

Datasheet **Preliminary**

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Table of Contents

Se	ction			Page							
1.	Introd	uction		7							
2.	Featur	res		7							
3.	Block	Diagran	1	9							
4.	Pin De	escriptio	ns	10							
2. Features 3. Block Diagram. 4. Pin Descriptions. 5. Pad Arrangement and Coordination. 6. Block Description 7. System Interface. 7.1. Interface Specifications. 7.2. Input Interfaces. 7.2.1. i80/18-bit System Interface. 7.2.2. i80/16-bit System Interface. 7.2.3. i80/9-bit System Interface. 7.2.4. i80/8-bit System Interface. 7.3. Serial Peripheral Interface (SPI). 7.4. VSYNC Interface. 7.5. RGB Input Interface 7.5.2. RGB Inferface. 7.5.3. Moving Picture Mode. 7.5.4. 6-bit RGB Interface. 7.5.5. 16-bit RGB Interface. 7.5.6. 18-bit RGB Interface. 7.6. Interface Timing. 8. Register Descriptions. 8.1. Registers Access. 8.2. Instruction Descriptions. 8.2.1. Index (IR).											
6.	Block	Descrip	tion	22							
7.	Syster	m Interfa	ace	25							
	7.1.	Interfa	ace Specifications	25							
	7.2.	Input	Interfaces	26							
		7.2.1.	i80/18-bit System Interface	27							
		7.2.2.	i80/16-bit System Interface	28							
		7.2.3.	i80/9-bit System Interface	29							
		7.2.4.	i80/8-bit System Interface	29							
	7.3.	Serial	Peripheral Interface (SPI)	30							
	7.4.	VSYN	IC Interface	35							
	7.5.	RGB I	Input Interface	39							
		7.5.1.	RGB Interface	40							
		7.5.2.	RGB Interface Timing	41							
		7.5.3.	Moving Picture Mode	43							
		7.5.4.	6-bit RGB Interface	44							
		7.5.5.	16-bit RGB Interface	45							
		7.5.6.	18-bit RGB Interface	45							
	7.6.	Interfa	ace Timing	48							
8.	Regis	ter Desc	criptions	49							
	8.1.	Regis	ters Access	49							
	8.2.	Instru	ction Descriptions	52							
		8.2.1.	Index (IR)	54							
		8.2.2.	Start Oscillation (R00h)	54							
		8.2.3.	Driver Output Control (R01h)	54							
		8.2.4.	LCD Driving Wave Control (R02h)	56							
		8.2.5.	Entry Mode (R03h)	56							
		8.2.6.	Resizing Control Register (R04h)	58							
		8.2.7.	Display Control 1 (R07h)	59							
		8.2.8.	Display Control 2 (R08h)	60							
		8.2.9.	Display Control 3 (R09h)	61							
		8.2.10.	Display Control 4 (R0Ah)	62							
		8.2.11.	RGB Display Interface Control 1 (R0Ch)	63							



8	8.2.12.	Frame Marker Position (R0Dh)	64
8	8.2.13.	RGB Display Interface Control 2 (R0Fh)	64
8	8.2.14.	Power Control 1 (R10h)	65
8	8.2.15.	Power Control 2 (R11h)	66
8	8.2.16.	Power Control 3 (R12h)	67
8	8.2.17.	Power Control 4 (R13h)	67
8	8.2.18.	GRAM Horizontal/Vertical Address Set (R20h, R21h)	68
8	8.2.19.	Write Data to GRAM (R22h)	68
8	8.2.20.	Read Data from GRAM (R22h)	69
8	8.2.21.	Power Control 7 (R29h)	70
8	8.2.22.	Frame Rate and Color Control (R2Bh)	71
8	8.2.23.	Gamma Control (R30h ~ R3Dh)	72
8	8.2.24.	Horizontal and Vertical RAM Address Position (R50h, R51h, R52h, R53h)	72
8	8.2.25.	Gate Scan Control (R60h, R61h, R6Ah)	73
8	8.2.26.	Partial Image 1 Display Position (R80h)	76
8	8.2.27.	Partial Image 1 RAM Start/End Address (R81h, R82h)	76
8	8.2.28.	Partial Image 2 Display Position (R83h)	76
8	8.2.29.	Partial Image 2 RAM Start/End Address (R84h, R85h)	76
8	8.2.30.	Panel Interface Control 1 (R90h)	77
8	8.2.31.	Panel Interface Control 2 (R92h)	77
8	8.2.32.	Panel Interface Control 4 (R95h)	77
8	8.2.33.	OTP VCM Programming Control (RA1h)	78
8	8.2.34.	OTP VCM Status and Enable (RA2h)	78
8	8.2.35.	OTP Programming ID Key (RA5h)	79
OTP Pr	rogram	ming Flow	80
GRAM	Addres	s Map & Read/Write	83
Windov	v Addre	ess Function	89
Gamma	a Corre	ction	91
Applica	ition		96
13.1.	Config	guration of Power Supply Circuit	96
13.2.	Displa	y ON/OFF Sequence	98
13.3.	Stand	by and Sleep Mode	100
13.4.	Power	r Supply Configuration	101
13.5.	Voltag	e Generation	102
13.6.	Applie	ed Voltage to the TFT panel	103
13.7.	Partia	l Display Function	103
13.8.	Resizi	ing Function	104
Electric	al Cha	racteristics	107
14.1.	Absolu	ute Maximum Ratings	107
	OTP PI GRAM Window Gamma Applica 13.1. 13.2. 13.3. 13.4. 13.5. 13.6. 13.7. 13.8. Electric	8.2.13. 8.2.14. 8.2.15. 8.2.16. 8.2.17. 8.2.18. 8.2.19. 8.2.20. 8.2.21. 8.2.22. 8.2.23. 8.2.24. 8.2.25. 8.2.26. 8.2.27. 8.2.28. 8.2.29. 8.2.30. 8.2.31. 8.2.32. 8.2.33. 8.2.34. 8.2.35. OTP Program GRAM Addres Window Addres Wind	8.2.12. Frame Marker Position (R0Dh) 8.2.13. RGB Display Interface Control 2 (R0Fh) 8.2.14. Power Control 1 (R10h) 8.2.15. Power Control 2 (R11h) 8.2.16. Power Control 3 (R12h) 8.2.17. Power Control 4 (R13h) 8.2.18. GRAM Horizontal/Vertical Address Set (R20h, R21h) 8.2.19. Write Data to GRAM (R22h) 8.2.20. Read Data from GRAM (R22h) 8.2.21. Power Control 7 (R29h) 8.2.22. Frame Rate and Color Control (R2Bh) 8.2.23. Gamma Control (R30h ~ R3Dh) 8.2.24. Horizontal and Vertical RAM Address Position (R50h, R51h, R52h, R53h) 8.2.25. Gate Scan Control (R60h, R61h, R6Ah) 8.2.26. Partial Image 1 Display Position (R80h) 8.2.27. Partial Image 1 Display Position (R80h) 8.2.28. Partial Image 2 Display Position (R83h) 8.2.29. Partial Image 2 Display Position (R83h) 8.2.29. Partial Image 2 Control 1 (R90h) 8.2.30. Panel Interface Control 1 (R90h) 8.2.31. Panel Interface Control 1 (R90h) 8.2.32. Panel Interface Control 1 (R95h) 8.2.33. OTP VCM Programming Control (RA1h) 8.2.34. OTP VCM Status and Enable (RA2h) 8.2.35. OTP Programming ID Key (RA5h) 0TP Programming Flow. 0TP Programming Flow. 0TP Programming Flow. 0TP Programming Flow. 0TR





	14.2. DC Characteristics	108
	14.3. Reset Timing Characteristics	108
	14.4. LCD Driver Output Characteristics	108
	14.5. AC Characteristics	108
	14.5.1. i80-System Interface Timing Characteristics	109
	14.5.2. Serial Data Transfer Interface Timing Characteristics	109
	14.5.3. RGB Interface Timing Characteristics	110
15	Revision History	112





Figures

FIGURE 1 SYSTEM INTERFACE AND RGB INTERFACE CONNECTION	26
Figure 218-bit System Interface Data Format	27
Figure3 16-bit System Interface Data Format	28
Figure4 9-bit System Interface Data Format	29
Figure5 8-bit System Interface Data Format	30
Figure6 Data Transfer Synchronization in 8/9-bit System Interface	30
Figure 7 Data Format of SPI Interface	32
FIGURE8 DATA TRANSMISSION THROUGH SERIAL PERIPHERAL INTERFACE (SPI)	33
FIGURE POATA TRANSMISSION THROUGH SERIAL PERIPHERAL INTERFACE (SPI), TRI="1" AND DFM="10")	34
FIGURE 10 DATA TRANSMISSION THROUGH VSYNC INTERFACE)	35
FIGURE 11 MOVING PICTURE DATA TRANSMISSION THROUGH VSYNC INTERFACE	35
FIGURE 12 OPERATION THROUGH VSYNC INTERFACE	36
FIGURE 13 TRANSITION FLOW BETWEEN VSYNC AND INTERNAL CLOCK OPERATION MODES	38
Figure 14 RGB Interface Data Format	39
FIGURE 15 GRAM ACCESS AREA BY RGB INTERFACE	40
FIGURE 16 TIMING CHART OF SIGNALS IN 18-/16-BIT RGB INTERFACE MODE	41
FIGURE 17 TIMING CHART OF SIGNALS IN 6-BIT RGB INTERFACE MODE	42
FIGURE 18 EXAMPLE OF UPDATE THE STILL AND MOVING PICTURE	43
FIGURE 19 INTERNAL CLOCK OPERATION/RGB INTERFACE MODE SWITCHING	46
FIGURE 20 GRAM ACCESS BETWEEN SYSTEM INTERFACE AND RGB INTERFACE	47
FIGURE 21 RELATIONSHIP BETWEEN RGB I/F SIGNALS AND LCD DRIVING SIGNALS FOR PANEL	48
FIGURE 22 REGISTER SETTING WITH SERIAL PERIPHERAL INTERFACE (SPI)	49
FIGURE 23 REGISTER SETTING WITH 180 SYSTEM INTERFACE	50
Figure 24 Register Read/Write Timing of 180 System Interface	51
FIGURE 25 GRAM Access DIRECTION SETTING	57
Figure26 16-bit MPU System Interface Data Format	58
Figure 27 8-bit MPU System Interface Data Format	58
Figure 28 Data Read from GRAM through Read Data Register in 18-/16-/9-/8-bit Interface Mode	69
Figure 29 GRAM Data Read Back Flow Chart	70
Figure 30 GRAM Access Range Configuration	73
FIGURE 31 GRAM READ/WRITE TIMING OF 180-SYSTEM INTERFACE	83
FIGURE 32 180-SYSTEM INTERFACE WITH 18-/16-/9-BIT DATA BUS (SS="0", BGR="0")	85
FIGURE 33 180-SYSTEM INTERFACE WITH 8-BIT DATA BUS (SS="0", BGR="0")	86
FIGURE 34 180-SYSTEM INTERFACE WITH 18-/9-BIT DATA BUS (SS="1", BGR="1")	88
FIGURE 35 GRAM ACCESS WINDOW MAP	
Figure 36 Grayscale Voltage Generation	91
Figure 37 Grayscale Voltage Adjustment	92
Figure 38 Gamma Curve Adjustment	93





FIGURE 39 RELATIONSHIP BETWEEN SOURCE OUTPUT AND VCOM	95
FIGURE 40 RELATIONSHIP BETWEEN GRAM DATA AND OUTPUT LEVEL	95
FIGURE 41 POWER SUPPLY CIRCUIT BLOCK	96
FIGURE 42 DISPLAY ON/OFF REGISTER SETTING SEQUENCE	100
FIGURE 43 STANDBY/SLEEP MODE REGISTER SETTING SEQUENCE	
FIGURE 44 POWER SUPPLY ON/OFF SEQUENCE	101
FIGURE 45 VOLTAGE CONFIGURATION DIAGRAM	
FIGURE 46 VOLTAGE OUTPUT TO TFT LCD PANEL	
FIGURE 47 PARTIAL DISPLAY EXAMPLE	
Figure 48 Data transfer in resizing	
Figure 49 Resizing Example	
FIGURE 50 180-SYSTEM BUS TIMING	109
FIGURE 51 SPI SYSTEM BUS TIMING	110
FIGURE 52 RGB INTERFACE TIMING	111





Version: 0.30

1. Introduction

ILI9325 is a 262,144-color one-chip SoC driver for a-TFT liquid crystal display with resolution of 240RGBx320 dots, comprising a 720-channel source driver, a 320-channel gate driver, 172,800 bytes RAM for graphic data of 240RGBx320 dots, and power supply circuit.

ILI9325 has four kinds of system interfaces which are i80-system MPU interface (8-/9-/16-/18-bit bus width), VSYNC interface (system interface + VSYNC, internal clock, DB[17:0]), serial data transfer interface (SPI) and RGB 6-/16-/18-bit interface (DOTCLK, VSYNC, HSYNC, ENABLE, DB[17:0]).

In RGB interface and VSYNC interface mode, the combined use of high-speed RAM write function and widow address function enables to display a moving picture at a position specified by a user and still pictures in other areas on the screen simultaneously, which makes it possible to transfer display the refresh data only to minimize data transfers and power consumption.

ILI9325 can operate with 1.65V I/O interface voltage, and an incorporated voltage follower circuit to generate voltage levels for driving an LCD. The ILI9325 also supports a function to display in 8 colors and a sleep mode, allowing for precise power control by software and these features make the ILI9325 an ideal LCD driver for medium or small size portable products such as digital cellular phones, smart phone, PDA and PMP where long battery life is a major concern.

2. Features

- Single chip solution for a liquid crystal QVGA TFT LCD display
- 240RGBx320-dot resolution capable with real 262,144 display color
- Support MVA (Multi-domain Vertical Alignment) wide view display
- Incorporate 720-channel source driver and 320-channel gate driver
- ◆ Internal 172,800 bytes graphic RAM
- High-speed RAM burst write function
- System interfaces
 - > i80 system interface with 8-/ 9-/16-/18-bit bus width
 - Serial Peripheral Interface (SPI)
 - RGB interface with 6-/16-/18-bit bus width (VSYNC, HSYNC, DOTCLK, ENABLE, DB[17:0])
 - VSYNC interface (System interface + VSYNC)
- Internal oscillator and hardware reset
- Resizing function (×1/2, ×1/4)
- Reversible source/gate driver shift direction
- Window address function to specify a rectangular area for internal GRAM access
- Bit operation function for facilitating graphics data processing
 - > Bit-unit write data mask function
 - Pixel-unit logical/conditional write function





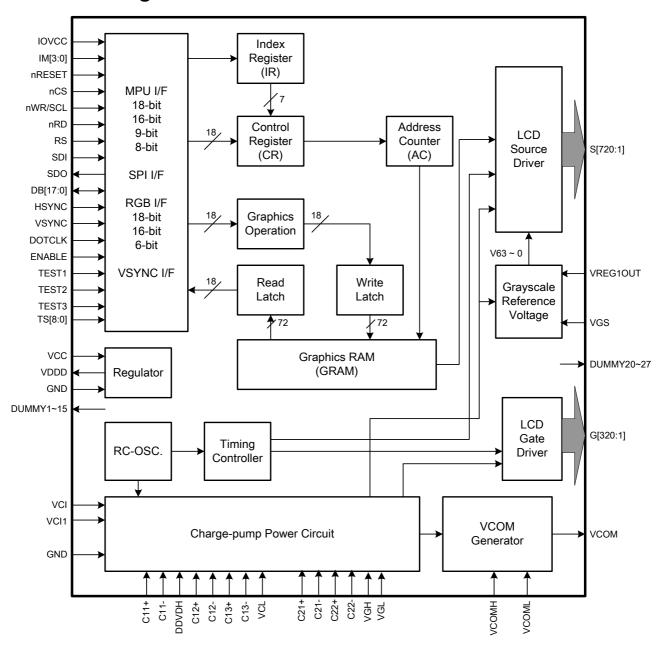
Version: 0.30

- Abundant functions for color display control
 - γ-correction function enabling display in 262,144 colors
 - Line-unit vertical scrolling function
- Partial drive function, enabling partially driving an LCD panel at positions specified by user
- Incorporate step-up circuits for stepping up a liquid crystal drive voltage level up to 6 times (x6)
- Power saving functions
 - > 8-color mode
 - > standby mode
 - sleep mode
- Low -power consumption architecture
 - > Low operating power supplies:
 - IOVcc = 1.65V ~ 3.3 V (interface I/O)
 - Vcc = 2.4V ~ 3.3 V (internal logic)
 - Vci = 2.5V ~ 3.3 V (analog)
- LCD Voltage drive:
 - Source/VCOM power supply voltage
 - DVDH GND = 4.5V ~ 6.0
 - VCL GND = -2.0V ~ -3.0V
 - $VCI VCL \le 6.0V$
 - Gate driver output voltage
 - VGH GND = 10V ~ 20V
 - VGL GND = -5V ~ -15V
 - $VGH VGL \le 32V$
 - VCOM driver output voltage
 - VCOMH = 3.0V ~ (DDVDH-0.5)V
 - VCOML = (VCL+0.5)V ~ 0V
 - VCOMH-VCOML $\leq 6.0 V$
- a-TFT LCD storage capacitor: Cst only

Page 8 of 112



3. Block Diagram



Page 9 of 112





4. Pin Descriptions

Indiana	Pin Name	I/O	Туре	Descriptions												
MR		1		<u> </u>												
IM3, IM3, IM2 IM5 IM								ĺ								
IM3, IM2, I				 -	_					DB Pin in use						
IM3, IM2, I					0	0	0	0								
Image					0	0	0	1	Setting invalid							
M3, M2, M1, M0/ID					0	0	1	0	i80-system 16-bit interface	DB[17:10], DB[8:1]						
MPU Nove N	18.40				0	0	1	1	i80-system 8-bit interface	DB[17:10]						
IMM/ID	T				0	1	0	ID	Serial Peripheral Interface (SPI)	SDI, SDO						
1		I	IOVcc		0	1	1	*	Setting invalid							
1	IM0/ID				1	0	0	0	Setting invalid							
1					1	0	0	1	Setting invalid							
MPU IOVcc Pix to either IOVcc or DGND level when not in use. A read strobe signal and enables an operation to read out data when the signal is low. RS I MPU IOVcc Pix to either IOVcc or DGND level when not in use. A write strobe signal and enables an operation to write data when the signal is low. Fix to either IOVcc or DGND level when not in use. A write strobe signal and enables an operation to write data when the signal is low. Fix to either IOVcc or DGND level when not in use. A read strobe signal and enables an operation to write data when the signal is low. Fix to either IOVcc or DGND level when not in use. SPI Mode: Synchronizing clock signal in SPI mode. A read strobe signal and enables an operation to read out data when the signal is low. Fix to either IOVcc or DGND level when not in use. A reset pin. I MPU IOVcc Pix to either IOVcc or DGND level when not in use. A reset pin. I MPU IOVcc Pix to either IOVcc or DGND level when not in use. A reset pin. I MPU IOVcc Pix to either IOVcc or DGND level when not in use. A reset pin. SPI interface input pin. SPI interface input pin. The data is latched on the rising edge of the SCL signal. SPI interface output pin. The data is outputted on the falling edge of the SCL signal. SPI interface output pin. The data is outputted on the falling edge of the SCL signal. SPI interface output pin. The data is outputted on the falling edge of the SCL signal. SPI interface output pin. The data is outputted on the falling edge of the SCL signal. SPI interface output pin. The data is outputted on the falling edge of the SCL signal. SPI interface output pin. The data is outputted on the falling edge of the SCL signal. SPI interface output pin. The data is latched on the rising edge of the SCL signal. SPI interface output pin. The data is latched on the rising edge of the SCL signal. SPI interface output pin. The data is latched on the rising edge of the SCL signal. SPI interface output pin. The data is latched on the rising edge of the S					1	0	1	0	i80-system 18-bit interface	DB[17:0]						
When the serial peripheral interface is selected, IM0 pin is used for the device code ID setting. A chip select signal. Low: the ILI9325 is selected and accessible High: the ILI9325 is selected and not accessible Fix to the DGND level when not in use. A register select signal. Low: select an index or status register High: select a control register Fix to either IO/vcc or DGND level when not in use. A write strobe signal and enables an operation to write data when the signal is low. Fix to either IO/vcc or DGND level when not in use. SPI Mode: Synchronizing clock signal in SPI mode. A read strobe signal and enables an operation to read out data when the signal is low. Fix to either IO/vcc or DGND level when not in use. A reset pin. Initializes the ILI9325 with a low input. Be sure to execute a power-on reset after supplying power. SPI interface input pin. The data is latched on the rising edge of the SCL signal. SPI interface output pin. The data is outputted on the falling edge of the SCL signal. BPU IO/vcc MPU IO/vcc MPU IO/vcc DB[17:0] I/O MPU IO/vcc INPU IO/vcc MPU IO/vcc DB[17:0] I/O MPU IO/vcc An 18-bit parallel bi-directional data bus for MPU system interface mode 8-bit I/F: DB[17:10] is used. 18-bit I/F: DB[17:0] is used. 18-bit I/F: DB[17:0] is used.					1	0	1	1	i80-system 9-bit interface	DB[17:9]						
I MPU IOVcc Fix to either IOVcc or DGND level when not in use. A read strobe signal and enables an operation to read out data when the signal is low. RES I MPU IOVcc Fix to either IOVcc or DGND level when not in use. A register select a control register High: select a control register Fix to either IOVcc or DGND level when not in use. A write strobe signal and enables an operation to write data when the signal is low. Fix to either IOVcc or DGND level when not in use. SPI Mode: Synchronizing clock signal in SPI mode. A read strobe signal and enables an operation to read out data when the signal is low. Fix to either IOVcc or DGND level when not in use. SPI Mode: Synchronizing clock signal in SPI mode. A read strobe signal and enables an operation to read out data when the signal is low. Fix to either IOVcc or DGND level when not in use. A reset pin. Initializes the ILI9325 with a low input. Be sure to execute a power-on reset after supplying power. SDI I MPU IOVcc SPI interface input pin. The data is latched on the rising edge of the SCL signal. SPI interface output pin. The data is outputted on the falling edge of the SCL signal. SPI interface output pin. The data is outputted on the falling edge of the SCL signal. An 18-bit parallel bi-directional data bus for MPU system interface mode 8-bit I/F: DB[17:10] is used. 18-bit I/F: DB[17:0] is used. 18-bit I/F: DB[17:10] is used.					1	1	*	*	Setting invalid							
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18-bit parallel bi-directional data bus for RGB interface operation	DB[17:0]	I/O			16-	bit I/F	: DB[17:10] and DB[8:1] is used.							
			10 000		18-	bit I/F	: DB[17:0]	is used.							
				12	R-hit :	narall	el hi-c	lirection	onal data hus for RGR interf	ace operation						
0-DIL KOD I/F. DDI I/ . IZI äte usea.				'0						ασο σροιαμοπ						





Pin Name	I/O	Туре	Descriptions
		7,1	16-bit RGB I/F: DB[17:13] and DB[11:1] are used.
			18-bit RGB I/F: DB[17:0] are used.
			Unused pins must be fixed to DGND level.
			Data ENEABLE signal for RGB interface operation.
			Low: Select (access enabled)
ENABLE		MPU	High: Not select (access inhibited)
		IOVcc	The EPL bit inverts the polarity of the ENABLE signal.
			Fix to either IOVcc or DGND level when not in use.
			Dot clock signal for RGB interface operation.
		MPU	DPL = "0": Input data on the rising edge of DOTCLK
DOTCLK	I	IOVcc	DPL = "1": Input data on the falling edge of DOTCLK
			Fix to the DGND level when not in use
			Frame synchronizing signal for RGB interface operation.
VSYNC		MPU	VSPL = "0": Active low.
VSTNC	I	IOVcc	VSPL = "1": Active high.
			Fix to the DGND level when not in use.
			Line synchronizing signal for RGB interface operation.
HSYNC		MPU	HSPL = "0": Active low.
		IOVcc	HSPL = "1": Active high.
			Fix to the DGND level when not in use
FMARK	0	MPU	Output a frame head pulse signal. The FMARK signal is used when writing RAM data in synchronization
FIVIARY		IOVcc	with frame. Leave the pin open when not in use.
			LCD Driving signals
			Source output voltage signals applied to liquid crystal.
			To change the shift direction of signal outputs, use the SS bit.
0700 04		1.00	SS = "0", the data in the RAM address "h00000" is output from S1.
S720~S1	0	LCD	SS = "1", the data in the RAM address "h00000" is output from S720.
			S1, S4, S7, display red (R), S2, S5, S8, display green (G), and
			S3, S6, S9, display blue (B) (SS = 0).
0000 04			Gate line output signals.
G320~G1	0	LCD	VGH: the level selecting gate lines
		TFT	VGL: the level not selecting gate lines A supply voltage to the common electrode of TFT panel.
VCOM	0	common	VCOM is AC voltage alternating signal between the VCOMH and
VOOIVI		electrode	VCOM is Ac voltage alternating signal between the vcomm and vCOML levels.
\(\alpha \alpha \cdot \c	_	Stabilizing	The high level of VCOM AC voltage. Connect to a stabilizing
VCOMH	0	capacitor	capacitor.
VCOM		Stabilizing	The low level of VCOM AC voltage. Adjust the VCOML level with the
VCOML	0	capacitor	VDV bits. Connect to a stabilizing capacitor.
		GND or	Reference level for the grayscale voltage generating circuit. The VGS
VGS	- 1	external	level can be changed by connecting to an external resistor.
		resistor	<u> </u>
	ı		narge-pump and Regulator Circuit
Vci	1	Power	A supply of 2.5 ~ 3.3\/
		supply Power	supply of $2.5 \sim 3.3V$. GND for the analog side: GND = 0V. In case of COG, connect to
GND	I	supply	GND on the FPC to prevent noise.
		Supply	An internal reference voltage for the step-up circuit1.
		Otabili-i-	The amplitude between Vci and DGND is determined by the VC[2:0]
Vci1	0	Stabilizing capacitor	bits.
ĺ			Make sure to set the Vci1 voltage so that the DDVDH, VGH and VGL
DDVDH	0	Stabilizing	voltages are set within the respective specification. Power supply for the source driver and Vcom drive.





Pin Name	I/O	Туре	Descriptions							
		capacitor								
VGH	I	Stabilizing capacitor	Power supply for the gate driver.							
VGL	I	Stabilizing capacitor	Power supply for the gate driver.							
VCL	0	Stabilizing capacitor	VcomL driver power supply. VCL = 0.5 ~ –VCI . Place a stabilizing capacitor between GND							
C11+, C11- C12+, C12-	I/O	Step-up capacitor	Capacitor connection pins for the step-up circuit 1.							
C13+, C13- C21+, C21- C22+, C22-	I/O	Step-up capacitor	Capacitor connection pins for the step-up circuit 2.							
			Output voltage generated from the reference voltage.							
VREG10UT	I/O	Stabilizing capacitor	The voltage level is set with the VRH bits. VREG10UT is (1) a source driver grayscale reference voltage, (2) VcomH level reference voltage, and (3) Vcom amplitude reference voltage. Connect to a stabilizing capacitor. VREG10UT = 3.0 ~ (DDVDH – 0.5)V.							
			Power Pads							
Vcc	I	Power supply	A supply voltage to the internal logic: Vcc = 2.4~3.3V							
IOVcc	I	Power supply	A supply voltage to the interface pins: IM[3:0], nRESET, nCS, nWR, nRD, RS, DB[17:0], VSYNC, HSYNC, DOTCLK, ENABLE, SCL, SDI, SDO. IOVcc = 1.65 \sim 3.3V and Vcc \geq IOVcc. In case of COG, connect to Vcc on the FPC if IOVcc=Vcc, to prevent noise.							
VDDD	0	Power	Digital circuit power pad. Connect these pins with the 1uF capacitor.							
GND	I	Power supply	GND for the analog side: DGND = 0V.							
			Test Pads							
DUMMY1~ 15 DUMMY20 ~ 27	-	-	Dummy pad. Leave these pins as open.							
IOGNDDUM	0	GND	GND pin.							
TESTO1~16	0	Open	Test pins. Leave them open.							
120101										
TEST1, 2, 3	I	IOGND	Test pins (internal pull low). Connect to GND or leave these pins as open.							

