SHARP

No.	LCY - 96065
DATE	July. 2 . 1996

TECHNICAL LITERATURE

FOR

TFT - LCD module

MODEL No. LQ6BW506

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LIQUID CRYSTAL DISPLAY GROUP

TFT DEVELOPMENT CENTER

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(1) Summary

This module utilizes amorphous silicon thin film transistors and a 16:9 aspect ratio. A 5.8 active matrix liquid crystal display allows full color to be displayed with both NTSC and PAL systems.

An outline of the module is given in Table 1.

(2) Features

Utilizes a panel with a 16:9 aspect ratio, which makes the module suitable for use in wide-screen systems.

Without any loss of wide-screen characteristics, the module's terminals allow a variety of display modes to be selected.

The 5.8 screen produces a high resolution image that is composed of 93,600 pixel elements in a stripe arrangement.

Wide viewing field angle technology is employed. (The most suitable viewing angle is in the 6 o'clock direction.)

External clock synchronization allows an extremely clear image to be displayed. By adopting an active matrix drive, a picture with high contrast is realized. The module is a dual mode type that can be used with both NTSC (M) and PAL

(B・G) systems.

Using a 234 scanning line display panel, a PAL system with a 273 line display screen is effectively obtained.

Reflection due to external light is minimized through the use of a low reflection, black matrix and an antiglare (AG) plate. A thin, light and compact module with an effective display to external surface area ratio of 70%, a thickness of 13.6 mm and a mass of 210 g is accomplished through the use of COG mounting technology.

Through the use of TN-normally white mode, an image with highly natural color reproduction is realized.

An antiglare (AG) surface polarization plate is used.

An inverted video display in the vertical as well as horizontal directions is possible.

Having considered vehicle-based use, the module contains a heaterless backlight whose emission characteristics are improved in low temperature.

(3) Structure and External Shape

External measurements for the module are given in Fig. 1, and the structure of the module is shown in Fig. 2.

The module is composed of the TFT-LCD panel, drivers, electronic parts mounted on a control pwb, frame, backlight, sealed front case, and sealed back case.

(4) Mechanical specifications

table 1

Parameter	Specifications	Units	Remarks
Display format	280,800	pixels	
	1200(W)×234(H)	dots	
Active area	127.2 (W) ×71.8 (H)	mm	
Screen size (Diagonal)	1 5 [5.8"]	cm	
Dot pitch	0.106 (W) ×0.307 (H)	mm	
Pixel configuration	R.G.B Stripe configuration		
Outline dimension	145.0(W)×89.0(H)×13.6(D)	mm	【Note1-1】
Mass	2 1 0 ± 1 0	g	

Note 1-1

Typical values are given. For detailed measurements and tolerances, please refer to Fig. 1.

(5)Input/Output terminal

5-1)TFT-LCD panel driving part

Table 2 (Hi=VSH、Lo=GND)

Pin No.	Symbol	i/o	Description	Remarks
1	HSY	i／o	Input/Output horizontal sync. signal (low active)	【Note2-1】
2	FRPT	o	Polarity alternating signal for common signal	【Note2-2】
3	SYN	i	Composite sync.signal (high active)	
4	VGH	i	Power supply for gate driver (high level)	
5	FRPV	o	Polarity alternating signal for video signal	【Note2-3】
6	VB	i	Color video signal (Blue)	【Note2-4】
7	VR	i	Color video signal (Red)	【Note2-4】
8	VG	i	Color video signal (Green)	【Note2-4】
9	GND	i	Ground	
10	VSH	i	Positive power supply voltage	
11	VGL	i	Power supply for gate driver (low level)	
12	COM	i	Common electrode driving signal	【Note2-5】
13	NTP	i	Selection for NTSC or PAL	【Note2-6】
14	VSY	i／o	Input/Output vertical sync. signal (low active)	【Note2-7】
15	HRV	i	Selection for horizontal scanning direction	【Note2-8】
16	VRV	i	Selection for vertical scanning direction	【Note2-9】
17	CLKC	i	Selection for input/output direction of CLK,HSY,VSY	【Note2-10】
18	PWM	o	Timing signal for PWM dimming of backlight	【Note2-11】
19	TST	o	open use only	test terminal
20	CLK	i／o	Input/output clock signal	【Note2-12】
21	MODS	i	Selection for display mode	【Note2-13】
22	MODW	i	Selection for display mode	【Note2-13】
23	MODN	i	Selection for display mode	【Note2-13】
24	VCS	o	Video selection timing signal	【Note2-14】

Note 2-1

When CLKC="Hi", the output is a horizontal synchronizing signal synchronized by the SYN signal. When CLKC="Lo", the module is synchronized via the horizontal synchronizing signal input at this terminal.

Note 2-2

Please use this inverse timing signal to invert the polarity of COM, the common pole drive signal.

Note 2-3

Please use this inverse timing signal to invert video signal polarity. Use of a dedicated video signal polarity reversing IC should be used. Recommended interface ICs are the IR3Y26A (analog RGB input type) and IR3Y29AM (composite video type) manufactured by Sharp.

Note 2-4

The input should be a video signal whose polarity has been reversed using the FRPV inverse timing signal.

Note 2-5

The input should be the common pole drive signal (COM) with polarity reversed using the FRPT inverse timing signal. Brightness is adjusted through a change in the COM signal amplitude. In addition, when the COM input signal (VCDC) is adjusted to its center value, maximum contrast for a module's display screen should be achieved.

Note 2-6

NTP="Hi": NTSC system

NTP="Lo": PAL system

Note 2-7

When CLKC="Hi", the output is a vertical synchronizing signal synchronized by the SYN signal. When CLKC="Lo", the module is synchronized via the vertical synchronizing signal input at this terminal.

Note 2-8
HRV="Hi": Regular video
HRV="Lo": Horizontally inverted video
Note 2-9
VRV="Hi": Regular video
VRV="Lo": Vertically inverted video
Note 2-10
CLCK="Hi": CLK, HSY and VSY terminals are in the output mode.
CLCK="Lo": CLK, HSY and VSY terminals are in the input mode.
Note 2-11
The PWM signal is a dedicated signal used to adjust the frequency for backlight adjustment PWM backlight adjustment is easily accomplished by combining the HSY and PWM signals. Please note that the PWM signal should only be used when a standard NTSC or PAL is input. See Fig. 5-H for details.
Note 2-12
When CLKC="Hi", the output level is low.
When CLKC="Lo", module operation is based on the input clock signal. This signal should correspond to sampling timing of the horizontal direction image. NTP, MODS, MODW, and MODN should be "Hi" when CLKC="Lo".
Note 2-13
Display mode settings are given in Table 3.
Note 2-14
During normal mode (MODS="Hi", MODW="Lo", MODN="Hi"), if masking of a video signal is done using timing that is based on the VCS output signal, an excellent display is possible. Mask the video signal when VCS is "Hi" (the two edges of the screen). (If masking causes the display to become black, input the VCS signal at the system switching terminal of the video interface IC, input the field signal into another video input, and input a signal for black into the other video input. By doing this, restoration of a normal (full frame) screen is easily accomplished. The VSC output becomes low when modes other than the normal mode is used. When in the module test mode (Table 3, "test mode"), the output of VCS is the test signal.

Table 3 Display Method and Characteristics

MODS	MODW	MODN	Display mode	Characteristics	Source	example
H	H	H	Full mode	The picture is displayed with uniform enlargement in the horizontal direction, and the horizontal retrace line of the input signal cannot be seen. If the video sampling frequency of the image is fixed and a 4:3 video signal is displayed, the picture will be prominently oblong.	4:3 signal, Navigation signal	Fig.3-1
H	H	L	Wide 1 mode	A 4:3 video signal is displayed with less feeling of incongruity than that in the full screen mode. Since the video horizontal sampling frequency is modulated in the horizontal direction, the degree of perfect roundness in the center of the screen is improved over that of the full screen mode.	4:3 signal	Fig.3-2
H	L	H	Normal mode	When displaying a 4:3 video signal, the displayed image is slightly less than perfectly round and the horizontal retrace line period is displayed at the two edges of the screen. With respect to the video horizontal sampling frequency, the center portion of the screen is slightly lower and the two edges become slightly higher. With respect to the horizontal retrace line period, a far better display is achieved than that of masking of the video signal by the VCS signal timing.	4:3 signal	Fig.3-3
H	L	L	Cinema mode	When displaying a 4:3 video signal, the displayed image is slightly less than perfectly round and the horizontal retrace line period is displayed at the two edges of the screen. With respect to the video horizontal sampling frequency, the center portion of the screen is slightly lower and the two edges become slightly higher. With respect to the horizontal retrace line period, a far better display is achieved than that of masking of the video signal by the VCS signal timing.	letter box type wide signal(16:9signal)	Fig.3-4
L	H	H	Wide 2 mode	In the horizontal direction, the Wide 1 display mode is employed. Due to the display being extended in the vertical direction, the portion of the picture in the center of the screen is slightly less than perfectly round. Also due to extending in the vertical direction, the upper and lower potions of the image are not displayed.	4:3 signal	Fig.3-5
L	H	L	test	This mode is unusable as it is the test mode.	—	—
L	L	H	test	This mode is unusable as it is the test mode.	—	—
L	L	L	test	This mode is unusable as it is the test mode.	—	—

