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Graphic Display Module

Part Number

G126ADGFGN02WRC0XAL

Overview

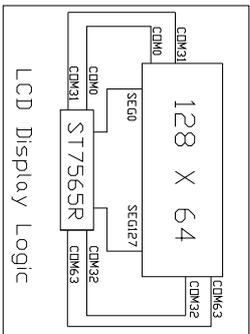
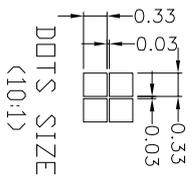
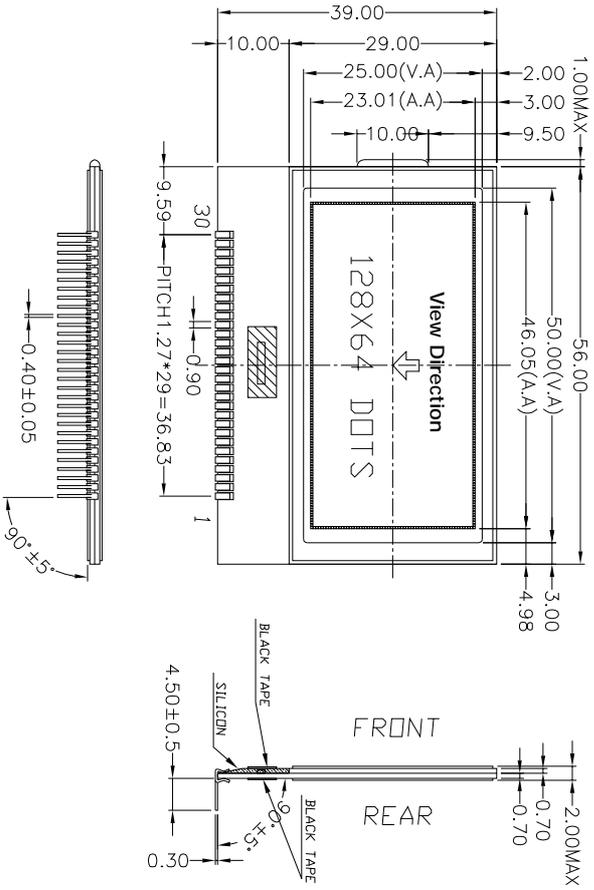
128x64(56x39), FSTN, Gray background, No Backlight, Top view, Wide temp, Reflective (Positive), 3.0V LCD, Controller=ST7565R, RoHS Compliant

FEATURES

1. Support display capacity: 128 x 64 Pixels dots with FSTN mode.
2. On-chip Display Data RAM , Capacity: $128 \times 64 = 8'192$ bits.
3. Serial interfaces are supported.
4. Abundant command functions Display data Read/Write, display ON/OFF, Normal/Reverse display mode, page address set, display start line set, column address set, status read, display all points ON/OFF, LCD bias set, electronic volume, read/modify/write, segment driver direction selects, power saver, static indicator, common output status select, Vo voltage regulation internal resistor ratio set.
5. Static drive circuit equipped internally for indicators.(1 system, with variable flashing speed.)
6. Low-power liquid crystal display power supply circuit equipped internally. Booster circuit (with Boost ratios of 4X/5X, where the step-up voltage reference power supply can be input externally).
7. High-accuracy voltage adjustment circuit (Thermal gradient $-0.05\%/^{\circ}\text{C}$) V0 voltage regulator resistors equipped internally, V1 to VSS voltage divider resistors equipped internally, electronic volume function equipped internally, voltage follower.
8. CR oscillator circuit equipped internally.
9. Extremely low power consumption Operating power when the built-in power supply is used (an example) 60uA (VDD – VSS =3.0 V, Quad voltage, V0 – VSS= 11.0 V). Conditions: When displays pattern OFF and the normal mode is selected.
10. Power supply operate on the low 1.8 voltage Logic power supply
 - VDD – VSS = 1.8V to 3.3 V (+10% Range)
 - Boost reference voltage: VDD2 – VSS = 2.4V to 3.3V
 - Booster maximum voltage limited
 - Liquid crystal drive power supply: V0 – VSS = 4.0V to 13.0 V

GENERAL SPECIFICATIONS

ITEM	DESCRIPTION	UNIT
Outline Size	56.0(L)×39.0(W)×2.0(T)	mm
LCD Type	FSTN, Reflective, Positive, 1/65Duty, 1/9Bias	---
Display type	128×64 dots	---
View Area	50.0×25.0	mm
Display Area	46.05×23.01	mm
Dots size	0.33×0.33	mm
Dots pitch	0.36×0.36	mm
Controller & driver	ST7565R	---
View Direction	12 O'Clock	---
Interface mode	8bit-6800 & 8080, 4-SPI	---
VDD&VOP(Type)	3.0 V & 9.0 V	V
Backlight(Type)	None	---
Operation Temp.	-10~+60	°C
Storage Temp.	-20~+70	°C



