FEMA ELECTRONICS CORPORATION

5.6” Color TFT LCD Module

FEMA P/N: GM960234B-56-TTX1NCW-HB

LCD MODULE SPECIFICATION
FOR CUSTOMER'S APPROVAL

APPROVED BY: (FOR CUSTOMER ONLY)

A. Physical specifications

NO.	Item	Specification	Remark
1	Display resolution(dot)	960(W)×234(H)	
2	Active area(mm)	113.3(W)×84.7(H)	
3	Screen size(inch)	5.6(Diagonal)	
4	Dot pitch(mm)	0.118(W)×0.362(H)	
5	Color configuration	R. G. B. stripe	
6	Overall dimension(mm)	126.5(W)×100(H)×6.8(D)	Note 1
7	Weight(g)	145±10	

Note 1: Refer to Fig. 1

B. Electrical specifications

1.Pin assignment

a. TFT-LCD panel driving section

Pin no	Symbol	I/O	Description	Remark
1	GND	-	Ground for logic circuit	
2	V_{CC}	I	Supply voltage of logic control circuit for scan driver	
3	V_{GL}	I	Negative power for scan driver	
4	V_{GH}	I	Positive power for scan driver	
5	STVR	I/O	Vertical start pulse	Note 1
6	STVL	I/O	Vertical start pulse	Note 1
7	CKV	I	Shift clock input for scan driver	
8	U/D	I	Up/Down scan control input	Note 1,2
9	OEV	I	Output enable input for scan driver	
10	VCOM	I	Common electrode driving signal	
11	VCOM	I	Common electrode driving signal	
12	L/R	I	Left/Right scan control input	Note 1,2
13	Q1H	I	Analog signal rotate input	
14	OEH	I	Output enable input for data driver	
15	STHL	I/O	Start pulse for horizontal scan line	Note 1
16	STHR	I/O	Start pulse for horizontal scan line	Note 1
17	CPH3	I	Sampling and shifting clock pulse for data driver	
18	CPH2	I	Sampling and shifting clock pulse for data driver	
19	CPH1	I	Sampling and shifting clock pulse for data driver	
20	V_{CC}	I	Supply voltage of logic control circuit for data driver	
21	GND	-	Ground for logic circuit	
22	VR	I	Alternated video signal input(Red)	
23	VG	I	Alternated video signal input(Green)	
24	VB	I	Alternated video signal input(Blue)	
25	AV_{DD}	I	Supply voltage for analog circuit	
26	AV_{SS}	-	Ground for analog circuit	

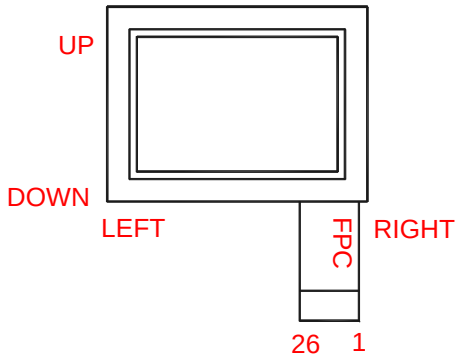
Note 1: Selection of scanning mode (please refer to the following table)

Setting of scan control input		IN/OUT state For start pulse				Scanning direction
U/D	L/R	STVR	STVL	STHR	STHL	
GND	V_{CC}	OUT	IN	OUT	IN	From up to down, and from left to right.
V_{CC}	GND	IN	OUT	IN	OUT	From down to up, and from right to left.
GND	GND	OUT	IN	IN	OUT	From up to down, and from right to left.
V_{CC}	V_{CC}	IN	OUT	OUT	IN	From down to up, and from left to right.

IN: Input; OUT: Output.

Note 2 : Definition of scanning direction.

Refer to figure as below:



b. Backlight driving section(Refer to Fig. 1)

No.	Symbol	I/O	Description	Remark
1	HI	I	Power supply for backlight unit (High voltage)	
2	GND	-	Ground for backlight unit	

2. Absolute maximum ratings

Item	Symbol	Condition	Min.	Max.	Unit	Remark
Power voltage	V_{CC}	GND=0	-0.3	7	V	
	AV_{DD}	AV_{SS}=0	-0.3	7	V	
	V_{GH}	GND=0	-0.3	18	V	
	V_{GL}		-15	0.3	V	
	$V_{GH}-V_{GL}$		-	31	V	
Input signal voltage	V_i		-0.3	AV_{DD}+0.3	V	Note 1
	V_I		-0.3	V_{CC}+0.3	V	Note 2
	VCOM		-2.9	5.2	V	
Operating temperature	Topa		0	60	℃	Ambient temperature
Storage temperature	Tstg		-25	60	℃	Ambient temperature

Note 1: VR, VG, VB

Note 2: STHL, STHR, Q1H, OEH, L/R, CPH1~CPH3, STVR, STVL, OEV, CKV, U/D.

