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Graphic Display Module
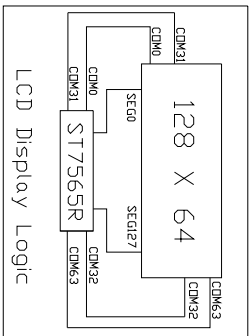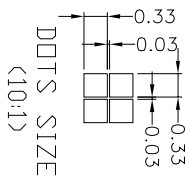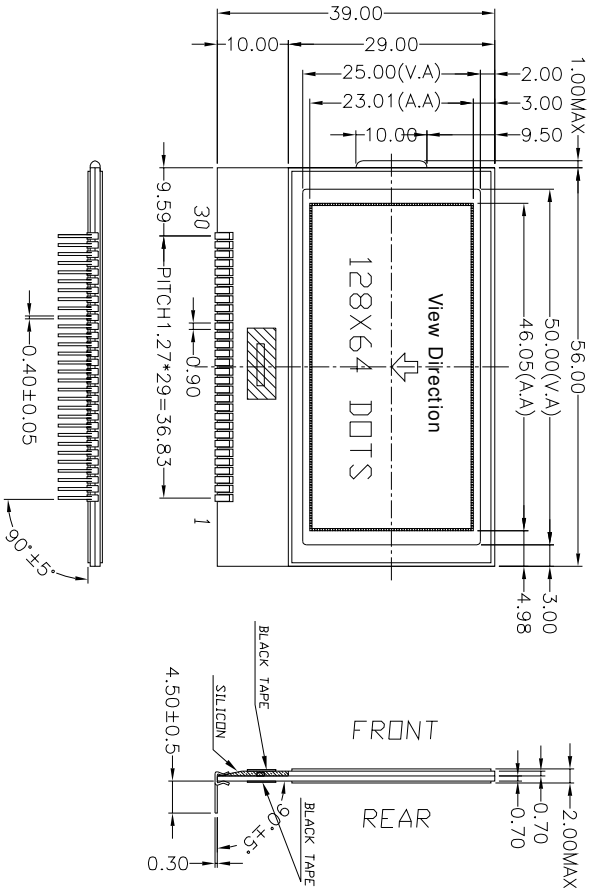
Part Number

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: 128×64 = 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%/℃) 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

