M7-B01

Product Preview

1215KB Embedded Display SRAM
LCD Display Controller

Appendix: IC Revision history of M7-B01 Specification

Version	Change Items	Effective Date
0.10 21-Nov-08	1st Release	24-Nov-08
0.10 08-Dec-08	Changed the set_pll_mnk to set_pll_mn in section 7.2 Change register name in section 8 Removed ABC Revised description for REG 0x00, 0x01, 0x0C, 0x0D, 0x0E, 0x10, 0x11, 0x21, 0x26, 0x28, 0x2A, 0x2B, 0x2C, 0x2E, 0x33, 0x34, 0x35, 0x36, 0x37, 0x3A, 0x3C, 0x3E, 0x44, 0x45, 0xA1, 0xB0, 0xB1, 0xB4, 0xB5, 0xB6, 0xB7, 0xB8, 0xB9, 0xBE, 0xBF, 0xD0, 0xD1, 0xD4, 0xE5. Added max VIH in Table 12-1 Added Table 9-1 Added Table 11-1 Revised Figure 9-19 Revised Figure 14-2 Revised Figure 13-4 Corrected typo for Table 7-2 Revised test condition for 12 and 13	10-Dec-08

CONTENTS

1 GENERAL DESCRIPTION 8

2 FEATURES 8

3 ORDERING INFORMATION 8

4 BLOCK DIAGRAM 9

5 PIN ARRANGEMENT 10

5.1 80 PIN TFBGA 10
5.2 128 PIN LQFP 11

6 PIN DESCRIPTIONS 13

7 FUNCTIONAL BLOCK DESCRIPTIONS 16

7.1 MCU INTERFACE 16
7.1.1 6800 Mode 16
7.1.2 8080 Mode 16
7.1.3 Register Pin Mapping 16
7.1.4 Pixel Data Format 16
7.1.5 Tearing Effect Signal (TE) 17
7.2 SYSTEM CLOCK 17
7.3 FRAME BUFFER 18
7.4 SYSTEM CLOCK AND RESET MANAGER 18
7.5 LCD CONTROLLER 19
7.5.1 Display Format 19
7.5.2 General Purpose Input/Output (GPIO) 19

8 COMMAND TABLE 20

9 COMMAND DESCRIPTIONS 23

9.1 NO OPERATION 23
9.2 SOFTWARE 23
9.3 GET POWER 23
9.4 GET ADDRESS MODE 24
9.5 GET PIXEL FORMAT 24
9.6 GET DISPLAY MODE 25
9.7 GET SIGNAL MODE 25
9.8 ENTER SLEEP MODE 26
9.9 EXIT SLEEP MODE 26
9.10 ENTER PARTIAL MODE 26
9.11 ENTER NORMAL MODE 27
9.12 EXIT INVERT MODE 27
9.13 ENTER INVERT MODE 27
9.14 SET GAMMA CURVE 28
9.15 SET DISPLAY OFF 28
9.16 SET DISPLAY ON 28
9.17 SET COLUMN ADDRESS 29
9.18 SET PAGE ADDRESS 29
9.19 WRITE MEMORY START 30
9.20 READ MEMORY START 31
9.21 SET PARTIAL AREA 31
9.22 SET SCROLL AREA 33
9.23 SET TEAR OFF 35
9.24 SET TEAR ON 35

9.25 SET ADDRESS MODE 35
9.26 SET SCROLL START 38
9.27 EXIT IDLE MODE 39
9.28 ENTER IDLE MODE 39
9.29 SET PIXEL FORMAT 40
9.30 WRITE MEMORY CONTINUE 40
9.31 READ MEMORY CONTINUE 41
9.32 SET TEAR SCANLINE 42
9.33 GET TEAR SCANLINE 42
9.34 READ DDB 43
9.35 SET LCD MODE 43
9.36 GET LCD MODE 45
9.37 SET HORIZONTAL PERIOD 46
9.38 GET HORIZONTAL PERIOD 47
9.39 SET VERTICAL PERIOD 48
9.40 GET VERTICAL PERIOD 48
9.41 SET GPIO CONFIGURATION 49
9.42 GET GPIO CONFIGURATION 50
9.43 SET GPIO VALUE 51
9.44 GET GPIO VALUE 51
9.45 SET POST PROC 52
9.46 GET POST PROC 52
9.47 SET PWM CONFIGURATION 53
9.48 GET PWM CONFIGURATION 54
9.49 SET LCD GEN0 55
9.50 GET LCD GEN0 56
9.51 SET LCD GEN1 57
9.52 GET LCD GEN1 58
9.53 SET LCD GEN2 59
9.54 GET LCD GEN2 60
9.55 SET LCD GEN3 61
9.56 GET LCD GEN3 62
9.57 SET GPIO0 ROP 63
9.58 GET GPIO0 ROP 63
9.59 SET GPIO1 ROP 64
9.60 GET GPIO1 ROP 65
9.61 SET GPIO2 ROP 65
9.62 GET GPIO2 ROP 66
9.63 SET GPIO3 ROP 67
9.64 GET GPIO3 ROP 67
9.65 SET DBC CONFIGURATION 68
9.66 GET DBC CONFIGURATION 69
9.67 SET DBC THRESHOLD 70
9.68 GET DBC THRESHOLD 71
9.69 SET PLL 71
9.70 SET PLL MN 72
9.71 GET PLL MN 73
9.72 GET PLL STATUS 73
9.73 SET DEEP SLEEP 73
9.74 SET LSHIFT FREQUENCY 74
9.75 GET LSHIFT FREQUENCY 74
9.76 SET PIXEL DATA INTERFACE 75
9.77 GET PIXEL DATA INTERFACE 75

10 MAXIMUM RATINGS 76

11 RECOMMENDED OPERATING CONDITIONS 76

11.1 POWER-UP SEQUENCE 76

12 DC CHARACTERISTICS 77

Confidential

13 AC CHARACTERISTICS 77

13.1 CLOCK TIMING 77
13.2 MCU INTERFACE TIMING 78
13.2.1 6800 Mode 78
13.2.2 8080 Mode Write Cycle 79
13.3 LCD INTERFACE TIMING 80
13.4 8-BIT SERIAL INTERFACE 81

14 APPLICATION EXAMPLE 82

15 PACKAGE INFORMATION 84

15.1 PACKAGE MECHANICAL DRAWING FOR 80 PINS TFBGA 84
15.2 PACKAGE MECHANICAL DRAWING FOR 128 PINS LQFP 85

TABLES

TABLE 3-1: ORDERING INFORMATION 8
TABLE 5-1: TFBGA PIN ASSIGNMENT TABLE 10
TABLE 5-2 : LQFP PIN ASSIGNMENT TABLE 12
TABLE 6-1: MCU INTERFACE PIN MAPPING 13
TABLE 6-2: LCD INTERFACE PIN MAPPING 14
TABLE 6-3: CONTROL SIGNAL PIN MAPPING 14
TABLE 6-4: POWER PIN MAPPING 14
TABLE 6-5 : LCD INTERFACE PIN MAPPING 15
TABLE 7-1: PIXEL DATA FORMAT 16
TABLE 7-2: FRAME BUFFER SETTINGS REGRADING TO SET_ADDRESS_MODE COMMAND 18
TABLE 10-1: MAXIMUM RATINGS (VOLTAGE REFERENCED TO V_{SS}) 76
TABLE 12-1 : DC CHARACTERISTICS 77
TABLE 13-1 : CLOCK INPUT REQUIREMENTS FOR CLK (PLL-BYPASS) 77
TABLE 13-2 : CLOCK INPUT REQUIREMENTS FOR CLK (USING PLL) 77
TABLE 13-3 : CLOCK INPUT REQUIREMENTS FOR CRYSTAL OSCILLATOR XTAL (USING PLL) 77
TABLE 13-4: 6800 MODE TIMING 78
TABLE 13-5: 8080 MODE TIMING 79

FIGURES

FIGURE 4-1: M7-B01 BLOCK DIAGRAM 9
FIGURE 5-1: PINOUT DIAGRAM –TFBGA (TOPVIEW) 10
FIGURE 5-2 : PINOUT DIAGRAM – LQFP (TOPVIEW) 11
FIGURE 7-1: RELATIONSHIP BETWEEN TEARING EFFECT SIGNAL AND MCU MEMORY WRITING 17
FIGURE 7-2: CLOCK CONTROL DIAGRAM 18
FIGURE 7-3: STATE DIAGRAM OF M7-B01 19
FIGURE 9-1: EXIT INVERT MODE EXAMPLE 27
FIGURE 9-2: ENTER INVERT MODE EXAMPLE 28
FIGURE 9-3: SET COLUMN ADDRESS EXAMPLE 29
FIGURE 9-4: SET PAGE ADDRESS EXAMPLE 30
FIGURE 9-5: SET PARTIAL AREA WITH SET ADDRESS MODE 0X36 A[4] = 0 32
FIGURE 9-6: SET PARTIAL AREA WITH SET ADDRESS MODE 0X36 A[4] = 1 32
FIGURE 9-7: SET PARTIAL AREA WITH SET ADDRESS MODE 0X36 A[4] = 0 32
FIGURE 9-8: SET PARTIAL AREA WITH SET ADDRESS MODE 0X36 A[4] = 1 32
FIGURE 9-9: SET SCROLL AREA WITH SET ADDRESS MODE 0X36 A[4] = 0 34
FIGURE 9-10: SET SCROLL AREA WITH SET ADDRESS MODE 0X36 A[4] = 1 34
FIGURE 9-11: A[7] PAGE ADDRESS ORDER 36
FIGURE 9-12: A[6] COLUMN ADDRESS ORDER 36
FIGURE 9-13: A[5] PAGE / COLUMN ADDRESS ORDER 36
FIGURE 9-14: A[3] RGB ORDER 37
FIGURE 9-15: A[1] FLIP HORIZONTAL 37
FIGURE 9-16: A[0] FLIP VERTICAL 38
FIGURE 9-17: SET SCROLL START WITH SET ADDRESS MODE, 0X36 A[4] = 0 38
FIGURE 9-18: SET SCROLL START WITH SET ADDRESS MODE, 0X36 A[4] = 1 39
FIGURE 9-19: PWM SIGNAL 53
FIGURE 11-1: POWER-UP SEQUENCE 76
FIGURE 13-1: 6800 MODE TIMING DIAGRAM (USE CS# AS CLOCK) 78
FIGURE 13-2: 6800 MODE TIMING DIAGRAM (USE E AS CLOCK) 78
FIGURE 13-3: 8080 MODE TIMING DIAGRAM 79
FIGURE 13-4: GENERIC TFT PANEL TIMING 80
FIGURE 13-5: 8-BIT SERIAL INTERFACE TIMING 81
FIGURE 14-1 : APPLICATION CIRCUIT FOR M7-B01 (WITH DIRECT CLOCK INPUT) 82
FIGURE 14-2 : APPLICATION CIRCUIT FOR M7-B01 (WITH CRYSTAL OSCILLATOR INPUT) 83

1 GENERAL DESCRIPTION

M7-B01 is a display controller of 1215K byte frame buffer to support up to 864 x 480 x 24bit graphics content. It also equips parallel MCU interfaces in different bus width to receive graphics data and command from MCU. Its display interface supports common RAM-less LCD driver of color depth up to 24 bit-per-pixel.

2 FEATURES

- Display feature
  - Built-in 1215K bytes frame buffer. Support up to 864 x 480 at 24bpp display
  - Support TFT 18/24-bit generic RGB and TTL interface panel
  - Support 8-bit RGB interface
  - Hardware rotation of 0, 90, 180, 270 degree
  - Hardware display mirroring
  - Hardware windowing
  - Programmable brightness, contrast and saturation control
  - Dynamic Backlight Control (DBC) via PWM signal
- MCU connectivity
  - 8/9/16/18/24-bit MCU interface
  - Tearing effect signal
- I/O Connectivity
  - 4 GPIO pins
- Built-in clock generator
- Deep sleep mode for power saving
- Core supply power (V_{DDPLL} and V_{DDD}): 1.2V±0.1V
- I/O supply power(V_{DDIO}): 1.65V to 3.6V
- LCD interface supply power (V_{DDLCD}): 1.65V to 3.6V

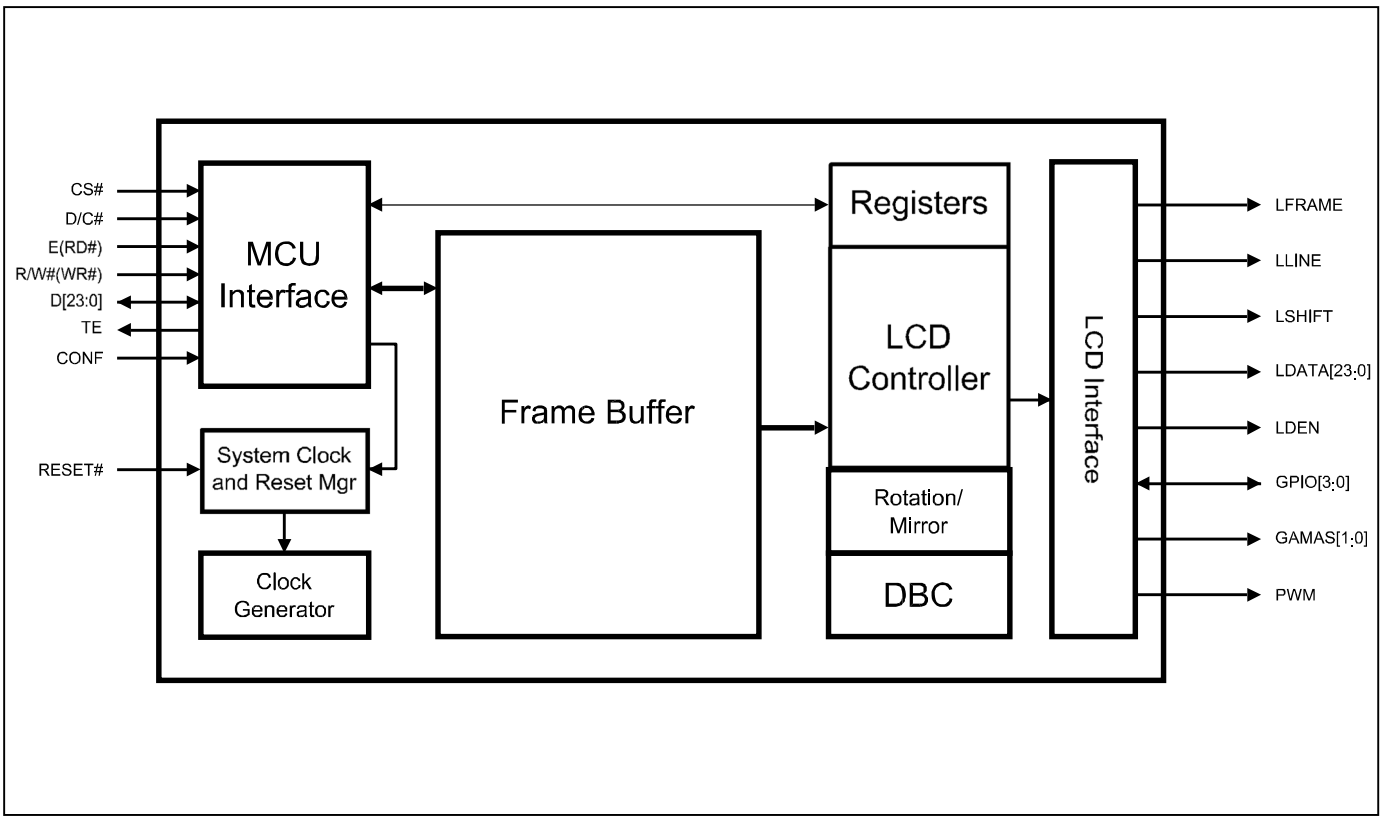
3 ORDERING INFORMATION

Table 3-1: Ordering Information

Ordering Part Number	Package Form
M7-B01G41	TFBGA-80
M7-B01QL9	LQFP-128

4 BLOCK DIAGRAM

Figure 4-1: M7-B01 Block Diagram



5 PIN ARRANGEMENT

5.1 80 pin TFBGA

Figure 5-1: Pinout Diagram –TFBGA (Topview)

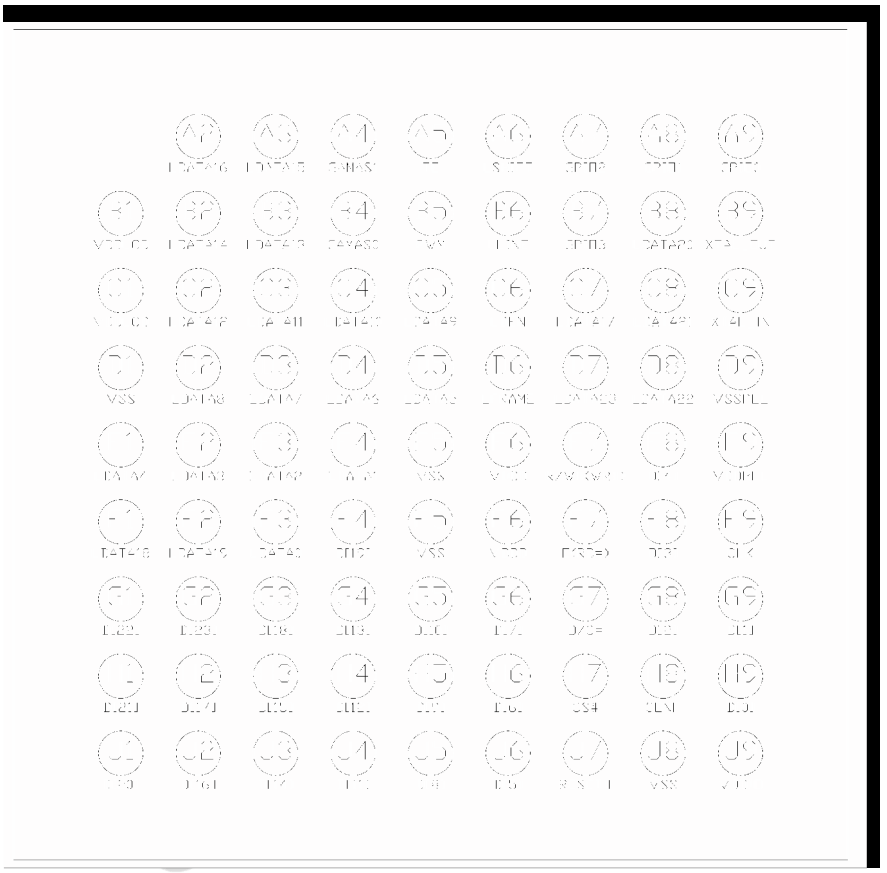


Table 5-1: TFBGA Pin Assignment Table

Pin #	Signal Name	Pin #	Signal Name	Pin #	Signal Name	Pin #	Signal Name	Pin #	Signal Name
A1	-	C1	VDDLCD	E1	LDATA4	G1	D[22]	J1	D[20]
A2	LDATA16	C2	LDATA12	E2	LDATA3	G2	D[23]	J2	D[16]
A3	LDATA15	C3	LDATA11	E3	LDATA2	G3	D[18]	J3	D[14]
A4	GAMAS1	C4	LDATA10	E4	LDATA1	G4	D[13]	J4	D[11]
A5	TE	C5	LDATA9	E5	VSS	G5	D[10]	J5	D[8]
A6	LSHIFT	C6	LDEN	E6	VDDD	G6	D[7]	J6	D[5]
A7	GPIO2	C7	LDATA17	E7	R/W# (WR#)	G7	D/C#	J7	RESET#
A8	GPIO1	C8	LDATA21	E8	D[4]	G8	D[2]	J8	VSS
A9	GPIO0	C9	XTAL_IN	E9	VDDPLL	G9	D[1]	J9	VDDIO
B1	VDDLCD	D1	VSS	F1	LDATA18	H1	D[21]		
B2	LDATA14	D2	LDATA8	F2	LDATA19	H2	D[17]		
B3	LDATA13	D3	LDATA7	F3	LDATA0	H3	D[15]		
B4	GAMAS0	D4	LDATA6	F4	D[19]	H4	D[12]		
B5	PWM	D5	LDATA5	F5	VSS	H5	D[9]		
B6	LLINE	D6	LFRAME	F6	VDDD	H6	D[6]		
B7	GPIO3	D7	LDATA23	F7	E(RD#)	H7	CS#		
B8	LDATA20	D8	LDATA22	F8	D[3]	H8	CONF		
B9	XTAL_OUT	D9	VSSPLL	F9	CLK	H9	D[0]		

5.2 128 pin LQFP

Figure 5-2 : Pinout Diagram – LQFP (Topview)

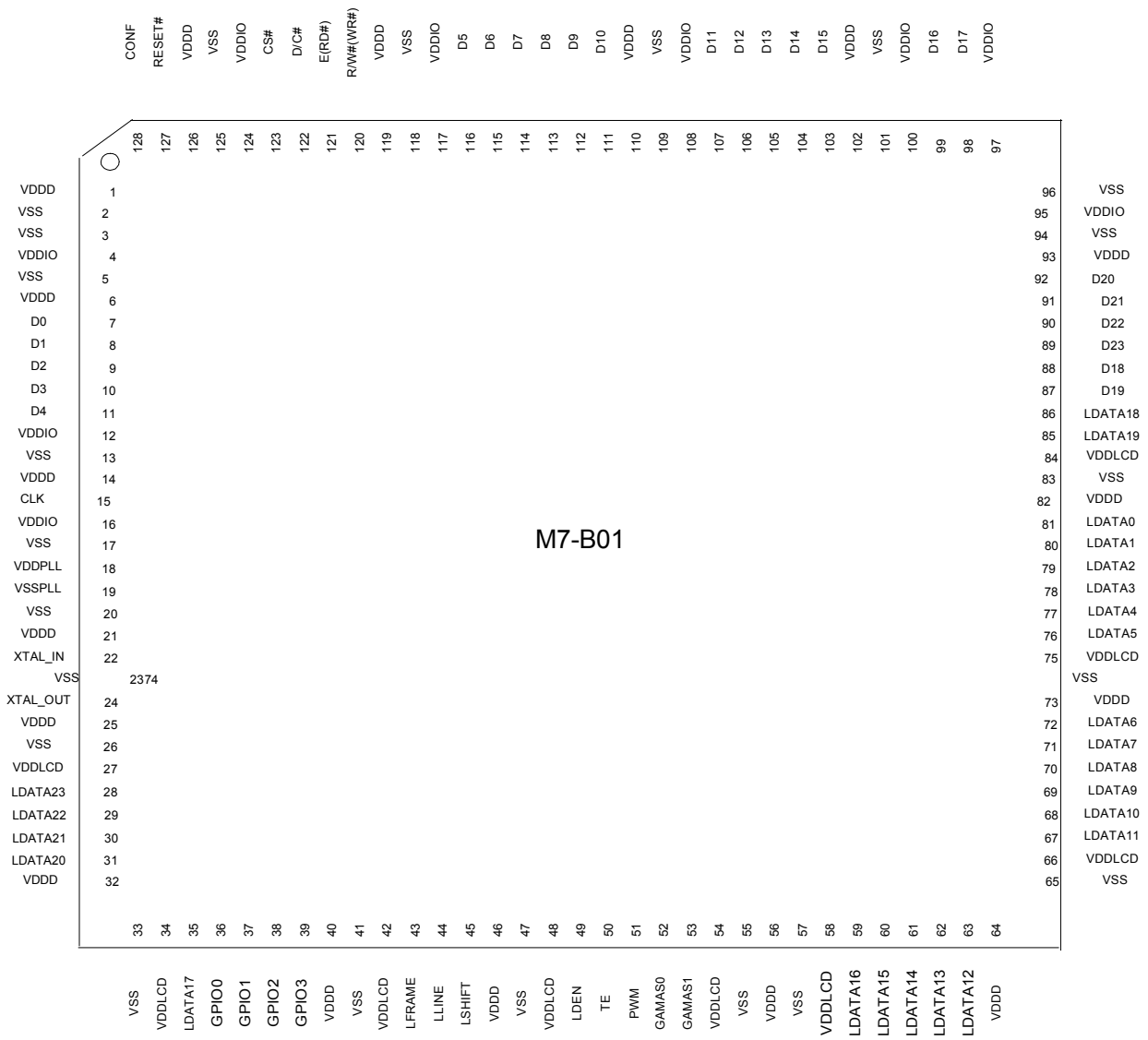


Table 5-2 : LQFP Pin Assignment Table

Pin #	Signal Name	Pin #	Signal Name	Pin #	Signal Name	Pin #	Signal Name
1	VDDD	33	VSS	65	VSS	97	VDDIO
2	VSS	34	VDDLCD	66	VDDLCD	98	D17
3	VSS	35	LDATA17	67	LDATA11	99	D16
4	VDDIO	36	GPIO0	68	LDATA10	100	VDDIO
5	VSS	37	GPIO1	69	LDATA9	101	VSS
6	VDDD	38	GPIO2	70	LDATA8	102	VDDD
7	D0	39	GPIO3	71	LDATA7	103	D15
8	D1	40	VDDD	72	LDATA6	104	D14
9	D2	41	VSS	73	VDDD	105	D13
10	D3	42	VDDLCD	74	VSS	106	D12
11	D4	43	LFRAME	75	VDDLCD	107	D11
12	VDDIO	44	LLINE	76	LDATA5	108	VDDIO
13	VSS	45	LSHIFT	77	LDATA4	109	VSS
14	VDDD	46	VDDD	78	LDATA3	110	VDDD
15	CLK	47	VSS	79	LDATA2	111	D10
16	VDDIO	48	VDDLCD	80	LDATA1	112	D9
17	VSS	49	LDEN	81	LDATA0	113	D8
18	VDDPLL	50	TE	82	VDDD	114	D7
19	VSSPLL	51	PWM	83	VSS	115	D6
20	VSS	52	GAMAS0	84	VDDLCD	116	D5
21	VDDD	53	GAMAS1	85	LDATA19	117	VDDIO
22	XTAL_IN	54	VDDLCD	86	LDATA18	118	VSS
23	VSS	55	VSS	87	D19	119	VDDD
24	XTAL_OUT	56	VDDD	88	D18	120	R/W#(WR#)
25	VDDD	57	VSS	89	D23	121	E(RD#)
26	VSS	58	VDDLCD	90	D22	122	D/C#
27	VDDLCD	59	LDATA16	91	D21	123	CS#
28	LDATA23	60	LDATA15	92	D20	124	VDDIO
29	LDATA22	61	LDATA14	93	VDDD	125	VSS
30	LDATA21	62	LDATA13	94	VSS	126	VDDD
31	LDATA20	63	LDATA12	95	VDDIO	127	RESET#
32	VDDD	64	VDDD	96	VSS	128	CONF