3. Electrical characteristics

a. Typical operating conditions (GND=AVss=0V, Note 5)

Item		Symbol	Min.	Typ.	Max.	Unit	Remark
Power supply		V_{CC}	4.8	5	5.2	V	
		AV_{DD}	4.8	5	5.2	V	
		V_{GH}	14.3	15	15.7	V	
		V_{GLAC}	-	5	-	Vp-p	AC component of $V_{GL.}$ Note 1
		V_{GL-H}	-10.5	-10	-9.5	V	High level of $V_{GL.}$
Video signal Amplitude (VR,VG,VB)		V_{iA}	AVss +0.4	-	AV_{DD}-0.4	V	Note 2
		V_{iAC}	-	3	-	V	AC component
		V_{iDC}	-	AV_{DD}/2	-	V	DC component
VCOM		V_{CAC}	-	5	-	Vp-p	AC component,Note 3
		V_{CDC}	1.3	1.4	1.5	V	DC component
Input Signal voltage	H Level	V_{IH}	$0.8V_{CC}$	-	V_{CC}	V	Note 4
	L Level	V_{IL}	0	-	$0.2V_{CC}$	V	

Note 1: The same phase and amplitude with common electrode driving signal(VCOM).
Note 2: Refer to Fig.4-(a)
Note 3: The brightness of LCD panel could be adjusted by the adjustment of the AC component of VCOM.
Note 4: STHL,STHR,Q1H,OEH,L/R,CPH1~CPH3,STVR,STVL,OEV,CKV,U/D.
Note 5: Be sure to apply GND, V_{CC} and V_{GL} to the LCD first, and then apply V_{GH}.

b. Current consumption (GND=AVss=0V)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Current for driver	I_{GH}	V_{GH}=15V	-	0.2	0.8	mA	
	I_{GL}	V_{GL}=-10V	-	-0.5	-1	mA	
	I_{CC}	V_{CC}=5V	-	4	8	mA	
	I_{DD}	AV_{DD}=5V	-	12	20	mA	
	I_{VCOM}	V_{CAC}=5V	-	10	18	mA	
	I_{LI1}	-	-10	-	10	μA	Note 1

Note 1: Logic Input Leakage Current

c. Backlight driving conditions

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remark
Lamp voltage	V_L	-	470	528	Vrms	Note 3
Lamp current	I_L	-	6	7	mArms	
Frequency	F_L	-	60	80	kHz	Note 3,4
Lamp starting voltage	V_S	-	-	650	Vrms	Note 1,3,5
		-	-	910	Vrms	Note 2,3,5
Lamp Lifetime	-	10,000	-	-	hr	Note 6

Note 1: Ta = 25℃.
Note 2: Ta = 0℃.
Note 3: Reference value, correct value is subject to final backlight specification which will be decided in the future.

Note 4: The lamp frequency should be selected as different as possible from display horizontal synchronous signal to avoid interference.

Note 5: For starting the backlight unit, the output voltage of DC/AC's transformer should be larger than the maximum lamp starting voltage.

Note 6:The" Lamp life time" is defined as the module brightness decrease to 50% original brightness at Ta=25℃, I_L=6mA.

4. AC Timing

a. Timing conditions

Parameter	Symbol	Min.	Typ.	Max.	Unit.	Remark
Rising time	t_{r1}	-	-	60	ns	CPH1~CPH3
Falling time	t_{f1}	-	-	60	ns	CPH1~CPH3
Rising time	t_{r2}	-	-	120	ns	CKV
Falling time	t_{f2}	-	-	120	ns	CKV
High and low level pulse width	t_{CPH}	150	154	158	ns	CPH1~CPH3
CPH pulse duty	t_{CWH}	40	50	60	%	CPH1~CPH3
CPH pulse delay	t_{C12} t_{C23} t_{C31}	30	t_{CPH}/3	t_{CPH}/2	ns	CPH1~CPH3
STH setup time	t_{SUH}	20	-	-	ns	STHR,STHL
STH hold time	t_{HDH}	20	-	-	ns	STHR,STHL
STH pulse width	t_{STH}	-	1	-	t_{CPH}	STHR,STHL
STH period	t_H	61.5	63.5	65.5	μs	STHR,STHL
OEH pulse width	t_{OEH}	-	7	-	t_{CPH}	OEH
Sample and hold disable time	t_{DIS1}	-	55	-	t_{CPH}	
OEV pulse width	t_{OEV}	-	27	-	t_{CPH}	OEV
CKV pulse width	t_{CKV}	-	41	-	t_{CPH}	CKV
Clean enable time	t_{DIS2}	-	16	-	t_{CPH}	
Horizontal display start	t_{SH}	-	0	-	t_{CPH}/3	
Horizontal display timing range	t_{DH}	-	960	-	t_{CPH}/3	
STV setup time	t_{SUV}	400	-	-	ns	STVL,STVR
STV hold time	t_{HDV}	400	-	-	ns	STVL,STVR
STV pulse width	t_{STV}	-	-	1	t_H	STVL,STVR
Horizontal lines per field	t_V	256	262	268	t_H	Note 1
Vertical display start	t_{SV}		3	-	t_H	
Vertical display timing range	t_{DV}		234	-	t_H	
VCOM rising time	t_{rCOM}		-	5	μs	
VCOM falling time	t_{fCOM}		-	5	μs	
VCOM delay time	t_{DCOM}		-	3	μs	
RGB delay time	t_{DRGB}		-	1	μs	

Note 1: Please don't use odd horizontal lines to drive LCD panel for both odd and even field simultaneously.

b. Timing diagram

Please refer to the attached drawing, from Fig.2 to Fig.6.

C. Optical specification (Note 1,Note 2, Note 3)

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Response time	Rise Fall	Tr Tf	θ =0°	- -	15 20	30 40	Ms Ms	Note 4,6
Contrast ratio		CR	At optimized viewing angle	100	250	-		Note 5,6
Viewing angle	Top Bottom Left Right		CR≧10	30 50 50 50	- - - -	- - - -	deg.	Note 6,7
Brightness			θ =0°	450	500	-	nit	Note 8
White chromaticity		X	θ =0°	0.25	0.30	0.35		Note 8
		Y	θ =0°	0.30	0.35	0.40		

Note 1. Ambient temperature =25℃. And lamp current I_L = 6mArms.

