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EPD Module User Manual

Specification for 7.5 inch EPD

Model NO. : MT-DEPG0750BNU590F33

This module uses ROHS material

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Revision History

Version	Content	Date	Producer
2.0	New release	2024/03/05	

CONTENTS

1. Over View

MT-DEPG0750BNU590F33 is an Active Matrix Electrophoretic Display (AM EPD), with interface and a reference system design. The display is capable to display images at 1-bit white,black and red full display capabilities.The 7.5 inch active area contains 640×384 pixels. The module is a TFT-array driving electrophoresis display, with integrated circuits including gate driver, source driver, MCU interface, timing controller, oscillator, DC-DC, SRAM, LUT, VCOM. Module can be used in portable electronic devices, such as Electronic Shelf Label (ESL) System.

2. Features

- 640×384 pixels display
- High contrast
- High reflectance
- Ultra wide viewing angle
- Ultra low power consumption
- Pure reflective mode
- Bi-stable display
- Commercial temperature range
- Landscape, portrait modes
- Hard-coat antiglare display surface
- Ultra Low current deep sleep mode
- On chip display RAM
- Waveform stored in flash on FPC
- Serial peripheral interface available
- On-chip oscillator
- On-chip booster and regulator control for generating VCOM, Gate and Source driving voltage
- I^2C signal master interface to read external temperature sensor
- Available in COG package IC thickness 280um
- Built-in temperature sensor

3. Mechanical And Optical Specification

Parameter	Specifications	Unit	Remark
Screen Size	7.5	Inch	
Display Resolution	640(H)×384(V)	Pixel	DPI:100
Active Area	163.2×97.92	mm	
Pixel Pitch	0.255×0.255	mm	
Pixel Configuration	Rectangle		
Outline Dimension	170.2(H)×111.2 (V) ×1.2(D)	mm	
Weight	42.5±0.5	g	

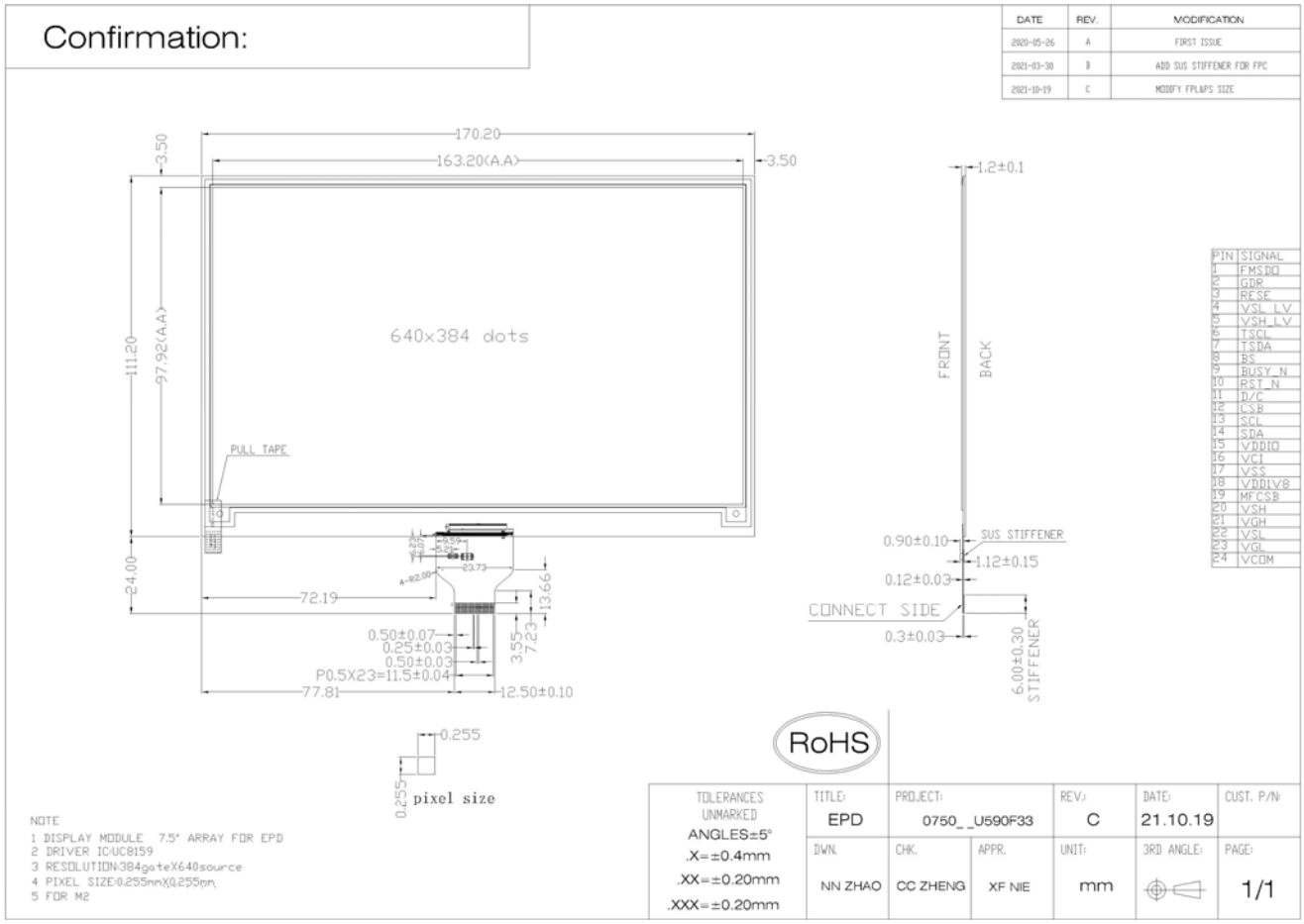
Symbol	Parameter	Conditions	Min	Typ.	Max	Units	Notes
KS	Black State L* value		-	19	22		3-1
	Black Ghosting ΔL		-	1	-		3-1
WS	White State L* value		66	67			3-1
	White Ghosting ΔL		-	1	-		3-1
R	White Reflectivity	White	30	34	-	%	3-1
CR	Contrast Ratio	Indoor	15:1	20:1	-		3-1 3-2
GN	2Grey Level	-	-	-	-		
Life		Temp:23±3°C Humidity:55±10%RH		5years			3-3

Notes: 3-1. Luminance meter: Eye-One Pro Spectrophotometer.

3-2. CR=Surface Reflectance with all white pixel/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



5. Input/output Pin Assignment

No.	Name	I/O	Description	Remark
1	FMSDO	O	Serial communication data output	
2	GDR	O	N-Channel MOSFET Gate Drive Control	
3	RESE	I	Current Sense Input for the Control Loop	
4	VSL_LV	NC	.Negative source voltage (-3.0V ~ -15.0V).	
5	VSH_LV	NC	Positive source voltage (+3.0V ~ +15.0V)	
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	D0	I	Serial Clock pin (SPI)	
14	D1	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	MFCSB	I	Serial communication chip select	
20	VSH	C	Positive Source driving voltage	
21	VGH	C	Positive Gate driving voltage	
22	VSL	C	Negative Source driving voltage	
23	VGL	C	Negative Gate driving voltage.	
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

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

Note 5-2: This pin is (D/C#)Data/Command control pin connecting to the MCU in 4-wire SPI mode. When the pin is pulled HIGH, the data at D1 will be interpreted as data. When the pin is pulled LOW, the data at D1 will be interpreted as command.

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

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

-Outputting display waveform
-Communicating with digital temperature sensor

Note 5-5: Bus interface selection pin.

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

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

6.Electrical Characteristics

6.1 Absolute Maximum Rating

Parameter	Symbol	Rating	Unit
Logic supply voltage	VCI	-0.3 to +6.0	V
Logic Input voltage	VIN	-0.3 to VCI +0.3	V
Operating Temp range	TOPR	0 to +40	ºC.
Storage Temp range	TSTG	-25 to+40	ºC.
Optimal Storage Temp	TSTGo	23±3	ºC.
Optimal Storage Humidity	HSTGo	55±10	%RH

Note:

1. **Maximum ratings are those values beyond which damages to the device may occur. Functional operation should be restricted to the limits in the Panel DC Characteristics tables.**
2. **We guarantee the single pixel display quality for 0-30℃, but we only guarantee the barcode readable for 35-40℃.**
3. **The storage time is within 10 days for -25℃ ~ 0℃ or 40℃ ~ 60℃.**

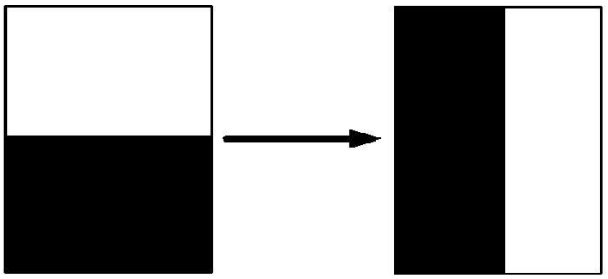
   The display screen should be kept white and face up.
   The recommended operating temperature should be kept above 10℃ to 30℃.

6.2 Panel DC Characteristics

The following specifications apply for: VSS=0V, VCI=3.0V, TOPR =25ºC.

