



# FOCUS LCDs

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

## Graphic Display Module

Part Number

G12864A1-BW-LW63

### Overview:

- 128x64 dots
- Overall Area: 89.7x49.8mm
- Viewing Area: 69.0x 36.5mm
- STN Blue Negative
- Parallel & Serial Interfaces
- Wide Temp  
(-20° - 70°C operating / -30° - 80°C storage)
- Bottom View
- Transmissive
- 3V LCD, 1/64 duty, 1/9 bias
- 3.5V White LED backlight
- Built-in controller (Aip31565CR)
- RoHS Compliant

## Graphic LCD Features

Resolution: 128x64 dots

Interfaces: 8-bit parallel (8080/6800) and 4-wire Serial

Built in IC Controller: (Aip31565CR)

Display Mode and Backlight Variations

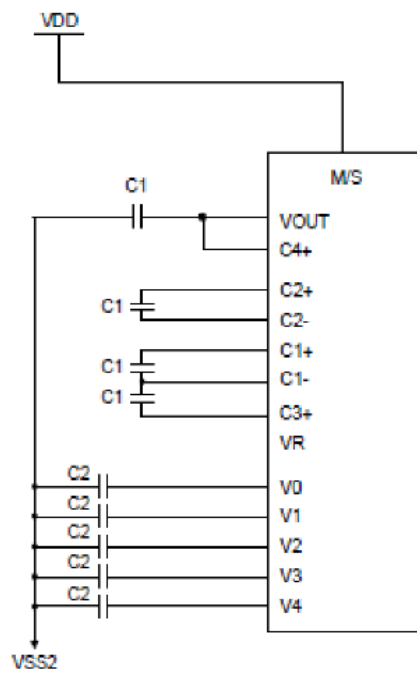
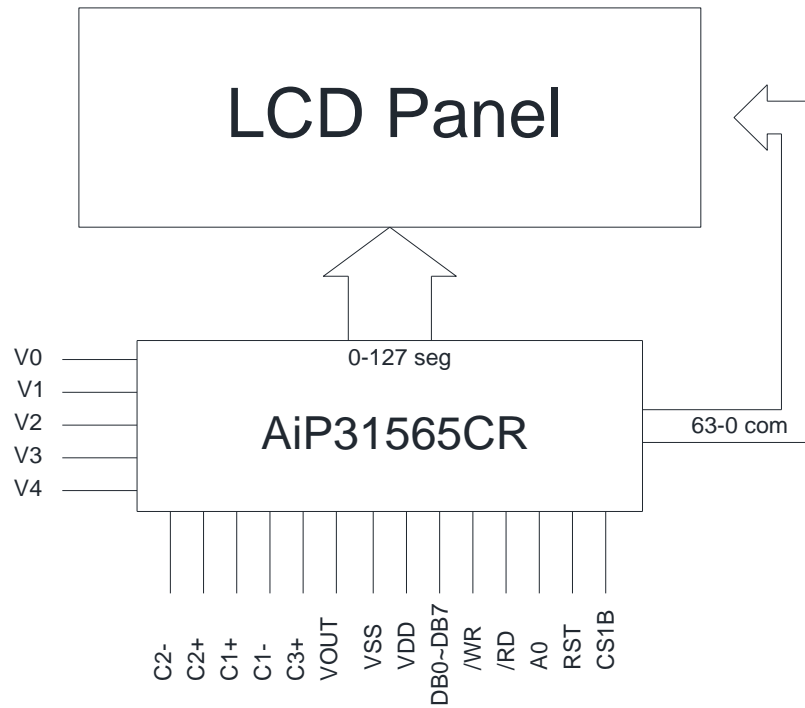
RoHS Compliant

General Information Items	Specification	Unit	Note
	Main Panel		
Viewing Area	69.0(L) x 36.5(W)	mm	-
LCD Type	STN Blue Negative	-	-
Viewing Direction	6:00	o'clock	-
Rear Polarizer	Transmissive	-	-
Number of Pixels	128x64	dots	-
Backlight Type	LED Edge	-	-
Backlight Color	White	-	-
Controller IC	Built-in controller (Aip31565CR)	-	-
Interfaces	8-bit Parallel/4-wire Serial	-	8080 & 6800
DC to DC Circuit	Built In	-	-
Operating temperature	-20~+70	°C	-
Storage temperature	-30~+80	°C	-

