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PI7VD9008ABH

Adaptive EQ 8-channel 960H Video Decoder

General Features

- Real time AEQ 8-channel Video/Audio decoder for WD1(960H) and D1 cameras
- Built-in Adaptive Equalizer(AEQ) for the best picture image in the several hundred meter coax cable condition
- Proprietary Pericom AEQ technology recover weak, noisy, or unstable analog input signals
- Resilient SYNC TIP detection to lock video signal in a noisy environment
- Programmable sharpness, CTI, hue, saturation, contrast and brightness
- Support time multiplexed format of ITU-R BT.656 output with 54/108MHz or72/144MHz
- Provides a programmable mapping from four or eight (non-real-time) analog video inputs to four BT.656 digital outputs
- NTSC(M), NTSC 4.43, PAL (B, D, G, H, I, M, Nc, 60) standard support
- High performance 5H comb filter for all NTSC/PAL standards
- Built-in 10-bit audio Codec to allow 10 analog audio inputs and 1audio output
- Mixed audio analog output for multiple audio channels with multiple audio sample rates for 8, 16, 32, 44.1, 48KHz audio frequency
- Two serial audio formats (I2S and DSP) are supported for recording/mixing output and playback input
- Selectable Master and Slave serial audio interface
- Integrated video PLL for 108MHz, 144MHz clock output
- Two-wire serial interface(I2C) for register access
- Industrial grade temperature support (-40˚C ~ 85˚C)
- Packages: 128-pin LQFP

Description

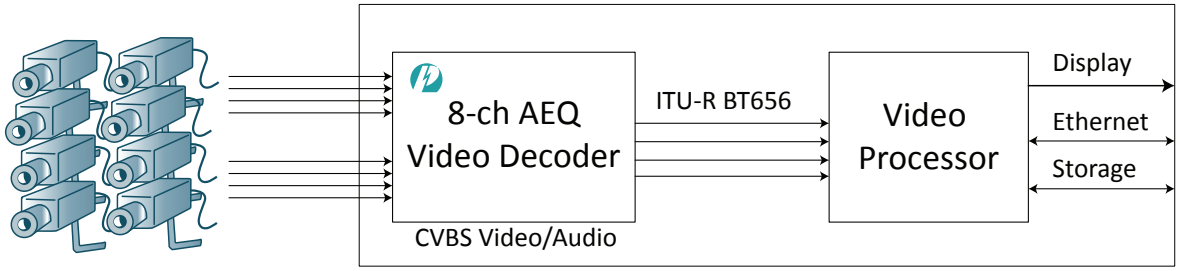
PI7VD9008ABH is AEQ 8-Channel Video Decoders and Audio Codec. Built-in Adaptive equalizer (AEQ) recover the noisy signals caused by long or small wire gauge Coax cables and display the best picture image view quality. The video decoder converts NTSC, PAL analog composite video broadcasting signal (CVBS) into digital components YCbCr for video controller or processor to perform pre-view, compression and storage etc. The converted digital video streams complying with ITU-R BT.656 are transported in time multiplexed format, which contains one, two or four video channels.

Single 27MHz reference crystal clock support NTSC, PAL and 960H standard resolution. Each video channel contains 10-bit ADC, proprietary clamp, automatic gain controller and 5H comb filter for separating luminance & chrominance to reduce artificial noise.

Application

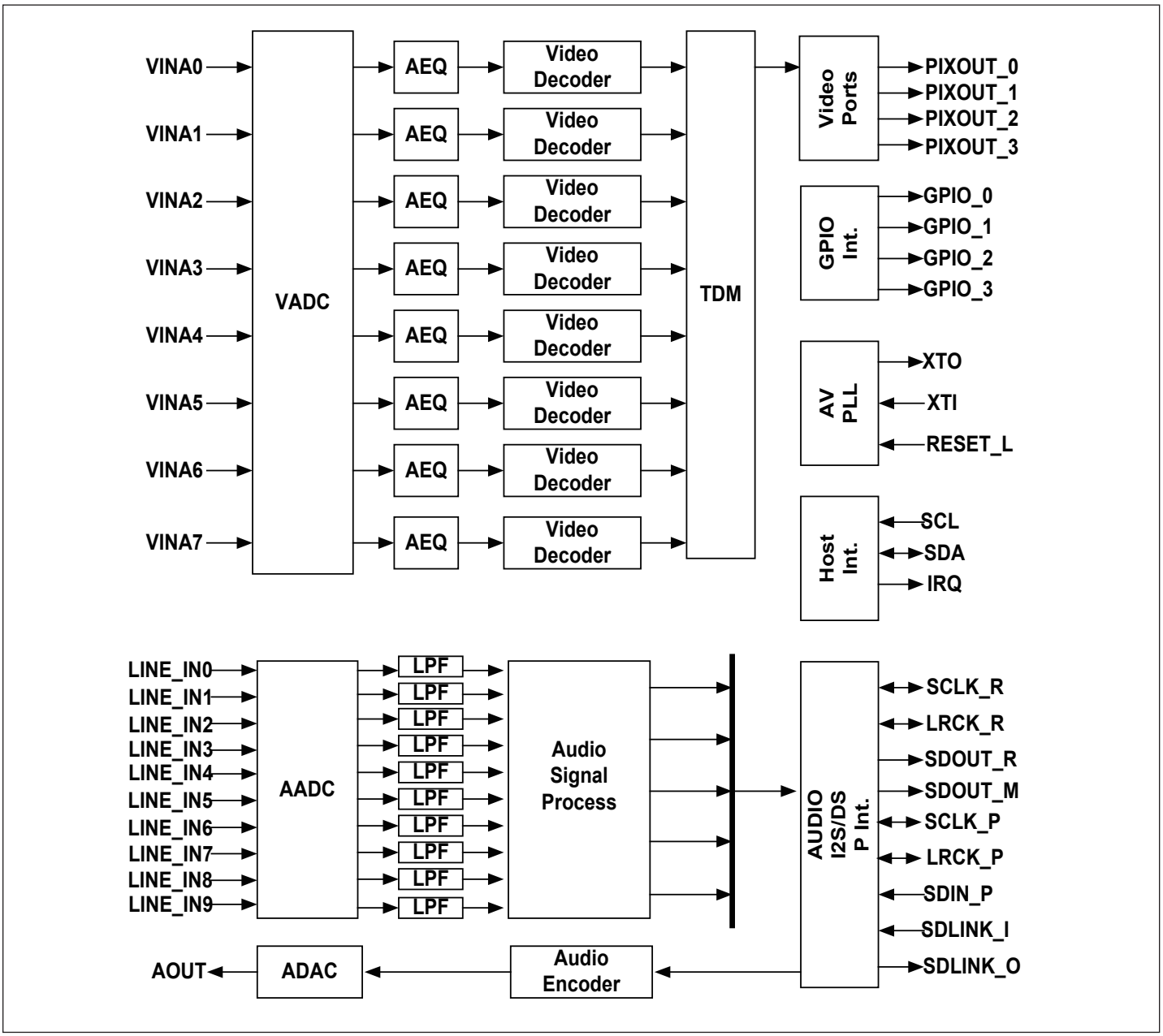
- Video Security DVRs
- Automotive Camera Driver Assistant Systems
- Video Capture Cards

