



# DATA SHEET

(DOC No. HX8369-A-DS)

## HX8369-A

480RGB x 864 dot, 16.7M color,  
with internal GRAM,  
TFT Mobile Single Chip Driver  
*Preliminary version 01 July, 2010*

**Himax Technologies, Inc.**  
<http://www.himax.com.tw>

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# » HX8369-A

480RGB x 864 dot, 16.7M color, with internal GRAM, TFT Mobile Single Chip Driver



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## List of Contents

July, 2010

<b>1. General Description</b> .....	<b>10</b>
<b>2. Features</b> .....	<b>11</b>
2.1 Display .....	11
2.2 Display module .....	11
2.3 Display / Control interface .....	12
2.4 Input power .....	12
2.5 Miscellaneous .....	12
<b>3. Device Overview</b> .....	<b>13</b>
3.1 Block diagram .....	13
3.2 Pin description .....	14
3.3 Pin assignment .....	18
3.4 PAD coordinates .....	19
3.4.1 Bump arrangement .....	27
<b>4. Interface</b> .....	<b>29</b>
4.1 System interface .....	29
4.1.1 MIPI DBI-A / DBI-B interface .....	31
4.2 Serial data transfer interface (MIPI DBI-C) .....	42
4.2.2 MIPI DPI interface (Display Pixel Interface) .....	46
4.2.3 DSI system interface .....	52
4.2.4 MDDI Interface (Mobile Display Digital Interface) .....	66
4.2.5 Terminology .....	67
4.2.6 Order of data transmission .....	68
4.2.7 Data-STB encoding .....	68
<b>5. Function Description</b> .....	<b>81</b>
5.1 Display data GRAM .....	81
5.2 Address counter (AC) .....	81
5.3 Source, gate and memory map .....	82
5.3.1 480RGB x 864 resolution .....	82
5.3.2 480RGB x 854 resolution .....	83
5.3.3 480RGB x 800 resolution .....	84
5.3.4 480RGB x 640 resolution .....	85
5.3.5 360RGB x 640 resolution .....	86
5.3.6 480RGB x 720 resolution .....	87
5.4 MCU to memory write / read direction .....	88
5.5 Fully display, partial display, vertical scrolling display .....	90
5.5.1 Fully display .....	90
5.5.2 Vertical scrolling display .....	96
5.5.3 Tearing effect output line .....	99
5.6 Color depth conversion .....	103
5.6.1 Color depth conversion Look-up tables .....	103
5.7 Oscillator .....	109
5.8 Source driver .....	110
5.9 LCD power generation scheme .....	111
5.10 DC/DC converter circuit .....	112
5.10.1 Use PFM DC/DC converter .....	112
5.10.2 Use HX5186-A .....	113
5.11 Idle display .....	114
5.12 Gamma characteristic correction function .....	115



5.13	Characteristics of I/O .....	157
5.13.1	Output or bi-directional (I/O) pins .....	157
5.13.2	Input pins .....	157
5.14	GIP control signal .....	158
5.15	Sleep Out –command and self-diagnostic functions of the display module .....	159
5.15.1	Register loading detection .....	159
5.15.2	Functionality detection .....	160
5.16	Power on/off sequence .....	161
5.16.1	Case 1: RESX line is held high or unstable by host at power on .....	162
5.16.2	Case 2: RESX line is held low by host at power on .....	163
5.17	Uncontrolled power off .....	163
5.18	Content adaptive brightness control (CABC) function .....	164
5.18.1	Module architectures .....	165
5.18.2	CABC block .....	166
5.18.3	Brightness control block .....	167
5.18.4	Minimum brightness setting of CABC function .....	168
5.19	OTP programming .....	169
5.19.1	OTP table .....	169
5.19.2	OTP programming flow .....	172
5.19.3	Programming sequence .....	173
5.19.4	OTP Programming example of VCMC_F1 and VCMC_B1 .....	174
5.19.5	OTP Programming example of ID1, ID2 and ID3 .....	175
5.19.6	OTP read example of 0x1Bh (VCOM setting re-load) .....	176
5.19.7	OTP read example of VCMC_F1 .....	177
5.20	Temperature sensor control .....	178
<b>6.</b>	<b>Command .....</b>	<b>179</b>
6.1	Command list .....	179
6.1.1	Standard command .....	179
6.1.2	User define command list table .....	183
6.2	Command description .....	187
6.2.1	NOP (00h) .....	187
6.2.2	Software reset (01h) .....	188
6.2.3	RDNUMPE: Read number of the parity errors (05h) .....	189
6.2.4	Get_red_channel (06h) .....	190
6.2.5	Get_green_channel (07h) .....	191
6.2.6	Get_blue_channel (08h) .....	192
6.2.7	Get_power_mode (0Ah) .....	193
6.2.8	Read display MADCTL (0Bh) .....	194
6.2.9	Get_pixel_format (0Ch) .....	196
6.2.10	Get_display_mode (0Dh) .....	198
6.2.11	Get_signal_mode (0Eh) .....	199
6.2.12	Get_diagnostic_result (0Fh) .....	200
6.2.13	Enter_sleep_mode (10h) .....	201
6.2.14	Exit_sleep_mode (11h) .....	202
6.2.15	Enter_partial_mode (12h) .....	203
6.2.16	Enter_normal_mode (13h) .....	204
6.2.17	Exit_inversion_mode (20h) .....	205
6.2.18	Enter_inversion_mode (21h) .....	206
6.2.19	Set_gamma_curve (26h) .....	207
6.2.20	Set_display_off (28h) .....	208
6.2.21	Set_display_on (29h) .....	209
6.2.22	Set_column_address (2Ah) .....	210
6.2.23	Set_page_address (2Bh) .....	211



6.2.24	Write_memory_start (2Ch) .....	212
6.2.25	Colour Set (2Dh).....	213
6.2.26	Raed_memory_start (2Eh) .....	216
6.2.27	Set_partial_area (30h).....	217
6.2.28	Set_scroll_area (33h) .....	219
6.2.29	Tearing effect line off (34h) .....	222
6.2.30	Set_tear_on (35h).....	223
6.2.31	Set_address_mode (36h) .....	224
6.2.32	Set_scroll_start (37h).....	226
6.2.33	Idle mode off (38h).....	227
6.2.34	Enter_Idle_mode (39h).....	228
6.2.35	Set_pixel_format (3Ah).....	229
6.2.36	Write_memory_contiune (3Ch).....	230
6.2.37	Raed_memory_continue (3Eh).....	231
6.2.38	Set tear scan lines (44h).....	232
6.2.39	Get the current scanline(45h) .....	233
6.2.40	Write display brightness (51h).....	234
6.2.41	Read display brightness value (52h) .....	235
6.2.42	Write CTRL display (53h) .....	236
6.2.43	Read CTRL value display (54h) .....	237
6.2.44	Write content adaptive brightness control (55h).....	238
6.2.45	Read content adaptive brightness control (56h).....	239
6.2.46	Write CABC minimum brightness (5Eh) .....	240
6.2.47	Read CABC minimum brightness (5Fh) .....	241
6.2.48	Read automatic brightness control self-diagnostic result (68h) .....	242
6.2.49	Read_DDB_start (A1h).....	243
6.2.50	Read_DDB_continue (A8h).....	245
6.2.51	Read ID1 (DAh).....	246
6.2.52	Read ID2 (DBh) .....	247
6.2.53	Read ID3 (DCh) .....	248
6.2.54	SETOSC: Set internal oscillator (B0h).....	249
6.2.55	SETPOWER: Set power (B1h).....	250
6.2.56	SETDISP: Set display related register (B2h).....	259
6.2.57	SETRGBIF: Set RGB interface related register (B3h).....	262
6.2.58	SETCYC: Set display waveform cycle (B4h).....	263
6.2.59	SETVCOM: Set VCOM voltage (B6h) .....	266
6.2.60	SETEXTC: Set extension command (B9h) .....	269
6.2.61	SETMIPI: (BAh) .....	270
6.2.62	SETOTP: Set OTP (BBh) .....	272
6.2.63	SETDGCLUT: Set DGC LUT (C1h).....	273
6.2.64	SETID: Set ID (C3h) .....	275
6.2.65	SETPANEL (CCh).....	276
6.2.66	SETGIP (D5h).....	277
6.2.67	SETTPSNR (D8h).....	284
6.2.68	SETGAMMA: Set gamma curve related setting (E0h) .....	289
6.2.69	SETOTPKEY (E9h) .....	291
6.2.70	GETHXID (F4h) .....	292
6.2.71	SETCNCD/GETCNCD (FDh) .....	293
6.2.72	SET SPI READ INDEX (FEh).....	294
6.2.73	GETSPIREAD: Read command data (FFh) .....	295



<b>7. Power Supply</b> .....	<b>296</b>
7.1 Power supply setup .....	296
7.1.1 Architecture 1 with PFM circuit .....	296
7.1.2 Architecture 2 with HX5186-A .....	297
7.2 Voltage configuration .....	298
<b>8. Electrical Characteristics</b> .....	<b>299</b>
8.1 Absolute maximum ratings .....	299
8.2 ESD protection level .....	299
8.3 DC characteristics .....	300
8.4 AC characteristics .....	301
8.4.1 DBI Type A interface characteristics .....	301
8.4.2 DBI Type B interface characteristics .....	302
8.4.3 DBI Type C interface characteristics .....	303
8.4.4 DPI interface characteristics .....	304
8.4.5 Reset input timing .....	308
8.4.6 MDDI electrical characteristics .....	309
<b>9. Layout Recommendation</b> .....	<b>312</b>
<b>10. Maximum Layout Resistance</b> .....	<b>313</b>
<b>11. Ordering Information</b> .....	<b>314</b>
<b>12. Revision History</b> .....	<b>314</b>

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**List of Figures**

July, 2010

Figure 4.1: DBI-A system interface protocol, write to register or GRAM .....31

Figure 4.2: DBI-A system interface protocol, read from register or GRAM.....31

Figure 4.3: DBI-B system interface protocol, write to register or GRAM .....32

Figure 4.4: DBI-B system interface protocol, read from register or GRAM.....32

Figure 4.5 Example of DBI-B system 18-bit parallel bus interface.....33

Figure 4.6: Write data for RGB 8-8-8 (16.7M colours) bit Input in 24-bit parallel interface.....33

Figure 4.7: Example of DBI-A- / DBI-B system 18-bit parallel bus interface.....34

Figure 4.8: Write data for RGB 5-6-5 (65k colours) bit input in 18-bit parallel interface .....34

Figure 4.9: Write data for RGB 6-6-6(262k colours) bit input in 18-bit parallel interface .....35

Figure 4.10: Write data for RGB 8-8-8 (16.7M colours) bit input in 18-bit parallel interface.....35

Figure 4.11: Example of DBI-A- / DBI-B system 16-bit bus interface.....36

Figure 4.12: Write data for RGB 5-6-5 (65k colours) bit input in 16-bit parallel interface .....36

Figure 4.13: Write data for RGB 6-6-6 (262k colours) bit input in 16-bit parallel interface .....37

Figure 4.14: Write data for RGB 8-8-8-bit (16.7M colours) input in 16-bit parallel interface.....37

Figure 4.15: Example of DBI-A- / DBI-B- system 9-bit bus interface .....38

Figure 4.16: Write data for RGB 5-6-5(65k colours) bit input in 9-bit parallel interface .....38

Figure 4.17: Write data for RGB 6-6-6-bit (262k colours) input in 9-bit parallel interface.....39

Figure 4.18: Write data for RGB 8-8-8-bit (16.7 M colours) input in 9-bit parallel interface.....39

Figure 4.19: Example of DBI-A- / DBI-B-system 8-bit bus interface .....40

Figure 4.20: Write data for RGB 5-6-5 (65k colours) bit input in 8-bit parallel interface .....40

Figure 4.21: Write data for RGB 6-6-6-bit (262k colours) input in 8-bit parallel interface.....41

Figure 4.22: Write data for RGB 8-8-8-bit (16.7 M colours) input in 8-bit parallel interface.....41

Figure 4.23: Serial data stream, write mode .....42

Figure 4.24: DBI Type C: Serial interface protocol 3-wire/4-wire, write mode .....43

Figure 4.25: Type C:Serial interface protocol 3-wire/4-wire read mode.....44

Figure 4.26: Display module data transfer recovery .....45

Figure 4.27: PCLK cycle.....46

Figure 4.28: General timing diagram.....47

Figure 4.29: DPI (480RGB x 864) timing diagram .....47

Figure 4.30: 16-bit / pixel 65K colours order on the DPI I/F .....49

Figure 4.31: 18-bit / pixel: 262k colours order on the DPI I/F .....50

Figure 4.32: 24-bit / pixel color order on the RGB I/F .....51

Figure 4.33: DSI transmitter and receiver interface .....52

Figure 4.34: DSI transmitter and receiver interface .....53

Figure 4.35: Multiple HS transmission packets .....54

Figure 4.36: Structure of the short packet.....54

Figure 4.37: Structure of the long packet .....55

Figure 4.38: The format of data ID. ....55

Figure 4.39: show Short- / Long-packet transmission command sequence .....56

Figure 4.40: Physical connection of MDDI host and client.....66

Figure 4.41: MDDI terminology .....67

Figure 4.42: Example of Bi-directional MDDI communication.....67

Figure 4.43: Transmission bit ordering for each type.....68

Figure 4.44: Data-STB encoding.....69

Figure 4.45: Data / STB generation & recovery circuit.....69

Figure 4.46: Differential connection between host and client .....70

Figure 4.47 MDDI packet structure .....71

Figure 4.48: MDDI Transceiver / Receiver state in hibernation .....78

Figure 4.49: Host-initiated link wakeup sequence .....79

Figure 4.50: MDDI operation mode.....80

Figure 5.1: MCU to Memory write / read direction .....88

Figure 5.2: MY, MX, MV setting of 480RGB x 864 dot .....88

Figure 5.3: MY, MX, MV setting of 480RGB x 864 dot .....88

Figure 5.4: Address direction settings.....89

Figure 5.5: 480RGB x 864 resolution.....90





Figure 5.6: 480RGB x 854 resolution	91
Figure 5.7: 480RGB x 800 resolution	92
Figure 5.8: 480RGB x 640 resolution	93
Figure 5.9: 360RGB x 640 resolution	94
Figure 5.10: 480RGB x 720 resolution	95
Figure 5.11: Vertical scrolling	96
Figure 5.12: Memory map of vertical scrolling 1	96
Figure 5.13: Memory map of vertical scrolling 2	97
Figure 5.14: Vertical scroll example 1	98
Figure 5.15: Vertical scroll example 2	98
Figure 5.16: Tearing effect output line–mode 1	99
Figure 5.17: Tearing effect output line–mode 2	99
Figure 5.18: Tearing effect output line–timing diagram	99
Figure 5.19: Tearing effect output line –tearing effect line timing	100
Figure 5.20: Tearing effect output line–definition of $t_f$ , $t_r$	100
Figure 5.21: Tearing effect output line–example 1 (Timing)	101
Figure 5.22: Tearing effect output line–example 1 (Image)	101
Figure 5.23: Tearing effect output line–example 2 (Timing)	102
Figure 5.24: Tearing effect output line–example 2 (Image)	102
Figure 5.25: OSC architecture	109
Figure 5.26: LCD power generation scheme	111
Figure 5.27: DC/DC converter circuit (PFM Type C)–PCCS=10	112
Figure 5.28: DC/DC converter circuit (HX5186-A)	113
Figure 5.29: Idle mode grayscale control	114
Figure 5.30: Grayscale control	115
Figure 5.31: Gamma resistor stream and gamma reference voltage	117
Figure 5.32: Gamma resistor stream	118
Figure 5.33: Sleep out flow chart–command and self-diagnostic functions	159
Figure 5.34: Sleep out flow chart internal function detection	160
Figure 5.35: Case 1: RESX line is held high or unstable by host at power on	162
Figure 5.36: Case 2: RESX line is held low by host at power on	163
Figure 5.37: CABC block diagram	164
Figure 5.38: Module architecture	165
Figure 5.39: CABC gain / CABC duty generation	166
Figure 5.40: CABC_PWM_OUT output duty	167
Figure 5.41: OTP programming sequence	172
Figure 5.42: OTP programming sequence example 1	174
Figure 5.43: OTP programming sequence example 2	175
Figure 5.44: OTP programming sequence index 0x1Bh read flow	176
Figure 5.45: OTP programming sequence read flow	177
Figure 5.46: Temperature sensor	178
Figure 7.1: Power supply with PFM circuit	296
Figure 7.2: Power supply with HX5186-A	297
Figure 8.1: DBI Type A interface characteristics(CLK-E mode)	301
Figure 8.2: DBI Type B interface characteristics	302
Figure 8.3: DBI Type C interface characteristics	303
Figure 8.4: DPI interface characteristics	304
Figure 8.5: Vertical Timings for RGB I/F	306
Figure 8.6: Horizontal Timing for RGB I/F	307
Figure 8.7: Reset input timing	308
Figure 9.1: Layout recommendation	312

# » HX8369-A

480RGB x 864 dot, 16.7M color, with internal GRAM, TFT Mobile Single Chip Driver



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## List of Tables

July, 2010

Table 4.1: Interface selection .....	29
Table 4.2: Pin connection based on different interface .....	30
Table 4.3: Data types for processor-sourced packets.....	57
Table 4.4: Shows the error report bit definitions.....	64
Table 4.5: The complete set of peripheral-to-processor data types.....	65
Table 4.6: List of supported MDDI packet .....	72
Table 4.7: Operation mode list .....	80
Table 5.1: Addresses counter range.....	81
Table 5.2: Memory map of 480RGB x 864 resolution .....	82
Table 5.3: Memory map of 480RGB x 854 resolution .....	83
Table 5.4: Memory map of 480RGB x 800 resolution .....	84
Table 5.5: Memory map of 480RGB x 640 resolution .....	85
Table 5.6: Memory map of 360RGB x 640 resolution .....	86
Table 5.7: Memory map of 480RGB x 720 resolution .....	87
Table 5.8: 480RGB x 864 resolution (SRAM assignment) .....	90
Table 5.9: 480RGB x 854 resolution (SRAM assignment) .....	91
Table 5.10: 480RGB x 800 resolution (SRAM assignment).....	92
Table 5.11: 480RGB x 640 resolution (SRAM assignment) .....	93
Table 5.12: 360RGB x 640 resolution (SRAM assignment) .....	94
Table 5.13: 480RGB x 720 resolution (SRAM assignment) .....	95
Table 5.14: AC characteristics of tearing effect signal .....	100
Table 5.15: Look-up tables-1 .....	103
Table 5.16: Look-up tables-2 .....	104
Table 5.17: Look-up tables-3 .....	105
Table 5.18: Look-up tables-4 .....	106
Table 5.19: Look-up tables-5 .....	107
Table 5.20: Look-up tables-6 .....	108
Table 5.21: Gamma-Adjustment registers.....	116
Table 5.22: Offset adjustment 0~5 .....	119
Table 5.23: Center adjustment .....	119
Table 5.24: VinP0 .....	120
Table 5.25: VinP1 .....	121
Table 5.26: VinP2 .....	122
Table 5.27: VinP14 .....	123
Table 5.28: VinP15 .....	124
Table 5.29: VinP16 .....	125
Table 5.30: VinP5 .....	127
Table 5.31: VinP11 .....	129
Table 5.32: VinP3 .....	130
Table 5.33: VinP4 .....	131
Table 5.34: VinP6 .....	131
Table 5.35: VinP7 .....	132
Table 5.36: VinP8 .....	132
Table 5.37: VinP9 .....	133
Table 5.38: VinP10 .....	133
Table 5.39: VinP12 .....	134
Table 5.40: VinP13 .....	134
Table 5.41: VinN0 .....	135
Table 5.42: VinN1 .....	136
Table 5.43: VinN2 .....	137
Table 5.44: VinN14 .....	138
Table 5.45: VinN15 .....	139
Table 5.46: VinN16 .....	140
Table 5.47: VinN5 .....	142
Table 5.48: VinN11 .....	144





Table 5.49: VinN3 .....	145
Table 5.50: VinN4 .....	146
Table 5.51: VinN6 .....	146
Table 5.52: VinN7 .....	147
Table 5.53: VinN8 .....	147
Table 5.54: VinN9 .....	148
Table 5.55: VinN10 .....	148
Table 5.56: VinN12 .....	149
Table 5.57: VinN13 .....	149
Table 5.58: Voltage calculation formula of 64-grayscale voltage (positive polarity).....	151
Table 5.59: Voltage calculation formula of 64-grayscale voltage (negative polarity) .....	153
Table 5.60: Voltage calculation formula of 256-grayscale voltage (positive/negative polarity)	156
Table 5.61 Characteristics of output or bi-directional (I/O) pins .....	157
Table 5.62 Characteristics of input pins .....	157
Table 5.63 CABC timing table .....	167
Table 5.64: OTP Programming sequence .....	173
Table 7.1: Adoptability of component .....	298
Table 8.1: Absolute maximum rating .....	299
Table 8.2: ESD protection level .....	299
Table 8.3: DC characteristic .....	300
Table 8.4: DBI Type A interface characteristics .....	301
Table 8.5: DBI Type B interface characteristics .....	302
Table 8.6: DBI Type C interface characteristics .....	303
Table 8.7: DPI interface characteristics .....	305
Table 8.8 Vertical Timings for RGB I/F .....	306
Table 8.9 Horizontal Timings for RGB I/F .....	307
Table 8.10: Reset timing .....	308
Table 10.1: Maximum layout resistance .....	313

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## 1. General Description

This document describes Himax's HX8369-A supports WVGA resolution driving controller. The HX8369-A is designed to provide a single-chip solution that combines a source driver, power supply circuit to drive a TFT dot matrix LCD with 480RGBx864 dots at maximum.

The HX8369-A can be operated in low-voltage condition for the interface and integrated internal boosters that produce the liquid crystal voltage, breeder resistance and the voltage follower circuit for liquid crystal driver. In addition, The HX8369-A also supports various functions to reduce the power consumption of a LCD system via software control.

The HX8369-A supports several interface modes, including MPU MIPI DBI Type A/Type B interface mode, MIPI DPI/DBI Type C interface mode, MIPI DSI (Display Serial Interface) interface mode and MDDI (Mobile Display Digital Interface) interface mode. The interface mode is selected by the external hardware pins BS3~0.

The HX8369-A is suitable for any small portable battery-driven and long-term driving products, such as small PDAs, digital cellular phones and bi-directional pagers.

## 2. Features

### 2.1 Display

- Single chip solution for a WVGA GIP (Gate In Panel) type TFT LCD display
- Resolution:
  - 480RGB x 864
  - 480RGB x 854
  - 480RGB x 800
  - 480RGB x 640
  - 480RGB x 720
  - 360RGB x 640
- Display color modes
  - Full color mode:
    - 16.7M colours (24-bit 8(R):8(G):8(B))
  - Reduce color mode:
    - 262k colours (18-bit 6(R):6(G):6(B))
    - 65k colours (16-bit 5(R):6(G):5(B))
    - 8 colors (Idle mode on): 8 colors (3-bit binary mode)

### 2.2 Display module

- Support 1440 source channel outputs
- Internal level shifter for GIP gate control
- Supports 1-dot / 2-dot / column / Zig-Zag inversion
- Gamma correction (1 preset gamma curve)
- On module VCOM control (-2 to 0V common electrode output voltage range)
- On module DC/DC converter
  - VSP=4.7 to 5.5V
  - VSN=-5.5 to -4.7V
  - Positive source output voltage level: VSPR=3.5V to 5V
  - Negative source output voltage level: VSNR=-5V to -3.5V
  - Positive gate driver output voltage level: VGH=+9V to +20V
  - Negative gate driver output voltage level: VGL=-6V to -13.5V
  - GIP most negative reference voltage: LVGL=VGL -VDD3
  - VCOM=-2.0V to 0V, a step=16mV
- Frame memory area 480 (H) x 864 (V) x 24-bit

## 2.3 Display / Control interface

- Display interface types supported
  - MPU mode
    - MIPI-DBI Type B (80 System) interface (16- / 18- / 24-bit bus)
    - MIPI-DBI Type A (68 System) interface (16- / 18- bit bus)
    - MIPI-DBI Type C (Serial data transfer interface) interface
  - MIPI-DSI (Display Serial Interface) interface
    - Support DSI Version 1.01
    - Support D-PHY version 0.90
  - MDDI (Mobile Display Digital Interface) interface
    - Support VESA Mobile Display Digital Interface Standard Version 1.2
  - RGB mode
    - 16 bit/pixel R(5), G(6), B(5)
    - 18 bit/pixel R(6), G(6), B(6)
    - 24 bit/pixel R(8), G(8), B(8)

## 2.4 Input power

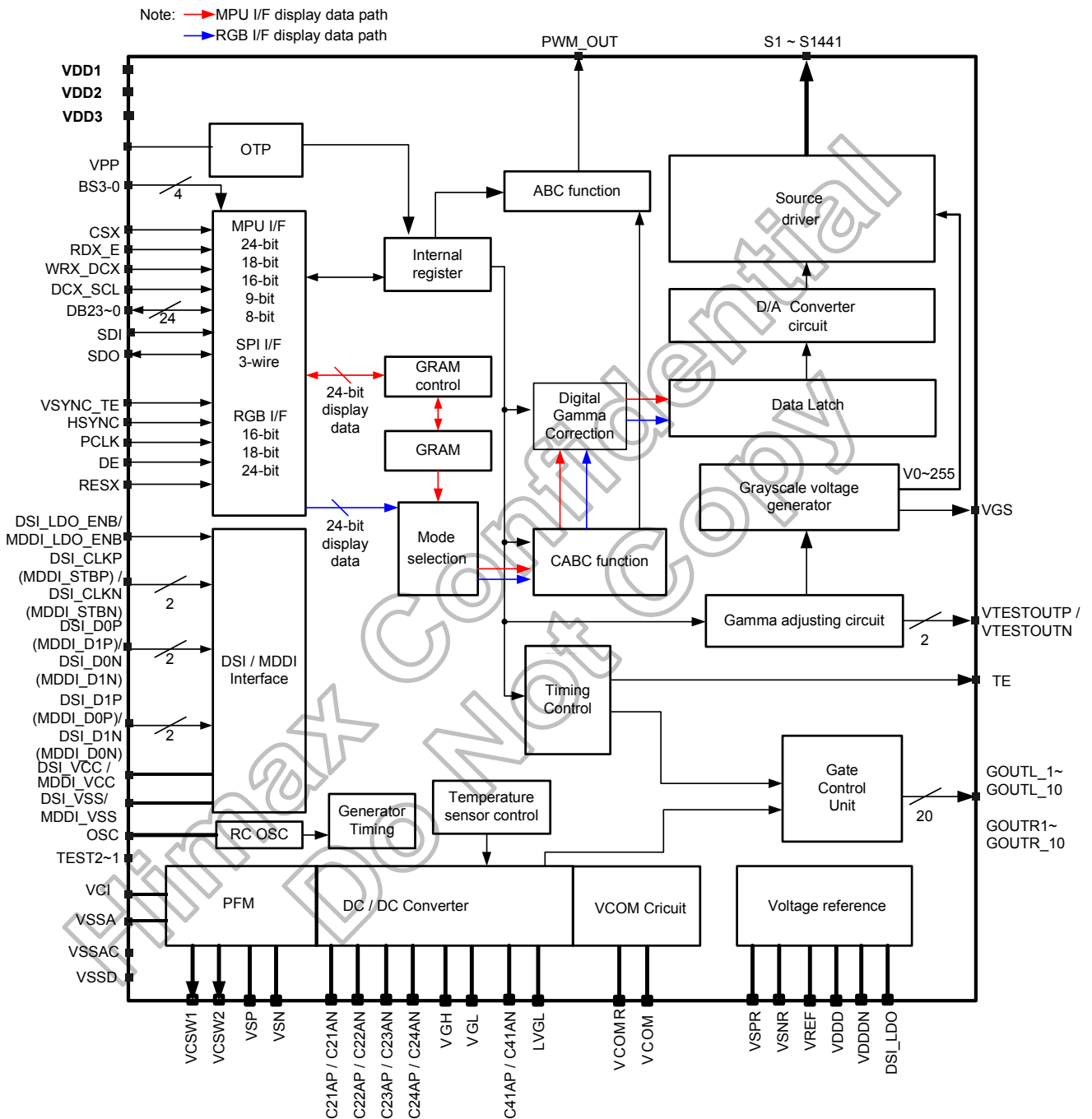
- I/O and interface power supply (VDD1): 1.65V to 3.3V
- Analog power supply (VDD2): 2.3V to 4.8V
- Logic power supply (VDD3): 2.3V to 4.8V
- DSI power supply (DSI\_VCC): 1.65V to 3.3V
- MDDI power supply (DSI\_VCC): 2.3V to 3.3V
- OTP programming voltage (VPP): 7.5V  $\pm$  0.2V

## 2.5 Miscellaneous

- Partial display mode
- Software programmable color depth mode
- Oscillator for display clock generation
- Low power consumption, suitable for battery operated systems
- CMOS compatible inputs
- Proprietary multi phase driving for lower power consumption
- GAS function for preventing image sticking when abnormal power off
- Optimized layout for COG assembly
- Temperature range: -40 to +85 °C
- HBM ESD (Human Body Mode)>2KV, MM(Machine Mode)> $\pm$ 200V and Latch up> $\pm$ 200mA
- Support inversion mode
- DC/DC converter for source
- Support DC COM driving
- VCOM voltage generator
- On-chip OTP program voltage generator
- OTP memory to store initialization register settings
- 3 times MTP for VCOM setting ,ID setting
- Support CAB (Content Adaptive Brightness Control) function
- Support DGC (Digital Gamma Correction) function
- Temperature Sensor Control

### 3. Device Overview

#### 3.1 Block diagram



3.2 Pin description

Host interface pins										
Signals	I/O	Pin no.	Connected with	Description						
BS3 ~ BS0	I	4	VSSD / VDD1	Select the MPU interface mode as listed below:						
				BS3	BS2	BS1	BS0	MPU interface mode	DB pins	Display mode
				0	0	0	0	DBI TYPE-A 8-bit (CLK-E)	DB23-DB8: Unused, DB7-DB0: Data	Type 1
				0	0	0	1	DBI TYPE-A 9-bit (CLK-E)	DB23-DB9: Unused, DB8-DB0: Data	Type 1
				0	0	1	0	DBI TYPE-A 16-bit (CLK-E)	DB23-DB16: Unused, DB15-DB0: Data	Type 1
				0	0	1	1	DBI TYPE-A 18-bit (CLK-E)	DB23-DB18: Unused, DB17-DB0: Data	Type 1
				0	1	0	0	DBI TYPE-B 8-bit	DB23-DB8: Unused, DB7-DB0: Data	Type 1
				0	1	0	1	DBI TYPE-B 9-bit	DB23-DB9: Unused, DB8-DB0: Data	Type 1
				0	1	1	0	DBI TYPE-B 16-bit	DB23-DB16: Unused, DB15-DB0: Data	Type 1
				0	1	1	1	DBI TYPE-B 18-bit	DB23-DB18: Unused, DB17-DB0: Data	Type 1
				1	0	0	0	DSI (Command mode)	DSI_CLKP, DSI_CLKN, DSI_D0P, DSI_D0N, DSI_D1P, DSI_D1N	Type 1
				1	0	0	1	3-wire serial + MDDI interface (note 1)	MDDI_STBP, MDDI_STBN, MDDI_D0P, MDDI_D0N, MDDI_D1P, MDDI_D1N,	-
				1	0	1	0	DBI TYPE-B 24-bit	DB23-DB0: Data	Type 1
				1	1	0	0	DSI (Video mode)	DSI_CLKP, DSI_CLKN, DSI_D0P, DSI_D0N, DSI_D1P, DSI_D1N	Type 3
1	1	0	1	DPI/DBI TYPE-C Option 1	SDI/SDO, DB23-DB0	Type 3				
1	1	1	0	DPI/DBI TYPE-C Option 2	SDI/SDO, DB23-DB0	Type 3				
1	1	1	1	DPI/DBI TYPE-C Option 3	SDI/SDO, DB23-DB0	Type 3				
Pixel format (RGB565 / RGB666 / RGB888) is selected by DCS command (0x3Ah) Note 1: 3-wire serial Interface only active on MDDI / Hibernation mode. Must be connected to VSSD or VDD1.										
CSX	I	1	MPU	Chip select signal. Low: chip can be accessed; High: chip cannot be accessed. If this pin is not used, please connect it to VSSD or VDD1.						
RESX	I	1	MPU or reset circuit	Reset pin. Setting either pin low initializes the LSI. Must be reset after power is supplied (Must be connected to VSSD or VDD1).						
RDX_E	I	1	MPU	DBI Type-A: 0: Read/Write disable, 1: Read / Write enable. DBI Type-B: Serves as a read signal and read data at the low level. If not use, let it open or connected to VDD1.						
DCX_SCL	I	1	MPU	DBI Type-A/B: Data / Command Selection pin DBI Type-C: it servers as SCL (Serial Clock) If not use, let it open or connected to VDD1.						



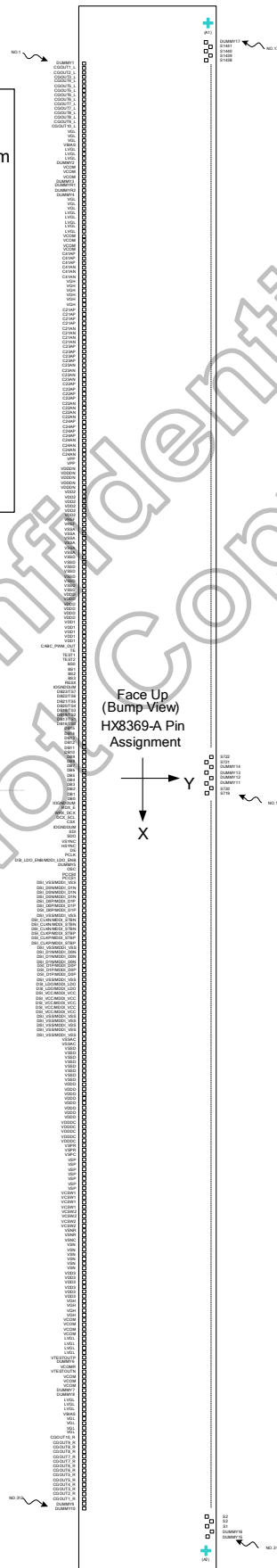
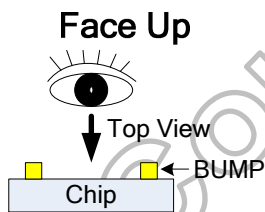
<b>WRX_DCX</b>	I	1	<b>MPU</b>	DBI Type-B mode: Serves as a write signal and write data at the low level. DBI Type-A mode: 0: Read/Write disable, 1: Read / Write enable. If not use, let it open or connected to VDD1.		
<b>DB23~0</b>	I/O	24	<b>MPU</b>	RGB interface		
				Data bus	Used	Unused
				16-bit bus	DB21-17, DB13-8, DB5-1	DB23-22, DB116-14, DB7-6, DB0
				18-bit bus	DB21-16, DB13-8, DB5-0	DB22-21, DB15-14, DB7-6
24-bit bus	DB23-D0	-	Let the unused pins open for each mode.			
<b>SDO</b>	O	1	<b>MPU</b>	Serial data output. Let it to open in MPU interface mode.		
<b>SDI</b>	I	1	<b>MPU</b>	Serial data input pin in serial interface operation.		
<b>Clock input and RGB interface</b>						
<b>HSYNC</b>	I	1	<b>MPU</b>	Line synchronizing signal. Must be connected to VSSD or VDD1 if not used.		
<b>DE</b>	I	1	<b>MPU</b>	A data enable signal in RGB I/F mode. Has to be fixed to VSSD level in MPU interface mode.		
<b>VSYNC</b>	I	1	<b>MPU</b>	Serves VS signal pin on RGB interface. (Input pad). Must be connected to VSSD or VDD1 if not used.		
<b>PCLK</b>	I	1	<b>MPU</b>	Dot clock signal. Must be connected to VSSD or VDD1 if not used.		
<b>Source driver output pins</b>						
<b>S1 to S1441</b>	O	1441	<b>LCD</b>	Output voltages applied to the liquid crystal.		
				RGB resolution	Source channels	
				360RGB	S1 ~ S540, S901 ~ S1440	
				480RGB	S1 to S1440	
480RGB+Z inversion	S1 to S1441					
<b>TE</b>	O	1	<b>MPU</b>	Serves TE (Tearing Effect) pin on MPU interface.		
<b>GIP control signal and bias voltage</b>						
CGOUT1_L CGOUT2_L CGOUT3_L CGOUT4_L CGOUT5_L CGOUT6_L CGOUT7_L CGOUT8_L CGOUT9_L CGOUT10_L	O	14	<b>GIP</b>	Signals for right side GIP on panel view (Left side in IC bump view), Unused pins should be left open.		
CGOUT1_R CGOUT2_R CGOUT3_R CGOUT4_R CGOUT5_R CGOUT6_R CGOUT7_R CGOUT8_R CGOUT9_R CGOUT10_R	O	14	<b>GIP</b>	Signals for Right side GIP on panel view (Right side in IC bump view), Unused pins should be left open.		
<b>VBIAS</b>	O	2	<b>GIP</b>	Bias voltage for some special GIP circuits. If not used, leave this pin open.		
<b>Power supply pins</b>						
<b>PCCS0 ~ PCCS1</b>	I	2	<b>VSSD / VDD3</b>	Select the VSP/VSN bumping method as listed below:		
				PCCS1	PCCS0	Driving mode
				0	0	Setting invalid
				0	1	Setting invalid
				1	0	PFM one Inductor Mode (Type C)
1	1	Charge Bump Mode(Use HX5186-A)				
				Must be connected to VSSD or VDD3.		
<b>VDD1</b>	I	5	<b>Power supply</b>	A power supply for the I/O circuit. VDD1=1.65 to 3.3V		
<b>VDD2</b>	I	6	<b>Power supply</b>	A power supply for the analog power. VDD2=2.3 to 4.8V VDD2 input level should be same as VDD3 input level to avoid the level-mismatching at internal level shifter circuit.		

VDD3	I	6	Power supply	A power supply for the logic power, DC/DC converter VDD3=2.3 to 4.8V.
VSSA	P	6	Power supply	Analog ground. VSSA=0V. When using the COG method, connect to VSSD on the FPC to prevent noise.
VSSAC	P	2	Power supply	Analog ground. Must connect to VSSA on the FPC.
VSSD	P	16	Power supply	Ground for the internal logic. VSSD=0V. When using the COG method, connect to VSSA on the FPC to prevent noise.
VPP	I	2	Power supply	External high voltage pin used in OTP mode and operates at 7.5V. If not used, let it open.
<b>Output Pins of Power and reference voltage</b>				
VSP	I	7	Stabilizing capacitor	Input voltage from the set-up circuit (4.7V to 5.5V). it is generated from VDD3.
VSN	I	6	Stabilizing capacitor	Input voltage from the set-up circuit (-4.7V to -5.5V). it is generated from VDD3.
VSPC	I	1	VSP	Positive boosting reference voltage input.
VSNC	I	1	VSN	Negative boosting reference voltage input.
VSPR	O	2	Stabilizing capacitor	Positive regulated voltage output (3.5V to VSP - 0.5)
VSNR	O	2	Stabilizing capacitor	Positive regulated voltage output (-3.5V to VSN + 0.5)
VDDD	O	19	Stabilizing capacitor	Internal logic voltage output
VDDDN	O	5	Stabilizing capacitor	Internal logic voltage output (-2.5V fixed)
VREF	O	2	Stabilizing capacitor	Reference voltage from internal band gap circuit. The tolerance of VREF voltage is $\pm 3\%$ (1.8V fixed)
VGH	O	10	Stabilizing capacitor	Output voltage from the step-up circuit, it is generated from VSP and VSN. Connect to a stabilizing capacitor between VSSA and VGH.
VGL	O	10	Stabilizing capacitor	Output voltage from the step-up circuit, it is generated from VSP and VSN. Connect to a stabilizing capacitor between VSSA and VGL. Place a schottkey barrier diode between VSSA and VGL.
LVGL	O	15	Stabilizing capacitor	Most negative voltage for some special GIP circuits. If not used, connect to VGL.
VCOM	O	14	Stabilizing capacitor	The power supply of common voltage in DC com driving. The voltage range is set between -2V to 0V. It must be connected a stabilizing capacitor 2.2u to VSSD.
VCOMR	I	1	Input	The input pad of external VCOM voltage.
<b>DC/DC pumping</b>				
C21AP, C21AN C22AP, C22AN	I/O	16	Step-up Capacitor	Connect to the step-up capacitors according to the DC/DC pumping factor by pumping the VGL voltage.
C23AP, C23AN C24AP, C24AN	I/O	16	Step-up Capacitor	Connect to the step-up capacitors according to the DC/DC pumping factor by pumping the VGH voltage.
C41AP, C41AN	I/O	6	Step-up Capacitor	Connect to the step-up capacitors according to the DC/DC pumping factor by pumping the LVGL voltage.
VCSW1	O	4	-	Boosting control output1, it needs to connect to the gate pin of NMOS on external DC/DC converter circuit. (0 to VDD3)
VCSW2	O	4	-	Boosting control output2, it needs to connect to the gate pin of PMOS on external DC/DC converter circuit. (0 to VDD3)
<b>CABC &amp; ABC &amp; Ambient light sensor</b>				
CABC_PWM_OUT	O	1	-	Backlight on/off control pin. If use CABC function, the pin can connect to external LED driver IC. The output voltage range=0 to VDD1.
<b>Test Pins</b>				
OSC	I	1	Open	Oscillator input for test purpose. If not used, please let it open or connected to VSSD.(weak pull low)
TEST1	I	1	Open	A test pin. This pin is by internal logic function test.This pin can output on FPC. If not used, let it open or connected to VSSD.(weak pull low)
TEST2	I	1	Open	A test pin. This pin is by internal logic function test.This pin can output on FPC. If not used, let it open or connected to VSSD.(weak pull low)
VTESTOUTP	O	1	Open	A test pin. Disconnect it. This pin will output Gamma voltage. This pin can output on FPC.
VTESTOUTN	O	1	Open	A test pin. Disconnect it. This pin will output Gamma voltage. This pin can output on FPC.

DUMMYR1 DUMMYR2	-	2	Open	Dummy pads. Available for measuring the COG contact resistance. They are short-circuited within the chip.
DUMMY17~1	-	17	Open	Not used. Let it open.
IOGNDDUM	-	3	Open	Dummy pad. Connect to grand internally.
<b>MIPI-DSI interface parts</b>				
DSI_D0P, DSI_D0N	I/O	6	DSI Host	MIPI-DSI Data differential signal input pins. (Data lane 0)
DSI_CP, DSI_CN	I	6	DSI Host	MIPI-DSI CLOCK differential signal input pins.
DSI_D1P, DSI_D1N	I	6	DSI Host	MIPI-DSI Data differential signal input pins. (Data lane 1)
DSI_VCC	P	5	Power Supply	Power supply for the MIPI DSI analog power. DSI_VCC=1.65V to 3.3V
DSI_VSS	P	9	Ground	MIPI DSI analogy ground. DSI_VSS=0V. When using the COG method, connect to VSSA on the FPC to prevent noise.
DSI_LDO	O	2	Capacitor	DSI: DSI regulator output pin. (1.2V to 1.3V) Connect to a stabilizing capacitor between DSI_VSS and DSI_LDO If not used, please open these pins.
DSI_LDO_ENB	I	1	Input	DSI I/F: Control signal of DSI_LDO. The default setting of DSI_LDO_ENB is Low. High: Disable the DSI_LDO. Low: Enable the DSI_LDO. It must be connected to VDD1 or VSSD. (latch type)
<b>MDDI interface parts</b>				
MDDI_STBP, MDDI_STBN	-	6	High Speed Interface Host	High Speed Interface clock differential signal input pins. Connect to a terminal resistance (100Ω) between MDDI_STBP and MDDI_STBN. If not used, please let it connected to VSSD.
MDDI_D0P, MDDI_D0N	-	6	High Speed Interface Host	High Speed Interface Data differential signal input pins (Data lane 0). Connect to a terminal resistance (100Ω) between MDDI_D0P and MDDI_D0N. If not used, please let it connected to VSSD.
MDDI_D1P, MDDI_D1N	-	6	High Speed Interface Host	High Speed Interface Data differential signal input pins. (Data lane 1) Connect to a terminal resistance (100Ω) between MDDI_D1P and MDDI_D1N. If not used, please let it connected to VSSD.
MDDI_VCC	P	5	Power Supply or Capacitor	High Speed Interface I/O power supply pin, 2.3V to 3.3V.
MDDI_VSS	P	9	Ground	High Speed Interface I/O ground pin.
MDDI_LDO	O	2	Capacitor	High Speed Interface regulator output pin. Connect to a stabilizing capacitor between MDDI_VSS and MDDI_LDO. If not used, please open these pins.
MDDI_LDO_ENB	I	1	Input	MDDI I/F: Control signal of MDDI_LDO. The default setting of MDDI_LDO_ENB is Low. High: Disable the MDDI_LDO. Low: Enable the MDDI_LDO. It must be connected to VDD1 or VSSD. (latch type)

## 3.3 Pin assignment

- Chip Size : 22430 x 1701 um
- Chip thickness: 250 um ± 25 um
- Pad Location: PAD Center
- Coordinate Origin: Chip Center
- Au Bump Size:
  1. 50 um x 80 um  
Input:  
No.1 ~ No.312
  2. 15 um x 95 um  
Staggered LCD output side  
No.313 ~ No.1760
- The chip size includes the core size seal ring size, and scribe line size
- Au bump pitch: Refer to Pad Coordinate
- Au bump height: 15 um ± 3 um
- Numbers in the figure corresponds to pad coordinate numbers



## 3.4 PAD coordinates

No.	Name	X	Y	No.	Name	X	Y	No.	Name	X	Y	No.	Name	X	Y
1	DUMMY1	-10885	-672	61	C21AN	-6685	-672	121	VDDD	-2485	-672	181	DSI_DON / MDDI_D1N	1715	-672
2	CGOUT1_L	-10815	-672	62	C21AN	-6615	-672	122	VDD1	-2415	-672	182	DSI_DOP / MDDI_D1P	1785	-672
3	CGOUT2_L	-10745	-672	63	C23AP	-6545	-672	123	VDD1	-2345	-672	183	DSI_DOP / MDDI_D1P	1855	-672
4	CGOUT3_L	-10675	-672	64	C23AP	-6475	-672	124	VDD1	-2275	-672	184	DSI_DOP / MDDI_D1P	1925	-672
5	CGOUT4_L	-10605	-672	65	C23AP	-6405	-672	125	VDD1	-2205	-672	185	DSI_VSS / MDDI_VSS	1995	-672
6	CGOUT5_L	-10535	-672	66	C23AP	-6335	-672	126	VDD1	-2135	-672	186	DSI_CN / MDDI_STBN	2065	-672
7	CGOUT5_L	-10465	-672	67	C23AN	-6265	-672	127	CABC_PWM_OUT	-2065	-672	187	DSI_CN / MDDI_STBN	2135	-672
8	CGOUT6_L	-10395	-672	68	C23AN	-6195	-672	128	TE	-1995	-672	188	DSI_CN / MDDI_STBN	2205	-672
9	CGOUT6_L	-10325	-672	69	C23AN	-6125	-672	129	TEST1	-1925	-672	189	DSI_CP / MDDI_STBP	2275	-672
10	CGOUT7_L	-10255	-672	70	C23AN	-6055	-672	130	TEST2	-1855	-672	190	DSI_CP / MDDI_STBP	2345	-672
11	CGOUT7_L	-10185	-672	71	C22AP	-5985	-672	131	BS0	-1785	-672	191	DSI_CP / MDDI_STBP	2415	-672
12	CGOUT8_L	-10115	-672	72	C22AP	-5915	-672	132	BS1	-1715	-672	192	DSI_VSS / MDDI_VSS	2485	-672
13	CGOUT8_L	-10045	-672	73	C22AP	-5845	-672	133	BS2	-1645	-672	193	DSI_D1N / MDDI_DON	2555	-672
14	CGOUT9_L	-9975	-672	74	C22AP	-5775	-672	134	BS3	-1575	-672	194	DSI_D1N / MDDI_DON	2625	-672
15	CGOUT10_L	-9905	-672	75	C22AN	-5705	-672	135	RESX	-1505	-672	195	DSI_D1N / MDDI_DON	2695	-672
16	VGL	-9835	-672	76	C22AN	-5635	-672	136	IOGNDDUM	-1435	-672	196	DSI_D1P / MDDI_DOP	2765	-672
17	VGL	-9765	-672	77	C22AN	-5565	-672	137	DB23	-1365	-672	197	DSI_D1P / MDDI_DOP	2835	-672
18	VGL	-9695	-672	78	C22AN	-5495	-672	138	DB22	-1295	-672	198	DSI_D1P / MDDI_DOP	2905	-672
19	VBIAS	-9625	-672	79	C24AP	-5425	-672	139	DB21	-1225	-672	199	DSI_VSS / MDDI_VSS	2975	-672
20	LVGL	-9555	-672	80	C24AP	-5355	-672	140	DB20	-1155	-672	200	DSI_LDO / MDDI_LDO	3045	-672
21	LVGL	-9485	-672	81	C24AP	-5285	-672	141	DB19	-1085	-672	201	DSI_LDO / MDDI_LDO	3115	-672
22	LVGL	-9415	-672	82	C24AP	-5215	-672	142	DB18	-1015	-672	202	DSI_VCC / MDDI_VCC	3185	-672
23	DUMMY2	-9345	-672	83	C24AN	-5145	-672	143	DB17	-945	-672	203	DSI_VCC / MDDI_VCC	3255	-672
24	VCOM	-9275	-672	84	C24AN	-5075	-672	144	DB16	-875	-672	204	DSI_VCC / MDDI_VCC	3325	-672
25	VCOM	-9205	-672	85	C24AN	-5005	-672	145	DB15	-805	-672	205	DSI_VCC / MDDI_VCC	3395	-672
26	VCOM	-9135	-672	86	C24AN	-4935	-672	146	DB14	-735	-672	206	DSI_VCC / MDDI_VCC	3465	-672
27	DUMMY3	-9065	-672	87	VPP	-4865	-672	147	DB13	-665	-672	207	DSI_VSS / MDDI_VSS	3535	-672
28	DUMMYR1	-8995	-672	88	VPP	-4795	-672	148	DB12	-595	-672	208	DSI_VSS / MDDI_VSS	3605	-672
29	DUMMYR2	-8925	-672	89	VDDDN	-4725	-672	149	DB11	-525	-672	209	DSI_VSS / MDDI_VSS	3675	-672
30	DUMMY4	-8855	-672	90	VDDDN	-4655	-672	150	DB10	-455	-672	210	DSI_VSS / MDDI_VSS	3745	-672
31	VGL	-8785	-672	91	VDDDN	-4585	-672	151	DB9	-385	-672	211	DSI_VSS / MDDI_VSS	3815	-672
32	VGL	-8715	-672	92	VDDDN	-4515	-672	152	DB8	-315	-672	212	VSSAC	3885	-672
33	VGL	-8645	-672	93	VDDDN	-4445	-672	153	DB7	-245	-672	213	VSSAC	3955	-672
34	LVGL	-8575	-672	94	VDD2	-4375	-672	154	DB6	-175	-672	214	VSSD	4025	-672
35	LVGL	-8505	-672	95	VDD2	-4305	-672	155	DB5	-105	-672	215	VSSD	4095	-672
36	LVGL	-8435	-672	96	VDD2	-4235	-672	156	DB4	-35	-672	216	VSSD	4165	-672
37	LVGL	-8365	-672	97	VDD2	-4165	-672	157	DB3	35	-672	217	VSSD	4235	-672
38	LVGL	-8295	-672	98	VDD2	-4095	-672	158	DB2	105	-672	218	VSSD	4305	-672
39	VCOM	-8225	-672	99	VDD2	-4025	-672	159	DB1	175	-672	219	VSSD	4375	-672
40	VCOM	-8155	-672	100	VREF	-3955	-672	160	DB0	245	-672	220	VSSD	4445	-672
41	VCOM	-8085	-672	101	VREF	-3885	-672	161	IOGNDDUM	315	-672	221	VSSD	4515	-672
42	VCOM	-8015	-672	102	VSSA	-3815	-672	162	RDX_E	385	-672	222	VDDD	4585	-672
43	C41AP	-7945	-672	103	VSSA	-3745	-672	163	WRX_DCX	455	-672	223	VDDD	4655	-672
44	C41AP	-7875	-672	104	VSSA	-3675	-672	164	DCX_SCL	525	-672	224	VDDD	4725	-672
45	C41AP	-7805	-672	105	VSSA	-3605	-672	165	CSX	595	-672	225	VDDD	4795	-672
46	C41AN	-7735	-672	106	VSSA	-3535	-672	166	IOGNDDUM	665	-672	226	VDDD	4865	-672
47	C41AN	-7665	-672	107	VSSA	-3465	-672	167	SDI	735	-672	227	VDDD	4935	-672
48	C41AN	-7595	-672	108	VSSD	-3395	-672	168	SDO	805	-672	228	VDDD	5005	-672
49	VGH	-7525	-672	109	VSSD	-3325	-672	169	VSYNC	875	-672	229	VDDD	5075	-672
50	VGH	-7455	-672	110	VSSD	-3255	-672	170	HSYNC	945	-672	230	VDDD	5145	-672
51	VGH	-7385	-672	111	VSSD	-3185	-672	171	DE	1015	-672	231	VDDD	5215	-672
52	VGH	-7315	-672	112	VSSD	-3115	-672	172	PCLK	1085	-672	232	VDDD	5285	-672
53	VGH	-7245	-672	113	VSSD	-3045	-672	173	DSI_LDO_ENB	1155	-672	233	VDDD	5355	-672
54	VGH	-7175	-672	114	VSSD	-2975	-672	174	DUMMY5	1225	-672	234	VDDD	5425	-672
55	C21AP	-7105	-672	115	VSSD	-2905	-672	175	OSC	1295	-672	235	VSPR	5495	-672
56	C21AP	-7035	-672	116	VDDD	-2835	-672	176	PCCS0	1365	-672	236	VSPR	5565	-672
57	C21AP	-6965	-672	117	VDDD	-2765	-672	177	PCCS1	1435	-672	237	VSPC	5635	-672
58	C21AP	-6895	-672	118	VDDD	-2695	-672	178	DSI_VSS / MDDI_VSS	1505	-672	238	VSP	5705	-672
59	C21AN	-6825	-672	119	VDDD	-2625	-672	179	DSI_DON / MDDI_D1N	1575	-672	239	VSP	5775	-672
60	C21AN	-6755	-672	120	VDDD	-2555	-672	180	DSI_DON / MDDI_D1N	1645	-672	240	VSP	5845	-672



No.	Name	X	Y	No.	Name	X	Y	No.	Name	X	Y	No.	Name	X	Y
241	VSP	5915	-672	301	CGOUT7_R	10115	-672	361	S47	10230	500	421	S107	9330	500
242	VSP	5985	-672	302	CGOUT7_R	10185	-672	362	S48	10215	613	422	S108	9315	613
243	VSP	6055	-672	303	CGOUT6_R	10255	-672	363	S49	10200	500	423	S109	9300	500
244	VSP	6125	-672	304	CGOUT6_R	10325	-672	364	S50	10185	613	424	S110	9285	613
245	VCSW1	6195	-672	305	CGOUT5_R	10395	-672	365	S51	10170	500	425	S111	9270	500
246	VCSW1	6265	-672	306	CGOUT5_R	10465	-672	366	S52	10155	613	426	S112	9255	613
247	VCSW1	6335	-672	307	CGOUT4_R	10535	-672	367	S53	10140	500	427	S113	9240	500
248	VCSW1	6405	-672	308	CGOUT3_R	10605	-672	368	S54	10125	613	428	S114	9225	613
249	VCSW2	6475	-672	309	CGOUT2_R	10675	-672	369	S55	10110	500	429	S115	9210	500
250	VCSW2	6545	-672	310	CGOUT1_R	10745	-672	370	S56	10095	613	430	S116	9195	613
251	VCSW2	6615	-672	311	DUMMY9	10815	-672	371	S57	10080	500	431	S117	9180	500
252	VCSW2	6685	-672	312	DUMMY10	10885	-672	372	S58	10065	613	432	S118	9165	613
253	VSNR	6755	-672	313	DUMMY15	10950	500	373	S59	10050	500	433	S119	9150	500
254	VSNR	6825	-672	314	DUMMY16	10935	613	374	S60	10035	613	434	S120	9135	613
255	VSNC	6895	-672	315	S1	10920	500	375	S61	10020	500	435	S121	9120	500
256	VSN	6965	-672	316	S2	10905	613	376	S62	10005	613	436	S122	9105	613
257	VSN	7035	-672	317	S3	10890	500	377	S63	9990	500	437	S123	9090	500
258	VSN	7105	-672	318	S4	10875	613	378	S64	9975	613	438	S124	9075	613
259	VSN	7175	-672	319	S5	10860	500	379	S65	9960	500	439	S125	9060	500
260	VSN	7245	-672	320	S6	10845	613	380	S66	9945	613	440	S126	9045	613
261	VSN	7315	-672	321	S7	10830	500	381	S67	9930	500	441	S127	9030	500
262	VDD3	7385	-672	322	S8	10815	613	382	S68	9915	613	442	S128	9015	613
263	VDD3	7455	-672	323	S9	10800	500	383	S69	9900	500	443	S129	9000	500
264	VDD3	7525	-672	324	S10	10785	613	384	S70	9885	613	444	S130	8985	613
265	VDD3	7595	-672	325	S11	10770	500	385	S71	9870	500	445	S131	8970	500
266	VDD3	7665	-672	326	S12	10755	613	386	S72	9855	613	446	S132	8955	613
267	VDD3	7735	-672	327	S13	10740	500	387	S73	9840	500	447	S133	8940	500
268	VGH	7805	-672	328	S14	10725	613	388	S74	9825	613	448	S134	8925	613
269	VGH	7875	-672	329	S15	10710	500	389	S75	9810	500	449	S135	8910	500
270	VGH	7945	-672	330	S16	10695	613	390	S76	9795	613	450	S136	8895	613
271	VGH	8015	-672	331	S17	10680	500	391	S77	9780	500	451	S137	8880	500
272	VCOM	8085	-672	332	S18	10665	613	392	S78	9765	613	452	S138	8865	613
273	VCOM	8155	-672	333	S19	10650	500	393	S79	9750	500	453	S139	8850	500
274	VCOM	8225	-672	334	S20	10635	613	394	S80	9735	613	454	S140	8835	613
275	VCOM	8295	-672	335	S21	10620	500	395	S81	9720	500	455	S141	8820	500
276	LVGL	8365	-672	336	S22	10605	613	396	S82	9705	613	456	S142	8805	613
277	LVGL	8435	-672	337	S23	10590	500	397	S83	9690	500	457	S143	8790	500
278	LVGL	8505	-672	338	S24	10575	613	398	S84	9675	613	458	S144	8775	613
279	LVGL	8575	-672	339	S25	10560	500	399	S85	9660	500	459	S145	8760	500
280	VTESTOUTP	8645	-672	340	S26	10545	613	400	S86	9645	613	460	S146	8745	613
281	DUMMY6	8715	-672	341	S27	10530	500	401	S87	9630	500	461	S147	8730	500
282	VCOMR	8785	-672	342	S28	10515	613	402	S88	9615	613	462	S148	8715	613
283	VTESTOUTN	8855	-672	343	S29	10500	500	403	S89	9600	500	463	S149	8700	500
284	VCOM	8925	-672	344	S30	10485	613	404	S90	9585	613	464	S150	8685	613
285	VCOM	8995	-672	345	S31	10470	500	405	S91	9570	500	465	S151	8670	500
286	VCOM	9065	-672	346	S32	10455	613	406	S92	9555	613	466	S152	8655	613
287	DUMMY7	9135	-672	347	S33	10440	500	407	S93	9540	500	467	S153	8640	500
288	DUMMY8	9205	-672	348	S34	10425	613	408	S94	9525	613	468	S154	8625	613
289	LVGL	9275	-672	349	S35	10410	500	409	S95	9510	500	469	S155	8610	500
290	LVGL	9345	-672	350	S36	10395	613	410	S96	9495	613	470	S156	8595	613
291	LVGL	9415	-672	351	S37	10380	500	411	S97	9480	500	471	S157	8580	500
292	VBIAS	9485	-672	352	S38	10365	613	412	S98	9465	613	472	S158	8565	613
293	VGL	9555	-672	353	S39	10350	500	413	S99	9450	500	473	S159	8550	500
294	VGL	9625	-672	354	S40	10335	613	414	S100	9435	613	474	S160	8535	613
295	VGL	9695	-672	355	S41	10320	500	415	S101	9420	500	475	S161	8520	500
296	VGL	9765	-672	356	S42	10305	613	416	S102	9405	613	476	S162	8505	613
297	CGOUT10_R	9835	-672	357	S43	10290	500	417	S103	9390	500	477	S163	8490	500
298	CGOUT9_R	9905	-672	358	S44	10275	613	418	S104	9375	613	478	S164	8475	613
299	CGOUT8_R	9975	-672	359	S45	10260	500	419	S105	9360	500	479	S165	8460	500
300	CGOUT8_R	10045	-672	360	S46	10245	613	420	S106	9345	613	480	S166	8445	613



No.	Name	X	Y	No.	Name	X	Y	No.	Name	X	Y	No.	Name	X	Y
481	S167	8430	500	541	S227	7530	500	601	S287	6630	500	661	S347	5730	500
482	S168	8415	613	542	S228	7515	613	602	S288	6615	613	662	S348	5715	613
483	S169	8400	500	543	S229	7500	500	603	S289	6600	500	663	S349	5700	500
484	S170	8385	613	544	S230	7485	613	604	S290	6585	613	664	S350	5685	613
485	S171	8370	500	545	S231	7470	500	605	S291	6570	500	665	S351	5670	500
486	S172	8355	613	546	S232	7455	613	606	S292	6555	613	666	S352	5655	613
487	S173	8340	500	547	S233	7440	500	607	S293	6540	500	667	S353	5640	500
488	S174	8325	613	548	S234	7425	613	608	S294	6525	613	668	S354	5625	613
489	S175	8310	500	549	S235	7410	500	609	S295	6510	500	669	S355	5610	500
490	S176	8295	613	550	S236	7395	613	610	S296	6495	613	670	S356	5595	613
491	S177	8280	500	551	S237	7380	500	611	S297	6480	500	671	S357	5580	500
492	S178	8265	613	552	S238	7365	613	612	S298	6465	613	672	S358	5565	613
493	S179	8250	500	553	S239	7350	500	613	S299	6450	500	673	S359	5550	500
494	S180	8235	613	554	S240	7335	613	614	S300	6435	613	674	S360	5535	613
495	S181	8220	500	555	S241	7320	500	615	S301	6420	500	675	S361	5520	500
496	S182	8205	613	556	S242	7305	613	616	S302	6405	613	676	S362	5505	613
497	S183	8190	500	557	S243	7290	500	617	S303	6390	500	677	S363	5490	500
498	S184	8175	613	558	S244	7275	613	618	S304	6375	613	678	S364	5475	613
499	S185	8160	500	559	S245	7260	500	619	S305	6360	500	679	S365	5460	500
500	S186	8145	613	560	S246	7245	613	620	S306	6345	613	680	S366	5445	613
501	S187	8130	500	561	S247	7230	500	621	S307	6330	500	681	S367	5430	500
502	S188	8115	613	562	S248	7215	613	622	S308	6315	613	682	S368	5415	613
503	S189	8100	500	563	S249	7200	500	623	S309	6300	500	683	S369	5400	500
504	S190	8085	613	564	S250	7185	613	624	S310	6285	613	684	S370	5385	613
505	S191	8070	500	565	S251	7170	500	625	S311	6270	500	685	S371	5370	500
506	S192	8055	613	566	S252	7155	613	626	S312	6255	613	686	S372	5355	613
507	S193	8040	500	567	S253	7140	500	627	S313	6240	500	687	S373	5340	500
508	S194	8025	613	568	S254	7125	613	628	S314	6225	613	688	S374	5325	613
509	S195	8010	500	569	S255	7110	500	629	S315	6210	500	689	S375	5310	500
510	S196	7995	613	570	S256	7095	613	630	S316	6195	613	690	S376	5295	613
511	S197	7980	500	571	S257	7080	500	631	S317	6180	500	691	S377	5280	500
512	S198	7965	613	572	S258	7065	613	632	S318	6165	613	692	S378	5265	613
513	S199	7950	500	573	S259	7050	500	633	S319	6150	500	693	S379	5250	500
514	S200	7935	613	574	S260	7035	613	634	S320	6135	613	694	S380	5235	613
515	S201	7920	500	575	S261	7020	500	635	S321	6120	500	695	S381	5220	500
516	S202	7905	613	576	S262	7005	613	636	S322	6105	613	696	S382	5205	613
517	S203	7890	500	577	S263	6990	500	637	S323	6090	500	697	S383	5190	500
518	S204	7875	613	578	S264	6975	613	638	S324	6075	613	698	S384	5175	613
519	S205	7860	500	579	S265	6960	500	639	S325	6060	500	699	S385	5160	500
520	S206	7845	613	580	S266	6945	613	640	S326	6045	613	700	S386	5145	613
521	S207	7830	500	581	S267	6930	500	641	S327	6030	500	701	S387	5130	500
522	S208	7815	613	582	S268	6915	613	642	S328	6015	613	702	S388	5115	613
523	S209	7800	500	583	S269	6900	500	643	S329	6000	500	703	S389	5100	500
524	S210	7785	613	584	S270	6885	613	644	S330	5985	613	704	S390	5085	613
525	S211	7770	500	585	S271	6870	500	645	S331	5970	500	705	S391	5070	500
526	S212	7755	613	586	S272	6855	613	646	S332	5955	613	706	S392	5055	613
527	S213	7740	500	587	S273	6840	500	647	S333	5940	500	707	S393	5040	500
528	S214	7725	613	588	S274	6825	613	648	S334	5925	613	708	S394	5025	613
529	S215	7710	500	589	S275	6810	500	649	S335	5910	500	709	S395	5010	500
530	S216	7695	613	590	S276	6795	613	650	S336	5895	613	710	S396	4995	613
531	S217	7680	500	591	S277	6780	500	651	S337	5880	500	711	S397	4980	500
532	S218	7665	613	592	S278	6765	613	652	S338	5865	613	712	S398	4965	613
533	S219	7650	500	593	S279	6750	500	653	S339	5850	500	713	S399	4950	500
534	S220	7635	613	594	S280	6735	613	654	S340	5835	613	714	S400	4935	613
535	S221	7620	500	595	S281	6720	500	655	S341	5820	500	715	S401	4920	500
536	S222	7605	613	596	S282	6705	613	656	S342	5805	613	716	S402	4905	613
537	S223	7590	500	597	S283	6690	500	657	S343	5790	500	717	S403	4890	500
538	S224	7575	613	598	S284	6675	613	658	S344	5775	613	718	S404	4875	613
539	S225	7560	500	599	S285	6660	500	659	S345	5760	500	719	S405	4860	500
540	S226	7545	613	600	S286	6645	613	660	S346	5745	613	720	S406	4845	613

No.	Name	X	Y	No.	Name	X	Y	No.	Name	X	Y	No.	Name	X	Y
721	S407	4830	500	781	S467	3930	500	841	S527	3030	500	901	S587	2130	500
722	S408	4815	613	782	S468	3915	613	842	S528	3015	613	902	S588	2115	613
723	S409	4800	500	783	S469	3900	500	843	S529	3000	500	903	S589	2100	500
724	S410	4785	613	784	S470	3885	613	844	S530	2985	613	904	S590	2085	613
725	S411	4770	500	785	S471	3870	500	845	S531	2970	500	905	S591	2070	500
726	S412	4755	613	786	S472	3855	613	846	S532	2955	613	906	S592	2055	613
727	S413	4740	500	787	S473	3840	500	847	S533	2940	500	907	S593	2040	500
728	S414	4725	613	788	S474	3825	613	848	S534	2925	613	908	S594	2025	613
729	S415	4710	500	789	S475	3810	500	849	S535	2910	500	909	S595	2010	500
730	S416	4695	613	790	S476	3795	613	850	S536	2895	613	910	S596	1995	613
731	S417	4680	500	791	S477	3780	500	851	S537	2880	500	911	S597	1980	500
732	S418	4665	613	792	S478	3765	613	852	S538	2865	613	912	S598	1965	613
733	S419	4650	500	793	S479	3750	500	853	S539	2850	500	913	S599	1950	500
734	S420	4635	613	794	S480	3735	613	854	S540	2835	613	914	S600	1935	613
735	S421	4620	500	795	S481	3720	500	855	S541	2820	500	915	S601	1920	500
736	S422	4605	613	796	S482	3705	613	856	S542	2805	613	916	S602	1905	613
737	S423	4590	500	797	S483	3690	500	857	S543	2790	500	917	S603	1890	500
738	S424	4575	613	798	S484	3675	613	858	S544	2775	613	918	S604	1875	613
739	S425	4560	500	799	S485	3660	500	859	S545	2760	500	919	S605	1860	500
740	S426	4545	613	800	S486	3645	613	860	S546	2745	613	920	S606	1845	613
741	S427	4530	500	801	S487	3630	500	861	S547	2730	500	921	S607	1830	500
742	S428	4515	613	802	S488	3615	613	862	S548	2715	613	922	S608	1815	613
743	S429	4500	500	803	S489	3600	500	863	S549	2700	500	923	S609	1800	500
744	S430	4485	613	804	S490	3585	613	864	S550	2685	613	924	S610	1785	613
745	S431	4470	500	805	S491	3570	500	865	S551	2670	500	925	S611	1770	500
746	S432	4455	613	806	S492	3555	613	866	S552	2655	613	926	S612	1755	613
747	S433	4440	500	807	S493	3540	500	867	S553	2640	500	927	S613	1740	500
748	S434	4425	613	808	S494	3525	613	868	S554	2625	613	928	S614	1725	613
749	S435	4410	500	809	S495	3510	500	869	S555	2610	500	929	S615	1710	500
750	S436	4395	613	810	S496	3495	613	870	S556	2595	613	930	S616	1695	613
751	S437	4380	500	811	S497	3480	500	871	S557	2580	500	931	S617	1680	500
752	S438	4365	613	812	S498	3465	613	872	S558	2565	613	932	S618	1665	613
753	S439	4350	500	813	S499	3450	500	873	S559	2550	500	933	S619	1650	500
754	S440	4335	613	814	S500	3435	613	874	S560	2535	613	934	S620	1635	613
755	S441	4320	500	815	S501	3420	500	875	S561	2520	500	935	S621	1620	500
756	S442	4305	613	816	S502	3405	613	876	S562	2505	613	936	S622	1605	613
757	S443	4290	500	817	S503	3390	500	877	S563	2490	500	937	S623	1590	500
758	S444	4275	613	818	S504	3375	613	878	S564	2475	613	938	S624	1575	613
759	S445	4260	500	819	S505	3360	500	879	S565	2460	500	939	S625	1560	500
760	S446	4245	613	820	S506	3345	613	880	S566	2445	613	940	S626	1545	613
761	S447	4230	500	821	S507	3330	500	881	S567	2430	500	941	S627	1530	500
762	S448	4215	613	822	S508	3315	613	882	S568	2415	613	942	S628	1515	613
763	S449	4200	500	823	S509	3300	500	883	S569	2400	500	943	S629	1500	500
764	S450	4185	613	824	S510	3285	613	884	S570	2385	613	944	S630	1485	613
765	S451	4170	500	825	S511	3270	500	885	S571	2370	500	945	S631	1470	500
766	S452	4155	613	826	S512	3255	613	886	S572	2355	613	946	S632	1455	613
767	S453	4140	500	827	S513	3240	500	887	S573	2340	500	947	S633	1440	500
768	S454	4125	613	828	S514	3225	613	888	S574	2325	613	948	S634	1425	613
769	S455	4110	500	829	S515	3210	500	889	S575	2310	500	949	S635	1410	500
770	S456	4095	613	830	S516	3195	613	890	S576	2295	613	950	S636	1395	613
771	S457	4080	500	831	S517	3180	500	891	S577	2280	500	951	S637	1380	500
772	S458	4065	613	832	S518	3165	613	892	S578	2265	613	952	S638	1365	613
773	S459	4050	500	833	S519	3150	500	893	S579	2250	500	953	S639	1350	500
774	S460	4035	613	834	S520	3135	613	894	S580	2235	613	954	S640	1335	613
775	S461	4020	500	835	S521	3120	500	895	S581	2220	500	955	S641	1320	500
776	S462	4005	613	836	S522	3105	613	896	S582	2205	613	956	S642	1305	613
777	S463	3990	500	837	S523	3090	500	897	S583	2190	500	957	S643	1290	500
778	S464	3975	613	838	S524	3075	613	898	S584	2175	613	958	S644	1275	613
779	S465	3960	500	839	S525	3060	500	899	S585	2160	500	959	S645	1260	500
780	S466	3945	613	840	S526	3045	613	900	S586	2145	613	960	S646	1245	613

No.	Name	X	Y	No.	Name	X	Y	No.	Name	X	Y	No.	Name	X	Y
961	S647	1230	500	1021	S707	330	500	1081	S763	-765	613	1141	S823	-1665	613
962	S648	1215	613	1022	S708	315	613	1082	S764	-780	500	1142	S824	-1680	500
963	S649	1200	500	1023	S709	300	500	1083	S765	-795	613	1143	S825	-1695	613
964	S650	1185	613	1024	S710	285	613	1084	S766	-810	500	1144	S826	-1710	500
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966	S652	1155	613	1026	S712	255	613	1086	S768	-840	500	1146	S828	-1740	500
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968	S654	1125	613	1028	S714	225	613	1088	S770	-870	500	1148	S830	-1770	500
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980	S666	945	613	1040	S722	-150	500	1100	S782	-1050	500	1160	S842	-1950	500
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982	S668	915	613	1042	S724	-180	500	1102	S784	-1080	500	1162	S844	-1980	500
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984	S670	885	613	1044	S726	-210	500	1104	S786	-1110	500	1164	S846	-2010	500
985	S671	870	500	1045	S727	-225	613	1105	S787	-1125	613	1165	S847	-2025	613
986	S672	855	613	1046	S728	-240	500	1106	S788	-1140	500	1166	S848	-2040	500
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988	S674	825	613	1048	S730	-270	500	1108	S790	-1170	500	1168	S850	-2070	500
989	S675	810	500	1049	S731	-285	613	1109	S791	-1185	613	1169	S851	-2085	613
990	S676	795	613	1050	S732	-300	500	1110	S792	-1200	500	1170	S852	-2100	500
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998	S684	675	613	1058	S740	-420	500	1118	S800	-1320	500	1178	S860	-2220	500
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1004	S690	585	613	1064	S746	-510	500	1124	S806	-1410	500	1184	S866	-2310	500
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1006	S692	555	613	1066	S748	-540	500	1126	S808	-1440	500	1186	S868	-2340	500
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1017	S703	390	500	1077	S759	-705	613	1137	S819	-1605	613	1197	S879	-2505	613
1018	S704	375	613	1078	S760	-720	500	1138	S820	-1620	500	1198	S880	-2520	500
1019	S705	360	500	1079	S761	-735	613	1139	S821	-1635	613	1199	S881	-2535	613
1020	S706	345	613	1080	S762	-750	500	1140	S822	-1650	500	1200	S882	-2550	500

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1203	S885	-2595	613	1263	S945	-3495	613	1323	S1005	-4395	613	1383	S1065	-5295	613
1204	S886	-2610	500	1264	S946	-3510	500	1324	S1006	-4410	500	1384	S1066	-5310	500
1205	S887	-2625	613	1265	S947	-3525	613	1325	S1007	-4425	613	1385	S1067	-5325	613
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1208	S890	-2670	500	1268	S950	-3570	500	1328	S1010	-4470	500	1388	S1070	-5370	500
1209	S891	-2685	613	1269	S951	-3585	613	1329	S1011	-4485	613	1389	S1071	-5385	613
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1243	S925	-3195	613	1303	S985	-4095	613	1363	S1045	-4995	613	1423	S1105	-5895	613
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1259	S941	-3435	613	1319	S1001	-4335	613	1379	S1061	-5235	613	1439	S1121	-6135	613
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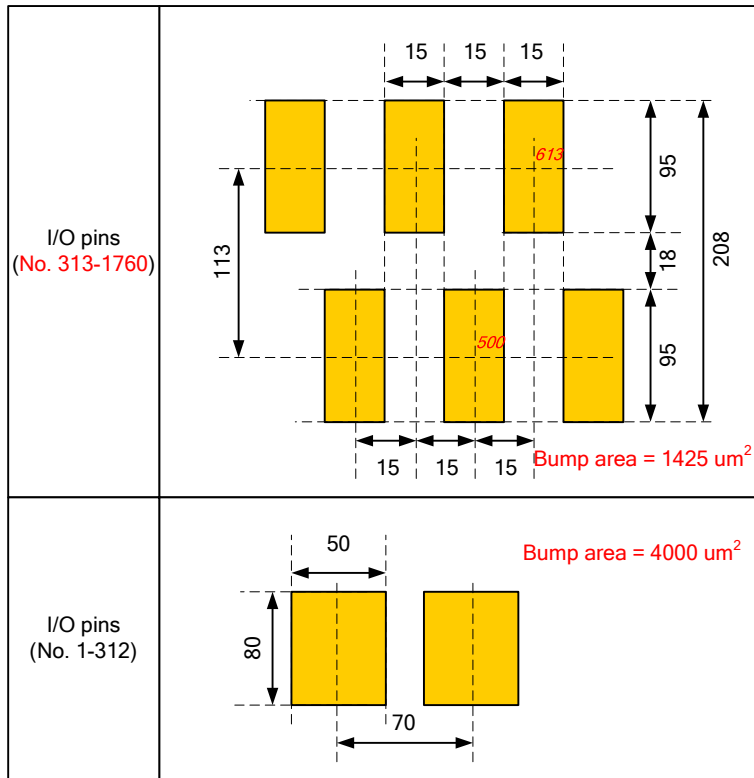
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1442	S1124	-6180	500	1502	S1184	-7080	500	1562	S1244	-7980	500	1622	S1304	-8880	500
1443	S1125	-6195	613	1503	S1185	-7095	613	1563	S1245	-7995	613	1623	S1305	-8895	613
1444	S1126	-6210	500	1504	S1186	-7110	500	1564	S1246	-8010	500	1624	S1306	-8910	500
1445	S1127	-6225	613	1505	S1187	-7125	613	1565	S1247	-8025	613	1625	S1307	-8925	613
1446	S1128	-6240	500	1506	S1188	-7140	500	1566	S1248	-8040	500	1626	S1308	-8940	500
1447	S1129	-6255	613	1507	S1189	-7155	613	1567	S1249	-8055	613	1627	S1309	-8955	613
1448	S1130	-6270	500	1508	S1190	-7170	500	1568	S1250	-8070	500	1628	S1310	-8970	500
1449	S1131	-6285	613	1509	S1191	-7185	613	1569	S1251	-8085	613	1629	S1311	-8985	613
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1451	S1133	-6315	613	1511	S1193	-7215	613	1571	S1253	-8115	613	1631	S1313	-9015	613
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1453	S1135	-6345	613	1513	S1195	-7245	613	1573	S1255	-8145	613	1633	S1315	-9045	613
1454	S1136	-6360	500	1514	S1196	-7260	500	1574	S1256	-8160	500	1634	S1316	-9060	500
1455	S1137	-6375	613	1515	S1197	-7275	613	1575	S1257	-8175	613	1635	S1317	-9075	613
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1457	S1139	-6405	613	1517	S1199	-7305	613	1577	S1259	-8205	613	1637	S1319	-9105	613
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1467	S1149	-6555	613	1527	S1209	-7455	613	1587	S1269	-8355	613	1647	S1329	-9255	613
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1481	S1163	-6765	613	1541	S1223	-7665	613	1601	S1283	-8565	613	1661	S1343	-9465	613
1482	S1164	-6780	500	1542	S1224	-7680	500	1602	S1284	-8580	500	1662	S1344	-9480	500
1483	S1165	-6795	613	1543	S1225	-7695	613	1603	S1285	-8595	613	1663	S1345	-9495	613
1484	S1166	-6810	500	1544	S1226	-7710	500	1604	S1286	-8610	500	1664	S1346	-9510	500
1485	S1167	-6825	613	1545	S1227	-7725	613	1605	S1287	-8625	613	1665	S1347	-9525	613
1486	S1168	-6840	500	1546	S1228	-7740	500	1606	S1288	-8640	500	1666	S1348	-9540	500
1487	S1169	-6855	613	1547	S1229	-7755	613	1607	S1289	-8655	613	1667	S1349	-9555	613
1488	S1170	-6870	500	1548	S1230	-7770	500	1608	S1290	-8670	500	1668	S1350	-9570	500
1489	S1171	-6885	613	1549	S1231	-7785	613	1609	S1291	-8685	613	1669	S1351	-9585	613
1490	S1172	-6900	500	1550	S1232	-7800	500	1610	S1292	-8700	500	1670	S1352	-9600	500
1491	S1173	-6915	613	1551	S1233	-7815	613	1611	S1293	-8715	613	1671	S1353	-9615	613
1492	S1174	-6930	500	1552	S1234	-7830	500	1612	S1294	-8730	500	1672	S1354	-9630	500
1493	S1175	-6945	613	1553	S1235	-7845	613	1613	S1295	-8745	613	1673	S1355	-9645	613
1494	S1176	-6960	500	1554	S1236	-7860	500	1614	S1296	-8760	500	1674	S1356	-9660	500
1495	S1177	-6975	613	1555	S1237	-7875	613	1615	S1297	-8775	613	1675	S1357	-9675	613
1496	S1178	-6990	500	1556	S1238	-7890	500	1616	S1298	-8790	500	1676	S1358	-9690	500
1497	S1179	-7005	613	1557	S1239	-7905	613	1617	S1299	-8805	613	1677	S1359	-9705	613
1498	S1180	-7020	500	1558	S1240	-7920	500	1618	S1300	-8820	500	1678	S1360	-9720	500
1499	S1181	-7035	613	1559	S1241	-7935	613	1619	S1301	-8835	613	1679	S1361	-9735	613
1500	S1182	-7050	500	1560	S1242	-7950	500	1620	S1302	-8850	500	1680	S1362	-9750	500

No.	Name	X	Y	No.	Name	X	Y	Alignment mark	X	Y
1681	S1363	-9765	613	1741	S1423	-10665	613	A1	-11060	600
1682	S1364	-9780	500	1742	S1424	-10680	500	A2	11060	600
1683	S1365	-9795	613	1743	S1425	-10695	613			
1684	S1366	-9810	500	1744	S1426	-10710	500			
1685	S1367	-9825	613	1745	S1427	-10725	613			
1686	S1368	-9840	500	1746	S1428	-10740	500			
1687	S1369	-9855	613	1747	S1429	-10755	613			
1688	S1370	-9870	500	1748	S1430	-10770	500			
1689	S1371	-9885	613	1749	S1431	-10785	613			
1690	S1372	-9900	500	1750	S1432	-10800	500			
1691	S1373	-9915	613	1751	S1433	-10815	613			
1692	S1374	-9930	500	1752	S1434	-10830	500			
1693	S1375	-9945	613	1753	S1435	-10845	613			
1694	S1376	-9960	500	1754	S1436	-10860	500			
1695	S1377	-9975	613	1755	S1437	-10875	613			
1696	S1378	-9990	500	1756	S1438	-10890	500			
1697	S1379	-10005	613	1757	S1439	-10905	613			
1698	S1380	-10020	500	1758	S1440	-10920	500			
1699	S1381	-10035	613	1759	S1441 (for Zig-Zag)	-10935	613			
1700	S1382	-10050	500	1760	Dummy17	-10950	500			
1701	S1383	-10065	613							
1702	S1384	-10080	500							
1703	S1385	-10095	613							
1704	S1386	-10110	500							
1705	S1387	-10125	613							
1706	S1388	-10140	500							
1707	S1389	-10155	613							
1708	S1390	-10170	500							
1709	S1391	-10185	613							
1710	S1392	-10200	500							
1711	S1393	-10215	613							
1712	S1394	-10230	500							
1713	S1395	-10245	613							
1714	S1396	-10260	500							
1715	S1397	-10275	613							
1716	S1398	-10290	500							
1717	S1399	-10305	613							
1718	S1400	-10320	500							
1719	S1401	-10335	613							
1720	S1402	-10350	500							
1721	S1403	-10365	613							
1722	S1404	-10380	500							
1723	S1405	-10395	613							
1724	S1406	-10410	500							
1725	S1407	-10425	613							
1726	S1408	-10440	500							
1727	S1409	-10455	613							
1728	S1410	-10470	500							
1729	S1411	-10485	613							
1730	S1412	-10500	500							
1731	S1413	-10515	613							
1732	S1414	-10530	500							
1733	S1415	-10545	613							
1734	S1416	-10560	500							
1735	S1417	-10575	613							
1736	S1418	-10590	500							
1737	S1419	-10605	613							
1738	S1420	-10620	500							
1739	S1421	-10635	613							
1740	S1422	-10650	500							

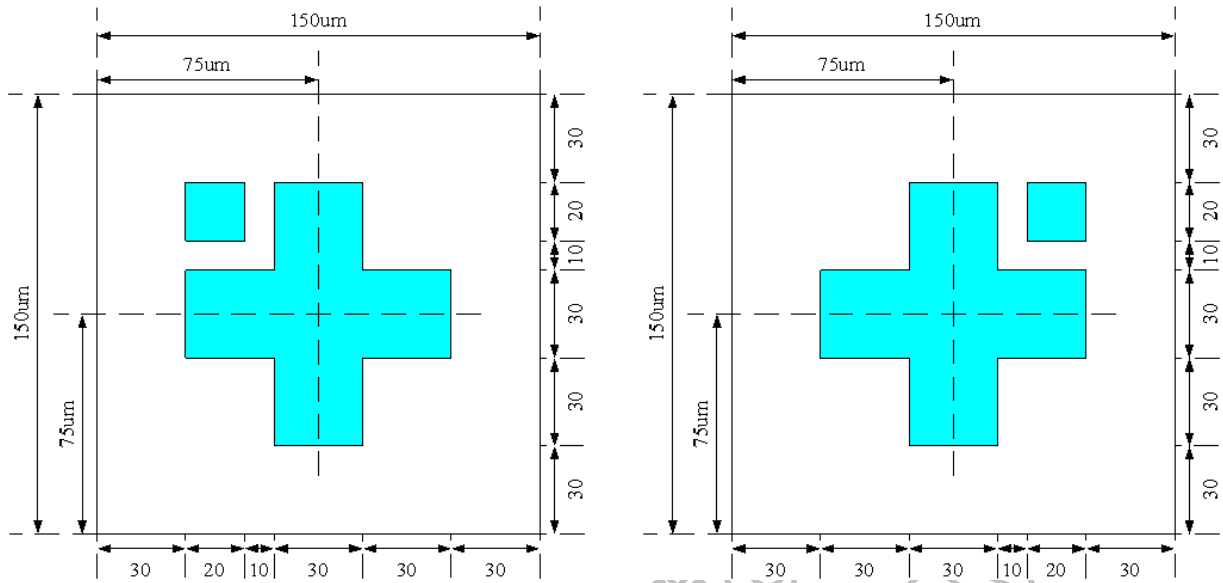
Himax Confidential  
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3.4.1 Bump arrangement



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## 4. Interface

### 4.1 System interface

The HX8369-A supports MDDI (Mobile Display Digital Interface) and MIPI interfaces: DBI (Display Bus Interface), DPI (Display Pixel Interface), DSI (Display Serial Interface). Where DBI supports (16-/9-/8-bit interface) Parallel Interface (Type A, Type B) and Serial interface (Type C). The interface mode can be selected by BS3-0 pins setting as show in Table 4.1.

BS3	BS2	BS1	BS0	Interface	Display data	Display mode
0	0	0	0	DBI TYPE-A 8-bit (CLK-E)	GRAM	Type 1
0	0	0	1	DBI TYPE-A 9-bit (CLK-E)	GRAM	Type 1
0	0	1	0	DBI TYPE-A 16-bit (CLK-E)	GRAM	Type 1
0	0	1	1	DBI TYPE-A 18-bit (CLK-E)	GRAM	Type 1
0	1	0	0	DBI TYPE-B 8-bit	GRAM	Type 1
0	1	0	1	DBI TYPE-B 9-bit	GRAM	Type 1
0	1	1	0	DBI TYPE-B 16-bit	GRAM	Type 1
0	1	1	1	DBI TYPE-B 18-bit	GRAM	Type 1
1	0	0	0	DSI (Command mode)	GRAM	Type 1
1	0	0	1	MDDI (3-wire serial + MDDI interface)	GRAM	-
1	0	1	0	DBI TYPE-B 24-bit	GRAM	Type 1
1	1	0	0	DSI (Video mode)	DSI I/F	Type 3
1	1	0	1	DPI / DBI TYPE-C Option 1	DPI / GRAM	Type 3
1	1	1	0	DPI / DBI TYPE-C Option 2	DPI / GRAM	Type 3
1	1	1	1	DPI / DBI TYPE-C Option 3	DPI / GRAM	Type 3

Table 4.1: Interface selection

The HX8369-A includes an index register (IR), which is stored the index data of internal control register and GRAM. When DCX="L", the command via DBI interface write into register. When DCX="H", GRAM data via R2Ch register can be written through data bus. When the data is written into the GRAM from the MPU, it is first written into the write-data latch and then automatically written into the GRAM by internal operation. Data is read through the read-data latch when reading from the GRAM.

When data is read from the GRAM to the MPU, it is first read from GRAM to the read-data latch and then data is read to MPU through the read-data latch in next read operation. Therefore, the read data in data bus in first read operation is invalid, and the read data in data bus in second and the following read operation is valid.

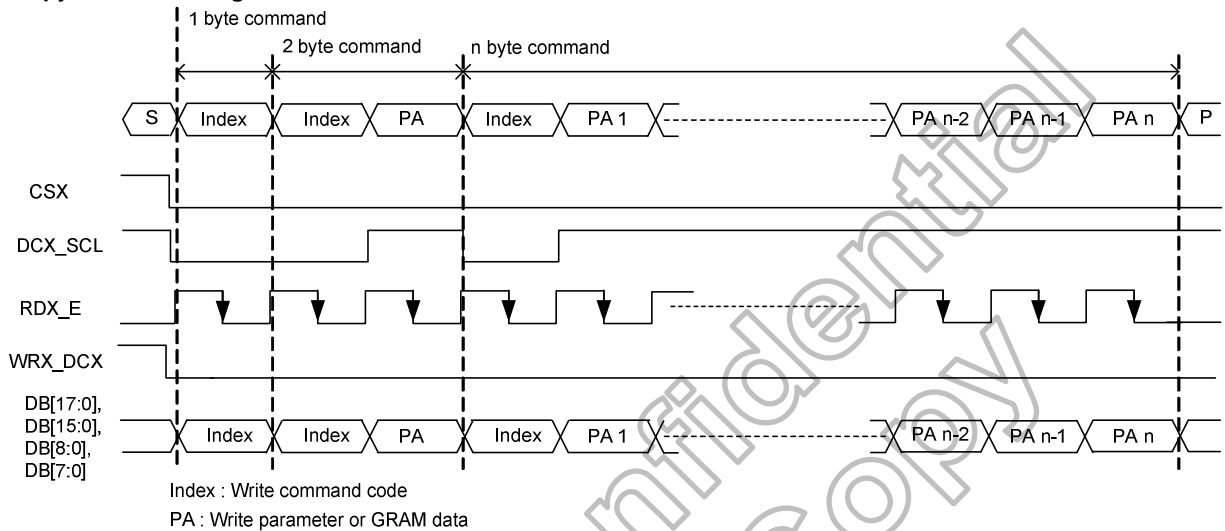
Interface	RDX_E	WRX_DCX	DCX_SCL	D23-D0 or other input pin
DBI Type C 3-wire serial interface + DPI interface	Unused	Unused	SCL	DB23-DB0: 18-bit data bus SDI/SDO
DBI Type A 8-bit parallel	E	RW	DCX	DB23-DB8: Unused, DB7-DB0: 8-bit data bus
DBI Type A 9-bit parallel	E	RW	DCX	DB23-DB9: Unused, DB8-DB0: 9-bit data bus
DBI Type A 16-bit parallel	E	RW	DCX	DB23-DB16: Unused, DB15-DB0: 16-bit data bus
DBI Type A 18-bit parallel	E	RW	DCX	DB23-DB18: Unused, DB17-DB0: 18-bit data bus
DBI Type C 4-wire serial interface + DPI interface	Unused	DCX	SCL	DB23-DB0: 18-bit data bus SDI/SDO
DBI Type B 8-bit parallel	RDX	WRX	DCX	DB23-DB8: Unused, D7-D0: 8-bit data bus
DBI Type B 9-bit parallel	RDX	WRX	DCX	DB23-DB9: Unused, DB8-DB0: 9-bit data bus
DBI Type B 16-bit parallel	RDX	WRX	DCX	DB23-DB16: Unused, DB15-DB0: 16-bit data bus
DBI Type B 18-bit parallel	RDX	WRX	DCX	DB23-DB18: Unused, DB17-DB0: 18-bit data bus
DBI Type B 24-bit parallel	RDX	WRX	DCX	DB23-DB0: 24-bit data bus
Display Serial Interface	Unused	Unused	Unused	DSI_CLKP, DSI_CLKN, DSI_D0P, DSI_D0N,
MDDI (Mobile Display Digital Interface)	Unused	Unused	Unused	MDDI_STBP, MDDI_STBN, MDDI_DATAP, MDDI_DATAN,

Table 4.2: Pin connection based on different interface

**4.1.1 MIPI DBI-A / DBI-B interface**

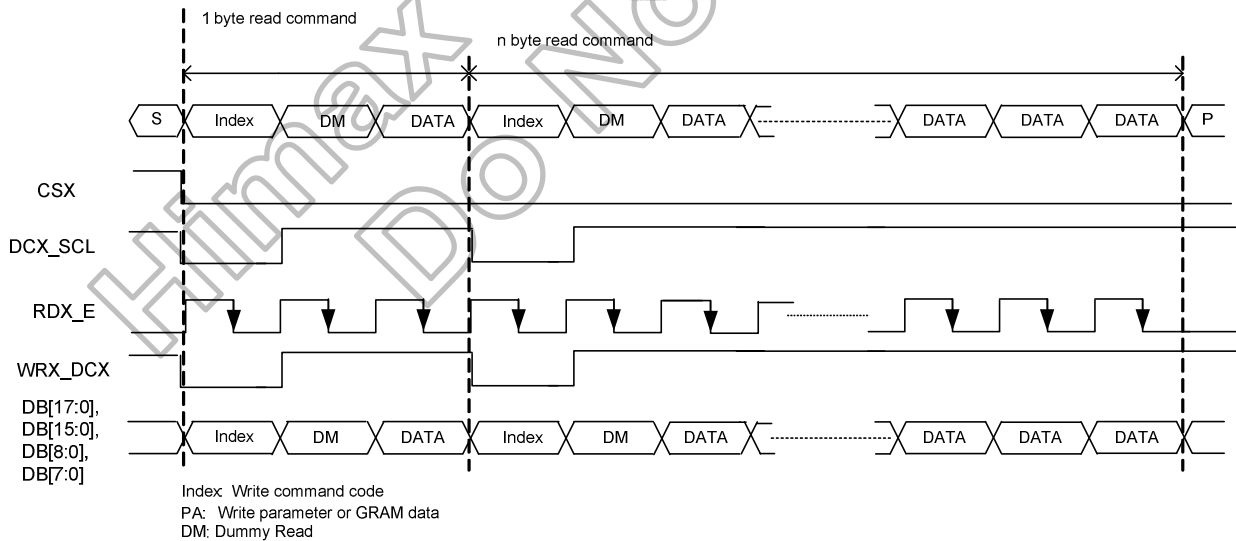
The selection of DBI interface is by BS3 pin. When this pin is low state (VSSD), the interface is use DBI system. And use BS2 to BS0 pins to selsect DBI interfacr mode. The parallel interface timing diagram is described in Figure 4.1 to Figure 4.4.

**DBI Type A write to register or GRAM – CLK-E mode**



**Figure 4.1: DBI-A system interface protocol, write to register or GRAM**

**DBI Type A read from register or GRAM – CLK-E mode**



**Figure 4.2: DBI-A system interface protocol, read from register or GRAM**

DBI Type B write to register or GRAM

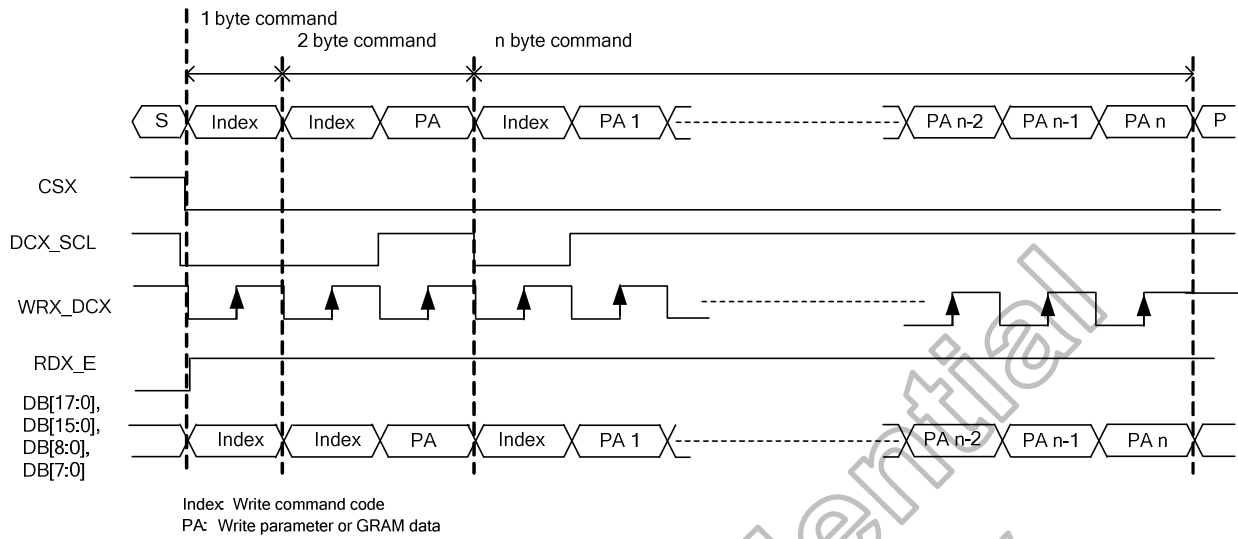


Figure 4.3: DBI-B system interface protocol, write to register or GRAM

DBI Type B read from register or GRAM

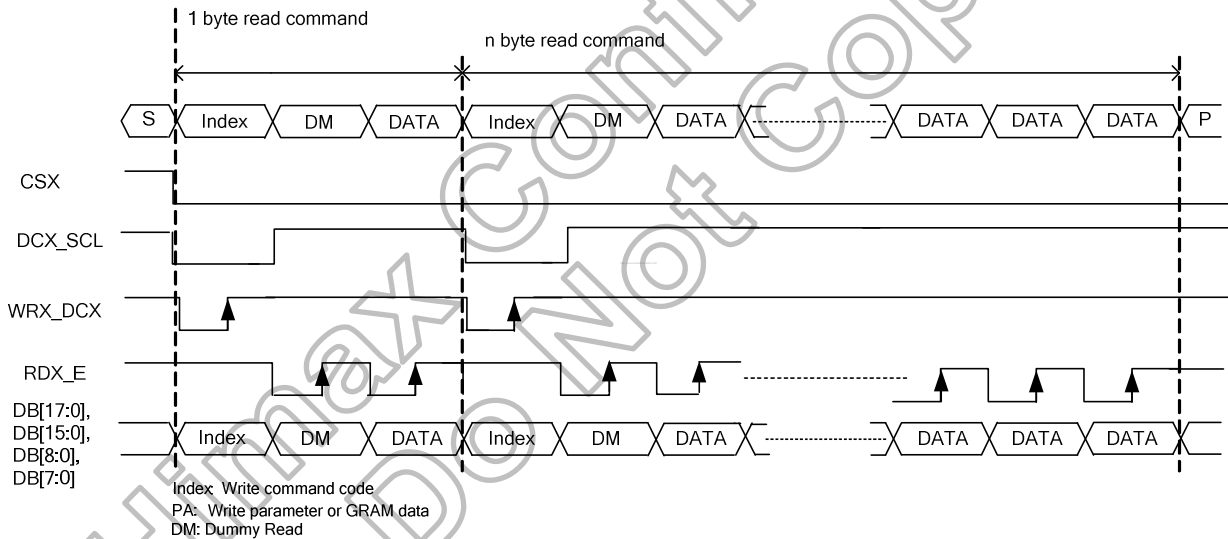


Figure 4.4: DBI-B system interface protocol, read from register or GRAM



4.1.1.1 24-bit parallel bus system interface

The DBI-B system 24-bit bus parallel data transfer can be used by setting “BS3-0” pins to “1010”. The Figure 4.5 is the example of interface with 18-bit DBI-A / DBI-B microcomputer system interface.

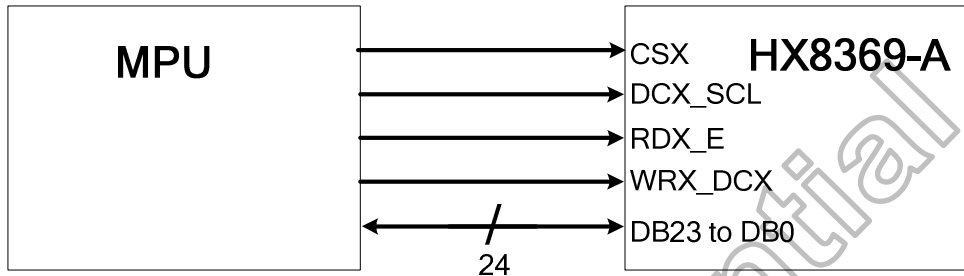


Figure 4.5 Example of DBI-B system 18-bit parallel bus interface

There are one type data format to write display data at 24-bit bus Interface. See Figure 4.6.

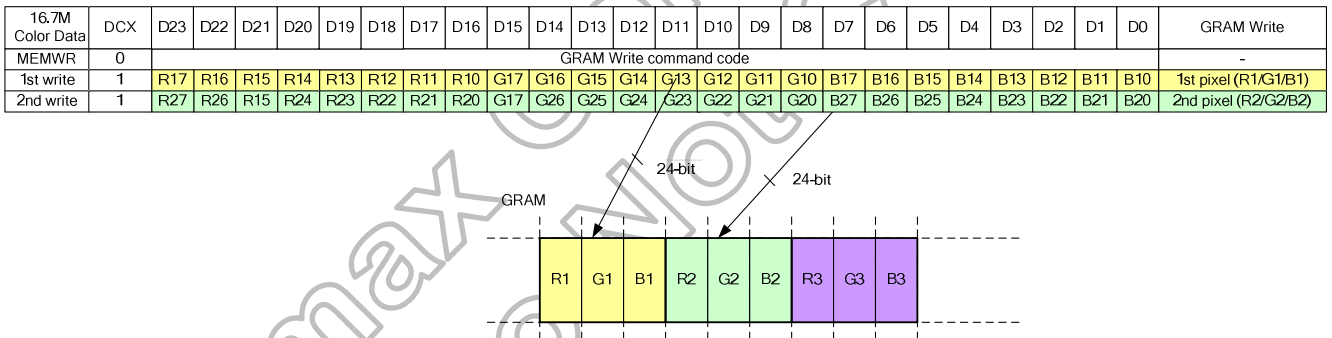


Figure 4.6: Write data for RGB 8-8-8 (16.7M colours) bit Input in 24-bit parallel interface

4.1.1.2 18-bit parallel bus system interface

The DBI-A system 18-bit bus parallel data transfer can be used by setting “BS3-0” pins to “0011”. And the DBI-B system 18-bit bus parallel data transfer can be used by setting “BS3-0” pins to “0111”. The Figure 4.7 is the example of interface with 18-bit DBI-A / DBI-B microcomputer system interface.

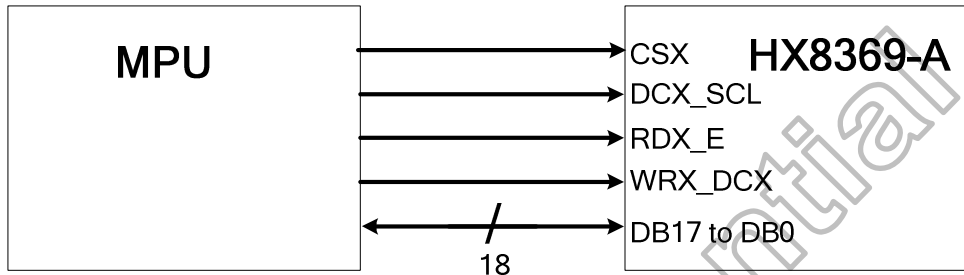


Figure 4.7: Example of DBI-A- / DBI-B system 18-bit parallel bus interface

There are three types data format to write display data at 18-bit bus Interface. See Figure 4.8 to Figure 4.10. Under this type, the data format can select as 16- / 18- / 24-bit by register R3Ah. (set\_pixel\_format)

65k Color Data	DCX	D17	D16	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0	GRAM Write
MEMWR	0	GRAM Write command code																		-
1st write	1	x	x	R14	R13	R12	R11	R10	G15	G14	G13	G12	G11	G10	B14	B13	B12	B11	B10	1st pixel (R1/G1/B1)
2nd write	1	x	x	R24	R23	R22	R21	R20	G25	G24	G23	G22	G21	G20	B24	B23	B22	B21	B20	2nd pixel (R2/G2/B2)

Look-Up Table for 65k Color data mapping (16-bit to 24-bit)

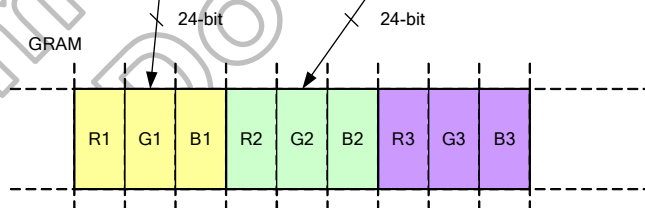


Figure 4.8: Write data for RGB 5-6-5 (65k colours) bit input in 18-bit parallel interface

262k Color Data	DCX	D17	D16	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0	GRAM Write
MEMWR	0	GRAM Write command code																		-
1st write	1	R15	R14	R13	R12	R11	R10	G15	G14	G13	G12	G11	G10	B15	B14	B13	B12	B11	B10	1st pixel (R1/G1/B1)
2nd write	1	R25	R24	R23	R22	R21	R20	G25	G24	G23	G22	G21	G20	B25	B24	B23	B22	B21	B20	2nd pixel (R2/G2/B2)

Look-Up Table for 262k Color data mapping (18-bit to 24-bit)

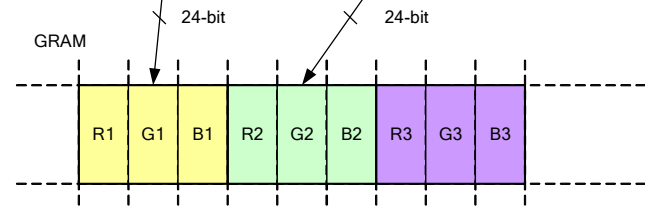
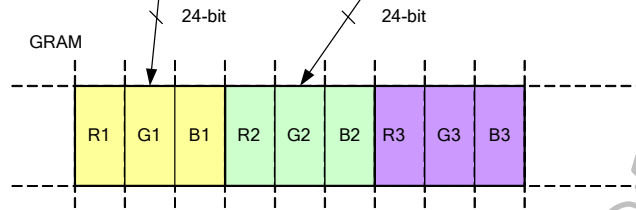
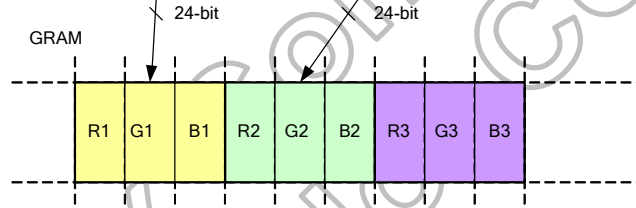


Figure 4.9: Write data for RGB 6-6-6(262k colours) bit input in 18-bit parallel interface

16.7M Color Data	DCX	D17	D16	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0	GRAM Write
MEMWR	0	GRAM Write command code																		-
1st write	1	R17	R16	R15	R14	R13	R12	R11	R10	x	x	G7	G6	G5	G4	G3	G2	G1	G0	1st pixel (R1/G1/B1)
2nd write	1	B17	B16	B15	B14	B13	B12	B11	B10	x	x	R27	R26	R25	R24	R23	R22	R21	R20	x
3rd write	1	G27	G26	G25	G24	G23	G22	G21	G20	x	x	B27	B26	B25	B24	B23	B22	B21	B20	2nd pixel (R2/G2/B2)



16.7M Color Data	DCX	D17	D16	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0	GRAM Write
MEMWR	0	GRAM Write command code																		-
1st write	1	R17	R16	R15	R14	R13	R12	R11	R10	x	x	G7	G6	G5	G4	G3	G2	G1	G0	1st pixel (R1/G1/B1)
2nd write	1	B17	B16	B15	B14	B13	B12	B11	B10	x	x	R27	R26	R25	R24	R23	R22	R21	R20	-
-	0	The other command																		-
MEMWR	0	GRAM Write command code																		-
1st write	1	R27	R26	R25	R24	R23	R22	R21	R20	x	x	G27	G26	G25	G24	G23	G22	G21	G20	2nd pixel (R2/G2/B2)
2nd write	1	B27	B26	B25	B24	B23	B22	B21	B20	x	x	R37	R36	R35	R34	R33	R32	R31	R30	-
3rd write	1	G37	G36	G35	G34	G33	G32	G31	G30	x	x	B37	B36	B35	B34	B33	B32	B31	B30	3rd pixel (R3/G3/B3)



R27 ~ R20 will be neglected and are not used

Figure 4.10: Write data for RGB 8-8-8 (16.7M colours) bit input in 18-bit parallel interface

4.1.1.3 16-bit parallel bus system interface

The DBI-A system 16-bit bus parallel data transfer can be used by setting “BS3-0” pins to “0010”. And the DBI-B system 16-bit bus parallel data transfer can be used by setting “BS3-0” pins to “0110”. The Figure 4.11 is the example of interface with 16-bit DBI-A / DBI-B microcomputer system interface.

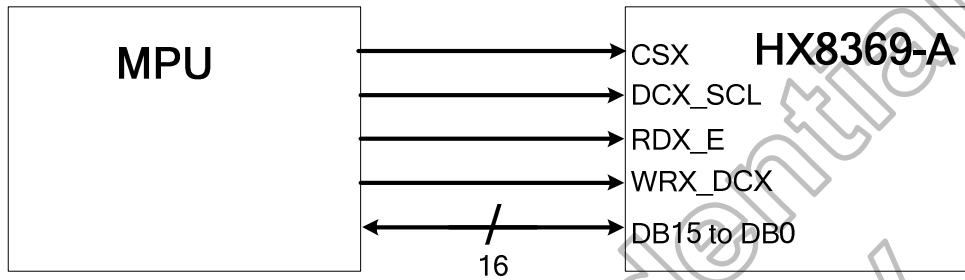


Figure 4.11: Example of DBI-A / DBI-B system 16-bit bus interface

There are three types data format to write display data at 16-bit bus Interface. See Figure 4.12 to Figure 4. 14. Under this type, the data format can select as 16- / 18- / 24-bit by register R3Ah. (set\_pixel\_format)

65k Color Data	DCX	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0	GRAM Write
MEMWR	0	GRAM Write command code																-
1st write	1	R14	R13	R12	R11	R10	G15	G14	G13	G12	G11	G10	B14	B13	B12	B11	B10	1st pixel (R1/G1/B1)
2nd write	1	R24	R23	R22	R21	R20	G25	G24	G23	G22	G21	G20	B24	B23	B22	B21	B20	2nd pixel (R2/G2/B2)

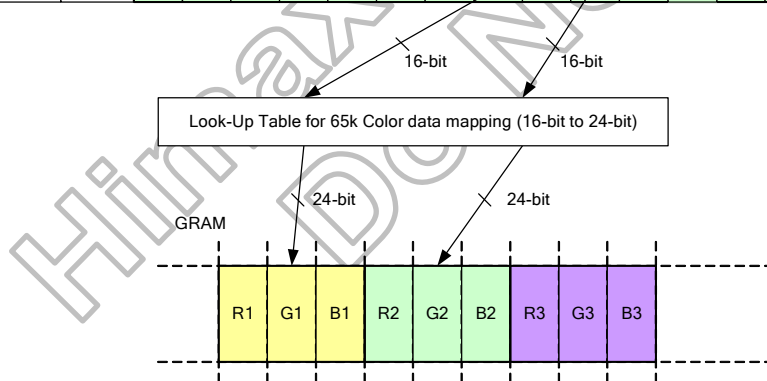


Figure 4.12: Write data for RGB 5-6-5 (65k colours) bit input in 16-bit parallel interface

262K Color Data	DCX	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0	GRAM Write
MEMWR	0	GRAM Write command code																-
1st write	1	R15	R14	R13	R12	R11	R10	x	x	G15	G14	G13	G12	G11	G10	x	x	1st pixel (R1/G1/B1)
2nd write	1	B15	B14	B13	B12	B11	B10	x	x	R25	R24	R23	R22	R21	R20	x	x	-
3rd write	1	G25	G24	G23	G22	G21	G20	x	x	B25	B24	B23	B22	B21	B20	x	x	2nd pixel (R2/G2/B2)

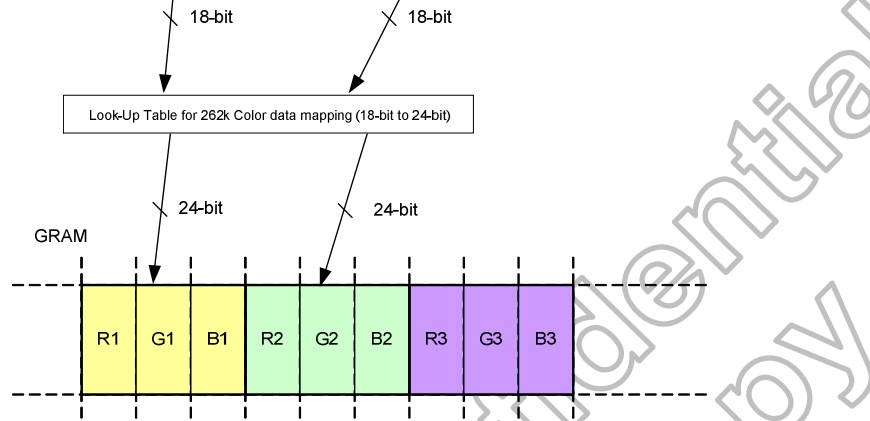


Figure 4.13: Write data for RGB 6-6-6 (262k colours) bit input in 16-bit parallel interface

16.7M Color Data	DCX	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0	GRAM Write
MEMWR	0	GRAM Write command code																-
1st write	1	R17	R16	R15	R14	R13	R12	R11	R10	G17	G16	G15	G14	G13	G12	G11	G10	1st pixel (R1/G1/B1)
2nd write	1	B17	B16	B15	B14	B13	B12	B11	B10	R27	R26	R25	R24	R23	R22	R21	R20	-
3rd write	1	G27	G26	G25	G24	G23	G22	G21	G20	B27	B26	B25	B24	B23	B22	B21	B20	2nd pixel (R2/G2/B2)

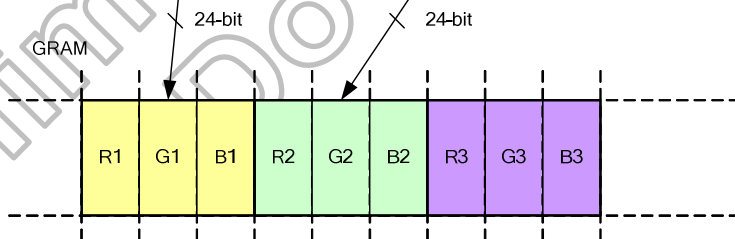


Figure 4.14: Write data for RGB 8-8-8-bit (16.7M colours) input in 16-bit parallel interface

4.1.1.4 9-bit parallel bus system interface

The DBI-A system 9-bit bus parallel data transfer can be used by setting “BS3-0” pins to “0001”. And the DBI-B system 9-bit bus parallel data transfer can be used by setting “BS3-0” pins to “0101”. The Figure 4.15 is the example of interface with 9-bit DBI-A / DBI-B microcomputer system interface.