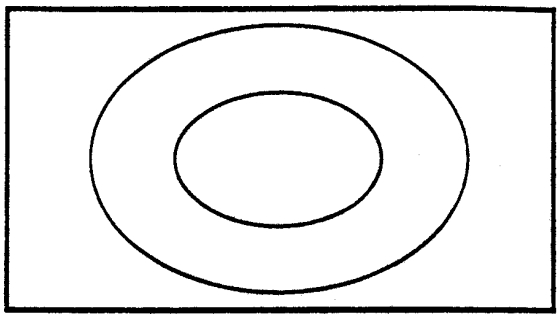


Fig.3-1 Full mode

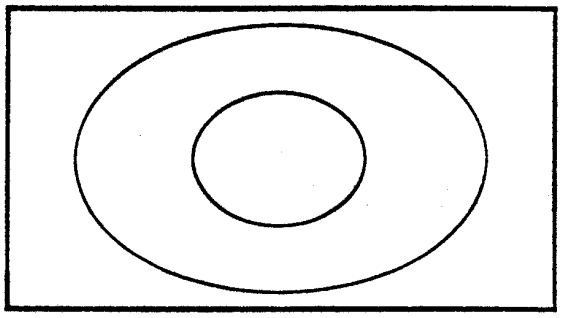


Fig.3-2 Wide 1 mode

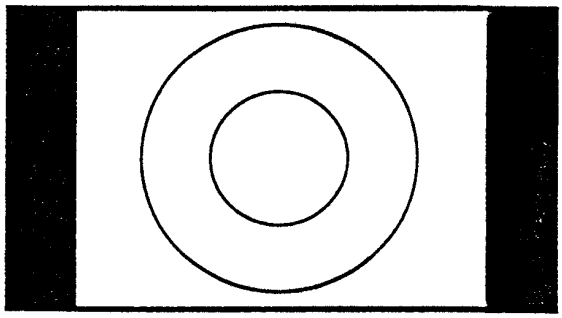


Fig.3-3 Normal mode

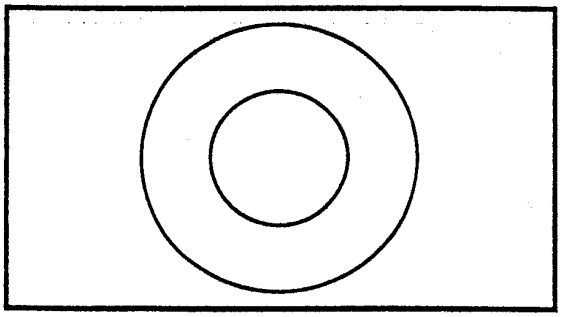


Fig.3-4 Cinema mode

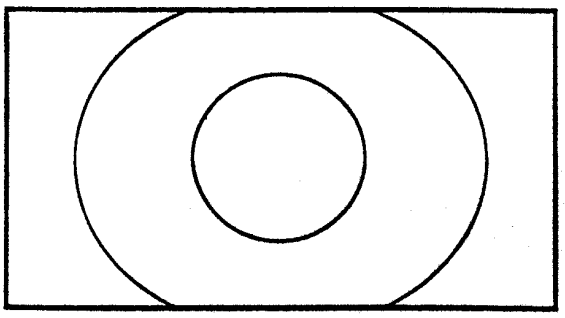


Fig.3-5 Wide 2 mode

5-2)Functions, Modes and Terminals (Table 4)

Mode terminals					Sync.signal I/O terminals					
CLKC	NTP	MODS	MODW	MODN	HSY	VSY	CLK	VCS	SYN	Remarks
H	H or L	L L L	H L L	L H L	H sync. output	V sync. output	Lo output	test signal output	Composite sync. input	test mode
H	H or L	H	L	H	H sync. output	V sync. output	Lo output	Masking signal output	Composite sync. input	NTSC or PAL mode (Normal mode)
H	H or L	other H or L settings			H sync. output	V sync. output	Lo output	Lo output	Composite sync. input	NTSC or PAL mode (Full,Wide,Cinema)
L	H	H	H	H	H sync. input	V sync. input	Pixel clock input	Lo output	input Hi or Lo fixed value	External clock synchronous mode

5-3) Backlight fluorescent tube driving part

Table 5

terminal	No.	Symbol	i/o	function	Remarks
CN1	1	VL1	i	input terminal (hi voltage side)	
	2	NC	—	non connection	
	3	VL2	i	input terminal (lo voltage side)	【Note3-1】

Note 3-1

Connect the low voltage side of the DC/AC inverter used to drive the fluorescent tube to GND of the inverter circuit.

(6)Absolute maximum ratings

Table 6

GND＝0 V

Parameter		Symbol	MIN	MAX	Unit	Note
Positive power supply voltage		VSH	-0.3	+6.0	V	Ta＝25℃
Power supply for gate driver	Hi	VGH	-0.3	+33.0	V	〃
	Lo	VGL	VGH-33.0	VGH+0.3	V	〃
Input signals [terminal 4-1]		VIA	-0.3	VSH+0.3	V	〃
Input signals [terminal 4-2]		VID	-0.3	VSH+0.3	V	〃
Output signals [terminal 4-3]		VOD	-0.3	VSH+0.3	V	〃
DC bias voltage of common electrode driving signal		VCDC	-4	+6	V	〃
Storage temperature		T stg	-30	85	℃	【Note 4-1,2】
Operating temperature (panel surface)		T oprl	-30	85	℃	【Note 4-1,2,3】
Operating temperature (Ambient temperature)		T opr2	-30	65	℃	【Note 4-4】

[terminal 4-1]VR, VG, VB

[terminal 4-2]HSY, SYN, NTP, VSY, HRV, VRV, CLKC, MODS, CLK, MODW, MODN

[terminal 4-3]HSY, FRPT, FRPV, VCS, VSY, CLK, PWM, TST

Note 4-1

This rating applies to all parts of the module and should not be exceeded.

Note 4-2

Maximum wet-bulb temperature is 58℃. Condensation of dew must be avoided as electrical current leaks will occur, causing a degradation of performance specifications.

Note 4-3
The operating temperature only guarantees operation of the circuit. For contrast, speed response, and other factors related to display quality, determine operating temperature using the formula Ta=+25℃
Note 4-4
Ambient temperature when the backlight is lit (reference value).

(7)Electrical characteristics
7-1)Recommended operating conditions
A)TFT-LCD panel driving section
Table 7

GND＝0 V, Ta＝25℃

Parameter			Symbol	MIN	TYP	MAX	Unit	Remarks
Positive power supply voltage			VSH	+5.0	+5.3	+5.5	V	【Note 5-1】
Power supply for gate driver	Hi voltage		VGH	+12.5	+13.0	+13.5	V	
	Lo voltage		VGL	-15.5	-16.0	-16.5	V	
Input voltage [terminal 5-1]	AC component		VIAC	∓2.0	-	±2.0	V	【Note 5-2】
	DC component		VIDC	VSM-0.1	VSM	VSM+0.1	V	【Note 5-3】
Input voltage [terminal 5-2]			VID	0	-	VSH	V	
Input horizontal sync. signal [terminal 5-3]	frequency	NTSC	fH(N)	15.13	15.73	16.33	kHz	CLKC='Hi'
		PAL	fH(P)	15.03	15.63	16.23	kHz	
	pulse width	NTSC	τ HI(N)	4.2	4.7	5.2	μs	
		PAL	τ HI(P)	4.2	4.7	5.2	μs	
	rising time		τ rHI1	-	-	0.5	μs	
	falling time		τ fHI1	-	-	0.5	μs	
Input vertical sync. signal [terminal 5-4]	frequency	NTSC	fV(N)	fH/284	fH/262	fH/258	Hz	CLKC='Hi'
		PAL	fV(P)	fH/344	fH/312	fH/304	Hz	
	pulse width	NTSC	τ VI(N)	-	3H	-	μs	
		PAL	τ VI(P)	-	2.5H	-	μs	
Input vertical sync. signal [terminal5-4,7]	rising time		τ rVI	-	-	0.5	μs	CLKC='Hi' or 'Lo'
	falling time		τ fVI	-	-	0.5	μs	
Input clock [terminal 5-5]	frequency		fCLI	7.2	8.0	8.8	MHz	CLKC='Lo'
	Hi pulse width		τ WH	20.0	-	-	ns	
	Lo pulse width		τ WL	20.0	-	-	ns	
	rising time		τ rCLI	-	-	10.0	ns	
	falling time		τ fCLI	-	-	10.0	ns	
Input horizontal sync. signal [terminal 5-6]	frequency		fHI	fCLI/550	fCLI/508	fCLI/490	kHz	CLKC='Lo'
	pulse width		τ HI	1	5	9	μs	
	rising time		τ rHI2	-	-	0.05	μs	
	falling time		τ fHI2	-	-	0.05	μs	
Input vertical sync. signal [terminal 5-7]	frequency		fVI	50	fHI/262	fHI/258	Hz	CLKC='Lo'
	pulse width		τ VI	1H	3H	5H	μs	
Data setup time [terminal 5-5,6]			tSU1	25	-	-	ns	CLKC='Lo'
Data hold time [terminal 5-5,6]			tHO1	25	-	-	ns	【Note 5-4】
Data setup time [terminal 5-5,7]			tSU2	1.0	-	-	μs	CLKC='Lo'
Data hold time [terminal 5-5,7]			tHO2	1.0	-	-	μs	【Note 5-5】
Polarity alternating delay time (FRPV-VRGB)			τ DV	-	-	4	μs	
Polarity alternating delay time (FRPT-COM)			τ DC	-	-	4	μs	
Common electrode driving signal	AC component		VCAC	±0.5	±3.9	±5.0	V	【Note 5-2】
	DC component		VCDC	+0.5	+2.0	+3.5	V	【Note 5-6】

Cautionary Matter: When applying or disconnecting power, please be sure that such action is simultaneously carried out for all power supplies. In addition, apply input signals only after power has been turned on.

[terminal 5-1] VR, VG, VB
[terminal 5-2] HSY, SYN, NTP, VSY, HRV, VRV, CLKC, MODS, CLK, MODW, MODN
[terminal 5-3] SYN (horizontal sync. component)
[terminal 5-4] SYN (vertical sync. component)
[terminal 5-5] CLK
[terminal 5-6] HSY
[terminal 5-7] VSY

Note 5-1
Any change in voltage after adjusting VCDC should be less than 0.1 V.
Note 5-2
Positive and negative amplitudes should be equal. When the AC input voltage is －／＋, FRPV and T are in phase. When the AC input voltage is＋／－, FRPV and T are 180° out of phase. The MIN value produces a white display, and the MAX value produces a black display.
Note 5-3
VSM=VSH/2. Any change in voltage after adjusting VCDC should be less than 0.1 V.
Note 5-4
During the clock input mode, CLK and the HSY input signal are out of phase. In this mode, the HSY input signal is effected by the rise time of the CLK input signal.
Note 5-5
During the clock input mode, HSY and the VSY input signal are out of phase. In this mode, the VSY input signal is effected by the rise time of the HSY input signal.
Note 5-6
To obtain the maximum value of contrast, each module must be adjusted to an optimum voltage.

