

 <i>Good Display</i>	EPAPER SPECIFICATIONS	SPEC NO	
	GDEW012	REV NO	

Good Display Specifications



Dalian Good Display Co., Ltd.

No.17 Gonghua Street, Shahekou District, Dalian 116021 China

Tel: +86-411-84619565 Fax: +86-411-84619585

E-mail: info@good-lcd.com.cn

Website: www.good-display.com

**Product Specification****Revision History**

Rev.	Issued Date	Revised Contents
1.0	Dec.11.2014	Preliminary
1.1	Oct.09.2015	1. In part 14: Modify point and line standard.
1.2	Nov.02.2015	1. In part 11-1): Modify update 100000 times to 1000000 times. 2. In part 13: Modify reliability test.



TECHNICAL SPECIFICATION

CONTENTS

NO.	ITEM	PAGE
-	Cover	1
-	Revision History	2
-	Contents	3
1	Overview	4
2	Features	4
3	Mechanical Specifications	4
4	Mechanical Drawing of EPD module	5
5	Segment mapping vs IC output pins	6
6	Input/Output Terminals	7
7	Command Table	8
8	Electrical Characteristics	14
9	MCU Serial Interface (3-wire SPI)	16
10	Waveform	17
11	Optical characteristics	18
12	Handling, Safety and Environment Requirements	20
13	Reliability test	21
14	Point and line standard	22
15	Packing	23



Product Specification

1. Overview

This 1.2 inch display is a segment display which use the flexible substrate as base plate. The 1.2" display's active area contains 57 segments and 1 background and 1 Vcom and 1bit full display capabilities.

2. Features

- High contrast
- High reflectance
- Ultra wide viewing angle
- Ultra low power consumption
- Pure reflective mode
- Bi-stable

3. Mechanical Specifications

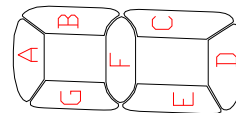
Parameter	Specifications	Unit	Remark
Screen Size	1.2	Inch	
Display content	57SEG+1BG+1VCOM	segment	
Active Area	29.94(H)×6.09(V)	mm	
Outline Dimension	42.50(H)×11.10(V) ×0.40(D)	mm	
Weight	TBD	g	



4. Mechanical Drawing of EPD module



5. Segment mapping vs IC output pins

[illegible]

Scale 2/1

**Product Specification****6. Input/Output Terminals****6-1) Pin out list**

Pin #	Type	Single	Description	Remark
1	C	VDL	Negative driving voltage pins	
2	C	VDH	Positive driving voltage pins	
3		GND	Ground	
4		VDD	Power Supply pin for the chip t	
5	I	SHD_N	Charge pump enable pin. Low shut down	
6	I	RST_N	Reset pin	
7	I/O	SDA	Serial data pin (SPI)	
8	O	SCL	Serial clock pin (SPI)	
9	I	CSB	Chip Select input pin	
10	O	BUSY_N	Busy state output pin	