Parameter	Symbol	Condition	Applicable pin	Min.	Typ.	Max.	Unit
Single ground	V_{SS}	-		-	0	-	V
Logic supply voltage	V_{CI}	-	VCI	2.3	3.0	3.6	V
Core logic voltage	V_{DD}		VDD	2.3	3.0	3.6	V
High level input voltage	V_{IH}	-	-	0.7 V_{CI}	-	V_{CI}	V
Low level input voltage	V_{IL}	-	-	0	-	0.3 V_{CI}	V
High level output voltage	V_{OH}	IOH =400uA	-	V_{CI} -0.4	-	-	V
Low level output voltage	V_{OL}	IOL = -400uA	-	0	-	0.4	V
Typical power	P_{TYP}	V_{CI} =3.0V	-	-	12.6	-	mW
Deep sleep mode	P_{STPY}	V_{CI} =3.0V	-	-	0.003	-	mW
Typical operating current	Iopr_VCI	V_{CI} =3.0V	-	-	4.2	- -	mA
Image update time	-	25 ºC	-	-	4	-	sec
Typical peak current	Iopr_VCI	2.3~3.6V			50	60	mA
Sleep mode current	Islp_V_{CI}	DC/DC off No clock No input load Ram data retain	-	-	20		uA
Deep sleep mode current	Idslp_V_{CI}	DC/DC off No clock No input load Ram data not retain	-	-	1	5	uA

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



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

3. The listed electrical characteristics are only guaranteed under the controller & waveform provided by Maker.

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 mode is summarized in Table 6-3-1. Different MCU mode 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 mode

6.3.2 MCU Serial Interface (4-wire SPI)

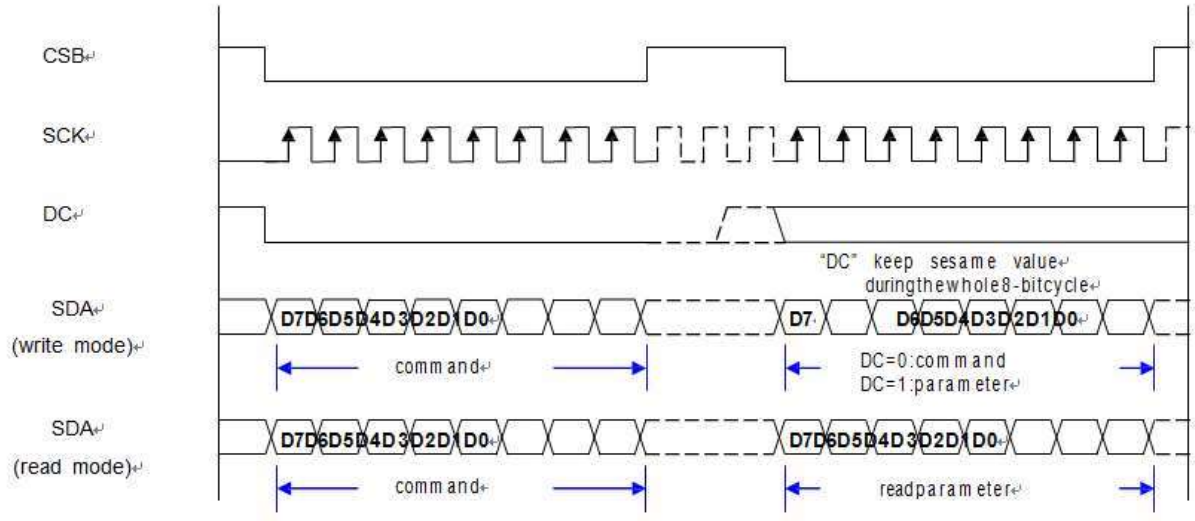
The serial interface consists of serial clock SCL, serial data SDA, D/C#, CS#. This interface supports Write mode and Read mode.

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

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

Note: ↑ stands for rising edge of signal

Figure 6-3-3: 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	↑

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

Note：↑ stands for rising edge of signal

Figure 6-3-5: 3-wire SPI mode

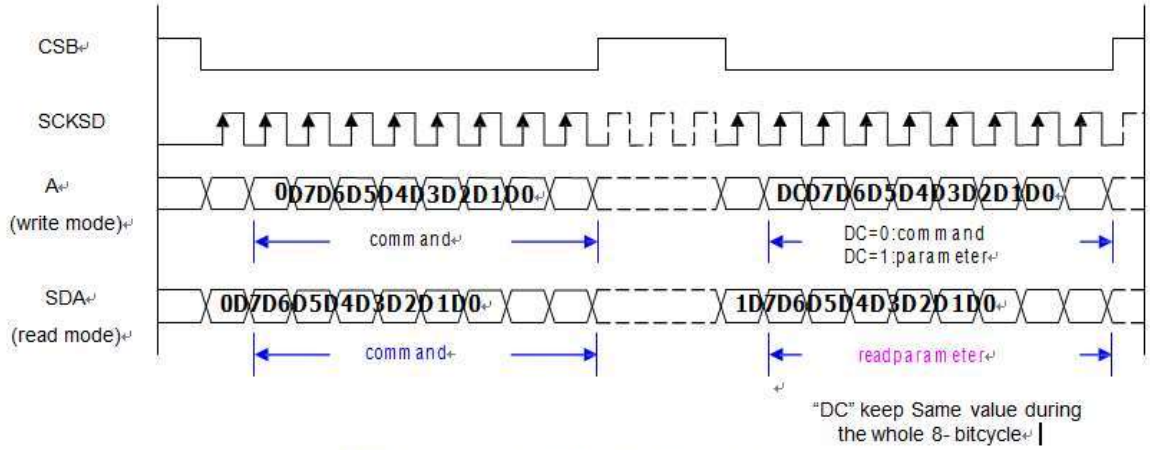


Figure : 3-wire SPI Typical Waveform –BS=1

6.3.4 Interface Timing

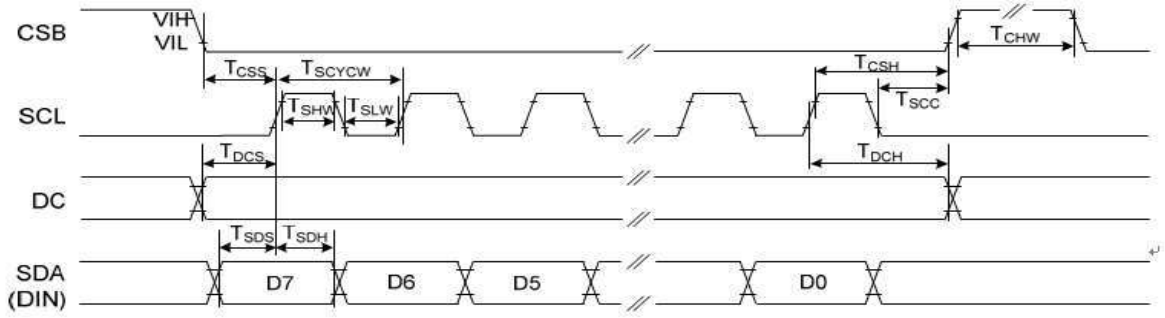


Figure: 4-wire Serial Interface Characteristics (Writemode)

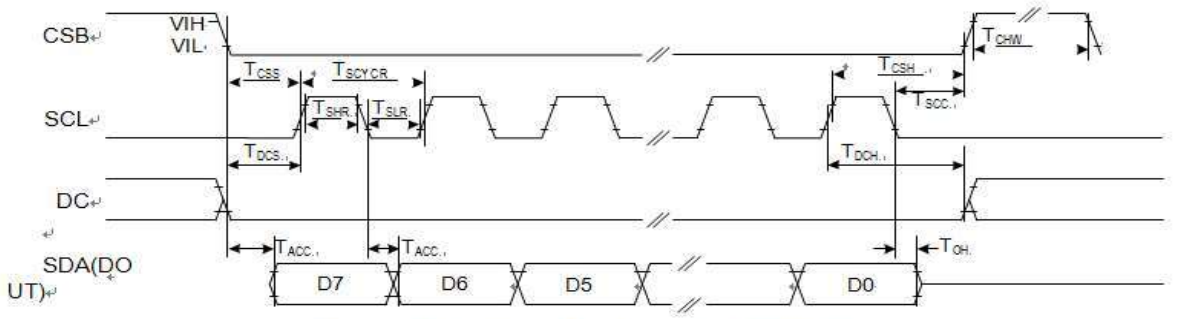


Figure: 4-wire Serial Interface Characteristics (Readmode)

Serial Interface Timing Characteristics

Symbol	Signal /Parameter	Conditions	Min.	Typ.	Max.	Unit
T_{CSS}	CSB	Chip select setuptime	60			ns
T_{CSH}		Chip select holdtime	65			ns
T_{SCC}		Chip select setuptime	20			ns
T_{CHW}		Chip select setuptime	40			ns
T_{SCYCW}	SCL	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)	150			ns
T_{SHR}		SCL “H” pulse width(Read)	60			ns
T_{SLR}		SCL “L” pulse width(Read)	60			ns
T_{DCS}	DC	DC setuptime	30			ns
T_{DCH}		DC holdtime	30			ns
T_{SDS}	SDA (DIN)	Data setuptime	30			ns
T_{SDH}		Data holdtime	30			ns
T_{ACC}	SDA (DOUT)	Accesstime			10	ns
T_{OH}		Output disabletime	15			ns

