Tailorpixels

A Professional Manufacturer of Display

Manufacturer Certificated

9001 CERT. No.: 282Q19070712006

14001 CERT. No.: 282E19070712007

Product Specification

Model: TTW128128D-A0

128X128 COG Module

This module uses RoHS material

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Specification Revision History

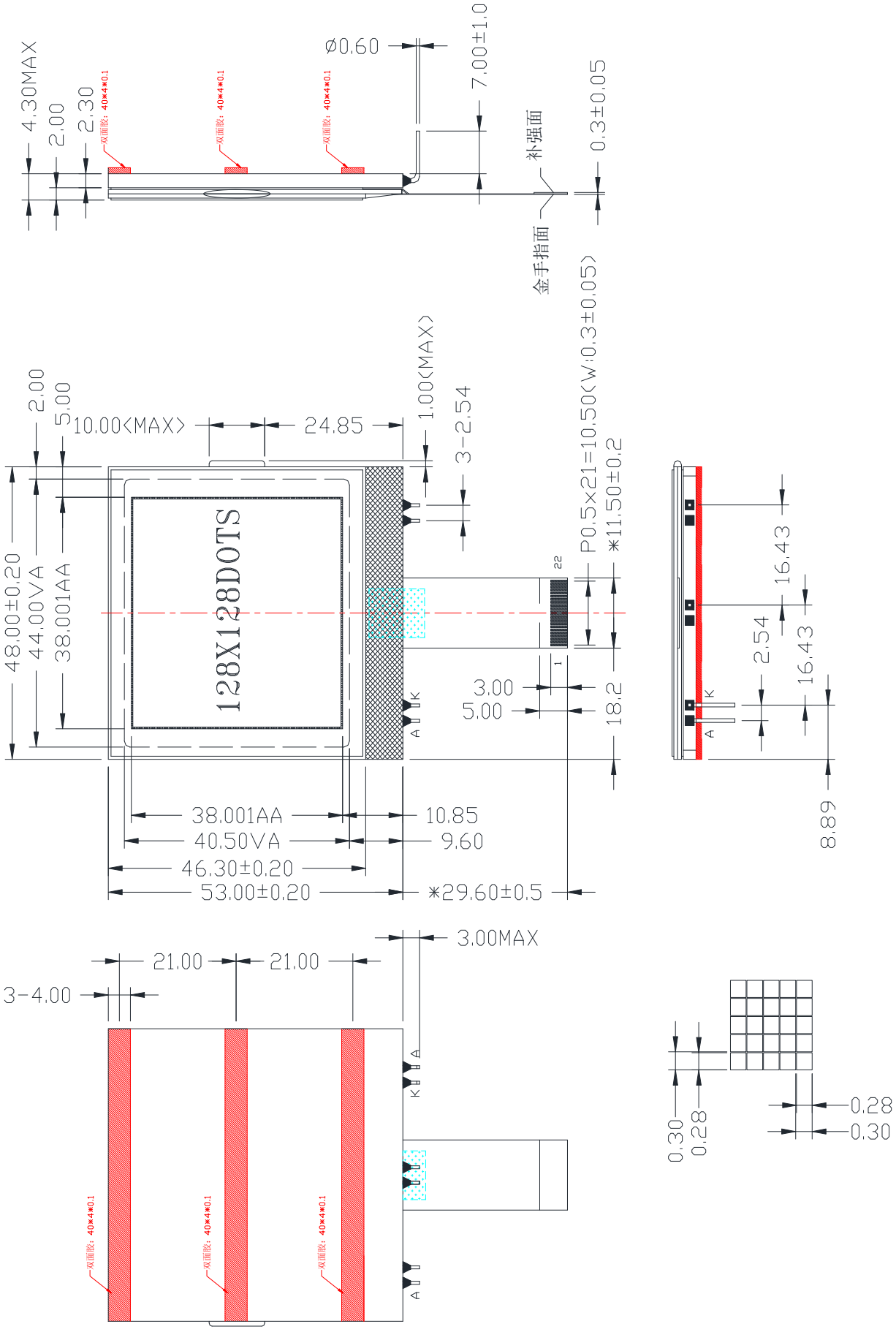
Version	Content	Date
A0	First Issue	27-Apr-18

CONTENTS

■ GENERAL SPECIFICATIONS

ITEM	STANDARD VALUE	UNIT
NUMBER OF GRAPHIC	128×128	
MODULE DIMENSION	48.0×53.0×12.3(MAX)	mm
EFFECTIVE DISPLAY AREA	44.0×40.5	mm
DOT SIZE	0.282×0.282	mm
DOT PITCH	0.297×0.297	mm
LCD TYPE	FSTN/POSITIVE/TRANSFLECTIVE	
DUTY	1/128duty 1/11bias	
VIEWING DIRECTION	6	o'clock
POLARIZING FILM HAZE	(防眩目)25	%
OPERATING TEMPERATURE	－10~＋50	℃
STORAGE TEMPERATURE	－30~＋80	℃
BACK LIGHT TYPE	SIDE LED	
BACK LIGHT COLOR	WHITE	
APPROX. WEIGHT	60	g
ROHS STANDARD	YES	

■ MECHANICAL DIMENSIONS



■ INTERFACE PIN CONNECTIONS

<table>
<tr><th>PIN</th><th>SYMBOL</th><th>FUNCTIONS</th></tr>
<tr><td>1</td><td>VLCD</td><td>High voltage LCD Power Supply.</td></tr>
<tr><td>2</td><td>VB0-</td><td rowspan="4">LCD Bias Voltages. These are the voltage sources to provide SEG driving currents. These voltages are generated internally. Connect capacitors of CBXvalue between VBX+and VBX-.</td></tr>
<tr><td>3</td><td>VB1-</td></tr>
<tr><td>6</td><td>VB1+</td></tr>
<tr><td>7</td><td>VB0+</td></tr>
<tr><td>4</td><td>BM1</td><td rowspan="2">Bus mode: The interface bus mode is determined by BM[1:0] and D[7:6] by the following relationship:
<table>
<tr><th>BM[1:0]</th><th>D[7:6]</th><th>Mode</th></tr>
<tr><td>11</td><td>Data</td><td>6800/8-bit</td></tr>
<tr><td>10</td><td>Data</td><td>8080/8-bit</td></tr>
<tr><td>01</td><td>11</td><td>2-wire I²C</td></tr>
<tr><td>00</td><td>10</td><td>4-wire SPI w/ 8-bit token (S8: conventional)</td></tr>
<tr><td>00</td><td>11</td><td>3-wire SPI w/ 8-bit token (S8uc: Ultra-Compact)</td></tr>
</table></td></tr>
<tr><td>5</td><td>BM0</td></tr>
<tr><td>8</td><td>VDD</td><td>power supply</td></tr>
<tr><td>9</td><td>VSS</td><td>Power Ground.</td></tr>
<tr><td>10</td><td>WR1</td><td rowspan="2">WR\[1:0] controls the read/write operation of the hostinterface. See section HostInterfaceformoredetail.In</td></tr>
<tr><td>11</td><td>WR0</td></tr>
<tr><td>12</td><td>CD</td><td>Select Control data or Display data for read/write operation. In I2C mode, CD pin is not used. Connect CD to VSS when not used. "L"±: Control data "H"±: Display data</td></tr>
<tr><td>13</td><td>CS0</td><td>Chip Select. Chip is selected when CS0 = "L"</td></tr>
<tr><td>14</td><td>RST</td><td>When RST="L"±, all control registers are re-initialized by their default states.</td></tr>
<tr><td>15~22</td><td>D7~D0</td><td>Bi-directional bus for both serial and parallel host interfaces.
In serial modes, connect D[0] to SCK, D[3] to SDA,
<table>
<tr><th></th><th>BM=1x (Parallel)</th><th>BM=01 (I²C)</th><th>BM=00 (S8/S8uc)</th></tr>
<tr><td>D0</td><td>D0</td><td>SCK</td><td>SCK</td></tr>
<tr><td>D1</td><td>D1</td><td>–</td><td>–</td></tr>
<tr><td>D2</td><td>D2</td><td>–</td><td>–</td></tr>
<tr><td>D3</td><td>D3</td><td>SDA</td><td>SDA</td></tr>
<tr><td>D4</td><td>D4</td><td>–</td><td>–</td></tr>
<tr><td>D5</td><td>D5</td><td>–</td><td>–</td></tr>
<tr><td>D6</td><td>D6</td><td>1</td><td>S8/S8uc</td></tr>
<tr><td>D7</td><td>D7</td><td>1</td><td>1</td></tr>
</table>
Connect unused pins to V_{SS}.</td></tr>
</table>

■ ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	MIN	MAX	UNIT
Supply voltage for logic	VDD	-0.3	4.0	V
Supply voltage for LCD	VEE-VSS	-0.3	+19.8	V
Input voltage	VI	-0.3	VDD+0.5	V
Output voltage	Vo	-0.3	VDD+0.5	V
Operating temperature	TOP	-10	+50	℃
Storage temperature	TST	-30	+80	℃

■ ELECTRICAL CHARACTERISTICS

▼ DC Characteristics

Condition: VDD=+3.3V±10%, VSS=0V, VEE-VSS=0 to 18V, Ta=-30 to +85℃

PARAMETER	SYMBOL	CONDITION	MIN	TYP	MAX	UNIT
Supply voltage for logic	VDD	----	2.7	3.3	3.5	V
Supply current for logic	IDD	----	---	2.0	2.5	mA
Operating voltage for LCD	VLCD-VSS	----	9.8	10.0		V
Input voltage ' H ' level	V_{IH}	----	0.8VDD	----	VDD	V
Input voltage ' L ' level	V_{IL}	----	VSS	----	0.2VDD	V

▼ AC Characteristics

System Bus Read/Write Characteristics (For the 8080 Series MPU) VDD=+3.3V±10%, VSS=0V, Ta=-30 to +85℃

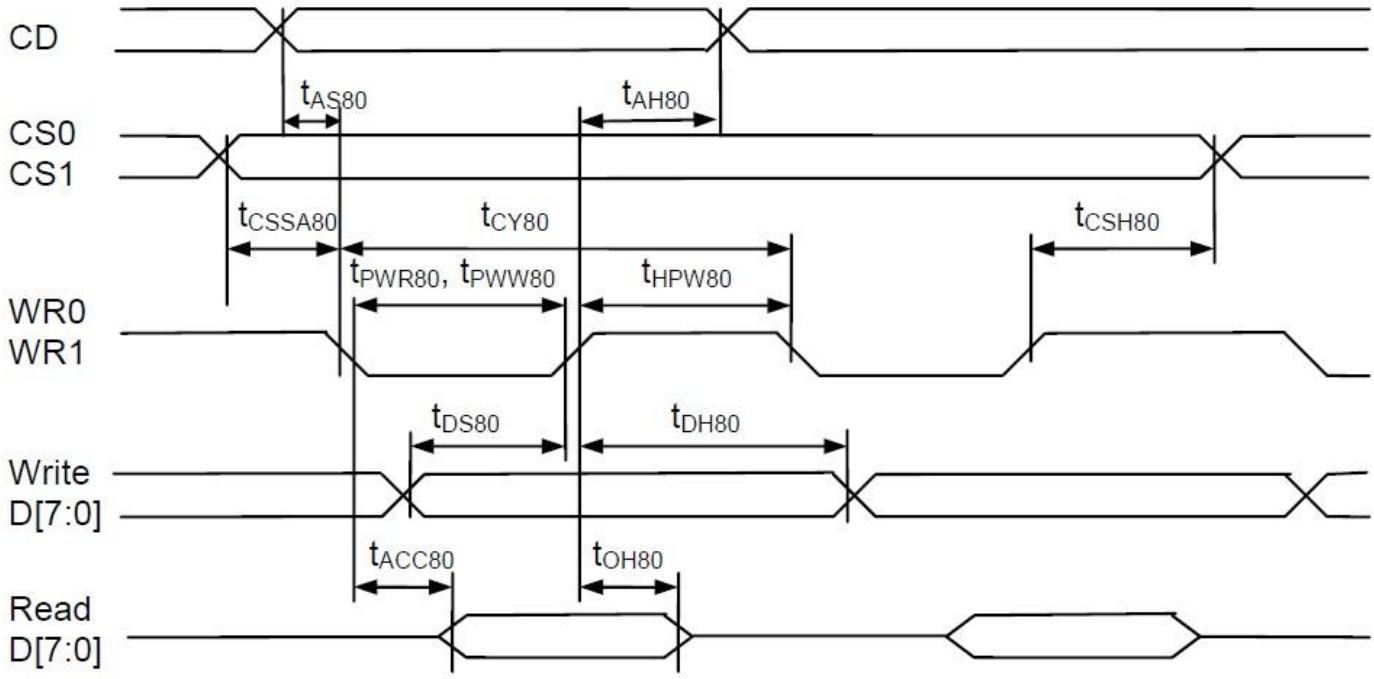


FIGURE 13: Parallel Bus Timing Characteristics (for 8080 MCU)

($2.5V \leqslant V_{DD} < 3.3V$, 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 (read) (write)		170 130	–	nS
t_{PWR80}	WR1	Pulse width (read)		85	–	nS
t_{PWW80}	WR0	Pulse width (write)		65	–	nS
t_{HPW80}	WR0, WR1	High pulse width (read) (write)		85 65	–	nS
t_{DS80} t_{DH80}	D0~D7	Data setup time Data hold time		30 0	–	nS
t_{ACC80} t_{OH80}		Read access time Output disable time	C_L = 100pF	– –	65 30	nS
t_{CSSA80} t_{CSH80}	CS1/CS0	Chip select setup time Chip select hold time		5 5		nS

System Bus Read/Write Characteristics (For the 6800 Series MPU) VDD=+3.3V±10%, VSS=0V, Ta=-30 to +85℃

