The National Gallery of New Products

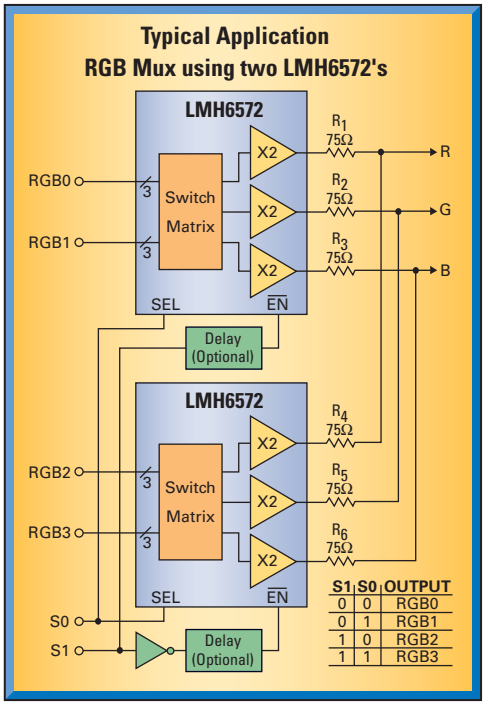
Focusing on Analog

Fall 2004

National Semiconductor

The Sight & Sound of Information

LMH6572 Triple 2:1 High Speed Video Multiplexer



Description

The LMH6572 is a high performance analog mulitplexer optimized for professional grade video and other high fidelity high bandwidth analog applications. The LMH6572 provides a 290 MHz bandwidth at 2 V_{PP} output signal levels. The 140 MHz of .1 dB bandwidth and a 1400 V/µs slew rate make this part suitable for high definition television (HDTV) and high resolution multimedia video applications.

The LMH6572 supports composite video applications with its 0.02% and 0.02° differential gain and phase errors for NTSC and PAL video signals while driving a single, back terminated 75Ω load. The LMH6572 can deliver 80 mA linear output current for driving multiple video load applications.

The LMH6572 has an internal gain of two for driving back terminated transmission lines at a net gain of one.

Features

- 350 MHz, 250 mV −3 dB bandwidth
- 290 MHz, 2 V_{PP} −3 dB bandwidth
- 10 ns channel switching time
- 90 dB channel to channel isolation @ 5 MHz
- 0.02%, 0.02° diff. gain, phase
- 0.1 dB gain flatness to 140 MHz
- 1400 V/µs slew rate
- Wide supply voltage range: 6V (±3V) to 12V (±6V)
- −78 dB HD2 @ 10 MHz
- −75 dB HD3 @ 10 MHz

Applications

- Analog video routers and switchers
- Broad market video
- Fault tolerant data switch
- HDTV, NTSC, PAL video systems
- Multimedia equipment (projection and conference room systems)
- Navigation systems (in-car)
- Professional and high-end video
- Security system monitoring

Competitive Edge

The LMH6572 is the first triple 2:1 mux from National and is the first of a family of high-speed multiplexers. The LMH6572 has 350 MHz SSBW and 1400 V/µs slew rate, making it the fastest 2:1 mux on the market (G=+2 V/V). The LMH6572 beats the competition in crosstalk with −90 dB at 5 MHz and excels in all key specs necessary for video applications.

Packaging

- SSOP-16

Tools

- Samples available online

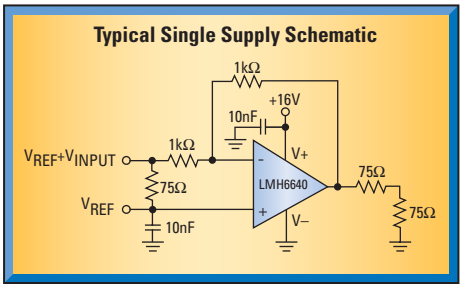
Further Information

- **www.national.com/see/amplifiers**

LMH6640 TFT-LCD Single, 16V RRO High Output Current Operational Amplifier

Description

The LMH6640 is a voltage feedback operational amplifier with rail-to-rail output drive capability of 110 mA. This, in combination with a supply range of up to 16V, makes the LMH6640 suitable for V_{COM} driver applications in TFT panels. The input common mode voltage range extends to 0.3V below V^- and to within 0.9V of V^+, makes the LMH6640 a true single supply op-amp. Employing National's patented VIP10HV process, the LMH6640 delivers a bandwidth of 190 MHz at a current consumption of only 4 mA. Special precautions have been taken to ensure device stability under all operating voltages and loads. The result is a very well behaved frequency response characteristic for gain settings, including +1.



Features

V_S = 16V, R_L= 2 kΩ to $V^+/2$ typical values unless specified

- Output voltage swing: 100 mV from rails
- Input common mode voltage: −0.3V to 15.1V
- Supply current (no load): 4 mA
- Linear output current: ±110 mA
- Supply voltage range: 4.5V to 16V
- Unity gain stable
- −3 dB BW (A_V = +1): 190 MHz
- Slew rate: 170 V/µs
- Output resistance (closed loop 1 MHz): 0.3Ω
- Total harmonic distortion (f = 5 MHz): −64 dBc
- Excellent overdrive recovery
- Differential gain: 0.12%
- Differential phase: 0.12°

Applications

- TFT panel V_{COM} driver

Competitive Edge

This is a 16V operational high speed, high output current single operational amplifier. There are not many high-speed parts that have the bandwidth at higher voltages (16V).

Packaging

- SOT23-5

Tools

- Amplifiers.national.com
- Samples available online

Further Information

- **www.national.com/see/amplifiers**

LMH6724/25 Dual/Quad 370 MHz, 1 mA Current Feedback Op

Description

The LMH6724/25 provides a 260 MHz small signal bandwidth at a gain of +2 V/V and a 600 V/µs slew rate while consuming only 1 mA from ±5V supplies.

The LMH6724/25 supports video applications with its 0.03% and 0.11° differential gain and phase errors for NTSC and PAL video signals while driving a back terminated 75Ω load. The LMH6724/25 also offers a flat gain response of 0.1 dB to 100 MHz. Additionally, the LMH6724/25 can deliver 110 mA of linear output current. This level of performance, as well as a wide supply range of 4.5 to 12V, makes the LMH6724/25 an ideal op amp for a variety of portable applications.

Features

- Large signal bandwidth and slew rate 100% tested
- 370 MHz bandwidth (A_V = 1, V_{OUT} = 0.5 V_{PP}) −3 dB BW
- 260 MHz (A_V = +2 V/V, V_{OUT} = 0.5V_{PP}) −3 dB BW
- 1 mA supply current
- 110 mA linear output current
- 0.03%, 0.11° differential gain, phase
- 0.1 dB gain flatness to 100 MHz
- Fast slew rate: 600 V/µs
- Unity gain stable
- Single supply range of 4.5 to 12V

Applications

- A/D driver
- Basestations
- Broadcast video systems
- HDTV
- Line driver
- Medical imaging
- Night vision
- Portable DVD
- Portable video
- Professional cameras

Competitive Edge

The LMH6724 and LMH6725 outperform the competition by offering higher AC performance, better line-driving capability, and good video-signal-conditioning for a nominal supply current of 1 mA.