## Mechanical Information

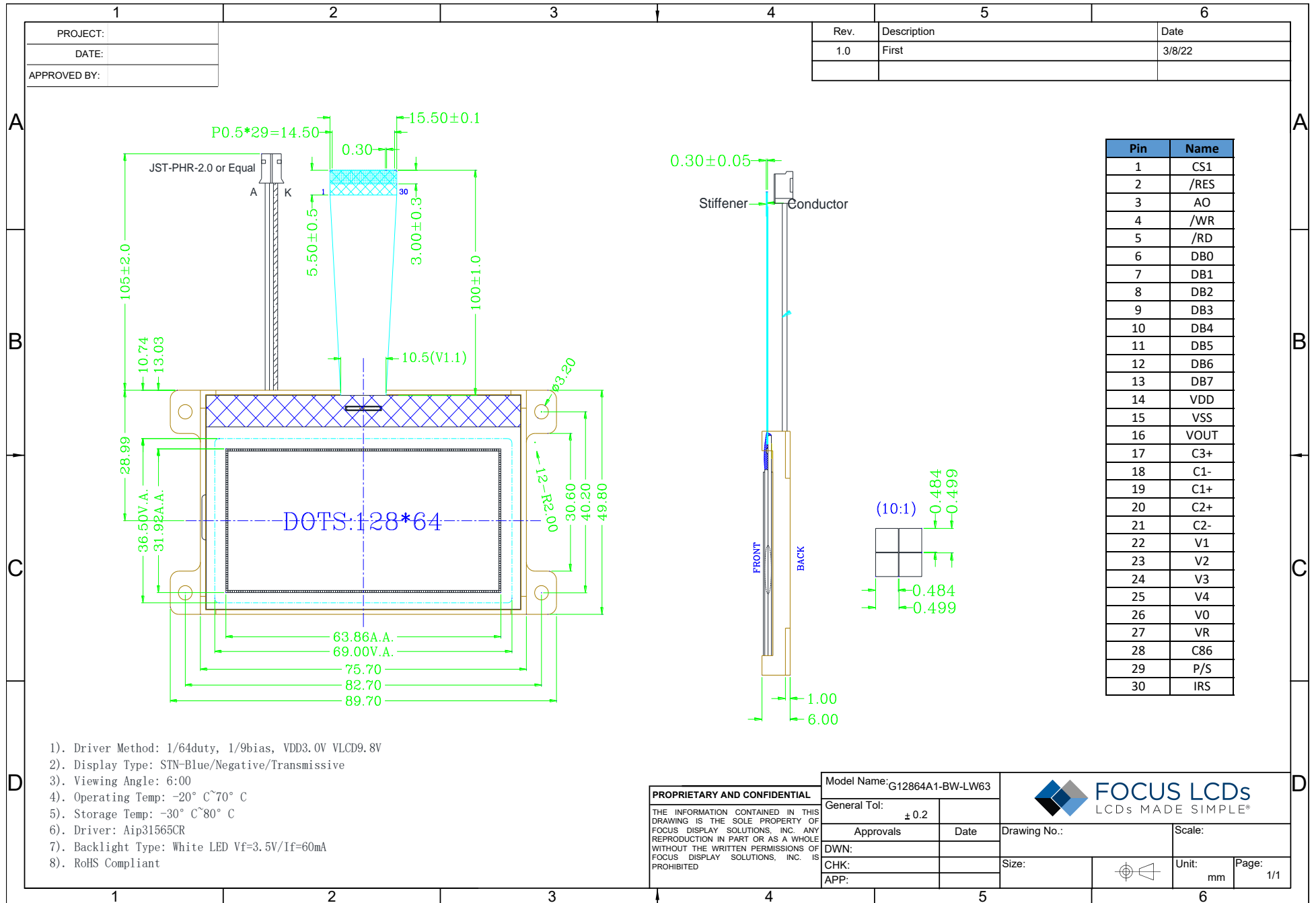
Item		Min	Typ.	Max	Unit	Note
Module size	Length (L)		89.7		mm	-
	Width (W)		49.8		mm	-
	Height (H)		6.0		mm	-