6 PIN DESCRIPTIONS

Key:

I = Input
O =Output
IO = Bi-directional (input/output)
P = Power pin
Hi-Z = High impedance

Table 6-1: MCU Interface Pin Mapping

Pin Name	Type	Reference Voltage Level	TFBGA Pin #	LQFP Pin #	Description
CLK	I	VDDIO	F9	15	TTL clock input. This pin should be tied to VSS if TTL clock input is not used
XTAL_IN	I	-	C9	22	Crystal oscillator input. This pin should be tied to VSS if not used
XTAL_OUT	O	-	B9	24	Crystal oscillator output. This pin should be floating if not used
CS#	I	VDDIO	H7	123	Chip select
D/C#	I	VDDIO	G7	122	Data/Command select
E(RD#)	I	VDDIO	F7	121	6800 mode: E (enable signal) 8080 mode: RD# (read strobe signal)
R/W#(WR#)	I	VDDIO	E7	120	6800 mode: R/W# 0: Write cycle 1: Read cycle 8080 mode: WR# (write strobe signal)
D[23:0]	IO	VDDIO	E8, F4, F8, G1, G2, G3, G4, G5, G6, G8, G9, H1, H2, H3, H4, H5, H6, H9, J1, J2,J3, J4, J5, J6	7, 8, 9, 10, 11, 87, 88, 89, 90, 91, 92, 98, 99, 103, 104, 105, 106, 107, 111, 112, 113, 114, 115, 116	Data bus. Pins not used should be floating
TE	O	VDDIO	A5	50	Tearing effect

Table 6-2: LCD Interface Pin Mapping

Pin Name	Type	Reference Voltage Level	TFBGA Pin #	LQFP Pin #	Description
LFRAME	O	VDDLCD	D6	43	Vertical sync (Frame pulse)
LLINE	O	VDDLCD	B6	44	Horizontal sync (Line pulse)
LSHIFT	O	VDDLCD	A6	45	Pixel clock (Pixel shift signal)
LDEN	O	VDDLCD	C6	49	Data valid
LDATA[23:0]	O	VDDLCD	A2, A3, B2, B3, B8, C2, C3, C4, C5, C7, C8, D2, D3, D4, D5, D7, D8, E1, E2, E3, E4, F1, F2, F3	28, 29, 30, 31, 35, 59, 60, 61, 62, 63, 67, 68, 69, 70, 71, 72, 76, 77, 78, 79, 80, 81, 85, 86	RGB data
GPIO[3:0]	IO	VDDLCD	A7, A8, A9, B7	36, 37, 38, 39	These pins can be configured for display miscellaneous signals or as general purpose I/O. Default as input
GAMAS [1:0]	O	VDDLCD	A4, B4	52, 53	Gamma selection for panel
PWM	O	VDDLCD	B5	51	PWM output for backlight driver

Table 6-3: Control Signal Pin Mapping

Pin Name	Type	Reference Voltage Level	TFBGA Pin #	LQFP Pin #	Description
RESET#	I	VDDIO	J7	127	Master synchronize reset
CONF	I	VDDIO	H8	128	MCU interface configuration 0: 6800 Interface 1: 8080 Interface

Table 6-4: Power Pin Mapping

Pin Name	Type	TFBGA Pin #	LQFP Pin #	Description
VDDD	P	E6, F6	1, 6, 14, 21, 25, 32, 40, 46, 56, 64, 73, 82, 93, 102, 110, 119, 126	Power supply for internal digital circuit
VDDLCD	P	B1, C1	27, 34, 42, 48, 54, 58, 66, 75, 84	Power supply for LCD interface related pads
VDDPLL	P	E9	18	Power supply for internal analog circuit and analog I/O pads
VDDIO	P	J9	4, 12, 16, 95, 97, 100, 108, 117, 124	Power supply for digital I/O pads
VSS	P	D1, E5, F5, J8	2, 3, 5, 13, 17, 20, 23, 26, 33, 41, 47, 55, 57, 65, 74, 83, 94, 96, 101, 109, 118, 125	Ground for internal digital circuit
VSSPLL	P	D9	19	Ground for internal analog circuit and analog I/O pads

Table 6-5 : LCD Interface Pin Mapping

Pin Names	24-bit	18-bit	8-bit serial
LFRAME	FRAME		
LLINE	LINE		
LSHIFT	SHIFT		
LDEN	DEN		
LDATA23	R7	Drive 0	Drive 0
LDATA22	R6	Drive 0	Drive 0
LDATA21	R5	Drive 0	Drive 0
LDATA20	R4	Drive 0	Drive 0
LDATA19	R3	Drive 0	Drive 0
LDATA18	R2	Drive 0	Drive 0
LDATA17	R1	R5	Drive 0
LDATA16	R0	R4	Drive 0
LDATA15	G7	R3	Drive 0
LDATA14	G6	R2	Drive 0
LDATA13	G5	R1	Drive 0
LDATA12	G4	R0	Drive 0
LDATA11	G3	G5	Drive 0
LDATA10	G2	G4	Drive 0
LDATA9	G1	G3	Drive 0
LDATA8	G0	G2	Drive 0
LDATA7	B7	G1	D7
LDATA6	B6	G0	D6
LDATA5	B5	B5	D5
LDATA4	B4	B4	D4
LDATA3	B3	B3	D3
LDATA2	B2	B2	D2
LDATA1	B1	B1	D1
LDATA0	B0	B0	D0

Note

(1) These pin mappings use signal names commonly used for each panel type, however signal names may differ between panel manufacturers.

7 FUNCTIONAL BLOCK DESCRIPTIONS

7.1 MCU Interface

The MCU interface connects the MCU and M7-B01 graphics controller. The MCU interface can be configured as 6800 mode and 8080 mode by the CONF pin. By pulling the CONF pin to VSSIO, the MCU interface will be configured as 6800 mode interface. If the CONF pin is connected to VDDIO, the MCU interface will be configure in 8080 mode.

7.1.1 6800 Mode

The 6800 mode MCU interface consist of CS#, D/C#, E, R/W#, D[23:0], and TE signals (Please refer to Table 6-1 for pin multiplexed with 8080 mode). This interface supports both fixed E and clock E scheme to define a read/write cycle. If the E signal is kept high and used as enable signal, the CS# signal acts as a bus clock, the data or command will be latched into the system at the rising edge of CS#. If the user wants to use the E pin as the clock pin, the CS# pin then need to be fixed to logic 0 to select the chip. Then the falling edge of the E signal will latch the data or command. For details, please refer to the timing diagram in chapter 13.2.1.

7.1.2 8080 Mode

The 8080 mode MCU interface consist of CS#, D/C#, RD#, WR#, D[23:0] and TE signals (Please refer to Table 6-1 for pin multiplexed with 6800 mode). This interface use WR# to define a write cycle and RD# for read cycle. If the WR# goes low when the CS# signal is low, the data or command will be latched into the system at the rising edge of WR#. Similarly, the read cycle will start when RD# goes low and end at the rising edge of RD#. The detailed timing will show in the chapter 13.2.2.

7.1.3 Register Pin Mapping

When user access the registers via the parallel MCU interface, only D[7:0] will be used regardless the width of the pixel data is. Therefore, D[23:8] will only be used to address the display data only. This provided the possibility that the pixel data format as shown in Table 7-1 can be configured by register 0xF0.

7.1.4 Pixel Data Format

Both 6800 and 8080 support 8-bit, 9-bit, 16-bit, 18-bit and 24-bit data bus. Depending on the width of the data bus, the display data are packed into the data bus in different ways.

Table 7-1: Pixel Data Format

Interface	Cycle	D[23]	D[22]	D[21]	D[20]	D[19]	D[18]	D[17]	D[16]	D[15]	D[14]	D[13]	D[12]	D[11]	D[10]	D[9]	D[8]	D[7]	D[6]	D[5]	D[4]	D[3]	D[2]	D[1]	D[0]
24 bits	1st	R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0
18 bits	1st							R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1	B0
16 bits (565 format)	1st									R5	R4	R3	R2	R1	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1
16 bits	1st									R5	R4	R3	R2	R1	R0	X	X	G5	G4	G3	G2	G1	G0	X	X
	2nd									B5	B4	B3	B2	B1	B0	X	X	R5	R4	R3	R2	R1	R0	X	X
	3rd									G5	G4	G3	G2	G1	G0	X	X	B5	B4	B3	B2	B1	B0	X	X
9 bits	1st																R5	R4	R3	R2	R1	R0	G5	G4	G3
	2nd																G2	G1	G0	B5	B4	B3	B2	B1	B0
8 bits	1st																	R5	R4	R3	R2	R1	R0	X	X
	2nd																	G5	G4	G3	G2	G1	G0	X	X
	3rd																	B5	B4	B3	B2	B1	B0	X	X

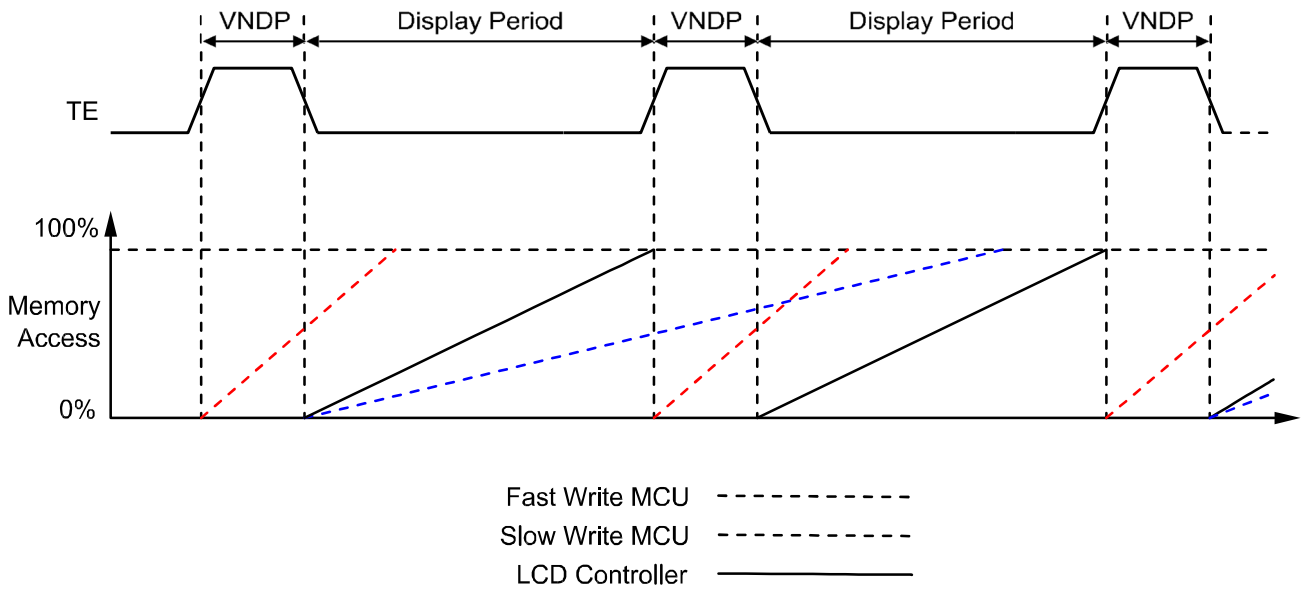
X: Don't Care

7.1.5 Tearing Effect Signal (TE)

The Tearing Effect Signal (TE) is a feedback signal from the LCD Controller to MCU. This signal reveals the display status of LCD controller. In the non-display period, the TE signal will go high. Therefore, this signal enables the MCU to send data by observing the non-display period to avoid tearing.

Figure 7-1 shows how the TE signal helps to avoid tearing. If the MCU writing speed is slower than the display speed, the display data should be updated after the LCD controller start to scan the frame buffer. Then the LCD controller will always display the old memory content until the next frame. However, if the MCU is faster than the LCD controller, it should start updating the display content in the vertical non-display period (VNDP) to enable the LCD controller will always get the newly updated data.

Figure 7-1: Relationship between Tearing Effect Signal and MCU Memory Writing



In M7-B01 graphics controller, users can configure the TE signal to reflect the vertical non-display period only or reflect both vertical and horizontal non-display period. With the additional horizontal non-display period information, the MCU can control the refresh action in more accurately by counting the horizontal line scanned by the LCD controller. Usually, a fast MCU will not need horizontal non-display period. But a slow MCU will need it to ensure the frame buffer update process always lags behind the LCD controller.

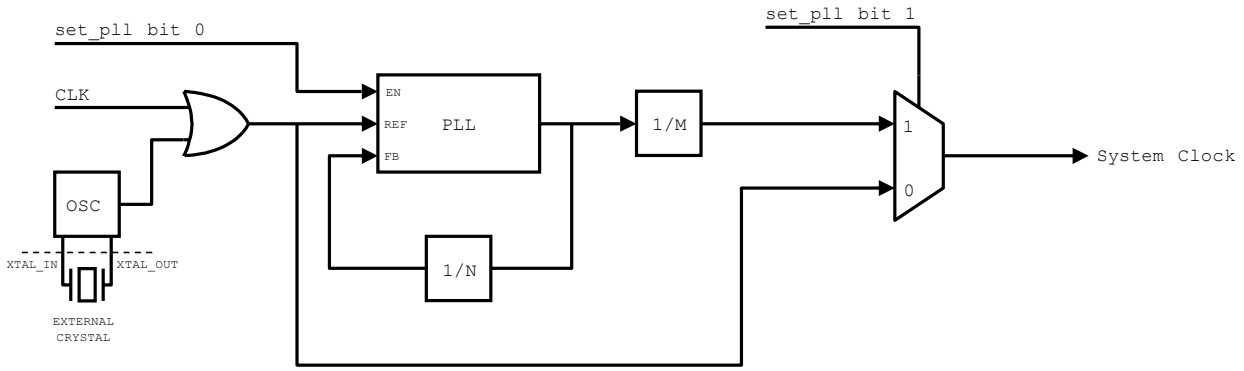
The TE signal is not generated by the MCU interface but the LCD controller. The MCU interface only route the signal to the external pad.

7.2 System Clock

The system clock of M7-B01 is generated by the built-in PLL. The reference clock of the PLL can come from either the CLK pin or the internal crystal oscillator. Since the CLK pin and the output of the oscillator was connected to PLL with an “OR” gate, the unused clock must be tied to VSS.

Before the PLL output is configured as the system clock by the bit 1 of "set_pll" command, the system will be clocked by the reference clock. This enables the user to send the "set_pll_mn" command to the PLL for frequency configuration. When the PLL frequency is configured and the PLL was enabled with the bit 0 of "set_pll" command, the user should still wait for 100ms for the PLL to lock. Then the PLL is ready and can be configured as system clock with the bit 1 of "set_pll" command.

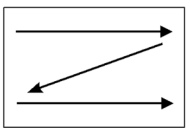
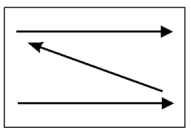
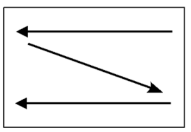
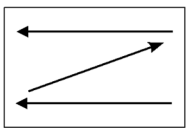
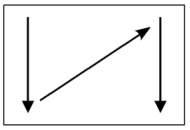
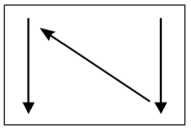
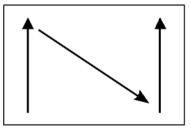
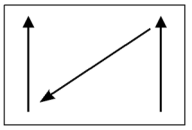
Figure 7-2: Clock Control Diagram



7.3 Frame Buffer

There are 1215K bytes built-in SRAM inside M7-B01 to use as frame buffer. When the frame buffer is written or read, the "address counter" will automatically increase by one or decrease by one depends on the frame buffer settings.

Table 7-2: Frame Buffer Settings regarding to set_address_mode command 0x36

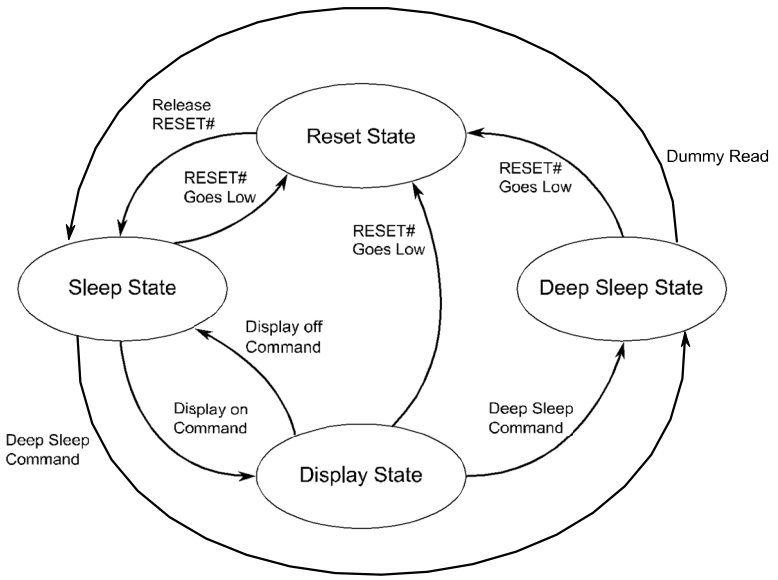
	Option 1 Horizontal: Increment Vertical: Increment B6 = 0; B7 = 0	Option 2 Horizontal: Increment Vertical: Decrement B6 = 0; B7 = 1	Option 3 Horizontal: Decrement Vertical: Increment B6 = 1; B7 = 0	Option 4 Horizontal: Decrement Vertical: Decrement B6 = 1; B7 = 1
Horizontal Frame Buffer Mode B5 = 0	00000h  5DC00h	00000h  5DC00h	00000h  5DC00h	00000h  5DC00h
Vertical Frame Buffer Mode B5 = 1	00000h  5DC00h	00000h  5DC00h	00000h  5DC00h	00000h  5DC00h

7.4 System Clock and Reset Manager

The "System Clock and Reset Manager" distributes the reset signal and clock signal to the entire system. It controls the Clock Generator and contains clock gating circuitry to turn on and off the clock of each functional module. Also, it divides the root clock from Clock Generator to operation clocks for different

module. The System Clock and Reset Manager also manage the reset signals to ensure all the module are reset to appropriate status when the system are in reset state, deep sleep state, sleep state and display state. Figure 7-3 shows a state diagram of four operation states of M7-B01.

Figure 7-3: State Diagram of M7-B01



Reset State:	Deep Sleep State:	Sleep State:	Display State:
Clock Generator Stop	Clock Generator Stop	Clock Generator On	Clock Generator On
Unable to Receive Command	Unable to Receive Command	Able to Receive Command	Able to Receive Command
Unable to Update Frame Buffer	Unable to Update Frame Buffer	Able to Update Frame Buffer	Able to Update Frame Buffer
Display Off	Display Off	Display Off	Display On
All Settings Reset	All Settings Retain	All Settings Retain	All Settings Retain

7.5 LCD Controller

7.5.1 Display Format

The LCD controller reads the frame buffer and generates display signals according to the selected display panel format. M7-B01 supports common RAM-less TFT driver using generic RGB data format or TTL format.

7.5.2 General Purpose Input/Output (GPIO)

The GPIO pins can operate in 2 modes, GPIO mode and miscellaneous display signal mode. When the pins are configured as GPIOs, these pins can be controlled directly by MCU. Therefore, user can use these pins to emulate other interface such as SPI or I2C. If these pins are configured as display signals, they will toggle with display periodically according to the signal settings. They can be set to toggle once a frame, once a line or in arbitrary period. Therefore they can be configured as some common signal needed for different panels such as STH or LP.

8 COMMAND TABLE

Hex Code	Command	Description
0x 00	nop	No operation
0x 01	soft_reset	Software Reset
0x 0A	get_power_mode	Get the current power mode
0x 0B	get_address_mode	Get the frame memory to the display panel read order
0x 0C	get_pixel_format	Get the current pixel format
0x 0D	get_display_mode	The display module returns the Display Signal Mode.
0x 0E	get_signal_mode	Get the current display mode from the peripheral
0x 0F	Reserved	Reserved
0x 10	enter_sleep_mode	Turn off the panel. This command will pull low the GPIO0. If GPIO0 is configured as normal GPIO or LCD miscellaneous signal with command set_gpio_conf, this command will be ignored.
0x 11	exit_sleep_mode	Turn on the panel. This command will pull high the GPIO0. If GPIO0 is configured as normal GPIO or LCD miscellaneous signal with command set_gpio_conf, this command will be ignored.
0x 12	enter_partial_mode	Part of the display area is used for image display.
0x 13	enter_normal_mode	The whole display area is used for image display.
0x 20	exit_invert_mode	Displayed image colors are not inverted.
0x 21	enter_invert_mode	Displayed image colors are inverted.
0x 26	set_gamma_curve	Selects the gamma curve used by the display device.
0x 28	set_display_off	Blanks the display device
0x 29	set_display_on	Show the image on the display device
0x 2A	set_column_address	Set the column extent
0x 2B	set_page_address	Set the page extent
0x 2C	write_memory_start	Transfer image information from the host processor interface to the peripheral starting at the location provided by set_column_address and set_page_address
0x 2E	read_memory_start	Transfer image data from the peripheral to the host processor interface starting at the location provided by set_column_address and set_page_address
0x 30	set_partial_area	Defines the partial display area on the display device
0x 33	set_scroll_area	Defines the vertical scrolling and fixed area on display area
0x 34	set_tear_off	Synchronization information is not sent from the display module to the host processor
0x 35	set_tear_on	Synchronization information is sent from the display module to the host processor at the start of VFP
0x 36	set_address_mode	Set the read order from frame buffer to the display panel
0x 37	set_scroll_start	Defines the vertical scrolling starting point
0x 38	exit_idle_mode	Full color depth is used for the display panel
0x 39	enter_idle_mode	Reduce color depth is used on the display panel.
0x 3A	set_pixel_format	Defines how many bits per pixel are used in the interface
0x 3C	write_memory_continue	Transfer image information from the host processor interface to the peripheral from the last written location
0x 3E	read_memory_continue	Read image data from the peripheral continuing after the last read_memory_continue or read_memory_start
0x 44	set_tear_scanline	Synchronization information is sent from the display module to the host processor when the display device refresh reaches the provided scanline

Hex Code	Command	Description
0x 45	get_scanline	Get the current scan line
0x A1	read_ddb	Read the DDB from the provided location
0x A8	Reserved	Reserved
0x B0	set_lcd_mode_	Set the LCD panel mode (RGB TFT or TTL)
0x B1	get_lcd_mode	Get the current LCD panel mode, pad strength and resolution
0x B4	set_hori_period	Set front porch
0x B5	get_hori_period	Get current front porch settings
0x B6	set_vert_period	Set the vertical blanking interval between last scan line and next LFRAME pulse
0x B7	get_vert_period	Set the vertical blanking interval between last scan line and next LFRAME pulse
0x B8	set_gpio_conf	Set the GPIO configuration. If the GPIO is not used for LCD, set the direction. Otherwise, they are toggled with LCD signals.
0x B9	get_gpio_conf	Get the current GPIO configuration
0x BA	set_gpio_value	Set GPIO value for GPIO configured as output
0x BB	get_gpio_status	Read current GPIO status. If the individual GPIO was configured as input, the value is the status of the corresponding pin. Otherwise, it is the programmed value.
0x BC	set_post_proc	Set the image post processor
0x BD	get_post_proc	Set the image post processor
0x BE	set_pwm_conf	Set the image post processor
0x BF	get_pwm_conf	Set the image post processor
0x C0	set_lcd_gen0	Set the rise, fall, period and toggling properties of LCD signal generator 0
0x C1	get_lcd_gen0	Get the current settings of LCD signal generator 0
0x C2	set_lcd_gen1	Set the rise, fall, period and toggling properties of LCD signal generator 1
0x C3	get_lcd_gen1	Get the current settings of LCD signal generator 1
0x C4	set_lcd_gen2	Set the rise, fall, period and toggling properties of LCD signal generator 2
0x C5	get_lcd_gen2	Get the current settings of LCD signal generator 2
0x C6	set_lcd_gen3	Set the rise, fall, period and toggling properties of LCD signal generator 3
0x C7	get_lcd_gen3	Get the current settings of LCD signal generator 3
0x C8	set_gpio0_rop	Set the GPIO0 with respect to the LCD signal generators using ROP3 operation. No effect if the GPIO0 is configured as general GPIO.
0x C9	get_gpio0_rop	Get the GPIO0 properties with respect to the LCD signal generators.
0x CA	set_gpio1_rop	Set the GPIO1 with respect to the LCD signal generators using ROP3 operation. No effect if the GPIO1 is configured as general GPIO.
0x CB	get_gpio1_rop	Get the GPIO1 properties with respect to the LCD signal generators.
0x CC	set_gpio2_rop	Set the GPIO2 with respect to the LCD signal generators using ROP3 operation. No effect if the GPIO2 is configured as general GPIO.
0x CD	get_gpio2_rop	Get the GPIO2 properties with respect to the LCD signal generators.

Hex Code	Command	Description
0x CE	set_gpio3_rop	Set the GPIO3 with respect to the LCD signal generators using ROP3 operation. No effect if the GPIO3 is configured as general GPIO.
0x CF	get_gpio3_rop	Get the GPIO3 properties with respect to the LCD signal generators.
0x D0	set_dbc_conf	Set the dynamic back light configuration
0x D1	get_dbc_conf	Get the current dynamic back light configuration
0x D4	set_dbc_th	Set the threshold for each level of power saving
0x D5	get_dbc_th	Get the threshold for each level of power saving
0x E0	set_pll	Start the PLL. Before the start, the system was operated with the crystal oscillator or clock input
0x E2	set_pll_mn	Set the PLL
0x E3	get_pll_mn	Get the PLL settings
0x E4	get_pll_status	Get the current PLL status
0x E5	set_deep_sleep	Set deep sleep mode
0x E6	set_lshift_freq	Set the LSHIFT (pixel clock) frequency
0x E7	get_lshift_freq	Get current LSHIFT (pixel clock) frequency setting
0x E8	Reserved	Reserved
0x E9	Reserved	Reserved
0x F0	set_pixel_data_interface	Set the pixel data format of the parallel host processor interface
0x F1	get_pixel_data_interface	Get the current pixel data format settings
0x FF	Reserved	Reserved

9 COMMAND DESCRIPTIONS

9.1 No operation

Command 00h
Parameters None

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	0	0	0	0	0	0	0	0	00

Description
No operation. It can be used to terminate the frame buffer write or read for Write Memory Continue, 0x3C and Read Memory Continue, 0x3E.

