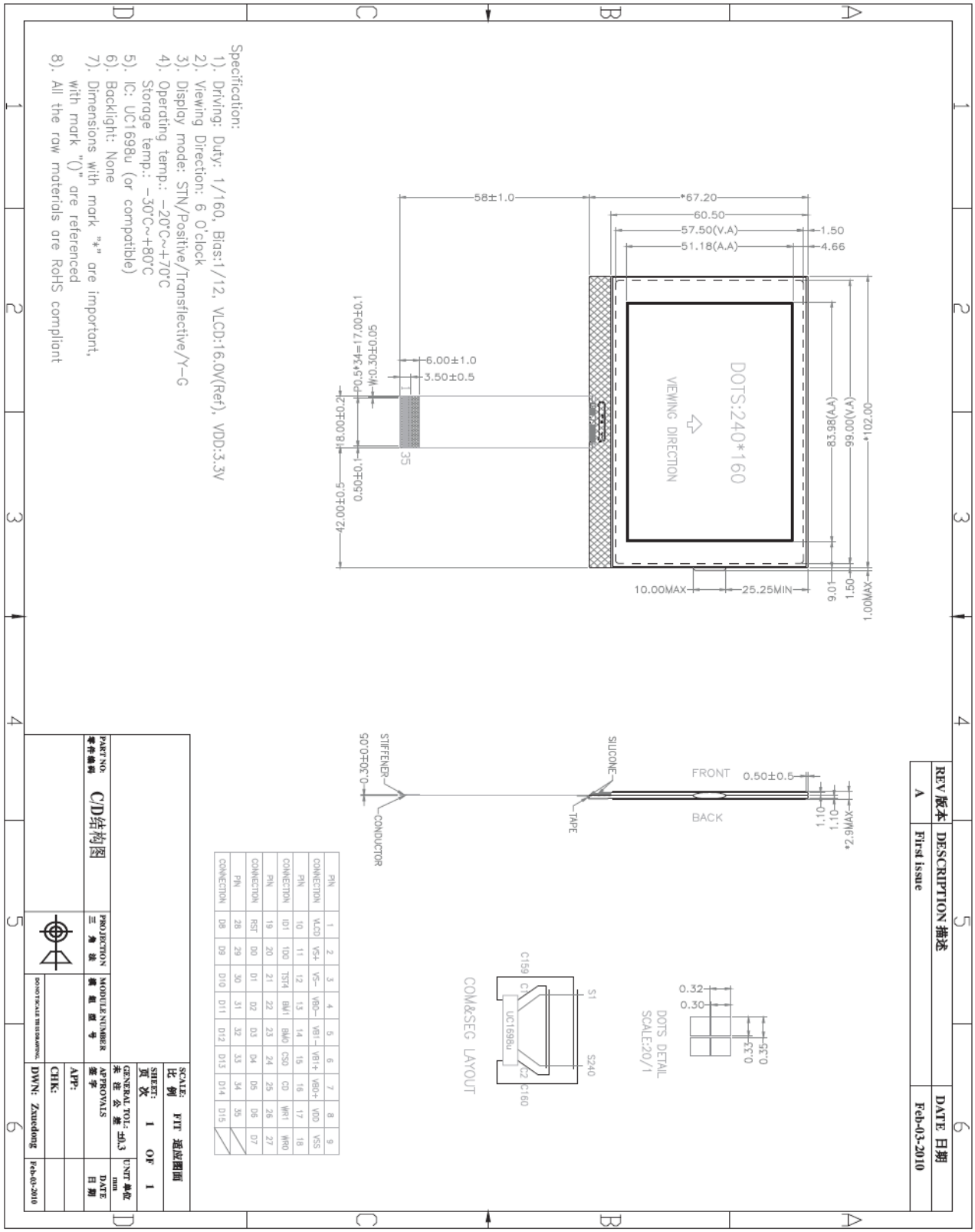


Figure 1.Block diagram

4. DIMENSIONAL OUTLINE



PIN	1	2	3	4	5	6	7	8	9
CONNECTION	VLCD	VS+	VS-	VB0-	VB1-	VB1+	VB0+	VDD	VSS
PIN	10	11	12	13	14	15	16	17	18
CONNECTION	ID1	ID0	TST4	BM1	BM0	CS0	CD	WR1	WR0
PIN	19	20	21	22	23	24	25	26	27
CONNECTION	RST	D0	D1	D2	D3	D4	D5	D6	D7
PIN	28	29	30	31	32	33	34	35	
CONNECTION	D8	D9	D10	D11	D12	D13	D14	D15	

Figure2. Dimensional outline

5. PIN DESCRIPTION

1	VLCD	Power supply for LCD voltage
2~7	VS+, VS-, VB0-, VB1-, VB1+, VB0+	LCD SEG driving voltages.
8	VDD	Power supply for logic(+3.3V)
9	VSS	Ground
10	ID1	Selects Input Data set for 8-bit mode. ID1=0 : 8-bit input data are D[0,2,4,6,8,10,12,14] ID1=1 : 8-bit input data are D[0:7] The wiring status of ID pins is available in PID[1:0] with command Get Status. Other than 8-bit mode, connect ID1 to V_{DD} for "H", or V_{SS} for "L".
11	ID0	ID0 pin can be used for product ion control. Connect ID0 pin to V_{DD} for "H" or V_{SS} for "L".
12	TST4	Test control. This pin has on-chip pull-up resistor. Leave it open during normal operation. TST4 is also used as one of the high voltage power supply for MTP programming operation. For COG designs, please wire out TST4 with trace resistance between 30~50 Ω.
13,14	BM1, BM0	Bus mode: The interface bus mode is determined by BM[1:0] and {DB15, DB13} by the following relationship:

BM[1:0]	{DB15, DB13}	Mode
11	Data	6800/16-bit
10	Data	8080/16-bit
01	0x	6800/8-bit
00	0x	8080/8-bit
00	10	4-wire SPI w/ 8-bit latch (S8: conventional)
00	11	3/4-wire SPI w/ 8-bit latch (S8uc: Ultra-Compact)
01	10	3-wire SPI w/ 9-bit latch (S9: conventional)