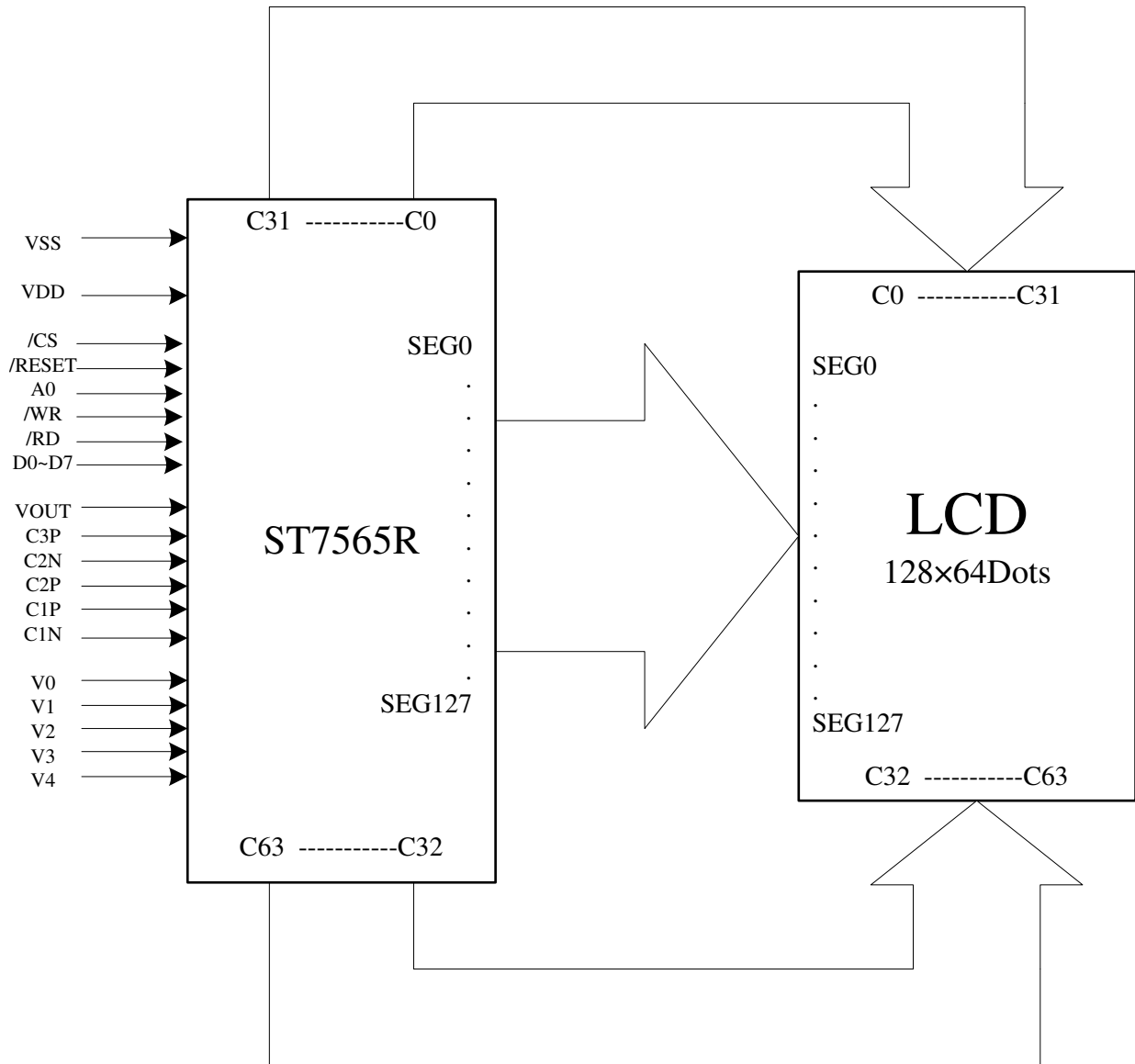| ITEM	DESCRIPTION	UNIT
Outline Size	56.0(L)×39.0(W)×2.0(T)	mm
LCD Type	FSTN, Reflective, Positive,1/65Duty,1/9Bias	---
Display type	128×64 dots	---
View Area	50.0×25.0	mm
Display Area	46.05×23.01	mm
Dots size	0.33×0.0.33	mm
Dots pitch	0.36×0.36	mm
Controller & driver	ST7565R	---
View Direction	12 O'Clock	---
Interface mode	8bit-6800 & 8080, 4-SPI	---
VDD&VOP(Type)	3.0 V & 9.0 V	V
Backlight(Type)	None	---
Operation Temp.	-10~+60	℃
Storage Temp.	-20~+70	℃

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
9. BACKLIGHT.: WITHOUT
10. RoHS

View Direction

128X64 DOTS

39.00
10.00
29.00
25.00(V.A)
23.01(A.A)
10.00
2.00
3.00
9.50
1.00MAX
56.00
50.00(V.A)
46.05(A.A)
3.00
4.98
9.59
30
PITCH1.27*29=36.83
0.90
1
0.40±0.05
90°±5°

FRONT

REAR

BLACK TAPE
SILICON
BLACK TAPE
4.50±0.5
0.30
6°±5°
0.70
0.70
2.00MAX

DOTS SIZE (10:1)
0.33
0.03
0.33
0.03

LCD Display Logic

ST7565R
128 X 64
COM31 COM0
COM0 COM31
SEG0
SEG127
SEG1127
COM32 COM63
COM63 COM32

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

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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><tr><td>PSB</td><td>C86</td><td>Selected Interface</td></tr><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></table>
29	P/S	PSB selects the interface type: Serial or Parallel.
30	VSS	Ground.