9.2 Software Reset

Command 01h
Parameters None

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	0	0	0	0	0	0	0	1	01

Description
The display module performs a software reset. Only the configuration register will be reset.

Note :

The host processor must wait 5ms before sending any new commands to a M7-B01 following this command.

The host processor must wait 120ms before sending an Exit Sleep Mode, 0x11.

9.3 Get Power Mode

Command 0Ah
Parameters 1

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	0	0	0	0	1	0	1	0	0A
Parameter 1	1	0	A_6	A_5	A_4	A_3	A_2	0	0	xx

Description
Get the current power mode

A[6] : Idle mode on/off (POR = 0)
0 Idle mode off
1 Idle mode on

A[5] : Partial mode on/off (POR = 0)
0 Partial mode off
1 Partial mode on

A[4] : Sleep mode on/off (POR = 0)
0 Sleep mode on
1 Sleep mode off

A[3] : Display normal mode on/off (POR = 1)
0 Display normal mode off
1 Display normal mode on

A[2] : Display on/off (POR = 0)
0 Display is off
1 Display is on

9.4 Get Address Mode

Command 0Bh
Parameters 1

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	0	0	0	0	1	0	1	1	0B
Parameter 1	1	A_7	A_6	A_5	A_4	A_3	A_2	0	0	xx

Description
Get the frame buffer to the display panel read order

A[7] : Page address order (POR = 0)
0 Top to bottom
1 Bottom to top

A[6] : Column address order (POR = 0)
0 Left to right
1 Right to left

A[5] : Page / Column order (POR = 0)
0 Normal mode
1 Reverse mode

A[4] : Line address order (POR = 0)
0 LCD refresh top to bottom
1 LCD refresh bottom to top

A[3] : RGB / BGR order (POR = 0)
0 RGB
1 BGR

A[2] : Display data latch data (POR = 0)
0 LCD refresh left to right
1 LCD refresh right to left

9.5 Get Pixel Format

Command 0Ch
Parameters 1

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	0	0	0	0	1	1	0	0	0C
Parameter 1	1	0	A_6	A_5	A_4	0	0	0	0	xx

Description
Get the current pixel format for the RGB image data.

A[6:4] : Display pixel format (POR = 000)

000	Reserved
001	3-bit/pixel
010	8-bit/pixel
011	12-bit/pixel
100	Reserved
101	16-bit/pixel
110	18-bit/pixel
111	24-bit/pixel

9.6 Get Display mode

Command 0Dh
Parameters 1

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	0	0	0	0	1	1	0	1	0D
Parameter 1	1	A_7	0	A_5	0	0	A_2	A_1	A_0	xx

Description
The display module returns the Display Image Mode status.

A[7] : Vertical scrolling status (POR = 0)

0	Vertical scrolling is off
1	Vertical scrolling is on

A[5] : Inversion on/off (POR = 0)

0	Inversion is off
1	Inversion is on

A[2:0] : Gamma curve selection (POR = 011)

000	Gamma curve 0
001	Gamma curve 1
010	Gamma curve 2
011	Gamma curve 3
100	Reserved
101	Reserved
110	Reserved
111	Reserved

9.7 Get Signal Mode

Command 0Eh
Parameters 1

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	0	0	0	0	1	1	1	0	0E
Parameter 1	1	A_7	0	0	0	0	0	0	0	xx

Description
Get the current display signal mode from the peripheral

A[7] : Tearing effect line mode (POR = 0)

0	Tearing effect line off
1	Tearing effect on

9.8 Enter Sleep Mode

Command 10h
Parameters None

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	0	0	0	1	0	0	0	0	10

Description
Turn off the panel. This command causes the display panel to enter sleep mode and pull low the GPIO0.
If GPIO0 is configured as normal GPIO or LCD miscellaneous signal with command Set GPIO Conf, 0xB8, this command will not affect the GPIO0.

Note :

The host processor must wait 5ms before sending any new commands to a M7-B01 following this command.

The host processor must wait 120ms after sending an Exit Sleep Mode, 0x11 before sending an Enter Sleep Mode, 0x10.

9.9 Exit Sleep Mode

Command 11h
Parameters None

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	0	0	0	1	0	0	0	1	11

Description
Turn on the panel. This command causes the display panel to exit sleep mode and will pull high the GPIO0.
If GPIO0 is configured as normal GPIO or LCD miscellaneous signal with command Set GPIO Conf (0xB8), this command will not affect the GPIO0.

Note :

The host processor must wait 5ms after sending this command before sending another command.

The host processor must wait 120ms after sending an Exit Sleep Mode, 0x11 before sending an Enter Sleep Mode, 0x10.

9.10 Enter Partial Mode

Command 12h
Parameters None

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	0	0	0	1	0	0	1	0	12

Description
This command causes the display module to enter the Partial Display Mode. The Partial Display Mode window is described by the Set Partial Area, 0x30h.
To leave Partial Display Mode, the Enter Normal Mode, 0x13h.

9.11 Enter Normal Mode

Command 13h
Parameters None

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	0	0	0	1	0	0	1	1	13

Description
This command causes the display module to enter the normal mode. Normal mode is defined as partial display and scroll mode are off. That means the whole display area is used for image display.

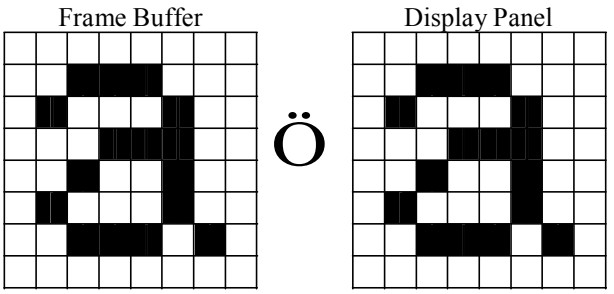
9.12 Exit Invert Mode

Command 20h
Parameters None

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	0	0	1	0	0	0	0	0	20

Description
This command causes the display module to stop inverting the image data on the display device. The frame buffer contents remain unchanged.

Figure 9-1: Exit Invert mode example



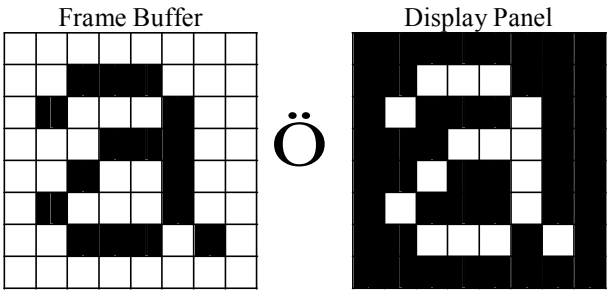
9.13 Enter Invert Mode

Command 21h
Parameters None

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	0	0	1	0	0	0	0	1	21

Description
This command causes the display module to invert the image data only on the display device. The frame buffer contents remain unchanged.

Figure 9-2: Enter Invert mode example



9.14 Set Gamma Curve

Command 26h
Parameters 1

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	0	0	1	0	0	1	1	0	26
Parameter 1	1	0	0	0	0	A_3	A_2	A_1	A_0	xx

Description
Selects the gamma curve used by the display device.

A[3:0]	Gamma curve selection (POR = 1000)	GAMAS[1]	GAMAS[0]
0000	No gamma curve selected (Same as 0001b)	0	0
0001	Gamma curve 0	0	0
0010	Gamma curve 1	0	1
0100	Gamma curve 2	1	0
1000	Gamma curve 3	1	1
Others	Reserved		

9.15 Set Display Off

Command 28h
Parameters None

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	0	0	1	0	1	0	0	0	28

Description
Blanks the display device. The frame buffer contents remain unchanged.

9.16 Set Display On

Command 29h
Parameters None

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	0	0	1	0	1	0	0	1	29

Description
Show the image on the display device

9.17 Set Column Address

Command 2Ah
Parameters 4

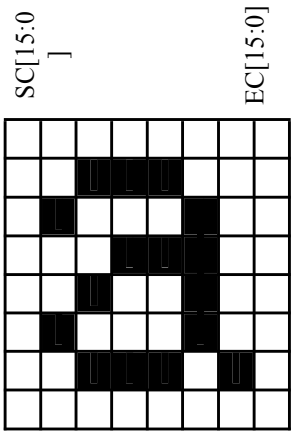
	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	0	0	1	0	1	0	1	0	2A
Parameter 1	1	SC_{15}	SC_{14}	SC_{13}	SC_{12}	SC_{11}	SC_{10}	SC_9	SC_8	xx
Parameter 2	1	SC_7	SC_6	SC_5	SC_4	SC_3	SC_2	SC_1	SC_0	xx
Parameter 3	1	EC_{15}	EC_{14}	EC_{13}	EC_{12}	EC_{11}	EC_{10}	EC_9	EC_8	xx
Parameter 4	1	EC_7	EC_6	EC_5	EC_4	EC_3	EC_2	EC_1	EC_0	xx

Description
Set the column extent of frame buffer accessed by the host processor with the Read Memory Continue, 0x3E and Write Memory Continue, 0x3C..

SC[15:8] : Start column number high byte (POR = 00000000)
SC[7:0] : Start column number low byte (POR = 00000000)
EC[15:8] : End column number high byte (POR = 00000000)
EC[7:0] : End column number low byte (POR = 00000000)

Note : SC[15:0] must always be equal to or less than EC[15:0]

Figure 9-3: Set Column Address example



9.18 Set Page Address

Command 2Bh
Parameters 4

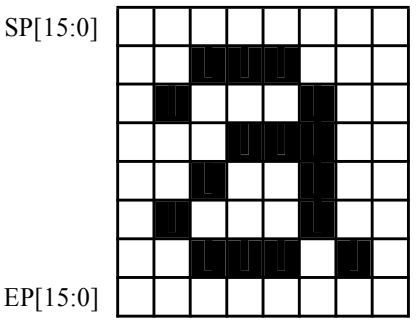
	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	0	0	1	0	1	0	0	1	2B
Parameter 1	1	SP_{15}	SP_{14}	SP_{13}	SP_{12}	SP_{11}	SP_{10}	SP_9	SP_8	xx
Parameter 2	1	SP_7	SP_6	SP_5	SP_4	SP_3	SP_2	SP_1	SP_0	xx
Parameter 3	1	EP_{15}	EP_{14}	EP_{13}	EP_{12}	EP_{11}	EP_{10}	EP_9	EP_8	xx
Parameter 4	1	EP_7	EP_6	EP_5	EP_4	EP_3	EP_2	EP_1	EP_0	xx

Description
Set the page extent of the frame buffer accessed by the host processor with the Read Memory Continue, 0x3E and Write Memory Continue, 0x3C..

SP[15:8] : Start page (row) number high byte (POR = 00000000)
SP[7:0] : Start page (row) number low byte (POR = 00000000)
EP[15:8] : End page (row) number high byte (POR = 00000000)
EP[7:0] : End page (row) number low byte (POR = 00000000)

Note : SP[15:0] must always be equal to or less than EP[15:0]

Figure 9-4: Set Page Address example



9.19 Write Memory Start

Command 2Ch
Parameters None

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	0	0	1	0	1	1	0	0	2C

Description
Transfer image information from the host processor interface to the M7-B01 starting at the location provided by Set Column Address, 0x2A and Set Page Address, 0x2B.

If Set Address Mode, 0x36 A[5] = 0:

The column and page registers are reset to the Start Column (SC) and Start Page (SP), respectively.

Pixel Data 1 is stored in frame buffer at (SC, SP). The column register is then incremented and pixels are written to the frame memory until the column register equals the End Column (EC) value. The column register is then reset to SC and the page register is incremented. Pixels are written to the frame buffer until the page register equals the End Page (EP) value and the column register equals the EC value, or the host processor sends another command. If the number of pixels exceeds (EC – SC + 1) * (EP – SP + 1) the extra pixels are ignored.

If Set Address Mode, 0x36 A[5] = 1:

The column and page registers are reset to the Start Column (SC) and Start Page (SP), respectively.

Pixel Data 1 is stored in frame buffer at (SC, SP). The page register is then incremented and pixels are written to the frame memory until the page register equals the End Page (EP) value. The page register is then reset to SP and the column register is incremented. Pixels are written to the frame buffer until the column register equals the End column (EC) value and the page register equals the EP value, or the host processor sends another command. If the number of pixels exceeds (EC – SC + 1) * (EP – SP + 1) the extra pixels are ignored.

9.20 Read Memory Start

Command 2Eh
Parameters None

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	0	0	1	0	1	1	1	0	2E

Description
Transfer image data from the M7-B01 to the host processor interface starting at the location provided by Set Column Address, 0x2A and Set Page Address, 0x2B.

If Set Address Mode, 0x36 A[5] = 0:

The column and page registers are reset to the Start Column (SC) and Start Page (SP), respectively.

Pixels are read from frame buffer at (SC, SP). The column register is then incremented and pixels read from the frame memory until the column register equals the End Column (EC) value. The column register is then reset to SC and the page register is incremented. Pixels are read from the frame buffer until the page register equals the End Page (EP) value and the column register equals the EC value, or the host processor sends another command.

If Set Address Mode, 0x36 A[5] = 1:

The column and page registers are reset to the Start Column (SC) and Start Page (SP), respectively.

Pixels are read from frame buffer at (SC, SP). The page register is then incremented and pixels read from the frame memory until the page register equals the End Page (EP) value. The page register is then reset to SP and the column register is incremented. Pixels are read from the frame buffer until the column register equals the End Column (EC) value and the page register equals the EP value, or the host processor sends another command.

9.21 Set Partial Area

Command 30h
Parameters 4

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	0	0	1	1	0	0	0	0	30
Parameter 1	1	SR_{15}	SR_{14}	SR_{13}	SR_{12}	SR_{11}	SR_{10}	SR_9	SR_8	xx
Parameter 2	1	SR_7	SR_6	SR_5	SR_4	SR_3	SR_2	SR_1	SR_0	xx
Parameter 3	1	ER_{15}	ER_{14}	ER_{13}	ER_{12}	ER_{11}	ER_{10}	ER_9	ER_8	xx
Parameter 4	1	ER_7	ER_6	ER_5	ER_4	ER_3	ER_2	ER_1	ER_0	xx

Description
This command defines the Partial Display mode's display area. There are two parameters associated with this command, the first defines the Start Row (SR) and the second the End Row (ER). SR and ER refer to the Frame Buffer Line Pointer.

SR[15:8] : Start display row number high byte (POR = 00000000)
SR[7:0] : Start display row number low byte (POR = 00000000)
ER[15:8] : End display row number high byte (POR = 00000000)
ER[7:0] : End display row number low byte (POR = 00000000)
Note : SR[15:0] and ER[15:0] cannot be 0000h nor exceed the last vertical line number.

If End Row > Start Row

Figure 9-5: Set Partial Area with Set Address Mode 0x36 A[4] = 0

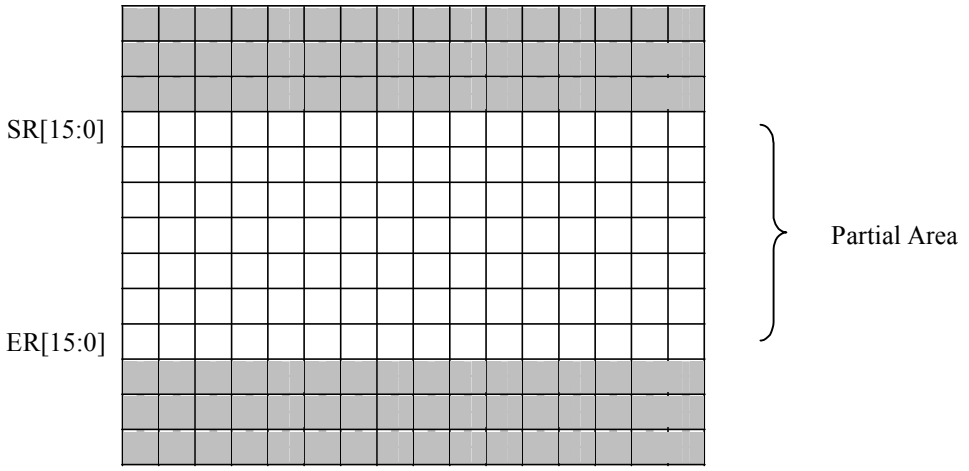
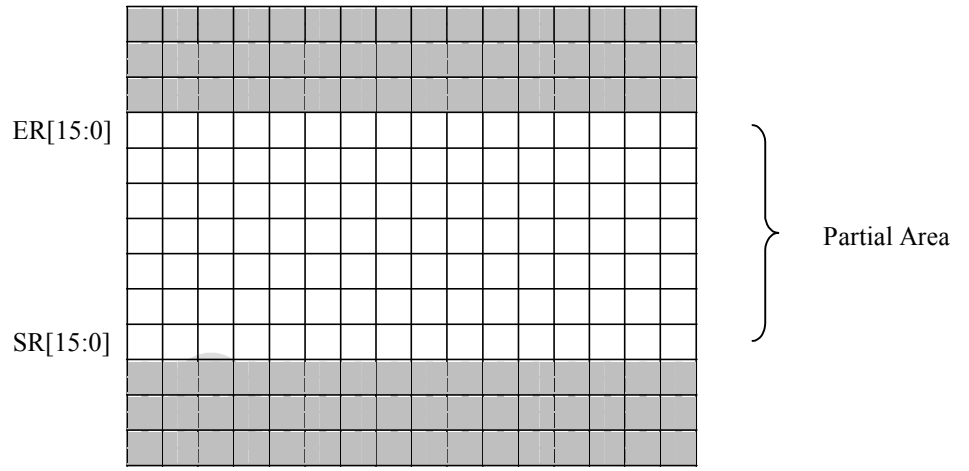


Figure 9-6: Set Partial Area with Set Address Mode 0x36 A[4] = 1



If Start Row > End Row

Figure 9-7: Set Partial Area with Set Address Mode 0x36 A[4] = 0

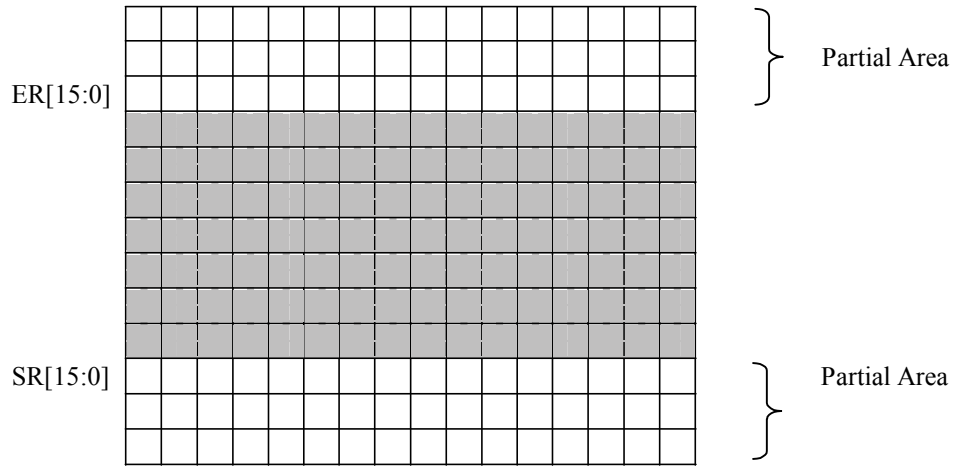
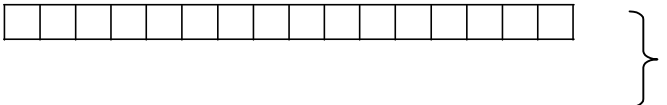
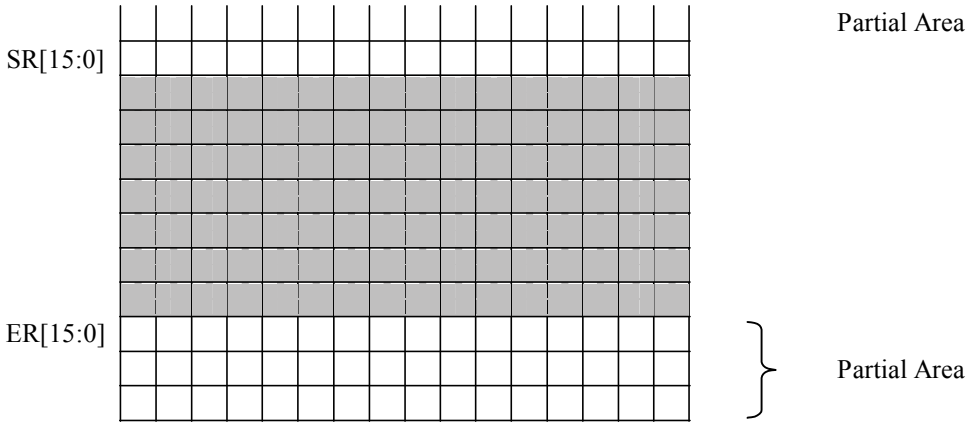


Figure 9-8: Set Partial Area with Set Address Mode 0x36 A[4] = 1





9.22 Set Scroll Area

Command 33h
Parameters 6

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	0	0	1	1	0	0	1	1	33
Parameter 1	1	TFA_{15}	TFA_{14}	TFA_{13}	TFA_{12}	TFA_{11}	TFA_{10}	TFA_9	TFA_8	xx
Parameter 2	1	TFA_7	TFA_6	TFA_5	TFA_4	TFA_3	TFA_2	TFA_1	TFA_0	xx
Parameter 3	1	VSA_{15}	VSA_{14}	VSA_{13}	VSA_{12}	VSA_{11}	VSA_{10}	VSA_9	VSA_8	xx
Parameter 4	1	VSA_7	VSA_6	VSA_5	VSA_4	VSA_3	VSA_2	VSA_1	VSA_0	xx
Parameter 5	1	BFA_{15}	BFA_{14}	BFA_{13}	BFA_{12}	BFA_{11}	BFA_{10}	BFA_9	BFA_8	xx
Parameter 6	1	BFA_7	BFA_6	BFA_5	BFA_4	BFA_3	BFA_2	BFA_1	BFA_0	xx

Description
Defines the vertical scrolling and fixed area on display area

TFA[15:8] : High byte of Top Fixed Area number in lines from the top of the frame buffer (POR = 00000000)
TFA[7:0] : Low byte of Top Fixed Area number in lines from the top of the frame buffer (POR = 00000000)

VSA[15:8] : High byte of Vertical scrolling area in number of lines of the frame buffer (POR = 00000000)
VSA[7:0] : Low byte of Vertical scrolling area in number of lines of the frame buffer (POR = 00000000)

BFA[15:8] : High byte of Bottom Fixed Area in number of lines from the bottom of the frame buffer (POR = 00000000)
BFA[7:0] : Low byte of Bottom Fixed Area in number of lines from the bottom of the frame buffer (POR = 00000000)

If Set Address Mode, 0x36 A[4] = 0 :

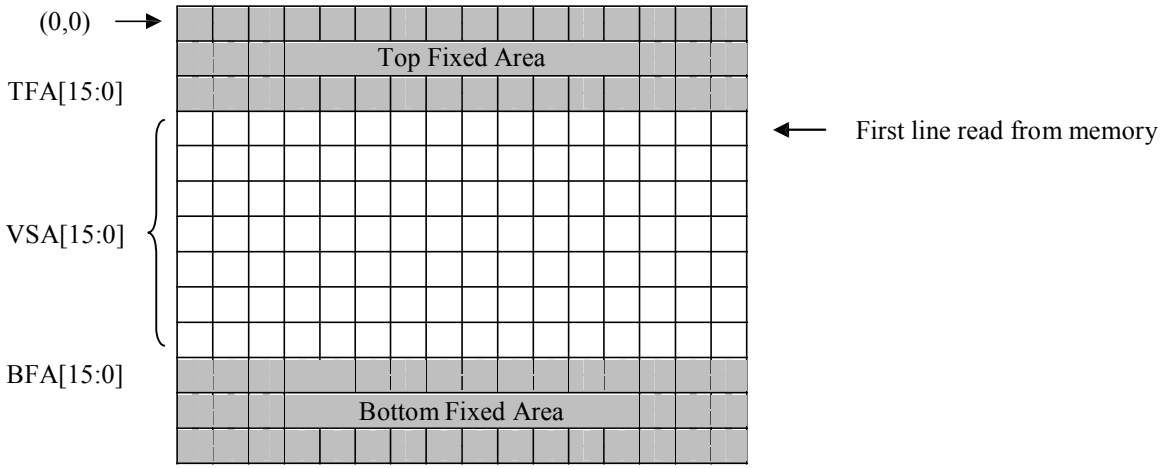
The TFA[15:0] describes the Top Fixed Area in number of lines from the top of the frame buffer. The top of the frame buffer and top of the display panel are aligned.

The VSA[15:0] describes the height of the Vertical Scrolling Area in number of lines of frame buffer from the Vertical Scrolling Start Address. The first line of the Vertical Scrolling Area starts immediately after the bottom most line of the Top Fixed Area. The last line of the Vertical Scrolling Area ends immediately before the top most line of the Bottom Fixed Area.

The BFA[15:0] describes the Bottom Fixed Area in number of lines from the bottom of the frame buffer. The bottom of the frame buffer and bottom of the display panel are aligned.

TFA, VSA and BFA refer to the Frame Buffer Line Pointer.

Figure 9-9: Set Scroll Area with Set Address Mode 0x36 A[4] = 0



If Set Address Mode, 0x36 A[4] = 1 :

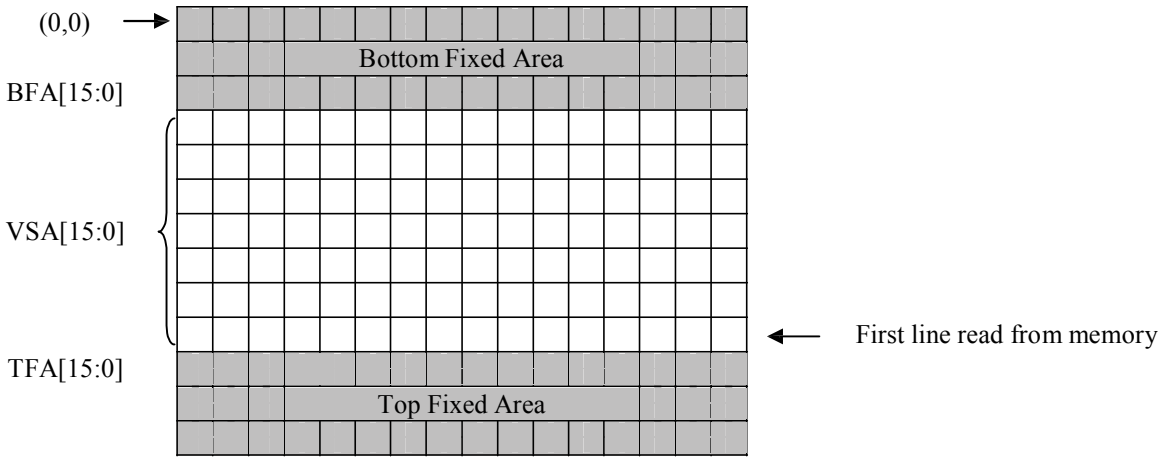
The TFA[15:0], describes the Top Fixed Area in number of lines from the bottom of the frame buffer. The bottom of the frame buffer and bottom of the display panel are aligned.

