

## **ENGINEERING SPECIFICATIONS**

TFT COLOR LCD MODULE

### **TM070WA-22L06**

- 18cm (7 inch) diagonal
- Resolution (480xR•G•Bx234 dots)
- With CFL backlight unit
- Nonglare surface type

**(PRELIMINARY)**

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■ **MECHANICAL CHARACTERISTICS**

Ta=25deg.

ITEM	SPECIFICATION	UNIT
Module size	167.0(W)×102.0(H)×11.0typ(t)	mm
Resolution	480×R•G•B(W)×234(H)	pixel
Dot pitch	0.107(W)×0.372(H)	mm
Pixel pitch	0.321(W)×0.372(H)	mm
Active viewing area	154.1(W)×87.05(H)	mm
Bezel opening area	158.1(W)×91.0(H)	mm
Weight	220 TYP.	g

■ **ABSOLUTE MAXIMUM RATINGS**

ITEM	SYMBOL	CONDITIONS	MIN	MAX	UNIT	NOTE
Logic/Source power supply voltage	VSH		-0.3	6.0	V	Common power supply voltage of Logic
Power supply voltage for gate driver	H	VGH	-0.3	28	V	
	H-L	VGH-VGL	0	33	V	
	L	VGL	-16.0	+0.3	V	
Common electrode driving signal	VCOM	DC	0	3.0	V	
		P-P	0	6.0	V	
TFT exclusive RGB	VR,VB,VG		-0.3	VSH+0.3	V	
Input signals	Vi		-0.3	VSH+0.3	V	
Output signals	Vo		-0.3	VSH+0.3	V	
Lamp current	Li		3	4.5	mA	
Ambient temperature	T <sub>ST</sub>	Storage	-30	85	deg.	Note 1),2)
	T <sub>OP</sub>	Operation	-30	85		
Humidity	-	TaC=<60deg.		90	%RH	not beyond 240H Note 3)

Note 1) Care should be taken so that the LCD module may not be subjected to the temperature beyond this specification.

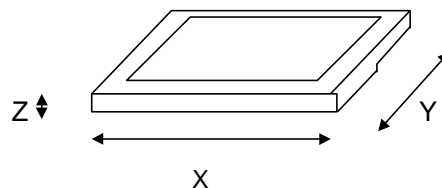
Note 2) Ambient temperature shows temperature on LCD surface. Module temperature is apt to increase while it's driving due to CFL heat etc. Please design carefully not to exceed +85 degree C on every surface of LCD that should come to contact with any other equipment. Temperature for operation is one which only assures LCD operation. Contrast, response time, or other LCD quality is regulated under condition of Ta=+25 degree C.

Note 3) Please be advised that dew condensation level should be less than maximum wet bulb temperature 58 degree C. Dew condensation may induce leak current, and also influence LCD performance.

■ **MECHANICAL ENVIRONMENT**

Vibration	-	Storage	-	2.9	G	Note 1)
Shock	-	Storage	-	100	G	XYZ 6ms/direction

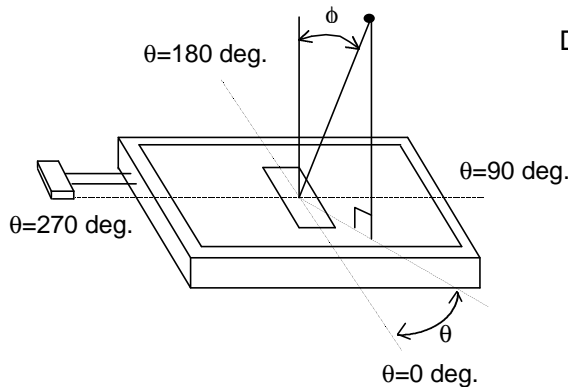
Note 1) Vibration frequency : 8 - 33.3 Hz displacement : 1.3mm  
 Vibration frequency : 33.3 - 400Hz  
 Sweep time : 15 min./1 sweep  
 total test time : X,Y-2Hr Z-4Hr



■ **OPTICAL CHARACTERISTICS (1)**

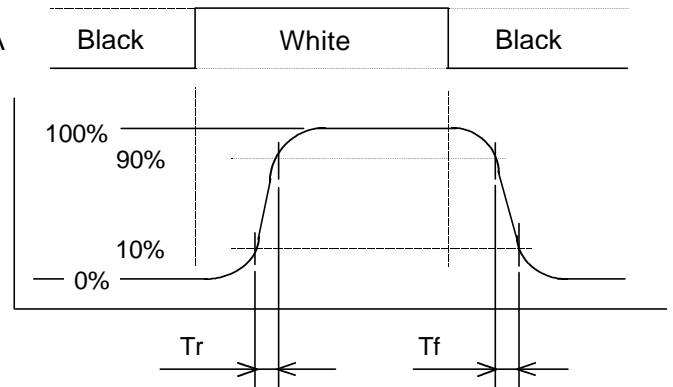
Ta=25deg., VSH=5.3V, fv=60Hz

ITEM	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT	NOTE	
Viewing angle range	φ	K=>5	θ = 0 deg.	-	-	40	deg.	Note 1),4)
			θ = 90 deg.	-	-	60		
			θ =180 deg.	-	-	30		
			θ =270 deg.	-	-	60		
Contrast ratio	K	θ =0 deg.,φ =0 deg.	100	-	-	-	Note 2),4)	
Response time	Rise	tr	θ =0 deg.,φ =0 deg.	-	30	-	ms.	Note 3),4)
	Fall	tf		-	20	-		
Color of CIE Coordinate	White	x	θ =0 deg.,φ =0 deg.	-	0.300	-		Note 4)
		y		-	0.298	-		



Note 1) θ and φ are defined as above figure.

DATA



Note 3) Response time

Note 2) Contrast ratio "K" is defined below formula.

$$K = \frac{\text{Brightness at ON (White)}}{\text{Brightness at OFF (Black)}}$$

Note 4) Measurement condition

- ① VSH=5.3V, VGH=15V, VGL=-14.0V, VCOM DC=1.8V, VCOM P-P=5.0V
- ② VR/VG/VB DC=VSH/2, VR/VG/VB AC=4.0V
- ③ Follow brightness measurement condition in next item.

## ■ OPTICAL CHARACTERISTICS (2)

Ta=25 deg.

ITEM	SYM.	CONDITIONS	MIN	TYP	MAX	UNIT	NOTE
Brightness	B		-	400	-	cd/m <sup>2</sup>	Surface Brightness of LCD

Note) The brightness shall be the following point.