B)Backlight driving section
Table 8

Parameter	Symbol	MIN	TYP	MAX	Unit	Remarks
lamp voltage	VL7	630	700	770	Vrms	IL=6.5mArms
lamp current	IL	3.0	6.5	7.0	mArms	ordinary state
	ILB	-	-	9.0	mArms	within 5 minutes at low temperature
lamp frequency	fL	20	-	70	kHz	
kick-off voltage	VS	-	-	1550	Vrms	Ta=+25℃
		-	-	1600	Vrms	Ta=-30℃

(Inverter : HIU－288 Harison Electric co. Ltd.)

7-2)Electrical characteristics

Table 9

VSH=+5.3V, GND=0V, Ta=-30～85℃

Parameter		Symbol	MIN	TYP	MAX	Unit	Remarks
input voltage [terminal 7-1]	Hi	VIT+	-	-	+3.7	V	
	Lo	VIT-	+1.0	-	-	V	
	Hysteresis	V+ - V-	+0.4	-	-	V	
input voltage [terminal 7-2]	Hi	VIDH	+3.5	-	-	V	
	Lo	VIDL	-	-	+1.5	V	
output voltage [terminal 7-3]	Hi	VOH1	+4.0	-	-	V	IODH1=-80 μA
	Lo	VOL1	-	-	+0.4	V	IODL1=80 μA
output voltage [terminal7-4]	Hi	VOH2	+4.0	-	-	V	IODH2=-0.8mA
	Lo	VOL2	-	-	+0.4	V	IODL2=1.6mA
input current [terminal 7-5]	Hi	| IIH1 |	-	-	+1	μA	VID=VSH
	Lo	IIL1	-	-	+1	μA	VID=0V
input current [terminal 7-6]	Hi	| IIH2 |	-	-	+1	μA	VID=VSH
	Lo	IIL2	+5.0	-	+75	μA	VID=0V
input capacity (reference) [terminal7-7]		CIA	-	130	-	pF	f=1MHz
input capacity (reference) [terminal 7-1,2]		CID	-	20	-	pF	f=1MHz

[terminal 7-1]SYN,NTP,HRV,VRV,CLKC,MODS,MODW,MODN terminal
[terminal 7-2]HSY,VSY,CLK terminal
[terminal 7-3]HSY,FRPT,FRPV,VCS,VSY,PWM,TST terminal
[terminal 7-4]CLK terminal
[terminal 7-5]SYN terminal
[terminal 7-6]HSY,NTP,VSY,HRV,VRV,CLKC,MODS,CLK,MODW,MODN terminal
[terminal 7-7]VR,VG,VB terminal

7-3)Power consumption

Table 10

Ta=25℃

Parameter		Sym	Conditions	MIN	TYP	MAX	Unit	Remarks
LCD panel driving power consumption	source	ISH	VSH=+5.3V	-	75	95	mA	
	gate high	IGH	VGH=+13.0V	-	0.9	1.3	mA	
	gate low	IGL	VGL=-16.0V	-	3.4	3.8	mA	
	total	WS		-	79	100	mW	【Note 8-7】
lamp power consumption		WL	normal driving	-	4.6	-	W	

【Note 8-7】 excluding backlight section

7-4)Input/output signal waveforms

Refer to Fig.5-A,B,C,D,E,F,G,H

Caution:

In case of NTSC or PAL mode, please input standard composite video (or sync.) signal, NTSC(M) or PAL(B,G).

A long time input of non-standard sync. signal may cause flicker or degradation of display quality.

In the case of external clock mode, please input signal to keep the condition specified in Table. 7.

7-5)Input/Output signal timing chart

Table 11　　CLKC=Hi

VSH=+5.3V,GND=0V　　NTSC:fH=15.73kHz,fv=60Hz, τ HI=4.7 μ s

PAL:fH=15.63kHz,fV=50Hz, τ HI=4.7 μ s

Parameter		Symbol	MIN	TYP	MAX	Unit	Remarks
Horizontal sync. output [HSY]	frequency	fHO	-	fH	-	kHz	
	pulse width	τ HO	1.0	4.6	8.0	μ s	【Note 9-1】
	rising time	τ rHO	-	-	0.5	μ s	CL=10pF
	falling time	τ fHO	-	-	0.5	μ s	CL=10pF
Horizontal sync. phase difference [HSY-SYN]	HSY falling time	τ pd1	0.5	2.1	3.0	μ s	【Note 9-2,3】
	HSY rising time	τ pd2		2.1	3.4	μ s	【Note 9-2】
Vertical sync. output [VSY]	frequency	fVO	-	fV	-	Hz	
	pulse width	τ VO	-	4H	-	μ s	1H=1/fH
	sync. output difference	τ VHO	-	11	29	μ s	【Note 9-4】
	rising time	τ rVO	-	-	2.0	μ s	CL=10pF
	falling time	τ fVO	-	-	2.0	μ s	CL=10pF
Vertical sync. phase difference [SYN-VSY]	odd field	τ DV1	-	1H	-	μ s	【Note 9-5】
	even field	τ DV2	-	0.5H	-		【Note 9-5】
Polarity alternating output signal [FRPT,FRPV]	rising time	τ rFR	-	-	0.5	μ s	CL=10pF
	falling time	τ fFR	-	-	0.5	μ s	CL=10pF

Note10-1】 Adjusted by variable resister (H-POS) in a module.

【Note10-2】 HSY proceeds SYN

【Note10-3】 Variable range by variable resister (H-POS) in a module.

adjustment : τ pd = 2.1±0.5 μ s

【Note10-4】 Synchronized with HSY, based on falling timing of HSY.

【Note10-5】 VSY signal delays.1H=1/fH

7-6) Display time range

(1) NTSC(M) mode (NTP='Hi',CLKC='Hi')

(a1) Horizontally : 13.1 ～ 63.2 μs from the falling edge of HSY. (full,wide1,2,cinema)
(a2) Horizontally : 7.9 ～ 68.4 μs from the falling edge of HSY. (normal)
(b1) Vertically : 20 ～ 253 H from the falling edge of VSY. (full,wide1,normal)
(b2) Vertically : 49 ～ 224 H from the falling edge of VSY. (cinema)
(b3) Vertically : 42 ～ 228 H from the falling edge of VSY. (wide2)

(2)PAL(B･G) mode (NTP='Lo',CLKC='Hi')

Displaying the following range within video signals.
(a1) Horizontally : 13.1 ～ 63.2 μs from the falling edge of HSY. (full,wide1,2,cinema)
(a2) Horizontally : 7.9 ～ 68.4 μs from the falling edge of HSY. (normal)
(b1) Vertically : 26～ 298 H from the falling edge of VSY. (full,wide1,normal)
However, the video signals of (14n+12)H,(14n+20)H/Even field.
(14n+17)H,(14n+23)H/Odd field (n=1,2･･･, 20)
are not displayed on the module.
(b2) Vertically : 49 ～ 282 H from the falling edge of VSY. (cinema)
(b3) Vertically : 35 ～ 291 H from the falling edge of VSY. (wide2)

(3) External clock mode (NTP='Hi',CLKC='Lo')

Displaying the following range within video signals.
(a) Horizontally : 86 ～ 485 clk from the falling edge of HSY.
(clk means input external clock.)
(b) Vertically : 20 ～ 253 H from the falling edge of VSY.