Packaging

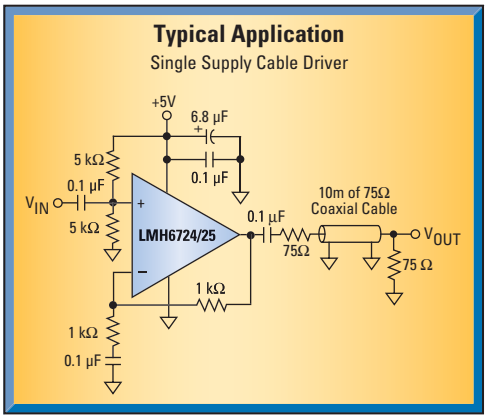
- SOIC-8 (LMH6724)
- SOIC-14 (LMH6725)

Tools

- Amplifiers.national.com
- WEBENCH® for Amplifiers: online amplifiers design tool
- Samples available online
  - CLC730036 SOIC-8 Dual evaluation board - Included with LMH6724MA sample order
  - CLC730031 SOIC-14 Quad evaluation board - Included with LMH6725MA sample order
- Application notes available online

Further Information

- **www.national.com/see/amplifiers**



LMH6738 Very Wideband, Low Distortion Triple Op Amp

Description

The LMH6738 is a very wideband, DC coupled monolithic operational amplifier designed specifically for ultra-high resolution video systems as well as wide dynamic range systems requiring exceptional signal fidelity. Benefiting from National's current feedback architecture, the LMH6738 offers a gain range of ±1 to ±10 while providing stable, operation without external compensation, even at unity gain. At a gain of +2 the LMH6738 supports ultra-high resolution video systems with a 400 MHz 2 V_{PP} −3 dB Bandwidth. With 12-bit distortion levels through 30 MHz (R_L = 100Ω), 2.3 nV/$\sqrt{Hz}$ Hz input referred noise, the LMH6738 is the ideal driver or buffer for high speed flash A/D and D/A converters.

Key Specifications

- 750 MHz −3 dB small signal bandwidth (A_V = +1)
- −85 dBc 3rd harmonic distortion (20 MHz)
- 2.3 nV/$\sqrt{Hz}$ Hz input noise voltage
- 3300 V/µs slew rate
- 33 mA supply current (11.3 mA per op amp)
- 90 mA linear output current
- 0.02/0.01 diff. gain / diff. phase (R_L = 150Ω)

Applications

- D/A transimpedance buffer
- DDS post-amps
- Flash A/D driver
- High resolution projectors
- Line driver
- Radar/communication receivers
- RGB video driver
- Wide dynamic range IF amp
- Wideband inverting summer

Competitive Edge

The LMH6738 outperforms the competition in both small and large signal bandwidth, slew rate, distortion, and gain flatness. The 3300 V/µs slew rate and 150 MHz to 0.1 dB bandwidth are best-in-class when compared to other triple video op amps. Even with its significantly higher performance, the LMH6738 beats the competition in distortion with 2nd/3rd harmonic distortions of −80/−90 dBc at 5 MHz, respectively.

Packaging

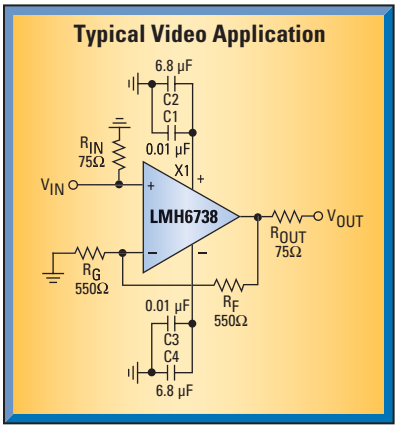
- SSOP-16

Tools

- Amplifiers.national.com
- Samples available online
- Evaluation board available with sample order
- Application notes available online

Further Information

- **www.national.com/see/amplifiers**



LMH6533 Four-Channel Laser Diode Driver with Dual Output, LVDS Interface and HFM Oscillator

Description

The LMH6533 is a laser diode driver for use in combination DVD/CD recordable and rewritable systems. The part contains two high-current outputs for reading and writing the DVD (650 nm) and CD (780 nm) lasers. Functionality includes read, write and erase through four separate switched current channels. The channel currents are summed together at the selected output to generate multilevel waveforms for reading, writing and erasing of optical discs. The LVDS interface delivers DVD write speeds of 12x and higher while minimizing noise and crosstalk. The part features a 150 mA read channel plus one 300 mA and two 150 mA write channels, which can be summed to allow a total output current of 500 mA or greater.

An on-board High-Frequency Modulator (HFM) oscillator helps reduce low-frequency noise of the laser and is enabled with the ENOSC pin. The fully differential oscillator circuit minimizes supply line noise, easing FCC approval of the overall system.

Features

- 5V single-supply operation
- Logic inputs TTL and CMOS compatible
- Fast switching: Rise and fall times < 0.8 ns
- Low voltage differential signaling (LVDS) channels enable interface for the fast switching lines
- Low output current noise: < 0.5 nA/$\sqrt{\text{Hz}}$
- Dual output: Selectable by SELB pin (active HIGH)
- Four independent current channels
  - Gain of 300, 300 mA write channel
  - Gain of 150, 150 mA low-noise read channel
  - Two gain of 150, 150 mA write channels
  - 500 mA minimum combined output current
- Integrated AC coupled HFM oscillator
  - Selectable frequency and amplitude setting by external resistors
  - 200 MHz to 600 MHz frequency range
  - Amplitude to 100 mA peak-to-peak modulation
- Complete shutdown by ENABLE pin

Applications

- Combination DVD/CD recordable and rewritable drives
- DVD camcorders
- DVD video recorders

Competitive Edge

National's LMH6533 is the industry's fastest, lowest noise, low power laser diode driver for optical storage devices. No competitor has this combination of speed (0.5 ns rise/fall times), low noise (<0.5 nA/$\sqrt{\text{Hz}}$), and low power.

Packaging

- LLP-28

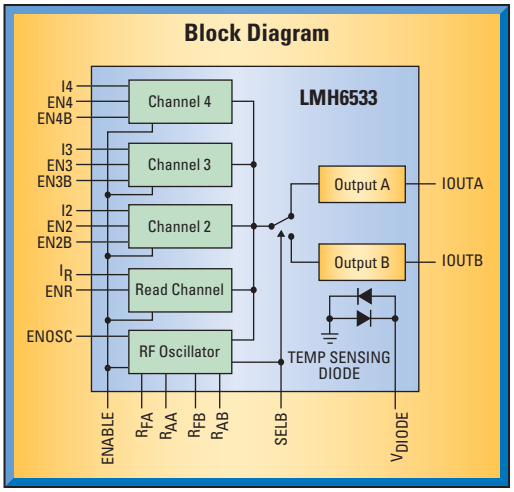
Tools

- Samples available online

Further Information

- **www.national.com/see/amplifiers**

Block Diagram



LMV242 Dual Output, Quad-Band GSM/GPRS Power Amplifier Controller

Description

The LMV242 is a power amplifier (PA) controller intended for use within an RF transmit power control loop in GSM/GPRS mobile phones. The LMV242 supports all single-supply PA's including InGaP, HBT and bipolar power amplifiers. The device operates with a single supply from 2.6V to 5.5V.

Included in the PA controller are an RF detector, a ramp filter and two selectable output drivers that function as error amplifiers for two different bands. Individual PA characteristics are accommodated by a user selectable external RC combination.