Product Specification

7. Command Table

W/R: 0: Write cycle / 1: Read cycle

D7~D0: -: Don't Care

#: valid data

#	Command	R/W	D/CX	D7	D6	D5	D4	D3	D2	D1	D0	Default
1	Panel Setting (PSR)	0	0	0	0	0	0	0	0	0	0	00h
		0	1	BWR	-	-	-	VDLH_EN	DDX	SHD_N	RST_N	8Fh
2	Power Setting (PWR)	0	0	0	0	0	0	0	0	0	1	01h
		0	1	-	-	-	-	-	-	VDL_EN	VDH_EN	03h
3	Power OFF (POF)	0	0	0	0	0	0	0	0	1	0	02h
		0	1	-	-	-	-	-	-	SGM_FL	VCOM_FL	03h
4	Power ON (PON)	0	0	0	0	0	0	0	1	0	0	04h
5	Data Start Transmission (DTM) (14-byte command)	0	0	0	0	0	1	0	0	0	0	10h
		0	1	Pixel1	Pixel2	Pixel3	Pixel4	Pixel5	Pixel6	Pixel7	Pixel8	00h
		0	1	..	..	..	..	..	..	..	..	00h
		0	1	Pixel33	Pixel34	Pixel35	Pixel36	Pixel37	Pixel38	Pixel39	Pixel40	00h
		0	1	Pixel41	Pixel42	Pixel43	Pixel44	0	0	0	0	00h
		0	1	Pixel49	Pixel50	Pixel51	Pixel52	Pixel53	Pixel54	Pixel55	Pixel56	00h
		0	1	..	..	..	..	..	..	..	..	00h
		0	1	Pixel89	Pixel90	Pixel91	Pixel92	Pixel93	Pixel94	Pixel95	Pixel96	00h
		0	1	BG	-	-	-	-	-	-	-	00h
6	Data Stop (DSP)	0	0	0	0	0	1	0	0	0	1	11h
		1	1	data_flag	-	-	-	-	-	-	-	--
7	Display Refresh(DRF)	0	0	0	0	0	1	0	0	1	0	12h
8	Vcom Lut(LUTV) (16-byte command, Bytes 2~4 repeated 5 times)	0	0	0	0	1	0	0	0	0	0	20h
9	Black LUT (LUTB) (16-byte command, bytes 2~4 repeated 5 times)	0	0	0	0	1	0	0	0	0	1	21h
10	White LUT (LUTW) (16-byte command, bytes 2~4 repeated 5 times)	0	0	0	0	1	0	0	0	1	0	22h
11	PLL control (PLL)	0	0	0	0	1	1	0	0	0	0	30h
		0	1	-	-	-	-	-	P2	P1	P0	03h
12	Temperature Sensor (TSC)	0	0	0	1	0	0	0	0	0	0	40h
		1	1	-	-	-	-	TS3	TS2	TS1	TS0	--
13	Revision (REV)	0	0	0	1	1	1	0	0	0	0	70h
		1	1	0	0	0	0	0	0	0	0	00h
14	Get Status (FLG)	0	0	0	1	1	1	0	0	0	1	71h
		1	1	0	0	0	0	Data_Flag	PON	POF	Busy_N	02h



Product Specification

- Note: (1) All other register addresses are invalid or reserved by UltraChip, and should NOT be used.
- (2) Any bits shown here as 0 must be written with a 0. All unused bits should also be set to zero. Device malfunction may occur if this is not done.
- (3) Command are processed on the 'stop' condition of the interface.
- (4) Registers marked 'W/R' can be read, but the contents are written when the SPI command completes-so the contents can be read and altered. The user can subsequently write the register to restore the contents following an SPI read.
- (5) All registers are accessible only when BUSY_N=1; except R04h for Power ON (PON), which is accessible either when BUSY_N=0 or 1.



Product Specification

Command Description

W/R: 0: Write cycle / 1: Read cycle

D/CX: 0: Write cycle / 1: Read cycle

D7~D0: -: Don't Care

(1) Panel Setting (PSR) (Register: R00h)

Action	W/R	D/CX	D7	D6	D5	D4	D3	D2	D1	D0
Setting the Panel	0	0	0	0	0	0	0	0	0	0
	0	1	BWR	-	-	-	VDLH_EN	DDX	SHD_N	RST_N

BWR: 0: select red

1: select black/white (default)

VDLH_EN: 0: external VDL/VDH power from VDL/VDH pin respectively

1: generate VDL/VDH using internal charge pump (default)

DDX: 0: 'data 0: white, data 1: black'

1: 'data 0: black, data 1: white' (default)

SHD_N: 0: Charge pump OFF

1: Charge pump ON (default)

When SHD_N become LOW, charge pump will be turned OFF, register and SRAM data will keep until VDD OFF, and SD output and VCOM will remain previous condition. It may have two conditions: 0v or floating.

RST_N: 0: The controller is reset. Reset all registers to default value.

1: No effect (Default)

When RST_N become LOW, the driver will be reset, all registers will be reset to their default value. All driver functions will be disabled. SD output and VCOM will base on previous condition. It may have two conditions: 0v or floating.

This command only active when BUSY_N = "1".

(2) Power Setting (PWR) (R01h)

Action	W/R	D/CX	D7	D6	D5	D4	D3	D2	D1	D0
Selecting	0	0	0	0	0	0	0	0	0	1
Internal/External	0	1	-	-	-	VDH_LV[4:0]				
Power	0	1	-	-	-	VDL_LV[4:0]				

VDH_LV: Internal VDH power selection.

VDL_LV: Internal VDL power selection.