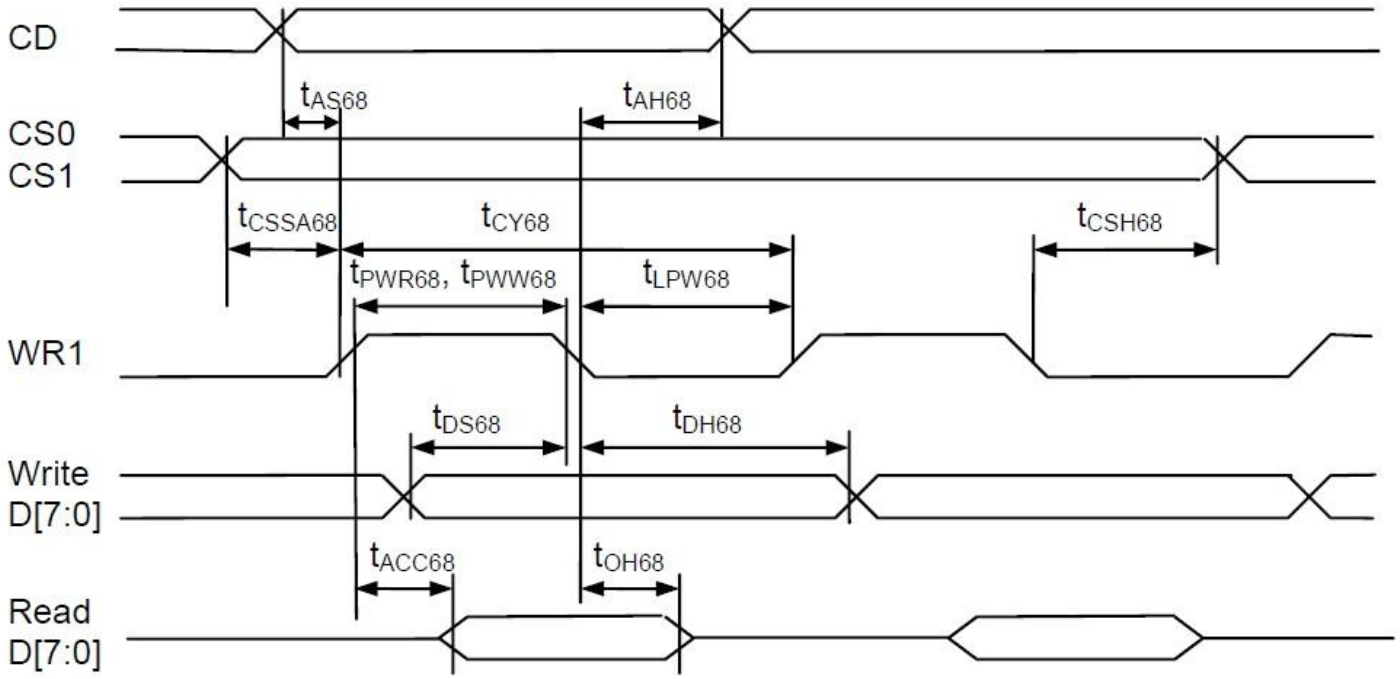


FIGURE 14: Parallel Bus Timing Characteristics (for 6800 MCU)

($2.5V \leqslant V_{DD} < 3.3V$, 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 (read) (write)		170 130	–	nS
t_{PWR68}	WR1	Pulse width (read)		85	–	nS
t_{PWW68}		Pulse width (write)		65	–	nS
t_{LPW68}		Low pulse width (read) (write)		85 65	–	nS
t_{DS68} t_{DH68}	D0~D7	Data setup time Data hold time		30 0	–	nS
t_{ACC68} t_{OH68}		Read access time Output disable time	C_L = 100pF	– –	70 30	nS
t_{CSSA68} t_{CSH68}	CS1/CS0	Chip select setup time Chip select hold time		5 5		nS

System Bus Read/Write Characteristics (For the S8 / S8uc Series MPU) VDD=+3.3V±10%, VSS=0V, Ta=-30 to +85℃

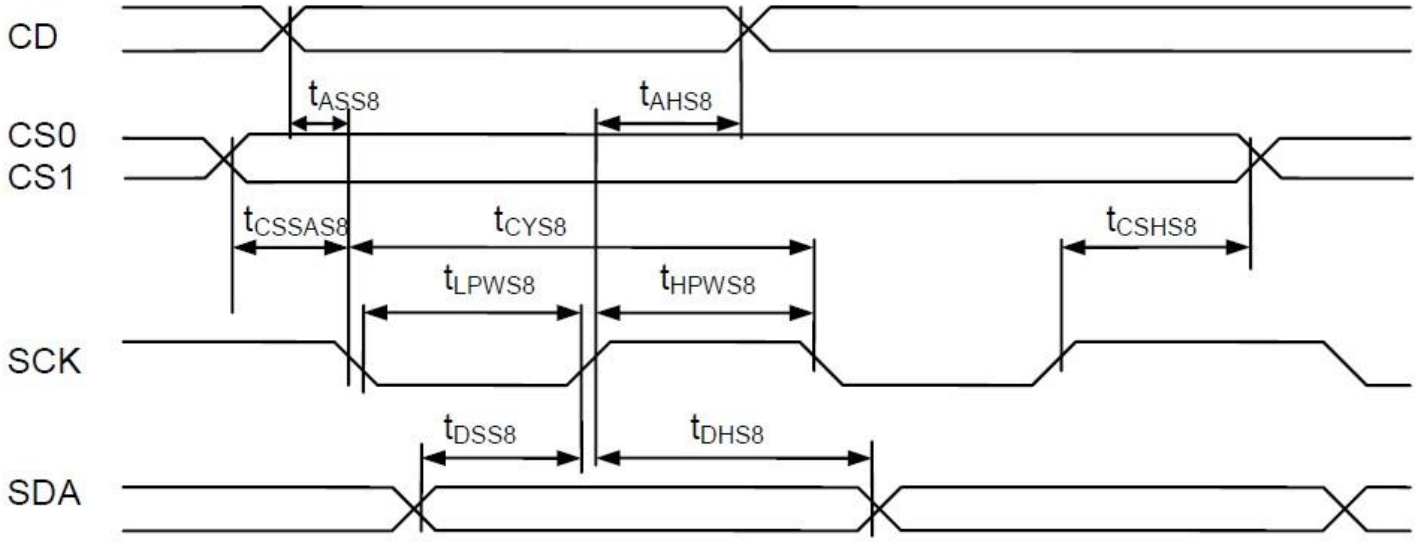


FIGURE 15: Serial Bus Timing Characteristics (for S8 / S8uc)

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

Symbol	Signal	Description	Condition	Min.	Max.	Units
t_{ASS8}	CD	Address setup time		0	–	nS
t_{AHS8}		Address hold time		0	–	nS
t_{CYS8}	SCK	System cycle time		40	–	nS
t_{LPWS8}		Low pulse width		20	–	nS
t_{HPWS8}		High pulse width		20	–	nS
t_{DSS8} t_{DHS8}	SDA	Data setup time Data disable time		15 0	–	nS
t_{CSSAS8} t_{CSHS8}	CS1/CS0	Chip select setup time Chip select hold time		5 5		nS

System Bus Read/Write Characteristics (For the I2C Series MPU) VDD=+3.3V±10%, VSS=0V, Ta=-30 to +85℃

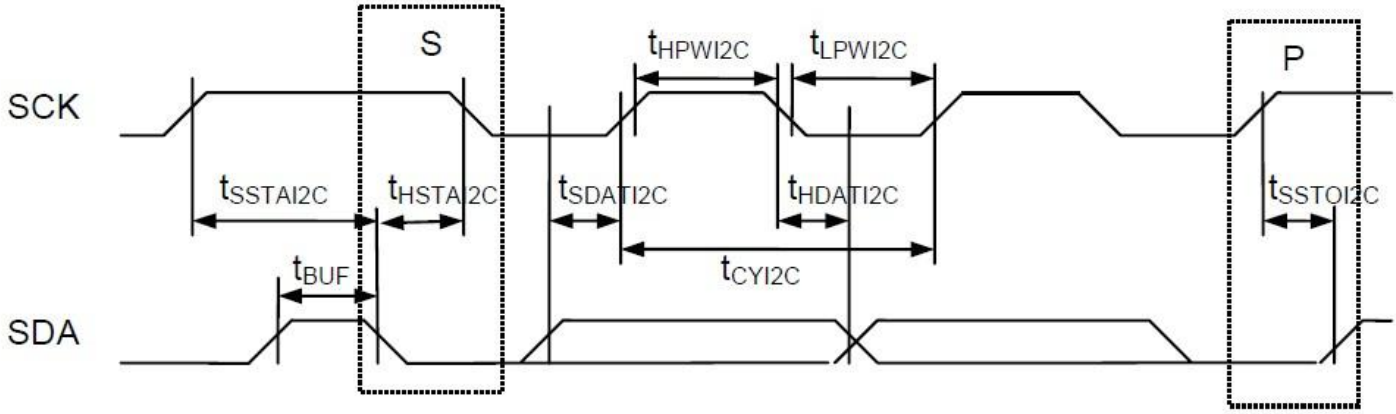


FIGURE 16: Serial bus timing characteristics (for I^2C)

