Specification For Approval

(●) Preliminary Specification

( ) Final Specification

Customer	
Model	3.5” qVGA TFT-LCD
Supplier	

Approved by		Proposed by	
APPROVED BY	SIGNATURE	APPROVED BY	SIGNATURE
DESIGNED BY	SIGNATURE	DESIGNED BY	SIGNATURE

VER.0.1	Sep. 04 . 2006

Revision History

(A sheet refers to the sheet number after revision)

Date	Rev.	Sheet (New)	Item	Old	New	Reason

— Table of Contents —

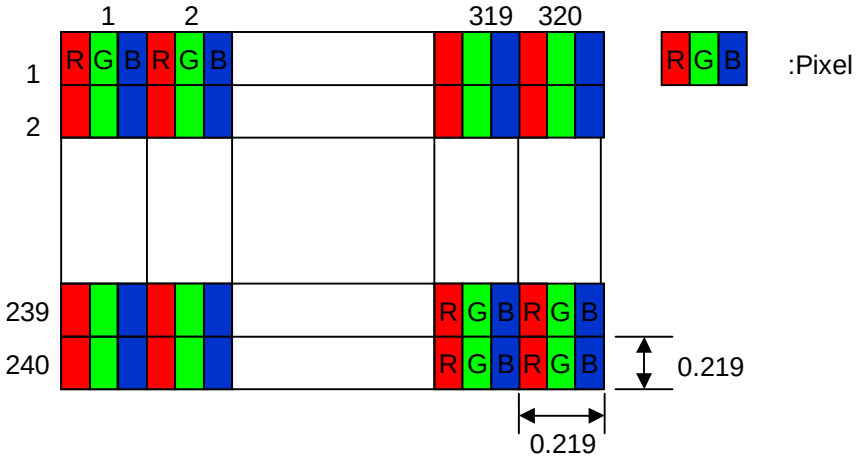
1. General Description

This main Module has a 3.5 inch diagonally measured active display area with 320X240 resolution
Each pixel is divided into Red, Green and Blue sub-pixels and dots which are arranged in vertical stripes.
Main LCD color is determined with 16.7M Color signal for each pixel.
The **IM350RBN1A** has been designed to apply the interface method that enables low power, high speed, and high contrast.

2. General Features

Item	Main display	Remark
Display Mode	Normally White, Transmissive LCD	
Viewing Direction	6 o´ clock (In optimum contrast direction) good viewing direction is 12'oclock)	
Driving Method	A-Si TFT Active Matrix	
Input Signals	Digital 8bit RGB/24bit interface	
Outside Dimensions	81.1mm(W) X 66.23mm(H) X 4.85mm(D)	
Active area	70.08mm(H) x 52.56mm(V)	
Number of Pixels	320×RGB×240 Pixels	1)
Pixel Pitch	0.219mm(H) X 0.219mm(W)	1)
Pixel Arrangement	RGB stripes	1)
Driver IC	HX8218C01(Source) / HX8655A(Gate)	himax

Note 1) Main Display



3. Absolute Maximum Ratings

The following are maximum values which, if exceeded, may cause operation or damage to the unit

Parameter	Symbol	Value		Unit	Notes
		Min.	Max.		
LC Operating Voltage *1)	V_{Op}	3.0	3.6	V	@ 25± 5 ˚C
Gate On Voltage	VGH	12	16	V	14 (Typ)
Gate Off Voltage	VGL	-10	-6	V	-8 (Typ)
Operating Temperature	T_{OP}	-20	70	˚C	
Storage Temperature	T_{STG}	-30	80	˚C	
Operating Ambient Humidity *2)	H_{OP}	10	90	%RH	*3)
Storage Humidity *2)	Hstg	10	90	%RH	*4)

Note :

* 1) Liquid Crystal driving voltage.
Due to the characteristics of LC Material, this voltage vary with environmental temperature.

* 2) Non-condensation.

* 3) Temp. ≤ 60℃ , 90% RH MAX.

* 4) Temp. ＞60℃ , Absolute humidity shall be less than 90% RH at 60℃

4. Electrical Specification 1)

4.1 Main Window Display (TFT LCD)

[Ta=25℃]

Properties		Sym.	Min	Typ.	Max	Unit	Note
Power Supply Voltage		Vcc	3.0	3.3	3.6	V	
Supply Voltage		Vdd	4.8	5.0	5.2	V	
Gate On Voltage		Vgh	12	14	16	V	
Gate Off Voltage		Vgl	-10	-8	-6	V	
Operation frequency		Fcpy	60	75	90	Hz	
Back-light Power Consumption		Pbl	-	400	-	mW	3)
Power Consumption	Full	Pfull	-	65	-	mW	3)
Back-light Current		I_B	-	20	-	mA	4)

Note :

1) The recommended operating conditions refers to a range in which operation of this product is guaranteed. Should this range is exceeded, the operation cannot be guaranteed even if the values may be within the absolute maximum ratings.
Accordingly, please make sure that the module is used within this range.
And these current values are measured under the condition that all device are stopped, each component is stable and Logic signal is input.

2) All the unused input terminals have to be connected to Vdd or Vss. Please select appropriate one which meet the function required by unused terminal.

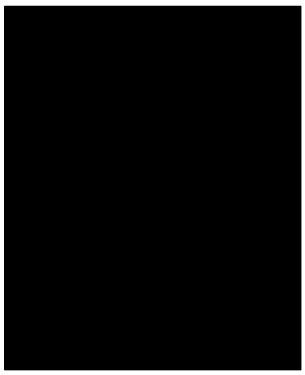
3) Power Consumption

(1) VDD=5.1V,

(2) check pattern = Black pattern. Vcc=3.1V, Frame=60Hz

(3) Where IB=20mA, VB=PBL/IB.

(4) 6 LEDs serial type.



<Check Pattern>

5. Optical Specification

Optical characteristics are determined after the unit has been 'ON' and stable for approximately 30 minutes in a dark environment at 25 °C. The values specified are at an approximate distance 500mm from the LCD surface at a viewing angle of Φ and θ equal to 0 °.