Liquid crystal power supply specifications Table 1

No.		Item		Description									
1	TFT Source Drive	r		720 pins (240 x RGB)									
2	TFT Gate Driver			320 pins									
3	TFT Display's Cap	acitor S	tructure	Cst structure only (Common VCOM)									
	Liquid Crystal	Daire	S1 ~ S720	V0 ~ V63 grayscales									
4	Liquid Crystal Output	Drive	G1 ~ G320	VGH - VGL									
	Output		VCOM	VCOMH - VCOML: Amplitude = electronic volumes									





		IOVcc	1.65 ~ 3.30V
5	Input Voltage	Vcc	2.40 ~ 3.30V
		Vci	2.50 ~ 3.30V
		DDVDH	4.5V ~ 6.0V
		VGH	10V ~ 20V
6	Liquid Crystal Drive	VGL	-5V ~ -15V
١	Voltages	VCL	-1.9V ~ -3.0V
		VGH - VGL	40 ~ 3.30V 50 ~ 3.30V 5V ~ 6.0V 0V ~ 20V V ~ -15V .9V ~ -3.0V ax. 32V ax. 6.0V ci1 x2 ci1 x4, x5, x6 ci1 x-3, x-4, x-5
		Vci - VCL	Max. 6.0V
		DDVDH	Vci1 x2
7	Internal Stan un Circuite	VGH	Vci1 x4, x5, x6
'	Internal Step-up Circuits	VGL	Vci1 x-3, x-4, x-5
		Vci 2 DDVDH 4 VGH 1 VGL	Vci1 x-1



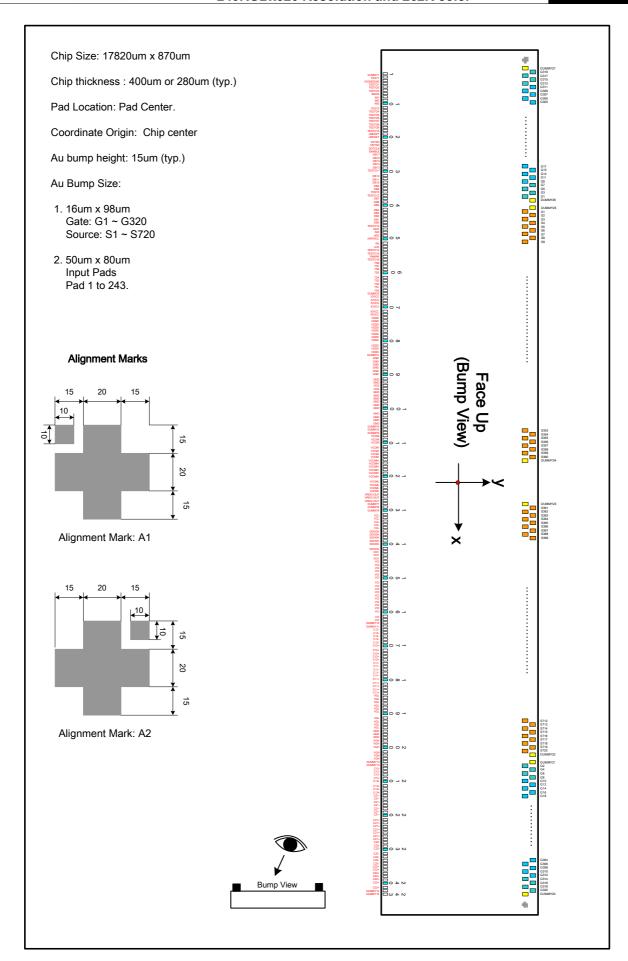


5. Pad Arrangement and Coordination

Page 14 of 112 Version: 0.30









	1																		
No. 1	Name DUMMY1	-8610	Y -307.5	No. 61	Name TS4	-4130	Y -307.5	No. 121	Name VCOML	70	-307.5	No. 181	Name	X 4270	Y -307.5	No. 241	Name C22+	X 8470	Y 207.5
-	_			Ė				-					C11+			-	_		-307.5
2	TEST1	-8540	-307.5	62	TS3	-4060	-307.5	122	VCOML	140	-307.5	182	C11+	4340	-307.5	242	DUMMY14	8540	-307.5
3	IOGNDDUM	-8470	-307.5	63	TS2	-3990	-307.5	123	VCOML	210	-307.5	183	C11+	4410	-307.5	243	DUMMY15	8610	-307.5
4	TESTO1	-8400	-307.5	64	TS1	-3920	-307.5	124	VCOML	280	-307.5	184	C11+	4480	-307.5	244	DUMMY20	8659	202.5
5		-8330	-307.5	65	TS0	-3850	-307.5	125	VREG10UT	350	-307.5	185	VGL	4550	-307.5	245	G320	8643	319.5
7	TESTO3	-8260	-307.5	66	DUMMY2	-3780	-307.5	126	VREG10UT	420	-307.5	186	VGL	4620	-307.5	246	G318	8627	202.5
-	IM0/ID	-8190	-307.5	67	IOVCC	-3710	-307.5	127	VREG10UT	490	-307.5	187	VGL	4690	-307.5	247	G316	8611	319.5
8	IM1	-8120	-307.5	68	IOVCC	-3640	-307.5	128	DUMMY7	560	-307.5	188	VGL	4760	-307.5	248	G314	8595	202.5
9	IM2	-8050	-307.5	69	IOVCC	-3570	-307.5	129	DUMMY8	630	-307.5	189	VGL	4830	-307.5	249	G312	8579	319.5
10	IM3	-7980	-307.5	70	IOVCC	-3500	-307.5	130	DUMMY9	700	-307.5	190	VGL	4900	-307.5	250	G310	8563	202.5
11	TEST2	-7910	-307.5	71	IOVCC	-3430	-307.5	131	VCL	770	-307.5	191	VGL	4970	-307.5	251	G308	8547	319.5
12	TESTO4	-7840	-307.5	72	IOVCC	-3360	-307.5	132	VCL	840	-307.5	192	VGL	5040	-307.5	252	G306	8531	202.5
13	TESTO5	-7770	-307.5	73	VDDD	-3290	-307.5	133	VCL	910	-307.5	193	VGL	5110	-307.5	253	G304	8515	319.5
14	TESTO6	-7700	-307.5	74	VDDD	-3220	-307.5	134	VCL	980	-307.5	194	VGL	5180	-307.5	254	G302	8499	202.5
15	TESTO7	-7630	-307.5	75	VDDD	-3150	-307.5	135	VCL	1050	-307.5	195	GND	5250	-307.5	255	G300	8483	319.5
16	TESTO8	-7560	-307.5	76	VDDD	-3080	-307.5	136	DDVDH	1120	-307.5	196	GND	5320	-307.5	256	G298	8467	202.5
17	TESTO9	-7490	-307.5	77	VDDD	-3010	-307.5	137	DDVDH	1190	-307.5	197	GND	5390	-307.5	257	G296	8451	319.5
18	TESTO10	-7420	-307.5	78	VDDD	-2940	-307.5	138	DDVDH	1260	-307.5	198	VGH	5460	-307.5	258	G294	8435	202.5
19	nRESET	-7350	-307.5	79	VDDD	-2870	-307.5	139	DDVDH	1330	-307.5	199	VGH	5530	-307.5	259	G292	8419	319.5
20	nRESET	-7280	-307.5	80	VDDD	-2800	-307.5	140	DDVDH	1400	-307.5	200	VGH	5600	-307.5	260	G290	8403	202.5
21	VSYNC	-7210	-307.5	81	VDDD	-2730	-307.5	141	DDVDH	1470	-307.5	201	VGH	5670	-307.5	261	G288	8387	319.5
22	HSYNC	-7140	-307.5	82	VDDD	-2660	-307.5	142	VCI1	1540	-307.5	202	VGH	5740	-307.5	262	G286	8371	202.5
23	DOTCLK	-7070	-307.5	83	VDDD	-2590	-307.5	143	VCI1	1610	-307.5	203	VGH	5810	-307.5	263	G284	8355	319.5
24	ENABLE	-7000	-307.5	84	DUMMY3	-2520	-307.5	144	VCI1	1680	-307.5	204	DUMMY12	5880	-307.5	264	G282	8339	202.5
25	DB17	-6905	-307.5	85	GND	-2450	-307.5	145	VCI	1750	-307.5	205	DUMMY13	5950	-307.5	265	G280	8323	319.5
26	DB16	-6825	-307.5	86	GND	-2380	-307.5	146	VCI	1820	-307.5	206	C13-	6020	-307.5	266	G278	8307	202.5
27	DB15	-6745	-307.5	87	GND	-2310	-307.5	147	VCI	1890	-307.5	207	C13-	6090	-307.5	267	G276	8291	319.5
28	DB14	-6665	-307.5	88	GND	-2240	-307.5	148	VCI	1960	-307.5	208	C13-	6160	-307.5	268	G274	8275	202.5
29	DB13	-6585	-307.5	89	GND	-2170	-307.5	149	VCI	2030	-307.5	209	C13-	6230	-307.5	269	G272	8259	319.5
30	TESTO11	-6495	-307.5	90	GND	-2100	-307.5	150	VCI	2100	-307.5	210	C13+	6300	-307.5	270	G270	8243	202.5
31	DB12	-6405	-307.5	91	GND	-2030	-307.5	151	VCI	2170	-307.5	211	C13+	6370	-307.5	271	G268	8227	319.5
32	DB11	-6325	-307.5	92	GND	-1960	-307.5	152	VCI	2240	-307.5	212	C13+	6440	-307.5	272	G266	8211	202.5
33	DB10	-6245	-307.5	93	VGS	-1890	-307.5	153	VCI	2310	-307.5	213	C13+	6510	-307.5	273	G264	8195	319.5
34	DB9	-6165	-307.5	94	VGS	-1820	-307.5	154	VCI	2380	-307.5	214	C21-	6580	-307.5	274	G262	8179	202.5
35	DB8	-6085	-307.5	95	GND	-1750	-307.5	155	VCI	2450	-307.5	215	C21-	6650	-307.5	275	G260	8163	319.5
36	TEST3	-5990	-307.5	96	GND	-1680	-307.5	156	VCI	2520	-307.5	216	C21-	6720	-307.5	276	G258	8147	202.5
37	TESTO12	-5920	-307.5	97	GND	-1610	-307.5	157	VCI	2590	-307.5	217	C21-	6790	-307.5	277	G256	8131	319.5
38	DB7	-5825	-307.5	98	GND	-1540	-307.5	158	VCI	2660	-307.5	218	C21-	6860	-307.5	278	G254	8115	202.5
39	DB6	-5745	-307.5	99	GND	-1470	-307.5	159	VCI	2730	-307.5	219	C21-	6930	-307.5	279	G252	8099	319.5
40	DB5	-5665	-307.5	100	GND	-1400	-307.5	160	VCI	2800	-307.5	220	C21-	7000	-307.5	280	G250	8083	202.5
41	DB4	-5585	-307.5	101	GND	-1330	-307.5	161	VCI	2870	-307.5	221	C21+	7070	-307.5	281	G248	8067	319.5
42	DB3	-5505	-307.5	102	GND	-1260	-307.5	162	VCI	2940	-307.5	222	C21+	7140	-307.5	282	G246	8051	202.5
43	DB2	-5425	-307.5	103	GND	-1190	-307.5	163	DUMMY10	3010	-307.5	223	C21+	7210	-307.5	283	G244	8035	319.5
44	DB1	-5345	-307.5	104	GND	-1120	-307.5	164	DUMMY11	3080	-307.5	224	C21+	7280	-307.5	284	G242	8019	202.5
45	DB0	-5265	-307.5	105	DUMMY4	-1050	-307.5	165	C12-	3150	-307.5	225	C21+	7350	-307.5	285	G240	8003	319.5
46	TESTO13	-5180	-307.5	106	DUMMY5	-980	-307.5	166	C12-	3220	-307.5	226	C21+	7420	-307.5	286	G238	7987	202.5
47	SDO	-5110	-307.5	107	DUMMY6	-910	-307.5	167	C12-	3290	-307.5	227	C21+	7490	-307.5	287	G236	7971	319.5
48	SDI	-5040	-307.5	108	VCOM	-840	-307.5	168	C12-	3360	-307.5	228	C22-	7560	-307.5	288	G234	7955	202.5
49	nRD	-4970	-307.5	109	VCOM	-770	-307.5	169	C12-	3430	-307.5	229	C22-	7630	-307.5	289	G232	7939	319.5
50	nWR/SCL	-4900	-307.5	110	VCOM	-700	-307.5	170	C12+	3500	-307.5	230	C22-	7700	-307.5	290	G230	7923	202.5
51	RS	-4830	-307.5	111	VCOM	-630	-307.5	171	C12+	3570	-307.5	231	C22-	7770	-307.5	291	G228	7907	319.5
52	nCS	-4760	-307.5	112	VCOM	-560	-307.5	172	C12+	3640	-307.5	232	C22-	7840	-307.5	292	G226	7891	202.5
53	TESTO14	-4690	-307.5	113	VCOM	-490	-307.5	173	C12+	3710	-307.5	233	C22-	7910	-307.5	293	G224	7875	319.5
54	TESTO15	-4620	-307.5	114	VCOM	-420	-307.5	174	C12+	3780	-307.5	234	C22-	7980	-307.5	294	G222	7859	202.5
55	FMARK	-4550	-307.5	115	VCOMH	-350	-307.5	175	C11-	3850	-307.5	235	C22+	8050	-307.5	295	G220	7843	319.5
56	TESTO16	-4480	-307.5	116	VCOMH	-280	-307.5	176	C11-	3920	-307.5	236	C22+	8120	-307.5	296	G218	7827	202.5
57	TS8	-4410	-307.5	117	VCOMH	-210	-307.5	177	C11-	3990	-307.5	237	C22+	8190	-307.5	297	G216	7811	319.5
58	TS7	-4340	-307.5	118	VCOMH	-140	-307.5	178	C11-	4060	-307.5	238	C22+	8260	-307.5	298		7795	202.5
59	TS6	-4270	-307.5	119	VCOMH	-70	-307.5	179	C11-	4130	-307.5	239	C22+	8330	-307.5	299		7779	319.5
60	TS5	-4200	-307.5	120	VCOMH	0	-307.5	180	C11+	4200	-307.5	240	C22+	8400	-307.5	300	G210	7763	202.5
00	100	7200	001.0	120	A OOIAII I	v	551.5	100	J.11	7200	501.5	240	JLLT	U-100	551.5	500	J2 10	, , , , ,	202.0



No	Nama	Х	Υ	No.	Nama	х	Υ	No	Name	х	Y	No	Nama	х	Y	No	Name	х	Υ
No. 301	Name G208	7747	319.5	361	Name G88	6787	319.5	No. 421	Name S706	5807	202.5	No. 481	Name S646	4847	202.5	No . 541	Name S586	3887	202.5
302	G206	7731	202.5	362	G86	6771	202.5	422	S705	5791	319.5	482	S645	4831	319.5	542	S585	3871	319.5
303	G204	7715	319.5	363	G84	6755	319.5	423	S703	5775	202.5	483	S644	4815	202.5	543	S584	3855	202.5
304	G204 G202	7699	202.5	364	G82	6739	202.5	424	S704	5759	319.5	484	S643	4799	319.5	544	S583	3839	319.5
305	G202	7683	319.5	365	G80	6723	319.5	425	S703	5743	202.5	485	S642	4783	202.5	545	S582	3823	202.5
306	G200	7667	202.5	366	G78	6707	202.5		S702	5727	319.5		S641		319.5	546	S581	3807	
307	G196	7651	319.5	367	G76	6691	319.5	426	S701	5711	202.5	486	S640	4767 4751	202.5	547	S580	3791	319.5 202.5
308	G194	7635	202.5	368	G74	6675	202.5	428	S699	5695	319.5	488	S639	4735	319.5	548	S579	3775	319.5
309	G194	7619	319.5	369	G72	6659	319.5	429	S698	5679	202.5	489	S638	4719	202.5	549	S578	3759	202.5
310	G190	7603	202.5	370	G70	6643	202.5	430	S697	5663	319.5	490	S637	4703	319.5	550	S577	3743	319.5
311	G188	7587	319.5	371	G68	6627	319.5	431	S696	5647	202.5	491	S636	4687	202.5	551	S576	3727	202.5
312	G186	7571	202.5	372	G66	6611	202.5	432	S695	5631	319.5	492	S635	4671	319.5	552	S575	3711	319.5
313	G184	7555	319.5	373	G64	6595	319.5	433	S694	5615	202.5	493	S634	4655	202.5	553	S574	3695	202.5
314	G182	7539	202.5	374	G62	6579	202.5	434	S693	5599	319.5	494	S633	4639	319.5	554	S573	3679	319.5
315	G180	7523	319.5	375	G60	6563	319.5	435	S692	5583	202.5	495	S632	4623	202.5	555	S572	3663	202.5
316	G178	7507	202.5	376	G58	6547	202.5	436	S691	5567	319.5	496	S631	4607	319.5	556	S571	3647	319.5
317	G176	7491	319.5	377	G56	6531	319.5	437	S690	5551	202.5	497	S630	4591	202.5	557	S570	3631	202.5
318	G174	7475	202.5	378	G54	6515	202.5	438	S689	5535	319.5	498	S629	4575	319.5	558	S569	3615	319.5
319	G172	7459	319.5	379	G52	6499	319.5	439	S688	5519	202.5	499	S628	4559	202.5	559	S568	3599	202.5
320	G170	7443	202.5	380	G50	6483	202.5	440	S687	5503	319.5	500	S627	4543	319.5	560	S567	3583	319.5
321	G168	7427	319.5	381	G48	6467	319.5	441	S686	5487	202.5	501	S626	4527	202.5	561	S566	3567	202.5
322	G166	7411	202.5	382	G46	6451	202.5	442	S685	5471	319.5	502	S625	4511	319.5	562	S565	3551	319.5
323	G164	7395	319.5	383	G44	6435	319.5	443	S684	5455	202.5	503	S624	4495	202.5	563	S564	3535	202.5
324	G162	7379	202.5	384	G42	6419	202.5	444	S683	5439	319.5	504	S623	4479	319.5	564	S563	3519	319.5
325	G160	7363	319.5	385	G40	6403	319.5	445	S682	5423	202.5	505	S622	4463	202.5	565	S562	3503	202.5
326	G158	7347	202.5	386	G38	6387	202.5	446	S681	5407	319.5	506	S621	4447	319.5	566	S561	3487	319.5
327	G156	7331	319.5	387	G36	6371	319.5	447	S680	5391	202.5	507	S620	4431	202.5	567	S560	3471	202.5
328	G154	7315	202.5	388	G34	6355	202.5	448	S679	5375	319.5	508	S619	4415	319.5	568	S559	3455	319.5
329	G152	7299	319.5	389	G32	6339	319.5	449	S678	5359	202.5	509	S618	4399	202.5	569	S558	3439	202.5
330	G150	7283	202.5	390	G30	6323	202.5	450	S677	5343	319.5	510	S617	4383	319.5	570	S557	3423	319.5
331	G148	7267	319.5	391	G28	6307	319.5	451	S676	5327	202.5	511	S616	4367	202.5	571	S556	3407	202.5
332	G146	7251	202.5	392	G26	6291	202.5	452	S675	5311	319.5	512	S615	4351	319.5	572	S555	3391	319.5
333	G144	7235	319.5	393	G24	6275	319.5	453	S674	5295	202.5	513	S614	4335	202.5	573	S554	3375	202.5
334	G142	7219	202.5	394	G22	6259	202.5	454	S673	5279	319.5	514	S613	4319	319.5	574	S553	3359	319.5
335	G140	7203	319.5	395	G20	6243	319.5	455	S672	5263	202.5	515	S612	4303	202.5	575	S552	3343	202.5
336	G138	7187	202.5	396	G18	6227	202.5	456	S671	5247	319.5	516	S611	4287	319.5	576	S551	3327	319.5
337	G136	7171	319.5	397	G16	6211	319.5	457	S670	5231	202.5	517	S610	4271	202.5	577	S550	3311	202.5
338	G134	7155	202.5	398	G14	6195	202.5	458	S669	5215	319.5	518	S609	4255	319.5	578	S549	3295	319.5
339	G132	7139	319.5	399	G12	6179	319.5	459	S668	5199	202.5	519	S608	4239	202.5	579	S548	3279	202.5
340	G130	7123	202.5	400	G10	6163	202.5	460	S667	5183	319.5	520	S607	4223	319.5	580	S547	3263	319.5
341	G128	7107	319.5	401	G8	6147	319.5	461	S666	5167	202.5	521	S606	4207	202.5	581	S546	3247	202.5
342	G126	7091	202.5	402	G6	6131	202.5	462	S665	5151	319.5	522	S605	4191	319.5	582	S545	3231	319.5
343	G124	7075	319.5	403	G4	6115	319.5	463	S664	5135	202.5	523	S604	4175	202.5	583	S544	3215	202.5
344	G122	7059	202.5	404	G2	6099	202.5	464	S663	5119	319.5	524	S603	4159	319.5	584	S543	3199	319.5
345	G120	7043	319.5	405	DUMMY21	6083	319.5	465	S662	5103	202.5	525	S602	4143	202.5	585	S542	3183	202.5
346	G118	7027	202.5	406	DUMMY22	6047	319.5	466	S661	5087	319.5	526	S601	4127	319.5	586	S541	3167	319.5
347	G116	7011	319.5	407	S720	6031	202.5	467	S660	5071	202.5	527	S600	4111	202.5	587	S540	3151	202.5
348	G114	6995	202.5	408	S719	6015	319.5	468	S659	5055	319.5	528	S599	4095	319.5	588	S539	3135	319.5
349	G112	6979	319.5	409	S718	5999	202.5	469	S658	5039	202.5	529	S598	4079	202.5	589	S538	3119	202.5
350	G110	6963	202.5	410	S717	5983	319.5	470	S657	5023	319.5	530	S597	4063	319.5	590	S537	3103	319.5
351	G108	6947	319.5	411	S716	5967	202.5	471	S656	5007	202.5	531	S596	4047	202.5	591	S536	3087	202.5
352	G106	6931	202.5	412	S715	5951	319.5	472	S655	4991	319.5	532	S595	4031	319.5	592	S535	3071	319.5
353	G104	6915	319.5	413	S714	5935	202.5	473	S654	4975	202.5	533	S594	4015	202.5	593	S534	3055	202.5
354	G102	6899	202.5	414	S713	5919	319.5	474	S653	4959	319.5	534	S593	3999	319.5	594	S533	3039	319.5
355	G100	6883	319.5	415	S712	5903	202.5	475	S652	4943	202.5	535	S592	3983	202.5	595	S532	3023	202.5
356 357	G98 G96	6867 6851	202.5 319.5	416	S711 S710	5887 5871	319.5 202.5	476	S651 S650	4927 4911	319.5 202.5	536	S591 S590	3967 3951	319.5 202.5	596 597	S531	3007 2991	319.5
	G96 G94	6835	202.5	417	S710 S709			477	S649		319.5	537	S590 S589	3935	319.5	597	S530	2991	202.5
358 359	G94 G92	6819	319.5	418	S709 S708	5855 5839	319.5 202.5	478	S648	4895 4879	202.5	538	S589 S588	3935	202.5	598	S529 S528	2975	319.5 202.5
360	G92 G90	6803	202.5	420	S706 S707	5823	319.5	480	S647	4863	319.5	540	S587	3903	319.5	600	S526 S527	2959	319.5
300	G90	0003	∠∪∠.5	420	3/0/	J023	J 19.5	460	3047	4003	319.5	540	336 <i>1</i>	3 9 U3	319.5	600	J321	∠943	J 18.5



	S526 S525 S524 S523 S522 S522	2927 2911 2895	Y 202.5 319.5	No. 661	Name S466	X 1967	Y 202 F	No.	Name	Х	Y	No.	Name	Х	Υ	No.	Name	Х	Υ
602 603 604 605 606 607 608 609	\$525 \$524 \$523 \$522	2911		661	S466	1967													
603 604 605 606 607 608 609	S524 S523 S522		319.5				202.5	721	S406	1007	202.5	781	S348	-479	319.5	841	S288	-1439	319.5
604 605 606 607 608 609	S523 S522	2895		662	S465	1951	319.5	722	S405	991	319.5	782	S347	-495	202.5	842	S287	-1455	202.5
605 606 607 608 609	S522		202.5	663	S464	1935	202.5	723	S404	975	202.5	783	S346	-511	319.5	843	S286	-1471	319.5
606 607 608 609		2879	319.5	664	S463	1919	319.5	724	S403	959	319.5	784	S345	-527	202.5	844	S285	-1487	202.5
607 608 609	S521	2863	202.5	665	S462	1903	202.5	725	S402	943	202.5	785	S344	-543	319.5	845	S284	-1503	319.5
608 609		2847	319.5	666	S461	1887	319.5	726	S401	927	319.5	786	S343	-559	202.5	846	S283	-1519	202.5
609	S520	2831	202.5	667	S460	1871	202.5	727	S400	911	202.5	787	S342	-575	319.5	847	S282	-1535	319.5
	S519	2815	319.5	668	S459	1855	319.5	728	S399	895	319.5	788	S341	-591	202.5	848	S281	-1551	202.5
610	S518	2799	202.5	669	S458	1839	202.5	729	S398	879	202.5	789	S340	-607	319.5	849	S280	-1567	319.5
	S517	2783	319.5	670	S457	1823	319.5	730	S397	863	319.5	790	S339	-623	202.5	850	S279	-1583	202.5
611	S516	2767	202.5	671	S456	1807	202.5	731	S396	847	202.5	791	S338	-639	319.5	851	S278	-1599	319.5
612	S515	2751	319.5	672	S455	1791	319.5	732	S395	831	319.5	792	S337	-655	202.5	852	S277	-1615	202.5
	S514	2735	202.5	673	S454	1775	202.5	733	S394	815	202.5	793	S336	-671	319.5	853	S276	-1631	319.5
614	S513	2719	319.5	674	S453	1759	319.5	734	S393	799	319.5	794	S335	-687	202.5	854	S275	-1647	202.5
		2719	202.5	675			202.5					794				1			1
615	S512			\vdash	S452	1743		735	S392	783	202.5		S334	-703	319.5	855	S274	-1663	319.5
616	S511	2687	319.5	676	S451	1727	319.5	736	S391	767	319.5	796	S333	-719	202.5	856	S273	-1679	202.5
617	S510	2671	202.5	677	S450	1711	202.5	737	S390	751	202.5	797	S332	-735	319.5	857	S272	-1695	319.5
618	S509	2655	319.5	678	S449	1695	319.5	738	S389	735	319.5	798	S331	-751	202.5	858	S271	-1711	202.5
619	S508	2639	202.5	679	S448	1679	202.5	739	S388	719	202.5	799	S330	-767	319.5	859	S270	-1727	319.5
620	S507	2623	319.5	680	S447	1663	319.5	740	S387	703	319.5	800	S329	-783	202.5	860	S269	-1743	202.5
621	S506	2607	202.5	681	S446	1647	202.5	741	S386	687	202.5	801	S328	-799	319.5	861	S268	-1759	319.5
622	S505	2591	319.5	682	S445	1631	319.5	742	S385	671	319.5	802	S327	-815	202.5	862	S267	-1775	202.5
623	S504	2575	202.5	683	S444	1615	202.5	743	S384	655	202.5	803	S326	-831	319.5	863	S266	-1791	319.5
624	S503	2559	319.5	684	S443	1599	319.5	744	S383	639	319.5	804	S325	-847	202.5	864	S265	-1807	202.5
625	S502	2543	202.5	685	S442	1583	202.5	745	S382	623	202.5	805	S324	-863	319.5	865	S264	-1823	319.5
626	S501	2527	319.5	686	S441	1567	319.5	746	S381	607	319.5	806	S323	-879	202.5	866	S263	-1839	202.5
627	S500	2511	202.5	687	S440	1551	202.5	747	S380	591	202.5	807	S322	-895	319.5	867	S262	-1855	319.5
628	S499	2495	319.5	688	S439	1535	319.5	748	S379	575	319.5	808	S321	-911	202.5	868	S261	-1871	202.5
629	S498	2479	202.5	689	S438	1519	202.5	749	S378	559	202.5	809	S320	-927	319.5	869	S260	-1887	319.5
630	S497	2463	319.5	690	S437	1503	319.5	750	S377	543	319.5	810	S319	-943	202.5	870	S259	-1903	202.5
631	S496	2447	202.5	691	S436	1487	202.5	751	S376	527	202.5	811	S318	-959	319.5	871	S258	-1919	319.5
632	S495	2431	319.5	692	S435	1471	319.5	752	S375	511	319.5	812	S317	-975	202.5	872	S257	-1935	202.5
633	S494	2415	202.5	693	S434	1455	202.5	753	S374	495	202.5	813	S316	-991		873	S257	-1951	319.5
-				\vdash				-							319.5		1	1	
634	S493	2399	319.5	694	S433	1439	319.5	754	S373	479	319.5	814	S315	-1007	202.5	874	S255	-1967	202.5
635	S492	2383	202.5	695	S432	1423	202.5	755	S372	463	202.5	815	S314	-1023	319.5	875	S254	-1983	319.5
636	S491	2367	319.5	696	S431	1407	319.5	756	S371	447	319.5	816	S313	-1039	202.5	876	S253	-1999	202.5
637	S490	2351	202.5	697	S430	1391	202.5	757	S370	431	202.5	817	S312	-1055	319.5	877	S252	-2015	319.5
638	S489	2335	319.5	698	S429	1375	319.5	758	S369	415	319.5	818	S311	-1071	202.5	878	S251	-2031	202.5
639	S488	2319	202.5	699	S428	1359	202.5	759	S368	399	202.5	819	S310	-1087	319.5	879	S250	-2047	319.5
640	S487	2303	319.5	700	S427	1343	319.5	760	S367	383	319.5	820	S309	-1103	202.5	880	S249	-2063	202.5
641	S486	2287	202.5	701	S426	1327	202.5	761	S366	367	202.5	821	S308	-1119	319.5	881	S248	-2079	319.5
642	S485	2271	319.5	702	S425	1311	319.5	762	S365	351	319.5	822	S307	-1135	202.5	882	S247	-2095	202.5
643	S484	2255	202.5	703	S424	1295	202.5	763	S364	335	202.5	823	S306	-1151	319.5	883	S246	-2111	319.5
644	S483	2239	319.5	704	S423	1279	319.5	764	S363	319	319.5	824	S305	-1167	202.5	884	S245	-2127	202.5
645	S482	2223	202.5	705	S422	1263	202.5	765	S362	303	202.5	825	S304	-1183	319.5	885	S244	-2143	319.5
646	S481	2207	319.5	706	S421	1247	319.5	766	S361	287	319.5	826	S303	-1199	202.5	886	S243	-2159	202.5
647	S480	2191	202.5	707	S420	1231	202.5	767	DUMMY23	271	202.5	827	S302	-1215	319.5	887	S242	-2175	319.5
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649	S478	2159	202.5	709	S418	1199	202.5	769	S360	-287	319.5	829	S300	-1247	319.5	889	S240	-2207	319.5
	S477	2143	319.5	710	S417	1183	319.5	770	S359	-303	202.5	830	S299	-1263	202.5	890	S239	-2223	202.5
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-				711				772								892		-2255	
	S475	2111	319.5	\vdash	S415	1151	319.5	-	S357	-335	202.5	832	S297	-1295	202.5		S237	1	202.5
	S474	2095	202.5	713	S414	1135	202.5	773	S356	-351	319.5	833	S296	-1311	319.5	893	S236	-2271	319.5
	S473	2079	319.5	714	S413	1119	319.5	774	S355	-367	202.5	834	S295	-1327	202.5	894	S235	-2287	202.5
655	S472	2063	202.5	715	S412	1103	202.5	775	S354	-383	319.5	835	S294	-1343	319.5	895	S234	-2303	319.5
656	S471	2047	319.5	716	S411	1087	319.5	776	S353	-399	202.5	836	S293	-1359	202.5	896	S233	-2319	202.5
657	S470	2031	202.5	717	S410	1071	202.5	777	S352	-415	319.5	837	S292	-1375	319.5	897	S232	-2335	319.5
658	S469	2015	319.5	718	S409	1055	319.5	778	S351	-431	202.5	838	S291	-1391	202.5	898	S231	-2351	202.5
659	S468	1999	202.5	719	S408	1039	202.5	779	S350	-447	319.5	839	S290	-1407	319.5	899	S230	-2367	319.5
660	S467	1983	319.5	720	S407	1023	319.5	780	S349	-463	202.5	840	S289	-1423	202.5	900	S229	-2383	202.5

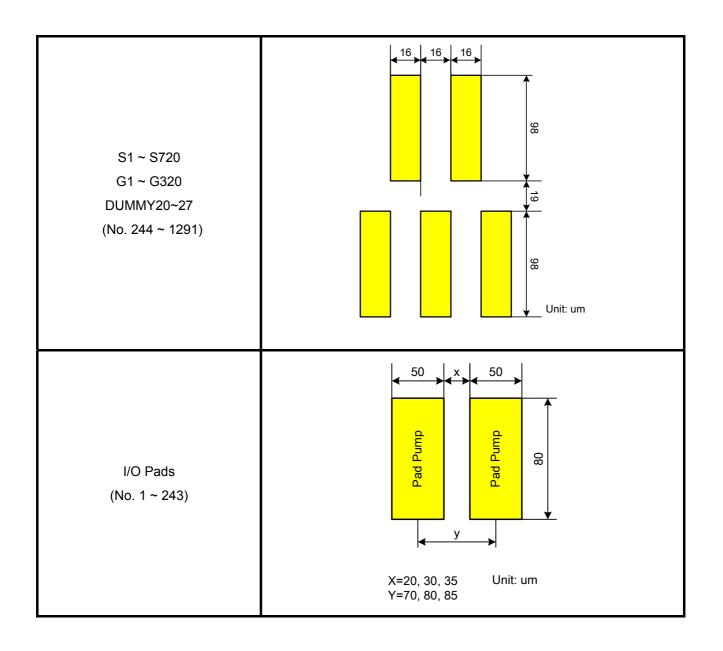


No	Nama	Х	Υ	No	Nama	v	Υ	No	Nama	х	Y	No	Nama	х	Y	No	Nome	х	Υ
No. 901	Name S228	-2399	319.5	No. 961	Name S168	-3359	319.5	No .	Name S108	-4319	319.5	No. 1081	Name S48	-5279	319.5	No. 1141	Name G21	-6259	202.5
902	S227	-2415	202.5	962	S167	-3375	202.5	1021	S100	-4335	202.5	1081	S47	-5295	202.5	1141	G23	-6275	319.5
903	S226	-2413	319.5	963	S166	-3391	319.5	1022	S107	-4351	319.5	1083	S46	-5311	319.5	1143	G25	-6291	202.5
904	S225	-2447	202.5	964	S165	-3407	202.5	1023	S105	-4367	202.5	1084	S45	-5327	202.5	1143	G27	-6307	319.5
905	S223	-2447	319.5	965	S164	-3423	319.5	1024	S103	-4383	319.5	1085	S44	-5343	319.5	1145	G27 G29	-6323	202.5
906	S224	-2479	202.5	966	S163	-3423	202.5	-	S104	-4399	202.5			-5359	202.5	1145	G29 G31	-6339	319.5
907	S223	-2479	319.5	967	S162	-3455	319.5	1026	S103	-4399	319.5	1086	S43 S42	-5375	319.5	1147	G33	-6355	202.5
908	S222	-2493	202.5	968	S161	-3455	202.5	1027	S102	-4415	202.5	1087	S41	-5375	202.5	1147	G35	-6371	319.5
909	S221	-2527	319.5	969	S160	-3487	319.5	1028	S101	-4447	319.5	1089	S40	-5407	319.5	1149	G37	-6387	202.5
910	S219	-2527	202.5	970	S159	-3503	202.5	1029	S99	-4463	202.5	1099	S39	-5423	202.5	1150	G37	-6403	319.5
911	S218	-2559	319.5	971	S158	-3519	319.5	1030	S98	-4479	319.5	1090	S38	-5439	319.5	1151	G39 G41	-6419	202.5
912	S217	-2575	202.5	<u> </u>			202.5	1031	S97			1091	S37		202.5				319.5
\vdash				972	S157	-3535				-4495	202.5			-5455		1152	G43	-6435	
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914	S215	-2607	202.5	974	S155	-3567	202.5	1034	S95	-4527	202.5	1094	S35	-5487	202.5	1154	G47	-6467	319.5
915	S214	-2623	319.5	975	S154	-3583	319.5	1035	S94	-4543	319.5	1095	S34	-5503	319.5	1155	G49	-6483	202.5
916	S213	-2639	202.5	976	S153	-3599	202.5	1036	S93	-4559 4575	202.5	1096	S33	-5519	202.5	1156	G51	-6499	319.5
917	S212	-2655	319.5	977	S152	-3615	319.5	1037	S92	-4575 4501	319.5	1097	S32	-5535	319.5	1157	G53	-6515 6521	202.5
918	S211	-2671	202.5	978	S151	-3631	202.5	1038	S91	-4591 4607	202.5	1098	S31	-5551	202.5	1158	G55	-6531 6547	319.5
919	S210	-2687	319.5	979	S150	-3647	319.5	1039	S90	-4607	319.5	1099	S30	-5567	319.5	1159	G57	-6547	202.5
920	S209	-2703	202.5	980	S149	-3663 -3679	202.5	1040	S89	-4623	202.5	1100	S29	-5583	202.5	1160	G59	-6563 6570	319.5
921	S208	-2719	319.5	981	S148		319.5	1041	S88	-4639	319.5	1101	S28	-5599	319.5	1161	G61	-6579	202.5
922	S207	-2735	202.5	982	S147	-3695	202.5	1042	S87	-4655 4671	202.5	1102	S27	-5615	202.5	1162	G63	-6595 6611	319.5
923	S206	-2751	319.5	983	S146	-3711	319.5	1043	S86	-4671	319.5	1103	S26	-5631	319.5	1163	G65	-6611	202.5
924	S205	-2767	202.5	984	S145	-3727	202.5	1044	S85	-4687	202.5	1104	S25	-5647	202.5	1164	G67	-6627	319.5
925	S204	-2783	319.5	985 986	S144	-3743	319.5	1045	S84	-4703	319.5	1105	S24	-5663	319.5	1165	G69	-6643	202.5
926	S203	-2799	202.5		S143	-3759	202.5	1046	S83	-4719 4725	202.5		S23	-5679	202.5	1166	G71	-6659	319.5
927	S202	-2815 -2831	319.5 202.5	987	S142 S141	-3775 -3791	319.5 202.5	1047	S82 S81	-4735 -4751	319.5	1107	S22 S21	-5695 -5711	319.5	1167	G73 G75	-6675 -6691	202.5 319.5
928 929	S201 S200	-2847	319.5			-3807		-	S80	-4751	319.5	1109	S21	-5727	202.5 319.5		G75	-6707	202.5
930	S199	-2863	202.5	989	S140 S139	-3823	319.5 202.5	1049	S79	-4783	202.5	11109	S19	-5743	202.5	1169	G77	-6723	319.5
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932	S196	-2895	202.5	992	S137	-3855	202.5	1051	S77	-4799 -4815	202.5	1112	S17	-5775	202.5	1171	G83	-6755	319.5
933	S196	-2911	319.5	993	S136	-3871	319.5	1053	S76	-4831	319.5	1113	S16	-5791	319.5	1173	G85	-6771	202.5
934	S195	-2927	202.5	994	S135	-3887	202.5	1054	S75	-4847	202.5	1114	S15	-5807	202.5	1174	G87	-6787	319.5
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938	S191	-2991	202.5	998	S131	-3951	202.5	1058	S71	-4911	202.5	1118	S11	-5871	202.5	1178	G95	-6851	319.5
939	S190	-3007	319.5	999	S130	-3967	319.5	1059	S70	-4927	319.5	1119	S10	-5887	319.5	1179	G97	-6867	202.5
940	S189	-3023	202.5	1000	S129	-3983	202.5	1060	S69	-4943	202.5	1120	S9	-5903	202.5	1180	G99	-6883	319.5
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943	S186	-3071	319.5	1002	S126	-4031	319.5	1063	S66	-4991	319.5	1123	S6	-5951	319.5	1183	G105	-6931	202.5
944	S185	-3087	202.5	1003	S125	-4047	202.5	1064	S65	-5007	202.5	1124	S5	-5967	202.5	1184	G107	-6947	319.5
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947	S182	-3135	319.5	1007	S122	-4095	319.5	1067	S62	-5055	319.5	1127	S2	-6015	319.5	1187	G113	-6995	202.5
948	S181	-3151	202.5	1008	S121	-4111	202.5	1068	S61	-5071	202.5	1128	S1	-6031	202.5	1188	G115	-7011	319.5
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950	S179	-3183	202.5	1010	S119	-4143	202.5	1070	S59	-5103	202.5	1130	DUMMY26	-6083	319.5	1190	G119	-7043	319.5
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955	S174	-3263	319.5	1015	S114	-4223	319.5	1075	S54	-5183	319.5	1135	G9	-6163	202.5	1195	G129	-7123	202.5
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958	S172	-3311	202.5	1017	S111	-4271	202.5	1078	S51	-5231	202.5	1138	G15	-6211	319.5	1198	G135	-7171	319.5
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960	S169	-3343	202.5	1020	S109	-4303	202.5	1080	S49	-5263	202.5	1140	G19	-6243	319.5	1200	G139	-7203	319.5
900	0109	-0040	202.5	1020	0108	-4303	202.5	1000	348	-5203	202.0	1140	919	-0243	318.3	1200	G 138	-1203	018.0