PIN	SYMBOL
1	CS1B
2	RESB
3	RS/A0
4	WR/RW
5	E/RD
6	DB0
7	DB1
8	DB2
9	DB3
10	DB4
11	DB5
12	DB6
13	DB7
14	VDD
15	VSS
16	VOUT
17	C1N
18	C3P
19	C1N
20	C1P
21	C2P
22	C2N
23	V4
24	V3
25	V2
26	V1
27	V0
28	C86
29	P/S
30	VSS

NOTES:

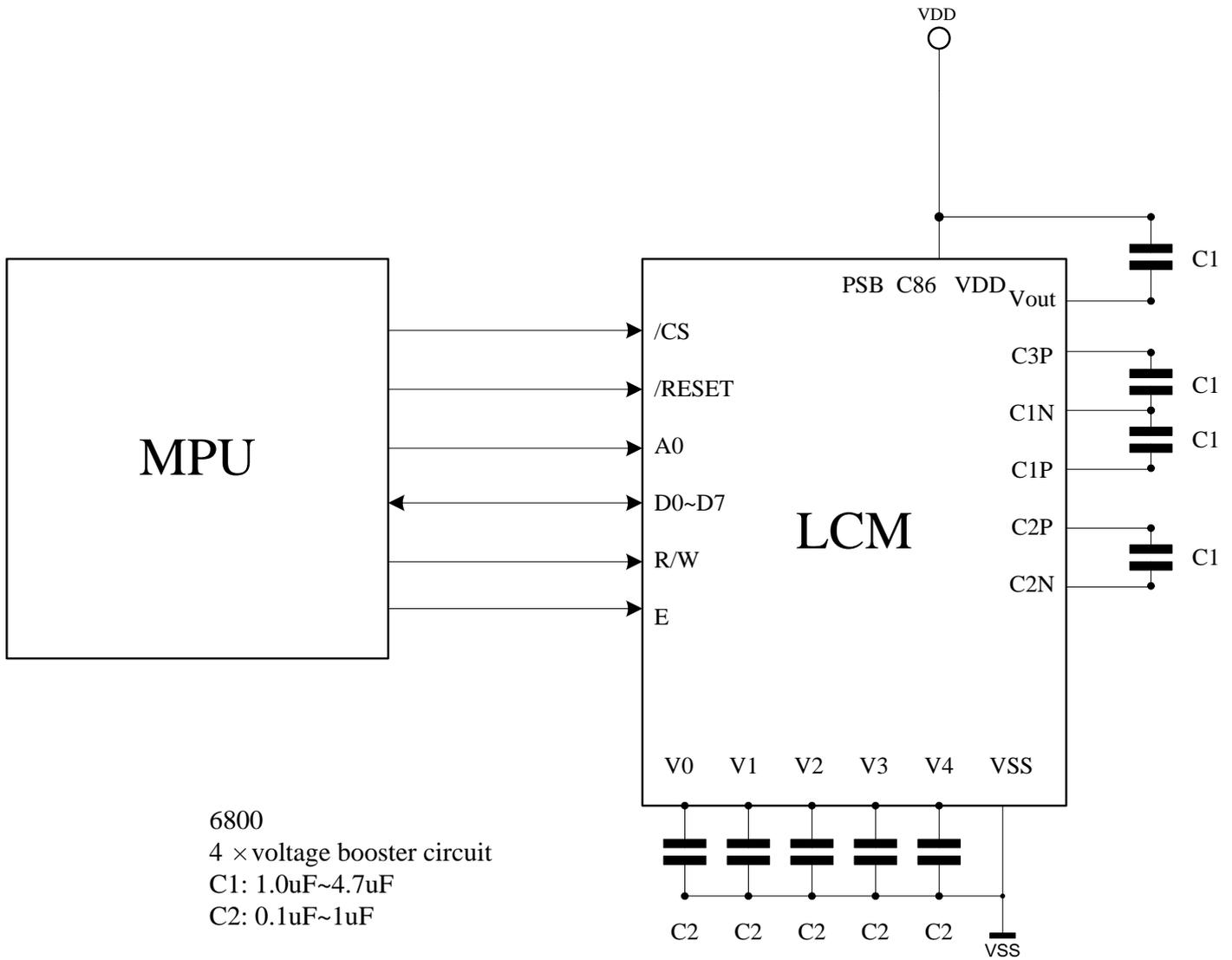
1. DISPLAY TYPE: FSTN/POSITIVE
2. OPERATING VOLTAGE: VDD=3V, Vlcd=9.0V
3. OPERATING TEMPERATURE: -10°C~60°C
4. STORAGE TEMPERATURE: -20°C~70°C
5. DRIVE MODE: 1/65D, 1/9B
6. VIEWING DIRECTION: 12:00
7. POLARIZER TYPE: REFLECTIVE
8. CONNECTOR: COG/ST7565R W/THOUT
9. BACKLIGHT: ROHS
- 10.