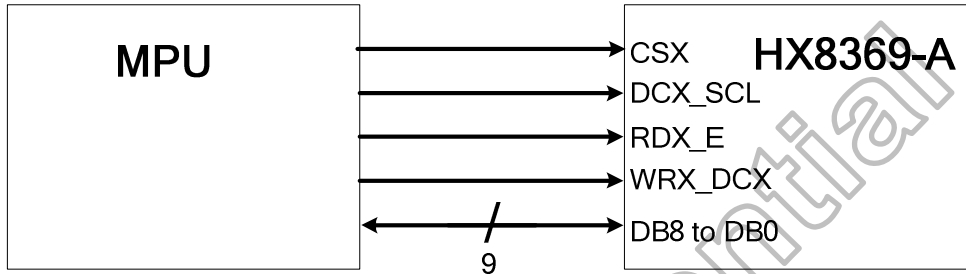


Figure 4.15: Example of DBI-A- / DBI-B- system 9-bit bus interface

There are three types data format to write display data at 9-bit bus Interface. See Figure 4.16 to Figure 4. 18. Under this type, the data format can select as 16-/18-/24-bit by register R3Ah. (set\_pixel\_format)

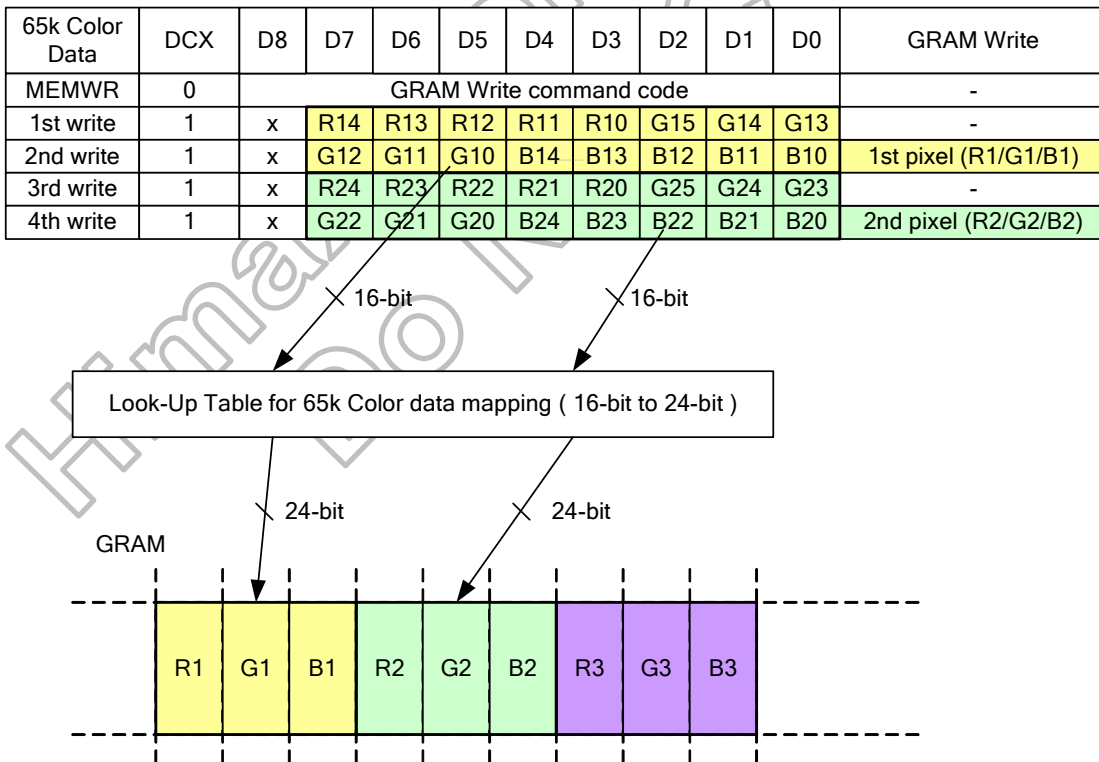


Figure 4.16: Write data for RGB 5-6-5(65k colours) bit input in 9-bit parallel interface



262k Color Data	DCX	D8	D7	D6	D5	D4	D3	D2	D1	D0	GRAM Write
MEMWR	0	GRAM Write command code									-
1st write	1	R15	R14	R13	R12	R11	R10	G15	G14	G13	-
2nd write	1	G12	G11	G10	B15	B14	B13	B12	B11	B10	1st pixel (R1/G1/B1)
3rd write	1	R25	R24	R23	R22	R21	R20	G25	G24	G23	-
4th write	1	G22	G21	G20	B25	B24	B23	B22	B21	B20	2nd pixel (R2/G2/B2)

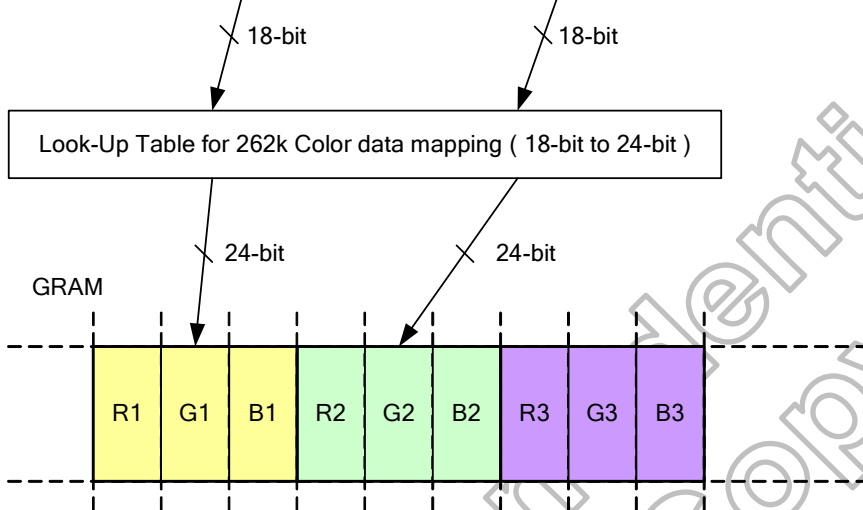


Figure 4.17: Write data for RGB 6-6-6-bit (262k colours) input in 9-bit parallel interface

16.7M Color Data	DCX	D8	D7	D6	D5	D4	D3	D2	D1	D0	GRAM Write
MEMWR	0	GRAM Write command code									-
1st write	1	R17	R16	R15	R14	R13	R12	R11	R10	x	-
2nd write	1	G17	G16	G15	G14	G13	G12	G11	G10	x	-
3rd write	1	B17	B16	B15	B14	B13	B12	B11	B10	x	1st pixel (R1/G1/B1)
4th write	1	R27	R26	R25	R24	R23	R22	R21	R20	x	-
5th write	1	G27	G26	G25	G24	G23	G22	G21	G20	x	-
6th write	1	B27	B26	B25	B24	B23	B22	B21	B20	x	2nd pixel (R2/G2/B2)

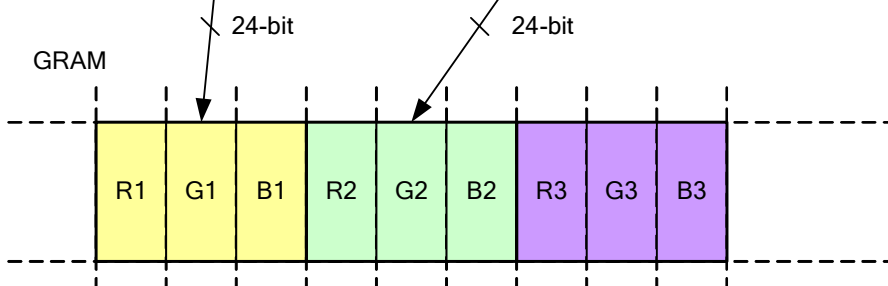


Figure 4.18: Write data for RGB 8-8-8-bit (16.7 M colours) input in 9-bit parallel interface

4.1.1.5 8-bit parallel bus system interface

The DBI-A system 8-bit bus parallel data transfer can be used by setting “BS3-0” pins to “0000”. And the DBI-B system 8-bit bus parallel data transfer can be used by setting “BS3-0” pins to “0100”. The Figure 4.19 is the example of interface with 8-bit DBI-A / DBI-B microcomputer system interface.

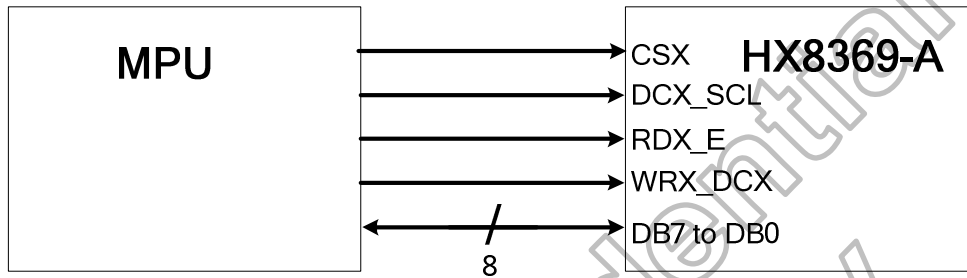


Figure 4.19: Example of DBI-A- / DBI-B-system 8-bit bus interface

There are three types data format to write display data at 8-bit bus Interface. See Figure 4. 20 to Figure 4. 22. Under this type, the data format can select as 16-/18-/24-bit by register R3Ah. (set\_pixel\_format)

65k Color Data	DCX	D7	D6	D5	D4	D3	D2	D1	D0	GRAM Write
MEMWR	0	GRAM Write command code								-
1st write	1	R14	R13	R12	R11	R10	G15	G14	G13	-
2nd write	1	G12	G11	G10	B14	B13	B12	B11	B10	1st pixel (R1/G1/B1)
3rd write	1	R24	R23	R22	R21	R20	G25	G24	G23	-
4th write	1	G22	G21	G20	B24	B23	B22	B21	B20	2nd pixel (R2/G2/B2)

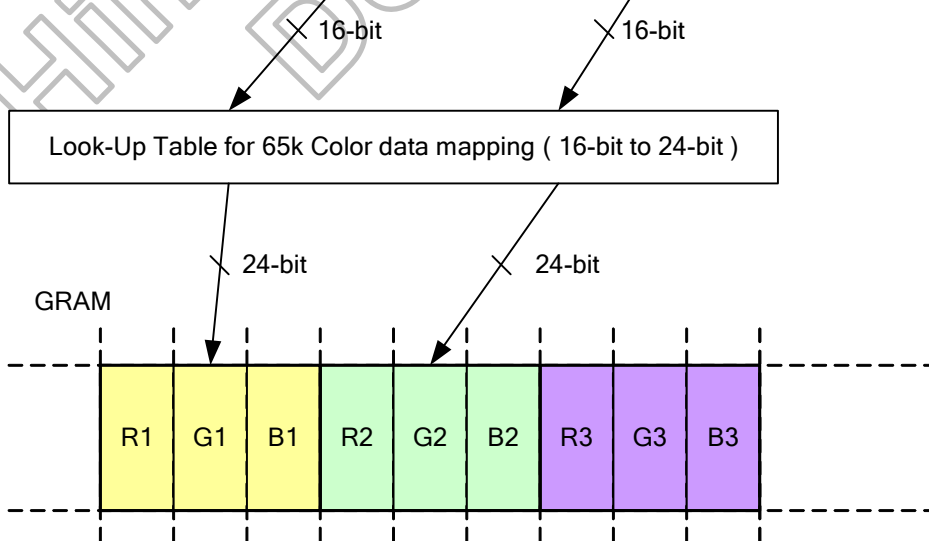


Figure 4.20: Write data for RGB 5-6-5 (65k colours) bit input in 8-bit parallel interface

262k Color Data	DCX	D7	D6	D5	D4	D3	D2	D1	D0	GRAM Write
MEMWR	0	GRAM Write command code								-
1st write	1	R15	R14	R13	R12	R11	R10	x	x	-
2nd write	1	G15	G14	G13	G12	G11	G10	x	x	-
3rd write	1	B15	B14	B13	B12	B11	B10	x	x	1st pixel (R1/G1/B1)
4th write	1	R25	R24	R23	R22	R21	R20	x	x	-
5th write	1	G25	G24	G23	G22	G21	G20	x	x	-
6th write	1	B25	B24	B23	B22	B21	B20	x	x	2nd pixel (R2/G2/B2)

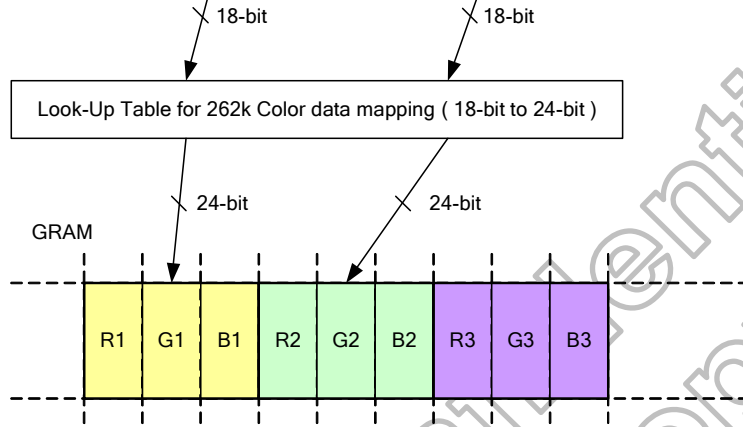


Figure 4.21: Write data for RGB 6-6-6-bit (262k colours) input in 8-bit parallel interface

16.7M Color Data	DCX	D7	D6	D5	D4	D3	D2	D1	D0	GRAM Write
MEMWR	0	GRAM Write command code								-
1st write	1	R17	R16	R15	R14	R13	R12	R11	R10	-
2nd write	1	G17	G16	G15	G14	G13	G12	G11	G10	-
3rd write	1	B17	B16	B15	B14	B13	B12	B11	B10	1st pixel (R1/G1/B1)
4th write	1	R27	R26	R25	R24	R23	R22	R21	R20	-
5th write	1	G27	G26	G25	G24	G23	G22	G21	G20	-
6th write	1	B27	B26	B25	B24	B23	B22	B21	B20	2nd pixel (R2/G2/B2)

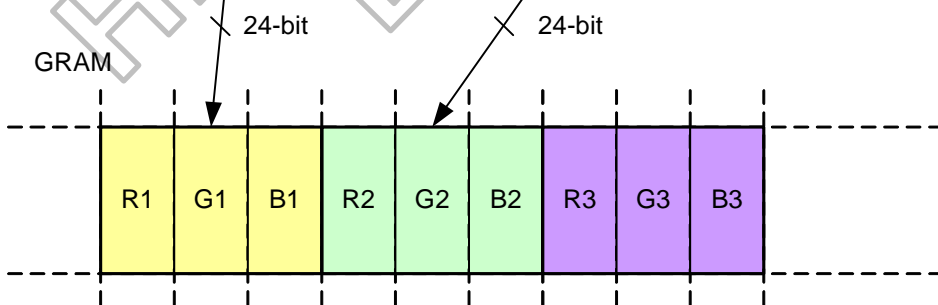


Figure 4.22: Write data for RGB 8-8-8-bit (16.7 M colours) input in 8-bit parallel interface

## 4.2 Serial data transfer interface (MIPI DBI-C)

The HX8369-A supports three type serial data transfer interface, the interface selection by setting BS3-0 pins. The BS3-0 set “1101” is select 3-wire option 1 serial bus. The BS3-0 set “1110” is select 3-wire option 2 serial bus. The BS3-0 is set “1111” when select 4-wire option 3 serial bus.

The 3-wire serial bus is use: chip select line (CSX), serial input/output data (SDI and SDO) and the serial transfer clock line (DCX\_SCL).The 4-wire serial bus is use: chip select line (CSX), data/command select (WRX\_DCX), serial input/output data (SDI and SDO) and the serial transfer clock line (DCX\_SCL).

### 4.2.1.1 Serial data write mode

The 3-pin serial data packet contains a control bit D/CX and a transmission byte and in 4-pin serial case, data packet contains just transmission byte and control signal D/CX is transferred by WRX\_DCX pin. If DCX is low, the transmission byte is command byte. If D/CX is high, the transmission byte is stored in to command register or GRAM. The MSB is transmitted first. The serial interface is initialized when CSX is high. In this state, SCL clock pulse or serial input/output data (SDI and SDO) have no effect. A falling edge on CSX enables the serial interface and indicates the start of data transmission. Where 3-wire serial write format include two types (8-/16-bit) is according command code.

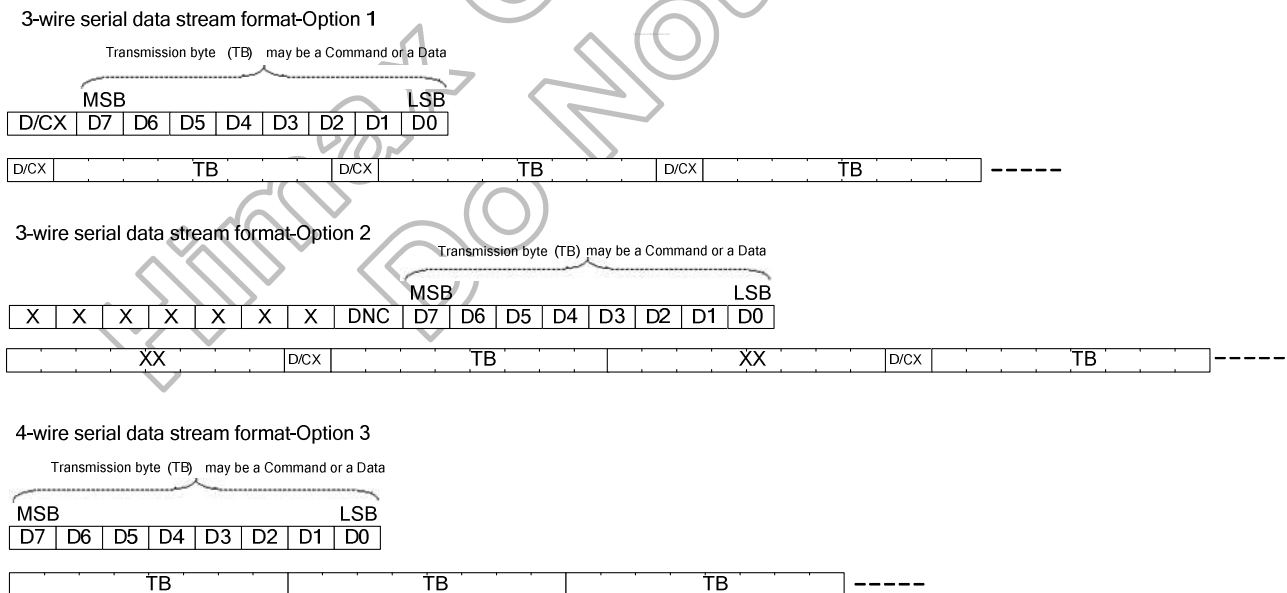
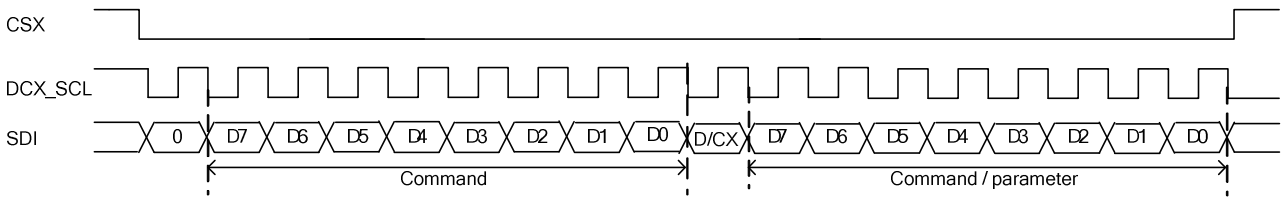
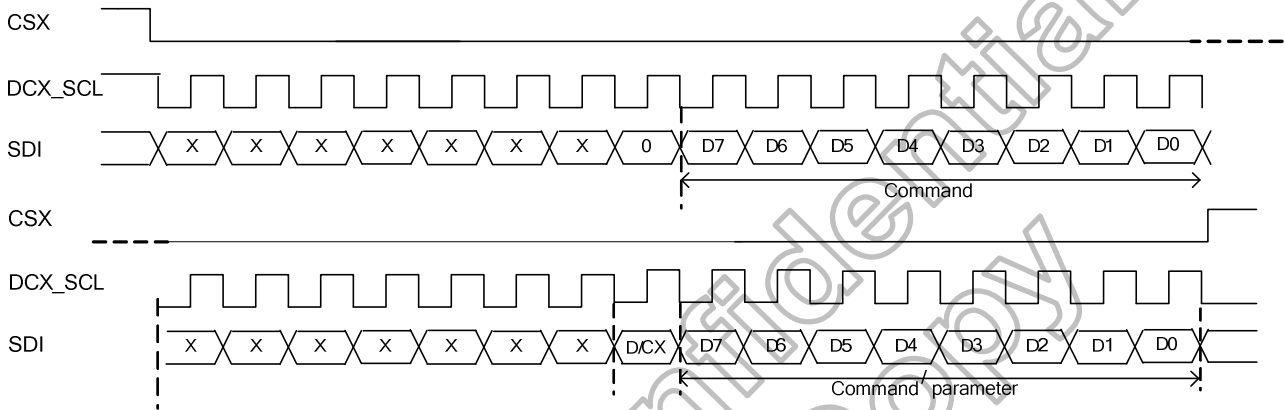


Figure 4.23: Serial data stream, write mode

DBI Type C: Interface protocol-Option 1 (3-wire)



DBI Type C: Interface protocol-Option 2 (3-wire)



DBI Type C: Interface protocol Option 3 (4-wire)

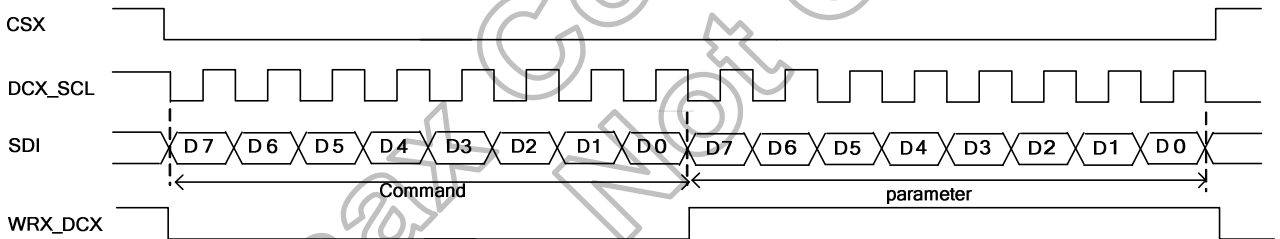
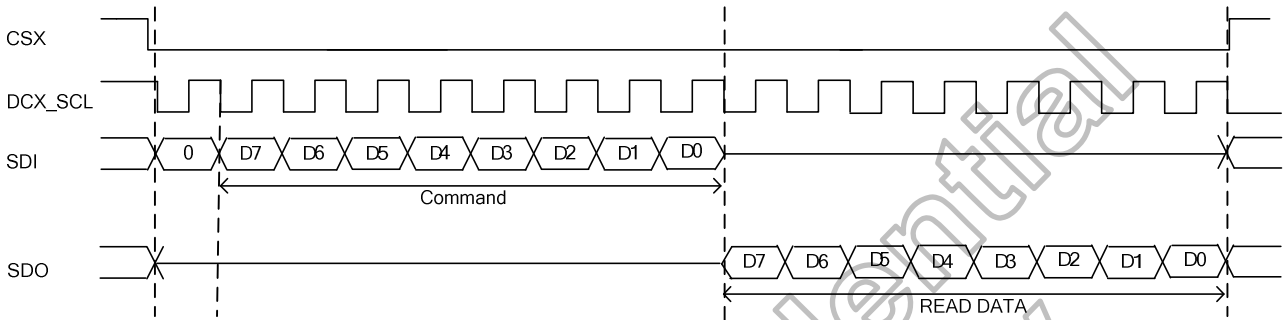


Figure 4.24: DBI Type C: Serial interface protocol 3-wire/4-wire, write mode

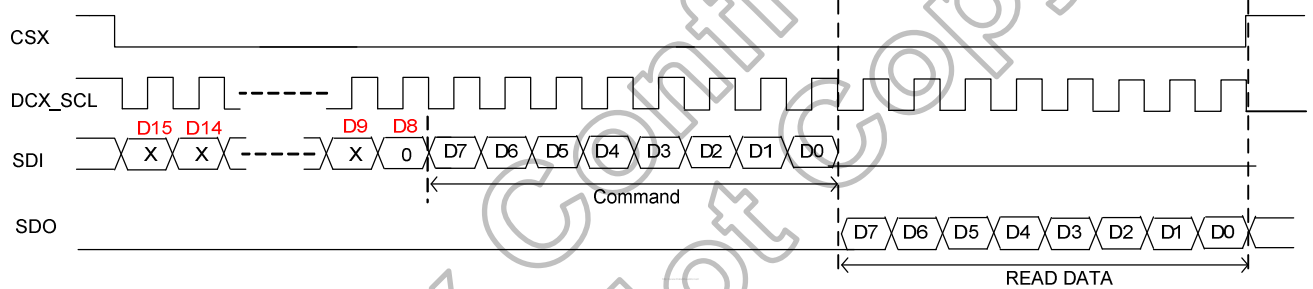
4.2.1.2 Serial data read mode

The micro-controller first has to send a command and then the following byte is transmitted in the opposite direction. The 3-wire serial read data format which just needs 8-bit.

DBI Type C: Interface protocol-Option 1 (3-wire)



DBI Type-C Interface Protocol - Option 2 (3 wire)



DBI Type-C Interface Protocol - Option 3 (4 wire)

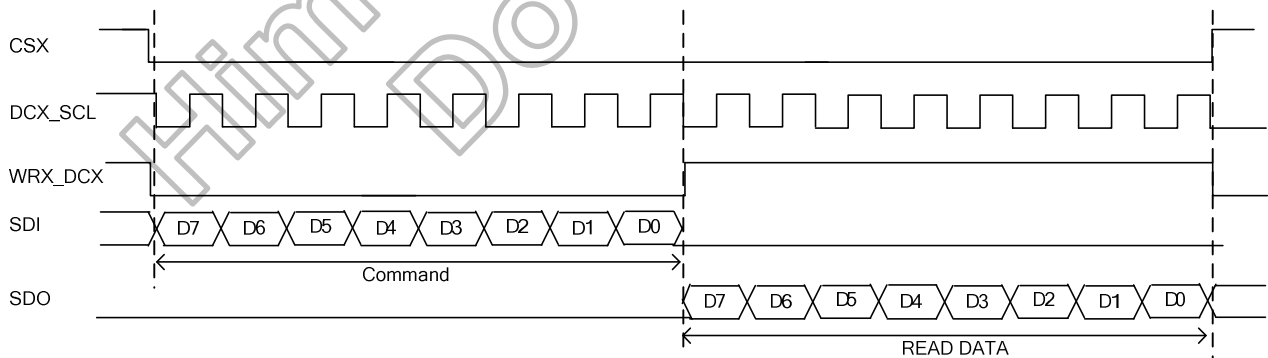


Figure 4.25: Type C:Serial interface protocol 3-wire/4-wire read mode



If there is a break on data transmission when transmit a command before a whole byte has been completed, then the display module will have reset the interface such that it will be ready to receive the same byte re-transmitted when the chip select line (CSX) is next activated. See the following figure.

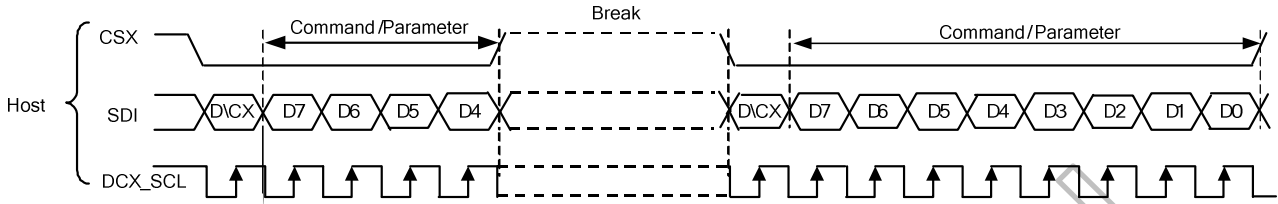


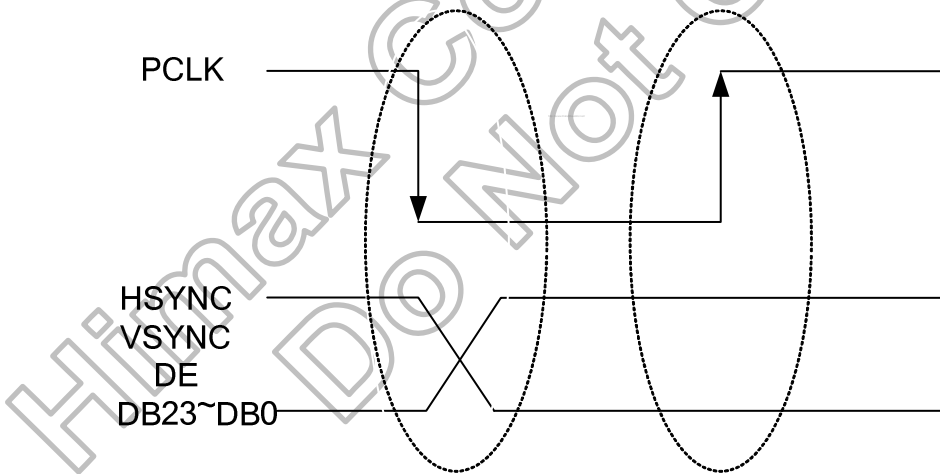
Figure 4.26: Display module data transfer recovery

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### 4.2.2 MIPI DPI interface (Display Pixel Interface)

The HX8369-A uses 16 or 18-bit or 24-bit parallel RGB interface which includes: HS, VSYNC, DE, PCLK, DB23~DB0. The interface is active after Power On sequence. Pixel clock (PCLK) is running all the time without stopping and it is used to entering HSYNC, VSYNC, DE and DB23~DB0– lines states when there is a rising edge of the PCLK. The PCLK cannot be used as continue internal clock for other functions of the display module e.g. Sleep In– mode etc. Vertical synchronization (VSYNC) is used to tell when there is received a new frame of the display. This is negative (“–”, “0”, low) active and its state is read to the display module by a rising edge of the PCLK-line. Horizontal synchronization (HSYNC) is used to tell when there is received a new line of the frame. This is negative (“–”, “0”, low) active and its state is read to the display module by a rising edge of the PCLK- line. Data enable (DE) is used to tell when there is received RGB information that should be transferred on the display. This is positive (“+”, “1”, high) active and its state is read to the display module by a rising edge of the PCLK-line. DB23~DB0 (24 bit: R7-R0, G7-G0 and B7-B0; 18 bit: R5- R0, G5-G0 and B5-B0; 16 bit: R4- R0, G5-G0 and B4-B0) are used to tell what is the information of the image that is transferred on the display (when DE=1 and there is a rising edge of PCLK). DB23~DB0– lines can be set to “0” (low) or “1” (high). These lines are read by a rising edge of the PCLK-line.

The pixel clock cycle is described in the following figure.



**Note:** PCLK is an unsynchronized signal (It can be stopped).

**Figure 4.27: PCLK cycle**

4.2.2.1 General timing diagram

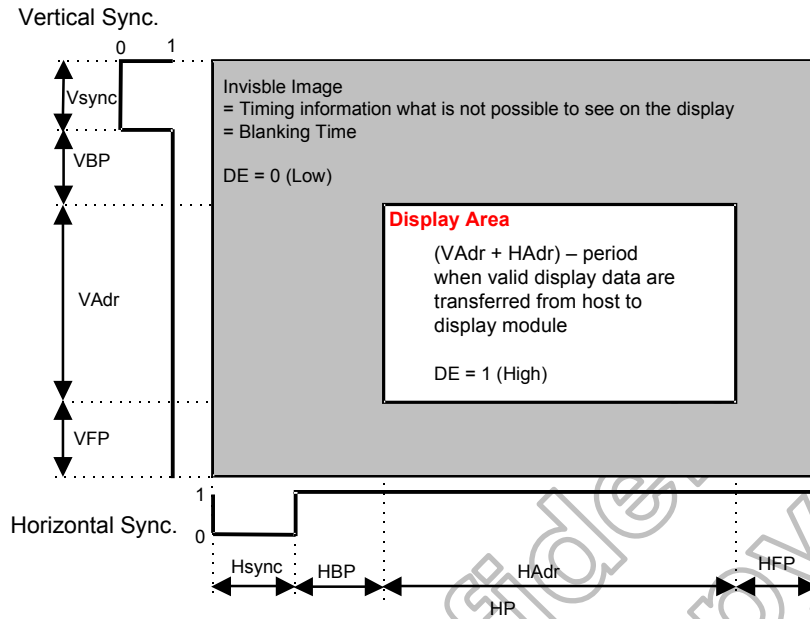


Figure 4.28: General timing diagram

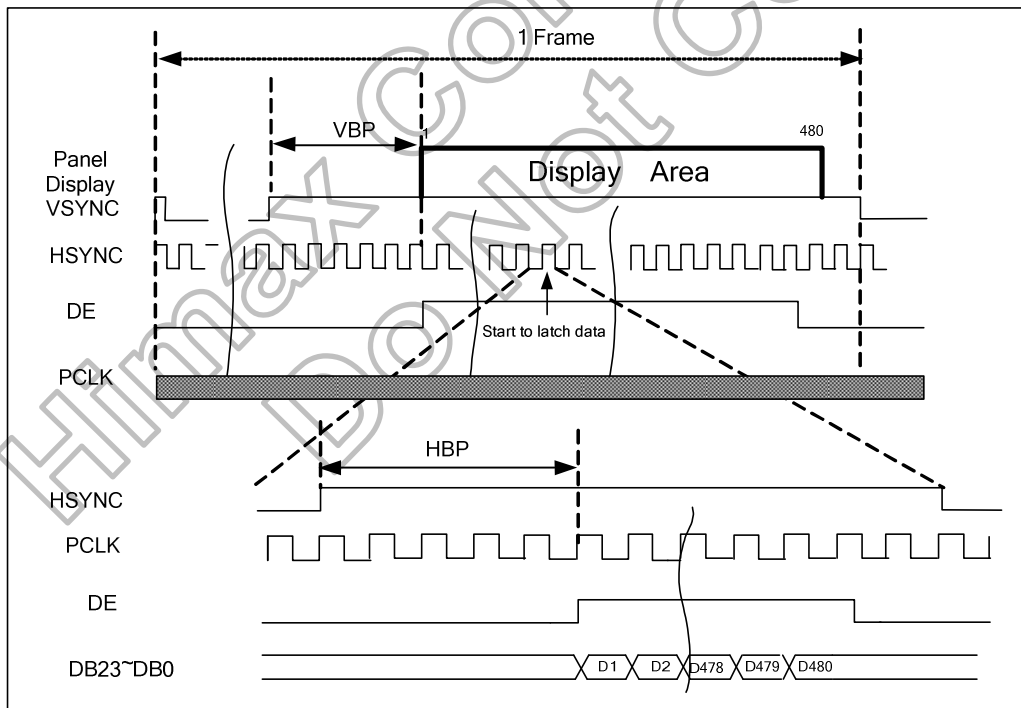


Figure 4.29: DPI (480RGB x 864) timing diagram

The image information must be correct on the display, when the timings are in range on the interface. However, the image information can be incorrect on the display, when timings are out of the range on the interface (Out of the range timings cannot cause any damage on the display module or it cannot cause any damage on the host side). The correct image information must be displayed automatically (by the display module) on the next frame (vertical sync.), when there is returned from out of the range to in range interface timings.

The MIPI DPI interface includes two types which are 16-/18-/24-bit data format by register 3Ah (set\_pixel\_format) to select.

DPI interface displaying moving pictures can be selected to rewrite into the GRAM or not through GRAM. The selection is set by register DM[1:0] and RM.

RM The bit is used to select an interface for the Frame Memory access operation. The Frame Memory is accessed only via the interface defined by RM bit. Because the interface can be selected separately from display operation mode, writing data to the Frame Memory is possible via system interface when RM = 0, even in the DPI display operation.

RM setting is enabled from the next frame. Wait 1 frame to transfer data after setting.

RM	Interface for RAM access
0	DBI Interface (CPU)
1	DPI Interface (RGB)

DM[1:0] The bit is used to select display operation mode. The setting allows switching between display operation in synchronization with internal oscillation clock, VSYNC, or DPI signal.

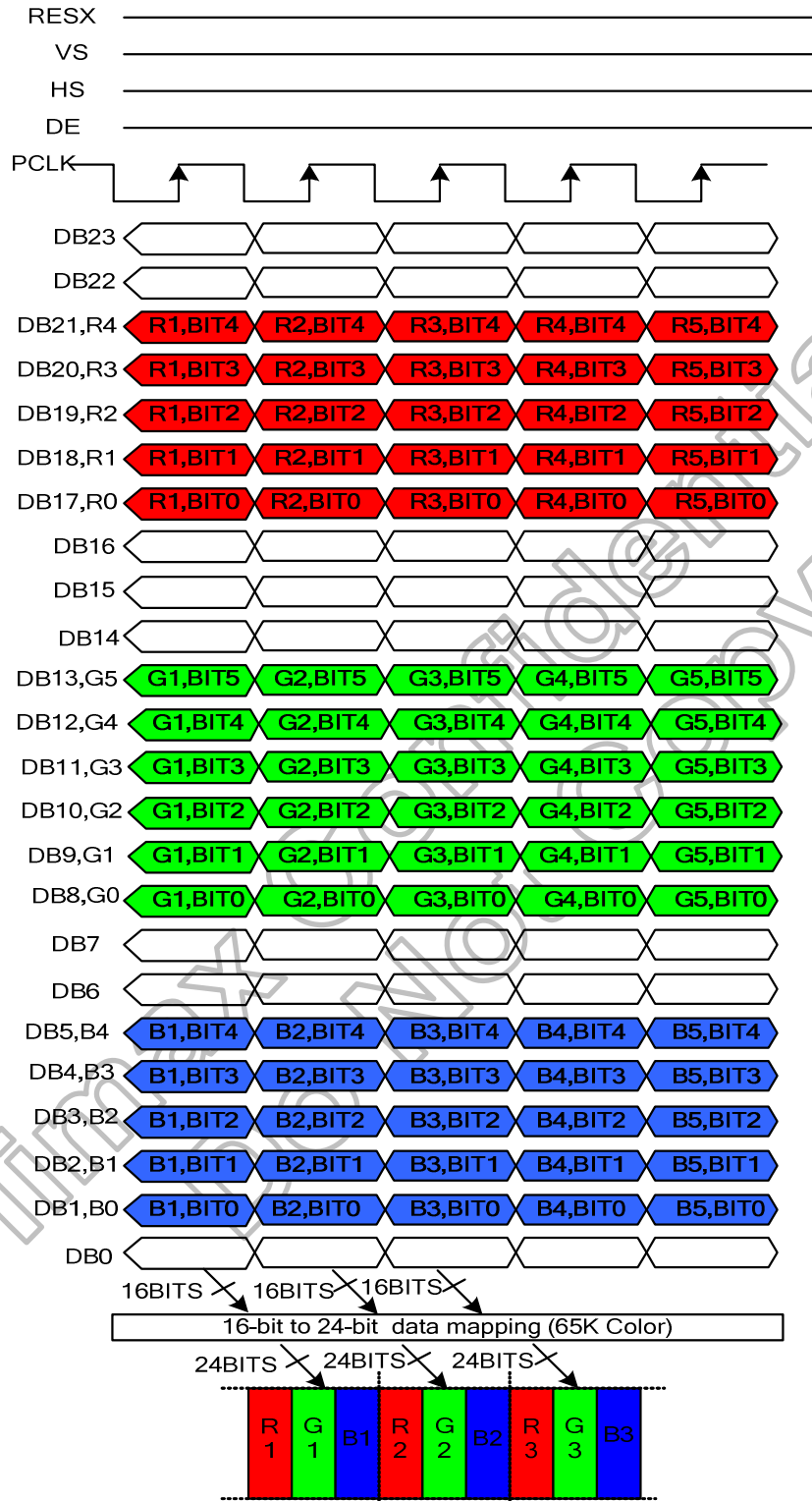
Note that switching between VSYNC and DPI operation is prohibited.

DM 1	DM 0	Display Mode
0	0	Internal oscillation clock
0	1	DPI signal
1	0	VSYNC signal only
1	1	RGB data bypass GRAM mode

Operation Mode	Frame Memory Access Setting (RM)	Display Operation Mode (DM[1:0])
Internal clock operation (displaying still pictures)	MPU interface (RM=0)	Internal clock operation (DM[1:0]=00)
RGB interface : capture mode 1 (displaying moving pictures)	RGB interface (RM=1)	RGB interface : VS & HS (DM[1:0]=01)
RGB interface : capture mode 2 (rewriting still pictures while displaying moving pictures)	MPU interface (RM=0)	RGB interface : VS & HS (DM[1:0]=01)
RGB interface : through mode (displaying moving pictures)	Bypass frame memory	RGB interface : VS & HS (DM[1:0]=11)
Internal clock operation RGB data format	RGB interface (RM=1)	Internal clock operation (DM[1:0]=00)

Note: RGB interface capture mode is only for 24-bit / pixel color order.

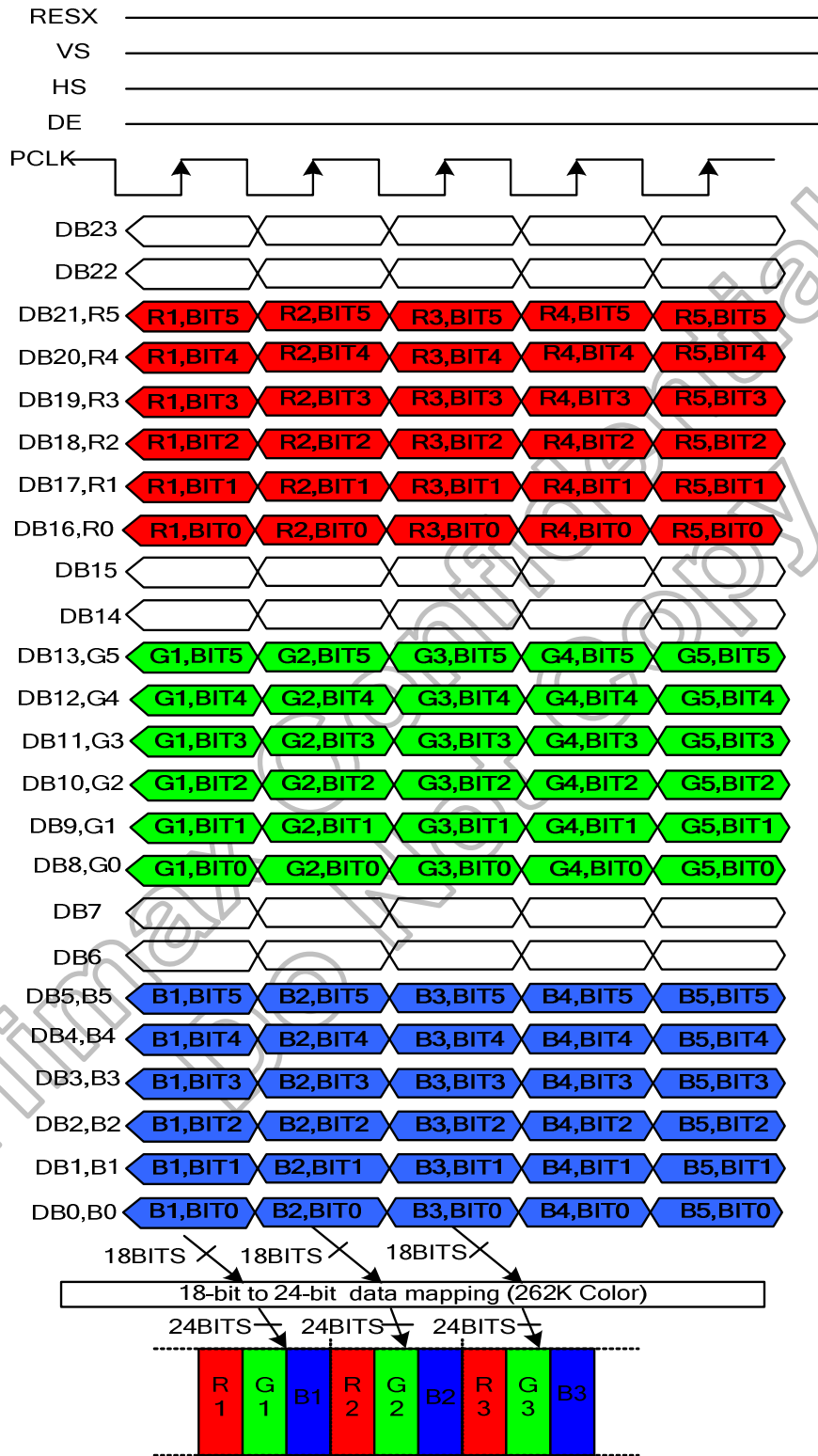
4.2.2.2 16-bit / pixel color order on the DPI I/F



**Note:** The data order is shown as follows, MSB=DB23, LSB=DB0 and picture data is MSB=Bit5, LSB=Bit0 for Green data and MSB=Bit4, LSB=Bit0 for Red and Blue data. DB23, DB22, DB16, DB15, DB14, DB7, DB6 and DB0 are set to high or low.

Figure 4.30: 16-bit / pixel 65K colours order on the DPI I/F

4.2.2.3 18-bit / pixel color order on the DPI I/F

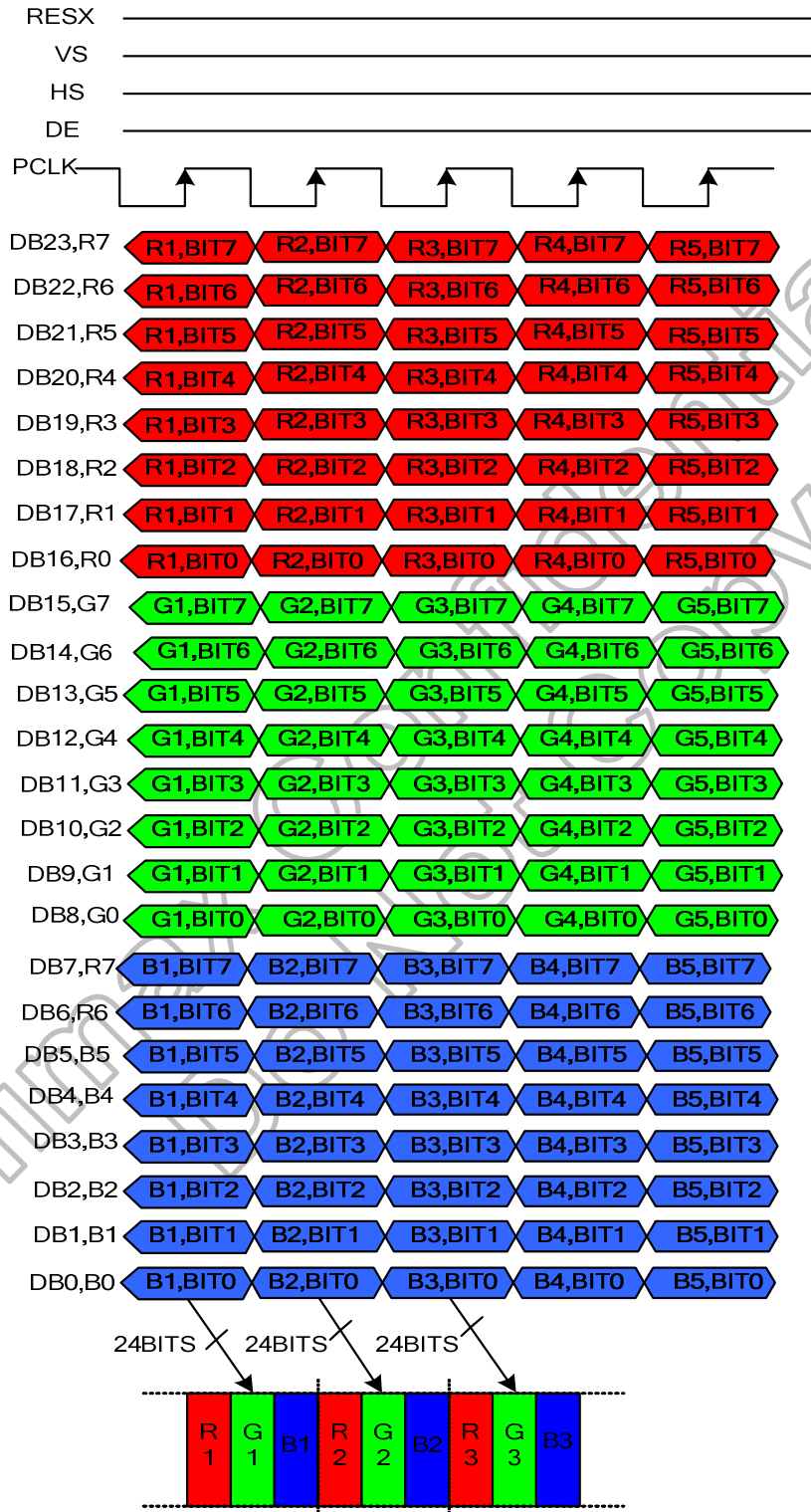


**Note:** The Data order is shown as follows, MSB = DB23, LSB = DB0 and Picture Data is MSB = Bit5, LSB = Bit0 for Red, Green and Blue data. DB23, DB22, DB15, DB14, DB7 and DB6 are set to high or low.

Figure 4.31: 18-bit / pixel: 262k colours order on the DPI I/F



4.2.2.4 24-bit / pixel color order on the RGB I/F



**Note:** The Data order is shown as follows, MSB = DB23, LSB = DB0 and Picture Data is MSB = Bit7, LSB = Bit0 for Red, Green and Blue data.

Figure 4.32: 24-bit / pixel color order on the RGB I/F

### 4.2.3 DSI system interface

The selection of interface is by BS(3-0) = "1000 " or "1100", the DSI specifies the interface between a host processor and a peripheral such as a display module. Figure 4.33 shows a simplified DSI interface. From a conceptual viewpoint, a DSI-compliant interface also sends pixels or commands to the peripheral, and can read back status or pixel information from the peripheral. The main difference is that DSI serializes all pixel data, commands, and events that. DSI-compliant peripherals support Command Mode. Which mode is used depends on the architecture and capabilities of the peripheral. The mode definitions reflect the primary intended use of DSI for display.

Command Mode refers to operation in which transactions primarily take the form of sending Commands and data to a peripheral, such as a display module, that incorporates a display controller. The display controller may include local registers and a frame buffer. Systems using Command Mode write to, and read from, the registers and frame buffer memory. The host processor indirectly controls activity at the peripheral by sending commands, parameters and data to the display controller. The host processor can also read display module status information or the contents of the frame memory. Command Mode operation requires a bidirectional interface.

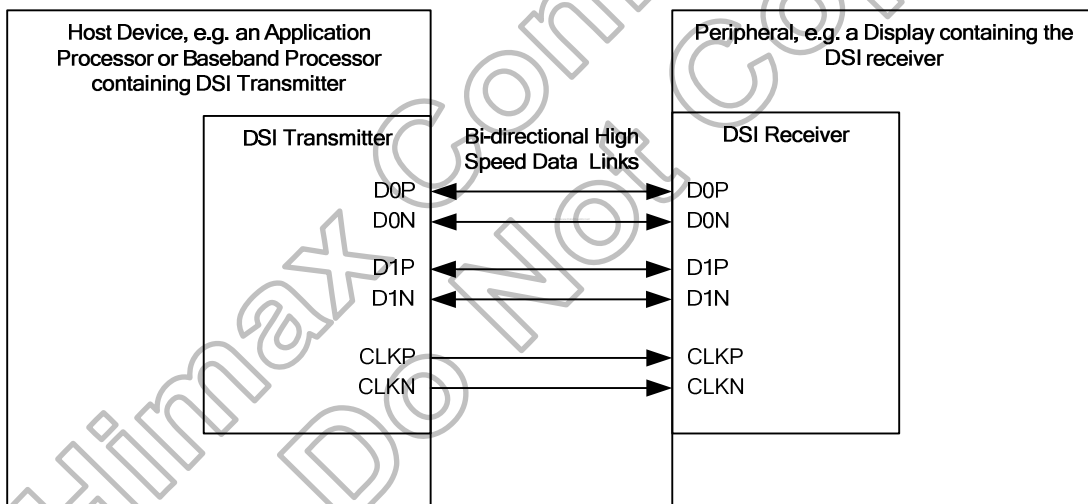


Figure 4.33: DSI transmitter and receiver interface

Please refer to “DRAFT MIPI Alliance Standard for DSI” for DSI detailed specifications.

4.2.3.1 DSI layer definitions

According Figure 4.34 DSI transmitter and Receiver interface to understand simple interface block diagram. Then under diagram is internal block for DSI which include four types: PHY Layer, Lane Management Layer, Low level protocol and Application Layer.

The PHY Layer specifies the characteristics of transmission medium and electrical parameters for signaling the timing relationship between clock and Data Lanes.

The Lane Management Layer specifies DSI is Lane-scalable for increased performance. The data signals maybe transmission through one or more channel depending on the bandwidth requirements of the application.

The Protocol Layer specifies at the lowest level, DSI protocol specifies the sequence and value of bits and bytes traversing the interface. It specifies how bytes are organized into defined groups called packets.

The Application Layer describes higher-level encoding and interpretation of data contained in the data stream. The DSI specification describes the mapping of pixel values, commands and command's parameters to bytes in the packet assembly.

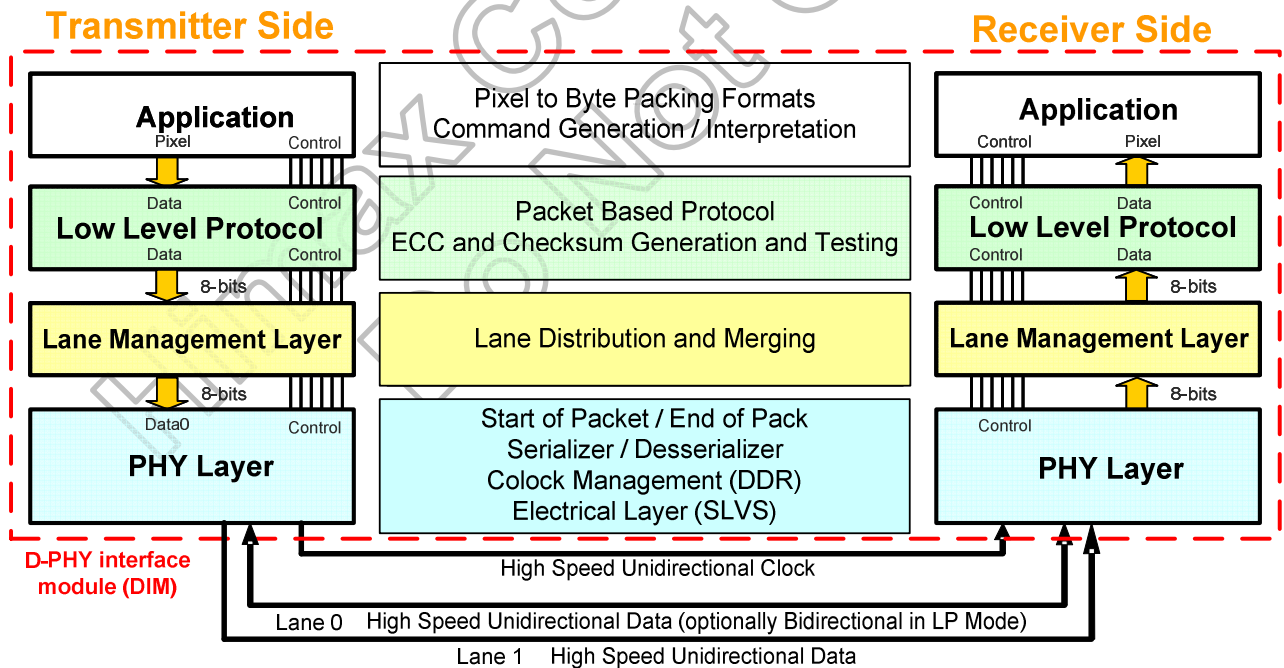
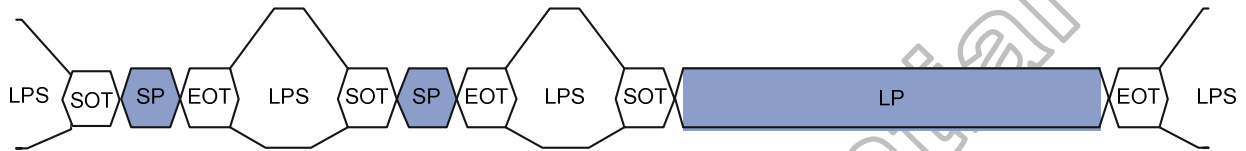


Figure 4.34: DSI transmitter and receiver interface

### 4.2.3.2 DSI protocol

The protocol layer appends packet-protocol information and headers. The receiver side of a DSI Link performs the converse of the transmitter side, decomposing the packet into parallel data, signal events and commands. The DSI protocol permits multiple packets which is useful for events such as peripheral initialization, where many registers may be loaded separate write commands at system startup. Figure 4.35 illustrates multiple HS Transmission packets.

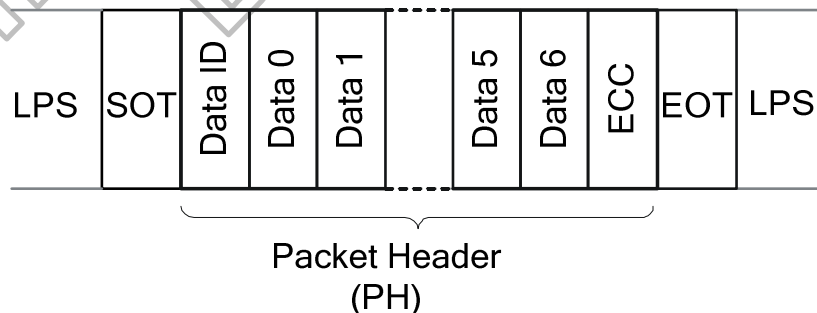


- LPS : Low power state
- SOT : Start of Transmission
- SP : Short Packet
- LP : Long Packet
- EOT : End of Transmission

**Figure 4.35: Multiple HS transmission packets**

The packet includes two types which are Long packet and short packet. The first byte of the packet, the Data Identifier (DI), includes information specifying the length of the packet. Command Mode systems send commands and an associated set of parameters, with the number of parameters depending on the command type.

**Short packets** specify the payload length using the Data Type field and are from two to nine bytes in length. Short packet is used for most Command Mode commands and associated parameters. Where short packets format include an 8-bit Data ID followed by zero to seven bytes and an 8-bit ECC. Figure 4.36 shows the structure of the Short packet.

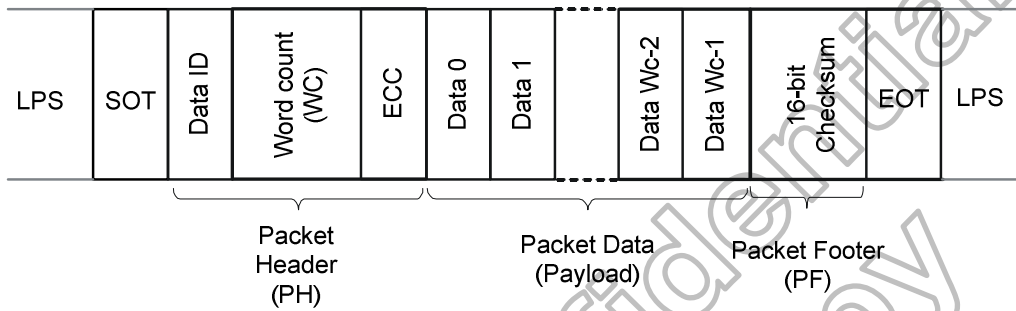


- DI(Data ID)** : Contain Virtual Channel Identifier and Data Type.
- ECC(Error Correction Code)** : The Error Correction Code allows single-bit errors to be corrected and 2-bit errors to be detected in the Packet Header.

**Figure 4.36: Structure of the short packet**

**Long packets** specify the payload length using a two-byte Word Count field and then the payload maybe from 0 to 65,541 bytes in length. Long packets permit transmission of large blocks of pixel or other data.. Figure 4.37 shows the structure of the Long packet. Long Packet Header composed of three elements: an 8-bit Data Identifier, a 16-bit Word Count, and 8-bit ECC. The Packet Footer has one element, a 16-bit checksum. Long packets can be from 6 to 65,541 bytes in length.

Where 65,541 bytes =  $(2^{16}-1) + 4$  bytes PH + 2 bytes PF



- DI (Data ID)** : Contain Virtual Channel Identifier and Data Type.
- WC (Word Count)** : The receiver use WC to define packet end.
- ECC (Error Correction Code)** : The Error Correction Code allows single-bit errors to be corrected and 2-bit errors to be detected in the Packet Header.
- PF(Packet Footer)** : Mean 16-bit Checksum.

**Figure 4.37: Structure of the long packet**

According to packet form, basic elements include DI and ECC. Figure 4.38 the shows format of Data ID.

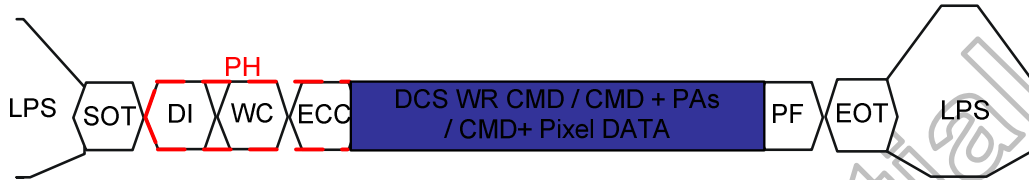
DI7	DI6	DI5	DI4	DI3	DI2	DI1	DI0
VC (Virtual Channel)		DT (Data Type)					

DI[7:6] → These two bits identify the data as directed to one of four virtual channels.  
 DI[5:0]: These six bits specify the Data Type, which specifies the size, format and, in some cases, the interpretation of the packet contents.

**Figure 4.38: The format of data ID.**

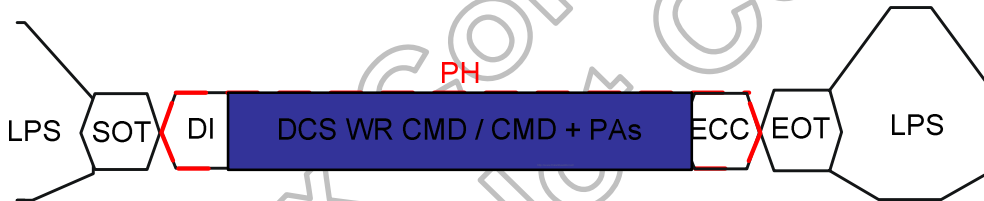
Due to Data Type (DT) mean format of transmission type, Figure 4.39 show Short- / Long-packet transmission command sequence.

Long packet write Command / Parameters / Pixel Datas



DI → Write suitable Data type.  
 WC → Write number of Payload Data.  
 Ex: One CMD write, WC setting as 1.  
 CMD + PAs write, WC setting as number of (CMD+PAs).  
 CMD + DATA write, WC setting as number of (CMD + Pixel DATA).

Short packet write Command / Parameters



DI → Write suitable Data type.  
 Ex: One CMD write, DI + DCS WR CMD  
 CMD + PAs write, DI + DCS WR CMD + PAs

Figure 4.39: show Short- / Long-packet transmission command sequence



**4.2.3.3 Processor to peripheral direction packets data types**

The set of transaction types sent from the host processor to a peripheral, such as a display module, are shown in Table 4.3 Data Types for Processor-sourced Packets.

Data type, hex	Data type, binary	Description packet	Size
01h	00 0001	Sync Event, V Sync Start	Short
11h	01 0001	Sync Event, V Sync End	Short
21h	10 0001	Sync Event, H Sync Start	Short
31h	11 0001	Sync Event, H Sync End	Short
22h	10 0010	Shut Down Peripheral Command	Short
32h	11 0010	Turn On Peripheral Command	Short
05h	000101	DCS WRITE, no parameter	Short
15h	010101	DCS WRITE, 1 parameter	Short
06h	00 0110	DCS READ, no parameters	Short
37h	11 0111	Set Maximum Return Packet Size	Short
09h	00 1001	Null Packet, no data	Long
19h	01 1001	Blanking Packet, no data	Long
39h	11 1001	DCS Long Write/write LUT Command Packet	Long
0Eh	00 1110	Packed Pixel Stream, 16-bit RGB, 5-6-5 Format	Long
1Eh	01 1110	Packed Pixel Stream, 18-bit RGB, 6-6-6 Format	Long
2Eh	10 1110	Loosely Packed Pixel Stream, 18-bit RGB, 6-6-6 Format	Long
3Eh	11 1110	Packed Pixel Stream, 24-bit RGB, 8-8-8 Format (This project is not use)	Long
X0h and XFh, unspecified	xx 0000 xx 1111	DO NOT USE All unspecified codes are reserved	-

**Table 4.3: Data types for processor-sourced packets**

Under tables list all detail function of all data types

Sync event (H start, H end, V start, V end), data type=xx 0001 (x1h)		
Data type, hex	Function description	Number of bytes
01h	V Sync start, Start of VSA pulse.	4 bytes (DI+Data0+Data1+ECC)
11h	V Sync End, End of VSA pulse.	
21h	H Sync Start, Start of HSA pulse.	
31h	H Sync End, End of HSA pulse.	
<b>Note:</b> V Sync Start and V Sync End event represents the start and end of the VSA, respectively. Similarly H Sync Start and H Sync End event represents the start and end of the HSA, respectively.		

Display status (shutdown command, turn-on command)		
Data type, hex	Function description	Number of bytes
22h	Shutdown Peripheral command that turns off the display in a Video Mode display for power saving.	4 bytes (DI+Data0+Data1+ECC)
32h	Turn On Peripheral command that turns on the display in Video Mode display for normal display.	
<b>Note:</b> When use shutdown command, interface shall remain powered in order to receive the turn-on, or wake-up, command.		

Color mode status (Color Mode On, Color Mode Off)		
Data type, hex	Function description	Number of bytes
05h and 15h	DCS Short Write command, 0 or 1 parameter, Data Types = 00 0101(05h), 01 0101 (15h), Respectively.	4 bytes (DI+Data0+Data1+ECC)
<b>NOTE:</b> (1) For write part, If DCS Short Write command, followed by BTA, the peripheral shall respond with <b>ACK</b> when without error was detected in the transmission (Host → Slave). Unless an error was detected, the peripheral shall respond with <b>Acknowledge with Error Report</b> .		

For example: 05h DCS WRITE for no parameter command set.

05h	CMD	0	ECC	Ex. 05h, 29h, 00, 1Ch — Display On(29h)
-----	-----	---	-----	---

For example: 15h DCS WRITE for only one parameter command set.

15h	CMD	Par	ECC	Ex. 15h, 36h, 08h, 11h — MADCTL(36h)-BGR bit=1
-----	-----	-----	-----	--

DCS command setting		
Data type, hex	Function description	Number of bytes
06h	DCS Read command, the returned data may be of Short or Long packet format.	4 bytes (DI+Data0+Data1+ECC)
39h	DCS Long Write/ Write _ LUT Command is used to send larger blocks of data to a display module that implements the Display Command Set.	Up to 65541 bytes ( DI + WC + ECC + DCS CMD. + Payload DATA + PF )
<b>NOTE:</b> (1) When use DCS Read Command, the <b>Set Max Return Packet Size</b> command will limit the size of returning packets. (2) The peripheral shall respond to DCS Read Command Request in one of the following ways: <ul style="list-style-type: none"> <li>◆ If an error was detected by the peripheral, it shall send <i>Acknowledge with Error Report</i>. So the peripheral shall transmit the requested READ data packet with suitable ECC in the same transmission.</li> <li>◆ If no error was detected by the peripheral, it shall send the requested READ packet (Short or Long) with appropriate ECC and Checksum, if either or both features are enabled.</li> </ul> (3) <b>One byte &lt;= Length of payload DATA &lt;= 2<sup>WC</sup>-1</b>		

Return packet size setting		
Data type, hex	Function description	Number of bytes
37h	Set Maximum Return Packet Size that specifies the maximum size of the payload in a Long packet transmitted from peripheral back to the host processor.	4 bytes (DI + WC + ECC)
<b>Note:</b> The two-byte value is transmitted with LS byte first. And during a power-on or Reset sequence, the Maximum Return Packet Size shall be set by the peripheral to a default value of one.		

Variable data packet		
Data type, hex	Function description	Number of bytes
09h	Null Packet is a mechanism for keeping the serial Data Lane(s) in High-Speed mode while sending dummy data.	Up to 65541 bytes (DI + WC + ECC
19h	Blanking packet is used to convey blanking timing information in a Long packet.	+ DCS CMD. + Payload DATA + PF)
<b>Note:</b> (1) When <b>Null Packet</b> , the Payload Data belong "null" Data, actual data values sent are irrelevant because the peripheral does not capture or store the data. (2) When <b>Blanking packet</b> , the packet represents a period between active scan lines of a Video Mode display,		

Data stream format		
Data type, hex	Function description	Number of bytes
0Eh	Packed Pixel Stream 16-Bit Format is used to transmit image data formatted as 16-bit pixels to a Video Mode display module. Pixel format is "(5 bits) red, (6 bits) green and (5 bits) blue".	Up to 65541 bytes (DI + WC + ECC + DCS CMD. + Payload DATA + PF)
<p>The diagram illustrates the data stream format for a 16-bit pixel. It shows a sequence of packets. Each packet consists of a Virtual Channel (1 byte), Data Type (2 bytes), Word Count (1 byte), ECC (1 byte), and a pixel (3 bytes). The pixel is composed of 5 bits of red (R0-R4), 6 bits of green (G0-G5), and 5 bits of blue (B0-B4). The packet is followed by a Checksum (2 bytes). The entire packet structure is labeled as PH (Packet Header), Variable Payload data, and PF (Packet Footer).</p>		
<b>Note:</b> Within a color component, the "LSB is sent first, the MSB last".		

Data stream format		
Data type, hex	Function description	Number of bytes
1Eh	Packed Pixel Stream 18-Bit Format is used to transmit image data formatted as 18-bit pixels to a Video Mode display module. Pixel format is “(6 bits) red, (6 bits) green and (6 bits) blue”.	Up to 65541 bytes ( DI + WC + ECC + DCS CMD. + Payload DATA + PF )
<p>The diagram illustrates the data stream format. It starts with a Virtual Channel (1 byte), followed by Data Type (2 bytes), Word Count (1 byte), and ECC (1 byte). The main data is a stream of pixels, each 18 bits long (6 bits red, 6 bits green, 6 bits blue). The first four pixels are shown as Pixel 1, Pixel 2, Pixel 3, and Pixel 4. The stream ends with a Checksum (2 bytes) and a Packet Footer (PF). The total length of the payload data is 9 bytes per pixel, and the total length of the packet is 10 bytes per pixel.</p>		
<p><b>Note:</b> Within a color component, the LSB is sent first and the MSB last and pixel boundaries only line up with byte boundaries every four pixels (nine bytes). Preferably, display modules employing this format have a horizontal extent (width in pixels) evenly divisible by four, so no partial bytes remain at the end of the display line data. It is possible to send pixel data that represent a line width that is not a multiple of four pixels, but display logic on the receiver end shall dispose of the extra bits of the partial byte at the end of active display and ensure a “clean start” for the next line.</p>		

Data stream format		
Data type, hex	Function description	Number of bytes
2Eh	Packed Pixel Stream 18-Bit Format, each R, G, or B color component is one byte form, but the valid pixel bits occupy bits [7:2] and bits [1:0] of are ignored. Pixel format is "(6 bits) red, (6 bits) green and (6 bits) blue".	Up to 65541 bytes ( DI + WC + ECC + DCS CMD. + Payload DATA + PF )
<p>The diagram illustrates the data stream format. It is divided into three main sections: PH (Packet Header), Variable Payload Data, and PF (Packet Footer).  <b>PH (Packet Header):</b> Consists of four fields: Virtual Channel (1 byte), Data Type (1 byte), Word Count (2 bytes), and ECC (1 byte).  <b>Variable Payload Data:</b> Contains a sequence of pixels. Each pixel (Pixel 1, Pixel n) is represented by three bytes. Each byte contains 6 bits of color data (R, G, or B). The bit order within each 6-bit component is R0-R5, G0-G5, or B0-B5, with the LSB sent first and the MSB last.  <b>PF (Packet Footer):</b> Consists of a Checksum (2 bytes).  <b>Note:</b> Within a color component, the LSB is sent first, the MSB last and With this format, pixel boundaries line up with byte boundaries every three bytes.</p>		

Packed pixel stream, 24-bit format		
Data type, hex	Function description	Number of bytes
3Eh	Packed Pixel Stream 24-Bit Format is used to transmit image data formatted as 24-bit pixels to a Video Mode display module. Pixel format is (8 bits) red, (8 bits) green and (8 bits) blue.	Up to 65541 bytes ( DI + WC + ECC + DCS CMD. + Payload DATA + PF )
<p>The diagram illustrates the Packed Pixel Stream 24-bit format. It shows a packet structure consisting of a Packet Header (PH), Variable Payload Data, and a Packet Footer (PF). The PH includes Virtual Channel (1 byte), Data Type (1 byte), Word Count (2 bytes), and ECC (1 byte). The Variable Payload Data contains a sequence of pixels, each with 8-bit Red, Green, and Blue components. The PF includes a 2-byte Checksum. A detailed view of 'Pixel 1' shows its 24-bit structure: 8 bits Red (D0-R0), 8 bits Green (D7-D0-R7-G0), and 8 bits Blue (D7-D0-G7-B0).</p>		
<p><b>Note:</b> Within a color component, the LSB is sent first, the MSB last and With this format, pixel boundaries line up with byte boundaries every three bytes.</p>		



#### 4.2.3.4 Peripheral to processor (reverse direction)

All Command Mode systems require bidirectional capability for returning READ data, ACK or error information to the host processor. Command Mode that use DCS shall have a bidirectional data path. Short packets and the header of Long packets may use ECC and Checksum to provide a higher level of data integrity. The Checksum feature enables detection of errors in the payload of Long packets. The packet structure for peripheral-to-processor transactions is the same as for the processor-to-peripheral direction.

Peripheral-to-processor transactions are of four basic types:

- A. *Tearing Effect* is a Trigger message sent to convey display timing information to the host processor. Trigger messages are signal byte packets sent by a peripheral's PHY layer in response to a signal from the DSI protocol layer.
- B. *Acknowledge* is a Trigger Message sent when the current transmission, as well as all preceding transmissions since the last peripheral to host communication.
- C. *Acknowledge and Error Report* is a Short packet sent if any errors were detected in preceding transmission from the host processor. Once reported, accumulated errors in the error register are cleared.
- D. *Response to Read Request* may be Short or Long packet that returns data requested by the preceding READ command from the processor.

In general, if the host processor completes a transmission to the peripheral with BTA asserted, the peripheral shall respond with one or more appropriate packet(s), and then return bus ownership to the host processor. If BTA is not asserted following a transmission from the host processor, the peripheral shall not communicate an Acknowledge or other error information back to the host processor.

The processor-to-peripheral transactions with BTA asserted, can contain under form.

- A. Following a **non-Read command** in which no error was detected, the peripheral shall respond with Acknowledge.
- B. Following a **Read request** in which no error was detected, the peripheral shall send the requested READ data.
- C. Following a **Read request in which the ECC error** was detected and corrected, the Peripheral shall send the requested READ data in a Long or Short packet, followed by a 4-byte (Acknowledge with Error Report) packet in the same LP transmission. The Error Report shall have the ECC Error flag set.
- D. Following a **non-Read command in which the ECC error** was detected and corrected, the peripheral shall proceed to execute the command, and shall respond to BTA by sending a 4-byte (Acknowledge with Error Report) packet, the Error Report shall have the ECC Error flag set.
- E. Following any command in which **SoT Error, SoT Sync Error, EoT Sync Error, LP Transmit Sync Error, checksum error or DSI VC ID Invalid** was detected, or the DSI command was not recognized, the peripheral shall send a 4-byte Acknowledge with Error Report response, with the appropriate error flags set in the two-byte error field. Only the ACK/Error Report packet shall be transmitted; no read or write accesses shall take place on the peripheral in response.

Which,

- A. "Acknowledge" includes 2 bytes which are DI (VC + Acknowledge Data Type) and ECC.
- B. "Acknowledge with Error Report" include 4 bytes which are DI, 2 bytes Error report and ECC.
- C. "Response to Read Request" contains 2 types which are Short packet and long packet.

An error report is comprised of two bytes following the DI byte, with an ECC byte following the error report bytes. Table 4.4 shows the Error Report Bit Definitions. And Table 4.5 list complete set of peripheral-to-processor Data Types.

Bit	Description
0	SoT Error
1	SoT Sync Error
2	reserved
3	Escape Mode Entry Command Error
4	Low-Power Transmit Sync Error
5	LP-TX Timeout Error
6	reserved
7	reserved
8	ECC Error, single-bit (detected and corrected)
9	ECC Error, multi-bit (detected, not corrected)
10	Checksum Error (long packet only)
11	DSI Data Type Not Recognized
12	DSI VC ID Invalid
13	reserved
14	reserved
15	reserved

**Table 4.4: Shows the error report bit definitions.**

Data type, hex	Data type, binary	Description packet	Size
02h	00 0010	Acknowledge with Error Report	Short
1Ch	01 1100	DCS Long READ Response	Long
Others (00h→3Fh)		Reserved	-

Table 4.5: The complete set of peripheral-to-processor data types.

Acknowledge types		
Data type, hex	Function description	Number of bytes
02	Get Acknowledge with Error report when Error occurs from processor transmission.	4 bytes

**Note:**When processor transmits complete Payload, following signal by BTA, peripheral must respond to processor.  
With error→Acknowledge with error report, Without error→ Acknowledge.

DCS Read types		
Data type, hex	Function description	Number of bytes
1Ch	This is the long-packet response to DCS Long Read Request.	Up to 65541 bytes ( DI + WC + ECC + DCS CMD. + Payload DATA + PF )

**Note:** If the peripheral is Checksum capable, it shall return a calculated two-byte Checksum appended to the N-byte payload data. If the peripheral does not support Checksum, it shall return 0000h.  
If the DCS command itself is possibly corrupt, due to an uncorrectable ECC error, SoT or SoT Sync error, the requested READ data packet shall not be sent after the Acknowledge with Error Report packet be sent.

### 4.2.4 MDDI Interface (Mobile Display Digital Interface)

#### 4.2.4.1 Introduction of MDDI

The HX8369-A support MDDI, which is a differential serial interface with high-speed low voltage swing characteristics. Both command and display image data can be transferred by MDDI. The devices connected by Data and STB link are host and client part.

Host transfer data to client in “forward” direction, client transfer data to host in “reverse” direction. The Data line is Dual direction, both command and image data are all send through the Data line. The STB line send strobe signal from host to client.

Data transferred in MDDI link are encoded as packet type.

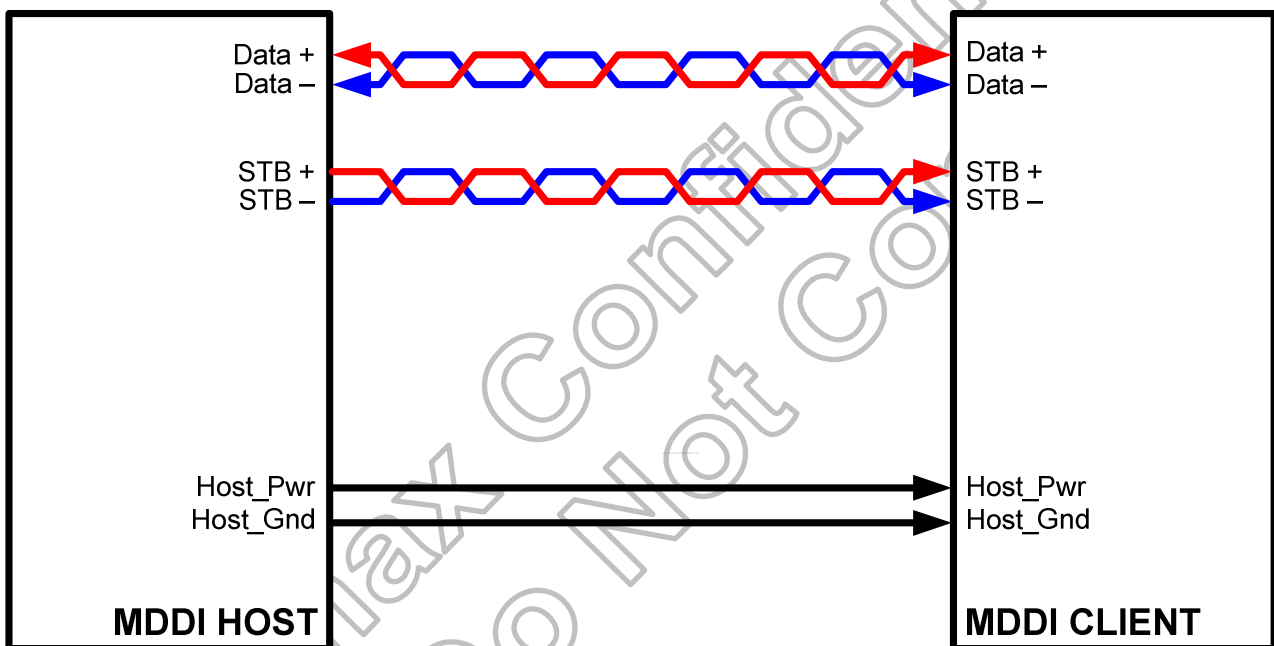


Figure 4.40: Physical connection of MDDI host and client

### 4.2.5 Terminology

The devices connected by the MDDI link are called the host and client. Data going from the host to the client travels in the **forward** direction, and data from the client to the host travels in the **reverse** direction.

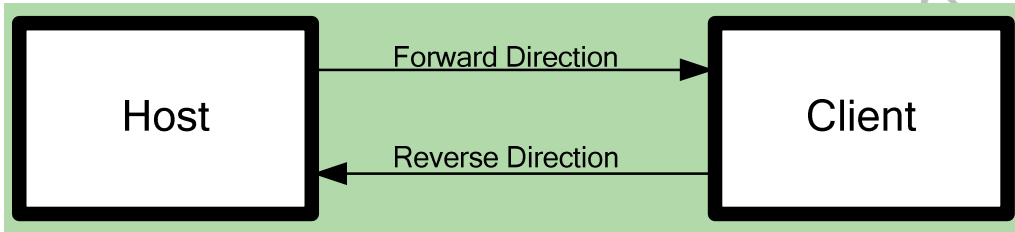


Figure 4.41: MDDI terminology

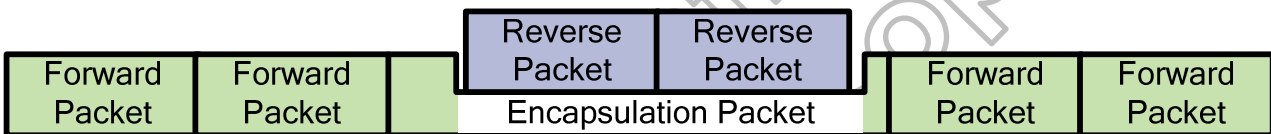


Figure 4.42: Example of Bi-directional MDDI communication

### 4.2.6 Order of data transmission

All fields are transmitted with the LSB first and the MSB transmitted last. Parameters that are more than one byte in length are transmitted in little-endian format, i.e. the least significant byte first. The data fields of each packet are transmitted in the exact order that they are defined in the subsequent sections below, with the first field listed being transmitted first, and the last field described being transmitted last.

MDDI\_Data0 is always aligned with bit 0 of bytes transmitted on the interface in any mode: Type 1, Type 2, Type 3, or Type 4.

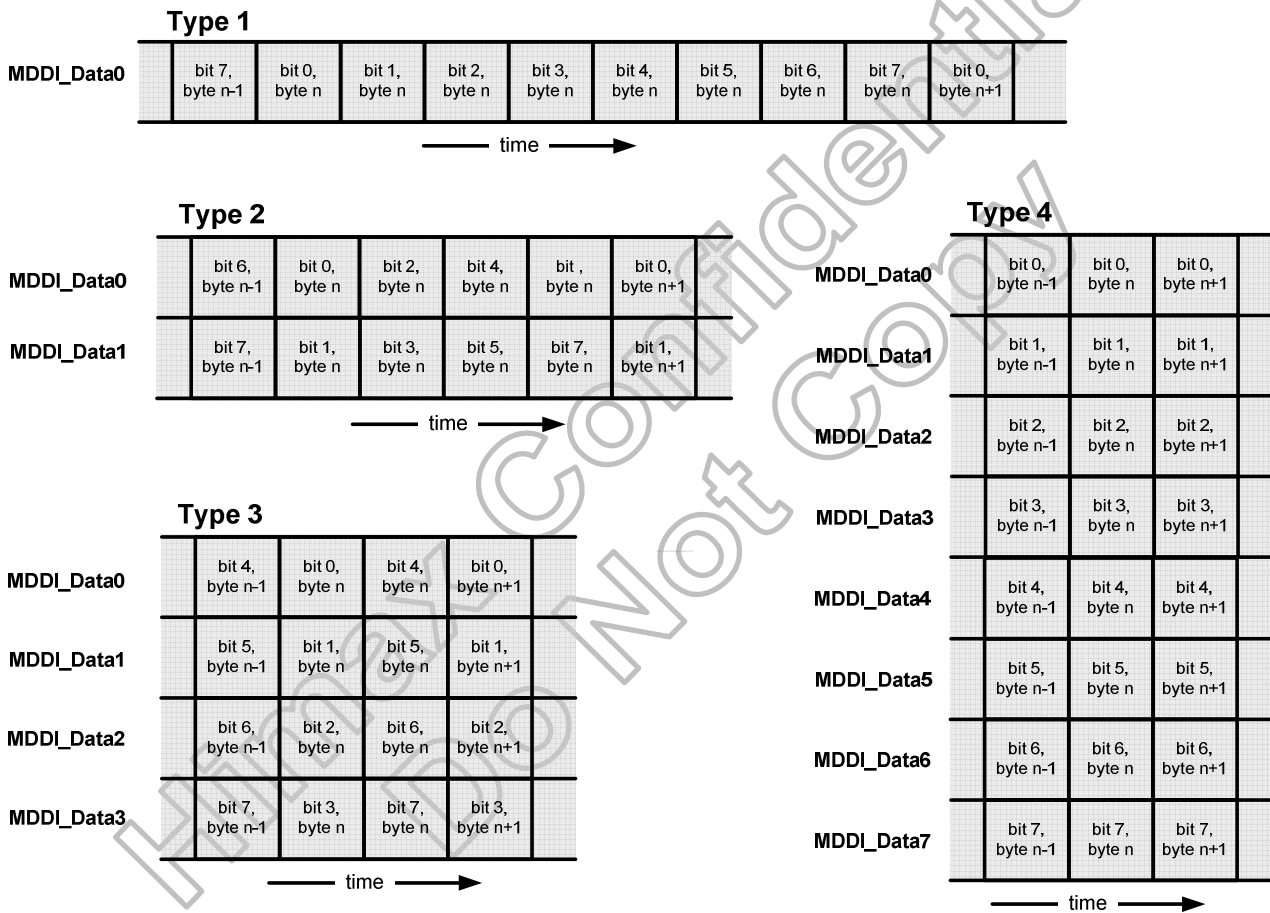
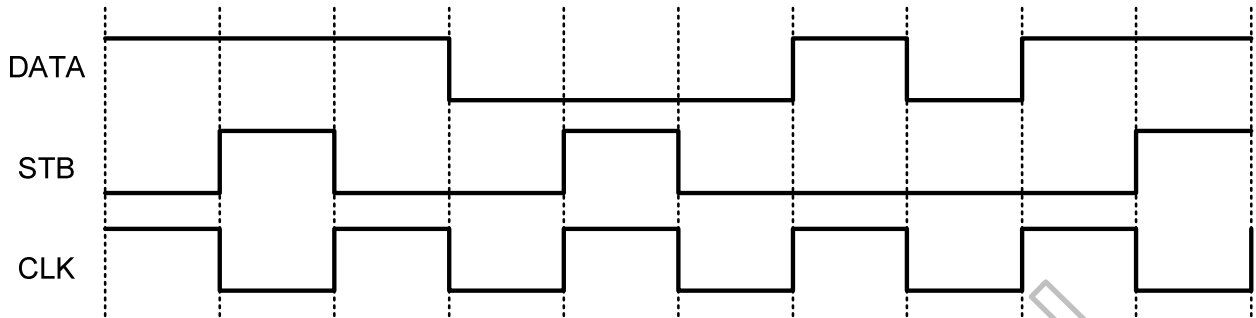


Figure 4.43: Transmission bit ordering for each type

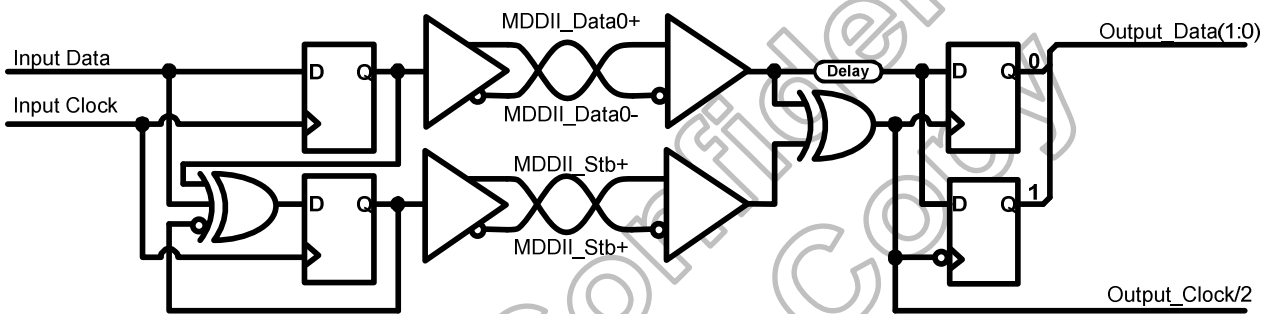
### 4.2.7 Data-STB encoding

Data is encoded using a DATA-STB format. DATA is carried over a bi-directional differential cable, while STB is carried over a unidirectional differential cable driven only by the host. Figure 4.44 illustrates how the data sequence “1110001011” is transmitted by using DATA-STB encoding.



**Figure 4.44: Data-STB encoding**

Figure 4.45 shows a sample circuit to generate DATA and STB from input data, and then decodes the DATA and STB to the Output Data.



**Figure 4.45: Data / STB generation & recovery circuit**



4.2.7.1 MDDI data / STB

The data (MDP/MDN) and STB (MSP/MSN) signals are always operated in a differential mode to maximize noise immunity. Each differential pair is parallel-terminated with the characteristic impedance of the cable. All parallel-terminations are in the client device. Figure below illustrates the configuration of the drivers, receivers, and terminations. The driver of each signal pair has a differential current output. While receiving MDDI packets the MDDI\_DATA and MDDI\_STB pairs use a conventional differential receiver with a differential voltage threshold of zero volts. In the hibernation state the driver outputs are disabled and the parallel termination resistors pull the differential voltage on each signal pair to zero volts. During hibernation a special receiver on the MDDI\_DATA pairs has an offset input differential voltage threshold of positive 125 mV, which causes the hibernation line receiver to interpret the un-driven signal pair as logic-zero level.

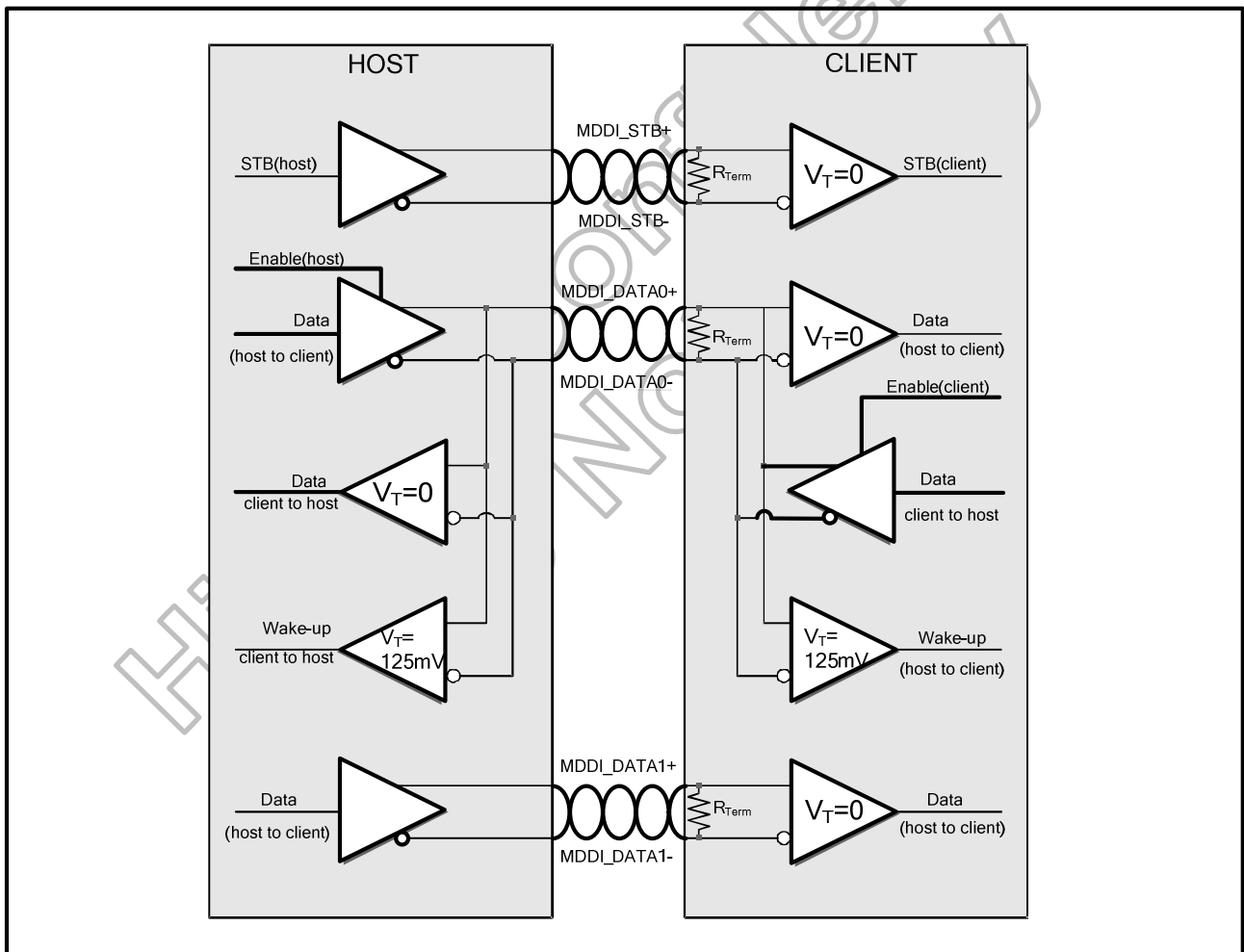


Figure 4.46: Differential connection between host and client

4.2.7.2 MDDI packet

Data transmission over the MDDI link is grouped into packets. Several packets format is supported in HX8369-A. Most packets are in forward direction, transferred from host to client; reverse encapsulation packet is in reverse direction, transferred from MDDI client to host. A number of packets, started by sub-frame header packet, construct one sub frame.

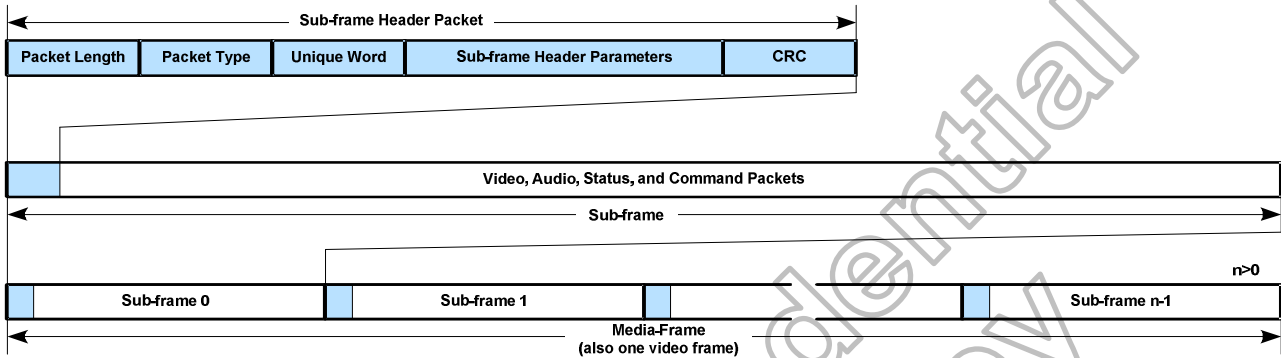
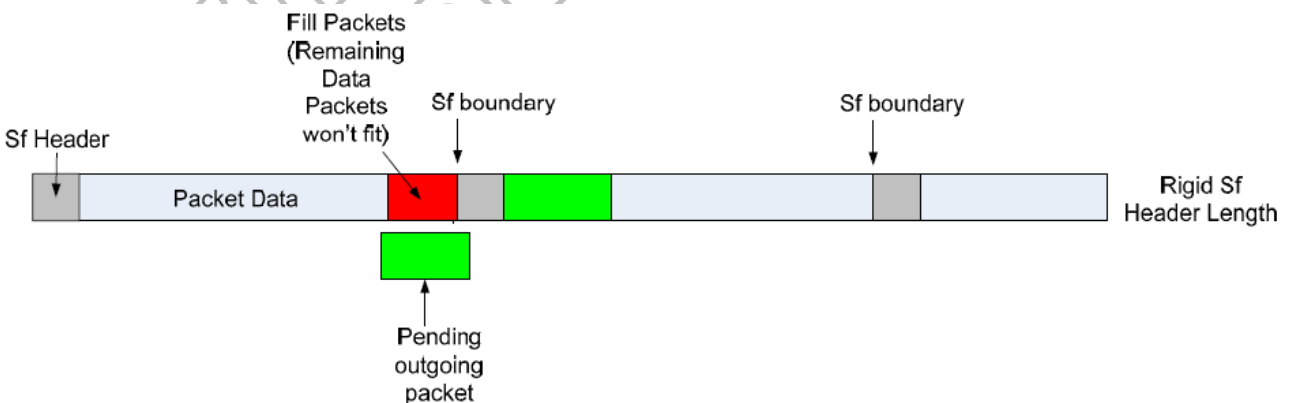


Figure 4.47 MDDI packet structure

Refer to MDDI frame structure, sub-frame header packet is placed in front of a sub-frame, and some sub-frames make up a media-frame.

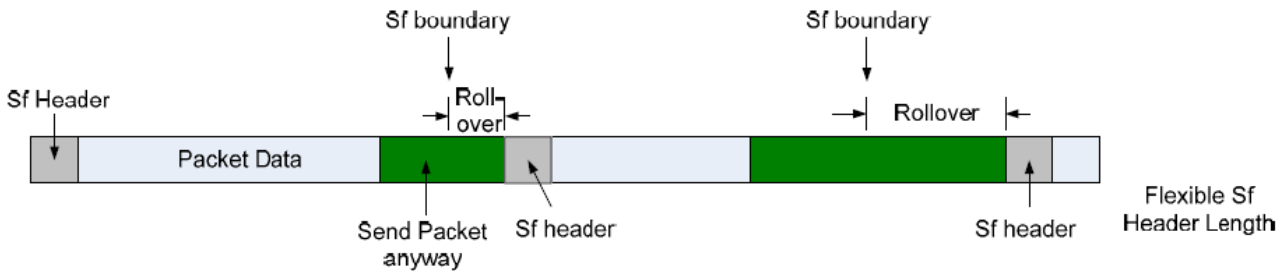
The length of sub-frame has three mode Fixed, Flexible and Unlimited.

Fixed sub-frame length means the total byte in a sub-frame will meet the value which defined in the sub-frame header packet in front of a sub-frame.

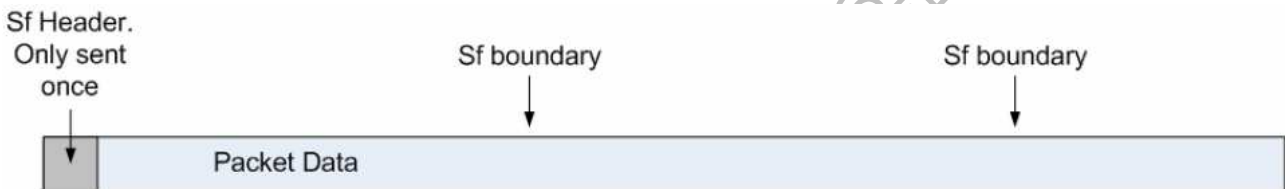


In flexible sub-frame When a packet is requested to be transmitted, it will never be blocked. This may cause a packet to cross a sub-frame boundary. The host therefore must maintain the sub-frame timing within its core to keep track of sub-frames that havelengths greater than the target length, to then transmit a matched number and length of sub-frames that are

less than the target sub-frame length to ensure an average sub-frame length that matches the target length.



hibernation to help the client sync up with the unique word pattern. The MDDI host is allowed to transmit a sub-frame at any time if it wishes, however it is not required.



HX8369-A support these packets, which described in the table below.

Packet	Function	Direction
Sub-frame header packet	Header of each sub frame	Forward
Register access packet	Register setting	Forward
Video stream packet	Video data transfer	Forward
Windowless Video stream packet	Video data transfer	Forward
Flexible Video stream packet	Video data transfer	Forward
Filler packet	Fill empty packet space	Forward
Reverse link encapsulation packet	Reverse data packet	Reverse
Round-trip delay measurement packet	Host->client->host delay check	Forward/Reverse
Enhanced Round-trip delay measurement packet	Host->client->host delay check	Forward/Reverse
Client capability packet	Capability of client check	Reverse
Client request and status packet	Information about client status	Reverse
Forward Link Skew Calibration Packet	Use to Calibrate the delay skew	Forward
Perform Type Handoff Packet	Change operate Type	Forward
Link shutdown packet	End of frame	Forward

Table 4.6: List of supported MDDI packet

**Sub-frame header packet**

Packet Length	Packet type =0x3bffh	Unique word =0x005a	Reserved 1	Sub-frame length	Protocol Version	Sub-frame Count	Media-frame Count	CRC
2 bytes	2 bytes	2 bytes	2 bytes	4 bytes	2 bytes	2 bytes	4 bytes	2 bytes

packet length	:	total number of bytes in the packet not including the packet length field, always 20
packet type	:	packet type, 0x3bffh for sub-frame header packet
unique word	:	link packet type to form a 32-bit unique word for good autocorrelation.
reserved 1	:	not used(all zero)
sub-frame length	:	In fixed Sub-Frame mode, this value specifies number of bytes per sub-frame. In the Flexible Sub-Frame mode ,this value represents the target length. In the unlimited Sub-Frame mode, the value is set to zero
	:	All zero define the length of the sub-frame is undefined.
protocol version	:	set all zero
sub-frame count	:	specifies number of sub-frame header packet.
media frame count	:	specifies number of media frame
CRC	:	error check

**Register access packet**

Packet Length	Packet type =146	bClient ID	Read/Write Info	Register Address	Parameter CRC	Register Data list	Register Data CRC
2 bytes	2 bytes	2 bytes	2 bytes	4 bytes	2 bytes	P_length-14 bytes	4 bytes

packet length	:	total number of bytes in the packet not including the packet length field
packet type	:	packet type, 146(decimal) for register access packet
bClient ID	:	set all zero
Read/Write Info	:	when write value to register, bit[15:14] = "00" when request data from register, bit[15:14]= "10" when data from client, bit[15:14] = "11" bit[13:0] : A 14-bit unsigned integer that specifies the number of 32-bit register Data List items to be transferred in the Register Data List field
register address	:	Register address is set written here.
parameter CRC	:	To error check from packet length to register address
register data list	:	A list of 4-byte register data values.

**Video stream packet**

Packet Length	Packet type =16	bClient ID	video data format descriptor	pixel data attributes	X left edge	Y top edge	X right edge	Y bottom dedge	X start	Y start
2 bytes	2 bytes	2 bytes	2 bytes	2 bytes	2 bytes	2 bytes	2 bytes	2 bytes	2 bytes	2 bytes

pixel count	parameter CRC	pixel data	pixel data CRC
2 bytes	2 bytes	packet length - 26 bytes	2 bytes

- packet length : total number of bytes in the packet not including the packet length field
- packet type : packet type, 16 (decimal) for register access packet
- bClient ID : set all zero
- video data format descriptor : bits[15:13]=010, raw RGB format (fixed value)  
 bit[12]=1,only packed type is available (fixed value)  
 bits[11:0]=number of bits per pixel,  
 bits[11:8]=for Red,bits[7:4]=for Green,bits[3:0]=for Blue
- pixel data attributes : bits[1:0]=11, displayed both eyes (fixed value)  
 : others are all zero
- X left edge : X coordinate of the left edge of the active window filled by the Pixel Data field.
- X top edge : Y coordinate of the top edge of the active window filled by the Pixel Data field
- X right edge : X coordinate of the right edge of the active window filled by the Pixel Data field.
- Y bottom edge : Y coordinate of the bottom edge of the active window filled by the Pixel Data field.
- X start : X coordinate of the first pixel in the Pixel Data field below
- Y start : X coordinate of the first pixel in the Pixel Data field below
- Pixel count : Write number of pixel
- Patameter CRC : To error check from packet length to pixel count
- pixel data : pixel data info. Number of pixel data must not be over 65509
- pixel data CRC : To pixel data error check.

**Windowless video stream packet**

Packet Length	Packet type =22	bClient ID	video data format descriptor	pixel data attributes	pixel count	parameter CRC	pixel data	pixel data CRC
2 bytes	2 bytes	2 bytes	2 bytes	2 bytes	2 bytes	2 bytes	packet length - 14 bytes	2 bytes

- packet length : total number of bytes in the packet not including the packet length field
- packet type : packet type, 22 (decimal) for register access packet
- bClient ID : set all zero
- video data format descriptor : bits[15:13]=010, raw RGB format (fixed value)  
 bit[12]=1,only packed type is available (fixed value)  
 bits[11:0]=number of bits per pixel,  
 bits[11:8]=for Red,bits[7:4]=for Green,bits[3:0]=for Blue
- pixel data attributes : bits[1:0]=11, displayed both eyes (fixed value)  
 : others are all zero
- Pixel count : Write number of pixel
- Patameter CRC : To error check from packet length to pixel count
- pixel data : pixel data info. Number of pixel data must not be over 65509
- pixel data CRC : To pixel data error check.

## Flexible video stream packet

Packet Length	Packet type =20	bClient ID	Field Present Flags	video data format descriptor	pixel data attributes	X left edge	Y top edge	X right edge	Y bottom edge	X start	Y start
2 bytes	2 bytes	2 bytes		2 bytes	2 bytes	2 bytes	2 bytes	2 bytes	2 bytes	2 bytes	2 bytes

pixel count	parameter CRC	pixel data	pixel data CRC
2 bytes	2 bytes	packet length - present header bytes	2 bytes

packet length	: total number of bytes in the packet not including the packet length field
packet type	: packet type, 16 (decimal) for register access packet
bClient ID	: set all zero
Field Present Flags	: A value of '1' for each bit indicates that the field is present in the packet. A value of '0' for the bit indicates that the field is not present. o Bit 0 indicates the presence of the Video Data Format Descriptor field. o Bit 1 indicates the presence of the Pixel Data Attributes field. o Bit 2 indicates the presence of the X Left Edge field. o Bit 3 indicates the presence of the Y Top Edge field. o Bit 4 indicates the presence of the X Right Edge field. o Bit 5 indicates the presence of the Y Bottom Edge field. o Bit 6 indicates the presence of the X Start field. o Bit 7 indicates the presence of the Y Start field. o Bit 8 indicates the presence of the Pixel Count field. o Bits [15:9] must be set to '0'.
video data format descriptor	: bits[15:13]=010, raw RGB format (fixed value) bit[12]=1, only packed type is available (fixed value) bits[11:0]=number of bits per pixel, bits[11:8]=for Red, bits[7:4]=for Green, bits[3:0]=for Blue
pixel data attributes	: bits[1:0]=11, displayed both eyes (fixed value) others are all zero
X left edge	: X coordinate of the left edge of the active window filled by the Pixel Data
X top edge	: Y coordinate of the top edge of the active window filled by the Pixel Data
X right edge	: X coordinate of the right edge of the active window filled by the Pixel Data
Y bottom edge	: Y coordinate of the bottom edge of the active window filled by the Pixel Data
X start	: X coordinate of the first pixel in the Pixel Data field below
Y start	: Y coordinate of the first pixel in the Pixel Data field below
Pixel count	: Write number of pixel
Parameter CRC	: To error check from packet length to pixel count
pixel data	: pixel data info. Number of pixel data must not be over 65509
pixel data CRC	: To pixel data error check.



**Perform type handoff packet**

Packet Length	Packet type =77	Interface Type	Reserved1	Delay filler	CRC
2 bytes	2 bytes	1 byte	1 byte	Packet Length - 6 bytes	2 bytes

packet length	:	total number of bytes in the packet not including the packet length field
packet type	:	packet type, 77(decimal) for perform type handoff packet
interface type	:	contain the new type to be used. Bit[2:0], define the forward link 1: handoff to type1 2: handoff to type2 others: not used. Bit[5:3], define the reverse link 1: handoff to type1 others not used bit[7:6], set all zero.
Reserved1	:	Set all zero
delay filler	:	Set all zero Forward link is Type1, Delay filler is 16byte Forward link is Type2, Delay filler is 32byte
CRC	:	To error check

**Forward link skew calibration pack**

Packet Length	Packet type =83	hClient ID	CRC	All Zero1	Calibration Data Sequence	All Zero2
2 bytes	2 bytes	2 bytes	2 bytes	8 bytes	Packet Length - 22 bytes	8 bytes

packet length	:	total number of bytes in the packet not including the packet length field
packet type	:	packet type, 83(decimal) for perform type handoff packet
hClient ID	:	contain the new type to be used.
CRC	:	To error check
All Zero 1	:	Set all zero
Calibration Data Sequence	:	a data sequence that causes the MDDI_Data signals to toggle at every data period. o Type 1 – (64 byte data sequence) AAh, AAh ... or 55h, 55h... o Type 2 – (128 byte data sequence) CCh, CCh ... or 33h, 33h...
All Zero 2	:	Set all zero



**Filler packet**

Packet Length	Packet type =0	filler bytes (all zero)	CRC
2 bytes	2 bytes	packet length - 4 bytes	2 bytes

- packet length      □ total number of bytes in the packet not including the packet length field
- packet type        □ packet type, 0 (decimal) for register access packet
- filler bytes        □ set to all zero (The size is under packet length available)
- CRC                 □ To error check

**Link shutdown packet**

Packet Length	Packet type =69	CRC	All zeros
2 bytes	2 bytes	2 bytes	16 bytes

- packet length      □ total number of bytes in the packet not including the packet length field
- packet type        □ packet type, 16 (decimal) for register access packet
- CRC                 □ To error check
- All zeros           □ write all zero (size is 16 bytes, because MDDI for HX8369-A is type 1)

 Fixed Value

For more information about MDDI packet refer to VESA MDDI spec.

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4.2.7.3 Hibernation / Wake up

HX8369-A MDDI provides the hibernation mode to reduce the power consumption. The MDDI link can enter the hibernation state quickly and wake up from hibernation quickly. This allows the system to force the MDDI link into hibernation frequently to reduce power consumption. In hibernation mode, hi-speed drivers and receivers are disabled and low-speed & low-power receivers are enabled to detect wake-up sequence.

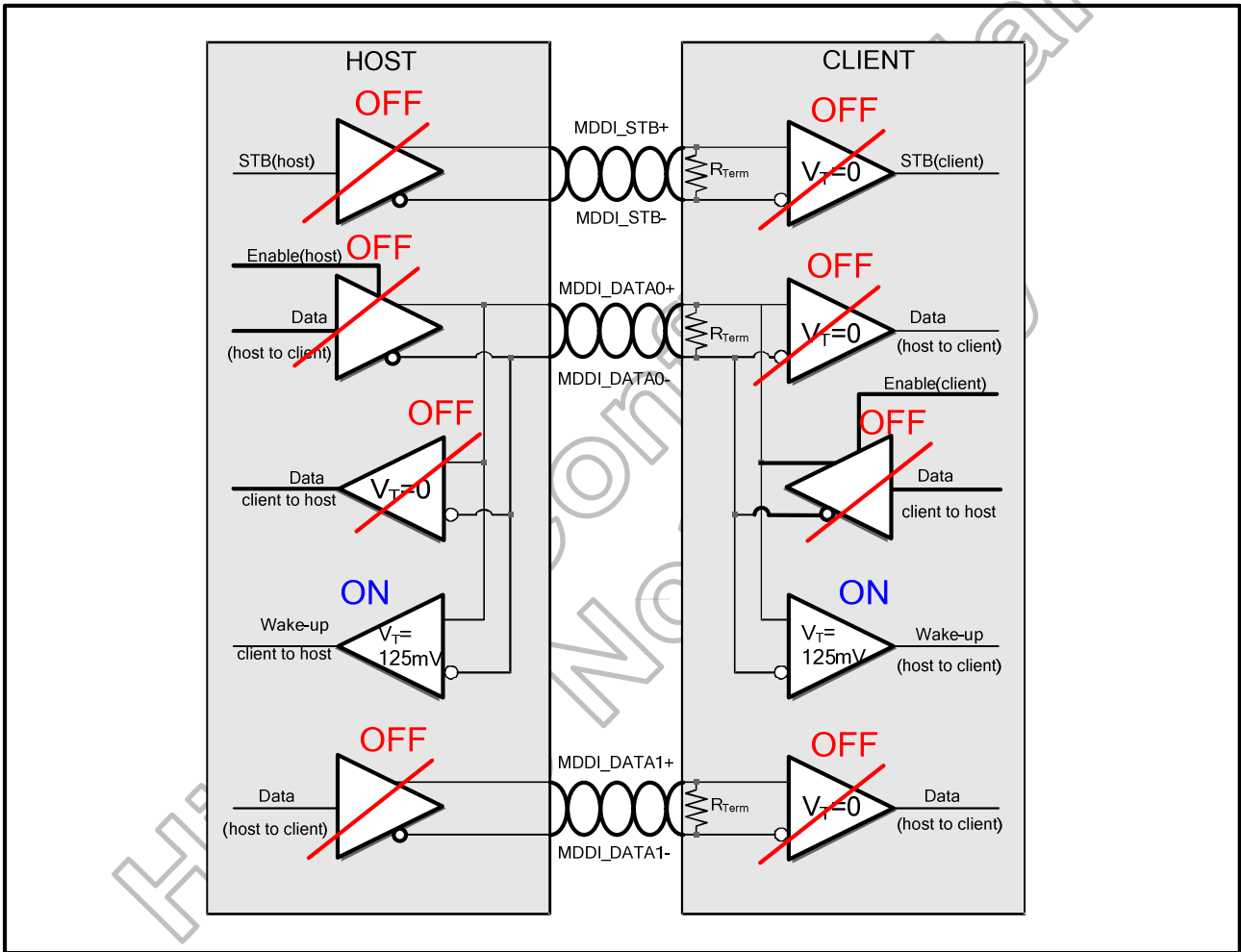


Figure 4.48: MDDI Transceiver / Receiver state in hibernation

When the link wakes up from hibernation the host and client exchange a sequence of pulses. These pulses can be detected using low-speed line receivers that consume only a fraction of the current as the differential receivers required to receive the signals at the maximum link operating speed.

#### 4.2.7.4 MDDI link wakeup sequence

Figure below provide a host-initiated wake-up is described below without contention from the client trying to wake up at the same time. The labeled events are :

Host-Initiated Wake-up

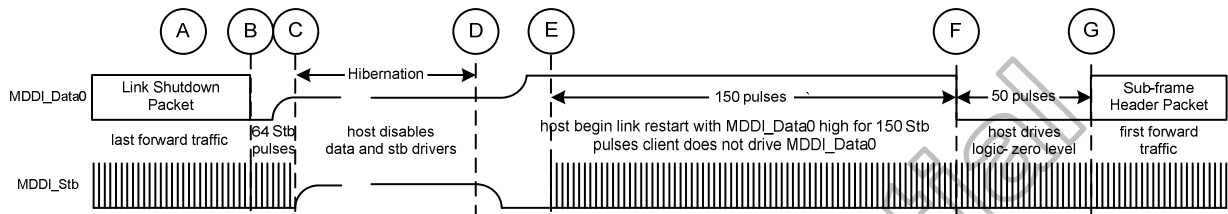


Figure 4.49: Host-initiated link wakeup sequence

An example of a typical client-initiated service request event with no contention is illustrated in below figure. The labeled events are :

- A. The host sends a Link Shutdown Packet to inform the client that the link will transition to the low-power hibernation state.
- B. Following the CRC of the Link Shutdown Packet the host toggles MDDI\_Stb for 64 cycles to allow processing in the client to finish before it stops MDDI\_Stb from toggling which stops the recovered clock in the client device. Also during this interval the host initially sets MDDI\_Data0 to a logic-zero level, and then disables the MDDI\_Data0 output in the range of 16 to 48 MDDI\_Stb cycles (including output disable propagation delays) after the CRC. It may be desirable for the client to place its high-speed receivers for MDDI\_Data0 and MDDI\_Stb into a low power state any time after 48 MDDI\_Stb cycles after the CRC and before point C.
- C. The host enters the low-power hibernation state by disabling the MDDI\_Data0 and MDDI\_Stb drivers and by placing the host controller into a low-power hibernation state. It is also allowable for MDDI\_Stb to be driven to a logic-zero level or to continue toggling during hibernation. The client is also in the low-power hibernation state.
- D. After a while, the host begins the link restart sequence by enabling the MDDI\_Data0 and MDDI\_Stb driver outputs. The host drives MDDI\_Data0 to a logic-one level and MDDI\_Stb to a logic-zero level for at least the time it takes for the drivers to fully enable their outputs. The host shall wait at least 200 nsec after MDDI\_Data0 reaches a valid logic-one level and MDDI\_Stb reaches a valid logic-zero level before driving pulses on MDDI\_Stb. This gives the client sufficient time to prepare to receive high-speed pulses on MDDI\_Stb. The client first detects the wake-up pulse using a low-power differential receiver having a +125mV input offset voltage.
- E. The host drivers are fully enabled and MDDI\_Data0 is being driven to a logic-one level. The host begins to toggle MDDI\_Stb in a manner consistent with having a logic-zero level on MDDI\_Data0 for a duration of 150 MDDI\_Stb cycles.
- F. The host drives MDDI\_Data0 to a logic-zero level for 50 MDDI\_Stb cycles. The client begins to look for the Sub-frame Header Packet after MDDI\_Data0 is at a logic-zero level for 40 MDDI\_Stb cycles.
- G. The host begins to transmit data on the forward link by sending a Sub-frame Header Packet. Beginning at point G the MDDI host generates MDDI\_Stb based on the logic level on MDDI\_Data0 so that proper data-strobe encoding commences from point G.

4.2.7.5 MDDI operation mode

The MDDI Link provides six operation modes, the mode flow is illustrated as below.