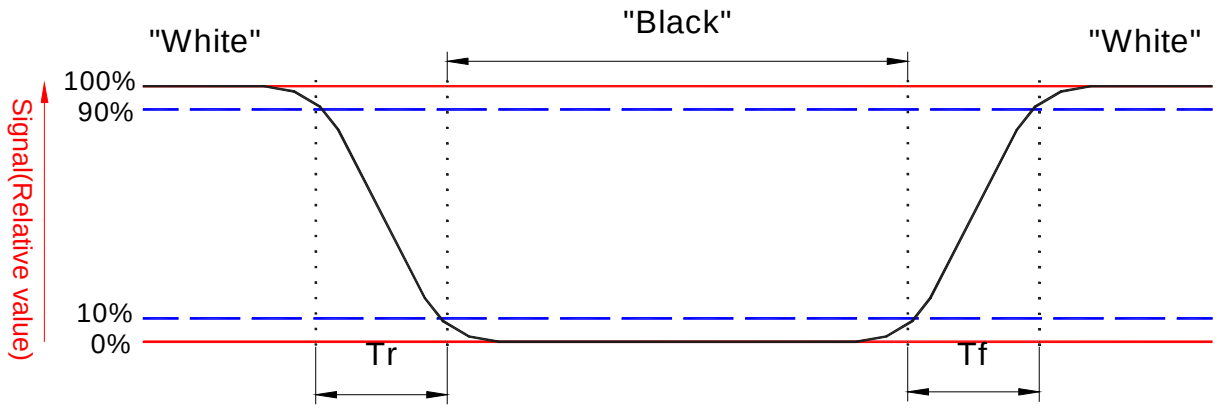
Note 2. To be measured in the dark room.

Note 3.To be measured on the center area of panel with a viewing cone of 1° by Topcon luminance meter BM-7, after 10 minutes operation.

Note 4. Definition of response time:

The output signals of photodetector are measured when the input signals are changed from “black” to “white”(falling time)and from “white” to “black”(rising time),respectively.

The response time is defined as the time interval between the 10% and 90% of amplitudes. Refer to figure as below.



Note 5. Definition of contrast ratio:

Contrast ratio is calculated with the following formula.

$$\text{Contrast ratio (CR)} = \frac{\text{Photodetector output when LCD is at “White” state}}{\text{Photodetector output when LCD is at “Black” state}}$$

Note 6. White $Vi=V_{i50} \overline{+} 1.5V$

Black $Vi=V_{i50} \pm 2.0V$

“±” means that the analog input signal swings in phase with COM signal.

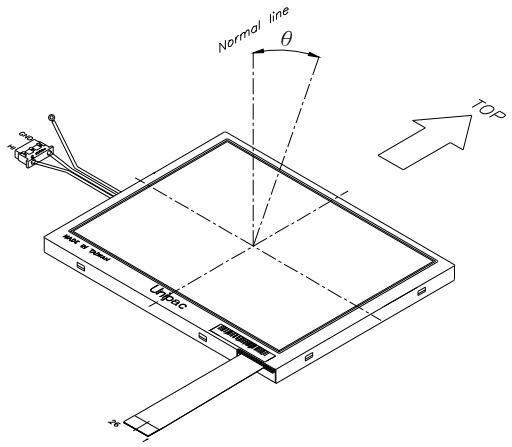
“$\overline{+}$” means that the analog input signal swings out of phase with COM signal.

V_{i50} : The analog input voltage when transmission is 50%

The 100% transmission is defined as the transmission of LCD panel when all the input terminals of module are electrically opened.

Note 7. Definition of viewing angle:

Refer to figure as below.



Note 8. Measured at the center area of the panel when all the input terminals of LCD panel are electrically opened.

D. Reliability test items:

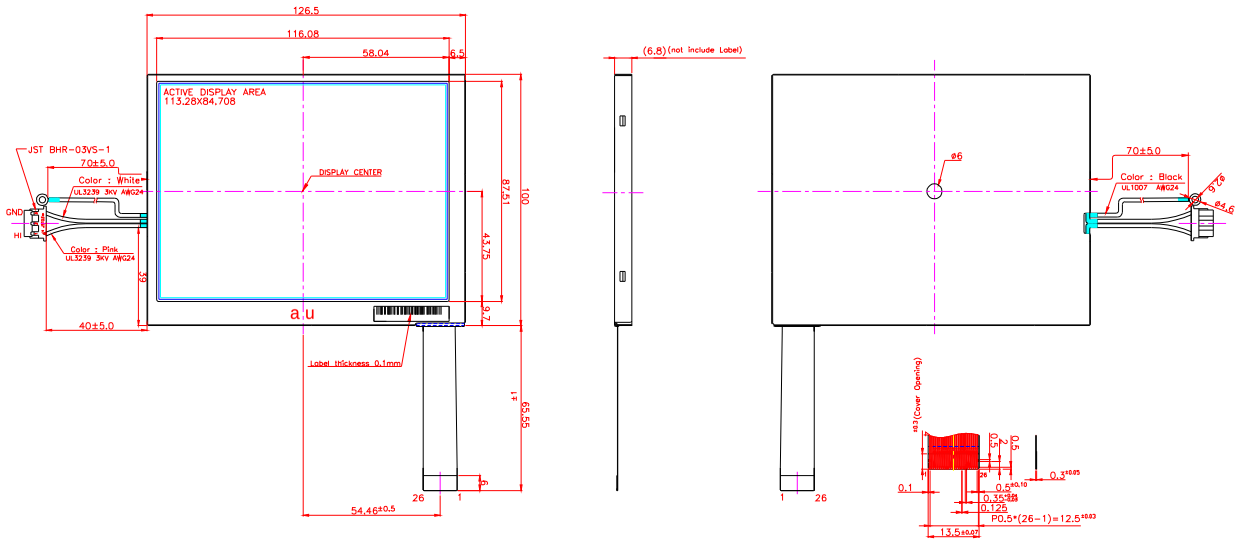
No.	Test items	Conditions	Remark
1	High temperature storage	Ta= 60℃ 240Hrs	
2	Low temperature storage	Ta= -25℃ 240Hrs	
3	High temperature operation	Ta= 60℃ 240Hrs	
4	Low temperature operation	Ta= 0℃ 240Hrs	
5	High temperature and high humidity	Ta= 60℃, 95% RH 240Hrs	Operation
6	Heat shock	-25℃~60℃/50 cycle 2Hrs/cycle	Non-operation
7	Electrostatic discharge	±200V,200pF(0Ω), once for each terminal	Non-operation
8	Vibration	Frequency range : 10~55Hz Stoke : 1.5mm Sweep : 10~55Hz~10Hz 2 hours for each direction of X,Y,Z (6 hours for total)	JIS C7021, A-10 condition A
9	Mechanical shock	100G , 6ms, ±X,±Y,±Z 3 times for each direction	JIS C7021, A-7 condition C
10	Vibration (with carton)	Random vibration: $0.015G^2$/Hz from 5~200Hz –6dB/Octave from 200~500Hz	IEC 68-34
11	Drop (with carton)	Height: (60)cm 1 corner, 3 edges, 6 surfaces	JIS Z0202