7.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[1:0], UD, SHL, 1 Panel Setting (PSR) SHD_N, RST_N	07h
		0	1	--	--	--	--	--	--	--	--		00h
2	Power Setting (PWR)	0	0	0	0	0	0	0	0	0	1		01h
		0	1	--	--	#	#	#	#	#	#	EDATA_SEL, EDATA_SET, VCM_HZ, VS_EN, VSC_EN, VG_EN	08h
		0	1	--	--	--	--	--	--	#	#	VGHL_LV[1:0]	01h
		0	1	--	--	#	#	#	#	#	#	VSHC_LVL[5:0]	05h
		0	1	--	--	#	#	#	#	#	#	VSLC_LVL[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	0	1	0		
6	Booster Soft Start (BTST)	0	0	0	0	0	0	0	1	1	0		17h
		0	1	#	#	#	#	#	#	#	#	BT_PHA[7:0]	17h
		0	1	#	#	#	#	#	#	#	#	BT_PHB[7:0]	17h
		0	1	--	--	#	#	--	--	--	--	BT_PHB[7:0]	17h
7	Deep Sleep(DSLP)	0	0	0	0	0	0	0	1	1	1		07h
		1	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	--	#	#	#	--	#	#	#	K pixel[2M-1][2:0], K pixel[2M][2:0]	00h
9	Data Stop (DSP)	0	0	0	0	0	0	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	VCOM LUT (LUTC) (221-byte command, bytes 2~12 repeated 20 times)	0	0	0	0	1	0	0	0	0	0		20h
13	LUT Blue(LUTB) (261-byte command, Bytes 2~14 repeated 20 times)	0	0	0	0	1	0	0	0	0	1		21h
14	LUT White (LUTW) (261-byte command, bytes 2~14 repeated 20 times)	0	0	0	0	1	0	0	0	1	0		22h

15	LUTGray1 (LUTG1) (261-byte command, bytes 2~14 repeated 20 times)	0	0	0	0	1	0	0	0	1	1		23h
16	LUTGray2 (LUTG2) (261-byte command, bytes 2~14 repeated 20 times)	0	0	0	0	1	0	0	1	0	0		24h
17	LUT Red0 (LUTR0) (261-byte command, bytes 2~14 repeated 20 times)	0	0	0	0	1	0	0	1	0	1		25h
18	LUT Red1 (LUTR1) (261-byte command, bytes 2~14 repeated 20 times)	0	0	0	0	1	0	0	1	1	0		26h
19	LUT Red2 (LUTR2) (261-byte command, bytes 2~14 repeated 20 times)	0	0	0	0	1	0	0	1	1	1		27h
20	LUT Red3 (LUTR3) (261-byte command, bytes 2~14 repeated 20 times)	0	0	0	0	1	0	1	0	0	0		28h
21	LUT XON (LUTXON) (201-byte command, bytes 2~11 repeated 20 times)	0	0	0	0	1	0	1	0	0	1		29h
22	PLL control (PLL)	0	0	0	0	1	1	0	0	0	0		30h
		0	1	--	--	#	#	#	#	#	#	M[2:0], N[2:0]	3ch
23	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
24	Temperature Sensor Calibration(TSE)	0	0	0	1	0	0	0	0	0	1		41h
		0	1	#	--	--	--	#	#	#	#	TSE, TO[3:0]	00h
25	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
26	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
27	Vcom and data interval setting(CDI)	0	0	0	1	0	1	0	0	0	0	RMSB[7:0]	50h
		0	1	#	#	#	#	#	#	#	#	RLSB[7:0]	F7h
28	Lower Power Detection (LPD)	0	0	0	1	0	1	0	0	0	1		51h
		1	1	--	--	--	--	--	--	--	#	LPD	01h
29	TCON setting (TCON)	0	0	0	1	1	0	0	0	0	0		60h
		0	1	#	#	#	#	#	#	#	#	S2G[3:0], G2S[3:0]	22h
30	TCON resolution (TRES)	0	0	0	1	1	0	0	0	0	1		
		0	1	--	--	--	--	--	--	#	#		00h
		0	1	#	#	#	#	#	#	#	#	HRES[9:0]	00h

		0	1	--	--	--	--	--	--	--	#		00h
		0	1	#	#	#	#	#	#	#	#	VRES[8:0]	00h
31	SPI flash control (DAM)	0	0	0	1	1	0	0	1	0	1		65h
		0	1	--	--	--	--	--	--	--	#	DAM	00h
32	Revision (REV)	0	0	0	1	1	1	0	0	0	0		70h
		1	1	#	#	#	#	#	#	#	#	LUTVER[7:0]	00h
		1	1	#	#	#	#	#	#	#	#	LUTVER[15:8]	00h
33	Get Status(FLG)	0	0	0	1	1	1	0	0	0	0		71h
		1	1	--	--	#	#	#	#	#	#	I2C_ERR, I2C_BUSYN, DATA_FLAG, PON, POF, BUSY_N	02h
34	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
35	Read Vcom Value(VV)	0	0	1	0	0	0	0	0	0	1		81h
		1	1	--	#	#	#	#	#	#	#	VV[6:0]	00h
36	VCM_DC Setting (VDCS)	0	0	1	0	0	0	0	0	1	0		82h
		0	1	--	#	#	#	#	#	#	#	VDCS[6:0]	02h
37	Power Saving (PWS)	0	0	1	1	1	0	0	0		1	1	E3h
		0	1	#	#	#	#	#	#	#	#	VCOM_W[3:0], SD_W[3:0]	00h

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)

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	-	-	UD	SHL	SHD_N	RST_N
	0	1	-	-	-	-	-	-	-	-

RES[1:0]: Display resolution setting(source ×gate) 00b: 640×480 (default)

01b: 600×450

10b: 640×448

11b:60

0×44

UD: Gate Scan Direction

0: Scan down(default)) First line to last: Gn-1→……→G0

1: Scan up. (default) First line to last: G0→ ……→Gn-1

SHL: Source shift direction

0: Shift left. First data to last data: Sn-1→……→S0

1: Shift right First data to last data: S0→……→Sn-1

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
	0	0	0	0	0	0	0	0	0	1
Selecting	0	1	-	-	EDATA_SEL	EDATA_SET	-	VCOM_HZ	V Source_ EN	VGate_EN
Internal/External	0	1	-	-	-	-	-	-	VGHL_LVL[1:0]	
Power	0	1	-	-	VSHC_LV[5:0]					
	0	1	-	-	VSLC_LV[5:0]					

EDATA_SEL: EDATA selection for pure driver mode

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

1 : When EDATA_SET=1, pixel bit =2`b11 output VSL_ 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)

VCM_HZ _EN: VCOM Hi-Z FUNCTION

0: VCOM NORMAL

1: VCOM FLOATING(default)

V Source_ EN: V Source power selection.

0: External source power from VSH and VSL pin.

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

VSC_EN: Source LV power selection.

0 : External source LV power from VSH_LV and VSL_LV pin. (default)

1 : Internal DCDC function for generate source LV power.

V Gate _EN: V Gate 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.

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

VSHC_LVL[5:0]: Internal VSH LV Voltage Level Selection for Red LUT.

VSHC_LVL[5:0]	VSH LV Voltage Level
000000	3.0V
000001	3.2V
000010	3.4V
000011	3.6V
000100	3.8V
000101	4.0V (Default)
..	..
111100	15.0V

VSLC_LVL[5:0]: Internal VSL LV Voltage Selection for Red LUT.

VSLC_LVL[5:0]	VSL LV Voltage Level
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
Setting Booster Soft Start	0	0	0	0	0	0	0	1	0	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 (m S)	Driving Strength	Minimum OFF Time (uS)
00b: 10 m S 01b: 20 10b: 11b:	000b: 001b: 010b: 011b: 100b: 101b: 110b: 111b:	000b: 001b: 010b: 011b: 100b: 101b: 110b: 111b:

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	1	0	0	0	0
	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	-	KPixel1 [2:0]			-	KPixel2 [2:0]		
	0	1	:	:			:	:		
	0	1	-	K pixel(2M-1) [2:0]			-	K pixel(2M) [2:0]		

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

K pixel[1~2M][2:0] :

K pixel [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) VCOM LUT (LUTC) (R20H)

Action	W/R	C/D	D7	D6	D5	D4	D3	D2	D1	D0
Build Look-Up Table for VCOM (221-byte command, bytes 2~12 repeated 20 times	0	1	0	0	1	0	0	0	0	0
	0	1	Phase repeat times [7:0]							
	0	1	1st level sele. [1:0]		2nd level sele. [1:0]		3rd level sele. [1:0]		4th level sele. [1:0]	
	0	1	5th level sele. [1:0]		6th level sele. [1:0]		7th level sele. [1:0]		8th level sele. [1:0]	
	0	1	1st Frame Number [7:0]							
	0	1	2nd Frame Number [7:0]							
	0	1	3rd Frame Number [7:0]							
	0	1	4th Frame Number [7:0]							
	0	1	5th Frame Number [7:0]							
	0	1	6th Frame Number [7:0]							
	0	1	7th Frame Number [7:0]							
	0	1	8th Frame Number [7:0]							

