DOT MATRIX
LIQUID CRYSTAL DISPLAY
MODULE

LMG-S2408001-LED Serial

USER‘ MANUAL

	LMG-SSC2408001DLGW		**LMG-SFC2408001DLGB**
	LMG-SSC2408001DLYG		**LMG-SFC2408001DLGG**
	LMG-SSC2408001DLNW		**LMG-SFC2408001DLNW**

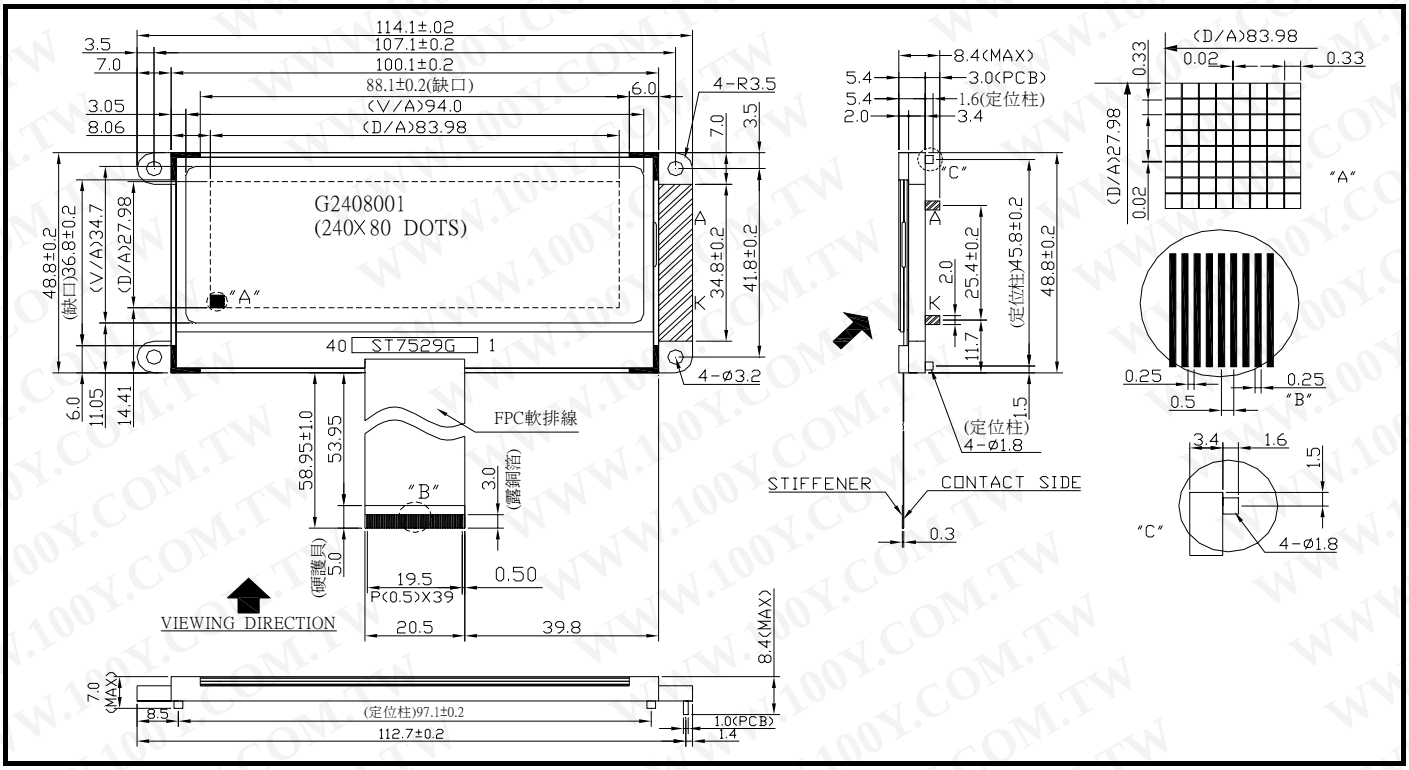
PROPOSED BY		**APPROVED**
Design	Approved	

