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Multiformat Video Encoder Six 14-Bit *Noise Shaped Video* DACs

Data Sheet

ADV7344

FEATURES

- 74.25 MHz 20-/30-bit high definition input support
  - Compliant with SMPTE 274M (1080i), 296M (720p), and 240M (1035i)
- 6 *Noise Shaped Video*® (NSV) 14-bit video DACs
  - 16× (216 MHz) DAC oversampling for SD
  - 8× (216 MHz) DAC oversampling for ED
  - 4× (297 MHz) DAC oversampling for HD
  - 37 mA maximum DAC output current
- NTSC M, PAL B/D/G/H/I/M/N, PAL 60 support
- NTSC and PAL square pixel operation (24.54 MHz/29.5 MHz)
- Multiformat video input support
  - 4:2:2 YCrCb (SD, ED, and HD)
  - 4:4:4 YCrCb (ED and HD)
  - 4:4:4 RGB (SD, ED, and HD)
- Multiformat video output support
  - Composite (CVBS) and S-Video (Y-C)
  - Component YPrPb (SD, ED, and HD)
  - Component RGB (SD, ED, and HD)
- Macrovision Rev 7.1.L1 (SD) and Rev 1.2 (ED) compliant
- Simultaneous SD and ED/HD operation
- EIA/CEA-861B compliance support
- Copy generation management system (CGMS)
- Closed captioning and wide screen signaling (WSS)
- Integrated subcarrier locking to external video source
- Complete on-chip video timing generator
- On-chip test pattern generation
- On-board voltage reference (optional external input)
- Programmable features
  - Luma and chroma filter responses
  - Vertical blanking interval (VBI)
  - Subcarrier frequency (F_{SC}) and phase
  - Luma delay
- High definition (HD) programmable features (720p/1080i/1035i)
  - 4× oversampling (297 MHz)
  - Internal test pattern generator
    - Color and black bar, hatch, flat field/frame
  - Fully programmable YCrCb to RGB matrix
  - Gamma correction
  - Programmable adaptive filter control
  - Programmable sharpness filter control
  - CGMS (720p/1080i) and CGMS Type B (720p/1080i)
  - Dual data rate (DDR) input support
- Enhanced definition (ED) programmable features (525p/625p)
  - 8× oversampling (216 MHz output)
  - Internal test pattern generator
    - Black bar, hatch, flat field/frame
  - Individual Y and PrPb output delay
  - Gamma correction
  - Programmable adaptive filter control
  - Fully programmable YCrCb to RGB matrix
  - Undershoot limiter
  - Macrovision Rev 1.2 (525p/625p)
  - CGMS (525p/625p) and CGMS Type B (525p)
  - Dual data rate (DDR) input support
- Standard definition (SD) programmable features
  - 16× oversampling (216 MHz)
  - Internal test pattern generator
    - Color and black bar
  - Controlled edge rates for start and end of active video
  - Individual Y and PrPb output delay
  - Undershoot limiter
  - Gamma correction
  - Digital noise reduction (DNR)
  - Multiple chroma and luma filters
  - Luma-SSAF filter with programmable gain/attenuation
  - PrPb SSAF
  - Separate pedestal control on component and composite/S-Video output
  - VCR FF/RW sync mode
  - Macrovision Rev 7.1.L1
  - Copy generation management system (CGMS)
  - Wide screen signaling (WSS)
  - Closed captioning
- Serial MPU interface with I^2C compatibility
- 3.3 V analog operation
- 1.8 V digital operation
- 1.8 V or 3.3 V I/O operation
- Temperature range: −40°C to +85°C

APPLICATIONS

- DVD recorders and players
- High definition Blu-ray DVD players

Rev. B
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REVISION HISTORY

2/12—Rev. A to Rev. B

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Changes to 24-/30-Bit 4:4:4 RGB Mode Section 50
Deleted ED/HD Nonstandard Timing Mode Section, Figure 58, and Table 42, Renumbered Sequentially 54
Added External Sync Polarity Section 57
Changed SD Subcarrier Frequency Lock, Subcarrier Phase Reset, and Timing Reset Section to SD Subcarrier Frequency Lock Section 58
Deleted Subaddress 0x84, Bits[2:1] Section, Timing Reset (TR) Mode Section, Subcarrier Phase Reset (SCR) Mode Section, and Figure 59 55
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3/09—Rev. 0 to Rev. A

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Added Configuration Scripts Section 93

10/06—Revision 0: Initial Version

GENERAL DESCRIPTION

The ADV7344 is a high speed, digital-to-analog video encoder in a 64-pin LQFP package. Six high speed, NSV, 3.3 V, 14-bit video DACs provide support for composite (CVBS), S-Video (YC), and component (YPrPb/RGB) analog outputs in standard definition (SD), enhanced definition (ED), or high definition (HD) video formats.

The ADV7344 has a 30-bit pixel input port that can be configured in a variety of ways. SD video formats are supported over an SDR interface and ED/HD video formats are supported over SDR and DDR interfaces. Pixel data can be supplied in either the YCrCb or RGB color space.

The ADV7344 also supports embedded EAV/SAV timing codes, external video synchronization signals, and I²C® communication protocol.

In addition, simultaneous SD and ED/HD input and output is supported. Full-drive DACs ensure that external output buffering is not required, while 216 MHz (SD and ED) and 297 MHz (HD) oversampling ensures that external output filtering is not required.

Cable detection and DAC autopower-down features keep power consumption to a minimum.

Table 1 lists the video standards directly supported by the ADV7344.

Table 1. Standards Directly Supported by the ADV7344

Active Resolution	I/P[1]	Frame Rate (Hz)	Clock Input (MHz)	Standard
720 × 240	P	59.94	27	
720 × 288	P	50	27	
720 × 480	I	29.97	27	ITU-R BT.601/656
720 × 576	I	25	27	ITU-R BT.601/656
640 × 480	I	29.97	24.54	NTSC Square Pixel
768 × 576	I	25	29.5	PAL Square Pixel
720 × 483	P	59.94	27	SMPTE 293M
720 × 483	P	59.94	27	BTA T-1004
720 × 483	P	59.94	27	ITU-R BT.1358
720 × 576	P	50	27	ITU-R BT.1358
720 × 483	P	59.94	27	ITU-R BT.1362
720 × 576	P	50	27	ITU-R BT.1362
1920 × 1035	I	30	74.25	SMPTE 240M
1920 × 1035	I	29.97	74.1758	SMPTE 240M
1280 × 720	P	60, 50, 30, 25, 24	74.25	SMPTE 296M
1280 × 720	P	23.97, 59.94, 29.97	74.1758	SMPTE 296M
1920 × 1080	I	30, 25	74.25	SMPTE 274M
1920 × 1080	I	29.97	74.1758	SMPTE 274M
1920 × 1080	P	30, 25, 24	74.25	SMPTE 274M
1920 × 1080	P	23.98, 29.97	74.1758	SMPTE 274M
1920 × 1080	P	24	74.25	ITU-R BT.709-5

[1] I = interlaced, P = progressive.

FUNCTIONAL BLOCK DIAGRAM

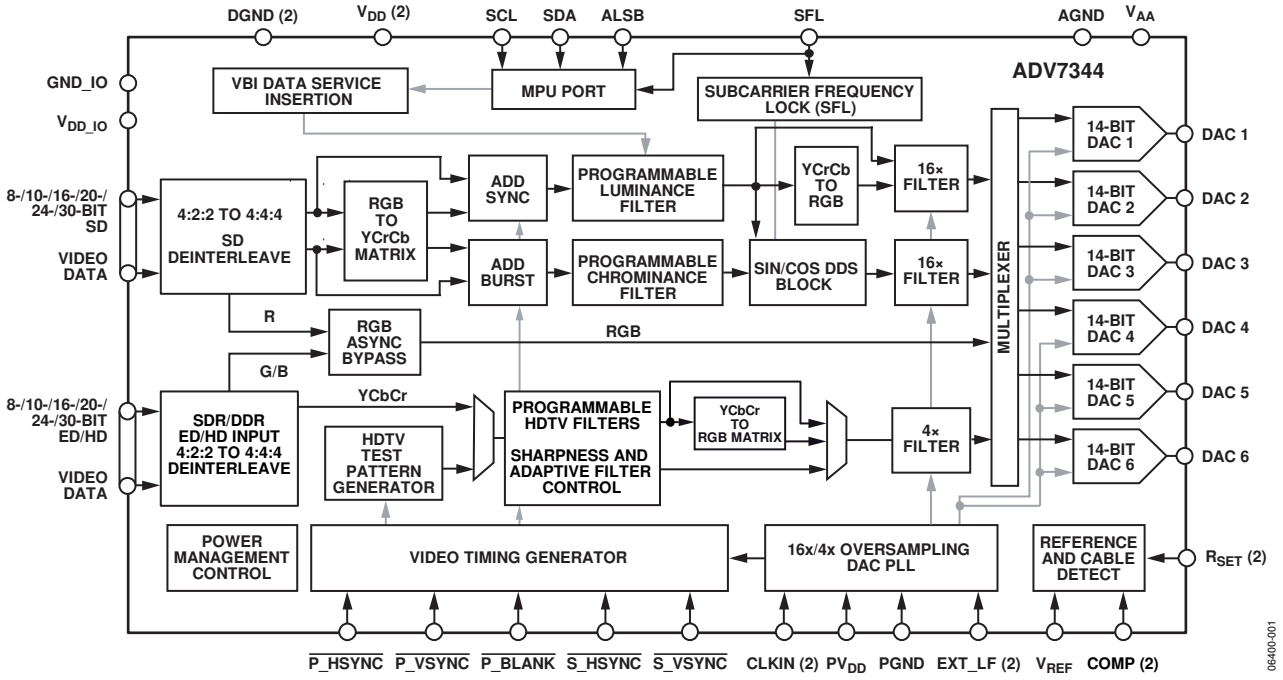


Figure 1.

SPECIFICATIONS

POWER SUPPLY AND VOLTAGE SPECIFICATIONS

All specifications T_{MIN} to T_{MAX} (−40°C to +85°C), unless otherwise noted.

Table 2.

Parameter	Min	Typ	Max	Unit
SUPPLY VOLTAGES				
V_{DD}	1.71	1.8	1.89	V
V_{DD_IO}	1.71	3.3	3.63	V
PV_{DD}	1.71	1.8	1.89	V
V_{AA}	2.6	3.3	3.465	V
POWER SUPPLY REJECTION RATIO		0.002		%/%

VOLTAGE REFERENCE SPECIFICATIONS

All specifications T_{MIN} to T_{MAX} (−40°C to +85°C), unless otherwise noted.

