CLOVER DISPLAY LTD.

LCD MODULE SPECIFICATION

Model: CG160160B - _ _ - _ _ - _ _ - _

Revision	01
Engineering	Timmy Kwan
Date	05 March 2010
Our Reference	X9037

ADDRESS : 1st FLOOR, EFFICIENCY HOUSE, 35 TAI YAU STREET, SAN PO KONG, KOWLOON, HONG KONG.

TEL : (852) 2341 3238 (SALES OFFICE) (852) 2342 8228 (GENERAL OFFICE)

FAX : (852) 2357 4237 (SALES OFFICE)

E-MAIL : cdl@cloverdisplay.com

URL : http://www.cloverdisplay.com

MODE OF DISPLAY

Display mode	**Display condition**	**Viewing direction**
STN : ☐ Yellow green	☐ Reflective type	☐ 6 O' clock
☐ Grey	☐ Transflective type	☐ 12 O' clock
☐ Blue (negative)	☐ Transmissive type	☐ 3 O' clock
☐ FSTN positive	☐ Others	☐ 9 O' clock
☐ FSTN negative		

LCD MODULE NUMBER NOTATION:

CG160160B- N N - S R - N 6 – T
(1) (2) (3) (4) (5) (6) (7) (8)

*(1)---Model number of standard LCD Modules
*(2)---Backlight type
N – No backlight
E – EL backlight
L – Side-lited LED backlight
M– Array LED backlight
C – CCFL
*(3)---Backlight color
N – No backlight
A – Amber
B – Blue
O– Orange
W–White
Y – Yellow green
*(4)---Display mode
T – TN
V – TN (Negative)
S – STN Yellow green
G – STN Grey
B – STN Blue (Negative)
F – FSTN
N – FSTN (Negative)
*(5)---Rear polarizer type
R – Reflective
F – Transflective
T – Transmissive
*(6)---Temperature range
N – Normal
W– Extended
*(7)---Viewing direction
6 – 6 O'clock
2 – 12 O'clock
3 – 3 O'clock
9 – 9 O'clock
*(8)---Special code for other requirements
(Can be omitted if not used)

GENERAL DESCRIPTION

Display mode : 160 X 160 dots, graphic COG LCD module

Interface : Serial / Parallel

Driving method : 1/160 duty, 1/14 bias

Controller IC : Sitronix ST7529 or equivalent
For the detailed information, please refer to the IC specifications.

MECHANICAL DIMENSIONS

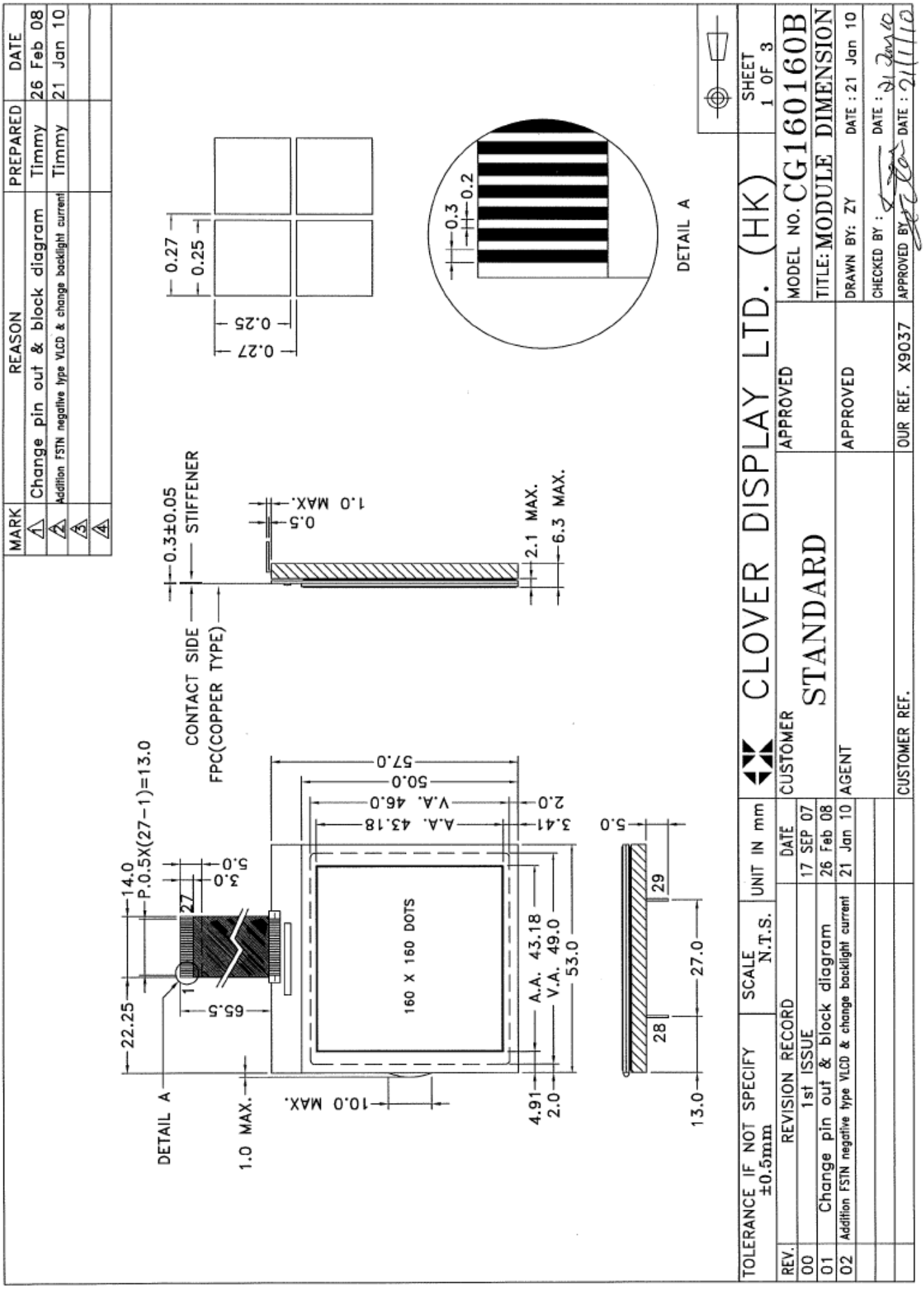
Item	Dimension	Unit	Item	Dimension	Unit
Outline Dimension			Viewing Area	49.0(L)x46.0(W)	mm
No Backlight (N)	53.0(L)x57.0(W)x2.1 MAX(H)	mm	Dot Size	0.25(L)x0.25(W)	mm
LED Sided Backlight(L)	53.0(L)x57.0(W)x6.3 MAX(H)	mm	Dot Pitch	0.27(L)x0.27(W)	mm

CONNECTOR PIN ASSIGNMENT

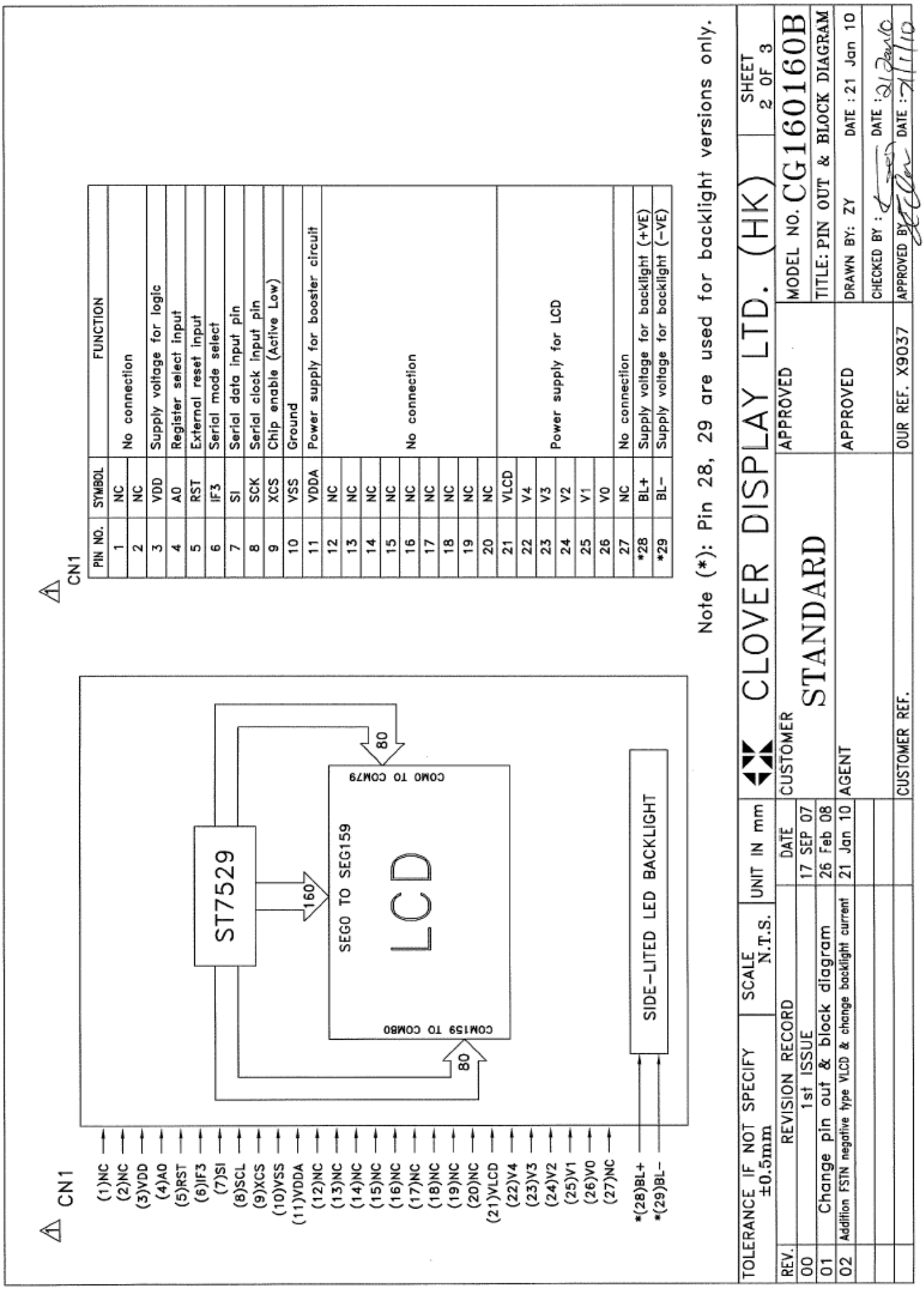
Pin No.	Symbol	Function	Pin No.	Symbol	Function
1	NC	No connection	16	NC	No connection
2	NC		17	NC	
3	VDD	Supply voltage for logic	18	NC	
4	A0	Register select input	19	NC	
5	RST	External reset input	20	NC	
6	IF3	Serial mode select	21	VLCD	Power supply for LCD
7	SI	Serial data input pin	22	V4	
8	SCK	Serial clock input pin	23	V3	
9	XCS	Chip enable (Active Low)	24	V2	
10	VSS	Ground	25	V1	
11	VDDA	Power supply for booster circuit	26	V0	
12	NC	No connection	27	NC	No connection
13	NC		* 28	A	Supply voltage for backlight (+VE)
14	NC		* 29	K	Supply voltage for backlight (-VE)
15	NC				

Note (*) : Pin 28, 29 are used for backlight version

COUNTER DRAWING OF MODULE DIMENSION



COUNTER DRAWING OF PIN OUT & BLOCK DIAGRAM



ELECTRICAL CHARACTERISTICS

Conditions: VSS=0V, Ta=25℃

Item	Symbol	MIN.	TYP.	MAX.	Unit	Item	Symbol	MIN.	TYP.	MAX.	Unit
Supply Voltage for Logic	VDD	2.75	3.0	3.25	V	"H"Level Input Voltage	VIH	0.7VDD	–	VDD	V
Supply Current for Logic	IDD	–	0.17	0.29	mA	"L"Level Input Voltage	VIL	VSS	–	0.3VDD	V
Power supply for LCD control (*)	VLCD	–	15.0	–	V	Operating voltage for LCD (*)	V0	12.35	13.0	13.65	V
Power supply for LCD control (* for FSTN negative mode)	VLCD	–	18.0	–	V	Operating voltage for LCD (*for FSTN negative mode)	V0	16.15	17.0	17.8	V

(*) Note: There is tolerance in optimum LCD driving voltage during production and it will be within the specified range.

