10.85inch e-Paper

User Manual

Revision History

Version	Content	Date	Page
1.0	New creation	2025/03/06	All

Contents

1. OVERVIEW

The display is a 10.85inch TFT active matrix electrophoretic display, featuring a welldesigned interface and reference system. It boasts a resolution of 1360 × 480 pixels, offering 1-bit grayscale with full display capabilities in both black and white. Each panel is equipped with an integrated circuit that includes a gate buffer, source buffer, interface, timing control logic, oscillator, DC-DC converter, SRAM, look-up table (LUT), VCOM support, and border features.

2. FEATURES

- 1360 × 480 pixels display
- High contrast
- High reflectance
- Ultra wide viewing angle
- Ultra low power consumption
- Pure reflective mode
- Bi-stable display
- Commercial temperature range
- Landscape and portrait modes
- Hard-coat antiglare display surface
- Ultra low current deep sleep mode
- On-chip display RAM
- Waveform can be stored in on-chip OTP or written by MCU
- Serial peripheral interface available
- On-chip oscillator
- On-chip booster and regulator control for generating VCOM, Gate and Source driving voltage
- I2C signal master interface to read external temperature sensor
- Built-in temperature sensor

3. MECHANICAL AND OPTICAL SPECIFICATIONS

Parameter	Specifications	Unit	Remark
Screen Size	10.85	Inch	
Display Resolution	1360(H)×480(V)	Pixel	DPI:133
Active Area	259.76(H)×91.68(V)	mm	
Pixel Pitch	0.191×0.191	mm	
Pixel Configuration	Rectangle		
Outline Dimension	270.56(H)×105.92(V)×1.20(D)	mm	
Weight	66.8±0.5	g	

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units	Notes
KS	Black State L* value		-	18	20		3-1
	Black Ghosting ΔL		-	1	-		3-1
WS	White State L* value		66	67	-		3-1
	White Ghosting ΔL		-	1	-		3-1
R	White Reflectivity	White	30	34	-	%	3-1
CR	Contrast Ratio	Indoor	15:1	20:1	-		3-1 3-2
GN	2Grey Level	-	-	-	-		
Life		Temp:23±3°C Humidity:55±10%RH		5years			3-3

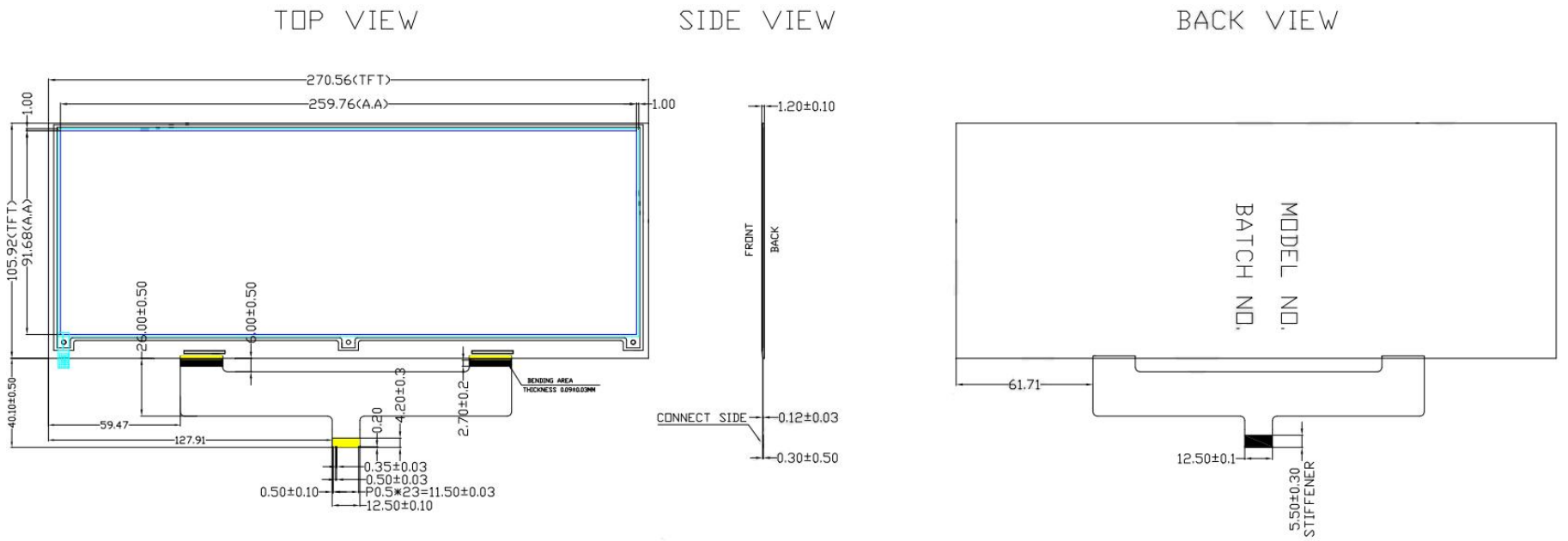
Notes:

3-1: Luminance meter: Eye-One Pro Spectrometer.

3-2: CR=Surface Reflectance with all white pixels/Surface Reflectance with all black pixels.

3-3: When the product is stored, the display screen should be kept white and face up.

4. MECHANICAL DRAWING OF EPD MODULE



Notes:

4-1: Display module 10.85″ array for EPD;

4-2: Driver IC: JD79686AB;

4-3: Resolution: 1360×480;

4-4: Pixel size: 0.191mm×0.191mm.

5. PIN ASSIGNMENT

NO.	Name	I/O	Description	Remark
1	CSB2	I	Chip select input pin	Note 5-1
2	GDR	O	N-Channel MOSFET Gate Drive Control	
3	RESE	I	Current Sense Input for the Control Loop	
4	NC	NC	Do not connect with other NC pins	Keep open
5	VSH2	C	Positive Source driving voltage 2	
6	TSCL	O	I2C Interface to digital temperature sensor Clock pin	Note 5-6
7	TSDA	I/O	I2C Interface to digital temperature sensor Data pin	Note 5-6
8	BS1	I	Bus Interface selection pin	Note 5-5
9	BUSY	O	Busy state output pin	Note 5-4
10	RES#	I	Reset signal input. Active Low	Note 5-3
11	D/C#	I	Data / Command control pin	Note 5-2
12	CS#	I	Chip select input pin	Note 5-1
13	SCL	I	Serial Clock pin (SPI)	
14	SDA	I/O	Serial Data pin (SPI)	
15	VDDIO	P	Power Supply for interface logic pins. It should be connected with VCI	
16	VCI	P	Power Supply for the chip	
17	VSS	P	Ground	
18	VDD	C	Core logic power pin VDD can be regulated internally from VCI. A capacitor should be connected between VDD and VSS	
19	VPP	P	FOR TEST	Keep open
20	VSH1	C	Positive Source driving voltage	
21	VGH	C	Power Supply pin for Positive Gate driving voltage and VSH1	
22	VSL	C	Negative Source driving voltage	
23	VGL	C	Power Supply pin for Negative Gate driving voltage VCOM and VSL	
24	VCOM	C	VCOM driving voltage	

I = Input Pin, O = Output Pin, I/O = Bi-directional Pin (Input/Output), P = Power Pin, C = Capacitor Pin

Notes:

5-1: This pin(CS#) is the chip select input pin connecting to the MCU. The chip is enabled for MCU communication only when CS# is pulled LOW.

5-2: This pin(D/C#) is Data/Command control pin connecting to the MCU in 4-wire SPI mode. When the pin is pulled HIGH, the data at SDA will be interpreted as data. When the pin is pulled LOW, the data at SDA will

be interpreted as command.

5-3: This pin(RES#) is reset signal input. The Reset is active low.

5-4: This pin is Busy state output pin. When Busy is Low, the operation of the chip should not be interrupted, the command should not be sent. The chip would put Busy pin Low when

- Outputting display waveform
- Communicating with digital temperature sensor

5-5: Bus interface selection pin.

5-6: This pin connects to the VSS if there is no external temperature sensor.

BS1 State	MPU Interface
L	4-line serial peripheral interface(SPI) - 8 bits SPI
H	3-line serial peripheral interface(SPI) - 9 bits SPI

6. ELECTRICAL CHARACTERISTICS

6.1 ABSOLUTE MAXIMUM RATING

Parameter	Symbol	Rating	Unit
Logic supply voltage	V_{CI}	-0.3 to +6.0	V
Logic Input voltage	V_{IN}	-0.3 to TBD	V
Operating Temp range	T_{OPR}	0 to +50	℃
Storage Temp range	T_{STG}	-25 to +70	℃
Optimal Storage Temp	T_{STGO}	23±3	℃
Optimal Storage Humidity	H_{STGO}	55±10	%RH

Note:

6-1-1: Maximum ratings are those values beyond which damages to the device may occur. Functional operations should be restricted to the limits in the Panel DC Characteristics table.

6.2 PANEL DC CHARACTERISTICS

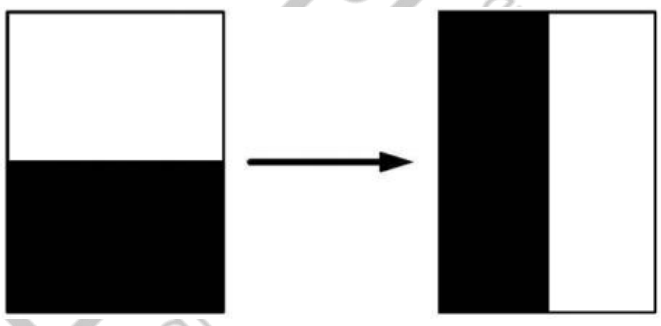
The following specifications apply for: V_{SS}=0V, V_{CI}=3.0V, T_{OPR} =25°C.

Parameter	Symbol	Condition	Applicable pin	Min.	Typ.	Max.	Unit
Single ground	V_{SS}	-	-	-	0	-	V
Logic supply voltage	V_{CI}	-	V_{CI}	2.3	3.0	3.6	V
Digital/Analog supply voltage	V_{DD}	-	V_{DD}	2.3	3.0	3.6	V
High level input voltage	V_{IH}	-	-	0.7V_{CI}	-	-	V
Low level input voltage	V_{IL}	-	-	GND	-	0.3V_{DD}	V
High level output voltage	V_{OH}	I_{OH} = 400 μA	-	V_{CI}-0.4	-	-	V
Low level output voltage	V_{OL}	I_{OL} = -400 μA	-	-	-	GND +0.4	V
Typical power	P_{TYP}	V_{CI}=3.0V	-	-	45	-	mW
Deep sleep mode	P_{STPY}	V_{CI}=3.0V	-	-	0.006	-	mW
Typical operating current	I_{opr}_V_{CI}	V_{CI}=3.0V	-		15		mA
Full update time	-	25℃	-	-	4	-	sec
Partial update time	-	25℃	-	-	0.4	-	sec
Typical peak current	I_{opr}_V_{CI}	2.3～3.6V	-	-	120	160	mA

Sleep mode current	$I_{slp}\_V_{CI}$	DC/DC OFF No clock No input load Ram data retain	-	-	40	-	μA
Deep sleep mode current	$I_{dslp}\_V_{CI}$	DC/DC OFF No clock No input load Ram data not retain	-	-	2	5	μA

Notes:

6-2-1: The typical power is measured with following transition from horizontal 2 scale pattern to vertical 2 scale pattern.



6-2-2: The deep sleep power is the consumed power when the panel controller is in deep sleep mode.

6-2-3: The listed electrical characteristics are only guaranteed under the controller & waveform provided by Waveshare.

6-2-4: Electrical measurement: Tektronix oscilloscope - MDO3024,
Tektronix current probe - TCP0030A.

