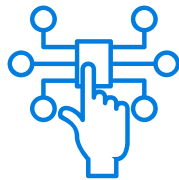


unisystem

USEC133SBSUSN

13.3" E-paper Display with Unisystem's Controller



SPECIFICATION

Revision Table

Revision	Description	Author	Date
1	Initial release	P. Dominik	19.09.2022
2	Correction to the power sequence	B. Soczyński	24.10.2022

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1 General Description

USEC133SBSUSN is a comprehensive solution consisting of an Electronic Paper Display (EPD) and Unisystem's EPD Controller. It ensures easy implementation of the module in the final product and facilitates EPD image handling. The display has a 13.3" active area with 1600x1200 pixels and can show content with 2, 4, 8, and 16 gray levels (1 to 4 bits). Users can choose between communication via USB or SPI interface. This unit is designed for indoor application.

Size (inch)	13.3
Resolution (Pixel)	1600 (H) x 1200 (V)
Controller Interface	USB, SPI
Active Area (mm)	270.4 (H) x 202.8 (V)
Grayscale Levels	2 to 16
EPD Outline Dimensions (mm)	285.8 (H) x 213.65 (V) x 0.78 (D)
Pixel Pitch (mm)	0.169
Driving Board Outline Dimensions (mm)	108.5 (H) x 66.5 (V)
Operating temp. (°C)	0 to 50
Storage temp. (°C)	-25 to 70

