ER-EPD075-1

E-Paper Display Module Datasheet

EastRising Technology Co., Limited

Attention:

A. Some specifications of IC are not listed in this datasheet. Please refer to the IC datasheet for more details.

B. The related documents for interfacing, demo code, IC datasheet are all available, please download from our web.

C. Please pay more attention to "INSPECTION CRITERIA" in this datasheet. We assume you already agree with these criterions when you place an order with us. No more recommendations.

REV	Description	Release Date
1.0	Preliminary Release	Jul-09-2020

CONTENTS

1. ORDERING INFORMATION

1.1 Order Number

Order Number	Description
ER-EPD075-1B	7.5 inch E-Paper (E-ink) Display White/Black Color
ER-EPD075-1Y	7.5 inch E-Paper (E-ink) Display Yelllow/White/Black Color
ER-EPD075-1R	7.5 inch E-Paper (E-ink) Display Red/White/Black Color
ER-EPD075-1-5070	7.5 inch E-Paper (E-ink) Display with Arduino Shield
ER-EPD075-1-5103	7.5 inch E-Paper (E-ink) Display with Raspberry Pi HAT

1.2 Image

ER-EPD075-1B ↓

ER-EPD075-1Y ↓

ER-EPD075-1R ↓

ER-EPD075-1B-5070 ↓

ER-EPD075-1Y-5070 ↓

ER-EPD075-1R-5070 ↓

ER-EPD075-1B-5103 ↓

ER-EPD075-1Y-5103 ↓

ER-EPD075-1R-5103 ↓

2. SPECIFICATION

2.1 Display Specification

Item	Standard Value		Unit
Display Format	640 x384		Pixels
Display Connector	FFC		--
FPC Connector	24 Pin,0.5mm Pitch, SMD Horizontal Type Top contact		--
Operating Temperature	ER-EPD075-1B	10 ~ 40	℃
	ER-EPD075-1R	10 ~ 40	
	ER-EPD075-1Y	10 ~ 40	
Storage Temperature	ER-EPD075-1B	-25 ~ 60	℃
	ER-EPD075-1R	-25 ~ 60	
	ER-EPD075-1Y	-25 ~ 60	
Sunlight Readable	Yes		--

2.2 Mechanical Specification

Item	Standard Value	Unit
Screen Size	7.5	inch
Outline Dimension with FPC Folded	170.20(W) x 111.20(H)x1.15(T)	mm
Active Area	163.20(W) x 97.92(H)	mm
Dot Pitch	0.255x 0.255	mm

2.3 Electrical Specification

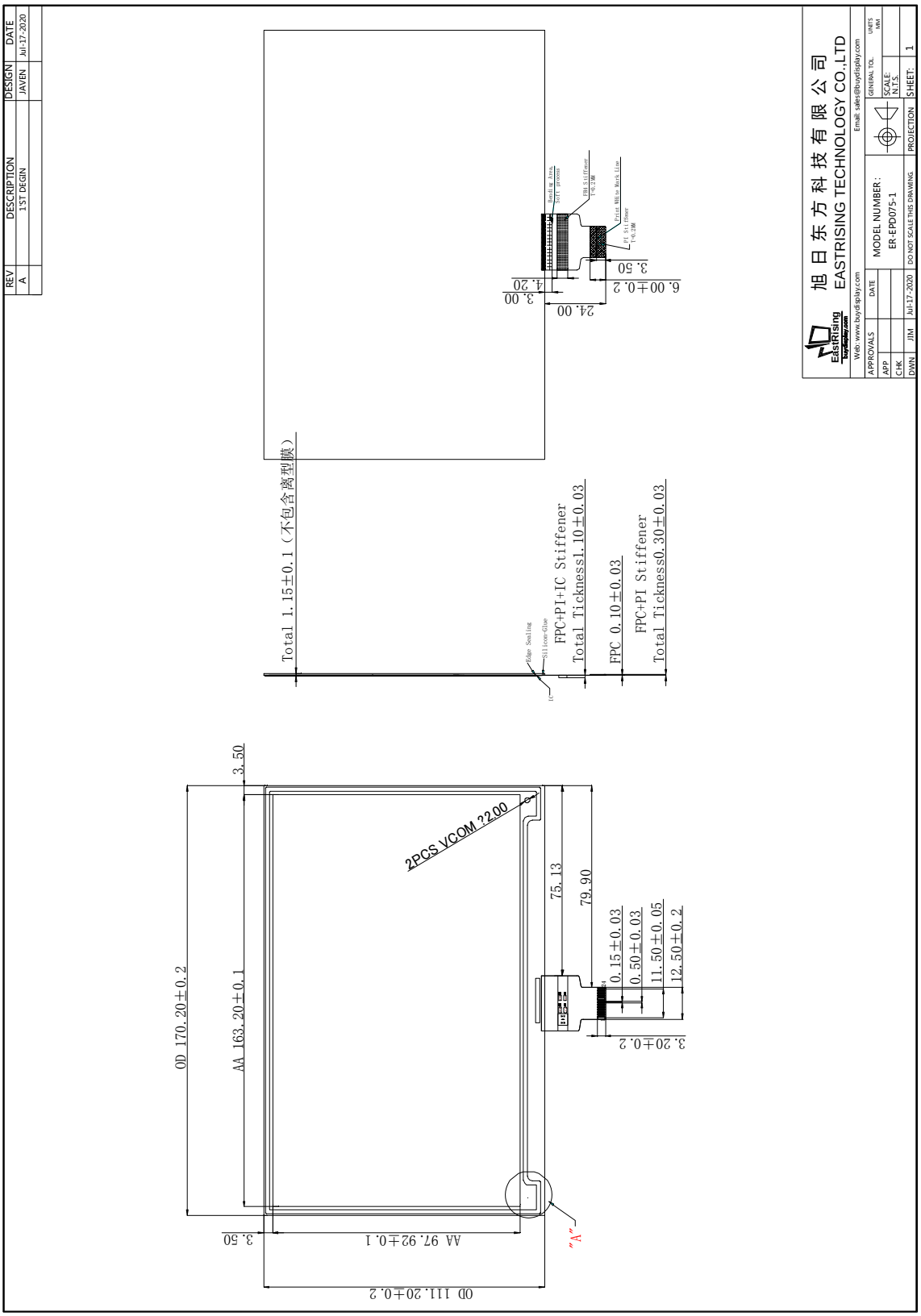
Item	Standard Value	Unit
IC Package	COG	--
Controller	UC8159	--
Interface	3/4 Wire SPI	--

2.4 Optical Specification

Item	Standard Value	Unit
LCD Type	E-Ink Display (E-Paper Display)	--
Viewing Angle Range	Left:85 , Right:85 , Up:85 , Down:85	deg

3. OUTLINE DRAWING

3.1 ER-EPD075-1 Outline Drawing



4. ELECTRICAL SPEC

4.1 Pin Configuration

Pin #	Single	Description	Remark
1	MFCSB	Serial communication chip select. It would bypass to MFCSB by R65H command.	
2	GDR	This pin is N-MOS gate control.	
3	RESE	Current Sense Input for the Control Loop	
4	VSL_LV	Negative source voltage (-3.0V ~ -15.0V).	
5	VSH_LV	Positive source voltage (+3.0V ~ +15.0V).	
6	TSCL	I2C Interface to digital temperature sensor Clock pin	
7	TSDA	I2C Interface to digital temperature sensor Date pin	
8	BS	Bus selection pin	Note 6-5
9	BUSY_N	Busy state output pin	Note 6-4
10	RST_N	Reset	Note 6-3
11	DC	Data /Command control pin	Note 6-2
12	CSB	Chip Select input pin	Note 6-1
13	SCL	serial clock pin (SPI)	
14	SDA	serial data pin (SPI)	
15	VDDIO	Power for interface logic pins	
16	VDDA	Power Supply pin for the chip	
17	GND	Ground	
18	VDDD	Core logic power pin	
19	FMSDO	Serial communication data output . It would bypass to FMSDO by R65H command.	
20	VSH	Positive Source driving voltage	
21	VGH	Positive Gate driving voltage	
22	VSL	Negative Source driving voltage	
23	VGL	Negative Gate voltage.	
24	VCOM	VCOM driving voltage	

Note 6-1: This pin (CSB) is the chip select input connecting to the MCU. The chip is enabled for MCU communication: only when CSB is pulled LOW.

Note 6-2: This pin (DC) is Data/Command control pin connecting to the MCU. When the pin is pulled HIGH, the data will be interpreted as data. When the pin is pulled LOW, the data will be interpreted as command.

Note 6-3: This pin (RST_N) is reset signal input. The Reset is active low.

Note 6-4: This pin (BUSY_N) is Busy state output pin. When Busy_N is High the operation of chip should not be interrupted and any commands should not be issued to the module. The driver IC will put Busy_N pin High when the driver IC is working such as:

- Outputting display waveform; or
- Communicating with digital temperature sensor

Note 6-5: This pin (BS) is for 3-line SPI or 4-line SPI selection. When it is "Low", 4-line SPI is selected. When it is "High", 3-line SPI (9 bits SPI) is selected.

Table: Bus interface selection

BS	MPU Interface
L	4-lines serial peripheral interface (SPI)
H	3-lines serial peripheral interface (SPI) – 9 bits SPI

5. COMMAND TABLE

#	Command	W/R	C/D	D7	D6	D5	D4	D3	D2	D1	D0	Registers	Default
1	Panel setting(PSR)	0	0	0	0	0	0	0	0	0	0		00h
		0	1	#	#	#	-	#	#	#	#	RES[1],RES[0], LUT_EN, UD,SHL,SHD_N,RST_N	0Fh
		0	1	-	-	-	#	-	-	-	-	VCM_HZ	00h
2	Power setting (PWR)	0	0	0	0	0	0	0	0	0	1		01h
		0	1	-	-	#	#	-	#	#	#	EDATA_SEL, EDATA_SET, VSource_LV_EN, VSource _EN, VGate_EN	07h
		0	1	-	-	-	-	-	#	#	#	VGHL_LV[1:0]	01h
		0	1	-	-	#	#	#	#	#	#	VDPS_LV[5:0]	05h
		0	1	-	-	#	#	#	#	#	#	VDNS_LV[5:0]	05h
3	Power OFF(POF)	0	0	0	0	0	0	0	0	1	0		02h
4	Power OFF Sequence Setting(PFS)	0	0	0	0	0	0	0	0	1	1		03h
		0	1	-	-	#	#	-	-	-	-	T_VDS_OFF[1:0]	00h
5	Power ON(PON)	0	0	0	0	0	0	0	1	0	0		04h
6	Booster Soft Start (BTST)	0	0	0	0	0	0	0	1	1	0		06h
		0	1	#	#	#	#	#	#	#	#	BT_PHA[7:0]	00h
		0	1	#	#	#	#	#	#	#	#	BT_PHB[7:0]	00h
		0	1			#	#	#	#	#	#	BT_PHC[5:0]	00h
7	Deep sleep(DSLP)	0	0	0	0	0	0	0	1	1	1		07h
		0	1	1	0	1	0	0	1	0	1	Check code	A5h
8	Data Start Transmission 1 (DTM1) (x-byte command)	0	0	0	0	0	1	0	0	0	0		10h
		0	1	-	#	#	#	-	#	#	#	KPixel1[2:0], KPixel2[2:0]	00h
		0	1										
		0	1	-	#	#	#	-	#	#	#	Kpixel[2M-1][2:0], Kpixel[2M][2:0]	00h
9	Data Stop(DSP)	0	0	0	0	0	1	0	0	0	1		11h
		1	1	#	-	-	-	-	-	-	-	Data_flag	
10	Display Refresh (DRF)	0	0	0	0	0	1	0	0	1	0		12h
11	Image Process Command (IPC)	0	0	0	0	0	1	0	0	1	1		13h
		0	1	-	-	-	#	-	#	#	#	IP_EN, IP_SEL[2:0]	00h
12	PLL control(PLL)	0	0	0	0	1	1	0	0	0	0		30h
		0	1	-	-	#	#	#	#	#	#	M[2:0], N[2:0]	3Ch
13	Temperature Sensor Command (TSC)	0	0	0	1	0	0	0	0	0	0		40h
		1	1	#	#	#	#	#	#	#	#	D[10:3]/TS[7:1]	00h
		1	1	#	#	#	-	-	-	-	-	D[2:0]/TS[0]	00h