No. Name X Y No. Name X Y		1	ı				1		
1002 G143 -7235 319.5 1262 G263 -8195 319.5 1203 G145 -7251 202.5 1268 G265 -8211 202.5 1204 G147 -7267 319.5 1264 G267 -8227 319.5 1206 G151 -7299 319.5 1266 G271 -8259 319.5 1206 G151 -7299 319.5 1266 G273 -8275 202.5 1208 G155 -7331 319.5 1268 G275 -8291 319.5 1209 G157 -7347 202.5 1269 G277 -8307 202.5 1210 G159 -7363 319.5 1270 G279 -8323 319.5 1211 G161 -7379 202.5 1271 G281 -8339 202.5 1212 G163 -7395 319.5 1272 G283 -8335 319.5 1272 G283 -8335 319.5 1271 G281 -8339 202.5 1212 G163 -7431 202.5 1273 G285 -8371 202.5 1215 G166 -7441 202.5 1275 G289 -8403 202.5 1216 G177 -7427 319.5 1276 G291 -8419 319.5 1276 G291 -8419 319.5 1276 G291 -8419 319.5 1278 G285 -8451 319.5 1279 G297 -8467 202.5 1221 G181 -7557 202.5 1277 G293 -8463 319.5 1218 G175 -7491 319.5 1276 G299 -8463 319.5 1220 G179 -7523 319.5 1280 G299 -8463 319.5 1221 G181 -7553 319.5 1280 G299 -8483 319.5 1222 G183 -7555 319.5 1281 G301 -8499 202.5 1222 G183 -7555 319.5 1281 G301 -8499 202.5 1222 G189 -7635 202.5 1281 G301 -8499 202.5 1222 G189 -7635 202.5 1283 G305 -8531 202.5 1224 G187 -7697 319.5 1288 G311 -8579 319.5 1288 G315 -8611 319.5 1228 G319 -7683 319.5 1288 G311 -8579 319.5 1288 G311 -8579 319.5 1228 G319 -7683 319.5 1288 G315 -8611 319.5 1230 G203 -7763 202.5 1281 G301 -8643 319.5 1230 G203 -7763 202.5 1289 G317 -8627 202.5 1230 G319 -8643 319.5 1230 G203 -7763 202.5 1288 G315 -8611 319.5 1286 G311 -8579 319.5 1286		Name	Х	Y				Х	
1203 G145 -7251 202.5 1264 G267 -8227 319.5 1205 G149 -7283 202.5 1206 G269 -8243 202.5 1206 G151 -7299 319.5 1266 G269 -8243 202.5 1207 G153 -7315 202.5 1266 G271 -8259 319.5 1208 G155 -7331 319.5 1268 G277 -8307 202.5 1209 G157 -7347 202.5 1209 G277 -8307 202.5 1210 G159 -7363 319.5 1209 G277 -8307 202.5 1211 G161 -7379 202.5 1270 G279 -8323 319.5 1211 G161 -7379 202.5 1271 G281 -8339 202.5 1211 G163 -7395 319.5 1272 G283 -8355 319.5 1212 G163 -7395 319.5 1272 G283 -8355 319.5 1216 G177 -7447 319.5 1274 G287 -8347 202.5 1274 G287 -8347 202.5 1274 G287 -8447 319.5 1276 G279 -8403 319.5 1277 G270 -8403 319.5 1278 G270 -8467 202.5 1278 G270 -8467 202.5 1279 G277 -8467 202.5 1221 G181 -7539 202.5 1281 G301 -8489 202.5 1222 G183 -7553 319.5 1282 G303 -8513 319.5 1222 G185 -7537 319.5 1282 G303 -8531 202.5 1222 G183 -7555 319.5 1284 G307 -8543 319.5 1226 G197 -7667 202.5 1286 G311 -8579 319.5 1228 G315 -8611 319.5 1228 G309 -8563 202.5 1228 G317 -8659 202.5 1234 G207 -7767 202.5 1286 G317 -8659 202.5 1236 G217 -7787 319.5 1240 G217 -7787 319.5 1241 G221 -7789 202.5 1242 G233 -7795 202.5 1244 G227 -7907 319.5 1244	-				-				
1204 G147 -7267 319.5 1264 G267 -8227 319.5 1205 G149 -7283 202.5 1266 G269 -8243 202.5 1206 G151 -7299 319.5 1266 G271 -8259 319.5 1208 G155 -7331 319.5 1268 G277 -8275 202.5 1209 G157 -7347 202.5 1269 G277 -8307 202.5 1210 G159 -7363 319.5 1270 G279 -8323 319.5 1211 G161 -7379 202.5 1271 G281 -8339 202.5 1212 G163 -7395 319.5 1270 G279 -8323 319.5 1211 G161 -7379 202.5 1271 G281 -8339 202.5 1213 G165 -7411 202.5 1273 G285 -8371 202.5 1214 G167 -7427 319.5 1274 G287 -8387 319.5 1215 G169 -7443 202.5 1275 G289 -8403 202.5 1216 G171 -7459 319.5 1276 G291 -8419 319.5 1276 G291 -8467 202.5 1279 G297 -8467 202.5 1220 G179 -7523 319.5 1280 G299 -8483 319.5 1220 G179 -7523 319.5 1280 G299 -8483 319.5 1221 G181 -7589 202.5 1281 G301 -8499 202.5 1222 G183 -7558 319.5 1280 G299 -8483 319.5 1222 G183 -7558 319.5 1284 G307 -8547 319.5 1226 G199 -7667 202.5 1283 G309 -8663 202.5 1226 G199 -7667 202.5 1288 G309 -8663 202.5 1226 G199 -7667 202.5 1289 G317 -8677 319.5 1280 G319 -8643 319.5 1220 G197 -7667 202.5 1289 G317 -8677 319.5 1280 G319 -8643 319.5 1220 G319 -7667 202.5 1289 G317 -8677 319.5 1280 G319 -8643 319.5 1280	1202	G143	-7235	319.5	126	2	G263	-8195	319.5
1205 G149 -7283 202.5 1265 G269 -8243 202.5 1206 G151 -7299 319.5 1266 G271 -8259 319.5 1208 G155 -7331 319.5 1268 G275 -8275 202.5 1208 G155 -7331 319.5 1268 G277 -8207 202.5 1209 G157 -7347 202.5 1269 G277 -8307 202.5 1210 G159 -7363 319.5 1270 G279 -8323 319.5 1211 G161 -7379 202.5 1271 G281 -8339 202.5 1212 G163 -7395 319.5 1272 G283 -8355 319.5 1212 G163 -7441 202.5 1273 G285 -8371 202.5 1215 G169 -7443 202.5 1274 G287 -8387 319.5 1274 G287 -8387 319.5 1276 G291 -8419 319.5 1276 G291 -8419 319.5 1276 G291 -8419 319.5 1278 G295 -8451 319.5 1279 G297 -8467 202.5 1220 G179 -7523 319.5 1280 G299 -8483 319.5 1220 G179 -7523 319.5 1280 G299 -8483 319.5 1222 G183 -7555 319.5 1280 G299 -8483 319.5 1222 G183 -7555 319.5 1280 G299 -8483 319.5 1222 G183 -7555 319.5 1280 G303 -8515 319.5 1222 G183 -7565 319.5 1280 G303 -8515 319.5 1222 G183 -7567 202.5 1281 G301 -8499 202.5 1222 G183 -7563 202.5 1281 G301 -8499 202.5 1222 G183 -7663 202.5 1286 G301 -8695 202.5 1280 G311 -8579 319.5 1281 G301 -8643 319.5 1290 G319 -8643 319.5 1290 G319 -8643 319.5 1291 D10MMY27 -8659 202.5 1281 G301 -8049 -8049 -8049 -8049 -8049 -8049 -8049 -8049 -8049 -8049 -8049 -8049 -8049 -8	1203	G145	-7251	202.5	126	3	G265	-8211	202.5
1206 G151 .7299 319.5 1266 G271 .8259 319.5 1207 G153 .7315 202.5 1267 G273 .8275 202.5 1208 G155 .7331 319.5 1268 G275 .8291 319.5 1209 G157 .7347 202.5 1269 G277 .8307 202.5 1210 G169 .7363 319.5 1270 G279 .8323 319.5 1211 G161 .7379 202.5 1271 G281 .8339 202.5 1212 G163 .7395 319.5 1272 G283 .8355 319.5 1213 G165 .7411 202.5 1273 G285 .8371 202.5 1214 G167 .7427 319.5 1274 G287 .8837 319.5 1215 G169 .7443 202.5 1273 G285 .8371 202.5 1216 G171 .7459 319.5 1276 G291 .8419 319.5 1217 G173 .7475 202.5 1277 G293 .8435 202.5 1218 G175 .7491 319.5 1278 G295 .8461 319.5 1220 G179 .7523 319.5 1278 G295 .8461 319.5 1221 G181 .7539 202.5 1279 G297 .8467 202.5 1222 G183 .7555 319.5 1280 G299 .8463 319.5 1222 G183 .7555 319.5 1280 G299 .8463 319.5 1223 G185 .7571 202.5 1281 G301 .8499 202.5 1224 G187 .7587 319.5 1284 G307 .8515 319.5 1225 G189 .7663 202.5 1288 G305 .8531 202.5 1226 G191 .7619 319.5 1286 G311 .8679 319.5 1227 G193 .7635 202.5 1287 G313 .8695 202.5 1228 G195 .7651 319.5 1288 G315 .8611 319.5 1229 G197 .7667 202.5 1289 G317 .8677 202.5 1230 G199 .7683 319.5 1288 G315 .8611 319.5 1231 G201 .7699 202.5 1289 G317 .8679 202.5 1232 G203 .7715 319.5 1288 G315 .8611 319.5 1233 G201 .7632 202.5 1289 G317 .8679 202.5 1234 G207 .7747 319.5 1.5 .8751 2.69 1235 G209 .7763 202.5 .8751 .8751 .869 1236 G211 .7779 319.5 .8751 .869 .8751 .869 1244 G227 .7897 319.5 .8751 .869 .8751 .869 1245 G229 .7983 319.5 .8751 .8751 .869 .8751 .8751 1246	1204	G147	-7267	319.5	126	4	G267	-8227	319.5
1207 G153 .7315 202.5 1267 G273 .8275 202.5 1208 G155 .7331 319.5 1268 G275 .8291 319.5 1209 G157 .7347 202.5 1269 G277 .8307 202.5 1210 G159 .7363 319.5 1270 G279 .8303 319.5 1211 G161 .7379 202.5 1271 G281 .8339 202.5 1212 G163 .7395 319.5 1272 G283 .8355 319.5 1272 G283 .8355 319.5 1213 G165 .7411 202.5 1273 G285 .8371 202.5 1214 G167 .7427 319.5 1274 G287 .8387 319.5 1216 G171 .7459 319.5 1276 G289 .8403 202.5 1218 G175 .7491 319.5 1276 G291 .8419 319.5 1218 G175 .7491 319.5 1278 G295 .8451 319.5 1219 G177 .7507 202.5 1279 G297 .8467 202.5 1220 G179 .7503 319.5 1280 G299 .8483 319.5 1222 G183 .7553 319.5 1280 G299 .8483 319.5 1222 G183 .7553 319.5 1282 G303 .8515 319.5 1222 G183 .7557 202.5 1281 G301 .8499 202.5 1222 G189 .7603 202.5 1283 G305 .8531 202.5 1224 G187 .7587 319.5 1284 G307 .8547 319.5 1222 G189 .7663 202.5 1288 G311 .8579 319.5 1222 G189 .7663 202.5 1288 G311 .8579 319.5 1222 G189 .7663 202.5 1288 G311 .8679 319.5 1228 G191 .7619 319.5 1288 G311 .8679 319.5 1228 G191 .7667 202.5 1288 G311 .8679 202.5 1230 G199 .7683 319.5 1288 G311 .8679 202.5 1230 G199 .7683 319.5 1288 G311 .8679 202.5 1230 G201 .7697 202.5 1289 G317 .8627 202.5 1281 G301 .8641 319.5 1234 G201 .7698 202.5 1289 G317 .8627 202.5 1289 G317 .8627 202.5 1281 G301 .8643 319.5 1284 G307 .8641 319.5 1284	1205	G149	-7283	202.5	126	5	G269	-8243	202.5
1208 G155 -7331 319.5 1268 G275 -8291 319.5 1209 G157 -7347 202.5 1269 G277 -8307 202.5 1210 G159 -7363 319.5 1270 G279 -8323 319.5 1211 G161 -7379 202.5 1271 G281 -8339 202.5 1212 G163 -7395 319.5 1270 G283 -8355 319.5 1213 G165 -7411 202.5 1273 G285 -8371 202.5 1214 G167 -7427 319.5 1274 G287 -8387 319.5 1216 G177 -7449 319.5 1276 G291 -8419 319.5 1216 G177 -7475 202.5 1277 G289 -8443 202.5 1218 G175 -7491 319.5 1278 G299 -8483 319.5 1218 G175 -7491 319.5 1280 G299 -8483 319.5 1220 G179 -7523 319.5 1280 G299 -8483 319.5 1222 G183 -7555 319.5 1282 G303 -8515 319.5 1222 G183 -7557 202.5 1281 G301 -8499 202.5 1222 G183 -7567 202.5 1283 G305 -8531 202.5 1222 G189 -7603 202.5 1285 G309 -8563 202.5 1226 G191 -7619 319.5 1286 G311 -8579 319.5 1228 G195 -7661 319.5 1286 G311 -8579 319.5 1228 G195 -7667 319.5 1280 G319 -8643 319.5 1229 G197 -7667 202.5 1289 G317 -8647 202.5 1229 G197 -7667 202.5 1289 G317 -8671 202.5 1231 G201 -7699 202.5 1291 DUMMY27 -8659 202.5 1231 G201 -7799 202.5 1291 DUMMY27 -8659 202.5 1236 G211 -7779 319.5 1290 G319 -8643 319.5 1291 G314 -8751 269 1224 G223 -7767 202.5 1291 DUMMY27 -8659 202.5 1224 G223 -7875 319.5 1244 G227 -7907 319.5 1245 G229 -7923 202.5 1244 G227 -7907 319.5 1246 G231 -7897 202.5	1206	G151	-7299	319.5	126	3	G271	-8259	319.5
1209 G157 -7347 202.5 1269 G277 -8307 202.5 1210 G159 -7363 319.5 1270 G279 -8323 319.5 1211 G161 -7379 202.5 1271 G281 -8339 202.5 1212 G163 -7395 319.5 1272 G283 -8355 319.5 1213 G165 -7411 202.5 1273 G285 -8351 319.5 1214 G167 -7427 319.5 1274 G287 -8387 319.5 1216 G169 -7443 202.5 1275 G289 -8403 202.5 1216 G171 -7459 319.5 1276 G291 -8419 319.5 1218 G175 -7491 319.5 1278 G295 -8451 319.5 1218 G175 -7491 319.5 1278 G295 -8451 319.5 1219 G177 -7507 202.5 1277 G293 -8457 319.5 1220 G179 -7523 319.5 1280 G299 -8483 319.5 1220 G179 -7523 319.5 1280 G299 -8483 319.5 1222 G183 -7555 319.5 1280 G299 -8483 319.5 1222 G183 -7555 319.5 1282 G303 -8551 319.5 1222 G183 -7557 202.5 1281 G301 -8499 202.5 1222 G183 -7557 202.5 1283 G305 -8531 202.5 1224 G187 -7587 319.5 1284 G307 -8547 319.5 1225 G189 -7663 202.5 1285 G309 -8563 202.5 1226 G191 -7619 319.5 1286 G311 -8679 319.5 1228 G195 -7651 319.5 1288 G315 -8611 319.5 1288 G315 -8611 319.5 1288 G315 -8611 319.5 1289 G317 -8627 202.5 1280 G319 -8643 319.5 1290 G319 -8643 319.5 1290	1207	G153	-7315	202.5	126	7	G273	-8275	202.5
1210	1208	G155	-7331	319.5	126	3	G275	-8291	319.5
1211	1209	G157	-7347	202.5	126	9	G277	-8307	202.5
1212 G163 -7395 319.5 1272 G283 -8355 319.5 1213 G165 -7411 202.5 1273 G285 -8371 202.5 1214 G167 -7427 319.5 1274 G287 -8387 319.5 1216 G171 -7459 319.5 1275 G289 -8403 202.5 1216 G171 -7459 319.5 1277 G293 -8435 202.5 1218 G175 -7491 319.5 1278 G295 -8451 319.5 1219 G177 -7507 202.5 1279 G297 -8467 202.5 1220 G179 -7523 319.5 1280 G299 -8483 319.5 1221 G181 -7539 202.5 1281 G301 -8499 202.5 1222 G183 -7555 319.5 1282 G303 -8515 319.5 1223 G185 -7571 202.5 1283 G305 -8531 202.5 1224 G187 -7587 319.5 1284 G307 -8547 319.5 1226 G199 -7603 202.5 1228 G309 -8563 202.5 1228 G315 -8611 319.5 1229 G317 -7667 202.5 1228 G315 -8611 319.5 1229 G317 -8627 202.5 1230 G199 -7683 319.5 1229 G317 -8627 202.5 1236 G201 -7689 202.5 1291 DUMMY27 -8659 202.5 1236 G211 -7778 319.5 1236 G211 -7778 319.5 1236 G211 -7785 202.5 1238 G211 -7785 202.5 1239 G211 -7785 202.5 1239 G211 -7785 202.5 1231 G201 -7843 319.5 1244 G227 -7887 202.5 1244 G227 -7887 202.5 1244 G227 -7897 202.5 1244 G221 -7889 202.5 1244 G221 -7889 202.5 1244 G223 -7887 202.5 1244 G221 -7889 202.5 1244 G223 -7887 202.5 1244 G223 -7887 202.5 1244 G223 -7887 202.5 1244 G223 -7887 202.5 1245 G239 -8003 319.5 1247 G233 -7967 202.5 1248 G235 -7891 202.5 1255 G249 -8003 319.5 1	1210	G159	-7363	319.5	127)	G279	-8323	319.5
1213 G165 -7411 202.5 1274 G287 -8387 319.5 1214 G167 -7427 319.5 1274 G287 -8387 319.5 1216 G171 -7459 319.5 1276 G291 -8419 319.5 1218 G175 -7491 319.5 1277 G293 -8435 202.5 1218 G175 -7491 319.5 1278 G295 -8451 319.5 1218 G177 -7507 202.5 1279 G297 -8467 202.5 1220 G179 -7523 319.5 1280 G299 -8483 319.5 1221 G181 -7539 202.5 1228 G303 -8515 319.5 1228 G303 -8531 202.5 1224 G187 -7587 319.5 1284 G307 -8547 319.5 1225 G189 -7603 202.5 1284 G307 -8563 202.5 1228 G191 -7619 319.5 1286 G311 -8579 319.5 1229 G197 -7667 202.5 1288 G315 -8611 319.5 1229 G197 -7667 202.5 1289 G317 -8627 202.5 1232 G203 -7763 202.5 1289 G317 -8627 202.5 1232 G203 -7715 319.5 1280 G319 -8643 319.5 1231 G201 -77699 202.5 1290 G319 -8643 319.5 1231 G201 -77699 202.5 1291 DUMMY27 -8659 202.5 1232 G203 -7715 319.5 1290 G319 -8643 319.5 1236 G207 -7747 319.5 1290 G319 -8643 319.5 1236 G207 -7747 319.5 1290 G319 -8643 319.5 1236 G207 -7747 319.5 1244 G227 -7907 319.5 1244 G227 -7907 319.5 1244 G221 -7899 202.5 1244 G221 -7899 202.5 1244 G221 -7899 202.5 1244 G221 -7899 202.5 1244 G221 -7895 202.5 1244 G221 -7895 202.5 1246 G231 -7995 202.5 1246 G231 -7997 202.5 1246 G231 -7997 202.5 1246 G231 -7997 202.5 1246 G231 -7995 202.5 1246 G231 -7995 202.5 1246 G231 -7995 202.5 1246 G231 -7997 202.5 1256 G241 -8099 319.5 1256 G241 -8099 319.5 1256 G241 -8099 319.5 1256 G241 -8099 319.5 1256 G257 -8147 202.5 1256 G257 -8147 202.5	1211	G161	-7379	202.5	127	1	G281	-8339	202.5
1214 G167 -7427 319.5 1274 G287 -8387 319.5 1215 G169 -7443 202.5 1275 G289 -8403 202.5 1216 G171 -7459 319.5 1276 G291 -8419 319.5 1217 G173 -7475 202.5 1277 G293 -8435 202.5 1218 G175 -7491 319.5 1278 G295 -8451 319.5 1219 G177 -7507 202.5 1279 G297 -8467 202.5 1220 G179 -7523 319.5 1280 G299 -8483 319.5 1221 G181 -7539 202.5 1281 G301 -8499 202.5 1223 G185 -7571 202.5 1283 G305 -8531 202.5 1226 G191 -7603 202.5 1284 G307 -8547 319.5 1226 G191 -7619 319.5 1286 G311 -8595 202.5 1228 G303 -8563 202.5 1228 G191 -7661 319.5 1286 G311 -8595 202.5 1228 G313 -8595 202.5 1228 G311 -8579 319.5 1228 G317 -8627 202.5 1229 G197 -7667 202.5 1289 G317 -8627 202.5 1233 G205 -7731 202.5 1290 G319 -8643 319.5 1233 G205 -7731 202.5 1291 DUMMY27 -8659 202.5 1232 G203 -7763 202.5 1291 DUMMY27 -8659 202.5 1236 G211 -7779 319.5 1236 G211 -7795 202.5 1236 G211 -7795 202.5 1236 G211 -7895 202.5 1244 G227 -7907 319.5 1244 G221 -7895 202.5 1246 G233 -7971 319.5 1247 G233 -7955 202.5 1248 G235 -7971 319.5 1244 G221 -7895 202.5 1245 G244 -8019 202.5 1255 G249 -8083 202.5 1256 G249 -8083 202.5 1256 G249 -8083 202.5 1256 G249 -8083 202.5 1256 G251 -8099 319.5 1257 G253 -8115 202.5 1258 G257 -8147 202.5 1258 G257 -8147 202.5	1212	G163	-7395	319.5	127	2	G283	-8355	319.5
1215 G169 -7443 202.5 1276 G289 -8403 202.5 1216 G171 -7459 319.5 1276 G291 -8419 319.5 1217 G173 -7475 202.5 1277 G293 -8435 202.5 1218 G175 -7491 319.5 1278 G295 -8451 319.5 1220 G179 -7523 319.5 1280 G299 -8483 319.5 1221 G181 -7539 202.5 1281 G301 -8499 202.5 1222 G183 -7557 202.5 1283 G305 -8531 202.5 1224 G187 -7587 319.5 1284 G307 -8547 319.5 12226 G189 -7603 202.5 1285 G309 -8563 202.5 1226 G191 -7619 319.5 1286 G311 -8579 319.5 1228 G193	1213	G165	-7411	202.5	127	3	G285	-8371	202.5
1216 G171 7459 319.5 1276 G291 -8419 319.5 1218 G175 -7491 319.5 1278 G295 -8451 319.5 1219 G177 -7507 202.5 1229 G179 -7553 319.5 1280 G299 -8483 319.5 1222 G183 -7555 319.5 1280 G299 -8483 319.5 1222 G183 -7555 319.5 1282 G303 -8515 319.5 1224 G187 -7571 202.5 1283 G305 -8531 202.5 1225 G189 -7671 202.5 1288 G307 -8547 319.5 1226 G191 -7619 319.5 1228 G399 -8563 202.5 1228 G399 -8563 202.5 1228 G399 -7635 202.5 1228 G399 -8563 202.5 1228 G399 -7635 202.5 1228 G399 -8563 202.5 1228 G399 -7667 202.5 1228 G391 -7667 202.5 1228 G391 -8643 319.5 1229 G197 -7667 202.5 1228 G317 -8627 202.5 1231 G201 -7669 202.5 1229 G319 -8643 319.5 1231 G201 -7669 202.5 1229 G319 -8643 319.5 1233 G205 -7731 202.5 1291 DUMMY27 -8659 202.5 1236 G211 -7779 319.5 1236 G211 -7779 319.5 1236 G211 -7779 319.5 1238 G215 -7811 319.5 1244 G221 -7869 202.5 1244 G223 -7875 319.5 1244 G223 -7875 319.5 1244 G223 -7875 319.5 1244 G223 -7861 202.5 1244 G223 -7861 202.5 1244 G223 -7861 202.5 1244 G223 -7861 202.5 12	1214	G167	-7427	319.5	127	4	G287	-8387	319.5
1217 G173 7-475 202.5 1218 G175 7-491 319.5 1219 G177 7-507 202.5 1220 G179 7-523 319.5 1280 G299 -8483 319.5 1221 G181 7-539 202.5 1281 G301 -8499 202.5 1223 G185 7-571 202.5 1282 G303 -8515 319.5 1223 G185 7-571 202.5 1282 G303 -8513 202.5 1226 G189 7-603 202.5 1286 G311 -8579 319.5 1228 G195 7-667 202.5 1286 G311 -8579 319.5 1228 G195 7-667 202.5 1288 G315 -8611 319.5 1229 G197 7-667 202.5 1288 G315 -8611 319.5 1282 G303 -8563 202.5 1228 G195 7-7667 202.5 1287 G313 -8595 202.5 1229 G197 7-667 202.5 1289 G317 -8627 202.5 1230 G199 7-683 319.5 1288 G315 -8611 319.5 1231 G201 7-699 202.5 1229 G319 -8643 319.5 1231 G201 7-799 202.5 1233 G205 7-771 202.5 1233 G205 7-773 202.5 1238 G209 7-763 202.5 1238 G209 7-763 202.5 1239 G217 7-795 202.5 1239 G217 7-787 202.5 1239 G217 7-787 202.5 1239 G217 7-787 202.5 1240 G219 7-7847 319.5 1240 G219 7-7847 319.5 1241 G221 7-7859 202.5 1242 G223 7-785 319.5 1244 G227 7-797 319.5 1245 G228 7-791 319.5 1255 G249 8-803 319.5 1256 G249 8-803 319.5 1256 G249 8-803 319.5 1256 G257 8-813 319.5 1256 G257 8-814 202.5 1257 G257 8-814 202.5	1215	G169	-7443	202.5	127	5	G289	-8403	202.5
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1258 G255 -8131 319.5 1259 G257 -8147 202.5	1256	G251	-8099	319.5					
1259 G257 -8147 202.5	1257	G253	-8115	202.5					
	1258	G255	-8131	319.5					
1260 G259 -8163 319.5	1259	G257	-8147	202.5					
	1260	G259	-8163	319.5					









Version: 0.30

6. Block Description

MPU System Interface

ILI9325 supports three system high-speed interfaces: i80-system high-speed interfaces to 8-, 9-, 16-, 18-bit parallel ports and serial peripheral interface (SPI). The interface mode is selected by setting the IM[3:0] pins.

ILI9325 has a 16-bit index register (IR), an 18-bit write-data register (WDR), and an 18-bit read-data register (RDR). The IR is the register to store index information from control registers and the internal GRAM. The WDR is the register to temporarily store data to be written to control registers and the internal GRAM. The RDR is the register to temporarily store data read from the GRAM. Data from the MPU to be written to the internal GRAM are first written to the WDR and then automatically written to the internal GRAM in internal operation. Data are read via the RDR from the internal GRAM. Therefore, invalid data are read out to the data bus when the ILI9325 read the first data from the internal GRAM. Valid data are read out after the ILI9325 performs the second read operation.

Registers are written consecutively as the register execution time except starting oscillator takes 0 clock cycle.

Registers selection by system interface (8-/9-/16-/18-bit bus width)	180		0
Function	RS	nWR	nRD
Write an index to IR register	0	0	1
Read an internal status	0	1	0
Write to control registers or the internal GRAM by WDR register.	1	0	1
Read from the internal GRAM by RDR register.	1	1	0

Registers selection by the SPI system interface								
Function	R/W	RS						
Write an index to IR register	0	0						
Read an internal status	1	0						
Write to control registers or the internal GRAM by WDR register.	0	1						
Read from the internal GRAM by RDR register. 1								

Parallel RGB Interface

ILI9325 supports the RGB interface and the VSYNC interface as the external interface for displaying a moving picture. When the RGB interface is selected, display operations are synchronized with externally supplied signals, VSYNC, HSYNC, and DOTCLK. In RGB interface mode, data (DB17-0) are written in synchronization with these signals according to the polarity of enable signal (ENABLE) to prevent flicker on display while updating display data.

In VSYNC interface mode, the display operation is synchronized with the internal clock except frame synchronization, where the operation is synchronized with the VSYNC signal. Display data are written to the internal GRAM via the system interface. In this case, there are constraints in speed and method in writing data to the internal RAM. For details, see the "External Display Interface" section. The ILI9325 allows for switching between the external display interface and the system interface by instruction so that the optimum interface is





Version: 0.30

selected for the kind of picture to be displayed on the screen (still and/or moving picture(s)). The RGB interface, by writing all display data to the internal RAM, allows for transferring data only when updating the frames of a moving picture, contributing to low power requirement for moving picture display.

Bit Operation

The ILI9325 supports a write data mask function for selectively writing data to the internal RAM in units of bits and a logical/compare operation to write data to the GRAM only when a condition is met as a result of comparing the data and the compare register bits. For details, see "Graphics Operation Functions".

Address Counter (AC)

The address counter (AC) gives an address to the internal GRAM. When the index of the register for setting a RAM address in the AC is written to the IR, the address information is sent from the IR to the AC. As writing data to the internal GRAM, the address in the AC is automatically updated plus or minus 1. The window address function enables writing data only in the rectangular area arbitrarily set by users on the GRAM.

Graphics RAM (GRAM)

GRAM is graphics RAM storing bit-pattern data of 172,820 (240 x 320x 18/8) bytes with 18 bits per pixel.