15	CS0	Chip select signal
16	CD	Selects Control data or Display data for read/write operation. In S9 mode, CD pin is not used. Connect to V_{SS} when not used. "L": Control data "H": Display data

<table>
<tr><td>17,18</td><td>WR1 ,WR0</td><td>WR[1:0] control the read/write operation of the host interface. See section Host Interface for more detail.
In parallel mode, the meaning of WR[1:0] depends on whether the interface is in the 6800 mode or the 8080 mode. In serial interface modes, these two pins are not used, connect them to V_{SS}.</td><td>WR[1:0] control the read/write operation of the host interface. See section Host Interface for more detail.
In parallel mode, the meaning of WR[1:0] depends on whether the interface is in the 6800 mode or the 8080 mode. In serial interface modes, these two pins are not used, connect them to V_{SS}.</td></tr>
<tr><td>19</td><td>RST</td><td colspan="2">The RESET signal</td></tr>
<tr><td>20~35</td><td>D0~D15</td><td>Bi-directional bus for parallel host interfaces.
In serial modes, connect DB[0] to SCK, DB[8] to SDA.
<table>
<tr><th></th><th>BM=1x (16-bit)</th><th>BM=0x (8-bit) ID1=0</th><th>BM=0x (8-bit) ID1=1</th><th>BM=00 (S8/S8uc)</th><th>BM=01 (S9)</th></tr>
<tr><td>DB0</td><td>D0</td><td>D0/D8</td><td>D0/D8</td><td>SCK</td><td>SCK</td></tr>
<tr><td>DB1</td><td>D1</td><td>–</td><td>D1/D9</td><td>–</td><td>–</td></tr>
<tr><td>DB2</td><td>D2</td><td>D1/D9</td><td>D2/D10</td><td>–</td><td>–</td></tr>
<tr><td>DB3</td><td>D3</td><td>–</td><td>D3/D11</td><td>–</td><td>–</td></tr>
<tr><td>DB4</td><td>D4</td><td>D2/D10</td><td>D4/D12</td><td>–</td><td>–</td></tr>
<tr><td>DB5</td><td>D5</td><td>–</td><td>D5/D13</td><td>–</td><td>–</td></tr>
<tr><td>DB6</td><td>D6</td><td>D3/D11</td><td>D6/D14</td><td>–</td><td>–</td></tr>
<tr><td>DB7</td><td>D7</td><td>–</td><td>D7/D15</td><td>–</td><td>–</td></tr>
<tr><td>DB8</td><td>D8</td><td>D4/D12</td><td>–</td><td>SDA</td><td>SDA</td></tr>
<tr><td>DB9</td><td>D9</td><td>–</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>DB10</td><td>D10</td><td>D5/D13</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>DB11</td><td>D11</td><td>–</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>DB12</td><td>D12</td><td>D6/D14</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>DB13</td><td>D13</td><td>–</td><td>–</td><td>0:S8/1:S8uc</td><td>0</td></tr>
<tr><td>DB14</td><td>D14</td><td>D7/D15</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>DB15</td><td>D15</td><td>0</td><td>0</td><td>1</td><td>1</td></tr>
</table>
Always connect unused pins to either V_{SS} or V_{DD}.</td><td>Bi-directional bus for parallel host interfaces.
In serial modes, connect DB[0] to SCK, DB[8] to SDA.
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<tr><td>DB2</td><td>D2</td><td>D1/D9</td><td>D2/D10</td><td>–</td><td>–</td></tr>
<tr><td>DB3</td><td>D3</td><td>–</td><td>D3/D11</td><td>–</td><td>–</td></tr>
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<tr><td>DB5</td><td>D5</td><td>–</td><td>D5/D13</td><td>–</td><td>–</td></tr>
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<tr><td>DB10</td><td>D10</td><td>D5/D13</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>DB11</td><td>D11</td><td>–</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>DB12</td><td>D12</td><td>D6/D14</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>DB13</td><td>D13</td><td>–</td><td>–</td><td>0:S8/1:S8uc</td><td>0</td></tr>
<tr><td>DB14</td><td>D14</td><td>D7/D15</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>DB15</td><td>D15</td><td>0</td><td>0</td><td>1</td><td>1</td></tr>
</table>
Always connect unused pins to either V_{SS} or V_{DD}.</td></tr>
</table>

6. MAXIMUM ABSOLUTE LIMIT

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

ABSOLUTE MAXIMUM RATINGS

In accordance with IEC134, Note 1 and 2

Symbol	Parameter	Min.	Max.	Unit
V_{DD}	Logic Supply voltage	-0.3	+4.0	V
V_{DD2}	LCD Generator Supply voltage	-0.3	+4.0	V
V_{DD3}	Analog Circuit Supply voltage	-0.3	+4.0	V
$V_{DD2/3}$-V_{DD}	Voltage difference between V_{DD} and $V_{DD2/3}$	--	1.6	V
V_{LCD}	LCD Driving voltage (-25°C ~ +75°C)	-0.3	+19.8	V
V_{IN}	Digital input signal	-0.4	V_{DD} + 0.5	V
T_{OPR}	Operating temperature range	-30	+85	°C
T_{STR}	Storage temperature	-55	+125	°C

NOTE:

1. V_{DD} is based on V_{SS} = 0V
2. Stress beyond ranges listed above may cause permanent damages to the device.

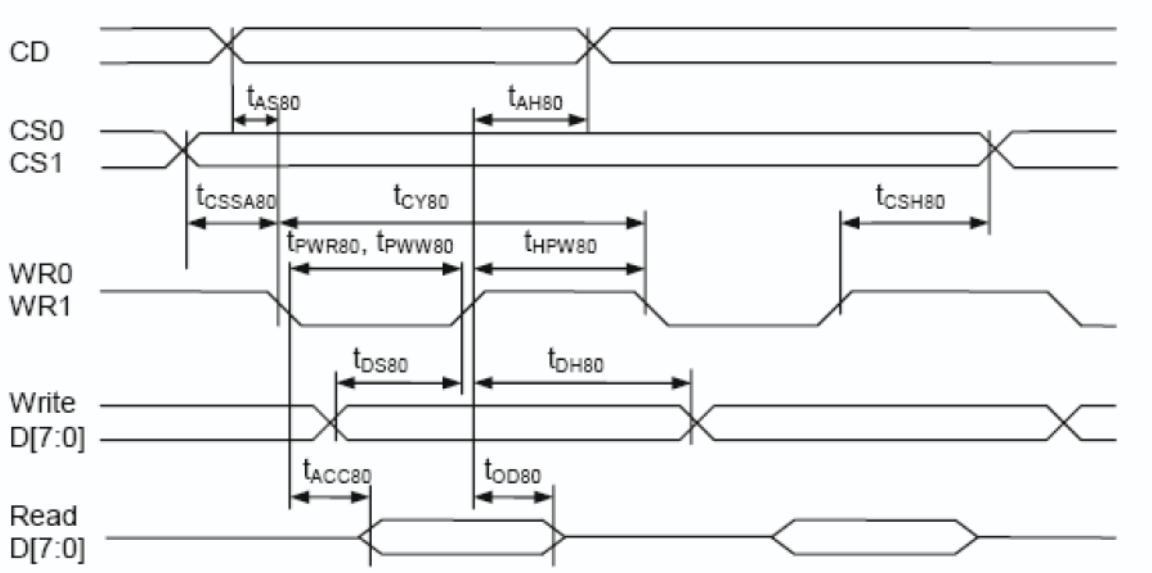
7. ELECTRICAL CHARACTERISTICS

DC CHARACTERISTICS

DC CHARACTERISTICS

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_{DD}	Supply for digital circuit		1.65		3.3	V
$V_{DD2/3}$	Supply for bias & pump		2.7		3.3	V
V_{LCD}	Charge pump output	$V_{DD2/3}$ = 2.8V, 25°C		15.2	18	V
V_D	LCD data voltage	$V_{DD2/3}$ = 2.8V, 25°C	1.09		1.95	V
V_{IL}	Input logic LOW				0.2V_{DD}	V
V_{IH}	Input logic HIGH		0.8V_{DD}			V
V_{OL}	Output logic LOW				0.2V_{DD}	V
V_{OH}	Output logic HIGH		0.8V_{DD}			V
I_{IL}	Input leakage current				1.5	μA
I_{SB}	Standby current	V_{DD} = $V_{DD2/3}$ = 3.3V, Temp = 85°C			50	μA
C_{IN}	Input capacitance			5	10	PF
C_{OUT}	Output capacitance			5	10	PF
$R_{ON(SEG)}$	SEG output impedance	V_{LCD} = 16.5V		850	1100	Ω
$R_{ON(COM)}$	COM output impedance	V_{LCD} = 16.5V		950	1100	Ω
f_{LINE}	Average line rate	LC[4:3] = 10b, 25°C	-10%	37.0	+10%	Klps

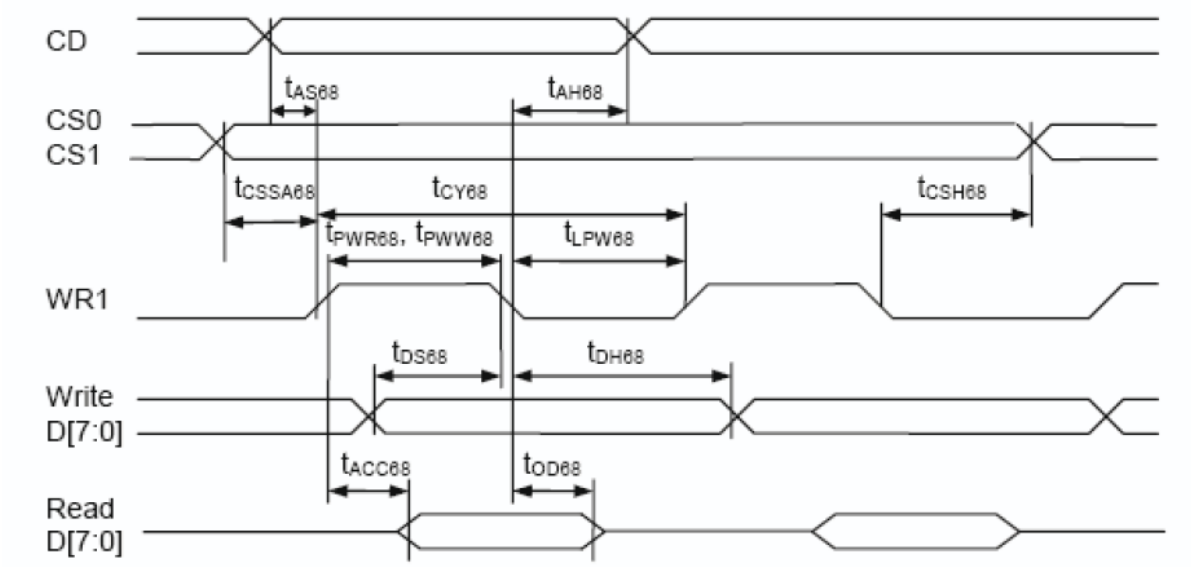
8. TIMING CHARACTERISTICS



Parallel Bus Timing Characteristics (for 8080 MCU)

($2.5V \leqslant V_{DD} < 3.3V$, Ta= –30 to +85°C)

Symbol	Signal	Description	Condition	Min.	Max.	Units
t_{AS80} t_{AH80}	CD	Address setup time Address hold time		0 0	–	nS
t_{CY80}		System cycle time 16-bit bus (read) (write) 8-bit bus (read) (write)	 LC[7:6]=10b LC[7:6]=01b	 170 130 100 80 90	–	nS
t_{PWR80}	WR1	Pulse width 16-bit (read) 8-bit		85 50	–	nS
t_{PWW80}	WR0	Pulse width 16-bit (write) 8-bit	 LC[7:6]=10b LC[7:6]=01b	65 40 45	–	nS
t_{HPW80}	WR0, WR1	High pulse width 16-bit bus (read) (write) 8-bit bus (read) (write)	 LC[7:6]=10b LC[7:6]=01b	 85 65 50 40 45	–	nS
t_{DS80} t_{DH80}	D0~D15	Data setup time Data hold time		30 0	–	nS
t_{ACC80} t_{OD80}		Read access time Output disable time	C_L = 100pF	– 15	60 30	nS
T_{CSSA80} t_{CSH80}	CS1/CS0	Chip select setup time		5 5		nS