## 1. Block Diagrams



C1: 1uF-4.7uF for Voltage rating from 10-35V  
C2: 1uF-2.2uF for Voltage rating from 6.3-25V

## 2. Outline dimensions



### 3. Input Terminal Pin Assignment

NO.	Symbol	Description	I/O
1	CS1	Chip select in serial interface. Low is active.	MPU
2	RES	External reset pin. Must be fixed to VDD. Low is active.	MPU
3	A0	Select registers. 0: instructions, 1: data registers.	MPU
4	WR	Read/write select signal	MPU
5	RD	Operation (data read/write) enable signal	MPU
6	DB0	Display data	MPU
7	DB1	Display data	MPU
8	DB2	Display data	MPU
9	DB3	Display data	MPU
10	DB4	Display data	MPU
11	DB5	Display data	MPU
12	DB6(SCL)	Display data (or serial clock in serial interface)	MPU
13	DB7(SI)	Display data (or serial data input in serial interface)	MPU
14	VDD	Power supply for logic LCM	MPU
15	VSS	Signal ground for LCM	MPU
16	VOUT	DC/DC voltage converter output	MPU
17	C3+	For voltage booster circuit External capacitors 0.1uF-4.7uF.	P
18	C1-		P
19	C1+		P
20	C2+		P
21	C2-		P
22	V1	Power supply for LCD.	P
23	V2		P
24	V3		P
25	V4		P
26	V0		P
27	VR	Voltage adjustment pin. Applies voltage between V0 and VSS using resistive divider.	MPU
28	C86	MPU parallel interface switch terminal)	MPU
29	P/S	Parallel or serial interface select	MPU
30	IRS	Resistor select for internal voltage divider for V0 voltage level adjustment	MPU

### 4. LCD Optical Characteristics

#### 4.1 Optical Specifications

STN Type Display Module

( $T_a=25^{\circ}\text{C}$ ,  $V_{DD}=3.0\text{V}$ )

Item	Symbol	Condition	Min	Typ.	Max	Unit	Note	
Contrast Ratio	CR	$C_r \geq 2$	--	6	--	--		
Response Time	Rising		TR	--	150	250	ms	
	Falling		TF	--	150	250		
Viewing Angle	Top-Bottom		$\theta$	-60	--	35	degree	
	Left-Right		$\Phi$	- 40	--	40		

## 5. Electrical Characteristics

### 5.1 Absolute Maximum Rating (Ta=25 °C, VSS=0V)

Characteristics	Symbol	Min	Max	Unit
Power Voltage Logic	VDD-VSS	0.3	3.6	V
Input Voltage	VIN	-0.3	VDD+0.3	V
Power Supply Voltage for LCD	V0-VSS	-0.3	14.2	V
Operating Temperature	VOP	-20	+70	°C
Storage Temperature	TST	-30	+80	°C

*NOTE: If the absolute maximum rating of the above parameters is exceeded, even momentarily, the quality of the product may be degraded. Absolute maximum ratings specify the values which the product may be physically damaged if exceeded. Be sure to use the product within the range of the absolute maximum ratings.*