Grayscale Voltage Generating Circuit

The grayscale voltage generating circuit generates a liquid crystal drive voltage according to grayscale data set in the γ -correction register to display in 262,144 colors. For details, see the " γ -Correction Register" section.

Timing Controller

The timing generator generates a timing signal for operation of internal circuits such as the internal GRAM. The timing for the display operation such as RAM read operation and the timing for the internal operation such as access from the MPU are generated in the way not to interfere each other.

Oscillator (OSC)

ILI9325 generates RC oscillation with an internal oscillation resistor. The frame rate is adjusted by the register setting.

LCD Driver Circuit

The LCD driver circuit of ILI9325 consists of a 720-output source driver (S1 \sim S720) and a 320-output gate driver (G1 \sim G320). Display pattern data are latched when the 720th bit data are input. The latched data control the source driver and generate a drive waveform. The gate driver for scanning gate lines outputs either VGH or VGL level. The shift direction of 720 source outputs from the source driver is set with the SS bit and the shift direction of gate outputs from the gate driver is set with the GS bit. The scan mode by the gate driver is





set with the SM bit. These bits allow setting an appropriate scan method for an LCD module.

LCD Driver Power Supply Circuit

The LCD drive power supply circuit generates the voltage levels VREG1OUT, VGH, VGL and Vcom for driving an LCD.

Page 24 of 112

Version: 0.30





7. System Interface

7.1. Interface Specifications

ILI9325 has the system interface to read/write the control registers and display graphics memory (GRAM), and the RGB Input Interface for displaying a moving picture. User can select an optimum interface to display the moving or still picture with efficient data transfer. All display data are stored in the GRAM to reduce the data transfer efforts and only the updating data is necessary to be transferred. User can only update a sub-range of GRAM by using the window address function.

ILI9325 also has the RGB interface and VSYNC interface to transfer the display data without flicker the moving picture on the screen. In RGB interface mode, the display data is written into the GRAM through the control signals of ENABLE, VSYNC, HSYNC, DOTCLK and data bus DB[17:0].

In VSYNC interface mode, the internal display timing is synchronized with the frame synchronization signal (VSYNC). The VSYNC interface mode enables to display the moving picture display through the system interface. In this case, there are some constraints of speed and method to write data to the internal RAM.

ILI9325 operates in one of the following 4 modes. The display mode can be switched by the control register. When switching from one mode to another, refer to the sequences mentioned in the sections of RGB and VSYNC interfaces.

Operation Mode	RAM Access Setting (RM)	Display Operation Mode (DM[1:0])
Internal operating clock only (Displaying still pictures)	System interface (RM = 0)	Internal operating clock (DM[1:0] = 00)
RGB interface (1) (Displaying moving pictures)	RGB interface (RM = 1)	RGB interface (DM[1:0] = 01)
RGB interface (2) (Rewriting still pictures while displaying moving pictures)	System interface (RM = 0)	RGB interface (DM[1:0] = 01)
VSYNC interface (Displaying moving pictures)	System interface (RM = 0)	VSYNC interface (DM[1:0] = 01)

Note 1) Registers are set only via the system interface.

Note 2) The RGB-I/F and the VSYNC-I/F are not available simultaneously.

Page 25 of 112

Version: 0.30



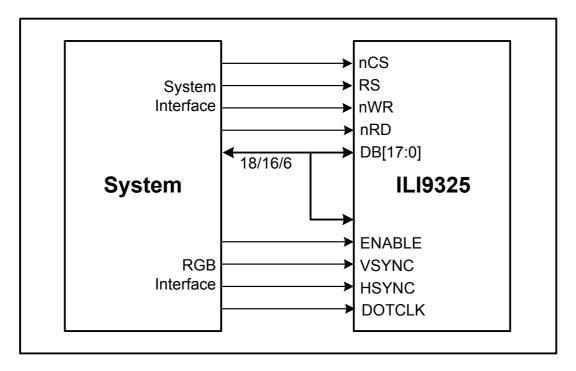


Figure1 System Interface and RGB Interface connection

7.2. Input Interfaces

The following are the system interfaces available with the ILI9325. The interface is selected by setting the IM[3:0] pins. The system interface is used for setting registers and GRAM access.

IM3	IM2	IM1	IM0/ID	Interface Mode	DB Pin
0	0	0	0	Setting invalid	
0	0	0	1	Setting invalid	
0	0	1	0	i80-system 16-bit interface	DB[17:10], DB[8:1]
0	0	1	1	i80-system 8-bit interface	DB[17:10]
0	1	0	ID	Serial Peripheral Interface (SPI)	SDI, SDO (DB[1:0])
0	1	1	*	Setting invalid	
1	0	0	0	Setting invalid	
1	0	0	1	Setting invalid	
1	0	1	0	i80-system18-bit interface	DB[17:0]
1	0	1	1	i80-system 9-bit interface	DB[17:9]
1	1	*	*	Setting invalid	

Page 26 of 112







7.2.1. i80/18-bit System Interface

The i80/18-bit system interface is selected by setting the IM[3:0] as "1010" levels.

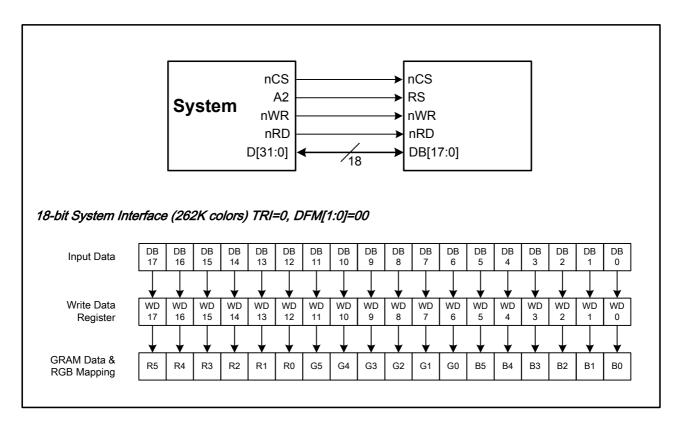


Figure 218-bit System Interface Data Format

Page 27 of 112





7.2.2. i80/16-bit System Interface

The i80/16-bit system interface is selected by setting the IM[3:0] as "0010" levels. The 262K or 65K color can be display through the 16-bit MPU interface. When the 262K color is displayed, two transfers (1st transfer: 2 bits, 2nd transfer: 16 bits or 1st transfer: 16 bits, 2nd transfer: 2 bits) are necessary for the 16-bit CPU interface.

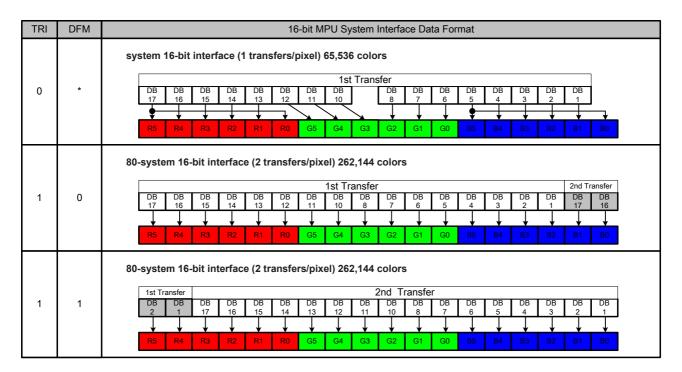


Figure 316-bit System Interface Data Format

Page 28 of 112

Version: 0.30



7.2.3. i80/9-bit System Interface

The i80/9-bit system interface is selected by setting the IM[3:0] as "1011" and the DB17~DB9 pins are used to transfer the data. When writing the 16-bit register, the data is divided into upper byte (8 bits and LSB is not used) lower byte and the upper byte is transferred first. The display data is also divided in upper byte (9 bits) and lower byte, and the upper byte is transferred first. The unused DB[8:0] pins must be tied to either Vcc or GND.

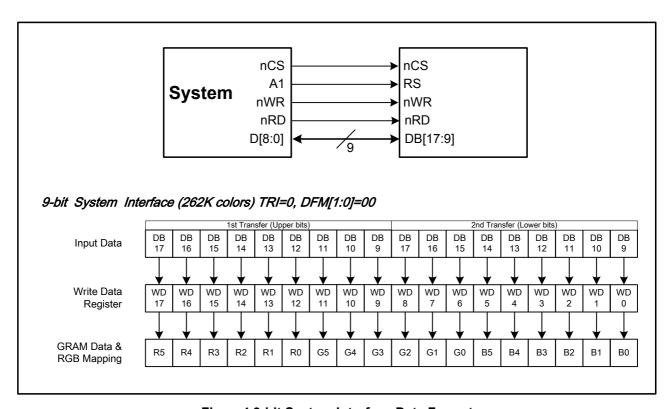


Figure 4 9-bit System Interface Data Format

7.2.4. i80/8-bit System Interface

The i80/8-bit system interface is selected by setting the IM[3:0] as "0011" and the DB17~DB10 pins are used to transfer the data. When writing the 16-bit register, the data is divided into upper byte (8 bits and LSB is not used) lower byte and the upper byte is transferred first. The display data is also divided in upper byte (8 bits) and lower byte, and the upper byte is transferred first. The written data is expanded into 18 bits internally (see the figure below) and then written into GRAM. The unused DB[9:0] pins must be tied to either Vcc or GND.

Page 29 of 112



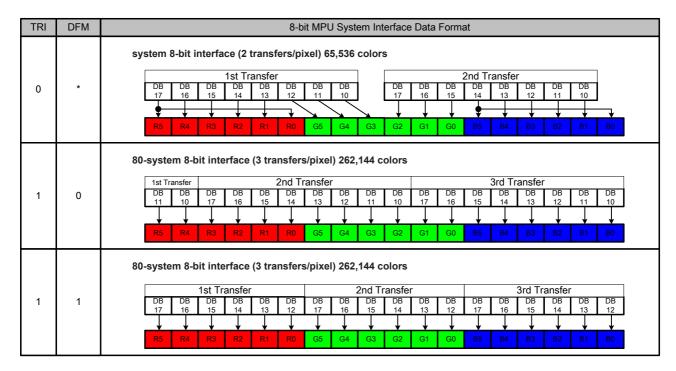


Figure 5 8-bit System Interface Data Format

Data transfer synchronization in 8/9-bit bus interface mode

ILI9325 supports a data transfer synchronization function to reset upper and lower counters which count the transfers numbers of upper and lower byte in 8/9-bit interface mode. If a mismatch arises in the numbers of transfers between the upper and lower byte counters due to noise and so on, the "00"h register is written 4 times consecutively to reset the upper and lower counters so that data transfer will restart with a transfer of upper byte. This synchronization function can effectively prevent display error if the upper/lower counters are periodically reset.

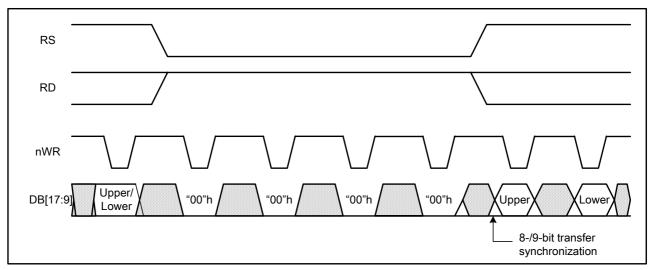


Figure 6 Data Transfer Synchronization in 8/9-bit System Interface

7.3. Serial Peripheral Interface (SPI)

The Serial Peripheral Interface (SPI) is selected by setting the IM[3:0] pins as "010x" level. The chip select pin





(nCS), the serial transfer clock pin (SCL), the serial data input pin (SDI) and the serial data output pin (SDO) are used in SPI mode. The ID pin sets the least significant bit of the identification code. The DB[17:0] pins, which are not used, must be tied to either IOVcc or DGND.

The SPI interface operation enables from the falling edge of nCS and ends of data transfer on the rising edge of nCS. The start byte is transferred to start the SPI interface and the read/write operation and RS information are also included in the start byte. When the start byte is matched, the subsequent data is received by ILI9325.

The seventh bit of start byte is RS bit. When RS = "0", either index write operation or status read operation is executed. When RS = "1", either register write operation or RAM read/write operation is executed. The eighth bit of the start byte is used to select either read or write operation (R/W bit). Data is written when the R/W bit is "0" and read back when the R/W bit is "1".

After receiving the start byte, ILI9325 starts to transfer or receive the data in unit of byte and the data transfer starts from the MSB bit. All the registers of the ILI9325 are 16-bit format and receive the first and the second byte datat as the upper and the lower eight bits of the 16-bit register respectively. In SPI mode, 5 bytes dummy read is necessary and the valid data starts from 6th byte of read back data.

Start Byte Format

Transferred bits	S	1	2	3	4	5	6	7	8
Start byte format	Transfer start			Device	ID code			RS	R/W
		0	1	1	1	0	ID	1/0	1/0

Note: ID bit is selected by setting the IMO/ID pin.

RS and R/W Bit Function

RS	R/W	Function
0	0	Set an index register
0	1	Read a status
1	0	Write a register or GRAM data
1	1	Read a register or GRAM data

Page 31 of 112

Version: 0.30



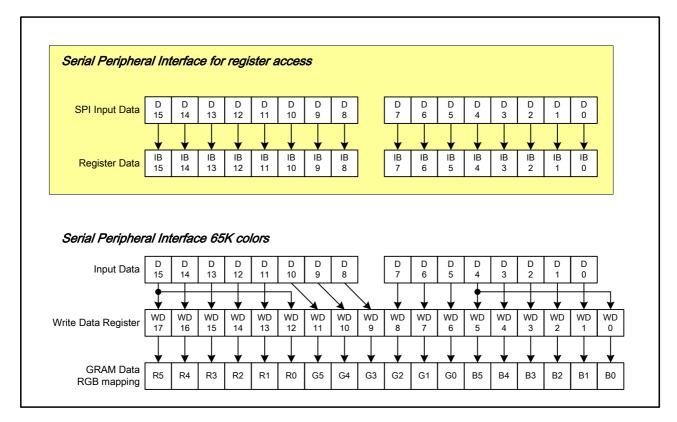


Figure 7 Data Format of SPI Interface

Page 32 of 112



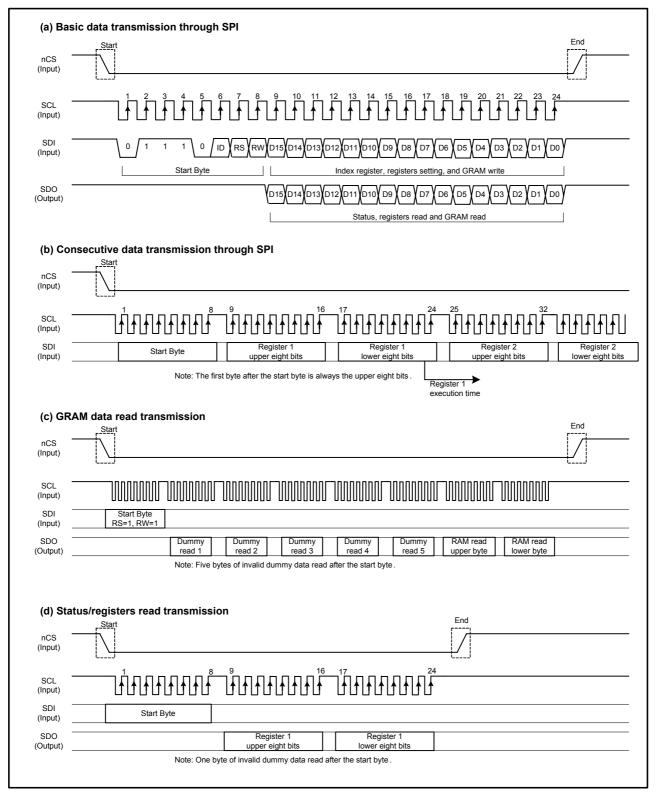


Figure 8 Data transmission through serial peripheral interface (SPI)

Page 33 of 112



Version: 0.30

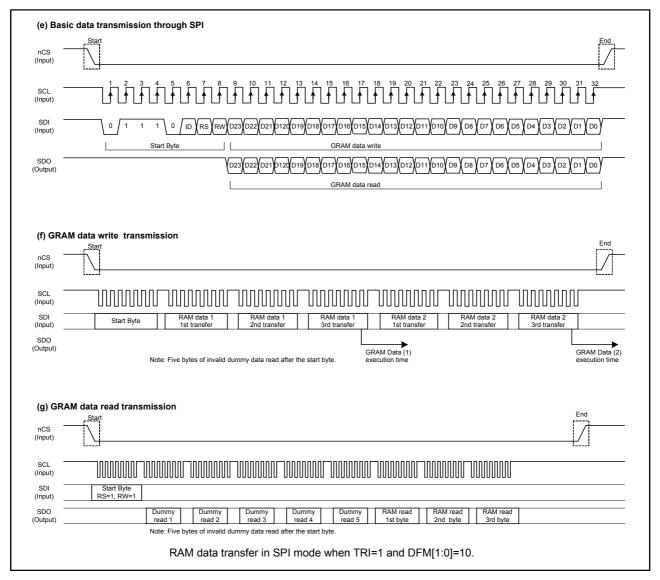


Figure Data transmission through serial peripheral interface (SPI), TRI="1" and DFM="10")



7.4. VSYNC Interface

ILI9325 supports the VSYNC interface in synchronization with the frame-synchronizing signal VSYNC to display the moving picture with the i80 system interface. When the VSYNC interface is selected to display a moving picture, the minimum GRAM update speed is limited and the VSYNC interface is enabled by setting DM[1:0] = "10" and RM = "0".

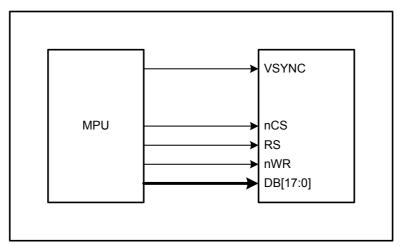


Figure 10 Data transmission through VSYNC interface)

In the VSYNC mode, the display operation is synchronized with the internal clock and VSYNC input and the frame rate is determined by the pulse rate of VSYNC signal. All display data are stored in GRAM to minimize total data transfer required for moving picture display.

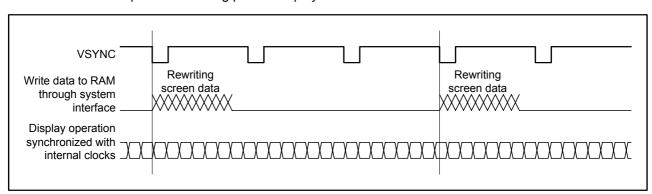


Figure 11 Moving picture data transmission through VSYNC interface

Page 35 of 112



Version: 0.30

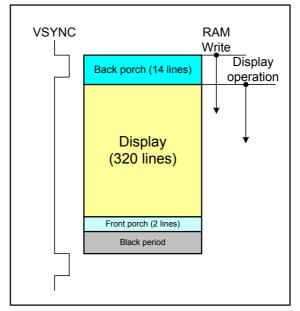


Figure 12 Operation through VSYNC Interface

The VSYNC interface has the minimum speed limitation of writing data to the internal GRAM via the system interface, which are calculated from the following formula.

Internal clock frequency (fosc.) [Hz] = FrameFrequency x (DisplayLine (NL) + FrontPorch (FP) + BackPorch (BP)) x ClockCyclePerLines (RTN) x FrequencyFluctuation.

Note: When the RAM write operation does not start from the falling edge of VSYNC, the time from the falling edge of VSYNC until the start of RAM write operation must also be taken into account.

An example of minimum GRAM writing speed and internal clock frequency in VSYNC interface mode is as below.

[Example]

Display size: 240 RGB × 320 lines Lines: 320 lines (NL = 1000111) Back porch: 14 lines (BP = 1110) Front porch: 2 lines (FP = 0010)

Frame frequency: 60 Hz Frequency fluctuation: 10%

Internal oscillator clock (fosc.) [Hz] = $60 \times [320+2+14] \times 16$ clocks $\times (1.1/0.9) = 394$ KHz





When calculate the internal clock frequency, the oscillator variation is needed to be taken into consideration. In the above example, the calculated internal clock frequency with ±10% margin variation is considered and ensures to complete the display operation within one VSYNC cycle. The causes of frequency variation come from fabrication process of LSI, room temperature, external resistors and VCI voltage variation.

Minimum speed for RAM writing [Hz] > 240 x 320 x 394K / [(14 + 320 − 2)lines x 16clocks] ≒ 5.7 MHz

The above theoretical value is calculated based on the premise that the ILI9325 starts to write data into the internal GRAM on the falling edge of VSYNC. There must at least be a margin of 2 lines between the physical display line and the GRAM line address where data writing operation is performed. The GRAM write speed of 5.7MHz or more will guarantee the completion of GRAM write operation before the ILI9325 starts to display the GRAM data on the screen and enable to rewrite the entire screen without flicker.

Notes in using the VSYNC interface

- 1. The minimum GRAM write speed must be satisfied and the frequency variation must be taken into consideration.
- 2. The display frame rate is determined by the VSYNC signal and the period of VSYNC must be longer than the scan period of an entire display.
- 3. When switching from the internal clock operation mode (DM[1:0] = "00") to the VSYNC interface mode or inversely, the switching starts from the next VSYNC cycle, i.e. after completing the display of the frame.
- 4. The partial display, vertical scroll, and interlaced scan functions are not available in VSYNC interface mode and set the AM bit to "0" to transfer display data.

Page 37 of 112



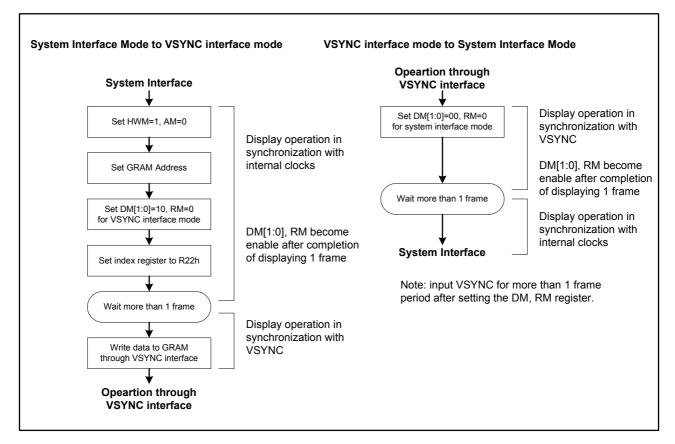


Figure 13 Transition flow between VSYNC and internal clock operation modes

Page 38 of 112





7.5. RGB Input Interface

The RGB Interface mode is available for ILI9325 and the interface is selected by setting the RIM[1:0] bits as following table.

RIM1	RIM0	RGB Interface	DB pins
0	0	18-bit RGB Interface	DB[17:0]
0	1	16-bit RGB Interface	DB[17:13], DB[11:1]
1	0	6-bit RGB Interface	DB[17:12]
1	1	Setting prohibited	

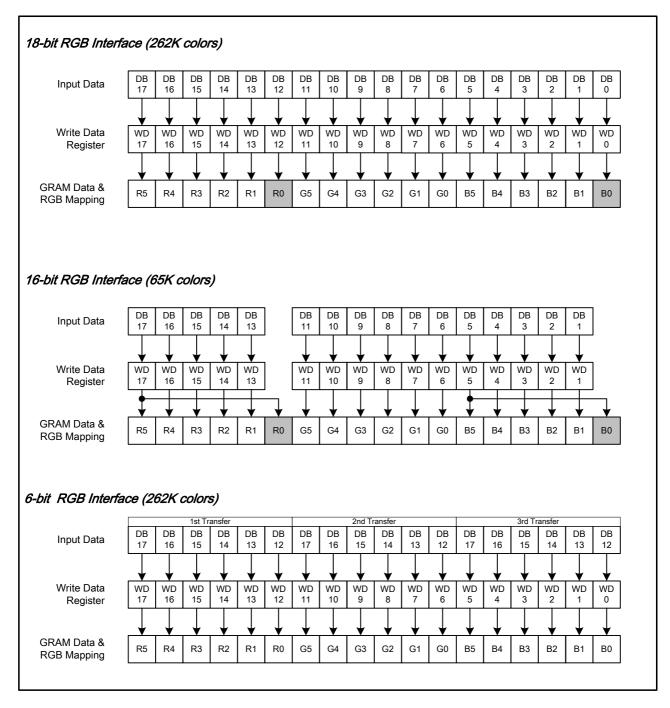


Figure 14 RGB Interface Data Format





7.5.1. RGB Interface

The display operation via the RGB interface is synchronized with the VSYNC, HSYNC, and DOTCLK signals. The RGB interface transfers the updated data to GRAM with the high-speed write function and the update area is defined by the window address function. The back porch and front porch are used to set the RGB interface timing.

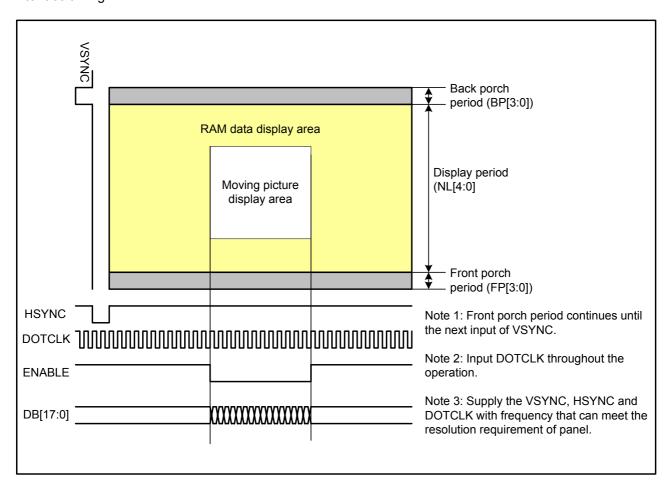


Figure 15 GRAM Access Area by RGB Interface

Page 40 of 112





7.5.2. RGB Interface Timing

The timing chart of 18-/16-bit RGB interface mode is shown as follows.

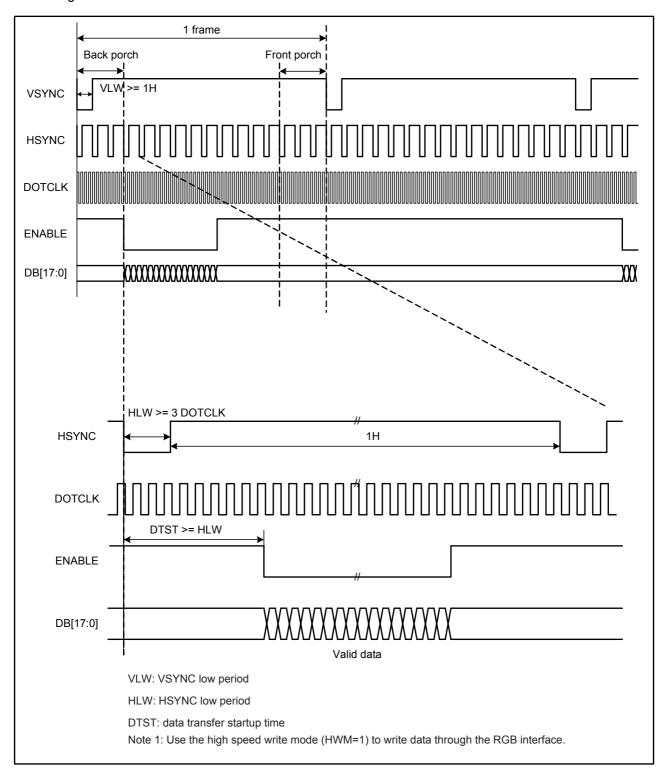


Figure 16 Timing Chart of Signals in 18-/16-bit RGB Interface Mode

Page 41 of 112





The timing chart of 6-bit RGB interface mode is shown as follows.

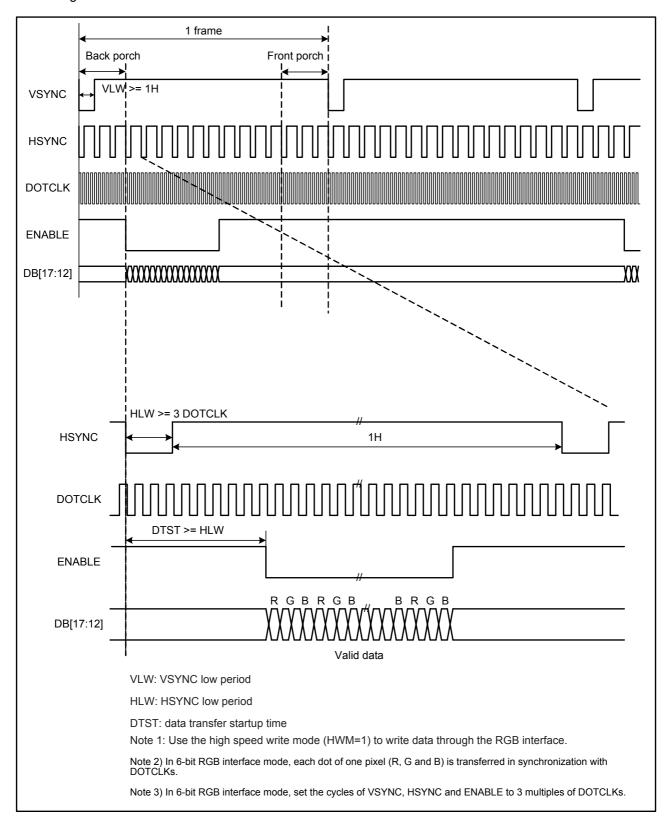


Figure 17 Timing chart of signals in 6-bit RGB interface mode

Page 42 of 112





7.5.3. Moving Picture Mode

ILI9325 has the RGB interface to display moving picture and incorporates GRAM to store display data, which has following merits in displaying a moving picture.

- The window address function defined the update area of GRAM.
- Only the moving picture area of GRAM is updated.
- When display the moving picture in RGB interface mode, the DB[17:0] can be switched as system interface to update still picture area and registers, such as icons.

RAM access via a system interface in RGB-I/F mode

ILI9325 allows GRAM access via the system interface in RGB interface mode. In RGB interface mode, data are written to the internal GRAM in synchronization with DOTCLK and ENABLE signals. When write data to the internal GRAM by the system interface, set ENABLE to terminate the RGB interface and switch to the system interface to update the registers (RM = "0") and the still picture of GRAM. When restart RAM access in RGB interface mode, wait one read/write cycle and then set RM = "1" and the index register to R22h to start accessing RAM via the RGB interface. If RAM accesses via two interfaces conflicts, there is no guarantee that data are written to the internal GRAM.

The following figure illustrates the operation of the ILI9325 when displaying a moving picture via the RGB interface and rewriting the still picture RAM area via the system interface.

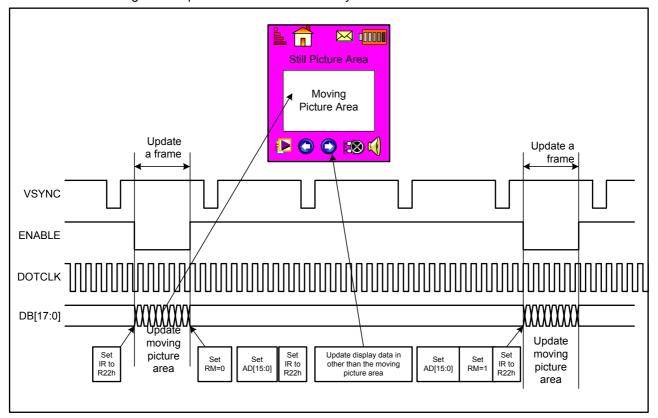


Figure 18 Example of update the still and moving picture

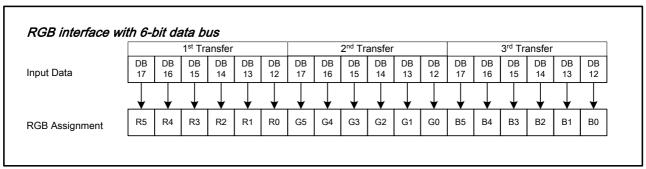
Page 43 of 112





7.5.4. 6-bit RGB Interface

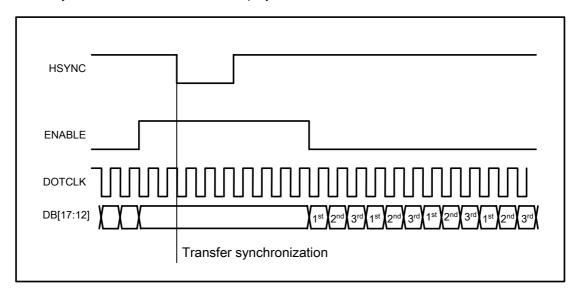
The 6-bit RGB interface is selected by setting the RIM[1:0] bits to "10". The display operation is synchronized with VSYNC, HSYNC, and DOTCLK signals. Display data are transferred to the internal GRAM in synchronization with the display operation via 6-bit RGB data bus (DB[17:12]) according to the data enable signal (ENABLE). Unused pins (DB[11:0]) must be fixed at either IOVcc or DGND level. Registers can be set by the system interface (i80/SPI).