Table 3.

Parameter	Min	Typ	Max	Unit
Internal Reference Range, V_{REF}	1.186	1.248	1.31	V
External Reference Range, V_{REF}	1.15	1.235	1.31	V
External V_{REF} Current[1]		±10		µA

[1] External current required to overdrive internal V_{REF}.

INPUT CLOCK SPECIFICATIONS

V_{DD} = 1.71 V to 1.89 V, PV_{DD} = 1.71 V to 1.89 V, V_{AA} = 2.6 V to 3.465 V, V_{DD_IO} = 1.71 V to 3.63 V.
All specifications T_{MIN} to T_{MAX} (−40°C to +85°C), unless otherwise noted.

Table 4.

Parameter	Conditions[1]	Min	Typ	Max	Unit
f_{CLKIN_A}	SD/ED		27		MHz
f_{CLKIN_A}	ED (at 54 MHz)		54		MHz
f_{CLKIN_A}	HD		74.25		MHz
f_{CLKIN_B}	ED		27		MHz
f_{CLKIN_B}	HD		74.25		MHz
CLKIN_A High Time, t_9		40			% of one clock cycle
CLKIN_A Low Time, t_{10}		40			% of one clock cycle
CLKIN_B High Time, t_9		40			% of one clock cycle
CLKIN_B Low Time, t_{10}		40			% of one clock cycle
CLKIN_A Peak-to-Peak Jitter Tolerance			2		±ns
CLKIN_B Peak-to-Peak Jitter Tolerance			2		±ns

[1] SD = standard definition, ED = enhanced definition (525p/625p), HD = high definition.

ANALOG OUTPUT SPECIFICATIONS

V_{DD} = 1.71 V to 1.89 V, PV_{DD} = 1.71 V to 1.89 V, V_{AA} = 2.6 V to 3.465 V, V_{DD_IO} = 1.71 V to 3.63 V, V_{REF} = 1.235 V (driven externally). All specifications T_{MIN} to T_{MAX} (−40°C to +85°C), unless otherwise noted.

Table 5.

Parameter	Conditions	Min	Typ	Max	Unit
Full Drive Output Current (Full-Scale)	R_{SET} = 510 Ω, R_L = 37.5 Ω DAC 1, DAC 2, DAC 3 enabled[1]	33	34.6	37	mA
	R_{SET} = 510 Ω, R_L = 37.5 Ω DAC 1 enabled only[2]	33	33.5	37	mA
Low-Drive Output Current (Full-Scale)[3]	R_{SET} = 4.12 kΩ, R_L = 300 Ω	4.1	4.3	4.5	mA
DAC-to-DAC Matching	DAC 1 to DAC 6		1.0		%
Output Compliance, V_{OC}		0		1.4	V
Output Capacitance, C_{OUT}	DAC 1, DAC 2, DAC 3		10		pF
	DAC 4, DAC 5, DAC 6		6		pF
Analog Output Delay[4]	DAC 1, DAC 2, DAC 3		8		ns
	DAC 4, DAC 5, DAC 6		6		ns
DAC Analog Output Skew	DAC 1, DAC 2, DAC 3		2		ns
	DAC 4, DAC 5, DAC 6		1		ns

[1] Applicable to full-drive capable DACs only, that is, DAC 1, DAC 2, DAC 3.
[2] The recommended method of bringing this typical value back to the ideal value is by adjusting Register 0x0B to the recommended value of 0x12.
[3] Applicable to all DACs.
[4] Output delay measured from the 50% point of the rising edge of the input clock to the 50% point of the DAC output full-scale transition.

DIGITAL INPUT/OUTPUT SPECIFICATIONS—3.3 V

V_{DD} = 1.71 V to 1.89 V, PV_{DD} = 1.71 V to 1.89 V, V_{AA} = 2.6 V to 3.465 V, V_{DD_IO} = 2.97 V to 3.63 V.
All specifications T_{MIN} to T_{MAX} (−40°C to +85°C), unless otherwise noted.

Table 6.

Parameter	Conditions	Min	Typ	Max	Unit
Input High Voltage, V_{IH}		2.0			V
Input Low Voltage, V_{IL}				0.8	V
Input Leakage Current, I_{IN}	V_{IN} = V_{DD_IO}			±10	µA
Input Capacitance, C_{IN}			4		pF
Output High Voltage, V_{OH}	I_{SOURCE} = 400 µA	2.4			V
Output Low Voltage, V_{OL}	I_{SINK} = 3.2 mA			0.4	V
Three-State Leakage Current	V_{IN} = 0.4 V, 2.4 V			±1.0	µA
Three-State Output Capacitance			4		pF

DIGITAL INPUT/OUTPUT SPECIFICATIONS—1.8 V

When V_{DD_IO} is set to 1.8 V, all the digital video inputs and control inputs, such as I^2C, HS, and VS, should use 1.8 V levels.

V_{DD} = 1.71 V to 1.89 V, PV_{DD} = 1.71 V to 1.89 V, V_{AA} = 2.6 V to 3.465 V, V_{DD_IO} = 1.71 V to 1.89 V.
All specifications T_{MIN} to T_{MAX} (−40°C to +85°C), unless otherwise noted.

Table 7.

Parameter	Conditions	Min	Typ	Max	Unit
Input High Voltage, V_{IH}		0.7 V_{DD_IO}			V
Input Low Voltage, V_{IL}				0.3 V_{DD_IO}	V
Input Capacitance, C_{IN}			4		pF
Output High Voltage, V_{OH}	I_{SOURCE} = 400 µA	V_{DD_IO} – 0.4			V
Output Low Voltage, V_{OL}	I_{SINK} = 3.2 mA			0.4	V
Three-State Output Capacitance			4		pF

DIGITAL TIMING SPECIFICATIONS—3.3 V

V_{DD} = 1.71 V to 1.89 V, PV_{DD} = 1.71 V to 1.89 V, V_{AA} = 2.6 V to 3.465 V, V_{DD_IO} = 2.97 V to 3.63 V.
All specifications T_{MIN} to T_{MAX} (−40°C to +85°C), unless otherwise noted.

Table 8.

Parameter	Conditions[1]	Min	Typ	Max	Unit
VIDEO DATA AND VIDEO CONTROL PORT[2, 3]					
Data Input Setup Time, t_{11}[4]	SD	2.1			ns
	ED/HD-SDR	2.3			ns
	ED/HD-DDR	2.3			ns
	ED (at 54 MHz)	1.7			ns
Data Input Hold Time, t_{12}[4]	SD	1.0			ns
	ED/HD-SDR	1.1			ns
	ED/HD-DDR	1.1			ns
	ED (at 54 MHz)	1.0			ns
Control Input Setup Time, t_{11}[4]	SD	2.1			ns
	ED/HD-SDR or ED/HD-DDR	2.3			ns
	ED (at 54 MHz)	1.7			ns
Control Input Hold Time, t_{12}[4]	SD	1.0			ns
	ED/HD-SDR or ED/HD-DDR	1.1			ns
	ED (at 54 MHz)	1.0			ns
Control Output Access Time, t_{13}[4]	SD			12	ns
	ED/HD-SDR, ED/HD-DDR or ED (at 54 MHz)			10	ns
Control Output Hold Time, t_{14}[4]	SD	4.0			ns
	ED/HD-SDR, ED/HD-DDR or ED (at 54 MHz)	3.5			ns
PIPELINE DELAY[5]					
SD[1]					
CVBS/YC Outputs (2×)	SD oversampling disabled		68		Clock cycles
CVBS/YC Outputs (16×)	SD oversampling enabled		67		Clock cycles
Component Outputs (2×)	SD oversampling disabled		78		Clock cycles
Component Outputs (16×)	SD oversampling enabled		84		Clock cycles
ED[1]					
Component Outputs (1×)	ED oversampling disabled		41		Clock cycles
Component Outputs (8×)	ED oversampling enabled		46		Clock cycles
HD[1]					
Component Outputs (1×)	HD oversampling disabled		40		Clock cycles
Component Outputs (4×)	HD oversampling enabled		44		Clock cycles

[1] SD = standard definition, ED = enhanced definition (525p/625p), HD = high definition, SDR = single data rate, DDR = dual data rate.
[2] Video data: C[9:0], Y[9:0], and S[9:0].
[3] Video control: P_HSYNC, P_VSYNC, P_BLANK, S_HSYNC, and S_VSYNC.
[4] Guaranteed by characterization.
[5] Guaranteed by design.

DIGITAL TIMING SPECIFICATIONS—1.8 V

V_{DD} = 1.71 V to 1.89 V, PV_{DD} = 1.71 V to 1.89 V, V_{AA} = 2.6 V to 3.465 V, V_{DD_IO} = 1.71 V to 1.89 V.
All specifications T_{MIN} to T_{MAX} (−40°C to +85°C), unless otherwise noted.

Table 9.

Parameter	Conditions[1]	Min	Typ	Max	Unit
VIDEO DATA AND VIDEO CONTROL PORT[2, 3]					
Data Input Setup Time, t_{11}[4]	SD	1.4			ns
	ED/HD-SDR	1.9			ns
	ED/HD-DDR	1.9			ns
	ED (at 54 MHz)	1.6			ns
Data Input Hold Time, t_{12}[4]	SD	1.4			ns
	ED/HD-SDR	1.5			ns
	ED/HD-DDR	1.5			ns
	ED (at 54 MHz)	1.3			ns
Control Input Setup Time, t_{11}[4]	SD	1.4			ns
	ED/HD-SDR or ED/HD-DDR	1.2			ns
	ED (at 54 MHz)	1.0			ns
Control Input Hold Time, t_{12}[4]	SD	1.4			ns
	ED/HD-SDR or ED/HD-DDR	1.0			ns
	ED (at 54 MHz)	1.0			ns
Control Output Access Time, t_{13}[4]	SD			13	ns
	ED/HD-SDR, ED/HD-DDR or ED (at 54 MHz)			12	ns
Control Output Hold Time, t_{14}[4]	SD	4.0			ns
	ED/HD-SDR, ED/HD-DDR or ED (at 54 MHz)	5.0			ns
PIPELINE DELAY[5]					
SD[1]					
CVBS/YC Outputs (2×)	SD oversampling disabled		68		Clock cycles
CVBS/YC Outputs (16×)	SD oversampling enabled		67		Clock cycles
Component Outputs (2×)	SD oversampling disabled		78		Clock cycles
Component Outputs (16×)	SD oversampling enabled		84		Clock cycles
ED[1]					
Component Outputs (1×)	ED oversampling disabled		41		Clock cycles
Component Outputs (8×)	ED oversampling enabled		46		Clock cycles
HD[1]					
Component Outputs (1×)	HD oversampling disabled		40		Clock cycles
Component Outputs (4×)	HD oversampling enabled		44		Clock cycles

[1] SD = standard definition, ED = enhanced definition (525p/625p), HD = high definition, SDR = single data rate, DDR = dual data rate.
[2] Video data: C[9:0], Y[9:0], and S[9:0].
[3] Video control: $\overline{\text{P_HSYNC}}$, $\overline{\text{P_VSYNC}}$, $\overline{\text{P_BLANK}}$, $\overline{\text{S_HSYNC}}$, and $\overline{\text{S_VSYNC}}$.
[4] Guaranteed by characterization.
[5] Guaranteed by design.

