AMP DISPLAY INC.

A Brighter Solution

SPECIFICATIONS

CUSTOMER	
CUSTOMER PART NO.	
AMP PART NO.	AM-320480B3TZQW-00H
APPROVED BY	
DATE	

☑ **Approved For Specifications**

☐ **Approved For Specifications & Sample**

AMP DISPLAY INC

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RECORD OF REVISION

Revision Date	Page	Contents	Editor
2013/05/30	-	New Release	Bob

1 Features

LCD 3.5 inch Amorphous-TFT-LCD (Thin Film Transistor Liquid Crystal Display) for mobile-phone or handy electrical equipments.

Construction: 3.5” a-Si color TFT-LCD, White LED driver & Backlight.
Main LCD:

2.1 Amorphous-TFT 3.5 inch display, normally black type

2.2 320(RGB) X480 dots Matrix, 1/480 Duty.

2.3 Main LCD Driver IC: ILI9488

2.4 262K: Red-6bit, Green-6bit, Blue-6bit (18-bit interface)

(3) Interface: RGB Interface

2 General Specification

Item	Specification
LCD size	3.5 inch(Diagonal)
Panel type	a-Si TFT active matrix
Resolution	320 X 3 (RGB) X 480
Driver IC	ILI9488
Display mode	Normally Black, Transmissive
Dot pitch	0.051(W) X 0.153(H) mm
Active area	48.96(W) X 73.44(H)
Module size	58.0(W) X 87.0X2.72(D)mm
Color arrangement	RGB-stripe
Interface	RGB 18Bits

3 Absolute max. Ratings and environment

3-1 Absolute max. ratings

Item	Symbol	Min.	Max.	Unit
Power voltage	VCC – GND	-0.3	+4.6	V
Power voltage	VLED – GND	-0.3	+6.5	V
Input voltage	VIN	-0.5	VCC+0.3	V

3-2 Environment

Item	Specifications	Remarks
Storage temperature	Max. +80 °C Min. -30 °C	Note 1: Non-condensing
Operating temperature	Max. +70 °C Min. -20 °C	Note 1: Non-condensing

Note 1：

Ta+40≦ ℃：Max.85%RH

Ta＞+40 ℃：The max. Humidity should not exceed the humidity with 40 oC 85%RH.

Electrical specifications

4-1 Electrical characteristics of LCM

(V_{CC}=3.0V, Ta=25 °C)

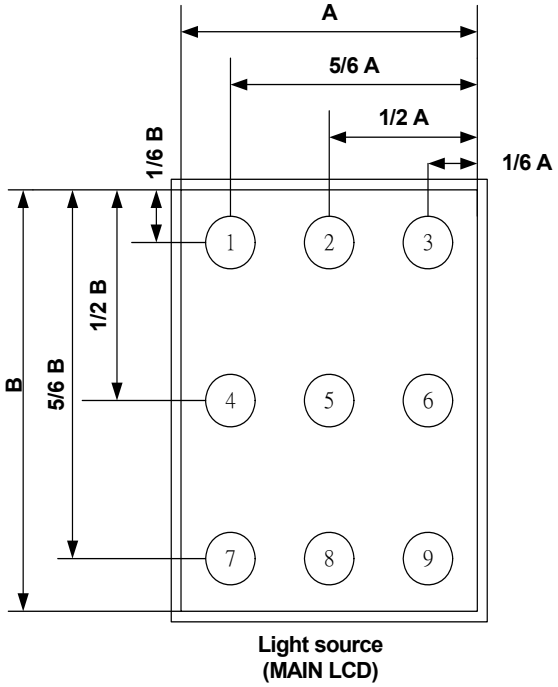
Item	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input power voltage	V_{CC}		2.5	2.8	3.3	V
LED driver input voltage	V_{LED}		2.5	3.3	6	
High-level input voltage	V_{IHC}		0.8V_{CC}		V_{CC}	V
Low-level input voltage	V_{ILC}		0		0.2V_{CC}	V
Consumption current of VCC	I_{CC}	LED OFF	-	T.B.D	-	mA
Consumption current of VLED	I_{LED}	V_{LED}=3.3V	-	140	-	mA

※ 1. 1/480 duty.

4-2 LED back light specification

Item	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Forward voltage	V_f	I_f =15mA	21	22.4	24.5	V
Reverse voltage	V_r		-	-	30	V
Forward current	I_f	7-chip Serial	10	15	20	mA
Power Consumption	P_{BL}	I_f =15mA	-	336	-	mW
Uniformity (with L/G)	-	I_f=15mA	75%*1	-	-	
Bare LED Luminous intensity	I_f	I_f =15mA	3750	-	-	cd/m^2
Color coordinate (Center point)	X	I_f =15mA	0.275	-	0.345	
	Y		0.275	-	0.345	
Luminous color	White					
Chip connection	7 chip Serial connection					

Bare LED measure position:



*1 Uniformity (LT): $\frac{Min(P1 \sim P9)}{Max(P1 \sim P9)} \times 100 \geq 80\%$

5 Optical characteristics

Main LCD

5-1 Optical characteristics

(1/480 Duty in case except as specified elsewhere Ta = 25°C)

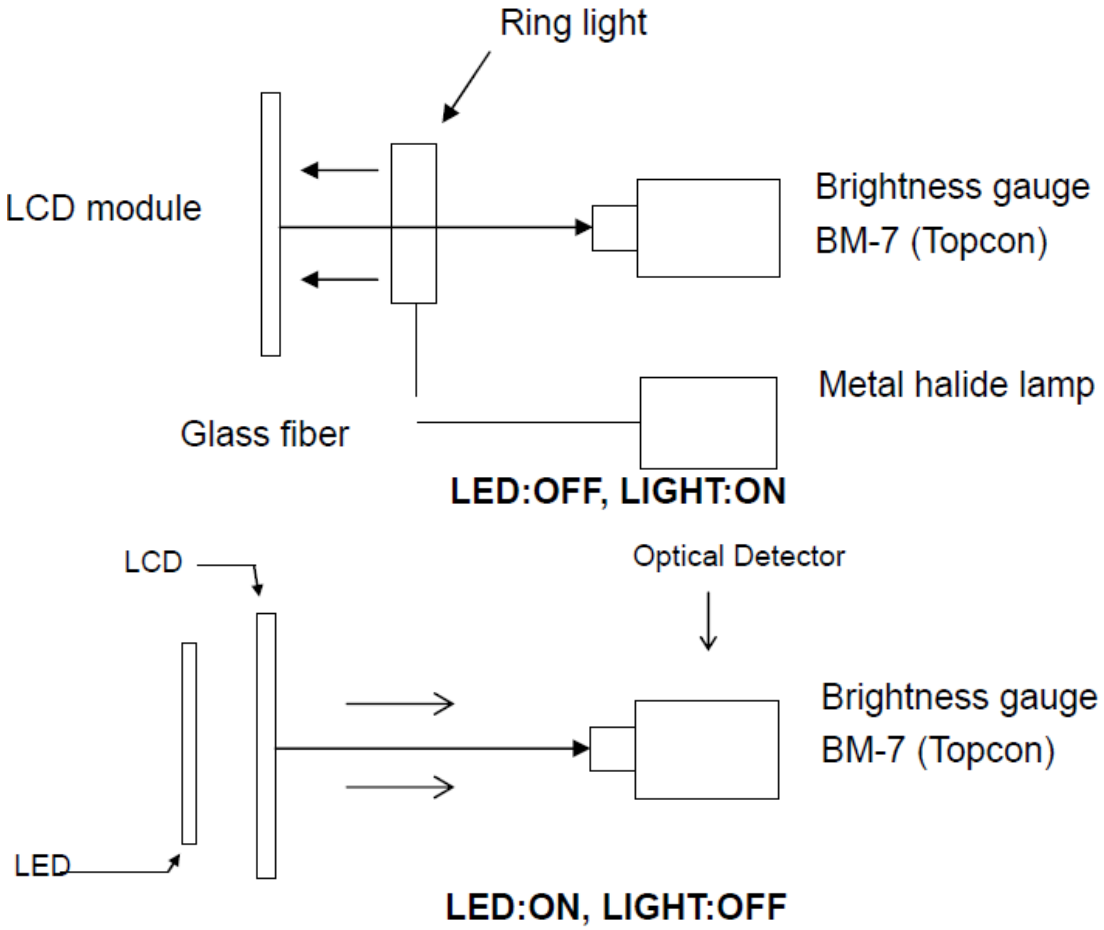
LED backlight transmissive module:

Item	Symbol	Temp.	Min.	Std.	Max.	Unit	Conditions
Response time	Tr	25 °C	-	10	20	ms	θ=0 °° ,φ=0 ° (Note 2)
	Tf	25 °C	-	15	30		
Contrast ratio	CR	25 °C	400	700	-	-	θ=0 °, φ=0 ° LED:ON, LIGHT:OFF (Note 4)
Transmittance	T	25 °C	-	4.0	-	%	
Visual angle range front and rear	θ	25 °C	(θf) 80 (θb) 80			De-gree	φ= 0°, CR≧10 LED:ON LIGHT:OFF (Note 3)
Visual angle range left and right	θ	25 °C	(θl) 80 (θr) 80			De-gree	φ=90°, CR≧10 LED:ON LIGHT:OFF (Note 3)
Brightness		25 °C	300	350	-	Cd/m2	V_{LED}=22.4, 15mA Full White pattern
Life time		25 °C	30k	-	-	Hrs	

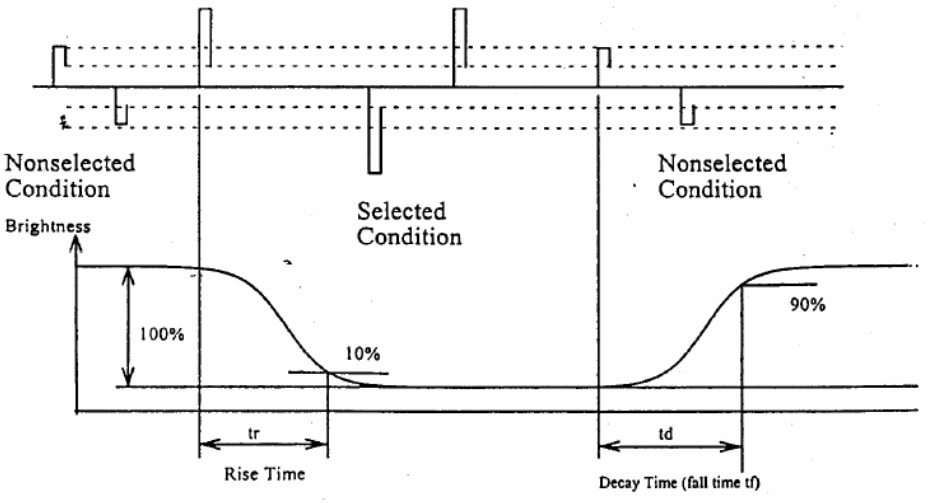
5-2 CIE (x, y) chromaticity (1/320 Duty Ta = 25°C)

Item	Symbol	Transmissive			Conditions
		Min.	Typ.	Max.	
Red	X	0.604	0.654	0.704	θ=0° ,φ=0°
	Y	0.276	0.326	0.376	
Green	X	0.221	0.271	0.321	θ=0° ,φ=0°
	Y	0.536	0.586	0.636	
Blue	X	0.100	0.150	0.200	θ=0° ,φ=0°
	Y	0.033	0.083	0.133	
White	X	0.256	0.306	0.356	θ=0° ,φ=0°
	Y	0.268	0.318	0.368	

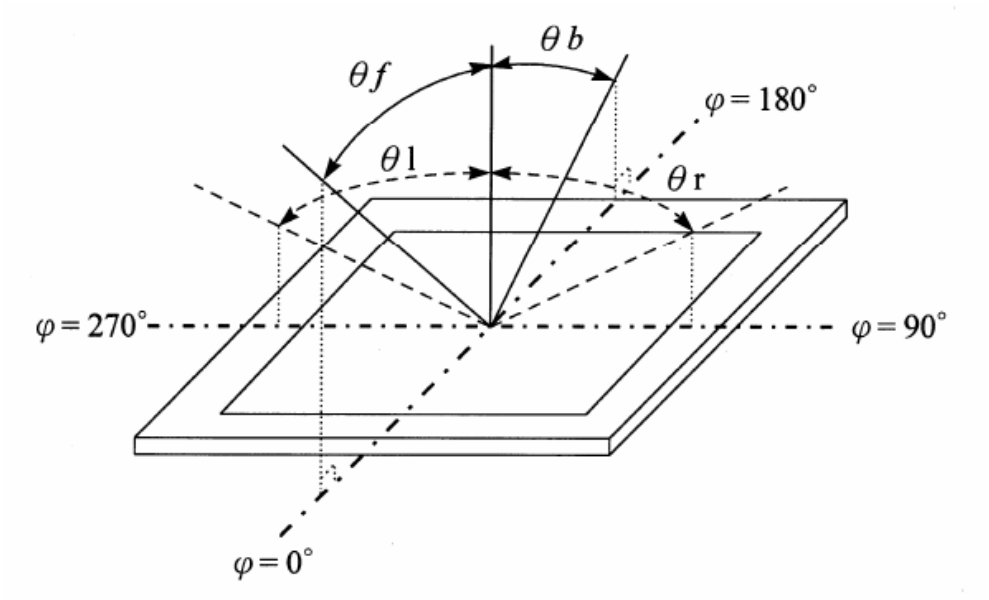
NOTE 1: Optical characteristic measurement system