### 5.2 DC Electrical Characteristics

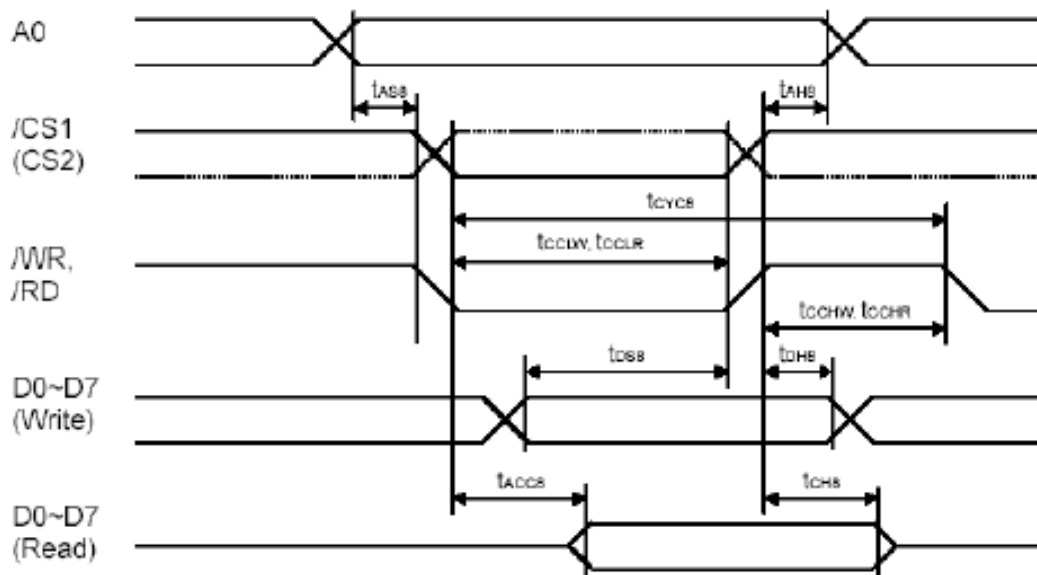
Characteristics	Symbol	Conditions	Min	Typ.	Max	Unit
Supply Voltage for LCD	V0-VSS	Ta=25°C	9.3	9.8	12.7	V
Supply Voltage for Logic	VDD		2.8	3.0	3.3	V
Supply Current	IDD	Ta=25°C, VDD=3.0V	--	1.1	1.6	mA
Backlight Supply Voltage	VF		2.8	3.0	3.2	V
Backlight Supply Current	ILED	VF=3.5V	30	60	90	mA

## 6. Signal Timing Characteristics

### 6.1 8-bit Parallel Timing Characteristics (8080-series)

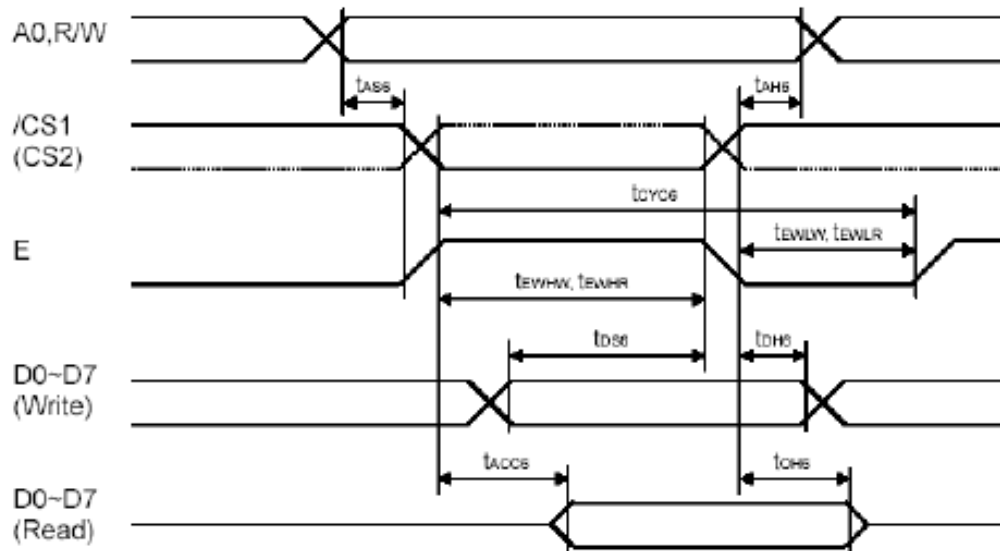
Parameter	Signal	Symbol	Min	Max	Unit	Note
Address hold time	A0	t <sub>AH8</sub>	0	--	ns	
Address setup time		t <sub>AW8</sub>	0	--	ns	
Address cycle time		t <sub>CYC8</sub>	240	--	ns	
Enable L pulse width (write)	WR	t <sub>CCLW</sub>	90	--	ns	
Enable H pulse width (write)		t <sub>CCHW</sub>	100	--	ns	
Enable L pulse width (read)	RD	t <sub>CCLR</sub>	120	--	ns	
Enable H pulse width (read)		t <sub>CCHR</sub>	60	--	ns	
Write data setup time	DB0-DB7	t <sub>DS8</sub>	40	--	ns	
Write address hold time		t <sub>DH8</sub>	10	--	ns	
Read access time		t <sub>ACC8</sub>	--	140	ns	CL=100pF
Read output disable time		t <sub>OH8</sub>	5	50	ns	CL=100pF

