



FocusLCDs.com
LCDs MADE SIMPLE®

Ph. 480-503-4295 | NOPP@FocusLCD.com

TFT | CHARACTER | UWVD | FSC | SEGMENT | CUSTOM | REPLACEMENT

Graphic Display Module

Part Number

G126FLGFGSW64T33XAR

Overview

128x64(80x57), FSTN, Gray background, White Edge lit, Bottom view, Super wide Temp (-40°C ~ +80°C), Transflective (positive), 3.3V LCD, 3.3V LED, Heater, Controller=ST7565P, RoHS Compliant

1.Features

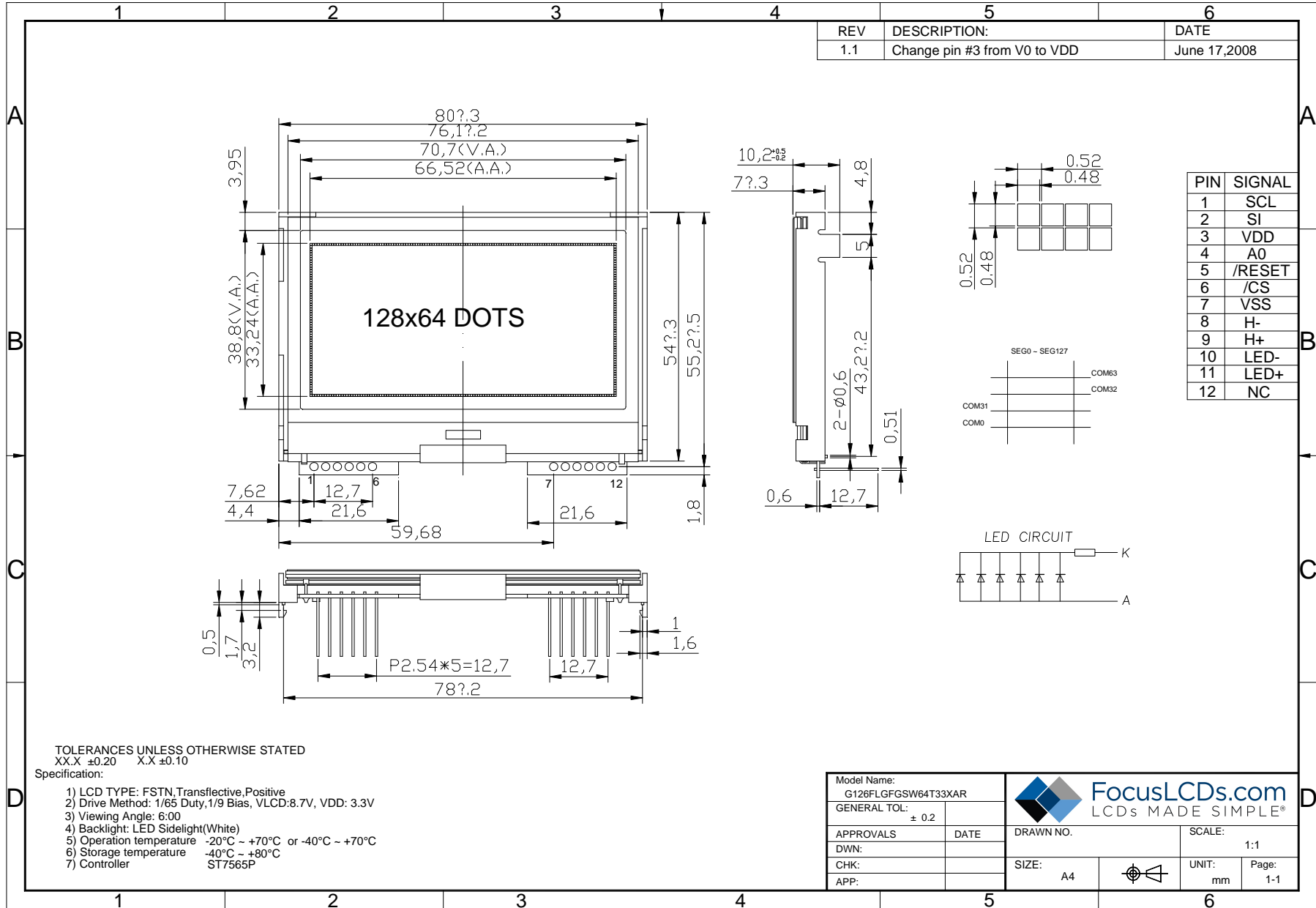
1. 128X64 dots
2. Built-in controller (ST7565P)
3. +3.3V power supply
4. 1/64 duty cycle;1/9bias
5. BKL to be driven by A, K.

LCD type	<input checked="" type="checkbox"/> FSTN positive		<input type="checkbox"/> FSTN Negative	
	<input type="checkbox"/> STN Yellow Green	<input type="checkbox"/> STN Gray		<input type="checkbox"/> STN-Blue
View direction	<input checked="" type="checkbox"/> 6 O'clock		<input type="checkbox"/> 12 O'clock	
Rear Polarizer	<input type="checkbox"/> Reflective		<input checked="" type="checkbox"/> Transflective	<input type="checkbox"/> Transmissive
Backlight Type	<input checked="" type="checkbox"/> LED	<input type="checkbox"/> EL		<input type="checkbox"/> Internal Power
		<input type="checkbox"/> CCFL	<input checked="" type="checkbox"/> External Power	<input checked="" type="checkbox"/> 3.3 input
Backlight Color	<input checked="" type="checkbox"/> White	<input type="checkbox"/> Amber	<input type="checkbox"/> Blue-Green	<input type="checkbox"/> Yellow-Green
Temperature Range	<input type="checkbox"/> Normal		<input type="checkbox"/> Wide	<input checked="" type="checkbox"/> Super Wide
DC to DC circuit	<input checked="" type="checkbox"/> Build-in		<input type="checkbox"/> Not Build-in	
EI Driver IC	<input type="checkbox"/> Build-in		<input checked="" type="checkbox"/> Not Build-in	
Touch screen	<input type="checkbox"/> With		<input type="checkbox"/> Without	
Font type	<input type="checkbox"/> English-Japanese	<input type="checkbox"/> English-European	<input type="checkbox"/> English-Russian	<input checked="" type="checkbox"/> other
	<input checked="" type="checkbox"/> ROHS			

2. MECHANICAL SPECIFICATIONS

Module size	80.0mm(L)*57.0mm(W)* Max10.2(H)mm
Viewing area	70.7mm(L)*38.8mm(W)
Dots size	0.48mm(L)*0.48mm(W)
Dots pitch	0.52mm(L)*0.52mm(W)
Weight	Approx.

