SPECIFICATION

YAOYU
TECHNOLOGY

YMFG-G128128FDPSWWN

December 09, 2008
Version 1.0

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RECORDS OF REVISION

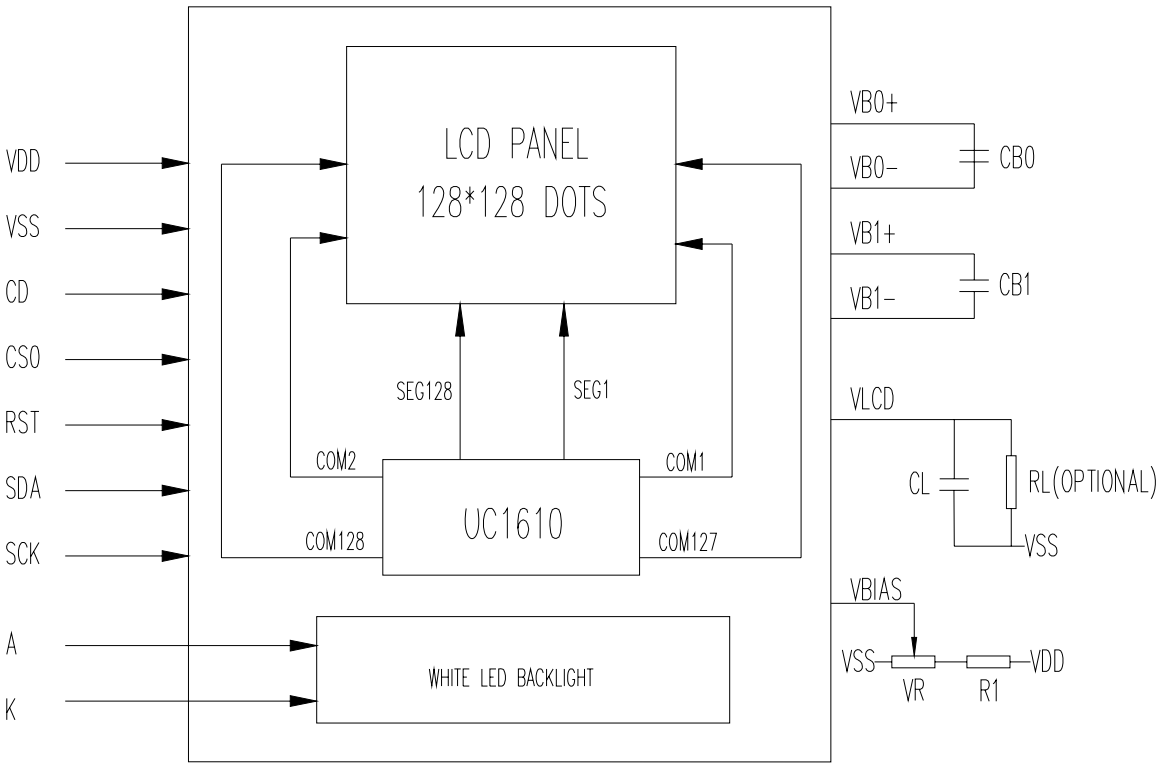
DATE	REVISED NO.	REVISED DESCRIPTIONS	PREPARED	CHECKED	APPROVED
December 09,2008	1.00	FIRST ISSUE	ynn		

CONTENTS

1. FEATURES：

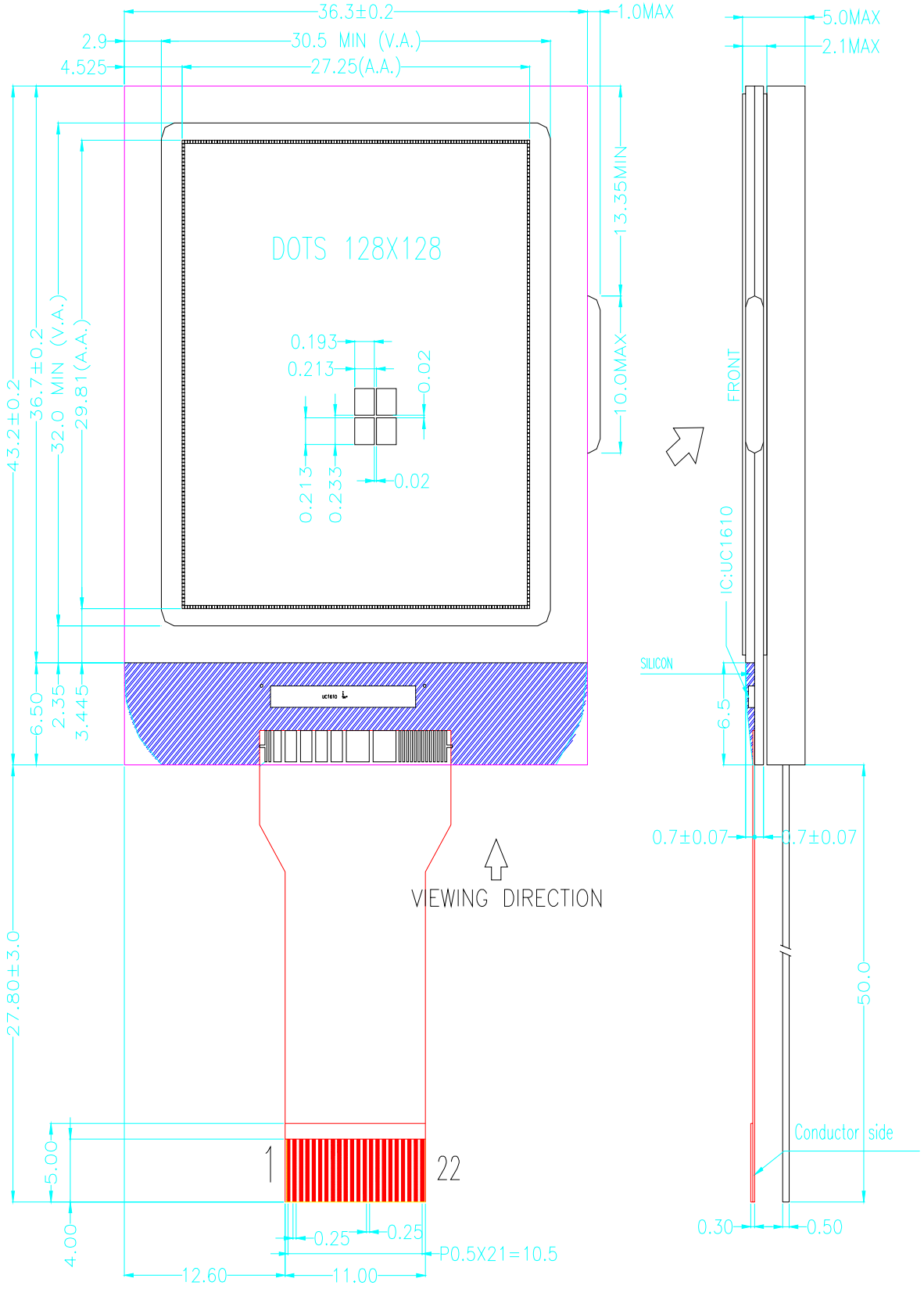
ITEM	STANDARD VALUE	UNIT
Display Type	128 *128 dots	-
LCD Type	FSTN,Transflective,Positive	-
LCD Duty	1/128	-
Viewing Direction	6:00	
Backlight Type	White edge LED	-
Interface	SPI Mode	-
Driver/Controller IC	UC1610	-
LCD Bias	1/12	-
Module Dimension	36.3(W)X43.2(H)X5.0(T)	mm
Effective Display Area	27.25(W)X29.81(H)	mm
Dot Size	0.193(W)X0.213(H)	mm
Dot Pitch	0.213(W)X0.233(H)	mm

2. BLOCK DIAGRAM &APPLICATION CIRCUIT：



NOTE: CB0,CB1:2uF(2.0V); CL:0.06uF~~0.3uF(16V); RL:10M; VR:1M; R1:330K

3. OUTLINE DIMENSIONS



4. ABSOLUTE MAXIMUM RATING

ITEM	SYMBOL	CONDITION	STANDARD VALUE			UNIT
			MIN	TYP	MAX	
POWER SUPPLY FOR LOGIC	VDD	Ta=25℃	-0.3	—	7.0	V
POWER SUPPLY FOR LCD	V0,VOUT		-0.3		17	
INPUT VOLTAGE	VIN	Ta=25℃	VSS-0.3	—	VDD+0.3	V
Module OPERATION TEMPERATURE	TOPR	---	-10	—	+20	℃
Module STORAGE TEMPERATURE	TSTG	---	- 20	—	+70	℃
Storage Humidity	H_D	Ta < 40 °C	-		90	%RH