System Buses Read/Write Characteristics (for 8080 Series MPU)



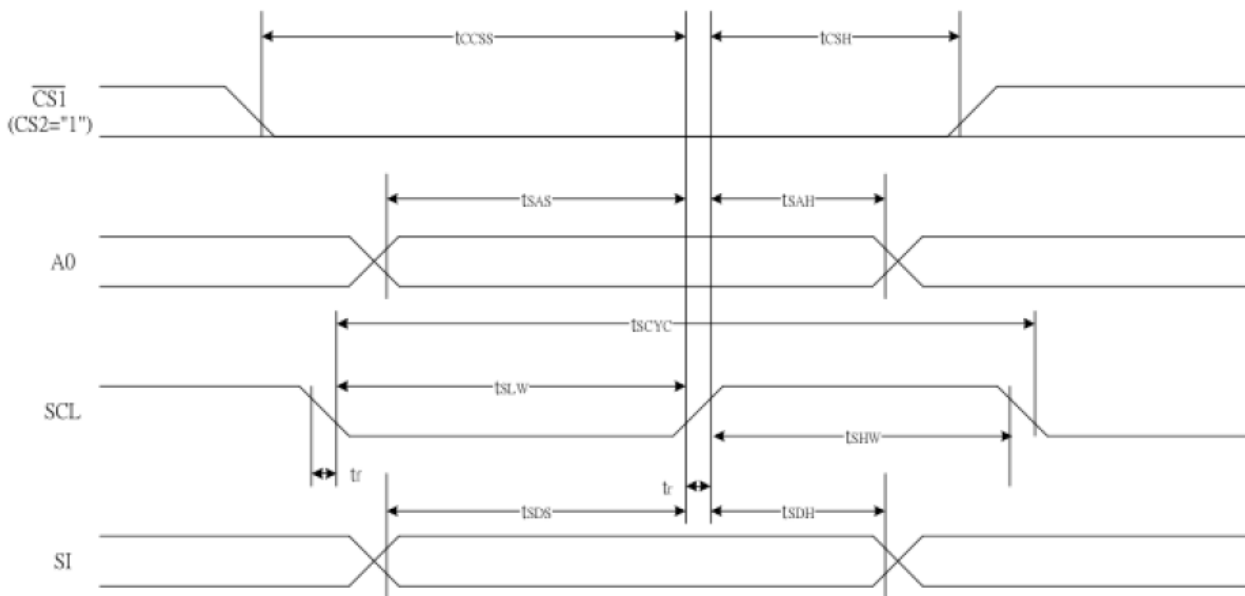
## 6.2 8-bit Parallel Timing Characteristics (6800-series)

Parameter	Signal	Symbol	Min	Max	Unit	Note
Address hold time	A0	$t_{AH6}$	0	--	ns	
Address setup time		$t_{AW6}$	0	--	ns	
Address cycle time		$t_{CYC6}$	240	--	ns	
Enable L pulse width (write)	WR	$t_{CCLW}$	100	--	ns	
Enable H pulse width (write)		$t_{CCHW}$	90	--	ns	
Enable L pulse width (read)	RD	$t_{CCLR}$	60	--	ns	
Enable H pulse width (read)		$t_{CCHR}$	120	--	ns	
Write data setup time	DB0-DB7	$t_{DS6}$	40	--	ns	
Write address hold time		$t_{DH6}$	10	--	ns	
Read access time		$t_{ACC6}$	--	140	ns	CL=100pF
Read output disable time		$t_{OH6}$	5	50	ns	CL=100pF