This command builds up VCOM Look-Up Table (LUT). This LUT includes 20 kinds of states, each state is of 11 bytes, as above.
Each state is made up 8 phases. And each phase is combined with "Repeat number", "Level selection", and "Frame Number".
Byte 2: repeat number.
Bytes 3 ~ 4: Level selection of each phase.
Bytes 5 ~12: Frame number of each phase.
Bytes 2, 13, 24, 35, 46, … : Times to Repeat
0000 0000b: No repeat
0000 0001b ~ 1111 1111b: Repeat 1 ~ 255 times
Bytes 3~4, 14~15, 25~26, 36~37, 47~48, … : Level Selection.
00b: VCM_DC
01b: 15V + VCM_DC (VCOMH)
10b: -15V + VCM_DC (VCOML)
11b: Floating
Bytes 5~12, 16~23, 27~34, 38~45, 49~56, … : Number of Frames
0000 0000b ~ 1111 1111b: 0 ~ 255 frame

Example:

Byte	D7~D0	Remark
2	0000 1000	Repeat 8 times
3	01 00 10 00	1st level: VCOMH, 2nd level: -VCM_DC, 3rd level: VCOML, 4th level: -VCM_DC
4	01 00 10 00	5th level: VCOMH, 6th level: -VCM_DC, 7th level: VCOML, 8th level: -VCM_DC
5	0000 0010	1st frame number: 2
6	0000 0001	2nd frame number: 1
7	0000 0011	3rd frame number: 3
8	0000 0001	4th frame number: 1
9	0000 0100	5th frame number: 4
10	0000 0001	6th frame number: 1
11	0000 0101	7th frame number: 5
12	0000 0001	

13) Black LUT (LUTB) (R21H)

Action	W/R	C/D	D7	D6	D5	D4	D3	D2	D1	D0
Build Look-Up Table for Black (261-byte command, bytes 2~14 repeated 20 times)	0	1	0	0	1	0	0	0	0	0
	0	1	Phase repeat times [7:0]							
	0	1	-	1st level sele. [2:0]			-	2nd level sele. [2:0]		
	0	1	-	3rd level sele. [2:0]			-	4th level sele. [2:0]		
	0	1	-	5th level sele. [2:0]			-	6th level sele. [2:0]		
	0	1	-	7th level sele. [2:0]			-	8th level sele. [2:0]		
	0	1	1st Frame Number [7:0]							
	0	1	2nd Frame Number [7:0]							
	0	1	3rd Frame Number [7:0]							
	0	1	4th Frame Number [7:0]							
	0	1	5th Frame Number [7:0]							
	0	1	6th Frame Number [7:0]							
	0	1	7th Frame Number [7:0]							
	0	1	8th Frame Number [7:0]							

This command builds LUTB for black. This LUT includes 20 kinds of states, each state is of 13 bytes as above.
Each state is made up 8 phases. And each phase is combined with “repeat number”, “Level selection”, and “frame number”.
Byte 2: repeat number.
Bytes 3 ~ 6: Level selection of each phase.
Bytes 7 ~14: Frame number of each phase.
Bytes 2, 15, 28, 41, 54, … : Times to Repeat
0000 0000b: No repeat
0000 0001b ~ 1111 1111b: Repeat 1 ~ 255 times
Bytes 3~6, 16~19, 29~32, 42~45, 55~58, … : Level Selection.
000b: 0V
001b: 15V (VSH)
010b: -15V (VSL)
011b: VSH_LV
100b: VSL_LV
101b: VSH_LVX (external source power from VSH_LVX pin)
110b: VSL_LVX (external source power from VSL_LVX pin)
111b: Floating
Bytes 7~14, 20~27, 33~40, 46~53, 59~66, … : Number of Frames
0000 0000b ~ 1111 1111b: 0 ~ 255 frames

Byte2	0000 0100	repeat 4 times
3	0001 0010	1st level: VSH, 2nd level: VSL
4	0011 0100	3rd level: VSH_LV, 4th level: VSL_LV
5	0000 0010	5th level: VSH, 6th level: VSL
6	0011 0100	7th level: VSH_LV, 8th level: VSL_LV
7	0000 0001	1st frame number: 1
8	0000 0010	2nd frame number: 2
9	0000 0011	3rd frame number: 3
10	0000 0100	4th frame number: 4
11	0000 0101	5th frame number: 5
12	0000 0110	6th frame number: 6
13	0000 0101	7th frame number: 5
14	0000 0001	8th frame number: 1

14） LUT WHITE (LUTW) (R22H)

Action	W/R	C/D	D7	D6	D5	D4	D3	D2	D1	D0
Build Look-Up Table for Gray1 (261-byte command, bytes 2~14 repeated 20 times)	0	1	0	0	1	0	0	0	1	1
	0	1	Phase repeat times [7:0]							
	0	1	-	1st level sele. [2:0]			-	2nd level sele. [2:0]		
	0	1	-	3rd level sele. [2:0]			-	4th level sele. [2:0]		
	0	1	-	5th level sele. [2:0]			-	6th level sele. [2:0]		
	0	1	-	7th level sele. [2:0]			-	8th level sele. [2:0]		
	0	1	1st Frame Number [7:0]							
	0	1	2nd Frame Number [7:0]							
	0	1	3rd Frame Number [7:0]							
	0	1	4th Frame Number [7:0]							
	0	1	5th Frame Number [7:0]							
	0	1	6th Frame Number [7:0]							
	0	1	7th Frame Number [7:0]							
	0	1	8th Frame Number [7:0]							

This command builds LUT for White. Please refer to command (13) LUTB for similar definition details.

15) GRAY1 LUT (LUTG1) (R23H)

Action	W/R	C/D	D7	D6	D5	D4	D3	D2	D1	D0
Build Look-Up Table for Gray1 (261-byte command, bytes 2~14 repeated 20 times)	0	1	0	0	1	0	0	0	1	1
	0	1	Phase repeat times [7:0]							
	0	1	-	1st level sele. [2:0]			-	2nd level sele. [2:0]		
	0	1	-	3rd level sele. [2:0]			-	4th level sele. [2:0]		
	0	1	-	5th level sele. [2:0]			-	6th level sele. [2:0]		
	0	1	-	7th level sele. [2:0]			-	8th level sele. [2:0]		
	0	1	1st Frame Number [7:0]							
	0	1	2nd Frame Number [7:0]							
	0	1	3rd Frame Number [7:0]							
	0	1	4th Frame Number [7:0]							
	0	1	5th Frame Number [7:0]							
	0	1	6th Frame Number [7:0]							
	0	1	7th Frame Number [7:0]							
	0	1	8th Frame Number [7:0]							

This command builds LUT for Gray 1. Please refer to command (13) LUTB for similar definition details.

16) GRAY2 LUT (LUTG2) (R24H)

Action	W/R	C/D	D7	D6	D5	D4	D3	D2	D1	D0
Build Look-Up Table for Gray2 (261-byte command, bytes 2~14 repeated 20 times)	0	1	0	0	1	0	0	1	0	1
	0	1	Phase repeat times [7:0]							
	0	1	-	1st level sele. [2:0]			-	2nd level sele. [2:0]		
	0	1	-	3rd level sele. [2:0]			-	4th level sele. [2:0]		
	0	1	-	5th level sele. [2:0]			-	6th level sele. [2:0]		
	0	1	-	7th level sele. [2:0]			-	8th level sele. [2:0]		
	0	1	1st Frame Number [7:0]							
	0	1	2nd Frame Number [7:0]							
	0	1	3rd Frame Number [7:0]							
	0	1	4th Frame Number [7:0]							
	0	1	5th Frame Number [7:0]							
	0	1	6th Frame Number [7:0]							
	0	1	7th Frame Number [7:0]							
	0	1	8th Frame Number [7:0]							

This command builds LUT for Gray 2. Please refer to command (13) LUTB for similar definition details.

(17) RED0 LUT (LUTR0) (R25H)

Action	W/R	C/D	D7	D6	D5	D4	D3	D2	D1	D0
Build Look-Up Table forRed0 (261-byte command, bytes 2~14 repeated 20 times)	0	1	0	0	1	0	0	1	0	1
	0	1	Phase repeat times [7:0]							
	0	1	-	1st level sele. [2:0]			-	2nd level sele. [2:0]		
	0	1	-	3rd level sele. [2:0]			-	4th level sele. [2:0]		
	0	1	-	5th level sele. [2:0]			-	6th level sele. [2:0]		
	0	1	-	7th level sele. [2:0]			-	8th level sele. [2:0]		
	0	1	1st Frame Number [7:0]							
	0	1	2nd Frame Number [7:0]							
	0	1	3rd Frame Number [7:0]							
	0	1	4th Frame Number [7:0]							
	0	1	5th Frame Number [7:0]							
	0	1	6th Frame Number [7:0]							
	0	1	7th Frame Number [7:0]							
	0	1	8th Frame Number [7:0]							

This command builds LUT for Red 0. Please refer to command (13) LUTB for similar definition details.

18) RED1 LUT (LUTR1) (R26H)

Action	W/R	C/D	D7	D6	D5	D4	D3	D2	D1	D0
Build Look-Up Table forRed0 (261-byte command, bytes 2~14 repeated 20 times)	0	1	0	0	1	0	0	1	0	1
	0	1	Phase repeat times [7:0]							
	0	1	-	1st level sele. [2:0]			-	2nd level sele. [2:0]		
	0	1	-	3rd level sele. [2:0]			-	4th level sele. [2:0]		
	0	1	-	5th level sele. [2:0]			-	6th level sele. [2:0]		
	0	1	-	7th level sele. [2:0]			-	8th level sele. [2:0]		
	0	1	1st Frame Number [7:0]							
	0	1	2nd Frame Number [7:0]							
	0	1	3rd Frame Number [7:0]							
	0	1	4th Frame Number [7:0]							
	0	1	5th Frame Number [7:0]							
	0	1	6th Frame Number [7:0]							
	0	1	7th Frame Number [7:0]							
	0	1	8th Frame Number [7:0]							

This command builds LUT for Red 1. Please refer to command (13) LUTB for similar definition details.