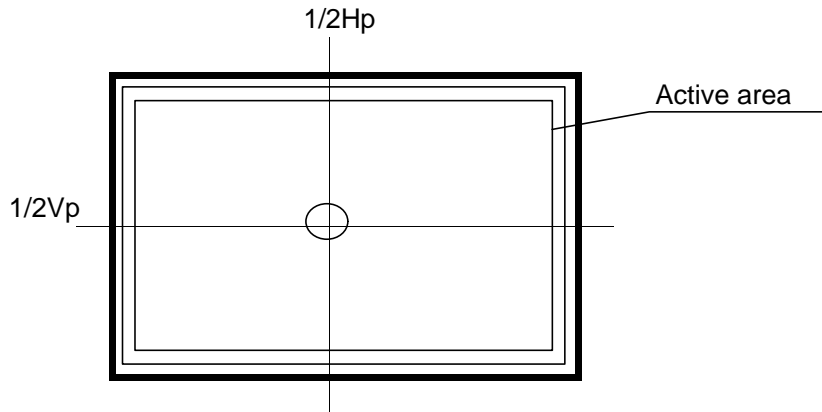


Fig.1 Measurement point

Vp : Total Number of Vertical pixel

Hp : Total Number of horizontal pixel

Measurement equipment : BM-7(TOPCON Corp.)

Measurement condition

- ① Ambient temperature : 25 ±2 deg.
- ② LCD : All pixels are WHITE
- ③ Measure after 30 minutes of CFL warm up.
- ④ IL=4.5mArms, CFL inverter:  
Operating TDK CXA-L0612A-VJL or equivalent inverter with capability of frequency 50kHz, Lamp current max.4.5mA

## ■ BACKLIGHT CHARACTERISTICS

Ta=25 deg.

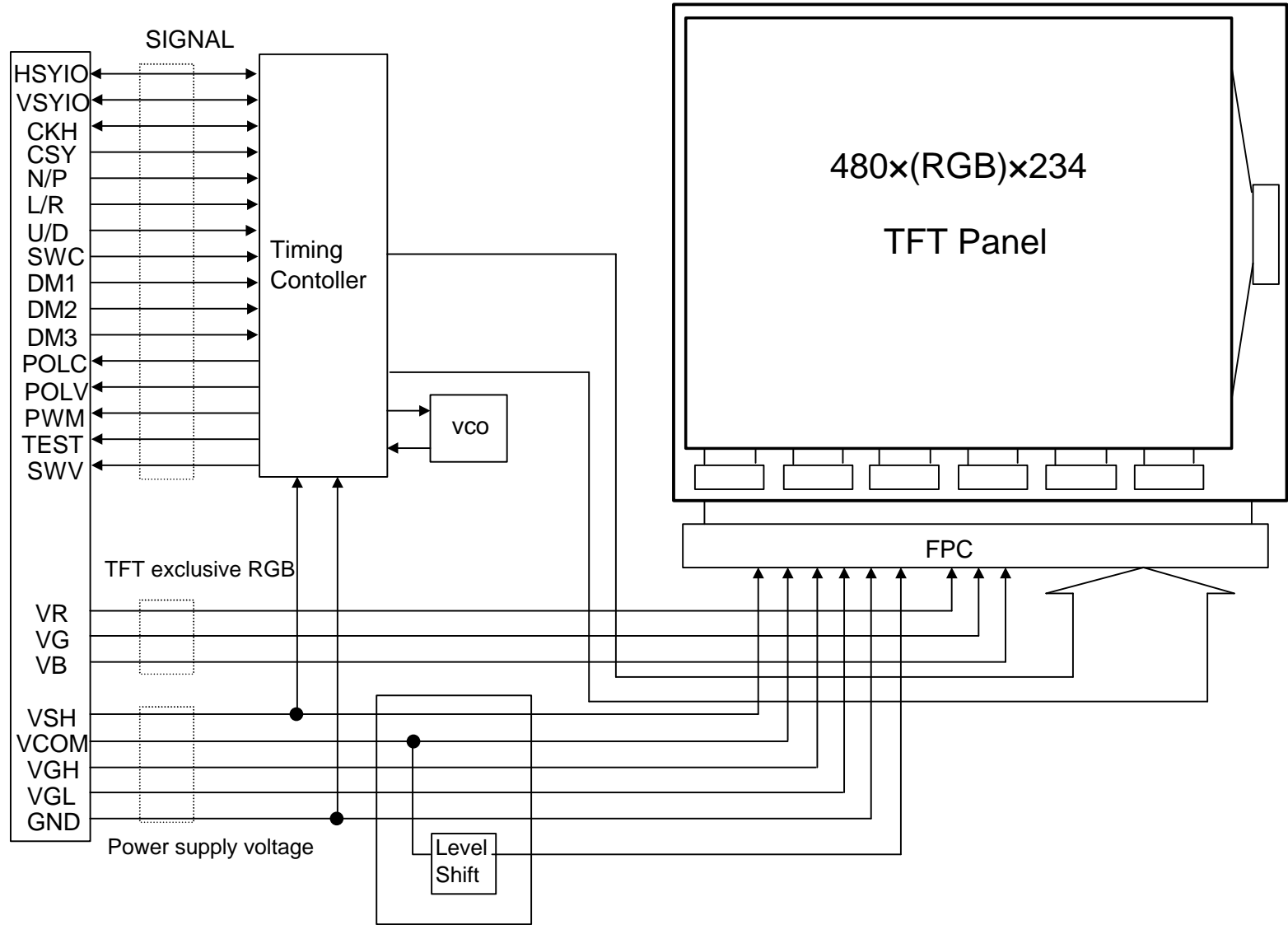
ITEM	SYM.	CONDITIONS	MIN	TYP	MAX	UNIT	NOTE
Lamp voltage	V <sub>L</sub>		-	740	-	Vrms	at IL=4.5mArms
Lamp current	I <sub>L</sub>		3.0	-	4.5	mArms	(Recommended value)
Operating frequency	f <sub>L</sub>		40	48	55	KHz	(Recommended value)
Start up voltage	V <sub>s1</sub>		-	-	1750	Vrms	at Ta= 25 deg.
Start up voltage	V <sub>s2</sub>		-	-	1800	Vrms	at Ta=-30 deg.
Lamp life	t <sub>OL</sub>		10000	-	-	Hours	at IL=4.5mArms, Note 1)
Backlight power supply	WL		-	3.3	-	W	at IL=4.5mArms

Note 1) CFL Lamp life indicates time from initial Lamp brightness to half of original brightness.

Note 2) Inverter GND shall be connected to LCD frame.(Please refer to outer dimension drawing) LCD frame is connected to internal circuitry GND.

