DATASHEET

4/30/2013

Fema Part Number

GM160128A-15-O3CF	
Description	1.5" Passive Matrix Full Color OLED Display
	160x128 Characters
	Extended Operating Temperature -40 to 85 °C
	Wide Viewing Angle

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1. Basic Specifications

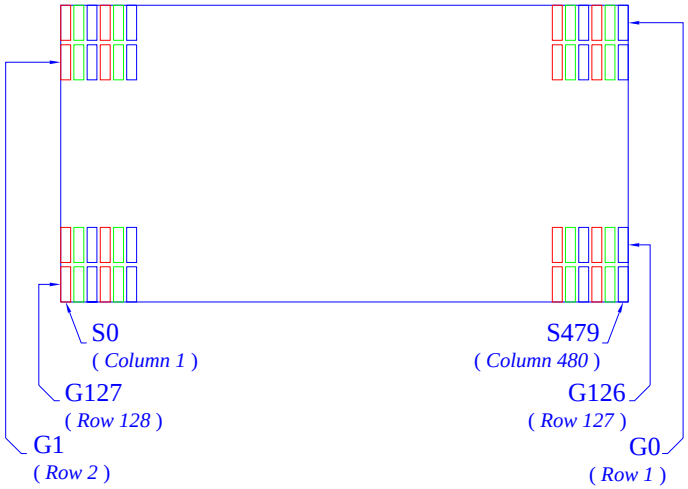
1.1 Display Specifications

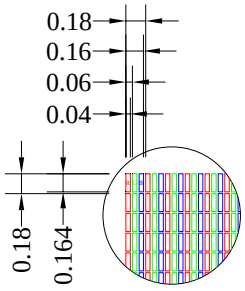
1) Display Mode: Passive Matrix
2) Display Color: 262,144 Colors (Maximum)
3) Drive Duty: 1/128 Duty

1.2 Mechanical Specifications

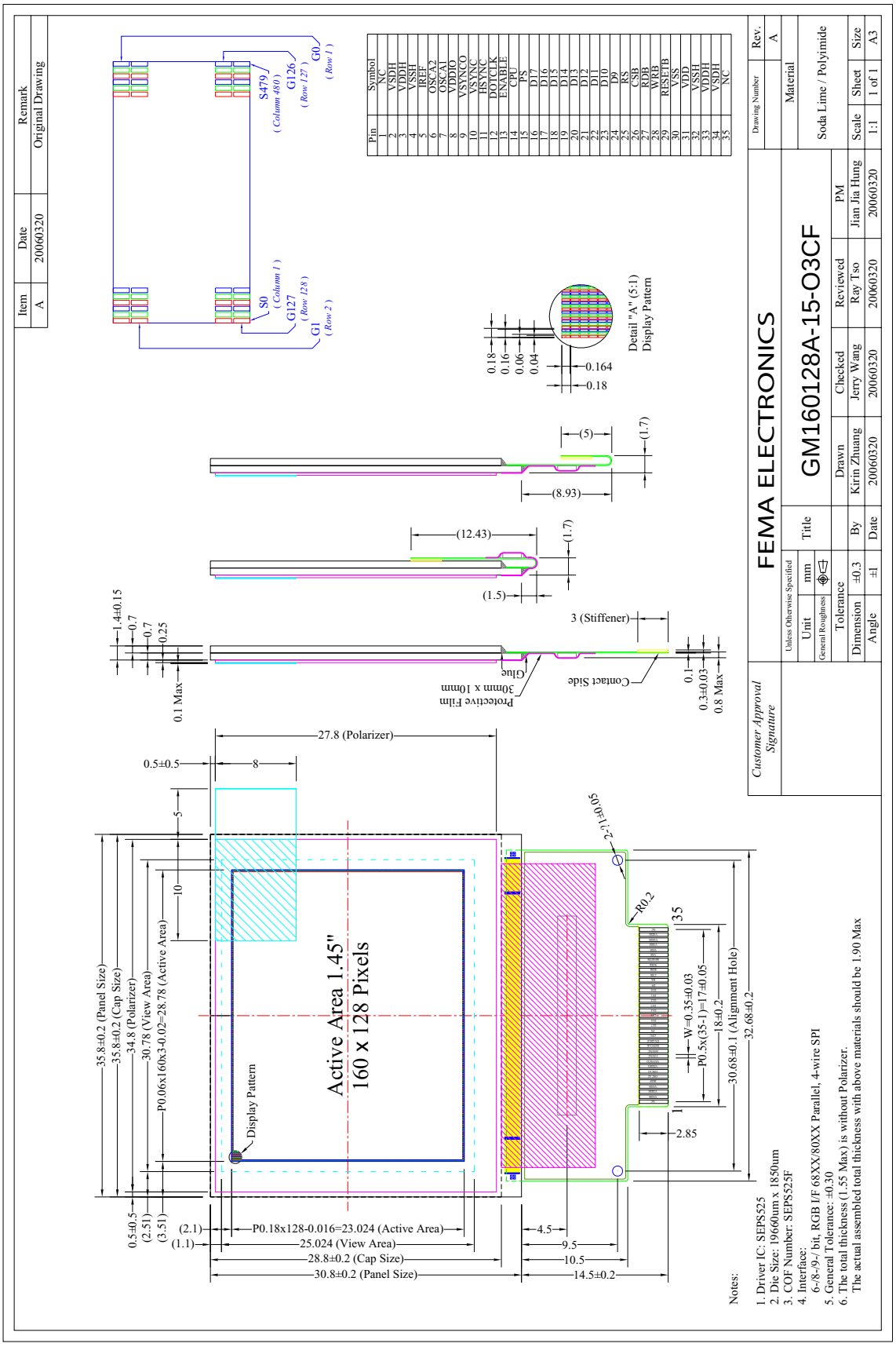
1) Outline Drawing: According to the annexed outline drawing number
2) Number of Pixels: 160 (RGB) × 128
3) Panel Size: 35.80 × 30.80 × 1.7 (mm)
4) Active Area: 28.78 × 23.024 (mm)
5) Pixel Pitch: 0.06 × 0.18 (mm)
6) Pixel Size: 0.04 × 0.164 (mm)
7) Weight: 3.6 (g)

