

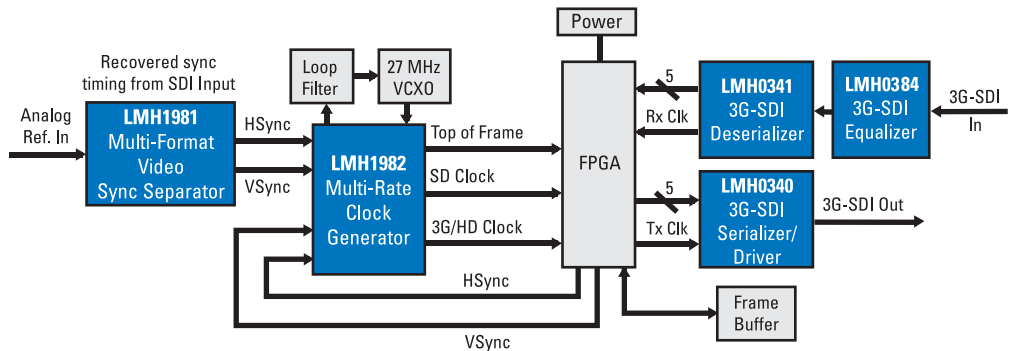
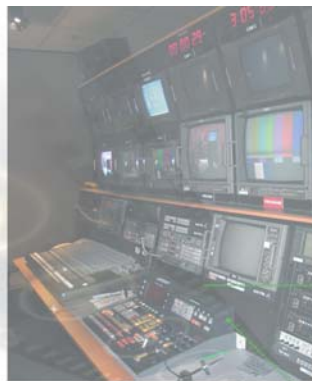
# Professional and Broadcast Video

Solutions Guide

[www.national.com/sdi](http://www.national.com/sdi)

2009 Vol. 1

- SDI Solutions
- SerDes Solutions
- Clock and Timing Solutions
- Analog Video Solutions
- Audio Solutions
- Power Solutions
- Design Resources



**START**

<broadcast> <PROJECTOR // DIGITAL PROJECTOR // PAL // NTSC // SECAM >--> HDTV <</broadcast>  
widescreen--letterbox <camera> 70mm II 35mm II 16mm II beta II digi-beta II mini-dv </camera>  
<aspect ratio> 4:3 // 14:9 // 16:9 // beyond </aspect ratio>  
<format> widescreen--letterbox </format>  
<aspect ratio> 4:3 // 14:9 // 16:9 // beyond </aspect ratio>  
<camera> 70mm II 35mm II 16mm II beta II digi-beta II mini-dv </camera>  
<broadcast> <PROJECTOR // DIGITAL PROJECTOR // PAL // NTSC // SECAM >--> HDTV <</broadcast>



# Enabling Energy Efficiency Through PowerWise® Video Solutions

[national.com/sdi](http://national.com/sdi)



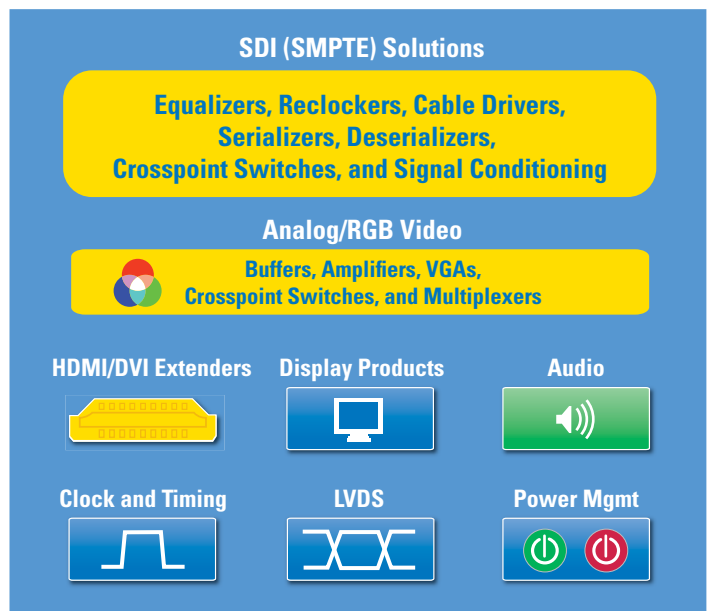
For decades, National Semiconductor has been a trusted advisor and solutions provider to the professional and broadcast video industry. National offers the industry's most comprehensive portfolio of analog and mixed-signal solutions including SDI, video clocking, FPGA-attach IP, analog video, performance audio, power management, LVDS, and signal conditioning products.

Today, energy conservation is driving innovation and forcing smarter design. National's PowerWise® family of ICs, subsystems, and architectures enable hardware designers to minimize power consumption, decrease heat, and improve performance. SDI system PowerWise features such as cable detect (LMH0303/07) and auto sleep (LMH0384) provide designers with intelligent diagnostic tools to evaluate operating conditions and potential faults. With these advanced features, system operators can make educated decisions to power down unused blocks to optimize efficiency, or flag system faults such as loss of signal or cable detachment. Clearly, smarter design results in smarter systems.

National is the only supplier to the broadcast video industry with in-house fabrication and manufacturing. By developing proprietary process technologies, National is able to optimize performance for specific parameters such as ultra-low-noise LC oscillators in Bi-CMOS that deliver the industry's lowest output jitter and highest input jitter tolerance reclockers. Similarly, National's in-house manufacturing facilities reduce part-to-part variation and guarantee maximum datasheet specifications, thereby delivering best-in-class performance products.

In-house manufacturing enables National to develop custom packages for a perfect-fit design. National's packaging experts work closely with process development technologists and IC designers to deliver the industry's smallest solutions. National's latest Micro-Array and LLP-packaged equalizers, reclockers, and cable drivers can be seen on page 4.

With a proven track record in service, quality, performance, and financial stability, National Semiconductor is committed to investing in and leading the way in technology developments for professional and broadcast video.

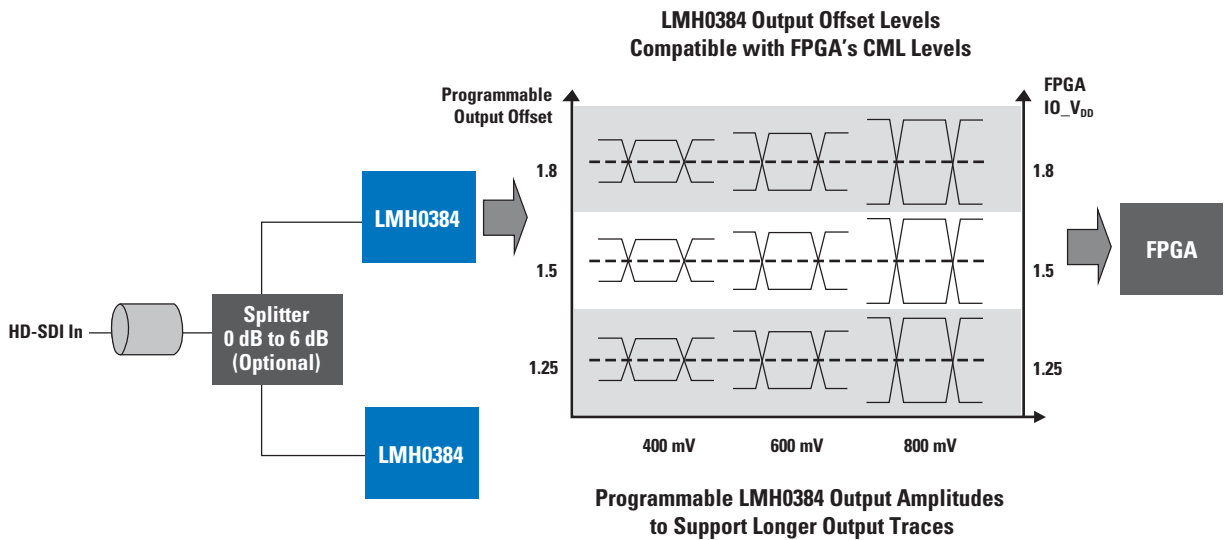
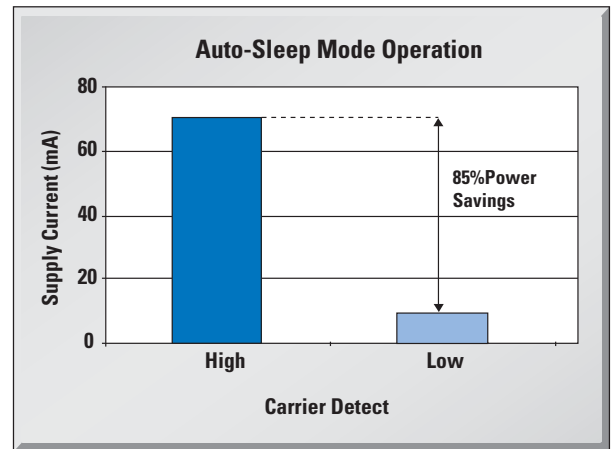
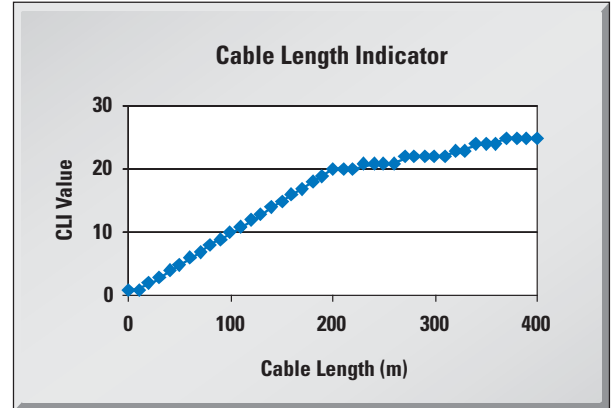


# Configurable 3G-SDI PowerWise® Adaptive Cable Equalizer

## LMH0384 Adaptive Cable Equalizer

### Features

- SMPTE-standard compliant
  - Supports SMPTE 424M (3G), 292M (HD), 259M/C (SD), and DVB-ASI
- Equalized cable lengths\*
  - 140m at 2.97 Gbps
  - 200m at 1.485 Gbps
  - 400m at 270 Mbps
- Power-save mode with auto-sleep control
  - Detects presence of valid input signal
  - 85% power savings in power-save mode
- Low-power LVDS output driver with internal termination
  - Allows DC coupling to most signal conditioning devices
- Two selectable modes of operation
  - Pin mode: compatible with other National equalizers\*\*
  - Register mode: SPI interface to access enhanced feature set
- Enhanced feature set in Register mode
  - Cable length indicator
  - Bypass and output mute threshold
  - Input amplitude control: allows operation with external splitters
  - Programmable output common-mode voltage and swing to enable direct coupling to deep sub-micron geometry CMOS FPGAs