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

Symbol	Signal	Description	Condition	Min.	Max.	Units
t_{CYI2C}	SCK	SCK cycle time (read) (write)	tr+tf ≤ 100nS	580 275	–	nS
t_{LPWI2C}		Low pulse width (read) (write)		290 165	–	nS
t_{HPWI2C}		High pulse width (read) (write)		290 110	–	nS
tr, tf	SCK SDA	Rise time and fall time		–	–	nS
$t_{SSDAI2C}$		Data setup time		28	–	nS
t_{HDAI2C}		Data hold time		11	–	nS
$t_{SSTAI2C}$		START Setup time		28	–	nS
$t_{HSTAI2C}$		START Hold time		28	–	nS
$t_{SSTOI2C}$		STOP setup time		28	–	nS
T_{BUF}		Bus Free time between STOP and START condition		165	–	nS

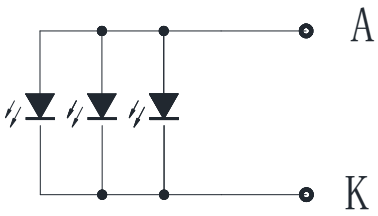
■ BACKLIGHT

Backlight Type

Backlight Type: LED

Backlight color: white

Power Supply For Backlight



Absolute Maximum Rating

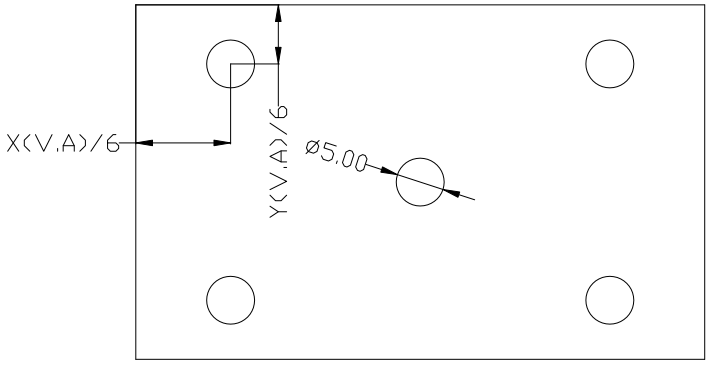
PARAMETER	SYMBOL	CONDITION	MAX	UNIT
Absolute maximum forward current	Ifm		60	mA
Peak forward current	Ifp	1 MSEC plus 10% Duty Cycle	120	mA
Reverse voltage	V_R		7.0	V
Life	Hour	If(forward current) =45mA	80000	H

Note: For operation above 25℃, Then Ifm Ifp must be decreased, the Current decreased is -1.08mA/℃ for DC drive and -2.58mA/℃ Pulse drive, the power dissipation is -4.5mW/℃. The product working current must not more than the 70% of the Ifm or Ifp according to the working temperature.

Electrical-Optical Characteristics

PARAMETER	SYMBOL	CONDITION	MIN	TYP	MAX	UNIT
Forward voltage	Vf (LED(+)-LED(-))		2.7	3.3	3.5	V
Forward current	If		----	45	60	mA
Reverse current	Ir	VR=7.0V	----	----	120	μA
Chromaticity	λp	If(forward current) = 45mA	x=0.28 y=0.27	x=0.30 y=0.29	x=0.32 y=0.31	
Luminance	Lv	If(forward current) =45mA	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.



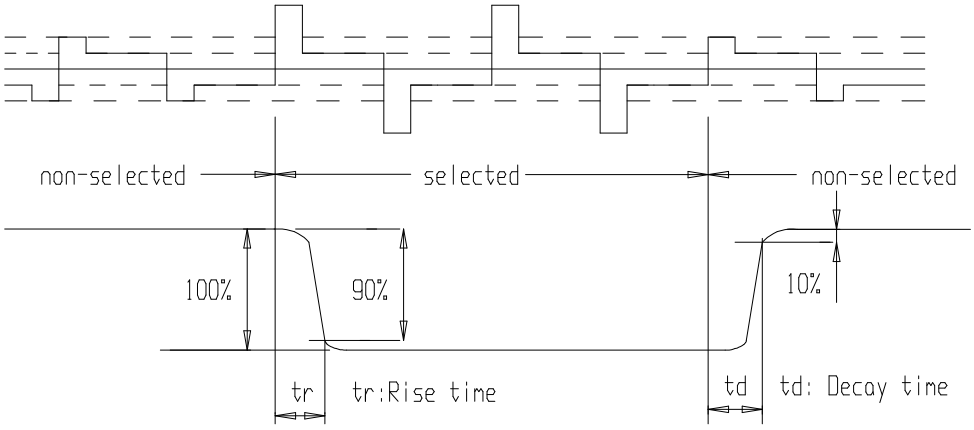
■ OPTICAL CHARACTERISTICS

Test instrument is LCD-5000,made in Japan

Item	Symbol	Condition	Min	Typ	Max	Unit	Remarks	Note
Operating voltage	Vop	25℃		TBD		V	---	---
Response time	Tr	----	----	350	400	ms	---	1
	Td	----	----	380	400	ms	---	1
Contrast ratio	Cr	----	----	24	----	---	---	2
Viewing angle range	θ	Cr≥6	----	60	----	deg	Ø=0°	3
			----	28	----	deg	Ø=180°	3

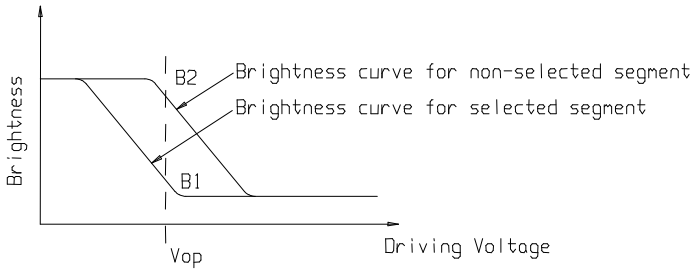
▼ Definition Of Viewing Angle

Note1: Definition of response time

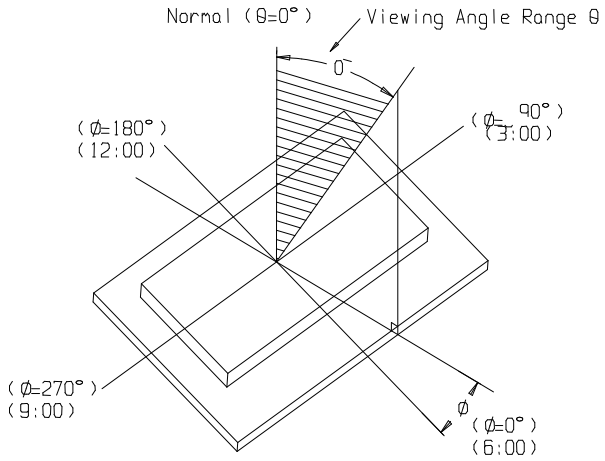


Note2: Definition of contrast ratio 'Cr'