The VSA[15:0] describes the height of the Vertical Scrolling Area in number of lines of frame buffer from the Vertical Scrolling Start Address. The first line of the Vertical Scrolling Area starts immediately after the top most line of the Top Fixed Area. The last line of the Vertical Scrolling Area ends immediately before the bottom most line of the Bottom Fixed Area.

The BFA[15:0] describes the Bottom Fixed Area in number of lines from the top of the frame buffer. The top of the frame buffer and top of the display panel are aligned.

TFA, VSA and BFA refer to the Frame Buffer Line Pointer.

Figure 9-10: Set Scroll Area with Set Address Mode 0x36 A[4] = 1



Note :

The sum of TFA, VSA and BFA must equal the number of the display panel's horizontal lines (pages), otherwise Scrolling mode is undefined.

In Vertical Scroll Mode, Set Address Mode, 0x36 A[5] should be set to '0' – this only affects the Frame Memory Write.

9.23 Set Tear Off

Command 34h
Parameters None

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	0	0	1	1	0	1	0	0	34

Description
TE signal is not sent from the display module to the host processor.

9.24 Set Tear On

Command 35h
Parameters 1

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	0	0	1	1	0	1	0	1	35
Parameter 1	1	0	0	0	0	0	0	0	A_0	xx

Description
TE signal is sent from the display module to the host processor at the start of VFP.

A[0] : Tearing effect line mode (POR = 0)
0 The tearing effect output line consists of V-blanking information only.
1 The tearing effect output line consists of both V-blanking and H-blanking information.

The TE signal shall be active low when the display panel is in Sleep mode.

9.25 Set Address Mode

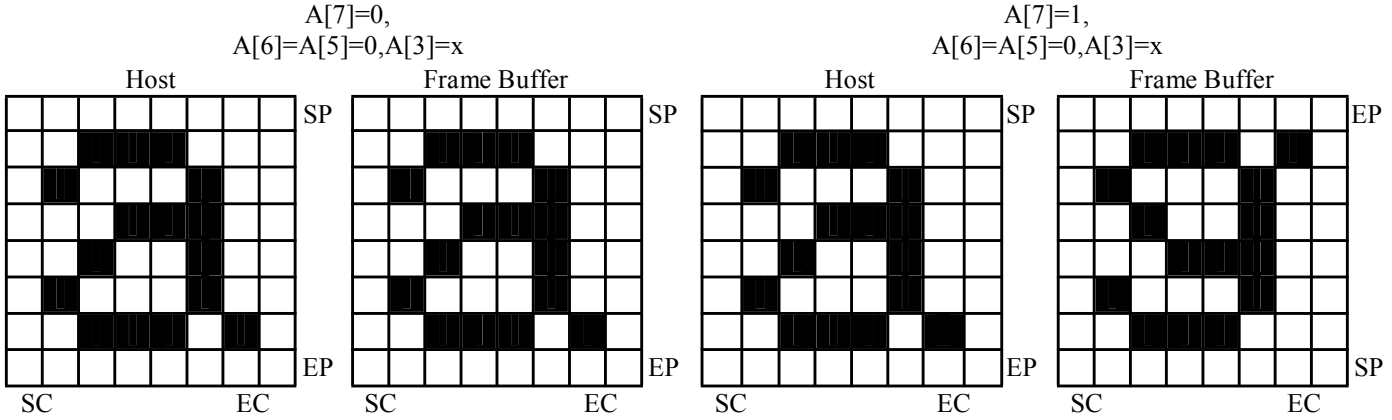
Command 36h
Parameters 1

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	0	0	1	1	0	1	1	0	36
Parameter 1	1	A_7	A_6	A_5	A_4	A_3	A_2	A_1	A_0	xx

Description
Set the read order from host processor to frame buffer by A[7:5] and A[3] and from frame buffer to the display panel by A[2:0] and A[4].

A[7] : Page address order (POR = 0)
This bit controls the order that pages of data are transferred from the host processor to the M7-B01's frame buffer.
0 Top to bottom, pages transferred from SP (Start Page) to EP (End Page).
1 Bottom to top, pages transferred from EP (End Page) to SP (Start Page).

Figure 9-11: A[7] Page Address Order



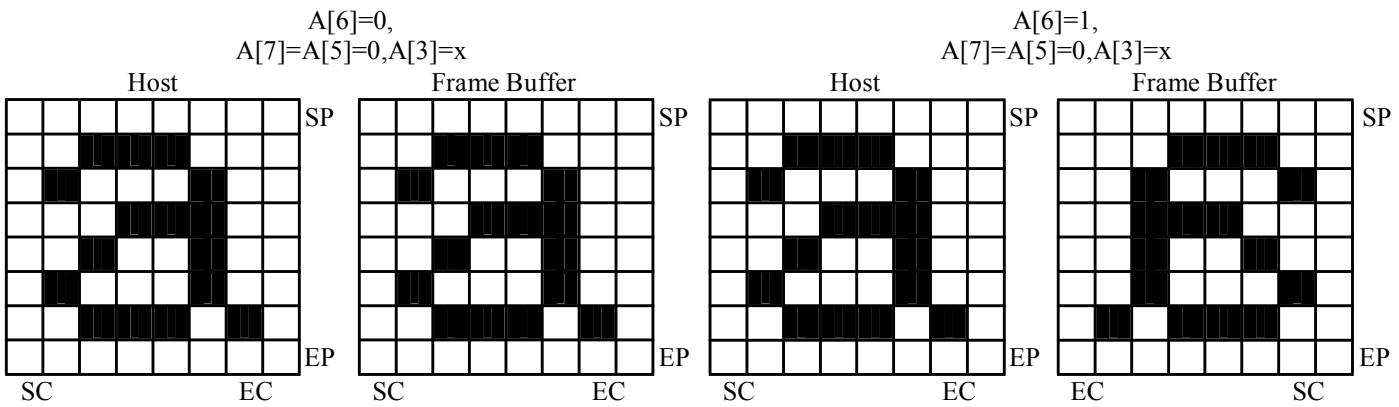
A[6] : Column address order (POR = 0)

This bit controls the order that columns of data are transferred from the host processor to the M7-B01's frame buffer.

0 Left to right, columns transferred from SC (Start Column) to EC (End Column).

1 Right to left, columns transferred from EC (End Column) to SC (Start Column).

Figure 9-12: A[6] Column Address Order



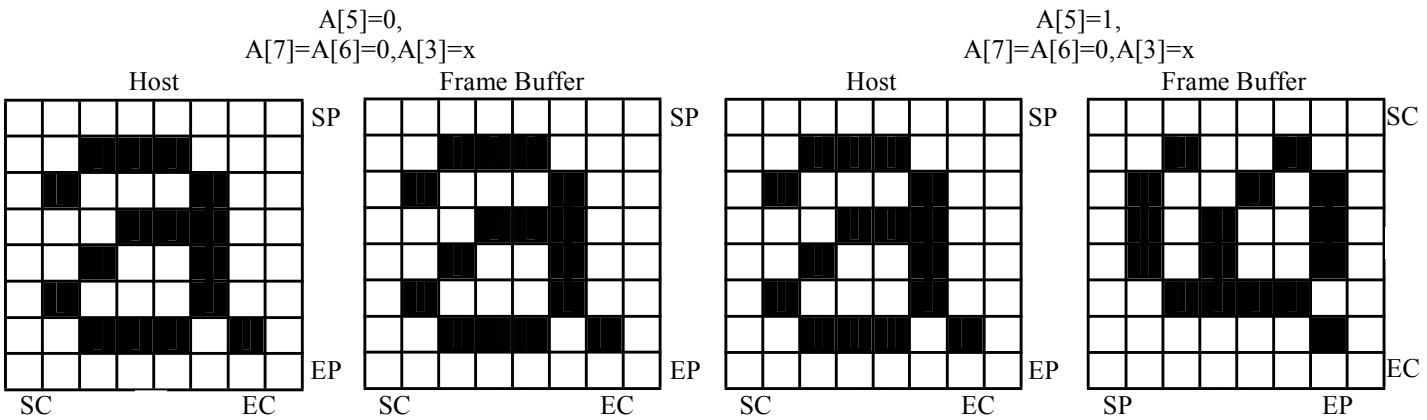
A[5] : Page / Column order (POR = 0)

This bit controls the order that columns of data are transferred from the host processor to the M7-B01's frame buffer.

0 Normal mode

1 Reverse mode

Figure 9-13: A[5] Page / Column Address Order



A[4] : Line address order (POR = 0)
This bit controls the display panel's horizontal line refresh order. The image shown on the display panel is unaffected, regardless of the bit setting.

0 LCD refresh from top line to bottom line.
1 LCD refresh from bottom line to top line.

A[3] : RGB / BGR order (POR = 0)
This bit controls the RGB data order transferred from the M7-B01's frame buffer to the display panel.

0 RGB
1 BGR

Figure 9-14: A[3] RGB Order



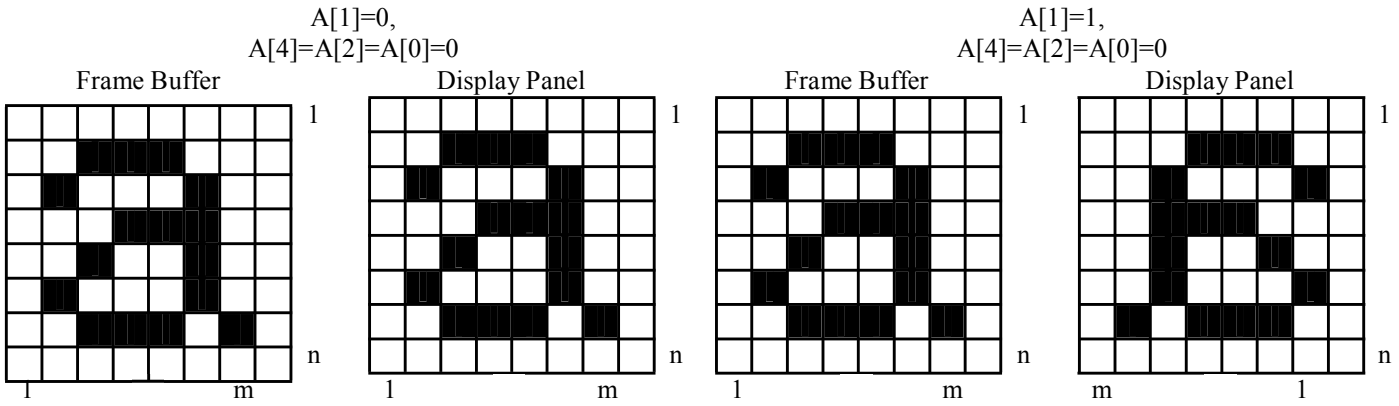
A[2] : Display data latch data (POR = 0)
This bit controls the display panel's vertical line data latch order. The image shown on the display panel is unaffected, regardless of the bit setting.

0 LCD refresh from left side to right side
1 LCD refresh from right side to left side

A[1] : Flip Horizontal (POR = 0)
This bit flips the image shown on the display panel left to right. No change is made to the frame memory.

0 Normal
1 Flipped

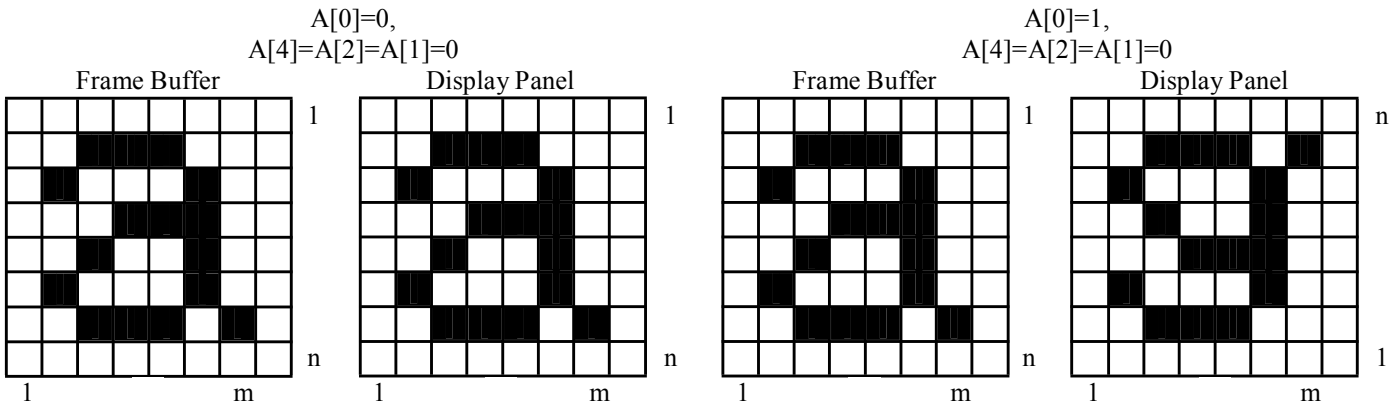
Figure 9-15: A[1] Flip Horizontal



A[0] : Flip Vertical (POR = 0)
This bit flips the image shown on the display panel top to bottom. No change is made to the frame memory.

0 Normal
1 Flipped

Figure 9-16: A[0] Flip Vertical



9.26 Set Scroll Start

Command 37h
Parameters 2

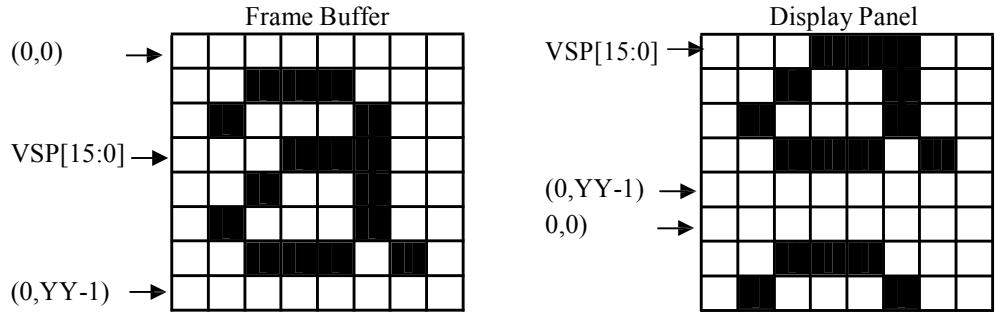
	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	0	0	1	1	0	1	1	1	37
Parameter 1	1	VSP_{15}	VSP_{14}	VSP_{13}	VSP_{12}	VSP_{11}	VSP_{10}	VSP_9	VSP_8	xx
Parameter 2	1	VSP_7	VSP_6	VSP_5	VSP_4	VSP_3	VSP_2	VSP_1	VSP_0	xx

Description
This command sets the start of the vertical scrolling area in the frame buffer. The vertical scrolling area is fully defined when this command is used with the Set Scroll Area 0x33.

VSP[15:8] : High byte of Vertical Scroll Pointer to define the line number in frame buffer that is written to the display as the first line of the vertical scrolling area (POR = 00000000)
VSP[7:0] : Low byte of Vertical Scroll Pointer to define the line number in frame buffer that is written to the display as the first line of the vertical scrolling area (POR = 00000000)

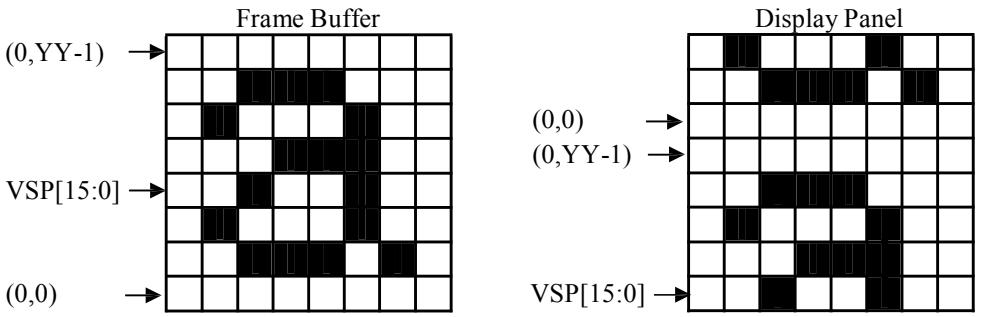
If Set Address Mode, 0x36 A[4] = 0:
Example:
When Top Fixed Area = Bottom Fixed Area = 0, Vertical Scrolling Area = YY and VSP = 3.

Figure 9-17: Set Scroll Start with Set Address Mode, 0x36 A[4] = 0



If Set Address Mode, 0x36 A[4] = 1:
Example:
When Top Fixed Area = Bottom Fixed Area = 0, Vertical Scrolling Area = YY and VSP = 3.

Figure 9-18: Set Scroll Start with Set Address Mode, 0x36 A[4] = 1



Note :
If Set Address Mode, 0x36 A[4] = 0, TFA[15:0] - 1< VSP[15:0] < # of lines in frame buffer - BFA[15:0]
If Set Address Mode, 0x36 A[4] = 1, BFA[15:0] - 1 < VSP[15:0] < # of lines in frame buffer - TFA[15:0]

9.27 Exit Idle Mode

Command 38h
Parameters None

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	0	0	1	1	1	0	0	0	38

Description
This command causes the display module to exit Idle Mode.
Full color depth is used for the display panel.

9.28 Enter Idle Mode

Command 39h
Parameters None

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	0	0	1	1	1	0	0	1	39

Description
This command causes the display module to enter Idle Mode.
In Idle Mode, color depth is reduced. Colors are shown on the display panel using the MSB of each of the R, G and B color components in the frame buffer.

Table 9-1 Enter Idle Mode memory content vs display color

Color	R_7 R_6 R_5 R_4 R_3 R_2 R_1 R_0	G_7 G_6 G_5 G_4 G_3 G_2 G_1 G_0	B_7 B_6 B_5 B_4 B_3 B_2 B_1 B_0
Black	0XXXXXXX	0XXXXXXX	0XXXXXXX
Blue	0XXXXXXX	0XXXXXXX	1XXXXXXX
Red	1XXXXXXX	0XXXXXXX	0XXXXXXX
Magenta	1XXXXXXX	0XXXXXXX	1XXXXXXX
Green	0XXXXXXX	1XXXXXXX	0XXXXXXX
Cyan	0XXXXXXX	1XXXXXXX	1XXXXXXX
Yellow	1XXXXXXX	1XXXXXXX	0XXXXXXX
White	1XXXXXXX	1XXXXXXX	1XXXXXXX

9.29 Set Pixel Format

Command 3Ah
Parameters 1

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	0	0	1	1	1	0	1	0	3A
Parameter 1	1	0	A_6	A_5	A_4	0	0	0	0	xx

Description
Set the current pixel format for RGB image data

A[6:4] : Display pixel format (POR = 000)
- 000 Reserved
- 001 3-bit/pixel
- 010 8-bit/pixel
- 011 12-bit/pixel
- 100 Reserved
- 101 16-bit/pixel
- 110 18-bit/pixel
- 111 24-bit/pixel

9.30 Write Memory Continue

Command 3Ch
Parameters None

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	0	0	1	1	1	1	0	0	3C

Description
Transfer image information from the host processor interface to the M7-B01 from the last Write Memory Continue, 0x3C or Write Memory Start, 0x2C.

If Set Address Mode, 0x36 A[5] = 0:

Data is written continuing from the pixel location after the write range of the previous Write Memory Start, 0x2C or Write Memory Continue, 0x3C. The column register is then incremented and pixels are written to the frame buffer until the column register equals the End Column (EC) value. The column register is then reset to SC and the page register is incremented. Pixels are written to the frame buffer until the page register equals the End Page (EP) value and the column register equals the EC value, or the host processor sends another command. If the number of pixels exceeds (EC – SC + 1) * (EP – SP + 1) the extra pixels are ignored.

If Set Address Mode, 0x36 A[5] = 1:

Data is written continuing from the pixel location after the write range of the previous Write Memory Start, 0x2C or Write Memory Continue, 0x3C. The page register is then incremented and pixels are written to the frame buffer until the page register equals the End Page (EP) value. The page register is then reset to SP and the column register is incremented. Pixels are written to the frame buffer until the column register equals the End column (EC) value and the page register equals the EP value, or the host processor sends another command. If the number of pixels exceeds (EC – SC + 1) * (EP – SP + 1) the extra pixels are ignored.

9.31 Read Memory Continue

Command 3Eh
Parameters None

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	0	0	1	1	1	1	1	0	3E

Description
Read image data from the M7-B01 to host processor continuing after the last Read Memory Continue, 0x3E or Read Memory Start, 0x2E.

If Set Address Mode, 0x36 A[5] = 0:

Pixels are read continuing from the pixel location after the read range of the previous Read Memory Start, 0x2E or Read Memory Continue, 0x3E. The column register is then incremented and pixels are read from the frame buffer until the column register equals the End Column (EC) value. The column register is then reset to SC and the page register is incremented. Pixels are read from the frame buffer until the page register equals the End Page (EP) value and the column register equals the EC value, or the host processor sends another command.

If Set Address Mode, 0x36 A[5] = 1:

Pixels are read continuing from the pixel location after the read range of the previous Read Memory Start, 0x2E or Read Memory Continue, 0x3E. The page register is then incremented and pixels are read from the frame buffer until the page register equals the End Page (EP) value. The page register is then reset to SP and the column register is incremented. Pixels are read from the frame buffer until the column register equals the End Column (EC) value and the page register equals the EP value, or the host processor sends another command.

9.32 Set Tear Scanline

Command 44h
Parameters 2

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	0	1	0	0	0	1	0	0	44
Parameter 1	1	N_{15}	N_{14}	N_{13}	N_{12}	N_{11}	N_{10}	N_9	N_8	xx
Parameter 2	1	N_7	N_6	N_5	N_4	N_3	N_2	N_1	N_0	xx

Description
TE signal is sent from the display module to the host processor when the display device refresh reaches the provided scanline, N.

N[15:8] : High byte of the scanline, N (POR = 00000000)
N[7:0] : Low byte of the scanline, N (POR = 00000000)

Note :

Set Tear Scanline with N = 0 is equivalent to Set Tear On, 0x35 A[0] = 0.

This command takes affect on the frame following the current frame. Therefore, if the Tear Effect (TE) signal is already ON, the TE output shall continue to operate as programmed by the previous Set Tear On, 0x35 or Set Tear Scanline, 0x44 until the end of the frame.

9.33 Get Tear Scanline

Command 45h
Parameters 2

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	0	1	0	0	0	1	0	1	45
Parameter 1	1	N_{15}	N_{14}	N_{13}	N_{12}	N_{11}	N_{10}	N_9	N_8	xx
Parameter 2	1	N_7	N_6	N_5	N_4	N_3	N_2	N_1	N_0	xx

Description
Get the current scan line, N.

N[15:8] : High byte of the current scanline (POR = 00000000)
N[7:0] : Low byte of the current scanline (POR = 00000000)

9.34 Read DDB

Command A1h
Parameters 5

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	1	0	1	0	0	0	0	1	A1
Parameter 1	1	SSL_{15}	SSL_{14}	SSL_{13}	SSL_{12}	SSL_{11}	SSL_{10}	SSL_9	SSL_8	xx
Parameter 2	1	SSL_7	SSL_6	SSL_5	SSL_4	SSL_3	SSL_2	SSL_1	SSL_0	xx
Parameter 3	1	$PROD_7$	$PROD_6$	$PROD_5$	$PROD_4$	$PROD_3$	$PROD_2$	$PROD_1$	$PROD_0$	xx
Parameter 4	1	0	0	0	0	0	REV_2	REV_1	REV_0	xx
Parameter 5	1	1	1	1	1	1	1	1	1	FF

Description
Read the DDB (Device Descriptor Block) information of M7-B01.

SSL[15:8] : Supplier ID of M7-B Systech Limited high byte, always 01h (POR = 00000001)
SSL[7:0] : Supplier ID of M7-B Systech Limited low byte, always 57h (POR = 010101110)
PROD[7:0] : Product ID, always 61h (POR = 01100001)
REV[2:0] : Revision code, always 01h (POR = 001)
Exit code, always FFh (POR = 11111111)

9.35 Set LCD Mode

Command B0h
Parameters 7

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	1	0	1	1	0	0	0	0	B0
Parameter 1	1	0	0	A_5	A_4	A_3	A_2	A_1	A_0	xx
Parameter 2	1	B_7	B_6	B_5	0	0	0	0	0	xx
Parameter 3	1	0	0	0	0	0	HPS_{10}	HPS_9	HPS_8	xx
Parameter 4	1	HPS_7	HPS_6	HPS_5	HPS_4	HPS_3	HPS_2	HPS_1	HPS_0	xx
Parameter 5	1	0	0	0	0	0	VPS_{10}	VPS_9	VPS_8	xx
Parameter 6	1	VPS_7	VPS_6	VPS_5	VPS_4	VPS_3	VPS_2	VPS_1	VPS_0	xx
Parameter 7	1	0	0	G_5	G_4	G_3	G_2	G_1	G_0	xx

Description
Set the LCD panel mode (RGB TFT or TTL) and pad strength

A[5] : TFT panel data width (POR = 0)
0 18-bit
1 24-bit

A[4] : TFT color depth enhancement enable (POR = 0)
0 Disable FRC or dithering
1 Enable FRC or dithering for color depth enhancement
If the panel data width was set to 24-bit, FRC and dithering feature will be disabled automatic regardless the value of this register.

A[3] : TFT FRC enable (POR = 0)
0 TFT dithering enable
1 TFT FRC enable

A[2] : LSHIFT polarity (POR = 0)
Set the dot clock pulse polarity.

0	Data latch in rising edge
1	Data latch in falling edge

A[1] : LLINE polarity (POR = 0)
Set the horizontal sync pulse polarity.