■ BLOCK DIAGRAM

IF BLOCK 24PIN



■ **INTERFACE PIN CONNECTIONS**

LCM : CN

PIN NO.	SYMBOL	I/O	FUNCTION
1	HSYIO	I/O	Input/Output horizontal sync.signal(low active)
2	POLC	O	Polarity alternating signal for common signal
3	CSY	I	Composite sync.signal(high active)
4	VGH	I	Power supply for gate driver(high level)
5	POLV	O	Polarity alternating signal for video signal)
6	VB	I	Color video signal(Blue)
7	VR	I	Color video signal(Red)
8	VG	I	Color video signal(Green)
9	GND	I	GND
10	VSH	I	Positive power supply voltage
11	VGL	I	Power supply for gate driver(low level)
12	VCOM	I	Common electrode driving signal
13	N/P	I	Selection for NTSC or PAL(NTSC=VSH,PAL=GND)
14	VSIO	I/O	Input/Output vertical sync.signal(low active)
15	L/R	I	Selection for horizontal scanning direction
16	U/D	I	Selection for vertical scanning direction
17	SWC	I	Selection for input/output direction of CKH,HSYNC,VSYNC
18	PWM	O	Timing signal for PWM dimming of backlight
19	TEST	O	Open use only
20	CKH	I/O	Input/output clock signal
21	DM1	I	Selection for display mode
22	DM2	I	Selection for display mode
23	DM3	I	Selection for display mode
24	SWV	O	Video selection timing signal

I/F CN : SFR24R-1ST(FCI)

Suitable FPC : Pitch 0.8mm,Width 20mm

Back Light : FLCN

PIN NO.	SYMBOL	FUNCTION
1	H.V	High voltage for CFL
2	N.C	No Connection
3	LGND	Low voltage for CFL

FLCN : BHR-03VS-1(JST)

Suitable mating connector : SM02(8.0)B-BHS-1(JST)





■ DISPLAY METHOD AND CHARACTERISTICS

H=VSH L=GND						Horizontal		Vertical		EXAMPLE
DM1	DM2	DM3	Display Mode	Display method, Feature	SOURCE	Disply area	Sampling	Disply area		
								NTSC	PAL	
H	H	H	Full mode	Display 4:3 image long sideways.	4:3 signal Navigation Signal	Signal area	Sender Both side Same	S=1/1	S=6/7 Compress	Fig.2-1
H	H	L	Wide1 mode	Display perfect circle around center better than Full screen mode.	4:3 signal	Signal area	Sender :Slow Botn side:Fast	S=1/1	S=6/7 Compress	Fig.2-2
H	L	H	Normal mode	Display perfect circle all around the screen. Both edge screen can be masked with SWV.	4:3 signal	Signal area & Blank	Sender :Slow Botn side:Fast <small>Modulation wide1,2&lt;Nomal</small>	S=1/1	S=6/7 Compress	Fig.2-3
H	L	L	Cinema mode	Display 16:9 image.	Wide signal(16:9)	Signal area	Sender Both side Same	S=4/3 Extend	S=20/21 Compress	Fig.2-4
L	H	H	Wide 2 mode	Display perfect circle around center better than Wide 1 mode. Top and bottom images are eliminated.	4:3 signal	Signal area	Sender :Slow Botn side:Fast	S=5/4 Extend	S=10/11 Compress	Fig.2-5
L	H	L	Test mode	This mode is unusable due to test mode.	-	-	-	-	-	-
L	L	H	Test mode	This mode is unusable due to test mode.	-	-	-	-	-	-
L	L	L	Test mode	This mode is unusable due to test mode.	-	-	-	-	-	-

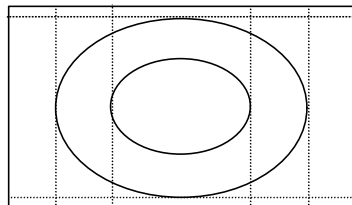


Fig2-1  
Full mode

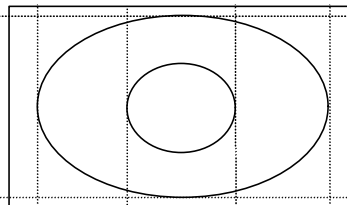


Fig2-2  
Wide1 mode

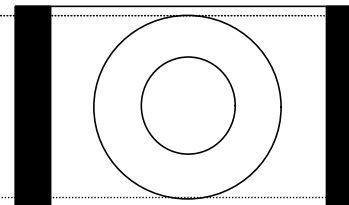


Fig2-3  
Normal mode

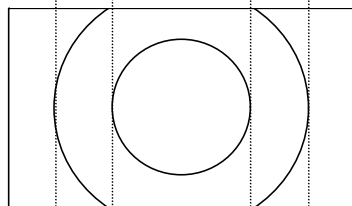


Fig2-4  
Chinema mode

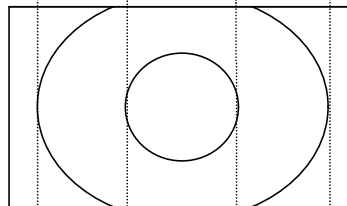


Fig2-5  
Wide 2 mode

**<DISPLAY AREA>**

① NTSC MODE(N/P=H, SWC=H)

(a1) Horizontal... Full mode, Wide1 mode, Wide2 mode, Cinema mode  
From falling edge of HSYIO output to 12.8-63.1 $\mu$ S.

(a2) Horizontal... Normal mode

From falling edge of HSYIO output to 7.5-68.5 $\mu$ S.

(b1) Vertical... Full mode, Wide2 mode, Normal mode

From falling edge of VSYIO output to 20H-253H.

(b2) Vertical... Cinema mode

From falling edge of VSYIO output to 49H-224H.

(b3) Vertical... Wide2 mode

From falling edge of VSYIO output to 42H-228H.

② PAL MODE(N/P=L, SWC=L)

(a1) Horizontal... Full mode, Wide1 mode, Wide2 mode, Cinema mode  
From falling edge of HSYIO output to 12.8-63.1 $\mu$ S.

(a2) Horizontal... Normal mode

From falling edge of HSYIO output to 7.5-68.5 $\mu$ S.

(b1) Vertical... Full mode, Wide2 mode, Normal mode

From falling edge of VSYIO output to 26H-298H.

Except for Even Number Field (14n+12) and (14n+20),  
Odd Number Field (14n+17) and (14n+23).

n=(1,2,3,...,20)

(b2) Vertical... Cinema mode

From falling edge of VSYIO output to 40H-284H.

Except for Even Number Field (42n+13) and (14n+35),  
Odd Number Field (42n) and (42n+22).

n=(1,2,3,...,6)

(b3) Vertical... Wide2 mode

From falling edge of VSYIO output to 35H-289H.

Except for Even Number Field (22n+14) and (22n+24),  
Odd Number Field (22n+21) and (22n+31).

n=(1,2,3,...,12)

③ EXTERNAL CLOCK MODE(N/P=H, SWC=L, DM1,2,3=H)

(a1) Horizontal

From falling edge of HSYIO output to 99-578CLK.

CLK is indicated as external CLK number.

(b3) Vertical

From falling edge of VSYIO output to 20H-253H.

## ■ ELECTRICAL CHARACTERISTICS

VSH=5.3V, Ta=25 deg.