1.3 Active Area & Pixel Construction





1.4 Mechanical Drawing



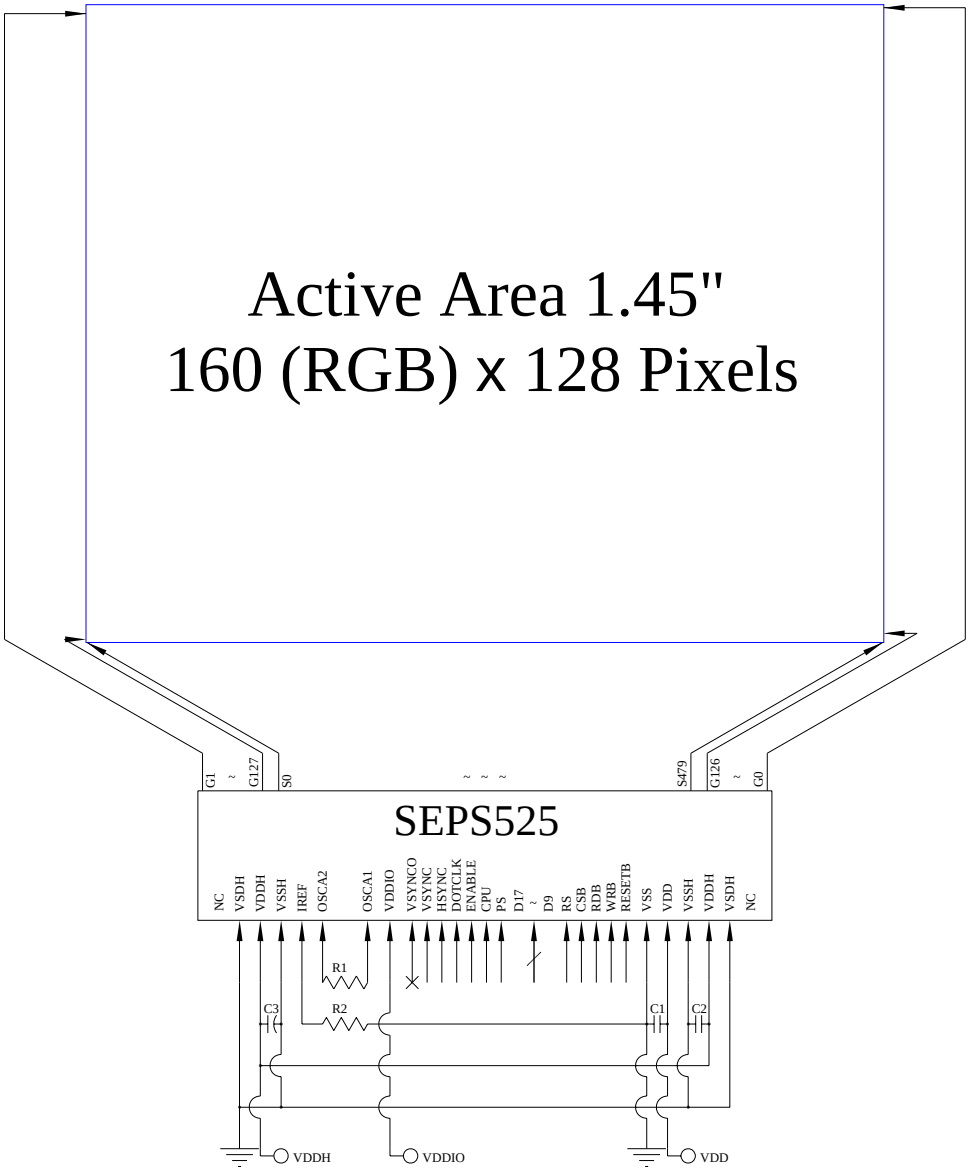
1.5 Pin Definition

<table>
<tr><th>Pin Number</th><th>Symbol</th><th>Type</th><th>Function</th></tr>
<tr><td colspan="4">Power Supply Pins</td></tr>
<tr><td>4,32</td><td>VSDH</td><td>P</td><td>Data Driver Ground</td></tr>
<tr><td>2,33</td><td>VSSH</td><td>P</td><td>Scan Driver Ground</td></tr>
<tr><td>3,34</td><td>VDDH</td><td>P</td><td>Data, Scan Driver Power Supply.</td></tr>
<tr><td>30</td><td>VSS</td><td>P</td><td>Power Supply Ground</td></tr>
<tr><td>31</td><td>VDD.</td><td>P</td><td>Logic Power Supply.</td></tr>
<tr><td>8</td><td>VDDIO</td><td>P</td><td>MPU I/F PAD Power Supply</td></tr>
<tr><td colspan="4">System Control Pins</td></tr>
<tr><td>5</td><td>IREF</td><td>I/O</td><td>Current Reference for Brightness Adjustment
Tie 70KΩ resistor to VSS.</td></tr>
<tr><td>6</td><td>OSCA2</td><td>O</td><td rowspan="2">Fine adjustment for oscillation
Tie 10 KΩ resistor to OSCA1 between OSCA2.
When the external clock mode is selected, OSCA1 is used external clock input.</td></tr>
<tr><td>7</td><td>OSCA1</td><td>I</td></tr>
<tr><td>14</td><td>CPU</td><td>I</td><td>Selects the CPU type
Low: 80-series CPU, High: 68-Series CPU.</td></tr>
<tr><td>15</td><td>PS</td><td>I</td><td>Selects parallel/Serial interface type
Low: serial, High: parallel.</td></tr>
<tr><td colspan="4">MPU Interface Pins</td></tr>
<tr><td>9</td><td>VSYNCO</td><td>O</td><td rowspan="5">RGB Mode Functional Pins
VSYNCO: Vertical Sync. Output
VSYNC: Vertical Sync. Input
HSYNC: Horizontal Sync. Input
DOTCLK: Dot Clock Input
ENABLE: Video Enable Input</td></tr>
<tr><td>10</td><td>VSYNC</td><td>I</td></tr>
<tr><td>11</td><td>HSYNC</td><td>I</td></tr>
<tr><td>12</td><td>DOTCLK</td><td>I</td></tr>
<tr><td>13</td><td>ENABLE</td><td>I</td></tr>
<tr><td>16~24</td><td>D17~D9</td><td>I/O</td><td>Host Data Input/Output Bus
These pins are 9-bit bi-directional data bus to be connected with MCU data bus.