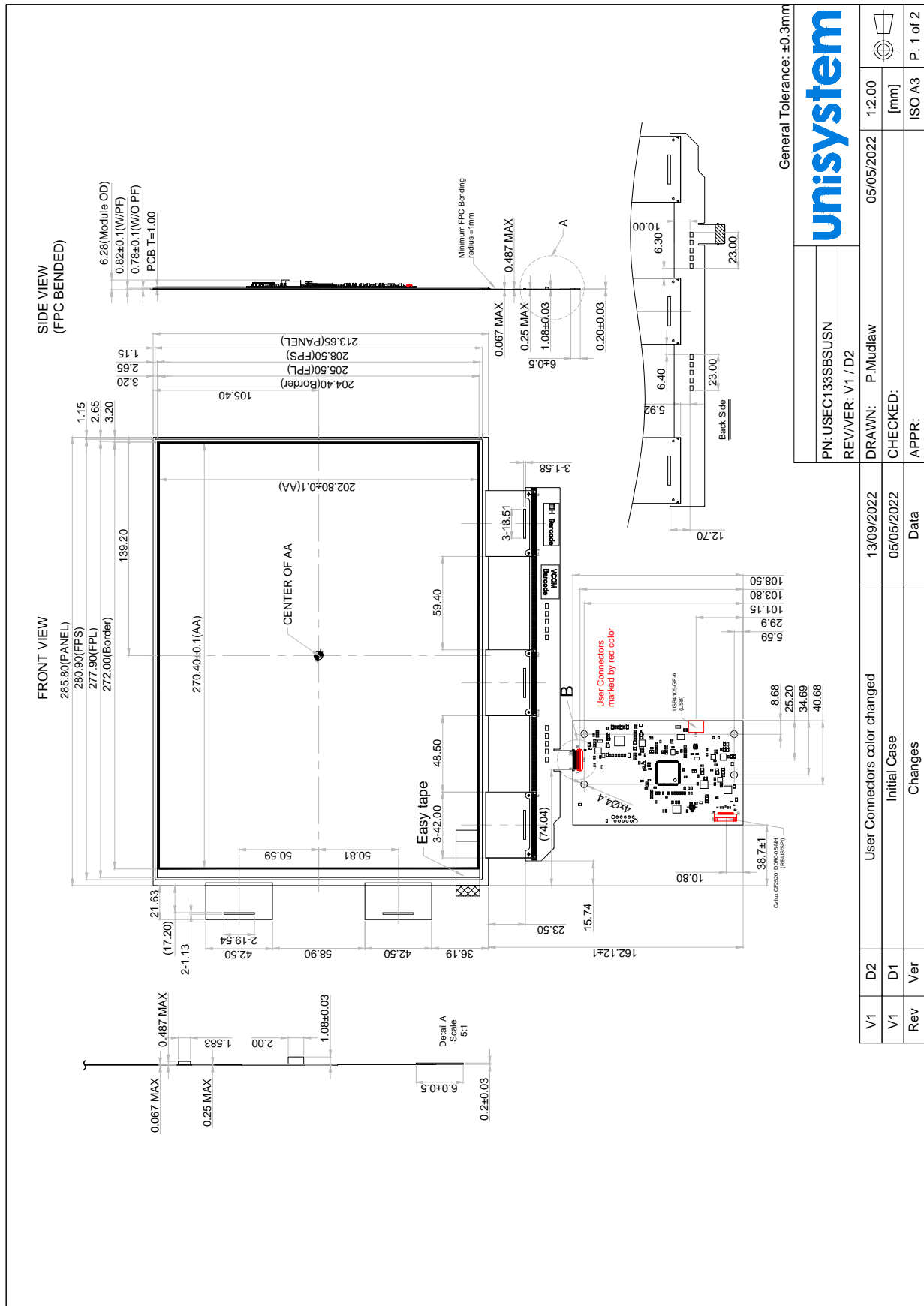
2 PN Description

Module Classification Description

USE	Mode	Size	Resolution	Color	Operating temperature	Interface	Type	Addons
1	2	3	4	5	6	7	8	9
USE	C	133	S	B	S	U	S	N

1	Unisystem Epaper
2	M – E-Ink display, 4mm cover glass, Uni EPD controller, metal housing C – E-Ink display, Unisystem EPD controller
3	078 – 7.8" (USEC only) 097 – 9.7" (USEC only) 113 – 11.3" (USEC only) 133 – 13.3" 312 – 31.2"
4	H – high resolution S – standard resolution
5	A – ACeP (E-Ink 13.3" only) B – black/white C – color, RGB filter R – black / white / red Y – black / white / yellow
6	S – standard temperature operating range L – supports temperatures below 0 and over 50
7	U – USB (for USEM), USB/SPI (for USEC) S – SPI (for USEM only, optional)
8	F – flexible S – standard
9	H – heater N – none

3 Mechanical Drawing



4 Driving Board Block Diagram

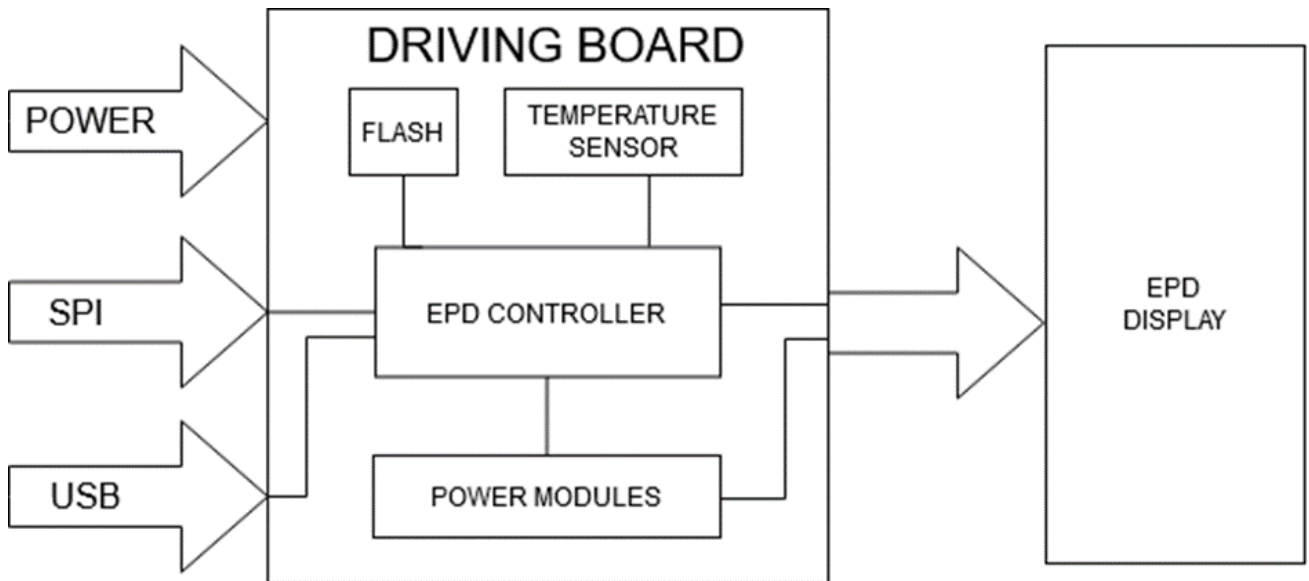


Figure 4-1 - Driving Board Block Diagram

5 User's Connectors

Unisystem's EPD Controller supports the following interfaces:

- USB 2.0,
- SPI (up to 14MHz SCK frequency)¹.