CONTENTS

1. Mechanical Specification

ITEM	STANDARD VALUE			UNIT
DOT MATRIX FORMAT	240 X 80 DOTS			--
Controller IC	ST7529 or equivalent			--
MODULE DIMENSION	114.1 (W) X 48.8 (H) X 8.4 (T)			mm
VIEWING DISPLAY AREA	94.0 (W) X 34.7 (H)			mm
ACTIVE DISPLAY AREA	83.98 (W) X 27.98 (H)			mm
DOT SIZE	0.33 (W) X 0.33 (H)			mm
DOT PITCH	0.35 (W) X 0.35 (H)			mm
LMG-SSC2408001DLGW	STN , Gray , 1/80 Duty , 1/9 Bias , 6 O'clock, LED Backlight (color is White)			
LMG-SFC2408001DLGB	FSTN , Gray , 1/80 Duty , 1/9 Bias , 6 O'clock, LED Backlight (color is Blue)			
LMG-SSC2408001DLYG	STN , Yellow Green , 1/80 Duty , 1/9 Bias , 6 O'clock , LED Backlight (color is Green)			
LMG-SFC2408001DLGG	FSTN , Gray , 1/80 Duty , 1/9 Bias , 6 O'clock , LED Backlight (color is Green)			
LMG-SSC2408001DLNW	STN , Blue , 1/80 Duty , 1/9 Bias , 6 O'clock, LED Backlight (color is White)			
LMG-SFC2408001DLNW	FSTN , Black , 1/80 Duty , 1/9 Bias , 6 O'clock , LED Backlight (color is White)			
LED Backlight Color	Blue / White / Green			
Backlight Input	DC +3.2V	V	78	mA
Continue Light (25℃ / IF=15mA / 80% Brightness)	1,000			HR.
Backlight Half-Lift Time (25℃ / IF=15mA / 60% Brightness)	3,000			HR.
Discontinuous Light (Everyday Less Than 10 HR.) (25℃ / IF=15mA / 40% Brightness)	8,000			HR.
Electronic Static Defend	500			V

2. Mechanical Diagram



3. Interface Pin Connections

NO	SYM	LEVEL	FUNCTION	NO	SYM	LEVEL	FUNCTION
1	VSS	—	0V	21	VDD	—	+3.3V
2	VDD	—	+3.3V	22	C7+	—	The Step-up Voltage Capacitance
3	A0	H/L	A0 = H : Data , A0 = L : Command	23	C1-	—	The Step-up Voltage Capacitance
4	RW_WR	L	68 Series : RW ; 80 Series : /WR	24	C5+	—	The Step-up Voltage Capacitance
5	DB0	H/L	DATA BIT0	25	C3+	—	The Step-up Voltage Capacitance
6	DB1	H/L	DATA BIT1	26	C1-	—	The Step-up Voltage Capacitance
7	DB2	H/L	DATA BIT2	27	C1+	—	The Step-up Voltage Capacitance
8	DB3	H/L	DATA BIT3	28	C2+	—	The Step-up Voltage Capacitance
9	DB4	H/L	DATA BIT4	29	C2-	—	The Step-up Voltage Capacitance
10	DB5	H/L	DATA BIT5	30	C4+	—	The Step-up Voltage Capacitance
11	DB6	H/L	DATA BIT6	31	C2-	—	The Step-up Voltage Capacitance
12	DB7	H/L	DATA BIT7	32	C6+	—	The Step-up Voltage Capacitance
13	E_RD	L	68 Series : E ; 80 Series : /RD	33	VLCD	—	LCD Driver Supply Voltages
14	RESET	L	CONTROLLER RESET	34	VREF	—	Reference Voltage Output For Monitor Only. Leave it Open
15	IF1	H/L	Interface Mode Select	35	V4	—	LCD Driver Supply Voltages
16	IF2	H/L	Interface Mode Select	36	V3	—	LCD Driver Supply Voltages
17	IF3	H/L	Interface Mode Select	37	V2	—	LCD Driver Supply Voltages
18	SI	H/L	Series Data Input	38	V1	—	LCD Driver Supply Voltages
19	SCL	H/L	Series Clock Input	39	V0OUT	—	LCD Driver Supply Voltages
20	XCS	L	CHIP ENABLE SIGNAL	40	V0IN	—	LCD Driver Supply Voltages