<table>
<tr><th>PS</th><th>Description</th></tr>
<tr><td>1</td><td>8_bit bus : D[17:10]
9_bit bus : D[17:9]</td></tr>
<tr><td>0</td><td>D[17] SCL : Synchronous clock input
D[16] SDI : Serial data input
D[15] SDO : Serial data output</td></tr>
</table>
Fix unused pins to the VSS level.</td></tr>
<tr><td>25</td><td>RS</td><td>I</td><td>Selects the data/command
Low: command, High: parameter/data</td></tr>
<tr><td>26</td><td>CSB</td><td>I</td><td>Chip Select
Low: SEPS225 is selected and can be accessed.
High: SEPS225 is not selected and cannot be accessed.</td></tr>
<tr><td>27</td><td>RDB</td><td>I</td><td>Read or Read/Write Enable
80-system bus interface: read strobe signal (active low).
68-system bus interface: bus enable strobe (active high).
When serial mode, fix it to VDD or VSS level.</td></tr>
</table>

1.5 Pin Definition (Continued)

Pin Number	Symbol	Type	Function
MPU Interface Pins (Continued)			
28	WRB	I	*Write or Read/Write Select* 80-system bus interface: write strobe signal (active low). 68-system bus interface: read/write select. Low: write, High: read. When serial mode, fix it to VDD or VSS level.
29	RESETB	I	*Chip Reset* Reset SEPS225 (active low)
Reserved Pins			
1,35	NC	-	*No Connection*

1.6 Block Diagram



MCU Interface Selection: PS, CPU

Pins connected to MCU interface: D17~D9, RS, CSB, RDB, WRB, RESETB, ENABLE, DOTCLK, HSYNC, and VSYNC

* When RGB mode is used, D[17:12], ENABLE, DOTCLK, HSYNC, and VSYNC should follow the 6-bit RGB interface instruction. Otherwise, ENABLE, DOTCLK, HSYNC, and VSYNC these four input signal should be tie to VDDIO level.

C1:	1μF
C2, C3:	4.7μF
R1:	10kΩ
R2:	68kΩ

2. *Absolute Maximum Ratings*

Parameter	Symbol	Min	Max	Unit	Notes
Supply Voltage	VDD	-0.3	4	V	1, 2
Supply Voltage for I/O Pins	VDDIO	-0.3	4	V	1, 2
Driver Supply Voltage	VDDH	-0.3	19.5	V	1, 2
Operating Temperature	T_{OP}	-30	70	°C	-
Storage Temperature	T_{STG}	-40	80	°C	-

Note 1: All the above voltages are on the basis of "GND = 0V".

