YES OPTOELECTRONICS CO.,LTD

SPECIFICATIONS

Product NO: YMS640384-075BAAMFGN

DATE: SEP.05.2018

Prepared by	Approved by
王惠颖	牛红丽

CUSTOMER'S APPROVAL

APPROVED BY：_____ DATE:_____

YES OPTOELECTRONICS CO.,LTD
DD: No.288Yueling Road Anshan,Liaoning,CHINA
TEL: 86-412-5211859 FAX: 86-412-5211729 P.C.:114045
E-mail : yes@yes-lcd.com, yeslcd@globalsources.com
Web: http://www.yes-lcd.com

REVISION HISTORY

Rev	Date	Item	Page	Remark
1.0	SEP.05.2018	New Creation	ALL	

LIST

1. Over View

The display is a TFT active matrix electrophoretic display, with interface and a reference system design. The 7.5inch active area contains 640×384 pixels, and has 1-bit white/black full display capabilities. An integrated circuit contains gate buffer, source buffer, interface, timing control logic, oscillator, DC-DC, SRAM, LUT, VCOM and border are supplied with each panel.

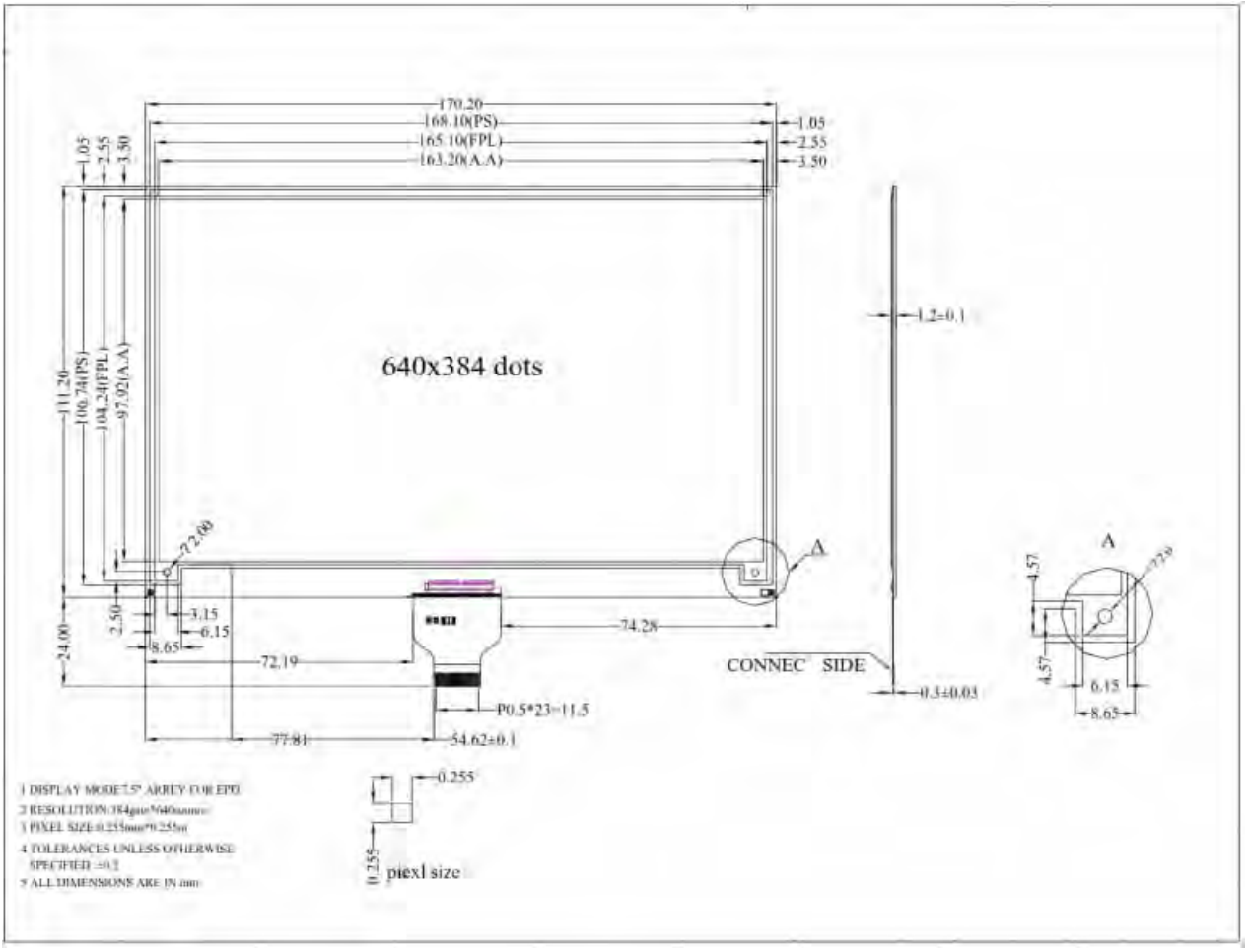
2.Features

- 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

3. Mechanical Specifications

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) ×1.18(D)	mm	
Weight	42.5±0.5	g	

