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Company Profile

LOGIC Devices Incorporated develops and markets high-performance integrated circuits that are utilized in a wide range of video and medical imaging processing, telecommunications, computing and military smart weapon applications. LOGIC Devices is committed to providing its customers with the highest performing products, processed on the highest quality materials, delivered on time at a competitive price. The company focuses on developing proprietary digital signal processing (DSP) ICs, and implementing them using its unique experience and expertise in very large scale integrated (VLSI) circuits.

2002

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Description

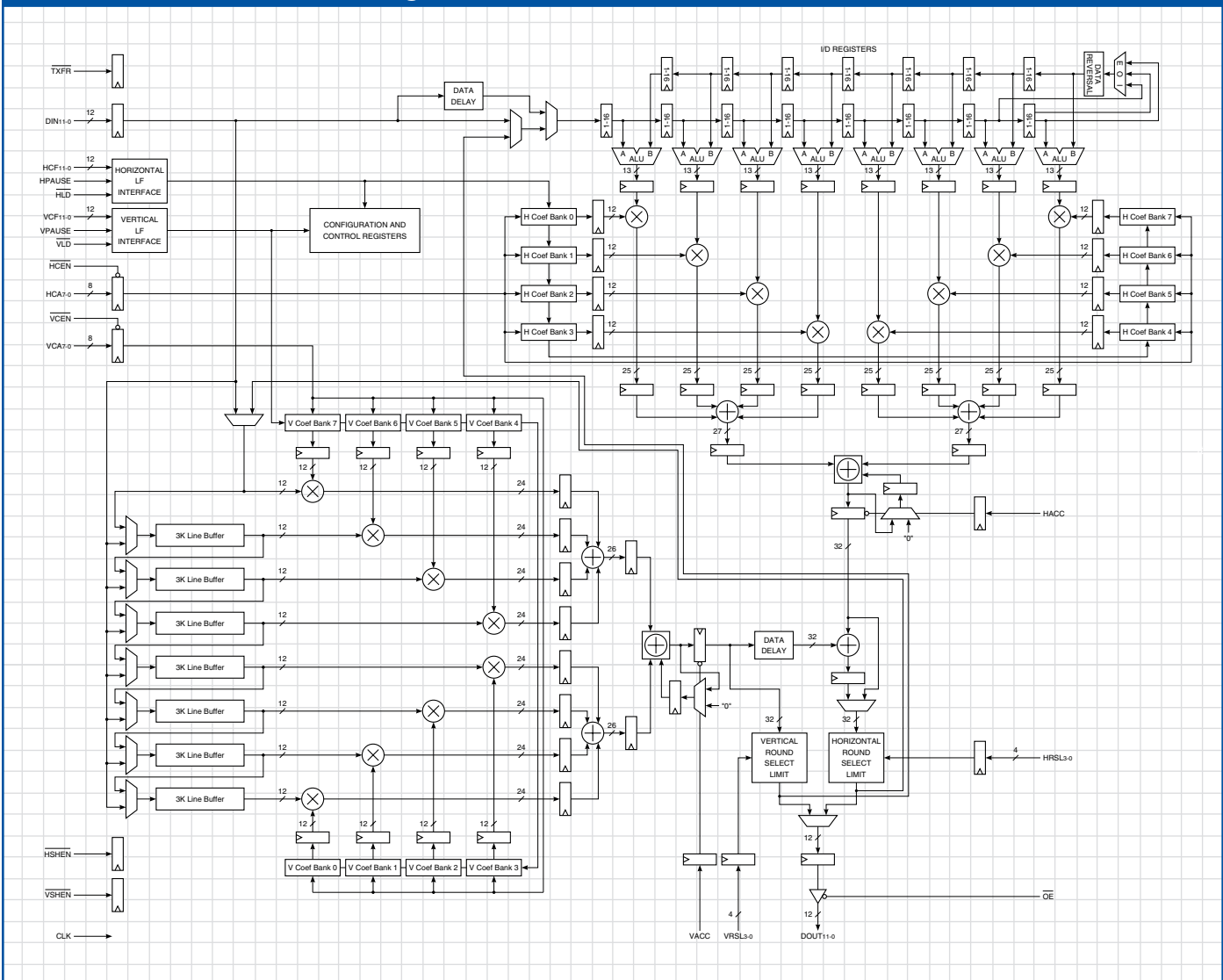
The LF3310 is a high speed two dimensional digital image filter capable of filtering data at real time video rates. The device can be configured to filter either as dimensionally separate (two ways; horizontal, then vertical or vertical, then horizontal) or as an orthogonal kernel (horizontal and vertical concurrently). During operation, both the horizontal and vertical filter sections can be independently held to facilitate resizing and other operations. The two (horizontal and vertical) 256-deep, independently programmable coefficient sets provide flexibility for many filter configurations. When combined with the 3K-deep onboard line buffers this brings the device to the next level of integration by reducing the need of fast, expensive external storage.

Features

- ▶ 83 MHz Data Rate
- ▶ Seven 3K x 12-bit, Programmable Two-Mode Line Buffers
- ▶ 16 Horizontal and 8 Vertical Filter Taps
- ▶ 12-bit Data and Coefficients
- ▶ Embedded Memory for 256 Horizontal and Vertical Coefficient Sets
- ▶ Selectable 12-bit Data Output with User-Defined Rounding and Limiting
- ▶ Supports Dimensionally Separate Filtering and Orthogonal Kernels
- ▶ Allows Interleaved Data Streams for Multi-Channel Applications
- ▶ All 4,096 Coefficients can be Updated Within 27.7 μ s
- ▶ Horizontal Filter Supports Decimation Up to 16 x 1 for Increasing Number of Filter Taps
- ▶ 3.3 Volt Power Supply
- ▶ 5 Volt Tolerant I/O
- ▶ 144-pin PQFP Package
- ▶ Industrial Temperature Available

Note: Application notes and behavioral models available at www.logicdevices.com

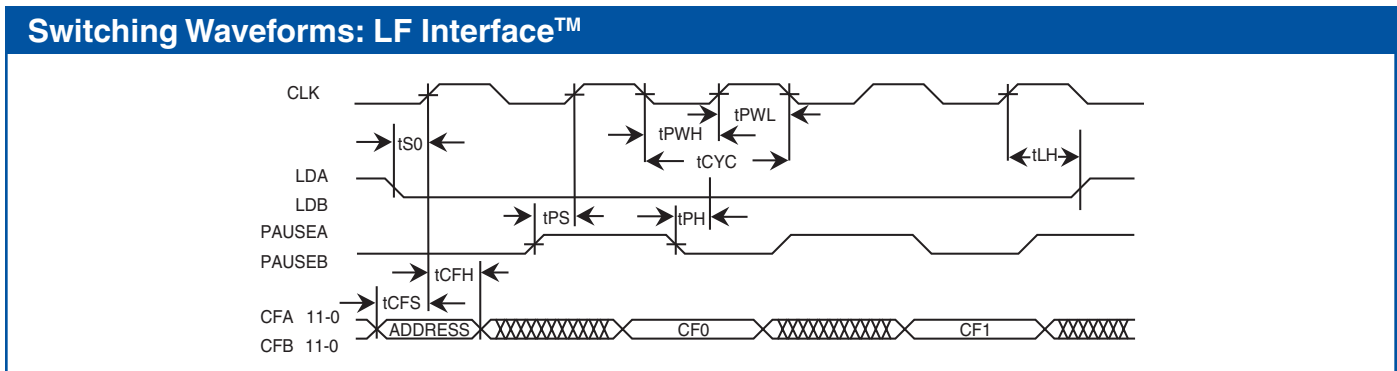
LF3310 Functional Block Diagram



Description

The LF3311 is an improved version of the LF3310 Horizontal/Vertical Digital Image Filter capable of operating at speeds of up to 111MHz. This improved speed will increase flexibility and performance. The added performance will enable you to use this device in more applications. For example, four interleaved data streams of 27MHz can now be processed within one device. The part is functionally identical to the LF3320 with the exception that the filter data path is specified to operate faster than the LF Control Interface. When operating the filter at speeds in excess of 90MHz, loading of coefficients via the LF Interface must be throttled to a maximum of 90MHz by asserting the PAUSE pin as required to allow sufficient setup time for the configuration data provided to the chip via the LF Interface.