Side-lited LED backlight:

Constant voltage driving:

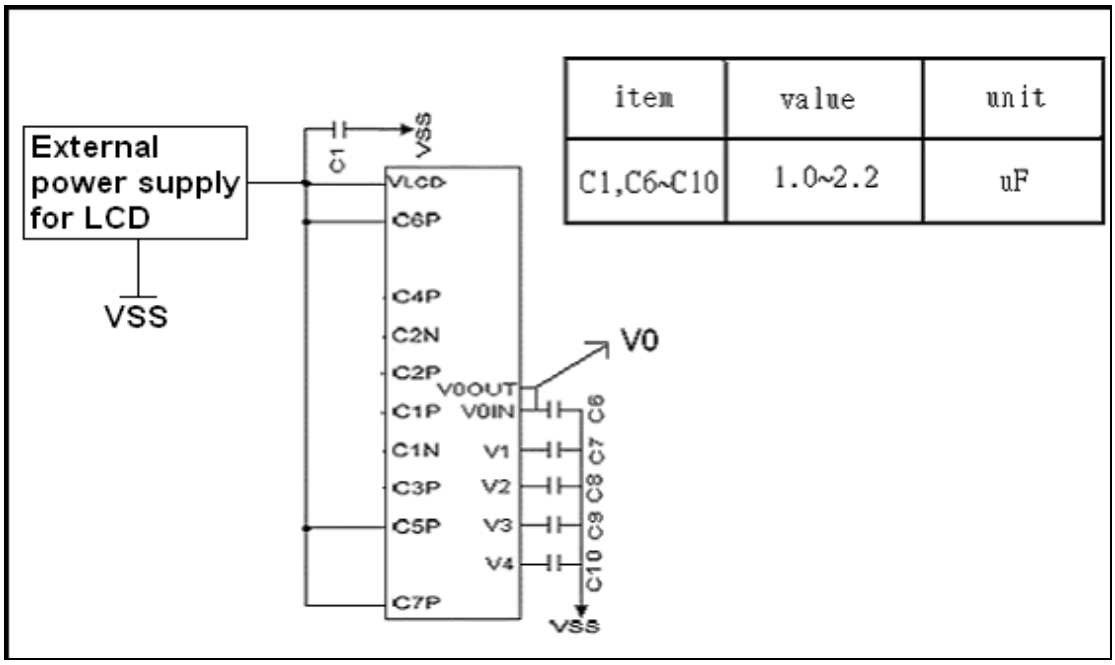
Item	Symbol	MIN.	TYP.	MAX.	Unit	Condition
White color	IBL	27	32	37	mA	VBL = 5.0V
Blue color	IBL	60	70	80	mA	VBL = 5.0V

ABSOLUTE MAXIMUM RATINGS

Please make sure not to exceed the following maximum rating values under the worst application conditions

Item	Symbol	Rating (for normal temperature)	Rating (for wide temperature)	Unit
Supply Voltage	VDD	4.0	4.0	V
Input Voltage	VT	-0.5 to VDD +0.5	0.5 to VDD +0.5	V
Operating Temperature	Topr	0 to 50	-20 to 70	℃
Storage Temperature	Tstg	-10 to 60	-30 to 80	℃

REFERENCE CIRCUIT EXAMPLE



item	value	unit
C1,C6~C10	1.0~2.2	uF

ST7529

8. COMMANDS

8.1 Command table

Ext=0 or Ext=1

Index	Command	A0	RD	WR	D7	D6	D5	D4	D3	D2	D1	D0	Function	Hex	Parameter
1	Ext In	0	1	0	0	0	1	1	0	0	0	0	Ext=0 Set	30	None
2	Ext Out	0	1	0	0	0	1	1	0	0	0	1	Ext=1 Set	31	None

Ext=0

Index	Command	A0	RD	WR	D7	D6	D5	D4	D3	D2	D1	D0	Function	Hex	Parameter
1	DISON	0	1	0	1	0	1	0	1	1	1	1	Display On	AF	None
2	DISOFF	0	1	0	1	0	1	0	1	1	1	0	Display Off	AE	None
3	DISNOR	0	1	0	1	0	1	0	0	1	1	0	Normal Display	A6	None
4	DISINV	0	1	0	1	0	1	0	0	1	1	1	Inverse Display	A7	None
5	COMSCN	0	1	0	1	0	1	1	1	0	1	1	COM Scan Direction	BB	1 byte
6	DISCTRL	0	1	0	1	1	0	0	1	0	1	0	Display Control	CA	3 bytes
7	SLPIN	0	1	0	1	0	0	1	0	1	0	1	Sleep In	95	None
8	SLPOUT	0	1	0	1	0	0	1	0	1	0	0	Sleep Out	94	None
9	LASET	0	1	0	0	1	1	1	0	1	0	1	Line Address Set	75	2 bytes
10	CASET	0	1	0	0	0	0	1	0	1	0	1	Column Address Set	15	2 bytes
11	DATSDR	0	1	0	1	0	1	1	1	1	0	0	Data Scan Direction	BC	3 bytes
12	RAMWR	0	1	0	0	1	0	1	1	1	0	0	Writing to Memory	5C	Data
13	RAMRD	0	1	0	0	1	0	1	1	1	0	1	Reading from Memory	5D	Data
14	PTLIN	0	1	0	1	0	1	0	1	0	0	0	Partial display in	A8	2 bytes
15	PTLOUT	0	1	0	1	0	1	0	1	0	0	1	Partial display out	A9	None
16	RMWIN	0	1	0	1	1	1	0	0	0	0	0	Read and Modify Write	E0	None
17	RMWOUT	0	1	0	1	1	1	0	1	1	1	0	RMW end	EE	None
18	ASCSET	0	1	0	1	0	1	0	1	0	1	0	Area Scroll Set	AA	4 bytes
19	SCSTART	0	1	0	1	0	1	0	1	0	1	1	Scroll Start Set	AB	1 byte
20	OSCON	0	1	0	1	1	0	1	0	0	0	1	Internal OSC on	D1	None
21	OSCOFF	0	1	0	1	1	0	1	0	0	1	0	Internal OSC off	D2	None
22	PWRCTRL	0	1	0	0	0	1	0	0	0	0	0	Power Control	20	1 byte
23	VOLCTRL	0	1	0	1	0	0	0	0	0	0	1	EC control	81	2 bytes
24	VOLUP	0	1	0	1	1	0	1	0	1	1	0	EC increase 1	D6	None
25	VOLDOWN	0	1	0	1	1	0	1	0	1	1	1	EC decrease 1	D7	None
26	RESERVED	0	1	0	1	0	0	0	0	0	1	0	Not Use	82	0

ST7529

27	EPSRRD1	0	1	0	0	1	1	1	1	1	0	0	READ Register1	7C	None
28	EPSRRD2	0	1	0	0	1	1	1	1	1	0	1	READ Register2	7D	None
29	NOP	0	1	0	0	0	1	0	0	1	0	1	NOP Instruction	25	None
30	STREAD	0	0	1	Read Data								Status Read		
31	EPINT	0	1	0	0	0	0	0	0	1	1	1	Initial code(1)	07	1 byte

Ext=1

Index	*Command*	*A0*	*RD*	*WR*	*D7*	*D6*	*D5*	*D4*	*D3*	*D2*	*D1*	*D0*	*Function*	*Hex*	*Parameter*
1	Gray 1 Set	0	1	0	0	0	1	0	0	0	0	0	FRAME 1 Gray PWM Set	20	16 bytes
2	Gray 2 Set	0	1	0	0	0	1	0	0	0	0	1	FRAME 2 Gray PWM Set	21	16 bytes
3	ANASET	0	1	0	0	0	1	1	0	0	1	0	Analog Circuit Set	32	3 bytes
4	SWINT	0	1	0	0	0	1	1	0	1	0	0	Software Initial	34	None
5	EPCTIN	0	1	0	1	1	0	0	1	1	0	1	Control EEPROM	CD	1 byte
6	EPCOUT	0	1	0	1	1	0	0	1	1	0	0	Cancel EEPROM	CC	None
7	EPMWR	0	1	0	1	1	1	1	1	1	0	0	Write to EEPROM	FC	None
8	EPMRD	0	1	0	1	1	1	1	1	1	0	1	Read from EEPROM	FD	None

Note: The table above is for 8-bit interface. For the application of 16-bit interface, fill D15~8 with 0, and other bits are just the same with the table above.

ST7529

EXT= "0" or "1"

(1) Extension instruction disable (EXT IN) - Parameter Byte: None (30H)

Use the "EXT=0" command table

	A0	RD	WR	D7	D6	D5	D4	D3	D2	D1	D0
Command	0	1	0	0	0	1	1	0	0	0	0

(2) Extension instruction enable (EXT OUT) - Parameter Byte: None (31H)

Use the extended command table EXT="1"

	A0	RD	WR	D7	D6	D5	D4	D3	D2	D1	D0
Command	0	1	0	0	0	1	1	0	0	0	1

EXT= "0"

(1) Display ON (DISON) - Parameter Byte: None (AFH)

It is to turn the display on. When the display is turned on, segment and common outputs are generated at the level corresponding to the display data and display timing. As long as the sleep mode is selected, the display cannot be turned on. Thus, whenever using this command, the sleep mode must be cancelled first.

	A0	RD	WR	D7	D6	D5	D4	D3	D2	D1	D0
Command	0	1	0	1	0	1	0	1	1	1	1

(2) Display OFF (DISOFF) - Parameter Byte: None (AEH)

It is to forcibly turn the display off. As long as the display is turned off, every segment and common outputs are forced to VSS level.