(8)Optical characteristics

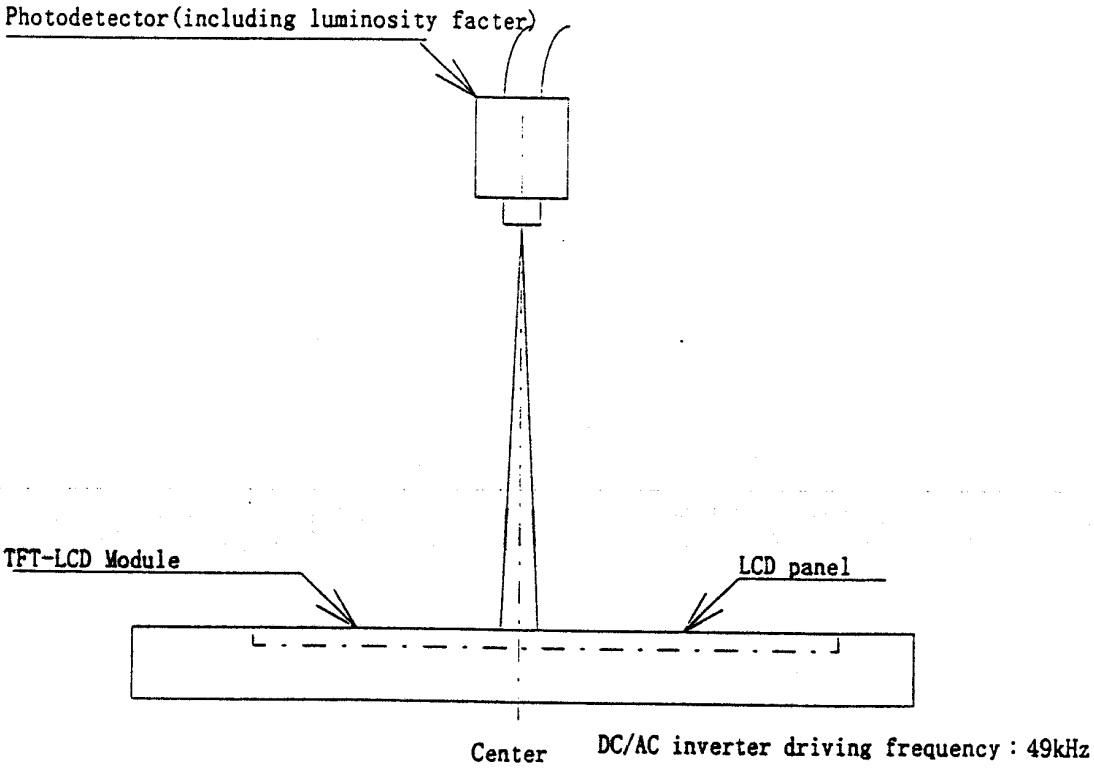
Table 12 Ta=25℃

Parameter		Symbol	Condition	Min	Typ	Max	Unit	Remarks
Viewing angle range		△θ 11	CR≧5	60	65	-	° (degree)	【Note 10-1,2,3】
		△θ 12		35	40	-	° (degree)	
		△θ 2		60	65	-	° (degree)	
Contrast ratio		CRmax	Optimal	60	-	-		【Note 10-2,3】
Response time	Rise	τ r	θ＝0°	-	30	60	ms	【Note 10-2,4】
	Fall	τ d		-	50	100	ms	
Luminance		Y	IL=6.5mArms	300	400	-	cd/m²	【Note 10-5】
	-10℃	YLOW	IL=9.0mArms	-	100	-	cd/m²	【Note 10-6】
White chromaticity		x	IL=6.5mArms	0.263	0.313	0.363		【Note 10-5】
		y	IL=6.5mArms	0.279	0.329	0.379		
lamp life time	+25℃	-	continuation	10,000	-	-	hour	【Note 10-7】
	-30℃	-	intermission	2,000	-	-	time	【Note 10-8】

DC/AC inverter for external connection shown in following.

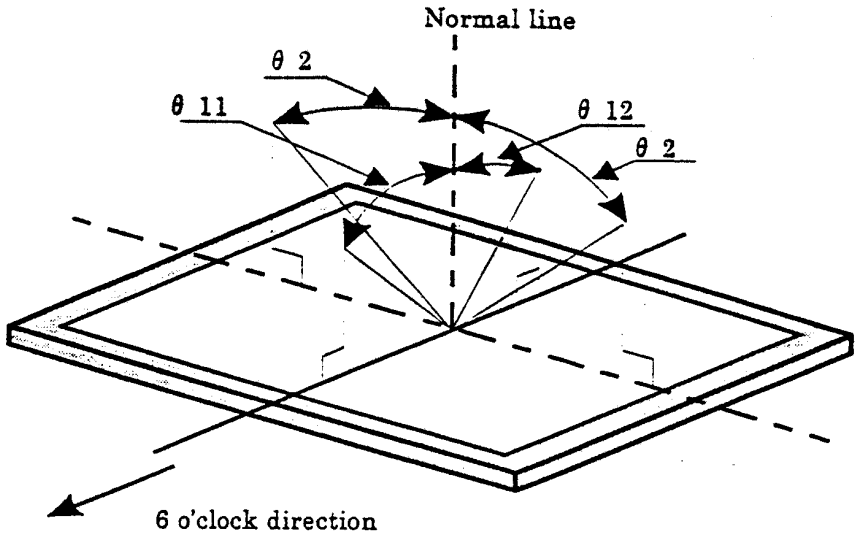
Harison Co.: HIU-288

※mesureing after 30minutes



mesuring method for optical characteristics

【Note 11-1】 Viewing angle range is defined as follows.



definition for viewing angle

【Note 10-2】 Applied voltage condition:

(1) VCDC is adjusted so as to attain maximum contrast ratio.

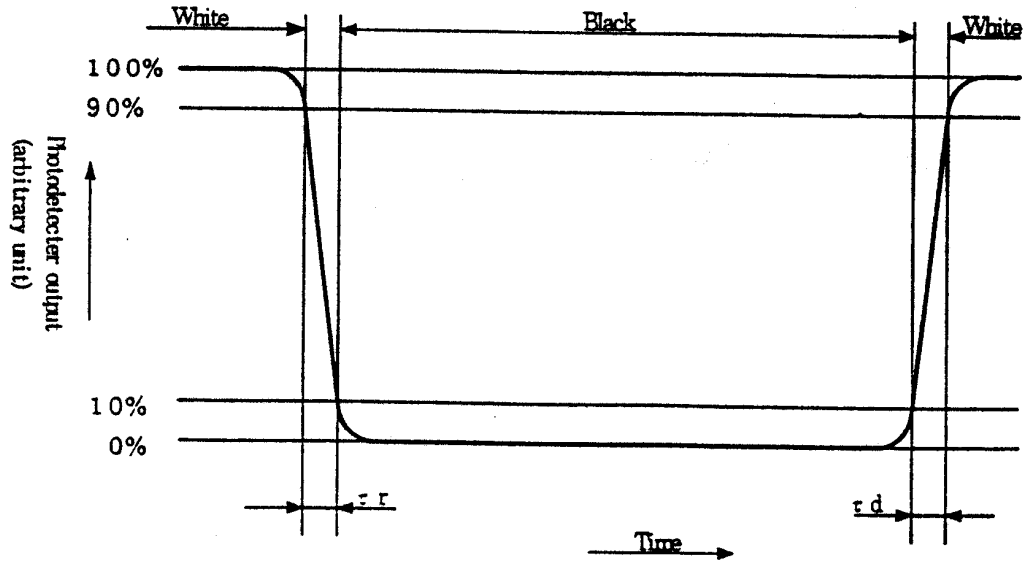
) Input ±1.90V at VIAC.

When VI50= transmission is 50% at Voltage-Transmission curve,
Black level : Vi50=±2.0V, White level :Vi50 = ∓ 1.5V

【Note 10-3】 Contrast ratio is defined as follows:

$$\text{Contrast ratio(CR)} = \frac{\text{Photodetector output with LCD being "white"}}{\text{Photodetechor output with LCD being "black"}}$$

【Note 10-4】 Response time is obtained by measuring the transition time of photodetector output, when input signals are applied so as to make the area "black" to and from "white".

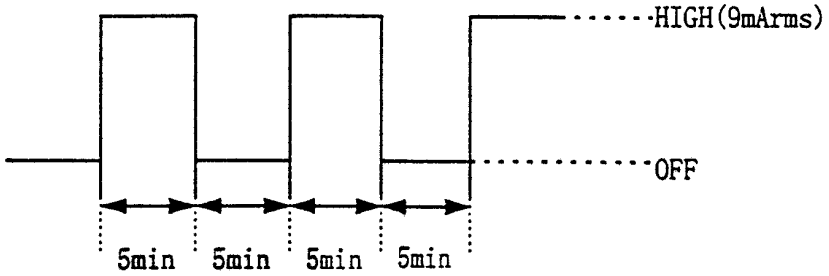


【Note 10-5】 Measured on the center area of the panel at a viewing cone 1° by TOPCON luminance meter BM-7.(After 10 minutes operation)
DC/AC inverter driving frequency:49kHz

【Note 10-6】 Ambient temperature:-10℃
Measured luminance on the panel after 2 minutes operation.

【Note 10-7】 Lamp life time is defined as the time when either or occurs in the continuous operation under the condition of lamp current IL=3~7mArms and PWM dimming 100%~5% (Ta=25℃)
Brightness not to become under 50% of the original value.

【Note 10-8】 The intermittent cycles is defined as a time when brightness not to become under 50% of the original value under the condition of following cycle.
Ambient temperature:-30℃



(9)Mechanical characteristics
9-1) External appearance
Do not exist extreme defects. (See Fig. 1)

9-2) Panel toughness
The panel shall not be broken,when 19N is pressed on the center of the panel by a smooth sphere having 15 mm diameter.
Caution: In spite of very soft toughness, if, in the long-term, add pressure on the active area, it is possible to occur the functional damage.

9-3) Input/output connector performance

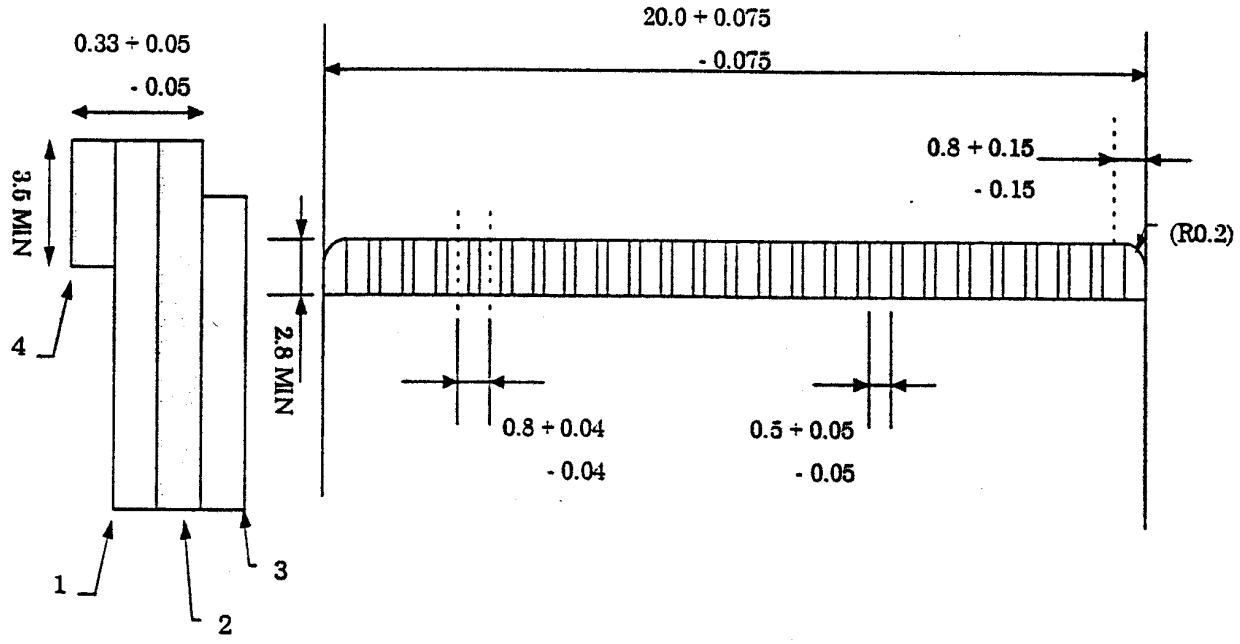
A)Input/output connectors for the operation of LCD module (24 pin FCI:SFR24R-5STE1)

1)Applicable FPC refer the below figure

2)Terminal holding force : More than 0.9N/pin

(Each terminal is pulled out at a rate of 25 ±3mm/min.)