VDH_LV,VDL_LV	VDL	VDH	VDH_LV,VDL_LV	VDL	VDH
00000 b	2.75	5.50	01111(Default)	3.50	7.00
00001	2.80	5.60	10000	3.55	7.10
00010	2.85	5.70	10001	3.60	7.20
00011	2.90	5.80	...	...	...
00100	2.95	5.90	11001	4.00	8.00
...	...	...	(others)	3.50	7.00

This command only active when BUSY_N="1".

(3) Power OFF(POF) (R02h)

Action	W/R	D/CX	D7	D6	D5	D4	D3	D2	D1	D0
Turning OFF the power	0	0	0	0	0	0	0	0	1	0
	0	1	-	-	-	-	-	-	SGM_FL	VCOM_FL

After power off command, the driver will power off base on power off sequence, BUSY_N will become "0", Power OFF command will turn off charge pump, T-con, source driver, gate driver, VCOM, and temperature sensor, but register data will be kept until VDD becomes OFF.



Product Specification

SGM_FL: SEGMENT & BG power selection.

0: SEGMENT & BG: floating when power OFF

1: SEGMENT & BG: Ground when power OFF. (Default)

VCOM_FL: VCOM power selection.

0: COM floating when power OFF

1: COM ground when power OFF. (Default)

This command only active when BUSY_N = "1".

(4) Power ON (PON) (Register: R04h)

Action	W/R	D/CX	D7	D6	D5	D4	D3	D2	D1	D0
Turning ON the power	0	0	0	0	0	0	0	1	0	0

After the Power ON command, the driver will be powered ON following the Power ON Sequence.

After the Power ON command and all power sequence are ready, the BUSY_N signal will become "1".

Please refer to the Power ON Sequence section.

(5) Data Start Transmission (DTM) (R10h)

Action	R/W	D/CX	D7	D6	D5	D4	D3	D2	D1	D0
Start Data Transmission (14-byte command)	0	0	0	0	0	1	0	0	0	0
	0	1	Pixel1	Pixel2	Pixel3	Pixel4	Pixel5	Pixel6	Pixel7	Pixel8
	0	1	..	..	..	..	..	..	..	..
	0	1	Pixel33	Pixel34	Pixel35	Pixel36	Pixel37	Pixel38	Pixel39	Pixel40
	0	1	Pixel41	Pixel42	Pixel43	Pixel44	0	0	0	0
	0	1	Pixel49	Pixel50	Pixel51	Pixel52	Pixel53	Pixel54	Pixel55	Pixel56
	0	1	..	..	..	..	..	..	..	..
	0	1	Pixel89	Pixel90	Pixel91	Pixel92	Pixel93	Pixel94	Pixel95	Pixel96
	0	1	BG	-	-	-	-	-	-	-

The register starts to transmit data and write to SRAM. To complete data transmission, command DSP (Data transmission Stop) must be issued. Then the chip will start to send data/VCOM for panel.

This command only active when BUSY_N = "1".

(6) Data Stop (DSP) (R11h)

Action	W/R	D/CX	D7	D6	D5	D4	D3	D2	D1	D0
Stopping data transmission	0	0	0	0	0	1	0	0	0	1
	0	1	data_flag	-	-	-	-	-	-	-

To stop data transmission, this command must be issued to check the data_flag.

Data_flag: Data flag of receiving user data.

0: Driver didn't receive all the data.

1: Driver has already received all the one frame data. BUSY_N

While user sent this command, the IC will refresh the display (data/VCOM) according to SRAM data and LUT. This command only active when BUSY_N = "1". After data start (10h) and data stop (11h) command, BUSY_N signal will become "0".



Product Specification

(7) Display Refresh (DRF) (R12h)

Action	W/R	D/CX	D7	D6	D5	D4	D3	D2	D1	D0
Refreshing the display	0	0	0	0	0	1	0	0	1	0

While user sent this command, driver will refresh display (data/VCOM) according to SRAM data and LUT. The IC behaves differently, depending on the driver state.

This command only active when BUSY_N = "1". After display refresh command, BUSY_N signal will become "0".