USEC133SBSUSN has two user connectors: USB C, and an FFC connector for SPI.

5.1 USB

USEC133SBSUSN is equipped with a USB C connector for the USB 2.0 standard.

5.2 SPI

For the SPI, use connector CN1 Cvilux CF25201D0R0-05-NH. Use matching FFC. Table 5.1 presents the pinout.

Pin Number	Pin name	Description
1	V _{IN}	Input Voltage
2	GND	Ground
3	SCK	SPI Clock signal input pin
4	MISO	SPI MISO output pin
5	MOSI	SPI MOSI input pin
6	CS	SPI Chip select
7	HRDY	Ready signal output. Do not send a command to the selected controller until the state of the HRDY line is high
8	RST	Reset signal input (active low)

¹ Maximum frequency for working SPI communication depends on the length and electrical characteristic of the cable

9	NC	No Connection
10	NC	No Connection
11	NC	No Connection
12	NC	No Connection
13	NC	No Connection
14	NC	No Connection
15	TX	Debug
16	RX	Debug
17	V _{IN}	Input Voltage
18	V _{IN}	Input Voltage
19	GND	Ground
20	GND	Ground

Table 5.1 SPI (CN1) Connector Pinout

6 Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Unit
USEC Power Supply	V _{IN}	-0.3	6	V
Logic Signals Voltage (RST, HRDY, MOSI, MISO, SCK, CS1-CS4)	V _{LOG}	-0.3	3.5	V
Operating temperature	T _{op}	0	50	°C
Storage temperature	T _{st}	-25	70	°C

Table 6.1 - Absolute Maximum Ratings

Note 6.1 Exceeding one or more limiting values from Table 6.1 may cause permanent damage to the module.

Note 6.2 For USB maximum ratings, please refer to the USB 2.0 specification.

7 Electrical Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit
USEC Power Supply	V _{IN}	4.75	5	5.25	V
Logic Signals High State Voltage (RST, HRDY, MOSI, MISO, SCK, CS1-CS4)	V _{LOG_H}	2.9	3.3	-	V
Logic Signals Low State Voltage (RST, HRDY, MOSI, MISO, SCK, CS1-CS4)	V _{LOG_L}	-	0	0.4	V
Operating temperature	T _{op_4bit}	0	-	50	°C
Supply Current (Conditions: 5V supply, screen change, mode 2, USB)	I _{IN}	-	0.13	0.43	A
Power consumption (Conditions: 5V supply, screen change, mode 2, USB)	P _{IN}	-	0.62	2.1	W
Screen change energy consumption (Conditions: 5V supply, mode 2, USB)	E _{IN_SC}	-	0.13	-	mWh
Sleep current (Conditions: 5V supply, USB)	I _{sleep}	-	54	84	mA

Table 7.1 - Electrical Characteristics

Note 7.1 For USB electrical characteristics, refer to the USB 2.0 specification.

8 Optical characteristics

Measurement made in the following conditions. Temperature 25 °C and illumination under 45 degrees angle. Detector positioned perpendicular to display surface. The contrast ratio value is the ratio between the reflectance in the entire white area and the reflectance in the fully dark area.

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Reflectance	R	White	35	45	-	%
Contrast Ratio	CR	-	10	16	-	-

Table 8.1 - Optical parameters

9 Reliability Tests of Display

Item	Test	Condition	Method
1	High Temperature Operation	T = +50°C, RH = 30% for 240 hrs	IEC 60 068-2-2Bp
2	Low-Temperature Operation	T = 0°C for 240 hrs	IEC 60 068-2-2Ab
3	High-Temperature Storage	T = +70°C, RH = 23% for 240 hrs	IEC 60 068-2-2Bp
4	Low-Temperature Storage	T = -25°C for 240 hrs	IEC 60 068-2-1Ab
5	High Temperature, High Humidity Operation	T = +40°C, RH = 90% for 168 hrs	IEC 60 068-2-3CA
6	High-Temperature, High-Humidity Storage	T = +60°C, RH = 80% for 240 hrs	IEC 60 068-2-3CA
7	Temperature Cycle	-25°C (30min) -> +70°C (30min), 100 Cycles	IEC 60 068-2-14
8	Solar radiation test	765W/m ² for 168hrs, 40°C	IEC 60 068-2-5Sa

Table 9.1 Reliability Test of Display

10 TFT Panel

The USEC133SBSUSN is driven by one TFT panel. Figure 10.1 shows the scan directions for the gate and source.