3)Insertion/pulling :contact resistance is not twice larger than the durability initial value after applicable FPC is inserted and pulled out 20 times



No.	Name	Materials
1	Base material	Polyimide or equivalent material(25 μ m thick)
2	Copper foil	Copper foil(35 μ m thick) Solder plated over 2 μ m
3	Cover lay	Polyimide or equivalent material
4	Reinforcing plate	Polyester polyimide or equivalent material(188 μ m thick)

FPC applied to input/output connector (0.8mm pitch)

B)I/O connector of backlight driving circuit 【JST】

Symbol	Used Connector	Corresponding connector
CN1	BHR-03VS-1	SM02(8.0)B-BHS-TB (assembled on PWB)
		BHMR-03V (interconecter)

(10) Display quality

The display quality of the color TFT-LCD module shall be in compliance with the Delivery Inspection Standard.

(11) Handling instructions

11-1) Mounting of module

The TFT-LCD module is designed to be mounted on equipment using the mounting tabs in the four corners of the module at the rear side.
On mounting the module, as the M2.6 tapping screw (fastening torque is 0.3 through 0.5N·m) is recommended, be sure to fix the module on the same plane, taking care not to wrap or twist the module.
Please power off the module when you connect the input/output connector.
Please connect the metallic shielding cases of the module and the ground pattern of the inverter circuit surely. If that connection is not perfect, there may be a possibility that the following problems happen.

a). The noise from the backlight unit will increase.
b). The output from inverter circuit will be unstable. Then, there may be a possibility that some problems happen.
c). In some cases, a part of module will heat.

11-2) Precautions in mounting

Polarizer which is made of soft material and susceptible to flaw must be handled carefully. Protective film (Laminator) is applied on the surface to protect it against scratches and dirts. It is recommended to peel off the laminator immediatery before the use, taking care of static electricity.
Precautions in peeling off the laminator

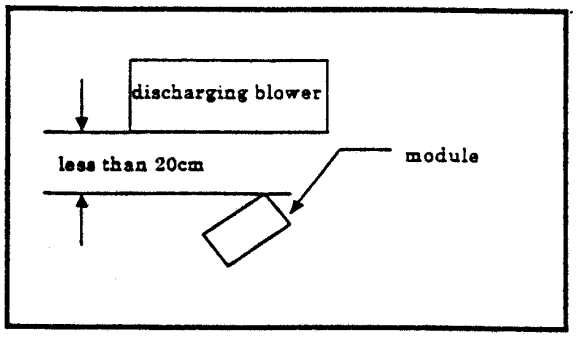
A) Working environment

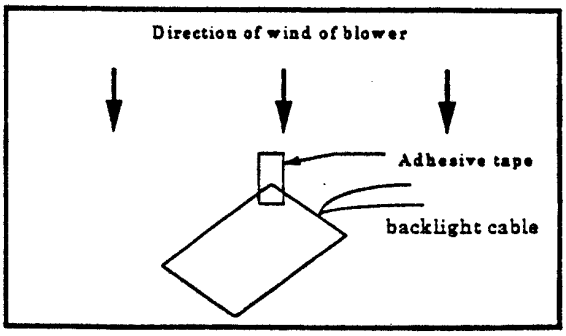
When the laminator is peeled off, static electricity may cause dust to stick to the polarizer surface. To avoid this, the following working environment is desirable.

a) Floor:Conductive treatment of 1M Ω or more on the tile
(conductive mat or conductive paint on the tile)
b) Clean room free form dust and with an adhensive mat on the doorway
c) Advisable humidity:50%～70% Advisable temperature:15℃～27℃
d) Workers shall wear conductive shoes, conductive work clothes, conductive gloves and an earth band.

B) Working procedures

a) Direct the wind of discharging blower somewhat downward to ensure that module is blown sufficiently. Keep the distance between module and discharging blower within 20 cm.
b) Attach adhensive tape to the laminator part near discharging blower so as to protect polarizer against flaw.
c) Peel off laminator, pulling adhesive tape slowly to your side taking 5 or more second.
d) On peeling off the laminator, pass the module to the next work process to prevent the module to get dust.





e) Method of removing dust from polarizer

- Blow off dust with N2 blower for which static electricity preventive measure has been taken. Ionized air gun (Hugle Electronics Co.) is recommended.
- Since polarizer is vulnerable, wiping should be avoided.
  But when the panel has stain or grease, we recommend to use adhesive tape to softly remove them from the panel.

When metal part of the TFT-LCD module (shielding lid and rear case) is soiled, wipe it with soft dry cloth. For stubborn dirts, wipe the part, breathing on it.
Wipe off water drop or finger grease immediately. Long contact with water may cause discoloration or spots.
TFT-LCD module uses glass which breaks or cracks easily if dropped or bumped on hard surface. Handle with care.
Since CMOS LSI is used in this module, take care of static electricity and earth your body when handling.

11-3) Precautions in adjusting module

Adjusting volumes on the rear face of the module have been set optimally before shipment. Therefore, do not change any adjusted values. If adjusted values are changed, the specifications described here may not be satisfied.

11-4) Caution of product design

The LCD module shall be protected against water salt-water by the waterproof cover.
Please take measures to interferential radiation from module, to do not interfere surrounding appliances.

11-5) Others

Do not expose the module to direct sunlight or intensive ultraviolet rays for many hours; liquid crystal is deteriorated by ultraviolet rays.
Store the module at a temperature near the room temperature. At lower than the rated storage temperature, liquid crystal solidifies, causing the panel to be damaged. At higher than the rated storage temperature, liquid crystal turns into isotropic liquid and may not recover.
The voltage of beginning electric discharge may over the normal voltage because of leakage current from approach conductor by to draw lump read lead line around.
If LCD panel breaks, there may be a possibility that the liquid crystal escapes from the panel. Since the liquid crystal is injurious, do not put it into the eyes or mouth. When liquid crystal sticks to hands, feet or clothes, wash it out immediately with soap.
Observe all other precautionary requirements in handling general electronic components.