3. Outline dimension



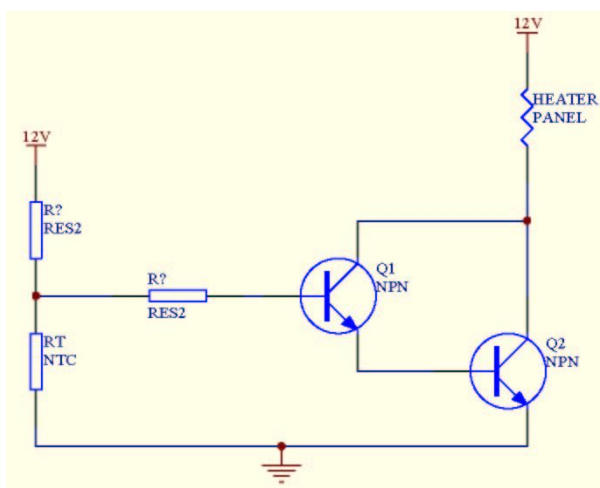
4. Absolute maximum ratings

Item	Symbol	Standard			Unit
Power voltage	$V_{DD}-V_{SS}$	0.3	-	3.6	V
Input voltage	V_{IN}	VSS	-	VDD	
Operating temperature range	T_{OP}	-20	-	+70	°C
	T_{OH}	-40	-	+70	
Storage temperature range	T_{ST}	-40	-	+80	

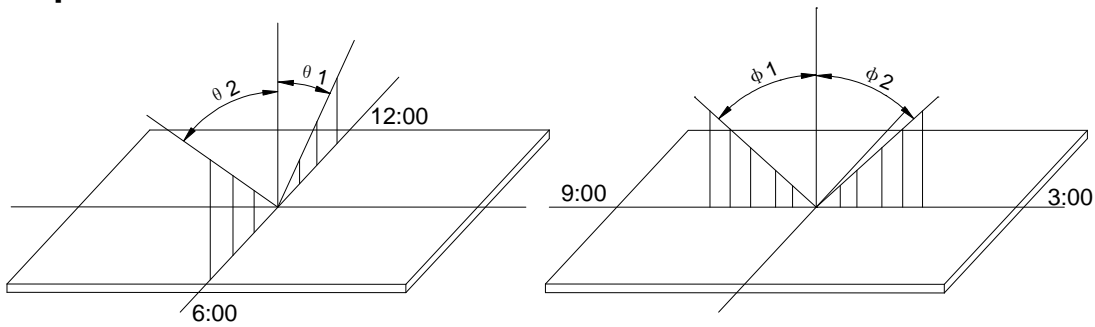
5. Interface pin description

Pin no.	Symbol	External connection	Function
1	SCL	MPU	Serial clock input
2	SI	MPU	Serial data input
3	V_{DD}	Power supply	Power supply for LCM (+3.3V)
4	A0	MPU	Register select signal
5	/RESET	MPU	Controller reset (module reset)
6	/CS	MPU	Used to enter chip select signal
7	V_{SS}	Power supply	Power supply for LCM (GND)
8	H-		Heater panel resistance
9	H+		
10	LED-	Power supply for BKL	Power supply for BKL (+0 V)
11	LED+		Power supply for BKL (+3.3V)
12	NC		

Connections between Heater Panel (reference example)



6. Optical characteristics



STN type display module ($T_a=25^\circ\text{C}$, $V_{DD}=5.0\text{V}$)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Viewing angle	$\theta 1$	$C_r \geq 3$		20		deg
	$\theta 2$			40		
	$\Phi 1$			35		
	$\Phi 2$			35		
Contrast ratio	C_r		-	10	-	-
Response time (rise)	T_r	-	-	200	250	ms
Response time (fall)	T_r	-	-	300	350	

7. Electrical characteristics

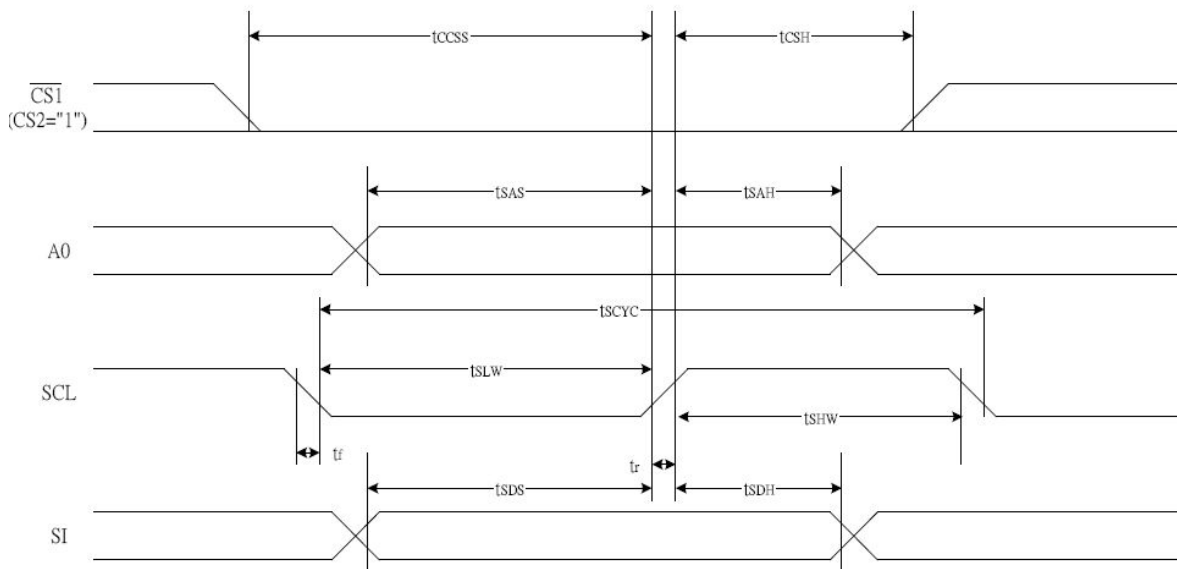
DC characteristics

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Supply voltage for LCD	$V_{DD}-V_0$	$T_a = 25^\circ\text{C}$	8.3	8.7	9.3	V
Input voltage	V_{DD}		2.4	3.3	3.3	
Supply current	I_{DD}	$T_a=25^\circ\text{C}$, $V_{DD}=5.0\text{V}$	-	500		μA
Input leakage current	I_{LKG}		-	-		μA
"H" level input voltage	V_{IH}		2.2	-	V_{DD}	V
"L" level input voltage	V_{IL}	Twice initial value or less	0	-	0.6	
"H" level output voltage	V_{OH}	$LOH=-0.25\text{mA}$	2.4	-	-	
"L" level output voltage	V_{OL}	$LOH=1.6\text{mA}$	-	-	0.4	
Backlight supply voltage	V_F		-	3.0	-	
Backlight supply current	I_{LED}	$V_F=3.0\text{V}$	-	50	-	mA
Heater panel resistance	$R_{H+/-}$		-	20	25	OHMS

8. TIMING CHARACTERISTICS

($V_{DD} = 3.3\text{V}$, $T_a = -30$ to 85°C)