PI7VD9008ABH System Application Diagram



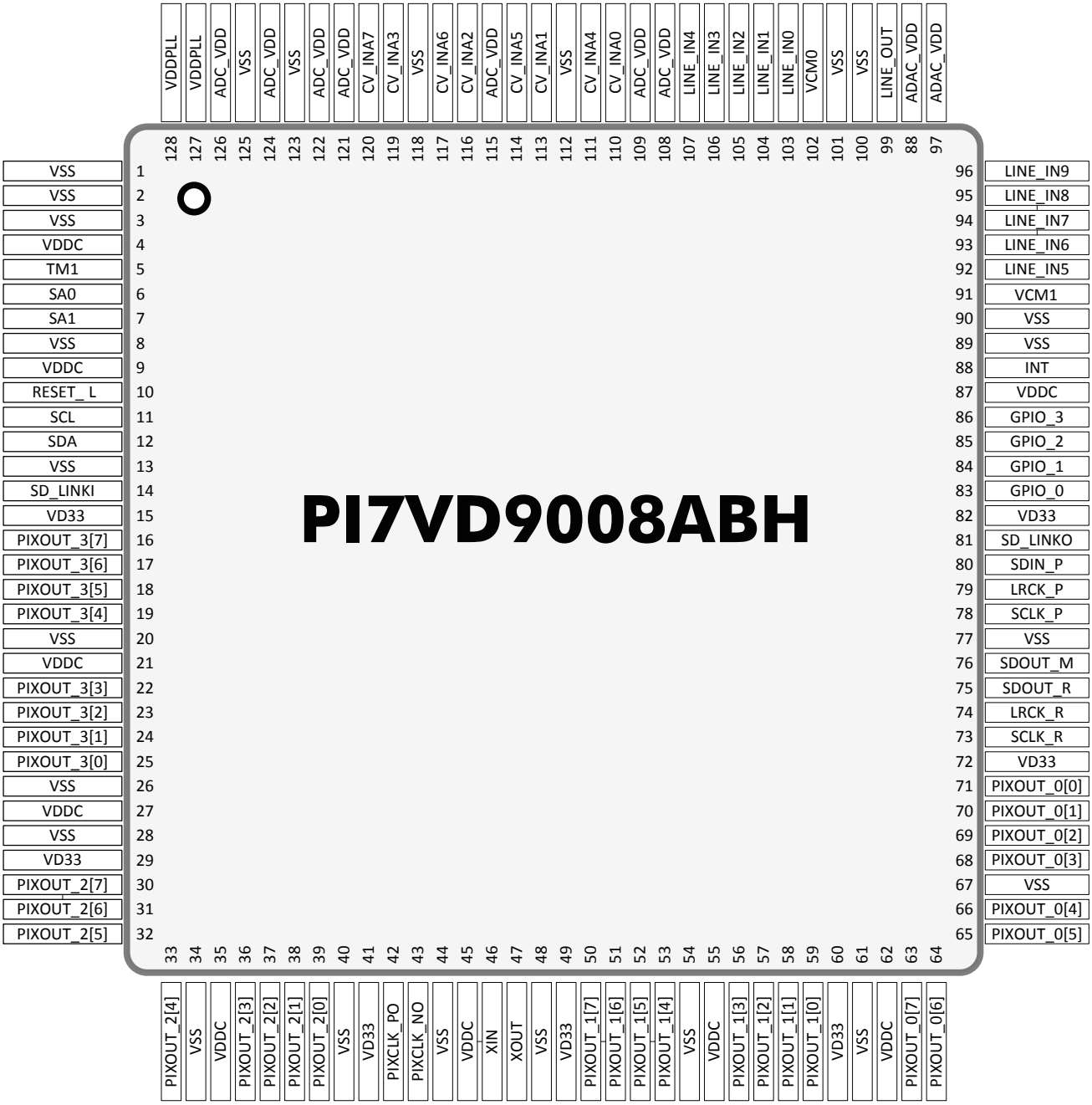
Typical Video Security System Application

PI7VD9008ABH Block Diagram



Video input sources:	CV_INA0, CV_INA1, CV_INA2, CV_INA3, CV_INA4, CV_INA5, CV_INA6, CV_INA7
BT.656 TDM ports:	PIXOUT_0, PIXOUT_1, PIXOUT_2 and PIXOUT_3
Audio input sources:	LINE_IN0, LINE_IN1, LINE_IN2, LINE_IN3, LINE_IN4,LINE_IN5,LINE_IN6,LINE_IN7,LINE_IN8,LINE_IN9
I2S/DSP Audio Interface	(SCLK_R, LRCK_R, SDOUT_R and SDOUT_M), (SCLK_P, LRCK_P and SDIN_P), (SD_LINKI, SD_LINKO)

Pin Configuration(128-LQFP)



Pin Configuration (128-LQFP)

Pin	Name	Pin	Name	Pin	Name	Pin	Name
1	VSS	33	PIXOUT_2[4]	65	PIXOUT_0[5]	97	ADAC_VDD
2	VSS	34	VSS	66	PIXOUT_0[4]	98	ADAC_VDD
3	VSS	35	VDDC	67	VSS	99	LINE_OUT
4	VDDC	36	PIXOUT_2[3]	68	PIXOUT_0[3]	100	VSS
5	TM1	37	PIXOUT_2[2]	69	PIXOUT_0[2]	101	VSS
6	SA0	38	PIXOUT_2[1]	70	PIXOUT_0[1]	102	VCM0
7	SA1	39	PIXOUT_2[0]	71	PIXOUT_0[0]	103	LINE_IN0
8	VSS	40	VSS	72	VD33	104	LINE_IN1
9	VDDC	41	VD33	73	SCLK_R	105	LINE_IN2
10	RESET_L	42	PIXCLK_PO	74	LRCK_R	106	LINE_IN3
11	SCL	43	PIXCLK_NO	75	SDOUT_R	107	LINE_IN4
12	SDA	44	VSS	76	SDOUT_M	108	ADC_VDD
13	VSS	45	VDDC	77	VSS	109	ADC_VDD
14	SD_LINKI	46	XIN	78	SCLK_P	110	CV_INA0
15	VD33	47	XOUT	79	LRCK_P	111	CV_INA4
16	PIXOUT_3[7]	48	VSS	80	SDIN_P	112	VSS
17	PIXOUT_3[6]	49	VD33	81	SD_LINKO	113	CV_INA1
18	PIXOUT_3[5]	50	PIXOUT_1[7]	82	VD33	114	CV_INA5
19	PIXOUT_3[4]	51	PIXOUT_1[6]	83	GPIO_0	115	ADC_VDD
20	VSS	52	PIXOUT_1[5]	84	GPIO_1	116	CV_INA2
21	VDDC	53	PIXOUT_1[4]	85	GPIO_2	117	CV_INA6
22	PIXOUT_3[3]	54	VSS	86	GPIO_3	118	VSS
23	PIXOUT_3[2]	55	VDDC	87	VDDC	119	CV_INA3
24	PIXOUT_3[1]	56	PIXOUT_1[3]	88	INT	120	CV_INA7
25	PIXOUT_3[0]	57	PIXOUT_1[2]	89	VSS	121	ADC_VDD
26	VSS	58	PIXOUT_1[1]	90	VSS	122	ADC_VDD
27	VDDC	59	PIXOUT_1[0]	91	VCM1	123	VSS
28	VSS	60	VD33	92	LINE_IN5	124	ADC_VDD
29	VD33	61	VSS	93	LINE_IN6	125	VSS
30	PIXOUT_2[7]	62	VDDC	94	LINE_IN7	126	ADC_VDD
31	PIXOUT_2[6]	63	PIXOUT_0[7]	95	LINE_IN8	127	VDDPLL
32	PIXOUT_2[5]	64	PIXOUT_0[6]	96	LINE_IN9	128	VDDPLL

Pin-out Information

Analog Video/Audio Interface

Pin Name	Pin Number	Type	Description
CV_INA0,	110,	Analog	CVBS input of Video channel 0
CV_INA4,	111,		CVBS input of Video channel 4
CV_INA1,	113,		CVBS input of Video channel 1
CV_INA5,	114,		CVBS input of Video channel 5
CV_INA2,	116,		CVBS input of Video channel 2
CV_INA6,	117,		CVBS input of Video channel 6
CV_INA3,	119,		CVBS input of Video channel 3
CV_INA7	120		CVBS input of Video channel 7
VCM0, VCM1	102, 91	Analog	Connect to an external capacitor
LINE_IN0,	103,	Analog	Line input of Audio channel 0
LINE_IN1,	104,		Line input of Audio channel 1
LINE_IN2,	105,		Line input of Audio channel 2
LINE_IN3,	106,		Line input of Audio channel 3
LINE_IN4	107		Line input of Audio channel 4
LINE_IN5,	92		Line input of Audio channel 5
LINE_IN6,	93		Line input of Audio channel 6
LINE_IN7,	94		Line input of Audio channel 7
LINE_IN8,	95		Line input of Audio channel 8
LINE_IN9	96		Line input of Audio channel 9
LINE_OUT	99	Analog	Mixed Analog Audio Output

Digital Video/Audio Interface

Pin Name	Pin Number	Type	Description
PIXOUT_0[7:0]	63, 64, 65, 66,68,69, 70,71	Output	Bt.656 Time Multiplex Division output of port 0
PIXOUT_1[7:0]	50, 51, 52, 53, 56,57,58,59	Output	Bt.656 Time Multiplex Division output of port 1
PIXOUT_2[7:0]	30, 31, 32, 33, 36, 37, 38, 39	Output	Bt.656 Time Multiplex Division output of port 2
PIXOUT_3[7:0]	16, 17, 18, 19, 22, 23, 24, 25	Output	Bt.656 Time Multiplex Division output of port 3
GPIO_0	83	Output	According to register setting, it outputs GPO, HSYC, VSYNC, FDFLAG, ACTIVE and VDLOSS of channel 0, 4
GPIO_1	84	Output	According to register setting, it outputs GPO, HSYC, VSYNC, FDFLAG, ACTIVE and VDLOSS of channel 1, 5
GPIO_2	85	Output	According to register setting, it outputs GPO, HSYC, VSYNC, FDFLAG, ACTIVE and VDLOSS of channel 2, 6
GPIO_3	86	Output	According to register setting, it outputs GPO, HSYC, VSYNC, FDFLAG, ACTIVE and VDLOSS of channel 3, 7

SCLK_R	73	Input/ Output	Record audio serial clock. It is an input pin under slave mode, while output pin under master mode.
LRCK_R	74	Input/ Output	Record audio serial sync pulse. It is an input pin under slave mode, while output pin under master mode.
SDOUT_R	75	Output	Record audio serial data output.
SDOUT_M	76	Output	Mixing audio serial data output.
SCLK_P	78	Input/ Output	Playback audio serial clock. It is an input pin under slave mode, while output pin under master mode
LRCK_P	79	Input/ Output	Playback audio serial sync pulse. It is an input pin under slave mode, while output pin under master mode.
SDIN_P	80	Input	Playback audio serial data input.
SD_LINKI	14	Input	Chip-to-Chip audio serial data input.
SD_LINKO	81	Output	Chip-to-Chip audio serial data output.

