Ordering number : ENA1957

SANYO Semiconductors
DATA SHEET

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LC749870W — CMOS IC Silicon gate NTSC/PAL/SECAM Digital Video Decoder

Overview

The LC749870W is a digital video decoder that converts NTSC, PAL and SECAM video signals into digital component video signals. Digital video data can be output easily by inputting NTSC, PAL and SECAM video signals. The output data format is compatible with ITU-R BT.656.

Features

- Supports NTSC (M, 4.43), PAL (B, D, G, H, I, M, N, 60), and SECAM video signal inputs.
- On-chip video switch that supports 4 video inputs
- 10-bit ADC (sampling at 27MHz)
- Automatic gain control (AGC) function
- Digital clamp circuit
- Digital automatic color control (ACC) circuit
- Sync separation circuit
- Signal-to-noise (S/N) detection capabilities
- Non-standard signal detection function
- No signal detection function
- Adaptive two-dimensional Y/C separation circuit
- NTSC/PAL/SECAM demodulator circuit
- Clock rate conversion circuit
- Picture quality improvement (sharpness, contrast, brightness, CTI, UV gain, HUE)
- 8-bit ITU-R BT.656 output format
  ITU-R BT.656 (8bit YCbCr 4:2:2 with SAV/EAV)
  8bit YCbCr 4:2:2 with Syncs
- I^2C control (100k/400kbps, 2 types of slave address selectable)

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IC Specifications

- Power supply voltage I/O: Analog 3.3V, Digital 1.8V or 3.3V
  Core: Analog 1.8V, Digital 1.1V
- Maximum operating frequency: 30MHz
- Package: SQFP64

Applications

- Small-size monitors

Specifications

Absolute Maximum Ratings at Ta = 25°C, DV_{SS} = 0V, AV_{SS} = 0V

Parameter	Symbol	Conditions	Ratings	unit
Maximum supply voltage (I/O)	$DV_{DD}33$ $XV_{DD}33$ $AV_{DD}33$		-0.3 to +3.95	V
Maximum supply voltage (Core)	$DV_{DD}11$ $XV_{DD}11$		-0.3 to +1.8	V
Digital input voltage	V_I		-0.3 to $DV_{DD}33$+0.3	V
Digital output voltage	V_O		-0.3 to $DV_{DD}33$+0.3	V
Operating temperature	Topr		-40 to +85	°C
Storage temperature	Tstg		-55 to +125	°C

Allowable Operation Ranges at Ta = 25°C, DV_{SS} = 0V, AV_{SS} = 0V

Parameter	Symbol	Conditions	min	typ	max	unit
Supply voltage (I/O)	$AV_{DD}33$ $XV_{DD}33$		3.0	3.3	3.6	V
	$DV_{DD}33$		1.7	1.8 or 3.3	3.6	V
Supply voltage (Core)	$DV_{DD}11$ $XV_{DD}11$		1.0	1.1	1.2	V
Input voltage range	V_{IN}		0		$DV_{DD}33$	V

DC Characteristics at Ta = -30 to +70°C, $DV_{DD}33$ = 1.7 to 3.63V, $AV_{DD}33$ = 3.0 to 3.63V, $DV_{DD}11$ = 1.0 to 1.2V

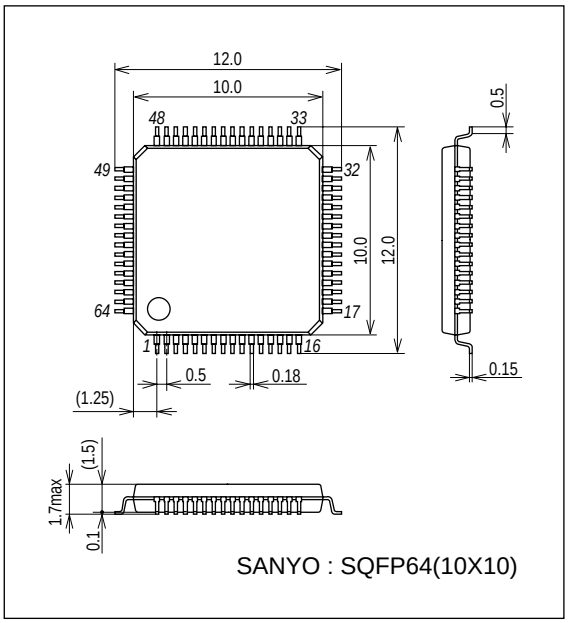
Parameter	Symbol	Conditions	min	typ	max	unit
Input high-level voltage	V_{IH}	CMOS level inputs	0.7$DV_{DD}33$			V
		CMOS level Schmitt inputs	0.7$DV_{DD}33$			V
Input low-level voltage	V_{IL}	CMOS level inputs	0		0.3$DV_{DD}33$	V
		CMOS level Schmitt inputs	0		0.3$DV_{DD}33$	V
Input high-level current	I_{IH}	$V_I = V_{DD}$			10	µA
		$V_I = V_{DD}$, with pull-down resistance			100	µA
Input low-level current	I_{IL}	$V_I = V_{SS}$	-10			µA
Output high-level voltage	V_{OH}	CMOS (Pin E/G: I_{OH} = -4mA, F: I_{OH} = -6mA)	V_{DD}-0.4			V
Output low-level voltage	V_{OL}	CMOS			0.4	V
Output leakage current	I_{OZ}	When in high-impedance output mode	-10		10	µA
Pull-down register	R_{DN}	$DV_{DD}11$ = 1.1V, $DV_{DD}33$ = 3.3V		159		kΩ
		$DV_{DD}11$ = 1.1V, $DV_{DD}33$ = 1.8V		95		kΩ
Operating current drain	I_{DDOP}	Output open, tck=27MHz, natural image. Ta = 25°C, $DV_{DD}33$ = 3.3V, $AV_{DD}33$ = 3.3V, $DV_{DD}11$ = 1.1V		42		mA
		Output open, tck=27MHz, natural image. Ta = 25°C, $DV_{DD}33$ = 1.8V, $AV_{DD}33$ = 3.3V, $DV_{DD}11$ = 1.1V		38		mA
Static current drain *1	I_{DDST}	Output open, $V_I = V_{SS}$, Ta = 25°C		10		µA

*1: There is an input pin which builds in pull down resistance. Note that there is no guarantee about static consumption current depending on circuit configuration.

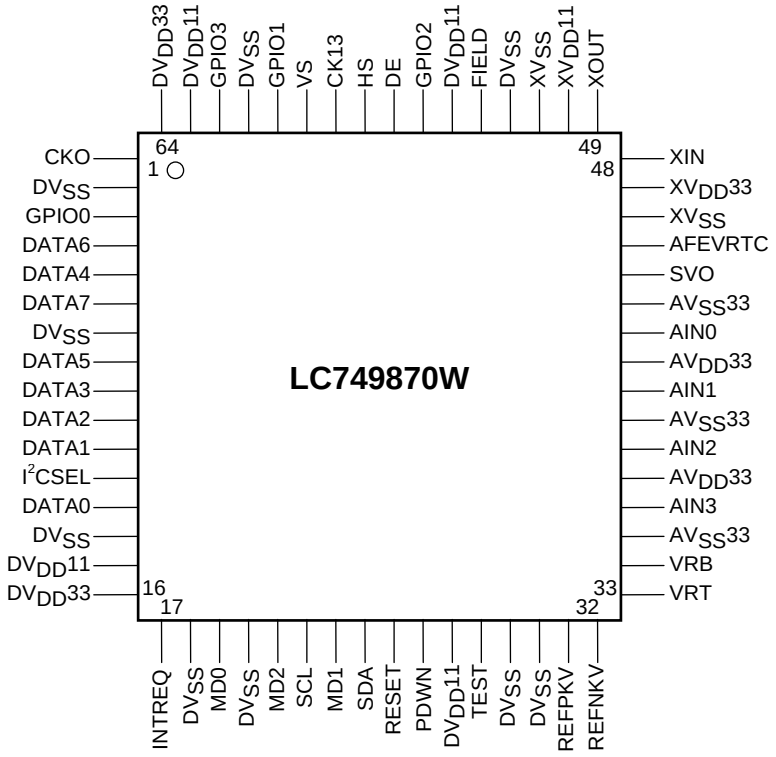
Package Dimensions

unit : mm (typ)

3190A



Pin Assignment



Top view

Pin Descriptions

Pin No.	Symbol	I/O Type		Connected to		Notes
		I/O	Type			
1	CKO	O	F	CMOS	Digital	Data synchronous clock output
2	DV_{SS}	P		GND	Digital	
3	GPIO0	I/O	G	CMOS	Digital	For test
4	DATA6	I/O	G	CMOS	Digital	Video signal output
5	DATA4	I/O	G	CMOS	Digital	Video signal output
6	DATA7	I/O	G	CMOS	Digital	Video signal output (MSB)
7	DV_{SS}	P		GND	Digital	
8	DATA5	I/O	G	CMOS	Digital	Video signal output
9	DATA3	I/O	G	CMOS	Digital	Video signal output
10	DATA2	I/O	G	CMOS	Digital	Video signal output
11	DATA1	I/O	G	CMOS	Digital	Video signal output
12	I^2CSEL	I	C	CMOS	Digital	I^2C slave select L = 0x88, H = 0x8A
13	DATA0	I/O	G	CMOS	Digital	Video signal output (LSB)
14	DV_{SS}	P		GND	Digital	
15	$DV_{DD}11$	P		Core voltage	Digital	
16	$DV_{DD}33$	P		I/O voltage	Digital	
17	INTREQ	O	E	CMOS	Digital	Interrupt (“H” active)
18	DV_{SS}	P		GND	Digital	
19	MD0	I	D	CMOS	Digital	For test (Connect to GND)
20	DV_{SS}	P		GND	Digital	
21	MD2	I	D	CMOS	Digital	For test (Connect to GND)
22	SCL	I	D	CMOS	Digital	I^2C clock
23	MD1	I	D	CMOS	Digital	For test (Connect to GND)
24	SDA	I/O	G	CMOS	Digital	I^2C data input/output
25	RESET	I	B	CMOS	Digital	System reset (“L” active)
26	PDWN	I	B	CMOS	Digital	Power down control
27	$DV_{DD}11$	P		Core voltage	Digital	
28	TEST	I	C	CMOS	Digital	For test (Connect to GND)
29	DV_{SS}	P		GND	Digital	
30	DV_{SS}	P		GND	Digital	
31	REFPKV	I	A		Analog	ADC top reference buffer-amp input
32	REFNKV	I	A		Analog	ADC bottom reference buffer-amp input
33	VRT	I	A		Analog	ADC top reference voltage input
34	VRB	I	A		Analog	ADC bottom reference voltage input
35	$AV_{SS}33$	P		GND	Analog	
36	AIN3	I	A		Analog	Video signal input (CVBS)
37	$AV_{DD}33$	P		Analog Voltage	Analog	
38	AIN2	I	A		Analog	Video signal input (CVBS)
39	$AV_{SS}33$	P		GND	Analog	
40	AIN1	I	A		Analog	Video signal input (CVBS)
41	$AV_{DD}33$	P		Analog Voltage	Analog	
42	AIN0	I	A		Analog	Video signal input (CVBS)
43	$AV_{SS}33$	P		GND	Analog	
44	SVO	O	A		Analog	AFE SVO output
45	AFEVRTC	I	A		Analog	ADC D-range control voltage external input
46	XV_{SS}	P		GND	Digital	
47	$XV_{DD}33$	P		I/O Voltage	Digital	
48	XIN	I	H	CMOS	Digital	X’tal input
49	XOUT	O	H	CMOS	Digital	X’tal output
50	$XV_{DD}11$	P		Core Voltage	Digital	

Continued on next page.

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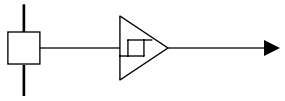
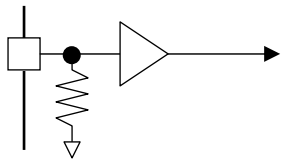
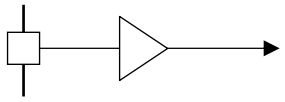
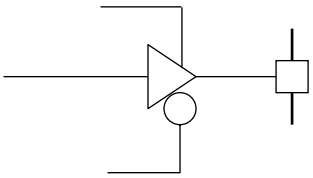
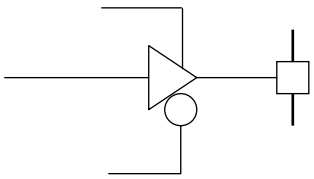
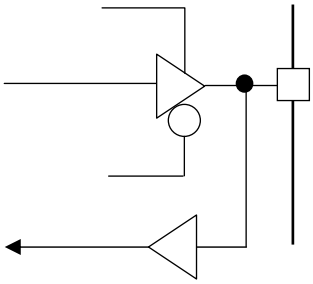
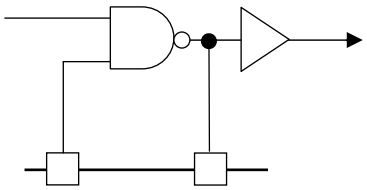
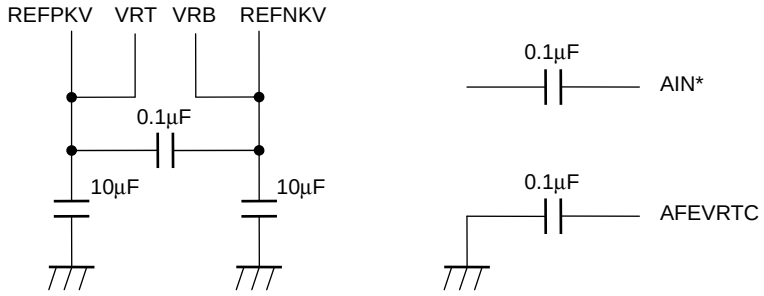
Pin No.	Pin symbol	I/O Type		Connected to		Notes
		I/O	Type			
51	XV_{SS}	P		GND	Digital	
52	DV_{SS}	P		GND	Digital	
53	FIELD	I/O	G	CMOS	Digital	Field signal
54	$DV_{DD}11$	P		Core voltage	Digital	
55	GPIO2	I/O	G	CMOS	Digital	For test
56	DE	I/O	G	CMOS	Digital	Data enable signal
57	HS	I/O	G	CMOS	Digital	Horizontal sync signal
58	CK13	O	F	CMOS	Digital	Clock output (13.5MHz)
59	VS	I/O	G	CMOS	Digital	Vertical sync signal
60	GPIO1	I/O	G	CMOS	Digital	For test
61	DV_{SS}	P		GND	Digital	
62	GPIO3	I/O	G	CMOS	Digital	For test
63	$DV_{DD}11$	P		Core voltage	Digital	
64	$DV_{DD}33$	P		I/O voltage	Digital	