BLOCK DIAGRAM

VSS →

VDD →

/CS →
/RESET →
A0 →
/WR →
/RD →
D0~D7 →

VOUT →
C3P →
C2N →
C2P →
C1P →
C1N →

V0 →
V1 →
V2 →
V3 →
V4 →

ST7565R

C31 ----------C0

SEG0
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SEG127

C63 ----------C32

LCD

128×64Dots

C0 ----------C31

SEG0
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.
.
SEG127

C32 ----------C63

APPLICATION CIRCUIT EXAMPLE

VDD

MPU

LCM

/CS

/RESET

A0

D0~D7

R/W

E

PSB C86 VDD Vout

C3P

C1N

C1P

C2P

C2N

C1

C1

C1

C1

V0 V1 V2 V3 V4 VSS

C2 C2 C2 C2 C2 VSS

6800
4 × voltage booster circuit
C1: 1.0uF~4.7uF
C2: 0.1uF~1uF
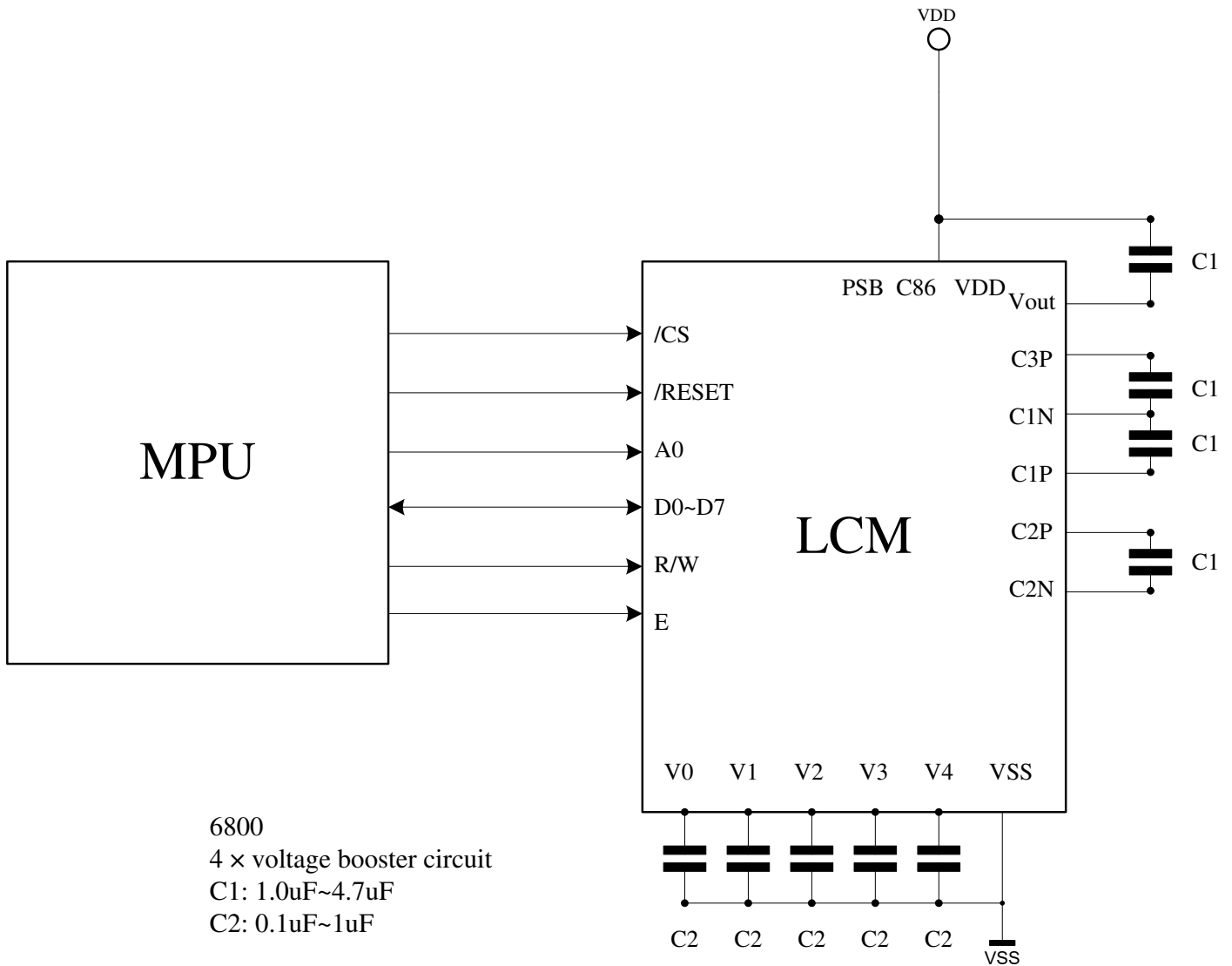
ABSOLUTE MAXIMUN RATING