19) RED2 LUT (LUTR2) (R27H)

Action	W/R	C/D	D7	D6	D5	D4	D3	D2	D1	D0
Build Look-Up Table for Red2 (261-byte command, bytes 2~14 repeated 20 times)	0	1	0	0	1	0	0	1	0	1
	0	1	Phase repeat times [7:0]							
	0	1	-	1st level sele. [2:0]			-	2nd level sele. [2:0]		
	0	1	-	3rd level sele. [2:0]			-	4th level sele. [2:0]		
	0	1	-	5th level sele. [2:0]			-	6th level sele. [2:0]		
	0	1	-	7th level sele. [2:0]			-	8th level sele. [2:0]		
	0	1	1st Frame Number [7:0]							
	0	1	2nd Frame Number [7:0]							
	0	1	3rd Frame Number [7:0]							
	0	1	4th Frame Number [7:0]							
	0	1	5th Frame Number [7:0]							
	0	1	6th Frame Number [7:0]							
	0	1	7th Frame Number [7:0]							
	0	1	8th Frame Number [7:0]							

This command builds LUT for Red 2. Please refer to command (13) LUTB for similar definition details.

20) RED3 LUT (LUTR3) (R28H)

Action	W/R	C/D	D7	D6	D5	D4	D3	D2	D1	D0
Build Look-Up Table for Red3 (261-byte command, bytes 2~14 repeated 20 times)	0	1	0	0	1	0	1	0	0	0
	0	1	Phase repeat times [7:0]							
	0	1	-	1st level sele. [2:0]			-	2nd level sele. [2:0]		
	0	1	-	3rd level sele. [2:0]			-	4th level sele. [2:0]		
	0	1	-	5th level sele. [2:0]			-	6th level sele. [2:0]		
	0	1	-	7th level sele. [2:0]			-	8th level sele. [2:0]		
	0	1	1st Frame Number [7:0]							
	0	1	2nd Frame Number [7:0]							
	0	1	3rd Frame Number [7:0]							
	0	1	4th Frame Number [7:0]							
	0	1	5th Frame Number [7:0]							
	0	1	6th Frame Number [7:0]							
	0	1	7th Frame Number [7:0]							
	0	1	8th Frame Number [7:0]							

This command builds LUT for Red 3. Please refer to command (13) LUTB for similar definition details.

(21) XON LUT (LUTXON) (R29H)

Action	W/R	C/D	D7	D6	D5	D4	D3	D2	D1	D0
Build Look-Up Table for XON (201-byte command, bytes 2~11 repeated 20 times)	0	1	0	0	1	0	1	0	0	0
	0	1	Phase repeat times [7:0]							
	0	1	-	1st level sele. [2:0]			-	2nd level sele. [2:0]		
	0	1	-	3rd level sele. [2:0]			-	4th level sele. [2:0]		
	0	1	-	5th level sele. [2:0]			-	6th level sele. [2:0]		
	0	1	-	7th level sele. [2:0]			-	8th level sele. [2:0]		
	0	1	1st Frame Number [7:0]							
	0	1	2nd Frame Number [7:0]							
	0	1	3rd Frame Number [7:0]							
	0	1	4th Frame Number [7:0]							
	0	1	5th Frame Number [7:0]							
	0	1	6th Frame Number [7:0]							
	0	1	7th Frame Number [7:0]							
	0	1	8th Frame Number [7:0]							

This command builds LUT for XON. This LUT includes 20 kinds of states, each state is of 10 bytes as above.

Each state is made up 8 phases. And each phase is combined with “repeat number”, “XON selection”, and “frame number”.

Byte 2: Repeat number.

Bytes 3: Level selection of each phase.

Bytes 4 ~11: Frame number of each phase.

Bytes 2, 12, 22, 32, 42, … : Times to Repeat

0000 0000b: No repeat

0000 0001b ~ 1111 1111b: Repeat 1 ~ 255 times

Bytes 3, 13, 23, 43, 53, … : XON Selection.

0: All gate ON (VGH)

1: Normal gate scan function

Bytes 4~11, 14~21, 24~31, 34~41, 44~51, … : Number of Frames

0000 0000b ~ 1111 1111b: 0 ~ 255 frames

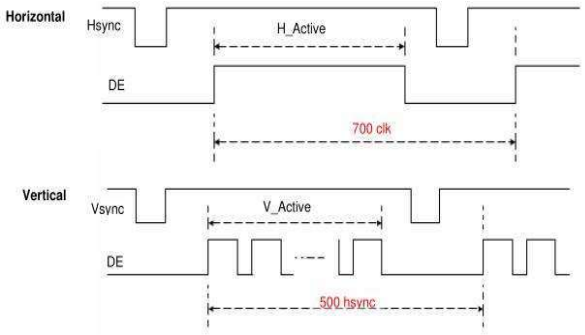
22) PLL CONTROL (PLL) (R30H)

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 supports the following frame rates:

(FR: Frame Rate, Unit: Hz)

M	N	FR	M	N	FR	M	N	FR	M	N	FR	M	N	FR	M	N	FR	M	N	FR
1	1	29	2	1	57	3	1	86		1	114		1	143		1	171		1	200
	2	14		2	29		2	43		2	59		2	71		2	86		2	100
	3	10		3	19		3	29		3	38		3	48		3	57		3	67
	4	5		4	4		4	21		4	29		4	36		4	43		4	50
	5	7		5	11		5	17		5	23		5	29		5	34		5	40
	6	6		6	10		6	14		6	19		6	24		6	29		6	33
	7	5		7	8		7	12		7	16		7	20		7	24		7	29



23) Temperature Sensor Calibration(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/TSO	D1	D0	-	-	-	-	-

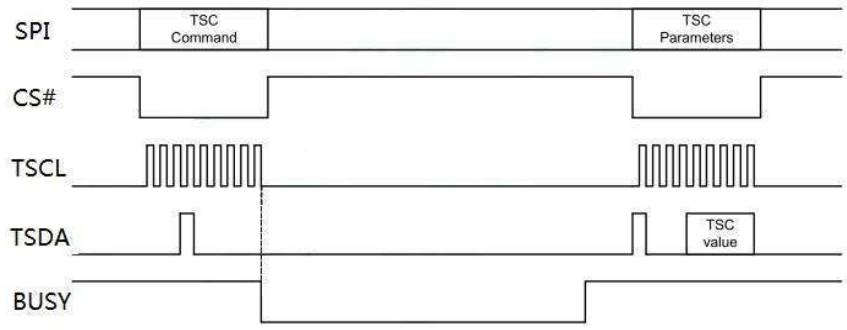
This command reads the temperature sensed by the temperature sensor.

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.

TS[7:0]	Temperature
1100 1110b	-24.5
1100 1111b	-24.5
1101 0000b	-24.5
:	
1111 1110b	-1
1111 1111b	-0.5
0000 0000b	0
0000 0001b	0.5
0000 0010b	1
:	:
0101 1010b	45
:	:
0110 0011b	49.5
0110 0100b	50

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



24) Temperature Sensor Internal/External(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	TO						

This command selects Internal or External temperature sensor.

TSE: Internal temperature sensor switch

0: Select internal temperature sensor (default)

1: Select external temperature sensor.

Temperature Offset

TO[3:0]	Temperature
0000	0
0001	0.5
0010	1
0011	1.5
0100	2
0101	2.5
0110	3.0
0111	3.5

TO[3:0]	Temperature
1000	-4.0
1001	-3.5
1010	-3.0
1011	-2.5
1100	-2.0
1101	-1.5
1110	-1.0
1111	-0.5

25) 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]: I^2C Write Byte Number

00: 1 byte (head byte only)

01: 2 bytes (head byte + pointer)

10: 3 bytes (head byte + pointer + 1st parameter)

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

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

D[2:0]: Pointer setting

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

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

26) 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]: MS Byte of read-data from external temperature sensor.

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

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

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

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

H sync).

VBD[2:0]: Border output selection.