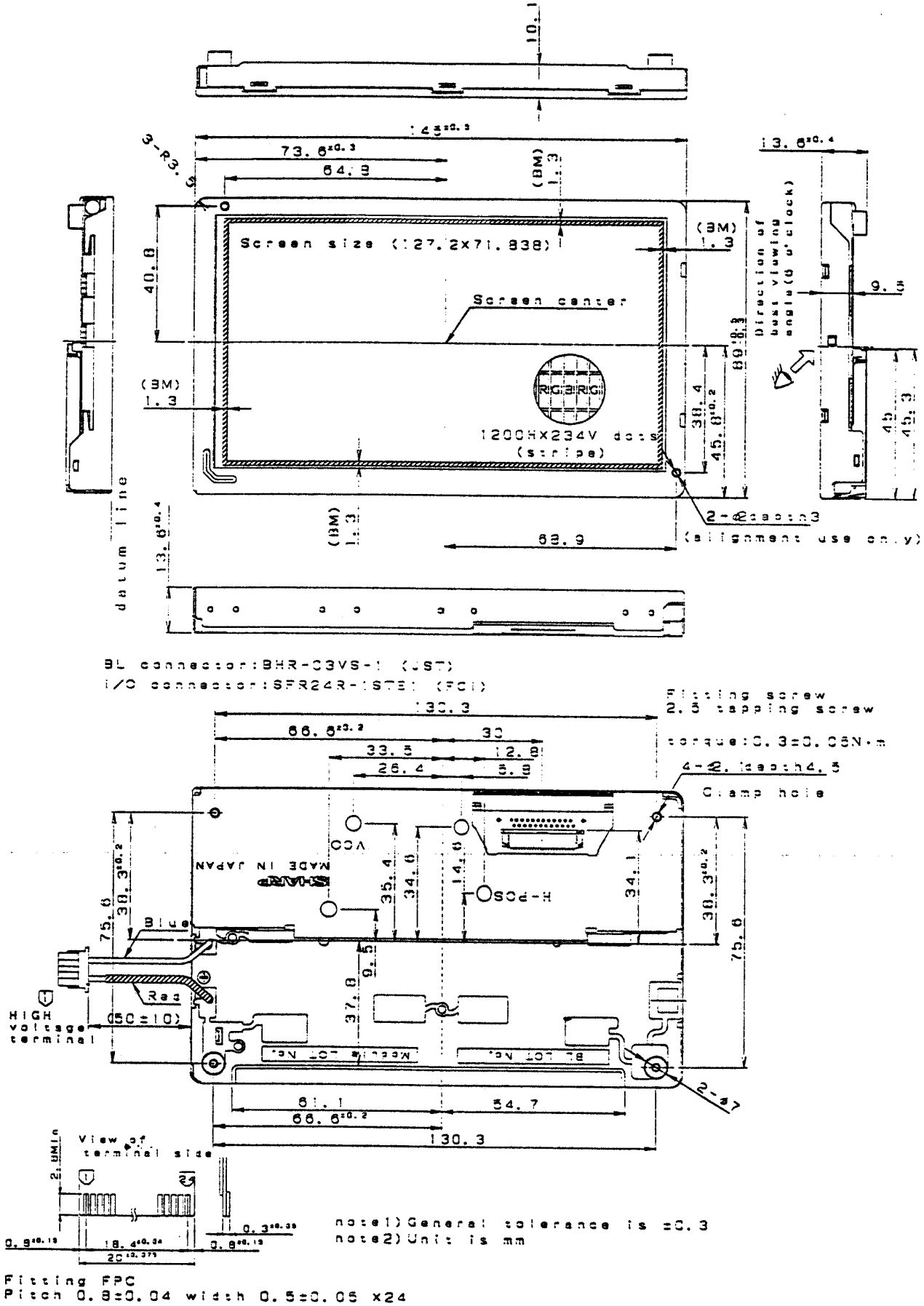


Fig1. Outline Dimensions

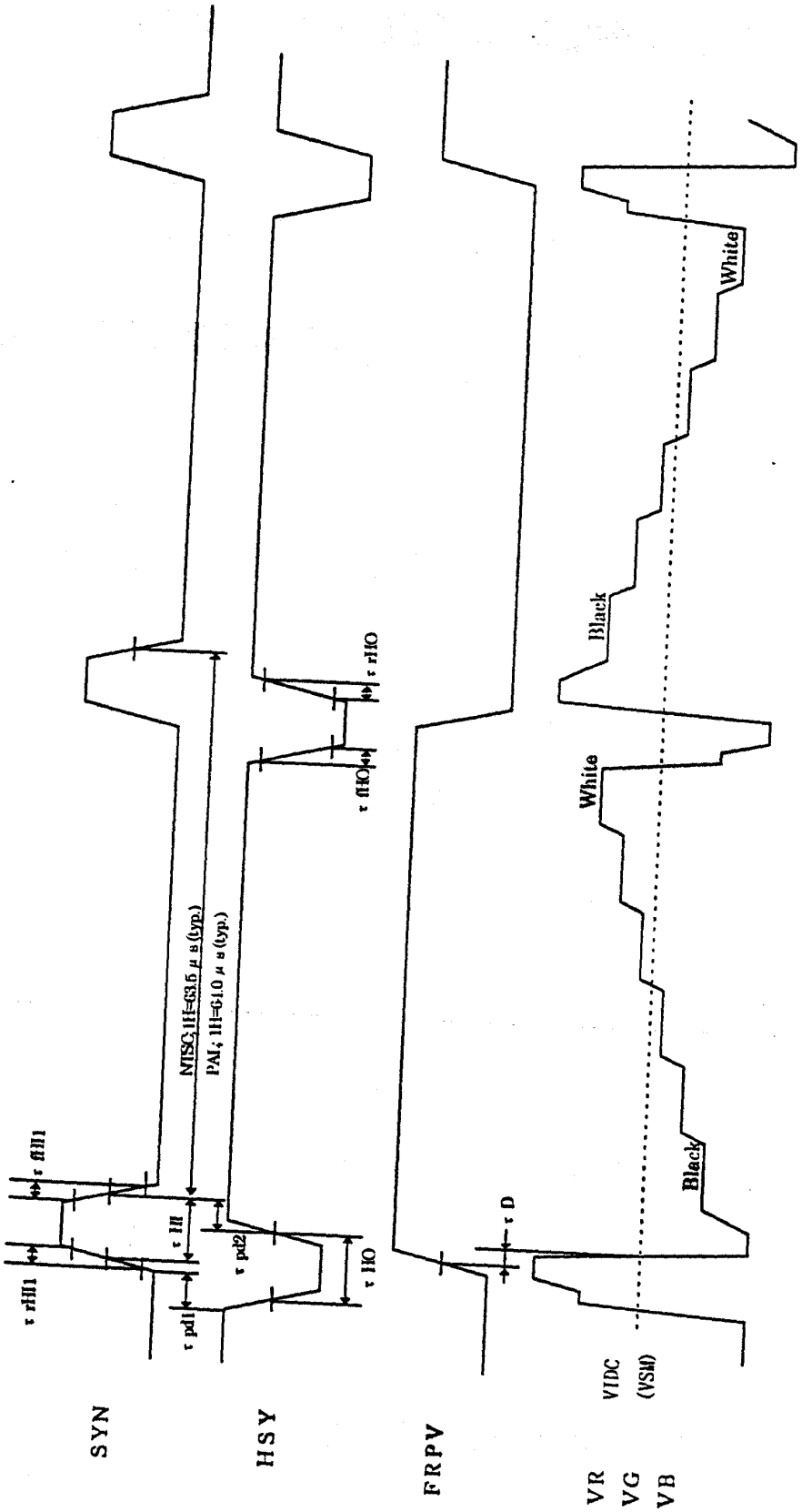


Fig. 5-A Input/Output signal waveforms (NTSC, PAL CLKC=Hi)

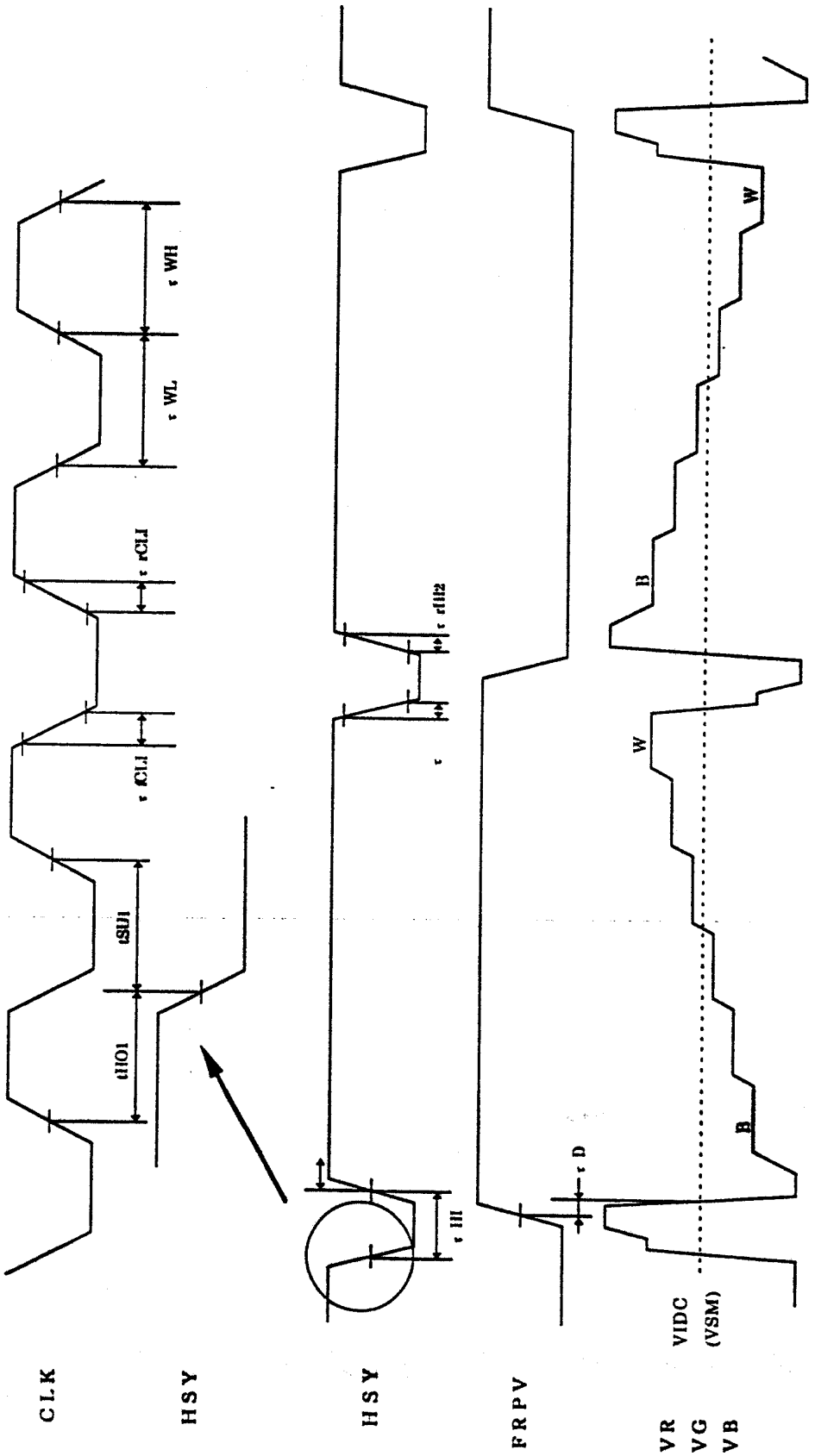


Fig. 5-B Input/Output signal waveforms (external clock mode NTPC=Hi, CLKC=Lo, MODS=MODW=MODN=Hi)