\* Belden 1694A cable

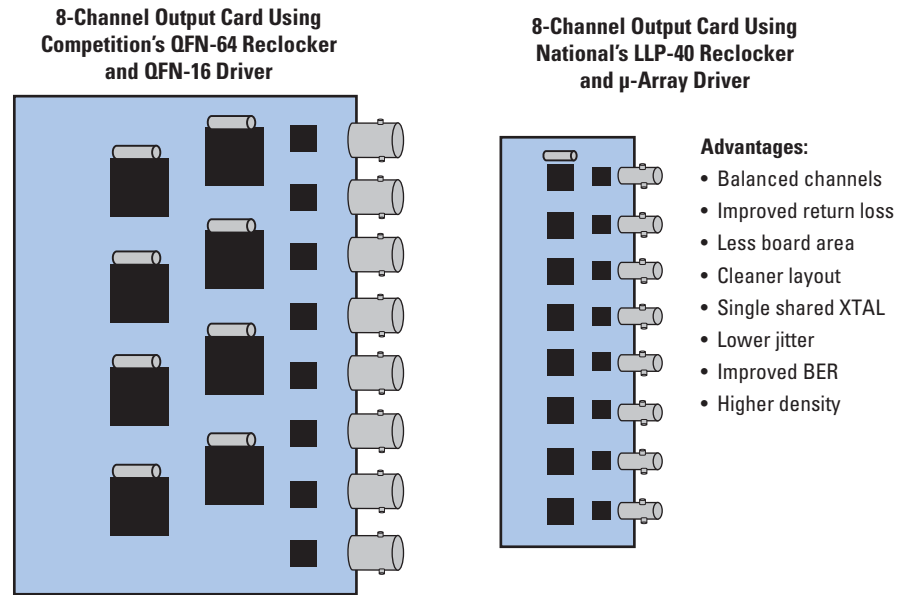
\*\* LMH0344, LMH0044, LMH0074

# Industry's Smallest Packages

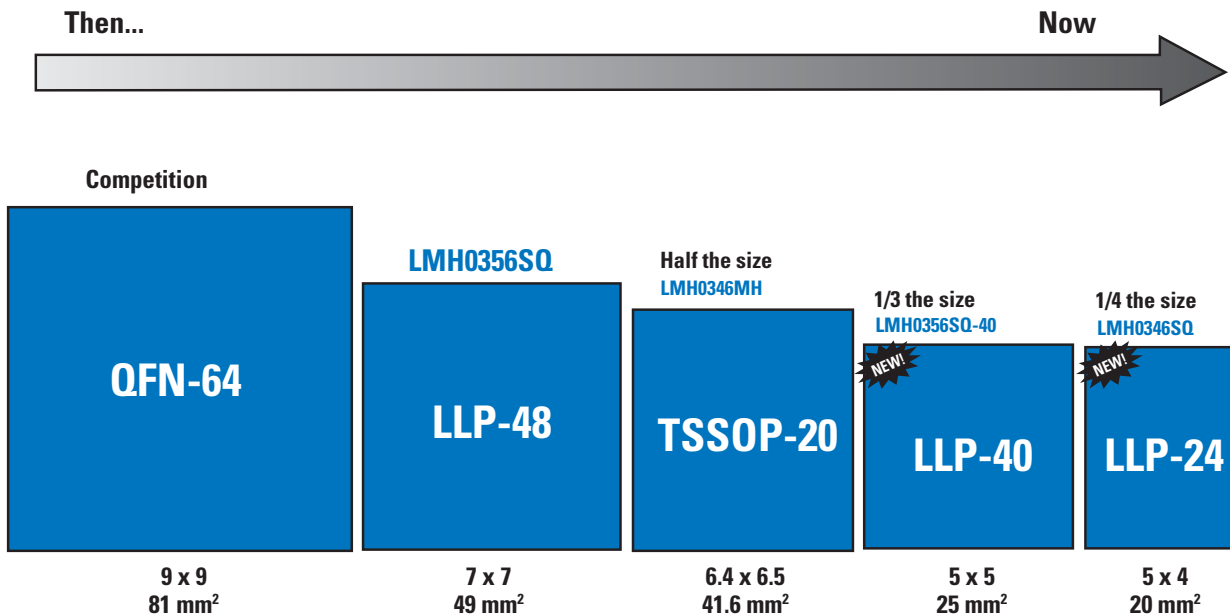
## Features

- Enables high-port-density applications
- 3G-SDI cable equalizer: LMH0344GR
  - $\mu$ Array-25 package (3 mm x 3 mm)
  - 44% board area savings compared to QFN-16 package
- 3G-SDI cable driver: LMH0307GR
  - $\mu$ Array-25 package (3 mm x 3 mm)
  - 44% board area savings compared to QFN-16 package
- 3G-SDI reclocker with 4:1 input mux: LMH0356SQ-40
  - LLP-40 package (5 mm x 5 mm)
  - 70% board area savings compared to QFN-64 package
- 3G-SDI reclocker: LMH0346SQ
  - LLP-24 package (5 mm x 4 mm)
  - 75% board area savings compared to QFN-64 package

## Cleaner Layout, Reduced Board Area, and Simplified BOM



## Evolution of Reclockers: Size Comparison

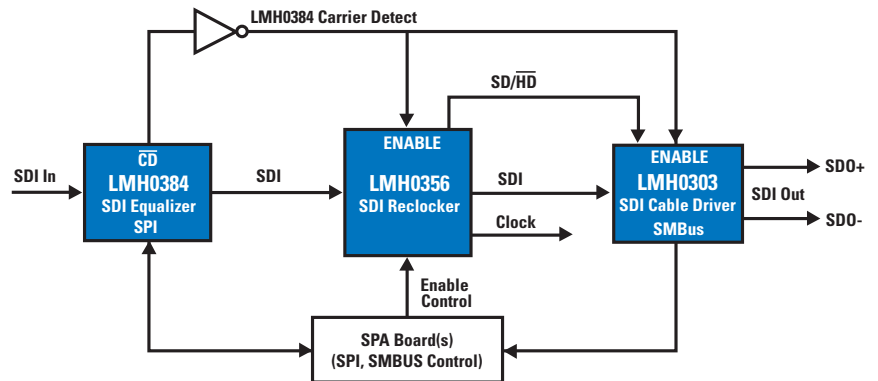


# Intelligent Sensing to Reduce System Power Consumption

## PowerWise® Triple-Rate Distribution Amplifier

### Features

- Auto signal detection at equalizer input
- Cable detection at driver output
- Significant power savings
  - 95% power savings in power-save mode
- Triple-rate SMPTE support
  - Supports SMPTE 424M (3G), 292M (HD), 259M/C (SD), and DVB-ASI



## SDI Equalizers, Reclockers, and Cable Drivers

Product ID	Description	Supply Voltage (V)	Typ Power (mW)	Data Rate (Mbps)	Temp Range <sup>1</sup>	Eval Board Product ID	Packaging
<b>Cable Equalizers</b>							
<b>NEW!</b> LMH0384SQ	3G/HD/SD extended reach adaptive cable equalizer	3.3	230	143 to 2970	Ind	SD384EVK	LLP-16
<b>NEW!</b> LMH0344GR/SQ	3G/HD/SD adaptive cable equalizer	3.3	280	143 to 2970	Ind	SD344EVK	μArray-25/LLP-16
LMH0044SQ	HD/SD adaptive cable equalizer	3.3	208	143 to 1485	Ext	SD044EVK	LLP-16
LMH0034MA	HD/SD adaptive cable equalizer	3.3	208	143 to 1485	Ext	SD034EVK	SOIC-16
LMH0074SQ	SD adaptive cable equalizer with cable detect	3.3	208	143 to 540	Ind	SD074EVK	LLP-16
LMH0024MA	3.3V SD adaptive cable equalizer	3.3	198	143 to 540	Ind	SD024EVK	SOIC-16
<b>Reclockers</b>							
<b>NEW!</b> LMH0346MH/SQ	3G/HD/SD reclocker with dual differential outputs	3.3	370	270 to 2970	Ind	SD3GDAEVK/ SD346EVK	eTSSOP-20/LLP-24
<b>NEW!</b> LMH0356SQ/SQ-40	3G/HD/SD reclocker with 4:1 input mux and FR4 equalization	3.3	430	270 to 2970	Ind	SD356EVK	LLP-48/LLP-40
LMH0046MH	HD/SD reclocker with dual differential outputs	3.3	330	143 to 1485	Ind	SD046EVK	eTSSOP-20
LMH0056SQ	HD/SD reclocker with 4:1 input mux and FR4 equalization	3.3	360	143 to 1485	Ind	SD046EVK	LLP-48
LMH0026MH	SD reclocker with dual differential outputs	3.3	330	270	Ind	SD046EVK	eTSSOP-20
LMH0036SQ	SD reclocker with 4:1 input mux and FR4 equalization	3.3	350	270	Ind	SD046EVK	LLP-48
<b>Cable Drivers</b>							
<b>NEW!</b> LMH0307GR/SQ	3G/HD/SD SDI dual cable driver with cable detect, input LOS, selectable slew rate and 4 mW power-down mode	3.3	275	Up to 2970	Ind	SD307EVK	μArray-25/LLP-16
LMH0302SQ	3G/HD/SD cable driver with enable feature	3.3	165	Up to 2970	Ind	SD302EVK	LLP-16
LMH0303SQ	3G/HD/SD SDI cable driver with cable detect, input LOS, selectable slew rate and 4 mW power-down mode	3.3	155	Up to 2970	Ind	SD303EVK	LLP-16
LMH0002MA/TMA	HD/SD serial digital cable driver with selectable slew rate	3.3	149	Up to 1485	Com/Ind	SD002EVK	SOIC-8
LMH0002SQ	HD/SD serial digital cable driver with selectable slew rate	3.3	149	Up to 1485	Ind	SD002SQ-EVK	LLP-16
LMH0202MT	Dual SD/DS serial cable driver with dual differential input and output	3.3	298	Up to 1485	Com	SD202EVK/ DVB202-EVK	TSSOP-16
LMH0001SQ	SD serial digital cable driver with adjustable output amplitude	3.3	125	Up to 540	Ind	SD001SQ-EVK	LLP-16

PowerWise® Product <sup>1</sup> Temperature ranges: Com: 0°C to 70°C Ext: 0°C to 85°C Ind: -40°C to 85°C

Older products not shown in the table, but still in production include: CLC012AJE, CLC014AJE, CLC016AJQ/MTC/ACQ, CLC001AJE, CLC005AJE, CLC006AJE, CLC007AJE

# Triple-Rate SDI Development Platform for Altera FPGAs

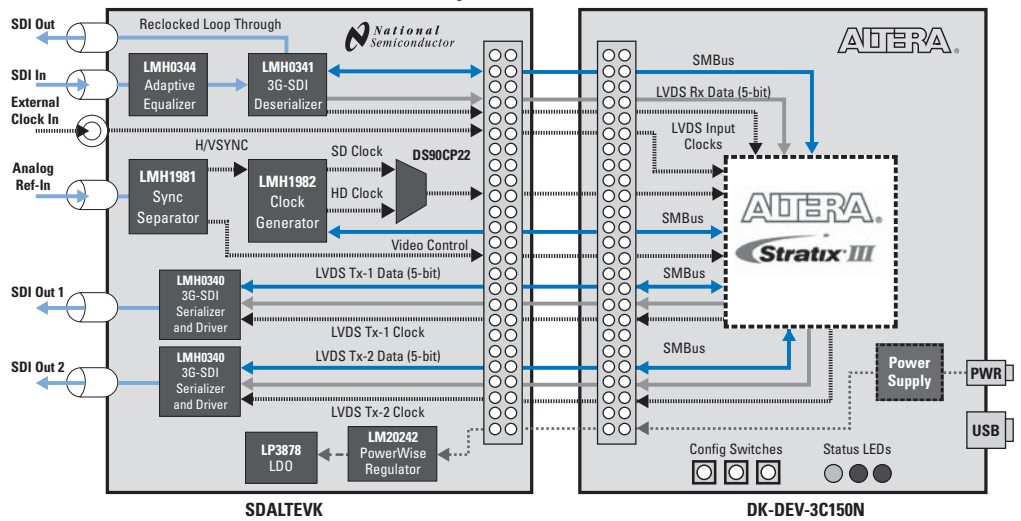
In collaboration with Altera, National Semiconductor has developed a triple-rate SDI and video clocking daughter card for Altera FPGA development kits. National's daughter card is compatible with both the Cyclone-III and the Stratix-III development kits. It plugs directly into the host FPGA development board via Altera's high-speed mezzanine connector (HSMC).

National provides FPGA source code for SMPTE protocol processing (included with the purchase of an evaluation kit or ICs). The FPGA IP along with the daughter card and the FPGA development kit provide broadcast video system designers a comprehensive platform for rapid evaluation and prototyping of new designs, thereby reducing time to market.

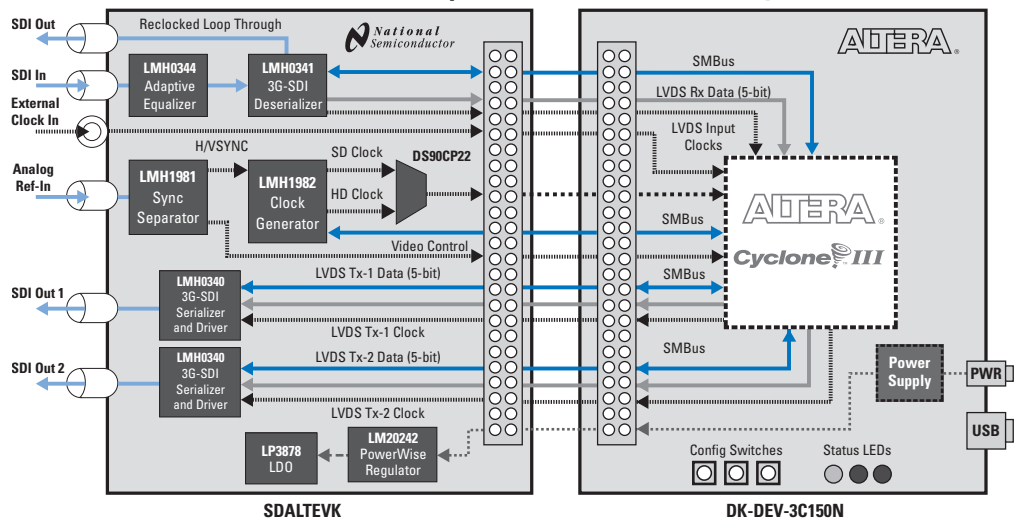
## Features

- 3G, HD, and SD compatible
- Comprehensive reference for hardware design and FPGA IP development
- Included HDL (Verilog, VHDL source) supports SDI framing, audio embedding/de-embedding and test pattern generation
  - IP available for both Cyclone-III and Stratix-III FPGAs
- Support for Genlock

**SDALTEVK: 3G-SDI Development Platform with Altera Stratix-III FPGA**



**SDALTEVK: 3G-SDI Development Platform with Altera Cyclone-III FPGA**



— Video  
 Clocks\*  
 Parallel  
— Data Control  
 Power

\*Four clocking options available

1. Recovered clock
2. Genlock (analog ref in with LMH1981 + LMH1982)
3. Local generation (free run with LMH1982)
4. External clock

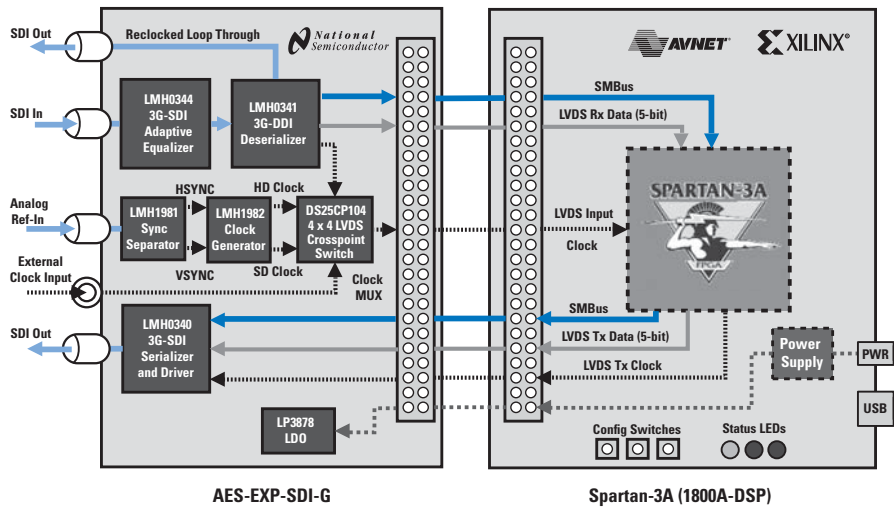
# Triple-Rate SDI Development Platform for Xilinx FPGAs

In collaboration with Avnet and Xilinx, National Semiconductor developed a triple-rate SDI and video clocking daughter card for the Xilinx Spartan-3A/3E development kits. The daughter card plugs directly into the Spartan development board through an EXP connector. The combined solution of the daughter card and the development kit provides broadcast video system designers with a comprehensive platform for rapid evaluation and prototyping of new designs, thereby reducing time to market.