4. Electrical Absolute Maximum Ratings

ITEM	SYMBOL	MIN.	TYPE	MAX.	UNIT
SUPPLY VOLTAGE FOR LOGIC	VDD-VSS	2.4	3.3	3.6	V
SUPPLY VOLTAGE FOR LCD	V0-SS	4.0	--	18.0	V
INPUT VOLAGE	VI	VSS	--	VDD	V

5. Environmental absolute maximum ratings

ITEM	OPERATING		STORAGE		REMARKS
	MIN.	MAX.	MIN.	MAX.	--
Ambient Temperature	0 °C	50 °C	-10 °C	60 °C	NOTE 1
Humidity	NOTE 1		NOTE 2		Without Condensation
Vibration	--	4.9m/s^2	--	19.6m/s^2	XYZ Directions
Shock	--	29.4m/s^2	--	490.0m/s^2	XYZ Directions

Remarks:

NOTE (1) : Ta at 60 °C : 50 HR Max.

NOTE (2) : Ta < 40 °C : 95% RH Max.

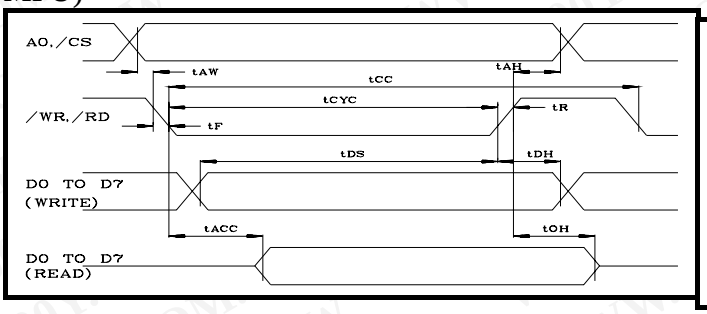
Ta > 40 °C : Absolute humidity must be lower than the humidity of 95% at 40 °C.

6. Electrical Characteristics

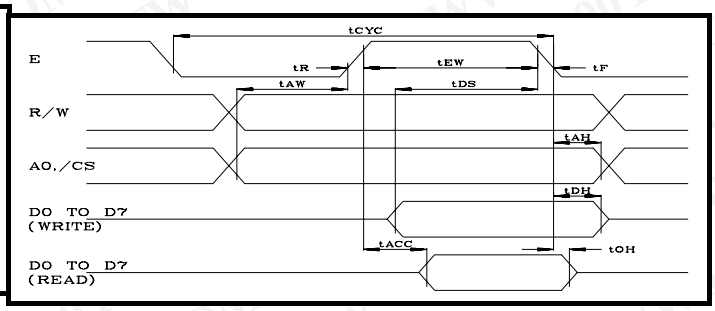
ITEM	SYN	CONDITION	MIN.	TYPE	MAX.	UNIT
SUPPLY VOLTAGE FOR LOGIC	VDD-VSS	--	2.4	3.3	3.6	V
SUPPLY VOLTAGE FOR LCD	VLCD	Ta= 25℃	--	--	18.0	V
INPUT HIGH VOLTAGE	VIH	--	0.7VDD	--	VDD	V
INPUT LOW VOLTAGE	VIL	--	0	--	0.3VDD	V

7. Timing Control

MPU Bus Read/Write(80-family MPU)

