MULTI-INNO TECHNOLOGY CO., LTD.

LCD MODULE SPECIFICATION

Model : MI128128AO

Revision	
Engineering	
Date	
Our Reference	

Revised History

Part Number	Revision	Revision Content	Revised on
MI128128AO	A	New August 15, 2006	

Contents

1. Basic Specifications

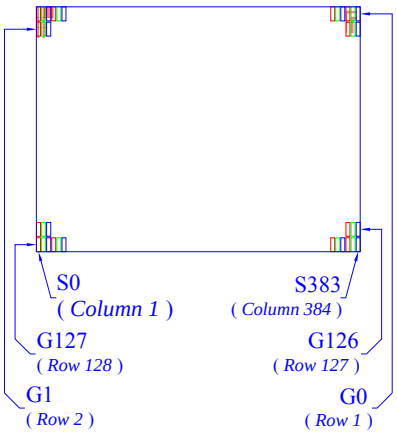
1.1 Display Specifications

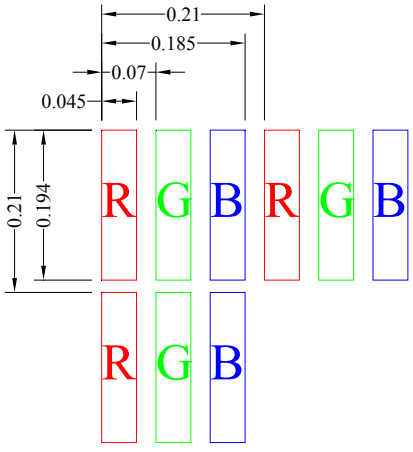
1) Display Mode: Passive Matrix
2) Display Color: 262,144 Colors (Maximum)
3) Drive Duty: 1/128 Duty

1.2 Mechanical Specifications

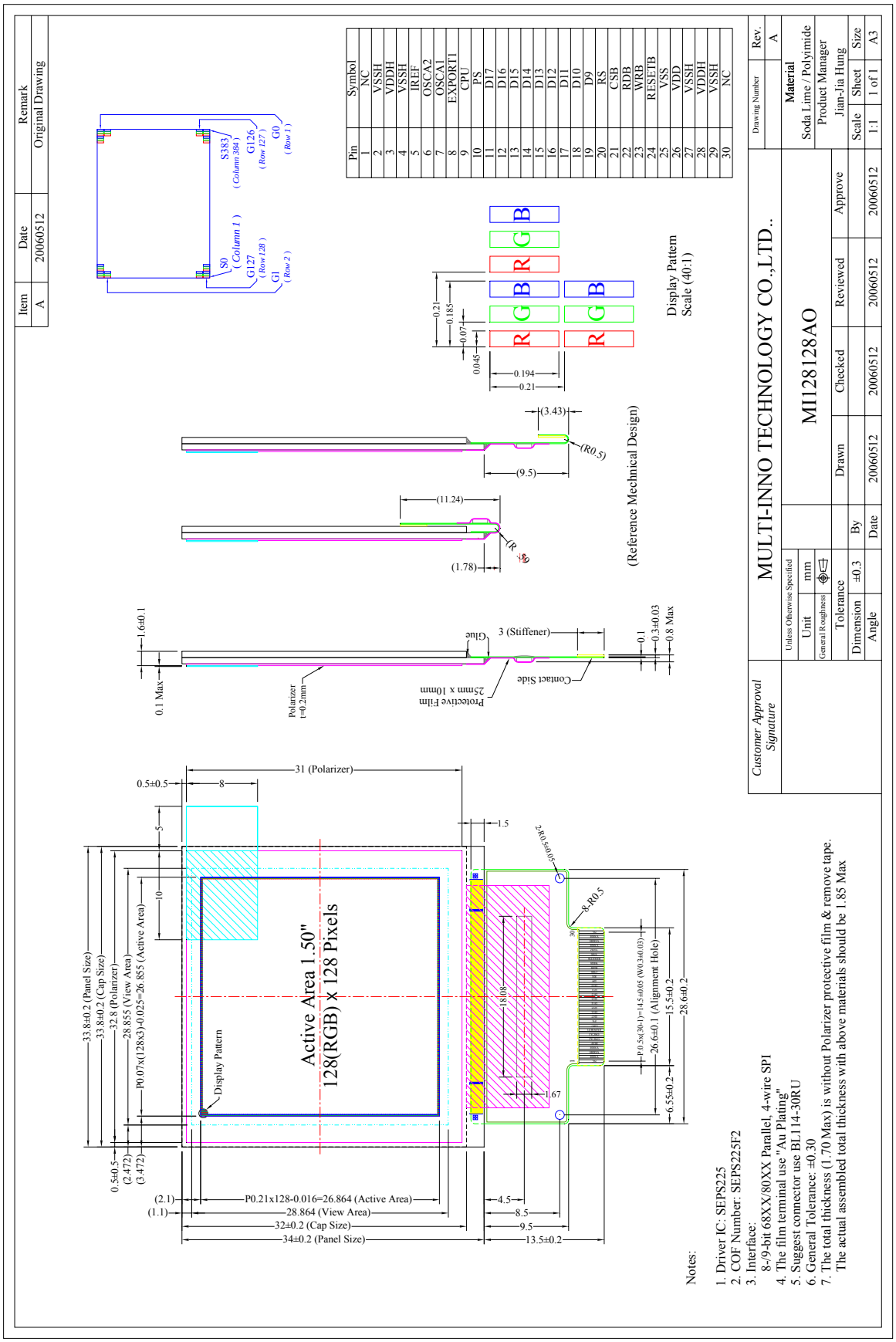
1) Outline Drawing: According to the annexed outline drawing number
2) Number of Pixels: 128(RGB) × 128
3) Panel Size: 33.80 × 34.00 × 1.70 (mm)
4) Active Area: 26.855 × 26.864 (mm)
5) Pixel Pitch: 0.07 × 0.21 (mm)
6) Pixel Size: 0.045 × 0.194 (mm)
7) Weight: 4.0 (g)