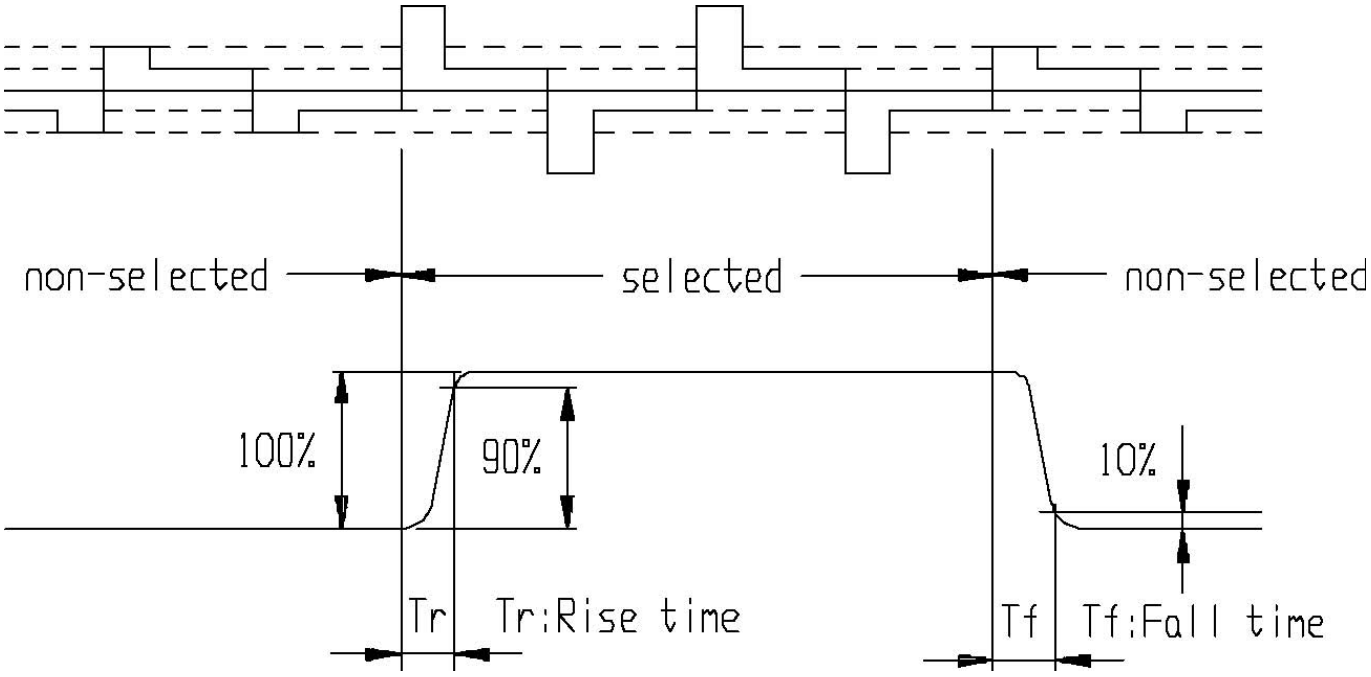
5. ELECTRICAL CHARACTERISTICS

ITEM	SYMBOL	CONDITION	MIN	TYP	MAX	UNIT
Supply Voltage (logic)	VDD-VSS	-	3.1	3.3	3.5	V
Supply Voltage (LCD)	VDD-V0	Ta= +25℃	10.5	12.5	13.0	V
Input signal voltage	V-IH	"H" level	0.8VDD	-	VDD	V
	V-IL	"L" level	0	-	0.2 VDD	V
Output signal voltage	V-OH	"H" level	0.8VDD	-	VDD	V
	VOL	"L" level	0	-	0.2VDD	V
Supply Current (logic)	IDD	VDD=3.3V	-	0.1	0.15	mA
Backlight Voltage	V-BL	-	2.9	3.0	3.1	V
Backlight Current	I-BL	-	-	30	-	mA

6. OPTICAL CHARACTERISTICS

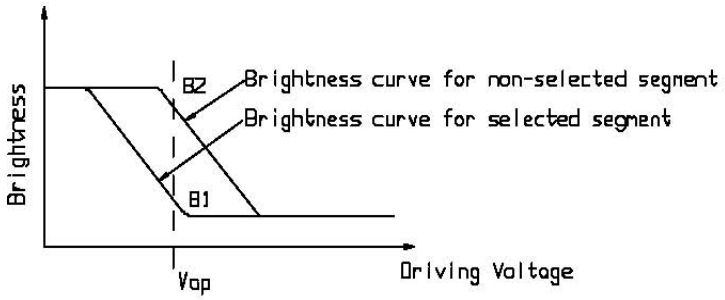
Item	Symbol	Condition	Min	Typ	Max	Unit	Remarks	Note
Response Time	Tr	-	-	110	220	ms	-	1
	Tf	-	-	260	520	ms	-	1
Contrast Ratio	Cr	-	-	6	-	-	-	2
Viewing Angle Range	θ	Cr≥ 2	-	-	30	deg	Ø= 90	3
			-	-	30	deg	Ø = 270	3
			15	-	105	deg	Ø = 0	3
			-	-	-	deg	Ø = 180	3

Note 1. Definition of response time

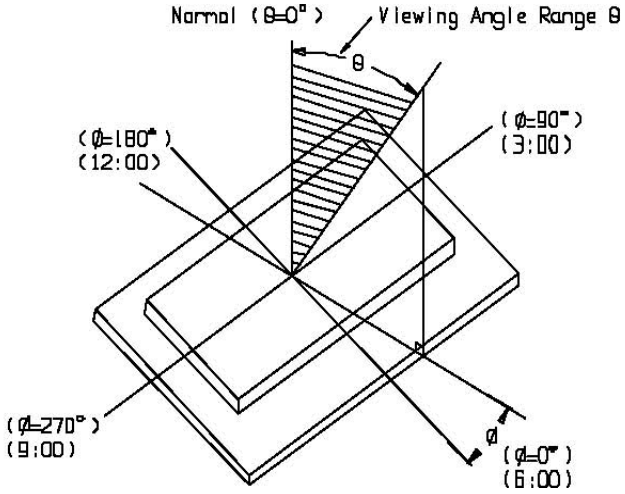


Note 2. Definition of Contrast Ratio 'Cr'

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



Note 3. Definition of Viewing Angle Range 'q'



7. TIMING CHARACTERISTICS

7.1 Interface

SERIAL INTERFACE

UC1610 supports three serial modes, one 4-wire SPI mode (S8), one compact 3/4-wire mode (S8uc) and one 3-wire SPI mode (S9). Bus interface mode is determined by the wiring of the BM[1:0] and D[7:6]. See table in last page for more detail.

S8 (4-WIRE) INTERFACE

Only write operations are supported in 4-wire serial mode. Pin CS[1:0] are used for chip select and bus cycle reset. Pin CD is used to determine the content of the data been transferred. During each write cycle, 8 bits of data, MSB first, are latched on eight rising SCK edges into an 8-bit data holder.

If CD=0, the data byte will be decoded as command. If CD=1, this 8-bit will be treated as data and transferred to proper address in the Display Data RAM on the rising edge of the last SCK pulse. Pin CD is examined when SCK is pulled low for the LSB (D0) of each token.

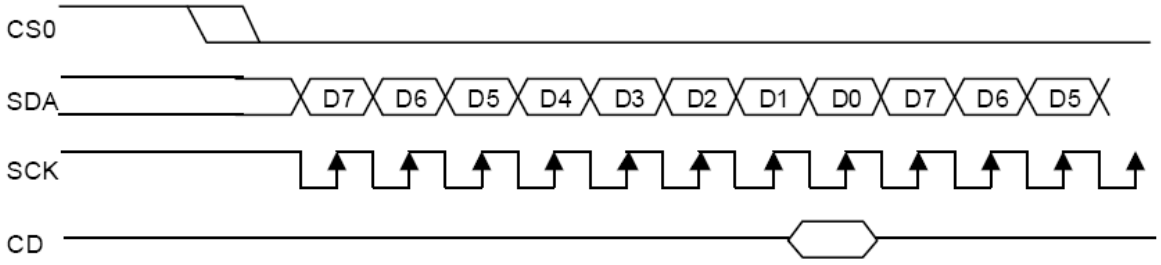


Figure 1.4-wire Serial Interface(S8)

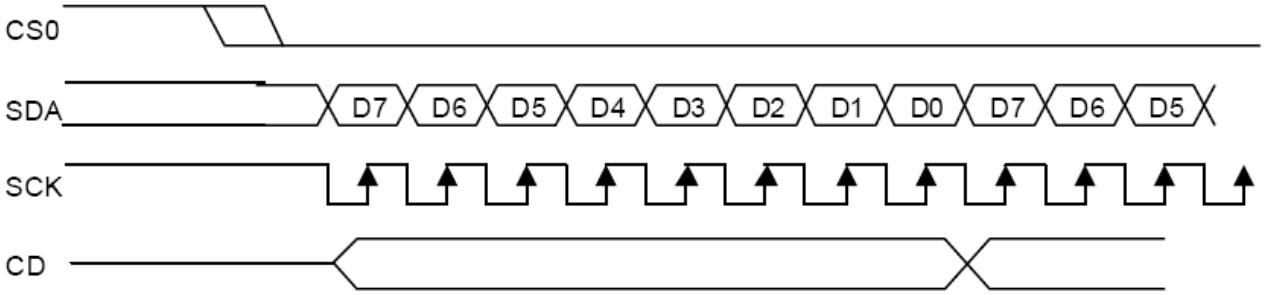


Figure 2. 3/4-wire Serial Interface (S8uc)

S8UC (3/4-WIRE) INTERFACE

Only write operations are supported in this 3/4-wire serial mode. The data format is identical as S8. However, in addition to CS pins, CD pin transitions will also reset the bus cycle in this mode. So, if CS pins are hardwired to enable chip-select, the bus can work properly with only three signal pins.