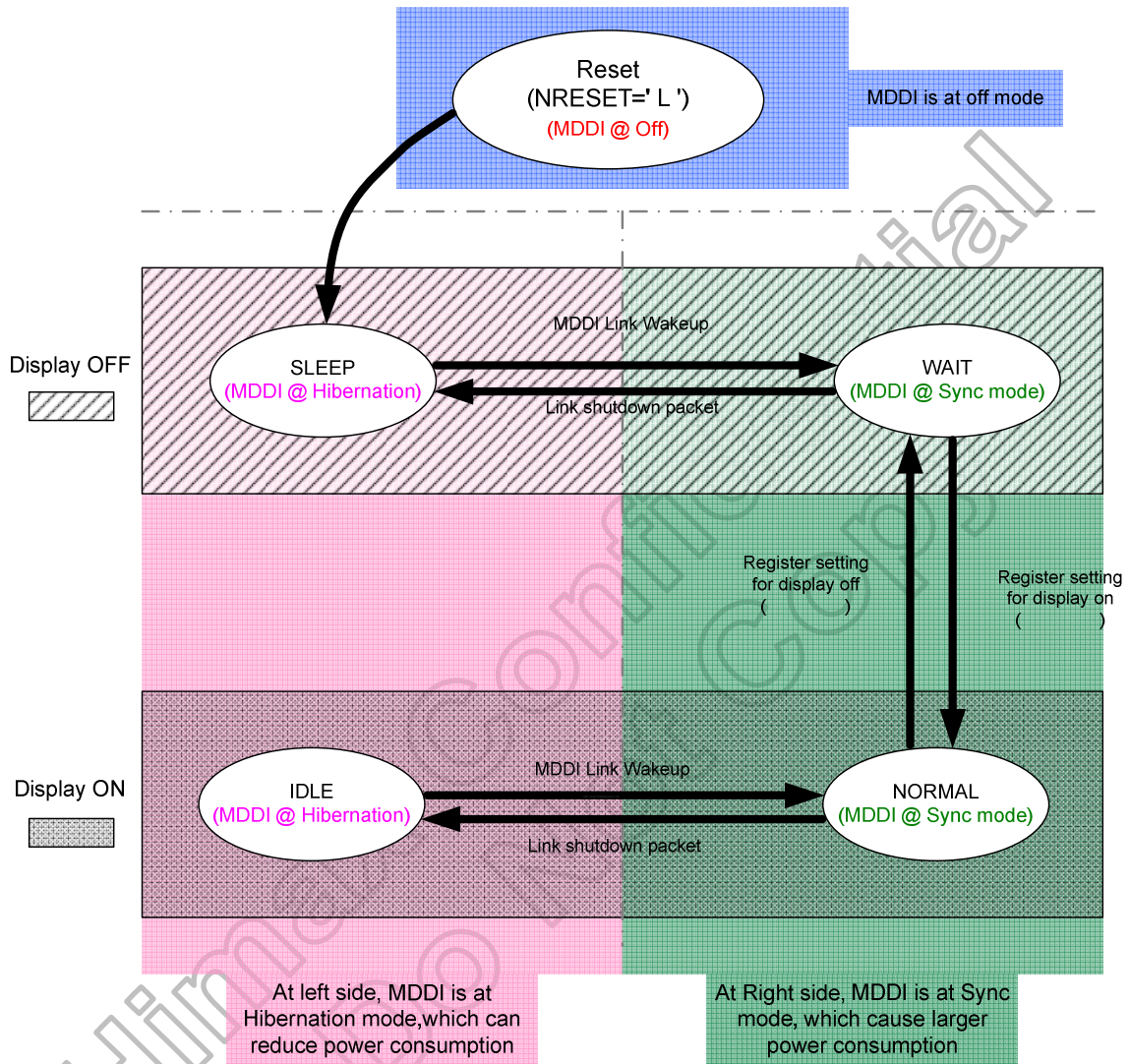


Figure 4.50: MDDI operation mode

The MDDI link provides five operation modes that are listed in the Table 4.7.

Function	RESET	SLEEP	WAIT	NORMAL	IDLE
MDDI hibernation receiver	OFF	ON	OFF	OFF	ON
MDDI normal receiver or normal driver	OFF	OFF	ON	ON	OFF
Register and RAM access	Disable	Disable	Enable	Enable	Disable
Internal oscillator(OSC)	OFF	OFF	ON/OFF <sup>(1)</sup>	ON <sup>(2)</sup>	ON <sup>(2)</sup>
Booster(VSP,VSN,VGH,VGL)	OFF	OFF	OFF	ON	ON
Regulator (VCOM,VSPR,VSNR)	OFF	OFF	OFF	ON	ON

Note: (1) While OSC\_EN = 0 is defined the operation as OFF, and OSC\_EN = 1 is ON.

(2) Do not set OSC\_EN = 1 in Normal mode, If OSC stopped, indication also stops.

Table 4.7: Operation mode list

## 5. Function Description

### 5.1 Display data GRAM

HX8369-A support the display data RAM that stores display dots and consists of 9,953,280 bits (480x864x24 bits). There is no restriction on access to the RAM even when the display data on the same address is loaded to DAC There will be no abnormal visible effect on the display when there is a simultaneous Panel Read and Interface Read or Write to the same location of the Frame Memory.

### 5.2 Address counter (AC)

The HX8369-A contains an address counter (AC) which assigns address for writing/reading pixel data to/from GRAM. The address pointers set the position of GRAM whose addresses range:

RES_SEL2	RES_SEL 1	RES_SEL 0	MV	X range	Y range	Panel resolution
0	0	0	0	0~479d.	0~863d.	480RGBX864 dot
			1	0~863d.	0~479d.	
0	0	1	0	0~479d..	0~853d.	480RGBX854 dot
			1	0~853d.	0~479d.	
0	1	0	0	0~479d.	0~799d.	480RGBX800 dot
			1	0~799d.	0~479d.	
0	1	1	0	0~479d.	0~639d.	480RGBX640 dot
			1	0~639d.	0~479d.	
1	0	0	0	0~359d.	0~639d.	360 RGBX640 dot
			1	0~639d.	0~359d.	
1	0	1	0	0~479d.	0~719d.	480RGBX720 dot
			1	0~719d.	0~479d.	

Table 5.1: Addresses counter range

Every time when a pixel data is written into the GRAM, the X address or Y address of AC will be automatically increased by 1 (or decreased by 1), which is decided by the register (MV, MX and MY bit) setting.

To simplify the address control of GRAM access, the window address function allows for writing data only to a window area of GRAM specified by registers. After data is written to the GRAM, the AC will be increased or decreased within setting window address-range which is specified by the Column address register (start: SC, end: EC) or the Row address register (start: SP, end: EP). Therefore, the data can be written consecutively without thinking a data wrap by those bit function.

5.3 Source, gate and memory map

5.3.1 480RGB x 864 resolution

R36h: B5=0

Source Out		S1	S2	S3	S4	S5	S6	---	S1435	S1436	S1437	S1438	S1439	S1440	SA	
RA		RGB=0		RGB=1		RGB=0		RGB=1		RGB=0		RGB=1		SA		
MY=0	MY=1	R0 7-0	G0 7-0	B0 7-0	R1 7-0	G1 7-0	B1 7-0	---	R478 7-0	G478 7-0	B478 7-0	R479 7-0	G479 7-0	B479 7-0	ML=0	ML=1
0	863							---							0	863
1	862							---							1	862
2	861							---							2	861
3	860							---							3	860
4	859							---							4	859
5	858							---							5	858
6	857							---							6	857
7	856							---							7	856
8	855							---							8	855
9	854							---							9	854
:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
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:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
856	7							---							856	7
857	6							---							857	6
858	5							---							858	5
859	4							---							859	4
860	3							---							860	3
861	2							---							861	2
862	1							---							862	1
863	0							---							863	0
CA	MX=0	0			1			---	478			479				
	MX=1	479			478			---	1			0				

Note: RA=Row Address  
 CA=Colum Address  
 SA=Scan Address  
 MX=Colum address direction parameter  
 MY=Row address direction parameter  
 ML=Scan direction parameter  
 RGB=Red,Green and Blue pixel position change

Table 5.2: Memory map of 480RGB x 864 resolution



**5.3.2 480RGB x 854 resolution**

R36h: B5=0

Source Out		S1	S2	S3	S4	S5	S6	---	S1435	S1436	S1437	S1438	S1439	S1440	SA	
RA		RGB=0		RGB=1		RGB=0		RGB=1		RGB=0		RGB=1		SA		
MY=0	MY=1	R0 7-0	G0 7-0	B0 7-0	R1 7-0	G1 7-0	B1 7-0	---	R478 7-0	G478 7-0	B478 7-0	R479 7-0	G479 7-0	B479 7-0	ML=0	ML=1
0	853							---							0	853
1	852							---							1	852
2	851							---							2	851
3	850							---							3	850
4	849							---							4	849
5	848							---							5	848
6	847							---							6	847
7	846							---							7	846
8	845							---							8	845
9	844							---							9	844
:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
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:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
846	7							---							846	7
847	6							---							847	6
848	5							---							848	5
849	4							---							849	4
850	3							---							850	3
851	2							---							851	2
852	1							---							852	1
853	0							---							853	0
CA	MX=0	0			1			---	478			479				
	MX=1	479			478			---	1			0				

Note: RA=Row Address  
 CA=Colum Address  
 SA=Scan Address  
 MX=Colum address direction parameter  
 MY=Row address direction parameter  
 ML=Scan direction parameter  
 RGB=Red,Green and Blue pixel position change

**Table 5.3: Memory map of 480RGB x 854 resolution**



5.3.3 480RGB x 800 resolution

R36h: B5=0

Source Out		S1	S2	S3	S4	S5	S6	---	S1435	S1436	S1437	S1438	S1439	S1440	SA	
RA		RGB=0		RGB=1		RGB=0		RGB=1		RGB=0		RGB=1		SA		
MY=0	MY=1	R0 7-0	G0 7-0	B0 7-0	R1 7-0	G1 7-0	B1 7-0	---	R478 7-0	G478 7-0	B478 7-0	R479 7-0	G479 7-0	B479 7-0	ML=0	ML=1
0	799							---							0	799
1	798							---							1	798
2	797							---							2	797
3	796							---							3	796
4	795							---							4	795
5	794							---							5	794
6	793							---							6	793
7	792							---							7	792
8	791							---							8	791
9	790							---							9	790
:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
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:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
792	7							---							792	7
793	6							---							793	6
794	5							---							794	5
795	4							---							795	4
796	3							---							796	3
797	2							---							797	2
798	1							---							798	1
799	0							---							799	0
CA	MX=0	0			1			---	478			479				
	MX=1	479			478			---	1			0				

Note: RA=Row Address  
 CA=Colum Address  
 SA=Scan Address  
 MX=Colum address direction parameter  
 MY=Row address direction parameter  
 ML=Scan direction parameter  
 RGB=Red,Green and Blue pixel position change

Table 5.4: Memory map of 480RGB x 800 resolution

5.3.4 480RGB x 640 resolution

R36h: B5=0

Source Out		S1	S2	S3	S4	S5	S6	---	S1435	S1436	S1437	S1438	S1439	S1440	SA	
RA		RGB=0		RGB=1		RGB=0		RGB=1		RGB=0		RGB=1		SA		
MY=0	MY=1	R0 7-0	G0 7-0	B0 7-0	R1 7-0	G1 7-0	B1 7-0	---	R478 7-0	G478 7-0	B478 7-0	R479 7-0	G479 7-0	B479 7-0	ML=0	ML=1
0	639							---							0	639
1	638							---							1	638
2	637							---							2	637
3	636							---							3	636
4	635							---							4	635
5	634							---							5	634
6	633							---							6	633
7	632							---							7	632
8	631							---							8	631
9	630							---							9	630
:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
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:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
632	7							---							632	7
633	6							---							633	6
634	5							---							634	5
635	4							---							635	4
636	3							---							636	3
637	2							---							637	2
638	1							---							638	1
639	0							---							639	0
CA	MX=0	0			1			---	478			479				
	MX=1	479			478			---	1			0				

Note: RA=Row Address  
 CA=Colum Address  
 SA=Scan Address  
 MX=Colum address direction parameter  
 MY=Row address direction parameter  
 ML=Scan direction parameter  
 RGB=Red,Green and Blue pixel position change

Table 5.5: Memory map of 480RGB x 640 resolution

5.3.5 360RGB x 640 resolution

R36h: B5=0

Source Out		S1	S2	S3	S4	S5	S6	---	S1435	S1436	S1437	S1438	S1439	S1440	SA	
RA		RGB=0		RGB=1		RGB=0		RGB=1		RGB=0		RGB=1		SA		
MY=0	MY=1	R0 7-0	G0 7-0	B0 7-0	R1 7-0	G1 7-0	B1 7-0	---	R358 7-0	G358 7-0	B358 7-0	R359 7-0	G359 7-0	B359 7-0	ML=0	ML=1
0	639							---							0	639
1	638							---							1	638
2	637							---							2	637
3	636							---							3	636
4	635							---							4	635
5	634							---							5	634
6	633							---							6	633
7	632							---							7	632
8	631							---							8	631
9	630							---							9	630
:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
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632	7							---							632	7
633	6							---							633	6
634	5							---							634	5
635	4							---							635	4
636	3							---							636	3
637	2							---							637	2
638	1							---							638	1
639	0							---							639	0
CA	MX=0	0			1			---	358			359				
	MX=1	359			358			---	1			0				

Note: RA=Row Address  
 CA=Colum Address  
 SA=Scan Address  
 MX=Colum address direction parameter  
 MY=Row address direction parameter  
 ML=Scan direction parameter  
 RGB=Red,Green and Blue pixel position change

Table 5.6: Memory map of 360RGB x640 resolution

5.3.6 480RGB x 720 resolution

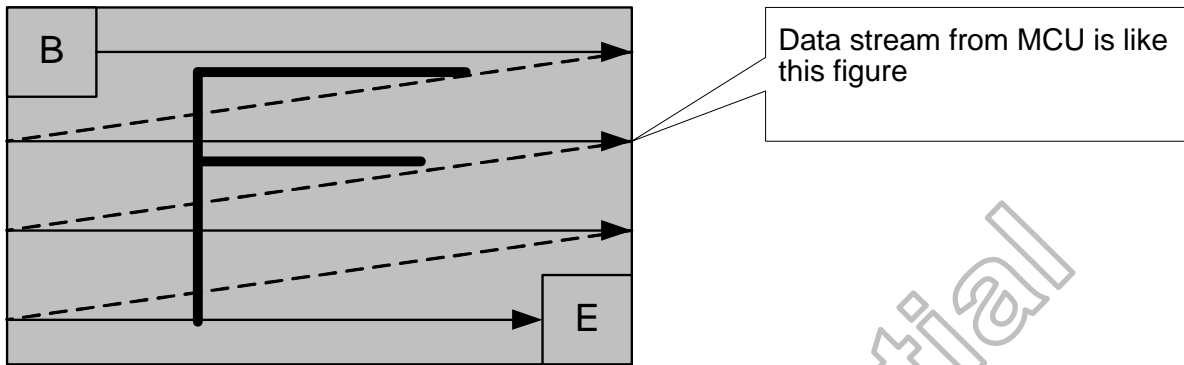
R36h: B5=0

Source Out		S1	S2	S3	S4	S5	S6	---	S1435	S1436	S1437	S1438	S1439	S1440	SA	
RA		RGB=0		RGB=1		RGB=0		RGB=1		RGB=0		RGB=1		SA		
MY=0	MY=1	R0 7-0	G0 7-0	B0 7-0	R1 7-0	G1 7-0	B1 7-0	---	R478 7-0	G478 7-0	B478 7-0	R479 7-0	G479 7-0	B479 7-0	ML=0	ML=1
0	719							---							0	719
1	718							---							1	718
2	717							---							2	717
3	716							---							3	716
4	715							---							4	715
5	714							---							5	714
6	713							---							6	713
7	712							---							7	712
8	711							---							8	711
9	710							---							9	710
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712	7							---							712	7
713	6							---							713	6
714	5							---							714	5
715	4							---							715	4
716	3							---							716	3
717	2							---							717	2
718	1							---							718	1
719	0							---							719	0
CA	MX=0	0			1			---	478			479				
	MX=1	479			478			---	1			0				

Note:RA=Row Address  
 CA=Colum Address  
 SA=Scan Address  
 MX=Colum address direction parameter  
 MY=Row address direction parameter  
 ML=Scan direction parameter  
 RGB=Red,Green and Blue pixel position change

Table 5.7: Memory map of 480RGB x 720 resolution

### 5.4 MCU to memory write / read direction



Data stream from MCU is like this figure

Figure 5.1: MCU to Memory write / read direction

The data is written in the order as illustrated above. The counter that dictates which physical memory the data is to be written is controlled by “Memory Access Control” Command, Bits MY, MX, MV as described below.

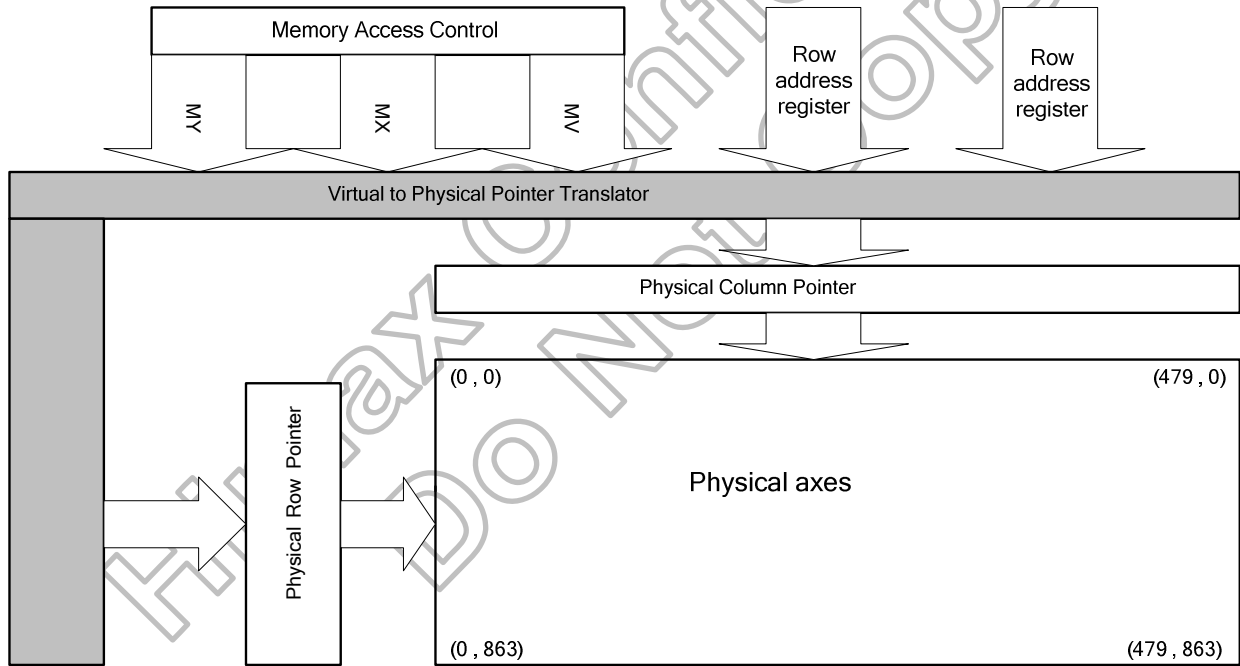


Figure 5.2: MY, MX, MV setting of 480RGB x 864 dot

MV	MX	MY	CASET	PASET
0	0	0	Direct to Physical Column Pointer	Direct to Physical Row Pointer
0	0	1	Direct to Physical Column Pointer	Direct to (863-Physical Row Pointer) with SC
0	1	0	Direct to (479-Physical Column Pointer)	Direct to Physical Row Pointer
0	1	1	Direct to (479-Physical Column Pointer)	Direct to (863-Physical Row Pointer)
1	0	0	Direct to Physical Row Pointer	Direct to Physical Column Pointer
1	0	1	Direct to (863-Physical Row Pointer)	Direct to Physical Column Pointer
1	1	0	Direct to Physical Row Pointer	Direct to (479-Physical Column Pointer)
1	1	1	Direct to (863-Physical Row Pointer)	Direct to (479-Physical Column Pointer)

Figure 5.3: MY, MX, MV setting of 480RGB x 864 dot

The following figure depicts the update method set by MV, MX and MY bit.

Display Data Direction	Memory Access Control			Image in the Host	Image in the Driver (GRAM)
	MV	MX	MY		
Normal	0	0	0		
Y-Mirror	0	0	1		
X-Mirror	0	1	0		
X-Mirror Y-Mirror	0	1	1		
X-Y Exchange	1	0	0		
X-Y Exchange Y-Mirror	1	0	1		
X-Y Exchange X-Mirror	1	1	0		
X-Y Exchange X-Mirror Y-Mirror	1	1	1		

Figure 5.4: Address direction settings

## 5.5 Fully display, partial display, vertical scrolling display

### 5.5.1 Fully display

- Example: (1) 480RGBx864 dot display mode.  
 (2) NORON (Normal Display Mode On) instruction (R13h).  
 (3) SC=0x000h, EC=0x1DFh (R2Ah) and SP=0x000h, EP=0x35Fh (R2Bh), ML=0.

GRAM	000h	001h	-----	1DEh	1DFh
	DB---DB 23 ---0	DB---DB 23 ---0	-----	DB---DB 23 ---0	DB---DB 23 ---0
000h	000000H	000001H	-----	0001DEH	0001DFH
001h	001000H	001001H	-----	0011DEH	0011DFH
002h	002000H	002001H	-----	0021DEH	0021DFH
003h	003000H	003001H	-----	0031DEH	0031DFH
004h	004000H	004001H	-----	0041DEH	0041DFH
005h	005000H	005001H	-----	0051DEH	0051DFH
⋮	⋮	⋮	-----	⋮	⋮
35Ah	35A000H	35A001H	-----	35A1DEH	35A1DFH
35Bh	35B000H	35B001H	-----	35B1DEH	35B1DFH
35Ch	35C000H	35C001H	-----	35C1DEH	35C1DFH
35Dh	35D000H	35D001H	-----	35D1DEH	35D1DFH
35Eh	35E000H	35E001H	-----	35E1DEH	35E1DFH
35Fh	35F000H	35F001H	-----	35F1DEH	35F1DFH

Table 5.8: 480RGB x 864 resolution (SRAM assignment)

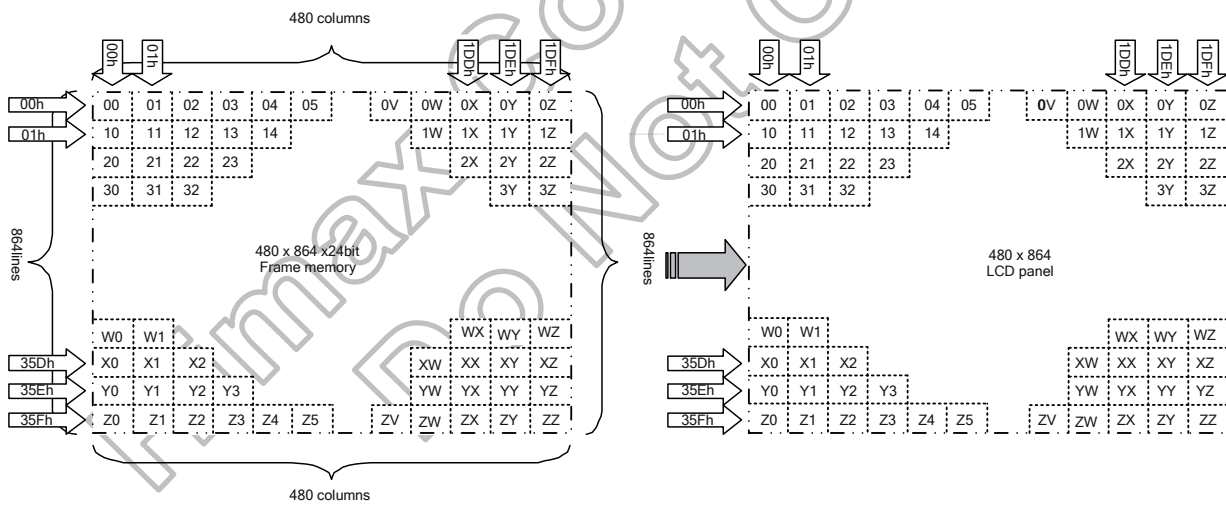


Figure 5.5: 480RGB x 864 resolution



- Example: (1) 480RGBx854 dot display mode.  
 (2) NORON (Normal Display Mode On) instruction (R13h).  
 (3) SC=0x000h, EC=0x1DFh (R2Ah) and SP=0x000h, EP=0x355h (R2Bh), ML=0.

GRAM	000h	001h	-----	1DEh	1DFh
	DB---DB	DB---DB		DB---DB	DB---DB
	23 ---0	23 ---0	-----	23 ---0	23 ---0
000h	000000H	000001H	-----	0001DEH	0001DFH
001h	001000H	001001H	-----	0011DEH	0011DFH
002h	002000H	002001H	-----	0021DEH	0021DFH
003h	003000H	003001H	-----	0031DEH	0031DFH
004h	004000H	004001H	-----	0041DEH	0041DFH
005h	005000H	005001H	-----	0051DEH	0051DFH
⋮	⋮	⋮	-----	⋮	⋮
350h	350000H	350001H	-----	3501DEH	3501DFH
351h	351000H	351001H	-----	3511DEH	3511DFH
352h	352000H	352001H	-----	3521DEH	3521DFH
353h	353000H	353001H	-----	3531DEH	3531DFH
354h	354000H	354001H	-----	3541DEH	3541DFH
355h	355000H	355001H	-----	3551DEH	3551DFH

Table 5.9: 480RGB x 854 resolution (SRAM assignment)

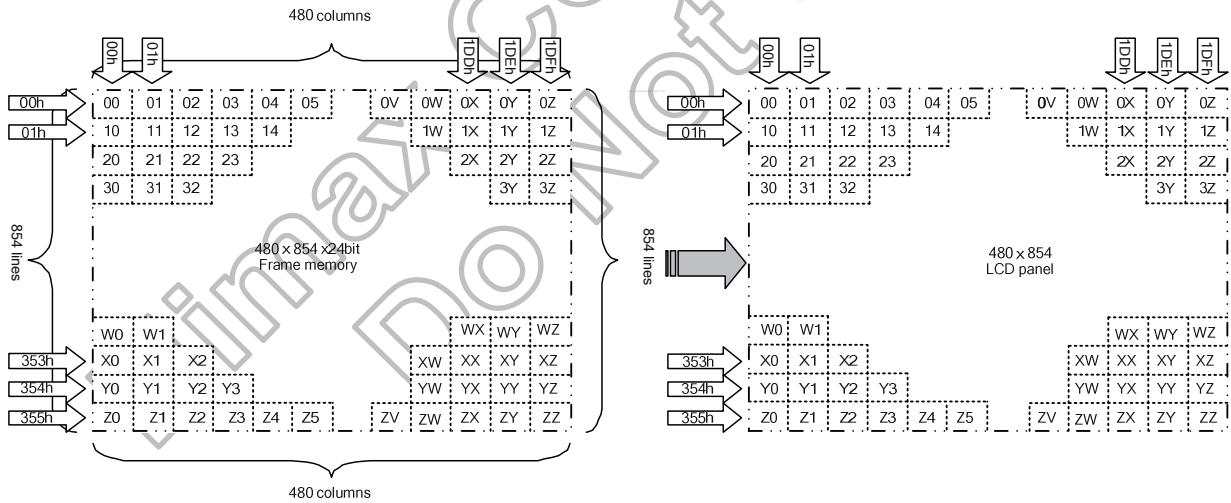


Figure 5.6: 480RGB x 854 resolution

- Example: (1) 480RGBx800 dot display mode.  
 (2) NORON (Normal Display Mode On) instruction (R13h).  
 (3) SC=0x000h, EC=0x1DFh (R2Ah) and SP=0x000h, EP=0x31Fh (R2Bh), ML=0.

GRAM	000h	001h	-----	1DEh	1DFh
	DB---DB 23 ---0	DB---DB 23 ---0	-----	DB---DB 23 ---0	DB---DB 23 ---0
000h	000000H	000001H	-----	0001DEH	0001DFH
001h	001000H	001001H	-----	0011DEH	0011DFH
002h	002000H	002001H	-----	0021DEH	0021DFH
003h	003000H	003001H	-----	0031DEH	0031DFH
004h	004000H	004001H	-----	0041DEH	0041DFH
005h	005000H	005001H	-----	0051DEH	0051DFH
⋮	⋮	⋮	-----	⋮	⋮
31Ah	31A000H	31A001H	-----	31A1DEH	31A1DFH
31Bh	31B000H	31B001H	-----	31B1DEH	31B1DFH
31Ch	31C000H	31C001H	-----	31C1DEH	31C1DFH
31Dh	31D000H	31D001H	-----	31D1DEH	31D1DFH
31Eh	31E000H	31E001H	-----	31E1DEH	31E1DFH
31Fh	31F000H	31F001H	-----	31F1DEH	31F1DFH

Table 5.10: 480RGB x 800 resolution (SRAM assignment)

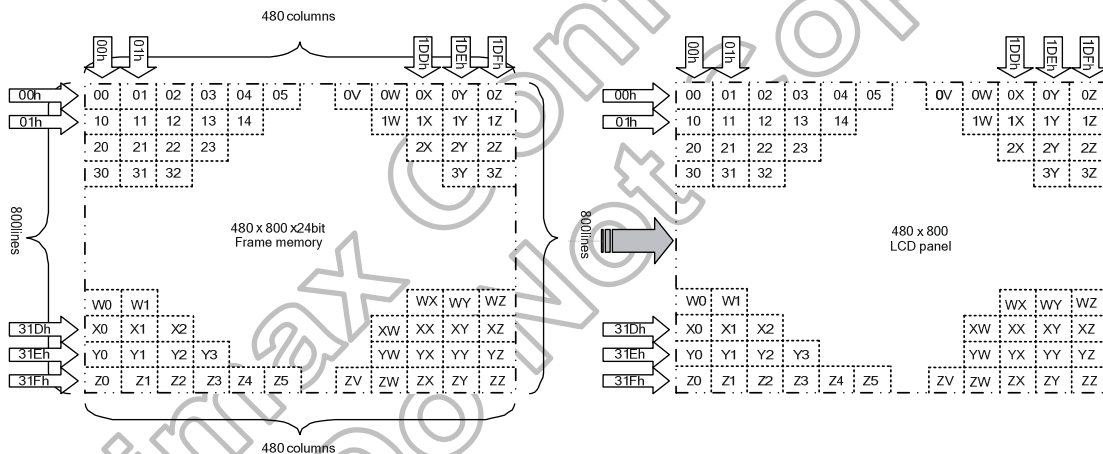


Figure 5.7: 480RGB x 800 resolution

- Example: (1) 480RGBx640 dot display mode.  
 (2) NORON (Normal Display Mode On) instruction (R13h).  
 (3) SC=0x000h, EC=0x1DFh (R2Ah) and SP=0x000h, EP=0x27Fh (R2Bh), ML=0.

GRAM	000h	001h	-----	1DEh	1DFh
	DB--DB 23 ---0	DB--DB 23 ---0	-----	DB--DB 23 ---0	DB--DB 23 ---0
000h	000000H	000001H	-----	0001DEH	0001DFH
001h	001000H	001001H	-----	0011DEH	0011DFH
002h	002000H	002001H	-----	0021DEH	0021DFH
003h	003000H	003001H	-----	0031DEH	0031DFH
004h	004000H	004001H	-----	0041DEH	0041DFH
005h	005000H	005001H	-----	0051DEH	0051DFH
⋮	⋮	⋮	-----	⋮	⋮
27Ah	27A000H	27A001H	-----	27A1DEH	27A1DFH
27Bh	27B000H	27B001H	-----	27B1DEH	27B1DFH
27Ch	27C000H	27C001H	-----	27C1DEH	27C1DFH
27Dh	27D000H	27D001H	-----	27D1DEH	27D1DFH
27Eh	27E000H	27E001H	-----	27E1DEH	27E1DFH
27Fh	27F000H	27F001H	-----	27F1DEH	27F1DFH

Table 5.11: 480RGB x 640 resolution (SRAM assignment)

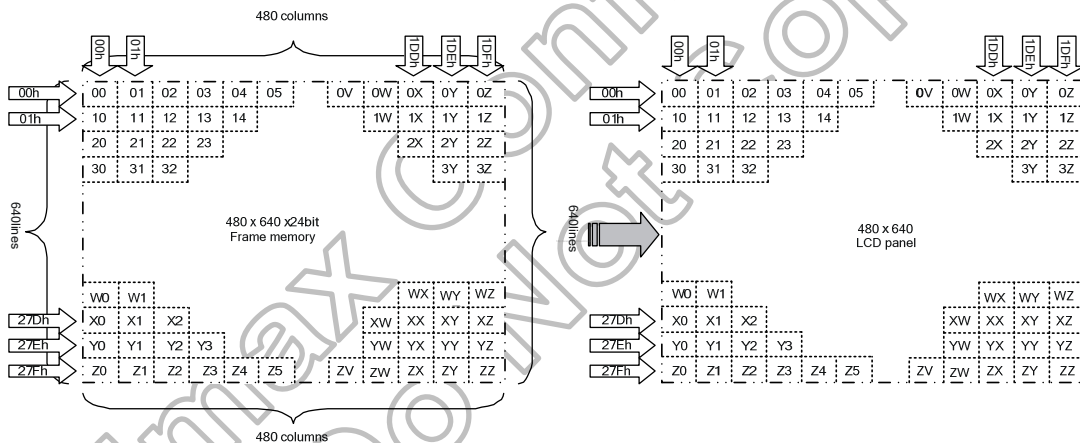


Figure 5.8: 480RGB x 640 resolution

- Example: (1) 360RGBx640 dot display mode.  
 (2) NORON (Normal Display Mode On) instruction (R13h).  
 (3) SC=0x000h, EC=0x167h (R2Ah) and SP=0x000h, EP=0x27Fh (R2Bh), ML=0.

GRAM	000h	001h	-----	166h	167h
	DB---DB 23 ---0	DB---DB 23 ---0	-----	DB---DB 23 ---0	DB---DB 23 ---0
000h	000000H	000001H	-----	000166H	000167H
001h	001000H	001001H	-----	001166H	001167H
002h	002000H	002001H	-----	002166H	002167H
003h	003000H	003001H	-----	003166H	003167H
004h	004000H	004001H	-----	004166H	004167H
005h	005000H	005001H	-----	005166H	005167H
⋮	⋮	⋮	-----	⋮	⋮
27Ah	27A000H	27A001H	-----	27A166H	27A167H
27Bh	27B000H	27B001H	-----	27B166H	27B167H
27Ch	27C000H	27C001H	-----	27C166H	27C167H
27Dh	27D000H	27D001H	-----	27D166H	27D167H
27Eh	27E000H	27E001H	-----	27E166H	27E167H
27Fh	27F000H	27F001H	-----	27F166H	27F167H

Table 5.12: 360RGB x 640 resolution (SRAM assignment)

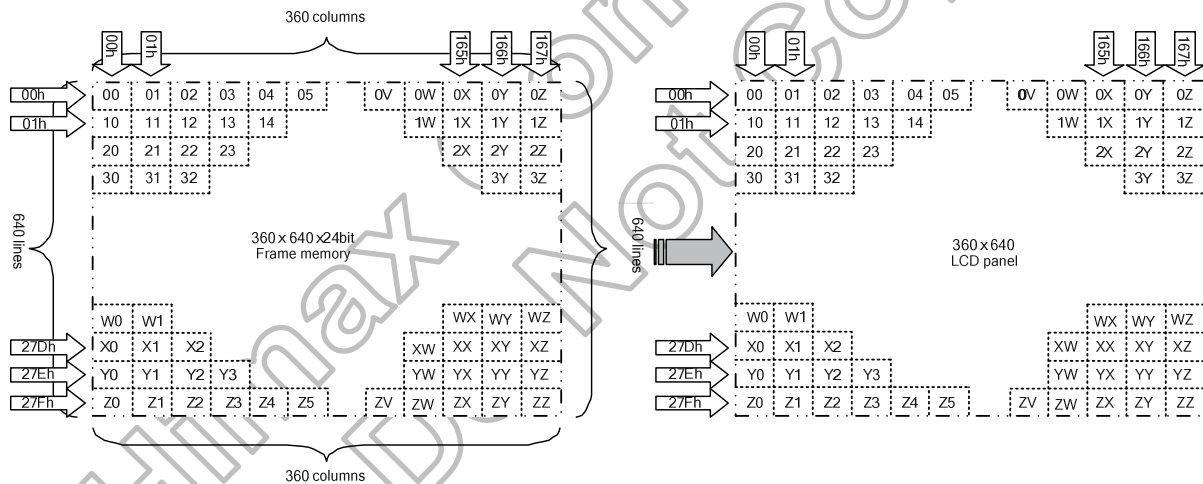
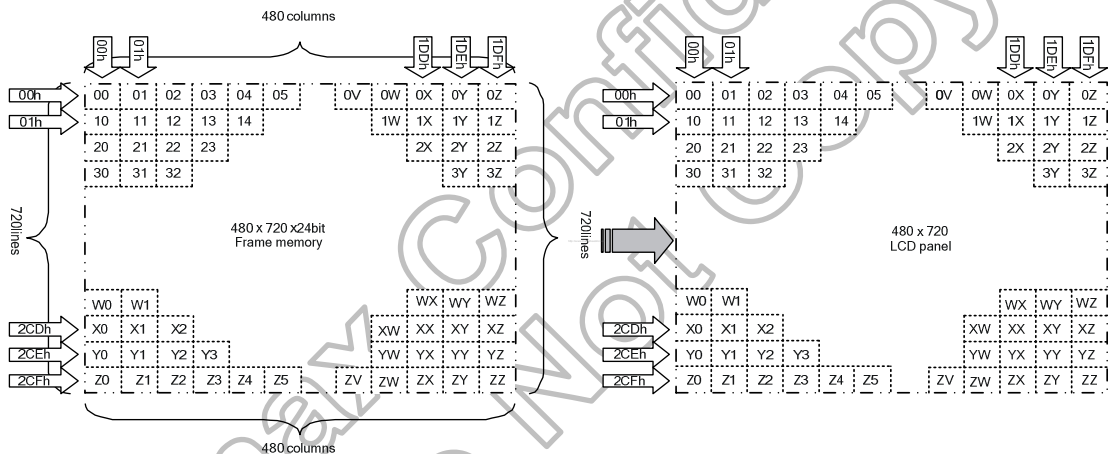


Figure 5.9: 360RGB x 640 resolution

- Example: (1) 480RGBx720 dot display mode.  
 (2) NORON (Normal Display Mode On) instruction (R13h).  
 (3) SC=0x000h, EC=0x1DFh (R2Ah) and SP=0x000h, EP=0x2CFh (R2Bh), ML=0.

GRAM	000h	001h	-----	1DEh	1DFh
	DB---DB 23 ---0	DB---DB 23 ---0	-----	DB---DB 23 ---0	DB---DB 23 ---0
000h	000000H	000001H	-----	0001DEH	0001DFH
001h	001000H	001001H	-----	0011DEH	0011DFH
002h	002000H	002001H	-----	0021DEH	0021DFH
003h	003000H	003001H	-----	0031DEH	0031DFH
004h	004000H	004001H	-----	0041DEH	0041DFH
005h	005000H	005001H	-----	0051DEH	0051DFH
⋮	⋮	⋮	-----	⋮	⋮
2CAh	2CA000H	2CA001H	-----	2CA1DEH	2CA1DFH
2CBh	2CB000H	2CB001H	-----	2CB1DEH	2CB1DFH
2CCh	2CC000H	2CC001H	-----	2CC1DEH	2CC1DFH
2CDh	2CD000H	2CD001H	-----	2CD1DEH	2CD1DFH
2CEh	2CE000H	2CE001H	-----	2CE1DEH	2CE1DFH
2CFh	2CF000H	2CF001H	-----	2CF1DEH	2CF1DFH

**Table 5.13: 480RGB x 720 resolution (SRAM assignment)**



**Figure 5.10: 480RGB x 720 resolution**

### 5.5.2 Vertical scrolling display

The vertical scrolling display is specified by VSCRDEF instruction (R33h) and VSCRSADD instruction (R37h).

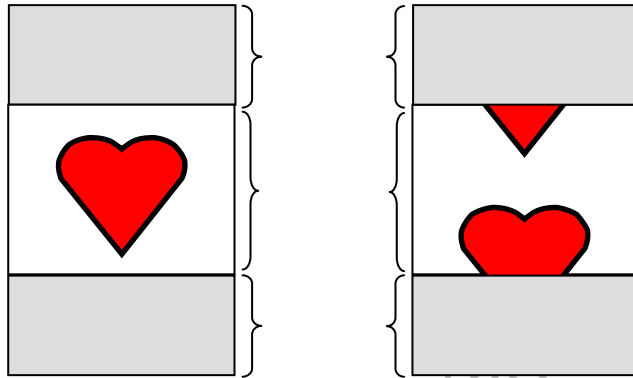


Figure 5.11: Vertical scrolling

When Vertical Scrolling Definition Parameters (TFA+VSA+BFA)=Panel total scan lines. In this case, scrolling is applied as shown below.

#### 5.5.2.1 Example: 480RGB X 864

When Vertical Scrolling Definition Parameters (TFA+VSA+BFA)=864. In this case, scrolling is applied as shown below.

Example (1) TFA=2, VSA=862, BFA=0 when MADCTL B4=0

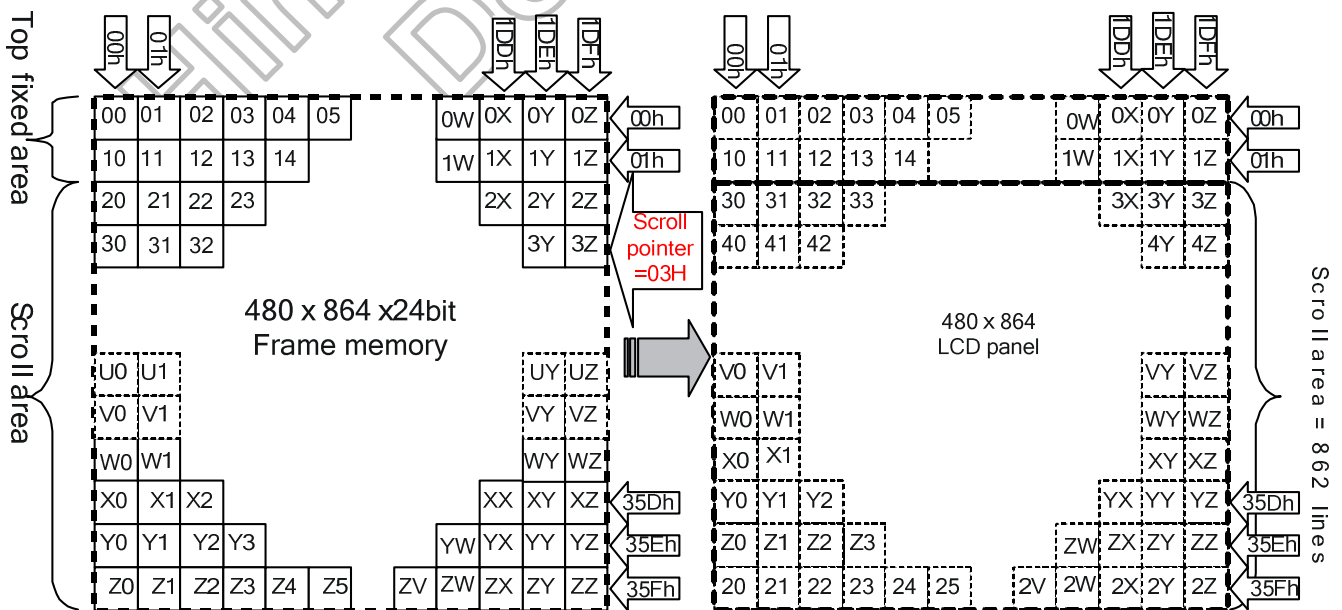


Figure 5.12: Memory map of vertical scrolling 1

Example (2) TFA=2, VSA=860, BFA=2 when MADCTL B4=0

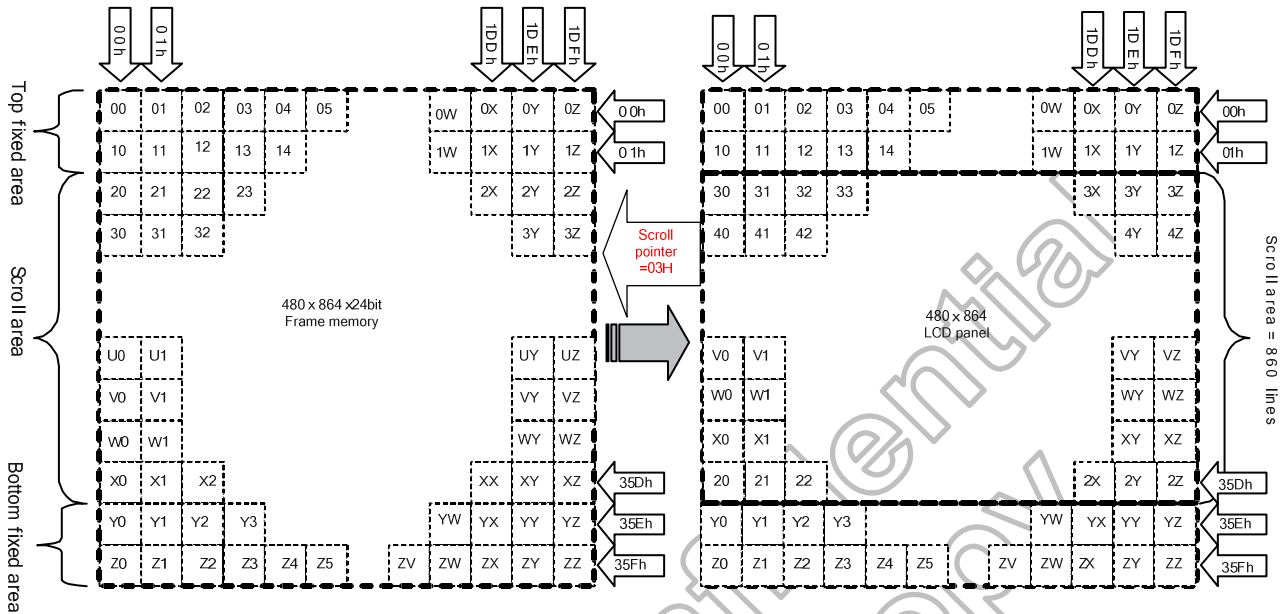


Figure 5.13: Memory map of vertical scrolling 2



5.5.2.2 Vertical scroll example

There are 2 types of vertical scrolling, which are determined by the commands “Vertical Scrolling Definition” (33h) and “Vertical Scrolling Start Address” (37h).

Case 1: TFA + VSA + BFA≠864

Do not set TFA + VSA + BFA=864. In that case, unexpected picture will be shown.

Case 2: TFA + VSA + BFA=864 (Scrolling)

Example (1) When TFA=0, VSA=864, BFA=0 and VSCRSADD=40.MADCTL parameter B4=“0”

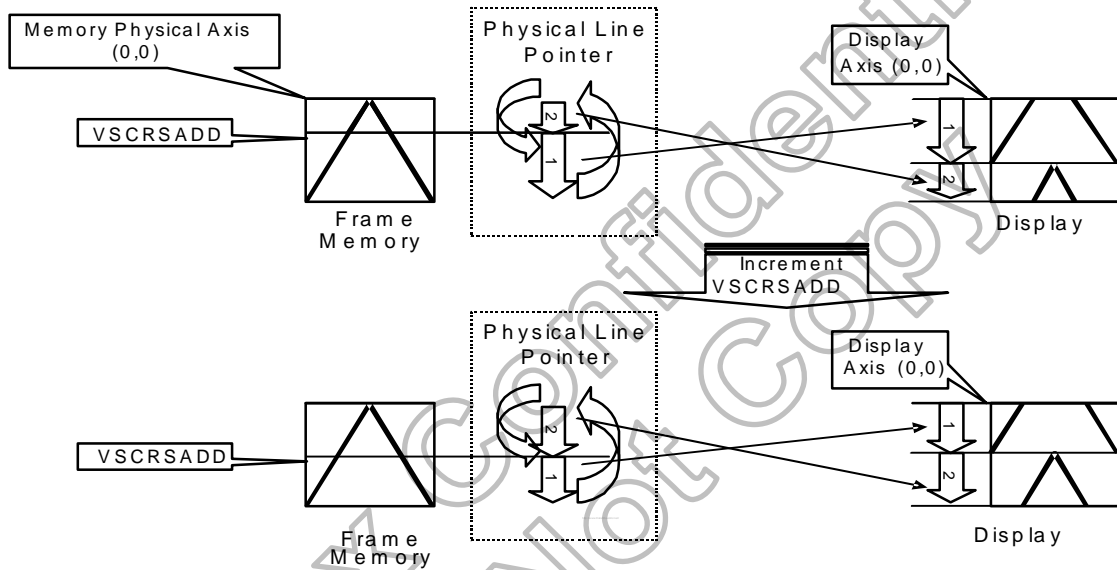


Figure 5.14: Vertical scroll example 1

Example (2) TFA=30, VSA=834, BFA=0 and VSCRSADD =80. MADCTRL parameter B4=“1”

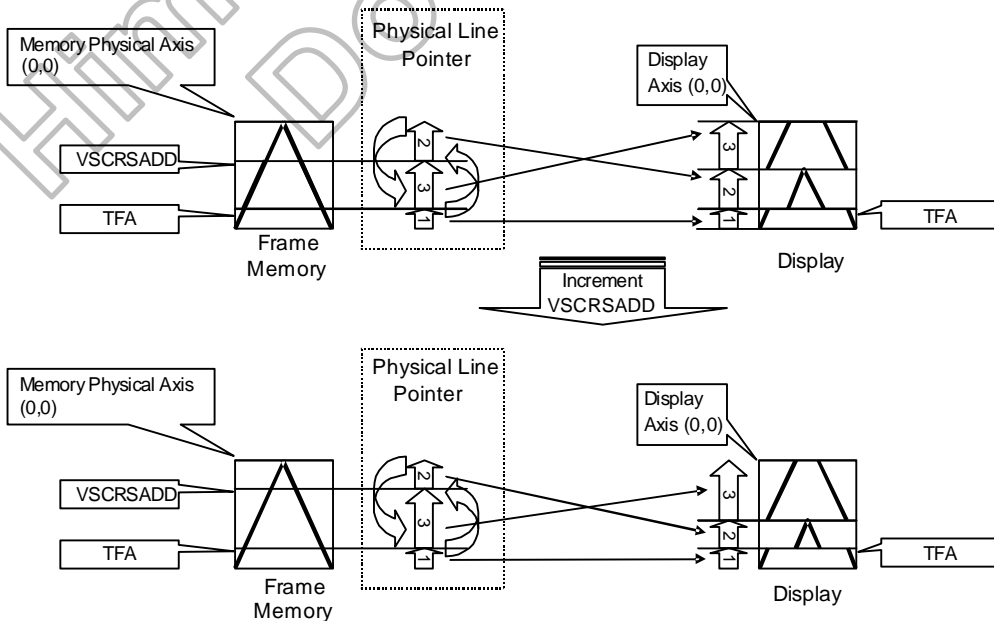


Figure 5.15: Vertical scroll example 2

### 5.5.3 Tearing effect output line

The Tearing Effect output line supplies to the MPU a Panel synchronization signal. This signal can be enabled or disabled by the Tearing Effect Line Off & On commands. The mode of the Tearing Effect signal is defined by the parameter of the Tearing Effect Line On command. The signal can be used by the MPU to synchronize Frame Memory Writing when displaying video images.

#### Tearing Effect Line Modes

**Mode 1**, the Tearing Effect Output signal consists of V-Blanking Information only:

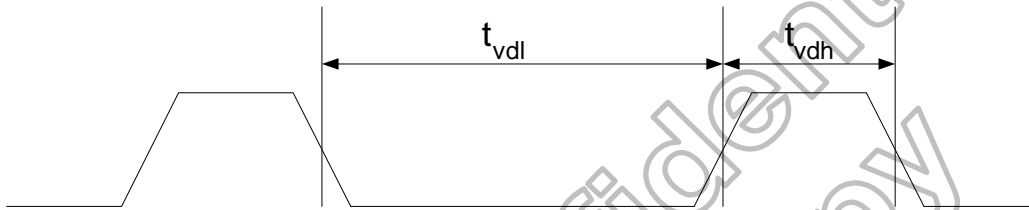


Figure 5.16: Tearing effect output line-mode 1

tvdh=The LCD display is not updated from the Frame Memory

tvdL=The LCD display is updated from the Frame Memory (except Invisible Line – see below)

**Mode 2**, the Tearing Effect Output signal consists of V-Blanking and H-Blanking Information, there is one V-sync and N H-sync pulses per field.

N: If RES\_SEL [2:0] set to = 3'b000, the resolution is 480 RGB X 864, the N=864.

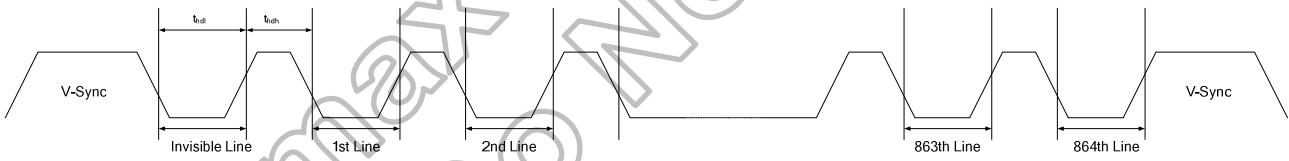
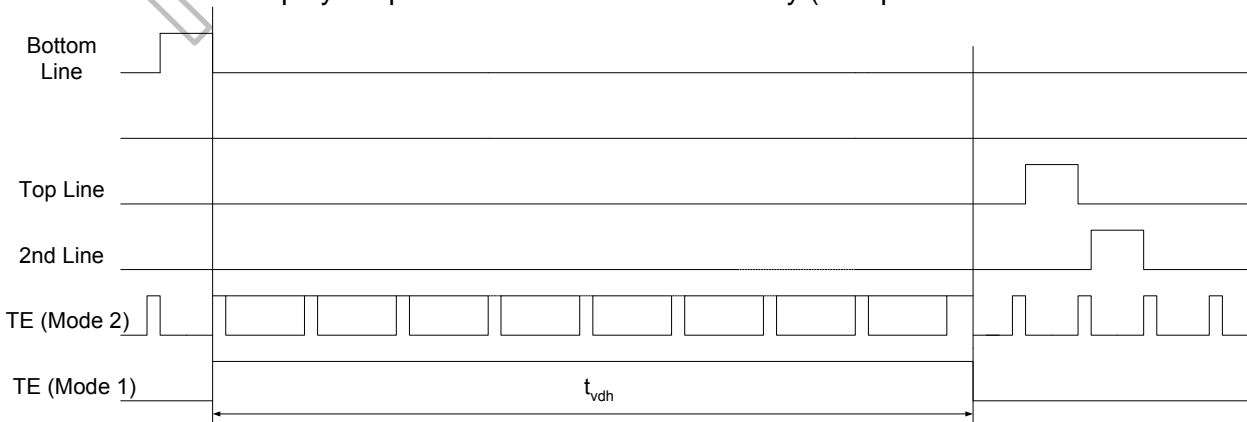


Figure 5.17: Tearing effect output line-mode 2

thdh=The LCD display is not updated from the Frame Memory

thdL=The LCD display is updated from the Frame Memory (except Invisible Line – see above)



**Note:** During Sleep In Mode, the Tearing Output Pin is active Low.

Figure 5.18: Tearing effect output line-timing diagram

5.5.3.1 Tearing effect line timing

The Tearing Effect signal is described below:

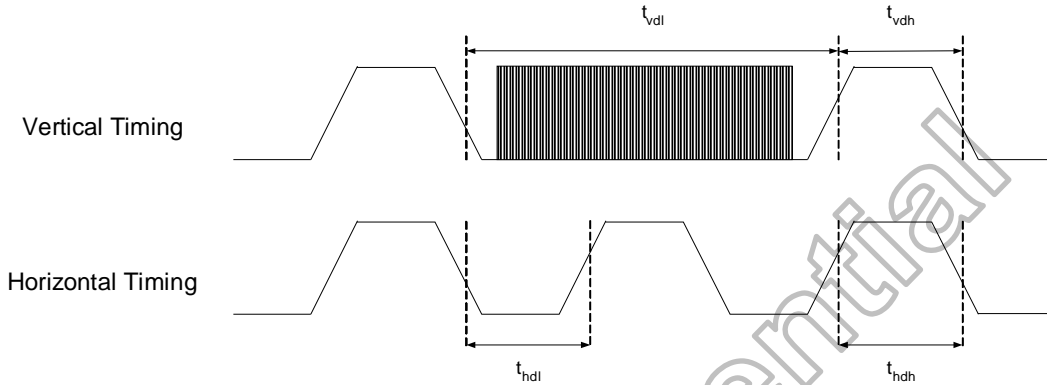


Figure 5.19: Tearing effect output line –tearing effect line timing

Idle Mode Off (Resolution 480x800 RGB, Frame Rate = 60.5 Hz)

Symbol	Parameter	Min.	Max.	Unit
tvdl	Vertical Timing Low Duration	15	-	ms
tvdh	Vertical Timing High Duration	1000	-	us
thdl	Horizontal Timing Low Duration	18	-	us
thdh	Horizontal Timing High Duration	0.13	500	us
tr	Rise time	-	15	ns
tf	Fall time	-	15	ns

Note: The timings in Table 5.13 apply when MADCTL ML=0 and ML=1

Table 5.14: AC characteristics of tearing effect signal

The signal's rise and fall times ( $t_f$ ,  $t_r$ ) are stipulated to be equal to or less than 15ns.

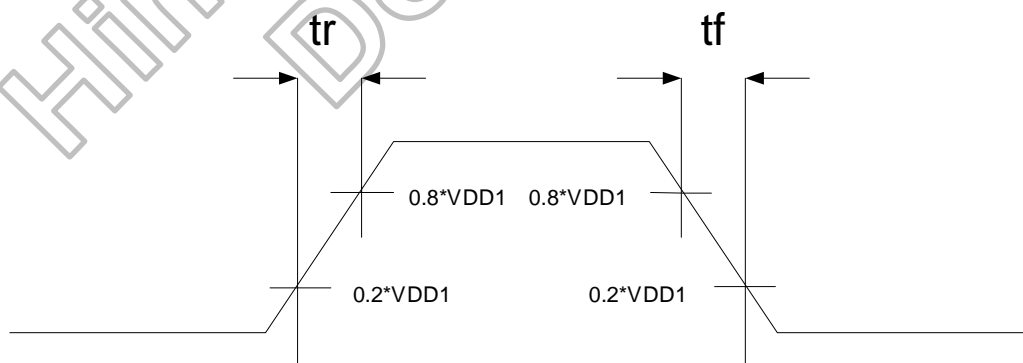
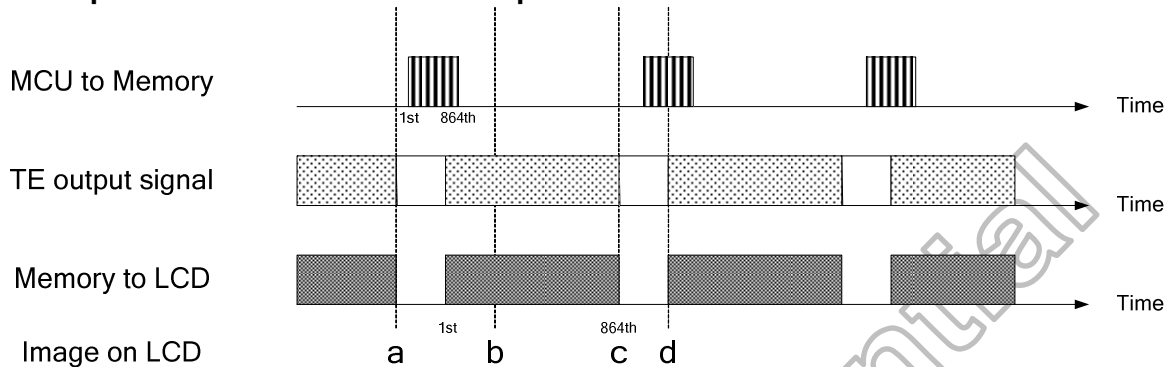


Figure 5.20: Tearing effect output line–definition of  $t_f$ ,  $t_r$

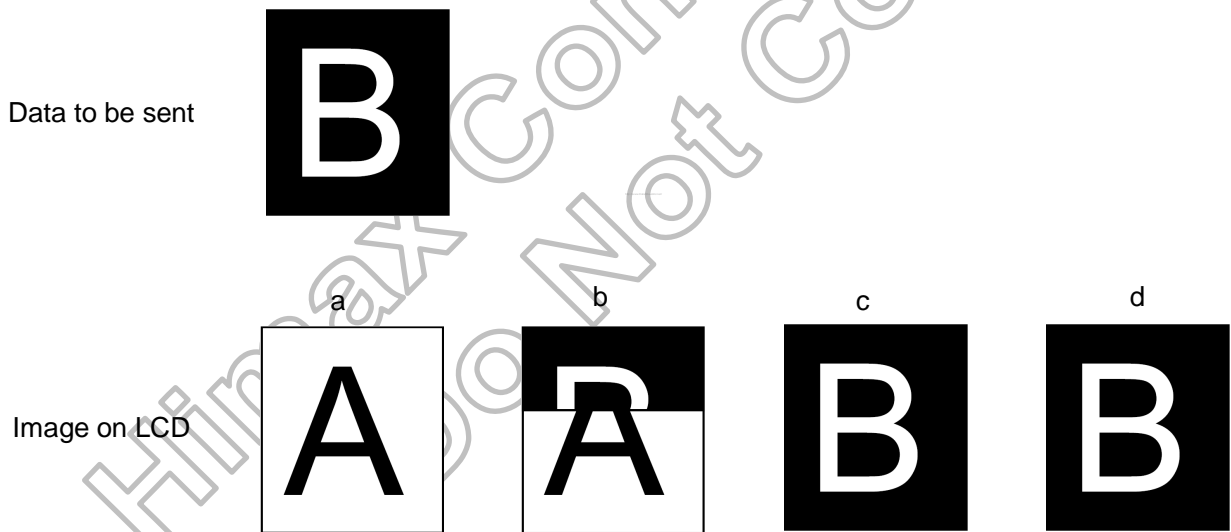
The Tearing Effect Output Line is fed back to the MPU and should be used as shown below to avoid Tearing Effect.

**Example 1: MPU write is faster than panel read.**



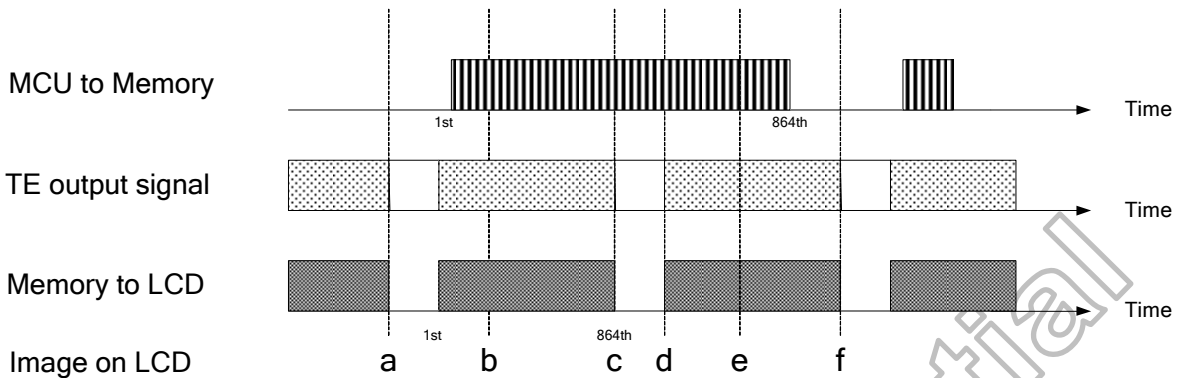
**Figure 5.21: Tearing effect output line—example 1 (Timing)**

Data write to Frame Memory is now synchronized to the Panel Scan. It should be written during the vertical sync pulse of the Tearing Effect Output Line. This ensures that data is always written ahead of the panel scan and each Panel Frame refresh has a complete new image:



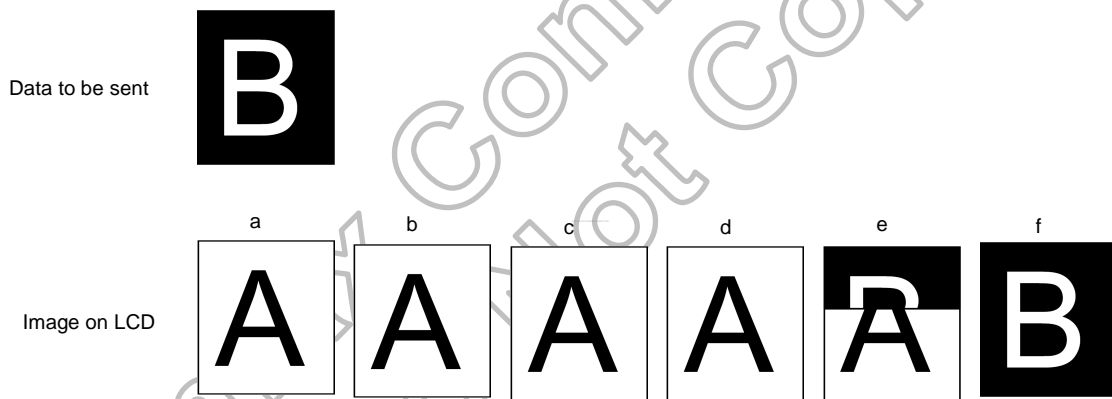
**Figure 5.22: Tearing effect output line—example 1 (Image)**

**Example 2: MPU write is slower than panel read.**



**Figure 5.23: Tearing effect output line—example 2 (Timing)**

The MPU to Frame Memory write begins just after Panel Read has commenced i.e. after one horizontal sync pulse of the Tearing Effect Output Line. This allows time for the image to download behind the Panel Read pointer and finishing download during the subsequent Frame before the Read Pointer “catches” the MPU to Frame memory write position.



**Figure 5.24: Tearing effect output line—example 2 (Image)**

5.6 Color depth conversion

5.6.1 Color depth conversion Look-up tables

R input (5-bit) 16-bit / pixel mode 65,536 colours	R input (6-bit) 18-bit / pixel mode 262,144 colours	R output (8-bit) 24-bit / pixel mode 16,777,216 colours	RGBSET Parameter
00000	000000	R007 R006R005 R004R003R002R001R000	1
00001	000001	R017R016R015R014R013R012R011R010	2
00010	000010	R027R026R025R024R023R022R021R020	3
00011	000011	R037R036R035R034R033R032R031R030	4
00100	000100	R047R046R045R044R043R042R041R040	5
00101	000101	R057R056R055R054R053R052R051R050	6
00110	000110	R067R066R065R064R063R062R061R060	7
00111	000111	R077R076R075R074R073R072R071R070	8
01000	001000	R087R086R085R084R083R082R081R080	9
01001	001001	R097R096R095R094R093R092R091R090	10
01010	001010	R107R106R105R104R103R102R101R100	11
01011	001011	R117R116R115R114R113R112R111R110	12
01100	001100	R127R126R125R124R123R122R121R120	13
01101	001101	R137R136R135R134R133R132R131R130	14
01110	001110	R147R146R145R144R143R142R141R140	15
01111	001111	R157R156R155R154R153R152R151R150	16
10000	010000	R167R166R165 R164R163R162R161R160	17
10001	010001	R177R176R175R174R173R172R171R170	18
10010	010010	R187R186R185R184R183R182R181R180	19
10011	010011	R197R196R195R194R193R192R191R190	20
10100	010100	R207R206R205R204R203R202R201R200	21
10101	010101	R217R216R215R214R213R212R211R210	22
10110	010110	R227R226R225R224R223R222R221R220	23
10111	010111	R237R236R235R234R233R232R231R230	24
11000	011000	R247R246R245R244R243R242R241R240	25
11001	011001	R257R256R255R254R253R252R251R250	26
11010	011010	R267R266R265R264R263R262R261R260	27
11011	011011	R277R276R275R274R273R272R271R270	28
11100	011100	R287R286R285R284R283R282R281R280	29
11101	011101	R297R296R295R294R293R292R291R290	30
11110	011110	R307R306R305R304R303R302R301R300	31
11111	011111	R317R316R315R314R313R312R311R310	32

Table 5.15: Look-up tables-1

R input (5-bit) 16-bit / pixel mode 65,536 colours	R input (6-bit) 18-bit / pixel mode 262,144 colours	R output (8-bit) 24-bit / pixel mode 16,777,216 colours	RGBSET Parameter
No Input	100000	R327 R326R325 R324R323R322R321R320	33
No Input	100001	R337R336R335R334R333R332R331R330	34
No Input	100010	R347R346R345R344R343R342R341R340	35
No Input	100011	R357R356R355R354R353R352R351R350	36
No Input	100100	R367R366R365R364R363R362R361R360	37
No Input	100101	R377R376R375R374R373R372R371R370	38
No Input	100110	R387R386R385R384R383R382R381R380	39
No Input	100111	R397R396R395R394R393R392R391R390	40
No Input	101000	R407R406R405R404R403R402R401R400	41
No Input	101001	R417R416R415R414R413R412R411R410	42
No Input	101010	R427R426R425R424R423R422R421R420	43
No Input	101011	R437R436R435R434R433R432R431R430	44
No Input	101100	R447R446R445R444R443R442R441R440	45
No Input	101101	R457R456R455R454R453R452R451R450	46
No Input	101110	R467R466R465R464R463R462R461R460	47
No Input	101111	R477R476R475R474R473R472R471R470	48
No Input	110000	R487 R486R485 R484R483R482R481R480	49
No Input	110001	R497R496R495R494R493R492R491R490	50
No Input	110010	R507R506R505R504R503R502R501R500	51
No Input	110011	R517R516R515R514R513R512R511R510	52
No Input	110100	R527R526R525R524R523R522R521R520	53
No Input	110101	R537R536R535R534R533R532R531R530	54
No Input	110110	R547R546R545R544R543R542R541R540	55
No Input	110111	R557R556R555R554R553R552R551R550	56
No Input	111000	R567R566R565R564R563R562R561R560	57
No Input	111001	R577R576R575R574R573R572R571R570	58
No Input	111010	R587R586R585R584R583R582R581R580	59
No Input	111011	R597R596R595R594R593R592R591R590	60
No Input	111100	R607R606R605R604R603R602R601R600	61
No Input	111101	R617R616R615R614R613R612R611R610	62
No Input	111110	R627R626R625R624R623R622R621R620	63
No Input	111111	R637R636R635R634R633R632R631R630	64

Table 5.16: Look-up tables-2



G input (5-bit) 16-bit / pixel mode 65,536 colours	G input (6-bit) 18-bit / pixel mode 262,144 colours	G output (8-bit) 24-bit / pixel mode 16,777,216 colours	RGBSET Parameter
000000	000000	G007 G006G005 G004G003G002G001G000	65
000001	000001	G017G016G015G014G013G012G011G010	66
000010	000010	G027G026G025G024G023G022G021G020	67
000011	000011	G037G036G035G034G033G032G031G030	68
000100	000100	G047G046G045G044G043G042G041G040	69
000101	000101	G057G056G055G054G053G052G051G050	70
000110	000110	G067G066G065G064G063G062G061G060	71
000111	000111	G077G076G075G074G073G072G071G070	72
001000	001000	G087G086G085G084G083G082G081G080	73
001001	001001	G097G096G095G094G093G092G091G090	74
001010	001010	G107G106G105G104G103G102G101G100	75
001011	001011	G117G116G115G114G113G112G111G110	76
001100	001100	G127G126G125G124G123G122G121G120	77
001101	001101	G137G136G135G134G133G132G131G130	78
001110	001110	G147G146G145G144G143G142G141G140	79
001111	001111	G157G156G155G154G153G152G151G150	80
010000	010000	G167G166G165G164G163G162G161G160	81
010001	010001	G177G176G175G174G173G172G171G170	82
010010	010010	G187G186G185G184G183G182G181G180	83
010011	010011	G197G196G195G194G193G192G191G190	84
010100	010100	G207G206G205G204G203G202G201G200	85
010101	010101	G217G216G215G214G213G212G211G210	86
010110	010110	G227G226G225G224G223G222G221G220	87
010111	010111	G237G236G235G234G233G232G231G230	88
011000	011000	G247G246G245G244G243G242G241G240	89
011001	011001	G257G256G255G254G253G252G251G250	90
011010	011010	G267G266G265G264G263G262G261G260	91
011011	011011	G277G276G275G274G273G272G271G270	92
011100	011100	G287G286G285G284G283G282G281G280	93
011101	011101	G297G296G295G294G293G292G291G290	94
011110	011110	G307G306G305G304G303G302G301G300	95
011111	011111	G317G316G315G314G313G312G311G310	96

Table 5.17: Look-up tables-3

G input (5-bit) 16-bit / pixel mode 65,536 colours	G input (6-bit) 18-bit / pixel mode 262,144 colours	G output (8-bit) 24-bit / pixel mode 16,777,216 colours	RGBSET Parameter
100000	100000	G327 G326G325 G324G323G322G321G320	97
100001	100001	G337G336G335G334G333G332G331G330	98
100010	100010	G347G346G345G344G343G342G341G340	99
100011	100011	G357G356G355G354G353G352G351G350	100
100100	100100	G367G366G365G364G363G362G361G360	101
100101	100101	G377G376G375G374G373G372G371G370	102
100110	100110	G387G386G385G384G383G382G381G380	103
100111	100111	G397G396G395G394G393G392G391G390	104
101000	101000	G407G406G405G404G403G402G401G400	105
101001	101001	G417G416G415G414G413G412G411G410	106
101010	101010	G427G426G425G424G423G422G421G420	107
101011	101011	G437G436G435G434G433G432G431G430	108
101100	101100	G447G446G445G444G443G442G441G440	109
101101	101101	G457G456G455G454G453G452G451G450	110
101110	101110	G467G466G465G464G463G462G461G460	111
101111	101111	G477G476G475G474G473G472G471G470	112
110000	110000	G487 G486G485 G484G483G482G481G480	113
110001	110001	G497G496G495G494G493G492G491G490	114
110010	110010	G507G506G505G504G503G502G501G500	115
110011	110011	G517G516G515G514G513G512G511G510	116
110100	110100	G527G526G525G524G523G522G521G520	117
110101	110101	G537G536G535G534G533G532G531G530	118
110110	110110	G547G546G545G544G543G542G541G540	119
110111	110111	G557G556G555G554G553G552G551G550	120
111000	111000	G567G566G565G564G563G562G561G560	121
111001	111001	G577G576G575G574G573G572G571G570	122
111010	111010	G587G586G585G584G583G582G581G580	123
111011	111011	G597G596G595G594G593G592G591G590	124
111100	111100	G607G606G605G604G603G602G601G600	125
111101	111101	G617G616G615G614G613G612G611G610	126
111110	111110	G627G626G625G624G623G622G621G620	127
111111	111111	G637G636G635G634G633G632G631G630	128

Table 5.18: Look-up tables-4

B input (5-bit) 16-bit / pixel mode 65,536 colours	B input (6-bit) 18-bit / pixel mode 262,144 colours	B output (8-bit) 24-bit / pixel mode 16,777,216 colours	RGBSET Parameter
00000	000000	B <sub>007</sub> B <sub>006</sub> B <sub>005</sub> B <sub>004</sub> B <sub>003</sub> B <sub>002</sub> B <sub>001</sub> B <sub>000</sub>	129
00001	000001	B <sub>017</sub> B <sub>016</sub> B <sub>015</sub> B <sub>014</sub> B <sub>013</sub> B <sub>012</sub> B <sub>011</sub> B <sub>010</sub>	130
00010	000010	B <sub>027</sub> B <sub>026</sub> B <sub>025</sub> B <sub>024</sub> B <sub>023</sub> B <sub>022</sub> B <sub>021</sub> B <sub>020</sub>	131
00011	000011	B <sub>037</sub> B <sub>036</sub> B <sub>035</sub> B <sub>034</sub> B <sub>033</sub> B <sub>032</sub> B <sub>031</sub> B <sub>030</sub>	132
00100	000100	B <sub>047</sub> B <sub>046</sub> B <sub>045</sub> B <sub>044</sub> B <sub>043</sub> B <sub>042</sub> B <sub>041</sub> B <sub>040</sub>	133
00101	000101	B <sub>057</sub> B <sub>056</sub> B <sub>055</sub> B <sub>054</sub> B <sub>053</sub> B <sub>052</sub> B <sub>051</sub> B <sub>050</sub>	134
00110	000110	B <sub>067</sub> B <sub>066</sub> B <sub>065</sub> B <sub>064</sub> B <sub>063</sub> B <sub>062</sub> B <sub>061</sub> B <sub>060</sub>	135
00111	000111	B <sub>077</sub> B <sub>076</sub> B <sub>075</sub> B <sub>074</sub> B <sub>073</sub> B <sub>072</sub> B <sub>071</sub> B <sub>070</sub>	136
01000	001000	B <sub>087</sub> B <sub>086</sub> B <sub>085</sub> B <sub>084</sub> B <sub>083</sub> B <sub>082</sub> B <sub>081</sub> B <sub>080</sub>	137
01001	001001	B <sub>097</sub> B <sub>096</sub> B <sub>095</sub> B <sub>094</sub> B <sub>093</sub> B <sub>092</sub> B <sub>091</sub> B <sub>090</sub>	138
01010	001010	B <sub>107</sub> B <sub>106</sub> B <sub>105</sub> B <sub>104</sub> B <sub>103</sub> B <sub>102</sub> B <sub>101</sub> B <sub>100</sub>	139
01011	001011	B <sub>117</sub> B <sub>116</sub> B <sub>115</sub> B <sub>114</sub> B <sub>113</sub> B <sub>112</sub> B <sub>111</sub> B <sub>110</sub>	140
01100	001100	B <sub>127</sub> B <sub>126</sub> B <sub>125</sub> B <sub>124</sub> B <sub>123</sub> B <sub>122</sub> B <sub>121</sub> B <sub>120</sub>	141
01101	001101	B <sub>137</sub> B <sub>136</sub> B <sub>135</sub> B <sub>134</sub> B <sub>133</sub> B <sub>132</sub> B <sub>131</sub> B <sub>130</sub>	142
01110	001110	B <sub>147</sub> B <sub>146</sub> B <sub>145</sub> B <sub>144</sub> B <sub>143</sub> B <sub>142</sub> B <sub>141</sub> B <sub>140</sub>	143
01111	001111	B <sub>157</sub> B <sub>156</sub> B <sub>155</sub> B <sub>154</sub> B <sub>153</sub> B <sub>152</sub> B <sub>151</sub> B <sub>150</sub>	144
10000	010000	B <sub>167</sub> B <sub>166</sub> B <sub>165</sub> B <sub>164</sub> B <sub>163</sub> B <sub>162</sub> B <sub>161</sub> B <sub>160</sub>	145
10001	010001	B <sub>177</sub> B <sub>176</sub> B <sub>175</sub> B <sub>174</sub> B <sub>173</sub> B <sub>172</sub> B <sub>171</sub> B <sub>170</sub>	146
10010	010010	B <sub>187</sub> B <sub>186</sub> B <sub>185</sub> B <sub>184</sub> B <sub>183</sub> B <sub>182</sub> B <sub>181</sub> B <sub>180</sub>	147
10011	010011	B <sub>197</sub> B <sub>196</sub> B <sub>195</sub> B <sub>194</sub> B <sub>193</sub> B <sub>192</sub> B <sub>191</sub> B <sub>190</sub>	148
10100	010100	B <sub>207</sub> B <sub>206</sub> B <sub>205</sub> B <sub>204</sub> B <sub>203</sub> B <sub>202</sub> B <sub>201</sub> B <sub>200</sub>	149
10101	010101	B <sub>217</sub> B <sub>216</sub> B <sub>215</sub> B <sub>214</sub> B <sub>213</sub> B <sub>212</sub> B <sub>211</sub> B <sub>210</sub>	150
10110	010110	B <sub>227</sub> B <sub>226</sub> B <sub>225</sub> B <sub>224</sub> B <sub>223</sub> B <sub>222</sub> B <sub>221</sub> B <sub>220</sub>	151
10111	010111	B <sub>237</sub> B <sub>236</sub> B <sub>235</sub> B <sub>234</sub> B <sub>233</sub> B <sub>232</sub> B <sub>231</sub> B <sub>230</sub>	152
11000	011000	B <sub>247</sub> B <sub>246</sub> B <sub>245</sub> B <sub>244</sub> B <sub>243</sub> B <sub>242</sub> B <sub>241</sub> B <sub>240</sub>	153
11001	011001	B <sub>257</sub> B <sub>256</sub> B <sub>255</sub> B <sub>254</sub> B <sub>253</sub> B <sub>252</sub> B <sub>251</sub> B <sub>250</sub>	154
11010	011010	B <sub>267</sub> B <sub>266</sub> B <sub>265</sub> B <sub>264</sub> B <sub>263</sub> B <sub>262</sub> B <sub>261</sub> B <sub>260</sub>	155
11011	011011	B <sub>277</sub> B <sub>276</sub> B <sub>275</sub> B <sub>274</sub> B <sub>273</sub> B <sub>272</sub> B <sub>271</sub> B <sub>270</sub>	156
11100	011100	B <sub>287</sub> B <sub>286</sub> B <sub>285</sub> B <sub>284</sub> B <sub>283</sub> B <sub>282</sub> B <sub>281</sub> B <sub>280</sub>	157
11101	011101	B <sub>297</sub> B <sub>296</sub> B <sub>295</sub> B <sub>294</sub> B <sub>293</sub> B <sub>292</sub> B <sub>291</sub> B <sub>290</sub>	158
11110	011110	B <sub>307</sub> B <sub>306</sub> B <sub>305</sub> B <sub>304</sub> B <sub>303</sub> B <sub>302</sub> B <sub>301</sub> B <sub>300</sub>	159
11111	011111	B <sub>317</sub> B <sub>316</sub> B <sub>315</sub> B <sub>314</sub> B <sub>313</sub> B <sub>312</sub> B <sub>311</sub> B <sub>310</sub>	160

Table 5.19: Look-up tables-5

B input (5-bit) 16-bit / pixel mode 65,536 colours	B input (6-bit) 18-bit / pixel mode 262,144 colours	B output (8-bit) 24-bit / pixel mode 16,777,216 colours	RGBSET Parameter
No Input	100000	B327 B326 B325 B324 B323 B322 B321 B320	161
No Input	100001	B337 B336 B335 B334 B333 B332 B331 B330	162
No Input	100010	B347 B346 B345 B344 B343 B342 B341 B340	163
No Input	100011	B357 B356 B355 B354 B353 B352 B351 B350	164
No Input	100100	B367 B366 B365 B364 B363 B362 B361 B360	165
No Input	100101	B377 B376 B375 B374 B373 B372 B371 B370	166
No Input	100110	B387 B386 B385 B384 B383 B382 B381 B380	167
No Input	100111	B397 B396 B395 B394 B393 B392 B391 B390	168
No Input	101000	B407 B406 B405 B404 B403 B402 B401 B400	169
No Input	101001	B417 B416 B415 B414 B413 B412 B411 B410	170
No Input	101010	B427 B426 B425 B424 B423 B422 B421 B420	171
No Input	101011	B437 B436 B435 B434 B433 B432 B431 B430	172
No Input	101100	B447 B446 B445 B444 B443 B442 B441 B440	173
No Input	101101	B457 B456 B455 B454 B453 B452 B451 B450	174
No Input	101110	B467 B466 B465 B464 B463 B462 B461 B460	175
No Input	101111	B477 B476 B475 B474 B473 B472 B471 B470	176
No Input	110000	B487 B486 B485 B484 B483 B482 B481 B480	177
No Input	110001	B497 B496 B495 B494 B493 B492 B491 B490	178
No Input	110010	B507 B506 B505 B504 B503 B502 B501 B500	179
No Input	110011	B517 B516 B515 B514 B513 B512 B511 B510	180
No Input	110100	B527 B526 B525 B524 B523 B522 B521 B520	181
No Input	110101	B537 B536 B535 B534 B533 B532 B531 B530	182
No Input	110110	B547 B546 B545 B544 B543 B542 B541 B540	183
No Input	110111	B557 B556 B555 B554 B553 B552 B551 B550	184
No Input	111000	B567 B566 B565 B564 B563 B562 B561 B560	185
No Input	111001	B577 B576 B575 B574 B573 B572 B571 B570	186
No Input	111010	B587 B586 B585 B584 B583 B582 B581 B580	187
No Input	111011	B597 B596 B595 B594 B593 B592 B591 B590	188
No Input	111100	B607 B606 B605 B604 B603 B602 B601 B600	189
No Input	111101	B617 B616 B615 B614 B613 B612 B611 B610	190
No Input	111110	B627 B626 B625 B624 B623 B622 B621 B620	191
No Input	111111	B637 B636 B635 B634 B633 B632 B631 B630	192

Table 5.20: Look-up tables-6

### 5.7 Oscillator

The HX8369-A can oscillate an internal R-C oscillator with an internal oscillation resistor (Rf). The oscillation frequency is changed according to the UADJ[3:0] internal register. Please refer to OSC control register (RB0h). The default frequency is 15MHz.

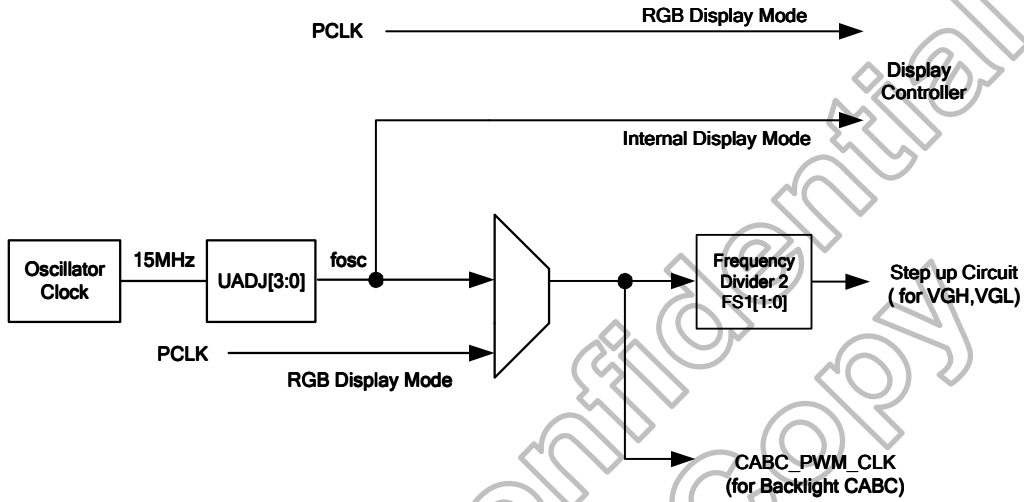
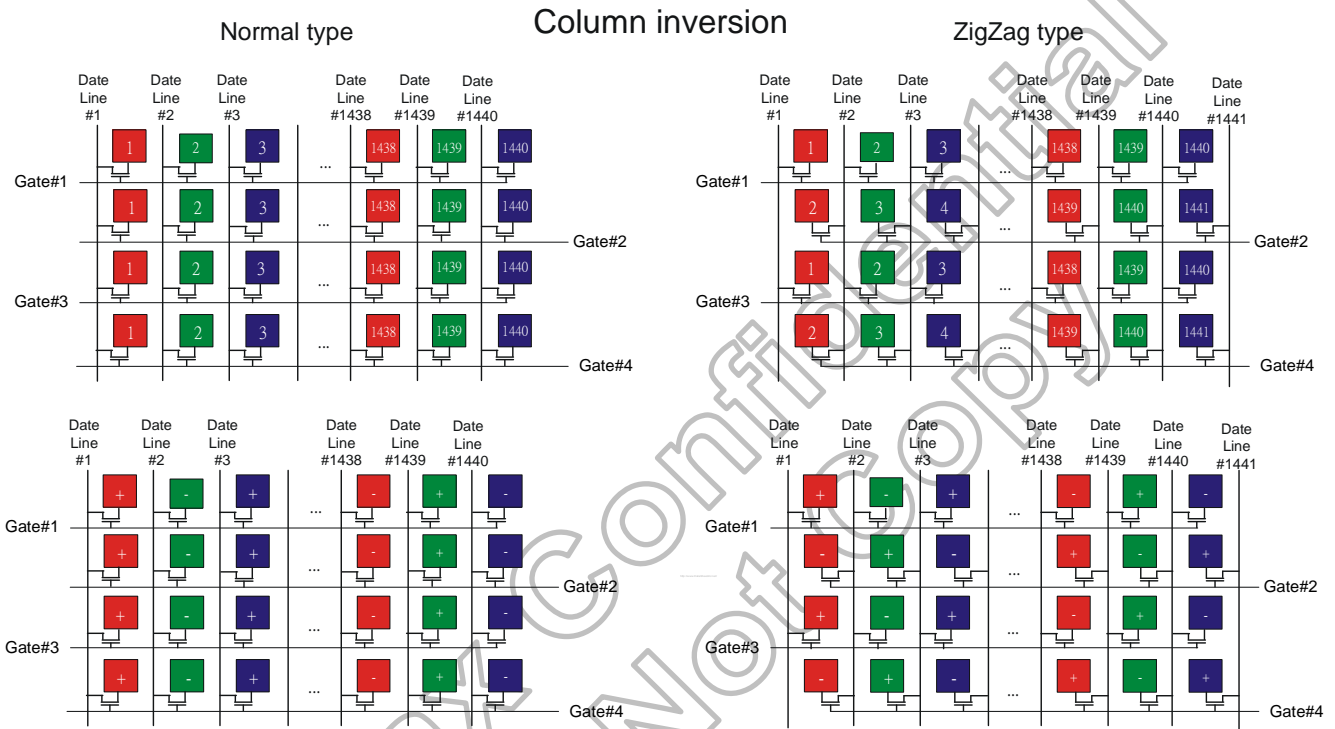


Figure 5.25: OSC aritecture

### 5.8 Source driver

The HX8369-A contains a 1440 channels of source driver (normal S1~S1440; Zig-zag S1~S1441) which is used for driving the source line of TFT LCD panel. The source driver converts the digital data from GRAM into the analog voltage for 1440 channels and generates corresponding gray scale voltage output, which can realize a 16.7M colors display simultaneously. Since the output circuit of this source driver incorporates an operational amplifier, a positive and a negative voltage can be alternately outputted from each channel.



5.9 LCD power generation scheme

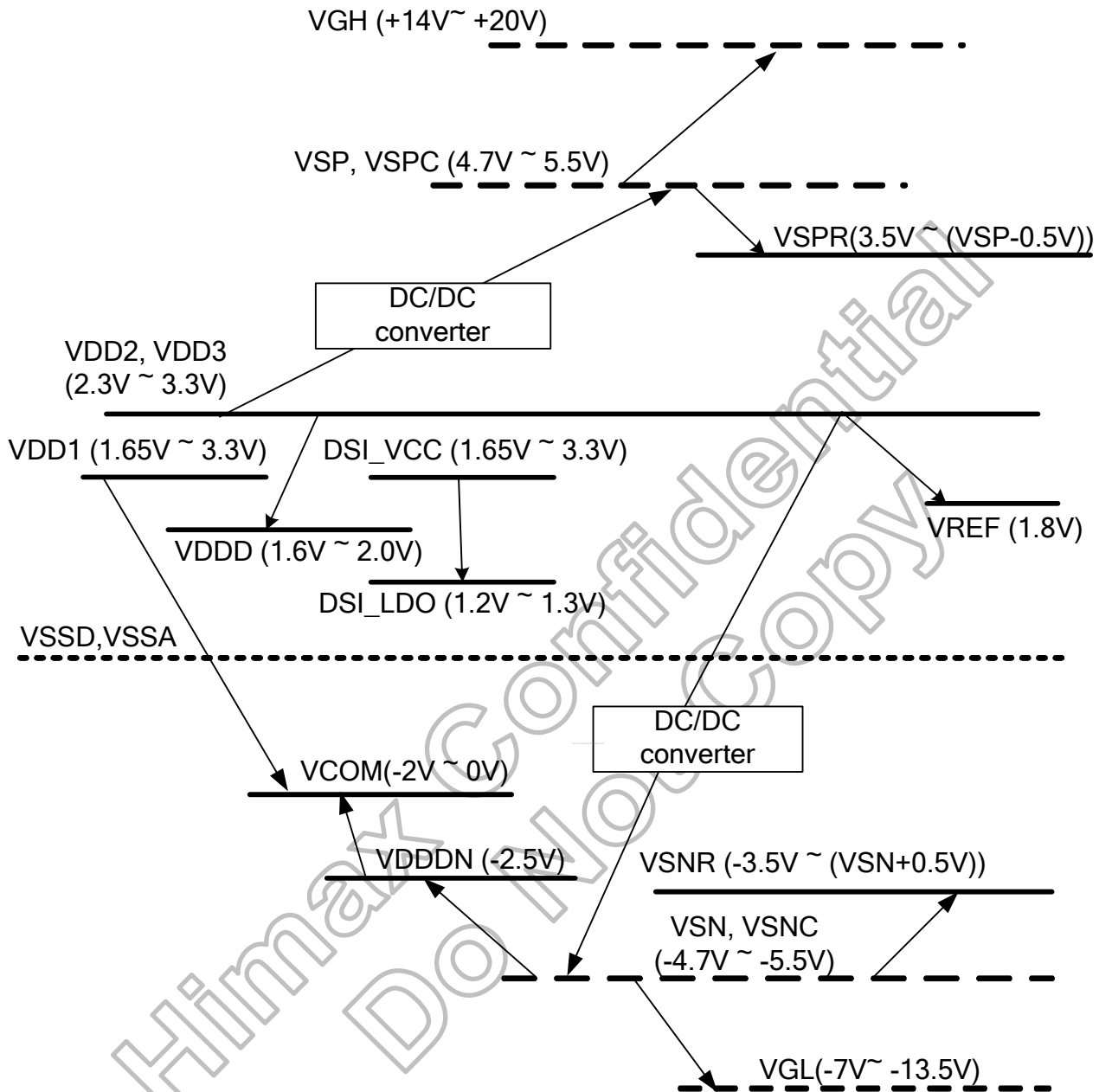


Figure 5.26: LCD power generation scheme



5.10 DC/DC converter circuit

5.10.1 Use PFM DC/DC converter

The PFM DC-DC converter generates the high voltage level VSP/VSN required for source drivers. HX8369-A contains sub-circuits of the PFM boost converter, including a precision 1.8V reference voltage, comparator, PFM controlling logic, and the output buffer. The boost converter uses a external power transistor to provide maximum efficiency and to minimize the number of external components. The output voltage of the boost converter can be set from 4.7 to 5.5 (VSP) and -4.7 to -5.5V (VSN)

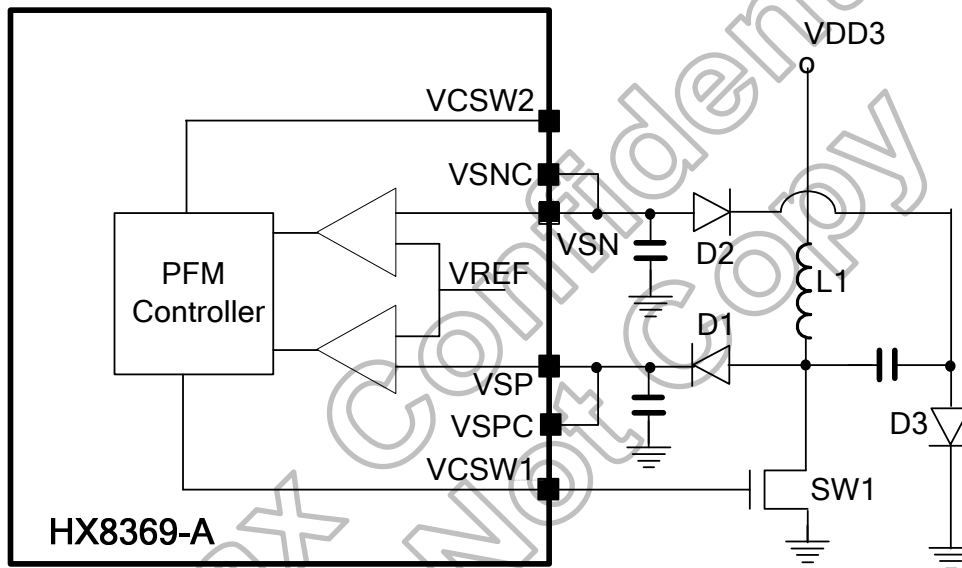


Figure 5.27: DC/DC converter circuit (PFM Type C)–PCCS=10

5.10.2 Use HX5186-A

The HX5186-A is highly efficient switching voltage generator circuits that generate the high voltage level VSP/VSN required for source drivers. HX8369-A contains Charge Pump Controller for HX5186-A, including a comparator for VSP/VSN feedback control. HX5186-A can provide maximum efficiency and use minimum number of external components. The output voltage of the boost converter can be set from 4.7 to 5.5 (VSP) and -4.7 to -5.5V (VSN)

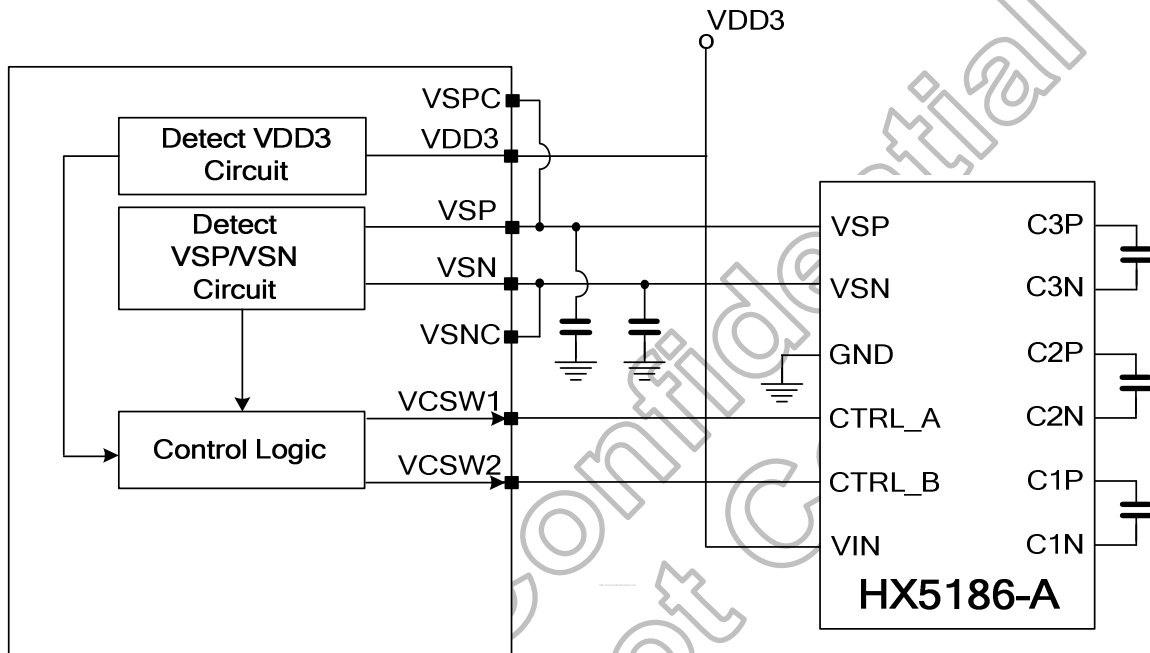


Figure 5.28: DC/DC converter circuit (HX5186-A)

5.11 Idle display

The HX8369-A supports an idle display mode. The grayscale level to be used is V0 and V64 with R7, G7, B7 decoding, and the other levels (V1-V63) are halted to reduce power consumption. In idle display mode, the Gamma-micro-adjustment registers are invalid and only the upper bits of RGB are used for display.

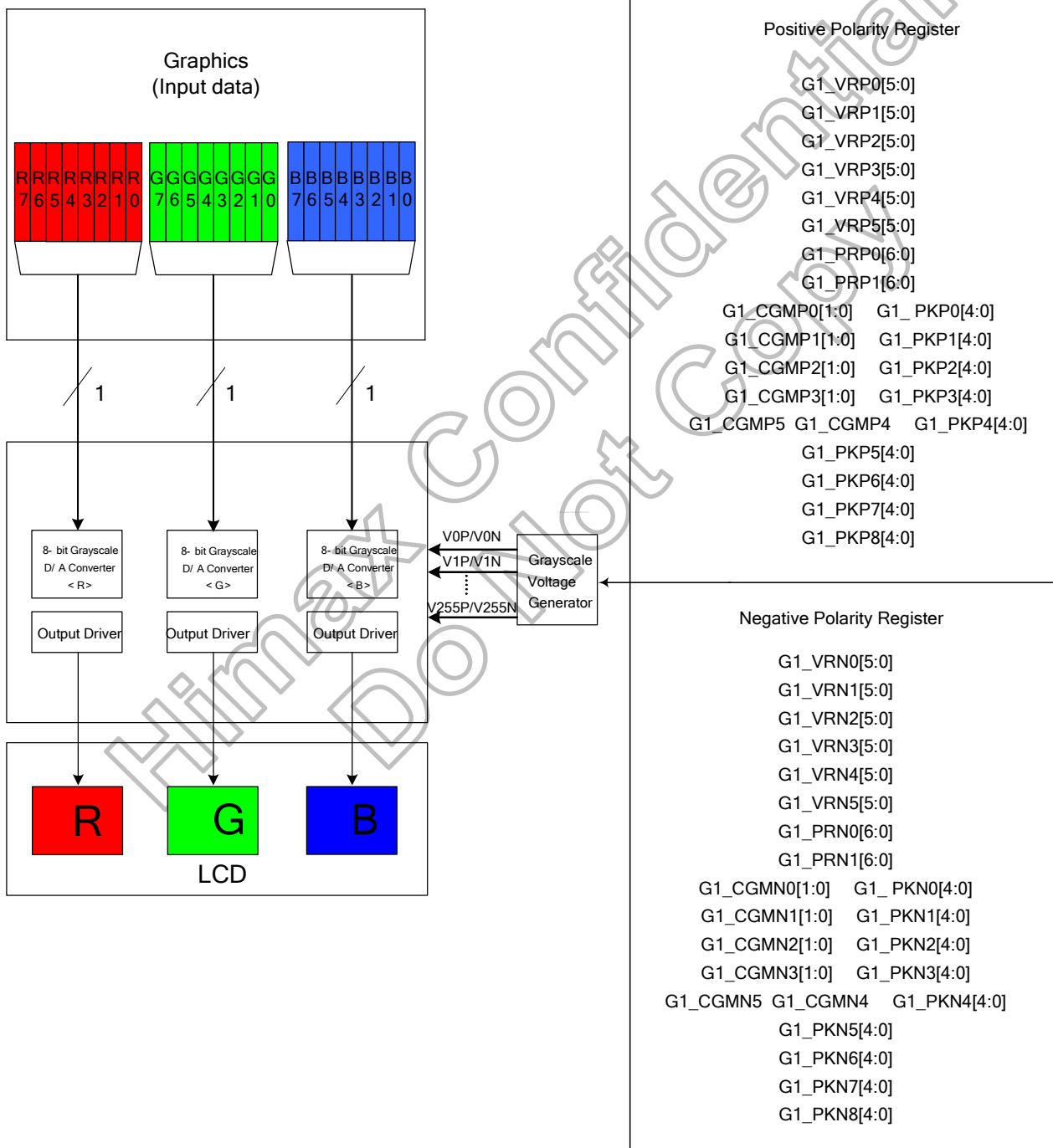


Figure 5.29: Idle mode grayscale control

5.12 Gamma characteristic correction function

The HX8369-A incorporates gamma adjustment function for the 16,777,216-color display (256 grayscale for each R, G, B color). Gamma adjustment operation is implemented by deciding the 16 grayscale levels firstly in gamma adjustment control registers to match the LCD panel. Then total 512 grayscale levels are generated in grayscale voltage generator. These registers are available for both polarities.

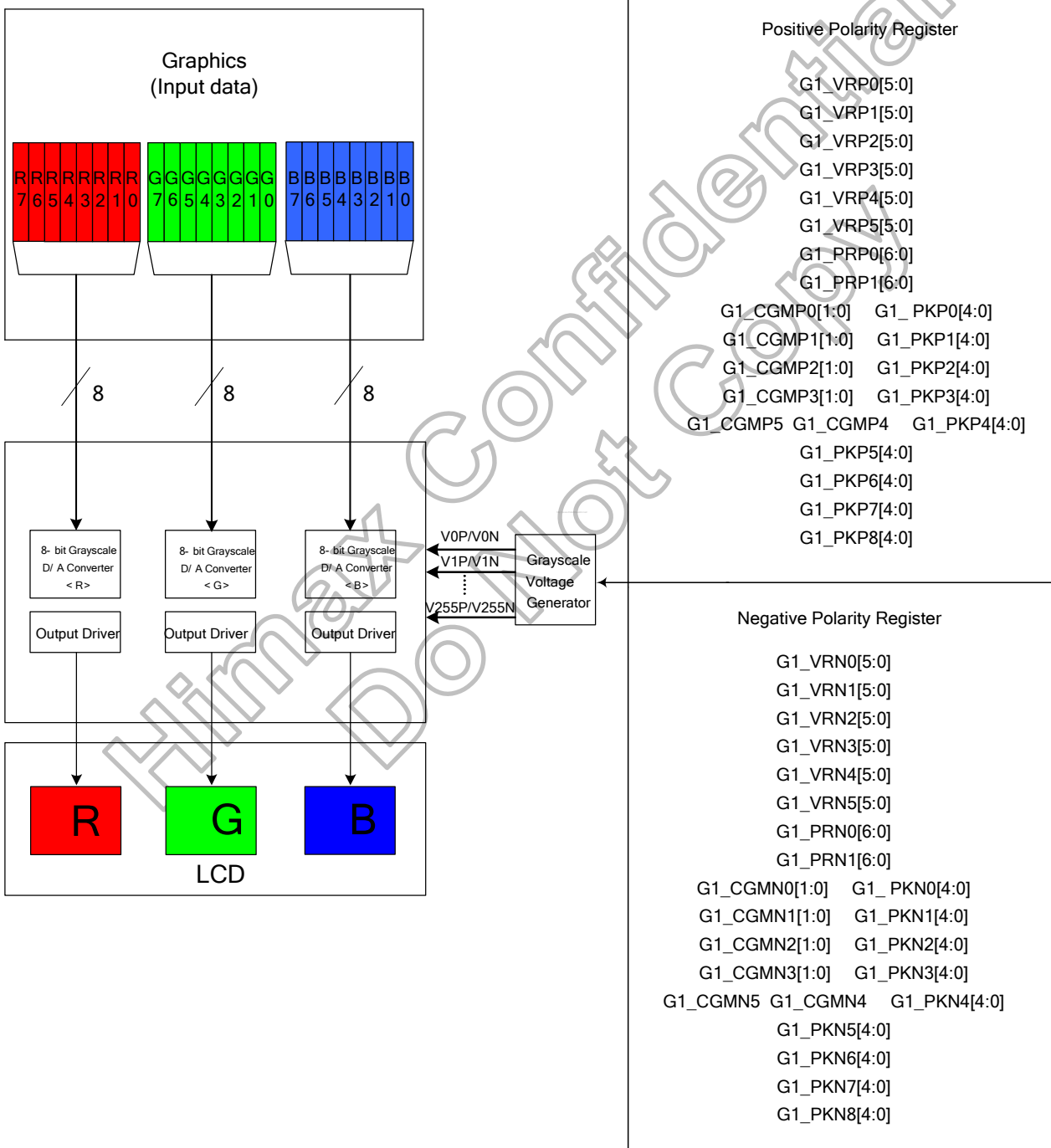


Figure 5.30: Grayscale control

**Gamma-Characteristics adjustment register**

This HX8369-A has register groups for specifying a series grayscale voltage that meets the Gamma-characteristics for the LCD panel used. These registers are divided into two groups, which correspond to the gradient, amplitude, and macro adjustment of the voltage for the grayscale characteristics. The polarity of each register can be specified independently.

**(1) Offset adjustment registers**

The offset adjustment variable registers are used to adjust the amplitude of the grayscale voltage. This function is implemented by controlling these variable resistors in the top and bottom of the gamma resistor stream for reference gamma voltage generation. These registers are available for both positive and negative polarities.

**(2) Gamma center adjustment registers**

The gamma center adjustment registers are used to adjust the reference gamma voltage in the middle level of grayscale without changing the dynamic range. This function is implemented by choosing one input of 88 to 1 selector in the gamma resistor stream for reference gamma voltage generation. These registers are available for both positive and negative polarities.

**(3) Gamma macro adjustment registers**

The gamma macro adjustment registers can be used for fine adjustment of the reference gamma voltage. This function is implemented by controlling the 32-to-1 selectors (PKP/N0~5), each of which has 5 inputs and generates one reference voltage output (Vg(P/N)3, 7, 19, 25, 32, 38, 44, 56, 60).

Register Groups	Positive Polarity	Negative Polarity	Description
Center Adjustment	PRP0 6-0	PRN0 6-0	Variable resistor (PRP/N0) for center adjustment
	PRP1 6-0	PRN1 6-0	Variable resistor (PRP/N1) for center adjustment
Macro Adjustment	PKP0 4-0	PKN0 4-0	32-to-1 selector (voltage level of grayscale 3)
	PKP1 4-0	PKN1 4-0	32-to-1 selector (voltage level of grayscale 7)
	PKP2 4-0	PKN2 4-0	32-to-1 selector (voltage level of grayscale 19)
	PKP3 4-0	PKN3 4-0	32-to-1 selector (voltage level of grayscale 25)
	PKP4 4-0	PKN4 4-0	32-to-1 selector (voltage level of grayscale 32 for positive polarity and grayscale 31 for negative polarity)
	PKP5 4-0	PKN5 4-0	32-to-1 selector (voltage level of grayscale 38)
	PKP6 4-0	PKN6 4-0	32-to-1 selector (voltage level of grayscale 44)
	PKP7 4-0	PKN7 4-0	32-to-1 selector (voltage level of grayscale 56)
	PKP8 4-0	PKN8 4-0	32-to-1 selector (voltage level of grayscale 60)
Offset Adjustment	VRP0 5-0	VRN0 5-0	Variable resistor (VRP/N0) for offset adjustment
	VRP1 5-0	VRN1 5-0	Variable resistor (VRP/N1) for offset adjustment
	VRP2 5-0	VRN2 5-0	Variable resistor (VRP/N2) for offset adjustment
	VRP3 5-0	VRN3 5-0	Variable resistor (VRP/N3) for offset adjustment
	VRP4 5-0	VRN4 5-0	Variable resistor (VRP/N4) for offset adjustment
	VRP5 5-0	VRN5 5-0	Variable resistor (VRP/N5) for offset adjustment

Table 5.21: Gamma-Adjustment registers

Gamma resister stream and 8 to 1 selector

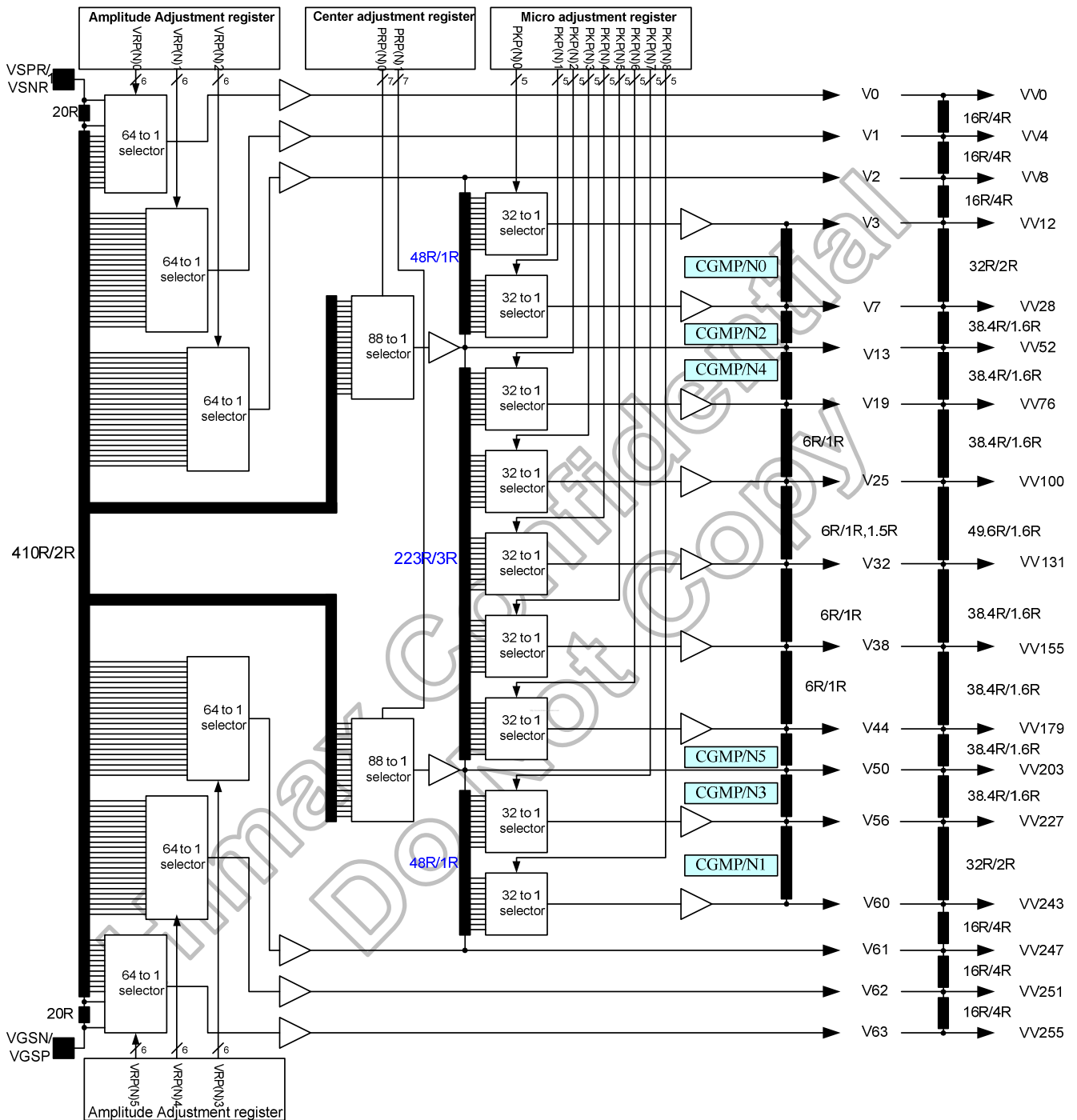


Figure 5.31: Gamma resister stream and gamma reference voltage

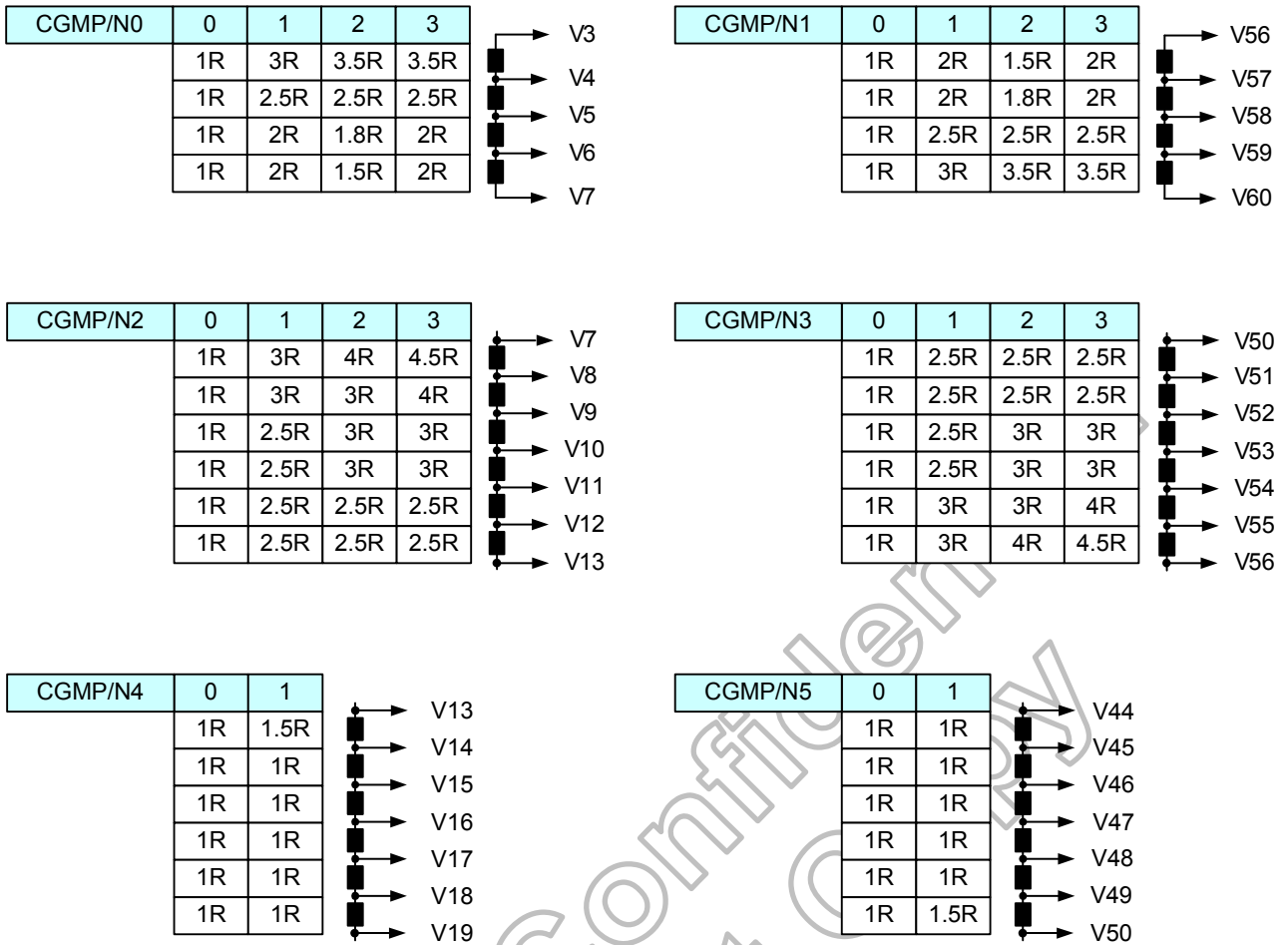


Figure 5.32: Gamma resistor stream



**Variable resister**

There are two types of variable resistors, one is for center adjustment and the other is for offset adjustment. The resistances are decided by setting values in the center adjustment, offset adjustment registers. Their relationships are shown below.