6.3 PANEL AC CHARACTERISTICS

6.3.1 MCU Interface Selection

The pin assignment at different interface modes is summarized in Table 6-3-1. Different MCU modes can be set by hardware selection on BS1 pins. The display panel only supports 4-wire SPI or 3-wire SPI interface mode.

Pin Name	Data/Command Interface		Control Signal		
Bus interface	SDA	SCL	CS#	D/C#	RES#
BS1=L 4-wire SPI	SDA	SCL	CS#	D/C#	RES#
BS1=H 3-wire SPI	SDA	SCL	CS#	L	RES#

Table 6-3-1: MCU interface assignment under different bus interface modes

6.3.2 MCU Serial Interface (4-wire SPI)

The serial interface consists of serial clock SCL, serial data SDA, D/C#, CS#. This interface supports Write mode and Read mode.

Function	CS#	D/C#	SCL
Write command	L	L	↑
Write data	L	H	↑

Note: ↑ stands for rising edge of signal

Table 6-3-2: Control pins of 4-wire Serial Peripheral Interface

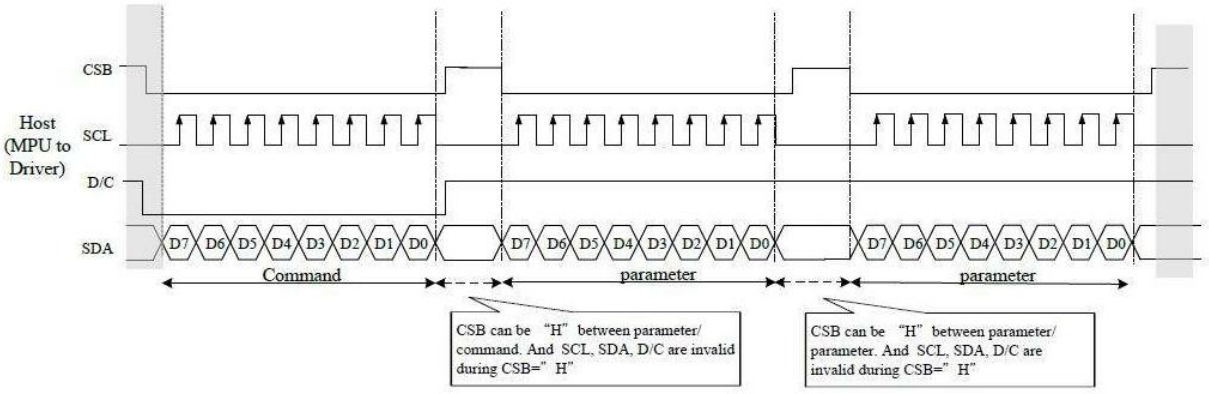


Figure 6-3-1: 4-wire SPI mode

6.3.3 MCU Serial Interface (3-wire SPI)

Function	CS#	D/C#	SCL
Write command	L	Tie	↑
Write data	L	Tie	↑

Note: ↑ stands for rising edge of signal

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

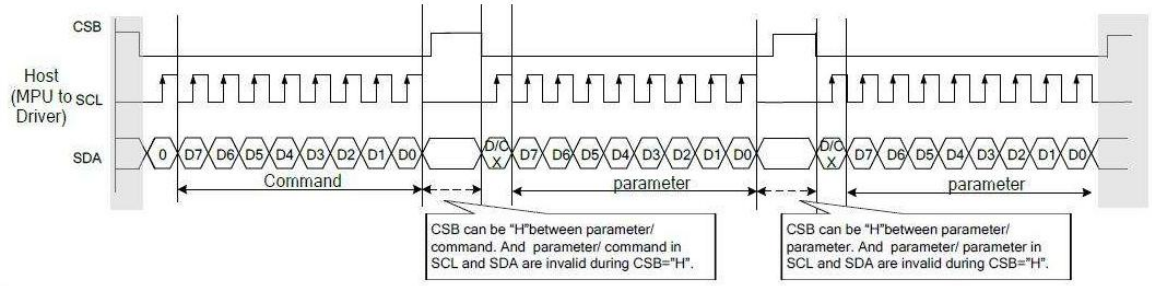
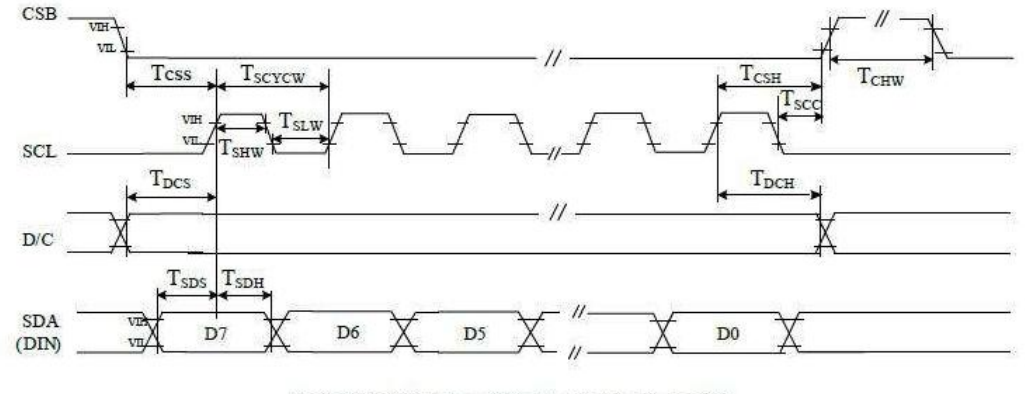
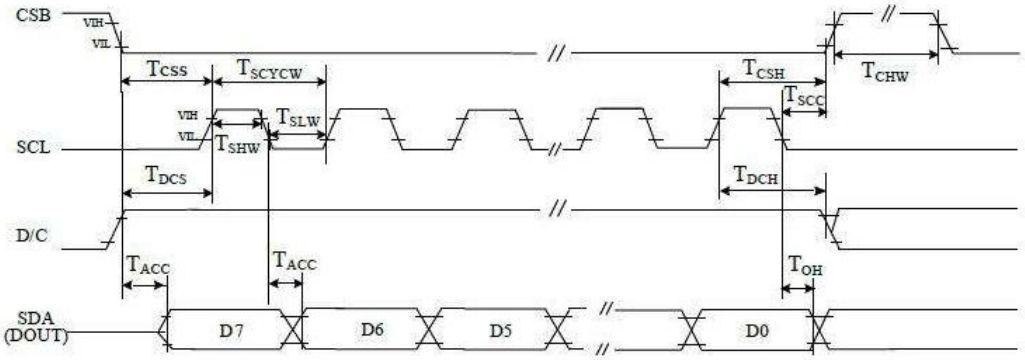


Figure 6-3-2: 3-wire SPI mode

6.3.4 Interface Timing



4 pin serial interface characteristics(write mode)



4 pin serial interface characteristics (read mode)

Figure 6-3-3: 4-pin serial interface characteristics

Symbol	Signal	Parameter	Min.	Typ.	Max.	Unit
T_{CSS}	CS#	Chip Select Setup Time	100	-	-	ns
T_{CSH}		Chip Select Hold Time	100	-	-	ns
T_{SCC}		Chip Select Setup Time	50	-	-	ns
T_{CHW}		Chip Select Setup Time	500	-	-	ns
T_{SCYCW}	SCLK	Serial clock cycle (write)	100	-	-	ns
T_{SHW}		SCL “H” pulse width (write)	35	-	-	ns
T_{SLW}		SCL “L” pulse width (write)	35	-	-	ns
T_{SCYCR}		Serial clock cycle (Read)	200	-	-	ns
T_{SHR}		SCL “H” pulse width (Read)	85	-	-	ns
T_{SLR}		SCL “L” pulse width (Read)	85	-	-	ns
T_{SDS}	SDIN (DIN) (DOUT)	Data setup time	30	-	-	ns
T_{SDH}		Data hold time	30	-	-	ns
T_{ACC}		Access time	10	-	-	ns
T_{OH}		Output disable time	15	-	-	ns

Table 6-3-4: Serial Interface Timing Characteristics

7. COMMAND TABLE

No.	Command	W/R	C/D	D7	D6	D5	D4	D3	D2	D1	D0	Default
1	Panel Setting (PSR)	W	0	0	0	0	0	0	0	0	0	00h
		W	1	RES[1]	RES[0]	REG-EN	BWR	UD	SHL	SHD-N	RST-N	8Fh
2	Power Setting (PWR)	W	0	0	0	0	0	0	0	0	1	01H
		W	1	-	-	-	-	-	-	VDS_EN	VDG_EN	03h
		W	1	-	-	-	-	VCOM_HV	VGHL_LV [2]	VGHL_LV [1]	VGHL_LV [0]	00h
		W	1	-	-	VSH [5]	VSH [4]	VSH [3]	VSH [2]	VSH [1]	VSH [0]	3Fh
		W	1	-	-	VSL [5]	VSL [4]	VSL [3]	VSL [2]	VSL [1]	VSL [0]	3bh
		W	1	-	VSHR [6]	VSHR [5]	VSHR [4]	VSHR [3]	VSHR [2]	VSHR [1]	VSHR [0]	0Fh
3	Power OFF (POF)	W	0	0	0	0	0	0	0	1	0	02H
4	Power OFF Sequence Setting (PFS)	W	0	0	0	0	0	0	0	1	1	03H
		W	1	-	-	T_VDS_OFF[1]	T_VDS_OFF[0]	-	-	-	-	00h
5	Power ON (PON)	W	0	0	0	0	0	0	1	0	0	04H
6	Power ON Measure Command	W	0	0	0	0	0	0	1	0	1	05H
7	Booster Soft Start (BTST)	W	0	0	0	0	0	0	1	1	0	06H
		W	1	BT_PHA7	BT_PHA6	BT_PHA5	BT_PHA4	BT_PHA3	BT_PHA2	BT_PHA1	BT_PHA0	17h
		W	1	BT_PHB7	BT_PHB6	BT_PHB5	BT_PHB4	BT_PHB3	BT_PHB2	BT_PHB1	BT_PHB0	17h
		W	1	-	-	BT_PHC5	BT_PHC4	BT_PHC3	BT_PHC2	BT_PHC1	BT_PHC0	17h
8	Deep Sleep (DSLP)	W	0	0	0	0	0	0	1	1	1	07H
		W	1	1	0	1	0	0	1	0	1	A5h
9	Data Start Transmission 1 (DTM1)	W	0	0	0	0	1	0	0	0	0	10H
		W	1	#	#	#	#	#	#	#	#	00H
10	Data Stop (DSP)	W	0	0	0	0	1	0	0	0	1	11H
		W	1	Data_flag	-	-	-	-	-	-	-	--
11	Display Refresh (DRF)	W	0	0	0	0	1	0	0	1	0	12h
12	Data Start transmission 2 (DTM2)	W	0	0	0	0	1	0	0	1	1	13H
		W	1	#	#	#	#	#	#	#	#	00h
13	Partial Data Start	W	0	0	0	0	1	0	1	0	0	14H