#	Command	W/R	C/D	D7	D6	D5	D4	D3	D2	D1	D0	Registers	Default
14	Temperature Sensor Calibration (TSE)	0	0	0	1	0	0	0	0	0	1		41h
		0	1	#	-	-	-	-	-	-	-	TSE	00h
15	Temperature Sensor Write (TSW)	0	0	0	1	0	0	0	0	1	0		42h
		0	1	#	#	#	#	#	#	#	#	WATTR[7:0]	00h
		0	1	#	#	#	#	#	#	#	#	WMSB[7:0]	00h
		0	1	#	#	#	#	#	#	#	#	WLSB[7:0]	00h
16	Temperature Sensor Read (TSR)	0	0	0	1	0	0	0	0	1	1		43h
		1	1	#	#	#	#	#	#	#	#	RMSB[7:0]	00h
		1	1	#	#	#	#	#	#	#	#	RLSB[7:0]	00h
17	Vcom and data interval setting (CDI)	0	0	0	1	0	1	0	0	0	0		50h
		0	1	#	#	#	#	#	#	#	#	VBD[2:0], DDX, CDI[3:0]	F7h
18	Lower Power Detection(LPD)	0	0	0	1	0	1	0	0	0	1		51h
		1	-	-	-	-	-	-	-	-	#	LPD	01h
19	TCON Setting (TCON)	0	0	0	1	1	0	0	0	0	0		60h
		0	1	#	#	#	#	#	#	#	#	S2G[3:0],G2S[3:0]	22h
20	TCON resolution (TRES)	0	0	0	1	1	0	0	0	0	1		61h
		0	1	#	#	#	#	#	#	#	#		00h
		0	1	-	-	-	-	-	-	#	#	HRES[9:0]	00h
		0	1	-	-	-	-	-	-	-	#		00h
		0	1	#	#	#	#	#	#	#	#	VRES[8:0]	00h
21	SPI flash control (DAM)	0	0	0	1	1	0	0	1	0	1		65h
		0	1	-	-	-	-	-	-	-	#	DAM	00h
22	Revision(REV)	0	0	0	1	1	1	0	0	0	0		70h
		0	1	-	-	#	#	#	#	#	#	MAN,SHRK,LUT_ REV[3:0]	00h
23	Get Status (FLG)	0	0	0	1	1	1	0	0	0	1		71h
		1	1	-	-	#	#	#	#	#	#	I2C_ERR,I2C_BUS Y, DATA_FLAG, PON, POF, BUSY	02h
24	Auto Measurement Vcom (AMV)	0	0	1	0	0	0	0	0	0	0		80h
		0	1	-	-	#	#	#	#	#	#	AMVT[1:0],AMVX, AMVS, AMV,AMVE	10h
25	Read Vcom Value(VV)	0	0	1	0	0	0	0	0	0	1		81h
		1	1	-	#	#	#	#	#	#	#	VV[6:0]	00h
26	VCM_DC Setting (VDCS)	0	0	1	0	0	0	0	0	1	0		82h
		0	1	-	#	#	#	#	#	#	#	VDCS[6:0]	02h

1)Panel Setting (PSR) (R00H)

Action	W/R	C/D	D7	D6	D5	D4	D3	D2	D1	D0
Setting the panel	0	0	0	0	0	0	0	0	0	0
	0	1	RES1	RES0	LUT_EN	-	UD	SHL	SHD_N	RST_N

RES[1:0]: Display resolution setting (source×gate)

00b: 640×480 (default)

01b: 600×450

10b: 640×448

11b: 600×448

LUT_EN: LUT selection

0: Using LUT from external Flash.

1: Using LUT from register.

UD: Gate Scan Direction

0: Scan down First line to last: Gn→·····→G1

1: Scan up. (default) First line to last: G1→ ·····→Gn

SHL: Source shift direction

0: Shift left. First data to last data: Sn→·····→S1

1: Shift right First data to last data: S1→·····→Sn

SHD_N: Booster switch

0: DC-DC converter OFF.

1: DC-DC converter ON (Default)

When SHD_N become low, DC-DC will turn OFF. Register and SRAM data will keep until VDD OFF. SD output and VCOM will remain previous condition. It may have two conditions: 0v or floating.

RST_N: Soft Reset

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

1: Normal operation (Default). Booster OFF, Register data are set to their default values, and SEG/BG/VCOM: 0V

When RST_N become low, driver will reset. All register will reset to default value. Driver all function will disable. SD output and VCOM will base on previous condition. It may have two conditions: 0v or floating.

VCM_HZ: VCOM Hi-Z function

0: VCOM normal output. (Default)

1: VCOM floating.

2) Power Setting (PWR) (R01H)

Action	W/R	C/D	D7	D6	D5	D4	D3	D2	D1	D0
Selecting Internal/External Power	0	0	0	0	0	0	0	0	0	1
	0	1	-	-	EDATA _SEL	EDATA _SET	-	VSource_LV_EN	VSource _EN	VGate_EN
	0	1	-	-	-	-	-		VGHL_LVL[1:0]	
	0	1	-	-	VDPS_LV [5:0]					
	0	1	-	-	VDNS_LV [5:0]					

EDATA_SEL: EDATA selection for pure driver mode

0 : When EDATA_SET=1, pixel bit =2`b11 output VDPS_L level

1 : When EDATA_SET=1, pixel bit =2`b11 output VDNS_L level (default)

EDATA_SET: EDATA setting for pure driver mode

0: 3-bit data mode for pure driver

1: 2-bit data mode for pure driver (default)

Vsource_LV_EN: VSource LV power selection.

0: External source power from VSH_LV and VSL_LV pin.

1: Internal DCDC function for generate source power. (default)

VSource_EN: VSource power selection.

0: External source power from VSH and VSL pin.

1: Internal DCDC function for generate source power. (default)

VGate_EN: VGate power selection.

0: External gate power from VGH and VGL pin.

1: Internal DCDC function for generate gate power. (default)

VGHL_LVL[1:0]: VGH / VGL Voltage Level selection.

VGHL_LV	VGHL Voltage level
00	VGH=20V, VGL= -20V
01 (Default)	VGH=19V, VGL= -19V
10	VGH=18V, VGL= -18V
11	VGH=17V, VGL= -17V

VDPS_LV[5:0]: Internal VDH power selection for Red LUT.

VDPS_LV	VDH_V
000000	3.0V
000001	3.2V
000010	3.4V
000011	3.6V
000100	3.8V
000101	4.0V (Default)
..	..
111100	15.0V

VDNS_LV[5:0]: Internal VDL power selection for Red LUT.

VDNS_LV	VDL_V
000000	-3.0V
000001	-3.2V
000010	-3.4V
000011	-3.6V
000100	-3.8V
000101	-4.0V (Default)
111100	-15.0V

3) Power OFF (POF) (R02H)

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

After power off command, driver will power off based on the Power OFF Sequence, BUSY signal will become "0".

The Power OFF command will turn off DCDC, T-con, source driver, gate driver, VCOM, temperature sensor, but register and SRAM data will keep until VDD off.

SD output and VCOM will base on previous condition. It may have two conditions: 0v or floating.

4) Power OFF Sequence Setting(PFS) (R03H)

Action	W/R	C/D	D7	D6	D5	D4	D3	D2	D1	D0
Setting Power OFF sequence	0	0	0	0	0	0	0	0	1	1
	0	1	-	-	T_VDS_OFF[1:0]					

T_VDS_OFF[1:0]: Power OFF Sequence of VDH and VDL.

00b: 1 frame (Default) 01b: 2 frames 10b: 3 frames 11b: 4 frame

5) Power ON (PON) (R04H)

Action	W/R	C/D	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, driver will power on based on the Power ON Sequence.

After power on command and all power sequence are ready, then BUSY signal will become "1".

6) Booster Soft Start (BTST) (R06H)

Action	W/R	C/D	D7	D6	D5	D4	D3	D2	D1	D0
Starting data transmission	0	0	0	0	0	0	0	1	1	0
	0	1	BTPHA7	BTPHA6	BTPHA5	BTPHA4	BTPHA3	BTPHA2	BTPHA1	BTPHA0
	0	1	BTPHB7	BTPHB6	BTPHB5	BTPHB4	BTPHB3	BTPHB2	BTPHB1	BTPHB0
	0	1	-	-	BTPHC5	BTPHC4	BTPHC3	BTPHC2	BTPHC1	BTPHC0

BTPHA7[7:6] **BTPHB7[7:6]**	**BTPHA[5:3],** **BTPHB[5:3],** **BTPHC[5:3],**	**BTPHA[2:0]** **BTPHB[2:0]** **BTPHC[2:0]**
Soft Start Phase Period (mS)	**Driving Strength**	**Minimum OFF Time (uS)**
00b: 10 mS	**000b: (reserved)**	**000b: 0.26 uS**
01b: 20	**001b: (reserved)**	**001b: 0.31**
10b: 30	**010b: 1**	**010b: 0.36**
11b: 40	**011b: 2**	**011b: 0.52**
	100b: 3	**100b: 0.77**
	101b: 4	**101b: 1.61**
	110b: 5	**110b: 3.43**
	111b: 6 (strongest)	**111b: 6.77**

7) Deep sleep (DSLP) (R07H)

Action	W/R	C/D	D7	D6	D5	D4	D3	D2	D1	D0
Deep sleep	0	0	0	0	0	0	0	1	1	1
	0	1	1	0	1	0	0	1	0	1

This command makes the chip enter the deep-sleep mode. The deep sleep mode could return to stand-by mode by hard ward reset assertion.

The only one parameter is a check code, the command would be executed if check code is A5h.

8) Data Start Transmission 1 (DTM1) (R10H)

Action	W/R	C/D	D7	D6	D5	D4	D3	D2	D1	D0
Starting data transmission	0	0	0	0	0	1	0	0	0	0
	0	1	Dummy	KPixel12	KPixel11	KPixel10	Dummy	KPixel22	KPixel21	KPixel20
	0	1	…	…	…	…	…	…	…	…
	0	1	Dummy	Kpixel (2M-1)2	Kpixel (2M-1)1	Kpixel (2M-1)0	Dummy	Kpixel (2M)2	Kpixel (2M)1	Kpixel (2M)0

This Command indicates that user starts to transmit data. Then write to SRAM. While complete data transmission, user must send a Datastop command (R11H). Then the chip will start to send data/VCOM for panel.

Kpixel[1~2M][2:0] :

Kpixel [2:0]	Source Driver Output	
	DDX=1(default)	DDX=0
	LUT	LUT
000	Black	White
001	Gray1	Gray2
010	Gray2	Gray1
011	White	Black
100	Red0	Red3
101	Red1	Red2
110	Red2	Red1
111	Red3	Red0

9) Data stop (DSP) (R11H)

Action	W/R	C/D	D7	D6	D5	D4	D3	D2	D1	D0
Stopping data transmission	0	0	0	0	0	1	0	0	0	1
	1	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 (DTM1 and DTM2).

After “Data Start” (10h) or “Data Stop” (11h) commands, BUSY signal will become “0” until display update is finished.

10) Display Refresh (DRF) (R12H)

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

After this command is issued, driver will refresh display (data/VCOM) according to SRAM data and LUT.

After Display Refresh command, BUSY signal will become “0” until display update is finished.

11) Image Process Command (IPC) (R13H)

Action	W/R	C/D	D7	D6	D5	D4	D3	D2	D1	D0
Image Process Setting	0	0	0	0	1	0	0	0	1	1
	0	1	-	-	-	IP_EN		IP_SEL[2:0]		

After this command is issued, image process engine will find thin lines/pixels from frame SRAM and update the frame SRAM for applying new gray level waveform.

IP_EN: Image process enable.

0: No action.

1: Image process enable (auto return to ‘0’ after image process is finished.

IP_SEL[2:0]: Image process selection.

000 : Deal with 1-pixel width

001 : Deal with 2-pixel width

010 : Deal with 3-pixel width

011 : Deal with 1-pixel and 2-pixel width

100 : Deal with 1-pixel, 2-pixel and 3-pixel width

Others : Deal with 1-pixel width

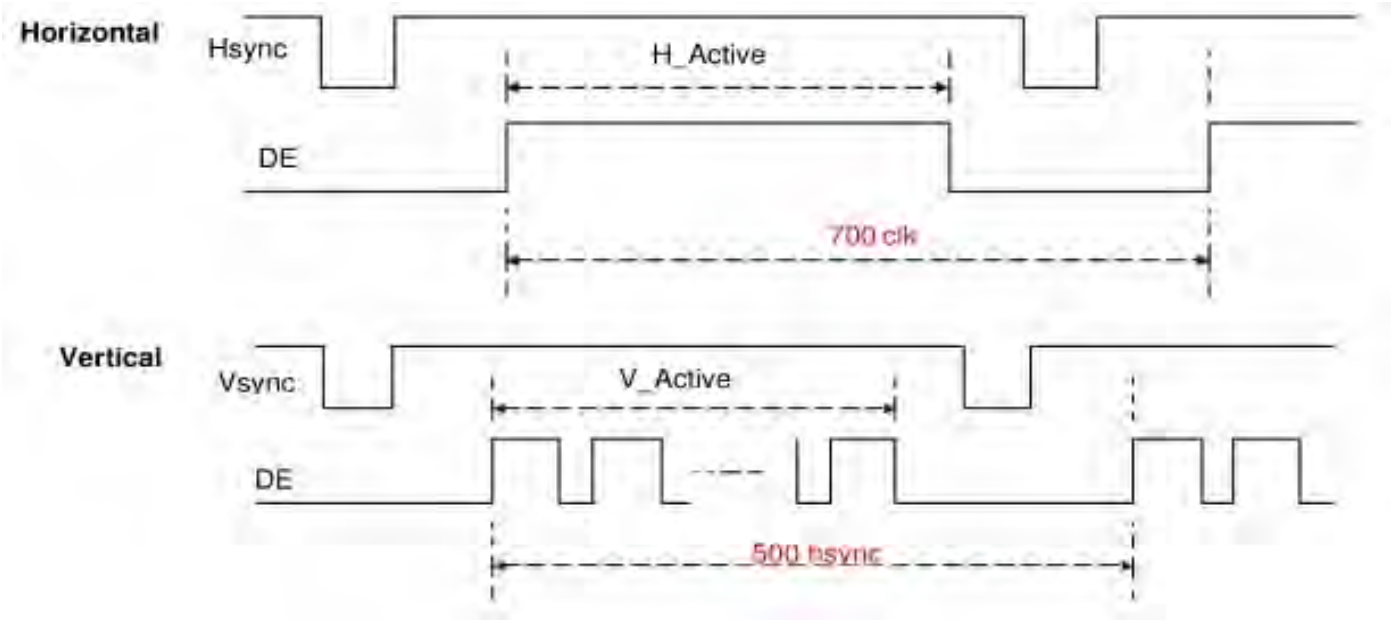
After “Image Process Command” (13h), BUSY_N signal will become “0” until image process is finished