Features

- Support of InGaP HBT, bipolar technology
- Quad-band operation
- Shutdown mode for power save in R_X slot
- Integrated ramp filter
- 50 dB RF detector
- GPRS compliant
- External loop compensation option
- Accurate temperature compensation

Applications

- GPS navigation modules
- GSM/GPRS/TDMA/TD_SCDMA mobile phone
- GSM GPRS power amplifier module
- PC and PDA module cards
- Pulse RF control
- RSSI for fiber modules
- Transmit module
- Wireless LAN

Competitive Edge

The LMV242 is a highly integrated solution replacing greater than 10 discretes and can be easily implemented using only 1-2 external components - saving time, noise, space and money.

The fully integrated controller also allows for external management.

Packaging

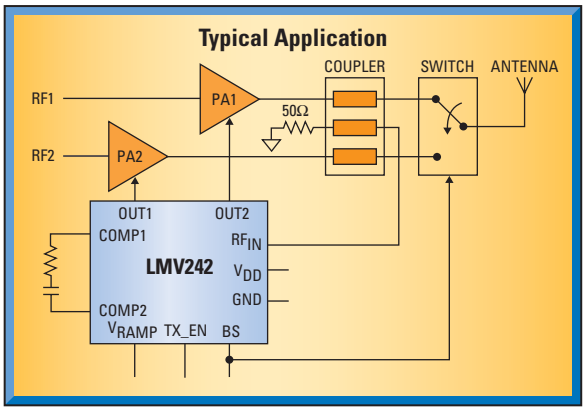
- LLP-10
- Fully tested die form

Tools

- Samples available online

Further Information

- **www.national.com/see/amplifiers**



LM4802B Boomer® Audio Power Amplifier with Boost Converter to drive Ceramic Speakers

Description

The LM4802B integrates a Boost Converter with an Audio Power Amplifier to drive Ceramic Speakers in portable applications. When powered by a 3V supply, it is capable of forcing 12 Vpp across a 2 µF + 30Ω bridge-tied-load (BTL) with less than 1% THD+N.

Boomer audio power amplifiers were designed specifically to provide high quality output power with a minimal amount of external components. The LM4802B does not require bootstrap capacitors, or snubber circuits. Therefore it is ideally suited for portable applications requiring high output voltage and minimal size.

The LM4802B is unity-gain stable and can be configured by external gain-setting resistors.

Features

- Pop & click circuitry eliminates noise during turn-on and turn-off transitions
- Short circuit protection
- Low-power consumption shutdown mode
- Internal thermal shutdown protection mechanism
- Unity-gain stable
- External gain configuration capability

Key Specifications

- Quiescent Power Supply Current: 12 mA (typ)
- Shutdown Current: 2 µA (max)
- BTL Voltage Swing (2 µF + 30Ω load, 1% THD+N,VDD = 3V): 12 Vpp (typ)

Applications

- Cellphone
- PDA
- Portable applications

Competitive Edge

National's LM4802B outperforms the competition with superior AB performance. It is highly integrated and offered as a single-chip solution versus competitive solutions requiring additional components. As such, it is ideal for cell phones, PDAs, notebooks, and other small speaker applications.

Packaging

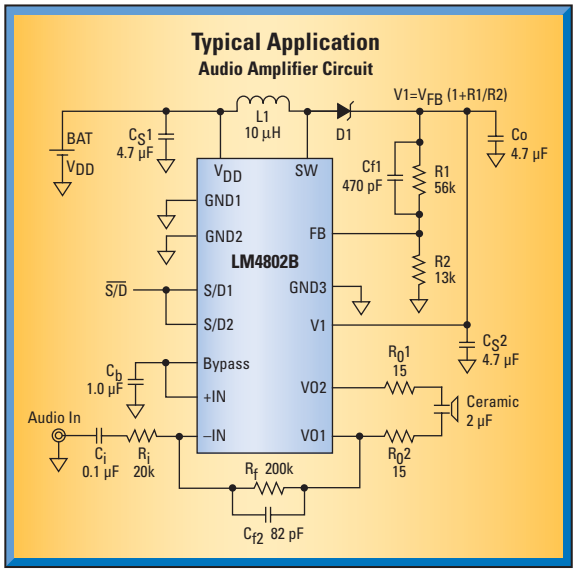
- LLP-28

Tools

- Samples available online

Further Information

- **www.national.com/see/audio**



LM4820-6 Boomer® Fixed Gain 1-Watt Audio Power Amplifier

Description

The LM4820-6 is an audio power amplifier primarily designed for demanding applications in mobile phones and other portable communication device applications. It is capable of delivering 1 watt of continuous average power to an 8Ω BTL load with less than 1% distortion (THD+N) at 6 dB of BTL gain from a 5 V_{DC} power supply.

Boomer audio power amplifiers were designed specifically to provide high quality output power with a minimal amount of external components.

Features

- Fixed 6 dB BTL voltage gain
- Ultra low current shutdown mode
- Can drive capacitive loads up to 500 pF
- Improved pop & click circuitry eliminates noises during turn-on and turn-off transitions
- 2.0 - 5.5V operation
- No output coupling capacitors, snubber networks or bootstrap capacitors required
- External gain configuration still possible
- Internal thermal shutdown protection mechanism

Key Specifications

- Improved PSRR at 217 Hz: 62 dB
- Power output at 5.0V & 1% THD: 1.0W(typ.)
- Power output at 3.3V & 1% THD: 400 mW(typ.)
- Shutdown current: 0.1 µA (typ.)

Applications

- Mobile phones
- PDAs
- Portable electronic devices

Competitive Edge

The LM4820-6 does not require input and gain resistors, output coupling capacitors or bootstrap capacitors, and therefore is ideally suited for mobile phone and other low voltage applications where minimal parts count and low power consumption is a primary requirement.

Packaging

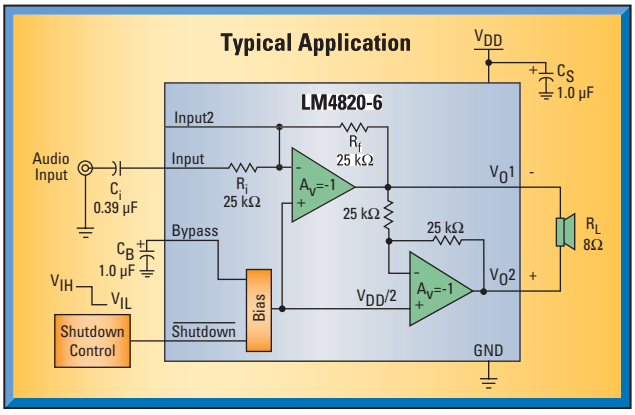
- MSOP-8
- SO-8
- micro SMD™-8

Tools

- Samples available online

Further Information

- **www.national.com/see/audio**



LM4782 Overture™ Audio Power Amplifier Series
3-Channel 25W Audio Power Amplifier with Mute and Standby

Description

The LM4782 is a three-channel audio amplifier capable of typically delivering 25W per channel of continuous average output power into an 8Ω load with less than 0.5% THD+N from 20 Hz - 20 kHz.

The LM4782 is fully protected utilizing National's Self Peak Instantaneous Temperature (°Ke) (SPiKe™) protection circuitry. SPiKe provides a dynamically optimized Safe Operating Area (SOA). SPiKe protection completely safeguards the LM4782's outputs against over-voltage, under-voltage, overloads, shorts to the supplies or GND, thermal runaway and instantaneous temperature peaks. The LM4782 can easily be configured for bridge or parallel operation for higher power and bi-amp solutions.