	transmission 1 (PDTM1)	W	1	#	#	#	#	#	#	#	#	00h
14	Partial Data Start	W	0	0	0	0	1	0	1	0	1	15H
	transmission 2 (PDTM2)	W	1	#	#	#	#	#	#	#	#	00h
15	Partial Display Refresh	W	0	0	0	0	1	0	1	1	0	16H
	(PDRF)	W	1	#	#	#	#	#	#	#	#	00h
16	LUT for VCOM (LUT1)	W	0	0	0	1	0	0	0	0	0	20H
		W	1	#	#	#	#	#	#	#	#	00h
17	White to White LUT	W	0	0	0	1	0	0	0	0	1	21H
	(LUTWW)	W	1	#	#	#	#	#	#	#	#	00h
18	Black to White LUT	W	0	0	0	1	0	0	0	1	0	22H
	(LUTBW/LUTR)	W	1	#	#	#	#	#	#	#	#	00h
19	White to Black LUT	W	0	0	0	1	0	0	0	1	1	23H
	(LUTWB/LUTW)	W	1	#	#	#	#	#	#	#	#	00h
20	Black to Black LUT	W	0	0	0	1	0	0	1	0	0	24H
	(LUTBB/LUTB)	W	1	#	#	#	#	#	#	#	#	00h
21	LUTC option	W	0	0	0	1	0	0	1	0	1	25H
		W	1							XON [9:8]		00h
		W	1	XON [7:0]								00h
		W	1							ST_CHV [9:8]		00h
		W	1	ST_CHV [7:0]								00h
22	Set Vcom/Red states	W	0	0	0	1	0	0	1	1	0	26H
		W	1	0	0			vcom_stg_sel [1:0]		b2w_stg_sel [1:0]		00h
23	OSC control (OSC)	W	0	0	0	1	1	0	0	0	0	30H
		W	1				M[2:0]			N[2:0]		3Ah
24	Temperature Sensor	W	0	0	1	0	0	0	0	0	0	40H
	Command (TSC)	R	1	D10/TS [7]	D9/TS [6]	D8/TS [5]	D7/TS [4]	D6/TS [3]	D5/TS [2]	D4/TS [1]	D3/TS [0]	-
		R	1	D2	D1	D0	-	-	-	-	-	-
25	Temperature Sensor	W	0	0	1	0	0	0	0	0	1	41H
	Calibration (TSE)	W	1	TSE	-	-		TO [3]	TO [2]	TO [1]	TO [0]	00h
26	Temperature Sensor	W	0	0	1	0	0	0	0	1	0	42H
	Write (TSW)	W	1	WATTR [7]	WATTR [6]	WATTR [5]	WATTR [4]	WATTR [3]	WATTR [2]	WATTR [1]	WATTR [0]	00h
		W	1	WMSB [7]	WMSB [6]	WMSB [5]	WMSB [4]	WMSB [3]	WMSB [2]	WMSB [1]	WMSB [0]	00h
		W	1	WLSB [7]	WLSB [6]	WLSB [5]	WLSB [4]	WLSB [3]	WLSB [2]	WLSB [1]	WLSB [0]	00h
27	Temperature Sensor	W	0	0	1	0	0	0	0	1	1	43H
	Read (TSR)	R	1	RMSB [7]	RMSB [6]	RMSB [5]	RMSB [4]	RMSB [3]	RMSB [2]	RMSB [1]	RMSB [0]	-

		R	1	RLSB [7]	RLSB [6]	RLSB [5]	RLSB [4]	RLSB [3]	RLSB [2]	RLSB [1]	RLSB [0]	-
28	Vcom and data interval setting (CDI)	W	0	0	1	0	1	0	0	0	0	50H
		W	1	VBD[1]	VBD[0]	DDX[1]	DDX[0]	CDI[3]	CDI[2]	CDI[1]	CDI[0]	D7h
29	Lower Power Detection (LPD)	W	0	0	1	0	1	0	0	0	1	51H
		R	1	-	-	-	-	-	-	-	LPD	-
30	TCON setting (TCON)	W	0	0	1	1	0	0	0	0	0	60H
		W	1	S2G[3]	S2G[2]	S2G[1]	S2G[0]	G2S[3]	G2S[2]	G2S[1]	G2S[0]	22h
31	TCON resolution (TRES)	W	0	0	1	1	0	0	0	0	1	61H
		W	1	HRES [7]	HRES [6]	HRES [5]	HRES [4]	HRES [3]	-	-	-	00h
		W	1	-	-	-	-	-	-	-	VRES[8]	00h
		W	1	VRES [7]	VRES [6]	VRES [5]	VRES [4]	VRES [3]	VRES [2]	VRES [1]	VRES [0]	00h
32	Source & gate start setting	W	0	0	1	1	0	0	0	1	0	62H
		W	1	S_start [7]	S_start [6]	S_start [5]	S_start [4]	S_start [3]	-	-	-	00h
		W	1				gscan				G_start [8]	00h
		W	1	G_start [7]	G_start [6]	G_start [5]	G_start [4]	G_start [3]	G_start [2]	G_start [1]	G_start [0]	00h
33	Revision (REV)	W	0	0	1	1	1	0	0	0	0	70H
		R	1	REV[7]	REV[6]	REV[5]	REV[4]	REV[3]	REV[2]	REV[1]	REV[0]	-
		R	1	REV [15]	REV[14]	REV[13]	REV[12]	REV[11]	REV[10]	REV[9]	REV[8]	-
34	Get Status (FLG)	W	0	0	1	1	1	0	0	0	1	71H
		R	1	-	PTL_ flag	I2C_ ERR	I2C_ BUSYN	Data_ flag	PON	POF	BUSY_ N	-
35	Auto Measurement Vcom (AMV)	W	0	1	0	0	0	0	0	0	0	80H
		W	1	-	-	AMVT [1]	AMVT [0]	XON	AMVS	AMV	AMVE	10h
36	Read Vcom Value (VV)	W	0	1	0	0	0	0	0	0	1	81H
		R	1	-	-	VV[5]	VV[4]	VV[3]	VV[2]	VV[1]	VV[0]	-
37	VCM_DC Setting (VDCS)	W	0	1	0	0	0	0	0	1	0	82H
		W	1	-	-	VCDS [5]	VCDS [4]	VCDS [3]	VCDS [2]	VCDS [1]	VCDS [0]	1Fh
38	Program Mode (PGM)	W	0	1	0	1	0	0	0	0	0	A0H
		W	1	1	0	1	0	0	1	0	1	A5h
39	Active program (APG)	W	0	1	0	1	0	0	0	0	1	A1H
40	Read OTP Data (ROTP)	W	0	1	0	1	0	0	0	1	0	A2H
		R	1	#	#	#	#	#	#	#	#	-

41	Force Temperature	W	0	1	1	1	0	0	1	0	1	E5H
		W	1	TS_SET [7]	TS_SET [6]	TS_SET [5]	TS_SET [4]	TS_SET [3]	TS_SET [2]	TS_SET [1]	TS_SET [0]	00h
42	LVD voltage Select	W	0	1	1	1	0	0	1	1	0	E6H
		W	1	-	-	-	-	-	-	LVD_SEL [1]	LVD_SEL [0]	11h
43	Panel Break Check	W	0	1	1	1	0	0	1	1	1	E7H
		R	1	-	-	-		-	-	-	PSTA	-
44	Power saving	W	0	1	1	1	0	1	0	0	0	E8H
		W	1	VCOM_W[3]	VCOM_W[2]	VCOM_W[1]	VCOM_W[0]	SD_W [3]	SD_W [2]	SD_W [1]	SD_W [0]	00h
45	AUTO sequence	W	0	1	1	1	0	1	0	0	1	E9H
		W	1	1	0	1	0	0	1	0	1	00h
46	OTP LUT backup1 program	W	0	1	1	1	0	1	0	1	1	EBH
47	Read OTP LUT backup1	W	0	1	1	1	0	1	1	0	0	ECH
		R	1	#	#	#	#	#	#	#	#	-
48	OTP LUT backup2 program	W	0	1	1	1	0	1	1	0	1	EDH
		R	1	#	#	#	#	#	#	#	#	-
49	Read OTP LUT backup2	W	0	1	1	1	0	1	1	1	0	EEH
50	Checksum Program to OTP	W	0	1	1	1	0	1	1	1	1	EFH
51	Remap LUT	W	0	1	1	1	1	0	0	0	0	F0H
		W	1	-	-	-	bkup_lut_2_en	rmp2_table_sel [3]	rmp2_table_sel [2]	rmp2_table_sel[1]	rmp2_table_sel [0]	1Fh
		W	1	-	-	-	bkup_lut_1_en	rmp1_table_sel [3]	rmp1_table_sel [2]	rmp1_table_sel[1]	rmp1_table_sel [0]	1Fh
52	Set OTP program	W	0	1	1	1	1	0	0	0	1	F1H
		W	1	-	-	-	-	-	-	LUT_bank	reg_bank	03h
53	Read checksum	W	0	1	1	1	1	0	0	1	0	F2H
		R	1	#	#	#	#	#	#	#	#	00h
54	Calculate Checksum	W	0	1	1	1	1	0	0	1	1	F3H

Command Description

W/R: 0:Write Cycle /1:Read Cycle C/D: 0: Command / 1: Data D7～D0: -:Don't Care

1) Panel Setting (PSR) (R00H)

R00H	Bit									
Inst/Para	R/W	D/CX	D7	D6	D5	D4	D3	D2	D1	D0
PSR	W	0	0	0	0	0	0	0	0	0
1st Parameter	W	1	RES[1]	RES[0]	REG_EN	BWR	UD	SHL	SHD_N	RST_N

The command defines as:

Bit	Name	Description
0	RST_N	RST_N function 1 : no effect. (default) 0: Booster OFF, Register data are set to their default values, and SEG/BG/VCOM:floating
1	SHD_N	SHD_N function 0 : Booster OFF, register data are kept, and SEG/BG/VCOM are kept floating. 1 : Booster on. **(default)**
2	SHL	SHL function 0: Shift left; First data=Sn →Sn-1 → …→S2 →Last data=S1. 1: Shift right: First data=S1→ S2 → …→Sn-1 → Last data=Sn. **(default)**
3	UD	UD function 0:Scan down; First line=Gn→Gn-1 →…→ G2 → Last line=G1. 1:Scan up; First line=G1 →G2 →…→Gn-1 →Last line=Gn. **(default)**
4	BWR	Color selection setting 0: Pixel with B/W/Red. Run both LU1 and LU2. **(default)** 1: Pixel with B/W. Run LU1 only
5	REG_EN	LUT selection setting 0 : Using LUT from OTP**(default)** 1 : Using LUT from register
7-6	RES[1,0]	Resolution setting 00: Display resolution is 600x448 01: Display resolution is 640x480 10: Display resolution is 720x540 11: Display resolution is 800x600 (default)

Notes:

1. When SHD_N become low, DCDC will be turned off. Register and SRAM data will be kept until VDD is turned off. SD output and VCOM will be based on the previous condition and keep floating.
2. When RST_N become low, the driver will be reset. All register data will be reset to default values. All of the driver's functions will be disabled. SD output and VCOM will be based on the previous condition and keep floating.