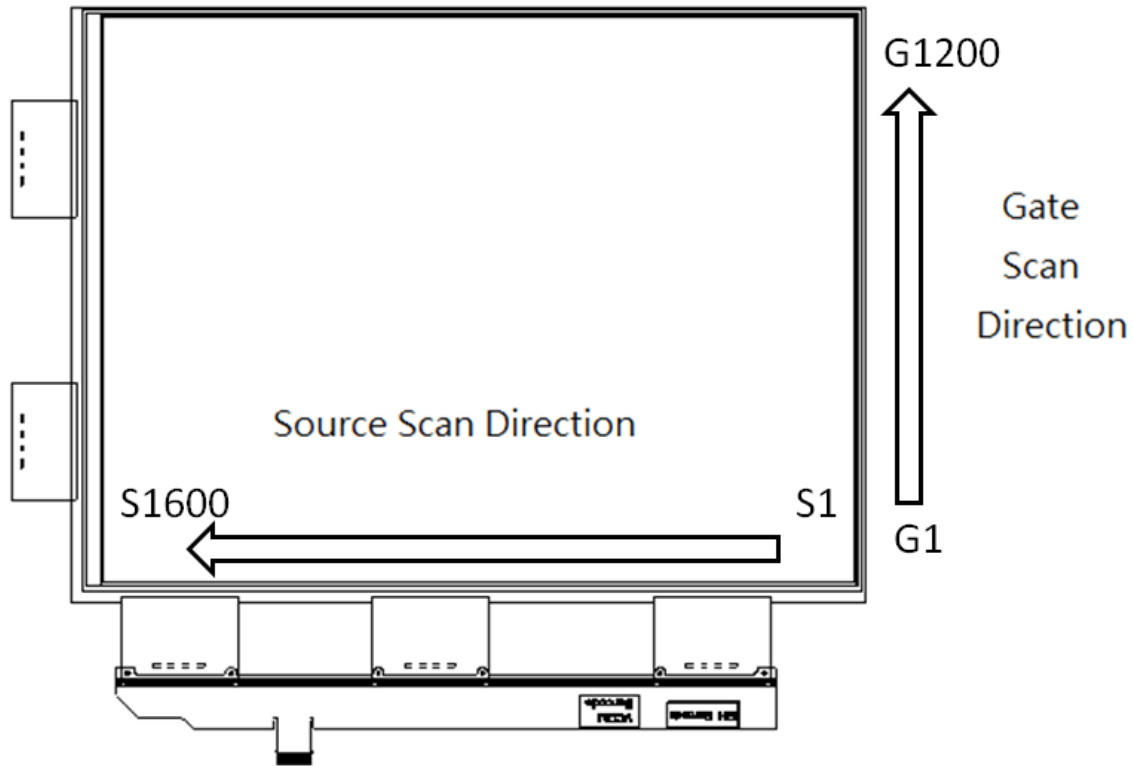


Figure 10-1 - Scan directions of display

11 Display modes

USEC133SBSUSN has six modes of displaying the content. For more information, please see "RP117D1 – Application Guide".

Mode	Name	Description	Type
0	INIT	Initialize	Global
1	DU	Direct update (black and white only)	Local
2	GC16	Grayscale Clear 16 levels	Global
3	GL16	Grayscale Clear 16 levels	Global
4	A2	Animation, 2 levels	Local
5	DU4	Direct update, 4 levels	Local

Table 11.1 - Display modes

12 Power Sequence

It is recommended to wait at least 7 ms between turning the power on and setting the RST line to a high state (simplified graph in figure 12.1).