Pin Circuits

I/O type	Function	Equivalent Circuit	Applicable Pins
A	Analog input/output		AIN0, AIN1, AIN2, AIN3, VRT, VRB, REFPKV, REFNKV, SVO, AFEVRTC
B	Schmitt trigger CMOS input		PDWN, RESET
C	CMOS input with built-in pull-down resistor		I^2CSEL, TEST
D	CMOS input		SCL, MD0, MD1, MD2
E	2mA/4mA switching 3-STATE drive CMOS output		INTREQ
F	4mA/8mA switching 3-STATE drive CMOS output		CKO, CK13
G	2mA/4mA switching 3-STATE drive CMOS input/output		SDA, GPIO0, GPIO1, GPIO2, GPIO3, DATA0, DATA1, DATA2, DATA3, DATA4, DATA5, DATA6, DATA7, FIELD, DE, VS, HS
H	Oscillator		XIN, XOUT

Pin Connection

1) ADC and its peripherals

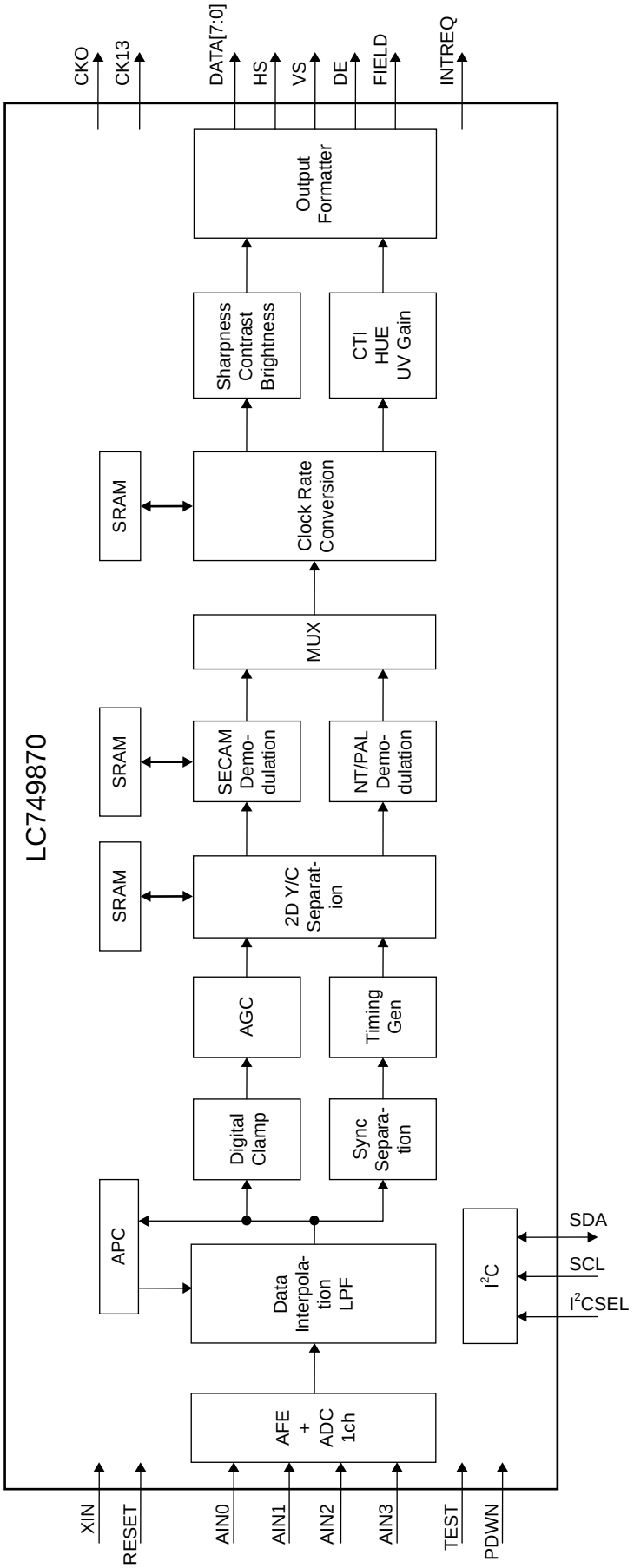


Capacitors must be placed as close as possible to the IC.

2) Unused Pin Handling (Please be sure to perform except input open processing)

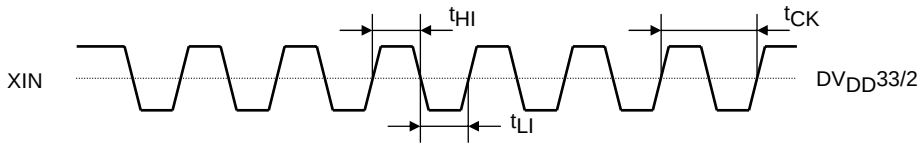
AIN0 to AIN3: Open
PDWN: Pull up
TEST, MD0, MD1, MD2: Pull down
RESET: Must always be configured for input.
GPIO0 to GPIO3: Open
DATA0 to DATA7: Open
FIELD, DE, VS, HS: Open
CKO, CK13: Open
INTREQ: Open
SVO: Open

Block Diagram



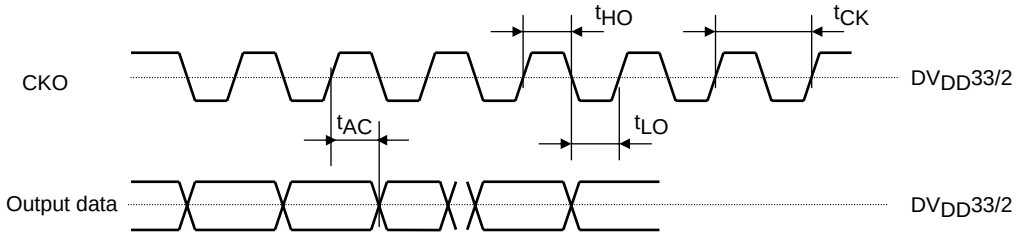
Input/Output Timing

1) Input clock timing



Pin Name	Parameter	Symbol	min	typ	max	unit
XIN	Clock cycle	t_{CK}		37		ns
	Duty			50		%

2) Output data timing



Pin Name	Parameter	Symbol	min	typ	max	unit
CKO	Clock cycle	t_{CK}		37		ns
	Duty			50		%
DATA*, HS,VS,DE,FIELD, INTREQ	Output data delay time ($DV_{DD}33$ = 2.6 to 3.6V) Pins E,G: 4mA setting Pin F: 8mA setting	t_{AC}	-3		3	ns
	Output data delay time ($DV_{DD}33$ = 2.6 to 3.6V) Pins E,G: 2mA setting Pin F: 4mA setting	t_{AC}	-3		6	ns
	Output data delay time ($DV_{DD}33$ = 1.7 to 1.9V) Pins E,G: 4mA setting Pin F: 8mA setting	t_{AC}	-5		4	ns
	Output data delay time ($DV_{DD}33$ = 1.7 to 1.9V) Pins E,G: 2mA setting Pin F: 4mA setting	t_{AC}	-6		9	ns

Register Specifications

BANK0 (AFE + ADC) Register Specification

Sub-address	Bit	Name	Bit-Size	Function Name	Functions	Initial value
00_H	7	I2C_BGRPWDB	1	Power down control	Band gap reference power down control 0: Power down 1: Normal operation	0_H
	6	I2C_SVOPWDB	1		AFE SVO AMP power down control 0: SVO AMP circuit OFF 1: SVO AMP circuit ON	0_H
	5	I2C_ SELFCLPPWDB	1		AFE self clamp circuit power down control 0: Self clamp OFF 1: Self clamp ON	0_H
	4	I2C_AFEPWDB	1		AFE power down control 0: AFE power down 1: AFE normal operation	0_H
	3	I2C_ADCPWDB	1		×2 AMP circuit and ×2 AMP bias circuit power down control 0: Power down 1: Normal operation	0_H
	2		1		Reference voltage generation circuit 1 power down control 0: Power down 1: Normal operation	0_H
	1		1		Reference voltage generation circuit 2 power down control 0: Power down 1: Normal operation	0_H
	0		1		Clock generation circuit power down control 0: Power down 1: Normal operation	0_H
01_H	7	I2C_LPFPWDB	1		LPF buffer circuit power down control 0: Power down 1: Normal operation	0_H
	6:5	I2C_AINSEL	2	Input switch control	AFE 4-input selector control signal (when in normal operation) 00: AIN0 01: AIN1 10: AIN2 11: AIN3	0_H
	4	I2C_CLPLPFON	1	LPF enable control	LPF enable control of AFE self clamp circuit 0: LPF OFF 1: LPF ON	0_H
	3:2	-	2	For test	For test Normally set to 0_H	0_H
	1:0	-	2	For test	For test Normally set to 0_H	0_H
02_H	7	I2C_SCARTON	1	AGC mode control	AFE D-range control voltage external input select control 0: AGC mode 1: Non-AGC mode	0_H
	6	-	1	For test	For test Normally set to 0_H	0_H
	5:0	-	6	For test	For test Normally set to 00_H	00_H
03_H	7	-	1	For test	For test Normally set to 0_H	0_H
	3:1	-	3	For test	For test Normally set to 0_H	0_H
	0	-	1	For test	For test Normally set to 0_H	0_H
04_H	5:4	-	2	For test	For test Normally set to 0_H	0_H
	3	-	1	For test	For test Normally set to 1_H	0_H
	2:0	-	3	For test	For test Normally set to 4_H	0_H
05_H	7	-	1	For test	For test Normally set to 0_H	0_H
	6		1		For test Normally set to 0_H	0_H
	5		1		For test Normally set to 0_H	0_H
	4		1		Reserved	0_H
	3		1		Reserved	0_H
	2		1		Reserved	0_H
	1		1		Reserved	0_H
	0		1		For test Normally set to 0_H	0_H

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Sub-address	Bit	Name	Bit-Size	Function Name	Functions	Initial value
06_H	7	-	1	For test	For test Normally set to 0_H	0_H
	6		1		For test Normally set to 0_H	0_H
	5		1		For test Normally set to 0_H	0_H
	4		1		For test Normally set to 0_H	0_H
	3		1		For test Normally set to 0_H	0_H
	2		1		For test Normally set to 0_H	0_H
	1		1		For test Normally set to 0_H	0_H
	0		1		For test Normally set to 0_H	0_H
07_H	7		1		For test Normally set to 0_H	0_H
	6		1		For test Normally set to 0_H	0_H
	5		1		For test Normally set to 0_H	0_H
	4		1		For test Normally set to 0_H	0_H
	3		1		For test Normally set to 0_H	0_H
	2		1		For test Normally set to 0_H	0_H
	1		1		For test Normally set to 0_H	0_H
	0		1		For test Normally set to 0_H	0_H
08_H	1	I2C_IOSEL2	1	Clock output current drive capability	Clock output current drive capability switching 0: 4mA 1: 8mA	0_H
	0	I2C_IOSEL1	1	Signal output current drive capability	Signal output current drive capability switching 0: 2mA 1: 4mA	0_H
09_H to $0F_H$	-	-	-	-	-	-
10_H	7	I2C_SRST	1	Soft reset	Software reset of digital video signal processing block 0: Reset ON 1: Reset OFF	0_H
	0	-	1	For test	For test Normally set to 0_H	0_H
11_H	7:6	-	2	For test	For test Normally set to 0_H	0_H
	1:0	-	2	For test	For test Normally set to 0_H	0_H
12_H	0	I2C_CKINV	1	Clock output invert	Clock output (CKO) invert control 0: Normal 1: Invert	0_H
13_H	6:4	-	3	For test	For test Normally set to 0_H	0_H
	2:0	-	3		For test Normally set to 0_H	0_H
14_H	7:0	-	8		For test Normally set to 0_H	00_H
15_H	7:0	-	8		For test Normally set to 0_H	00_H
16_H	7:0	-	8		For test Normally set to 0_H	00_H

BANK1 (Digital Video Signal Processing Block 1) Register Specifications

Sub-address	Bit	Name	Bit-Size	Function Name	Functions	Initial value
00_H	5:4	-	2	For test	For test Normally set to 0_H	0_H
	0	-	1	For test	For test Normally set to 0_H	0_H
01_H	7:6	I2A_ACCON	2	ACC control	ACC ON/OFF switching 00: OFF 01: ON 1x: Amplifier fixed	1_H
	5:4	I2A_ACCFRAME	2	Number of update frames	Number of update frame select 00: 1 frame 01: 2 frames 10: 4 frames 11: 8 frames	0_H
	3:0	-	4	For test	For test Normally set to 0_H	0_H
02_H	7:3	I2A_ACCSELAMP	5	ACC amplifier fixed mode	ACC amplifier fixed mode Gain adjustment -5 to +26dB	00_H
	2:0	I2A_TMCTRL	3	Auto mode switching	Auto/manual mode switching 000: Auto 001: NTSC-M 010: NTSC-4.43 011: PAL 100: PAL-M 101: PAL-N 110: PAL-60 111: SECAM	0_H
03_H	7:0	-	8	For test	For test Normally set to 20_H	20_H
04_H	7:0	-	8	For test	For test Normally set to 80_H	80_H
05_H	7:0	-	8	For test	For test Normally set to 40_H	40_H
06_H	7:0	-	8		For test Normally set to 10_H	10_H
07_H	7:0	-	8	For test	For test Normally set to 80_H	80_H
08_H	7:0	-	8	For test	For test Normally set to 00_H	00_H
09_H	7:0	-	8	For test	For test Normally set to 80_H	80_H
$0A_H$	7:5	-	3	For test	For test Normally set to 5_H	5_H
	4	-	1	For test	For test Normally set to 0_H	0_H
	3:0	-	4	For test	For test Normally set to 2_H	2_H
$0B_H$	7:4	-	4	For test	For test Normally set to 3_H	3_H
	3:0	-	4		For test Normally set to 3_H	3_H
$0C_H$	7	-	1	For test	For test Normally set to 0_H	0_H
	6:0	-	7	For test	For test Normally set to 18_H	18_H
$0D_H$	7:0	-	8	For test	For test Normally set to $A0_H$	$A0_H$
$0E_H$	-	-	-	-	-	-
$0F_H$	7:0	-	8	For test	For test Normally set to 60_H	60_H
10_H	7:0	-	8	For test	For test Normally set to 80_H	80_H
11_H	7:4	-	4	For test	For test Normally set to C_H	C_H
	3:0		4		For test Normally set to 8_H	8_H
12_H	7:6	-	2	For test	For test Normally set to 3_H	3_H
	5:4	-	2	For test	For test Normally set to 3_H	3_H
	3	-	1		For test Normally set to 1_H	1_H
	2:0	-	3	For test	For test Normally set to 0_H	0_H