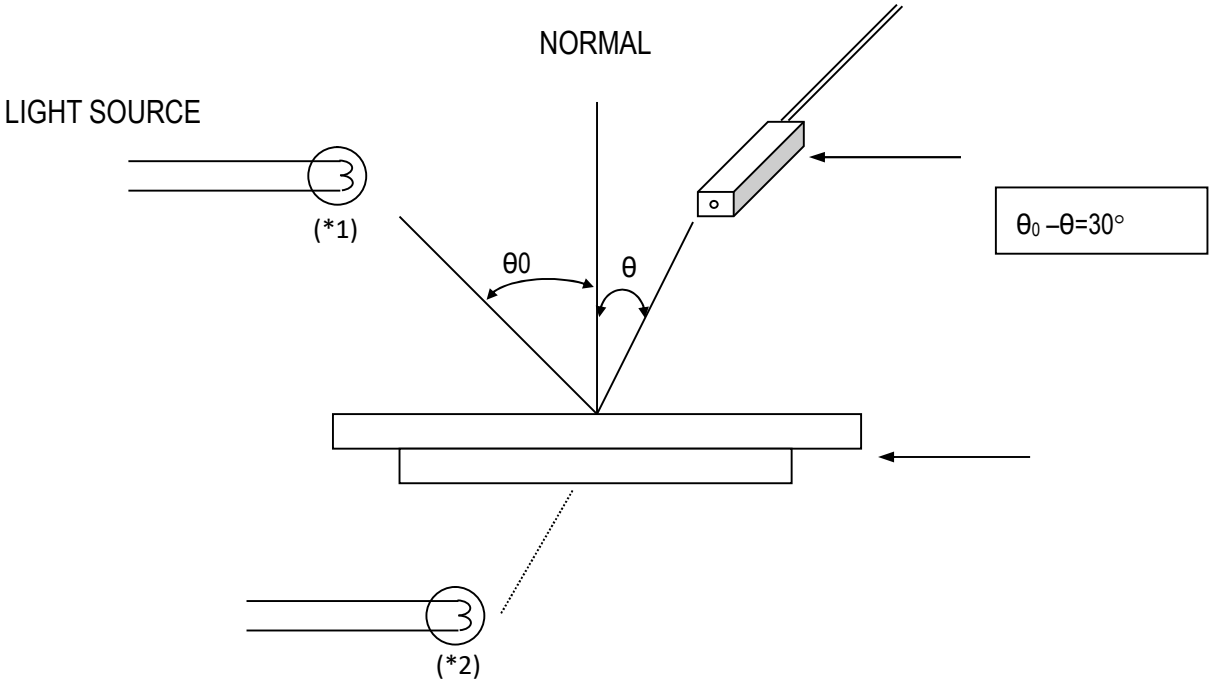
$$Cr = \frac{\text{Brightness of non-selected segment(B2)}}{\text{Brightness of selected segment(B1)}}$$



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

■ OPERATING PRINCIPLES & METHODS

▼ Control registers

Name	Bits	Default	Description
SL	7	0H	Scroll Line. Scroll the displayed image up by SL rows. The valid SL value is between 0 (no scrolling) and (127– 2x(FLT+FLB)). Setting SL outside of this range causes undefined effect on the displayed image.
FLT FLB	4 4	0H 0H	Fixed Lines. The first FLTx2 lines and the last FLBx2 lines (relative to CEN) of each frame are fixed and are not affected by scrolling (SL). When FLT and/or FLB are non-zero, the screen is effectively separated into three regions: one scrollable, surrounded by two non-scrollable regions. When partial display mode is activated, the display of these 2xFLT and 2xFLB lines is also controlled by LC[0]. When LC[0]=1, the display will have three sections, 2xFLT on one side non-scrollable, 2XFLB on the other side also non-scrollable, and scrollable DST~DEN in the middle.
CR	5	0H	Return Page_C Address. Useful for cursor implementation.
CA	5	0H	Display Data RAM Page_C Address (Used in Host to Display Data RAM access)
RA	7	0H	Display Data RAM Row Address (Used in Host to Display Data RAM access)
BR	2	3H	Bias Ratio. The ratio between V_{LCD} and V_{BIAS}. 00b: 6 01b: 9 10b: 10 **11b: 11**
TC	2	0H	Temperature Compensation (per °C) **00b: -0.00%** 01b: -0.10% 10b: -0.15% 11b: -0.20%
PM	8	4EH	Electronic Potentiometer to fine tune V_{BIAS} and V_{LCD}
PMO	6	--	PM offset. PMO[5] = 1: The effective PM value, PMV = PM – PMO[4:0] PMO[5] = 0: The effective PM value, PMV = PM + PMO[4:0]
PC	4	EH	Power Control. PC[1:0]: 00b: LCD: ≤ 6nF 01b: LCD: 6~9nF **10b: LCD: 9~13nF** 11b: LCD: 13~18nF PC[3:2]: 00b: External V_{LCD} **11b: Internal V_{LCD} (9X pump, standard)**
DC	4	8H	Display Control: DC[0]: PXV: Pixels Inverse. Bit-wise data inversion. (Default **0: OFF**) DC[1]: APO: All Pixels ON (Default **0: OFF**) DC[2]: Display ON/OFF (Default **0: OFF**) DC[3]: Gray Shade and B/W mode 0b: B/W Mode **1b: 4-Shade Mode**