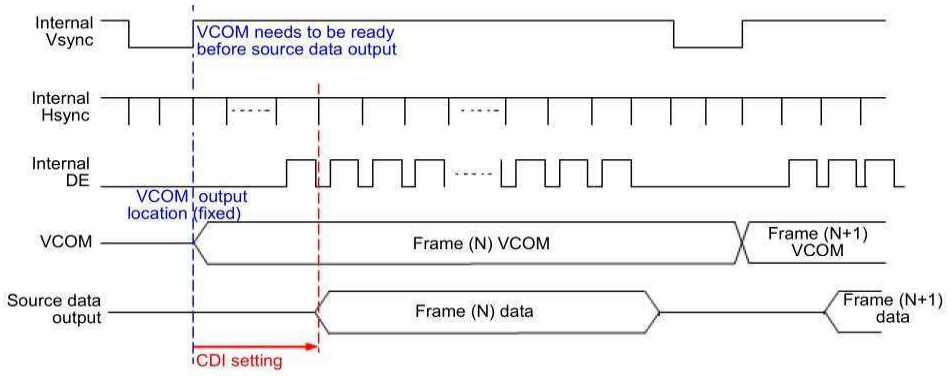
DDX: Data polarity

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]: V com and data interval

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



28) Low Power Detection(LPD) (R51h)

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)**

29) TCON Setting(TCON) (R60h)

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

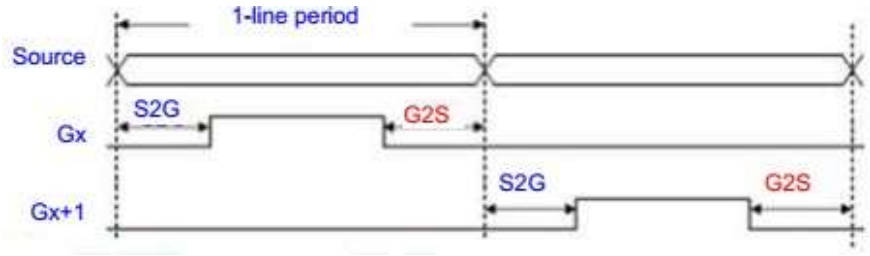
This command defines non-overlap period of Gate and Source.

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 n S.



30) Resolution Setting(TRES) (R61H)

Action	W / R	C / D	D 7	D 6	D 5	D 4	D 3	D 2	D 1	D 0
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.

32) Revision(REV) (R70H)

Action	W/R	C/D	D7	D6	D5	D4	D3	D2	D1	D0
LUT/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 version

33) 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	-	-	I^2C_ERR	I^2C_BUSY	Data_ flag	PON	POF	BUSY

This command reads the IC status.

I^2C_ERR: I^2C master error status

I^2C_BUSY: I^2C 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)

34) Auto measure v com(AMV) (R80h)

Action	W/R	C/D	D7	D6	D5	D4	D3	D2	D1	D0
Automatically measure v com	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 V com 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 V com value with the VV command (R81h) (default)

1: Get V com value in analog signal.

AMVE: Auto Measure V com Enable (/Disable)

0: Disabled 1: n able

35) VCOM Value(VV) (R81h)

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

This command gets the V com value.

VV[6:0]: V com Value Output

VV[6:0]	V com value
000 0000b	0 V
000 0001b	-0.05 V
000 0010b	-0.10 V
000 0011b	-0.15 V
:	:
101 0000b	-4.00 V
(Others)	-4.00V

36) 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

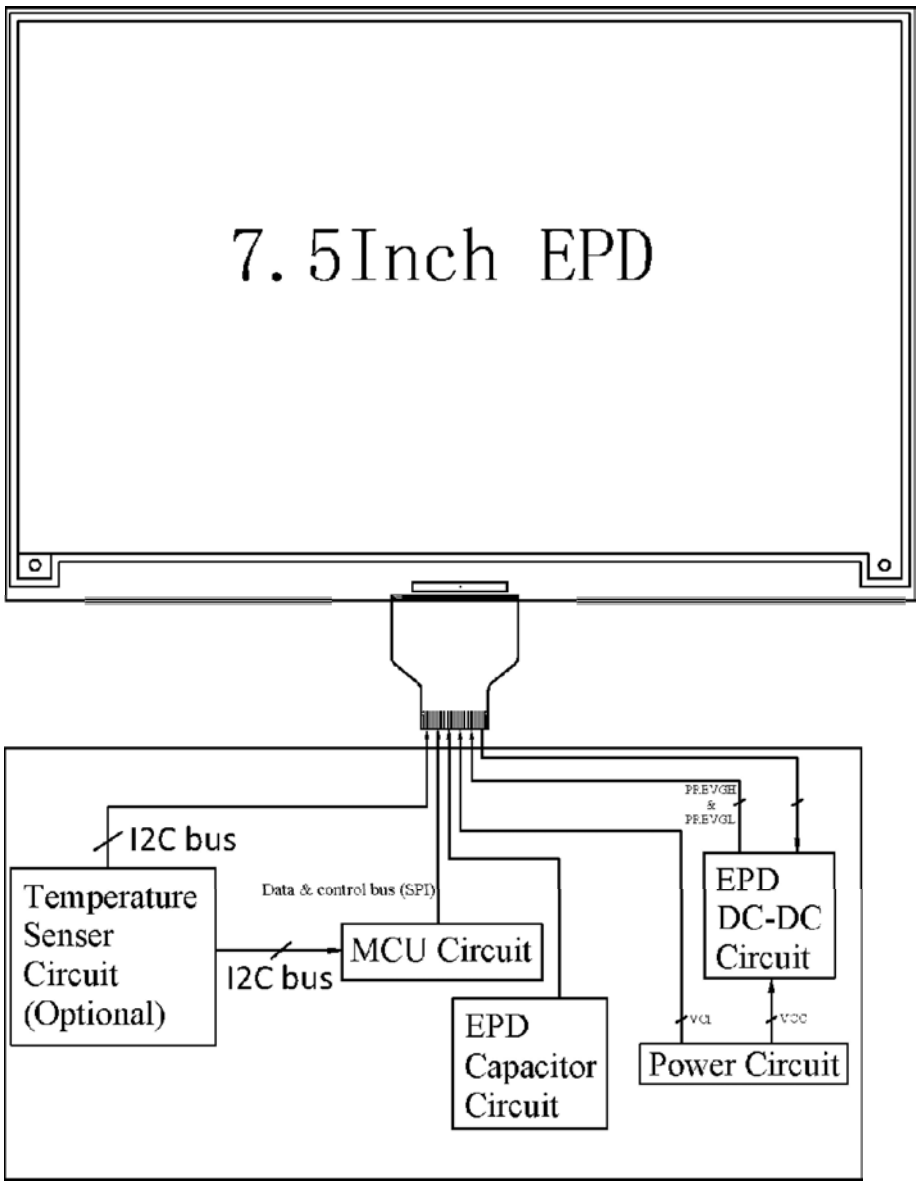
37) Flash Address Byte Number (RE5H)

Action	W/R	C/D	D7	D6	D5	D4	D3	D2	D1	D0
Flash Address Byte Number	0	0	1	0	0	0	0	0	0	0
	0	1	-	-	-	-	-	-	1	ADR3B

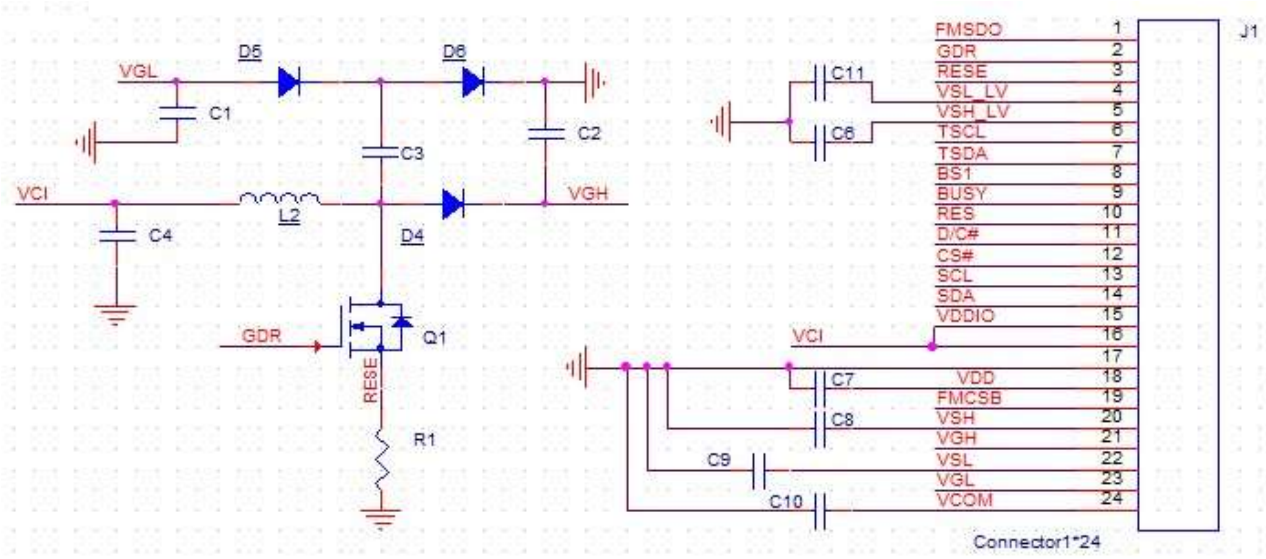
This command sets address byte number control for flash type.