Data transfer synchronization in 6-bit RGB interface mode

ILI9325 has data transfer counters to count the first, second, third data transfers in 6-bit RGB interface mode. The transfer counter is always reset to the state of first data transfer on the falling edge of VSYNC. If a mismatch arises in the number of each data transfer, the counter is reset to the state of first data transfer at the start of the frame (i.e. on the falling edge of VSYNC) to restart data transfer in the correct order from the next frame. This function is expedient for moving picture display, which requires consecutive data transfer in light of minimizing effects from failed data transfer and enabling the system to return to a normal state.

Note that internal display operation is performed in units of pixels (RGB: taking 3 inputs of DOTCLK). Accordingly, the number of DOTCLK inputs in one frame period must be a multiple of 3 to complete data transfer correctly. Otherwise it will affect the display of that frame as well as the next frame.



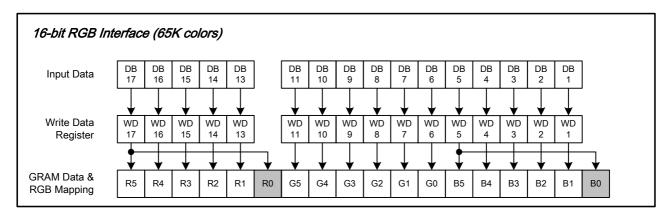
Page 44 of 112





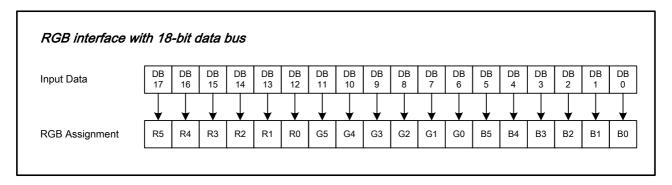
7.5.5. 16-bit RGB Interface

The 16-bit RGB interface is selected by setting the RIM[1:0] bits to "01". The display operation is synchronized with VSYNC, HSYNC, and DOTCLK signals. Display data are transferred to the internal RAM in synchronization with the display operation via 16-bit RGB data bus (DB17-13, DB11-1) according to the data enable signal (ENABLE). Registers are set only via the system interface.



7.5.6. 18-bit RGB Interface

The 18-bit RGB interface is selected by setting the RIM[1:0] bits to "00". The display operation is synchronized with VSYNC, HSYNC, and DOTCLK signals. Display data are transferred to the internal RAM in synchronization with the display operation via 18-bit RGB data bus (DB[17:0]) according to the data enable signal (ENABLE). Registers are set only via the system interface.



Notes in using the RGB Input Interface

1. The following are the functions not available in RGB Input Interface mode.

Function	RGB interface	180 system interface
Partial display	Not available	Available
Scroll function	Not available	Available
Interlaced scan	Not available	Available
Graphics operation function	Not available	Available

- 2. VSYNC, HSYNC, and DOTCLK signals must be supplied throughout a display operation period.
- 3. The periods set with the NO[1:0] bits (gate output non-overlap period), STD[1:0] bits (source output delay period) and EQ[1:0] bits (equalization period) are not based on the internal clock but based on DOTCLK in





RGB interface mode.

- 4. In 6-bit RGB interface mode, each of RGB dots is transferred in synchronization with a DOTCLK input. In other words, it takes 3 DOTCLK inputs to transfer one pixel. Be sure to complete data transfer in units of 3 DOTCLK inputs in 6-bit RGB interface mode.
- 5. In 6-bit RGB interface mode, data of one pixel, which consists of RGB dots, are transferred in units of 3 DOTCLK. Accordingly, set the cycle of each signal in 6-bit interface mode (VSYNC, HSYNC, ENABLE, DB[17:0]) to contain DOTCLK inputs of a multiple of 3 to complete data transfer in units of pixels.
- 6. When switching from the internal operation mode to the RGB Input Interface mode, or the other way around, follow the sequence below.
- 7. In RGB interface mode, the front porch period continues until the next VSYNC input is detected after drawing one frame.
- 8. In RGB interface mode, a RAM address (AD[15:0]) is set in the address counter every frame on the falling edge of VSYNC.

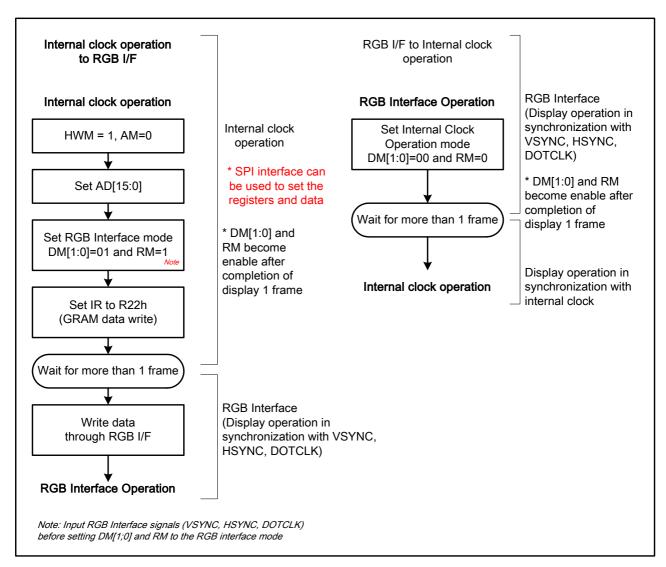


Figure19 Internal clock operation/RGB interface mode switching



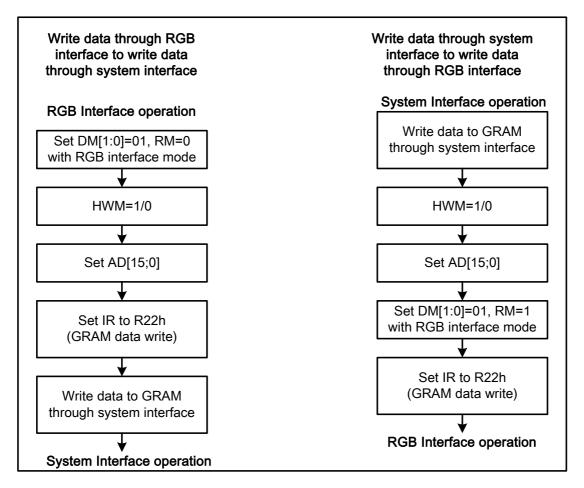


Figure 20 GRAM access between system interface and RGB interface

Page 47 of 112





7.6. Interface Timing

The following are diagrams of interfacing timing with LCD panel control signals in internal operation and RGB interface modes.

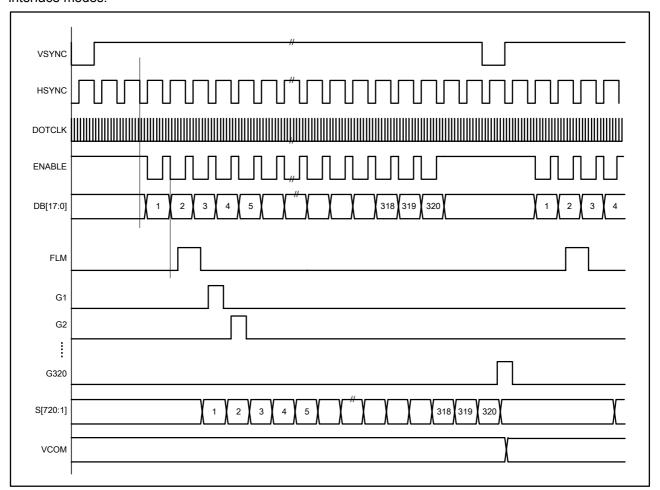


Figure 21 Relationship between RGB I/F signals and LCD Driving Signals for Panel

Page 48 of 112





8. Register Descriptions

8.1. Registers Access

ILI9325 adopts 18-bit bus interface architecture for high-performance microprocessor. All the functional blocks of ILI9325 starts to work after receiving the correct instruction from the external microprocessor by the 18-, 16-, 9-, 8-bit interface. The index register (IR) stores the register address to which the instructions and display data will be written. The register selection signal (RS), the read/write signals (nRD/nWR) and data bus D17-0 are used to read/write the instructions and data of ILI9325. The registers of the ILI9325 are categorized into the following groups.

- 1. Specify the index of register (IR)
- 2. Read a status
- 3. Display control
- 4. Power management Control
- 5. Graphics data processing
- 6. Set internal GRAM address (AC)
- 7. Transfer data to/from the internal GRAM (R22)
- 8. Internal grayscale γ-correction (R30 ~ R39)

Normally, the display data (GRAM) is most often updated, and in order since the ILI9325 can update internal GRAM address automatically as it writes data to the internal GRAM and minimize data transfer by using the window address function, there are fewer loads on the program in the microprocessor. As the following figure shows, the way of assigning data to the 16 register bits (D[15:0]) varies for each interface. Send registers in accordance with the following data transfer format.

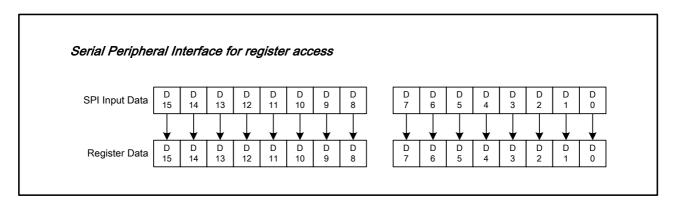


Figure 22 Register Setting with Serial Peripheral Interface (SPI)

Page 49 of 112



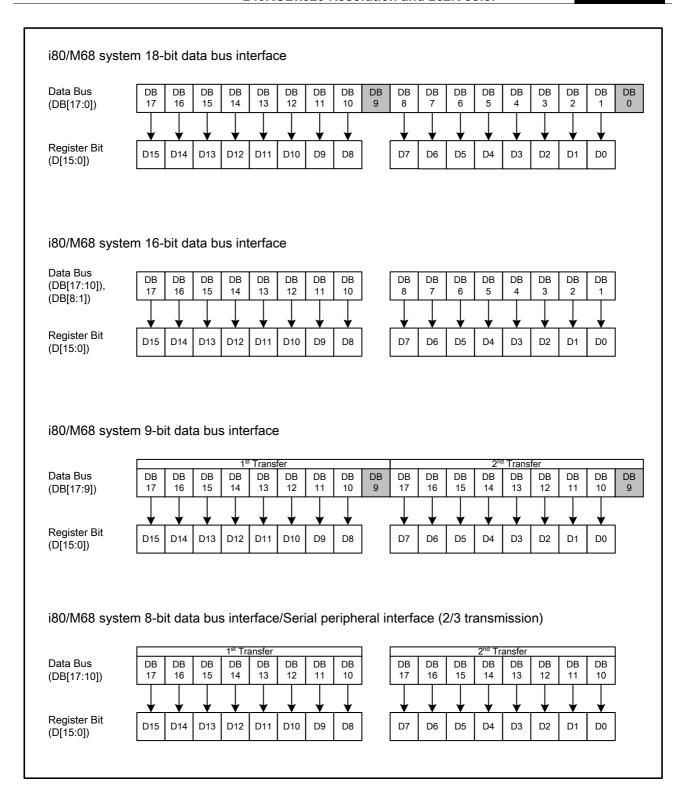


Figure 23 Register setting with i80 System Interface

Page 50 of 112





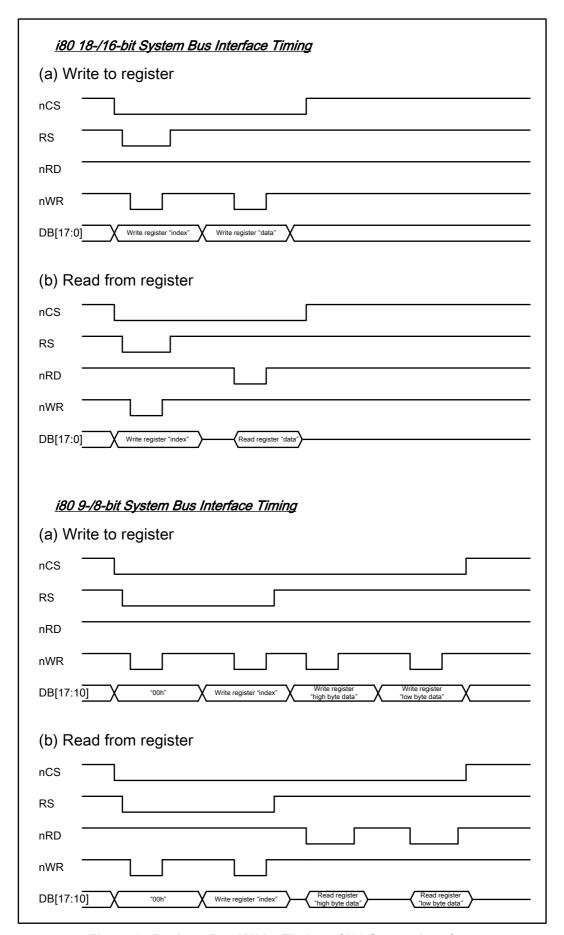


Figure 24 Register Read/Write Timing of i80 System Interface





8.2. Instruction Descriptions

	z. manachom bes		•		1	ı	1		ı	ı	1		ı			1			
No.	Registers Name	R/W	RS	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
IR	Index Register	W	0	-	-	-	-	-	-	-	-	ID7	ID6	ID5	ID4	ID3	ID2	ID1	ID0
00h	Driver Code Read	R	1	1	0	0	1	0	0	1	1	0	0	1	0	0	1	0	1
01h	Driver Output Control 1	W	1	0	0	0	0	0	SM	0	SS	0	0	0	0	0	0	0	0
02h	LCD Driving Control	W	1	0	0	0	0	0	0	BC0	EOR	0	0	0	0	0	0	0	0
03h	Entry Mode	W	1	TRI	DFM	0	BGR	0	0	HWM	0	ORG	0	I/D1	I/D0	AM	0	0	0
04h	Resize Control	W	1	0	0	0	0	0	0	RCV1	RCV0	0	0	RCH1	RCH0	0	0	RSZ1	RSZ0
07h	Display Control 1	W	1	0	0	PTDE1	PTDE0	0	0	0	BASEE	0	0	GON	DTE	CL	0	D1	D0
08h	Display Control 2	W	1	0	0	0	0	FP3	FP2	FP1	FP0	0	0	0	0	BP3	BP2	BP1	BP0
09h	Display Control 3	W	1	0	0	0	0	0	PTS2	PTS1	PTS0	0	0	PTG1	PTG0	ISC3	ISC2	ISC1	ISC0
0Ah	Display Control 4	W	1	0	0	0	0	0	0	0	0	0	0	0	0	FMARKOE	FMI2	FMI1	FMI0
0Ch	RGB Display Interface Control 1	W	1	0	ENC2	ENC1	ENC0	0	0	0	RM	0	0	DM1	DM0	0	0	RIM1	RIM0
0Dh	Frame Maker Position	W	1	0	0	0	0	0	0	0	FMP8	FMP7	FMP6	FMP5	FMP4	FMP3	FMP2	FMP1	FMP0
0Fh	RGB Display Interface Control 2	W	1	0	0	0	0	0	0	0	0	0	0	0	VSPL	HSPL	0	DPL	EPL
10h	Power Control 1	W	1	0	0	0	SAP	0	BT2	BT1	ВТ0	APE	AP2	AP1	AP0	0	DSTB	SLP	STB
11h	Power Control 2	W	1	0	0	0	0	0	DC12	DC11	DC10	0	DC02	DC01	DC00	0	VC2	VC1	VC0
12h	Power Control 3	W	1	0	0	0	0	0	0	0	0	VCIRE	0	0	PON	VRH3	VRH2	VRH1	VRH0
13h	Power Control 4	W	1	0	0	0	VDV4	VDV3	VDV2	VDV1	VDV0	0	0	0	0	0	0	0	0
20h	Horizontal GRAM Address Set	W	1	0	0	0	0	0	0	0	0	AD7	AD6	AD5	AD4	AD3	AD2	AD1	AD0
21h	Vertical GRAM Address Set	W	1	0	0	0	0	0	0	0	AD16	AD15	AD14	AD13	AD12	AD11	AD10	AD9	AD8
22h	Write Data to GRAM	W	1	RAM w	rite data (\	ND17-0) /	read data	(RD17-0) bi	ts are tran	sferred via	different o	data bus li	nes accor	ding to the	selected in	terfaces.			
29h	Power Control 7	W	1	0	0	0	0	0	0	0	0	0	0	VCM5	VCM4	VCM3	VCM2	VCM1	VCM0
2Bh	Frame Rate and Color Control	W	1	0	0	0	0	0	0	0	0	0	0	0	0	FRS[3]	FRS[2]	FRS[1]	FRS[0]
30h	Gamma Control 1	W	1	0	0	0	0	0	KP1[2]	KP1[1]	KP1[0]	0	0	0	0	0	KP0[2]	KP0[1]	KP0[0]
31h	Gamma Control 2	W	1	0	0	0	0	0	KP3[2]	KP3[1]	KP3[0]	0	0	0	0	0	KP2[2]	KP2[1]	KP2[0]
32h	Gamma Control 3	W	1	0	0	0	0	0	KP5[2]	KP5[1]	KP5[0]	0	0	0	0	0	KP4[2]	KP4[1]	KP4[0]
35h	Gamma Control 4	W	1	0	0	0	0	0	RP1[2]	RP1[1]	RP1[0]	0	0	0	0	0	RP0[2]	RP0[1]	RP0[0]
36h	Gamma Control 5	W	1	0	0	0	VRP1[4]	VRP1[3]	VRP1[2]	VRP1[1]	VRP1[0]	0	0	0	0	VRP0[3]	VRP0[2]	VRP0[1]	VRP0[0]
37h	Gamma Control 6	W	1	0	0	0	0	0	KN1[2]	KN1[1]	KN1[0]	0	0	0	0	0	KN0[2]	KN0[1]	KN0[0]
38h	Gamma Control 7	W	1	0	0	0	0	0	KN3[2]	KN3[1]	KN3[0]	0	0	0	0	0	KN2[2]	KN2[1]	KN2[0]
39h	Gamma Control 8	W	1	0	0	0	0	0	KN5[2]	KN5[1]	KN5[0]	0	0	0	0	0	KN4[2]	KN4[1]	KN4[0]
3Ch	Gamma Control 9	W	1	0	0	0	0	0	RN1[2]	RN1[1]	RN1[0]	0	0	0	0	0	RN0[2]	RN0[1]	RN0[0]
3Dh	Gamma Control 10	W	1	0	0	0	VRN1[4]	VRN1[3]	VRN1[2]	VRN1[1]	VRN1[0]	0	0	0	0	VRN0[3]	VRN0[2]	VRN0[1]	VRN0[0]
50h	Horizontal Address Start	W	1	0	0	0	0	0	0	0	0	HSA7	HSA6	HSA5	HSA4	HSA3	HSA2	HSA1	HSA0

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Page 52 of 112 Version: 0.30





No.	Registers Name	R/W	RS	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
	Position																		
51h	Horizontal Address End Position	W	1	0	0	0	0	0	0	0	0	HEA7	HEA6	HEA5	HEA4	HEA3	HEA2	HEA1	HEA0
52h	Vertical Address Start Position	W	1	0	0	0	0	0	0	0	VSA8	VSA7	VSA6	VSA5	VSA4	VSA3	VSA2	VSA1	VSA0
53h	Vertical Address End Position	W	1	0	0	0	0	0	0	0	VEA8	VEA7	VEA6	VEA5	VEA4	VEA3	VEA2	VEA1	VEA0
60h	Driver Output Control 2	W	1	GS	0	NL5	NL4	NL3	NL2	NL1	NL0	0	0	SCN5	SCN4	SCN3	SCN2	SCN1	SCN0
61h	Base Image Display Control	W	1	0	0	0	0	0	0	0	0	0	0	0	0	0	NDL	VLE	REV
6Ah	Vertical Scroll Control	W	1	0	0	0	0	0	0	0	VL8	VL7	VL6	VL5	VL4	VL3	VL2	VL1	VL0
80h	Partial Image 1 Display Position	W	1	0	0	0	0	0	0	0	PTDP08	PTDP07	PTDP06	PTDP05	PTDP04	PTDP03	PTDP02	PTDP01	PTDP00
81h	Partial Image 1 Area (Start Line)	W	1	0	0	0	0	0	0	0	PTSA08	PTSA07	PTSA06	PTSA05	PTSA04	PTSA03	PTSA02	PTSA01	PTSA00
82h	Partial Image 1 Area (End Line)	W	1	0	0	0	0	0	0	0	PTEA08	PTEA07	PTEA06	PTEA05	PTEA04	PTEA03	PTEA02	PTEA01	PTEA00
83h	Partial Image 2 Display Position	W	1	0	0	0	0	0	0	0	PTDP18	PTDP17	PTDP16	PTDP15	PTDP14	PTDP13	PTDP12	PTDP11	PTDP10
84h	Partial Image 2 Area (Start Line)	W	1	0	0	0	0	0	0	0	PTSA18	PTSA17	PTSA16	PTSA15	PTSA14	PTSA13	PTSA12	PTSA11	PTSA10
85h	Partial Image 2 Area (End Line)	W	1	0	0	0	0	0	0	0	PTEA18	PTEA17	PTEA16	PTEA15	PTEA14	PTEA13	PTEA12	PTEA11	PTEA10
90h	Panel Interface Control 1	W	1	0	0	0	0	0	0	DIVI1	DIVI00	0	0	0	0	RTNI3	RTNI2	RTNI1	RTNI0
92h	Panel Interface Control 2	W	1	0	0	0	0	0	NOWI2	NOWI1	NOWI0	0	0	0	0	0	0	0	0
95h	Panel Interface Control 4	W	1	0	0	0	0	0	0	DIVE1	DIVE0	0	0	RTNE5	RTNE4	RTNE3	RTNE2	RTNE1	RTNE0
A1h	OTP VCM Programming Control	W	1	0	0	0	0	OTP_ PGM_EN	0	0	0	0	0	VCM_ OTP5	VCM_ OTP4	VCM_ OTP3	VCM_ OTP2	VCM_ OTP1	VCM_ OTP0
A2h	OTP VCM Status and Enable	W	1	PGM_ CNT1	PGM_ CNT0	VCM_ D5	VCM_ D4	VCM_ D3	VCM_ D2	VCM_ D1	VCM_ D0	0	0	0	0	0	0	0	VCM_ EN
A5h	OTP Programming ID Key	W	1	KEY 15	KEY 14	KEY 13	KEY 12	KEY 11	KEY 10	KEY 9	KEY 8	KEY 7	KEY 6	KEY 5	KEY 4	KEY 3	KEY 2	KEY 1	KEY 0

Page 53 of 112 Version: 0.30





Version: 0.30

8.2.1. Index (IR)

R/W	RS	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
W	0	-	-	į	-	-	-	-	-	ID7	ID6	ID5	ID4	ID3	ID2	ID1	ID0

The index register specifies the address of register (R00h ~ RFFh) or RAM which will be accessed.

8.2.2. Start Oscillation (R00h)

_	R/W	RS	 D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
	W	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
	R	1	1	0	0	1	0	0	1	1	0	0	1	0	0	1	0	1

The device code "9325"h is read out when read this register.

8.2.3. Driver Output Control (R01h)

R/W	RS	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
W	1	0	0	0	0	0	SM	0	SS	0	0	0	0	0	0	0	0

SS: Select the shift direction of outputs from the source driver.

When SS = 0, the shift direction of outputs is from S1 to S720

When SS = 1, the shift direction of outputs is from S720 to S1.

In addition to the shift direction, the settings for both SS and BGR bits are required to change the assignment of R, G, B dots to the source driver pins.

To assign R, G, B dots to the source driver pins from S1 to S720, set SS = 0.

To assign R, G, B dots to the source driver pins from S720 to S1, set SS = 1.

When changing SS or BGR bits, RAM data must be rewritten.

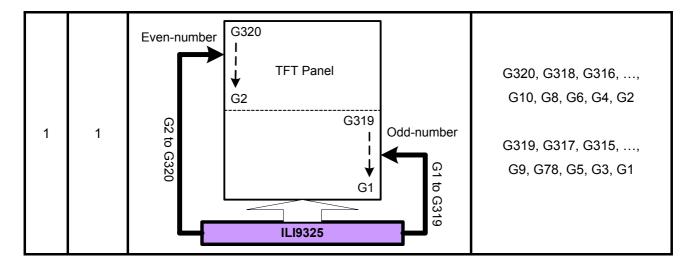
SM: Sets the gate driver pin arrangement in combination with the GS bit (R60h) to select the optimal scan mode for the module.

Page 54 of 112



SM	GS	Scan Direction	Gate Output Sequence
0	0	G320 G319 G318 G317 TFT Panel Odd-number G2 to G3 G2 G1 ILI9325	G1, G2, G3, G4,,G316 G317, G318, G319, G320
0	1	G320 G319 G318 G317 TFT Panel Odd-number G1 to G319 G3 to G319 G1 to G319 G3 to G319 G2 G1 ILl9325	G320, G319, G318,, G6, G5, G4, G3, G2, G1
1	0	G320 TFT Panel G2 G319 Odd-number G1 to G319 G1 G1 G1 G1 G1 G320 G319 Odd-number G1 G1 G1 G1 G320 G319 Odd-number	G1, G3, G5, G7,, G311 G313, G315, G317, G319 G2, G4, G6, G8,, G312 G314, G316, G318, G320





8.2.4. LCD Driving Wave Control (R02h)

R/W	RS	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
W	1	0	0	0	0	0	1	В/С	EOR	0	0	0	0	0	0	0	0

.B/C 0 : Frame/Field inversion

1: Line inversion

EOR: EOR = 1 and B/C=1 to set the line inversion.

8.2.5. Entry Mode (R03h)

R/W	RS	_	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
W	1		TRI	DFM	0	BGR	0	0	HWM	0	ORG	0	I/D1	I/D0	AM	0	0	0

AM Control the GRAM update direction.

When AM = "0", the address is updated in horizontal writing direction.

When AM = "1", the address is updated in vertical writing direction.

When a window area is set by registers R50h ~R53h, only the addressed GRAM area is updated based on I/D[1:0] and AM bits setting.

I/D[1:0] Control the address counter (AC) to automatically increase or decrease by 1 when update one pixel display data. Refer to the following figure for the details.

Page 56 of 112





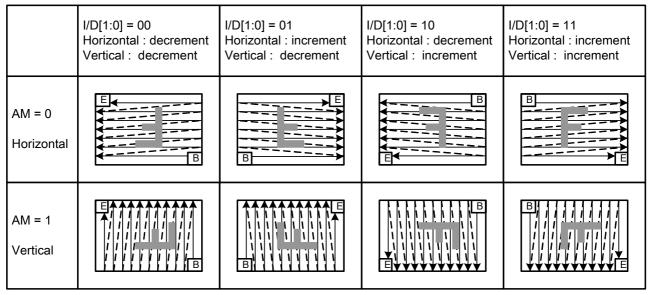


Figure 25 GRAM Access Direction Setting

- **ORG** Moves the origin address according to the ID setting when a window address area is made. This function is enabled when writing data with the window address area using high-speed RAM write.
 - ORG = "0": The origin address is not moved. In this case, specify the address to start write operation according to the GRAM address map within the window address area.
 - ORG = "1": The original address "00000h" moves according to the I/D[1:0] setting.
- Notes: 1. When ORG=1, only the origin address address"00000h" can be set in the RAM address set registers R20h, and R21h.
 - 2. In RAM read operation, make sure to set ORG=0.

BGR Swap the R and B order of written data.

BGR="0": Follow the RGB order to write the pixel data.

BGR="1": Swap the RGB data to BGR in writing into GRAM.

TRI When TRI = "1", data are transferred to the internal RAM in 8-bit x 3 transfers mode via the 8-bit interface. It is also possible to send data via the 16-bit interface or SPI in the transfer mode that realizes display in 262k colors in combination with DFM bits. When not using these interface modes, be sure to set TRI = "0".

DFM Set the mode of transferring data to the internal RAM when TRI = "1". See the following figures for details.

Page 57 of 112



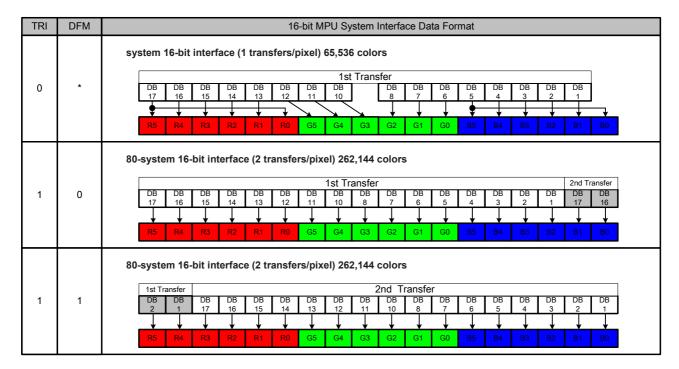


Figure 26 16-bit MPU System Interface Data Format

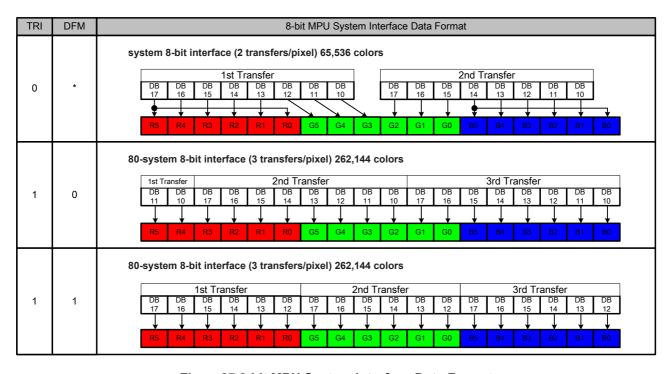


Figure 27 8-bit MPU System Interface Data Format

8.2.6. Resizing Control Register (R04h)

R/W	RS	_	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
W	1		0	0	0	0	0	0	RCV1	RCV0	0	0	RCH1	RCH0	0	0	RSZ1	RSZ0

RSZ[1:0] Sets the resizing factor.

When the RSZ bits are set for resizing, the ILI9325 writes the data according to the resizing factor so that the original image is displayed in horizontal and vertical dimensions, which are contracted





according to the factor respectively. See "Resizing function".

RCH[1:0] Sets the number of remainder pixels in horizontal direction when resizing a picture.

By specifying the number of remainder pixels by RCH bits, the data can be transferred without taking the reminder pixels into consideration. Make sure that RCH = 2'h0 when not using the resizing function (RSZ = 2'h0) or there are no remainder pixels.

RCV[1:0] Sets the number of remainder pixels in vertical direction when resizing a picture.

By specifying the number of remainder pixels by RCV bits, the data can be transferred without taking the reminder pixels into consideration. Make sure that RCV = 2'h0 when not using the resizing function (RSZ = 2'h0) or there are no remainder pixels.

RSZ[1:0]	Resizing factor
00	No resizing (x1)
01	x 1/2
10	Setting prohibited
11	x 1/4

RCH[1:0]	Number of remainder Pixels in Horizontal Direction
00	0 pixel*
01	1 pixel
10	2 pixel
11	3 pixel

RCV[1:0]	Number of remainder Pixels in Vertical Direction
00	0 pixel*
01	1 pixel
10	2 pixel
11	3 pixel

^{*1} pixel = 1RGB

8.2.7. Display Control 1 (R07h)

R/W	RS	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
W	1	0	0	PTDE1	PTDE0	0	0	0	BASEE	0	0	GON	DTE	CL	0	D1	D0

D[1:0] Set D[1:0]="11" to turn on the display panel, and D[1:0]="00" to turn off the display panel.

A graphics display is turned on the panel when writing D1 = "1", and is turned off when writing D1 = "0".

When writing D1 = "0", the graphics display data is retained in the internal GRAM and the ILI9325 displays the data when writing D1 = "1". When D1 = "0", i.e. while no display is shown on the panel, all source outputs becomes the GND level to reduce charging/discharging current, which is generated within the LCD while driving liquid crystal with AC voltage.

When the display is turned off by setting D[1:0] = "01", the ILI9325 continues internal display operation. When the display is turned off by setting D[1:0] = "00", the ILI9325 internal display operation is halted completely. In combination with the GON, DTE setting, the D[1:0] setting controls display ON/OFF.





Version: 0.30

D1	D0	BASEE	Source, VCOM Output	ILI9325 internal operation
0	0	0	GND	Halt
0	1	1	GND	Operate
1	0	0	Non-lit display	Operate
1	1	0	Non-lit display	Operate
1	1	1	Base image display	Operate

Note: 1. data write operation from the microcontroller is performed irrespective of the setting of D[1:0] bits.

- 2. The D[1:0] setting is valid on both 1st and 2nd displays.
- 3. The non-lit display level from the source output pins is determined by instruction (PTS).

CL When CL = "1", the 8-color display mode is selected.

CL	Colors
0	262,144
1	8

GON and DTE Set the output level of gate driver G1 ~ G320 as follows

GON	DTE	G1 ~G320 Gate Output
0	0	VGH
0	1	VGH
1	0	VGL
1	1	Normal Display

BASEE

Base image display enable bit. When BASEE = "0", no base image is displayed. The ILI9325 drives liquid crystal at non-lit display level or displays only partial images. When BASEE = "1", the base image is displayed. The D[1:0] setting has higher priority over the BASEE setting.