2) Power setting Register (PWR) (R01H)

R01H	Bit									
Inst/Para	R/W	D/CX	D7	D6	D5	D4	D3	D2	D1	D0
PWR	W	0	0	0	0	0	0	0	0	1
1st Parameter	W	1	-	-	-	-	-	-	VDS_EN	VDG_EN
2nd Parameter	W	1	-	-	-	-	VCOM_HV	VGHL_LV [2]	VGHL_LV [1]	VGHL_LV [0]
3rd Parameter	W	1	-	-	VSH [5]	VSH [4]	VSH [3]	VSH [2]	VSH [1]	VSH [0]
4th Parameter	W	1	-	-	VSL [5]	VSL [4]	VSL [3]	VSL [2]	VSL [1]	VSL [0]
5th Parameter	W	1	-	VSHR [6]	VSHR [5]	VSHR [4]	VSHR [3]	VSHR [2]	VSHR [1]	VSHR [0]

The command defines as:

1st Parameter:

Bit	Name	Description
0	VDG_EN	**Gate power selection.** 0 : External VDNS power from VGH/VGL pins. (VDNG_EN open) 1 : Internal DCDC function for generate VGH/VGL. (default)
1	VDS_EN	**Source power selection.** 0 : External source power from VSH/VSL pins. 1 : Internal DC/DC function for generate VSH/VSL. (default)

2nd Parameter:

Bit	Name	Description
2-0	VGHL_LV	**VGHL_LV Voltage Level.** 000: VGH=20 v, VGL=-20v (default) 001: VGH=19 v, VGL=-19v 010: VGH=18 v, VGL=-18v 011: VGH=17 v, VGL=-17v 100: VGH=16 v, VGL=-16v 101: VGH=15 v, VGL=-15v 110: VGH=14 v, VGL=-14v 111: VGH=13 v, VGL=-13v
3	VCOM_HV	**VCOM Voltage Level** 0: VCOMH=VSH+VCOMDC,VCOML=VSL+VCOMDC(default) 1: VCOMH=VGH, VCOML=VGL

3rd Parameter: Internal VSH power selection for B/W LUT. (Default value: 111111b)

Bit	Name	Description
5-0	**VSH**	**Internal VSH power selection.** 000000: 2.4 v 000001: 2.6 v 000010: 2.8 v 000011: 3.0 v
		010111: 7.0V 011000: 7.2 V 011001: 7.4 V .... 111010: 14.0V 111011: 14.2 V 111100: 14.4V 111101: 14.6V 111110: 14.8V 111111: 15.0V

4th Parameter: Internal VSL power selection for B/W LUT. (Default value: 111111b)

Bit	Name	Description
5-0	VSL	Internal VSL power selection. 000000: -2.4 v 000001: -2.6 v 000010: -2.8 v 000011: -3.0 v .... 010111: -7.0V 011000: -7.2 V 011001: -7.4 V .... 111010 :-14.0V 111011: -14.2 V 111100: -14.4 V 111101: -14.6V 111110: -14.8V 111111: -15.0V

5th Parameter: Internal VSHR power selection for Red LUT. (Default value: 00001111b)

Bit	Name	Description
6-0	VSHR	Internal VSL power selection. 0000000: 2.4 v 0000001: 2.5 v 0000010: 2.6 v 0000011: 2.7 v .... 0101110: 7.0 V 0101111: 7.1 V 0110000: 7.2 V .... 1010001: 10.5V 1010010: 10.6 V 1010011: 10.7 V 1010100: 10.8V 1010101: 10.9V 1010110: 11.0V

Note: VSH>VSHR

3) Power OFF Command (POF) (R02H)

R02H	Bit									
Inst/Para	R/W	D/CX	D7	D6	D5	D4	D3	D2	D1	D0
POF	W	0	0	0	0	0	0	0	1	0

The command defines as:

After the power off command, the driver will power off based on power off sequence.

After the power off command, BUSY_N signal will drop from high to low. When the power off sequence is finished, BUSY_N signal will rise from low to high.

Power off command will turn off charge pump, T-con, source driver, gate driver, VCOM, and temperature sensor, but register and SRAM data will be kept until VDD is turned off.

SD output and VCOM will keep floating.

4) Power off Sequence Setting Register (PFS) (R03H)

R03H	Bit									
Inst/Para	R/W	D/CX	D7	D6	D5	D4	D3	D2	D1	D0
PFS	W	0	0	0	0	0	0	0	1	1
1st Parameter	W	1	-	-	Vsh_off[1]	Vsh_off[0]	Vsl_off[1]	Vsl_off[0]	Vshr_off[1]	Vshr_off[0]

The command defines as:

Bit	Name	Description
1-0	vshr_off	00: 5ms. (default) 01: 10ms 10: 20ms 11: 40ms
3-2	vsl_off	00: 5ms. (default) 01: 10ms 10: 20ms 11: 40ms
5-4	vsh_off	00: 5ms. (default) 01: 10ms 10: 20ms 11: 40ms

5) Power ON Command (PON) (R04H)

R04H	Bit									
Inst/Para	R/W	D/CX	D7	D6	D5	D4	D3	D2	D1	D0
PON	W	0	0	0	0	0	0	1	0	0

The command defines as:

After the power on command, the driver will power on based on power on sequence.

After the power on command, BUSY_N signal will drop from high to low. When the power off sequence is finished, BUSY_N signal will rise from low to high.

6) Power ON Measure Command (PMES) (R05H)

R05H	Bit									
Inst/Para	R/W	D/CX	D7	D6	D5	D4	D3	D2	D1	D0
PMES	W	0	0	0	0	0	0	1	0	1

The command defines as:

If the user wants to read temperature sensor or detect low power in power off mode, the user has to send this command.

After the power on measure command, the driver will switch on relevant commands with Low Power detection (R51H) and Temperature measurement (R40H).

7) Booster Soft Start Command (BTST) (R06H)

R06H	Bit									
Inst/Para	R/W	D/CX	D7	D6	D5	D4	D3	D2	D1	D0
BTST	W	0	0	0	0	0	0	1	1	0
1st Parameter	W	1	BT_PHA7	BT_PHA6	BT_PHA5	BT_PHA4	BT_PHA3	BT_PHA2	BT_PHA1	BT_PHA0
2nd Parameter	W	1	BT_PHB7	BT_PHB6	BT_PHB5	BT_PHB4	BT_PHB3	BT_PHB2	BT_PHB1	BT_PHB0
3rd Parameter	W	1	-	-	BT_PHC5	BT_PHC4	BT_PHC3	BT_PHC2	BT_PHC1	BT_PHC0

The command defines as follows:

1st Parameter:

Bit	Name	Description
2-0	**Driving strength of phase A**	000: period1 001: period2 010: period3 011: period4 100: period5 101: period6 110: period7 111: period8
5-3		000: Strength 1 001: Strength 2 010: Strength 3 (default) 011: Strength 4 100: Strength 5 101: Strength 6 110: Strength 7 111: Strength 8
7-6	**Soft start period of phase A**	00: 10mS (default) 01: 20mS 10: 30mS 11: 40mS

2nd Parameter:

Bit	Name	Description
2-0	**Driving strength of phase B**	000: period1 001: period2 010: period3 011: period4 100: period5 101: period6 110: period7 111: period8
5-3		000: Strength 1 001: Strength 2 010: Strength 3 (default) 011: Strength 4 100: Strength 5 101: Strength 6 110: Strength 7 111: Strength 8
7-6	**Soft start period of phase B**	00: 10mS (default) 01: 20mS 10: 30mS 11: 40mS

3rd Parameter:

Bit	Name	Description
2-0	**Minimum OFF time setting of GDR in phase C**	000: period1 001: period2 010: period3 011: period4 100: period5 101: period6 110: period7 111: period8
5-3	**Driving strength of phase C**	000: Strength 1 001: Strength 2 010: Strength 3 (default) 011: Strength 4 100: Strength 5 101: Strength 6 110: Strength 7 111: Strength 8

8) Deep Sleep (DSLP) (R07H)

R07H	Bit									
Inst/Para	R/W	D/CX	D7	D6	D5	D4	D3	D2	D1	D0
DSLP	W	0	0	0	0	0	0	1	1	1
1st Parameter	W	1	1	0	1	0	0	1	0	1

The command defines as follows:

After this command is transmitted, the chip would enter the deep-sleep mode to save power.

The deep sleep mode would return to standby by hardware reset.

The only one parameter is a check code, the command would be excited if check code=0xA5.

9) Data Start transmission 1 Register (DTM1) (R10H)

R10H	Bit									
Inst/Para	R/W	D/CX	D7	D6	D5	D4	D3	D2	D1	D0
DTM1	W	0	0	0	0	1	0	0	0	0
1st Parameter	W	1	KPixel1	KPixel2	KPixel3	KPixel4	KPixel5	KPixel6	KPixel7	KPixel8
2nd Parameter	W	1								
...	W	1								
Mth Parameter	W	1	KPixel(n-7)	KPixel(n-6)	KPixel(n-5)	KPixel(n-4)	KPixel(n-3)	KPixel(n-2)	KPixel(n-1)	KPixel(n)

The command defines as follows:

The register indicates that the user starts to transmit data, then writes to SRAM. While data transmission complete, the user must send command 11H. Then the chip will start to send data/VCOM for the panel.

In B/W mode, this command writes “OLD” data to SRAM.

In B/W/Red mode, this command writes “B/W” data to SRAM.

10) Display Refresh Command (DRF) (R12H)

R12H	Bit									
Inst/Para	R/W	D/CX	D7	D6	D5	D4	D3	D2	D1	D0
DRF	W	0	0	0	0	1	0	0	1	0

The command defines as follows:

While the user sends this command, the driver will refresh display (data/VCOM) based on SRAM data and LUT.

After the display refresh command, BUSY_N signal will become “0”.

11) Data Start transmission 2 Register (DTM2) (R13H)

R13H	Bit									
Inst/Para	R/W	D/CX	D7	D6	D5	D4	D3	D2	D1	D0
DTM2	W	0	0	0	0	1	0	0	1	1
1st Parameter	W	1	KPixel1	KPixel2	KPixel3	KPixel4	KPixel5	KPixel6	KPixel7	KPixel8

2nd Parameter	W	1								
...	W	1								
Mth Parameter	W	1	KPixel(n-7)	KPixel(n-6)	KPixel(n-5)	KPixel(n-4)	KPixel(n-3)	KPixel(n-2)	KPixel(n-1)	KPixel(n)

The command defines as follows:

The register indicates that the user starts to transmit data, then writes to SRAM. While data transmission complete, the user must send command 11H. Then the chip will start to send data/VCOM for the panel.

In B/W mode, this command writes “NEW” data to SRAM.

In B/W/Red mode, this command writes “RED” data to SRAM.

12) LUT for VCOM (LUTC) (R20H)

R20H	Bit									
Inst/Para	R/W	D/CX	D7	D6	D5	D4	D3	D2	D1	D0
LUTC	W	0	0	0	1	0	0	0	0	0
1st Parameter	W	1	1st Level selection [1:0]		2nd Level selection [1:0]		3rd Level selection [1:0]		4th Level selection [1:0]	
2nd Parameter	W	1	1st Frame number [7:0]							
3rd Parameter	W	1	2nd Frame number [7:0]							
4th Parameter	W	1	3rd Frame number [7:0]							
5th Parameter	W	1	4th Frame number [7:0]							
6th Parameter	W	1	Repeat numbers [7:0]							
7th～13th Parameter	W	1	2nd state							
...	W	1	3rd～9th state							
55th～60th Parameter	W	1	10th state							

The command defines as follows:

This register is set for VCOM LUT.

This command stores VCOM Look-Up Table with 10 states of data. Each group contains information for one state and is stored with 6 bytes, while the sixth byte indicates how many times that the phase will repeat.

If BWR=0 (BWR mode), the user could choose 7~10 groups by R26H (SET_STG).