NOTE 2: Response tome definition



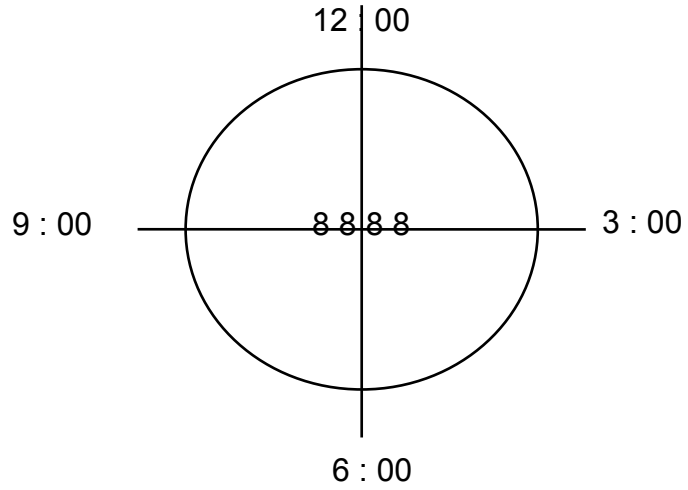
NOTE 3: φ、θ definition



NOTE 4: Contrast definition

Contrast Ratio (CR) = (White) Luminance of ON ÷ (Black) Luminance of OFF

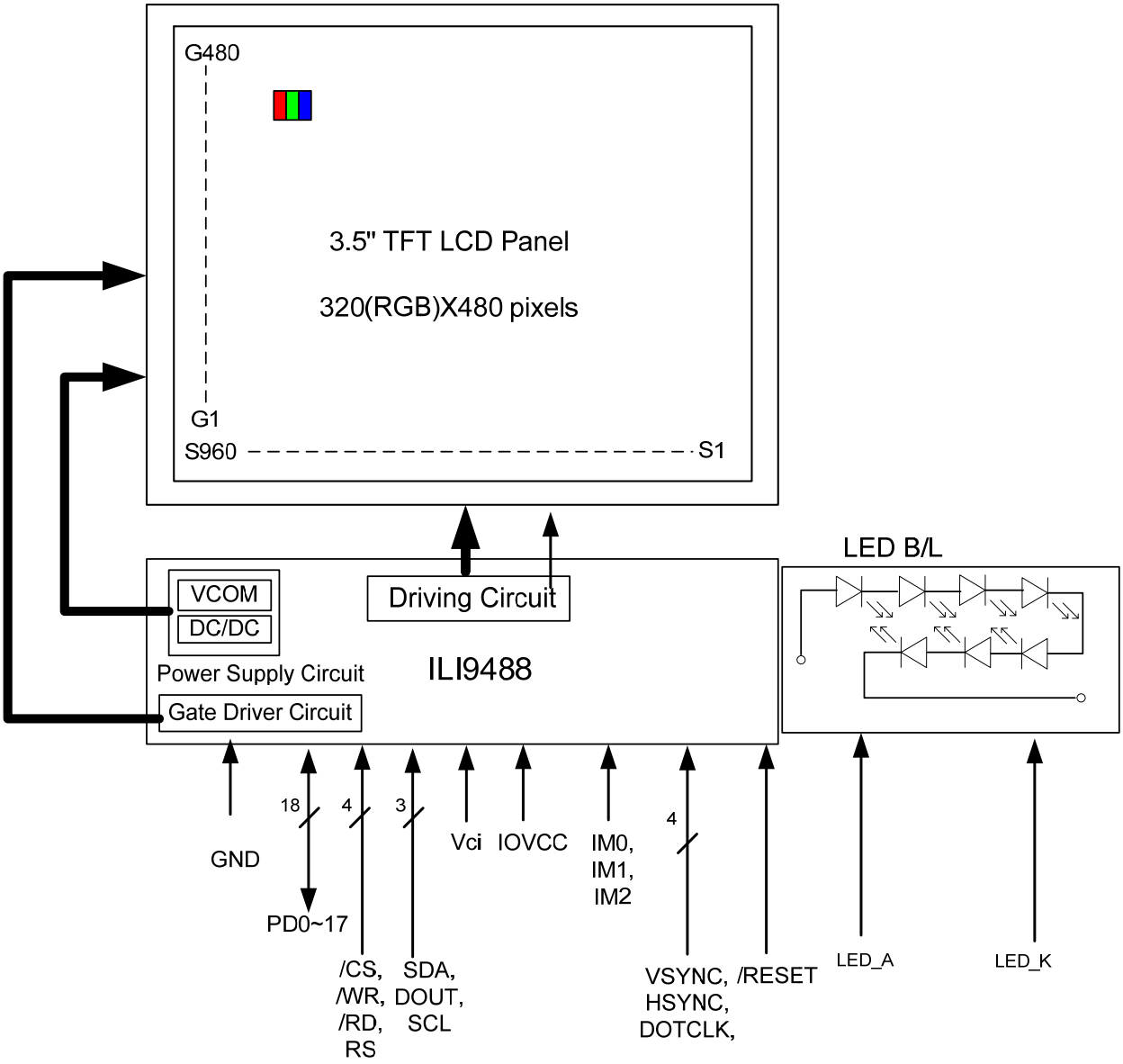
NOTE 5: Visual angle direction priority



6 Block Diagram

Block diagram (Main LCD)

Display format	:	A-Si TFT, Normally Black type
Display composition	:	320 x RGB x 480 dots
LCD Driver	:	ILI9488
Back light	:	White LED x 7



7 Electrical Specifications

Pin No	Symbol	Function
1	NC	No Connection
2	GND	Ground
3	VCI	Power supply to liquid crystal power supply analog circuit. Connect to external power supply (VCI=2.5~3.3V).
4	IOVCC	Power supply to interface pins Connect to external power supply (IOVCC= 1.65~3.3V).
5	/CS	Chip select input pin (“Low” enable)
6	RS	Display data / Command selection pin RS=’1’: Display data. RS=’0’: Command data. If not used, please fix this pin at GND level.
7	/WR	Write control pin. Low active signal for TFT LCD controller
8	/RD	Read control pin. Low active signal for TFT LCD controller
9	SDA	Serial data input pin
10	DOUT	Serial data output pin
11	D0/B0	These pin are data bus.
12	D1/B1	
13	D2/B2	
14	D3/B3	
15	D4/B4	
16	D5/B5	
17	D6/G0	
18	D7/G1	
19	D8/G2	
20	D9/G3	
21	D10/G4	
22	D11/G5	
23	D12/R0	
24	D13/R1	
25	D14/R2	
26	D15/R3	
27	D16/R4	
28	D17/R5	
29	DE	Data enable signal
30	DCLK	Clock signal
31	HSYNC	Horizontal sync. signal
32	VSYNC	Vertical sync. signal
33	/RESET	This signal low will reset the device and must be applied to properly initialize the chip. Signal is low active

34	IM2	Select the MPU system interface mode
35	IM1	
36	IM0	
37	GND	Power ground. Make sure GND＝0V.
38	NC	No Connection

Note1. HSYNC, VSYNC, DE, DCLK, SDA, D/CX. If not used, please fix this pin at GND level.

Note2. /WR, /RD. If not used, please connect this pin to IOVCC.

Note3. MPU system interface mode

IM2	IM1	IM0	Interface	Data Pins in Use	
				Command/Parameter	GRAM
0	0	0			
0	0	0	DBI Type B 18-bit (DB_EN = 0)	DB [7:0]	DB [17:0]: 18-bits Data
0	0	1	DBI Type B 9-bit	DB [7:0]	DB [8:0]: 9-bits Data
0	1	0	DBI Type B 16-bit	DB [7:0]	DB [15:0]: 16-bits Data
0	1	1	DBI Type B 8-bit	DB [7:0]	DB [7:0]: 8-bits Data
1	0	1	DBI Type C Option 1 (3-line SPI)	SDA/SDO	
1	1	0			
1	1	1	DBI Type C Option 3 (4-line SPI)	SDA/SDO	

8. Electrical Characteristics

8.1 AC Characteristics (MCU Interface Timing Characteristics)

8.1.1Write Cycle Sequence

The WRX signal is driven from high to low then pulled back to high during the write cycle. The host processor provides information while the display module captures the information from the host processor on the rising edge of the WRX. Figure 1 below shows the write cycle of the DBI Type B interface.