	A0	RD	WR	D7	D6	D5	D4	D3	D2	D1	D0
Command	0	1	0	1	0	1	0	1	1	1	0

(3) Normal display (DISNOR) - Parameter Byte: None (A6H)

It is to normally highlight the display area without modifying contents of the display data RAM.

	A0	RD	WR	D7	D6	D5	D4	D3	D2	D1	D0
Command	0	1	0	1	0	1	0	0	1	1	0

(4) Inverse display (DISINV) - Parameter Byte: None (A7)

It is to inversely highlight the display area without modifying contents of the display data RAM. This command does not invert non-display areas in case of using partial display.

	A0	RD	WR	D7	D6	D5	D4	D3	D2	D1	D0
Command	0	1	0	1	0	1	0	0	1	1	1

ST7529

(5) Common scan (COMSCN) - Parameter Byte: 1 (BBH)

It is to specify the common output scan direction. This command is for the convenience of wiring on the LCD panel.

	A0	RD	WR	D7	D6	D5	D4	D3	D2	D1	D0	Function
Command	0	1	0	1	0	1	1	1	0	1	1	–
Parameter Byte 1 (PB1)	1	1	0	*	*	*	*	*	CD2	CD1	CD0	Common Scan direction

When 1/160 is selected for the display duty, pins and common output are scanned in the order shown below.

CD2	CD1	CD0	Common scan direction					
			COM0 pin		COM79 pin	COM80 pin		COM159 pin
0	0	0	0	→	79	80	→	159
0	0	1	0	→	79	159	→	80
0	1	0	79	→	0	80	→	159
0	1	1	79	→	0	159	→	80

Original graphic :

CD[2-0] = [0,0,0] (0→79, 80→159)

CD[2-0] = [0,0,1] (0→79, 159→80)

CD[2-0] = [0,1,0] (79→0, 80→159)

CD[2-0] = [0,1,1] (79→0, 159→80)

Figure 8.1.1 Common scan direction configuration

ST7529

(6) Display control (DISCTRL) - Parameter Byte: 3 (CAH)

This command and succeeding parameters are used to perform the display timing-related setups. This command must be selected before using SLPOUT. Do not change this command while the display is turned on.

	A0	RD	WR	D7	D6	D5	D4	D3	D2	D1	D0	Function
Command	0	1	0	1	1	0	0	1	0	1	0	
Parameter Byte 1 (PB1)	1	1	0	*	*	*	0	0	CLD	0	0	CL dividing ratio, F1 and F2 drive pattern.
Parameter Byte 2 (PB2)	1	1	0	*	*	DT5	DT4	DT3	DT2	DT1	DT0	Drive duty
Parameter Byte 3 (PB3)	1	1	0	*	*	*	FI	LF3	LF2	LF1	LF0	FR inverse-set value

PB1 specifies the CL dividing ratio.

CLD: CL dividing ratio. They are used to change number of dividing stages of external or internal clock.

CLD=0: not divide, CLD=1: 2 divisions.

PB2 specifies the duty of the module on block basis. Initial: 00H

(Numbers of display lines)/4-1 = DT5 x 2^5 + DT4 x 2^4 + DT3 x 2^3 + DT2 x 2^2 + DT1 x 2^1 + DT0 x 2^0

For example, 1/128 duty → 128/4-1=31 → (DT5, DT4, DT3, DT2, DT1, DT0) = (0, 1, 1, 1, 1, 1)

PB3 specifies number of line cycles (range from 2 to 16) in a frame.

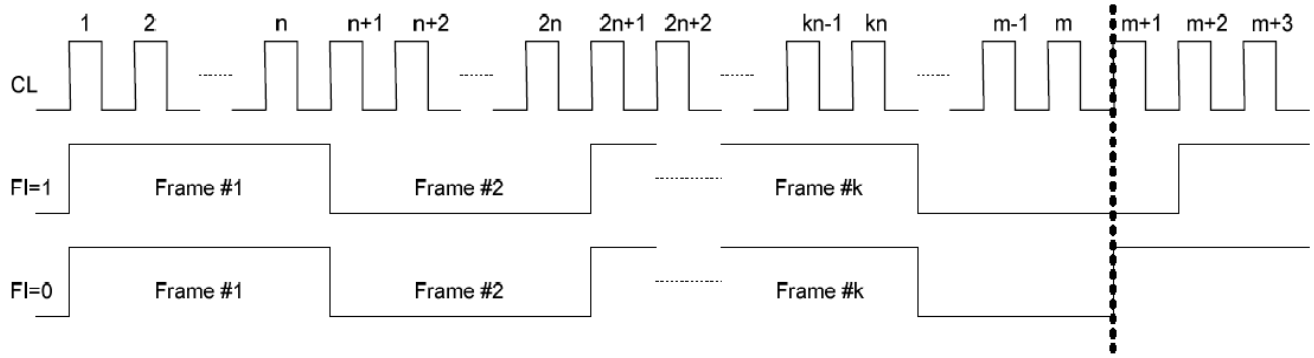
Number of line cycles-1 = LF3 x 2^3 + LF2 x 2^2 + LF1 x 2^1 + LF0 x 2^0

For example, 11 line cycles in a frame → 11-1=10 → (LF3, LF2, LF1, LF0) = (1, 0, 1, 0)

In the default, 11 line cycles in a frame is selected.

FI decides the inversion type of frame at the end of common scan cycle while the number of duty is not divisible by the number of line cycles per frame. For example, in the application of 1/m duty and n line cycles in a frame set, the difference of the choice in FI is shown as the following figure.

m = n x k + r, where m, n, k, and r are all whole numbers, and r is the remainder of m divided by n (r < n).



(7) Sleep in (SLPIN) - Parameter Byte: None (95H)

This command is to enter the SLEEP MODE.

	A0	RD	WR	D7	D6	D5	D4	D3	D2	D1	D0
Command	0	1	0	1	0	0	1	0	1	0	1

(8) Sleep out (SLPOUT) - Parameter Byte: None (94H)

This command is to exit the SLEEP MODE.

	A0	RD	WR	D7	D6	D5	D4	D3	D2	D1	D0
Command	0	1	0	1	0	0	1	0	1	0	0

(9) Line address set (LASET) - Parameter Byte: 2 (75H)

This command is to specify the line address area when MPU makes access to the display data RAM. As the addresses are increased from the start to the end line in the line-direction scan, the column address is increased by 1 and the line address return to the start line. Note that the start and end line must be a pair. Moreover, the relation "start line <end line" must be maintained.

	A0	RD	WR	D7	D6	D5	D4	D3	D2	D1	D0	Function
Command	0	1	0	0	1	1	1	0	1	0	1	—
Parameter Byte 1 (PB1)	1	1	0	SL7	SL6	SL5	SL4	SL3	SL2	SL1	SL0	Start Line
Parameter Byte 2 (PB2)	1	1	0	EL7	EL6	EL5	EL4	EL3	EL2	EL1	EL0	End Line

Note: The range of line address is 0 ~ 159.

(10) Column address set (CASET) - Parameter Byte: 2 (15H)

This command is to specify the column address area when MPU makes access to the display data RAM. As the addresses are increased from the start to the end column in the column-direction scan, the line address is incremented by 1 and the column address is returned to the start column. Note that the start and end line must be a pair. Moreover, the relation "start column <end column" must be maintained.

	A0	RD	WR	D7	D6	D5	D4	D3	D2	D1	D0	Function
Command	0	1	0	0	0	0	1	0	1	0	1	—
Parameter Byte 1 (PB1)	1	1	0	SC7	SC6	SC5	SC4	SC3	SC2	SC1	SC0	Start Column
Parameter Byte 2 (PB2)	1	1	0	EC7	EC6	EC5	EC4	EC3	EC2	EC1	EC0	End Column

Note: The range of column address is 0 ~ 84.

(11) Data scan direction (DATSDR) - Parameter Byte: 3 (BCH)

This command is to setup various parameters in the operations of display data stored on the built-in RAM by MPU.

	A0	RD	WR	D7	D6	D5	D4	D3	D2	D1	D0	Function
Command	0	1	0	1	0	1	1	1	1	0	0	—
Parameter Byte 1 (PB1)	1	1	0	*	*	*	*	*	C/L	CI	LI	Normal/inverse display of address and address scan direction.
Parameter Byte 2 (PB2)	1	1	0	*	*	*	*	*	*	*	CLR	P1, P2, P3 arrangement
Parameter Byte 3 (PB3)	1	1	0	*	*	*	*	*	GS2	GS1	GS0	Gray-scale setup

PB1 is to specify the normal/inverse display of the line and column address and the address scanning direction.

LI: Normal/inverse direction of the line address. LI =0: Normal, LI =1: Inverse

CI: Normal/reverse direction of the column address. CI =0: Normal, CI =1: Reverse

C/L: Address-scan direction. C/L =0: In the column direction, C/L =1: In the line direction