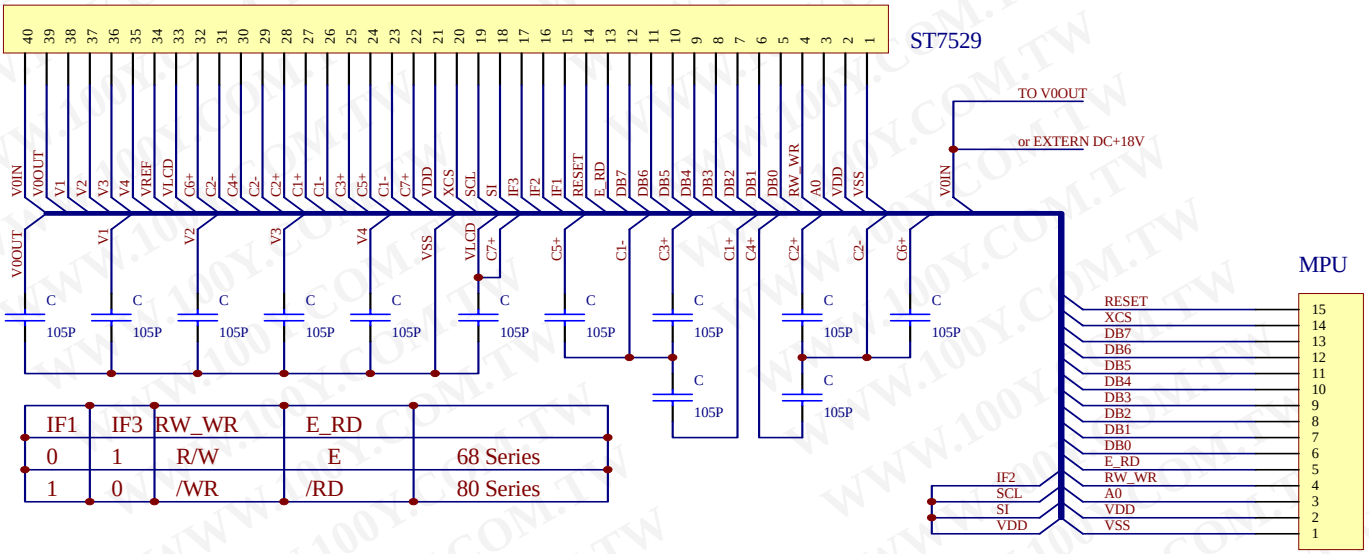


MPU Bus Read/Write(68-family MPU)



Item		Symbol	Limit (Min.)	Limit (Max.)	Unit
System cycle time		tCYC	240	--	ns
Address setup time		tAW	0	--	ns
Address hold time		tAH	0	--	ns
Control pulse width		tCC	240	--	ns
Data setup time		tDS	40	--	ns
Data hold time		tDH	10	--	ns
Output disable time		tOH	5	50	ns
READ access time		tACC	--	70	ns
Enable Pulse width	Read	tEW	140	--	ns
	Write		80	--	ns
Rise and Fall time		tR,tF	--	10	ns

8. Application Circuit



9. Instruction Set

Ext=0 or Ext=1

Index	Command	A0	RD	WR	D7	D6	D5	D4	D3	D2	D3	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
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	Wt. Set	0	1	0	0	0	1	0	0	0	1	0	Weight Set	22	3 bytes
4	ANASET	0	1	0	0	0	1	1	0	0	1	0	Analog Circuit Set	32	3 bytes
5	DITHOFF	0	1	0	0	0	1	1	0	1	0	0	Dithering Circuit Off	34	None
6	DITHON	0	1	0	0	0	1	1	0	1	0	1	Dithering Circuit On	35	None
7	EPCTIN	0	1	0	1	1	0	0	1	1	0	1	Control EEPROM	CD	1 byte
8	EPCOUT	0	1	0	1	1	0	0	1	1	0	0	Cancel EEPROM	CC	None
9	EPMWR	0	1	0	1	1	1	1	1	1	0	0	Write to EEPROM	FC	None
10	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.