## Features

- 3G, HD, and SD compatible
- Comprehensive reference for hardware design and FPGA IP development
  - HDL (Verilog, VHDL) available from AVNET
  - Supports SDI framing, audio embedding/de-embedding and test pattern generation
- Support for Genlock

**AES-EXP-SDI-G: 3G-SDI Development Platform with Xilinx Spartan-3A FPGA**



— Video  
■ Clocks\*  
— Parallel  
— Data Control  
... Power

\*Four clocking options available

1. Recovered clock
2. Genlock (analog ref in with LMH1981 + LMH1982)
3. Local generation (free run with LMH1982)
4. External clock

[www.national.com/analog/interface/sdxilevk](http://www.national.com/analog/interface/sdxilevk)

# Flexible IP and High-Performance SerDes

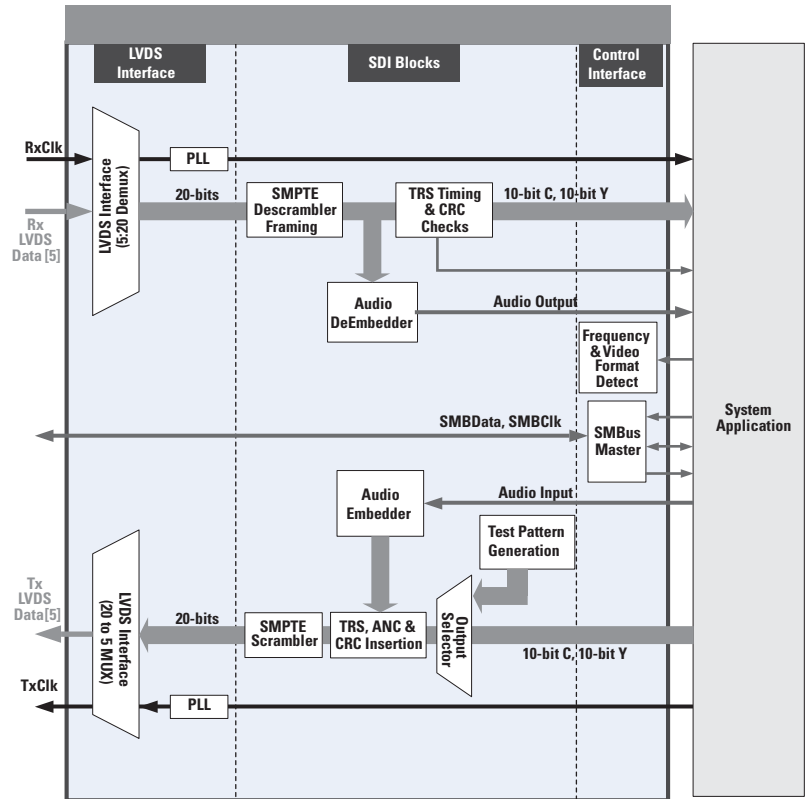
## Triple-Rate FPGA IP

National's SerDes solution includes a comprehensive IP package to support common SDI applications and popular FPGA models.

### IP Package includes:

- Triple-rate SDI support with automatic rate detect
- SMPTE scrambling, descrambling, and framing
- Support for embedded audio
- Test pattern generation for development and validation
- 20:5 output muxing and 5:20 input demuxing to support the 5-bit LVDS interface bus
- SMBus management interface
- Support for both level-A and level-B 3G-SDI formats
- Source code in synthesizable HDL (Verilog, VHDL format)

FPGA IP Block Diagram



## SDI Serializers and Deserializers

Product ID	Description	Supply Voltage (V)	Typ. Power (mW)	Data Rate (Mbps)	Temp Range <sup>1</sup>	Eval board Product ID	Packaging
<b>Serializers</b>							
<b>NEW!</b> LMH0340SQ	3G/HD/SD serializer with LVDS interface and integrated cable driver	3.3, 2.5	440	270 to 2970	Ind	SDALTEVK	LLP-48
<b>NEW!</b> LMH0040SQ	HD/SD serializer with LVDS interface and integrated cable driver	3.3, 2.5	440	270 to 1485	Ind	SDALTEVK (Altera)	LLP-48
<b>NEW!</b> LMH0050SQ	HD/SD serializer with LVDS interface	3.3, 2.5	460	270 to 1485	Ind	SDXILEVK (Xilinx)	LLP-48
<b>NEW!</b> LMH0070SQ	SD serializer with LVDS interface and integrated cable driver	3.3, 2.5	400	270	Ind	SDXILEVK (Xilinx)	LLP-48
LMH0030VS	HD/SD serializer with FIFOs, integrated cable driver, 85 ps typical output jitter, no external VCOs required, BIST, and TPG	3.3, 2.5	430	270 to 1485	Com	SD130EVK	TQFP-64
<b>Deserializers</b>							
<b>NEW!</b> LMH0341SQ	3G/HD/SD reclocking deserializer with LVDS interface and active loopthrough	3.3, 2.5	590	270 to 2970	Ind	SDALTEVK	LLP-48
<b>NEW!</b> LMH0041SQ	HD/SD reclocking deserializer with LVDS interface and active loopthrough	3.3, 2.5	550	270 to 1485	Ind	SDALTEVK (Altera)	LLP-48
<b>NEW!</b> LMH0051SQ	HD/SD reclocking deserializer with LVDS interface	3.3, 2.5	555	270 to 1485	Ind	SDXILEVK (Xilinx)	LLP-48
<b>NEW!</b> LMH0071SQ	SD reclocking deserializer with LVDS interface and active loopthrough	3.3, 2.5	525	270	Ind	SDXILEVK (Xilinx)	LLP-48
LMH0031VS	HD/SD deserializer / descrambler with FIFOs, 27 MHz reference, BIST, TPG, and automatic EDH/CRC	3.3, 2.5	850	270 to 1485	Com	SD131EVK	TQFP-64

<sup>1</sup>Temperature ranges: Com: 0°C to 70°C Ext: 0°C to 85°C Ind: -40°C to 85°C

Older products not shown in the table, but still in production include: CLC020BCQ, CLC021AVGZ-5.0, CLC021AVGZ-3.3, CLC011BCQ



# Sync Separators and Video Clocking Solutions

## Sync Separators

Product ID	Type	Key Features	Supported Video Formats	Inputs	Outputs	Spec Supply Range (V)	Packaging
LMH1981	50% slicing	Auto-video format detection, 50% sync slicing, low H sync jitter	NTSC, PAL, SECAM, 480i/p, 576i/p, 720p, 1080i/p	0.5 to 2.0 V <sub>p-p</sub>	H sync, V sync, C sync, odd/even, burst/clamp, video format	3.3 - 5	TSSOP-14
LMH1980	70 mV fixed	Auto-video format detection	NTSC, PAL, SECAM, 480i/p, 576i/p, 720p, 1080i/p, PC Sync on Green	0.5 to 2.0 V <sub>p-p</sub>	H sync, V sync, C sync, odd/even, burst/clamp, HD detect flag	3.3 - 5	MSOP-10

## Clock Generators

Product ID	Key Features	Number of Inputs	Inputs Reference	Number of Outputs	Output Clock Frequencies (MHz)	Supply (V)	Packaging
<b>NEW</b> LMH1982	Simultaneous SD and 3G/HD clock outputs, exceeds SMPTE jitter spec, genlock and free-run modes, programmable output top-of-frame pulse generator	2	H/V Sync, and/or 27 MHz	2	SD: Clock 27 or 67.5 MHz 3G/HD Clock: 74.25, 74.25/1.001, 148.5 or 148.5/1.001 MHz	3.3 and 2.5	LLP-32

## Clock Conditioners

Product ID	LVDS Outputs	LVPECL Outputs	VCO	PLL	VCO Frequency	Jitter RMS (Typ)	Supply (V)	Packaging
LMK03000C	3	5	Integrated	Integrated	1185 to 1296 MHz	0.4 ps	3.3	TSSOP-14
LMK03000	3	5	Integrated	Integrated	1185 to 1296 MHz	0.8 ps	3.3	SOIC-8, DIP-8

 PowerWise product

## LMH1981 Lowest Jitter Sync Separator for HD Video Formats Featuring 50% Sync Slicing

### Features

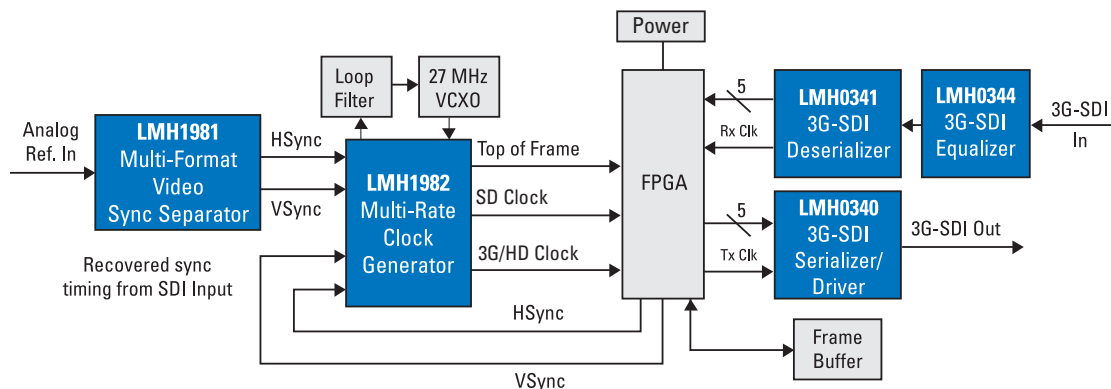
- 50% sync slicing
- Low-jitter horizontal sync outputs
- Supports NTSC, PAL, SECAM, 480i/p, 576i/p, 720p, 1080i/p
- Accepts video signals from 0.5 V<sub>p-p</sub> to 2.0 V<sub>p-p</sub>
- No external programming with  $\mu$ C required
- Horizontal sync output propagation delay < 50 ns
- 3.3V or 5V single supply operation
- 31 mW typical power dissipation

## LMH1982 – 3G/HD/SD Video Clock Generator with Genlock

### Features

- Two reference ports for genlocking the outputs
  - H and V sync inputs for NTSC/525i, PAL/625i, 525p, 625p, 720p, 1080i, 1080p video timing
- Simultaneous SD and 3G/HD LVDS-compatible clock outputs
- Achieves low jitter output clocks capable of directly driving FPGA serializers with no additional clock cleansing required
- Genlock or free run mode operation
- Programmable output top-of-frame pulse
- Supports cross locking