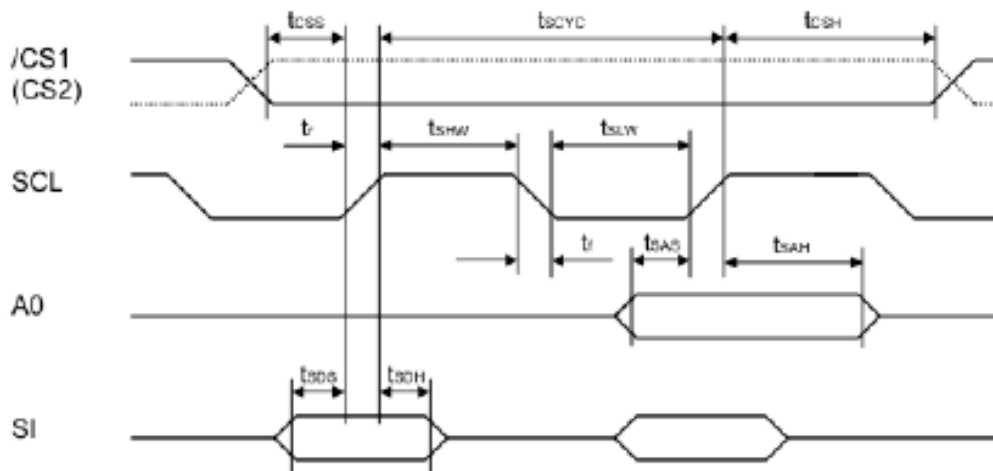
### 6.3 Serial Interface



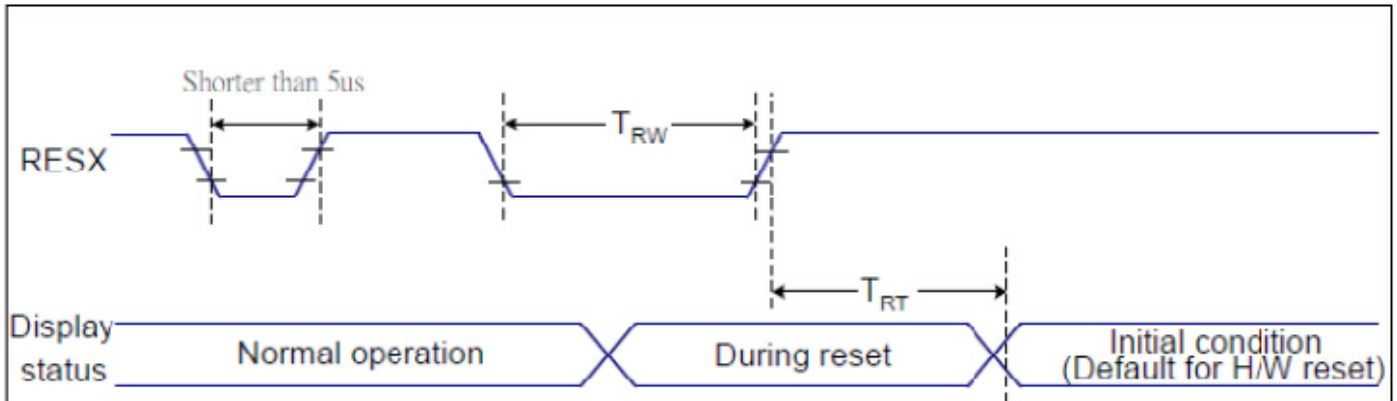
(VDD=3.0V, Ta=25°C)

Parameter	Signal	Symbol	Min	Max	Unit	Note
Serial Clock Period	SCL	Tscyc	120	--	ns	
SCL "H" pulse width		Tshw	60	--	ns	
SCL "L" pulse width		Tslw	60	--	ns	
Address setup time	A0	Tsas	30	--	ns	
Address hold time		Tsah	20	--	ns	
Data setup time	SI	Tsds	30	--	ns	
Data hold time		Tsdh	20	--	ns	
CS-SCL time	CS	Tcss	20	--	ns	
CS-SCL time		Tcsh	40	--	ns	