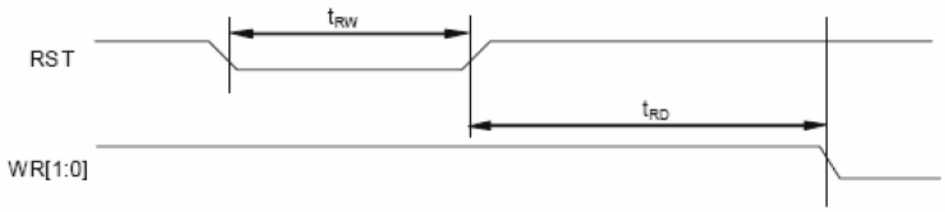


Parallel Bus Timing Characteristics (for 6800 MCU)

($2.5V \leq V_{DD} < 3.3V$, Ta= –30 to +85°C)

Symbol	Signal	Description	Condition	Min.	Max.	Units
t_{AS68} t_{AH68}	CD	Address setup time Address hold time		0 0	–	nS
t_{CY68}		System cycle time 16-bit bus (read) (write) 8-bit bus (read) (write)	 LC[7:6]=10b LC[7:6]=01b	 170 130 100 80 90	–	nS
t_{PWR68}	WR1	Pulse width 16-bit (read) 8-bit		85 50	–	nS
t_{PWW68}		Pulse width 16-bit (write) 8-bit	 LC[7:6]=10b LC[7:6]=01b	65 40 45	–	nS
t_{LPW68}		Low pulse width 16-bit bus (read) (write) 8-bit bus (read) (write)	 LC[7:6]=10b LC[7:6]=01b	 85 65 50 40 45	–	nS
t_{DS68} t_{DH68}	D0~D7	Data setup time Data hold time		30 0	–	nS
t_{ACC68} t_{OD68}		Read access time Output disable time	C_L = 100pF	– 15	60 30	nS
t_{CSSA68} t_{CSH68}	CS1/CS0	Chip select setup time		5 5		nS

RESET TIMING



Reset Characteristics

(1.65V ≤ V_{DD} < 3.3V, Ta= –30 to +85°C)

Symbol	Signal	Description	Condition	Min.	Max.	Units
t_{RW}	RST	Reset low pulse width		3	–	µS
t_{RD}	RST, WR	Reset to WR pulse delay		10	–	mS

9. CONTROL AND DISPLAY COMMAND

The following is a list of host commands supported by UC1698u

C/D: 0: Control, 1: Data
W/R: 0: Write Cycle, 1: Read Cycle
#: Useful Data bits –: Don't Care

	Command	C/D	W/R	D7	D6	D5	D4	D3	D2	D1	D0	Action	Default
1	Write Data Byte	1	0	#	#	#	#	#	#	#	#	Write 1 byte	N/A
2	Read Data Byte	1	1	#	#	#	#	#	#	#	#	Read 1 byte	N/A
3	Get Status & PM	0	1	GE	MX	MY	WA	DE	WS	MD	MS	Get {Status, Ver, PMO, Product Code, PID, MID}	N/A
				Ver	PMO[6:0]								
				Product Code (8h)				PID[1:0]		MID[1:0]			
4	Set Column Address LSB	0	0	0	0	0	0	#	#	#	#	Set CA[3:0]	0
	Set Column Address MSB	0	0	0	0	0	1	0	#	#	#	Set CA[6:4]	0
5	Set Temp. Compensation	0	0	0	0	1	0	0	1	#	#	Set TC[1:0]	0
6	Set Power Control	0	0	0	0	1	0	1	0	#	#	Set PC[1:0]	10b
7	Set Adv. Program Control	0	0	0	0	1	1	0	0	0	R	Set APC[R][7:0], R = 0 or 1	N/A
	(double-byte command)	0	0	#	#	#	#	#	#	#	#		
8	Set Scroll Line LSB	0	0	0	1	0	0	#	#	#	#	Set SL[3:0]	0
	Set Scroll Line MSB	0	0	0	1	0	1	#	#	#	#	Set SL[7:4]	0
9	Set Row Address LSB	0	0	0	1	1	0	#	#	#	#	Set RA[3:0]	0
	Set Row Address MSB	0	0	0	1	1	1	#	#	#	#	Set RA[7:4]	0
10	Set V_{BIAS} Potentiometer	0	0	1	0	0	0	0	0	0	1	Set PM[7:0]	40H
	(double-byte command)	0	0	#	#	#	#	#	#	#	#		
11	Set Partial Display Control	0	0	1	0	0	0	0	1	0	#	Set LC[8]	0
12	Set RAM Address Control	0	0	1	0	0	0	1	#	#	#	Set AC[2:0]	001b
13	Set Fixed Lines	0	0	1	0	0	1	0	0	0	0	Set {FLT, FLB}	0
		0	0	#	#	#	#	#	#	#	#		
14	Set Line Rate	0	0	1	0	1	0	0	0	#	#	Set LC[4:3]	10b
15	Set All-Pixel-ON	0	0	1	0	1	0	0	1	0	#	Set DC[1]	0
16	Set Inverse Display	0	0	1	0	1	0	0	1	1	#	Set DC[0]	0
17	Set Display Enable	0	0	1	0	1	0	1	#	#	#	Set DC[4:2]	110b
18	Set LCD Mapping Control	0	0	1	1	0	0	0	#	#	#	Set LC[2:0]	0
19	Set N-Line Inversion	0	0	1	1	0	0	1	0	0	0	Set NIV[4:0]	1DH
				-	-	-	#	#	#	#	#		
20	Set Color Pattern	0	0	1	1	0	1	0	0	0	#	Set LC[5]	0 (BGR)
21	Set Color Mode	0	0	1	1	0	1	0	1	#	#	Set LC[7:6]	10b
22	Set COM Scan Function	0	0	1	1	0	1	1	#	#	#	Set CSF[2:0]	000b
23	System Reset	0	0	1	1	1	0	0	0	1	0	System Reset	N/A
24	NOP	0	0	1	1	1	0	0	0	1	1	No operation	N/A
25	Set Test Control	0	0	1	1	1	0	0	1	TT		For testing only. Do not use.	N/A
	(double-byte command)	0	0	#	#	#	#	#	#	#	#		
26	Set LCD Bias Ratio	0	0	1	1	1	0	1	0	#	#	Set BR[1:0]	11b: 12
27	Set COM End	0	0	1	1	1	1	0	0	0	1	Set CEN[6:0]	159
		0	0	-	#	#	#	#	#	#	#		
28	Set Partial Display Start	0	0	1	1	1	1	0	0	1	0	Set DST[6:0]	0
		0	0	-	#	#	#	#	#	#	#		
29	Set Partial Display End	0	0	1	1	1	1	0	0	1	1	Set DEN[6:0]	159
		0	0	-	#	#	#	#	#	#	#		
30	Set Window Program Starting Column Address	0	0	1	1	1	1	0	1	0	0	Shared with MTP commands: Set WPC0	0
		0	0	-	#	#	#	#	#	#	#		
31	Set Window Program Starting Row Address	0	0	1	1	1	1	0	1	0	1	Shared with MTP commands: Set WPP0	0
		0	0	#	#	#	#	#	#	#	#		
32	Set Window Program Ending Column Address	0	0	1	1	1	1	0	1	1	0	Shared with MTP commands: Set WPC1	127
		0	0	-	#	#	#	#	#	#	#		
33	Set Window Program Ending Row Address	0	0	1	1	1	1	0	1	1	1	Shared with MTP commands: Set WPP1	159
		0	0	#	#	#	#	#	#	#	#		
34	Window Program Mode	0	0	1	1	1	1	1	0	0	#	Set AC[3]	0: Inside
35	Set MTP Operation control	0	0	1	0	1	1	1	0	0	0	Set MTPC[4:0]	10H
		0	0	-	-	-	#	#	#	#	#		