System Control Interface

Pin Name	Pin Number	Type	Description
RESET_L	10	Input	Chip Reset. Active Low.
XIN	46	Input	27MHz or 54MHz crystal input or 27MHz/54MHz/108MHz oscillator input
XOUT	47	Output	27MHz or 54MHz crystal output
PIXCLK_P0	42	Output	Positive Output clock signal running at 27/54/108MHz (720H mode) or 36/72/144MHz (960H mode) for bus PIXOUT_0.
PIXCLK_N0	43	Output	Negative Output clock signal running at 27/54/108MHz (720H mode) or 36/72/144MHz (960H mode) for bus PIXOUT_0
TM1	5	Input	Test pin. Tied to VSS.
SA1	7	Input	Device Address 1 of I2C slave interface
SA0	6	Input	Device Address 0 of I2C slave interface
SCL	11	Input	Input clock signal of I2C slave interface
SDA	12	Input/ Output	Data signal of I2C slave interface
INT	88	Output	Interrupt signal to system. Active High.

Power and Ground

Pin Name	Pin Number	Type	Description
VDDC	4, 9, 21, 27, 35, 45, 55, 62, 87	Power	1.0V Power for core logic
VD33	15, 29, 41, 49, 60, 72, 82	Power	3.3V Power for IO pads
VSS	1, 2, 3, 8, 13, 20, 26, 28, 34, 40, 44, 48, 54, 61, 67, 77, 89, 90, 100, 101, 112, 118, 123, 125	Ground	Ground for video ADC, audio ADC, audio DAC, PLL, core logic and IO pads
ADC_VDD	108, 109, 115, 121, 122, 124, 126	Power	3.3V Power for video ADC and audio ADC.
ADAC_VDD	97, 98	Power	3.3V Power for audio DAC
VDDPLL	127, 128	Power	3.3V Power for AV PLL

Functional Description

Video/Audio Analog Input

PI7VD9004ABH offers4 channels NTSC, PAL (720H or 960H) format composite (CVBS) inputs(CV_INAx x= 0,1,2,3,4,5,6,7). When the input signal is weak and the color burst is not able to be recognized, the video is automatically switched to Black and White mode to enhance the picture image quality.

Format	Lines	Field	Fsc	Country
NTSC-M	525	60	3.579545 MHz	U.S., many others
NTSC-Japan	525	60	3.579545 MHz	Japan *
NTSC (4.43)	525	60	4.433619 MHz	Transcoding
PAL-B, G, N	625	50	4.433619 MHz	Many
PAL-I /H /D	625	50	4.433619 MHz	Belgium ,China Great Britain, oth ers
PAL-M	525	60	3.575612 MHz	Brazil
PAL-CN	625	50	3.582056 MHz	Argentina
PAL-60	525	60	4.433619 MHz	China

* PNTSC-Japan has 0 IRE setup

Clamping and Automatic Gain Control

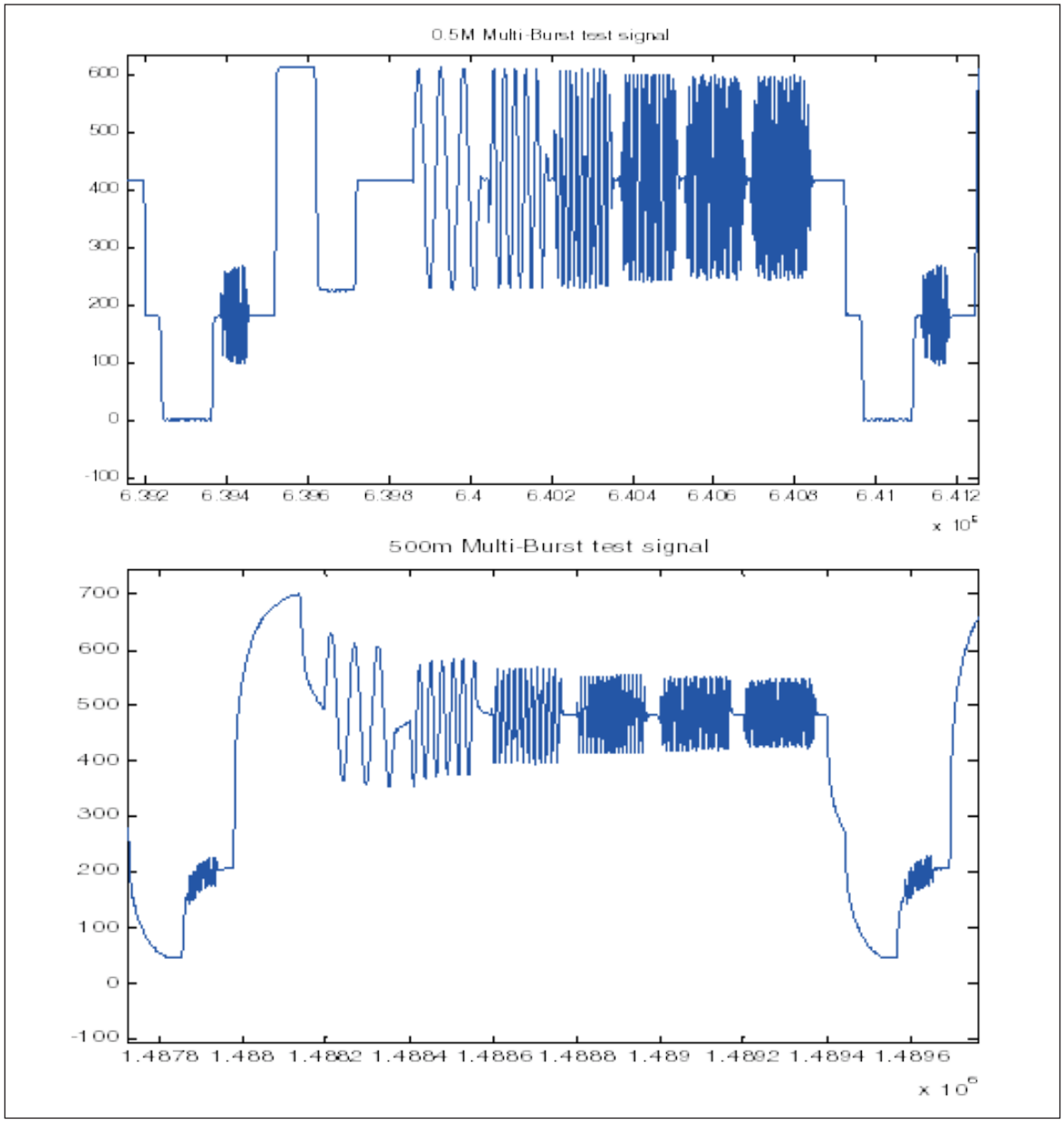
Each analog input channel has built-in clamping circuits to restore signal DC level. Automatic Gain Control (AGC) circuits in the internal video processor can compensate average input video signal level for each analog input channel. The AGC and clamping circuits prevent signal level saturation and allow the video decoder to deliver the best signal-to-noise performance. On the other hand, the AGC cooperates with the digital multiplier of video decoder to boost the weak signals.The circuits perform Automatic Gain Control through internal feedback look. Manual gain control is also available through configuring the Video Decoder Control and Status Registers.

Video Decoder

EThe video decoder in the chip converts NTSC and PAL video signals to 8-bit ITU-R BT.656 format. The chip includes four high speed and low power 10-bit analog-to-digital converters (ADC) with 2x sampling rate to support 4-channel video decoding. When the incoming video is in the 720H format, the sampling rate is 27MHz or 54MHz by 2x factor. For 960H format, the sampling rate is 36MHz or 72MHz by 2x factor. The chip implements proprietary circuit design that is optimized for locking in weak, noisy, or unstable signals. The minimal signal voltage that can be locked in is at 160/80 mV.

Adaptive Equalization

EThe CVBS is suffered from channel loss by an extended transmission distance (greater than 500m) and a small diameter (less than 0.5mm) of CCTV cable. The distortion on CVBS after the energy reduction effect of cable length is illustrated as below. For example, a Multi-Burst test signal is respectively measured at 0.5m and 500m of cable.It appears that color burst and sync tip have sever degration after 500m transmission distance. Adaptive equalization on the distorted CVBS recovers the signal back to close to the original level. Since the different cable conditions present various effects on CVBS picture image, the adaptive equalization provides to compensate the signal loss on some frequency components pertinent to the Coax cable.



Comb filter and Y/C Separation

Thevideo decoder is capable of separating luma (Y) and chroma (C) of NTSC or PAL video signals using 5-line adaptive comb filter or notch/band-pass filter. The comb filter searches for correlation between 5 lines of input video stored in the internal buffer. The lines are averaged based on the degree of correlation to produce the output video line. If no correlation is found between the 5 lines of video, notch/band-pass filter is used. This process is very effective at reducing cross-luma and cross-chroma noise. The noise appears as artifacts that degrade the image quality. Reduction of the noise improves the image quality significantly.