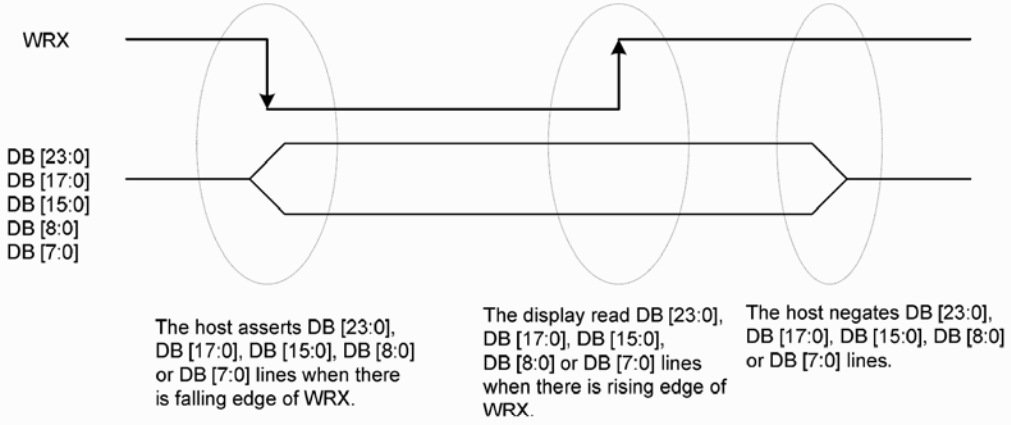


Figure 1: DBI Type B Write Cycle

Note: WRX is an unsynchronized signal that can be terminated when not being used.

When the D/CX signal is driven to low level, the input data on the interface is interpreted as command information. The D/CX signal can also be pulled to high level when the data is RAM data or command parameter.

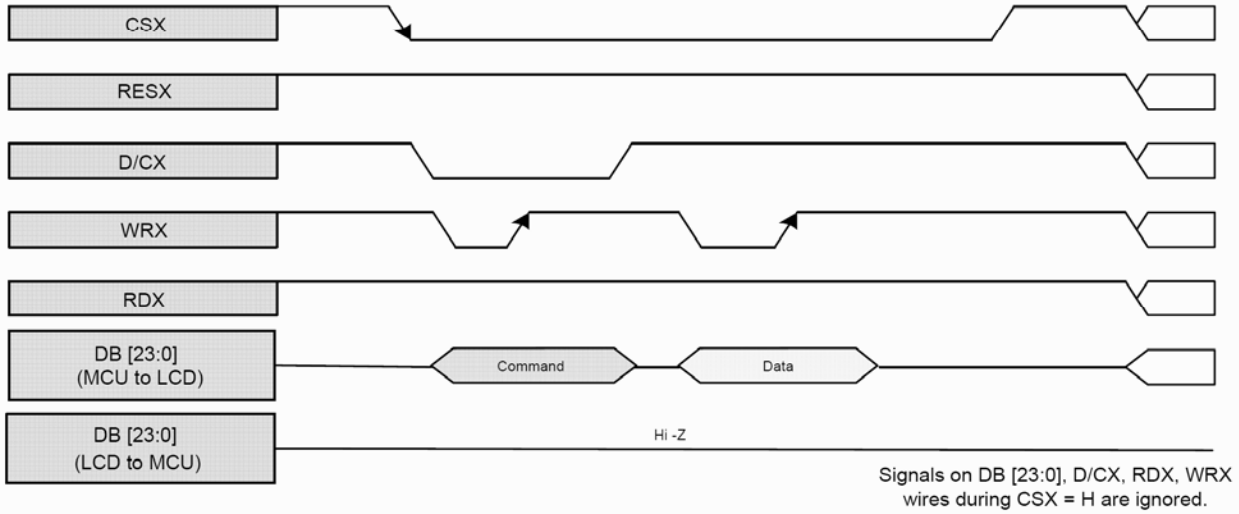


Figure 2: DBI Type B Write Cycle Sequence

8.1.2 Read Cycle Sequence

The RDX signal is driven from high to low and then pulled back to high during the read cycle. The display module provides information to the host processor while the host processor reads the display module information on the rising edge of the RDX signal. Figure 3 below shows the read cycle of the DBI Type B interface.

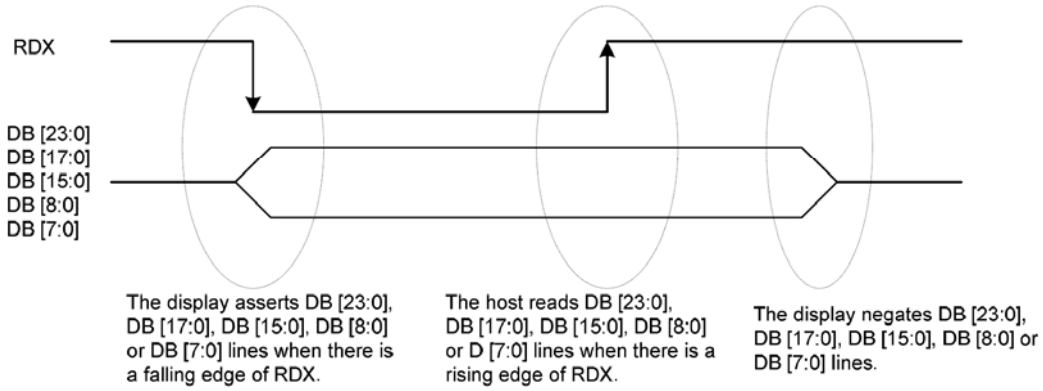


Figure 3: DBI Type B Read Cycle

Note: RDX is an unsynchronized signal that can be terminated when not being used.

When the D/CX signal is driven to the low level, the input data on the interface is interpreted as internal status or parameter data. The D/CX signal can also be pulled to a high level when the data on the interface is RAM data or a command parameter data.

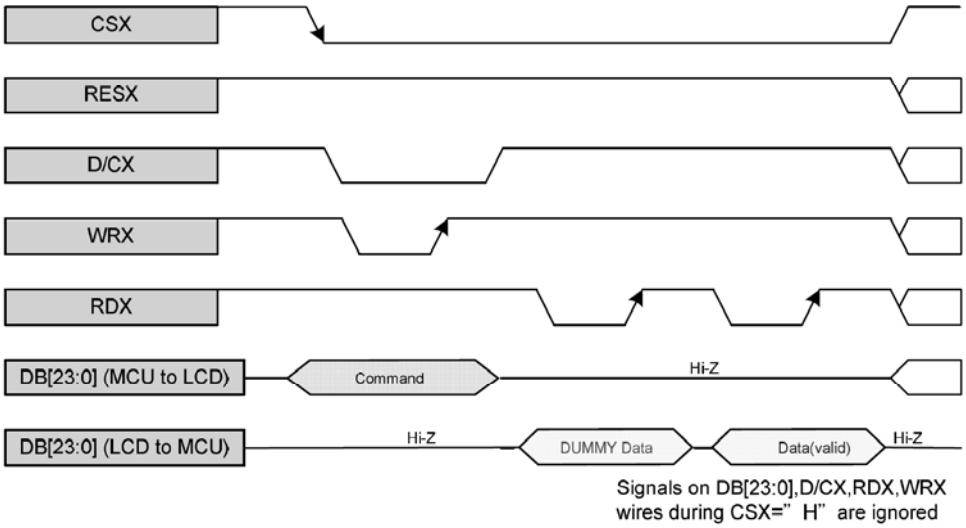


Figure 4: DBI Type B Read Cycle Sequence

Note: Read Data is only valid when the D/CX input is pulled high. If the D/CX signal is driven to low during the read cycle then the display information outputs will be High-Z.