ST7529

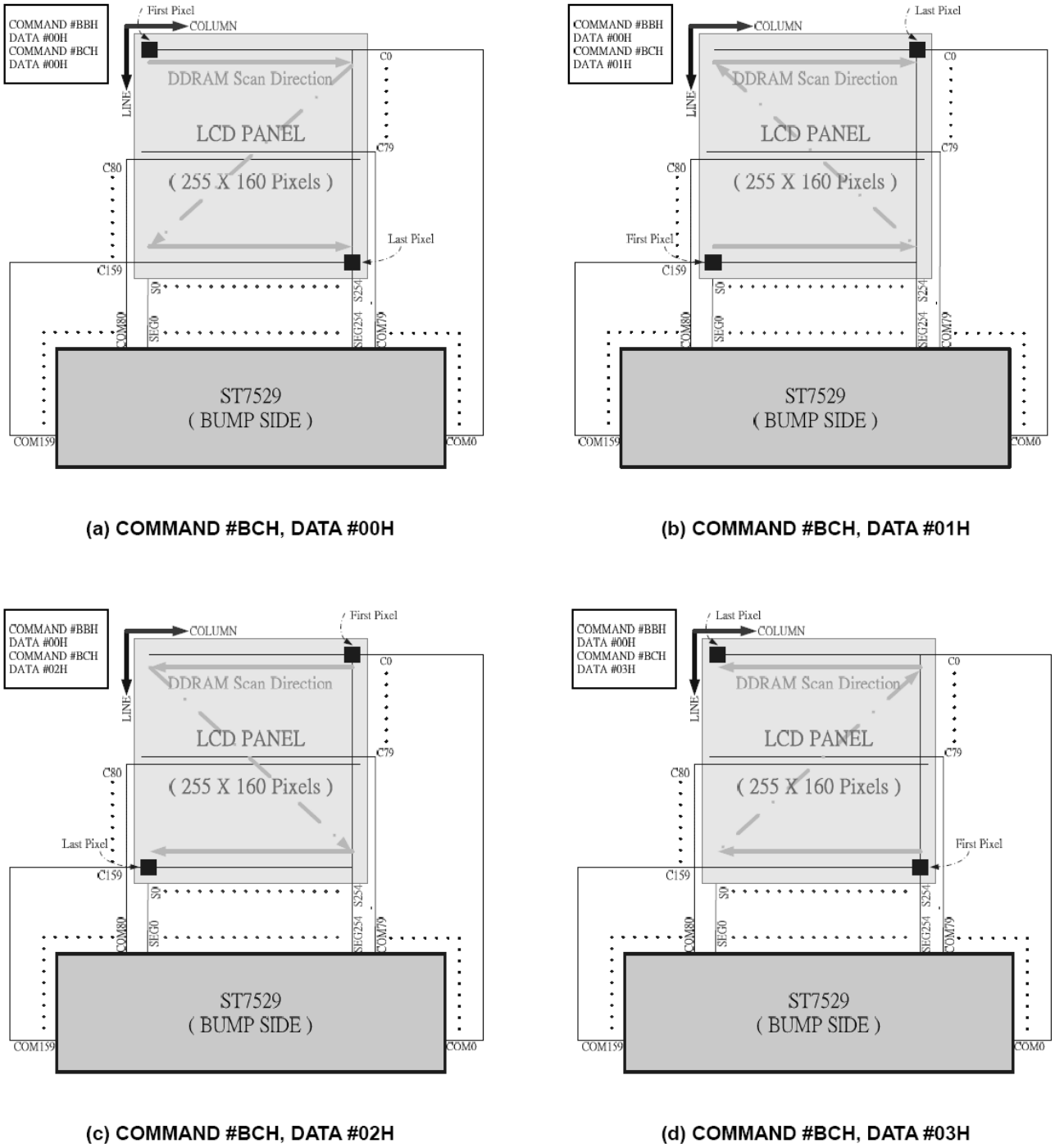
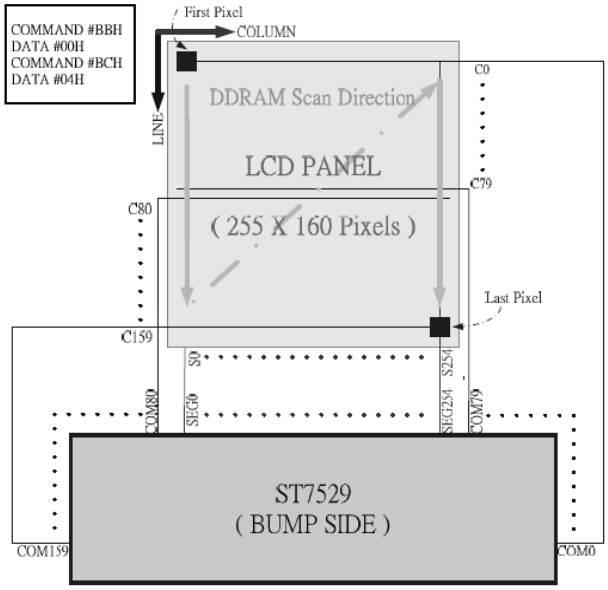
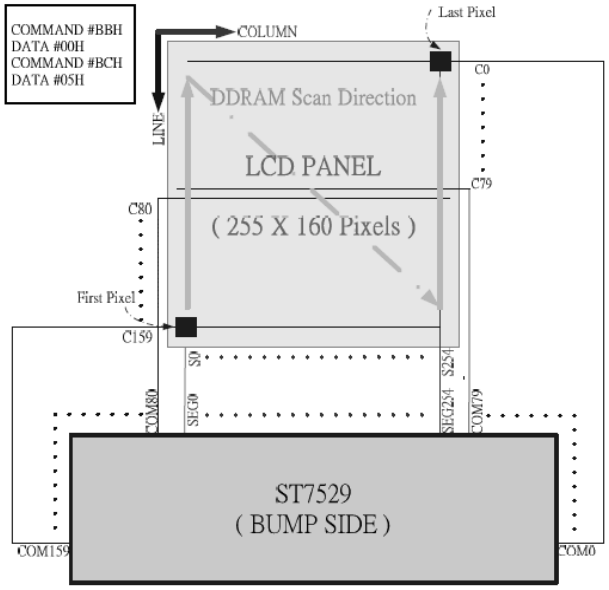


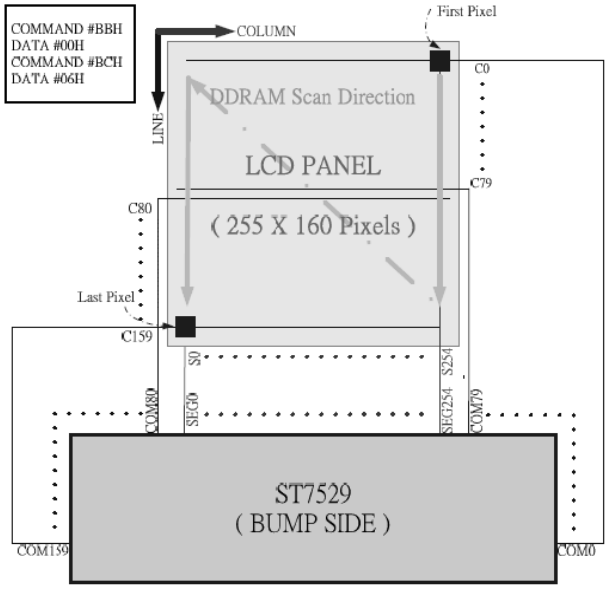
Figure 8.1.2 Different RAM accessing setup under COMMAND #BBH, DATA #00H
(a) COMMAND #BCH, DATA #00H
(b) COMMAND #BCH, DATA #01H
(c) COMMAND #BCH, DATA #02H
(d) COMMAND #BCH, DATA #03H



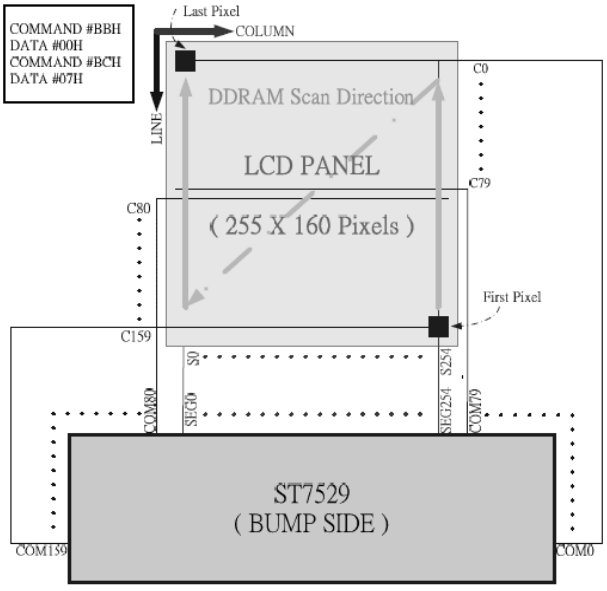
(e) COMMAND #BCH, DATA #04H



(f) COMMAND #BCH, DATA #05H



(g) COMMAND #BCH, DATA #06H



(h) COMMAND #BCH, DATA #07H

Figure 8.1.2 Different RAM accessing setup under COMMAND #BBH, DATA #00H (continue)
(e) COMMAND #BCH, DATA #04H
(f) COMMAND #BCH, DATA #05H
(g) COMMAND #BCH, DATA #06H
(h) COMMAND #BCH, DATA #07H

ST7529

PB2 is to change P1, P2, P3 arrangement of the segment output according to P1, P2, P3 arrangement on the LCD panel.

This command will set the writing position of data (P1, P2, P3) on the display memory to be changed or not.

CLR	SEG0	SEG1	SEG2	SEG3	SEG4	SEG5	SEG6	SEG7	…	SEG254
0	P1	P2	P3	P1	P2	P3	P1	P2	…	P3
1	P3	P2	P1	P3	P2	P1	P3	P2	…	P1

PB3 is to select desired gray scale display 2B3P mode or 3B3P mode.

GS2	GS1	GS0	Numbers of gray-scale
0	0	1	32 gray-scale 2Byte 3Pixel mode
0	1	0	32 gray-scale 3Byte 3Pixel mode

(12) Memory write (RAMWR) - Parameter Byte: Numbers of data written (5CH)

This command turns on the data entry mode when MPU writes data to the display memory. This command will always sets the line and column address at the start address while executed. The following parameter byte rewrites contents of the display data RAM and increases the line or column address automatically. The write mode is automatically cancelled if any other command is entered.

1. 8-bit bus

	A0	RD	RW	D7	D6	D5	D4	D3	D2	D1	D0	Function
Command	0	1	0	0	1	0	1	1	1	0	0	–
Parameter Byte 1 (PB1)	1	1	0	Data to be written								Data to be written

2. 16-bit bus

	A0	RD	RW	D15	D14	…	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0	Function
Command	0	1	0	*	*	…	*	*	0	1	0	1	1	1	0	0	Memory write
Parameter Byte 1 (PB1)	1	1	0	Data to be written													Write date

(13) Memory read (RAMRD) - Parameter Byte: Numbers of data read (5DH)

This command turns on the data read mode when MPU read data from the display memory. This command will always sets the line and column address at the start address while executed. The contents of the display data RAM will be read in the following parameter byte and increases the line or column address automatically. The data read mode is automatically cancelled if any other command is entered.

1. 8-bit bus

	A0	RD	RW	D7	D6	D5	D4	D3	D2	D1	D0	Function
Command	0	1	0	0	1	0	1	1	1	0	1	--
Parameter Byte 1 (PB1)	1	0	1	Data to be read								Data to be read

2. 16-bit bus

	A0	RD	RW	D15	D14	….	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0	Function
Command	0	1	0	*	*	*	*	*	0	1	0	1	1	1	0	1	Memory read
Parameter Byte 1 (PB1)	1	0	1	Data to be read													Read data

ST7529

(14) Partial in (PTLIN) - Parameter Byte: 2 (A8H)

This command is to specify the partial display area. It will turn on partial display of the screen (dividing screen by lines) to save power. Since ST7529 processes the liquid crystal display signal on 4-line basis (block basis), the display and no-display areas are also specified on 4-bit line (block basis).

	A0	RD	RW	D7	D6	D5	D4	D3	D2	D1	D0	Function
Command	0	1	0	1	0	1	0	1	0	0	0	--
Parameter Byte 1 (PB1)	1	1	0	*	*	PTS5	PTS4	PTS3	PTS2	PTS1	PTS0	Start block address
Parameter Byte 2 (PB2)	1	1	0	*	*	PTE5	PTE4	PTE3	PTE2	PTE1	PTE0	End block address

Only the address of the display block can be specified for the partial display. Do not specify an address not to be displayed when scrolled.

(15) Partial out (PTLOUT) - Parameter Byte: none (A9H)

This command is to exit the PARTIAL DISPLAY MODE.