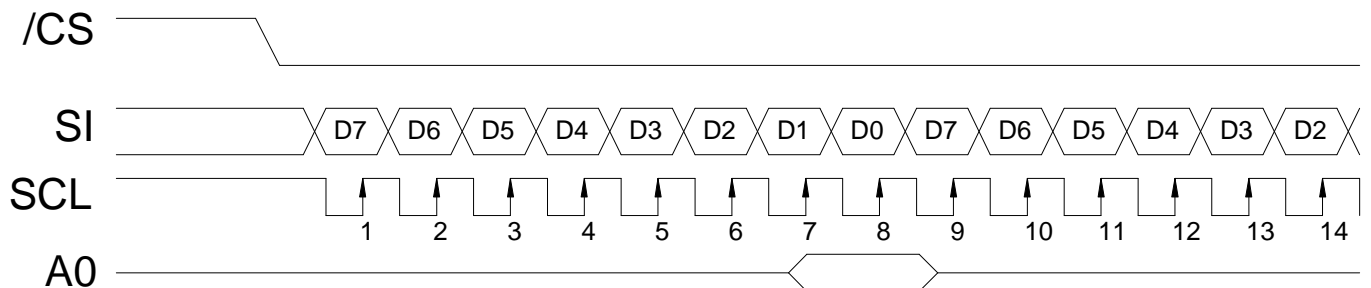
Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
Serial Clock Period	SCL	T_{scyc}		50	—	ns
SCL "H" pulse width		T_{shw}		25	—	
SCL "L" pulse width		T_{SLW}		25	—	
Address setup time	A0	T_{SAS}		20	—	
Address hold time		T_{sah}		10	—	
Data setup time	SI	T_{sds}		20	—	
Data hold time		T_{SDH}		10	—	
CS-SCL time	CS	T_{css}		20	—	
CS-SCL time		T_{csh}		40	—	



9. DESCRIPTION OF FUNCTIONS

● The Serial Interface

When the chip is in active state ($/CS = "L"$), the serial data input (SI) and the serial clock input (SCL) can be received. The serial data is read from the serial data input pin in the rising edge of the serial clocks D7, D6 through D0, in this order. This data is converted to 8 bits parallel data in the rising edge of the eighth serial clock for the processing. The $A0$ input is used to determine whether or the serial data input is display data or command data; when $A0 = "H"$, the data is display data, and when $A0 = "L"$ then the data is command data. The $A0$ input is read and used for detection every 8th rising edge of the serial clock after the chip becomes active. Figure 1 is a serial interface signal chart.



* When the chip is not active, the shift registers and the counter are reset to their initial states.

* Reading is not possible while in serial interface mode.

* Caution is required on the SCL signal when it comes to line-end reflections and external noise. We recommend that operation be rechecked on the actual equipment.

● Display Data RAM

The display data RAM stores the dot data for the LCD. It has a 65 (8 page x 8 bit +1) x 132 bit structure. As is shown in Figure 3, the D7 to D0 display data from the MPU corresponds to the LCD display common direction; there are few constraints at the time of display data transfer when multiple ST7565P are used, thus and display structures can be created easily and with a high degree of freedom. Moreover, reading from and writing to the display RAM from the MPU side is performed through the I/O buffer, which is an independent operation from signal reading for the liquid crystal driver. Consequently, even if the display data RAM is accessed asynchronously during liquid crystal display, it will not cause adverse effects on the display (such as flickering).

D0	0	1	1	1		0
D1	1	0	0	0		0
D2	0	0	0	0		0
D3	0	1	1	1		0
D4	1	0	0	0		0
-						

Display data RAM

COM0						
COM1						
COM2						
COM3						
COM4						
-						

Liquid crystal display

● The Page Address Circuit

Page address of the display data RAM is specified through the Page Address Set Command. The page address must be specified again when changing pages to perform access. Page address 8 (D3, D2, D1, D0 = 1, 0, 0, 0) is a special RAM for icons, and only display data D0 is used. shown in Figure 4,

● The Column Addresses

The display data RAM column address is specified by the Column Address Set command. The specified column address is incremented (+1) with each display data read/write command. This allows the MPU display data to be accessed continuously. Moreover, the incrementing of column addresses stops with 83H. Because the column address is independent of the page address, when moving, for example, from page 0 column 83H to page 1 column 00H, it is necessary to respective both the page address and the column address. Furthermore, as is shown in Table 4, the ADC command (segment driver direction select command) can be used to reverse the relationship between the display data RAM column address and the segment output. Because of this, the constraints on the IC layout when the LCD module is assembled can be minimized. shown in Figure 4,

Table 4

SEG Output ADC	SEG0	SEG 131
(D0) "0"	0 (H) → Column Address →	83 (H)
(D0) "1"	83 (H) ← Column Address ←	0 (H)

● The Reset Circuit

When the /RES input comes to the “L” level, these LSIs return to the default state. Their default states are as follows:

1. Display OFF
2. Normal display
3. ADC select: Normal (ADC command D0 = “L”)
4. Power control register: (D2, D1, D0) = (0, 0, 0)
5. Serial interface internal register data clear
6. LCD power supply bias rate: 1/65 DUTY = 1/9 bias
7. All-indicator lamps-on OFF (All-indicator lamps ON/OFF command D0 = “L”)
8. Power saving clear
9. V0 voltage regulator internal resistors Ra and Rb separation
10. Output conditions of SEG and COM terminals SEG=VSS , COM=VSS
11. Read modify write OFF
12. Static indicator OFF Static indicator register : (D1, D2) = (0, 0)
13. Display start line set to first line
14. Column address set to Address 0
15. Page address set to Page 0
16. Common output status normal
17. V0 voltage regulator internal resistor ratio set mode clear
18. Electronic volume register set mode clear Electronic volume register : (D5, D4, D3, D2, D1, D0) = (1, 0, 0, 0, 0,0)
19. Test mode clear

On the other hand, when the reset command is used, the above default settings from 11 to 19 are only executed. When the power is turned on, the IC internal state becomes unstable, and it is necessary to initialize it using the /RES terminal. After the initialization, each input terminal should be controlled normally. Moreover, when the control signal from the MPU is in the high impedance, an over current may flow to the IC. After applying a current, it is necessary to take proper measures to prevent the input terminal from getting into the high impedance state.

If the internal liquid crystal power supply circuit is not used on ST7565P, it is necessary that /RES is “H” when the external liquid crystal power supply is turned on. This IC has the function to discharge V0 when /RES is “L,” and the external power supply short-circuits to Vss when /RES is “L.” While /RES is “L,” the oscillator and the display timing generator stop, and the CL, FR, FRS and /DOF terminals are fixed to “H.” The terminals D0 to D7 are not affected. The VSS level is output from the SEG and COM output terminals. This means that an internal resistor is connected between VSS and V0. When the internal liquid crystal power supply circuit is not used on other models of ST7565P series, it is necessary that /RES is “L” when the external liquid crystal power supply is turned on. While /RES is “L,” the oscillator works but the display timing generator stops, and the CL, FR, FRS and /DOF terminals are fixed to “H.” The terminals D0 to D7 are not affected.