Note: Ta: Ambient temperature.

REV	ECN NO.	DESCRIPTION	SIGN	DATE
A	–	–	–	–

LCM (FOR 0.7mm Glass)

NOTES:
1.General tolerance is ±0.30.
2.The bending radius of FPC should be larger than 0.6.
3.Unit : mm.
4. Glass thickness = 0.7mm



UNIT	SCALE	WEIGHT	ANGLE GENERAL TOLERANCE		ORIGINAL MODEL
mm	1:1	–	–	3rd Angle	

LEVEL / DIM.	General tolerance ± 1	2	3	SELECT LEVEL
0 ~ 4	0.05	0.1	0.1	2
4 ~ 14	0.05	0.1	0.1	
14 ~ 63	0.05	0.1	0.2	
63 ~ 250	0.1	0.2	0.3	
250 ~ 600		0.3	0.5	
600 ~ 4000			0.8	

MATERIAL		# CRITICAL DIMENSION
FINISH	–	SPC DIMENSION
APPROVED		
CHECKED		
DESIGNED	Eric Kuo	03/02/27

TITLE

DRAWING NO.(PART NO.) FEMA P/N GM960234B-56-TTXINCW-HB

FEMA ELECTRONICS CORPORATION

SIZE	SHT	REV
A4	1 of 1	0

Fig. 1 Outline dimensio of TFT-LCD module

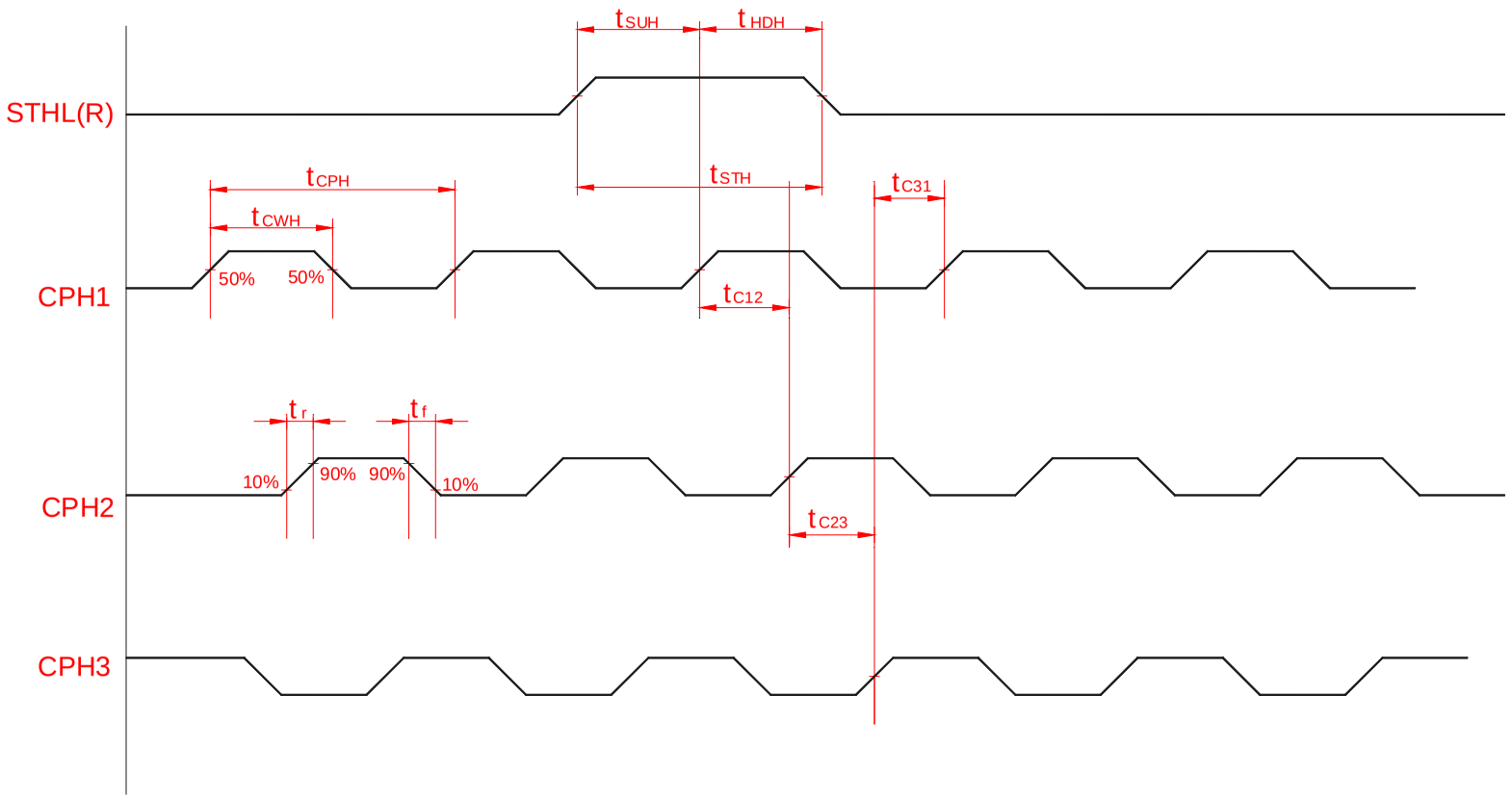


Fig. 2 Sampling clock timing

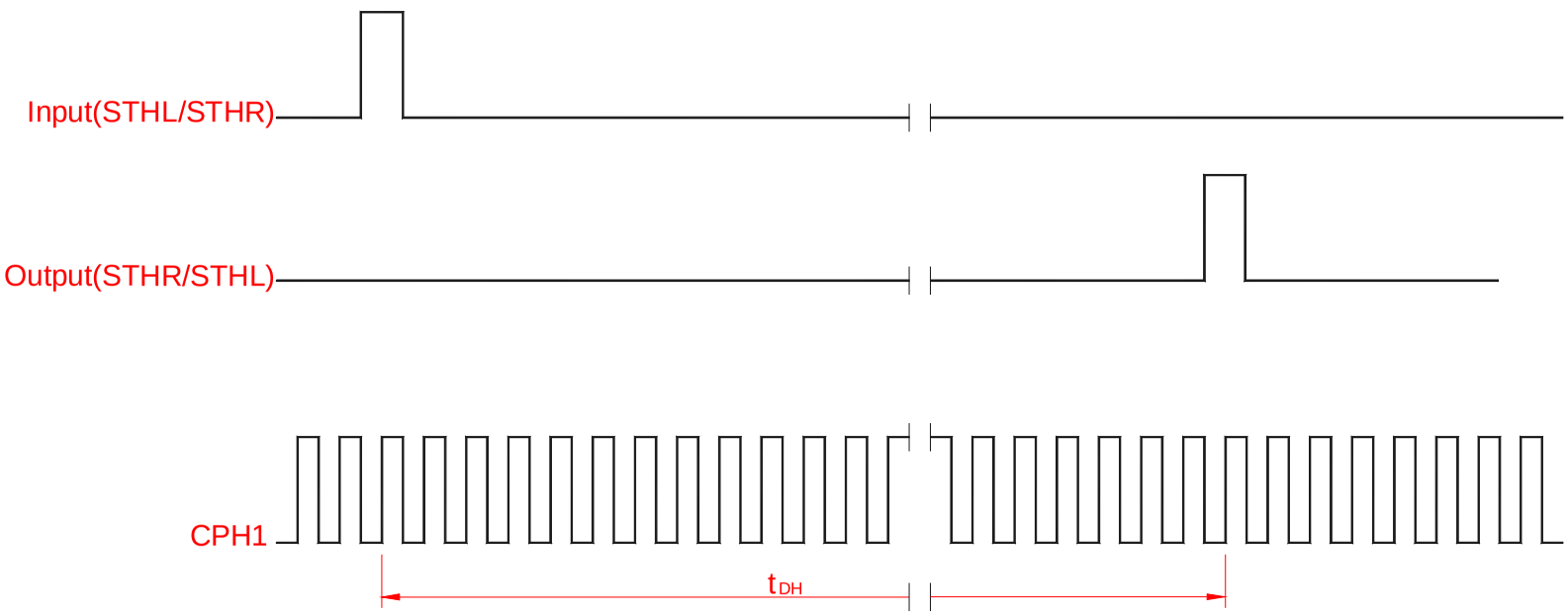


Fig. 3 Horizontal display timing range

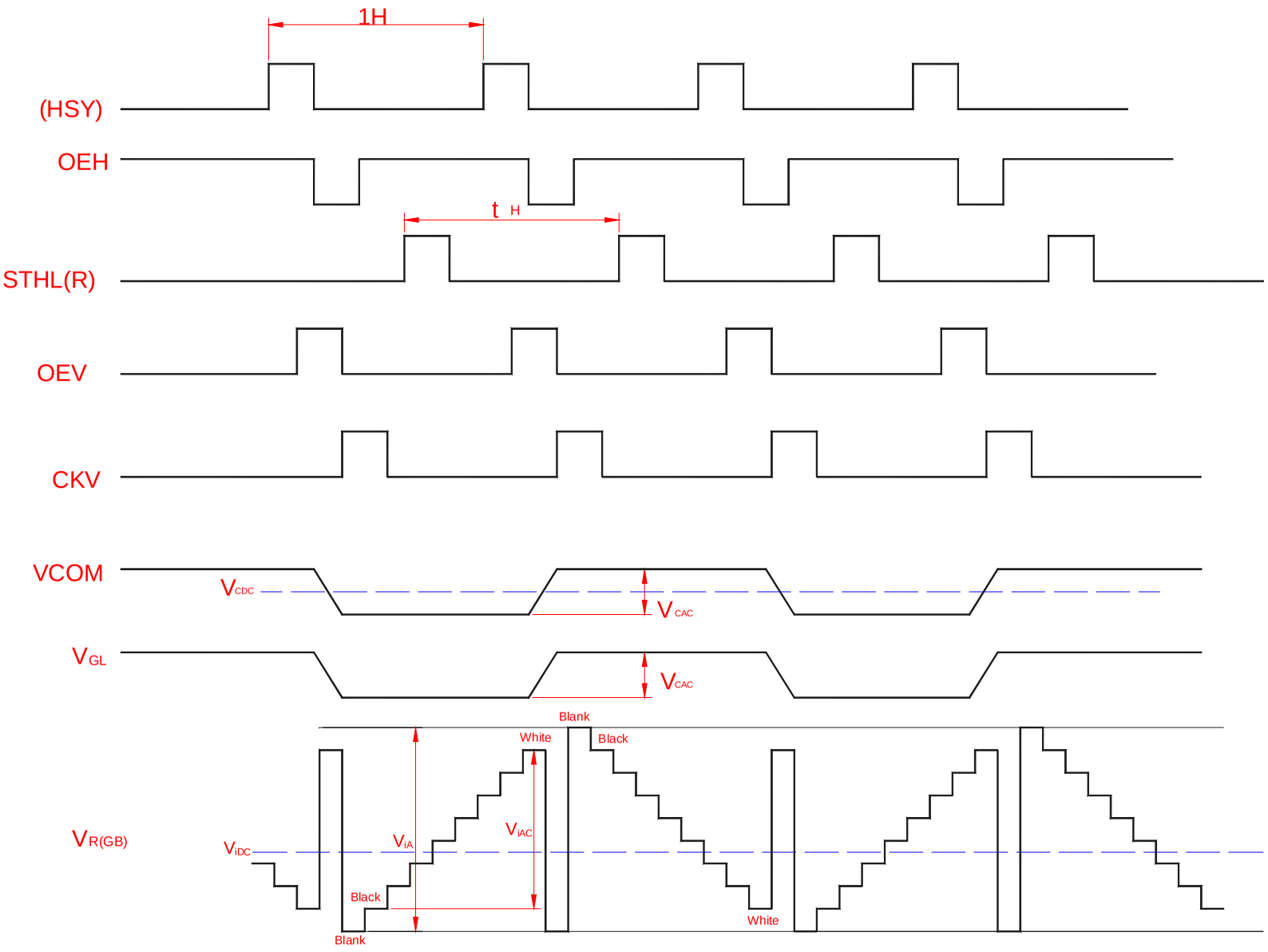
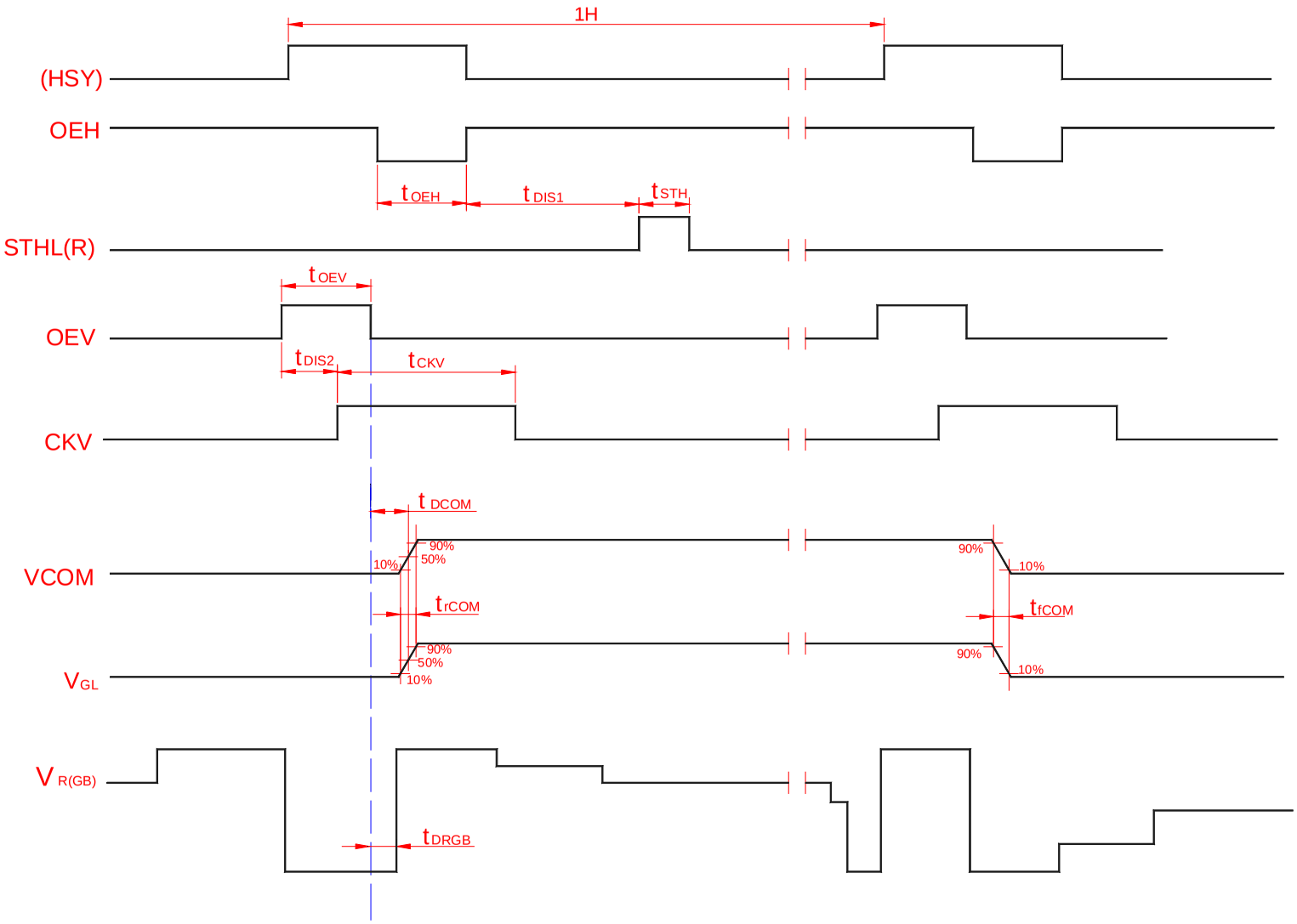