12) PLL Control (PLL) (R30H)

Action	W/R	C/D	D7	D6	D5	D4	D3	D2	D1	D0
Controlling PLL	0	0	0	0	1	1	0	0	0	0
	0	1	-	-	M[2:0]			N[2:0]		

The command controls the PLL clock frequency. The PLL structure must support the following frame rates:

M	N	FR	M	N	FR	M	N	FR	M	N	FR
1	1	29	3	1	86	5	1	143	7	1	200
	2	14		2	43		2	71		2	100
	3	10		3	29		3	48		3	67
	4	5		4	21		4	36		4	50
	5	7		5	17		5	29		5	40
	6	6		6	14		6	24		6	33
	7	5		7	12		7	20		7	29
2	1	57	4	1	114	6	1	171			
	2	29		2	57		2	86			
	3	19		3	38		3	57			
	4	14		4	29		4	43			
	5	11		5	23		5	34			
	6	10		6	19		6	29			
	7	8		7	16		7	24			



13) Temperature Sensor Command(TSC) (R40H)

Action	W/R	C/D	D7	D6	D5	D4	D3	D2	D1	D0
Sensing Temperature	0	0	0	1	0	0	0	0	0	0
	1	1	D10	D9/TS7	D8/TS6	D7/TS5	D6/TS4	D5/TS3	D4/TS2	D3/TS1
	1	1	D2/TS0	D1	D0					

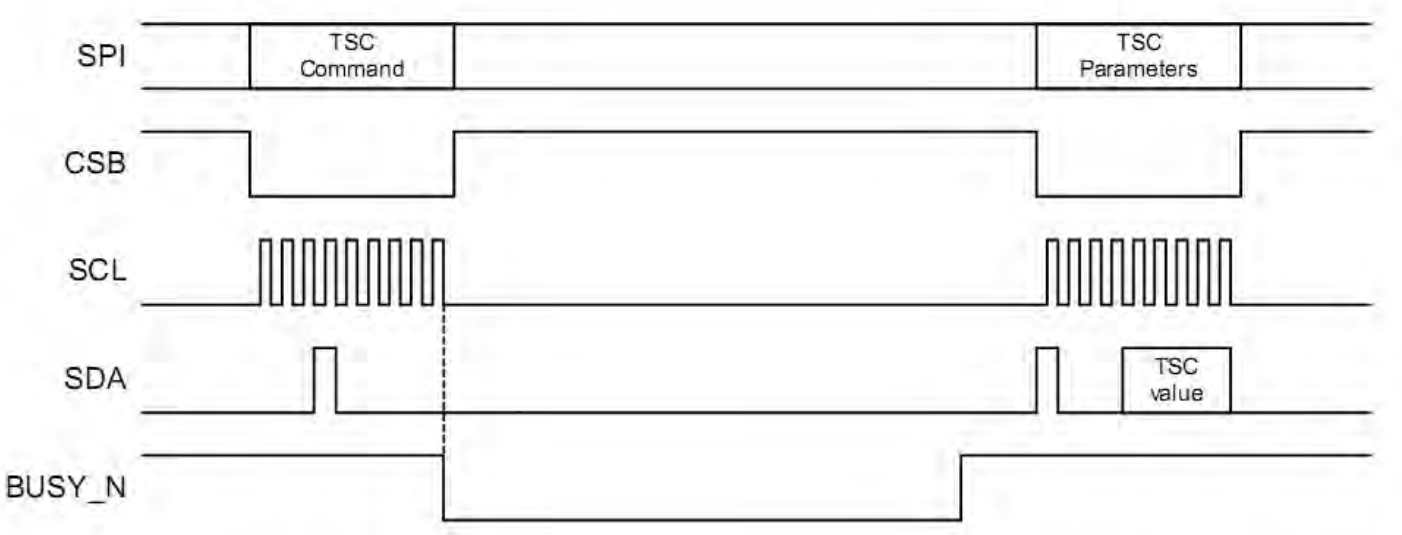
This command reads the temperature sensed by the temperature sensor.

TS[7:0]: When TSE (R41h) is set to 0, this command reads internal temperature sensor value.

D[10:0]: When TSE (R41h) is set to 1, this command reads external LM75 temperature sensor value.

Bit 7~0	Temperature(℃)
0000 0000b	0
0000 0001b	0.5
0000 0010b	1
..	..
0101 1010b	45
..	..
0110 0100b	50
..	..
1100 1110b	-25
..	..
1111 1110b	-1
1111 1111b	-0.5

BUSY become low after TSC command. When BUSY become high, Parameter can be read.



14) Temperature Sensor Calibration (TSE) (R41H)

Action	W/R	C/D	D7	D6	D5	D4	D3	D2	D1	D0
Temperature Sensor Selection	0	0	0	1	0	0	0	0	0	1
	0	1	TSE	-						

This command selects Internal or External temperature sensor.

TSE: Internal temperature sensor switch

0: Select internal temperature sensor (default) 1: Select external temperature sensor.

15) Temperature Sensor Write (TSW) (R42H)

Action	W/R	C/D	D7	D6	D5	D4	D3	D2	D1	D0
Temperature Sensor Selection	0	0	0	1	0	0	0	0	1	0
	0	1	WATTR[7:0]-							
	0	1	WMSB[7:0]							
	0	1	WLSB[7:0]							

This command could write data to the external temperature sensor.

WATTR: D[7:6]: I2C Write Byte Number

00: 1 byte (head byte only)

01: 2 bytes (head byte + pointer)

10: 3 bytes (head byte + pointer + 1stparameter)

11: 4 bytes (head byte + pointer + 1stparameter + 2nd parameter)

D[5:3]: User-defined address bits (A2, A1, A0)

D[2:0]: Pointer setting

WMSB[7:0]: MSByte of write-data to external temperature sensor

WLSB[7:0]: LSByte of write-data to external temperature sensor.

16) Temperature Sensor Read (TSR) (R43H)

Action	W/R	C/D	D7	D6	D5	D4	D3	D2	D1	D0
Temperature Sensor Selection	0	0	0	1	0	0	0	0	1	1
	1	1	RMSB[7:0]							
	1	1	RLSB[7:0]							

This command could read data from the external temperature sensor.

RMSB[7:0]: MSByte of read-data from external temperature sensor.

RLSB[7:0]: LSByte of read-data from external temperature sensor.

17) VCOM and Data Interval Setting(CDI) (R50H)

Action	W/R	C/D	D7	D6	D5	D4	D3	D2	D1	D0
Set Interval between Vcom and Data	0	0	0	1	0	1	0	0	0	0
	0	1	VBD[2:0]			DDX	CDI[3:0]			

This command indicates the interval of Vcom and data output. When setting the vertical back porch, the total blanking will be kept (20 Hsync).

VBD[2:0]: Border output selection.

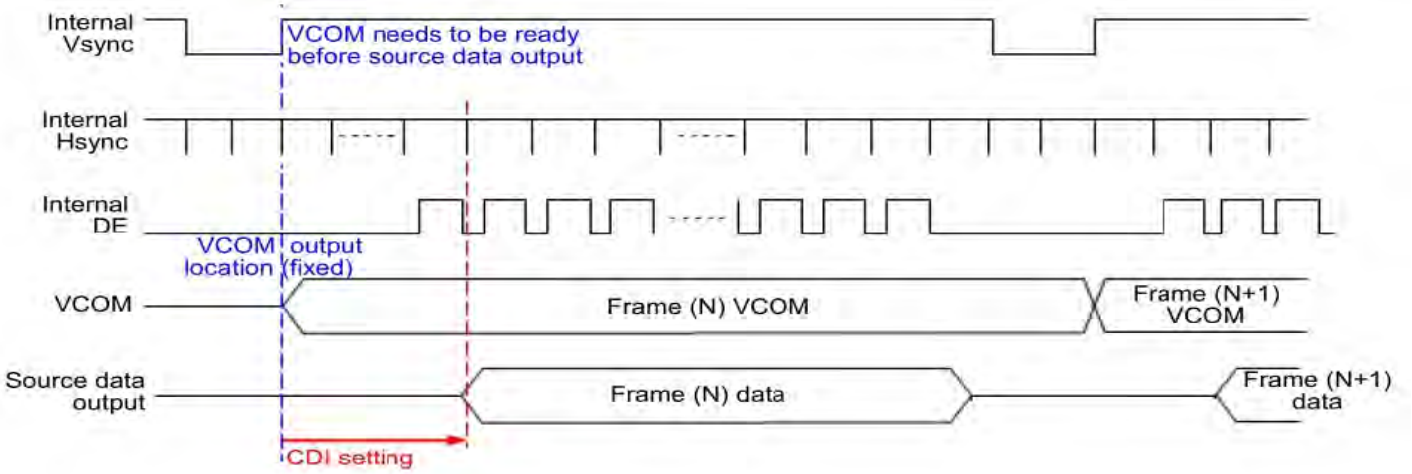
DDX: Data polality.

The mapping table of VBD[2:0] and DDX is listed as below.

	Border Output	
VBD[2:0]	DDX=1(default)	DDX=0
	LUT	LUT
000	Black	White
001	Gray1	Gray2
010	Gray2	Gray1
011	White	Black
100	Red0	Floating
101	Red1	Red2
110	Red2	Red1
111	Floating	Red0

CDI[3:0]: Vcom and data interva

CDI[3:0]	Vcom and Data Interval	CDI[3:0]	Vcom and Data Interval
0000b	17 hsync	1000	9
0001	16	1001	8
0010	15	1010	7
…			
0110	11	1110	3
0111	10(Default)	1111	2



Action	W/R	C/D	D7	D6	D5	D4	D3	D2	D1	D0
Detect Low Power	0	0	0	1	0	1	0	0	0	1
	1	1	-	-	-	-	-	-	-	LPD

This command indicates the input power condition. Host can read this flag to learn the battery condition.

LPD: Internal temperature sensor switch

0: Low power input (VDD<2.5V) 1: Normal status (default)

19) TCON Setting(TCON) (R60h)

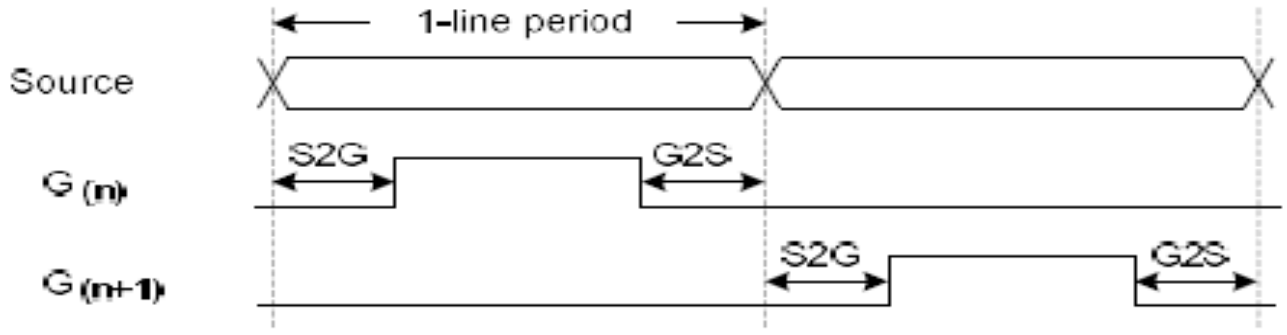
Action	W/R	C/D	D7	D6	D5	D4	D3	D2	D1	D0
Sensing	0	0	0	1	1	0	0	0	0	0
Temperature	0	1	S2G[3:0]				G2S[3:0]			

This command defines non-overlap period of Gate and Source.

S2G[3:0] or G2S[3:0]: Source to Gate / Gate to Source Non-overlap period

S2G[3:0] or G2S[3:0]	Period		S2G[3:0] or G2S[3:0]	Period
0000b	4		…	…
0001	8		1011	48
0010	12(Default)		1100	52
0011	16		1101	56
0100	20		1110	60
0101	24		1111	64

Period = 660 nS.



20) Resolution Setting(TRES) (R61H)

Action	W/R	C/D	D7	D6	D5	D4	D3	D2	D1	D0
Set Display Resolution	0	0	0	1	1	0	0	0	0	1
	0	1	HRES[7:0]							
	0	1	-	-	-	-	-	-	HRES[9:8]	
	0	1	VRES[7:0]							
	0	1	-	-	-	-	-	-	-	VRES[8]

This command defines alternative resolution and this setting is of higher priority than the RES[1:0] in R00H (PSR).

HRES[9:0]: Horizontal Display Resolution

VRES[8:0]: Vertical Display Resolution

Resolution setting (R61H) has higher priority than RES[1:0] (R00H). Resolution should be even number.