### Genlock and Video Timing Interface



# Analog Video Products

Product ID	Key Features	SSBW (MHz)	$A_v$ (V/V)	Slew Rate (V/ $\mu$ s)	$I_{CC}$ (mA/ch)	Spec. Supply Range (V)	2nd/3rd HD into $R_L = 100\Omega$	NTSC Diff. G/P %/Deg.
<b>Fully Differential Amplifiers</b>								
LMH6550	Fully differential amplifier with disable	400	1	3000	20	4.5 to 12	-78/-88 at 20 MHz, $R_L = 800\Omega$	—
LMH6551	Fully differential amplifier	370	1	2400	12.5	3 to 12	-94/-96 at 5 MHz, $R_L = 800\Omega$	—
<b>NEW</b> LMH6552	Fully differential amplifier with disable	1500	1	3800	22.5	4.5 to 12	-92/-93 at 20 MHz, $R_L = 800\Omega$	—
<b>Consumer Video Applications</b>								
LMH6601	250 MHz, 2.4V CMOS op amp with shutdown	125	2	260	9.2	2.4 to 6	-79/-69 at 10 MHz into $R_L = 1\text{ K}\Omega$	0.06/0.23
<b>NEW</b> LMH6611/12	365 MHz Rail to rail Output Amplifier	365	1	460	3.2	2.7 to 11	-69/-74 $R_L=1\text{k}\Omega$	0.05/0.05
LMH6643/44	130 MHz, 75 mA rail-to-rail output amplifiers	130	1	135	2.7	3 to 12.8	-62 at 5 MHz	0.15/0.04
LMH6647	Rail-to-rail input/output, low power, shutdown VFB	55	1	22	0.73	2.5 to 12	N/A	N/A
LMH6657/58	270 MHz single supply, CMIR < 0V amplifiers	270	1	700	6.5	3 to 12	-70/-57 at 5 MHz	0.03/0.1
LMH6682/83	3V single supply, CMIR < 0V, low diff. gain/phase amp	190	2	940	6.5	3 to 12	-66/-54 at 5 MHz	0.01/0.08
<b>High-End Professional Video Applications</b>								
LMH6609	900 MHz, 1400 V/ $\mu$ s VFB amplifier	900	2	1400	7	$\pm 6.6$	-63 /-57 at 20 MHz	0.01/0.026
LMH6702	Ultra-low distortion, wide bandwidth op amp	1700	2	3100	12.5	$\pm 5$ to $\pm 6$	-63/-70 at 60 MHz	0.01/0.02
LMH6703	Low distortion, op amp with shutdown	1.2 GHz	2	3300	11.5	$\pm 5$ to $\pm 6$	-80/-90 at 5 MHz	0.02/0.02
LMH6714	Wideband video op amp	400	2	1800	5.6	$\pm 5$ to $\pm 6$	-58/-70 at 20 MHz	0.01/0.01
LMH6715	Wideband video op amp	400	2	1300	5.8	$\pm 5$ to $\pm 6$	-60/-75 at 20 MHz	0.02/0.02
LMH6720	Wideband video, disable	400	2	1800	5.6	$\pm 5$ to $\pm 6$	-58/-70 at 20 MHz	0.02/0.01
LMH6722	Wideband video op amp	400	2	1800	5.6	$\pm 5$ to $\pm 6$	-58/-70 at 20 MHz	0.01/0.01
LMH6732	Adjustable supply current vs bandwidth	540 (1.5 GHz)	2	2700	9	$\pm 4.5$ to $\pm 6$	-60/-64 at 20 MHz	0.02/0.01
<b>NEW</b> LMH6733	Triple wideband amplifier with shutdown	1 GHz	1	3750	5.5	3 to 12	-72/-63 at 10 MHz	0.03/0.025
LMH6738	Triple wideband op amp individual disable	750	1	3300	11.6	8 to 12	-80/-90 at 5 MHz	0.02/0.01
<b>Video Buffers/Programmable Gain Buffers</b>								
LMH6559	Ultra-high slew rate, closed loop buffer	1.75 GHz	1	4580	10	3 to $\pm 5$	-58/-53 at 20 MHz	0.06/0.02
LMH6560	High-speed, closed loop buffer	680	1	3100	10	3 to $\pm 5$	-58/-53 at 20 MHz	0.1/0.03
LMH6704	Buffer with shutdown	650	1	3000	11.5	8 to 12	-62/-78 at 10 MHz	0.02/0.02
LMH6718	Programmable gain buffer, $A_v = -1, +1, \text{ or } +2$	130	2	600	2.6	$\pm 2.5, \pm 5$ to $\pm 6$	-84/-84 at 1 MHz	0.04/0.03
LMH6734	Selectable Gain Buffer, $A_v = -1, +1, \text{ or } +2$	925	1	3750	5.5	3 to 12	-63/-73 at 10 MHz	0.03/0.025
LMH6739	RGB buffer with shutdown	750	1	3300	11.5	8 to 12	-80/-90 at 20 MHz	0.02/0.01

1 Blank evaluation board: A=CLC730227/CLC730027; B=CLC730036; C=CLC730031/CLC730231; D=CLC730245; E=CLC730145; F=CLC730033/CLC730146; G=CLC730066/CLC730166, M=LMH730275, N=LMH730154, P=LMH730276, Q=LMH730277 and S=LMH730277 Note: Evaluation boards accompany sample requests and cannot be ordered separately.

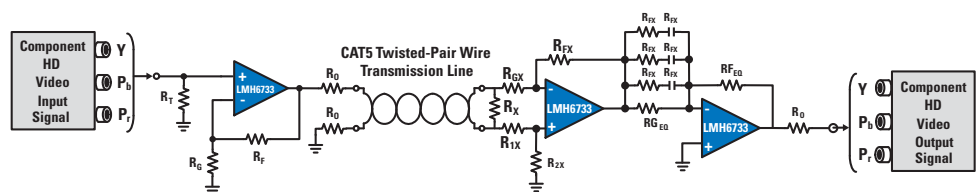
2 Temperature ranges: COM = 0°C to 70°C Ext = 0°C to 85°C Ind = -40°C to 85°C

## **NEW** LMH6733 – Triple Amplifier with Industry's Best Bandwidth-to-Power Ratio

### Features

- 1.0 GHz -3 dB small signal bandwidth ( $A_v = +1, V_S = \pm 5V$ )
- 600 MHz -3 dB large signal bandwidth ( $A_v = +2, V_S = \pm 5V$ )
- 350 MHz 0.1 dB gain flatness
- -80 dB crosstalk at 10 MHz
- 5.5 mA/channel supply current
- Single supply operation: 3V to 12V

### LMH6733 Typical Application



Product ID	I <sub>out</sub> (mA) (typ.)	Settling time (2V step) (ns to %)	VOS Typ./Temp. (mV)	Voltage Noise (nV/√Hz)	i <sub>inn</sub> (pA/√Hz)	i <sub>ini</sub> (pA/√Hz)	Temp. Range <sup>2</sup>	SPICE Model	Blank Eval. Board <sup>1</sup>	Package Type	Packaging
<b>Fully Differential Amplifiers</b>											
LMH6550	±75	8 to 0.1	0.5	6	1.5	—	Ind	Y	N	Single	SOIC-8, MSOP-8
LMH6551	±65	18 to 0.05	0.5	6	1.5	—	Ext	Y	N	Single	SOIC-8, MSOP-8
NEW LMH6552	±80	10 to 0.1	1.5	1.1	19.5	—	Ind	Y	N	Single	SOIC-8, LLP-8
<b>Consumer Video Applications</b>											
LMH6601	+50/-75	70 to 0.1 <sup>3</sup>	1/5	10	0.05	0	Ind	N	T	Single	SC70-6
NEW LMH6611/12	120	60 to 0.1	0.074/1.1	10	2	2	Ind	Y	Y	Single/Dual	TSOT23-6/SOIC-8
LMH6643/44	75	68 to 0.1	1/7	17	0.9	0.9	Ind	Y	B/C	Dual/Quad	SOIC-8, MSOP-8/SOIC-14, TSSOP-14
LMH6647	20	N/A	1/4	17	0.75	0.75	Ind	Y	A	Single	SOIC-8, SOT23-6
LMH6657/58	110	35 to 0.1	1/7	11	2.1	2.1	Ind	Y	B	Single/Dual	SC70-5, SOT23-5, SOIC-8, MSOP-8
LMH6682/83	85	42 to 0.1	1/7	12	3	3	Ind	Y	B/C	Dual/Triple	SOIC-8, MSOP-8, SOIC-14, TSSOP-14
<b>High-End Professional Video Applications</b>											
LMH6609	90	15 to 0.05	—	4	1	1	Ind	Y	A	Single	SOIC-8, SOT23-5
LMH6702	80	13.4 to 0.1	1/6	1.83	3	18.5	Ind	Y	A	Single	SOIC-8, SOT23-5
LMH6703	90	10 to 0.1	0.5/6	2.3	3	12	Ind	Y	A	Single	SOT23-6, SOIC-8
LMH6714	70	12 to 0.05	0.2/8	3.4	1.2	10	Ind	Y	A	Single	SOIC-8, SOT23-5
LMH6715	70	12 to 0.05	2/8	3.4	1.4	10	Ind	Y	B	Dual	SOIC-8
LMH6720	70	12 to 0.05	0.2/8	3.4	1.2	10	Ind	Y	B	Single	SOIC-8
LMH6722	70	12 to 0.05	0.2/8	3.4	1.2	10	Ind	Y	C	Quad	SOIC-14
LMH6732	115	18 to 0.04	3/9.9	2.5	1.8	9.7	Ind	Y	A	Single	SOT23-6, SOIC-8
NEW LMH6733	60	10 to 0.1	2.0/2.5	2.1	26.9	18.6	Ind	Y	M	Triple	SSOP-16
LMH6738	90	13.4 to 0.1	0.5/2.5	2	4	12	Ind	Y	M	Triple	SSOP-16
<b>Video Buffers/Programmable Gain Buffers</b>											
LMH6559	74	9 to 0.1	3/25	2.8	1.6	N/A	Ind	Y	D	Single	SOIC-8, SOT23-5
LMH6560	74	9 to 0.1	2/25	3	0.9	N/A	Ind	Y	E	Quad	SOIC-14, TSSOP-14
LMH6704	90	10 to 0.1	2/9.3	2.3	3	12	Ind	Y	A	Single	SOT23-6, SOIC-8
LMH6718	200	17 to 0.05	0.2/15	8	9	12	Ind	Y	B	Dual	SOIC-8
LMH6734	70	10 to 0.1	2/2.5	2.1	26.9	18.6	Ind	N	M	Single	SSOP-16
LMH6739	90	10 to 0.1	0.5/4.5	2.3	3	12	Ind	Y	M	Triple	SSOP-16

1 Blank evaluation board: A=CLC730227/CLC730027; B=CLC730036; C=CLC730031/CLC730231; D=CLC730245; E=CLC730145; F=CLC730033/CLC730146; G=CLC730066/CLC730166, M=LMH730275, N=LMH730154, P=LMH730276, Q=LMH730277 and S=LMH730277 Note: Evaluation boards accompany sample requests and cannot be ordered separately.

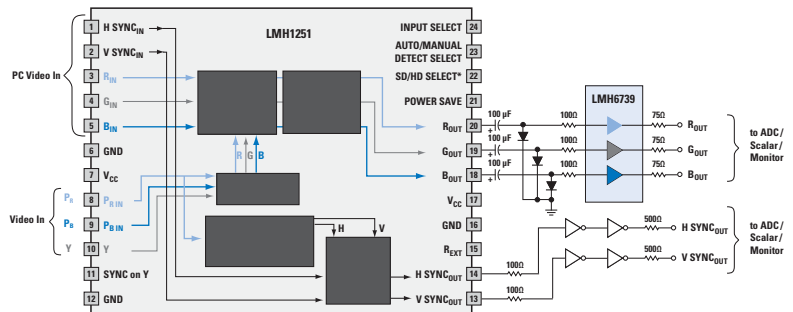
2 Temperature ranges: COM = 0°C to 70°C Ext = 0°C to 85°C Ind = -40°C to 85°C

## LMH1251 YPbPr to RGBHV Converter and 2:1 Video Switch

### Features

- YPbPr to RGBHV conversion
- YPbPr path: 70 MHz, -3 dB, 700 mV<sub>P-P</sub> bandwidth
- RGB path: 400 MHz, -3 dB, 700 mV<sub>P-P</sub> bandwidth
- Supports PC video display resolutions up to UXGA (1600 x 1200 at 75 Hz)
- Supports 480i, 480p, 576i, 576p, 720p, 1080i, and 1080p
- Smart video format detection for SD and HD
- Power save mode

### LMH1251 Typical Application Driving a Video Load



Ideal for use in TFT LCD monitors, CRT monitors, set-top boxes, display projectors, and video peripheral products

# Multiplexers, VGAs, and Crosspoint Switches for Analog Video

Product ID	Single/Dual/Triple/Quad	Key Features	Single Channel BW (MHz)	Control Channel BW (MHz)	Gain Adjust Range (dB)	Slew Rate SR (V/ $\mu$ s)	Supply Voltage Vs (V)	Supply Current Is (mA)	Common Mode Input Range CMIR (V)	Gain Response	Temp. Range <sup>2</sup>	SPICE Model	Blank Eval Board <sup>1</sup>	Packaging
<b>Video Equalizer</b>														
LMH6502	S	Differential input	130	100	70	1800	5 to 12	27	$\pm 2.2$	Linear-in-dB	Ind	Y	F	SOIC-14, TSSOP-14
LMH6503	S	Differential input	135	100	70	1800	5 to 12	37	$\pm 2.2$	Linear-in-V/V	Ind	Y	F	SOIC-14, TSSOP-14
LMH6505	S	Single-ended input	150	100	80	1500	7 to 12	11	$\pm 3.0$	Linear-in-dB	Ind	Y	G	SOIC-8, MSOP-8

Product ID	Channels	Key Features	SSBW (MHz)	Switching Speed (ns)	Crosstalk Rejection (dB)	Settling Time to 0.1% (ns)	2nd/3rd HD into $R_L=100\Omega$ (dBc)	$I_{OUT}$ [mA] (typ.)	Supply Current $I_{CC}$ (mA)	Spec. Supply Range (V)	Temp. Range <sup>2</sup>	SPICE Model	Blank Eval Board <sup>1</sup>	Packaging
<b>High-Performance Multiplexer Products</b>														
LMH6570	2:1	Buffered video mux, shutdown	500	8	85	17	-68/-84 at 5 MHz	80	13	$\pm 3.3$ to $\pm 5$	Ind	Y	S	SOIC-8
LMH6572	Triple 2:1	Buffered video mux, 2x gain stage disable	350	10	90	17	-78/-75 at 10 MHz	80	23	$\pm 3.3$ to $\pm 6$	Ind	Y	N	SSOP-16
LMH6574	4:1	Buffered video mux, shutdown	500	8	70	17	-68/-84 at 5 MHz	75	13	$\pm 3.3$ to $\pm 5$	Ind	Y	P	SOIC-14, TSSOP-14