(8)Vcom LUT (LUTV) (R20h)

Action	W/R	D/CX	D7	D6	D5	D4	D3	D2	D1	D0
Building Look-up table for Vcom (16-byte command, bytes 2~4 repeated 5 times)	0	0	0	0	1	0	0	0	0	0

(9) Black LUT (LUTB) (R21h)

Action	W/R	D/CX	D7	D6	D5	D4	D3	D2	D1	D0
Building Looking up table for Black (16-byte command, bytes 2~4 repeated 5 times)	0	0	0	0	1	0	0	0	0	1

(10) White LUT(LUTW) (R22h)

Action	W/R	D/CX	D7	D6	D5	D4	D3	D2	D1	D0
Building Looking up table for White (16-byte command, bytes 2~4 repeated 5 times)	0	0	0	0	1	0	0	0	1	0

(11) PLL control (PLL) (R30h)

Action	W/R	D/CX	D7	D6	D5	D4	D3	D2	D1	D0
Controlling PLL	0	0	0	0	1	1	0	0	0	0
	0	1	-	-	-	-	-	P2	P1	P0

The command controls the PLL clock frequency. The PLL structure must support follow frame rate:

P[2:0]: Frame rate.

P[2:0]	Frame rate
000b	10Hz
001b	20Hz
010b	40Hz
011b	50Hz. (default)

P[2:0]	Frame rate
100b	60Hz
101b	70Hz
110b	80Hz
111b	100Hz

This command only active when BUSY_N = "1".

**Product Specification****(12) Temperature Sensor (TSC) (R40h)**

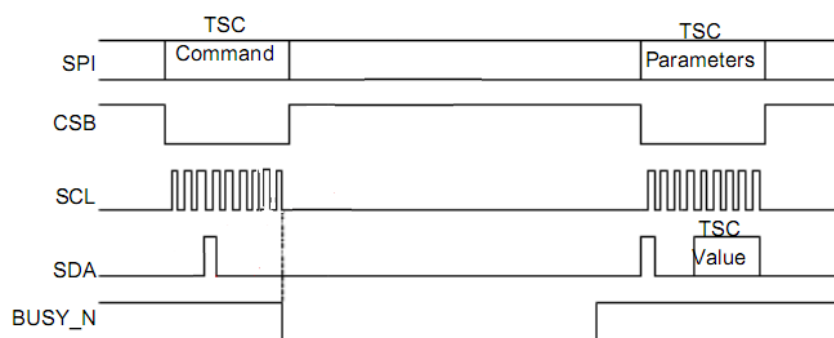
Action	W/R	D/CX	D7	D6	D5	D4	D3	D2	D1	D0
Sensing Temperature	0	0	0	1	0	0	0	0	0	0
	1	1	-	-	-	-	TS3	TS2	TS1	TS0

This command reads the temperature sensed by the temperature sensor.

TS[3:0]: Temperature

TS[3:0]	Temperature
0000b	0°C
0001b	5°C
0010b	10°C
0011b	15°C
:	:
1010b	50°C

This command only active when BUSY_N = "1". BUSY_N becomes LOW after TSC command.

**(13) Revision (REV) (R70h)**

Action	W/R	D/CX	D7	D6	D5	D4	D3	D2	D1	D0
Chip revision	0	0	0	1	1	1	0	0	0	0
	1	1	0	0	0	0	0	0	0	0

This command only active when BUSY_N = "1". Default: 00h

(14) Get Status (FLG) (71h)

Action	W/R	D/CX	D7	D6	D5	D4	D3	D2	D1	D0
Read Flags	0	0	0	1	1	1	0	0	0	1
	1	1	0	0	0	TS_ON	Data_Flag	PON	POF	Busy_N

Data_Flag: Data flag. 1-All data are received.

PON: 1 - Power is ON.

POF: 1 - Power is OFF.