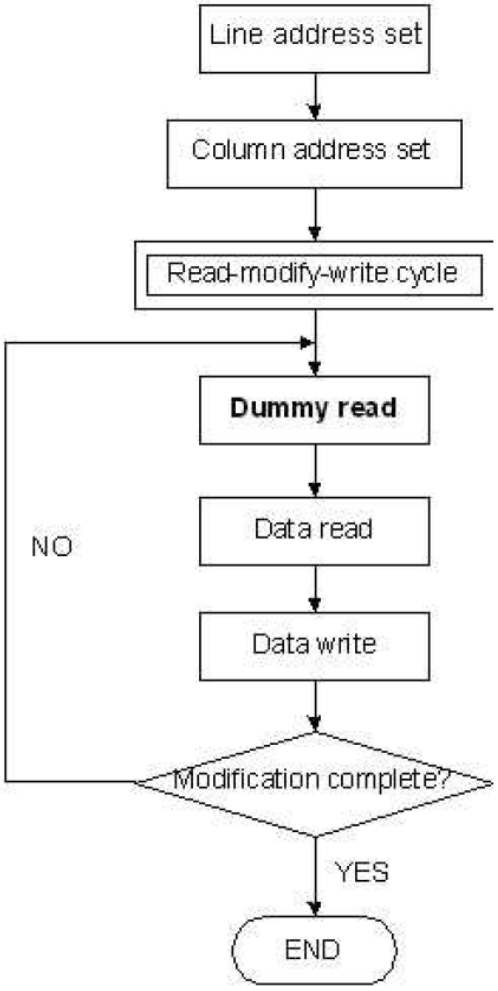
	A0	RD	RW	D7	D6	D5	D4	D3	D2	D1	D0
Command	0	1	0	1	0	1	0	1	0	0	1

(16) Read modify write in (RMWIN) - Parameter Byte: none (E0H)

This command is used along with the (9) line address set command (LASET), (10) column address set command (CASET), and (17) read modify write out command (RMWOUT). This function is for frequently modified data on a specific area, such as blinking cursor. First, set a specific display area using the column and line address commands. Then, execute this command to set the column and line addresses as the start address of the specific area. When this operation is complete, the column and line address will not be modified by the display data read command. It is increased only when the display data write command is executed. You can cancel this mode by entering the read modify write out or any other command.

	A0	RD	RW	D7	D6	D5	D4	D3	D2	D1	D0
Command	0	1	0	1	1	1	0	0	0	0	0

ST7529



(17) Read modify write out (RMWOUT) - Parameter Byte: none (EEH)

This command cancels the read modify write mode.

	A0	RD	RW	D7	D6	D5	D4	D3	D2	D1	D0
Command	0	1	0	1	1	1	0	1	1	1	0

(18) Area scroll set (ASCSET) - Parameter Byte: 4 (AAH)

It is to scroll only the specified portion of the screen (dividing the screen by lines). This command specifies the scrolling type of area, fixed area and scrolled area.

	A0	RD	RW	D7	D6	D5	D4	D3	D2	D1	D0	Function
Command	0	1	0	1	0	1	0	1	0	1	0	--
Parameter Byte 1 (PB1)	1	1	0	*	*	TB5	TB4	TB3	TB2	TB1	TB0	Top block address
Parameter Byte 2 (PB2)	1	1	0	*	*	BB5	BB4	BB3	BB2	BB1	BB0	Bottom block address
Parameter Byte 3 (PB3)	1	1	0	*	*	NSB5	NSB4	NSB3	NSB2	NSB1	NSB0	Number of specified blocks
Parameter Byte 4 (PB4)	1	1	0	*	*	*	*	*	*	SCM1	SCM0	Area scroll mode

ST7529

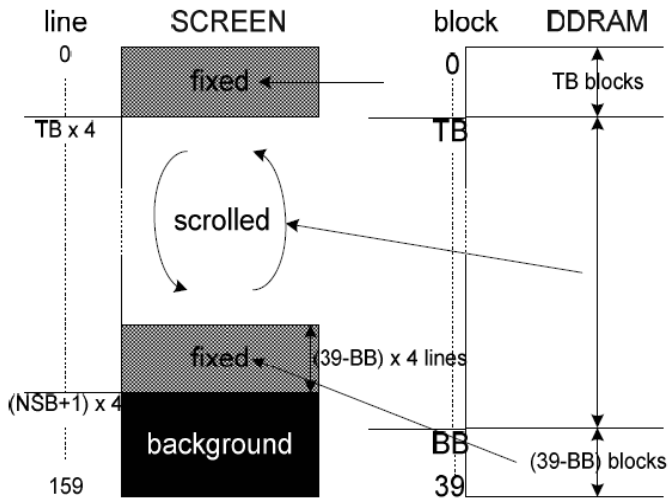
PB4: It is used to specify the scrolling mode.

SCM1	SCM0	Scrolling Mode	Settings		
			Top block address (TB)	Bottom block address (BB)	Number of specified blocks (NSB)
0	0	Center mode	Top(fixed area) height = Top address	Bottom(fixed area) height = 39-Bottom address	Bottom start address = Specified number
0	1	Top mode	0	Bottom(fixed area) height = 39-Bottom address	Bottom start address = Specified number
1	0	Bottom mode	Top(fixed area) height = Top address	39	39
1	1	Whole mode	0	39	39

Since ST7529 processes the liquid crystal display signals on the four-line basis (block basis), fixed and scrolled areas are also specified on the four-line basis (block basis).

DDRAM address of the top fixed area is set in the block address increasing direction starting with the 0th block.

DDRAM address of the bottom fixed area is set in the block address decreasing direction starting with 39st block. The DDRAM address of other blocks fixed areas are assigned to the scrolled + background areas.



PB1 is to specify the top block address of the scrolled + background areas. Specify the 0th block for the top screen scroll or whole screen scroll.

PB2 specifies the bottom address of the scroll + background areas. Specify the 39th block for the bottom or whole screen scroll. The relation that top block address < bottom block address must be maintained.

PB3 specifies a specific number of blocks {Numbers of (Top fixed area +Scroll area) block-1}. In the case of the bottom scroll or whole screen scroll, the value is identical with PB2.

The user can turn on the area scroll function by executing the area scroll set command first and then specifying the display start block of the scroll area with the scroll start set command.

(19) Scroll start address set (SCSTART) - Parameter Byte: 1 (ABH)

This command is to specify which line address of DDRAM to be the start line content shown on screen. Note that you must execute this command after executing the area scroll set command. Scroll becomes available by dynamically changing the start block address.

	A0	RD	RW	D7	D6	D5	D4	D3	D2	D1	D0	Function
Command	0	1	0	1	0	1	0	1	0	1	1	--
Parameter Byte 1 (PB1)	1	1	0	*	*	SB5	SB4	SB3	SB2	SB1	SB0	Start block address

Note : Don't repeat "Area scroll set(AAH)" instruction when "Scroll start address set" is executed.

(20) Internal oscillation on (OSCON) - Parameter Byte: none (D1H)

This command turns on the internal oscillation circuit. It is valid only when the internal oscillation circuit CLS = HIGH.

	A0	RD	RW	D7	D6	D5	D4	D3	D2	D1	D0
Command	0	1	0	1	1	0	1	0	0	0	1

(21) Internal oscillation off (OSCOFF) - Parameter Byte: none (D2H)

It turns off the internal oscillation circuit. The circuit is also turned off in the reset mode.

	A0	RD	RW	D7	D6	D5	D4	D3	D2	D1	D0
Command	0	1	0	1	1	0	1	0	0	1	0

(22) Power control set (PWRCTRL) - Parameter Byte: 1 (20H)

This command is used to turn on or off the Booster circuit, voltage regulator circuit, and reference voltage.

	A0	RD	RW	D7	D6	D5	D4	D3	D2	D1	D0	Function
Command	0	1	1	0	0	1	0	0	0	0	0	--
Parameter Byte 1 (PB1)	1	1	0	*	*	*	0	VB	0	VF	VR	LCD drive power

VR turns on/off the reference voltage generation circuit. VR = “1”: ON, VR =” 0”: OFF

VF turns on/off the circuit voltage follower. VF = “1”: ON, VF =” 0”: OFF

VB: It turns on or off the Booster. VB = “1”: ON, VB =” 0”: OFF

(23) Electronic volume control (VOLCTRL) - Parameter Byte: 2 (81H)

The command is used to program the optimum LCD supply voltage V_0. Refer to 7.10.2.

	A0	RD	RW	D7	D6	D5	D4	D3	D2	D1	D0	Function
Command	0	1	0	1	0	0	0	0	0	0	1	--
Parameter Byte 1 (PB1)	1	1	0	*	*	VPR5	VPR4	VPR3	VPR2	VPR1	VPR0	VPR[5:0]
Parameter Byte 2 (PB2)	1	1	0	*	*	*	*	*	VPR8	VPR7	VPR6	VPR[8:6]

With the VOLUP and VOLDOWN command the V_0 voltage and therewith the contrast of the LCD can be adjusted.

(24) Increment electronic control (VOLUP) - Parameter Byte: none (D6H)

This command increments electronic control offset value of voltage regulator (V0) circuit by 1. Each step is 0.04V.

	A0	RD	RW	D7	D6	D5	D4	D3	D2	D1	D0
Command	0	1	0	1	1	0	1	0	1	1	0

If you set the electronic control value to 111111, the control value is set to 000000 after this command has been executed.

(25) Decrement electronic control (VOLDOWN) - Parameter Byte: none (D7H)

This command decrements electronic control offset value of voltage regulator (V0) circuit by 1. Each step is 0.04V.

	A0	RD	RW	D7	D6	D5	D4	D3	D2	D1	D0
Command	0	1	0	1	1	0	1	0	1	1	1

If you set the electronic control value to 000000, the control value is set to 111111 after this command has been executed.

(26) Reserved (82H)

Do not use this command.

	A0	RD	RW	D7	D6	D5	D4	D3	D2	D1	D0
Command	0	1	0	1	0	0	0	0	0	1	0

ST7529

(27) Read Register 1 (EPSRRD1) Command: 1 Parameter Byte: none (7CH)

Execute the EPSRRD1 and STREAD (Status Read) commands in succession to read the Electronic Control value.

	A0	RD	RW	D7	D6	D5	D4	D3	D2	D1	D0
Command	0	1	0	0	1	1	1	1	1	0	0

Execute the Status Read command immediately after this command and execute the NOP command after the STREAD (Status Read) command.

(28) Read Register 2 (EPSRRD2) Command: 1 Parameter Byte: none (7DH)

Execute the EPSRRD2 and STREAD (Status Read) commands in succession to read the built-in resistance ratio.

	A0	RD	RW	D7	D6	D5	D4	D3	D2	D1	D0
Command	0	1	0	0	1	1	1	1	1	0	1

Execute the Status Read command immediately after this command and execute the NOP(Reset) command after the STREAD (Status Read) command.

(29) Non-operating (NOP) - Parameter Byte: none (25H)

This command does not affect the operation but has the function of canceling the IC test mode. Thus, it is recommended to enter it periodically to prevent malfunctioning due to noise and so on.

	A0	RD	RW	D7	D6	D5	D4	D3	D2	D1	D0
Command	0	1	0	0	0	1	0	0	1	0	1

(30) Status read (STREAD) - Parameter Byte: none

The command is to read the internal condition of the IC. One status can be displayed depending on the setting status after reset or after NOP operation.