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Sub-address	Bit	Name	Bit-Size	Function Name	Functions	Initial value
13_H	6:4	-	3	For test	For test Normally set to 0_H	0_H
	1:0	-	2	For test	For test Normally set to 2_H	2_H
14_H	7:0	-	8	For test	For test Normally set to 96_H	96_H
15_H	7:0	-	8		For test Normally set to 64_H	64_H
16_H	7:0	-	8		For test Normally set to 64_H	64_H
17_H	7:4	I2A_ATMODE	4	Video system auto-detect switch	Auto mode switching (It takes effect at I2A_TMCTRL=3'h0.) 0000: Manual mode 0001: Auto0 (NTSC/PAL) 0010: Auot1 (PAL/SECAM) 0011: Auto2 (NTSC/PAL-N/PAL-M) 0100: Auto3 (NTSC/PAL/SECAM) 0101: Auto4 (NTSC/PAL/SECAM/PAL-N/PAL-M) 0110: Auto5 (Auto0+NTSC-443/PAL-60) 0111: Auto6 (Auto1+NTSC-443/PAL-60) 1000: Auto7 (Auto2+NTSC-443/PAL-60) 1001: Auto8 (Auto3+NTSC-443/PAL-60) 1010: Auto9 (Auto4+NTSC-443/PAL-60) 1011 to 1111: Full	F_H
	3:2	I2A_FSCSEL	2	Fsc select	Fsc select at manual mode 00: 3.579545MHz 01: 4.43361875MHz 10: 3.57561149MHz 11: 3.58205625MHz	1_H
	1	I2A_SCANSEL	1	Scanning line number select	Scanning line number select at manual mode 0: 525i 1: 625i	0_H
	0	I2A_NTPALSEL	1	NTSC/PAL select	NTSC/PAL select at manual mode 0: NTSC 1: PAL	0_H
18_H	7:6	-	2	For test	For test Normally set to 3_H	3_H
	5:4	-	2		For test Normally set to 0_H	0_H
	1	-	1	For test	For test Normally set to 1_H	1_H
	0	I2A_SECAMSEL	1	SECAM select	SECAM select at manual mode 0: not SECAM 1: SECAM	0_H
19_H	6:0	-	7	For test	For test Normally set to $7F_H$	$7F_H$
$1A_H$	6:0	-	7		For test Normally set to 00_H	00_H
$1B_H$	2	I2A_DCON	1	Digital clamp ON/OFF setting	Digital clamp ON/OFF setting 0: OFF 1: ON	1_H
	1	I2A_DCLINE	1	Detection level update unit switching	Pedestal level update unit switching 0: Each frame 1: Each line	0_H
	0	-	1	For test	For test Normally set to 0_H	0_H
$1C_H$	6:0	I2A_STDLEVY	7	Pedestal level setting	Target pedestal level setting Level setting range: 236 to 363LSB	40_H
$1D_H$	7:5	I2A_TCDC	3	Time constant setting	Digital clamp time constant setting 000: Time constant none 001: 1/2 010: 1/4 011: 1/8 100: 1/16 101: 1/32 110: 1/64 111: 1/128	0_H
	4:0	I2A_FRAMEDC	5	Update field number setting	Pedestal level update field number setting Setting range: 0 to 31 fields	10_H
$1E_H$	6:0	-	7	For test	For test Normally set to 00_H	00_H
$1F_H$	4:0	-	5	For test	For test Normally set to 17_H	17_H

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Sub-address	Bit	Name	Bit-Size	Function Name	Functions	Initial value
20_H	7	I2A_FILSEL	1	LPF characteristic switch	LPF characteristic switching for sync separation (It takes effect at I2A_AUTOFIL = 1'b0.) 0: Cutoff frequency 0.35MHz 1: Cutoff frequency 1.4MHz	1_H
	6	I2A_AUTOFIL	1	LPF characteristic auto-switching setting	LPF characteristics automatic switching setting for sync separation 0: OFF 1: ON	1_H
	5	-	1	For test	For test Normally set to 1_H	1_H
	4	-	1	For test	For test Normally set to 0_H	0_H
	3:0	-	4	For test	For test Normally set to F_H	F_H
21_H	7:0	-	8		For test Normally set to 55_H	55_H
22_H	7	-	1	For test	For test Normally set to 1_H	1_H
	6	-	1		For test Normally set to 0_H	0_H
	5	I2A_MANMODE	1	Input signal system setting	Input signal system auto/manual setting 0: Auto setting 1: Manual setting	0_H
	4		1		Input signal line number auto/manual setting 0: Auto setting 1: Manual setting	0_H
	2:0	I2A_TVMODE	3		Input signal system setting (It takes effect at I2A_MANMODE[1] = 1'b1) 000: NTSC-M 001: PAL-M 010: PAL-N 011: PAL-GBI 100: SECAM	0_H
23_H	6	I2A_INSIG	1		Input signal line number setting (It takes effect at I2A_MANMODE[0] = 1'b0) 0: 625 lines 1: 525 lines	1_H
	5:4	-	2	For test	For test Normally set to 1_H	1_H
	3:0	-	4	For test	For test Normally set to 1_H	1_H
24_H	7	I2A_SLDET	1	Slice level setting	Sync separation slice level auto-setting 0: Manual setting 1: Auto setting	1_H
	5:4	I2A_TCLEV	2	Slice level time constant setting	Slice level time constant setting 00: 1/2 01: 1/4 10: 1/8 11: 1/16	1_H
	3:2	I2A_LEVAD	2	Initial slice level setting	Slice level initial value setting 00: 60LSB 01: 80LSB 10: 100LSB 11: 120LSB As for an initial value of the slice level, the above value is added to the detected sync tip level.	3_H
25_H	7:0	I2A_SLST	8	Slice level Level setting range: 236 to 363LSB setting	Slice level setting (It takes effect at I2A_SLDET = 1'b0) Settable in 4 LSB units Setting range: 0 to 1020LSB	08_H
26_H	7:4	-	4	For test	For test Normally set to 7_H	7_H
	3:0	-	4		For test Normally set to 9_H	9_H
27_H	7:4	-	4		For test Normally set to 7_H	7_H
	3:2	-	2	For test	For test Normally set to 3_H	3_H
	1:0	-	2		For test Normally set to 0_H	0_H
28_H	7:4	-	4	For test	For test Normally set to 3_H	3_H
	3:0	-	4		For test Normally set to 1_H	1_H

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Sub-address	Bit	Name	Bit-Size	Function Name	Functions	Initial value
29_H	7	-	1	For test	For test Normally set to 1_H	1_H
	6:4	-	3	For test	For test Normally set to 1_H	1_H
	2:0	-	3		For test Normally set to 7_H	7_H
$2A_H$	7:0	-	8	For test	For test Normally set to 04_H	04_H
$2B_H$	7:0	-	8		For test Normally set to 14_H	14_H
$2C_H$	7:0	-	8		For test Normally set to 00_H	00_H
$2D_H$	7:0	-	8		For test Normally set to 03_H	03_H
$2E_H$	6:4	-	3	For test	For test Normally set to 4_H	4_H
$2F_H$	5:0	-	6		For test Normally set to 02_H	02_H
30_H	5:0	-	6		For test Normally set to 01_H	01_H
31_H	7:0	I2A_HSPAD	8	H-sync positioning	H-sync position adjustment	05_H
32_H	7	-	1	For test	For test Normally set to 0_H	0_H
	6	-	1	For test	For test Normally set to 1_H	1_H
	5	-	1		For test Normally set to 1_H	1_H
	4	-	1	For test	For test Normally set to 1_H	1_H
	3:0	-	4		For test Normally set to 0_H	0_H
33_H	7:0	-	8	For test	For test Normally set to CB_H	CB_H
34_H	7:0	-	8	For test	For test Normally set to CA_H	CA_H
35_H	7:0	-	8	For test	For test Normally set to CD_H	CD_H
36_H	6	-	1	For test	For test Normally set to 1_H	1_H
	5	-	1	For test	For test Normally set to 0_H	0_H
	4	I2A_FIXLN	1	Line number fixed mode ON/OFF setting	Line number fixed mode ON/OFF setting 0: OFF 1: ON	1_H
	2:0	I2A_VSTART	3	V-sync positioning	V-sync position adjustment	3_H
37_H	7:5	I2A_VBSTART	3	V-blank positioning	V-blank position adjustment	3_H
	4:0	I2A_HBSTART	5	H-blank rising positioning	H-blank rising position adjustment	$0F_H$
38_H	7:5	I2A_VBWIDTH	3	V-blank width adjustment	V-blank width adjustment	3_H
	4:0	I2A_HBEND	5	H-blank falling positioning	H-blank falling position adjustment	$0F_H$

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Sub-address	Bit	Name	Bit-Size	Function Name	Functions	Initial value
39_H	7:0	-	8	For test	For test Normally set to 50_H	50_H
$3A_H$	7:0	-	8	For test	For test Normally set to 10_H	10_H
$3B_H$	7:0	-	8	For test	For test Normally set to 24_H	24_H
$3C_H$	7:0	-	8	For test	For test Normally set to $F1_H$	$F1_H$
$3D_H$	7:0	-	8	For test	For test Normally set to 93_H	93_H
$3E_H$	7:0	-	8	For test	For test Normally set to 50_H	50_H
$3F_H$	7:0	-	8	For test	For test Normally set to 30_H	30_H
40_H	7:0	-	8	For test	For test Normally set to 18_H	18_H
41_H	7:0	-	8	For test	For test Normally set to 25_H	25_H
42_H	7:0	-	8	For test	For test Normally set to 23_H	23_H
43_H	7:0	-	8	For test	For test Normally set to $C8_H$	$C8_H$
44_H	7	I2A_NSDON	1	No signal detection ON/OFF setting	No signal detection ON/OFF setting 0: OFF 1: ON	1_H
	6		1		Forced no signal mode ON/OFF setting (It takes effect at I2A_NSDON[1] = 1'b0) 0: OFF 1: ON	1_H
	4	-	1	For test	For test Normally set to 0_H	0_H
	3:2	I2A_NSDTHH	2	No signal detection threshold setting	Threshold setting where signals can be measured	0_H
	1:0	I2A_NSDTHL	2		Threshold setting where no signal can be measured	1_H
45_H	5	-	1	For test	For test Normally set to 0_H	0_H
	3:2	-	2	For test	For test Normally set to 1_H	1_H
	1:0	-	2	For test	For test Normally set to 1_H	1_H
46_H	4:0	-	5	For test	For test Normally set to 10_H	10_H
47_H	5:0	-	6		For test Normally set to $3F_H$	$3F_H$
48_H	5	-	1	For test	For test Normally set to 0_H	0_H
	3	-	1	For test	For test Normally set to 0_H	0_H
	2	-	1	For test	For test Normally set to 0_H	0_H
	1	I2A_EXAGCON	1	External AGC ON/OFF setting	External AGC ON/OFF setting 0: OFF 1: ON	0_H
49_H	7:0	-	8	For test	For test Normally set to 00_H	00_H
$4A_H$	7:0	-	8		For test Normally set to 00_H	00_H
$4B_H$	7:0	I2A_SYNLEV	8	Sync level setting	AGC target sync level setting Setting range: 158 to 413LSB	80_H
$4C_H$	6:4	I2A_FRMCNT	3	Update field number setting	AGC update field number setting	0_H
	3:0	I2A_FIXGAIN	4	Fixed gain setting	Fixed gain setting Setting range: -6 to +9dB	6_H

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Sub-address	Bit	Name	Bit-Size	Function Name	Functions	Initial value
$4D_H$	7:6	I2A_TCAGC	2	Time constant setting	AGC time constant setting 00: No time constant 01: 1/2 10: 1/4 11: 1/8	0_H
	4:0	I2A_EXAGCINIT	5	External AGC gain value setting	External AGC initial gain value setting	$0F_H$
$4E_H$	7:6	I2A_AMPLIMIT	2	Amplifier limit switching	AGC amplifier limit switching 00: ±3dB 01: ±6dB 10: ±9dB 11: ±12dB	0_H
	4:0	-	5	For test	For test Normally set to 00_H	00_H
$4F_H$	7:5	I2A_NLFIELD	3	Update field number setting	Noise detection results update field number setting 000: 1 field 001: 2 fields 010: 4 fields 011: 8 fields 100: 16 fields 101: 32 fields 110: 64 fields 111: 128 fields	0_H
	4:0	-	5	For test	For test Normally set to $0F_H$	$0F_H$
50_H	5:4	-	2	For test	For test Normally set to 2_H	2_H
	3:0	-	4	For test	For test Normally set to 0_H	0_H
51_H	6:0	I2A_NLTH	15	Noise detection threshold setting	Threshold value setting of noise detection	$0C80_H$
52_H	7:0					
53_H	5:4	I2A_SELNTPAL	2	System detection select	System detection select 00: Both NTSC/PAL (Line number is distinguished.) 01: Only NTSC 10: Only PAL 11: Both NTSC/PAL	0_H
	2	I2A_AUTODET	1	System auto-detection ON/OFF setting	System auto-detection ON/OFF setting 0: OFF 1: ON	0_H
	0	I2A_NOSTDDET	1	Non-standard detection ON/OFF setting	Non-standard detection ON/OFF setting 0: OFF 1: ON	0_H
54_H	1:0	I2A_HSELFORMAT	2	System designation	Input signal system designation (It takes effect at I2A_AUTODET = 1'b0) 00: 576i 01: 480i 10: 576i (Non-standard) 11: 480i (Non-standard)	1_H
55_H	5	-	1	For test	For test Normally set to 0_H	0_H
	4	-	1	For test	For test Normally set to 0_H	0_H
	3:2	-	2	For test	For test Normally set to 0_H	0_H
	1:0	-	2	For test	For test Normally set to 3_H	3_H
56_H	6:4	-	3	For test	For test Normally set to 0_H	0_H
	2:0	-	3	For test	For test Normally set to 0_H	0_H
57_H	6:4	-	3	For test	For test Normally set to 5_H	5_H
	3	-	1	For test	For test Normally set to 1_H	1_H
	2	-	1	For test	For test Normally set to 0_H	0_H
	1:0	-	2		For test Normally set to 2_H	2_H

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Sub-address	Bit	Name	Bit-Size	Function Name	Functions	Initial value
58_H	7:0	-	8	For test	For test Normally set to $0C_H$	$0C_H$
59_H	5:0	-	6		For test Normally set to 32_H	32_H
$5A_H$	7:0	-	8		For test Normally set to $F0_H$	$F0_H$
$5B_H$	5:0	-	6		For test Normally set to 05_H	05_H
5C	7:0	-	8		For test Normally set to 28_H	28_H
$5D_H$	6:4	-	3		For test Normally set to 4_H	4_H
	2:0	-	3		For test Normally set to 3_H	3_H
$5E_H$	7:0	-	8		For test Normally set to $0A_H$	$0A_H$
$5F_H$	7:6	-	2	For test	For test Normally set to 3_H	3_H
	5:4	-	2		For test Normally set to 3_H	3_H
	3:2	-	2		For test Normally set to 3_H	3_H
	1:0	-	2		For test Normally set to 3_H	3_H
60_H	7:6	-	2		For test Normally set to 3_H	3_H
	5:4	-	2		For test Normally set to 3_H	3_H
	3:2	-	2		For test Normally set to 3_H	3_H
	1:0	-	2		For test Normally set to 3_H	3_H
61_H	7:4	-	4	For test	For test Normally set to 0_H	0_H
	3:0	-	4		For test Normally set to 0_H	0_H
62_H to $6F_H$	-	-	-	-	-	-
70_H	1:0	-	10	For test	Read only	-
71_H	7:0					
72_H	0	NOSIG	1	No signal detection	No signal detection result Read only	-
73_H to 74_H	-	-	-	-	-	-
75_H	7	NLDOUT	1	S/N detection	S/N detection result Read only	-
	6:0	NLDET	15		Noise level Read only	-
76_H	7:0					
77_H	0	-	1	For test	Read only	-
78_H	5:4	HSYSFORMAT	2	System detection	System detection result Read only	-
	1	-	1	For test	Read only	-
	0	-	1	For test	Read only	-