5.1 Main (TFT LCD)

Ta = 25 (Ambient Temperature)

Spec	Parameter	Symbol	Condition	Values			Unit	Notes
				Min	Typ	Max		
With Backlight LED ON	Contrast Ratio	C/R	θ =0°	200	300	-		FIG.1
	Luminance	BP	θ =0°	-	350	-	cd/m^2	FIG.2
	Luminance Uniformity	ΔL	θ =0°	80	-	-	%	FIG.2
	Response Time	Tr+Tf	θ =0°	-	30	45	ms	FIG.3
	Viewing Angle	Φ=180°	CR>10	-	43	-	Degree	FIG.4
		Φ=0°		-	43	-	Degree	
		Φ=90°		-	45	-	Degree	
		Φ=270°		-	25	-	Degree	
	CIE Color Coordinate 1931	Wx	θ =0°	0.264	0.314	0.364		FIG.1
		Wy		0.286	0.336	0.386		
		Rx	θ =0°	0.518	0.568	0.618		
		Ry		0.322	0.372	0.422		
		Gx	θ =0°	0.313	0.363	0.413		
		Gy		0.507	0.557	0.607		
		Bx	θ =0°	0.109	0.159	.209		
		By		0.088	0.138	0.188		
Flicker			θ =0°	-	-	7	%	FIG.5
Color Gamut			θ =0°	-	39	-	%	

◈ Measurement System

Notes :

1. Contrast Ratio(CR) is defined mathematically as :

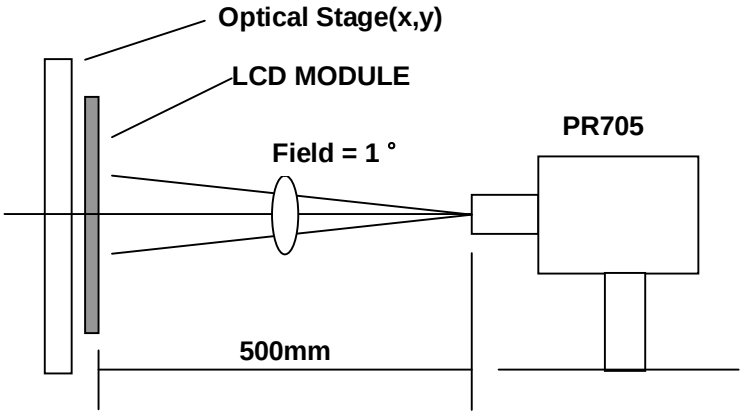
$$\text{Contrast Ratio} = \frac{\text{Surface Luminance with all white pixels}}{\text{Surface Luminance with all black pixels}}$$

2. Surface luminance is the center point across the LCD surface 500mm from the surface with all pixels displaying white. For more information see FIG 1.

3. Response time is the time required for the display to transition from white to black (Rising Time, Tr) and from black to white (Falling Time, Tf). For additional information see FIG 3.

4. Viewing angle is the angle at which the contrast ratio is greater than 10. The angles are determined for the horizontal or x axis and the vertical or y axis with respect to the z axis which is normal to the LCD surface. For more information see FIG 4.

FIG. 1. Optical Characteristic Measurement Equipment and Method



<Transmissive Mode>

- Measurement System (Test Procedure) With backlight turned on
- Measuring Instrument: PR705 made by PHOTO RESEARCH
- Measuring Field : 1°
- Environment: Inside a darkroom

FIG. 2. Measurement Points for Luminance

▶ Luminance Uniformity

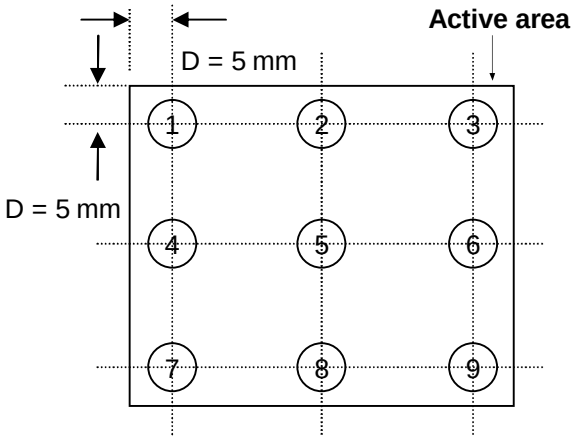
Using FIG.1 Measurement System with the backlight turned on, the luminance uniformity should be obtained from the next expression, when white raster (white : gradation level L63) is displayed: (* LED Current = 20mA)

Luminance Uniformity = Lmin / Lmax X100 (%)

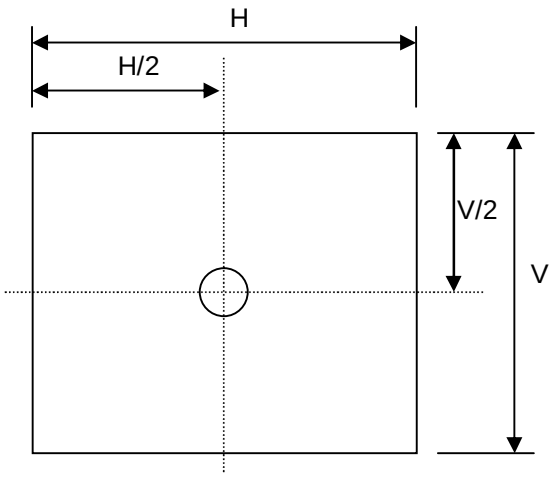
, Lmin = Minimum luminance point
Lmax = Maximum luminance point

▶ Luminance

Use FIG.1(Test Procedure) under Measurement System with the backlight turned on to measure the luminance when white raster (white: Gradation level L63) is displayed.



<Measuring point for luminance uniformity>



<Measuring point for luminance>

FIG. 3. The definition of Response Time

The response time is defined as the following figure and shall be measured by switching the input signal for “black” and “white”.

Response Time = Rising Time (Tr) + Falling Time (Tf)
, Rising Time(Tr) : Full White 90% **à** Full White 10% Transmittance.
Falling Time(Tf) : Full White 10% **à** Full White 90% Transmittance.