1.3 Active Area & Pixel Construction





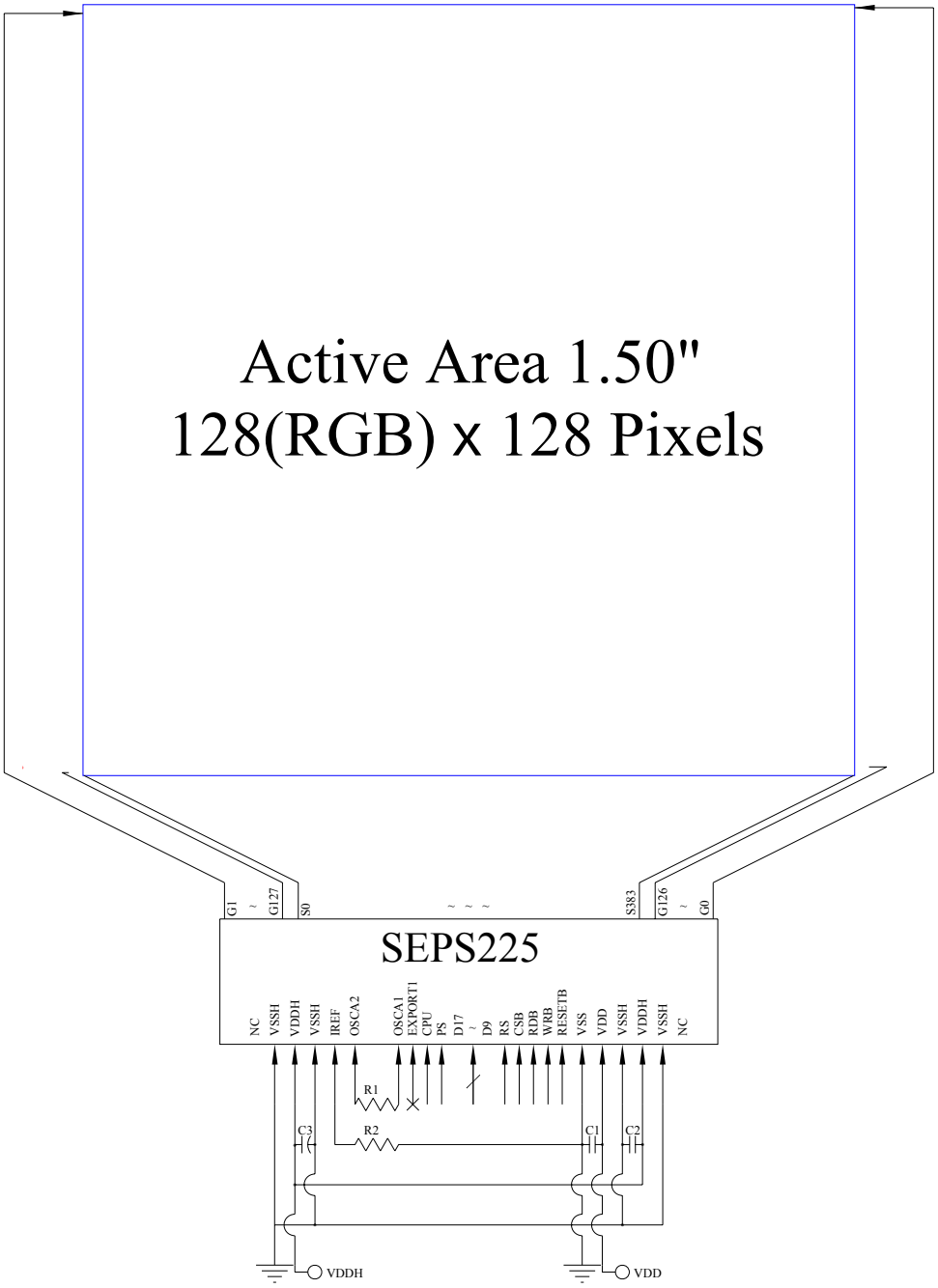
1.4 Mechanical Drawing



1.5 Pin Definition

Pin Number	Symbol	Type	Function
2,4,27,29	VSSH	P	*Return Ground for VDDH*
3,28	VDDH	P	*External Column Driving Power Supply.*
25	VSS	P	*Power supply ground*
26	VDD.	P	*Logic power supply.*
5	IREF	I/O	*Current Reference for Brightness Adjustment* Tie 68KΩ resistor to VSS.
6	OSCA2	O	*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.
7	OSCA1	I	
8	EXPORT1	O	*OSC Test*
9	CPU	I	*Selects the CPU type* Low: 80-series CPU, High: 68-Series CPU.
10	PS	I	*Selects parallel/Serial interface type* Low: serial, High: parallel.
11~19	D17~D9	I/O	*Host Data Input/Output Bus* These pins are 9-bit bi-directional data bus to connected with MCU data bus. PS: 1 — 8_bit bus : D[17:10]; 9_bit bus : D[17:9] PS: 0 — D[17] SCL : Synchronous clock input; D[16] SDI : Serial data input; D[15] SDO : Serial data output Fix unused pins to the VSS level.
20	RS	I	*Selects the data/command* Low: command, High: parameter/data
21	CSB	I	*Chip Select* Low: SEPS225 is selected and can be accessed. High: SEPS225 is not selected and cannot be accessed.
22	RDB	I	*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.
23	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.
24	RESETB	I	*Chip Reset* Reset SEPS225 (active low)
1,30	NC	-	*No Connection*

1.6 Block Diagram



MCU Interface Selection: PS, CPU
Pins connected to MCU interface: D17~D9, RDB, RS, CSB, WRB, and RESB
* EXPORT1would be left float.