4. Mechanical Drawing of EPD module



5. Input / Output Terminals

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	Positive source voltage (+3.0V ~ +15.0V).	
5	VSH_LV	NC	Negative source voltage (-3.0V ~ -15.0V).	
6	TSCL	O	I2C Interface to digital temperature sensor Clock pin	
7	TSDA	I/O	I2C Interface to digital temperature sensor Data pin	
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	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, /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

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. 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		04h
6	Booster Soft Start (BTST)	0	0	0	0	0	0	0	1	1	0		06h
		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		61h
		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:600×44

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
Selecting Internal/External Power	0	0	0	0	0	0	0	0	0	1
	0	1	-	-	EDATA_SEL	EDATA_SET	-	VCOM_HZ	V Source_EN	VGate_EN
	0	1	-	-	-	-	-	-	VGHL_LVL[1:0]	
	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 ser 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 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 frames

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

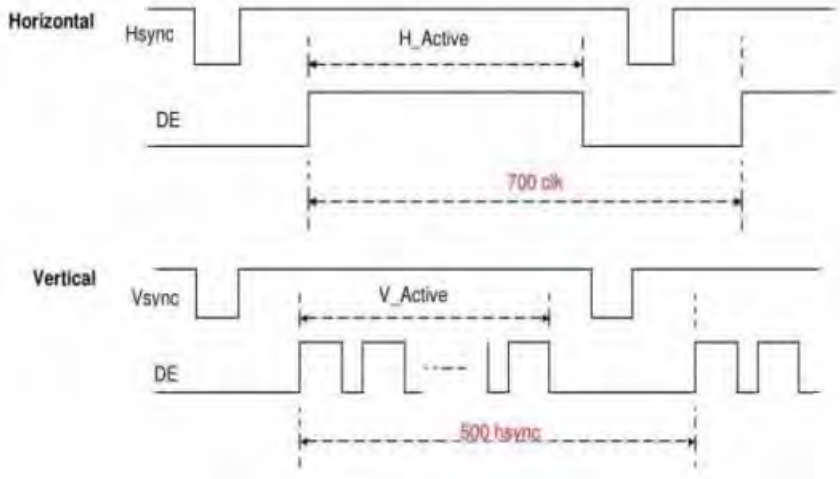
22) PLL CONTROL (PLL) (R30H)

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	-	-	-	-	-

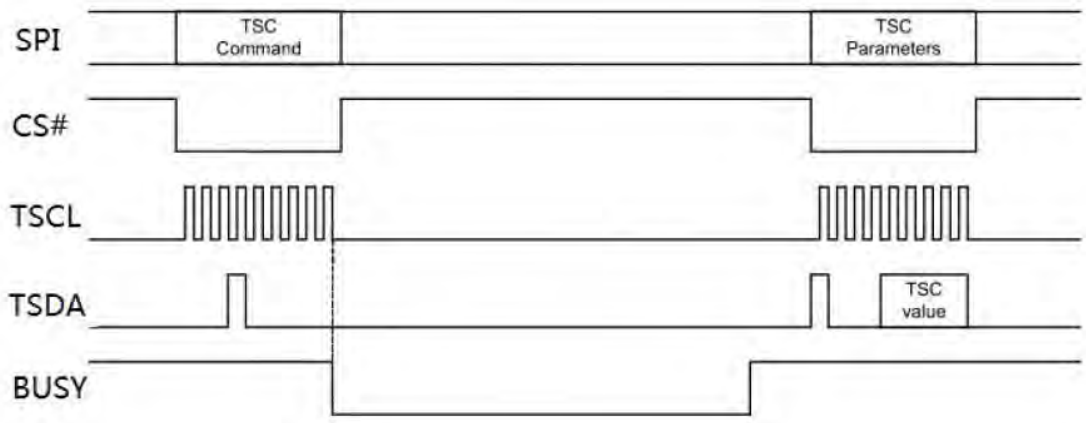
This command reads the temperature sensed by the temperature sensor.

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 + 1^{st} parameter)

11: 4 bytes (head byte + pointer + 1^{st} parameter + 2^{nd} 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.

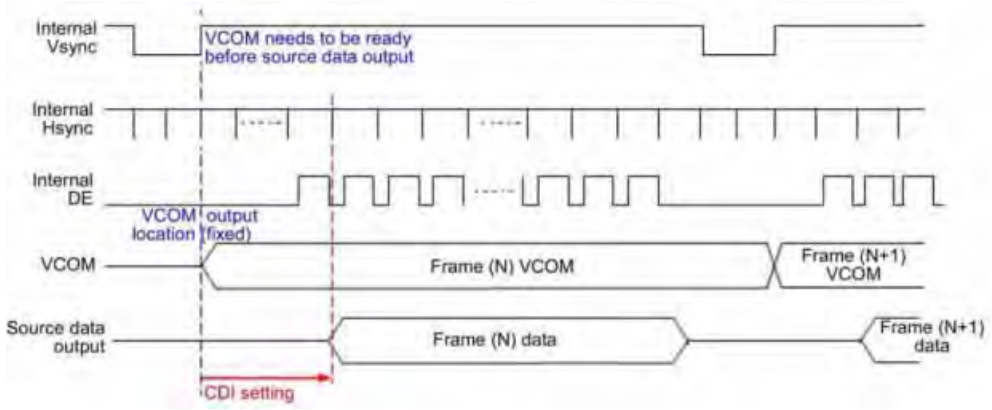
DDX: Data polarity.