Busy_N: 1 - Busy. (Default: 1)



Product Specification

8. Electrical Characteristics

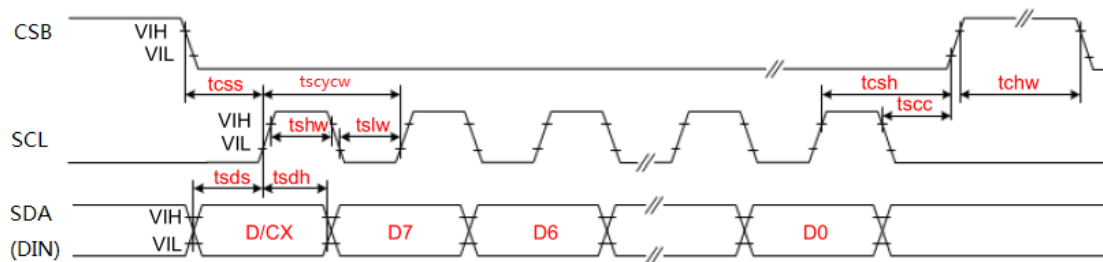
8-1) Absolute maximum rating

Parameter	Symbol	Rating	Unit
Supply voltage	V _{DD}	-0.3 ~ +7.0	V
HV positive supply voltages	V _{DH}	-0.3 ~ +12	V
LV positive supply voltages	V _{DL}	-0.3 ~ +12	V
Operating Temp. range	T _{OPR}	0 to +50	°C
Storage Temp. range	T _{STG}	-25 to +70	°C

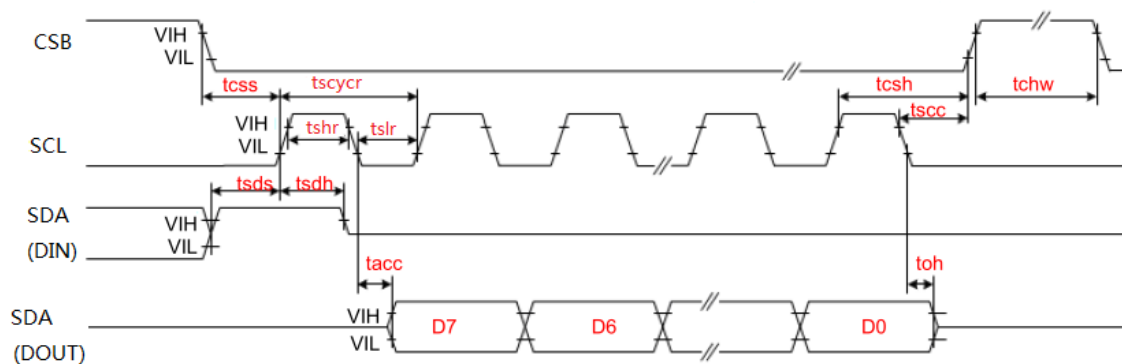
8-2) Panel DC Characteristics

V_{IO} = 2.3~3.6 V

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Power Supply voltage	VDD	-	2.3	3.3	3.6	V
High level input voltage	VIH	-	0.7 V _{IO}	-	V _{IO}	V
Low level input voltage	VIL	-	0	-	0.3V _{IO}	V
High level output voltage	VOH	IO= 1mA	-	-	0.4	V
Low level output voltage	VOL	IO= -1mA	V _{IO} -0.4	-	-	V
Image update current	I _{update}	-	0.1	-	1.2	mA
power panel (update)	P _{update}	-	0.33	-	4.0	mW
Operating temperature	-	-	0	-	50	°C
Sleep current	-	-	-	1.2	5	uA
Storage temperature	-	-	-25	-	70	°C
Image update time at 25°C	-	-	1.5	-	4	Sec

**Product Specification****8-3) Panel AC Characteristics**

3-wire Serial Interface – Write



3-wire Serial Interface – Read

VDD = 2.0~3.6V

Signal	Symbol	Parameter	Min	Typ	Max	Unit
CSB	tcss	Chip Select Setup Time	60	-	-	ns
	tcsh	Chip Select Hold Time	65	-	-	ns
	tscc	Chip Select Setup Time	20	-	-	ns
	tch	Chip Select Setup Time	40	-	-	ns
SCL	tscyc	SCL clock cycle time	150/100	-	-	ns
	tsh	SCL “H” pulse width	60/35	-	-	ns
	tsl	SCL “L” pulse width	60/35	-	-	ns
SDA	tsds	Data setup time	30	-	-	ns
	tsdh	Data hold time	30	-	-	ns
	tacc	Access time	10	-	-	ns
	toh	Output disable time	15	-	-	ns



9. MCU Serial Interface (3-wire SPI)

The 3-wire serial interface consists of serial clock SCL, serial data SDA and CSB.

