Tailorpixels

A Professional Manufacturer of Display

Manufacturer Certificated

9001
CERT. No.: 282Q19070712006

14001
CERT. No.: 282E19070712007

Product Specification

Model: TWW12864H-A0

128X64 COG Module

This module uses RoHS material

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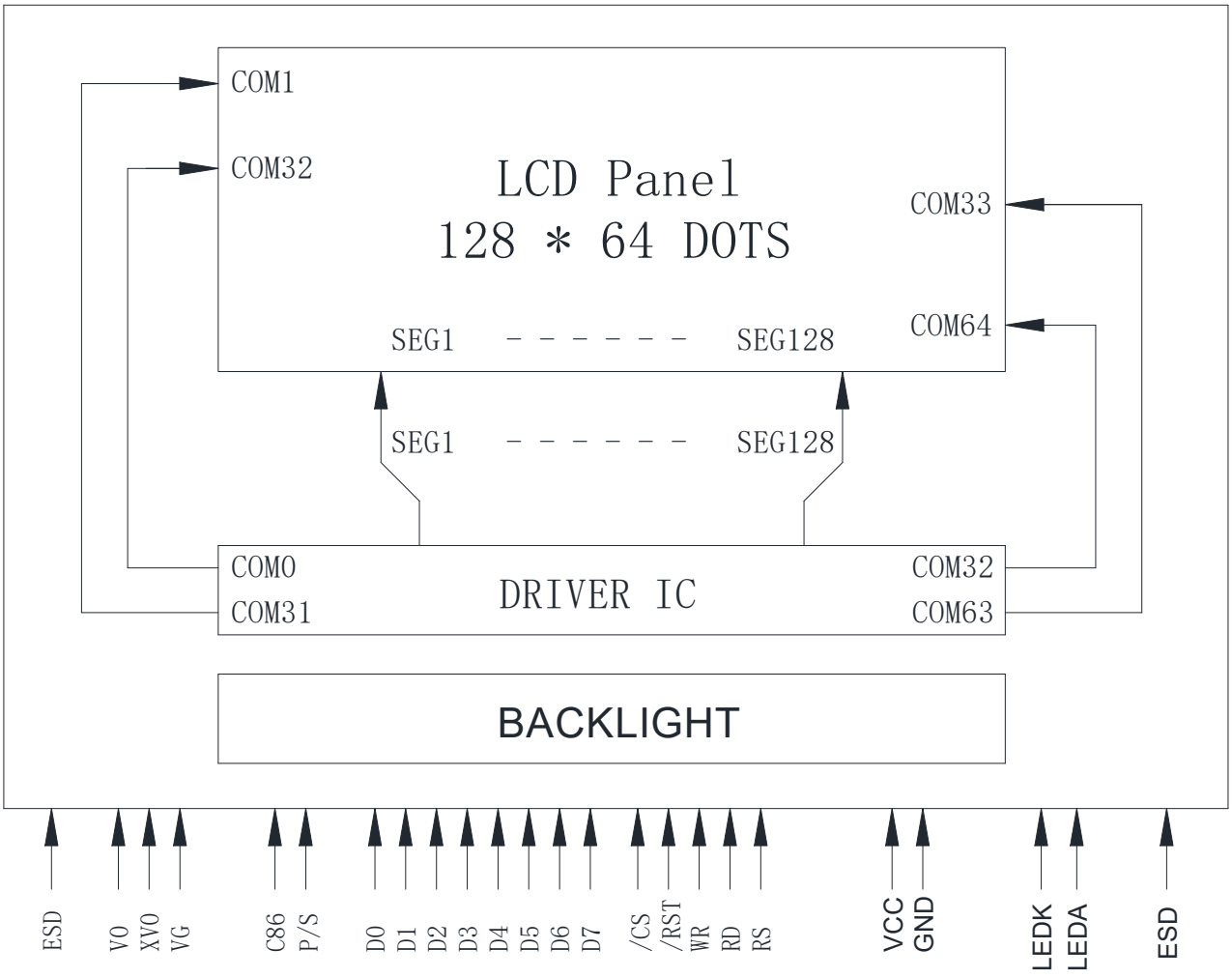
CONTENTS

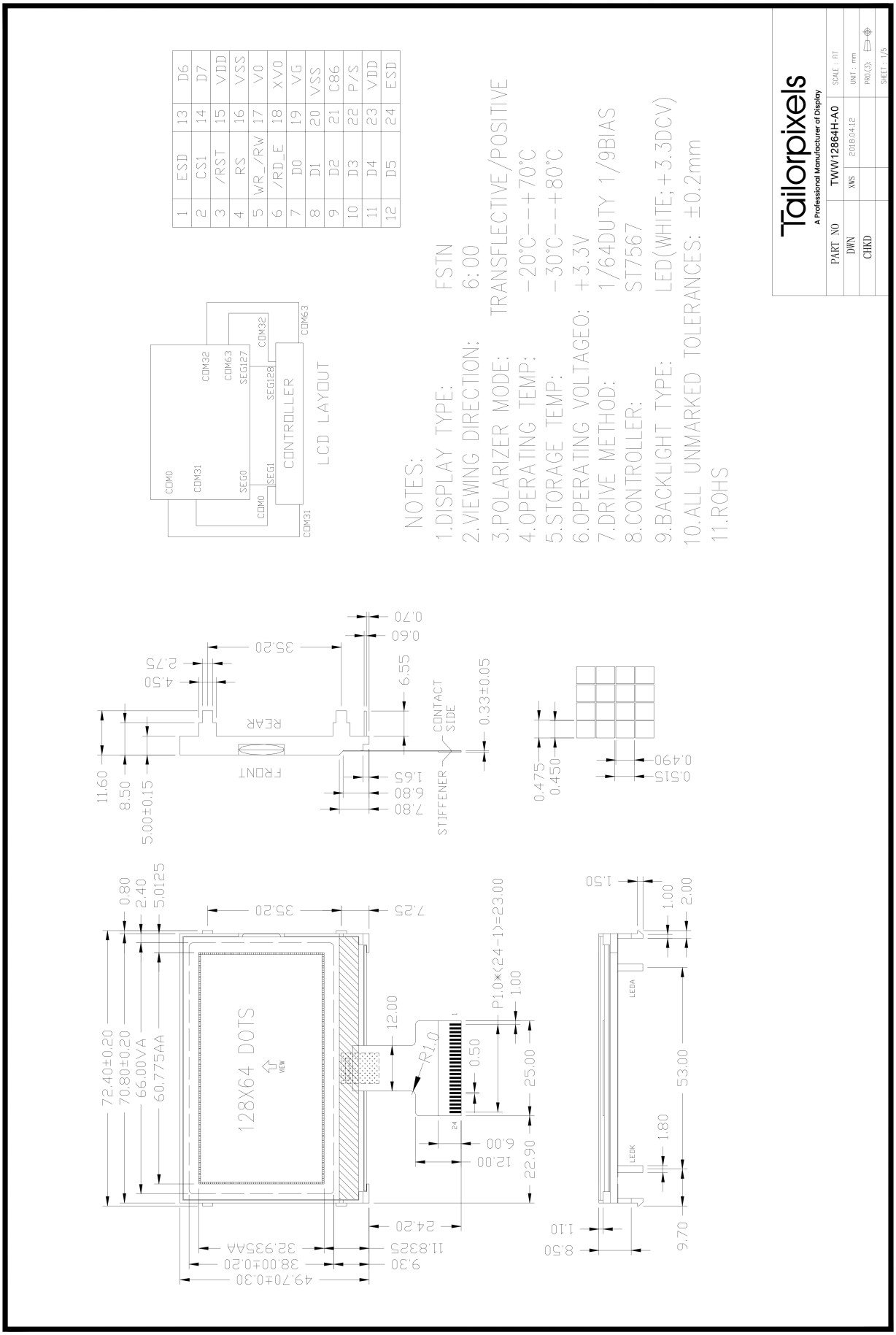
■ GENERAL SPECIFICATIONS

ITEM	STANDARD VALUE	UNIT
NUMBER OF GRAPHIC	128×64	
MODULE DIMENSION	72.4×49.7×11.6(MAX)	mm
EFFECTIVE DISPLAY AREA	66.0×38.0	mm
DOT SIZE	0.45×0.49	mm
DOT PITCH	0.475×0.415	mm
LCD TYPE	FSTN/TRANSFLECTIVE/POSITIVE	
DUTY	1/64duty 1/9bias	
VIEWING DIRECTION	6	o'clock
OPERATING TEMPERATURE	－20~＋70	℃
STORAGE TEMPERATURE	－30~＋80	℃
BACK LIGHT TYPE	LED	
BACK LIGHT COLOR	WHITE	
APPROX. WEIGHT	35	g
ROHS STANDARD	YES	

■ BLOCK DIAGRAM



■ MECHANICAL DIMENSIONS



■ INTERFACE PIN CONNECTIONS

<table>
<tr><th>NO</th><th>SYMBOL</th><th>LEVEL</th><th>FUNCTION</th></tr>
<tr><td>1</td><td>ESD</td><td>L</td><td>Connect ground.</td></tr>
<tr><td>2</td><td>CS1</td><td>H/L</td><td>Chip select input pin.</td></tr>
<tr><td>3</td><td>/RST</td><td>H->L->H</td><td>Reset input signal.</td></tr>
<tr><td>4</td><td>RS</td><td>H/L</td><td>Register selection input:
H: Indicate that SID is display data.
L: Indicate that SID is control data.</td></tr>
<tr><td>5</td><td>WR_/RW</td><td>H/L</td><td rowspan="2">Read/Write execution control pin. When PSB is “H”,<table><tr><th>C86</th><th>MPU Type</th><th>RWR</th><th>Description</th></tr><tr><td>H</td><td>6800 series</td><td>R/W</td><td>Read/Write control input pin.
R/W=“H”: read.
R/W=“L”: write.</td></tr><tr><td>L</td><td>8080 series</td><td>/WR</td><td>Write enable input pin.
Signals on D[7:0] will be latched at the rising edge of /WR signal.</td></tr></table>RWR is not used in serial interface and should fix to “H” by VDD1 or VDDH.</td></tr>
<tr><td>6</td><td>/RD_E</td><td>H/L</td></tr>
<tr><td>7</td><td>D0</td><td>L</td><td>Data bus 0</td></tr>
<tr><td>8</td><td>D1</td><td>L</td><td>Data bus 1</td></tr>
<tr><td>9</td><td>D2</td><td>L</td><td>Data bus 2</td></tr>
<tr><td>10</td><td>D3</td><td>H/L</td><td>Data bus 3</td></tr>
<tr><td>11</td><td>D4</td><td>H/L</td><td>Data bus 4</td></tr>
<tr><td>12</td><td>D5</td><td>H</td><td>Data bus 5</td></tr>
<tr><td>13</td><td>D6/SCL</td><td>H/L</td><td>Data bus 6/ The serial clock input.</td></tr>
<tr><td>14</td><td>D7/SI</td><td>L</td><td>Data bus 7/ The serial data input.</td></tr>
<tr><td>15</td><td>VDD</td><td>+3.3V</td><td>Logic power supply.</td></tr>
<tr><td>16</td><td>VSS</td><td>0V</td><td>Ground.</td></tr>
<tr><td>17</td><td>V0</td><td>-</td><td>V0 is the LCD driving voltage for common circuits at negative frame.</td></tr>
<tr><td>18</td><td>XV0</td><td>-</td><td>XV0 is the LCD driving voltage for common circuits at positive frame.</td></tr>
<tr><td>19</td><td>VG</td><td>-</td><td>VG is the LCD driving voltage for segment circuits.</td></tr>
<tr><td>20</td><td>VSS</td><td>0V</td><td>Ground.</td></tr>
<tr><td>21</td><td>C86</td><td>H/L</td><td rowspan="2">C86 selects the microprocessor type in parallel interface mode.<table><tr><th>PSB</th><th>C86</th><th>Selected Interface</th></tr><tr><td>“H”</td><td>“H”</td><td>Parallel 6800 Series MPU Interface</td></tr><tr><td>“H”</td><td>“L”</td><td>Parallel 8080 Series MPU Interface</td></tr><tr><td>“L”</td><td>“X”</td><td>Serial 4-Line SPI Interface</td></tr></table>Please refer to “APPLICATION NOTES” and “Microprocessor Interface” (Section 6) for detailed connection of the selected interface.</td></tr>
<tr><td>22</td><td>P/S</td><td>H/L</td></tr>
<tr><td>23</td><td>VDD</td><td>+3.3V</td><td>Logic power supply.</td></tr>
<tr><td>24</td><td>ESD</td><td>-</td><td>Connect ground.</td></tr>
</table>

NO	SYMBOL	LEVEL	FUNCTION
1	BL+	+3.0V	Back light anode.
2	BL-	0V	Back light cathode.

■ ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	MIN	MAX	UNIT
Supply voltage for logic	VDD	-0.3	4.0	V
Supply voltage for LCD	VOUT-VSS	-0.3	15.0	V
Driving voltage for LCD	V0-VSS	-0.3	15.0	
Operating temperature	TOP	-20	+70	°C
Storage temperature	TST	-30	+80	°C

■ ELECTRICAL CHARACTERISTICS

▼ DC Characteristics

Condition: VDD=+3.3V±10%, VSS=0V, Ta= +25℃

PARAMETER	SYMBOL	CONDITION	MIN	TYP	MAX	UNIT
Supply voltage for logic	VDD	----	3.15	3.3	3.5	V
Supply current for logic	IDD	----	1.8	2.0	2.5	mA
Operating voltage for LCD	V0-XV0	----	9.0	9.2	9.4	V
Input voltage ' H ' level	V_{IH}	----	0.7VDD	----	VDD	V
Input voltage ' L ' level	V_{IL}	----	0	----	0.3VDD	V
output voltage ' H ' level	V_{OH}	I_{OH}=-200μA	2.4	----	----	V
output voltage ' L ' level	V_{OL}	I_{OL}=1.6mA	----	----	0.4	V

▼ AC Characteristics

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

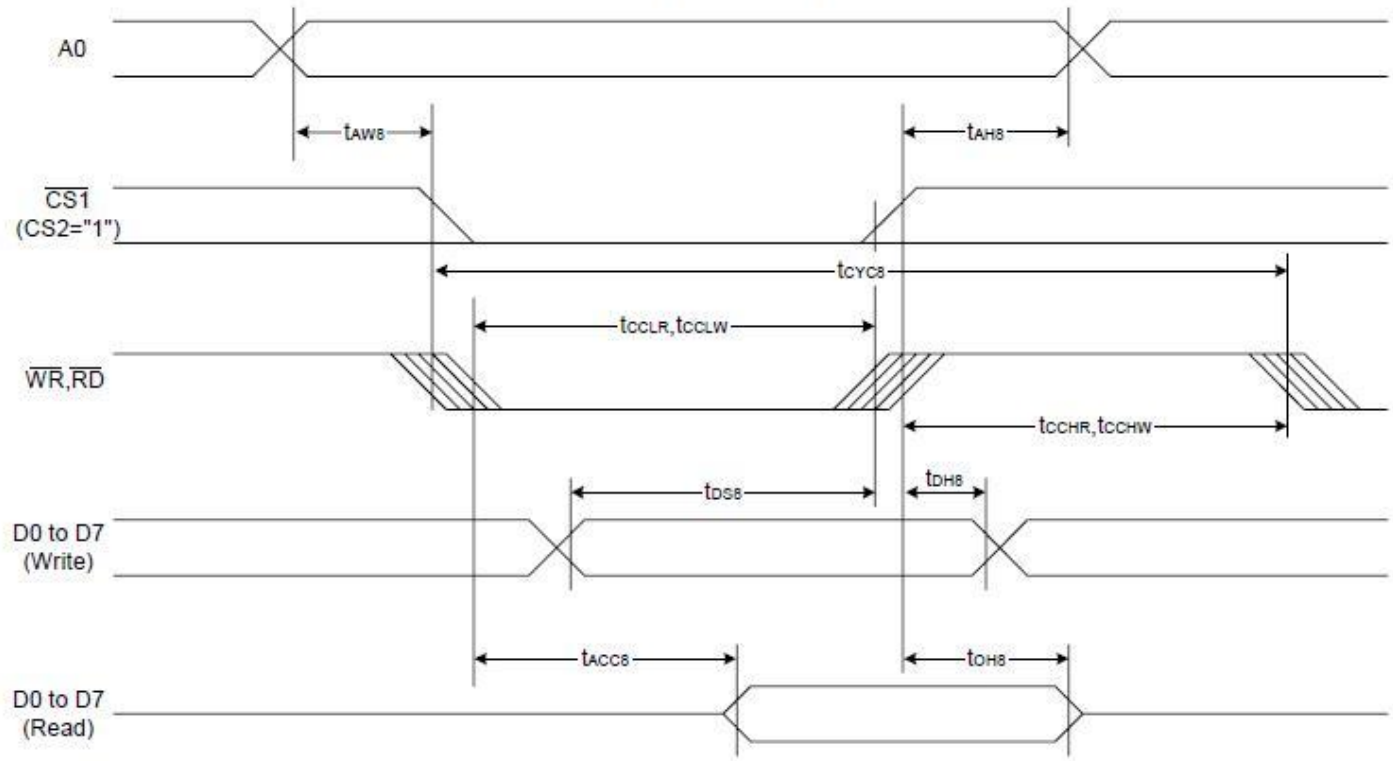
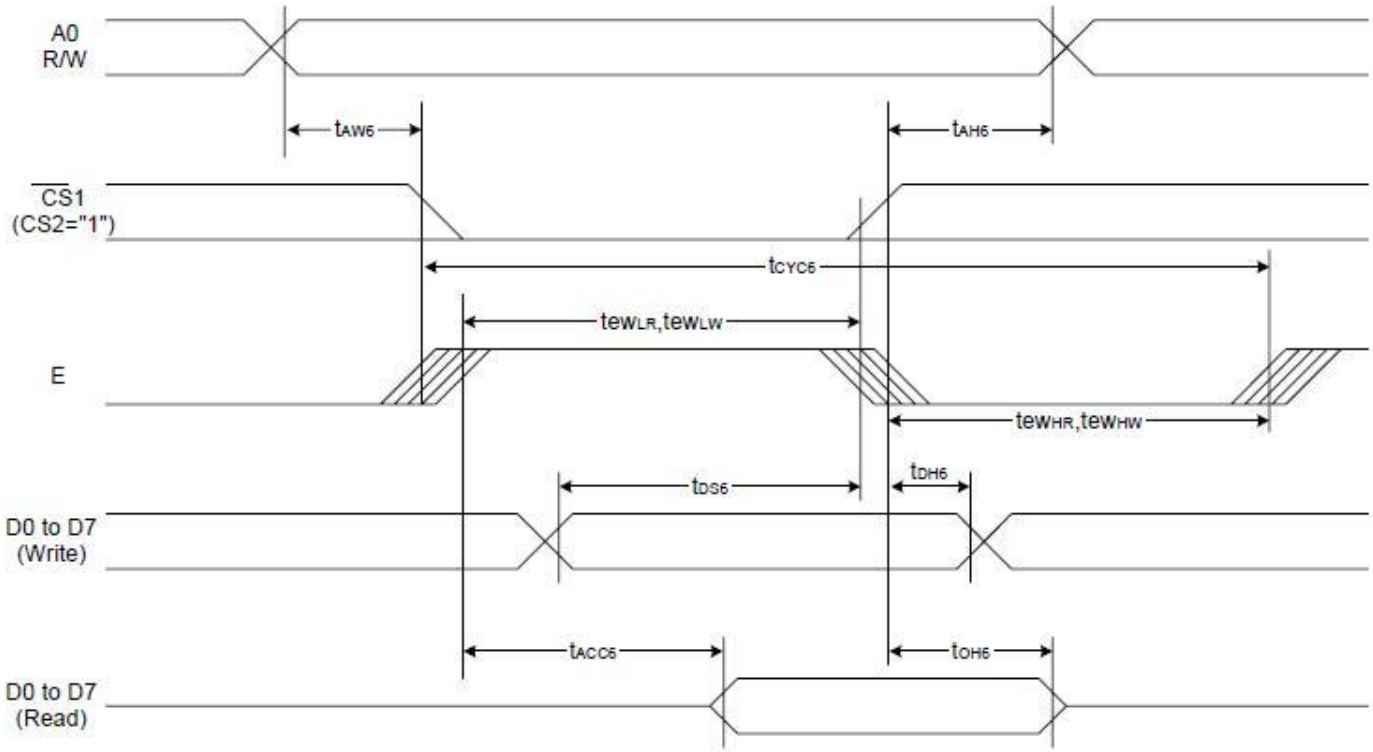


Figure 37

(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	

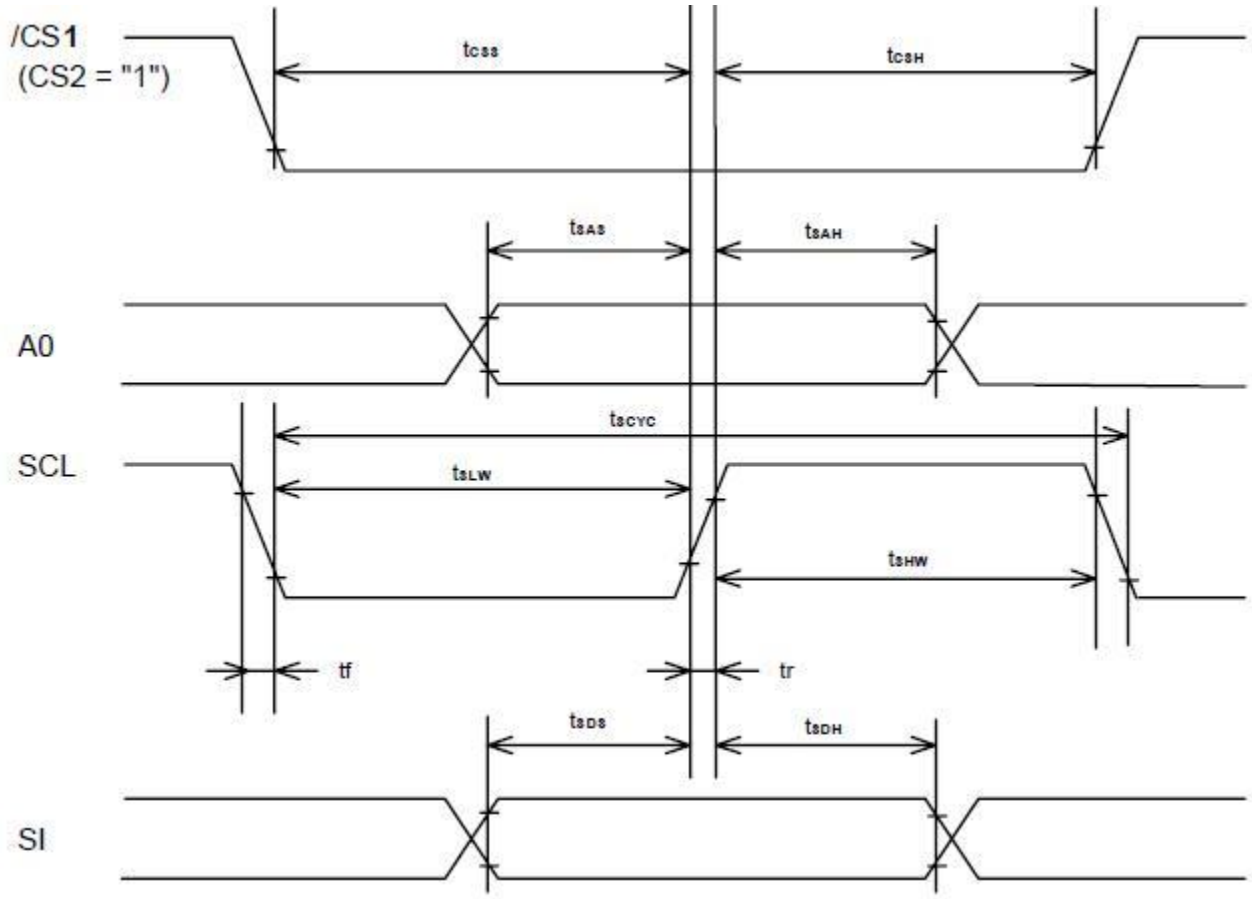
System Bus Read/Write Characteristics 2 (For the 6800 Series MPU)



(V_{DD} = 3.3V, Ta = –30 to 85°C)

Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
Address hold time	A0	t_{AH6}		0	—	ns
Address setup time		t_{AW6}		0	—	
System cycle time		t_{CYC6}		240	—	
Enable L pulse width (WRITE)	WR	t_{EWLW}		80	—	
Enable H pulse width (WRITE)		t_{EWHW}		80	—	
Enable L pulse width (READ)	RD	t_{EWLR}		80	—	
Enable H pulse width (READ)		t_{EWHR}		140		
WRITE Data setup time	D0 to D7	t_{DS6}		40	—	
WRITE Address hold time		t_{DH6}		0	—	
READ access time		t_{ACC6}	C_L = 100 pF	—	70	
READ Output disable time		t_{OH6}	C_L = 100 pF	5	50	

The 4-line SPI Interface:



(V_{DD} = 2.4 - 3.5V, T_A = -40 - 85°C)

Symbol	Parameter	Min.	Typ.	Max.	Unit	Conditions
tSCYC	Serial clock cycle	250			ns	
tSHW	Serial clock H pulse width	100			ns	
tSLW	Serial clock L pulse width	100			ns	
tSAS	Address setup time	150			ns	
tSAH	Address hold time	150			ns	
tSDS	Data setup time	100			ns	
tSDH	Data hold time	100			ns	
tCSS	/CS serial clock time	150			ns	
tCSH	/CS serial clock time	150			ns	

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

*2. All timing is specified using 20% and 80% of V_{DD} as the standard.