Command table

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

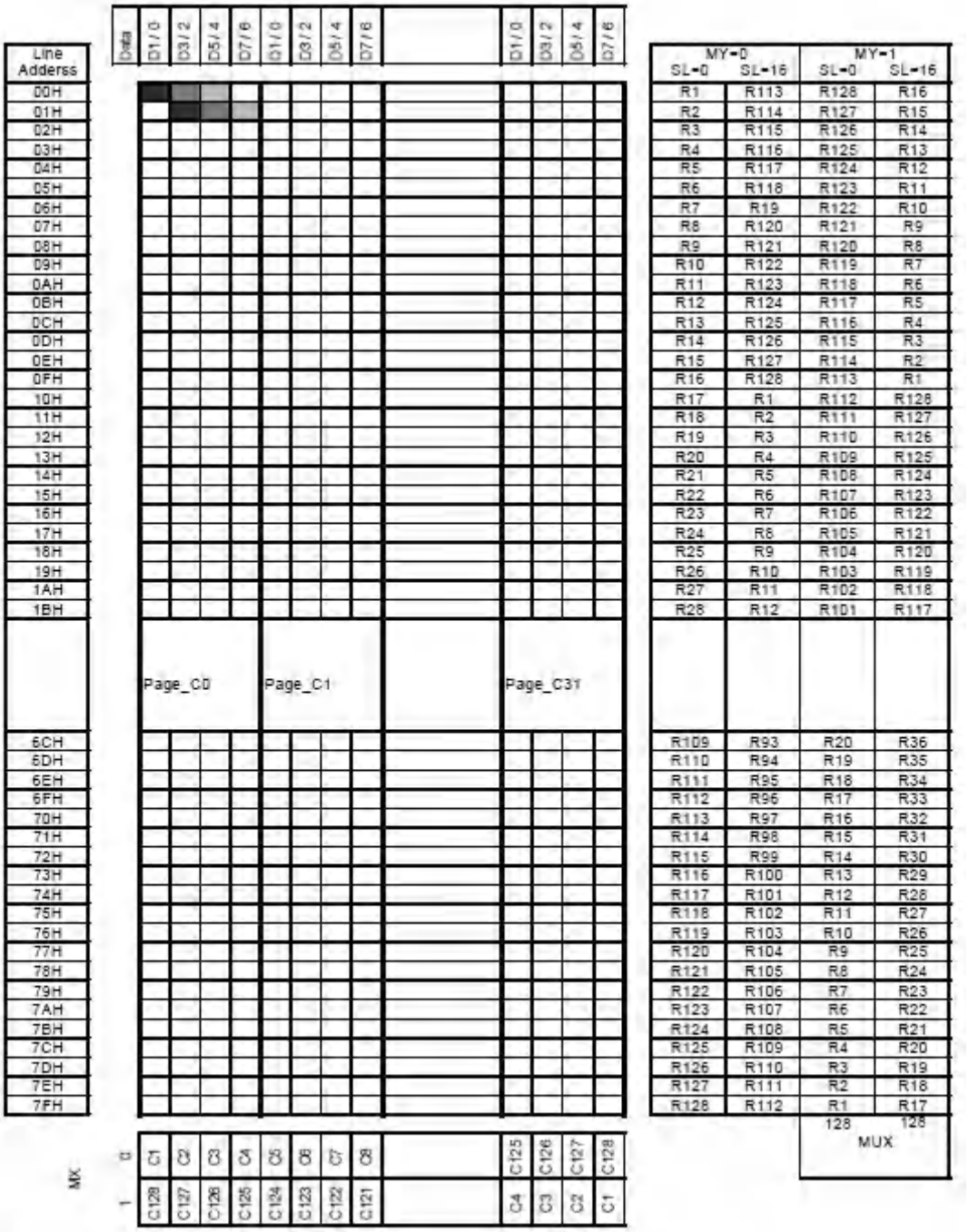
	Command	C/D	W/R	D7	D6	D5	D4	D3	D2	D1	D0	Action	Default
1	Write Data Byte	1	0	#	#	#	#	#	#	#	#	Write 1 byte	N/A
2	Read Data Byte	1	1	#	#	#	#	#	#	#	#	Read 1 byte	N/A
3	Get Status	0	1	1	MX	MY	WA	DE	WS	MD	MS	Get {Status, Ver, PMO, Product Code, PID, MID}	N/A
				Ver		PMO[5:0]							
				Product Code				PID		MID			
4	Set Page_C Address	0	0	0	0	0	#	#	#	#	#	Set CA[4:0]	0H
5	Set Temp. Compensation	0	0	0	0	1	0	0	1	#	#	Set TC[1:0]	00b
6	Set Panel Loading	0	0	0	0	1	0	1	0	#	#	Set PC[1:0]	10b
7	Set Pump Control	0	0	0	0	1	0	1	1	#	#	Set PC[3:2]	11b
8	Set Adv. Program Control (double-byte command)	0	0	0	0	1	1	0	0	R	R	Set APC[R][7:0], R = 0, 1 or 2	N/A
		0	0	#	#	#	#	#	#	#	#		
9	Set Scroll Line LSB	0	0	0	1	0	0	#	#	#	#	Set SL[3:0]	0H
	Set Scroll Line MSB	0	0	0	1	0	1	-	#	#	#	Set SL[6:4]	0H
10	Set Row Address LSB	0	0	0	1	1	0	#	#	#	#	Set RA[3:0]	00H
	Set Row Address MSB	0	0	0	1	1	1	-	#	#	#	Set RA[6:4]	00H
11	Set V_{BIAS} Potentiometer (double-byte command)	0 0	0 0	1 #	0 #	0 #	0 #	0 #	0 #	0 #	1 #	Set PM[7:0]	4EH
12	Set Partial Display Control	0	0	1	0	0	0	0	1	#	#	Set LC[9:8]	00b: Disable
13	Set RAM Address Control	0	0	1	0	0	0	1	#	#	#	Set AC[2:0]	001b
14	Set Fixed Lines	0	0	1 #	0 #	0 #	1 #	0 #	0 #	0 #	0 #	Set {FLT, FLB}	0
15	Set Line Rate	0	0	1	0	1	0	0	0	#	#	Set LC[4:3]	00b
16	Set All-Pixel-ON	0	0	1	0	1	0	0	1	0	#	Set DC[1]	0b
17	Set Inverse Display	0	0	1	0	1	0	0	1	1	#	Set DC[0]	0b
18	Set Display Enable	0	0	1	0	1	0	1	1	#	#	Set DC[3:2]	10b
19	Set LCD Mapping Control	0	0	1	1	0	0	0	#	#	#	Set LC[2:0]	000b
20	Set N-Line Inversion	0	0	1 -	1 -	0 -	0 -	1 #	0 #	0 #	0 #	Set NIV[3:0]	6H
21	Set LCD Gray Shade	0	0	1	1	0	1	0	#	#	#	Set LC[7:5]	001b
22	System Reset	0	0	1	1	1	0	0	0	1	0	System Reset	N/A
23	NOP	0	0	1	1	1	0	0	0	1	1	No operation	N/A
24	Set Test Control (double-byte command)	0	0	1	1	1	0	0	1	TT		For testing only. Do not use.	N/A
		0	0	#	#	#	#	#	#	#	#		
25	Set LCD Bias Ratio	0	0	1	1	1	0	1	0	#	#	Set BR[1:0]	11b: 11
26	Reset Cursor Update Mode	0	0	1	1	1	0	1	1	1	0	AC[3]=0, CA=CR	AC[3]=0
27	Set Cursor Update Mode	0	0	1	1	1	0	1	1	1	1	AC[3]=1, CR=CA	AC[3]=1
28	Set COM End	0 0	0 0	1 -	1 #	1 #	1 #	0 #	0 #	0 #	1 #	Set CEN[6:0]	127
29	Set Partial Display Start	0 0	0 0	1 -	1 #	1 #	1 #	0 #	0 #	1 #	0 #	Set DST[6:0]	0
30	Set Partial Display End	0 0	0 0	1 -	1 #	1 #	1 #	0 #	0 #	1 #	1 #	Set DEN[6:0]	127

	Command	C/D	W/R	D7	D6	D5	D4	D3	D2	D1	D0	Action		Default
31	Set Window Program Starting Page_C Address	0 0	0 0	1 -	1 -	1 -	1 #	0 #	1 #	0 #	0 #	Shared with MTP commands	Set WPC0	0
32	Set Window Programming Starting Row Address	0 0	0 0	1 -	1 #	1 #	1 #	0 #	1 #	0 #	1 #		Set WPP0	0
33	Set Window Programming Ending Page_C Address	0 0	0 0	1 -	1 -	1 -	1 #	0 #	1 #	1 #	0 #		Set WPC1	31
34	Set Window Programming Ending Row Address	0 0	0 0	1 -	1 #	1 #	1 #	0 #	1 #	1 #	1 #		Set WPP1	127
35	Enable window program	0	0	1	1	1	1	1	0	0	#	Set AC[4]		0: Disable
36	Set MTP Operation control	0 0	0 0	1 -	0 -	1 #	1 #	1 #	0 #	0 #	0 #	Set MTPC[5:0]		10H
37	Set MTP Write Mask	0 0	0 0	1 #	0 #	1 #	1 #	1 #	0 #	0 #	1 #	Set MTPM[7:0]		0
38	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
39	Set V_{MTP2} Potentiometer	0 0	0 0	1 #	1 #	1 #	1 #	0 #	1 #	0 #	1 #		Set MTP2	
40	Set MTP Write Timer	0 0	0 0	1 #	1 #	1 #	1 #	0 #	1 #	1 #	0 #		Set MTP3	
41	Set MTP Read Timer	0 0	0 0	1 #	1 #	1 #	1 #	0 #	1 #	1 #	1 #		Set MTP4	

Notes:

- Any bit patterns other than the commands listed above may result in undefined behavior.
- The interpretation of commands (37)~(41) depends on register MTPC[3].
- Commands (38)~(41) are shared with commands (31)~(34) and have exactly the same code. When MTPC[3]=0, commands (38)~(41) are interpreted as `Window Programming` commands. When MTPC[3]=1, they are the `MTP Control` commands.
- MTPM and PM are actually the same register. Only one of the commands (37 or 11) is valid at any time, and it is determined by MTPC[3].
- After MTP-ERASE or MTP-PROGRAM operation, before resuming normal operation, please always
  a) Remove TST4 power source,
  b) Do a full V_{DD} ON-OFF-ON cycle.

DDRAM



Example: when MX=0, MY=0, SL=0, the corresponding data in SRAM as the pixels shown is:

Row1 Page_C0 ⇨ 11100100b

Row2 Page_C0 ⇨ 10010011b

Reset

System reset can be initialized by setting RSTB terminal at low level when turning power on, receiving instruction from MPU. When RSTB becomes low, following procedure is occurred.

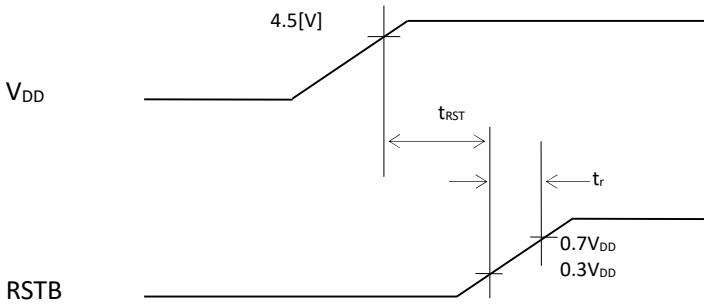
- Display off
- Display start line register become set by 0.(Z-address 0)

While RSTB is low level, no instruction except status read can be accepted. Reset status appears at DB4. After DB4 is low, any instruction can be accepted.