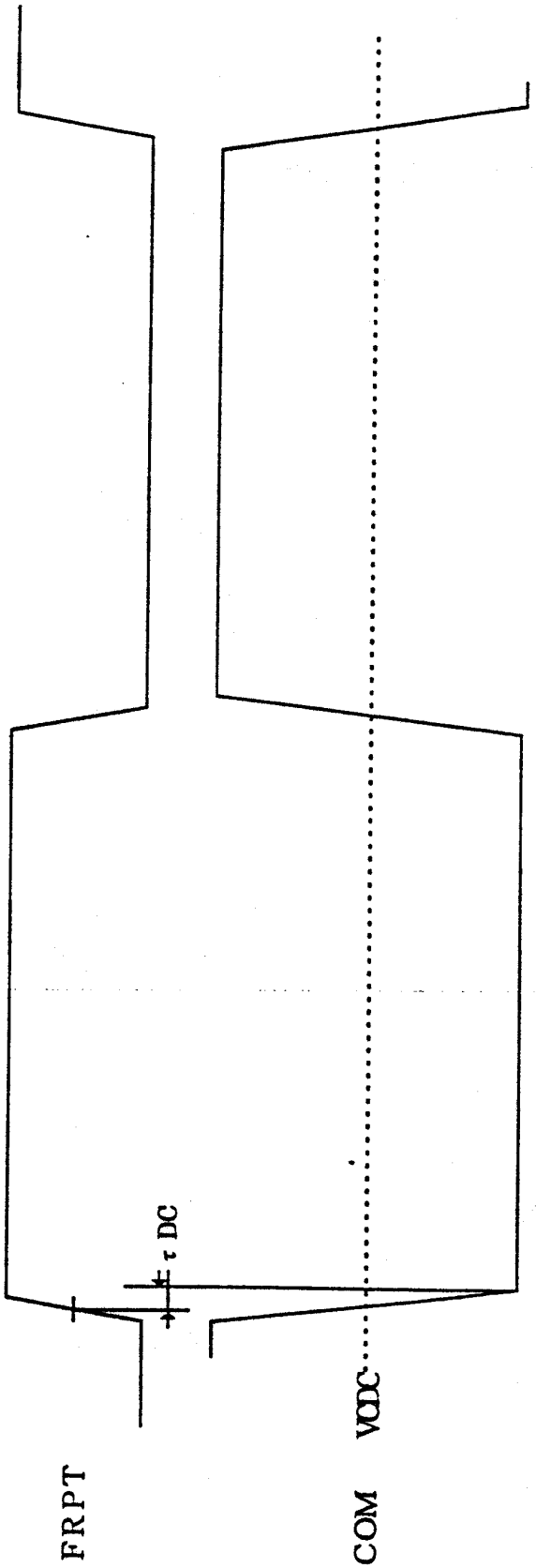


Fig. 5 — C Input/Output signal waveforms

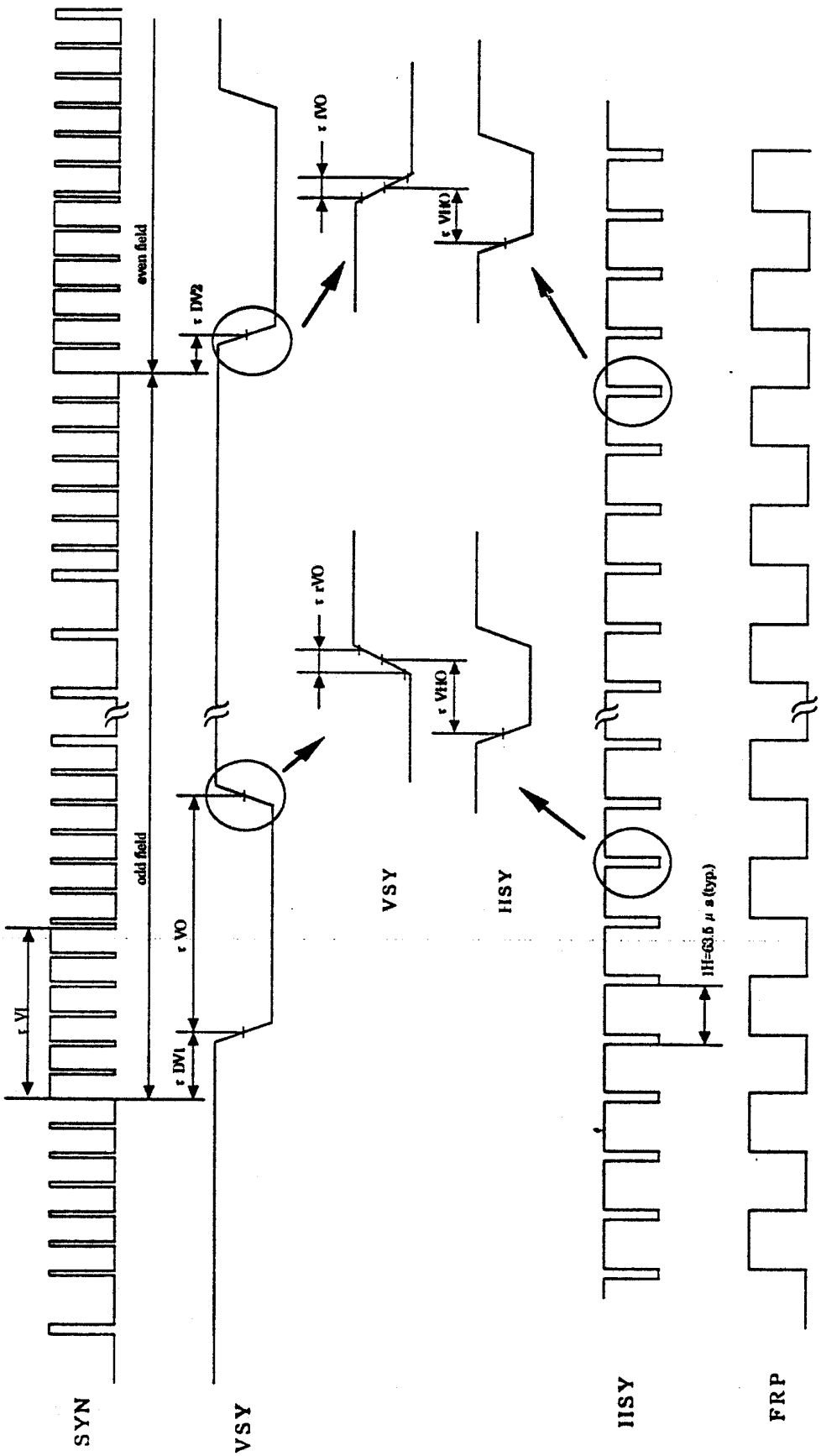


Fig. 5—D Input/Output signal waveforms (NTSC NTPC=Hi, CLKC=Hi)

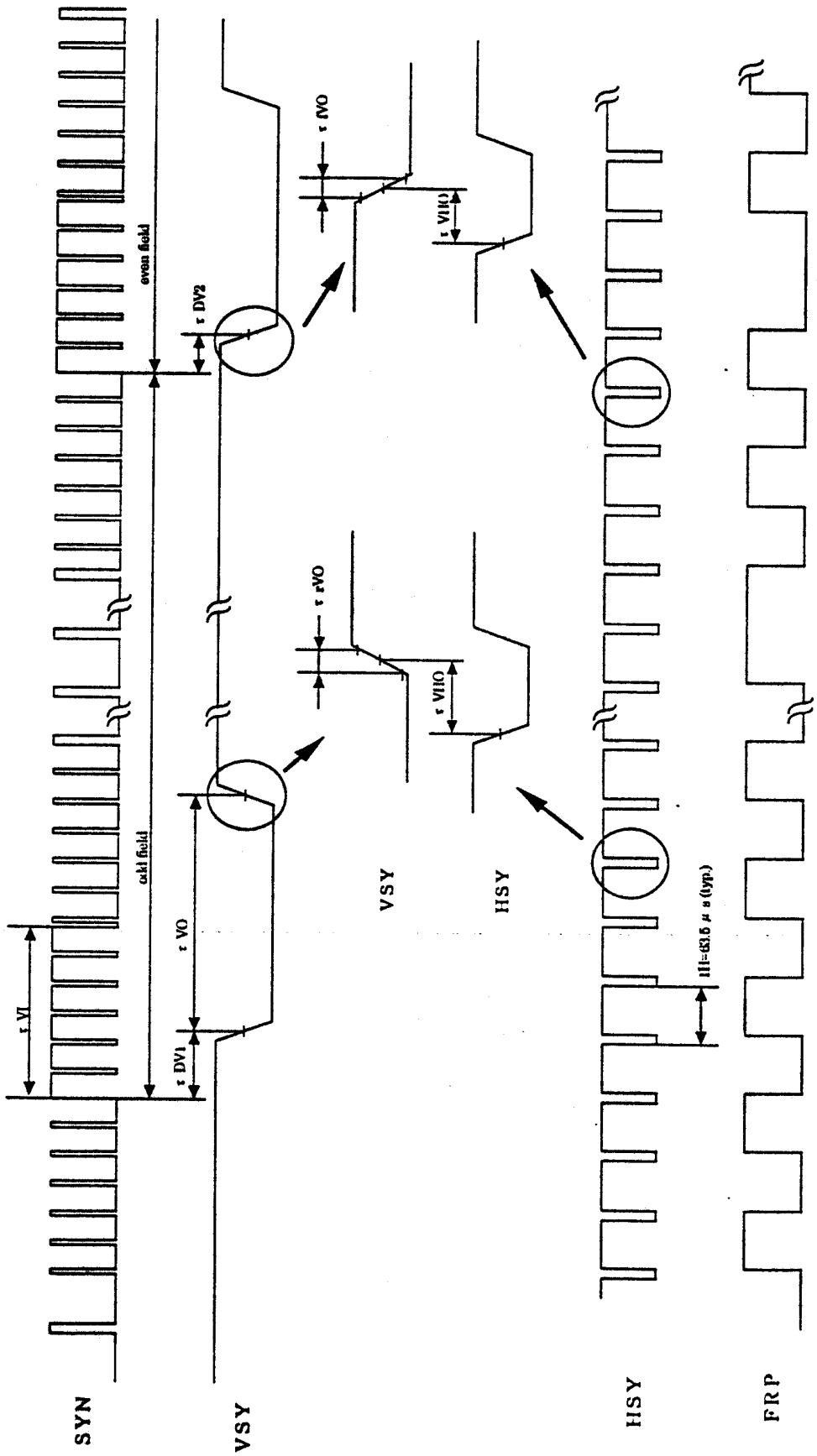


Fig. 5－E Input/Output signal waveforms (PAL NTPC=Lo, CLKC=Hi)