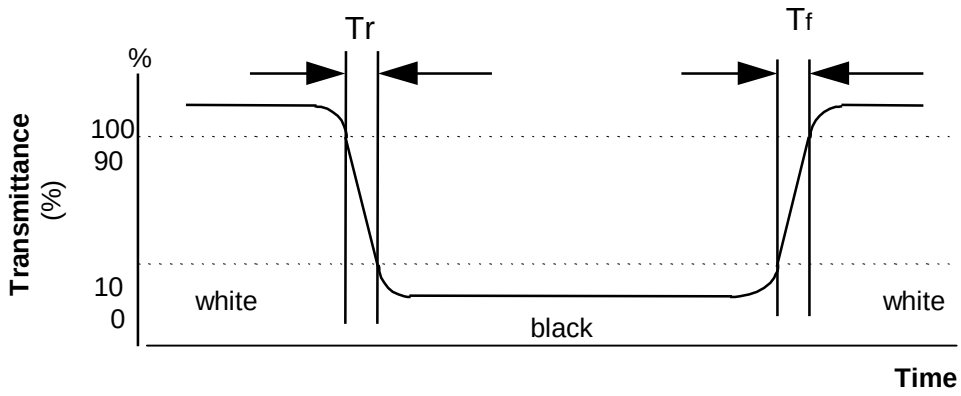


FIG. 4. The definition of Viewing Angle

Use Fig. 1(Test Procedure) under Measurement System to measure the contrast from the measuring direction specified by the conditions as the following figure.
The definition of viewing angle range is that the contrast ratio is higher than CR 10.(CR >10)

<dimension of viewing angle range>

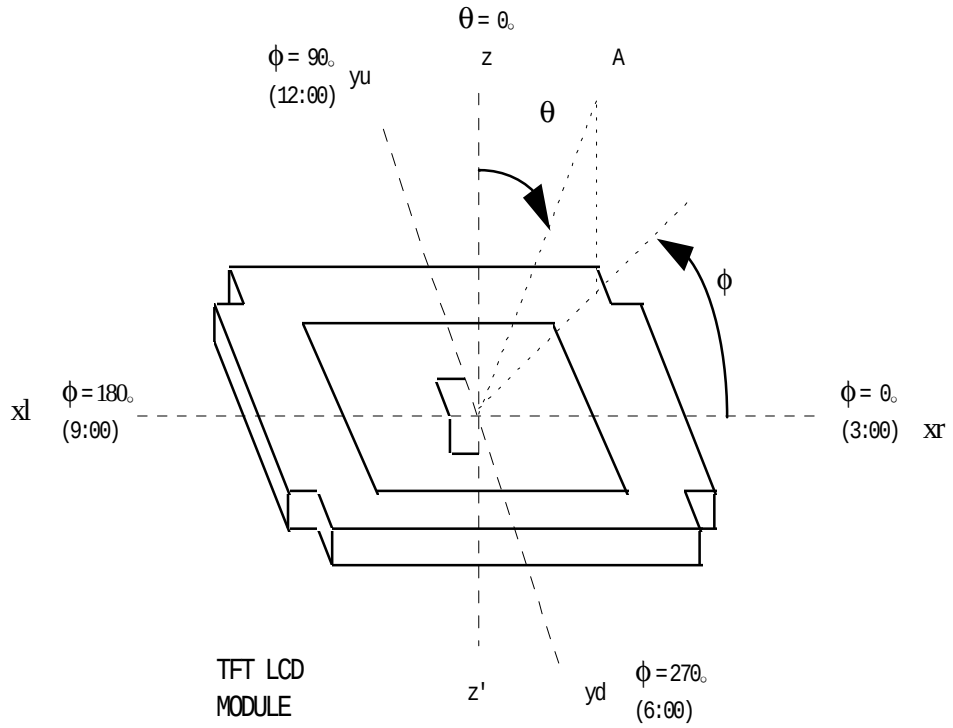
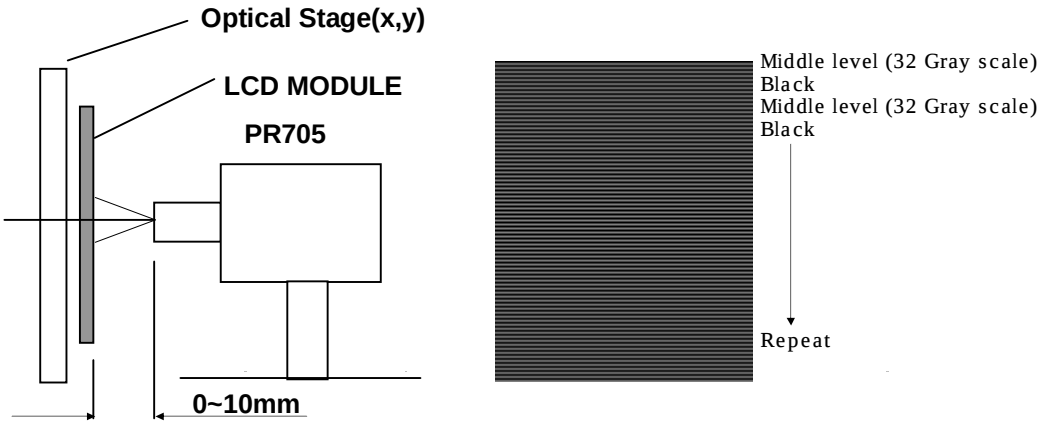