If BWR=1 (BW mode), only 7 groups are used.

define	description
Level selection [1:0]	00: -VCM_DC 01: VSH+VCM_DC. 10: VSL+VCM_DC. 11: Floating.
Frame number [7:0]	00000000 :0 frame 00000001: 1 frame ... 11111110: 254 frame 11111111: 255 frame
Repeat numbers [7:0]	00000000 : 0 00000001: 1 ... 11111110: 254 11111111: 255

13) White to White LUT Register (LUTWW) (R21H)

R21H	Bit									
Inst/Para	R/W	D/CX	D7	D6	D5	D4	D3	D2	D1	D0
LUTWW	W	0	0	0	1	0	0	0	0	1
1st Parameter	W	1	1st Level selection [1:0]		2nd Level selection [1:0]		3rd Level selection [1:0]		4th Level selection [1:0]	
2nd Parameter	W	1	1st Frame number [7:0]							
3rd Parameter	W	1	2nd Frame number [7:0]							
4th Parameter	W	1	3rd Frame number [7:0]							
5th Parameter	W	1	4th Frame number [7:0]							
6th Parameter	W	1	Repeat numbers [7:0]							
7th～13th Parameter	W	1	2nd state							
...	W	1	3rd～9th state							
55th～60th Parameter	W	1	10th state							

The command defines as:

This command stores White-to-White Look-Up Table with 7 groups of data. Each group contains information for one state and is stored with 6 bytes, while the sixth byte indicates how many times that the phase will repeat.

define	description
Level selection [1:0]	00: GND 01: VSH 10: VSL 11: VSHR
Frame number [7:0]	00000000 :0 frame 00000001: 1 frame . 11111110: 254 frame 11111111: 255 frame
Repeat numbers [7:0]	00000000 : 0 time 00000001: 1 time . 11111110: 254 times 11111111: 255 times

14) Black to White LUT or Red LUT Register (LUTBW/LUTR) (R22H)

R22H	Bit									
Inst/Para	R/W	D/CX	D7	D6	D5	D4	D3	D2	D1	D0
LUTBW/LUTR	W	0	0	0	1	0	0	0	1	0
1st Parameter	W	1	1st Level selection [1:0]		2nd Level selection [1:0]		3rd Level selection [1:0]		4th Level selection [1:0]	
2nd Parameter	W	1	1st Frame number [7:0]							
3rd Parameter	W	1	2nd Frame number [7:0]							
4th Parameter	W	1	3rd Frame number [7:0]							
5th Parameter	W	1	4th Frame number [7:0]							

6th Parameter	W	1	Repeat numbers [7:0]
7th～13th Parameter	W	1	2nd state
...	W	1	3rd～9th state
55th～60th Parameter	W	1	10th state

The command defines as:

This command stores White-to-White Look-Up Table with 10 groups of data. Each group contains information for one state and is stored with 6 bytes, while the sixth byte indicates how many times that the phase will repeat.

define	description
Level selection [1:0]	00: GND 01: VSH 10: VSL 11: VSHR
Frame number [7:0]	00000000 :0 frame 00000001: 1 frame . 11111110: 254 frame 11111111: 255 frame
Repeat numbers [7:0]	00000000 : 0 time 00000001: 1 time . 11111110: 254 times 11111111: 255 times

15) White to Black LUT or White LUT Register (LUTWB/LUTW) (R23H)

R23H	Bit									
Inst/Para	R/W	D/CX	D7	D6	D5	D4	D3	D2	D1	D0
LUTWB/LUTW	W	0	0	0	1	0	0	0	1	1
1st Parameter	W	1	1st Level selection [1:0]		2nd Level selection [1:0]		3rd Level selection [1:0]		4th Level selection [1:0]	
2nd Parameter	W	1	1st Frame number [7:0]							
3rd Parameter	W	1	2nd Frame number [7:0]							
4th Parameter	W	1	3rd Frame number [7:0]							
5th Parameter	W	1	4th Frame number [7:0]							
6th Parameter	W	1	Repeat numbers [7:0]							
7th～13th Parameter	W	1	2nd state							
...	W	1	3rd～9th state							
55th～60th Parameter	W	1	10th state							

The command defines as:

This command stores White-to-White Look-Up Table with 7 groups of data. Each group contains information for one state and is stored with 6 bytes, while the sixth byte indicates how many times that the phase will repeat.

define	description
Level selection [1:0]	00: GND 01: VSH 10: VSL 11: VSHR
Frame number [7:0]	00000000 :0 frame 00000001: 1 frame . 11111110: 254 frame 11111111: 255 frame
Repeat numbers [7:0]	00000000 : 0 time 00000001: 1 time . 11111110: 254 times 11111111: 255 times

16) Black to Black LUT or Black LUT Register (LUTBB/LUTB) (R24H)

R24H	Bit									
Inst/Para	R/W	D/CX	D7	D6	D5	D4	D3	D2	D1	D0
LUTBB/LUTB	W	0	0	0	1	0	0	1	0	0
1st Parameter	W	1	1st Level selection [1:0]		2nd Level selection [1:0]		3rd Level selection [1:0]		4th Level selection [1:0]	
2nd Parameter	W	1	1st Frame number [7:0]							
3rd Parameter	W	1	2nd Frame number [7:0]							
4th Parameter	W	1	3rd Frame number [7:0]							
5th Parameter	W	1	4th Frame number [7:0]							
6th Parameter	W	1	Repeat numbers [7:0]							
7th～13th Parameter	W	1	2nd state							
...	W	1	3rd～9th state							
55th～60th Parameter	W	1	10th state							

The command defines as:

This command stores White-to-White Look-Up Table with 7 groups of data. Each group contains information for one state and is stored with 6 bytes, while the sixth byte indicates how many times that the phase will repeat.

define	description
Level selection [1:0]	00: GND 01: VSH 10: VSL 11: VSHR
Frame number [7:0]	00000000 :0 frame 00000001: 1 frame . 11111110: 254 frame 11111111: 255 frame
Repeat numbers [7:0]	00000000 : 0 time 00000001: 1 time . 11111110: 254 times 11111111: 255 times

17) LUTC option (LUTC Option) (R25H)

R25H	Bit									
Inst/Para	R/W	D/CX	D7	D6	D5	D4	D3	D2	D1	D0
LUTC Option	W	0	0	0	1	0	0	1	0	1
1st Parameter	W	1	-						XON [9:8]	
2nd Parameter	W	1	XON [7:0]							
3rd Parameter	W	1	-						VCOM_H [9:8]	
4th Parameter	W	1	VCOM_H [7:0]							

The command defines as:

This register is set for VCOM LUT.

XON[9:0]	All Gate ON 0000000000: No all gate on. 0000000001: State1 gate power on 1111111111: State1~10 all gate power on
VCOM_H[9:0]	Control VCOM Power as High 0000000000: No VCOM High voltage 0000000001: State1 VCOM High voltage .... 1111111111: State1~10 VCOM High voltage

18) Set VCOM/Red States (SET_STG) (R26H)

R26H	Bit									
Inst/Para	R/W	D/CX	D7	D6	D5	D4	D3	D2	D1	D0
SET_STG	W	0	0	0	1	0	0	1	1	0
1st Parameter	W	1	-	-	-	-	vcom_stg_sel [1:0]		b2w_stg_sel [1:0]	

This command is used to set VCOM/Red LUT states.

The functions of vcom_stg_sel [1:0] / b2w_stg_sel [1:0] are shown below. The default setting is 7 stages.

Value	Stages
00	7
01	8
10	9
11	10

19) OSC control Register (OSC) (R30H)

R30H	Bit									
Inst/Para	R/W	D/CX	D7	D6	D5	D4	D3	D2	D1	D0
OSC	W	0	0	0	1	1	0	0	0	0
1st Parameter	W	1	-	-	M[2:0]			N[2:0]		

The command defines as:

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

M	N	Frame rate	M	N	Frame rate	M	N	Frame rate	M	N	Frame rate
1	1	29HZ	3	1	86HZ	5	1	150HZ	7	1	200HZ
	2	14HZ		2	43HZ		2	72HZ		2	100HZ
	3	10HZ		3	29HZ		3	48HZ		3	67HZ
	4	7HZ		4	21HZ		4	36HZ		4	50HZ (default)
	5	6HZ		5	17HZ		5	29HZ		5	40HZ
	6	5HZ		6	14HZ		6	24HZ		6	33HZ
	7	4HZ		7	12HZ		7	20HZ		7	29HZ
2	1	57HZ	4	1	114HZ	6	1	171HZ			
	2	29HZ		2	57HZ		2	86HZ			
	3	19HZ		3	38HZ		3	57HZ			
	4	14HZ		4	29HZ		4	43HZ			
	5	11HZ		5	23HZ		5	34HZ			
	6	10HZ		6	19HZ		6	29HZ			
	7	8HZ		7	16HZ		7	24HZ			

20) Temperature Sensor Command (TSC) (R40H)

R40H	Bit									
Inst/Para	R/W	D/CX	D7	D6	D5	D4	D3	D2	D1	D0
TSC	W	0	0	1	0	0	0	0	0	0
1st Parameter	R	1	D10/TS[7]	D9/TS[6]	D8/TS[5]	D7/TS[4]	D6/TS[3]	D5/TS[2]	D4/TS[1]	D3/TS[0]
2nd Parameter	R	1	D2	D1	D0	-	-	-	-	-

The command define as follows:

This command indicates the temperature value.

If R41H(TSE) bit7 is set to 0, this command reads internal temperature sensor value.

If R41H(TSE) bit7 is set to 1, this command reads external (LM75) temperature sensor value.

This command only actives after R04H (PON) or R05H (PMES).

TS[7:0]/D[10:3]	T (°C)	TS[7:0]/D[10:3]	T (°C)	TS[7:0]/D[10:3]	T (°C)
11100111	-25	00000000	0	00011001	25
11101000	-24	00000001	1	00011010	26
11101001	-23	00000010	2	00011011	27
11101010	-22	00000011	3	00011100	28
11101011	-21	00000100	4	00011101	29
11101100	-20	00000101	5	00011110	30
11101101	-19	00000110	6	00011111	31
11101110	-18	00000111	7	00100000	32
11101111	-17	00001000	8	00100001	33
11110000	-16	00001001	9	00100010	34
11110001	-15	00001010	10	00100011	35
11110010	-14	00001011	11	00100100	36
11110011	-13	00001100	12	00100101	37
11110100	-12	00001101	13	00100110	38
11110101	-11	00001110	14	00100111	39
11110110	-10	00001111	15	00101000	40
11110111	-9	00010000	16	00101001	41
11111000	-8	00010001	17	00101010	42
11111001	-7	00010010	18	00101011	43
11111010	-6	00010011	19	00101100	44
11111011	-5	00010100	20	00101101	45
11111100	-4	00010101	21	00101110	46
11111101	-3	00010110	22	00101111	47
11111110	-2	00010111	23	00110000	48
11111111	-1	00011000	24	00110001	49

21) VCOM and DATA interval setting Register (CDI) (R50H)

R50H	Bit									
Inst/Para	R/W	D/CX	D7	D6	D5	D4	D3	D2	D1	D0
CDI	W	0	0	1	0	1	0	0	0	0
1st Parameter	W	1	VBD[1]	VBD[0]	DDX[1]	DDX[0]	CDI[3]	CDI[2]	CDI[1]	CDI[0]

The command defines as:

1st Parameter:

CDI[1:0]: This command indicates the interval of VCOM and data output. When setting the vertical back porch, the total blanking will be kept (20hsync).

Bit	
3-0	Vcom and data interval 0000: 17 hsync 0001:16 hsync 0010:15 hsync 0011:14 hsync 0100:13 hsync 0101:12 hsync 0110:11 hsync 0111:10 hsync 1000:9 hsync 1001:8 hsync 1010:7 hsync 1011:6 hsync 1100:5 hsync 1101:4 hsync 1110:3 hsync 1111:2 hsync

VBD[1:0] Border data selection.