10. Table of LCM commands

Command	Command Code										Function	
	A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1		D0
(1) Display ON/OFF	0	1	0	1	0	1	0	1	1	1	0	LCD display ON/OFF 0: OFF, 1: ON
(2) Display start line set	0	1	0	0	1	Display start address						Sets the display RAM display start line address
(3) Page address set	0	1	0	1	0	1	1	Page address				Sets the display RAM page address
(4) Column address set upper bit	0	1	0	0	0	0	1	Most significant column address				Sets the most significant 4 bits of the display RAM column address. Sets the least significant 4 bits of the display RAM column address.
Column address set lower bit	0	1	0	0	0	0	0	Least significant column address				
(5) Status read	0	0	1	Status				0	0	0	0	Reads the status data
(6) Display data write	1	1	0	Write data							Writes to the display RAM	
(7) Display data read	1	0	1	Read data							Reads from the display RAM	
(8) ADC select	0	1	0	1	0	1	0	0	0	0	0	Sets the display RAM address SEG output correspondence 0: normal, 1: reverse
(9) Display normal/reverse	0	1	0	1	0	1	0	0	1	1	0	Sets the LCD display normal/reverse 0: normal, 1: reverse
(10) Display all points ON/OFF	0	1	0	1	0	1	0	0	1	0	0	Display all points 0: normal display 1: all points ON
(11) LCD bias set	0	1	0	1	0	1	0	0	0	1	0	Sets the LCD drive voltage bias ratio 0: 1/9 bias, 1: 1/7 bias (ST7565P)
(12) Read/modify/write	0	1	0	1	1	1	0	0	0	0	0	Column address increment At write: +1 At read: 0
(13) End	0	1	0	1	1	1	0	1	1	1	0	Clear read/modify/write
(14) Reset	0	1	0	1	1	1	0	0	0	1	0	Internal reset
(15) Common output mode select	0	1	0	1	1	0	0	0	*	*	*	Select COM output scan direction 0: normal direction 1: reverse direction
(16) Power control set	0	1	0	0	0	1	0	1	Operating mode		Select internal power supply operating mode	
(17) V ₀ voltage regulator internal resistor ratio set	0	1	0	0	0	1	0	0	Resistor ratio		Select internal resistor ratio(Rb/Ra) mode	
(18) Electronic volume mode set	0	1	0	1	0	0	0	0	0	0	1	Set the V ₀ output voltage electronic volume register
Electronic volume register set				0	0	Electronic volume value						
(19) Static indicator ON/OFF	0	1	0	1	0	1	0	1	1	0	0	0: OFF, 1: ON Set the flashing mode
Static indicator register set				0	0	0	0	0	0	0	0	
(20) Booster ratio set	0	1	0	1	1	1	1	1	0	0	0	select booster ratio 00: 2x,3x,4x 01: 5x 11: 6x
(21) Power saver												Display OFF and display all points ON compound command
(22) NOP	0	1	0	1	1	1	0	0	0	1	1	Command for non-operation
(23) Test	0	1	0	1	1	1	1	*	*	*	*	Command for IC test. Do not use this command

BUSY	BUSY = 1: it indicates that either processing is occurring internally or a reset condition is in process. BUSY = 0: A new command can be accepted . if the cycle time can be satisfied, there is no need to check for BUSY conditions.
ADC	This shows the relationship between the column address and the segment driver. 0: Normal (column address n « SEG n) 1: Reverse (column address 131-n « SEG n) (The ADC command switches the polarity.)
ON/OFF	ON/OFF: indicates the display ON/OFF state. 0: Display ON 1: Display OFF (This display ON/OFF command switches the polarity.)
RESET	This indicates that the chip is in the process of initialization either because of a /RES signal or because of a reset command. 0: Operating state 1: Reset in progress

Display Data Write

This command writes 8-bit data to the specified display data RAM address. Since the column address is automatically incremented by "1" after the write, the MPU can write the display data.

E		R/W									
A0	/RD	/WR	D7 D6 D5 D4 D3 D2 D1 D0								
1	1	0	Write data								

Display Data Read

This command reads 8-bit data from the specified display data RAM address. Since the column address is automatically incremented by "1" after the read, the CPU can continuously read multiple-word data. One dummy read is required immediately after the column address has been set. See the function explanation in "Display Data RAM" for the explanation of accessing the internal registers. When the serial interface is used, reading of the display data becomes unavailable.

E		R/W									
A0	/RD	/WR	D7 D6 D5 D4 D3 D2 D1 D0								
1	0	1	Read data								

ADC Select (Segment Driver Direction Select)

This command can reverse the correspondence between the display RAM data column address and the segment driver output. Thus, sequence of the segment driver output pins may be reversed by the command. See the column address circuit for the detail. Increment of the column address (by "1") accompanying the reading or writing the display data is done according to the column address indicated in Figure 4.

E		R/W										
A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0	Setting	
0	1	0	1	0	1	0	0	0	0	0	Normal	
										1	Reverse	

Display Normal/Reverse

This command can reverse the lit and unlit display without overwriting the contents of the display data RAM. When this is done the display data RAM contents are maintained.

E		R/W										
A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0	Setting	
0	1	0	1	0	1	0	0	1	1	0	RAM Data "H"	
										1	LCD ON voltage (normal)	
											RAM Data "L"	
											LCD ON voltage (reverse)	

Display All Points ON/OFF

This command makes it possible to force all display points ON regardless of the content of the display data RAM. The contents of the display data RAM are maintained when this is done. This command takes priority over the display normal/reverse command.

E R/W											
A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0	Setting
0	1	0	1	0	1	0	0	1	0	0	Normal display mode Display all points ON

When the display is in an OFF mode, executing the display all points ON command will place the display in power save mode. For details, see the Power Save section.

LCD Bias Set

This command selects the voltage bias ratio required for the liquid crystal display.

E R/W											Select Status				
A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0	1/65duty	1/49duty	1/33duty	1/55duty	1/53duty
0	1	0	1	0	1	0	0	0	1	0	1/9 bias	1/8 bias	1/6 bias	1/8 bias	1/8 bias
									1		1/7 bias	1/6 bias	1/5 bias	1/6 bias	1/6 bias

Read/Modify/Write

This command is used paired with the "END" command. Once this command has been input, the display data read command does not change the column address, but only the display data write command increments (+1) the column address. This mode is maintained until the END command is input. When the END command is input, the column address returns to the address it was at when the read/modify/write command was entered. This function makes it possible to reduce the load on the MPU when there are repeating data changes in a specified display region, such as when there is a blanking cursor.

E R/W										
A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	1	1	1	0	0	0	0	0

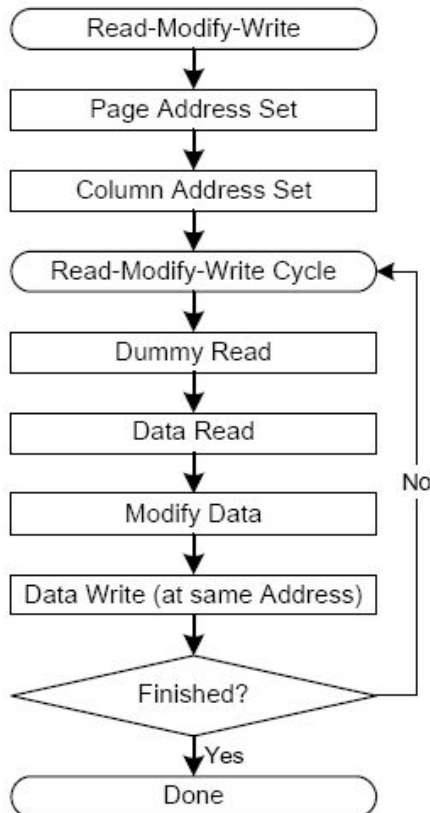
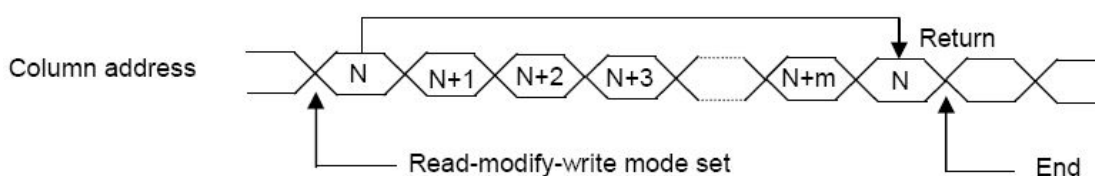


Figure 24 Command Sequence For read modify write



End

This command releases the read/modify/write mode, and returns the column address to the address it was at when the mode was entered.