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
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
Driver Supply Voltage	VDDH		-	13	-	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

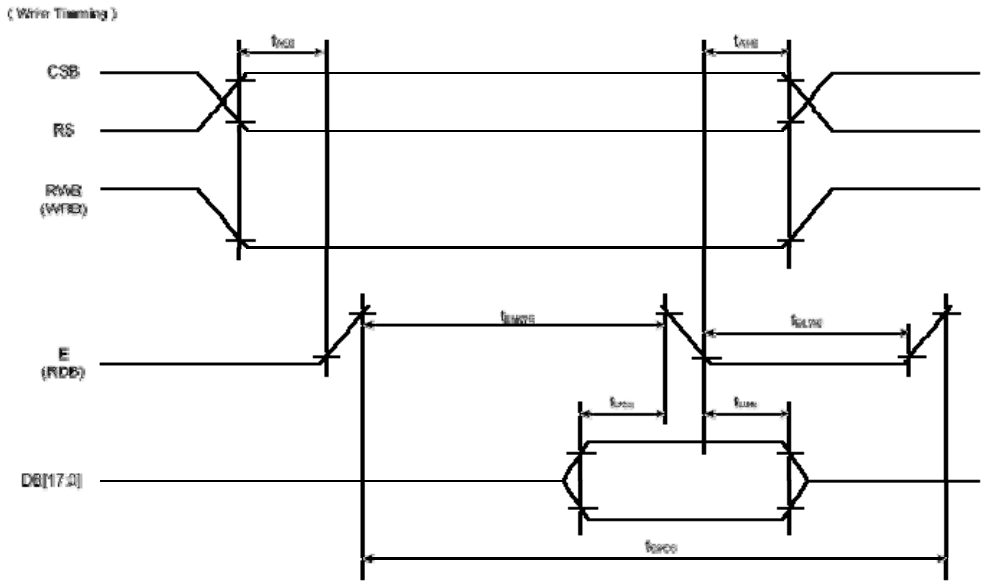
3.2 AC Characteristics

3.2.1 68XX-Series MPU Parallel Interface Timing Characteristics:

(VDD = 2.8V, Ta = 25℃)

Symbol	Description	Condition	Min	Max	Unit	Port
t_{AH6}	Address hold timing	-	5	-	ns	CSB
t_{AS6}	Address setup timing	-	5	-	ns	RS
t_{CYC6}	System cycle timing	-	100	-	ns	E
t_{WRLW6}	Write “L” pulse width	-	45	-	ns	
t_{WRHW6}	Write “H” pulse width	-	45	-	ns	
t_{DS6}	Data setup timing	-	40	-	ns	DB[17:0]
t_{DH6}	Data hold timing	-	10	-	ns	

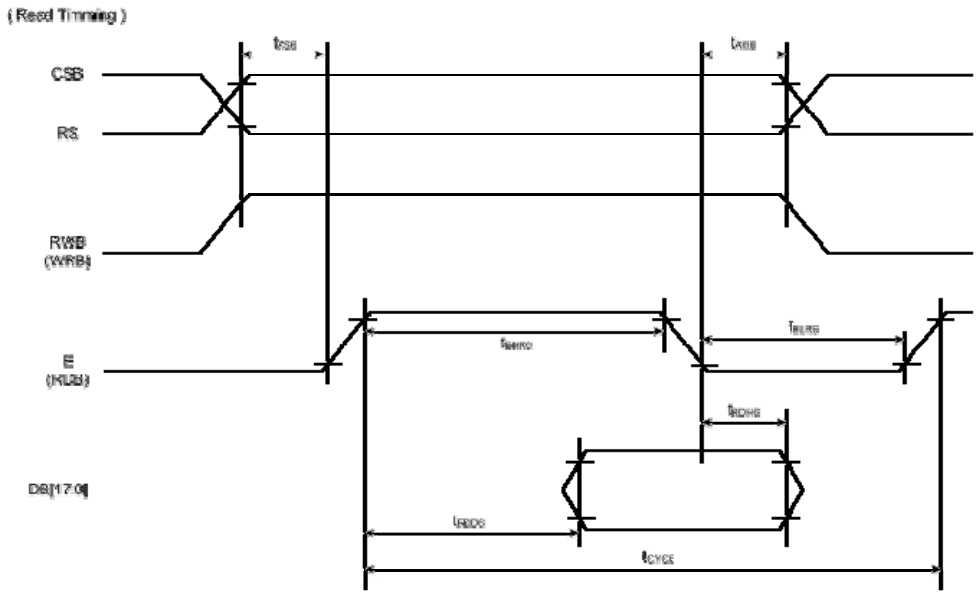
*All the timing reference is 10% and 90% of VDD.