Note 2: When this module is used beyond the above absolute maximum ratings, permanent breakage of the module may occur. Also, for normal operations, it is desirable to use this module under the conditions according to Section 3. "Electrical Characteristics". If this module is used beyond these conditions, malfunctioning of the module can occur and the reliability of the module may deteriorate.

3. Electrical Characteristics

3.1 DC Characteristics

Characteristics	Symbol	Conditions	Min	Typ	Max	Unit
Supply Voltage	VDD		2.6	2.8	3.3	V
Supply Voltage for I/O Pins	VDDIO		1.6	2.8	3.3	V
Driver Supply Voltage	VDDH		-	13.0	-	V
High Level Input	V_{IH}		0.8×VDD	-	VDD	V
Low Level Input	V_{IL}		0	-	0.4	V
High Level Output	V_{OH}		VDD-0.4	-	-	V
Low Level Output	V_{OL}		-	-	0.4	V

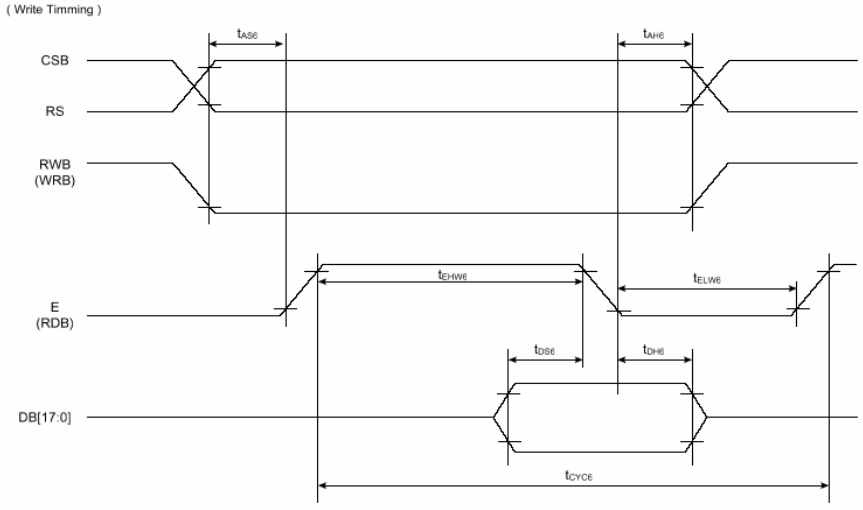
3.2 AC Characteristics

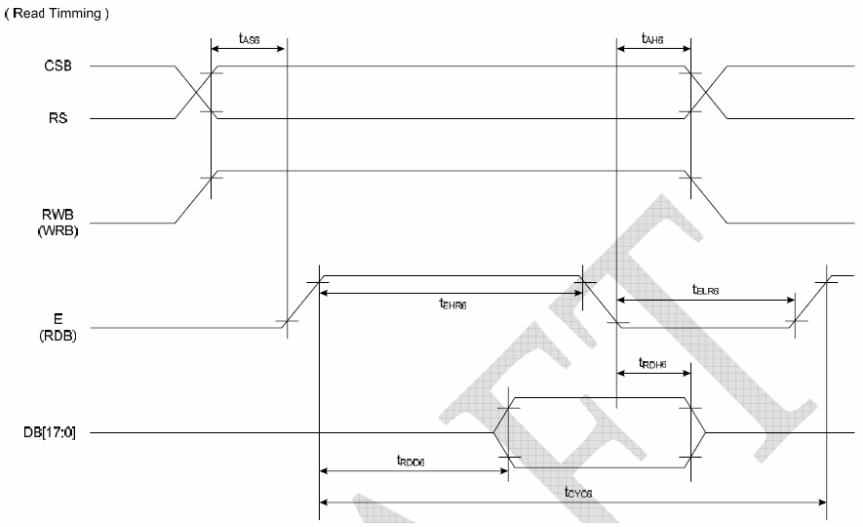
3.2.1 68XX-Series MPU Parallel Interface Timing Characteristics:

(VDD = 2.8V, Ta = 25℃)

Item	Symbol	Condition	Min	Max	Unit	Port
Write Timing						
Address hold timing Address setup timing	t_{AH6} t_{AS6}	-	5 5	-	ns	CSB RS
System cycle timing Write “L” pulse width Write “H” pulse width	t_{CYC6} t_{ELW6} t_{EHW6}	-	100 45 45	-	ns	E
Data setup timing Data hold Timing	t_{DS6} t_{DH6}		40 10	-	ns	DB[17:0]
Read Timing						
Address hold timing Address setup timing	t_{AH6} t_{AS6}	-	10 10	-	ns	CSB RS
System cycle timing Read “L” pulse width Read “H” pulse width	t_{CYC6} t_{ELR6} t_{EHR6}	-	200 90 90	-	ns	E
Read data output delay time Data hold Timing	t_{RDD6} t_{RDH6}	C_L = 15pF	0	70	ns	DB[17:0]

*) All the timing reference is 10% and 90% of VDD.