Reset

The ST7567 may be reset by an external active low TTL signal from a MPU or other logic device or it may be reset using the following circuit

The Conditions of power supply at initial power up are shown in table 1.

Table 1. Power Supply Initial Conditions

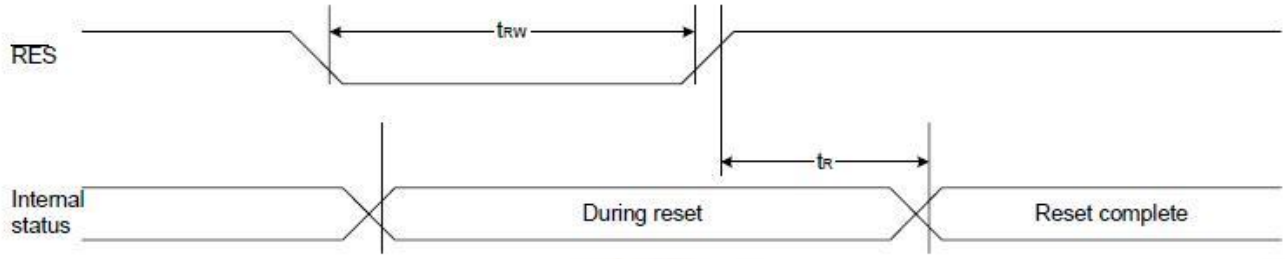


Table 30

(V_{DD} = 3.3V,Ta = –30 to 85°C)

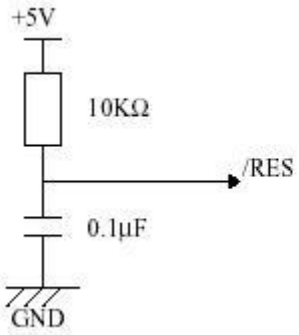
Item	Signal	Symbol	Condition	Rating			Units
				Min.	Typ.	Max.	
Reset time		tR		—	—	1.0	us
Reset "L" pulse width	/RES	tRW		1.0	—	—	us

Table 31

(V_{DD} = 2.7V,Ta = –30 to 85°C)

Item	Signal	Symbol	Condition	Rating			Units
				Min.	Typ.	Max.	
Reset time		tR		—	—	2.0	us
Reset "L" pulse width	/RES	tRW		2.0	—	—	us

*1 All timing is specified with 20% and 80% of V_{DD} as the standard.



■ DISPLAY DATA RAM ADDRESS MAP0

(if initial display line is 1DH)

ST7567 is built-in a RAM with 65X132 bit capacity which stores the display data. The display data RAM (DDRAM) store the dot data of the LCD. It is an addressable array with 132 columns by 65 rows (8-page with 8-bit and 1-page with 1-bit). The X-address is directly related to the column output number. Each pixel can be selected when the page and column addresses are specified (please refer to Fig 7 for detailed illustration). The rows are divided into: 8 pages (Page-0 ~ Page-7) each with 8 lines (for COM0~63) and Page-8 with only 1 line (COMS, for icon). The display data (D7~D0) corresponds to the LCD common-line direction and D0 is on top. All pages can be accessed through D[7:0] directly except icon page. Icon RAM uses only 1-bit of data bus (D0). Refer to Fig 8 for detailed illustration. The microprocessor can write to and read from (only Parallel interfaces) DDRAM by the I/O buffer. Since the LCD controller operates independently, data can be written into DDRAM at the same time as data is being displayed without causing the LCD flicker or data-conflict.

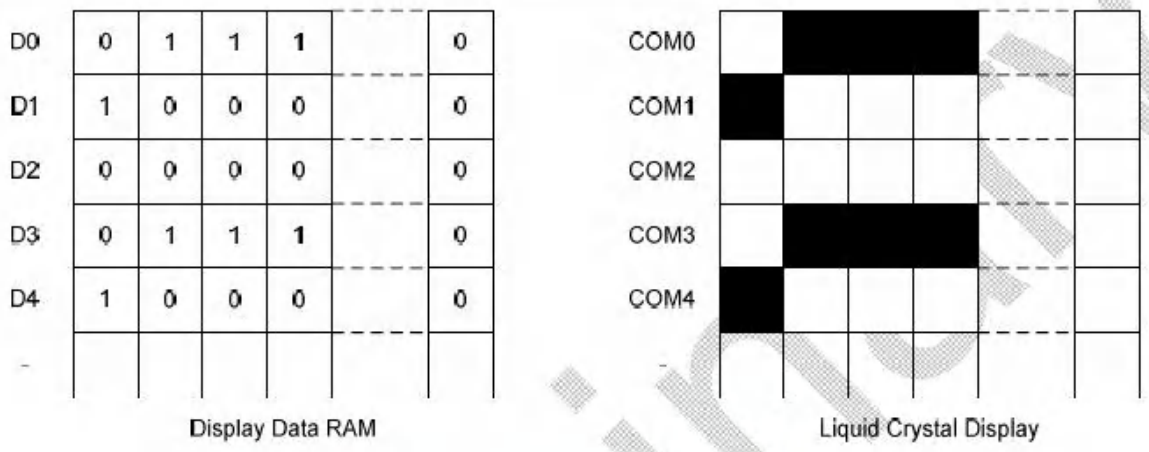


Fig 7. DDRAM Mapping Mode (Default Setting)

Fig 8. DDRAM Format

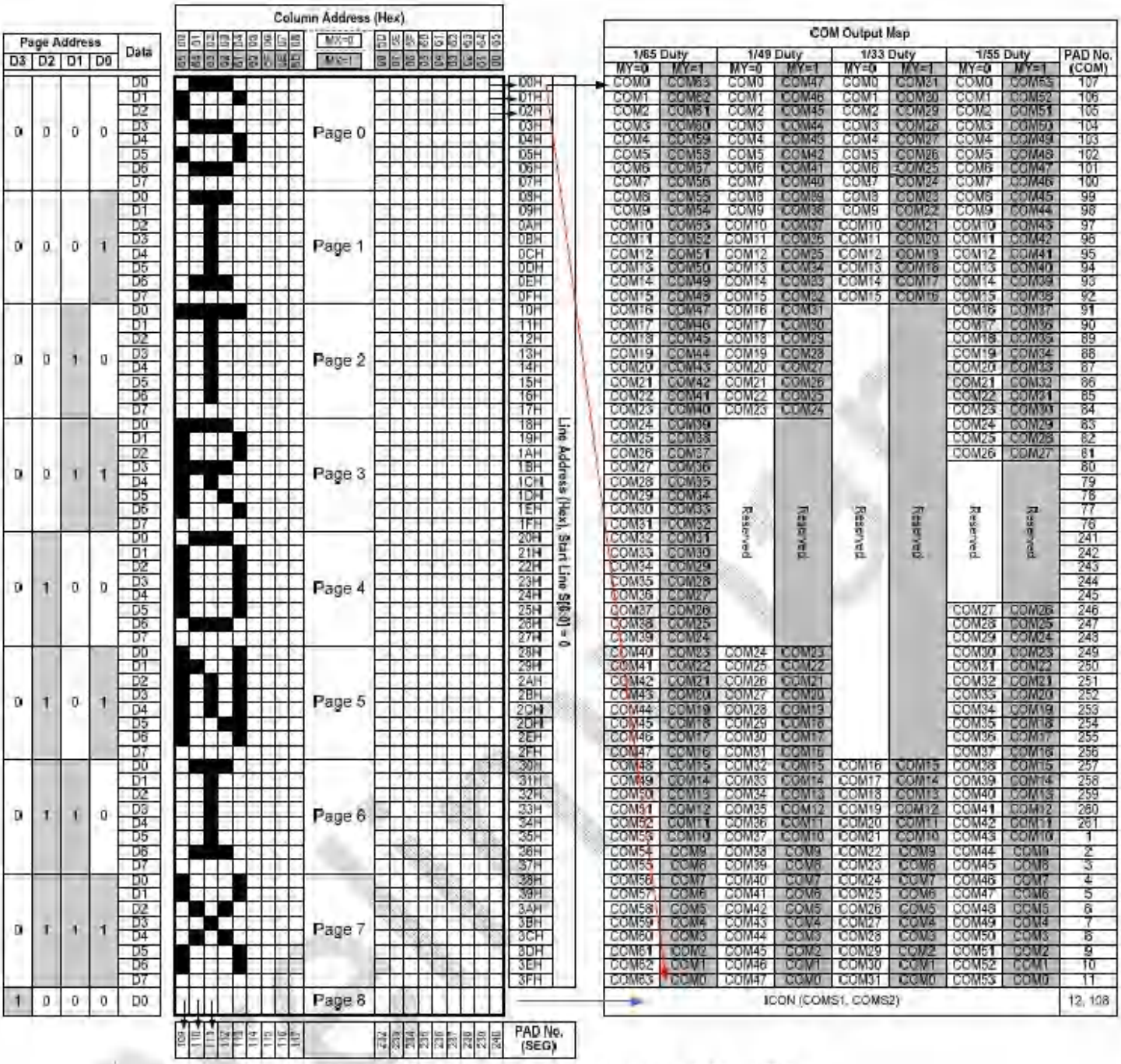


Fig 9. DDRAM and Output Map (COM/SEG)

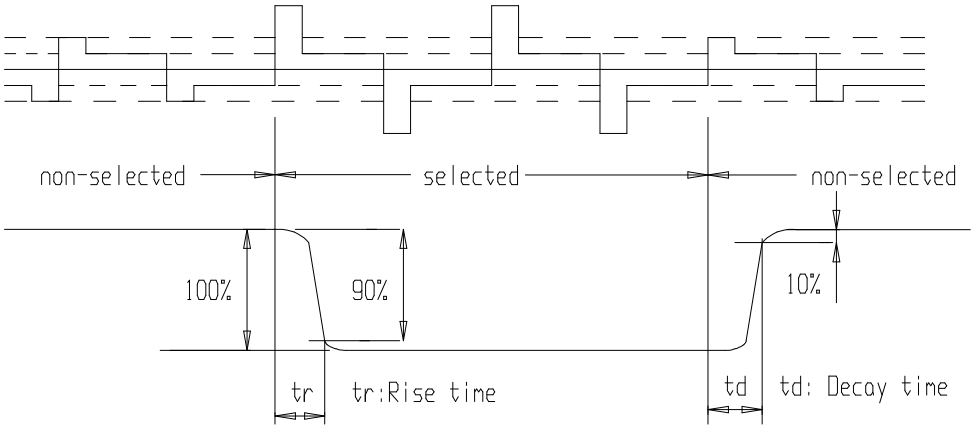
■ OPTICAL CHARACTERISTICS

Test instrument is LCD-5000,made in Japan

Item	Symbol	Condition	Min	Typ	Max	Unit	Remarks	Note
Operating voltage	Vop	-20℃	9.4	9.6	9.8	V		
		+25℃	9.0	9.2	9.4	V	---	---
		+70℃	8.8	9.0	9.2	V		
Response time	Tr	----	----	185	--	ms	---	1
	Td	----	----	200	--	ms	---	1
Contrast ratio	Cr	----	----	4	----	---	---	2
Viewing angle range	θ	Cr≥6	-40	--	40	deg	Ø=0°	3
			-40	--	40	deg	Ø=180°	3

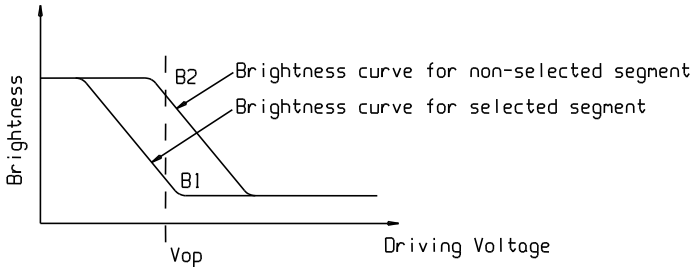
▼ Definition Of Viewing Angle

Note1: Definition of response time

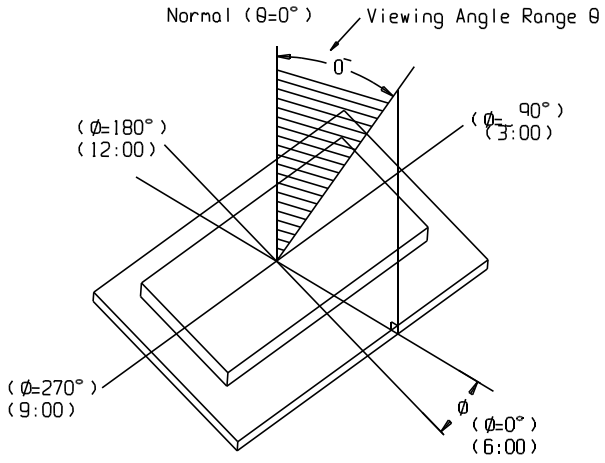


Note2: Definition of contrast ratio 'Cr'