10. Description Of Instructions

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

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

It us 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

(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	0	1	1	1	0	1	1	--
Parameter Byte 1 (PB1)	1	1	0	*	*	*	0	0	CLD	0	0	CL dividing ratio. F1 and F2 drive pattern
Parameter Byte 1 (PB2)	1	1	0	*	*	DT5	DT4	DT3	DT2	DT1	DT0	Drive duty
Parameter Byte 1 (PB3)	1	1	0	*	*	*	FI	LF3	LF2	LF1	LF0	DR 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*2^5+ DT4*2^4+ DT3*2^3+ DT2*2^2+ DT1*2^1+ DT0*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.
Numbers of line cycles-1=LF3*2^3+ LF2*2^2+ LF1*2^1+ LF0*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*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 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	Common Scan direction
Parameter Byte 1 (PB2)	1	1	0	EL7	EL6	EL5	EL4	EL3	EL2	EL1	EL0	

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 increased by 1 and column address 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	Common Scan direction
Parameter Byte 1 (PB2)	1	1	0	EC7	EC6	EC5	EC4	EC3	EC2	EC1	EC0	

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 1 (PB2)	1	1	0	*	*	*	*	*	*	*	0	Not used, D0 must be 0.
Parameter Byte 1 (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/inverse 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.
PB2 is not used, D0 must be 0.
PB3 is to select desired gray scale display mode 2B3P or 3B3PD1 or 3B3PD2 mode.

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

2B3P 32 Gray Scale Display

D7	D6	D5	D4	D3	D2	D1	D0	
P0	P0	P0	P0	P0	P1	P1	P1	1 st write
P1	P1	D	P2	P2	P2	P2	P2	2nd write

A single pixel of data is read after the second write operation as shown, and it is written in the display RAM. "X" are dummy bits, which are ignored for display, "D" are dither bits, which are used for dither.

3B3PD1 32 Gray Scale Display

D7	D6	D5	D4	D3	D2	D1	D0	
P0	P0	P0	P0	P0	D	X	X	1 st write
P1	P1	P1	P1	P1	D	X	X	2nd write
P2	P2	P2	P2	P2	D	X	X	3rd write

A single pixel of data is read after the third write operation as shown, and it is written in the display RAM. "X" are dummy bits, which are ignored for display, "D" are dither bits, which are used for dither.

3B3PD2 32 Gray Scale Display

D7	D6	D5	D4	D3	D2	D1	D0	
P0	P0	P0	P0	P0	D	D	D	1 st write
P1	P1	P1	P1	P1	D	D	D	2nd write
P2	P2	P2	P2	P2	D	D	D	3rd write

A single pixel of data is read after the third write operation as shown, and it is written in the display RAM. "X" are dummy bits, which are ignored for display, "D" are dither bits, which are used for dither.

(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.

	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	0	1	Data to be written								Data to be written

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

This command turns on the data entry mode when MPU read data to 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 following parameter byte and increases the line or column address automatically. The data read mode is automatically cancelled if any other command is entered.

	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

(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

(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)

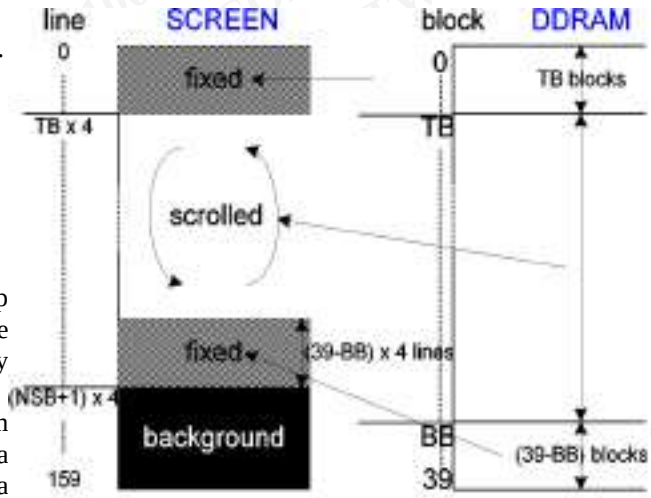
It is to scroll only the specified portion of the screen (dividing the screen by lines). This command specifies the scrolling type of area, fixed area and scrolled area.