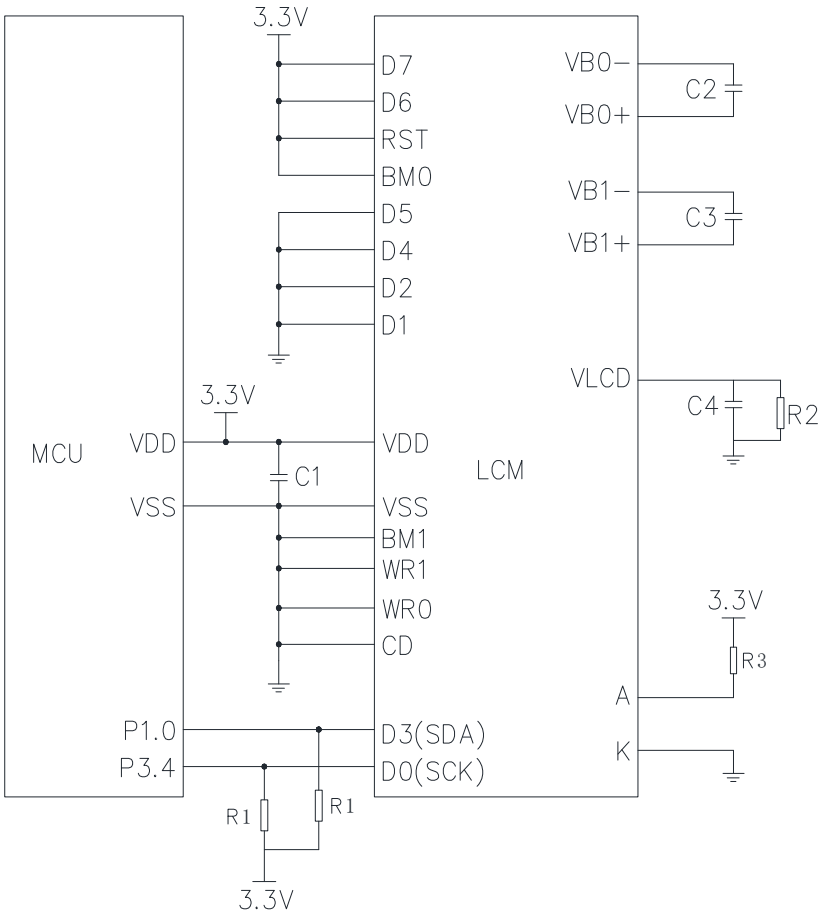
The Conditions of power supply at initial power up are shown in table 1.

Table 1. Power Supply Initial Conditions

Item	Symbol	Min	Typ	Max	Unit
Reset time	tRST	1.0	---	---	ms
Rise time	tr	---	---	200	ns



■ POWER SUPPLY FOR LCM MODULE



I2C应用连接图

CON1:

1	VLCD	12	D5
2	VB0−	13	CD
3	VB1−	14	RST
4	BM1	15	D7
5	BM0	16	D6
6	VB1+	17	D5
7	VB0+	18	D4
8	VDD	19	D3
9	VSS	20	D2
10	WR1	21	D1
11	WR0	22	D0

C1=C2=C3=2.2UF/25V
C4=330nF/25V
R1=10K
R2=4.7M
R3=10 ohm/0805

■ EXAMPLE

```
/*************************************************************;
;*       LCM        : GT128128D
;*        IC        : UC1617s
;*       Data       : 2007.12.29 128x128dots 8 bit 8080 Mode -----Sunpring
;*************************************************************/
#include<reg51.h>
#include<intrins.h>
sbit sck=P3^7;
sbit sda=P1^0;

void init();
void font(int a);
void alldisplayon();
void displayoff();
void displaycom();
void displayseg();
void displaycom1();
void displayseg1();
void displaysnow();
void frame();
void delay(int t);
void write_com(unsigned char d);
void write_come(unsigned char d);
void write_data(unsigned char d);
void grayh();
void grayv();
void display_image1();

void init()
    {
      delay(300);
      delay(300);
      delay(300);

 write_com(0xe2);//system rest
 delay(300);
 write_com(0x25);//set temp  -10℃~+50℃
// write_com(0x27);//set temp  -20℃~+70℃
 write_com(0xd0);//set gray shade
 write_com(0xd4);//set gray shade
 write_com(0x2b);//panel loading
 write_com(0x2f);//set pump control
 write_com(0x81);//set vop 10.0v
 write_com(0XC1);
```

```
 write_com(0xc8);//
 write_com(0x0B);
write_com(0x89);//set ram adders control
 write_com(0xa0);//set line rate
 write_com(0xc4);//set lcd map control
 write_com(0xe8);//1/6bias
 write_com(0xf9);
 write_com(0xf1);//set com end 127
 write_com(127);
write_com(0xaD);//set disply enable BW-mode
 delay(300);
     }

/* void display_image1(void)
{
int i;
//int j;
write_com(0x00);
write_com(0x60);
write_com(0x70);
for(i=0;i<128*32;i++)
 {
  write_data(image1[i]);
 }
}  */

void alldisplayon()       //全屏显示
{
 int i,j;

 write_com(0x00);
 write_com(0x60);
 write_com(0x70);
 for(i=0;i<128;i++)
 {
     for(j=0;j<32;j++)
     {
         write_data(0xff);
     }
 }
}

void displayoff()    //清屏
{
     int i,j;
```

```
  write_com(0x00);
  write_com(0x60);
  write_com(0x70);
  for(i=0;i<128;i++)
  {
      for(j=0;j<32;j++)
      {
          write_data(0x00);
      }
  }
}

void displaycom()    //横线
{
      int i,j;

  write_com(0x00);
  write_com(0x60);
  write_com(0x70);
  for(i=0;i<64;i++)
  {
      for(j=0;j<32;j++)
      {
          write_data(0x00);
      }
      for(j=0;j<32;j++)
      {
          write_data(0xff);
      }
  }
}
void displaycom1()      //横线
{
      int i,j;

  write_com(0x00);
  write_com(0x60);
  write_com(0x70);
  for(i=0;i<64;i++)
  {
      for(j=0;j<32;j++)
      {
          write_data(0xff);
      }
      for(j=0;j<32;j++)
      {
```

```
            write_data(0x00);
        }
    }
}

void displayseg()       //竖线
{
    int i,j;

  write_com(0x00);
  write_com(0x60);
  write_com(0x70);
  for(i=0;i<128;i++)
  {
      for(j=0;j<32;j++)
      {
          write_data(0xcc);
      }
  }
}
void displayseg1()       //竖线
{
    int i,j;

  write_com(0x00);
  write_com(0x60);
  write_com(0x70);
  for(i=0;i<128;i++)
  {
      for(j=0;j<32;j++)
      {
          write_data(0x33);
      }
  }
}

void displaysnow()        //雪花画面
{
    int i,j;

  write_com(0x00);
  write_com(0x60);
  write_com(0x70);
  for(i=0;i<64;i++)
  {
      for(j=0;j<32;j++)
```

```
        {
            write_data(0xcc);
        }
        for(j=0;j<32;j++)
        {
            write_data(0x33);
        }
    }
}
void iic_start(unsigned char cd)            //1send IIC start condition
{
  sda=1;
  _nop_( );
  _nop_( );
  _nop_( );
  sck=1;
  _nop_( );
  _nop_( );
  _nop_( );
  _nop_( );
  _nop_( );
  sda=0;
     _nop_( );
  _nop_( );
  _nop_( );
  _nop_( );
  _nop_( );
  sck=0;
  _nop_( );
  _nop_( );


  sda=0;
  _nop_( );
  _nop_( );
  sck=1;
  _nop_( );
  _nop_( );
  sck=0;
  _nop_( );
  _nop_( );



  sda=1;
  _nop_( );
```

```
_nop_( );
sck=1;
_nop_( );
_nop_( );
sck=0;
_nop_( );
_nop_( );


sda=1;
_nop_( );
_nop_( );
sck=1;
_nop_( );
_nop_( );
sck=0;
_nop_( );
_nop_( );


sda=1;
_nop_( );
_nop_( );
sck=1;
_nop_( );
_nop_( );
sck=0;//------------sequence header(0111B)
_nop_( );
_nop_( );


sda=1;
_nop_( );
_nop_( );
sck=1;
_nop_( );
_nop_( );
sck=0;
_nop_( );
_nop_( );

sda=0;
_nop_( );
_nop_( );
sck=1;
_nop_( );
```

```
  _nop_( );
  sck=0;     //------------device address [1,0]
  _nop_( );
  _nop_( );

     sda=cd;//cd=0(control);  cd=1(data)
      _nop_( );
  _nop_( );
  sck=1;
  _nop_( );
  _nop_( );
  sck=0;//----------------------cd control
  _nop_( );
  _nop_( );

  sda=0;//write mode(1 read mode)
  _nop_( );
  _nop_( );
  sck=1;
  _nop_( );
  _nop_( );
  sck=0;//----------------------cd control
  _nop_( );
  _nop_( );



}

//----------------------write_iic{cd=0(control);  cd=1(data)}--------------------//
void iic_send(unsigned char y)
{
  unsigned char i;

   sck=1;       //---signal A-----------//
      _nop_();
      _nop_();
      sck=0;
      _nop_();
      _nop_();
  for(i=0;i<8;i++)
  {
      sda=y&0x80;
         sck=1;
        // _nop_( );
        // _nop_( );
```

```
      //  _nop_( );
      //  _nop_( );
     //   _nop_( );
     /*if(y&0x80)
         sda=1;
     else
         sda=0;
     sck=1;
        _nop_( );
        _nop_( );
        _nop_( );
        _nop_( );
        _nop_( );
     sck=0;
     //y=y<<1;*/
  //  delay(1);
     sck=0;
     y<<=1;

  }
     sck=1;       //---signal A----------//
     _nop_();
     _nop_();
     sck=0;
     _nop_();
     _nop_();

}

/*============================
  I2c stop condition
  SDA low->high while SCL=high

            _________
  SCL______/

              _______
  SDA_______/
============================*/

void iic_stop()
{
        sda=0;
        _nop_();
        _nop_();
        _nop_();
        _nop_();
        sck=0;
```

```
        _nop_();
        sck=1;
        _nop_();
        _nop_();
        _nop_();
        _nop_();
        _nop_();
        sda=1;
        _nop_();
        _nop_();
        _nop_();
        _nop_();
}

void write_com(unsigned char d)
{
     iic_start(0);
     iic_send(d);
     iic_stop();
}

void write_come(unsigned char d)
{
     iic_start(0);
     iic_send(d);
     iic_stop();
}

void write_data(unsigned char d)
{
     iic_start(1);
     iic_send(d);
     iic_stop();
}


void delay(int t)
{
 register int i,j;
 for(i=0;i<t;i++)
 for(j=0;j<125;j++);
}
```

```
void main()
{


while(1)
  {
  init();
  displayoff();
     delay(1000);

    alldisplayon();
    delay(1000);

  displayoff();
     delay(1000);

     displaycom();
     delay(1000);
//     press();
  displayoff();
     delay(1000);
//     displayoff();
     displaycom1();
     delay(1000);
  displayoff();
     delay(1000);
     displayseg();
     delay(1000);
//     press();
//     displayoff();
  displayoff();
     delay(1000);
     displayseg1();
     delay(1000);
//     press();
//     displayoff();
  displayoff();
     delay(1000);
     displaysnow();
     delay(1000);
 //    press();
  }

}
```