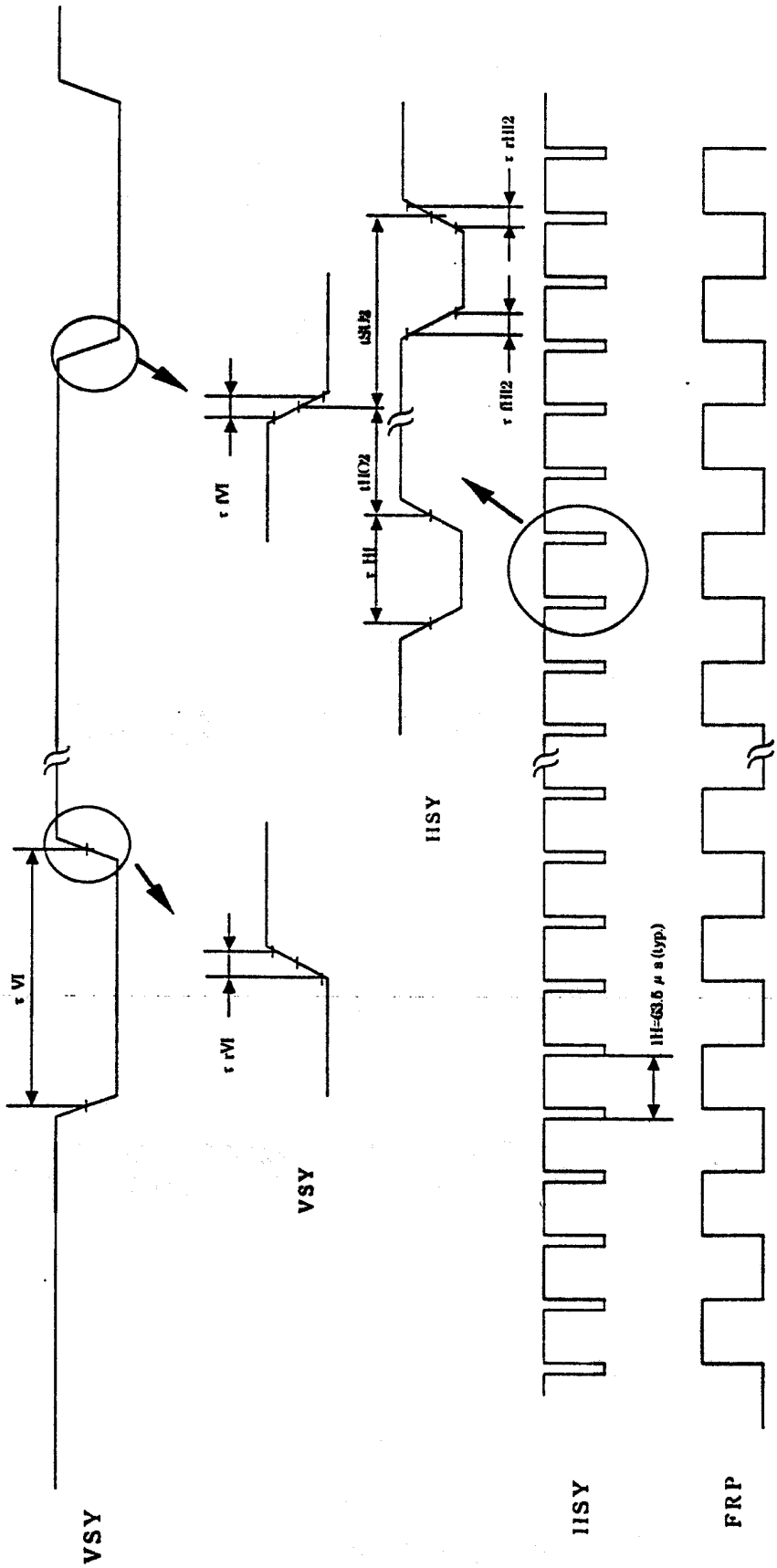


Fig. 5－F Input/Output signal waveforms (external clock mode NTPC=Hi, CLKC=Lo)

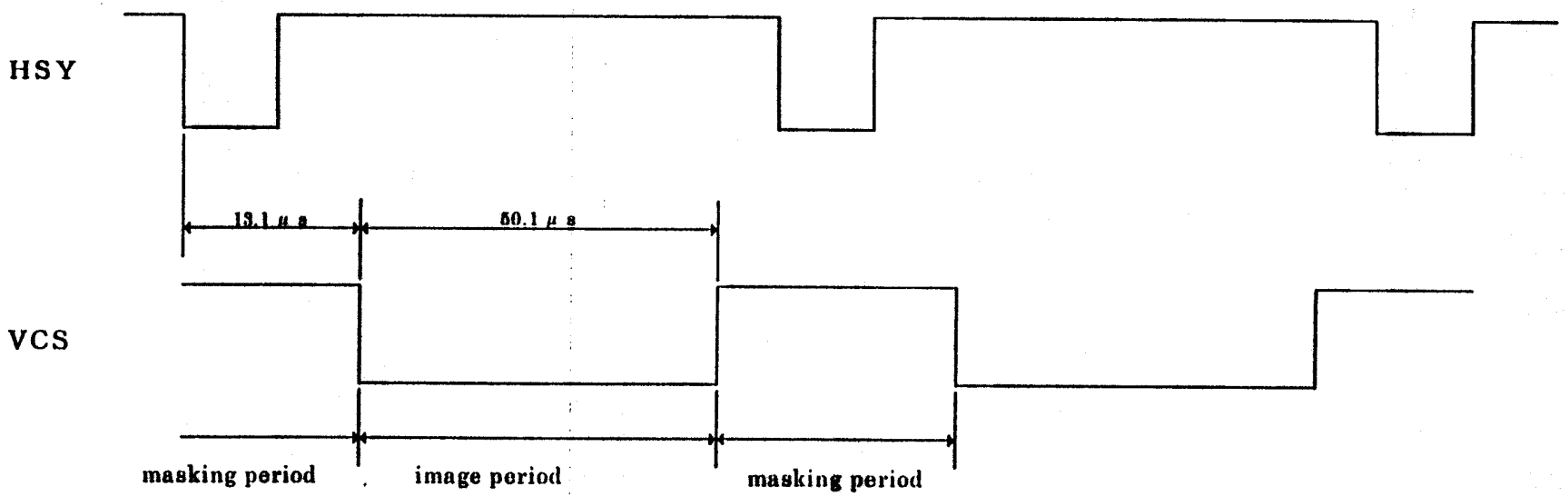


Fig. 5－G　Input/Output signal waveforms　(normal mode, NTSC, PAL　CLKC=Hi, MODS=Hi, MODW=Lo, MODN=Hi)

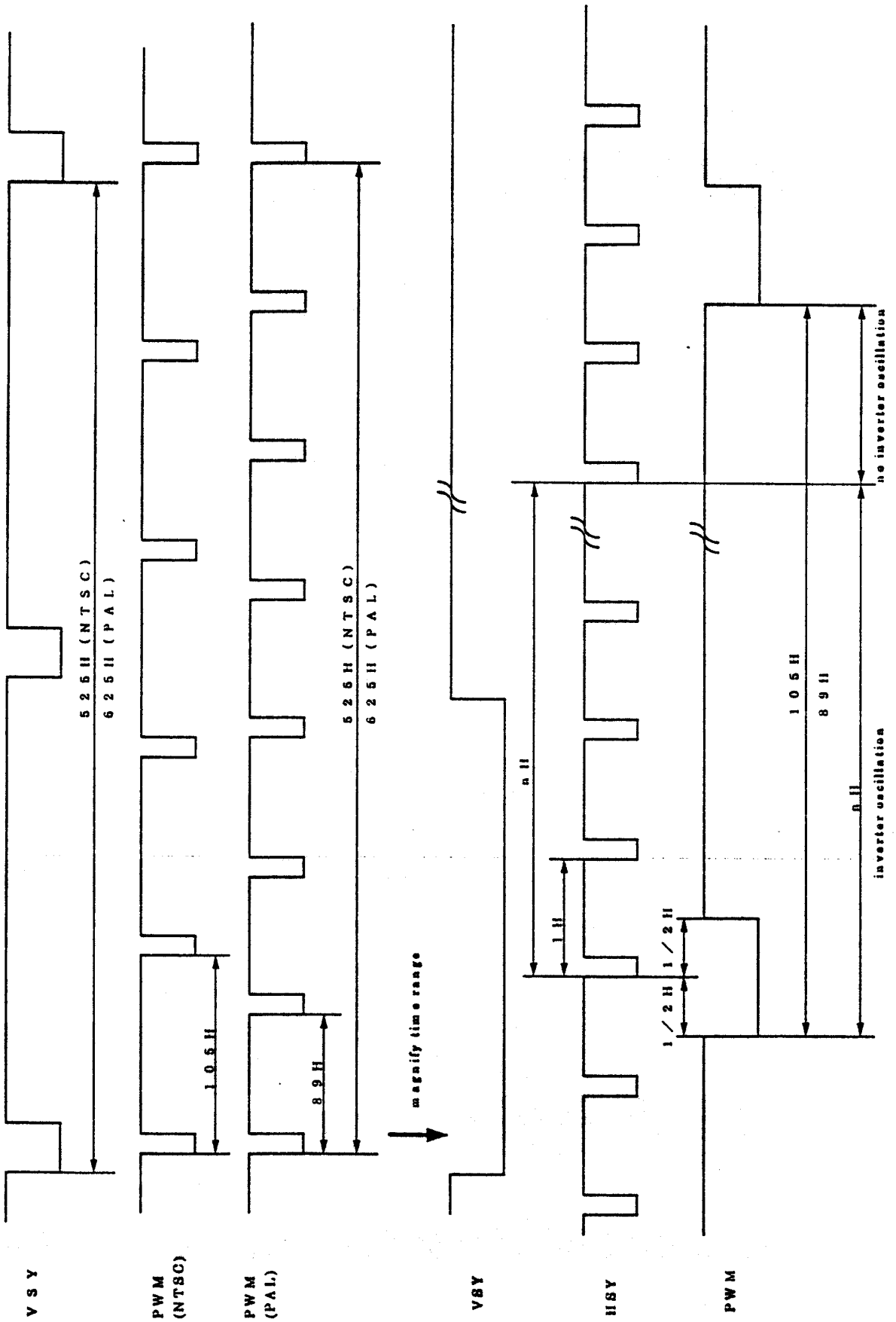


Fig. 5 - 11 PWM dimming timing