Value in Register VR(P/N)0 5-0	Resistance VR(P/N)0	Value in Register VR(P/N)1 5-0	Resistance VR(P/N)1	Value in Register VR(P/N)2 5-0	Resistance VR(P/N)2
000000	0R	000000	0R	000000	0R
000001	20R	000001	2R	000001	2R
000010	22R	000010	4R	000010	4R
000011	24R	000011	6R	000011	6R
•	•	•	•	•	•
•	•	•	•	•	•
011101	76R	011101	58R	011101	58R
011110	78R	011110	60R	011110	60R
011111	80R	011111	62R	011111	62R
100000	82R	100000	64R	100000	64R
100001	84R	100001	66R	100001	66R
100010	86R	100010	68R	100010	68R
•	•	•	•	•	•
•	•	•	•	•	•
111101	140R	111101	122R	111101	122R
111110	142R	111110	124R	111110	124R
111111	144R	111111	126R	111111	126R

Value in Register VR(P/N)3 5-0	Resistance VR(P/N)3	Value in Register VR(P/N)4 5-0	Resistance VR(P/N)4	Value in Register VR(P/N)5 5-0	Resistance VR(P/N)2
000000	0R	000000	0R	000000	0R
000001	2R	000001	2R	000001	2R
000010	4R	000010	4R	000010	4R
•	•	•	•	•	•
•	•	•	•	•	•
011101	58R	011101	58R	011101	58R
011110	60R	011110	60R	011110	60R
011111	62R	011111	62R	011111	62R
100000	64R	100000	64R	100000	64R
100001	66R	100001	66R	100001	66R
100010	68R	100010	68R	100010	68R
•	•	•	•	•	•
•	•	•	•	•	•
111100	120R	111100	120R	111100	120R
111101	122R	111101	122R	111101	122R
111110	124R	111110	124R	111110	124R
111111	126R	111111	126R	111111	144R

Table 5.22: Offset adjustment 0~5

Value in Register PR(P/N)0 6-0	Resistance PR(P/N)0	Value in Register PR(P/N)1 6-0	Resistance PR(P/N)1
0000000	0R	0000000	0R
0000001	2R	0000001	2R
0000010	4R	0000010	4R
•	•	•	•
•	•	•	•
1010101	170R	1010101	170R
1010110	172R	1010110	172R
1010111	174R	1010111	174R

Table 5.23: Center adjustment

The grayscale levels are determined by the following formulas:

Reference voltage	Macro adjustment value	VinP0 formula
VinP0	VRP0 5-0 = 000000	VSPR
	VRP0 5-0 = 000001	$((450R - 20R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP0 5-0 = 000010	$((450R - 22R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP0 5-0 = 000011	$((450R - 24R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP0 5-0 = 000100	$((450R - 26R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP0 5-0 = 000101	$((450R - 28R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP0 5-0 = 000110	$((450R - 30R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP0 5-0 = 000111	$((450R - 32R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP0 5-0 = 001000	$((450R - 34R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP0 5-0 = 001001	$((450R - 36R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP0 5-0 = 001010	$((450R - 38R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP0 5-0 = 001011	$((450R - 40R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP0 5-0 = 001100	$((450R - 42R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP0 5-0 = 001101	$((450R - 44R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP0 5-0 = 001110	$((450R - 46R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP0 5-0 = 001111	$((450R - 48R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP0 5-0 = 010000	$((450R - 50R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP0 5-0 = 010001	$((450R - 52R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP0 5-0 = 010010	$((450R - 54R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP0 5-0 = 010011	$((450R - 56R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP0 5-0 = 010100	$((450R - 58R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP0 5-0 = 010101	$((450R - 60R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP0 5-0 = 010110	$((450R - 62R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP0 5-0 = 010111	$((450R - 64R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP0 5-0 = 011000	$((450R - 66R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP0 5-0 = 011001	$((450R - 68R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP0 5-0 = 011010	$((450R - 70R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP0 5-0 = 011011	$((450R - 72R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP0 5-0 = 011100	$((450R - 74R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP0 5-0 = 011101	$((450R - 76R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP0 5-0 = 011110	$((450R - 78R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP0 5-0 = 011111	$((450R - 80R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP0 5-0 = 100000	$((450R - 82R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP0 5-0 = 100001	$((450R - 84R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP0 5-0 = 100010	$((450R - 86R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP0 5-0 = 100011	$((450R - 88R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP0 5-0 = 100100	$((450R - 90R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP0 5-0 = 100101	$((450R - 92R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP0 5-0 = 100110	$((450R - 94R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP0 5-0 = 100111	$((450R - 96R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP0 5-0 = 101000	$((450R - 98R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP0 5-0 = 101001	$((450R - 100R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP0 5-0 = 101010	$((450R - 102R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP0 5-0 = 101011	$((450R - 104R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP0 5-0 = 101100	$((450R - 106R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP0 5-0 = 101101	$((450R - 108R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP0 5-0 = 101110	$((450R - 110R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP0 5-0 = 101111	$((450R - 112R) / 450R) * (VSPR - VGSP) + VGSP$
VRP0 5-0 = 110000	$((450R - 114R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP0 5-0 = 110001	$((450R - 116R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP0 5-0 = 110010	$((450R - 118R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP0 5-0 = 110011	$((450R - 120R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP0 5-0 = 110100	$((450R - 122R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP0 5-0 = 110101	$((450R - 124R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP0 5-0 = 110110	$((450R - 126R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP0 5-0 = 110111	$((450R - 128R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP0 5-0 = 111000	$((450R - 130R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP0 5-0 = 111001	$((450R - 132R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP0 5-0 = 111010	$((450R - 134R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP0 5-0 = 111011	$((450R - 136R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP0 5-0 = 111100	$((450R - 138R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP0 5-0 = 111101	$((450R - 140R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP0 5-0 = 111110	$((450R - 142R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP0 5-0 = 111111	$((450R - 144R) / 450R) * (VSPR - VGSP) + VGSP$	

Table 5.24: VinP0

Reference voltage	Macro adjustment value	VinP1 formula
VinP1	VRP1 5-0 = 000000	$(430R / 450R) * (VSPR - VGSP) + VGSP$
	VRP1 5-0 = 000001	$((430R - 2R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP1 5-0 = 000010	$((430R - 4R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP1 5-0 = 000011	$((430R - 6R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP1 5-0 = 000100	$((430R - 8R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP1 5-0 = 000101	$((430R - 10R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP1 5-0 = 000110	$((430R - 12R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP1 5-0 = 000111	$((430R - 14R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP1 5-0 = 001000	$((430R - 16R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP1 5-0 = 001001	$((430R - 18R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP1 5-0 = 001010	$((430R - 20R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP1 5-0 = 001011	$((430R - 22R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP1 5-0 = 001100	$((430R - 24R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP1 5-0 = 001101	$((430R - 26R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP1 5-0 = 001110	$((430R - 28R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP1 5-0 = 001111	$((430R - 30R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP1 5-0 = 010000	$((430R - 32R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP1 5-0 = 010001	$((430R - 34R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP1 5-0 = 010010	$((430R - 36R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP1 5-0 = 010011	$((430R - 38R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP1 5-0 = 010100	$((430R - 40R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP1 5-0 = 010101	$((430R - 42R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP1 5-0 = 010110	$((430R - 44R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP1 5-0 = 010111	$((430R - 46R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP1 5-0 = 011000	$((430R - 48R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP1 5-0 = 011001	$((430R - 50R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP1 5-0 = 011010	$((430R - 52R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP1 5-0 = 011011	$((430R - 54R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP1 5-0 = 011100	$((430R - 56R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP1 5-0 = 011101	$((430R - 58R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP1 5-0 = 011110	$((430R - 60R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP1 5-0 = 011111	$((430R - 62R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP1 5-0 = 100000	$((430R - 64R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP1 5-0 = 100001	$((430R - 66R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP1 5-0 = 100010	$((430R - 68R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP1 5-0 = 100011	$((430R - 70R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP1 5-0 = 100100	$((430R - 72R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP1 5-0 = 100101	$((430R - 74R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP1 5-0 = 100110	$((430R - 76R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP1 5-0 = 100111	$((430R - 78R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP1 5-0 = 101000	$((430R - 80R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP1 5-0 = 101001	$((430R - 82R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP1 5-0 = 101010	$((430R - 84R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP1 5-0 = 101011	$((430R - 86R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP1 5-0 = 101100	$((430R - 88R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP1 5-0 = 101101	$((430R - 90R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP1 5-0 = 101110	$((430R - 92R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP1 5-0 = 101111	$((430R - 94R) / 450R) * (VSPR - VGSP) + VGSP$
VRP1 5-0 = 110000	$((430R - 96R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP1 5-0 = 110001	$((430R - 98R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP1 5-0 = 110010	$((430R - 100R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP1 5-0 = 110011	$((430R - 102R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP1 5-0 = 110100	$((430R - 104R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP1 5-0 = 110101	$((430R - 106R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP1 5-0 = 110110	$((430R - 108R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP1 5-0 = 110111	$((430R - 110R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP1 5-0 = 111000	$((430R - 112R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP1 5-0 = 111001	$((430R - 114R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP1 5-0 = 111010	$((430R - 116R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP1 5-0 = 111011	$((430R - 118R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP1 5-0 = 111100	$((430R - 120R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP1 5-0 = 111101	$((430R - 122R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP1 5-0 = 111110	$((430R - 124R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP1 5-0 = 111111	$((430R - 126R) / 450R) * (VSPR - VGSP) + VGSP$	

Table 5.25: VinP1

Reference voltage	Macro adjustment value	VinP2 formula
VinP2	VRP2 5-0 = 000000	$(420R / 450R) * (VSPR - VGSP) + VGSP$
	VRP2 5-0 = 000001	$((420R - 2R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP2 5-0 = 000010	$((420R - 4R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP2 5-0 = 000011	$((420R - 6R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP2 5-0 = 000100	$((420R - 8R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP2 5-0 = 000101	$((420R - 10R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP2 5-0 = 000110	$((420R - 12R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP2 5-0 = 000111	$((420R - 14R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP2 5-0 = 001000	$((420R - 16R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP2 5-0 = 001001	$((420R - 18R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP2 5-0 = 001010	$((420R - 20R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP2 5-0 = 001011	$((420R - 22R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP2 5-0 = 001100	$((420R - 24R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP2 5-0 = 001101	$((420R - 26R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP2 5-0 = 001110	$((420R - 28R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP2 5-0 = 001111	$((420R - 30R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP2 5-0 = 010000	$((420R - 32R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP2 5-0 = 010001	$((420R - 34R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP2 5-0 = 010010	$((420R - 36R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP2 5-0 = 010011	$((420R - 38R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP2 5-0 = 010100	$((420R - 40R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP2 5-0 = 010101	$((420R - 42R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP2 5-0 = 010110	$((420R - 44R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP2 5-0 = 010111	$((420R - 46R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP2 5-0 = 011000	$((420R - 48R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP2 5-0 = 011001	$((420R - 50R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP2 5-0 = 011010	$((420R - 52R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP2 5-0 = 011011	$((420R - 54R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP2 5-0 = 011100	$((420R - 56R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP2 5-0 = 011101	$((420R - 58R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP2 5-0 = 011110	$((420R - 60R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP2 5-0 = 011111	$((420R - 62R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP2 5-0 = 100000	$((420R - 64R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP2 5-0 = 100001	$((420R - 66R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP2 5-0 = 100010	$((420R - 68R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP2 5-0 = 100011	$((420R - 70R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP2 5-0 = 100100	$((420R - 72R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP2 5-0 = 100101	$((420R - 74R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP2 5-0 = 100110	$((420R - 76R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP2 5-0 = 100111	$((420R - 78R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP2 5-0 = 101000	$((420R - 80R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP2 5-0 = 101001	$((420R - 82R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP2 5-0 = 101010	$((420R - 84R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP2 5-0 = 101011	$((420R - 86R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP2 5-0 = 101100	$((420R - 88R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP2 5-0 = 101101	$((420R - 90R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP2 5-0 = 101110	$((420R - 92R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP2 5-0 = 101111	$((420R - 94R) / 450R) * (VSPR - VGSP) + VGSP$
VRP2 5-0 = 110000	$((420R - 96R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP2 5-0 = 110001	$((420R - 98R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP2 5-0 = 110010	$((420R - 100R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP2 5-0 = 110011	$((420R - 102R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP2 5-0 = 110100	$((420R - 104R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP2 5-0 = 110101	$((420R - 106R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP2 5-0 = 110110	$((420R - 108R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP2 5-0 = 110111	$((420R - 110R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP2 5-0 = 111000	$((420R - 112R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP2 5-0 = 111001	$((420R - 114R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP2 5-0 = 111010	$((420R - 116R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP2 5-0 = 111011	$((420R - 118R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP2 5-0 = 111100	$((420R - 120R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP2 5-0 = 111101	$((420R - 122R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP2 5-0 = 111110	$((420R - 124R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP2 5-0 = 111111	$((420R - 126R) / 450R) * (VSPR - VGSP) + VGSP$	

Table 5.26: VinP2



Reference voltage	Macro adjustment value	VinP14 formula
VinP14	VRP3 5-0 = 000000	$(156R / 450R) * (VSPR - VGSP) + VGSP$
	VRP3 5-0 = 000001	$((156R - 2R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP3 5-0 = 000010	$((156R - 4R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP3 5-0 = 000011	$((156R - 6R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP3 5-0 = 000100	$((156R - 8R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP3 5-0 = 000101	$((156R - 10R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP3 5-0 = 000110	$((156R - 12R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP3 5-0 = 000111	$((156R - 14R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP3 5-0 = 001000	$((156R - 16R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP3 5-0 = 001001	$((156R - 18R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP3 5-0 = 001010	$((156R - 20R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP3 5-0 = 001011	$((156R - 22R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP3 5-0 = 001100	$((156R - 24R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP3 5-0 = 001101	$((156R - 26R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP3 5-0 = 001110	$((156R - 28R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP3 5-0 = 001111	$((156R - 30R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP3 5-0 = 010000	$((156R - 32R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP3 5-0 = 010001	$((156R - 34R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP3 5-0 = 010010	$((156R - 36R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP3 5-0 = 010011	$((156R - 38R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP3 5-0 = 010100	$((156R - 40R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP3 5-0 = 010101	$((156R - 42R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP3 5-0 = 010110	$((156R - 44R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP3 5-0 = 010111	$((156R - 46R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP3 5-0 = 011000	$((156R - 48R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP3 5-0 = 011001	$((156R - 50R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP3 5-0 = 011010	$((156R - 52R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP3 5-0 = 011011	$((156R - 54R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP3 5-0 = 011100	$((156R - 56R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP3 5-0 = 011101	$((156R - 58R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP3 5-0 = 011110	$((156R - 60R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP3 5-0 = 011111	$((156R - 62R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP3 5-0 = 100000	$((156R - 64R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP3 5-0 = 100001	$((156R - 66R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP3 5-0 = 100010	$((156R - 68R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP3 5-0 = 100011	$((156R - 70R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP3 5-0 = 100100	$((156R - 72R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP3 5-0 = 100101	$((156R - 74R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP3 5-0 = 100110	$((156R - 76R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP3 5-0 = 100111	$((156R - 78R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP3 5-0 = 101000	$((156R - 80R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP3 5-0 = 101001	$((156R - 82R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP3 5-0 = 101010	$((156R - 84R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP3 5-0 = 101011	$((156R - 86R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP3 5-0 = 101100	$((156R - 88R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP3 5-0 = 101101	$((156R - 90R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP3 5-0 = 101110	$((156R - 92R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP3 5-0 = 101111	$((156R - 94R) / 450R) * (VSPR - VGSP) + VGSP$
VRP3 5-0 = 110000	$((156R - 96R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP3 5-0 = 110001	$((156R - 98R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP3 5-0 = 110010	$((156R - 100R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP3 5-0 = 110011	$((156R - 102R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP3 5-0 = 110100	$((156R - 104R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP3 5-0 = 110101	$((156R - 106R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP3 5-0 = 110110	$((156R - 108R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP3 5-0 = 110111	$((156R - 110R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP3 5-0 = 111000	$((156R - 112R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP3 5-0 = 111001	$((156R - 114R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP3 5-0 = 111010	$((156R - 116R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP3 5-0 = 111011	$((156R - 118R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP3 5-0 = 111100	$((156R - 120R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP3 5-0 = 111101	$((156R - 122R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP3 5-0 = 111110	$((156R - 124R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP3 5-0 = 111111	$((156R - 126R) / 450R) * (VSPR - VGSP) + VGSP$	

Table 5.27: VinP14

Reference voltage	Macro adjustment value	VinP15 formula
VinP15	VRP4 5-0 = 000000	$(146R / 450R) * (VSPR - VGSP) + VGSP$
	VRP4 5-0 = 000001	$((146R - 2R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP4 5-0 = 000010	$((146R - 4R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP4 5-0 = 000011	$((146R - 6R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP4 5-0 = 000100	$((146R - 8R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP4 5-0 = 000101	$((146R - 10R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP4 5-0 = 000110	$((146R - 12R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP4 5-0 = 000111	$((146R - 14R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP4 5-0 = 001000	$((146R - 16R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP4 5-0 = 001001	$((146R - 18R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP4 5-0 = 001010	$((146R - 20R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP4 5-0 = 001011	$((146R - 22R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP4 5-0 = 001100	$((146R - 24R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP4 5-0 = 001101	$((146R - 26R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP4 5-0 = 001110	$((146R - 28R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP4 5-0 = 001111	$((146R - 30R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP4 5-0 = 010000	$((146R - 32R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP4 5-0 = 010001	$((146R - 34R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP4 5-0 = 010010	$((146R - 36R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP4 5-0 = 010011	$((146R - 38R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP4 5-0 = 010100	$((146R - 40R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP4 5-0 = 010101	$((146R - 42R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP4 5-0 = 010110	$((146R - 44R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP4 5-0 = 010111	$((146R - 46R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP4 5-0 = 011000	$((146R - 48R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP4 5-0 = 011001	$((146R - 50R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP4 5-0 = 011010	$((146R - 52R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP4 5-0 = 011011	$((146R - 54R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP4 5-0 = 011100	$((146R - 56R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP4 5-0 = 011101	$((146R - 58R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP4 5-0 = 011110	$((146R - 60R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP4 5-0 = 011111	$((146R - 62R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP4 5-0 = 100000	$((146R - 64R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP4 5-0 = 100001	$((146R - 66R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP4 5-0 = 100010	$((146R - 68R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP4 5-0 = 100011	$((146R - 70R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP4 5-0 = 100100	$((146R - 72R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP4 5-0 = 100101	$((146R - 74R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP4 5-0 = 100110	$((146R - 76R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP4 5-0 = 100111	$((146R - 78R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP4 5-0 = 101000	$((146R - 80R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP4 5-0 = 101001	$((146R - 82R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP4 5-0 = 101010	$((146R - 84R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP4 5-0 = 101011	$((146R - 86R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP4 5-0 = 101100	$((146R - 88R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP4 5-0 = 101101	$((146R - 90R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP4 5-0 = 101110	$((146R - 92R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP4 5-0 = 101111	$((146R - 94R) / 450R) * (VSPR - VGSP) + VGSP$
VRP4 5-0 = 110000	$((146R - 96R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP4 5-0 = 110001	$((146R - 98R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP4 5-0 = 110010	$((146R - 100R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP4 5-0 = 110011	$((146R - 102R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP4 5-0 = 110100	$((146R - 104R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP4 5-0 = 110101	$((146R - 106R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP4 5-0 = 110110	$((146R - 108R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP4 5-0 = 110111	$((146R - 110R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP4 5-0 = 111000	$((146R - 112R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP4 5-0 = 111001	$((146R - 114R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP4 5-0 = 111010	$((146R - 116R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP4 5-0 = 111011	$((146R - 118R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP4 5-0 = 111100	$((146R - 120R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP4 5-0 = 111101	$((146R - 122R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP4 5-0 = 111110	$((146R - 124R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP4 5-0 = 111111	$((146R - 126R) / 450R) * (VSPR - VGSP) + VGSP$	

Table 5.28: VinP15

Reference voltage	Macro adjustment value	VinP16 formula
VinP16	VRP5 5-0 = 000000	$(144R / 450R) * (VSPR - VGSP) + VGSP$
	VRP5 5-0 = 000001	$((144R - 2R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP5 5-0 = 000010	$((144R - 4R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP5 5-0 = 000011	$((144R - 6R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP5 5-0 = 000100	$((144R - 8R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP5 5-0 = 000101	$((144R - 10R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP5 5-0 = 000110	$((144R - 12R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP5 5-0 = 000111	$((144R - 14R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP5 5-0 = 001000	$((144R - 16R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP5 5-0 = 001001	$((144R - 18R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP5 5-0 = 001010	$((144R - 20R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP5 5-0 = 001011	$((144R - 22R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP5 5-0 = 001100	$((144R - 24R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP5 5-0 = 001101	$((144R - 26R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP5 5-0 = 001110	$((144R - 28R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP5 5-0 = 001111	$((144R - 30R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP5 5-0 = 010000	$((144R - 32R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP5 5-0 = 010001	$((144R - 34R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP5 5-0 = 010010	$((144R - 36R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP5 5-0 = 010011	$((144R - 38R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP5 5-0 = 010100	$((144R - 40R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP5 5-0 = 010101	$((144R - 42R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP5 5-0 = 010110	$((144R - 44R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP5 5-0 = 010111	$((144R - 46R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP5 5-0 = 011000	$((144R - 48R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP5 5-0 = 011001	$((144R - 50R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP5 5-0 = 011010	$((144R - 52R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP5 5-0 = 011011	$((144R - 54R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP5 5-0 = 011100	$((144R - 56R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP5 5-0 = 011101	$((144R - 58R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP5 5-0 = 011110	$((144R - 60R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP5 5-0 = 011111	$((144R - 62R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP5 5-0 = 100000	$((144R - 64R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP5 5-0 = 100001	$((144R - 66R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP5 5-0 = 100010	$((144R - 68R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP5 5-0 = 100011	$((144R - 70R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP5 5-0 = 100100	$((144R - 72R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP5 5-0 = 100101	$((144R - 74R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP5 5-0 = 100110	$((144R - 76R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP5 5-0 = 100111	$((144R - 78R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP5 5-0 = 101000	$((144R - 80R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP5 5-0 = 101001	$((144R - 82R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP5 5-0 = 101010	$((144R - 84R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP5 5-0 = 101011	$((144R - 86R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP5 5-0 = 101100	$((144R - 88R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP5 5-0 = 101101	$((144R - 90R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP5 5-0 = 101110	$((144R - 92R) / 450R) * (VSPR - VGSP) + VGSP$
	VRP5 5-0 = 101111	$((144R - 94R) / 450R) * (VSPR - VGSP) + VGSP$
VRP5 5-0 = 110000	$((144R - 96R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP5 5-0 = 110001	$((144R - 98R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP5 5-0 = 110010	$((144R - 100R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP5 5-0 = 110011	$((144R - 102R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP5 5-0 = 110100	$((144R - 104R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP5 5-0 = 110101	$((144R - 106R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP5 5-0 = 110110	$((144R - 108R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP5 5-0 = 110111	$((144R - 110R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP5 5-0 = 111000	$((144R - 112R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP5 5-0 = 111001	$((144R - 114R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP5 5-0 = 111010	$((144R - 116R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP5 5-0 = 111011	$((144R - 118R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP5 5-0 = 111100	$((144R - 120R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP5 5-0 = 111101	$((144R - 122R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP5 5-0 = 111110	$((144R - 124R) / 450R) * (VSPR - VGSP) + VGSP$	
VRP5 5-0 = 111111	VGSP	

Table 5.29: VinP16



Reference voltage	Macro adjustment value	VinP5 formula
VinP5	PRP0 6-0 = 0000000	$(350R / 450R) (VSPR - VGSP) + VGSP$
	PRP0 6-0 = 0000001	$((350R - 2R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP0 6-0 = 0000010	$((350R - 4R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP0 6-0 = 0000011	$((350R - 6R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP0 6-0 = 0000100	$((350R - 8R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP0 6-0 = 0000101	$((350R - 10R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP0 6-0 = 0000110	$((350R - 12R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP0 6-0 = 0000111	$((350R - 14R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP0 6-0 = 0001000	$((350R - 16R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP0 6-0 = 0001001	$((350R - 18R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP0 6-0 = 0001010	$((350R - 20R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP0 6-0 = 0001011	$((350R - 22R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP0 6-0 = 0001100	$((350R - 24R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP0 6-0 = 0001101	$((350R - 26R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP0 6-0 = 0001110	$((350R - 28R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP0 6-0 = 0001111	$((350R - 30R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP0 6-0 = 0010000	$((350R - 32R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP0 6-0 = 0010001	$((350R - 34R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP0 6-0 = 0010010	$((350R - 36R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP0 6-0 = 0010011	$((350R - 38R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP0 6-0 = 0010100	$((350R - 40R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP0 6-0 = 0010101	$((350R - 42R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP0 6-0 = 0010110	$((350R - 44R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP0 6-0 = 0010111	$((350R - 46R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP0 6-0 = 0011000	$((350R - 48R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP0 6-0 = 0011001	$((350R - 50R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP0 6-0 = 0011010	$((350R - 52R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP0 6-0 = 0011011	$((350R - 54R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP0 6-0 = 0011100	$((350R - 56R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP0 6-0 = 0011101	$((350R - 58R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP0 6-0 = 0011110	$((350R - 60R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP0 6-0 = 0011111	$((350R - 62R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP0 6-0 = 0100000	$((350R - 64R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP0 6-0 = 0100001	$((350R - 66R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP0 6-0 = 0100010	$((350R - 68R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP0 6-0 = 0100011	$((350R - 70R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP0 6-0 = 0100100	$((350R - 72R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP0 6-0 = 0100101	$((350R - 74R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP0 6-0 = 0100110	$((350R - 76R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP0 6-0 = 0100111	$((350R - 78R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP0 6-0 = 0101000	$((350R - 80R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP0 6-0 = 0101001	$((350R - 82R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP0 6-0 = 0101010	$((350R - 84R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP0 6-0 = 0101011	$((350R - 86R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP0 6-0 = 0101100	$((350R - 88R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP0 6-0 = 0101101	$((350R - 90R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP0 6-0 = 0101110	$((350R - 92R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP0 6-0 = 0101111	$((350R - 94R) / 450R) * (VSPR - VGSP) + VGSP$
PRP0 6-0 = 0110000	$((350R - 96R) / 450R) * (VSPR - VGSP) + VGSP$	
PRP0 6-0 = 0110001	$((350R - 98R) / 450R) * (VSPR - VGSP) + VGSP$	
PRP0 6-0 = 0110010	$((350R - 100R) / 450R) * (VSPR - VGSP) + VGSP$	
PRP0 6-0 = 0110011	$((350R - 102R) / 450R) * (VSPR - VGSP) + VGSP$	
PRP0 6-0 = 0110100	$((350R - 104R) / 450R) * (VSPR - VGSP) + VGSP$	
PRP0 6-0 = 0110101	$((350R - 106R) / 450R) * (VSPR - VGSP) + VGSP$	
PRP0 6-0 = 0110110	$((350R - 108R) / 450R) * (VSPR - VGSP) + VGSP$	
PRP0 6-0 = 0110111	$((350R - 110R) / 450R) * (VSPR - VGSP) + VGSP$	
PRP0 6-0 = 0111000	$((350R - 112R) / 450R) * (VSPR - VGSP) + VGSP$	
PRP0 6-0 = 0111001	$((350R - 114R) / 450R) * (VSPR - VGSP) + VGSP$	
PRP0 6-0 = 0111010	$((350R - 116R) / 450R) * (VSPR - VGSP) + VGSP$	
PRP0 6-0 = 0111011	$((350R - 118R) / 450R) * (VSPR - VGSP) + VGSP$	
PRP0 6-0 = 0111100	$((350R - 120R) / 450R) * (VSPR - VGSP) + VGSP$	
PRP0 6-0 = 0111101	$((350R - 122R) / 450R) * (VSPR - VGSP) + VGSP$	
PRP0 6-0 = 0111110	$((350R - 124R) / 450R) * (VSPR - VGSP) + VGSP$	
PRP0 6-0 = 0111111	$((350R - 126R) / 450R) * (VSPR - VGSP) + VGSP$	
PRP0 6-0 = 1000000	$((350R - 128R) / 450R) * (VSPR - VGSP) + VGSP$	
PRP0 6-0 = 1000001	$((350R - 130R) / 450R) * (VSPR - VGSP) + VGSP$	
PRP0 6-0 = 1000010	$((350R - 132R) / 450R) * (VSPR - VGSP) + VGSP$	
PRP0 6-0 = 1000011	$((350R - 134R) / 450R) * (VSPR - VGSP) + VGSP$	
PRP0 6-0 = 1000100	$((350R - 136R) / 450R) * (VSPR - VGSP) + VGSP$	

PRP0 6-0 = 1000101	$((350R - 138R) / 450R) * (VSPR - VGSP) + VGSP$
PRP0 6-0 = 1000110	$((350R - 140R) / 450R) * (VSPR - VGSP) + VGSP$
PRP0 6-0 = 1000111	$((350R - 142R) / 450R) * (VSPR - VGSP) + VGSP$
PRP0 6-0 = 1001000	$((350R - 144R) / 450R) * (VSPR - VGSP) + VGSP$
PRP0 6-0 = 1001001	$((350R - 146R) / 450R) * (VSPR - VGSP) + VGSP$
PRP0 6-0 = 1001010	$((350R - 148R) / 450R) * (VSPR - VGSP) + VGSP$
PRP0 6-0 = 1001011	$((350R - 150R) / 450R) * (VSPR - VGSP) + VGSP$
PRP0 6-0 = 1001100	$((350R - 152R) / 450R) * (VSPR - VGSP) + VGSP$
PRP0 6-0 = 1001101	$((350R - 154R) / 450R) * (VSPR - VGSP) + VGSP$
PRP0 6-0 = 1001110	$((350R - 156R) / 450R) * (VSPR - VGSP) + VGSP$
PRP0 6-0 = 1001111	$((350R - 158R) / 450R) * (VSPR - VGSP) + VGSP$
PRP0 6-0 = 1010000	$((350R - 160R) / 450R) * (VSPR - VGSP) + VGSP$
PRP0 6-0 = 1010001	$((350R - 162R) / 450R) * (VSPR - VGSP) + VGSP$
PRP0 6-0 = 1010010	$((350R - 164R) / 450R) * (VSPR - VGSP) + VGSP$
PRP0 6-0 = 1010011	$((350R - 166R) / 450R) * (VSPR - VGSP) + VGSP$
PRP0 6-0 = 1010100	$((350R - 168R) / 450R) * (VSPR - VGSP) + VGSP$
PRP0 6-0 = 1010101	$((350R - 170R) / 450R) * (VSPR - VGSP) + VGSP$
PRP0 6-0 = 1010110	$((350R - 172R) / 450R) * (VSPR - VGSP) + VGSP$
PRP0 6-0 = 1010111	$((350R - 174R) / 450R) * (VSPR - VGSP) + VGSP$
PRP0 6-0 = 1011000	inhibit
PRP0 6-0 = 1011001	inhibit
PRP0 6-0 = 1011010	inhibit
PRP0 6-0 = 1011011	inhibit
PRP0 6-0 = 1011100	inhibit
PRP0 6-0 = 1011101	inhibit
PRP0 6-0 = 1011110	inhibit
PRP0 6-0 = 1011111	inhibit
PRP0 6-0 = 1100000	inhibit
PRP0 6-0 = 1100001	inhibit
PRP0 6-0 = 1100010	inhibit
PRP0 6-0 = 1100011	inhibit
PRP0 6-0 = 1100100	inhibit
PRP0 6-0 = 1100101	inhibit
PRP0 6-0 = 1100110	inhibit
PRP0 6-0 = 1100111	inhibit
PRP0 6-0 = 1101000	inhibit
PRP0 6-0 = 1101001	inhibit
PRP0 6-0 = 1101010	inhibit
PRP0 6-0 = 1101011	inhibit
PRP0 6-0 = 1101100	inhibit
PRP0 6-0 = 1101101	inhibit
PRP0 6-0 = 1101110	inhibit
PRP0 6-0 = 1101111	inhibit
PRP0 6-0 = 1110000	inhibit
PRP0 6-0 = 1110001	inhibit
PRP0 6-0 = 1110010	inhibit
PRP0 6-0 = 1110011	inhibit
PRP0 6-0 = 1110100	inhibit
PRP0 6-0 = 1110101	inhibit
PRP0 6-0 = 1110110	inhibit
PRP0 6-0 = 1110111	inhibit
PRP0 6-0 = 1111000	inhibit
PRP0 6-0 = 1111001	inhibit
PRP0 6-0 = 1111010	inhibit
PRP0 6-0 = 1111011	inhibit
PRP0 6-0 = 1111100	inhibit
PRP0 6-0 = 1111101	inhibit
PRP0 6-0 = 1111110	inhibit
PRP0 6-0 = 1111111	inhibit

Table 5.30: VinP5

Reference voltage	Macro adjustment value	VinP11 formula
VinP11	PRP1 6-0 = 0000000	$(274R / 450R) (VSPR - VGSP) + VGSP$
	PRP1 6-0 = 0000001	$((274R - 2R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP1 6-0 = 0000010	$((274R - 4R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP1 6-0 = 0000011	$((274R - 6R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP1 6-0 = 0000100	$((274R - 8R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP1 6-0 = 0000101	$((274R - 10R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP1 6-0 = 0000110	$((274R - 12R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP1 6-0 = 0000111	$((274R - 14R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP1 6-0 = 0001000	$((274R - 16R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP1 6-0 = 0001001	$((274R - 18R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP1 6-0 = 0001010	$((274R - 20R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP1 6-0 = 0001011	$((274R - 22R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP1 6-0 = 0001100	$((274R - 24R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP1 6-0 = 0001101	$((274R - 26R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP1 6-0 = 0001110	$((274R - 28R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP1 6-0 = 0001111	$((274R - 30R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP1 6-0 = 0010000	$((274R - 32R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP1 6-0 = 0010001	$((274R - 34R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP1 6-0 = 0010010	$((274R - 36R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP1 6-0 = 0010011	$((274R - 38R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP1 6-0 = 0010100	$((274R - 40R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP1 6-0 = 0010101	$((274R - 42R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP1 6-0 = 0010110	$((274R - 44R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP1 6-0 = 0010111	$((274R - 46R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP1 6-0 = 0011000	$((274R - 48R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP1 6-0 = 0011001	$((274R - 50R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP1 6-0 = 0011010	$((274R - 52R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP1 6-0 = 0011011	$((274R - 54R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP1 6-0 = 0011100	$((274R - 56R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP1 6-0 = 0011101	$((274R - 58R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP1 6-0 = 0011110	$((274R - 60R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP1 6-0 = 0011111	$((274R - 62R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP1 6-0 = 0100000	$((274R - 64R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP1 6-0 = 0100001	$((274R - 66R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP1 6-0 = 0100010	$((274R - 68R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP1 6-0 = 0100011	$((274R - 70R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP1 6-0 = 0100100	$((274R - 72R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP1 6-0 = 0100101	$((274R - 74R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP1 6-0 = 0100110	$((274R - 76R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP1 6-0 = 0100111	$((274R - 78R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP1 6-0 = 0101000	$((274R - 80R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP1 6-0 = 0101001	$((274R - 82R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP1 6-0 = 0101010	$((274R - 84R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP1 6-0 = 0101011	$((274R - 86R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP1 6-0 = 0101100	$((274R - 88R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP1 6-0 = 0101101	$((274R - 90R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP1 6-0 = 0101110	$((274R - 92R) / 450R) * (VSPR - VGSP) + VGSP$
	PRP1 6-0 = 0101111	$((274R - 94R) / 450R) * (VSPR - VGSP) + VGSP$
PRP1 6-0 = 0110000	$((274R - 96R) / 450R) * (VSPR - VGSP) + VGSP$	
PRP1 6-0 = 0110001	$((274R - 98R) / 450R) * (VSPR - VGSP) + VGSP$	
PRP1 6-0 = 0110010	$((274R - 100R) / 450R) * (VSPR - VGSP) + VGSP$	
PRP1 6-0 = 0110011	$((274R - 102R) / 450R) * (VSPR - VGSP) + VGSP$	
PRP1 6-0 = 0110100	$((274R - 104R) / 450R) * (VSPR - VGSP) + VGSP$	
PRP1 6-0 = 0110101	$((274R - 106R) / 450R) * (VSPR - VGSP) + VGSP$	
PRP1 6-0 = 0110110	$((274R - 108R) / 450R) * (VSPR - VGSP) + VGSP$	
PRP1 6-0 = 0110111	$((274R - 110R) / 450R) * (VSPR - VGSP) + VGSP$	
PRP1 6-0 = 0111000	$((274R - 112R) / 450R) * (VSPR - VGSP) + VGSP$	
PRP1 6-0 = 0111001	$((274R - 114R) / 450R) * (VSPR - VGSP) + VGSP$	
PRP1 6-0 = 0111010	$((274R - 116R) / 450R) * (VSPR - VGSP) + VGSP$	
PRP1 6-0 = 0111011	$((274R - 118R) / 450R) * (VSPR - VGSP) + VGSP$	
PRP1 6-0 = 0111100	$((274R - 120R) / 450R) * (VSPR - VGSP) + VGSP$	
PRP1 6-0 = 0111101	$((274R - 122R) / 450R) * (VSPR - VGSP) + VGSP$	
PRP1 6-0 = 0111110	$((274R - 124R) / 450R) * (VSPR - VGSP) + VGSP$	
PRP1 6-0 = 0111111	$((274R - 126R) / 450R) * (VSPR - VGSP) + VGSP$	
PRP1 6-0 = 1000000	$((274R - 128R) / 450R) * (VSPR - VGSP) + VGSP$	
PRP1 6-0 = 1000001	$((274R - 130R) / 450R) * (VSPR - VGSP) + VGSP$	
PRP1 6-0 = 1000010	$((274R - 132R) / 450R) * (VSPR - VGSP) + VGSP$	
PRP1 6-0 = 1000011	$((274R - 134R) / 450R) * (VSPR - VGSP) + VGSP$	
PRP1 6-0 = 1000100	$((274R - 136R) / 450R) * (VSPR - VGSP) + VGSP$	

PRP1 6-0 = 1000101	$((274R - 138R) / 450R) * (VSPR - VGSP) + VGSP$
PRP1 6-0 = 1000110	$((274R - 140R) / 450R) * (VSPR - VGSP) + VGSP$
PRP1 6-0 = 1000111	$((274R - 142R) / 450R) * (VSPR - VGSP) + VGSP$
PRP1 6-0 = 1001000	$((274R - 144R) / 450R) * (VSPR - VGSP) + VGSP$
PRP1 6-0 = 1001001	$((274R - 146R) / 450R) * (VSPR - VGSP) + VGSP$
PRP1 6-0 = 1001010	$((274R - 148R) / 450R) * (VSPR - VGSP) + VGSP$
PRP1 6-0 = 1001011	$((274R - 150R) / 450R) * (VSPR - VGSP) + VGSP$
PRP1 6-0 = 1001100	$((274R - 152R) / 450R) * (VSPR - VGSP) + VGSP$
PRP1 6-0 = 1001101	$((274R - 154R) / 450R) * (VSPR - VGSP) + VGSP$
PRP1 6-0 = 1001110	$((274R - 156R) / 450R) * (VSPR - VGSP) + VGSP$
PRP1 6-0 = 1001111	$((274R - 158R) / 450R) * (VSPR - VGSP) + VGSP$
PRP1 6-0 = 1010000	$((274R - 160R) / 450R) * (VSPR - VGSP) + VGSP$
PRP1 6-0 = 1010001	$((274R - 162R) / 450R) * (VSPR - VGSP) + VGSP$
PRP1 6-0 = 1010010	$((274R - 164R) / 450R) * (VSPR - VGSP) + VGSP$
PRP1 6-0 = 1010011	$((274R - 166R) / 450R) * (VSPR - VGSP) + VGSP$
PRP1 6-0 = 1010100	$((274R - 168R) / 450R) * (VSPR - VGSP) + VGSP$
PRP1 6-0 = 1010101	$((274R - 170R) / 450R) * (VSPR - VGSP) + VGSP$
PRP1 6-0 = 1010110	$((274R - 172R) / 450R) * (VSPR - VGSP) + VGSP$
PRP1 6-0 = 1010111	$((274R - 174R) / 450R) * (VSPR - VGSP) + VGSP$
PRP1 6-0 = 1011000	inhibit
PRP1 6-0 = 1011001	inhibit
PRP1 6-0 = 1011010	inhibit
PRP1 6-0 = 1011011	inhibit
PRP1 6-0 = 1011100	inhibit
PRP1 6-0 = 1011101	inhibit
PRP1 6-0 = 1011110	inhibit
PRP1 6-0 = 1011111	inhibit
PRP1 6-0 = 1100000	inhibit
PRP1 6-0 = 1100001	inhibit
PRP1 6-0 = 1100010	inhibit
PRP1 6-0 = 1100011	inhibit
PRP1 6-0 = 1100100	inhibit
PRP1 6-0 = 1100101	inhibit
PRP1 6-0 = 1100110	inhibit
PRP1 6-0 = 1100111	inhibit
PRP1 6-0 = 1101000	inhibit
PRP1 6-0 = 1101001	inhibit
PRP1 6-0 = 1101010	inhibit
PRP1 6-0 = 1101011	inhibit
PRP1 6-0 = 1101100	inhibit
PRP1 6-0 = 1101101	inhibit
PRP1 6-0 = 1101110	inhibit
PRP1 6-0 = 1101111	inhibit
PRP1 6-0 = 1110000	inhibit
PRP1 6-0 = 1110001	inhibit
PRP1 6-0 = 1110010	inhibit
PRP1 6-0 = 1110011	inhibit
PRP1 6-0 = 1110100	inhibit
PRP1 6-0 = 1110101	inhibit
PRP1 6-0 = 1110110	inhibit
PRP1 6-0 = 1110111	inhibit
PRP1 6-0 = 1111000	inhibit
PRP1 6-0 = 1111001	inhibit
PRP1 6-0 = 1111010	inhibit
PRP1 6-0 = 1111011	inhibit
PRP1 6-0 = 1111100	inhibit
PRP1 6-0 = 1111101	inhibit
PRP1 6-0 = 1111110	inhibit
PRP1 6-0 = 1111111	inhibit

Table 5.31: VinP11

Reference voltage	Macro adjustment value	VinP3 formula
VinP3	PKP0 4-0 = 00000	$(47R / 48R) * (VinP2 - VinP5) + VinP5$
	PKP0 4-0 = 00001	$((47R - 1R) / 48R) * (VinP2 - VinP5) + VinP5$
	PKP0 4-0 = 00010	$((47R - 2R) / 48R) * (VinP2 - VinP5) + VinP5$
	PKP0 4-0 = 00011	$((47R - 3R) / 48R) * (VinP2 - VinP5) + VinP5$
	PKP0 4-0 = 00100	$((47R - 4R) / 48R) * (VinP2 - VinP5) + VinP5$
	PKP0 4-0 = 00101	$((47R - 5R) / 48R) * (VinP2 - VinP5) + VinP5$
	PKP0 4-0 = 00110	$((47R - 6R) / 48R) * (VinP2 - VinP5) + VinP5$
	PKP0 4-0 = 00111	$((47R - 7R) / 48R) * (VinP2 - VinP5) + VinP5$
	PKP0 4-0 = 01000	$((47R - 8R) / 48R) * (VinP2 - VinP5) + VinP5$
	PKP0 4-0 = 01001	$((47R - 9R) / 48R) * (VinP2 - VinP5) + VinP5$
	PKP0 4-0 = 01010	$((47R - 10R) / 48R) * (VinP2 - VinP5) + VinP5$
	PKP0 4-0 = 01011	$((47R - 11R) / 48R) * (VinP2 - VinP5) + VinP5$
	PKP0 4-0 = 01100	$((47R - 12R) / 48R) * (VinP2 - VinP5) + VinP5$
	PKP0 4-0 = 01101	$((47R - 13R) / 48R) * (VinP2 - VinP5) + VinP5$
	PKP0 4-0 = 01110	$((47R - 14R) / 48R) * (VinP2 - VinP5) + VinP5$
	PKP0 4-0 = 01111	$((47R - 15R) / 48R) * (VinP2 - VinP5) + VinP5$
	PKP0 4-0 = 10000	$((47R - 16R) / 48R) * (VinP2 - VinP5) + VinP5$
	PKP0 4-0 = 10001	$((47R - 17R) / 48R) * (VinP2 - VinP5) + VinP5$
	PKP0 4-0 = 10010	$((47R - 18R) / 48R) * (VinP2 - VinP5) + VinP5$
	PKP0 4-0 = 10011	$((47R - 19R) / 48R) * (VinP2 - VinP5) + VinP5$
	PKP0 4-0 = 10100	$((47R - 20R) / 48R) * (VinP2 - VinP5) + VinP5$
	PKP0 4-0 = 10101	$((47R - 21R) / 48R) * (VinP2 - VinP5) + VinP5$
	PKP0 4-0 = 10110	$((47R - 22R) / 48R) * (VinP2 - VinP5) + VinP5$
	PKP0 4-0 = 10111	$((47R - 23R) / 48R) * (VinP2 - VinP5) + VinP5$
	PKP0 4-0 = 11000	$((47R - 24R) / 48R) * (VinP2 - VinP5) + VinP5$
	PKP0 4-0 = 11001	$((47R - 25R) / 48R) * (VinP2 - VinP5) + VinP5$
	PKP0 4-0 = 11010	$((47R - 26R) / 48R) * (VinP2 - VinP5) + VinP5$
	PKP0 4-0 = 11011	$((47R - 27R) / 48R) * (VinP2 - VinP5) + VinP5$
	PKP0 4-0 = 11100	$((47R - 28R) / 48R) * (VinP2 - VinP5) + VinP5$
	PKP0 4-0 = 11101	$((47R - 29R) / 48R) * (VinP2 - VinP5) + VinP5$
	PKP0 4-0 = 11110	$((47R - 30R) / 48R) * (VinP2 - VinP5) + VinP5$
PKP0 4-0 = 11111	$((47R - 31R) / 48R) * (VinP2 - VinP5) + VinP5$	

Table 5.32: VinP3



Reference voltage	Macro adjustment value	VinP4 formula
VinP4	PKP1 4-0 = 00000	$(32R / 48R) * (VinP2 - VinP5) + VinP5$
	PKP1 4-0 = 00001	$((32R - 1R) / 48R) * (VinP2 - VinP5) + VinP5$
	PKP1 4-0 = 00010	$((32R - 2R) / 48R) * (VinP2 - VinP5) + VinP5$
	PKP1 4-0 = 00011	$((32R - 3R) / 48R) * (VinP2 - VinP5) + VinP5$
	PKP1 4-0 = 00100	$((32R - 4R) / 48R) * (VinP2 - VinP5) + VinP5$
	PKP1 4-0 = 00101	$((32R - 5R) / 48R) * (VinP2 - VinP5) + VinP5$
	PKP1 4-0 = 00110	$((32R - 6R) / 48R) * (VinP2 - VinP5) + VinP5$
	PKP1 4-0 = 00111	$((32R - 7R) / 48R) * (VinP2 - VinP5) + VinP5$
	PKP1 4-0 = 01000	$((32R - 8R) / 48R) * (VinP2 - VinP5) + VinP5$
	PKP1 4-0 = 01001	$((32R - 9R) / 48R) * (VinP2 - VinP5) + VinP5$
	PKP1 4-0 = 01010	$((32R - 10R) / 48R) * (VinP2 - VinP5) + VinP5$
	PKP1 4-0 = 01011	$((32R - 11R) / 48R) * (VinP2 - VinP5) + VinP5$
	PKP1 4-0 = 01100	$((32R - 12R) / 48R) * (VinP2 - VinP5) + VinP5$
	PKP1 4-0 = 01101	$((32R - 13R) / 48R) * (VinP2 - VinP5) + VinP5$
	PKP1 4-0 = 01110	$((32R - 14R) / 48R) * (VinP2 - VinP5) + VinP5$
	PKP1 4-0 = 01111	$((32R - 15R) / 48R) * (VinP2 - VinP5) + VinP5$
	PKP1 4-0 = 10000	$((32R - 16R) / 48R) * (VinP2 - VinP5) + VinP5$
	PKP1 4-0 = 10001	$((32R - 17R) / 48R) * (VinP2 - VinP5) + VinP5$
	PKP1 4-0 = 10010	$((32R - 18R) / 48R) * (VinP2 - VinP5) + VinP5$
	PKP1 4-0 = 10011	$((32R - 19R) / 48R) * (VinP2 - VinP5) + VinP5$
	PKP1 4-0 = 10100	$((32R - 20R) / 48R) * (VinP2 - VinP5) + VinP5$
	PKP1 4-0 = 10101	$((32R - 21R) / 48R) * (VinP2 - VinP5) + VinP5$
	PKP1 4-0 = 10110	$((32R - 22R) / 48R) * (VinP2 - VinP5) + VinP5$
	PKP1 4-0 = 10111	$((32R - 23R) / 48R) * (VinP2 - VinP5) + VinP5$
	PKP1 4-0 = 11000	$((32R - 24R) / 48R) * (VinP2 - VinP5) + VinP5$
	PKP1 4-0 = 11001	$((32R - 25R) / 48R) * (VinP2 - VinP5) + VinP5$
	PKP1 4-0 = 11010	$((32R - 26R) / 48R) * (VinP2 - VinP5) + VinP5$
	PKP1 4-0 = 11011	$((32R - 27R) / 48R) * (VinP2 - VinP5) + VinP5$
PKP1 4-0 = 11100	$((32R - 28R) / 48R) * (VinP2 - VinP5) + VinP5$	
PKP1 4-0 = 11101	$((32R - 29R) / 48R) * (VinP2 - VinP5) + VinP5$	
PKP1 4-0 = 11110	$((32R - 30R) / 48R) * (VinP2 - VinP5) + VinP5$	
PKP1 4-0 = 11111	$((32R - 31R) / 48R) * (VinP2 - VinP5) + VinP5$	

Table 5.33: VinP4

Reference voltage	Macro adjustment value	VinP6 formula
VinP6	PKP2 4-0 = 00000	$(220R / 223R) * (VinP5 - VinP11) + VinP11$
	PKP2 4-0 = 00001	$((220R - 3R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP2 4-0 = 00010	$((220R - 6R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP2 4-0 = 00011	$((220R - 9R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP2 4-0 = 00100	$((220R - 12R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP2 4-0 = 00101	$((220R - 15R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP2 4-0 = 00110	$((220R - 18R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP2 4-0 = 00111	$((220R - 21R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP2 4-0 = 01000	$((220R - 24R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP2 4-0 = 01001	$((220R - 27R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP2 4-0 = 01010	$((220R - 30R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP2 4-0 = 01011	$((220R - 33R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP2 4-0 = 01100	$((220R - 36R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP2 4-0 = 01101	$((220R - 39R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP2 4-0 = 01110	$((220R - 42R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP2 4-0 = 01111	$((220R - 45R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP2 4-0 = 10000	$((220R - 48R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP2 4-0 = 10001	$((220R - 51R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP2 4-0 = 10010	$((220R - 54R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP2 4-0 = 10011	$((220R - 57R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP2 4-0 = 10100	$((220R - 60R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP2 4-0 = 10101	$((220R - 63R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP2 4-0 = 10110	$((220R - 66R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP2 4-0 = 10111	$((220R - 69R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP2 4-0 = 11000	$((220R - 72R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP2 4-0 = 11001	$((220R - 75R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP2 4-0 = 11010	$((220R - 78R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP2 4-0 = 11011	$((220R - 81R) / 223R) * (VinP5 - VinP11) + VinP11$
PKP2 4-0 = 11100	$((220R - 84R) / 223R) * (VinP5 - VinP11) + VinP11$	
PKP2 4-0 = 11101	$((220R - 87R) / 223R) * (VinP5 - VinP11) + VinP11$	
PKP2 4-0 = 11110	$((220R - 90R) / 223R) * (VinP5 - VinP11) + VinP11$	
PKP2 4-0 = 11111	$((220R - 93R) / 223R) * (VinP5 - VinP11) + VinP11$	

Table 5.34: VinP6

Reference voltage	Macro adjustment value	VinP7 formula
VinP7	PKP3 4-0 = 00000	$(193R / 223R) * (VinP5 - VinP11) + VinP11$
	PKP3 4-0 = 00001	$((193R - 3R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP3 4-0 = 00010	$((193R - 6R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP3 4-0 = 00011	$((193R - 9R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP3 4-0 = 00100	$((193R - 12R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP3 4-0 = 00101	$((193R - 15R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP3 4-0 = 00110	$((193R - 18R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP3 4-0 = 00111	$((193R - 21R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP3 4-0 = 01000	$((193R - 24R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP3 4-0 = 01001	$((193R - 27R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP3 4-0 = 01010	$((193R - 30R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP3 4-0 = 01011	$((193R - 33R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP3 4-0 = 01100	$((193R - 36R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP3 4-0 = 01101	$((193R - 39R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP3 4-0 = 01110	$((193R - 42R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP3 4-0 = 01111	$((193R - 45R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP3 4-0 = 10000	$((193R - 48R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP3 4-0 = 10001	$((193R - 51R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP3 4-0 = 10010	$((193R - 54R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP3 4-0 = 10011	$((193R - 57R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP3 4-0 = 10100	$((193R - 60R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP3 4-0 = 10101	$((193R - 63R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP3 4-0 = 10110	$((193R - 66R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP3 4-0 = 10111	$((193R - 69R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP3 4-0 = 11000	$((193R - 72R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP3 4-0 = 11001	$((193R - 75R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP3 4-0 = 11010	$((193R - 78R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP3 4-0 = 11011	$((193R - 81R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP3 4-0 = 11100	$((193R - 84R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP3 4-0 = 11101	$((193R - 87R) / 223R) * (VinP5 - VinP11) + VinP11$
PKP3 4-0 = 11110	$((193R - 90R) / 223R) * (VinP5 - VinP11) + VinP11$	
PKP3 4-0 = 11111	$((193R - 93R) / 223R) * (VinP5 - VinP11) + VinP11$	

Table 5.35: VinP7

Reference voltage	Macro adjustment value	VinP8 formula
VinP8	PKP4 4-0 = 00000	$(158R / 223R) * (VinP5 - VinP11) + VinP11$
	PKP4 4-0 = 00001	$((158R - 3R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP4 4-0 = 00010	$((158R - 6R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP4 4-0 = 00011	$((158R - 9R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP4 4-0 = 00100	$((158R - 12R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP4 4-0 = 00101	$((158R - 15R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP4 4-0 = 00110	$((158R - 18R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP4 4-0 = 00111	$((158R - 21R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP4 4-0 = 01000	$((158R - 24R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP4 4-0 = 01001	$((158R - 27R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP4 4-0 = 01010	$((158R - 30R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP4 4-0 = 01011	$((158R - 33R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP4 4-0 = 01100	$((158R - 36R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP4 4-0 = 01101	$((158R - 39R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP4 4-0 = 01110	$((158R - 42R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP4 4-0 = 01111	$((158R - 45R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP4 4-0 = 10000	$((158R - 48R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP4 4-0 = 10001	$((158R - 51R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP4 4-0 = 10010	$((158R - 54R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP4 4-0 = 10011	$((158R - 57R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP4 4-0 = 10100	$((158R - 60R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP4 4-0 = 10101	$((158R - 63R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP4 4-0 = 10110	$((158R - 66R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP4 4-0 = 10111	$((158R - 69R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP4 4-0 = 11000	$((158R - 72R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP4 4-0 = 11001	$((158R - 75R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP4 4-0 = 11010	$((158R - 78R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP4 4-0 = 11011	$((158R - 81R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP4 4-0 = 11100	$((158R - 84R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP4 4-0 = 11101	$((158R - 87R) / 223R) * (VinP5 - VinP11) + VinP11$
PKP4 4-0 = 11110	$((158R - 90R) / 223R) * (VinP5 - VinP11) + VinP11$	
PKP4 4-0 = 11111	$((158R - 93R) / 223R) * (VinP5 - VinP11) + VinP11$	

Table 5.36: VinP8



Reference voltage	Macro adjustment value	VinP9 formula
VinP9	PKP5 4-0 = 00000	$(123R / 223R) * (VinP5 - VinP11) + VinP11$
	PKP5 4-0 = 00001	$((123R - 3R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP5 4-0 = 00010	$((123R - 6R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP5 4-0 = 00011	$((123R - 9R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP5 4-0 = 00100	$((123R - 12R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP5 4-0 = 00101	$((123R - 15R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP5 4-0 = 00110	$((123R - 18R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP5 4-0 = 00111	$((123R - 21R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP5 4-0 = 01000	$((123R - 24R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP5 4-0 = 01001	$((123R - 27R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP5 4-0 = 01010	$((123R - 30R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP5 4-0 = 01011	$((123R - 33R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP5 4-0 = 01100	$((123R - 36R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP5 4-0 = 01101	$((123R - 39R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP5 4-0 = 01110	$((123R - 42R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP5 4-0 = 01111	$((123R - 45R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP5 4-0 = 10000	$((123R - 48R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP5 4-0 = 10001	$((123R - 51R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP5 4-0 = 10010	$((123R - 54R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP5 4-0 = 10011	$((123R - 57R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP5 4-0 = 10100	$((123R - 60R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP5 4-0 = 10101	$((123R - 63R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP5 4-0 = 10110	$((123R - 66R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP5 4-0 = 10111	$((123R - 69R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP5 4-0 = 11000	$((123R - 72R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP5 4-0 = 11001	$((123R - 75R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP5 4-0 = 11010	$((123R - 78R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP5 4-0 = 11011	$((123R - 81R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP5 4-0 = 11100	$((123R - 84R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP5 4-0 = 11101	$((123R - 87R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP5 4-0 = 11110	$((123R - 90R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP5 4-0 = 11111	$((123R - 93R) / 223R) * (VinP5 - VinP11) + VinP11$

Table 5.37: VinP9

Reference voltage	Macro adjustment value	VinP10 formula
VinP10	PKP6 4-0 = 00000	$(96R / 223R) * (VinP5 - VinP11) + VinP11$
	PKP6 4-0 = 00001	$((96R - 3R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP6 4-0 = 00010	$((96R - 6R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP6 4-0 = 00011	$((96R - 9R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP6 4-0 = 00100	$((96R - 12R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP6 4-0 = 00101	$((96R - 15R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP6 4-0 = 00110	$((96R - 18R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP6 4-0 = 00111	$((96R - 21R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP6 4-0 = 01000	$((96R - 24R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP6 4-0 = 01001	$((96R - 27R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP6 4-0 = 01010	$((96R - 30R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP6 4-0 = 01011	$((96R - 33R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP6 4-0 = 01100	$((96R - 36R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP6 4-0 = 01101	$((96R - 39R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP6 4-0 = 01110	$((96R - 42R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP6 4-0 = 01111	$((96R - 45R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP6 4-0 = 10000	$((96R - 48R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP6 4-0 = 10001	$((96R - 51R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP6 4-0 = 10010	$((96R - 54R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP6 4-0 = 10011	$((96R - 57R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP6 4-0 = 10100	$((96R - 60R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP6 4-0 = 10101	$((96R - 63R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP6 4-0 = 10110	$((96R - 66R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP6 4-0 = 10111	$((96R - 69R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP6 4-0 = 11000	$((96R - 72R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP6 4-0 = 11001	$((96R - 75R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP6 4-0 = 11010	$((96R - 78R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP6 4-0 = 11011	$((96R - 81R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP6 4-0 = 11100	$((96R - 84R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP6 4-0 = 11101	$((96R - 87R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP6 4-0 = 11110	$((96R - 90R) / 223R) * (VinP5 - VinP11) + VinP11$
	PKP6 4-0 = 11111	$((96R - 93R) / 223R) * (VinP5 - VinP11) + VinP11$

Table 5.38: VinP10

Reference voltage	Macro adjustment value	VinP12 formula
VinP12	PKP7 4-0 = 00000	$(47R / 48R) * (VinP11 - VinP14) + VinP14$
	PKP7 4-0 = 00001	$((47R - 1R) / 48R) * (VinP11 - VinP14) + VinP14$
	PKP7 4-0 = 00010	$((47R - 2R) / 48R) * (VinP11 - VinP14) + VinP14$
	PKP7 4-0 = 00011	$((47R - 3R) / 48R) * (VinP11 - VinP14) + VinP14$
	PKP7 4-0 = 00100	$((47R - 4R) / 48R) * (VinP11 - VinP14) + VinP14$
	PKP7 4-0 = 00101	$((47R - 5R) / 48R) * (VinP11 - VinP14) + VinP14$
	PKP7 4-0 = 00110	$((47R - 6R) / 48R) * (VinP11 - VinP14) + VinP14$
	PKP7 4-0 = 00111	$((47R - 7R) / 48R) * (VinP11 - VinP14) + VinP14$
	PKP7 4-0 = 01000	$((47R - 8R) / 48R) * (VinP11 - VinP14) + VinP14$
	PKP7 4-0 = 01001	$((47R - 9R) / 48R) * (VinP11 - VinP14) + VinP14$
	PKP7 4-0 = 01010	$((47R - 10R) / 48R) * (VinP11 - VinP14) + VinP14$
	PKP7 4-0 = 01011	$((47R - 11R) / 48R) * (VinP11 - VinP14) + VinP14$
	PKP7 4-0 = 01100	$((47R - 12R) / 48R) * (VinP11 - VinP14) + VinP14$
	PKP7 4-0 = 01101	$((47R - 13R) / 48R) * (VinP11 - VinP14) + VinP14$
	PKP7 4-0 = 01110	$((47R - 14R) / 48R) * (VinP11 - VinP14) + VinP14$
	PKP7 4-0 = 01111	$((47R - 15R) / 48R) * (VinP11 - VinP14) + VinP14$
	PKP7 4-0 = 10000	$((47R - 16R) / 48R) * (VinP11 - VinP14) + VinP14$
	PKP7 4-0 = 10001	$((47R - 17R) / 48R) * (VinP11 - VinP14) + VinP14$
	PKP7 4-0 = 10010	$((47R - 18R) / 48R) * (VinP11 - VinP14) + VinP14$
	PKP7 4-0 = 10011	$((47R - 19R) / 48R) * (VinP11 - VinP14) + VinP14$
	PKP7 4-0 = 10100	$((47R - 20R) / 48R) * (VinP11 - VinP14) + VinP14$
	PKP7 4-0 = 10101	$((47R - 21R) / 48R) * (VinP11 - VinP14) + VinP14$
	PKP7 4-0 = 10110	$((47R - 22R) / 48R) * (VinP11 - VinP14) + VinP14$
	PKP7 4-0 = 10111	$((47R - 23R) / 48R) * (VinP11 - VinP14) + VinP14$
	PKP7 4-0 = 11000	$((47R - 24R) / 48R) * (VinP11 - VinP14) + VinP14$
	PKP7 4-0 = 11001	$((47R - 25R) / 48R) * (VinP11 - VinP14) + VinP14$
	PKP7 4-0 = 11010	$((47R - 26R) / 48R) * (VinP11 - VinP14) + VinP14$
	PKP7 4-0 = 11011	$((47R - 27R) / 48R) * (VinP11 - VinP14) + VinP14$
	PKP7 4-0 = 11100	$((47R - 28R) / 48R) * (VinP11 - VinP14) + VinP14$
	PKP7 4-0 = 11101	$((47R - 29R) / 48R) * (VinP11 - VinP14) + VinP14$
PKP7 4-0 = 11110	$((47R - 30R) / 48R) * (VinP11 - VinP14) + VinP14$	
PKP7 4-0 = 11111	$((47R - 31R) / 48R) * (VinP11 - VinP14) + VinP14$	

Table 5.39: VinP12

Reference voltage	Macro adjustment value	VinP13 formula
VinP13	PKP8 4-0 = 00000	$(32R / 48R) * (VinP11 - VinP14) + VinP14$
	PKP8 4-0 = 00001	$((32R - 1R) / 48R) * (VinP11 - VinP14) + VinP14$
	PKP8 4-0 = 00010	$((32R - 2R) / 48R) * (VinP11 - VinP14) + VinP14$
	PKP8 4-0 = 00011	$((32R - 3R) / 48R) * (VinP11 - VinP14) + VinP14$
	PKP8 4-0 = 00100	$((32R - 4R) / 48R) * (VinP11 - VinP14) + VinP14$
	PKP8 4-0 = 00101	$((32R - 5R) / 48R) * (VinP11 - VinP14) + VinP14$
	PKP8 4-0 = 00110	$((32R - 6R) / 48R) * (VinP11 - VinP14) + VinP14$
	PKP8 4-0 = 00111	$((32R - 7R) / 48R) * (VinP11 - VinP14) + VinP14$
	PKP8 4-0 = 01000	$((32R - 8R) / 48R) * (VinP11 - VinP14) + VinP14$
	PKP8 4-0 = 01001	$((32R - 9R) / 48R) * (VinP11 - VinP14) + VinP14$
	PKP8 4-0 = 01010	$((32R - 10R) / 48R) * (VinP11 - VinP14) + VinP14$
	PKP8 4-0 = 01011	$((32R - 11R) / 48R) * (VinP11 - VinP14) + VinP14$
	PKP8 4-0 = 01100	$((32R - 12R) / 48R) * (VinP11 - VinP14) + VinP14$
	PKP8 4-0 = 01101	$((32R - 13R) / 48R) * (VinP11 - VinP14) + VinP14$
	PKP8 4-0 = 01110	$((32R - 14R) / 48R) * (VinP11 - VinP14) + VinP14$
	PKP8 4-0 = 01111	$((32R - 15R) / 48R) * (VinP11 - VinP14) + VinP14$
	PKP8 4-0 = 10000	$((32R - 16R) / 48R) * (VinP11 - VinP14) + VinP14$
	PKP8 4-0 = 10001	$((32R - 17R) / 48R) * (VinP11 - VinP14) + VinP14$
	PKP8 4-0 = 10010	$((32R - 18R) / 48R) * (VinP11 - VinP14) + VinP14$
	PKP8 4-0 = 10011	$((32R - 19R) / 48R) * (VinP11 - VinP14) + VinP14$
	PKP8 4-0 = 10100	$((32R - 20R) / 48R) * (VinP11 - VinP14) + VinP14$
	PKP8 4-0 = 10101	$((32R - 21R) / 48R) * (VinP11 - VinP14) + VinP14$
	PKP8 4-0 = 10110	$((32R - 22R) / 48R) * (VinP11 - VinP14) + VinP14$
	PKP8 4-0 = 10111	$((32R - 23R) / 48R) * (VinP11 - VinP14) + VinP14$
	PKP8 4-0 = 11000	$((32R - 24R) / 48R) * (VinP11 - VinP14) + VinP14$
	PKP8 4-0 = 11001	$((32R - 25R) / 48R) * (VinP11 - VinP14) + VinP14$
	PKP8 4-0 = 11010	$((32R - 26R) / 48R) * (VinP11 - VinP14) + VinP14$
	PKP8 4-0 = 11011	$((32R - 27R) / 48R) * (VinP11 - VinP14) + VinP14$
	PKP8 4-0 = 11100	$((32R - 28R) / 48R) * (VinP11 - VinP14) + VinP14$
	PKP8 4-0 = 11101	$((32R - 29R) / 48R) * (VinP11 - VinP14) + VinP14$
PKP8 4-0 = 11110	$((32R - 30R) / 48R) * (VinP11 - VinP14) + VinP14$	
PKP8 4-0 = 11111	$((32R - 31R) / 48R) * (VinP11 - VinP14) + VinP14$	

Table 5.40: VinP13

Reference voltage	Macro adjustment value	VinNO formula
VinNO	VRN0 5-0 = 000000	VSNR
	VRN0 5-0 = 000001	$((450R - 20R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN0 5-0 = 000010	$((450R - 22R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN0 5-0 = 000011	$((450R - 24R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN0 5-0 = 000100	$((450R - 26R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN0 5-0 = 000101	$((450R - 28R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN0 5-0 = 000110	$((450R - 30R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN0 5-0 = 000111	$((450R - 32R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN0 5-0 = 001000	$((450R - 34R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN0 5-0 = 001001	$((450R - 36R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN0 5-0 = 001010	$((450R - 38R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN0 5-0 = 001011	$((450R - 40R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN0 5-0 = 001100	$((450R - 42R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN0 5-0 = 001101	$((450R - 44R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN0 5-0 = 001110	$((450R - 46R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN0 5-0 = 001111	$((450R - 48R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN0 5-0 = 010000	$((450R - 50R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN0 5-0 = 010001	$((450R - 52R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN0 5-0 = 010010	$((450R - 54R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN0 5-0 = 010011	$((450R - 56R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN0 5-0 = 010100	$((450R - 58R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN0 5-0 = 010101	$((450R - 60R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN0 5-0 = 010110	$((450R - 62R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN0 5-0 = 010111	$((450R - 64R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN0 5-0 = 011000	$((450R - 66R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN0 5-0 = 011001	$((450R - 68R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN0 5-0 = 011010	$((450R - 70R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN0 5-0 = 011011	$((450R - 72R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN0 5-0 = 011100	$((450R - 74R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN0 5-0 = 011101	$((450R - 76R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN0 5-0 = 011110	$((450R - 78R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN0 5-0 = 011111	$((450R - 80R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN0 5-0 = 100000	$((450R - 82R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN0 5-0 = 100001	$((450R - 84R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN0 5-0 = 100010	$((450R - 86R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN0 5-0 = 100011	$((450R - 88R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN0 5-0 = 100100	$((450R - 90R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN0 5-0 = 100101	$((450R - 92R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN0 5-0 = 100110	$((450R - 94R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN0 5-0 = 100111	$((450R - 96R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN0 5-0 = 101000	$((450R - 98R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN0 5-0 = 101001	$((450R - 100R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN0 5-0 = 101010	$((450R - 102R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN0 5-0 = 101011	$((450R - 104R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN0 5-0 = 101100	$((450R - 106R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN0 5-0 = 101101	$((450R - 108R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN0 5-0 = 101110	$((450R - 110R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN0 5-0 = 101111	$((450R - 112R) / 450R) * (VSNR - VGSN) + VGSN$
VRN0 5-0 = 110000	$((450R - 114R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN0 5-0 = 110001	$((450R - 116R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN0 5-0 = 110010	$((450R - 118R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN0 5-0 = 110011	$((450R - 120R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN0 5-0 = 110100	$((450R - 122R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN0 5-0 = 110101	$((450R - 124R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN0 5-0 = 110110	$((450R - 126R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN0 5-0 = 110111	$((450R - 128R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN0 5-0 = 111000	$((450R - 130R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN0 5-0 = 111001	$((450R - 132R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN0 5-0 = 111010	$((450R - 134R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN0 5-0 = 111011	$((450R - 136R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN0 5-0 = 111100	$((450R - 138R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN0 5-0 = 111101	$((450R - 140R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN0 5-0 = 111110	$((450R - 142R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN0 5-0 = 111111	$((450R - 144R) / 450R) * (VSNR - VGSN) + VGSN$	

Table 5.41: VinNO

Reference voltage	Macro adjustment value	VinN1 formula
VinN1	VRN1 5-0 = 000000	$(430R / 450R) * (VSNR - VGSN) + VGSN$
	VRN1 5-0 = 000001	$((430R - 2R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN1 5-0 = 000010	$((430R - 4R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN1 5-0 = 000011	$((430R - 6R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN1 5-0 = 000100	$((430R - 8R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN1 5-0 = 000101	$((430R - 10R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN1 5-0 = 000110	$((430R - 12R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN1 5-0 = 000111	$((430R - 14R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN1 5-0 = 001000	$((430R - 16R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN1 5-0 = 001001	$((430R - 18R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN1 5-0 = 001010	$((430R - 20R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN1 5-0 = 001011	$((430R - 22R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN1 5-0 = 001100	$((430R - 24R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN1 5-0 = 001101	$((430R - 26R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN1 5-0 = 001110	$((430R - 28R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN1 5-0 = 001111	$((430R - 30R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN1 5-0 = 010000	$((430R - 32R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN1 5-0 = 010001	$((430R - 34R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN1 5-0 = 010010	$((430R - 36R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN1 5-0 = 010011	$((430R - 38R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN1 5-0 = 010100	$((430R - 40R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN1 5-0 = 010101	$((430R - 42R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN1 5-0 = 010110	$((430R - 44R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN1 5-0 = 010111	$((430R - 46R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN1 5-0 = 011000	$((430R - 48R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN1 5-0 = 011001	$((430R - 50R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN1 5-0 = 011010	$((430R - 52R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN1 5-0 = 011011	$((430R - 54R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN1 5-0 = 011100	$((430R - 56R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN1 5-0 = 011101	$((430R - 58R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN1 5-0 = 011110	$((430R - 60R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN1 5-0 = 011111	$((430R - 62R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN1 5-0 = 100000	$((430R - 64R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN1 5-0 = 100001	$((430R - 66R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN1 5-0 = 100010	$((430R - 68R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN1 5-0 = 100011	$((430R - 70R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN1 5-0 = 100100	$((430R - 72R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN1 5-0 = 100101	$((430R - 74R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN1 5-0 = 100110	$((430R - 76R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN1 5-0 = 100111	$((430R - 78R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN1 5-0 = 101000	$((430R - 80R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN1 5-0 = 101001	$((430R - 82R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN1 5-0 = 101010	$((430R - 84R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN1 5-0 = 101011	$((430R - 86R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN1 5-0 = 101100	$((430R - 88R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN1 5-0 = 101101	$((430R - 90R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN1 5-0 = 101110	$((430R - 92R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN1 5-0 = 101111	$((430R - 94R) / 450R) * (VSNR - VGSN) + VGSN$
VRN1 5-0 = 110000	$((430R - 96R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN1 5-0 = 110001	$((430R - 98R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN1 5-0 = 110010	$((430R - 100R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN1 5-0 = 110011	$((430R - 102R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN1 5-0 = 110100	$((430R - 104R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN1 5-0 = 110101	$((430R - 106R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN1 5-0 = 110110	$((430R - 108R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN1 5-0 = 110111	$((430R - 110R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN1 5-0 = 111000	$((430R - 112R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN1 5-0 = 111001	$((430R - 114R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN1 5-0 = 111010	$((430R - 116R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN1 5-0 = 111011	$((430R - 118R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN1 5-0 = 111100	$((430R - 120R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN1 5-0 = 111101	$((430R - 122R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN1 5-0 = 111110	$((430R - 124R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN1 5-0 = 111111	$((430R - 126R) / 450R) * (VSNR - VGSN) + VGSN$	

Table 5.42: VinN1



Reference voltage	Macro adjustment value	VinN2 formula
VinN2	VRN2 5-0 = 000000	$(420R / 450R) * (VSNR - VGSN) + VGSN$
	VRN2 5-0 = 000001	$((420R - 2R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN2 5-0 = 000010	$((420R - 4R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN2 5-0 = 000011	$((420R - 6R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN2 5-0 = 000100	$((420R - 8R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN2 5-0 = 000101	$((420R - 10R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN2 5-0 = 000110	$((420R - 12R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN2 5-0 = 000111	$((420R - 14R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN2 5-0 = 001000	$((420R - 16R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN2 5-0 = 001001	$((420R - 18R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN2 5-0 = 001010	$((420R - 20R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN2 5-0 = 001011	$((420R - 22R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN2 5-0 = 001100	$((420R - 24R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN2 5-0 = 001101	$((420R - 26R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN2 5-0 = 001110	$((420R - 28R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN2 5-0 = 001111	$((420R - 30R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN2 5-0 = 010000	$((420R - 32R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN2 5-0 = 010001	$((420R - 34R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN2 5-0 = 010010	$((420R - 36R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN2 5-0 = 010011	$((420R - 38R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN2 5-0 = 010100	$((420R - 40R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN2 5-0 = 010101	$((420R - 42R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN2 5-0 = 010110	$((420R - 44R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN2 5-0 = 010111	$((420R - 46R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN2 5-0 = 011000	$((420R - 48R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN2 5-0 = 011001	$((420R - 50R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN2 5-0 = 011010	$((420R - 52R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN2 5-0 = 011011	$((420R - 54R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN2 5-0 = 011100	$((420R - 56R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN2 5-0 = 011101	$((420R - 58R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN2 5-0 = 011110	$((420R - 60R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN2 5-0 = 011111	$((420R - 62R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN2 5-0 = 100000	$((420R - 64R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN2 5-0 = 100001	$((420R - 66R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN2 5-0 = 100010	$((420R - 68R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN2 5-0 = 100011	$((420R - 70R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN2 5-0 = 100100	$((420R - 72R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN2 5-0 = 100101	$((420R - 74R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN2 5-0 = 100110	$((420R - 76R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN2 5-0 = 100111	$((420R - 78R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN2 5-0 = 101000	$((420R - 80R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN2 5-0 = 101001	$((420R - 82R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN2 5-0 = 101010	$((420R - 84R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN2 5-0 = 101011	$((420R - 86R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN2 5-0 = 101100	$((420R - 88R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN2 5-0 = 101101	$((420R - 90R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN2 5-0 = 101110	$((420R - 92R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN2 5-0 = 101111	$((420R - 94R) / 450R) * (VSNR - VGSN) + VGSN$
VRN2 5-0 = 110000	$((420R - 96R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN2 5-0 = 110001	$((420R - 98R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN2 5-0 = 110010	$((420R - 100R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN2 5-0 = 110011	$((420R - 102R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN2 5-0 = 110100	$((420R - 104R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN2 5-0 = 110101	$((420R - 106R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN2 5-0 = 110110	$((420R - 108R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN2 5-0 = 110111	$((420R - 110R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN2 5-0 = 111000	$((420R - 112R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN2 5-0 = 111001	$((420R - 114R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN2 5-0 = 111010	$((420R - 116R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN2 5-0 = 111011	$((420R - 118R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN2 5-0 = 111100	$((420R - 120R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN2 5-0 = 111101	$((420R - 122R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN2 5-0 = 111110	$((420R - 124R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN2 5-0 = 111111	$((420R - 126R) / 450R) * (VSNR - VGSN) + VGSN$	

Table 5.43: VinN2

Reference voltage	Macro adjustment value	VinN14 formula
VinN14	VRN3 5-0 = 000000	$(156R / 450R) * (VSNR - VGSN) + VGSN$
	VRN3 5-0 = 000001	$((156R - 2R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN3 5-0 = 000010	$((156R - 4R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN3 5-0 = 000011	$((156R - 6R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN3 5-0 = 000100	$((156R - 8R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN3 5-0 = 000101	$((156R - 10R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN3 5-0 = 000110	$((156R - 12R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN3 5-0 = 000111	$((156R - 14R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN3 5-0 = 001000	$((156R - 16R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN3 5-0 = 001001	$((156R - 18R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN3 5-0 = 001010	$((156R - 20R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN3 5-0 = 001011	$((156R - 22R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN3 5-0 = 001100	$((156R - 24R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN3 5-0 = 001101	$((156R - 26R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN3 5-0 = 001110	$((156R - 28R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN3 5-0 = 001111	$((156R - 30R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN3 5-0 = 010000	$((156R - 32R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN3 5-0 = 010001	$((156R - 34R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN3 5-0 = 010010	$((156R - 36R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN3 5-0 = 010011	$((156R - 38R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN3 5-0 = 010100	$((156R - 40R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN3 5-0 = 010101	$((156R - 42R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN3 5-0 = 010110	$((156R - 44R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN3 5-0 = 010111	$((156R - 46R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN3 5-0 = 011000	$((156R - 48R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN3 5-0 = 011001	$((156R - 50R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN3 5-0 = 011010	$((156R - 52R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN3 5-0 = 011011	$((156R - 54R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN3 5-0 = 011100	$((156R - 56R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN3 5-0 = 011101	$((156R - 58R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN3 5-0 = 011110	$((156R - 60R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN3 5-0 = 011111	$((156R - 62R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN3 5-0 = 100000	$((156R - 64R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN3 5-0 = 100001	$((156R - 66R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN3 5-0 = 100010	$((156R - 68R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN3 5-0 = 100011	$((156R - 70R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN3 5-0 = 100100	$((156R - 72R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN3 5-0 = 100101	$((156R - 74R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN3 5-0 = 100110	$((156R - 76R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN3 5-0 = 100111	$((156R - 78R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN3 5-0 = 101000	$((156R - 80R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN3 5-0 = 101001	$((156R - 82R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN3 5-0 = 101010	$((156R - 84R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN3 5-0 = 101011	$((156R - 86R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN3 5-0 = 101100	$((156R - 88R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN3 5-0 = 101101	$((156R - 90R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN3 5-0 = 101110	$((156R - 92R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN3 5-0 = 101111	$((156R - 94R) / 450R) * (VSNR - VGSN) + VGSN$
VRN3 5-0 = 110000	$((156R - 96R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN3 5-0 = 110001	$((156R - 98R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN3 5-0 = 110010	$((156R - 100R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN3 5-0 = 110011	$((156R - 102R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN3 5-0 = 110100	$((156R - 104R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN3 5-0 = 110101	$((156R - 106R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN3 5-0 = 110110	$((156R - 108R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN3 5-0 = 110111	$((156R - 110R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN3 5-0 = 111000	$((156R - 112R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN3 5-0 = 111001	$((156R - 114R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN3 5-0 = 111010	$((156R - 116R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN3 5-0 = 111011	$((156R - 118R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN3 5-0 = 111100	$((156R - 120R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN3 5-0 = 111101	$((156R - 122R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN3 5-0 = 111110	$((156R - 124R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN3 5-0 = 111111	$((156R - 126R) / 450R) * (VSNR - VGSN) + VGSN$	

Table 5.44: VinN14



Reference voltage	Macro adjustment value	VinN15 formula
VinN15	VRN4 5-0 = 000000	$(146R / 450R) * (VSNR - VGSN) + VGSN$
	VRN4 5-0 = 000001	$((146R - 2R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN4 5-0 = 000010	$((146R - 4R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN4 5-0 = 000011	$((146R - 6R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN4 5-0 = 000100	$((146R - 8R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN4 5-0 = 000101	$((146R - 10R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN4 5-0 = 000110	$((146R - 12R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN4 5-0 = 000111	$((146R - 14R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN4 5-0 = 001000	$((146R - 16R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN4 5-0 = 001001	$((146R - 18R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN4 5-0 = 001010	$((146R - 20R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN4 5-0 = 001011	$((146R - 22R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN4 5-0 = 001100	$((146R - 24R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN4 5-0 = 001101	$((146R - 26R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN4 5-0 = 001110	$((146R - 28R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN4 5-0 = 001111	$((146R - 30R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN4 5-0 = 010000	$((146R - 32R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN4 5-0 = 010001	$((146R - 34R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN4 5-0 = 010010	$((146R - 36R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN4 5-0 = 010011	$((146R - 38R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN4 5-0 = 010100	$((146R - 40R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN4 5-0 = 010101	$((146R - 42R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN4 5-0 = 010110	$((146R - 44R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN4 5-0 = 010111	$((146R - 46R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN4 5-0 = 011000	$((146R - 48R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN4 5-0 = 011001	$((146R - 50R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN4 5-0 = 011010	$((146R - 52R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN4 5-0 = 011011	$((146R - 54R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN4 5-0 = 011100	$((146R - 56R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN4 5-0 = 011101	$((146R - 58R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN4 5-0 = 011110	$((146R - 60R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN4 5-0 = 011111	$((146R - 62R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN4 5-0 = 100000	$((146R - 64R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN4 5-0 = 100001	$((146R - 66R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN4 5-0 = 100010	$((146R - 68R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN4 5-0 = 100011	$((146R - 70R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN4 5-0 = 100100	$((146R - 72R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN4 5-0 = 100101	$((146R - 74R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN4 5-0 = 100110	$((146R - 76R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN4 5-0 = 100111	$((146R - 78R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN4 5-0 = 101000	$((146R - 80R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN4 5-0 = 101001	$((146R - 82R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN4 5-0 = 101010	$((146R - 84R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN4 5-0 = 101011	$((146R - 86R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN4 5-0 = 101100	$((146R - 88R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN4 5-0 = 101101	$((146R - 90R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN4 5-0 = 101110	$((146R - 92R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN4 5-0 = 101111	$((146R - 94R) / 450R) * (VSNR - VGSN) + VGSN$
VRN4 5-0 = 110000	$((146R - 96R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN4 5-0 = 110001	$((146R - 98R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN4 5-0 = 110010	$((146R - 100R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN4 5-0 = 110011	$((146R - 102R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN4 5-0 = 110100	$((146R - 104R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN4 5-0 = 110101	$((146R - 106R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN4 5-0 = 110110	$((146R - 108R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN4 5-0 = 110111	$((146R - 110R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN4 5-0 = 111000	$((146R - 112R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN4 5-0 = 111001	$((146R - 114R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN4 5-0 = 111010	$((146R - 116R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN4 5-0 = 111011	$((146R - 118R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN4 5-0 = 111100	$((146R - 120R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN4 5-0 = 111101	$((146R - 122R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN4 5-0 = 111110	$((146R - 124R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN4 5-0 = 111111	$((146R - 126R) / 450R) * (VSNR - VGSN) + VGSN$	

Table 5.45: VinN15

Reference voltage	Macro adjustment value	VinN16 formula
VinN16	VRN5 5-0 = 000000	$(144R / 450R) * (VSNR - VGSN) + VGSN$
	VRN5 5-0 = 000001	$((144R - 2R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN5 5-0 = 000010	$((144R - 4R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN5 5-0 = 000011	$((144R - 6R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN5 5-0 = 000100	$((144R - 8R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN5 5-0 = 000101	$((144R - 10R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN5 5-0 = 000110	$((144R - 12R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN5 5-0 = 000111	$((144R - 14R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN5 5-0 = 001000	$((144R - 16R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN5 5-0 = 001001	$((144R - 18R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN5 5-0 = 001010	$((144R - 20R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN5 5-0 = 001011	$((144R - 22R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN5 5-0 = 001100	$((144R - 24R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN5 5-0 = 001101	$((144R - 26R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN5 5-0 = 001110	$((144R - 28R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN5 5-0 = 001111	$((144R - 30R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN5 5-0 = 010000	$((144R - 32R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN5 5-0 = 010001	$((144R - 34R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN5 5-0 = 010010	$((144R - 36R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN5 5-0 = 010011	$((144R - 38R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN5 5-0 = 010100	$((144R - 40R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN5 5-0 = 010101	$((144R - 42R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN5 5-0 = 010110	$((144R - 44R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN5 5-0 = 010111	$((144R - 46R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN5 5-0 = 011000	$((144R - 48R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN5 5-0 = 011001	$((144R - 50R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN5 5-0 = 011010	$((144R - 52R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN5 5-0 = 011011	$((144R - 54R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN5 5-0 = 011100	$((144R - 56R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN5 5-0 = 011101	$((144R - 58R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN5 5-0 = 011110	$((144R - 60R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN5 5-0 = 011111	$((144R - 62R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN5 5-0 = 100000	$((144R - 64R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN5 5-0 = 100001	$((144R - 66R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN5 5-0 = 100010	$((144R - 68R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN5 5-0 = 100011	$((144R - 70R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN5 5-0 = 100100	$((144R - 72R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN5 5-0 = 100101	$((144R - 74R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN5 5-0 = 100110	$((144R - 76R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN5 5-0 = 100111	$((144R - 78R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN5 5-0 = 101000	$((144R - 80R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN5 5-0 = 101001	$((144R - 82R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN5 5-0 = 101010	$((144R - 84R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN5 5-0 = 101011	$((144R - 86R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN5 5-0 = 101100	$((144R - 88R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN5 5-0 = 101101	$((144R - 90R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN5 5-0 = 101110	$((144R - 92R) / 450R) * (VSNR - VGSN) + VGSN$
	VRN5 5-0 = 101111	$((144R - 94R) / 450R) * (VSNR - VGSN) + VGSN$
VRN5 5-0 = 110000	$((144R - 96R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN5 5-0 = 110001	$((144R - 98R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN5 5-0 = 110010	$((144R - 100R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN5 5-0 = 110011	$((144R - 102R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN5 5-0 = 110100	$((144R - 104R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN5 5-0 = 110101	$((144R - 106R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN5 5-0 = 110110	$((144R - 108R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN5 5-0 = 110111	$((144R - 110R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN5 5-0 = 111000	$((144R - 112R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN5 5-0 = 111001	$((144R - 114R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN5 5-0 = 111010	$((144R - 116R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN5 5-0 = 111011	$((144R - 118R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN5 5-0 = 111100	$((144R - 120R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN5 5-0 = 111101	$((144R - 122R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN5 5-0 = 111110	$((144R - 124R) / 450R) * (VSNR - VGSN) + VGSN$	
VRN5 5-0 = 111111	VGSN	

Table 5.46: VinN16

Reference voltage	Macro adjustment value	VinN5 formula
VinN5	PRN0 6-0 = 0000000	$(350R / 450R) (VSNR - VGSN) + VGSN$
	PRN0 6-0 = 0000001	$((350R - 2R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN0 6-0 = 0000010	$((350R - 4R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN0 6-0 = 0000011	$((350R - 6R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN0 6-0 = 0000100	$((350R - 8R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN0 6-0 = 0000101	$((350R - 10R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN0 6-0 = 0000110	$((350R - 12R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN0 6-0 = 0000111	$((350R - 14R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN0 6-0 = 0001000	$((350R - 16R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN0 6-0 = 0001001	$((350R - 18R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN0 6-0 = 0001010	$((350R - 20R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN0 6-0 = 0001011	$((350R - 22R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN0 6-0 = 0001100	$((350R - 24R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN0 6-0 = 0001101	$((350R - 26R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN0 6-0 = 0001110	$((350R - 28R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN0 6-0 = 0001111	$((350R - 30R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN0 6-0 = 0010000	$((350R - 32R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN0 6-0 = 0010001	$((350R - 34R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN0 6-0 = 0010010	$((350R - 36R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN0 6-0 = 0010011	$((350R - 38R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN0 6-0 = 0010100	$((350R - 40R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN0 6-0 = 0010101	$((350R - 42R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN0 6-0 = 0010110	$((350R - 44R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN0 6-0 = 0010111	$((350R - 46R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN0 6-0 = 0011000	$((350R - 48R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN0 6-0 = 0011001	$((350R - 50R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN0 6-0 = 0011010	$((350R - 52R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN0 6-0 = 0011011	$((350R - 54R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN0 6-0 = 0011100	$((350R - 56R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN0 6-0 = 0011101	$((350R - 58R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN0 6-0 = 0011110	$((350R - 60R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN0 6-0 = 0011111	$((350R - 62R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN0 6-0 = 0100000	$((350R - 64R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN0 6-0 = 0100001	$((350R - 66R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN0 6-0 = 0100010	$((350R - 68R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN0 6-0 = 0100011	$((350R - 70R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN0 6-0 = 0100100	$((350R - 72R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN0 6-0 = 0100101	$((350R - 74R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN0 6-0 = 0100110	$((350R - 76R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN0 6-0 = 0100111	$((350R - 78R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN0 6-0 = 0101000	$((350R - 80R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN0 6-0 = 0101001	$((350R - 82R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN0 6-0 = 0101010	$((350R - 84R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN0 6-0 = 0101011	$((350R - 86R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN0 6-0 = 0101100	$((350R - 88R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN0 6-0 = 0101101	$((350R - 90R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN0 6-0 = 0101110	$((350R - 92R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN0 6-0 = 0101111	$((350R - 94R) / 450R) * (VSNR - VGSN) + VGSN$
PRN0 6-0 = 0110000	$((350R - 96R) / 450R) * (VSNR - VGSN) + VGSN$	
PRN0 6-0 = 0110001	$((350R - 98R) / 450R) * (VSNR - VGSN) + VGSN$	
PRN0 6-0 = 0110010	$((350R - 100R) / 450R) * (VSNR - VGSN) + VGSN$	
PRN0 6-0 = 0110011	$((350R - 102R) / 450R) * (VSNR - VGSN) + VGSN$	
PRN0 6-0 = 0110100	$((350R - 104R) / 450R) * (VSNR - VGSN) + VGSN$	
PRN0 6-0 = 0110101	$((350R - 106R) / 450R) * (VSNR - VGSN) + VGSN$	
PRN0 6-0 = 0110110	$((350R - 108R) / 450R) * (VSNR - VGSN) + VGSN$	
PRN0 6-0 = 0110111	$((350R - 110R) / 450R) * (VSNR - VGSN) + VGSN$	
PRN0 6-0 = 0111000	$((350R - 112R) / 450R) * (VSNR - VGSN) + VGSN$	
PRN0 6-0 = 0111001	$((350R - 114R) / 450R) * (VSNR - VGSN) + VGSN$	
PRN0 6-0 = 0111010	$((350R - 116R) / 450R) * (VSNR - VGSN) + VGSN$	
PRN0 6-0 = 0111011	$((350R - 118R) / 450R) * (VSNR - VGSN) + VGSN$	
PRN0 6-0 = 0111100	$((350R - 120R) / 450R) * (VSNR - VGSN) + VGSN$	
PRN0 6-0 = 0111101	$((350R - 122R) / 450R) * (VSNR - VGSN) + VGSN$	
PRN0 6-0 = 0111110	$((350R - 124R) / 450R) * (VSNR - VGSN) + VGSN$	
PRN0 6-0 = 0111111	$((350R - 126R) / 450R) * (VSNR - VGSN) + VGSN$	
PRN0 6-0 = 1000000	$((350R - 128R) / 450R) * (VSNR - VGSN) + VGSN$	
PRN0 6-0 = 1000001	$((350R - 130R) / 450R) * (VSNR - VGSN) + VGSN$	
PRN0 6-0 = 1000010	$((350R - 132R) / 450R) * (VSNR - VGSN) + VGSN$	
PRN0 6-0 = 1000011	$((350R - 134R) / 450R) * (VSNR - VGSN) + VGSN$	
PRN0 6-0 = 1000100	$((350R - 136R) / 450R) * (VSNR - VGSN) + VGSN$	

PRN0 6-0 = 1000101	$((350R - 138R) / 450R) * (VSNR - VGSN) + VGSN$
PRN0 6-0 = 1000110	$((350R - 140R) / 450R) * (VSNR - VGSN) + VGSN$
PRN0 6-0 = 1000111	$((350R - 142R) / 450R) * (VSNR - VGSN) + VGSN$
PRN0 6-0 = 1001000	$((350R - 144R) / 450R) * (VSNR - VGSN) + VGSN$
PRN0 6-0 = 1001001	$((350R - 146R) / 450R) * (VSNR - VGSN) + VGSN$
PRN0 6-0 = 1001010	$((350R - 148R) / 450R) * (VSNR - VGSN) + VGSN$
PRN0 6-0 = 1001011	$((350R - 150R) / 450R) * (VSNR - VGSN) + VGSN$
PRN0 6-0 = 1001100	$((350R - 152R) / 450R) * (VSNR - VGSN) + VGSN$
PRN0 6-0 = 1001101	$((350R - 154R) / 450R) * (VSNR - VGSN) + VGSN$
PRN0 6-0 = 1001110	$((350R - 156R) / 450R) * (VSNR - VGSN) + VGSN$
PRN0 6-0 = 1001111	$((350R - 158R) / 450R) * (VSNR - VGSN) + VGSN$
PRN0 6-0 = 1010000	$((350R - 160R) / 450R) * (VSNR - VGSN) + VGSN$
PRN0 6-0 = 1010001	$((350R - 162R) / 450R) * (VSNR - VGSN) + VGSN$
PRN0 6-0 = 1010010	$((350R - 164R) / 450R) * (VSNR - VGSN) + VGSN$
PRN0 6-0 = 1010011	$((350R - 166R) / 450R) * (VSNR - VGSN) + VGSN$
PRN0 6-0 = 1010100	$((350R - 168R) / 450R) * (VSNR - VGSN) + VGSN$
PRN0 6-0 = 1010101	$((350R - 170R) / 450R) * (VSNR - VGSN) + VGSN$
PRN0 6-0 = 1010110	$((350R - 172R) / 450R) * (VSNR - VGSN) + VGSN$
PRN0 6-0 = 1010111	$((350R - 174R) / 450R) * (VSNR - VGSN) + VGSN$
PRN0 6-0 = 1011000	inhibit
PRN0 6-0 = 1011001	inhibit
PRN0 6-0 = 1011010	inhibit
PRN0 6-0 = 1011011	inhibit
PRN0 6-0 = 1011100	inhibit
PRN0 6-0 = 1011101	inhibit
PRN0 6-0 = 1011110	inhibit
PRN0 6-0 = 1011111	inhibit
PRN0 6-0 = 1100000	inhibit
PRN0 6-0 = 1100001	inhibit
PRN0 6-0 = 1100010	inhibit
PRN0 6-0 = 1100011	inhibit
PRN0 6-0 = 1100100	inhibit
PRN0 6-0 = 1100101	inhibit
PRN0 6-0 = 1100110	inhibit
PRN0 6-0 = 1100111	inhibit
PRN0 6-0 = 1101000	inhibit
PRN0 6-0 = 1101001	inhibit
PRN0 6-0 = 1101010	inhibit
PRN0 6-0 = 1101011	inhibit
PRN0 6-0 = 1101100	inhibit
PRN0 6-0 = 1101101	inhibit
PRN0 6-0 = 1101110	inhibit
PRN0 6-0 = 1101111	inhibit
PRN0 6-0 = 1110000	inhibit
PRN0 6-0 = 1110001	inhibit
PRN0 6-0 = 1110010	inhibit
PRN0 6-0 = 1110011	inhibit
PRN0 6-0 = 1110100	inhibit
PRN0 6-0 = 1110101	inhibit
PRN0 6-0 = 1110110	inhibit
PRN0 6-0 = 1110111	inhibit
PRN0 6-0 = 1111000	inhibit
PRN0 6-0 = 1111001	inhibit
PRN0 6-0 = 1111010	inhibit
PRN0 6-0 = 1111011	inhibit
PRN0 6-0 = 1111100	inhibit
PRN0 6-0 = 1111101	inhibit
PRN0 6-0 = 1111110	inhibit
PRN0 6-0 = 1111111	inhibit

Table 5.47: VinN5



Reference voltage	Macro adjustment value	VinN11 formula
VinN11	PRN1 6-0 = 0000000	$(274R / 450R) (VSNR - VGSN) + VGSN$
	PRN1 6-0 = 0000001	$((274R - 2R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN1 6-0 = 0000010	$((274R - 4R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN1 6-0 = 0000011	$((274R - 6R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN1 6-0 = 0000100	$((274R - 8R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN1 6-0 = 0000101	$((274R - 10R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN1 6-0 = 0000110	$((274R - 12R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN1 6-0 = 0000111	$((274R - 14R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN1 6-0 = 0001000	$((274R - 16R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN1 6-0 = 0001001	$((274R - 18R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN1 6-0 = 0001010	$((274R - 20R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN1 6-0 = 0001011	$((274R - 22R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN1 6-0 = 0001100	$((274R - 24R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN1 6-0 = 0001101	$((274R - 26R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN1 6-0 = 0001110	$((274R - 28R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN1 6-0 = 0001111	$((274R - 30R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN1 6-0 = 0010000	$((274R - 32R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN1 6-0 = 0010001	$((274R - 34R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN1 6-0 = 0010010	$((274R - 36R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN1 6-0 = 0010011	$((274R - 38R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN1 6-0 = 0010100	$((274R - 40R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN1 6-0 = 0010101	$((274R - 42R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN1 6-0 = 0010110	$((274R - 44R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN1 6-0 = 0010111	$((274R - 46R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN1 6-0 = 0011000	$((274R - 48R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN1 6-0 = 0011001	$((274R - 50R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN1 6-0 = 0011010	$((274R - 52R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN1 6-0 = 0011011	$((274R - 54R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN1 6-0 = 0011100	$((274R - 56R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN1 6-0 = 0011101	$((274R - 58R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN1 6-0 = 0011110	$((274R - 60R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN1 6-0 = 0011111	$((274R - 62R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN1 6-0 = 0100000	$((274R - 64R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN1 6-0 = 0100001	$((274R - 66R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN1 6-0 = 0100010	$((274R - 68R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN1 6-0 = 0100011	$((274R - 70R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN1 6-0 = 0100100	$((274R - 72R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN1 6-0 = 0100101	$((274R - 74R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN1 6-0 = 0100110	$((274R - 76R) / 450R) * (VSNR - VGSN) + VGSN$
	PRN1 6-0 = 0100111	$((274R - 78R) / 450R) * (VSNR - VGSN) + VGSN$
PRN1 6-0 = 0101000	$((274R - 80R) / 450R) * (VSNR - VGSN) + VGSN$	
PRN1 6-0 = 0101001	$((274R - 82R) / 450R) * (VSNR - VGSN) + VGSN$	
PRN1 6-0 = 0101010	$((274R - 84R) / 450R) * (VSNR - VGSN) + VGSN$	
PRN1 6-0 = 0101011	$((274R - 86R) / 450R) * (VSNR - VGSN) + VGSN$	
PRN1 6-0 = 0101100	$((274R - 88R) / 450R) * (VSNR - VGSN) + VGSN$	
PRN1 6-0 = 0101101	$((274R - 90R) / 450R) * (VSNR - VGSN) + VGSN$	
PRN1 6-0 = 0101110	$((274R - 92R) / 450R) * (VSNR - VGSN) + VGSN$	
PRN1 6-0 = 0101111	$((274R - 94R) / 450R) * (VSNR - VGSN) + VGSN$	
PRN1 6-0 = 0110000	$((274R - 96R) / 450R) * (VSNR - VGSN) + VGSN$	
PRN1 6-0 = 0110001	$((274R - 98R) / 450R) * (VSNR - VGSN) + VGSN$	
PRN1 6-0 = 0110010	$((274R - 100R) / 450R) * (VSNR - VGSN) + VGSN$	
PRN1 6-0 = 0110011	$((274R - 102R) / 450R) * (VSNR - VGSN) + VGSN$	
PRN1 6-0 = 0110100	$((274R - 104R) / 450R) * (VSNR - VGSN) + VGSN$	
PRN1 6-0 = 0110101	$((274R - 106R) / 450R) * (VSNR - VGSN) + VGSN$	
PRN1 6-0 = 0110110	$((274R - 108R) / 450R) * (VSNR - VGSN) + VGSN$	
PRN1 6-0 = 0110111	$((274R - 110R) / 450R) * (VSNR - VGSN) + VGSN$	
PRN1 6-0 = 0111000	$((274R - 112R) / 450R) * (VSNR - VGSN) + VGSN$	
PRN1 6-0 = 0111001	$((274R - 114R) / 450R) * (VSNR - VGSN) + VGSN$	
PRN1 6-0 = 0111010	$((274R - 116R) / 450R) * (VSNR - VGSN) + VGSN$	
PRN1 6-0 = 0111011	$((274R - 118R) / 450R) * (VSNR - VGSN) + VGSN$	
PRN1 6-0 = 0111100	$((274R - 120R) / 450R) * (VSNR - VGSN) + VGSN$	
PRN1 6-0 = 0111101	$((274R - 122R) / 450R) * (VSNR - VGSN) + VGSN$	
PRN1 6-0 = 0111110	$((274R - 124R) / 450R) * (VSNR - VGSN) + VGSN$	
PRN1 6-0 = 0111111	$((274R - 126R) / 450R) * (VSNR - VGSN) + VGSN$	
PRN1 6-0 = 1000000	$((274R - 128R) / 450R) * (VSNR - VGSN) + VGSN$	
PRN1 6-0 = 1000001	$((274R - 130R) / 450R) * (VSNR - VGSN) + VGSN$	
PRN1 6-0 = 1000010	$((274R - 132R) / 450R) * (VSNR - VGSN) + VGSN$	
PRN1 6-0 = 1000011	$((274R - 134R) / 450R) * (VSNR - VGSN) + VGSN$	
PRN1 6-0 = 1000100	$((274R - 136R) / 450R) * (VSNR - VGSN) + VGSN$	

PRN1 6-0 = 1000101	$((274R - 138R) / 450R) * (VSNR - VGSN) + VGSN$
PRN1 6-0 = 1000110	$((274R - 140R) / 450R) * (VSNR - VGSN) + VGSN$
PRN1 6-0 = 1000111	$((274R - 142R) / 450R) * (VSNR - VGSN) + VGSN$
PRN1 6-0 = 1001000	$((274R - 144R) / 450R) * (VSNR - VGSN) + VGSN$
PRN1 6-0 = 1001001	$((274R - 146R) / 450R) * (VSNR - VGSN) + VGSN$
PRN1 6-0 = 1001010	$((274R - 148R) / 450R) * (VSNR - VGSN) + VGSN$
PRN1 6-0 = 1001011	$((274R - 150R) / 450R) * (VSNR - VGSN) + VGSN$
PRN1 6-0 = 1001100	$((274R - 152R) / 450R) * (VSNR - VGSN) + VGSN$
PRN1 6-0 = 1001101	$((274R - 154R) / 450R) * (VSNR - VGSN) + VGSN$
PRN1 6-0 = 1001110	$((274R - 156R) / 450R) * (VSNR - VGSN) + VGSN$
PRN1 6-0 = 1001111	$((274R - 158R) / 450R) * (VSNR - VGSN) + VGSN$
PRN1 6-0 = 1010000	$((274R - 160R) / 450R) * (VSNR - VGSN) + VGSN$
PRN1 6-0 = 1010001	$((274R - 162R) / 450R) * (VSNR - VGSN) + VGSN$
PRN1 6-0 = 1010010	$((274R - 164R) / 450R) * (VSNR - VGSN) + VGSN$
PRN1 6-0 = 1010011	$((274R - 166R) / 450R) * (VSNR - VGSN) + VGSN$
PRN1 6-0 = 1010100	$((274R - 168R) / 450R) * (VSNR - VGSN) + VGSN$
PRN1 6-0 = 1010101	$((274R - 170R) / 450R) * (VSNR - VGSN) + VGSN$
PRN1 6-0 = 1010110	$((274R - 172R) / 450R) * (VSNR - VGSN) + VGSN$
PRN1 6-0 = 1010111	$((274R - 174R) / 450R) * (VSNR - VGSN) + VGSN$
PRN1 6-0 = 1011000	inhibit
PRN1 6-0 = 1011001	inhibit
PRN1 6-0 = 1011010	inhibit
PRN1 6-0 = 1011011	inhibit
PRN1 6-0 = 1011100	inhibit
PRN1 6-0 = 1011101	inhibit
PRN1 6-0 = 1011110	inhibit
PRN1 6-0 = 1011111	inhibit
PRN1 6-0 = 1100000	inhibit
PRN1 6-0 = 1100001	inhibit
PRN1 6-0 = 1100010	inhibit
PRN1 6-0 = 1100011	inhibit
PRN1 6-0 = 1100100	inhibit
PRN1 6-0 = 1100101	inhibit
PRN1 6-0 = 1100110	inhibit
PRN1 6-0 = 1100111	inhibit
PRN1 6-0 = 1101000	inhibit
PRN1 6-0 = 1101001	inhibit
PRN1 6-0 = 1101010	inhibit
PRN1 6-0 = 1101011	inhibit
PRN1 6-0 = 1101100	inhibit
PRN1 6-0 = 1101101	inhibit
PRN1 6-0 = 1101110	inhibit
PRN1 6-0 = 1101111	inhibit
PRN1 6-0 = 1110000	inhibit
PRN1 6-0 = 1110001	inhibit
PRN1 6-0 = 1110010	inhibit
PRN1 6-0 = 1110011	inhibit
PRN1 6-0 = 1110100	inhibit
PRN1 6-0 = 1110101	inhibit
PRN1 6-0 = 1110110	inhibit
PRN1 6-0 = 1110111	inhibit
PRN1 6-0 = 1111000	inhibit
PRN1 6-0 = 1111001	inhibit
PRN1 6-0 = 1111010	inhibit
PRN1 6-0 = 1111011	inhibit
PRN1 6-0 = 1111100	inhibit
PRN1 6-0 = 1111101	inhibit
PRN1 6-0 = 1111110	inhibit
PRN1 6-0 = 1111111	inhibit

Table 5.48: VinN11



Reference voltage	Macro adjustment value	VinN3 formula
VinN3	PKN0 4-0 = 00000	$(47R / 48R) * (VinN2 - VinN5) + VinN5$
	PKN0 4-0 = 00001	$((47R - 1R) / 48R) * (VinN2 - VinN5) + VinN5$
	PKN0 4-0 = 00010	$((47R - 2R) / 48R) * (VinN2 - VinN5) + VinN5$
	PKN0 4-0 = 00011	$((47R - 3R) / 48R) * (VinN2 - VinN5) + VinN5$
	PKN0 4-0 = 00100	$((47R - 4R) / 48R) * (VinN2 - VinN5) + VinN5$
	PKN0 4-0 = 00101	$((47R - 5R) / 48R) * (VinN2 - VinN5) + VinN5$
	PKN0 4-0 = 00110	$((47R - 6R) / 48R) * (VinN2 - VinN5) + VinN5$
	PKN0 4-0 = 00111	$((47R - 7R) / 48R) * (VinN2 - VinN5) + VinN5$
	PKN0 4-0 = 01000	$((47R - 8R) / 48R) * (VinN2 - VinN5) + VinN5$
	PKN0 4-0 = 01001	$((47R - 9R) / 48R) * (VinN2 - VinN5) + VinN5$
	PKN0 4-0 = 01010	$((47R - 10R) / 48R) * (VinN2 - VinN5) + VinN5$
	PKN0 4-0 = 01011	$((47R - 11R) / 48R) * (VinN2 - VinN5) + VinN5$
	PKN0 4-0 = 01100	$((47R - 12R) / 48R) * (VinN2 - VinN5) + VinN5$
	PKN0 4-0 = 01101	$((47R - 13R) / 48R) * (VinN2 - VinN5) + VinN5$
	PKN0 4-0 = 01110	$((47R - 14R) / 48R) * (VinN2 - VinN5) + VinN5$
	PKN0 4-0 = 01111	$((47R - 15R) / 48R) * (VinN2 - VinN5) + VinN5$
	PKN0 4-0 = 10000	$((47R - 16R) / 48R) * (VinN2 - VinN5) + VinN5$
	PKN0 4-0 = 10001	$((47R - 17R) / 48R) * (VinN2 - VinN5) + VinN5$
	PKN0 4-0 = 10010	$((47R - 18R) / 48R) * (VinN2 - VinN5) + VinN5$
	PKN0 4-0 = 10011	$((47R - 19R) / 48R) * (VinN2 - VinN5) + VinN5$
	PKN0 4-0 = 10100	$((47R - 20R) / 48R) * (VinN2 - VinN5) + VinN5$
	PKN0 4-0 = 10101	$((47R - 21R) / 48R) * (VinN2 - VinN5) + VinN5$
	PKN0 4-0 = 10110	$((47R - 22R) / 48R) * (VinN2 - VinN5) + VinN5$
	PKN0 4-0 = 10111	$((47R - 23R) / 48R) * (VinN2 - VinN5) + VinN5$
	PKN0 4-0 = 11000	$((47R - 24R) / 48R) * (VinN2 - VinN5) + VinN5$
	PKN0 4-0 = 11001	$((47R - 25R) / 48R) * (VinN2 - VinN5) + VinN5$
	PKN0 4-0 = 11010	$((47R - 26R) / 48R) * (VinN2 - VinN5) + VinN5$
	PKN0 4-0 = 11011	$((47R - 27R) / 48R) * (VinN2 - VinN5) + VinN5$
	PKN0 4-0 = 11100	$((47R - 28R) / 48R) * (VinN2 - VinN5) + VinN5$
	PKN0 4-0 = 11101	$((47R - 29R) / 48R) * (VinN2 - VinN5) + VinN5$
	PKN0 4-0 = 11110	$((47R - 30R) / 48R) * (VinN2 - VinN5) + VinN5$
PKN0 4-0 = 11111	$((47R - 31R) / 48R) * (VinN2 - VinN5) + VinN5$	

Table 5.49: VinN3

Reference voltage	Macro adjustment value	VinN4 formula
VinN4	PKN1 4-0 = 00000	$(32R / 48R) * (VinN2 - VinN5) + VinN5$
	PKN1 4-0 = 00001	$((32R - 1R) / 48R) * (VinN2 - VinN5) + VinN5$
	PKN1 4-0 = 00010	$((32R - 2R) / 48R) * (VinN2 - VinN5) + VinN5$
	PKN1 4-0 = 00011	$((32R - 3R) / 48R) * (VinN2 - VinN5) + VinN5$
	PKN1 4-0 = 00100	$((32R - 4R) / 48R) * (VinN2 - VinN5) + VinN5$
	PKN1 4-0 = 00101	$((32R - 5R) / 48R) * (VinN2 - VinN5) + VinN5$
	PKN1 4-0 = 00110	$((32R - 6R) / 48R) * (VinN2 - VinN5) + VinN5$
	PKN1 4-0 = 00111	$((32R - 7R) / 48R) * (VinN2 - VinN5) + VinN5$
	PKN1 4-0 = 01000	$((32R - 8R) / 48R) * (VinN2 - VinN5) + VinN5$
	PKN1 4-0 = 01001	$((32R - 9R) / 48R) * (VinN2 - VinN5) + VinN5$
	PKN1 4-0 = 01010	$((32R - 10R) / 48R) * (VinN2 - VinN5) + VinN5$
	PKN1 4-0 = 01011	$((32R - 11R) / 48R) * (VinN2 - VinN5) + VinN5$
	PKN1 4-0 = 01100	$((32R - 12R) / 48R) * (VinN2 - VinN5) + VinN5$
	PKN1 4-0 = 01101	$((32R - 13R) / 48R) * (VinN2 - VinN5) + VinN5$
	PKN1 4-0 = 01110	$((32R - 14R) / 48R) * (VinN2 - VinN5) + VinN5$
	PKN1 4-0 = 01111	$((32R - 15R) / 48R) * (VinN2 - VinN5) + VinN5$
	PKN1 4-0 = 10000	$((32R - 16R) / 48R) * (VinN2 - VinN5) + VinN5$
	PKN1 4-0 = 10001	$((32R - 17R) / 48R) * (VinN2 - VinN5) + VinN5$
	PKN1 4-0 = 10010	$((32R - 18R) / 48R) * (VinN2 - VinN5) + VinN5$
	PKN1 4-0 = 10011	$((32R - 19R) / 48R) * (VinN2 - VinN5) + VinN5$
	PKN1 4-0 = 10100	$((32R - 20R) / 48R) * (VinN2 - VinN5) + VinN5$
	PKN1 4-0 = 10101	$((32R - 21R) / 48R) * (VinN2 - VinN5) + VinN5$
	PKN1 4-0 = 10110	$((32R - 22R) / 48R) * (VinN2 - VinN5) + VinN5$
	PKN1 4-0 = 10111	$((32R - 23R) / 48R) * (VinN2 - VinN5) + VinN5$
	PKN1 4-0 = 11000	$((32R - 24R) / 48R) * (VinN2 - VinN5) + VinN5$
	PKN1 4-0 = 11001	$((32R - 25R) / 48R) * (VinN2 - VinN5) + VinN5$
	PKN1 4-0 = 11010	$((32R - 26R) / 48R) * (VinN2 - VinN5) + VinN5$
	PKN1 4-0 = 11011	$((32R - 27R) / 48R) * (VinN2 - VinN5) + VinN5$
PKN1 4-0 = 11100	$((32R - 28R) / 48R) * (VinN2 - VinN5) + VinN5$	
PKN1 4-0 = 11101	$((32R - 29R) / 48R) * (VinN2 - VinN5) + VinN5$	
PKN1 4-0 = 11110	$((32R - 30R) / 48R) * (VinN2 - VinN5) + VinN5$	
PKN1 4-0 = 11111	$((32R - 31R) / 48R) * (VinN2 - VinN5) + VinN5$	

Table 5.50: VinN4

Reference voltage	Macro adjustment value	VinN6 formula
VinN6	PKN2 4-0 = 00000	$(220R / 223R) * (VinN5 - VinN11) + VinN11$
	PKN2 4-0 = 00001	$((220R - 3R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN2 4-0 = 00010	$((220R - 6R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN2 4-0 = 00011	$((220R - 9R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN2 4-0 = 00100	$((220R - 12R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN2 4-0 = 00101	$((220R - 15R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN2 4-0 = 00110	$((220R - 18R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN2 4-0 = 00111	$((220R - 21R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN2 4-0 = 01000	$((220R - 24R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN2 4-0 = 01001	$((220R - 27R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN2 4-0 = 01010	$((220R - 30R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN2 4-0 = 01011	$((220R - 33R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN2 4-0 = 01100	$((220R - 36R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN2 4-0 = 01101	$((220R - 39R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN2 4-0 = 01110	$((220R - 42R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN2 4-0 = 01111	$((220R - 45R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN2 4-0 = 10000	$((220R - 48R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN2 4-0 = 10001	$((220R - 51R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN2 4-0 = 10010	$((220R - 54R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN2 4-0 = 10011	$((220R - 57R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN2 4-0 = 10100	$((220R - 60R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN2 4-0 = 10101	$((220R - 63R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN2 4-0 = 10110	$((220R - 66R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN2 4-0 = 10111	$((220R - 69R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN2 4-0 = 11000	$((220R - 72R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN2 4-0 = 11001	$((220R - 75R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN2 4-0 = 11010	$((220R - 78R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN2 4-0 = 11011	$((220R - 81R) / 223R) * (VinN5 - VinN11) + VinN11$
PKN2 4-0 = 11100	$((220R - 84R) / 223R) * (VinN5 - VinN11) + VinN11$	
PKN2 4-0 = 11101	$((220R - 87R) / 223R) * (VinN5 - VinN11) + VinN11$	
PKN2 4-0 = 11110	$((220R - 90R) / 223R) * (VinN5 - VinN11) + VinN11$	
PKN2 4-0 = 11111	$((220R - 93R) / 223R) * (VinN5 - VinN11) + VinN11$	