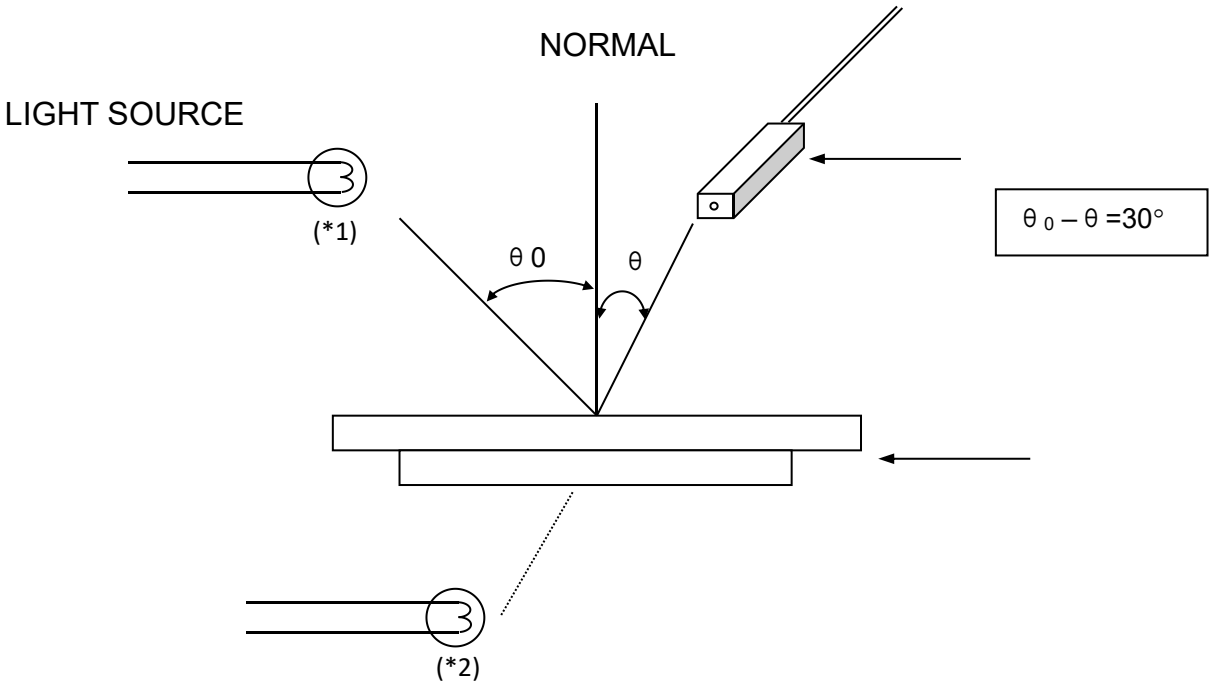
$$Cr = \frac{\text{Brightness of non-selected segment(B2)}}{\text{Brightness of selected segment(B1)}}$$



Note3: Definition of viewing angle range 'θ'



Note4:Measuring Instruments For Electro-optical Characteristics



*1.Light source position for measuring the reflective type of LCD panel
*2.Light source position for measuring the transflective / transmissive types of LCD panel

■ INTERFACE TYPE SELECTION

▼ Serial Interface

The interface selection is controlled by C86 and PSB pins. The selection for parallel or serial interface is shown in Table 1.

Table 1. Parallel/Serial Interface Mode

PSB	C86	CSB	A0	ERD	RWR	D[7:0]	MPU Interface
"H"	"H"	CSB	A0	E	R/W	D[7:0]	6800-series parallel interface
"H"	"L"			/RD	/WR		8080-series parallel interface
"L"	"X"			---	---	Refer to serial interface.	4-Line SPI interface

* The un-used pins are marked as "---" and should be fixed to "H" by VDD1 or VDDH.

Parallel Interface

When PSB= "H", the 8-bit bi-directional parallel interface is enabled and the type of MPU is selected by "C86" pin as shown in Table 2. The data transfer type is determined by signals on A0, ERD and RWR as shown in Table 3.

Table 2. Microprocessor Selection for Parallel Interface

PSB	C86	CSB	A0	ERD	RWR	D[7:0]	MPU Interface
"H"	"H"	CSB	A0	E	R/W	D[7:0]	6800-series parallel interface
"H"	"L"			/RD	/WR		8080-series parallel interface

Table 3. Parallel Data Transfer Type

Common Pins		6800-Series		8080-Series		Description
CSB	A0	E (ERD)	R/W (RWR)	/RD (ERD)	/WR (RWR)	
"L"	"H"	"H"	"H"	"L"	"H"	Display data read out
	"H"	"H"	"L"	"H"	"L"	Display data write
	"L"	"H"	"H"	"L"	"H"	Internal status read
	"L"	"H"	"L"	"H"	"L"	Writes to internal register (instruction)

Setting Serial Interface

Serial Mode	PSB	C86	CSB	A0	ERD	RWR	D[7:0]
4-Line SPI interface	"L"	X	CSB	A0	---	---	SDA, SCLK, ---, ---, ---, ---, ---, ---

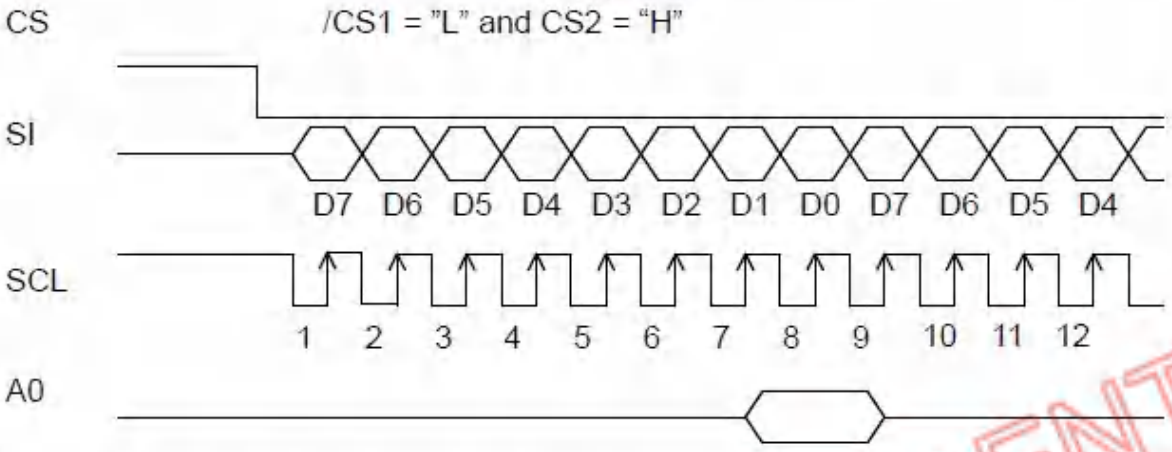
* The un-used pins are marked as "---" and should be fixed to "H" by VDD1 or VDDH.

* C86 is marked as "X" and can be fixed to "H" or "L".

When the serial interface has been selected (P/S = "L"), then when the chip is in active state (/CS1 = "L" and CS2 = "H"), the serial data input (SI) and the serial clock input (SCL) can be received. The serial data is read from the serial data input pin in the rising edge of the serial clocks D7, D6 through D0, in this order. This data is converted to 8 bits of parallel data in the rising edge of eighth serial clock for processing.

The A0 input is used to determine whether or not the serial data input is display data, and when A0 = "L" then the data is command data. The A0 input is read and used for detection of every 8th rising edge of the serial clock after the chip becomes active. Figure 1 is the serial interface signal chart.

Figure 1



Note:
1. When the chip is not active, the shift registers and the counters are reset to their initial states.
2. Reading is not possible while in serial interface mode.
3. Caution is required on the SCL signal when it comes to line-end reflections and external noise. We recommend that the operation can be rechecked on the actual equipment.

■ OPERATING PRINCIPLES & METHODS

▼ Control And Display Command

INSTRUCTION	A0	R/W (RWR)	COMMAND BYTE D7	D6	D5	D4	D3	D2	D1	D0	DESCRIPTION
(1) Display ON/OFF	0	0	1	0	1	0	1	1	1	D	D=1, display ON D=0, display OFF
(2) Set Start Line	0	0	0	1	S5	S4	S3	S2	S1	S0	Set display start line
(3) Set Page Address	0	0	1	0	1	1	Y3	Y2	Y1	Y0	Set page address
(4) Set Column Address	0	0	0	0	0	1	X7	X6	X5	X4	Set column address (MSB)
	0	0	0	0	0	0	X3	X2	X1	X0	Set column address (LSB)
(5) Read Status	0	1	0	MX	D	RST	0	0	0	0	Read IC Status
(6) Write Data	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Write display data to RAM
(7) Read Data	1	1	D7	D6	D5	D4	D3	D2	D1	D0	Read display data from RAM
(8) SEG Direction	0	0	1	0	1	0	0	0	0	MX	Set scan direction of SEG MX=1, reverse direction MX=0, normal direction
(9) Inverse Display	0	0	1	0	1	0	0	1	1	INV	INV =1, inverse display INV =0, normal display
(10) All Pixel ON	0	0	1	0	1	0	0	1	0	AP	AP=1, set all pixel ON AP=0, normal display
(11) Bias Select	0	0	1	0	1	0	0	0	1	BS	Select bias setting 0=1/9; 1=1/7 (at 1/65 duty)
(12) Read-modify-Write	0	0	1	1	1	0	0	0	0	0	Column address increment: Read:+0 , Write:+1
(13) END	0	0	1	1	1	0	1	1	1	0	Exit Read-modify-Write mode
(14) RESET	0	0	1	1	1	0	0	0	1	0	Software reset
(15) COM Direction	0	0	1	1	0	0	MY	-	-	-	Set output direction of COM MY=1, reverse direction MY=0, normal direction
(16) Power Control	0	0	0	0	1	0	1	VB	VR	VF	Control built-in power circuit ON/OFF
(17) Regulation Ratio	0	0	0	0	1	0	0	RR2	RR1	RR0	Select regulation resistor ratio
(18) Set EV	0	0	1	0	0	0	0	0	0	1	Double command!! Set electronic volume (EV) level
	0	0	0	0	EV5	EV4	EV3	EV2	EV1	EV0	
(19) Set Booster	0	0	1	1	1	1	1	0	0	0	Double command!! Set booster level: 00=4X, 01=5X, 10=6X
	0	0	0	0	0	0	0	0	BL1	BL0	
(20) Power Save	0	0	Compound Command								Display OFF + All Pixel ON
(21) NOP	0	0	1	1	1	0	0	0	1	1	No operation
(22) Test	0	0	1	1	1	1	1	1	1	-	Do NOT use. Reserved for testing.

Note: Symbol "-" means this bit can be "H" or "L".

Display ON/OFF

The D flag selects the display mode.

A0	R/W(RWR)	D7	D6	D5	D4	D3	D2	D1	D0
0	0	1	0	1	0	1	1	1	D

D=1: Normal Display Mode.

D=0: Display OFF. All SEGs/COMs output with VSS.

Set Start Line

This instruction sets the line address of the Display Data RAM to determine the initial display line. The display data of the specified line address is displayed at the top row (COM0) of the LCD panel.

A0	R/W(RWR)	D7	D6	D5	D4	D3	D2	D1	D0
0	0	0	1	S5	S4	S3	S2	S1	S0

S5	S4	S3	S2	S1	S0	Line address
0	0	0	0	0	0	0
0	0	0	0	0	1	1
0	0	0	0	1	0	2
0	0	0	0	1	1	3
:	:	:	:	:	:	:
1	1	1	1	0	1	61
1	1	1	1	1	0	62
1	1	1	1	1	1	63

Set Page Address

Y [3:0] defines the Y address vector address of the display RAM.

A0	R/W(RWR)	D7	D6	D5	D4	D3	D2	D1	D0
0	0	1	0	1	1	Y3	Y2	Y1	Y0

Y3	Y2	Y1	Y0	Page Address	Valid Bit
0	0	0	0	Page0	D0~ D7
0	0	0	1	Page1	D0~ D7
0	0	1	0	Page2	D0~ D7
:	:	:	:	:	:
0	1	1	0	Page6	D0~ D7
0	1	1	1	Page7	D0~ D7
1	0	0	0	Page8 (icon page)	D0

Set Column Address of RAM

The range of column address is 0…131. The parameter is separated into 2 instructions. The column address is increased (+1) after each byte of display data access (read/write). This allows MPU accessing DDRAM content continuously. This feature stops at the end of each page (Column Address "83h").

A0	R/W(RWR)	D7	D6	D5	D4	D3	D2	D1	D0
0	0	0	0	0	1	X7	X6	X5	X4

A0	R/W(RWR)	D7	D6	D5	D4	D3	D2	D1	D0
0	0	0	0	0	0	X3	X2	X1	X0

X7	X6	X5	X4	X3	X2	X1	X0	Column address
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	1	1
0	0	0	0	0	0	1	0	2
0	0	0	0	0	0	1	1	3
:	:	:	:	:	:	:	:	:
1	0	0	0	0	0	0	1	129
1	0	0	0	0	0	1	0	120
1	0	0	0	0	0	1	1	131

Read Status

Read the internal status of ST7567. The read function is not available in serial interface mode.