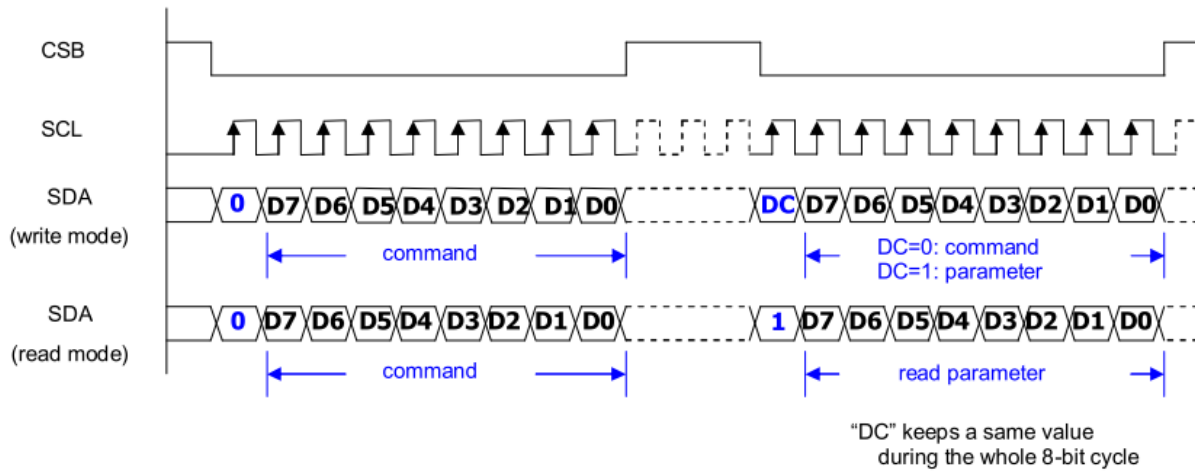


Figure 9-1: Write procedure in 3-wire Serial Peripheral Interface mode



Product Specification

10. Waveform

10-1) Two level voltage input waveform

For every batch of EPD the waveform data is different, so you may receive the waveform LUT from Good Display. You just need to use the follow sequence to download the waveform into driver IC.

sequence	command	Action Description	remark
1	04	Power on	Send cmd 04
2	20	VCOM LUT Setting	Send cmd 20 data lut_vcom0[]
3	21	White LUT Setting	Send cmd 21 data lut_w[]
4	22	Black LUT Setting	Send cmd 22 data lut_b[]

Note: To download the waveform into driver ic, you must send command 04 first, then send 20, 21, 22 command.

The data of lut_vcom0[], lut_w[], lut_b[], each batch of EPD is different. Good Display will support the data after you receive the EPD.



Product Specification

11. Optical characteristics

11-1) Specifications

Measurements are made with that the illumination is under an angle of 45 degrees, the detection is perpendicular unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN	TYPE	MAX	UNIT	Note
R	Reflectance	White	30	35	-	%	Note 11-1
Gn	2Grey Level	-	-	$DS+(WS-DS) \times n(m-1)$	-	L*	-
CR	Contrast Ratio	indoor	8		-	-	-
Panel's life		0°C~50°C		1000000 times or 5 years			Note 11-2

WS: White state, DS: Dark state

Gray state from Dark to White : DS、WS

m: 2

Note 11-1: Luminance meter: Eye – One Pro Spectrophotometer

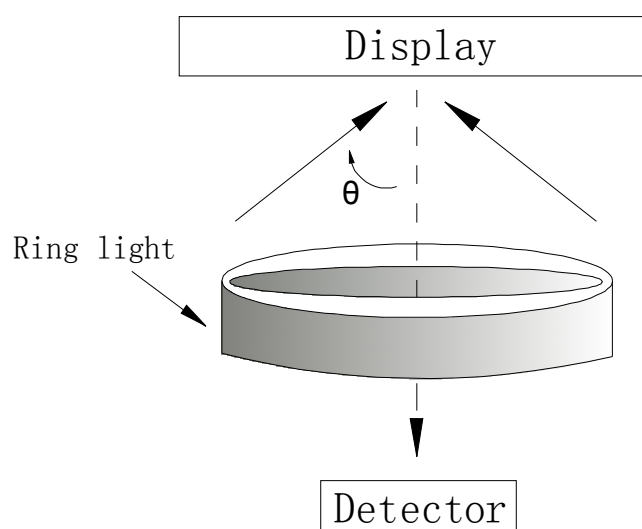
Note 11-2: When work in temperature below 0 degree or above 50 degree, we do not recommend because the panel's life will not be guaranteed. Each update interval time should be minimum at 180 seconds.