Table 5.51: VinN6

Reference voltage	Macro adjustment value	VinN7 formula
VinN7	PKN3 4-0 = 00000	$(193R / 223R) * (VinN5 - VinN11) + VinN11$
	PKN3 4-0 = 00001	$((193R - 3R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN3 4-0 = 00010	$((193R - 6R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN3 4-0 = 00011	$((193R - 9R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN3 4-0 = 00100	$((193R - 12R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN3 4-0 = 00101	$((193R - 15R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN3 4-0 = 00110	$((193R - 18R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN3 4-0 = 00111	$((193R - 21R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN3 4-0 = 01000	$((193R - 24R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN3 4-0 = 01001	$((193R - 27R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN3 4-0 = 01010	$((193R - 30R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN3 4-0 = 01011	$((193R - 33R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN3 4-0 = 01100	$((193R - 36R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN3 4-0 = 01101	$((193R - 39R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN3 4-0 = 01110	$((193R - 42R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN3 4-0 = 01111	$((193R - 45R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN3 4-0 = 10000	$((193R - 48R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN3 4-0 = 10001	$((193R - 51R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN3 4-0 = 10010	$((193R - 54R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN3 4-0 = 10011	$((193R - 57R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN3 4-0 = 10100	$((193R - 60R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN3 4-0 = 10101	$((193R - 63R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN3 4-0 = 10110	$((193R - 66R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN3 4-0 = 10111	$((193R - 69R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN3 4-0 = 11000	$((193R - 72R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN3 4-0 = 11001	$((193R - 75R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN3 4-0 = 11010	$((193R - 78R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN3 4-0 = 11011	$((193R - 81R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN3 4-0 = 11100	$((193R - 84R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN3 4-0 = 11101	$((193R - 87R) / 223R) * (VinN5 - VinN11) + VinN11$
PKN3 4-0 = 11110	$((193R - 90R) / 223R) * (VinN5 - VinN11) + VinN11$	
PKN3 4-0 = 11111	$((193R - 93R) / 223R) * (VinN5 - VinN11) + VinN11$	

Table 5.52: VinN7

Reference voltage	Macro adjustment value	VinN8 formula
VinN8	PKN4 4-0 = 00000	$(158R / 223R) * (VinN5 - VinN11) + VinN11$
	PKN4 4-0 = 00001	$((158R - 3R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN4 4-0 = 00010	$((158R - 6R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN4 4-0 = 00011	$((158R - 9R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN4 4-0 = 00100	$((158R - 12R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN4 4-0 = 00101	$((158R - 15R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN4 4-0 = 00110	$((158R - 18R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN4 4-0 = 00111	$((158R - 21R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN4 4-0 = 01000	$((158R - 24R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN4 4-0 = 01001	$((158R - 27R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN4 4-0 = 01010	$((158R - 30R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN4 4-0 = 01011	$((158R - 33R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN4 4-0 = 01100	$((158R - 36R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN4 4-0 = 01101	$((158R - 39R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN4 4-0 = 01110	$((158R - 42R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN4 4-0 = 01111	$((158R - 45R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN4 4-0 = 10000	$((158R - 48R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN4 4-0 = 10001	$((158R - 51R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN4 4-0 = 10010	$((158R - 54R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN4 4-0 = 10011	$((158R - 57R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN4 4-0 = 10100	$((158R - 60R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN4 4-0 = 10101	$((158R - 63R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN4 4-0 = 10110	$((158R - 66R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN4 4-0 = 10111	$((158R - 69R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN4 4-0 = 11000	$((158R - 72R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN4 4-0 = 11001	$((158R - 75R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN4 4-0 = 11010	$((158R - 78R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN4 4-0 = 11011	$((158R - 81R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN4 4-0 = 11100	$((158R - 84R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN4 4-0 = 11101	$((158R - 87R) / 223R) * (VinN5 - VinN11) + VinN11$
PKN4 4-0 = 11110	$((158R - 90R) / 223R) * (VinN5 - VinN11) + VinN11$	
PKN4 4-0 = 11111	$((158R - 93R) / 223R) * (VinN5 - VinN11) + VinN11$	

Table 5.53: VinN8

Reference voltage	Macro adjustment value	VinN9 formula
VinN9	PKN5 4-0 = 00000	$(123R / 223R) * (VinN5 - VinN11) + VinN11$
	PKN5 4-0 = 00001	$((123R - 3R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN5 4-0 = 00010	$((123R - 6R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN5 4-0 = 00011	$((123R - 9R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN5 4-0 = 00100	$((123R - 12R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN5 4-0 = 00101	$((123R - 15R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN5 4-0 = 00110	$((123R - 18R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN5 4-0 = 00111	$((123R - 21R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN5 4-0 = 01000	$((123R - 24R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN5 4-0 = 01001	$((123R - 27R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN5 4-0 = 01010	$((123R - 30R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN5 4-0 = 01011	$((123R - 33R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN5 4-0 = 01100	$((123R - 36R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN5 4-0 = 01101	$((123R - 39R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN5 4-0 = 01110	$((123R - 42R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN5 4-0 = 01111	$((123R - 45R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN5 4-0 = 10000	$((123R - 48R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN5 4-0 = 10001	$((123R - 51R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN5 4-0 = 10010	$((123R - 54R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN5 4-0 = 10011	$((123R - 57R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN5 4-0 = 10100	$((123R - 60R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN5 4-0 = 10101	$((123R - 63R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN5 4-0 = 10110	$((123R - 66R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN5 4-0 = 10111	$((123R - 69R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN5 4-0 = 11000	$((123R - 72R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN5 4-0 = 11001	$((123R - 75R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN5 4-0 = 11010	$((123R - 78R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN5 4-0 = 11011	$((123R - 81R) / 223R) * (VinN5 - VinN11) + VinN11$
PKN5 4-0 = 11100	$((123R - 84R) / 223R) * (VinN5 - VinN11) + VinN11$	
PKN5 4-0 = 11101	$((123R - 87R) / 223R) * (VinN5 - VinN11) + VinN11$	
PKN5 4-0 = 11110	$((123R - 90R) / 223R) * (VinN5 - VinN11) + VinN11$	
PKN5 4-0 = 11111	$((123R - 93R) / 223R) * (VinN5 - VinN11) + VinN11$	

Table 5.54: VinN9

Reference voltage	Macro adjustment value	VinN10 formula
VinN10	PKN6 4-0 = 00000	$(96R / 223R) * (VinN5 - VinN11) + VinN11$
	PKN6 4-0 = 00001	$((96R - 3R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN6 4-0 = 00010	$((96R - 6R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN6 4-0 = 00011	$((96R - 9R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN6 4-0 = 00100	$((96R - 12R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN6 4-0 = 00101	$((96R - 15R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN6 4-0 = 00110	$((96R - 18R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN6 4-0 = 00111	$((96R - 21R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN6 4-0 = 01000	$((96R - 24R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN6 4-0 = 01001	$((96R - 27R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN6 4-0 = 01010	$((96R - 30R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN6 4-0 = 01011	$((96R - 33R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN6 4-0 = 01100	$((96R - 36R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN6 4-0 = 01101	$((96R - 39R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN6 4-0 = 01110	$((96R - 42R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN6 4-0 = 01111	$((96R - 45R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN6 4-0 = 10000	$((96R - 48R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN6 4-0 = 10001	$((96R - 51R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN6 4-0 = 10010	$((96R - 54R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN6 4-0 = 10011	$((96R - 57R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN6 4-0 = 10100	$((96R - 60R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN6 4-0 = 10101	$((96R - 63R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN6 4-0 = 10110	$((96R - 66R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN6 4-0 = 10111	$((96R - 69R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN6 4-0 = 11000	$((96R - 72R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN6 4-0 = 11001	$((96R - 75R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN6 4-0 = 11010	$((96R - 78R) / 223R) * (VinN5 - VinN11) + VinN11$
	PKN6 4-0 = 11011	$((96R - 81R) / 223R) * (VinN5 - VinN11) + VinN11$
PKN6 4-0 = 11100	$((96R - 84R) / 223R) * (VinN5 - VinN11) + VinN11$	
PKN6 4-0 = 11101	$((96R - 87R) / 223R) * (VinN5 - VinN11) + VinN11$	
PKN6 4-0 = 11110	$((96R - 90R) / 223R) * (VinN5 - VinN11) + VinN11$	
PKN6 4-0 = 11111	$((96R - 93R) / 223R) * (VinN5 - VinN11) + VinN11$	

Table 5.55: VinN10



Reference voltage	Macro adjustment value	VinN12 formula
VinN12	PKN7 4-0 = 00000	$(47R / 48R) * (VinN11 - VinN14) + VinN14$
	PKN7 4-0 = 00001	$((47R - 1R) / 48R) * (VinN11 - VinN14) + VinN14$
	PKN7 4-0 = 00010	$((47R - 2R) / 48R) * (VinN11 - VinN14) + VinN14$
	PKN7 4-0 = 00011	$((47R - 3R) / 48R) * (VinN11 - VinN14) + VinN14$
	PKN7 4-0 = 00100	$((47R - 4R) / 48R) * (VinN11 - VinN14) + VinN14$
	PKN7 4-0 = 00101	$((47R - 5R) / 48R) * (VinN11 - VinN14) + VinN14$
	PKN7 4-0 = 00110	$((47R - 6R) / 48R) * (VinN11 - VinN14) + VinN14$
	PKN7 4-0 = 00111	$((47R - 7R) / 48R) * (VinN11 - VinN14) + VinN14$
	PKN7 4-0 = 01000	$((47R - 8R) / 48R) * (VinN11 - VinN14) + VinN14$
	PKN7 4-0 = 01001	$((47R - 9R) / 48R) * (VinN11 - VinN14) + VinN14$
	PKN7 4-0 = 01010	$((47R - 10R) / 48R) * (VinN11 - VinN14) + VinN14$
	PKN7 4-0 = 01011	$((47R - 11R) / 48R) * (VinN11 - VinN14) + VinN14$
	PKN7 4-0 = 01100	$((47R - 12R) / 48R) * (VinN11 - VinN14) + VinN14$
	PKN7 4-0 = 01101	$((47R - 13R) / 48R) * (VinN11 - VinN14) + VinN14$
	PKN7 4-0 = 01110	$((47R - 14R) / 48R) * (VinN11 - VinN14) + VinN14$
	PKN7 4-0 = 01111	$((47R - 15R) / 48R) * (VinN11 - VinN14) + VinN14$
	PKN7 4-0 = 10000	$((47R - 16R) / 48R) * (VinN11 - VinN14) + VinN14$
	PKN7 4-0 = 10001	$((47R - 17R) / 48R) * (VinN11 - VinN14) + VinN14$
	PKN7 4-0 = 10010	$((47R - 18R) / 48R) * (VinN11 - VinN14) + VinN14$
	PKN7 4-0 = 10011	$((47R - 19R) / 48R) * (VinN11 - VinN14) + VinN14$
	PKN7 4-0 = 10100	$((47R - 20R) / 48R) * (VinN11 - VinN14) + VinN14$
	PKN7 4-0 = 10101	$((47R - 21R) / 48R) * (VinN11 - VinN14) + VinN14$
	PKN7 4-0 = 10110	$((47R - 22R) / 48R) * (VinN11 - VinN14) + VinN14$
	PKN7 4-0 = 10111	$((47R - 23R) / 48R) * (VinN11 - VinN14) + VinN14$
	PKN7 4-0 = 11000	$((47R - 24R) / 48R) * (VinN11 - VinN14) + VinN14$
	PKN7 4-0 = 11001	$((47R - 25R) / 48R) * (VinN11 - VinN14) + VinN14$
	PKN7 4-0 = 11010	$((47R - 26R) / 48R) * (VinN11 - VinN14) + VinN14$
	PKN7 4-0 = 11011	$((47R - 27R) / 48R) * (VinN11 - VinN14) + VinN14$
	PKN7 4-0 = 11100	$((47R - 28R) / 48R) * (VinN11 - VinN14) + VinN14$
	PKN7 4-0 = 11101	$((47R - 29R) / 48R) * (VinN11 - VinN14) + VinN14$
	PKN7 4-0 = 11110	$((47R - 30R) / 48R) * (VinN11 - VinN14) + VinN14$
	PKN7 4-0 = 11111	$((47R - 31R) / 48R) * (VinN11 - VinN14) + VinN14$

Table 5.56: VinN12

Reference voltage	Macro adjustment value	VinN13 formula
VinN13	PKN8 4-0 = 00000	$(32R / 48R) * (VinN11 - VinN14) + VinN14$
	PKN8 4-0 = 00001	$((32R - 1R) / 48R) * (VinN11 - VinN14) + VinN14$
	PKN8 4-0 = 00010	$((32R - 2R) / 48R) * (VinN11 - VinN14) + VinN14$
	PKN8 4-0 = 00011	$((32R - 3R) / 48R) * (VinN11 - VinN14) + VinN14$
	PKN8 4-0 = 00100	$((32R - 4R) / 48R) * (VinN11 - VinN14) + VinN14$
	PKN8 4-0 = 00101	$((32R - 5R) / 48R) * (VinN11 - VinN14) + VinN14$
	PKN8 4-0 = 00110	$((32R - 6R) / 48R) * (VinN11 - VinN14) + VinN14$
	PKN8 4-0 = 00111	$((32R - 7R) / 48R) * (VinN11 - VinN14) + VinN14$
	PKN8 4-0 = 01000	$((32R - 8R) / 48R) * (VinN11 - VinN14) + VinN14$
	PKN8 4-0 = 01001	$((32R - 9R) / 48R) * (VinN11 - VinN14) + VinN14$
	PKN8 4-0 = 01010	$((32R - 10R) / 48R) * (VinN11 - VinN14) + VinN14$
	PKN8 4-0 = 01011	$((32R - 11R) / 48R) * (VinN11 - VinN14) + VinN14$
	PKN8 4-0 = 01100	$((32R - 12R) / 48R) * (VinN11 - VinN14) + VinN14$
	PKN8 4-0 = 01101	$((32R - 13R) / 48R) * (VinN11 - VinN14) + VinN14$
	PKN8 4-0 = 01110	$((32R - 14R) / 48R) * (VinN11 - VinN14) + VinN14$
	PKN8 4-0 = 01111	$((32R - 15R) / 48R) * (VinN11 - VinN14) + VinN14$
	PKN8 4-0 = 10000	$((32R - 16R) / 48R) * (VinN11 - VinN14) + VinN14$
	PKN8 4-0 = 10001	$((32R - 17R) / 48R) * (VinN11 - VinN14) + VinN14$
	PKN8 4-0 = 10010	$((32R - 18R) / 48R) * (VinN11 - VinN14) + VinN14$
	PKN8 4-0 = 10011	$((32R - 19R) / 48R) * (VinN11 - VinN14) + VinN14$
	PKN8 4-0 = 10100	$((32R - 20R) / 48R) * (VinN11 - VinN14) + VinN14$
	PKN8 4-0 = 10101	$((32R - 21R) / 48R) * (VinN11 - VinN14) + VinN14$
	PKN8 4-0 = 10110	$((32R - 22R) / 48R) * (VinN11 - VinN14) + VinN14$
	PKN8 4-0 = 10111	$((32R - 23R) / 48R) * (VinN11 - VinN14) + VinN14$
	PKN8 4-0 = 11000	$((32R - 24R) / 48R) * (VinN11 - VinN14) + VinN14$
	PKN8 4-0 = 11001	$((32R - 25R) / 48R) * (VinN11 - VinN14) + VinN14$
	PKN8 4-0 = 11010	$((32R - 26R) / 48R) * (VinN11 - VinN14) + VinN14$
	PKN8 4-0 = 11011	$((32R - 27R) / 48R) * (VinN11 - VinN14) + VinN14$
	PKN8 4-0 = 11100	$((32R - 28R) / 48R) * (VinN11 - VinN14) + VinN14$
	PKN8 4-0 = 11101	$((32R - 29R) / 48R) * (VinN11 - VinN14) + VinN14$
	PKN8 4-0 = 11110	$((32R - 30R) / 48R) * (VinN11 - VinN14) + VinN14$
	PKN8 4-0 = 11111	$((32R - 31R) / 48R) * (VinN11 - VinN14) + VinN14$

Table 5.57: VinN13

Grayscale voltage	Formula	Grayscale voltage	Formula
V0	VinP0	V16	CGMP4=0 =VinP5 - (VinP5 - VinP6)*(3R/6R) CGMP4=1 =VinP5 - (VinP5 - VinP6)*(3.5R/6.5R)
V1	VinP1	V17	CGMP4=0 =VinP5 - (VinP5 - VinP6)*(4R/6R) CGMP4=1 =VinP5 - (VinP5 - VinP6)*(4.5R/6.5R)
V2	VinP2	V18	CGMP4=0 =VinP5 - (VinP5 - VinP6)*(5R/6R) CGMP4=1 =VinP5 - (VinP5 - VinP6)*(5.5R/6.5R)
V3	VinP3	V19	VinP6
V4	CGMP0=0 = VinP3 - (VinP3 - VinP4)*(1R/4R)	V20	VinP6 - (VinP6 - VinP7)*(1R/6R)
	CGMP0=1 = VinP3 - (VinP3 - VinP4)*(3R/9.5R)	V21	VinP6 - (VinP6 - VinP7)*(2R/6R)
	CGMP0=2 = VinP3 - (VinP3 - VinP4)*(3.5R/9.3R)	V22	VinP6 - (VinP6 - VinP7)*(3R/6R)
	CGMP0=3 = VinP3 - (VinP3 - VinP4)*(3.5R/10R)	V23	VinP6 - (VinP6 - VinP7)*(4R/6R)
V5	CGMP0=0 = VinP3 - (VinP3 - VinP4)*(2R/4R)	V24	VinP6 - (VinP6 - VinP7)*(5R/6R)
	CGMP0=1 = VinP3 - (VinP3 - VinP4)*(5.5R/9.5R)	V25	VinP7
	CGMP0=2 = VinP3 - (VinP3 - VinP4)*(6R/9.3R)	V26	VinP7 - (VinP7 - VinP8)*(1R/7.5R)
	CGMP0=3 = VinP3 - (VinP3 - VinP4)*(6R/10R)	V27	VinP7 - (VinP7 - VinP8)*(2R/7.5R)
V6	CGMP0=0 = VinP3 - (VinP3 - VinP4)*(3R/4R)	V28	VinP7 - (VinP7 - VinP8)*(3R/7.5R)
	CGMP0=1 = VinP3 - (VinP3 - VinP4)*(7.5R/9.5R)	V29	VinP7 - (VinP7 - VinP8)*(4R/7.5R)
	CGMP0=2 = VinP3 - (VinP3 - VinP4)*(7.8R/9.3R)	V30	VinP7 - (VinP7 - VinP8)*(5R/7.5R)
	CGMP0=3 = VinP3 - (VinP3 - VinP4)*(8R/10R)	V31	VinP7 - (VinP7 - VinP8)*(6R/7.5R)
V7	VinP4	V32	VinP8
V8	CGMP2=0 = VinP4 - (VinP4 - VinP5)*(1R/6R)	V33	VinP8 - (VinP8 - VinP9)*(1R/6R)
	CGMP2=1 = VinP4 - (VinP4 - VinP5)*(3R/16R)	V34	VinP8 - (VinP8 - VinP9)*(2R/6R)
	CGMP2=2 = VinP4 - (VinP4 - VinP5)*(4R/18R)	V35	VinP8 - (VinP8 - VinP9)*(3R/6R)
	CGMP2=3 = VinP4 - (VinP4 - VinP5)*(4.5R/19.5R)	V36	VinP8 - (VinP8 - VinP9)*(4R/6R)
V9	CGMP2=0 = VinP4 - (VinP4 - VinP5)*(2R/6R)	V37	VinP8 - (VinP8 - VinP9)*(5R/6R)
	CGMP2=1 = VinP4 - (VinP4 - VinP5)*(6R/16R)	V38	VinP9
	CGMP2=2 = VinP4 - (VinP4 - VinP5)*(7R/18R)	V39	VinP9 - (VinP9 - VinP10)*(1R/6R)
	CGMP2=3 = VinP4 - (VinP4 - VinP5)*(8.5R/19.5R)	V40	VinP9 - (VinP9 - VinP10)*(2R/6R)
V10	CGMP2=0 = VinP4 - (VinP4 - VinP5)*(3R/6R)	V41	VinP9 - (VinP9 - VinP10)*(3R/6R)
	CGMP2=1 = VinP4 - (VinP4 - VinP5)*(8.5R/16R)	V42	VinP9 - (VinP9 - VinP10)*(4R/6R)
	CGMP2=2 = VinP4 - (VinP4 - VinP5)*(10R/18R)	V43	VinP9 - (VinP9 - VinP10)*(5R/6R)
	CGMP2=3 = VinP4 - (VinP4 - VinP5)*(11.5R/19.5R)	V44	VinP10
V11	CGMP2=0 = VinP4 - (VinP4 - VinP5)*(4R/6R)	V45	CGMP5=0 =VinP10 - (VinP10 - VinP11)*(1R/6R) CGMP5=1 =VinP10 - (VinP10 - VinP11)*(1R/6.5R)
	CGMP2=1 = VinP4 - (VinP4 - VinP5)*(11R/16R)	V46	CGMP5=0 =VinP10 - (VinP10 - VinP11)*(2R/6R) CGMP5=1 =VinP10 - (VinP10 - VinP11)*(2R/6.5R)
	CGMP2=2 = VinP4 - (VinP4 - VinP5)*(13R/18R)	V47	CGMP5=0 =VinP10 - (VinP10 - VinP11)*(3R/6R) CGMP5=1 =VinP10 - (VinP10 - VinP11)*(3R/6.5R)
	CGMP2=3 = VinP4 - (VinP4 - VinP5)*(14.5R/19.5R)	V48	CGMP5=0 =VinP10 - (VinP10 - VinP11)*(4R/6R) CGMP5=1 =VinP10 - (VinP10 - VinP11)*(4R/6.5R)
V12	CGMP2=0 = VinP4 - (VinP4 - VinP5)*(5R/6R)	V49	CGMP5=0 =VinP10 - (VinP10 - VinP11)*(5R/6R) CGMP5=1 =VinP10 - (VinP10 - VinP11)*(5R/6.5R)
	CGMP2=1 = VinP4 - (VinP4 - VinP5)*(13.5R/16R)		
	CGMP2=2 = VinP4 - (VinP4 - VinP5)*(15.5R/18R)		
	CGMP2=3 = VinP4 - (VinP4 - VinP5)*(17R/19.5R)		
V13	VinP5		
V14	CGMP4=0 =VinP5 - (VinP5 - VinP6)*(1R/6R)		
	CGMP4=1 =VinP5 - (VinP5 - VinP6)*(1.5R/6.5R)		
V15	CGMP4=0 =VinP5 - (VinP5 - VinP6)*(2R/6R)		
	CGMP4=1 =VinP5 - (VinP5 - VinP6)*(2.5R/6.5R)		



Grayscale voltage	Formula	Grayscale voltage	Formula
V50	VinP11	V56	VinP12
V51	CGMP3=0 = VinP11 - (VinP11 - VinP12)*(1R/6R)	V57	CGMP1=0 = VinP12 - (VinP12 - VinP13)*(1R/4R)
	CGMP3=1 = VinP11 - (VinP11 - VinP12)*(2.5R/16R)		CGMP1=1 = VinP12 - (VinP12 - VinP13)*(2R/9.5R)
	CGMP3=2 = VinP11 - (VinP11 - VinP12)*(2.5R/18R)		CGMP1=2 = VinP12 - (VinP12 - VinP13)*(1.5R/9.3R)
	CGMP3=3 = VinP11 - (VinP11 - VinP12)*(2.5R/19.5R)		CGMP1=3 = VinP12 - (VinP12 - VinP13)*(2R/10R)
V52	CGMP3=0 = VinP11 - (VinP11 - VinP12)*(2R/6R)	V58	CGMP1=0 = VinP12 - (VinP12 - VinP13)*(2R/4R)
	CGMP3=1 = VinP11 - (VinP11 - VinP12)*(5R/16R)		CGMP1=1 = VinP12 - (VinP12 - VinP13)*(4R/9.5R)
	CGMP3=2 = VinP11 - (VinP11 - VinP12)*(5R/18R)		CGMP1=2 = VinP12 - (VinP12 - VinP13)*(3.3R/9.3R)
	CGMP3=3 = VinP11 - (VinP11 - VinP12)*(5R/19.5R)		CGMP1=3 = VinP12 - (VinP12 - VinP13)*(4R/10R)
V53	CGMP3=0 = VinP11 - (VinP11 - VinP12)*(3R/6R)	V59	CGMP1=0 = VinP12 - (VinP12 - VinP13)*(3R/4R)
	CGMP3=1 = VinP11 - (VinP11 - VinP12)*(7.5R/16R)		CGMP1=1 = VinP12 - (VinP12 - VinP13)*(6.5R/9.5R)
	CGMP3=2 = VinP11 - (VinP11 - VinP12)*(8R/18R)		CGMP1=2 = VinP12 - (VinP12 - VinP13)*(5.8R/9.3R)
	CGMP3=3 = VinP11 - (VinP11 - VinP12)*(8R/19.5R)		CGMP1=3 = VinP12 - (VinP12 - VinP13)*(6.5R/10R)
V54	CGMP3=0 = VinP11 - (VinP11 - VinP12)*(4R/6R)	V60	VinP13
	CGMP3=1 = VinP11 - (VinP11 - VinP12)*(10R/16R)	V61	VinP14
	CGMP3=2 = VinP11 - (VinP11 - VinP12)*(11R/18R)	V62	VinP15
	CGMP3=3 = VinP11 - (VinP11 - VinP12)*(11R/19.5R)	V63	VinP16
V55	CGMP3=0 = VinP11 - (VinP11 - VinP12)*(5R/6R)		
	CGMP3=1 = VinP11 - (VinP11 - VinP12)*(13R/16R)		
	CGMP3=2 = VinP11 - (VinP11 - VinP12)*(14R/18R)		
	CGMP3=3 = VinP11 - (VinP11 - VinP12)*(15R/19.5R)		

Table 5.58: Voltage calculation formula of 64-grayscale voltage (positive polarity)

Grayscale voltage	Formula	Grayscale voltage	Formula
V0	VinN0	V16	CGMN4=0 =VinN5 - (VinN5 - VinN6)*(3R/6R)
V1	VinN1		CGMN4=1 =VinN5 - (VinN5 - VinN6)*(3.5R/6.5R)
V2	VinN2	V17	CGMN4=0 =VinN5 - (VinN5 - VinN6)*(4R/6R)
V3	VinN3		CGMN4=1 =VinN5 - (VinN5 - VinN6)*(4.5R/6.5R)
V4	CGMN0=0 = VinN3 - (VinN3 - VinN4)*(1R/4R)	V18	CGMN4=0 =VinN5 - (VinN5 - VinN6)*(5R/6R)
	CGMN0=1 = VinN3 - (VinN3 - VinN4)*(3R/9.5R)		CGMN4=1 =VinN5 - (VinN5 - VinN6)*(5.5R/6.5R)
	CGMN0=2 = VinN3 - (VinN3 - VinN4)*(3.5R/9.3R)	V19	VinN6
	CGMN0=3 = VinN3 - (VinN3 - VinN4)*(3.5R/10R)	V20	VinN6 - (VinN6 - VinN7)*(1R/6R)
V5	CGMN0=0 = VinN3 - (VinN3 - VinN4)*(2R/4R)	V21	VinN6 - (VinN6 - VinN7)*(2R/6R)
	CGMN0=1 = VinN3 - (VinN3 - VinN4)*(5.5R/9.5R)	V22	VinN6 - (VinN6 - VinN7)*(3R/6R)
	CGMN0=2 = VinN3 - (VinN3 - VinN4)*(6R/9.3R)	V23	VinN6 - (VinN6 - VinN7)*(4R/6R)
	CGMN0=3 = VinN3 - (VinN3 - VinN4)*(6R/10R)	V24	VinN6 - (VinN6 - VinN7)*(5R/6R)
V6	CGMN0=0 = VinN3 - (VinN3 - VinN4)*(3R/4R)	V25	VinP7
	CGMN0=1 = VinN3 - (VinN3 - VinN4)*(7.5R/9.5R)	V26	VinP7 - (VinP7 - VinP8)*(1R/7.5R)
	CGMN0=2 = VinN3 - (VinN3 - VinN4)*(7.8R/9.3R)	V27	VinP7 - (VinP7 - VinP8)*(2R/7.5R)
	CGMN0=3 = VinN3 - (VinN3 - VinN4)*(8R/10R)	V28	VinP7 - (VinP7 - VinP8)*(3R/7.5R)
V7	VinN4	V29	VinP7 - (VinP7 - VinP8)*(4R/7.5R)
V8	CGMN2=0 = VinN4 - (VinN4 - VinN5)*(1R/6R)	V30	VinP7 - (VinP7 - VinP8)*(5R/7.5R)
	CGMN2=1 = VinN4 - (VinN4 - VinN5)*(3R/16R)	V31	VinP7 - (VinP7 - VinP8)*(6R/7.5R)
	CGMN2=2 = VinN4 - (VinN4 - VinN5)*(4R/18R)	V32	VinP8
	CGMN2=3 = VinN4 - (VinN4 - VinN5)*(4.5R/19.5R)	V33	VinP8 - (VinP8 - VinP9)*(1R/6R)
V9	CGMN2=0 = VinN4 - (VinN4 - VinN5)*(2R/6R)	V34	VinP8 - (VinP8 - VinP9)*(2R/6R)
	CGMN2=1 = VinN4 - (VinN4 - VinN5)*(6R/16R)	V35	VinP8 - (VinP8 - VinP9)*(3R/6R)
	CGMN2=2 = VinN4 - (VinN4 - VinN5)*(7R/18R)	V36	VinP8 - (VinP8 - VinP9)*(4R/6R)
	CGMN2=3 = VinN4 - (VinN4 - VinN5)*(8.5R/19.5R)	V37	VinP8 - (VinP8 - VinP9)*(5R/6R)
V10	CGMN2=0 = VinN4 - (VinN4 - VinN5)*(3R/6R)	V38	VinN9
	CGMN2=1 = VinN4 - (VinN4 - VinN5)*(8.5R/16R)	V39	VinN9 - (VinN9 - VinN10)*(1R/6R)
	CGMN2=2 = VinN4 - (VinN4 - VinN5)*(10R/18R)	V40	VinN9 - (VinN9 - VinN10)*(2R/6R)
	CGMN2=3 = VinN4 - (VinN4 - VinN5)*(11.5R/19.5R)	V41	VinN9 - (VinN9 - VinN10)*(3R/6R)
V11	CGMN2=0 = VinN4 - (VinN4 - VinN5)*(4R/6R)	V42	VinN9 - (VinN9 - VinN10)*(4R/6R)
	CGMN2=1 = VinN4 - (VinN4 - VinN5)*(11R/16R)	V43	VinN9 - (VinN9 - VinN10)*(5R/6R)
	CGMN2=2 = VinN4 - (VinN4 - VinN5)*(13R/18R)	V44	VinN10
	CGMN2=3 = VinN4 - (VinN4 - VinN5)*(14.5R/19.5R)	V45	CGMN5=0 =VinN10 - (VinN10 - VinN11)*(1R/6R)
CGMN2=0 = VinN4 - (VinN4 - VinN5)*(5R/6R)	CGMN5=1 =VinN10 - (VinN10 - VinN11)*(1R/6.5R)		
V12	CGMN2=1 = VinN4 - (VinN4 - VinN5)*(13.5R/16R)	V46	CGMN5=0 =VinN10 - (VinN10 - VinN11)*(2R/6R)
	CGMN2=2 = VinN4 - (VinN4 - VinN5)*(15.5R/18R)		CGMN5=1 =VinN10 - (VinN10 - VinN11)*(2R/6.5R)
	CGMN2=3 = VinN4 - (VinN4 - VinN5)*(17R/19.5R)	V47	CGMN5=0 =VinN10 - (VinN10 - VinN11)*(3R/6R)
	V13		VinN5
V14	CGMN4=0 =VinN5 - (VinN5 - VinN6)*(1R/6R)	V48	CGMN5=0 =VinN10 - (VinN10 - VinN11)*(4R/6R)
	CGMN4=1 =VinN5 - (VinN5 - VinN6)*(1.5R/6.5R)		CGMN5=1 =VinN10 - (VinN10 - VinN11)*(4R/6.5R)
V15	CGMN4=0 =VinN5 - (VinN5 - VinN6)*(2R/6R)	V49	CGMN5=0 =VinN10 - (VinN10 - VinN11)*(5R/6R)
	CGMN4=1 =VinN5 - (VinN5 - VinN6)*(2.5R/6.5R)		CGMN5=1 =VinN10 - (VinN10 - VinN11)*(5R/6.5R)

Grayscale voltage	Formula	Grayscale voltage	Formula
V50	VinN11	V56	VinN12
V51	CGMN3=0 = VinN11 - (VinN11 - VinN12)*(1R/6R)	V57	CGMN1=0 = VinN12 - (VinN12 - VinN13)*(1R/4R)
	CGMN3=1 = VinN11 - (VinN11 - VinN12)*(2.5R/16R)		CGMN1=1 = VinN12 - (VinN12 - VinN13)*(2R/9.5R)
	CGMN3=2 = VinN11 - (VinN11 - VinN12)*(2.5R/18R)		CGMN1=2 = VinN12 - (VinN12 - VinN13)*(1.5R/9.3R)
	CGMN3=3 = VinN11 - (VinN11 - VinN12)*(2.5R/19.5R)		CGMN1=3 = VinN12 - (VinN12 - VinN13)*(2R/10R)
V52	CGMN3=0 = VinN11 - (VinN11 - VinN12)*(2R/6R)	V58	CGMN1=0 = VinN12 - (VinN12 - VinN13)*(2R/4R)
	CGMN3=1 = VinN11 - (VinN11 - VinN12)*(5R/16R)		CGMN1=1 = VinN12 - (VinN12 - VinN13)*(4R/9.5R)
	CGMN3=2 = VinN11 - (VinN11 - VinN12)*(5R/18R)		CGMN1=2 = VinN12 - (VinN12 - VinN13)*(3.3R/9.3R)
	CGMN3=3 = VinN11 - (VinN11 - VinN12)*(5R/19.5R)		CGMN1=3 = VinN12 - (VinN12 - VinN13)*(4R/10R)
V53	CGMN3=0 = VinN11 - (VinN11 - VinN12)*(3R/6R)	V59	CGMN1=0 = VinN12 - (VinN12 - VinN13)*(3R/4R)
	CGMN3=1 = VinN11 - (VinN11 - VinN12)*(7.5R/16R)		CGMN1=1 = VinN12 - (VinN12 - VinN13)*(6.5R/9.5R)
	CGMN3=2 = VinN11 - (VinN11 - VinN12)*(8R/18R)		CGMN1=2 = VinN12 - (VinN12 - VinN13)*(5.8R/9.3R)
	CGMN3=3 = VinN11 - (VinN11 - VinN12)*(8R/19.5R)		CGMN1=3 = VinN12 - (VinN12 - VinN13)*(6.5R/10R)
V54	CGMN3=0 = VinN11 - (VinN11 - VinN12)*(4R/6R)	V60	VinN13
	CGMN3=1 = VinN11 - (VinN11 - VinN12)*(10R/16R)	V61	VinN14
	CGMN3=2 = VinN11 - (VinN11 - VinN12)*(11R/18R)	V62	VinN15
	CGMN3=3 = VinN11 - (VinN11 - VinN12)*(11R/19.5R)	V63	VinN16
V55	CGMN3=0 = VinN11 - (VinN11 - VinN12)*(5R/6R)		
	CGMN3=1 = VinN11 - (VinN11 - VinN12)*(13R/16R)		
	CGMN3=2 = VinN11 - (VinN11 - VinN12)*(14R/18R)		
	CGMN3=3 = VinN11 - (VinN11 - VinN12)*(15R/19.5R)		

**Table 5.59: Voltage calculation formula of 64-grayscale voltage (negative polarity)**

Grayscale voltage	Formula
VV0	V0
VV1	$V0 - (V0 - V1) \cdot (4R/16R)$
VV2	$V0 - (V0 - V1) \cdot (8R/16R)$
VV3	$V0 - (V0 - V1) \cdot (12R/16R)$
VV4	V1
VV5	$V1 - (V1 - V2) \cdot (4R/16R)$
VV6	$V1 - (V1 - V2) \cdot (8R/16R)$
VV7	$V1 - (V1 - V2) \cdot (12R/16R)$
VV8	V2
VV9	$V2 - (V2 - V3) \cdot (4R/16R)$
VV10	$V2 - (V2 - V3) \cdot (8R/16R)$
VV11	$V2 - (V2 - V3) \cdot (12R/16R)$
VV12	V3
VV13	$V3 - (V3 - V4) \cdot (2R/8R)$
VV14	$V3 - (V3 - V4) \cdot (4R/8R)$
VV15	$V3 - (V3 - V4) \cdot (6R/8R)$
VV16	V4
VV17	$V4 - (V4 - V5) \cdot (2R/8R)$
VV18	$V4 - (V4 - V5) \cdot (4R/8R)$
VV19	$V4 - (V4 - V5) \cdot (6R/8R)$
VV20	V5
VV21	$V5 - (V5 - V6) \cdot (2R/8R)$
VV22	$V5 - (V5 - V6) \cdot (4R/8R)$
VV23	$V5 - (V5 - V6) \cdot (6R/8R)$
VV24	V6
VV25	$V6 - (V6 - V7) \cdot (2R/8R)$
VV26	$V6 - (V6 - V7) \cdot (4R/8R)$
VV27	$V6 - (V6 - V7) \cdot (6R/8R)$
VV28	V7
VV29	$V7 - (V7 - V8) \cdot (1.6R/6.4R)$
VV30	$V7 - (V7 - V8) \cdot (3.2R/6.4R)$
VV31	$V7 - (V7 - V8) \cdot (4.8R/6.4R)$
VV32	V8
VV33	$V8 - (V8 - V9) \cdot (1.6R/6.4R)$
VV34	$V8 - (V8 - V9) \cdot (3.2R/6.4R)$
VV35	$V8 - (V8 - V9) \cdot (4.8R/6.4R)$
VV36	V9
VV37	$V9 - (V9 - V10) \cdot (1.6R/6.4R)$
VV38	$V9 - (V9 - V10) \cdot (3.2R/6.4R)$
VV39	$V9 - (V9 - V10) \cdot (4.8R/6.4R)$
VV40	V10
VV41	$V10 - (V10 - V11) \cdot (1.6R/6.4R)$
VV42	$V10 - (V10 - V11) \cdot (3.2R/6.4R)$
VV43	$V10 - (V10 - V11) \cdot (4.8R/6.4R)$

Grayscale voltage	Formula
VV44	V11
VV45	$V11 - (V11 - V12) \cdot (1.6R/6.4R)$
VV46	$V11 - (V11 - V12) \cdot (3.2R/6.4R)$
VV47	$V11 - (V11 - V12) \cdot (4.8R/6.4R)$
VV48	V12
VV49	$V12 - (V12 - V13) \cdot (1.6R/6.4R)$
VV50	$V12 - (V12 - V13) \cdot (3.2R/6.4R)$
VV51	$V12 - (V12 - V13) \cdot (4.8R/6.4R)$
VV52	V13
VV53	$V13 - (V13 - V14) \cdot (1.6R/6.4R)$
VV54	$V13 - (V13 - V14) \cdot (3.2R/6.4R)$
VV55	$V13 - (V13 - V14) \cdot (4.8R/6.4R)$
VV56	V14
VV57	$V14 - (V14 - V15) \cdot (1.6R/6.4R)$
VV58	$V14 - (V14 - V15) \cdot (3.2R/6.4R)$
VV59	$V14 - (V14 - V15) \cdot (4.8R/6.4R)$
VV60	V15
VV61	$V15 - (V15 - V16) \cdot (1.6R/6.4R)$
VV62	$V15 - (V15 - V16) \cdot (3.2R/6.4R)$
VV63	$V15 - (V15 - V16) \cdot (4.8R/6.4R)$
VV64	V16
VV65	$V16 - (V16 - V17) \cdot (1.6R/6.4R)$
VV66	$V16 - (V16 - V17) \cdot (3.2R/6.4R)$
VV67	$V16 - (V16 - V17) \cdot (4.8R/6.4R)$
VV68	V17
VV69	$V17 - (V17 - V18) \cdot (1.6R/6.4R)$
VV70	$V17 - (V17 - V18) \cdot (3.2R/6.4R)$
VV71	$V17 - (V17 - V18) \cdot (4.8R/6.4R)$
VV72	V18
VV73	$V18 - (V18 - V19) \cdot (1.6R/6.4R)$
VV74	$V18 - (V18 - V19) \cdot (3.2R/6.4R)$
VV75	$V18 - (V18 - V19) \cdot (4.8R/6.4R)$
VV76	V19
VV77	$V19 - (V19 - V20) \cdot (1.6R/6.4R)$
VV78	$V19 - (V19 - V20) \cdot (3.2R/6.4R)$
VV79	$V19 - (V19 - V20) \cdot (4.8R/6.4R)$
VV80	V20
VV81	$V20 - (V20 - V21) \cdot (1.6R/6.4R)$
VV82	$V20 - (V20 - V21) \cdot (3.2R/6.4R)$
VV83	$V20 - (V20 - V21) \cdot (4.8R/6.4R)$
VV84	V21
VV85	$V21 - (V21 - V22) \cdot (1.6R/6.4R)$
VV86	$V21 - (V21 - V22) \cdot (3.2R/6.4R)$
VV87	$V21 - (V21 - V22) \cdot (4.8R/6.4R)$

Grayscale voltage	Formula
VV88	V22
VV89	$V22 - (V22 - V23) * (1.6R/6.4R)$
VV90	$V22 - (V22 - V23) * (3.2R/6.4R)$
VV91	$V22 - (V22 - V23) * (4.8R/6.4R)$
VV92	V23
VV93	$V23 - (V23 - V24) * (1.6R/6.4R)$
VV94	$V23 - (V23 - V24) * (3.2R/6.4R)$
VV95	$V23 - (V23 - V24) * (4.8R/6.4R)$
VV96	V24
VV97	$V24 - (V24 - V25) * (1.6R/6.4R)$
VV98	$V24 - (V24 - V25) * (3.2R/6.4R)$
VV99	$V24 - (V24 - V25) * (4.8R/6.4R)$
VV100	V25
VV101	$V25 - (V25 - V26) * (1.6R/6.4R)$
VV102	$V25 - (V25 - V26) * (3.2R/6.4R)$
VV103	$V25 - (V25 - V26) * (4.8R/6.4R)$
VV104	V26
VV105	$V26 - (V26 - V27) * (1.6R/6.4R)$
VV106	$V26 - (V26 - V27) * (3.2R/6.4R)$
VV107	$V26 - (V26 - V27) * (4.8R/6.4R)$
VV108	V27
VV109	$V27 - (V27 - V28) * (1.6R/6.4R)$
VV110	$V27 - (V27 - V28) * (3.2R/6.4R)$
VV111	$V27 - (V27 - V28) * (4.8R/6.4R)$
VV112	V28
VV113	$V28 - (V28 - V29) * (1.6R/6.4R)$
VV114	$V28 - (V28 - V29) * (3.2R/6.4R)$
VV115	$V28 - (V28 - V29) * (4.8R/6.4R)$
VV116	V29
VV117	$V29 - (V29 - V30) * (1.6R/6.4R)$
VV118	$V29 - (V29 - V30) * (3.2R/6.4R)$
VV119	$V29 - (V29 - V30) * (4.8R/6.4R)$
VV120	V30
VV121	$V30 - (V30 - V31) * (1.6R/6.4R)$
VV122	$V30 - (V30 - V31) * (3.2R/6.4R)$
VV123	$V30 - (V30 - V31) * (4.8R/6.4R)$
VV124	V31
VV125	$V31 - (V31 - V32) * (1.6R/11.2R)$
VV126	$V31 - (V31 - V32) * (3.2R/11.2R)$
VV127	$V31 - (V31 - V32) * (4.8R/11.2R)$
VV128	$V31 - (V31 - V32) * (6.4R/11.2R)$
VV129	$V31 - (V31 - V32) * (8R/11.2R)$
VV130	$V31 - (V31 - V32) * (9.6R/11.2R)$
VV131	V32

Grayscale voltage	Formula
VV132	$V32 - (V32 - V33) * (1.6R/6.4R)$
VV133	$V32 - (V32 - V33) * (3.2R/6.4R)$
VV134	$V32 - (V32 - V33) * (4.8R/6.4R)$
VV135	V33
VV136	$V33 - (V33 - V34) * (1.6R/6.4R)$
VV137	$V33 - (V33 - V34) * (3.2R/6.4R)$
VV138	$V33 - (V33 - V34) * (4.8R/6.4R)$
VV139	V34
VV140	$V34 - (V34 - V35) * (1.6R/6.4R)$
VV141	$V34 - (V34 - V35) * (3.2R/6.4R)$
VV142	$V34 - (V34 - V35) * (4.8R/6.4R)$
VV143	V35
VV144	$V35 - (V35 - V36) * (1.6R/6.4R)$
VV145	$V35 - (V35 - V36) * (3.2R/6.4R)$
VV146	$V35 - (V35 - V36) * (4.8R/6.4R)$
VV147	V36
VV148	$V36 - (V36 - V37) * (1.6R/6.4R)$
VV149	$V36 - (V36 - V37) * (3.2R/6.4R)$
VV150	$V36 - (V36 - V37) * (4.8R/6.4R)$
VV151	V37
VV152	$V37 - (V37 - V38) * (1.6R/6.4R)$
VV153	$V37 - (V37 - V38) * (3.2R/6.4R)$
VV154	$V37 - (V37 - V38) * (4.8R/6.4R)$
VV155	V38
VV156	$V38 - (V38 - V39) * (1.6R/6.4R)$
VV157	$V38 - (V38 - V39) * (3.2R/6.4R)$
VV158	$V38 - (V38 - V39) * (4.8R/6.4R)$
VV159	V39
VV160	$V39 - (V39 - V40) * (1.6R/6.4R)$
VV161	$V39 - (V39 - V40) * (3.2R/6.4R)$
VV162	$V39 - (V39 - V40) * (4.8R/6.4R)$
VV163	V40
VV164	$V40 - (V40 - V41) * (1.6R/6.4R)$
VV165	$V40 - (V40 - V41) * (3.2R/6.4R)$
VV166	$V40 - (V40 - V41) * (4.8R/6.4R)$
VV167	V41
VV168	$V41 - (V41 - V42) * (1.6R/6.4R)$
VV169	$V41 - (V41 - V42) * (3.2R/6.4R)$
VV170	$V41 - (V41 - V42) * (4.8R/6.4R)$
VV171	V42
VV172	$V42 - (V42 - V43) * (1.6R/6.4R)$
VV173	$V42 - (V42 - V43) * (3.2R/6.4R)$
VV174	$V42 - (V42 - V43) * (4.8R/6.4R)$
VV175	V43

Grayscale voltage	Formula	Grayscale voltage	Formula
VV176	$V43 - (V43 - V44) * (1.6R/6.4R)$	VV216	$V53 - (V53 - V54) * (1.6R/6.4R)$
VV177	$V43 - (V43 - V44) * (3.2R/6.4R)$	VV217	$V53 - (V53 - V54) * (3.2R/6.4R)$
VV178	$V43 - (V43 - V44) * (4.8R/6.4R)$	VV218	$V53 - (V53 - V54) * (4.8R/6.4R)$
VV179	V44	VV219	V54
VV180	$V44 - (V44 - V45) * (1.6R/6.4R)$	VV220	$V54 - (V54 - V55) * (1.6R/6.4R)$
VV181	$V44 - (V44 - V45) * (3.2R/6.4R)$	VV221	$V54 - (V54 - V55) * (3.2R/6.4R)$
VV182	$V44 - (V44 - V45) * (4.8R/6.4R)$	VV222	$V54 - (V54 - V55) * (4.8R/6.4R)$
VV183	V45	VV223	V55
VV184	$V45 - (V45 - V46) * (1.6R/6.4R)$	VV224	$V55 - (V55 - V56) * (1.6R/6.4R)$
VV185	$V45 - (V45 - V46) * (3.2R/6.4R)$	VV225	$V55 - (V55 - V56) * (3.2R/6.4R)$
VV186	$V45 - (V45 - V46) * (4.8R/6.4R)$	VV226	$V55 - (V55 - V56) * (4.8R/6.4R)$
VV187	V46	VV227	V56
VV188	$V46 - (V46 - V47) * (1.6R/6.4R)$	VV228	$V56 - (V56 - V57) * (2R/8R)$
VV189	$V46 - (V46 - V47) * (3.2R/6.4R)$	VV229	$V56 - (V56 - V57) * (4R/8R)$
VV190	$V46 - (V46 - V47) * (4.8R/6.4R)$	VV230	$V56 - (V56 - V57) * (6R/8R)$
VV191	V47	VV231	V57
VV192	$V47 - (V47 - V48) * (1.6R/6.4R)$	VV232	$V57 - (V57 - V58) * (2R/8R)$
VV193	$V47 - (V47 - V48) * (3.2R/6.4R)$	VV233	$V57 - (V57 - V58) * (4R/8R)$
VV194	$V47 - (V47 - V48) * (4.8R/6.4R)$	VV234	$V57 - (V57 - V58) * (6R/8R)$
VV195	V48	VV235	V58
VV196	$V48 - (V48 - V49) * (1.6R/6.4R)$	VV236	$V58 - (V58 - V59) * (2R/8R)$
VV197	$V48 - (V48 - V49) * (3.2R/6.4R)$	VV237	$V58 - (V58 - V59) * (4R/8R)$
VV198	$V48 - (V48 - V49) * (4.8R/6.4R)$	VV238	$V58 - (V58 - V59) * (6R/8R)$
VV199	V49	VV239	V59
VV200	$V49 - (V49 - V50) * (1.6R/6.4R)$	VV240	$V59 - (V59 - V60) * (2R/8R)$
VV201	$V49 - (V49 - V50) * (3.2R/6.4R)$	VV241	$V59 - (V59 - V60) * (4R/8R)$
VV202	$V49 - (V49 - V50) * (4.8R/6.4R)$	VV242	$V59 - (V59 - V60) * (6R/8R)$
VV203	V50	VV243	V60
VV204	$V50 - (V50 - V51) * (1.6R/6.4R)$	VV244	$V60 - (V60 - V61) * (4R/16R)$
VV205	$V50 - (V50 - V51) * (3.2R/6.4R)$	VV245	$V60 - (V60 - V61) * (8R/16R)$
VV206	$V50 - (V50 - V51) * (4.8R/6.4R)$	VV246	$V60 - (V60 - V61) * (12R/16R)$
VV207	V51	VV247	V61
VV208	$V51 - (V51 - V52) * (1.6R/6.4R)$	VV248	$V61 - (V61 - V62) * (4R/16R)$
VV209	$V51 - (V51 - V52) * (3.2R/6.4R)$	VV249	$V61 - (V61 - V62) * (8R/16R)$
VV210	$V51 - (V51 - V52) * (4.8R/6.4R)$	VV250	$V61 - (V61 - V62) * (12R/16R)$
VV211	V52	VV251	V62
VV212	$V52 - (V52 - V53) * (1.6R/6.4R)$	VV252	$V62 - (V62 - V63) * (4R/16R)$
VV213	$V52 - (V52 - V53) * (3.2R/6.4R)$	VV253	$V62 - (V62 - V63) * (8R/16R)$
VV214	$V52 - (V52 - V53) * (4.8R/6.4R)$	VV254	$V62 - (V62 - V63) * (12R/16R)$
VV215	V53	VV255	V63

Table 5.60: Voltage calculation formula of 256-grayscale voltage (positive/negative polarity)



**5.13 Characteristics of I/O**

**5.13.1 Output or bi-directional (I/O) pins**

Output or bi-directional pins	After power on	After hardware reset	After software reset
TE	Low	Low	Low
DB23 to DB0 (Output driver)	High-Z (Inactive)	High-Z (Inactive)	High-Z (Inactive)
SDO	High-Z (Inactive)	High-Z (Inactive)	High-Z (Inactive)
CABC_PWM_OUT	Low	Low	Low

**Table 5.61 Characteristics of output or bi-directional (I/O) pins**

**5.13.2 Input pins**

Input pins	During power on process	After power on	After hardware reset	After software reset	During power off process
RESX	Setion.5.18	Input valid	Input valid	Input valid	Setion.5.18
CSX	Input valid	Input valid	Input valid	Input valid	Input valid
DCX_SCL	Input valid	Input valid	Input valid	Input valid	Input valid
WRX_DCX	Input valid	Input valid	Input valid	Input valid	Input valid
RDX_E	Input valid	Input valid	Input valid	Input valid	Input valid
DB23 to DB0 SDI	Input valid	Input valid	Input valid	Input valid	Input valid
HSYNC	Input valid	Input valid	Input valid	Input valid	Input valid
VSYNC	Input valid	Input valid	Input valid	Input valid	Input valid
PCLK	Input valid	Input valid	Input valid	Input valid	Input valid
DE	Input valid	Input valid	Input valid	Input valid	Input valid
OSC, BS3, BS2, BS1, BS0,	Input valid	Input valid	Input valid	Input valid	Input valid
TEST2-1	Low	Low	Low	Low	Low

**Table 5.62 Characteristics of input pins**

### 5.14 GIP control signal

HX8369-A is a single chip solution for a WVGA GIP (Gate In Panel) type TFT LCD display. There are many GIP/ASG type TFT panels that correspond to different GIP timing. Therefore, the GIP setting must be setup to the correct GIP/ASG timing for the normal display. The GIP timing adjustment is related to register 0xD5h SETGIP.

The GIP control signals (GOUT[1~10]\_L and GOUT[1~10]\_R) is for panel used. The assignment of each panel type is specified on the application note. Regarding the GIP/ASG timing, please refer to HX8369-A application note.

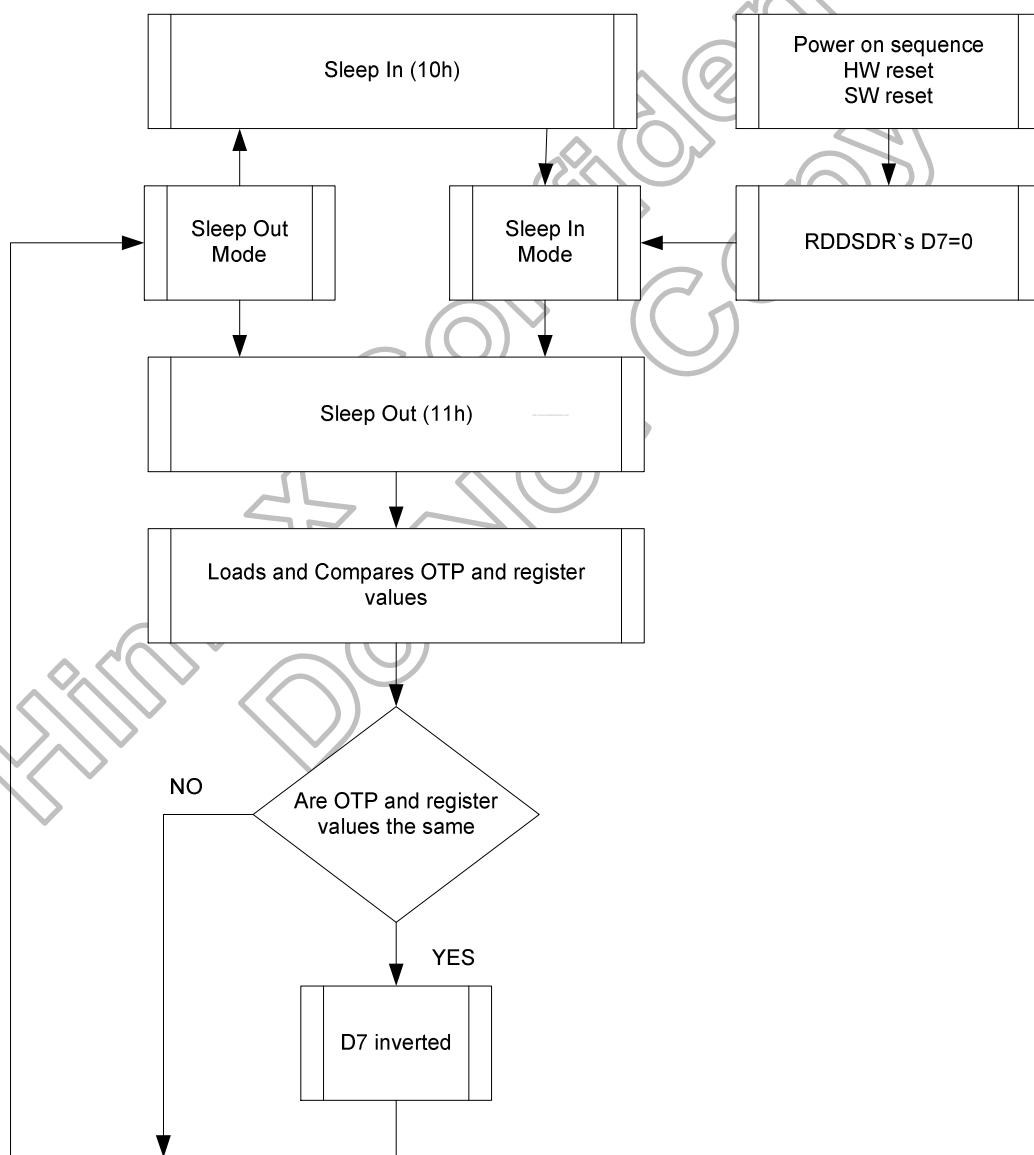
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**5.15 Sleep Out –command and self-diagnostic functions of the display module**

**5.15.1 Register loading detection**

Sleep Out-command (See “Sleep Out (11h)”) is a trigger for an internal function of the display module, which indicates, if the display module loading function of factory default values from OTP (or similar device) to registers of the display controller is working properly. There are compared factory values of the OTP and register values of the display controller by the display controller. If those both values (OTP and register values) are same, there is inverted (=increased by 1) a bit, which is defined in command “Read Display Self-Diagnostic Result (0Fh)” (=RDDSDR) (The used bit of this command is D7). If those both values are not same, this bit (D7) is not inverted (=increased by 1).

The flow chart for this internal function is following:

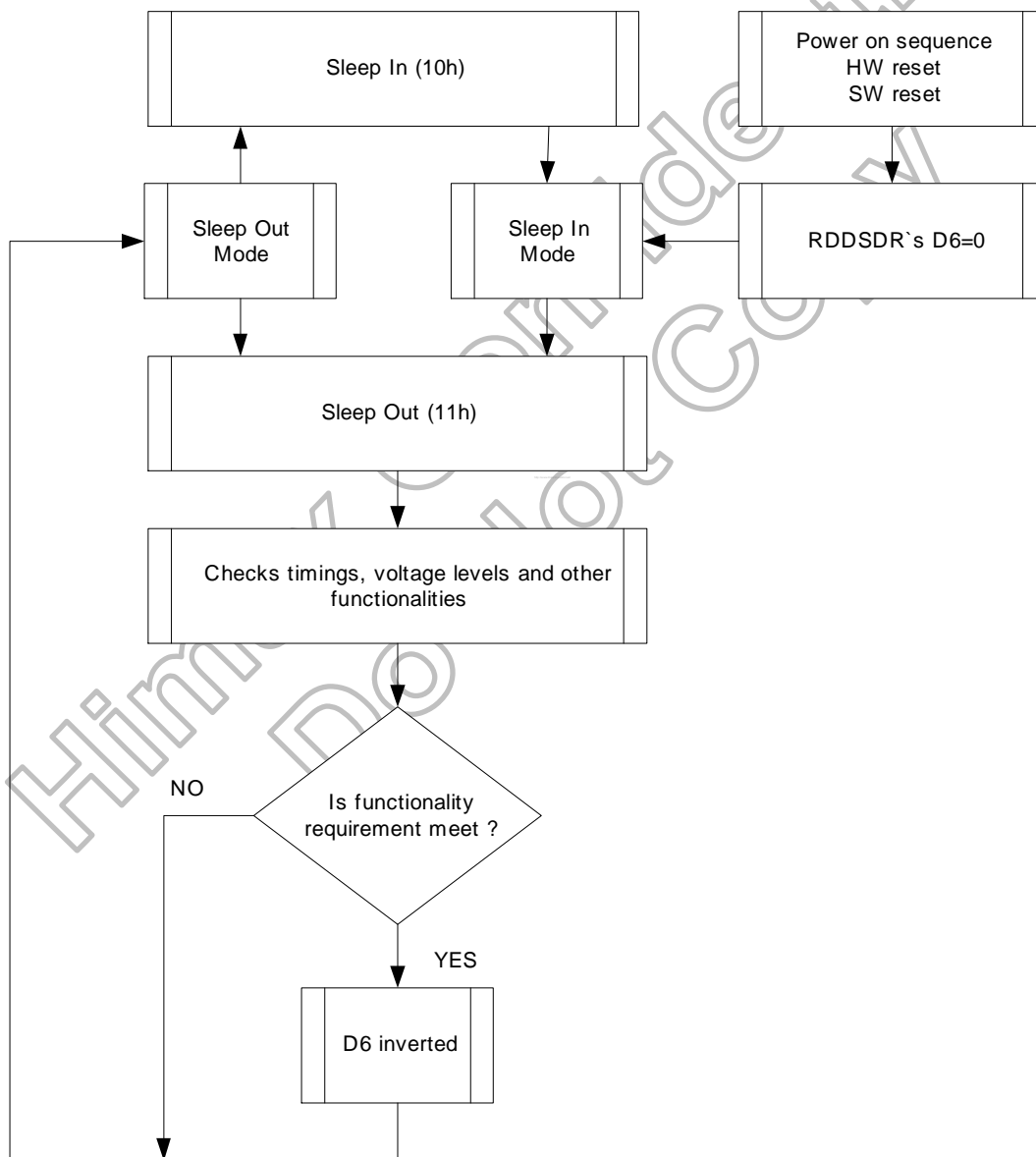


**Figure 5.33: Sleep out flow chart–command and self-diagnostic functions**

### 5.15.2 Functionality detection

Sleep Out-command (See “Sleep Out (11h)”) is a trigger for an internal function of the display module, which indicates, if the display module is still running and meets functionality requirements.

The internal function (=the display controller) is comparing, if the display module still meets functionality requirements (e.g. booster voltage levels, timings, etc.). If functionality requirement is met, 1 bit will be inverted (=increased by 1), which is defined in command “Read Display Self- Diagnostic Result (0Fh)” (=RDDSDR) (The used bit of this command is D6). If functionality requirement is not the same, this bit (D6) is not inverted (=increased by 1). The flow chart for this internal function is shown as below.



**Note:** There is needed 120msec after Sleep Out -command, when there is changing from Sleep In-mode to Sleep Out -mode, before there is possible to check if Customer's functionality requirements are met and a value of RDDSDR's D6 is valid. Otherwise, there is 5msec delay for D6's value, when Sleep Out -command is sent in Sleep Out -mode.

**Figure 5.34: Sleep out flow chart internal function detection**

## 5.16 Power on/off sequence

VDD1, VDD2 and VDD3 can be applied in any order. VDD1, VDD2 and VDD3 can be powered down in any order. During power off, if LCD is in the Sleep Out mode, VDD1 and VDD2 must be powered down minimum 120msec after RESX has been released. During power off, if LCD is in the Sleep In mode, VDD1, VDD2 and VDD3 can be powered down minimum 0msec after RESX has been released. CSX can be applied at any timing or can be permanently grounded. RESX has priority over CSX. There will be no damage to the display module if the power sequences are not met. There will be no abnormal visible effects on the display panel during the Power On/Off Sequences. There will be no abnormal visible effects on the display between end of Power On Sequence and before receiving Sleep Out command. Also between receiving Sleep In command and Power Off Sequence. If RESX line is not held stable by host during Power On Sequence as defined in Sections 5.16.1 and 5.16.2, then it will be necessary to apply a Hardware Reset (RESX) after Host Power On Sequence is complete to ensure correct operation. Otherwise function is not guaranteed. The power on/off sequence is illustrated below.

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5.16.1 Case 1: RESX line is held high or unstable by host at power on

If RESX line is held high or unstable by the host during power on, then a Hardware Reset must be applied after both VDD1, VDD2 and VDD3 have been applied-otherwise correct functionality is not guaranteed. There is no timing restriction upon this hardware reset.

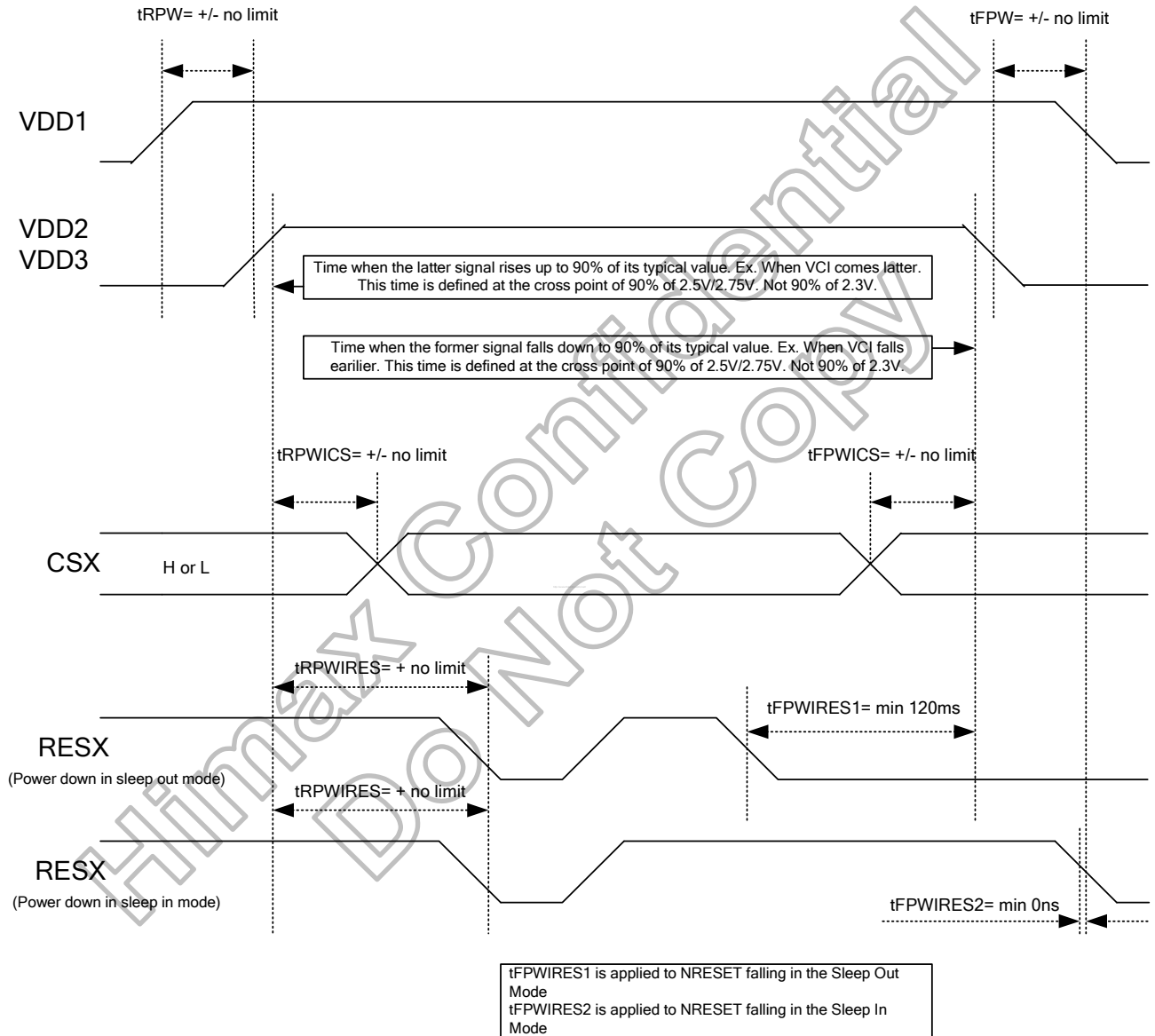


Figure 5.35: Case 1: RESX line is held high or unstable by host at power on



**5.16.2 Case 2: RESX line is held low by host at power on**

If RESX line is held low (and stable) by the host during power on, then the RESX must be held low for minimum 10μsec after both VDD1, VDD2 and VDD3 have been applied.

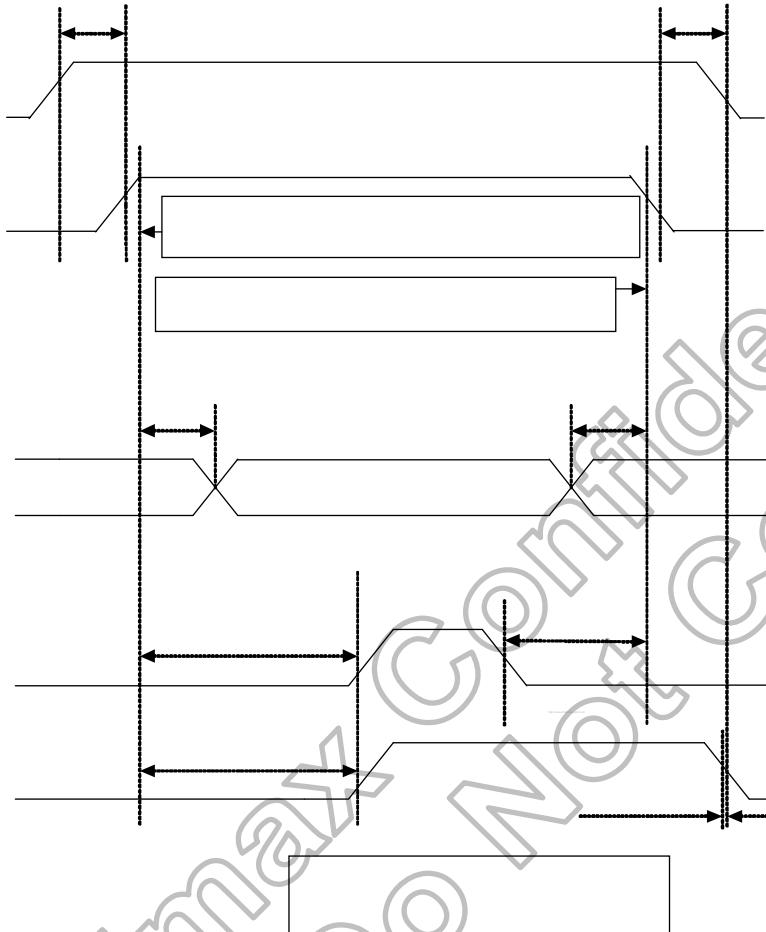
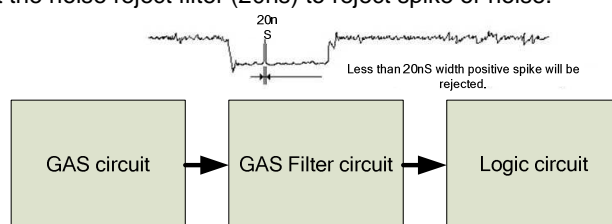


Figure 5.36: Case 2: RESX line is held low by host at power on

**5.17 Uncontrolled power off**

The uncontrolled power off means a situation when e.g. there is removed a battery without the controlled power off sequence. There will not be any damages for the display module or the display module will not cause any damages for the host or lines of the interface. At an uncontrolled power off the display will go blank and there will not be any visible effects within 1 second on the display (blank display) and remains blank until “Power On Sequence” powers it up.

**Note:** HX8369-A is support the noise reject filter (20ns) to reject spike or noise.



### 5.18 Content adaptive brightness control (CABC) function

The general block diagram of the CABC and the brightness control is illustrated below:

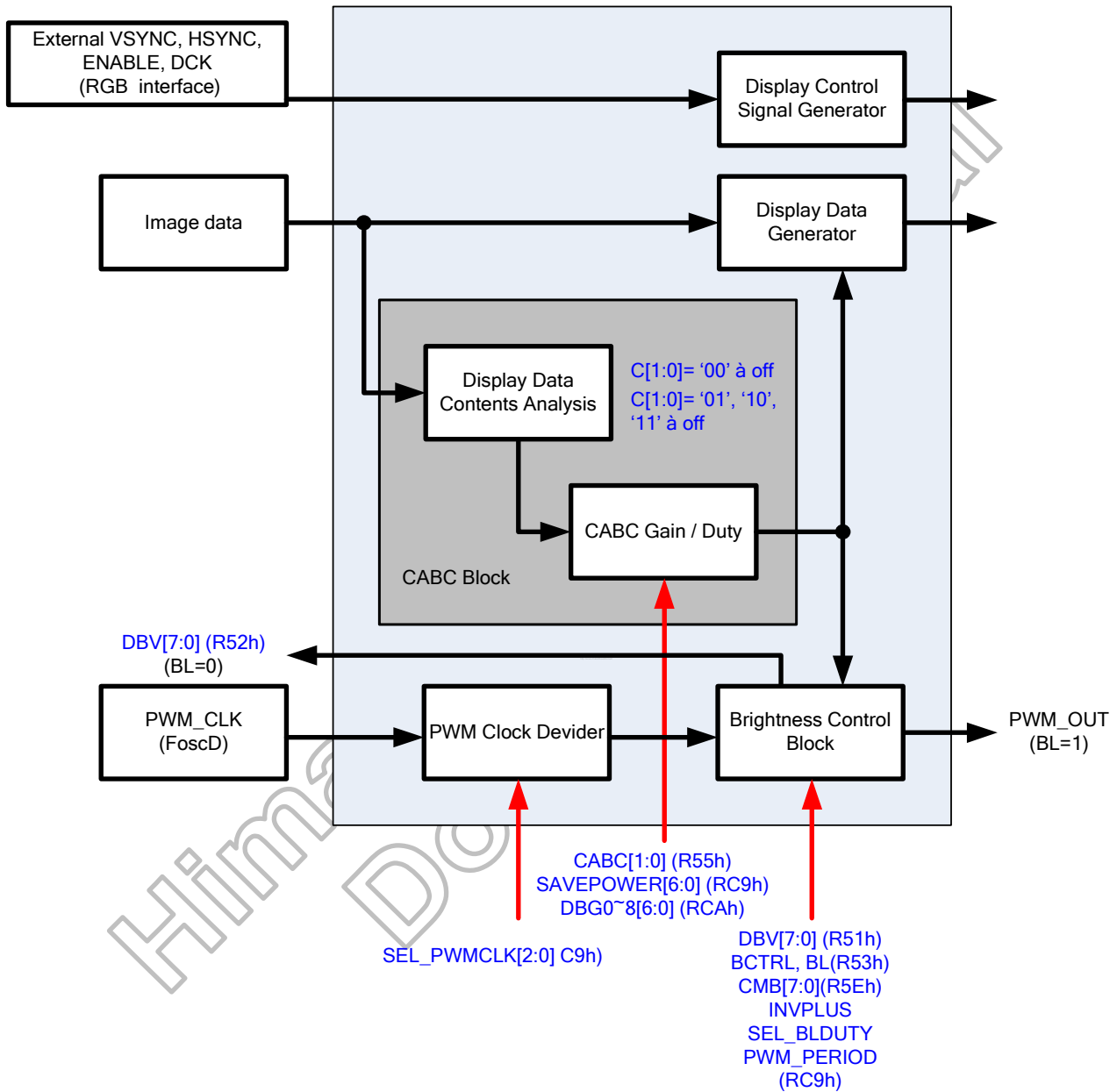
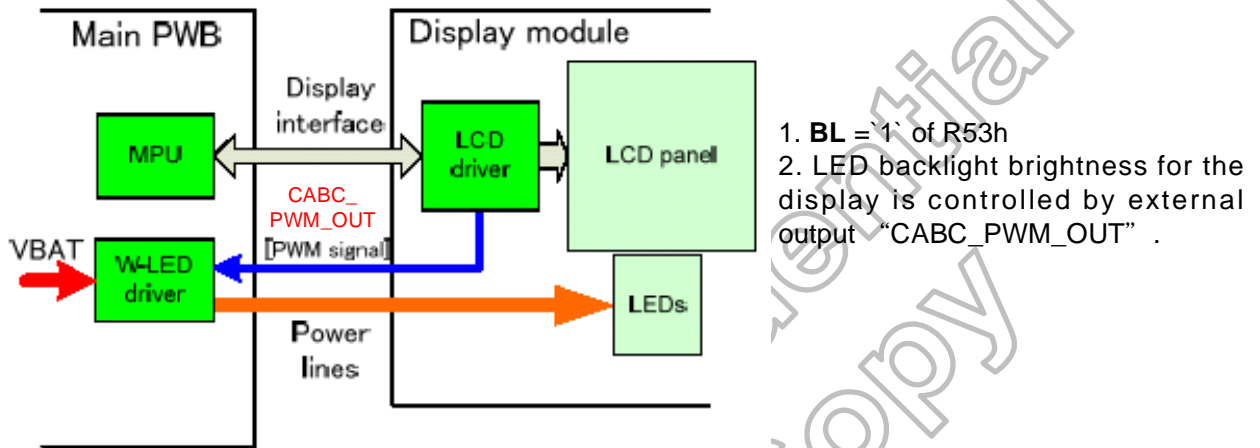


Figure 5.37: CABC block diagram

5.18.1 Module architectures

HX8369-A can support two module architectures for CABC operation. The BL bit setting of R53h can be used to select used display module architecture. White LED driver circuit for display backlight is located on the main PWB, not in the display module both in architecture I and II.

• Architecture I



• Architecture II

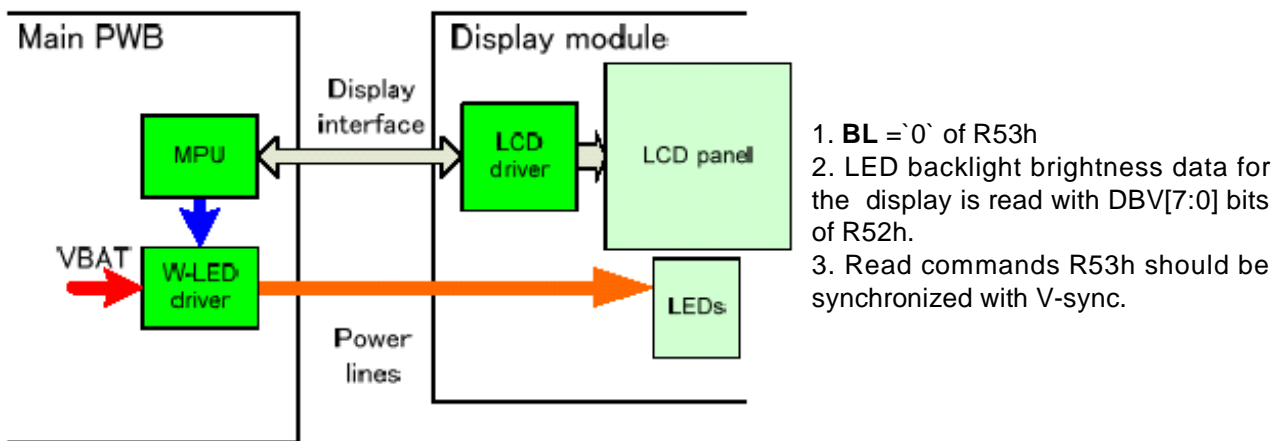


Figure 5.38: Module architecture

5.18.2 CABC block

There are DBG0~8[6:0] register bits in CABC block to define the “CABC gain”/ “CABC duty” table. Every DBGx[6:0] has 33 gain/duty value setting.

After one-frame display data content analysis, LSI will generate one CABC gain / CABC duty value calculated from DBG0~8[6:0] register bits setting (by using interpolated method) for display data generating and for backlight PWM pulse generating.

Please note that the CABC gain / CABC duty value calculated by the LSI is one of the 33 gain/duty value setting in DBGxx[6:0].

Please note that : Duty ( valid level period (LED on) / one complete period)=1/ gain.

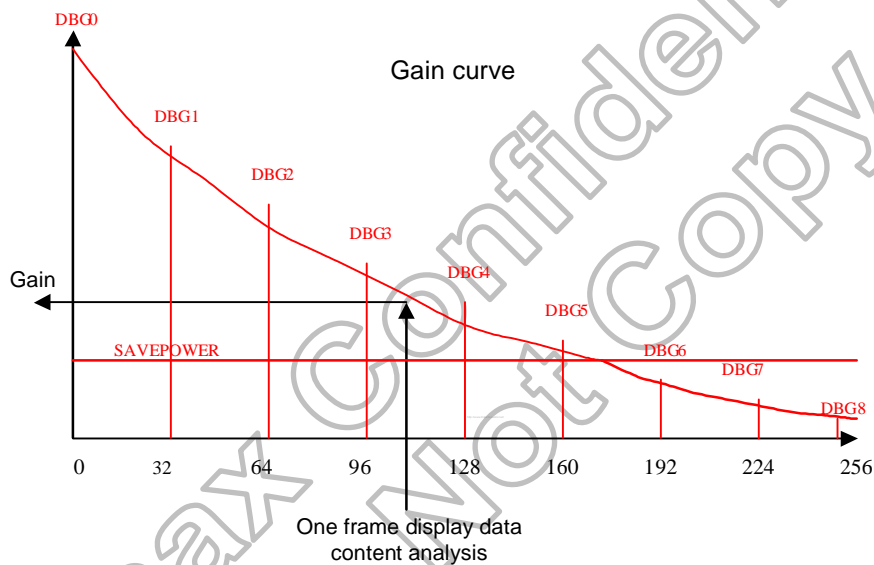


Figure 5.39: CABC gain / CABC duty generation

For power saving of backlight module, there are SAVEPOWER[6:0] bits to define the “minimum gain”/ “maximum duty” of CABC block output. If the CABC gain / duty after one-frame display data contents analysis is smaller(gain) / larger(duty) than SAVEPOWER[6:0] bits setting, the CABC block will output CABC gain / duty equal to SAVEPOWER[6:0] and ignore the result of display data contents analysis.

### 5.18.3 Brightness control block

There is an external output signal from brightness block, CABC\_PWM\_OUT, to control the LED driver IC in order to control display brightness.

There are resister bits, DBV[7:0] of R51h, for display brightness of manual brightness setting. The CABC\_PWM\_OUT duty is calculated as  $(DBV[7:0])/255 \times \text{CABC duty}$  (generated after one-frame display data content analysis).

For ex: CABC\_PWM\_OUT period=2.95 ms, and DBV[7:0](R51h)='228DEC' and CABC duty is 74%. Then CABC\_PWM\_OUT duty= $(228) / 255 \times 74.42\% \approx 66.54\%$ . Correspond to the CABC\_PWM\_OUT period=2.95 ms, the high-level of CABC\_PWM\_OUT (high effective) = 1.96ms, and the low-level of CABC\_PWM\_OUT =0.99ms.

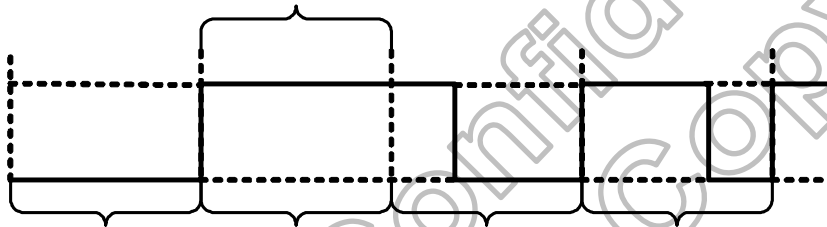


Figure 5.40: CABC\_PWM\_OUT output duty

Symbol	Parameter	Min.	Max.	Unit	Description
tpw	Pulse width	0.0333	8.33	ms	-

Table 5.63 CABC timing table

**Note1:** The signal rise and fall times (tf, tr) are stipulated to be equal to or less than 15ns.

**Note2:** The pulse width range by setting CABC related registers is locate between 0.0333ms to 8.33ms.

When Architecture II module is used (BL='0') with the example below, the CABC\_PWM\_OUT is always output low and the DBV[7:0](R51h) will be read a value as 169DEC ( $(169)/255 \approx 66.27\%$ ).

#### 5.18.4 Minimum brightness setting of CABC function

CABC function is automatically reduced backlight brightness based on image contents. In the case of the combination with the CABC or manual brightness setting, display brightness is too dark. It must affect to image quality degradation. CABC minimum brightness setting (CMB[7:0] bits of R5Eh) is to avoid too much brightness reduction.

When CABC is active, CABC can not reduce the display brightness to less than CABC minimum brightness setting. Image processing function is worked as normal, even if the brightness can not be changed.

This function does not affect to the other function, manual brightness setting. Manual brightness can be set the display brightness to less than CABC minimum brightness. Smooth transition and dimming function can be worked as normal.

When display brightness is turned off (BCTRL='0' of R53h), CABC minimum brightness setting is ignored. "CMB[7:0], Read CABC minimum brightness (R5Fh)" always read the setting value of "CMB[7:0], Write CABC minimum brightness (R5Eh)"

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**5.19OTP programing**

**5.19.1 OTP table**

OTP_INDEX (HEX)	Ref. Command	B7	B6	B5	B4	B3	B2	B1	B0	
00	SETOSC (B0h)	NVALID0	-	-	-	UADJ[3:0]				
1B	SETVCOM (B6h)	NVALID_VCMF1	NVALID_VCMF2	NVALID_VCMF3	NVALID_VCMB1	NVALID_VCMB2	NVALID_VCMB3	-	-	
1C		VCMC_F1[7:0]								
1D		VCMC_B1[7:0]								
1E		VCMC_F2[7:0]								
1F		VCMC_B2[7:0]								
20		VCMC_F3[7:0]								
21		VCMC_B3[7:0]								
22		ID1_1[7:0]								
23	NVALID_ID1	ID2_1[6:0]								
24	ID3_1[7:0]									
25	ID1_2[7:0]									
26	NVALID_ID2	ID2_2[6:0]								
27	ID3_2[7:0]									
28	ID1_3[7:0]									
29	NVALID_ID3	ID2_3[6:0]								
2A	ID3_3[7:0]									
2B	ID1_4[7:0]									
2C	NVALID_ID4	ID2_4[6:0]								
2D	ID3_4[7:0]									
2E	ID1_5[7:0]									
2F	NVALID_ID5	ID2_5[6:0]								
30	ID3_5[7:0]									
31	NVALID8	FS1[2:0]			-	AP[2:0]				
32	-	-	-	-	BT[3:0]					
33	DT[1:0]		-	-	DCDIV[3:0]					
34	-	-	-	-	BTP[4:0]					
35	-	-	-	-	BTN[4:0]					
36	VRHP[7:0]									
37	VRHN[7:0]									
38	-	-	VRMP[5:0]							
39	-	-	VRMN[5:0]							
3A	-	-	DD_TU	VPNL_EN	-	VBS[2:0]				
3B	-	DC86_DIV3	DC86_DIV2	DC86_DIV1	DC86_DIV0	XDK1	XDK0	AUTO_XDK		
3C	-	DTPS[2:0]			-	DTNS[2:0]				
3D	A_DC[1:0]		A_DTP[2:0]			A_DTN[2:0]				
3E	B_DC[1:0]		B_DTP[2:0]			B_DTN[2:0]				
3F	C_DC[1:0]		C_DTP[2:0]			C_DTN[2:0]				
40	D_DC[1:0]		D_DTP[2:0]			D_DTN[2:0]				
41	E_DC[1:0]		E_DTP[2:0]			E_DTN[2:0]				
42	NVALID9	-	-	-	NW_PE[1:0]		NW[1:0]			
43	SETCYC (B4h)	SON[7:0]								
44		SOFF[7:0]								
45		EQS[7:0]								
46		EQON[7:0]								
47	SETPANEL (CCh)	NVALID10	VPL	HPL	EPL	SS_PANEL	DPL	REV_PANEL	BGR_PANEL	
48	SETDISP (B2h)	NVALID11	RES_SEL[2:0]			RM	DFR	DM[1:0]		
49		BP [7:0]								
4A		FP [7:0]								
4B		SAP[3:0]			-	-	-	-	-	
4C		GEN_ON[7:0]								
4D		GEN_OFF[7:0]								
4E		RTN[7:0]								
4F		-	-	-	-	TEI[3:0]				

50		-	-	-	-	-	TEP[9:8]	
51		TEP[7:0]						
52		BP_PE [7:0]						
53		FP_PE [7:0]						
54		RTN_PE[7:0]						
78	SETGAMMA (E0h) (GC0)	INVALID_GV0	-				G1_VRP0[5:0]	
79		-	-				G1_VRP1[5:0]	
7A		-	-				G1_VRP2[5:0]	
7B		-	-				G1_VRP3[5:0]	
7C		-	-				G1_VRP4[5:0]	
7D		-	-				G1_VRP5[5:0]	
7E		-					G1_PRP0[6:0]	
7F		-					G1_PRP1[6:0]	
80			G1_CGMP0[1:0]	-				G1_PKP0[4:0]
81			G1_CGMP1[1:0]	-				G1_PKP1[4:0]
82			G1_CGMP2[1:0]	-				G1_PKP2[4:0]
83			G1_CGMP3[1:0]	-				G1_PKP3[4:0]
84			G1_CGMP5	G1_CGMP4	-			G1_PKP4[4:0]
85			-	-	-			G1_PKP5[4:0]
86			-	-	-			G1_PKP6[4:0]
87			-	-	-			G1_PKP7[4:0]
88			-	-	-			G1_PKP8[4:0]
89			-	-	-			G1_VRN0[5:0]
8A			-	-	-			G1_VRN1[5:0]
8B			-	-	-			G1_VRN2[5:0]
8C			-	-	-			G1_VRN3[5:0]
8D			-	-	-			G1_VRN4[5:0]
8E			-	-	-			G1_VRN5[5:0]
8F			-					G1_PRN0[6:0]
90		-					G1_PRN1[6:0]	
91		G1_CGMN0[1:0]	-				G1_PKN0[4:0]	
92		G1_CGMN1[1:0]	-				G1_PKN1[4:0]	
93		G1_CGMN2[1:0]	-				G1_PKN2[4:0]	
94		G1_CGMN3[1:0]	-				G1_PKN3[4:0]	
95		G1_CGMN5	G1_CGMN4	-			G1_PKN4[4:0]	
96		-	-	-			G1_PKN5[4:0]	
97		-	-	-			G1_PKN6[4:0]	
98		-	-	-			G1_PKN7[4:0]	
99		-	-	-			G1_PKN8[4:0]	
9A	SETGIP(D5h)	INVALID13	-	-	-		SHR_0[11:8]	
9B		SHR_0[7:0]						
9C		-	-	-	-		SHR_1[11:8]	
9D		SHR_1[7:0]						
9E		SPD[7:0]						
9F		CHR[7:0]						
A0		CON[7:0]						
A1		COFF[7:0]						
A2		SHP[3:0]			SCP[3:0]			
A3		CHP[3:0]			CCP[3:0]			
A4		SOS_1[3:0]			SOS_0[3:0]			
A5		SOS_3[3:0]			SOS_2[3:0]			
A6		COS_1[3:0]			COS_0[3:0]			
A7		COS_3[3:0]			COS_2[3:0]			
A8		COS_5[3:0]			COS_4[3:0]			
A9		COS_7[3:0]			COS_6[3:0]			
AA		SOS_1_ML[3:0]			SOS_0_ML[3:0]			
AB		SOS_3_ML[3:0]			SOS_2_ML[3:0]			
AC		COS_1_ML[3:0]			COS_0_ML[3:0]			
AD		COS_3_ML[3:0]			COS_2_ML[3:0]			

AE		COS_5_ML[3:0]				COS_4_ML[3:0]			
AF		COS_7_ML[3:0]				COS_6_ML[3:0]			
B0		-	-	GTO[5:0]					
B1		GNO[7:0]							
B2		EQ_DELAY[7:0]							
B3		GIP_OPT[7:0]							
100	SETDGCLUT (C1h)	INVALID16	-	-	-	-	-	DITH_OPT	DGC_EN
101		D1[7:0]							
102		D2[7:0]							
...		Dn[7:0]							
17D		D125[7:0]							
17E		D126[7:0]							

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5.19.2 OTP programming flow

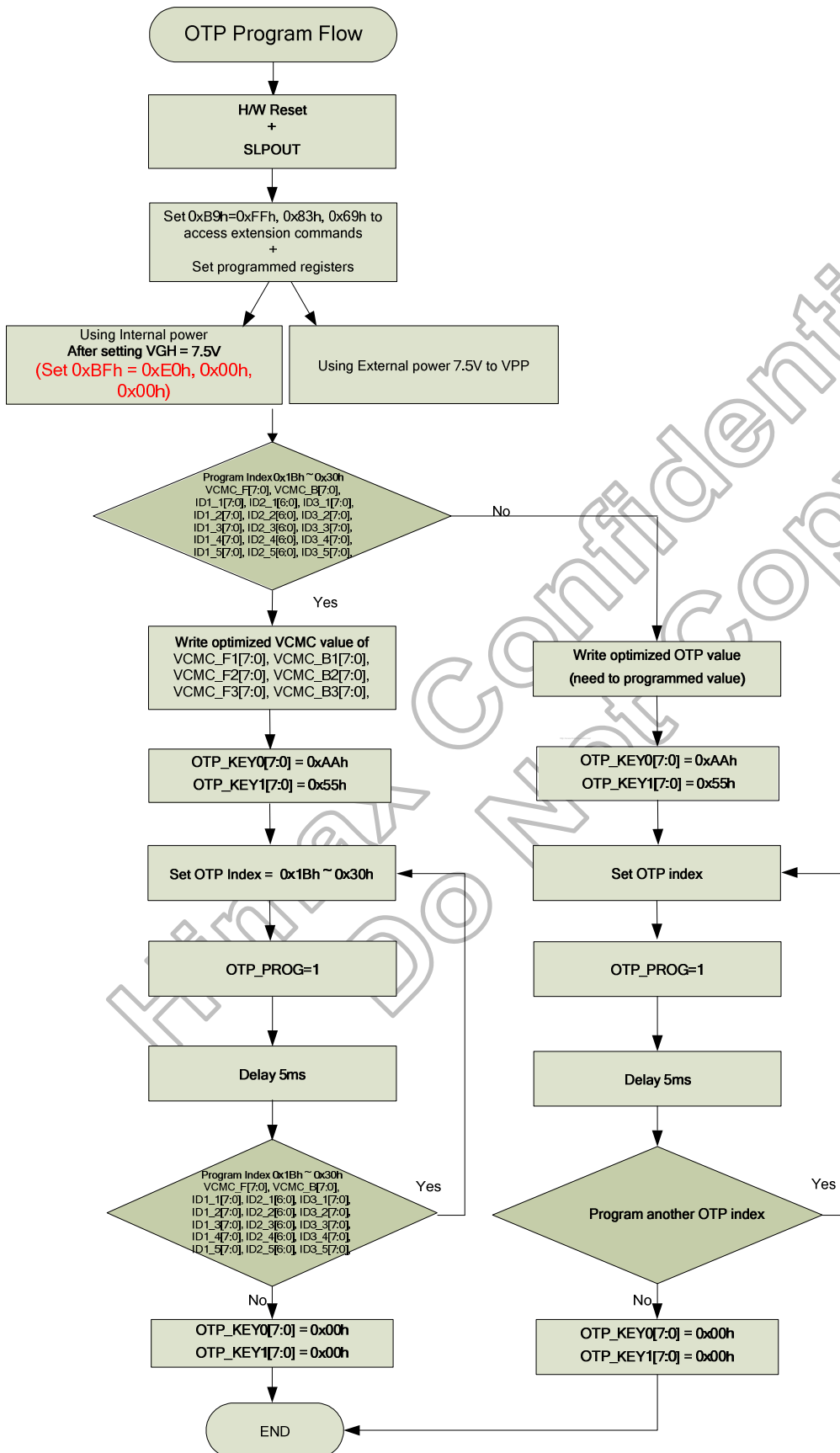


Figure 5.41: OTP programming sequence

5.19.3 Programming sequence

Step	Operation
1	Power on and reset the module.
2	SLPOUT and set 0xB9h = 0xFFh, 0x83h, 0x69h to access the extension commands.
3	Set VGH power to 7.5V for OTP programming state.
4	Write optimized values to related registers.
5	Set OTP_KEY1[7:0] (RE9h)=0xAAh and OTP_KEY1[7:0] (RE9h)=0x55h to enter OTP program mode.
6	Specify OTP_index, please refer to the OTP table.
7	Set OTP_Mask=0x00h, programming the entire bit of one parameter.
8	Set OTP_PROG=1, Internal register begin write to OTP according to OTP_index.
9	Wait 5 ms ( <b>Note 1</b> )
10	Complete programming one parameter to OTP. If continue to programming other parameter, return to step (5). Otherwise, set OTP_KEY1[7:0] (RE9h)=0x00h and OTP_KEY1[7:0] (RE9h)=0x00h to leave OTP program mode and power off the module and remove the external power on VPP pin.

**Note:** When do the OTP program on gamma setting, it must add 5ms delay time after setting OTP\_PROG=1.

Table 5.64: OTP Programming sequence

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5.19.4 OTP Programming example of VCMC\_F1 and VCMC\_B1 DATA SHEET Preliminary V01

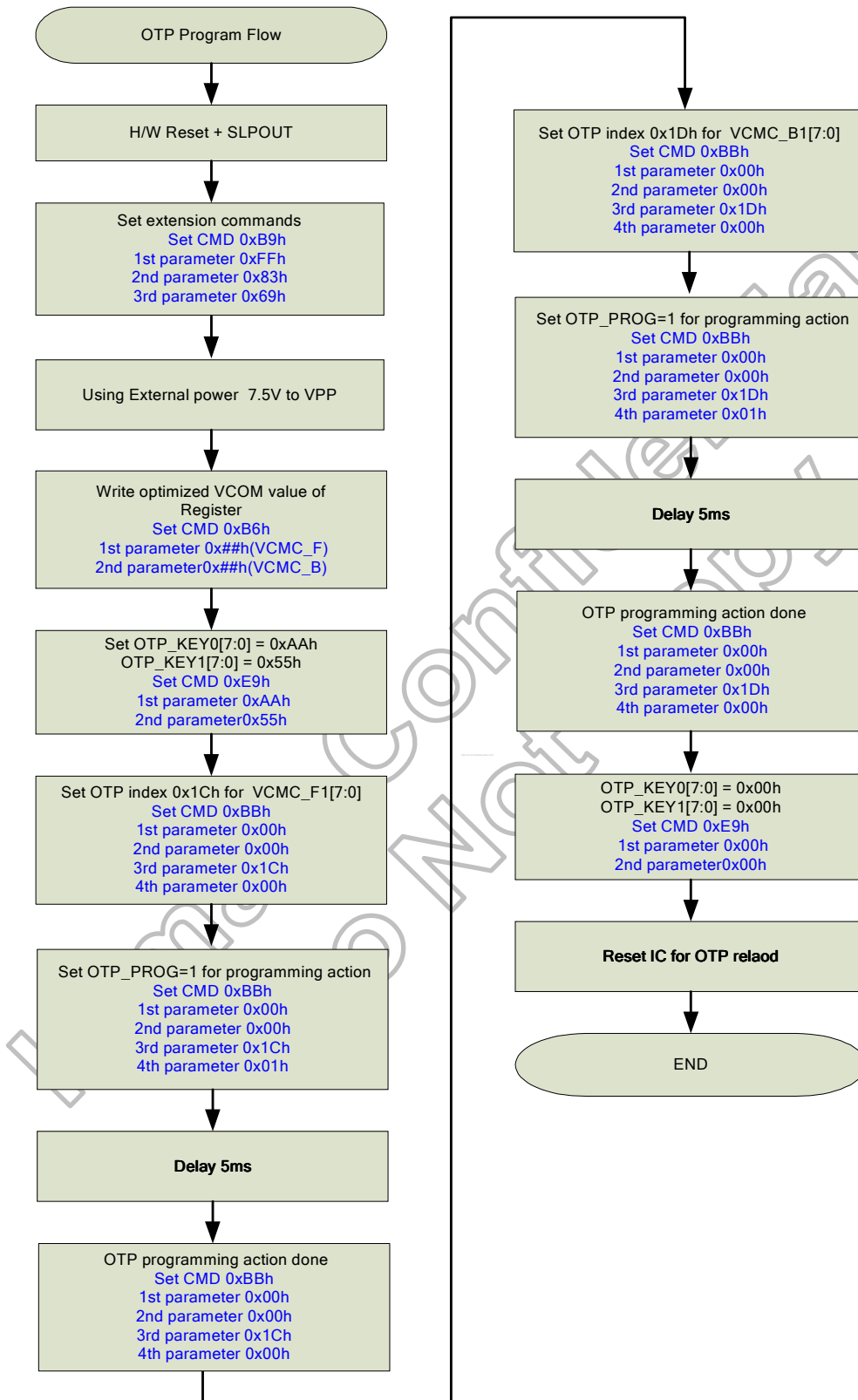


Figure 5.42: OTP programming sequence example 1.



5.19.5 OTP Programming example of ID1, ID2 and ID3

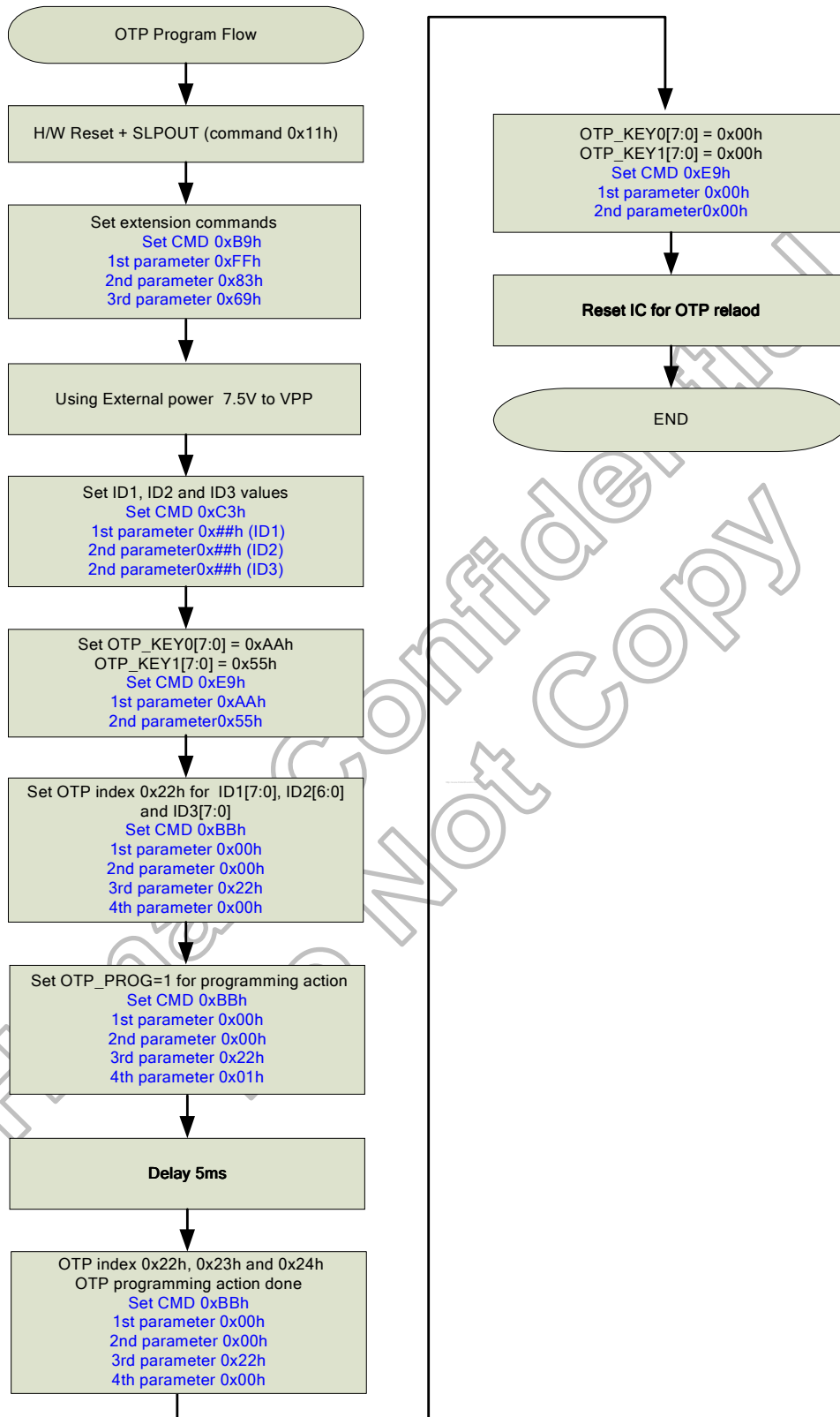
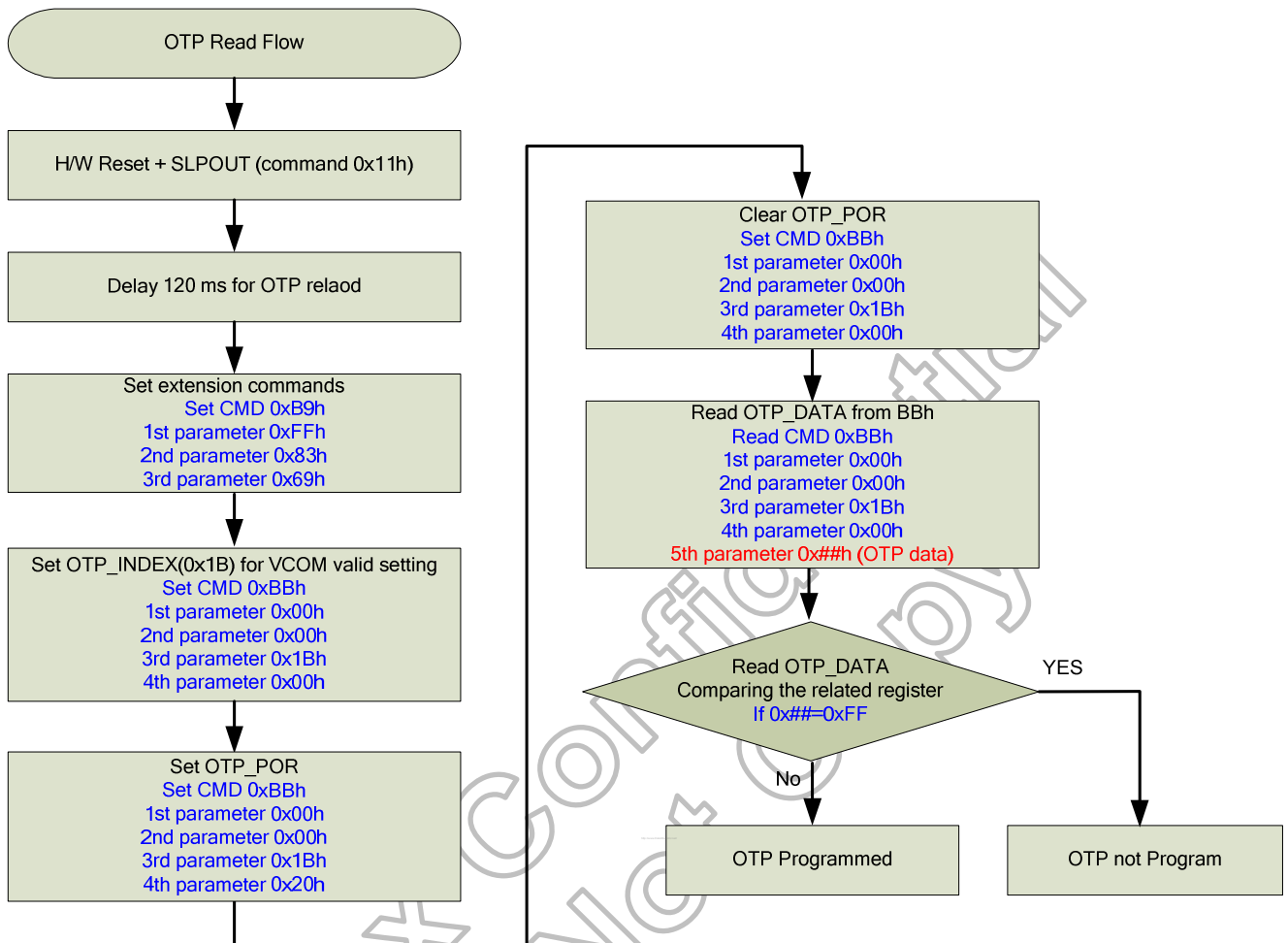


Figure 5.43: OTP programming sequence example 2.

5.19.6 OTP read example of 0x1Bh (VCOM setting re-load)



OTP_index 0x1Bh	value	1 <sup>st</sup> VCOM OTP	2 <sup>nd</sup> VCOM OTP	3 <sup>rd</sup> VCOM OTP
D7 NVALID_VCMF1	1	0	0	0
D6 NVALID_VCMF2	1	1	0	0
D5 NVALID_VCMF3	1	1	1	0
D4 NVALID_VCMB1	1	0	0	0
D3 NVALID_VCMB2	1	1	0	0
D2 NVALID_VCMB3	1	1	1	0
0x1Bh value	0xFFh	0x6Fh	0x27h	0x03h
Reload OTP index	Default	0x1Ch and 0x1Dh	0x1Eh and 0x1Fh	0x20h and 0x21h

Figure 5.44: OTP programming sequence index 0x1Bh read flow.

5.19.7 OTP read example of VCMC\_F1

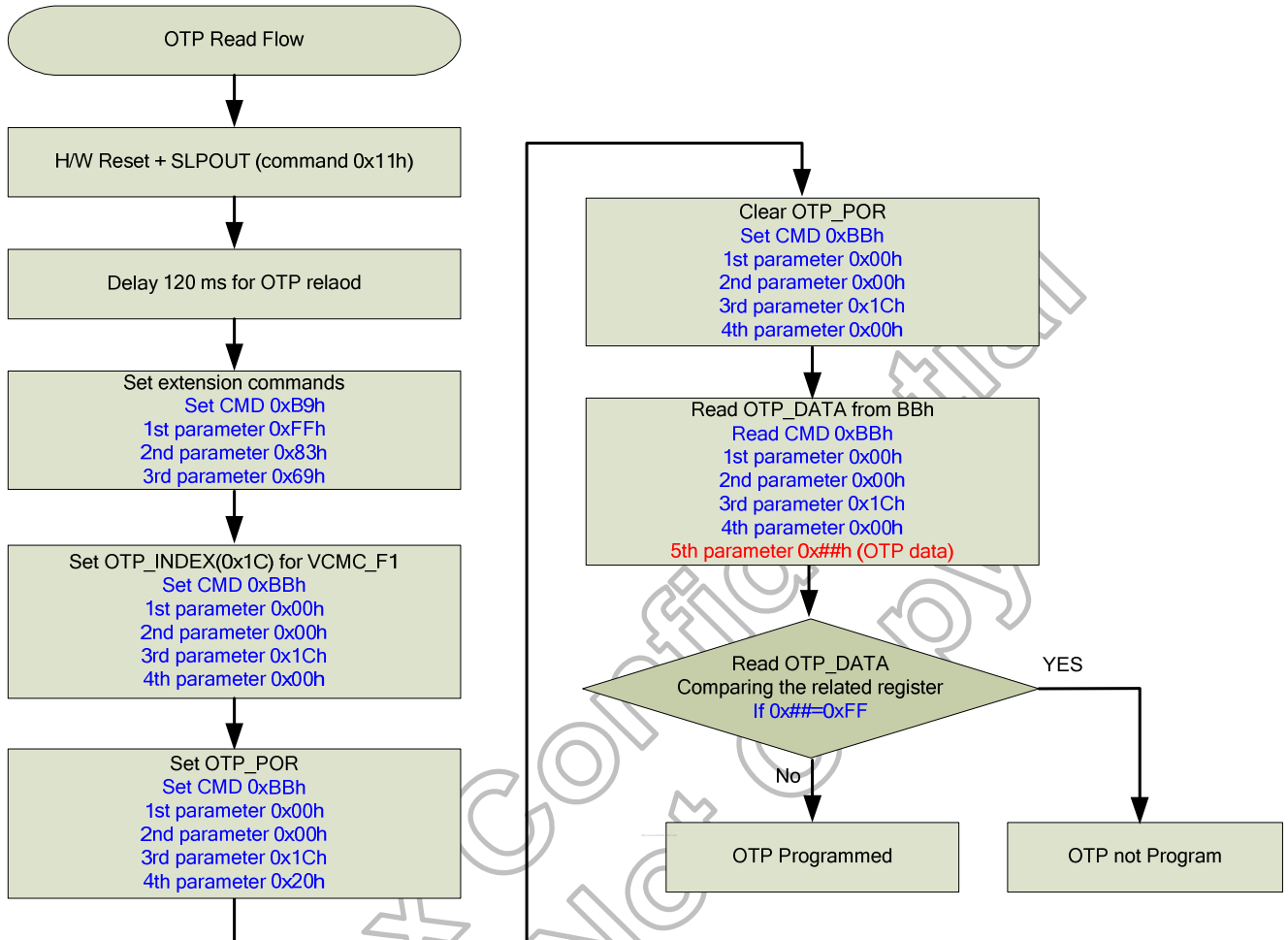


Figure 5.45: OTP programming sequence read flow.

### 5.20 Temperature sensor control

The HX8369-A has the calibration scheme that including Gain and Offset Control to compensate the Temperature Sensor.

The temperature sensor control block diagram as below.