Features

- SPiKe protection
- Low external component count
- Quiet fade-in/out mute mode
- Low power standby mode
- Mute and standby modes can be controlled by external logic.
- Wide supply range: 20V - 64V
- Signal-to-Noise Ratio ≥ 98 dB (ref. to P_O = 1W)

Key Specifications

- Output Power/Channel with 0.5% THD+N, 1 kHz into 8Ω: 25W (typ)
- THD+N at 3x 15W into 8Ω (20 Hz - 20 kHz): 0.2% (typ)
- THD+N at 3x 15W into 6Ω (20 Hz - 20 kHz): 0.3% (typ)
- THD+N at 3x 15W into 4Ω (20 Hz - 20 kHz): 0.4% (typ)
- Mute Attenuation: 115 dB (typ)
- PSRR: 85 dB (min)
- Slew Rate: 18 V/µs (typ)

Applications

- Component stereo
- Compact stereo
- Home theater in a box (HTB)
- Self-powered speakers
- High-end and HD TVs

Competitive Edge

The advanced protection features of the LM4782 places it in a class above discrete and hybrid amplifiers. National Semiconductor is the only company in the market with a three-channel, 25W audio amplifier with mute and standby.

Packaging

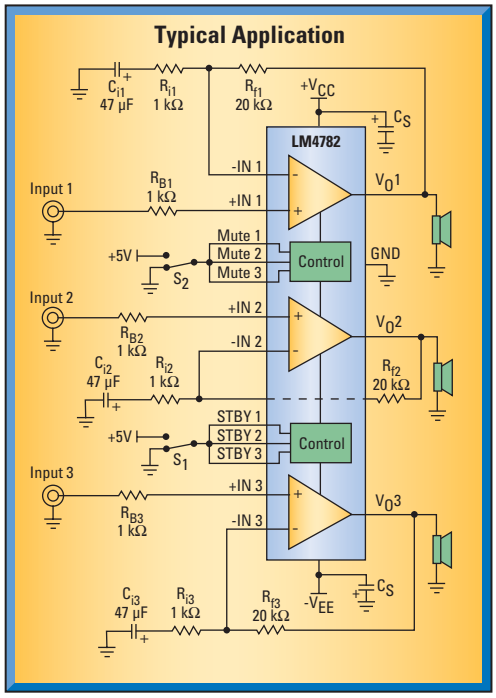
- TO220-27

Tools

- Samples available online

Further Information

- **www.national.com/see/audio**



LMV7291 Single 1.8V Low Power Comparator with Rail-to-Rail Input

Description

The LMV7291 is a rail-to-rail input low power comparator, characterized at supply voltage 1.8V, 2.7V and 5.0V. It consumes only 9 uA supply current per channel while achieving a 800 ns propagation delay.

The LMV7291 features a push-pull output stage which allows operation with minimum power consumption when driving a load.

The LMV7291 is built with National Semiconductor's advance submicron silicon-gate BiCMOS process. It has bipolar inputs for improved noise performance and CMOS outputs for rail-to-rail output swing.

Features

V_S = 1.8V, T_A = 25°C, Typical values unless specified

- Single supply
- Ultra low supply current: 9 µA per channel
- Low input bias current: 10 nA
- Low input offset current: 200 pA
- Low guaranteed V_{OS}: 4 mV
- Propagation delay: 880 ns (20 mV overdrive)
- Input common mode voltage range: 0.1V beyond rails

Applications

- Battery powered electronics
- General purpose low voltage applications
- Laptops and PDA's
- Mobile communications

Competitive Edge

The LMV7291 is available in SC70 package. With this tiny package, the PC board area can be significantly reduced. It is ideal for low voltage, low power and space critical designs.

Packaging

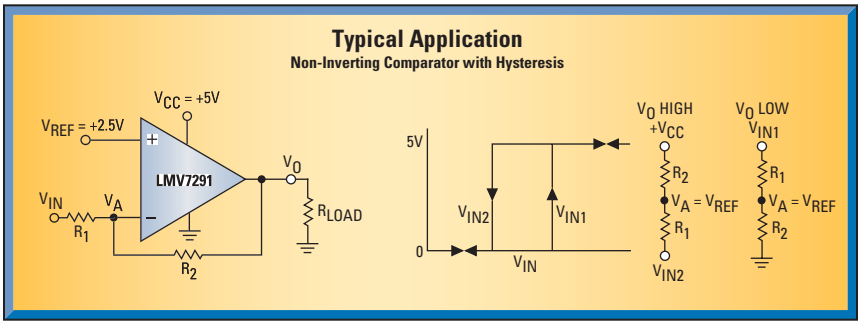
- SC70-5

Tools

- Amplifiers.national.com
- Samples available online

Further Information

- **www.national.com/see/amplifiers**



ADC12DL066 Dual 12-Bit, 66 MSPS, 450 MHz Input Bandwidth A/D Converter with Internal Reference

Description

The ADC12DL066 is a dual, low-power monolithic CMOS analog-to-digital converter capable of converting analog input signals into 12-bit digital words at 66 Megasamples per second (MSPS), minimum.

This converter uses a differential, pipeline architecture with digital error correction and an on-chip sample-and-hold circuit to minimize die size and power consumption while providing excellent dynamic performance and a 450 MHz full power bandwidth.

Operating on a single 3.3V power supply, the ADC12DL066 achieves 10.7 effective bits and consumes just 686 mW at 66 MSPS, including the reference current. The power down feature reduces power consumption to 75 mW.

The differential inputs provide a full scale differential input swing equal to 2 times V_{REF} with the possibility of a single-ended input. Full use of the differential input is recommended for optimum performance. The digital outputs from the two ADCs are available on separate 12-bit buses with an output data format choice of offset binary or two's complement.

To ease interfacing to lower voltage systems, the digital output driver power pins of the ADC12DL066 can be connected to a separate supply voltage in the range of 2.4V to the digital supply voltage.

This device will operate over the industrial temperature range of −40°C to +85°C. An evaluation board is available to ease the evaluation process.

Features

- Single +3.3V supply operation
- Internal sample-and-hold
- Outputs 2.4V to 3.3V compatible
- Pin compatible with ADC12D040
- Power down mode
- On-chip reference

Key Specifications

- Resolution: 12 Bits
- DNL: ±0.5 LSB (typ)
- SNR (f_{IN} = 10 MHz): 66 dB (typ)
- SFDR (f_{IN} = 10 MHz): 81 dB (typ)
- Data latency: 6 clock cycles
- Power consumption
  - Operating: 686 mW (typ)
  - Power down mode: 75 mW (typ)

Applications

- Cable modems
- Communications receivers
- DSP front ends
- Instrumentation
- Sonar/radar
- Ultrasound and imaging
- xDSL

Competitive Edge

ADC12DL066 offers great performance even at 66 Msps and offers low operating power consumption (650 mW typ). Additionally, the dual input channels allows for space savings and less power consumption (than using 2 devices).