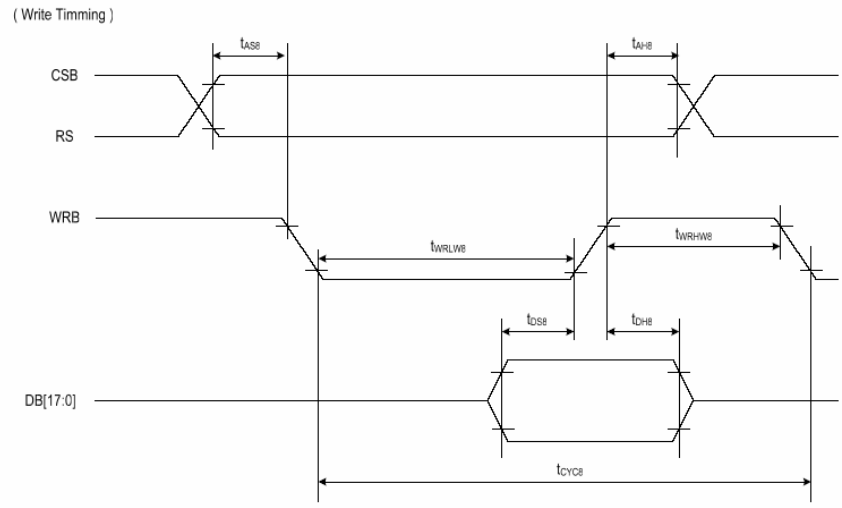


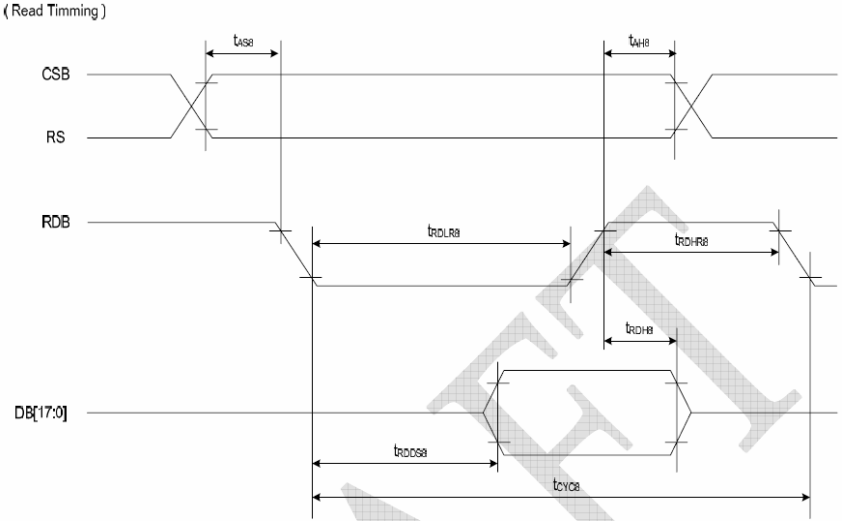
3.2.2 80XX-Series MPU Parallel Interface Timing Characteristics:

(VDD = 2.8V, Ta = 25℃)

Item	Symbol	Condition	Min	Max	Unit	Port
Write Timing						
Address hold timing Address setup timing	t_{AH8} t_{AS8}	-	5 5	-	ns	CSB RS
System cycle timing Write "L" pulse width Write "H" pulse width	t_{CYC8} t_{WRLW8} t_{WRHW8}	-	100 45 45	-	ns	WRB
Data setup timing Data hold Timing	t_{DS8} t_{DH8}		30 10	-	ns	DB[17:0]
Read Timing						
Address hold timing Address setup timing	t_{AH8} t_{AS8}	-	10 10	-	ns	CSB RS
System cycle timing Read "L" pulse width Read "H" pulse width	t_{CYC8} t_{RDLR8} t_{RDHR8}	-	200 90 90	-	ns	RDB
Read data output delay time Data hold Timing	t_{RDD8} t_{RDH8}	C_L = 15pF	- 0	60	ns	DB[17:0]

*) All the timing reference is 10% and 90% of VDD.



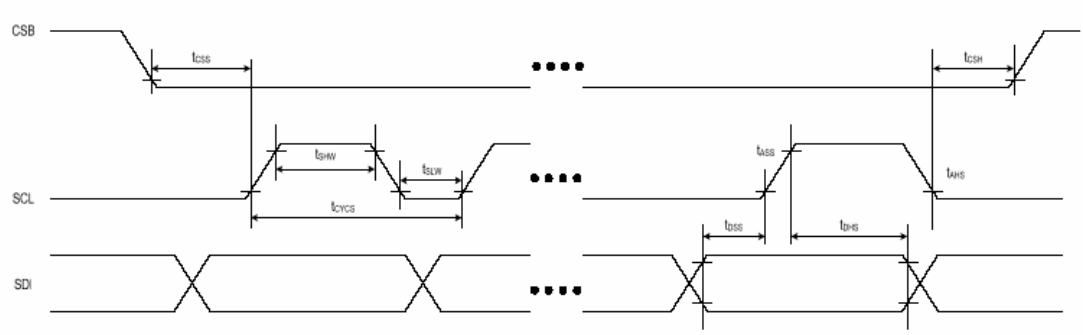


3.2.3 Serial Interface Timing Characteristics:

(VDD = 2.8V, Ta = 25℃)

Item	Symbol	Condition	Min	Max	Unit	Port
Serial clock cycle	t_{CYCS}	-	60	-	ns	SCL
SCL "H" pulse width	t_{SHW}		25			
SCL "L" pulse width	t_{SLW}		25			
Data setup timing	t_{DSS}	-	25	-	ns	SDI
Data hold Timing	t_{DHS}		25			
CSB-SCL timing	t_{CSS}		25	-	ns	CSB
CSB-hold timing	t_{CSH}		25			

*) All the timing reference is 10% and 90% of VDD.