0	Active low
1	Active high

A[0] : LFRAME polarity (POR = 0)
Set the vertical sync pulse polarity.

0	Active low
1	Active high

B[7] : LCD panel mode (POR = 0)

0	Hsync+Vsync +DE mode
1	TTL mode

B[6:5] : TFT type (POR = 01)

00, 01	TFT mode
10	Serial RGB mode
11	Serial RGB+dummy mode

HPS[10:8] : Set the horizontal panel size (POR = 010)
HPS[7:0] : Set the horizontal panel size (POR = 01111111)
Horizontal panel size = (HPS + 1) pixels

VPS[10:8] : Set the vertical panel size (POR = 001)
VPS[7:0] : Set the vertical panel size (POR = 11011111)
Vertical panel size = (VPS + 1) lines

G[5:3] : Even line RGB sequence (POR = 000)

000	RGB
001	RBG
010	GRB
011	GBR
100	BRG
101	BGR
11x	Reserved

G[2:1] : Odd line RGB sequence (POR = 000)

000	RGB
001	RBG
010	GRB
011	GBR
100	BRG
101	BGR
11x	Reserved

9.36 Get LCD Mode

Command B1h
Parameters 7

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	1	0	1	1	0	0	0	1	B1
Parameter 1	1	0	0	A_5	A_4	A_3	A_2	A_1	A_0	xx
Parameter 2	1	B_7	B_6	B_5	0	0	0	0	0	xx
Parameter 3	1	0	0	0	0	0	HPS_{10}	HPS_9	HPS_8	xx
Parameter 4	1	HPS_7	HPS_6	HPS_5	HPS_4	HPS_3	HPS_2	HPS_1	HPS_0	xx
Parameter 5	1	0	0	0	0	0	VPS_{10}	VPS_9	VPS_8	xx
Parameter 6	1	VPS_7	VPS_6	VPS_5	VPS_4	VPS_3	VPS_2	VPS_1	VPS_0	xx
Parameter 7	1	0	0	G_5	G_4	G_3	G_2	G_1	G_0	xx

Description
Get the current LCD panel mode and resolution

A[5] : TFT panel data width(POR = 0)
0 18-bit
1 24-bit

A[4] : TFT color depth enhancement enable(POR = 0)
0 Disable FRC or dithering
1 Enable FRC or dithering for color depth enhancement
If the panel data width was set to 24-bit, FRC and dithering feature will be disabled automatic regardless the value of this register.

A[3] : TFT FRC enable (POR = 0)
0 TFT dithering enable
1 TFT FRC enable

A[2] : LSHIFT polarity (POR = 0)
The dot clock pulse polarity.
0 Data latch in rising edge
1 Data latch in falling edge

A[1] : LLINE polarity (POR = 0)
The horizontal sync pulse polarity.
0 Active low
1 Active high

A[0] : LFRAME polarity (POR = 0)
The vertical sync pulse polarity.
0 Active low
1 Active high

B[7] : LCD panel mode(POR = 0)
0 Hsync+Vsync +DE mode
1 TTL mode

B[6:5] : TFT type(POR = 01)
00 Reserved
01 TFT mode
10 Serial RGB mode
11 Serial RGB+dummy mode

HPS[10:8] : The horizontal panel size (POR = 010)
HPS[7:0] : The horizontal panel size (POR = 01111111)

VPS[10:8] : The vertical panel size (POR = 001)
VPS[7:0] : The vertical panel size (POR = 11011111)

G[5:3] : Even line RGB sequence (POR = 000)

000	RGB
001	RBG
010	GRB
011	GBR
100	BRG
101	BGR
11x	Reserved

G[2:1] : Odd line RGB sequence (POR = 000)

000	RGB
001	RBG
010	GRB
011	GBR
100	BRG
101	BGR
11x	Reserved

9.37 Set Horizontal Period

Command B4h
Parameters 8

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	1	0	1	1	0	1	0	0	B4
Parameter 1	1	0	0	0	0	0	HT_{10}	HT_9	HT_8	xx
Parameter 2	1	HT_7	HT_6	HT_5	HT_4	HT_3	HT_2	HT_1	HT_0	xx
Parameter 3	1	0	0	0	0	0	HPS_{10}	HPS_9	HPS_8	xx
Parameter 4	1	HPS_7	HPS_6	HPS_5	HPS_4	HPS_3	HPS_2	HPS_1	HPS_0	xx
Parameter 5	1	0	HPW_6	HPW_5	HPW_4	HPW_3	HPW_2	HPW_1	HPW_0	xx
Parameter 6	1	0	0	0	0	0	LPS_{10}	LPS_9	LPS_8	xx
Parameter 7	1	LPS_7	LPS_6	LPS_5	LPS_4	LPS_3	LPS_2	LPS_1	LPS_0	xx
Parameter 8	1	0	0	0	0	0	0	$LPSPP_1$	$LPSPP_0$	xx

Description
Set front porch

HT[10:8] : High byte of horizontal total period (display + non-display) in pixel clock (POR = 010)
HT[7:0] : Low byte of the horizontal total period (display + non-display) in pixel clock (POR = 10101111)
Horizontal total period = (HT + 1) pixels

HPS[10:8] : High byte of the non-display period between the start of the horizontal sync (LLINE) signal and the first display data. (POR = 000)
HPS[7:0] : Low byte of the non-display period between the start of the horizontal sync (LLINE) signal and the first display data. (POR = 00100000)
For TFT : Horizontal Sync Pulse Start Position = (HPS + 1) pixels
For Serial TFT : Horizontal Sync Pulse Start Position = (HPS + 1) pixels + LPSPP subpixels

HPW[6:0] : Set the horizontal sync pulse width (LLINE) in pixel clock. (POR = 000111)
Horizontal Sync Pulse Width = (HPW + 1) pixels

LPS[10:8] : Set the horizontal sync pulse (LLINE) start location in pixel clock. (POR = 000)
LPS[7:0] : Set the horizontal sync pulse width (LLINE) in start. (POR = 00000000)
Horizontal Display Period Start Position = LPS pixels

LPSPP[1:0] : Set the horizontal sync pulse subpixel start position (POR = 00)

Timing refer to Figure 13-4.

9.38 Get Horizontal Period

Command B5h
Parameters 8

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	1	0	1	1	0	1	0	1	B5
Parameter 1	1	0	0	0	0	0	HT_{10}	HT_9	HT_8	xx
Parameter 2	1	HT_7	HT_6	HT_5	HT_4	HT_3	HT_2	HT_1	HT_0	xx
Parameter 3	1	0	0	0	0	0	HPS_{10}	HPS_9	HPS_8	xx
Parameter 4	1	HPS_7	HPS_6	HPS_5	HPS_4	HPS_3	HPS_2	HPS_1	HPS_0	xx
Parameter 5	1	0	HPW_6	HPW_5	HPW_4	HPW_3	HPW_2	HPW_1	HPW_0	xx
Parameter 6	1	0	0	0	0	0	LPS_{10}	LPS_9	LPS_8	xx
Parameter 7	1	LPS_7	LPS_6	LPS_5	LPS_4	LPS_3	LPS_2	LPS_1	LPS_0	xx
Parameter 8	1	0	0	0	0	0	0	$LPSPP_1$	$LPSPP_0$	xx

Description
Get current front porch settings

HT[10:8] : High byte of the horizontal total period (display + non-display) in pixel clock (POR = 010)
HT[7:0] : Low byte of the horizontal total period (display + non-display) in pixel clock (POR = 10101111)

HPS[10:8] : High byte of the non-display period between the start of the horizontal sync (LLINE) signal and the first display data. (POR = 000)
HPS[7:0] : Low byte of the non-display period between the start of the horizontal sync (LLINE) signal and the first display data. (POR = 00100000)

HPW[6:0] : The horizontal sync pulse width (LLINE) in pixel clock. (POR = 000111)

LPS[10:8] : High byte of the horizontal sync pulse (LLINE) start location in pixel clock. (POR = 000)
LPS[7:0] : Low byte of the horizontal sync pulse width (LLINE) in start. (POR = 00000000)

LPSPP[1:0] : The horizontal sync pulse subpixel start position (POR = 00)

9.39 Set Vertical Period

Command B6h
Parameters 7

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	1	0	1	1	0	1	1	0	B6
Parameter 1	1	0	0	0	0	0	VT_{10}	VT_9	VT_8	xx
Parameter 2	1	VT_7	VT_6	VT_5	VT_4	VT_3	VT_2	VT_1	VT_0	xx
Parameter 3	1	0	0	0	0	0	VPS_{10}	VPS_9	VPS_8	xx
Parameter 4	1	VPS_7	VPS_6	VPS_5	VPS_4	VPS_3	VPS_2	VPS_1	VPS_0	xx
Parameter 5	1	0	VPW_6	VPW_5	VPW_4	VPW_3	VPW_2	VPW_1	VPW_0	xx
Parameter 6	1	0	0	0	0	0	FPS_{10}	FPS_9	FPS_8	xx
Parameter 7	1	FPS_7	FPS_6	FPS_5	FPS_4	FPS_3	FPS_2	FPS_1	FPS_0	xx

Description
Set the vertical blanking interval between last scan line and next LFRAME pulse

VT[10:8] : High byte of the vertical total (display + non-display) period in lines (POR = 001)
VT[7:0] : Low byte of the vertical total (display + non-display) period in lines (POR = 11101111)
Vertical Total = (VT + 1) lines

VPS[10:8] : High byte the non-display period in lines between the start of the frame and the first display data in line. (POR = 000)
VPS[7:0] : The non-display period in lines between the start of the frame and the first display data in line. (POR = 00000100)
Vertical Sync Pulse Start Position = VPS lines

VPW[6:0] : Set the vertical sync pulse width (LFRAME) in lines. (POR = 000001)
Vertical Sync Pulse Width = (VPW + 1) lines

FPS[10:8] : High byte of the vertical sync pulse (LFRAME) start location in lines. (POR = 000)
FPS[7:0] : Low byte of the vertical sync pulse (LFRAME) start location in lines. (POR = 00000000)
Vertical Display Period Start Position = FPS lines

Timing refer to Figure 13-4.

9.40 Get Vertical Period

Command B7h
Parameters 7

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	1	0	1	1	0	1	1	1	B7
Parameter 1	1	0	0	0	0	0	VT_{10}	VT_9	VT_8	xx
Parameter 2	1	VT_7	VT_6	VT_5	VT_4	VT_3	VT_2	VT_1	VT_0	xx
Parameter 3	1	0	0	0	0	0	VPS_{10}	VPS_9	VPS_8	xx
Parameter 4	1	VPS_7	VPS_6	VPS_5	VPS_4	VPS_3	VPS_2	VPS_1	VPS_0	xx
Parameter 5	1	0	VPW_6	VPW_5	VPW_4	VPW_3	VPW_2	VPW_1	VPW_0	xx
Parameter 6	1	0	0	0	0	0	FPS_{10}	FPS_9	FPS_8	xx
Parameter 7	1	FPS_7	FPS_6	FPS_5	FPS_4	FPS_3	FPS_2	FPS_1	FPS_0	xx

Description
Get the vertical blanking interval between last scan line and next LFRAME pulse

VT[10:8] : High byte of the vertical total (display + non-display) period in lines (POR = 001)
VT[7:0] : Low byte of the vertical total (display + non-display) period in lines (POR = 01111111)

VPS[10:8] : High byte of the non-display period in lines between the start of the frame and the first display data in line. (POR = 000)
VPS[7:0] : Low byte of the non-display period in lines between the start of the frame and the first display data in line. (POR = 00000100)

VPW[6:0] : The vertical sync pulse width (LFRAME) in lines. (POR = 000001)

FPS[10:8] : High byte of the vertical sync pulse (LFRAME) start location in lines. (POR = 000)
FPS[7:0] : Low byte of the vertical sync pulse (LFRAME) start location in lines. (POR = 00000000)

9.41 Set GPIO Configuration

Command B8h
Parameters 2

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	1	0	1	1	1	0	0	0	B8
Parameter 1	1	A_7	A_6	A_5	A_4	A_3	A_2	A_1	A_0	xx
Parameter 2	1	0	0	0	0	0	0	0	B_0	xx

Description
Set the GPIOs configuration. If the GPIOs are not used for LCD, set the direction. Otherwise, they are toggled with LCD signals by 0xC0 – 0xCF.

A[7] : GPIO3 configuration (POR = 0)
0 GPIO3 is controlled by host
1 GPIO3 is controlled by LCDC

A[6] : GPIO2 configuration (POR = 0)
0 GPIO2 is controlled by host
1 GPIO2 is controlled by LCDC

A[5] : GPIO1 configuration (POR = 0)
0 GPIO1 is controlled by host
1 GPIO1 is controlled by LCDC

A[4] : GPIO0 configuration (POR = 0)
0 GPIO0 is controlled by host
1 GPIO0 is controlled by LCDC

A[3] : GPIO3 direction (POR = 0)
0 GPIO3 is input
1 GPIO3 is output

A[2] : GPIO3 direction (POR = 0)
0 GPIO2 is input
1 GPIO2 is output

A[1] : GPIO1 direction (POR = 0)
0 GPIO1 is input
1 GPIO1 is output

A[0] : GPIO0 direction (POR = 0)
0 GPIO0 is input
1 GPIO0 is output

B[0] : GPIO0 direction (POR = 0)
0 GPIO0 is used to control the panel power with Enter Sleep Mode 0x10 or Exit Sleep Mode 0x11.
1 GPIO0 is used as normal GPIO

9.42 Get GPIO Configuration

Command B9h
Parameters 2

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	1	0	1	1	1	0	0	1	B9
Parameter 1	1	A_7	A_6	A_5	A_4	A_3	A_2	A_1	A_0	xx
Parameter 2	1	0	0	0	0	0	0	0	B_0	xx

Description
Get the current GPIOs configuration

A[7] : GPIO3 configuration (POR = 0)
0 GPIO3 is controlled by host
1 GPIO3 is controlled by LCDC

A[6] : GPIO2 configuration (POR = 0)
0 GPIO2 is controlled by host
1 GPIO2 is controlled by LCDC

A[5] : GPIO1 configuration (POR = 0)
0 GPIO1 is controlled by host
1 GPIO1 is controlled by LCDC

A[4] : GPIO0 configuration (POR = 0)
0 GPIO0 is controlled by host
1 GPIO0 is controlled by LCDC

A[3] : GPIO3 direction (POR = 0)
0 GPIO3 is input
1 GPIO3 is output

A[2] : GPIO3 direction (POR = 0)
0 GPIO2 is input
1 GPIO2 is output

A[1] : GPIO1 direction (POR = 0)
0 GPIO1 is input
1 GPIO1 is output

A[0] : GPIO0 direction (POR = 0)
0 GPIO0 is input
1 GPIO0 is output

B[0] : GPIO0 direction (POR = 0)
0 GPIO0 is used to control the panel power
1 GPIO0 is used as normal GPIO

9.43 Set GPIO Value

Command BAh
Parameters 1

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	1	0	1	1	1	0	1	0	BA
Parameter 1	1	0	0	0	0	A_3	A_2	A_1	A_0	xx

Description
Set GPIO value for GPIO configured as output

A[3] : GPIO3 value (POR = 0)
0 GPIO3 outputs 0
1 GPIO3 outputs 1

A[2] : GPIO2 value (POR = 0)
0 GPIO2 outputs 0
1 GPIO2 outputs 1

A[1] : GPIO1 value (POR = 0)
0 GPIO1 outputs 0
1 GPIO1 outputs 1

A[0] : GPIO0 value (POR = 0)
0 GPIO0 outputs 0
1 GPIO0 outputs 1

9.44 Get GPIO Value

Command BBh
Parameters 1

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	1	0	1	1	1	0	1	1	BB
Parameter 1	1	0	0	0	0	A_3	A_2	A_1	A_0	xx

Description
Read current GPIO status. If the individual GPIO was configured as input, the value is the status of the corresponding pin. Otherwise, it is the programmed value.

A[3] : GPIO3 value (POR : depends on pad value)
0 GPIO3 is pulled low
1 GPIO3 is pulled high

A[2] : GPIO2 value (POR : depends on pad value)
0 GPIO2 is pulled low
1 GPIO2 is pulled high

A[1] : GPIO1 value (POR : depends on pad value)
0 GPIO1 is pulled low
1 GPIO1 is pulled high

A[0] : GPIO0 value (POR : depends on pad value)
0 GPIO0 is pulled low
1 GPIO0 is pulled high

9.45 Set Post Proc

Command BCh
Parameters 4

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	1	0	1	1	1	1	0	0	BC
Parameter 1	1	A_7	A_6	A_5	A_4	A_3	A_2	A_1	A_0	xx
Parameter 2	1	B_7	B_6	B_5	B_4	B_3	B_2	B_1	B_0	xx
Parameter 3	1	C_7	C_6	C_5	C_4	C_3	C_2	C_1	C_0	xx
Parameter 4	1	0	0	0	0	0	0	0	D_0	xx

Description
Set the image post processor

A[7:0] : Set the contrast value (POR = 01000000)

B[7:0] : Set the brightness value (POR = 10000000)

C[7:0] : Set the saturation value (POR = 01000000)

D[0] : Post Processor Enable (POR = 0)
0 Disable the postprocessor
1 Enable the postprocessor

9.46 Get Post Proc

Command BDh
Parameters 4

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	1	0	1	1	1	1	0	1	BD
Parameter 1	1	A_7	A_6	A_5	A_4	A_3	A_2	A_1	A_0	xx
Parameter 2	1	B_7	B_6	B_5	B_4	B_3	B_2	B_1	B_0	xx
Parameter 3	1	C_7	C_6	C_5	C_4	C_3	C_2	C_1	C_0	xx
Parameter 4	1	0	0	0	0	0	0	0	D_0	xx

Description
Get the image post processor

A[7:0] : Get the contrast value (POR = 01000000)

B[7:0] : Get the brightness value (POR = 10000000)

C[7:0] : Get the saturation value (POR = 01000000)

D[0] : Post Processor Enable (POR = 0)
0 Disable the postprocessor
1 Enable the postprocessor

9.47 Set PWM Configuration

Command BEh
Parameters 6

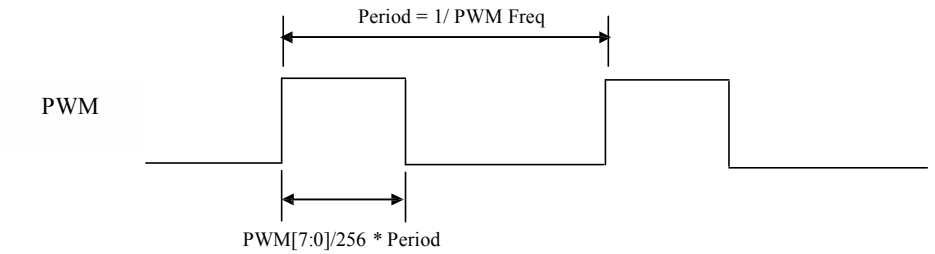
	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	1	0	1	1	1	1	1	0	BE
Parameter 1	1	$PWMF_7$	$PWMF_6$	$PWMF_5$	$PWMF_4$	$PWMF_3$	$PWMF_2$	$PWMF_1$	$PWMF_0$	xx
Parameter 2	1	PWM_7	PWM_6	PWM_5	PWM_4	PWM_3	PWM_2	PWM_1	PWM_0	xx
Parameter 3	1	0	0	0	0	C_3	0	0	C_0	xx
Parameter 4	1	D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0	xx
Parameter 5	1	E_7	E_6	E_5	E_4	E_3	E_2	E_1	E_0	xx
Parameter 6	1	0	0	0	0	F_3	F_2	F_1	F_0	xx

Description
Set the PWM configuration

PWMF[7:0] : Set the PWM frequency in system clock (POR = 00000000)
PWM signal frequency = PLL clock / (256 * PWMF[7:0]) / 256

PWM[7:0] : Set the PWM duty cycle (POR = 00000000)
PWM duty cycle = PWM[7:0] / 256
Note : PWM always 0 if PWM[7:0] = 00h

Figure 9-19: PWM signal



C[3] : PWM configuration (POR = 0)
0 PWM controlled by host
1 PWM controlled by DBC

C[0] : PWM enable (POR = 0)
0 PWM disable
1 PWM enable

D[7:0] : DBC manual brightness (POR = 00000000)
Set the brightness level
00 Dimmest
FF brightest

E[7:0] : DBC minimum brightness (POR = 00000000)
Set the minimum brightness level
00 Dimmest
FF Brightest
F[3:0] : Brightness prescaler (POR = 0000)
Set the brightness prescaler
0 Dimmest
F Brightest

9.48 Get PWM Configuration

Command BFh
Parameters 7

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	1	0	1	1	1	1	1	1	BF
Parameter 1	1	$PWMF_7$	$PWMF_6$	$PWMF_5$	$PWMF_4$	$PWMF_3$	$PWMF_2$	$PWMF_1$	$PWMF_0$	xx
Parameter 2	1	PWM_7	PWM_6	PWM_5	PWM_4	PWM_3	PWM_2	PWM_1	PWM_0	xx
Parameter 3	1	0	0	0	0	C_3	0	0	C_0	xx
Parameter 4	1	D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0	xx
Parameter 5	1	E_7	E_6	E_5	E_4	E_3	E_2	E_1	E_0	xx
Parameter 6	1	0	0	0	0	F_3	F_2	F_1	F_0	xx
Parameter 7	1	G_7	G_6	G_5	G_4	G_3	G_2	G_1	G_0	xx

Description
Get the PWM configuration

PWMF[7:0] : Get the PWM frequency in system clock (POR = 00000000)

PWM[7:0] : Get the PWM duty cycle (POR = 00000000)

C[3] : PWM configuration (POR = 0)
0 PWM controlled by host
1 PWM controlled by DBC

C[0] : PWM enable (POR = 0)
0 PWM disable
1 PWM enable

D[7:0] : DBC manual brightness (POR = 00000000)
Set the brightness level
00 Dimmest
FF brightest

When Manual Brightness Mode (0xD0 A[6]) is enabled, the final DBC duty cycle output will be multiplied by this Manual Brightness value / 255.

E[7:0] : DBC minimum brightness (POR = 00000000)
Set the minimum brightness level. DBC duty cycle output will be limited by this value. This will prevent from backlight being too dark or off.
00 Dimmest
FF Brightest

F[3:0] : Brightness prescaler (POR = 0000)
Set the brightness prescaler
0 Dimmest
F Brightest

This field is valid when Transition Effect (0xD0 A[5]) is on.

G[7:0] : Dynamic backlight duty cycle : Get the current PWM duty cycle controlled by PWM (POR = 00000000)

9.49 Set LCD Gen0

Command C0h
Parameters 7

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	1	1	0	0	0	0	0	0	C0
Parameter 1	1	A_7	0	0	0	0	0	0	0	xx
Parameter 2	1	0	0	0	0	0	$GF0_2$	$GF0_1$	$GF0_0$	xx
Parameter 3	1	$GF0_7$	$GF0_6$	$GF0_5$	$GF0_4$	$GF0_3$	$GF0_2$	$GF0_1$	$GF0_0$	xx
Parameter 4	1	0	0	0	0	0	$GR0_2$	$GR0_1$	$GR0_0$	xx
Parameter 5	1	$GR0_7$	$GR0_6$	$GR0_5$	$GR0_4$	$GR0_3$	$GR0_2$	$GR0_1$	$GR0_0$	xx
Parameter 6	1	F_7	F_6	F_5	F_4	F_3	$GP0_2$	$GP0_1$	$GP0_0$	xx
Parameter 7	1	$GP0_7$	$GP0_6$	$GP0_5$	$GP0_4$	$GP0_3$	$GP0_2$	$GP0_1$	$GP0_0$	xx

Description
Set the rise, fall, period and toggling properties of LCD signal generator 0

A[7] : Reset LCD generator 0 at every frame start
- 0 The generator 0 will not reset in the starting point of a frame
- 1 The generator 0 will reset in the starting point of a frame

GF0[10:8] : The highest 3 bits of the generator 0 falling position (POR = 000)
GF0[7:0] : The lower byte of the generator 0 falling position (POR = 00000001)

GR0[10:8] : The highest 3 bits of the generator 0 rising position (POR = 000)
GR0[7:0] : The lower byte of the generator 0 rising position (POR = 00000000)

F[7] : Force the generator 0 output to 0 in non-display period
- 0 generator 0 is normal
- 1 generator 0 output is forced to zero in non-display period

F[6:5] : Force the generator 0 output to 0 in odd or even lines
- 00 generator 0 is normal in both odd and even lines
- 01 generator 0 output is force to 0 in odd lines
- 10 generator 0 output is force to 0 in even lines
- 11 generator 0 is normal in both odd and even line

F[4:3] : Generator 0 toggle mode
- 00 Disable
- 01 Toggle by pixel clock (LSHIFT)
- 10 Toggle by Line (LLINE)
- 11 Toggle by Frame (LFRAME)

GP0[10:8] : The highest 3 bits of the generator 0 period (POR = 100)
GP0[7:0] : The lower byte of the generator 0 period (POR = 00000000)

9.50 Get LCD Gen0

Command C1h
Parameters 7

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	1	1	0	0	0	0	0	1	C1
Parameter 1	1	A_7	0	0	0	0	0	0	0	xx
Parameter 2	1	0	0	0	0	0	$GF0_2$	$GF0_1$	$GF0_0$	xx
Parameter 3	1	$GF0_7$	$GF0_6$	$GF0_5$	$GF0_4$	$GF0_3$	$GF0_2$	$GF0_1$	$GF0_0$	xx
Parameter 4	1	0	0	0	0	0	$GR0_2$	$GR0_1$	$GR0_0$	xx
Parameter 5	1	$GR0_7$	$GR0_6$	$GR0_5$	$GR0_4$	$GR0_3$	$GR0_2$	$GR0_1$	$GR0_0$	xx
Parameter 6	1	F_7	F_6	F_5	F_4	F_3	$GP0_2$	$GP0_1$	$GP0_0$	xx
Parameter 7	1	$GP0_7$	$GP0_6$	$GP0_5$	$GP0_4$	$GP0_3$	$GP0_2$	$GP0_1$	$GP0_0$	xx

Description
Get the rise, fall, period and toggling properties of LCD signal generator 0

A[7] : Reset LCD generator 0 at every frame start
- 0 The generator 0 will not reset in the starting point of a frame
- 1 The generator 0 will reset in the starting point of a frame

GF0[10:8] : The highest 3 bits of the generator 0 falling position (POR = 000)
GF0[7:0] : The lower byte of the generator 0 falling position (POR = 00000001)