S9 (3-WIRE) INTERFACE

Only write operations are supported in this 3-wire serial mode. Pin CS[1-0] are used for chip select and bus cycle reset. On each write cycle, the first bit is CD, which determines the content of the following 8 bits of data, MSB first. These 8 command or data bits are latched on rising SCK edges into an 8-bit data holder. If CD=0, the data byte will be decoded as command. If CD=1, this 8-bit will be treated as data and transferred to proper address in the Display Data RAM at the rising edge of the last SCK pulse.

By sending CD information explicitly in the bit stream, control pin CD is not used, and should be connected to either V_{DD} or V_{SS}. The toggle of CS0 or CS1 for each byte of data/command is recommended but optional.

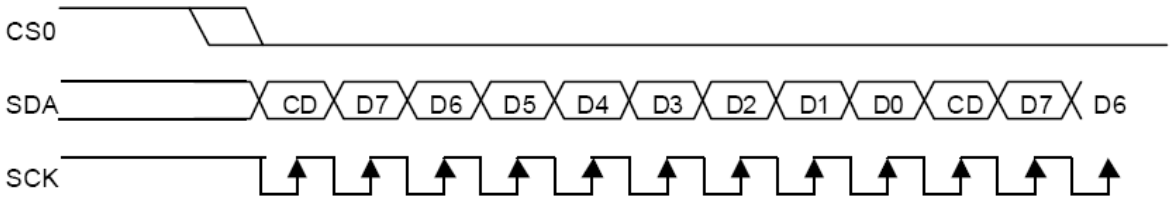


Figure 3. 3-wire Serial Interface (S9)

2-WIRE SERIAL INTERFACE (I^2C)

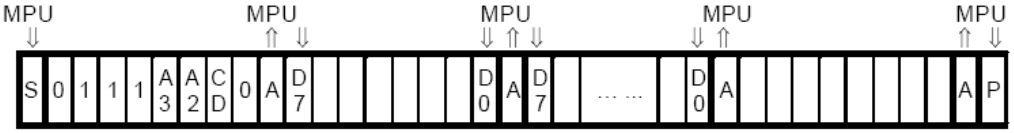
When BM[1:0] is set to "LH" and D[7:6] is set to "HH", UC1610 is configured as an I^2C bus signaling protocol compliant slave device. Please refer to I^2C standard for details of the bus signaling protocol. Please refer to AC Characteristic section for timing parameters of UltraChip implementation.

In this mode, pins CS[1:0] become A[3:2] and is used to configure UC1610' s device address. Proper wiring to V_{DD} or V_{SS} is required for the IC to operate properly for I^2C mode.

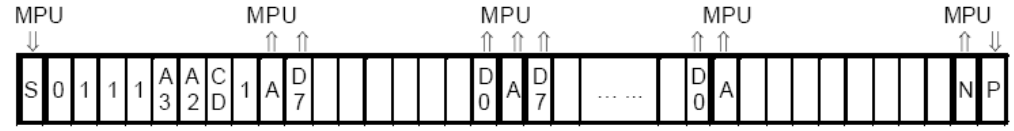
Each UC1610 I^2C interface sequence starts with a START condition (S) from the bus master, followed by a sequence header, containing a device address, the mode of transfer (CD, 0:Control, 1:Data), and the direction of the transfer (RW, 0:Write, 1:Read).

Since both WR and CD are expressed explicitly in the header byte, the control pins WR[1:0] and CD are not used in I^2C mode and should be connected to V_{SS}.

Write Mode



Read Mode



The direction (read or write) and content type (command or data) of the data bytes following each header byte are fixed for the sequence. To change the direction (R⇔W) or the content type (C⇔D), start a new sequence with a START (S) flag, followed by a new header.

After receiving the header, the UC1610 will send out an acknowledge signal (A). Then, depends on the setting of the header, the transmitting device (either the bus master or UC1610) will start placing data bits on SDA, MSB to LSB, and the sequence will repeat until a STOP signal (P, in WRITE), or a Not Acknowledge (N, in READ mode) is sent by the bus master.

7.2 AC Characteristics

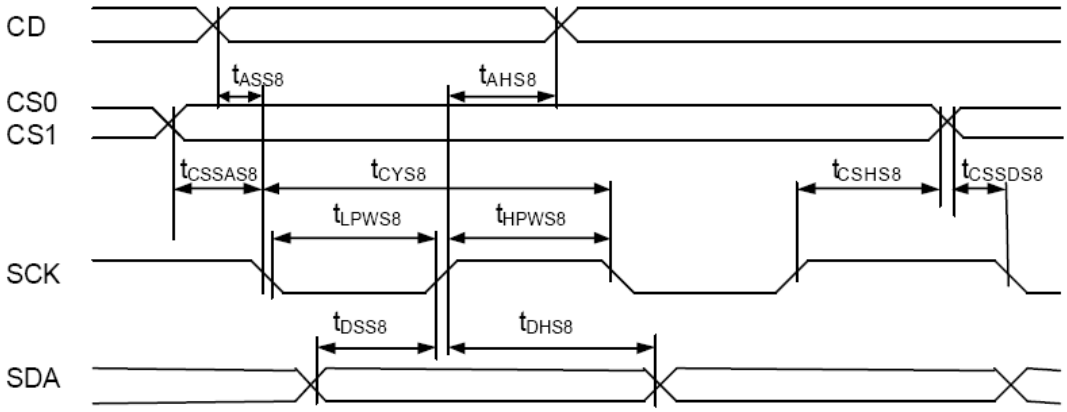


Figure 4. Serial Bus Timing Characteristics (for S8)

($2.5V \leq V_{DD} < 3.3V$, 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		15	–	nS
t_{CYS8}	SCK	System cycle time		80	–	nS
t_{LPWS8}		Low pulse width		35	–	nS
t_{HPWS8}		High pulse width		35	–	nS
t_{DSS8}	SDA	Data setup time		30	–	nS
t_{DHS8}		Data hold time		20		
t_{CSSAS8}	CS1/CS0	Chip select setup time		5		nS
t_{CSSDS8}				10		
t_{CSHS8}				5		

($1.8V \leq V_{DD} < 2.5V$, 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		30	–	nS
t_{CYS8}	SCK	System cycle time		160	–	nS
t_{LPWS8}		Low pulse width		70	–	nS
t_{HPWS8}		High pulse width		70	–	nS
t_{DSS8}	SDA	Data setup time		60	–	nS
t_{DHS8}		Data hold time		40		
t_{CSSAS8}	CS1/CS0	Chip select setup time		10		nS
t_{CSSDS8}				20		
t_{CSHS8}				10		

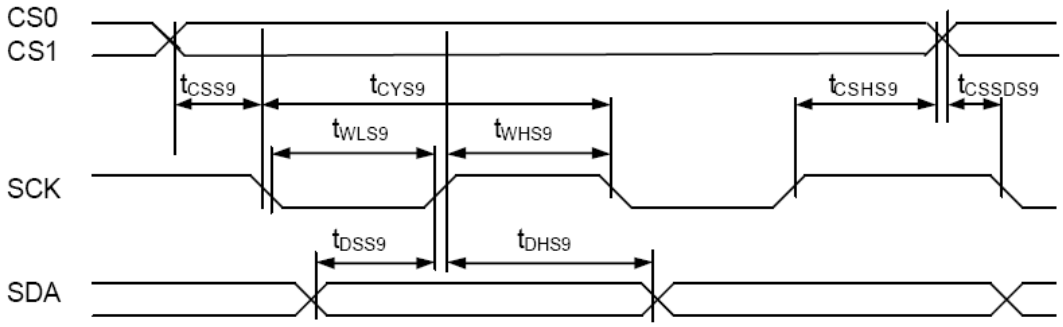


Figure 5 Serial Bus Timing Characteristics (for S9)

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

Symbol	Signal	Description	Condition	Min.	Max.	Units
t_{CYS9}	SCK	System cycle time		80	–	nS
t_{LPWS9}		Low pulse width		35	–	nS
t_{HPWS9}		High pulse width		35	–	nS
t_{DSS9} t_{DHS9}	SDA	Data setup time Data hold time		30 20	–	nS
t_{CSSAS9} t_{CSSDS9} t_{CSHS9}	CS1/CS0	Chip select setup time		5 10 5		nS

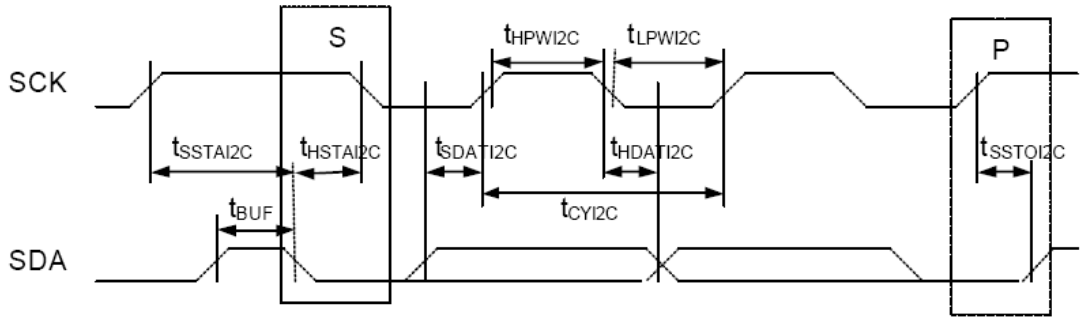


Figure 6 Serial Bus Timing Characteristics (for I2C)