E R/W										
A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	1	1	1	0	1	1	1	0

Reset

This command initializes the display start line, the column address, the page address, the common output mode, the V₀ voltage regulator internal resistor ratio, the electronic volume, and the static indicator are reset, and the read/modify/write mode and test mode are released. There is no impact on the display data RAM. See the function explanation in "Reset" for details. The reset operation is performed after the reset command is entered.

E R/W										
A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	1	1	1	0	0	0	1	0

The initialization when the power supply is applied must be done through applying a reset signal to the /RES terminal. The reset command must not be used instead.

Common Output Mode Select

This command can select the scan direction of the COM output terminal. For details, see the function explanation in "Common Output Mode Select Circuit."

E R/W		Selected Mode									
A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0	
0	1	0	1	1	0	0	0	*	*	*	Normal Reverse
											1/65duty
											1/49duty
											1/33duty
											1/55duty
											1/53duty
											COM0→COM63 COM63→COM0
											COM0→COM47 COM47→COM0
											COM0→COM31 COM31→COM0
											COM0→COM53 COM53→COM0
											COM0→COM51 COM51→COM0

* Disabled bit

Power Controller Set

This command sets the power supply circuit functions. See the function explanation in "The Power Supply Circuit," for details

E R/W											Selected Mode	
A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0		
0	1	0	0	0	1	0	1	0	1	0	Booster circuit: OFF	
											Booster circuit: ON	
											Voltage regulator circuit: OFF	
											Voltage regulator circuit: ON	
0	1	0	0	0	0	0	0	0	0	0	Voltage follower circuit: OFF	
											Voltage follower circuit: ON	

V₀ Voltage Regulator Internal Resistor Ratio Set

This command sets the V₀ voltage regulator internal resistor ratio. For details, see the function explanation is "The Voltage Regulator circuit " and table 11 .

E R/W											Rb/Ra Ratio	
A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0		
0	1	0	0	0	1	0	0	0	0	0	Small	
											↓	
											↓	
											Large	

The Electronic Volume (Double Byte Command)

This command makes it possible to adjust the brightness of the liquid crystal display by controlling the LCD drive voltage V₀ through the output from the voltage regulator circuits of the internal liquid crystal power supply. This command is a two byte command used as a pair with the electronic volume mode set command and the electronic volume register set command, and both commands must be issued one after the other.

The Electronic Volume Mode Set

When this command is input, the electronic volume register set command becomes enabled. Once the electronic volume

mode has been set, no other command except for the electronic volume register command can be used. Once the electronic volume register set command has been used to set data into the register, then the electronic volume mode is released.

E R/W										
A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	1	0	0	0	0	0	0	1

Electronic Volume Register Set

By using this command to set six bits of data to the electronic volume register, the liquid crystal drive voltage V_0 assumes one of the 64 voltage levels.

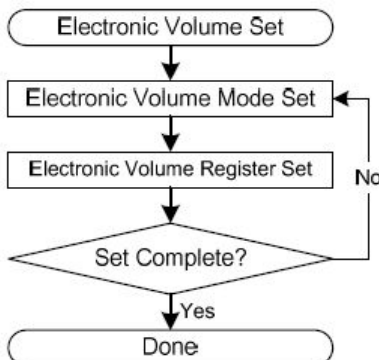
When this command is input, the electronic volume mode is released after the electronic volume register has been set.

E R/W												
A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0	V_0	
0	1	0	*	*	0	0	0	0	0	1	Small	
			*	*	0	0	0	0	1	0		
			*	*	0	0	0	0	1	1		
								↓				↓
			*	*	1	1	1	1	1	0		Large
			*	*	1	1	1	1	1			

* Inactive bit (set "0")

When the electronic volume function is not used, set this to (1, 0, 0, 0, 0, 0, 0)

The Electronic Volume Register Set Sequence



Static Indicator (Double Byte Command)

This command controls the static drive system indicator display. The static indicator display is controlled by this command only, and is independent of other display control commands.

This is used when one of the static indicator liquid crystal drive electrodes is connected to the FR terminal, and the other is connected to the FRS terminal. A different pattern is recommended for the static indicator electrodes than for the dynamic drive electrodes. If the pattern is too close, it can result in deterioration of the liquid crystal and of the electrodes.

The static indicator ON command is a double byte command paired with the static indicator register set command, and thus one must execute one after the other. (The static indicator OFF command is a single byte command.)

Static Indicator ON/OFF

When the static indicator ON command is entered, the static indicator register set command is enabled. Once the static indicator ON command has been entered, no other command aside from the static indicator register set command can be used. This mode is cleared when data is set in the register by the static indicator register set command.

E R/W											
A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0	Static Indicator
0	1	0	1	0	1	0	1	1	0	0	OFF
										1	ON

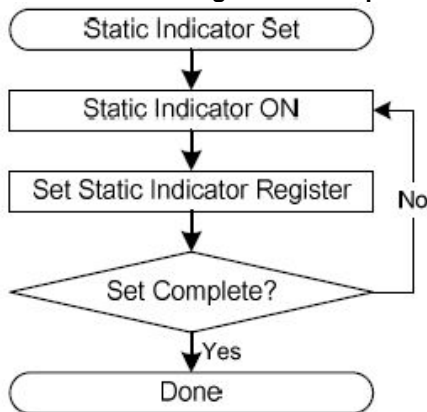
Static Indicator Register Set

This command sets two bits of data into the static indicator register, and is used to set the static indicator into a blinking mode.

E R/W													
A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0	Indicator Display State		
0	1	0	*	*	*	*	*	*	0	0	OFF		
									0	1	ON (blinking at approximately one second intervals)		
									1	0	ON (blinking at approximately 0.5 second intervals)		
									1	1	ON (constantly on)		

- Disabled bit (set "0")

Static Indicator Register Set Sequence



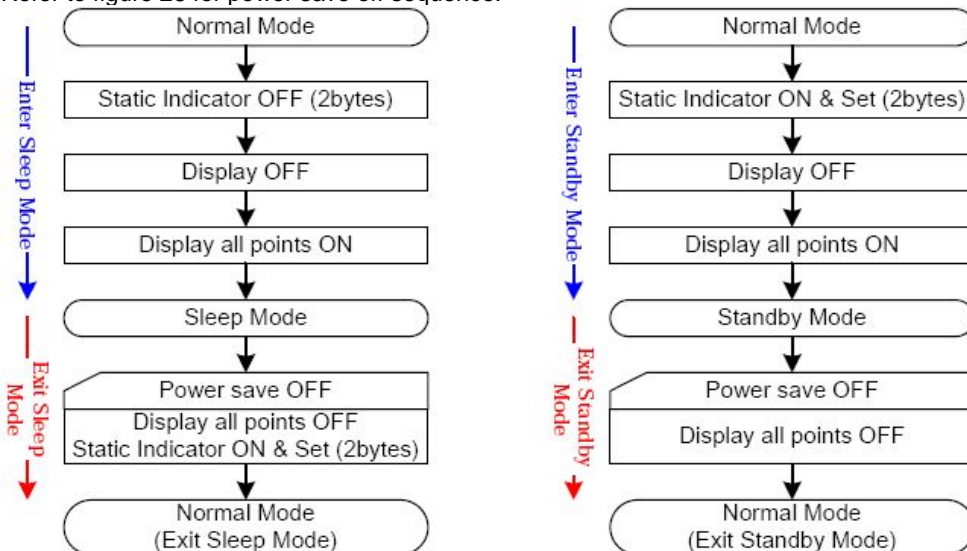
Power Save (Compound Command)

When the display all points ON is performed while the display is in the OFF mode, the power saver mode is entered, thus greatly reducing power consumption.