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	℃	
HUMIDITY	/		/		--	WITHOUT CONDENSTION
VIBRATION (M/S^2)	/	/	/	/	--	SEE "ITEMS OF RELIABILITY"
TEMPERATURE CYCLING TEST	/	/	/	/	--	SEE "ITEMS OF RELIABILITY"
CORROSIVE GAS	NOT ACCEPTABLE		NOT ACCEPTABLE		--	

ELECTRICAL CHARACTERISTICS (Vss=0V)

Item	Symbol	Condition	Min.	Typ	Max.	Unit	note
Power Supply for Logic	$V_{DD}-V_{SS}$	Ta=25℃	2.8	3.0	3.3	Volt	
Power Supply for Backlight	$V_{LED}+$ ~ $V_{LED}-$	Ta=25℃	--	--	--	Volt	
Input Voltage	V_{IL}	Vdd=3V±5%	V_{SS}		$0.3\ V_{DD}$	Volt	
	V_{IH}	Vdd=3V±5%	$0.7\ V_{DD}$	-	V_{DD}	Volt	
Output Voltage	V_{OL}	Vdd=3V±5%	V_{SS}	-	$0.3\ V_{DD}$	Volt	
	V_{OH}	Vdd=3V±5%	$0.7\ V_{DD}$	-	V_{DD}	Volt	
LCD driveVoltage(recommended Voltage)	$VSS-V0$	$T_a=0℃$	--	--	--	Volt	
		$T_a=25℃$	8.8	9.0	9.2		
		$T_a=50℃$	--	--	--		
Power Supply Current for LCM	I_{DD}	$V_{DD}=3.0V$ $T_a=25℃$	-	150	300	uA	
	I_{LED}	$V_{LED}=$	--	--	--	mA	

ELECTRO-OPTICAL CHARACTERISTICS

Item	Symbol	Condition	Min.	Typ	Max.	Unit	note
Viewing angle range	$\Theta2-\Theta1$	$T_a=25℃$	20	-	-	Deg	K=1.4 A,B
	Φ		-	-	-		
Rise Time	T_r	$T_a=25℃$	-	200	300	ms	$\Phi=10$ $\Theta=0$ C
		$T_a=0℃$	-	-	-		
Fall Time	T_f	$T_a=25℃$	-	214	300		
		$T_a=0℃$	-	-	-		
Contrast	Cr	$T_a=25℃$	-	8	-	-	$\Phi=10$ $\Theta=0$ D

Definition of angle θandφ
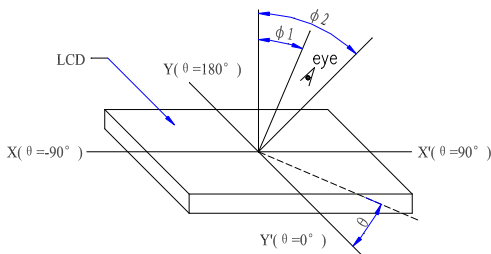
POSITIVE TYPE

Definition of viewing angle φ1 andφ2

Contrast Ratio K
VS Viewing Angle φ

POSITIVE TYPE

Definition of contrast "K"