(VDD = 2.8V, Ta = 25℃)

Symbol	Description	Condition	Min	Max	Unit	Port
t_{AH6}	Address hold timing	-	10	-	ns	CSB
t_{AS6}	Address setup timing	-	10	-	ns	RS
t_{CYC6}	System cycle timing	-	200	-	ns	RDB
t_{RDLR6}	Read “L” pulse width	-	90	-	ns	
t_{RDHR6}	Read “H” pulse width	-	90	-	ns	
t_{RDD6}	Read data output delay time	CL = 15 pF	0	70	ns	DB[17:0]
t_{RDH6}	Data hold timing				ns	

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

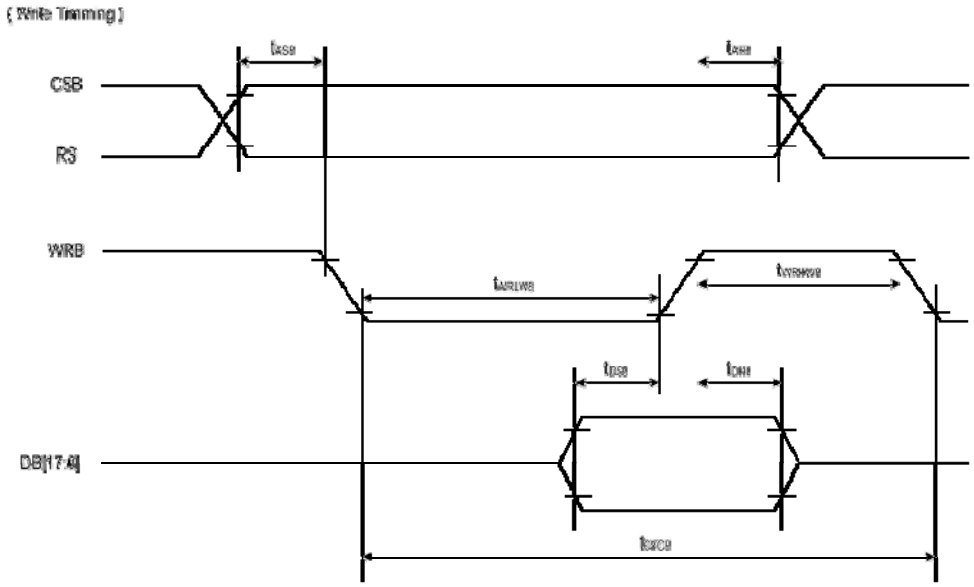


3.2.2 80XX-Series MPU Parallel Interface Timing Characteristics:

(VDD = 2.8V, Ta = 25℃)

Symbol	Description	Condition	Min	Max	Unit	Port
t_{AH8}	Address hold timing	-	5	-	ns	CSB
t_{AS8}	Address setup timing	-	5	-	ns	RS
t_{CYC8}	System cycle timing	-	100	-	ns	WRB
t_{WRLW8}	Write “L” pulse width	-	45	-	ns	
t_{WRHW8}	Write “H” pulse width	-	45	-	ns	
t_{DS8}	Data setup timing	-	30	-	ns	DB[17:0]
t_{DH8}	Data hold timing	-	10	-	ns	

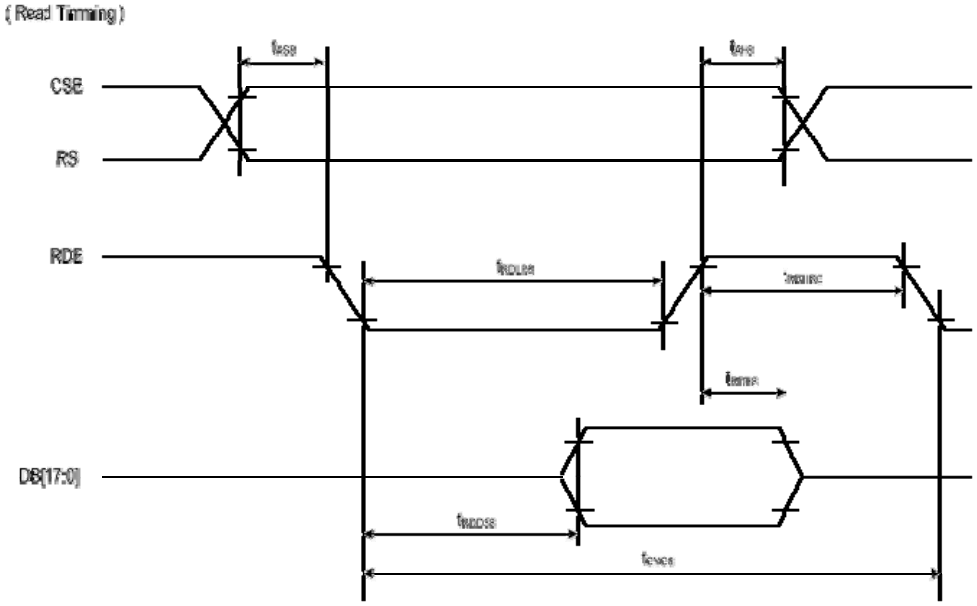
*All the timing reference is 10% and 90% of VDD.