8.2 AC Characteristics (Serial Interface Timing Characteristics)

8.2.1 Write Cycle Sequence

3-line Serial Interface Data Format

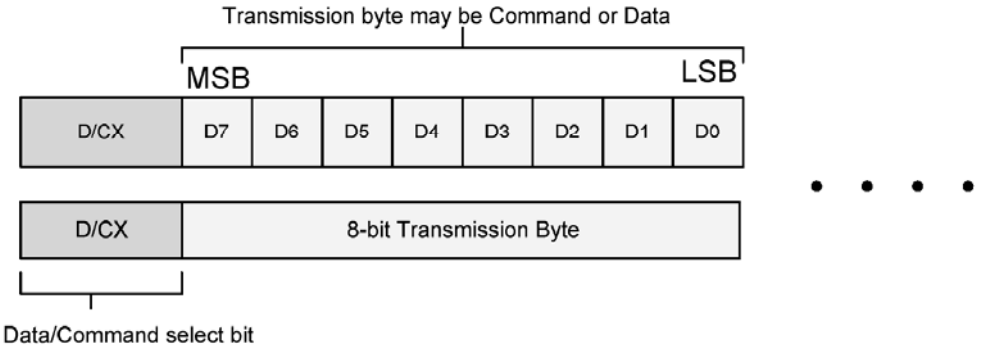


Figure 5: DBI Type C (Option 1) Data Format

3-line Serial Interface Protocol

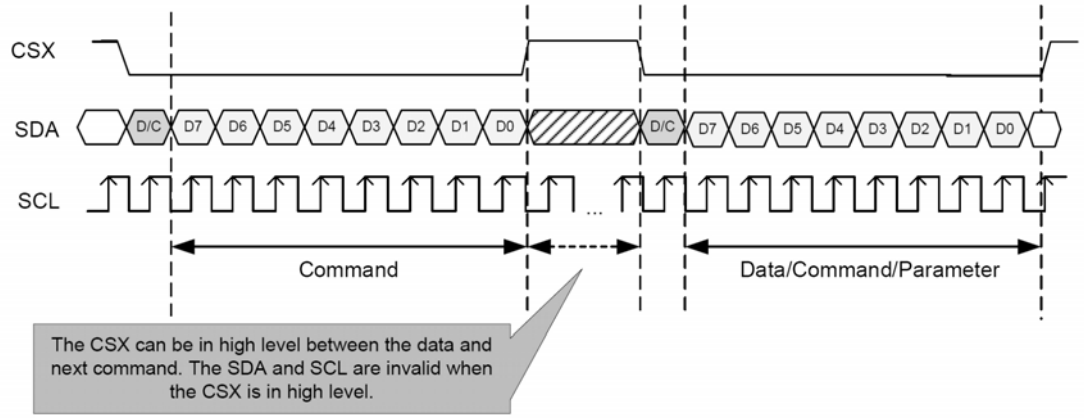


Figure 7: DBI Type C (Option 1) Protocol

4-line Serial Interface Data Format

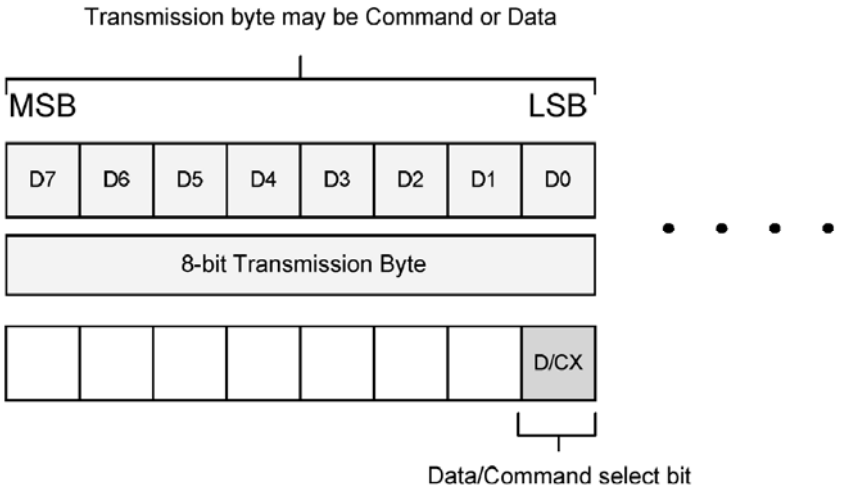


Figure 6: DBI Type C (Option 3) Data Format

4 - line Serial Interface Protocol

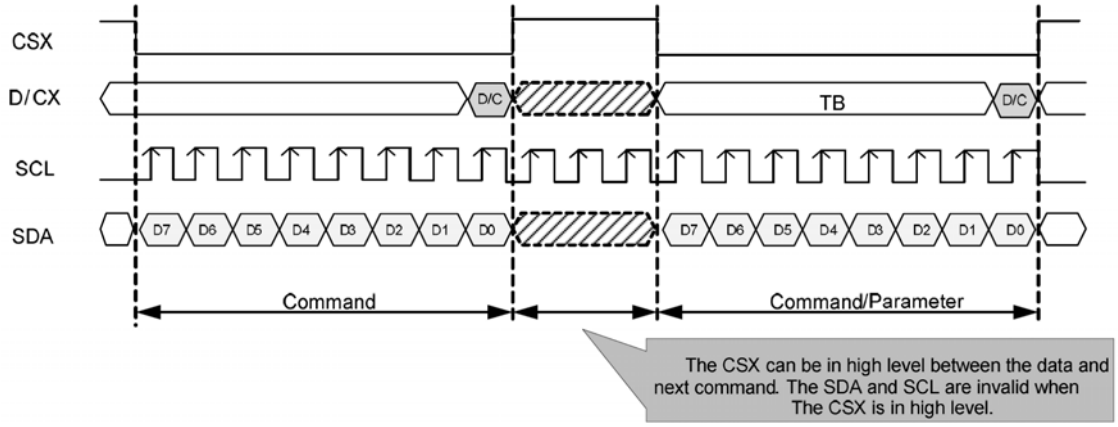