Product ID	Channels	Key Features	SSBW (MHz)	Slew Rate (V/ $\mu$ s)	Crosstalk Rejection (dB)	Settling Time	Diff. G/P %/deg. into $R_L=150\Omega$	2nd/3rd HD into $R_L=100\Omega$ (dBc)	$I_{OUT}$ (mA) (typ.)	Temp. Range <sup>2</sup>	Spec. Supply	Packaging
<b>High-Performance Crosspoint Switch</b>												
<b>NEW</b> LMH6584/85	32 x 16	Crosspoint switch, gain+1, +2, serial prog.	400	1200	-43 dB at 100 MHz	15 ns 2V step at 0.5%	0.04/0.03 at 3.58 MHz and 4.43 MHz	-70 at 10 MHz/-75 at 10 MHz	+/- 45	Ind	$\pm 3$ to $\pm 5$	TQFP-144
LMH6582/83	16 x 8	Crosspoint switch, gain +1, +2, serial prog.	550	1900	-70/-45 (10 MHz/100 MHz)	18 ns 2V step at 0.1%	0.04/0.04 at 3.58 MHz and 4.43 MHz	-74 at 20 MHz/-77 at 5 MHz	$\pm 60$	Ind	$\pm 3$ to $\pm 5$	TQFP-64 (Exposed pad)
LMH6580/81	8 x 4	Crosspoint switch, gain +1, +2, serial prog.	500	1700	-45 dB at 100 MHz	6 ns 2V step at 0.5%	0.05/0.05 at 3.58 MHz and 4.43 MHz	-80/-70 at 5 MHz	70	Ind	$\pm 3$ to $\pm 5$	TQFP-48

Product ID	Channels	Key Features	SSBW (MHz)	LSBW (MHz)	Crosstalk Rejection (dB)	Diff. G/P %/deg. into $R_L=150\Omega$	Temp. Range <sup>2</sup>	Spec. Supply	Packaging
<b>Composite Video Crosspoint Switch</b>									
<b>NEW</b> LMH6586	32 x 16	Video clamps, loss of video det., I <sup>2</sup> C prog.	66	29	-58 db at 6 MHz	0.05/0.05 at 3.58 MHz	Ind	5V	TQFP-80

Product ID	Title/Function	Supported Video Formats	Inputs	Outputs	YPbPr Path BW (MHz)	RGB Path BW (MHz)	Spec Supply Range (V)	Packaging
<b>Video Format Converters</b>								
<b>NEW</b> LMH1251	YPbPr to RGBHV converter with integrated 2:1 switch, auto-format detection for YPbPr	480i/p, 576i/p 720p, 1080i/p, XGA, SXGA, UXGA	YPbPr and RGBHV	RGBHV	70	400	5	TSSOP-24

1 A=CLC730227/027; B=CLC730036; C=CLC730031/231; D=CLC730245; E=CLC730145; F=CLC730033/146; G=CLC730066/166; M=LMH730275; N=LMH730151; P=LMH730276; Q=LMH730277 and S=LMH730277 Note: Evaluation boards accompany sample requests only.  
 2 Temperature ranges: COM = 0°C to 70°C Ext = 0°C to 85°C Ind = -40°C to 85°C

## LMH6570/72/74 – Family of Multiplexers

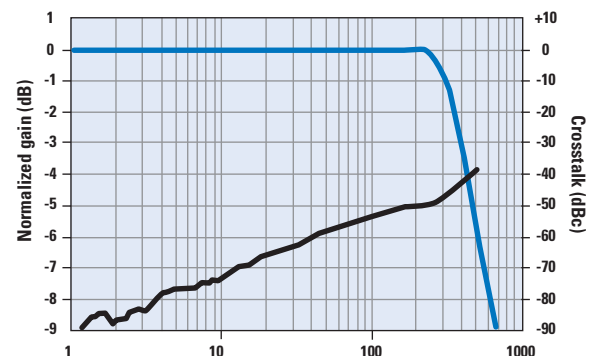
### LMH6570/74 Features

- Single 2:1 Mux (LMH6570)
- Single 4:1 Mux (LMH6574)
- 400 MHz, 2  $V_{P-P}$ , -3 dB bandwidth
- 0.1 dB gain flatness to 150 MHz
- 8 ns channel switching time

### LMH6572 Features

- Triple 2:1 Mux
- 290 MHz, 2  $V_{P-P}$ , -3 dB bandwidth
- 0.1 dB gain flatness to 140 MHz
- 10 ns channel switching time

LMH6574 Performance Bandwidth vs Crosstalk



## LMH6582/83 Industry's Fastest Analog Crosspoint Switches for High-Resolution Video Applications

### Features

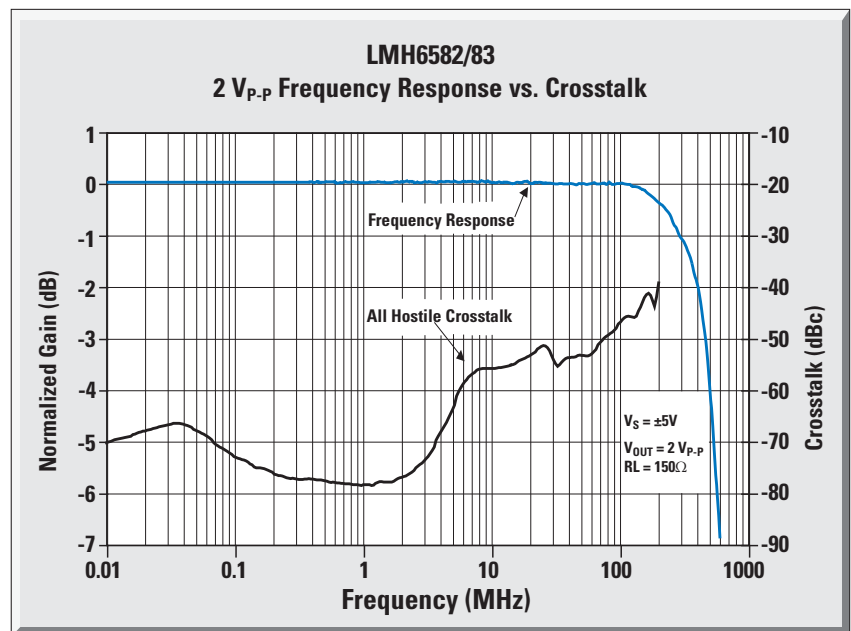
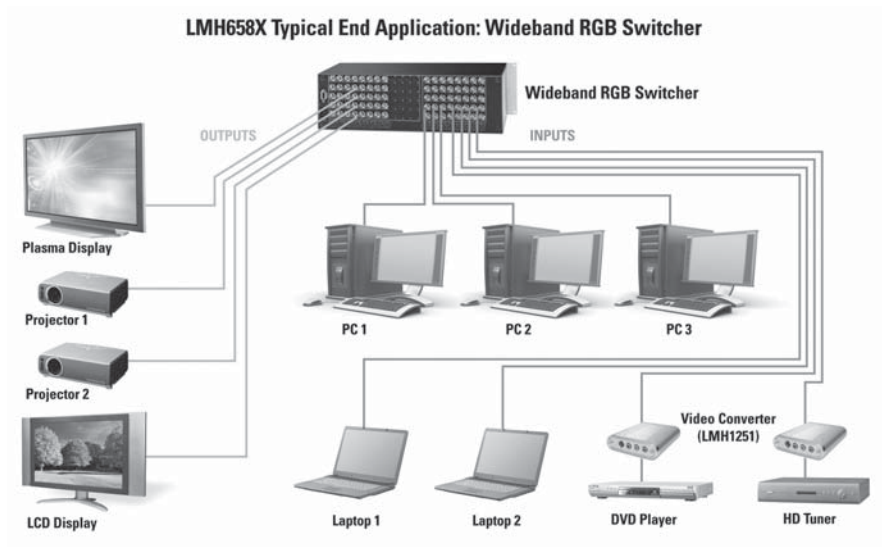
- 550 MHz, -3 dB bandwidth
- Fast slew rate: 1900 V/ $\mu$ s
- 100 MHz, 0.1 dB gain flatness
- Low crosstalk:
  - -70 dBc at 10 MHz (channel-to-channel)
  - -45 dBc at 100 MHz (all hostile)
- Gain of 1 (LMH6582)
- Gain of 2 (LMH6583)
- Diagonally symmetrical pin configuration
- Ease of control: 4-pin serial interface
- Available in TQFP-64 (exposed pad) packaging

### Expansion Options

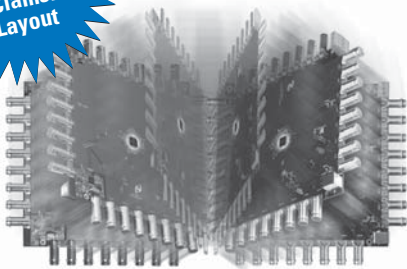
- One-chip solution: 16 inputs, 8 outputs
- Two-chip solution: 16 inputs, 16 outputs\* or 32 inputs, 8 outputs

### Applications

Ideal for use in conference room systems, KVM (Keyboard, Video, and Mouse) systems, security and surveillance systems, multimedia video systems, and professional A/V systems



Symmetrical Pin-out Allows for "Clamshell" Layout



\* 16 x 16 configuration using two LMH6583 devices on opposite sides of the board is shown above

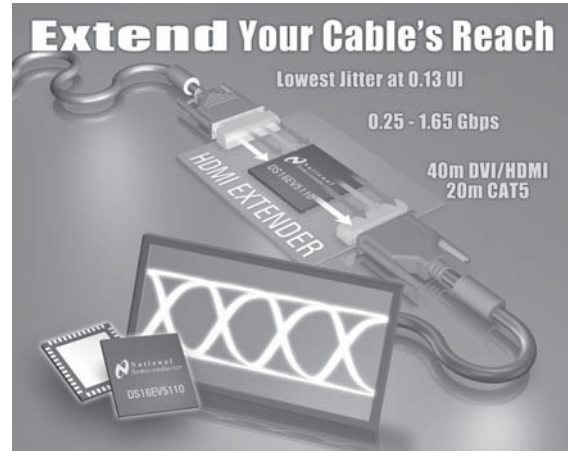
# Eye-Opening Cable Equalizers for HDMI/DVI Applications

## Features

- Significantly extends the reach of DVI, HDMI, and CAT5 cables
- Pin-selectable boost for equalization optimization
- Pin-selectable de-emphasis for signal conditioning optimization (DS34RT5110)
- Low output jitter
- DS16EV5110A EQ supports 1080p applications – 225 MHz/6.75 Gbps
- DS22EV5110 Super-EQ supports 1080p applications, enables longer reach with lower output jitter
- DS34RT5110 reclocking EQ supports 1080p/1440p and/or deeper-color/higher-resolutions/higher-frame rate applications – 340 MHz/10.2 Gbps
  - Enables multi-hop applications