A0	R/W(RWR)	D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	MX	D	RST	0	0	0	0

Flag	Description
MX	MX=0: Normal direction (SEG0->SEG131) MX=1: Reverse direction (SEG131->SEG0)
D	D=0: Display ON D=1: Display OFF
RST	RST=1: During reset (hardware or software reset) RST=0: Normal operation

Write Data

8-bit data of Display Data from the microprocessor can be written to the RAM location specified by the column address and page address. The column address is increased by 1 automatically so that the microprocessor can continuously write data to the addressed page. During auto-increment, the column address wraps to 0 after the last column is written.

A0	R/W(RWR)	D7	D6	D5	D4	D3	D2	D1	D0
1	0	Write Data							

Read Data

8-bit data of Display Data from the RAM location specified by the column address and page address can be read to the microprocessor. The read function is not available in serial interface mode.

A0	R/W(RWR)	D7	D6	D5	D4	D3	D2	D1	D0
1	1	Read Data							

SEG Direction

A0	R/W(RWR)	D7	D6	D5	D4	D3	D2	D1	D0
0	0	1	0	1	0	0	0	0	MX

Flag	Description
MX	MX=0: Normal direction (SEG0->SEG131) MX=1: Reverse direction (SEG131->SEG0)

Inverse Display

This instruction changes the selected and non-selected voltage of SEG. The display will be inversed (white -> Black, Black -> White) while the display data in the Display Data RAM is never changed.

A0	R/W(RWR)	D7	D6	D5	D4	D3	D2	D1	D0
0	0	1	0	1	0	0	1	1	INV

Flag	Description
INV	INV=0: Normal display INV =1: Inverse display

All Pixel ON

This instruction will let all segments output the selected voltage and make all pixels turned ON.

A0	R/W(RWR)	D7	D6	D5	D4	D3	D2	D1	D0
0	0	1	0	1	0	0	1	0	AP

Flag	Description
AP	AP =0: Normal display AP =1: All pixels ON

Bias Select

Select LCD bias ratio of the voltage required for driving the LCD.

A0	R/W(RWR)	D7	D6	D5	D4	D3	D2	D1	D0
0	0	1	0	1	0	0	0	1	BS

Duty	Bias	
	BS=0	BS=1
1/65	1/9	1/7
1/49	1/8	1/6
1/33	1/6	1/5
1/55	1/8	1/6

Reference LCD Bias Voltage (1/65 Duty with 1/9 Bias)

Symbol	Bias Voltage
V0	V0
VG	2/9 x V0
VM	1/9 x V0
VSS	VSS

Please Note:

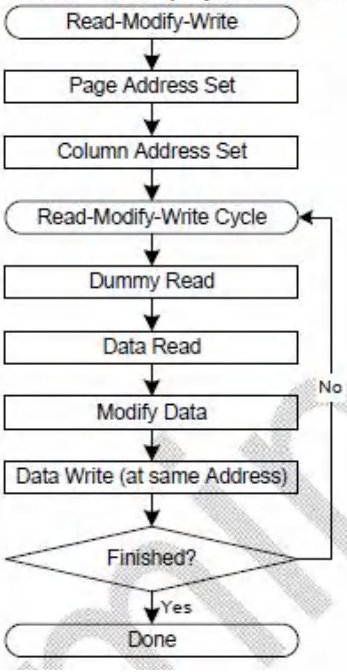
* VG range: 1.24V ≤ VG < VDD2.
* VM range: 0.62V ≤ VM < VDD2.

Read-modify-Write

This command is used paired with the "END" instruction. Once this command has been input, the display data read operation will not change the column address, but only the display data write operation will increase the column address (X[7:0]+1). This mode is maintained until the END command is input. This function makes it possible to reduce the load on the MPU when there are repeating data changes in a specified display region, such as a blanking cursor.

A0	R/W(RWR)	D7	D6	D5	D4	D3	D2	D1	D0
0	0	1	1	1	0	0	0	0	0

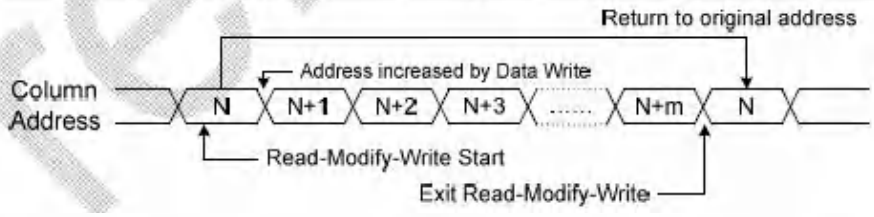
* In Read-modify-Write mode, other instructions aside from display data read/write commands can also be used.



END

When the END command is input, the Read-modify-Write mode is released and the column address returns to the address it was when the Read-modify-Write instruction was entered.

A0	R/W(RWR)	D7	D6	D5	D4	D3	D2	D1	D0
0	0	1	1	1	0	1	1	1	0



RESET

This instruction resets Start Line (S[5:0]), Column Address (X[7:0]), Page Address (Y[3:0]) and COM Direction (MY) to their default setting. Please note this instruction is not complete same as hardware reset (RSTB=L) and cannot initialize the built-in power circuit which is initialized by the RSTB pin. The detailed information is in "Section 7. RESET CIRCUIT".

A0	R/W(RWR)	D7	D6	D5	D4	D3	D2	D1	D0
0	0	1	1	1	0	0	0	1	0

COM Direction

This instruction controls the common output status which changes the vertical display direction. The detailed information can be found in Fig 9.

A0	R/W(RWR)	D7	D6	D5	D4	D3	D2	D1	D0
0	0	1	1	0	0	MY	-	-	-

Flag	Description
MY	MY=0: Normal direction (COM0->COM63) MY=1: Reverse direction (COM63->COM0)

Power Control

This instruction controls the built-in power circuits. Typically, these 3 flags are turned ON at the same time.

A0	R/W(RWR)	D7	D6	D5	D4	D3	D2	D1	D0
0	0	0	0	1	0	1	VB	VR	VF

Flag	Description
VB	VB=0: Built-in Booster OFF VB=1: Built-in Booster ON
VR	VR=0: Built-in Regulator OFF VR=1: Built-in Regulator ON
VF	VF=0: Built-in Follower OFF VF=1: Built-in Follower ON

Regulation Ratio

This instruction controls the regulation ratio of the built-in regulator.

A0	R/W(RWR)	D7	D6	D5	D4	D3	D2	D1	D0
0	0	0	0	1	0	0	RR2	RR1	RR0

RR2	RR1	RR0	Regulation Ratio (RR)
0	0	0	3.0
0	0	1	3.5
0	1	0	4.0
0	1	1	4.5
1	0	0	5.0
1	0	1	5.5
1	1	0	6.0
1	1	1	6.5

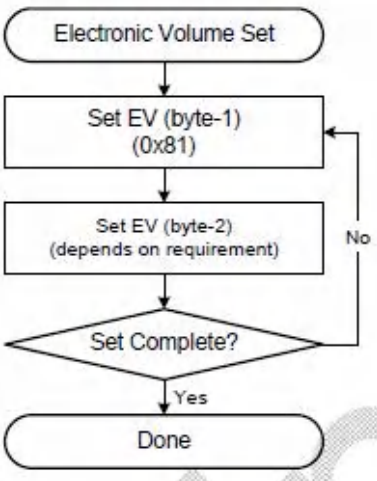
The operation voltage (V0) calculation formula is shown below: (RR comes from Regulation Ratio, EV comes from EV[5:0])
V0 = RR X [1 – (63 – EV) / 162] X 2.1, or **V0 = RR X [(99 + EV) / 162] X 2.1**

SYMBOL	REGISTER	VALUE
RR	RR[2:0]	3, 3.5, 4, 4.5, 5, 5.5, 6 and 6.5
EV	EV[5:0]	0~63

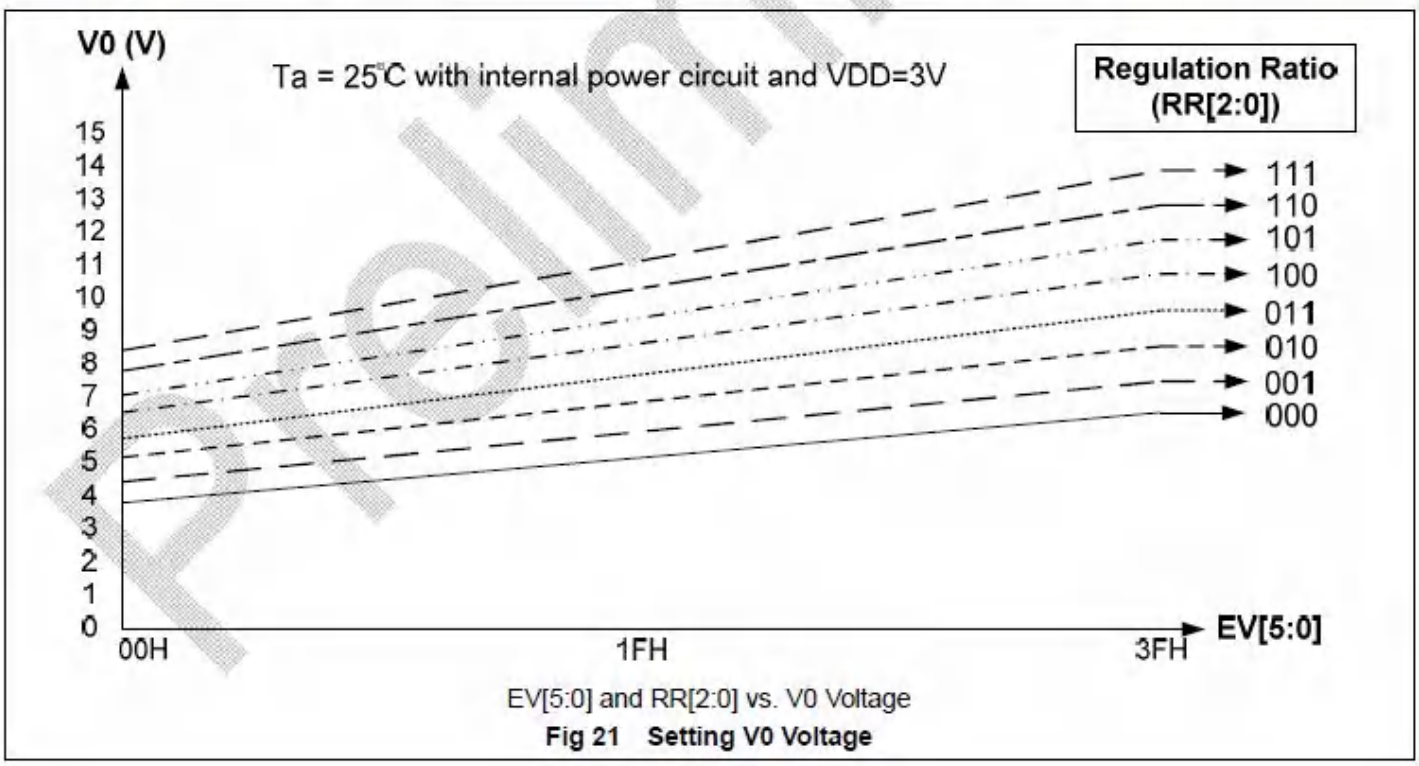
Set EV

This is double byte instruction. The first byte set ST7567 into EV adjust mode and the following instruction will change the EV setting. That means these 2 bytes must be used together. They control the electronic volume to adjust a suitable V0 voltage for the LCD.

A0	R/W(RWR)	D7	D6	D5	D4	D3	D2	D1	D0
0	0	1	0	0	0	0	0	0	1
0	0	0	0	EV5	EV4	EV3	EV2	EV1	EV0



The maximum voltage that can be generated is dependent on the VDD2 voltage and the loading of LCD module. There are 8 V0 voltage curve can be selected. It is recommended the EV should be close to the center (1FH) for easy contrast adjustment. Please refer to the "Selection of Application Voltage" section for detailed information.



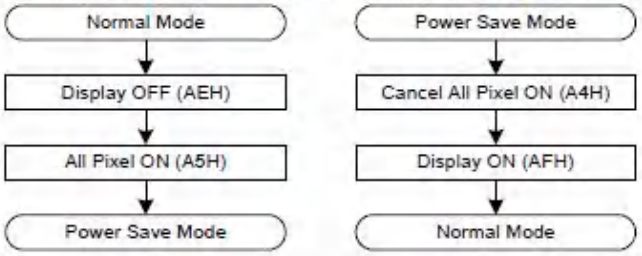
EV[5:0] and RR[2:0] vs. V0 Voltage

Fig 21 Setting V0 Voltage

Power Save (Compound Instruction)

This is compound instruction. The 1st instruction is Display OFF (D=0) and the 2nd instruction is All Pixel ON (AP=1). The Power Save mode starts the following procedure: (the display data and register settings are still kept except D-Flag and AP-Flag)

1. Stops internal oscillation circuit;
2. Stops the built-in power circuits;
3. Stops the LCD driving circuits and keeps the common and segment outputs at VSS.