Fig. 5. Measuring Method for Flicker Level

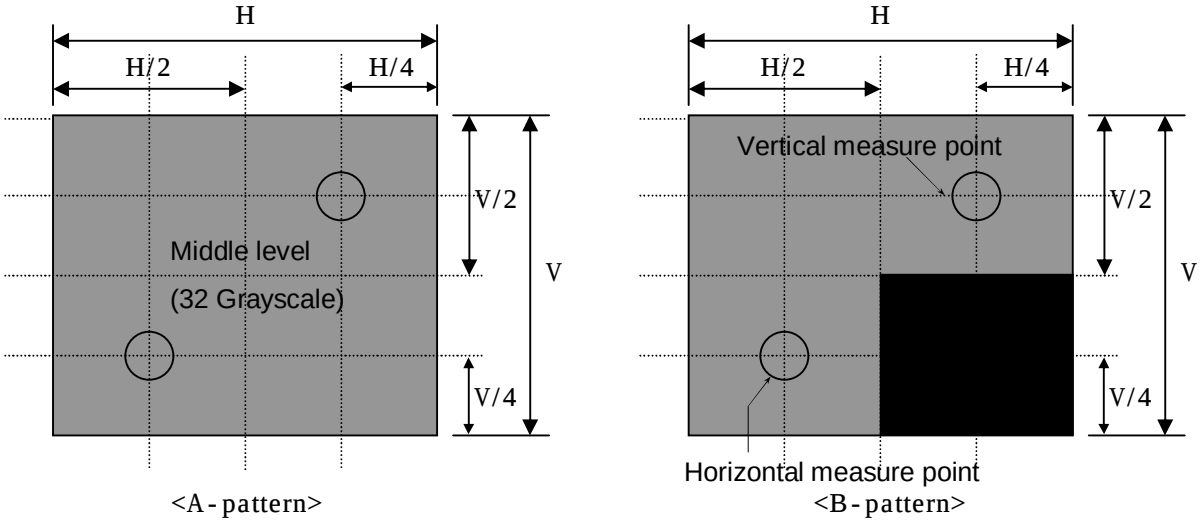


<Flicker Test> <Flicker pattern>

- Measurement System (Test Procedure) With backlight turned on
- Measuring Instrument : PR705 made by PHOTO RESEARCH
- Measuring Field : 1°
- Environment: Inside a darkroom
- Display a flicker pattern (see below) and measure flicker level (%) with flicker checker.
- Distance from the flicker pattern to the checker is 0~10mm.

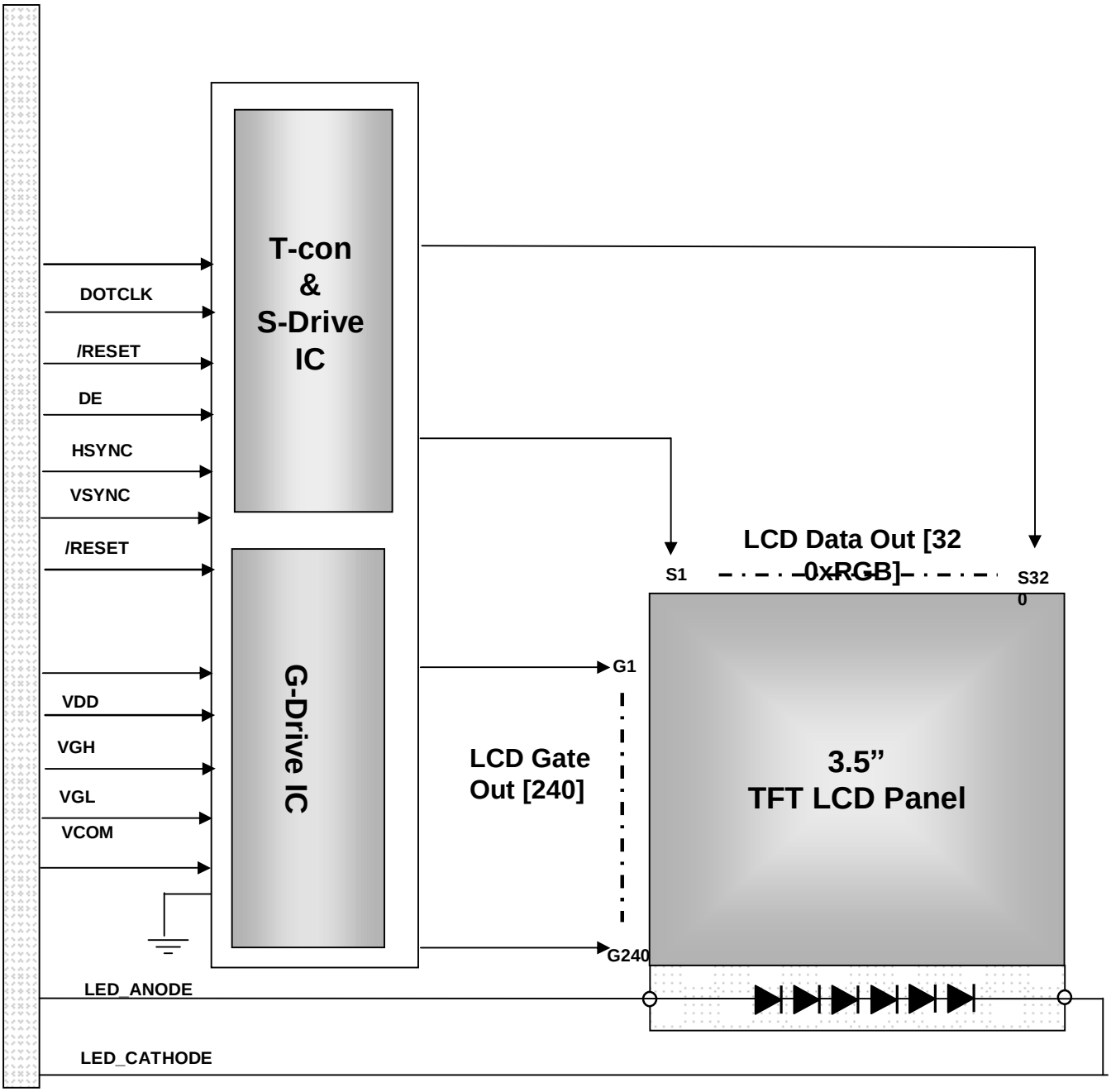
Fig. 6. Measuring Method for Crosstalk

$$\text{Crosstalk}(\%) = \frac{|\,\text{Luminance(A-pattern)} - \text{Luminance(B-pattern)}\,|}{\text{Luminance(A-pattern)}} \times 100$$



Crosstalk means irregularity of luminance in the background when window pattern (white against black background) is displayed.