11-2) Definition of contrast ratio

The contrast ratio (CR) is the ratio between the reflectance in a full white area (R1) and the reflectance in a dark area (Rd) :

R1: white reflectance Rd: dark reflectance

$CR = R1/Rd$





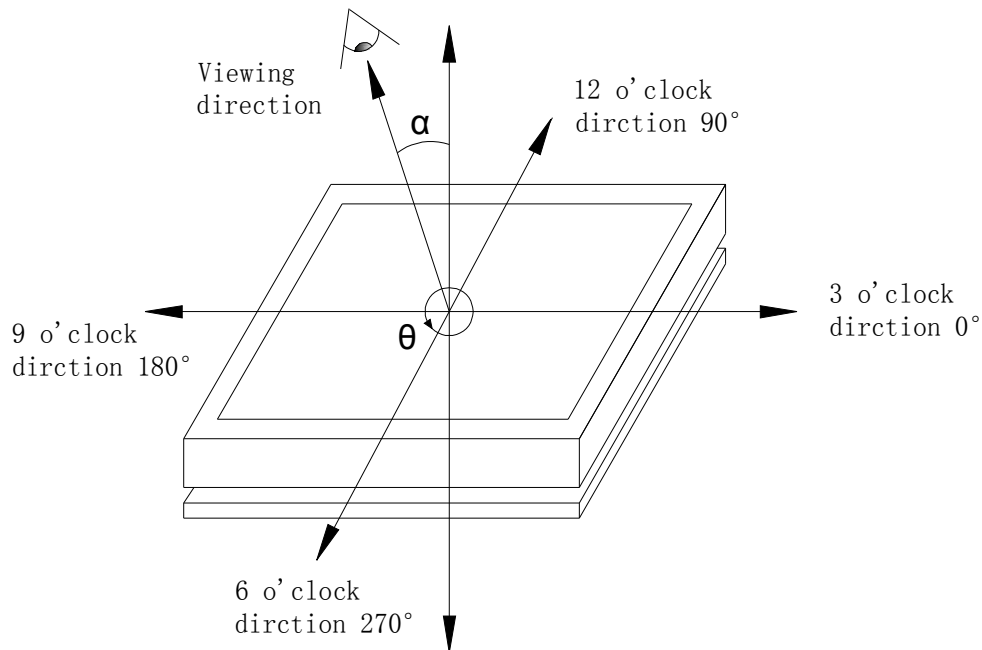
Product Specification

11-3) Reflection Ratio

The reflection ratio is expressed as:

$$R = \text{Reflectance Factor}_{\text{white board}} \times (L_{\text{center}} / L_{\text{white board}})$$

L_{center} is the luminance measured at center in a white area ($R=G=B=1$). $L_{\text{white board}}$ is the luminance of a standard white board. Both are measured with equivalent illumination source. The viewing angle shall be no more than 2 degrees.



11-4) Bi-stability

The Bi-stability standard as follows:

Bi-stability	Result		
		AVG	MAX
24 hours Luminance drift	White state ΔL^*	-	3
	Black state ΔL^*	-	3

**Product Specification****12. HANDLING, SAFETY AND ENVIRONMENTAL REQUIREMENTS**

WARNING
The display may be injured when it is dropped or bumped on a hard surface or sharp corner. Handle with care, do not touch the electrophoretic material. In case of contact with electrophoretic material, wash with water and soap.

CAUTION
The display module should not be exposed to harmful gases, such as acid and alkali gases, which corrode electronic components.
Disassembling the display module can cause permanent damage and invalidate the warranty agreements.

Observe general precautions that are common to handling delicate electronic components. The front surfaces can easily be damaged. Moreover the display is sensitive to the environmental conditions.

Data sheet status	
Product specification	The data sheet contains final product specifications.
Limiting values	
Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.	
Application information	
Where application information is given, it is advisory and does not form part of the specification.	