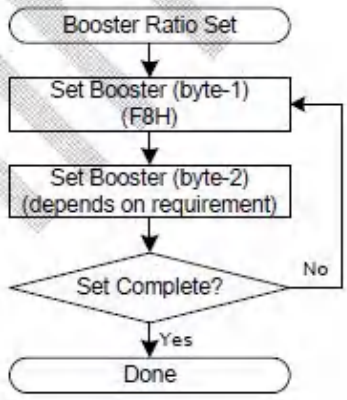
Enter Power Save Mode Exit Power Save Mode

After exiting Power Save mode, the settings will return to be as they were before.

Set Booster

This is double byte instruction. The first byte set ST7567 into booster configuration mode and the following instruction will change the booster setting. That means these 2 bytes must be used together. They control the built-in booster circuit to provide the power source of the built-in regulator. ST7567 booster is built-in booster capacitors. The only external component is a keep capacitor between V0 and XV0. Booster level can be changed with instruction only without changing hardware connection.

A0	R/W(RWR)	D7	D6	D5	D4	D3	D2	D1	D0
0	0	1	1	1	1	1	0	0	0
0	0	0	0	0	0	0	0	BL1	BL0



NOP

"No Operation" instruction. ST7567 will do nothing when receiving this instruction.

A0	R/W(RWR)	D7	D6	D5	D4	D3	D2	D1	D0
0	0	1	1	1	0	0	0	1	1

Test

The test mode is reserved for IC testing. Please don't use this instruction. If the test mode is enabled accidentally, it can be cleared by: issuing an "L" pulse on RSTB pin, issuing RESET instruction or issuing NOP instruction.

A0	R/W(RWR)	D7	D6	D5	D4	D3	D2	D1	D0
0	0	1	1	1	1	1	1	1	-

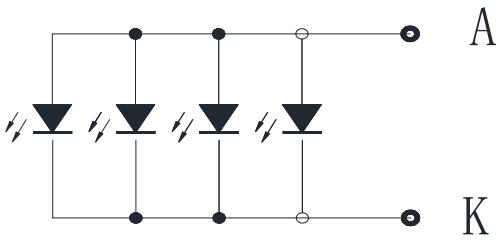
Note: "-" means "1" or "0".

■ BACKLIGHT

●BACKLIGHT TYPE

Backlight Type: LED

●POWER SUPPLY FOR BACKLIGHT



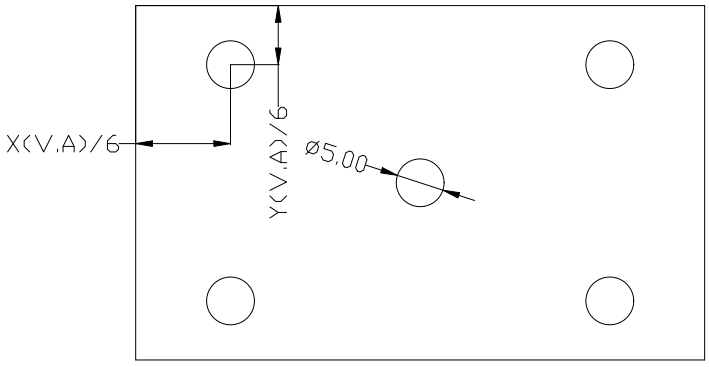
●ABSOLUTE MAXIMUM RATING

PARAMETER	SYMBOL	CONDITION	MIN	MAX	UNIT
Absolute maximum forward current	Ifm			100	mA
Peak forward current	Ifp	1 msec plus 10% Duty cycle		180	mA
Reverse voltage	V_R			5.0	V
Operating temperature	TOP		-20	+70	℃
Storage temperature	TST		-30	+80	℃
Life	Hour	If =60mA	80000		H

●ELECTRICAL-OPTICAL CHARACTERISTICS

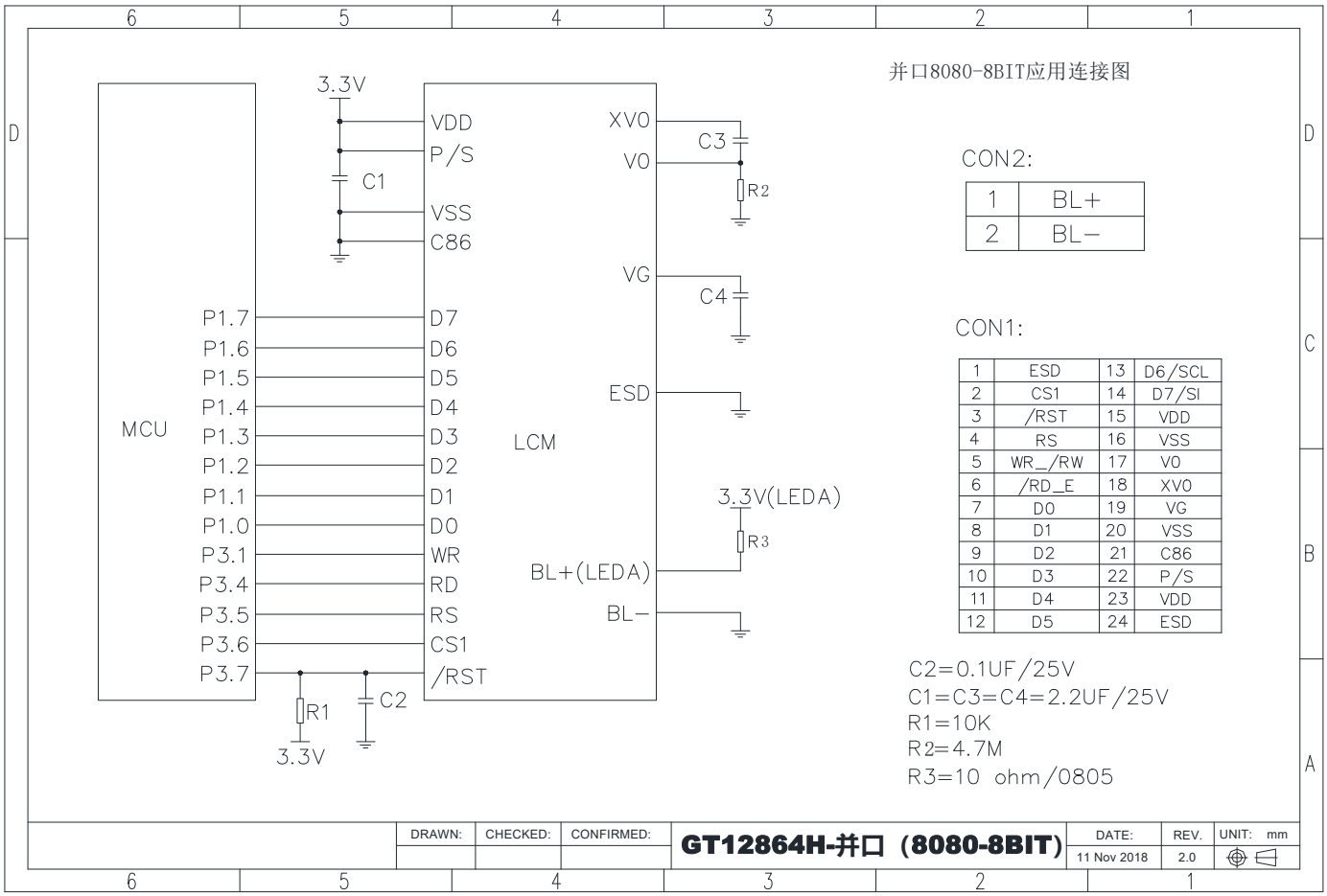
PARAMETER	SYMBOL	CONDITION	MIN	TYP	MAX	UNIT
Forward voltage	Vf (LED(+)-LED(-))	If=60mA	2.6	3.0	3.2	V
Forward current	If		----	60	80	mA
Reverse current	Ir	VR=5.0V	----	----	60	μA
Chromaticity Coordinates ranks	X	If=60mA	0.28	----	0.32	
	Y		0.28		0.32	
Luminance	Lv	If=60mA	200	----	----	cd/㎡

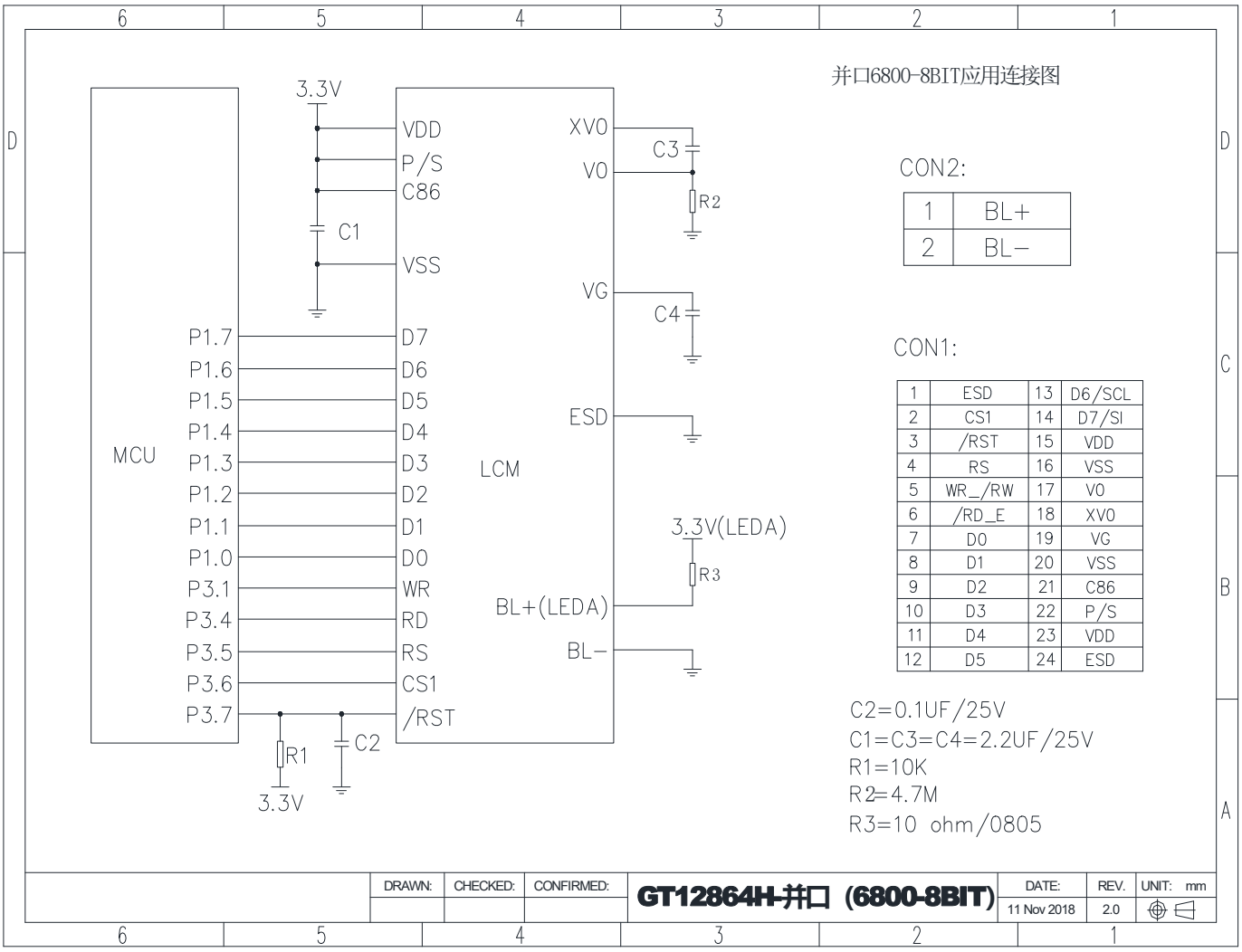
Note: The Master Screen's luminance is the average value of 5 points, and The Lvmin./Lvmax. is not less than 70%. The measurement instrument is BM-7 luminance Colorimeter. The aperture is Φ5 mm.