Video Signal Processing

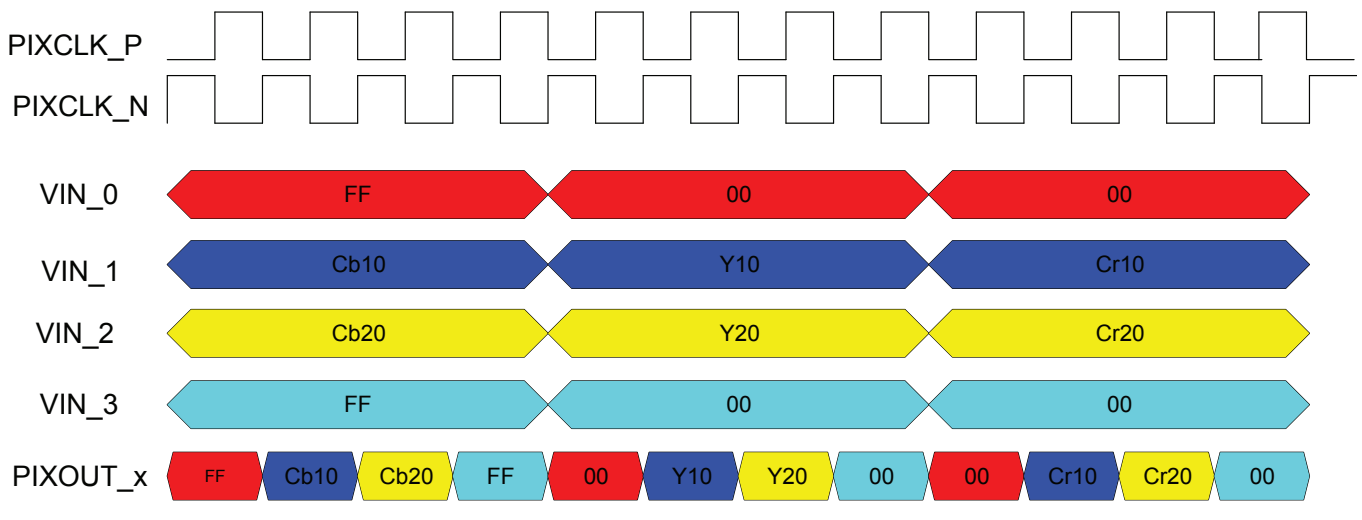
The chip is capable of processing digital video signal to fulfill better detection in a noisy environment and achieve good image quality for viewing as well. For video signal detection, a resilient SYNC TIP detection mechanism is implemented to locate VSYNC and HSYNC correctly in order to lock the video frame or video line.

In general, the poor power adaptor or camera would introduce high frequency ripples coupling with sync tip to cause the misjudgment on the beginning of a video frame or line. The built-in video processing circuit is able to decouple the noise from sync tip to prevent from video loss.

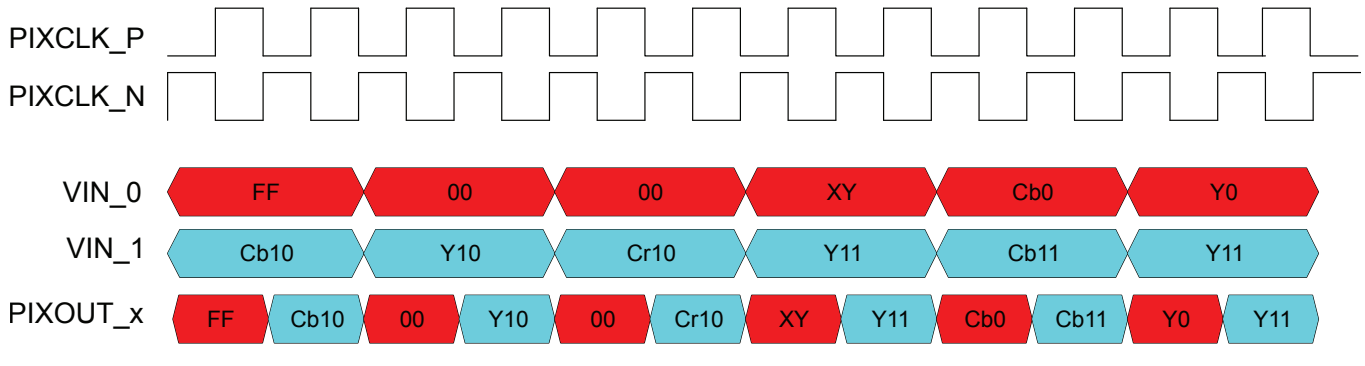
A sharpness filter is implemented to offer programmable 16 level gains to increase the high frequency and edge information of luma for better viewing on the contour of each object. Through the I2C serial interface, hue, contrast, brightness and saturation can be programmed in the configuration registers. Hue can be controlled in 256 steps from -180 degrees to +180 degrees. Saturation can be programmed in 256 grades. Brightness can be adjusted in 256 levels.

Video Output Port

The four CVBS analog video channels are converted into four individual digital video data streams. There are four video output ports (PIXOUT_0, PIXOUT_1, PIXOUT_2 and PIXOUT_3) in the chip and each video output port can carry several converted digital video data stream following ITU-R BT.656 compatible data format. The video data of each port is synchronous with the corresponding clock signals of PIXCLK_PO or PIXCLK_NO. The frequency of PIXCLK_*O can be operated at 1x, 2x or 4x of 27MHz (720H mode) or 36MHz (960H mode). When the clock frequency is 2x or 4x rate, the video port outputs 2-channel or 4-channel video data stream in time-multiplexed format. The clock phase of PIXCLK_POorPIXCLK_NOcanbe programmed by delay cells through writing delay value into the registers of PIXCLK_P_DEL or PIXCLK_N_DEL. Also, the clock polarity can be controlled through inverter by setting or resetting the register of PIXCLK_P_POL or PIXCLK_N_POL. The flexibility on changing clock phase or polarity facilitates the timing design for video data stream on PCB.



Time-multipexed Format with 108/ 144MHz



Time-multipexed Format with 54/ 72MHz

ANALOG AUDIO INPUT

The audioADC offers 5 channels of analog inputs (LINE_INx, x= 0, 1, 2, 3, 4, 5, 6, 7, 8, 9) with a peak-to-peak voltage range from 0.5V to 2V. Each input channel contains 4-bit programmable gain amplifier and an ADC with maximum over-sampling speed of 3.6M Sample/s. A pseudo differential input is used to minimize board level noise problems. The converted audio data stream is fed into a low pass filter to decimate audio sample at an appropriate audio sampling rate such as 8 KHz, 16 KHz, 32 KHz, 44.1 KHz and 48 KHz etc.

AUDIO PROCESSING

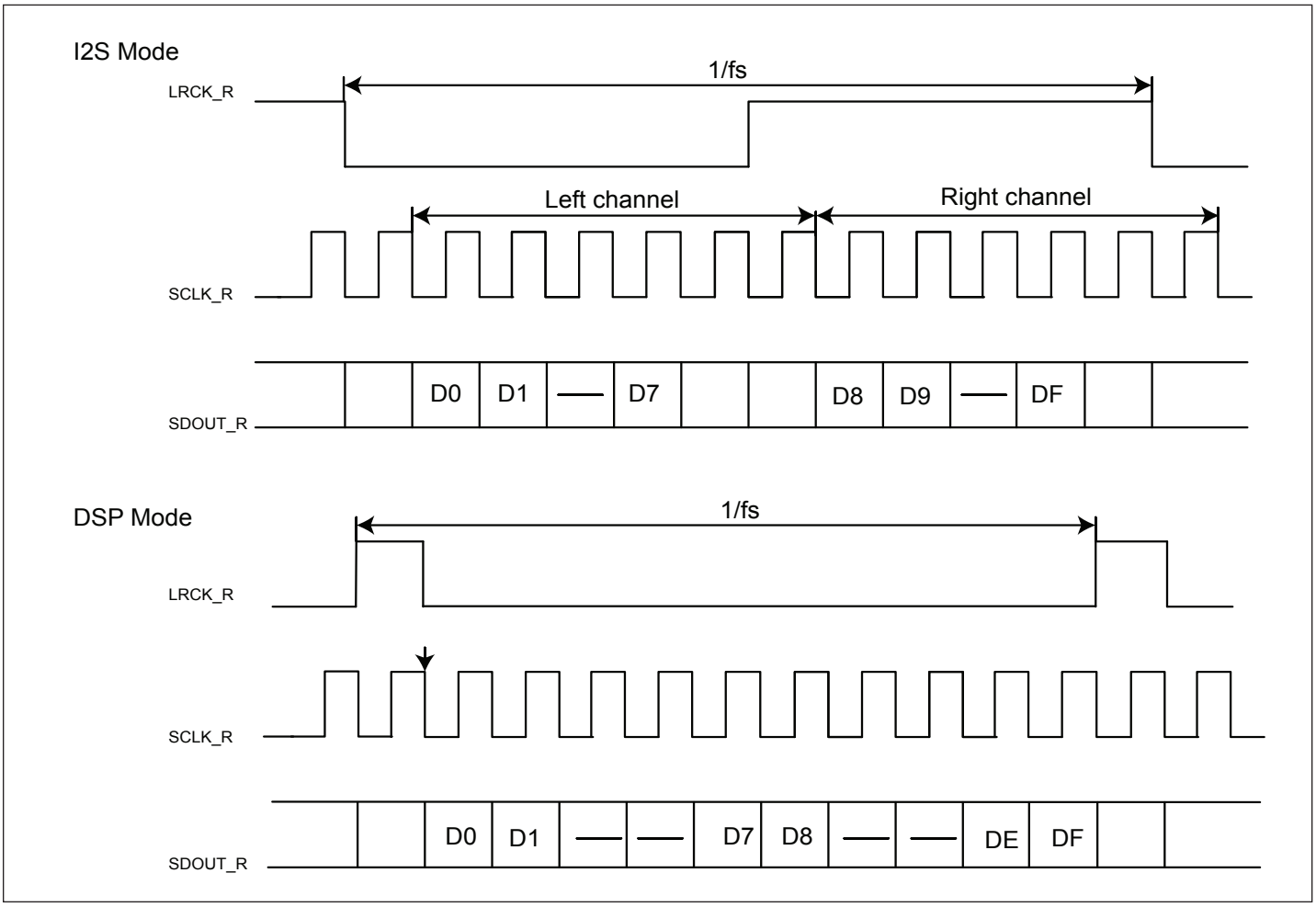
The audio processor accepts 5 digital audio streams from audio ADC. It also receives 2 additional digital serial audio data from pins. One digital serial audio data is SDIN_P coming from AV compression processor, while the other one is SD_LINKI coming from companion device.