Packaging

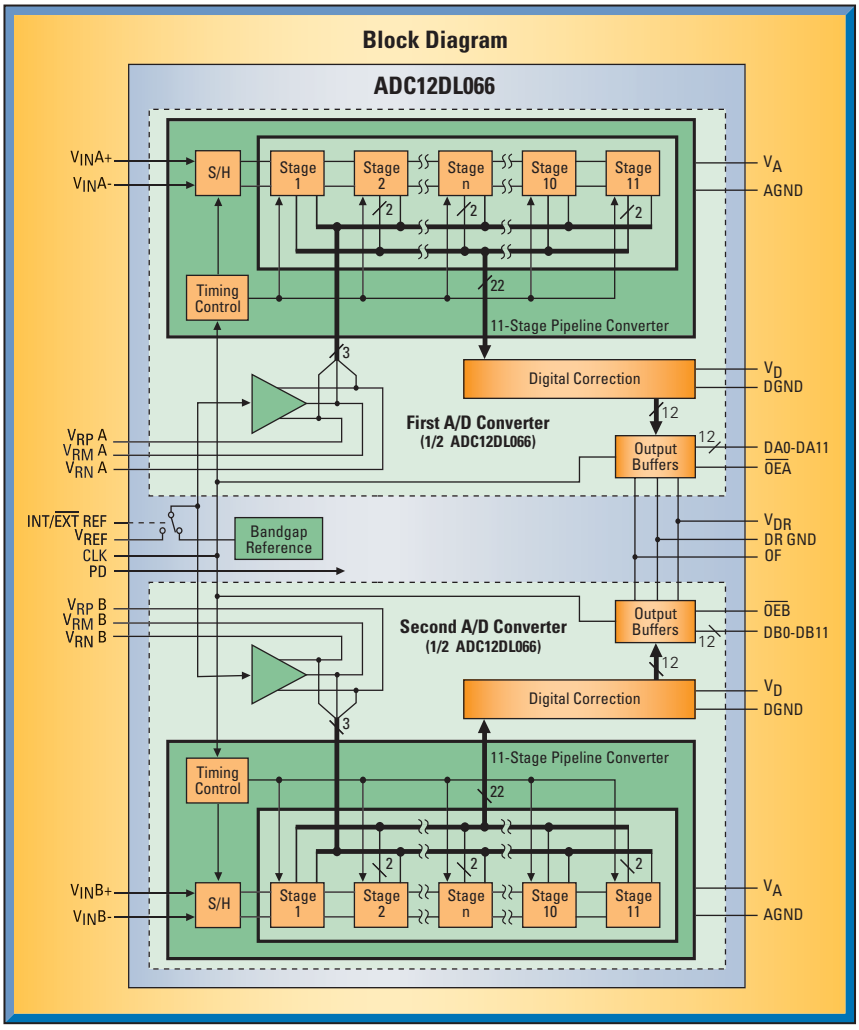
- TQFP-64

Tools

- Samples available online
- Evaluation board
  - ADC12DL066EVAL at $294.00

Further Information

- **www.national.com/see/adconverters**



ADC081000 High Performance, Low Power, 8-Bit, 1 GSPS A/D Converter

Description

The ADC081000 is a low power, high performance CMOS analog-to-digital converter that digitizes signals to 8 bits resolution at sampling rates up to 1.6 GSPS. Consuming a typical 1.4 Watts at 1 GSPS from a single 1.9 Volt supply, this device is guaranteed to have no missing codes over the full operating temperature range. Output formatting is offset binary and the LVDS digital outputs are compliant with IEEE 1596.3- 1996, with the exception of a reduced common mode voltage of 0.8V.

The converter has a 1:2 demultiplexer that feeds two LVDS buses, reducing the output data rate on each bus to half the sampling rate. The data on these buses are interleaved in time to provide a 500 MHz output rate per bus and a combined output rate of 1 GSPS.

Features

- LVDS digital outputs
- Internal sample-and-hold
- Single +1.9V ±0.1V operation
- Adjustable output levels
- Guaranteed no missing codes
- Low power standby mode

Key Specifications

- Resolution: 8 Bits
- Max conversion rate: 1 GSPS (min)
- ENOB @ 500 MHz input: 7.5 Bits (typ)
- DNL: ±0.25 LSB (typ)
- Conversion latency: 7 and 8 clock cycles
- Power consumption
  - Operating: 1.45 W (typ)
  - Power down mode: 9 mW (typ)
- Industrial ($-40°C \leq T_A \leq +85°C$) temperature range

Applications

- Communications systems
- Direct RF down conversion
- Digital oscilloscopes
- Satellite set-top boxes
- Test instrumentation

Competitive Edge

The ADC081000 is the most accurate, lowest power, ultra high-speed 8-bit ADC in the market today. The competition offers faster ADCs, but none that consume only 1.4W from a single 1.9V supply while running at GHz speeds.

The unique folding and interpolating architecture, the fully differential comparator design, the innovative design of the internal sample-and-hold amplifier and the self-calibration scheme enable a very flat response of all dynamic parameters beyond Nyquist, producing a high 7.5 ENOB with a 500 MHz input signal and a 1 GHz sample rate.

Packaging

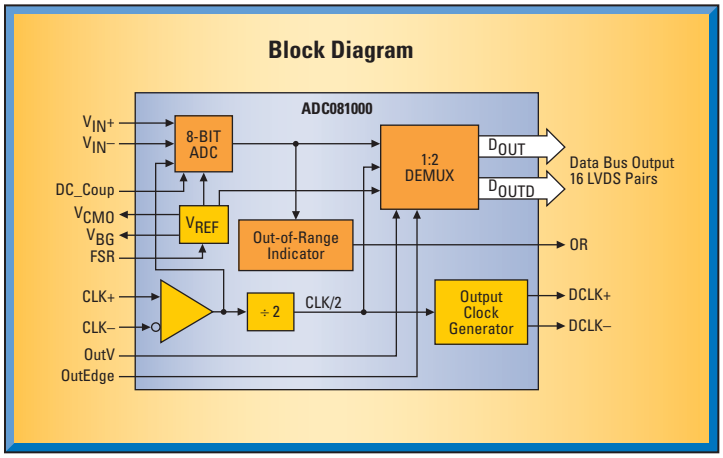
- LQFP-128

Tools

- Samples available online
- Evaluation board
  - ADC081000EVAL at $1000.00
  - ADC081000 Evaluation board user's guide available online

Further Information

- **www.national.com/see/adconverters**



ADC121S101/ ADC101S101/ ADC081S101

1 MSPS, 12-/10-/8-Bit A/D Converters

Description

The ADC121S101, ADC101S101, and ADC081S101 are low power, monolithic CMOS 12-, 10- and 8-bit analog-to-digital converters that operate at 1 MSPS. Each device is based on a successive approximation register architecture with internal track-and-hold. The serial interface is compatible with several standards, such as SPI™, QSPI™, MICROWIRE™, and many common DSP serial interfaces.

The ADC121S101/101S101/ 081S101 uses the supply voltage as a reference. This enables the devices to operate with a full-scale input range of 0 to V_{DD}. The conversion rate is determined from the serial clock (SCLK) speed. These converters offer a shutdown mode, which can be used to trade throughput for power consumption.