The power saver mode has two different modes: the sleep mode and the standby mode. When the static indicator is OFF, it is the sleep mode that is entered. When the static indicator is ON, it is the standby mode that is entered.

In the sleep mode and in the standby mode, the display data is saved as is the operating mode that was in effect before the power saver mode was initiated, and the MPU is still able to access the display data RAM.

Refer to figure 28 for power save off sequence.



Sleep Mode

This stops all operations in the LCD display system, and as long as there are no accesses from the MPU, the consumption current is reduced to a value near the static current. The internal modes during sleep mode are as follows:

1. The oscillator circuit and the LCD power supply circuit are halted.
2. All liquid crystal drive circuits are halted, and the segment in common drive outputs output a V_{ss} level.

Standby Mode

The duty LCD display system operations are halted and only the static drive system for the indicator continues to operate, providing the minimum required consumption current for the static drive. The internal modes are in the following states during standby mode.

- 1 The LCD power supply circuits are halted. The oscillator circuit continues to operate.
- 2 The duty drive system liquid crystal drive circuits are halted and the segment and common driver outputs output a V_{ss} level. The static drive system does not operate.

When a reset command is performed while in standby mode, the system enters sleep mode.

* When an external power supply is used, it is recommended that the functions of the external power supply circuit be stopped when the power saver mode is started. For example, when the various levels of liquid crystal drive voltage are provided by external resistive voltage dividers, it is recommended that a circuit be added in order to cut the electrical current flowing through the resistive voltage divider circuit when the power saver mode is in effect. The ST7565P series chips have a liquid crystal display blanking control terminal /DOF. This terminal enters an "L" state when the power saver mode is launched. Using the output of /DOF, it is possible to stop the function of an external power supply circuit.

* When the master is turned on, the oscillator circuit is operable immediately after the powering on.

The Booster Ratio (Double Byte Command)

This command makes it possible to select step-up ratio. It is used when the power control set have turn on the internal booster circuit. This command is a two byte command used as a pair with the booster ratio select mode set command and the booster ratio register set command, and both commands must be issued one after the other.

Booster Ratio Select Mode Set

When this command is input, the Booster ratio register set command becomes enabled. Once the booster ratio select mode has been set, no other command except for the booster ratio register command can be used. Once the booster ratio register set command has been used to set data into the register, then the booster ratio select mode is released.

E R/W										
A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	1	1	1	1	1	0	0	0

Booster Ratio Register Set

By using this command to set two bits of data to the booster ratio register, it can be select what kind of the booster ratio can be used.

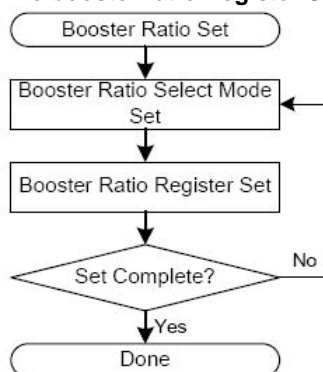
When this command is input, the booster ratio select mode is released after the booster ratio register has been set.

E R/W											Booster ratio select
A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0	
0	1	0	*	*	*	*	*	*	0	0	2x,3x,4x
			*	*	*	*	*	*	0	1	5x
			*	*	*	*	*	*	1	1	6x

Inactive bit (set "0")

When the booster ratio select function is not used, set this to (0, 0) 2x,3x,4x step-up mode

The booster ratio Register Set Sequence



NOP

Non-Operation Command

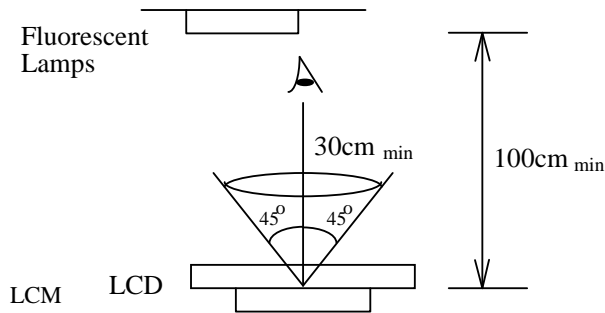
E R/W										
A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	1	1	1	0	0	0	1	1

11.QUALITY SPECIFICATIONS

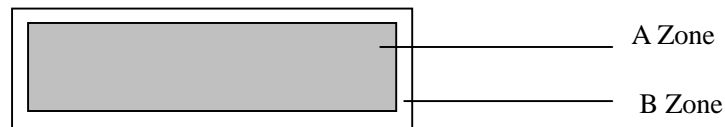
11.1 Standard of the product appearance test

Manner of appearance test: The inspection should be performed in using 20W x 2 fluorescent lamps.
Distance between LCM and fluorescent lamps should be 100 cm or more. Distance between LCM and inspector eyes should be 30 cm or more.

Viewing direction for inspection is 45° from vertical against LCM.



Definition of zone:



A Zone: Active display area (minimum viewing area).

B Zone: Non-active display area (outside viewing area).

11.2 Specification of quality assurance

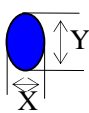
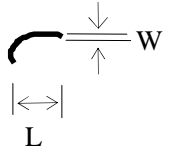
AQL inspection standard

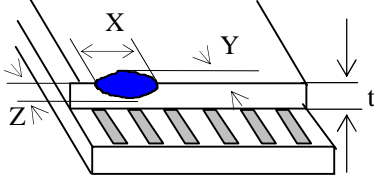
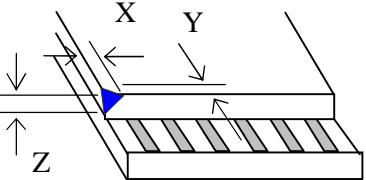
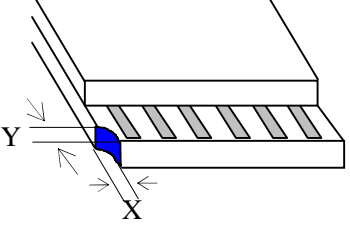
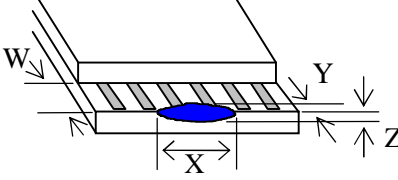
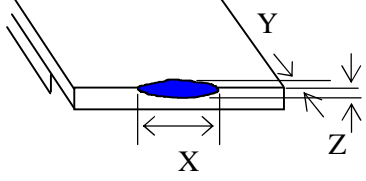
Sampling method: MIL-STD-105E, Level II, single sampling