6. Block Diagram



7. Pin Description

7.1. Input signal and power : pin description (Kyocera 04-6240-045-003-800)

Pin No.	Symbol	Description	Pin No.	Symbol	Description
1	LED_Cathode	LED_CATHODE	24	D16	
2			25	D17	
3	LED_Anode	LED_ANODE	26	D0	Display Data (R) D0: LSB, D7: MSB
4			27	D1	
5	GND	Ground	28	D2	
6	/RESET	Reset	29	D3	
7	/CS	NC	30	D4	
8	SCK	NC	31	D5	
9	SDI	NC	32	D6	
10	D20	Display Data (B) D20: LSB, D27: MSB	33	D7	
11	D21		34	HSYNC	Horizontal Sync. Signal
12	D22		35	VSYNC	Vertical Sync. Signal
13	D23		36	DOTCLK	Data Clock
14	D24		37	VDD	Analog voltage(5V)
15	D25		38	VCC	Digital Voltage(3.3V)
16	D26		39	T_Y+	Touch Panel Y+
17	D27		40	T_Y-	Touch Panel Y-
18	D10	Display Data (G) D10: LSB, D17: MSB	41	T_X+	Touch Panel X+
19	D11		42	T_X-	Touch Panel X-
20	D12		43	DE	Input Data Enable
21	D13		44	GND	Ground
22	D14		45		
23	D15				

7.2. Relation Between Input Signal and Color

COLOR	DISPLAY	DATA SIGNAL																		GARY SCALE LEVEL
		RED						GREEN						BLUE						
		R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1	B0	
BASIC COLOR	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
	BLUE	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	-
	GREEN	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	-
	CYAN	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	-
	RED	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	-
	MAGENTA	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1	-
	YELLOW	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	-
	WHITE	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-
GARY SCALE OF RED	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R0
	DARK	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	R1
	.	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	R2
	.	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	R3~R252
	.	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	.	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	R253
	LIGHT	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	R254
	RED	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	R255
GARY SCALE OF GREEN	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G0
	DARK	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	G1
	.	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	G2
	.	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	G3~G252
	.	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	.	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	G253
	LIGHT	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0	G254
	GREEN	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	G255
GARY SCALE OF BLUE	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B0
	DARK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	B1
	.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	B2
	.	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	B3~B252
	.	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	.	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	1	B253
	LIGHT	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0	B254
	BLUE	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	B255

Note) Gray definition

Rn : RED Gray, Gn : GREEN Gray, Bn : BLUE Gray (n = Gray Level)

Input Signal : 0 = Low level voltage, 1 = High level voltage

8. Register Values

8.1 Command Description

8.1.1 SPI Resister Description

- **Register R0:**

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	reserved	STHD1	STHD0	STHP4	STHP3	STHP2	STHP1	STHP0
Default	0	0	0	0	0	0	0	0

STHD [1:0]: adjust start pulse position by dot.

STHD1	STHD0	STH position adjust by dot
1	1	-1
1	0	-2
0	0	0
0	1	+1

STHP [4:0]: adjust start pulse position by pixel

STHP4	STHP3	STHP2	STHP1	STHP0	STH position adjust by pixel
1	1	1	1	1	-1
1	1	1	1	0	-2
1	1	1	0	1	-3
1	1	1	0	0	-4
1	1	0	1	1	-5
1	1	0	1	0	-6
1	1	0	0	1	-7
1	1	0	0	0	-8
1	0	1	1	1	-9
1	0	1	1	0	-10
1	0	1	0	1	-11
1	0	1	0	0	-12
1	0	0	1	1	-13
1	0	0	1	0	-14
1	0	0	0	1	-15
1	0	0	0	0	-16
0	0	0	0	0	0
0	0	0	0	1	+1
0	0	0	1	0	+2
0	0	0	1	1	+3
0	0	1	0	0	+4
0	0	1	0	1	+5
0	0	1	1	0	+6
0	0	1	1	1	+7
0	1	0	0	0	+8
0	1	0	0	1	+9
0	1	0	1	0	+10
0	1	0	1	1	+11
0	1	1	0	0	+12
0	1	1	0	1	+13
0	1	1	1	0	+14
0	1	1	1	1	+15

- **Register R1:**

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	STVP3	STVP2	STVP1	STVP0	reserved	reserved	reserved	reserved
Default	0	0	0	0	0	0	0	1

STVP [3:0]: adjust first line position by line

STVP3	STVP2	STVP1	STVP0	STV position adjust by line
1	1	1	1	-1
1	1	1	0	-2
1	1	0	1	-3
1	1	0	0	-4
1	0	1	1	-5
1	0	1	0	-6
1	0	0	1	-7
1	0	0	0	-8
0	0	0	0	0
0	0	0	1	+1
0	0	1	0	+2
0	0	1	1	+3
0	1	0	0	+4
0	1	0	1	+5
0	1	1	0	+6
0	1	1	1	+7

- **Register R2:**

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	reserved	reserved	reserved	reserved	VS_POL	HS_POL	NPC_IN	NPC_SET
Default	0	0	1	1	0	0	1	0

VS_POL: VS polarity setting.
VS_POL=L, negative polarity.
VS_POL=H, positive polarity.
HS_POL: HS polarity setting.
HS_POL=L, negative polarity.
HS_POL=H, positive polarity.
NPC_IN: define the NTSC/PAL mode by SPI.
NPC_IN=L, PAL.
NPC_IN=H, NTSC.
NPC_SET: set the NTSC/PAL auto detection or define by NPC_IN.
NPC_SET=L, auto detection.
NPC_SET=H, define by NPC_IN.