	Command	C/D	W/R	D7	D6	D5	D4	D3	D2	D1	D0	Action		Default
36	Set MTP Write Mask	0 0 0	0 0 0	1 - -	0 # -	1 # -	1 # -	1 # -	0 # -	0 # #	1 # #	Set MTPM[6:0] MTPM1[1:0]		0
37	Set V_{MTP1} Potentiometer	0 0	0 0	1 #	1 #	1 #	1 #	0 #	1 #	0 #	0 #	Shared with Window Program commands	Set MTP1	N/A
38	Set V_{MTP2} Potentiometer	0 0	0 0	1 #	1 #	1 #	1 #	0 #	1 #	0 #	1 #		Set MTP2	N/A
39	Set MTP Write Timer	0 0	0 0	1 #	1 #	1 #	1 #	0 #	1 #	1 #	0 #		Set MTP3	N/A
40	Set MTP Read Timer	0 0	0 0	1 #	1 #	1 #	1 #	0 #	1 #	1 #	1 #		Set MTP4	N/A

NOTE:

- All other bit patterns other than commands listed above may result in undefined behavior.
- The interpretation of commands (36)~(40) depends on the setting of register MTPC[3].
  - Commands (37)~(40) are shared with commands (30)~(33). These two sets of commands share exactly the same code and control registers. When MTPC[3]=0, they are interpreted as Window Program commands and registers. When MTPC[3]=1, they function as MTP Control commands and registers.
- After MTP ERASE or PROGRAM operation, before resuming normal operation, please always
  a) Remove TST4 power source,
  b) Do a full V_{DD} ON-OFF-ON cycle.
- Under 16-bit bus mode and CD=0, D[15:8] is ignored and only D[7:0] is used. As a result, the bus cycles for commands under 16-bit bus and 8-bit bus are the same, and double-byte commands still need two bus cycles under 16-bit bus mode.

  Example:

  8-bit bus mode:

  Set PL[1:0] = 2'b11 : D[7:0] = 0010 1011

  Set PM[7:0] = 8'h8b : 1st D[7:0] = 1000 0001

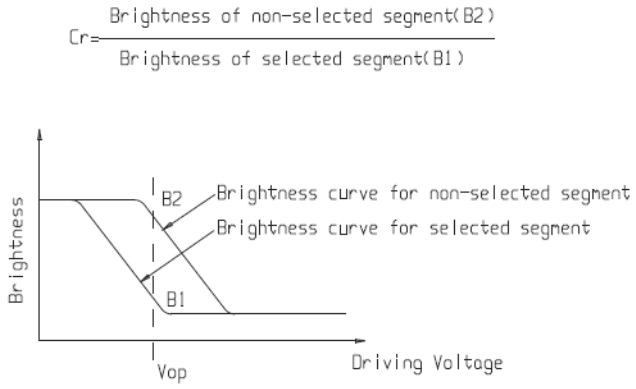
  2nd D[7:0] = 1000 1011

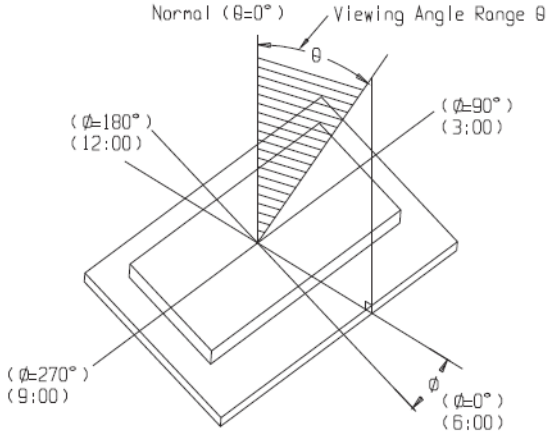
10. ELECTRO-OPTICAL CHARACTERISTICS

(V_{DD} = 3.3V, Ta = 25°C)

Item	Symbol	Condition	Min	Typ	Max	Unit
Operating Voltage for LCD	Vop	Ta =-20°C	16.2	16.5	16.8	V
		Ta = 25°C	15.7	16.0	16.3	
		Ta = 70°C	15.2	15.5	15.8	
Response time	Tr	Ta = 25°C	---	250	500	ms
	Tf		---	300	600	ms
Contrast	Cr	Ta = 25°C	2	4	---	---
Viewing angle range	θ	Cr≥2	-35	---	+35	deg
	Φ		-35	---	+40	deg

The following charts is for your reference of the data in the above form.