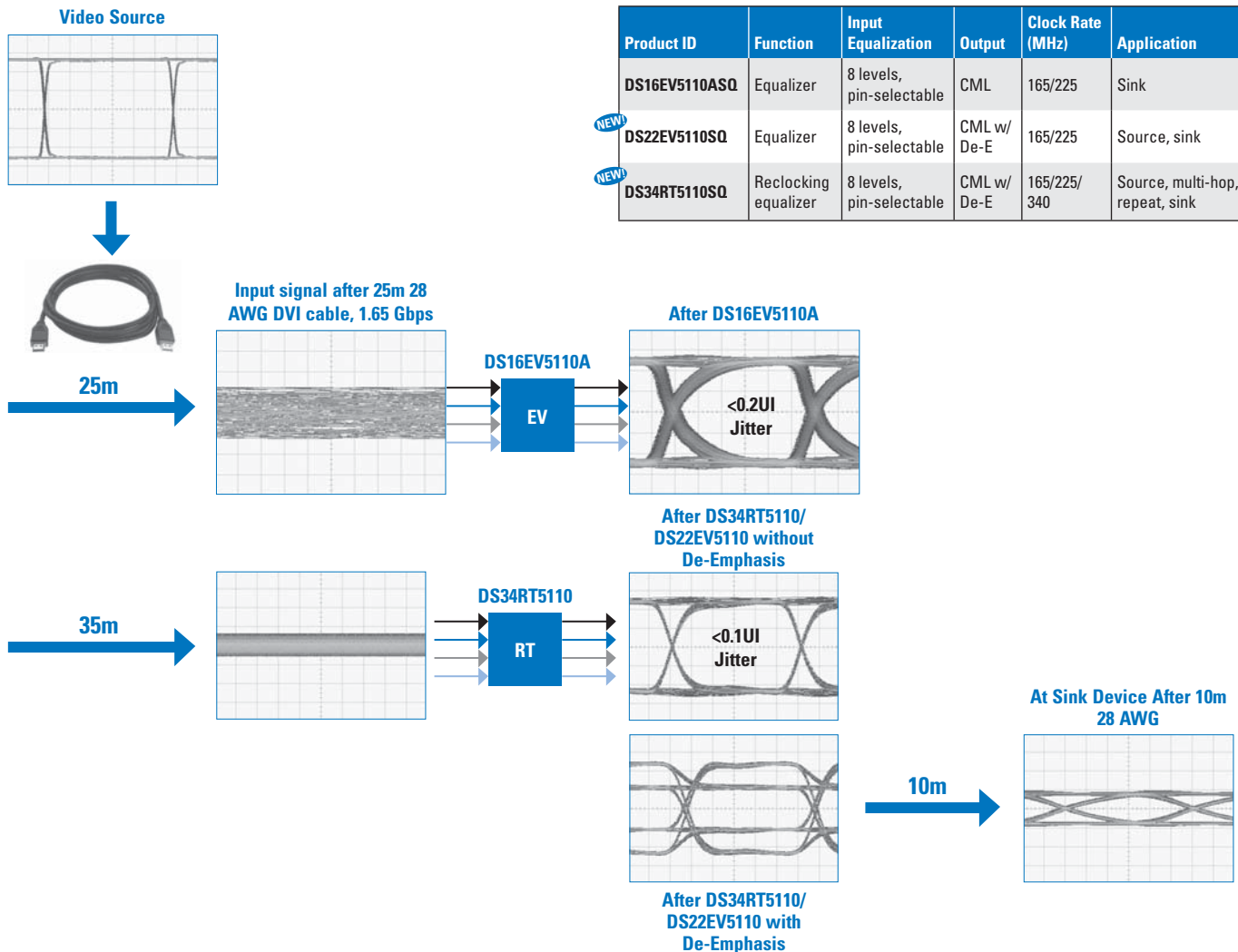
## Applications

Ideal for use in HDTVs, projects, extenders, and dongles

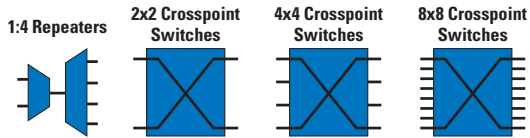


## Cable Extending Equalizers

Product ID	Function	Input Equalization	Output	Clock Rate (MHz)	Application
DS16EV5110ASQ	Equalizer	8 levels, pin-selectable	CML	165/225	Sink
<b>NEW!</b> DS22EV5110SQ	Equalizer	8 levels, pin-selectable	CML w/ De-E	165/225	Source, sink
<b>NEW!</b> DS34RT5110SQ	Reclocking equalizer	8 levels, pin-selectable	CML w/ De-E	165/225/340	Source, multi-hop, repeat, sink



# High-Speed Switching and Signal Conditioning



Signal Conditioning



Product ID	Function	Inputs	Outputs	Input Compatibility	Output	Pre-emphasis (dB)	Receive Equalization (dB)	Max Speed/Ch (Mbps)	Package	Comments
<b>Buffers</b>										
DS15BR400TSQ/TVS	Quad LVDS buffer	4	4	LVDS/LVPECL/CML	LVDS	0/6	—	2000	LLP-32, TQFP-48	Int termination, 15 kV ESD
DS15BR401TSQ/TVS	Quad LVDS buffer	4	4	LVDS/LVPECL/CML	LVDS	0/6	—	2000	LLP-32, TQFP-48	15 kV ESD
DS25BR440SQ	Quad LVDS buffer	4	4	LVDS/LVPECL/CML	LVDS	0/6	0/6	3125	LLP-40	Loss of signal
DS25BR100TSD	LVDS repeater	1	1	LVDS/LVPECL/CML	LVDS	0/6	4/8	3125	LLP-8	
DS25BR110TSD	LVDS equalizer	1	1	LVDS/LVPECL/CML	LVDS	—	0/4/8/12	3125	LLP-8	
DS25BR120TSD	LVDS buffer	1	1	LVDS/LVPECL/CML	LVDS	0/3/6/9	—	3125	LLP-8	

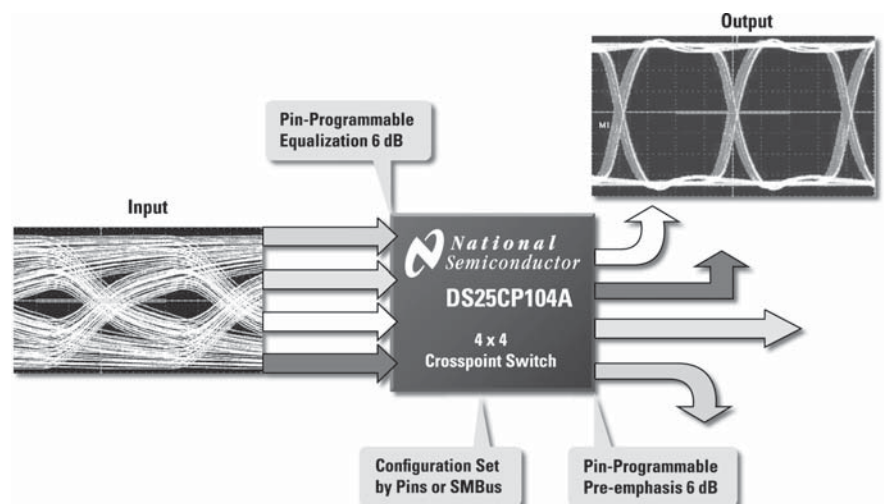
Product ID	Description	Supply Voltage (V)	Typ. Power (mW)	Max Speed/Ch (Mbps)	Total Jitter (psp-p)	ESD (kV)	Eval board Product ID	Package	Comments
<b>Crosspoint Switches / Splitters</b>									
DS25CP102TSQ	2 x 2 LVDS crosspoint switch	3.3	254	3125	12	8	DS25CP102EVK	LLP-16	Transmit pre-emphasis and receive equalization
DS25CP104TSQ	4 x 4 LVDS crosspoint switch	3.3	518	3125	10	8	DS25CP104EVK	LLP-40	Transmit pre-emphasis and receive equalization
DS25CP152TSQ	2 x 2 LVDS crosspoint switch	3.3	211	3125	3	8	DS25CP152EVK	LLP-16	
DS10CP152TMA	2 x 2 LVDS crosspoint switch	3.3	191	1500	9	7	DS10CP152EVK	SOIC-16	
DS10CP154TSQ	4 x 4 LVDS crosspoint switch	3.3	380	1500	12	8	DS10CP154EVK	LLP-40	SMBus interface
CLC018AJVJQ	8 x 8 digital crosspoint switch	5	850	1485	50	—	—	PQFP-64	Non-blocking, expandable
DS25BR204TSQ	1:4 LVDS repeater	3.3	495	3125	9	8	DS25BR204EVK	LLP-40	Transmit pre-emphasis and receive equalization
DS10BR254TSQ	1:4 LVDS repeater	3.3	373	1500	7	8	—	LLP-40	

PowerWise product

## DS25CP104A Lowest Jitter, Lowest Power 4 x 4 LVDS Crosspoint

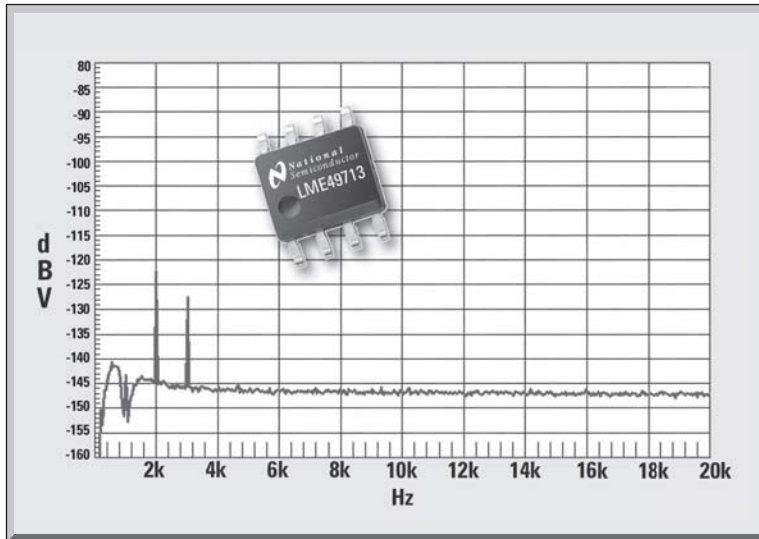
### Features

- 3.125 Gbps max data rate
- 10 ps typ jitter
- $I_{CC}$  37 mA per channel (typ)
- 6 dB pin-programmable equalization compensates for lossy cables, backplanes
- 6 dB pin-programmable pre-emphasis for improved cable driving
- Crosspoint configurable using external pins or SMBus
- Available in LLP-40 packaging



# High-Performance, High-Fidelity Audio Products

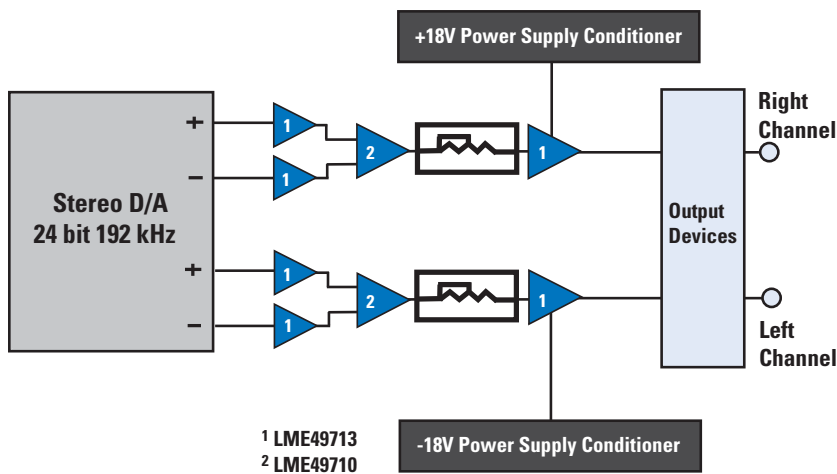
## LME49713 Current Feedback Op Amp FFT Plot



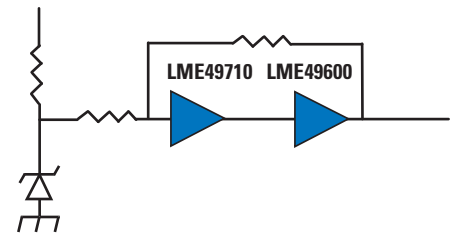
### LME49713 Features

- Extended dynamic range: 139 dB
- Distortion and noise <math>< 0.00008\%</math>
- +22 dBu input/output handling capability
- Slew rate: 1900 V/ $\mu$ s

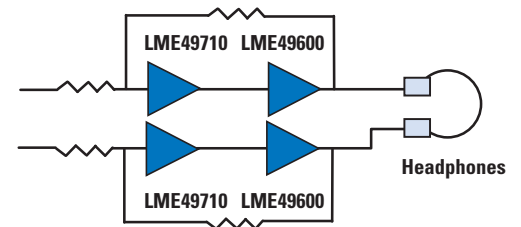
### Digital-to-Analog Converter



### Power Supply Voltage Conditioner



### Buffer Headphone



## Performance Audio Products

Product ID	Type	Channels	V <sub>CC</sub> (V)	I <sub>CC</sub> (per amp)	THD+N	Bandwidth (MHz)	Slew Rate (V/ $\mu$ s)	Noise (nV/ $\sqrt$ Hz)	V <sub>OS</sub> (mV)	I <sub>BIAS</sub> ( $\mu$ A)
LME49710	Variable Feedback	1	34	5 mA	0.00003%	55	20	2.5	0.1	10 nA
LME49713	Current Feedback	1	36	8 mA	0.00008%	132	1900	1.9	0.05	1.8
LME49600	Buffer	1	36	7.3 mA	0.00003%*	180	2000	2.6	17	1

\* Enclosed loop with the LME49710

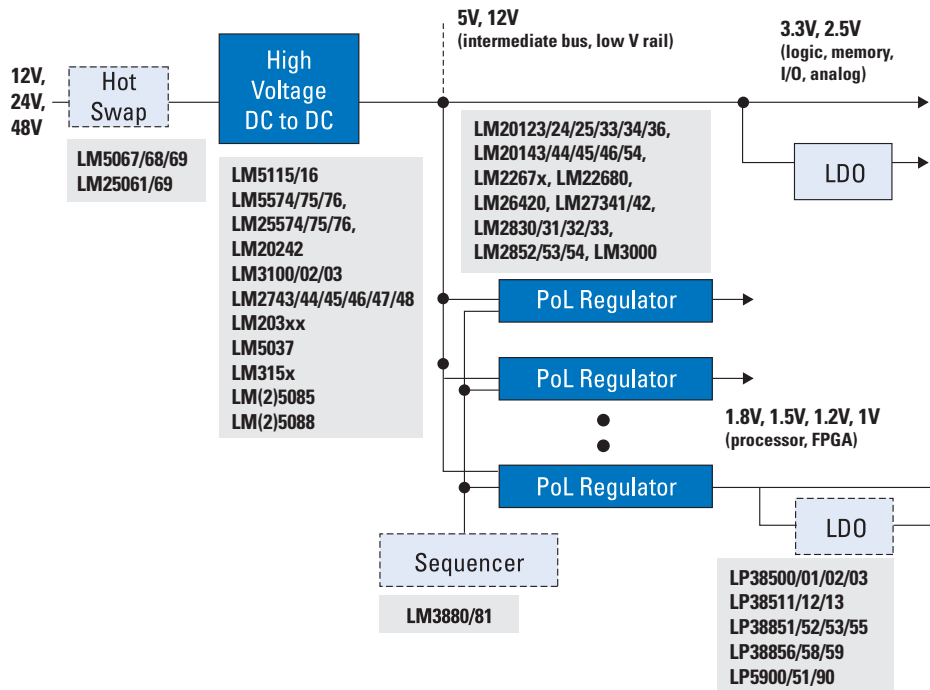


# Power Products for Broadcast Video

National's analog leadership extends into power management, with a complete portfolio of products for any broadcast video application. National's PowerWise® family spotlights innovative products with industry-leading performance and minimal power

consumption. National's WEBENCH® environment provides end-to-end design and prototyping tools to easily create power supplies that meet your design requirements. Visit National's website today to design a power supply for your video application.