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)

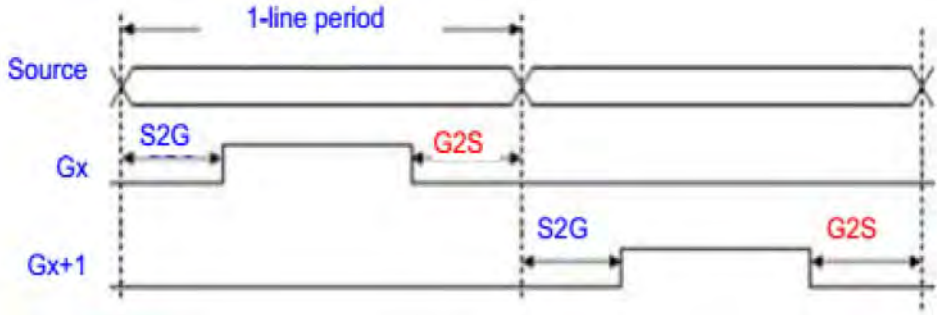
Action	W/R	C/D	D7	D6	D5	D4	D3	D2	D1	D0
Sensing Temperature	0	0	0	1	1	0	0	0	0	0
	0	1	S2G[3:0]				G2S[3:0]			

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

7. Electrical Characteristics

7-1) 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 VCI +0.3	V
Operating Temp. range	T_{OPR}	0 to +50	℃
Storage Temp. range	T_{STG}	-25 to +70	℃
Optimal Storage Temp	TSTGo	23±2	°C.
Optimal Storage Humidity	HSTGo	55±10	%RH

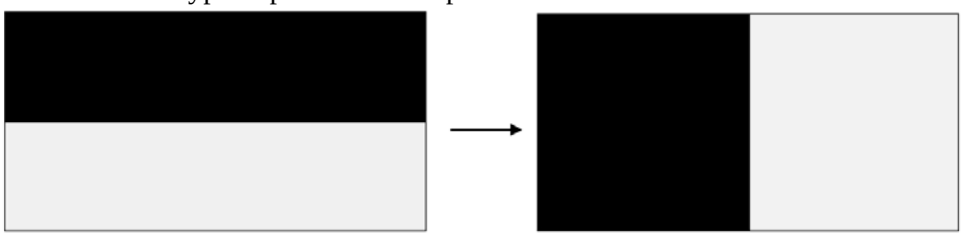
7-2) Panel DC Characteristics

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

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Single ground	V_{SS}	-	-	0	-	V
Logic Supply Voltage	VCI	-	2.3	3.3	3.6	V
High level input voltage	VIH	-	0.7VCI	-	VCI	V
Low level input voltage	VIL	-	GND	-	0.3VCI	V
High level output voltage	VOH	IOH= 400uA	VCI-0.4	-	-	V
Low level output voltage	VOL	IOH= -400uA	GND	-	GND + 0.4	V
Image update current	I_{UPDATE}	-	-	12	-	M A
Standby panel current	$I_{standby}$	-	-	2.0	-	U A
Power panel (update)	P_{UPDATE}	-	-	-	-	M W
Standby power panel	P_{STBY}	-	-	-	0.018	M W
Image update Time at 25 ℃	-	-	-	6	-	Sec
POF	VCI	DC/DC off No clock No input load Ram data not retain	2	5	-	UA

- The Typical power consumption is measured with following pattern transition: from horizontal 2 gray scale pattern to vertical 2 gray scale pattern. (Note 7-1)
- The standby power is the consumed power when the panel controller is in standby mode.
- The listed electrical/optical characteristics are only guaranteed under the controller & waveform provided by YES
- Vcom is recommended to be set in the range of assigned value ± 0.1V.

Note 7-1: The Typical power consumption



7-3) Panel AC Characteristics

7-3-1) MCU Interface

7-3-1-1) MCU Interface Selection

In this module, there are 4-wire SPI and 3-wire SPI that can communicate with MCU. The MCU interface mode can be set by hardware selection on BS1 pins. When it is "Low", 4-wire SPI is selected. When it is "High", 3-wire SPI (9 bits SPI) is selected.

Pin Name	Data/Command Interface		Control Signal		
Bus interface	D1	D0	CS#	D/C#	RES#
SPI4	S D in	SCLK	CS#	D/C#	RES#
SPI3	S D in	SCLK	CS#	L	RES#

Table 7-4-1-1: MCU interface assignment under different bus interface mode

Note 7-2: L is connected to VSS

Note 7-3: H is connected to VCI

7-3-1-2) MCU Serial Interface (4-wire SPI)

The 4-wire SPI consists of serial clock SCLK, serial data SDIN, D/C#, CS#. In SPI mode, D0 acts as SCLK, D1 acts as SDIN.