Product Environmental certification
RoHS

**Product Specification****13. Reliability test**

	TEST	CONDITION	METHOD	REMARK
1	High-Temperature Operation	T = 50℃, RH=35% for 240 hrs	IEC 60 068-2-2Bp	
2	Low-Temperature Operation	T = 0℃ for 240 hrs	IEC 60 068-2-2Ab	
3	High-Temperature Storage	T = +70℃, RH=35% for 240 hrs Test in white pattern	IEC 60 068-2-2Bp	
4	Low-Temperature Storage	T = -25℃ for 240 hrs Test in white pattern	IEC 60 068-2-2Ab	
5	High Temperature, High-Humidity Operation	T=+40℃, RH=80%for 240 hrs	IEC 60 068-2-3CA	
6	High Temperature, High-Humidity Storage	T=+60℃, RH=80%for 240 hrs Test in white pattern	IEC 60 068-2-3CA	
7	Temperature Cycle	[-25℃ 30mins]→ [+70℃, RH=35% 30mins], 70cycles Test in white pattern	IEC 60 068-2-14NB	
8	UV exposure Resistance	765 W/m ² for 168 hrs, 40℃	IEC 60 068-2-5 Sa	
9	Electrostatic discharge	Machine model: +/-250V, 0 Ω, 200pF	IEC61000-4-2	
10	Package Vibration	1.04G, Frequency : 10~500Hz Direction : X,Y,Z Duration: 1 hours in each direction	Full packed for shipment	
11	Package Drop Impact	Drop from height of 122 cm on Concrete surface Drop sequence: 1 corner, 3 edges, 6 face One drop for each.	Full packed for shipment	

Actual EMC level to be measured on customer application.

Note: The protective film must be removed before temperature test.



Product Specification

14. Point and line standard

Shipment Inseption Standard

Part-A: Active area

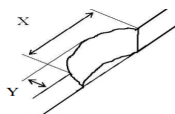
Part-B: Border area

Equipment: Electrical test fixture, Point gauge

Outline demension:

42.50(H)×11.10(V) ×0.40(D)

Unit: mm

Environment	Temperature	Humidity	Illuminance	Distance	Time	Angle
	23 ± 2℃	55 ± 5%RH	1200~1500Lux	300 mm	35 Sec	
Name	Causes	Spot size			Part-A	Part-B
Spot	B/W spot in glass or protection sheet, foreign mat. Pin hole	D ≤ 0.15mm			Ignore	Ignore
		0.15mm < D ≤ 0.25mm			2	
		0.25mm < D			0	
Scratch or line defect	Scratch on glass or Scratch on FPL or Particle is Protection sheet.	Length	Width		Part-A	Ignore
		L ≤ 1.0mm	W ≤ 0.1 mm		Ignore	
		1.0 mm < L ≤ 2.5mm	0.1 mm < W ≤ 0.2mm		2	
		2.5 mm < L	0.2mm < W		0	
Air bubble	Air bubble	D1, D2 ≤ 0.15 mm			Ignore	Ignore
		0.15 mm < D1, D2 ≤ 0.2mm			2	
		0.2mm < D1, D2			0	
Side Fragment						
	X ≤ 3mm, Y ≤ 0.5mm & display is ok, Ignore					

Remarks: Spot define: That only can be seen under WS or DS defects.

Any defect which is visible under gray pattern or transition process but invisible under black and white is disregarded.

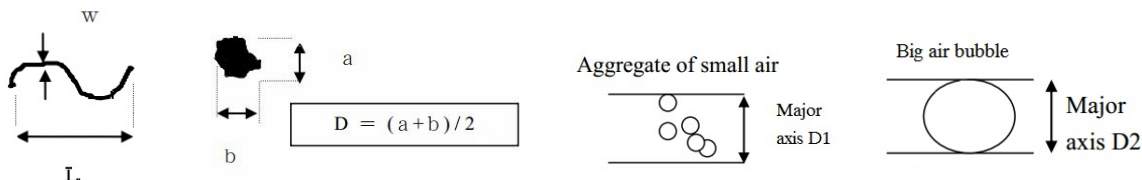
Here is definition of the “Spot” and “Scratch or line defect”.

Spot: $W > 1/4L$

Scratch or line defect: $W \leq 1/4L$

Definition for L/W and D (major axis)

FPC bonding area pad doesn't allowed visual inspection.



Note: AQL = 0.4



15. Packing
TBD