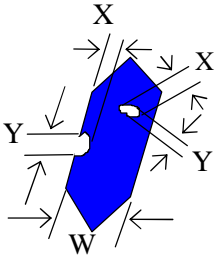
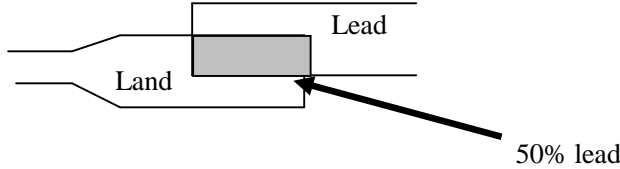
Defect classification **(Note: * is not including)**

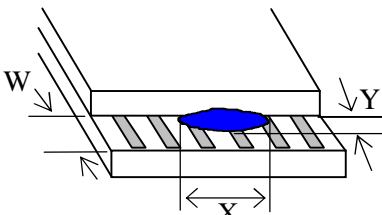
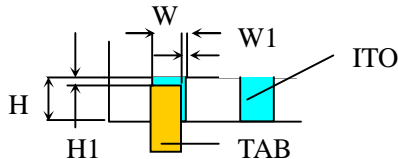
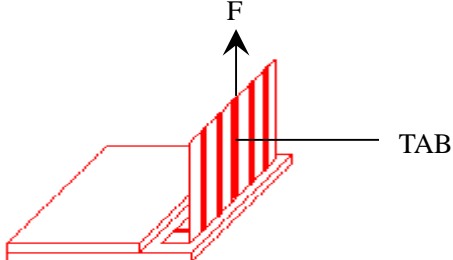
Classify	Item		Note	AQL
Major	Display state	Short or open circuit	1	0.65
		LC leakage		
		Flickering		
		No display		
		Wrong viewing direction		
		Contrast defect (dim, ghost)	2	
	Back-light	1,8		
	Non-display	Flat cable or pin reverse	10	
Wrong or missing component		11		
Minor	Display state	Background color deviation	2	1.0
		Black spot and dust	3	
		Line defect, Scratch	4	
		Rainbow	5	
		Chip	6	
		Pin hole	7	
	Polarizer	Protruded	12	
		Bubble and foreign material	3	
	Soldering	Poor connection	9	
	Wire	Poor connection	10	
	TAB	Position, Bonding strength	13	

Note on defect classification

No.	Item	Criterion																				
1	Short or open circuit	Not allow																				
	LC leakage																					
	Flickering																					
	No display																					
	Wrong viewing direction																					
	Wrong Back-light																					
2	Contrast defect	Refer to approval sample																				
	Background color deviation																					
3	Point defect, Black spot, dust (including Polarizer) $\phi = (X+Y)/2$	 <table border="1" data-bbox="861 974 1300 1265"> <thead> <tr> <th>Point Size</th> <th>Acceptable Qty.</th> </tr> </thead> <tbody> <tr> <td>$\phi \leq 0.10$</td> <td>Disregard</td> </tr> <tr> <td>$0.10 < \phi \leq 0.20$</td> <td>3</td> </tr> <tr> <td>$0.20 < \phi \leq 0.25$</td> <td>2</td> </tr> <tr> <td>$0.25 < \phi \leq 0.30$</td> <td>1</td> </tr> <tr> <td>$\phi > 0.30$</td> <td>0</td> </tr> </tbody> </table> <p style="text-align: right;">Unit: mm</p>	Point Size	Acceptable Qty.	$\phi \leq 0.10$	Disregard	$0.10 < \phi \leq 0.20$	3	$0.20 < \phi \leq 0.25$	2	$0.25 < \phi \leq 0.30$	1	$\phi > 0.30$	0								
Point Size	Acceptable Qty.																					
$\phi \leq 0.10$	Disregard																					
$0.10 < \phi \leq 0.20$	3																					
$0.20 < \phi \leq 0.25$	2																					
$0.25 < \phi \leq 0.30$	1																					
$\phi > 0.30$	0																					
4	Line defect, Scratch	 <table border="1" data-bbox="790 1400 1340 1668"> <thead> <tr> <th colspan="2">Line</th> <th>Acceptable Qty.</th> </tr> <tr> <th>L</th> <th>W</th> <th></th> </tr> </thead> <tbody> <tr> <td>---</td> <td>$0.015 \geq W$</td> <td>Disregard</td> </tr> <tr> <td>$3.0 \geq L$</td> <td>$0.03 \geq W$</td> <td rowspan="2">2</td> </tr> <tr> <td>$2.0 \geq L$</td> <td>$0.05 \geq W$</td> </tr> <tr> <td>$1.0 \geq L$</td> <td>$0.1 > W$</td> <td>1</td> </tr> <tr> <td>---</td> <td>$0.05 < W$</td> <td>Applied as point defect</td> </tr> </tbody> </table> <p style="text-align: right;">Unit: mm</p>	Line		Acceptable Qty.	L	W		---	$0.015 \geq W$	Disregard	$3.0 \geq L$	$0.03 \geq W$	2	$2.0 \geq L$	$0.05 \geq W$	$1.0 \geq L$	$0.1 > W$	1	---	$0.05 < W$	Applied as point defect
Line		Acceptable Qty.																				
L	W																					
---	$0.015 \geq W$	Disregard																				
$3.0 \geq L$	$0.03 \geq W$	2																				
$2.0 \geq L$	$0.05 \geq W$																					
$1.0 \geq L$	$0.1 > W$	1																				
---	$0.05 < W$	Applied as point defect																				
5	Rainbow	Not more than two color changes across the viewing area.																				

No	Item	Criterion								
6 Chip Remark: X: Length direction Y: Short direction Z: Thickness direction t: Glass thickness W: Terminal Width		Acceptable criterion <table border="1" data-bbox="933 436 1324 515"> <thead> <tr> <th>X</th> <th>Y</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td>≤ 2</td> <td>0.5mm</td> <td>$\leq t/2$</td> </tr> </tbody> </table>	X	Y	Z	≤ 2	0.5mm	$\leq t/2$		
	X	Y	Z							
	≤ 2	0.5mm	$\leq t/2$							
		Acceptable criterion <table border="1" data-bbox="925 750 1332 828"> <thead> <tr> <th>X</th> <th>Y</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td>≤ 2</td> <td>0.5mm</td> <td>$\leq t$</td> </tr> </tbody> </table>	X	Y	Z	≤ 2	0.5mm	$\leq t$		
	X	Y	Z							
≤ 2	0.5mm	$\leq t$								
	Acceptable criterion <table border="1" data-bbox="941 1041 1332 1153"> <thead> <tr> <th>X</th> <th>Y</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td>≤ 3</td> <td>≤ 2</td> <td>$\leq t$</td> </tr> <tr> <td colspan="2">shall not reach to ITO</td> <td></td> </tr> </tbody> </table>	X	Y	Z	≤ 3	≤ 2	$\leq t$	shall not reach to ITO		
X	Y	Z								
≤ 3	≤ 2	$\leq t$								
shall not reach to ITO										
	Acceptable criterion <table border="1" data-bbox="925 1422 1332 1500"> <thead> <tr> <th>X</th> <th>Y</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td>Disregard</td> <td>≤ 0.2</td> <td>$\leq t$</td> </tr> </tbody> </table>	X	Y	Z	Disregard	≤ 0.2	$\leq t$			
X	Y	Z								
Disregard	≤ 0.2	$\leq t$								
	Acceptable criterion <table border="1" data-bbox="925 1702 1300 1780"> <thead> <tr> <th>X</th> <th>Y</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td>≤ 5</td> <td>≤ 2</td> <td>$\leq t/3$</td> </tr> </tbody> </table>	X	Y	Z	≤ 5	≤ 2	$\leq t/3$			
X	Y	Z								
≤ 5	≤ 2	$\leq t/3$								