ITEMS	CONTENT	DATE	DIMENSION TOLERANCE :	
①	Modify plus definition	2018.1.2	±0.2 mm	
②				
③				
④				
 <p>FocusLCDs.com LCDs MADE SIMPLE®</p>				
CUSTOMER P./N: G126ADGF GND2WRC0XAL			UNITS: mm SHEET: 1/1	
MODIFICATION:			REVISION : 1	

PIN CONNECTIONS

Pin No.	Pin Out	Description												
1	CS1B	Chip select input pin.												
2	RESB	Reset input pin; When /RES is set to "L".												
3	A0	A0 = "H": Indicates that D0 to D7 are display data. A0 = "L": Indicates that D0 to D7 are control data.												
4	WR(R/W)	Read/Write execution control pin. When PSB is "H". RWR is not used in serial interface and should fix to "H" by VDD.												
5	RD(E)	Read/Write execution control pin. When PSB is "H". ERD is not used in serial interface and should fix to "H" by VDD.												
6	DB0	When using 8-bit parallel interface: (6800 or 8080 mode) 8-bit bi-directional data bus. Connect to the data bus of 8-bit microprocessor. When CS1B and CS2 are non-active (CS1B="H" & CS2="L"), D[7:0] pins are high impedance. When using serial interface: 4-LINE D7=SDA: Serial data input. D6=SCL: Serial clock input. D[5:0] are not used and should connect to "H" by VDD.												
7	DB1													
8	DB2													
9	DB3													
10	DB4													
11	DB5													
12	DB6													
13	DB7													
14	VDD		Power supply for logic circuit.											
15	VSS		Ground.											
16	VOUT		DC/DC voltage converter.											
17	C1N													
18	C3P													
19	C1N													
20	C1P													
21	C2P													
22	C2N													
23	V4													
24	V3													
25	V2													
26	V1													
27	V0													
28	C86	C86 selects the microprocessor type in parallel interface mode. <table border="1"> <thead> <tr> <th>PSB</th> <th>C86</th> <th>Selected Interface</th> </tr> </thead> <tbody> <tr> <td>"H"</td> <td>"H"</td> <td>Parallel 6800 Series MPU Interface</td> </tr> <tr> <td>"H"</td> <td>"L"</td> <td>Parallel 8080 Series MPU Interface</td> </tr> <tr> <td>"L"</td> <td>-</td> <td>Serial 4-Line SPI Interface</td> </tr> </tbody> </table>	PSB	C86	Selected Interface	"H"	"H"	Parallel 6800 Series MPU Interface	"H"	"L"	Parallel 8080 Series MPU Interface	"L"	-	Serial 4-Line SPI Interface
PSB	C86	Selected Interface												
"H"	"H"	Parallel 6800 Series MPU Interface												
"H"	"L"	Parallel 8080 Series MPU Interface												
"L"	-	Serial 4-Line SPI Interface												
29	P/S	PSB selects the interface type: Serial or Parallel.												
30	VSS	Ground.												

APPLICATION CIRCUIT EXAMPLE



ABSOLUTE MAXIMUN RATING

ELECTRICAL ABSOLUTE MAXIMUM RATINGS

ITEM	SYMBOL	MIN	MAX	UNIT
POWER SUPPLY FOR LOGIC	VDD-VSS	-0.3	3.6	V
POWER SUPPLY FOR LCD DRIVE	V0-VSS	-0.3	16	V
INPUT VOLTAGE	VIN	-0.3	VDD+0.3	V
POWER SUPPLY FOR LED	VA-VK	-0.3	--	V

ENVIRONMENTAL ABSOLUTE MAXIMUM RATINGS

ITEM	OPERATING		STORAGE		UNIT	COMMENT
	MIN	MAX	MIN	MAX		
AMBIENT TEMPERATURE	-10	+60	-20	+70	°C	
HUMIDITY	/		/		--	WITHOUT CONDENSATION
VIBRATION (M/S ²)	/	/	/	/	--	SEE "ITEMS OF RELIABILITY"
TEMPERATURE CYCLING TEST	/	/	/	/	--	SEE "ITEMS OF RELIABILITY"
CORROSIVE GAS	NOT ACCEPTABLE		NOT ACCEPTABLE		--	

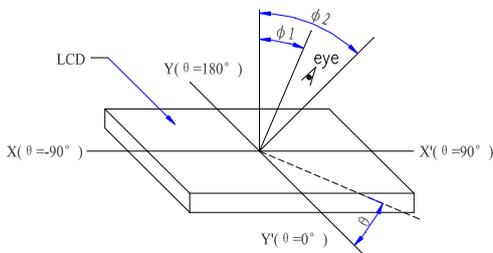
ELECTRICAL CHARACTERISTICS (V_{SS}=0V)