	A0	RD	RW	D7	D6	D5	D4	D3	D2	D1	D0
Command	0	0	1	Status data							

D7: Area scroll mode	Refer to SCM1 (ASCSET)	
D6: Area scroll mode	Refer to SCM0 (ASCSET)	
D5: RMW on/off	0 : Out	1 : In
D4: Scan direction	0 : Column	1 : Line
D3: Display ON/OFF	0 : OFF	1 : ON
D2: EEPROM access	0: OutAccess	1: InAccess
D1: Display normal/inverse	0 : Inverse	1 : Normal
D0: Partial display	0 : OFF	1 : ON

(31) Initial code (1) (EPINT) Command: 1; Parameter: 1 (07H)

	A0	RD	RW	D7	D6	D5	D4	D3	D2	D1	D0	Function
Command	0	1	0	0	0	0	0	0	1	1	1	07H
Parameter(P1)	1	1	0	0	0	0	1	1	0	0	1	19H

This command is used for EEPROM internal ACK signal generating ,suggest using this command before EEPROM read/write operation . This command improve the EEPROM internal ACK signal under unstable power system.

ST7529

EXT="1"

The ST7529 applies 16-gray level and 2 FRC to achieve 32-gray scale display. Every gray level is in the strength controlled by 31-PWM (5-bit). The following 2 commands are to set the gray scale value.

(1) Set Gray 1 value (Gray 1 set) - Parameter Byte: 16 (20H)

Command	A0	RD	WR	D7	D6	D5	D4	D3	D2	D1	D0	Function
Gray1 Set	0	1	0	0	0	1	0	0	0	0	0	ODD FRAME Gray PWM Set
Parameter Byte 1 (PB1)	1	1	0	*	*	*	G0F14	G0F13	G0F12	G0F11	G0F10	Set Gray level 0 at odd frames
Parameter Byte 2 (PB2)	1	1	0	*	*	*	G1F14	G1F13	G1F12	G1F11	G1F10	Set Gray level 1 at odd frames
Parameter Byte 14 (PB14)	1	1	0	*	*	*	G13F14	G13F13	G13F12	G13F11	G13F10	Set Gray level 13 at odd frames
Parameter Byte 16 (PB16)	1	1	0	*	*	*	G15F14	G15F13	G15F12	G15F11	G15F10	Set Gray level 15 at odd frames

(2) Set Gray 2 value (Gray 2 set) - Parameter Byte: 16 (21H)

Command	A0	RD	WR	D7	D6	D5	D4	D3	D2	D1	D0	Function
Gray1 Set	0	1	0	0	0	1	0	0	0	0	1	EVEN FRAME Gray PWM Set
Parameter Byte 1 (PB1)	1	1	0	*	*	*	G0F24	G0F23	G0F22	G0F21	G0F20	Set Gray level 0 at even frames
Parameter Byte 2 (PB2)	1	1	0	*	*	*	G1F24	G1F23	G1F22	G1F21	G1F20	Set Gray level 1 at even frames
Parameter Byte 14 (PB14)	1	1	0	*	*	*	G13F24	G13F23	G13F22	G13F21	G13F20	Set Gray level 13 at even frames
Parameter Byte 16 (PB16)	1	1	0	*	*	*	G15F24	G15F23	G15F22	G15F21	G15F20	Set Gray level 15 at even frames

(3) Analog circuit set (ANASET) – Parameter Byte: 3 (32H)

	A0	RD	WR	D7	D6	D5	D4	D3	D2	D1	D0	Function
Command	0	1	0	0	0	1	1	0	0	1	0	–
Parameter Byte 1 (PB1)	1	1	0	*	*	*	*	*	OSF2	OSF1	OSF0	OSC frequency Adjustment
Parameter Byte 2 (PB2)	1	1	0	*	*	*	*	*	*	BE1	BE0	Booster Efficiency Set
Parameter Byte 3 (PB3)	1	1	0	*	*	*	*	*	BS2	BS1	BS0	Bias setting

PB1: Oscillator frequency adjustment

OSF2	OSF1	OSF0	Frequency (KHz)
0	0	0	12.7 (Default)
1	0	0	13.2
0	1	0	14.3
1	1	0	15.7
0	0	1	17.3
1	0	1	19.3
0	1	1	21.9
1	1	1	25.4

Condition : 1/160 duty, $f_{CL(Hz)}$ = Frame frequency x (duty + 1dummy)

ST7529

PB2: Booster Efficiency set

BE1	BE0	Frequency on booster capacitors (Hz)
0	0	3K
0	1	6K (Default)
1	0	12K
1	1	24K

PB3: Select LCD bias ratio of the voltage required for driving the LCD.

BS2	BS1	BS0	LCD bias
0	0	0	1/14
0	0	1	1/13
0	1	0	1/12
0	1	1	1/11
1	0	0	1/10
1	0	1	1/9
1	1	0	1/7
1	1	1	1/5

(4) Software Initial (SWINT) - Parameter Byte: None (34H)

	A0	RD	RW	D7	D6	D5	D4	D3	D2	D1	D0
Command	0	1	0	0	0	1	1	0	1	0	0

(5) Control EEPROM (EPCTIN) - Parameter Byte: 1 (CDH)

	A0	RD	RW	D7	D6	D5	D4	D3	D2	D1	D0
Command	0	1	0	1	1	0	0	1	1	0	1
Parameter Byte 1 (PB1)	1	1	0	0	0	EEWR	0	0	0	0	0

When EEWR = “1”, EEPROM will be Write Enable; when EEWR = “0”, EEPROM will be Read Enable.

(6) Cancel EEPROM Command (EPCOUT) - Parameter Byte: None (CCH)

This command is to cancel the EEPROM Read/Write Enable.

	A0	RD	RW	D7	D6	D5	D4	D3	D2	D1	D0
Command	0	1	0	1	1	0	0	1	1	0	0

(7) Write data to EEPROM (EPMWR) - Parameter Byte: None (FCH)

This command is to Write data to EEPROM.

	A0	RD	RW	D7	D6	D5	D4	D3	D2	D1	D0
Command	0	1	0	1	1	1	1	1	1	0	0

(8) Read data from EEPROM (EPMRD) - Parameter Byte: None (FDH)

This command is to Read data from EEPROM.

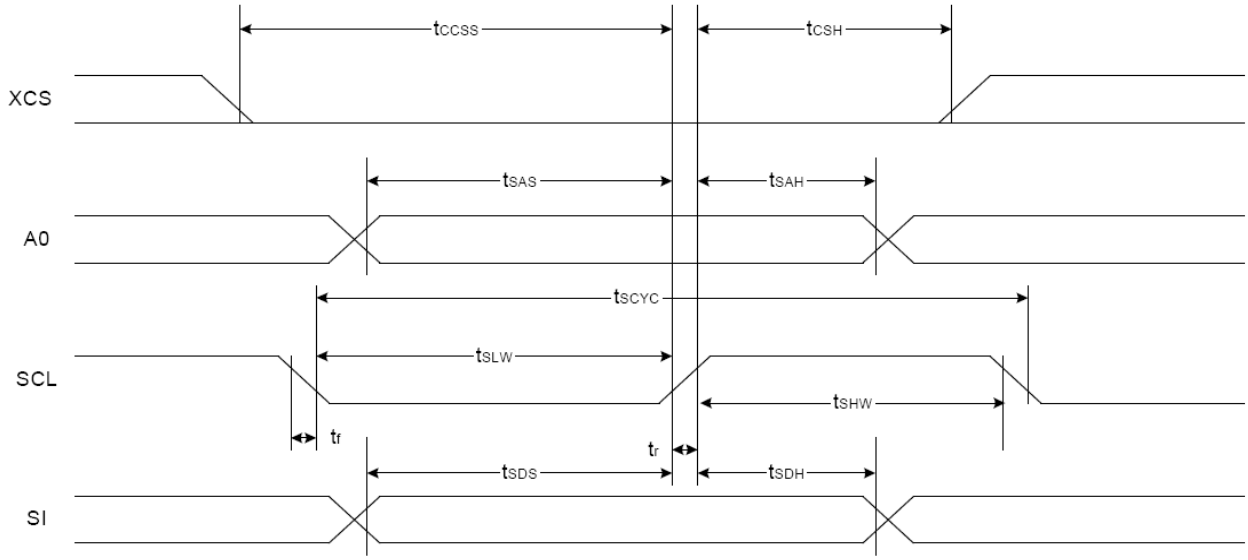
	A0	RD	RW	D7	D6	D5	D4	D3	D2	D1	D0
Command	0	1	0	1	1	1	1	1	1	0	1

TIMING CHARACTERISTICS OF COMPATIBLE CONTROLLER CHIPS
1:SERIAL INTERFACE(4-Line interface)

(V_{DD}=3.3V,Ta= –30 to 85°C,Die)

Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
Serial Clock Period	SCL	tSCYC	-	100	-	ns
SCL “H” pulse width		tSHW	-	50	-	
SCL “L” pulse width		tSLW	-	50	-	
Address setup time	A0	tSAS	-	40	-	
Address hold time		tSAH	-	30	-	
Data setup time	SI	tSDS	-	30	-	
Data hold time		tSDH	-	30	-	
CS-SCL time	XCS	tCSS	-	20	-	
CS-SCL time		tCSH	-	50	-	

Figure 1 Timing Characteristics



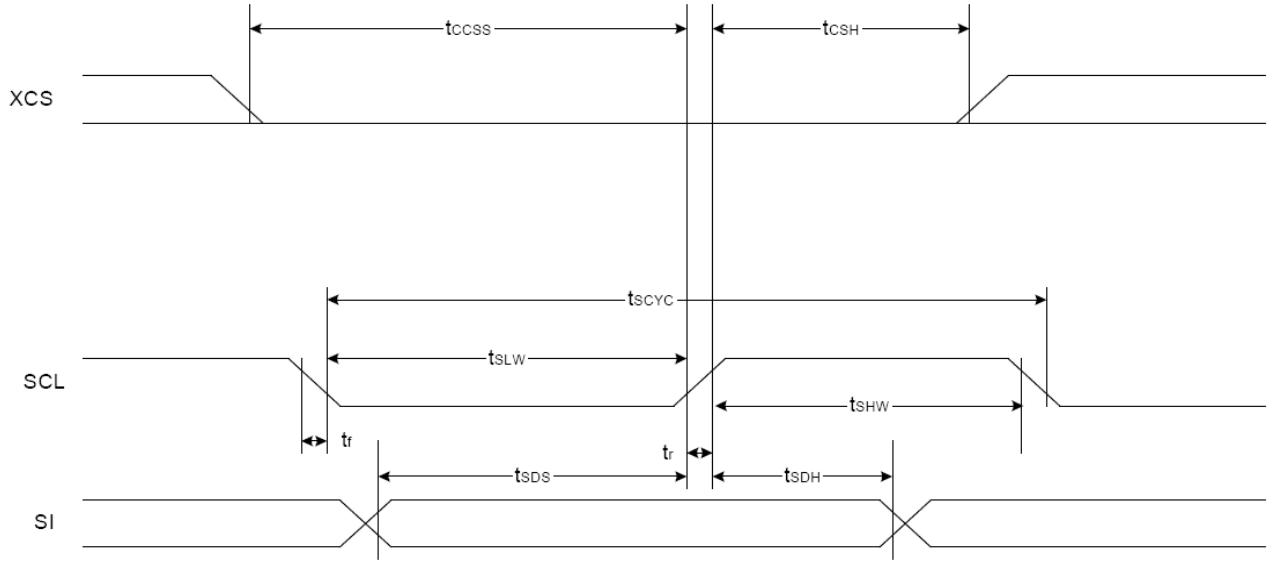
note:*1 The input signal rise and fall time(tr,tf)are specified at 15 ns less.
***2 All timing is specified using 20% and 80% of VDD as the standard.**