8. 2 Power on/off sequence

To prevent the device damage from latch up, the power on/off sequence shown below must be followed

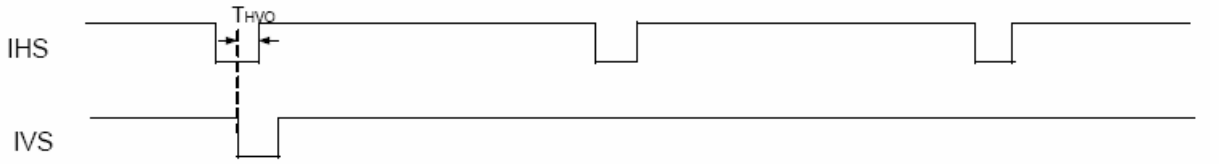
Power ON : VCC **à** VDD **à** V1 ~V8

Power OFF : V1 ~ V8 **à** VDD **à** VCC

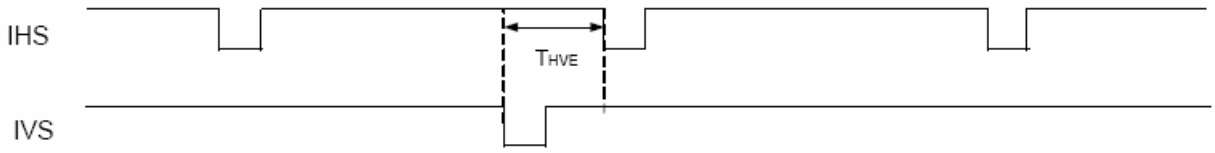
8. 3 Digital RGB Timing Waveform

8.3.1 HIS and IVS Timing

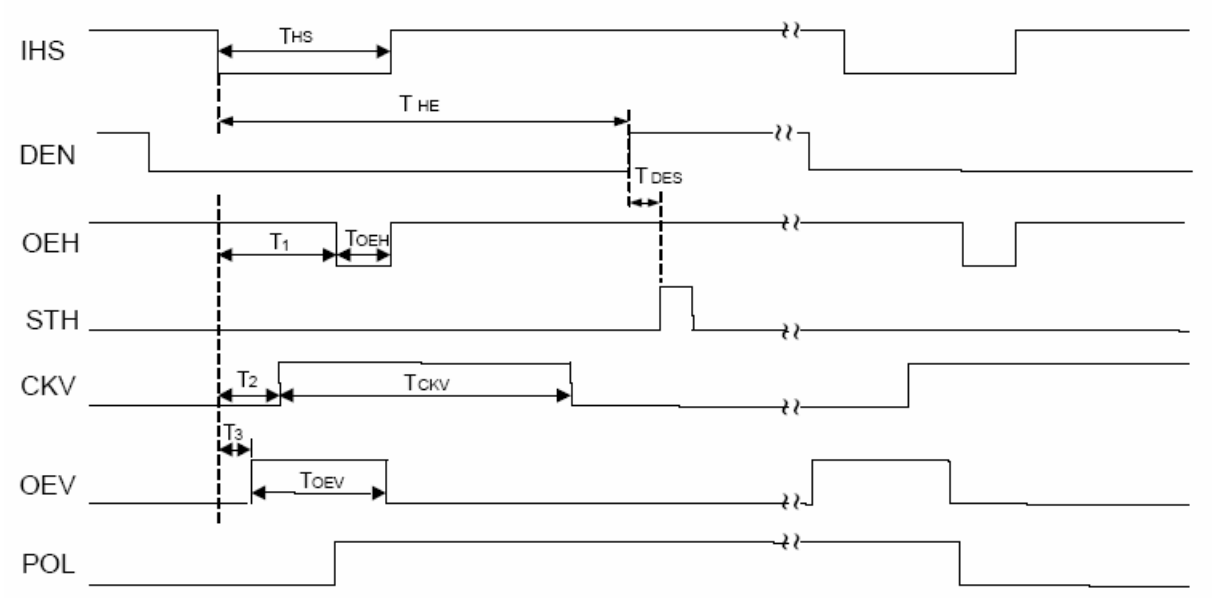
- Odd field



- Even field

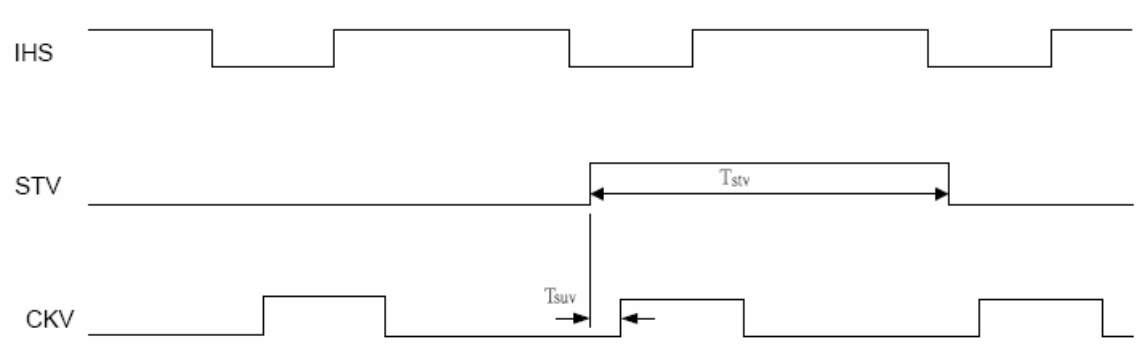


8.3.2 HIS and Horizontal control timing waveform

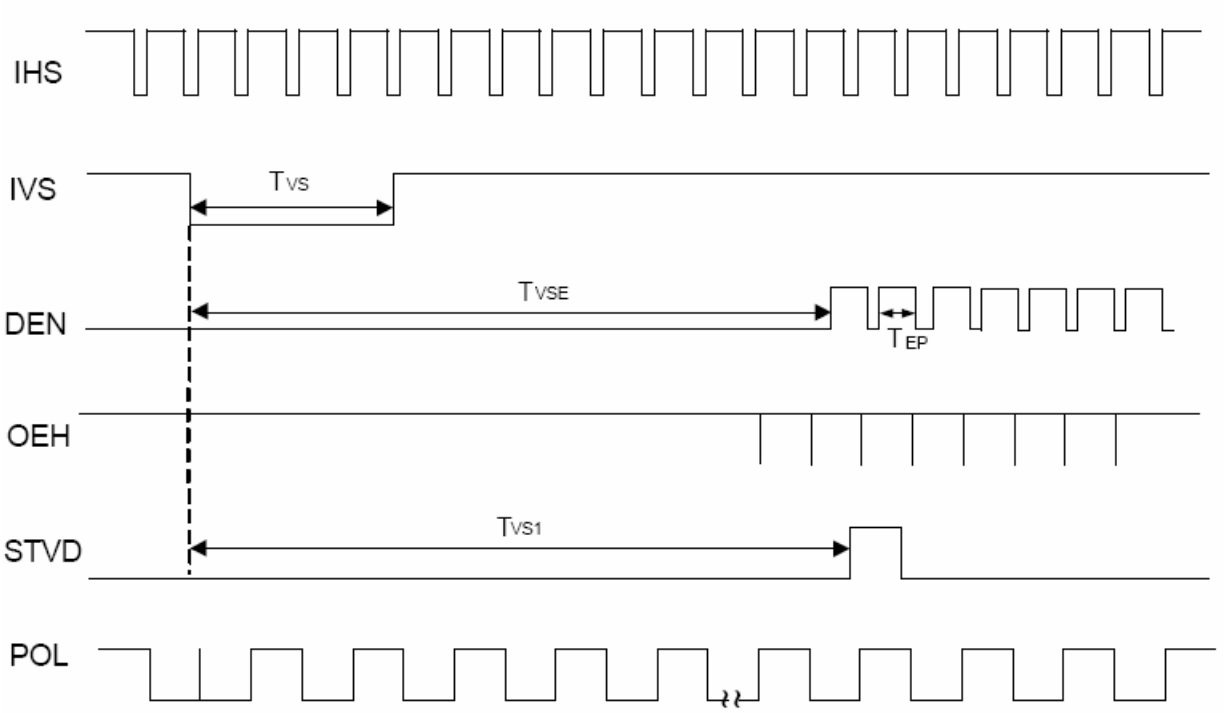


Note : (1) HIS=Hsync, IVS=Vsync