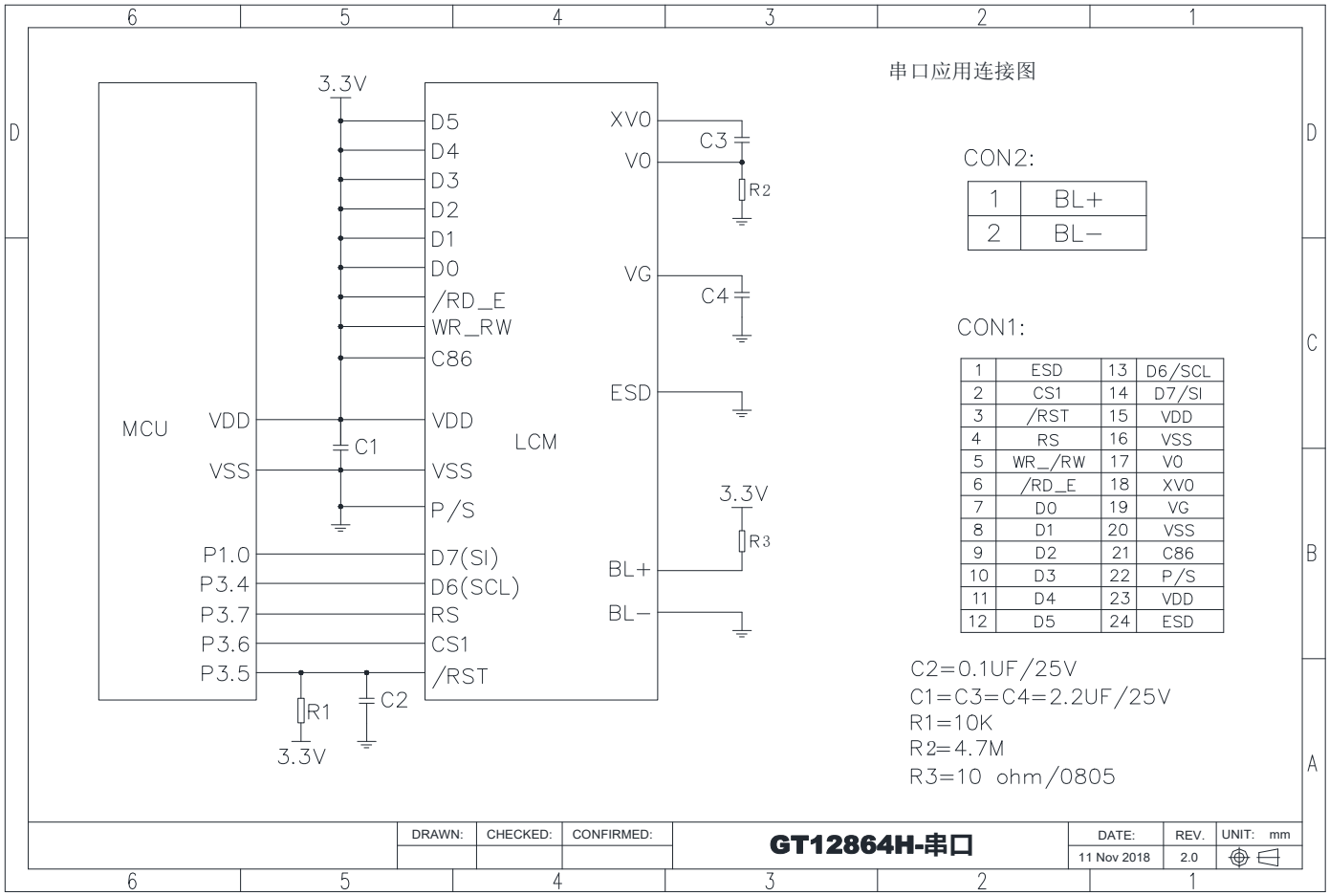


EXAMPLE

Application Circuit




并口6800-8BIT应用连接图
MCU
LCM
3.3V
C1
C2
C3
C4
R1
R2
R3
VDD
P/S
C86
VSS
D7
D6
D5
D4
D3
D2
D1
D0
WR
RD
RS
CS1
/RST
XVO
VO
VG
ESD
3.3V(LEDA)
BL+(LEDA)
BL−
P1.7
P1.6
P1.5
P1.4
P1.3
P1.2
P1.1
P1.0
P3.1
P3.4
P3.5
P3.6
P3.7
CON2:
1 BL+
2 BL−
CON1:
1 ESD 13 D6/SCL
2 CS1 14 D7/SI
3 /RST 15 VDD
4 RS 16 VSS
5 WR_/RW 17 VO
6 /RD_E 18 XVO
7 D0 19 VG
8 D1 20 VSS
9 D2 21 C86
10 D3 22 P/S
11 D4 23 VDD
12 D5 24 ESD
C2=0.1UF/25V
C1=C3=C4=2.2UF/25V
R1=10K
R2=4.7M
R3=10 ohm/0805
DRAWN:
CHECKED:
CONFIRMED:
GT12864H-并口 (6800-8BIT)
DATE: 11 Nov 2018
REV. 2.0
UNIT: mm



Programme

```
;*************************************************
;LCM:      12864H
;CONTROLLER: ST7567
;VDD=3.3V     VOP=8.8V
;INTERFACE: 8080 8-BIT
;D0~D7:     P1 口
;*************************************************
CS1       bit p3.6
RESETB    bit P3.5
RS         bit P3.7
WR_RW     BIT P3.1
E_RD      BIT P3.4
;SI        BIT P1.0
;SCL       BIT P3.4
;-------------------------
INIT:                              ;初始化

    MOV     A,#0e2H              ;11100010 Software Reset
    LCALL   WCOM         ;initialize the internal status
    LCALL   DELAY
```

```
;----------------------
    MOV     A,#02CH    ;Set Power Control Register
(A=00101111)                              ;internal voltage follower circuit is ON
    LCALL   WCOM       ;X0,X1,X2=1,1,1
    LCALL   DELAY
    ;----------------------
    MOV     A,#02EH    ;Set Power Control Register
(A=00101111)                              ;internal voltage follower circuit is ON
    LCALL   WCOM       ;X0,X1,X2=1,1,1
    LCALL   DELAY
    ;----------------------
    MOV     A,#02FH    ;Set Power Control Register
(A=00101111)                              ;internal voltage follower circuit is ON
    LCALL   WCOM       ;X0,X1,X2=1,1,1
    LCALL   DELAY
;----------------------
    MOV     A,#025H    ;A=00100101  (1+Rb/Ra)ratio=5.5 Set internal Regulator resistor ratio
    LCALL   WCOM       ;
;----------------------
    MOV     A,#0A2H    ;A=10100010  Set LCD Bias: 1/9  (DUTY=1/65)
    LCALL   WCOM
;----------------------
    MOV     A,#081H    ;A=10000001  Set reference voltage mode
    LCALL   WCOM
    MOV     A,#23      ;A=00011110  ?=30
    LCALL   WCOM
;----------------------
    MOV     A,#0C8H        ;A=11001000 COM63~COM0  Set COM Output Scan Direction
    LCALL   WCOM       ;X3=0: normal mode
;----------------------
    MOV     A,#0A0H    ;A=10100000 SEG0~SEG131 Set Segment Re-map
    LCALL   WCOM       ;X0=1:column address 83H is mapped to SEG0
;----------------------
    MOV     A,#060H    ;A=01000000  Set Display start Line
    LCALL   WCOM       ;COM0
    ;----------------------
    MOV     A,#0F8H    ;A=11111000  Set Display start Line
    LCALL   WCOM       ;COM0
   MOV     A,#000H     ;A=00000000  *4 BOOSTER
   LCALL   WCOM
;----------------------
    MOV     A,#0A6H    ;A=10100110 Set Normal/Reverse display
    LCALL   WCOM       ;X0=0: normal display
;----------------------
    MOV     A,#0AFH     ;A=10101111 Set Display On/Off
    LCALL   WCOM
    RET

TEST:
            mov    r3,#00                          ;测试画面
```

```
            MOV       R2,#0B0H
TEST2:      MOV       A,R2              ;set page address
            LCALL     WCOM
            MOV       A,#010H           ;set column address MSB
            LCALL     WCOM
            MOV       A,#01H            ;set column address LSB
            LCALL     WCOM
            MOV       R1,#22     ;132/6=22  set (6*8)*(22-5)characters
TEST1:      MOV       DPTR,#CHAR
            MOV       R0,#06H
TEST0:
            MOV       A,R3
            MOVC      A,@A+DPTR
            LCALL     WDATA
            INC       DPTR
            DJNZ      R0,TEST0
            DJNZ      R1,TEST1
            INC       R2
            CJNE      R2,#0B8H,TEST2
            RET

DISPLAY:    MOV     DPTR,#BM          ;显示图片
            MOV       R6,#0B0H
DISPLAY0:   MOV       A,R6
            LCALL     WCOM
DISPLAY1:   MOV       A,#10H            ;set column address MSB; set column low bit address
            LCALL     WCOM
            MOV       A,#01H            ;set column address LSB; set column hige bit address
            LCALL     WCOM
            MOV       R0,#128           ;SEG=106
DISPLAY2:   MOV       A,#0
           MOVC       A,@A+DPTR
           LCALL     WDATA              ;write data
           INC      DPTR               ;DPTR+1
           DJNZ      R0,DISPLAY2       ;scan 106 SEG
            INC       R6                  ;PAGE+1
            CJNE      R6,#0B8H,DISPLAY0   ;when the page=8,LCALL DISPLAY0
           RET
;*******************************
;8080-8BIT  INTERFACE
;*******************************
WCOM:
       ;LCALL          CHECK_BUSY
       CLR      RS
       lcall     TRANSMIT
       RET
```

```
WDATA:  ;LCALL          CHECK_BUSY
         SETB    RS
TRANSMIT:
        clr     CS
        CLR    WR_RW
        setb     E_RD
        NOP
        MOV     P1,A
        setb   wr_rw            ;8080 INTERFACE
         RET
;*********************************
;6800-8BIT  INTERFACE
;*********************************
WCOM:
        ;LCALL          CHECK_BUSY
        CLR     RS
        lcall     TRANSMIT
        RET

WDATA:  ;LCALL          CHECK_BUSY
         SETB    RS
TRANSMIT:
        clr     CS
        CLR    WR_RW
        setb     E_RD
        NOP
        MOV     P1,A
        CLR     RD            ;6800 INTERFACE
        RET

;*********************************
;SERIAL 4-LINE SPI  INTERFACE
;*********************************
WCOM:                                   ;写指令
           CLR      CS1  ;active IC
           CLR      RS   ;prepare the instruction for writing
           JMP      WRITE
WDATA:                                   ;写数据
           CLR      CS1  ;active IC
           SETB     RS   ;ready to read data
WRITE:

           CLR      SCLK
           MOV       48h,#08
WRITE1:
           RLC      A
           MOV      SDI,C    ;sdi=1
```

```
        SETB    SCLK
        CLR     SCLK
        NOP
        NOP
        NOP
        NOP
        DJNZ    48h,WRITE1; 8 cycle(8 bit data)
        RET
```

```
CHAR:   DB      0FFH,0FFH,0FFH,0FFH,0FFH,0FFH       ;全显
        DB      0AAH,0AAH,0AAH,0AAH,0AAH,0AAH       ;横线
        DB      055H,055H,055H,055H,055H,055H       ;横线
        DB      0FFH,000H,0FFH,000H,0FFH,000H       ;竖线
        DB      055H,0AAH,055H,0AAH,055H,0AAH       ;雪花
        DB      092H,054H,0FEH,054H,092H,000H       ;*
```

■ RELIABILITY

▼ Content of Reliability Test

Environmental Test				
No.	**Test Item**	**Content of Test**	**Test Condition**	**Applicable Standard**
1	High temperature storage	Endurance test applying the high storage temperature for a long time.	80 °C 200 hrs	------
2	Low temperature storage	Endurance test applying the low storage temperature for a long time.	-30 °C 200 hrs	------
3	High temperature operation	Endurance test applying the electric stress (Voltage & Current) and the thermal stress to the element for a long time.	70 °C 200 hrs	------
4	Low temperature operation	Endurance test applying the electric stress under low temperature for a long time.	-20 °C 200 hrs	------
5	High temperature / Humidity storage	Endurance test applying the high tempera-ture and high humidity storage for a long time.	50 °C , 90 %RH 96 hrs	MIL-202E-103B JIS-C5023
6	High temperature / Humidity operation	Endurance test applying the electric stress (Voltage & Current) and temperature / humidity stress to the element for a long time.	40 °C 90 %RH 96 hrs	MIL-202E-103B JIS-C5023
7	Temperature cycle	Endurance test applying the low and high temperature cycle. -10°C 30min. ⇌ 25°C 5min. ⇌ 60°C 30min. 1 cycle	-10°C / 60°C 10 cycles	------

Mechanical Test				
8	Vibration test	Endurance test applying the vibration during transportation and using.	10~22Hz → 1.5mmp-p 22~500Hz → 1.5G Total 0.5hrs	MIL-202E-201A JIS-C5025 JIS-C7022-A-10
9	Shock test	Constructional and mechanical endurance test applying the shock during transportation.	50G half sign wave 11msedc 3 times of each direction	MIL-202E-213B
10	Atmospheric pressure test	Endurance test applying the atmospheric pressure during transportation by air.	115 mbar 40 hrs	MIL-202E-105C
Others				
11	Static electricity test	Endurance test applying the electric stress to the terminal.	VS=800V , RS=1.5 kΩ CS=100 pF 1 time	MIL-883B-3015.1

*** Supply voltage for logic system = 3.3V. Supply voltage for LCD system = Operating voltage at 25°C.

■ INSPECTION CRITERIA

1. Objective

The criteria is applied for consolidating the LCM quality standard between AVD 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 AVD.