2:SERIAL INTERFACE(3-Line interface)

(V_{DD}=3.3V,Ta= –30 to 85°C,Die)

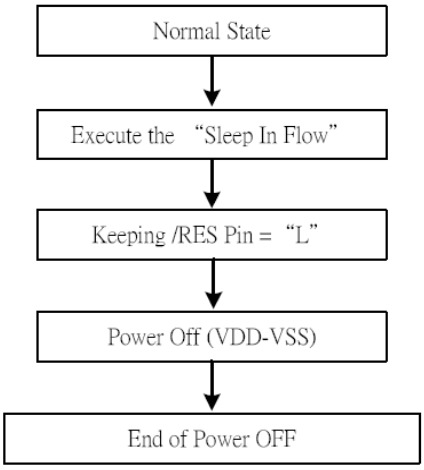
Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
Serial Clock Period	SCL	tSCYC	-	100	-	ns
SCL “H” pulse width		tSHW	-	50	-	
SCL “L” pulse width		tSLW	-	50	-	
Data setup time	SI	tSDS	-	30	-	
Data hold time		tSDH	-	30	-	
CS-SCL time	XCS	tCSS	-	20	-	
CS-SCL time		tCSH	-	50	-	

Figure 2 Timing Characteristics



note:*1 The input signal rise and fall time(tr,tf)are specified at 15 ns less.
***2 All timing is specified using 20% and 80% of VDD as the standard.**

3 Power OFF timing



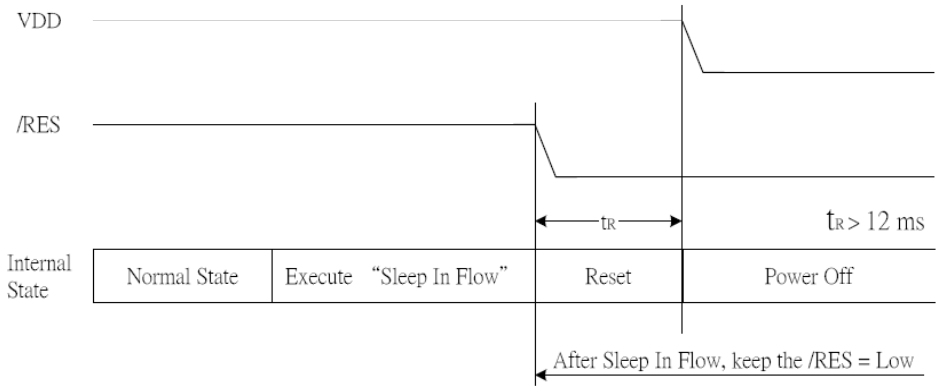


Figure 8.2.8.1 Power off

Note：The sequence is that users must set the VDD to low after keeping the /RES=low time longer than 12ms.

4 RESET Timing

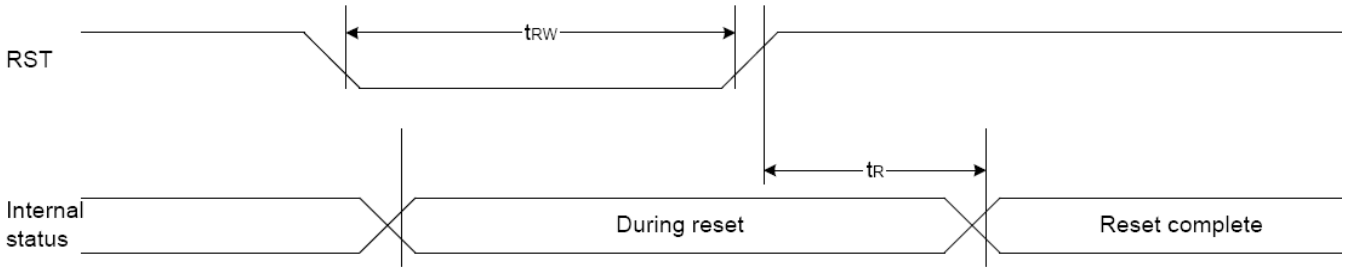


Fig 43.

(VDD =3.3V , Ta = –30 to 85°C,Die)

Item	Signal	Symbol	Condition	Rating			Units
				Min.	Typ.	Max.	
Reset time		tR	-	-	-	1	us
Reset “L” pulse width	RST	tRW	-	1	-	-	us

(VDD = 2.7V , Ta = –30 to 85°C,Die)

Item	Signal	Symbol	Condition	Rating			Units
				Min.	Typ.	Max.	
Reset time		tR	-	-	-	1.5	us
Reset “L” pulse width	RST	tRW	-	1.5	-	-	us

INITIALIZATION METHOD

The module will automatically perform initialization by detecting the rising or falling edge of the RST input after the power is turned on. The following instructions are executed during initialization.

Extension instruction disable:30H
Sleep out:94H
Internal oscillation on:D1H
Power control set:03H
Electronic volume control:2CH,03H
Display control:00H,27H,00H
Inverse display:A7H
Common scan:02H
Data scan direction:00H,00H,02H
Line address set:00H,9FH
Column address set:10H,45H
Extension instruction enable:31H
Analog circuit set:00H,01H,00H
Software Initial:34H
Extension instruction disable:30H
Display ON:AFH

DISPLAY DDRAM

Memory Map (2B3P, 8-bit mode)

			Column									
LCD read direction ↓	CI = 0		0			1				84		
	CI = 1		84			83				0		
	Pixel		P0	P1	P2	P3	P4	P5		P252	P253	P254
	Data Line		$D7'_{1,0}$ $D6'_{1,0}$ $D5'_{1,0}$ $D4'_{1,0}$ $D3'_{1,0}$	$D2'_{1,0}$ $D1'_{1,0}$ $D0'_{1,0}$ $D7'_{2,0}$ $D6'_{2,0}$	$D4'_{2,0}$ $D3'_{2,0}$ $D2'_{2,0}$ $D1'_{2,0}$ $D0'_{2,0}$	$D7'_{1,1}$ $D6'_{1,1}$ $D5'_{1,1}$ $D4'_{1,1}$ $D3'_{1,1}$	$D2'_{1,1}$ $D1'_{1,1}$ $D0'_{1,1}$ $D7'_{2,1}$ $D6'_{2,1}$	$D4'_{2,1}$ $D3'_{2,1}$ $D2'_{2,1}$ $D1'_{2,1}$ $D0'_{2,1}$		$D7'_{1,84}$ $D6'_{1,84}$ $D5'_{1,84}$ $D4'_{1,84}$ $D3'_{1,84}$	$D2'_{1,84}$ $D1'_{1,84}$ $D0'_{1,84}$ $D7'_{2,84}$ $D6'_{2,84}$	$D4'_{2,84}$ $D3'_{2,84}$ $D2'_{2,84}$ $D1'_{2,84}$ $D0'_{2,84}$
Block	LI = 0	LI = 1										
0	0	159										
	1	158										
	2	157										
	3	156										
1	4	155										
	5	154										
	6	153										
	7	152										
2	8	151										
	9	150										
38	152	7										
	153	6										
	154	5										
	155	4										
39	156	3										
	157	2										
	158	1										
	159	0										
SEGout			0	1	2	3	4	5		252	253	254

Memory Map (2B3P, 16-bit mode)

			Column									
LCD read direction ↓	CI = 0		0			1					84	
	CI = 1		84			83					0	
	Pixel		P0	P1	P2	P3	P4	P5		P252	P253	P254
	Data Line		$D15'_0$ $D14'_0$ $D13'_0$ $D12'_0$ $D11'_0$	$D10'_0$ $D9'_0$ $D8'_0$ $D7'_0$ $D6'_0$	$D4'_0$ $D3'_0$ $D2'_0$ $D1'_0$ $D0'_0$	$D15'_1$ $D14'_1$ $D13'_1$ $D12'_1$ $D11'_1$	$D10'_1$ $D9'_1$ $D8'_1$ $D7'_1$ $D6'_1$	$D4'_1$ $D3'_1$ $D2'_1$ $D1'_1$ $D0'_1$		$D15'_{84}$ $D14'_{84}$ $D13'_{84}$ $D12'_{84}$ $D11'_{84}$	$D10'_{84}$ $D9'_{84}$ $D8'_{84}$ $D7'_{84}$ $D6'_{84}$	$D4'_{84}$ $D3'_{84}$ $D2'_{84}$ $D1'_{84}$ $D0'_{84}$
Block	LI = 0	LI = 1										
0	0	159										
	1	158										
	2	157										
	3	156										
1	4	155										
	5	154										
	6	153										
	7	152										
2	8	151										
	9	150										
38	152	7										
	153	6										
	154	5										
	155	4										
39	156	3										
	157	2										
	158	1										
	159	0										
SEGout			0	1	2	3	4	5		252	253	254

Memory Map (3B3P, 8-bit mode)

			Column									
LCD read direction ↓	CI = 0		0			1				84		
	CI = 1		84			83				0		
	Pixel		P0	P1	P2	P3	P4	P5		P252	P253	P254
	Data Line		D7'$_{1,0}$ D6'$_{1,0}$ D5'$_{1,0}$ D4'$_{1,0}$ D3'$_{1,0}$	D7'$_{2,0}$ D6'$_{2,0}$ D5'$_{2,0}$ D4'$_{2,0}$ D3'$_{2,0}$	D7'$_{3,0}$ D6'$_{3,0}$ D5'$_{3,0}$ D4'$_{3,0}$ D3'$_{3,0}$	D7'$_{1,1}$ D6'$_{1,1}$ D5'$_{1,1}$ D4'$_{1,1}$ D3'$_{1,1}$	D7'$_{2,1}$ D6'$_{2,1}$ D5'$_{2,1}$ D4'$_{2,1}$ D3'$_{2,1}$	D7'$_{3,1}$ D6'$_{3,1}$ D5'$_{3,1}$ D4'$_{3,1}$ D3'$_{3,1}$		D7'$_{1,84}$ D6'$_{1,84}$ D5'$_{1,84}$ D4'$_{1,84}$ D3'$_{1,84}$	D7'$_{2,84}$ D6'$_{2,84}$ D5'$_{2,84}$ D4'$_{2,84}$ D3'$_{2,84}$	D7'$_{3,84}$ D6'$_{3,84}$ D5'$_{3,84}$ D4'$_{3,84}$ D3'$_{3,84}$
Block	LI = 0	LI = 1										
0	0	159										
	1	158										
	2	157										
	3	156										
1	4	155										
	5	154										
	6	153										
	7	152										
2	8	151										
	9	150										
38	152	7										
	153	6										
	154	5										
	155	4										
39	156	3										
	157	2										
	158	1										
	159	0										
SEGout			0	1	2	3	4	5		252	253	254