Item	Symbol	Condition	Min.	Typ	Max.	Unit	note
Power Supply for Logic	V _{DD} -V _{SS}	T _a =25°C	2.8	3.0	3.3	Volt	
Power Supply for Backlight	V _{LED+} ~ V _{LED-}		--	--	--	Volt	
Input Voltage	V _{IL}	V _{DD} =3V±5%	V _{SS}	-	0.3 V _{DD}	Volt	
	V _{IH}		0.7 V _{DD}	-	V _{DD}	Volt	
Output Voltage	V _{OL}	V _{DD} =3V±5%	V _{SS}	-	0.3 V _{DD}	Volt	
	V _{OH}		0.7 V _{DD}	-	V _{DD}	Volt	
LCD drive Voltage (recommended Voltage)	V _{SS} -V ₀	T _a =0°C	--	--	--	Volt	
		T _a =25°C	8.8	9.0	9.2		
		T _a =50°C	--	--	--		
Power Supply Current for LCM	I _{DD}	V _{DD} =3.0V T _a =25°C	-	150	300	uA	
	I _{LED}	V _{LED} =	--	--	--	mA	

ELECTRO-OPTICAL CHARACTERISTICS

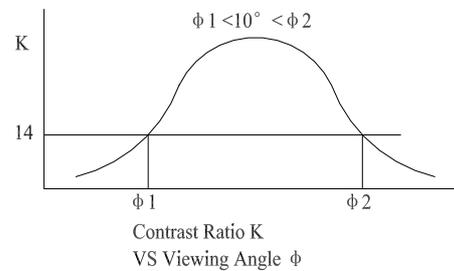
Item	Symbol	Condition	Min.	Typ	Max.	Unit	note
Viewing angle range	$\Theta 2-\Theta 1$	$T_a=25^\circ\text{C}$	20	-	-	Deg	K=1.4 A,B
	Φ		-	-	-		
Rise Time	T_r	$T_a=25^\circ\text{C}$	-	200	300	ms	$\Phi=10$ $\Theta=0$ C
		$T_a=0^\circ\text{C}$	-	-	-		
Fall Time	T_f	$T_a=25^\circ\text{C}$	-	214	300	ms	$\Phi=10$ $\Theta=0$ C
		$T_a=0^\circ\text{C}$	-	-	-		
Contrast	Cr	$T_a=25^\circ\text{C}$	-	8	-	-	$\Phi=10$ $\Theta=0$ D

Definition of angle θ and ϕ



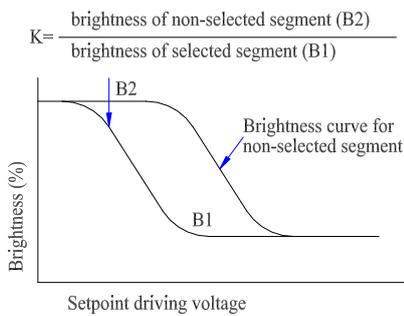
POSITIVE TYPE

Definition of viewing angle $\phi 1$ and $\phi 2$



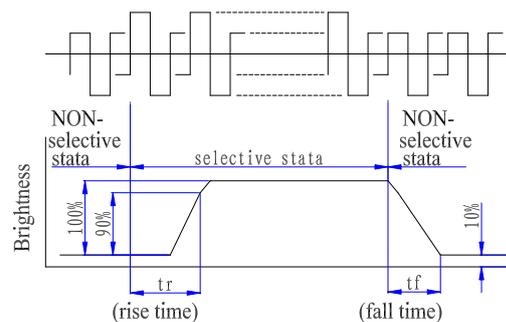
POSITIVE TYPE

Definition of contrast "K"