The switching waveforms shown below help to demonstrate this and the changes to the switching characteristics are detailed at the bottom.



Switching Characteristics

Commercial Operating Range (0°C to ± 70°C)

Symbol	Parameter	9* (ns) speed grade	
		MIN	MAX
tCYC	Cycle Time	9	
tPWL	Clock Pulse Width Low	4	
tPWH	Clock Pulse Width High	4	
tS0	Input Setup Time	4	
tS1	Input Setup Time (xCEN, xRSL)	4	
tH0	Input Hold Time	1	
tH1	Input Hold Time (xCEN, xRSL)	1.5	
tD	Output Delay		8
tDIS	Three-State Output Disable Delay		10
tENA	Three-State Output Enable Delay		10
tCFS	Coefficient Input Setup Time	5	
tCFH	Coefficient input Hold Time	1.5	
tLS	Load Setup Time	4	
tLH	Load Hold Time	1.5	
tPS	PAUSE Setup Time	4	
tPH	PAUSE Hold time	1.5	

* Tester conditions relaxed to reflect capacitive loading effects of tester comparator pins.

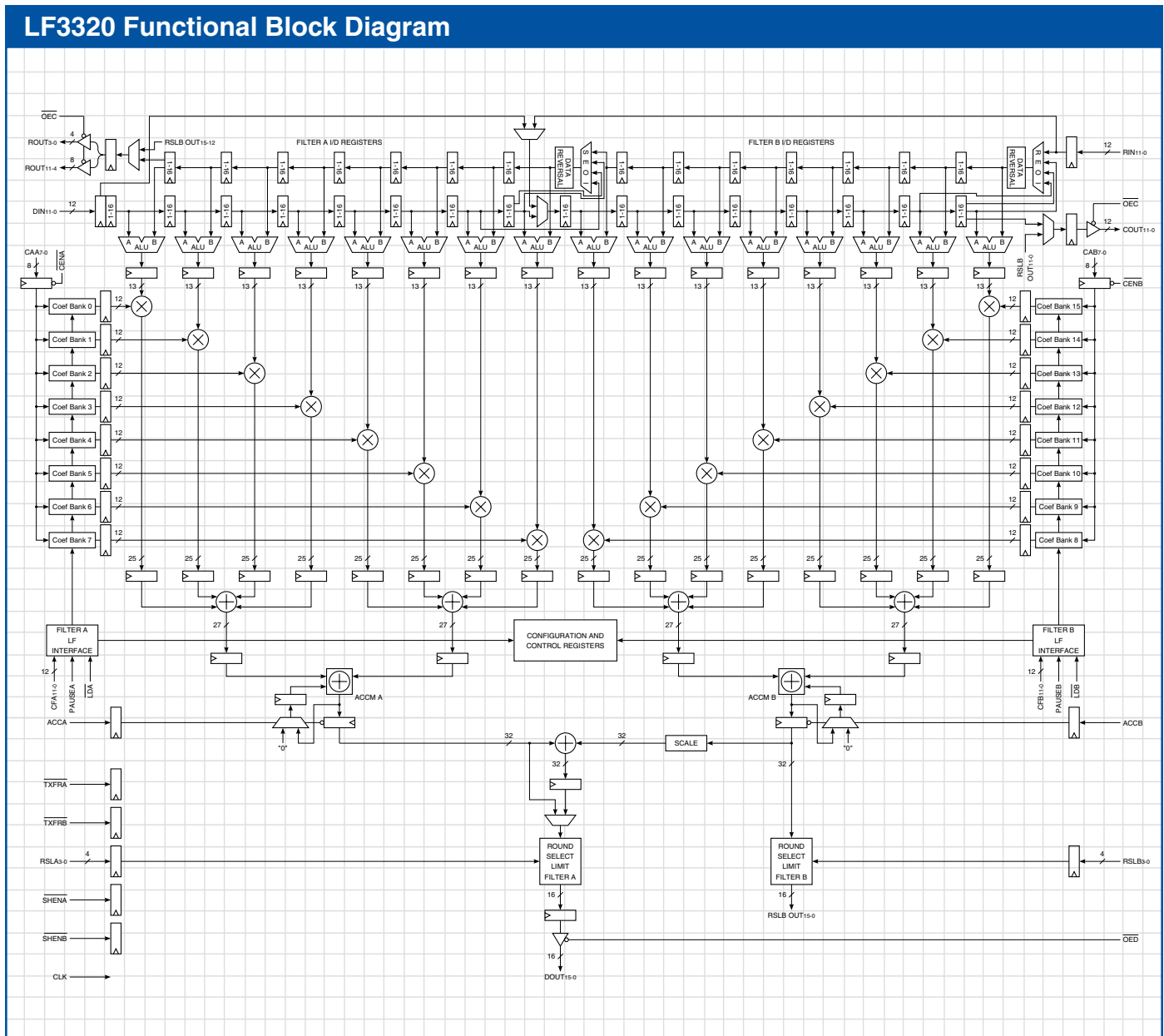
Description

The high speed LF3320 is optimised to filter digital images in the horizontal dimension at real time video rates. It can support adaptive filtering of up to 16 interleaved data streams thus meeting a wide array of requirements for various communication systems. Two separate interfaces allow both sets of 256 coefficients to be updated within 27.7µs. When symmetric coefficients are used, the device can be configured as a single 32-tap FIR filter or as two separate 16-tap FIR filters. When asymmetric coefficient sets are used, the device can be configured as a single 16-tap FIR filter or as two separate 8-tap FIR filters.

Features

- ▶ 83 MHz Data Rate
- ▶ 32-Tap Transversal FIR Filter
- ▶ Cascadable for More Filter Taps Using the LF3347
- ▶ Single or Dual Filter Modes
- ▶ 12-bit Data and Coefficients
- ▶ Embedded Memory for 256 Coefficient Sets
- ▶ Selectable 16-bit Data Output with User-Defined Rounding and Limiting
- ▶ Allows Interleaved Data Streams for Multi-Channel Applications
- ▶ Supports Decimation up to 16:1 for up to 512 Filter Taps
- ▶ All 4,096 Coefficients can be Updated Within 27.7 µs
- ▶ 3.3 Volt Power Supply
- ▶ 5 Volt Tolerant I/O
- ▶ 144-pin PQFP Package
- ▶ Industrial Temperature Available

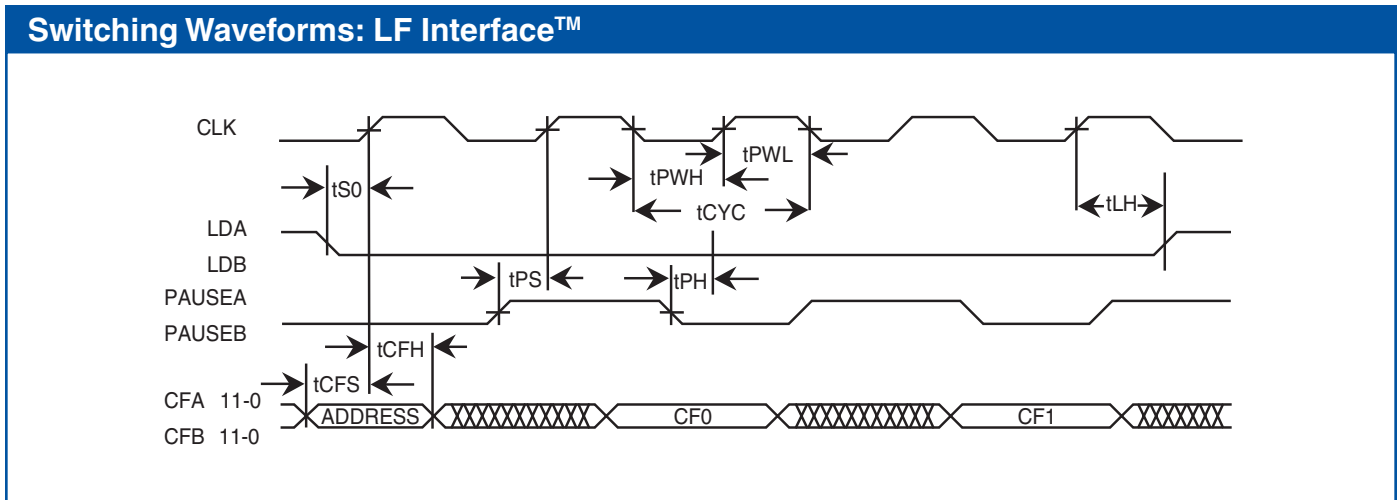
Note: Application notes and behavioral models available at www.logicdevices.com