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Sub-address	Bit	Name	Bit-Size	Function Name	Functions	Initial value
79_H	3	DOUTH	1	Non-standard detection	Non-standard detection result (H) When non-standard is detected in field-blanking period 0: Normal 1: Special reproduction Read only	-
	2	DOUTH2	1		Non-standard detection result (H) 0: Standard 1: Non-standard Read only	-
	1	DOUTV	1		Non-standard detection result (V) 0: Standard 1: Non-standard Read only	-
	0	DOUTSTA	1		Stability judgment result 0: Stable 1: Unstable Read only	-
$7A_H$	4:0	-	5	For test	Read only	-
$7B_H$ to $8A_H$	-	-	-	-	-	-
$8B_H$	0	-	1	For test	For test Normally set to 0_H	0_H
$8C_H$	0	-	1	For test	For test Normally set to 0_H	0_H
$8D_H$	-	-	-	-	-	-
$8E_H$	0	-	1	For test	For test Normally set to 0_H	0_H

BANK2 (Digital Video Signal Processing Block 2) Register Specification

Sub-address	Bit	Name	Bit-Size	Function Name	Functions	Initial value
00_H	7	-	1	For test	For test Normally set to 0_H	0_H
	6	I2BYC_ SOFTRESET	1	Soft reset	Soft reset Y/C separation is initialized on the rising edge of the register clock	0_H
	5:3	I2BYC_ SEL_FORMAT	3	Input switching setting	Input switching (It takes effect at I2BYC_INSEL[0] = 0) 000: NTSC 010: PAL-M 100: PAL 110: PAL-N xx1: SECAM	0_H
	2	I2BYC_INSEL	1	For test	For test Normally set to 1_H	1_H
	1		1	For test	For test Normally set to 1_H	1_H
	0		1	Input switching setting	Input switching setting 0: I2BYC_SEL_PAL[7:6] 1: INSEL(input port)	1_H
01_H	7:0	-	8	For test	For test Normally set to 16_H	16_H
02_H	7:0	-	2	For test	For test Normally set to 16_H	16_H
03_H	7:6	-	2	For test	For test Normally set to 3_H	3_H
	5		1		For test Normally set to 0_H	0_H
	4		1		For test Normally set to 1_H	1_H
	3:0		4		For test Normally set to 4_H	4_H
04_H	7:4	-	4	For test	For test Normally set to 4_H	4_H
	3		1		For test Normally set to 0_H	0_H
	2		1		For test Normally set to 0_H	0_H
	1		1		For test Normally set to 0_H	0_H
	0				For test Normally set to 0_H	0_H
05_H	7	I2BYC_2DCOMB2	1	For test	For test Normally set to 0_H	0_H
	6:5		2	Vertical high region line comb setting	Line comb vertical high region element BSF coefficient select 00: BSF1 01: BSF2 10: BSF3 11: BSF4	3_H
	4		1	For test	For test Normally set to 0_H	0_H
	3		1	Dot interference reduction setting	Dot interference reduction BSF 0: OFF 1: ON	1_H
	2		1	For test	For test Normally set to 1_H	1_H
	1:0		2		For test Normally set to 2_H	2_H
06_H	7:5	-	3	For test	For test Normally set to 2_H	2_H
	3		1		For test Normally set to 0_H	0_H
	1		1		For test Normally set to 0_H	0_H
	0		1		For test Normally set to 0_H	0_H

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Sub-address	Bit	Name	Bit-Size	Function Name	Functions	Initial value
07_H	7	I2BYC_2DCOMB4	1	For test	For test Normally set to 1_H	1_H
	6		1		For test Normally set to 1_H	1_H
	5		1		For test Normally set to 1_H	1_H
	4		1	Cross color reduction ON/OFF	Cross color reduction 0: OFF 1: ON	0_H
	3		1	For test	For test Normally set to 1_H	1_H
	2		1		For test Normally set to 1_H	1_H
	1		1	For test	For test Normally set to 1_H	1_H
	0		1	For test	For test Normally set to 0_H	0_H
08_H	7	-	1	For test	For test Normally set to 0_H	0_H
	6		1	For test	For test Normally set to 1_H	1_H
	5		1	For test	For test Normally set to 1_H	1_H
	4		1		For test Normally set to 1_H	1_H
	3:2		2		For test Normally set to 1_H	1_H
	1		1		For test Normally set to 1_H	1_H
	0		1		For test Normally set to 1_H	1_H
09_H	7	-	1	For test	For test Normally set to 1_H	1_H
	6		1	For test	For test Normally set to 1_H	1_H
	5		1		For test Normally set to 1_H	1_H
$0A_H$	7	I2BYC_2DCOMB8	1	One dimensional filter setting	Adaptive two dimensional filter enable/disable setting 0: Two dimensional 1: Adaptive two dimensional	1_H
	6		1	For test	For test Normally set to 1_H	1_H
	5		1		For test Normally set to 1_H	1_H
	4		1		For test Normally set to 1_H	1_H
	3:2		2		For test Normally set to 3_H	3_H
	1		1		For test Normally set to 1_H	1_H
	0		1		For test Normally set to 1_H	1_H
$0B_H$	7:4	-	4	For test	For test Normally set to 4_H	4_H
	3:0		4		For test Normally set to 4_H	4_H
$0C_H$	7:4	-	4	For test	For test Normally set to 7_H	7_H
	3:0		4		For test Normally set to 8_H	8_H
$0D_H$	7:0	-	8	For test	For test Normally set to $0C_H$	$0C_H$
$0E_H$	7:0	-	8	For test	For test Normally set to 14_H	14_H

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Sub-address	Bit	Name	Bit-Size	Function Name	Functions	Initial value
$0F_H$	7:4	I2BYC_2DVENH	4	Vertical enhancer setting	Vertical enhancer gain setting 000: OFF 001: 2/8 times to 0111: 8/8 times to 1111: 16/8 times	0_H
	3:0		4		Vertical enhancer coring setting	0_H
10_H	7:0	-	8	For test	For test Normally set to $4B_H$	$4B_H$
11_H	7	-	1	For test	For test Normally set to 0_H	0_H
	6		1		For test Normally set to 0_H	0_H
	5		1		For test Normally set to 0_H	0_H
	4		1		For test Normally set to 0_H	0_H
	2		1		For test Normally set to 0_H	0_H
	1		1		For test Normally set to 0_H	0_H
	0		1		For test Normally set to 0_H	0_H
12_H	7	-	1	For test	For test Normally set to 0_H	0_H
	6		1		For test Normally set to 0_H	0_H
	5		1		For test Normally set to 0_H	0_H
	4		1		For test Normally set to 0_H	0_H
	2		1		For test Normally set to 0_H	0_H
	1		1		For test Normally set to 0_H	0_H
	0		1		For test Normally set to 0_H	0_H
13_H	7	-	1	For test	For test Normally set to 0_H	0_H
	5		1		For test Normally set to 0_H	0_H
	4		1		For test Normally set to 0_H	0_H
	3		1		For test Normally set to 0_H	0_H
	2		1		For test Normally set to 0_H	0_H
	1		1		For test Normally set to 1_H	1_H
	0		1		For test Normally set to 1_H	1_H
14_H	0	-	1	For test	For test Normally set to 0_H	0_H

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Sub-address	Bit	Name	Bit-Size	Function Name	Functions	Initial value
15_H	7	-	1	For test	For test Normally set to 0_H	0_H
	6		1	For test	For test Normally set to 0_H	0_H
	5:4		2	For test	For test Normally set to 0_H	0_H
	3		1		For test Normally set to 0_H	0_H
	2		1		For test Normally set to 0_H	0_H
	1		1		For test Normally set to 0_H	0_H
16_H	7:4	I2BYC_1DFIL	4	One dimensional BPF select	One dimensional BPF select 000: BPF0 to 1011: BPF11	4_H
	3:1		3	BPF for SECAM select	One dimensional BPF select for SECAM 000: BPF0 to 111: BPF7	2_H
	0		1	One dimensional filter ON	One dimensional filter ON/OFF setting 0: Line comb filter 1: One dimension filter	0_H
17_H to $1F_H$	-	-	-	-	-	-
20_H	7:0	-	8	For test	For test Normally set to $2C_H$	$2C_H$
21_H	5	-	1	For test	For test Normally set to 0_H	0_H
	4	-	1	For test	For test Normally set to 1_H	1_H
	3	-	1	For test	For test Normally set to 1_H	1_H
	2:0	-	3	For test	For test Normally set to 0_H	0_H
22_H to 25_H	-	-	-	-	-	-
26_H	7:0	I2BCD_UGAIN	8	Cb gain setting	Gain control of Cb signal	80_H
27_H	7:0	I2BCD_VGAIN	8	Cr gain setting	Gain control of Cr signal	80_H
28_H	-	-	-	-	-	-
29_H	4:3	-	2	For test	For test Normally set to 0_H	0_H
	2:0	-	3	For test	For test Normally set to 0_H	0_H
$2A_H$	7:0	-	8		For test Normally set to 80_H	80_H
$2B_H$	-	-	-	-	-	-
$2C_H$	7:0	-	8	For test	For test Normally set to 80_H	80_H
$2D_H$ to $2F_H$	-	-	-	-	-	-
30_H	3	-	1	For test	For test Normally set to 0_H	0_H
	2	I2BAC_SW_ACC_NTPAL	1	ACC NTSC/PAL setting	0: NTSC = 286LSB 1: PAL = 300LSB (when ACC_BSTLV is center value)	0_H
	1:0	I2BAC_ACC_ON	2	ACC ON	ACC ON/OFF setting 00: OFF 01: ON 1x: Gain fix	1_H
31_H	7:0	I2BAC_ACC_BSTLV	8	ACC setting	ACC target value setting 158 to 413LSB	80_H
32_H	3:0	I2BAC_ACC_TIMCON	4		Maximum value of time constant, characteristics select Setting range: 1 time to 16 times	3_H
33_H	1:0	-	2	For test	For test Normally set to 0_H	0_H

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Sub-address	Bit	Name	Bit-Size	Function Name	Functions	Initial value
34_H	3:0	I2BAC_CKILL_ON	4	Color killer setting	Color killer ON/OFF setting 0000: OFF 0001: ON by APC 0010: ON by ACC 0011: ON by APC + ACC 0100: ON at the time of noncompliant signal input 0101: ON by APC and at the time of noncompliant signal input 0110: ON by ACC and at the time of noncompliant signal input 0111: ON by APC + ACC and at the time of noncompliant signal input 1xxx: Forced ON	7_H
35_H	4:0	I2BAC_CKILL_LV	5		Threshold value killer is turned on by burst-amplitude	3_H
36_H	4:0	I2BAC_ CKILL_HYST	5		Threshold value killer is turned off by burst-amplitude	0_H
37_H	1:0	-	2	For test	For test Normally set to 1_H	1_H
38_H to $3A_H$	-	-	-	-	-	-
$3B_H$	4:0	-	5	For test	For test Normally set to 0_H	0_H
$3C_H$	2:0	-	3		For test Normally set to 0_H	0_H
$3D_H$	1:0	-	2	For test	For test Normally set to 0_H	0_H
$3E_H$	4:0	I2BAC_ ACC_SELAMP	5	ACC setting	Gain setting at ACC_ON = 2'b1x Setting range: -6 to 32dB	0_H
$3F_H$	-	-	-	-	-	-
40_H	5	-	1	For test	For test Normally set to 1_H	1_H
	4	-	1	For test	For test Normally set to 0_H	0_H
	3:0	I2BSE_BELLF0	4	Bell filter setting	Bell filter f0 select	8_H
41_H	7:4	I2BSE_BELLQ	4		Bell filter Q select	8_H
	3:2	I2BSE_BELLAMP	2		Bell filter amplifier select 0: 1 time 1: 2 times	1_H
42_H	2	-	1	For test	For test Normally set to 1_H	1_H
	1:0	I2BSE_CLPFSEL	2	LPF setting after FM demodulation	LPF select after FM demodulation	2_H
43_H	5:0	-	6	For test	For test Normally set to 28_H	28_H
44_H	7:0	-	8		For test Normally set to 40_H	40_H
45_H	3:2	-	2		For test Normally set to 3_H	3_H
	1:0	-	2		For test Normally set to 3_H	3_H

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Sub-address	Bit	Name	Bit-Size	Function Name	Functions	Initial value
46_H	6:4	-	3	For test	For test Normally set to 1_H	1_H
	3	-	1	For test	For test Normally set to 1_H	1_H
	2:1	-	2		For test Normally set to 3_H	3_H
	0	-	1		For test Normally set to 0_H	0_H
47_H	5:0	-	6		For test Normally set to 1_H	1_H
48_H	3:0	-	4		For test Normally set to 1_H	1_H
49_H	6:0	-	7		For test Normally set to 40_H	40_H
$4A_H$	6:0	-	7		For test Normally set to 40_H	40_H
$4B_H$	5:0	-	6	For test	For test Normally set to 3_H	3_H
$4C_H$	5:0	-	6	For test	For test Normally set to A_H	A_H
$4D_H$ to $4F_H$	-	-	-	-	-	-
50_H	2	-	1	For test	For test Normally set to 1_H	1_H
	1	-	1		For test Normally set to 0_H	0_H
	0	-	1		For test Normally set to 0_H	0_H
51_H	7:0	I2BSE_UGAIN	8	SECAM chroma adjustment	Cb/Cr gain control 0 to 3.984375 0 = 0 64 = 1 128 = 2 255 = 3.984375	80_H
52_H	7:0	I2BSE_VGAIN	8			80_H
53_H	7:0	I2BSE_UOFFSET	8		Cb/Cr offset adjustment -128 to 127 0 = -128 128 = 0 255 = 127	80_H
54_H	7:0	I2BSE_VOFFSET	8			80_H
55_H	5	-	1	For test	For test Normally set to 0_H	0_H
	4:3	I2BSE_DEIIR	2	De-emphasis filter setting	De-emphasis filter select	0_H
	2:0	-	3	For test	For test Normally set to 0_H	0_H
56_H to $5F_H$	-	-	-	-	-	-
60_H	7:0	-	8	For test	For test Normally set to F_H	F_H
61_H	7:0	-	8	For test	For test Normally set to 64_H	64_H