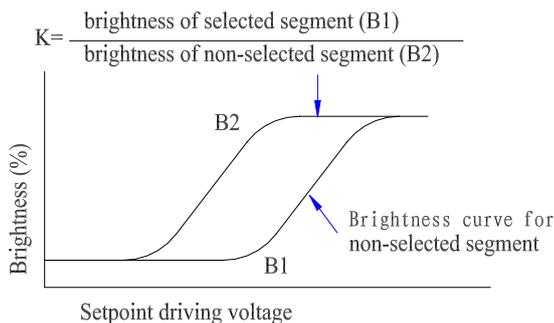
NEGATIVE TYPE

Definition of optical response

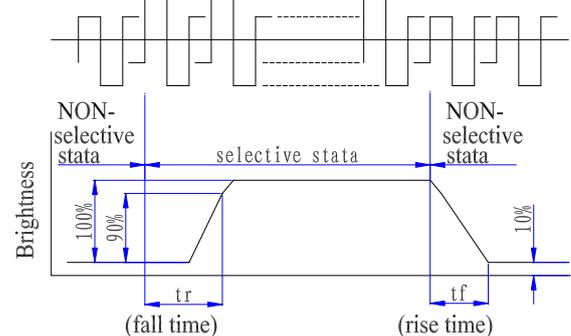


NEGATIVE TYPE

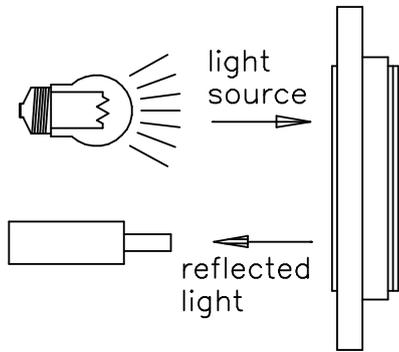
Definition of contrast "K"



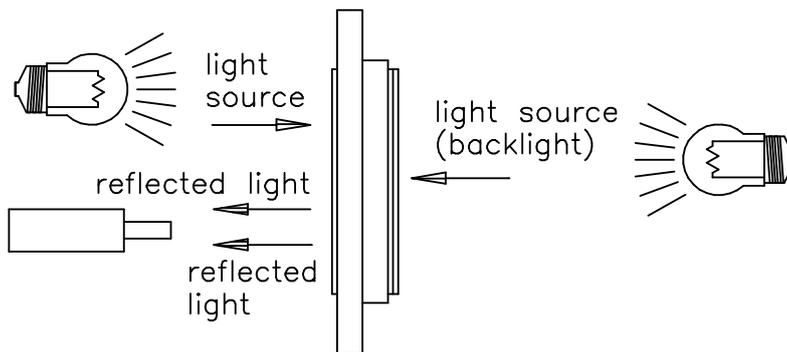
Definition of optical response



DESCRIPTION OF MEASURING EQUIPMENT



Reflective type



Transflective type

CONTROLLER ELECTRICAL CHARACTERISTICS

DC Characteristics

VSS=0V; Tamb = -30°C to +85°C; unless otherwise specified.

Item	Symbol	Condition	Rating			Unit	Applicable Pin	
			Min.	Typ.	Max.			
Operating Voltage (1)	VDD1		1.7	—	3.3	V	VDD1	
Operating Voltage (2)	VDD2		2.4	—	3.3	V	VDD2	
Operating Voltage (3)	VDD3		2.4	—	3.3	V	VDD3	
Input High-level Voltage	V _{IHC}		0.7 x VDD1	—	VDD1	V	MPU Interface	
Input Low-level Voltage	V _{ILC}		VSS1	—	0.3 x VDD1	V	MPU Interface	
Output High-level Voltage	V _{OHC}	I _{OUT} =1mA, VDD1=1.8V	0.8 x VDD1	—	VDD1	V	D[7:0]	
Output Low-level Voltage	V _{OLC}	I _{OUT} =-1mA, VDD1=1.8V	VSS1	—	0.2 x VDD1	V	D[7:0]	
Input Leakage Current	I _{LI}		-1.0	—	1.0	μA	MPU Interface	
Output Leakage Current	I _{LO}		-3.0	—	3.0	μA	MPU Interface	
Liquid Crystal Driver ON Resistance	R _{ON}	Ta=25°C	V _{OP} =8.5V, ΔV=0.85V	—	0.6	0.8	KΩ	COMx
			V _G =1.9V, ΔV=0.19V	—	1.3	1.5	KΩ	SEGx
Frame Frequency	FR	Duty=1/65, V _{OP} =8.5V Ta = 25°C	70	75	80	Hz		

Current consumption: During Display, with internal power system, current consumed by whole IC (bare die).