Description

The LF3321 is an improved version of the LF3320 Horizontal Digital Image Filter capable of operating at speeds of up to 111MHz. This improved speed will increase flexibility and performance. The added performance will enable you to use this device in more applications. For example, four interleaved data streams of 27MHz can now be processed within one device. The part is functionally identical to the LF3320 with the exception that the filter data path is specified to operate faster than the LF Control Interface. When operating the filter at speeds in excess of 90MHz, loading of coefficients via the LF Interface must be throttled to a maximum of 90MHz by asserting the PAUSE pin as required to allow sufficient setup time for the configuration data provided to the chip via the LF Interface.

The switching waveforms shown below help to demonstrate this and the changes to the switching characteristics are detailed at the bottom.



Switching Characteristics

Commercial Operating Range (0°C to ± 70°C)

Symbol	Parameter	9* (ns) speed grade	
		MIN	MAX
tCYC	Cycle Time	9	
tPWL	Clock Pulse Width Low	4	
tPWH	Clock Pulse Width High	4	
tS0	Input Setup Time	4	
tH0	Input Hold Time	0	
tSCT	Setup Time Control Inputs	4	
tHCT	Hold Time Control Inputs	0	
tSCC	Setup Time Coefficient Control Inputs	4	
tHCC	Hold Time Coefficient Control Inputs	0	
tD	Output Delay		8
tDCC	Cascade Output Delay		7.5
tDIS	Three State Output Display Delay		10
tDIS	Three State Output Enable Delay		10

* Tester conditions relaxed to reflect capacitive loading effects of tester comparator pins.

Description

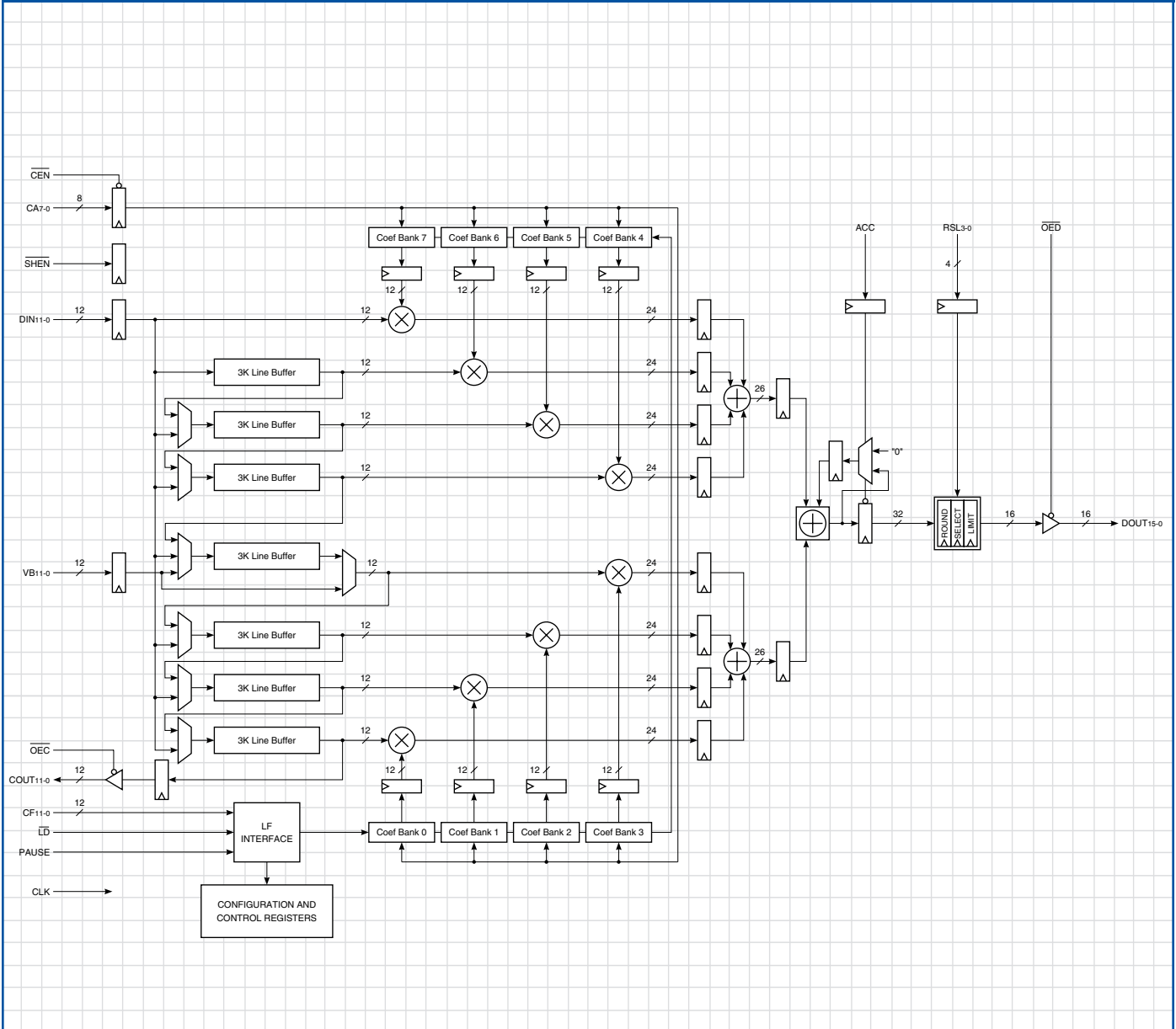
The high speed LF3330 is specifically designed for filtering digital images in the vertical dimension, at real time video rate. The device is an 8-tap FIR filter with all required line buffers required contained on chip. Onboard memory stores up to 256 coefficients sets, which can all be updated within vertical blanking. 7 Line buffers can store video lines with lengths from 4 to 3076 pixels. Due to the length of line buffers, interleaved data can be fed directly into the device and filtered without separating the data into individual data streams.