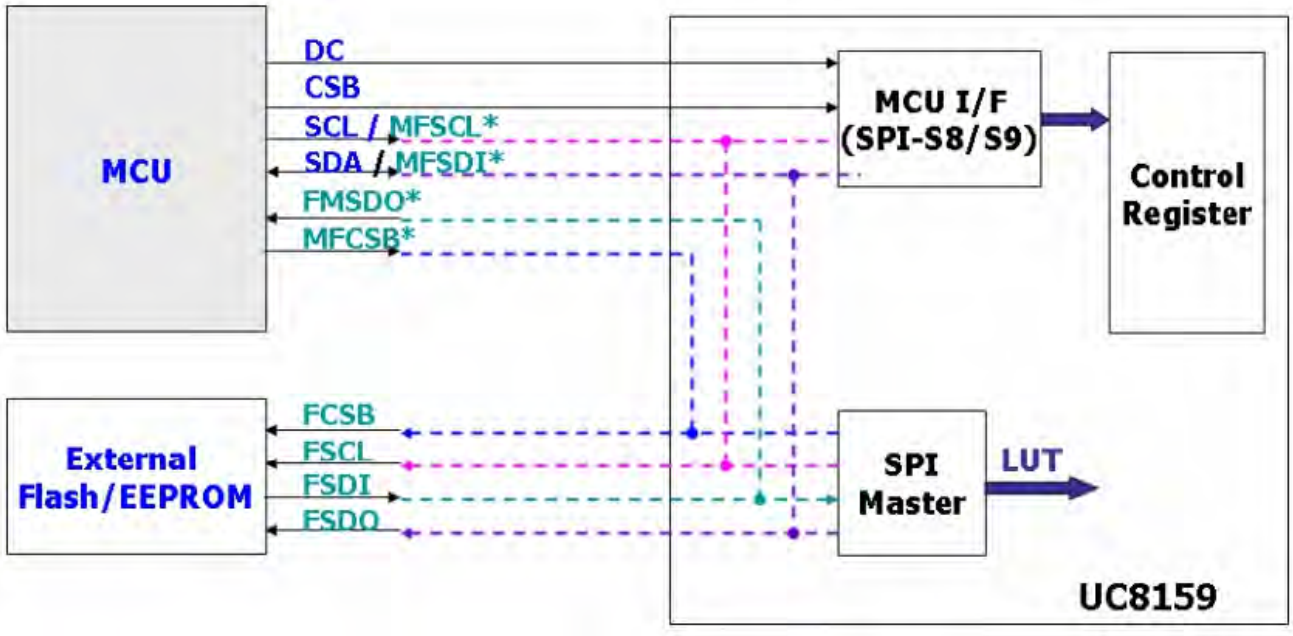
21) SPI Flash Control(DAM) (R65H)

Action	W/R	C/D	D7	D6	D5	D4	D3	D2	D1	D0
Sensing Temperature	0	0	0	1	1	0	0	0	0	1
	1	1	-	-	-	-	-	-	-	DAM

This command defines MCU host direct access external memory mode.

DAM: 0: Disable (default)

1: Enable. By pass MFSCL*, MFSDI*, MFSDO*, AND MFCSB* to external flash.



22) Revision(REV) (R70H)

Action	W/R	C/D	D7	D6	D5	D4	D3	D2	D1	D0
RLUT/Chip Revision	0	0	0	1	1	1	0	0	0	0
	1	1	LUTVER[7:0]							
	1	1	LUTVER[15:8]							
	1	1	0	0	0	0	CHREV[3:0]			

The LUTVER[15:0] is read from OTP address = 25001 and 25000.

LUTVER[15:0]: LUT versionL.

CHREV [3:0]: Chip Revision.

23) Get status(FLG) (R71H)

Action	W/R	C/D	D7	D6	D5	D4	D3	D2	D1	D0
Read Flags	0	0	0	1	1	1	0	0	0	1
	1	1	-	-	I2C_ERR	I 2C_ BUSY	data_ flag	PON	POF	BUSY

This command reads the IC status.

I2C_ERR: I2C master error status

I2C_BUSY: I2C master busy status (low active)

Data_flag: Driver has already received all the one frame data

PON: Power ON status

POF: Power OFF status

BUSY: Driver busy status (low active)

24) Auto measure vcom(AMV) (R80h)

Action	W/R	C/D	D7	D6	D5	D4	D3	D2	D1	D0
Automatically measure vcom	0	0	1	0	0	0	0	0	0	0
	0	1	-	-	AMVT[1:0]		AMVX	AMVS	AMV	AMVE

This command implements related VCOM sensing setting.

AMVT[1:0]: Auto Measure Vcom Time

00b: 3s 01b: 5s (default)

10b: 8s 11b: 10s

AMVX: Auto Measure VCOM without XON function

0: Measure VCOM without XON function. (Gate scanning) (default)

1: Measure VCOM without XON function. (All Gate ON)

AMVS: Source output of AMV

0: Set Source output to 0V during Auto Measure VCOM period. (default)

1: Set Source output to 3V (or VDPS_L) during Auto Measure VCOM period.

AMV: Analog signal

0: Get Vcom value with the VV command (R81h) (default)

1: Get Vcom value in analog signal.

AMVE: Auto Measure Vcom Enable (/Disable)

0: Disabled 1: Enabled

25) VCOM Value(VV) (R81h)

Action	W/R	C/D	D7	D6	D5	D4	D3	D2	D1	D0
Automatically measure vcom	0	0	1	0	0	0	0	0	0	1
	1	1	-	VV [6:0]						

This command gets the Vcom value.

VV[6:0]: Vcom Value Output

VV[60]	VCOM Value
000 0000b	0V
000 0001b	-0.05V
000 0010b	-0.10V
000 0011b	-0.15V
101 0000b:	-4.00V
(Others)	-4.00V

26) VCOM-DC Setting(VDCS) (R82H)

Action	W/R	C/D	D7	D6	D5	D4	D3	D2	D1	D0
Set VCM_DC	0	0	1	0	0	0	0	0	1	0
	0	1	-	VDCS[6:0]						

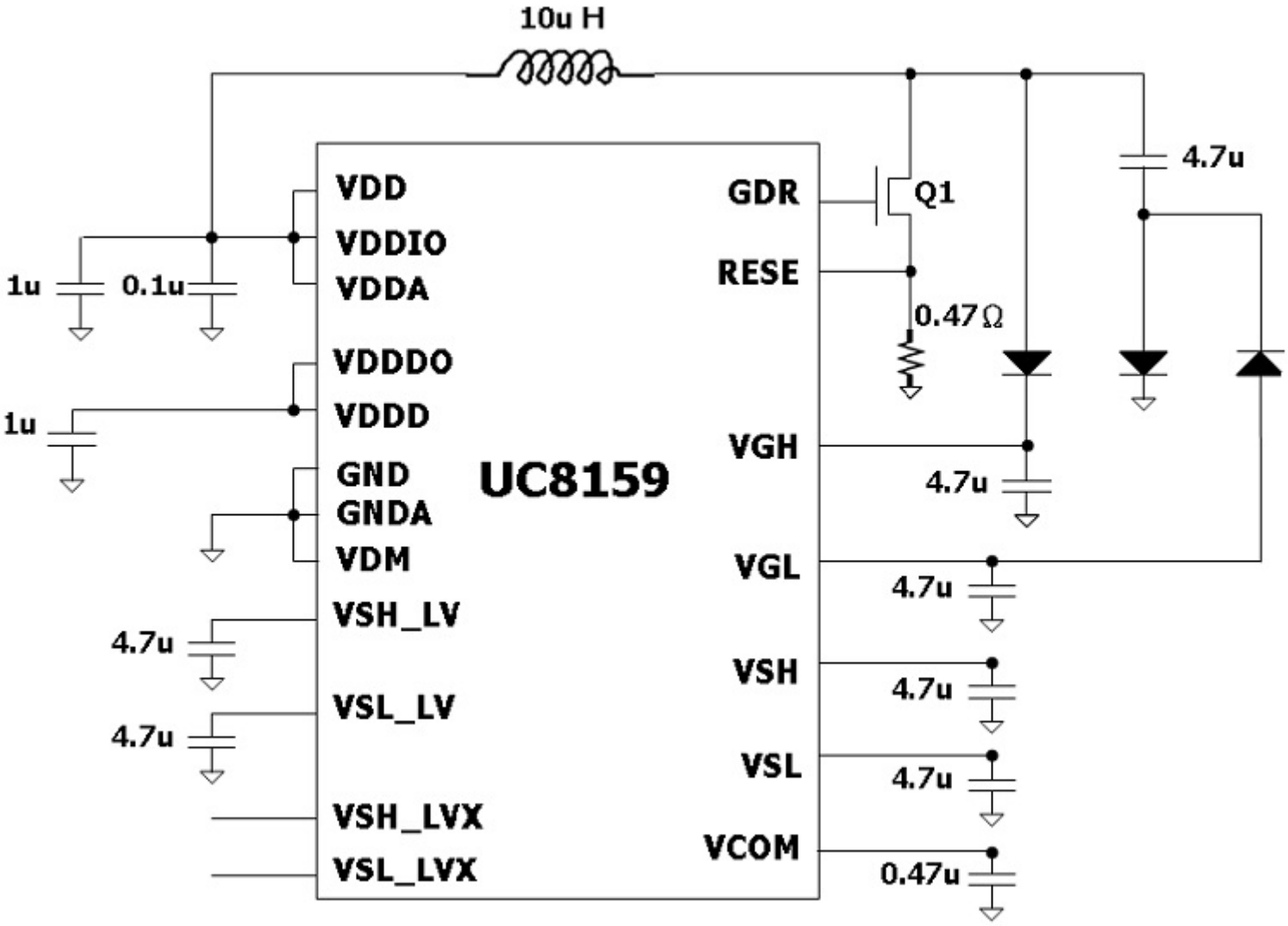
This command sets VCOM_DC value.

VDCS[6:0]: VCOM_DC Setting

VDCS[6:0]	VCOM_DC Value
000 0000b	(Reserved)
000 0001b	(Reserved)
000 0010b	-0.10v
000 0011b	-0.15v
000 0100b	-0.20v
..	..
101 0000b	-4.0v
(others)	-4.0v

6. Electrical Characteristics

6-1) Reference Circuit



6-2) Absolute maximum rating

Symbol	Parameter	Rating	Unit
V_{CI}	Logic supply voltage	2.3 to +3.6	V
T_{OPR}	Operation temperature range	10 to 40	℃
T_{STG}	Storage temperature range	-25 to 60	℃

Note; Maximum ratings are those values beyond which damages to the device may occur,
Functional operation should be restricted to the limits in the Electrical Characteristics chapter
Note: The recommended operating temperature should ge kept above 10℃ to 30℃
Note: Tstg is the transportation condition，the transport time is within 10 days for -25℃~0℃ or 30℃~60℃.

6-3) Panel DC Characteristics

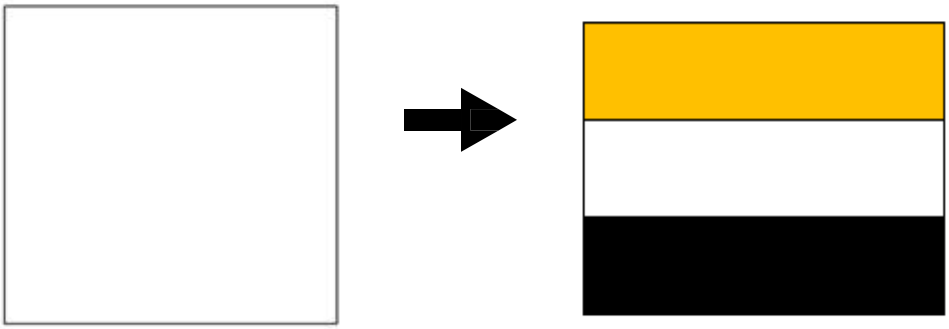
The following specifications apply for: VSS = 0V, VCI = 3.3V, TA = 25℃

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
VCI	Logic Supply Voltage	-	2.5	3.3	3.6	V
VIH	High level input voltage	Digital input pins	0.8xVDDIO	-	VDDIO	V
VIL	Low level input voltage	Digital input pins	GND	-	0.2x VDDIO	V
VOH	High level output voltage	Digital output pins, IOH=400UA	0.8xVDDIO	-	-	V
VOL	Low level output voltage	Digital output pins, IOL=-400UA	GND	-	0.2xVDDIO	V
Iupdate	Module operating current	-	-	20	-	mA
Isleep	Deep sleep mode	VCI=3.3V	-	1	2	uA

- The Typical power consumption is measured using associated 25℃ waveform with following pattern transition: from horizontal scan pattern to vertical scan pattern. (Note 8-3)
- The listed electrical/optical characteristics are only guaranteed under the controller & waveform provided by XingTai.
- Vcom value will be provided by XingTai.

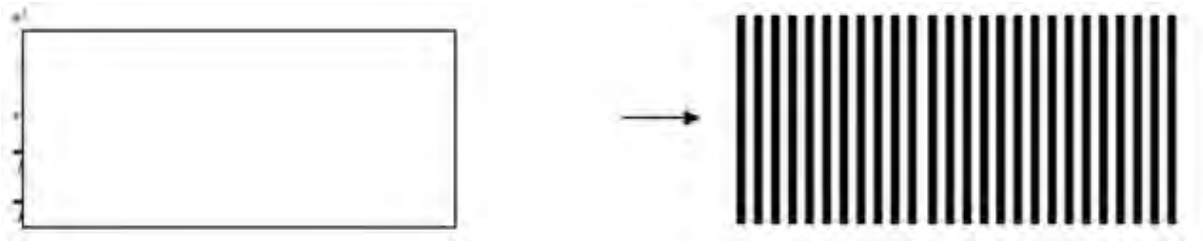
Note 8-3

The Typical power consumption



Maximum pattern

The maximum power consumption



6-4) Panel AC Characteristics

6-4-1) MCU Interface

6-4-1-1) MCU Interface Selection

In this module, there are 4-wire SPI and 3-wire SPI that can communicate with MCU. The MCU interface mode can be set by hardware selection on BS pins. When it is “Low”, 4-wire SPI is selected. When it is “High”, 3-wire SPI (9 bits SPI) is selected.