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

Symbol	Signal	Description	Condition	Min.	Max.	Units
t_{CYI2C}	SCK	SCK cycle time	tr+tf ≤ 100ns	250	–	nS
t_{LPWI2C}		Low pulse width		65	–	nS
t_{HPWI2C}		High pulse width		65	–	nS
tr, tf	SCK SDA	Rise time and fall time		–	–	nS
$t_{SSDAI2C}$		Data setup time		30	–	nS
t_{HDAI2C}		Data hold time		10	–	nS
$t_{SSTAI2C}$		START Setup time		30	–	nS
$t_{HSTAI2C}$		STAR Hold time		10	–	nS
$t_{SSTOI2C}$		STOP setup time		30	–	nS

8. DISPLAY CONTROL INSTRUCTION

8.1 Command Summary

The following is a list of host commands supported by UC1610

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	ID	MX	MY	WA	DE	PM7	PM6	1	Get Status	N/A
4	Set Column Address LSB	0	0	0	0	0	0	#	#	#	#	Set CA[3:0]	0
	Set Column Address MSB	0	0	0	0	0	1	#	#	#	#	Set CA[7:4]	0
5	Set Temp. Compensation	0	0	0	0	1	0	0	1	#	#	Set TC[1:0]	0
6	Set Panel Loading	0	0	0	0	1	0	1	0	#	#	Set PC[1:0]	1
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	0	R	Set APC[R][7:0], R = 0, or 1	N/A
		0	0	#	#	#	#	#	#	#	#		
9	Set Scroll Line LSB	0	0	0	1	0	0	#	#	#	#	Set SL[3:0]	0
	Set Scroll Line MSB	0	0	0	1	0	1	-	#	#	#	Set SL[6:4]	0
10	Set Page Address	0	0	0	1	1	#	#	#	#	#	Set PA[4:0]	0
11	Set V_{BIAS} Potentiometer (double-byte command)	0	0	1	0	0	0	0	0	0	1	Set PM[7:0]	B2H
		0	0	#	#	#	#	#	#	#	#		
12	Set Partial Display Control	0	0	1	0	0	0	0	1	#	#	Set LC[8:7]	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	#	#	#	#	Set FL[3:0]	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]	0
17	Set Inverse Display	0	0	1	0	1	0	0	1	1	#	Set DC[0]	0
18	Set Display Enable	0	0	1	0	1	0	1	1	1	#	Set DC[2]	0b
19	Set LCD Mapping Control	0	0	1	1	0	0	0	#	#	#	Set LC[2:0]	000b
20	Set LCD Gray Shade	0	0	1	1	0	1	0	0	#	#	Set LC[6:5]	00b
21	System Reset	0	0	1	1	1	0	0	0	1	0	System Reset	N/A
22	NOP	0	0	1	1	1	0	0	0	1	1	No operation	N/A
23	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	#	#	#	#	#	#	#	#		
24	Set LCD Bias Ratio	0	0	1	1	1	0	1	0	#	#	Set BR[1:0]	10b: 11
25	Reset Cursor Update Mode	0	0	1	1	1	0	1	1	1	0	AC[3]=0, CA=CR	AC[3]=0
26	Set Cursor Update Mode	0	0	1	1	1	0	1	1	1	1	AC[3]=1, CR=CA	AC[3]=1
27	Set COM End	0	0	1	1	1	1	0	0	0	1	Set CEN[6:0]	127
		0	0	-	#	#	#	#	#	#	#		
28	Set Partial Display Start	0	0	1	1	1	1	0	0	1	0	Set DST[6:0]	0
		0	0	-	#	#	#	#	#	#	#		
29	Set Partial Display End	0	0	1	1	1	1	0	0	1	1	Set DEN[6:0]	127
		0	0	-	#	#	#	#	#	#	#		
30	Set Window Program Starting Column Address	0	0	1	1	1	1	0	1	0	0	Set WPC0[7:0]	0
		0	0	#	#	#	#	#	#	#	#		
31	Set Window Programming Starting Page Address	0	0	1	1	1	1	0	1	0	1	Set WPP0[4:0]	0
		0	0	-	-	-	#	#	#	#	#		
32	Set Window Programming Ending Column Address	0	0	1	1	1	1	0	1	1	0	Set WPC1[7:0]	159
		0	0	#	#	#	#	#	#	#	#		
33	Set Window Programming Ending Page Address	0	0	1	1	1	1	0	1	1	1	Set WPP1[4:0]	31
		0	0	-	-	-	#	#	#	#	#		
34	Enable window program	0	0	1	1	1	1	1	0	0	#	Set AC[4]	0: Disable

* All other bit patterns other than the commands listed above may result in undefined behavior.

8.2 Command Description

(1) Write Data To Display Memory

Action	C/D	W/R	D7	D6	D5	D4	D3	D2	D1	D0
Write data	1	0	8bits data write to DDRAM							

(2) Read Data From Display Memory

Action	C/D	W/R	D7	D6	D5	D4	D3	D2	D1	D0
Read data	1	1	8bits data from DDRAM							

Write/Read Data Byte (command 1 ,2) operation use internal Page Address register (PA) and Column Address register (CA). Four rows of LCD pixel image are defined as one page in DDRAM. Each column of pixel corresponds to one column of DDRAM data. PA and CA registers can be programmed by issuing *Set Page Address* and *Set Column Address* commands. If wrap-around (WA, AC[0]) is OFF (0), CA will stop incrementing after reaching the CA boundary, and system programmers need to set the values of PA and CA explicitly. If WA is ON (1), when CA reaches end of column address, CA will be reset to 0 and PA will be incremented or decremented, depending on the setting of Row Increment Direction (PID, AC[2]). When PA reaches the boundary of RAM (i.e. PA = 0 or 31), PA will be wrapped around to the other end of RAM and continue.

(3) Get Status

Action	C/D	W/R	D7	D6	D5	D4	D3	D2	D1	D0
Get Status	0	1	ID	MX	MY	WA	DE	PM7	PM6	1

Status flag definitions:

ID: Provide access to ID pin connection status .
MX: Status of register LC[1], mirror X.
MY: Status of register LC[2], mirror Y.
WA: Status of register AC[0]. Automatic column/page wrap around.
DE: Display enable flag. DE=1 when display is enabled

(4) Set Column Address

Action	C/D	W/R	D7	D6	D5	D4	D3	D2	D1	D0
Set Column Address LSB CA[3:0]	0	0	**0**	**0**	**0**	**0**	CA3	CA2	CA1	CA0
Set Column Address MSB CA[7 :4]	0	0	**0**	**0**	**0**	**1**	CA7	CA6	CA5	CA4

Set DDRAM column address for read/write access. Each CA corresponds to one individual SEG electrode.

CA value range: **0**~159

(5) Set Temperature Compensation

Action	C/D	W/R	D7	D6	D5	D4	D3	D2	D1	D0
Set Temperature Comp. TC[1:0]	0	0	**0**	**0**	**1**	**0**	**0**	**1**	TC1	TC0

Set V_{BIAS} temperature compensation coefficient (%-per-degree-C)

Temperature compensation curve definition:
00b= -0.05%/°C 01b= -0.10%/°C 10b= -0.15%/°C 11b= -0.20%/°C

(6) SET PANEL LOADING

Action	C/D	W/R	D7	D6	D5	D4	D3	D2	D1	D0
Set Panel Loading PC[1:0]	0	0	0	0	1	0	1	0	PC1	PC0

Set PC[1:0] according to the capacitance loading of LCD panel.

Panel loading definition: 00b≤16nF **01b=16~21nF** 10b=21~28nF 11b=28~38nF

(7) SET PUMP CONTROL

Action	C/D	W/R	D7	D6	D5	D4	D3	D2	D1	D0
Set Pump Control PC[3:2]	0	0	0	0	1	0	1	1	PC3	PC2

Set PC[3:2] to program the build-in charge pump stages.

Pump control definition:

00b=External V_{LCD} 01b= Internal V_{LCD} (6X pump, for BR=5)
01b= Internal V_{LCD} (7X pump) **11b= Internal V_{LCD}** (8X pump, standard)

(8) SET ADVANCED PROGRAM CONTROL

Action	C/D	W/R	D7	D6	D5	D4	D3	D2	D1	D0
Set APC[R]	0	0	0	0	1	1	0	0	0	R
(Double byte command)	0	0	APC register parameter							

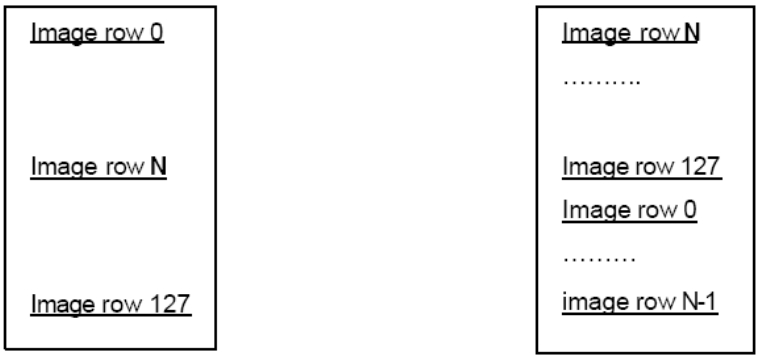
For UltraChip only. Please do NOT use.