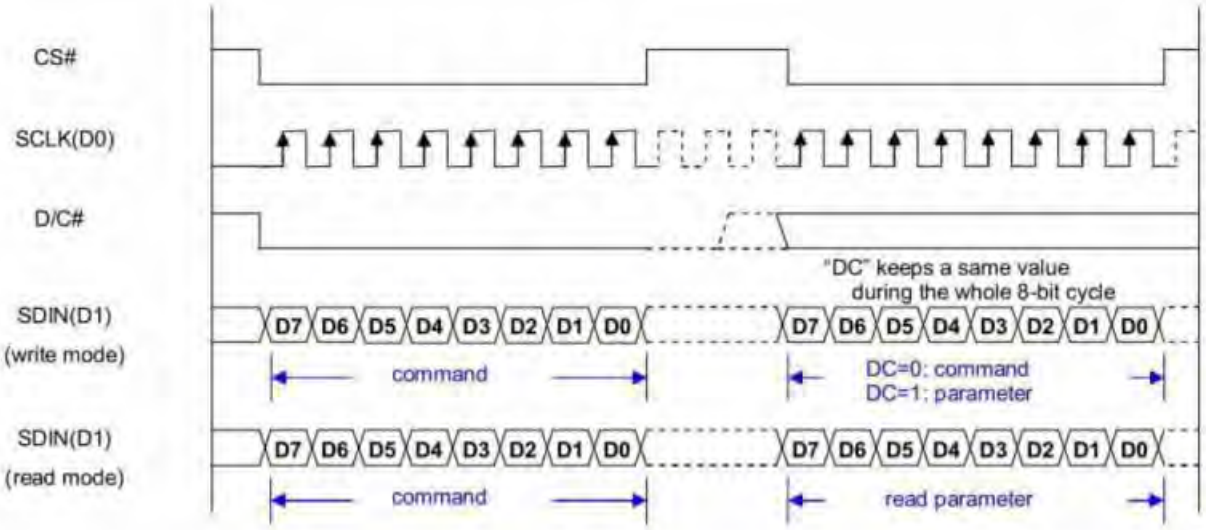
Function	CS#	D/C#	SCLK
Write Command	L	L	↑
Write data	L	H	↑

Table 7-4-1-2: Control pins of 4-wire Serial Peripheral interface

Note 7-4: ↑stands for rising edge of signal

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

Figure 7-4-1-2: Write procedure in 4-wire Serial Peripheral Interface mode



7-3-1-3) MCU Serial Interface (3-wire SPI)

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

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

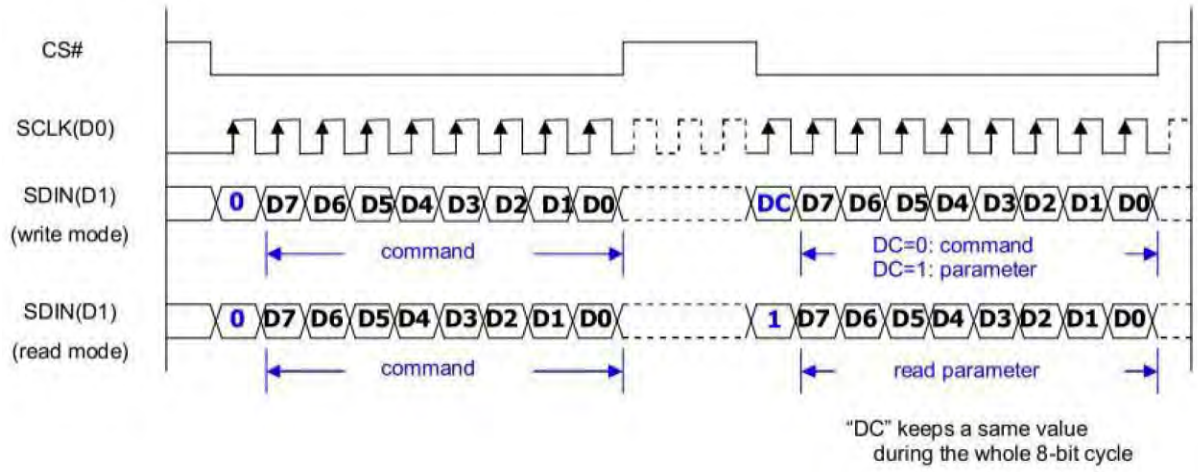
The operation is similar to 4-wire serial interface while D/C# pin is not used. There are altogether 9-bits will be shifted into the shift register on every ninth clock in sequence: D/C# bit, D7 to D0 bit. The D/C# bit (first bit of the sequential data) will determine the following data byte in shift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

Function	CS#	D/C#	SCLK
Write Command	L	Tie LOW	↑
Write data	L	Tie LOW	↑

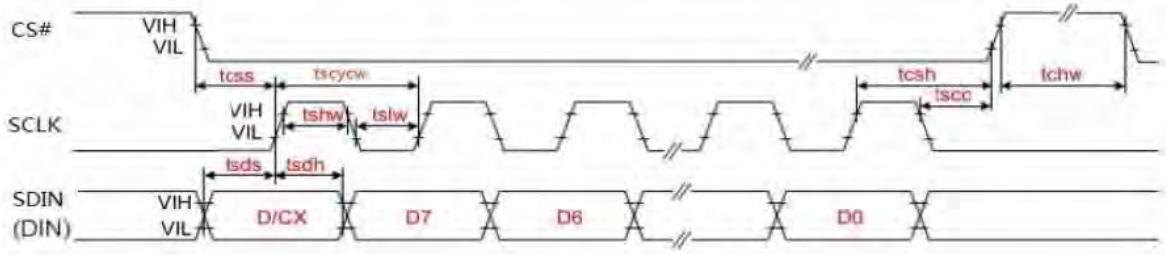
Table 7-4-1-3: Control pins of 3-wire Serial Peripheral Interface