Fig.4-(a) Horizontal timing



Note: The falling edge of OEV should be synchronized with the falling edge of OEH

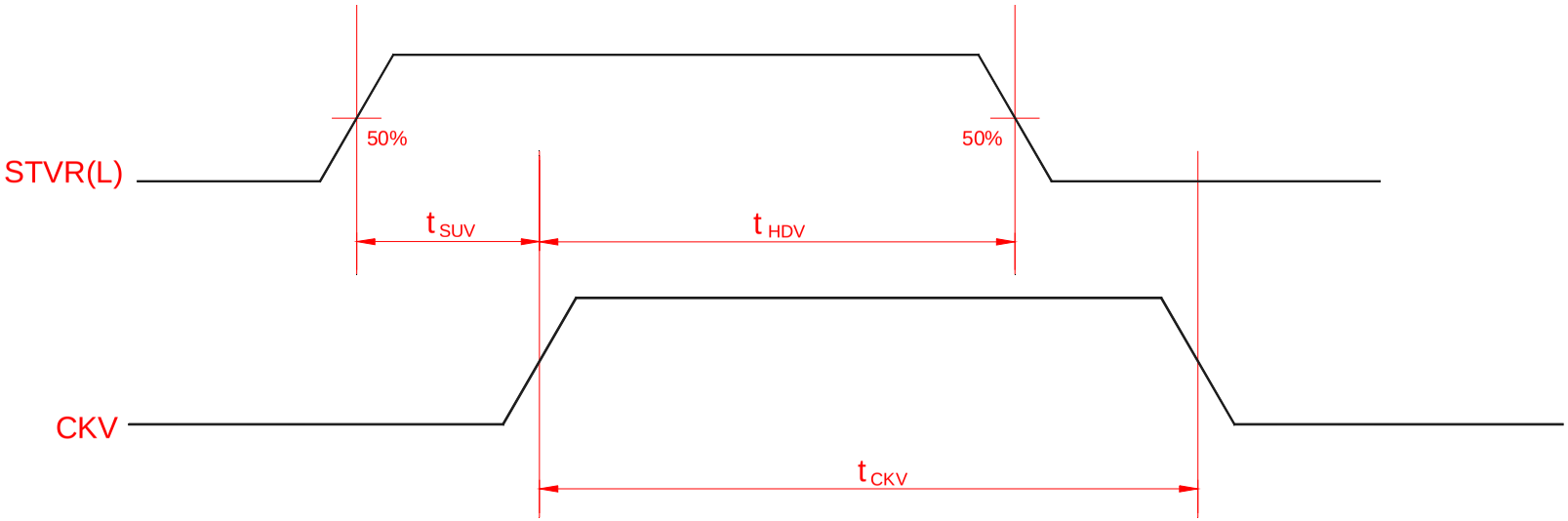


Fig.5 Vertical shift clock timing