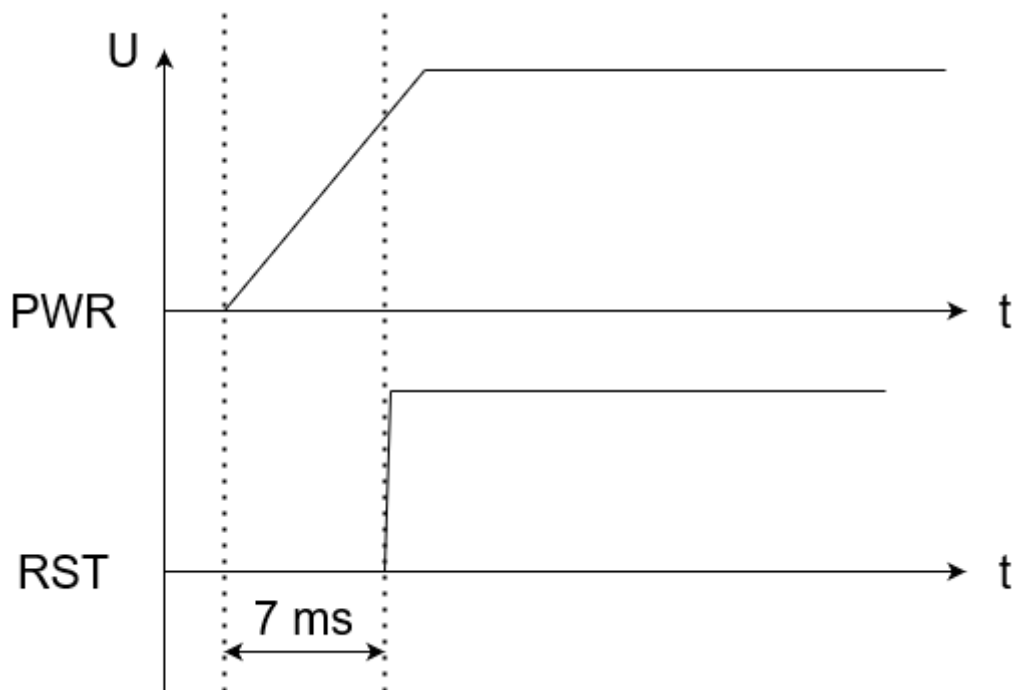


Figure 12-1 Power sequence

13 SPI Timing

Figure 13.1 presents the SPI Timing diagram:

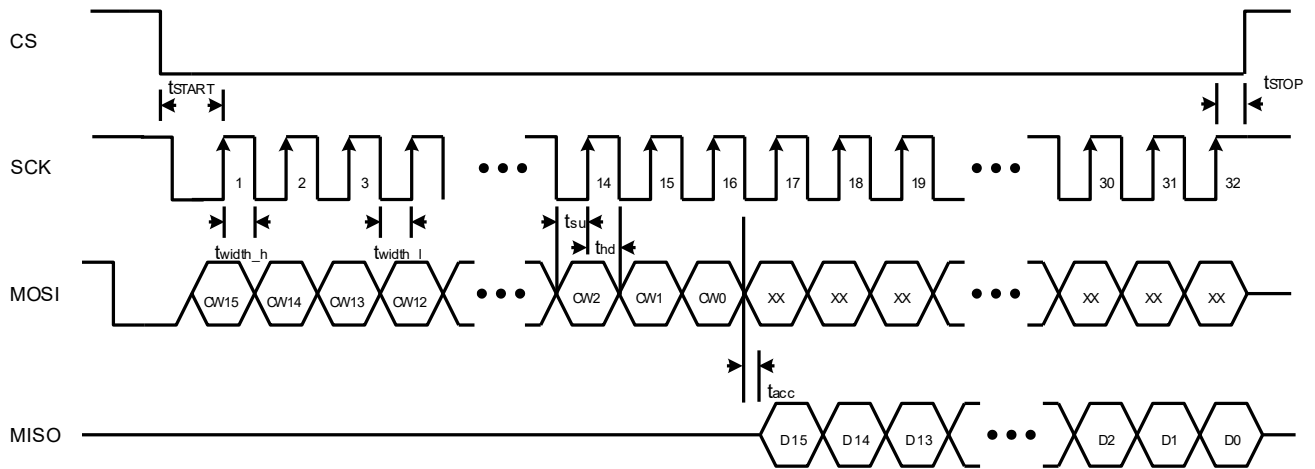


Figure 13-1 - SPI Timing diagram

Table 13.1 presents the values of timing parameters:

Symbol	Parameter	Min	Max	Unit
t_{START}	CS falling to SCK rising edge	10	-	ns
t_{STOP}	SCK rising to CS rising edge	10	-	ns
t_{width_h}	SCK high pulse width	20	-	ns
t_{width_l}	SCK low pulse width	20	-	ns
t_{su}	MOSI to SCK setup time	10	-	ns
t_{hd}	MOSI to SCK hold time	10	-	ns
t_{acc}	MISO access time after SCK falling edge	-	20	ns

Table 13.1 - SPI Timing values

14 Precautions

Please, pay attention to the following precautions while using the USEC133SBSUSN.