MPU PORT TIMING SPECIFICATIONS

V_{DD} = 1.71 V to 1.89 V, PV_{DD} = 1.71 V to 1.89 V, V_{AA} = 2.6 V to 3.465 V, V_{DD_IO} = 1.71 V to 3.63 V.
All specifications T_{MIN} to T_{MAX} (−40°C to +85°C), unless otherwise noted.

Table 10.

Parameter	Conditions	Min	Typ	Max	Unit
MPU PORT, I²C MODE[1]	See Figure 19				
SCL Frequency		0		400	kHz
SCL High Pulse Width, t_1		0.6			µs
SCL Low Pulse Width, t_2		1.3			µs
Hold Time (Start Condition), t_3		0.6			µs
Setup Time (Start Condition), t_4		0.6			µs
Data Setup Time, t_5		100			ns
SDA, SCL Rise Time, t_6				300	ns
SDA, SCL Fall Time, t_7				300	ns
Setup Time (Stop Condition), t_8		0.6			µs

[1] Guaranteed by characterization.

POWER SPECIFICATIONS

V_{DD} = 1.8 V, PV_{DD} = 1.8 V, V_{AA} = 3.3 V, V_{DD_IO} = 3.3 V, T_A = 25°C.

Table 11.

Parameter	Conditions	Min	Typ	Max	Unit
NORMAL POWER MODE[1, 2]					
I_{DD}[3]	SD only (16× oversampling)		90		mA
	ED only (8× oversampling)[4]		65		mA
	HD only (4× oversampling)[4]		91		mA
	SD (16× oversampling) and ED (8× oversampling)		95		mA
	SD (16× oversampling) and HD (4× oversampling)		122		mA
I_{DD_IO}			1		mA
I_{AA}[5]	Three DACs enabled (ED/HD only)		124		mA
	Six DACs enabled (SD only and simultaneous modes)		140		mA
I_{PLL}	SD only, ED only, or HD only modes		5		mA
	Simultaneous modes		10		mA
SLEEP MODE					
I_{DD}			5		µA
I_{AA}			0.3		µA
I_{DD_IO}			0.2		µA
I_{PLL}			0.1		µA

[1] R_{SET1} = 510 Ω (DAC 1, DAC 2 and DAC 3 operating in full-drive mode). R_{SET2} = 4.12 kΩ (DAC 4, DAC 5, and DAC 6 operating in low drive mode).
[2] 75% color bar test pattern applied to pixel data pins.
[3] I_{DD} is the continuous current required to drive the digital core.
[4] Applicable to both single data rate (SDR) and dual data rate (DDR) input modes.
[5] I_{AA} is the total current required to supply all DACs including the V_{REF} circuitry.

VIDEO PERFORMANCE SPECIFICATIONS

V_{DD} = 1.8 V, PV_{DD} = 1.8 V, V_{AA} = 3.3 V, V_{DD_IO} = 3.3 V, T_A = 25°C, V_{REF} driven externally.

Table 12.

Parameter	Conditions	Min	Typ	Max	Unit
STATIC PERFORMANCE					
Resolution			14		Bits
Integral Nonlinearity	R_{SET1} = 510 Ω, R_{L1} = 37.5 Ω		3		LSBs
	R_{SET2} = 4.12 kΩ, R_{L2} = 300 Ω		4		LSBs
Differential Nonlinearity [1] +ve	R_{SET1} = 510 Ω, R_{L1} = 37.5 Ω		1		LSBs
	R_{SET2} = 4.12 kΩ, R_{L2} = 300 Ω		3.2		LSBs
Differential Nonlinearity[1] −ve	R_{SET1} = 510 Ω, R_{L1} = 37.5 Ω		1.7		LSBs
	R_{SET2} = 4.12 kΩ, R_{L2} = 300 Ω		1.4		LSBs
STANDARD DEFINTION (SD) MODE					
Luminance Nonlinearity			0.2		±%
Differential Gain	NTSC		0.2		%
Differential Phase	NTSC		0.3		Degrees
SNR	Luma ramp		64.5		dB
SNR	Flat field full bandwidth		79.5		dB
ENHANCED DEFINITION (ED) MODE					
Luma Bandwidth			12.5		MHz
Chroma Bandwidth			5.8		MHz
HIGH DEFINITION (HD) MODE					
Luma Bandwidth			30		MHz
Chroma Bandwidth			13.75		MHz

[1] Differential nonlinearity (DNL) measures the deviation of the actual DAC output voltage step from the ideal. For +ve DNL, the actual step value lies above the ideal step value. For −ve DNL, the actual step value lies below the ideal step value.

TIMING DIAGRAMS

The following abbreviations are used in Figure 2 to Figure 13:

- t_9 = clock high time
- t_{10} = clock low time
- t_{11} = data setup time
- t_{12} = data hold time
- t_{13} = control output access time
- t_{14} = control output hold time

In addition, refer to Table 36 for the ADV7344 input configuration.

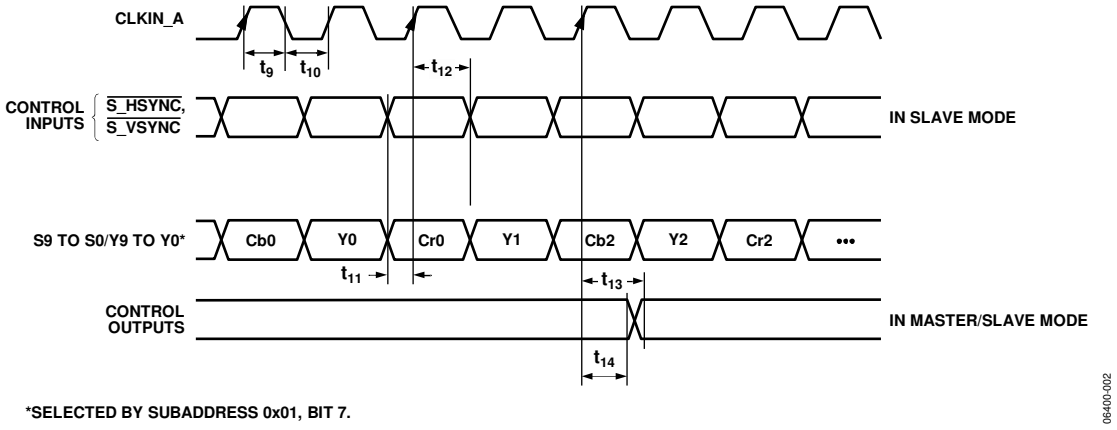


Figure 2. SD Only, 8-/10-Bit, 4:2:2 YCrCb Pixel Input Mode (Input Mode 000)

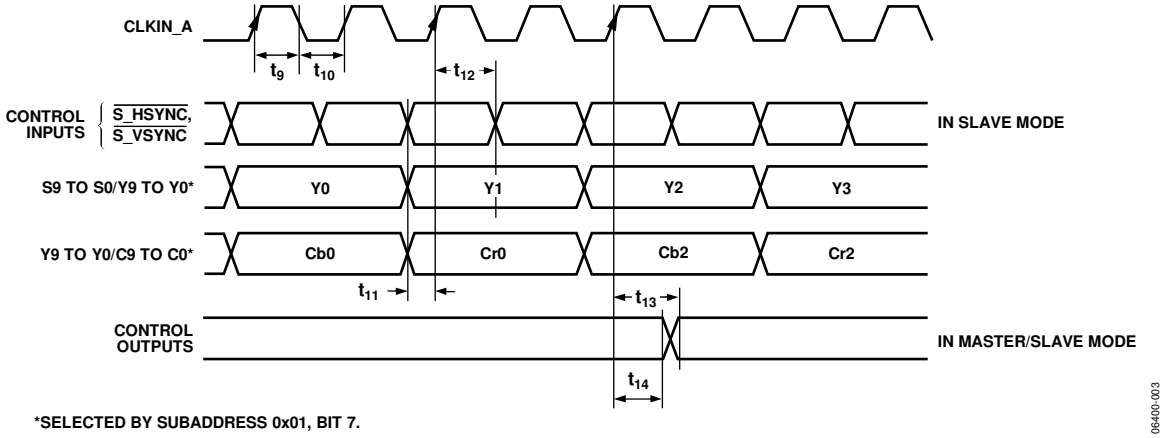


Figure 3. SD Only, 16-/20-Bit, 4:2:2 YCrCb Pixel Input Mode (Input Mode 000)

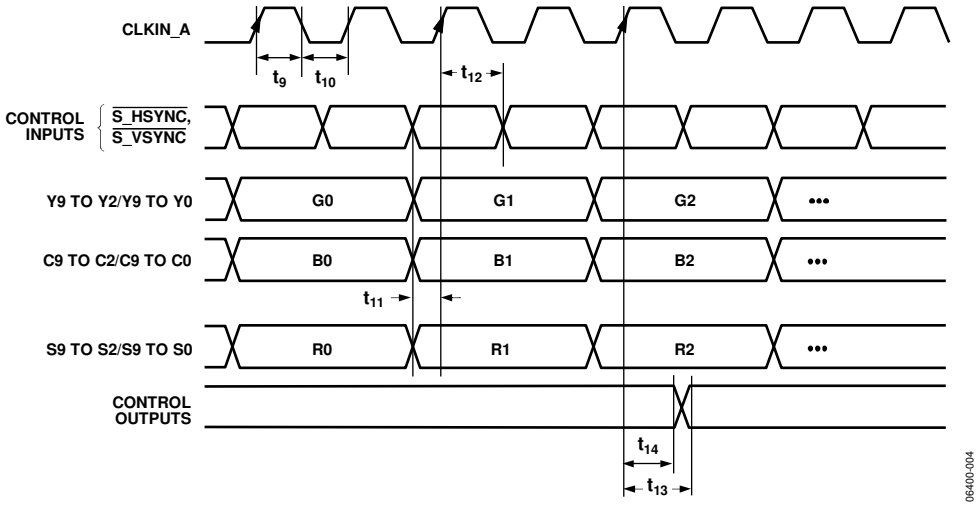


Figure 4. SD Only, 24-/30-Bit, 4:4:4 RGB Pixel Input Mode (Input Mode 000)