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Sub-address	Bit	Name	Bit-Size	Function Name	Functions	Initial value
62_H	7	-	1	For test	For test Normally set to 0_H	0_H
	6		1	For test	For test Normally set to 1_H	1_H
	5		1	For test	For test Normally set to 0_H	0_H
	4		1	For test	For test Normally set to 0_H	0_H
	3		1	For test	For test Normally set to 0_H	0_H
63_H	-	-	-	-	-	-
64_H	7	I2BCV_TVMODE	1	For test	For test Normally set to 0_H	0_H
	6		1	For test	For test Normally set to 0_H	0_H
	3		1	TV mode select	0: Auto setting 1: Manual setting with TVMODE[2: 0]	0_H
	2		1	Frequency select	0: 50Hz (625 lines) 1: 60Hz (525 lines)	0_H
	1:0		2	System setting	0: NTSC 1: PAL-M 2: PAL 3: PAL-N	0_H
65_H	7:6	-	2	For test	For test Normally set to 0_H	0_H
	2:0		3	For test	For test Normally set to 1_H	1_H
66_H	-	-	-	-	-	-
67_H	7:6	-	2	For test	For test Normally set to 0_H	0_H
	5		1	For test	For test Normally set to 0_H	0_H
	4		1	For test	For test Normally set to 0_H	0_H
	3:1		3	For test	For test Normally set to 0_H	0_H
	0		1	For test	For test Normally set to 0_H	0_H
68_H to 69_H	-	-	-	-	-	-
$6A_H$	7:0	-	8	For test	For test Normally set to 10_H	10_H
$6B_H$ to 70_H	-	-	-	-	-	-
71_H	5:0	I2BSR_GAIN	6	Sub contrast/ brightness setting	Contrast adjustment	20_H
72_H	5:0	I2BSR_OFST	6		Brightness adjustment	20_H
73_H to $7B_H$	-	-	-	-	-	-
$7C_H$	1	-	1	For test	For test Normally set to 0_H	0_H
	0	I2BSR_SETUP	1	Setup	Setup processing	1_H
$7D_H$ to $7F_H$	-	-	-	-	-	-
80_H	0	-	1	For test	For test Normally set to 1_H	1_H
81_H	0	-	1		For test Normally set to 0_H	0_H
82_H to $9F_H$	-	-	-	-	-	-

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Sub-address	Bit	Name	Bit-Size	Function Name	Functions	Initial value
$A0_H$	2:0	-	3	For test	For test Normally set to 0_H	0_H
$A1_H$	2:0	-	3		For test Normally set to 0_H	0_H

BANK3 (Digital Video Signal Processing Block 3) Register Specification

Sub-address	Bit	Name	Bit-Size	Function Name	Functions	Initial value
00_H	2	I2DSH_LPFOFF	1	Sharpness setting	Sharpness LPF ON/OFF setting 0: ON 1: OFF	0_H
	1	-	1	For test	For test Normally set to 0_H	0_H
	0	I2DSH_ON	1	Sharpness setting	Sharpness ON/OFF setting 0: OFF 1: ON	0_H
01_H	5:0	I2DSH_ATT	6		Sharpness ATT value setting Setting range: -47.5 to 12dB	10_H
02_H	2:0	I2DSH_CORR	3		Sharpness coring threshold	0_H
03_H	3:0	I2DSH_FILTER	4		Sharpness characteristic select	1_H
04_H	2	-	1	For test	For test Normally set to 0_H	0_H
	1	-	1		For test Normally set to 0_H	0_H
	0	-	1		For test Normally set to 1_H	1_H
05_H	0	-	1	For test	For test Normally set to 0_H	0_H
06_H	7:0	I2DCB_CONT	8	Contrast/ Brightness setting	Contrast adjustment	80_H
07_H	7:0	I2DCB_BRIGHT	8		Brightness adjustment	80_H
08_H	6:0	I2DHU_HUE	7	HUE setting	HUE adjustment	40_H
09_H	7:0	I2DUV_UGAIN	8	U/V gain setting	Cb gain control	$B4_H$
$0A_H$	7:0	I2DUV_VGAIN	8		Cr gain control	$B4_H$
$0B_H$ to $0E_H$	-	-	-	-	-	-
$0F_H$	1:0	-	2	For test	For test Normally set to 1_H	1_H
10_H	3:1	I2DCT_SMP	3	CTI setting	CTI correction tap coefficient	0_H
	0	I2DCT_CTIEN	1		CTI ON/OFF setting 0: OFF 1: ON	0_H
11_H	7:4	I2DCT_CORR	4		CTI Coring threshold	0_H
	3:0	I2DCT_GAIN	4		CTI gain GAIN=C_GAIN/8 ($0 \le$ C_GAIN ≤ 15)	6_H
12_H	7:4	-	4	For test	For test Normally set to 0_H	0_H
	3:0	-	1		For test Normally set to 0_H	0_H
13_H	5:4	I2D65_ AUTOBBACK	2	656 conversion setting	No signal output mode 00: Black background 01: Blue background 10: OFF 11: BL	0_H
	3	I2D65_SEPIA	1		0: Normal output 1: Sepia output	0_H
	2	I2D65_601LIM	1		0: Signal level 1 to 254 1: Y level 16 to 235, C level 16 to 240	0_H
	1	I2D65_AVOFF	1		0: 656 with SAV,EAV 1: No SAV, EAV	1_H
	0	-	1	For test	For test Normally set to 0_H	0_H
14_H to $1F_H$	-	-	-	-	-	-
20_H	1:0	-	2	For test	For test Normally set to 0_H	0_H
21_H	1:0	-	2		For test Normally set to 0_H	0_H

Function Descriptions

1. CPU I/F
The LC749870W registers are controlled by I^2C.

1) I^2C
The LC749870W supports high-speed mode slave operation (400 kHz) and the slave address is as follows.

bit[7] (MSB)	bit[6]	bit[5]	bit[4]	bit[3]	bit[2]	bit[1]	bit[0] (LSB)
1	0	0	0	1	0	I^2CSEL	R/W

*Note: The bit 1 is decided according to the I^2CSEL pin condition.
bit 0 R/W: 0 = write, 1 = read

■Write Mode
- Auto address increment.
- As shown below, after the start condition, the settings must be made in the following order: slave address (W), ACK waiting, write start sub address, ACK waiting, write data. The stop condition must be set last. Data can be transmitted continuously from the write start sub address using the auto address increment function.

[ST] [Slave Address(W)] [A] [Sub address] [A] [Data] [A] [Data] • • • [SP]

■Read Mode
- Auto address increment.
- The read start sub address must be assigned in write mode.
- As shown below, after the start condition, first set the slave address (W), ACK waiting and read start sub address. Next, set the start condition again or set the start condition after setting the stop condition. Next set the slave address (R) and ACK waiting in read mode. The data for each sub address is output continuously from the read start sub address data using the auto address increment function. After receiving the data for each sub address, return the ACK. Finally, set the stop condition.

[ST] [Slave Address (W)] [A] [Sub address] [ST] [Slave Address(R)] [A] [Data] [A] [Data] [A] [Data] • • • [SP]

or

[ST] [Slave Address (W)] [A] [Sub address] [SP] [ST] [Slave Address(R)] [A] [Data] [A] [Data] [A] [Data] • • • [SP]

[ST]: Start condition
[SP]: Stop condition
[A]: ACK
[A]: ACK waiting
[Data]: Data transmission
[Data]: Data reception

2) BANK

Each register is allocated to the BANK depending on its function (Refer to Table 1). After the BANK is specified, the register can be controlled. The BANK is specified by setting the BANK code to sub address FF_H. Note that the register cannot be transmitted or received if codes other than the BANK codes in Table1 are specified.

Table 1 Allocation of BANK

BANK	BANK Code	Controlled Function
0	01_H	AFE + ADC
1	02_H	Digital video signal processing block 1 (Data interpolator, APC, AGC, digital clamp, sync separator, timing generator, video system detection, S/N detection, non-standard signal detection, No-signal detection)
2	04_H	Digital video signal processing block 2 (Y/C separator, color demodulator, clock rate converter)
3	08_H	Digital video signal processing block 3 (Sharpness, contrast/brightness, CTI, HUE, UV gain)

- Auto address increment.

[ST] [Slave address (W)] [A] [FF_H] [A] [BANK Code] [SP]

[ST]: Start condition
[SP]: Stop condition
[A]: ACK
[Data]: Data transmission

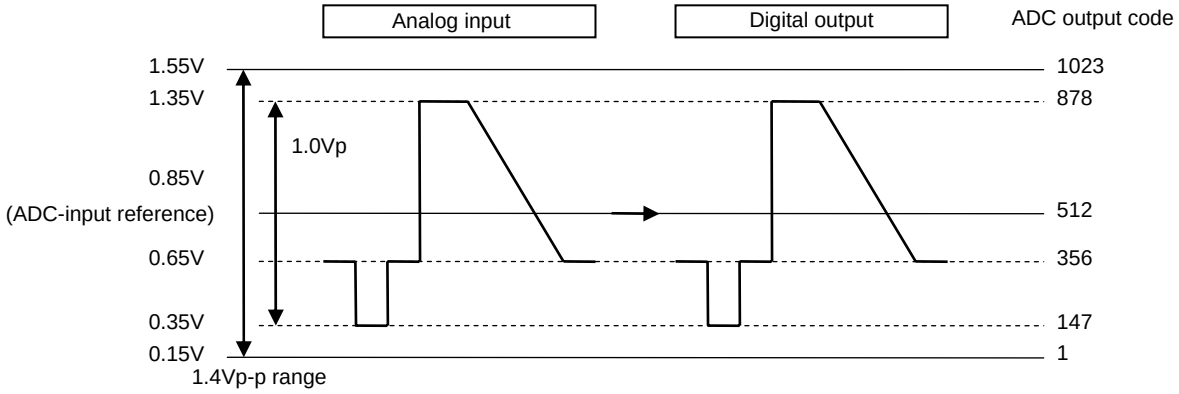
2. AFE and ADC

This IC (LC749870W) incorporates 1-channel of video AFE and 10-bit 30MHz ADC.

- Analog clamp (Self-clamp circuit)

The self clamp circuit clamps the sync-tip without supplying clamp pulses to AFE module. When the self-clamp function is not used, it can be placed in power down mode using I^2C_SELFCLPPWDB.

- Sync-tip clamp specifications



* The figures represent the values under ideal conditions.

Clamp Setting

Self Clamp Setting
SELFCLPPWDB 1: Self Clamp enable

Main Clamp Level Setting
MAINCLPLVCNT [1:0] 00: Main Clamp Level 0.35V

- Low pass filter before self-clamp

A primary LPF with a 1MHz cutoff frequency has been inserted in the stage before the self-clamp circuit as a measure to deal with the high-frequency noise that is present in weak electric fields. The LPF function is for minimizing shifts in the clamp levels of the self-clamp when high-frequency noise components are present in the video signals. The LPF can be set to ON or OFF using I^2C_CLPLPFON.

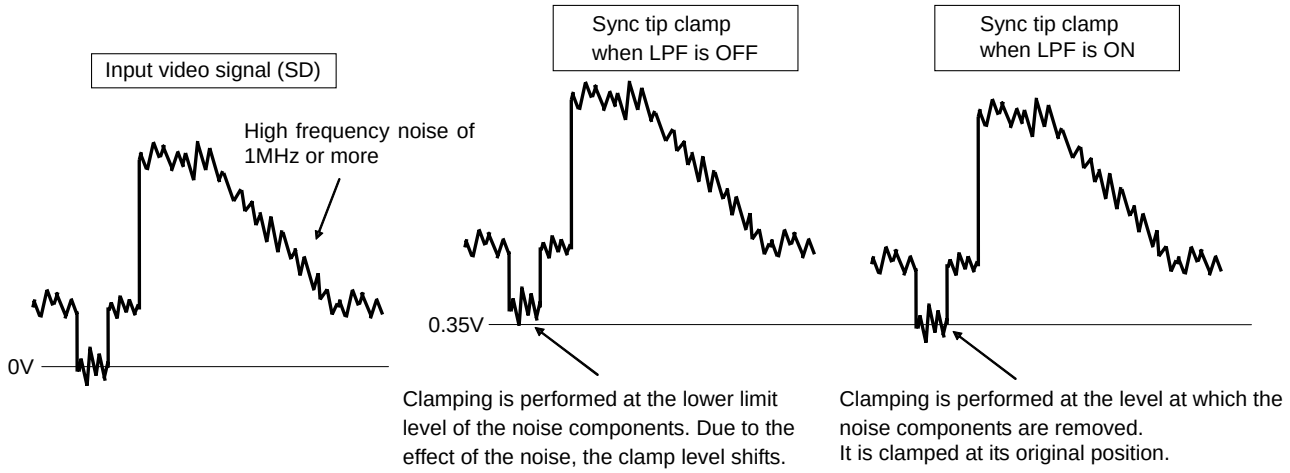


Fig.1 Self Clamp in Weak Electric Fields

- AGC Mode and Non-AGC Mode
  Switch between non-AGC mode and AGC mode using I^2C_SCARTON.
  Non-AGC mode is used when the amplitude of the video signal is steady in the environment of a strong electric field. The maximum of the sync tip clamped analog video input amplitude assumes 1.0Vp-p in non-AGC mode. The ADC full-scale input range is fixed at 1.4Vp-p.
  AGC mode is used when the amplitude of the video signal is unsteady in the environment of a weak electric field. The maximum of the sync tip clamped analog video input amplitude assumes a value no greater than from 0.7Vp-p (-3dB) to 1.4Vp-p (+3dB) in AGC mode. Because the AFEVRTC is controlled according to the amplitude of SYNC detected by the decoder, AGC mode is enabled by varying the ADC full-scale input range.

3. Data Interpolator
   Data interpolator converts the input video signal sampled at 27MHz into 4fsc data. Supported video systems are shown in the following table.

Table 2: Supported Video System

Video System	Input	Output	
	Sampling clock	Data transfer rate	Clock lock method
NTSC	27MHz	14.318180MHz	Burst Lock
PAL-B, G, D, K, I	27MHz	17.734476MHz	Burst Lock
PAL-M	27MHz	14.302444MHz	Burst Lock
PAL-N	27MHz	14.328224MHz	Burst Lock
NTSC4.43	27MHz	17.734476MHz	Burst Lock
PAL-60	27MHz	17.734476MHz	Burst Lock
SECAM	27MHz	13.5MHz	H Lock

4. APC (Auto Phase Control)
   In order to burst lock input video signals, the APC circuit detects the color burst phase error. The data interpolation coefficient is calculated using the detected phase error, and is then output to the data interpolator circuit. It is equipped with a function to turn on the color killer when not burst-locked, and also has an ACC circuit to maintain the amplitude of the carrier chrominance signal at a constant level.

5. AGC (Auto Gain Control)
   The AGC keeps the sync level constant by automatically calculating an appropriate gain value from the input video signal sync level and amplifying the input video signal. Because the AGC circuit includes a time constant circuit, following rapid changes in the input video signal can be suppressed.

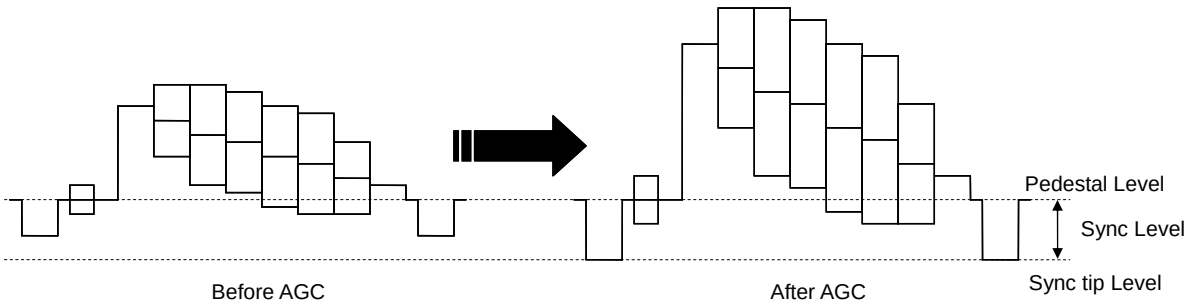


Fig.2 Waveform Change Before and After AGC

6. Digital Clamp

The digital clamp circuit detects the pedestal level of the input video signal, and keeps the level constant. Because the digital clamp includes a time constant circuit, following rapid changes in the input video signal can be suppressed.