ITEM	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT	NOTE
Logic/Source power supply voltage	VSH		5.0	5.3	5.5	V	Note 3)
Power supply voltage for gate driver	H	VGH	14.5	15.0	15.5	V	
	L	VGL	-14.5	-14.0	-13.5	V	
Common electrode driving signal	VCOM	DC center	1.0	1.8	2.5	V	Note 1)
		P-P	4.0	5.0	6.0	V	Note 2),4)
TFT exclusive RGB	VR, VG, VB	DC center	TYP-0.1	VSH/2	TYP+0.1	V	Note 3)
		AC White pattern	+1.5	2.0	VSH/2	V	POLV=H Note4),5)
		AC Black pattern	-1.5	-2.0	-VSH/2	V	POLV=H Note4),5)
		AC White pattern	-1.5	-2.0	-VSH/2	V	POLV=L Note4),5)
		AC Black pattern	+1.5	2.0	VSH/2	V	POLV=L Note4),5)
Input signals	V <sub>IH</sub>	High level	0.7VSH	-	VSH	V	Note 6)
	V <sub>IL</sub>	Low level	0	-	0.3VSH	V	
Input signals	V <sub>IH</sub>	High level	0.8VSH	-	VSH	V	Note 7)
	V <sub>IL</sub>	Low level	0	-	0.2VSH	V	
Output signals	V <sub>OH</sub>	High level	VSH-2.1	-	-	V	Note 8)
	V <sub>OL</sub>	Low level	-	-	0.4	V	
Power Supply current	I <sub>VSH</sub>	VSH=5.3V	-	50	80	mA	Note 9,10)
	I <sub>VGH</sub>	VGH=15V	-	1.2	3	mA	
	I <sub>VGL</sub>	VGL=-14.0V	-	6	15	mA	
Power Supply	WS		-	367	679	mW	

Note 1) Please adjust DC voltage on opposite electrode (VCOM) to optimum BIAS voltage in order to minimize flicker.

Note 2) Please optimize voltage of each module to achieve optimum contrast.

Note 3) Please control voltage fluctuation less than 0.1V after VCOM is adjusted.

Note 4) =+/- amplitude shall be symmetry.

Note 5) In case of POLV=Low, the signal polarity inverts working with polarity of VCOM.

Note 6) Symmetric terminal name: HSYIO, VSYIO (CMOS INPUT)

Note 7) Symmetric terminal name: CSY, N/P, L/R, U/D, SWC, CKH, DM1, DM2, DM3 (CMOS Schmitt INPUT)

Note 8) Symmetric terminal name: HSYIO, POLC, POLV, VSYIO < PWM, CKH, SWC (CMOS OUTPUT)  
(COMS output level)

Note 9) Under the following conditions:

Display pattern: ALL BLACK FULL MODIfv:60Hz

VCOM DC=1.8V, VCOM P-P=5.0V

VR/VG/VB DC=VSH/2 VR/VG/VB AC=4.0V

Note10) Value for module circuitry portion (except for backlight)

## ■ ELECTRICAL CHARACTERISTICS AC TIMING

NTSC :fH=15.73kHz,fV=60Hz,t HI=4.7μs

PAL :fH=15.63kHz,fV=50Hz,t HI=4.7μs

### <COMMON: EXTERNAL CLK MODE/BUILT-IN CLK MODE>(SWC=Hi or Low)

VSH=5.3V GND=0V, Ta=25 deg.

ITEM		SYMBOL	MIN	TYP	MAX	UNIT	NOTE
Input voltage		VID	0	-	VSH	V	
Input composite sync [CSY]Vertical location	rising time	t rVI	-	-	0.2	μs	
	falling time	t fVI	-	-	0.2	μs	
Polarity alternating delay time [POLV-VRGB]		t DV	-	-	4	μs	
Polarity alternating delay time[POLC-VCOM]		t DC	-	-	4	μs	
Output polarity signal [POLC,POLV]	rising time	t rPL	-	-	0.5	μs	
	falling time	t fPL	-	-	0.5	μs	

### <BUILT-IN CLK MODE>(SWC=Hi )

VSH=5.3V GND=0V, Ta=25 deg.

ITEM			SYMBOL	MIN	TYP	MAX	UNIT	NOTE
Input composite sync horizontal location [CSY]	frequency	NTSC	fH(N)	15.13	15.73	16.33	kHz	Note 1
		PAL	fH(P)	15.03	15.63	16.23	kHz	
	pulse wide	NTSC	t HI(N)	4.2	4.7	5.2	μs	
		PAL	t HI(P)	4.2	4.7	5.2	μs	
	rising time		t rHI1	-	-	0.5	μs	
	falling time		t fHI1	-	-	0.5	μs	
Input composite sync Vertical location [CSY]	frequency	NTSC	fV(N)	fH/284	fH/262.5	fH/258	Hz	Note 1
		PAL	fV(P)	fH/344	fH/312.5	fH/304	Hz	
	pulse wide	NTSC	t VI(N)	-	3	-	H	
		PAL	t VI(P)	-	2.5	-	H	
Output horizontal sync signal [HSYIO]	frequency	fH0	-	fH	-	kHz	Note 2	
	pulse wide	t H0	-	4.7	-	μs		
	rising time	t rH0	-	-	0.5	μs		
	falling time	t fH0	-	-	0.5	μs		
horizontal sync phase [HSYIO-CSY]	rising HSY	tpd1	-	2.1	-	Hz		
	falling HSY	tpd2	-	2.1	-	Hz		
Output vertical sync signal [VSYIO]	frequency	fV0	-	fV	-	Hz		
	pulse wide	t V0	-	4	-	H	1H=1/fH	
	Output phase	t VH0	-	11	-	μs	Sync HSYIO	
	rising time	t rV0	-	-	0.5	μs		
	falling time	t fV0	-	-	0.5	μs		
Vertical sync phase [CSY-VSYIO]	ODD FIELD	t DV1	-	1	-	H		
	EVEN FIELD	t DV2	-	0.5	-	H		

Note 1) Standard complex synchronized signal [CSY] type of NTSC/PAL signal shall be inputted. It would be a factor of display quality degradation if nonstandard synchronized signal were inputted.

Note 2) Varied by tpd1 value.

**<EXTERNAL CLK MODE>(SWC=Low )**

VSH=5.3V GND=0V, Ta=25 deg.