8.3.3 HIS and Vertical shift clock timing waveform

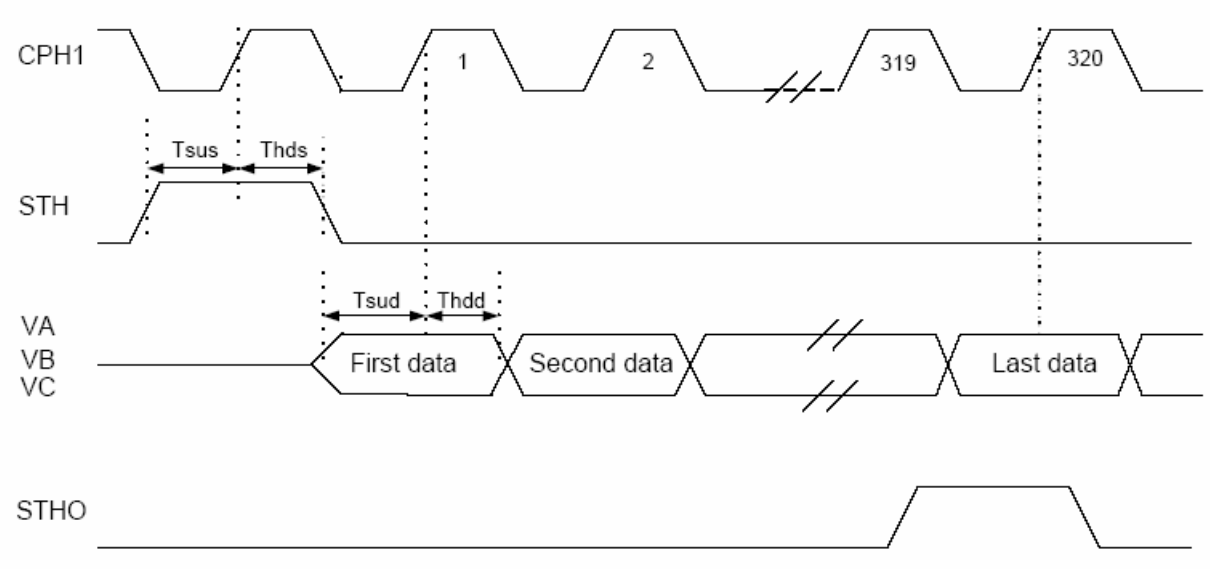


8.3.4 HIS and Vertical control timing waveform

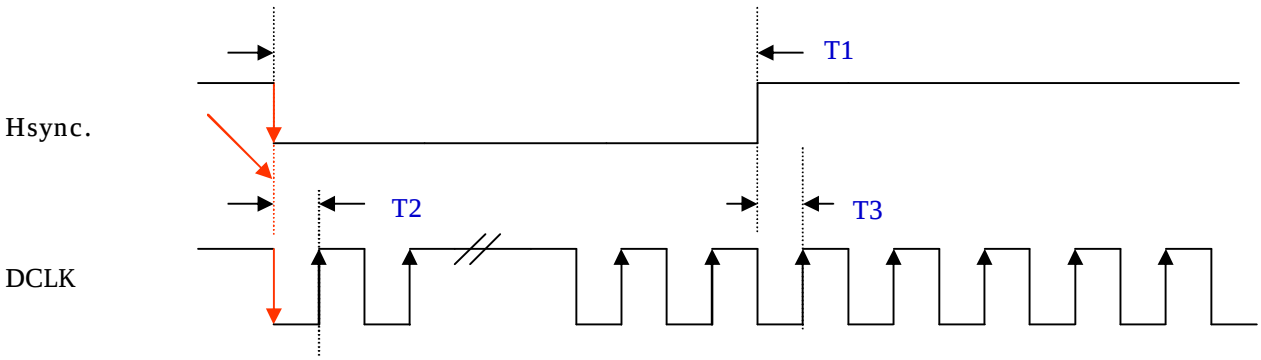


8.4 Source Driver Timing Chart

8.4.1 Clock and Start Pulse timing waveform



8.4.2 Control Signal and RGB Data timing waveform



T1 : Min. 5 DCLK ~ Max. 30 DCLK
T2 : Set-up Time Min. 12ns
T3 : Hold Time Min.12ns

** Must be synchronized between Hsync. Falling edge and Dot Clock falling edge.

9. AC Characteristics

9.1 Input Signal characteristics

Digital Parallel RGB Interface (960 x 240 resolution)