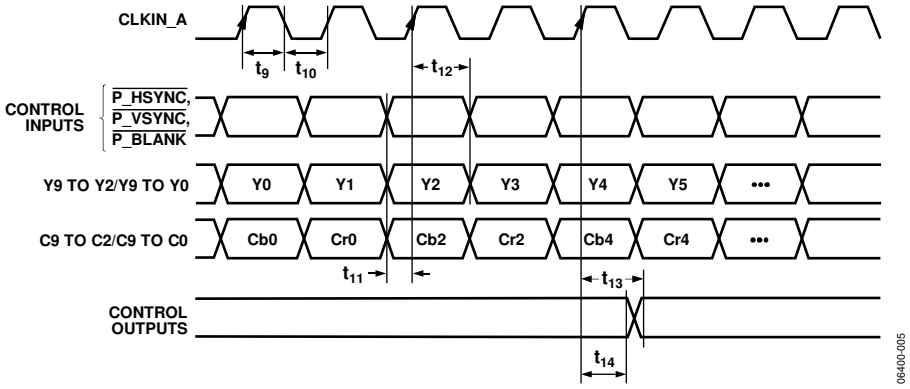


Figure 5. ED/HD-SDR Only, 16-/20-Bit, 4:2:2 YCrCb Pixel Input Mode (Input Mode 001)

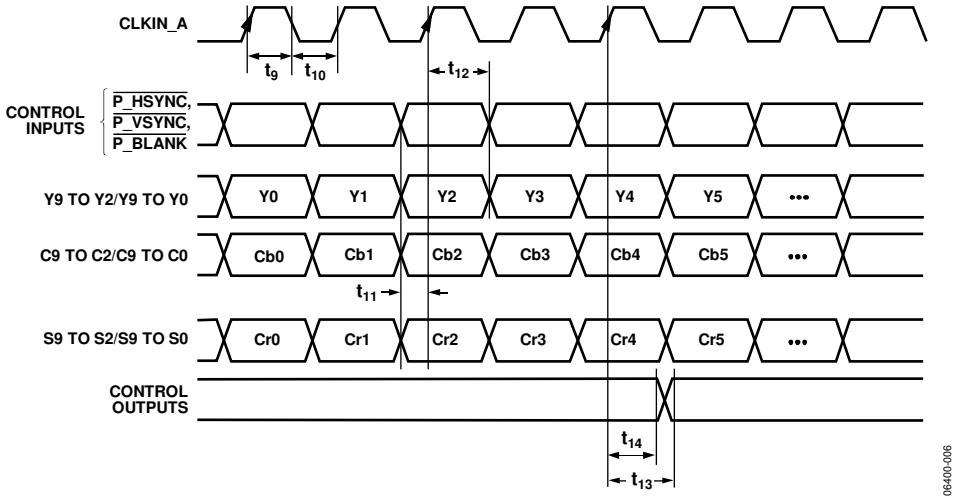


Figure 6. ED/HD-SDR Only, 24-/30-Bit, 4:4:4 YCrCb Pixel Input Mode (Input Mode 001)

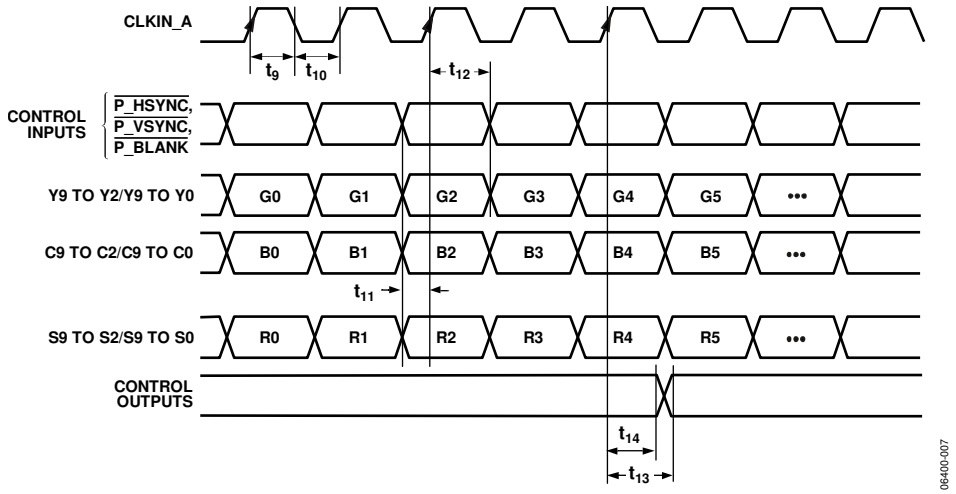


Figure 7. ED/HD-SDR Only, 24-/30-Bit, 4:4:4 RGB Pixel Input Mode (Input Mode 001)

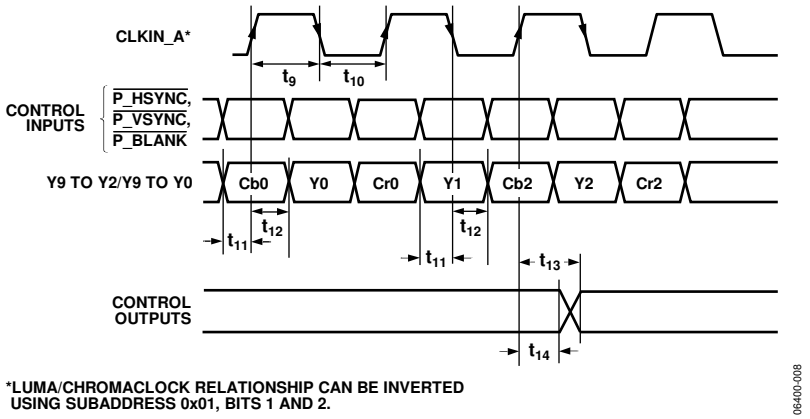


Figure 8. ED/HD-DDR Only, 8-/10-Bit, 4:2:2 YCrCb ($\overline{HSYNC}$/$\overline{VSYNC}$) Pixel Input Mode (Input Mode 010)

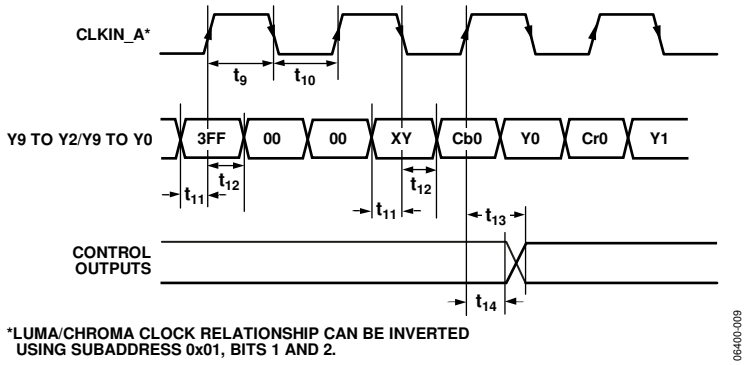


Figure 9. ED/HD-DDR Only, 8-/10-Bit, 4:2:2 YCrCb (EAV/SAV) Pixel Input Mode (Input Mode 010)

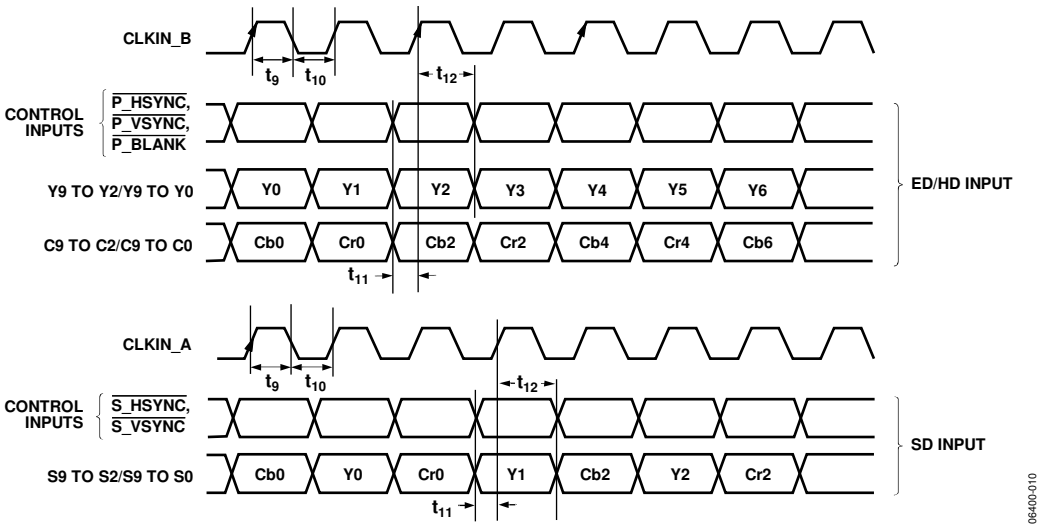


Figure 10. SD, ED/HD-SDR Input Mode, 16-/20-Bit, 4:2:2 ED/HD and 8-/10-Bit, SD Pixel Input Mode (Input Mode 011)