Memory Map (3B3P, 16-bit mode)

			Column									
LCD read direction	CI = 0		0			1					84	
	CI = 1		84			83					0	
	Pixel		P0	P1	P2	P3	P4	P5		P252	P253	P254
	Data Line		$D15'_{1,0}$ $D14'_{1,0}$ $D13'_{1,0}$ $D12'_{1,0}$ $D11'_{1,0}$	$D7'_{1,0}$ $D6'_{1,0}$ $D5'_{1,0}$ $D4'_{1,0}$ $D3'_{1,0}$	$D15'_{2,0}$ $D14'_{2,0}$ $D13'_{2,0}$ $D12'_{2,0}$ $D11'_{2,0}$	$D15'_{1,1}$ $D14'_{1,1}$ $D13'_{1,1}$ $D12'_{1,1}$ $D11'_{1,1}$	$D7'_{1,1}$ $D6'_{1,1}$ $D5'_{1,1}$ $D4'_{1,1}$ $D3'_{1,1}$	$D15'_{2,1}$ $D14'_{2,1}$ $D13'_{2,1}$ $D12'_{2,1}$ $D11'_{2,1}$		$D15'_{1,84}$ $D14'_{1,84}$ $D13'_{1,84}$ $D12'_{1,84}$ $D11'_{1,84}$	$D7'_{1,84}$ $D6'_{1,84}$ $D5'_{1,84}$ $D4'_{1,84}$ $D3'_{1,84}$	$D15'_{2,84}$ $D14'_{2,84}$ $D13'_{2,84}$ $D12'_{2,84}$ $D11'_{2,84}$
Block	LI = 0	LI = 1										
0	0	159										
	1	158										
	2	157										
	3	156										
1	4	155										
	5	154										
	6	153										
	7	152										
2	8	151										
	9	150										
38	152	7										
	153	6										
	154	5										
	155	4										
39	156	3										
	157	2										
	158	1										
	159	0										
SEGout			0	1	2	3	4	5		252	253	254

ELECTRO-OPTICAL CHARACTERISTICS

MEASURING CONDITION: POWER SUPPLY = V_{OP} / 64 Hz
TEMPERATURE = 23 ± 5 °C
RELATIVE HUMIDITY = 60 ± 20 %

ITEM	SYMBOL	UNIT	TYP. STN
RESPONSE TIME	T_{on}	ms	320
	T_{off}	ms	430
CONTRAST RATIO	Cr	-	8
VIEWING ANGLE (Cr ≥ 2)	$V_{3:00}$	°	40
	$V_{6:00}$	°	55
	$V_{9:00}$	°	40
	$V_{12:00}$	°	35

THE ELECTRO-OPTICAL CHARACTERISTICS ARE MEASURED VALUE BUT NOT GUARANTEED ONES.

RELIABILITY OF LCD MODULE

ITEM	TEST CONDITION FOR NORMAL TEMPERATURE	TEST CONDITION FOR WIDE TEMPERATURE	TIME
High temperature operating	50°C	70°C	240 hours
Low temperature operating	0°C	-20°C	240 hours
High temperature storage	60°C	80°C	240 hours
Low temperature storage	-10°C	-30°C	240 hours
Temperature-humidity storage	40°C 90% R.H.	60°C 90% R.H.	96 hours
Temperature cycling	-10°C to 60°C 30 Min Dwell	-30°C to 80°C 30 Min Dwell	5 cycle
Vibration Test at LCM Level	Freq 10-55 Hz Sweep rate: 10-55-10 at 1 min Sweep mode Linear Displacement: 2 mm p-p 1 Hour each for X, Y, Z	Freq 10-55 Hz Sweep rate: 10-55-10 at 1 min Sweep mode Linear Displacement: 2 mm p-p 1 Hour each for X, Y, Z	—

SAMPLING METHOD

SAMPLING PLAN: MIL-STD 105E

CLASS OF AQL: LEVEL II/ SINGLE SAMPLING
MAJOR-0.65% MINOR – 1.5%

QUALITY STANDARD

DEFECT	CRITERIA	TYPE	FIGURE
SHORT CIRCUIT	-	MAJOR	-
MISSING SEGMENT	-	MAJOR	-
UNEVEN / POOR CONTRAST	-	MAJOR	-
CROSS TALK	-	MAJOR	-
PIN HOLE	MAX(a,b) ≤ 1 / 4 W	MINOR	1
EXCESS SEGMENT	MAX(c,d) ≤ 1 / 4 T	MINOR	1
BUBBLES	d* ≥ 0.2 QTY=0	MINOR	2
BLACKS SPOTS	d ≤ 0.3 N.A.** 0.3<d≤0.4 QTY≤1 0.4<d QTY=0	MINOR	2
LINE SCRATCHES	x≥0.7 y≥0.05 QTY=0	MINOR	3
BLACK LINE	x≥0.7 y≥0.05 QTY=0	MINOR	3

*d = MAX (d_1,d_2) ** N. A . = NOT APPLICABLE DEFECT TABLE : B

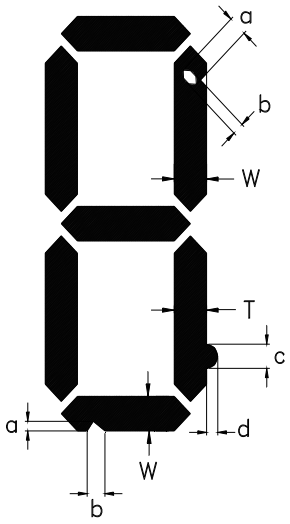
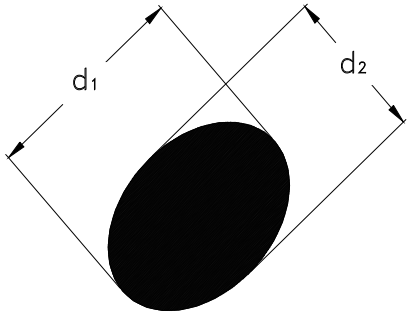
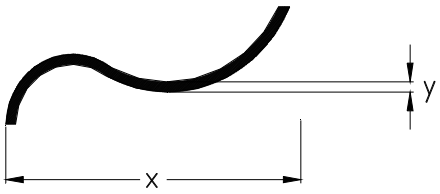


fig . 1



POLARIZER BUBBLES / SPOTS
fig . 2



LINE SCRATCHES / BLACK LINE
fig . 3

QUALITY STANDARD (CONT.)

DEFECT		CRITERIA	TYPE	FIGURE
CHIPS	CONTACT EDGE	e≤1/2T f≤1/3W g≤3.5	MINOR	4
	BOTTOM GLASS	p≤1.0 q≤3.5 r≤1/2T		4
	CORNER	a≤1.5 b≤W		4
	TOP GLASS	a≤3.0 b≤1/3T c≤1/2W		5
GLASS PROTRUSION		a ≤ 1/4 W	MINOR	6
RAINBOW		-	MINOR	-

UNLESS STATE OTHERWISE , ALL UNIT ARE IN MILLIMETER . DEFECT TABLE : B

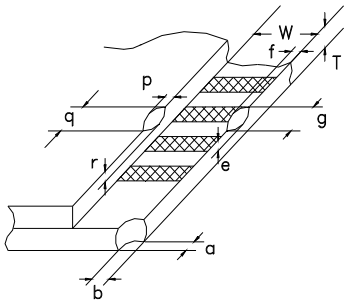


fig . 4

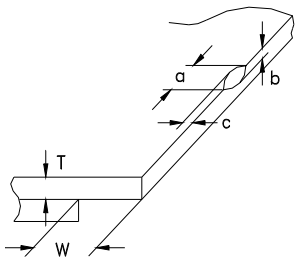


fig . 5

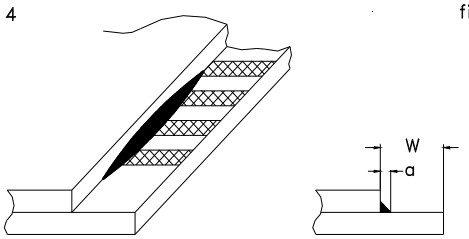


fig . 6

HANDLING PRECAUTIONS

(1) CAUTION OF LCD HANDLING & CLEANING

The polarizing plate on the surface of the panel is made from organic substances. Be very careful for chemicals not to touch the plate or it leads the polarizing plate to deteriorate.

If the use of a chemical is unavoidable, wipe the panel lightly with soft materials, such as gauze and absorbent cotton, soaked in a solvent.

*Usable solvent: Alcohol (ethanol, IPA and the like)
*Appropriate solvent: Ketones, ethyl alcohol

Avoid wiping with a dry cloth, since it could damage the surface of the polarizing plate and others.
Do not expose to direct sunlight or fluorescent light for a long time

(2) CAUTION AGAINST STATIC CHARGE

The LCD modules use CMOS LSI drivers, so customers are recommended that any unused input terminal would be connected to V_{DD} or V_{SS} , do not input any signals before power is turned on, and ground your body, work/assembly areas, assembly equipment to protect against static electricity.

(3) ESD PRECAUTION

Inputs and outputs are protected against electrostatic discharge in normal handling. However, to be totally safe, it is recommended to take normal precautions appropriate to handling LCM module. For example: product surface grounding.

Always take ESD precaution when handling the *LCD Module*. Components are exposed for direct finger touches and can be damaged unless ESD precaution is taken.

(4) PACKAGING

Avoid intense shock and falls from a height and do not operate or store them exposed to direct sunshine or high temperature/humidity for long periods.

(5) CAUTION FOR OPERATION

The viewing angle can be adjusted by varying the LCD driving voltage VO.

Driving voltage should be kept within specified range, excess voltage shortens display life.

Response time increases with decrease in temperature.

Display may turn black or dark Blue at temperature above its operational range; this is however not destructive and the display will return to normal once the temperature falls back to range.

Mechanical disturbance during operation (such as pressing on the viewing area) may cause the segments to appear “fractured”. They will recover once the display is turned off.

Condensation at terminals will cause malfunction and possible electrochemical reaction. Relative humidity of the environment should therefore be kept below 60%.

(6) SAFETY

Liquid crystal may leak out of a damaged LCD, it is recommended to wash off the liquid crystal by using solvents such as acetone or ethanol and should be burned up later.

If any liquid leak out of a damaged glass cell comes in contact with your hands, wash it off with soap and water immediately.

WARRANTY

CLOVER will replace or repair any of her LCD module in accordance with her LCD specification for a period of one year from date of shipment. The warranty liability of Clover is limited to repair and/or replacement. Clover will not be responsible for any subsequent or consequential event.