ITEM		SYMBOL	MIN	TYP	MAX	UNIT	NOTE
Input CLK sync signal [CKH]	frequency	fCL1	8.5	9.5	9.8	MHz	
	H pulse wide	tWH	20.0	-	-	ns	
	L pulse wide	tWL	20.0	-	-	ns	
	rising time	trCL1	-	-	10.0	ns	
	falling time	tfCL1	-	-	10.0	ns	
Input horizontal sync signal [HSYIO]	frequency	fHI	fCLI/650	fCLI/608	fCLI/590	kHz	
	pulse wide	tHI	1	5	9	μs	
	rising time	trHI2	-	-	0.05	μs	
	falling time	tfHI2	-	-	0.05	μs	
Input Vertical sync signal [VSYIO]	frequency	fVI	50	fHI/262	fHI/258	Hz	
	pulse wide	tVI	1	3	5	H	
Data setup time		t SU1	25	-	-	ns	Note 3)
Data hold time		t HO1	25	-	-	ns	
Data setup time		t SU2	1.0	-	-	μs	Note 4)
Data hold time		t HO2	1.0	-	-	μs	

Note 3) In external clock input mode, they show input phase contrast of CKH and HSYIO signal.  
Data is loaded latching with CKH rising signal.

Note 4) In external clock input mode, they show input phase contrast of HSYIO andVSYIO signal.  
Data is loaded latching with HSYIO falling signal.