(9) SET SCROLL LINE

Action	C/D	W/R	D7	D6	D5	D4	D3	D2	D1	D0
Set Scroll Line LSB SL[3:0]	0	0	0	1	0	0	SL3	SL2	SL1	SL0
Set Scroll Line MSB SL[6:4]	0	0	0	1	0	1	-	SL6	SL5	SL4

Set the scroll line number.

Scroll line setting will scroll the displayed image up by SL rows. The valid value for SL is between 0 (no scrolling) and (127-2xFL). FL is the register value programmed by *Set Fixed Lines* command.



(10) SET PAGE ADDRESS

Action	C/D	W/R	D7	D6	D5	D4	D3	D2	D1	D0
Set Page Address PA [4:0]	0	0	0	1	1	PA4	PA3	PA2	PA1	PA0

Set DDRAM Page Address for read/write access.

Possible value = **0**~31

(11) SET V_{BIAS} POTENTIOMETER

Action	C/D	W/R	D7	D6	D5	D4	D3	D2	D1	D0
Set V_{BIAS} Potentiometer. PM [7:0] (Double byte command)	0	0	1	0	0	0	0	0	0	1
	0	0	PM7	PM6	PM5	PM4	PM3	PM2	PM1	PM0

Program V_{BIAS} Potentiometer (PM[7:0]). See section LCD VOLTAGE SETTING for more detail.

Effective range: **0 ~ 255**

(12) SET PARTIAL DISPLAY CONTROL

Action	C/D	W/R	D7	D6	D5	D4	D3	D2	D1	D0
Set Partial Display Enable LC [8:7]	0	0	1	0	0	0	0	1	LC8	LC7

This command is used to enable partial display function.

LC[8:7] : **00b: Disable Partial Display**, Mux-Rate = CEN+1 (DST, DEN not used.)
10b: Enable Partial Display, Mux-Rate = CEN+1
11b: Enable Partial Display, Mux-Rate = DEN-DST+1

(13) SET RAM ADDRESS CONTROL

Action	C/D	W/R	D7	D6	D5	D4	D3	D2	D1	D0
Set AC [2:0]	0	0	1	0	0	0	1	AC2	AC1	AC0

Program registers AC[2:0] for RAM address control.

AC[0]: WA, Automatic column/page wrap around.
0: CA or PA (depends on AC[1]= 0 or 1) will stop incrementing after reaching boundary
1: CA or PA (depends on AC[1]= 0 or 1) will restart, and PA or CA will increment by one step.

AC[1]: Auto-Increment order
0 : column (CA) increment (+1) first until CA reaches CA boundary, then PA will increment by (+/-1).
1 : row (PA) increment (+/-1) first until PA reach PA boundary, then CA will increment by (+1) .

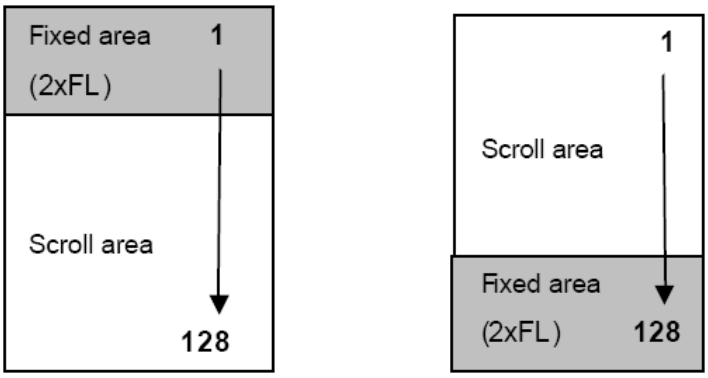
AC[2]: PID, Page Address (PA) auto increment direction (0/1 = +/- 1)
When WA=1 and CA reaches CA boundary, PID controls whether Page Address will be adjusted by +1 or -1.

AC[2:0] controls the auto-increment behavior of CA and PA. When Window Program is enabled (AC[4]=ON), see command description (32) ~ (36) for more details. When Window Program is disabled (AC[4]=OFF), the behavior of CA, PA auto-increment is the same as WPC[1:0] and WPP[1:0] values are the default values and AC[4]=ON.

(14) SET FIXED LINES

Action	C/D	W/R	D7	D6	D5	D4	D3	D2	D1	D0
Set Fixed Lines FL [3:0]	0	0	1	0	0	1	FL3	FL2	FL1	FL0

The fixed line function is used to implement the partial scroll function by dividing the screen into scroll and fixed area. Set Fixed Lines command will define the fixed area, which will not be affected by the SL scroll function. The fixed area covers the top 2xFL rows for mirror Y (MY) is 0 and bottom 2xFL rows for MY=1. One example of the visual effect on LCD is illustrated in the figure below.



MY = 0 MY = 1

(15) SET LINE RATE

Action	C/D	W/R	D7	D6	D5	D4	D3	D2	D1	D0
Set Line Rate LC [4:3]	0	0	1	0	1	0	0	0	LC4	LC3

Program LC [4:3] for line rate setting (Frame-Rate = Line-Rate / Mux-Rate). The line rate is automatically scaled down by 1/2 and 1/4 at Mux-Rate = 56 and 24.

The following are line rates at Mux Rate = 57~128.

LC[4:3]: **00b: 12.1 Klps** 01b: 13.4 Klps 10b: 14.7 Klps 11b: 16.6 Klps
(Klps: Kilo-Line-per-second)

(16) SET ALL PIXEL ON

Action	C/D	W/R	D7	D6	D5	D4	D3	D2	D1	D0
Set All Pixel ON DC [1]	0	0	1	0	1	0	0	1	0	DC1

Set DC[1] to force all SEG drivers to output ON signals. This function has no effect on the existing data stored in display RAM.

(17) SET INVERSE DISPLAY

Action	C/D	W/R	D7	D6	D5	D4	D3	D2	D1	D0
Set Inverse Display DC [0]	0	0	1	0	1	0	0	1	1	DC0

Set DC[0] to force all SEG drivers to output the inverse of the data (bit-wise) stored in display RAM. This function has no effect on the existing data stored in display RAM.

(18) SET DISPLAY ENABLE

Action	C/D	W/R	D7	D6	D5	D4	D3	D2	D1	D0
Set Display Enable DC [2]	0	0	1	0	1	0	1	1	1	DC2

This command is for programming register DC[2].

When DC[2] is set to 0, the IC will put itself into Sleep mode. All drivers, voltage generation circuit and timin circuit will be halted to conserve power. When any of the DC[2] bits is set to 1, UC1610 will first exit from Sleep Mode, restore the power and then turn on COM drivers and SEG drivers. There is no other explicit user action or timing sequence required to enter or exit the Sleep mode.

(19) SET LCD MAPPING CONTROL

Action	C/D	W/R	D7	D6	D5	D4	D3	D2	D1	D0
Set LCD Mapping Control LC [2:0]	0	0	1	1	0	0	0	MY	MX	LC0

This command is used for program LC[2:0] for COM (row) mirror (MY), SEG (column) mirror (MX).

LC2 controls Mirror Y (MY): MY is implemented by reversing the mapping order between RAM and COM electrodes. The data stored in RAM is not affected by MY command. MY will have immediate effect on the display image.

LC1 controls Mirror X (MX): MX is implemented by selecting the CA or 127-CA as write/read (from host interface) display RAM column address so this function will only take effect after rewriting the RAM data.

LC0 controls whether the soft icon section (0~ 2xFL) is display or not during partial display mode.

(20) SET LCD GRAY SHADE

Action	C/D	W/R	D7	D6	D5	D4	D3	D2	D1	D0
Set LCD Gray Shade [6:5]	0	0	1	1	0	1	0	0	LC6	LC5

Program gray scale register (LC[6:5]). This register controls the voltage RMS separation between the two gray shade levels (data "01" and data "10")

00b=24% 01b=29% 10b=36% 11b=40%

(21) SYSTEM RESET

Action	C/D	W/R	D7	D6	D5	D4	D3	D2	D1	D0
System Reset	0	0	1	1	1	0	0	0	1	0

This command will activate the system reset. Control register values will be reset to their default values. Data stored in RAM will not be affected.

(22) NOP

Action	C/D	W/R	D7	D6	D5	D4	D3	D2	D1	D0
No Operation	0	0	1	1	1	0	0	0	1	1

This command is used for "no operation".

(23) SET TEST CONTROL

Action	C/D	W/R	D7	D6	D5	D4	D3	D2	D1	D0
Set TT	0	0	1	1	1	0	0	1	TT	
(Double byte command)	0	0	Testing parameter							

This command is used for UltraChip production testing. Please do not use.

(24) SET LCD BIAS RATIO

Action	C/D	W/R	D7	D6	D5	D4	D3	D2	D1	D0
Set Bias Ratio BR [1:0]	0	0	1	1	1	0	1	0	BR1	BR0

Bias ratio definition:

00b = 5 01b = 10 **10b = 11** 11b = 12

(25) RESET CURSOR UPDATE MODE

Action	C/D	W/R	D7	D6	D5	D4	D3	D2	D1	D0
Reset Cursor Update Mode AC[3]=0 CA=CR	0	0	1	1	1	0	1	1	1	AC3

This command is used to reset cursor update mode function.