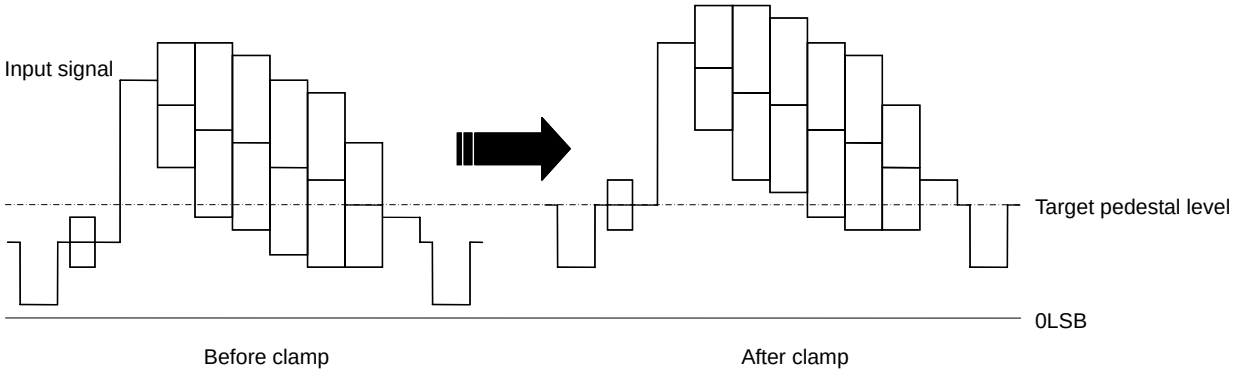


Fig.3 Waveform Change Before and After Digital Clamp

7. Sync Separator

The sync separator circuit separates horizontal and vertical sync signals out of the input video signals. Because an LPF is built in, the sync signal can be separated even in a weak electric field. The weak electric field is detected using the S/N detection result. Moreover, the stability of the sync signal in the weak electric field is improved by the internal AFC circuit. Fig. 4 shows the LPF characteristics for the sync separator. “FILSEL = 1’b0” is the characteristic of an LPF for a weak electric field, and “FILSEL = 1’b1” is the characteristic of an LPF for a strong electric field.

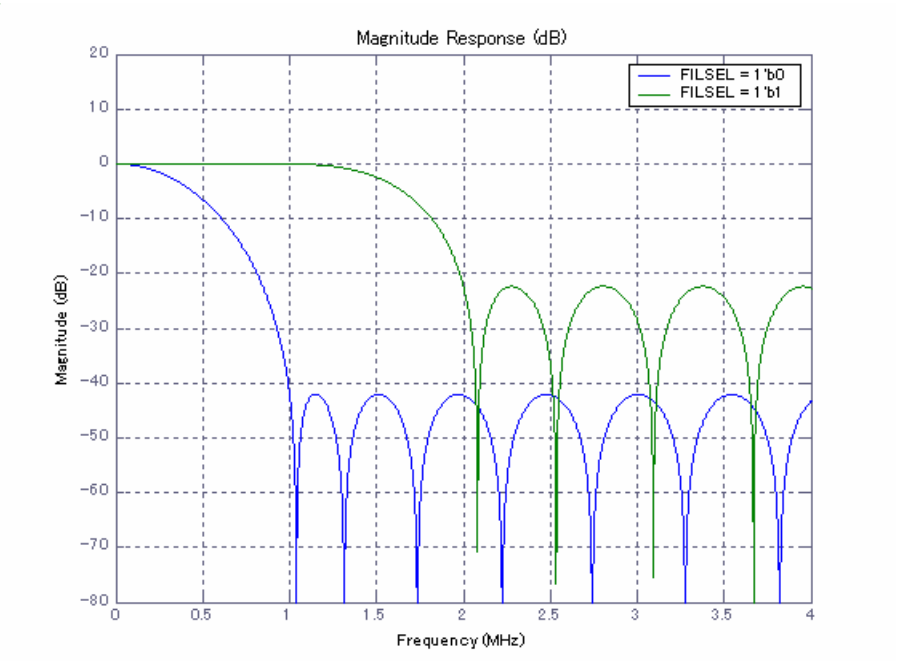


Fig.4 LPF Characteristic for Sync Separator

8. Timing Generator

Using the sync signal separated by the sync separator circuit, the timing generator generates various timing signals to be used for each module as well as for horizontal and vertical blanking signals.

The adjustments of timing signals are possible by setting the corresponding register (s) as follows:

Positioning of horizontal sync signal: I2A_HSPAD

Positioning of vertical sync signal: I2A_VSTART

Positioning of horizontal blanking signal: I2A_HBSTART, I2A_HBEND

Positioning and width adjustment of vertical blanking signal: I2A_VBSTART, I2A_VBWIDTH

9. Two-dimensional Y/C Separation

The Y/C separator switches adaptive two-dimensional Y/C separation and one-dimensional Y/C separation according to the input video system. The table below shows the relationship between input video system and Y/C separation method.

Table 3 Relationship Between Input Video System and Y/C Separation Method

Video System	Y/C Separation Filter
NTSC	Adaptive two-dimensional Y/C separation
NTSC-4.43	One-dimensional Y/C separation
PAL-B, G, D, K, I, M, N	Adaptive two-dimensional Y/C separation
PAL-60	One-dimensional Y/C separation
SECAM	One-dimensional Y/C separation

1) Adaptive Two-dimensional Y/C Separation

The correlation between lines is detected in the vertical LPF and BPF, and the system switches between upper two line processing and lower two or three line processing, based on the results. The adaptive two-dimensional Y/C separation and two-dimensional Y/C separation can be switched using I2BYC_2DCOMB8 [7]. Note that the Y/C separation filter is switched to one-dimensional Y/C separation when I2BYC_1DFIL [0] is set to 1'b1 (I2BYC_1DFIL [0] = 1'b1).

- Y signal = (Vertical low frequency component) + (Horizontal low frequency component of vertical high frequency component)
- C signal = Horizontal high frequency component of vertical high frequency component

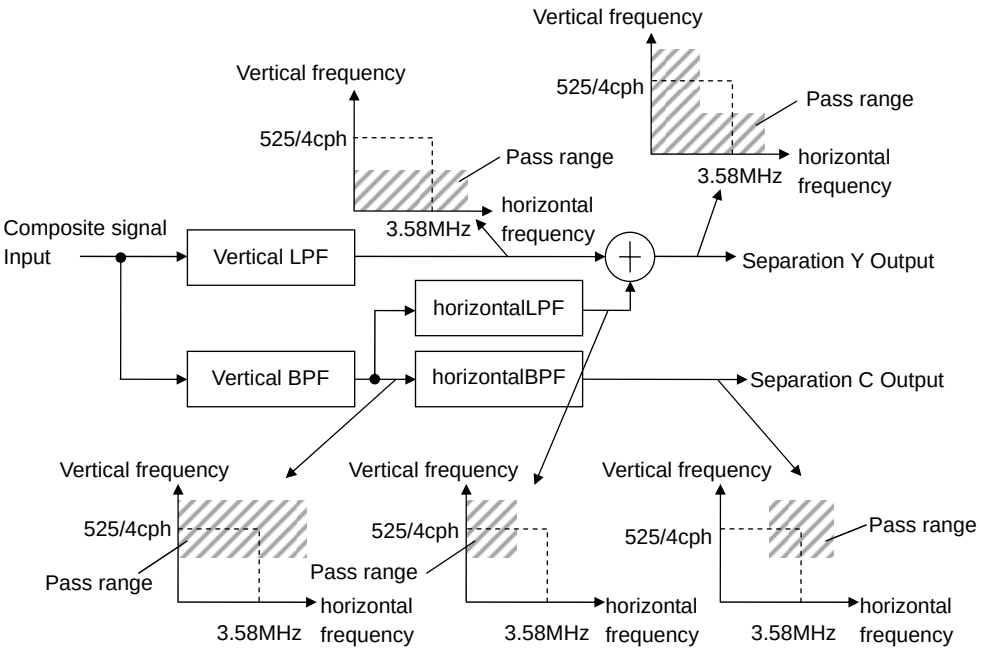


Fig.5 Basic Block Diagram of Two-dimensional Y/C Separation (Line Comb Filter)

- 1 Line Chroma Detector

When 1 line chroma is separated with the two-dimensional Y/C separation, the dot interference is generated because there is no correlation between lines. Therefore, 1 line chroma is detected and dot interference reduction is attempted by subtracting chroma components.

When the following conditions exist, it is judged to be 1 line chroma.

(1) No chroma changes in the line (horizontal direction).

(2) Chroma changes between lines (vertical direction).

(3) Luminance changes between lines (vertical direction).

- 3 Line Median Processing
  When the vertical color in the DVD color bar changes and blurs, dot interference may be generated. Dot interference reduction is attempted by detecting this location and removing the chroma components.

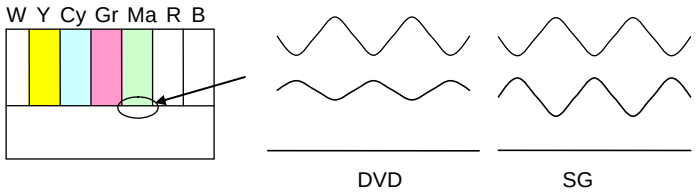


Fig.6 Dot interference

When the following conditions exist as a result of comparing the BPF values for each line, the chroma components must be removed.
(1) When there is a match between the median value of each line and the pixel of the line at the center.
(2) When there is a change between lines.

- Y Signal Bypass Processing
  If the chroma band component of the separated Y signal is compared with the chroma band component of the signal before separation, and if the chroma band of the signal before separation is smaller, the signal is output as a Y signal.

- C Signal Bypass Processing
  If a C signal processed by the comb filter is compared with the result processed by the BPF, and if the result of the BPF is smaller, the BPF processing result is output as a C signal.

- Dot Interference Reduction
  The line comb filter need not add HLVH[*1] to the Y signal if there is a complete line correlation, such as with the Color Bar. Such an addition will only increase the dot interference shown in Fig. 6 above. Therefore, when a location with strong line correlation is detected, the horizontal BSF pass band of HLVH to be added to the Y signal is narrowed, and the dot interference is reduced. The dot interference reduction BSF can be set to ON or OFF using I2BYC_2DCOMB2[3].

  *1: Horizontal low frequency component of vertical high frequency component

- Cross Color Reduction
  When a location with weak line correlation is detected, the BPF pass band in the subsequent stage of the C signal is narrowed, and the cross color is reduced. cross color reduction can be set to ON or OFF using I2BYC_2DCOMB4 [4].

2) One-dimensional Y/C separation (BPF)

Y/C separation is performed by using BPF. The BPF characteristics for NTSC/PAL and for SECAM are selected by I2BYC_1DFIL [7:1]. It is forced to one-dimensional Y/C separation when I2BYC_1DFIL [0] is set to 1'b1 (I2BYC_1DFIL [0] = 1'b1). When performing adaptive two-dimensional Y/C separation, I2BYC_1DFIL [0] must be set to 1'b0 (I2BYC_1DFIL [0] = 1'b0) . Fig.7 and 8 show the characteristics of BPF.

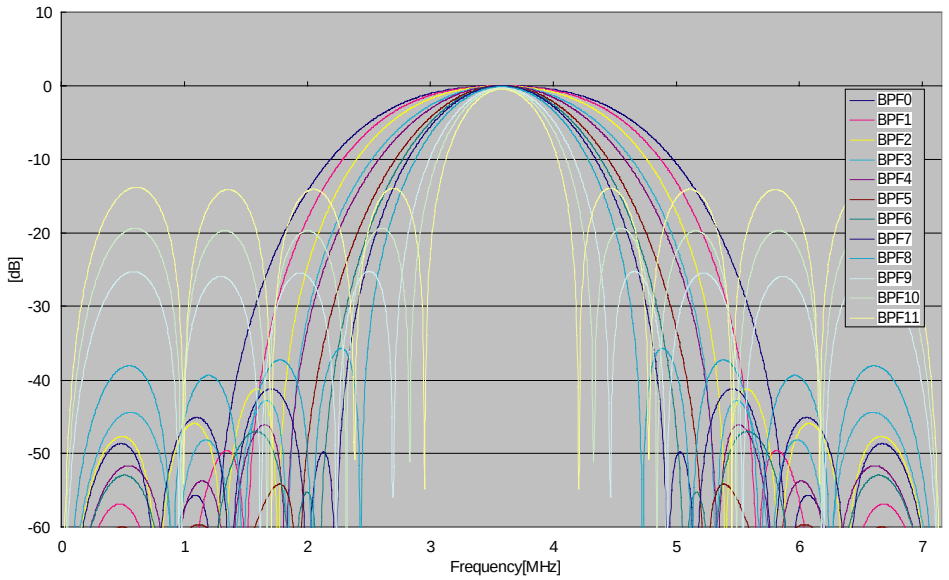


Fig.7 BPF Characteristic for NTSC/PAL

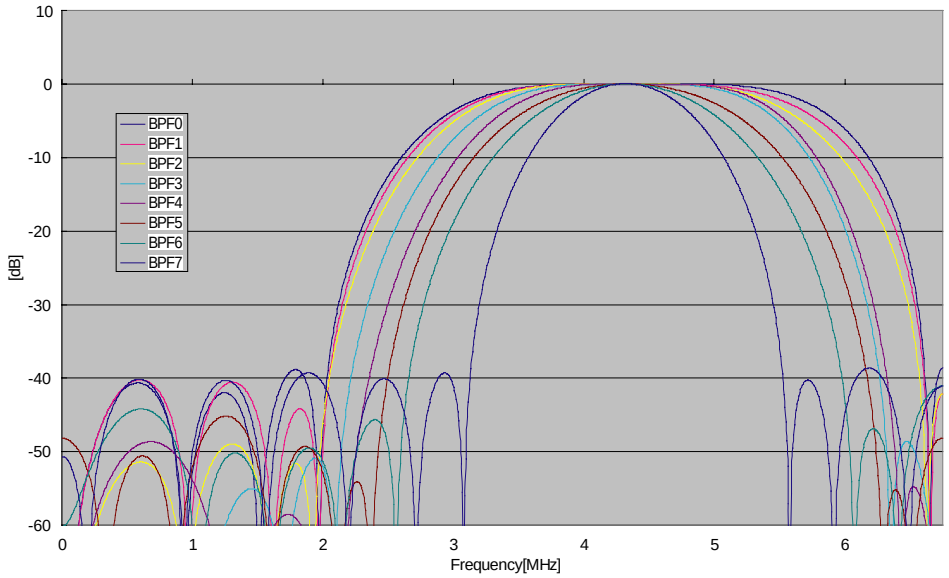


Fig.8 BPF characteristic for SECAM

10. Chrominance Signal Processing

In chrominance signal processing, U/V axial demodulation is performed on the carrier chrominance signal after Y/C separation, and the UV signal is output.