Figure 8: DBI Type C (Option 3) Protocol

8.2.2 Read Cycle Sequence

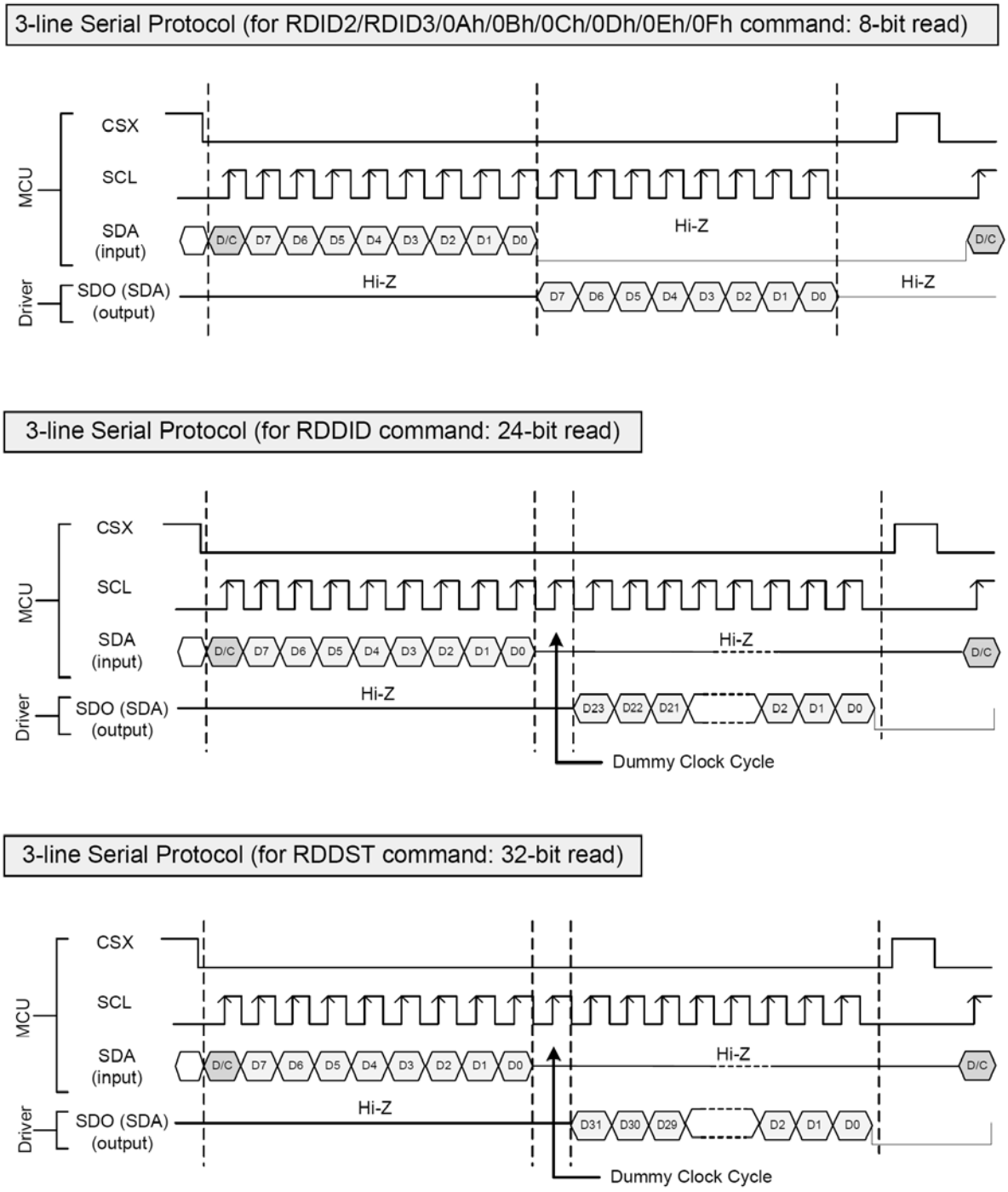
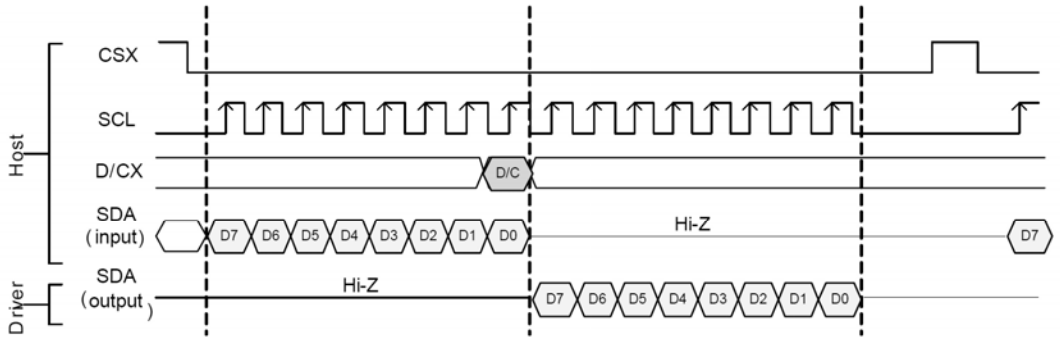
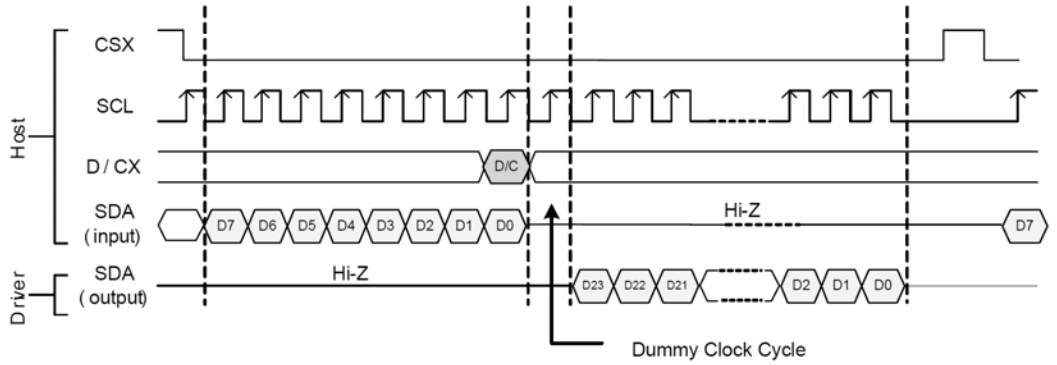


Figure 9: DBI Type C (Option 1) Read Cycle Sequence

4-line Serial Protocol (for RDID2/RDID3/0Ah/0Bh/0Ch/0Dh/0Eh/0Fh command: 8-bit read)



4-line Serial Protocol (for RDDID command: 24-bit read)



4-line Serial Protocol (for RDDST command: 32-bit read)

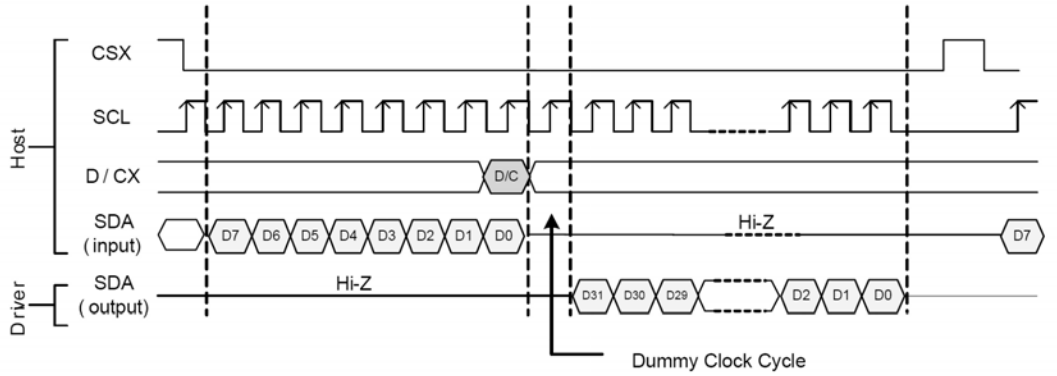
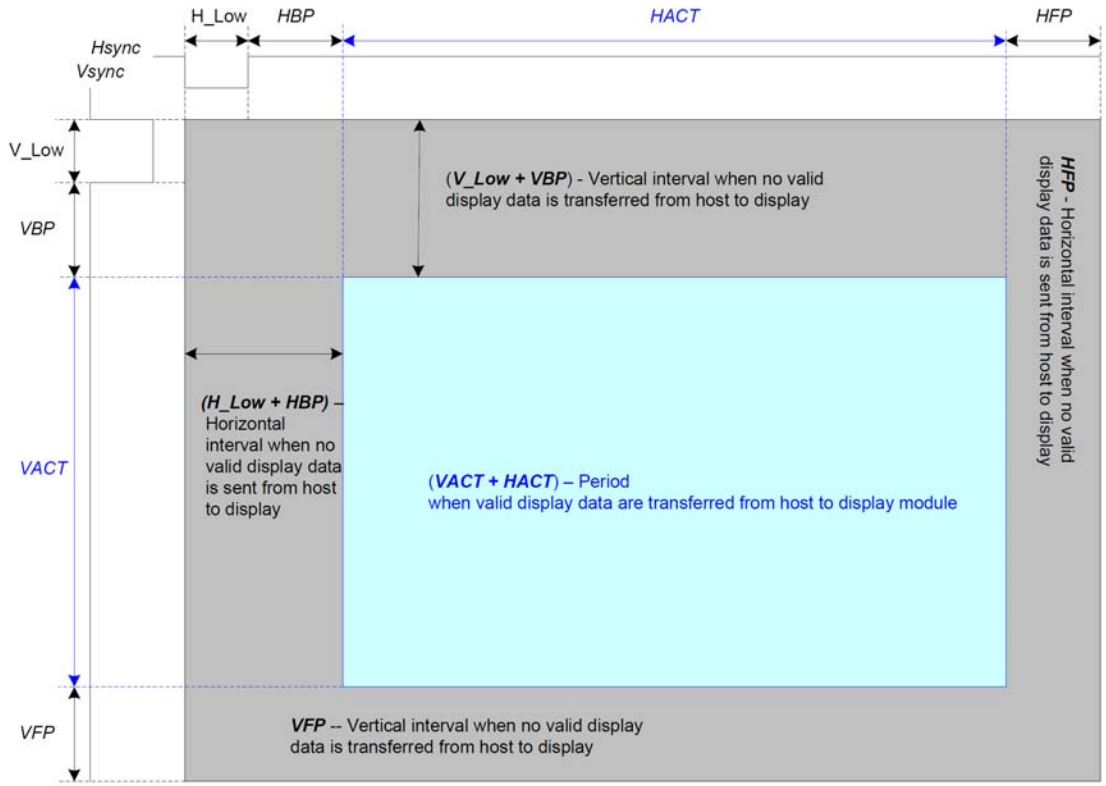