## Power Architecture For Broadcast Video

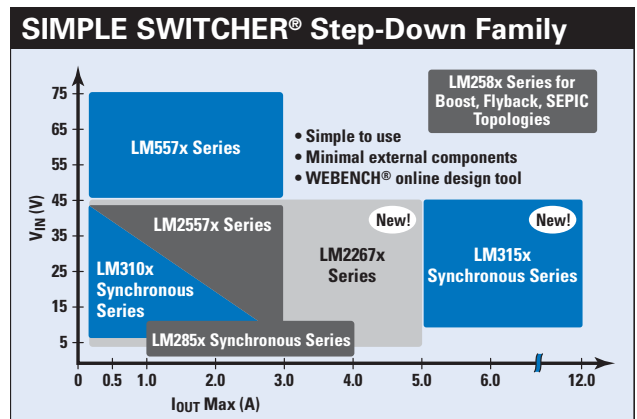


### NEW! LM2267x AND LM22680 SIMPLE SWITCHER® Regulators

The LM2267x and LM22680 SIMPLE SWITCHER regulators provide intuitive, easy-to-use design capabilities while delivering high performance and flexibility.

#### Features

- Wide input voltage range from 4.5V to 42V
- Load currents from 0.5A to 5A
- Adjustable and fixed output voltages down to 1.285V
- Adjustable and fixed switching frequencies allow for optimization between size and efficiency (up to 1 MHz)
- Frequency sync up to 1 MHz allows for easy management of EMI and/or input capacitance optimization
- Precision enable – precise turn-on and turn-off for power sequencing needs assists with proper system startup
- External soft-start – flexibility to control output voltage rampup, ensuring proper end-system startup to avoid latch-up conditions
- PSOP-8 and TO263-7 THIN packages – exposed DAPs provide enhanced thermal dissipation, halogen-free and lead-free
- Fully enabled for WEBENCH® online design tool

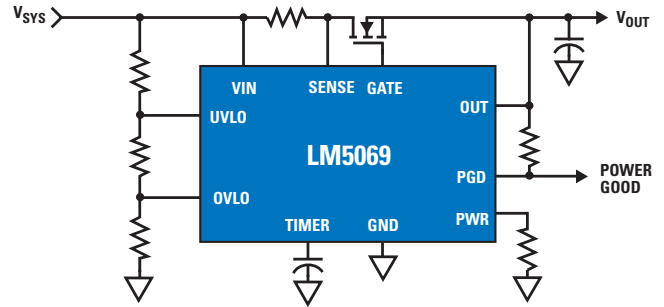


# Hot Swap and PWM Controllers

## LM(2)506x – Hot Swap/In-Rush Current Limit Controllers with Current and Power Limiting

### Features

- In-rush current limit for safe module insertion and removal from live power sources
- Adjustable power limit sets maximum power dissipation in the external pass device and ensures MOSFET stays in safe operating area (SOA)
- Programmable input under voltage lockout (UVLO) and hysteresis
- Programmable input over voltage lockout (OVLO) and hysteresis
- Programmable multifunction timer to prevent nuisance trips
- Programmable POWER GOOD flag output using FB pin (LM25061)
- Internal high-side charge pump and gate driver for external N-channel MOSFET
- Available in latched fault and automatic restart versions



### Hot Swap/In-Rush Current Controllers

Product ID	V <sub>IN</sub> Range	POWER GOOD	Adjustable UVLO	Adjustable OVLO	Active In-Rush Current Limit	Active Current Limiting	Active Power Limiting	Fault Latch-Off / Auto Retry	Packaging
LM5067	-9V to -80V	V <sub>DS</sub>	✓	✓	✓	✓	✓	✓	MSOP-10, LLP-10
LM5069	+9 to +100V	V <sub>DS</sub>	✓	✓	✓	✓	✓	✓	MSOP-10
<b>NEW</b> LM25061	+2.9V to +16V	V <sub>OUT</sub> (adj.)	✓		✓	✓	✓	✓	MSOP-10
<b>NEW</b> LM25069	+2.9V to +16V	V <sub>DS</sub>	✓	✓	✓	✓	✓	✓	MSOP-10

### PWM Switching Controllers

Product ID	Description
LM5020	Single-ended 100V current-mode PWM controller
LM3000	Dual-output emulated current-mode controller
LM5021	AC-DC current-mode PWM controller
LM5025/A/B	Active-clamp voltage-mode 100V PWM controller with feed-forward and 3A gate driver
LM5026	Active-clamp current-mode 100V PWM controller with 3A gate driver
LM5030	100V push-pull current-mode PWM controller with synchronization
LM5032	High-voltage dual interleaved current-mode PWM controller
LM5033	100V push-pull voltage-mode IBC PWM controller with synchronization
LM5034	High-voltage dual interleaved current-mode controller with active clamp
<b>NEW</b> LM(2)5037	Dual-mode PWM controller with alternating outputs
LM5041/A	100V input cascaded PWM controller
<b>NEW</b> LM5085/LM25085	4.5 to 75V/42V constant on-time PFET buck switching controller
<b>NEW</b> LM5088/LM25088	4.5 to 75/42V non-synchronous buck controller
LM5115/A	Secondary side post regulator controller or synchronous buck controller
LM5116	6V to 100V current-mode synchronous buck controller
<b>NEW</b> LM5118	Wide 3V to 75V input, buck-boost controller
LM5035A	High-performance, half-bridge PWM controller-driver for compact, efficient converters

PowerWise® product

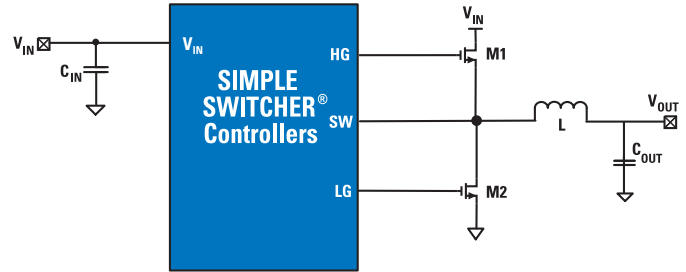
# Synchronous Switching Controllers and Regulators

## **NEW!** LM315x – SIMPLE SWITCHER® Synchronous Controllers

Designed to support higher current applications, the LM315x SIMPLE SWITCHER® controllers are National's newest addition to its popular brand of switching solutions.

### Features

- Input voltage ranging from 6V to 42V
- Output current up to 12A
- Constant On-Time control eliminates the need for complex compensation circuitry
- Patent-pending emulated ripple mode allows for the use of low-ESR output capacitors for reduced solution size and reduced output voltage ripple
- Fully WEBENCH® enabled, including MOSFET selector tool



## LM315x Family of SIMPLE SWITCHER Controllers

Product ID	Input Max (V)	Input Min (V)	Output Min (V)	Output Max (V)	Feedback Tolerance %	Frequency Range (kHz) and Sync	Packaging
<b>NEW!</b> LM3150	42	6	0.6	Adj	1.50	Adj to 1 MHz	eTSSOP-14
<b>NEW!</b> LM3151	42	6	0.6	42	1.50	250	eTSSOP-14
<b>NEW!</b> LM3152	33	6	3.3	3.3	1.50	500	eTSSOP-14
<b>NEW!</b> LM3153	18	6	3.3	3.3	1.50	750	eTSSOP-14

PowerWise® product







## High-Current Synchronous Step-Down Switching Regulators

Product ID	Input Max Voltage (V)	Input Min Voltage (V)	Output Min (V)	Output Max (V)	Output Current (mA)	Frequency Range (KHz) & Sync (computed field)	On/Off Pin	PWM Mode	Packaging
LM20242	36	4.5	0.8	32	2000	1000	✓	Current-mode control	TSSOP-20
LM20123	5.5	2.95	0.8	5	3000	1500	✓	Current-mode control	eTSSOP-16
LM20133	5.5	2.95	0.8	5	3000	460 to 1.5 MHz, sync	✓	Current-mode control	eTSSOP-16
LM20143	5.5	2.95	0.8	5	3000	500 to 1500	✓	Current-mode control	eTSSOP-16
LM20343	36	4.5	0.8	32	3000	500, sync	✓	Current-mode control	eTSSOP-20
LM20333	36	4.5	0.8	32	3000	200 to 1500	✓	Current-mode control	eTSSOP-16
LM20124	5.5	2.95	0.8	5	4000	1000	✓	Current-mode control	eTSSOP-16
LM20134	5.5	2.95	0.8	5	4000	460 to 1.5 MHz, sync	✓	Current-mode control	eTSSOP-16
LM20144	5.5	2.95	0.8	5	4000	500 to 1000	✓	Current-mode control	eTSSOP-16
LM20154	5.5	2.95	0.8	5	4000	1000	✓	Current-mode control	eTSSOP-16
LM20125	5.5	2.95	0.8	5	5000	500	✓	Current-mode control	eTSSOP-16
LM20145	5.5	2.95	0.8	5	5000	250 to 750	✓	Current-mode control	eTSSOP-16
<b>NEW!</b> LM20136	5.5	2.95	0.8	5	6000	460 to 750, sync	✓	Current-mode control	eTSSOP-16
<b>NEW!</b> LM20146	5.5	2.95	0.8	5	6000	250 to 750 adj.	✓	Current-mode control	eTSSOP-16

PowerWise product










# Synchronous Step-Down (Buck) Switching Regulators

## SIMPLE SWITCHER® Synchronous Regulators

Product ID	Input Max Voltage (V)	Input Min Voltage (V)	Output Min (V)	Output Max (V)	Output Current (mA)	Frequency Range (kHz)	PWM Mode	Packaging
LM3103 	42	4.5	0.6	38	750	1000	COT	eTSSOP-16
LM3100 	36	4.5	0.8	32	1500	1000	COT	eTSSOP-20
LM2852 	5.5	2.85	0.8	3.3	2000	500, 1500	Voltage	TSSOP-14
LM3102 	42	4.5	0.8	38	2500	1000	COT	eTSSOP-20
LM2853 	5.5	3	0.8	3.3	3000	550	Voltage	TSSOP-14
LM2854 	5.5	2.95	0.8	V <sub>IN</sub>	4000	500, 1000	Voltage	eTSSOP-16

 PowerWise® product

## Synchronous Buck Regulators

Product ID	Input Max Voltage (V)	Input Min Voltage (V)	Output Min (V)	Output Max (V)	Output Current (mA)	Frequency Range (kHz) & Sync (computed field)	On/Off Pin	PWM Mode	Packaging
LM3670 	5.5	2.5	0.7	3.3	350	1000	✓	Voltage with input feedforward	SOT23-5
LM3673 	5.5	2.7	1.1	3.3	350	2000	✓	Voltage with input feedforward	micro SMD-5
LM3679 	5.5	2.5	1.2	1.8	350	3000	✓	Auto	micro SMD-5
LM3671 	5.5	2.7	1.1	3.3	600	2000	✓	Voltage with input feedforward	SOT23-5, LLP-6, micro SMD
LM3674 	5.5	2.7	1.0	3.3	600	2000	✓	Voltage with input feedforward	SOT23-5
LM3676	5.5	2.9	1.1	3.3	600	2000	✓	Voltage with input feed forward	LLP-8
LM3677 	5.5	2.7	1.2	3.3	600	3000	✓	Voltage with input feedforward	micro SMD-5
LM3691 	5.5	2.3	0.75	1.8	1000	4000	✓	Voltage with input feedforward	micro SMD-6
LM2651	14	4	1.24	13	1500	3000	✓	Current	TSSOP-16
LM3678 	5.5	2.5	0.8	3.3	1500	3300	✓	PWM only	LLP-10
<b>NEW</b> LM26420 (dual) 	6.6	3	0.8	4.5	2000 per output	660, 2200	✓	Current	eTSSOP-20, LLP-16