3.3 Optics & Electrical Characteristics

Characteristics	Symbol	Conditions	Min	Typ	Max	Unit
Brightness (White)	L_{br}	Display Average (Note 3)	75	100	-	cd/m^2
C.I.E. (White)	(x) (y)		0.25 0.29	0.29 0.33	0.33 0.37	
C.I.E. (Red)	(x) (y)		0.57 0.32	0.61 0.36	0.65 0.40	
C.I.E. (Green)	(x) (y)		0.26 0.60	0.30 0.64	0.34 0.68	
C.I.E. (Blue)	(x) (y)		0.10 0.15	0.14 0.19	0.18 0.23	
Dark Room Contrast	CR		-	>1000:1	-	
View Angle			>160	-	-	degree

* Optical Measurement Follow the Software Initial Setting with Chapter 4.4 “Initial Code”

3.4 General Electrical Specification

Characteristics	Symbol	Conditions	Min	Typ	Max	Unit
Supply Voltage	V_{DD}		2.4	2.8	3.3	V
Supply Voltage for I/O Pins	V_{DDIO}		1.6	2.8	3.3	V
Driver Supply Voltage	V_{CC}	Note 3	-	13.0	-	V
Operating Current for V_{DD}	I_{DD}	Note 4	-	2.5	3.5	mA
		Note 5	-	2.5	3.5	mA
Operating Current for V_{CC}	I_{CC}	Note 4	-	16	19	mA
		Note 5	-	27	32	mA

Note 3: Brightness (L_{br}) and Driver Supply Voltage (V_{CC}) are subject to the change of the panel characteristics and the customer’s request.

Note 4: V_{DD} = 2.8V, V_{CC} = 13V, Software Initial Setting follow Chapter 4.4 “Initial Code”, 50% Display Area Turn on.

Note 5: V_{DD} = 2.8V, V_{CC} = 13V, Software Initial Setting follow Chapter 4.4 “Initial Code”, 100% Display Area Turn on.

4. Functional Specification

4.1. Commands

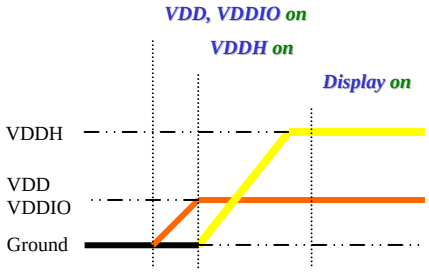
Refer to the Technical Manual for the SEPS525

4.2 Power down and Power up Sequence

To protect OEL panel and extend the panel life time, the driver IC power up/down routine should include a delay period between high voltage and low voltage power sources during turn on/off. It gives the OEL panel enough time to complete the action of charge and discharge before/after the operation.

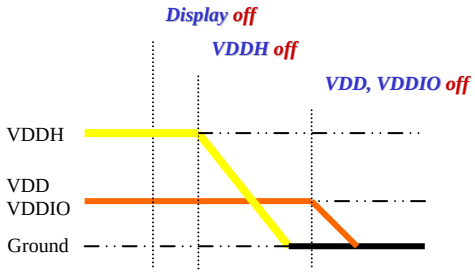
4.2.1 Power up Sequence:

1. Power up VDD, VDDIO
2. Send Display off command
3. Clear Screen
4. Power up VDDH
5. Delay 100ms
   (when VDD is stable)
6. Send Display on command



4.2.2 Power down Sequence:

1. Send Display off command
2. Power down VDDH
3. Delay 100ms
   (when VDDH is reach 0 and panel is completely discharges)
4. Power down VDD, VDDIO



4.3 Reset Circuit

When RESETB input is low, the chip is initialized with the following status:

1. Frame frequency: 90Hz
2. OSC: internal OSC
3. Internal OSC: ON
4. DDRAM write horizontal address: MX1 = 00h, MX2 = 9Fh
5. DDRAM write vertical address: MY1 = 00h, MY2 = 7Fh
6. Display data RAM write: HC = 1, VC = 1, HV = 0
7. RGB data swap: OFF
8. Row scan shift direction: G0, G1, … , G126, G127
9. Column data shift direction: S0, S1, … , S478, S479
10. Display ON/OFF: OFF
11. Panel display size: FX1 = 00h, FX2 = 9Fh, FY1 = 00h, FY2 = 7Fh
12. Display data RAM read column/row address: FAC = 00h, FAR = 00h
13. Precharge time(R/G/B): 0 clock
14. Precharge current(R/G/B): 0 uA
15. Driving current(R/G/B): 0 uA