(VDD = 2.8V, Ta = 25℃)

Symbol	Description	Condition	Min	Max	Unit	Port
t_{AH8}	Address hold timing	-	5	-	ns	CSB
t_{AS8}	Address setup timing	-	5	-	ns	RS
t_{CYC8}	System cycle timing	-	200	-	ns	RDB
t_{RDLR8}	Read “L” pulse width	-	90	-	ns	
t_{RDHR8}	Read “H” pulse width	-	90	-	ns	
t_{RDD8}	Read data output delay time	CL = 15 pF	-	60	ns	DB[17:0]
t_{RDH8}	Data hold timing		0		ns	

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

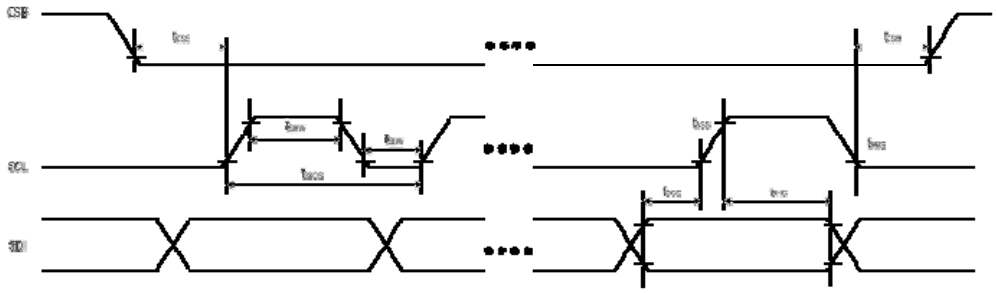


3.2.3 Serial Interface Timing Characteristics:

(VDD = 2.8V, Ta = 25℃)

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

*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}	With Polarizer (Note 3)	70	90	-	cd/m^2
C.I.E. (White)	(x) (y)	With Polarizer	0.24 0.29	0.28 0.33	0.32 0.37	
C.I.E. (Red)	(x) (y)	With Polarizer	0.60 0.31	0.64 0.35	0.68 0.39	
C.I.E. (Green)	(x) (y)	With Polarizer	0.28 0.59	0.32 0.63	0.36 0.67	
C.I.E. (Blue)	(x) (y)	With Polarizer	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 Sec. 4.4 “Initial Sequence & Setting Value”

3.4 General Electrical Specification

Characteristics	Symbol	Conditions	Min	Typ	Max	Unit
Supply Voltage	V		2.6	2.8	3.5	V
Supply Voltage for I/O Pins	V_{DDIO}		1.5	2.8	3.5	V
Driver Supply Voltage	V_{CC}	Note 3	-	13	-	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	-	19	23	mA
		Note 5	-	30	36	mA
Sleep Mode Current for V_{DD}	$I_{DD, SLEEP}$		-	<1	1	μA
Sleep Mode Current for V_{DDH}	$I_{DDH,SLEEP}$		-	<1	1	μA

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, Test condition follow Sec.4.4 “Initial Sequence & Setting Value”, 50% Display Area Turn on.

Note 5: V_{DD} = 2.8V, V_{CC} = 13V, Test condition follow Sec.4.4 “Initial Sequence & Setting Value”, 100% Display Area Turn on.

4. Functional Specification

4.1. Commands

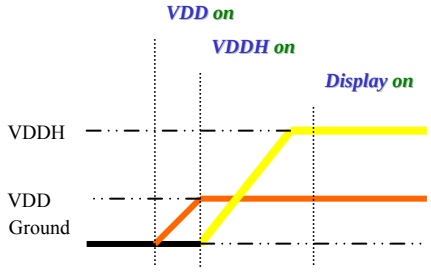
Refer to the Technical Manual for the SEPS225

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.

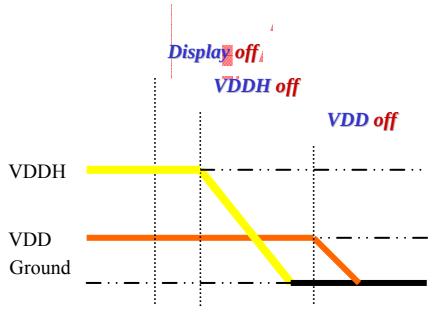
4.2.1 Power up Sequence:

1. Power up VDD
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



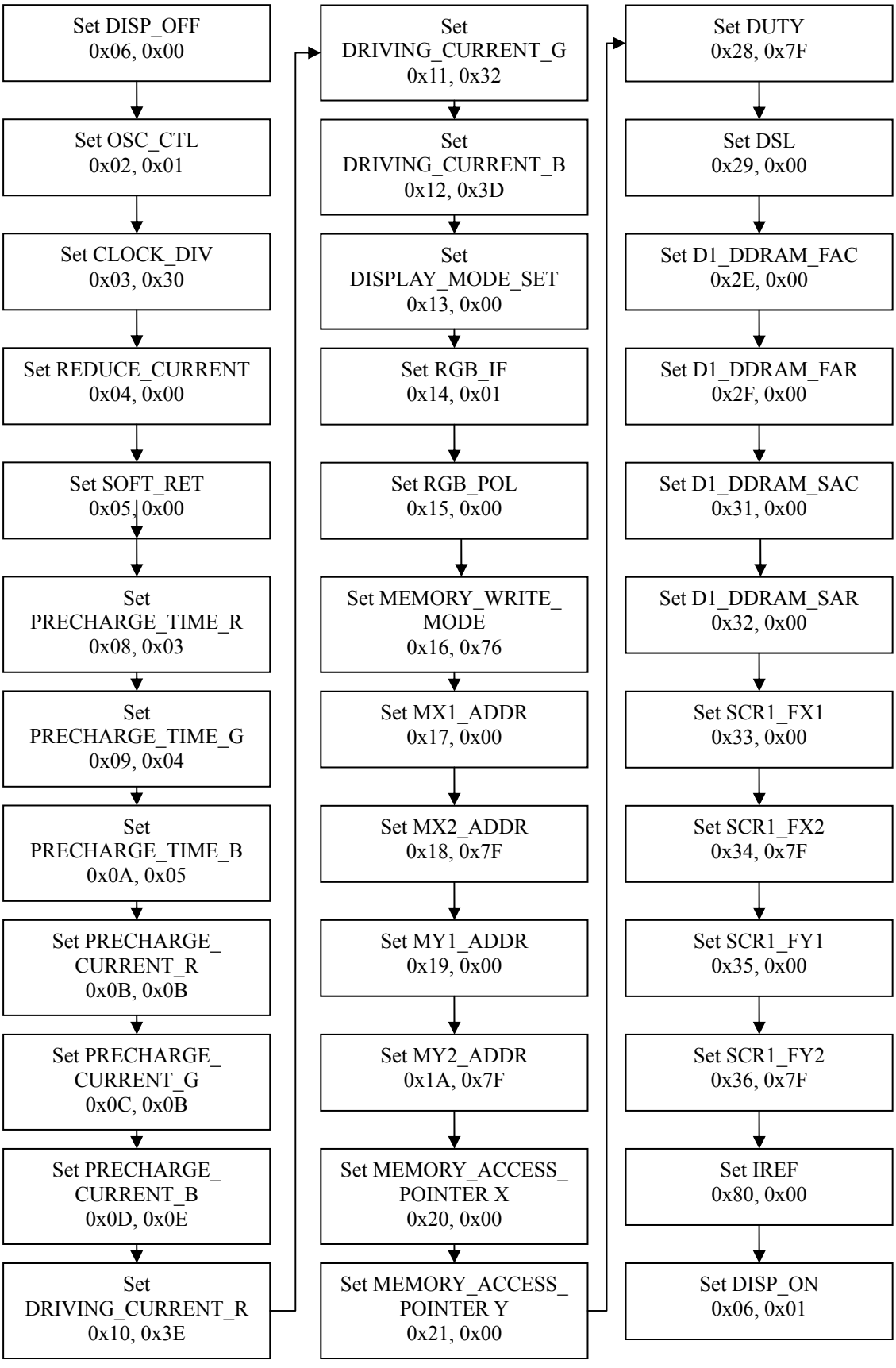
4.3 Reset Circuit

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 = 7Fh
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, … , S382, S383
10. Display ON/OFF: OFF
11. Panel display size: FX1 = 00h, FX2 = 7Fh, 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 Sequence & Setting Value:



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	70 cd/m , 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.

6. *Outgoing Quality Control Specifications*

6.1 Environment Required

Customer's test & measurement are required to be conducted under the following conditions:

Temperature:	23 ± 5°C
Humidity:	55 ± 15 %RH
Fluorescent Lamp:	30W
Distance between the Panel & Lamp:	≥ 50 cm
Distance between the Panel & Eyes of the Inspector:	≥ 30 cm

Finger glove (or finger cover) must be worn by the inspector.
Inspection table or jig must be anti-electrostatic.

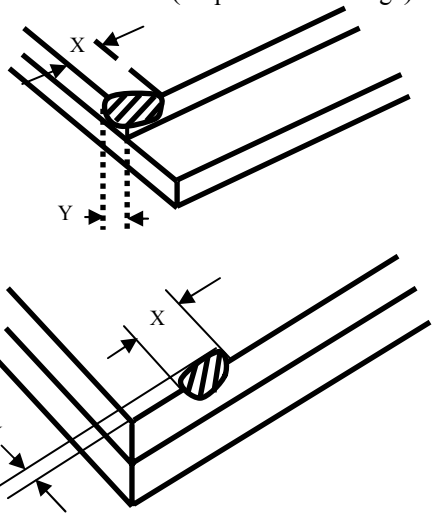
6.2 Sampling Plan

Level II, Normal Inspection, Single Sampling, MIL-STD-105E

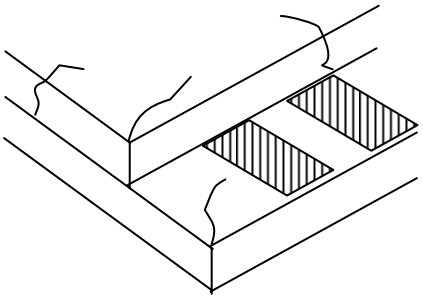
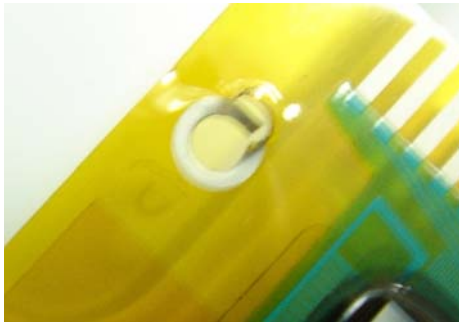
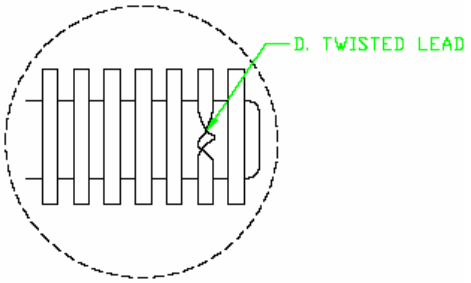
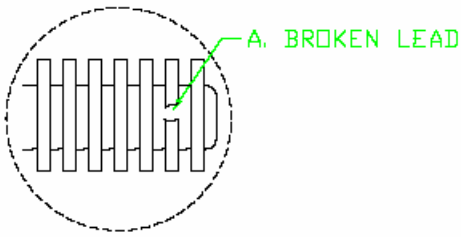
6.3 Criteria & Acceptable Quality Level