Features

- ▶ 83 MHz Data Rate
- ▶ Seven 3K x 12-bit, Programmable Two-Mode Line Buffers
- ▶ Cascadable for More Filter Taps Using the LF3347
- ▶ 12-bit Data and Coefficients
- ▶ Embedded Memory for 256 Coefficient Sets
- ▶ Selectable 16-bit Data Output with User-Defined Rounding and Limiting
- ▶ Allows Interleaved Data Streams for Multi-Channel Applications
- ▶ Separate Input Port for Odd and Even Field Filtering
- ▶ All 2,048 Coefficients can be Updated Within 27.7 μ s
- ▶ 3.3 Volt Power Supply
- ▶ 5 Volt Tolerant I/O
- ▶ 100-pin PQFP Package
- ▶ Industrial Temperature Available

Note: Application notes and behavioral models available at www.logicdevices.com

LF3330 Functional Block Diagram



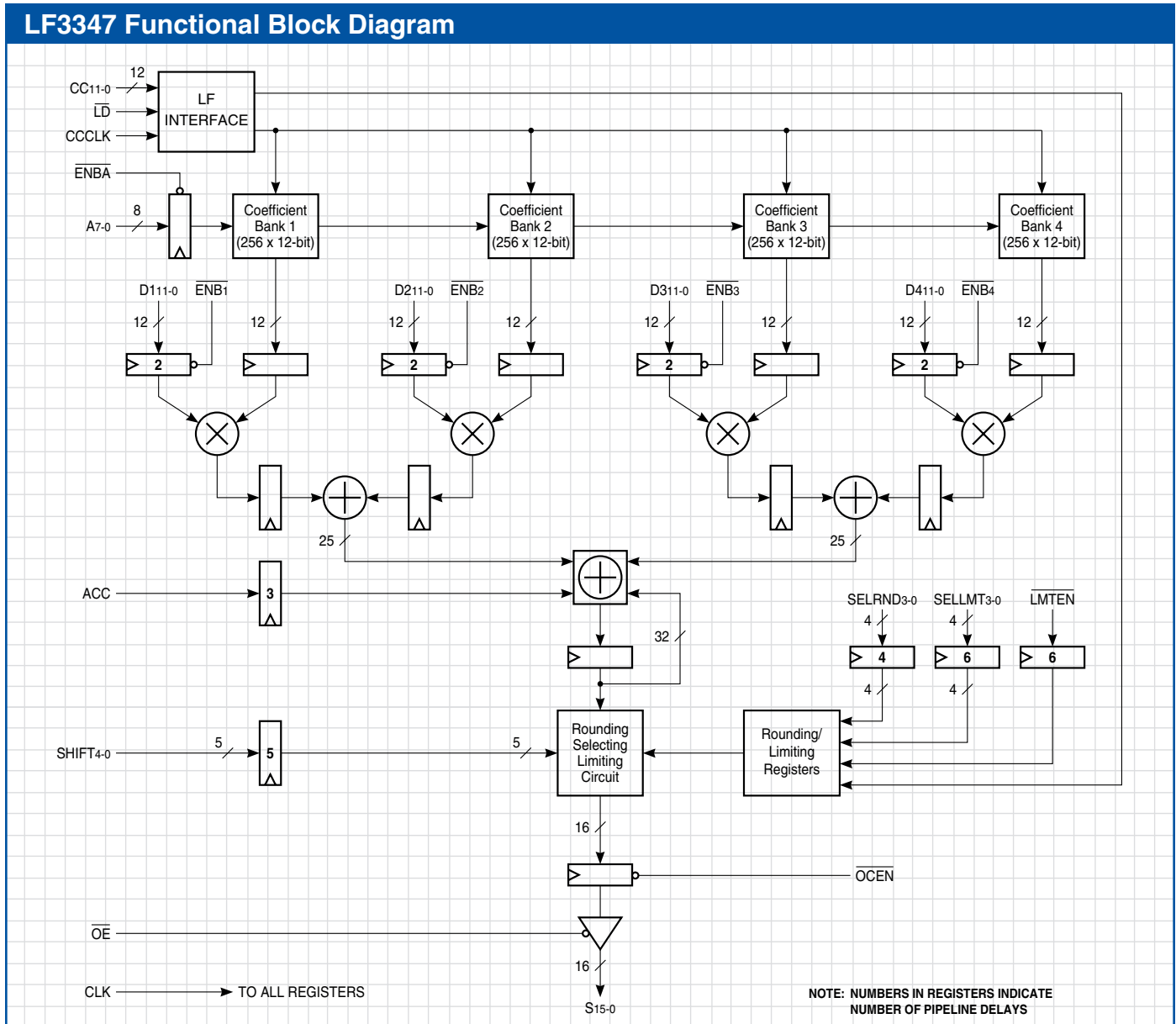
Description

The LF3347 is a high speed FIR filter consisting of an array of four 12 x 12-bit multipliers followed by two summers and a 32-bit accumulator. Each multiplier array is provided with a 256 x 12-bit coefficient bank. All multiplier data inputs are user accessible and can be updated every clock cycle. The device is ideal for performing pixel interpolation in image manipulation and filtering applications. The LF3347 can perform a bilinear interpolation of an image (4 - pixel kernels) at real time video rates when used with an image resampling sequencer. Larger kernels or more complex functions can be realised by utilizing multiple devices.

Features

- ▶ 83 MHz Data Input and Computation Rate
- ▶ Four 12 x 12-bit Multipliers with Individual Data and Coefficient Inputs
- ▶ Four 256 x 12-bit Coefficient Banks
- ▶ 32-bit Accumulator
- ▶ Selectable 16-bit Data Output with User-Defined Rounding and Limiting
- ▶ Two's Complement Operands
- ▶ 3.3 Volt Power Supply
- ▶ 5 Volt Tolerant I/O
- ▶ 120-pin PQFP Package
- ▶ Industrial Temperature Available