SDIN_P represents the decompressed audio data for playback purpose. SD_LINKI is used to cascade with digital audio outputs from one other PI7VD9008ABH chips for forming one timing multiplexed I2S digital serial audio data containing 8 or 10 digital audio channels. This device processes these 10 digital audio streams and 2 digital serial audio data, then generates one mixing analog audio signal and three digital serial audio data to fulfill the functions of mixing, recording and cascading etc.

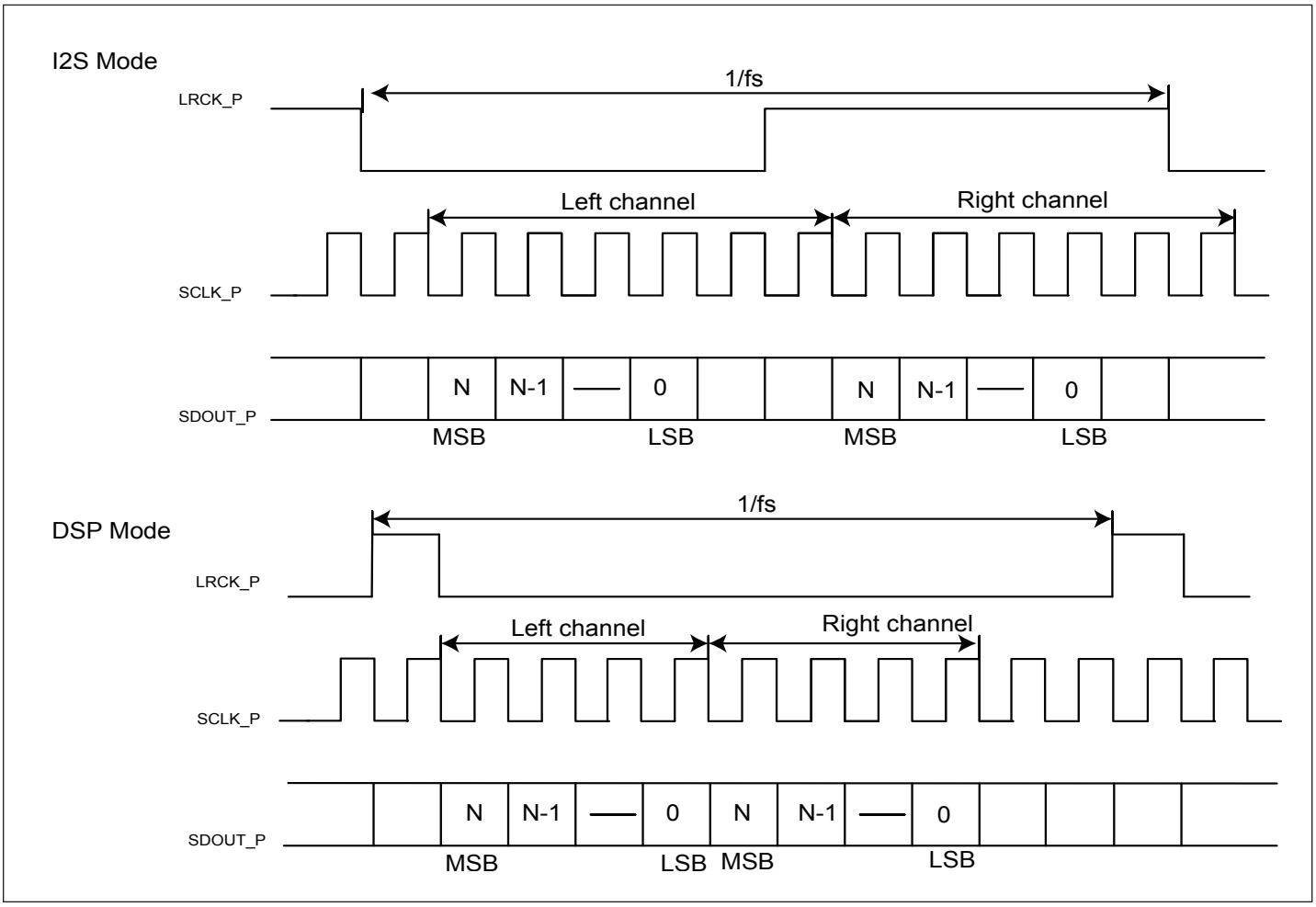
For audio mixing, this device has both analog and digital format. The built-in mixer selects among all audio input data to generate the mixing digital audio data (SDOUT_M), which connects to audio DAC for converting to mixing analog audio signal output (LINE_OUT).

For audio recording, the audio processor performs multiplexing over 16 digital audio streams in timing division way to generate record digital audio output data (SDOUT_R). For the digital serial audio data SDOUT_R and SDOUT_M, they are both synchronized with SCLK_R and LRCK_R. As to SDIN_P, it is synchronized with SCLK_P and LRCK_P. These digital serial audio data support two formats of I2S and DSP that can be selected by control bits RM_SYNC in the register at offset 0xD2 and PB_SYNC in the register at offset 0xDB. Meanwhile, the record and playback digital serial audio interfaces of PI7VD9008ABH can be acted as Master or Slave mode based upon the setting of ACLKRMASTER and PB_MASTER bits in the register at offset 0xDB

This device supports audio system clock with 256fs or 320fs mode, which is controlled by AIN5MD register. The record output pin contains several channel inputs that can be defined by the registers at offset of 0xD2~ 0xDA describing the number and sequence of recorded audio streams. It supports 8bit and 16bit record data width for trading off between higher audio qualities and saving disk storage space. By controlling bit2 of register at offset 0xDB, the chip allows to select the output record data width to be either 8-bit or 16-bit mode.