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

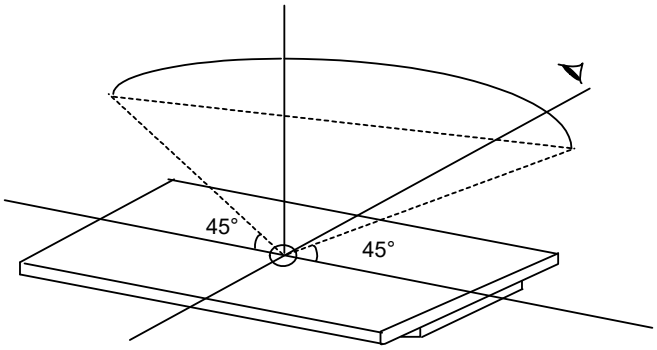
4.1.6 IPC-A-610C Acceptance Condition for Electrical Assemblies.

5. Inspection Condition and Inspection Reference

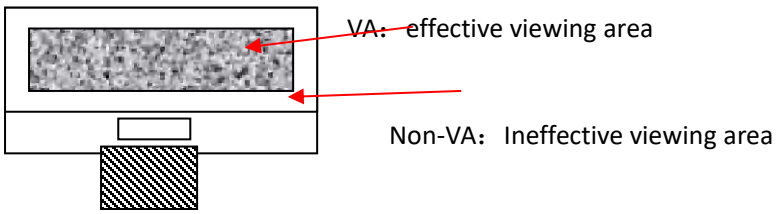
5.1 The ambient temperature and humidity are 25±5℃ and 45±20%RH respectively, and the ambient luminance should be more than 300cd/cm^2. The distance between inspector's eyes and the LCD panel should be 30cm away. Normally we inspect products with reflected light, when we inspect the LCD produces with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



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.

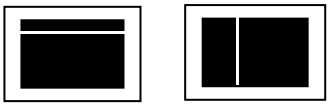
5.5.1.2 As per the product with the fixed voltage the test voltage setting is same as Vop and keeps the constant voltage through the internal circuit. And the limited sample on the voltage range is needed if necessary.

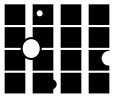
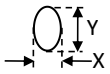
5.5.2 Current Consumption（I）：refer to product document and approval drawing to confirm it.

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

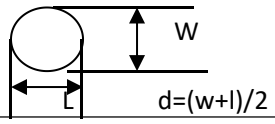
6.3.1 Dot defect(defined within VA, out of VA spots not accounted)

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		

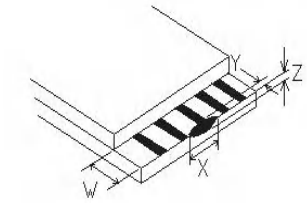
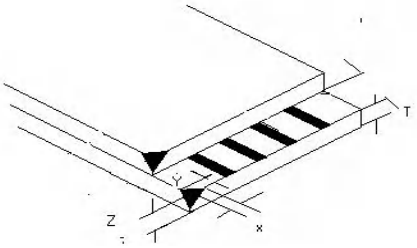
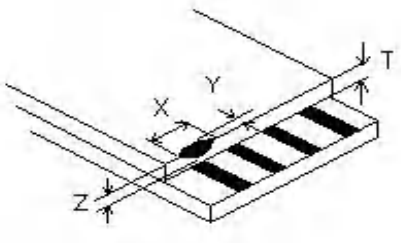
6.3.2 Line defect(defined within VA, out of VA spots not accounted)

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≤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.		√	Rejected

		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.			
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

■ PRECAUTIONS FOR USING LCD MODULES

▼ Handing Precautions

(1) The display panel is made of glass. Do not subject it to a mechanical shock by dropping it or impact.

(2) If the display panel is damaged and the liquid crystal substance leaks out, be sure not to get any in your mouth. If the substance contacts your skin or clothes, wash it off using soap and water.

(3) Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.

(4) The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully.

(5) If the display surface becomes contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If it is heavily contaminated, moisten cloth with one of the following solvents :

- Isopropyl alcohol
- Ethyl alcohol

(6) Solvents other than those above-mentioned may damage the polarizer. Especially, do not use the following.

- Water
- Ketone
- Aromatic solvents

(7) Exercise care to minimize corrosion of the electrode. Corrosion of the electrodes is accelerated by water droplets, moisture condensation or a current flow in a high-humidity environment.

■ USING LCD MODULES

▼ Liquid Crystal Display Modules

LCD is composed of glass and polarizer. Pay attention to the following items when handling.

(1) Please keep the temperature within specified range for use and storage. Polarization degradation, bubble generation or polarizer peel-off may occur with high temperature and high humidity.

(2) Do not touch, push or rub the exposed polarizers with anything harder than an HB pencil lead (glass, tweezers, etc.).

(3) N-hexane is recommended for cleaning the adhesives used to attach front/rear polarizers and reflectors made of organic substances which will be damaged by chemicals such as acetone, toluene, ethanol and isopropylalcohol.

(4) When the display surface becomes dusty, wipe gently with absorbent cotton or other soft material like chamois soaked in petroleum benzin. Do not scrub hard to avoid damaging the display surface.

(5) Wipe off saliva or water drops immediately, contact with water over a long period of time may cause deformation or color fading.

(6) Avoid contacting oil and fats.

(7) Condensation on the surface and contact with terminals due to cold will damage, stain or dirty the polarizers. After products are tested at low temperature they must be warmed up in a container before coming is contacting with room temperature air.

(8) Do not put or attach anything on the display area to avoid leaving marks on.

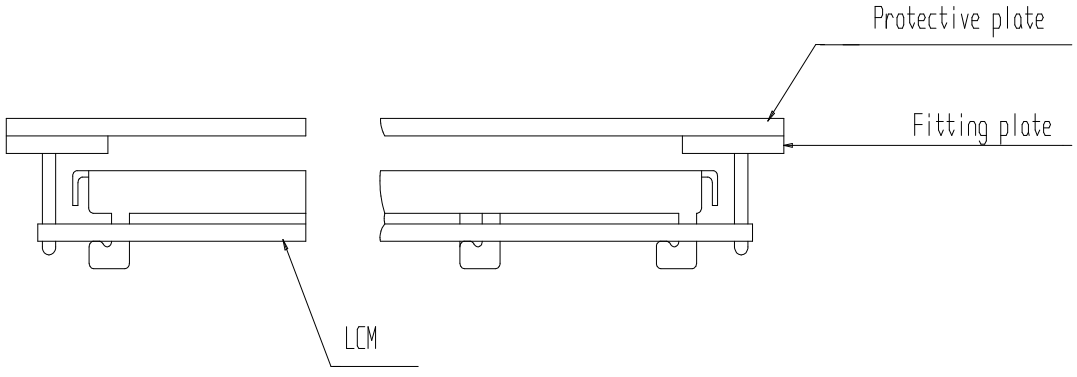
(9) Do not touch the display with bare hands. This will stain the display area and degradate insulation between terminals (some cosmetics are determinated to the polarizers).

(10) As glass is fragile. It tends to become or chipped during handling especially on the edges. Please avoid dropping or jarring.

▼ Installing LCD Modules

The hole in the printed circuit board is used to fix LCM as shown in the picture below. Attend to the following items when installing the LCM.

(1) Cover the surface with a transparent protective plate to protect the polarizer and LC cell.



(2) When assembling the LCM into other equipment, the spacer to the bit between the LCM and the fitting plate should have enough height to avoid causing stress to the module surface, refer to the individual specifications for measurements. The measurement tolerance should be ±0.1mm.

▼ Precaution for Handing LCD Modules

Since LCM has been assembled and adjusted with a high degree of precision, avoid applying excessive

shocks to the module or making any alterations or modifications to it.

(1) Do not alter, modify or change the shape of the tab on the metal frame.
(2) Do not make extra holes on the printed circuit board, modify its shape or change the positions of components to be attached.
(3) Do not damage or modify the pattern writing on the printed circuit board.
(4) Absolutely do not modify the zebra rubber strip (conductive rubber) or heat seal connector.
(5) Except for soldering the interface, do not make any alterations or modifications with a soldering iron.
(6) Do not drop, bend or twist LCM.

Electro-Static Discharge Control

Since this module uses a CMOS LSI, the same careful attention should be paid to electrostatic discharge as for an ordinary CMOS IC.

(1) Make certain that you are grounded when handing LCM.
(2) Before remove LCM from its packing case or incorporating it into a set, be sure the module and your body have the same electric potential.
(3) When soldering the terminal of LCM, make certain the AC power source for the soldering iron does not leak.
(4) When using an electric screwdriver to attach LCM, the screwdriver should be of ground potentiality to minimize as much as possible any transmission of electromagnetic waves produced sparks coming from the commutator of the motor.
(5) As far as possible make the electric potential of your work clothes and that of the work bench the ground potential.
(6) To reduce the generation of static electricity be careful that the air in the work is not too dried. A relative humidity of 50%-60% is recommended.

Precaution for soldering to the LCM

(1) Observe the following when soldering lead wire, connector cable and etc. to the LCM.
- Soldering iron temperature : 280°C ± 10°C.
- Soldering time : 3-4 sec.
- Solder : eutectic solder.

If soldering flux is used, be sure to remove any remaining flux after finishing to soldering operation. (This does not apply in the case of a non-halogen type of flux.) It is recommended that you protect the LCD surface with a cover during soldering to prevent any damage dur to flux spatters.

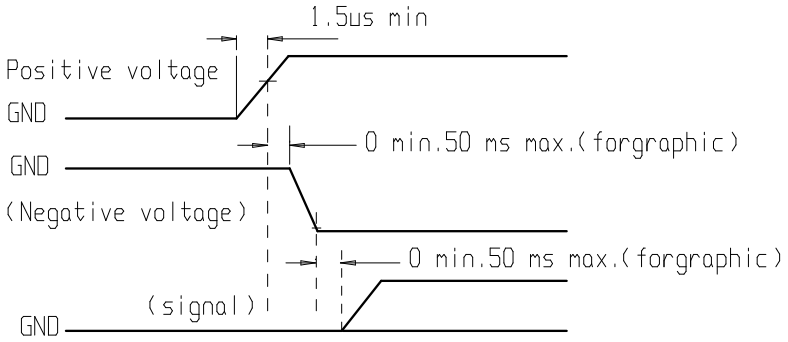
(2) When soldering the electroluminescent panel and PC board, the panel and board should not be detached more than three times. This maximum number is determined by the temperature and time conditions mentioned above, though there may be some variance depending on the temperature of the soldering iron.
(3) When remove the electroluminescent panel from the PC board, be sure the solder has completely melted, the soldered pad on the PC board could be damaged.

Precautions for Operation

(1) Viewing angle varies with the change of liquid crystal driving voltage (VO). Adjust VO to show the best contrast.
(2) Driving the LCD in the voltage above the limit shortens its life.
(3) Response time is greatly delayed at temperature below the operating temperature range. However, this does not mean the LCD will be out of the order. It will recover when it returns to the specified temperature range.
(4) If the display area is pushed hard during operation, the display will become abnormal. However, it will return to normal if it is turned off and then back on.

(5) Condensation on terminals can cause an electrochemical reaction disrupting the terminal circuit. Therefore, it must be used under the relative condition of 40°C , 50% RH.

(6) When turning the power on, input each signal after the positive/negative voltage becomes stable.



Storage

When storing LCD's as spares for some years, the following precaution are necessary.

(1) Store them in a sealed polyethylene bag. If properly sealed, there is no need for dessicant.

(2) Store them in a dark place. Do not expose to sunlight or fluorescent light, keep the temperature between 0°C and 35°C.

(3) The polarizer surface should not come in contact with any other objects. (We advise you to store them in the container in which they were shipped.)

(4) Environmental conditions :

- Do not leave them for more than 168hrs. at 80°C.
- Should not be left for more than 48hrs. at -30°C.

Safety

(1) It is recommended to crush damaged or unnecessary LCD's into pieces and wash them off with solvents such as acetone and ethanol, which should later be burned.

(2) If any liquid out of a damaged glass cell and comes in contact with the hands, wash off thoroughly with soap and water.

Limited Warranty

Unless agreed between TPS and customer, TPS will replace or repair any of its LCD modules which are found to be functionally defective when inspected in accordance with TPS LCD acceptance standards (copies available upon request) for a period of one year from date of shipments. Cosmetic/visual defects must be returned to TPSwithin 90 days of shipment. Confirmation of such date shall be based on freight documents.The warranty liability of TPS limited to repair and/or replacement on the terms set forth above.TPS will not be responsible for any subsequent or consequential events.

Return LCM under warranty

No warranty can be granted if the precautions stated above have been disregarded. The typical examples of violations are :

- Broken LCD glass.
- PCB eyelet's damaged or modified.
- PCB conductors damaged.
- Circuit modified in any way, including addition of components.
- PCB tampered with by grinding, engraving or painting varnish.
- soldering to or modifying the bezel in any manner.

Module repairs will be invoiced to the customer upon mutual agreement. Modules must be returned with sufficient description of the failures or defects. Any connectors or cable installed by the customer must be removed completely without damaging the PCB eyelet's, conductors and terminals.