Note: Application notes and behavioral models available at www.logicdevices.com

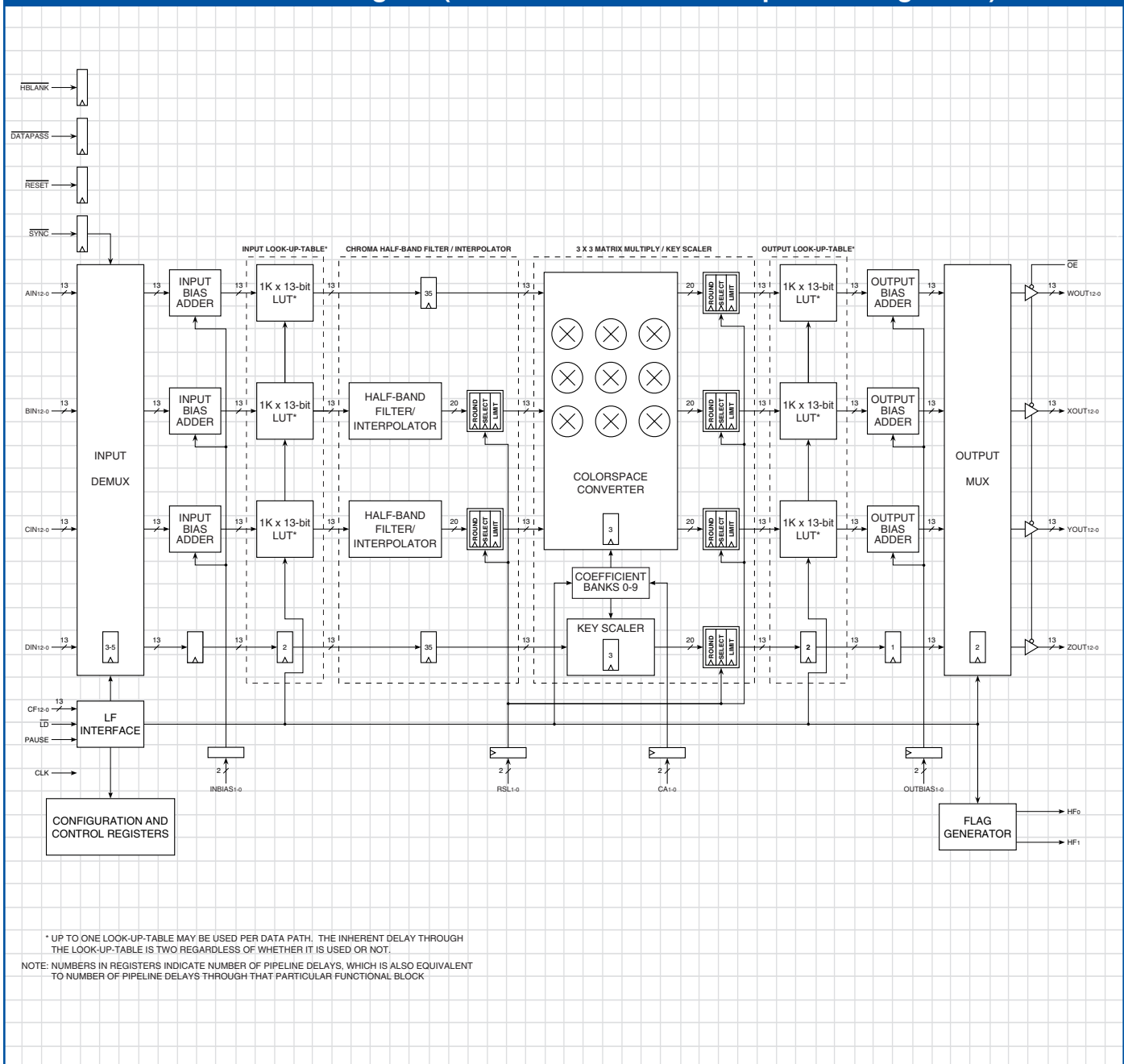


Decription

The LF3370 is a video format converter capable of operating at HDTV data rates. This device converts to and from any of the various SDTV/HDTV digital video formats by utilizing an internal 3 x 3 Matrix Multiplier and two 1:2 Interpolation / 2:1 Decimation Half-Band Filters. Using the Input Demultiplexer and Output Multiplexer, the LF3370 can accept and output interleaved or non-interleaved video. For example, R/G/B/ Key data can be color space converted to Y/U/V/Key and down-converted to 4:2:2:4. By re-arranging the order of the functional sections, the opposite conversion can be achieved. The coefficients for the 3 x 3 Matrix Multiplier are fully user programmable to support a wide range of color space conversions.

Note: Application notes and behavioral models available at www.logicdevices.com

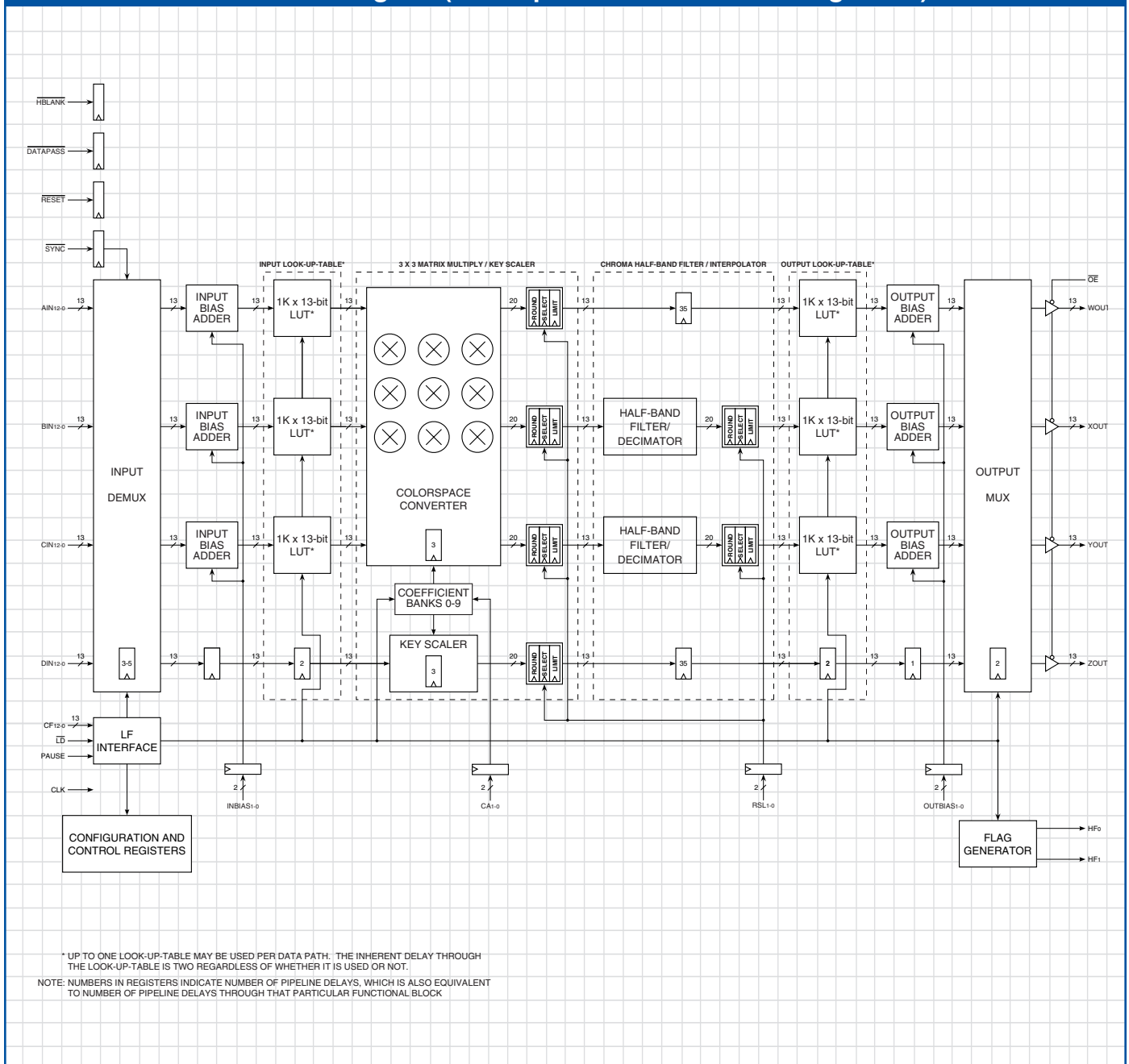
LF3370 Functional Block Diagram (Half-Band Filter to Colorspace Arrangement)



Features

- ▶ 83 MHz Data Rate for HDTV Applications
- ▶ Supports Multiple Video Formats
- ▶ Bi-Directional Conversions:
 - 4:2:2:4
 - 4:4:4:4
 - R/G/B/Key
 - Y/U/V/Key
- ▶ Multiplexed and Non-multiplexed I/O Data
- ▶ 13-bit Data Path, Colorspace Converter Coefficients and Key Channel Scaling Coefficients
- ▶ User-Programmable:
 - 3 x 3 Colorspace Converter
 - LUT for Gamma Correction
 - I/O Bias Compensation
 - Bypass Capability
- ▶ 3.3 Volt Power Supply
- ▶ 5 Volt Tolerant I/O
- ▶ 160-lead PQFP Package
- ▶ Industrial Temperature Available

LF3370 Functional Block Diagram (Colorspace to Half-Band Arrangement)