ADR3B: 0:Apply flash w/2-byte address 1:Apply flash w/3-byte address

8. Block Diagram



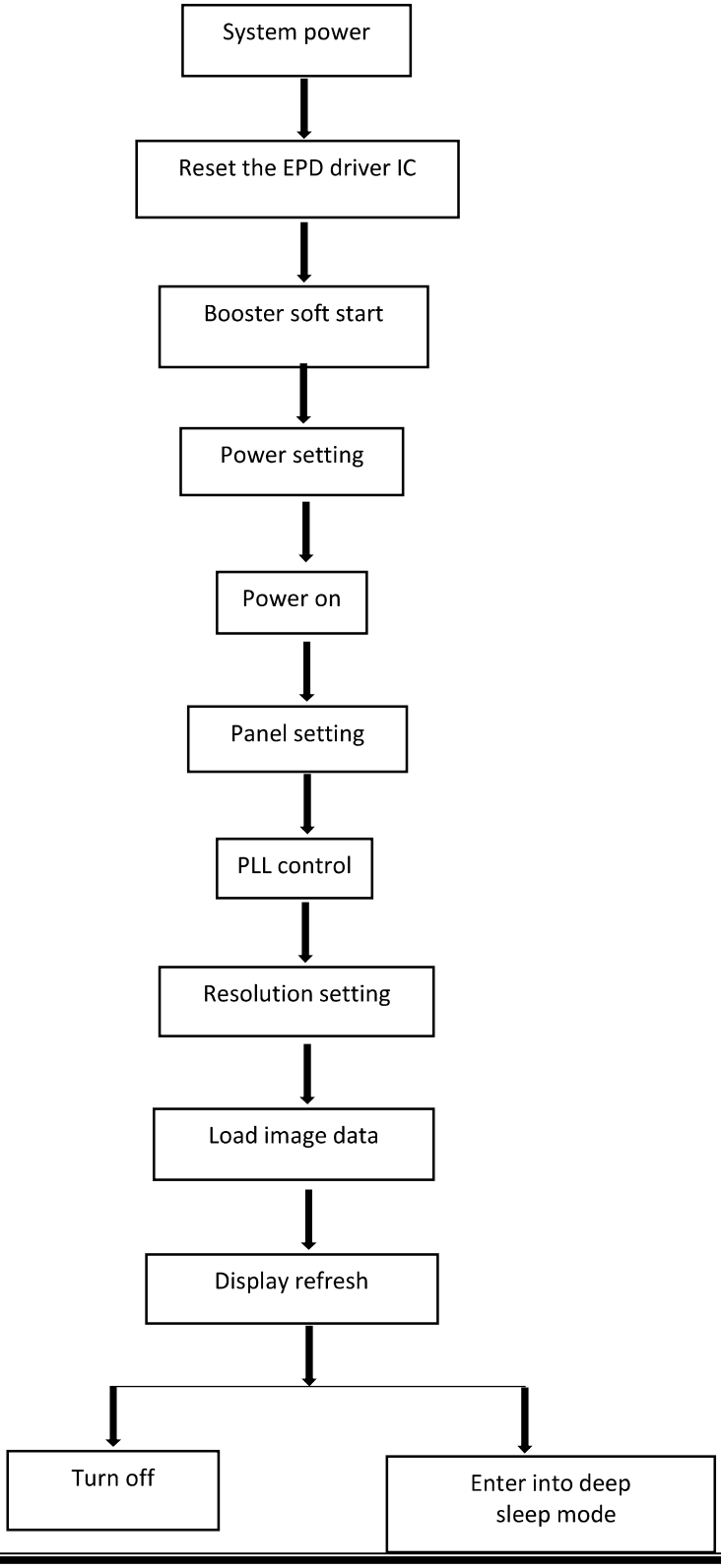
9. Typical Application Circuit with SPI Interface



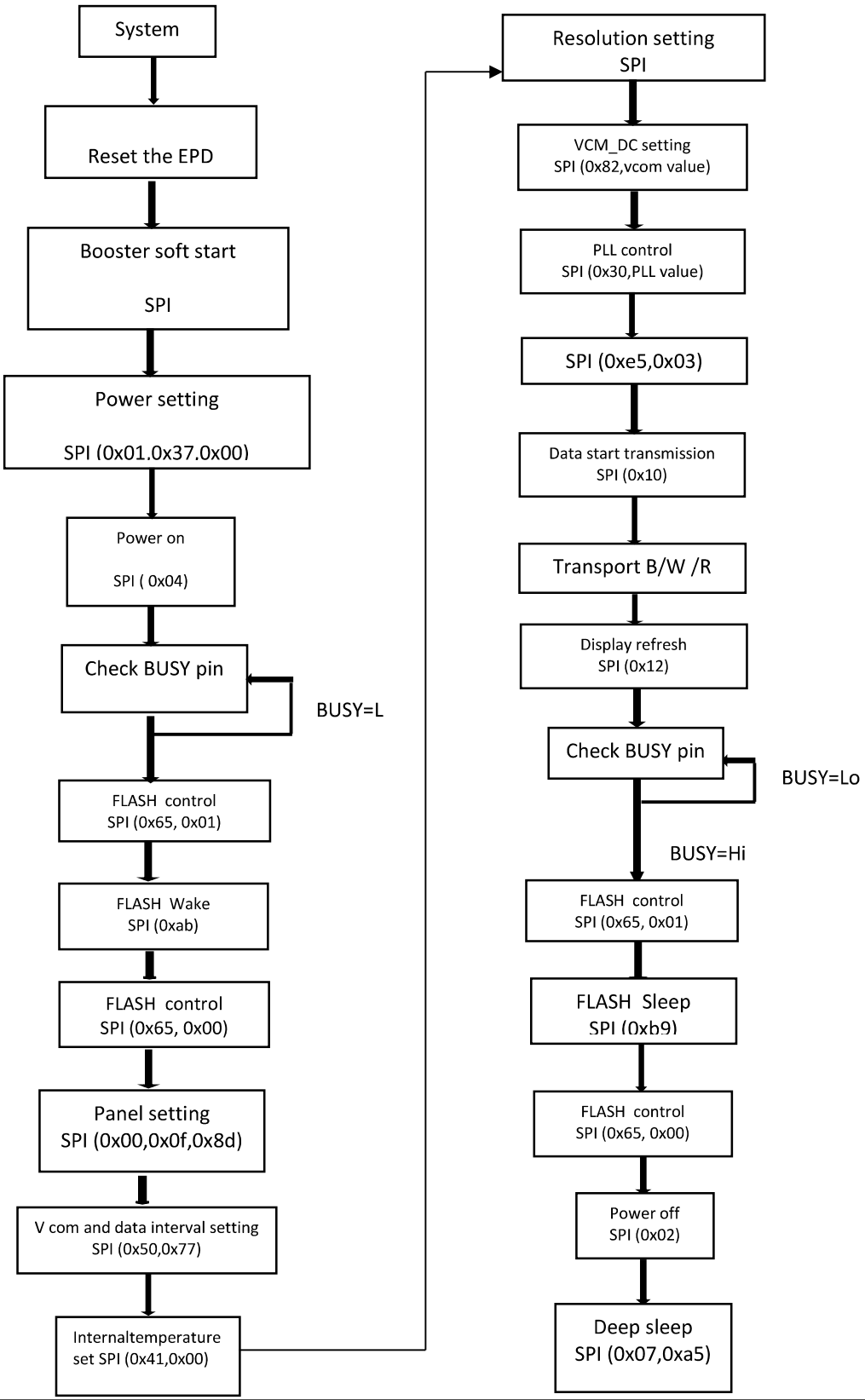
Part Name	Value	Reference Part	Requirements for spare part
C1 C2 C3 C6 C8 C9 C11	4.7uF	Voltage Rating:25v	
C4 C7	1uF	Voltage Rating:10v	
C10	0.47uF	Voltage Rating:25v	
R1	0.47Ohm	NO	
D4 D5 D6	Diode	MBR0530	(VR≥20V,IF≥500mA,Ir<1mA)
Q1	NMOS	RUF015N02	(VDS≥20V,ID≥1.2A,VGS(th)<1.5V RDS(ON)<350m-Ω)
L2	10UH	NO	

10. Typical Operating Sequence

10.1 LUT from OTP Operation Flow



10.2 OTP Operation Reference Program Code



11. Reliability test

NO	Test items	Test condition
1	Low-Temperature Storage	T = -25°C, 240 h Test in white pattern
2	High-Temperature Storage	T=60ºC，RH=40%，240h Test in white pattern
3	High-Temperature Operation	T=40ºC，RH=35%，240h
4	Low-Temperature Operation	0ºC，240h
5	High-Temperature, High-Humidity Operation	T=40ºC，RH=80%，240h
6	High Temperature, High Humidity Storage	T=50ºC，RH=80%, 240h Test in white pattern
7	Temperature Cycle	1 cycle:[-25°C 30min]→[+60 °C 30 min] : 50 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)
9	UV exposure Resistance	765W/m² for 168hrs,40 °C Test in white pattern

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

2. Operation is black→white-red pattern, the interval is 150s.

3. Put in 20℃--25℃ for 1hour after test finished, The function ,appearance and display performance is OK.

12.Quality Assurance

12.1 Environment

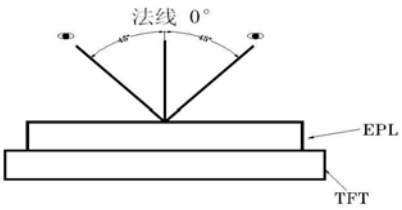
Temperature： 23±3℃

Humidity： 55±10%RH

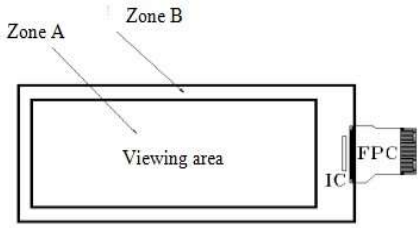
12.2 Illuminance

Brightness:1200～1500LUX;distance:20-30CM;Angle:Relate 45°surround.