B/W/Red mode(BWR=0)

Bit 5-4	Bit7-6	Description
DDX[0]	VBD[1:0]	LUT
0	00	Floating
	01	LUTR
	10	LUTW
	11	LUTB
1 (default)	00	LUTB
	01	LUTW
	10	LUTR
	11 (default)	Floating

B/W mode (BWR=1)

Bit 5-4	Bit7-6	description
DDX[0]	VBD[1:0]	LUT
0	00	Floating
	01	LUTBW (1->0)
	10	LUTWB (0->1)
	11	Floating
1 (default)	00	Floating
	01	LUTWB (1->0)
	10	LUTBW (0->1)
	11	Floating

DDX[1:0]: Data polarity
1. DDX[1] for RED data, DDX[0] for BW data in the B/W/Red mode
2. DDX[0] for B/W mode

B/W/Red mode(BWR=0)

Bit 5-4	Description	
DDX[1:0]	Data (Red/B/W)	LUT
00	00	LUTW
	01	LUTB
	10	LUTR
	11	LUTR
01 (default)	00	LUTB
	01	LUTW
	10	LUTR
	11	LUTR
10	00	LUTR
	01	LUTR
	10	LUTW
	11	LUTB
11	00	LUTR
	01	LUTR
	10	LUTB
	11	LUTW

B/W mode (BWR=1)

Bit 5-4	Description	
DDX[0]	Data (B/W)	LUT
0	00	LUTWW (0->0)
	01	LUTBW(1->0)
	10	LUTWB(0->1)
	11	LUTBB(1->1)
1 (default)	00	LUTBB(0->0)
	01	LUTWB(1->0)
	10	LUTBW(0->1)
	11	LUTWW(1->1)

22) TCON setting (TCON) (R60H)

R60H	Bit									
Inst/Para	R/W	D/CX	D7	D6	D5	D4	D3	D2	D1	D0
TCON	W	0	0	1	1	0	0	0	0	0
1st Parameter	W	1	-	-	-	-	-	-	-	LPD

The command defines Non-overlap period of gate and source as below:

1st Parameter:

Bit	Period
S2G[3:0]/G2S[3:0]	0000: 2 clock(default) 0001: 4 clock 0010: 6 clock 0011:8 clock 0100: 10 clock 0101: 12 clock 0110: 14 clock 0111: 16 clock 1000: 18 clock 1001: 20 clock 1010: 22 clock 1011: 24 clock 1100: 26 clock 1101: 28 clock 1110: 40 clock 1111: 32 clock

23) Resolution setting (TRES) (R61H)

R61H	Bit									
Inst/Para	R/W	D/CX	D7	D6	D5	D4	D3	D2	D1	D0
TRES	W	0	0	1	1	0	0	0	0	1
1st Parameter	W	1	-	-	-	-	-	-	HRES(9)	HRES(8)
2nd Parameter	W	1	HRES(7)	HRES(6)	HRES(5)	HRES(4)	HRES(3)	-	-	-
3rd Parameter	W	1	-	-	-	-	-	-	VRES(9)	VRES(8)
4th Parameter	W	1	VRES(7)	VRES(6)	VRES(5)	VRES(4)	VRES(3)	VRES(2)	VRES(1)	VRES(0)

The command defines as follows:

When using register:

Horizontal display resolution=HRES Vertical display resolution=VRES

Channel disable calculation:

GD: First G active=G0; LAST active GD=first active + VRES[8:0] - 1

SD: First active channel:=S0; LAST active SD=first active + HRES[7:3]*8 - 1

EX: 128X272

GD: First G active=G0

LAST active GD=0+272-1=271; (G271)

SD: First active channel:=S0

LAST active SD=0+16*8-1=127; (S127)

24) Source & gate start setting (TSGS) (R62H)

R62H	Bit									
Inst/Para	R/W	D/CX	D7	D6	D5	D4	D3	D2	D1	D0
TSGS	W	0	0	1	1	0	0	0	1	0
1st Parameter	W	1	-	-	-	-	-	-	S_Start(9)	S_Start(8)
2nd Parameter	W	1	S_Start(7)	S_Start(6)	S_Start(5)	S_Start(4)	S_Start(3)	-	-	-
3rd Parameter	W	1	-	-	-	-	-	-	G_Start(9)	G_Start(8)
4th Parameter	W	1	G_Start(7)	G_Start(6)	G_Start(5)	G_Start(4)	G_Start(3)	G_Start(2)	G_Start(1)	G_Start(0)

The command defines as follows:

1. S_Start [8:0] describes which source output line is the first date line
2. G_Start[8:0] describes which gate line is the first scan line
3. gscan: Gate scan select

0: Normal scan

1: Cascade type 2 scan

Restriction: S_Start should be the multiple of 8

Bit	Function
5-0	Vcom value 000000: -0.1V 000001:-0.15V 000010:-0.2V 111000:-2.9V 111001:-2.95V 111010:-3.0V

25) Program Mode (PGM) (RA0H)

RA0H	Bit									
Inst/Para	R/W	D/CX	D7	D6	D5	D4	D3	D2	D1	D0
PTIN	W	0	1	0	1	0	0	0	0	0
1st Parameter	W	1	1	0	1	0	0	1	0	1

The command defines as follows:

After this command is issued, the chip would enter the program mode.

The mode would return to standby by hardware reset.

The only one parameter is a check code, the command would be executed if check code=0xA5.

26) Active Program (APG) (RA1H)

RA1H	Bit									
Inst/Para	R/W	D/CX	D7	D6	D5	D4	D3	D2	D1	D0
APG	W	0	1	0	1	0	0	0	0	1

The command defines as follows:

After this command is transmitted, the programming state machine would be activated.

27) Read OTP Data (ROTP) (RA2H)

RA2H	Bit									
Inst/Para	R/W	D/CX	D7	D6	D5	D4	D3	D2	D1	D0
LUTBB/LUTB	W	0	1	0	1	0	0	0	1	0
1st Parameter	W	1	Dummy							
2nd Parameter	W	1	The date of address 0x000 in the OTP							
3rd Parameter	W	1	The date of address 0x001 in the OTP							
4th Parameter	W	1	...							
5th Parameter	W	1	The date of address (n-1) in the OTP							
6th～(m-1)th Parameter	W	1	...							
mth Parameter	W	1	The date of address (n) in the OTP							

The command defines as follows:

The command is used for reading the content of OTP for checking the data of programming. The value of (n) is depending on the amount of programmed data, the max address=0xFFF.

28) Remap LUT command (RM_LUT_CMD) (RF0H)

RF0H	Bit									
Inst/Para	R/W	D/CX	D7	D6	D5	D4	D3	D2	D1	D0
RM_LUT_CMD	W	0	1	1	1	1	0	0	0	0
1st Parameter	W	1	-	-	-	tr10_lut_en	rmp2_table_sel[3]	rmp2_table_sel[2]	rmp2_table_sel[1]	rmp2_table_sel[0]
2nd Parameter	W	1	-	-	-	tr9_lut_en	rmp1_table_sel[3]	rmp1_table_sel[2]	rmp1_table_sel[1]	rmp1_table_sel[0]

The command is used for indicating backup OTP blocks to remap for LUTs.

Addr (hex)	OTP Bank 0 (3K Bytes)	Addr (hex)	OTP Bank 1 (3K Bytes)
00h~0Fh	Temp. segment	C00h~C0Fh	Temp. segment
20h~60h	Default setting	C20h~C60h	Default setting
100h	TR0 WF	D00h	TR0 WF
200h	TR1 WF	E00h	TR1 WF
300h	TR2 WF	F00h	TR2 WF
400h	TR3 WF	1000h	TR3 WF
500h	TR4 WF	1100h	TR4 WF
600h	TR5 WF	1200h	TR5 WF
700h	TR6 WF	1300h	TR6 WF
800h	TR7 WF	1400h	TR7 WF
900h	TR8 WF	1500h	TR8 WF
A00h	TR9 WF / Backup 1	1600h	TR9 WF / Backup 1
B00h	TR10 WF / Backup 2	1700h	TR10 WF / Backup 2

1st Parameter:
tr10_lut_en :

Value	Function
1	OTP Address B00h~BFFh is used as "TR10 WF"
0	OTP Address B00h~BFFh is used as "Backup 2", And you can replace one of TR0 ~TR9.

rmp2_tab_sel [3:0] :
Only be functional when tr10_lut_en is set "0", target LUTs to be replaced is shown below

Value	Target LUTs
0001	TR0
0010	TR1
0011	TR2
0100	TR3
0101	TR4
0110	TR5
0111	TR6
1000	TR7
1001	TR8
1010	TR9
1011~1111	None

2nd Parameter
tr9_lut_en :

Value	Function
1	OTP Address B00h~BFFh is used as "TR9 WF"
0	OTP Address B00h~BFFh is used as "Backup 1", And you can replace one of TR0 ~TR8.

rmp1_tab_sel[3:0]
Only be functional when tr9_lut_en is set "0", target LUTs to be replaced is shown below

Value	Target LUTs
0001	TR0
0010	TR1
0011	TR2
0100	TR3
0101	TR4
0110	TR5
0111	TR6
1000	TR7
1001	TR8
1010~1111	None

Notice:
If rmp1_tab_sel=rmp2_tab_sel, the control hardware will reload "backup1" block to replace target LUT.

29) Set OTP program bank (SET_OTP_BANK) (RF1H)

RF1H	Bit									
Inst/Para	R/W	D/CX	D7	D6	D5	D4	D3	D2	D1	D0
SET_OTP_BANK	W	0	1	1	1	1	0	0	0	1
1st Parameter	W	1	-	-	-	-	-	-	LUT_bank0	reg_bank0

This command is used to set program bank for registers and LUTs.

Addr (hex)	OTP Bank 0 (3K Bytes)	Addr (hex)	OTP Bank 1 (3K Bytes)
00h~0Fh	Temp. segment	C00h~C0Fh	Temp. segment
20h~60h	Default setting	C20h~C60h	Default setting
100h~BFFh	LUTs	D00h~17FFh	LUTs

reg_bank :

Value	Function
1	Program “Temp. segment” and “Default Setting” in bank 0
0	Program “Temp. segment” and “Default Setting” in bank 1

LUT_bank :

Value	Function
1	Program “LUTs” in bank 0
0	Program “LUTs” in bank 1

30) Read checksum information (RD_CHKSUM) (RF2H)

RF2H	Bit									
Inst/Para	R/W	D/CX	D7	D6	D5	D4	D3	D2	D1	D0
RD_CHKSUM	W	0	1	1	1	1	0	0	1	0
1st~9th Parameter	W	1	Checksum from “TR0WF” to “TR8WF”							
10th Parameter	W	1	Checksum from “TR9WF / backup1”							
11th Parameter	W	1	Checksum from “TR10WF / backup2”							
12th Parameter	W	1	Checksum comparison result from “TR0WF” to “TR7WF”							
13th Parameter	W	1	Checksum comparison result from “TR8” and “TR10WF/backup2”							

This command is to read checksum information from OTP.