11. 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 make any modification on the PCB without consulting P-tec.
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 LCDs and modules are not consumer products, but may be incorporated by P-tec's customers into consumer products or components thereof, P-tec does not warrant that its LCDs and components are fit for any such particular purpose.

1. The liability of P-tec is limited to repair or replacement on the terms set forth below. P-tec 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 P-tec and the customer, P-tec will only replace or repair any of its LCD which is found defective electrically or visually when inspected in accordance with P-tec 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.

12. LCM test criteria

1. Objective

The criteria is applied for consolidating the LCM quality standard between P-tec and customer in finished products acceptance inspection and shipment, to guarantee the products quality to meet with customer's demand.

2. Scope

2.1 This criteria is applicable to all the LCM products produced by P-tec.

3. Inspection equipment

Function Tester、Vernier Calipers、Microscope、Magnifier、ESD Wrist Strap、Finger Cover、Labels、 High-Low Temperature Oven、 Refrigerator、Constant Voltage Power Supply（DC），Desk Lamp, etc.

4. Sampling Plan and Reference Standard

4.1.1 According to GB/T 2828.1---2003/ISO2859-1:1999，single sampling under normal inspection, general inspection level II.

Item of Inspection	Times of Sampling	AQL Judgment
Cosmetic	II Single Sampling	MA=0.4 MI=1.5
Mechanical	N=3	C=0
Functional	II Single Sampling	MA=0.4 MI=1.5

4.1.2 GB/T 2828.1---2003/ISO2859-1:1999 Counting and sampling procedures and sampling table for Batch-to-Batch Inspection.

4.1.3 GB/T 1619.96 Test method for TN LCD.

4.1.4 GB/T 12848.91 General Specification for STN LCD.

4.1.5 GB2421-89 Basic Environmental Test Procedures for Electrical and Electronic Products

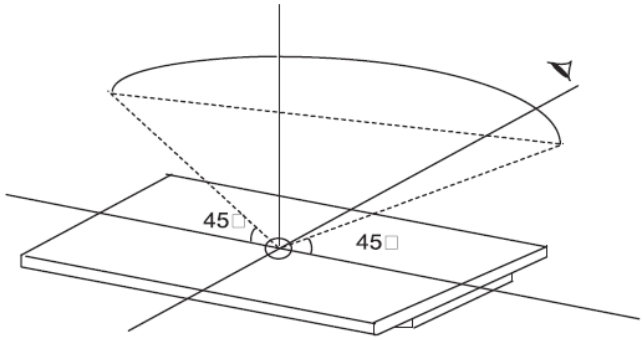
4.1.6 IPC-A-610C Acceptance Condition for Electrical Assemblies.

5. Inspection Condition and Inspection Reference

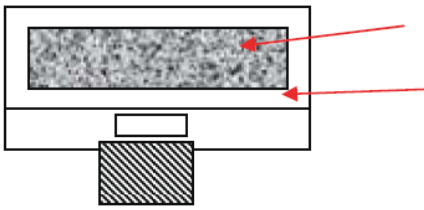
5.1 The ambient temperature and humidity are 25±5℃ and 45±20%RH respectively, and the ambient luminance should be more than 300cd/cm^2. The distance between inspector's eyes and the LCD panel should be 30cm away. Normally we inspect products with reflected light, when we inspect the LCD produces with backlight turned on, the ambient luminance should be less than 100cd/cm^2.

5.2 The LCD should be test with 45° both left and right side, 0-45° both upside

and downside （if for STN product, -20-55° is needed）.



5.3 Definition of VA



VA：effective viewing area

Non-VA：Ineffective viewing area

5.4 Inspection with viewed eyes（not including defect size measure by magnifiers）.

5.5 Electrical property

Inspect with the test jig to meet with the requirement indicated in the approved documents, including the pattern design and the display performance.

5.5.1 Testing voltage（V）

5.5.1.1 According to the inspection of test jig and production specification the test voltage setting is Vop±0.3V when the Vop is under 9.0V, and Vop ±3%Vop when the Vop is above 9.0V.

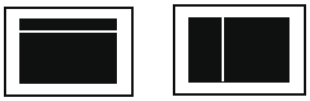
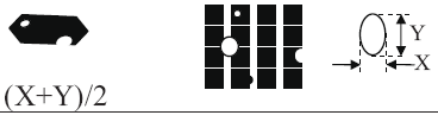
5.5.1.2 As per the product with the fixed voltage the test voltage setting is same as Vop and keeps the constant voltage through the internal circuit. And the limited sample on the voltage range is needed if necessary.

5.5.2 Current Consumption（I）： refer to product document and approval drawing to confirm it.

6. Inspection Item and Acceptance Standard

6.1 Outer dimension： For the outer dimension and the sizes which could influence the assembly at the customer's side, it should be in accordance to the approval drawing, and it belongs to the major defect.