Note 7-5: ↑stands for rising edge of signal

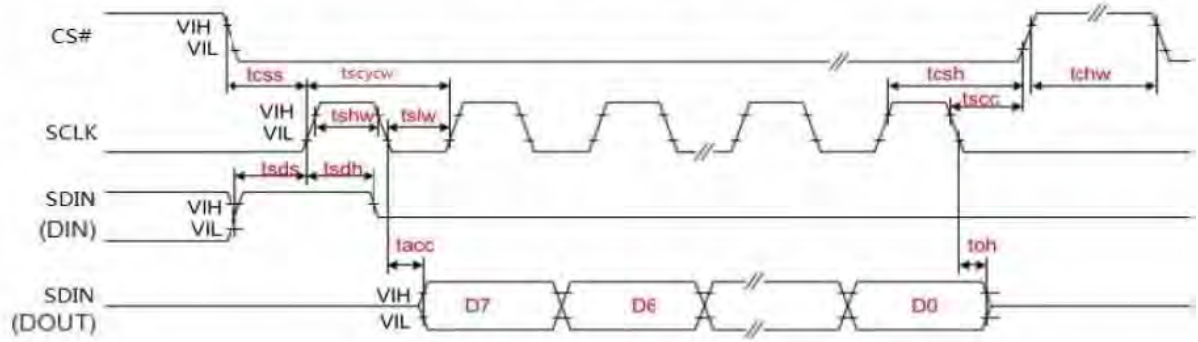
Figure 7-4-1-3: Write procedure in 3-wire Serial Peripheral Interface mode



7-3-2) Timing Characteristics of Series Interface



3-wire Serial Interface – Write



3-wire Serial Interface – Read

Symbol	Signal	Parameter	Min	Typ	Max	Unit
tcss	CS#	Chip Select Setup Time	60	-	-	ns
tcsh		Chip Select Hold Time	65	-	-	ns
tscc		Chip Select Setup Time	20	-	-	ns
tchw		Chip Select Setup Time	40	-	-	ns
tscy	SCLK	Serial clock cycle (write)	100	-	-	ns
tshw		SCL "H" pulse width (write)	35	-	-	ns
tslw		SCL"L" pulse width (write)	35	-	-	ns
tscycr		Serial clock cycle (Read)	150	-	-	ns
tshr		SCL "H" pulse width (Read)	60	-	-	ns
tslr		SCL "L" pulse width (Read)	60	-	-	ns
tsds	SDIN (DIN) SDIN (DOUT)	Data setup time	30	-	-	ns
tsdh		Data hold time	30	-	-	ns
tacc		Access time	10	-	-	ns
toh		Output disable time	15	-	-	ns

7-4) Power Consumption

Parameter	Symbol	Conditions	TYP	Max	Unit	Remark
Panel power consumption during update	-	25 ℃	26.4	40	m W	-
Power consumption in standby mode	-	25 ℃	-	0.0165	mW	-