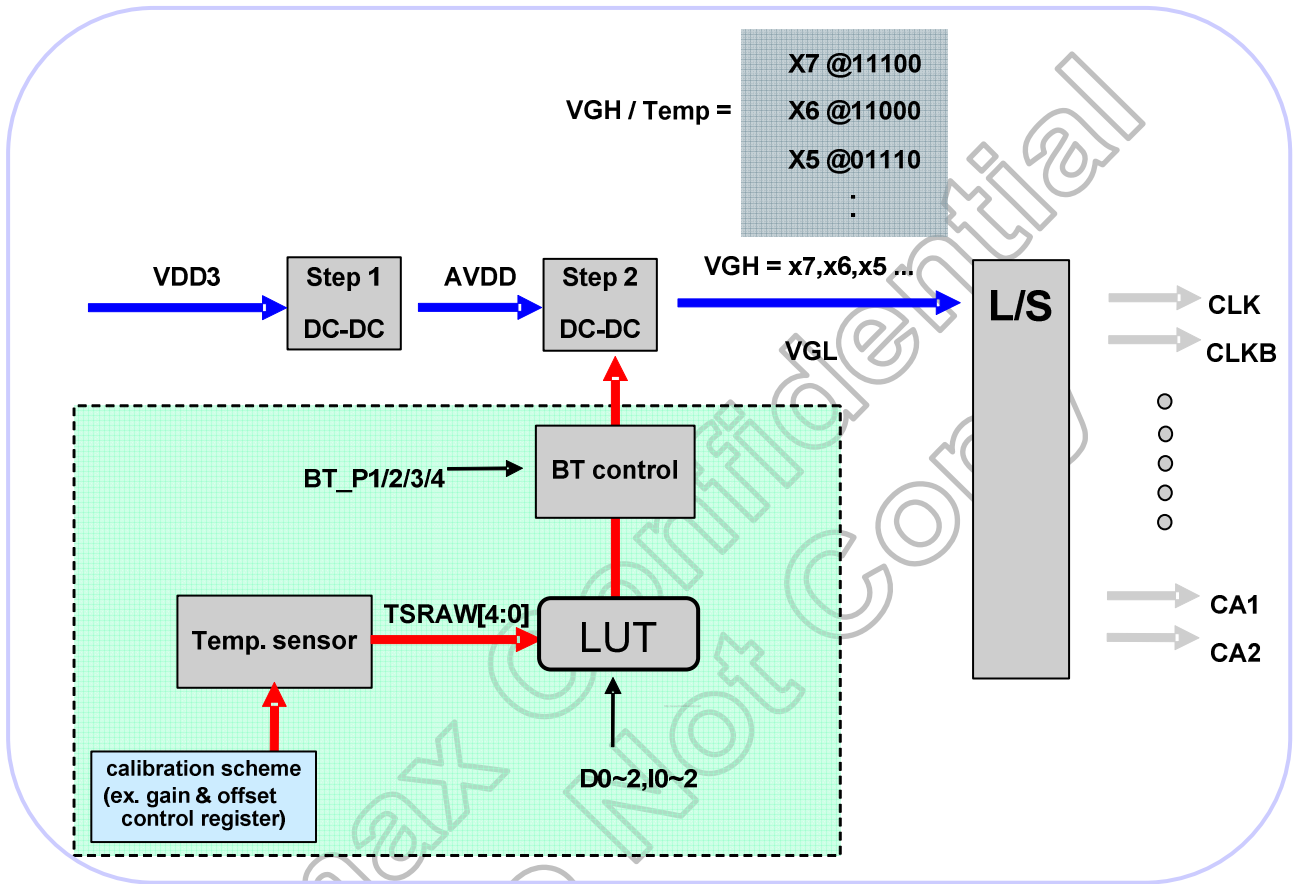


Figure 5.46: Temperature sensor

## 6. Command

### 6.1 Command list

#### 6.1.1 Standard command

(Hex)	Operation code	D/CX	RDX	WRX	D7	D6	D5	D4	D3	D2	D1	D0	Function	Default (Hex)	RGB	
00	NOP	0	1	↑	0	0	0	0	0	0	0	0	No Operation	-	Yes	
01	SWRESET	0	1	↑	0	0	0	0	0	0	0	1	Software Reset	-	Yes	
05	RDNUMPE	0	1	↑	0	0	0	0	0	1	0	1	Read Number of DSI Parity Error	-	-	
		1	↑	1	x	x	x	x	x	x	x	x	x	Dummy read	-	-
		1	↑	1	P[7:0]									-	-	-
06	RDRED	0	1	↑	0	0	0	0	0	1	1	0	Read Red Colour	-	Yes	
		1	↑	1	x	x	x	x	x	x	x	x	x	Dummy read	-	-
		1	↑	1	R7	R6	R5	R4	R3	R2	R1	R0	xx	-	-	
07	RDGREEN	0	1	↑	0	0	0	0	0	1	1	1	Read Green Colour	-	Yes	
		1	↑	1	x	x	x	x	x	x	x	x	x	Dummy read	-	-
		1	↑	1	G7	G6	G5	G4	G3	G2	G1	G0	xx	-	-	
08	RDBLUE	0	1	↑	0	0	0	0	1	0	0	0	Read Blue Colour	-	Yes	
		1	↑	1	x	x	x	x	x	x	x	x	x	Dummy read	-	-
		1	↑	1	B7	B6	B5	B4	B3	B2	B1	B0	xx	-	-	
0A	RDDPM	0	1	↑	0	0	0	0	1	0	1	0	Read display power mode	-	Yes	
		1	↑	1	x	x	x	x	x	x	x	x	x	Dummy read	-	-
		1	↑	1	D7	D6	D5	D4	D3	D2	0	0	-	-	-	
0B	RDDMADCTL	0	1	↑	0	0	0	0	1	0	1	1	Read display MADCTL	-	Yes	
		1	↑	1	x	x	x	x	x	x	x	x	x	Dummy read	-	-
		1	↑	1	D7	D6	D5	D4	D3	D2	0	0	-	-	-	
0C	RDDCOLMOD	0	1	↑	0	0	0	0	1	1	0	0	Read display pixel format	-	Yes	
		1	↑	1	x	x	x	x	x	x	x	x	x	Dummy read	-	-
		1	↑	1	-	D6	D5	D4	-	D2	D1	D0	-	-	-	
0D	RDDIM	0	1	↑	0	0	0	0	1	1	0	1	Read display image mode	-	Yes	
		1	↑	1	x	x	x	x	x	x	x	x	x	Dummy read	-	-
		1	↑	1	D7	D6	D5	0	0	D2	D1	D0	-	-	-	
0E	RDDSM	0	1	↑	0	0	0	0	1	1	1	0	Read display signal mode	-	Yes	
		1	↑	1	x	x	x	x	x	x	x	x	x	Dummy read	-	-
		1	↑	1	D7	D6	0	0	0	0	0	0	-	-	-	
0F	RDDSDR	0	1	↑	0	0	0	0	1	1	1	1	Read display self-diagnostic result	-	Yes	
		1	↑	1	x	x	x	x	x	x	x	x	x	Dummy read	-	-
		1	↑	1	D7	D6	D5	D4	0	0	0	0	-	-	-	

(Hex)	Operation Code	D/CX	RDX	WRX	D7	D6	D5	D4	D3	D2	D1	D0	Function	Default (Hex)	RGB
10	SLPIN	0	1	↑	0	0	0	1	0	0	0	0	Sleep In	-	Yes
11	SLPOUT	0	1	↑	0	0	0	1	0	0	0	1	Sleep Out	-	Yes
12	PTLON	0	1	↑	0	0	0	1	0	0	1	0	Partial Mode On	-	No
13	NORON	0	1	↑	0	0	0	1	0	0	1	1	Normal display mode on	-	No
20	INVOFF	0	1	↑	0	0	1	0	0	0	0	0	Display inversion off	-	No
21	INVON	0	1	↑	0	0	1	0	0	0	0	1	Display inversion on	-	No
26	GAMSET	0	1	↑	0	0	1	0	0	1	1	0	Gamma set	-	Yes
		1	1	↑	GC7	GC6	GC5	GC4	GC3	GC2	GC1	GC0	-	-	-
28	DISPOFF	0	1	↑	0	0	1	0	1	0	0	0	Display off	-	Yes
29	DISPON	0	1	↑	0	0	1	0	1	0	0	1	Display on	-	Yes
2A	CASET	0	1	↑	0	0	1	0	1	0	1	0	Column Address Set	-	No
		1	1	↑	SC15	SC14	SC13	SC12	SC11	SC10	SC9	SC8	Column address start	-	-
		1	1	↑	SC7	SC6	SC5	SC4	SC3	SC2	SC1	SC0	Column address start	-	-
		1	1	↑	EC15	EC14	EC13	EC12	EC11	EC10	EC9	EC8	Column address end	-	-
		1	1	↑	EC7	EC6	EC5	EC4	EC3	EC2	EC1	EC0	Column address end	-	-
2B	PASET	0	1	↑	0	0	1	0	1	0	1	1	Row address set	-	No
		1	1	↑	SP15	SP14	SP13	SP12	SP11	SP10	SP9	SP8	Row address start	-	-
		1	1	↑	SP7	SP6	SP5	SP4	SP3	SP2	SP1	SP0	Row address start	-	-
		1	1	↑	EP15	EP14	EP13	EP12	EP11	EP10	EP9	EP8	Row address end	-	-
		1	1	↑	EP7	EP6	EP5	EP4	EP3	EP2	EP1	EP0	Row address end	-	-
2C	RAMWR	0	1	↑	0	0	1	0	1	1	0	0	Memory Write	-	No
		1	1	↑	D17	D16	D15	D14	D13	D12	D11	D10	Write data	-	-
		1	1	↑	Dx7	Dx6	Dx5	Dx4	Dx3	Dx2	Dx1	Dx0	Write data	-	-
		1	1	↑	Dn7	Dn6	Dn5	Dn4	Dn3	Dn2	Dn1	Dn0	Write data	-	-
2D	RGBSET	0	1	↑	0	0	1	0	1	1	0	1	Color Set	-	Yes
		1	1	↑	R007	R006	R005	R004	R003	R002	R001	R000	Red tone	-	-
		1	1	↑	Rnn7	Rnn6	Rnn5	Rnn4	Rnn3	Rnn2	Rnn1	Rnn0	Red tone	-	-
		1	1	↑	R637	R636	R635	R634	R633	R632	R631	R630	Red tone	-	-
		1	1	↑	G007	G006	G005	G004	G003	G002	G001	G000	Green tone	-	-
		1	1	↑	Gnn7	Gnn6	Gnn5	Gnn4	Gnn3	Gnn2	Gnn1	Gnn0	Green tone	-	-
		1	1	↑	G637	G636	G635	G634	G633	G632	G631	G630	Green tone	-	-
		1	1	↑	B007	B006	B005	B004	B003	B002	B001	B000	Blue tone	-	-
		1	1	↑	Bnn7	Bnn6	Bnn5	Bnn4	Bnn3	Bnn2	Bnn1	Bnn0	Blue tone	-	-
2E	RAMRD	0	1	↑	0	0	1	0	1	1	1	0	Memory read	-	No
		1	↑	1	X	X	X	X	X	X	X	X	Dummy read	-	-
		1	↑	1	D17	D16	D15	D14	D13	D12	D11	D10	Read data	-	-
		1	↑	1	Dx7	Dx6	Dx5	Dx4	Dx3	Dx2	Dx1	Dx0	Read data	-	-
		1	↑	1	Dn7	Dn6	Dn5	Dn4	Dn3	Dn2	Dn1	Dn0	-	-	-
30	PLTAR	0	1	↑	0	0	1	1	0	0	0	0	Partial Area	-	No
		1	1	↑	SR15	SR14	SR13	SR12	SR11	SR10	SR9	SR8	Start row	-	-
		1	1	↑	SR7	SR6	SR5	SR4	SR3	SR2	SR1	SR0	Start row	-	-
		1	1	↑	ER15	ER14	ER13	ER12	ER11	ER10	ER9	ER8	End row	-	-
		1	1	↑	ER7	ER6	ER5	ER4	ER3	ER2	ER1	ER0	End row	-	-



(Hex)	Operation Code	D/CX	RDX	WRX	D7	D6	D5	D4	D3	D2	D1	D0	Function	Default (Hex)	RGB	
33	VSCRDEF	0	1	↑	0	0	1	1	0	0	1	1	Vertical scrolling definition	-	No	
		1	1	↑	TFA[15:8]									-	-	
		1	1	↑	TFA[7:0]									-	-	
		1	1	↑	VSA[15:8]									-	-	
		1	1	↑	VSA[7:0]									-	-	
		1	1	↑	BFA[15:8]									-	-	
1	1	↑	BFA[7:0]									-	-			
34	TEOFF	0	1	↑	0	0	1	1	0	1	0	0	Tearing Effect Line OFF	-	No	
35	TEON	0	1	↑	0	0	1	1	0	1	0	1	Tearing Effect Line ON	-	No	
		1	1	↑	X	X	X	X	X	X	X	X	M	-	-	
36	MADCTL	0	1	↑	0	0	1	1	0	1	1	0	Memory Access Control	-	Yes	
		1	1	↑	B7	B6	B5	B4	B3	B2	X	X	-	-	-	
37	VSCRSADD	0	1	↑	0	0	1	1	0	1	1	1	Vertical scrolling start address	-	No	
		1	1	↑	VSP[15:8]									-	-	
		1	1	↑	VSP[7:0]									-	-	
38	IDMOFF	0	1	↑	0	0	1	1	1	0	0	0	Idle mode off	-	No	
39	IDMON	0	1	↑	0	0	1	1	1	0	0	1	Idle mode on	-	No	
3A	COLMOD	0	1	↑	0	0	1	1	1	0	1	0	-	-	Yes	
		1	1	↑	X	D6	D5	D4	X	D2	D1	D0	-	-	-	
3C	RAMWRCON	0	1	↑	0	0	1	1	1	1	0	0	Memory write	-	No	
		1	1	↑	D17	D16	D15	D14	D13	D12	D11	D10	-	-	-	
		1	1	↑	Dx7	Dx6	Dx5	Dx4	Dx3	Dx2	Dx1	Dx0	-	-	-	
		1	1	↑	Dn7	Dn6	Dn5	Dn4	Dn3	Dn2	Dn1	Dn0	-	-	-	
3E	RAMRDCON	0	1	↑	0	0	1	1	1	1	1	0	Memory read	-	No	
		1	↑	1	X	X	X	X	X	X	X	X	Dummy read	-	-	
		1	↑	1	D17	D16	D15	D14	D13	D12	D11	D10	-	-	-	
		1	↑	1	Dx7	Dx6	Dx5	Dx4	Dx3	Dx2	Dx1	Dx0	-	-	-	
		1	↑	1	Dn7	Dn6	Dn5	Dn4	Dn3	Dn2	Dn1	Dn0	-	-	-	
44	TESL	0	1	↑	0	1	0	0	0	1	0	0	TESL	-	Yes	
		1	1	↑	TELIN[15:8](8'b0)									-	-	
		1	1	↑	TELIN[7:0](8'b0)									-	-	
45	GETSCAN	0	1	↑	0	1	0	0	0	1	0	1	Return the current scanline SLN[15:0]	-	No	
		1	1	↑	SLN[15:8]									-	-	
		1	1	↑	SLN[7:0]									-	-	
51	WRDISBV	0	1	↑	0	1	0	1	0	0	0	1	Write Display Brightness	-	Yes	
		1	1	↑	DBV[7:0]									-	-	
52	RDISBV	0	1	↑	0	1	0	1	0	0	1	0	Read Display Brightness Value	-	Yes	
		1	↑	1	xx	xx	xx	xx	xx	xx	xx	xx	xx	Dummy read	-	-
		1	↑	1	DBV[7:0]									-	-	
53	WRCTRLD	0	1	↑	0	1	0	1	0	0	1	1	Write CTRL Display	-	Yes	
		1	1	↑	xx	xx	BCTRL	xx	DD	BL	xx	xx	-	-	-	
54	RDCTRLD	0	1	↑	0	1	0	1	0	0	1	1	Read Control Value Display	-	Yes	
		1	↑	1	xx	xx	xx	xx	xx	xx	xx	xx	xx	Dummy read	-	-
		1	↑	1	0	0	BCTRL	0	DD	BL	0	0	-	-	-	
55	WRCABC	0	1	↑	0	1	0	1	0	1	0	1	Write Adaptive Brightness Control	-	Yes	
		1	1	↑	xx	xx	xx	xx	xx	xx	xx	CABC[1:0]	-	-	-	
56	RDCABC	0	1	↑	0	1	0	1	0	1	1	0	Read Adaptive Brightness Control Content	-	Yes	
		1	↑	1	XX	XX	XX	XX	XX	XX	XX	XX	XX	Dummy read	-	-
		1	↑	1	0	0	0	0	0	0	0	C1	C0	-	-	-

(Hex)	Operation Code	D/CX	RDX	WRX	D7	D6	D5	D4	D3	D2	D1	D0	Function	Default (Hex)	RGB
5E	WRCABCMB	0	1	↑	0	1	0	1	1	1	1	0	Write CABC minimum brightness	-	Yes
		1	1	↑	CMB[7:0]									-	-
5F	RDCABCMB	0	1	↑	0	1	0	1	1	1	1	1	Read CABC minimum brightness	-	Yes
		1	↑	1	-	XX	XX	XX	XX	XX	XX	XX	Dummy read	-	-
		1	↑	1	CMB[7:0]									-	-
68	RDABCSDR	0	1	↑	0	1	1	0	1	0	0	0	Read Automatic Brightness Control Self-Diagnostic Result	-	Yes
		1	↑	1	XX	XX	XX	XX	XX	XX	XX	XX	-	-	
		1	↑	1	D[7:6]		0	0	0	0	0	0	-	-	
DA	RDID1	0	↑	1	1	1	0	1	1	0	1	0	Read ID1	-	Yes
		1	1	↑	XX	XX	XX	XX	XX	XX	XX	XX	Dummy read	-	-
		1	1	↑	module's manufacturer[7:0]									-	-
DB	RDID2	0	↑	1	1	1	0	1	1	0	1	1	Read ID2	-	Yes
		1	1	↑	XX	XX	XX	XX	XX	XX	XX	XX	Dummy read	-	-
		1	1	↑	LCD module/driver version [6:0]									-	-
DC	RDID3	0	↑	1	1	1	0	1	1	1	0	0	Read ID3	-	Yes
		1	1	↑	XX	XX	XX	XX	XX	XX	XX	XX	Dummy read	-	-
		1	1	↑	LCD module/driver ID[7:0]									-	-
A1	Read_DDB_start	0	1	↑	1	0	1	0	0	0	0	1	Read the DDB from the provided location.	-	Yes
		1	↑	1	XX	XX	XX	XX	XX	XX	XX	XX	Dummy read	-	-
		1	↑	1	x	x	x	x	x	x	x	x	x	-	-
		1	↑	1	x	x	x	x	x	x	x	x	x	-	-
A8	Read_DDB_continue	0	1	↑	1	0	1	0	1	0	0	0	Continue reading the DDB from the last read location.	-	Yes
		1	↑	1	XX	XX	XX	XX	XX	XX	XX	XX	Dummy read	-	-
		1	↑	1	x	x	x	x	x	x	x	x	x	-	-
		1	↑	1	x	x	x	x	x	x	x	x	x	-	-

**Note:** (1) Undefined commands are treated as NOP (00BHB) command.  
 (2) B0BHB to D9BHB and DEBHB to FFBHB are for factory use of display supplier. Nokia can decide if these commands are available or they are treated as NOP (00BHB) commands before shipping to Nokia.  
 Default value is NOP (00BHB).

## 6.1.2 User define command list table

User define command list is available only set "SETEXC" command.

(Hex)	Operation Code	DCX	RDX	WRX	D7	D6	D5	D4	D3	D2	D1	D0	Function	Default (Hex)	
B0	SETOSC	0	1	↑	1	0	1	1	0	0	0	0	Set Internal oscillator	-	
		1	1	↑	-	-	-	-	-	-	-	-	OSC_EN	(00h)	
		1	1	↑	-	-	-	-	-	-	UADJ[3:0]		-	(0Bh)	
B1	SETPOWER	0	1	↑	1	0	1	1	0	0	0	1	Set power related setting	-	
		1	1	↑	VBIAS_EN	VSN_EN	VSP_EN	VGL_EN	VGH_EN	LVGL_EN	VDDDN_HZ	STB	-	(01h)	
		1	1	↑	-	-	-	-	-	-	-	DSTB	-	(00h)	
		1	1	↑	-	FS1[2:0]			-	AP[2:0]		-	(34h)		
		1	1	↑	-	-	-	-	BT[3:0]			-	(07h)		
		1	1	↑	DT[1:0]		-	-	DCDIV[3:0]			-	(00h)		
		1	1	↑	-	-	-	BTP[4:0]			-	(0Eh)			
		1	1	↑	-	-	-	BTN[4:0]			-	(0Eh)			
		1	1	↑	VRHP[7:0]				-				-	(21h)	
		1	1	↑	VRHN[7:0]				-				-	(29h)	
		1	1	↑	-	-	VRMP[5:0]			-				-	(19h)
		1	1	↑	-	-	VRMN[5:0]			-				-	(19h)
		1	1	↑	-	-	DD_TU	VPNL_EN	-	VBS[2:0]			-	(07h)	
		1	1	↑	-	DC86_DIV3	DC86_DIV2	DC86_DIV1	DC86_DIV0	XDK1	XDK0	AUTO_XDK	-	(22h)	
		1	1	↑	-	DTPS[2:0]			-	DTNS[2:0]			-	(01h)	
1	1	↑	A_DC[1:0]		A_DTP[2:0]		A_DTN[2:0]			-	(E6h)				
1	1	↑	B_DC[1:0]		B_DTP[2:0]		B_DTN[2:0]			-	(E6h)				
1	1	↑	C_DC[1:0]		C_DTP[2:0]		C_DTN[2:0]			-	(E6h)				
1	1	↑	D_DC[1:0]		D_DTP[2:0]		D_DTN[2:0]			-	(E6h)				
1	1	↑	E_DC[1:0]		E_DTP[2:0]		E_DTN[2:0]			-	(E6h)				
B2	SETDISP	0	1	↑	1	0	1	1	0	0	1	0	Set display related register	-	
		1	1	↑	-	-	-	-	-	-	D[1:0]		-	(00h)	
		1	1	↑	-	RES_SEL[2:0]			RM	DFR	DM[1:0] <sup>(1)</sup>		-	(10h)	
		1	1	↑	BP [7:0]				-				-	(03h)	
		1	1	↑	FP [7:0]				-				-	(03h)	
		1	1	↑	SAP[3:0]			-	-	-	-	-	-	-	(70h)
		1	1	↑	GEN_ON[7:0]				-				-	(00h)	
		1	1	↑	GEN_OFF[7:0]				-				-	(FFh)	
		1	1	↑	RTN[7:0]				-				-	(00h)	
		1	1	↑	-	-	-	-	TEI[3:0]			-	(00h)		
		1	1	↑	-	-	-	-	-	-	TEP[9:8]		-	(00h)	
		1	1	↑	TEP[7:0]				-				-	(00h)	
		1	1	↑	BP_PE [7:0]				-				-	(03h)	
		1	1	↑	FP_PE [7:0]				-				-	(03h)	
1	1	↑	RTN_PE[7:0]				-				-	(03h)			
1	1	↑	-	-	-	-	-	-	-	-	GON	-	(01h)		
-	-	-	-	Note: (1) When BS[3:0]=1101, 1110, 1111 DM[1:0] default =11 Other condition, DM[1:0] default =00									-	-	
B3	SETRGBIF	0	1	↑	1	0	1	1	0	0	1	1	Set RGB interface related register	-	
		1	1	↑	-	-	-	-	DPL	HSPL	VSPL	EPL	-	(01h)	
B4	SETCYC	0	1	↑	1	0	1	0	0	1	0	0	Set Display waveform cycles	-	
		1	1	↑	-	-	-	-	NW_PE[1:0]		NW[1:0]		-	(00h)	
		1	1	↑	SON[7:0]				-				-	(0Fh)	
		1	1	↑	SOFF[7:0]				-				-	(82h)	
		1	1	↑	EQS[7:0]				-				-	(0Ch)	
1	1	↑	EQON[7:0]				-				-	(03h)			

B6	SETVCOM (OTPx3)	0	1	↑	1	0	1	1	0	1	1	0	Set VCOM Voltage	-		
		1	1	↑	VCMC_F[7:0]								-	(5Eh)		
		1	1	↑	VCMC_B[7:0]								-	(5Eh)		
B9	SETEXTC	0	1	↑	1	0	1	1	1	0	0	1	Set extended command set	-		
		1	1	↑	EXTC1[7:0]								-	(00h/FFh)		
		1	1	↑	EXTC2[7:0]								-	(00h/83h)		
		1	1	↑	EXTC3[7:0]								-	(00h/69h)		
BA	SETMIPI	0	1	↑	1	0	1	1	1	0	1	0	Set MIPI Control	-		
		1	1	↑	DPHYCMD0[7:0]								-	(00h)		
		1	1	↑	DPHYCMD1[7:0]								-	(A0h)		
		1	1	↑	DPHYCMD2[7:0]								-	(C6h)		
		1	1	↑	DSICMD0[7:0]								-	(00h)		
		1	1	↑	DSICMD1[7:0]								-	(0Ah)		
		1	1	↑	DSICMD2[7:0]								-	(00h)		
		1	1	↑	DSICMD3[7:0]								-	(10h)		
		1	1	↑	DPHYOTP0[7:0]								-	(30h)		
		1	1	↑	DPHYOTP1[7:0]								-	(6Fh)		
		1	1	↑	DPHYOTP2[7:0]								-	(02h)		
		1	1	↑	DSIOTP0[7:0]								-	(10h)		
		1	1	↑	DSIOTP1[7:0]								-	(18h)		
BB	SETOTP	1	1	↑	-	DSI_INITRD Y	-	-	-	-	-	-	-	(40h)		
		0	1	↑	1	0	1	1	1	0	1	1	Set OTP	-		
		1	1	↑	OTP_MASK[7:0]								-	(00h)		
		1	1	↑	-	-	-	-	-	-	-	OTP_INDEX[8]	-	(01h)		
		1	1	↑	OTP_INDEX[7:0]								-	(FFh)		
		1	1	↑	OTP_LOAD DISABLE	OTP_TEST	OTP_POR	OTP_PWE	OTP_PTM[1:0]	VPP_SEL	OTP_PROG	-	(00h)			
C1	SETDGLUT	1	1	↑	OTP_DATA[7:0]								OTP read / write	(xxh)		
		0	1	↑	1	1	0	0	0	0	0	1	Set DGC LUT	-		
		1	1	↑	-	-	-	-	-	-	DITH_OPT	DGC_EN	-	-		
		1	1	↑	D1[7:0]								-	-		
		1	1	↑	Dn[7:0]								-	-		
C3	SETID (OTPx5)	1	1	↑	D126[7:0]								-	-		
		0	1	↑	1	1	0	0	0	0	1	1	Set ID	-		
		1	1	↑	ID1[7:0]								-	(00h)		
		1	1	↑	0	ID2[6:0]							-	(00h)		
CC	SETPANEL	1	1	↑	ID3[7:0]							-	(00h)			
		0	1	↑	1	1	0	0	1	1	0	0	Set panel related register	-		
D5	SETGIP	1	1	↑	-	-	-	-	-	-	-	-	-	(02h)		
		1	1	↑	SS_PANEL								REV_PANE	BGR_PANE L	-	(02h)
		0	1	↑	1	1	0	1	0	1	0	1	SET GIP control	-		
		1	1	↑	SHR_0[11:8]								-	(00h)		
		1	1	↑	SHR_0[7:0]								-	(02h)		
		1	1	↑	-	-	-	-	-	-	SHR_1[11:8]	-	(00h)			
		1	1	↑	SHR_1[7:0]								-	(01h)		
		1	1	↑	SPD[7:0]								-	(02h)		
		1	1	↑	CHR[7:0]								-	(03h)		
		1	1	↑	CON[7:0]								-	(20h)		
		1	1	↑	COFF[7:0]								-	(6Ch)		
		1	1	↑	SHP[3:0]				SCP[3:0]				-	(03h)		
		1	1	↑	CHP[3:0]				CCP[3:0]				-	(03h)		
		1	1	↑	SOS_1[3:0]				SOS_0[3:0]				-	(00h)		
		1	1	↑	SOS_3[3:0]				SOS_2[3:0]				-	(00h)		
		1	1	↑	COS_1[3:0]				COS_0[3:0]				-	(60h)		
1	1	↑	COS_3[3:0]				COS_2[3:0]				-	(04h)				
1	1	↑	COS_5[3:0]				COS_4[3:0]				-	(71h)				
1	1	↑	COS_7[3:0]				COS_6[3:0]				-	(75h)				
1	1	↑	SOS_1_ML[3:0]				SOS_0_ML[3:0]				-	(00h)				

		1	1	↑	SOS_3_ML[3:0]				SOS_2_ML[3:0]				-	(00h)	
		1	1	↑	COS_1_ML[3:0]				COS_0_ML[3:0]				-	(51h)	
		1	1	↑	COS_3_ML[3:0]				COS_2_ML[3:0]				-	(57h)	
		1	1	↑	COS_5_ML[3:0]				COS_4_ML[3:0]				-	(40h)	
		1	1	↑	COS_7_ML[3:0]				COS_6_ML[3:0]				-	(46h)	
		1	1	↑	-	-	GTO[5:0]				-	(01h)			
		1	1	↑	GNO[7:0]								-	(0Ch)	
		1	1	↑	EQ_DELAY[7:0]								-	(0Ch)	
		1	1	↑	GIP_OPT[7:0]								-	(00h)	
D8	SETTPSNR	0	1	↑	1	1	0	1	1	0	0	1	Set the Temp Senor control		
		1	1	↑	-	-	-	TSRAW[4:0]				(read only)			
		1	1	↑	-	-	-	TS_OS2[4:0]				-	(12h)		
		1	1	↑	BT_P2[3:0]				BT_P1[3:0]				-	(74h)	
		1	1	↑	BT_P4[3:0]				BT_P3[3:0]				-	(A7h)	
		1	1	↑	-	-	-	D0[4:0]				-	(0Ch)		
		1	1	↑	TS_G[2:0]				I0[4:0]				-	(6Ah)	
		1	1	↑	-	TS_OS1[4:3]				D1[4:0]				-	(57h)
		1	1	↑	TS_OS1[2:0]				I1[4:0]				-	(55h)	
		1	1	↑	PORE	RER[1:0]				D2[4:0]				-	(17h)
		1	1	↑	-	TF_ON	TSON				I2[4:0]	-	(55h)		
E0	SETGAMMA (OTPx1)	0	1	↑	1	1	1	0	0	0	0	0	Set Gamma Curve Related Setting	-	
		1	1	↑	-	-	G1_VRP0[5:0]				-	(00h)			
		1	1	↑	-	-	G1_VRP1[5:0]				-	(18h)			
		1	1	↑	-	-	G1_VRP2[5:0]				-	(1Fh)			
		1	1	↑	-	-	G1_VRP3[5:0]				-	(3Fh)			
		1	1	↑	-	-	G1_VRP4[5:0]				-	(3Fh)			
		1	1	↑	-	-	G1_VRP5[5:0]				-	(3Fh)			
		1	1	↑	-	G1_PRP0[6:0]				-	(33h)				
		1	1	↑	-	G1_PRP1[6:0]				-	(57h)				
		1	1	↑	G1_CGMP0[1:0]	-	G1_PKP0[4:0]				-	(07h)			
		1	1	↑	G1_CGMP1[1:0]	-	G1_PKP1[4:0]				-	(0Dh)			
		1	1	↑	G1_CGMP2[1:0]	-	G1_PKP2[4:0]				-	(0Fh)			
		1	1	↑	G1_CGMP3[1:0]	-	G1_PKP3[4:0]				-	(13h)			
		1	1	↑	G1_CGMP5	G1_CGMP4	-	G1_PKP4[4:0]				-	(16h)		
		1	1	↑	-	-	-	G1_PKP5[4:0]				-	(14h)		
		1	1	↑	-	-	-	G1_PKP6[4:0]				-	(16h)		
		1	1	↑	-	-	-	G1_PKP7[4:0]				-	(18h)		
		1	1	↑	-	-	-	G1_PKP8[4:0]				-	(1Fh)		
		1	1	↑	-	-	G1_VRN0[5:0]				-	(00h)			
		1	1	↑	-	-	G1_VRN1[5:0]				-	(18h)			
		1	1	↑	-	-	G1_VRN2[5:0]				-	(1Fh)			
		1	1	↑	-	-	G1_VRN3[5:0]				-	(3Fh)			
		1	1	↑	-	-	G1_VRN4[5:0]				-	(3Fh)			
		1	1	↑	-	-	G1_VRN5[5:0]				-	(3Fh)			
		1	1	↑	-	G1_PRN0[6:0]				-	(33h)				
		1	1	↑	-	G1_PRN1[6:0]				-	(57h)				
		1	1	↑	G1_CGMN0[1:0]	-	G1_PKN0[4:0]				-	(07h)			
		1	1	↑	G1_CGMN1[1:0]	-	G1_PKN1[4:0]				-	(0Dh)			
		1	1	↑	G1_CGMN2[1:0]	-	G1_PKN2[4:0]				-	(0Fh)			
		1	1	↑	G1_CGMN3[1:0]	-	G1_PKN3[4:0]				-	(13h)			
		1	1	↑	G1_CGMN5	G1_CGMN4	-	G1_PKN4[4:0]				-	(16h)		
		1	1	↑	-	-	-	G1_PKN5[4:0]				-	(14h)		
		1	1	↑	-	-	-	G1_PKN6[4:0]				-	(16h)		
		1	1	↑	-	-	-	G1_PKN7[4:0]				-	(18h)		
1	1	↑	-	-	-	G1_PKN8[4:0]				-	(1Fh)				
E9	SETOTPKEY	0	1	↑	1	1	1	0	1	0	1	-	-		
		1	1	↑	OTP_KEY0[7:0]				-	(00h/AAh)					
		1	1	↑	OTP_KEY1[7:0]				-	(00h/55h)					
F4	GETHXID	0	1	↑	1	1	1	1	0	1	0	0	-	-	

		1	↑	1	Himax ID[7:0]							-	(69h)	
		1	↑	1	Version[7:0]							-	(02h)	
FD	SETCNCD/ GETCNCD	0	1	↑	1	1	1	1	1	1	0	1	Set/Get Continue Command	-
		1	1	↑	WR_CMD_CN[7:0]							-	-	
FE	SET READ INDEX	0	1	↑	1	1	1	1	1	1	1	0	SET READ Command Address	-
		1	1	↑	CMD_ADD[7:0]							-	(00h)	
FF	GETSPIREAD	0	1	↑	1	1	1	1	1	1	1	1	Read Command Data	-
		1	↑	1	CMD_DATA1[7:0]							-	-	
		1	↑	1	:							-	-	
		1	↑	1	CMD_DATAN[7:0]							-	-	

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## 6.2 Command description

### 6.2.1 NOP (00h)

00H	NOP (No Operation)												
	D/CX	RDX	WRX	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX
<b>Command</b>	0	1	↑	-	0	0	0	0	0	0	0	0	00
Parameter	NO PARAMETER												
Description	This command is an empty command; it does not have any effect on the display module. However it can be used to terminate Frame Memory Write or Read as described in RAMWR (Memory Write) and RAMRD (Memory Read) Commands.												
Restriction	-												
Register Availability	Status						Availability						
	Normal Mode On, Idle Mode Off, Sleep Out						Yes						
	Normal Mode On, Idle Mode On, Sleep Out						Yes						
	Partial Mode On, Idle Mode Off, Sleep Out						Yes						
	Partial Mode On, Idle Mode On, Sleep Out						Yes						
Default	N/A												
Flow Chart	-												

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**6.2.2 Software reset (01h)**

01H	SWRESET (Software Reset)												
	D/CX	RDX	WRX	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	1	0	0	0	0	0	0	0	1	01
Parameter	NO PARAMETER												
Description	When the Software Reset command is written, it causes a software reset. It resets the commands and parameters to their S/W Reset default values. (See default tables in each command description.) Note: The Frame Memory contents are unaffected by this command. It will be necessary to wait 5msec before sending new command following software reset.												
Restriction	The display module loads all display supplier's factory default values to the registers during this 5msec. If Software Reset is applied during Sleep Out mode, it will be necessary to wait 120msec before sending Sleep out command. Software Reset Command cannot be sent during Sleep Out sequence.												
Register Availability	Status						Availability						
	Normal Mode On, Idle Mode Off, Sleep Out						Yes						
	Normal Mode On, Idle Mode On, Sleep Out						Yes						
	Partial Mode On, Idle Mode Off, Sleep Out						Yes						
	Partial Mode On, Idle Mode On, Sleep Out						Yes						
Default	N/A												
Flow Chart	<pre> graph TD     A[SWRESET] --&gt; B[Display whole blank screen]     B --&gt; C[Set Commands to S/W Default Value]     C --&gt; D[Sleep In Mode]     </pre>												

6.2.3 RDNUMPE: Read number of the parity errors (05h)

05H	RDNUMPE (Read Number of the Parity Errors)												HEX										
	D/CX	RDX	WRX	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0											
Command	0	1	↑	-	0	0	0	0	0	1	0	1	05										
1 <sup>st</sup> parameter	1	↑	1	-	x	x	x	x	x	x	x	x	Dummy read										
2 <sup>nd</sup> parameter	1	↑	1	-	P7	P6	P5	P4	P3	P2	P1	P0	xx										
Description	The first parameter is telling a number of the errors on DSI. The more detailed description of the bits is below. P[6..0] bits are telling a number of the errors. P[7] is set to '1' if there is overflow with P[6..0] bits. P[7..0] bits are set to '0's (as well as RDDSM(0Eh)'s D0 is set '0' at the same time) after there is sent the second parameter information (The read function is completed).																						
Restriction	SETEXTC turn on to enable this command																						
Register Availability	<table border="1"> <thead> <tr> <th>Status</th> <th>Availability</th> </tr> </thead> <tbody> <tr> <td>Normal Mode On, Idle Mode Off, Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Normal Mode On, Idle Mode On, Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Partial Mode On, Idle Mode Off, Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Partial Mode On, Idle Mode On, Sleep Out</td> <td>Yes</td> </tr> </tbody> </table>													Status	Availability	Normal Mode On, Idle Mode Off, Sleep Out	Yes	Normal Mode On, Idle Mode On, Sleep Out	Yes	Partial Mode On, Idle Mode Off, Sleep Out	Yes	Partial Mode On, Idle Mode On, Sleep Out	Yes
Status	Availability																						
Normal Mode On, Idle Mode Off, Sleep Out	Yes																						
Normal Mode On, Idle Mode On, Sleep Out	Yes																						
Partial Mode On, Idle Mode Off, Sleep Out	Yes																						
Partial Mode On, Idle Mode On, Sleep Out	Yes																						
Default	P[7:0] = 0x00h																						
Flow Chart	<div style="display: flex; justify-content: space-between;"> <div style="width: 60%;"> <p style="text-align: center;">DSI I/F Mode</p> <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;">RDNUMPE (R05h)</div> <p style="text-align: center;">↓</p> <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;">Send 1st parameter</div> <p style="text-align: center;">↓</p> <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;">                     RDDSM (R0Eh)'s D0 = '0'                      P[7:0] = "00"h                 </div> </div> <div style="width: 35%; border: 1px dashed black; padding: 5px;"> <p>Legend</p> <div style="border: 1px solid black; padding: 2px; margin-bottom: 5px; width: 80px; height: 20px; margin-left: 20px;">Command</div> <div style="border: 1px solid black; padding: 2px; margin-bottom: 5px; width: 100px; height: 20px; margin-left: 20px; transform: rotate(-15deg);">Parameter</div> <div style="border: 1px solid black; padding: 2px; margin-bottom: 5px; width: 100px; height: 20px; margin-left: 20px; border-radius: 10px;">Display</div> <div style="border: 1px solid black; padding: 2px; margin-bottom: 5px; width: 100px; height: 20px; margin-left: 20px; border-radius: 10px;">Action</div> <div style="border: 1px solid black; padding: 2px; margin-bottom: 5px; width: 100px; height: 20px; margin-left: 20px; border-radius: 10px;">Mode</div> <div style="border: 1px solid black; padding: 2px; margin-bottom: 5px; width: 100px; height: 20px; margin-left: 20px; border-radius: 10px;">Sequential transfer</div> </div> </div> <p style="text-align: center; margin-top: 10px;">Host Driver</p>																						

6.2.4 Get\_red\_channel (06h)

06H	RDRED (Read Red Colour)												HEX
	D/CX	RDX	WRX	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0	
Command	0	1	↑	-	0	0	0	0	0	1	1	0	06
1 <sup>st</sup> parameter	1	↑	1	-	x	x	x	x	x	x	x	x	Dummy read
2 <sup>nd</sup> parameter	1	↑	1	-	R7	R6	R5	R4	R3	R2	R1	R0	xx
Description	The first parameter is telling red colour value of the first pixel of the frame when there is used DPI I/F. 16 bit format: R5 is MSB and R1 is LSB. R7, R6 and R0 are set to '0'. 18 bit format: R5 is MSB and R0 is LSB. R7 and R6 are set to '0'.												
Restriction	-												
Register Availability	Status						Availability						
	Sleep Out						Yes						
Default	R[7:0] = 0x00h												
Flow Chart													

6.2.5 Get\_green\_channel (07h)

07H	RDGREEN (Read Green Colour)												HEX
	D/CX	RDX	WRX	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0	
Command	0	1	↑	-	0	0	0	0	0	1	1	1	07
1 <sup>st</sup> parameter	1	↑	1	-	x	x	x	x	x	x	x	x	Dummy read
2 <sup>nd</sup> parameter	1	↑	1	-	G7	G6	G5	G4	G3	G2	G1	G0	xx
Description	The first parameter is telling green colour value of the first pixel of the frame when there is used DPI I/F. 16 and 18 bit formats: G5 is MSB and G0 is LSB. G7 and G6 are set to '0'.												
Restriction	-												
Register Availability	Status						Availability						
	Sleep Out						Yes						
Default	G[7:0] = 0x00h												
Flow Chart	<div style="border: 1px dashed black; padding: 10px;"> <p style="text-align: center;">Serial I/F Mode</p> <p style="text-align: center;">Host ----- Driver</p> </div>												

**6.2.6 Get\_blue\_channel (08h)**

08H	RDBLUE (Read Blue Colour)												HEX
	D/CX	RDX	WRX	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0	
Command	0	1	↑	-	0	0	0	0	1	0	0	0	08
1 <sup>st</sup> parameter	1	↑	1	-	x	x	x	x	x	x	x	x	Dummy read
2 <sup>nd</sup> parameter	1	↑	1	-	B7	B6	B5	B4	B3	B2	B1	B0	xx
Description	The first parameter is telling blue colour value of the first pixel of the frame when there is used DPI I/F. 16 bit format: B5 is MSB and B1 is LSB. B7, B6 and B0 are set to '0'. 18 bit format: B5 is MSB and B0 is LSB. B7 and B6 are set to '0'.												
Restriction	-												
Register Availability	Status		Availability										
	Sleep Out		Yes										
	Sleep In		Yes										
Default	B[7:0] = 0x00h												
Flow Chart	<p>The flowchart illustrates the communication between the Host and the Driver for the RDBLUE (08h) command. The Host sends the RDBLUE (08h) command, which is received by the Driver. The Driver then sends the data D[7:0]. A legend defines the symbols used in the flowchart: Command (trapezoid), Parameter (parallelogram), Display (hexagon), Action (pointed rectangle), Mode (rounded rectangle), and Sequential transfer (oval).</p>												

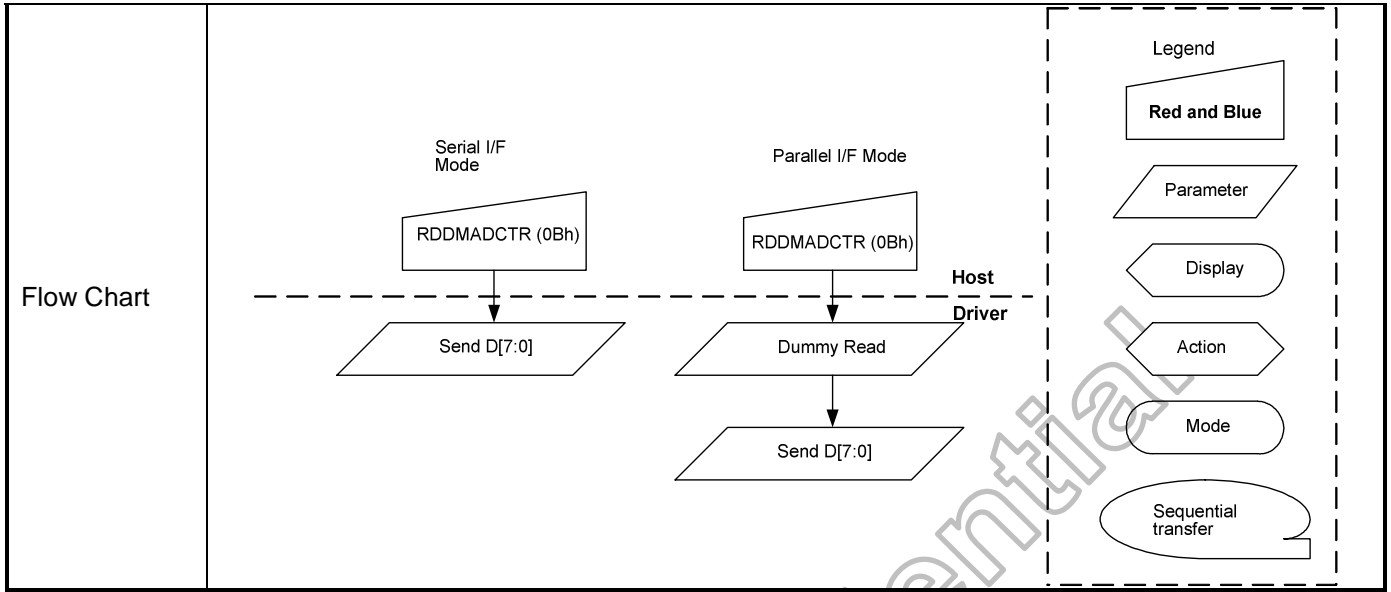


6.2.7 Get\_power\_mode (0Ah)

0AH	RDDPM (Read Display Power Mode)												HEX
	D/CX	RDX	WRX	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0	
Command	0	1	↑	-	0	0	0	0	1	0	1	0	0A
1 <sup>st</sup> parameter	1	↑	1	-	x	x	x	x	x	x	x	x	Dummy read
2 <sup>nd</sup> parameter	1	↑	1	-	D7	D6	D5	D4	D3	D2	0	0	xx
Description	This command indicates the current status of the display as described in the table below:												
	Bit		Description										Comment
D7		Not Defined										Set to '0'	
D6		Idle Mode On/Off										-	
D5		Partial Mode On/Off										-	
D4		Sleep In/Out										-	
D3		Display Normal Mode On/Off										-	
D2		Display On/Off										-	
D1		Not Defined										Set to '0'	
D0		Not Defined										Set to '0'	
Bits D7 for future use and are set to '0'. Bit D6 – Idle Mode On/Off '0' = Idle Mode Off. '1' = Idle Mode On. Bit D5 – Partial Mode On/Off '0' = Partial Mode Off. '1' = Partial Mode On. Bit D4 – Sleep In/Out '0' = Sleep In Mode. '1' = Sleep Out Mode. Bit D3 – Display Normal Mode On/Off '0' = Display Normal Mode Off. '1' = Display Normal Mode On. Bit D2 – Display On/Off '0' = Display is Off. '1' = Display is On.													
Restrictions	-												
Register Availability	Status					Availability							
	Normal Mode On, Idle Mode Off, Sleep Out					Yes							
	Normal Mode On, Idle Mode On, Sleep Out					Yes							
	Partial Mode On, Idle Mode Off, Sleep Out					Yes							
Partial Mode On, Idle Mode On, Sleep Out					Yes								
Default	D[7:0] = 0x08h												

6.2.8 Read display MADCTL (0Bh)

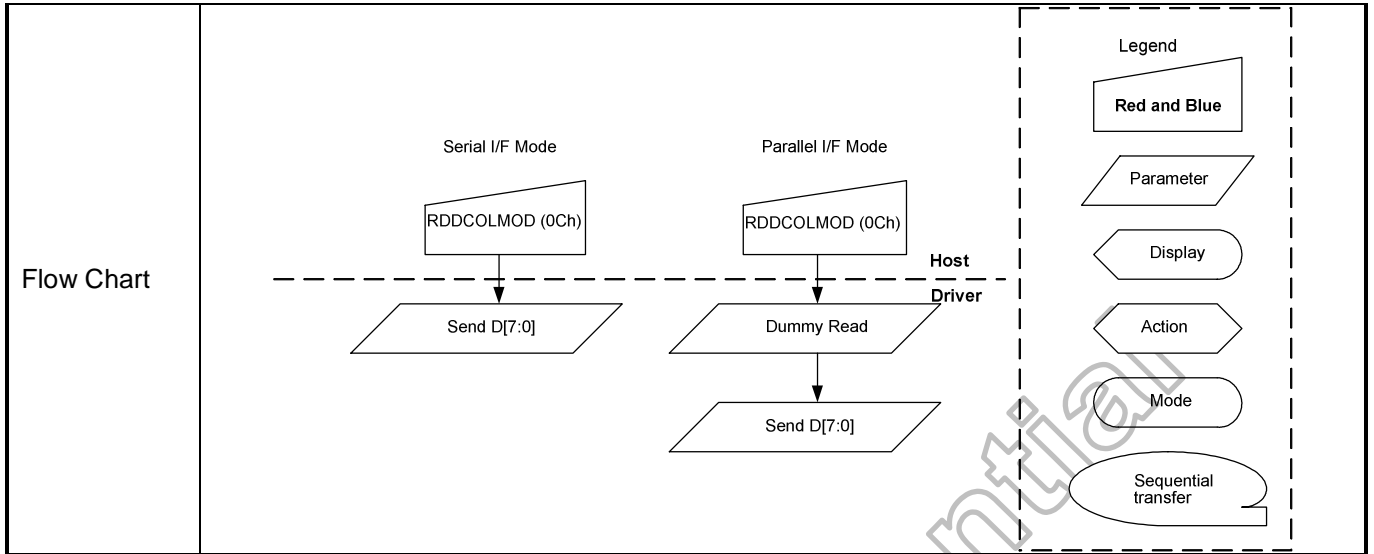
0BH	RDDMADCTL (Read Display MADCTL)												HEX																										
	D/CX	RDX	WRX	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0																											
Command	0	1	↑	-	0	0	0	0	1	0	1	1	0B																										
1 <sup>st</sup> parameter	1	↑	1	-	x	x	x	x	x	x	x	x	Dummy read																										
2 <sup>nd</sup> parameter	1	↑	1	-	D7	D6	D5	D4	D3	D2	0	0	xx																										
Description	This command indicates the current status of the display as described in the table below:																																						
	<table border="1"> <thead> <tr> <th>Bit</th> <th>Description</th> <th>Comment</th> </tr> </thead> <tbody> <tr> <td>D7</td> <td>Page Address Order</td> <td>-</td> </tr> <tr> <td>D6</td> <td>Column Address Order</td> <td>-</td> </tr> <tr> <td>D5</td> <td>Page/Column Order</td> <td>-</td> </tr> <tr> <td>D4</td> <td>Line Address Order</td> <td>-</td> </tr> <tr> <td>D3</td> <td>RGB/BGR Order</td> <td>-</td> </tr> <tr> <td>D2</td> <td>Display Data Latch Order</td> <td>-</td> </tr> <tr> <td>D1</td> <td>Reserved</td> <td>Set to '0'</td> </tr> <tr> <td>D0</td> <td>Reserved</td> <td>Set to '0'</td> </tr> </tbody> </table> <p>                     Bit D7 – Page Address Order                      '0' = Top to Bottom (When MADCTL B7='0').                      '1' = Bottom to Top (When MADCTL B7='1').                      Bit D6 – Column Address Order                      '0' = Left to Right (When MADCTL B6='0').                      '1' = Right to Left (When MADCTL B6='1').                      Bit D5 – Page/Column Order                      '0' = Normal (When MADCTL B5='0').                      '1' = Roration (When MADCTL B5='1').                      Note: For Bits D7 to D5, also refer to Section 5.3 MCU to memory write/read direction.                      Bit D4 – Line Address Order                      '0' = LCD Refresh Top to Bottom (When MADCTL B4='0').                      '1' = LCD Refresh Bottom to Top (When MADCTL B4='1').                      Bit D3 – RGB/BGR Order                      '0' = RGB (When MADCTL B3='0').                      '1' = BGR (When MADCTL B3='1').                      Note: For Bits D4 and D3 also refer to Section 6.2.31 Set_address_mode (36h).                      Bit D2 – Display Data Latch Data Order                      '0' = LCD Refresh Left to Right (When MADCTL B2='0').                      '1' = LCD Refresh Right to Left (When MADCTL B2='1').                 </p>													Bit	Description	Comment	D7	Page Address Order	-	D6	Column Address Order	-	D5	Page/Column Order	-	D4	Line Address Order	-	D3	RGB/BGR Order	-	D2	Display Data Latch Order	-	D1	Reserved	Set to '0'	D0	Reserved
Bit	Description	Comment																																					
D7	Page Address Order	-																																					
D6	Column Address Order	-																																					
D5	Page/Column Order	-																																					
D4	Line Address Order	-																																					
D3	RGB/BGR Order	-																																					
D2	Display Data Latch Order	-																																					
D1	Reserved	Set to '0'																																					
D0	Reserved	Set to '0'																																					
Restrictions	-																																						
Register Availability	Status		Availability																																				
	Normal Mode On, Idle Mode Off, Sleep Out		Yes																																				
	Normal Mode On, Idle Mode On, Sleep Out		Yes																																				
	Partial Mode On, Idle Mode Off, Sleep Out		Yes																																				
	Partial Mode On, Idle Mode On, Sleep Out		Yes																																				
Sleep In or Booster Off		Yes																																					
Default	D[7:0] = 0x00h																																						



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6.2.9 Get\_pixel\_format (0Ch)

0CH	RDDCOLMOD (Read Display COLMOD)												HEX
	D/CX	RDX	WRX	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0	
Command	0	1	↑	-	0	0	0	0	1	1	0	0	0C
1 <sup>st</sup> parameter	1	↑	1	-	x	x	x	x	x	x	x	x	Dummy read
2 <sup>nd</sup> parameter	1	↑	1	-	-	D6	D5	D4	-	D2	D1	D0	xx
Description	This command indicates the current status of the display as described in the table below:												
	Bit		Description										Comment
	D7		Reserved										Set to '0'
	D6		DPI Interface Pixel format										-
	D5												-
	D4												-
	D3												Reserved
	D2		DBI Interface Pixel format										-
	D1												-
	D0												-
Bits D6, D5, D4 – DPI Interface Colour Pixel Format Definition Bits D2, D1, D0 – DBI Interface Colour Pixel Format Definition. For Setting pixel format, see section 6.2.35 Set_pixel_format (3Ah)".													
Interface Colour Format		D6	D5	D4									
		D2	D1	D0									
Not Defined		0	0	0									
Not Defined		0	0	1									
Not Defined		0	1	0									
Not Defined		0	1	1									
Not Defined		1	0	0									
16 bit/pixel		1	0	1									
18 bit/pixel		1	1	0									
24 bit/pixel		1	1	1									
If a particular interface, either DBI or DPI, is not used then the corresponding bits in the parameter returned from the display module are undefined.													
Restrictions	-												
Register Availability	Status					Availability							
	Normal Mode On, Idle Mode Off, Sleep Out					Yes							
	Normal Mode On, Idle Mode On, Sleep Out					Yes							
	Partial Mode On, Idle Mode Off, Sleep Out					Yes							
	Partial Mode On, Idle Mode On, Sleep Out					Yes							
Sleep In or Booster Off					Yes								
Default	D[7:0] = 0x07h												



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**6.2.10 Get\_display\_mode (0Dh)**

0DH	RDDIM (Read Display Image Mode)												HEX																																												
	D/CX	RDX	WRX	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0																																													
Command	0	1	↑	-	0	0	0	0	1	1	0	1	0D																																												
1 <sup>st</sup> parameter	1	↑	1	-	x	x	x	x	x	x	x	x	Dummy read																																												
2 <sup>nd</sup> parameter	1	↑	1	-	D7	D6	D5	0	0	D2	D1	D0	xx																																												
Description	<p>This command indicates the current status of the display as described in the table below:                      Bit D7 – Vertical Scrolling On/Off                      ‘0’ = Vertical Scrolling is Off.                      ‘1’ = Vertical Scrolling is On.                      Bit D6 – Horizontal Scrolling Status                      This bit is not applicable for this project, so it is set to ‘0’                      Bit D5 – Inversion On/Off                      ‘0’ = Inversion is Off.                      ‘1’ = Inversion is On.                      Bit D4, D4 – Reserved                      Bits D2, D1, D0 – Gamma Curve Selection</p> <table border="1"> <thead> <tr> <th>Gamma Curve Selected</th> <th>D2</th> <th>D1</th> <th>D0</th> <th>Gamma Set (26h) Parameter</th> </tr> </thead> <tbody> <tr> <td>Gamma Curve 1</td> <td>0</td> <td>0</td> <td>0</td> <td>GC0</td> </tr> <tr> <td>Gamma Curve 2</td> <td>0</td> <td>0</td> <td>1</td> <td>GC1</td> </tr> <tr> <td>Gamma Curve 3</td> <td>0</td> <td>1</td> <td>0</td> <td>GC2</td> </tr> <tr> <td>Gamma Curve 4</td> <td>0</td> <td>1</td> <td>1</td> <td>GC3</td> </tr> <tr> <td>Not Defined</td> <td>1</td> <td>0</td> <td>0</td> <td>Not Defined</td> </tr> <tr> <td>Not Defined</td> <td>1</td> <td>0</td> <td>1</td> <td>Not Defined</td> </tr> <tr> <td>Not Defined</td> <td>1</td> <td>1</td> <td>0</td> <td>Not Defined</td> </tr> <tr> <td>Not Defined</td> <td>1</td> <td>1</td> <td>1</td> <td>Not Defined</td> </tr> </tbody> </table>												Gamma Curve Selected	D2	D1	D0	Gamma Set (26h) Parameter	Gamma Curve 1	0	0	0	GC0	Gamma Curve 2	0	0	1	GC1	Gamma Curve 3	0	1	0	GC2	Gamma Curve 4	0	1	1	GC3	Not Defined	1	0	0	Not Defined	Not Defined	1	0	1	Not Defined	Not Defined	1	1	0	Not Defined	Not Defined	1	1	1	Not Defined
Gamma Curve Selected	D2	D1	D0	Gamma Set (26h) Parameter																																																					
Gamma Curve 1	0	0	0	GC0																																																					
Gamma Curve 2	0	0	1	GC1																																																					
Gamma Curve 3	0	1	0	GC2																																																					
Gamma Curve 4	0	1	1	GC3																																																					
Not Defined	1	0	0	Not Defined																																																					
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Partial Mode On, Idle Mode On, Sleep Out	Yes																																																								
Sleep In or Booster Off	Yes																																																								
Default	D[7:0] = 0x00h																																																								
Flow Chart																																																									



**6.2.11 Get\_signal\_mode (0Eh)**

0EH	RDDSM (Read Display Signal Mode)												HEX												
	D/CX	RDX	WRX	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0													
Command	0	1	↑	-	0	0	0	0	1	1	1	0	0E												
1 <sup>st</sup> parameter	1	↑	1	-	x	x	x	x	x	x	x	x	Dummy read												
2 <sup>nd</sup> parameter	1	↑	1	-	D7	D6	0	0	0	0	0	0	xx												
Description	This command indicates the current status of the display as described in the table below: Bit D7 – Tearing Effect Line On/Off '0' = Tearing Effect Line Off. '1' = Tearing Effect On. Bit D6 – Tearing Effect Line Output Mode, see section 5.5.3 for mode definitions. '0' = Mode 1. '1' = Mode 2. D5 are D0 – are for future use and are set to '0'.																								
Restrictions	-																								
Register Availability	<table border="1"> <thead> <tr> <th>Status</th> <th>Availability</th> </tr> </thead> <tbody> <tr> <td>Normal Mode On, Idle Mode Off, Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Normal Mode On, Idle Mode On, Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Partial Mode On, Idle Mode Off, Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Partial Mode On, Idle Mode On, Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Sleep In or Booster Off</td> <td>Yes</td> </tr> </tbody> </table>													Status	Availability	Normal Mode On, Idle Mode Off, Sleep Out	Yes	Normal Mode On, Idle Mode On, Sleep Out	Yes	Partial Mode On, Idle Mode Off, Sleep Out	Yes	Partial Mode On, Idle Mode On, Sleep Out	Yes	Sleep In or Booster Off	Yes
Status	Availability																								
Normal Mode On, Idle Mode Off, Sleep Out	Yes																								
Normal Mode On, Idle Mode On, Sleep Out	Yes																								
Partial Mode On, Idle Mode Off, Sleep Out	Yes																								
Partial Mode On, Idle Mode On, Sleep Out	Yes																								
Sleep In or Booster Off	Yes																								
Default	D[7:0] = 0x00h																								
Flow Chart																									

6.2.12 Get\_diagnostic\_result (0Fh)

0FH	RDDSDR (Read Display Self-Diagnostic Result)												HEX											
	D/CX	RDX	WRX	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0												
Command	0	1	↑	-	0	0	0	0	1	1	1	1	0F											
1 <sup>st</sup> parameter	1	↑	1	-	x	x	x	x	x	x	x	x	Dummy read											
2 <sup>nd</sup> parameter	1	1	1	-	D7	D6	D5	D4	0	0	0	0	xx											
Description	The display module returns the self-diagnostic results following a Sleep Out command. See section 5.15 for a description of the status results. Bit D7 – Register Loading Detection Bit D6 – Functionality Detection Bit D5 – Chip Attachment Detection Set to '0' if feature unimplemented. Bit D4 – Display Glass Break Detection Set to '0' if feature unimplemented. Bits D[3:0] – Reserved Set to '0'.																							
Restrictions	-																							
Register Availability	<table border="1"> <thead> <tr> <th>Status</th> <th>Availability</th> </tr> </thead> <tbody> <tr> <td>Normal Mode On, Idle Mode Off, Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Normal Mode On, Idle Mode On, Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Partial Mode On, Idle Mode Off, Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Partial Mode On, Idle Mode On, Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Sleep In or Booster Off</td> <td>Yes</td> </tr> </tbody> </table>												Status	Availability	Normal Mode On, Idle Mode Off, Sleep Out	Yes	Normal Mode On, Idle Mode On, Sleep Out	Yes	Partial Mode On, Idle Mode Off, Sleep Out	Yes	Partial Mode On, Idle Mode On, Sleep Out	Yes	Sleep In or Booster Off	Yes
Status	Availability																							
Normal Mode On, Idle Mode Off, Sleep Out	Yes																							
Normal Mode On, Idle Mode On, Sleep Out	Yes																							
Partial Mode On, Idle Mode Off, Sleep Out	Yes																							
Partial Mode On, Idle Mode On, Sleep Out	Yes																							
Sleep In or Booster Off	Yes																							
Default	D[7:0] = 0x00h																							
Flow Chart																								

6.2.13 Enter\_sleep\_mode (10h)

10H	SLPIN (Sleep In)												HEX												
	D/CX	RDX	WRX	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0													
Command	0	1	↑	-	0	0	0	1	0	0	0	0	10												
Parameter	NO PARAMETER																								
Description	<p>This command causes the LCD module to enter the minimum power consumption mode. In this mode the DC/DC converter is stopped, Internal oscillator is stopped, and panel scanning is stopped.</p> <p>MCU interface and memory are still working and the memory keeps its contents.</p>																								
Restriction	<p>This command has no effect when module is already in sleep in mode. Sleep In Mode can only be left by the Sleep Out Command (11h). It will be necessary to wait 5msec before sending next command, this is to allow time for the supply voltages and clock circuits to stabilize. It will be necessary to wait 120msec after sending Sleep Out command (when in Sleep In Mode) before Sleep In command can be sent.</p>																								
Register Availability	<table border="1"> <thead> <tr> <th>Status</th> <th>Availability</th> </tr> </thead> <tbody> <tr> <td>Normal Mode On, Idle Mode Off, Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Normal Mode On, Idle Mode On, Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Partial Mode On, Idle Mode Off, Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Partial Mode On, Idle Mode On, Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Sleep In or Booster Off</td> <td>Yes</td> </tr> </tbody> </table>													Status	Availability	Normal Mode On, Idle Mode Off, Sleep Out	Yes	Normal Mode On, Idle Mode On, Sleep Out	Yes	Partial Mode On, Idle Mode Off, Sleep Out	Yes	Partial Mode On, Idle Mode On, Sleep Out	Yes	Sleep In or Booster Off	Yes
Status	Availability																								
Normal Mode On, Idle Mode Off, Sleep Out	Yes																								
Normal Mode On, Idle Mode On, Sleep Out	Yes																								
Partial Mode On, Idle Mode Off, Sleep Out	Yes																								
Partial Mode On, Idle Mode On, Sleep Out	Yes																								
Sleep In or Booster Off	Yes																								
Default	N/A																								
Flow Chart	<p>It takes 120msec to get into Sleep In mode after SLPIN command issued.</p> <div style="border: 1px dashed black; padding: 5px; margin-top: 10px;"> <p><b>Legend</b></p> <ul style="list-style-type: none"> <li>▭ Command</li> <li>▭ Parameter</li> <li>◻ Display</li> <li>◻ Action</li> <li>◻ Mode</li> <li>◻ Sequential transfer</li> </ul> </div>																								

6.2.14 Exit\_sleep\_omde (11h)

11H	SLPOUT (Sleep Out)												HEX										
	D/CX	RDX	WRX	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0											
Command	0	1	↑	-	0	0	0	1	0	0	0	1	11										
Parameter	NO PARAMETER																						
Description	<p>This command turns off sleep mode. In this mode the DC/DC converter is enabled, Internal oscillator is started, and panel scanning is started.</p>																						
Restriction	<p>This command has no effect when module is already in sleep out mode. Sleep Out Mode can only be left by the Sleep In Command (10h). It will be necessary to wait 5msec before sending next command, this is to allow time for the supply voltages and clock circuits to stabilize. The display module loads all display supplier's factory default values to the registers during this 5msec and there cannot be any abnormal visual effect on the display image if factory default and register values are same when this load is done and when the display module is already Sleep Out –mode.</p> <p>The display module is doing self-diagnostic functions during this 5msec. It will be necessary to wait 120msec after sending Sleep In command (when in Sleep Out mode) before Sleep Out command can be sent.</p>																						
Register Availability	<table border="1"> <thead> <tr> <th>Status</th> <th>Availability</th> </tr> </thead> <tbody> <tr> <td>Normal Mode On, Idle Mode Off, Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Normal Mode On, Idle Mode On, Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Partial Mode On, Idle Mode Off, Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Partial Mode On, Idle Mode On, Sleep Out</td> <td>Yes</td> </tr> </tbody> </table>													Status	Availability	Normal Mode On, Idle Mode Off, Sleep Out	Yes	Normal Mode On, Idle Mode On, Sleep Out	Yes	Partial Mode On, Idle Mode Off, Sleep Out	Yes	Partial Mode On, Idle Mode On, Sleep Out	Yes
Status	Availability																						
Normal Mode On, Idle Mode Off, Sleep Out	Yes																						
Normal Mode On, Idle Mode On, Sleep Out	Yes																						
Partial Mode On, Idle Mode Off, Sleep Out	Yes																						
Partial Mode On, Idle Mode On, Sleep Out	Yes																						
Default	N/A																						
Flow Chart	<p>It takes 120msec to become Sleep Out mode after SLPOUT command issued.</p>																						

**6.2.15 Enter\_partial\_mode (12h)**

12H	PTLON (Partial Mode On)												
	D/CX	RDX	WRX	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	-	0	0	0	1	0	0	1	0	12
Parameter	NO PARAMETER												
Description	This command turns on partial mode The partial mode window is described by the "Set_partial_area" command (30H). To leave Partial mode, the "Enter_norma_mode" command (13H) should be written.												
Restrictions	This command has no effect when Partial mode is active.												
Register Availability	Status						Availability						
	Normal Mode On, Idle Mode Off, Sleep Out						Yes						
	Normal Mode On, Idle Mode On, Sleep Out						Yes						
	Partial Mode On, Idle Mode Off, Sleep Out						Yes						
	Partial Mode On, Idle Mode On, Sleep Out						Yes						
	Sleep In or Booster Off						Yes						
Default	N/A												
Flow Chart	See Partial Area (30h)												

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**6.2.16 Enter\_normal\_mode (13h)**

13H	NORON (Normal Display Mode On)													
	D/CX	RDX	WRX	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX	
Command	0	1	↑	-	0	0	0	1	0	0	1	1	13	
Parameter	NO PARAMETER													
Description	This command returns the display to normal mode. Normal display mode is means Partial mode off, Scroll mode Off.													
Restriction	This command has no effect when Normal Display mode is active.													
Register Availability	Status							Availability						
	Normal Mode On, Idle Mode Off, Sleep Out							Yes						
	Normal Mode On, Idle Mode On, Sleep Out							Yes						
	Partial Mode On, Idle Mode Off, Sleep Out							Yes						
	Partial Mode On, Idle Mode On, Sleep Out							Yes						
	Sleep In or Booster Off							Yes						
Default	N/A													
Flow Chart	See Partial Area and Vertical Scrolling Definition Descriptions for details of when to use this command.													

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6.2.17 Exit\_inversion\_mode (20h)

20H	INVOFF (Display Inversion Off)												HEX
	D/CX	RDX	WRX	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0	
Command	0	1	↑	-	0	0	1	0	0	0	0	0	20
Parameter	No parameter												
Description	<p>This command is used to recover from display inversion mode.                      This command makes no change of contents of frame memory.                      This command does not change any other status.                      (Example)</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"> <p>Memory</p> </div> <div style="font-size: 2em;">→</div> <div style="text-align: center;"> <p>Display</p> </div> </div>												
Restriction	This command has no effect when module is already in inversion off mode.												
Register Availability	Status						Availability						
	Normal Mode On, Idle Mode Off, Sleep Out						Yes						
	Normal Mode On, Idle Mode On, Sleep Out						Yes						
	Partial Mode On, Idle Mode Off, Sleep Out						Yes						
	Partial Mode On, Idle Mode On, Sleep Out						Yes						
Sleep In or Booster Off						Yes							
Default	N/A												
Flow Chart													

6.2.18 Enter\_inversion\_mode (21h)

21H	INVON (Display Inversion On)													
	D/CX	RDX	WRX	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX	
Command	0	1	↑	-	0	0	1	0	0	0	0	0	1	21
Parameter	NO PARAMETER													
Description	<p>This command is used to enter into display inversion mode.                      This command makes no change of contents of frame memory. Every bit is inverted from the frame memory to the display.                      This command does not change any other status.</p> <p>(Example)</p>													
Restriction	This command has no effect when module is already in inversion on mode.													
Register Availability	Status						Availability							
	Normal Mode On, Idle Mode Off, Sleep Out						Yes							
	Normal Mode On, Idle Mode On, Sleep Out						Yes							
	Partial Mode On, Idle Mode Off, Sleep Out						Yes							
	Partial Mode On, Idle Mode On, Sleep Out						Yes							
Sleep In or Booster Off						Yes								
Default	N/A													
Flow Chart	<div style="border: 1px dashed black; padding: 5px; margin-top: 10px;"> <p><b>Legend</b></p> <ul style="list-style-type: none"> <li><span style="border: 1px solid black; padding: 2px;">Command</span></li> <li><span style="border: 1px solid black; padding: 2px;">Parameter</span></li> <li><span style="border: 1px solid black; padding: 2px;">Display</span></li> <li><span style="border: 1px solid black; padding: 2px;">Action</span></li> <li><span style="border: 1px solid black; padding: 2px;">Mode</span></li> <li><span style="border: 1px solid black; padding: 2px;">Sequential transfer</span></li> </ul> </div>													

6.2.19 Set\_gamma\_curve (26h)

26H	GAMSET (Gamma Set)												
	D/CX	RDX	WRX	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	-	0	0	1	0	0	1	1	0	26
Parameter	1	1	↑	-	GC7	GC6	GC5	GC4	GC3	GC2	GC1	GC0	1..08
Description	This command is used to select the desired Gamma curve for the current display. A maximum of 4 fixed gamma curves can be selected. The curves are defined in Curve Correction Power Supply Circuit. The curve is selected by setting the appropriate bit in the parameter as described in the Table:												
	GC[7..0]		Parameter		Curve selected								
	01h		GC0		Gamma Curve 1								
	02h		GC1		Gamma Curve 2								
	04h		GC2		Gamma Curve 3								
08h		GC3		Gamma Curve 4									
<b>Note:</b> All other values are undefined.													
Restriction	Values of GC[7..0] not shown in table above are invalid and will not change the current selected Gamma curve until valid value is received.												
Register Availability	Status						Availability						
	Normal Mode On, Idle Mode Off, Sleep Out						Yes						
	Normal Mode On, Idle Mode On, Sleep Out						Yes						
	Partial Mode On, Idle Mode Off, Sleep Out						Yes						
Partial Mode On, Idle Mode On, Sleep Out						Yes							
Default	GC[7:0] = 0x01h												
Flow Chart	<pre> graph TD     A[GAMSET] --&gt; B[/GC [7:0]/]     B --&gt; C{New Gamma Curve Loaded}             </pre> <div style="border: 1px dashed black; padding: 5px; margin-top: 10px;"> <p><b>Legend</b></p> <ul style="list-style-type: none"> <li>Command: [Rectangle]</li> <li>Parameter: [Parallelogram]</li> <li>Display: [Oval]</li> <li>Action: [Arrowhead]</li> <li>Mode: [Rounded rectangle]</li> <li>Sequential transfer: [Speech bubble]</li> </ul> </div>												

6.2.20 Set\_display\_off (28h)

28H	DISPOFF (Display Off)												
	D/CX	RDX	WRX	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	-	0	0	1	0	1	0	0	0	28
Parameter	NO PARAMETER												
Description	<p>This command is used to enter into DISPLAY OFF mode. In this mode, the output from Frame Memory is disabled and blank page inserted.                      This command makes no change of contents of frame memory.                      This command does not change any other status.                      There will be no abnormal visible effect on the display.</p> <p>Example</p>												
Restriction	This command has no effect when module is already in display off mode.												
Register Availability	Status						Availability						
	Normal Mode On, Idle Mode Off, Sleep Out						Yes						
	Normal Mode On, Idle Mode On, Sleep Out						Yes						
	Partial Mode On, Idle Mode Off, Sleep Out						Yes						
	Partial Mode On, Idle Mode On, Sleep Out						Yes						
Sleep In or Booster Off						Yes							
Default	N/A												
Flow Chart													

6.2.21 Set\_display\_on (29h)

29H	DISPON (Display On)												
	D/CX	RDX	WRX	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	-	0	0	1	0	1	0	0	1	29
Parameter	NO PARAMETER												
Description	<p>This command is used to recover from DISPLAY OFF mode. Output from the Frame Memory is enabled.                      This command makes no change of contents of frame memory.                      This command does not change any other status.                      (Example)</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"> <p>Memory</p> </div> <div style="font-size: 2em;">→</div> <div style="text-align: center;"> <p>Display</p> </div> </div>												
Restriction	This command has no effect when module is already in display on mode.												
Register Availability	Status						Availability						
	Normal Mode On, Idle Mode Off, Sleep Out						Yes						
	Normal Mode On, Idle Mode On, Sleep Out						Yes						
	Partial Mode On, Idle Mode Off, Sleep Out						Yes						
	Partial Mode On, Idle Mode On, Sleep Out						Yes						
Sleep In or Booster Off						Yes							
Default	N/A												
Flow Chart	<div style="display: flex; justify-content: space-between; align-items: center;"> <div style="text-align: center;"> <pre>                     graph TD                         A[Display Off Mode] --&gt; B[DISPON]                         B --&gt; C[Display On Mode]                     </pre> </div> <div style="border: 1px dashed black; padding: 5px;"> <p>Legend</p> <ul style="list-style-type: none"> <li>Command</li> <li>Parameter</li> <li>Display</li> <li>Action</li> <li>Mode</li> <li>Sequential transfer</li> </ul> </div> </div>												

6.2.22 Set\_column\_address (2Ah)

2AH	CASET (Column Address Set)																								
	D/CX	RDX	WRX	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX												
Command	0	1	↑	-	0	0	1	0	1	0	1	0	2A												
1 <sup>st</sup> parameter	1	1	↑	-	SC15	SC14	SC13	SC12	SC11	SC10	SC9	SC8	00..												
2 <sup>nd</sup> parameter	1	1	↑	-	SC7	SC6	SC5	SC4	SC3	SC2	SC1	SC0	Note 1												
3 <sup>rd</sup> parameter	1	1	↑	-	EC15	EC14	EC13	EC12	EC11	EC10	EC9	EC8	00..												
4 <sup>th</sup> parameter	1	1	↑	-	EC7	EC6	EC5	EC4	EC3	EC2	EC1	EC0	Note 1												
Description	<p>This command is used to define area of frame memory where MCU can access. This command makes no change on the other driver status. The values of SC[15:0] and EC[15:0] are referred when RAMWR command comes. Each value represents one column line in the Frame Memory.</p> <p>(Example)</p>																								
Restriction	<p>SC[15:0] always must be equal to or less than EC[15:0]                      Note 1: When SC[15:0] or EC[15:0] is greater than horizontal line (when MADCTL's B5=0) or vertical line (when MADCTL's B5=1), data of out of range will be ignored.</p>																								
Register Availability	<table border="1"> <thead> <tr> <th>Status</th> <th>Availability</th> </tr> </thead> <tbody> <tr> <td>Normal Mode On, Idle Mode Off, Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Normal Mode On, Idle Mode On, Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Partial Mode On, Idle Mode Off, Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Partial Mode On, Idle Mode On, Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Sleep In or Booster Off</td> <td>Yes</td> </tr> </tbody> </table>													Status	Availability	Normal Mode On, Idle Mode Off, Sleep Out	Yes	Normal Mode On, Idle Mode On, Sleep Out	Yes	Partial Mode On, Idle Mode Off, Sleep Out	Yes	Partial Mode On, Idle Mode On, Sleep Out	Yes	Sleep In or Booster Off	Yes
Status	Availability																								
Normal Mode On, Idle Mode Off, Sleep Out	Yes																								
Normal Mode On, Idle Mode On, Sleep Out	Yes																								
Partial Mode On, Idle Mode Off, Sleep Out	Yes																								
Partial Mode On, Idle Mode On, Sleep Out	Yes																								
Sleep In or Booster Off	Yes																								
Default	<p>RES_SEL[2:0]=000, Resoulution 480RGBx864: SC[15:0] = 0x0000h, EC[15:0] = 0x01DFh                      RES_SEL[2:0]=001, Resoulution 480RGBx854: SC[15:0] = 0x0000h, EC[15:0] = 0x01DFh                      RES_SEL[2:0]=010, Resoulution 480RGBx800: SC[15:0] = 0x0000h, EC[15:0] = 0x01DFh                      RES_SEL[2:0]=011, Resoulution 480RGBx640: SC[15:0] = 0x0000h, EC[15:0] = 0x01DFh                      RES_SEL[2:0]=100, Resoulution 360RGBx640: SC[15:0] = 0x0000h, EC[15:0] = 0x0167h                      RES_SEL[2:0]=101, Resoulution 480RGBx720: SC[15:0] = 0x0000h, EC[15:0] = 0x01DFh</p>																								
Flow Chart																									



**6.2.23 Set\_page\_address (2Bh)**

2BH	PASET (Page Address Set)												HEX									
	D/CX	RDX	WRX	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0										
Command	0	1	↑	-	0	0	1	0	1	0	1	1	2B									
1 <sup>st</sup> parameter	1	1	↑	-	SP15	SP14	SP13	SP12	SP11	SP10	SP9	SP8	00 ..									
2 <sup>nd</sup> parameter	1	1	↑	-	SP7	SP6	SP5	SP4	SP3	SP2	SP1	SP0	Note 1									
3 <sup>rd</sup> parameter	1	1	↑	-	EP15	EP14	EP13	EP12	EP11	EP10	EP9	EP8	00 .. Note 1									
4 <sup>th</sup> parameter	1	1	↑	-	EP7	EP6	EP5	EP4	EP3	EP2	EP1	EP0										
Description	<p>This command is used to define area of frame memory where MCU can access. This command makes no change on the other driver status. The values of SP[15:0] and EP[15:0] are referred when RAMWR command comes. Each value represents one Page line in the Frame Memory.</p> <p>(Example)</p>																					
Restriction	<p>SP[15:0] always must be equal to or less than EP[15:0]                      Note 1: When SP[15:0] or EP[15:0] is greater than vertical line (When MADCTL's B5=0) or horizontal line (When MADCTL's B5=1), data of out of range will be ignored.</p>																					
Register Availability	<table border="1"> <thead> <tr> <th>Status</th> <th>Availability</th> </tr> </thead> <tbody> <tr> <td>Normal Mode On, Idle Mode Off, Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Normal Mode On, Idle Mode On, Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Partial Mode On, Idle Mode Off, Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Partial Mode On, Idle Mode On, Sleep Out</td> <td>Yes</td> </tr> </tbody> </table>												Status	Availability	Normal Mode On, Idle Mode Off, Sleep Out	Yes	Normal Mode On, Idle Mode On, Sleep Out	Yes	Partial Mode On, Idle Mode Off, Sleep Out	Yes	Partial Mode On, Idle Mode On, Sleep Out	Yes
Status	Availability																					
Normal Mode On, Idle Mode Off, Sleep Out	Yes																					
Normal Mode On, Idle Mode On, Sleep Out	Yes																					
Partial Mode On, Idle Mode Off, Sleep Out	Yes																					
Partial Mode On, Idle Mode On, Sleep Out	Yes																					
Default	<p>RES_SEL[2:0]=000, Resolution 480RGBx864: SP[15:0] = 0x0000h, EP[15:0] = 0x035Fh                      RES_SEL[2:0]=001, Resolution 480RGBx854: SP[15:0] = 0x0000h, EP[15:0] = 0x0355h                      RES_SEL[2:0]=010, Resolution 480RGBx800: SP[15:0] = 0x0000h, EP[15:0] = 0x031Fh                      RES_SEL[2:0]=011, Resolution 480RGBx640: SP[15:0] = 0x0000h, EP[15:0] = 0x027Fh                      RES_SEL[2:0]=100, Resolution 360RGBx640: SP[15:0] = 0x0000h, EP[15:0] = 0x027Fh                      RES_SEL[2:0]=101, Resolution 480RGBx720: SP[15:0] = 0x0000h, EP[15:0] = 0x02CFh</p>																					
Flow Chart																						

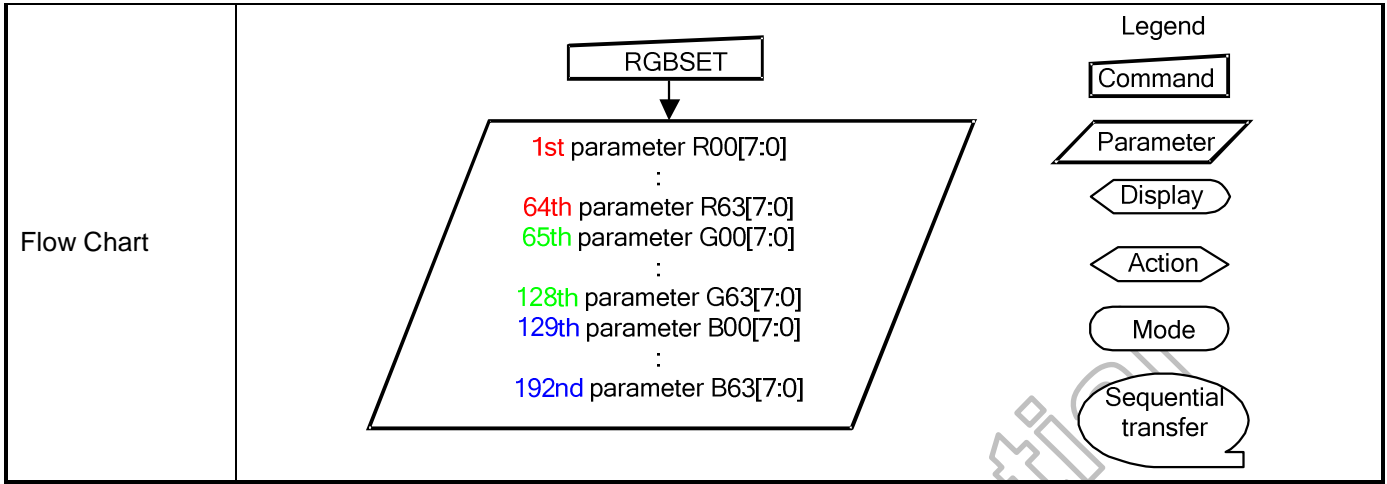
6.2.24 Write\_memory\_start (2Ch)

2CH	RAMWR (Memory Write)												
	D/CX	RDX	WRX	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	-	0	0	1	0	1	1	0	0	2C
1 <sup>st</sup> parameter	1	1	↑	-	D17	D16	D15	D14	D13	D12	D11	D10	00..FF
:	1	1	↑	-	Dx7	Dx6	Dx5	Dx4	Dx3	Dx2	Dx1	Dx0	00..FF
N <sup>th</sup> parameter	1	1	↑	-	Dn7	Dn6	Dn5	Dn4	Dn3	Dn2	Dn1	Dn0	00..FF
Description	<p>This command transfers image data from the host processor to the display module's frame memory starting at the pixel location specified by preceding set_column_address and set_page_address commands.</p> <p>The column and page registers are reset to the Start Column (SC) and Start Page (SP), respectively.</p> <p>Pixel Data 1 is stored in frame memory 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 memory until the page register equals the End Page (EP) value or the host processor sends another command.</p> <p>If the number of pixels exceeds <math>(EC - SC + 1) * (EP - SP + 1)</math> the extra pixels are ignored.</p>												
Restriction	In all colour modes, there is no restriction on length of parameters.												
Register Availability	Status						Availability						
	Normal Mode On, Idle Mode Off, Sleep Out						Yes						
	Normal Mode On, Idle Mode On, Sleep Out						Yes						
	Partial Mode On, Idle Mode Off, Sleep Out						Yes						
	Partial Mode On, Idle Mode On, Sleep Out						Yes						
Default	Contents of memory is set randomly and not cleared.												
Flow Chart	<pre> graph TD     A[RAMWR] --&gt; B(Image Data D1[7:0], D2[7:0], ..., Dn[7:0])     B --&gt; C[Any Command]     </pre> <p>Legend</p> <ul style="list-style-type: none"> <li>Command: [ ]</li> <li>Parameter: // ]</li> <li>Display: &lt; ]</li> <li>Action: &gt; ]</li> <li>Mode: ( ]</li> <li>Sequential transfer: ☁ ]</li> </ul>												

## 6.2.25 Colour Set (2Dh)

2DH	COLSET (Colour Set)																																																																																																																																							
	DNC	NRD	NWR	D8~D15	D7	D6	D5	D4	D3	D2	D1	D0	HEX																																																																																																																											
Command	0	1	↑	-	0	0	1	0	1	1	0	1	2D																																																																																																																											
1 <sup>st</sup> parameter	1	1	↑	-	R007	R006	R005	R004	R003	R002	R001	R000	00..FF																																																																																																																											
:	1	1	↑	-	Rnn7	Rnn6	Rnn5	Rnn4	Rnn3	Rnn2	Rnn1	Rnn0	00..FF																																																																																																																											
64 <sup>th</sup> parameter	1	1	↑	-	R637	R636	R635	R634	R633	R632	R631	R630	00..FF																																																																																																																											
65 <sup>th</sup> parameter	1	1	↑	-	G007	G006	G005	G004	G003	G002	G001	G000	00..FF																																																																																																																											
:	1	1	↑	-	Gnn7	Gnn6	Gnn5	Gnn4	Gnn3	Gnn2	Gnn1	Gnn0	00..FF																																																																																																																											
128 <sup>th</sup> parameter	1	1	↑	-	G637	G636	G635	G634	G633	G632	G631	G630	00..FF																																																																																																																											
129 <sup>th</sup> parameter	1	1	↑	-	B007	B006	B005	B004	B003	B002	B001	B000	00..FF																																																																																																																											
:	1	1	↑	-	Bnn7	Bnn6	Bnn5	Bnn4	Bnn3	Bnn2	Bnn1	Bnn0	00..FF																																																																																																																											
192 <sup>nd</sup> parameter	1	1	↑	-	B637	B636	B635	B634	B633	B632	B631	B630	00..FF																																																																																																																											
Description	<p>This command is used to define the LUT for 18bit to 24bit, 16bit-to-24bit colour depth conversions. 192bytes must be written to the LUT regardless of the colour mode. This command has no effect on other commands/parameters and Contents of frame memory. Visible change takes effect next time the Frame Memory is written to.</p>																																																																																																																																							
Restriction	<p>This command is needed to be set in write_data for RGB 5-6-5 (65K colours) and RGB 6-6-6 (262K colours) pixel format.                      The default for command Colour Set (2Dh) is 0x00h. The colour depth conversion must be followed the below tables.                      Once write data is RGB 5-6-5 (65K colours), the set pixel format 0x3A=0x05h command must be set and using the 16bit-to-24bit colour depth conversion.</p> <table border="1"> <thead> <tr> <th>R-G-B=5-6-5</th> <th>RGBSET parameter</th> <th>24-bit /pixel mode</th> <th>LUT 24-bit /pixel value</th> <th>Input 16-bit /pixel</th> </tr> </thead> <tbody> <tr> <td rowspan="13">R</td> <td>1</td> <td>R00[7:0]</td> <td>00000000</td> <td>00000</td> </tr> <tr> <td>2</td> <td>R01[7:0]</td> <td>00001000</td> <td>00001</td> </tr> <tr> <td>3</td> <td>R02[7:0]</td> <td>00010000</td> <td>00010</td> </tr> <tr> <td>..</td> <td>..</td> <td>..</td> <td>..</td> </tr> <tr> <td>..</td> <td>..</td> <td>..</td> <td>..</td> </tr> <tr> <td>30</td> <td>R29[7:0]</td> <td>11101111</td> <td>11101</td> </tr> <tr> <td>31</td> <td>R30[7:0]</td> <td>11110111</td> <td>11110</td> </tr> <tr> <td>32</td> <td>R31[7:0]</td> <td>11111111</td> <td>11111</td> </tr> <tr> <td>33</td> <td rowspan="4">Not Used</td> <td rowspan="4">Not Used</td> <td rowspan="4">Not Used</td> </tr> <tr> <td>34</td> </tr> <tr> <td>35</td> </tr> <tr> <td>..</td> </tr> <tr> <td>62</td> <td rowspan="3">Not Used</td> <td rowspan="3">Not Used</td> <td rowspan="3">Not Used</td> </tr> <tr> <td>63</td> </tr> <tr> <td>64</td> </tr> <tr> <td rowspan="7">G</td> <td>65</td> <td>G00[7:0]</td> <td>00000000</td> <td>000000</td> </tr> <tr> <td>66</td> <td>G01[7:0]</td> <td>00000100</td> <td>000001</td> </tr> <tr> <td>67</td> <td>G02[7:0]</td> <td>00001000</td> <td>000010</td> </tr> <tr> <td>..</td> <td>..</td> <td>..</td> <td>..</td> </tr> <tr> <td>..</td> <td>..</td> <td>..</td> <td>..</td> </tr> <tr> <td>126</td> <td>G61[7:0]</td> <td>11110111</td> <td>111101</td> </tr> <tr> <td>127</td> <td>G62[7:0]</td> <td>11111011</td> <td>111110</td> </tr> <tr> <td>128</td> <td>G63[7:0]</td> <td>11111111</td> <td>111111</td> </tr> <tr> <td rowspan="10">B</td> <td>129</td> <td>B00[7:0]</td> <td>00000000</td> <td>00000</td> </tr> <tr> <td>130</td> <td>B01[7:0]</td> <td>00001000</td> <td>00001</td> </tr> <tr> <td>131</td> <td>B02[7:0]</td> <td>00010000</td> <td>00010</td> </tr> <tr> <td>..</td> <td>..</td> <td>..</td> <td>..</td> </tr> <tr> <td>..</td> <td>..</td> <td>..</td> <td>..</td> </tr> <tr> <td>158</td> <td>B29[7:0]</td> <td>11101111</td> <td>11101</td> </tr> <tr> <td>159</td> <td>B30[7:0]</td> <td>11110111</td> <td>11110</td> </tr> <tr> <td>160</td> <td>B31[7:0]</td> <td>11111111</td> <td>11111</td> </tr> <tr> <td>161</td> <td rowspan="3">Not Used</td> <td rowspan="3">Not Used</td> <td rowspan="3">Not Used</td> </tr> <tr> <td>162</td> </tr> <tr> <td>163</td> </tr> </tbody> </table>													R-G-B=5-6-5	RGBSET parameter	24-bit /pixel mode	LUT 24-bit /pixel value	Input 16-bit /pixel	R	1	R00[7:0]	00000000	00000	2	R01[7:0]	00001000	00001	3	R02[7:0]	00010000	00010	..	..	..	..	..	..	..	..	30	R29[7:0]	11101111	11101	31	R30[7:0]	11110111	11110	32	R31[7:0]	11111111	11111	33	Not Used	Not Used	Not Used	34	35	..	62	Not Used	Not Used	Not Used	63	64	G	65	G00[7:0]	00000000	000000	66	G01[7:0]	00000100	000001	67	G02[7:0]	00001000	000010	..	..	..	..	..	..	..	..	126	G61[7:0]	11110111	111101	127	G62[7:0]	11111011	111110	128	G63[7:0]	11111111	111111	B	129	B00[7:0]	00000000	00000	130	B01[7:0]	00001000	00001	131	B02[7:0]	00010000	00010	..	..	..	..	..	..	..	..	158	B29[7:0]	11101111	11101	159	B30[7:0]	11110111	11110	160	B31[7:0]	11111111	11111	161	Not Used	Not Used	Not Used	162	163
R-G-B=5-6-5	RGBSET parameter	24-bit /pixel mode	LUT 24-bit /pixel value	Input 16-bit /pixel																																																																																																																																				
R	1	R00[7:0]	00000000	00000																																																																																																																																				
	2	R01[7:0]	00001000	00001																																																																																																																																				
	3	R02[7:0]	00010000	00010																																																																																																																																				
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	30	R29[7:0]	11101111	11101																																																																																																																																				
	31	R30[7:0]	11110111	11110																																																																																																																																				
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G	65	G00[7:0]	00000000	000000																																																																																																																																				
	66	G01[7:0]	00000100	000001																																																																																																																																				
	67	G02[7:0]	00001000	000010																																																																																																																																				
	..	..	..	..																																																																																																																																				
	..	..	..	..																																																																																																																																				
	126	G61[7:0]	11110111	111101																																																																																																																																				
	127	G62[7:0]	11111011	111110																																																																																																																																				
128	G63[7:0]	11111111	111111																																																																																																																																					
B	129	B00[7:0]	00000000	00000																																																																																																																																				
	130	B01[7:0]	00001000	00001																																																																																																																																				
	131	B02[7:0]	00010000	00010																																																																																																																																				
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	161	Not Used	Not Used	Not Used																																																																																																																																				
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		..			
		..			
		190			
		191			
		192			
<p>Once write data is RGB 5-6-5 (65K colours), the set pixel format 0x3A=0x06h command must be set and using the 18bit-to-24bit colour depth conversion.</p>					
R-G-B=6-6-6	RGBSET parameter	24-bit /pixel mode	LUT 24-bit /pixel value	Input 18-bit /pixel	
R	1	R00[7:0]	00000000	000000	
	2	R01[7:0]	00000100	000001	
	3	R02[7:0]	00001000	000010	
	..	..	..	..	
	..	..	..	..	
	62	R61[7:0]	11110111	111101	
	63	R62[7:0]	11111011	111110	
G	64	R63[7:0]	11111111	111111	
	65	G00[7:0]	00000000	000000	
	66	G01[7:0]	00000100	000001	
	67	G02[7:0]	00001000	000010	
	..	..	..	..	
	..	..	..	..	
	126	G61[7:0]	11110111	111101	
127	G62[7:0]	11111011	111110		
B	128	G63[7:0]	11111111	111111	
	129	B00[7:0]	00000000	000000	
	130	B01[7:0]	00000100	000001	
	131	B02[7:0]	00001000	000010	
	..	..	..	..	
	..	..	..	..	
	190	B61[7:0]	11110111	111101	
191	B62[7:0]	11111011	111110		
192	B63[7:0]	11111111	111111		
Register Availability	Status		Availability		
	Normal Mode On, Idle Mode Off, Sleep Out		Yes		
	Normal Mode On, Idle Mode On, Sleep Out		Yes		
	Partial Mode On, Idle Mode Off, Sleep Out		Yes		
	Partial Mode On, Idle Mode On, Sleep Out		Yes		
Sleep In or Booster Off		Yes			
Default	Status		Default value		
	S/W Reset		Contents of the look-up table protected		
	H/W Reset		R00[7:0]~R63[7:0] =0x00h G00[7:0]~G63[7:0] =0x00h B00[7:0]~B63[7:0] =0x00h		



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6.2.26 Raed\_memory\_start (2Eh)

2EH	RAMRD (Memory Read)												HEX												
	D/CX	RDX	WRX	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0													
Command	0	1	↑	-	0	0	1	0	1	1	1	0	2E												
1 <sup>st</sup> parameter	1	↑	1	-	X	X	X	X	X	X	X	X	Dummy read												
2 <sup>nd</sup> parameter	1	↑	1	-	D17	D16	D15	D14	D13	D12	D11	D10	00..FF												
:	1	↑	1	-	Dx7	Dx6	Dx5	Dx4	Dx3	Dx2	Dx1	Dx0	00..FF												
(n+1) <sup>th</sup> parameter	1	↑	1	-	Dn7	Dn6	Dn5	Dn4	Dn3	Dn2	Dn1	Dn0	00..FF												
Description	<p>This command transfers image data from the display module's frame memory to the host processor starting at the pixel location specified by preceding set_column_address and set_page_address commands.</p> <p>The column and page registers are reset to the Start Column (SC) and Start Page (SP), respectively. Pixels are read from frame memory 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.</p> <p>Pixels are read from the frame memory until the page register equals the End Page (EP) value or the host processor sends another command.</p>																								
Restriction	<p>In all colour modes, the Frame Read is always 24bit so there is no restriction on length of parameters.                      Note – Memory Read is only possible via the Parallel Interface.</p>																								
Register Availability	<table border="1"> <thead> <tr> <th>Status</th> <th>Availability</th> </tr> </thead> <tbody> <tr> <td>Normal Mode On, Idle Mode Off, Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Normal Mode On, Idle Mode On, Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Partial Mode On, Idle Mode Off, Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Partial Mode On, Idle Mode On, Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Sleep In or Booster Off</td> <td>Yes</td> </tr> </tbody> </table>													Status	Availability	Normal Mode On, Idle Mode Off, Sleep Out	Yes	Normal Mode On, Idle Mode On, Sleep Out	Yes	Partial Mode On, Idle Mode Off, Sleep Out	Yes	Partial Mode On, Idle Mode On, Sleep Out	Yes	Sleep In or Booster Off	Yes
Status	Availability																								
Normal Mode On, Idle Mode Off, Sleep Out	Yes																								
Normal Mode On, Idle Mode On, Sleep Out	Yes																								
Partial Mode On, Idle Mode Off, Sleep Out	Yes																								
Partial Mode On, Idle Mode On, Sleep Out	Yes																								
Sleep In or Booster Off	Yes																								
Default	<p>Contents of memory is set randomly and not cleared.</p>																								
Flow Chart	<pre>                     graph TD                         A[RAMRD] --&gt; B[/Dummy/]                         B --&gt; C([Image Data D1[7:0], D2[7:0], ..., Dn[7:0]])                         C --&gt; D[Any Command]                     </pre>																								



6.2.27 Set\_partial\_area (30h)

30H	PLTAR (Partial Area)												HEX
	D/CX	RDX	WRX	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0	
Command	0	1	↑	-	0	0	1	1	0	0	0	0	30
1 <sup>st</sup> parameter	1	1	↑	-	SR15	SR14	SR13	SR12	SR11	SR10	SR9	SR8	xx
2 <sup>nd</sup> parameter	1	1	↑	-	SR7	SR6	SR5	SR4	SR3	SR2	SR1	SR0	xx
3 <sup>rd</sup> parameter	1	1	↑	-	ER15	ER14	ER13	ER12	ER11	ER10	ER9	ER8	xx
4 <sup>th</sup> parameter	1	1	↑	-	ER7	ER6	ER5	ER4	ER3	ER2	ER1	ER0	xx
Description	<p>This command defines the partial mode's display area. There are 4 parameters associated with this command, the first defines the Start Row (SR) and the second the End Row (ER), as illustrated in the figures below. SR and ER refer to the Frame Memory Line Pointer. If End Row &gt; Start Row when MADCTL B4=0:-</p> <p>If End Row &gt; Start Row when MADCTL B4=1:-</p> <p>If End Row &lt; Start Row when MADCTL B4=0:-</p> <p>If End Row = Start Row then the Partial Area will be one row deep.</p>												
	Restriction	SR[15..0] and ER[15..0] cannot be greater than horizontal line number.											
	Register Availability	Status						Availability					
		Normal Mode On, Idle Mode Off, Sleep Out						Yes					
Normal Mode On, Idle Mode On, Sleep Out						Yes							
Partial Mode On, Idle Mode Off, Sleep Out						Yes							
Partial Mode On, Idle Mode On, Sleep Out						Yes							
Sleep In or Booster Off						Yes							

<p>Default</p>	<p>RES_SEL[2:0]=000, Resoultion 480RGBx864: SR[15:0] = 0x0000h, ER[15:0] = 0x035Fh                  RES_SEL[2:0]=001, Resoultion 480RGBx854: SR[15:0] = 0x0000h, ER[15:0] = 0x0355h                  RES_SEL[2:0]=010, Resoultion 480RGBx800: SR[15:0] = 0x0000h, ER[15:0] = 0x031Fh                  RES_SEL[2:0]=011, Resoultion 480RGBx640: SR[15:0] = 0x0000h, ER[15:0] = 0x027Fh                  RES_SEL[2:0]=100, Resoultion 360RGBx640: SR[15:0] = 0x0000h, ER[15:0] = 0x027Fh                  RES_SEL[2:0]=101, Resoultion 480RGBx720: SR[15:0] = 0x0000h, ER[15:0] = 0x02CFh</p>
<p>Flow Chart</p>	<p>1. To Enter Partial Mode:-</p> <pre>                 graph TD                     PLTAR[PLTAR] --&gt; SR[/SR[15...0]/]                     SR --&gt; ER[/ER[15...0]/]                     ER --&gt; PTLON[PTLON]                     PTLON --&gt; PM1([Partial Mode])                     PM1 --&gt; DISPOFF[DISPOFF]                     DISPOFF --&gt; NORON[NORON]                     NORON --&gt; PM2([Partial Mode OFF])                     PM2 --&gt; RAMRW[RAMRW]                     RAMRW --&gt; ID[/Image Data D1[17:0], D2[17:0], ..., Dn[15:0]/]                     ID --&gt; DISPON[DISPON]                     Omit["(Optional) To prevent Tearing Effect Image displayed"] -.-&gt; DISPOFF                 </pre> <p>2. To Leave Partial Mode</p> <p>Legend</p> <ul style="list-style-type: none"> <li>Command</li> <li>Parameter</li> <li>Display</li> <li>Action</li> <li>Mode</li> <li>Sequential transfer</li> </ul>

6.2.28 Set\_scroll\_area (33h)

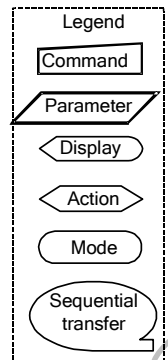
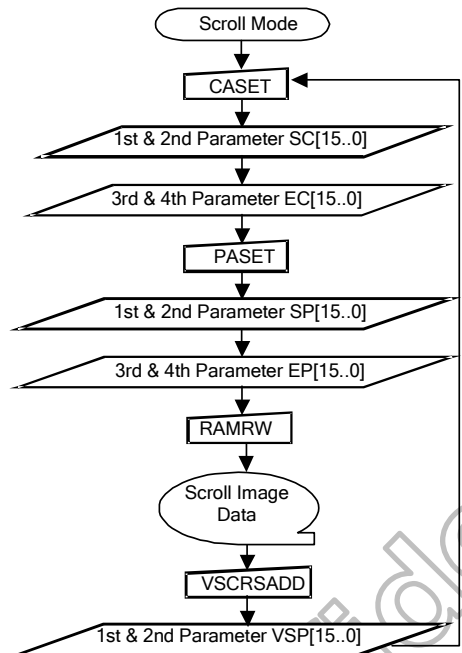
33H	VSCRDEF (Vertical Scrolling Definition)												HEX											
	D/CX	RDX	WRX	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0												
Command	0	1	↑	-	0	0	1	1	0	0	1	1	33											
1 <sup>st</sup> parameter	1	1	↑	-	TFA15	TFA14	TFA13	TFA12	TFA11	TFA10	TFA9	TFA8	xx											
2 <sup>nd</sup> parameter	1	1	↑	-	TFA7	TFA 6	TFA 5	TFA 4	TFA 3	TFA 2	TFA1	TFA0	xx											
3 <sup>rd</sup> parameter	1	1	↑	-	VSA15	VSA14	VSA13	VSA12	VSA11	VSA10	VSA9	VSA8	xx											
4 <sup>th</sup> parameter	1	1	↑	-	VSA7	VSA 6	VSA 5	VSA 4	VSA 3	VSA 2	VSA1	VSA0	xx											
5 <sup>th</sup> parameter	1	1	↑	-	BFA15	BFA14	BFA13	BFA12	BFA11	BFA10	BFA9	BFA8	xx											
6 <sup>th</sup> parameter	1	1	↑	-	BFA7	BFA 6	BFA 5	BFA 4	BFA 3	BFA 2	BFA1	BFA0	xx											
Description	<p>This command defines the Vertical Scrolling Area of the display. When MADCTL B4=0, the 1<sup>st</sup> &amp; 2<sup>nd</sup> parameter TFA[15..0] describes the Top Fixed Area (in No. of lines from top of the Frame Memory and Display). The 3<sup>rd</sup> &amp; 4<sup>th</sup> parameter VSA[15..0] describes the height of the Vertical Scrolling Area (in No. of lines of the Frame Memory [not the display] from the Vertical Scrolling Start Address). The first line read from Frame Memory appears immediately after the bottom most line of the Top Fixed Area. The 5<sup>th</sup> &amp; 6<sup>th</sup> parameter BFA[15..0] describes the Bottom Fixed Area (in No. of lines from Bottom of the Frame Memory and Display). TFA, VSA and BFA refer to the Frame Memory Line Pointer.</p> <p>When MADCTL B4=1  The 1<sup>st</sup> &amp; 2<sup>nd</sup> parameter TFA[15..0] describes the Top Fixed Area (in No. of lines from bottom of the Frame Memory and Display). The 3<sup>rd</sup> &amp; 4<sup>th</sup> parameter VSA[15..0] describes the height of the Vertical Scrolling Area (in No. of lines of the Frame Memory [not the display] from the Vertical Scrolling Start Address). The first line read from Frame Memory appears immediately after the top most line of the Top Fixed Area. The 5<sup>th</sup> &amp; 6<sup>th</sup> parameter BFA[15..0] describes the Bottom Fixed Area (in No. of lines from Top of the Frame Memory and Display).</p>																							
Restriction	The condition is (TFA+VSA+BFA)= Vertical line number, otherwise Scrolling mode is undefined. In Vertical Scroll Mode, MADCTL B5 should be set to '0' – this only affects the Frame Memory Write.																							
Register Availability	<table border="1"> <thead> <tr> <th>Status</th> <th>Availability</th> </tr> </thead> <tbody> <tr> <td>Normal Mode On, Idle Mode Off, Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Normal Mode On, Idle Mode On, Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Partial Mode On, Idle Mode Off, Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Partial Mode On, Idle Mode On, Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Sleep In or Booster Off</td> <td>Yes</td> </tr> </tbody> </table>												Status	Availability	Normal Mode On, Idle Mode Off, Sleep Out	Yes	Normal Mode On, Idle Mode On, Sleep Out	Yes	Partial Mode On, Idle Mode Off, Sleep Out	Yes	Partial Mode On, Idle Mode On, Sleep Out	Yes	Sleep In or Booster Off	Yes
Status	Availability																							
Normal Mode On, Idle Mode Off, Sleep Out	Yes																							
Normal Mode On, Idle Mode On, Sleep Out	Yes																							
Partial Mode On, Idle Mode Off, Sleep Out	Yes																							
Partial Mode On, Idle Mode On, Sleep Out	Yes																							
Sleep In or Booster Off	Yes																							

Default	Status	Default value		
	RES_SEL[2:0]=000, 480RGBx864	TFA[15..0]= 0x0000h	VSA[15..0]= 0x0360h	BFA[15..0]= 0x0000h
RES_SEL[2:0]=001, 480RGBx854	TFA[15..0]= 0x0000h	VSA[15..0]= 0x0356h	BFA[15..0]= 0x0000h	
RES_SEL[2:0]=010, 480RGBx800	TFA[15..0]= 0x0000h	VSA[15..0]= 0x0320h	BFA[15..0]= 0x0000h	
RES_SEL[2:0]=011, 480RGBx640	TFA[15..0]= 0x0000h	VSA[15..0]= 0x0280h	BFA[15..0]= 0x0000h	
RES_SEL[2:0]=100, 360RGBx640	TFA[15..0]= 0x0000h	VSA[15..0]= 0x0280h	BFA[15..0]= 0x0000h	
RES_SEL[2:0]=101,	TFA[15..0]= 0x0000h	VSA[15..0]= 0x02D0h	BFA[15..0]= 0x0000h	

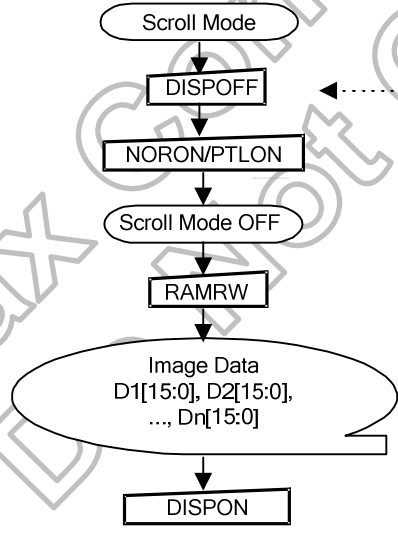
1.To enter Vertical Scroll Mode:

**Note:** The Frame Memory Window size must be defined correctly otherwise undesirable image will be displayed.

2. Continuous Scroll:



3. To Leave Vertical Scroll Mode:



(Optional)  
To prevent  
Tearing Effect  
Image displayed

**Note:** Scroll Mode can be left by both the Normal Display Mode On (13h) and Partial Mode On (12h) commands.

6.2.29 Tearing effect line off (34h)

34H	TEOFF (Tearing Effect Line OFF)												
	D/CX	RDX	WRX	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	-	0	0	1	1	0	1	0	0	34
Parameter	NO PARAMETER												
Description	This command is used to turn OFF (Active Low) the Tearing Effect output signal from the TE signal line.												
Restriction	This command has no effect when Tearing Effect output is already OFF.												
Register Availability	Status						Availability						
	Normal Mode On, Idle Mode Off, Sleep Out						Yes						
	Normal Mode On, Idle Mode On, Sleep Out						Yes						
	Partial Mode On, Idle Mode Off, Sleep Out						Yes						
	Partial Mode On, Idle Mode On, Sleep Out						Yes						
	Sleep In or Booster Off						Yes						
Default	OFF												
Flow Chart	<div style="text-align: center;"> <pre> graph TD     A([TE Line Output ON]) --&gt; B[TEOFF]     B --&gt; C([TE Line Output OFF])             </pre> </div> <div style="text-align: right;"> <p>Legend</p> <ul style="list-style-type: none"> <li><span style="border: 1px solid black; padding: 2px;">Command</span></li> <li><span style="border: 1px solid black; border-style: dashed; padding: 2px;">Parameter</span></li> <li><span style="border: 1px solid black; border-radius: 15px; padding: 2px;">Display</span></li> <li><span style="border: 1px solid black; border-style: dashed; padding: 2px;">Action</span></li> <li><span style="border: 1px solid black; border-radius: 15px; padding: 2px;">Mode</span></li> <li><span style="border: 1px solid black; border-radius: 50%; padding: 2px;">Sequential transfer</span></li> </ul> </div>												



6.2.30 Set\_tear\_on (35h)

35H	TEON (Tearing Effect Line ON)																						
	D/CX	RDX	WRX	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX										
Command	0	1	↑	-	0	0	1	1	0	1	0	1	35										
Parameter	1	1	↑	-	X	X	X	X	X	X	X	M	xx										
Description	<p>This command is used to turn ON the Tearing Effect output signal from the TE signal line. This output is not affected by changing MADCTL bit B4. The Tearing Effect Line On has one parameter which describes the mode of the Tearing Effect Output Line. (X=Don't Care). When M=0: The Tearing Effect Output line consists of V-Blanking information only:</p> <p>When M=1: The Tearing Effect Output Line consists of both V-Blanking and H-Blanking information:</p> <p><b>Note:</b> During Sleep In Mode with Tearing Effect Line On, Tearing Effect Output pin will be active Low.</p>																						
Restriction	This command has no effect when Tearing Effect output is already ON.																						
Register Availability	<table border="1"> <thead> <tr> <th>Status</th> <th>Availability</th> </tr> </thead> <tbody> <tr> <td>Normal Mode On, Idle Mode Off, Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Normal Mode On, Idle Mode On, Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Partial Mode On, Idle Mode Off, Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Partial Mode On, Idle Mode On, Sleep Out</td> <td>Yes</td> </tr> </tbody> </table>													Status	Availability	Normal Mode On, Idle Mode Off, Sleep Out	Yes	Normal Mode On, Idle Mode On, Sleep Out	Yes	Partial Mode On, Idle Mode Off, Sleep Out	Yes	Partial Mode On, Idle Mode On, Sleep Out	Yes
Status	Availability																						
Normal Mode On, Idle Mode Off, Sleep Out	Yes																						
Normal Mode On, Idle Mode On, Sleep Out	Yes																						
Partial Mode On, Idle Mode Off, Sleep Out	Yes																						
Partial Mode On, Idle Mode On, Sleep Out	Yes																						
Default	OFF																						
Flow Chart																							

6.2.31 Set\_address\_mode (36h)

36H	MADCTL (Memory Access Control)												HEX																			
	D/CX	RDX	WRX	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0																				
Command	0	1	↑	-	0	0	1	1	0	1	1	0	36																			
1 <sup>st</sup> parameter	1	1	↑	-	B7	B6	B5	B4	B3	B2	X	X	XX																			
Description	<p>This command defines read/write scanning direction of frame memory. This command makes no change on the other driver status.</p> <p><b>Bit Assignment</b></p> <table border="1"> <thead> <tr> <th>BIT</th> <th>NAME</th> <th>DESCRIPTION</th> </tr> </thead> <tbody> <tr> <td>B7</td> <td>PAGE ADDRESS ORDER (MY)</td> <td rowspan="3">These 3 bits controls MCU to memory write/read direction.</td> </tr> <tr> <td>B6</td> <td>COLUMN ADDRESS ORDER (MX)</td> </tr> <tr> <td>B5</td> <td>PAGE/COLUMN SELECTION (MV)</td> </tr> <tr> <td>B4</td> <td>Vertical ORDER (ML)</td> <td>LCD vertical refresh direction control</td> </tr> <tr> <td>B3</td> <td>RGB-BGR ORDER (BGR)</td> <td>Colour selector switch control (0=RGB colour filter panel, 1=BGR colour filter panel)</td> </tr> <tr> <td>B2</td> <td>Horizontal ORDER (SS)</td> <td>LCD horizontal refresh direction control</td> </tr> </tbody> </table> <p><b>ML - Vertical Updating order</b></p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>ML= 0</p> </div> <div style="text-align: center;"> <p>ML= 1</p> </div> </div> <p><b>RGB-BGR Order</b></p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>B3= 0</p> </div> <div style="text-align: center;"> <p>B3= 1</p> </div> </div> <p><b>SS - Horizontal Updating order</b></p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>SS= 0</p> </div> <div style="text-align: center;"> <p>SS= 1</p> </div> </div> <p>Note: Top-Left (0,0) means a physical memory location. Bit D1 – Switching Between Segment Output and RAM Bit D0 – Switching Between Common Output and RAM</p>													BIT	NAME	DESCRIPTION	B7	PAGE ADDRESS ORDER (MY)	These 3 bits controls MCU to memory write/read direction.	B6	COLUMN ADDRESS ORDER (MX)	B5	PAGE/COLUMN SELECTION (MV)	B4	Vertical ORDER (ML)	LCD vertical refresh direction control	B3	RGB-BGR ORDER (BGR)	Colour selector switch control (0=RGB colour filter panel, 1=BGR colour filter panel)	B2	Horizontal ORDER (SS)	LCD horizontal refresh direction control
	BIT	NAME	DESCRIPTION																													
	B7	PAGE ADDRESS ORDER (MY)	These 3 bits controls MCU to memory write/read direction.																													
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	B3	RGB-BGR ORDER (BGR)	Colour selector switch control (0=RGB colour filter panel, 1=BGR colour filter panel)																													
	B2	Horizontal ORDER (SS)	LCD horizontal refresh direction control																													
	Restriction	-																														

Register Availability	Status		Availability
	Normal Mode On, Idle Mode Off, Sleep Out		Yes
	Normal Mode On, Idle Mode On, Sleep Out		Yes
	Partial Mode On, Idle Mode Off, Sleep Out		Yes
	Partial Mode On, Idle Mode On, Sleep Out		Yes
Sleep In or Booster Off		Yes	
Default	Status		Default value
	Power On Sequence	B7=0,B6=0,B5=0,B4=0,B3=0,B2=0,B1=0,B0=0	
	S/W Reset	No Change	
Flow Chart	<pre> graph TD     MADCTL[MADCTL] --&gt; Param[/1st parameter B[7:0]/]         </pre> <p>Legend</p> <ul style="list-style-type: none"> <li>Command</li> <li>Parameter</li> <li>Display</li> <li>Action</li> <li>Mode</li> <li>Sequential transfer</li> </ul>		

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6.2.32 Set\_scroll\_start (37h)

37H	VSCRSADD (Vertical Scrolling Start Address)												HEX									
	D/CX	RDX	WRX	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0										
Command	0	1	↑	-	0	0	1	1	0	1	1	1	37									
1 <sup>st</sup> parameter	1	1	↑	-	VSP 15	VSP 14	VSP 13	VSP 12	VSP 11	VSP 10	VSP 9	VSP 8	00. 13F									
2 <sup>nd</sup> parameter	1	1	↑	-	VSP 7	VSP 6	VSP 5	VSP 4	VSP 3	VSP 2	VSP 1	VSP 0										
Description	<p>This command is used together with Vertical Scrolling Definition (33h). These two commands describe the scrolling area and the scrolling mode. The Vertical Scrolling Start Address command has one parameter which describes the address of the line in the Frame Memory that will be written as the first line after the last line of the Top Fixed Area on the display as illustrated below:-</p> <p>When MADCTL B4=0 Example: When Top Fixed Area = Bottom Fixed Area = 00, Vertical Scrolling Area = 864(DM=10) and (Example)</p> <p>When MADCTL B4=1 Example: When Top Fixed Area = Bottom Fixed Area = 00, Vertical Scrolling Area = 320(DM=10) and (Example)</p> <p>When new Pointer position and Picture Data are sent, the result on the display will happen at the next Panel Scan to avoid tearing effect. VSP refers to the Frame Memory line Pointer.</p>																					
Restriction	<p>Since the value of the Vertical Scrolling Start Address is absolute (with reference to the Frame Memory), it must not enter the fixed area (defined by Vertical Scrolling Definition (33h) – otherwise undesirable image will be displayed on the Panel.</p>																					
Register Availability	<table border="1"> <thead> <tr> <th>Status</th> <th>Availability</th> </tr> </thead> <tbody> <tr> <td>Normal Mode On, Idle Mode Off, Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Normal Mode On, Idle Mode On, Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Partial Mode On, Idle Mode Off, Sleep Out</td> <td>No</td> </tr> <tr> <td>Partial Mode On, Idle Mode On, Sleep Out</td> <td>No</td> </tr> </tbody> </table>												Status	Availability	Normal Mode On, Idle Mode Off, Sleep Out	Yes	Normal Mode On, Idle Mode On, Sleep Out	Yes	Partial Mode On, Idle Mode Off, Sleep Out	No	Partial Mode On, Idle Mode On, Sleep Out	No
Status	Availability																					
Normal Mode On, Idle Mode Off, Sleep Out	Yes																					
Normal Mode On, Idle Mode On, Sleep Out	Yes																					
Partial Mode On, Idle Mode Off, Sleep Out	No																					
Partial Mode On, Idle Mode On, Sleep Out	No																					
Default	VSP[15:0]= 0x0000h																					
Flow Chart	See Vertical Scrolling Definition (33h) description.																					