PTDE[1:0]

Partial image 2 and Partial image 1 enable bits

PTDE1/0 = 0: turns off partial image. Only base image is displayed.

PTDE1/0 = 1: turns on partial image. Set the base image display enable bit to 0 (BASEE = 0).

8.2.8. Display Control 2 (R08h)

_	R/W	RS	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
	W	1	0	0	0	0	FP3	FP2	FP1	FP0	0	0	0	0	BP3	BP2	BP1	BP0

FP[3:0]/BP[3:0]

The FP[3:0] and BP[3:0] bits specify the line number of front and back porch periods respectively. When setting the FP[3:0] and BP[3:0] value, the following conditions shall be met:

BP + FP ≤ 16 lines

FP ≥ 2 lines

BP ≥ 2 lines

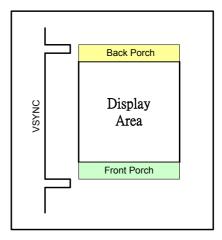




Set the BP[3:0] and FP[3:0] bits as below for each operation modes

Operation Mode	ВР	FP	BP+FP
180 System Interface Operation Mode	BP ≥ 2 lines	FP ≥ 2 lines	FP +BP ≤ 16 lines
RGB interface Operation	BP ≥ 2 lines	FP ≥ 2 lines	FP +BP ≤ 16 lines
VSYNC interface Operation	BP ≥ 2 lines	FP ≥ 2 lines	FP +BP = 16 lines

FP[3:0]	Number of lines for Front Porch
BP[3:0]	Number of lines for Back Porch
0000	Setting Prohibited
0001	Setting Prohibited
0010	2 lines
0011	3 lines
0100	4 lines
0101	5 lines
0110	6 lines
0111	7 lines
1000	8 lines
1001	9 lines
1010	10 lines
1011	11 lines
1100	12 lines
1101	13 lines
1110	14 lines
1111	Setting Prohibited



Note: The output timing to the LCD is delayed by 2 lines period from the input of synchronizing signal.

8.2.9. Display Control 3 (R09h)

R/W	RS	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
W	1	0	0	0	0	0	PTS2	PTS1	PTS0	0	0	PTG1	PTG0	ISC3	ISC2	ISC1	ISC0

ISC[3:0]: Specify the scan cycle interval of gate driver in non-display area when PTG[1:0]="10" to select interval scan. Then scan cycle is set as odd number from 0~29 frame periods. The polarity is inverted every scan cycle.

ISC3	ISC3	ISC3	ISC3	Scan Cycle	f _{FLM} =60 Hz
0	0	0	0	0 frame	-
0	0	0	1	1 frame	17ms
0	0	1	0	3 frame	50ms
0	0	1	1	5 frame	84ms
0	1	0	0	7 frame	117ms
0	1	0	1	9 frame	150ms
0	1	1	0	11 frame	184ms
0	1	1	1	13 frame	217ms
1	0	0	0	15 frame	251ms
1	0	0	1	17 frame	284ms
1	0	1	0	19 frame	317ms
1	0	1	1	21 frame	351ms
1	1	0	0	23 frame	384ms
1	1	0	1	25 frame	418ms
1	1	1	0	27 frame	451ms
1	1	1	1	29 frame	484ms





PTG[1:0] Set the scan mode in non-display area.

PTG1	PTG0	Gate outputs in non-display area	Source outputs in non-display area	Vcom output
0	0	Normal scan	Set with the PTS[2:0] bits	VcomH/VcomL
0	1	Setting Prohibited	-	-
1	0	Interval scan	Set with the PTS[2:0] bits	VcomH/VcomL
1	1	Setting Prohibited	-	-

PTS[2:0]

Set the source output level in non-display area drive period (front/back porch period and blank area between partial displays).

When PTS[2] = 1, the operation of amplifiers which generates the grayscales other than V0 and V63 are halted and the step-up clock frequency becomes half the normal frequency in non-display drive period in order to reduce power consumption.

DTCI2:01	Source ou	utput level	Grayscale amplifier	Stan un alaak fraguanay				
PTS[2:0]	Positive polarity	Negative polarity	in operation	Step-up clock frequency				
000	V63	V0	V63 to V0	Register Setting (DC1, DC0)				
001	Setting Prohibited	Setting Prohibited	-	-				
010	GND	GND GND		Register Setting (DC1, DC0)				
011	Hi-Z	Hi-Z	V63 to V0	Register Setting (DC1, DC0)				
100	V63	V0	V63 and V0	frequency setting by DC1, DC0				
101	Setting Prohibited	Setting Prohibited	-	-				
110	GND	GND	V63 and V0	frequency setting by DC1, DC0				
111	Hi-Z	Hi-Z	V63 and V0	frequency setting by DC1, DC0				

Notes: 1. The power efficiency can be improved by halting grayscale amplifiers and slowing down the step-up clock frequency only in non-display drive period.

8.2.10. Display Control 4 (R0Ah)

R/W	RS	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
W	1	0	0	0	0	0	0	0	0	0	0	0	0	FMARKOE	FMI2	FMI1	FMI0

FMI[2:0] Set the output interval of FMARK signal according to the display data rewrite cycle and data transfer rate.

FMARKOE When FMARKOE=1, ILI9325 starts to output FMARK signal in the output interval set by FMI[2:0] bits.

FMI[2:0]	Output Interval					
000	1 frame					
001	2 frame					
011	4 frame					
101	6 frame					
Others	Setting disabled					

Page 62 of 112

^{2.} The gate output level in non-lit display area drive period is determined by PTG[1:0].





8.2.11. RGB Display Interface Control 1 (R0Ch)

R/W	RS	_	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0	
W	1		0	ENC2	ENC1	ENC0	0	0	0	RM	0	0	DM1	DM0	0	0	RIM1	RIM0	

RIM[1:0] Select the RGB interface data width.

RIM1	RIM0	RGB Interface Mode
0	0	18-bit RGB interface (1 transfer/pixel), DB[17:0]
0	1	16-bit RGB interface (1 transfer/pixel), DB[17:13] and DB[11:1]
1	0	6-bit RGB interface (3 transfers/pixel), DB[17:12]
1	1	Setting disabled

Note1: Registers are set only by the system interface.

Note2: Be sure that one pixel (3 dots) data transfer finished when interface switch.

DM[1:0] Select the display operation mode.

DM1	DM0	Display Interface
0	0	Internal system clock
0	1	RGB interface
1	0	VSYNC interface
1	1	Setting disabled

The DM[1:0] setting allows switching between internal clock operation mode and external display interface operation mode. However, switching between the RGB interface operation mode and the VSYNC interface operation mode is prohibited.

RM Select the interface to access the GRAM.

Set RM to "1" when writing display data by the RGB interface.

RM	Interface for RAM Access
0	System interface/VSYNC interface
1	RGB interface

Display State	Operation Mode	RAM Access (RM)	Display Operation Mode (DM[1:0]				
Still pictures	Internal clock operation	System interface	Internal clock operation				
Still pictures	internal clock operation	(RM = 0)	(DM[1:0] = 00)				
Maying pictures	DCD interface (1)	RGB interface	RGB interface				
Moving pictures	RGB interface (1)	(RM = 1)	(DM[1:0] = 01)				
Rewrite still picture	e area while RGB interface	System interface	RGB interface				
Displaying moving	pictures.	(RM = 0)	(DM[1:0] = 01)				
Maying pictures	VSYNC interface	System interface	VSYNC interface				
Moving pictures	votino interrace	(RM = 0)	(DM[1:0] = 10)				

Note 1: Registers are set only via the system interface or SPI interface.

Note 2: Refer to the flowcharts of "RGB Input Interface" section for the mode switch.

ENC[2:0] Set the GRAM write cycle through the RGB interface

ENC[2:0]	GRAM Write Cycle (Frame periods)
000	1 Frame
001	2 Frames
010	3 Frames
011	4 Frames





100	5 Frames
101	6 Frames
110	7 Frames
111	8 Frames

8.2.12. Frame Marker Position (R0Dh)

_	R/W	RS	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
	W	1	0	0	0	0	0	0	0	FMP8	FMP7	FMP6	FMP5	FMP4	FMP3	FMP2	FMP1	FMP0

EMP[8:0] Sets the output position of frame cycle (frame marker).

When FMP[8:0]=0, a high-active pulse FMARK is output at the start of back porch period for one display line period (1H).

Make sure the 9'h000 \leq FMP \leq BP+NL+FP

FMP[8:0]	FMARK Output Position
	· ·
9'h000	0 th line
9'h001	1 st line
9'h002	2 nd line
9'h003	3 rd line
•	
9'h175	373 rd line
9'h176	374 th line
9'h177	375 th line

8.2.13. RGB Display Interface Control 2 (R0Fh)

R/W	RS	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
W	1	0	0	0	0	0	0	0	0	0	0	0	VSPL	HSPL	0	EPL	DPL

DPL: Sets the signal polarity of the DOTCLK pin.

DPL = "0" The data is input on the rising edge of DOTCLK

DPL = "1" The data is input on the falling edge of DOTCLK

EPL: Sets the signal polarity of the ENABLE pin.

EPL = "0" The data DB17-0 is written when ENABLE = "0". Disable data write operation when

ENABLE = "1".

EPL = "1" The data DB17-0 is written when ENABLE = "1". Disable data write operation when

ENABLE = "0".

HSPL: Sets the signal polarity of the HSYNC pin.

HSPL = "0" Low active

HSPL = "1" High active

VSPL: Sets the signal polarity of the VSYNC pin.

VSPL = "0" Low active

VSPL = "1" High active





Version: 0.30

8.2.14. Power Control 1 (R10h)

R/W	RS	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
W	1	0	0	0	SAP	0	BT2	BT1	ВТ0	APE	AP2	AP1	AP0	0	DSTB	SLP	STB

SLP: When SLP = 1, ILI9325 enters the sleep mode and the display operation stops except the RC oscillator to reduce the power consumption. In the sleep mode, the GRAM data and instructions cannot be updated except the following two instructions.

- a. Exit sleep mode (SLP = "0")
- b. Start oscillation

STB: When STB = 1, ILI9325 enters the standby mode and the display operation stops except the GRAM power supply to reduce the power consumption. In the sleep mode, the GRAM data and instructions cannot be updated except the following two instructions.

- a. Exit standby mode (STB = "0")
- b. Start oscillation

DSTB: When DSTB = 1, the ILI9325 enters the deep standby mode. In deep standby mode, the internal logic power supply is turned off to reduce power consumption. The GRAM data and instruction setting are not maintained when the ILI9325 enters the deep standby mode, and they must be reset after exiting deep standby mode.

AP[2:0]: Adjusts the constant current in the operational amplifier circuit in the LCD power supply circuit. The larger constant current enhances the drivability of the LCD, but it also increases the current consumption. Adjust the constant current taking the trade-off into account between the display quality and the current consumption. In no-display period, set AP[2:0] = "000" to halt the operational amplifier circuits and the step-up circuits to reduce current consumption.

AP[2:0]	Gamma driver amplifiers	Source driver amplifiers
000	Halt	Halt
001	1.00	1.00
010	1.00	0.75
011	1.00	0.50
100	0.75	1.00
101	0.75	0.75
110	0.75	0.50
111	0.50	0.50

SAP: Source Driver output control

SAP=0, Source driver is disabled.

SAP=1, Source driver is enabled.

When starting the charge-pump of LCD in the Power ON stage, make sure that SAP=0, and set the SAP=1, after starting up the LCD power supply circuit.

APE: Power supply enable bit.





Set APE = "1" to start the generation of power supply according to the power supply startup sequence.

BT[3:0]: Sets the factor used in the step-up circuits.

Select the optimal step-up factor for the operating voltage. To reduce power consumption, set a smaller factor.

BT[2:0]	DDVDH	VCL	VGH	VGL
3'h0	Vci1 x 2	- Vci1		- Vci1 x 5
3'h1	Void v 2	\/oi1	Vci1 x 6	- Vci1 x 4
3'h2	Vci1 x 2	- Vci1		- Vci1 x 3
3'h3				- Vci1 x 5
3'h4	Vci1 x 2	- Vci1	Vci1 x 5	- Vci1 x 4
3'h5				- Vci1 x 3
3'h6	V-i4 · · 0	1/=:4	Vaid v. 4	- Vci1 x 4
3'h7	Vci1 x 2	- Vci1	Vci1 x 4	- Vci1 x 3

Notes: 1. Connect capacitors to the capacitor connection pins when generating DDVDH, VGH, VGL and VCL levels.

2. Make sure DDVDH = 6.0V (max.), VGH = 15.0V (max.), VGL = - 12.5V (max) and VCL= -3.0V (max.)

8.2.15. Power Control 2 (R11h)

R/W	RS	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
W	1	0	0	0	0	0	DC12	DC11	DC10	0	DC02	DC01	DC00	0	VC2	VC1	VC0

VC[2:0] Sets the ratio factor of Vci to generate the reference voltages Vci1.

VC2	VC1	VC0	Vci1 voltage
0	0	0	0.95 x Vci
0	0	1	0.90 x Vci
0	1	0	0.85 x Vci
0	1	1	0.80 x Vci
1	0	0	0.75 x Vci
1	0	1	0.70 x Vci
1	1	0	Disabled
1	1	1	1.0 x Vci

DC0[2:0]: Selects the operating frequency of the step-up circuit 1. The higher step-up operating frequency enhances the drivability of the step-up circuit and the quality of display but increases the current consumption. Adjust the frequency taking the trade-off between the display quality and the current consumption into account.

DC1[2:0]: Selects the operating frequency of the step-up circuit 2. The higher step-up operating frequency enhances the drivability of the step-up circuit and the quality of display but increases the current consumption. Adjust the frequency taking the trade-off between the display quality and the current consumption into account.

DC02	DC01	DC00	Step-up circuit1 step-up frequency (f _{DCDC1})	DC12	DC11		Step-up circuit2 step-up frequency (f _{DCDC2})
0	0	0	Fosc	0	0	0	Fosc / 4





0	0	1	Fosc / 2	0	0	1	Fosc / 8
0	1	0	Fosc / 4	0	1	0	Fosc / 16
0	1	1	Fosc / 8	0	1	1	Fosc / 32
1	0	0	Fosc / 16	1	0	0	Fosc / 64
1	0	1	Fosc / 32	1	0	1	Fosc / 128
1	1	0	Fosc / 64	1	1	0	Fosc / 256
1	1	1	Halt step-up circuit 1	1	1	1	Halt step-up circuit 2

Note: Be sure f_{DCDC1}≥f_{DCDC2} when setting DC0[2:0] and DC1[2:0].

8.2.16. Power Control 3 (R12h)

R/W	RS	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
W	1	0	0	0	0	0	0	0	0	VCIRE	0	0	PON	VRH3	VRH2	VRH1	VRH0

VRH[3:0] Set the amplifying rate (1.6 ~ 1.9) of Vci applied to output the VREG1OUT level, which is a reference level for the VCOM level and the grayscale voltage level.

VCIRE: Select the external reference voltage Vci or internal reference voltage VCIR.

VCIRE=0	External reference voltage Vci (default)
VCIRE =1	Internal reference voltage 2.5V

		VCIRE	E =0		VCIRE =1						
VRH3	VRH2	VRH1	VRH0	VREG10UT	VRH3	VRH2	VRH1	VRH0	VREG10UT		
0	0	0	0	Halt	0	0	0	0	Halt		
0	0	0	1	Vci x 2.00	0	0	0	1	2.5V x 2.00 = 5.000V		
0	0	1	0	Vci x 2.05	0	0	1	0	2.5V x 2.05 = 5.125V		
0	0	1	1	Vci x 2.10	0	0	1	1	2.5V x 2.10 = 5.250V		
0	1	0	0	Vci x 2.20	0	1	0	0	2.5V x 2.20 = 5.500V		
0	1	0	1	Vci x 2.30	0	1	0	1	2.5V x 2.30 = 5.750V		
0	1	1	0	Vci x 2.40	0	1	1	0	2.5V x 2.40 = 6.000V		
0	1	1	1	Vci x 2.40	0	1	1	1	2.5V x 2.40 = 6.000V		
1	0	0	0	Vci x 1.60	1	0	0	0	2.5V x 1.60 = 4.000V		
1	0	0	1	Vci x 1.65	1	0	0	1	2.5V x 1.65 = 4.125V		
1	0	1	0	Vci x 1.70	1	0	1	0	2.5V x 1.70 = 4.250V		
1	0	1	1	Vci x 1.75	1	0	1	1	2.5V x 1.75 = 4.375V		
1	1	0	0	Vci x 1.80	1	1	0	0	2.5V x 1.80 = 4.500V		
1	1	0	1	Vci x 1.85	1	1	0	1	2.5V x 1.85 = 4.625V		
1	1	1	0	Vci x 1.90	1	1	1	0	2.5V x 1.90 = 4.750V		
1	1	1	1	Vci x 1.95	1	1	1	1	2.5V x 1.95 = 4.875V		

When VCI<2.5V, Internal reference voltage will be same as VCI.

Make sure that VC and VRH setting restriction: $VREG1OUT \leq (DDVDH - 0.5)V$.

PON: Control ON/OFF of circuit3 (VGL) output.

PON=0	VGL output is disable
PON=1	VGL output is enable

8.2.17. Power Control 4 (R13h)

R/W	RS	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
W	1	0	0	0	VDV4	VDV3	VDV2	VDV1	VDV0	0	0	0	0	0	0	0	0





VDV[4:0] Select the factor of VREG1OUT to set the amplitude of Vcom alternating voltage from 0.70 to 1.24 x VREG1OUT.

VDV4	VDV3	VDV2	VDV1	VDV0	VCOM amp	litude	VDV4	VDV3	VDV2	VDV1	VDV0	VCOM amp	litude
0	0	0	0	0	VREG10UT	x 0.70	1	0	0	0	0	VREG10UT	x 0.94
0	0	0	0	1	VREG10UT	x 0.72	1	0	0	0	1	VREG10UT	x 0.96
0	0	0	1	0	VREG10UT	x 0.74	1	0	0	1	0	VREG10UT	x 0.98
0	0	0	1	1	VREG10UT	x 0.76	1	0	0	1	1	VREG10UT	x 1.00
0	0	1	0	0	VREG10UT	x 0.78	1	0	1	0	0	VREG10UT	x 1.02
0	0	1	0	1	VREG10UT	x 0.80	1	0	1	0	1	VREG10UT	x 1.04
0	0	1	1	0	VREG10UT	x 0.82	1	0	1	1	0	VREG10UT	x 1.06
0	0	1	1	1	VREG10UT	x 0.84	1	0	1	1	1	VREG10UT	x 1.08
0	1	0	0	0	VREG10UT	x 0.86	1	1	0	0	0	VREG10UT	x 1.10
0	1	0	0	1	VREG10UT	x 0.88	1	1	0	0	1	VREG10UT	x 1.12
0	1	0	1	0	VREG10UT	x 0.90	1	1	0	1	0	VREG10UT	x 1.14
0	1	0	1	1	VREG10UT	x 0.92	1	1	0	1	1	VREG10UT	x 1.16
0	1	1	0	0	VREG10UT	x 0.94	1	1	1	0	0	VREG10UT	x 1.18
0	1	1	0	1	VREG10UT	x 0.96	1	1	1	0	1	VREG10UT	x 1.20
0	1	1	1	0	VREG10UT	x 0.98	1	1	1	1	0	VREG10UT	x 1.22
0	1	1	1	1	VREG10UT	x 1.00	1	1	1	1	1	VREG10UT	x 1.24

Set VDV[4:0] to let Vcom amplitude less than 6V.

8.2.18. GRAM Horizontal/Vertical Address Set (R20h, R21h)

R/V	٧	RS	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
W	'	1	0	0	0	0	0	0	0	0	AD7	AD6	AD5	AD4	AD3	AD2	AD1	AD0
W		1	0	0	0	0	0	0	0	AD16	AD15	AD14	AD13	AD12	AD11	AD10	AD9	AD8

AD[16:0] Set the initial value of address counter (AC).

The address counter (AC) is automatically updated in accordance to the setting of the AM, I/D bits as data is written to the internal GRAM. The address counter is not automatically updated when read data from the internal GRAM.

AD[16:0]	GRAM Data Map
17'h00000 ~ 17'h000EF	1 st line GRAM Data
17'h00100 ~ 17'h001EF	2 nd line GRAM Data
17'h00200 ~ 17'h002EF	3 rd line GRAM Data
17'h00300 ~ 17'h003EF	4 th line GRAM Data
17'h13D00 ~ 17' h13DEF	318 th line GRAM Data
17'h13E00 ~ 17' h13EEF	319 th line GRAM Data
17'h13F00 ~ 17'h13FEF	320 th line GRAM Data

Note1: When the RGB interface is selected (RM = "1"), the address AD[16:0] is set to the address counter every frame on the falling edge of VSYNC.

Note2: When the internal clock operation or the VSYNC interface mode is selected (RM = "0"), the address AD[16:0] is set to address counter when update register R21.

8.2.19. Write Data to GRAM (R22h)

R/W	RS	 D17	D16	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
W	1			RA	M write	data (V	VD[17:0)], the [DB[17:0] pin a	ssignr	nent d	liffers	for ead	ch inte	rface.			

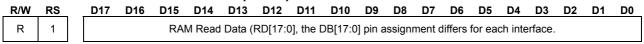
This register is the GRAM access port. When update the display data through this register, the address





counter (AC) is increased/decreased automatically.

8.2.20. Read Data from GRAM (R22h)



RD[17:0] Read 18-bit data from GRAM through the read data register (RDR).

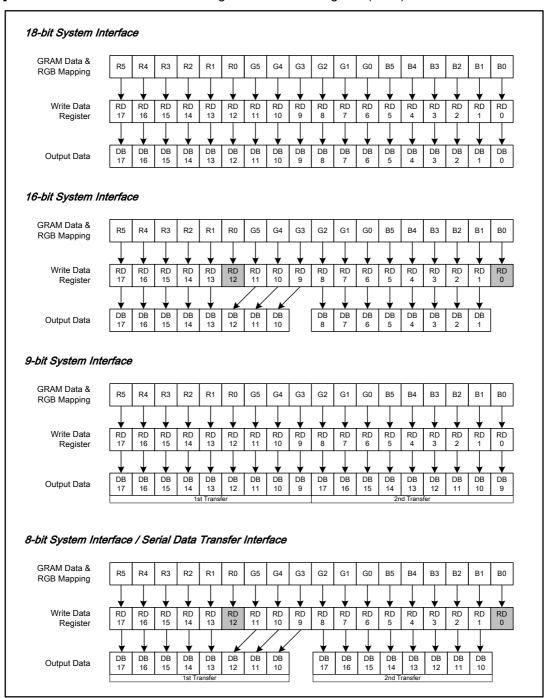


Figure 28 Data Read from GRAM through Read Data Register in 18-/16-/9-/8-bit Interface Mode



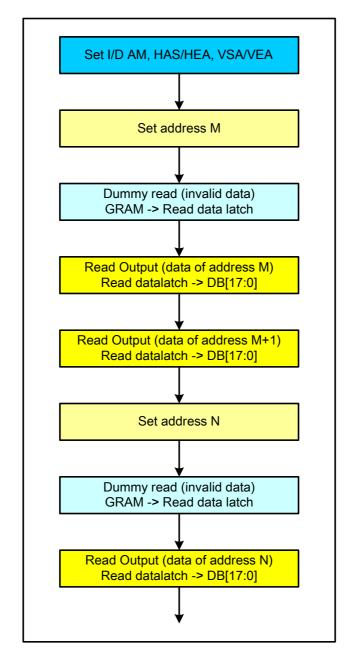


Figure 29 GRAM Data Read Back Flow Chart

8.2.21. Power Control 7 (R29h)

R/W	RS	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
W	1	0	0	0	0	0	0	0	0	0	0	VCM5	VCM4	VCM3	VCM2	VCM1	VCM0

VCM[5:0] Set the internal VcomH voltage.

VCM5	VCM4	VCM3	VCM2	VCM1	VCM0	VCOMH	V	CM5	VCM4	VCM3	VCM2	VCM1	VCM0	VCOMH	
0	0	0	0	0	0	VREG1OUT x 0.685	(1	0	0	0	0	0	VREG1OUT x 0.845	<
0	0	0	0	0	1	VREG1OUT x 0.690	(1	0	0	0	0	1	VREG1OUT x 0.850	(
0	0	0	0	1	0	VREG1OUT x 0.695	(1	0	0	0	1	0	VREG1OUT x 0.855	<
0	0	0	0	1	1	VREG1OUT x 0.700	(1	0	0	0	1	1	VREG1OUT x 0.860	<u> </u>
0	0	0	1	0	0	VREG10UT x	(1	0	0	1	0	0	VREG10UT x	(

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						0.705							0.865
0	0	0	1	0	1	VREG10UT x 0.710	1	0	0	1	0	1	VREG1OUT x 0.870
0	0	0	1	1	0	VREG1OUT x	1	0	0	1	1	0	VREG1OUT x
	0					0.715 VREG1OUT x				1		1	0.875 VREG1OUT x
0		0	1	1	1	0.720 VREG1OUT x	1	0	0		1		0.880 VREG1OUT x
0	0	1	0	0	0	0.725	1	0	1	0	0	0	0.885
0	0	1	0	0	1	VREG1OUT x 0.730	1	0	1	0	0	1	VREG1OUT x 0.890
0	0	1	0	1	0	VREG1OUT x 0.735	1	0	1	0	1	0	VREG1OUT x 0.895
0	0	1	0	1	1	VREG1OUT x 0.740	1	0	1	0	1	1	VREG1OUT x 0.900
0	0	1	1	0	0	VREG10UT x 0.745	1	0	1	1	0	0	VREG1OUT x 0.905
0	0	1	1	0	1	VREG1OUT x	1	0	1	1	0	1	VREG1OUT x 0.910
0	0	1	1	1	0	0.750 VREG1OUT x	1	0	1	1	1	0	VREG1OUT x
0	0	1	1	1	1	0.755 VREG1OUT x	1	0	1	1	1	1	0.915 VREG1OUT x
		'			'	0.760	I .				'		0.920
0	1	0	0	0	0	VREG1OUT x 0.765	1	1	0	0	0	0	VREG1OUT x 0.925
0	1	0	0	0	1	VREG1OUT x 0.770	1	1	0	0	0	1	VREG1OUT x 0.930
0	1	0	0	1	0	VREG1OUT x 0.775	1	1	0	0	1	0	VREG1OUT x 0.935
0	1	0	0	1	1	VREG1OUT x 0.780	1	1	0	0	1	1	VREG1OUT x 0.940
0	1	0	1	0	0	VREG1OUT x 0.785	1	1	0	1	0	0	VREG1OUT x 0.945
0	1	0	1	0	1	VREG1OUT x	1	1	0	1	0	1	VREG1OUT x
0	1	0	1	1	0	0.790 VREG1OUT x	1	1	0	1	1	0	0.950 VREG1OUT x
0	1	0	1	1	1	0.795 VREG1OUT x	1	1	0	 1	1	1	0.955 VREG1OUT x
						0.800 VREG1OUT x							0.960 VREG1OUT x
0	1	1	0	0	0	0.805	1	1	1	0	0	0	0.965
0	1	1	0	0	1	VREG1OUT x 0.810	1	1	1	0	0	1	VREG1OUT x 0.970
0	1	1	0	1	0	VREG1OUT x 0.815	1	1	1	0	1	0	VREG1OUT x 0.975
0	1	1	0	1	1	VREG1OUT x 0.820	1	1	1	0	1	1	VREG1OUT x 0.980
0	1	1	1	0	0	VREG1OUT x 0.825	1	1	1	1	0	0	VREG1OUT x 0.985
0	1	1	1	0	1	VREG1OUT x 0.830	1	1	1	1	0	1	VREG1OUT x 0.990
0	1	1	1	1	0	VREG1OUT x	1	1	1	1	1	0	VREG10UT x
0	1	1	1	1	1	0.835 VREG1OUT x	1	1	1	1	1	1	0.995 VREG1OUT x
						0.840							1.000

8.2.22. Frame Rate and Color Control (R2Bh)

							•		,									
R/W	RS	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0	
W	1	0	0	0	0	0	0	0	0	0	0	0	0	FRS3	FRS2	FRS1	FRS0	

FRS[4:0] Set the frame rate when the internal resistor is used for oscillator circuit.

FRS[3:0]	FRS[3:0]	Frame Rate
0000	4'h0	30





0001	4'h1	31
0010	4'h2	33
0011	4'h3	35
0100	4'h4	38
0101	4'h5	40
0110	4'h6	43
0111	4'h7	47
1000	4'h8	51
1001	4'h9	56
1010	4'hA	62
1011	4'hB	70
1100	4'hC	80
1101	4'hD	93
1110	4'hE	112
1111	4'hF	Setting Prohibited

8.2.23. Gamma Control (R30h ~ R3Dh)

	R/W	RS	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
R30h	W	1	0	0	0	0	0	KP1[2]	KP1[1]	KP1[0]	0	0	0	0	0	KP0[2]	KP0[1]	KP0[0]
R31h	W	1	0	0	0	0	0	KP3[2]	KP3[1]	KP3[0]	0	0	0	0	0	KP2[2]	KP2[1]	KP2[0]
R32h	W	1	0	0	0	0	0	KP5[2]	KP5[1]	KP5[0]	0	0	0	0	0	KP4[2]	KP4[1]	KP4[0]
R35h	W	1	0	0	0	0	0	RP1[2]	RP1[1]	RP1[0]	0	0	0	0	0	RP0[2]	RP0[1]	RP0[0]
R36h	W	1	0	0	0	VRP1[4]	VRP1[3]	VRP1[2]	VRP1[1]	VRP1[0]	0	0	0	0	VRP0[3]	VRP0[2]	VRP0[1]	VRP0[0]
R37h	W	1	0	0	0	0	0	KN1[2]	KN1[1]	KN1[0]	0	0	0	0	0	KN0[2]	KN0[1]	KN0[0]
R38h	W	1	0	0	0	0	0	KN3[2]	KN3[1]	KN3[0]	0	0	0	0	0	KN2[2]	KN2[1]	KN2[0]
R39h	W	1	0	0	0	0	0	KN5[2]	KN5[1]	KN5[0]	0	0	0	0	0	KN4[2]	KN4[1]	KN4[0]
R3Ch	W	1	0	0	0	0	0	RN1[2]	RN1[1]	RN1[0]	0	0	0	0	0	RN0[2]	RN0[1]	RN0[0]
R3Dh	W	1	0	0	0	VRN1[4]	VRN1[3]	VRN1[2]	VRN1[1]	VRN1[0]	0	0	0	0	VRN0[3]	VRN0[2]	VRN0[1]	VRN0[0]

KP5-0[2:0] : γ fine adjustment register for positive polarity

RP1-0[2:0]: γ gradient adjustment register for positive polarity

VRP1-0[4:0] : γ amplitude adjustment register for positive polarity

KN5-0[2:0]: γ fine adjustment register for negative polarity

RN1-0[2:0] : γ gradient adjustment register for negative polarity

VRN1-0[4:0] : γ amplitude adjustment register for negative polarity

For details " $\boldsymbol{\gamma}$ -Correction Function" section.

8.2.24. Horizontal and Vertical RAM Address Position (R50h, R51h, R52h, R53h)

	R/W	RS	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
R50h	W	1	0	0	0	0	0	0	0	0	HSA7	HSA6	HSA5	HSA4	HSA3	HSA2	HSA1	HSA0
R51h	W	1	0	0	0	0	0	0	0	0	HEA7	HEA6	HEA5	HEA4	HEA3	HEA2	HEA1	HEA0
R52h	W	1	0	0	0	0	0	0	0	VSA8	VSA7	VSA6	VSA5	VSA4	VSA3	VSA2	VSA1	VSA0
R53h	W	1	0	0	0	0	0	0	0	VEA8	VEA7	VEA6	VEA5	VEA4	VEA3	VEA2	VEA1	VEA0

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HSA[7:0]/HEA[7:0] HSA[7:0] and HEA[7:0] represent the respective addresses at the start and end of the window address area in horizontal direction. By setting HSA and HEA bits, it is possible to limit the area on the GRAM horizontally for writing data. The HSA and HEA bits must be set before starting RAM write operation. In setting these bits, be sure "00"h ≤ HSA[7:0]< HEA[7:0] ≤ "EF"h. and "04"h≤HEA-HAS.

VSA[8:0]/VEA[8:0] VSA[8:0] and VEA[8:0] represent the respective addresses at the start and end of the window address area in vertical direction. By setting VSA and VEA bits, it is possible to limit the area on the GRAM vertically for writing data. The VSA and VEA bits must be set before starting RAM write operation. In setting, be sure "000"h ≤ VSA[8:0] < VEA[8:0] ≤ "13F"h.

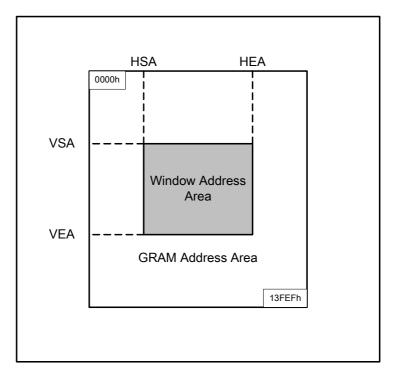


Figure 30 GRAM Access Range Configuration

"00"h ≤HAS[7:0] ≤HEA[7:0] ≤"EF"h "00"h ≤VSA[7:0] ≤VEA[7:0] ≤"13F"h

Note1. The window address range must be within the GRAM address space.