7-5) Reference Circuit

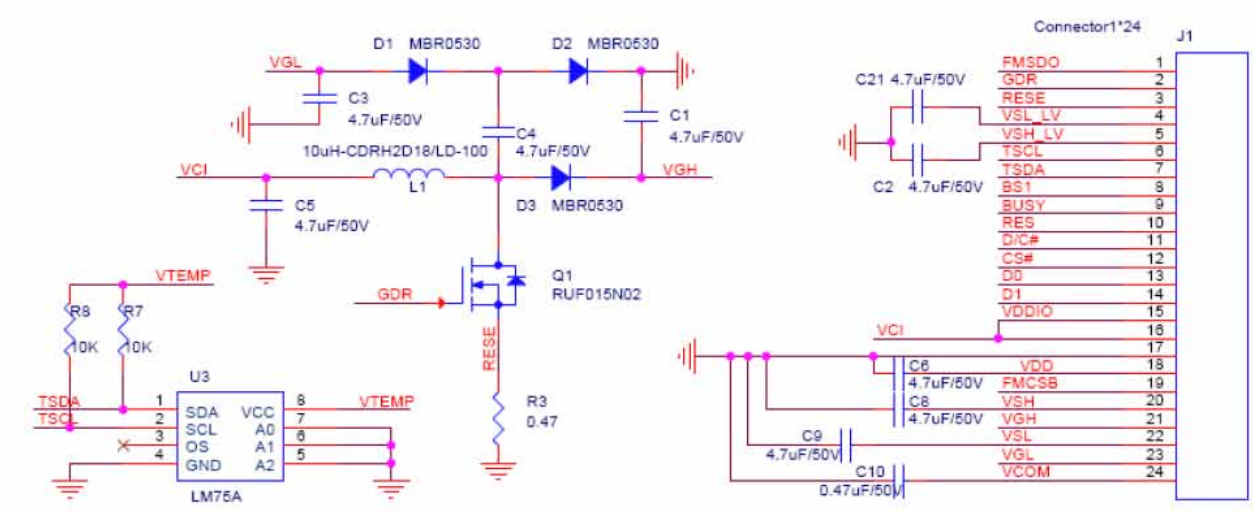
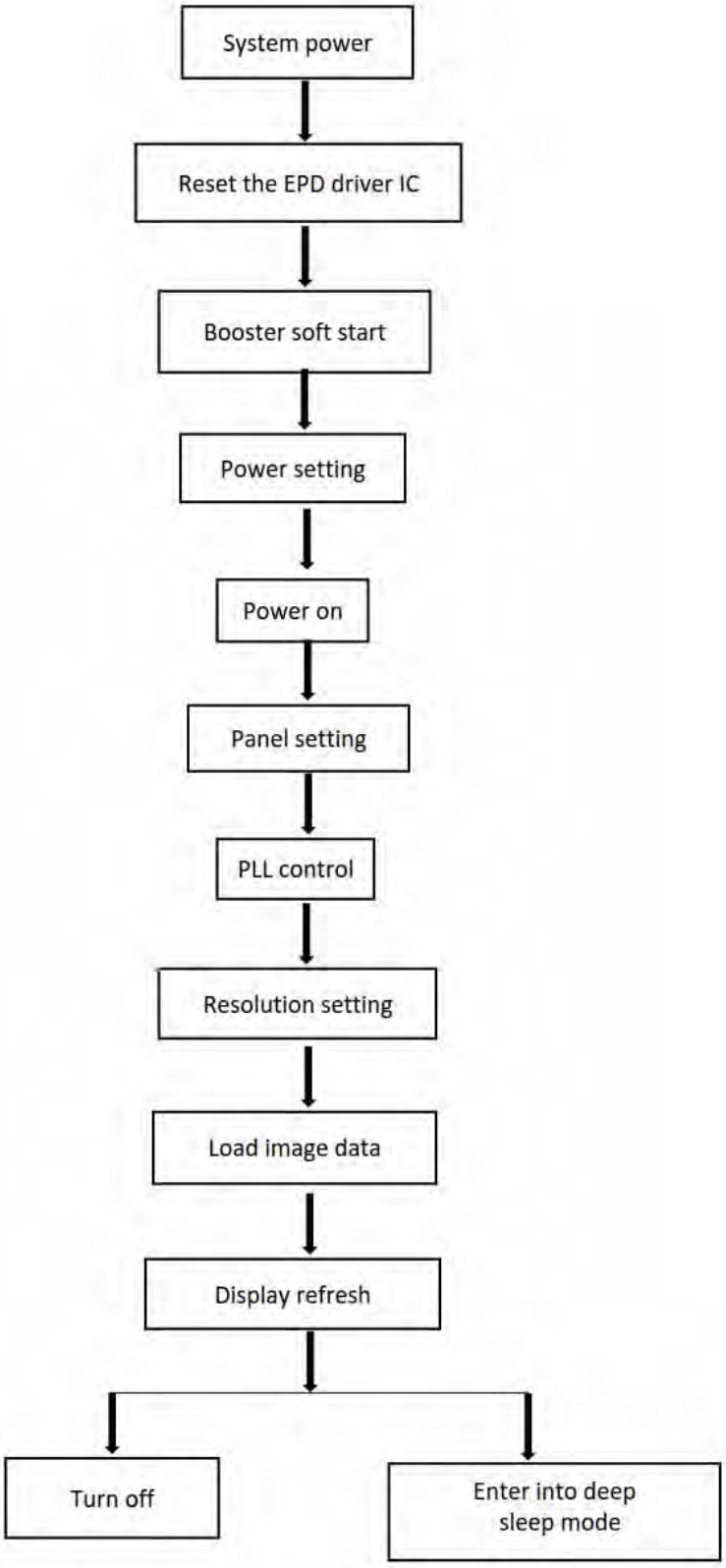