1st to 11th Parameter: Checksum from “TR0WF” to “TR10WF/backup2"

12th Parameter

D7	D6	D5	D4	D3	D2	D1	D0
fault_TR7	fault_TR6	fault_TR5	fault_TR4	fault_TR3	fault_TR2	fault_TR1	fault_TR0

13th Parameter

D7	D6	D5	D4	D3	D2	D1	D0
-	-	-	-	-	fault_TR10 / fault_backup2	fault_TR9 / fault_backup1	fault_TR9

definition of fault_TRx / fault_backup_x

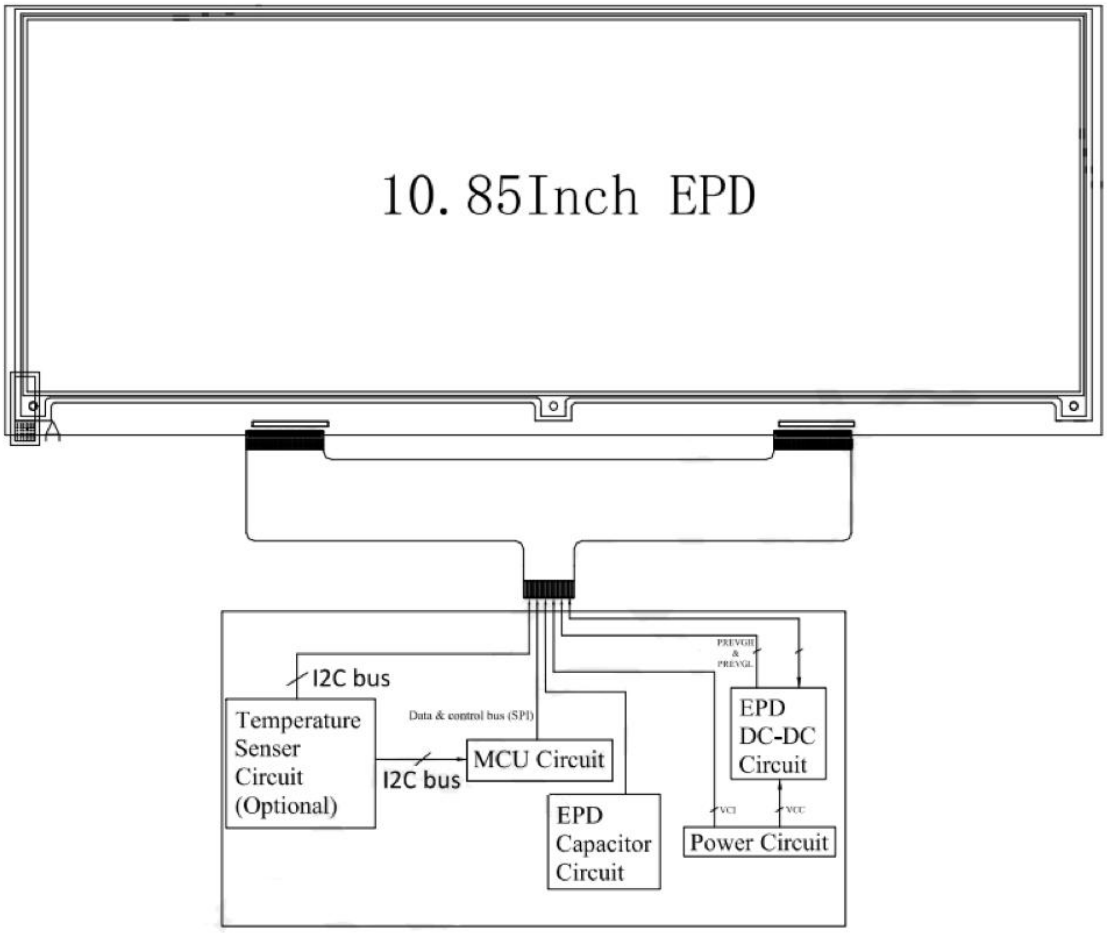
Value	Function
0	Checksum comparison : Equal
1	Checksum comparison : Not Equal

31) Calculate Checksum (CAL_CHKSUM) (RF3H)

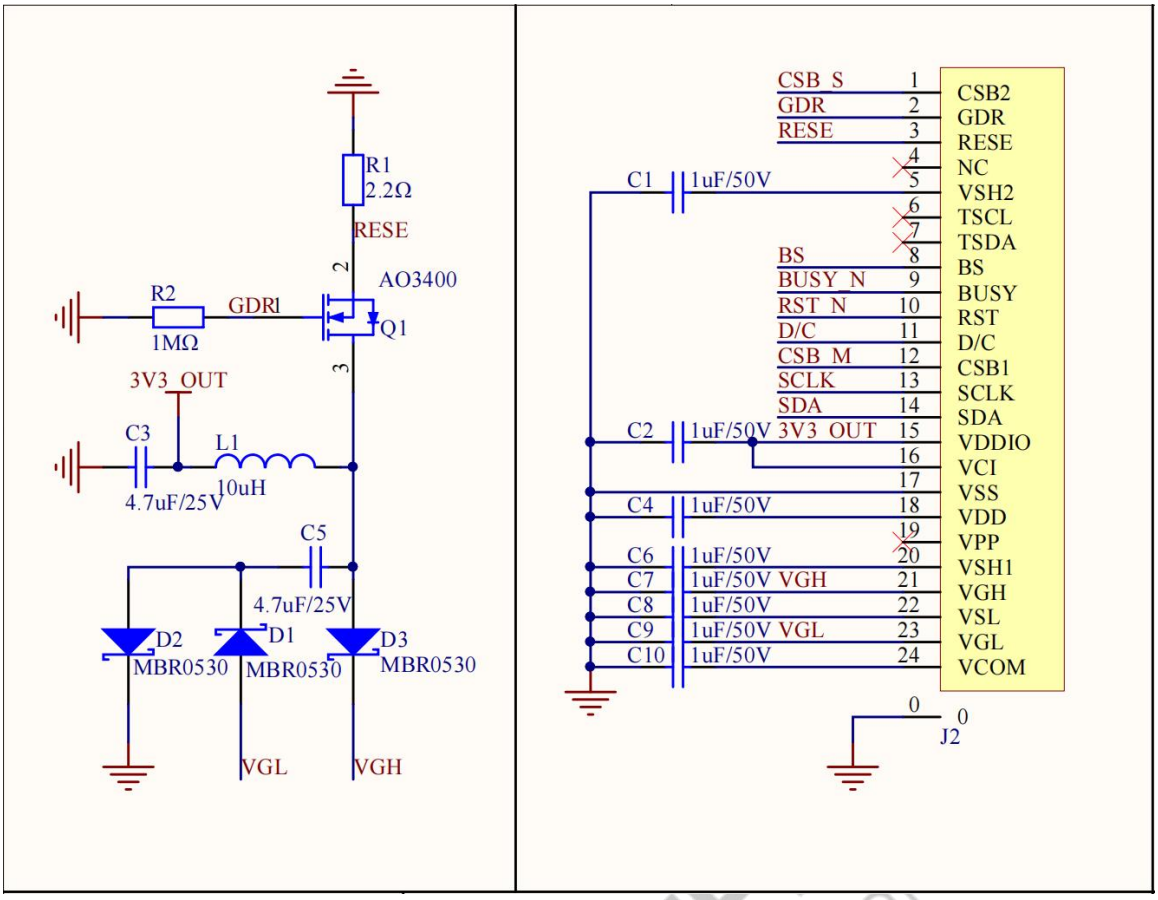
RF3H	Bit									
Inst/Para	R/W	D/CX	D7	D6	D5	D4	D3	D2	D1	D0
CAL_CHKSUM	W	0	1	1	1	1	0	0	1	1

This command is used to Calculate Checksum of LUT Table.