Pin Name	Data/Command Interface		Control Signal		
Bus interface	D1	D0	CSB	DC	RST_N
SPI4	SDIN	SCLK	CSB	DC	RST_N
SPI3	SDIN	SCLK	CSB	L	RST_N

Table 8-4-1-1: MCU interface assignment under different bus interface mode

Note 8-2: L is connected to GND

Note 8-3: H is connected to VCI

6-4-1-2) MCU Serial Interface (4-wire SPI)

The 4-wire SPI consists of serial clock SCLK, serial data SDIN, DC, CSB. In SPI mode, D0 acts as SCLK, D1 acts as SDIN.

Function	CSB	DC	SCLK
Write Command	L	L	↑
Write data	L	H	↑

Table 8-4-1-2: Control pins of 4-wire Serial Peripheral interface

Note8-4: ↑ stands for rising edge of signal

SDIN is shifted into an 8-bit shift register in the order of D7, D6, ... D0. The data byte in the shift register is written to the Graphic Display Data RAM (RAM) or command register in the same clock. Under serial mode, only write operations are allowed.

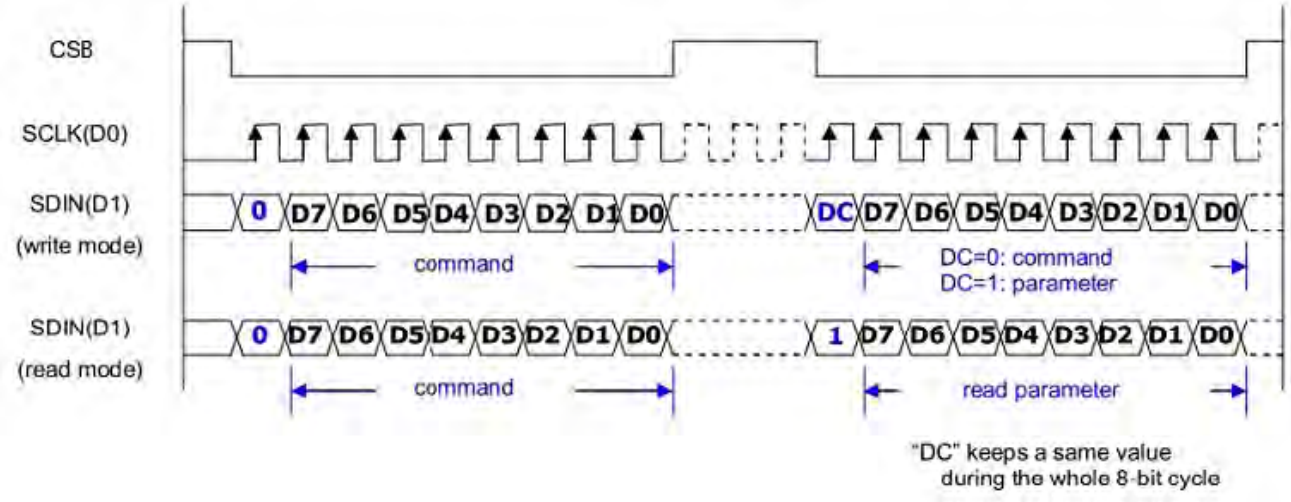


Figure8-4-1-2: Write procedure in 4-wire Serial Peripheral Interface mode

6-4-1-3) MCU Serial Interface (3-wire SPI)

The 3-wire serial interface consists of serial clock SCLK, serial data SDIN and CSB.

In 3-wire SPI mode, D0 acts as SCLK, D1 acts as SDIN, The pin DC can be connected to an external ground.

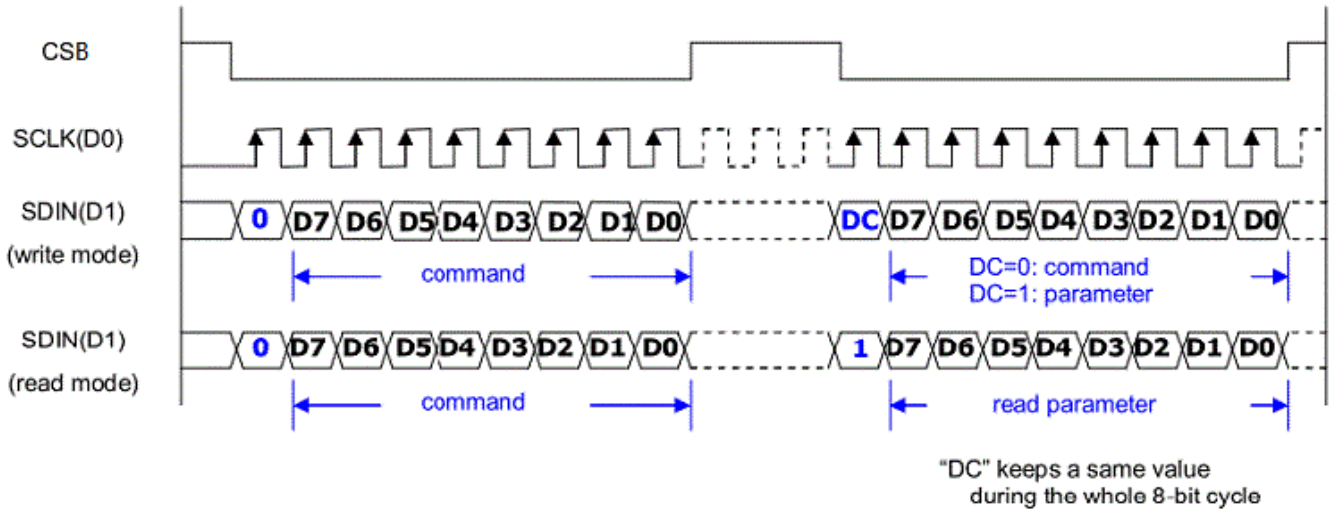
The operation is similar to 4-wire serial interface while DC pin is not used. There are altogether 9-bits will be shifted into the shift register on each ninth clock in sequence: DC bit, D7 to D0 bit. The DC bit (first bit of the sequential data) will determine the following data byte in shift register is written to the Display Data RAM (DC bit = 1) or the command register (DC bit = 0).Under serial mode, only write operations are allowed.

Function	CSB	DC	SCLK
Write Command	L	Tie LOW	↑
Write data	L	Tie LOW	↑

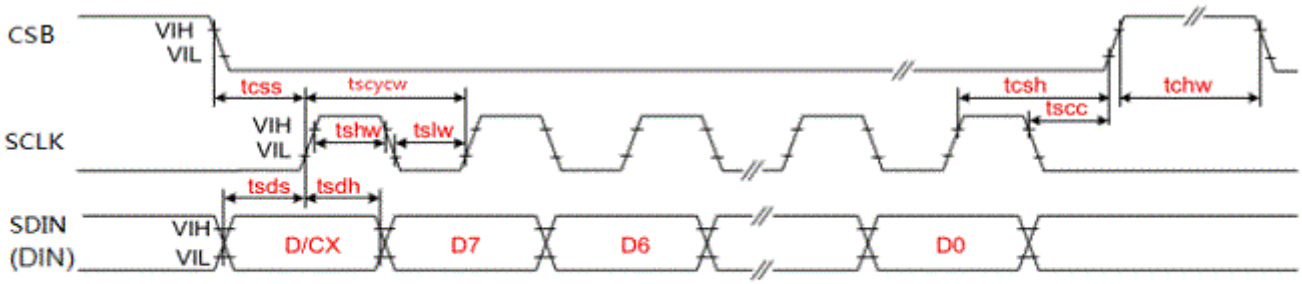
Table 6-4-1-3: Control pins of 3-wire Serial Peripheral Interface

Note 8-5: ↑ stands for rising edge of signal

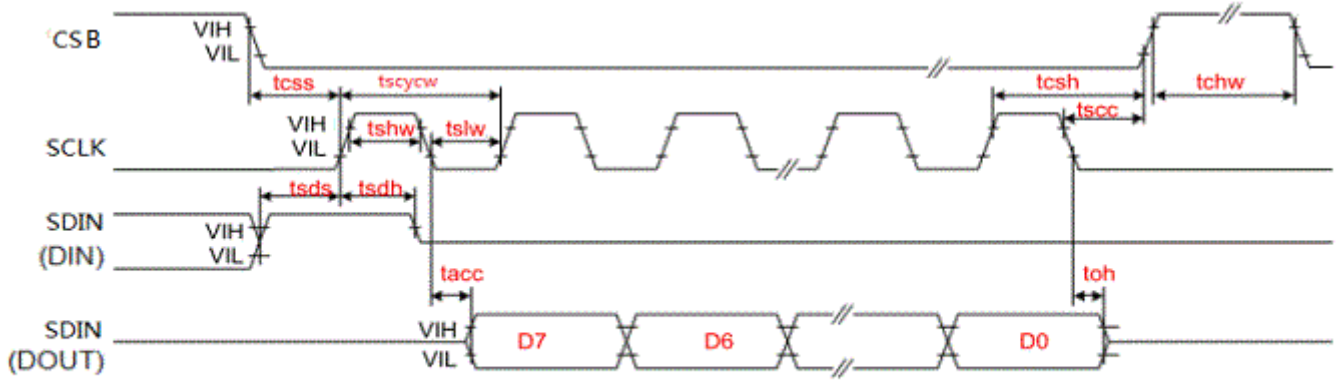
Figure 6-4-1-3: Write procedure in 3-wire Serial Peripheral Interface mode



6-4-2) Timing Characteristics of Series Interface



3-wire Serial Interface – Write



3-wire Serial Interface – Read

Symbol	Signal	Parameter	Min	Typ	Max	Unit
Tcss	CSB	Chip Select Setup Time	60	-	-	ns
Tcsh		Chip Select Hold Time	65	-	-	ns
Tscc		Chip Select Setup Time	20	-	-	ns
Tchw		Chip Select Setup Time	40	-	-	ns
Tscycw	SCLK	Serial clock cycle (write)	100	-	-	ns
Tshw		SCL “H” pulse width (write)	35	-	-	ns
Tslw		SCL “L” pulse width (write)	35	-	-	ns
Tscycr		Serial clock cycle (Read)	150	-	-	ns
Tshr		SCL “H” pulse width (Read)	60	-	-	ns
Tslr		SCL “L” pulse width (Read)	60	-	-	ns
Tsds	SDIN (DIN) (DOUT)	Data setup time	30	-	-	ns
Tsdh		Data hold time	30	-	-	ns
Tacc		Access time	10	-	-	ns
toh		Output disable time	15	-	-	ns

6-5) Power Consumption

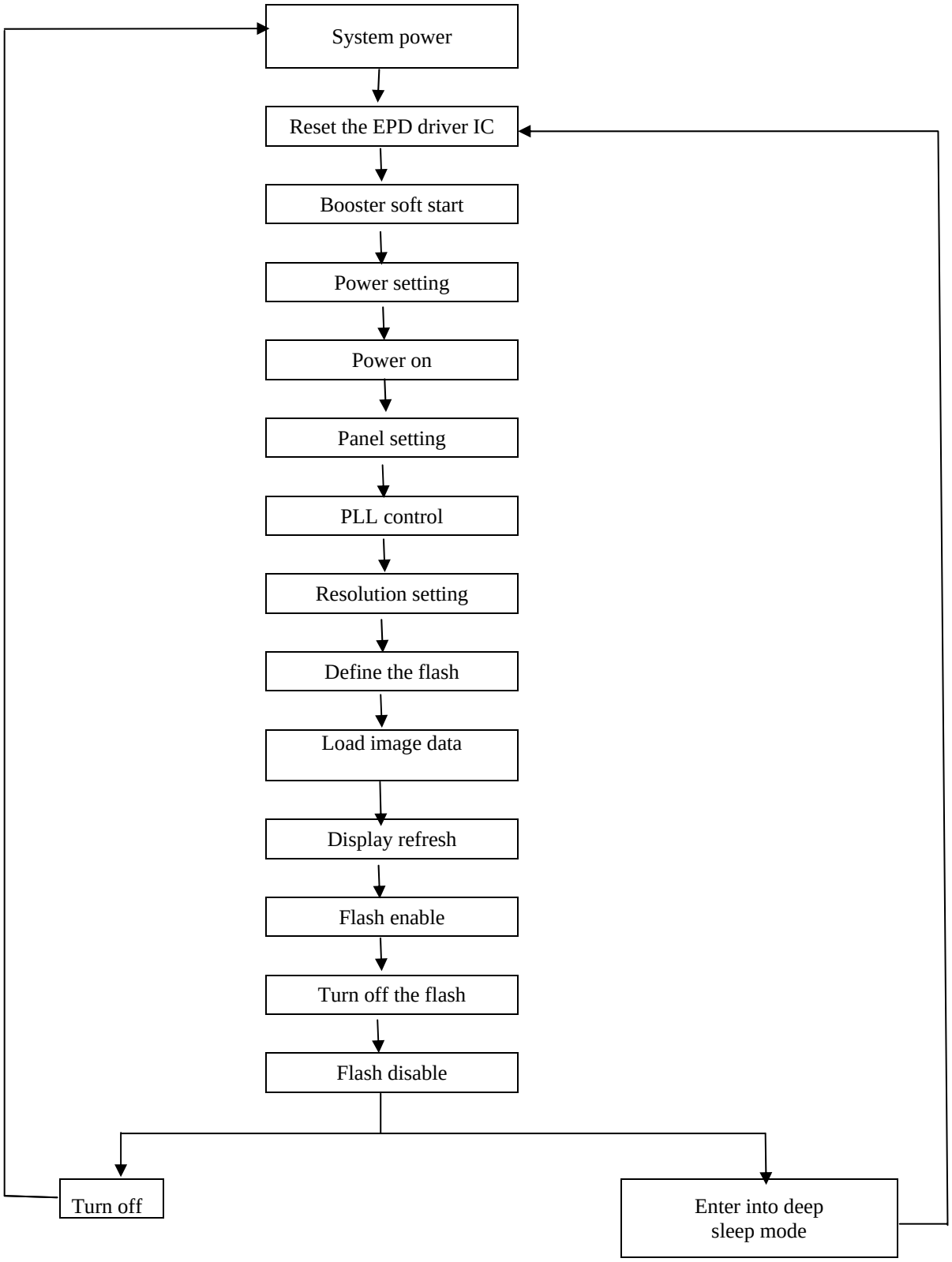
Parameter	Symbol	Conditions	TYP	Max	Unit	Remark
Panel power consumption during update	-	25℃	600	-	mAs	-
Deep sleep mode	-	25℃	7	-	uA	-