Description

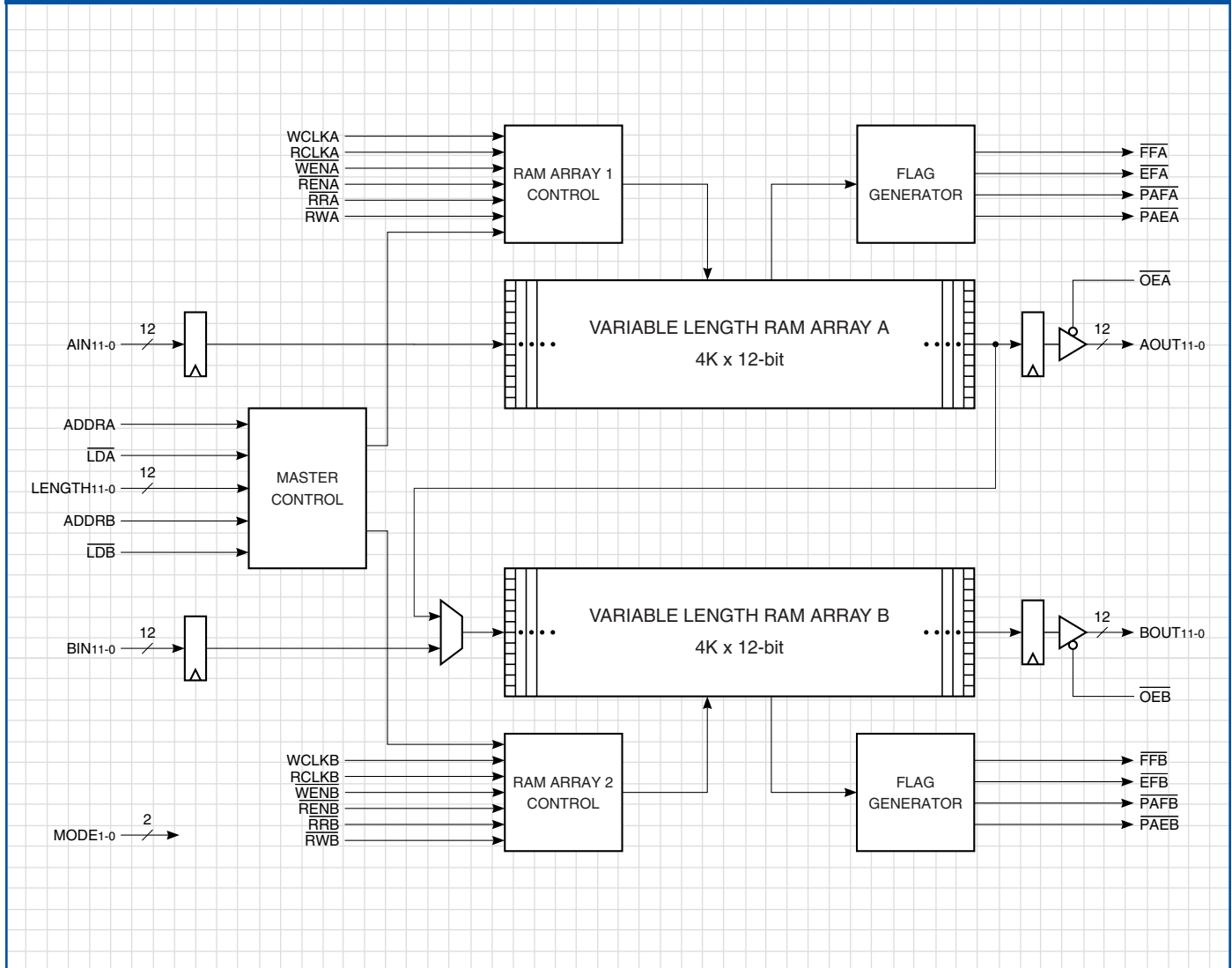
The LF3304 will operate in two distinct modes, either as a high speed dual line buffer or FIFO. In either mode the two memories can operate independently or with common control. The device comprises of two 4K x 12-bit memories configurable in a variety of ways, as shown in the feature table. In FIFO mode, independent Read and Write Resets gives the designer control over the internal pointers, providing flexibility not commonly found in ordinary FIFO's.

Features

- ▶ 100 MHz Data Rate for Video and Other High-Speed Applications
- ▶ User-Resetable Read and Write Pointers
- ▶ Dual Modes: Line Buffer or FIFO
- ▶ Organized in the Following Memory Configurations:
 - 4K x 24-bit
 - 8K x 12-bit
 - 4K x 12-bit (2 Channels)
 - 4K x 8-bit (3 Channels)
- ▶ User-Programmable FIFO Flags
- ▶ 3.3 Volt Power Supply
- ▶ 5 Volt Tolerant I/O
- ▶ 100-lead PQFP Package
- ▶ Industrial Temperature Available

Note: Application notes and behavioral models available at www.logicdevices.com

LF3304 Functional Block Diagram



Features

- ▶ 12,441,600-bit Frame Memory
- ▶ Eight Operating Modes:
 - One-Channel Synchronous Shift Register (Single Clock Source)
 - One-Channel Framestore with Sequential Write and Random Access Read
 - One-Channel Framestore with Random Access Write and Sequential Read
 - One-Channel FIFO with Asynchronous I/O
 - Two-Channel Synchronous Shift Register (Single Clock Source)
 - FIFO + Shift Register; Channel B Synchronized to Channel A
 - Shift register + FIFO; Channel A Synchronized to Channel B
 - Two-Channel FIFO; Both Channels Synchronized to External Signal^(a)
- ▶ Features in the Four Modes with Asynchronous FIFOs:
 - Near-Full/Empty Flags with Programmable Thresholds
- ▶ Features in the Six Purely Sequential (FIFO, shift register) Modes:
 - Up to 100 MHz Continuous Data Throughput Rate
- ▶ Features in the Two Random Access (non-FIFO) Modes:
 - Up to 83 MHz Data Rate
- ▶ LF3312s may be Connected in Parallel for HDTV, multiframe SDTV, etc.
- ▶ Built-in ITUR-656 TRS Detection and Synchronization
- ▶ May be Organized Into the Following Configurations:
 - 1,555,200 x 8-bit (single channel)
 - 1,244,160 x 10-bit (single channel)
 - 1,036,800 x 12-bit (single channel)
 - 777,600 x 16-bit (single channel)
 - 622,080 x 20-bit (single channel)
 - 518,400 x 24-bit (single channel)
 - 777,600 x 8-bit (each of two parallel channels)
 - 622,080 x 10-bit (each of two parallel channels)
 - 518,400 x 12-bit (each of two parallel channels)
- ▶ User-Resettable Read and Write Pointers
- ▶ Choice of Control Interfaces:
 - Two-Wire Serial Microprocessor Interface
 - Eight-Wire Parallel Microprocessor Bus
- ▶ 1.8 Volt Power Supply
- ▶ 5 Volt Tolerant I/O
- ▶ 100-lead PQFP Package
- ▶ Industrial / Military Temperatures Available

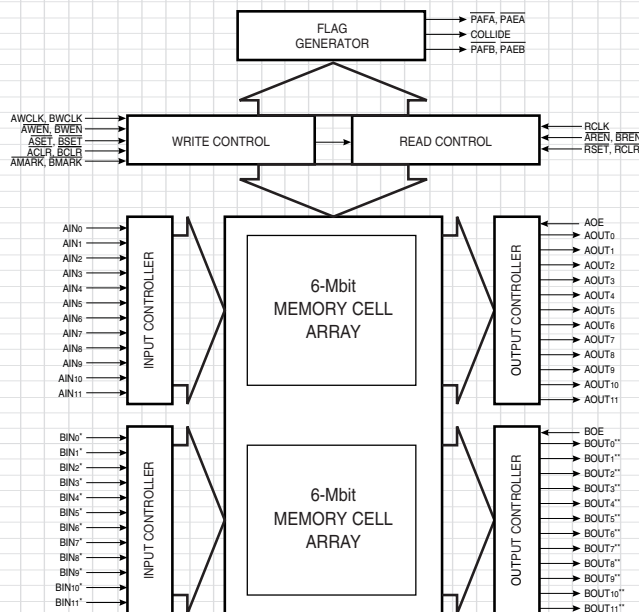
^(a) Power-up Default Mode

Note: Application notes and behavioral models available at www.logicdevices.com

Applications

- ▶ Field-Based or Frame-Based Comb Filtering
- ▶ Image or Data Sequence Capture
- ▶ Resynchronization of Data Streams
- ▶ Frame/Field Synchronization
- ▶ Video Special Effects:
 - Rotation, Zoom, Picture-in-Picture
- ▶ NTSC, PAL, HDTV and DTV Editing and Video Capture Systems
- ▶ Scan Rate Converter
- ▶ Digital Video Cameras
- ▶ Closed Circuit of Security Camera Systems
- ▶ Motion Detection or Frame-to-Frame Correlation
- ▶ Test Pattern Generation
- ▶ Two Dimensional Vertical Filtering
- ▶ TBC(Time Base Correction)
- ▶ Buffer in High-Speed Communication Systems