PARAMETER		Symbol	Min.	Typ.	Max.	Unit
CLK period		T_{OSC}	-	156	-	ns
Data setup time		T_{SU}	12	-	-	ns
Data hold time		T_{HD}	12	-	-	ns
IHS period		T_H	-	408	-	T_{OSC}
IHS pulse width		T_{HS}	5	30	-	T_{OSC}
IHS rising time		T_{Cr}	-	-	700	ns
IHS falling time		T_{Cf}	-	-	300	ns
IVS pulse width		T_{VS}	1	3	5	T_H
IVS rising time		T_{Vr}	-	-	700	ns
IVS falling time		T_{Vf}	-	-	1.5	µs
IVS falling to IHS rising time for odd field		T_{HVO}	1	-	-	T_{OSC}
IVS falling to IHS falling time for even field		T_{HVE}	1	-	-	T_{OSC}
IVS-DEN time	NTSC	T_{VSE}	-	18	-	T_H
	PAL	T_{VSE}	-	26	-	T_H
IHS-DEN time		T_{HE}	36	68	88	T_{OSC}
DEN pulse width		T_{EP}	-	320	-	T_{OSC}
DEN-STH time		T_{DES}	-	1	-	T_{OSC}
IVS period	NTSC		-	262.5	-	T_H
	PAL		-	312.5	-	T_H

Note:
(1)When SYNC mode is used, 1st data start from 68th CLK after IHS falling.

9.2 Hardware reset timing

PARAMETER	Symbol	Min.	Typ.	Max.	Unit.
RESETB low pulse width	T_{RSB}	10	-	-	µs

9.3 Output signal characteristics for digital input signal

PARAMETER		Symbol	Min.	Typ.	Max.	Unit.
Rising time		T_r	-	-	10	ns
Falling time		T_f	-	-	10	ns
Internal STH setup time		T_{SUS}	12	-	-	ns
Internal STH hold time		T_{HDS}	12	-	-	ns
Internal data setup time		T_{SUD}	60	-	-	ns
Internal data hold time		T_{HDD}	40	-	-	ns
OEH pulse width		T_{OEH}	-	1248	-	ns
OEV pulse width		T_{OEV}	-	4992	-	ns
CKV pulse width		T_{CKV}	-	3744	-	ns
IHS-OEH time		T_1	-	4368	-	ns
IHS-CKV time		T_2	-	2496	-	ns
IHS-OEV time		T_3	-	624	-	ns
STV setup time		T_{SUV}	-	1872	-	ns
STV pulse width		T_{STV}	-	1	-	T_H
IVS-STV time	NTSC	T_{VS1}	-	19	-	T_H
	PAL	T_{VS1}	-	27	-	T_H
OEH-STV time		T_{OES}	-	2	-	T_H
Output settling time		T_{ST}	-	12	20	µs

10. SPI Timing Characteristics

PARAMETER	Symbol	Min.	Typ.	Max.	Unit.
SPCK period	T_{CK}	60	-	-	ns
SPCK high width	T_{CKH}	30	-	-	ns
SPCK low width	T_{CKL}	30	-	-	ns
Data setup time	T_{SU1}	12	-	-	ns
Data hold time	T_{HD1}	12	-	-	ns
SPENA to SPCK setup time	T_{CS}	20	-	-	ns
SPENA to SPDA hold time	T_{CE}	20	-	-	ns
SPENA high pulse width	T_{CD}	50	-	-	ns
SPDA output latency	T_{CR}	-	1/2	-	T_{CK}

- **SPI read timing**

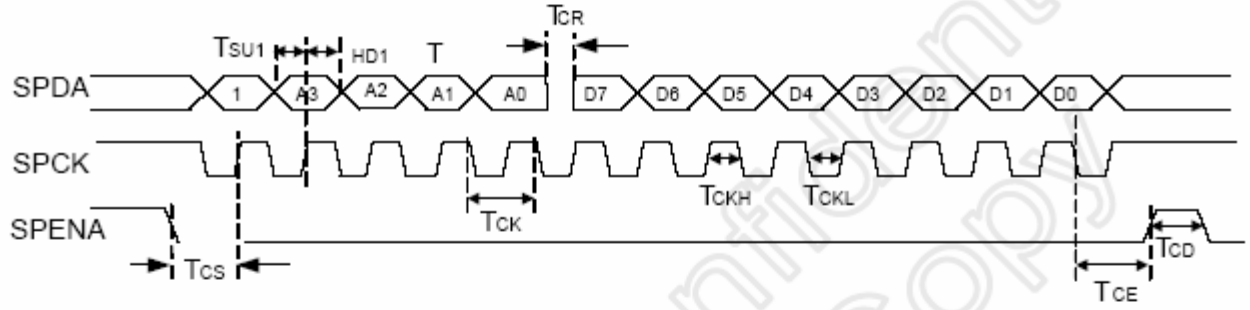
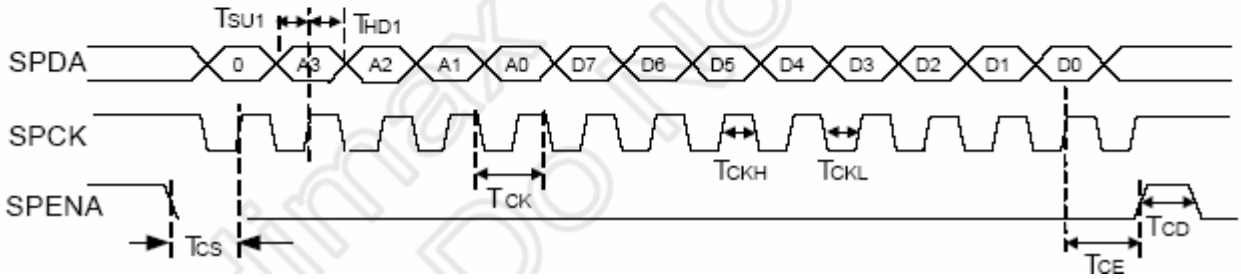


Figure 9. 2 SPI Read Timing

- **SPI write timing**



11. Outline Dimension