	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

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 V0. 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 V0 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

(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**
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.

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	0	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	*	*	*	G13F23	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) Weight Set (Wt. set) - Parameter Byte: 3 (22H)

	A0	RD	RW	D7	D6	D5	D4	D3	D2	D1	D0	Function
Command	0	1	0	0	0	1	0	0	0	1	0	—
Parameter Byte 1 (PB1)	1	1	0	*	*	*	*	*	WT2	WT1	WT0	
Parameter Byte 2 (PB2)	1	1	0	*	*	*	ED4	ED3	ED2	ED1	ED0	set edge detector detect value
Parameter Byte 3 (PB3)	1	1	0	*	*	*	*	*	*	EE	WE	

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

	A0	RD	RW	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
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)
0	0	1	13.2
0	1	0	14.3
0	1	1	15.7
1	0	0	17.3
1	0	1	19.3
1	1	0	21.9
1	1	1	25.4

Condition ; 1/160 duty, fCL(Hz) = Frame frequency * (duty+1dummy)

PB2: Booster Efficiency set

BE1	BE0	Booster 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

(5) Color Dither OFF (DITHOFF) - Parameter Byte: None (34H)

Turn off dithering circuit.

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

(6) Color Dither ON (DITHON) - Parameter Byte: None (35H)

Turn on dithering circuit.

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

(7) 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.

(8) 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**

(9) 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**

(10) 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**

11. Memory Map

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 (3B3PD1 / 3B3PD2, 8-bit mode)

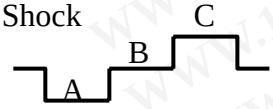
			Column									
LCD Read direction	CI = 0		0			1				84		
	CI = 1		84			83				0		
	Pixel		P0	P1	P2	P3	P4	P5		P252	P253	P254
	Data Line		D7'1,0 D6'1,0 D5'1,0 D4'1,0 D3'1,0	D7'2,0 D6'2,0 D5'2,0 D4'2,0 D3'2,0	D7'3,0 D6'3,0 D5'3,0 D4'3,0 D3'3,0	D7'1,1 D6'1,1 D5'1,1 D4'1,1 D3'1,1	D7'2,1 D6'2,1 D5'2,1 D4'2,1	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

12. Initializing And Programming

Mode : ST7529 Interface : 80-8bit

```
;-------------------------------------------------------------------------------
        write_inst(0x30);           //EXT = 0
        write_inst(0x04);           //
        write_data(0x3E);           //
        write_inst(0x94);           //sleep out
        write_inst(0xD1);           //OSC on
        write_inst(0xCA);           //display control
        write_data(0x04);           //CL dividing ratio = 2
        write_data(0x1D);           //duty
        write_data(0x00);           //N-Line
        write_inst(0xBB);           //com scan direc. = 0~65 / 131~66
        write_data(0x01);           //
        write_inst(0x31);           //EXT = 1
        write_inst(0x32);           //analog
        write_data(0x00);           //OSC freq
        write_data(0x01);           //booster effic.
        write_data(0x05);           //bias
        write_inst(0x30);           //EXT = 0
        write_inst(0x81);           //EC control
        write_data(0x2F);           //vop[5:0]
        write_data(0x02);           //vop[8:6]
        write_inst(0x20);           //power control
        write_data(0x0B);           //D0 = regulator / D1 = follwer / D3 = booster
        write_inst(0x07);           //
        write_data(0x19);           //
        write_inst(0x31);           //EXT = 1
        write_inst(0xCD);           //
        write_data(0x00);           //EEPROM Enable
        delay(100);                 //delay 100mS
        write_inst(0xFD);           //EEPROM read
        delay(100);                 //delay 100mS
        write_inst(0xCC);           //EEPROM disable
        write_inst(0x30);           //EXT = 0
        write_inst(0xA6);           //normal display
        write_inst(0xBC);           //data scan direc.
        write_data(0x02);           //address direc.
        write_data(0x01);           //BGR
        write_data(0x01);           //gray scale
        write_inst(0xAF);           //display on
        write_inst(0x15);           //column range
        write_data(000);            //start
        write_data(239);            //end
        write_inst(0x75);           //page range
        write_data(040);            //start
        write_data(119);            //end
        write_inst(0x31);           //EXT = 1
        write_inst(0x34);           //dither off
        write_inst(0x22);           //weight
        write_data(0x00);           //
        write_data(0x00);           //
        write_data(0x00);           //
        write_inst(0x20);           //gamma
        write_data(00);             //
        write_data(03);             //
        write_data(06);             //
          :
          :
          :
          :
```