1) ACC (Auto Color Control)

ACC maintains a constant carrier chrominance signal amplitude for NTSC and PAL. The amplitude is kept constant by observing the color burst amplitude of the input carrier chrominance signal, and controlling the amplifier according to the amplitude level. It can also turn on the color killer when the color burst amplitude is small. I2BAC_ACC_ON switches between ACC ON and OFF.

2) Color Killer

The color killer masks the carrier chrominance signal so that a monochrome image is output. When entering the detection results from APC or ACC circuits or an incompatible signal, the color killer is turned on and off. The color killer can be set using I2BAC_CKILL_ON.

3) NTSC/PAL Color Decoder

The NTSC/PAL color decoder demodulates the carrier chrominance signal into color component signals (U/V).

- Color Demodulator and Low Pass Filter

  The Cb/Cr signal is demodulated by multiplying the chrominance signal and phase-controlled color sub-carrier (4Fsc). Fig. 9 shows the block diagram.

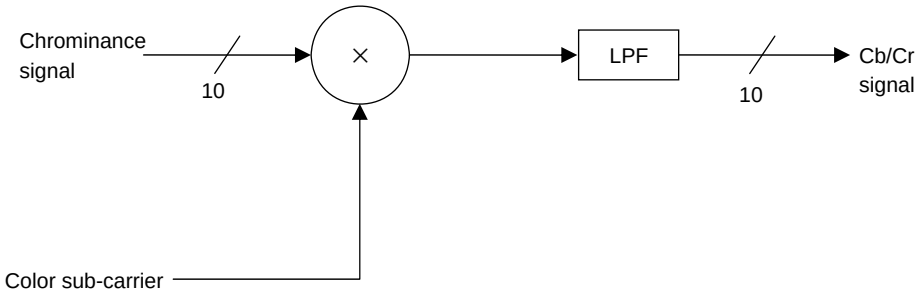


Fig.9 Color Demodulator

The LPF characteristic after demodulation is shown in Fig.10.

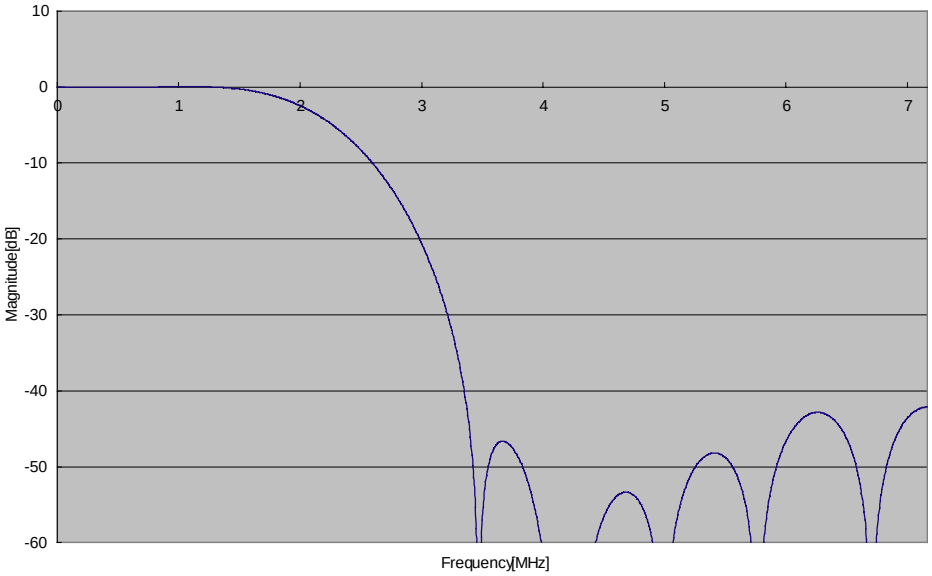


Fig.10 LPF Characteristic after Demodulation

• UVGAIN (Cb/Cr Gain Control)

The UVGAIN adjustment changes the Cb/Cr signal gain based on a center value. Fig.11 shows the block diagram. The gain can be controlled using I2BCD_UGAIN and I2BCD_VGAIN.

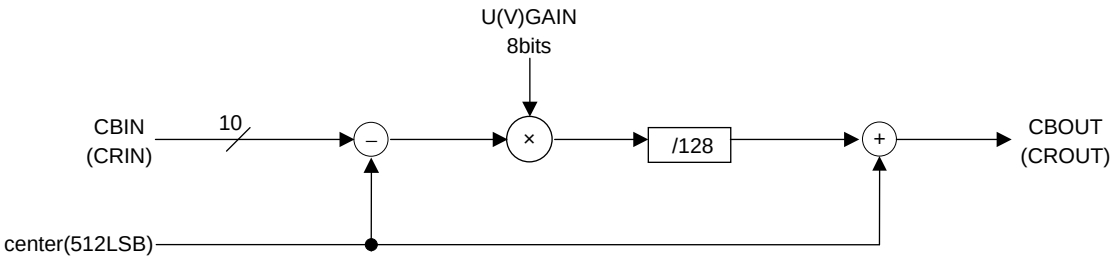


Fig.11 UVGAIN Block Diagram

4) SECAM Color Decoder

The SECAM color decoder demodulates the carrier chrominance signal into color difference signals (U/V).

• Bell Filter

The bell filter is used to maintain the color sub-carrier amplitude of the Y/C-separated chrominance signal constant. The f0 parameter can be selected using I2BSE_BELLF0, and the Q parameter using I2BSE_BELLQ.

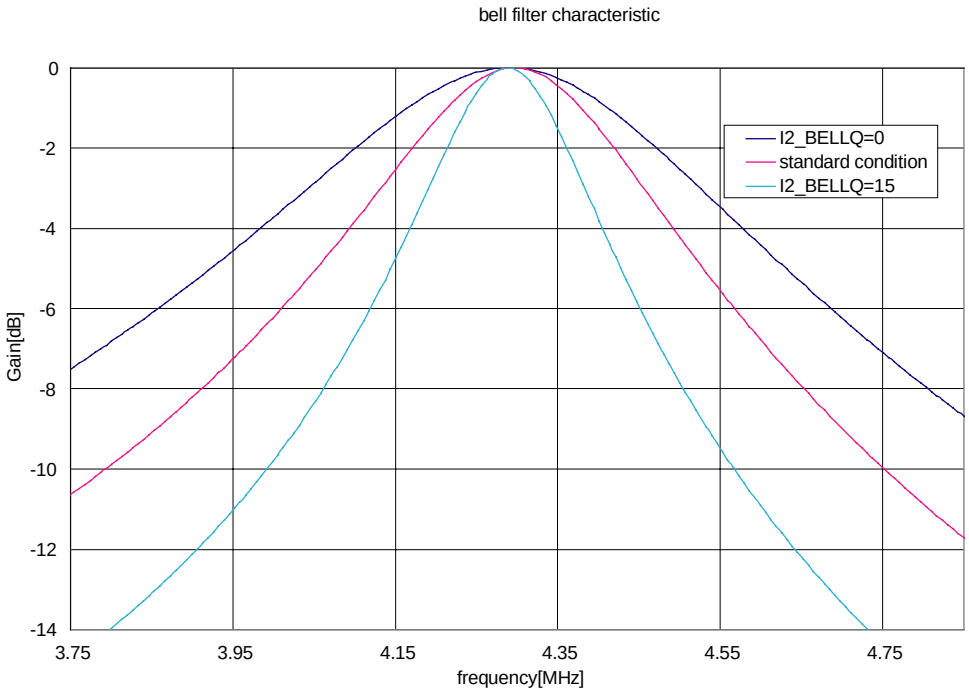


Fig.12 Bell Filter characteristics

- Low Pass Filter

  The LPF is used to reduce noise in FM demodulated DB/DR signals. The characteristics of the LPF can be selected using I2BSE_CLPFSEL.

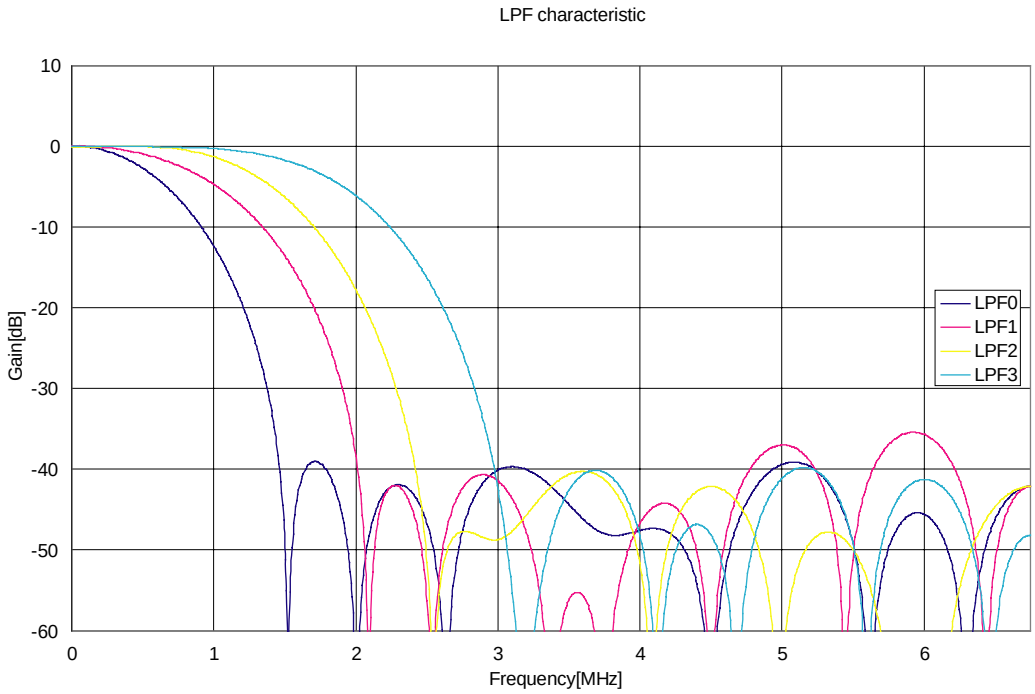


Fig.13 LPF Characteristics

- UV Gain and Offset Adjustment

  The UV gain adjustment is performed to convert DB/DR to CB/CR, and the UV offset fine adjustment is also performed. The UV gain can be adjusted by changing I2BSE_UGAIN and I2BSE_VGAIN, and the UV offset can be adjusted by I2BSE_UOFFSET and I2BSE_VOFFSET.

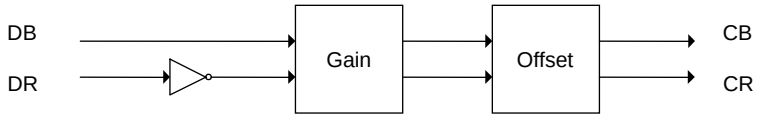


Fig.14 UV Gain and Offset Adjustment

• De-emphasis Filter

The de-emphasis filter characteristics can be selected using I2BSE_DEIIR.

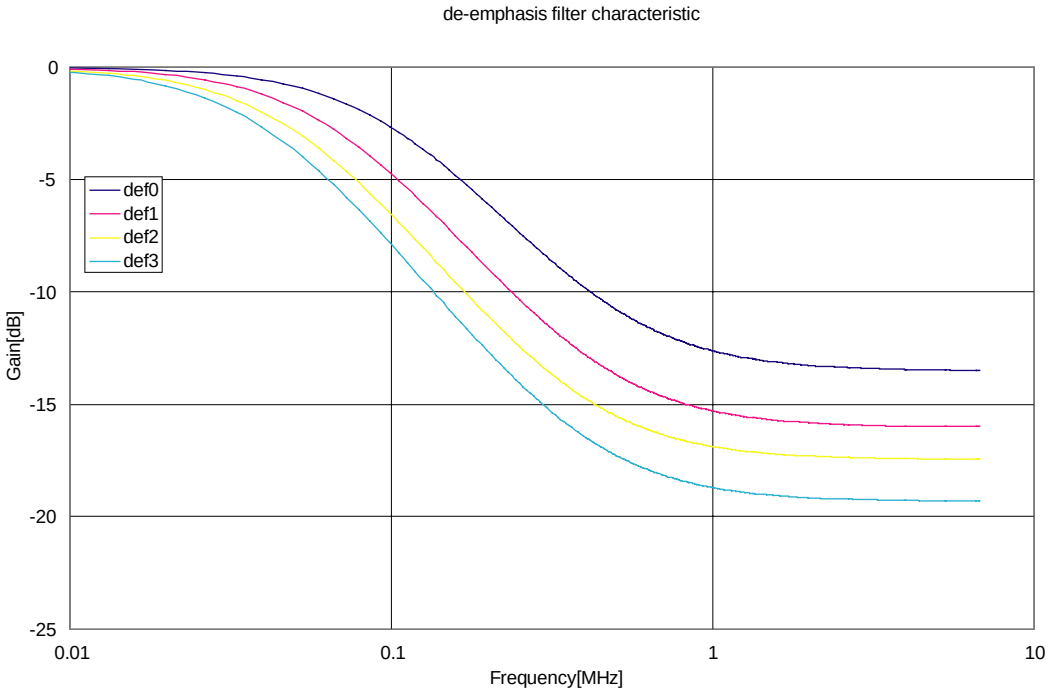


Fig.15 De-emphasis Filter Characteristics

11. Automatic Video Standard Recognition

The video input standard is recognized automatically. Automatic video standard recognition can be set to ON or OFF using I2A_AUTODET.

12. S/N Detection

S/N detection determines the video input noise level. During a vertical blanking period, the detection of noise is processed while the detection enable signal is high. The level of S/N detection can be controlled using I2A_NLTH.

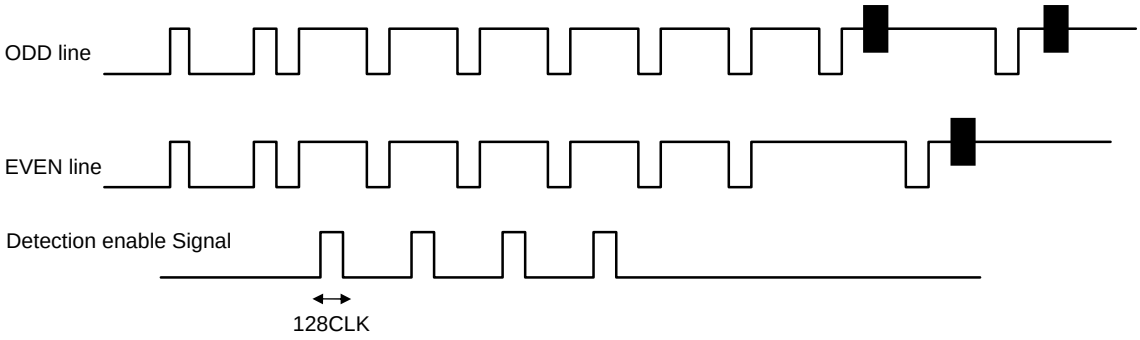


Fig.16 S/N Detection

13. Non-standard Detectionn

This function determines whether the video input is non-standard. The video input is judged standard/non-standard by observing any variation from the standard VSYNC cycle.