MAS=update average current ×update time

7. Typical Operating Sequence

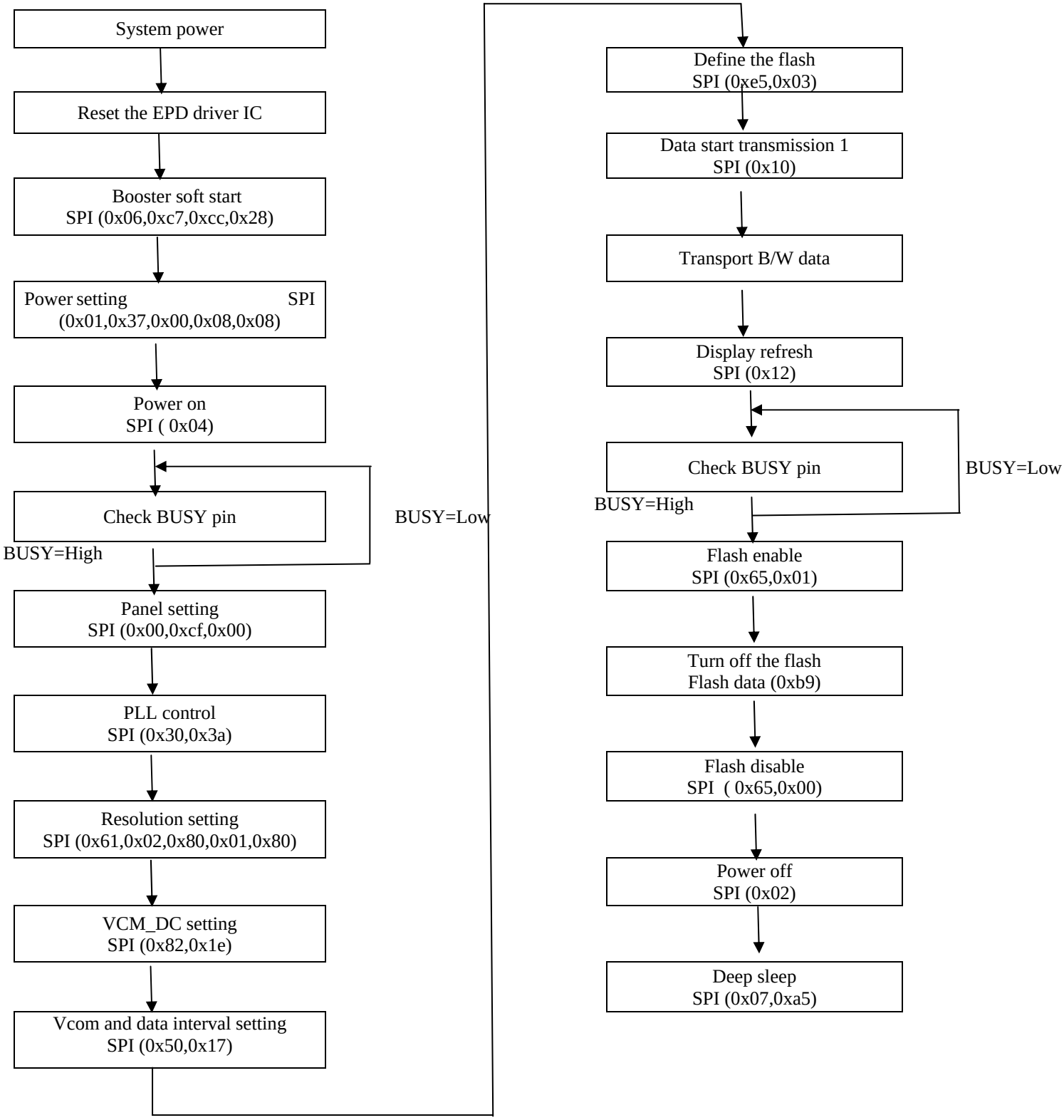
7-1) Normal Operation Flow

1. LUT from flash



7-2) Reference Program Code

1.LUT from flash



8. Optical characteristics

8.1Specifications

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

T=25℃

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP.	MAX	UNIT	Note
R	Reflectance	White	30	35	-	%	Note 10-1
CR	Contrast Ratio	-	10	15	-		-
Tupdate	Update time	Black/White		15		sec	
YS	Yellow State L* value	Yellow	45	52	--		Note 10-1
	Yellow State b* value	Yellow	50	58	--		Note 10-1
Tupdate_YS	Update time	Yellow		22		sec	

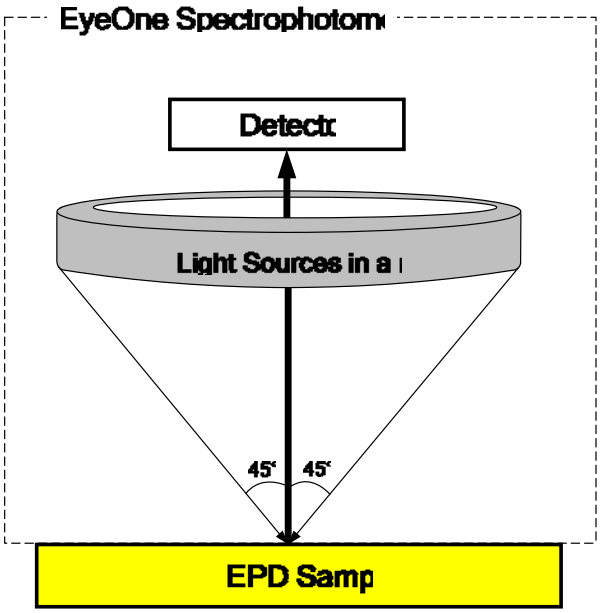
WS: White state, DS : Dark state

Note 10-1: Luminance meter : Eye - One Pro Spectrophotometer

8.2 Defi nition of contrast ratio

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

CR = Rl/Rd

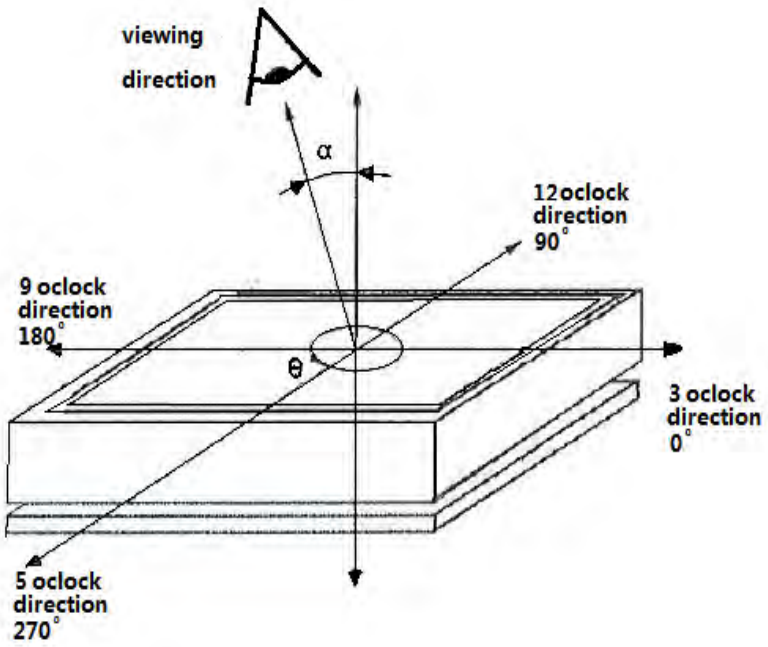


8 .3Reflection Ratio

The reflection ratio is expressed as:

R = Reflectance Factor $_{\text{white board}}$ x (L_{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.



9. HANDLING, SAFETY AND ENVIROMENTAL REQUIREMENTS

WARNING
The display glass may break when it is dropped or bumped on a hard surface. Handle with care. Should the display break, 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.
IPA solvent can only be applied on active area and the back of a glass. For the rest part, it is not allowed.

Observe general precautions that are common to handling delicate electronic components. The glass can break and front surfaces can easily be damaged . Moreover the display is sensitive to static electricity and other rough environmental conditions.

Mounting Precautions
(1) It`s recommended that you consider the mounting structure so that uneven force (ex. Twisted stress) is not applied to the module.
(2) It`s recommended that you attach a transparent protective plate to the surface in order to protect the EPD. Transparent protective plate should have sufficient strength in order to resist external force.
(3) You should adopt radiation structure to satisfy the temperature specification.
(4) Acetic acid type and chlorine type materials for the cover case are not desirable because the former generates corrosive gas of attacking the PS at high temperature and the latter causes circuit break by electro-chemical reaction.
(5) Do not touch, push or rub the exposed PS with glass, tweezers or anything harder than HB pencil lead. And please do not rub with dust clothes with chemical treatment. Do not touch the surface of PS for bare hand or greasy cloth. (Some cosmetics deteriorate the PS)
(6) When the surface becomes dusty, please wipe gently with absorbent cotton or other soft materials like chamois soaks with petroleum benzene. Normal-hexane is recommended for cleaning the adhesives used to attach the PS. Do not use acetone, toluene and alcohol because they cause chemical damage to the PS.
(7) Wipe off saliva or water drops as soon as possible. Their long time contact with PS causes deformations and color fading.

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 dose not form part of the specification.

Product Environmental certification

ROHS

REMARK

All The specifications listed in this document are guaranteed for module only. Post-assembled operation or component(s) may impact module performance or cause unexpected effect or damage and therefore listed specifications is not warranted after any Post-assembled operation.

10. Reliability test

	TEST	CONDITION	METHOD	REMARK
1	High-Temperature Operation	T=40℃，RH=35%RH，For 240Hr	IEC 60 068-2-2Bb	
2	Low-Temperature Operation	T = 0℃ for 240 hrs	IEC 60 068-2-2Ab	
3	High-Temperature Storage	T=60℃ RH=35%RH For 240Hr Test in white pattern	IEC 60 068-2-2Bb	
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%RH，For 240Hr	IEC 60 068-2-3CA	
6	High Temperature, High-Humidity Storage	T=50℃，RH=80%RH，For 240Hr Test in white pattern	IEC 60 068-2-3CA	
7	Temperature Cycle	-25℃(30min)~60℃(30min)，50 Cycle Test in white pattern	IEC 60 068-2-14NB	
8	Package Vibration	1.04G,Frequency : 10~500Hz Direction : X,Y,Z Duration:1hours in each direction	Full packed for shipment	
9	Package Drop Impact	Drop from height of 122 cm on Concrete surface Drop sequence:1 corner, 3edges, 6face One drop for each.	Full packed for shipment	
10	UV exposure Resistance	765 W/㎡ for 168hrs,40℃	IEC 60068-2-5 Sa	
11	Electrostatic discharge	Machine model: +/-250V,0Ω,200pF	IEC61000-4-2	

Actual EMC level to be measured on customer application.

Note1: The protective film must be removed before temperature test.