13. Reliability Condition

			TN Type		STN Type	
			Normal Temp.	Wide Temp.	Normal Temp.	Wide Temp.
Viewing Angle	Horizontal Φ		±30°	±30°	±30°	±30°
	Vertical Θ(mm)		-10° to 30°	-10° to 30°	-10° to 40°	-10° to 40°
Operating Temperature			-10 to 70℃	-25 to 80℃	0 to 50℃	*-20 to 70℃
Storage Temperature			-20 to 80℃	-35 to 90℃	-20 to 70℃	*-30 to 80℃
High Temperature (Power Off)			240 Hours @70℃	240 Hours @90℃	240 Hours @65℃	240 Hours @75℃
Low Temperature (Power Off)			240 Hours @-20℃	240 Hours @-35℃	240 Hours @-15℃	240 Hours @-25℃
High Temperature (Power On)			240 Hours @70℃	240 Hours @80℃	240 Hours @60℃	240 Hours @70℃
Low Temperature (Power On)			240 Hours @-10℃	240 Hours @-25℃	240 Hours @-10℃	240 Hours @-20℃
High Temperature & High Humidity			55℃/90%RH 240 Hours	75℃/90%RH 240 Hours	45℃/90%RH 240 Hours	65℃/90%RH 240 Hours
Thermal Shock 5 Cycle 		A	60min@-20℃	60min@-35℃	60min@-20℃	60min@-30℃
		B	5min@25℃	5min@25℃	5min@25℃	5min@25℃
		C	60min@70℃	60min@90℃	60min@70℃	60min@80℃
Expected Lift			50,000 Hours	50,000 Hours	50,000 Hours	50,000 Hours

*Wide temp. version may not available for some products, Please consult our sales engineer or respresentative.

14. Functional Test & Inspection Criteria

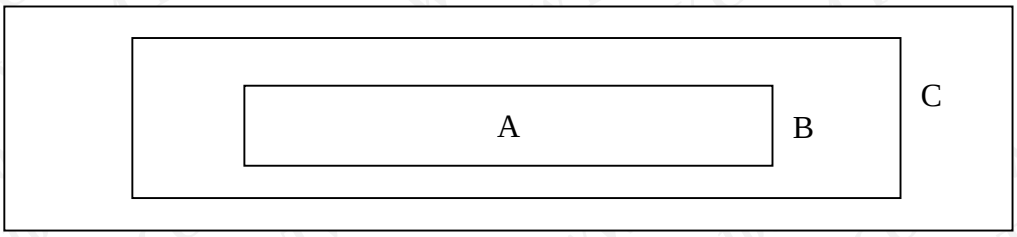
14.1 Sample plan

Sample plan according to MIL-STD-105D level 2, and acceptance/rejection criteria is.
Base on : Major defect : AQL 0.65 Minor defect : AQL 2.5

14.2 Inspection condition

Viewing distance for cosmetic inspection is 30cm with bare eyes, and under an environment of 800 lus (20W) light intensity. All direction for inspecting the sample should be within 45° against perpendicular line.

14.3 Definition of Inspection Zone in LCD



Zone A : Character / Digit area
Zone B : Viewing area except Zone A (Zone A + Zone B = minimum Viewing area)
Zone C : Outside viewing area (invisible area after assembly in customer's product)
Note : As a general rule, visual defects in Zone C are permissible, when it is no trouble for quality and assembly of customer's product.