14. No Signal Detection

This function detects no signal state.
The result of no signal detection is output to the INTREQ pin.
No signal detection function can be turned ON or OFF using I2A_NSDON [1]. Note that I2A_NSDON [0] is available when no signal detection is OFF.

15. Clock Rate Conversion

The sampling rate converter converts an input video signal sampled at 4fsc into 13.5MHz, and outputs synchronized signals with video data.

16. Sharpness

Sharpness of the image can be adjusted by detecting and forcibly correcting the edge of the luminance signal when the image is scanned horizontally. Adjustments to the enhancing frequency range and level of enhancement are possible. Sharpness can be turned ON or OFF using I2DSH_ON.The enhancing frequency range can be selected using I2DSH_FILTER, and the level of enhancement can be adjusted using I2DSH_ATT.

17. Contrast/Brightness

Brightness adjusts the brightness of the entire screen and Contrast adjusts the brightness gain.

1) Contrast

Contrast can be controlled using I2DCB_CONT.
00_H: × 0 to 80_H: × 1 to FF_H: × 2

2) Brightness

Brightness can be controlled using I2DCB_BRIGHT.
00_H: -128 to 80_H: ±0 to FF_H: +127

18. CTI (Color Transient Improvement)

The color transient can be improved by steepening the slope of the input signal. Processed video without overshoot or undershoot can provide more natural video images. The CTI can be switched between ON and OFF using I2DCT_CTIEN. The gain can be controlled using I2DCT_GAIN. The higher the I2DCT_GAIN is set, the more effective the CTI will be. CTI coring can be controlled using I2DCT_CORR. The higher the I2DCT_CORR is set, the less effective coring will be for extremely small amounts of noise. The CTI's tap parameter can be selected using I2DCT_SMP. The higher the I2DCT_SMP is set, the more the CTI characteristics shift toward lower frequencies.

19. HUE

The hue of the screen as a whole can be adjusted. (Refer to Fig.17.)
The phase angle can be selected using I2DHU_HUE.
0_H: -45° to 80_H: 0° to FF_H: 44° (with approx. 0.7° increments)

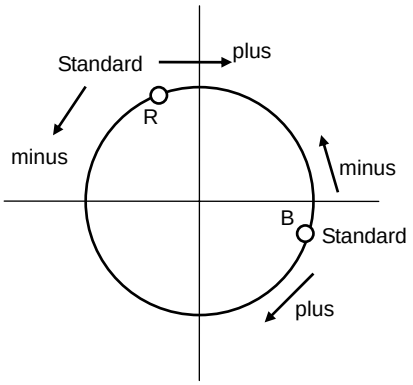


Fig.17 HUE

20. U/ V Gain

The saturation (color density) is adjusted by varying the Cb and Cr gain. The Cb gain can be adjusted using I2DUV_UGAIN, and the Cr gain using I2DUV_VGAIN.

21. 8-bit output format conversion

The 8-bit output format is converted to a format that is compatible with the ITU-R BT.656 format output.
Blue back color can be output in non-signal mode using I2D65_AUTOBBACK. Sepia color can be output using I2D65_SEPIA.

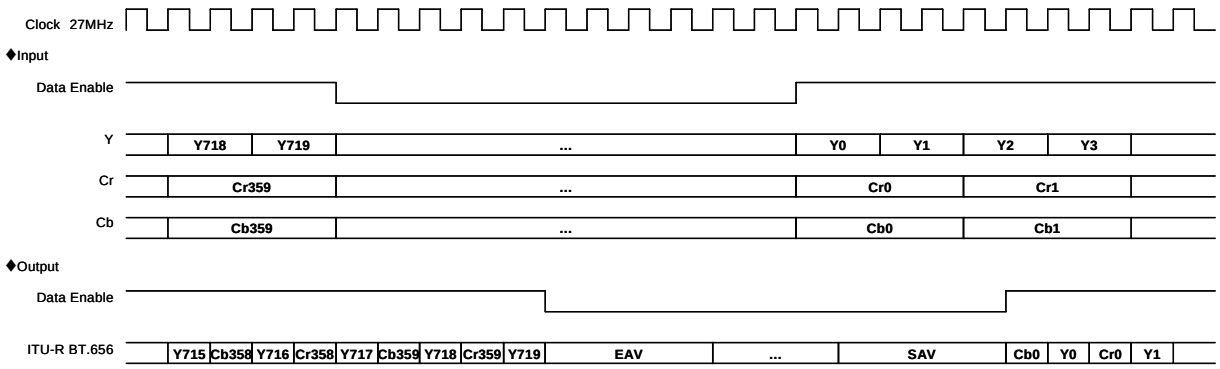


Fig.18 Timing Chart (ITU-R BT.656)

* The processing is being performed by a 27MHz free-run clock, and so the number of pixels in one line cannot be guaranteed. The data in the period from SAV to EAV can be guaranteed, so read the data using the SAV standard. (Data cannot be read using the EAV standard.)
* If equipment without an ITU-R BT.656 interface is connected, connect the HS and VS, or DE and read the data.

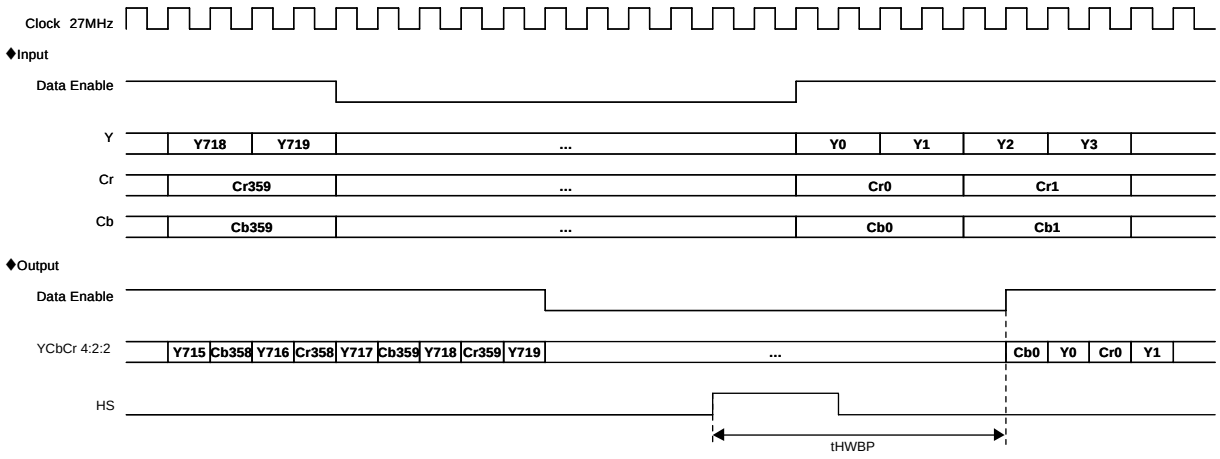
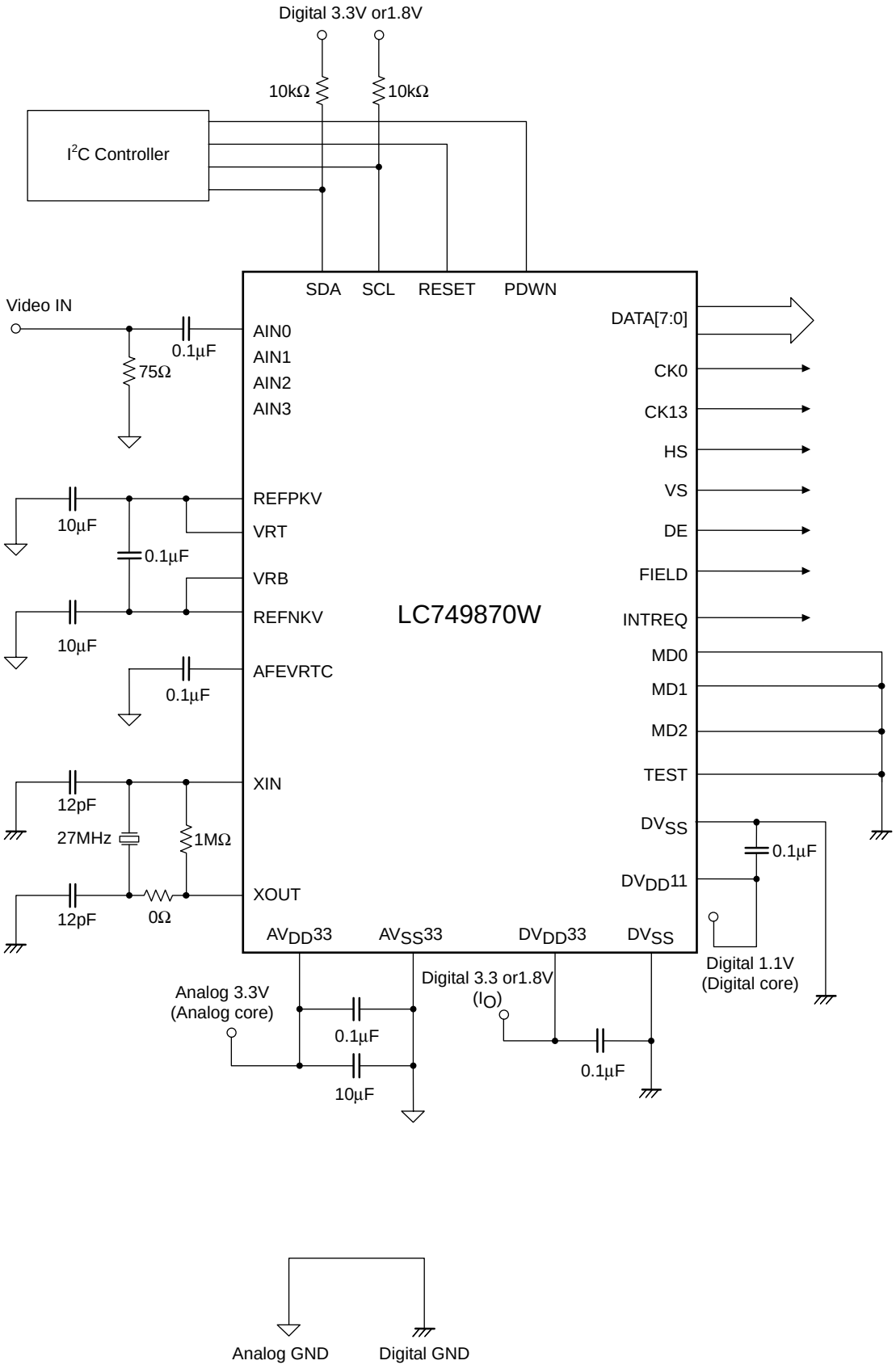


Figure 19 Timing Chart (YCbCr 4:2:2)

* tHWBP shown in Figure 19 has the same value for each format. It can be adjusted by registers.

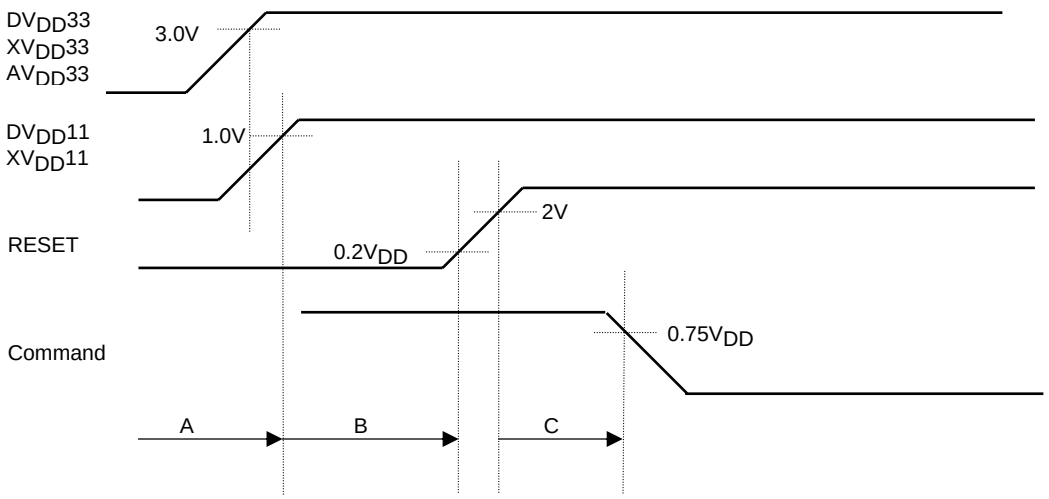
Application Example



Other (usage precautions)

1. Precaution when turning-on the power

As shown in the figure below, start transfer of the I^2C bus command after factoring in the power-on time (A), RST operation time (B) and command transfer start time (C).



A: Power-on time

This is the time taken from power-on to when the *$V_{DD}11$ operating voltage has reached the lowest level (0.99V) and operation has stabilized. The power-on-time depends on the characteristics of the power ICs and other components, so it must be checked separately.

With regard to *$V_{DD}33$ and *$V_{DD}11$, *$V_{DD}11$ must be turned on after *$V_{DD}33$ has turned on.

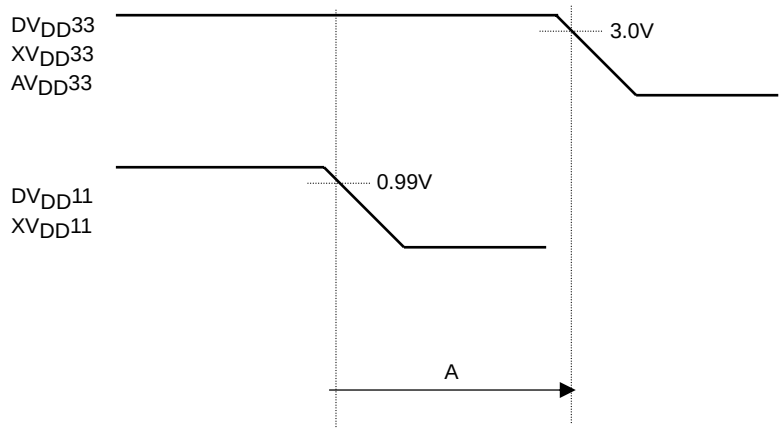
B: RESET operation time

This is the time during which the “L”level must be applied continuously for a period of 10ms or more to the RESET pin after the PDWN is released (“H” level).

C: Command transfer start time

At least an interval of 10ms is required from the time RESET pin is released (“H” level) to the start of command transfer.

2. Precaution when turning-off the power



As a basic rule, power-off must be performed in the reverse sequence of power-on. However, no problems are posed if there is no wait time.

A: Power-off time

This is the time it takes to reach the I_O supply voltage and for operation to stabilize from the lowest level (0.99V) of the *$V_{DD}11$ operating supply voltage. With regard to *$V_{DD}33$ and *$V_{DD}11$, *$V_{DD}33$ must be turned off after *$V_{DD}11$ has been turned off or they must be turned off at the same time.