Partition	AQL	Definition
Major	0.65	Defects in Pattern Check (Display On)
Minor	1.0	Defects in Cosmetic Check (Display Off)

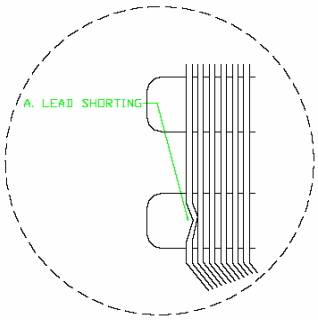
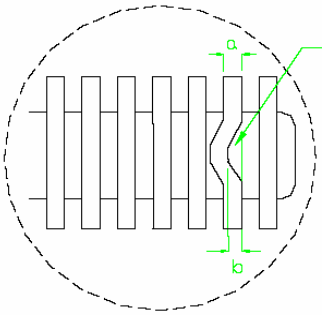
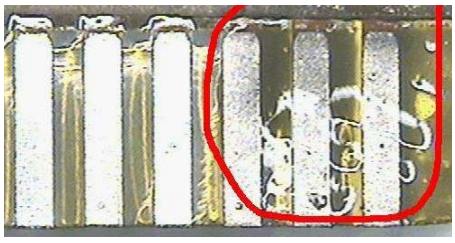
6.3.1 Cosmetic Check (Display Off) in Non-Active Area

Check Item	Classification	Criteria
Panel General Chipping	Minor	X > 6 mm (Along with Edge) Y > 1 mm (Perpendicular to edge) 

6.3.1 Cosmetic Check (Display Off) in Non-Active Area (Continued)

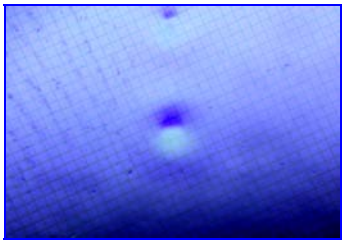
Check Item	Classification	Criteria
Panel Crack	Minor	Any crack is not allowable. 
Cupper Exposed (Even Pin or Film)	Minor	Not Allowable by Naked Eye Inspection
Film or Trace Damage	Minor	
Terminal Lead Twist	Minor	Not Allowable 
Terminal Lead Broken	Minor	Not Allowable 
Terminal Lead Probe Mark	Acceptable	Ok

6.3.1 Cosmetic Check (Display Off) in Non-Active Area (Continued)

Check Item	Classification	Criteria
Terminal Lead Bent (Not Twist or Broken)	Minor	NG if any bent lead cause lead shorting. 
	Minor	NG for horizontally bent lead more than 50% of its width. 
Glue or Contamination on Pin (Couldn't Be Removed by Alcohol)	Minor	
Ink Marking on Back Side of panel (Exclude on Film)	Acceptable	Ignore for Any

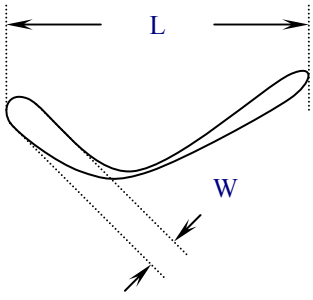
6.3.2 Cosmetic Check (Display Off) in Active Area

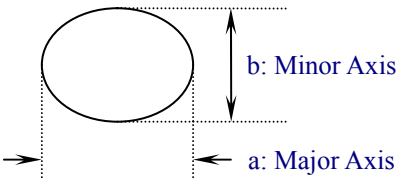
It is recommended to execute in clear room environment (class 10k) if actual in necessary.

Check Item	Classification	Criteria
Any Dirt & Scratch on Protective Film	Acceptable	Ignore for Any
Scratches, Fiber, Line-Shape Defect (On Polarizer)	Minor	W ≤ 0.1 Ignore
		W ≤ 0.1 Ignore W > 0.1, L ≤ 2 n ≤ 1 L > 2 n = 0
Dirt, Spot-Shape Defect (On Polarizer)	Minor	Φ ≤ 0.1 Ignore 0.1 <Φ ≤ 0.25 n ≤ 1 0.25 <Φ n = 0
Dent, Bubbles, White spot (Any Transparent Spot on	Minor	Φ ≤ 0.5 ➔ Ignore if no Influence on Display 0.5 < Φ n = 0 
Fingerprint, Flow Mark (On Polarizer)	Minor	Not allowable

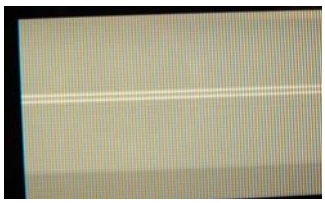
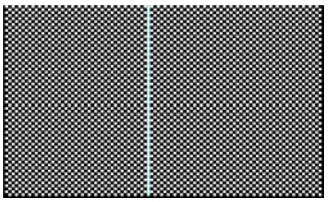
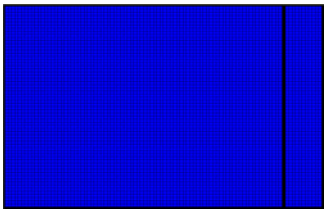
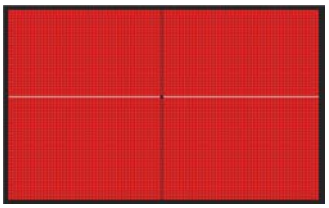
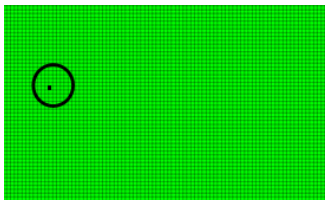
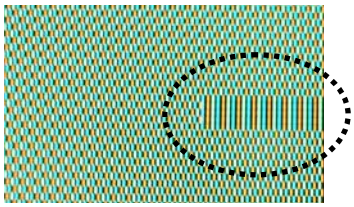
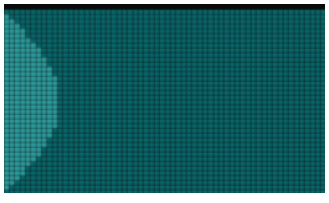
* Protective film should not be tear off when cosmetic check.