#### Serial Interface Timing



## 6.4 Reset Timing



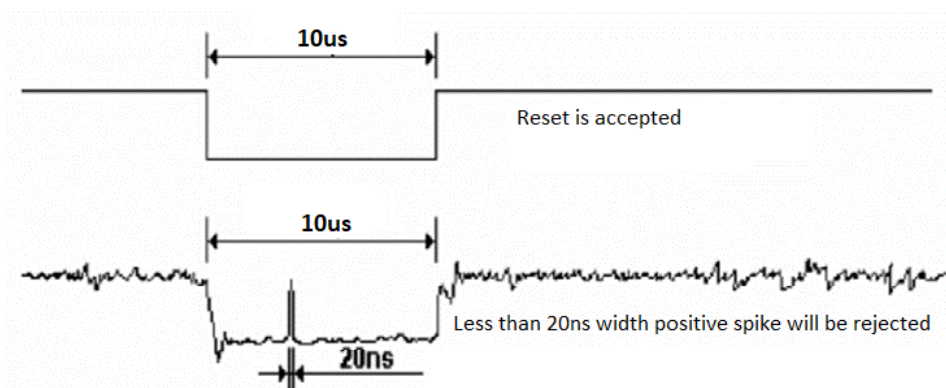
Related Pins	Symbol	Parameter	Min	Max	Unit
RESX	TRW	Reset 'L' pulse width	10	-	us
	TRT	Reset cancel	-	5 (Note 1,5)	ms
			-	120 (Note 1, 6, 7)	ms

Notes:

- The reset cancel includes also required time for loading ID bytes, VCOM setting and other settings from NVM (or similar device) to registers. This loading is done every time when there is HW reset cancel time (tRT) within 5ms after a rising edge of RESX.
- Spike due to an electrostatic discharge on RESX line does not because irregular system reset according to the table below:

RESX Pulse	Action
Shorter than 5us	Reset Rejected
Longer than 9us	Reset
Between 5us and 9 us	Reset starts

- During the resetting period, the display will be blanked (the display is entering blanking sequence, which maximum time is 120ms, when reset starts in Sleep Out mode. The display remains the blank state in Sleep in mode) and then return to Default condition for Hardware Reset.
- Spike Rejection also applies during a valid reset pulse as shown below:



- When Reset applied during Sleep In Mode.
- When Reset applied during Sleep Out Mode.
- It is necessary to wait 5ms after releasing RESX before sending commands. Also Sleep Out command cannot be sent for 120ms.