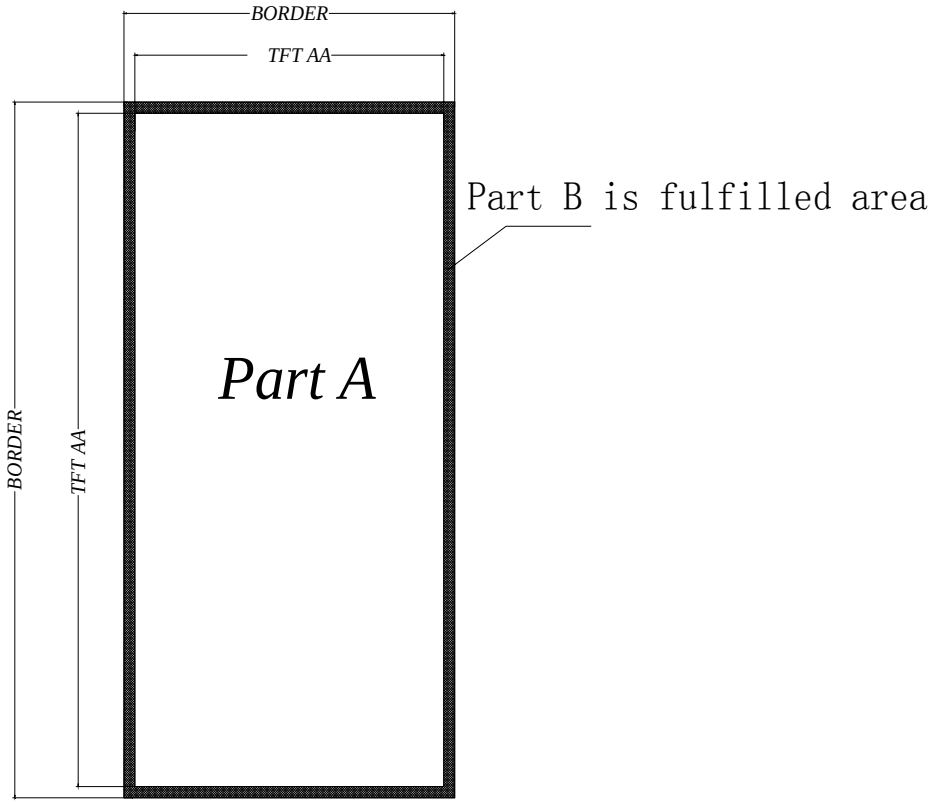
Note2：Stay white pattern for storage and non-operation test.

Note3：Operation is black/white/red pattern , hold time is 150S.

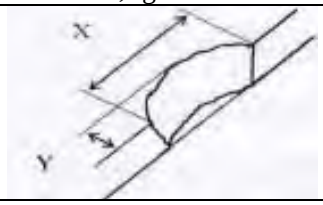
Note4：The function,appearence,opticals should meet the requirements of the test before and after the test.

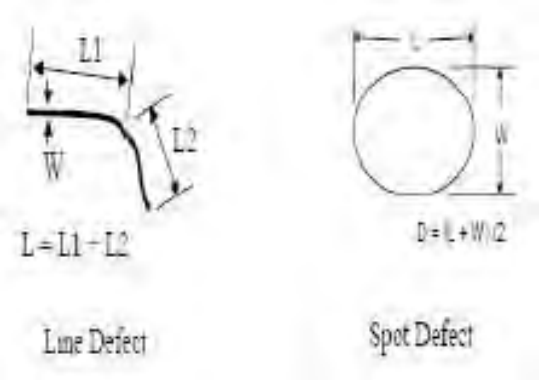
Note5：Keep testing after 2 hours placing at 20℃-25℃.

11· PartA/PartB specification



12. Point and line standard

<table>
<tr><th colspan="7">Shipment Inspection Standard</th></tr>
<tr><td colspan="7">Equipment：Electrical test fixture, Point gauge</td></tr>
<tr><td>Outline dimension</td><td>170.20 (H) × 111.20(V) × 1.25(D)</td><td>Unit：㎜</td><td>Part-A</td><td>Active area</td><td>Part-B</td><td>Border area</td></tr>
<tr><td rowspan="2">Environment</td><td>Temperature</td><td>Humidity</td><td>Illuminance</td><td>Distance</td><td>Time</td><td>Angle</td></tr>
<tr><td>19℃～25℃</td><td>55%±5%RH</td><td>800～1300Lux</td><td>300 ㎜</td><td>35Sec</td><td></td></tr>
<tr><td>Defet type</td><td>Inspection method</td><td colspan="2">Standard</td><td colspan="2">Part-A</td><td>Part-B</td></tr>
<tr><td rowspan="4">Spot</td><td rowspan="4">Electric Display</td><td colspan="2">D≤0.25 ㎜</td><td colspan="2">Ignore</td><td>Ignore</td></tr>
<tr><td colspan="2">0.25 ㎜＜D≤0.4 ㎜</td><td colspan="2">N≤4</td><td>Ignore</td></tr>
<tr><td colspan="2">0.40 ㎜＜D≤0.5 ㎜</td><td colspan="2">N≤1</td><td>Ignore</td></tr>
<tr><td colspan="2">D＞0.5 ㎜</td><td colspan="2">Not Allow</td><td>Ignore</td></tr>
<tr><td>Display unwork</td><td>Electric Display</td><td colspan="2">Not Allow</td><td colspan="2">Not Allow</td><td>Ignore</td></tr>
<tr><td>Display error</td><td>Electric Display</td><td colspan="2">Not Allow</td><td colspan="2">Not Allow</td><td>Ignore</td></tr>
<tr><td rowspan="3">Scratch or line defect(include dirt)</td><td rowspan="3">Visual/Film card</td><td colspan="2">L≤2 ㎜，W≤0.2 ㎜</td><td colspan="2">Ignore</td><td>Ignore</td></tr>
<tr><td colspan="2">2.0mm＜L≤8.0mm，0.2＜W≤0.5mm,</td><td colspan="2">N≤2</td><td>Ignore</td></tr>
<tr><td colspan="2">L＞8.0 ㎜，W＞0.5 ㎜</td><td colspan="2">Not Allow</td><td>Ignore</td></tr>
<tr><td rowspan="3">PS Bubble</td><td rowspan="3">Visual/Film card</td><td colspan="2">D≤0.25mm</td><td colspan="2">Ignore</td><td>Ignore</td></tr>
<tr><td colspan="2">0.25mm≤D≤0.40mm</td><td colspan="2">N≤4</td><td>Ignore</td></tr>
<tr><td colspan="2">D＞0.40 mm</td><td colspan="2">Not Allow</td><td>Ignore</td></tr>
<tr><td rowspan="2">Side Fragment</td><td rowspan="2">Visual/Film card</td><td colspan="5">X≤6mm，Y≤0.5mm, Do not affect the electrode circuit , Ignore</td></tr>
<tr><td colspan="5"> 
</td></tr>
<tr><td rowspan="3">Remark</td><td colspan="6">1.Cannot be defect & failure cause by appearance defect；</td></tr>
<tr><td colspan="6">2.Cannot be larger size cause by appearance defect；</td></tr>
<tr><td colspan="6">L=long W=wide D=point size N=Defects NO</td></tr>
</table>



L=long W=wide D=point size

13. INSPECTION CRITERIA

13.1 Acceptable Quality Level

Each lot should satisfy the quality level defined as follows

Partition	AQL	Definition
A. Major	0.4%	Functional defective as product
B. Minor	1.5%	Satisfy all functions as product but not satisfy cosmetic standard

13.2 Definition of Lot

One lot means the delivery quantity to customer at one time.

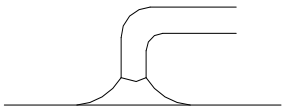
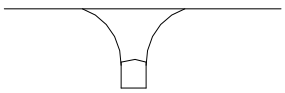
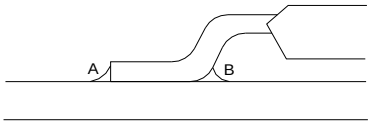
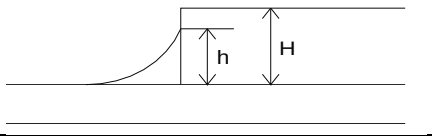
1 3.3 Condition of Cosmetic Inspection

◆ INSPECTION AND TEST
-FUNCTION TEST
-APPEARANCE INSPECTION
-PACKING SPECIFICTION

◆ INSPECTION CONDITION
- Put under the lamp (20W) at a distance 100mm from
- Tilt upright 45 degree by the front (back) to inspect LCD appearance.

◆ AQL INSPECTION LEVEL
- SAMPLING METHOD: MIL-STD-105D
- SAMPLING PLAN: SINGLE
- MAJOR DEFECT: 0.4% (MAJOR)
- MINOR DEFECT: 1.5% (MINOR)
- GENERAL LEVEL: II/NORMAL

13.4 Module Cosmetic Criteria

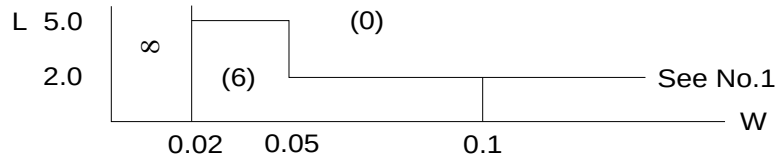
No.	Item	Judgment Criterion	Partition
1	Difference in Spec.	None allowed	Major
2	Pattern Peeling	No substrate pattern peeling and floating	Major
3	Soldering Defects	No soldering missing	Major
		No soldering bridge	Major
		No cold soldering	Minor
4	Resist Flaw on Substrate	Invisible copper foil(¢ 0.5mm or more)on substrate pattern	Minor
5	Accretion of Metallic Foreign Matter	No soldering dust	Minor
		No accretion of metallic foreign matters(Not exceed ¢ 0.2mm)	
6	Stain	No stain to spoil cosmetic badly	Minor
7	Plate Discoloring	No plate fading, rusting and discoloring	Minor
8	Solder Amount 1.Lead Parts	a. Soldering side of PCB Solder to form a' Filet' all around t Solder should not hide the lead form  b.Components side (In case of 'Through Hole PCB') Solder to reach the Components side of PCB 	Minor
	2.Flat Packages	Either 'toe' (A) or 'heal' (B) of the lead to be covered by Filet' Lead form to be assume over solder. 	Minor
	3.Chips	(3/2) H≧h≧(1/2)H 	Minor

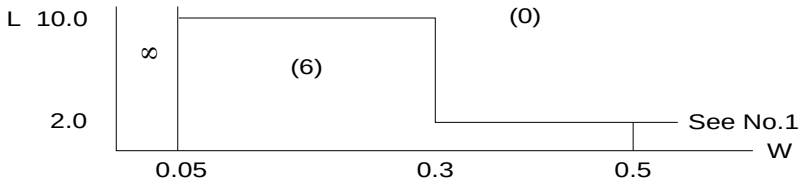
9	Backlight Defects	1.Light fails or flickers.(Major) 2. Color and luminance do not correspond to specifications. (Major) 3.Exceeds standards for display' s blemishes, foreign matter, dark lines or scratches.(Minor)	See list ←
10	PCB Defects	Oxidation or contamination on connectors.* 2. Wrong parts, missing parts, or parts not in specification.* 3.Jumpers set incorrectly.(Minor) 4.Solder(if any)on bezel, LED pad, zebra pad, or screw hole pad is not smooth.(Minor) *Minor if display functions correctly. Major if the display fails.	See list ←
11	Soldering Defects	1. Unmelted solder paste. 2. Cold solder joints, missing solder connections, or oxidation.* 3. Solder bridges causing short circuits.* 4. Residue or solder balls. 5. Solder flux is black or brown. *Minor if display functions correctly. Major if the display fails.	Minor

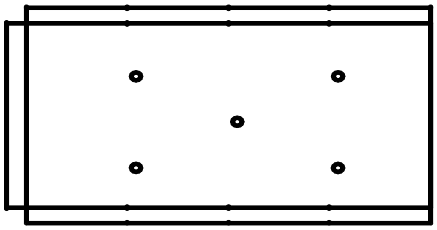
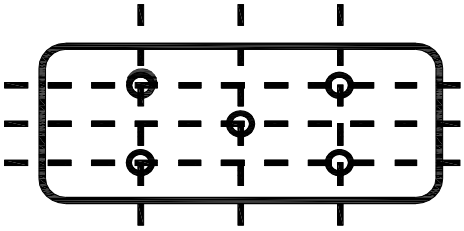
13.5 Screen Cosmetic Criteria (Non-Operating)

<table>
<tr><th>No.</th><th>Defect</th><th>Judgment Criterion</th><th>Partition</th></tr>
<tr><td>1</td><td>Spots</td><td>In accordance with Screen Cosmetic Criteria (Operating) No.1.</td><td>Minor</td></tr>
<tr><td>2</td><td>Lines</td><td>In accordance with Screen Cosmetic Criteria (Operation) No.2.</td><td>Minor</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">Bubbles in Polarizer</td><td><table>
<tr><td>Size: d mm</td><td>Acceptable Qty in active area</td></tr>
<tr><td>d≦0.3
0.3<d≦1.0
1.0<d≦1.5
1.5<d</td><td>Disregard
3
1
0</td></tr>
</table></td><td>Minor</td></tr>
<tr><td></td><td></td></tr>
<tr><td>4</td><td>Scratch</td><td>In accordance with spots and lines operating cosmetic criteria, When the light reflects on the panel surface, the scratches are not to be remarkable.</td><td>Minor</td></tr>
<tr><td>5</td><td>Allowable density</td><td>Above defects should be separated more than 30mm each other.</td><td>Minor</td></tr>
<tr><td>6</td><td>Coloration</td><td>Not to be noticeable coloration in the viewing area of the LCD panels.
Back-lit type should be judged with back-lit on state only.</td><td>Minor</td></tr>
<tr><td>7</td><td>Contamination</td><td>Not to be noticeable.</td><td>Minor</td></tr>
</table>

13.6 Screen Cosmetic Criteria (Operating)

<table>
<tr><th>No.</th><th>Defect</th><th>Judgment Criterion</th><th>Partition</th></tr>
<tr><td>1</td><td>Spots</td><td>A) Clear
<table>
<tr><td>Size:d mm</td><td>Acceptable Qty in active area</td></tr>
<tr><td>d≦0.1
0.1<d≦0.2
0.2<d≦0.3
0.3<d</td><td>Disregard
6
2
0</td></tr>
</table>
Note: Including pin holes and defective dots which must be within one pixel Size.
Unclear
<table>
<tr><td>Size:d mm</td><td>Acceptable Qty in active area</td></tr>
<tr><td>d≦0.2
0.2<d≦0.5
0.5<d≦0.7
0.7<d</td><td>Disregard
6
2
0</td></tr>
</table></td><td>Minor</td></tr>
<tr><td>2</td><td>Lines</td><td>A) Clear
 

Note: () – Acceptable Qty in active area
L - Length (mm)
W -Width(mm)
∞-Disregard
B) Unclear
 
</td><td>Minor</td></tr>
<tr><td colspan="4">Clear' = The shade and size are not changed by Vo.
Unclear' = The shade and size are changed by Vo.</td></tr>
</table>

No.	Defect	Judgment Criterion	Partition
3	Rubbing line	Not to be noticeable.	Minor
4	Allowable density	Above defects should be separated more than 10mm each other.	Minor
5	Rainbow	Not to be noticeable.	Minor
6	Dot size	To be 95%~105%of the dot size (Typ.) in drawing. Partial defects of each dot (ex.pin-hole) should be treated as spot. (see Screen Cosmetic Criteria (Operating) No.1)	Minor
7	Brightness (only back-lit Module)	Brightness Uniformity must be BMAX/BMIN≦2 - BMAX : Max.value by measure in 5 points - BMIN : Min.value by measure in 5 points Divide active area into 4 vertically and horizontally. Measure 5 points shown in the following figure. 	Minor
8	Contrast Uniformity	Contrast Uniformity must be BmAX/BMIN≦2 Measure 5 points shown in the following figure. Dashed lines divide active area into 4 vertically and horizontally. Measuring points are located at the inter-sections of dashed line.  Note: BMAX – Max.value by measure in 5 points. BMIN – Min.value by measure in 5 points. O – Measuring points in ¢10mm.	Minor

Note:
(1) Size: d=(long length + short length)/2
(2) The limit samples for each item have priority.
(3) Complexed defects are defined item by item, but if the number of defects is defined in above table, the total number should not exceed 10.