(26) SET CURSOR UPDATE MODE

Action	C/D	W/R	D7	D6	D5	D4	D3	D2	D1	D0
Set AC[3]=1 CR=CA	0	0	1	1	1	0	1	1	1	AC3

This command is used for set cursor update mode function. When cursor update mode sets, UC1610 will update register CR with the value of register CA. The column address CA will increment with write RAM data operation but the address wraps around will be suspended no matter what WA setting is. However, the column address will not increment in read RAM data operation.

The set cursor update mode can be used to implement "write after read RAM" function. The column address (CA) will be restored to the value, which is before the set cursor update mode command, when reset cursor update mode.

The purpose of this pair of commands and their features is to support "write after read" function for cursor implementation.

(27) SET COM END

Action	C/D	W/R	D7	D6	D5	D4	D3	D2	D1	D0
Set CEN	0	0	1	1	1	1	0	0	0	1
(Double byte command)	0	0	*CEN* register parameter							

This command programs the ending COM electrode. CEN defines the number of used COM electrodes, and it should correspond to the number of pixel-rows in the LCD.

(28) SET DISPLAY START

Action	C/D	W/R	D7	D6	D5	D4	D3	D2	D1	D0
Set DST	0	0	1	1	1	1	0	0	1	0
(Double byte command)	0	0	*DST* register parameter							

This command programs the starting COM electrode, which has been assigned a full scanning period, and which will output an active COM scanning pulse.

(29) SET DISPLAY END

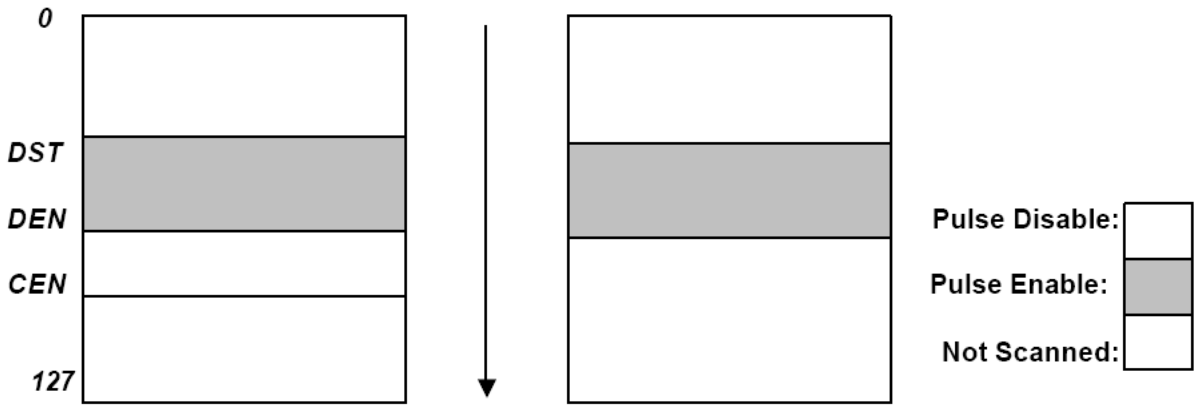
Action	C/D	W/R	D7	D6	D5	D4	D3	D2	D1	D0
Set DEN	0	0	1	1	1	1	0	0	1	1
(Double byte command)			*DEN* register parameter							

This command programs the ending COM electrode, which has been assigned a full scanning period, and which will output an active COM scanning pulse.

CEN, DST DEN are 0-based index of COM electrodes. They control only the COM electrode activity, and do not affect the mapping of display RAM to each COM electrodes. The image displayed by each pixel row is therefore not affected by the setting of these three registers.

When LC[8]=1, two partial display modes are possible with UC1610:
LC[7]=1: ON-OFF only, ultra-low-power mode (if Mux-Rate ≤ 32, set BR=5, PC[3:2]=01b).
LC[7]=0: Full gray shade low power mode (BR and PM stays the same)

When LC[8:7]=11b, the Mux-Rate is narrowed down to just the range between DST and DEN. When Mux-Rate is under 32, set BR=5, PC[3:2]=01b, and adjust PM to reduce V_{LCD} and achieve the lowest power consumption. When LC[8:7]=10b, the Mux-Rate is still CEN+1. This is achieved by suppressing only the scanning pulses, but not the scanning time slots, for COM electrodes that is outside of DST~DEN. Under this m ode, the gray-scale quality of the display is preserved, while the power can be reduced significantly. In either case, DST/DEN defines a small subsection of the display which will remain active while shutting down all the rest of the display to conserve energy.



(30) SET WINDOW PROGRAM STARTING COLUMN ADDRESS

Action	C/D	W/R	D7	D6	D5	D4	D3	D2	D1	D0
Set WPC0	0	0	1	1	1	1	0	1	0	0
(Double byte command)			*WPC0[7:0]* register parameter							

This command is to program the starting column address of RAM program window.

(31) SET WINDOW PROGRAM STARTING PAGE ADDRESS

Action	C/D	W/R	D7	D6	D5	D4	D3	D2	D1	D0
Set WPP0	0	0	1	1	1	1	0	1	0	1
(Double byte command)			*WPP0[4:0]* register parameter							

This command is to program the starting Page Address of RAM program window.

(32) SET WINDOW PROGRAM ENDING COLUMN ADDRESS

Action	C/D	W/R	D7	D6	D5	D4	D3	D2	D1	D0
Set WPC1 (Double byte command)	0	0	1	1	1	1	0	1	1	0
			WPC1[7:0] register parameter							

This command is to program the ending column address of RAM program window.

(33) SET WINDOW PROGRAM ENDING PAGE ADDRESS

Action	C/D	W/R	D7	D6	D5	D4	D3	D2	D1	D0
Set WPP1 (Double byte command)	0	0	1	1	1	1	0	1	1	1
			WPP1[4:0] register parameter							

This command is to program the ending Page Address of RAM program window.

(34) SET WINDOW PROGRAM ENABLE

Action	C/D	W/R	D7	D6	D5	D4	D3	D2	D1	D0
Set Window Program Enable AC[4]	0	0	1	1	1	1	1	0	0	AC4

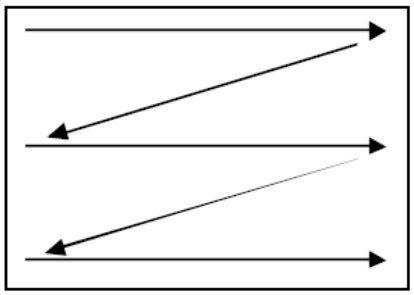
This command is to enable the Window Program Function. Window Program Enable should always be reset when changing the window program boundary and then set right before starting the new boundary program.

Window Program Function can be used to refresh the RAM data in a specified window of DDRAM address. When window programming is enabled, the CA and PA increment and wrap around will be automatically adjusted, and therefore allow effective data update within the window.

The direction of Window Program will depend on the WA (AC[0]) , PID (AC[2]), auto -increment order (AC[1]) and MX (LC[1]) register setting. WA decides whether the program RAM address advances to next row / column after reaching the specified window column / row boundary. PID controls the RAM address incrementing from WPP0 toward WPP1 (PID=0) or reverse the direction (PID=1). Auto-increment order directs the RAM address increment vertically (AC[1]=1) or horizontally (AC[1]=0). MX results the RAM column address incrementing from 127-WPC0 to 127-WPC1 (MX=1) or WPC0 to WPC1 (MX=0).

Auto-increment order = 0 MX=0 PID = 0

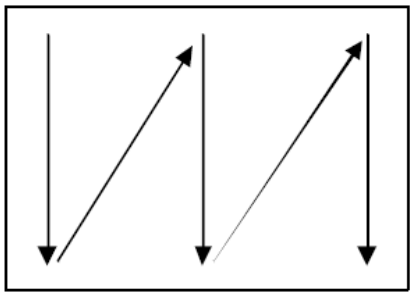
(WPP0,WPC0)



(WPP1,WPC1)

Auto-increment order = 1 MX=0 PID = 0

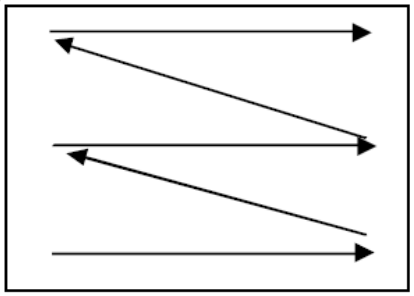
(WPP0,WPC0)



(WPP1,WPC1)

Auto-increment order = 0 MX=0 PID = 1

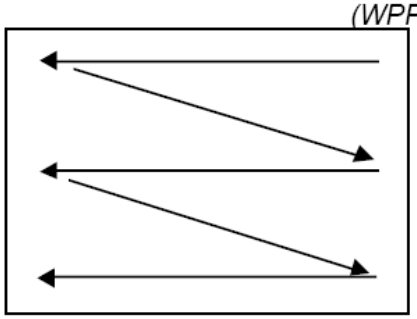
(WPP0,WPC0)



(WPP1,WPC1)