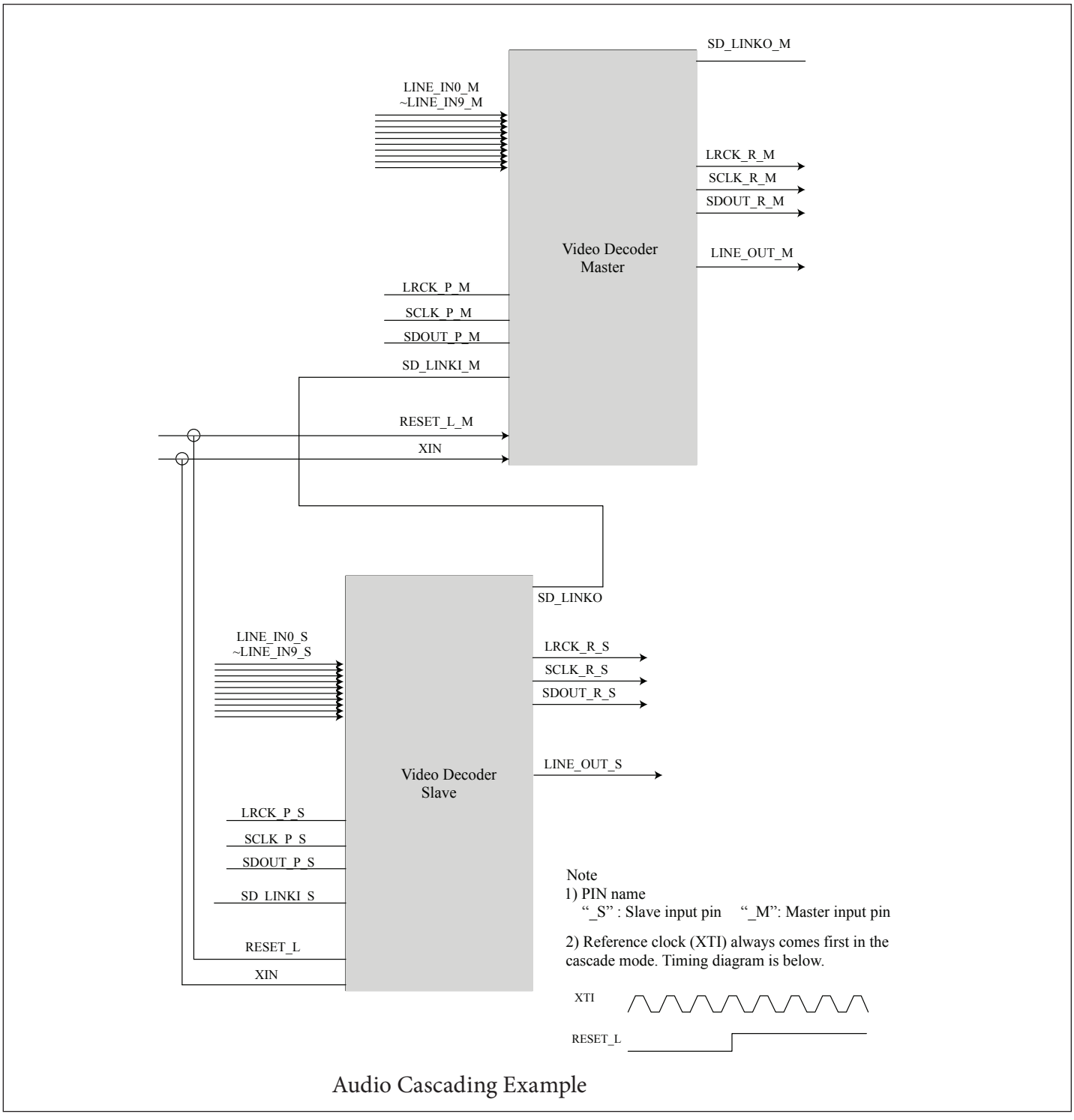
Audio Record Signal Output Format



Playback Input Format

PI7VD9008ABH Cascade Mode

For audio cascading, the chip redirects SDOUT_R as SD_LINKO to connect with SD_LINKI of another PI7VD9008AB product, which cascades its original SDOUT_R and SD_LINKI to create a new SDOUT_R. PI7VD9008ABcan support 16 channel data output on first level chip recordoutput pin for saving pin layout on PCB board. The cascade chips have to use same crystal clock source and same reset signal.

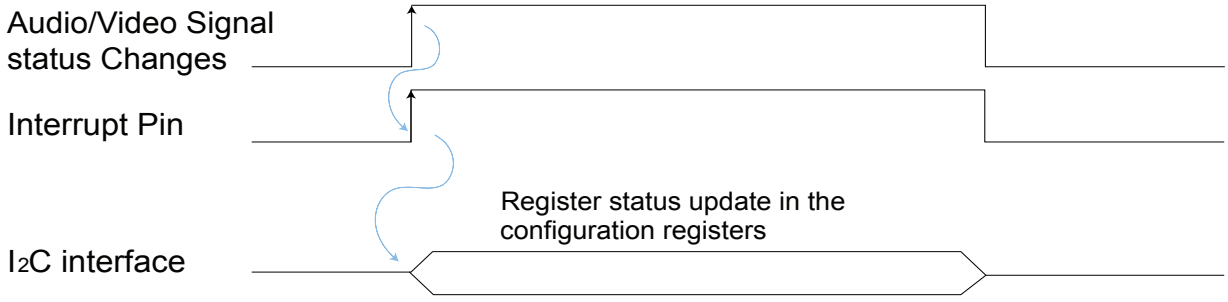


Audio Cascading Example

I2C Host Interface

The processor can access the internal register by executing read or write command to the indexed locations to implement the function of detecting audio and video signal and reveals the detection status through the configuration registers. If any audio or video channel is present or absent, interrupt pin (INT) can notify the status to the processor to manage CPU resource effectively by polling the status. The chip supports flexibilities to select various detection modes and enable individual audio/video channel for generating interrupt.

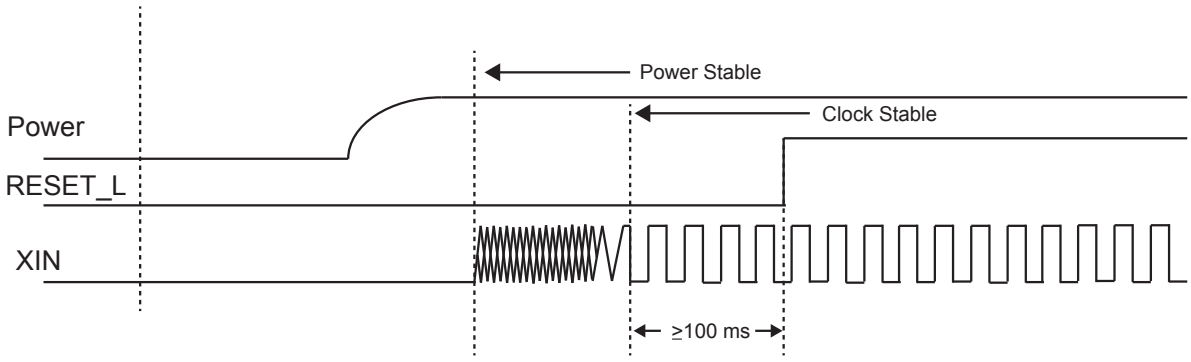
These control bits to interrupt pin are defined in the registers of AVDET_MODE, AVDET1_ENA, AVDET2_ENA, A51DET_ENA and A52DET_ENA.



Interrupt timing diagram of Audio/Video detection

Power Sequence

The power supply should be turned on first. After the power is turned on, the clock signal should be supplied. Finally, after both power and clock signals are turned on, the RESET_L signal is turned to HIGH to complete the power sequence.



CONFIGURATION, CONTROL AND STATUS REGISTER MAP

PAGE_0 REGISTER MAP (address 40h =00h)

Address	Function
00h/10h/20h/30h (00h)	Video Status
01h/11h/21h/31h (00h)	Brightness Control
02h/12h/22h/32h (64h)	Contrast Control
03h/13h/23h/33h (00h)	Sharpness Control
04h/14h/24h/34h (80h)	Chroma (U) Gain
05h/15h/25h/35h (80h)	Chroma (V) Gain
06h/16h/26h/36h (00h)	Hue Control
07h/17h/27h/37h	Reserved
08h/18h/28h/38h	Reserved
09h/19h/29h/39h	Reserved
0Ah/1Ah/2Ah/3Ah	Hdelay
0Bh/1Bh/2Bh/3Bh	Reserved
0Ch/1Ch/2Ch/3Ch	Reserved
0Dh/1Dh/2Dh/3Dh	Reserved
0Eh/1Eh/2Eh/3Eh (77h)	Standard Selection
0Fh/1Fh/2Fh/3Fh	Reserved
40h-50h	Reserved
51h (00h)	F-Bit of SAV/EAV Inverted
52h-55h	Reserved
56h	Blanking Length of Horizontal Line
57h/58h/59h/5Ah (90h)	Blanking Length of Horizontal Line
5Bh-5Ch	Reserved
5Dh(C0h)	Vin2 Color Kill Enable
5Eh(C0h)	Vin3 Color Kill Enable
5Fh(C0h)	Vin4 Color Kill Enable
60h	Reserved
61h (03h)	Crystal Clock Select
62h (00h)	GPIO Output Enable
63h (10h)	ID for Video Channel 0&1
64h (32h)	ID for Video Channel 2&3
65h (54h)	ID for Video Channel 4&5
66h (76h)	ID for Video Channel 6&7
67h(80h)	HZOOM Enable
68h(00h)	HI-Bits of 1234 HZOOM
69h(00h)	LOW-Bits of 1 HZOOM
6Ah(00h)	LOW-Bits of 2 HZOOM
6Bh(00h)	LOW-Bits of 3 HZOOM
6Ch(00h)	LOW-Bits of 4 HZOOM
6Dh-6Dh	Reserved
6Fh(00h)	Video Output Enable
70h (08h)	Audio Clock Control
71h (00h)	I2S Audio Input Control
72h	Reserved
73h(00h)	LINE_IN4_Control
74h(00h)	LINE_IN4 Detect Enable
75h-7Ah	Reserved
7Bh (00h)	SDOUT_M Select (R)
7Ch (00h)	SDOUT_M Select (L)
7Dh (E4h)	Extended Line Select
7Eh	SDOUT_M I2S
7Fh (00h)	Mix Ratio LINE_IN4