$$K= \frac{\text{brightness of non-selected segment (B2)}}{\text{brightness of selected segment (B1)}}$$
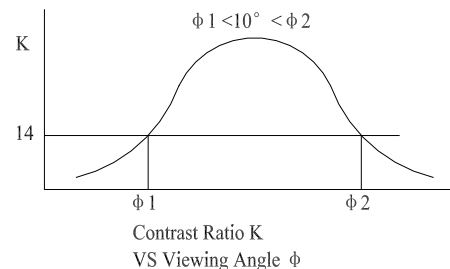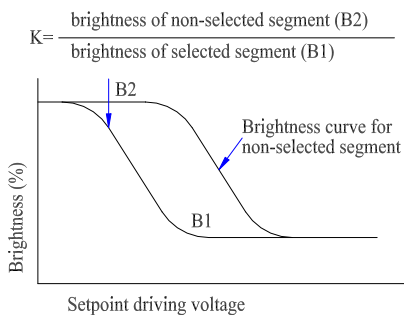
NEGATIVE TYPE

Definition of optical response

NEGATIVE TYPE

Definition of contrast "K"

$$K= \frac{\text{brightness of selected segment (B1)}}{\text{brightness of non-selected segment (B2)}}$$

Definition of optical response

10
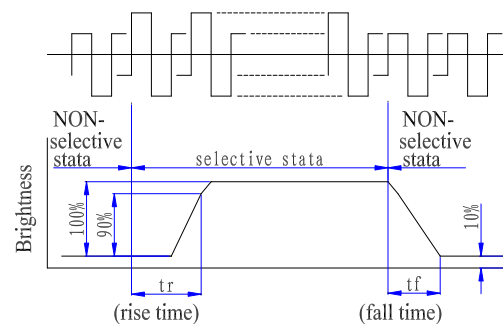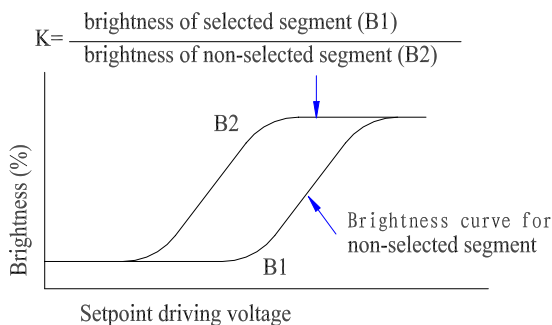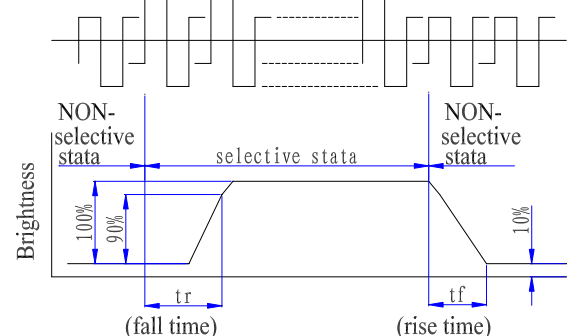
DESCRIPTION OF MEASURING EQUIPMENT

light source

reflected light

Reflective type

light source

light source (backlight)

reflected light

reflected light
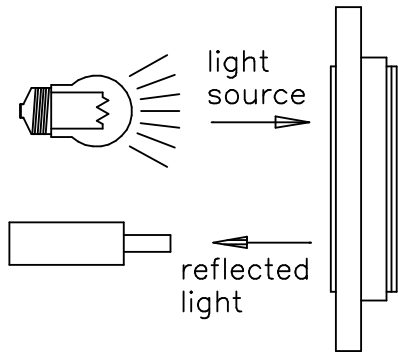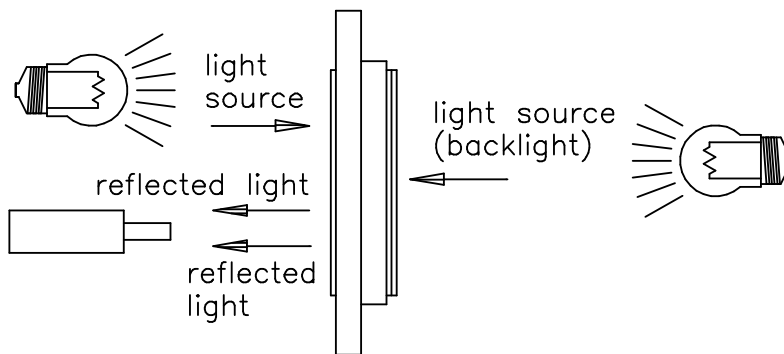
Transflective type