14.1 Handling

- 1) Handle with care. The display glass may break when dropped or bumped on a hard surface. Please, avoid bending the module and applying uneven force to the display. Do not hit the module with sharp-edged or hard objects.
- 2) Do not touch, push or rub the exposed display with tweezers, glass or other sharp objects. Do not rub with dust clothes with chemical treatment and do not touch the surface of the protective sheet with a bare hand or greasy cloth. Some cosmetics also can worsen the protective sheet.
- 3) When the display surface becomes dusty, it can be wiped with absorbent cotton or other soft materials like chamois soaked with petroleum benzene.
- 4) IPA solvent can be applied to the active area and the back of a glass, but it shouldn't be used for other display parts.
- 5) Acetic acid type and chlorine type materials should not be applied to the cover.
- 6) In case of getting saliva or water drops onto the display, wipe them off as soon as possible. Their long-time contact with a protective sheet can cause deformations and color fading

- 7) It is recommended to attach a transparent protective plate to the display surface to protect the EPD. The transparent protective plate should have sufficient strength to resist an external force.

14.2 Storage and Operation

- 1) The module should be stored and operated in suggested temperature ranges. A heat dissipation structure can be adapted to satisfy the temperature specification.
- 2) The module should be stored and operated in an environment without abrupt changes in the conditions.
- 3) The module should not be exposed to harmful gases, such as acid and alkali gases, which can cause corrosion of electronic components.
- 4) Do not pull the interface connector in or out while the module operates.

14.3 Others

- 1) The product meets the specification requirement of the RoHS standard criteria.
- 2) Avoid applying high voltage and static discharges to the module.
- 3) Keep the module's surface clean for good optical characteristics.
- 4) If the display breaks, do not touch the electrophoretic material. In case of contact with electrophoretic material, use water and soap to remove particles from the skin.

15 Quality Standards for Inspection

15.1 Inspection condition

The inspection should be conducted within the viewing angle range.

$\alpha = \pm 45^\circ$ inspection under non-operating condition.

$\alpha = \pm 45^\circ$ inspection under operating condition.

Viewing Distance:	30 +/- 10cm
Ambient Luminance:	1000lux~1300lux
Temperature:	23±5°C
Humidity:	40-70%RH

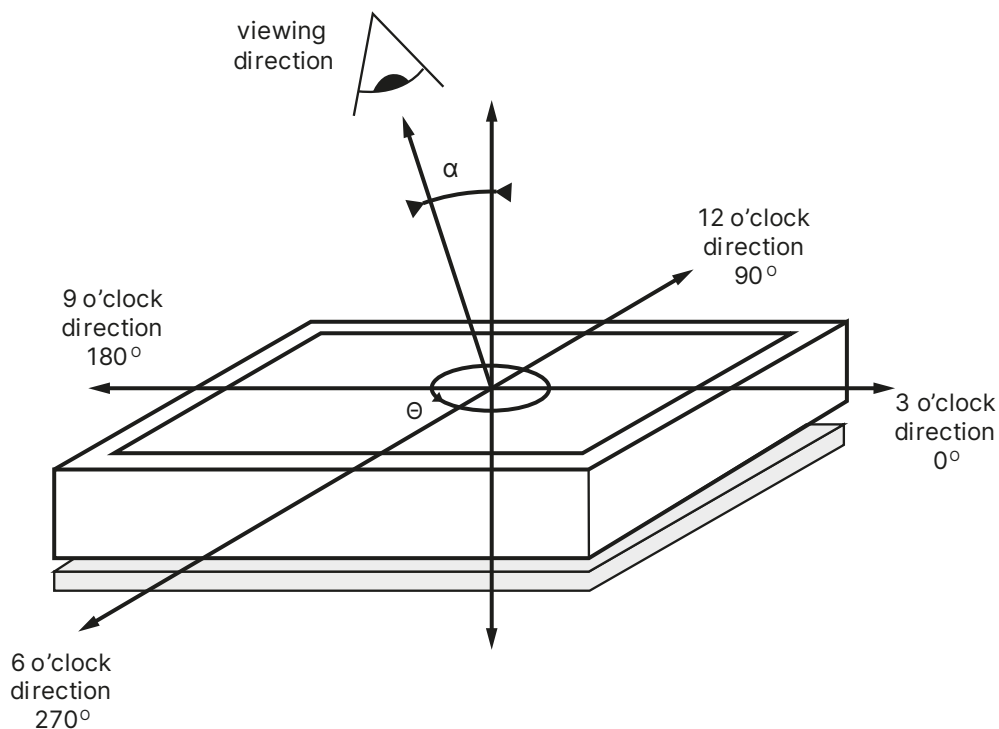


Figure 15-1 Inspection conditions

15.2 Sampling Method

Lot size:	Quantity of shipment lot per model.
Sampling type:	Normal inspection, single sampling.
Inspection Level:	Level II
Sampling table:	ISO2859 (Also known as MIL-STD 105E II)
Acceptance Quality Level (AQL)	
	Major defect: 0.65
	Minor defect: 1.5

15.2.1 Classification of defects

Defects are classified as either major or minor defects defined below.