## 7. Commands for Initialization of the Display

Instruction	A0	R/W (RWR)	COMMAND BYTE								DESCRIPTION	
			D7	D6	D5	D4	D3	D2	D1	D0		
DISPLAY ON/OFF	0	0	1	0	1	0	1	1	1	D	D=1, DISPLAY ON D=2, DISPLAY OFF	
SET START LINE	0	0	0	1	S5	S4	S3	S2	S1	S0	SET DISPLAY START LINE	
SET PAGE ADDRESS	0	0	1	0	1	1	Y3	Y2	Y1	Y0	SET PAGE ADDRESS	
SET COLUMN ADDRESS	0	0	0	0	0	1	X7	X6	X5	X4	SET COLUMN ADDRESS (MSB)	
	0	0	0	0	0	0	X3	X2	X1	X0	SET COLUMN ADDRESS (LSB)	
READ STATUS	0	1	BUSY	MX	D5	RST	0	0	0	0	READ IC STATUS	
WRITE DATA	1	0	D7	D6	D5	D4	D3	D2	D1	D0	WRITE DISPLAY DATA TO RAM	
READ DATA	1	1	D7	D6	D5	D4	D3	D2	D1	D0	READ DISPLAY DATA FROM RAM	
SEG DIRECTION	0	0	1	0	1	0	0	0	0	MX	SET SCAN DIRECTION OF SEG MX=1, REVERSE DIRECTION MX=0, NORMAL DIRECTION	
INVERSE DISPLAY	0	0	1	0	1	0	0	1	1	INV	INV=1 INVERSE DISPLAY, INV=0 NORMAL DISPLAY	
ALL PIXEL ON	0	0	1	0	1	0	0	1	0	AP	AP=1, SET ALL PIXEL ON AP=0, NORMAL DISPLAY	
BIAS SELECT	0	0	1	0	1	0	0	0	1	BS	SELECT BIAS SETTING 0=1/9; 1=1/7 (AT 1/65 DUTY)	
READ-MODIFY-WRITE	0	0	1	1	1	0	0	0	0	0	COLUMN ADDRESS INCREMENT: READ:+0, WRITE:+1	
END	0	0	1	1	1	0	1	1	1	0	EXIT READ-MODIFY-WRITE MODE	
RESET	0	0	1	1	1	0	0	0	1	0	SOFTWARE REST	
COM DIRECTION	0	0	1	1	0	0	MY	-	-	-	SET OUTPUT DIRECTION OF COM; MY=1 REVERSE DIRECTION, MY=0 NORMAL DIRECTION	
POWER CONTROL	0	0	0	0	1	0	1	VB	VR	VF	CONTROL BUILT IN POWER CIRCUIT ON/OFF	
REGULATION RATIO	0	0	0	0	1	0	0	RR2	RR1	RR0	SELECT REGULATION RESISTOR RATIO	
SET EV	0	0	1	0	0	0	0	0	0	1	DOUBLE COMMAND (SET ELECTRONIV VOLUME LEVEL)	
	0	0	0	0	EV5	EV4	EV3	EV2	EV1	RV0		
POWER SAVE MODE SET	0	0	1	0	1	0	1	1	0	MD	MD=0, SLEEP MODE; MD=1, NORMAL	
	0	0	0	0	0	0	0	0	0	0		
POWER SAVE	0	0	COMPOUND COMMAND								0	DISPLAY OFF + ALL PIXEL ON
SET BOOSTER	0	0	1	1	1	1	1	0	0	0	DOUBLE COMMAND SET BOOSTER LEVEL	
	0	0	0	0	0	0	0	0	BL1	BL0		
NOP	0	0	1	1	1	0	0	0	1	1	BL[1:0]=(0,0),X2,X3,X4 BL[1:0]=(0,1),X5 BL[1:0]=(1,1),X6	
TEST	0	0	1	1	1	1	-	-	-	-	DO NOT USE, RESERVED FOR TESTING	

## **8. Cautions and Handling Precautions**

### **8.1 Handling and Operating the Module**

1. When the module is assembled, it should be attached to the system firmly. Do not warp or twist the module during assembly work.
2. Protect the module from physical shock or any force. In addition to damage, this may cause improper operation or damage to the module and back-light unit.
3. Note that polarizer is very fragile and could be easily damaged. Do not press or scratch the surface.
4. Do not allow drops of water or chemicals to remain on the display surface. If you have the droplets for a long time, staining and discoloration may occur.
5. If the surface of the polarizer is dirty, clean it using some absorbent cotton or soft cloth.
6. The desirable cleaners are water, IPA (Isopropyl Alcohol) or Hexane. Do not use ketene type materials (ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might permanent damage to the polarizer due to chemical reaction.
7. If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contact with hands, legs, or clothes, it must be washed away thoroughly with soap.
8. Protect the module from static, it may cause damage to the CMOS ICs.
9. Use fingerstalls with soft gloves in order to keep display clean during the incoming inspection and assembly process.
10. Do not disassemble the module.
11. Protection film for polarizer on the module shall be slowly peeled off just before use so that the electrostatic charge can be minimized.
12. Pins of I/F connector shall not be touched directly with bare hands.
13. Do not connect, disconnect the module in the "Power ON" condition.
14. Power supply should always be turned on/off by the item Power On Sequence & Power Off Sequence.

### **8.2 Storage and Transportation**

1. Do not leave the panel in high temperature, and high humidity for a long time. It is highly recommended to store the module with temperature from 0 to 35 °C and relative humidity of less than 70%
2. Do not store the Graphic LCD module in direct sunlight.
3. The module shall be stored in a dark place. When storing the modules for a long time, be sure to adopt effective measures for protecting the modules from strong ultraviolet radiation, sunlight, or fluorescent light.
4. It is recommended that the modules should be stored under a condition where no condensation is allowed. Formation of dewdrops may cause an abnormal operation or a failure of the module. In particular, the greatest possible care should be taken to prevent any module from being operated where condensation has occurred inside.
5. This panel has its circuitry FPC on the bottom side and should be handled carefully in order not to be stressed.