Figure 10: DBI Type C (Option 3) Read Cycle Sequence

8.3 AC Characteristics (RGB Interface Timing Characteristics)



Parameters	Symbols	Min.	Typ.	Max.	Units
Horizontal Synchronization	H_Low	3	-	H_Low+HBP <192	DOTCLK
Horizontal Back Porch	HBP	3	-		DOTCLK
Horizontal Front Porch	HFP	3	-	255	DOTCLK
Horizontal Address	HACT	-	320	-	DOTCLK
Horizontal Frequency		-	-	33	KHz
Vertical Synchronization	V_Low	1	-	V_Low+VBP+VFP < 32	Line
Vertical Back Porch	VBP	2	-		Line
Vertical Front Porch	VFP	2	-		Line
Vertical Address	VACT	-	480	-	Line
Vertical Frequency		60	-	70	Hz
DOTCLK cycle		100	-	50	ns
DOTCLK Frequency		10	-	20	MHz

RGB Interface Timing

The timing chart of 16/18 bit DPI interface mode is illustrated in Figure 19.

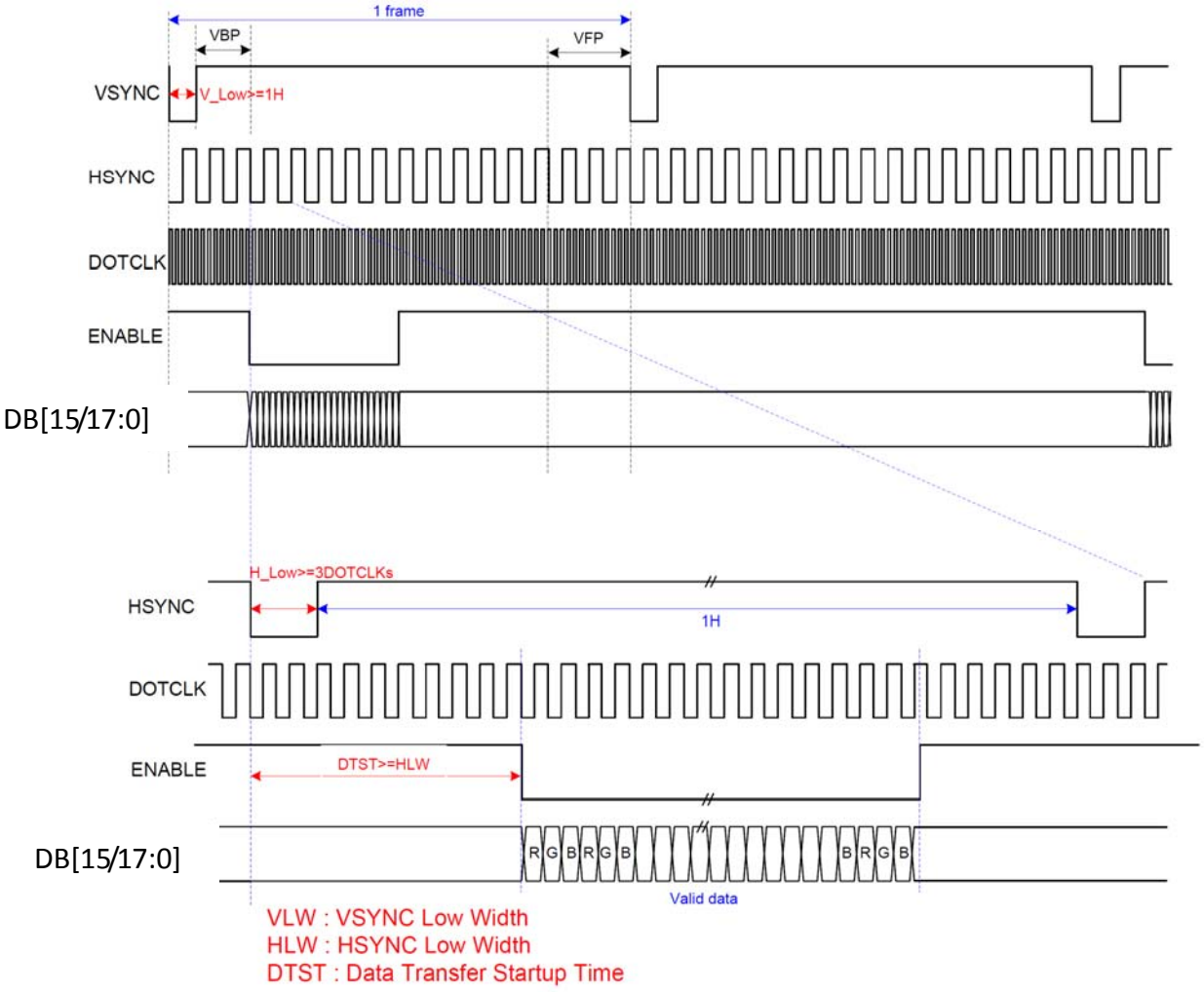


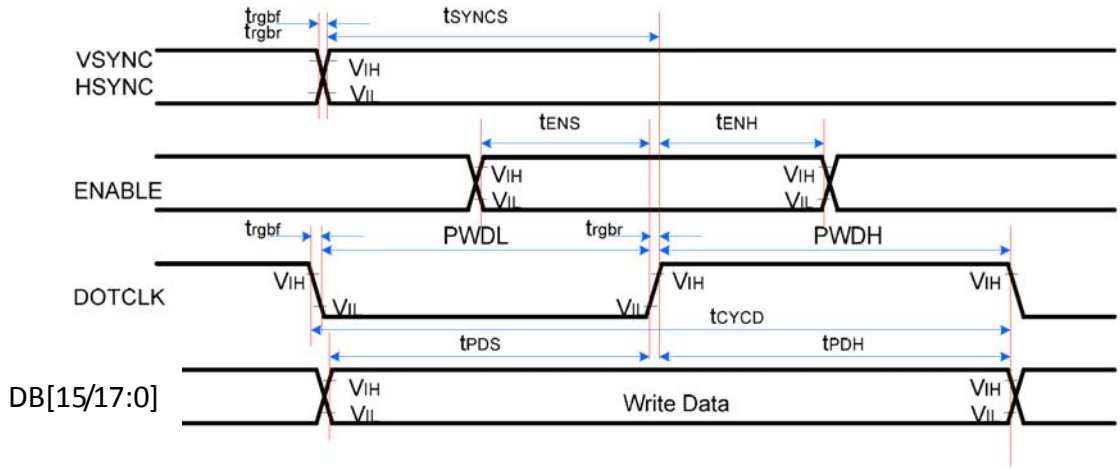
Figure 19: DPI Interface Timing Diagram

18-bit DPI interface connection (DB [17:0] is used): set pixel format DPI [2:0] = 3'h6