(4) In case of 'concentration', even the spots or the lines of 'disregarded' size should not be allowed. Following three situations should be treated as 'concentration'.
-7 or over defects in circle of ¢5mm.
-10 or over defects in circle of ¢10mm
-20 or over defects in circle of ¢20mm

14. PRECAUTIONS FOR USING

14.1 Handling Precautions

- This device is susceptible to Electro-Static Discharge (ESD) damage. Observe Anti-Static precautions.
- EastRising display panel is made of glass. Do not subject it to a mechanical shock by dropping it or impact.
- If EastRising display panel is damaged and the liquid crystal substance leaks out, be sure not to get any in your mouth. If the substance contacts your skin or clothes, wash it off using soap and water.
- Do not apply excessive force to the EastRising display surface or the adjoining areas since this may cause the color tone to vary.
- The polarizer covering the EastRising display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully.
- If EastRising display surface becomes contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If it is heavily contaminated, moisten cloth with one of the following Isopropyl or alcohol.
- Solvents other than those above-mentioned may damage the polarizer. Especially, do not use the Water.
- Exercise care to minimize corrosion of the electrode. Corrosion of the electrodes is accelerated by water droplets, moisture condensation or a current flow in a high-humidity environment.
- Install the EastRising LCD Module by using the mounting holes. When mounting the LCD module make sure it is free of twisting, warping and distortion. In particular, do not forcibly pull or bend the cable or the backlight cable.
- Do not attempt to disassemble or process EastRising LCD module.
- NC terminal should be open. Do not connect anything.
- If the logic circuit power is off, do not apply the input signals.
- To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.
  -Be sure to ground the body when handling EastRising LCD modules.
  -Tools required for assembling, such as soldering irons, must be properly grounded.

-To reduce the amount of static electricity generated, do not conduct assembling and other work under dry conditions.
-The LCD module is coated with a film to protect the display surface. Exercise care when peeling off this protective film since static electricity may be generated.

14.2 Power Supply Precautions

- Identify and, at all times, observe absolute maximum ratings for both logic and LC drivers. Note that there is some variance between models.
- Prevent the application of reverse polarity to VDD and VSS, however briefly.
- Use a clean power source free from transients. Power-up conditions are occasionally jolting and may exceed the maximum ratings of EastRising modules.
- The VDD power of EastRising module should also supply the power to all devices that may access the display. Don’ t allow the data bus to be driven when the logic supply to the module is turned off.

14.3 Operating Precautions

- DO NOT plug or unplug EastRising module when the system is powered up.
- Minimize the cable length between EastRising module and host MPU.
- For models with backlights, do not disable the backlight by interrupting the HV line. Unload inverters produce voltage extremes that may arc within a cable or at the display.
- Operate EastRising module within the limits of the modules temperature specifications.

14.4 Mechanical/Environmental Precautions

- Improper soldering is the major cause of module difficulty. Use of flux cleaner is not recommended as they may seep under the electrometric connection and cause display failure.
- Mount EastRising module so that it is free from torque and mechanical stress.
- Surface of the LCD panel should not be touched or scratched. The display front surface is an easily scratched, plastic polarizer. Avoid contact and clean only when necessary with soft, absorbent cotton dampened with petroleum benzene.
- Always employ anti-static procedure while handling EastRising module.
- Prevent moisture build-up upon the module and observe the environmental constraints for storage tem
- Do not store in direct sunlight
- If leakage of the liquid crystal material should occur, avoid contact with this material, particularly ingestion. If the body or clothing becomes contaminated by the liquid crystal material, wash thoroughly with water and soap.

14.5 Storage Precautions

When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps.
Keep EastRising modules in bags (avoid high temperature / high humidity and low temperatures below 0 ºC.
Whenever possible, EastRising LCD modules should be stored in the same conditions in which they were shipped from our company.

14.6 Others

Liquid crystals solidify under low temperature (below the storage temperature range) leading to defective orientation or the generation of air bubbles (black or white). Air bubbles may also be generated if the module is subject to a low temperature.
If EastRising LCD modules have been operating for a long time showing the same display patterns, the display patterns may remain on the screen as ghost images and a slight contrast irregularity may also appear. A normal operating status can be regained by suspending use for some time. It should be noted that this phenomenon does not adversely affect performance reliability.
To minimize the performance degradation of the LCD modules resulting from destruction caused by static electricity etc., exercise care to avoid holding the following sections when handling the modules.
-Exposed area of the printed circuit board.
-Terminal electrode sections.

15. USING LCD MODULES

15.1 Liquid Crystal Display Modules

EastRising LCD is composed of glass and polarizer. Pay attention to the following items when handling.

- Please keep the temperature within specified range for use and storage. Polarization degradation, bubble generation or polarizer peel-off may occur with high temperature and high humidity.
- Do not touch, push or rub the exposed polarizers with anything harder than an HB pencil lead (glass, tweezers, etc.).
- N-hexane is recommended for cleaning the adhesives used to attach front/rear polarizers and reflectors made of organic substances which will be damaged by chemicals such as acetone, toluene, ethanol and isopropyl alcohol.
- When EastRising display surface becomes dusty, wipe gently with absorbent cotton or other soft material like chamois soaked in petroleum benzin. Do not scrub hard to avoid damaging the display surface.
- Wipe off saliva or water drops immediately, contact with water over a long period of time may cause deformation or color fading.
- Avoid contacting oil and fats.
- Condensation on the surface and contact with terminals due to cold will damage, stain or dirty the polarizers. After products are tested at low temperature they must be warmed up in a container before coming is contacting with room temperature air.
- Do not put or attach anything on EastRising display area to avoid leaving marks on.
- Do not touch the display with bare hands. This will stain the display area and degradate insulation between terminals (some cosmetics are determinated to the polarizers).
- As glass is fragile. It tends to become or chipped during handling especially on the edges. Please avoid dropping.

15.2 Installing LCD Modules

- Cover the surface with a transparent protective plate to protect the polarizer and LC cell.
- When assembling the LCM into other equipment, the spacer to the bit between the LCM and the fitting plate should have enough height to avoid causing stress to the module surface, refer to the individual specifications for measurements. The measurement tolerance should be±0.1mm.

15.3 Precaution for Handling LCD Modules

Since EastRising LCM has been assembled and adjusted with a high degree of precision; avoid applying excessive shocks to the module or making any alterations or modifications to it.

- Do not alter, modify or change the shape of the tab on the metal frame.
- Do not make extra holes on the printed circuit board, modify its shape or change the positions of components to be attached.
- Do not damage or modify the pattern writing on the printed circuit board.
- Absolutely do not modify the zebra rubber strip (conductive rubber) or heat seal connector.
- Except for soldering the interface, do not make any alterations or modifications with a soldering iron.
- Do not drop, bend or twist EastRising LCM.

15.4 Electro-Static Discharge Control

Since this module uses a CMOS LSI, the same careful attention should be paid to electrostatic discharge as for an ordinary CMOS IC.

- Make certain that you are grounded when handing LCM.
- Before remove LCM from its packing case or incorporating it into a set, be sure the module and your body have the same electric potential.
- When soldering the terminal of LCM, make certain the AC power source for the soldering iron does not leak.
- When using an electric screwdriver to attach LCM, the screwdriver should be of ground potentiality to minimize as much as possible any transmission of electromagnetic waves produced sparks coming from the commutator of the motor.
- As far as possible make the electric potential of your work clothes and that of the work bench the ground potential.
- To reduce the generation of static electricity be careful that the air in the work is not too dried. A relative humidity of 50%-60% is recommended.

15.5 Precaution for Soldering to EastRising LCM

- Observe the following when soldering lead wire, connector cable and etc. to the LCM.
  -Soldering iron temperature : 280℃±10℃
  -Soldering time: 3-4 sec.
  -Solder: eutectic solder.

If soldering flux is used, be sure to remove any remaining flux after finishing to soldering operation. (This does not apply in the case of a non-halogen type of flux.) It is recommended that you protect the LCD surface with a cover during soldering to prevent any damage due to flux spatters.

- When soldering the electroluminescent panel and PC board, the panel and board should not be detached more than three times. This maximum number is determined by the temperature and time conditions mentioned above, though there may be some variance depending on the temperature of the soldering iron.
- When remove the electroluminescent panel from the PC board, be sure the solder has completely melted, the soldered pad on the PCs board could be damaged.

15.6 Precaution for Operation

- Driving the EastRising LCD in the voltage above the limit shortens its life.
- Response time is greatly delayed at temperature below the operating temperature range. However, this does not mean the LCD will be out of the order. It will recover when it returns to the specified temperature range.
- If EastRising display area is pushed hard during operation, the display will become abnormal. However, it will return to normal if it is turned off and then back on.
- Condensation on terminals can cause an electrochemical reaction disrupting the terminal circuit. Therefore, it must be used under the relative condition of 40℃, 50% RH.
- When turning the power on, input each signal after the positive/negative voltage becomes stable.

15.7 Limited Warranty

Unless agreed between EastRising and customer, EastRising will replace or repair any of its LCD modules which are found to be functionally defective when inspected in accordance with EastRising LCD acceptance standards (copies available upon request) for a period of one year from date of shipments. Cosmetic/visual defects must be returned to EastRising within 90 days of shipment. Confirmation of such date shall be based on freight documents. The warranty liability of EastRising limited to repair and/or replacement on the terms set forth above. EastRising will not be responsible for any subsequent or consequential events.

15.8 Return Policy

No warranty can be granted if the precautions stated above have been disregarded. The typical examples of violations are:
-Broken LCD glass.
-PCB eyelet damaged or modified.
-PCB conductors damaged.
-Circuit modified in any way, including addition of components.
-PCB tampered with by grinding, engraving or painting varnish.
-Soldering to or modifying the bezel in any manner.
Module repairs will be invoiced to the customer upon mutual agreement. Modules must be returned with sufficient description of the failures or defects. Any connectors or cable installed by the customer must be removed completely without damaging the PCB eyelet’ s, conductors and terminals.

16. IMAGE STICKING

16.1 What is Image Sticking?

If you remain a fixed image on LCD Display for a long period of time, you may experience a phenomenon called Image Sticking. Image Sticking - sometimes also called "image retention" or "ghosting" - is a phenomenon where a faint outline of a previously displayed image remains visible on the screen when the image is changed. It can occur at variable levels of intensity depending on the specific image makeup, as well as the amount of time the core image elements are allowed to remain unchanged on the screen.

16.2 What Causes Image Sticking and How to Avoid?

1. The e-Paper display cannot be powered on for a long time, you must set e-Paper display to sleep mode or power off when it needn't refresh ,otherwise e-Paper keeps in high voltage status for long time which will damage e-Paper and cannot be fixed. We suggest customers to update e-Paper display every 24 hours or at least 10 days to update again. Otherwise, ghost of the last content may cannot be cleared.
It is also recommended that customer ships or stores the e-Paper display with completely white image to avoid image sticking issue and refresh

2. Three-color e-Paper display is normal to be a little "color" . You can refresh it to white to keep it upward for storage.

3. The e-Paper display ignores the data sent when it is in sleep mode, you need to initialize it for properly refreshing. The e-Paper display cannot refresh directly under sunlight. The refresh steps should be done indoor.

4. For those e-Paper displays which support partial refresh, you cannot use partial refresh all the time. A full refresh should be done to clear screen after several times (partial refresh), otherwise, e-Paper display will be damaged and cannot fixed.

17. STORAGE

We recommend customers to refresh three-color e-Paper displays one by one if storage period is more than half a year, otherwise the image on display may be unclear as below image shows.