4.4 Actual Application Example

Initial Code:

```
//OSC control
//EXPORT1 internal clock and OSC operates with external resister
    Write_Register(0x02);
    Write_Parameter(0x01);

//REDUCE_CURRENT
//Reduced driving current : normal
//Power save mode:normal
    Write_Register(0x04);
    Write_Parameter(0x00);

//CLOCK_DIV
//OSC frequency setting : 90Hz
//Display frequency divide ration:1
    Write_Register(0x03);
    Write_Parameter(0x30);

//IREF→Reference volt. controlled by External resister
//→RGB current and precharge time,current separate control
    Write_Register(0x80);
    Write_Parameter(0x00);

//PRECHARGE_TIME_R
//1 Precharge Time
    Write_Register(0x08);
    Write_Parameter(0x01);

//PRECHARGE_TIME_G
//1 Precharge Time
    Write_Register(0x09);
    Write_Parameter(0x01);

//PRECHARGE_TIME_B
//1 Precharge Time
    Write_Register(0x0A);
    Write_Parameter(0x01);

//PRECHARGE_CURRENT_R
    Write_Register(0x0B);
    Write_Parameter(0x0A);

//PRECHARGE_CURRENT_G
    Write_Register(0x0C);
    Write_Parameter(0x0A);

//PRECHARGE_CURRENT_B
    Write_Register(0x0D);
    Write_Parameter(0x0A);

//DRIVING_CURRENT_R
//82uA
    Write_Register(0x10);
    Write_Parameter(0x52);
```

```
//DRIVING_CURRENT_G
//56uA
    Write_Register(0x11);
    Write_Parameter(0x38);

//DRIVING_CURRENT_B
//58uA
    Write_Register(0x12);
    Write_Parameter(0x3A);

//Display mode set
//RGB,column=0→159,column data display control=Normal Dispaly
    Write_Register(0x13);
    Write_Parameter(0x00);

//External interface mode =MPU
    Write_Register(0x14);
    Write_Parameter(0x01);

//MEMORY_WRITE_MODE
//6btis Triple transfer,262K support ,Horizontal address counter is increased,Vertical
  address
//counter is increased,The data is continuously written horizontally
    Write_Register(0x16);
    Write_Parameter(0x76);

//Memory addrss setting range 0x17~0x19→160x128
    Write_Register(0x17);    //column start
    Write_Parameter(0x00);
    Write_Register(0x18);    //column end
    Write_Parameter(0x9F);
    Write_Register(0x19);    //row start
    Write_Parameter(0x00);
    Write_Register(0x1A);    //row end
    Write_Parameter(0x7F);

//Memory Start Address set 0x20~0x21
    Write_Register(0x20);    // X
    Write_Parameter(0x00);
    Write_Register(0x21);    // Y
    Write_Parameter(0x00);

//DUTY
    Write_Register(0x28);
    Write_Parameter(0x7F);//128

//Display Start LIne
    Write_Register(0x29);
    Write_Parameter(0x00);

//DDRAM Read Address Start point 0x2E~0x2F
    Write_Register(0x2E);    // X
    Write_Parameter(0x00);
    Write_Register(0x2F);    // Y
    Write_Parameter(0x00);
```

```
//Display Screen Saver Size 0x33~0x36
    Write_Register(0x33);    //Display Screen Saver Columns Start
    Write_Parameter(0x00);
    Write_Register(0x34);    //Display Screen Saver Columns End
    Write_Parameter(0x9F);
    Write_Register(0x35);    //Display Screen Saver Row Start
    Write_Parameter(0x00);
    Write_Register(0x36);    //Display Screen Saver Row End
    Write_Parameter(0x7F);
    Write_Register(0x06);    //Display ON
    Write_Parameter(0x01);
```

5. Reliability

5.1 Contents of Reliability Tests

Item	Conditions	Criteria
High Temperature Operation	70°C, 240 hrs	The operational functions work.
Low Temperature Operation	-30°C, 240 hrs	
High Temperature Storage	80°C, 240 hrs	
Low Temperature Storage	-40°C, 240 hrs	
High Temperature/Humidity Operation	60°C, 90% RH, 120 hrs	
Thermal Shock	-40°C ⇔ 85°C, 24 cycles 1 hr dwell	

* The samples used for the above tests do not include polarizer.
* No moisture condensation is observed during tests.

5.2 Lifetime

End of lifetime is specified as 50% of initial brightness.

Parameter	Min	Max	Unit	Condition	Notes
Operating Life Time	10,000	-	Hrs	100 cd/m^2, 50%checkerboard	6
Storage Life Time	20,000	-	Hrs	Ta=25°C, 50%RH	-

Note 6: The average operating lifetime at room temperature is estimated by the accelerated operation at high temperature conditions.

5.3 Failure Check Standard

After the completion of the described reliability test, the samples were left at room temperature for 2 hrs prior to conducting the failure test at 23±5°C; 55±15% RH.