15.2.1.1 Major defect

A major defect is a defect that is likely to result in failure or to reduce materially the usability of the product for its intended purpose.

15.2.1.2 Minor defect

A minor defect is either a defect that is not likely to reduce materially the usability of the product for its intended purpose or a stray from an intended purpose with little bearing on the effective usage.

15.3 Zone Definition

- A Zone: Active area
- B Zone: Non-Active area

For precise dimensions, please see chapter 3 Mechanical drawing.

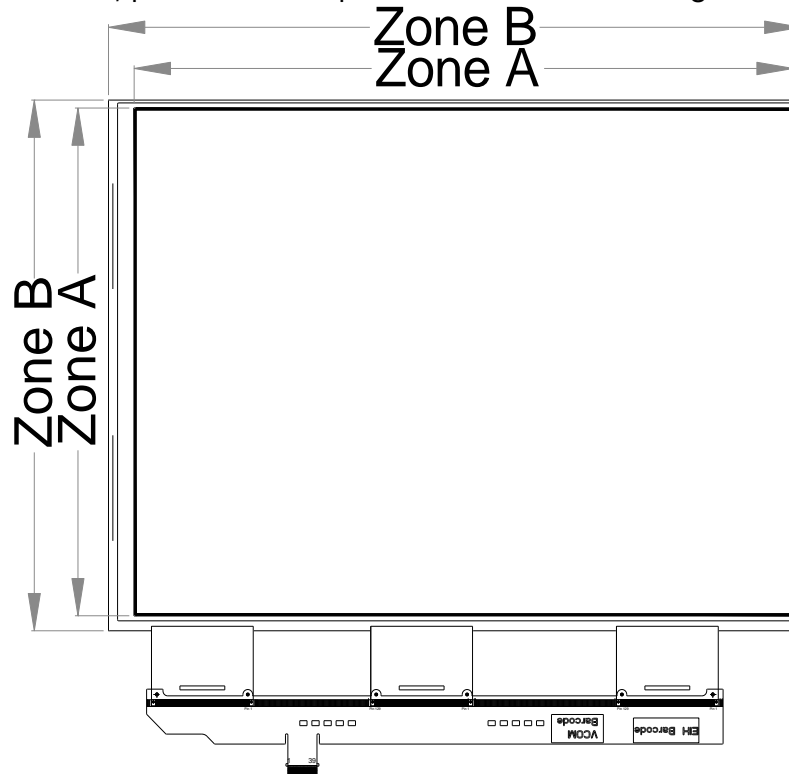


Figure 15-2 Zone Definition

15.4 Cosmetic Defects and Classification.

The cosmetic defects solely mean the items listed below.

15.4.1 Major Defects

Item	Description
No display	No display shows on screen due to malfunction
Line defect	Line missing or unusual appear when display
Abnormal display	Unusual pattern displayed

Table 155.15.1 Major Defects definition.

15.4.2 Minor Defects

15.4.2.1 General Minor defects

Name	Cause	Criteria	Zone A	Zone B
Spot	Contamination in module	Spot dimension		
		D ≤ 0.35 mm	Ignore	Ignore
		0.35 mm < D ≤ 0.6 mm	10	
D > 0.6 mm	0			
Scratch or line defect	Scratch on module	Scratch/line dimension		
		L ≤ 2.0 mm and W ≤ 0.2 mm	Ignore	Ignore
		2 < L ≤ 10.0 mm or 0.2 < W ≤ 0.5 mm	8	
L > 8.0 mm or W > 0.5 mm	0			
Air bubble or aggregation	Air bubble	Air bubble/aggregation dimension		
		D ≤ 0.5 mm	Ignore	Ignore
		0.5 mm < D ≤ 1.0 mm	8	
D > 1.0 mm	0			

Table 155.15.2 General Minor defects definition.