** Definition of W & L & Φ (Unit: mm): Φ = (a + b) / 2

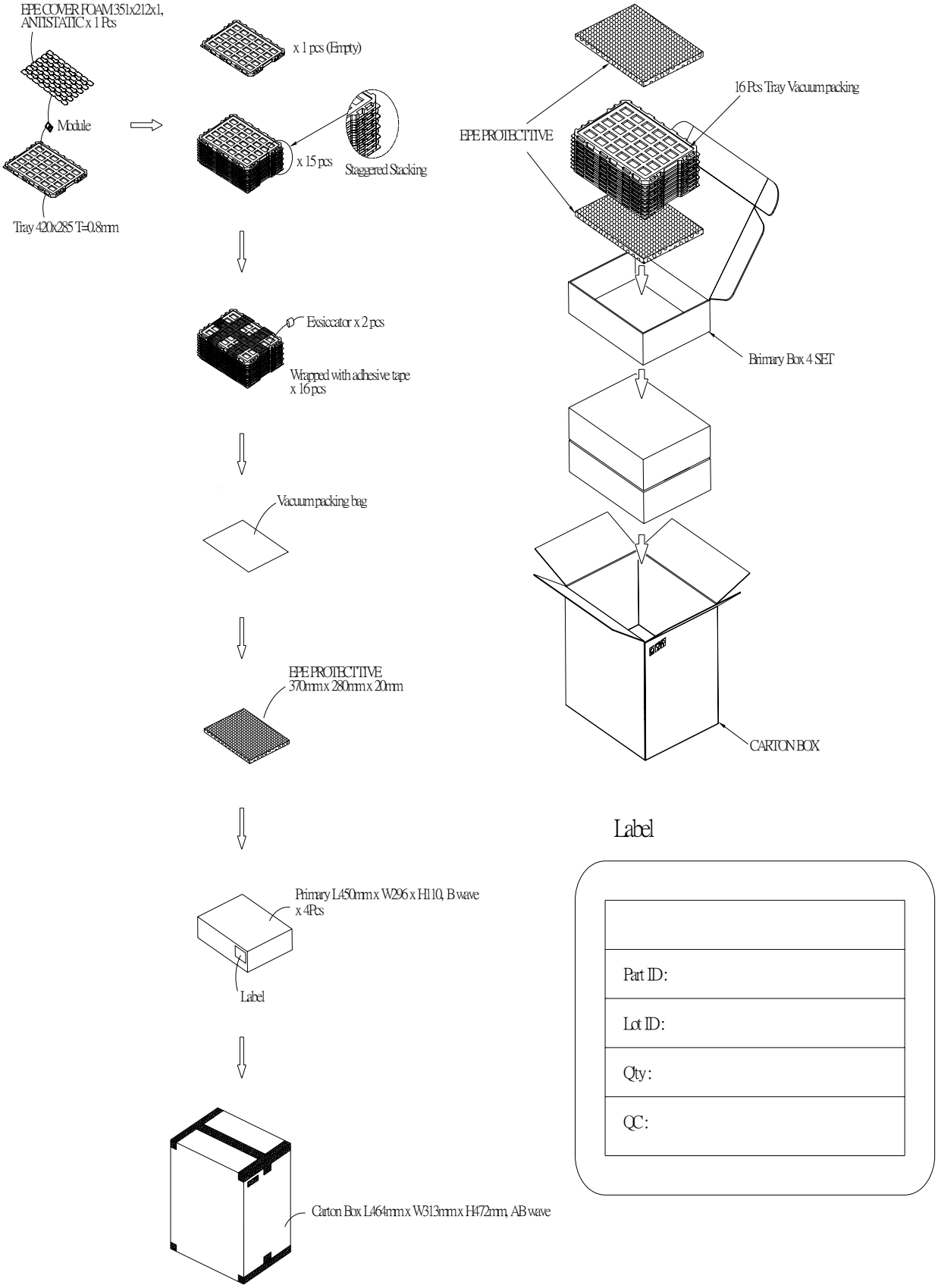




6.3.3 Pattern Check (Display On) in Active Area

Check Item	Classification	Criteria
No Display	Major	Not allowable
Bright Line	Major	
Missed Line	Major	 
Pixel Short	Major	
Darker Pixel	Major	
Wrong Display	Major	
Un-Uniform (Luminance Variation within a Display)	Major	

7. Package Specifications



Label

Part ID:
Lot ID:
Qty:
QC:

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 area, both of top and back sides, or its neighborhood of the OEL display module, the cell structure may be damaged and be careful not to touch these sections on carrying and assembly.
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 Multi-Inno 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 atten
   VIL and VIH specifications and, at the same time, to make the signal line cable
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: SSPS225
   * 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 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.