6.2.33 Idle mode off (38h)

38H	IDMOFF (Idle mode off)												
	D/CX	RDX	WRX	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	-	0	0	1	1	1	0	0	0	38
Parameter	NO PARAMETER												
Description	This command is used to recover from Idle mode on. In the idle off mode, LCD can display maximum 16.7M colours.												
Restriction	This command has no effect when module is already in idle off mode.												
Register Availability	Status						Availability						
	Normal Mode On, Idle Mode Off, Sleep Out						Yes						
	Normal Mode On, Idle Mode On, Sleep Out						Yes						
	Partial Mode On, Idle Mode Off, Sleep Out						Yes						
	Partial Mode On, Idle Mode On, Sleep Out						Yes						
Default	Idle mode is OFF.												
Flow Chart	<pre> graph TD     A{{Idle on mode}} --&gt; B[IDMOFF]     B --&gt; C{{Idle off mode}}     </pre> <p>Legend</p> <ul style="list-style-type: none"> <li>Command: [ ]</li> <li>Parameter: // ]</li> <li>Display: {{ }} (hexagon)</li> <li>Action: →</li> <li>Mode: ( ) (oval)</li> <li>Sequential transfer: ( ) (oval with tail)</li> </ul>												

6.2.34 Enter\_Idle\_mode (39h)

39H	IDMON (Idle mode on)												HEX																																			
	D/CX	RDX	WRX	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0																																				
Command	0	1	↑	-	0	0	1	1	1	0	0	1	39																																			
Parameter	NO PARAMETER																																															
Description	This command is used to enter into Idle mode on. In the idle on mode, colour expression is reduced. The primary and the secondary colours using MSB of each R, G and B in the Frame Memory, 8 colour depth data is displayed.																																															
	(Example) <div style="display: flex; justify-content: center; align-items: center; gap: 20px;"> <div style="text-align: center;">                         Memory  </div> <div style="font-size: 2em;">→</div> <div style="text-align: center;">                         Display  </div> </div>																																															
	Memory contents vs. Display Colour <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th style="color: red;">R7 - R0</th> <th style="color: green;">G7 - G0</th> <th style="color: blue;">B7 - B0</th> </tr> </thead> <tbody> <tr> <td>Black</td> <td>0XXXXX</td> <td>0XXXXX</td> <td>0XXXXX</td> </tr> <tr> <td>Blue</td> <td>0XXXXX</td> <td>0XXXXX</td> <td>1XXXXX</td> </tr> <tr> <td>Red</td> <td>1XXXXX</td> <td>0XXXXX</td> <td>0XXXXX</td> </tr> <tr> <td>Magent</td> <td>1XXXXX</td> <td>0XXXXX</td> <td>1XXXXX</td> </tr> <tr> <td>Green</td> <td>0XXXXX</td> <td>1XXXXX</td> <td>0XXXXX</td> </tr> <tr> <td>Cyan</td> <td>0XXXXX</td> <td>1XXXXX</td> <td>1XXXXX</td> </tr> <tr> <td>Yellow</td> <td>1XXXXX</td> <td>1XXXXX</td> <td>0XXXXX</td> </tr> <tr> <td>White</td> <td>1XXXXX</td> <td>1XXXXX</td> <td>1XXXXX</td> </tr> </tbody> </table>													R7 - R0	G7 - G0	B7 - B0	Black	0XXXXX	0XXXXX	0XXXXX	Blue	0XXXXX	0XXXXX	1XXXXX	Red	1XXXXX	0XXXXX	0XXXXX	Magent	1XXXXX	0XXXXX	1XXXXX	Green	0XXXXX	1XXXXX	0XXXXX	Cyan	0XXXXX	1XXXXX	1XXXXX	Yellow	1XXXXX	1XXXXX	0XXXXX	White	1XXXXX	1XXXXX	1XXXXX
	R7 - R0	G7 - G0	B7 - B0																																													
Black	0XXXXX	0XXXXX	0XXXXX																																													
Blue	0XXXXX	0XXXXX	1XXXXX																																													
Red	1XXXXX	0XXXXX	0XXXXX																																													
Magent	1XXXXX	0XXXXX	1XXXXX																																													
Green	0XXXXX	1XXXXX	0XXXXX																																													
Cyan	0XXXXX	1XXXXX	1XXXXX																																													
Yellow	1XXXXX	1XXXXX	0XXXXX																																													
White	1XXXXX	1XXXXX	1XXXXX																																													
	X=don't care																																															
Restriction	This command has no effect when module is already in idle on mode.																																															
Register Availability	Status						Availability																																									
	Normal Mode On, Idle Mode Off, Sleep Out						Yes																																									
	Normal Mode On, Idle Mode On, Sleep Out						Yes																																									
	Partial Mode On, Idle Mode Off, Sleep Out						Yes																																									
	Partial Mode On, Idle Mode On, Sleep Out						Yes																																									
Sleep In or Booster Off						Yes																																										
Default	Idle mode is OFF.																																															
Flow Chart	<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"> </div> <div style="border: 1px dashed black; padding: 5px;"> <p style="text-align: center;">Legend</p> <ul style="list-style-type: none"> <li>Command</li> <li>Parameter</li> <li>Display</li> <li>Action</li> <li>Mode</li> <li>Sequential transfer</li> </ul> </div> </div>																																															

6.2.35 Set\_pixel\_format (3Ah)

3A H	COLMOD (Interface Pixel Format)																								
	D/CX	RDX	WRX	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX												
Command	0	1	↑	-	0	0	1	1	1	0	1	0	3A												
1 <sup>st</sup> parameter	1	1	↑	-	X	D6	D5	D4	X	D2	D1	D0	XX												
Description	This command is used to define the format of RGB picture data. D6~D4 : DPI Pixel format Definition. D2~D0 : DBI Pixel format Definition. The formats are shown in the table:																								
	Pixel Format		D6/D2	D5/D1	D4/D0																				
	Not Defined		0	0	0																				
	Not Defined		0	0	1																				
	Not Defined		0	1	0																				
	Not Defined		0	1	1																				
	Not Defined		1	0	0																				
	16 Bit/Pixel		1	0	1																				
	18 Bit/Pixel		1	1	0																				
	24 Bit/Pixel		1	1	1																				
If a particular interface, enter DBI or DPI, is not used then the corresponding bits in the parameter returned from the display module undefined.																									
Restriction	There is no visible effect until the Frame Memory is written to.																								
Register Availability	Status						Availability																		
	Normal Mode On, Idle Mode Off, Sleep Out						Yes																		
	Normal Mode On, Idle Mode On, Sleep Out						Yes																		
	Partial Mode On, Idle Mode Off, Sleep Out						Yes																		
	Partial Mode On, Idle Mode On, Sleep Out						Yes																		
Default	Status						Default value																		
	Power On Sequence						24 Bit/Pixel																		
Flow Chart																									
	<table border="1"> <thead> <tr> <th colspan="2">Legend</th> </tr> </thead> <tbody> <tr> <td></td> <td>Command</td> </tr> <tr> <td></td> <td>Parameter</td> </tr> <tr> <td></td> <td>Display</td> </tr> <tr> <td></td> <td>Action</td> </tr> <tr> <td></td> <td>Mode</td> </tr> <tr> <td></td> <td>Sequential transfer</td> </tr> </tbody> </table>												Legend			Command		Parameter		Display		Action		Mode	
Legend																									
	Command																								
	Parameter																								
	Display																								
	Action																								
	Mode																								
	Sequential transfer																								



6.2.36 Write\_memory\_contiune (3Ch)

3CH	Write_memory_contiune												
	D/CX	RDX	WRX	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	-	0	0	1	1	1	1	0	0	3C
1 <sup>st</sup> parameter	1	1	↑	-	D17	D16	D15	D14	D13	D12	D11	D10	00..FF
:	1	1	↑	-	Dx7	Dx6	Dx5	Dx4	Dx3	Dx2	Dx1	Dx0	00..FF
N <sup>th</sup> parameter	1	1	↑	-	Dn7	Dn6	Dn5	Dn4	Dn3	Dn2	Dn1	Dn0	00..FF
Description	<p>This command transfers image data from the host processor to the display module's frame memory continuing from the pixel location following the previous write_memory_contiune or write_memory_start command. Sending any other command can stop frame Write.</p> <p>If set_address_mode B5 = 0: Data is written continuing from the pixel location after the write range of the previous write_memory_start or write_memory_contiune. 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 memory until the page register equals the End Page (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.</p> <p>If set_address_mode B5 = 1: Data is written continuing from the pixel location after the write range of the previous write_memory_start or write_memory_contiune. 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 memory until the column register equals the End column (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.</p>												
Restriction	In all colour modes, there is no restriction on length of parameters.												
Register Availability	Status						Availability						
	Normal Mode On, Idle Mode Off, Sleep Out						Yes						
	Normal Mode On, Idle Mode On, Sleep Out						Yes						
	Partial Mode On, Idle Mode Off, Sleep Out						Yes						
	Partial Mode On, Idle Mode On, Sleep Out						Yes						
Default	Status						Default value						
	Power On Sequence						Contents of memory is set randomly						
	S/W Reset						Contents of memory is set randomly						
Flow Chart	<pre> graph TD     RAMWR[RAMWR] --&gt; ImageData([Image Data D1[7:0], D2[7:0], ..., Dn[7:0]])     ImageData --&gt; AnyCommand[Any Command]             </pre> <p>Legend:</p> <ul style="list-style-type: none"> <li>Command: [ ]</li> <li>Parameter: /</li> <li>Display: &lt;&gt;</li> <li>Action: &lt;&gt;</li> <li>Mode: ( )</li> <li>Sequential transfer: [ ]</li> </ul>												

6.2.37 Raed\_memory\_continue (3Eh)

3EH	Raed_memory_continue												HEX
	D/CX	RDX	WRX	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0	
Command	0	1	↑	-	0	0	1	1	1	1	1	0	3E
1 <sup>st</sup> parameter	1	↑	1	-	X	X	X	X	X	X	X	X	Dummy read
2 <sup>nd</sup> parameter	1	↑	1	-	D17	D16	D15	D14	D13	D12	D11	D10	00..FF
:	1	↑	1	-	Dx7	Dx6	Dx5	Dx4	Dx3	Dx2	Dx1	Dx0	00..FF
(n+1) <sup>th</sup> parameter	1	↑	1	-	Dn7	Dn6	Dn5	Dn4	Dn3	Dn2	Dn1	Dn0	00..FF
Description	<p>This command transfers image data from the display module's frame memory to the host processor continuing from the location following the previous read_memory_continue or read_memory_start command.</p> <p>If set_address_mode B5=0:                      Pixels are read continuing from the pixel location after the read range of the previous read_memory_start or read_memory_continue. The column register is then incremented and pixels are 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 memory until the page register equals the End Page (EP) value or the host processor sends another command.</p> <p>If set_address_mode B5=1:                      Pixels are read continuing from the pixel location after the read range of the previous read_memory_start or read_memory_continue. The page register is then incremented and pixels are 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 memory until the column register equals the End Column (EC) value or the host processor sends another command.</p>												
Restriction	<p>Regardless of the color mode set in set_pixel_format, the pixel format returned by read_memory_continue is always 24-bit so there is no restriction on the length of data. A read_memory_start should follow a set_column_address, set_page_address or set_address_mode to define the read location. Otherwise, data read with read_memory_continue is undefined.</p>												
Register Availability	Status						Availability						
	Normal Mode On, Idle Mode Off, Sleep Out						Yes						
	Normal Mode On, Idle Mode On, Sleep Out						Yes						
	Partial Mode On, Idle Mode Off, Sleep Out						Yes						
	Partial Mode On, Idle Mode On, Sleep Out						Yes						
Default	Status						Default value						
	Power On Sequence						Contents of memory is set randomly						
Flow Chart	<pre>                     graph TD                         RAMRD[RAMRD] --&gt; Dummy[/Dummy/]                         Dummy --&gt; ImageData([Image Data D1[7:0], D2[7:0], ..., Dn[7:0]])                         ImageData --&gt; AnyCommand[Any Command]                     </pre>												

6.2.38 Set tear scan lines (44h)

44H	TESL (Tear Effect Scan Lines)																						
	D/CX	RDX	WRX	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX										
Command	0	1	↑	-	0	1	0	0	0	1	0	0	44										
1 <sup>st</sup> parameter	1	1	↑	-	TELINE[15:8](8'b0)								00..FF										
2 <sup>nd</sup> parameter	1	1	↑	-	TELINE[7:0](8'b0)								00..FF										
Description	<p>This command is turns on the display module's Tearing Effect output signal on the TE signal Line when the display module reacfes line TELINE. The TE signal is not affected by changing MADCTL bit B4.</p> <p>The Tearing Effect Line On has one parameter which describes the mode of the Tearing Effect Output Line.</p> <p>The Tearing Effect Output line consists of V-Blanking information only:</p> <p>Note: That TELINE=0 is equivalent to TEMODE=0. The Tearing Effect Output Line shall be active low when the display module is in Sleep mode.</p>																						
Restriction	The command has no effect when Tearing Effect output is already ON.																						
Register Availability	<table border="1"> <thead> <tr> <th>Status</th> <th>Availability</th> </tr> </thead> <tbody> <tr> <td>Normal Mode On, Idle Mode Off, Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Normal Mode On, Idle Mode On, Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Partial Mode On, Idle Mode Off, Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Partial Mode On, Idle Mode On, Sleep Out</td> <td>Yes</td> </tr> </tbody> </table>													Status	Availability	Normal Mode On, Idle Mode Off, Sleep Out	Yes	Normal Mode On, Idle Mode On, Sleep Out	Yes	Partial Mode On, Idle Mode Off, Sleep Out	Yes	Partial Mode On, Idle Mode On, Sleep Out	Yes
Status	Availability																						
Normal Mode On, Idle Mode Off, Sleep Out	Yes																						
Normal Mode On, Idle Mode On, Sleep Out	Yes																						
Partial Mode On, Idle Mode Off, Sleep Out	Yes																						
Partial Mode On, Idle Mode On, Sleep Out	Yes																						
Default	TELINE[15:0]=0x0000h																						
Flow Chart	<pre> graph TD     Start([TE Output On or Off]) --&gt; SetTearOn[set_tear_on]     subgraph DashedBox [ ]         SetTearOn --&gt; LineNLSB[/Line N (LSB)/]         LineNLSB --&gt; LineNMSB[/Line N (MSB)/]     end     LineNMSB --&gt; End([TE Output On])         </pre>																						

6.2.39 Get the current scanline(45h)

45H	GETSCAN (Get the current scanline)												
	D/CX	RDX	WRX	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	-	0	1	0	0	0	1	0	1	45
1 <sup>st</sup> parameter	1	1	↑	-	SLN[15:8](8'b0)								00..FF
2 <sup>nd</sup> parameter	1	1	↑	-	SLN[7:0](8'b0)								00..FF
Description	The display module returns the current scanline, N, used to update the display device. The total number of scanlines on a display device is defined as VSYNC + VBP + VACT + VFP. The first scanline is defined as the first line of V Sync and is denoted as Line 0. When in Sleep Mode, the value returned by get_scanline is undefined.												
Restriction	-												
Register Availability	Status						Availability						
	Normal Mode On, Idle Mode Off, Sleep Out						Yes						
	Normal Mode On, Idle Mode On, Sleep Out						Yes						
	Partial Mode On, Idle Mode Off, Sleep Out						Yes						
Default	SLN[15:0]= 0x0000h												
Flow Chart	<pre>                     graph TD                         subgraph Host_Processor [Host Processor]                             A[get_scanline]                         end                         subgraph Display_Module [Display Module]                             B[/scanline MSB/]                             C[/scanline LSB/]                         end                         A --- B                         B --- C                     </pre>												

6.2.40 Write display brightness (51h)

51H	WRDISBV (Write Display Brightness)												
	D/CX	RDX	WRX	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	-	0	1	0	1	0	0	0	1	51
1 <sup>st</sup> parameter	1	1	↑	-	DBV[7:0]							00 .. FF	
Description	<p>This command is used to adjust the brightness value of the display. It should be checked what the relationship between this written value and output brightness of the display is. This relationship is defined on the display module specification.</p> <p>In principle relationship is that 00h value means the lowest brightness and FFh value means the highest brightness. See chapter "7.17.4 Brightness Control BlockX".</p>												
Restriction	-												
Register Availability	Status		Availability										
	Sleep Out		Yes										
	Sleep In		Yes										
Default	DBV[7:0]= 0x00h												
Flow Chart	<pre> graph TD     A[WRDISBV] --&gt; B[/DBV[7:0]/]     B --&gt; C{{New Display Luminance Value Loaded}}     </pre> <p>Legend</p> <ul style="list-style-type: none"> <li>Command: [ ]</li> <li>Parameter: [ ]</li> <li>Display: [ ]</li> <li>Action: [ ]</li> <li>Mode: [ ]</li> <li>Sequential transfer: [ ]</li> </ul>												

**6.2.41 Read display brightness value (52h)**

52H	RDISBV (Read Display Brightness Value)												HEX
	D/CX	RDX	WRX	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0	
Command	0	1	↑	-	0	1	0	1	0	0	1	0	52
1 <sup>st</sup> parameter	1	↑	1	-	xx	xx	xx	xx	xx	xx	xx	xx	Dummy read
2 <sup>nd</sup> parameter	1	↑	1	-	DBV[7:0]							xx	
Description	<p>This command returns the brightness value of the display.                      It should be checked what the relationship between this returned value and output brightness of the display. This relationship is defined on the display modulespecification is.                      In principle the relationship is that 00h value means the lowest brightness and FFh value means the highest brightness.                      See chapters: "7.17.4 Brightness Control BlockX", 7.14.1 Display configuration" and "8.2.39 XWrite Display Brightness (51h)X"                      DBV[7:0] is reset when display is in sleep-in mode.                      DBV[7:0] is '0' when bit BCTRL of "8.2.41 Write CTRL Display (53h)" command is '0'.                      DBV[7:0] is manual set brightness specified with "8.2.41 Write CTRL Display (53h)" command when bit BCTRL is '1'.                      When bit BCTRL of "8.2.41 Write CTRL Display (53h)" command is '1' and bit C1/C0 of "8.2.43 Write Content Adaptive Brightness Control (55h)" are '0', DBV[7:0] output is the brightness value specified with "8.2.39 Write Display Brightness (51h)" command.                      Refers to "2.8.1 Display configuration" for the function matrix.</p>												
Restriction	-												
Register Availability	Status		Availability										
	Sleep Out		Yes										
	Sleep In		Yes										
Default	DBV[7:0]= 0x00h												
Flow Chart													

6.2.42 Write CTRL display (53h)

53H	WRCTRLD (Write Control Display)												
	D/CX	RDX	WRX	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	-	0	1	0	1	0	0	1	1	53
1 <sup>st</sup> parameter	1	1	↑	-	xx	xx	BCTRL	xx	DD	BL	xx	xx	00 .. FF
Description	<p>This command is used to control display brightness.                      BCTRL: Brightness Control Block On/Off, This bit is always used to switch brightness for display.                      0 = Off (Brightness registers are 00h, DBV[7..0])                      1 = On (Brightness registers are active, according to the other parameters.)                      Display Dimming (DD): (Only for manual brightness setting)                      DD = 0: Display Dimming is off                      DD = 1: Display Dimming is on                      BL: Backlight Control On/Off                      0 = Off (Completely turn off backlight circuit. Control lines must be low.)                      1 = On                      Dimming function is adapted to the brightness registers for display when bit BCTRL is changed at DD=1, e.g. BCTRL: 0 -&gt; 1 or 1 -&gt; 0.                      When BL bit change from "On" to "Off", backlight is turned off without gradual dimming, even if dimming-on (DD=1) are selected.                      X = Don't care.</p>												
Restriction	-												
Register Availability	Status		Availability										
	Sleep Out		Yes										
	Sleep In		Yes										
Default	D[7:0]= 0x00h												
Flow Chart	<pre>                     graph TD                         WRCTRLD[WRCTRLD] --&gt; Params[BCTRL, DD, BL]                         Params --&gt; NewValue{New Control Value Loaded}                     </pre> <p>Legend:                      Command: [ ]                      Parameter: /                      Display: &lt;&gt;                      Action: &lt;&gt;                      Mode: ( )                      Sequential transfer: [ ]</p>												



**6.2.43 Read CTRL value display (54h)**

54H	RDCTRLD (Read Control Value Display)																		
	D/CX	RDX	WRX	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX						
Command	0	1	↑	-	0	1	0	1	0	1	0	0	54						
1 <sup>st</sup> parameter	1	↑	1	-	xx	xx	xx	xx	xx	xx	xx	xx	xx						
2 <sup>nd</sup> parameter	1	↑	1	-	0	0	BCTRL	0	DD	BL	0	0	xx						
Description	<p>This command returns ambient light and brightness control values, see chapter: "8.2.41 Write CTRL Display (53h)X".</p> <p>BCTRL: Brightness Control Block On/Off, This bit is always used to switch brightness for display.                      0 = Off                      1 = On</p> <p>Display Dimming (DD):                      DD = 0: Display Dimming is off                      DD = 1: Display Dimming is on</p> <p>BL: Backlight Control On/Off                      0 = Off (completely turn off backlight circuit)                      1 = On</p>																		
Restriction	-																		
Register Availability	<table border="1"> <thead> <tr> <th>Status</th> <th>Availability</th> </tr> </thead> <tbody> <tr> <td>Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Sleep In</td> <td>Yes</td> </tr> </tbody> </table>													Status	Availability	Sleep Out	Yes	Sleep In	Yes
Status	Availability																		
Sleep Out	Yes																		
Sleep In	Yes																		
Default	D[7:0]= 0x00h																		
Flow Chart	<p>The flow chart illustrates the sequence of operations for the Read RDCTRLD command in both Serial I/F Mode and Parallel I/F Mode. In Serial I/F Mode, the sequence is: Host sends Command (Read RDCTRLD), Host sends Parameter (Send 2nd Parameter), and Host receives Action (Data). In Parallel I/F Mode, the sequence is: Host sends Command (Read RDCTRLD), Host sends Parameter (Dummy Read), Host sends Parameter (Send 2nd Parameter), and Host receives Action (Data). The legend defines the symbols used: a rectangle for Command, a parallelogram for Parameter, a double-headed arrow for Action, a rounded rectangle for Mode, and a rounded rectangle with a vertical line for Sequential transfer.</p>																		

**6.2.44 Write content adaptive brightness control (55h)**

55 H	WRCABC (Write Content Adaptive Brightness Control)												HEX														
	D/CX	RDX	WRX	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0															
Command	0	1	↑	-	0	1	0	1	0	1	0	1	55														
1 <sup>st</sup> parameter	1	1	↑	-	xx	xx	xx	xx	xx	xx	xx	CABC[1:0]	xx														
Description	This command is used to set parameters for image content based adaptive brightness control functionality. There is possible to use 4 different modes for content adaptive image functionality, which are defined on a table below. See chapter "7.17 Content Adaptive Brightness Control (CABC)".																										
	<table border="1"> <thead> <tr> <th>C1</th> <th>C0</th> <th>Function</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>Off</td> </tr> <tr> <td>0</td> <td>1</td> <td>User Interface Image</td> </tr> <tr> <td>1</td> <td>0</td> <td>Still Picture</td> </tr> <tr> <td>1</td> <td>1</td> <td>Moving Image</td> </tr> </tbody> </table> X = Don't care.													C1	C0	Function	0	0	Off	0	1	User Interface Image	1	0	Still Picture	1	1
C1	C0	Function																									
0	0	Off																									
0	1	User Interface Image																									
1	0	Still Picture																									
1	1	Moving Image																									
Restriction																											
Register Availability	Status						Availability																				
	Sleep Out						Yes																				
	Sleep In						Yes																				
Default	CABC[1:0] = 00																										
Flow Chart	<pre>                     graph TD                         WRCABC[WRCABC] --&gt; Param[1st parameter: C[1:0]]                         Param --&gt; Mode{New Adaptive Image Mode}                     </pre>																										

**6.2.45 Read content adaptive brightness control (56h)**

56H	RDCABC (Read Content Adaptive Brightness Control)												HEX															
	D/CX	RDX	WRX	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0																
Command	0	1	↑	-	0	1	0	1	0	1	1	0	56															
1 <sup>st</sup> parameter	1	↑	1	-	XX	XX	XX	XX	XX	XX	XX	XX	Dummy read															
2 <sup>nd</sup> parameter	1	↑	1	-	0	0	0	0	0	0	C1	C0	xx															
Description	<p>This command is used to set parameters for image content based adaptive brightness control functionality.</p> <p>There is possible to use 4 different modes for content adaptive image functionality, which are defined on a table below. See chapter "7.17 Content Adaptive Brightness Control (CABC)".</p> <table border="1"> <thead> <tr> <th>C1</th> <th>C0</th> <th>Function</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>Off</td> </tr> <tr> <td>0</td> <td>1</td> <td>User Interface Image</td> </tr> <tr> <td>1</td> <td>0</td> <td>Still Picture</td> </tr> <tr> <td>1</td> <td>1</td> <td>Moving Image</td> </tr> </tbody> </table>													C1	C0	Function	0	0	Off	0	1	User Interface Image	1	0	Still Picture	1	1	Moving Image
C1	C0	Function																										
0	0	Off																										
0	1	User Interface Image																										
1	0	Still Picture																										
1	1	Moving Image																										
Restriction																												
Register Availability	Status		Availability																									
	Sleep Out		Yes																									
	Sleep In		Yes																									
Default	C[1:0] = 00																											
Flow Chart	<p>The flowchart illustrates the process of reading RDCABC. It branches into Serial I/F Mode and Parallel I/F Mode. In Serial I/F Mode, the sequence is: Read RDCABC (Command) → Send 2<sup>nd</sup> Parameter (Parameter). In Parallel I/F Mode, the sequence is: Read RDCABC (Command) → Dummy Read (Action) → Send 2<sup>nd</sup> Parameter (Parameter). A legend defines the symbols: Command (rectangle), Parameter (parallelogram), Display (trapezoid), Action (diamond), Mode (oval), and Sequential transfer (curved arrow). The Host and Display are also indicated.</p>																											

6.2.46 Write CABC minimum brightness (5Eh)

5E H	WRCABCMB (Write CABC minimum brightness)												HEX
	D/CX	RDX	WRX	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0	
Command	0	1	↑	-	0	1	0	1	1	1	1	0	5E
1 <sup>st</sup> parameter	1	1	1	-	CMB[7:0]							00 .. FF	
Description	This command is used to set the minimum brightness value of the display for CABC function. In principle relationship is that 00h value means the lowest brightness for CABC and FFh value means the highest brightness for CABC. See chapter "7.17.4 Minimum brightness setting of CABC function".												
Restriction	-												
Register Availability	Status		Availability										
	Sleep Out		Yes										
	Sleep In		Yes										
Default	CMB[7:0] = 0x00h												
Flow Chart	<pre>                     graph TD                         WRCABCMB[Command] --&gt; CMB[7:0[/Parameter/]]                         CMB[7:0] --&gt; NewDisplayLuminance{New Display Luminance Value Loaded}                     </pre>												

6.2.47 Read CABC minimum brightness (5Fh)

5FH	RDCABCMB (Read CABC minimum brightness)												
	D/CX	RDX	WRX	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	-	0	1	0	1	1	1	1	1	5F
1 <sup>st</sup> parameter	1	↑	1	-	XX	XX	XX	XX	XX	XX	XX	XX	XX
2 <sup>nd</sup> parameter	1	↑	1	-	CMB[7:0]							XX	
Description	This command returns the minimum brightness value of CABC function. In principle the relationship is that 00h value means the lowest brightness and FFh value means the highest brightness. See chapter "7.17.4 Minimum brightness setting of CABC function". CMB[7:0] is CABC minimum brightness specified with "8.2.45 Write CABC minimum brightness (5Eh)" command.												
Restriction	-												
Register Availability	Status				Availability								
	Sleep Out				Yes								
	Sleep In				Yes								
Default	CMB[7:0] = 0x00h												
Flow Chart													

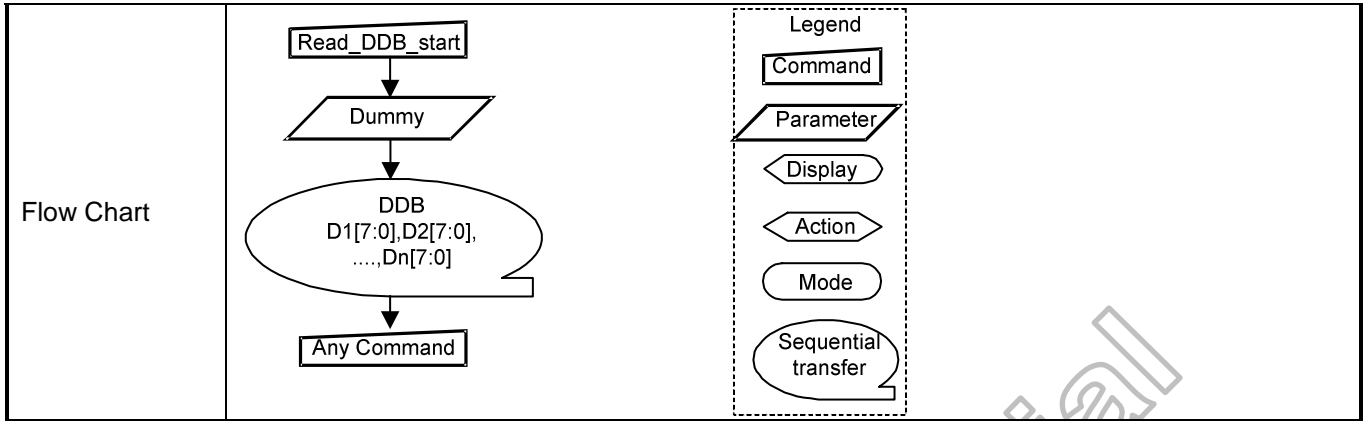
6.2.48 Read automatic brightness control self-diagnostic result (68h)

68H	RDABCSDR (Read Automatic Brightness Control Self-Diagnostic Result)												
	D/CX	RDX	WRX	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	-	0	1	1	0	1	0	0	0	68
1 <sup>st</sup> parameter	1	↑	1	-	xx	xx	xx	xx	xx	xx	xx	xx	xx
2 <sup>nd</sup> parameter	1	↑	1	-	D[7:6]		0	0	0	0	0	0	xx
Description	<p>This command indicates the status of the display self-diagnostic results for automatic brightness control after Sleep Out -command as described in the table below:</p> <ul style="list-style-type: none"> <li>• Bit D7 – Register Loading Detection See section “5.15.1 Register loading Detection”.</li> <li>• Bit D6 – Functionality Detection See section “5.15.2 Functionality Detection”.</li> <li>• Bits D5, D4, D3, D2, D1 and D0 are for future use and are set to ‘0’.</li> </ul>												
Restriction	-												
Register Availability	Status		Availability										
	Sleep Out		Yes										
	Sleep In		Yes										
Default	D[7:0] = 0x00h												
Flow Chart	<p>The flowchart illustrates the process of reading the RDABCSDR register. It is divided into two modes: Serial I/F Mode and Parallel I/F Mode. In Serial I/F Mode, the sequence is: Host sends 'Read RDABCSDR' (Command), Display sends 'Send 2<sup>nd</sup> Parameter' (Parameter), Host receives 'Read RDABCSDR' (Data). In Parallel I/F Mode, the sequence is: Host sends 'Read RDABCSDR' (Command), Display performs a 'Dummy Read' (Action), Host receives 'Read RDABCSDR' (Data), and then Display sends 'Send 2<sup>nd</sup> Parameter' (Parameter). A legend defines the symbols: a box for Command, a parallelogram for Parameter, a double-headed arrow for Display, a diamond for Action, an oval for Mode, and a dashed oval for Sequential transfer.</p>												

**6.2.49 Read\_DDB\_start (A1h)**

A1H	Read_DDB_start												HEX	
	D/CX	RDX	WRX	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0		
Command	0	1	↑	-	1	0	1	0	0	0	0	0	1	A1
1 <sup>st</sup> parameter	1	↑	1	-	x	x	x	x	x	x	x	x	X	Dummy read
2 <sup>nd</sup> parameter	1	↑	1	-	x	x	x	x	x	x	x	x	x	xx
:	1	↑	1	-	x	x	x	x	x	x	x	x	x	xx
N <sup>th</sup> parameter	1	↑	1	-	x	x	x	x	x	x	x	x	x	xx
Description	<p>This command reads identifying and descriptive information from the peripheral. This information is organized in the Device Descriptor Block (DDB) stored on the peripheral. The response to this command returns a sequence of bytes that may be any length up to 64K bytes. Note that the returned sequence of bytes does not necessarily correspond to the entire DDB; it may be a portion of a larger block of data.</p> <p>The format of returned data is as follows:                      Parameter 2: LS (least significant) byte of Supplier ID. Supplier ID is a unique value assigned to each peripheral supplier by the MIPI organization.                      Parameter 3: MS (most significant) byte of Supplier ID.                      Parameter 4: LS (least significant) byte of Supplier Elective Data. This is a byte of information that is determined by the supplier. It could include model number or revision information, for example.                      Parameter 5: MS (most significant) byte of Supplier Elective Data                      Parameter 6: single-byte <i>Escape or Exit Code</i> (EEC). The code is interpreted as follows:                      - FFh - Exit code – there is no more data in the Descriptor Block                      - 00h - Escape code – there is supplier-proprietary data in the Descriptor Block (does not conform to any MIPI standard)                      - Any other value – there is DDB data in the Descriptor Block. The format and interpretation of this data is documented in <i>MIPI Alliance Standard for Device Descriptor Block (DDB)</i>.                      DDBs may contain many more data fields providing information about the peripheral.                      In a DSI system, read activity takes the form of two separate transactions across the bus: first the read command read_DDB_start from host processor to peripheral, which includes the bus turn-around token.                      The peripheral then takes control of the bus and returns the requested data. The peripheral response to read_DDB_start is a Long Packet type, so its length may be up to 64K bytes unless limited by a previous set_max_return_size command.                      The response to a read_DDB_start command always starts at the beginning of the Device Descriptor Block. After receiving the first packet and processing the returned DDB data, the host processor may initiate a read_DDB_continue command to access the next portion of the DDB. A read_DDB_continue command begins the next read at the location following the last byte of the previous data read from the DDB.                      Subsequent read_DDB_continue commands can be used to read a DDB or supplier-proprietary block of arbitrary size. There is, however, no obligation to read the entire block. The host processor may choose to stop reading after completion of any read_DDB_xxx command.</p>													
Restrictions	-													
Register Availability	Status						Availability							
	Normal Mode On, Idle Mode Off, Sleep Out						Yes							
	Normal Mode On, Idle Mode On, Sleep Out						Yes							
	Partial Mode On, Idle Mode Off, Sleep Out						Yes							
Partial Mode On, Idle Mode On, Sleep Out						Yes								
Default	D[7:0] = 0x00h													





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6.2.50 Read\_DDB\_continue (A8h)

A8H	Read_DDB_continue												HEX
	D/CX	RDX	WRX	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0	
Command	0	1	↑	-	1	0	1	0	1	0	0	0	A8
1 <sup>st</sup> parameter	1	↑	1	-	x	x	x	x	x	x	x	x	Dummy read
2 <sup>nd</sup> parameter	1	↑	1	-	x	x	x	x	x	x	x	x	xx
:	1	↑	1	-	x	x	x	x	x	x	x	x	xx
N <sup>th</sup> parameter	1	↑	1	-	x	x	x	x	x	x	x	x	xx
Description	A read_DDB_start command should be executed at least once before a read_DDB_continue command to define the read location. Otherwise, data read with a read_DDB_continue command is undefined.												
Restrictions	-												
Register Availability	Status						Availability						
	Normal Mode On, Idle Mode Off, Sleep Out						Yes						
	Normal Mode On, Idle Mode On, Sleep Out						Yes						
	Partial Mode On, Idle Mode Off, Sleep Out						Yes						
Partial Mode On, Idle Mode On, Sleep Out						Yes							
Default	D[7:0] = 0x00h												
Flow Chart	<pre> graph TD     A[Read_DDB_continue] --&gt; B[/Dummy/]     B --&gt; C([DDB D1[7:0], D2[7:0], ..., Dn[7:0]])     C --&gt; D[Any Command]     </pre> <p>Legend:</p> <ul style="list-style-type: none"> <li>Command: [ ]</li> <li>Parameter: [ ]</li> <li>Display: [ ]</li> <li>Action: [ ]</li> <li>Mode: [ ]</li> <li>Sequential transfer: [ ]</li> </ul>												

**6.2.51 Read ID1 (DAh)**

DAH	RDID1 (Read ID1)												
	DNC	NRD	NWR	D15~D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	-	1	1	0	1	1	0	1	0	DA
1 <sup>st</sup> parameter	1	↑	1	-	-	-	-	-	-	-	-	-	-
2 <sup>nd</sup> parameter	1	↑	1	-	module's manufacturer[7:0]							xx	
Description	This read byte identifies the LCD module's manufacturer. It is specified by display supplier and for xx is defined as xxHEX.												
Restriction	-												
Register Availability	Status						Availability						
	Normal Mode On, Idle Mode Off, Sleep Out						Yes						
	Normal Mode On, Idle Mode On, Sleep Out						Yes						
	Partial Mode On, Idle Mode Off, Sleep Out						Yes						
	Partial Mode On, Idle Mode On, Sleep Out						Yes						
	Sleep In or Booster Off						Yes						
Default	Default value						OTP value						
	ID1[7:0]=0x00h						Define by customer						
Flow Chart	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Serial I/F Mode (P/SX=Low)</p> </div> <div style="text-align: center;"> <p>Parallel I/F Mode (P/SX=High)</p> </div> <div style="border: 1px dashed black; padding: 5px;"> <p>Legend</p> <ul style="list-style-type: none"> <li>Command: [Rectangle]</li> <li>Parameter: [Parallelogram]</li> <li>Display: [Oval]</li> <li>Action: [Arrow]</li> <li>Mode: [Oval]</li> <li>Sequential transfer: [Curved arrow]</li> </ul> </div> </div>												

6.2.52 Read ID2 (DBh)

DBH	RDID2 (Read ID2)												HEX
	DNC	NRD	NWR	D15~D8	D7	D6	D5	D4	D3	D2	D1	D0	
Command	0	1	↑	-	1	1	0	1	1	0	1	1	DB
1 <sup>st</sup> parameter	1	↑	1	-	XX	XX	XX	XX	XX	XX	XX	XX	XX
2 <sup>nd</sup> parameter	1	↑	1	-	-	LCD module/driver version [6:0]						-	
Description	This read byte is used to track the LCD module/driver version. It is defined by display supplier and changes each time a revision is made to the display, material or construction specifications. See Table:												
	ID Byte Value V[7:0]			Version				Changes					
	80h												
	81h												
	82h												
	83h												
	84h												
85h													
X= Don't care													
Restrictions	-												
Register Availability	Status						Availability						
	Normal Mode On, Idle Mode Off, Sleep Out						Yes						
	Normal Mode On, Idle Mode On, Sleep Out						Yes						
	Partial Mode On, Idle Mode Off, Sleep Out						Yes						
	Partial Mode On, Idle Mode On, Sleep Out						Yes						
	Sleep In or Booster Off						Yes						
Default	Default value						OTP value						
	ID2[6:0]=0x00h						Define by customer						
Flow Chart													

6.2.53 Read ID3 (DCh)

DCH	RDID3 (Read ID3)												
	DNC	NRD	NWR	D15~D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	-	1	1	0	1	1	1	0	0	DC
1 <sup>st</sup> parameter	1	↑	1	-	xx	xx	xx	xx	xx	xx	xx	xx	xx
2 <sup>nd</sup> parameter	1	↑	1	-	LCD module/driver ID[7:0]							xx	
Description	This read byte identifies the LCD module/driver. It is specified by display supplier and for this LCD project module is defined as xxHEX.												
Restrictions	-												
Register Availability	Status						Availability						
	Normal Mode On, Idle Mode Off, Sleep Out						Yes						
	Normal Mode On, Idle Mode On, Sleep Out						Yes						
	Partial Mode On, Idle Mode Off, Sleep Out						Yes						
	Partial Mode On, Idle Mode On, Sleep Out						Yes						
Sleep In or Booster Off						Yes							
Default	Default value						OTP value						
	ID3[7:0]=0x00h						Define by customer						
Flow Chart	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Serial I/F Mode (P/SX=Low)</p> </div> <div style="text-align: center;"> <p>Parallel I/F Mode (P/SX=High)</p> </div> <div style="border: 1px dashed black; padding: 5px;"> <p>Legend</p> <ul style="list-style-type: none"> <li>Command: [Rectangle]</li> <li>Parameter: [Parallelogram]</li> <li>Display: [Oval]</li> <li>Action: [Arrow]</li> <li>Mode: [Oval]</li> <li>Sequential transfer: [Speech bubble]</li> </ul> </div> </div>												

6.2.54 SETOSC: Set internal oscillator (B0h)

B0H	SETOSC( Set Internal Oscillator)												
	DNC	NRD	NWR	D15~D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	-	1	1	0	1	1	1	0	0	DC
1 <sup>st</sup> parameter	1	1	↑	-	-	-	-	-	-	-	-	OSC_EN	-
2 <sup>nd</sup> parameter	1	1	↑	-	-	-	-	-	UADJ[3:0]			-	
Description	This command is used to set internal oscillator related setting <b>OSC_EN</b> : Enable internal oscillator, High active. <b>UADJ[3:0]</b> : For User to adjust OSC frequency, default is 15 MHZ.												
	UADJ				Internal oscillator frequency								
	0	0	0	0	28.0%								
	0	0	0	1	34.8%								
	0	0	1	0	41.5%								
	0	0	1	1	48.1%								
	0	1	0	0	54.7%								
	0	1	0	1	61.3%								
	0	1	1	0	67.8%								
	0	1	1	1	74.4%								
	1	0	0	0	80.6%								
	1	0	0	1	87.2%								
	1	0	1	0	93.5%								
	1	0	1	1	100.0%								
	1	1	0	0	106.4%								
	1	1	0	1	112.7%								
	1	1	1	0	119.4%								
	1	1	1	1	125.8%								
Restrictions	SETEXTC turn on to enable this command.												
Register Availability	Status						Availability						
	Normal Mode On, Idle Mode Off, Sleep Out						Yes						
	Normal Mode On, Idle Mode On, Sleep Out						Yes						
	Partial Mode On, Idle Mode Off, Sleep Out						Yes						
	Partial Mode On, Idle Mode On, Sleep Out						Yes						
Default	Status			Default value				OTP value					
	Power On Sequence			OSC_EN=0,				UADJ[3:0]					
	S/W Reset			UADJ[3:0]= 1011									
H/W Reset													

## 6.2.55 SETPOWER: Set power (B1h)

B1H	SETPOWER( Set power related setting)												
	DNC	NRD	NWR	D15~D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	-	1	0	1	1	0	0	0	1	B1
1 <sup>st</sup> parameter	1	1	↑	-	VBIA_S_EN	VSN_EN	VSP_EN	VGL_EN	VGH_EN	LVGL_EN	VDDD_N_HZ	STB	-
2 <sup>nd</sup> parameter	1	1	↑	-	-	-	-	-	-	-	-	DSTB	-
3 <sup>rd</sup> parameter	1	1	↑	-	-	FS1[2:0]		-	AP[2:0]				-
4 <sup>th</sup> parameter	1	1	↑	-	-	-	-	BT[3:0]					-
5 <sup>th</sup> parameter	1	1	↑	-	DT[1:0]		-	DCDIV[3:0]					-
6 <sup>th</sup> parameter	1	1	↑	-	-	-	-	BTP[4:0]					-
7 <sup>th</sup> parameter	1	1	↑	-	-	-	-	BTN[4:0]					-
8 <sup>th</sup> parameter	1	1	↑	-	VRHP[7:0]							-	
9 <sup>th</sup> parameter	1	1	↑	-	VRHN[7:0]							-	
10 <sup>th</sup> parameter	1	1	↑	-	-	-	VRMP[5:0]					-	
11 <sup>th</sup> parameter	1	1	↑	-	-	-	VRMN[5:0]					-	
12 <sup>th</sup> parameter	1	1	↑	-	-	-	DD_TU	VPNL_EN	-	VBS[2:0]			-
13 <sup>th</sup> parameter	1	1	↑	-	-	DC86_DIV[3:0]			XDK1	XDK0	AUTO_XDK	-	
14 <sup>th</sup> parameter	1	1	↑	-	-	DTPS[2:0]		-	DTNS[2:0]				-
15 <sup>th</sup> parameter	1	1	↑	-	A_DC[1:0]		A_DTP[2:0]		A_DTN[2:0]				-
16 <sup>th</sup> parameter	1	1	↑	-	B_DC[1:0]		B_DTP[2:0]		B_DTN[2:0]				-
17 <sup>th</sup> parameter	1	1	↑	-	C_DC[1:0]		C_DTP[2:0]		C_DTN[2:0]				-
18 <sup>th</sup> parameter	1	1	↑	-	D_DC[1:0]		D_DTP[2:0]		D_DTN[2:0]				-
19 <sup>th</sup> parameter	1	1	↑	-	E_DC[1:0]		E_DTP[2:0]		E_DTN[2:0]				-

This command is used to set related setting of power.

**DSTB:** When DSTB = "1", the HX8369-A into the deep\_standby mode, where all display operation stops, suspend all the internal operations including the internal R-C oscillator. During the standby mode, only the following process can be executed.

- Exit the Standby mode (DSTB = "0")

In the deep standby mode, the GRAM data and register content may be lost. For preventing this, they have to reset again after the deep standby mode cancel.

**STB:** When SLP = "1", the HX8369-A enters the standby mode, where all display operation stops, suspend all the internal operations. But the internal R-C oscillator stop or not is determined by OSC\_EN bit. To minimize the standby power, please set OSC\_EN to 0. During the standby mode, only the following process can be executed.

- Exit the Standby (Sleep) mode (SLP = "0")
- Enable or disable the oscillation
- Software reset

**VSP\_EN:** ON/OFF the operation of VSP circuit.

VSP_EN	Operation of VSP DC/DC circuit
0	OFF
1	ON

**VSN\_EN:** ON/OFF the operation of VSN circuit.

VSN_EN	Operation of VSN DC/DC circuit
0	OFF
1	ON

**VGH\_EN:** ON/OFF the operation of VGH charge bump circuit.

VGH_EN	Operation of VGH charge bump circuit
0	OFF
1	ON



VGL_EN	Operation of VGL charge bump circuit
0	OFF
1	ON

**LVGL\_EN** : ON/OFF the operation of LVGL charge bump circuit.

LVGL_EN	Operation of LVGL charge bump circuit
0	OFF
1	ON

BT3	BT2	BT1	BT0	VGH	VGL
0	0	0	0	2*(VSP-VSN)	VDDDN-1*(VSP-VSN)
0	0	0	1	2*(VSP-VSN)	-1*(VSP-VSN)
0	0	1	0	2*(VSP-VSN)	VDD3-1*(VSP-VSN)
0	0	1	1	(VSP-VSN)+(VDD3-VSN)	VDDDN-1*(VSP-VSN)
0	1	0	0	(VSP-VSN)+(VDD3-VSN)	-1*(VSP-VSN)
0	1	0	1	(VSP-VSN)+(VDD3-VSN)	VDD3-1*(VSP-VSN)
0	1	1	0	(VSP-VSN)+(VSP-VSSD)	VDDDN-1*(VSP-VSN)
0	1	1	1	(VSP-VSN)+(VSP-VSSD)	-1*(VSP-VSN)
1	0	0	0	(VSP-VSN)+(VSP-VSSD)	VDD3-1*(VSP-VSN)
1	0	0	1	(VDD3-VSN)+(VSP-VSSD)	VDDDN-1*(VSP-VSN)
1	0	1	0	(VDD3-VSN)+(VSP-VSSD)	-1*(VSP-VSN)
1	0	1	1	(VDD3-VSN)+(VSP-VSSD)	VDD3-1*(VSP-VSN)
1	1	0	0	(VSP-VSN)	VDDDN-1*(VSP-VSN)
1	1	0	1	(VSP-VSN)	-1*(VSP-VSN)
1	1	1	0	(VSP-VSN)	VDD3-1*(VSP-VSN)
1	1	1	1	2*(VSP-VSSD)	-2*(VSP-VSSD)

**FS1[2:0]**: Set the operating frequency of the step-up circuit for VGH and VGL voltage generation.

FS12	FS11	FS10	Operation Frequency of Step-up Circuit
0	0	0	Inhibit
0	0	1	Fosc/64
0	1	0	Fosc/128
0	1	1	Fosc/256
1	0	0	Fosc/512
1	0	1	Fosc/1024
1	1	0	Fosc/2048
1	1	1	Fosc/4096

**VDDDN\_HZ**: Choose external or internal VDDDN power.

VDDDN\_HZ=0, VDDDN=-2.5V.

VDDDN\_HZ=1, VDDDN output HZ. (For external VDDDN.)

**DCDIV[3:0]**: Set the normal operate frequency of DC/DC converter circuit during normal mode.

**For PFM circuit**: Set the operate frequency of DC/DC converter circuit for PFM design.

(PCCS[1:0]=00, PCCS[1:0]=01, PCCS[1:0]=10)

DCDIV3	DCDIV2	DCDIV1	DCDIV0	Normal operate frequency of DC/DC converter
0	0	0	0	Fosc / 1
0	0	0	1	Fosc / 2
0	0	1	0	Fosc / 3
0	0	1	1	Fosc / 4
0	1	0	0	Fosc / 5
0	1	0	1	Fosc / 6
0	1	1	0	Fosc / 7
0	1	1	1	Fosc / 8
1	0	0	0	Fosc / 1
1	0	0	1	Fosc / 2
1	0	1	0	Fosc / 3
1	0	1	1	Fosc / 4
1	1	0	0	Fosc / 5
1	1	0	1	Fosc / 6
1	1	1	0	Fosc / 7

1	1	1	1	Fosc / 8
---	---	---	---	----------

**DT[1:0]:** Delay time of power on and power off sequence.

DT1	DT0	Delay time of power on and power off sequence on (ms)
0	0	5ms
0	1	10ms
1	0	15ms
1	1	20ms

**DTPS[2:0]:** Set the soft start operating duty cycle of DC/DC circuit. (PFM DC/DC circuit).  
1 duty cycle = 1 M clock

DTPS2	DTPS1	DTPS0	soft start operating duty cycle of DC/DC circuit circuit
0	0	0	1
0	0	1	2
0	1	0	3
0	1	1	4
1	0	0	5
1	0	1	6
1	1	0	7
1	1	1	8

**DTNS[2:0]:** Set the soft start operating duty cycle of DC/DC circuit. (PFM DC/DC circuit).  
1 duty cycle = 1 M clock

DTNS2	DTNS1	DTNS0	soft start operating duty cycle of DC/DC circuit circuit
0	0	0	1
0	0	1	2
0	1	0	3
0	1	1	4
1	0	0	5
1	0	1	6
1	1	0	7
1	1	1	8

**BTP[4:0]:** Switch the output factor for DC/DC circuit for VSP voltage generation. The LCD drive voltage level VSP can be selected according to the characteristic of liquid crystal which panel used.

BTP4	BTP3	BTP2	BTP1	BTP0	VSP
0	0	0	0	0	3.01
0	0	0	0	1	3.15
0	0	0	1	0	3.29
0	0	0	1	1	3.46
0	0	1	0	0	3.60
0	0	1	0	1	3.74
0	0	1	1	0	3.91
0	0	1	1	1	4.05
0	1	0	0	0	4.19
0	1	0	0	1	4.36
0	1	0	1	0	4.50
0	1	0	1	1	4.64
0	1	1	0	0	4.81
0	1	1	0	1	4.95
0	1	1	1	0	5.09
0	1	1	1	1	5.26
1	0	0	0	0	5.40
1	0	0	0	1	5.54
1	0	0	1	0	5.71

1	0	0	1	1	Inhibit
. . . . .					Inhibit
1	1	1	1	1	Inhibit

**BTN[4:0]:** Switch the output factor of DC/DC circuit for VSN voltage generation. The LCD drive voltage level VSN can be selected according to the characteristic of liquid crystal which panel used.

While using PFM type-C or HX5186-A mode (PCCS1-0 = 10, PCCS1-0 = 11), VSN is followed the BTP[4:0] setting.

PFM mode type-C :  $VSN = -VSP + 0.6V$

Using HX5186-A charge Pump mode :  $VSN = -VSP$

**AP[2:0]:** Adjust the amount of fixed current from the fixed current source for the operational amplifier in the power supply circuit. When the amount of fixed current is increased, the LCD driving capacity and the display quality are high, but the current consumption is increased. This is a tradeoff, Adjust the fixed current by considering both the display quality and the current consumption. During no display operation, when AP[2:0] = 000, the current consumption can be reduced by stopping the operations of operational amplifier and step-up circuit.

AP2	AP1	AP0	Constant Current of Operational Amplifier
0	0	0	Stop
0	0	1	0.5μA
0	1	0	1μA
0	1	1	1.5μA
1	0	0	2μA
1	0	1	2.5μA
1	1	0	3μA
1	1	1	3.5μA

**VRHP[7:0]:** VSPR regulator output control setting for source data output driving.

VRHP[7:0]								VSPR
0	0	0	0	0	0	0	0	3.488
0	0	0	0	0	0	0	1	3.516
0	0	0	0	0	0	1	0	3.544
0	0	0	0	0	0	1	1	3.572
0	0	0	0	0	1	0	0	3.600
0	0	0	0	0	1	0	1	3.628
0	0	0	0	0	1	1	0	3.656
0	0	0	0	0	1	1	1	3.684
0	0	0	0	1	0	0	0	3.713
0	0	0	0	1	0	0	1	3.741
0	0	0	0	1	0	1	0	3.769
0	0	0	0	1	0	1	1	3.797
0	0	0	0	1	1	0	0	3.825
0	0	0	0	1	1	0	1	3.853
0	0	0	0	1	1	1	0	3.881
0	0	0	0	1	1	1	1	3.909
0	0	0	1	0	0	0	0	3.938
0	0	0	1	0	0	0	1	3.966
0	0	0	1	0	0	1	0	3.994
0	0	0	1	0	0	1	1	4.022
0	0	0	1	0	1	0	0	4.050
0	0	0	1	0	1	0	1	4.078
0	0	0	1	0	1	1	0	4.106
0	0	0	1	0	1	1	1	4.134
0	0	0	1	1	0	0	0	4.163
0	0	0	1	1	0	0	1	4.191
0	0	0	1	1	0	1	0	4.219
0	0	0	1	1	0	1	1	4.247
0	0	0	1	1	1	0	0	4.275
0	0	0	1	1	1	0	1	4.303
0	0	0	1	1	1	1	0	4.331
0	0	0	1	1	1	1	1	4.359
0	0	1	0	0	0	0	0	4.388

0	0	1	0	0	0	0	1	4.416
0	0	1	0	0	0	1	0	4.444
0	0	1	0	0	0	1	1	4.472
0	0	1	0	0	1	0	0	4.500
0	0	1	0	0	1	0	1	4.528
0	0	1	0	0	1	1	0	4.556
0	0	1	0	0	1	1	1	4.584
0	0	1	0	1	0	0	0	4.613
0	0	1	0	1	0	0	1	4.641
0	0	1	0	1	0	1	0	4.669
0	0	1	0	1	0	1	1	4.697
0	0	1	0	1	1	0	0	4.725
0	0	1	0	1	1	0	1	4.753
0	0	1	0	1	1	1	0	4.781
0	0	1	0	1	1	1	1	4.809
0	0	1	1	0	0	0	0	4.838
0	0	1	1	0	0	0	1	4.866
0	0	1	1	0	0	1	0	4.894
0	0	1	1	0	0	1	1	4.922
0	0	1	1	0	1	0	0	4.950
0	0	1	1	0	1	0	1	4.978
0	0	1	1	0	1	1	0	5.006
0	0	1	1	0	1	1	1	5.034
0	0	1	1	1	0	0	0	5.063
0	0	1	1	1	0	0	1	5.091
0	0	1	1	1	0	1	0	5.119
00111011 ~ 01111110								Inhibit
0	1	1	1	1	1	1	1	VSP
10000000 ~ 11111110								Inhibit
1	1	1	1	1	1	1	1	HZ

VRHN[7:0]: VSNR regulator output control setting for source data output driving.

VRHN[7:0]								VSNR
0	0	0	0	0	0	0	0	-3.263
0	0	0	0	0	0	0	1	-3.291
0	0	0	0	0	0	1	0	-3.319
0	0	0	0	0	0	1	1	-3.347
0	0	0	0	0	1	0	0	-3.375
0	0	0	0	0	1	0	1	-3.403
0	0	0	0	0	1	1	0	-3.431
0	0	0	0	0	1	1	1	-3.459
0	0	0	0	1	0	0	0	-3.488
0	0	0	0	1	0	0	1	-3.516
0	0	0	0	1	0	1	0	-3.544
0	0	0	0	1	0	1	1	-3.572
0	0	0	0	1	1	0	0	-3.600
0	0	0	0	1	1	0	1	-3.628
0	0	0	0	1	1	1	0	-3.656
0	0	0	0	1	1	1	1	-3.684
0	0	0	1	0	0	0	0	-3.713
0	0	0	1	0	0	0	1	-3.741
0	0	0	1	0	0	1	0	-3.769
0	0	0	1	0	0	1	1	-3.797
0	0	0	1	0	1	0	0	-3.825
0	0	0	1	0	1	0	1	-3.853
0	0	0	1	0	1	1	0	-3.881
0	0	0	1	0	1	1	1	-3.909
0	0	0	1	1	0	0	0	-3.938
0	0	0	1	1	0	0	1	-3.966
0	0	0	1	1	0	1	0	-3.994
0	0	0	1	1	0	1	1	-4.022
0	0	0	1	1	1	0	0	-4.050
0	0	0	1	1	1	0	1	-4.078
0	0	0	1	1	1	1	0	-4.106

0	0	0	1	1	1	1	1	-4.134
0	0	1	0	0	0	0	0	-4.163
0	0	1	0	0	0	0	1	-4.191
0	0	1	0	0	0	1	0	-4.219
0	0	1	0	0	0	1	1	-4.247
0	0	1	0	0	1	0	0	-4.275
0	0	1	0	0	1	0	1	-4.303
0	0	1	0	0	1	1	0	-4.331
0	0	1	0	0	1	1	1	-4.359
0	0	1	0	1	0	0	0	-4.388
0	0	1	0	1	0	0	1	-4.416
0	0	1	0	1	0	1	0	-4.444
0	0	1	0	1	0	1	1	-4.472
0	0	1	0	1	1	0	0	-4.500
0	0	1	0	1	1	0	1	-4.528
0	0	1	0	1	1	1	0	-4.556
0	0	1	0	1	1	1	1	-4.584
0	0	1	1	0	0	0	0	-4.613
0	0	1	1	0	0	0	1	-4.641
0	0	1	1	0	0	1	0	-4.669
0	0	1	1	0	0	1	1	-4.697
0	0	1	1	0	1	0	0	-4.725
0	0	1	1	0	1	0	1	-4.753
0	0	1	1	0	1	1	0	-4.781
0	0	1	1	0	1	1	1	-4.809
0	0	1	1	1	0	0	0	-4.838
0	0	1	1	1	0	0	1	-4.866
0	0	1	1	1	0	1	0	-4.894
0	0	1	1	1	0	1	1	-4.922
0	0	1	1	1	1	0	0	-4.950
0	0	1	1	1	1	0	1	-4.978
0	0	1	1	1	1	1	0	-5.006
0	0	1	1	1	1	1	1	-5.034
0	1	0	0	0	0	0	0	-5.063
0	1	0	0	0	0	0	1	-5.091
0	1	0	0	0	0	1	0	-5.119
0100011 ~ 01111110								Inhibit
0	1	1	1	1	1	1	1	VSN
10000000 ~ 11111110								Inhibit
1	1	1	1	1	1	1	1	HZ

VRMP[5:0]: The positive polarity gamma amplitude voltage setting (VSPR-VGSP).

VRMP[5:0]						VSPR-VGSP
0	0	0	0	0	0	2.588
0	0	0	0	0	1	2.644
0	0	0	0	1	0	2.700
0	0	0	0	1	1	2.756
0	0	0	1	0	0	2.813
0	0	0	1	0	1	2.869
0	0	0	1	1	0	2.925
0	0	0	1	1	1	2.981
0	0	1	0	0	0	3.038
0	0	1	0	0	1	3.094
0	0	1	0	1	0	3.150
0	0	1	0	1	1	3.206
0	0	1	1	0	0	3.263
0	0	1	1	0	1	3.319
0	0	1	1	1	0	3.375
0	0	1	1	1	1	3.431
0	1	0	0	0	0	3.488
0	1	0	0	0	1	3.544
0	1	0	0	1	0	3.600
0	1	0	0	1	1	3.656
0	1	0	1	0	0	3.713
0	1	0	1	0	1	3.769

0	1	0	1	1	0	3.825
0	1	0	1	1	1	3.881
0	1	1	0	0	0	3.938
0	1	1	0	0	1	3.994
0	1	1	0	1	0	4.050
0	1	1	0	1	1	4.106
0	1	1	1	0	0	4.163
0	1	1	1	0	1	4.219
0	1	1	1	1	0	4.275
0	1	1	1	1	1	4.331
1	0	0	0	0	0	4.388
1	0	0	0	0	1	4.444
1	0	0	0	1	0	4.500
1	0	0	0	1	1	4.556
1	0	0	1	0	0	4.613
1	0	0	1	0	1	4.669
1	0	0	1	1	0	4.725
1	0	0	1	1	1	4.781
1	0	1	0	0	0	4.838
1	0	1	0	0	1	4.894
1	0	1	0	1	0	4.950
1	0	1	0	1	1	5.006
1	0	1	1	0	0	5.063
1	0	1	1	0	1	5.119
1	0	1	1	1	0	Inhibit
. . . . .						Inhibit
1	1	1	1	1	0	Inhibit
1	1	1	1	1	1	VSPR(VGSP=VSSA)

VRMN[5:0]: The negative polarity gamma amplitude voltage setting (VSNR-VGSN).

VRMN[5:0]						VSNR-VGSN
0	0	0	0	0	0	-2.588
0	0	0	0	0	1	-2.644
0	0	0	0	1	0	-2.700
0	0	0	0	1	1	-2.756
0	0	0	1	0	0	-2.813
0	0	0	1	0	1	-2.869
0	0	0	1	1	0	-2.925
0	0	0	1	1	1	-2.981
0	0	1	0	0	0	-3.038
0	0	1	0	0	1	-3.094
0	0	1	0	1	0	-3.150
0	0	1	0	1	1	-3.206
0	0	1	1	0	0	-3.263
0	0	1	1	0	1	-3.319
0	0	1	1	1	0	-3.375
0	0	1	1	1	1	-3.431
0	1	0	0	0	0	-3.488
0	1	0	0	0	1	-3.544
0	1	0	0	1	0	-3.600
0	1	0	0	1	1	-3.656
0	1	0	1	0	0	-3.713
0	1	0	1	0	1	-3.769
0	1	0	1	1	0	-3.825
0	1	0	1	1	1	-3.881
0	1	1	0	0	0	-3.938
0	1	1	0	0	1	-3.994
0	1	1	0	1	0	-4.050
0	1	1	0	1	1	-4.106
0	1	1	1	0	0	-4.163
0	1	1	1	0	1	-4.219
0	1	1	1	1	0	-4.275
0	1	1	1	1	1	-4.331
1	0	0	0	0	0	-4.388
1	0	0	0	0	1	-4.444

1	0	0	0	1	0	-4.500
1	0	0	0	1	1	-4.556
1	0	0	1	0	0	-4.613
1	0	0	1	0	1	-4.669
1	0	0	1	1	0	-4.725
1	0	0	1	1	1	-4.781
1	0	1	0	0	0	-4.838
1	0	1	0	0	1	-4.894
1	0	1	0	1	0	-4.950
1	0	1	0	1	1	-5.006
1	0	1	1	0	0	-5.063
1	0	1	1	0	1	-5.119
1	0	1	1	1	0	Inhibit
. . . . .						Inhibit
1	1	1	1	1	0	Inhibit
1	1	1	1	1	1	VSNR(VGSN=VSSA)

**VBS[2:0]:** Set the VBIAS level.

VBS2	VBS1	VBS0	VBIAS
0	0	0	Inhibit
0	0	1	4.68
0	1	0	4.50
0	1	1	4.32
1	0	0	4.14
1	0	1	3.96
1	1	0	3.78
1	1	1	3.60

**DC86\_DIV[3:0]:** Frequency for Charge Pump Mode (HX5186-A)

DC86_DIV[3:0]	Frequency - Charge Pump Mode (HX5186-A)
0000	Fosc/2
0001	Fosc/4
0010	Fosc/8
0011	Fosc/16
0100	Fosc/24
0101	Fosc/32
0110	Fosc/40
0111	Fosc/48
1000	Fosc/56
1001	Fosc/64
1010	Fosc/72
1011	Fosc/80
1100	Fosc/88
1101	Fosc/96
1110	Fosc/104
1111	Fosc/112

**XDK[1:0]:** Setting HX5186-A

XDK[1]	XDK[0]	HX5186-A or Internal-Charge Pump
0	0	X1.5 Pump
0	1	x2 Pump
1	0	X3 Pump
1	1	Inhibited

**AUTO\_XDK:** Auto XDK function enable, when using HX5186-A.

Auto_XDK=1	Hx5186-A
VDD3 x 1.5 > VSPtarget	X1.5
VDD3 x 2 > VSPtarget	X2
VDD3 x 2 < VSPtarget	X3
Auto_XDK=0	Depend on XDK[2:0]

**DD\_TU:** In-house function, and not open.

**VPNL\_EN:** Enable VPNL function.



Restriction	SETEXTC turn on to enable this command.		
Register Availability	Status	Availability	
	Normal Mode On, Idle Mode Off, Sleep Out	Yes	
	Normal Mode On, Idle Mode On, Sleep Out	Yes	
	Partial Mode On, Idle Mode Off, Sleep Out	Yes	
	Partial Mode On, Idle Mode On, Sleep Out	Yes	
	Sleep In or Booster Off	Yes	
Default	Status	Default value	OTP value
	Power On Sequence S/W Reset H/W Reset	VBIAS_EN=0, VSN_EN=0, VSP_EN=0, VGL_EN=0, VGH_EN=0, LVGL_EN=0, VDDDN_HZ=0, STB=1, DSTB=0, FS1[2:0]=011, AP[2:0]=100, BT[3:0]=111, DT[1:0]=00, DCDIV[3:0]=0000, BTP[4:0]=01110, BTN[4:0]=01110, VRHP[7:0]=0x21h, VRHN[7:0]=0x29h, VRMP[5:0]=0x19h, VRMN[5:0]=0x19h, DD_TU= 0, VPNL_EN=0, VBS[2:0]=111, DC86_DIV[3:0]=0111, XDK1=0, XDK0=1, AUTO_XDK=0, DTPS[2:0]=000, DTNS[2:0]=001, A_DC[1:0]=11, A_DTP[2:0]=100, A_DTN[2:0]=110, B_DC[1:0]=11, B_DTP[2:0]=100, B_DTN[2:0]=110, C_DC[1:0]=11, C_DTP[2:0]=100, C_DTN[2:0]=110, D_DC[1:0]=11, D_DTP[2:0]=100, D_DTN[2:0]=110, E_DC[1:0]=11, E_DTP[2:0]=100, E_DTN[2:0]=110,	FS1[2:0], AP[2:0], BT[3:0], DT[1:0], DCDIV[3:0], BTP[4:0], BTN[4:0], VRHP[7:0], VRHN[7:0], VRMP[5:0], VRMN[5:0], DD_TU, VPNL_EN, VBS[2:0], DC86_DIV[3:0], XDK1, XDK0, AUTO_XDK, DTPS[2:0], DTNS[2:0], A_DC[1:0], A_DTP[2:0], A_DTN[2:0], B_DC[1:0], B_DTP[2:0], B_DTN[2:0], C_DC[1:0], C_DTP[2:0], C_DTN[2:0], D_DC[1:0], D_DTP[2:0], D_DTN[2:0], E_DC[1:0], E_DTP[2:0], E_DTN[2:0],

6.2.56 SETDISP: Set display related register (B2h)

B2H	SETDISP( Set display related register)												HEX
	DNC	NRD	NWR	D15~D8	D7	D6	D5	D4	D3	D2	D1	D0	
Command	0	1	↑	-	1	0	1	1	0	0	1	0	B2
1 <sup>st</sup> parameter	1	1	↑	-	-	-	-	-	-	-	D[1:0]		
2 <sup>nd</sup> parameter	1	1	↑	-	-	RES_SEL[2:0]		RM	DFR	DM[1:0]			
3 <sup>rd</sup> parameter	1	1	↑	-	BP [7:0]								
4 <sup>th</sup> parameter	1	1	↑	-	FP [7:0]								
5 <sup>th</sup> parameter	1	1	↑	-	SAP[3:0]		-	-	-	-			
6 <sup>th</sup> parameter	1	1	↑	-	GEN_ON[7:0]								
7 <sup>th</sup> parameter	1	1	↑	-	GEN_OFF[7:0]								
8 <sup>th</sup> parameter	1	1	↑	-	RTN[7:0]								
9 <sup>th</sup> parameter	1	1	↑	-	-	-	-	-	TE[3:0]				
10 <sup>th</sup> parameter	1	1	↑	-	-	-	-	-	-	TEP[9:8]			
11 <sup>th</sup> parameter	1	1	↑	-	TEP[7:0]								
12 <sup>th</sup> parameter	1	1	↑	-	BP_PE[7:0]								
13 <sup>th</sup> parameter	1	1	↑	-	FP_PE[7:0]								
14 <sup>th</sup> parameter	1	1	↑	-	RTN_PE[7:0]								
15 <sup>th</sup> parameter	1	1	↑	-	-	-	-	-	-	-	-	GON	

This command is used to set display related register **D1-0**:

D1	D0	Source Output	HX8369-A Internal Display Operations
0	0	VSSD	Halt
0	1	Inhibit	Inhibit
1	0	V255	Operate
1	1	Display	Operate

**RES\_SEL[2:0]:** Resolution selection.

RES_SEL 2	RES_SEL 1	RES_SEL 0	Resolution
0	0	0	480RGBX864
0	0	1	480RGBX854
0	1	0	480RGBX800
0	1	1	480RGBX640
1	0	0	360 RGBX640
1	0	1	480RGBX720
1	1	0	Setting disable
1	1	1	Setting disable

**RM** The bit is used to select an interface for the Frame Memory access operation. The Frame Memory is accessed only via the interface defined by RM bit. Because the interface can be selected separately from display operation mode, writing data to the Frame Memory is possible via system interface when RM = 0, even in the DPI display operation. RM setting is enabled from the next frame. Wait 1 frame to transfer data after setting

RM	Interface for RAM Access
0	DBI Interface (CPU)
1	DPI Interface (RGB)

**DM[1:0]** The bit is used to select display operation mode. The setting allows switching between display operation in synchronization with internal oscillation clock, VSYNC, or DIP signal. Note that switching between VSYNC and DPI operation is prohibited.

DM 1	DM 0	Display Mode
0	0	Internal oscillation clock
0	1	DPI signal
1	0	VSYNC signal

**FP[7:0]:** Specify the amount of scan line for front porch (FP).

**BP[7:0] :** Specify the amount of scan line for back porch(BP).

**FP\_PE[7:0]:** Specify the amount of scan line for front porch (FP) on partial idle mode.

**BP\_PE[7:0] :** Specify the amount of scan line for back porch(BP) on partial idle mode.

FP[7:0] / FP_PE[7:0] BP[7:0] / BP_PE[7:0]	Number of FP Line	Number of BP Line
8h'00	<b>Inhibited</b>	
8h'01	3 lines	
8h'02	4 lines	
8h'03	5 lines	
8h'04	6 lines	
8h'05	7 lines	
...	...	
8h'FB	253 lines	
8h'FC	254 lines	
8h'FD	255 lines	
8h'FE	256 lines	
8h'FF	257 lines	

SAP3	SAP2	SAP1	SAP0	Fixed Current of Operational Amplifier
0	0	0	0	0.5u
0	0	0	1	1u
0	0	1	0	1.5u
0	0	1	1	2u
0	1	0	0	2.5u
0	1	0	1	3u
0	1	1	0	3.5u
0	1	1	1	4u
.....				
1	1	1	1	8u

**GEN\_ON[7:0]:** Gamma OP turned on timing and in-house function not open.

**GEN\_OFF[7:0]:** Gamma OP turned off timing and in-house function not open.

**RTN[7:0]:** A cycle time of line width, in-house function not open.

**RTN\_PE[7:0]:** A cycle time of line width on partial idle mode, in-house function not open.

RTN[7:0]/ RTN_PE[7:0]	Clock per Line
8h'00	275 clocks
8h'01	(275 + 1x2) 277 clocks
8h'02	(275 + 2x2) 279 clocks
8h'03	(275 + 3x2) 281 clocks
...	...
8h'FD	(275 + 253x2) 781 clocks
8h'FE	(275 + 254x2) 783 clocks
8h'FF	(275 + 255x2) 785 clocks

**TEI[3:0]:** Sets the output interval of TE signal according to the display data rewrite cycle and data transfer rate.

TEI3	TEI2	TEI1	TEI0	Output Interval
0	0	0	0	1 frame
0	0	0	1	2 frames
0	0	1	0	3 frames
.....				..
1	1	1	0	15 frames

	1	1	1	1	16 frames																		
<p><b>TEP[9:0]:</b> Sets the output position of frame cycle signal. TE can be used as the trigger signal for frame synchronous write operation.  <b>Make sure the setting restriction <math>9'h000 \leq TEP[9:0] \leq BP+Number\ of\ Line +FP</math>.</b></p> <table border="1"> <thead> <tr> <th>TEP[9:0]</th> <th>Output position</th> </tr> </thead> <tbody> <tr> <td>10'h000</td> <td>0th line</td> </tr> <tr> <td>10'h001</td> <td>1st line</td> </tr> <tr> <td>10'h002</td> <td>2nd line</td> </tr> <tr> <td>10'h003</td> <td>3rd line</td> </tr> <tr> <td>...</td> <td>...</td> </tr> <tr> <td>10'h35D</td> <td>861th line</td> </tr> <tr> <td>10'h35E</td> <td>862th line</td> </tr> <tr> <td>10'h35F</td> <td>863th line</td> </tr> </tbody> </table>						TEP[9:0]	Output position	10'h000	0th line	10'h001	1st line	10'h002	2nd line	10'h003	3rd line	...	...	10'h35D	861th line	10'h35E	862th line	10'h35F	863th line
TEP[9:0]	Output position																						
10'h000	0th line																						
10'h001	1st line																						
10'h002	2nd line																						
10'h003	3rd line																						
...	...																						
10'h35D	861th line																						
10'h35E	862th line																						
10'h35F	863th line																						
Restrictions	SETEXTC turn on to enable this command																						
Register Availability	Status	Availability																					
	Normal Mode On, Idle Mode Off, Sleep Out	Yes																					
	Normal Mode On, Idle Mode On, Sleep Out	Yes																					
	Partial Mode On, Idle Mode Off, Sleep Out	Yes																					
Default	Status	Default value	OTP value																				
	Power On Sequence S/W Reset H/W Reset	D[1:0]=00, RES_SEL[2:0]=001, RM=0, DFR=0, DM[1:0]=00 BP[7:0]=0x03h, FP[7:0]=0x03h, SAP[3:0]=0111, GEN_ON=0x00h, GEN_OFF=0xFFh, RTN[7:0]=0x00h, TEI[3:0]=0000, TEP[9:0]=0x000h, BP_PE[7:0]=0x03h, FP_PE[7:0]=0x03h, RTN_PE[7:0]=0x00h, GON=1	RES_SEL[2:0], RM, DFR, DM[1:0] BP[7:0], FP[7:0], SAP[3:0], GEN_ON, GEN_OFF, RTN[7:0], TEI[3:0], TEP[9:0], BP_PE[7:0], FP_PE[7:0], RTN_PE[7:0]																				

**6.2.57 SETRGBIF: Set RGB interface related register (B3h)**

B3H	SETRGBIF( Set RGB interface related register)																										
	DNC	NRD	NWR	D15~D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX														
Command	0	1	↑	-	1	0	1	1	0	0	1	1	B3														
1 <sup>st</sup> parameter	1	1	↑	-	-	-	-	-	DPL	HSPL	VSPL	EPL	-														
Description	This command is used to set RGB interface related register. <b>EPL:</b> Specify the polarity of DE pin in RGB interface mode.																										
	<table border="1"> <thead> <tr> <th>EPL</th> <th>DE pin</th> <th>Display</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>Enable</td> </tr> <tr> <td>0</td> <td>1</td> <td>Disable</td> </tr> <tr> <td>1</td> <td>0</td> <td>Disable</td> </tr> <tr> <td>1</td> <td>1</td> <td>Enable</td> </tr> </tbody> </table> <p><b>VSPL:</b> The polarity of VS pin. When VSPL=0, the VS pin is Low active. When VSPL=1, the VS pin is High active.  <b>HSPL:</b> The polarity of HS pin. When HSPL=0, the HS pin is Low active. When HSPL=1, the HS pin is High active.  <b>DPL:</b> The polarity of PCLK pin. When DPL=0, the data is read on the rising edge of PCLK signal. When DPL=1, the data is read on the falling edge of PCLK signal.</p>													EPL	DE pin	Display	0	0	Enable	0	1	Disable	1	0	Disable	1	1
EPL	DE pin	Display																									
0	0	Enable																									
0	1	Disable																									
1	0	Disable																									
1	1	Enable																									
Restrictions	SETEXTC turn on to enable this command.																										
Register Availability	<table border="1"> <thead> <tr> <th>Status</th> <th>Availability</th> </tr> </thead> <tbody> <tr> <td>Normal Mode On, Idle Mode Off, Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Normal Mode On, Idle Mode On, Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Partial Mode On, Idle Mode Off, Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Partial Mode On, Idle Mode On, Sleep Out</td> <td>Yes</td> </tr> </tbody> </table>												Status	Availability	Normal Mode On, Idle Mode Off, Sleep Out	Yes	Normal Mode On, Idle Mode On, Sleep Out	Yes	Partial Mode On, Idle Mode Off, Sleep Out	Yes	Partial Mode On, Idle Mode On, Sleep Out	Yes					
	Status	Availability																									
	Normal Mode On, Idle Mode Off, Sleep Out	Yes																									
	Normal Mode On, Idle Mode On, Sleep Out	Yes																									
	Partial Mode On, Idle Mode Off, Sleep Out	Yes																									
Partial Mode On, Idle Mode On, Sleep Out	Yes																										
Default	<table border="1"> <thead> <tr> <th>Status</th> <th>Default value</th> <th>OTP value</th> </tr> </thead> <tbody> <tr> <td>Power On Sequence</td> <td rowspan="3">DPL=0,HSPL=0,VSPL=0,EPL=1</td> <td rowspan="3">DPL,HSPL,VSPL,EPL</td> </tr> <tr> <td>S/W Reset</td> </tr> <tr> <td>H/W Reset</td> </tr> </tbody> </table>												Status	Default value	OTP value	Power On Sequence	DPL=0,HSPL=0,VSPL=0,EPL=1	DPL,HSPL,VSPL,EPL	S/W Reset	H/W Reset							
	Status	Default value	OTP value																								
	Power On Sequence	DPL=0,HSPL=0,VSPL=0,EPL=1	DPL,HSPL,VSPL,EPL																								
S/W Reset																											
H/W Reset																											

6.2.58 SETCYC: Set display waveform cycle (B4h)

B4H	SETCYC( Set display waveform cycles)												
	DNC	NRD	NWR	D15~D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	-	1	0	1	0	0	1	0	0	B4
1 <sup>st</sup> parameter	1	1	↑	-	-	-	-	-	NW_PE[1:0]		NW[1:0]		-
2 <sup>nd</sup> parameter	1	1	↑	-	SON[7:0]								-
3 <sup>rd</sup> parameter	1	1	↑	-	SOFF[7:0]								-
4 <sup>th</sup> parameter	1	1	↑	-	EQS[7:0]								-
5 <sup>th</sup> parameter	1	1	↑	-	EQON[7:0]								-

This command is used to get setting of display waveform cycles.

**NW[1:0]:** Inversion type setting.

NW1	NW0	Inversion type
0	0	Column inversion
0	1	1-dot inversion
1	0	2-dot inversion
1	1	Zig-zag inversion

**NW\_PE[1:0]:** Inversion type setting on partial idle mode.

NW_PE1	NW_PE0	Inversion type
0	0	Column inversion
0	1	1-dot inversion
1	0	2-dot inversion
1	1	Zig-zag inversion

**Description**

SON[7:0]: Specify the valid source output start time.

SON [7:0]								Source output start time
0	0	0	0	0	0	0	0	Inhibit
0	0	0	0	0	0	0	1	1 OSC clock cycle
0	0	0	0	0	0	1	0	2 OSC clock cycle
0	0	0	0	0	0	1	1	3 OSC clock cycle
0	0	0	0	0	1	0	0	4 OSC clock cycle

.....								.....
0	0	0	0	1	1	1	1	15 OSC clock cycle
.....								.....
1	1	1	1	1	0	1	0	250 OSC clock cycle
1	1	1	1	1	0	1	1	251 OSC clock cycle
1	1	1	1	1	1	0	0	252 OSC clock cycle
1	1	1	1	1	1	0	1	253 OSC clock cycle
1	1	1	1	1	1	1	0	254 OSC clock cycle
1	1	1	1	1	1	1	1	255 OSC clock cycle

**SOFF[7:0]:** Specify the valid source output end time.

SOFF [7:0]								Source output end time
0	0	0	0	0	0	0	0	Inhibit
0	0	0	0	0	0	0	1	1 OSC clock cycle
0	0	0	0	0	0	1	0	2 OSC clock cycle
0	0	0	0	0	0	1	1	3 OSC clock cycle
0	0	0	0	0	1	0	0	4 OSC clock cycle
.....								.....
1	0	0	0	0	0	1	0	130 OSC clock cycle
.....								.....
1	1	1	1	1	0	1	0	250 OSC clock cycle
1	1	1	1	1	0	1	1	251 OSC clock cycle
1	1	1	1	1	1	0	0	252 OSC clock cycle
1	1	1	1	1	1	0	1	253 OSC clock cycle
1	1	1	1	1	1	1	0	254 OSC clock cycle
1	1	1	1	1	1	1	1	255 OSC clock cycle

**EQON[7:0]:** Specify the valid Equalize output start time.

(Please note that the EQON[7:0] ≤ EQS[7:0]-1)

EQON [7:0]								Gate output start time
0	0	0	0	0	0	0	0	Inhibit
0	0	0	0	0	0	0	1	1 OSC clock cycle
0	0	0	0	0	0	1	0	2 OSC clock cycle
0	0	0	0	0	0	1	1	3 OSC clock cycle
0	0	0	0	0	1	0	0	4 OSC clock cycle
.....								.....
0	0	0	0	1	1	0	0	12 OSC clock cycle
.....								.....
1	1	1	1	1	0	1	0	250 OSC clock cycle
1	1	1	1	1	0	1	1	251 OSC clock cycle
1	1	1	1	1	1	0	0	252 OSC clock cycle
1	1	1	1	1	1	0	1	253 OSC clock cycle
1	1	1	1	1	1	1	0	254 OSC clock cycle
1	1	1	1	1	1	1	1	255 OSC clock cycle

**EQS[7:0]:** Specify the Equalize time of source output. (Please note that the EQS[7:0] ≤ SON-1).

EQS [7:0]								Equalize time of source output
0	0	0	0	0	0	0	0	Equalize function off
0	0	0	0	0	0	0	1	1 OSC clock cycle
0	0	0	0	0	0	1	0	2 OSC clock cycle
0	0	0	0	0	0	1	1	3 OSC clock cycle
0	0	0	0	0	1	0	0	4 OSC clock cycle
0	0	0	0	0	1	0	1	5 OSC clock cycle
0	0	0	0	0	1	1	0	6 OSC clock cycle
.....								.....
1	1	1	1	1	0	1	0	250 OSC clock cycle
1	1	1	1	1	0	1	1	251 OSC clock cycle



	1	1	1	1	1	1	0	0	252 OSC clock cycle
	1	1	1	1	1	1	0	1	253 OSC clock cycle
	1	1	1	1	1	1	1	0	254 OSC clock cycle
	1	1	1	1	1	1	1	1	255 OSC clock cycle
Restrictions	SETEXTC turn on to enable this command.								
Register Availability	Status						Availability		
	Normal Mode On, Idle Mode Off, Sleep Out						Yes		
	Normal Mode On, Idle Mode On, Sleep Out						Yes		
	Partial Mode On, Idle Mode Off, Sleep Out						Yes		
	Partial Mode On, Idle Mode On, Sleep Out						Yes		
	Sleep In or Booster Off						Yes		
Default	Status		Default value				OTP value		
	Power On Sequence S/W Reset H/W Reset		NW_PE[1:0]=00,NW[1:0]=00, SON[7:0]=0x0Fh,SOFF[7:0]=0x82h, EQS[7:0]=0x0Ch, EQON[7:0]=0x03h				NW_PE[1:0], NW[1:0], SON[7:0], SOFF[7:0], EQS[7:0], EQON[7:0]		

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6.2.59 SETVCOM: Set VCOM voltage (B6h)

B6 H	SETVCOM ( Set VCOM Voltage)												HEX
	DNC	NRD	NWR	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0	
Command	0	1	↑	-	1	0	1	1	0	1	1	0	B6
1 <sup>st</sup> parameter	1	1	↑	-	VCMC_F[7:0]							-	
2 <sup>nd</sup> parameter	1	1	↑	-	VCMC_B[7:0]							-	
Description	This command is used to set VCOM Voltage include VCOM Low and VCOM High Voltage.												
	VCMC_F[7:0]: DC VCOM voltage setting for forward scan.												
	VCMC_B[7:0]: DC VCOM voltage setting for backward scan.												
	VCMC_F[7:0] / VCMC_B[7:0]								VCOM (V)				
	D7	D6	D5	D4	D3	D2	D1	D0					
	0	0	0	0	0	0	0	0	-2				
	0	0	0	0	0	0	0	1	-1.984				
	0	0	0	0	0	0	1	0	-1.968				
	0	0	0	0	0	0	1	1	-1.952				
	0	0	0	0	0	1	0	0	-1.936				
	0	0	0	0	0	1	1	0	-1.92				
	0	0	0	0	0	1	1	0	-1.904				
	0	0	0	0	0	1	1	1	-1.888				
	0	0	0	0	1	0	0	0	-1.872				
	0	0	0	0	1	0	0	1	-1.856				
	0	0	0	0	1	0	1	0	-1.84				
	0	0	0	0	1	0	1	1	-1.824				
	0	0	0	0	1	1	0	0	-1.808				
	0	0	0	0	1	1	0	1	-1.792				
	0	0	0	0	1	1	1	0	-1.776				
	0	0	0	0	1	1	1	1	-1.76				
	0	0	0	1	0	0	0	0	-1.744				
	0	0	0	1	0	0	0	1	-1.728				
	0	0	0	1	0	0	1	0	-1.712				
	0	0	0	1	0	0	1	1	-1.696				
	0	0	0	1	0	1	0	0	-1.68				
	0	0	0	1	0	1	0	1	-1.664				
	0	0	0	1	0	1	1	0	-1.648				
	0	0	0	1	0	1	1	1	-1.632				
	0	0	0	1	1	0	0	0	-1.616				
	0	0	0	1	1	0	0	1	-1.6				
	0	0	0	1	1	0	1	0	-1.584				
	0	0	0	1	1	0	1	1	-1.568				
0	0	0	1	1	1	0	0	-1.552					
0	0	0	1	1	1	0	1	-1.536					
0	0	0	1	1	1	1	0	-1.52					
0	0	0	1	1	1	1	1	-1.504					
0	0	1	0	0	0	0	0	-1.488					
0	0	1	0	0	0	0	1	-1.472					
0	0	1	0	0	0	1	0	-1.456					
0	0	1	0	0	0	1	1	-1.44					
0	0	1	0	0	1	0	0	-1.424					
0	0	1	0	0	1	0	1	-1.408					
0	0	1	0	0	1	1	0	-1.392					
0	0	1	0	0	1	1	1	-1.376					
0	0	1	0	1	0	0	0	-1.36					
0	0	1	0	1	0	0	1	-1.344					
0	0	1	0	1	0	1	0	-1.328					
0	0	1	0	1	0	1	1	-1.312					
0	0	1	0	1	1	0	0	-1.296					

0	0	1	0	1	1	0	1	-1.28
0	0	1	0	1	1	1	0	-1.264
0	0	1	0	1	1	1	1	-1.248
0	0	1	1	0	0	0	0	-1.232
0	0	1	1	0	0	0	1	-1.216
0	0	1	1	0	0	1	0	-1.2
0	0	1	1	0	0	1	1	-1.184
0	0	1	1	0	1	0	0	-1.168
0	0	1	1	0	1	0	1	-1.152
0	0	1	1	0	1	1	0	-1.136
0	0	1	1	0	1	1	1	-1.12
0	0	1	1	1	0	0	0	-1.104
0	0	1	1	1	0	0	1	-1.088
0	0	1	1	1	0	1	0	-1.072
0	0	1	1	1	0	1	1	-1.056
0	0	1	1	1	1	0	0	-1.04
0	0	1	1	1	1	0	1	-1.024
0	0	1	1	1	1	1	0	-1.008
0	0	1	1	1	1	1	1	-0.992
0	1	0	0	0	0	0	0	-0.976
0	1	0	0	0	0	0	1	-0.96
0	1	0	0	0	0	1	0	-0.944
0	1	0	0	0	0	1	1	-0.928
0	1	0	0	0	1	0	0	-0.912
0	1	0	0	0	1	0	1	-0.896
0	1	0	0	0	1	1	0	-0.88
0	1	0	0	0	1	1	1	-0.864
0	1	0	0	1	0	0	0	-0.848
0	1	0	0	1	0	0	1	-0.832
0	1	0	0	1	0	1	0	-0.816
0	1	0	0	1	0	1	1	-0.8
0	1	0	0	1	1	0	0	-0.784
0	1	0	0	1	1	0	1	-0.768
0	1	0	0	1	1	1	0	-0.752
0	1	0	0	1	1	1	1	-0.736
0	1	0	1	0	0	0	0	-0.72
0	1	0	1	0	0	0	1	-0.704
0	1	0	1	0	0	1	0	-0.688
0	1	0	1	0	0	1	1	-0.672
0	1	0	1	0	1	0	0	-0.656
0	1	0	1	0	1	0	1	-0.64
0	1	0	1	0	1	1	0	-0.624
0	1	0	1	0	1	1	1	-0.608
0	1	0	1	1	0	0	0	-0.592
0	1	0	1	1	0	0	1	-0.576
0	1	0	1	1	0	1	0	-0.56
0	1	0	1	1	0	1	1	-0.544
0	1	0	1	1	1	0	0	-0.528
0	1	0	1	1	1	1	0	-0.512
0	1	0	1	1	1	1	0	-0.496
0	1	0	1	1	1	1	1	-0.48
0	1	1	0	0	0	0	0	-0.464
0	1	1	0	0	0	0	1	-0.448
0	1	1	0	0	0	1	0	-0.432
0	1	1	0	0	0	1	1	-0.416
0	1	1	0	0	1	0	0	-0.4
0	1	1	0	0	1	0	1	-0.384
0	1	1	0	0	1	1	0	-0.368

0	1	1	0	0	1	1	1	-0.352
0	1	1	0	1	0	0	0	-0.336
0	1	1	0	1	0	0	1	-0.32
0	1	1	0	1	0	1	0	-0.304
0	1	1	0	1	0	1	1	-0.288
0	1	1	0	1	1	0	0	-0.272
0	1	1	0	1	1	0	1	-0.256
0	1	1	0	1	1	1	0	-0.24
0	1	1	0	1	1	1	1	-0.224
0	1	1	1	0	0	0	0	-0.208
0	1	1	1	0	0	0	1	-0.192
0	1	1	1	0	0	1	0	-0.176
0	1	1	1	0	0	1	1	-0.16
0	1	1	1	0	1	0	0	-0.144
0	1	1	1	0	1	0	1	-0.128
0	1	1	1	0	1	1	0	-0.112
0	1	1	1	0	1	1	1	-0.096
0	1	1	1	1	0	0	0	-0.08
0	1	1	1	1	0	0	1	-0.064
0	1	1	1	1	0	1	0	-0.048
0	1	1	1	1	0	1	1	-0.032
0	1	1	1	1	1	0	0	-0.016
01111101 ~ 01111101								Inhibit
0	1	1	1	1	1	1	0	VCOMR
0	1	1	1	1	1	1	1	VSSA
10000000 ~ 11111110								Inhibit
1	1	1	1	1	1	1	1	HZ
Restrictions	SETEXTC turn on to enable this command.							
Register Availability	Status							Availability
	Normal Mode On, Idle Mode Off, Sleep Out							Yes
	Normal Mode On, Idle Mode On, Sleep Out							Yes
	Partial Mode On, Idle Mode Off, Sleep Out							Yes
	Partial Mode On, Idle Mode On, Sleep Out							Yes
Sleep In or Booster Off							Yes	
Default	Status		Default value			OTP value		
	Power On Sequence		VCMC_F[7:0]=0x5Eh,			VCMC_F[7:0], VCMC_B[7:0]		
	S/W Reset		VCMC_B[7:0]=0x5Eh					
H/W Reset								

**6.2.60 SETEXTC: Set extension command (B9h)**

B9H	SETEXTC ( Set extended command set)												
	DNC	NRD	NWR	D15~D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	-	1	0	1	1	1	0	0	1	B9
1 <sup>st</sup> parameter	1	1	↑	-	EXTC1[7:0](FFh)								-
2 <sup>nd</sup> parameter	1	1	↑	-	EXTC2[7:0](83h)								-
3 <sup>rd</sup> parameter	1	1	↑	-	EXTC3[7:0](69h)								-
Description	This command is used to set extended command set access enable.												
	Extend cmd		Command description										
	Enable		After command (B0h), must write 3 parameters (ffh,83h,69h) by order										
	Disable(default)		After command(B0h), write 3 parameters (xxh,xxh,xxh) any value is all right, but can not be (ffh,83h,69h)										
Restrictions	-												
Register Availability	Status				Availability								
	Normal Mode On, Idle Mode Off, Sleep Out				Yes								
	Normal Mode On, Idle Mode On, Sleep Out				Yes								
	Partial Mode On, Idle Mode Off, Sleep Out				Yes								
	Partial Mode On, Idle Mode On, Sleep Out				Yes								
	Sleep In or Booster Off				Yes								
Default	Status				Default value				OTP value				
	Power On Sequence				EXTC1[7:0]=0x00h,				N/A				
	S/W Reset				EXTC2[7:0]=0x00h,								
	H/W Reset				EXTC3[7:0]=0x00h,								

## 6.2.61 SETMIPI: (BAh)

BAH	SETMIPI ( Set extended command set)												
	DNC	NRD	NWR	D15~D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	-	1	1	0	0	1	0	0	1	BA
1 <sup>st</sup> parameter	1	1	↑	-	DPHYCMD0[7:0]							-	
2 <sup>nd</sup> parameter	1	1	↑	-	DPHYCMD1[7:0]							-	
3 <sup>rd</sup> parameter	1	1	↑	-	DPHYCMD2[7:0]							-	
4 <sup>th</sup> parameter	1	1	↑	-	DSICMD0[7:0]							-	
5 <sup>th</sup> parameter	1	1	↑	-	DSICMD1[7:0]							-	
6 <sup>th</sup> parameter	1	1	↑	-	DSICMD2[7:0]							-	
7 <sup>th</sup> parameter	1	1	↑	-	DSICMD3[7:0]							-	
8 <sup>th</sup> parameter	1	1	↑	-	DPHYOTP0[7:0]							-	
9 <sup>th</sup> parameter	1	1	↑	-	DPHYOTP1[7:0]							-	
10 <sup>th</sup> parameter	1	1	↑	-	DPHYOTP2[7:0]							-	
11 <sup>th</sup> parameter	1	1	↑	-	DSIOTP0[7:0]							-	
12 <sup>th</sup> parameter	1	1	↑	-	DSIOTP1[7:0]							-	
13 <sup>th</sup> parameter	1	1	↑	-	-	DSI_INI TRDY	-	-	-	-	-	-	-
Description	<b>In-house function and not open.</b>												
	Command Table												
	Register Name						Hardware Setting						
	DPHYCMD0[7: 0]=0x00h						Default setting is fixed.						
	DPHYCMD1[7: 0]=0xA0h						Default setting is fixed.						
	DPHYCMD2[7: 0]=0xC6h						Default setting is fixed.						
	Register Name						Hardware Setting						
	DSICMD0[7: 0]=0x00h						Default setting is fixed.						
	DSICMD1[7: 0]=0x0Ah						Default setting is fixed.						
	DSICMD2[7: 0]=0x00h						Default setting is fixed.						
DSICMD3[7: 0]=0x10h						Default setting is fixed.							
<b>In-house function and not open.</b>													
OTP Table:													
Register Name						DSI OTP setting							
DPHYOTP0[7:0]						Default setting is fixed.							
DPHYOTP1[7:0]						Default setting is fixed.							
DPHYOTP2[7:0]						Default setting is fixed.							
DSI data lane number setting													
DSIOTP0[7:0] (00)NW0						Data Lane Number							
0x10h						One Data Lane Mode							
0x11h						Two Data Lane Mode							
Restrictions	SETEXTC turn on to enable this command.												
Register Availability	Status						Availability						
	Normal Mode On, Idle Mode Off, Sleep Out						Yes						
	Normal Mode On, Idle Mode On, Sleep Out						Yes						
	Partial Mode On, Idle Mode Off, Sleep Out						Yes						
	Partial Mode On, Idle Mode On, Sleep Out						Yes						
	Sleep In or Booster Off						Yes						
Default	Status				Default value				OTP value				
	Power On Sequence S/W Reset H/W Reset				DPHYCMD0[7:0]=0x00h, DPHYCMD1[7:0]=0xA0h, DPHYCMD2[7:0]=0xC6h, DSICMD0[7:0]=0x00h, DSICMD1[7:0]=0x0Ah, DSICMD2[7:0]=0x00h, DSICMD3[7:0]=0x10h, DPHYOTP0[7:0]=0x30h,				DPHYOTP0[7:0] DPHYOTP1[7:0] DPHYOTP2[7:0] DSIOTP0[7:0] DSIOTP1[7:0]				

# » HX8369-A

480RGBx864dots, TFT Mobile Single Chip Driver



DATA SHEET Preliminary V01

		DPHYOTP1[7:0]=0x6Fh, DPHYOTP2[7:0]=0x02h, DSIOTP0[7:0]=0x10h, DSIOTP1[7:0]=0x18h, DSL_INITRDY=1		
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6.2.62 SETOTP: Set OTP (BBh)

BBH	SETOTP( Set OTP Related Setting)													HEX
	DNC	NRD	NWR	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0		
Command	0	1	↑	-	1	0	1	1	1	0	1	1	BB	
1 <sup>st</sup> parameter	1	1	↑	-	OTP_MASK[7:0] (8'b0)								-	
2 <sup>nd</sup> parameter	1	1	↑	-	-	-	-	-	-	-	-	OTP_INDEX[8]	-	
3 <sup>rd</sup> parameter	1	1	↑	-	OTP_INDEX[7:0]								-	
4 <sup>th</sup> parameter	1	1	↑	-	OTP_LOAD_DISABLE	OTP_TEST	OTP_POR	OTP_PWE	OTP_PTM[1:0]	VPP_SEL	OTP_PROG	-	-	
5 <sup>th</sup> parameter	1	1	↑	-	OTP_DATA[7:0]								-	
Description	<p>This command is used to set OTP Related Setting.</p> <p><b>OTP_MASK[7:0]:</b> Bit programming mask, if 1, means this bit can't be programmed.</p> <p><b>OTP_INDEX[8:0]:</b> Set index of OTP table for programming.</p> <p><b>OTP_PWE:</b> OTP program write enable, if 1, means OTP is able to be programmed.</p> <p><b>OTP_PROG:</b> When set to 1, the register content of OTP index is programmed.</p> <p><b>OTP_LOAD_DISABLE:</b> Normally the internal registers are auto-loaded from OTP when the SLPOUT command is received. Nevertheless, if this bit is set to 1, it will disable the auto loading function when the SLPOUT command was received. In general, this bit is used when OTP is not yet programmed.</p> <p><b>OTP_PTM[1:0]:</b> Not open, internal use.</p> <p><b>VPP_SEL:</b> When written to 1, <b>VPP</b> voltage is fed to OTP.</p> <p><b>OTP_DATA[7:0]:</b> Read back the OTP index data.</p>													
Restrictions	SETEXTC turn on to enable this command.													
Register Availability	Status						Availability							
	Normal Mode On, Idle Mode Off, Sleep Out						Yes							
	Normal Mode On, Idle Mode On, Sleep Out						Yes							
	Partial Mode On, Idle Mode Off, Sleep Out						Yes							
	Partial Mode On, Idle Mode On, Sleep Out						Yes							
	Sleep In						Yes							
Default	Status				Default value				OTP value					
	Power On Sequence S/W Reset H/W Reset				OTP_MASK[7:0]=0x00h, OTP_INDEX[8:0]=0x1FFh, OTP_LOAD_DISABLE=0, OTP_TEST=0, OTP_POR=0, OTP_PWE=0, OTP_PTM[1:0]=00, VPP_SEL=0, OTP_PROG=0, OTP_DATA[7:0]=xxh				N/A					

## 6.2.63 SETDGCLUT: Set DGC LUT (C1h)

C1H	SETDGCLUT ( Set DGC LUT)																																																																																																																																																																																																																																																																																																																																																																
	DNC	NRD	NWR	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX																																																																																																																																																																																																																																																																																																																																																				
Command	0	1	↑	-	1	1	0	0	0	0	0	1	C1																																																																																																																																																																																																																																																																																																																																																				
1 <sup>st</sup> parameter	1	1	↑	-	-	-	-	-	-	-	DITH_OPT	DGC_EN	-																																																																																																																																																																																																																																																																																																																																																				
2 <sup>nd</sup> parameter	1	1	↑	-	D1[7:0]							-																																																																																																																																																																																																																																																																																																																																																					
:	1	1	↑	-	Dn[7:0]							-																																																																																																																																																																																																																																																																																																																																																					
127 <sup>th</sup> parameter	1	1	↑	-	D126[7:0]							-																																																																																																																																																																																																																																																																																																																																																					
Description	<p>This command is used to set DGC LUT.  <b>DITH_OPT</b>: Not open, internal use.  <b>DGC_EN</b>: Enable the DGC function  <b>D1[7:0] ~ D126[7:0]</b>:</p> <table border="1"> <thead> <tr> <th>LUT</th> <th>D7</th> <th>D6</th> <th>D5</th> <th>D4</th> <th>D3</th> <th>D2</th> <th>D1</th> <th>D0</th> <th>Default</th> </tr> </thead> <tbody> <tr><td>1<sup>st</sup></td><td>R009</td><td>R008</td><td>R007</td><td>R006</td><td>R005</td><td>R004</td><td>R003</td><td>R002</td><td>00h</td></tr> <tr><td>2<sup>nd</sup></td><td>R019</td><td>R018</td><td>R017</td><td>R016</td><td>R015</td><td>R014</td><td>R013</td><td>R012</td><td>08h</td></tr> <tr><td>3<sup>rd</sup></td><td>R029</td><td>R028</td><td>R027</td><td>R026</td><td>R025</td><td>R024</td><td>R023</td><td>R022</td><td>10h</td></tr> <tr><td>:</td><td>:</td><td>:</td><td>:</td><td>:</td><td>:</td><td>:</td><td>:</td><td>:</td><td>:</td></tr> <tr><td>32<sup>rd</sup></td><td>R319</td><td>R318</td><td>R317</td><td>R316</td><td>R315</td><td>R314</td><td>R313</td><td>R312</td><td>F8h</td></tr> <tr><td>33<sup>rd</sup></td><td>R329</td><td>R328</td><td>R327</td><td>R326</td><td>R325</td><td>R324</td><td>R323</td><td>R322</td><td>FFh</td></tr> <tr><td>34<sup>th</sup></td><td>R001</td><td>R000</td><td>R011</td><td>R010</td><td>R021</td><td>R020</td><td>R031</td><td>R030</td><td>00h</td></tr> <tr><td>35<sup>th</sup></td><td>R041</td><td>R040</td><td>R051</td><td>R050</td><td>R061</td><td>R060</td><td>R071</td><td>R070</td><td>00h</td></tr> <tr><td>:</td><td>:</td><td>:</td><td>:</td><td>:</td><td>:</td><td>:</td><td>:</td><td>:</td><td>:</td></tr> <tr><td>41<sup>st</sup></td><td>R281</td><td>R280</td><td>R291</td><td>R290</td><td>R301</td><td>R300</td><td>R311</td><td>R310</td><td>00h</td></tr> <tr><td>42<sup>nd</sup></td><td>R321</td><td>R320</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>00h</td></tr> <tr><td>43<sup>rd</sup></td><td>G009</td><td>G008</td><td>G007</td><td>G006</td><td>G005</td><td>G004</td><td>G003</td><td>G002</td><td>00h</td></tr> <tr><td>44<sup>th</sup></td><td>G019</td><td>G018</td><td>G017</td><td>G016</td><td>G015</td><td>G014</td><td>G013</td><td>G012</td><td>08h</td></tr> <tr><td>45<sup>th</sup></td><td>G029</td><td>G028</td><td>G027</td><td>G026</td><td>G025</td><td>G024</td><td>G023</td><td>G022</td><td>10h</td></tr> <tr><td>:</td><td>:</td><td>:</td><td>:</td><td>:</td><td>:</td><td>:</td><td>:</td><td>:</td><td>:</td></tr> <tr><td>74<sup>th</sup></td><td>G319</td><td>G318</td><td>G317</td><td>G316</td><td>G315</td><td>G314</td><td>G313</td><td>G312</td><td>F8h</td></tr> <tr><td>75<sup>th</sup></td><td>G329</td><td>G328</td><td>G327</td><td>G326</td><td>G325</td><td>G324</td><td>G323</td><td>G322</td><td>FFh</td></tr> <tr><td>76<sup>th</sup></td><td>G001</td><td>G000</td><td>G011</td><td>G010</td><td>G021</td><td>G020</td><td>G031</td><td>G030</td><td>00h</td></tr> <tr><td>77<sup>th</sup></td><td>G041</td><td>G040</td><td>G051</td><td>G050</td><td>G061</td><td>G060</td><td>G071</td><td>G070</td><td>00h</td></tr> <tr><td>:</td><td>:</td><td>:</td><td>:</td><td>:</td><td>:</td><td>:</td><td>:</td><td>:</td><td>:</td></tr> <tr><td>83<sup>rd</sup></td><td>G281</td><td>G280</td><td>G291</td><td>G290</td><td>G301</td><td>G300</td><td>G311</td><td>G310</td><td>00h</td></tr> <tr><td>84<sup>th</sup></td><td>G321</td><td>G320</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>00h</td></tr> <tr><td>85<sup>th</sup></td><td>B009</td><td>B008</td><td>B007</td><td>B006</td><td>B005</td><td>B004</td><td>B003</td><td>B002</td><td>00h</td></tr> <tr><td>86<sup>th</sup></td><td>B019</td><td>B018</td><td>B017</td><td>B016</td><td>B015</td><td>B014</td><td>B013</td><td>B012</td><td>08h</td></tr> <tr><td>87<sup>th</sup></td><td>B029</td><td>B028</td><td>B027</td><td>B026</td><td>B025</td><td>B024</td><td>B023</td><td>B022</td><td>10h</td></tr> <tr><td>:</td><td>:</td><td>:</td><td>:</td><td>:</td><td>:</td><td>:</td><td>:</td><td>:</td><td>:</td></tr> <tr><td>116<sup>th</sup></td><td>B319</td><td>B318</td><td>B317</td><td>B316</td><td>B315</td><td>B314</td><td>B313</td><td>B312</td><td>F8h</td></tr> <tr><td>117<sup>th</sup></td><td>B329</td><td>B328</td><td>B327</td><td>B326</td><td>B325</td><td>B324</td><td>B323</td><td>B322</td><td>FFh</td></tr> <tr><td>118<sup>th</sup></td><td>B001</td><td>B000</td><td>B011</td><td>B010</td><td>B021</td><td>B020</td><td>B031</td><td>B030</td><td>00h</td></tr> <tr><td>119<sup>th</sup></td><td>B041</td><td>B040</td><td>B051</td><td>B050</td><td>B061</td><td>B060</td><td>B071</td><td>B070</td><td>00h</td></tr> <tr><td>:</td><td>:</td><td>:</td><td>:</td><td>:</td><td>:</td><td>:</td><td>:</td><td>:</td><td>:</td></tr> <tr><td>125<sup>th</sup></td><td>B281</td><td>B280</td><td>B291</td><td>B290</td><td>B301</td><td>B300</td><td>B311</td><td>B310</td><td>00h</td></tr> <tr><td>126<sup>th</sup></td><td>B321</td><td>B320</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>00h</td></tr> </tbody> </table> <p><b>Write D1[7:0] (R 1st), D43[7:0] (G 1st) and D85[7:0] (B 1st), but Read is from D1[7:0], D2[7:0] and D3[7:0]</b></p>													LUT	D7	D6	D5	D4	D3	D2	D1	D0	Default	1 <sup>st</sup>	R009	R008	R007	R006	R005	R004	R003	R002	00h	2 <sup>nd</sup>	R019	R018	R017	R016	R015	R014	R013	R012	08h	3 <sup>rd</sup>	R029	R028	R027	R026	R025	R024	R023	R022	10h	:	:	:	:	:	:	:	:	:	:	32 <sup>rd</sup>	R319	R318	R317	R316	R315	R314	R313	R312	F8h	33 <sup>rd</sup>	R329	R328	R327	R326	R325	R324	R323	R322	FFh	34 <sup>th</sup>	R001	R000	R011	R010	R021	R020	R031	R030	00h	35 <sup>th</sup>	R041	R040	R051	R050	R061	R060	R071	R070	00h	:	:	:	:	:	:	:	:	:	:	41 <sup>st</sup>	R281	R280	R291	R290	R301	R300	R311	R310	00h	42 <sup>nd</sup>	R321	R320	0	0	0	0	0	0	00h	43 <sup>rd</sup>	G009	G008	G007	G006	G005	G004	G003	G002	00h	44 <sup>th</sup>	G019	G018	G017	G016	G015	G014	G013	G012	08h	45 <sup>th</sup>	G029	G028	G027	G026	G025	G024	G023	G022	10h	:	:	:	:	:	:	:	:	:	:	74 <sup>th</sup>	G319	G318	G317	G316	G315	G314	G313	G312	F8h	75 <sup>th</sup>	G329	G328	G327	G326	G325	G324	G323	G322	FFh	76 <sup>th</sup>	G001	G000	G011	G010	G021	G020	G031	G030	00h	77 <sup>th</sup>	G041	G040	G051	G050	G061	G060	G071	G070	00h	:	:	:	:	:	:	:	:	:	:	83 <sup>rd</sup>	G281	G280	G291	G290	G301	G300	G311	G310	00h	84 <sup>th</sup>	G321	G320	0	0	0	0	0	0	00h	85 <sup>th</sup>	B009	B008	B007	B006	B005	B004	B003	B002	00h	86 <sup>th</sup>	B019	B018	B017	B016	B015	B014	B013	B012	08h	87 <sup>th</sup>	B029	B028	B027	B026	B025	B024	B023	B022	10h	:	:	:	:	:	:	:	:	:	:	116 <sup>th</sup>	B319	B318	B317	B316	B315	B314	B313	B312	F8h	117 <sup>th</sup>	B329	B328	B327	B326	B325	B324	B323	B322	FFh	118 <sup>th</sup>	B001	B000	B011	B010	B021	B020	B031	B030	00h	119 <sup>th</sup>	B041	B040	B051	B050	B061	B060	B071	B070	00h	:	:	:	:	:	:	:	:	:	:	125 <sup>th</sup>	B281	B280	B291	B290	B301	B300	B311	B310	00h	126 <sup>th</sup>	B321	B320	0	0	0	0	0	0	00h
	LUT	D7	D6	D5	D4	D3	D2	D1	D0	Default																																																																																																																																																																																																																																																																																																																																																							
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	41 <sup>st</sup>	R281	R280	R291	R290	R301	R300	R311	R310	00h																																																																																																																																																																																																																																																																																																																																																							
	42 <sup>nd</sup>	R321	R320	0	0	0	0	0	0	00h																																																																																																																																																																																																																																																																																																																																																							
	43 <sup>rd</sup>	G009	G008	G007	G006	G005	G004	G003	G002	00h																																																																																																																																																																																																																																																																																																																																																							
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126 <sup>th</sup>	B321	B320	0	0	0	0	0	0	00h																																																																																																																																																																																																																																																																																																																																																								
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Register Availability	<table border="1"> <thead> <tr> <th>Status</th> <th>Availability</th> </tr> </thead> <tbody> <tr> <td>Idle Mode Off, Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Idle Mode On, Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Sleep In or Booster Off</td> <td>Yes</td> </tr> </tbody> </table>													Status	Availability	Idle Mode Off, Sleep Out	Yes	Idle Mode On, Sleep Out	Yes	Sleep In or Booster Off	Yes																																																																																																																																																																																																																																																																																																																																												
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	Status	Default value	OTP value
Default	Power On Sequence S/W Reset H/W Reset	DITH_OPT DGC_EN D1[7:0]~D126[7:0]	DITH_OPT DGC_EN D1[7:0]~D126[7:0]

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6.2.64 SETID: Set ID (C3h)

C3H	SETID ( Set ID)												
	DNC	NRD	NWR	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	-	1	1	0	0	0	0	1	1	C3
1 <sup>st</sup> parameter	1	1	↑	-	ID1[7:0]								-
2 <sup>nd</sup> parameter	1	1	↑	-	0	ID2[6:0]							-
3 <sup>rd</sup> parameter	1	1	↑	-	ID3[7:0]								-
Description	This command is used to set ID (RDAh, RDBh, RDCh) value.												
Restrictions	SETEXTC turn on to enable this command.												
Register Availability	Status						Availability						
	Normal Mode On, Idle Mode Off, Sleep Out						Yes						
	Normal Mode On, Idle Mode On, Sleep Out						Yes						
	Partial Mode On, Idle Mode Off, Sleep Out						Yes						
	Partial Mode On, Idle Mode On, Sleep Out						Yes						
	Sleep In						Yes						
Default	Status				Default value				OTP value				
	Power On Sequence				ID1[7:0]=0x00h,				ID1[7:0], ID2[6:0], ID3[7:0]				
	S/W Reset				ID2[6:0]=0x00h,								
	H/W Reset				ID3[7:0]=0x00h,								

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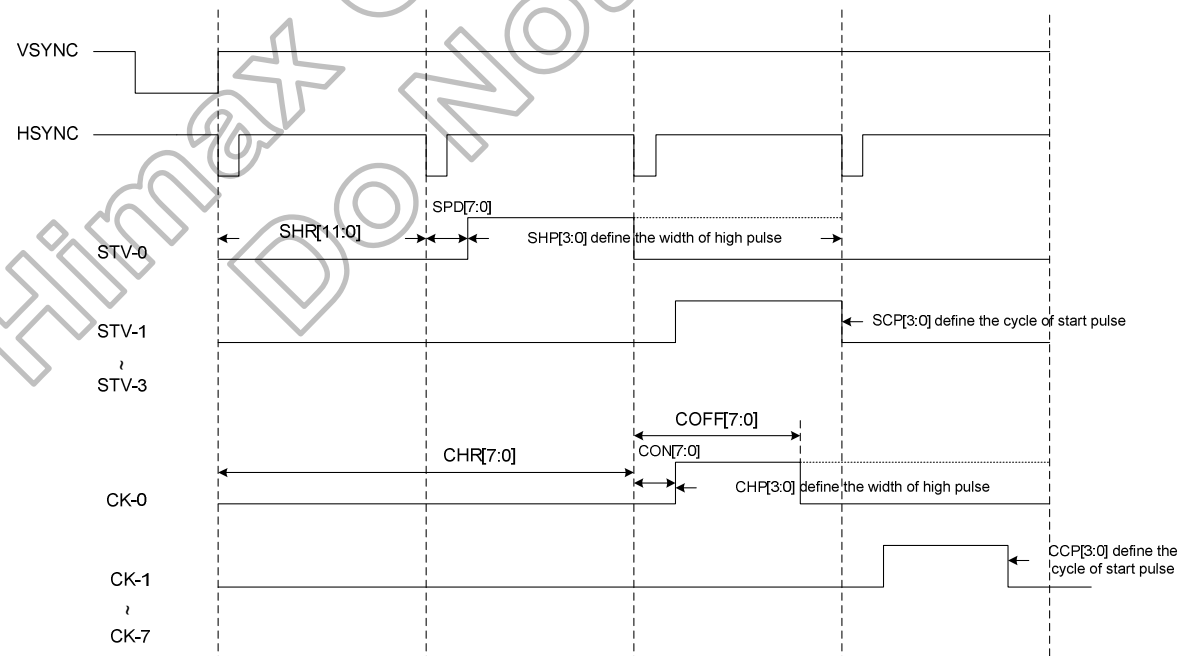
6.2.65 SETPANEL (CCh)

CCH	SETPANEL( Set panel related register)												
	DNC	NRD	NWR	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	-	1	1	0	0	1	1	0	0	CC
1 <sup>st</sup> parameter	1	1	↑	-	-	-	-	-	SS_PANEL	-	REV_PANEL	BGR_PANEL	-
Description0	<p>This command is used to set setting of panel related register and make panel module meets below spec from viewpoint of user</p> <p><b>BGR_PANEL:</b> The order of &lt;R&gt;&lt;G&gt;&lt;B&gt; dot color for module supplier, default value is stored in OTP. If color filter of panel is &lt;B&gt;&lt;G&gt;&lt;R&gt; type, setting BGR_PANEL = 1, if color filter of panel is &lt;R&gt;&lt;G&gt;&lt;B&gt; type, setting BGR_PANEL = 0. This bit is to make panel module look like a &lt;R&gt;&lt;G&gt;&lt;B&gt; type panel form the user viewpoint.</p> <p><b>SS_PANEL:</b> Specify the shift direction of source driver output. When SS_PANEL = 0, the shift direction from S1 to S1440 When SS_PANEL = 1, the shift direction from S1440 to S1.</p> <p><b>REV_PANEL:</b> Select the inversion of the display of all characters and graphics. This setting allows the display of the same data on both normally-white and normally-black panels.</p> <p>REV_PANEL = 1 normal-white panel REV_PANEL = 0 normal-black panel</p>												
Restrictions	SETEXTC turn on to enable this command												
Register Availability	Status						Availability						
	Normal Mode On, Idle Mode Off, Sleep Out						Yes						
	Normal Mode On, Idle Mode On, Sleep Out						Yes						
	Partial Mode On, Idle Mode Off, Sleep Out						Yes						
	Partial Mode On, Idle Mode On, Sleep Out						Yes						
Sleep In						Yes							
Default	Status				Default value				OTP value				
	Power On Sequence				SS_PANEL=0,				SS_PANEL, REV_PANE, BGR_PANEL				
	S/W Reset				REV_PANE=1,								
H/W Reset				BGR_PANEL=0									

6.2.66 SETGIP (D5h)

D5H	SETGIP												HEX
	DNC	NRD	NWR	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0	
Command	0	1	↑	-	1	1	0	1	0	1	0	1	D5
1 <sup>st</sup> parameter	1	1	↑	-	-	-	-	-	SHR_0[11:8]				-
2 <sup>nd</sup> parameter	1	1	↑	-	SHR_0[7:0]								-
3 <sup>rd</sup> parameter	1	1	↑	-	-	-	-	-	SHR_1[11:8]				-
4 <sup>th</sup> parameter	1	1	↑	-	SHR_1[7:0]								-
5 <sup>th</sup> parameter	1	1	↑	-	SPD[7:0]								-
6 <sup>th</sup> parameter	1	1	↑	-	CHR[7:0]								-
7 <sup>th</sup> parameter	1	1	↑	-	CON[7:0]								-
8 <sup>th</sup> parameter	1	1	↑	-	COFF[7:0]								-
9 <sup>th</sup> parameter	1	1	↑	-	SHP[3:0]				SCP[3:0]				-
10 <sup>th</sup> parameter	1	1	↑	-	CHP[3:0]				CCP[3:0]				-
11 <sup>th</sup> parameter	1	1	↑	-	SOS_1[4:0]				SOS_0[3:0]				-
12 <sup>th</sup> parameter	1	1	↑	-	SOS_3[4:0]				SOS_2[3:0]				-
13 <sup>th</sup> parameter	1	1	↑	-	COS_1[4:0]				COS_0[3:0]				-
14 <sup>th</sup> parameter	1	1	↑	-	COS_3[4:0]				COS_2[3:0]				-
15 <sup>th</sup> parameter	1	1	↑	-	COS_5[4:0]				COS_4[3:0]				-
16 <sup>th</sup> parameter	1	1	↑	-	COS_7[4:0]				COS_6[3:0]				-
17 <sup>th</sup> parameter	1	1	↑	-	SOS_1_ML[3:0]				SOS_0_ML[3:0]				-
18 <sup>th</sup> parameter	1	1	↑	-	SOS_3_ML[3:0]				SOS_2_ML[3:0]				-
19 <sup>th</sup> parameter	1	1	↑	-	COS_1_ML[3:0]				COS_0_ML[3:0]				-
20 <sup>th</sup> parameter	1	1	↑	-	COS_3_ML[3:0]				COS_2_ML[3:0]				-
21 <sup>th</sup> parameter	1	1	↑	-	COS_5_ML[3:0]				COS_4_ML[3:0]				-
22 <sup>th</sup> parameter	1	1	↑	-	COS_7_ML[3:0]				COS_6_ML[3:0]				-
23 <sup>th</sup> parameter	1	1	↑	-	-	-	-	GTO[5:0]				-	
24 <sup>th</sup> parameter	1	1	↑	-	GNO[7:0]								-
25 <sup>th</sup> parameter	1	1	↑	-	EQ_DELAY[7:0]								-
26 <sup>th</sup> parameter	1	1	↑	-	GIP_OPT[7:0]								-

This command is used for GIP timing output control.