Note2. Data are written to GRAM in four-words when operating in high speed mode, the dummy write operations should be inserted depending on the window address area. For details, see the High-Speed RAM Write Function section.

8.2.25. Gate Scan Control (R60h, R61h, R6Ah)

	R/W	RS	_	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
R60h	W	1		GS	0	NL5	NL4	NL3	NL2	NL1	NL0	0	0	SCN5	SCN4	SCN3	SCN2	SCN1	SCN0
R61h	W	1		0	0	0	0	0	0	0	0	0	0	0	0	0	NDL	VLE	REV

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R6Ah W 1 0 0 0 0 0 0 0 VL8 VL7 VL6 VL5 VL4 VL3 VL2 VL1 VL0

SCN[5:0] The ILI9325 allows to specify the gate line from which the gate driver starts to scan by setting the SCN[5:0] bits.

		Scanning S	tart Position	
SCN[5:0]	SM	1=0	SM	1=1
	GS=0	GS=1	GS=0	GS=1
00h	G1	G320	G1	G320
01h	G9	G312	G17	G304
02h	G17	G304	G33	G288
03h	G25	G296	G49	G272
04h	G33	G288	G65	G256
05h	G41	G280	G81	G240
06h	G49	G272	G97	G224
07h	G57	G264	G113	G208
08h	G65	G256	G129	G192
09h	G73	G248	G145	G176
0Ah	G81	G240	G161	G160
0Bh	G89	G232	G177	G144
0Ch	G97	G224	G193	G128
0Dh	G105	G216	G209	G112
0Eh	G113	G208	G2	G96
0Fh	G121	G200	G18	G80
10h	G129	G192	G34	G64
11h	G137	G184	G50	G48
12h	G145	G176	G66	G32
13h	G153	G168	G82	G16
14h	G161	G160	G98	G319
15h	G169	G152	G114	G303
16h	G177	G144	G130	G287
17h	G185	G136	G146	G271
18h	G193	G128	G162	G255
19h	G201	G120	G178	G239
1Ah	G209	G112	G194	G223
1Bh	G217	G104	G114	G207
1Ch	G225	G96	G130	G191
1Dh	G233	G88	G146	G175
1Eh	G241	G80	G162	G159
1Fh	G249	G72	G178	G143
20h	G257	G64	G194	G127
21h	G265	G56	G210	G111
22h	G273	G48	G226	G95
23h	G281	G40	G242	G79
24h	G289	G32	G258	G63
25h	G297	G24	G274	G47
26h	G305	G16	G290	G31
27h	G313	G8	G306	G15
28h ~ 3Fh	Setting disabled	Setting disabled	Setting disabled	Setting disabled

NL[5:0]: Sets the number of lines to drive the LCD at an interval of 8 lines. The GRAM address mapping is not affected by the number of lines set by NL[5:0]. The number of lines must be the same or more than the number of lines necessary for the size of the liquid crystal panel.



NL[5:0]	LCD Drive Line
6'h1D	240 lines
6'h1E	248 lines
6'h1F	256 lines
6'h20	264 lines
6'h21	272 lines
6'h22	280 lines
6'h23	288 lines
6'h24	296 lines
6'h25	304 lines
6'h26	312 line
6'h27	320 line
Others	Setting inhibited

NDL: Sets the source driver output level in the non-display area.

NDL -	Non-Dis	play Area
NDL	Positive Polarity	Negative Polarity
0	V63	V0
1	V0	V63

GS: Sets the direction of scan by the gate driver in the range determined by SCN[4:0] and NL[4:0]. The scan direction determined by GS = 0 can be reversed by setting GS = 1.

When GS = 0, the scan direction is from G1 to G320.

When GS = 1, the scan direction is from G320 to G1

REV: Enables the grayscale inversion of the image by setting REV=1.

REV	GRAM Data	Source Output in	Display Area
IXLV	GIVAINI Data	Positive polarity	negative polarity
	18'h00000	V63	V0
_	•		•
0		•	•
	18'h3FFFF	V0	V63
	18'h00000	V0	V63
	•	•	
1			
	18'h3FFFF	V63	V0

VLE: Vertical scroll display enable bit. When VLE = 1, the ILI9325 starts displaying the base image from the line (of the physical display) determined by VL[8:0] bits. VL[8:0] sets the amount of scrolling, which is the number of lines to shift the start line of the display from the first line of the physical display. Note that the partial image display position is not affected by the base image scrolling.

The vertical scrolling is not available in external display interface operation. In this case, make sure to set VLE = "0".





VLE	Base Image Display
0	Fixed
1	Enable Scrolling

VL[8:0]: Sets the scrolling amount of base image. The base image is scrolled in vertical direction and displayed from the line determined by VL[8:0]. Make sure that VL[8:0] ≤ 320 .

8.2.26. Partial Image 1 Display Position (R80h)

R/W	RS	_	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
×	1		0	0	0	0	0	0	0	PTD								
VV	'		0	U		U	U	0		P0[8]	P0[7]	P0[6]	P0[5]	P0[4]	P0[3]	P0[2]	P0[1]	P0[0]

PTDP0[8:0]: Sets the display start position of partial image 1. The display areas of the partial images 1 and 2 must not overlap each another.

8.2.27. Partial Image 1 RAM Start/End Address (R81h, R82h)

R/W	RS	_	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
10/	4					0		0		PTS								
W			U	0	0	U	U	U	0	A0[8]	A0[7]	A0[6]	A0[5]	A0[4]	A0[3]	A0[2]	A0[1]	A0[0]
W	1		0	0	0	0	0	0	0	PTE								
										A0[8]	A0[7]	A0[6]	A0[5]	A0[4]	A0[3]	A0[2]	A0[1]	A0[0]

PTSA0[8:0] PTEA0[8:0]: Sets the start line address and the end line address of the RAM area storing the data of partial image 1. Make sure PTSA0[8:0] ≤ PTEA0[8:0].

8.2.28. Partial Image 2 Display Position (R83h)

R/W	RS	_	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
10/	1								0	PTD								
W	1		0	0	0	0	U	0	0	P1[8]	P1[7]	P1[6]	P1[5]	P1[4]	P1[3]	P1[2]	P1[1]	P1[0]

PTDP1[8:0]: Sets the display start position of partial image 2 The display areas of the partial images 1 and 2 must not overlap each another.

8.2.29. Partial Image 2 RAM Start/End Address (R84h, R85h)

R/W	RS	_	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
W	1		0	0		0	0	0		PTS								
VV	'		0	U	0	U	U	0	0	A1[8]	A1[7]	A1[6]	A1[5]	A1[4]	A1[3]	A1[2]	A1[1]	A1[0]
W	1		0	0	0	0	0	0	0	PTE								
										A1[8]	A1[7]	A1[6]	A1[5]	A1[4]	A1[3]	A1[2]	A1[1]	A1[0]

PTSA1[8:0] PTEA1[8:0]: Sets the start line address and the end line address of the RAM area storing the data of partial image 2 Make sure PTSA1[8:0] ≤ PTEA1[8:0].





8.2.30. Panel Interface Control 1 (R90h)

R/W	RS	_	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
W	1		0	0	0	0	0	0	DIVI1	DIVI0	0	0	0	RTNI4	RTNI3	RTNI2	RTNI1	RTNI0

RTNI[4:0]: Sets 1H (line) clock number of internal clock operating mode. In this mode, ILI9325 display operation is synchronized with internal clock signal.

		_	
RTNI[4:0]	Clocks/Line	RTNI[4:0]	Clocks/Line
00000~01111	Setting Disabled	11000	24 clocks
10000	16 clocks	11001	25 clocks
10001	17 clocks	11010	26 clocks
10010	18 clocks	11011	27 clocks
10011	19 clocks	11100	28 clocks
10100	20 clocks	11101	29 clocks
10101	21 clocks	11110	30 clocks
10110	22 clocks	11111	31 clocks
10111	23 clocks		
		•	***

DIVI[1:0]: Sets the division ratio of internal clock frequency.

DIVI1	DIVI0	Division Ratio	Internal Operation Clock Frequency
0	0	1	fosc / 1
0	1	2	fosc / 2
1	0	4	fosc / 4
1	1	8	fosc / 8

8.2.31. Panel Interface Control 2 (R92h)

R/	W	RS	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
	٧	1	0	0	0	0	0	NOWI[2]	NOWI[1]	NOWI[0]	0	0	0	0	0	0	0	0

NOWI[2:0]: Sets the gate output non-overlap period when ILI9325 display operation is synchronized with internal clock signal.

NOWI[2:0]	Gate Non-overlap Period
000	0 clocks
001	1 clocks
010	2 clocks
011	3 clocks
100	4 clocks
101	5 clocks
110	6 clocks
111	7 clocks

Note: The gate output non-overlap period is defined by the number of frequency-divided internal clocks, the frequency of which is determined by instruction (DIVI), from the reference point.

8.2.32. Panel Interface Control 4 (R95h)

R/W	RS	_	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
W	1		0	0	0	0	0	0	DIVE1	DIVE0	0	0	RTNE5	RTNE4	RTNE3	RTNE2	RTNE1	RTNE0

RTNE[5:0]: Sets 1H (line) clock number of RGB interface mode. In this mode, ILI9325 display operation is synchronized with RGB interface signals.





DIVE (division ratio) x RTNE (DOTCLKs) \leq DOTCLKs in 1H period.

RTNE[5:0]	Clocks per line period (1H)						
00h	Setting Prohibited	10h	16 clocks	20h	32 clocks	30h	48 clocks
01h	Setting Prohibited	11h	17 clocks	21h	33 clocks	31h	49 clocks
02h	Setting Prohibited	12h	18 clocks	22h	34 clocks	32h	50 clocks
03h	Setting Prohibited	13h	19 clocks	23h	35 clocks	33h	51 clocks
04h	Setting Prohibited	14h	20 clocks	24h	36 clocks	34h	52 clocks
05h	Setting Prohibited	15h	21 clocks	25h	37 clocks	35h	53 clocks
06h	Setting Prohibited	16h	22 clocks	26h	38 clocks	36h	54 clocks
07h	Setting Prohibited	17h	23 clocks	27h	39 clocks	37h	55 clocks
08h	Setting Prohibited	18h	24 clocks	28h	40 clocks	38h	56 clocks
09h	Setting Prohibited	19h	25 clocks	29h	41 clocks	39h	57 clocks
0ah	Setting Prohibited	1ah	26 clocks	2ah	42 clocks	3ah	58 clocks
0bh	Setting Prohibited	1bh	27 clocks	2bh	43 clocks	3bh	59 clocks
0ch	Setting Prohibited	1ch	28 clocks	2ch	44 clocks	3ch	60 clocks
0dh	Setting Prohibited	1dh	29 clocks	2dh	45 clocks	3dh	61 clocks
0eh	Setting Prohibited	1eh	30 clocks	2eh	46 clocks	3eh	62 clocks
0fh	Setting Prohibited	1fh	31 clocks	2fh	47 clocks	3fh	63 clocks

DIVE[1:0]: Sets the division ratio of DOTCLK when ILI9325 display operation is synchronized with RGB interface signals.

DIVE[1:0]	Division Ratio	18/16-bit RGB Interface	DOTCLK=5MHz	6-bit x 3 Transfers RGB Interface	DOTCLK=5MHz
00	Setting Prohibited	Setting Prohibited	-	Setting Prohibited	-
01	1/4	4 DOTCLKS	0.8 µs	12 DOTCLKS	0.8 µs
10	1/8	8 DOTCLKS	1.6 µs	24 DOTCLKS	1.6 µs
11	1/16	16 DOTCLKS	3.2 µs	48 DOTCLKS	3.2 µs

8.2.33. OTP VCM Programming Control (RA1h)

_	R/W	RS	_	D15	D14	D13	D12	D11	D10	D9 `	D8	D7	D6	D5	D4	D3	D2	D1	D0
	W	1		0	0	0	0	OTP_ PGM_EN	0	0	0	0	0	VCM_ OTP5	VCM_ OTP4	VCM_ OTP3	VCM_ OTP2	VCM_ OTP1	VCM_ OTP0

OTP_PGM_EN: OTP programming enable. When program OTP, must set this bit. OTP data can be programmed 3 times.

VCM_OTP[5:0]: OTP programming data for VCOMH voltage, the voltage refer to VCM[5:0] value.

8.2.34. OTP VCM Status and Enable (RA2h)

R/W	RS	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
W	1	PGM_ CNT1	PGM_ CNT0	VCM_ D5	VCM_ D4	VCM_ D3	VCM_ D2	VCM_ D1	VCM_ D0	0	0	0	0	0	0	0	VCM_ EN

PGM_CNT[1:0]: OTP programmed record. These bits are read only.

OTP_PGM_CNT[1:0]	Description
00	OTP clean
01	OTP programmed 1 time
10	OTP programmed 2 times





11	OTP programmed 3 times

VCM_D[5:0]: OTP VCM data read value. These bits are read only.

VCM_EN: OTP VCM data enable.

'1': Set this bit to enable OTP VCM data to replace R29h VCM value.

'0': Default value, use R29h VCM value.

8.2.35. OTP Programming ID Key (RA5h)

R	/W	RS	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
	Ν	1	KEY															
١ ٧	v	1	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

KEY[15:0]: OTP Programming ID key protection. Before writing OTP programming data RA1h, it must write RA5h with 0xAA55 value first to make OTP programming successfully. If RA5h is not written with 0xAA55, OTP programming will be fail. See OTP Programming flow.

Page 79 of 112

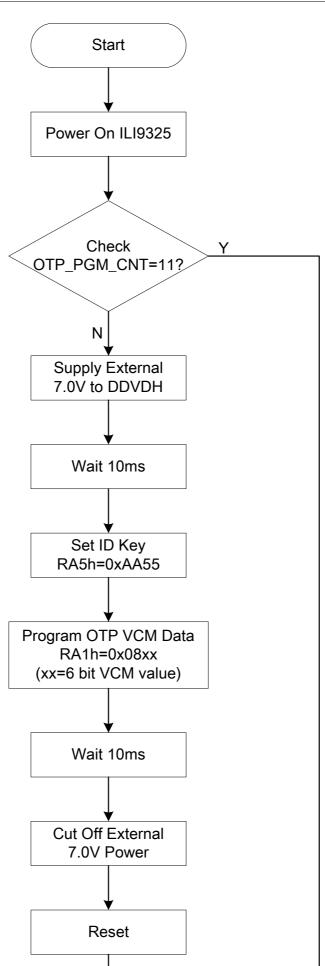
Version: 0.30





9. OTP Programming Flow

Page 80 of 112



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112









10. GRAM Address Map & Read/Write

ILI9325 has an internal graphics RAM (GRAM) of 87,120 bytes to store the display data and one pixel is constructed of 18 bits. The GRAM can be accessed through the i80 system, SPI and RGB interfaces.

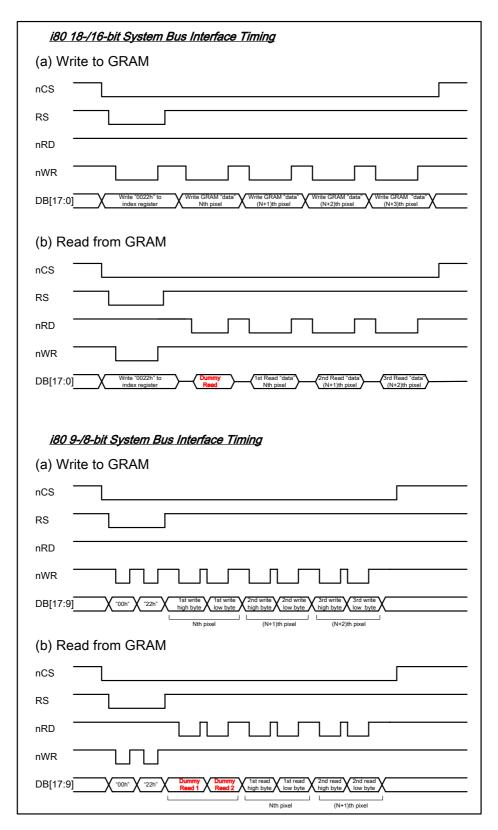


Figure31 GRAM Read/Write Timing of i80-System Interface





GRAM address map table of SS=0, BGR=0

SS=0,	BGR=0	S1S3	S4S6	S7S9	S10S12	 S517S519	S520S522	S523S525	S526S720
GS=0	GS=1	DB170	DB170	DB170	DB170	 DB170	DB170	DB170	DB170
G1	G320	"00000h"	"00001h"	"00002h"	"00003h"	 "000ECh"	"000EDh"	"000EEh"	"000EFh"
G2	G319	"00100h"	"00101h"	"00102h"	"00103h"	 "001ECh"	"001EDh"	"001EEh"	"001EFh"
G3	G318	"00200h"	"00201h"	"00202h"	"00203h"	 "002ECh"	"002EDh"	"002EEh"	"002EFh"
G4	G317	"00300h"	"00301h"	"00302h"	"00303h"	 "003ECh"	"003EDh"	"003EEh"	"003EFh"
G5	G316	"00400h"	"00401h"	"00402h"	"00403h"	 "004ECh"	"004EDh"	"004EEh"	"004EFh"
G6	G315	"00500h"	"00501h"	"00502h"	"00503h"	 "005ECh"	"005EDh"	"005EEh"	"005EFh"
G7	G314	"00600h"	"00601h"	"00602h"	"00603h"	 "006ECh"	"006EDh"	"006EEh"	"006EFh"
G8	G313	"00700h"	"00701h"	"00702h"	"00703h"	 "007ECh"	"007EDh"	"007EEh"	"007EFh"
G9	G312	"00800h"	"00801h"	"00802h"	"00803h"	 "008ECh"	"008EDh"	"008EEh"	"008EFh"
G10	G311	"00900h"	"00901h"	"00902h"	"00903h"	 "009ECh"	"009EDh"	"009EEh"	"009EFh"
	-					 -	•	-	-
	•	•			•		-		
	-				-	-	-	-	
G311	G10	"13600h"	"13601h"	"13602h"	"13603h"	 "136ECh"	"136EDh"	"136EEh"	"136EFh"
G312	G9	"13700h"	"13701h"	"13702h"	"13703h"	 "137ECh"	"137EDh"	"137EEh"	"137EFh"
G313	G8	"13800h"	"13801h"	"13802h"	"13803h"	 "138ECh"	"138EDh"	"138EEh"	"138EFh"
G314	G7	"13900h"	"13901h"	"13902h"	"13903h"	 "139ECh"	"139EDh"	"139EEh"	"139EFh"
G315	G6	"13A00h"	"13A01h"	"13A02h"	"13A03h"	 "13AECh"	"13AEDh"	"13AEEh"	"13AEFh"
G316	G5	"13B00h"	"13B01h"	"13B02h"	"13B03h"	 "13BECh"	"13BEDh"	"13BEEh"	"13BEFh"
G317	G4	"13C00h"	"13C01h"	"13C02h"	"13C03h"	 "13CECh"	"13CEDh"	"13CEEh"	"13CEFh"
G318	G3	"13D00h"	"13D01h"	"13D02h"	"13D03h"	 "13DECh"	"13DEDh"	"13DEEh"	"13DEFh"
G319	G2	"13E00h"	"13E01h"	"13E02h"	"13E03h"	 "13EECh"	"13EEDh"	"13EEEh"	"13EEFh"
G320	G1	"13F00h"	"13F01h"	"13F02h"	"13F03h"	 "13FECh"	"13FEDh"	"13FEEh"	"13FEFh"





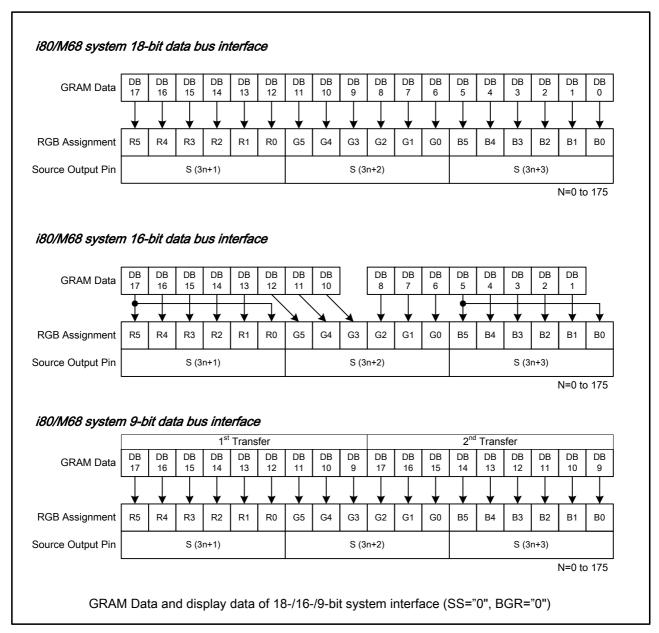


Figure 32 i 80-System Interface with 18-/16-/9-bit Data Bus (SS="0", BGR="0")

Page 85 of 112

Version: 0.30



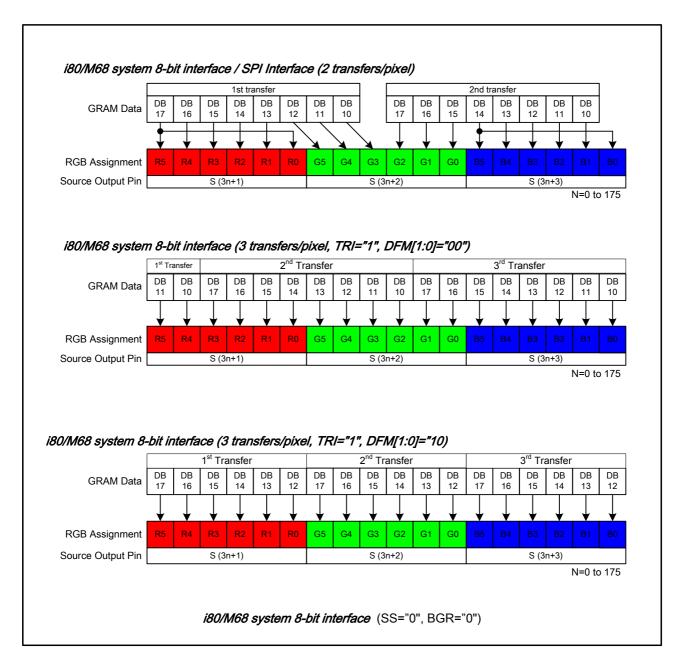


Figure 33 i80-System Interface with 8-bit Data Bus (SS="0", BGR="0")

Page 86 of 112

Version: 0.30





GRAM address map table of SS=1, BGR=1

SS=0,	BGR=0	S720S718	S717S715	S714S712	S711S709	 S12S10	S9S7	S6S4	S3S1
GS=0	GS=1	DB170	DB170	DB170	DB170	 DB170	DB170	DB170	DB170
G1	G320	"00000h"	"00001h"	"00002h"	"00003h"	 "000ECh"	"000EDh"	"000EEh"	"000EFh"
G2	G319	"00100h"	"00101h"	"00102h"	"00103h"	 "001ECh"	"001EDh"	"001EEh"	"001EFh"
G3	G318	"00200h"	"00201h"	"00202h"	"00203h"	 "002ECh"	"002EDh"	"002EEh"	"002EFh"
G4	G317	"00300h"	"00301h"	"00302h"	"00303h"	 "003ECh"	"003EDh"	"003EEh"	"003EFh"
G5	G316	"00400h"	"00401h"	"00402h"	"00403h"	 "004ECh"	"004EDh"	"004EEh"	"004EFh"
G6	G315	"00500h"	"00501h"	"00502h"	"00503h"	 "005ECh"	"005EDh"	"005EEh"	"005EFh"
G7	G314	"00600h"	"00601h"	"00602h"	"00603h"	 "006ECh"	"006EDh"	"006EEh"	"006EFh"
G8	G313	"00700h"	"00701h"	"00702h"	"00703h"	 "007ECh"	"007EDh"	"007EEh"	"007EFh"
G9	G312	"00800h"	"00801h"	"00802h"	"00803h"	 "008ECh"	"008EDh"	"008EEh"	"008EFh"
G10	G311	"00900h"	"00901h"	"00902h"	"00903h"	 "009ECh"	"009EDh"	"009EEh"	"009EFh"
-					-			-	
	-	·	·	·	÷				
		·	·		÷	ē	-		
G311	G10	"13600h"	"13601h"	"13602h"	"13603h"	 "136ECh"	"136EDh"	"136EEh"	"136EFh"
G312	G9	"13700h"	"13701h"	"13702h"	"13703h"	 "137ECh"	"137EDh"	"137EEh"	"137EFh"
G313	G8	"13800h"	"13801h"	"13802h"	"13803h"	 "138ECh"	"138EDh"	"138EEh"	"138EFh"
G314	G7	"13900h"	"13901h"	"13902h"	"13903h"	 "139ECh"	"139EDh"	"139EEh"	"139EFh"
G315	G6	"13A00h"	"13A01h"	"13A02h"	"13A03h"	 "13AECh"	"13AEDh"	"13AEEh"	"13AEFh"
G316	G5	"13B00h"	"13B01h"	"13B02h"	"13B03h"	 "13BECh"	"13BEDh"	"13BEEh"	"13BEFh"
G317	G4	"13C00h"	"13C01h"	"13C02h"	"13C03h"	 "13CECh"	"13CEDh"	"13CEEh"	"13CEFh"
G318	G3	"13D00h"	"13D01h"	"13D02h"	"13D03h"	 "13DECh"	"13DEDh"	"13DEEh"	"13DEFh"
G319	G2	"13E00h"	"13E01h"	"13E02h"	"13E03h"	 "13EECh"	"13EEDh"	"13EEEh"	"13EEFh"
G320	G1	"13F00h"	"13F01h"	"13F02h"	"13F03h"	 "13FECh"	"13FEDh"	"13FEEh"	"13FEFh"

Page 87 of 112



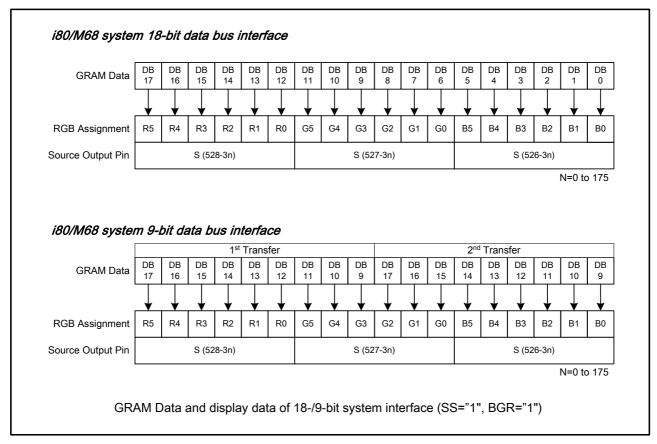


Figure 34 i80-System Interface with 18-/9-bit Data Bus (SS="1", BGR="1")

Page 88 of 112

Version: 0.30





11. Window Address Function

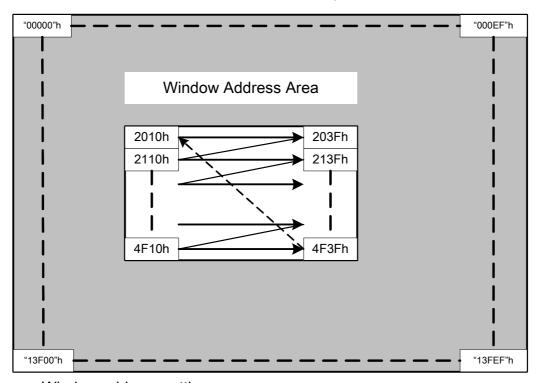
The window address function enables writing display data consecutively in a rectangular area (a window address area) made on the internal RAM. The window address area is made by setting the horizontal address register (start: HSA[7:0], end: HEA[7:0] bits) and the vertical address register (start: VSA[8:0], end: VEA[8:0] bits). The AM bit sets the transition direction of RAM address (either increment or decrement). These bits enable the ILI9325 to write data including image data consecutively not taking data wrap positions into account.

The window address area must be made within the GRAM address map area. Also, the GRAM address bits (RAM address set register) must be an address within the window address area.

[Window address setting area]

(Horizontal direction) $00H \le HSA[7:0] \le HEA[7:0] \le "EF"H$ (Vertical direction) $00H \le VSA[8:0] \le VEA[8:0] \le "13F"H$ [RAM address, AD (an address within a window address area)]] (RAM address) $HSA[7:0] \le AD[7:0] \le HEA[7:0]$ $VSA[8:0] \le AD[15:8] \le VEA[8:0]$

GRAM Address Map



Window address setting area

HSA[7:0] = 10h, HSA[7:0] = 3Fh, I/D = 1 (increment)VSA[8:0] = 20h, VSA[8:0] = 4Fh, AM = 0 (horizontal writing)

Figure 35 GRAM Access Window Map









12. Gamma Correction

ILI9325 incorporates the γ -correction function to display 262,144 colors for the LCD panel. The γ -correction is performed with 3 groups of registers determining eight reference grayscale levels, which are gradient adjustment, amplitude adjustment and fine-adjustment registers for positive and negative polarities, to make ILI9325 available with liquid crystal panels of various characteristics.

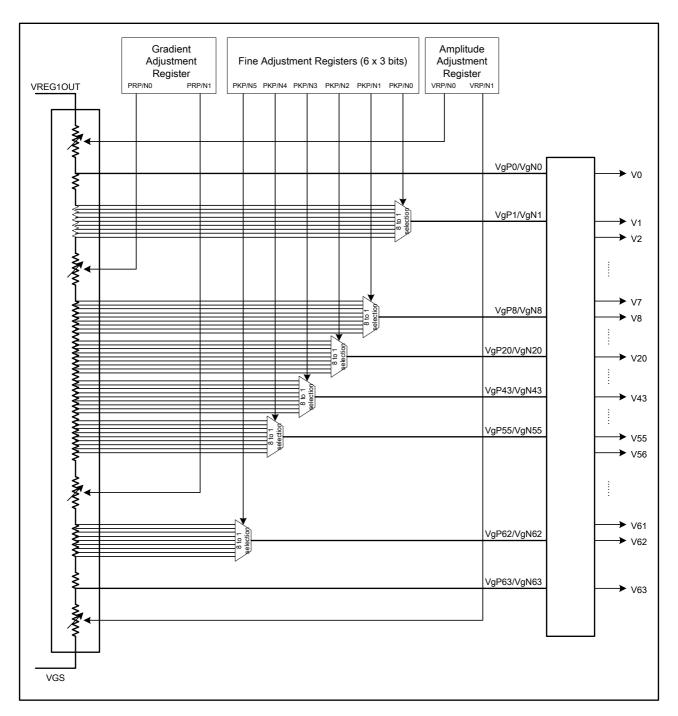


Figure 36 Grayscale Voltage Generation

Page 91 of 112



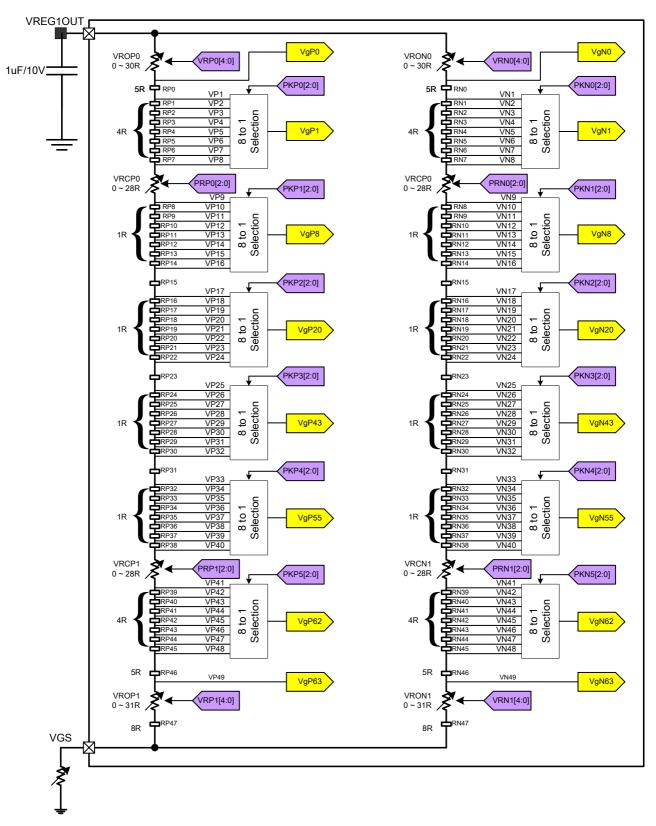


Figure 37 Grayscale Voltage Adjustment





1. Gradient adjustment registers

The gradient adjustment registers are used to adjust the gradient of the curve representing the relationship between the grayscale and the grayscale reference voltage level. To adjust the gradient, the resistance values of variable resistors in the middle of the ladder resistor are adjusted by registers PRP0[2:0]/PRN0[2:0], PRP1[2:0]/PRN1[2:0]. The registers consist of positive and negative polarity registers, allowing asymmetric drive.