■ RELIABILITY

▼ Content of Reliability Test

No.	Test Item	Content of Test	Test Condition	Applicable Standard
Environmental Test				
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 200hrs	------
3	High temperature operation	Endurance test applying the electric stress (Voltage & Current) and the thermal stress to the element for a long time.	50 °C 200 hrs	------
4	Low temperature operation	Endurance test applying the electric stress under low temperature for a long time.	-10 °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. ⇌ 50°C 30min. 1 cycle	-10°C / 50°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 1l msedc 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 = 5V. Supply voltage for LCD system = Operating voltage at 25°C.

▼ Failure Judgement Criterion

Criterion Item	Test Item No.											Failure Judgment Criterion
	1	2	3	4	5	6	7	8	9	10	11	
Basic specification												Out of the Basic Specification
Electrical characteristic												Out of the DC and AC Characteristic
Mechanical characteristic												Out of the Mechanical Specification Color change : Out of Limit Apperance Specification

Optical characteristic											Out of the Apperance Standard

■ INSPECTION CRITERIA

see : IS-QC-001(液晶显示模块检验标准)

■ 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.

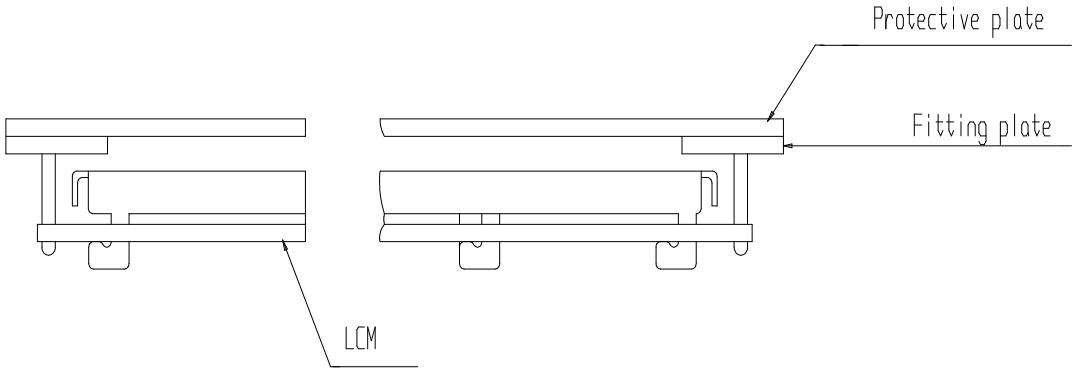
(9) Do not touch the display with bare hands. This will stain the display area and degradate insulation between terminals (some cosmetics are determinated to the polarizers).

(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.

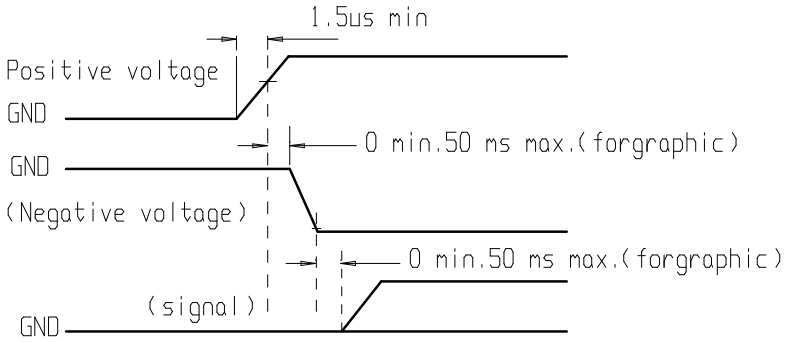
(2) When soldering the electroluminescent panel and PC board, the panel and board should not be detached more than three times. This maximum number is determined by the temperature and time conditions mentioned above, though there may be some variance depending on the temperature of the soldering iron.
(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 TPS within 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.