No.	Item	Criterion								
7	Segment pattern $W = \text{Segment width}$ $\phi = (X+Y)/2$	(1) Pin hole $\phi < 0.10\text{mm}$ is acceptable.  <table border="1" data-bbox="853 638 1316 817"> <thead> <tr> <th>Point Size</th> <th>Acceptable Qty</th> </tr> </thead> <tbody> <tr> <td>$\phi \leq 1/4W$</td> <td>Disregard</td> </tr> <tr> <td>$1/4W < \phi \leq 1/2W$</td> <td>1</td> </tr> <tr> <td>$\phi > 1/2W$</td> <td>0</td> </tr> </tbody> </table> <p style="text-align: right;">Unit: mm</p>	Point Size	Acceptable Qty	$\phi \leq 1/4W$	Disregard	$1/4W < \phi \leq 1/2W$	1	$\phi > 1/2W$	0
Point Size	Acceptable Qty									
$\phi \leq 1/4W$	Disregard									
$1/4W < \phi \leq 1/2W$	1									
$\phi > 1/2W$	0									
8	Back-light	(1) The color of backlight should correspond its specification. (2) Not allow flickering								
9	Soldering	(1) Not allow heavy dirty and solder ball on PCB. (The size of dirty refer to point and dust defect) (2) Over 50% of lead should be soldered on Land. 								
10	Wire	(1) Copper wire should not be rusted (2) Not allow crack on copper wire connection. (3) Not allow reversing the position of the flat cable. (4) Not allow exposed copper wire inside the flat cable.								
11*	PCB	(1) Not allow screw rust or damage. (2) Not allow missing or wrong putting of component.								

No	Item	Criterion
12	Protruded W: Terminal Width	 <p>Acceptable criteria: $Y \leq 0.4$</p>
13	TAB	<p>1. Position</p>  <div style="border: 1px solid black; padding: 5px; width: fit-content; margin-left: auto;"> $W1 \leq 1/3W$ $H1 \leq 1/3H$ </div> <p>2. TAB bonding strength test</p>  <p> $P (=F/TAB \text{ bonding width}) \geq 650\text{gf/cm}$,(speed rate: 1mm/min) 5pcs per SOA (shipment) </p>
14	Total no. of acceptable Defect	<p>A. Zone</p> <p>Maximum 2 minor non-conformities per one unit.</p> <p>Defect distance: each point to be separated over 10mm</p> <p>B. Zone</p> <p>It is acceptable when it is no trouble for quality and assembly in customer's end product.</p>

11.3 Reliability of LCM

Reliability test condition:

Item	Condition	Time (hrs)	Assessment
High temp. Storage	80°C	48	No abnormalities in functions and appearance
High temp. Operating	70°C	48	
Low temp. Storage	-30°C	48	
Low temp. Operating	-20°C	48	
Humidity	40°C/ 90%RH	48	
Temp. Cycle	0°C ← 25°C → 50°C (30 min ← 5 min → 30min)	10cycles	

Recovery time should be 24 hours minimum. Moreover, functions, performance and appearance shall be free from remarkable deterioration within 50,000 hours under ordinary operating and storage conditions room temperature (20±8°C), normal humidity (below 65% RH), and in the area not exposed to direct sun light.

11.4 Precaution for using LCD/LCM

LCD/LCM is assembled and adjusted with a high degree of precision. Do not attempt to make any alteration or modification. The followings should be noted.

General Precautions:

1. LCD panel is made of glass. Avoid excessive mechanical shock or applying strong pressure onto the surface of display area.
2. The polarizer used on the display surface is easily scratched and damaged. Extreme care should be taken when handling. To clean dust or dirt off the display surface, wipe gently with cotton, or other soft material soaked with isopropyl alcohol, ethyl alcohol or trichlorotrifluoroethane, do not use water, ketone or aromatics and never scrub hard.
3. Do not tamper in any way with the tabs on the metal frame.
4. Do not make any modification on the PCB without consulting Focus LCDs
5. When mounting a LCM, make sure that the PCB is not under any stress such as bending or twisting. Elastomer contacts are very delicate and missing pixels could result from slight dislocation of any of the elements.
6. Avoid pressing on the metal bezel, otherwise the elastomer connector could be deformed and lose contact, resulting in missing pixels and also cause rainbow on the display.
7. Be careful not to touch or swallow liquid crystal that might leak from a damaged cell. Any liquid crystal adheres to skin or clothes, wash it off immediately with soap and water.

Static Electricity Precautions:

1. CMOS-LSI is used for the module circuit; therefore operators should be grounded whenever he/she comes into contact with the module.
2. Do not touch any of the conductive parts such as the LSI pads; the copper leads on the PCB and

- the interface terminals with any parts of the human body.
3. Do not touch the connection terminals of the display with bare hand; it will cause disconnection or defective insulation of terminals.
 4. The modules should be kept in anti-static bags or other containers resistant to static for storage.
 5. Only properly grounded soldering irons should be used.
 6. If an electric screwdriver is used, it should be grounded and shielded to prevent sparks.
 7. The normal static prevention measures should be observed for work clothes and working benches.
 8. Since dry air is inductive to static, a relative humidity of 50-60% is recommended.

Soldering Precautions:

1. Soldering should be performed only on the I/O terminals.
2. Use soldering irons with proper grounding and no leakage.
3. Soldering temperature: $280^{\circ}\text{C}\pm 10^{\circ}\text{C}$
4. Soldering time: 3 to 4 second.
5. Use eutectic solder with resin flux filling.
6. If flux is used, the LCD surface should be protected to avoid spattering flux.
7. Flux residue should be removed.

Operation Precautions:

1. The viewing angle can be adjusted by varying the LCD driving voltage V_o .
2. Since applied DC voltage causes electro-chemical reactions, which deteriorate the display, the applied pulse waveform should be a symmetric waveform such that no DC component remains. Be sure to use the specified operating voltage.
3. Driving voltage should be kept within specified range; excess voltage will shorten display life.
4. Response time increases with decrease in temperature.
5. Display color may be affected at temperatures above its operational range.
6. Keep the temperature within the specified range usage and storage. Excessive temperature and humidity could cause polarization degradation, polarizer peel-off or generate bubbles.
7. For long-term storage over 40°C is required, the relative humidity should be kept below 60%, and avoid direct sunlight.