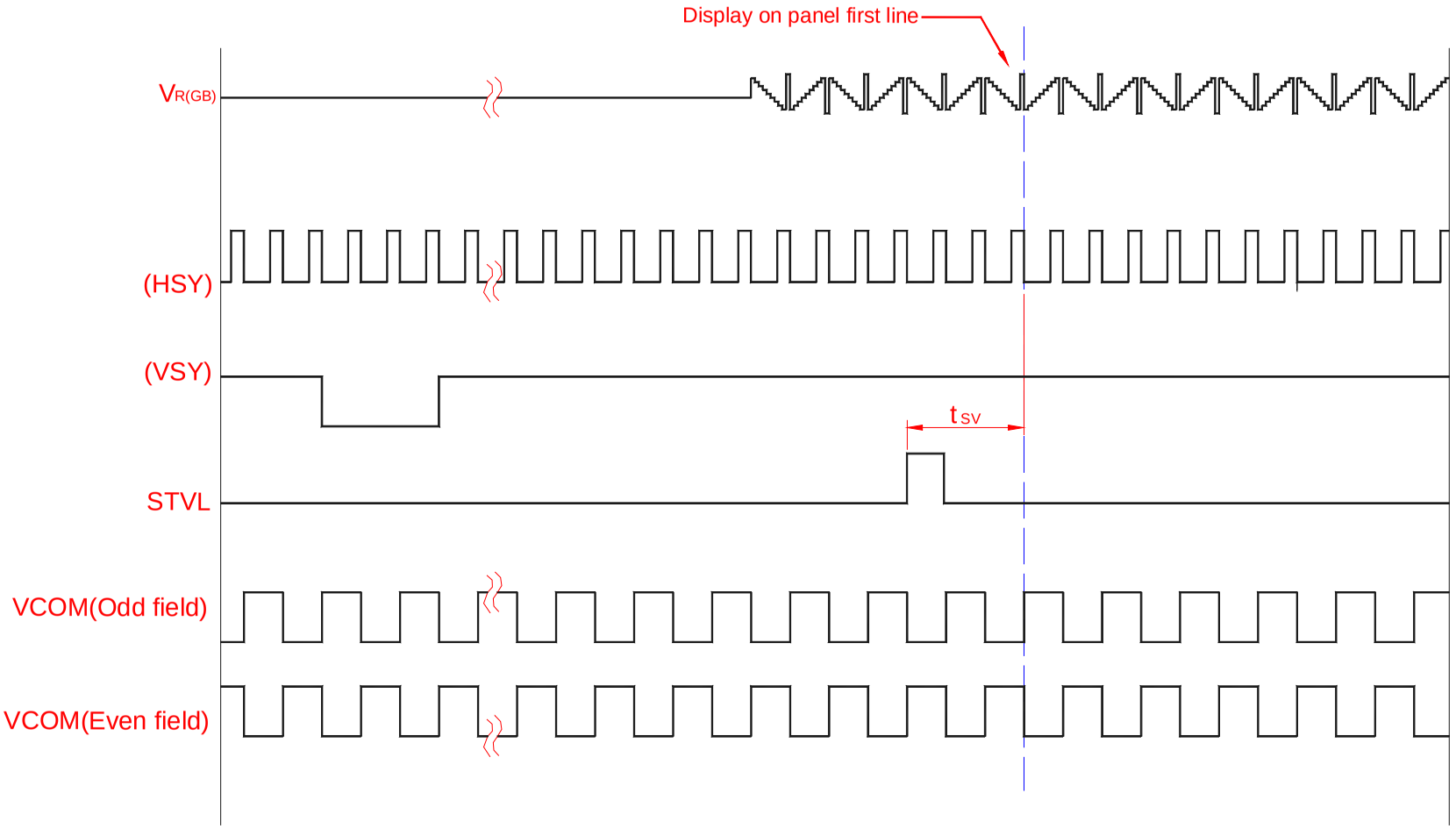


Fig.6-(a) Vertical timing (From up to down)

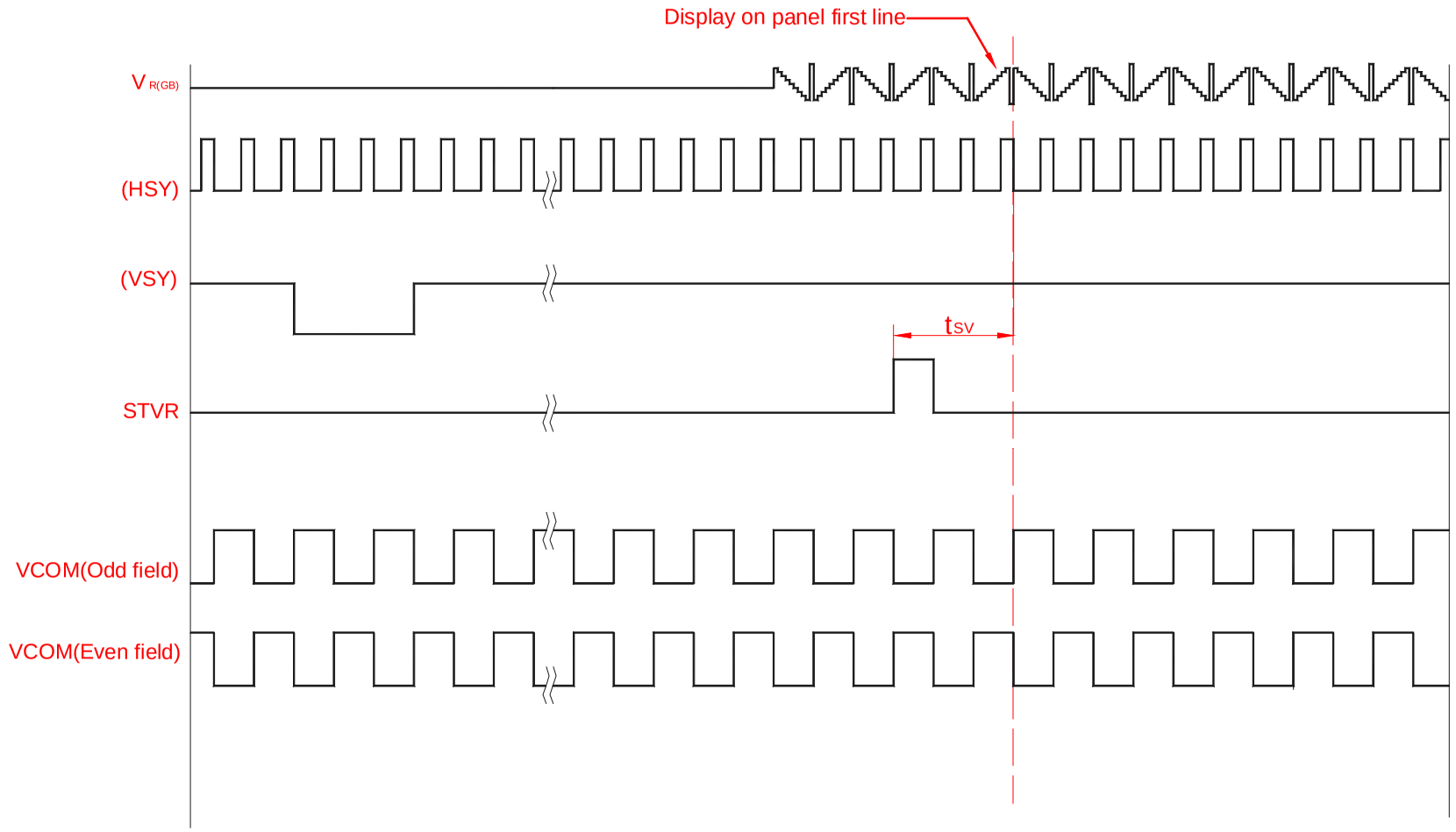


Fig.6-(b) Vertical timing (From down to up)