14.4 Major Defect

All functional defects such as open (or missing segment), short, contrast differential, excess power consumption, smearing, leakage, etc. and overall outline dimension beyond the drawing. Are classified as major defects.

14.5 Minor Defect

Except the Major defects above, all cosmetic defects are classified as minor defects.

<table>
<tr><th>Item No.</th><th>Item to be Inspected</th><th colspan="5">Inspection Standard</th><th>Classification of defects</th></tr>
<tr><td rowspan="6">1.</td><td rowspan="6">Spot defect
(Defects in spot from)</td><td rowspan="2">Zone size (mm)</td><td colspan="3">Acceptable Qty</td><td rowspan="6">Minor</td></tr>
<tr><td>A</td><td>B</td><td>C</td></tr>
<tr><td>Φ ≦0.15</td><td colspan="2">Acceptable
(clutering of spot not allowed)</td><td>Accepta-ble</td></tr>
<tr><td>0.15≦ Φ ≦0.20</td><td>1</td><td>2</td><td rowspan="3"></td></tr>
<tr><td>0.20≦ Φ ≦0.25</td><td>0</td><td>1</td></tr>
<tr><td>Φ>0.25</td><td>0</td><td>0</td></tr>
<tr><td colspan="5">Remarks : for dark/white spot, size Φ is defined as Φ=1/2(X+Y)</td></tr>
<tr><td rowspan="8">2.</td><td rowspan="8">Line defect
(Defects in line form)</td><td colspan="2">Size (mm)</td><td colspan="3">Acceptable Qty</td><td rowspan="8">Minor</td></tr>
<tr><td>L
Length</td><td>W
Width</td><td colspan="3">Zone</td></tr>
<tr><td>Accep-table</td><td>W≦0.02</td><td>Accep-table</td><td></td><td>Accep-table</td></tr>
<tr><td>L≦3.0</td><td>W≦0.03</td><td>2</td><td colspan="2" rowspan="4"></td></tr>
<tr><td>L>2.5</td><td>W≦0.03</td><td>0</td></tr>
<tr><td>L≦3.0</td><td>0.03<W≦0.05</td><td>2</td></tr>
<tr><td>L>2.5</td><td>0.03<W≦0.05</td><td>0</td></tr>
<tr><td colspan="2">W>0.05</td><td colspan="3">Counted as spot defect (Follows item 14.5.1)</td></tr>
<tr><td colspan="5">Remarks: The total of spot defect and line defect shall not exceed four.</td></tr>
<tr><td>3.</td><td>Orientation defect (such as misalignment of L/C)</td><td colspan="5">Not allowed inside viewing area (Zone A or Zone B)</td><td>Minor</td></tr>
<tr><td rowspan="6">4.</td><td rowspan="6">Polarizing</td><td colspan="5">14.5.4.1 Polarizer Position
1. Shifting in Position Should not exceed the glass outline dimension.
2. Incomplete covering of the viewing area due to Shifting is not allowed.</td><td rowspan="6">Minor</td></tr>
<tr><td colspan="5">14.5.4.2 Seratches, bubble or dent on Glass/ Polarizer/Reflector, Bubble between Polarizer & Reflector/Glass:</td></tr>
<tr><td rowspan="3">Size (mm)</td><td colspan="3">Acceptable Qty</td><td rowspan="5">Accep-table</td></tr>
<tr><td colspan="3">Zone</td></tr>
<tr><td>A</td><td>B</td><td>C</td></tr>
<tr><td>Φ ≦0.20</td><td colspan="2">Acceptable</td></tr>
<tr><td>0.20<Φ ≦0.50</td><td colspan="2">3</td></tr>
<tr><td>0.50<Φ ≦1.00</td><td colspan="2">2</td></tr>
<tr><td>Φ>1.00</td><td colspan="2">0</td></tr>
</table>