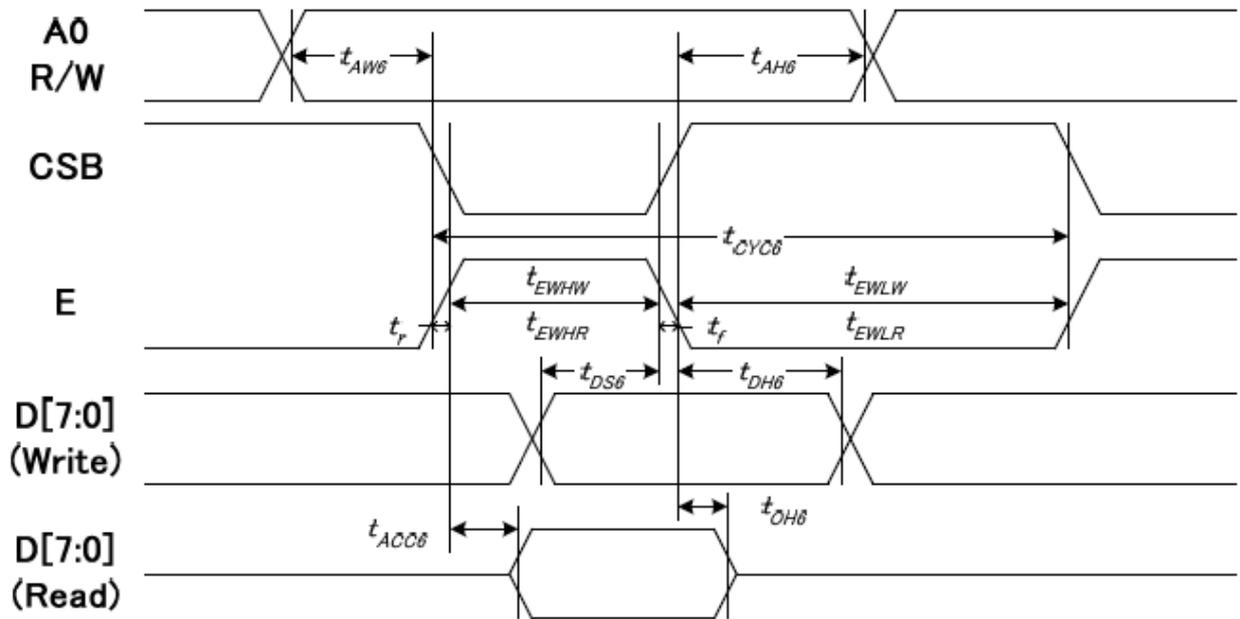
Test Pattern	Symbol	Condition	Rating			Unit	Note
			Min.	Typ.	Max.		
Display Pattern: SNOW (Static)	ISS	VDD1=VDD2=VDD3=3.0V, Booster X5 V _{OP} = 8.5 V, Bias=1/9 Ta=25°C	—	150	300	μA	
Display OFF	ISS	VDD1=VDD2=VDD3=3.0V, Booster X5 V _{OP} = 8.5 V, Bias=1/9 Ta=25°C	—	95	190	uA	
Power Down	ISS	VDD1=VDD2=VDD3=3.0V, Ta=25°C	—	8	16	μA	

Note:

- The Current Consumption is DC characteristics

TIMING CHARACTERISTICS

System Bus Timing for 6800 Series MPU



(VDD1 = 3.3V, Ta = 25°C)

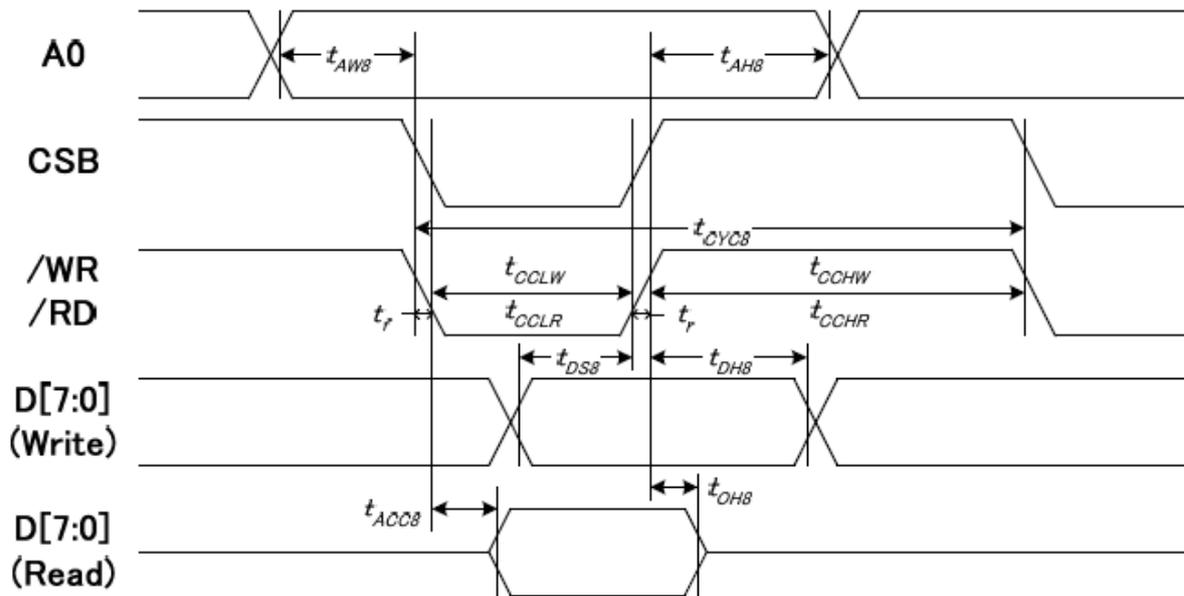
Item	Signal	Symbol	Condition	Min.	Max.	Unit
Address setup time	A0	tAW6		0	—	ns
Address hold time		tAH6		10	—	
System cycle time	E	tCYC6		240	—	
Enable L pulse width (WRITE)		tEHLW		80	—	
Enable H pulse width (WRITE)		tEHWLW		80	—	
Enable L pulse width (READ)		tEHLR		80	—	
Enable H pulse width (READ)	tEHWLR		140	—		
Write data setup time	D[7:0]	tDS6		40	—	
Write data hold time		tDH6		10	—	
Read data access time		tACC6	CL = 16 pF	—	70	
Read data output disable time		tOH6	CL = 16 pF	5	50	

*1 The input signal rise time and fall time (tr, tf) is specified at 15 ns or less. When the system cycle time is extremely fast, (tr + tf) ≧ (tCYC6 - tEHLW - tEHWLW) for (tr + tf) ≧ (tCYC6 - tEHLR - tEHWLR) are specified.