■ **ELECTRICAL CHARACTERISTICS AC TIMING**

**<COMMON: EXTERNAL CLK MODE/BUILT-IN CLK MODE>(SWC=Hi or Low)**

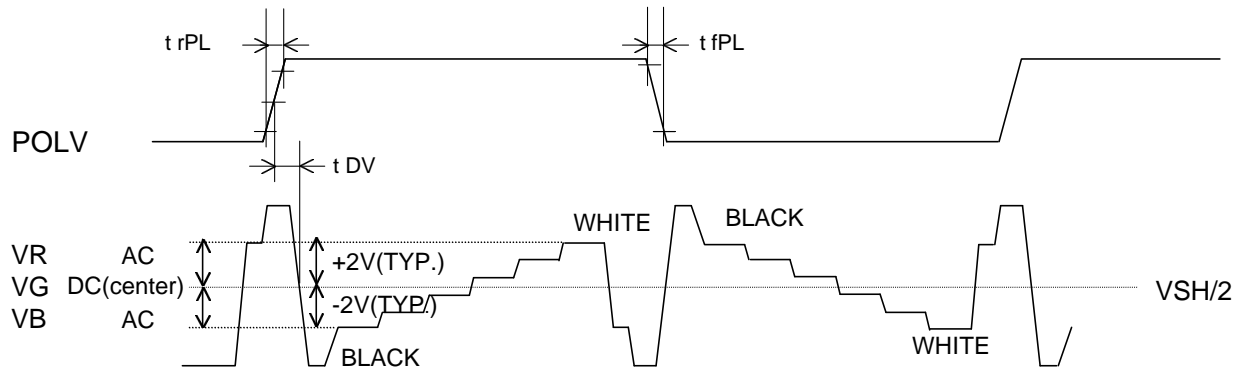


Fig-A

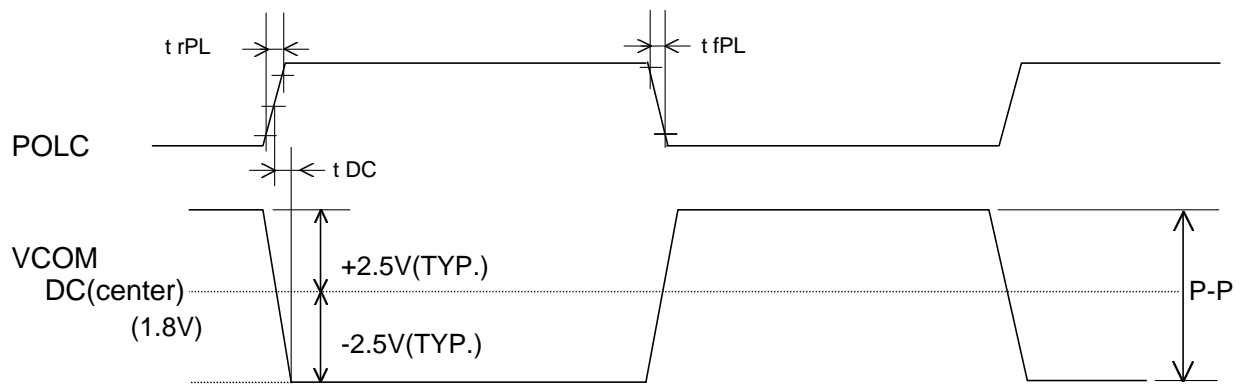


Fig-B

**<BUILT-IN CLK MODE>(SWC=Hi NTSC/PAL)**

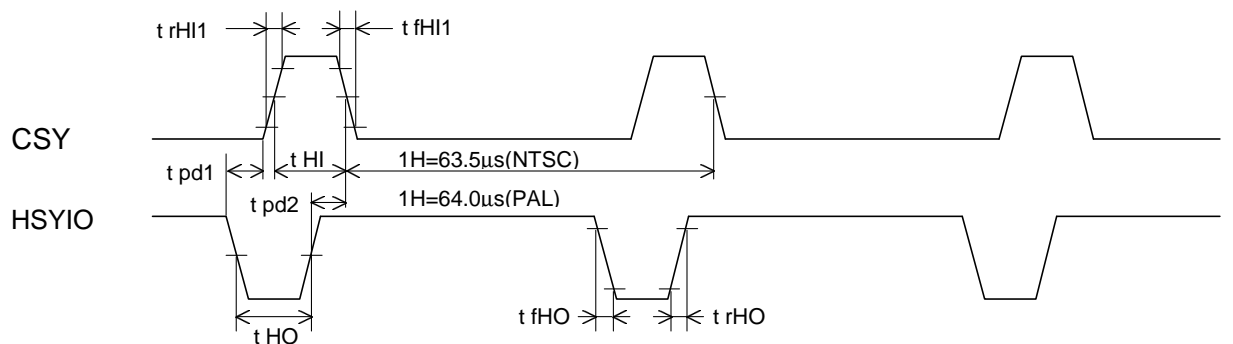


Fig-C

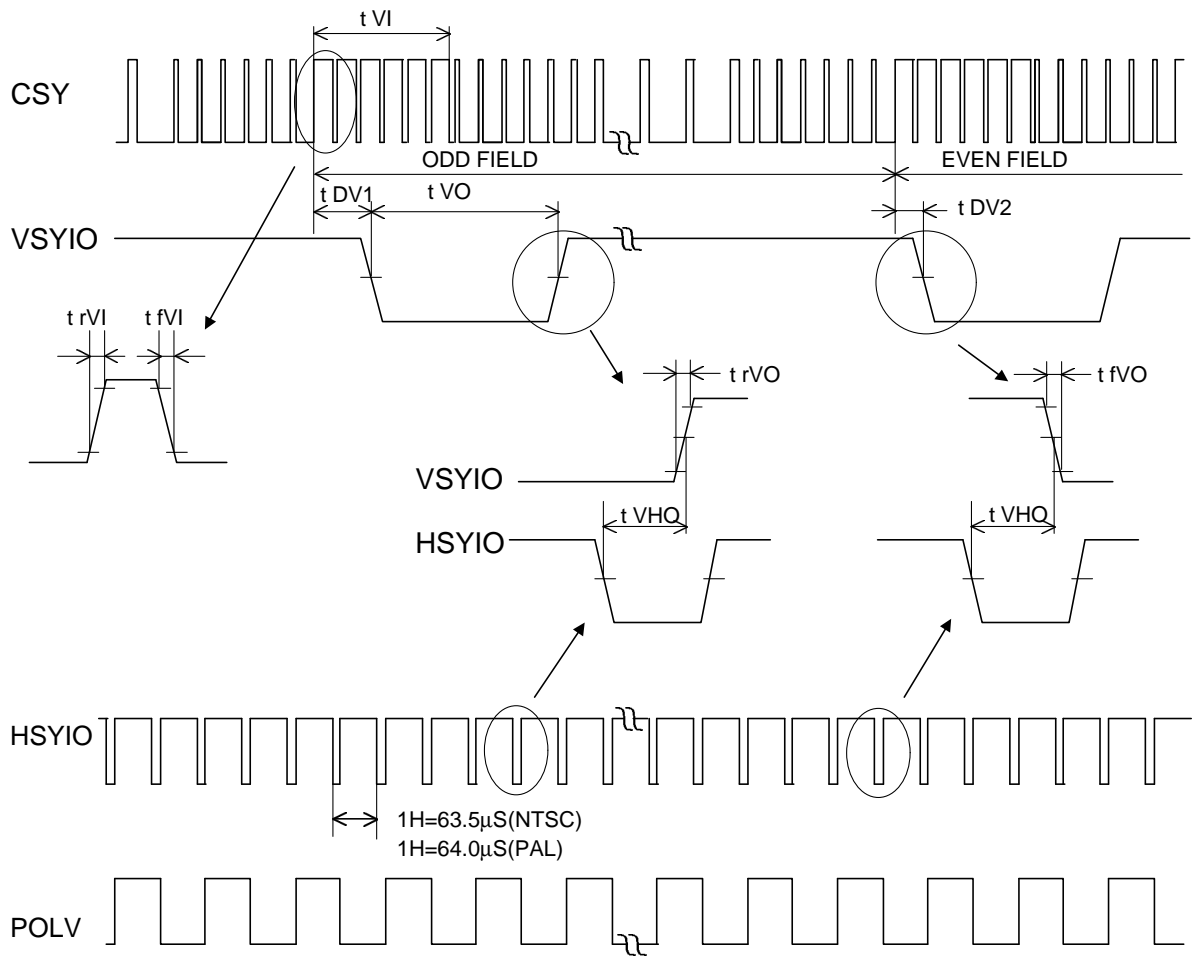


Fig-D

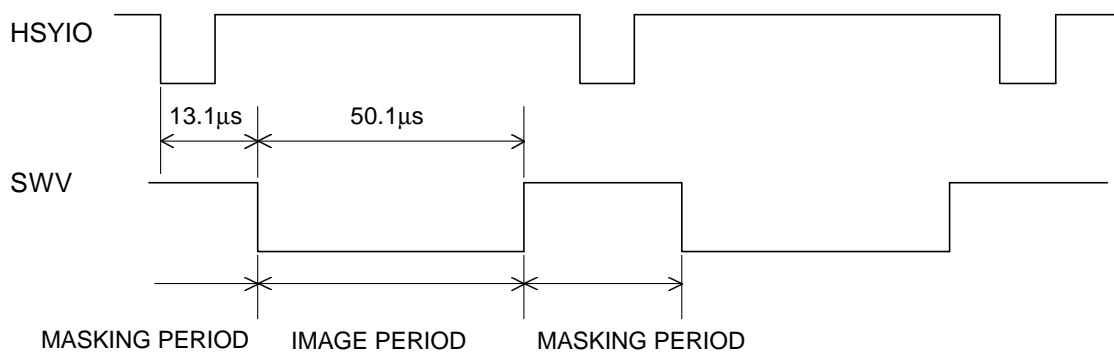


Fig-E (NORMAL MODE DM1=Hi, DM2=Low, DM3=Hi)



<EXTERNAL CLK MODE>(SWC=Low)

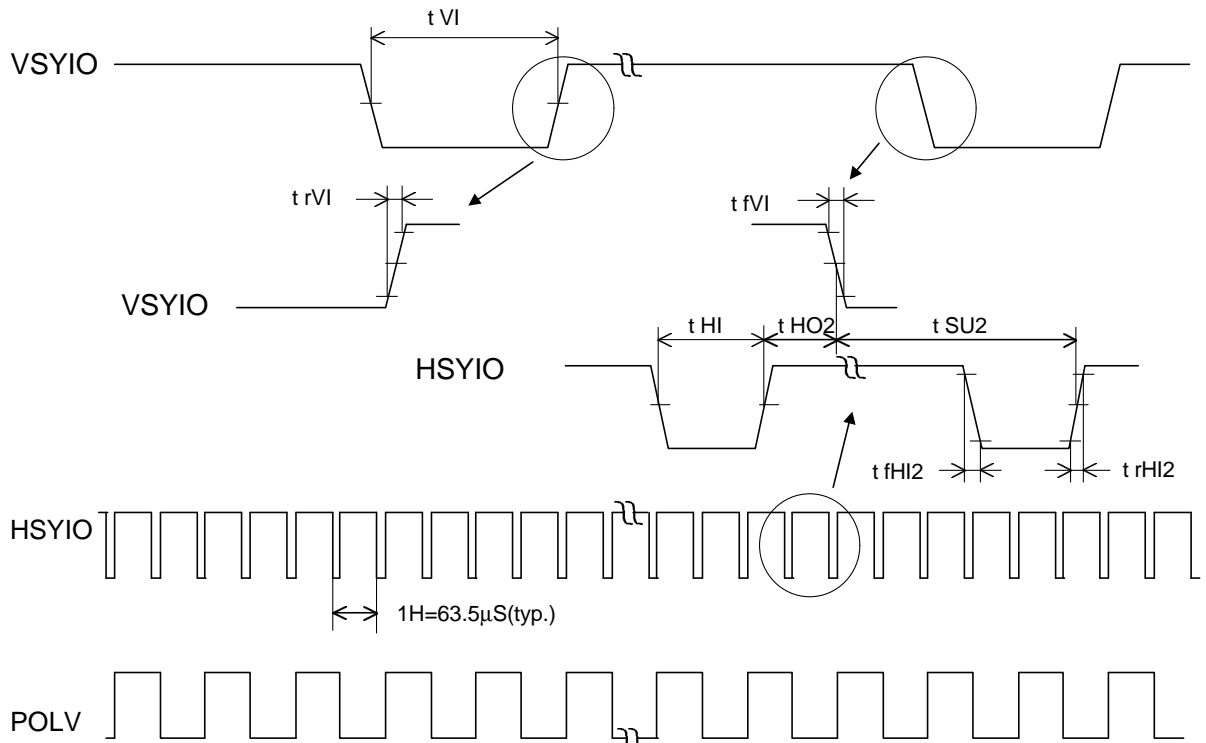


Fig-F (N/P=Hi)