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	Vop=8.5V, △V=0.85V	—	0.6	0.8	KΩ	COMx
			VG=1.9V, △V=0.19V	—	1.3	1.5	KΩ	SEGx
Frame Frequency	FR	Duty=1/65, Vop=8.5V Ta = 25℃		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
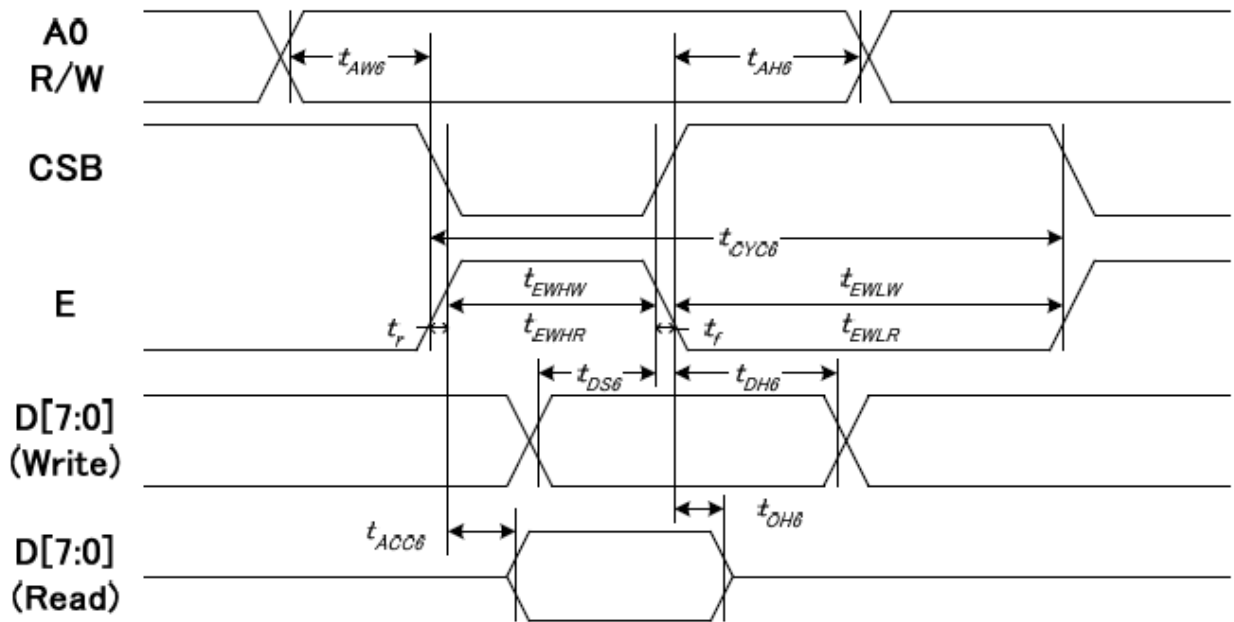
(VDD1 = 3.3V , Ta =25°C)

Item	Signal	Symbol	Condition	Min.	Max.	Unit
Address setup time	A0	tAW6		0	—	
Address hold time		tAH6		10	—	
System cycle time	E	tCYC6		240	—	
Enable L pulse width (WRITE)		tEWLW		80	—	
Enable H pulse width (WRITE)		tEWHW		80	—	
Enable L pulse width (READ)		tEWLR		80	—	ns
Enable H pulse width (READ)		tEWHR		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) $\leq$ (tCYC6 – tEWLW – tEWHW) for (tr + tf) $\leq$ (tCYC6 – tEWLR – tEWHR) are specified.
*2 All timing is specified using 20% and 80% of VDD1 as the reference.
*3 tEWLW and tEWLR are specified as the overlap between CSB being "L" and E.