Figure. 7-5

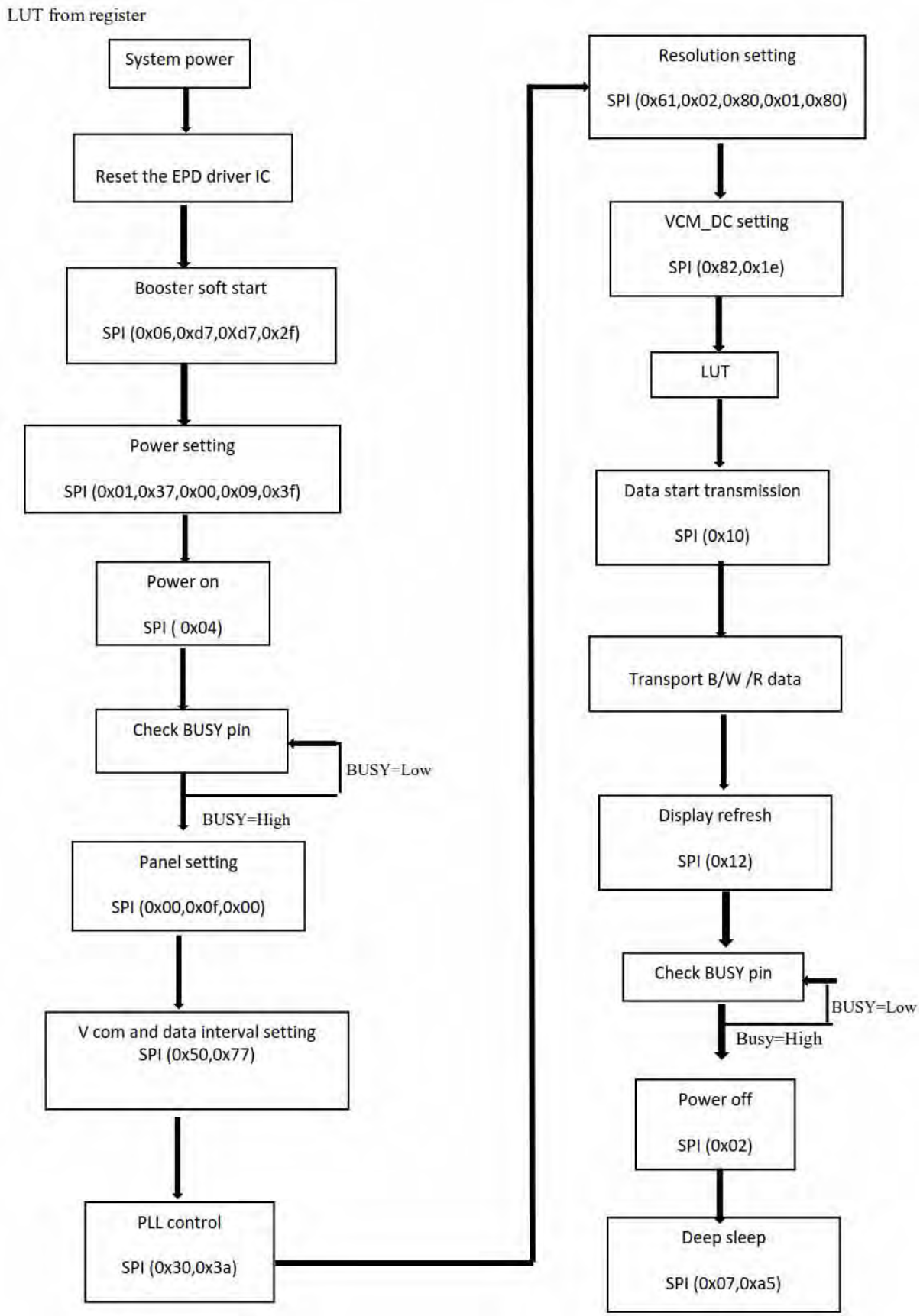
8. Typical Operating Sequence

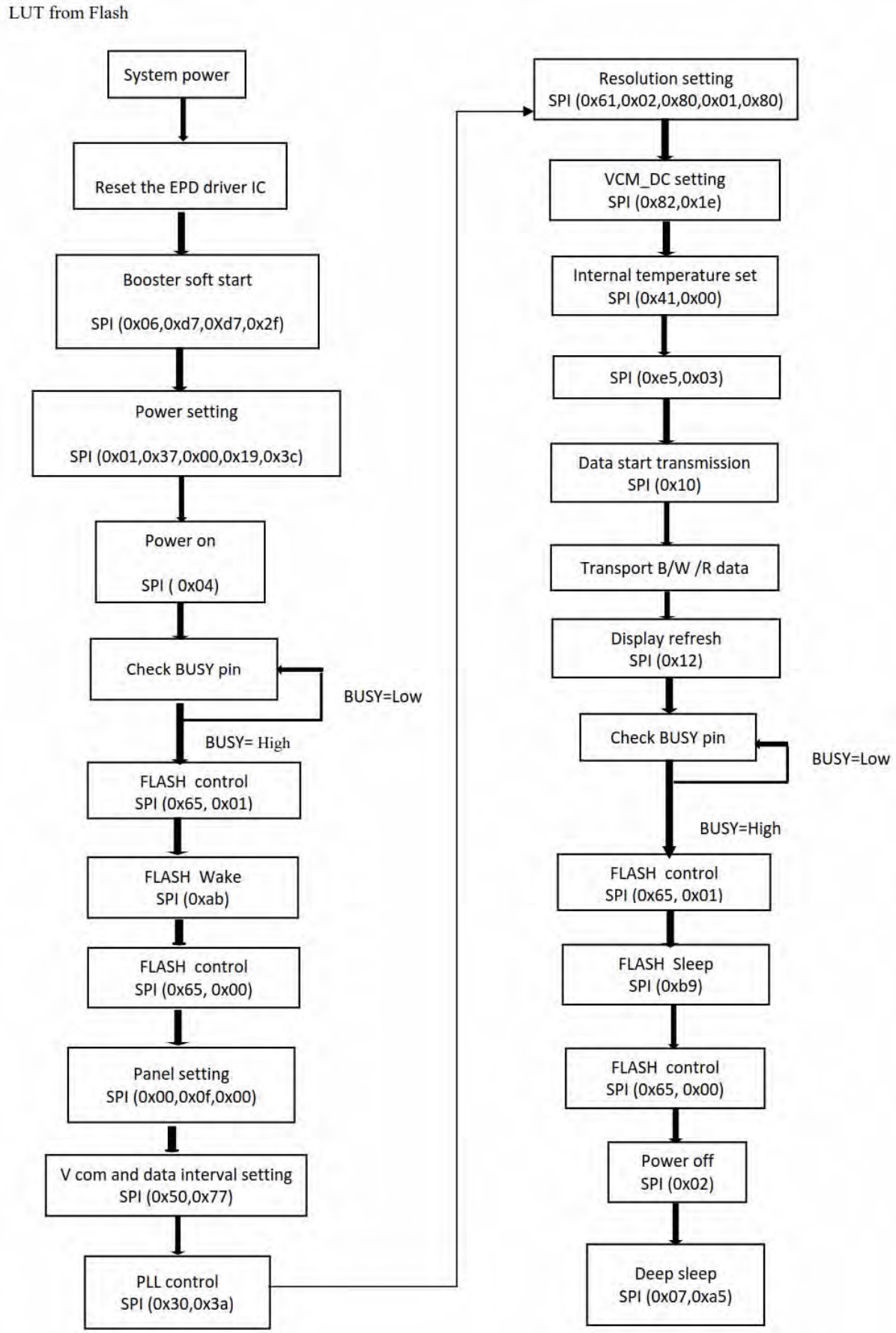
8-1) Normal Operation Flow

LUT from register



8-2) Reference Program Code




LUT from Flash
System power
Reset the EPD driver IC
Booster soft start
SPI (0x06,0xd7,0Xd7,0x2f)
Power setting
SPI (0x01,0x37,0x00,0x19,0x3c)
Power on
SPI (0x04)
Check BUSY pin
BUSY=Low
BUSY= High
FLASH control
SPI (0x65, 0x01)
FLASH Wake
SPI (0xab)
FLASH control
SPI (0x65, 0x00)
Panel setting
SPI (0x00,0x0f,0x00)
V com and data interval setting
SPI (0x50,0x77)
PLL control
SPI (0x30,0x3a)
Resolution setting
SPI (0x61,0x02,0x80,0x01,0x80)
VCM_DC setting
SPI (0x82,0x1e)
Internal temperature set
SPI (0x41,0x00)
SPI (0xe5,0x03)
Data start transmission
SPI (0x10)
Transport B/W /R data
Display refresh
SPI (0x12)
Check BUSY pin
BUSY=Low
BUSY=High
FLASH control
SPI (0x65, 0x01)
FLASH Sleep
SPI (0xb9)
FLASH control
SPI (0x65, 0x00)
Power off
SPI (0x02)
Deep sleep
SPI (0x07,0xa5)

9. Optical characteristics

9-1) Specifications

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

Symbol	Parameter	Conditions	Min	Typ.	Max	Units	Notes
R	White Reflectivity	White	30	35	-	%	9-1
CR	Contrast Ratio	indoor	8:1		-		9-2
G n	2Grey Level	-	-	DS+(WS-DS)xn(m-1)			9-3
T update	Image update time	at 25 °C	-	6	-	sec	
Life		Topr		1000000times or 5years			

Notes: 9-1. Luminance meter: Eye-One Pro Spectrophotometer.
9-2. CR=Surface Reflectance with all white pixel/Surface Reflectance with all black pixels.
9-3. WS: White statge, DS :Dark state

10. Handling, Safety and Environmental Requirement

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 electricality and other rough environmental conditions.

c	
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.	