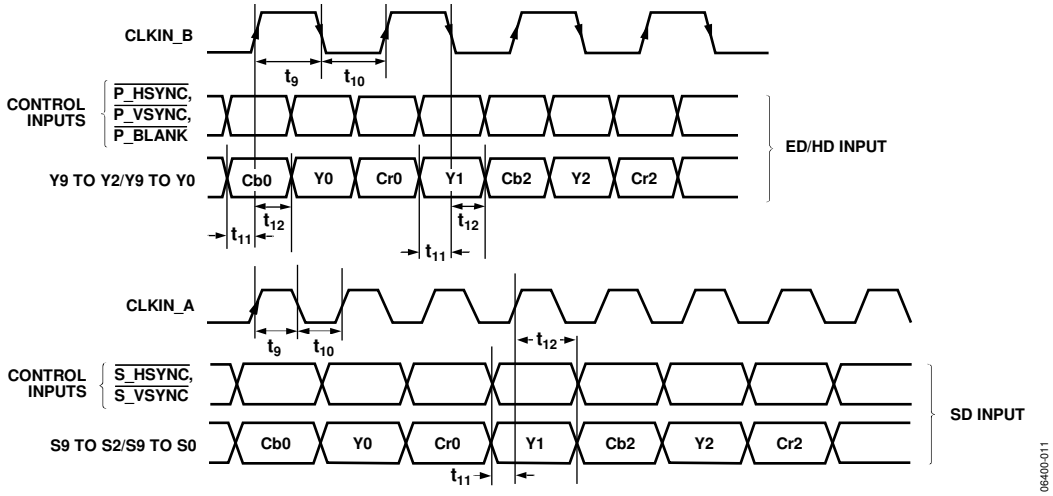


Figure 11. SD, ED/HD-DDR Input Mode, 8-/10-Bit, 4:2:2 ED/HD and 8-/10-Bit, SD Pixel Input Mode (Input Mode 100)

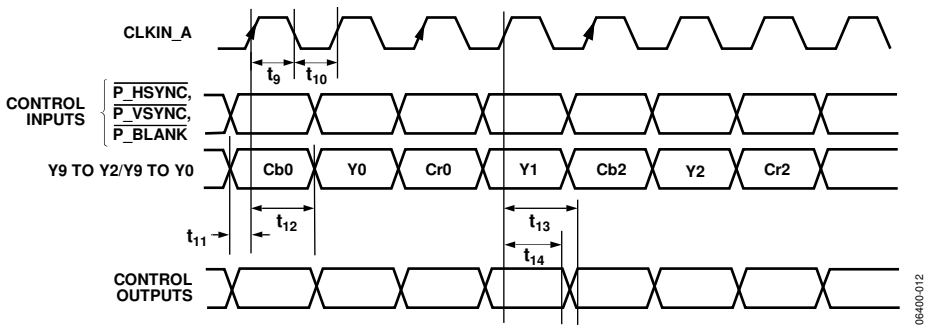


Figure 12. ED Only (at 54 MHz), 8-/10-Bit, 4:2:2 YCrCb ($\overline{HSYNC}$/$\overline{VSYNC}$) Pixel Input Mode (Input Mode 111)

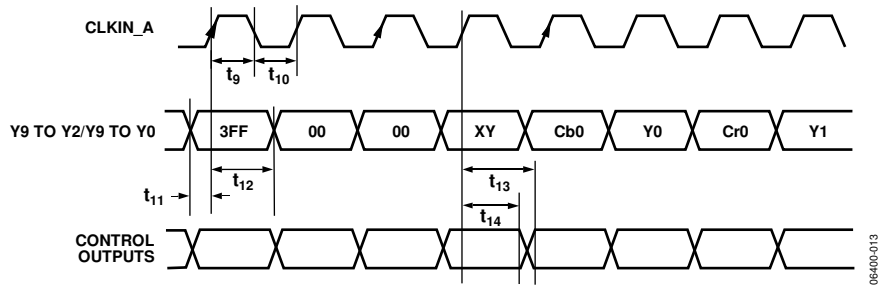


Figure 13. ED Only (at 54 MHz), 8-/10-Bit, 4:2:2 YCrCb (EAV/SAV) Pixel Input Mode (Input Mode 111)

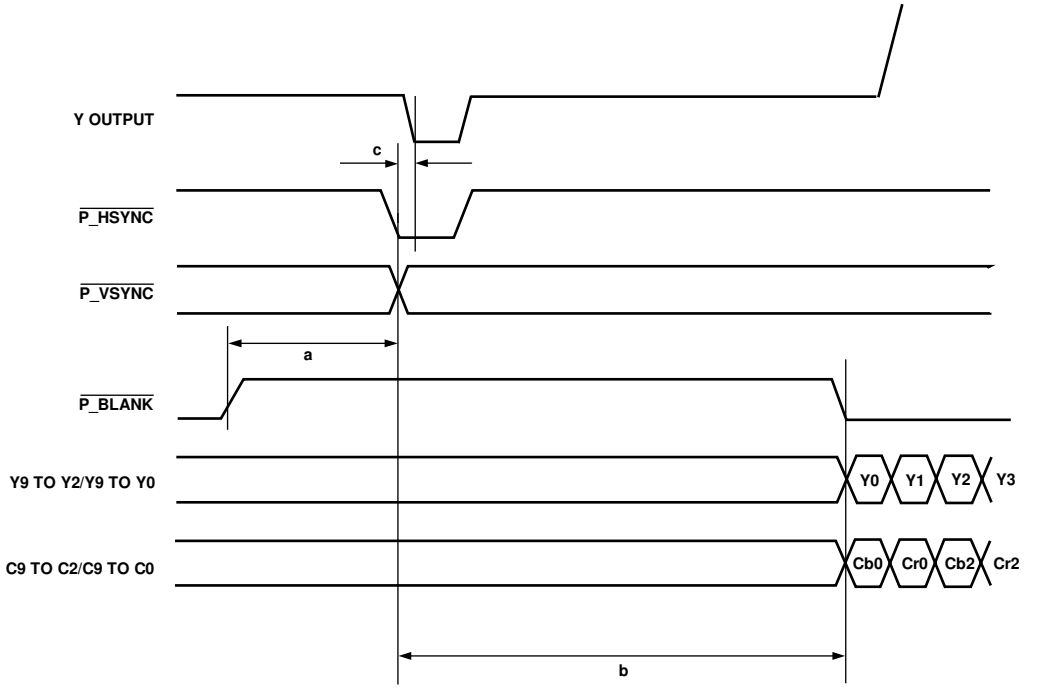
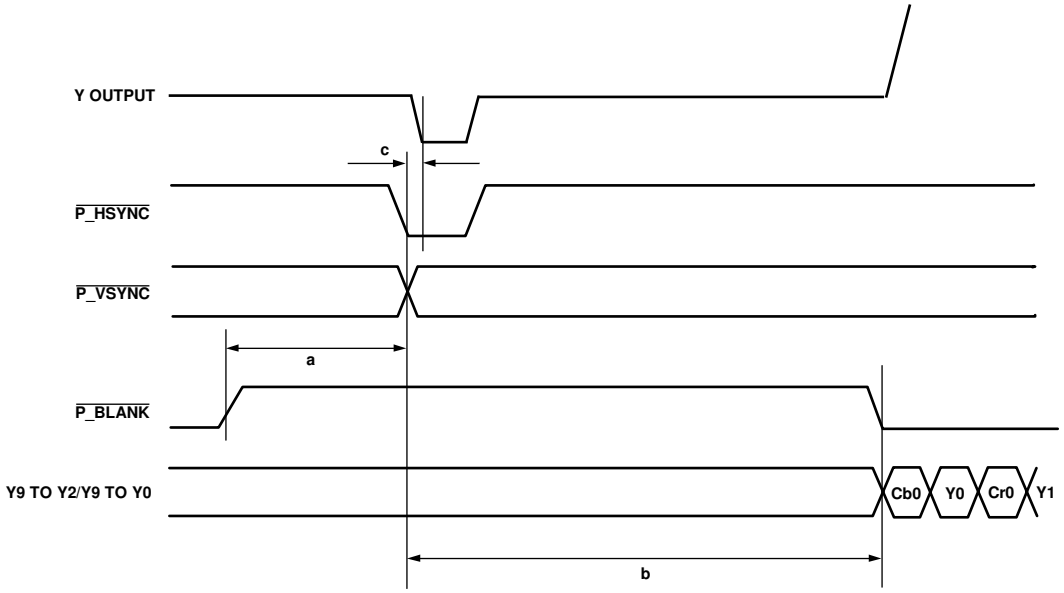


Figure 14. ED-SDR, 16-/20-Bit, 4:2:2 YCrCb ($\overline{HSYNC}$/$\overline{VSYNC}$) Input Timing Diagram



a = 32 CLOCK CYCLES FOR 525p
a = 24 CLOCK CYCLES FOR 625p
AS RECOMMENDED BY STANDARD

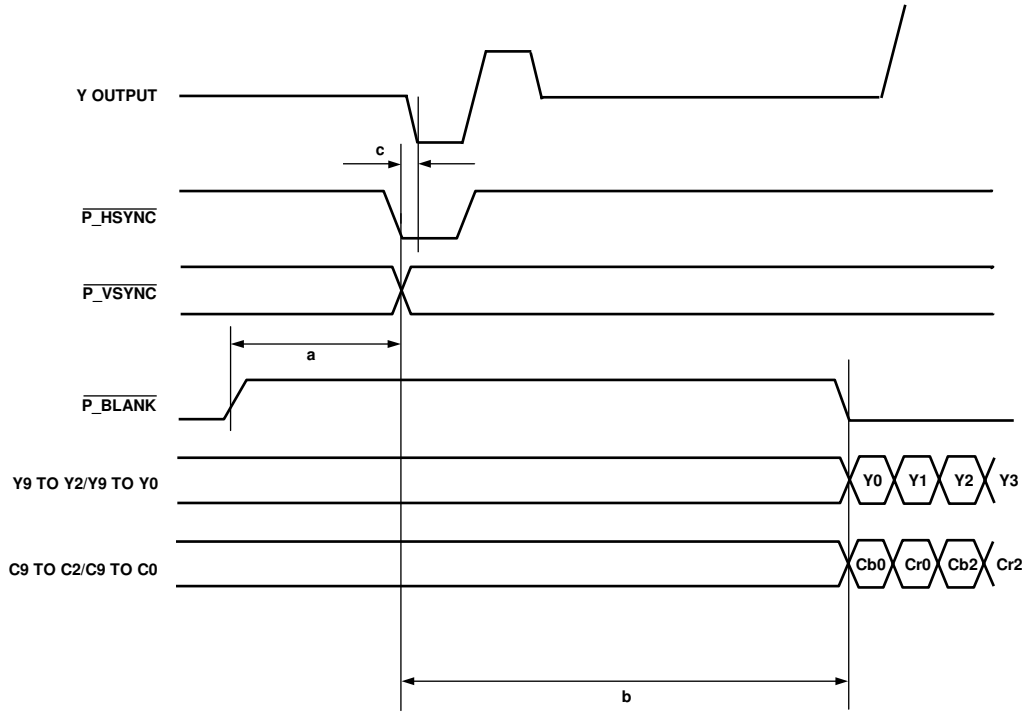
b(MIN) = 244 CLOCK CYCLES FOR 525p
b(MIN) = 264 CLOCK CYCLES FOR 625p

c = PIPELINE DELAY. PLEASE REFER TO RELEVANT PIPELINE DELAY. THIS CAN BE FOUND IN THE DIGITAL TIMING SPECIFICATION SECTION OF THE DATA SHEET.