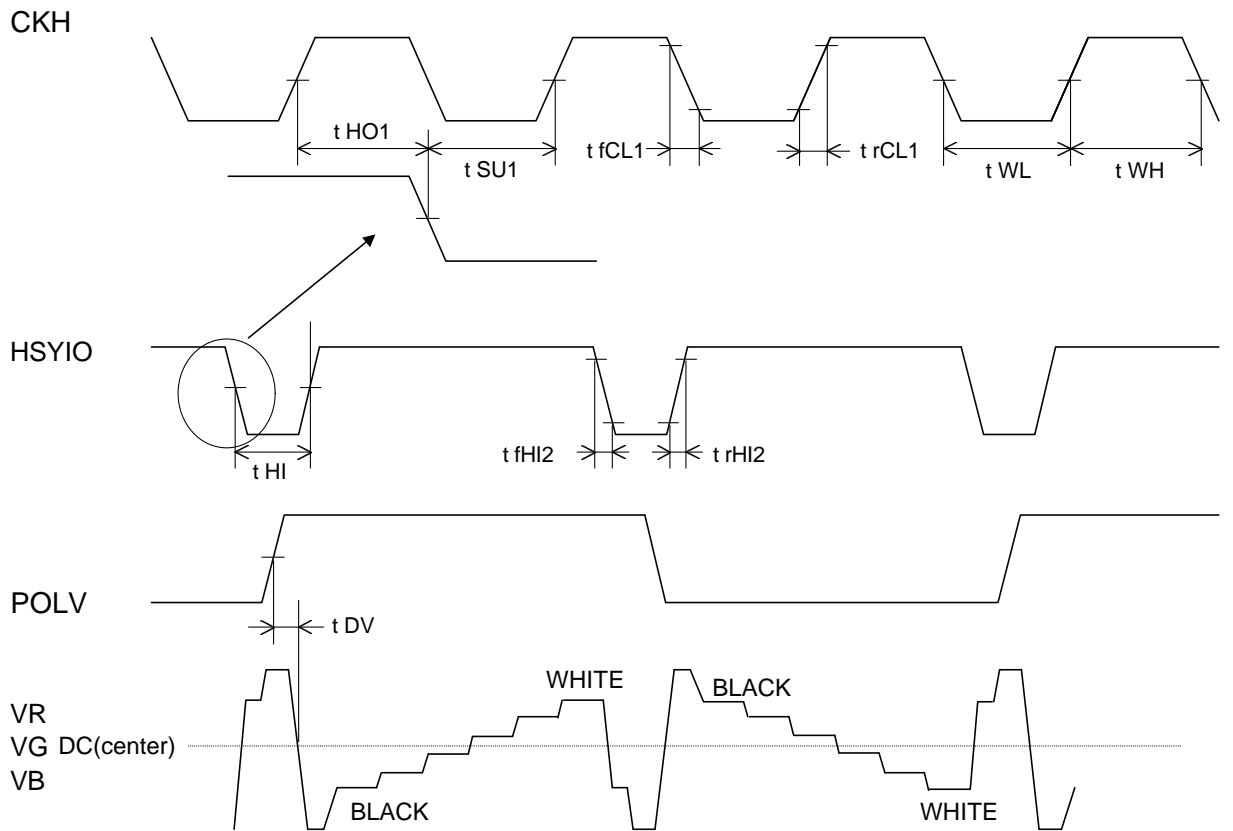


Fig-G(N/P=Hi, DM1=DM2=DM3=Hi)