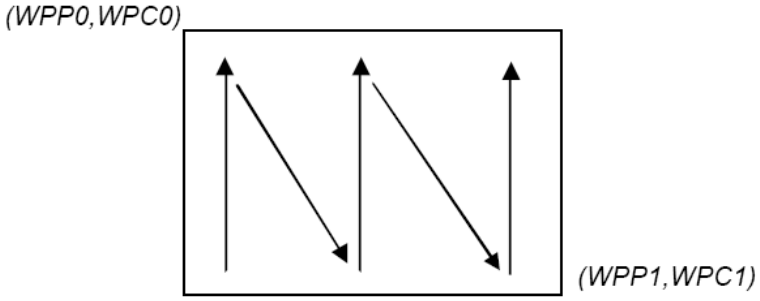
Auto-increment order = 0 MX=1 PID = 0

(WPP0,159-WPC0)

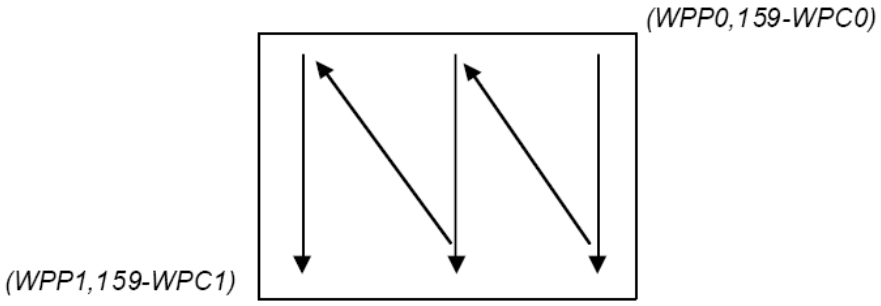


(WPP1,159-WPC1)

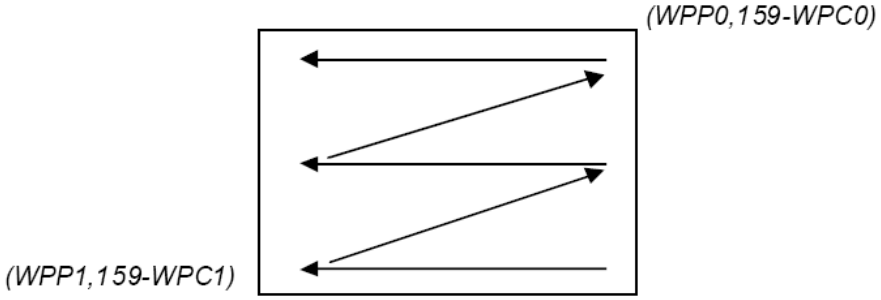
Auto-increment order = 1 MX=0 PID = 1



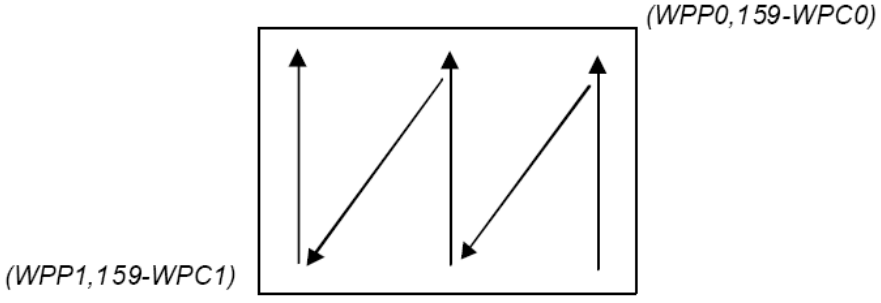
Auto-increment order = 1 MX=1 PID = 0



Auto-increment order = 0 MX=1 PID = 1



Auto-increment order = 1 MX=1 PID = 1



9. INTERFACE PIN CONNECTIONS

PIN No.	Symbol	Typ	Description
1.	NC	-	No connected
2.	VBIAS	I	The reference voltage to generate the actual SEG driving voltage.
3.	VLCD	PWR	Power supply for LCD driving(+12.5V).
4.	VB0+	PWR	LCD bias voltage.
5.	VB1+		
6.	VB1-		
7.	VB0-		
8.	VDD	PWR	Power supply for logic(+3.3V).
9.	VSS	PWR	Ground(0V).
10.	BM0	I	Bus mode select.
11.	CD	I	Select control data or display data for read/write operation.
12.	CS0	I	Chip select.
13.	RST	I	Reset signal.
14.	NC	-	No connect.
15.	NC		
16.	NC		
17.	NC		
18.	SDA	I	Serial data input pin.
19.	NC	-	No connect.
20.	NC		
21.	SCK	I	Serial clock input pin.
22.	NC	-	No connect.

10. 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.	70 ℃ 200 hrs	
2	Low temperature storage	Endurance test applying the low storage temperature for a long time.	-20 ℃ 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.	60 ℃ 200 hrs	
4	Low temperature	Endurance test applying the electric stress	-10 ℃	

	operation	under low temperature for a long time.	200 hrs	
5	High temperature Humidity storage	Endurance test applying the high temperature and high humidity storage for a long time.	50 ℃ , 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.	50 ℃ , 90 RH 96 hrs	MIL-202E-103B JIS-C5023
7	Temperature cycle	Endurance test applying the low and high temperature cycle. -10℃ 25℃ 60℃ 30min. ⇌ 5min. ⇌ 30min. 1 cycle	-10℃--60℃ 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 k CS=100 pF 1 time	MIL-883B-3015.1

*** Supply voltage for logic system = 3V. Supply voltage for LCD system = Operating voltage at 25℃.

Failure Judgment 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 Characteristics
Mechanical characteristics												Out of the Mechanical Specification Color change : Out of Limit Apperance Specification
Optical characteristics												Out of the Apperance Standard

11. QUALITY GUARANTEE

Acceptable Quality Level

Each lot should satisfy the quality level defined as follows.

- Inspection method : MIL-STD-105E LEVEL II Normal one time sampling
- AQL

Partition	AQL	Definition
A: Major	0.4%	Functional defective as product
B: Minor	1.5%	Satisfy all functions as product but not satisfy cosmetic standard

Definition of 'LOT'

One lot means the delivery quantity to customer at one time.

Conditions of Cosmetic Inspection

Environmental condition

The inspection should be performed at the 1cm of height from the LCD module under 2 pieces of 40W white fluorescent lamps (Normal temperature 20~25℃and normal humidity 60±15%RH).

Inspection method

The visual check should be performed vertically at more than 30cm distance from the LCD panel.

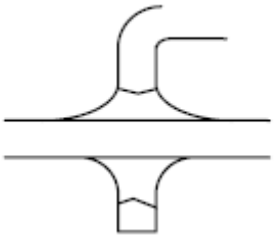
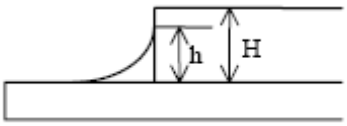
Driving voltage

The VO value which the most optimal contrast can be obtained near the specified VO in the specification. (Within ±0.5V of typical value at 25℃.).

12. INSPECTION CRITERIA

12.1 Module Cosmetic Criteria

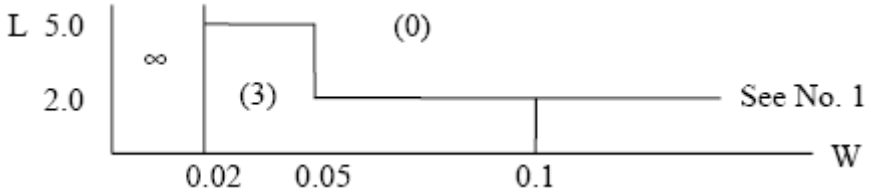
No.	Item	Judgment Criterion	Partition
1	Difference in Spec.	None allowed	Major
2	Pattern peeling	No substrate pattern peeling and floating	Major
3	Soldering defects	No soldering missing No soldering bridge No cold soldering	Major Major Major
4	Resist flaw on substrate	Invisible copper foil (′0.5mm or more) on substrate pattern	Minor

5	Accretion of metallic Foreign matter	No soldering dust No accretion of metallic foreign matters (Not exceed ′0.2mm)	Minor Minor
6	Stain	No stain to spoil cosmetic badly	Minor
7	Plate discoloring	No plate fading, rusting and discoloring	Minor
8	Solder amount 1. Lead parts	a. Soldering side of PCB Solder to form a ‘Filet’ all around the lead. Solder should not hide the lead form perfectly. (too much) b. Components side (In case of ‘Through Hole PCB’) Solder to reach the Components side of PCB. 	Minor
	2. Flat packages	Either ‘Toe’ (A) or ‘Seal’ (B) of the lead to be covered by ‘Filet’. Lead form to be assume over solder. A B 	Minor
	3. Chips	(3/2) H ≥h ≥(1/2) H 	Minor

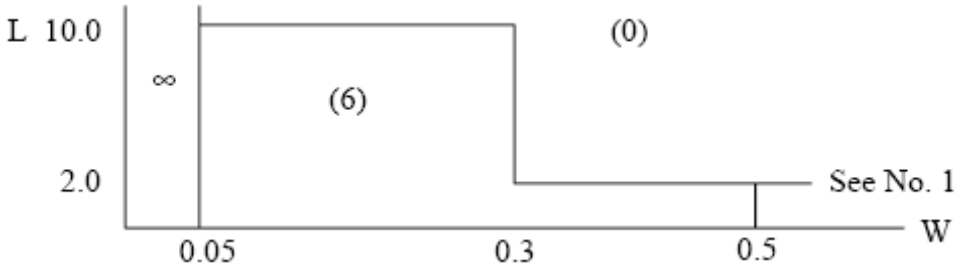
12.2 Screen Cosmetic Criteria (Non-Operating)