LF3312 Functional Block Diagram



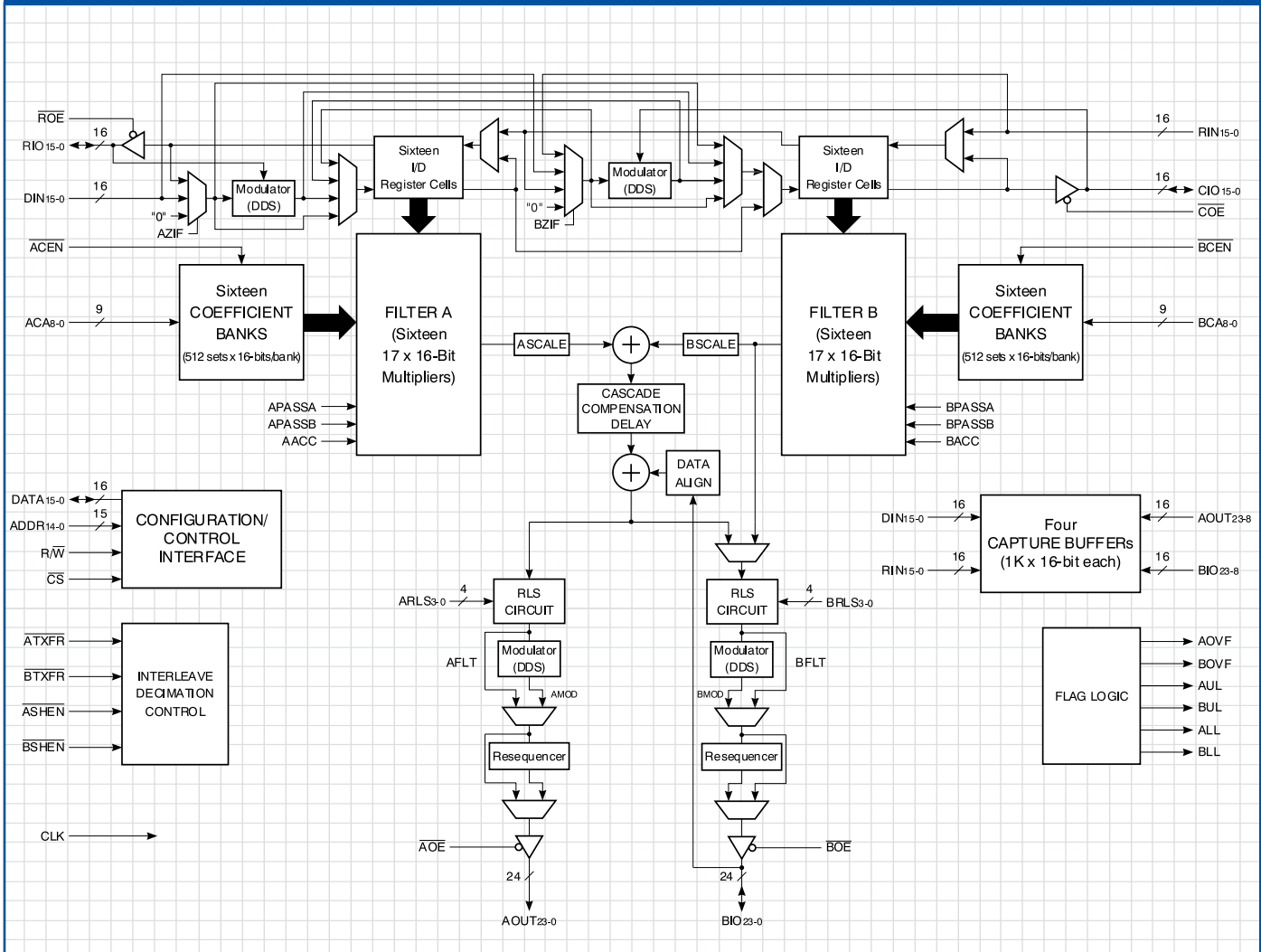
* Doubles as lower portion of random address input
 ** Doubles as upper portion of random address input or as parallel microprocessor port

Features

- ▶ 165 MHz Max Data Rate
- ▶ 330 MHz Max Core Clock Rate
- ▶ 16-bit Data and Coefficients Paths
- ▶ 64-Tap FIR Filter, Cascadable for Additional Filter Taps
- ▶ Multiple Operating Modes: Dual Filter, Single Filter, 32-Bit Data, 32-bit Coefficient, Double Rate, Auto Decimate, Asymmetric Coefficient Set Expansion, and Matrix Multiplication
- ▶ Selectable 24- or 48-bit Data Output with User Defined Rounding and Limiting
- ▶ Supports up to 64 Interleaved Data Streams or a Decimation Factor of up to 64:1 for Increasing Filter Taps
- ▶ Interleaved Accumulator Capability Adds Increased Flexibility When Interleaving
- ▶ 512 User Determined Coefficients Options Per Tap
- ▶ Performs 10 Billion Multiply Accumulates Per Second
- ▶ Built-in Cascade Ports Allow up to 16 Devices to be Cascaded Without Any Additional Hardware
- ▶ Pre/Post-Modulator Stage With Built-In User-Programmable Direct Digital Synthesizer (32-bit Accumulator)
- ▶ Auto Decimation Mode Eliminates the Need for External Coefficient, Transfer and Accumulator Controllers
- ▶ 1K Word by 16-bit Capture Buffer. Supports the Microcontroller When Calculation of New Coefficients is Required for Adaptive Filtering
- ▶ Microcontroller Interface
- ▶ Low Voltage CMOS I/O Interface
- ▶ 5V Tolerant I/O
- ▶ 2.5 Volt Power Supply
- ▶ 272 BGA Package Ball Pitch 1.27mm
- ▶ Industrial / Military Temperatures Available