 PowerWise® product

# Non-Synchronous Step-Down (Buck) Switching Regulators

## Non-Synchronous SIMPLE SWITCHER® Step-Down Regulators

Product ID	Input Max Voltage (V)	Input Min Voltage (V)	Output Min (V)	Output Max (V)	Output Current (mA)	Frequency Range (kHz) and Sync	PWM Mode	Packaging
<b>NEW</b> LM22671/74	42	4.5	1.285	35	500	500 to 1000 Adj	Voltage	PSOP-8
<b>NEW</b> LM22672/75	42	4.5	1.285	35	1000	500 to 1000 Adj	Voltage	PSOP-8
<b>NEW</b> LM22680	42	4.5	1.285	35	2000	500 to 1000 Adj	Voltage	PSOP-8
<b>NEW</b> LM22670/73/76	42	4.5	1.285	35	3000	500 to 1000 Adj	Voltage	T0263-7 Thin, PSOP-8
<b>NEW</b> LM22677/78/79	42	4.5	1.285	35	5000	500 to 1000 Adj	Voltage	T0263-7 Thin
LM2671/72/74/75	40	6.5	1.23	37	500 (LM2671/74) 1000 (LM2672/75)	260 sync (LM2671/2)	Voltage with $V_{IN}$ Feedforward	MDIP-8, LLP-16, SO-8
LM2670/73/76/77/78/79	40	8	1.23	37	3000 (LM2670/73/76) 5000 (LM2677/78/79)	260 sync (LM2670/7)	Voltage with $V_{IN}$ Feedforward	T0263-7, LLP-14, T0220-9
<b>PowerWise</b> LM25574/75/76	42	6	1.23	40	500 / 1500 / 3000	50 to 1000, sync	Current	TSSOP-16 / TSSOP-16EP / TSSOP-20EP
<b>PowerWise</b> LM5574/75/76	75	6	1.23	70	500 / 1500 / 3000	500, sync	Current	TSSOP-16 / TSSOP-16EP / TSSOP-20EP

 PowerWise® product

## Non-Synchronous Step-Down (Buck) Switching Regulators

Product ID	Input Max Voltage (V)	Input Min Voltage (V)	Output Min (V)	Output Max (V)	Output Current (mA)	Frequency Range (kHz) and Sync	On/Off Pin	PWM Mode	Packaging
LM5008/9 <b>PowerWise</b>	95	9.5	2.5	75/85	350/150	50 to 600		Constant on-time	LLP-8, MSOP-8
LM25007	42	9	2.5	37	500	50 to 800		Constant on-time	MSOP-8
LM2694	30	8	2.5	24	600	50 to 1000		Hysteretic	LLP-10, TSSOP-14
LM34919	40	8	2.5	35	600	1600		Constant on-time	micro SMD-10
LM2736	18	3	1.25	16	750	550, 1600		Current	SOT23-6
LM2830	5.5	3	0.6	4.5	1000	1600, 3000		Current	SOT23-5
LM2734/Z	20	3	0.8	18	1000	550, 1600/3000		Current	SOT23-6
<b>NEW</b> LM34930 <b>PowerWise</b>	30	8	2.5	30	1000	up to 2000		Constant on-time	micro SMD-12
LM5010A/25010	75/42	6	2.5	70/37	1000	50 to 1000		Constant on-time	LLP-10, TSSOP-14EP
LM2695	30	8	2.5	24	1250	50 to 800		Hysteretic	LLP-10, TSSOP-14EP
LM34917A <b>PowerWise</b>	33	8	2.5	30	1250	2000		Constant on-time	micro SMD-12
LM34910/C	36/50	8	2.5	33/45	1250	1000		Constant on-time	LLP-10
LM34914	40	8	2.5	37	1250	1300		Constant on-time	LLP-10
LM2831	5.5	3	0.6	4.5	1500	550, 1600, 3000		Current	SOT23-5
LM2738	20	3	0.8	18	1500	500, 1600		Current	LLP-8, eMSOP-8
LM26001 <b>PowerWise</b>	38	3	1.25	35	1500	150 to 1000, sync		Current	TSSOP-16
<b>NEW</b> LM27341/2	20	3	1	18	1500/2000	1000 to 2350, sync	✓	Current	LLP-10, eMSOP-10
LM2832	5.5	3	0.6	4.5	2000	550, 1600, 3000		Current	LLP-6, eMSOP-8
LM5005/25005	75/42	7	1.23	70/40	2500	50 to 500, sync/ 50 to 1000, sync		Current	TSSOP-20
<b>NEW</b> LM2833	5.5	3	0.6	4.5	3000	3000	✓	Current	LLP-10, eMSOP-10
LM2696	24	4.5	1.29	20	3000	100 to 500		Constant on-time	TSSOP-16
<b>NEW</b> LM26003 <b>PowerWise</b>	38	3	1.25	35	3000	150 to 500, sync		Current	TSSOP-20

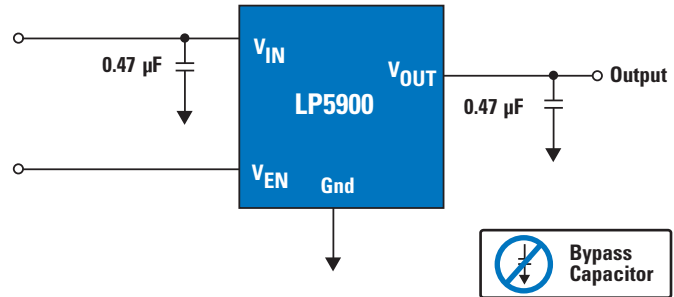
 PowerWise® product

# Low Dropout (LDO) Linear Regulators

## LP5900 – Low-Noise 150 mA CMOS LDO

### Features

- Industry’s lowest noise (6.5  $\mu$ VRMS) combined with 85 dB of power supply ripple rejection (PSRR) guarantees signal integrity
- 25  $\mu$ A Iq minimizes current drain when system operates in low-power mode
- Elimination of bypass capacitor reduces BOM to only two ceramic 0.47  $\mu$ F capacitors
- Available in a micro SMD-4 and LLP-6 packaging



## Low Dropout (LDO) Linear Regulators

Product ID	Load Current (mA)	V <sub>IN</sub> Min (V)	V <sub>IN</sub> Max (V)	V <sub>OUT</sub> (V)	Packaging
LP8900	280	1.8	5.5	2.7 to 1.8V	SMD-6
LP38511	800	2.25	5.5	1.8, adj down to 0.8V	TO263-5
LP38851	800	1.2	5.5	0.8 to 1.8V, adj	PSOP-8
LP38690	1000	3.95	10	1.25V to 9V, adj	TO-252
LP38692	1000	3.75	10	1.25V to 9V, adj	LLP-6
LP38512	1500	2.25	5.5	1.8, adj down to 0.8V	TO263, LLP-8
LP38500	1500	2.7	5.5	0.6V to 5V, adj	TO-263
LP38502	1500	2.7	5.5	0.6V to 5V, adj	TO-263
LP38852	1500	1.2	5.5	0.8 to 1.8V, adj	TO220-7
LP38855	1500	1.38	5.5	1.2 to 1.8V, adj	TO220-7
LP38858	1500	1.38	5.5	1.2 to 1.8V, adj	TO220-7
LP38513	3000	2.25	5.5	1.8, adj down to 0.8V	TO263-5
LP38501	3000	2.7	5.5	0.6V to 5V, adj	TO-263 THIN
LP38503	3000	2.7	5.5	0.6V to 5V, adj	TO-263 THIN
LP38853	3000	1.2	5.5	0.8 to 1.8V, adj	PSOP-8
LP38856	3000	1.15	5.5	0.8 to 1.8V, adj	TO263-7
LP38859	3000	1.55	5.5	1.2 to 1.8V, adj	TO220-7

## Low-Noise, Low-Power Linear Regulators

Product ID	Output Current (mA)	Input Max Voltage (V)	Input Min Voltage (V)	Dropout Voltage (V)	Output Voltage (V)	On/Off Pin	Quiescent Current (mA)	PSRR (dB)	Voltage Noise (rms)	Packaging
LP3995	150	6	2.5	0.06	3, 2.8, 1.9	—	0.085	60	25	micro SMD-5, LLP-6
LP3999	150	6	2.5	0.06	1.5, 2.4, 1.8, 2.5, 2.8, 3.3	—	0.085	60	30	micro SMD-5
LP5900	150	5.5	2.5	0.08	1.5, 2.8, 3.3	—	0.025	75	6.5	micro SMD-4
LP5990	200	5.5	2.2	0.15	0.8 to 3.6	—	0.03	55	60	micro SMD-4
LP3871/74	800	7	2.5	0.24	5, 1.8, 2.5, 3.3	✓	6	73	150	TO-263-5, SOT-223-5, TO-220-5
LP3878	800	16	2.5	0.475	Adj	✓	0.18	60	18	LLP-8, PSOP-8
LP3879	800	6	2.5	—	1.2, 1	✓	0.1	60	18	LLP-8, PSOP-8
LP3875	1500	7	2.5	0.38	1.8, 2.5, 3.3	✓	6	73	150	TO-263-5, SOT-223-5
LP3876	3000	7	2.5	0.8	2.5, adj.	✓	6	73	150	TO-263-5

# Design Tools

## Resources for Next-Generation Design



Design, build, and test analog circuits in this online design and prototyping environment.

[www.national.com/webench](http://www.national.com/webench)



Register to receive updates on the products and technical topics that interest you—spam-free!

[www.national.com/newsletter](http://www.national.com/newsletter)



Online seminars by industry experts. Log onto National's analog online seminars today.

[www.national.com/onlineseminars](http://www.national.com/onlineseminars)



Expand your knowledge and understanding of analog with our free online educational training tool.

[www.national.com/AU](http://www.national.com/AU)



Published bi-monthly, the Power Designer technical articles cover key power design tips and techniques for today's design engineers.

[www.national.com/powerdesigner](http://www.national.com/powerdesigner)



Published bi-monthly, the Signal Path Designer technical articles cover analog signal path tips and techniques for today's design engineers.

[www.national.com/spdesigner](http://www.national.com/spdesigner)



National's monthly analog design technical journal.

[www.national.com/edge](http://www.national.com/edge)



Easy, natural-language online search engine provides quick access to products and technical information.

[www.national.com/kbase](http://www.national.com/kbase)

[www.national.com/sdi](http://www.national.com/sdi)



Tune in to learn technical energy-saving tips, hosted by National's Chief PowerWise® Technologist, Richard Zarr, and streamed 24/7 on the web.

[www.national.com/powerwisetv](http://www.national.com/powerwisetv)

### Tools for Energy-Efficient Designs

Access white papers, reference designs, and application notes on PowerWise® products and systems.

[www.national.com/powerwise](http://www.national.com/powerwise)

### Parametric Catalog and Search

Search for desired product folder, product database by attributes of interest.

[www.national.com/cat](http://www.national.com/cat)

### Application Solutions

Access over 100 dynamic diagrams for medical systems, consumer electronics, communications, and many more applications.

[www.national.com/solutions](http://www.national.com/solutions)

### Application Notes

Access hundreds of application notes on a variety of design topics from product to end application specific app notes.

[www.national.com/apnotes](http://www.national.com/apnotes)

### FPGA Design Guides

These design guides feature National device solutions by part number for different FPGA manufacturers, including Xilinx and Altera.

[www.national.com/selguide](http://www.national.com/selguide)

### Document Library

Find end market solutions and products using National's Solutions Guides.

[www.national.com/selguide](http://www.national.com/selguide)

# Worldwide Design Centers and Manufacturing Facilities



- Design Centers
- Manufacturing Facilities

## Design Centers

### USA:

Arlington, Texas  
 Calabasas, California  
 Chandler, Arizona  
 Federal Way, Washington  
 Fort Collins, Colorado  
 Grass Valley, California  
 Indianapolis, Indiana  
 Longmont, Colorado  
 Norcross, Georgia  
 Phoenix, Arizona  
 Rochester, New York  
 Salem, New Hampshire  
 San Diego, California  
 Santa Clara, California  
 South Portland, Maine  
 Tucson, Arizona

### EUROPE:

Delft, Netherlands  
 Fürstentfeldbruck, Germany  
 Unterhaching, Germany  
 Greenock, Scotland  
 Kemi, Finland  
 Milan, Italy  
 Oulu, Finland  
 Tallinn, Estonia

### ASIA:

Bangalore, India  
 Hangzhou, China  
 (joint with Zhejiang University)  
 Hong Kong, China  
 Tokyo, Japan

## Manufacturing Facilities

### Wafer (Die) Fabrication:

Arlington, Texas  
 South Portland, Maine  
 Greenock, Scotland

### Chip Test and Assembly:

Melaka, Malaysia  
 Suzhou, China

### World Headquarters

2900 Semiconductor Drive  
 Santa Clara, CA 95051  
 USA  
 +1 408 721 5000  
[www.national.com](http://www.national.com)

### Mailing Address:

PO Box 58090  
 Santa Clara, CA 95052  
[support@nsc.com](mailto:support@nsc.com)

### European Headquarters

Livry-Gargan-Str. 10  
 82256 Fürstentfeldbruck  
 Germany  
 +49 8141 35 0  
[europe.support@nsc.com](mailto:europe.support@nsc.com)

### Asia Pacific Headquarters

2501 Miramar Tower  
 1 Kimberley Road  
 Tsimshatsui, Kowloon  
 Hong Kong  
 +852 2737 1800  
[ap.support@nsc.com](mailto:ap.support@nsc.com)

### Japan Headquarters

Beside KIBA  
 2-17-16  
 Kiba, Koto-ku  
 Tokyo, 135-0042, Japan  
 +81 3 5639 7300  
[jpn.feedback@nsc.com](mailto:jpn.feedback@nsc.com)