6.2 Functional Test:

No.	Item	Description	MAJ	MIN	Accept standard
6.2.1	Missing Segment	Any missing segment caused by an open circuit; Any missing COM, pattern, dot or segment caused by an open circuit or poor crossover contact 	√		Rejected
6.2.3	No display/no action	No segment is displayed when the product is connected correctly.	√		Rejected
6.2.4	Display error/abnormal	The display pattern and display order is not as required under the normal scanning procedure.	√		Rejected
6.2.5	Viewing angle wrong	The direction with the best display of patterns should be as customer required (or refer to the approval samples)	√		Rejected
6.2.6	Display dim/dark	The contrast of LCD is too dark or too dim under normal operation	√		Beyond the voltage tolerance, Rejected
6.2.7	Slow response	Response of some segments is different with others when turned on or off the LCD	√		Rejected
6.2.8	Extra segment	Display of wiring, or extra pattern, caused by wrong alignment or insufficient corrosion..		√	refer to spot/line standard
6.2.9	Dim segment	Under the normal voltage, the contrast of segment are uneven		√	Reject or refer to samples
6.2.10	PI black/white spot	Partial black and white spot are visible while changing display content due to the PI layer defective		√	refer to the spot/line criteria for the visible spots when display image stopped, others O
6.2.11	pinhole/white spot	The phenomena of missing patterns when turned on caused by missing of ITO fragment.  d = (X+Y)/2		√	refer to spot/line standard

6.2.12	Pattern distortion	Width of pattern displayed is wider , narrower or deformed from the specifications caused by wrong alignment, i.e. extra heave or missing: |Ia-Ib|≤ 1/4W(W is the normal width) 		√	Acceptable |Ia-Ib|>1/4W rejected
6.2.13	High current	the current is bigger than regulated value.		√	Rejected

6.3 LCD Visual Defect

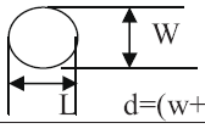
6.3.1 Dot defect(defined within VA, out of VA spots not accounted)

Defect item	Average diameter（d）	Accept numbers	MAJ	MIN
Spot defect （black spot, foreign material, nick, scratches, LC defect）	d≤0.2	3		√
	0.2<d≤0.25	2		
	0.25<d≤0.30	1		

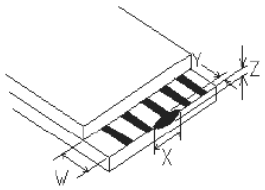
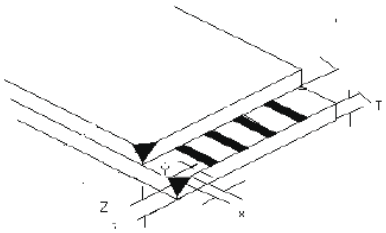
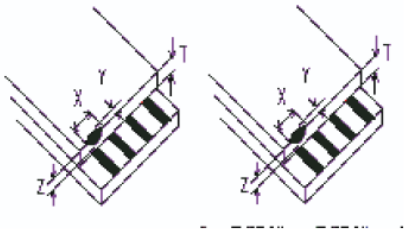
6.3.2 Line defect(defined within VA, out of VA spots not accounted)

Defective item	length(L)	width(W)	Accept numbers	MAJ	MIN
line defect (scratch, liner foreign material) 	≤5.0	≤0.02	3		√
	≤3.0	≤0.03	3		
	≤3.0	≤0.05	1		
note： 1. If the width is bigger than 0.1mm, it can be treated as spot defect.					

6.3.3 Polarizer Air Bubble (defined within VA, out of VA spots not accounted)

Defective item	Average diameter（d）	Accept numbers	MAJ	MIN
polarizer Air Bubble、Concave-Convex Dot  d=(w+l)/2	d≤0.3	3		√
	0.3<d≤0.5	2		
	0.5<d≤0.8	1		

6.3.4 Damaged(For the products with LCD edge expose to outside without mental frame, including products in COG, with H/S or assembled with backlight)

No.	Item	Acceptance Standard		MAJ	MIN
6.3.4.1	Chip on lead 		（mm）		√
		X	≤1/8L		
		Y	≤1/3W		
		Z	≤1/2t		
		Accept number	2		
		When Y≤0.2mm, neglect the length of X, chip on the side without lead, and not perforated, when X≤1/10L，Y≤1/2W max, accept.			
6.3.4.2	chip on corner(ITO lead) 		（mm）	MAJ	MIN
		X	Not enter into frame epoxy and touch the lead		√
		Y			
		Z	≤t		
		Accept numbers	2		
		Chips on corner refer to 6.3.4.3 and must be out of the frame epoxy. If chips on lead, refer to 6.3.4.1			
6.3.4.3	Chip on sealed area (outer chip) 		（mm）	MAJ	MIN
		X	≤1/8 L		√
		Y	≤1/2H		
		z	≤ 1/2t		
		Accept numbers	2		
		The standard for inner chip on sealed area is same as the standard for outer. If chip on the opposite side of ITO lead, the value Y refer to 6.3.4.1 for the chip on the side without lead.			
note: t---glass thickness, L---length, H---The distance between the LCD edge to the inner of LCD frame epoxy. W—The width of ITO lead					

6.3.5 Others

No.	Item	Description	MAJ	MIN	Accept standard
6.3.5.1	Newton/ B/G color uniformity not good	There exists more than one color on one product or same batch.		√	Reject or refer to limited sample

6.3.5.2	Leakage(LC)	/	√		Rejected
6.3.5.3	No protective film	/		√	Rejected

6.4 Backlight components

No.	Item	Description	MAJ	MIN	Accept standard
6.4.1	Backlight not work, wrong color	/	√		Rejected
6.4.2	Color deviation	Turn backlight, the color differ from the sample, do not match the drawing after testing		√	Refer to sample and drawing
6.4.3	Brightness deviation	Turn on backlight, the brightness is differ from the sample, or do not match the drawing after testing, or over±30% compare with sample if drawing not specified.		√	Refer to sample and drawing
6.4.4	Uneven brightness	Turn on the backlight, the brightness is uneven on the same LED and beyond the specification of drawing.		√	Refer to sample and drawing
6.4.5	Spot/line scratch	There is stain, scratches on backlight when turn on.		√	Refer to 6.3.1/6.3.2

6.5 Mental frame

No.	Item	Description	MAJ	MIN	Accept standard
6.5.1	material/surface	Mental frame/surface approach inconsistent with specification.	√		Rejected
6.5.2	Twist not qualified/without twisting	Twist method/direction wrong, not twist as required	√		Rejected
6.5.3	Oxidized steak, paint stripped, color changed, dented mark, scratches	1.Oxidized steak on the surface of the metal frame;2. front surface paint scratch to substrate, the stripped spot ≤0.8mm and exceed 3 areas;3.line defect in length≤5.0mm and width ≤0.05mm exceed 2 areas, front dent, bubble and side surface have paint stripping to substrate≤1.0mm exceed 3 areas, line defect in width ≤0.05mm exceed 3 areas.		√	Rejected