System Bus Timing for 8080 Series MPU
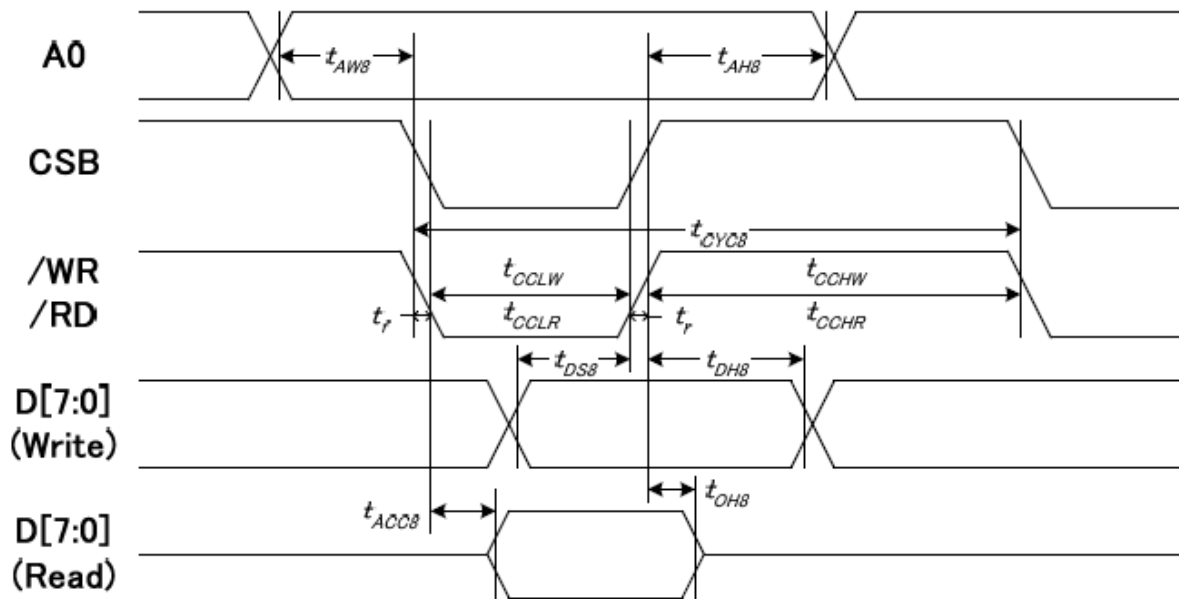
(VDD1 = 3.3V , Ta =25°C)

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
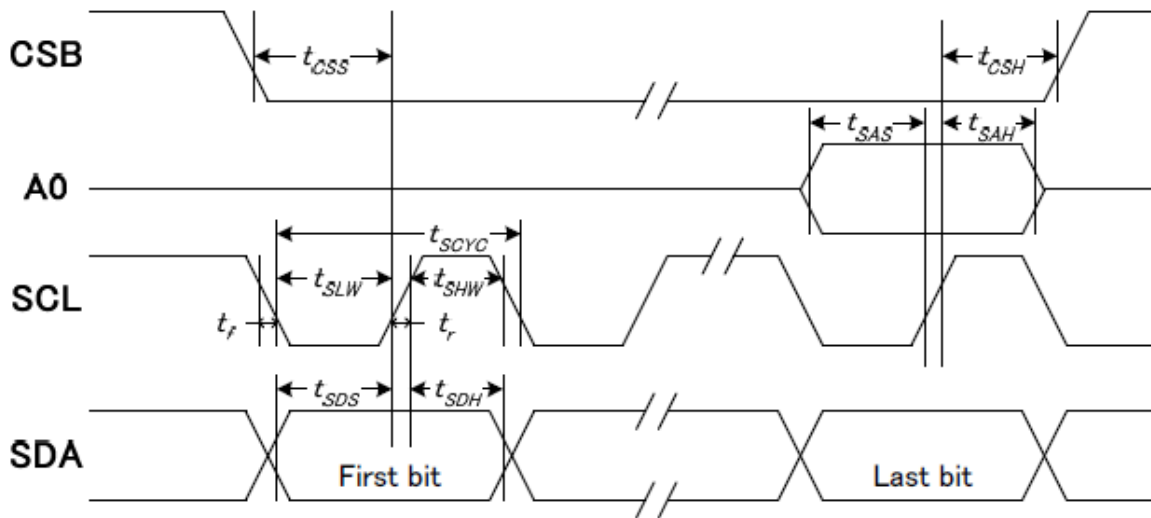
(VDD1 = 3.3V , Ta =25°C)