*2 All timing is specified using 20% and 80% of VDD1 as the reference.

*3 tEHLW and tEHLR are specified as the overlap between CSB being “L” and E.

System Bus Timing for 8080 Series MPU



(VDD1 = 3.3V, Ta = 25°C)

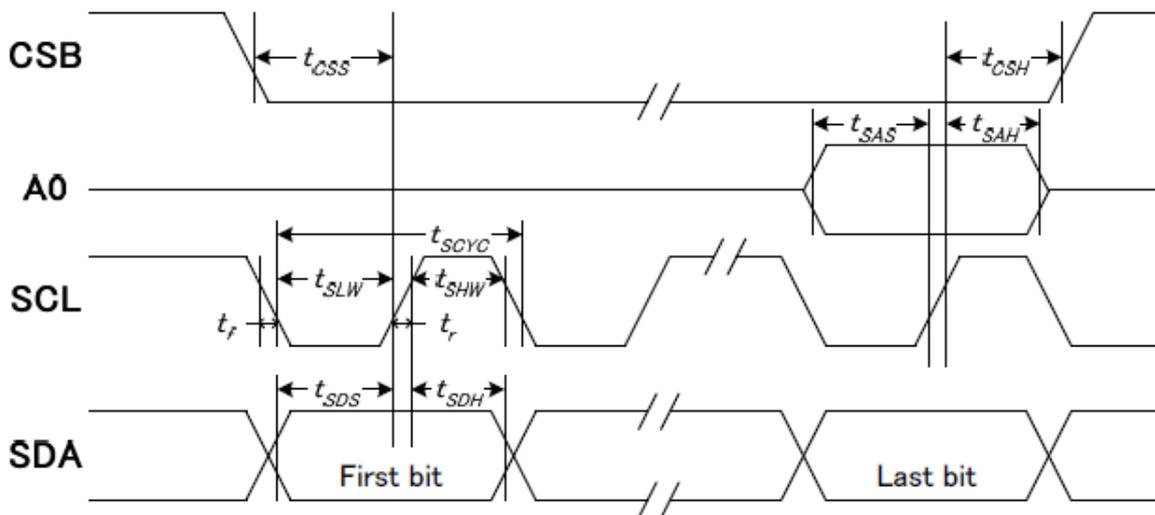
Item	Signal	Symbol	Condition	Min.	Max.	Unit
Address setup time	A0	tAW8		0	—	ns
Address hold time		tAH8		10	—	
System cycle time	/WR	tCYC8		240	—	
/WR L pulse width (WRITE)		tCCLW		80	—	
/WR H pulse width (WRITE)		tCCHW		80	—	
/RD L pulse width (READ)		RD	tCCLR		140	
/RD H pulse width (READ)	tCCHR			80	—	
WRITE Data setup time	D[7:0]	tDS8		40	—	
WRITE Data hold time		tDH8		20	—	
READ access time		tACC8	CL = 16 pF	—	70	
READ Output disable time		tOH8	CL = 16 pF	5	50	

*1 The input signal rise time and fall time (tr, tf) is specified at 15 ns or less. When the system cycle time is extremely fast, (tr + tf) ≦ (tCYC8 - tCCLW - tCCHW) for (tr + tf) ≦ (tCYC8 - tCCLR - tCCHR) are specified.

*2 All timing is specified using 20% and 80% of VDD1 as the reference.

*3 tCCLW and tCCLR are specified as the overlap between CSB being “L” and WR and RD being at the “L” level.