Notes:

- Any defect visible under the grey pattern or transition process but invisible under black and white is disregarded.
- Definition of the "Spot" and "Scratch or line defect"
 - Spot: $W > 1/4L$
 - Scratch or line defect: $W \leq 1/4L$
- Dimension definition for each defect from table 14.2

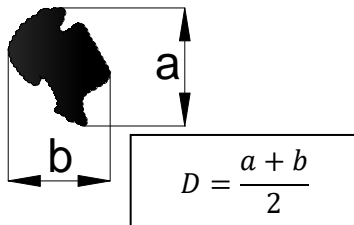


Figure 15-3 Spot dimension definition.

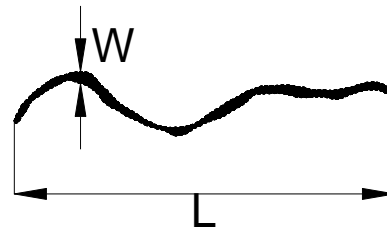


Figure 15-4 Scratch or line defect dimension definition.

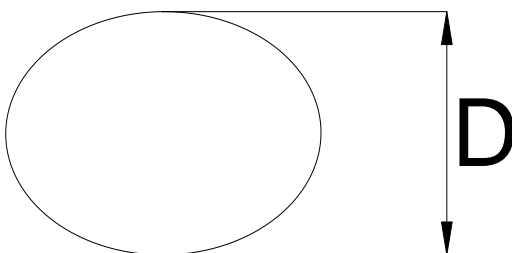


Figure 15-5 Big air bubble dimension definition.

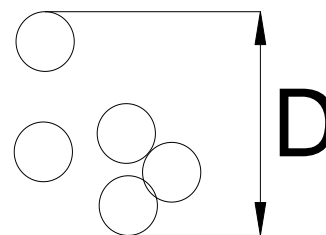


Figure 15-6 Air bubble aggregation dimension definition.

15.4.2.2 Curl of Panel

Lifts of the edge of the module from a flat surface. Curl's dimension definition:

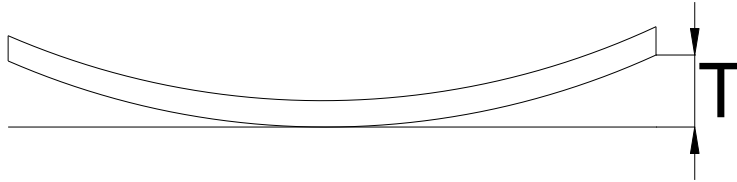


Figure 15-7 Curl dimension definition.

Acceptance criteria $T \leq 4\text{mm}$.

15.4.2.3 Glass Chipping and Crack.

Item	Criteria	Number	Note
Chipping	$W \leq 10\text{ mm}$	$L \leq 1.0\text{ mm}$	Negligible
		$L > 1.0\text{ mm}$	None
	$W > 10\text{ mm}$	None	
Chipping on the corner	See figure 15.9		
Crack ²	-	None	V-shaped chipping included

Table 15.3 Glass and chipping defects definition

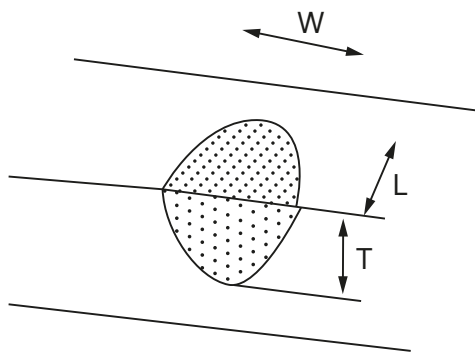


Figure 15-8 Chipping dimension definition.

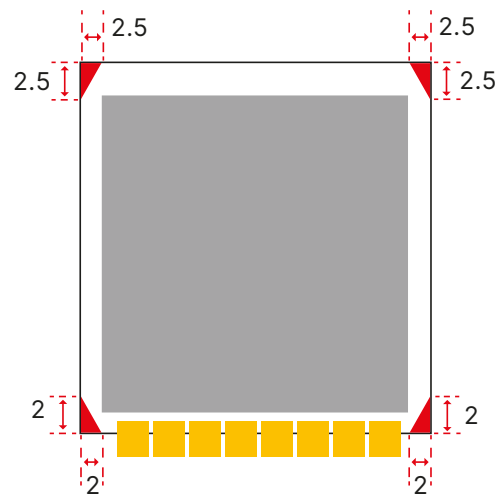


Figure 15-9 Chipping on the corner acceptance criteria.

² Crack is defect that will progress further.

16 Contact Information

unisystem

UNISYSTEM SP. Z O.O.

Nowy Świat 36
80-299 Gdańsk
Poland

+48 58 761 54 20
office@unisystem.pl

*UE VAT No:
PL5842741076*