GR0[10:8] : The highest 3 bits of the generator 0 rising position (POR = 000)
GR0[7:0] : The lower byte of the generator 0 rising position (POR = 00000000)

F[7] : Force the generator 0 output to 0 in non-display period
- 0 generator 0 is normal
- 1 generator 0 output is forced to zero in non-display period

F[6:5] : Force the generator 0 output to 0 in odd or even lines
- 00 generator 0 is normal in both odd and even lines
- 01 generator 0 output is force to 0 in odd lines
- 10 generator 0 output is force to 0 in even lines
- 11 generator 0 is normal in both odd and even line

F[4:3] : Generator 0 toggle mode
- 00 Disable
- 01 Toggle by pixel clock (LSHIFT)
- 10 Toggle by Line (LLINE)
- 11 Toggle by Frame (LFRAME)

GP0[10:8] : The highest 3 bits of the generator 0 period (POR = 100)
GP0[7:0] : The lower byte of the generator 0 period (POR = 00000000)

9.51 Set LCD Gen1

Command C2h
Parameters 7

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	1	1	0	0	0	0	1	0	C2
Parameter 1	1	A_7	0	0	0	0	0	0	0	xx
Parameter 2	1	0	0	0	0	0	$GF1_2$	$GF1_1$	$GF1_0$	xx
Parameter 3	1	$GF1_7$	$GF1_6$	$GF1_5$	$GF1_4$	$GF1_3$	$GF1_2$	$GF1_1$	$GF1_0$	xx
Parameter 4	1	0	0	0	0	0	$GR1_2$	$GR1_1$	$GR1_0$	xx
Parameter 5	1	$GR1_7$	$GR1_6$	$GR1_5$	$GR1_4$	$GR1_3$	$GR1_2$	$GR1_1$	$GR1_0$	xx
Parameter 6	1	F_7	F_6	F_5	F_4	F_3	$GP1_2$	$GP1_1$	$GP1_0$	xx
Parameter 7	1	$GP1_7$	$GP1_6$	$GP1_5$	$GP1_4$	$GP1_3$	$GP1_2$	$GP1_1$	$GP1_0$	xx

Description
Set the rise, fall, period and toggling properties of LCD signal generator 1

A[7] : Reset LCD generator 1 at every frame start
- 0 The generator 1 will not reset in the starting point of a frame
- 1 The generator 1 will reset in the starting point of a frame

GF1[10:8] : The highest 3 bits of the generator 1 falling position (POR = 000)
GF1[7:0] : The lower byte of the generator 1 falling position (POR = 00000001)

GR1[10:8] : The highest 3 bits of the generator 1 rising position (POR = 000)
GR1[7:0] : The lower byte of the generator 1 rising position (POR = 00000000)

F[7] : Force the generator 1 output to 0 in non-display period
- 0 generator 1 is normal
- 1 generator 1 output is forced to zero in non-display period

F[6:5] : Force the generator 1 output to 0 in odd or even lines
- 00 generator 1 is normal in both odd and even lines
- 01 generator 1 output is force to 0 in odd lines
- 10 generator 1 output is force to 0 in even lines
- 11 generator 1 is normal in both odd and even line

F[4:3] : Generator 1 toggle mode
- 00 Disable
- 01 Toggle by pixel clock (LSHIFT)
- 10 Toggle by Line (LLINE)
- 11 Toggle by Frame (LFRAME)

GP1[10:8] : The highest 3 bits of the generator 1 period (POR = 100)
GP1[7:0] : The lower byte of the generator 1 period (POR = 00000000)

9.52 Get LCD Gen1

Command C3h
Parameters 7

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	1	1	0	0	0	0	1	1	C3
Parameter 1	1	A_7	0	0	0	0	0	0	0	xx
Parameter 2	1	0	0	0	0	0	$GF1_2$	$GF1_1$	$GF1_0$	xx
Parameter 3	1	$GF1_7$	$GF1_6$	$GF1_5$	$GF1_4$	$GF1_3$	$GF1_2$	$GF1_1$	$GF1_0$	xx
Parameter 4	1	0	0	0	0	0	$GR1_2$	$GR1_1$	$GR1_0$	xx
Parameter 5	1	$GR1_7$	$GR1_6$	$GR1_5$	$GR1_4$	$GR1_3$	$GR1_2$	$GR1_1$	$GR1_0$	xx
Parameter 6	1	F_7	F_6	F_5	F_4	F_3	$GP1_2$	$GP1_1$	$GP1_0$	xx
Parameter 7	1	$GP1_7$	$GP1_6$	$GP1_5$	$GP1_4$	$GP1_3$	$GP1_2$	$GP1_1$	$GP1_0$	xx

Description
Get the rise, fall, period and toggling properties of LCD signal generator 1

A[7] : Reset LCD generator 1 at every frame start
- 0 The generator 1 will not reset in the starting point of a frame
- 1 The generator 1 will reset in the starting point of a frame

GF1[10:8] : The highest 3 bits of the generator 1 falling position (POR = 000)
GF1[7:0] : The lower byte of the generator 1 falling position (POR = 00000001)

GR1[10:8] : The highest 3 bits of the generator 1 rising position (POR = 000)
GR1[7:0] : The lower byte of the generator 1 rising position (POR = 00000000)

F[7] : Force the generator 1 output to 0 in non-display period
- 0 generator 1 is normal
- 1 generator 1 output is forced to zero in non-display period

F[6:5] : Force the generator 1 output to 0 in odd or even lines
- 00 generator 1 is normal in both odd and even lines
- 01 generator 1 output is force to 0 in odd lines
- 10 generator 1 output is force to 0 in even lines
- 11 generator 1 is normal in both odd and even line

F[4:3] : Generator 1 toggle mode
- 00 Disable
- 01 Toggle by pixel clock (LSHIFT)
- 10 Toggle by Line (LLINE)
- 11 Toggle by Frame (LFRAME)

GP1[10:8] : The highest 3 bits of the generator 1 period (POR = 100)
GP1[7:0] : The lower byte of the generator 1 period (POR = 00000000)

9.53 Set LCD Gen2

Command C4h
Parameters 7

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	1	1	0	0	0	1	0	0	C4
Parameter 1	1	A_7	0	0	0	0	0	0	0	xx
Parameter 2	1	0	0	0	0	0	$GF2_2$	$GF2_1$	$GF2_0$	xx
Parameter 3	1	$GF2_7$	$GF2_6$	$GF2_5$	$GF2_4$	$GF2_3$	$GF2_2$	$GF2_1$	$GF2_0$	xx
Parameter 4	1	0	0	0	0	0	$GR2_2$	$GR2_1$	$GR2_0$	xx
Parameter 5	1	$GR2_7$	$GR2_6$	$GR2_5$	$GR2_4$	$GR2_3$	$GR2_2$	$GR2_1$	$GR2_0$	xx
Parameter 6	1	F_7	F_6	F_5	F_4	F_3	$GP2_2$	$GP2_1$	$GP2_0$	xx
Parameter 7	1	$GP2_7$	$GP2_6$	$GP2_5$	$GP2_4$	$GP2_3$	$GP2_2$	$GP2_1$	$GP2_0$	xx

Description
Set the rise, fall, period and toggling properties of LCD signal generator 2

A[7] : Reset LCD generator 2 at every frame start
- 0 The generator 2 will not reset in the starting point of a frame
- 1 The generator 2 will reset in the starting point of a frame

GF2[10:8] : The highest 3 bits of the generator 2 falling position (POR = 000)
GF2[7:0] : The lower byte of the generator 2 falling position (POR = 00000001)

GR2[10:8] : The highest 3 bits of the generator 2 rising position (POR = 000)
GR2[7:0] : The lower byte of the generator 2 rising position (POR = 00000000)

F[7] : Force the generator 2 output to 0 in non-display period
- 0 generator 2 is normal
- 1 generator 2 output is forced to zero in non-display period

F[6:5] : Force the generator 2 output to 0 in odd or even lines
- 00 generator 2 is normal in both odd and even lines
- 01 generator 2 output is force to 0 in odd lines
- 10 generator 2 output is force to 0 in even lines
- 11 generator 2 is normal in both odd and even line

F[4:3] : Generator 2 toggle mode
- 00 Disable
- 01 Toggle by pixel clock (LSHIFT)
- 10 Toggle by Line (LLINE)
- 11 Toggle by Frame (LFRAME)

GP2[10:8] : The highest 3 bits of the generator 2 period (POR = 100)
GP2[7:0] : The lower byte of the generator 2 period (POR = 00000000)

9.54 Get LCD Gen2

Command C5h
Parameters 7

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	1	1	0	0	0	1	0	1	C5
Parameter 1	1	A_7	0	0	0	0	0	0	0	xx
Parameter 2	1	0	0	0	0	0	$GF2_2$	$GF2_1$	$GF2_0$	xx
Parameter 3	1	$GF2_7$	$GF2_6$	$GF2_5$	$GF2_4$	$GF2_3$	$GF2_2$	$GF2_1$	$GF2_0$	xx
Parameter 4	1	0	0	0	0	0	$GR2_2$	$GR2_1$	$GR2_0$	xx
Parameter 5	1	$GR2_7$	$GR2_6$	$GR2_5$	$GR2_4$	$GR2_3$	$GR2_2$	$GR2_1$	$GR2_0$	xx
Parameter 6	1	F_7	F_6	F_5	F_4	F_3	$GP2_2$	$GP2_1$	$GP2_0$	xx
Parameter 7	1	$GP2_7$	$GP2_6$	$GP2_5$	$GP2_4$	$GP2_3$	$GP2_2$	$GP2_1$	$GP2_0$	xx

Description
Get the rise, fall, period and toggling properties of LCD signal generator 2

A[7] : Reset LCD generator 2 at every frame start
- 0 The generator 2 will not reset in the starting point of a frame
- 1 The generator 2 will reset in the starting point of a frame

GF2[10:8] : The highest 3 bits of the generator 2 falling position (POR = 000)
GF2[7:0] : The lower byte of the generator 2 falling position (POR = 00000001)

GR2[10:8] : The highest 3 bits of the generator 2 rising position (POR = 000)
GR2[7:0] : The lower byte of the generator 2 rising position (POR = 00000000)

F[7] : Force the generator 2 output to 0 in non-display period
- 0 generator 2 is normal
- 1 generator 2 output is forced to zero in non-display period

F[6:5] : Force the generator 2 output to 0 in odd or even lines
- 00 generator 2 is normal in both odd and even lines
- 01 generator 2 output is force to 0 in odd lines
- 10 generator 2 output is force to 0 in even lines
- 11 generator 2 is normal in both odd and even line

F[4:3] : Generator 2 toggle mode
- 00 Disable
- 01 Toggle by pixel clock (LSHIFT)
- 10 Toggle by Line (LLINE)
- 11 Toggle by Frame (LFRAME)

GP2[10:8] : The highest 3 bits of the generator 2 period (POR = 100)
GP2[7:0] : The lower byte of the generator 2 period (POR = 00000000)

9.55 Set LCD Gen3

Command C6h
Parameters 7

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	1	1	0	0	0	1	1	0	C6
Parameter 1	1	A_7	0	0	0	0	0	0	0	xx
Parameter 2	1	0	0	0	0	0	$GF3_2$	$GF3_1$	$GF3_0$	xx
Parameter 3	1	$GF3_7$	$GF3_6$	$GF3_5$	$GF3_4$	$GF3_3$	$GF3_2$	$GF3_1$	$GF3_0$	xx
Parameter 4	1	0	0	0	0	0	$GR3_2$	$GR3_1$	$GR3_0$	xx
Parameter 5	1	$GR3_7$	$GR3_6$	$GR3_5$	$GR3_4$	$GR3_3$	$GR3_2$	$GR3_1$	$GR3_0$	xx
Parameter 6	1	F_7	F_6	F_5	F_4	F_3	$GP3_2$	$GP3_1$	$GP3_0$	xx
Parameter 7	1	$GP3_7$	$GP3_6$	$GP3_5$	$GP3_4$	$GP3_3$	$GP3_2$	$GP3_1$	$GP3_0$	xx

Description
Set the rise, fall, period and toggling properties of LCD signal generator 3

A[7] : Reset LCD generator 3 at every frame start
- 0 The generator 3 will not reset in the starting point of a frame
- 1 The generator 3 will reset in the starting point of a frame

GF3[10:8] : The highest 3 bits of the generator 3 falling position (POR = 000)
GF3[7:0] : The lower byte of the generator 3 falling position (POR = 00000001)

GR3[10:8] : The highest 3 bits of the generator 3 rising position (POR = 000)
GR3[7:0] : The lower byte of the generator 3 rising position (POR = 00000000)

F[7] : Force the generator 3 output to 0 in non-display period
- 0 generator 3 is normal
- 1 generator 3 output is forced to zero in non-display period

F[6:5] : Force the generator 3 output to 0 in odd or even lines
- 00 generator 3 is normal in both odd and even lines
- 01 generator 3 output is force to 0 in odd lines
- 10 generator 3 output is force to 0 in even lines
- 11 generator 3 is normal in both odd and even line

F[4:3] : Generator 3 toggle mode
- 00 Disable
- 01 Toggle by pixel clock (LSHIFT)
- 10 Toggle by Line (LLINE)
- 11 Toggle by Frame (LFRAME)

GP3[10:8] : The highest 3 bits of the generator 3 period (POR = 100)
GP3[7:0] : The lower byte of the generator 3 period (POR = 00000000)

9.56 Get LCD Gen3

Command C7h
Parameters 7

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	1	1	0	0	0	1	1	1	C7
Parameter 1	1	A_7	0	0	0	0	0	0	0	xx
Parameter 2	1	0	0	0	0	0	$GF3_2$	$GF3_1$	$GF3_0$	xx
Parameter 3	1	$GF3_7$	$GF3_6$	$GF3_5$	$GF3_4$	$GF3_3$	$GF3_2$	$GF3_1$	$GF3_0$	xx
Parameter 4	1	0	0	0	0	0	$GR3_2$	$GR3_1$	$GR3_0$	xx
Parameter 5	1	$GR3_7$	$GR3_6$	$GR3_5$	$GR3_4$	$GR3_3$	$GR3_2$	$GR3_1$	$GR3_0$	xx
Parameter 6	1	F_7	F_6	F_5	F_4	F_3	$GP3_2$	$GP3_1$	$GP3_0$	xx
Parameter 7	1	$GP3_7$	$GP3_6$	$GP3_5$	$GP3_4$	$GP3_3$	$GP3_2$	$GP3_1$	$GP3_0$	xx

Description
Get the rise, fall, period and toggling properties of LCD signal generator 3

A[7] : Reset LCD generator 3 at every frame start
- 0 The generator 3 will not reset in the starting point of a frame
- 1 The generator 3 will reset in the starting point of a frame

GF3[10:8] : The highest 3 bits of the generator 3 falling position (POR = 000)
GF3[7:0] : The lower byte of the generator 3 falling position (POR = 00000001)

GR3[10:8] : The highest 3 bits of the generator 3 rising position (POR = 000)
GR3[7:0] : The lower byte of the generator 3 rising position (POR = 00000000)

F[7] : Force the generator 3 output to 0 in non-display period
- 0 generator 3 is normal
- 1 generator 3 output is forced to zero in non-display period

F[6:5] : Force the generator 3 output to 0 in odd or even lines
- 00 generator 3 is normal in both odd and even lines
- 01 generator 3 output is force to 0 in odd lines
- 10 generator 3 output is force to 0 in even lines
- 11 generator 3 is normal in both odd and even line

F[4:3] : Generator 3 toggle mode
- 00 Disable
- 01 Toggle by pixel clock (LSHIFT)
- 10 Toggle by Line (LLINE)
- 11 Toggle by Frame (LFRAME)

GP3[10:8] : The highest 3 bits of the generator 3 period (POR = 100)
GP3[7:0] : The lower byte of the generator 3 period (POR = 00000000)

9.57 Set GPIO0 ROP

Command C8h
Parameters 2

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	1	1	0	0	1	0	0	0	C8
Parameter 1	1	0	A_6	A_5	0	A_3	A_2	A_1	A_0	xx
Parameter 2	1	B_7	B_6	B_5	B_4	B_3	B_2	B_1	B_0	xx

Description
Set the GPIO0 with respect to the LCD signal generators using ROP3 operation. No effect if the GPIO0 is configured as general GPIO.

A[6:5] : Source 1 for GPIO0 when controlled by LCDC (POR = 00)
- 00 Generator 0
- 01 Generator 1
- 10 Generator 2
- 11 Generator 3

A[3:2] : Source 2 for GPIO0 when controlled by LCDC (POR = 00)
- 00 Generator 0
- 01 Generator 1
- 10 Generator 2
- 11 Generator 3

A[1:0] : Source 3 for GPIO0 when controlled by LCDC (POR = 00)
- 00 Generator 0
- 01 Generator 1
- 10 Generator 2
- 11 Generator 3

B[7:0] : ROP3 operation between source 1, 2 and 3 for GPIO0 (POR = 00000000)
Please refer to the ROP3 operation table

9.58 Get GPIO0 ROP

Command C9h
Parameters 2

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	1	1	0	0	1	0	0	1	C9
Parameter 1	1	0	A_6	A_5	0	A_3	A_2	A_1	A_0	xx
Parameter 2	1	B_7	B_6	B_5	B_4	B_3	B_2	B_1	B_0	xx

Description
Get the GPIO0 properties with respect to the LCD signal generators.

A[6:5] : Source 1 for GPIO0 when controlled by LCDC (POR = 00)
- 00 Generator 0
- 01 Generator 1
- 10 Generator 2
- 11 Generator 3

A[3:2] : Source 2 for GPIO0 when controlled by LCDC (POR = 00)
- 00 Generator 0
- 01 Generator 1
- 10 Generator 2
- 11 Generator 3

A[1:0] : Source 3 for GPIO0 when controlled by LCDC (POR = 00)
- 00 Generator 0
- 01 Generator 1
- 10 Generator 2
- 11 Generator 3

B[7:0] : ROP3 operation between source 1, 2 and 3 for GPIO0 (POR = 00000000)
Please refer to the ROP3 operation table

9.59 Set GPIO1 ROP

Command CAh
Parameters 2

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	1	1	0	0	1	0	1	0	CA
Parameter 1	1	0	A_6	A_5	0	A_3	A_2	A_1	A_0	xx
Parameter 2	1	B_7	B_6	B_5	B_4	B_3	B_2	B_1	B_0	xx

Description
Set the GPIO1 with respect to the LCD signal generators using ROP3 operation. No effect if the GPIO1 is configured as general GPIO.

A[6:5] : Source 1 for GPIO1 when controlled by LCDC (POR = 00)
- 00 Generator 0
- 01 Generator 1
- 10 Generator 2
- 11 Generator 3

A[3:2] : Source 2 for GPIO1 when controlled by LCDC (POR = 00)
- 00 Generator 0
- 01 Generator 1
- 10 Generator 2
- 11 Generator 3

A[1:0] : Source 3 for GPIO1 when controlled by LCDC (POR = 00)
- 00 Generator 0
- 01 Generator 1
- 10 Generator 2
- 11 Generator 3

B[7:0] : ROP3 operation between source 1, 2 and 3 for GPIO1 (POR = 00000000)
Please refer to the ROP3 operation table

9.60 Get GPIO1 ROP

Command CBh
Parameters 2

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	1	1	0	0	1	0	1	1	CB
Parameter 1	1	0	A_6	A_5	0	A_3	A_2	A_1	A_0	xx
Parameter 2	1	B_7	B_6	B_5	B_4	B_3	B_2	B_1	B_0	xx

Description
Get the GPIO1 properties with respect to the LCD signal generators.

A[6:5] : Source 1 for GPIO1 when controlled by LCDC (POR = 00)
- 00 Generator 0
- 01 Generator 1
- 10 Generator 2
- 11 Generator 3

A[3:2] : Source 2 for GPIO1 when controlled by LCDC (POR = 00)
- 00 Generator 0
- 01 Generator 1
- 10 Generator 2
- 11 Generator 3

A[1:0] : Source 3 for GPIO1 when controlled by LCDC (POR = 00)
- 00 Generator 0
- 01 Generator 1
- 10 Generator 2
- 11 Generator 3

B[7:0] : ROP3 operation between source 1, 2 and 3 for GPIO1 (POR = 00000000)
Please refer to the ROP3 operation table

9.61 Set GPIO2 ROP

Command CCh
Parameters 2

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	1	1	0	0	1	1	0	0	CC
Parameter 1	1	0	A_6	A_5	0	A_3	A_2	A_1	A_0	xx
Parameter 2	1	B_7	B_6	B_5	B_4	B_3	B_2	B_1	B_0	xx

Description
Set the GPIO2 with respect to the LCD signal generators using ROP3 operation. No effect if the GPIO2 is configured as general GPIO.

A[6:5] : Source 1 for GPIO2 when controlled by LCDC (POR = 00)
- 00 Generator 0
- 01 Generator 1
- 10 Generator 2
- 11 Generator 3

A[3:2] : Source 2 for GPIO2 when controlled by LCDC (POR = 00)
- 00 Generator 0
- 01 Generator 1
- 10 Generator 2
- 11 Generator 3

A[1:0] : Source 3 for GPIO2 when controlled by LCDC (POR = 00)
- 00 Generator 0
- 01 Generator 1
- 10 Generator 2
- 11 Generator 3

B[7:0] : ROP3 operation between source 1, 2 and 3 for GPIO2 (POR = 00000000)
Please refer to the ROP3 operation table

9.62 Get GPIO2 ROP

Command CDh
Parameters 2

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	1	1	0	0	1	1	0	1	CD
Parameter 1	1	0	A_6	A_5	0	A_3	A_2	A_1	A_0	xx
Parameter 2	1	B_7	B_6	B_5	B_4	B_3	B_2	B_1	B_0	xx

Description
Get the GPIO2 properties with respect to the LCD signal generators.

A[6:5] : Source 1 for GPIO2 when controlled by LCDC (POR = 00)
- 00 Generator 0
- 01 Generator 1
- 10 Generator 2
- 11 Generator 3

A[3:2] : Source 2 for GPIO2 when controlled by LCDC (POR = 00)
- 00 Generator 0
- 01 Generator 1
- 10 Generator 2
- 11 Generator 3

A[1:0] : Source 3 for GPIO2 when controlled by LCDC (POR = 00)
- 00 Generator 0
- 01 Generator 1
- 10 Generator 2
- 11 Generator 3

B[7:0] : ROP3 operation between source 1, 2 and 3 for GPIO2 (POR = 00000000)
Please refer to the ROP3 operation table

9.63 Set GPIO3 ROP

Command CEh
Parameters 2

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	1	1	0	0	1	1	1	0	CE
Parameter 1	1	0	A_6	A_5	0	A_3	A_2	A_1	A_0	xx
Parameter 2	1	B_7	B_6	B_5	B_4	B_3	B_2	B_1	B_0	xx

Description
Set the GPIO3 with respect to the LCD signal generators using ROP3 operation. No effect if the GPIO3 is configured as general GPIO.

A[6:5] : Source 1 for GPIO3 when controlled by LCDC (POR = 00)
- 00 Generator 0
- 01 Generator 1
- 10 Generator 2
- 11 Generator 3

A[3:2] : Source 2 for GPIO3 when controlled by LCDC (POR = 00)
- 00 Generator 0
- 01 Generator 1
- 10 Generator 2
- 11 Generator 3

A[1:0] : Source 3 for GPIO3 when controlled by LCDC (POR = 00)
- 00 Generator 0
- 01 Generator 1
- 10 Generator 2
- 11 Generator 3

B[7:0] : ROP3 operation between source 1, 2 and 3 for GPIO3 (POR = 00000000)
Please refer to the ROP3 operation table

9.64 Get GPIO3 ROP

Command CFh
Parameters 2

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	1	1	0	0	1	1	1	1	CF
Parameter 1	1	0	A_6	A_5	0	A_3	A_2	A_1	A_0	xx
Parameter 2	1	B_7	B_6	B_5	B_4	B_3	B_2	B_1	B_0	xx

Description
Get the GPIO3 properties with respect to the LCD signal generators.

A[6:5] : Source 1 for GPIO3 when controlled by LCDC (POR = 00)
- 00 Generator 0
- 01 Generator 1
- 10 Generator 2
- 11 Generator 3

A[3:2] : Source 2 for GPIO3 when controlled by LCDC (POR = 00)
- 00 Generator 0
- 01 Generator 1
- 10 Generator 2
- 11 Generator 3

A[1:0] : Source 3 for GPIO3 when controlled by LCDC (POR = 00)
- 00 Generator 0
- 01 Generator 1
- 10 Generator 2
- 11 Generator 3

B[7:0] : ROP3 operation between source 1, 2 and 3 for GPIO3 (POR = 00000000)
Please refer to the ROP3 operation table

9.65 Set DBC Configuration

Command D0h
Parameters 1

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	1	1	0	1	0	0	0	0	D0
Parameter 1	1	0	A_6	A_5	0	A_3	A_2	0	A_0	xx

Description
Set the Dynamic Backlight Control configuration.

A[6] : DBC Manual Brightness enable (POR = 1)
- 0 Enable
- 1 Disable

A[5] : Transition effect (POR = 0)
- 0 Transition effect disable
- 1 Transition effect enable

Transition effect is used to remove visible backlight flickering. If rapid brightness change is required, it is recommended to enable this bit.

A[3:2] : Energy saving selection for DBC (POR = 00)
- 00 DBC is disable
- 01 Conservative mode
- 10 Normal mode
- 11 Aggressive mode

A[0] : Master enable of DBC (POR = 0)
- 0 DBC disable
- 1 DBC enable

The hardware pin, PWM is the output signal from M7-B01 to the system backlight driver. So it should configure PWM module before enable DBC.

WRITE COMMAND "0xBE"
WRITE DATA "0x0E" (set PWM frequency)
WRITE DATA "0xFF" (dummy value if DBC is used)
WRITE DATA "0x09" (enable PWM controlled by DBC)
WRITE DATA "0xFF"
WRITE DATA "0x00"
WRITE DATA "0x00"

WRITE COMMAND "0xD4" (Define the threshold value)
WRITE DATA …..

WRITE COMMAND "0xD0"
WRITE DATA "0x0D" (Enable DBC with Aggressive mode)

9.66 Get DBC Configuration

Command D1h
Parameters 1

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	1	1	0	1	0	0	0	1	D1
Parameter 1	1	0	A_6	A_5	0	A_3	A_2	1	A_0	xx

Description
Get the current dynamic back light configuration.