12.3 Inspect method

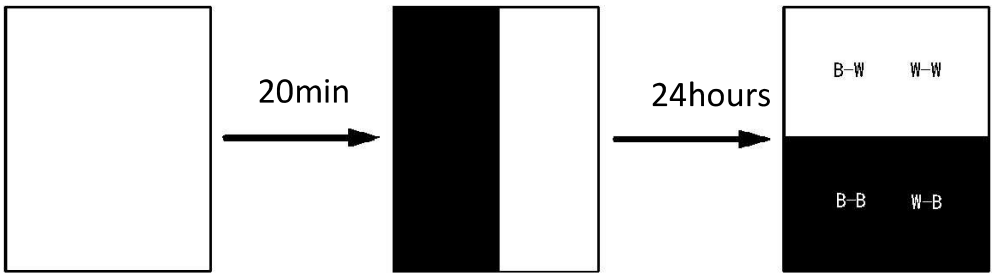


12.4 Display area



12.5 Ghosting test method

Three-color ghosting is measured with following transition from horizontal 3 scale pattern to vertical 3 scale pattern. The listed optical characteristics are only guaranteed under the controller & waveform provided by Maker.



1）Measurement Instruments：X-rite i1Pro

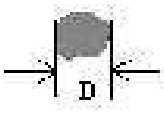
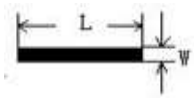
2）Ghosting formula:

W ghosting：△L= Max (Δ L(W-W, B-W)) - Min (Δ L(W-W B-W))

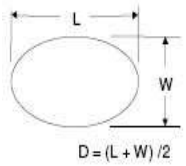
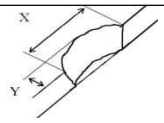
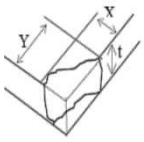
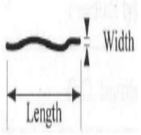
K ghosting：△L= Max (Δ L(W-B, B-B)) - Min(Δ L(W-B, B-B))

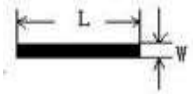
12.6 Inspection standard

12.6.1 Electric inspection standard

NO.	Item	Standard	Defect level	Method	Scope
1	Display	Clear display Display complete Display uniform	MA	Visual inspection	Zone A
2	Black/White spots	 D≤0.3mm，negligible 0.3mm＜D≤0.5mm， N≤5， 0.5mm＜D≤0.6mm，N≤1， Allowed 0.6mm＜D Not Allow	MI		
3	Black/White line (No switch)	 L≤1.0mm,W≤0.15mm negligible 1.0mm＜L≤4.0mm 0.15mm＜W≤0.5mm N≤4 allowable L＞4.0mm ,W＞0.5mm is not allowed		Visual/ Inspection card	
4	Ghost image	Allowed in switching process	MI	Visual inspection	
5	Flash dot / Multilateral	Flash points are allowed when switching screens Multilateral colors outside the frame are allowed for fixed screen time	MI	Visual/ Inspection card	Zone A Zone B
6	Segmented display	Selection segments are all displayed, and other segments are not displayed after the selection segment.	MA	Visual inspection	Zone A
7	Short circuit/ Circuit break/ Abnormal Display	Not Allow			

12.6.2 Appearance inspection standard

NO.	Item	Standard	Defect level	Method	Scope
1	B/W spots /Bubble/ Foreign bodies/ Dents	 D≤0.3mm，Allowed 0.3mm＜D≤0.5mm，N≤5 D＞0.5mm，Not Allow	MI	Visual inspection	Zone A
2	Glass crack	Not Allow	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  2mm≤X or 2mm≤Y Not Allow  W≤0.1mm,L≤5mm, No harm to the electrodes and N≤2 allow	MI	Visual / Microscope	Zone A Zone B
5	TFT Cracks	 Not Allow	MA	Visual / Microscope	Zone A Zone B
6	Dirty/ foreign body	Allowed if can be removed/ allow	MI	Visual / Microscope	Zone A / Zone B
7	FPC broken/ FPC oxidation / scratch	  Not Allow	MA	Visual / Microscope	Zone B

8	B/W Line	 L≤1.0mm,W≤0.15mm negligible 1.0mm＜L≤4.0mm 0.15mm＜W≤0.5mm N≤4 allowable L＞4.0mm ,W＞0.5mm is not allowed	MI	Visual / Ruler	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≤0.25mm, allow 0.25mm＜D≤0.4mm ,n≤4 allow D＞0.4mm is not allowed (n≤8 items are allowed within 5 mm in diameter)	MI	Visual / Microscope	Zone A
11	PCB damaged/ Poor welding/ Curl	PCB（Circuit area）damaged Not Allow PCB Poor welding Not Allow PCB Curl≤1%	MI	Visual / Ruler	Zone B
12	Edge glue height/ Edge glue bubble	Edge Adhesives H≤PS surface (Including protect film) Edge adhesives seep in≤1/2 Margin width Length excluding Edge adhesives bubble：bubble Width ≤1/2 Margin width；Length ≤0.5mm。n≤5	MI		
13	Protect film	Surface scratch but not effect protect function, Allow	MI	Visual Inspection	Zone B
14	Silicon glue	Thickness≤PS surface(With protect 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 raised.	MI	Visual Inspection	
15	Warp degree (TFT substrate)	 t≤1.5mm	MI	Ruler	
16	Color difference in COM area (Silver point area)	Allowed		Visual Inspection	

13.Packaging

PACKING INSTRUCTION

P/N	Customer Code	Ref. P/N
0750		

Type	PKG Method	Marking	Surface Marks	Pull Tape	
GLASS	Blister	BACK	None	YES	

Packing Materials List				
List	Model	Materials	Q'ty	Unit
Carton	12# 417*362*229 mm	corrugate	1	Piece
Inner Carton	12#(INNER)400*343 *95 mm	corrugate	2	Piece
Blister	0750G	PET	22	Piece
Thin foam	341.76x273.8*T1.5-1.8mm	EPE	20	Piece
Antistatic vacuum bag	450*590*0.075		2	Piece
Foam board	2251-10	EPE	3	Piece
PULL TAPE	16*5*T0.05		80	Piece

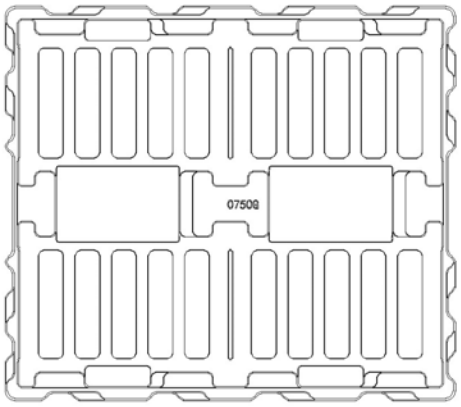
4PCS/LAYER, 20LAYER/CTN, TOTAL 80PCS/CTN.

Pull tape:

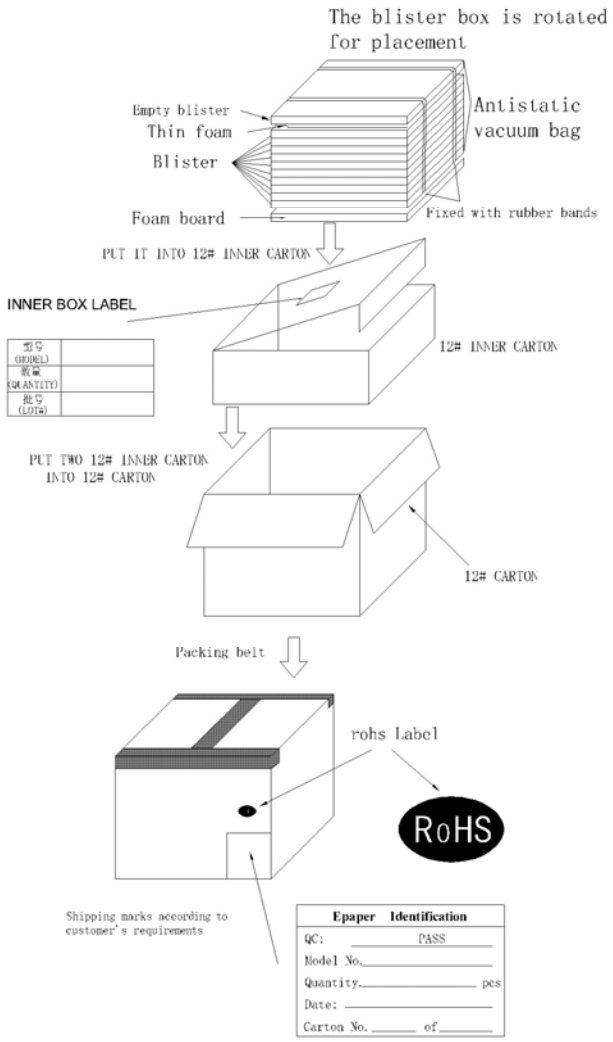
Detail:

Blister box:

Note: there are 20 layers of products, divided into 2 inner boxes, and an empty blister box is placed on the top of each inner box, so the number of blister boxes is 22



QUANTITY：4PCS



14. 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.

Disassembling the display module can cause permanent damage and invalidates 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	This 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 at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.	
Application information	
Where application information is given, it is advisory and does not form part of the specification.	
Product Environmental certification	
ROHS	
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.	
Transport environment	
When the humidity of transportation environment is between 45%RH~70%RH, the product can be stored for 30 days, and the product can be stored for 10 days if it is lower or higher than this range	

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