A FALLING EDGE OF $\overline{\text{HSYNC}}$ INTO THE ENCODER GENERATES A SYNC FALLING EDGE ON THE OUTPUT AFTER A TIME EQUAL TO THE PIPELINE DELAY.

06400-015

Figure 15. ED-DDR, 8-/10-Bit, 4:2:2 YCrCb ($\overline{\text{HSYNC}}$/$\overline{\text{VSYNC}}$) Input Timing Diagram



a AND b AS PER RELEVANT STANDARD.

c = PIPELINE DELAY. PLEASE REFER TO RELEVANT PIPELINE DELAY. THIS CAN BE FOUND IN THE DIGITAL TIMING SPECIFICATION SECTION OF THE DATA SHEET.

A FALLING EDGE OF $\overline{\text{HSYNC}}$ INTO THE ENCODER GENERATES A FALLING EDGE OF TRI-LEVEL SYNC ON THE OUTPUT AFTER A TIME EQUAL TO THE PIPELINE DELAY.

06400-016

Figure 16. HD-SDR, 16-/20-Bit, 4:2:2 YCrCb ($\overline{\text{HSYNC}}$/$\overline{\text{VSYNC}}$) Input Timing Diagram

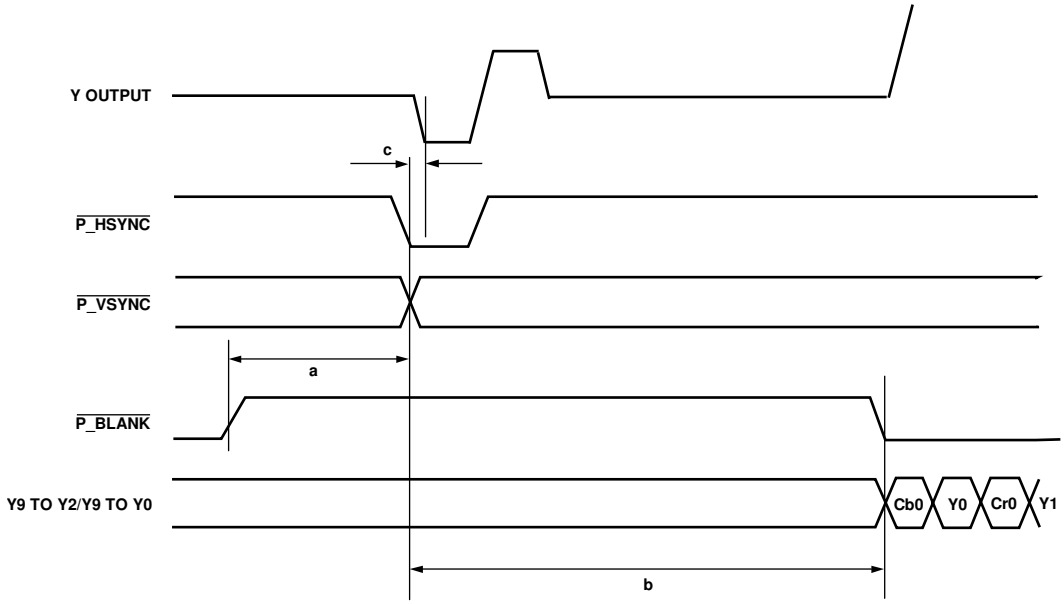


Figure 17. HD-DDR, 8-/10-Bit, 4:2:2 YCrCb (HSYNC/VSYNC) Input Timing Diagram

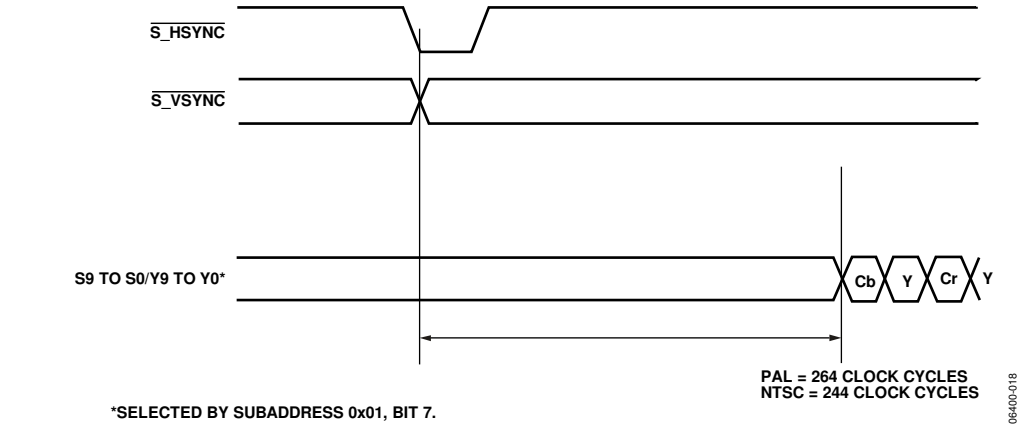


Figure 18. SD Input Timing Diagram (Timing Mode 1)

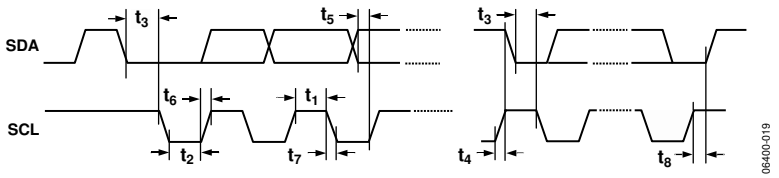


Figure 19. MPU Port Timing Diagram (I²C Mode)

ABSOLUTE MAXIMUM RATINGS

Table 13.

Parameter[1]	Rating
V_{AA} to AGND	−0.3 V to +3.9 V
V_{DD} to DGND	−0.3 V to +2.3 V
PV_{DD} to PGND	−0.3 V to +2.3 V
V_{DD_IO} to GND_IO	−0.3 V to +3.9 V
AGND to DGND	−0.3 V to +0.3 V
AGND to PGND	−0.3 V to +0.3 V
AGND to GND_IO	−0.3 V to +0.3 V
DGND to PGND	−0.3 V to +0.3 V
DGND to GND_IO	−0.3 V to +0.3 V
PGND to GND_IO	−0.3 V to +0.3 V
Digital Input Voltage to GND_IO	−0.3 V to V_{DD_IO} + 0.3 V
Analog Outputs to AGND	−0.3 V to V_{AA}
Maximum CLKIN Input Frequency	80 MHz
Storage Temperature Range (T_S)	−65°C to +150°C
Junction Temperature (T_J)	150°C
Lead Temperature (Soldering, 10 sec)	260°C

[1] Analog output short circuit to any power supply or common can be of an indefinite duration.

Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only; functional operation of the device at these or any other conditions above those indicated in the operational section of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

The ADV7344 is a high performance integrated circuit with an ESD rating of <1 kV, and it is ESD sensitive. Proper precautions should be taken for handling and assembly.

THERMAL RESISTANCE

θ_{JA} is specified for the worst-case conditions, that is, a device soldered in a circuit board for surface-mount packages.

Table 14. Thermal Resistance[1]

Package Type	θ_{JA}	θ_{JC}	Unit
64-Lead LQFP	47	11	°C/W

[1] Values are based on a JEDEC 4-layer test board.

The ADV7344 is an RoHS-compliant, Pb-free product. The lead finish is 100% pure Sn electroplate. The device is suitable for Pb-free applications up to 255°C (±5°C) IR reflow (JEDEC STD-20).

It is backward compatible with conventional SnPb soldering processes. The electroplated Sn coating can be soldered with Sn/Pb solder paste at conventional reflow temperatures of 220°C to 235°C.