No.	Defect	Judgment Criterion	Partition
1	Spots	In accordance with *Screen Cosmetic Criteria (Operating) No.1*.	Minor
2	Lines	In accordance with *Screen Cosmetic Criteria (Operating) No.2*.	Minor
3	Bubbles in polarizer	Size : d mm / Acceptable Qty in active area d ≤ 0.3 : Disregard 0.3 < d ≤ 1.0 : 3 1.0 < d ≤ 1.5 : 1 1.5 < d : 0	Minor
4	Scratch	In accordance with spots and lines operating cosmetic criteria. When the light reflects on the panel surface, the scratches are not to be remarkable.	Minor
5	Allowable density	Above defects should be separated more than 30mm each other.	Minor
6	Coloration	Not to be noticeable coloration in the viewing area of the LCD panels. Back-lit type should be judged with back-lit on state only.	Minor
7	Contamination	Not to be noticeable.	Minor

12.3. Screen Cosmetic Criteria (Operating)

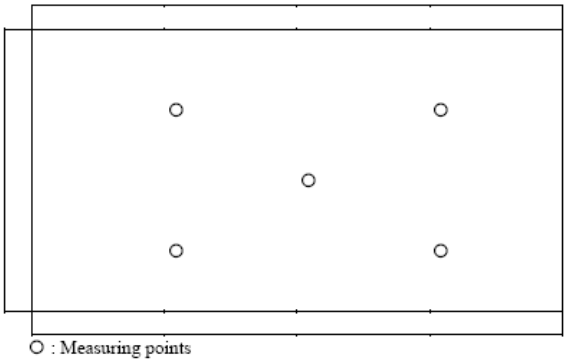
<table>
<tr><th>No.</th><th>Defect</th><th>Judgment Criterion</th><th>Partition</th></tr>
<tr><td>1</td><td>Spots</td><td>A) Clear Note :
<table>
<tr><th>Size : d mm</th><th>Acceptable Qty in active area</th></tr>
<tr><td>d ≤ 0.1</td><td>Disregard</td></tr>
<tr><td>0.1 < d ≤ 0.2</td><td>3</td></tr>
<tr><td>0.2 < d ≤ 0.3</td><td>2</td></tr>
<tr><td>0.3 < d</td><td>0</td></tr>
</table>
Including pin holes and defective dots which must be within one pixel size.
B) Unclear Size :
<table>
<tr><th>Size : d mm</th><th>Acceptable Qty in active area</th></tr>
<tr><td>d ≤ 0.2</td><td>Disregard</td></tr>
<tr><td>0.2 < d ≤ 0.5</td><td>6</td></tr>
<tr><td>0.5 < d ≤ 0.7</td><td>2</td></tr>
<tr><td>0.7 < d</td><td>0</td></tr>
</table></td><td>Minor</td></tr>
<tr><td>2</td><td>Lines</td><td>A)Clear
 

Note : ( ) - Acceptable Qty in active area L -Length (mm) W - Width (mm)
∞ - Disregard

B) Unclear
 
</td><td>Minor</td></tr>
</table>

'Clear' = The shade and size are not changed by VO.
'Unclear' = The shade and size are changed by VO.

12.4. Screen Cosmetic Criteria (Operating) (Continued)

No.	Defect	Judgment Criterion	Partition
3	Rubbing line	Not to be noticeable.	
4	Allowable density	Above defects should be separated more than 10mm each other.	Minor
5	Rainbow	Not to be noticeable.	Minor
6	Dot size	To be 95% ~ 105% of the dot size (Typ.) in drawing. Partial defects of each dot (ex. pin-hole) should be treated as 'Spot'. (see *Screen Cosmetic Criteria (Operating) No.1*)	Minor
7	Uneven brightness (only back-lit type module)	Uneven brightness must be BMAX / BMIN ≤ 2 - BMAX : Max. value by measure in 5 points - BMIN : Min. value by measure in 5 points Divide active area into 4 vertically and horizontally. Measure 5 points shown in the following figure.  ○ : Measuring points	Minor

Note :

(1) Size : d = (long length + short length) / 2

(2) The limit samples for each item have priority.

(3) Complexed defects are defined item by item, but if the number of defects are defined in above table, the total number should not exceed 10.

(4) In case of 'concentration', even the spots or the lines of 'disregarded' size should not allowed. Following three situations should be treated as 'concentration'.

- 7 or over defects in circle of ′5mm.
- 10 or over defects in circle of ′10mm.
- 20 or over defects in circle of ′20mm.

13. 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.

(8) Install the LCD Module by using the mounting holes. When mounting the LCD module make sure it is free of twisting, warping and distortion. In particular, do not forcibly pull or bend the I/O cable or the backlight cable.

(9) Do not attempt to disassemble or process the LCD module.

(10) NC terminal should be open. Do not connect anything.

(11) If the logic circuit power is off, do not apply the input signals.

(12) To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.

- Be sure to ground the body when handling the LCD modules.
- Tools required for assembling, such as soldering irons, must be properly grounded.
- To reduce the amount of static electricity generated, do not conduct assembling and other work under dry conditions.
- The LCD module is coated with a film to protect the display surface. Exercise care when peeling off this protective film since static electricity may be generated.

Storage Precautions

When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps. Keep the modules in bags (avoid high temperature, high humidity and low temperatures below 0□C). Whenever possible, the LCD modules should be stored in the same conditions in which they were shipped from our company.

Others

Liquid crystals solidify under low temperature (below the storage temperature range) leading to defective orientation or the generation of air bubbles (black or white). Air bubbles may also be generated if the module is subject to a low temperature.

If the LCD modules have been operating for a long time showing the same display patterns, the display patterns may remain on the screen as ghost images and a slight contrast irregularity may also appear. A normal operating status can be regained by suspending use for some time. It should be noted that this phenomenon does not adversely affect performance reliability.

To minimize the performance degradation of the LCD modules resulting from destruction caused by static electricity etc., exercise care to avoid holding the following sections when handling the modules.

- Exposed area of the printed circuit board.
- Terminal electrode sections.

14. 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 temp erature air.

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

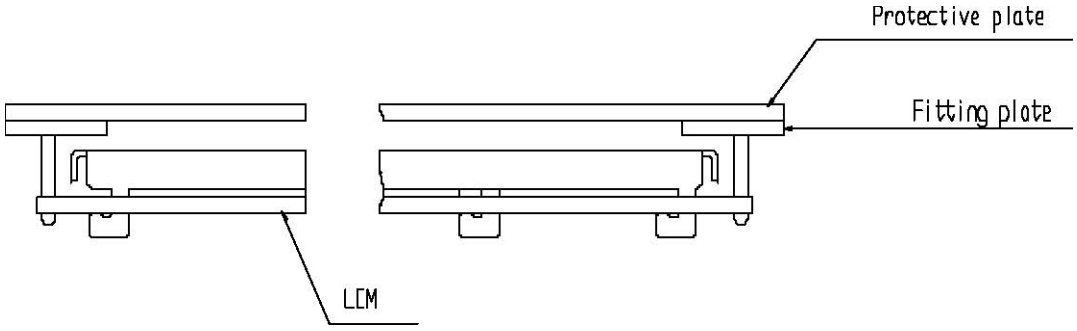
(9) Do not touch the display with bare hands. This will stain the display area and degradate insulation between terminals (some cosmetics are determinated to the polarizers).

(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 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℃ 10℃
- 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 electoluminescent 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.

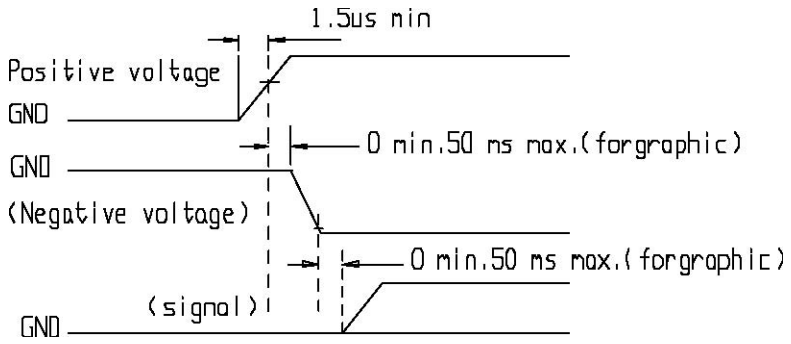
(2) Driving the LCD in the voltage above the limit shortens its life.

(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℃ , 50% RH.

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



Storage

When storing LCDs 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℃ and 35℃.

(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.)

Safety

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

(2) If any liquid leakes 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 YAOYU and customer, YAOYU will replace or repair any of its LCD modules which are found to be functionally defective when inspected in accordance with YAOYU LCD acceptance standards (copies available upon request) for a period of one year from date of shipments. Cosmetic/visual defects must be returned to YAOYU within 90 days of shipment. Confirmation of such date shall be based on freight documents. The warranty liability of YAOYU limited to repair and/or replacement on the terms set forth above. YAOYU 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.