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 = +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%,168h
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 30 min] : 100 cycles Test in white pattern
8	UV exposure Resistance	765W/m² for 168hrs,40 °C Test in white pattern
9	ESD Gun	Air+/-15KV;Contact+/-8KV (Test finished product shell, not display only) Air+/-8KV;Contact+/-6KV (Naked EPD display, no including IC and FPC area) Air+/-4KV;Contact+/-2KV (Naked EPD display, including IC and FPC area)

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

12. Part Number Definition

TBD

13. Point and line standard

Shipment Inspection standard

Equipment: Electrical test fixture, Point gauge

Outline dimension:170.2(H)x111.2(V)x1.18 Unit :mm

Environment	Temperature	Humidity	Illumination	Distance	Time	Angle
	20℃～25℃	40%～55%RH	800～1200Lux	200～300㎜	35Sec	rolate30° surround
apperence standard	Defet type	Inspection	Standard		Part-A	
	1. dead/ switch point (point overproof)	Electric Display	D≤0.25㎜		Ignore	
			0.25㎜＜D≤0.4㎜		N≤4	
			D＞0.4㎜		Not Allow	
	2. Line (No switch)	L ＜ 0.24, W ＜0.06	- -	Ignore	No defect within 20mm range of PartA	
		0.24≤L≤0.4; 0.06≤W≤0.1	- -	4		
		L＞0.4; W＞0.1	- -	0	Part-A	
	3. line (Switching line)	Electric Display	Ignore in gray scale viewing In Blak&white viewing Follow Non-Switching Criteria			
	3. Display unwork	Electric Display	Not Allow			
	4. Display error	Electric Display	Not Allow			
	5. PS PET warping	Vsual	cannot beyond 1/2 of the border			
	6. Protector hurt	Vsual	L≤2㎜, W≤0.05㎜, Ignore;			
			L＞2㎜, W＞0.05㎜, Not Allow;			
	7. Drawing tape	Vsual	Drawing NO. WFQC-011			
	8. Barcode label	Vsual	Drawing NO. WFQC-012			
	9. Adhesive coating	Vsual	Bubble: D≤0.65 & N≤2			
	10. Packing	Vsual	cannot be dirty and breakdown; must be marked			

14.Packing

TBD