A[6] : DBC Manual Brightness enable (POR = 1)
0 Enable
1 Disable

A[5] : Transition effect (POR = 0)
0 Transition effect disable
1 Transition effect enable

A[3:2] : Energy saving selection for DBC (POR = 00)
00 DBC is disable
01 Conservative mode
10 Normal mode
11 Aggressive mode

A[0] : Master enable DBC (POR = 0)
0 DBC disable
1 DBC enable

9.67 Set DBC Threshold

Command D4h
Parameters 9

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	1	1	0	1	0	1	0	0	D4
Parameter 1	1	0	0	0	0	0	0	0	DBC_TH1_{16}	xx
Parameter 2	1	DBC_TH1_{15}	DBC_TH1_{14}	DBC_TH1_{13}	DBC_TH1_{12}	DBC_TH1_{11}	DBC_TH1_{10}	DBC_TH1_{9}	DBC_TH1_{8}	xx
Parameter 3	1	DBC_TH1_{7}	DBC_TH1_{6}	DBC_TH1_{5}	DBC_TH1_{4}	DBC_TH1_{3}	DBC_TH1_{2}	DBC_TH1_{1}	DBC_TH1_{0}	xx
Parameter 4	1	0	0	0	0	0	0	0	DBC_TH2_{16}	xx
Parameter 5	1	DBC_TH2_{15}	DBC_TH2_{14}	DBC_TH2_{13}	DBC_TH2_{12}	DBC_TH2_{11}	DBC_TH2_{10}	DBC_TH2_{9}	DBC_TH2_{8}	xx
Parameter 6	1	DBC_TH2_{7}	DBC_TH2_{6}	DBC_TH2_{5}	DBC_TH2_{4}	DBC_TH2_{3}	DBC_TH2_{2}	DBC_TH2_{1}	DBC_TH2_{0}	xx
Parameter 7	1	0	0	0	0	0	0	0	DBC_TH3_{16}	xx
Parameter 8	1	DBC_TH3_{15}	DBC_TH3_{14}	DBC_TH3_{13}	DBC_TH3_{12}	DBC_TH3_{11}	DBC_TH3_{10}	DBC_TH3_{9}	DBC_TH3_{8}	xx
Parameter 9	1	DBC_TH3_{7}	DBC_TH3_{6}	DBC_TH3_{5}	DBC_TH3_{4}	DBC_TH3_{3}	DBC_TH3_{2}	DBC_TH3_{1}	DBC_TH3_{0}	xx

Description
Set the threshold for each level of power saving.

DBC_TH1[16] : High byte of the threshold setting for the Conservative mode of DBC. (POR = 0)
DBC_TH1[15:8] : 2nd byte of the threshold setting for the Conservative mode of DBC. (POR = 00000000)
DBC_TH1[7:0] : Low byte of the threshold setting for the Conservative mode of DBC. (POR = 00000000)

TH1 = display width * display height * 3 * 0.1 /16

DBC_TH2[16] : High byte of the threshold setting for the Normal mode of DBC. (POR = 0)
DBC_TH2[15:8] : 2nd byte of the threshold setting for the Normal mode of DBC. (POR = 00000000)
DBC_TH2[7:0] : Low byte of the threshold setting for the Normal mode of DBC. (POR = 00000000)

TH2 = display width * display height * 3 * 0.25 /16

DBC_TH3[16] : High byte of the threshold setting for the Aggressive mode of DBC. (POR = 0)
DBC_TH3[15:8] : 2nd byte of the threshold setting for the Aggressive mode of DBC. (POR = 00000000)
DBC_TH3[7:0] : Low byte of the threshold setting for the Aggressive mode of DBC. (POR = 00000000)

TH3 = display width * display height * 3 * 0.6 /16

9.68 Get DBC Threshold

Command D5h
Parameters 9

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	1	1	0	1	0	1	0	1	D5
Parameter 1	1	0	0	0	0	0	0	0	DBC_TH1_{16}	xx
Parameter 2	1	DBC_TH1_{15}	DBC_TH1_{14}	DBC_TH1_{13}	DBC_TH1_{12}	DBC_TH1_{11}	DBC_TH1_{10}	DBC_TH1_{9}	DBC_TH1_{8}	xx
Parameter 3	1	DBC_TH1_{7}	DBC_TH1_{6}	DBC_TH1_{5}	DBC_TH1_{4}	DBC_TH1_{3}	DBC_TH1_{2}	DBC_TH1_{1}	DBC_TH1_{0}	xx
Parameter 4	1	0	0	0	0	0	0	0	DBC_TH2_{16}	xx
Parameter 5	1	DBC_TH2_{15}	DBC_TH2_{14}	DBC_TH2_{13}	DBC_TH2_{12}	DBC_TH2_{11}	DBC_TH2_{10}	DBC_TH2_{9}	DBC_TH2_{8}	xx
Parameter 6	1	DBC_TH2_{7}	DBC_TH2_{6}	DBC_TH2_{5}	DBC_TH2_{4}	DBC_TH2_{3}	DBC_TH2_{2}	DBC_TH2_{1}	DBC_TH2_{0}	xx
Parameter 7	1	0	0	0	0	0	0	0	DBC_TH3_{16}	xx
Parameter 8	1	DBC_TH3_{15}	DBC_TH3_{14}	DBC_TH3_{13}	DBC_TH3_{12}	DBC_TH3_{11}	DBC_TH3_{10}	DBC_TH3_{9}	DBC_TH3_{8}	xx
Parameter 9	1	DBC_TH3_{7}	DBC_TH3_{6}	DBC_TH3_{5}	DBC_TH3_{4}	DBC_TH3_{3}	DBC_TH3_{2}	DBC_TH3_{1}	DBC_TH3_{0}	xx

Description
Get the threshold for each level of power saving.

DBC_TH1[16] : High byte of the threshold setting for the Conservative mode of DBC. (POR = 0)
DBC_TH1[15:8] : 2nd byte of the threshold setting for the Conservative mode of DBC. (POR = 00000000)
DBC_TH1[7:0] : Low byte of the threshold setting for the Conservative mode of DBC. (POR = 00000000)

DBC_TH2[16] : High byte of the threshold setting for the Normal mode of DBC. (POR = 0)
DBC_TH2[15:8] : 2nd byte of the threshold setting for the Normal mode of DBC. (POR = 00000000)
DBC_TH2[7:0] : Low byte of the threshold setting for the Normal mode of DBC. (POR = 00000000)

DBC_TH3[16] : High byte of the threshold setting for the Aggressive mode of DBC. (POR = 0)
DBC_TH3[15:8] : 2nd byte of the threshold setting for the Aggressive mode of DBC. (POR = 00000000)
DBC_TH3[7:0] : Low byte of the threshold setting for the Aggressive mode of DBC. (POR = 00000000)

9.69 Set PLL

Command E0h
Parameters 1

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	1	1	1	0	0	0	0	0	E0
Parameter 1	1	0	0	0	0	0	0	A_1	A_0	xx

Description
Start the PLL. Before the start, the system was operated with the crystal oscillator or clock input.

A[1] : Lock PLL (POR = 0)
After PLL enabled for 100us, can start to lock PLL
0 Use reference clock as system clock
1 Use PLL output as system clock

A[0] : Enable PLL (POR = 0)
0 Disable PLL
1 Enable PLL

M7-B01 needed to switch to PLL output as system clock after PLL is locked. The following is the program sequence.

WRITE COMMAND “0xE0”
WRITE DATA “0x01”
Wait 100us to let the PLL stable
WRITE DATA “0x03”

* Note : M7-B01 is operating under reference clock before PLL is locked, registers cannot be set faster than half of the reference clock frequency. For instance, M7-B01 with a 10MHz reference clock is not allowed to be programmed higher than 5M words/s.

9.70 Set PLL MN

Command E2h
Parameters 3

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	1	1	1	0	0	0	1	0	E2
Parameter 1	1	N_7	N_6	N_5	N_4	N_3	N_2	N_1	N_0	xx
Parameter 2	1	0	0	0	0	M_3	M_2	M_1	M_0	xx
Parameter 3	1	0	0	0	0	0	C_2	0	0	xx

Description
Set the MN of PLL
N[7:0] : Multiplier (N) of PLL. (POR = 00101101)

M[3:0] : Divider (M) of PLL. (POR = 0011)

C[2] : Effectuate MN value (POR = 0)
0 Ignore the multiplier (N) and divider (M) values in A[7:0] and B[7:0]
1 Effectuate the multiplier and divider value

VCO = Reference input clock x N
PLL frequency = VCO / M

*** Note : 250MHz < VCO < 800MHz**

For a 10MHz reference clock to obtain 115MHz PLL frequency, user cannot program N = 23 and M = 2. The closet setting in this situation is setting N=34 and M=3, where 10 x 34 / 3 = 113.33MHz.

WRITE COMMAND “0xE2” WRITE
DATA “0x21” (N=34)
WRITE DATA “0x02” (M=3)
WRITE DATA “0x54” (Dummy Byte)

9.71 Get PLL MN

Command E3h
Parameters 3

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	1	1	1	0	0	0	1	1	E3
Parameter 1	1	N_7	N_6	N_5	N_4	N_3	N_2	N_1	N_0	xx
Parameter 2	1	0	0	0	0	M_3	M_2	M_1	M_0	xx
Parameter 3	1	0	0	0	0	0	C_2	0	0	xx

Description
Get the MN setting of PLL

N[7:0] : Multiplier (N) of PLL. (POR = 00101101)

M[3:0] : Divider (M) of PLL. (POR = 0011)

C[2] : Effectuate MN value (POR = 0)
0 Ignore the multiplier (N) and divider (M) values in A[7:0] and B[7:0]
1 Effectuate the multiplier and divider value

9.72 Get PLL Status

Command E4h
Parameters 1

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	1	1	1	0	0	1	0	0	E4
Parameter 1	1	0	0	0	0	0	A_2	0	0	xx

Description
Get the PLL status
A[2] : PLL Lock
0 Not locked
1 Locked

9.73 Set Deep Sleep

Command E5h
Parameters None

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	1	1	1	0	0	1	0	1	E5

Description
Set deep sleep mode. PLL would be stopped.

It needs to issue 2 dummy read to exit Deep Sleep mode.

9.74 Set LSHIFT Frequency

Command E6h
Parameters 3

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	1	1	1	0	0	1	1	0	E6
Parameter 1	1	0	0	0	0	$LCDC_FPR_{19}$	$LCDC_FPR_{18}$	$LCDC_FPR_{17}$	$LCDC_FPR_{16}$	xx
Parameter 2	1	$LCDC_FPR_{15}$	$LCDC_FPR_{14}$	$LCDC_FPR_{13}$	$LCDC_FPR_{12}$	$LCDC_FPR_{11}$	$LCDC_FPR_{10}$	$LCDC_FPR_{9}$	$LCDC_FPR_{8}$	xx
Parameter 3	1	$LCDC_FPR_{7}$	$LCDC_FPR_{6}$	$LCDC_FPR_{5}$	$LCDC_FPR_{4}$	$LCDC_FPR_{3}$	$LCDC_FPR_{2}$	$LCDC_FPR_{1}$	$LCDC_FPR_{0}$	xx

Description
Set the LSHIFT (pixel clock) frequency

LCDC_FPR[19:16] : The highest 4 bits for the pixel clock frequency settings. (POR = 0111)
LCDC_FPR[15:8] : The higher byte for the pixel clock frequency settings. (POR = 11111111)
LCDC_FPR[7:0] : The low byte for the pixel clock frequency settings. (POR = 11111111)

Configure the pixel clock to PLL freq x ((LCDC_FPR + 1) / 2^{20})

To obtain PCLK = 5.3MHz with PLL Frequency = 120MHz,
5.3MHz = 120MHz * LCDC_FPR / 2^{20}
LCDC_FPR = 46312

WRITE COMMAND “0xE6”
WRITE DATA “0x00” (LCDC_FPR = 46312)
WRITE DATA “0xB4”
WRITE DATA “0xE7”

9.75 Get LSHIFT Frequency

Command E7h
Parameters 3

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	1	1	1	0	0	1	1	1	E7
Parameter 1	1	0	0	0	0	$LCDC_FPR_{19}$	$LCDC_FPR_{18}$	$LCDC_FPR_{17}$	$LCDC_FPR_{16}$	xx
Parameter 2	1	$LCDC_FPR_{15}$	$LCDC_FPR_{14}$	$LCDC_FPR_{13}$	$LCDC_FPR_{12}$	$LCDC_FPR_{11}$	$LCDC_FPR_{10}$	$LCDC_FPR_{9}$	$LCDC_FPR_{8}$	xx
Parameter 3	1	$LCDC_FPR_{7}$	$LCDC_FPR_{6}$	$LCDC_FPR_{5}$	$LCDC_FPR_{4}$	$LCDC_FPR_{3}$	$LCDC_FPR_{2}$	$LCDC_FPR_{1}$	$LCDC_FPR_{0}$	xx

Description
Get the current LSHIFT (pixel clock) frequency setting

LCDC_FPR[19:16] : The highest 4 bits for the pixel clock frequency settings. (POR = 0111)
LCDC_FPR[15:8] : The higher byte for the pixel clock frequency settings. (POR = 11111111)
LCDC_FPR[7:0] : The low byte for the pixel clock frequency settings. (POR = 11111111)

9.76 Set Pixel Data Interface

Command F0h
Parameters 1

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	1	1	1	1	0	0	0	0	F0
Parameter 1	1	0	0	0	0	0	A_2	A_1	A_0	xx

Description
Set the pixel data format to 8-bit / 9-bit / 12-bit / 16-bit / 16-bit(565) / 18-bit / 24-bit in the parallel host processor interface

A[2:0] : Pixel Data Interface Format (POR = 101)
- 000 8-bit
- 001 12-bit
- 010 16-bit packed
- 011 16-bit (565 format)
- 100 18-bit
- 101 24-bit
- 110 9-bit
- Others Reserved

9.77 Get Pixel Data Interface

Command F1h
Parameters 1

	D/C	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Command	0	1	1	1	1	0	0	0	1	F1
Parameter 1	1	0	0	0	0	0	A_2	A_1	A_0	xx

Description
Get the current pixel data format settings in the parallel host processor interface.

A[2:0] : Pixel Data Interface Format (POR = 101)
- 000 8-bit
- 001 12-bit
- 010 16-bit packed
- 011 16-bit (565 format)
- 100 18-bit
- 101 24-bit
- 110 9-bit
- Others Reserved

10 MAXIMUM RATINGS

Table 10-1: Maximum Ratings (Voltage Referenced to V_{SS})

Symbol	Parameter	Value	Unit
V_{DDD}	Digital Core power supply	-0.5 to 1.8	V
V_{DDPLL}	PLL power supply	-0.5 to 1.8	V
V_{DDLCD}	LCD Interface power supply	-0.5 to 4.6	V
V_{DDIO}	I/O power supply	-0.5 to 4.6	V
V_{IN}	Input Voltage	-0.5 to 4.6	V
V_{OUT}	Output Voltage	-0.5 to 4.6	V
T_{SOL}	Solder Temperature / Time	225 for 40 sec max at solder ball	^oC
T_{STG}	Storage temperature	-45 to 125	^oC

Maximum ratings are those values beyond which damages to the device may occur. Functional operation should be restricted to the limits in the Electrical Characteristics tables or Pin Description section

This device contains circuitry to protect the inputs against damage due to high static voltages or electric fields; however, it is advised that normal precautions be taken to avoid application of any voltage higher than maximum rated voltages to this high impedance circuit. For proper operation it is recommended that V_{IN} and V_{OUT} be constrained to the range $V_{SS} < (V_{IN}$ or $V_{OUT}) < V_{DDIO}$. Reliability of operation is enhanced if unused input is connected to an appropriate logic voltage level (e.g., either V_{SS} or V_{DDIO}). Unused outputs must be left open. This device may be light sensitive. Caution should be taken to avoid exposure of this device to any light source during normal operation. This device is not radiation protected.

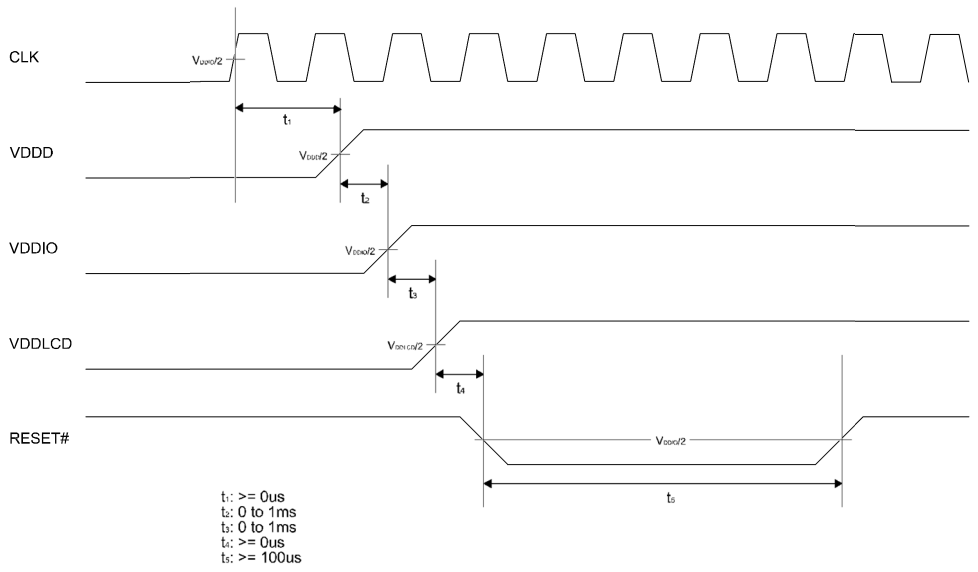
11 RECOMMENDED OPERATING CONDITIONS

Table 11-1: Recommended Operating Condition

Symbol	Parameter	Min	Typ	Max	Unit
V_{DDD}	Digital Core power supply	1.08	1.2	1.32	V
V_{DDPLL}	PLL power supply	1.08	1.2	1.32	V
V_{DDLCD}	LCD Interface power supply	1.65	3.3	3.6	V
V_{DDIO}	I/O power supply	1.65	3.3	3.6	V
T_A	Operating temperature	-30	25	85	^oC

11.1 Power-up sequence

Figure 11-1: Power-up Sequence



Note

Clock reference is only applicable when CLK is used.

12 DC CHARACTERISTICS

Conditions:

Voltage referenced to V_{SS}
V_{DDD}, V_{DDPLL} = 1.2V
V_{DDIO}, V_{DDLCD} = 3.3V
T_A = 25°C

Table 12-1 : DC Characteristics

Symbol	Parameter	Test Condition	Min	Typ	Max	Unit
PSTY	Quiescent Power			300		uW
IIZ	Input leakage current		-1		1	uA
IOZ	Output leakage current		-1		1	uA
VOH	Output high voltage		$0.8V_{DDIO}$			V
VOL	Output low voltage				$0.2V_{DDIO}$	V
VIH	Input high voltage		$0.8V_{DDIO}$		V_{DDIO} + 0.5	V
VIL	Input low voltage				$0.2V_{DDIO}$	V

13 AC CHARACTERISTICS

Conditions:

Voltage referenced to V_{SS}
V_{DDD}, V_{DDPLL} = 1.2V
V_{DDIO}, V_{DDLCD} = 3.3V
T_A = 25°C
C_L = 50pF (Bus/CPU Interface)
C_L = 0pF (LCD Panel Interface)

13.1 Clock Timing

Table 13-1 : Clock Input Requirements for CLK (PLL-bypass)

Symbol	Parameter	Min	Max	Units
F_{CLK}	Input Clock Frequency (CLK)		120	MHz
T_{CLK}	Input Clock period (CLK)	$1/f_{CLK}$		ns

Table 13-2 : Clock Input Requirements for CLK (Using PLL)

Symbol	Parameter	Min	Max	Units
F_{CLK}	Input Clock Frequency (CLK)	2.5	50	MHz
T_{CLK}	Input Clock period (CLK)	$1/f_{CLK}$		ns

Table 13-3 : Clock Input Requirements for crystal oscillator XTAL (Using PLL)

Symbol	Parameter	Min	Max	Units
F_{XTAL}	Input Clock Frequency	2.5	10	MHz
T_{XTAL}	Input Clock period	$1/f_{XTAL}$		ns

13.2 MCU Interface Timing

13.2.1 6800 Mode

Table 13-4: 6800 Mode Timing

Symbol	Parameter	Min	Typ	Max	Unit
t_{cyc}	Reference Clock Cycle Time	9	-	-	ns
t_{PWCSL}	Pulse width CS# or E low	1	-	-	t_{CYC}
t_{PWCSH}	Pulse width CS# or E high	1	-	-	t_{CYC}
t_{FDRD}	First Data Read Delay	5	-	-	t_{CYC}
t_{AS}	Address Setup Time	1	-	-	ns
t_{AH}	Address Hold Time	1	-	-	ns
t_{DSW}	Data Setup Time	4	-	-	ns
t_{DHW}	Data Hold Time	1	-	-	ns
t_{DSR}	Data Access Time	-	-	5	ns
t_{DHR}	Output Hold time	1	-	-	ns

Figure 13-1: 6800 Mode Timing Diagram (Use CS# as Clock)

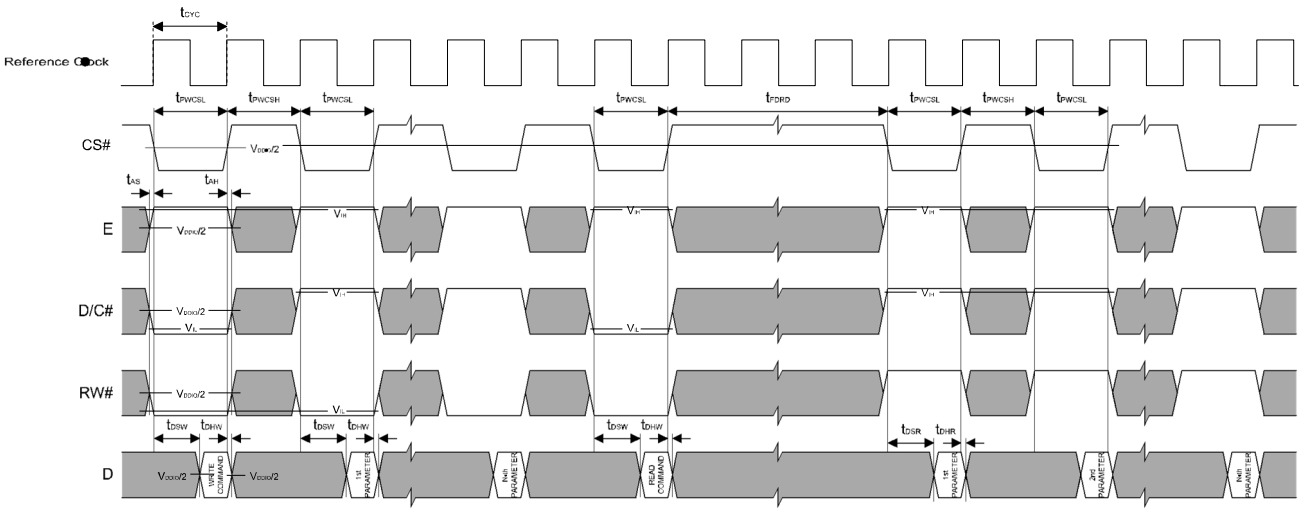
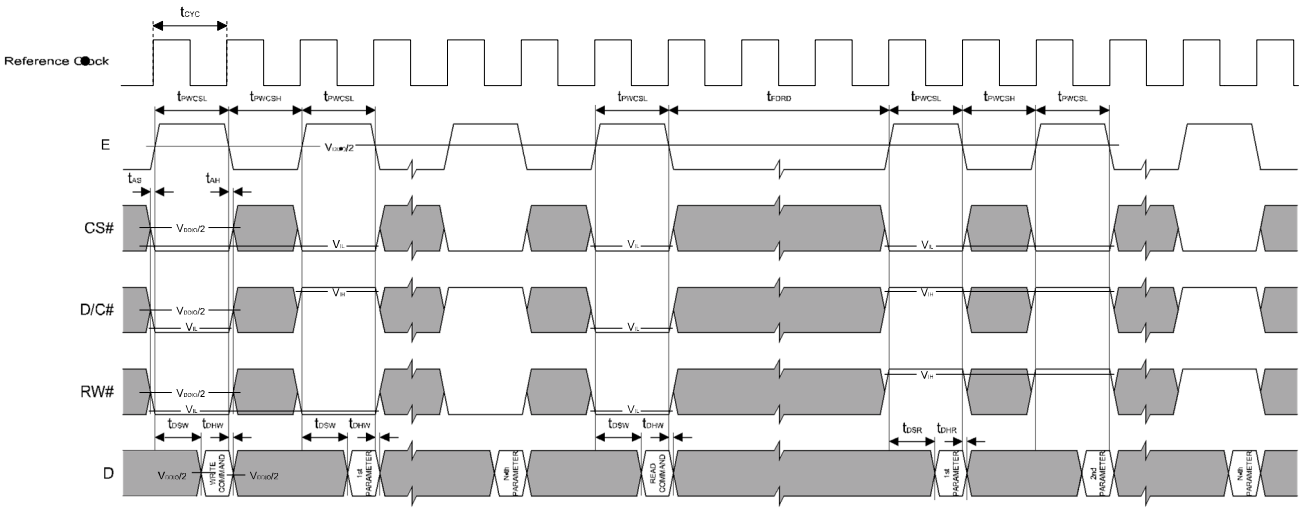


Figure 13-2: 6800 Mode Timing Diagram (Use E as Clock)