Item	Signal	Symbol	Condition	Min.	Max.	Unit
Serial clock period		tSCYC		50	—	
SCLK "H" pulse width	SCLK	tSHW		25	—	
SCLK "L" pulse width		tSLW		25	—	
Address setup time	A0	tSAS		20	—	
Address hold time		tSAH		10	—	ns
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
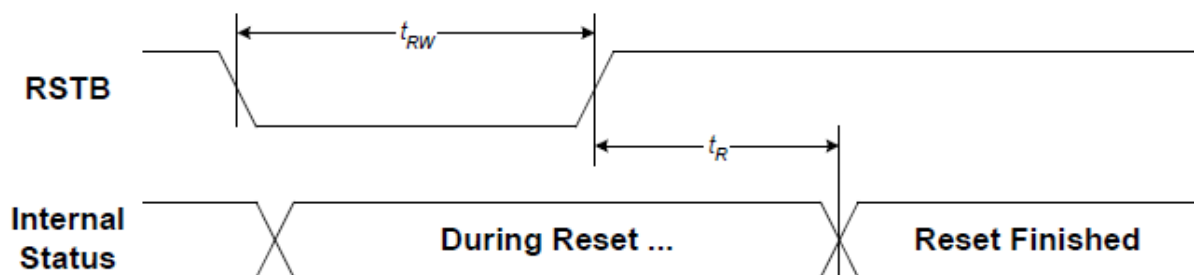
(VDD1 = 3.3V , Ta =25°C)

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	A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0	Function
(1) Display ON/OFF	0	1	0	1	0	1	0	1	1	1	0 / 1	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.
Column address set lower bit	0	1	0	0	0	0	0	Least significant column address				Sets the least significant 4 bits of the display RAM 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 / 1	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 / 1	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 / 1	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 / 1	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 / 1	*	*	*	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) V0 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 / Electronic volume register set	0	1	0	1 / 0	0 / 0	0	0	0	0	0	1	Set the V0 output voltage electronic volume register
						Electronic volume value						
(19) Static indicator ON/OFF / Static indicator register set	0	1	0	1	0	1	0	1	1	0	0 / 1	0: OFF, 1: ON
				0	0	0	0	0	0	0	Mode	Set the flashing mode
(20) Booster ratio set	0	1	0	1 / 0	1 / 0	1 / 0	1 / 0	1 / 0	0 / 0	0 / step-up value	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±3℃; Humidity:

50±10%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℃ in the room without ray of sun)

Items of reliability

ITEM	CONDITIONS	CRITERION
High temperature operation test	+60℃ \ 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
Low temperature operation test	-10℃ \ 120 hours	
High temperature/humidity storage test	+70℃,80%±10%RH \ 120 hours	
High temperature storage test	+70℃ \ 120 hours	
Low temperature storage test	-20℃ \ 120 hours	
Temperature cycling test	-10℃ (30 min) ↓ ↑ 25℃ (5 min) ↓ ↑ 60℃ (30 min) CYCLES: 10	5-10pcs

Vibration	Random Wave: 10 ~ 50 Hz Each Direction (x, y, z): 30 Min.	

Cosmetic criteria of LCD screen

DEFECT	JUDGEMENT CRITERION		
Spots	**Size d (mm)**		**Acceptable quantity in active area**
	d≤0.1 0.1<d≤0.2 0.2<d≤0.3 d>0.3		Disregard 6 2 0
	Note: d = (Length + Width)/2		
Polarizer Bubbles	**Size d (mm)**		**Acceptable quantity in active area**
	d≤0.3 0.3<d≤1.0 1.0<d≤1.5 d>1.5		Disregard 3 1 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			