System Bus Timing for 4-Line Serial Interface



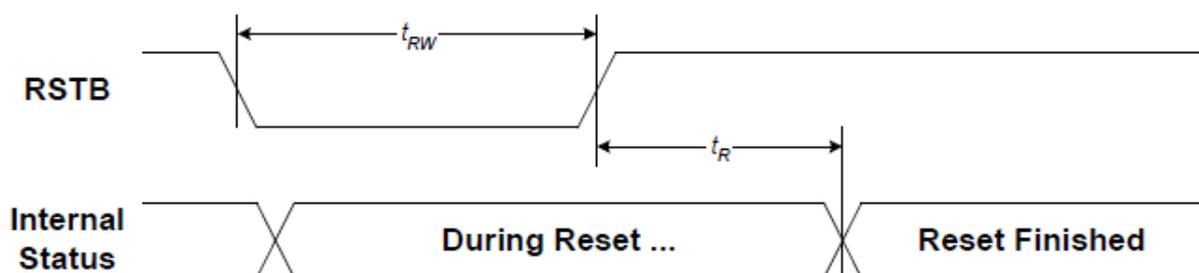
(VDD1 = 3.3V, Ta = 25°C)

Item	Signal	Symbol	Condition	Min.	Max.	Unit
Serial clock period		tSCYC		50	—	ns
SCLK "H" pulse width	SCLK	tSHW		25	—	
SCLK "L" pulse width		tSLW		25	—	
Address setup time		A0	tSAS		20	
Address hold time	tSAH			10	—	
Data setup time	SDA	tSDS		20	—	
Data hold time		tSDH		10	—	
CSB-SCLK time	CSB	tCSS		20	—	
CSB-SCLK time		tCSH		40	—	

*1 The input signal rise and fall time (tr, tf) are specified at 15 ns or less.

*2 All timing is specified using 20% and 80% of VDD1 as the standard.

Hardware Reset Timing



(VDD1 = 3.3V, Ta = 25°C)

Item	Symbol	Condition	Min.	Max.	Unit
Reset time	tR		—	1.0	us
Reset "L" pulse width	tRW		1.0	—	

DISPLAY COMMANDS

The display commands shown below control the internal state of the LCD driver ICs. Commands are sent from CPU to LCD module for the display control. (please to visit the web: <http://www.sitronix.com.tw>)

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					1	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							0	Writes to the display RAM
(7) Display data read	1	0	1	Read data							0	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		0	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		0	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

QUALITY LEVEL

Inspection conditions

Environmental conditions

The environmental conditions for inspection shall be as follows: Room temperature: $22 \pm 3^{\circ}\text{C}$; Humidity: $50 \pm 10\% \text{RH}$.

The external visual inspection

The inspection shall be performed by using a single 20W fluorescent lamp for illumination and the distance from LCD to eyes of the inspector should be 30cm or more.

Classification of defects

A major defect

A major defect refers to A defect which may substantially degrade usability for product applications.

Minor defect

A Minor defect refers to A defect which is not considered to substantially degrade product application or A defect which deviates from existing standards almost unrelated to the effective use of the product or its operation

Sampling procedures for each items acceptance level table

Defect type	Sampling procedures	AQL
Major defect	MIL-STD-105D Inspection level1 normal inspection Single sample inspection	1.0
Minor defect	MIL-STD-105D Inspection level1 normal inspection Single sample inspection	2.5

Life time

50,000Hrs(25°C in the room without ray of sun)

Items of reliability

ITEM	CONDITIONS	CRITERION
High temperature operation test	$+60^{\circ}\text{C} \setminus 120$ hours	1. It judged at room temperature after 1 hours to be good as appearance and electrical test is normal after the experiment. 2. Current consumption should within the specification of Approval sheet Electro-optical characteristics 5-10pcs
Low temperature operation test	$-10^{\circ}\text{C} \setminus 120$ hours	
High temperature/humidity storage test	$+70^{\circ}\text{C}, 80\% \pm 10\% \text{RH} \setminus 120$ hours	
High temperature storage test	$+70^{\circ}\text{C} \setminus 120$ hours	
Low temperature storage test	$-20^{\circ}\text{C} \setminus 120$ hours	
Temperature cycling test	-10°C (30 min) ↓ ↑ 25°C (5 min) ↓ ↑ 60°C (30 min) CYCLES: 10	

Vibration	Random Wave: 10 ~ 50 Hz Each Direction (x, y, z): 30 Min.	
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Cosmetic criteria of LCD screen

DEFECT	JUDGEMENT CRITERION		
Spots	Size d (mm)	Acceptable quantity in active area	
	d ≤ 0.1	Disregard	
	0.1 < d ≤ 0.2	6	
	0.2 < d ≤ 0.3	2	
	d > 0.3	0	
	Note: d = (Length + Width)/2		
Polarizer Bubbles	Size d (mm)	Acceptable quantity in active area	
	d ≤ 0.3	Disregard	
	0.3 < d ≤ 1.0	3	
	1.0 < d ≤ 1.5	1	
	d > 1.5	0	
	Note: d = (Length + Width)/2		
Lines	Width W (mm) Length L (mm)	Acceptable quantity in active area	
	W ≤ 0.02		Disregard
	0.02 < W ≤ 0.05	L ≤ 5.0	6
		L > 5.0	0
	0.05 < W ≤ 0.1	L ≤ 2.0	6
L > 2.0		0	
W > 0.1		See criteria for spots	
Testing conditions: 20W fluorescent lamp at 30 cm distance at normal viewing angle			