6.5.4	Burred	Burr is too long, enter into viewing area		√	Rejected

6.6 PCB/COB

No.	Item	Description	MAJ	MIN	Accept standard
6.6.1	Epoxy Cover Improper	1. The Pad within the round white mark is exposed to outside. 2. The height of epoxy covers beyond document /drawing specification. 3. The epoxy should be covered within the white round mark and the maximum overage is 2mm more than the radius of white mark. 4. Clear liner mark on COB surface or pinhole that it is possible to penetrate through the epoxy to chip. 5. The pinhole diameter over 0.25mm or other material on COB surface.		√	Rejected
6.6.2	PCB cosmetic defect	1. PCB pad surface can not be oxidized or contaminated. 2. PCB can not appear bubbles after through the reflow oven. 3. Copper lead due to the PCB green oil drop or scratches. If repaired by adding the green oil, circuit diameter Φ can not over 1.3mm, other diameter Φ can not over 2.6mm, total less than 10 areas. Otherwise reject.		√	Rejected
6.6.3	Components error	1. PCB components inconsistent with drawing. Wrong components, more or less pa, polar reverse（The bias circuit of LCD voltage or BL limit current value adjustment is not controlled if not special specified.） 2. The JUMP short of PCB should be consistent of the mechanical drawing. 3. The components is specially required by the customers and specified in mechanical drawing / technical documents, the components specification should be conformed to technique demand. Otherwise rejected	√		Rejected

6.7 SMT part (Refer to IPC-A-610C if not specified)

No.	Item	Description	MAJ	MIN	Accept standard
6.7.1	Soldering defect	Cold soldering, false solder, missing solder, tin crack, tin un-dissolved happened with soldering.		√	Rejected
6.7.2	Solder ball/splash	Solder ball/tin dross drop lead to solder short.		√	Rejected
6.7.3	DIP parts	DIP parts, keypad, connection appear floating and tilted.		√	Rejected
6.7.4	Spot weld shape	The spot weld should be inner dent, can not form to cover solder or less solder or icicle, otherwise reject		√	Rejected
6.7.5	Component foot exposed	For the DIP type components, after soldered, 0.5~2mm component foot must be remained, and should not damage the solder surface nor fully covered the component foot. Otherwise rejected.		√	Rejected
6.7.6	Appearance poor	After soldering, the solder residues appear brown or black. PCB solder spot remained white mist residues after clean.		√	Rejected

6.8 Heating pressure part (including H/S，FPC, etc.）

No.	Item	Description	MAJ	MIN	Accept standard
6.8.1	Out of specification		√		Rejected
6.8.2	Size/position	The size of heating material should be within the specification of the drawing, the contact area of conducted material should be attached more than 1/2 of the body (ITO, PDA, etc)		√	Acceptable
6.8.3	Heat pressure dirty	The obstacle existed in non-conductive heating area and not lead to short, or existed in conductive area but the obstacle is less than 50% of pressure area, it is acceptable.		√	Acceptable
6.8.4	Folding defect			√	Refer to limited sample

6.9 Connector and other parts

No.	Item	Description	MAJ	MIN	Accept standard
6.9.1	Specification improper	The specification of connector and other components do not conform to the drawing as required.	√		Rejected
6.9.2	Position and order	Solder position and Pin 1 should be consistent with the drawing.		√	Rejected
6.9.3	Cosmetic	1. The body of outer component and the PIN has flux. 2. The deformation bigger of PIN connector is bigger than 1/2 of PIN width.		√	Rejected

6.10 General cosmetic

No.	Item	Description	MAJ	MIN	Accept standard
6.10.1	Connection material	Copper lead on FPC pad or the pin terminal of H/S, FFC and damaged. FPC,FFC, COF,H/S connected material curved （except for original ）. FPC、PCB pad is bigger than 1PIN width. FPC/FFC material segment, crease exceed the specification.		√	Rejected
6.10.2	Stiffing type defect	Stiffening tape is not covered or fully covered the product's circuit needs to be protected.（Like H/S，FFC，FPC） or cover to the output pin.		√	Rejected
6.10.3	Visual dirty	Dirty on surface of finished products, residual glue, solder spatter or solder ball remain on non-soldered area of PCB/COB. The defective mark or label on product does not remove.		√	Rejected
6.10.4	Assembly black spot	The spot or black dots found after assembly the products with backlight or diffuser.		√	Refer to 6.3.1
6.10.5	Product mark	Part number and batch mark is not conformed with the technical requirement and position, not clear or without mark.		√	Rejected
6.10.6	Inner packing	Packing is inconsistent with requirement，short or over load，Packing is inconsistent with shipment mark/ order demand.		√	Rejected

7. Reliability test

Test item	Condition	Time(hrs)	Accept standard
High Temp Storage	80℃	120	No abnormalities in functions and appearance
High Temp Operating	70℃	120	
Low Temp Storage	-30℃	120	
Low Temp Operating	-20℃	120	
Temp& Humidity Test	40℃/90%RH	120	
Temp Shock	-20℃<-- 25℃ -->+70℃ (30 min<-- 5 min -->30min)	10 cycles	

Note: ①The customer should inform the special requirements on the reliability test to P-tec when starting the project.

②For high/low temperature test under both storage and operating condition, the temperature is referrer to the product specification.

③For temperature test ±5℃ deviation could be accepted.

8. Packing

8.1 Product packing must meet the requirement of packing design. The label should be qualified by QA department and it includes the Item No., specification sheet, quantity and production date. Incomplete or mistake is regarded as not qualified.

8.2 When the safety of the packing exist the problems, including shock resistance, moisture resistance, anti-ESD and press resistance, it is regarded as not qualified.

8.3 When customer has special requirement on packing, which is confirmed and accepted by P-tec , inspect and release the products as customer required.

8.4 For RoHS or non-RoHS products it should be distinguished with obvious label. Currently we adopt the “RoHS” label for all the products meet the RoHS compliance, or using the labels / marks as the customer required.

9. Others

9.1 For unregulated and compromised items, reference shall be taken to mutual agreements and limit samples.