Note: Application notes and behavioral models available at www.logicdevices.com

LT4420 Functional Block Diagram



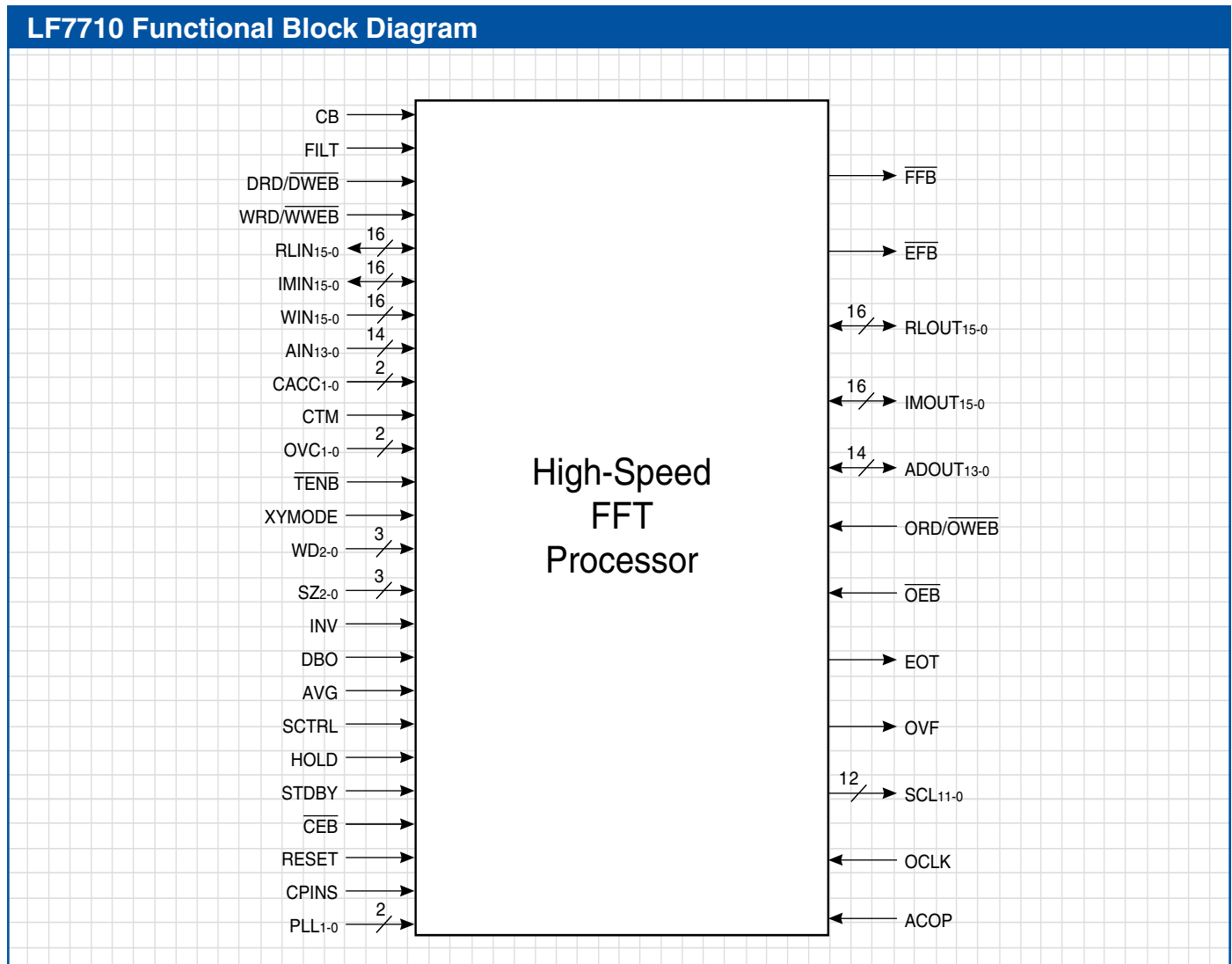
Features

- ▶ 600 MHz Core Operation
- ▶ 16-bit Fixed Point Data Precision (96 dB Dynamic Range) on Output with 24-bit Internal Computation Precision
- ▶ Computes up to a 8192 Point Complex FFT in 26 μ s using a Single Processor *
- ▶ Six Programmable Complex FFT Point Sizes: 16 Point (40 ns), 64 Point (200 ns), 256 Point (600 ns), 1,024 Point (3.2 μ s), 4,096 Point (17 μ s), and 8,192 (26 μ s)*, the fastest single chip FFT performance available! * **
- ▶ Supports Both Forward and Inverse Fast Fourier Transforms
- ▶ Configurable as a FIR Filter with up to 8,192 Complex Taps
- ▶ Contains Seven Built-In Windowing Functions in ROM
- ▶ Window Buffer (16K x 16-bit) Enables Users to Program Their Own Complex Window Functions Through Independent Address and Data Input Lines
- ▶ Standby Modes Result in Significant Power Savings While Simultaneously Retaining Internal Memory Data
- ▶ 1.7 M-bit Internal RAM
- ▶ 1.1 M-bit Internal Function ROM
- ▶ 1.8 Volt Power Supply
- ▶ 5 Volt Tolerant I/O
- ▶ BGA Package TBA
- ▶ Industrial / Military Temperatures Available

* 8192 Complex FFT Computation Time Based on XY Mode with 25% Input Overlap. 8192 Complex FFT with No Overlap and Averaged Linear or Decibel Power is Computed in 32 μ s.

** All Computation Times Based on XY Mode with 25% Input Overlap.

Note: Application notes and behavioral models available at www.logicdevices.com



Imaging Products						
Device	Product	Bits	Pin/Package Options		Voltage	Speed (ns)
LF2242	Half-Band Digital Filter	12	44L. PLCC	44L. PQFP	5	25
LF2246	Image Filter	10	120L. PQFP		5	15
LF2247	Image Filter w/ Coefficient RAM	10	84L. PLCC	100L. PQFP	5	15
LF2249	Digital Mixer	12	120L. PQFP		5	25
LF2250	Matrix Multiplier	10	120L. PQFP		5	20
LF2272	Colorspace Converter	12	120L. PQFP		5	20
LF2301	Image Resampling Sequencer	12	68L. PLCC		5	25
LF3304	Dual 4K Line Buffer / FIFO	12	100L. PQFP		3.3	10
LF3310	Horizontal/Vertical Digital Image Filter	12	144L. PQFP		3.3	12
LF3320	Horizontal Digital Image Filter	12	144L. PQFP		3.3	12
LF3330	Vertical Digital Image Filter	12	100L. PQFP		3.3	12
LF3338*	Vertical Digital Image Filter	8	100L. PQFP		3.3	12
LF3347	High-Speed Image Filter w/ Coefficient RAM	12	120L. PQFP		3.3	12
LF3370	High-Definition Video Format Converter	13	160L. PQFP		3.3	12
LF43168	Dual 8-Tap FIR Filter	10	84L. PLCC	100L. PQFP	5	15
LF43881*	Digital Filter	8	84L. PLCC		5	40
LF43891*	Digital Filter	9	84L. PLCC		5	33
LF48212	Alpha Mixer	12	68L. PLCC	64L. PQFP	5	20
LF48410	Video Histogrammer	24	84L. PLCC		5	25
LF48908	Two Dimensional Convolver	8	84L. PLCC	100L. PQFP	5	25
LF9501	1K Line Buffer	10	44L. PLCC		5	20
LF9502	2K Line Buffer	10	44L. PLCC		5	20

Multipliers						
Device	Product	Bits	Pin/Package Options		Voltage	Speed (ns)
LMU08	Signed	8	44L. PLCC	40L. DIP	5	35
LMU8U*	Unsigned	8	44L. PLCC	40L. DIP	5	35
LMU18	32 Outputs	16	84L. PLCC		5	35
LMU112	Reduced Pin Out	12	52L. PLCC	48L. DIP	5	25
LMU216	Surface Mount	16	68L. PLCC		5	20
LMU217	Microprogram, Surface Mount	16	68L. PLCC		5	25

Multiplier - Accumulators						
Device	Product	Bits	Pin/Package Options		Voltage	Speed (ns)
LMA2009	Surface Mount	12	68L. PLCC		5	20
LMA2010	Surface Mount	16	68L. PLCC		5	25

* Not recommended for new designs, slated to be discontinued. Consult factory regarding long term availability.

Multiplier - Summers

Device	Product	Bits	Pin/Package Options	Voltage	Speed (ns)
LMS12*	Plus 26-bit FIR	12	84L. PLCC	5	35

Arithmetic Logic Units

Device	Product	Bits	Pin/Package Options	Voltage	Speed (ns)
L4C381	Cascadable ALU	16	68L. PLCC	5	15
L4C383*	Cascadable ALU (Extended Set)	16	68L. PLCC	5	20

Special Arithmetic Functions

Device	Product	Bits	Pin/Package Options	Voltage	Speed (ns)
LSH32*	Barrel Shifter	32	68L. PLCC	5	20
LSH33*	Barrel Shifter w / Registers	32	68L. PLCC	5	30
L2330	Coordinate Transformer	24	120L. PQFP	5	20
L2340*	Digital Synthesizer	24	120L. PQFP	5	20

Pipeline Registers

Device	Product	Bits	Pin/Package Options	Voltage	Speed (ns)
L10C11*	Variable Length (3-18 Stages)	8	28L. PLCC 24L. DIP	5	15
L29C520*	Multilevel (1-4 Stages)	8	28L. PLCC 24L. DIP	5	22
L29C521*	Multilevel (1-4 Stages)	8	28L. PLCC 24L. DIP	5	22
L29C525	Dual 8 Deep (1-16)	8	28L. PLCC 28L. DIP	5	15
LPR520	Multilevel (1-4 Stages)	16	44L. PLCC 40L. DIP	5	22

Product Ordering Information**

Prefix, LOGIC Devices Inc.

LF 3320 Q C 12

Device Number

Performance/Speed Range

Package Codes	
Suffix	Description
J	Plastic J-Lead Chip Carrier
P	Plastic DIP
Q	Plastic Quad Flatpack

Temperature Range	
Suffix	Description
C	Commerical 0°C to +70°C
I	Industrial -40°C to +85°C

**The Product Ordering Information Table on the last page of each data sheet provides valid combination of package, temperature, and performance codes for a given product. Please check our web site at <http://www.logicdevices.com> for the latest data.

* Not recommended for new designs, slated to be discontinued. Consult factory regarding long term availability.

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