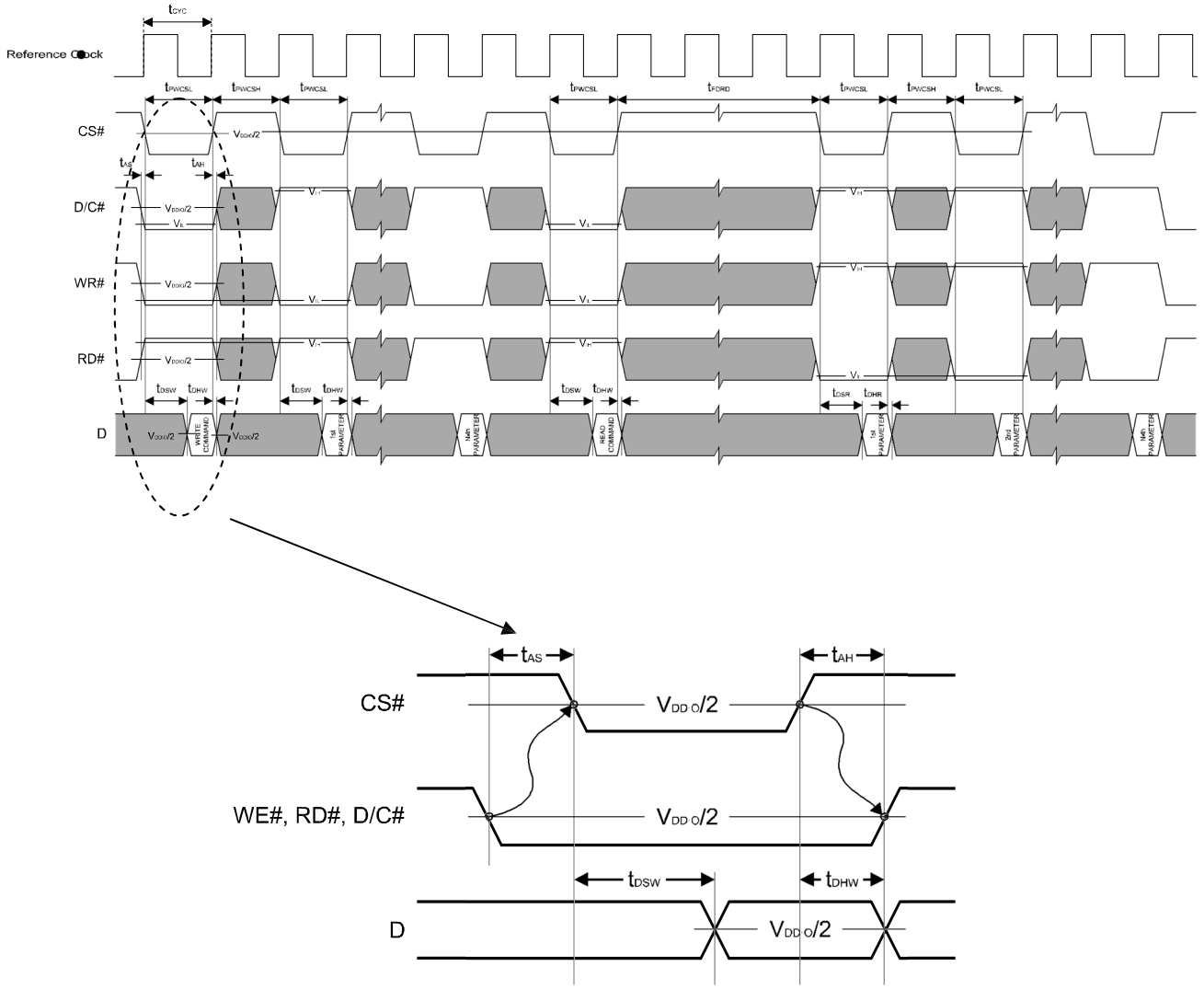


13.2.2 8080 Mode Write Cycle

Table 13-5: 8080 Mode Timing

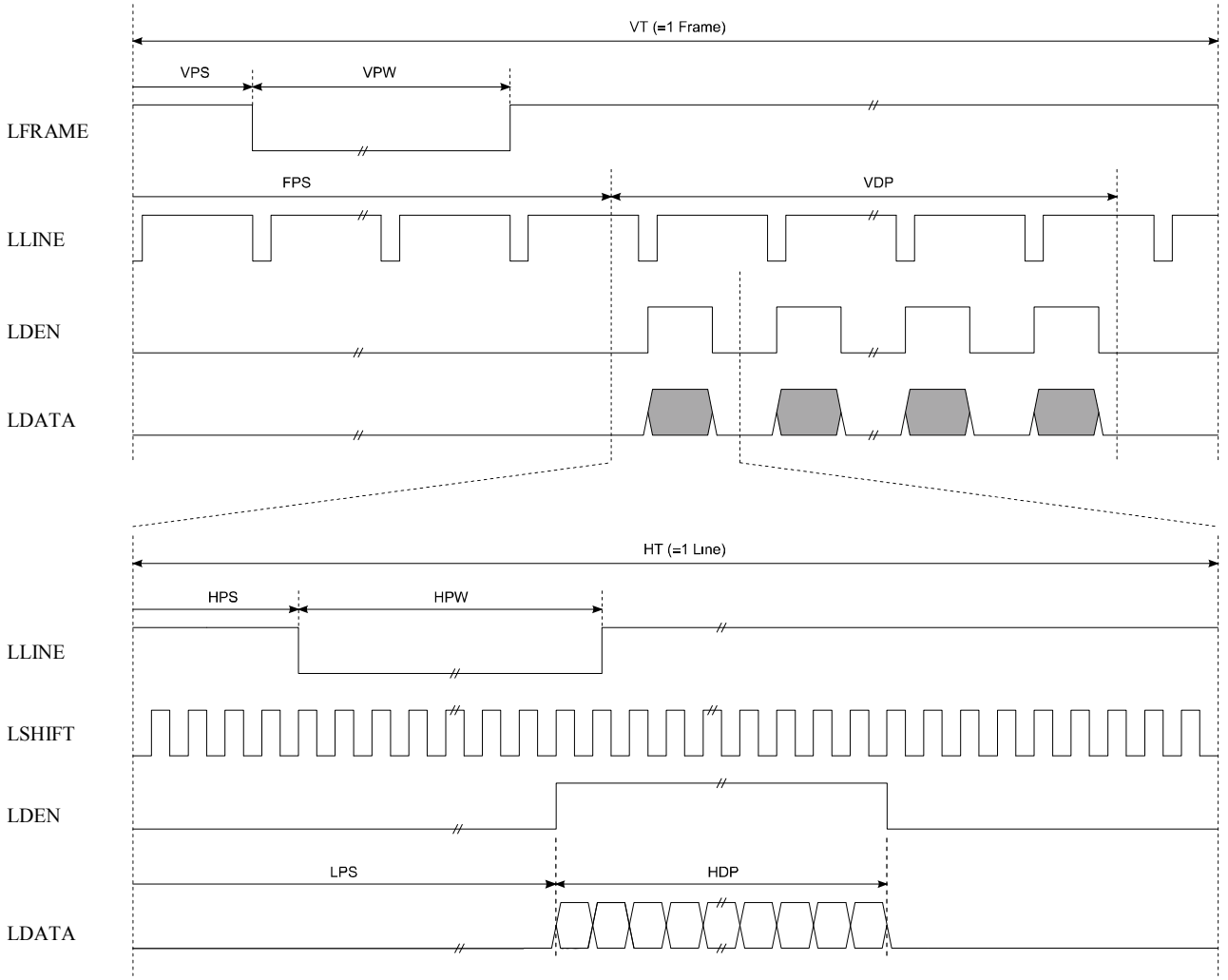
Symbol	Parameter	Min	Typ	Max	Unit
t_{cyc}	Reference Clock Cycle Time	9	-	-	ns
t_{PWCSL}	Pulse width CS# low	1	-	-	t_{CYC}
t_{PWCSH}	Pulse width CS# high	1	-	-	t_{CYC}
t_{FDRD}	First Read Data Delay	5	-	-	t_{CYC}
t_{AS}	Address Setup Time	1	-	-	ns
t_{AH}	Address Hold Time	1	-	-	ns
t_{DSW}	Data Setup Time	4	-	-	ns
t_{DHW}	Data Hold Time	1	-	-	ns
t_{DSR}	Data Access Time	-	-	5	ns
t_{DHR}	Output Hold time	1	-	-	ns

Figure 13-3: 8080 Mode Timing Diagram



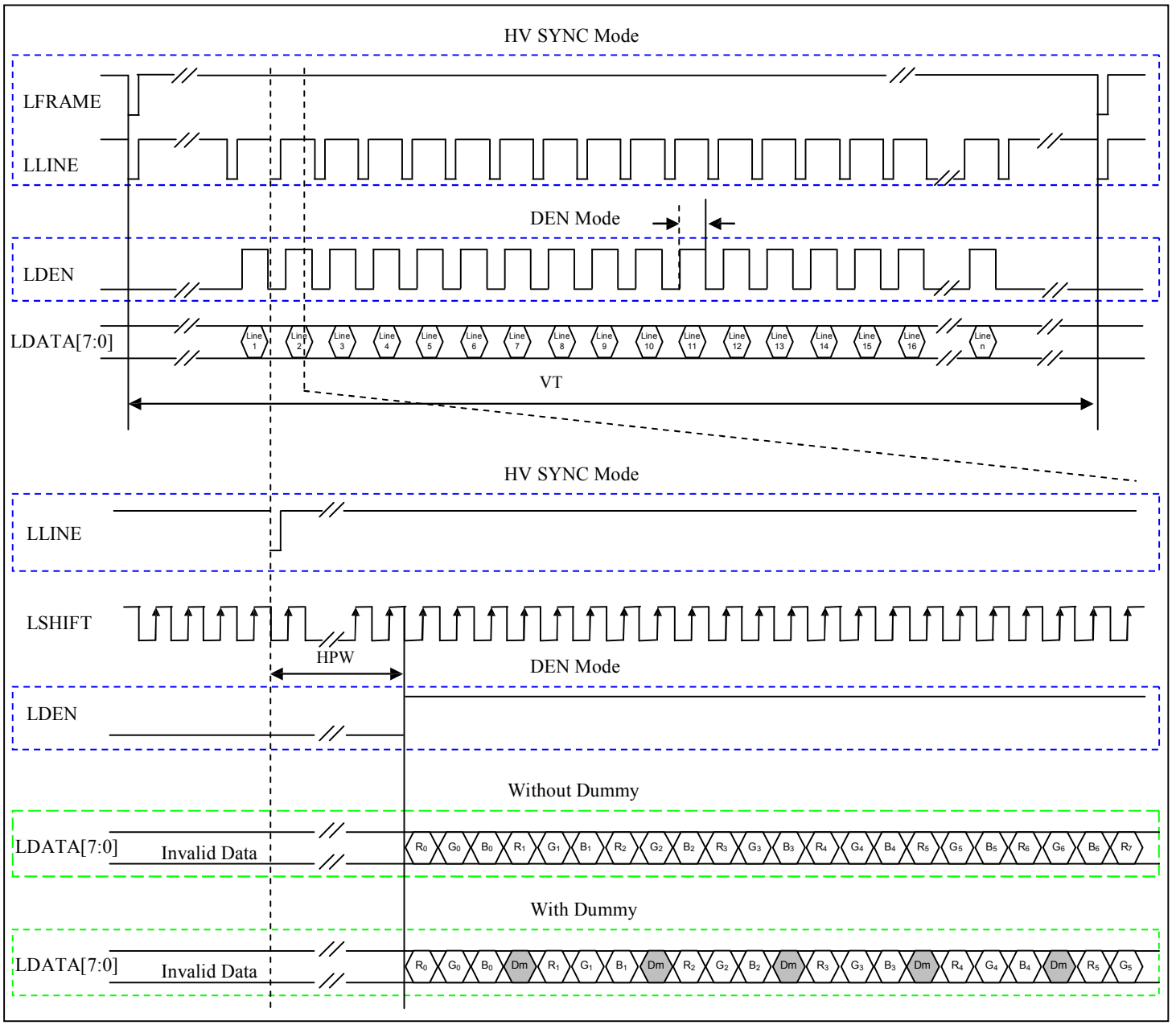
13.3 LCD Interface Timing

Figure 13-4: Generic TFT Panel Timing



13.4 8-bit Serial Interface

Figure 13-5: 8-bit Serial Interface Timing



14 APPLICATION EXAMPLE

Figure 14-1 : Application circuit for M7-B01 (With Direct clock input)

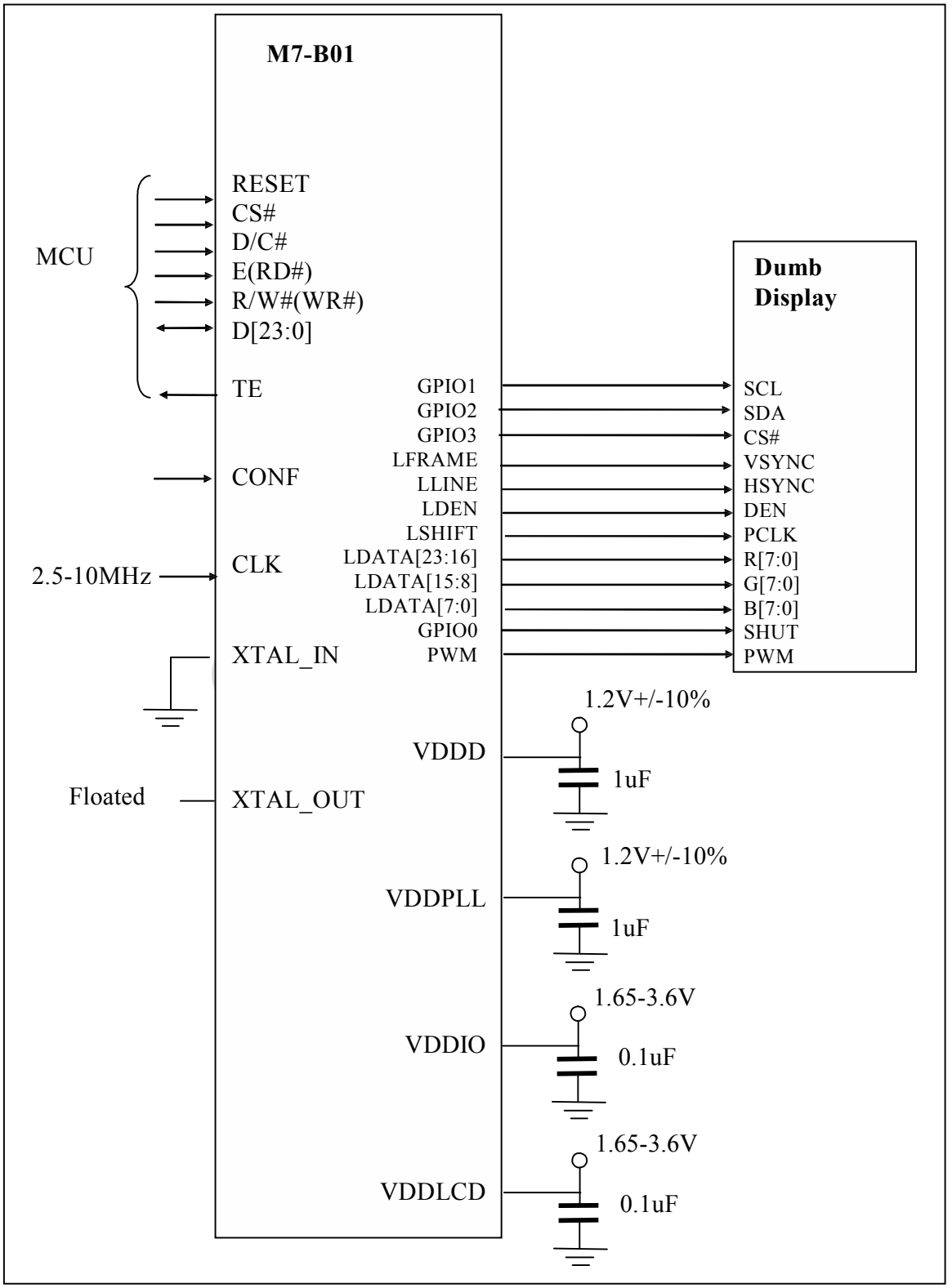
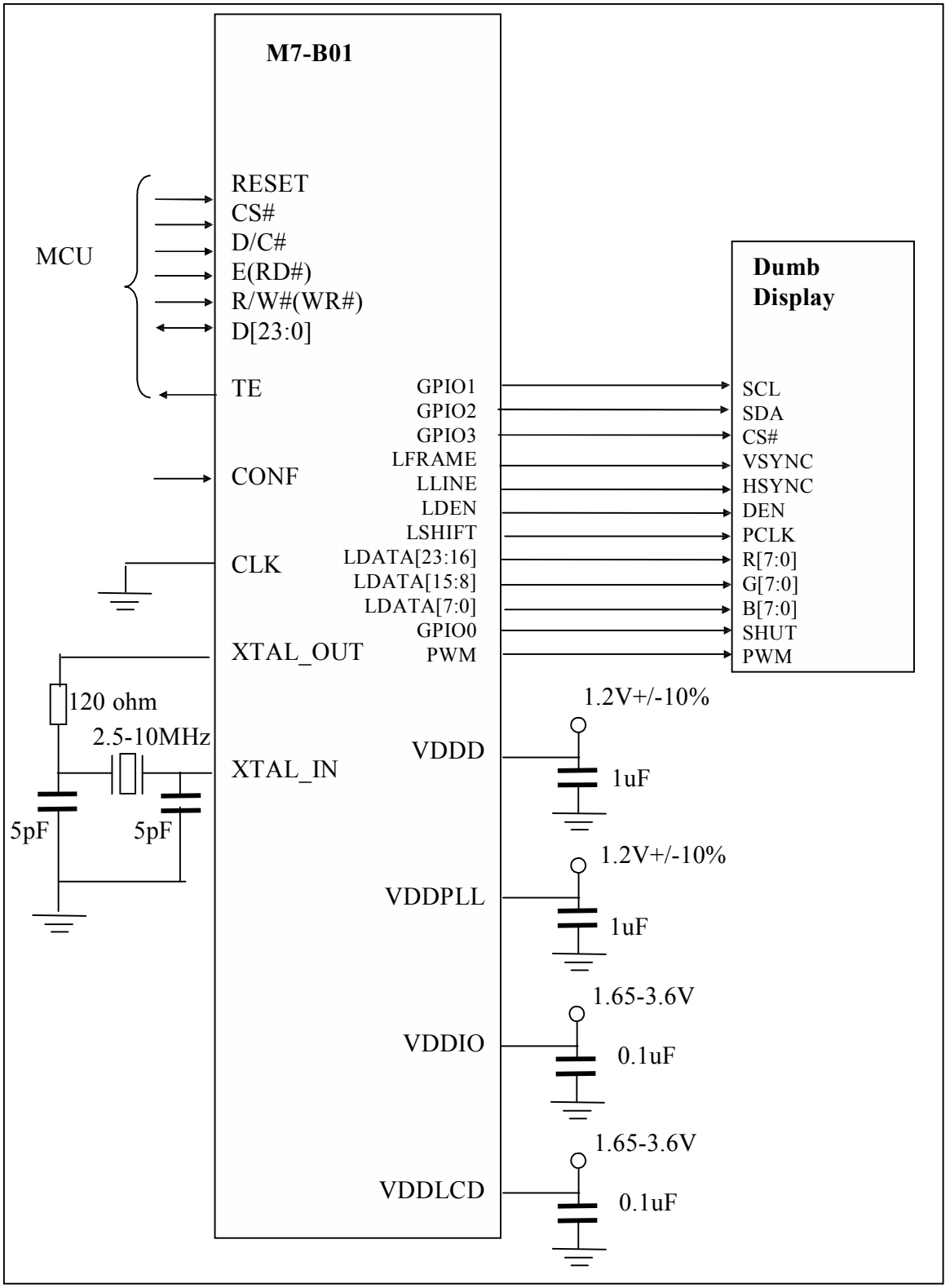
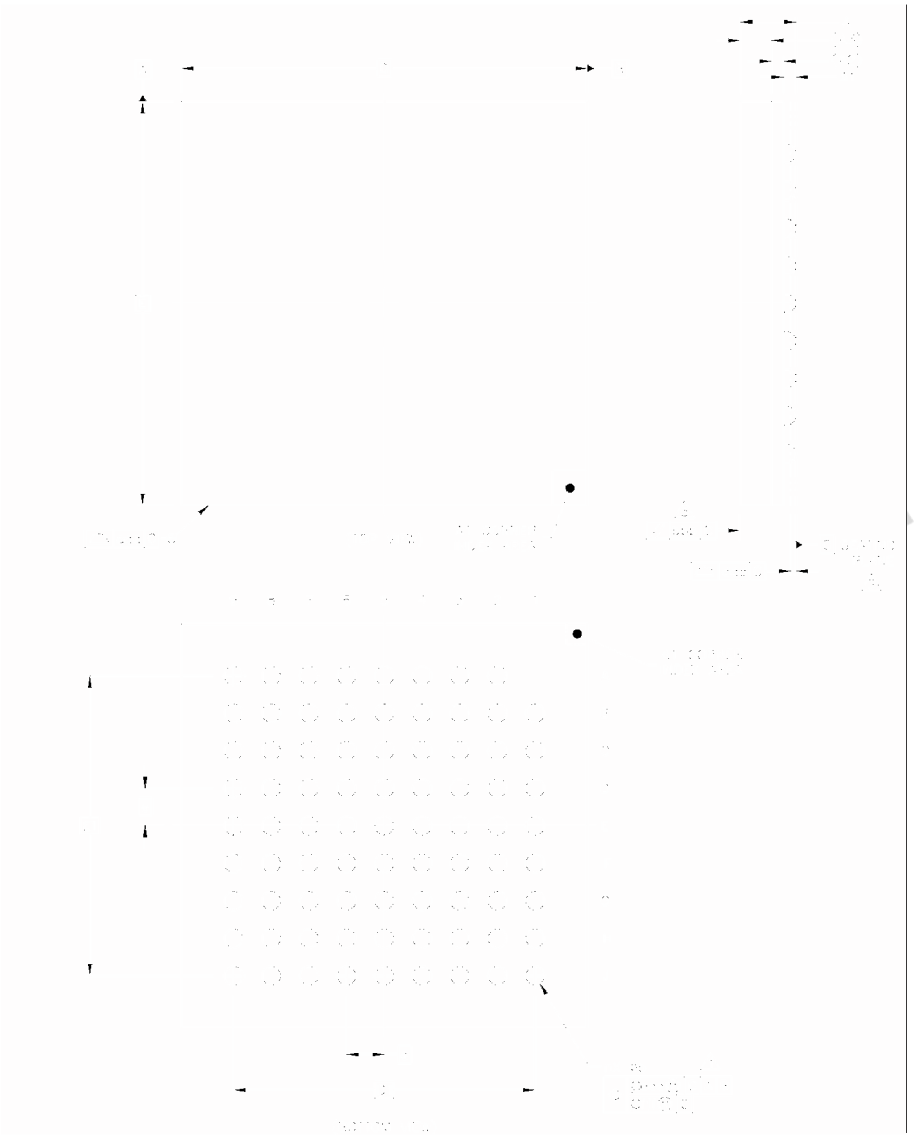


Figure 14-2 : Application circuit for M7-B01 (With crystal oscillator input)



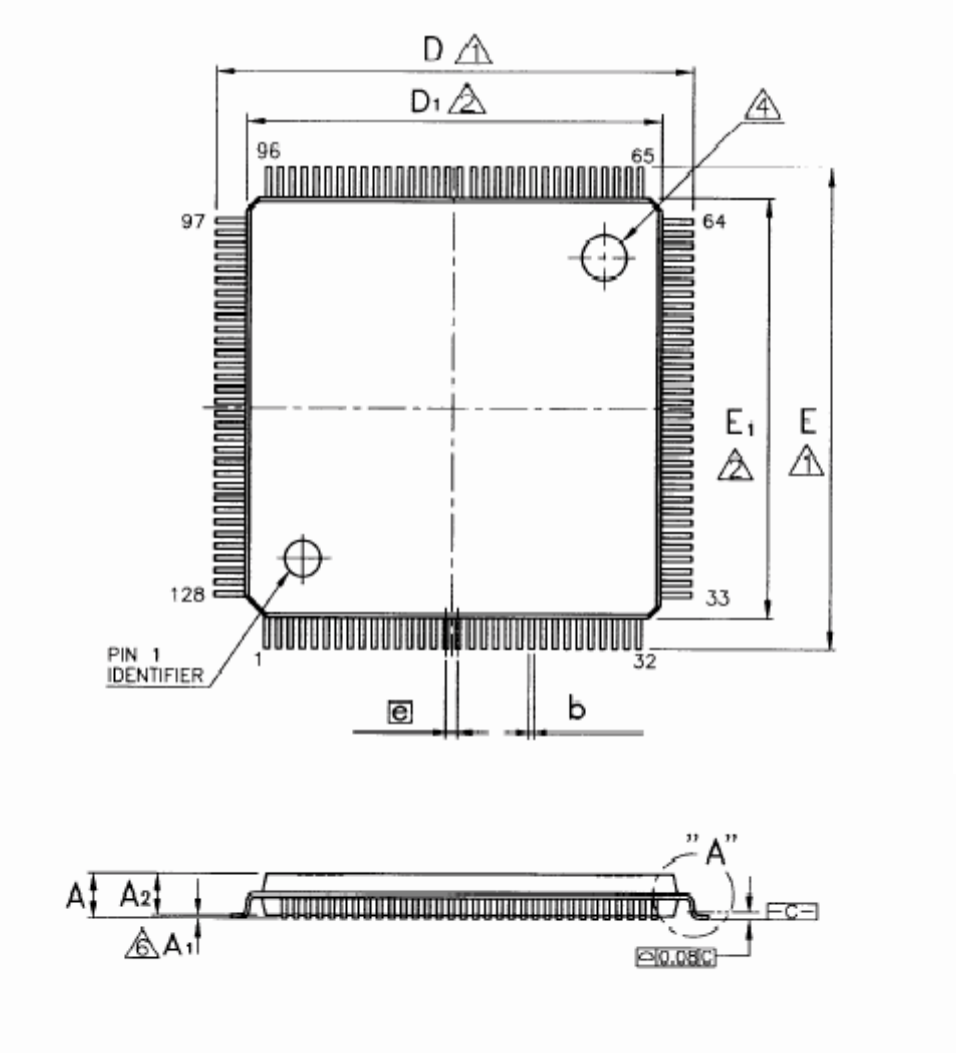
15 PACKAGE INFORMATION

15.1 Package Mechanical Drawing for 80 pins TFBGA



Dimension in mm			
Symbol	**Min**	**Typical**	**Max**
A	--	---	1.1
A1	0.16	---	0.26
A2	---	0.21	---
A3	---	0.54	---
b	0.27	---	0.37
D	---	7.00 BSC	---
E	---	7.00 BSC	---
e	---	0.65 BSC	---
D1	---	5.2 BSC	---
E1	---	5.2 BSC	---
aaa	---	0.1	---
bbb	---	0.2	---
ddd	---	0.08	---
eee	---	0.15	---
fff	---	0.08	---

15.2 Package Mechanical Drawing for 128 pins LQFP



Symbol	Dimension in mm		
	Min	Nom	Max
A			1.60
A1	0.05		
A2		1.40	
D		16.00	
D1		14.00	
E		16.00	
E1		14.00	
e		0.40 BSC	
b		0.18	