Address	Function
80h (00h)	Software Reset
81h-88h	Reserved
89h (00h)	Audio FS Mode
8Ah-95h	Reserved
96h(C0h)	Vin1 Color Kill Enable
97h-9Eh	Reserved
9Fh (00h)	PIXCLK 0Delay
A0h-B1h	Reserved
B2h (00h)	Vin1~Vin8 Video Loss Status
B3h-C7h	Reserved
C8h (00h)	GPIO_0_1 Mode
C9h (00h)	GPIO_2_3 Mode
CAh (55h)	Reserved
CBh (00h)	GPIO Polarity
CCh (00h)	Reserved
CDh (00h)	WD1 ,D1 Select
CEh	Reserved
CFh (00h)	Serial Mode Control
D0h-D1h	Reserved
D2h (03h)	SDOUT_RM Output
D3h (10h)	SDOUT_R_SEQ_1_0
D4h(32h)	SDOUT_R_SEQ_3_2
D5h (54h)	SDOUT_R_SEQ_5_4
D6h (76h)	SDOUT_R_SEQ_7_6
D7h (98h)	SDOUT_R_SEQ_9_8
D8h (BAh)	SDOUT_R_SEQ_B_A
D9h (DCh)	SDOUT_R_SEQ_D_C
DAh (FEh)	SDOUT_R_SEQ_F_E
DBh (C2h)	I2S Master Control
DCh(10h)	MIX MUTE Control
DDh (00h)	Mix Ratio 0 & 1
DEh (00h)	Mix Ratio 2 & 3
DFh (08h)	PB Ratio
E0h (14h)	Mixing Output Control
E1h (00h)	Audio Detect Threshold 0123 MSB
E2h (aah)	Audio Detect Threshold 01 LSB
E3h (aah)	Audio Detect Threshold 23 LSB
E4h-E6h	Reserved
E7h(55h)	VD0~VD4 Output Mode
E8h (10h)	PIXOUT_0 Output CH12 Select
E9h (32h)	PIXOUT_0 Output CH34 Select
EAh (32h)	PIXOUT_1 Output CH12 Select
EBh (54h)	PIXOUT_1 Output CH34 Select
ECh (54h)	PIXOUT_2 Output CH12 Select
EDh (76h)	PIXOUT_2 Output CH34 Select
EEh (76h)	PIXOUT_3 Output CH12 Select
EFh (10h)	PIXOUT_3 Output CH34 Select
F0h-F8_h	Reserved
F9h (00h)	PIXCLK Output Mode
FAh (00h)	CCIR656 Control
FBh (0Fh)	Clock Polarity
FCh (FFh)	AV Detection Enable
FDh (00h)	AV Detection Status
FEh (00h)	Device ID_H
FFh (F0h)	Device ID_L

PAGE_0 REGISTER MAP (address 40h =01h)

Address	Function
00h/10h/20h/30h (00h)	Video Status
01h/11h/21h/31h (00h)	Brightness Control
02h/12h/22h/32h (64h)	Contrast Control
03h/13h/23h/33h (00h)	Sharpness Control
04h/14h/24h/34h (80h)	Chroma (U) Gain
05h/15h/25h/35h (80h)	Chroma (V) Gain
06h/16h/26h/36h (00h)	Hue Control
0Ah/1Ah/2Ah/3Ah	Hdelay
0Eh/1Eh/2Eh/3Eh (77h)	Standard Selection
56h	Blanking Length of Horizontal Line
57h/58h/59h/5Ah (90h)	Blanking Length of Horizontal Line
5Dh(C0h)	Vin6 Color Kill Enable
5Eh(C0h)	Vin7 Color Kill Enable
5Fh(C0h)	Vin8 Color Kill Enable
68h(00h)	HI-Bits of 5 6 7 8HZOOM
69h(00h)	LOW-Bits of 5 HZOOM
6Ah(00h)	LOW-Bits of 6 HZOOM
6Bh(00h)	LOW-Bits of 7 HZOOM
6Ch(00h)	LOW-Bits of 8 HZOOM
73h(00h)	LINE_IN9 Control
74h(00h)	LINE_IN9 Detect Enable
7Eh	LINE_IN9 Detect Threshold
7Fh (00h)	Mix Ratio LINE_IN9
96h(C0h)	Vin5 Color Kill Enable
C8h (00h)	GPIO_4_5 Mode
C9h (00h)	GPIO_6_7 Mode
DDh (00h)	Mix Ratio 4 & 5
DEh (00h)	Mix Ratio 6 & 7
E1h (00h)	Audio Detect Threshold 5678 MSB
E2h (aah)	Audio Detect Threshold 56 LSB
E3h (aah)	Audio Detect Threshold 78 LSB
FCh (FFh)	AV Detection Enable
FDh (00h)	AV Detection Status

Control Register

PAGE 0 REGISTERS

Register Type	Descriptions
R	Read Only
RW	Read/Write

VIDEO STATUS REGISTER – OFFSET 00H/10H/20H/30H (Default: 00H)

BIT	FUNCTION	TYPE	DESCRIPTION
0	DET50	R	0: 60Hz source detected 1: 50Hz source detected
1	MONO	R	0:Color burst signal detected 1: No color burst signal detected
2	Reserved	R	Reset to 0b
3	VLOCK	R	0: Vertical logic is not locked 1: Vertical logic is locked to incoming video
4	Reserved	R	Reset to 0b
5	SLOCK	R	0: Sub-carrier sync is not detected 1: Sub-carrier sync is detected
6	HLOCK	R	0:Horizontal sync is not detected 1: Horizontal sync is detected
7	VDLOSS	R	0: Video is detected 1: Video not present

BRIGHTNESS CONTROL REGISTER – OFFSET 01H/11H/21H/31H(Default=00H)

BIT	FUNCTION	TYPE	DESCRIPTION
[7:0]	Brightness	RW	These Signed bits control the brightness.Value range from -128 to 127 8'h7F: brightest; 8'h80: darkest ;8'h00 : no effect

CONTRASTCONTROL REGISTER – OFFSET 02H/12H/22H/32H(Default=64H)

BIT	FUNCTION	TYPE	DESCRIPTION
[7:0]	Contrast	RW	These unsigned bits control the luminance gain. 8'h7F: maximum contrast 8'h00: minimum contrast

SHARPNESSCONTROL REGISTER – OFFSET 03H/13H/23H/33H(Default=00H)

BIT	FUNCTION	TYPE	DESCRIPTION
[3:0]	Sharpness	RW	These bits control the amount of sharpness enhancement on the luminance signals "0" has no effect on the output image "1" through "15" provides sharpness enhancement with "15" being the strongest
[7:4]	Reserved	R	Reset to 0h

CHROMA(U) GAIN REGISTER – OFFSET 04H/14H/24H/34H(Default=80H)

BIT	FUNCTION	TYPE	DESCRIPTION
[7:0]	Chroma (U) Gain	RW	Chroma gain value of controlling the color saturation

CHROMA(V) GAIN REGISTER – OFFSET 05H/15H/25H/35H(Default=80H)

BIT	FUNCTION	TYPE	DESCRIPTION
[7:0]	Chroma (V) Gain	RW	Chroma gain value of controlling the color saturation

HUECONTROL REGISTER – OFFSET 06H/16H/26H/36H(Default=00H)

BIT	FUNCTION	TYPE	DESCRIPTION
[7:0]	Hue	RW	These signed bits control color hue. +90C(7Fh) to -90C(80h)

RESERVED REGISTER– OFFSET07H/17H/27H/37H

RESERVED REGISTER – OFFSET 08H/18H/28H/38H

RESERVED REGISTER – OFFSET09H/19H/29H/39H

H-Delay REGISTER – OFFSET 0AH/1AH/2AH/3AH(Default=00H)

BIT	FUNCTION	TYPE	DESCRIPTION
[7:5]	Reserved	R	Reset to 0b
[4:0]	HorizontalShift Pixels Poinis	R/W	Left shift the start points of video outputs

RESERVED REGISTER – OFFSET 0BH/1BH/2BH/3BH

RESERVED REGISTER – OFFSET 0CH/1CH/2CH/3CH

RESERVED REGISTER – OFFSET 0DH/1DH/2DH/3DH

STANDARD SELECTION REGISTER – OFFSET 0EH/1EH/2EH/3EH(Default=77H)

BIT	FUNCTION	TYPE	DESCRIPTION
[2:0]	Standard Selection	RW	0: NTSC(M) 1: PAL(B,D,G,H,I) 2:Not valid 3: NTSC4.43 4: PAL(M) 5: PAL(CN) 6: PAL60 7: Auto detection
[3]	Reserved	R	Reset to 0b
[6:4]	Current Standard Detected	R	0: NTSC(M) 1: PAL(B,D,G,H,I) 2:Not valid 3: NTSC4.43 4: PAL(M) 5: PAL(CN) 6: PAL60 7:Not valid
[7]	Reserved	R	Reset to 0b

RESERVEDREGISTER – OFFSET 0FH/1FH/2FH/3FH

RESERVED REGISTER – OFFSET 40H-50H

FBITINV REGISTER – OFFSET 51H(Default=00H)