Features

- Variable power management
- Power supply used as reference
- Single +2.7V to +5.25V supply operation
- SPI™/QSPI™/MICROWIRE™/ DSP compatible

Key Specifications

- Resolution with no missing codes:
  - 12 bits (ADC121S101)
  - 10 bits (ADC101S101)
  - 8 bits (ADC081S101)
- Conversion rate: 1 MSPS
- DNL: +0.5, -0.3 LSB (typ)
- INL: ± 0.4 LSB (typ)
- Power consumption:
  - 3V Supply 2 mW (typ)
  - 5V Supply 10 mW (typ)
- Power down: <5 µW (typ., 5V Supply)
- Automotive/extended industrial temperature range of –40°C to +125°C

Applications

- Automotive navigation
- FA/ATM equipment
- Instrumentation and control systems
- Medical instruments
- Mobile communications
- Portable systems

Competitive Edge

The ADCADC121S101/101S101/ 081S101 family offers excellent dynamic and DC linearity performance while operating at low power. Each device is packaged in a SOT23-6, which provides an advantage for applications where limited board space is a critical requirement.

Packaging

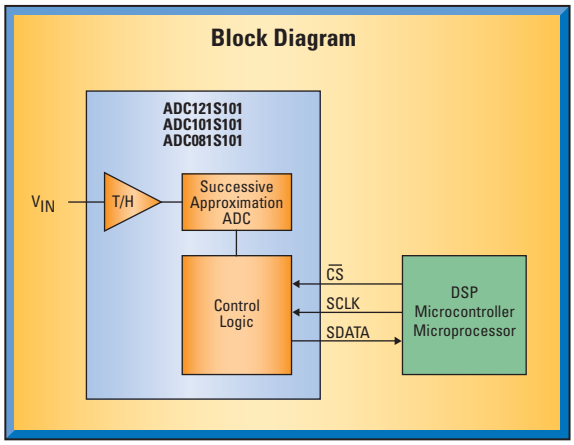
- SOT23-6

Tools

- Samples available online
- Evaluation boards
  - ADC081S101EVAL at $75.10
  - ADC101S101EVAL at $75.10
  - ADC121S101EVAL at $75.10

Further Information

- **www.national.com/see/adconverters**



LM2796 Dual-Display White-LED Driver with 3/2x Switched Capacitor Boost

Description

The LM2796 is a charge-pump based white-LED driver that is ideal for mobile phone display back-lighting. It can drive up to seven LEDs in parallel with up to 20 mA through each LED. Regulated internal current sources deliver excellent current and brightness matching in all LEDs. The LED-driver current sources are split into two independently controlled groups. The primary group (four LEDs) can be used to back-light the main phone display. The second group (three LEDs) can be used to back-light a secondary display or to provide other lighting features (keypad LEDs, for example). Brightness of the two groups can be adjusted independently with pulse-width modulated (PWM) digital signals.

See Also:
LM2793: 2 LED outputs
LM2794: 4 LED outputs
LM2795: 4 LED outputs
LP3933:
RGB lighting, inductive boost
LP3936:
RGB lighting, inductive boost

Features

- Drives up to seven LEDs with up to 20 mA each
- Excellent current and brightness matching
- LEDs controlled in two distinct groups, for back-lighting two displays (main LCD and sub-LCD)
- Extended Li-Ion input: 2.7V to 5.5V
- High-efficiency 3/2x charge pump
- PWM brightness control: 100 Hz to 1 kHz

Applications

- Digital cameras
- General LED lighting
- LCD instrument panels
- Medical instrumentation
- Mobile phone display lighting
- Mobile phone keypad lighting
- PDAs
- POS (barcode scanners)

Competitive Edge

The LM2796 provides an optimized solution. The overall solution is:

- Smaller
- Less expensive
- More efficient
- More powerful

The LM2796 differentiates itself by being able to provide light to large screen displays. It enables a smaller total solution, brighter displays and allows for higher density information to be displayed.

Packaging

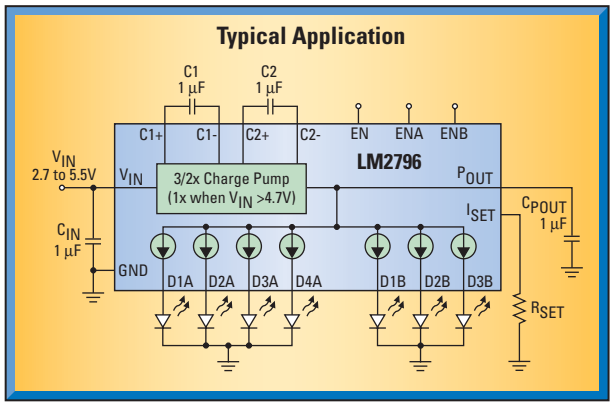
- micro SMD-18

Tools

- Samples available online
- Evaluation board:
  - LM2796TLEV at $55.10
- Application note:
  - AN-1321: *LM2796 Evaluation Board*

Further Information

- **www.national.com/see/power**



LM3570 Low-Noise White LED Driver System

Description

The LM3570 device provides a complete LED driver solution for wireless handsets and other portable devices using a display and keypad. With three constant current sources, up to three white LEDs can be used for display lighting with excellent current matching (0.3% typ.). The regulated 4.35V output voltage is perfect for driving auxiliary keypad LEDs in voltage mode.

The LM3570 accepts an input voltage range from 2.7V to 5.5V and maintains a constant current determined by an external R_{SET} resistor.

By applying a pulse width modulated (PWM) signal to the PWM pin, the user has the ability to independently control the brightness of the regulated current source outputs without shutting down the regulated output voltage.

Features

- 2.7V to 5.5V input voltage
- Regulated output voltage (V_{OUT} = 4.35V)
- Regulated I_{DX} with ±0.3% matching between constant current outputs
- High efficiency 3/2 boost function
- Drives one, two, or three white LEDs with no bias resistor losses
- Drives auxiliary keypad LEDS in voltage mode
- Up to 80 mA total output current
- Active-high enable
- Active-high PWM control pin for independent control of current sources
- 1 µA(max) shutdown current
- 500 kHz (typ) switching frequency
- Linear regulation generates predictable noise spectrum

Applications

- Portable devices using white or blue LEDs with display and backlight or frontlight
- 1-Cell LiIon battery-operated equipment including PDAs, hand-held PCs and cellular phones

Packaging

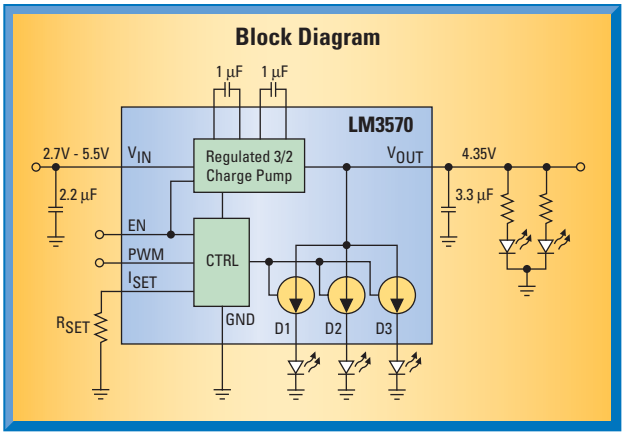
- LLP-14

Tools

- Samples available online

Further Information

- **www.national.com/see/power**



LP399x CMOS Low Dropout (LDO) Regulators

Description

The LP399x family is the next-generation of CMOS low dropout (LDO) regulators. These new regulators are designed to meet the requirements of portable, battery-powered systems by providing accurate output voltage, low noise, and low quiescent current. The LP399x family has been optimized to power RF/analog loads as well as digital loads. The LP399x family of devices is available in a variety of advanced packaging options such as micro SMD, SOT-23, LLP® and MSOP.