2. Amplitude adjustment registers

The amplitude adjustment registers, VRP0[3:0]/VRN0[3:0], VRP1[4:0]/VRN1[4:0], are used to adjust the amplitude of grayscale voltages. To adjust the amplitude, the resistance values of variable resistors at the top and bottom of the ladder resistor are adjusted. Same as the gradient registers, the amplitude adjustment registers consist of positive and negative polarity registers.

3. Fine adjustment registers

The fine adjustment registers are used to fine-adjust grayscale voltage levels. To fine-adjust grayscale voltage levels, fine adjustment registers adjust the reference voltage levels, 8 levels for each register generated from the ladder resistor, in respective 8-to-1 selectors. Same with other registers, the fine adjustment registers consist of positive and negative polarity registers.

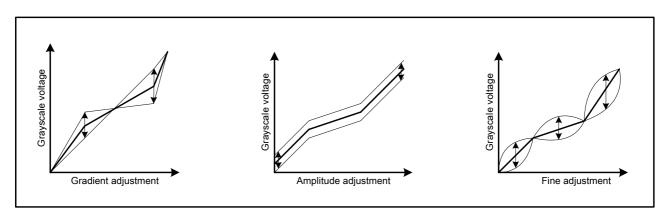


Figure 38 Gamma Curve Adjustment

Register Groups	Positive Polarity	Negative Polarity	Description
Gradient	PRP0 [2:0]	PRN0 [2:0]	Variable resistor VRCP0, VRCN0
adjustment	PRP1 [2:0]	PRN1 [2:0]	Variable resistor VRCP1, VRCN1
Amplitude	VRP0 [3:0]	VRN0 [3:0]	Variable resistor VROP0, VRON0
adjustment	VRP1 [4:0]	VRN1 [4:0]	Variable resistor VROP1, VRON1
	KP0 [2:0]	KN0 [2:0]	8-to-1 selector (voltage level of grayscale 1)
	KP1 [2:0]	KN1 [2:0]	8-to-1 selector (voltage level of grayscale 8)
Eine adjustment	KP2 [2:0]	KN2 [2:0]	8-to-1 selector (voltage level of grayscale 20)
Fine adjustment	KP3 [2:0]	KN3 [2:0]	8-to-1 selector (voltage level of grayscale 43)
	KP4 [2:0]	KN4 [2:0]	8-to-1 selector (voltage level of grayscale 55)
	KP5 [2:0]	KN5 [2:0]	8-to-1 selector (voltage level of grayscale 62)





Version: 0.30

Ladder resistors and 8-to-1 selector Block configuration

The reference voltage generating block consists of two ladder resistor units including variable resistors and 8-to-1 selectors. Each 8-to-1 selector selects one of the 8 voltage levels generated from the ladder resistor unit to output as a grayscale reference voltage. Both variable resistors and 8-to-1 selectors are controlled according to the γ -correction registers. This unit has pins to connect a volume resistor externally to compensate differences in various characteristics of panels.

Variable resistors

ILI9325 uses variable resistors of the following three purposes: gradient adjustment (VRCP(N)0/VRCP(N)1); amplitude adjustment (1) (VROP(N)0); and the amplitude adjustment (2) (VROP(N)1). The resistance values of these variable resistors are set by gradient adjustment registers and amplitude adjustment registers as follows.

Gradient ad	justment	Amplitude ad	justment (1)	Amplitude adjustment (2		
PRP(N)0/1[2:0] Register	VRCP(N)0 Resistance	VRP(N)0[3:0] Register	VROP(N)0 Resistance	VRP(N)1[4:0] Register	VROP(N)1 Resistance	
000	0R	0000	0R	00000	0R	
001	4R	0001	2R	00001	1R	
010	8R	0010	4R	00010	2R	
011	12R	:	:	:	:	
100	16R	:	:	:	:	
101	20R	1101	26R	11101	29R	
110	24R	1111	28R	11110	30R	
111	28R	1111	30R	11111	31R	

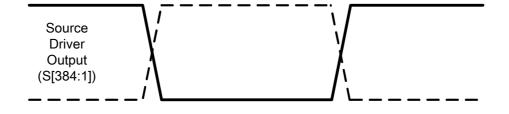
8-to-1 selectors

The 8-to-1 selector selects one of eight voltage levels generated from the ladder resistor unit according to the fine adjustment register and output the selected voltage level as a reference grayscale voltage (VgP(N)1~6). The table below shows the setting in the fine adjustment register and the selected voltage levels for respective reference grayscale voltages.

Fine adjust	Fine adjustment registers and selected voltage									
Register		Selected Voltage								
KP(N)[2:0]	VgP(N)1	VgP(N)8	VgP(N)20	VgP(N)43	VgP(N)55	VgP(N)62				
000	VP(N)1	VP(N)9	VP(N)17	VP(N)25	VP(N)33	VP(N)41				
001	VP(N)2	VP(N)10	VP(N)18	VP(N)26	VP(N)34	VP(N)42				
010	VP(N)3	VP(N)11	VP(N)19	VP(N)27	VP(N)35	VP(N)43				
011	VP(N)4	VP(N)12	VP(N)20	VP(N)28	VP(N)36	VP(N)44				
100	VP(N)5	VP(N)13	VP(N)21	VP(N)29	VP(N)37	VP(N)45				
101	VP(N)6	VP(N)14	VP(N)22	VP(N)30	VP(N)38	VP(N)46				
110	VP(N)7	VP(N)15	VP(N)23	VP(N)31	VP(N)39	VP(N)47				
111	VP(N)8	VP(N)16	VP(N)24	VP(N)32	VP(N)40	VP(N)48				







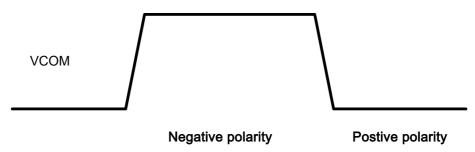


Figure 39 Relationship between Source Output and VCOM

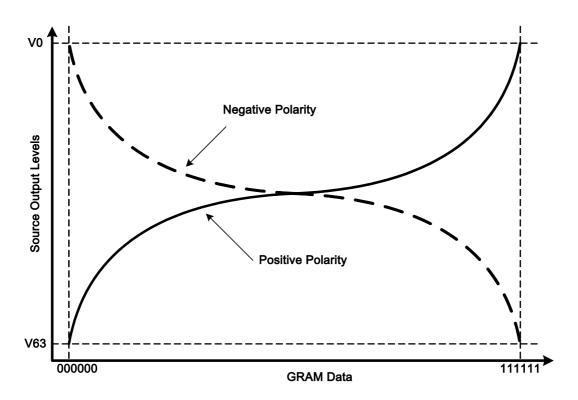


Figure 40 Relationship between GRAM Data and Output Level

Page 95 of 112





13. Application

13.1. Configuration of Power Supply Circuit

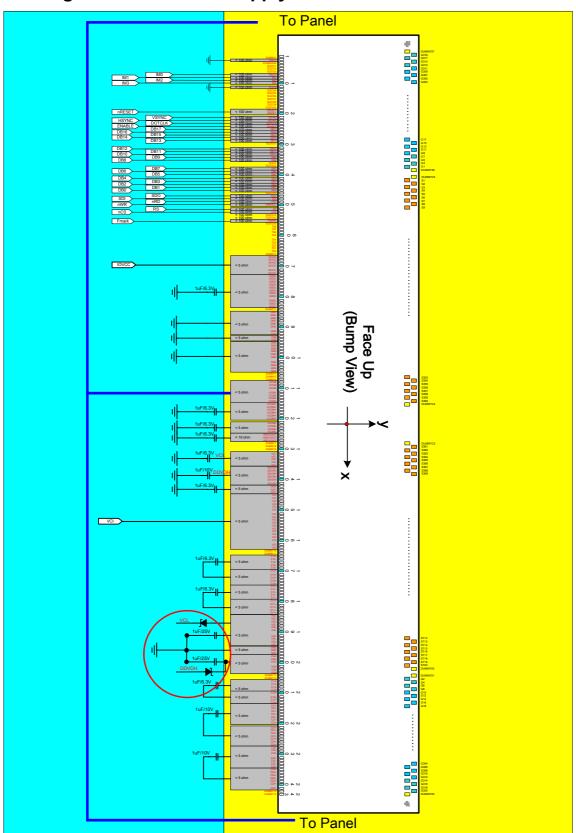


Figure 41 Power Supply Circuit Block

Page 96 of 112





The following table shows specifications of external elements connected to the ILI9325's power supply circuit.

Items	Recommended Specification	Pin connection				
	6.3V	VREG1OUT, VCI1, VDDD, VCL, VCOMH,				
Capacity	0.37	VCOML, C11+/-, C12+/-, C13+/-,				
1 μF (B characteristics)	10V	DDVDH, C21+/-, C22+/-				
	25V	VGH, VGL				
Schottky diode	VF<0.4V/20mA at 25°C, VR ≥30V					
	(Recommended diode: HSC226)	(GND – VGL), (Vci – VGH), (Vci – DDVDH)				

Page 97 of 112

Version: 0.30





13.2. Display ON/OFF Sequence





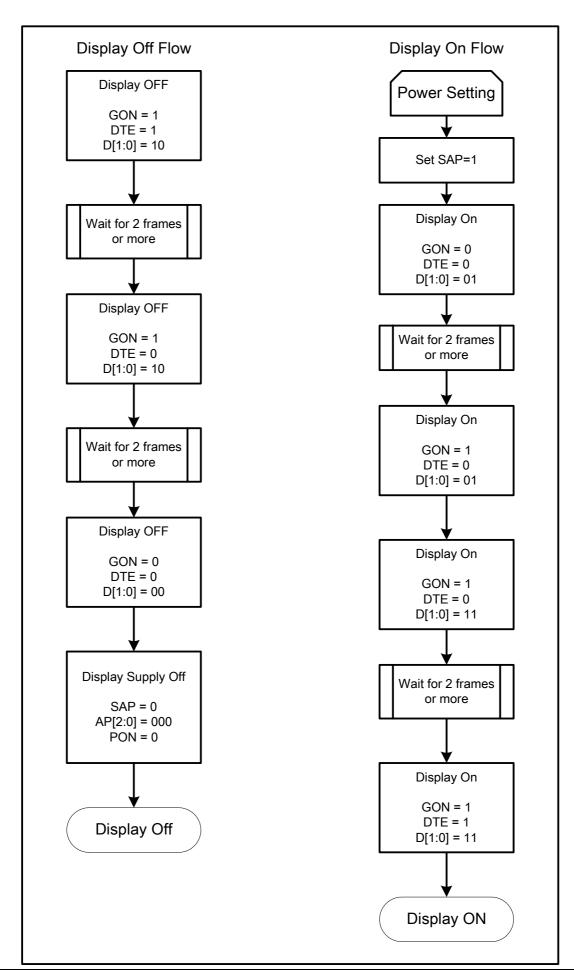






Figure 42 Display On/Off Register Setting Sequence

13.3. Standby and Sleep Mode

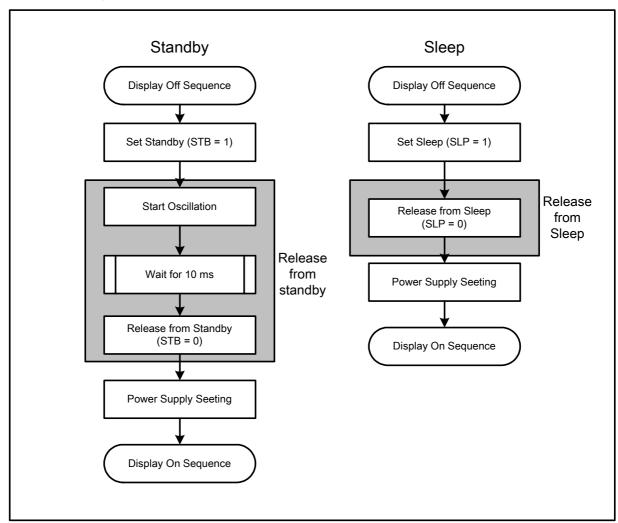


Figure 43 Standby/Sleep Mode Register Setting Sequence

Page 100 of 112 Version: 0.30





Version: 0.30

13.4. Power Supply Configuration

When supplying and cutting off power, follow the sequence below. The setting time for oscillators, step-up circuits and operational amplifiers depends on external resistance and capacitance.

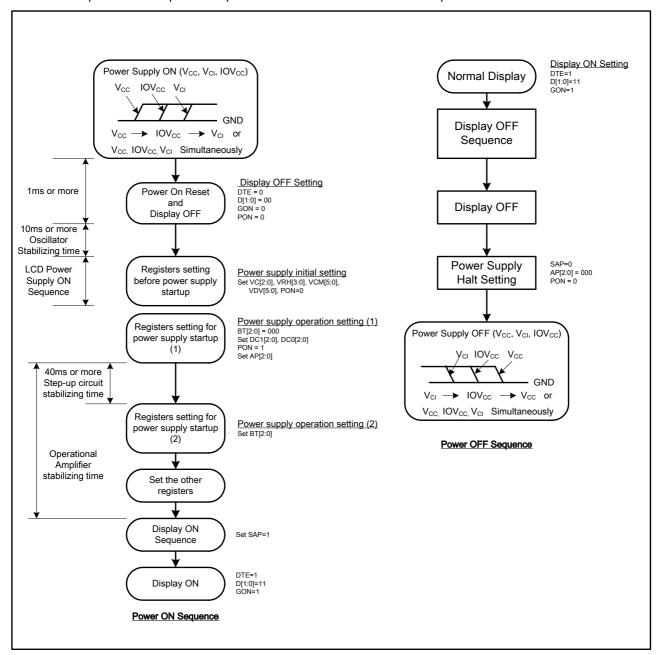


Figure 44 Power Supply ON/OFF Sequence

Page 101 of 112





13.5. Voltage Generation

The pattern diagram for setting the voltages and the waveforms of the voltages of the ILI9325 are as follows.

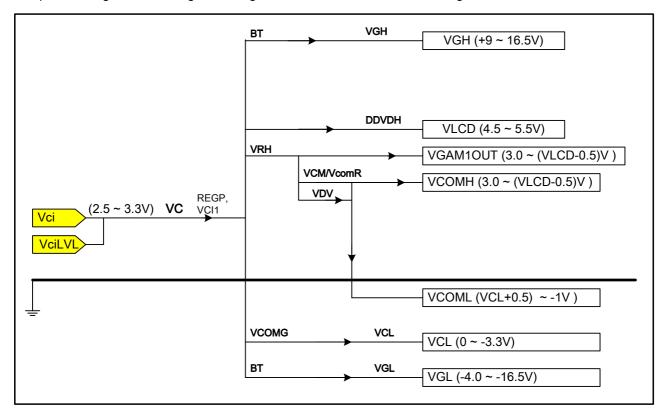


Figure 45 Voltage Configuration Diagram

Note: The DDVDH, VGH, VGL, and VCL output voltage levels are lower than their theoretical levels (ideal voltage levels) due to current consumption at respective outputs. The voltage levels in the following relationships (DDVDH - VREG1OUT) > 0.5V, (VCOML1 - VCL) > 0.5V, (VCOML2 - VCL) > 0.5V are the actual voltage levels. When the alternating cycles of VCOM are set high (e.g. the polarity inverts every line cycle), current consumption is large. In this case, check the voltage before use.

Page 102 of 112





13.6. Applied Voltage to the TFT panel

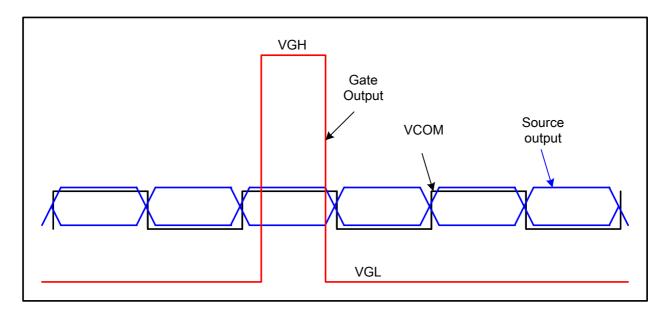


Figure 46 Voltage Output to TFT LCD Panel

13.7. Partial Display Function

The ILI9325 allows selectively driving two partial images on the screen at arbitrary positions set in the screen drive position registers.

The following example shows the setting for partial display function:

	Base Image Display Setting						
BASEE	0						
NL[5:0]	6'h27						
	Partial Image 1 Display Setting						
PTDE0	1						
PTSA0[8:0]	9'h000						
PTEA0[8:0]	9'h00F						
PTDP0[8:0]	9'h080						
	Partial Image 2 Display Setting						
PTDE1	1						
PTSA1[8:0]	9'h020						
PTEA1[8:0]	9'h02F						
PTDP1[8:0]	9'h0C0						

Page 103 of 112



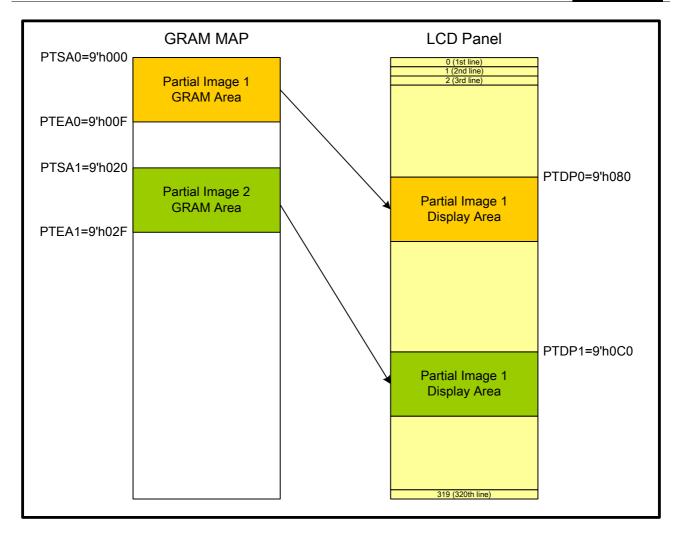


Figure 47 Partial Display Example

13.8. Resizing Function

ILI9325 supports resizing function (x1/2, x1/4), which is performed when writing image data to GRAM. The resizing function is enabled by setting a window address area and the RSZ bit which represents the resizing factor (x1/2, x1/4) of image. The resizing function allows the system to transfer the original-size image data into the GRAM with resized image data.

Page 104 of 112



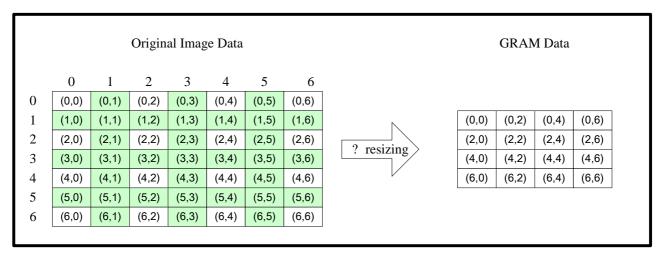


Figure 48 Data transfer in resizing

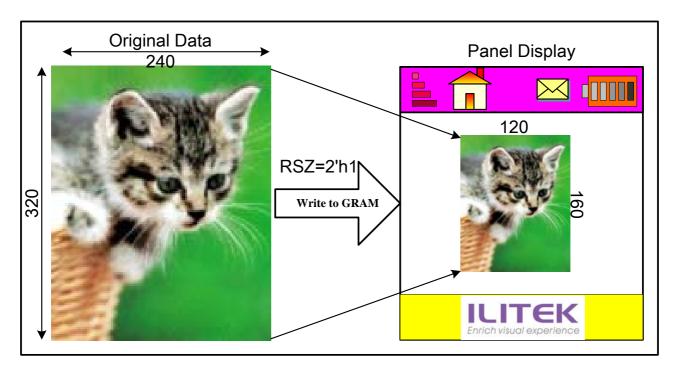
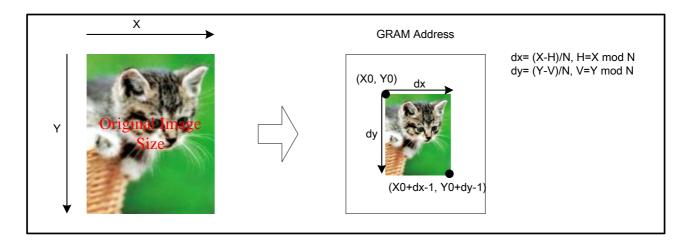


Figure 49 Resizing Example

Original Image Size (X × Y)	Resized Imag	ge Resolution		
Original image Size (X ^ 1)	1/2 (RSZ=2'h1)	1/4 (RSZ=2'h3)		
640 × 480	320 × 240	160 × 120		
352 × 288	176 × 144	88 × 72		
320 × 240	160 × 120	80× 60		
176 × 144	88 × 72	44× 36		
120 × 160	60× 80	30 × 40		
132 × 132	66 × 66	33 × 33		

The RSZ bit sets the resizing factor of an image. When setting a window address area in the internal GRAM, the GRAM window address area must fit the size of resized image. The following example show the resizing setting.





Original image data number in horizontal direction		Х
Original image data number in Vertical direction		Y
Resizing Ration		1/N
Resizing Setting	RSZ	N-1
Remainder pixels in horizontal direction	RCH	Н
Remainder pixels in vertical direction	RCV	V
GRAM writing start address	AD	(x0, y0)
	HSA	x0
CPAM window sotting	HEA	V (x0, y0) x0 x0+dx-1
GRAM window setting	AD (x0, y0) HSA x0 HEA x0+dx-1	
	VEA	y0+dy-1





Version: 0.30

14. Electrical Characteristics

14.1. Absolute Maximum Ratings

The absolute maximum rating is listed on following table. When ILI9325 is used out of the absolute maximum ratings, the ILI9325 may be permanently damaged. To use the ILI9325 within the following electrical characteristics limit is strongly recommended for normal operation. If these electrical characteristic conditions are exceeded during normal operation, the ILI9325 will malfunction and cause poor reliability.

Item	Symbol	Unit	Value	Note
Power supply voltage (1)	VCC, IOVCC	V	-0.3 ~ + 4.6	1, 2
Power supply voltage (1)	VCI - GND	V	-0.3 ~ + 4.6	1, 4
Power supply voltage (1)	DDVDH - GND	V	-0.3 ~ + 6.0	1, 4
Power supply voltage (1)	GND -VCL	V	-0.3 ~ + 4.6	1
Power supply voltage (1)	DDVDH - VCL	V	-0.3 ~ + 9.0	1, 5
Power supply voltage (1)	VGH - GND	V	-0.3 ~ + 18.5	1, 5
Power supply voltage (1)	GND - VGL	V	-0.3 ~ + 18.5	1, 6
Input voltage	Vt	V	-0.3 ~ VCC+ 0.3	1
Operating temperature	Topr	°C	-40 ~ + 85	8, 9
Storage temperature	Tstg	°C	-55 ~ + 110	8, 9

Notes:

- 1. VCC, DGND must be maintained
- 2. (High) (VCC = VCC) ≥ DGND (Low), (High) IOVCC ≥ DGND (Low).
- 3. Make sure (High) VCI ≥ DGND (Low).
- 4. Make sure (High) DDVDH ≥ ASSD (Low).
- 5. Make sure (High) DDVDH ≥ VCL (Low).
- 6. Make sure (High) VGH ≥ ASSD (Low).
- 7. Make sure (High) ASSD ≥ VGL (Low).
- 8. For die and wafer products, specified up to 85°C.
- 9. This temperature specifications apply to the TCP package

Page 107 of 112





14.2. DC Characteristics

(VCC = VCI=2.40 ~ 3.0V, IOVCC = 1.65 ~ 3.30V, Ta= -40 ~ 85 °C)

Item	Symbol	Unit	Test Condition	Min.	Тур.	Max.	Note
Input high voltage	V _{IH}	V	VCC= 1.8 ~ 3.3V	0.8*IOVCC	-	IOVCC	-
Input low voltage	V _{IL}	V	VCC= 1.8 ~ 3.3V	-0.3	-	0.2*IOVCC	-
Output high voltage(1) (DB0-17 Pins)	V_{OH1}	V	IOH = -0.1 mA	0.8*IOVCC	-	-	-
Output low voltage (DB0-17 Pins)	V _{OL1}	V	IOVCC=1.65~3.3V VCC= 2.4 ~ 3.3V IOL = 0.1mA	-	-	0.2*IOVCC	-
I/O leakage current	ILI	μΑ	Vin = 0 ~ VCC	-0.1	-	0.1	-
Current consumption during normal operation $(V_{CC} - DGND)$	I _{OP}	μΑ	VCC=2.8V , Ta=25°C , fOSC = 512KHz (Line) GRAM data = 0000h	-	100 (VCC)	-	-
Current consumption during standby mode $(V_{CC} - DGND)$	I _{ST}	μΑ	VCC=2.8V , Ta=25 °C	-	30	50	1
LCD Drive Power Supply Current (DDVDH-DGND)	ILCD	mA	VCC=2.8V , VREG1OUT =4.8V DDVDH=5.2V , Frame Rate: 70Hz, line-inversion, Ta=25 °C, GRAM data = 0000h,	-	3.0	-	1
LCD Driving Voltage (DDVDH-DGND)	DDVDH	V	-	4.5	-	6	-
Output voltage deviation		mV	-	-	10	-	-
Dispersion of the Average Output Voltage	V	mV	-	-10	-	10	-

14.3. Reset Timing Characteristics

Reset Timing Characteristics (VCC = 1.8 ~ 3.3 V, IOVCC = 1.65 ~ 3.3 V)

Item	Symbol	Unit	Min.	Тур.	Max.
Reset low-level width	t _{RES}	ms	1	-	-
Reset rise time	t _{rRES}	μs	-	-	10



14.4. LCD Driver Output Characteristics

Item	Symbol	Timing diagram	Min.	Тур.	Max.	Unit
Driver output delay time	tdd	VCC=2.8V, DDVDH=5.0V, VREG1OUT =4.8V, RC oscillation: fosc =512kHz (320 lines), Ta=25°C REV=0, SAP=010, AP=010, 0N14-00=0, 0P14-00=0, MP52-00=0, MN52-00=0, CP12-00=0, CN12-00=0, Load resistance R=10kΩ, Load capacitance C=20pF • when the level changes from a same grayscale level on all pins • Time to reach +/-35mV when VCOM polarity inverts	-	35	-	μs

14.5. AC Characteristics





14.5.1. i80-System Interface Timing Characteristics

Normal Write Mode (IOVCC = 1.65~3.3V, VCC=2.4~3.3V)

	Item	Symbol	Unit	Min.	Тур.	Max.	Test Condition
Bue evele time	Write	tcycw	ns	100	-	-	-
Bus cycle time	Read	t _{CYCR}	ns	300	-	-	-
Write low-level pu	PW_{LW}	ns	50	-	500	-	
Write high-level p	ulse width	PW_{HW}	ns	50	-	-	-
Read low-level pu	PW_{LR}	ns	150	-	-	-	
Read high-level po	PW_{HR}	ns	150	-	-		
Write / Read rise / fall time		t _{WRr} /t _{WRf}	ns	-	-	25	
Catum time	Write (RS to nCS, E/nWR)		ns	10	-	-	
Setup time	Read (RS to nCS, RW/nRD)	t _{AS}		5	-	-	
Address hold time		t _{AH}	ns	5	-	-	
Write data set up t	t _{DSW}	ns	10	-	-		
Write data hold time		t _H	ns	15	-	-	
Read data delay ti	t _{DDR}	ns	-	-	100		
Read data hold tin	ne	t _{DHR}	ns	5	-	-	

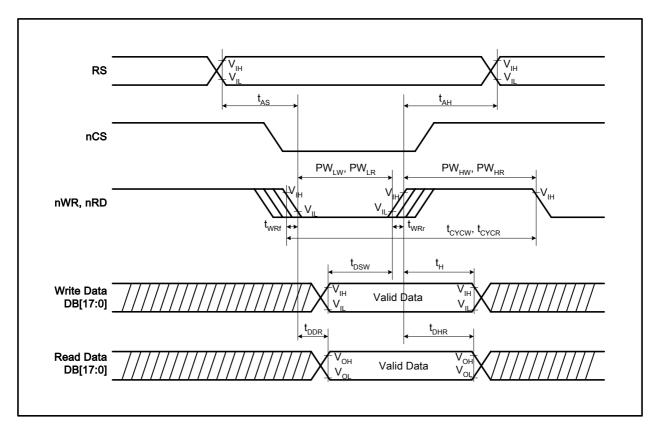


Figure 50 i80-System Bus Timing

14.5.2. Serial Data Transfer Interface Timing Characteristics

(IOVCC= 1.653.3V and VCC=2.4~3.3V)

Item	Symbol	Unit	Min.	Тур.	Max.	Test Condition	
Serial clock cycle time	Write (received)	tscyc	μs	100	-	-	

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Item	Item			Min.	Тур.	Max.	Test Condition
	Read (transmitted)	tscyc	μs	200	-	-	
Serial clock high - level	Write (received)	t _{sch}	ns	40	ı	-	
pulse width	Read (transmitted)	t _{sch}	ns	100	ı	-	
Serial clock low - level	Write (received)	t _{SCL}	ns	40	ı	-	
pulse width	Read (transmitted)	t _{SCL}	ns	100	ı	-	
Serial clock rise / fall time	Serial clock rise / fall time			ı	ı	5	
Chip select set up time		t _{CSU}	ns	10	ı	-	
Chip select hold time		t _{CH}	ns	50	ı	-	
Serial input data set up ti	me	t _{SISU}	ns	20	ı	-	
Serial input data hold tim	t _{SIH}	ns	20	i	-		
Serial output data set up	t _{SOD}	ns	1	-	100		
Serial output data hold til	ne	t _{soн}	ns	5	-	-	

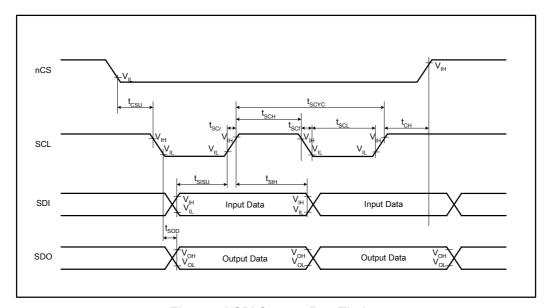


Figure 51 SPI System Bus Timing

14.5.3. RGB Interface Timing Characteristics

18/16-bit Bus RGB Interface Mode (IOVCC = 1.65 ~ 3.3V, VCC=2.4~3.3V)

Item	Symbol	Unit	Min.	Тур.	Max.	Test Condition
VSYNC/HSYNC setup time	t _{SYNCS}	ns	0	-	-	-
ENABLE setup time	t _{ENS}	ns	10	-	-	-
ENABLE hold time	t _{ENH}	ns	10	-	-	-
PD Data setup time	t _{PDS}	ns	10	-	-	-
PD Data hold time	t _{PDH}	ns	40	-	-	-
DOTCLK high-level pulse width	PWDH	ns	40	-	-	-
DOTCLK low-level pulse width	PWDL	ns	40	-	-	-
DOTCLK cycle time	t _{CYCD}	ns	100	-	-	-
DOTCLK, VSYNC, HSYNC, rise/fall time	t _{rghr} , t _{rghf}	ns	-	-	25	-

6-bit Bus RGB Interface Mode (IOVCC = 1.65 ~ 3.3V, VCC=2.4~3.3V)

Item	Symbol	Unit	Min.	Тур.	Max.	Test Condition
VSYNC/HSYNC setup time	tsyncs	ns	0	-	-	-
ENABLE setup time	t _{ENS}	ns	10	-	-	-



ENABLE hold time	t _{ENH}	ns	10	-	-	-
PD Data setup time	t _{PDS}	ns	10	ı	ı	-
PD Data hold time	t _{PDH}	ns	30	-	-	-
DOTCLK high-level pulse width	PWDH	ns	30	-	-	-
DOTCLK low-level pulse width	PWDL	ns	30	ı	ı	-
DOTCLK cycle time	tcycd	ns	80	ı	ı	-
DOTCLK, VSYNC, HSYNC, rise/fall time	t _{rghr} , t _{rghf}	ns	-	-	25	-

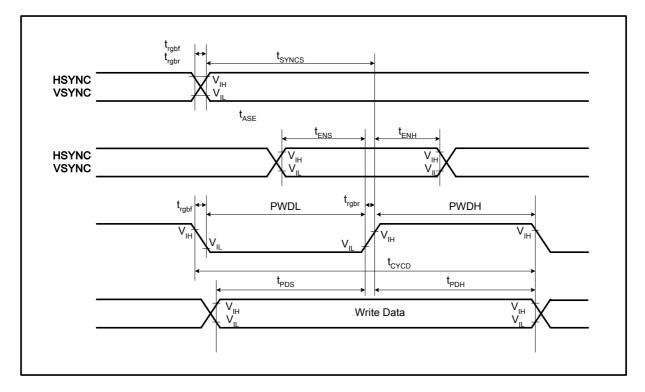


Figure 52 RGB Interface Timing

Page 111 of 112





15. Revision History

Version No.	Date	Page	Description
V0.28	2007/07/05	96	Modify the FPC circuit
V0.29	2007/07/12	15	Modify the alignment mark pattern
V0.30	2007/09/07	55	Modify the frame rate setting of R2Bh register

Page 112 of 112