SHR\_0[11:0]:STV\_0 Hsync Rise

SHR_0[11:0]	Start Pulse 0 Output delay
0x000h	0 x HSYNC
0x001h	1 x HSYNC
0x002h	2 x HSYNC
0x003h	3 x HSYNC

0x004h	4 x HSYNC
0x005h	5 x HSYNC
. . . . .	
0xFFEh	4094 x HSYNC
0xFFFFh	4095 x HSYNC

SHR\_1[11:0]:STV\_1 Hsync Rise

SHR_1[11:0]	Start Pulse 1 Output delay
0x000h	0 x HSYNC
0x001h	1 x HSYNC
0x002h	2 x HSYNC
0x003h	3 x HSYNC
0x004h	4 x HSYNC
0x005h	5 x HSYNC
. . . . .	
0xFFEh	4094 x HSYNC
0xFFFFh	4095 x HSYNC

SPD[7:0]: STV Pulse Delay

SPD[7:0]	Start Pulse Output delay
0x00h	0 x OSC CLK
0x01h	1 x OSC CLK
0x02h	2 x OSC CLK
0x03h	3 x OSC CLK
0x04h	4 x OSC CLK
0x05h	5 x OSC CLK
. . . . .	
0xFEh	254 x OSC CLK
0xFFh	255 x OSC CLK

CHR[7:0]: CK Hsync Rise

CHR[7:0]	Start Pulse 1 Output delay
0x00h	0 x HSYNC
0x01h	1 x HSYNC
0x02h	2 x HSYNC
0x03h	3 x HSYNC
0x004h	4 x HSYNC
0x005h	5 x HSYNC
. . . . .	
0xFEh	254 x HSYNC
0xFFh	255 x HSYNC

CON[7:0]: CK Pulse Delay

CON[7:0]	CK Pulse Output delay
0x00h	0 x OSC CLK
0x01h	1 x OSC CLK
0x02h	2 x OSC CLK
0x03h	3 x OSC CLK
0x04h	4 x OSC CLK
0x05h	5 x OSC CLK
. . . . .	
0xFEh	254 x OSC CLK
0xFFh	255 x OSC CLK

Note: Avoid CON[7:0] OSC LCK width > 1-line width

COFF[7:0]: CK Pulse width

COFF[7:0]	CK Pulse Output
0x00h	Inhibit
0x01h	1 x OSC CLK



0x02h	2 x OSC CLK
0x03h	3 x OSC CLK
0x04h	4 x OSC CLK
0x05h	5 x OSC CLK
. . . . .	
0xFEh	254 x OSC CLK
0xFFh	255 x OSC CLK

Note: COFF[7:0] value must bigger than CON[7:0] value

SHP[3:0]: Width of STV High pulse

SHP3	SHP2	SHP1	SHP0	Start Pulse Width
0	0	0	0	1 x HSYNC
0	0	0	1	2 x HSYNC
0	0	1	0	3 x HSYNC
0	0	1	1	4 x HSYNC
0	1	0	0	5 x HSYNC
0	1	0	1	6 x HSYNC
. . . . .				
1	1	1	0	15 x HSYNC
1	1	1	1	16 x HSYNC

SCP[3:0]: A Cycle of STV pulse

SCP3	SCP2	SCP1	SCP0	Start Pulse cycle
0	0	0	0	1 x HSYNC
0	0	0	1	2 x HSYNC
0	0	1	0	3 x HSYNC
0	0	1	1	4 x HSYNC
0	1	0	0	5 x HSYNC
0	1	0	1	6 x HSYNC
. . . . .				
1	1	1	0	15 x HSYNC
1	1	1	1	16 x HSYNC

CHP[3:0]: Width of CK High pulse

CHP3	CHP2	CHP1	CHP0	CK Pulse Width
0	0	0	0	1 x HSYNC
0	0	0	1	2 x HSYNC
0	0	1	0	3 x HSYNC
0	0	1	1	4 x HSYNC
0	1	0	0	5 x HSYNC
0	1	0	1	6 x HSYNC
. . . . .				
1	1	1	0	15 x HSYNC
1	1	1	1	16 x HSYNC

CCP[3:0]: A Cycle of CK pulse

CCP3	CCP2	CCP1	CCP0	CK Pulse cycle
0	0	0	0	1 x HSYNC
0	0	0	1	2 x HSYNC
0	0	1	0	3 x HSYNC
0	0	1	1	4 x HSYNC
0	1	0	0	5 x HSYNC
0	1	0	1	6 x HSYNC
. . . . .				
1	1	1	0	15 x HSYNC
1	1	1	1	16 x HSYNC

SOS\_0[3:0] for CGOUT9\_L pulse selector  
 SOS\_1[3:0] for CGOUT10\_L pulse selector

SOS\_2[3:0] for CGOUT9\_R pulse selector  
 SOS\_3[3:0] for CGOUT10\_R pulse selector

SOS_0/1/2/3[3]	SOS_0/1/2/3[2]	SOS_0/1/2/3[1]	SOS_0/1/2/3[0]	Signal Type
0	0	0	0	STV-0
0	0	0	1	STV-1
0	0	1	0	STV-2
0	0	1	1	STV-3
0	1	0	0	CK-0
0	1	0	1	CK-1
0	1	1	0	CK-2
0	1	1	1	CK-3
1	0	0	0	CK-4
1	0	0	1	CK-5
1	0	1	0	CK-6
1	0	1	1	CK-7
1	1	0	0	Inhibit
1	1	0	1	Inhibit
1	1	1	0	Inhibit
1	1	1	1	Inhibit

COS\_0[3:0] for CGOUT5L pulse selector  
 COS\_1[3:0] for CGOUT6L pulse selector  
 COS\_2[3:0] for CGOUT7L pulse selector  
 COS\_3[3:0] for CGOUT8L pulse selector  
 COS\_4[3:0] for CGOUT5R pulse selector  
 COS\_5[3:0] for CGOUT6R pulse selector  
 COS\_6[3:0] for CGOUT7R pulse selector  
 COS\_7[3:0] for CGOUT8R pulse selector

COS_0-7[3]	COS_0-7[2]	COS_0-7[1]	COS_0-7[0]	Signal Type
0	0	0	0	STV-0
0	0	0	1	STV-1
0	0	1	0	STV-2
0	0	1	1	STV-3
0	1	0	0	CK-0
0	1	0	1	CK-1
0	1	1	0	CK-2
0	1	1	1	CK-3
1	0	0	0	CK-4
1	0	0	1	CK-5
1	0	1	0	CK-6
1	0	1	1	CK-7
1	1	0	0	Inhibit
1	1	0	1	Inhibit
1	1	1	0	Inhibit
1	1	1	1	Inhibit

Once the R36h ML=1 the STV gate control signals are referred to the below registers:

SOS\_0\_ML[3:0] for CGOUT9\_L pulse selector  
 SOS\_1\_ML[3:0] for CGOUT10\_L pulse selector  
 SOS\_2\_ML[3:0] for CGOUT9\_R pulse selector  
 SOS\_3\_ML[3:0] for CGOUT10\_R pulse selector

SOS_0-3_ML[3]	SOS_0-3_ML[2]	SOS_0-3_ML[1]	SOS_0-3_ML[0]	Signal Type
0	0	0	0	STV-0
0	0	0	1	STV-1
0	0	1	0	STV-2
0	0	1	1	STV-3

0	1	0	0	CK-0
0	1	0	1	CK-1
0	1	1	0	CK-2
0	1	1	1	CK-3
1	0	0	0	CK-4
1	0	0	1	CK-5
1	0	1	0	CK-6
1	0	1	1	CK-7
1	1	0	0	Inhibit
1	1	0	1	Inhibit
1	1	1	0	Inhibit
1	1	1	1	Inhibit

Once the R36h ML=1 the CK gate control signals are referred to the below registers:

COS\_0\_ML[3:0] for CGOUT5L pulse selector

COS\_1\_ML[3:0] for CGOUT6L pulse selector

COS\_2\_ML[3:0] for CGOUT7L pulse selector

COS\_3\_ML[3:0] for CGOUT8L pulse selector

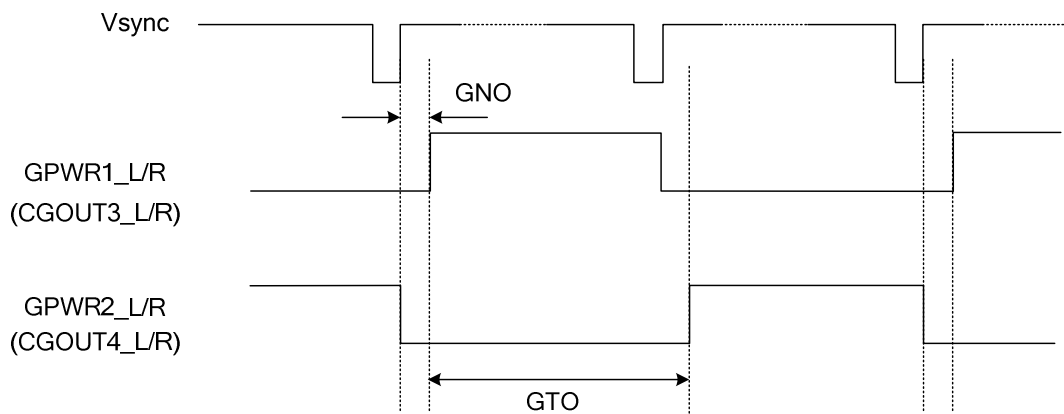
COS\_4\_ML[3:0] for CGOUT5R pulse selector

COS\_5\_ML[3:0] for CGOUT6R pulse selector

COS\_6\_ML[3:0] for CGOUT7R pulse selector

COS\_7\_ML[3:0] for CGOUT8R pulse selector

COS_0-7_ML[3]	COS_0-7_ML[2]	COS_0-7_ML[1]	COS_0-7_ML[0]	Signal Type
0	0	0	0	STV-0
0	0	0	1	STV-1
0	0	1	0	STV-2
0	0	1	1	STV-3
0	1	0	0	CK-0
0	1	0	1	CK-1
0	1	1	0	CK-2
0	1	1	1	CK-3
1	0	0	0	CK-4
1	0	0	1	CK-5
1	0	1	0	CK-6
1	0	1	1	CK-7
1	1	0	0	Inhibit
1	1	0	1	Inhibit
1	1	1	0	Inhibit
1	1	1	1	Inhibit



GTO[5:0]	GPWR toggle frequency
6'h00	64 x Frame
6'h01	1 x Frame
6'h02	2 x Frame
6'h03	3 x Frame
. . . . .	. . . . .
6'h3D	61 x Frame
6'h3E	62 x Frame
6'h3F	63 x Frame

GNO[7:0]	GPWR non-overlap timing
8'h00	0
8'h01	1 x OSC CLK
8'h02	2 x OSC CLK
8'h03	3 x OSC CLK
. . . . .	. . . . .
8'hFD	253 x OSC CLK
8'hFE	254 x OSC CLK
8'hFF	255 x OSC CLK

EQ\_DELAY[7:0] is in-house function not open.  
 GIP\_OPT[7:0]= 5'b0, stv\_2\_time, stv\_gated, toggle\_en  
 stv\_2\_time : Make SHR\_1 control the inner STV\_1. In order to meet 2 STV pulses for BP and FP separately.  
 stv\_gated: CK will be off while STV on.  
 toggle\_en: CK will toggle while porch duration.

Status	Default value	OTP value
Default	SHR_0[11:0]= 0x02h SHR_1[11:0]= 0x01h SPD[7:0]= 0x02h CHR[7:0]= 0x03h CON[7:0]= 0x20h COFF[7:0]= 0x6Cg SCP[3:0]= 0x03h SHP[3:0]= 0x00h CCP[3:0]= 0x03h CHP[3:0]= 0x00h SOS_0[3:0]= 0x00h SOS_1[3:0]= 0x00h SOS_2[3:0]= 0x00h SOS_3[3:0]= 0x00h COS_0[3:0]= 0x00h COS_1[3:0]= 0x06h COS_2[3:0]= 0x04h COS_3[3:0]= 0x00h COS_4[3:0]= 0x01h COS_5[3:0]= 0x07h COS_6[3:0]= 0x05h COS_7[3:0]= 0x07h SOS_0_ML[3:0]= 0x00h SOS_1_ML[3:0]= 0x00h SOS_2_ML[3:0]= 0x00h SOS_3_ML[3:0]= 0x00h COS_0_ML[3:0]= 0x01h COS_1_ML[3:0]= 0x05h COS_2_ML[3:0]= 0x07h COS_3_ML[3:0]= 0x05h COS_4_ML[3:0]= 0x00h COS_5_ML[3:0]= 0x04h	SHR_0[11:0], SHR_1[11:0] SPD[7:0], CHR[7:0] CON[7:0], COFF[7:0] SCP[3:0], SHP[3:0] CCP[3:0], CHP[3:0] SOS_0[3:0], SOS_1[3:0] SOS_2[3:0], SOS_3[3:0] COS_0[3:0], COS_1[3:0] COS_2[3:0], COS_3[3:0] COS_4[3:0], COS_5[3:0] COS_6[3:0], COS_7[3:0] SOS_0_ML[3:0] SOS_1_ML[3:0] SOS_2_ML[3:0] SOS_3_ML[3:0] COS_0_ML[3:0] COS_1_ML[3:0] COS_2_ML[3:0] COS_3_ML[3:0] COS_4_ML[3:0] COS_5_ML[3:0] COS_6_ML[3:0] COS_7_ML[3:0] GTO[5:0], GNO[7:0] EQ_DELAY[7:0] GIP_OPT[7:0]

		COS_6_ML[3:0]= 0x06h COS_7_ML[3:0]= 0x04h GTO[5:0]= 0x01h GNO[7:0]= 0x0Ch EQ_DELAY[7:0]= 0x0Ch GIP_OPT[7:0]= 0x00h	
--	--	---	--

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## 6.2.67 SETTPSNR (D8h)

D8H	SETTPSNR (Set the Temp Sensor control)												
	DNC	NRD	NWR	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	-	1	1	0	1	0	1	0	1	D5
1 <sup>st</sup> parameter	1	1	↑	-	-	-	-	TSRAW[4:0]					(read only)
2 <sup>nd</sup> parameter	1	1	↑	-	-	-	-	TS_OS2[4:0]					-
3 <sup>rd</sup> parameter	1	1	↑	-	BT_P2[3:0]			BT_P1[3:0]			-		
4 <sup>th</sup> parameter	1	1	↑	-	BT_P4[3:0]			BT_P3[3:0]			-		
5 <sup>th</sup> parameter	1	1	↑	-	-	-	-	D0[4:0]					-
6 <sup>th</sup> parameter	1	1	↑	-	TS_G[2:0]			I0[4:0]			-		
7 <sup>th</sup> parameter	1	1	↑	-	-	TS_OS1[4:3]			D1[4:0]			-	
8 <sup>th</sup> parameter	1	1	↑	-	TS_OS1[2:0]			I1[4:0]			-		
9 <sup>th</sup> parameter	1	1	↑	-	PORE	RER[1:0]			D2[4:0]			-	
10 <sup>th</sup> parameter	1	1	↑	-	-	TF_ON	TSON			I2[4:0]			-

This command is used for the temperature sensor control.

**TSON** : Temp. sensor on/off function.

1 = On

0 = Off (default);

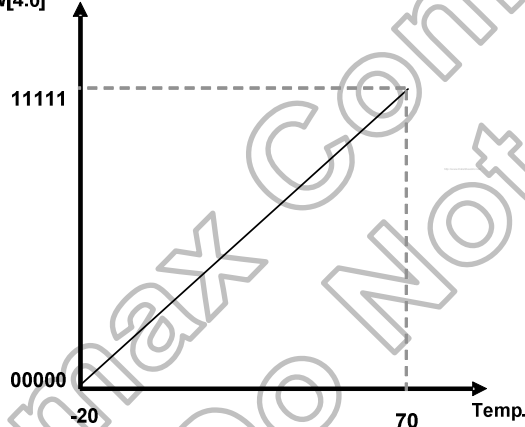
VGH level is controlled by only BT\_P1[1:0]

**TF\_ON** : Median filter on/off function.

1 = On (default)

0 = Off

TSRAW[4:0] (Temp Sensor Output)

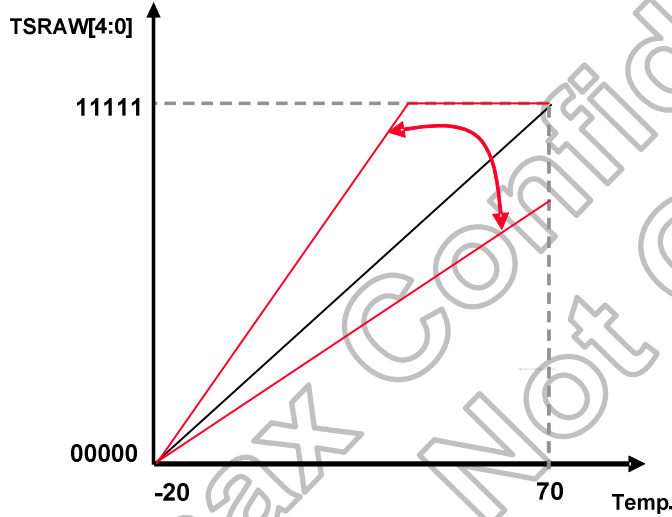


Temp. sensor variation = Under +/- 3 degree

TSRAW[4:0]	Temp.(°C)
00000	-18.55 ~ -20.00
00001	-15.65 ~ -18.55
00010	-12.74 ~ -15.65
00011	-9.84 ~ -12.74
00100	-6.94 ~ -9.84
00101	-4.03 ~ -6.94
00110	-1.13 ~ -4.03
00111	1.77 ~ -1.13
01000	4.68 ~ 1.77
01001	7.58 ~ 4.68
01010	10.48 ~ 7.58
01011	13.39 ~ 10.48
01100	16.29 ~ 13.39
01101	19.19 ~ 16.29
01110	22.10 ~ 19.19
01111	25.00 ~ 22.10

10000	27.90 ~ 25.00
10001	30.81 ~ 27.90
10010	33.71 ~ 30.81
10011	36.61 ~ 33.71
10100	39.52 ~ 36.61
10101	42.42 ~ 39.52
10110	45.32 ~ 42.42
10111	48.23 ~ 45.32
11000	51.13 ~ 48.23
11001	54.03 ~ 51.13
11010	56.93 ~ 54.03
11011	59.84 ~ 56.93
11100	62.74 ~ 59.84
11101	65.64 ~ 62.74
11110	68.55 ~ 65.64
11111	70.00 ~ 68.55

TS\_G[2:0] : Gain control of Temp sensor output.

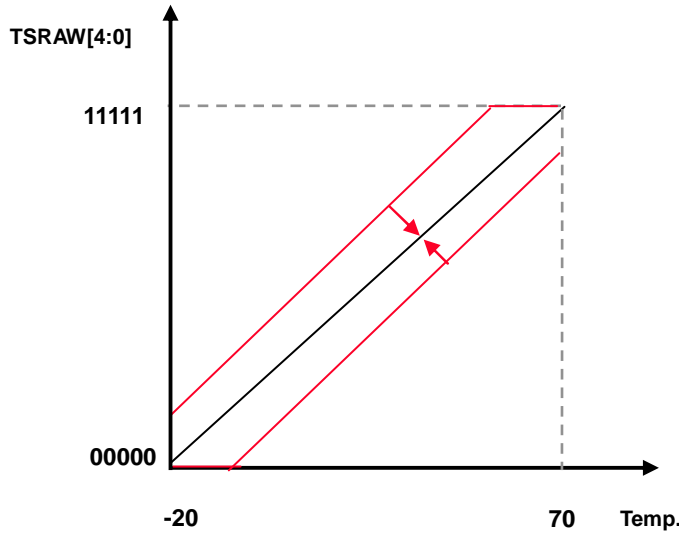


TS_G[2:0]	Gain Range
000	0.8125
001	0.8750
010	0.9375
011	1
100	1.0625
101	1.1250
110	1.1875
111	1.2500

(step=0.0625)



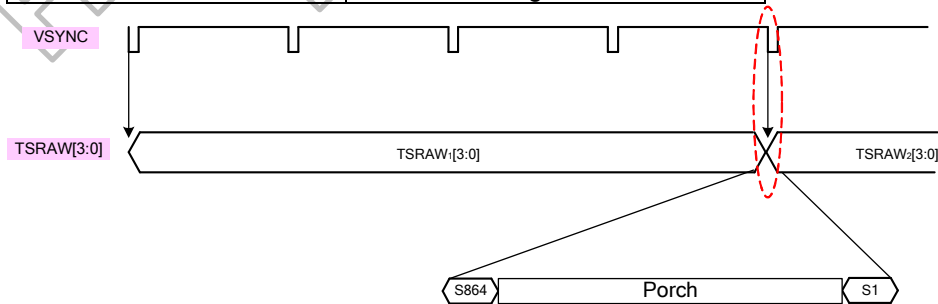
TS\_OS1[4:0] & TS\_OS2 [4:0]: Offset control of Temp sensor output



TS_OS1[4:0] / TS_OS2[4:0]	Temp.(°C)
00000	-54
00001	-51
00010	-48
00011	-45
....	..
<b>10010</b>	<b>0</b>
....	..
11100	30
11101	33
11110	36
11111	39

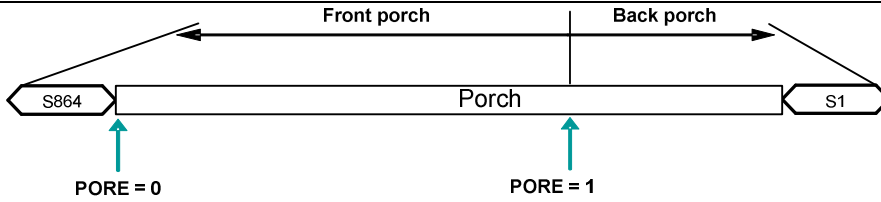
RER[1:0] : Refresh rate of TSRAW[4:0]

RER[1:0]	Refresh Rate
<b>00</b>	Every 4 vsync
01	Every 6 vsync
10	Every 60 vsync
11	Setting disabled

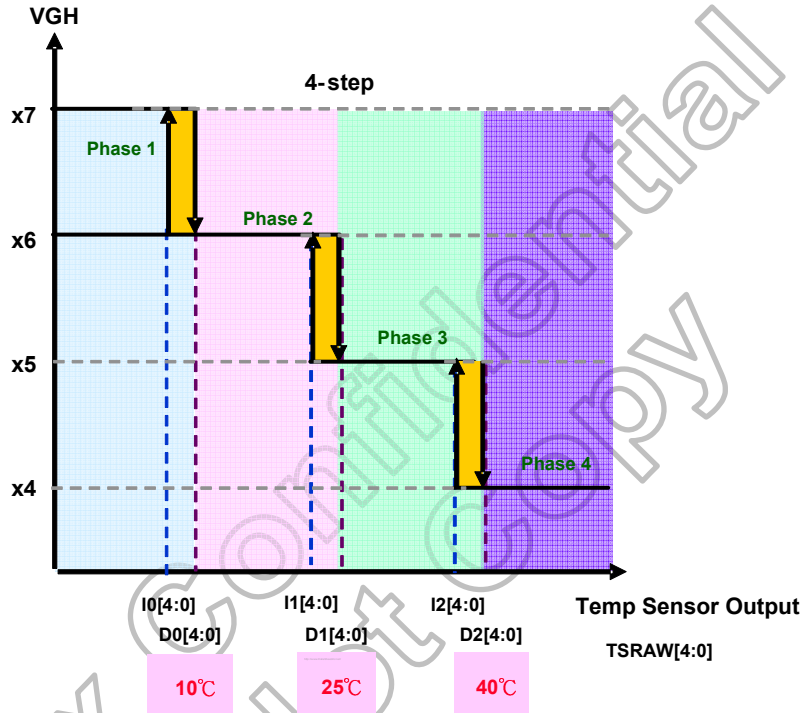


PORE: The point of refresh rate

PORE	Description
<b>0</b>	Start of vertical porch
1	End of vertical porch



BT : VGH pumping control



\* I0~2 & D0~2 is needed for hysteresis

- BT\_P1[3:0] : VGH control at Phase 1
- BT\_P2[3:0] : VGH control at Phase 2
- BT\_P3[3:0] : VGH control at Phase 3
- BT\_P4[3:0] : VGH control at Phase 4

BT_P1[3:0]/ BT_P2[3:0]/ BT_P3[3:0]/ BT_P4[3:0]	VGH	VGL
0000	$2*(VSP-VSN)$	$VDDDN-1*(VSP-VSN)$
0001	$2*(VSP-VSN)$	$-1*(VSP-VSN)$
<b>0010</b>	$2*(VSP-VSN)$	$VDD3-1*(VSP-VSN)$
0011	$(VSP-VSN)+(VDD3-VSN)$	$VDDDN-1*(VSP-VSN)$
0100	$(VSP-VSN)+(VDD3-VSN)$	$-1*(VSP-VSN)$
0101	$(VSP-VSN)+(VDD3-VSN)$	$VDD3-1*(VSP-VSN)$
0110	$(VSP-VSN)+(VSP-VSSD)$	$VDDDN-1*(VSP-VSN)$
0111	$(VSP-VSN)+(VSP-VSSD)$	$-1*(VSP-VSN)$
1000	$(VSP-VSN)+(VSP-VSSD)$	$VDD3-1*(VSP-VSN)$
1001	$(VDD3-VSN)+(VSP-VSSD)$	$VDDDN-1*(VSP-VSN)$
1010	$(VDD3-VSN)+(VSP-VSSD)$	$-1*(VSP-VSN)$
1011	$(VDD3-VSN)+(VSP-VSSD)$	$VDD3-1*(VSP-VSN)$
1100	$(VSP-VSN)$	$VDDDN-1*(VSP-VSN)$
1101	$(VSP-VSN)$	$-1*(VSP-VSN)$
1110	$(VSP-VSN)$	$VDD3-1*(VSP-VSN)$
1111	$2*(VSP-VSSD)$	$-2*(VSP-VSSD)$

	<p> <b>I0 [4:0]</b> : Set the lower boundary of the phase 1, 2  <b>D0 [4:0]</b> : Set the higher boundary of the phase 1, 2  <b>I1 [4:0]</b> : Set the lower boundary of the phase 2, 3  <b>D1 [4:0]</b> : Set the higher boundary of the phase 2, 3  <b>I2 [4:0]</b> : Set the lower boundary of the phase 3, 4  <b>D2 [4:0]</b> : Set the higher boundary of the phase 3, 4                 </p> <p><b>Boundary of the phase:</b></p> <table border="1" data-bbox="308 528 1476 916"> <thead> <tr> <th>IO,DO,I1,D1,I2,D2[4:0]</th> <th>Temp.(°C)</th> </tr> </thead> <tbody> <tr><td>00000</td><td>-20</td></tr> <tr><td>00001</td><td>-17</td></tr> <tr><td>00010</td><td>-14</td></tr> <tr><td>00011</td><td>-11</td></tr> <tr><td>00100</td><td>-8</td></tr> <tr><td>----</td><td>----</td></tr> <tr><td>----</td><td>----</td></tr> <tr><td>11100</td><td>64</td></tr> <tr><td>11101</td><td>67</td></tr> <tr><td>11110</td><td>70</td></tr> <tr><td>11111</td><td>Disabled</td></tr> </tbody> </table>	IO,DO,I1,D1,I2,D2[4:0]	Temp.(°C)	00000	-20	00001	-17	00010	-14	00011	-11	00100	-8	----	----	----	----	11100	64	11101	67	11110	70	11111	Disabled
IO,DO,I1,D1,I2,D2[4:0]	Temp.(°C)																								
00000	-20																								
00001	-17																								
00010	-14																								
00011	-11																								
00100	-8																								
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11100	64																								
11101	67																								
11110	70																								
11111	Disabled																								
Restrictions	SETEXTC turn on to enable this command.																								
Register Availability	<table border="1" data-bbox="308 1111 1476 1245"> <thead> <tr> <th>Status</th> <th>Availability</th> </tr> </thead> <tbody> <tr> <td>Idle Mode Off, Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Idle Mode On, Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Sleep In or Booster Off</td> <td>Yes</td> </tr> </tbody> </table>	Status	Availability	Idle Mode Off, Sleep Out	Yes	Idle Mode On, Sleep Out	Yes	Sleep In or Booster Off	Yes																
Status	Availability																								
Idle Mode Off, Sleep Out	Yes																								
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Default	<table border="1" data-bbox="308 1335 1449 1856"> <thead> <tr> <th>Status</th> <th>Default value</th> <th>OTP value</th> </tr> </thead> <tbody> <tr> <td>Power On Sequence S/W Reset H/W Reset</td> <td>                     TS_OS1[4:0]=0x0Ah,                      TS_OS2[4:0]=0x12h,                      BT_P1[3:0]=4b'0100,                      BT_P2[3:0]=4b'0111,                      BT_P3[3:0]=4b'0111,                      BT_P4[3:0]=4b'1010,                      D0[4:0]=0x0Ch,                      D1[4:0]= 0x17h,                      D2[4:0]= 0x17h,                      I0[4:0]= 0x0Ah,                      I1[4:0]= 0x15h,                      I2[4:0]= 0x15h,                      PORE=0,                      RER=2b'00,                      TF_ON=1,                      TSON=0,                 </td> <td>                     TS_OS1[4:0],                      TS_OS2[4:0],                      BT_P1[3:0], BT_P2[3:0],                      BT_P3[3:0], BT_P4[3:0],                      D0[4:0], D1[4:0], D2[4:0],                      I0[4:0], I1[4:0], I2[4:0],                      PORE, RER,                      TF_ON, TSON                 </td> </tr> </tbody> </table>	Status	Default value	OTP value	Power On Sequence S/W Reset H/W Reset	TS_OS1[4:0]=0x0Ah, TS_OS2[4:0]=0x12h, BT_P1[3:0]=4b'0100, BT_P2[3:0]=4b'0111, BT_P3[3:0]=4b'0111, BT_P4[3:0]=4b'1010, D0[4:0]=0x0Ch, D1[4:0]= 0x17h, D2[4:0]= 0x17h, I0[4:0]= 0x0Ah, I1[4:0]= 0x15h, I2[4:0]= 0x15h, PORE=0, RER=2b'00, TF_ON=1, TSON=0,	TS_OS1[4:0], TS_OS2[4:0], BT_P1[3:0], BT_P2[3:0], BT_P3[3:0], BT_P4[3:0], D0[4:0], D1[4:0], D2[4:0], I0[4:0], I1[4:0], I2[4:0], PORE, RER, TF_ON, TSON																		
Status	Default value	OTP value																							
Power On Sequence S/W Reset H/W Reset	TS_OS1[4:0]=0x0Ah, TS_OS2[4:0]=0x12h, BT_P1[3:0]=4b'0100, BT_P2[3:0]=4b'0111, BT_P3[3:0]=4b'0111, BT_P4[3:0]=4b'1010, D0[4:0]=0x0Ch, D1[4:0]= 0x17h, D2[4:0]= 0x17h, I0[4:0]= 0x0Ah, I1[4:0]= 0x15h, I2[4:0]= 0x15h, PORE=0, RER=2b'00, TF_ON=1, TSON=0,	TS_OS1[4:0], TS_OS2[4:0], BT_P1[3:0], BT_P2[3:0], BT_P3[3:0], BT_P4[3:0], D0[4:0], D1[4:0], D2[4:0], I0[4:0], I1[4:0], I2[4:0], PORE, RER, TF_ON, TSON																							

**6.2.68 SETGAMMA: Set gamma curve related setting (E0h)**

E0H	SETGAMMAR ( Set Gamma Curve Related Setting )													
	DNC	NRD	NWR	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX	
Command	0	1	↑	-	1	1	1	0	0	0	0	0	E0	
1 <sup>st</sup> parameter										G1_VRP0[5:0]				
2 <sup>nd</sup> parameter										G1_VRP1[5:0]				
3 <sup>rd</sup> Parameter										G1_VRP2[5:0]				
4 <sup>th</sup> Parameter										G1_VRP3[5:0]				
5 <sup>th</sup> Parameter										G1_VRP4[5:0]				
6 <sup>th</sup> Parameter										G1_VRP5[5:0]				
7 <sup>th</sup> Parameter									G1_PRP0[6:0]					
8 <sup>th</sup> Parameter									G1_PRP1[6:0]					
9 <sup>th</sup> Parameter					G1_CGMP0 [1:0]			-	G1_PKP0[4:0]					
10 <sup>th</sup> Parameter					G1_CGMP1 [1:0]			-	G1_PKP1[4:0]					
11 <sup>th</sup> Parameter					G1_CGMP2 [1:0]			-	G1_PKP2[4:0]					
12 <sup>th</sup> Parameter					G1_CGMP3 [1:0]			-	G1_PKP3[4:0]					
13 <sup>th</sup> Parameter					G1_CGMP5	G1_CGMP4		-	G1_PKP4[4:0]					
14 <sup>th</sup> Parameter					-	-		-	G1_PKP5[4:0]					
15 <sup>th</sup> Parameter					-	-		-	G1_PKP6[4:0]					
16 <sup>th</sup> Parameter					-	-		-	G1_PKP7[4:0]					
17 <sup>th</sup> Parameter					-	-		-	G1_PKP8[4:0]					
18 <sup>th</sup> Parameter					-	-		-	G1_VRN0[5:0]					
19 <sup>th</sup> Parameter					-	-		-	G1_VRN1[5:0]					
20 <sup>th</sup> Parameter					-	-		-	G1_VRN2[5:0]					
21 <sup>th</sup> Parameter					-	-		-	G1_VRN3[5:0]					
22 <sup>th</sup> Parameter					-	-		-	G1_VRN4[5:0]					
23 <sup>th</sup> Parameter					-	-		-	G1_VRN5[5:0]					
24 <sup>th</sup> Parameter					-	-		-	G1_PRN0[6:0]					
25 <sup>th</sup> Parameter					-	-		-	G1_PRN1[6:0]					
26 <sup>th</sup> Parameter					G1_CGMN0 [1:0]			-	G1_PKN0[4:0]					
27 <sup>th</sup> Parameter					G1_CGMN1 [1:0]			-	G1_PKN1[4:0]					
28 <sup>th</sup> Parameter					G1_CGMN2 [1:0]			-	G1_PKN2[4:0]					
29 <sup>th</sup> Parameter					G1_CGMN3 [1:0]			-	G1_PKN3[4:0]					
30 <sup>th</sup> Parameter					G1_CGMN5	G1_CGMN4		-	G1_PKN4[4:0]					
31 <sup>th</sup> Parameter					-	-		-	G1_PKN5[4:0]					
32 <sup>th</sup> Parameter					-	-		-	G1_PKN6[4:0]					
33 <sup>th</sup> Parameter					-	-		-	G1_PKN7[4:0]					
34 <sup>th</sup> Parameter					-	-		-	G1_PKN8[4:0]					

Description	Register Groups	Positive Polarity	Negative Polarity	Description
	Center Adjustment	G1_PRP0 6-0	G1_PRN0 6-0	G1_PRN0 6-0
G1_PRP1 6-0		G1_PRN1 6-0	G1_PRN1 6-0	Variable resistor (PRP/N1) for center adjustment
Macro Adjustment	G1_PKP0 4-0	G1_PKN0 4-0	G1_PKN0 4-0	32-to-1 selector (voltage level of grayscale 3)
	G1_PKP1 4-0	G1_PKN1 4-0	G1_PKN1 4-0	32-to-1 selector (voltage level of grayscale 7)
	G1_PKP2 4-0	G1_PKN2 4-0	G1_PKN2 4-0	32-to-1 selector (voltage level of grayscale 19)
	G1_PKP3 4-0	G1_PKN3 4-0	G1_PKN3 4-0	32-to-1 selector (voltage level of grayscale 25)
	G1_PKP4 4-0	G1_PKN4 4-0	G1_PKN4 4-0	32-to-1 selector (voltage level of grayscale 32 for positive polarity and grayscale 31 for negative polarity)
	G1_PKP5 4-0	G1_PKN5 4-0	G1_PKN5 4-0	32-to-1 selector (voltage level of grayscale 38)
	G1_PKP6 4-0	G1_PKN6 4-0	G1_PKN6 4-0	32-to-1 selector (voltage level of grayscale 44)
	G1_PKP7 4-0	G1_PKN7 4-0	G1_PKN7 4-0	32-to-1 selector (voltage level of grayscale 56)
Offset Adjustment	G1_VRP0 5-0	G1_VRN0 5-0	G1_VRN0 5-0	Variable resistor (VRP/N0) for offset adjustment
	G1_VRP1 5-0	G1_VRN1 5-0	G1_VRN1 5-0	Variable resistor (VRP/N1) for offset adjustment
	G1_VRP2 5-0	G1_VRN2 5-0	G1_VRN2 5-0	Variable resistor (VRP/N2) for offset adjustment

	<table border="1"> <tr> <td>G1_VRP3 5-0</td> <td>G1_VRN3 5-0</td> <td>Variable resistor (VRP/N3)for offset adjustment</td> </tr> <tr> <td>G1_VRP4 5-0</td> <td>G1_VRN4 5-0</td> <td>Variable resistor (VRP/N4)for offset adjustment</td> </tr> <tr> <td>G1_VRP5 5-0</td> <td>G1_VRN5 5-0</td> <td>Variable resistor (VRP/N5)for offset adjustment</td> </tr> </table> <p> <b>G1_CGMP/N0:</b> Select to change gamma resistor stream.  <b>G1_CGMP/N1:</b> Select to change gamma resistor stream.  <b>G1_CGMP/N2:</b> Select to change gamma resistor stream.  <b>G1_CGMP/N3:</b> Select to change gamma resistor stream. Please refer to Figure 5.31.  <b>G1_CGMP/N4:</b> Select to change gamma resistor stream. Please refer to Figure 5.31.  <b>G1_CGMP/N5:</b> Select to change gamma resistor stream. Please refer to Figure 5.31.                 </p>	G1_VRP3 5-0	G1_VRN3 5-0	Variable resistor (VRP/N3)for offset adjustment	G1_VRP4 5-0	G1_VRN4 5-0	Variable resistor (VRP/N4)for offset adjustment	G1_VRP5 5-0	G1_VRN5 5-0	Variable resistor (VRP/N5)for offset adjustment			
G1_VRP3 5-0	G1_VRN3 5-0	Variable resistor (VRP/N3)for offset adjustment											
G1_VRP4 5-0	G1_VRN4 5-0	Variable resistor (VRP/N4)for offset adjustment											
G1_VRP5 5-0	G1_VRN5 5-0	Variable resistor (VRP/N5)for offset adjustment											
Restriction	SETEXTC turn on to enable this command.												
Register Availability	<table border="1"> <thead> <tr> <th>Status</th> <th>Availability</th> </tr> </thead> <tbody> <tr> <td>Normal Mode On, Idle Mode Off, Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Normal Mode On, Idle Mode On, Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Partial Mode On, Idle Mode Off, Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Partial Mode On, Idle Mode On, Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Sleep In</td> <td>Yes</td> </tr> </tbody> </table>	Status	Availability	Normal Mode On, Idle Mode Off, Sleep Out	Yes	Normal Mode On, Idle Mode On, Sleep Out	Yes	Partial Mode On, Idle Mode Off, Sleep Out	Yes	Partial Mode On, Idle Mode On, Sleep Out	Yes	Sleep In	Yes
Status	Availability												
Normal Mode On, Idle Mode Off, Sleep Out	Yes												
Normal Mode On, Idle Mode On, Sleep Out	Yes												
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Partial Mode On, Idle Mode On, Sleep Out	Yes												
Sleep In	Yes												
Default	<table border="1"> <thead> <tr> <th>Status</th> <th>Default value</th> <th>OTP value</th> </tr> </thead> <tbody> <tr> <td>Power On Sequence S/W Reset H/W Reset</td> <td>                     G1_VRP0[5:0]=0x00h,                      G1_VRP1[5:0]=0x18h,                      G1_VRP2[5:0]=0x1Fh,                      G1_VRP3[5:0]=0x3Fh,                      G1_VRP4[5:0]=0x3Fh,                      G1_VRP5[5:0]=0x3Fh,                      G1_PRP0[6:0]=0x33h,                      G1_PRP1[6:0]=0x57h,                      G1_CGMP0[1:0]=00,                      G1_CGMP1[1:0]=00,                      G1_CGMP2[1:0]=00,                      G1_CGMP3[1:0]=00,                      G1_CGMP4=0, G1_CGMP5=0,                      G1_PKP0[4:0]=0x07h, G1_PKP1[4:0]=0x0Dh,                      G1_PKP2[4:0]=0x0Fh, G1_PKP3[4:0]=0x13h,                      G1_PKP4[4:0]=0x16h, G1_PKP5[4:0]=0x14h,                      G1_PKP6[4:0]=0x16h, G1_PKP7[4:0]=0x18h,                      G1_PKP8[4:0]=0x1Fh,                      G1_VRN0[5:0]=0x00h,                      G1_VRN1[5:0]=0x18h,                      G1_VRN2[5:0]=0x1Fh,                      G1_VRN3[5:0]=0x3Fh,                      G1_VRN4[5:0]=0x3Fh,                      G1_VRN5[5:0]=0x3Fh,                      G1_PKN0[4:0]=0x07h,                      G1_PKN1[4:0]=0x0Dh,                      G1_PKN2[4:0]=0x0Fh,                      G1_PKN3[4:0]=0x13h,                      G1_PKN4[4:0]=0x16h,                      G1_PKN5[4:0]=0x14h,                      G1_PKN6[4:0]=0x16h,                      G1_PKN7[4:0]=0x18h,                      G1_PKN8[4:0]=0x1Fh,                      G1_CGMN0[1:0]=00,                      G1_CGMN1[1:0]=00,                      G1_CGMN2[1:0]=00,                      G1_CGMN3[1:0]=00,                      G1_CGMN4=0, G1_CGMN5=0,                 </td> <td>                     G1_VRP0[5:0], G1_VRP1[5:0],                      G1_VRP2[5:0], G1_VRP3[5:0],                      G1_VRP4[5:0], G1_VRP5[5:0],                      G1_PRP0[6:0], G1_PRP1[6:0],                      G1_CGMP0[1:0], G1_CGMP1[1:0],                      G1_CGMP2[1:0], G1_CGMP3[1:0],                      G1_CGMP4, G1_CGMP5,                      G1_PKP0[4:0], G1_PKP1[4:0],                      G1_PKP2[4:0], G1_PKP3[4:0],                      G1_PKP4[4:0], G1_PKP5[4:0],                      G1_PKP6[4:0], G1_PKP7[4:0],                      G1_PKP8[4:0], G1_VRN0[5:0],                      G1_VRN1[5:0], G1_VRN2[5:0],                      G1_VRN3[5:0], G1_VRN4[5:0],                      G1_VRN5[5:0], G1_PKN0[4:0],                      G1_PKN1[4:0], G1_PKN2[4:0],                      G1_PKN3[4:0], G1_PKN4[4:0],                      G1_PKN5[4:0], G1_PKN6[4:0],                      G1_PKN7[4:0], G1_PKN8[4:0],                      G1_CGMN0[1:0],                      G1_CGMN1[1:0],                      G1_CGMN2[1:0],                      G1_CGMN3[1:0],                      G1_CGMN4, G1_CGMN5.                 </td> </tr> </tbody> </table>	Status	Default value	OTP value	Power On Sequence S/W Reset H/W Reset	G1_VRP0[5:0]=0x00h, G1_VRP1[5:0]=0x18h, G1_VRP2[5:0]=0x1Fh, G1_VRP3[5:0]=0x3Fh, G1_VRP4[5:0]=0x3Fh, G1_VRP5[5:0]=0x3Fh, G1_PRP0[6:0]=0x33h, G1_PRP1[6:0]=0x57h, G1_CGMP0[1:0]=00, G1_CGMP1[1:0]=00, G1_CGMP2[1:0]=00, G1_CGMP3[1:0]=00, G1_CGMP4=0, G1_CGMP5=0, G1_PKP0[4:0]=0x07h, G1_PKP1[4:0]=0x0Dh, G1_PKP2[4:0]=0x0Fh, G1_PKP3[4:0]=0x13h, G1_PKP4[4:0]=0x16h, G1_PKP5[4:0]=0x14h, G1_PKP6[4:0]=0x16h, G1_PKP7[4:0]=0x18h, G1_PKP8[4:0]=0x1Fh, G1_VRN0[5:0]=0x00h, G1_VRN1[5:0]=0x18h, G1_VRN2[5:0]=0x1Fh, G1_VRN3[5:0]=0x3Fh, G1_VRN4[5:0]=0x3Fh, G1_VRN5[5:0]=0x3Fh, G1_PKN0[4:0]=0x07h, G1_PKN1[4:0]=0x0Dh, G1_PKN2[4:0]=0x0Fh, G1_PKN3[4:0]=0x13h, G1_PKN4[4:0]=0x16h, G1_PKN5[4:0]=0x14h, G1_PKN6[4:0]=0x16h, G1_PKN7[4:0]=0x18h, G1_PKN8[4:0]=0x1Fh, G1_CGMN0[1:0]=00, G1_CGMN1[1:0]=00, G1_CGMN2[1:0]=00, G1_CGMN3[1:0]=00, G1_CGMN4=0, G1_CGMN5=0,	G1_VRP0[5:0], G1_VRP1[5:0], G1_VRP2[5:0], G1_VRP3[5:0], G1_VRP4[5:0], G1_VRP5[5:0], G1_PRP0[6:0], G1_PRP1[6:0], G1_CGMP0[1:0], G1_CGMP1[1:0], G1_CGMP2[1:0], G1_CGMP3[1:0], G1_CGMP4, G1_CGMP5, G1_PKP0[4:0], G1_PKP1[4:0], G1_PKP2[4:0], G1_PKP3[4:0], G1_PKP4[4:0], G1_PKP5[4:0], G1_PKP6[4:0], G1_PKP7[4:0], G1_PKP8[4:0], G1_VRN0[5:0], G1_VRN1[5:0], G1_VRN2[5:0], G1_VRN3[5:0], G1_VRN4[5:0], G1_VRN5[5:0], G1_PKN0[4:0], G1_PKN1[4:0], G1_PKN2[4:0], G1_PKN3[4:0], G1_PKN4[4:0], G1_PKN5[4:0], G1_PKN6[4:0], G1_PKN7[4:0], G1_PKN8[4:0], G1_CGMN0[1:0], G1_CGMN1[1:0], G1_CGMN2[1:0], G1_CGMN3[1:0], G1_CGMN4, G1_CGMN5.						
Status	Default value	OTP value											
Power On Sequence S/W Reset H/W Reset	G1_VRP0[5:0]=0x00h, G1_VRP1[5:0]=0x18h, G1_VRP2[5:0]=0x1Fh, G1_VRP3[5:0]=0x3Fh, G1_VRP4[5:0]=0x3Fh, G1_VRP5[5:0]=0x3Fh, G1_PRP0[6:0]=0x33h, G1_PRP1[6:0]=0x57h, G1_CGMP0[1:0]=00, G1_CGMP1[1:0]=00, G1_CGMP2[1:0]=00, G1_CGMP3[1:0]=00, G1_CGMP4=0, G1_CGMP5=0, G1_PKP0[4:0]=0x07h, G1_PKP1[4:0]=0x0Dh, G1_PKP2[4:0]=0x0Fh, G1_PKP3[4:0]=0x13h, G1_PKP4[4:0]=0x16h, G1_PKP5[4:0]=0x14h, G1_PKP6[4:0]=0x16h, G1_PKP7[4:0]=0x18h, G1_PKP8[4:0]=0x1Fh, G1_VRN0[5:0]=0x00h, G1_VRN1[5:0]=0x18h, G1_VRN2[5:0]=0x1Fh, G1_VRN3[5:0]=0x3Fh, G1_VRN4[5:0]=0x3Fh, G1_VRN5[5:0]=0x3Fh, G1_PKN0[4:0]=0x07h, G1_PKN1[4:0]=0x0Dh, G1_PKN2[4:0]=0x0Fh, G1_PKN3[4:0]=0x13h, G1_PKN4[4:0]=0x16h, G1_PKN5[4:0]=0x14h, G1_PKN6[4:0]=0x16h, G1_PKN7[4:0]=0x18h, G1_PKN8[4:0]=0x1Fh, G1_CGMN0[1:0]=00, G1_CGMN1[1:0]=00, G1_CGMN2[1:0]=00, G1_CGMN3[1:0]=00, G1_CGMN4=0, G1_CGMN5=0,	G1_VRP0[5:0], G1_VRP1[5:0], G1_VRP2[5:0], G1_VRP3[5:0], G1_VRP4[5:0], G1_VRP5[5:0], G1_PRP0[6:0], G1_PRP1[6:0], G1_CGMP0[1:0], G1_CGMP1[1:0], G1_CGMP2[1:0], G1_CGMP3[1:0], G1_CGMP4, G1_CGMP5, G1_PKP0[4:0], G1_PKP1[4:0], G1_PKP2[4:0], G1_PKP3[4:0], G1_PKP4[4:0], G1_PKP5[4:0], G1_PKP6[4:0], G1_PKP7[4:0], G1_PKP8[4:0], G1_VRN0[5:0], G1_VRN1[5:0], G1_VRN2[5:0], G1_VRN3[5:0], G1_VRN4[5:0], G1_VRN5[5:0], G1_PKN0[4:0], G1_PKN1[4:0], G1_PKN2[4:0], G1_PKN3[4:0], G1_PKN4[4:0], G1_PKN5[4:0], G1_PKN6[4:0], G1_PKN7[4:0], G1_PKN8[4:0], G1_CGMN0[1:0], G1_CGMN1[1:0], G1_CGMN2[1:0], G1_CGMN3[1:0], G1_CGMN4, G1_CGMN5.											

**6.2.69 SETOTPKEY (E9h)**

E9H	SETOTPKEY												HEX
	DNC	NRD	NWR	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0	
Command	0	1	↑	-	1	1	1	0	1	0	0	1	E9
1 <sup>st</sup> parameter	1	1	↑	-	OTP_KEY0[7:0]							00h	
2 <sup>nd</sup> parameter	1	1	↑	-	OTP_KEY1[7:0]							00h	
Description	This command is used to set OTP key to enter or leave OTP program mode.												
	OTP_KEY0[7:0] OTP_KEY1[7:0]		Description					Note					
	OTP_KEY0[7:0] = 0xAAh OTP_KEY1[7:0] = 0x55h		Enter OTP program mode										
	OTP_KEY0[7:0] = 0x00h OTP_KEY1[7:0] = 0x00h		Leave OTP program mode										
	Other value		Invalid					1. If HX8369-A operate on OTP program mode, Then keep on OTP program mode. 2. If HX8369-A operate on non-OTP program mode, Then keep on non-OTP program mode.					
Restrictions	SETEXTC turn on to enable this command.												
Register Availability	Status						Availability						
	Normal Mode On, Idle Mode Off, Sleep Out						Yes						
	Normal Mode On, Idle Mode On, Sleep Out						Yes						
	Partial Mode On, Idle Mode Off, Sleep Out						Yes						
	Partial Mode On, Idle Mode On, Sleep Out						Yes						
	Sleep In						Yes						
Default	Status			Default value				OTP value					
	Power On Sequence			OTP_KEY0[7:0]=0x00h,				N/A					
	S/W Reset H/W Reset			OTP_KEY1[7:0]=0x00h									

6.2.70 GETHXID (F4h)

F4H	GETHXIC												
	DNC	NRD	NWR	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	-	1	1	1	1	0	1	0	0	F4
1 <sup>st</sup> parameter	1	↑	1	-	Himax ID[7:0]								-
2 <sup>nd</sup> parameter	1	↑	1	-	Version[7:0]								-
Description	This command is used to get LCD ID and version.												
Restrictions	SETEXTC turn on to enable this command.												
Register Availability	Status						Availability						
	Normal Mode On, Idle Mode Off, Sleep Out						Yes						
	Normal Mode On, Idle Mode On, Sleep Out						Yes						
	Partial Mode On, Idle Mode Off, Sleep Out						Yes						
	Partial Mode On, Idle Mode On, Sleep Out						Yes						
	Sleep In						Yes						
Default	Status				Default value				OTP value				
	Power On Sequence				Himax ID[7:0] = 0x69h				N/A				
	S/W Reset H/W Reset				Version[7:0] = 0x02h								

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**6.2.71 SETCNCD/GETCNCD (FDh)**

FDH	SETCNCD/GETCNCD (Set/Get Continue Command)												
	DNC	NRD	NWR	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	-	1	1	1	1	1	1	0	1	FD
1 <sup>st</sup> parameter	1	1	↑	-	WR_CMD_CN[7:0]							-	
Description	This function is use to instead of Register-Content interface mode. The parameter for SETCNCD will continue to read from the last command address automatically.												
Restrictions	SETEXTC turn on to enable this command												
Register Availability	Status				Availability								
	Idle Mode Off, Sleep Out				Yes								
	Idle Mode On, Sleep Out				Yes								
	Sleep In or Booster Off				Yes								
Default	Status				Default value				OTP value				
	Power On Sequence				N/A				N/A				
	S/W Reset				N/A				N/A				
	H/W Reset				N/A				N/A				

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**6.2.72 SET SPI READ INDEX (FEh)**

FEH	SET SPI READ INDEX (Set SPI READ Command Address)												
	DNC	NRD	NWR	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	-	1	1	1	1	1	1	1	0	FE
1 <sup>st</sup> parameter	1	1	↑	-	CMD_ADD[7:0]							-	
Description	SET SPI READ Command Address for User Define Command.												
Restrictions	SETEXTC turn on to enable this command												
Register Availability	Status				Availability								
	Idle Mode Off, Sleep Out				Yes								
	Idle Mode On, Sleep Out				Yes								
Default	Status				Default value				OTP value				
	Power On Sequence				CMD_ADD[7:0]=0x00h				N/A				
	S/W Reset												
H/W Reset													

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**6.2.73 GETSPIREAD: Read command data (FFh)**

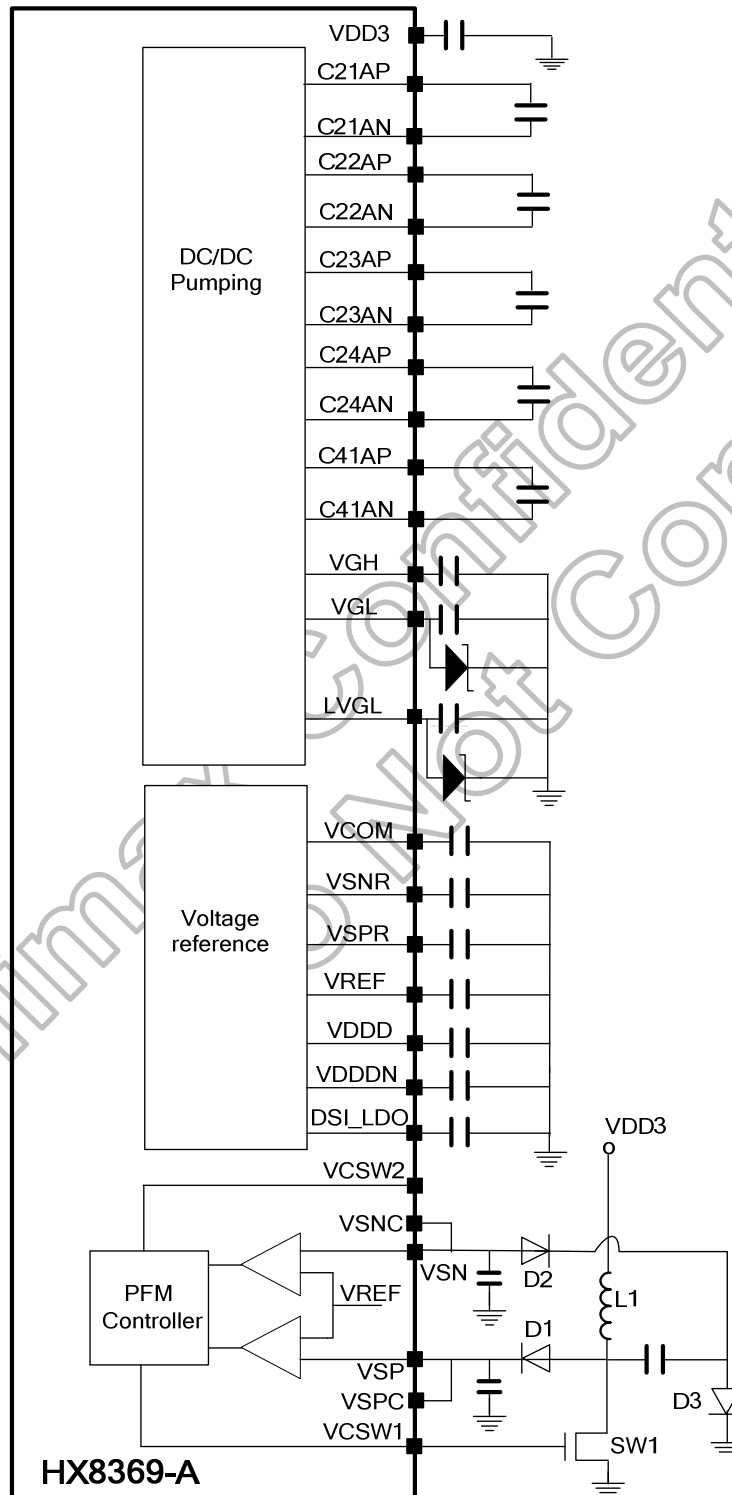
FFH	GETMPUREAD (Read Command Data)												
	DNC	NRD	NWR	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	-	1	1	1	1	1	1	1	1	FF
1 <sup>st</sup> parameter	1	↑	1	-	CMD_DATA1[7:0]								-
:	1	↑	1	-	:								-
n <sup>th</sup> parameter	1	↑	1	-	CMD_DATAN[7:0]								-
Description	Read SPI Command Data for User Define Command.												
Restrictions	SETEXTC turn on to enable this command.												
Register Availability	Status				Availability								
	Idle Mode Off, Sleep Out				Yes								
	Idle Mode On, Sleep Out				Yes								
	Sleep In or Booster Off				Yes								
Default	Status				Default value				OTP value				
	Power On Sequence				N/A				N/A				
	S/W Reset				N/A				N/A				
	H/W Reset				N/A				N/A				

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## 7. Power Supply

### 7.1 Power supply setup

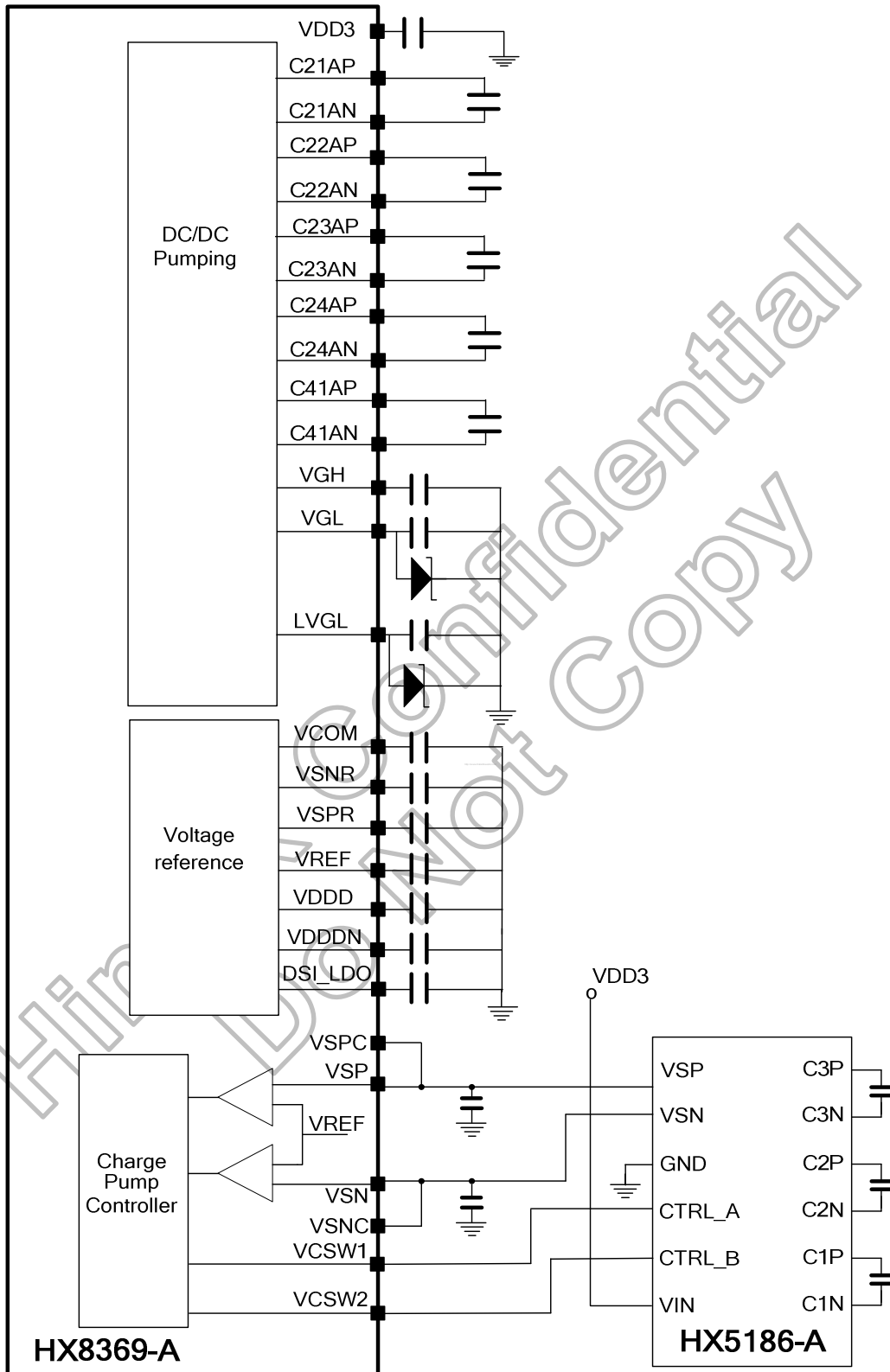
#### 7.1.1 Architecture 1 with PFM circuit



Note: If not use LVGL, please connect the VGL and LVGL together.

Figure 7.1: Power supply with PFM circuit

7.1.2 Architecture 2 with HX5186-A



Note: If not use LVGL, please connect the VGL and LVGL together.

Figure 7.2: Power supply with HX5186-A

## 7.2 Voltage configuration

The HX8369-A has an internal power supply circuit to drive TFTLCD panel. Please set up each voltage output according to the LCD panel.

Name	Function	Set up value	Note
VREF	Reference voltage from internal band gap circuit	1.8V	-
VSP	DC/DC converter circuit output	4.7V ~ 5.5V	Do not exceed 6 V
VSN	DC/DC converter circuit output	-4.7V ~ -5.5V	Do not exceed 6V
VSPC	DC/DC converter circuit output	4.7V ~ 5.5V	Do not exceed 6 V
VSNC	DC/DC converter circuit output	-4.7V ~ -5.5V	Do not exceed 6V
VSPR	Reference voltage for gamma circuit	3.5V ~ (VSP - 0.5V)	Reference register
VSNR	Reference voltage for gamma circuit	-3.5V ~ (VSN + 0.5V)	Reference register
VDDDN	Logic power supply	-2.5V	-
VGH	Positive gate driver output voltage level	+9V ~ +20V	Depend on VSP and VSN
VGL	Negative gate driver output voltage level	-6V ~ -13.5V	Depend on VSP and VSN
LVGL	GIP most negative voltage level	VGL-VDD3	Depend on VSP and VSN
VCOM	VCOM DC voltage	-2V ~ 0V	-
DSI_LDO	Analog power for MIPI DSI circuit	1.2V ~ 1.3V	-

Pad Name	Connection	Typical Component Value
VCOM	Connect to Capacitor (Max 6V): VCOM ---(-)----   --- (+)---- VSSA	2.2 $\mu$ F
VGH	Connect to Capacitor (Max 25V): VGH ---(+)-   --- (-)---- VSSA	1.0 $\mu$ F
VGL	Connect to Capacitor (Max 16V): VGL ---(+)-   --- (-)---- VSSA	1.0 $\mu$ F
	Connect to Schottky Diode(VR $\geq$ 30V): VSSA ---(-)----   --- (+)---- VGL	VF < 0.4V / 20mA @ 25°C, VR $\geq$ 30V (Recommended diode: RB521S-30)
C24AP - C24AN	Connect to Capacitor (Max 16V): C24AP ---(+)-   --- (-)----C24AN	1.0 $\mu$ F
C23AP - C23AN	Connect to Capacitor (Max 16V): C23AP ---(+)-   --- (-)----C23AN	1.0 $\mu$ F
C22AP - C22AN	Connect to Capacitor (Max 16V): C22AP ---(+)-   --- (-)----C22AN	1.0 $\mu$ F
C21AP - C21AN	Connect to Capacitor (Max 16V): C21AP ---(+)-   --- (-)----C21AN	1.0 $\mu$ F
C41AP - C41AN	Connect to Capacitor (Max 16V): C41AP ---(+)-   --- (-)----C41AN	1.0 $\mu$ F
VSPR	Connect to Capacitor (Max 10V): VSPR ---(+)-   --- (-)----VSSA	1.0 $\mu$ F
VSNR	Connect to Capacitor (Max 10V): VSNR ---(+)-   --- (-)----VSSA	1.0 $\mu$ F
VDDD	Connect to Capacitor (Max 6V): VDDD ---(+)-   --- (-)----VSSA	1.0 $\mu$ F
VDDDN	Connect to Capacitor (Max 6V): VDDDN ---(+)-   --- (-)----VSSA	1.0 $\mu$ F
VREF	Connect to Capacitor (Max 6V): VREF ---(-)----   --- (+)---- VSSA	1.0 $\mu$ F
VSP	Connect to Capacitor (Max 10V):VSP ---(+)-   --- (-)----VSSA	2.2 $\mu$ F
VSN	Connect to Capacitor (Max 10V):VSN ---(+)-   --- (-)----VSSA	2.2 $\mu$ F
VDD3	Connect to Capacitor (Max 10V): VDD3 ---(+)-   --- (-)----VSSA	1.0 $\mu$ F
DSI_LDO	Connect to Capacitor (Max 6V): DSI_LDO ---(+)-   --- (-)----DSI_VSS	1.0 $\mu$ F
LVGL	Connect to Capacitor (Max 16V): LVGL ---(-)----   --- (+)---- VSSA	1.0 $\mu$ F
	Connect to Schottky Diode(VR $\geq$ 30V): VSSA ---(-)----   --- (+)---- LVGL	VF < 0.4V / 20mA @ 25°C, VR $\geq$ 30V (Recommended diode: RB521S-30)

Table 7.1: Adoptability of component

## 8. Electrical Characteristics

### 8.1 Absolute maximum ratings

The absolute maximum ratings are list on Table 8.1. When used out of the absolute maximum ratings, the LSI may be permanently damaged. Using the LSI within the following electrical characteristics limit is strongly recommended for normal operation. If these electrical characteristic conditions are exceeded during normal operation, the LSI will malfunction and cause poor reliability.

Item	Symbol	Unit	Value	Note
Power Supply Voltage 1	VDD1~ VSSD	V	-0.3 to +3.6	Note <sup>(1),(2)</sup>
Power Supply Voltage 2	VDD2 ~ VSSA	V	-0.3 to +5.5	Note <sup>(1),(3)</sup>
Power Supply Voltage 3	VDD3 ~ VSSA	V	-0.3 to +5.5	Note <sup>(1)(4)</sup>
Power Supply Voltage 4	DSI_VCC ~ DSI_VSS	V	-0.3 to +3.6	Note <sup>(1)(5)</sup>
Power Supply Voltage 5	VSP ~ VSSA	V	-0.3 to +6.6	Note <sup>(6)</sup>
Power Supply Voltage 6	VSSA ~ VSN	V	0 to -6.6	Note <sup>(7)</sup>
Power Supply Voltage 7	VGH ~ VSSA	V	-0.3 to +25	Note <sup>(8)</sup>
Power Supply Voltage 8	VSSA ~ VGL	V	0 to -16	Note <sup>(9)</sup>
Operating Temperature	Topr	°C	-40 to +85	Note <sup>(10)</sup>
Storage Temperature	Tstg	°C	-55 to +110	Note <sup>(11)</sup>

**Note:** (1) VDD1, VSSD must be maintained.

(2) To make sure VDD1 ≥ VSSD.

(3) To make sure VDD2 ≥ VSSA.

(4) To make sure VDD3 ≥ VSSA.

(5) To make sure DSI\_VCC ≥ DSI\_VSS.

(6) To make sure VSP ≥ VSSA.

(7) To make sure VSSA ≥ VSN

(8) To make sure VGH ≥ VSSA.

(9) To make sure VSSA ≥ VGL

VGH +|VGL| < 32V

(10) For die and wafer products, specified up to +85°C.

(11) This temperature specifications apply to the TCP package.

**Table 8.1: Absolute maximum rating**

### 8.2 ESD protection level

Mode	Test condition	Criteria	Standard
Human Body Model	C=100 pF, R=1.5 kΩ	±2.0KV	MIL-STD-883F Method 3015.7
Machine Model	C=200 pF, R=0.0 Ω	±200V	EIA/JEDEC JESD22-A115-A

**Table 8.2: ESD protection level**



8.3 DC characteristics

(VDD2=2.3 ~ 4.8V, VDD3=2.3 ~ 4.8V, VDD1=1.65~3.3V, T<sub>A</sub>=-40 ~ 85 °C)

Item	Symbol	Unit	Test Condition	Min.	Typ.	Max.	Note
Input high voltage	V <sub>IH</sub>	V	VDD1= 1.65 ~ 3.3V	0.7 V <sub>DD1</sub>	-	VDD1	V
Input low voltage	V <sub>IL</sub>	V	VDD2= 2.3 ~ 3.3V VDD3= 2.3 ~ 3.3V	0	-	0.3 V <sub>DD1</sub>	V
VPP	V <sub>IH</sub>	V	VPP	7.25V	7.5V	7.75V	V
	V <sub>IL</sub>	V					
Output high voltage (SDO, CABC_PWM_OUT)	V <sub>OH1</sub>	V	I <sub>OH</sub> = -1.0 mA	0.8 V <sub>DD1</sub>	-	VDD1	V
Output low voltage (SDO, CABC_PWM_OUT)	V <sub>OL1</sub>	V	VDD1= 1.65 ~ 2.4V I <sub>OL</sub> = 1.0 mA	0	-	0.2 V <sub>DD1</sub>	V
Logic High level input current	I <sub>IH</sub>	μA	VSYNC, HSYNC	-	-	1	μA
			RESX, DCX_SCL, CSX, RDX_E, WRX_DCX	-	-	1	μA
	I <sub>IHD</sub>	μA	DB[23...0], SDI, DCX_SCL DB[23...0]	-	-	1	μA
Logic Low level input current	I <sub>IL</sub>	μA	VSYNC, HSYNC	-1	-	-	μA
			RESX, DCX_SCL, CSX, RDX_E, WRX_DCX	-1	-	-	μA
	I <sub>ILD</sub>	μA	DB[23...0], SDI, DCX_SCL DB[17...0]	-1	-	-	μA
Current consumption standby mode (VDD2/VDD3-VSSD)	I <sub>ST(VDD)</sub>	μA	VDD2/VDD3=2.8V, VDD1=1.8V T <sub>A</sub> =25°C	-	30	-	μA
Current consumption standby mode (VDD1-VSSD)	I <sub>ST(VDD1)</sub>	μA		-	1	-	μA
Current consumption during Deep-standby mode (VDD2/VDD3-VSSD)	I <sub>DP-ST(VDD)</sub>	μA	VDD2/VDD3=2.8V, VDD1=1.8V T <sub>A</sub> =25°C	-	5	-	μA
Current consumption during Deep-standby mode (VDD1-VSSD)	I <sub>DP-ST(VDD1)</sub>	μA		-	1	-	μA

Note: 1. The VPP pin is open on normal mode and in used while OTP programming condition.  
2. The GRAM data is eliminated under the Deep standby mode.

Table 8.3: DC characteristic

8.4 AC characteristics

8.4.1 DBI Type A interface characteristics

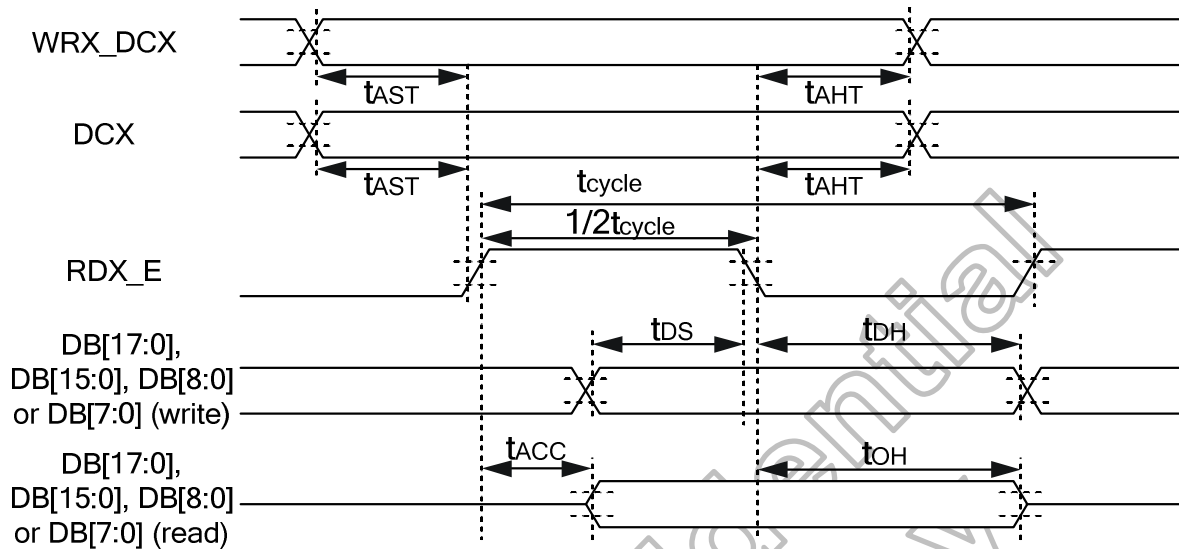


Figure 8.1: DBI Type A interface characteristics(CLK-E mode)

(VSSA=0V, VDD1=1.8V, VDD2=2.8V, VDD3=2.8V, TA=25°C)

Signal	Symbol	Parameter	Min.	Max.	Unit	Description
WRX_DCX or DCX_SCL	tAST	Address setup time	10	-	ns	-
	tAHT	Address hold time (Write/Read)	10	-		
CSX or RDX_E	tcycle	System clock cycle time read register	100	790	ns	-
		Read GRAM	350	790	ns	-
		Write register	100	790	ns	-
		Write GRAM @ SLPOUT	33	790	ns	-
		Write GRAM @ SLPIN	100	790	ns	-
DB23-DB0	tDS	Data setup time	15	-	ns	For maximum CL=30pF For minimum CL=8pF
	tDH	Data hold time	25	-		
	tACC	Read access time	10	-		
	tOH	Output disable time	10	-		

Note: The input signal rise time and fall time (tr, tf) is specified at 15 ns or less.

Logic high and low levels are specified as 30% and 70% of VDD1 for Input signals.

Table 8.4: DBI Type A interface characteristics

8.4.2 DBI Type B interface characteristics

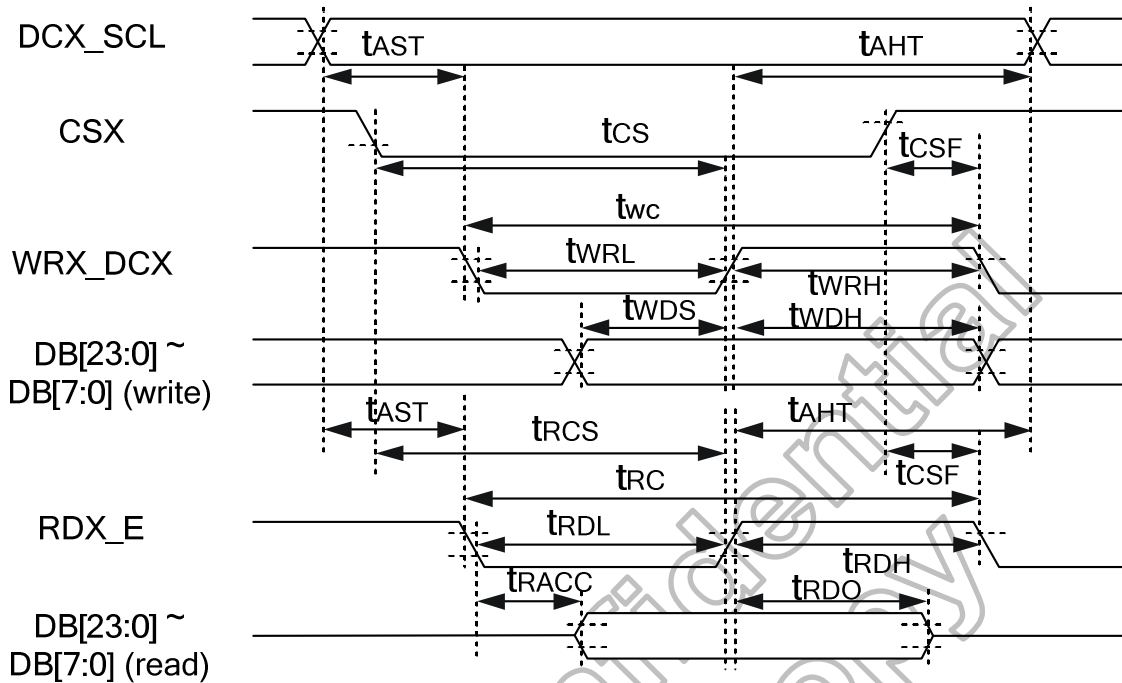


Figure 8.2: DBI Type B interface characteristics

(VSSA=0V, VDD1=1.8V, VDD2=2.8V, VDD3=2.8V, T<sub>A</sub>=25°C)

Signal	Symbol	Parameter	Min.	Max.	Unit	Description
DCX_SCL	tAST	Address setup time	10	-	ns	-
	tAHT	Address hold time (Write/Read)	10	-		
CSX	tCS	Chip select setup time (Write)	20	-	ns	-
	tRCS	Chip select setup time (Read ID)	45	-		
	tRCSFM	Chip Select setup time (Read FM)	355	-		
	tCSF	Chip select wait time (Write/Read)	20	-		
WRX_DCX	tWC	Write cycle (write register)	100	790	ns	-
	tWC	Write cycle (write GRAM@SLPOUT)	33	790		
	tWC	Write cycle (write GRAM@SLPIN)	100	790		
	tWRH	Control pulse "H" duration	15	630		
	tWRL	Control pulse "L" duration	15	160		
RDX_E	tRC	Read cycle (read register)	100	790	ns	-
	tRC	Read cycle (GRAM)	350	790		
	tRDH	Control pulse "H" duration	30	630		
	tRDL	Control pulse "L" duration	20	160		
DB23-DB0	tWDS	Data setup time	15	-	ns	For maximum C <sub>L</sub> =30pF For minimum C <sub>L</sub> =8pF
	tWDH	Data hold time	25	-		
	tRACC	Read access time	10	-		
	tRDO	Output disable time	10	-		

Note: The input signal rise time and fall time (tr, tf) is specified at 15 ns or less.

Logic high and low levels are specified as 30% and 70% of VDD1 for Input signals.

Table 8.5: DBI Type B interface characteristics

8.4.3 DBI Type C interface characteristics

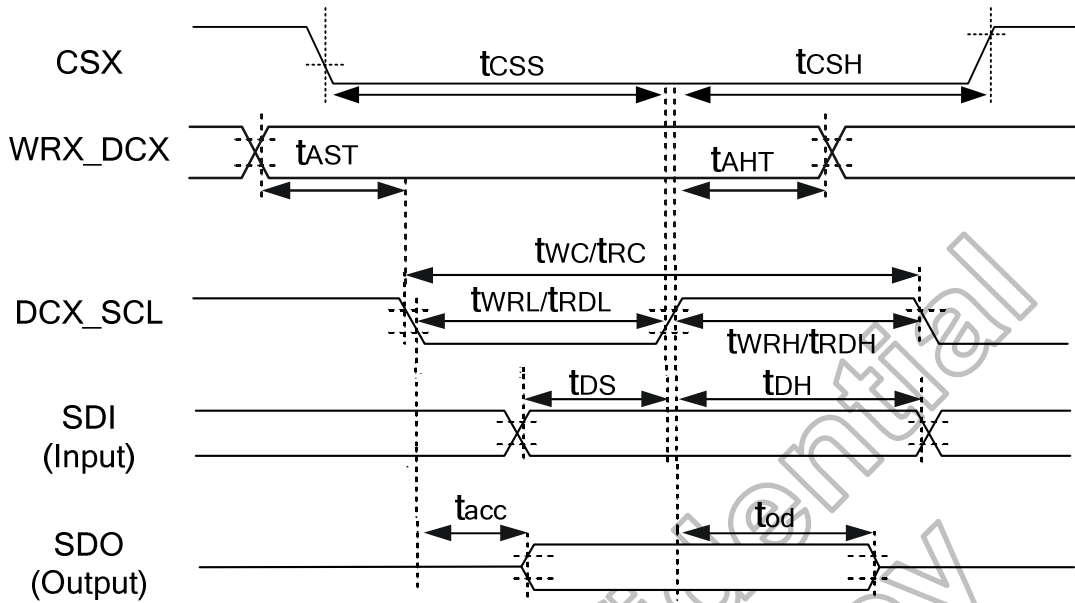


Figure 8.3: DBI Type C interface characteristics

(VSSA=0V, VDD1=1.8V, VDD2=2.8V, VDD3=2.8V, T<sub>A</sub> = 25°C)

Signal	Symbol	Parameter	Min.	Max.	Unit	Description
CSX	t <sub>CSS</sub>	Chip select setup time (Write)	40	-	ns	-
	t <sub>CSh</sub>	Chip select setup time (Read)	40	-		
WRX_DCX	t <sub>AST</sub>	Address setup time	10	-	ns	-
	t <sub>AHT</sub>	Address hold time (Write/Read)	10	-		
DCX_SCL (Write)	t <sub>WC</sub>	Write cycle	100	-	ns	-
	t <sub>WRH</sub>	Control pulse "H" duration	40	-		
	t <sub>WRL</sub>	Control pulse "L" duration	40	-		
DCX_SCL (Read)	t <sub>RC</sub>	Read cycle	150	-	ns	-
	t <sub>RDH</sub>	Control pulse "H" duration	60	-		
	t <sub>RDL</sub>	Control pulse "L" duration	60	-		
SDI/SDO (Input)	t <sub>DS</sub>	Data setup time	30	-	ns	For maximum C <sub>L</sub> =30pF For minimum C <sub>L</sub> =8pF
	t <sub>DH</sub>	Data hold time	30	-		
SDI/SDO (Output)	t <sub>ACC</sub>	Read access time	10	-	ns	
	t <sub>OD</sub>	Output disable time	10	50		

**Note:** The input signal rise time and fall time (tr, tf) is specified at 15 ns or less.

Logic high and low levels are specified as 30% and 70% of VDD1 for Input signals.

Table 8.6: DBI Type C interface characteristics

8.4.4 DPI interface characteristics

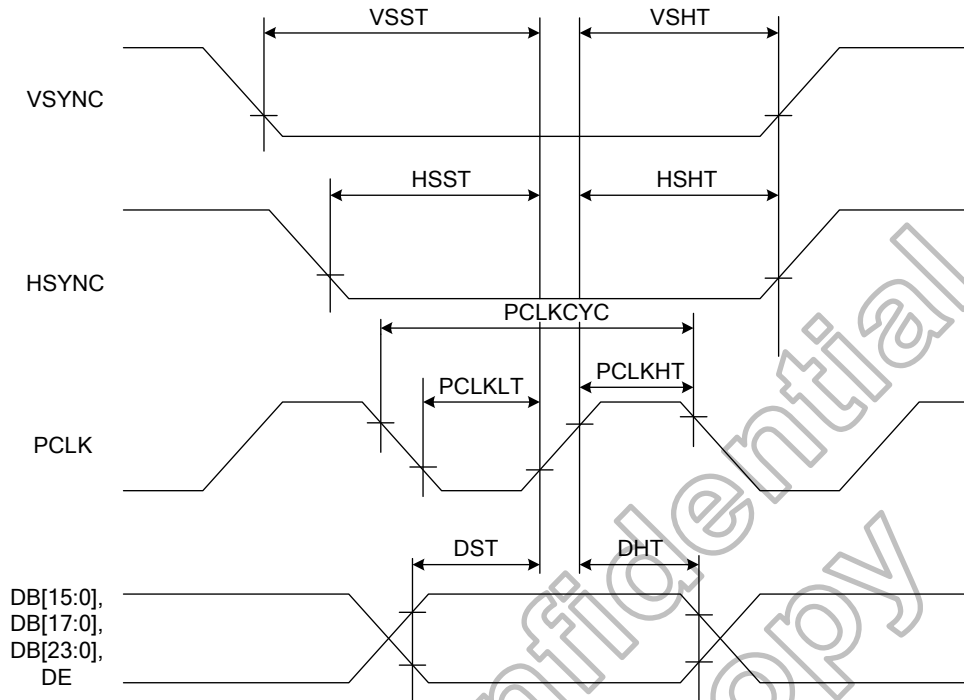


Figure 8.4: DPI interface characteristics

Resolution=480x800 (VSSA=0V, VDD1=1.8V, VDD2=2.8V, VDD3=2.8V, T<sub>A</sub>=25°C)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Vertical sync. setup time	VSST	-	5	-	-	ns
Vertical sync. hold time	VSHT	-	5	-	-	ns
Horizontal sync. setup time	HSST	-	5	-	-	ns
Horizontal sync. hold time	HSHT	-	5	-	-	ns
Pixel clock cycle when RGB I/F is running	PCLKCYC	VRR <sup>(5)</sup> = Min . 50 Hz Max. 70 Hz	31 <sup>(3)</sup>	-	49.2 <sup>(4)</sup>	ns
Pixel clock low time	PCLKLT	-	5	-	-	ns
Pixel clock high time	PCLKHT	-	5	-	-	ns
Data setup time DB[23:0]	DST	-	5	-	-	ns
Data hold time DB[23:0]	DHT	-	5	-	-	ns

- Note:** (1) Signal rise and fall times are equal to or less than 20 ns.  
 (2) Input signals are measured by 0.30 x VDD1 for low state and 0.70 x VDD1 for high state.  
 (3) 32.2 MHz  
 (4) 20.3 MHz  
 (5) VRR : Vertical Refresh Rate, equal to VSYNC frequency.

Resolution=480x854 (VSSA=0V, VDD1=1.8V, VDD2=2.8V, VDD3=2.8V, T<sub>A</sub>=25°C)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Vertical sync. Setup time	VSST	-	5	-	-	ns
Vertical sync. Hold time	VSHT	-	5	-	-	ns
Horizontal sync. Setup time	HSST	-	5	-	-	ns
Horizontal sync. Hold time	HSHT	-	5	-	-	ns
Pixel clock cycle When RGB I/F is running	DCKCYC	VRR <sup>(5)</sup> = Min . 50 Hz Max. 70 Hz	29.1 (Note 3)	-	46.2 (Note 4)	ns
Pixel clock low time	DCKLT	-	5	-	-	ns
Pixel clock high time	DCKHT	-	5	-	-	ns
Data setup time DB[23:0]	DST	-	5	-	-	ns
Data Hold time DB[23:0]	DHT	-	5	-	-	ns

**Note:** (1) Signal rise and fall times are equal to or less than 20 ns.

(2) Input signals are measured by 0.30 x VDD1 for low state and 0.70 x VDD1 for high state.

(3) 34.3 MHz

(4) 21.6 MHz

**Table 8.7: DPI interface characteristics**

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Vertical Timings for RGB I/F

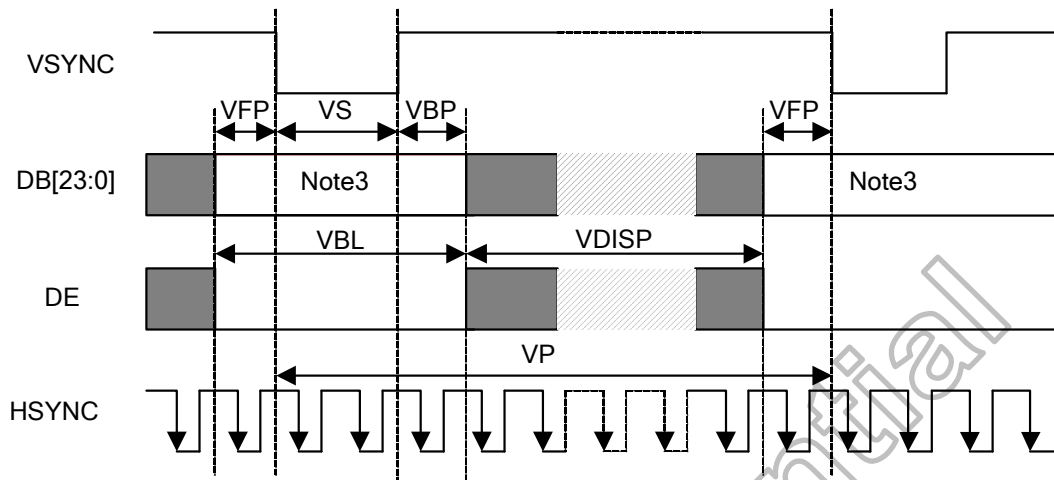


Figure 8.5: Vertical Timings for RGB I/F

Resolution=480x854 (VSSA=0V, VDD1=1.8V, VDD2=2.8V, VDD3=2.8V, T<sub>A</sub>=25°C)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Vertical cycle	VP	-	860	-	-	Line
Vertical low pulse width	VS	-	2	-	Note(4)	Line
Vertical front porch	VFP	-	2	-	-	Line
Vertical back porch	VBP	-	2	-	Note(4)	Line
Vertical data start point	-	VS+VBP	4	-	Note(4)	Line
Vertical blanking period	VBL	VS+VBP+VFP	6	-	-	Line
Vertical active area	-	VDISP	-	854	-	Line
Vertical Refresh rate	VRR	-	50	-	70	Hz

- Note:** (1) Signal rise and fall times are equal to or less than 20 ns.  
 (2) Input signals are measured by 0.30 x VDD1 for low state and 0.70 x VDD1 for highstate.  
 (3) Data lines can be set to "High" or "Low" during blanking time – Don't care.  
 (4) The VS and VBP pulse width are related to ASG/GIP STV and CKV timing. The STV and CKV must be set at corresponding position for LCD normal display. Also refer to section 6.2.66 SETGIP.

Resolution=480x800 (VSSA=0V, VDD1=1.8V, VDD2=2.8V, VDD3=2.8V, T<sub>A</sub>=25°C)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Vertical cycle	VP	-	806	-	-	Line
Vertical low pulse width	VS	-	2	-	Note(4)	Line
Vertical front porch	VFP	-	2	-	-	Line
Vertical back porch	VBP	-	2	-	Note(4)	Line
Vertical data start point	-	VS+VBP	4	-	Note(4)	Line
Vertical blanking period	VBL	VS+VBP+VFP	6	-	-	Line
Vertical active area	-	VDISP	-	800	-	Line
Vertical Refresh rate	VRR	-	50	-	70	Hz

- Note:** (1) Signal rise and fall times are equal to or less than 20 ns.  
 (2) Input signals are measured by 0.30 x VDD1 for low state and 0.70 x VDD1 for highstate.  
 (3) Data lines can be set to "High" or "Low" during blanking time – Don't care.  
 (4) The VS and VBP pulse width are related to ASG/GIP STV and CKV timing. The STV and CKV must be set at corresponding position for LCD normal display. Also refer to section 6.2.66 SETGIP.

Table 8.8 Vertical Timings for RGB I/F



Horizontal Timings for RGB I/F

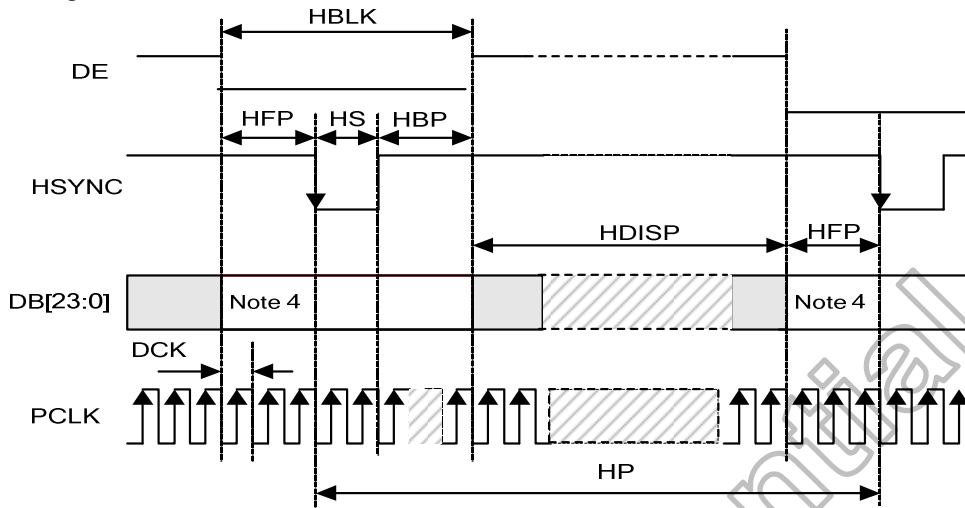


Figure 8.6: Horizontal Timing for RGB I/F

Resolution=480x854 (VSSA=0V, VDD1=1.8V, VDD2=2.8V, VDD3=2.8V, T<sub>A</sub>=25°C)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
HS cycle	HP	Note 3	504	-	568	DCK
HS low pulse width	HS	-	5	-	78	DCK
Horizontal back porch	HBP	-	5	-	78	DCK
Horizontal front porch	HFP	-	5	-	78	DCK
Horizontal data start point	-	HS+HBP	19	-	83	DCK
			700	-	-	ns
Horizontal blanking period	HBLK	HS+HBP+HFP	24	-	88	DCK
Horizontal active area	HDISP	-	-	480	-	DCK
Pixel clock frequency When RGB I/F is running	DCK	VRR = Min. 50 Hz – Max. 70 Hz	21.6	-	34.3	MHz
			29.1	-	46.2	ns

- Note:** (1) Signal rise and fall times are equal to or less than 20 ns.  
 (2) Input signals are measured by 0.30 x VDD1 for low state and 0.70 x VDD1 for high state.  
 (3) HP is multiples of eight DCK.  
 (4) Data lines can be set to "High" or "Low" during blanking time – Don't care.

Resolution=480x800 (VSSA=0V, VDD1=1.8V, VDD2=2.8V, VDD3=2.8V, T<sub>A</sub>=25°C)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
HS cycle	HP	Note 3	504	-	568	DCK
HS low pulse width	HS	-	5	-	78	DCK
Horizontal back porch	HBP	-	5	-	78	DCK
Horizontal front porch	HFP	-	5	-	78	DCK
Horizontal data start point	-	HS+HBP	19	-	83	DCK
			700	-	-	ns
Horizontal blanking period	HBLK	HS+HBP+HFP	24	-	88	DCK
Horizontal active area	HDISP	-	-	480	-	DCK
Pixel clock frequency When RGB I/F is running	DCK	VRR = Min. 50 Hz – Max. 70 Hz	20.3	-	32.2	MHz
			31	-	49.2	ns

- Note:** (1) Signal rise and fall times are equal to or less than 20 ns.  
 (2) Input signals are measured by 0.30 x VDD1 for low state and 0.70 x VDD1 for high state.  
 (3) HP is multiples of eight DCK.  
 (4) Data lines can be set to "High" or "Low" during blanking time – Don't care.

Table 8.9 Horizontal Timings for RGB I/F

### 8.4.5 Reset input timing

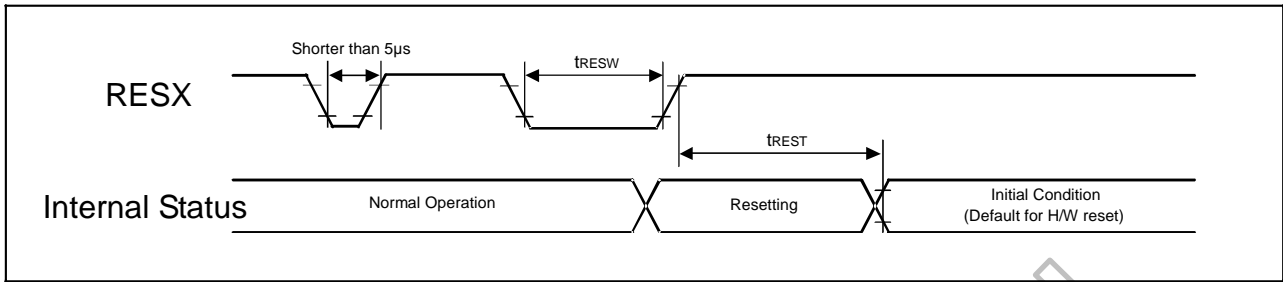


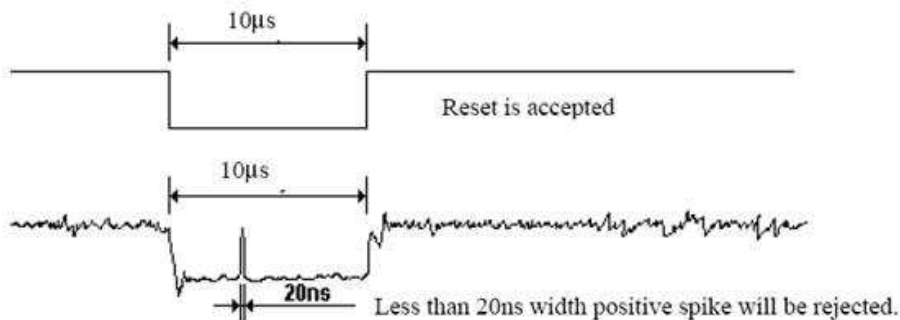
Figure 8.7: Reset input timing

Symbol	Parameter	Related pins	Min.	Typ.	Max.	Note	Unit
$t_{RESW}$	Reset low pulse width <sup>(1)</sup>	RESX	10	-	-	-	$\mu s$
$t_{REST}$	Reset complete time <sup>(2)</sup>	-	-	-	5	When reset is applied during Sleep In mode	ms
		-	-	-	120	When reset is applied during Sleep Out mode	ms

**Note:** (1) Spike due to an electrostatic discharge on RESX line does not cause irregular system reset according to the table below.

RESX Pulse	Action
Shorter than 5 $\mu$	Reset Rejected
Longer than 10 $\mu s$	Reset
Between 5 $\mu s$ and 10 $\mu s$	Reset Start

- (2) During the resetting period, the display will be blanked (The display is entering blanking sequence, which maximum time is 120 ms, when Reset Starts in Sleep Out –mode. The display remains the blank state in Sleep In –mode) and then returns to Default condition for H/W reset.
- (3) During Reset Complete Time, ID2 value in OTP will be latched to internal register during this period. This loading is done every time when there is H/W reset complete time ( $t_{REST}$ ) within 5ms after a rising edge of RESX.
- (4) Spike Rejection also applies during a valid reset pulse as shown below:



- (5) When Reset is applied during Sleep In Mode.
- (6) When Reset is applied during Sleep Out Mode.
- (7) It is necessary to wait 5msec after releasing RESX before sending commands. Also Sleep Out command cannot be sent for 120msec.

Table 8.10: Reset timing

**8.4.6 MDDI electrical characteristics**

**8.4.6.1 DC characteristic**

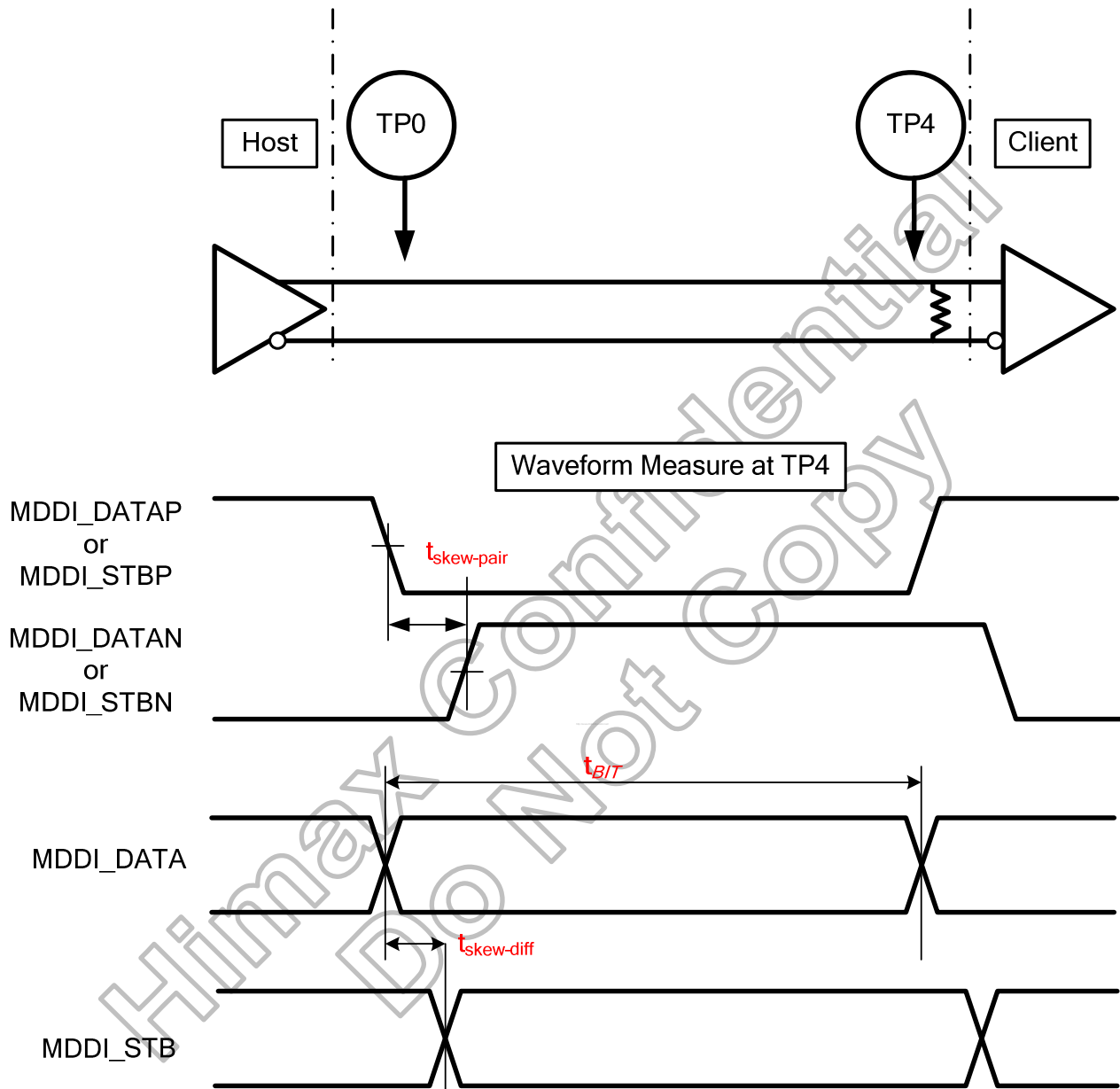
DC characteristic:

Parameter	Description	Min.	Typ.	Max.	Unit
$V_{IT+}$	Receiver differential input high threshold voltage. Above this differential voltage the input signal shall be interpreted as a logic-one level.	-	0	50	mV
$V_{IT-}$	Receiver differential input low threshold voltage. Below this differential voltage the input signal shall be interpreted as a logic-zero level.	-50	0	-	-
$V_{IT+_hib}$	Receiver differential input high threshold voltage (offset for hibernation wake-up). Above this differential voltage the input signal shall be interpreted as a logic-one level.	-	100	125	mV
$V_{IT-_hib}$	Receiver differential input low threshold voltage (offset for hibernation wake-up). Below this differential voltage the input signal shall be interpreted as a logic-zero level.	75	100	-	mV
$V_{Input-Range}$	Allowable receiver input voltage range with respect to client ground.	0.5	-	1.2	V

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8.4.6.2 AC characteristic

AC characteristic:

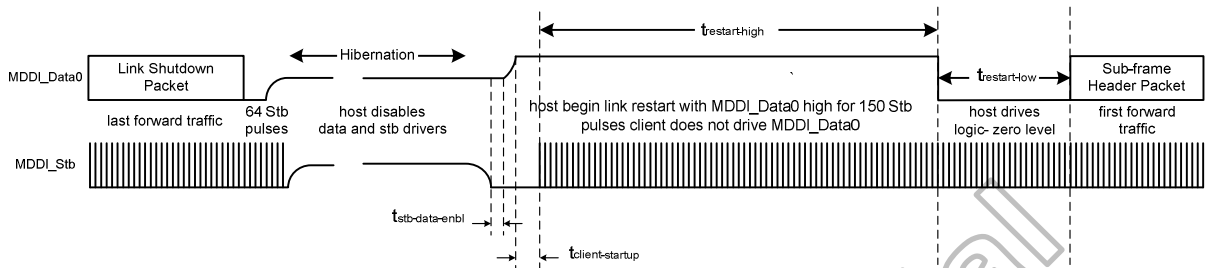


Parameter	Description	Min.	Typ.	Max.	Unit
$1/t_{BIT}$	MDDI operate speed	50	350	400	Mbps
$t_{skew-pair}$	Skew between positive and negative inputs of the differential receiver of the same differential pair (intra-pair skew)	-0.05	0	0.05	ns
$t_{skew-diff}$	Peak delay skew between one differential pair and any other differential pair	$-0.45 t_{BIT}$	0	$0.45 t_{BIT}$	ns
$t_{Rise-Fall}$	Rise/Fall time(20%-80% of swing)	200	-	Note <sup>(1)</sup>	ps

Note : The maximum rise and fall time is either 35% of the interval to transmit one bit on one differential pair or 100 nsec, whichever is smaller.

Wake-up AC characteristic:

Host-Initiated Wake-up



Parameter	Description	Min.	Typ.	Max.	Unit
$t_{\text{restart-high}}$	Duration of host link restart high pulse	140	150	250	Stb clock
$t_{\text{restart-low}}$	Duration of host link restart low pulse	50	50	50	Stb clock
$t_{\text{stb-data-enbl}}$	MDDI_Stb completely enabled to MDDI_Data0 enabled	0	-	-	$\mu\text{sec}$
$t_{\text{client-startup}}$	Time for host to hold MDDI_Stb at logic-zero level after MDDI_Data0 reaches logic-high level	200	-	-	nsec

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### 9. Layout Recommendation

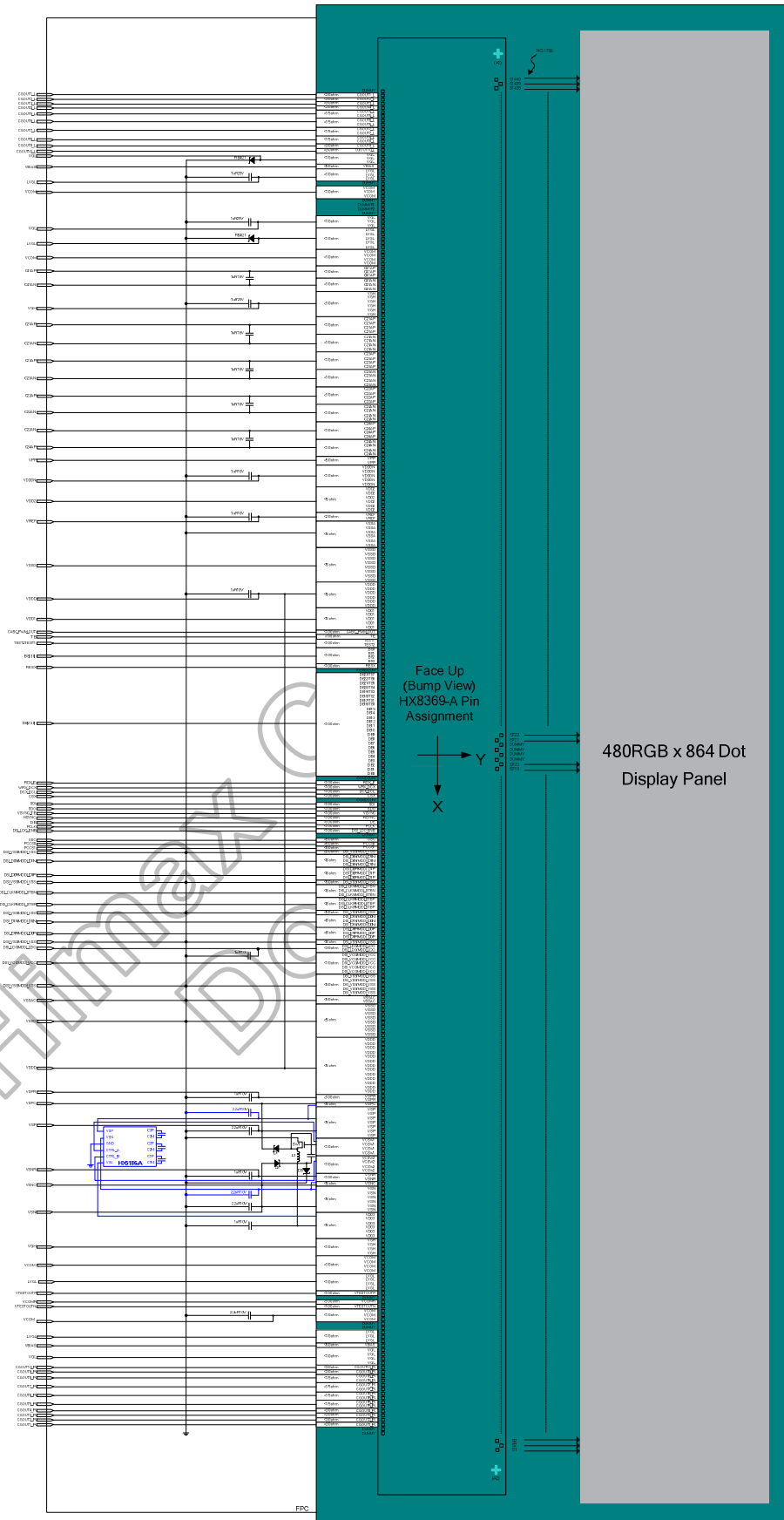


Figure 9.1: Layout recommendation

## 10. Maximum Layout Resistance

Name	Type	Maximum series resistance	Unit
VDD1	Power supply	10	Ω
VDD2	Power supply	20	Ω
VDD3	Power supply	10	Ω
VSSD	Power supply	10	Ω
VSSA	Power supply	10	Ω
DSI_VCC / MDDI_VCC	Power supply	10	Ω
DSI_VSS / MDDI_VSS	Power supply	10	Ω
VSSAC	Power supply	20	Ω
VPP	Input	10	Ω
PCCS0, PCCS1	Input	50	Ω
VCSW1, VCSW2	Output	30	Ω
BS[3:0]	Input	100	Ω
RDX_E, WRX_DCX, DCX_SCL, CSX, RESX	Input	100	Ω
HSYNC, VSYNC, DE, PCLK	Input	100	Ω
SDI	Input	100	Ω
SDO	Output	100	Ω
DB[23:0]	Output	100	Ω
CABC_PWM_OUT	Output	100	Ω
VCOM	Output	10	Ω
DSI_D0P / MDDI_D1P	Input + Output	8	Ω
DSI_D0N / MDDI_D1N	Input + Output	8	Ω
DSI_CLKP / MDDI_STBP	Input	8	Ω
DSI_CLKN / MDDI_STBN	Input	8	Ω
DSI_D1P / MDDI_D0P	Input	8	Ω
DSI_D1N / MDDI_D0N	Input	8	Ω
VDDD	Capacitor Connection	5	Ω
VDDDN	Capacitor Connection	50	Ω
VSP, VSN	Capacitor Connection	10	Ω
VSPC, VSNC	Capacitor Connection	50	Ω
VSPR, VSNR	Capacitor Connection	50	Ω
VREF	Capacitor Connection	20	Ω
VGL, LVGL	Capacitor Connection	10	Ω
VGH	Capacitor Connection	10	Ω
DSI_LDO/MDDI_LDO	Capacitor Connection	20	Ω
DSI_LDO_ENB	Input	100	Ω
OSC	Input	100	Ω
C21AP,C21AN,C22AP,C22AN, C23AP,C23AN,C24AP,C24AN, C41AP,C41AN,	Capacitor Connection	10	Ω
TEST[2:1]	Input	100	Ω
TE	Output	100	Ω
VTESTOUTP, VTESTOUTN	Output	100	Ω
VBIAS	Output	50	Ω
VCOMR	Input	100	Ω

Table 10.1: Maximum layout resistance



## 11. Ordering Information

Part No.	Package
HX8369-A000 PDxxx	PD: mean COG xxx: mean chip thickness (μm), (default: 250 μm)

## 12. Revision History

Version	Date	Description of Changes
01	2009/08/26	1. New setup
	2009/08/31	1. Adds RGB interface access the GRAM function (page30) 2. Update OTP table (page 173~176) 3. Adds Temperature Sensor Control function (page 181) 4. Update Himax Commands table (page 188~194)
	2009/09/28	1. Add On-chip OTP program voltage generator(page10) 2. Add BS[3:0]=1011, 3 wire interface + MDDI video mode. (page 13) 3. TE I/O pin define (page 14) 4. Add S1441 I/O pin (page 14) 5. Update PCCS[1:0] setting (page 14) 6. Update DBI type A, type B and type C AC timing (Page 257~259) 7. Update DPI AC timing.(page 260)
	2009/10/27	1. Update pin assignment (page 19) 2. Update bump arrangement (page 28) 3. Add temperature sensor control register (page 238 ~ 242) 4. Update PFM circuit and HX5186-A application diagrams (page 253~254)
	2009/10/29	1. Update RTN, RTN_PE, FP_PE and BP_PE setting (page 218) 2. Update absolute maximum rating VDD2 and VDD3 (page 254) 3. Update BT[3:0] setting (page205)
	2009/11/6	1. Error typing. Update 3Ah interface format table (page 182) 2. Error typing. Update 0Ch interface format table (page 150) 3. Update table7.1 adoptability of component. (page253)
	2009/11/12	1. Update OTP table (page 129)
	2009/11/13	1. Update MDDI operate speed (page 274)
	2009/11/26	1. Update registers default values (page200~234)
	2010/03/08	1. Update 0xB2h FP[7:0] and BP[7:0] = 8h'00 definition(page 212). 2. Update 0xB1h BTN[4:0] VSN definition(page 204).
	2010/04/01	1. Update OTP index 0x47h (page 128) 2. Update command list 0xB1h default (page 139) 3. Error typing PCLKCYC, PCLKLT and PCLKHT (page 246) 4. Adds Gamma resister stream description (page 113 and 114)
	2010/04/09	1. Error typing I/O pins. (page 26)

2010/04/23	<ol style="list-style-type: none"> <li>1. Update the chip thickness information.(page 17)</li> <li>2. Update register 2Dh Look Up table description. (page 168)</li> <li>3. Add register Bah SETMIPI DSI data lane number setting.(page 227)</li> <li>4. Add DCS write 05h and 15h description. (page55)</li> <li>5. Update DC characteristics information. (page246)</li> </ol>
2010/04/30	<ol style="list-style-type: none"> <li>1. Error typing, change Figure 5.32 to 5.31 (page235)</li> <li>2. Error typing, change maximum 256k colours to 16.7M colours.(page 182)</li> <li>3. Error typing, change SDA to SDI and SDO. (page 40~42)</li> <li>4. Adds notice for RGB caputer mode only used in RGB 24-bit. (page 46)</li> <li>5. Add notice for GIP description.(page 117)</li> </ol>
2010/05/03	<ol style="list-style-type: none"> <li>1. Error typing, change NRESET to RESX.(page17)</li> <li>2. Error typing section 5.15(page153)</li> <li>3. Error typing, change PVSS to VPP. (page 131,225 and 242)</li> <li>4. Add the I/O pin CAB_C_PWM_OUT in the table 5.22.(page 116)</li> <li>5. Update the OTP table. (page 128 &amp; 129)</li> </ol>
2010/05/10	<ol style="list-style-type: none"> <li>1. Update figure SDI,SDO and RESX(page 245 &amp; 247)</li> <li>2. Update the revision date(all pages).</li> <li>3. Error typing, change SDA to SDI and SDO. (page 13)</li> </ol>
2010/5/14	<ol style="list-style-type: none"> <li>1. Adds Vertical Timings for RGB I/F(page249-250).</li> <li>2. Updates DPI interface characteristic(page247-248).</li> </ol>
2010/5/19	<ol style="list-style-type: none"> <li>1. Update Command list table.(page178-179)</li> <li>2. Update Gamma stream description.(page117-155)</li> <li>3. Adds register D5hSETGIP description.(page271-277)</li> <li>4. Adds register D8hSETTPSNR description. (page278-282).</li> </ol>
2010/5/20	<ol style="list-style-type: none"> <li>1. Update Vertical RGB I/F timing note(4).(page301)</li> </ol>
2010/5/28	<ol style="list-style-type: none"> <li>1. Update FS1[2:0]=000 setting is inhibited.(page 246).</li> </ol>
2010/6/02	<ol style="list-style-type: none"> <li>1. Update CSX tRCS and tRCSFM (page 297)</li> </ol>
2010/7/13	<ol style="list-style-type: none"> <li>1. Adds the setion 5.194~ 5.197 OTP programming examples.(page 174 – 177)</li> </ol>