BIT	FUNCTION	TYPE	DESCRIPTION
[0]	FBITINV0	R/W	0: F-bit in the 4th byte of 656 EAV/SAV for channel 1 is not inverted. 1: F-bit in the 4th byte for channel 0 is inverted.
[1]	FBITINV1	R/W	0: F-bit in the 4th byte of 656 EAV/SAV for channel 2 is not inverted. 1: F-bit in the 4th byte for channel 1is inverted.
[2]	FBITINV2	R/W	0: F-bit in the 4th byte of 656 EAV/SAV for channel 3 is not inverted. 1: F-bit in the 4th byte for channel 2is inverted.
[3]	FBITINV3	R/W	0: F-bit in the 4th byte of 656 EAV/SAV for channel 4 is not inverted. 1: F-bit in the 4th byte for channel 3is inverted.
[7:4]	Reserved	R	Reset to 0b

RESERVED REGISTER – OFFSET 52H-56H

High HBLEN REGISTER – OFFSET 56H (Default=00H)

BIT	FUNCTION	TYPE	DESCRIPTION
[0]	HBLEN1[8]	R	Display the blanking length starting from EAV to SAV code.
[1]	HBLEN2[8]	R	Display the blanking length starting from EAV to SAV code.
[2]	HBLEN3[8]	R	Display the blanking length starting from EAV to SAV code.
[3]	HBLEN4[8]	R	Display the blanking length starting from EAV to SAV code.
[7:4]	Reserved	R	Reset to 0b

LOW HBLEN REGISTER – OFFSET 57H/58H/59H/5AH(Default=90H)

BIT	FUNCTION	TYPE	DESCRIPTION
[7:0]	HBLENn[7:0] n=1,2,3,4	R	Display the blanking length starting from EAV to SAV code. (1) In 27MHz D1 Mode: 90H for PAL while 8AH for NTSC (2) In 36MHz WD1 Mode: C0H for PAL while B8H for NTSC

RESERVED REGISTER – OFFSET 5BH-5CH

VIN2 COLOR KILL ENABLE-REGISTER – OFFSET 5DH(Default=C0H)

BIT	FUNCTION	TYPE	DESCRIPTION
[5:0]	Reserved	RW	Reset to 0h
[6]	PAL CKILL EN	RW	1:enable color kill mode in PAL 0:disable color kill mode in PAL
[7]	NTSC CKILL EN	RW	1:enable color kill mode in NTSC 0:disable color kill mode in NTSC

VIN3 COLOR KILL ENABLE-REGISTER – OFFSET 5EH(Default=C0H)

BIT	FUNCTION	TYPE	DESCRIPTION
[5:0]	Reserved	RW	Reset to 0h
[6]	PAL CKILL EN	RW	1:enable color kill mode in PAL 0:disable color kill mode in PAL
[7]	NTSC CKILL EN	RW	1:enable color kill mode in NTSC 0:disable color kill mode in NTSC

VIN4 COLOR KILL ENABLE-REGISTER – OFFSET 5FH(Default=C0H)

BIT	FUNCTION	TYPE	DESCRIPTION
[5:0]	Reserved	RW	Reset to 0h
[6]	PAL CKILL EN	RW	1:enable color kill mode in PAL 0:disable color kill mode in PAL

[7]	NTSC CKILL EN	RW	1:enable color kill mode in NTSC 0:disable color kill mode in NTSC

RESERVED REGISTER – OFFSET 60H

CRYSTAL CLOCK SELECT REGISTER – OFFSET 61H(Default=03H)

BIT	FUNCTION	TYPE	DESCRIPTION
[1:0]	XINMD	RW	XIN input frequency 0:27Mhz 1:54Mhz 2:108Mhz 3:27Mhz
[7:2]	Reserved	RW	Reset to 00h

GPIO_OE REGISTER – OFFSET 62H(Default=00H)

BIT	FUNCTION	TYPE	DESCRIPTION
[0]	GPIO_0OE	RW	0: GPIO_0 pin is input. 1: GPIO_0 pin is output.
[1]	GPIO_1OE	RW	0: GPIO_1 pin is input. 1: GPIO_1 pin is output.
[2]	GPIO_2OE	RW	0: GPIO_2 pin is input. 1: GPIO_2 pin is output.
[3]	GPIO_3OE	RW	0: GPIO_3 pin is input. 1: GPIO_3 pin is output.
[7:4]	Reserved	RW	Reset to 00h

CHANNEL ID01 REGISTER – OFFSET 63H(Default=10H)

BIT	FUNCTION	TYPE	DESCRIPTION
[3:0]	CH0NUM	RW	Assign channel ID number in CV_IN0A video data output
[7:4]	CH1NUM	RW	Assign channel ID number in CV_IN1A video data output

CHANNEL ID23 REGISTER – OFFSET 64H(Default=32H)

BIT	FUNCTION	TYPE	DESCRIPTION
[3:0]	CH2NUM	RW	Assign channel ID number in CV_IN2A video data output
[7:4]	CH3NUM	RW	Assign channel ID number in CV_IN3A video data output

CHANNEL ID45 REGISTER – OFFSET 65H(Default=54H)

BIT	FUNCTION	TYPE	DESCRIPTION
[3:0]	CH4NUM	RW	Assign channel ID number in CV_IN4A video data output
[7:4]	CH5NUM	RW	Assign channel ID number in CV_IN5A video data output

CHANNEL ID67 REGISTER – OFFSET 66H(Default=76H)

BIT	FUNCTION	TYPE	DESCRIPTION
[3:0]	CH6NUM	RW	Assign channel ID number in CV_IN6A video data output
[7:4]	CH7NUM	RW	Assign channel ID number in CV_IN7A video data output

HZOOM ENABLE REGISTER – OFFSET 67H(Default=80H)

BIT	FUNCTION	TYPE	DESCRIPTION
[6:0]	Reserved	R	Reset to 00h
[7]	HZOOM ENABLE	RW	1: Enable HZOOM function 0: Disable HZOOM function

HI –Bits HZOOM REGISTER – OFFSET 68H(Default=00H)

BIT	FUNCTION	TYPE	DESCRIPTION
[1:0]	HZOOM1[9:8]	RW	MSB of reg69
[3:2]	HZOOM2[9:8]	RW	MSB of reg6A
[5:4]	HZOOM3[9:8]	RW	MSB of reg6B
[7:6]	HZOOM4[9:8]	RW	MSB of reg6C

LOW–Bits HZOOM VIN1 REGISTER – OFFSET 69H(Default=00H)

BIT	FUNCTION	TYPE	DESCRIPTION
[7:0]	HZOOM1[7:0]	R/W	HZOOM UP register the number is from 3DE to 3FF if HZOOM1[9:0]=00h No HZOOM Function

LOW–Bits HZOOM VIN2 REGISTER – OFFSET 6AH(Default=00H)

BIT	FUNCTION	TYPE	DESCRIPTION
[7:0]	HZOOM2[7:0]	R/W	HZOOM UP register the number is from 3DE to 3FF if HZOOM2[9:0]=00h No HZOOM Function

LOW–Bits HZOOM VIN3 REGISTER – OFFSET 6BH(Default=00H)

BIT	FUNCTION	TYPE	DESCRIPTION
[7:0]	HZOOM3[7:0]	R/W	HZOOM UP register the number is from 3DE to 3FF if HZOOM3[9:0]=00h No HZOOM Function

LOW–Bits HZOOM VIN4 REGISTER – OFFSET 6CH(Default=00H)

BIT	FUNCTION	TYPE	DESCRIPTION
[7:0]	HZOOM4[7:0]	R/W	HZOOM UP register the number is from 3DE to 3FF if HZOOM4[9:0]=00h No HZOOM Function

RESERVED REGISTER – OFFSET 6DH-6EH

PIXOUT OUTPUT ENABLE REGISTER – OFFSET 6FH(Default=00H)

BIT	FUNCTION	TYPE	DESCRIPTION
[0]	PIXOUT0_OEB	R	0: enable output 1: disable output
[1]	PIXOUT1_OEB	R	0: enable output 1: disable output
[2]	PIXOUT2_OEB	R	0: enable output 1: disable output
[3]	PIXOUT3_OEB	R	0: enable output 1: disable output
[7:4]	Reserved	R	Reset to 0b

AUDIO CLOCK CONTROL REGISTER – OFFSET 70H(Default=08H)

BIT	FUNCTION	TYPE	DESCRIPTION
[2:0]	AFMD	RW	0: 8KHz 1: 16KHz 2: 32KHz 3: 44.1KHz 4: 48KHz
[3]	Reserved	R	Reset to 1b
[5:4]	Reserved	R	Reset to 0b
[6]	S2I_8BIT	RW	0:SCLK_P/LRCK_P/SDOUT_P pin input 16-bit control 1: SCLK_P/LRCK_P/SDOUT_P pin input 8-bit control
[7]	Reserved	R	Reset to 0b

I2S AUDIO INPUT CONTROL REGISTER – OFFSET 71H(Default=00H)

BIT	FUNCTION	TYPE	DESCRIPTION
[1:0]	Reserved	R	Reset to 00b
[2]	SDINPDLY	RW	SDIN_P input data delay by one SCLK_P clock 0:No delay; 1T delay for I2S interface 1:Add 1 SCLK_P clock delay in SDIN_P input.; 0T delay for left-justified interface.
[7:3]	Reserved	R	Reset to 00h