8. Precautions When Using These OEL Display Modules

8.1 Handling Precautions

1) Since the display panel is being made of glass, do not apply mechanical impacts such us dropping from a high position.
2) If the display panel is broken by some accident and the internal organic substance leaks out, be careful not to inhale nor lick the organic substance.
3) If pressure is applied to the display surface or its neighborhood of the OEL display module, the cell structure may be damaged and be careful not to apply pressure to these sections.
4) The polarizer covering the surface of the OEL display module is soft and easily scratched. Please be careful when handling the OEL display module.
5) When the surface of the polarizer of the OEL display module has soil, clean the surface. It takes advantage of by using following adhesion tape.
   * Scotch Mending Tape No. 810 or an equivalent

   Never try to breathe upon the soiled surface nor wipe the surface using cloth containing solvent such as ethyl alcohol, since the surface of the polarizer will become cloudy.

   Also, pay attention that the following liquid and solvent may spoil the polarizer:
   * Water
   * Ketone
   * Aromatic Solvents
6) When installing the OEL display module, be careful not to apply twisting stress or deflection stress to the OEL display module. And, do not over bend the film with electrode pattern layouts. These stresses will influence the display performance. Also, secure sufficient rigidity for the outer cases.
7) Do not apply stress to the LSI chips and the surrounding molded sections.
8) Do not disassemble nor modify the OEL display module.
9) Do not apply input signals while the logic power is off.
10) Pay sufficient attention to the working environments when handing OEL display modules to prevent occurrence of element breakage accidents by static electricity.
    * Be sure to make human body grounding when handling OEL display modules.
    * Be sure to ground tools to use or assembly such as soldering irons.
    * To suppress generation of static electricity, avoid carrying out assembly work under dry environments.
    * Protective film is being applied to the surface of the display panel of the OEL display module. Be careful since static electricity may be generated when exfoliating the protective film.
11) Protection film is being applied to the surface of the display panel and removes the protection film before assembling it. At this time, if the OEL display module has been stored for a long period of time, residue adhesive material of the protection film may remain on the surface of the display panel after removed of the film. In such case, remove the residue material by the method introduced in the above Section 5).
12) If electric current is applied when the OEL display module is being dewed or when it is placed under high humidity environments, the electrodes may be corroded and be careful to avoid the above.

8.2 Storage Precautions

1) When storing OEL display modules, put them in static electricity preventive bags avoiding exposure to direct sun light nor to lights of fluorescent lamps, etc. and, also, avoiding high temperature and high humidity environments or low temperature (less than 0°C) environments. (We recommend you to store these modules in the packaged state when they were shipped from Univision Technology Inc.)
   At that time, be careful not to let water drops adhere to the packages or bags nor let dewing occur with them.
2) If electric current is applied when water drops are adhering to the surface of the OEL display module, when the OEL display module is being dewed or when it is placed under high humidity environments, the electrodes may be corroded and be careful about the above.

8.3 Designing Precautions

1) The absolute maximum ratings are the ratings which cannot be exceeded for OEL display module, and if these values are exceeded, panel damage may be happen.
2) To prevent occurrence of malfunctioning by noise, pay attention to satisfy the VIL and VIH specifications and, at the same time, to make the signal line cable as short as possible.
3) We recommend you to install excess current preventive unit (fuses, etc.) to the power circuit (VDD). (Recommend value: 0.5A)
4) Pay sufficient attention to avoid occurrence of mutual noise interference with the neighboring devices.
5) As for EMI, take necessary measures on the equipment side basically.
6) When fastening the OEL display module, fasten the external plastic housing section.
7) If power supply to the OEL display module is forcibly shut down by such errors as taking out the main battery while the OEL display panel is in operation, we cannot guarantee the quality of this OEL display module.
8) The electric potential to be connected to the rear face of the IC chip should be as follows: SSPS525
   * Connection (contact) to any other potential than the above may lead to rupture of the IC.

8.4 Precautions when disposing of the OEL display modules

1) Request the qualified companies to handle industrial wastes when disposing of the OEL display modules. Or, when burning them, be sure to observe the environmental and hygienic laws and regulations.

8.5 Other Precautions

1) When an OEL display module is operated for a long of time with fixed pattern may remain as an after image or slight contrast deviation may occur.
   Nonetheless, if the operation is interrupted and left unused for a while, normal state can be restored. Also, there will be no problem in the reliability of the module.
2) To protect OEL display modules from performance drops by static electricity rapture, etc., do not touch the following sections whenever possible while handling the OEL display modules.
   * Pins and electrodes
   * Pattern layouts such as the COF
3) With this OEL display module, the OEL driver is being exposed. Generally speaking, semiconductor elements change their characteristics when light is radiated according to the principle of the solar battery. Consequently, if this OEL driver is exposed to light, malfunctioning may occur.
   * Design the product and installation method so that the OEL driver may be shielded from light in actual usage.
   * Design the product and installation method so that the OEL driver may be shielded from light during the inspection processes.
4) Although this OEL display module stores the operation state data by the commands and the indication data, when excessive external noise, etc. enters into the module, the internal status may be changed. It therefore is necessary to take appropriate measures to suppress noise generation or to protect from influences of noise on the system design.
5) We recommend you to construct its software to make periodical refreshment of the operation statuses (re-setting of the commands and re-transference of the display data) to cope with catastrophic noise.