Features

- Operating currents as low as 10 µA improve product standby time without compromising performance
- Core regulators with excellent transient response enable peak performance from digital ICs
- RF/analog regulators with ultra-low noise and high power supply rejection enable clean analog signals
- Advanced packaging with few external components significantly reduces BOM and PCB area

Applications

- Bluetooth devices
- Cell phones
- Industrial equipment
- Medical equipment
- MP3 players
- Notebooks
- PDAs
- Wireless headsets
- Wireless LAN

Competitive Edge

These regulators are optimized in performance for either digital or analog loads. Digital has faster turn on/turn off and excellent line/load transient performance. Analog has improved noise and PSRR performance. These devices have been designed for lower operating current without compromising performance. They allow longer standby times and significantly reduce the overall power budget for the power management solution.

Packaging

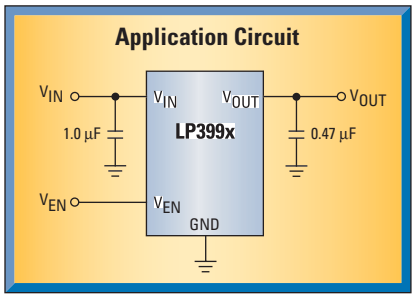
- LP3990: micro SMD, LLP
- LP3992: SOT-23
- LP3993: SOT-23
- LP3994: micro SMD, LLP
- LP3995: micro SMD, LLP
- LP3997: MSOP
- LP3999: micro SMD

Tools

- Samples available online

Further Information

- **www.national.com/see/power**



Core Regulators

Product ID	No Load Supply Current	Load Transient Response	Output	Packages
LP3990	43 µA	50 mV from no load to 150 mA in 1 µS	0.8V to 3.3V	LLP, micro SMD, SOT-23
LP3992	29 µA	60 mV from no load to 30 mA in 1 µS	1.5V	SOT-23
LP3993	10 µA	70 mV from no load to 80 mA in 1 µS	1.5V to 3.3V	SOT-23, micro SMD
LP3994	20 µA	50 mV from no load to 50 mA in 1 µS	1.5V to 3.3V	LLP, micro SMD
LP3997	45 µA	70 mV from no load to 250 mA in 1 µS	3.3V	MSOP

RF / Analog Regulators

Product ID	Noise Output	PSRR at 1 kHz	Dropout at Full Load	Output	Packages
LP3985	30 µV rms	70 dB	60 mV	2.5V to 4.7V	micro SMD, SOT-23
LP3995	25 µV rms	70 dB	60 mV	1.8V to 3.3V	micro SMD
LP3999	25 µV rms	70 dB	60 mV	1.8V to 3.3V	micro SMD, LLP

LM5111/2 Dual 5A Peak and Single 7A Peak MOSFET Gate Drivers

Description

The LM5111 is an industry standard footprint dual-power MOSFET gate driver. The LM5112 is a non-standard, tiny (LLP-6 thermal package) single driver, both deploying National's unique "compound gate-driver technology" to extend and improve the drivers' output sink and sourcing capability. These two new drivers can be used in conjunction with National's LM5000 family of high-voltage PWM controllers as building blocks to ease the design of modern, high-performance DC-DC converters. Their "compound gate-drive technology" output stage includes MOS and bipolar transistors operating in parallel to sink more than 5A/7A peak (LM5111/12) from capacitive loads.

Features

- The LM5111 replaces industry standard gate drivers (SOIC-8 package) when the input/output ground pins are connected to common.
- The LM5112 can drive off the MOSFET with a negative gate drive supply ($-V_{GS}$) by separating the input ground reference pin and driving the V_{EE} output ground pin with a negative bias supply.
- Designed with a "compound Bi-CMOS technology" output stage for highly efficient rail-to-rail output current delivery, as well as reduction in output current variation typical of conventional MOS or bipolar-only gate drivers.
- Each dual channel LM5111 can sink/source 5A/3A (or 7A/3A for single LM5112) with very fast rise/fall times (14 ns/12 ns into a 2 nF load).
- LM5112 has both an inverting and non-inverting input pin easing the signal interface design by allowing the user to drive the input with either a positive or negative-active control signal.
- Short propagation delay times (25 ns typ.).
- Integrated UVLO protection (2.8V typ.).

Applications

- Class D amplifiers
- DC-DC converters
- Low voltage threshold synchronous rectifier driver
- Motion control systems/motor drivers
- Pulse generators and line drivers
- Pulse transformer drivers
- Switch-mode power supplies
- UPS systems

Competitive Edge

Competitive drivers do not offer negative drive of the LM5112, so the ground noise in these DC-DC supplies tends to falsely trigger low-threshold, voltage-power MOSFETs causing unexpected power losses.

Packaging

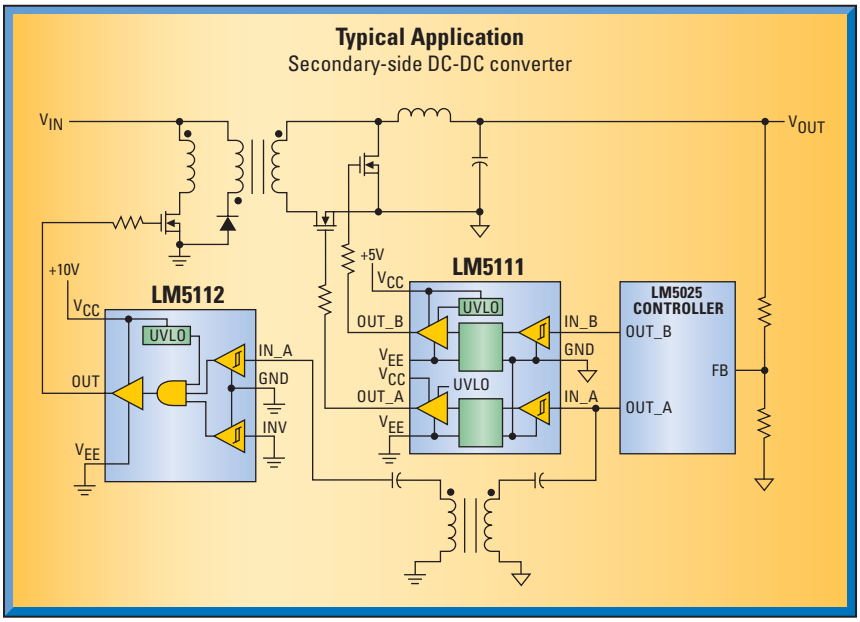
- SOIC-8 (LM5111)
- LLP-6 (LM5112)

Tools

- Samples available online

Further Information

- **www.national.com/see/power**



LP3941A Cellular Phone Power Management Unit

Description

LP3941A is a complete power management IC designed for a cellular phone. It contains 11 low noise low dropout regulators, a linear charger for Li-Ion battery, a backup battery charger, real time clock supply regulator, three open drain drivers, two comparators and high speed I^2C compatible serial interface to program individual regulator output voltages as well as on/off control.