8. BLOCK DIAGRAM

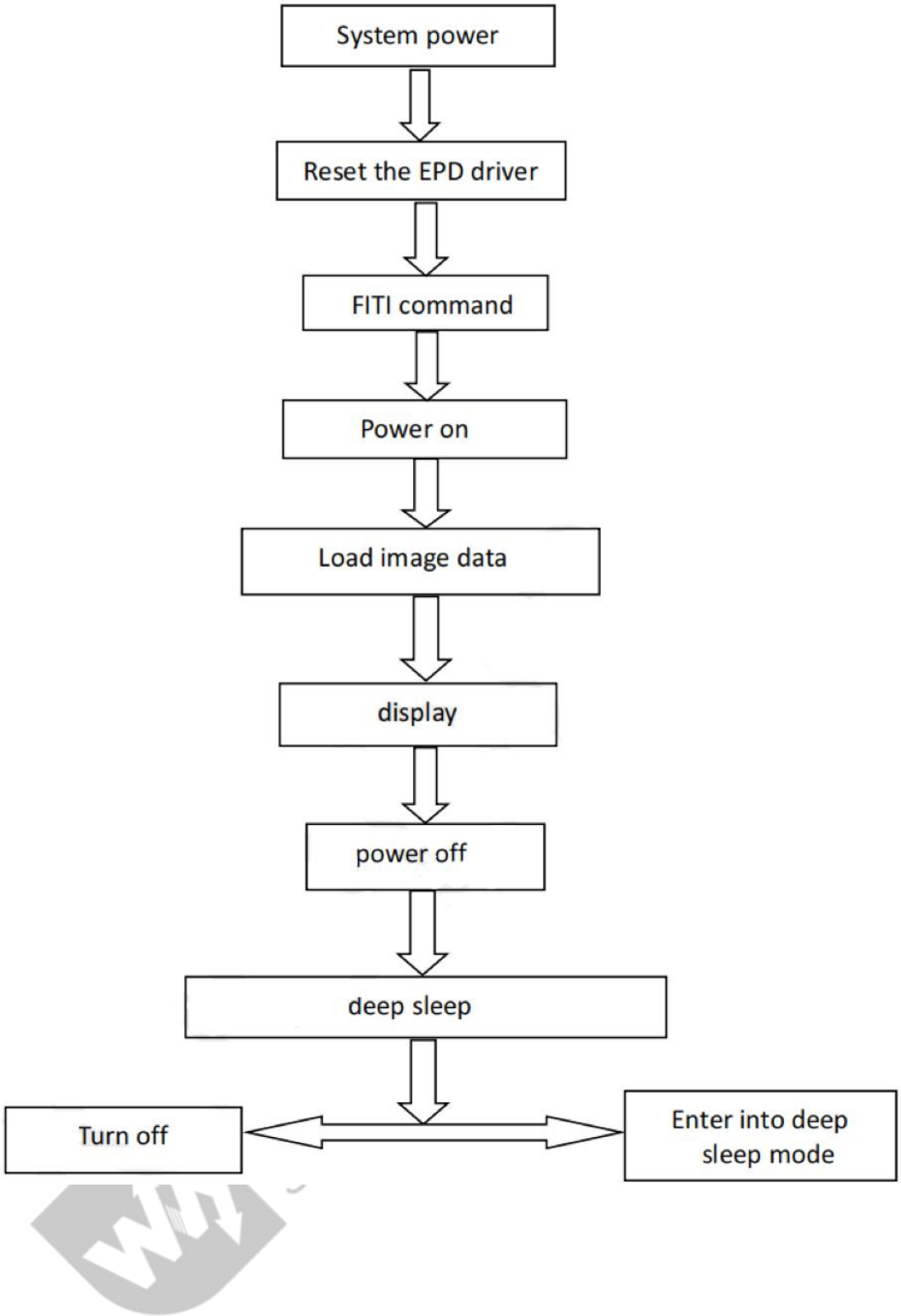


9. TYPICAL APPLICATION CIRCUIT WITH SPI INTERFACE

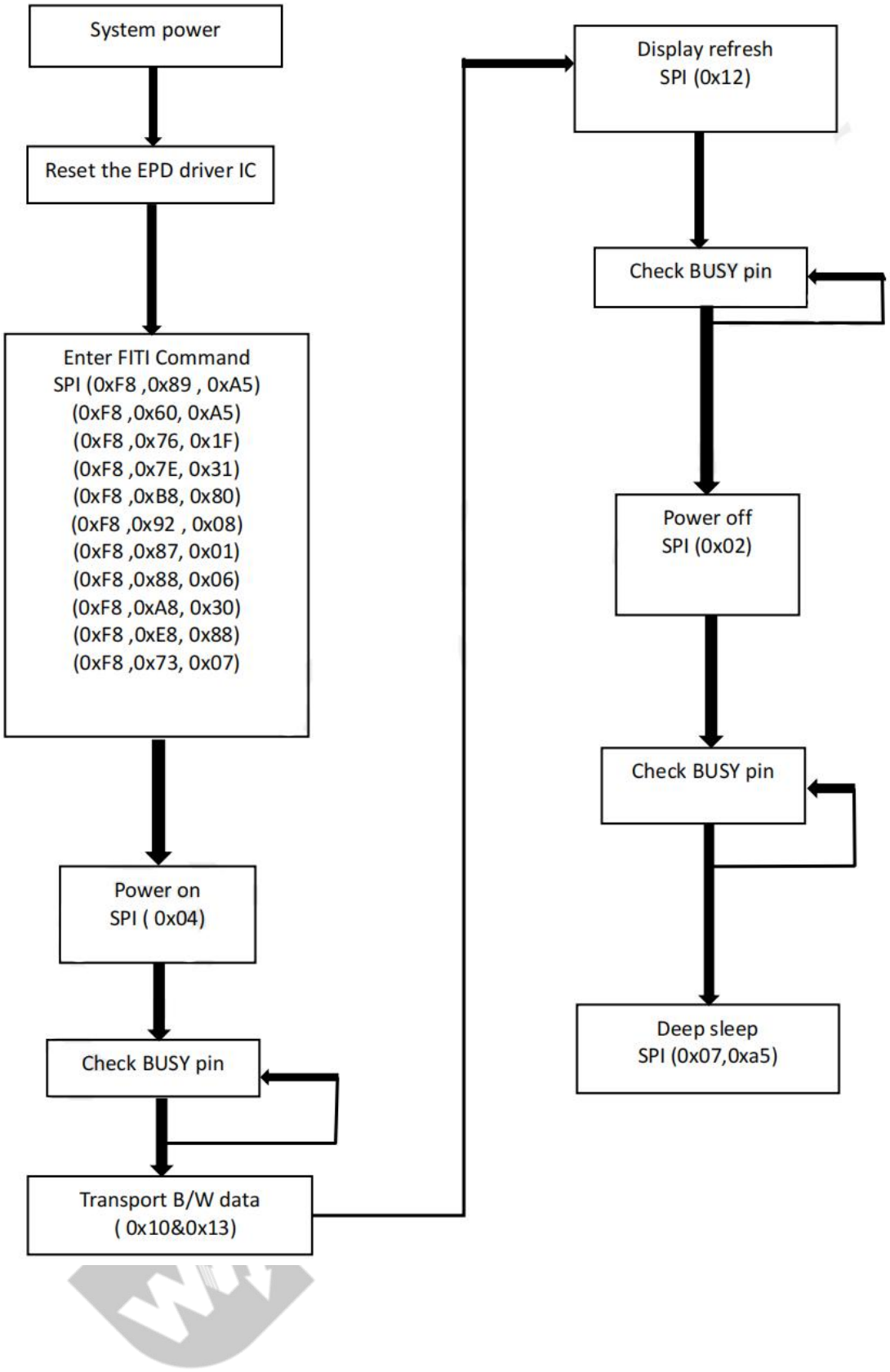


10. TYPICAL OPERATING SEQUENCE

10.1 OTP OPERATION FLOW



10.2 OTP OPERATION REFERENCE PROGRAM CODE



11. RELIABILITY TEST

No.	Test Items	Test Conditions
1	Low-Temperature Storage	T= -25°C, 240h Test in white pattern
2	High-Temperature Storage	T= +70°C, RH=40%, 240h Test in white pattern
3	High-Temperature Operation	T= +50°C, RH=30%, 240h
4	Low-Temperature Operation	0°C, 240h
5	High-Temperature, High-Humidity Operation	T= 40°C, RH=90%, 240h
6	High Temperature, High-Humidity Storage	T= 60°C, RH=80%, 240h Test in white pattern
7	Temperature Cycle	1 cycle:[-25°C 30min] → [+70°C 30min]:100 cycles Test in white pattern
8	ESD Gun	Air +/-4KV; Contact +/-2KV Contact +/-2KV (HBM C: 100pF; R: 1.5k ohm) Contact +/-200V (MM C: 200pF; R: 0 ohm) (Naked EPD display, including IC and FPC area)

Notes:

11-1: Stay white pattern for storage and non-operation test.

11-2: The operation is black → white pattern, the interval is 150s.

12. QUALITY ASSURANCE

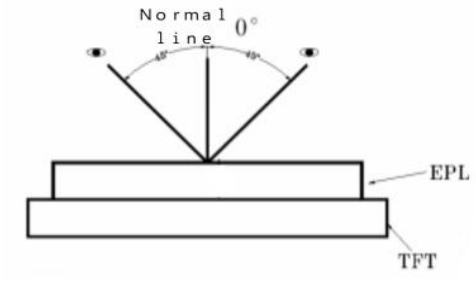
12.1 ENVIRONMENT

Temperature: 25±3℃; Humidity: 55±10%RH

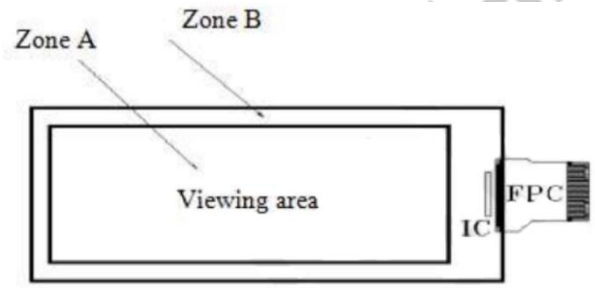
12.2 ILLUMINANCE

Brightness: 1200~1500LUX;
Distance: 30CM;
Angle: The light source surrounds the module at a 45 degree angle.

12.3 INSPECTION METHOD

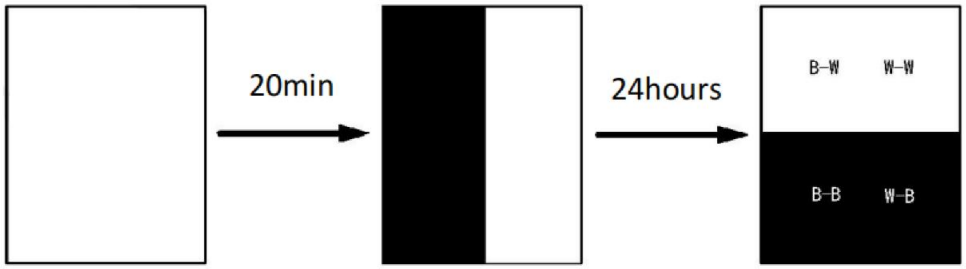


12.4 DISPLAY AREA



12.5 GHOSTING TEST METHOD

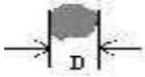
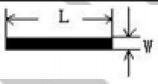
Two-color ghosting is measured with following transition from horizontal 2 scale pattern to vertical 2 scale pattern. The listed optical characteristics are only guaranteed under the controller & waveform provided by Waveshare.



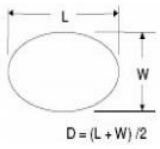
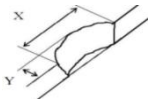
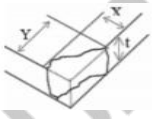
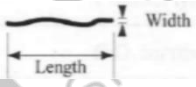
1) Measurement Instrument: X-rite i1Pro
2) Ghosting formula:
W ghosting: ΔL=Max(ΔL(W-W,B-W)) - Min(ΔL(W-W,B-W))
K ghosting: ΔL=Max(ΔL(W-B,B-B)) - Min(ΔL(W-B,B-B))

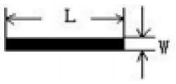
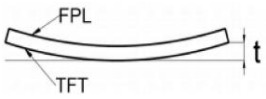
12.6 INSPECTION STANDARD

12.6.1 Electric Inspection Standards

No.	Item	Standard	Defect Level	Method	Scope
1	Display	Display complete; Display uniform	MA	Visual inspection	Zone A
2	Black/Write spots	 D≤0.4mm, negligible; 0.4mm<D≤0.7mm, N≤6 allowed; D>0.7mm, not allowed	MI		
3	Black/White lines (No switch)	 L≤2.0mm, W≤0.2mm, negligible; 2.0mm<L≤8.0mm,0.2mm<W≤0.5mm,N≤5 allowable; L>8.0mm,W>0.5mm, not allowed		Visual/ Inspection card	
4	Ghost image	Allowed in switching process	MI	Visual inspection	
5	Flash spots/ Larger FPL size	Flash spots in switching, allowed FPL size larger than viewing area, allowed	MI	Visual/ Inspection card	Zone A Zone B
6	Display wrong/Missing	All appointed displays are showed correctly	MA	Visual inspection	Zone A
7	Short circuit/ Circuit break/ Abnormal Display	Not allowed			

12.6.2 Appearance Inspection Standards

No.	Item	Standard	Defect Level	Method	Scope
1	B/W spots /Bubble/ Foreign bodies/ Dents	 D≤0.4mm, negligible; 0.4mm<D≤0.7mm, N≤6 allowable; D>0.7mm, not allowed	MI	Visual inspection	Zone A
2	Glass crack	Not allowed	MA	Visual /Microscope	Zone A Zone B
3	Dirty	Allowed if can be removed	MI		Zone A Zone B
4	Chips/Scratch/ Edge crown	 X≤3mm,Y≤0.5mm and without affecting the electrode is permissible  X≥2mm or Y≥2mm, not allowed  W≤0.1mm, L≤5mm, no harm to the electrode and n≤2, allowed	MI	Visual /Microscope	Zone A Zone B
5	TFT cracks	 Not allowed	MA	Visual /Microscope	Zone A Zone B
6	Dirty/Foreign bodies	Allowed if can be removed/Allowed	MI	Visual /Microscope	Zone A Zone B
7	FPC broken/FPC oxidation/scratch	  Not allowed	MA	Visual /Microscope	Zone B

8	B/W line	 L≤2.0mm, W≤0.2mm, negligible; 2.0mm<L≤8.0mm, 0.2mm<W≤0.5mm, N≤5 allowable; L>8.0mm, W>0.5mm, not allowed	MI	Visual /Microscope	Zone A/ Zone B
9	TFT edge bulge /TFT chromatic aberration	TFT edge bulge: X≤3mm,Y≤0.3mm, allowed TFT chromatic aberration: allowed	MI	Visual /Microscope	Zone A Zone B
10	Electrostatic point	D≤0.3mm, allowed; 0.3mm<D≤0.5mm, N≤4 allowed; D>0.5mm is not allowed (n≤10 items are allowed within 5mm in diameter)	MI	Visual /Microscope	Zone A
11	PCB damaged /Poor welding /Curl	PCB(Circuit area) damaged, not allowed PCB Poor welding, not allowed PCB Curl≤1%	MI	Visual /Ruler	Zone B
12	Edge glue height /Edge glue bubble	Edge adhesives H≤PS surface (including protective film) Edge adhesives seep in≤1/2 Margin width Length excluding Edge adhesive bubble: bubble width≤1/2 Margin width; Length≤0.5mm. n≤5	MI	Visual inspection	Zone B
13	Protective film	Surface scratch but not effect protection function, allowed	MI	Visual inspection	Zone B
14	Silicon glue	Thickness≤PS surface(with protective film): Full cover the IC; Shape: The width on the FPC≤0.5mm(Front) The width on the FPC≤1.0mm(Back) Smooth surface, no obvious protrusions	MI	Visual inspection	
15	Wrap degree (TFT substrate)	 t ≤2.0mm	MI	Ruler	
16	Color difference in COM area(Silver point area)	Allowed		Visual inspection	

13. HANDLING, SAFETY, AND ENVIRONMENT 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.

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.

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 dose not form part of the specification.	

Product Environmental certification
RoHS

14. PRECAUTIONS

(1) Do not apply pressure to the EPD panel in order to prevent damaging it.
(2) Do not connect or disconnect the interface connector while the EPD panel is in operation.
(3) Do not touch IC bonding area. It may scratch TFT lead or damage IC function.
(4) Please be mindful of moisture to avoid its penetration into the EPD panel, which may cause damage during operation.
(5) If the EPD Panel / Module is not refreshed every 24 hours, a phenomena known as “Ghosting” or “Image Sticking” may occur. It is recommended to refreshed the ESL /EPD Tag every 24 hours in use case. It is recommended that customer ships or stores the ESL / EPD Tag with a completely white image to avoid this issue.
(6) High temperature, high humidity, sunlight or fluorescent light may degrade the EPD panel’s performance. Please do not expose the unprotected EPD panel to high temperature, high humidity, sunlight, or fluorescent for long periods of time.