DB23	DB22	DB21	DB20	DB19	DB18	DB17	DB16	DB15	DB14	DB13	DB12	DB11	DB10	DB9	DB8	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
						R[5]	R[4]	R[3]	R[2]	R[1]	R[0]	G[5]	G[4]	G[3]	G[2]	G[1]	G[0]	B[5]	B[4]	B[3]	B[2]	B[1]	B[0]

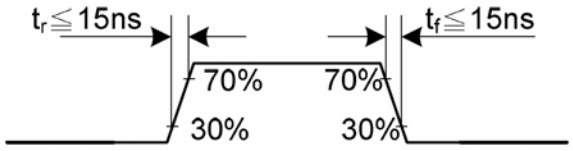
16-bit DPI interface connection (DB [15:0] is used): set pixel format DPI [2:0] = 3'h5

DB23	DB22	DB21	DB20	DB19	DB18	DB17	DB16	DB15	DB14	DB13	DB12	DB11	DB10	DB9	DB8	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
								R[4]	R[3]	R[2]	R[1]	R[0]	G[5]	G[4]	G[3]	G[2]	G[1]	G[0]	B[4]	B[3]	B[2]	B[1]	B[0]



Signal	Symbol	Parameter	min	max	Unit	Description
VSYNC/ HSYNC	t_{SYNCS}	VSYNC/HSYNC setup time	15	-	ns	**16/18** bit bus RGB interface mode
	t_{SYNCH}	VSYNC/HSYNC hold time	15	-	ns	
ENABLE	t_{ENS}	ENABLE setup time	15	-	ns	
	t_{ENH}	ENABLE hold time	15	-	ns	
DB[15/17:0]	t_{POS}	Data setup time	15	-	ns	
	t_{PDH}	Data hold time	15	-	ns	
DOTCLK	PWDH	DOTCLK high-level period	20	-	ns	
	PWDL	DOTCLK low-level period	20	-	ns	
	t_{CYCD}	DOTCLK cycle time	50	-	ns	
	t_{rgbr} , t_{rgbf}	DOTCLK,HSYNC,VSYNC rise/fall time	-	15	ns	

Note: Ta = -30 to 70 ℃, IOVCC = 1.65V to 3.3V, VCI = 2.5V to 3.3V, AGND = DGND = 0V



9 RELIABILITY

Test Item	Test Conditions	Note
High Temperature Operation	70±3°C , t=240 hrs	
Low Temperature Operation	-20±3°C , t=240 hrs	
High Temperature Storage	80±3°C , t=240 hrs	1,2
Low Temperature Storage	-30±3°C , t=240 hrs	1,2
Storage at High Temperature and Humidity	60°C, 90% RH , 240 hrs	1,2
Thermal Shock Test	-20°C (30min) ~ 70°C (30min) 100 cycles	1,2
Vibration Test (Packing)	Sweep frequency : 10 ~ 55 ~ 10 Hz/1min Amplitude : 0.75mm Test direction : X.Y.Z/3 axis Duration : 30min/each axis	2

Note 1 : Condensation of water is not permitted on the module.

Note 2 : The module should be inspected after 1 hour storage in normal conditions (15-35°C , 45-65%RH).

10 USE PRECAUTIONS

10-1 Handling precautions

1) The polarizing plate may break easily so be careful when handling it. Do not touch, press or rub it with a hard-material tool like tweezers.
2) Do not touch the polarizing plate surface with bare hands so as not to make it dirty. If the surface or other related part of the polarizing plate is dirty, soak a soft cotton cloth or chamois leather in benzine and wipe off with it. Do not use chemical liquids such as acetone, toluene and isopropyl alcohol. Failure to do so may bring chemical reaction phenomena and deteriorations.
3) Remove any spit or water immediately. If it is left for hours, the suffered part may deform or decolorize.
4) If the LCD element breaks and any LC stuff leaks, do not suck or lick it. Also if LC stuff is stuck on your skin or clothing, wash thoroughly with soap and water immediately.

10-2 Installing precautions

1) The PCB has many ICs that may be damaged easily by static electricity. To prevent breaking by static electricity from the human body and clothing, earth the human body properly using the high resistance and discharge static electricity during the operation. In this case, however, the resistance value should be approx. 1MΩ and the resistance should be placed near the human body rather than the ground surface. When the indoor space is dry, static electricity may occur easily so be careful. We recommend the indoor space should be kept with humidity of 60% or more. When a soldering iron or other similar tool is used for assembly, be sure to earth it.
2) When installing the module and ICs, do not bend or twist them. Failure to do so may crack LC element and cause circuit failure.
3) To protect LC element, especially polarizing plate, use a transparent protective plate (e.g., acrylic plate, glass etc) for the product case.
4) Do not use an adhesive like a both-side adhesive tape to make LCD surface (polarizing plate) and product case stick together. Failure to do so may cause the polarizing plate to peel off.

10-3 Storage precautions

1) Avoid a high temperature and humidity area. Keep the temperature between 0°C and 35°C and also the humidity under 60%.
2) Choose the dark spaces where the product is not exposed to direct sunlight or fluorescent light.
3) Store the products as they are put in the boxes provided from us or in the same conditions as we recommend.

10-4 Operating precautions

1) Do not boost the applied drive voltage abnormally. Failure to do so may break ICs. When applying power voltage, check the electrical features beforehand and be careful. Always turn off the power to the LC module controller before removing or inserting the LC module input connector. If the input connector is removed or inserted while the power is turned on, the LC module internal circuit may break.
2) The display response may be late if the operating temperature is under the normal standard, and the display may be out of order if it is above the normal standard. But this is not a failure; this will be restored if it is within the normal standard.
3) The LCD contrast varies depending on the visual angle, ambient temperature, power voltage etc. Obtain the optimum contrast by adjusting the LC dive voltage.
4) When carrying out the test, do not take the module out of the low-temperature space suddenly. Failure to do so will cause the module condensing, leading to malfunctions.
5) Make certain that each signal noise level is within the standard (L level: 0.2Vdd or less and H level: 0.8Vdd or more) even if the module has functioned properly. If it is beyond the standard, the module may often malfunction. In addition, always connect the module when making noise level measurements.
6) The CMOS ICs are incorporated in the module and the pull-up and pull-down function is not adopted for the input so avoid putting the input signal open while the power is ON.
7) The characteristic of the semiconductor element changes when it is exposed to light emissions, therefore ICs on the LCD may malfunction if they receive light emissions. To prevent these malfunctions, design and assemble ICs so that they are shielded from light emissions.

8) Crosstalk occurs because of characteristics of the LCD. In general, crosstalk occurs when the regularized display is maintained. Also, crosstalk is affected by the LC drive voltage. Design the contents of the display, considering crosstalk.

10-5 Other

1) Do not disassemble or take the LC module into pieces. The LC modules once disassembled or taken into pieces are not the guarantee articles.
2) The residual image may exist if the same display pattern is shown for hours. This residual image, however, disappears when another display pattern is shown or the drive is interrupted and left for a while. But this is not a problem on reliability.
3) AMIPRE will provide one year warrantee for all products and three months warrantee for all repairing products.

11. MECHANIC DRAWING