ESD CAUTION

ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

PIN CONFIGURATION AND FUNCTION DESCRIPTIONS

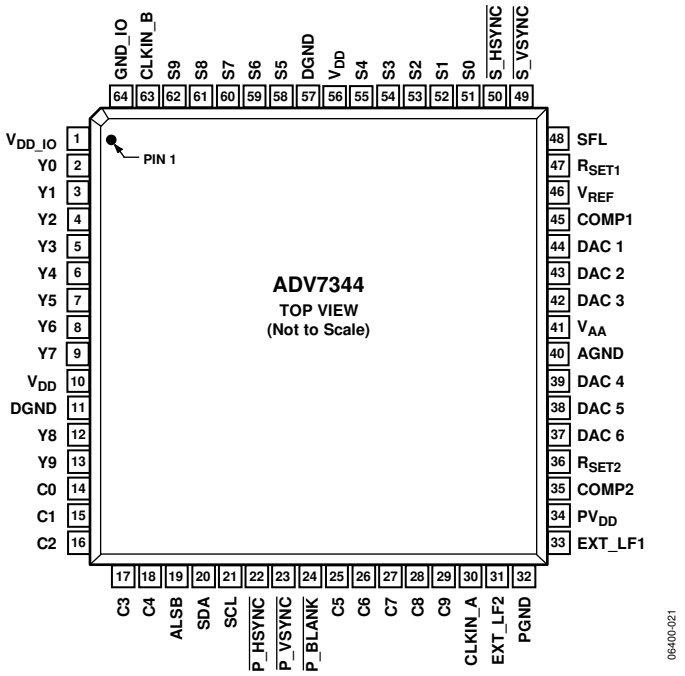


Figure 20. Pin Configuration

Table 15. Pin Function Descriptions

Pin No.	Mnemonic	Input/ Output	Description
13, 12, 9 to 2	Y9 to Y0	I	10-Bit Pixel Port (Y9 to Y0). Y0 is the LSB. Refer to Table 36 for input modes.
29 to 25, 18 to 14	C9 to C0	I	10-Bit Pixel Port (C9 to C0). C0 is the LSB. Refer to Table 36 for input modes.
62 to 58, 55 to 51	S9 to S0	I	10-Bit Pixel Port (S9 to S0). S0 is the LSB. Refer to Table 36 for input modes.
30	CLKIN_A	I	Pixel Clock Input for HD only (74.25 MHz), ED[1] only (27 MHz or 54 MHz), or SD only (27 MHz).
63	CLKIN_B	I	Pixel Clock Input for Dual Modes Only. Requires a 27 MHz reference clock for ED operation or a 74.25 MHz reference clock for HD operation.
50	$\overline{\text{S_HSYNC}}$	I/O	SD Horizontal Synchronization Signal. This pin can also be configured to output an SD, ED, or HD horizontal synchronization signal. See the External Horizontal and Vertical Synchronization Control section.
49	$\overline{\text{S_VSYNC}}$	I/O	SD Vertical Synchronization Signal. This pin can also be configured to output an SD, ED, or HD vertical synchronization signal. See the External Horizontal and Vertical Synchronization Control section.
22	$\overline{\text{P_HSYNC}}$	I	ED/HD Horizontal Synchronization Signal. See the External Horizontal and Vertical Synchronization Control section.
23	$\overline{\text{P_VSYNC}}$	I	ED/HD Vertical Synchronization Signal. See the External Horizontal and Vertical Synchronization Control section.
24	$\overline{\text{P_BLANK}}$	I	ED/HD Blanking Signal. See the External Horizontal and Vertical Synchronization Control section.
48	SFL	I/O	Subcarrier Frequency Lock (SFL) Input.
47	R_{SET1}	I	This pin is used to control the amplitudes of the DAC 1, DAC 2, and DAC 3 outputs. For full-drive operation (for example, into a 37.5 Ω load), a 510 Ω resistor must be connected from R_{SET1} to AGND. For low-drive operation (for example, into a 300 Ω load), a 4.12 kΩ resistor must be connected from R_{SET1} to AGND.
36	R_{SET2}	I	This pin is used to control the amplitudes of the DAC 4, DAC 5, and DAC 6 outputs. A 4.12 kΩ resistor must be connected from R_{SET2} to AGND.
45, 35	COMP1, COMP2	O	Compensation Pins. Connect a 2.2 nF capacitor from both COMP pins to V_{AA}.
44, 43, 42	DAC 1, DAC 2, DAC 3	O	DAC Outputs. Full- and low -drive capable DACs.

Pin No.	Mnemonic	Input/ Output	Description
39, 38, 37	DAC 4, DAC 5, DAC 6	O	DAC Outputs. Low-drive only capable DACs.
21	SCL	I	I^2C Clock Input.
20	SDA	I/O	I^2C Data Input/Output.
19	ALSB	I	This signal sets up the LSB[2] of the MPU I^2C address (see the Power Supply Sequencing section for more information).
46	V_{REF}		Optional External Voltage Reference Input for DACs or Voltage Reference Output.
41	V_{AA}	P	Analog Power Supply (3.3 V).
10, 56	V_{DD}	P	Digital Power Supply (1.8 V). For dual-supply configurations, V_{DD} can be connected to other 1.8 V supplies through a ferrite bead or suitable filtering.
1	V_{DD_IO}	P	Input/Output Digital Power Supply (1.8 V or 3.3 V).
34	PV_{DD}	P	PLL Power Supply (1.8 V). For dual-supply configurations, PV_{DD} can be connected to other 1.8 V supplies through a ferrite bead or suitable filtering.
33	EXT_LF1	I	External Loop Filter for On-Chip PLL 1.
31	EXT_LF2	I	External Loop Filter for On-Chip PLL 2.
32	PGND	G	PLL Ground Pin.
40	AGND	G	Analog Ground Pin.
11, 57	DGND	G	Digital Ground Pin.
64	GND_IO	G	Input/Output Supply Ground Pin.

[1] ED = enhanced definition = 525p and 625p.
[2] LSB = least significant bit. In the ADV7344, setting the LSB to 0 sets the I^2C address to 0xD4. Setting it to 1 sets the I^2C address to 0xD6.

TYPICAL PERFORMANCE CHARACTERISTICS

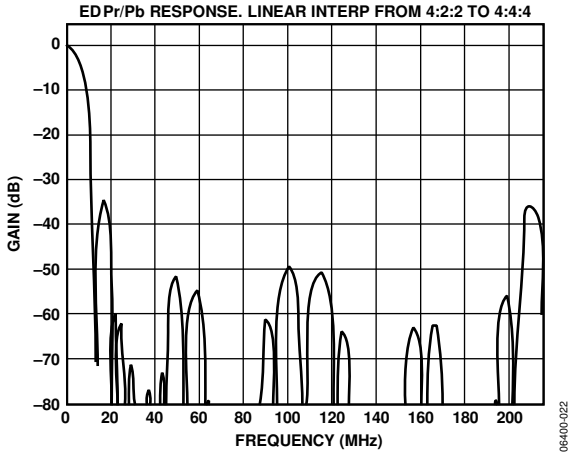


Figure 21. ED 8× Oversampling, PrPb Filter (Linear) Response

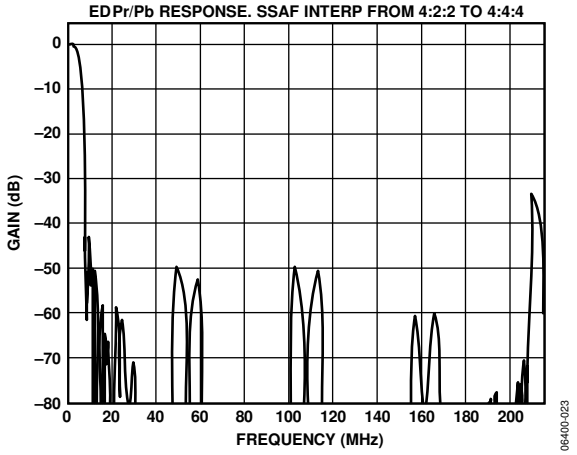


Figure 22. ED 8× Oversampling, PrPb Filter (SSAF™) Response

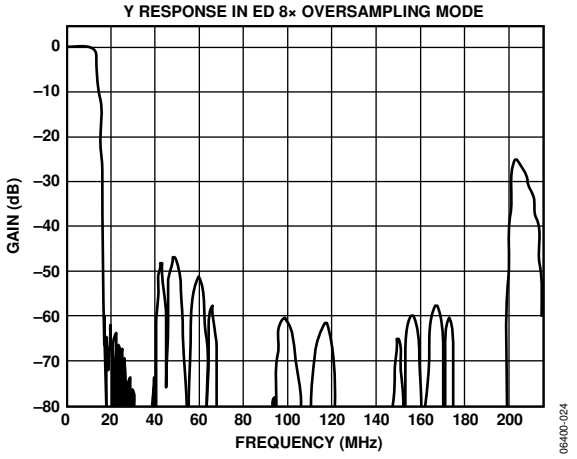


Figure 23. ED 8× Oversampling, Y Filter Response

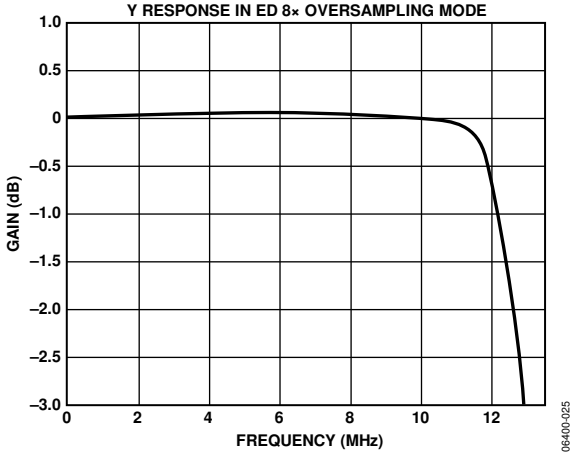


Figure 24. ED 8× Oversampling, Y Filter Response (Focus on Pass Band)

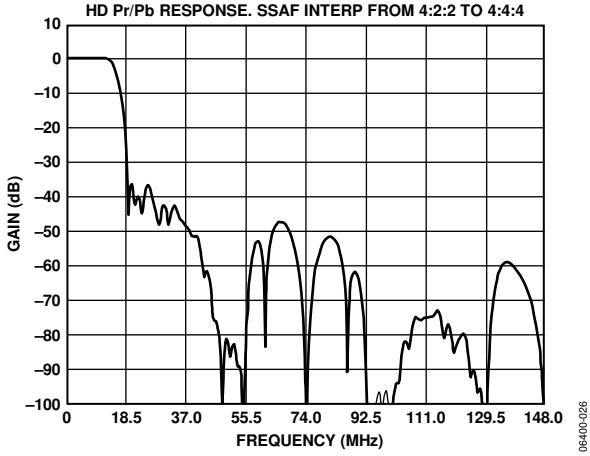


Figure 25. HD 4× Oversampling, PrPb (SSAF) Filter Response (4:2:2 Input)

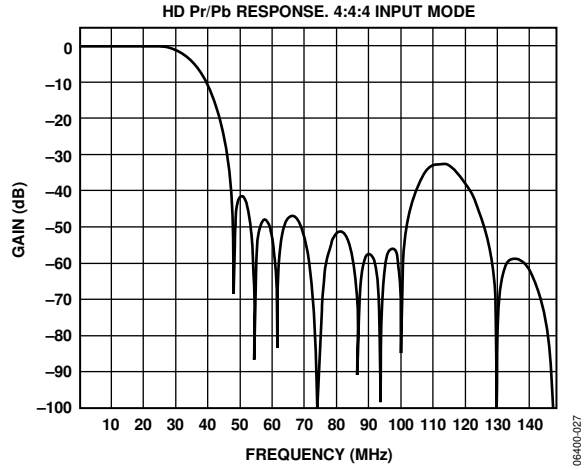


Figure 26. HD 4× Oversampling, PrPb (SSAF) Filter Response (4:4:4 Input)