■ PWM DIMMING TIMING

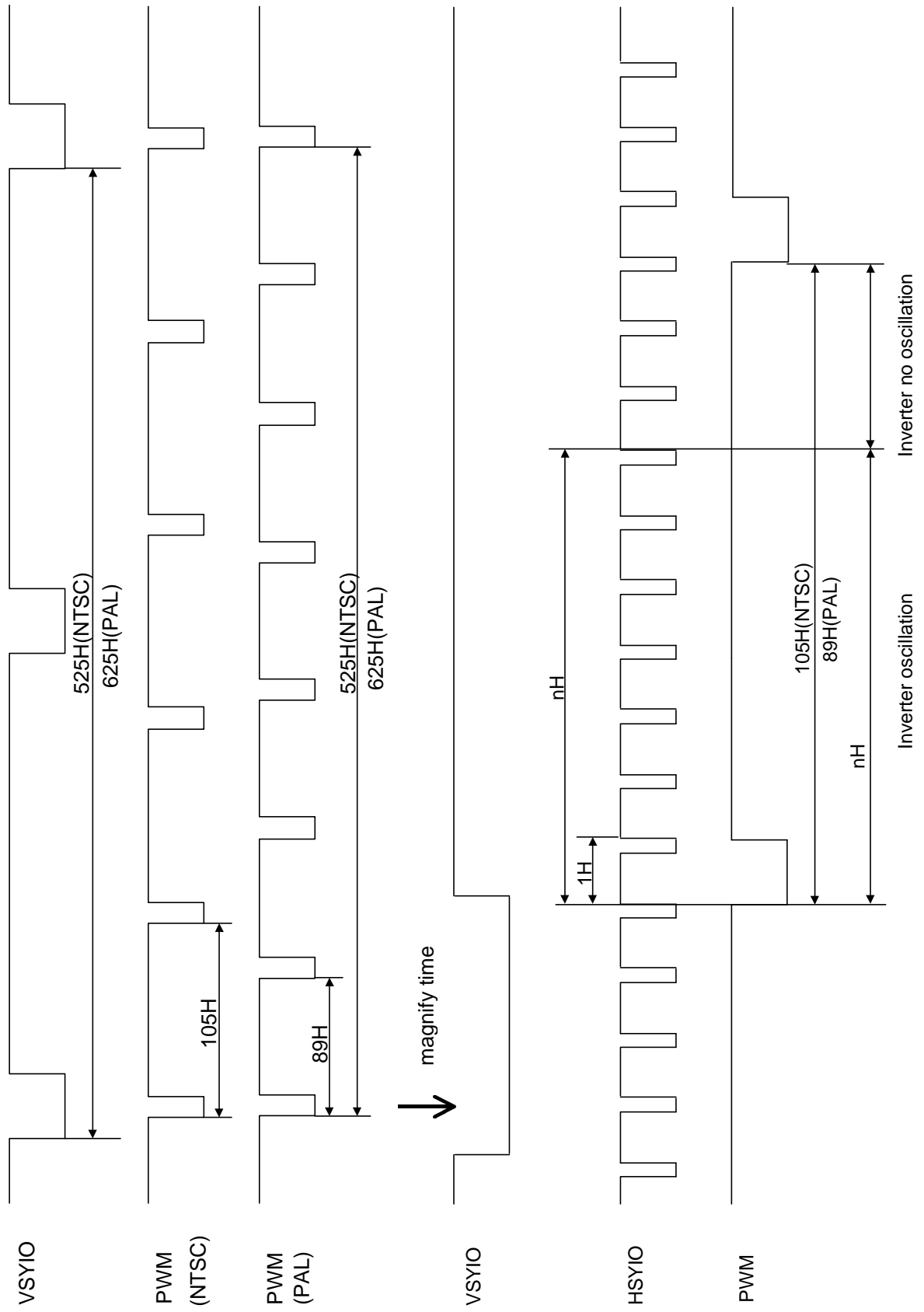
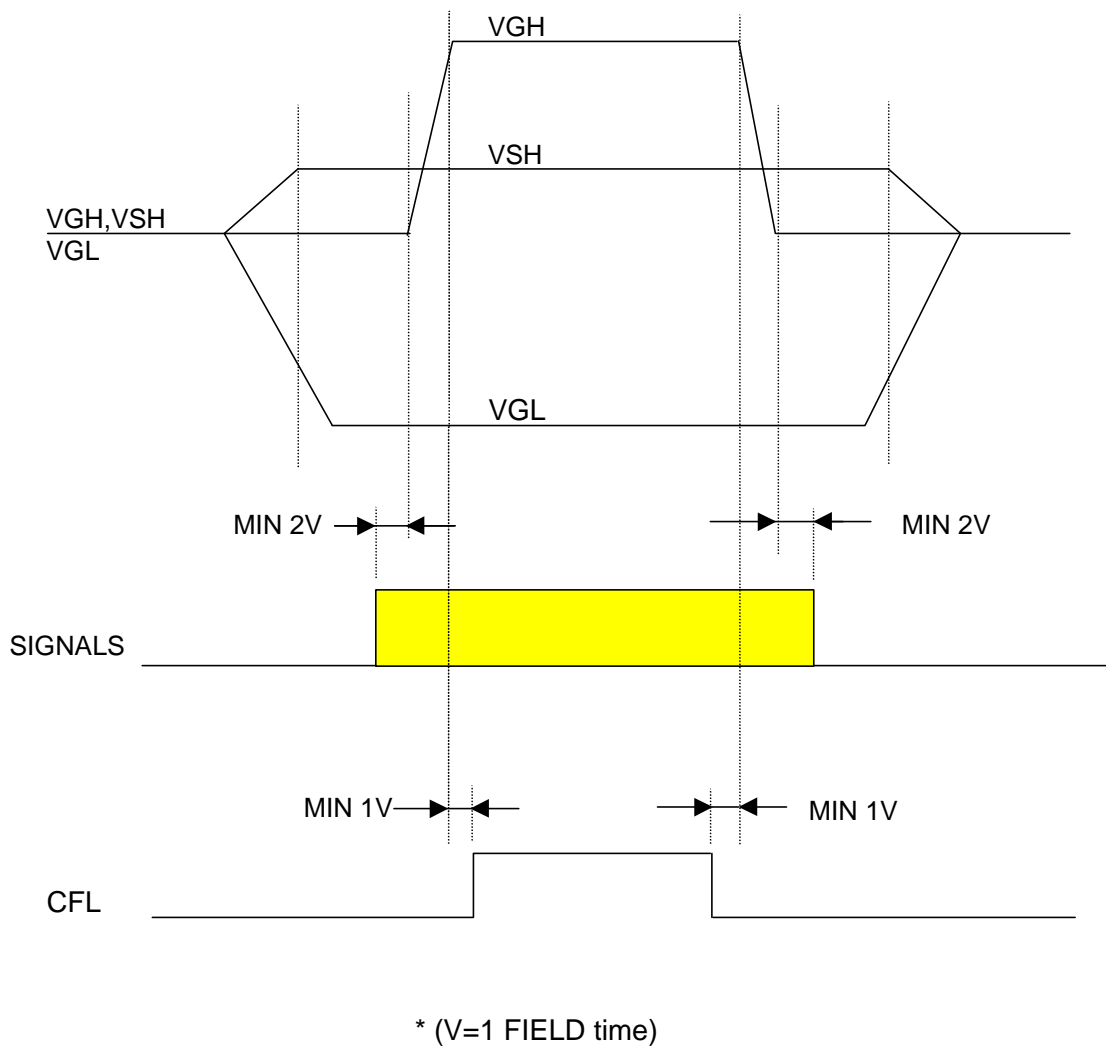


Fig-H

■ **POWER ON/OFF SEQUENCE REQUIREMENT**



## ■ **PRECAUTIONS**

### **Caution for designing**

1. This technical spec just explains general specification of the LCD module.  
Please request us customer specification before you start designing.
2. Please apply waterproof design to avoid any moisture or saline matter into LCD module.
3. Long CFL wiring may result in increase of leak current.  
Please carefully design the wiring in order to minimize leak current, which causes reduction of inverter start-up voltage.
4. Please implement enough shielding for LCD's excess noise radiation not to interfere other peripheral device by.

### **Caution for LCD handling**

1. Disassembling or remodeling of LCD module is prohibited.
2. Please do not touch volume control on the backside of module.  
In the case you change it, LCD module may not achieve proper performance mentioned in the spec.
3. LCD shall be stored in same packing material during import, and under the condition of room temperature (10-30 degree C).  
Please do not leave LCD modules under the direct sunlight or strong infra-red radiation for a long period time to prevent liquid

4. LCD module integrates semi-conductor components.  
Please handle it with static electricity protection.
5. Please turn off the power supply before plugging or unplugging LCD module.
6. Since high voltage is supplied to CFL when it's driving,  
please make careful treatment and design around CFL portion.  
And please be sure that CFL connector does not have a loose connection  
to prevent large risk of fire due to high voltage.
7. Please do not rub, push, or hit LCD surface with hard tool etc.  
Film on surface is easily scratched.  
When droplets of water or dirt are on the surface,  
please gently remove them with soft fabric.
8. Glass in LCD module is easily damaged or broken when it is dropped,  
strongly pinched or hit.  
Please be careful not to cut your hand if you break the glass.
9. In case that liquid crystal fluid runs off from broken panel,  
please do not swallow or handle the fluid for any reason.  
If liquid crystal accretes hands or clothes, please remove it with  
or alcohol and wash them. By any chance, liquid crystal ge.
10. Cold Cathode Lamp contains small amount of mercury.  
Please follow local ordinances or regulation for disposal.