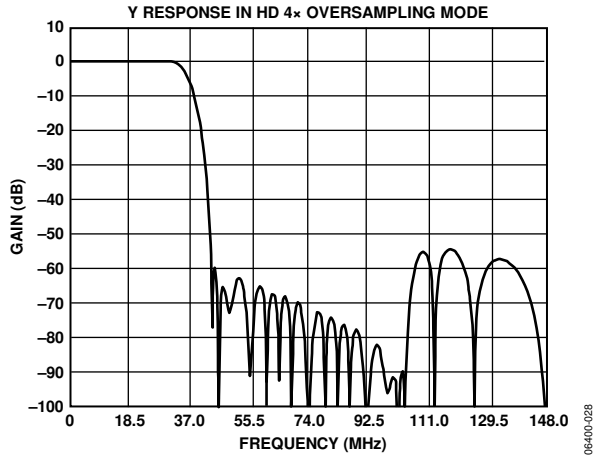


Figure 27. HD 4× Oversampling, Y Filter Response

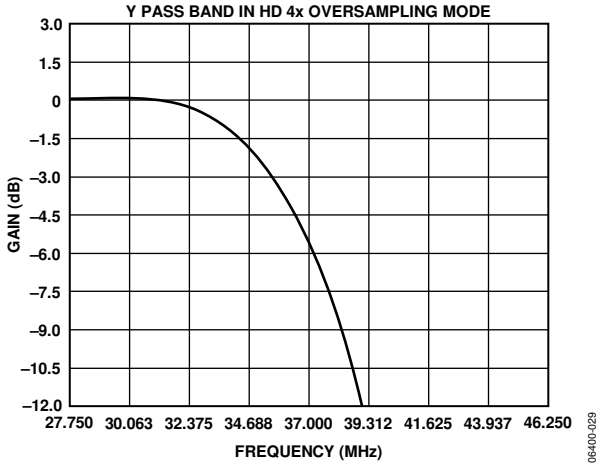


Figure 28. HD 4× Oversampling, Y Filter Response (Focus on Pass Band)

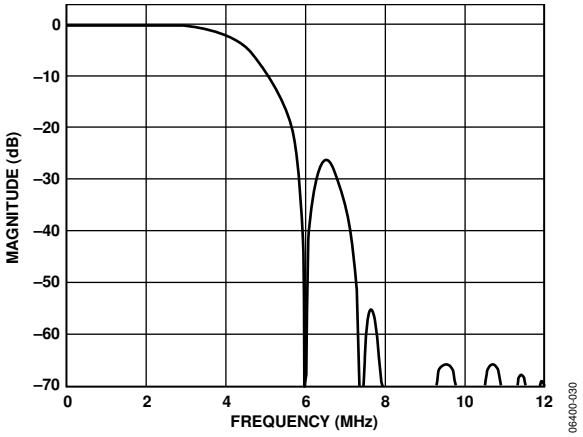


Figure 29. SD NTSC, Luma Low-Pass Filter Response

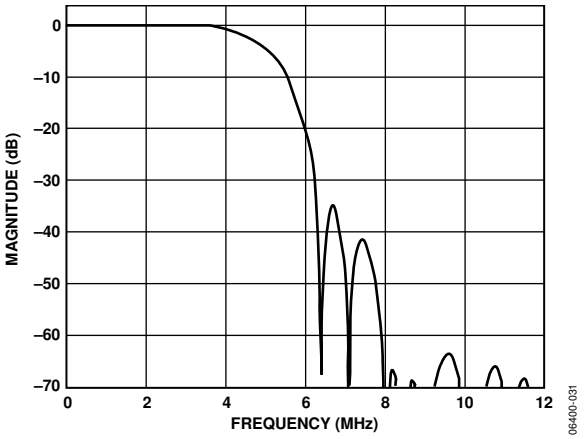


Figure 30. SD PAL, Luma Low-Pass Filter Response

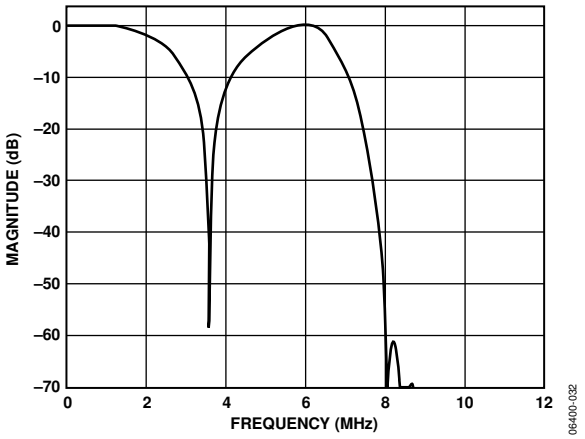


Figure 31. SD NTSC, Luma Notch Filter Response

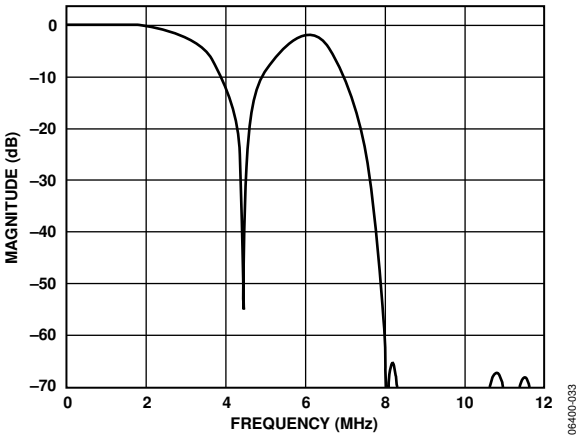


Figure 32. SD PAL, Luma Notch Filter Response

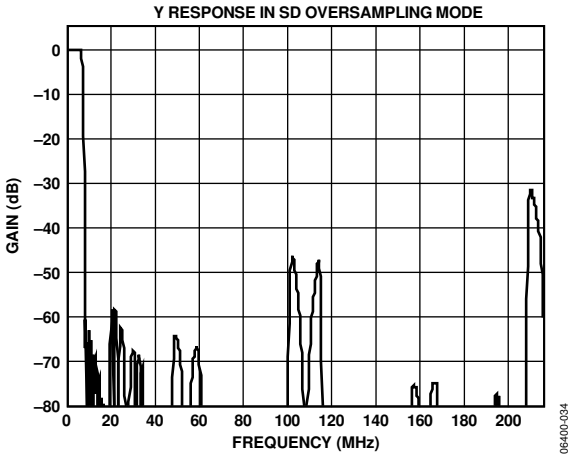


Figure 33. SD, 16× Oversampling, Y Filter Response

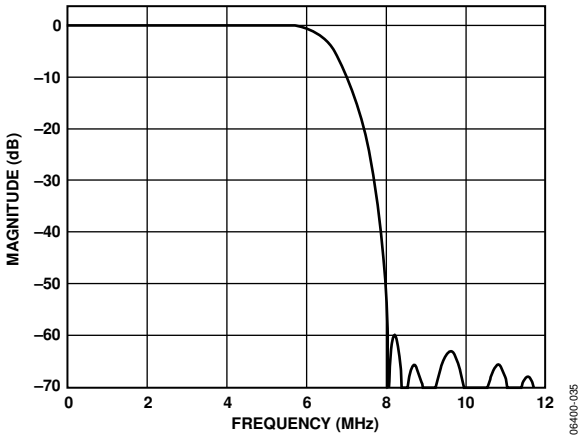


Figure 34. SD Luma SSAF Filter Response up to 12 MHz

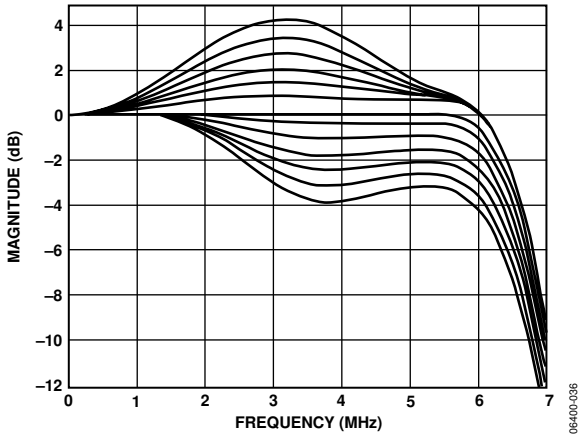


Figure 35. SD Luma SSAF Filter, Programmable Responses

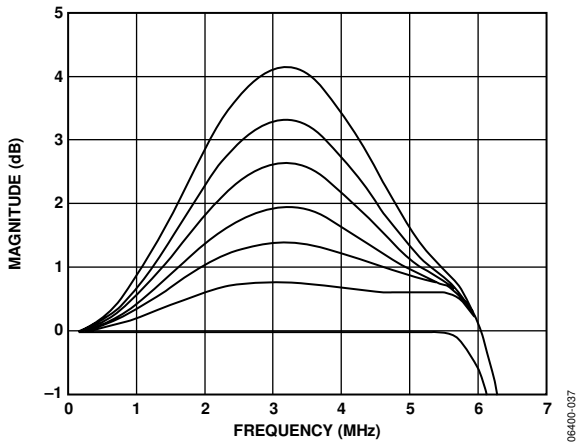


Figure 36. SD Luma SSAF Filter, Programmable Gain

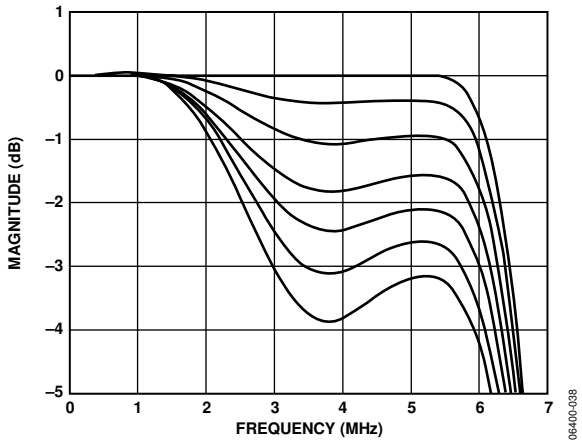


Figure 37. SD Luma SSAF Filter, Programmable Attenuation

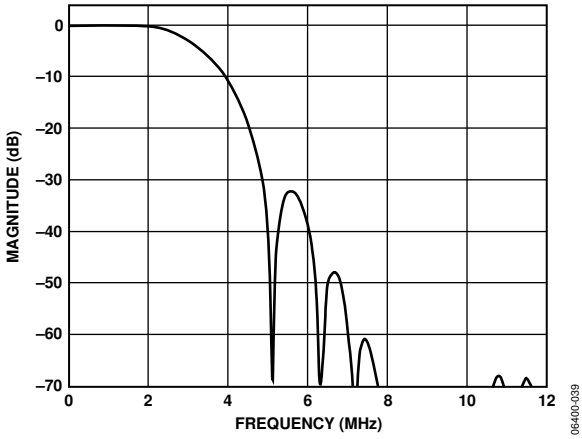


Figure 38. SD Luma CIF Low-Pass Filter Response