Features

- 11 low dropout, low noise LDOs.
- Dedicated low current LDO for real time clock supply.
- Back-up battery charger
- I^2C compatible serial interface for maximum flexibility
- A constant current / constant voltage battery charger controller with charge status indication via I^2C compatible interface.
- Three open drain drivers to control a RGB LED

Key Specifications

- 3.0V to 5.5V input voltage range
- 27 μV_{RMS} output noise
- 2% (typical) output voltage accuracy
- 1% charger voltage accuracy

Applications

- GSM/EDGE cellular handsets
- Wideband CDMA cellular handsets

Packaging

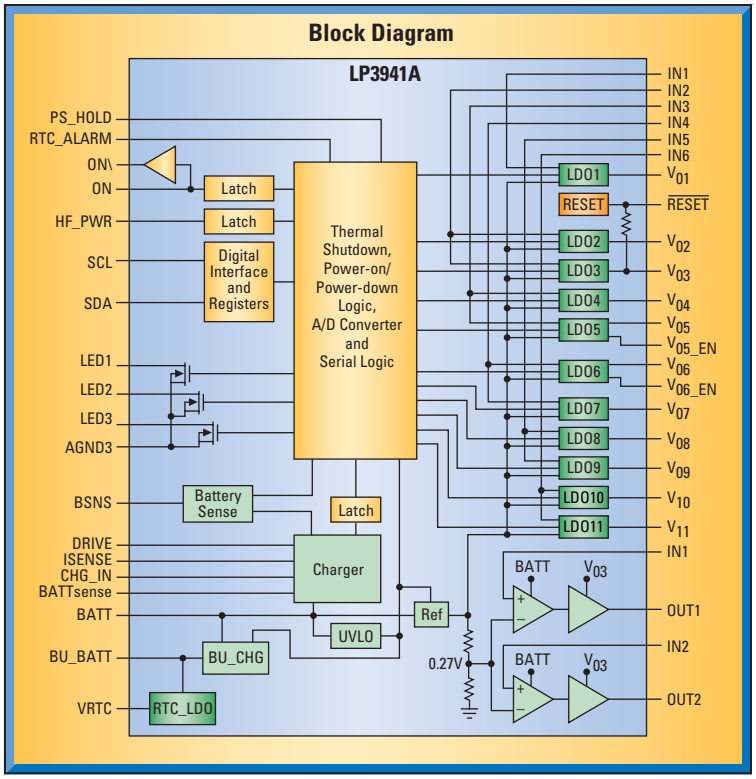
- LLP-48

Tools

- Samples available online

Further Information

- **www.national.com/see/power**



LM2743 N-Channel FET Synchronous Buck Regulator Controller for Conversion from 3.3V

Description

The LM2743 is a high-speed, N-Channel synchronous buck regulator controller with a 2%, 0.6V feedback reference voltage intended to make down conversion from 3.3V to as low as 0.6V easy. A fixed-frequency voltage-mode PWM control architecture is used, that is adjustable from 50 kHz to 2 MHz through an external resistor. The power MOSFETs can run on a separate 1V to 16V (Input Voltage, V_{IN}) rail while the regulator is biased from a 3V to 6V (IC Input Voltage, V_{CC}), 2 mA rail. The LM2743 employs output under-voltage and over-voltage flag, and current limit. The adaptive non-overlapping MOSFET gate drivers help avoid potential shoot-through problems while maintaining high efficiency. Both high-side and low-side MOSFETs are the lower cost N-Channel type, and the IC can accept a bootstrap structure to saturate the high-side MOSFET for highest efficiency.

See Also:

LM2647: Dual channel, 28V Max V_{IN}

Features

- MOSFET input voltage (V_{IN}) from 1V to 16V
- IC input voltage (V_{CC}) from 3V to 6V
- Output voltage adjustable down to 0.6V
- Power good flag and output enable
- Output over-voltage and under-voltage flag
- FB voltage: 2% over temperature
- Current limit without series sense resistor
- Adjustable soft start
- Tracking and sequencing with shutdown and soft start pins
- Switching frequency from 50 kHz to 2 MHz

Applications

- 3.3V Buck regulation
- Cable modems
- Core logic regulators
- Distributed supplies
- Graphic cards
- High-efficiency buck regulation
- Industrial
- Networking equipment
- Power supply modules
- Printers and scanners
- Rack-mounted equipment
- Set-top boxes/ home gateways
- Telecommunications

Competitive Edge

The advanced feature set and flexibility gives the expert power user the tool for most 3.3V or 5.0V conversion requirements. Excellent transient response, high efficiency, high switching frequency of 1.5 MHz, capable of 0.6 Vout at 2% accuracy over temperature –40°C to 125°C (<1.5% over 0°C to 85°C), soft start with tracking capability provides a compelling solution.

Tools

- Samples available online
- Evaluation board:
  - LM2743EVAL at $30.00
- Application notes available online

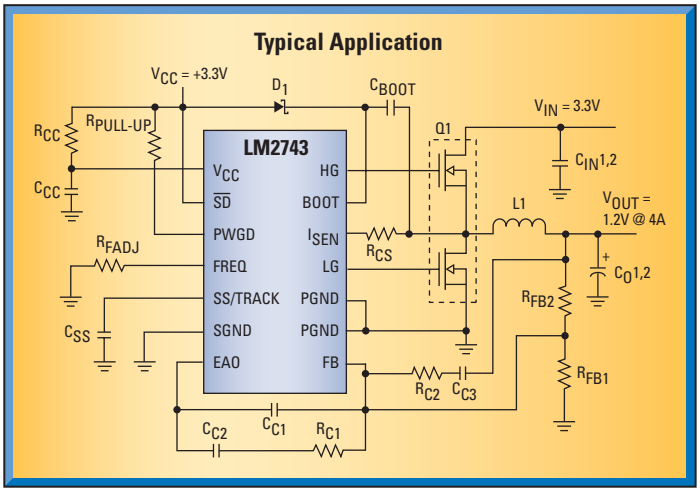
Packaging

- TSSOP-14

Further Information

- **www.national.com/see/power**

Typical Application



LM5008 High-Voltage (100V) Step Down Switching Regulator

Description

The LM5008 is the world's first 100V fully integrated buck bias regulator. This "bias regulator" steps-down a higher voltage (up to 100V) primary-side power supply and produces a low voltage (5V to 12V typ.) bias supply for primary or secondary-side control chips.

The LM5008 uses a small high-frequency buck inductor with a few external components and provides efficiencies as high as 90%. This high-voltage regulator has a 100V N-channel buck switch rated at 0.5 amp peak.

The LM5008 is based on a hysteretic control scheme using an ON time inversely proportional to V_{IN}. This feature allows the operating frequency to remain relatively constant with load and input voltage variations.

Features

- 100V, 0.5A peak power MOSFET integrated with high-side gate driver and bootstrap diode
- Ultra-low quiescent current: 500 µA operating, 100 µA max. in low-power shutdown mode
- High-voltage start-up regulator
- Programmable output voltage
- Programmable current limit OFF time
- Programmable ON time / operating frequency
- ON-timer varies inversely with line voltage
- Operating frequency remains constant with varying line voltage
- Ultra-fast line and load transient response
- No control loop compensation required
- Thermal shutdown
- Line under-voltage lockout

Applications

- +42V automotive electronics
- Battery chargers
- Battery powered systems
- Distributed power systems
- High-voltage telecom, industrial and automotive

Competitive Edge

- Outperforms existing buck regulator solutions in FET breakdown, boost diode, soft start and thermal protection
- Wide unregulated input operating voltage makes it suitable for battery-powered applications and versatile for any distributed power bus (9V through 100V)
- Industry's first and smallest high-voltage buck bias regulator

Packaging

- MSOP-8
- LLP-8

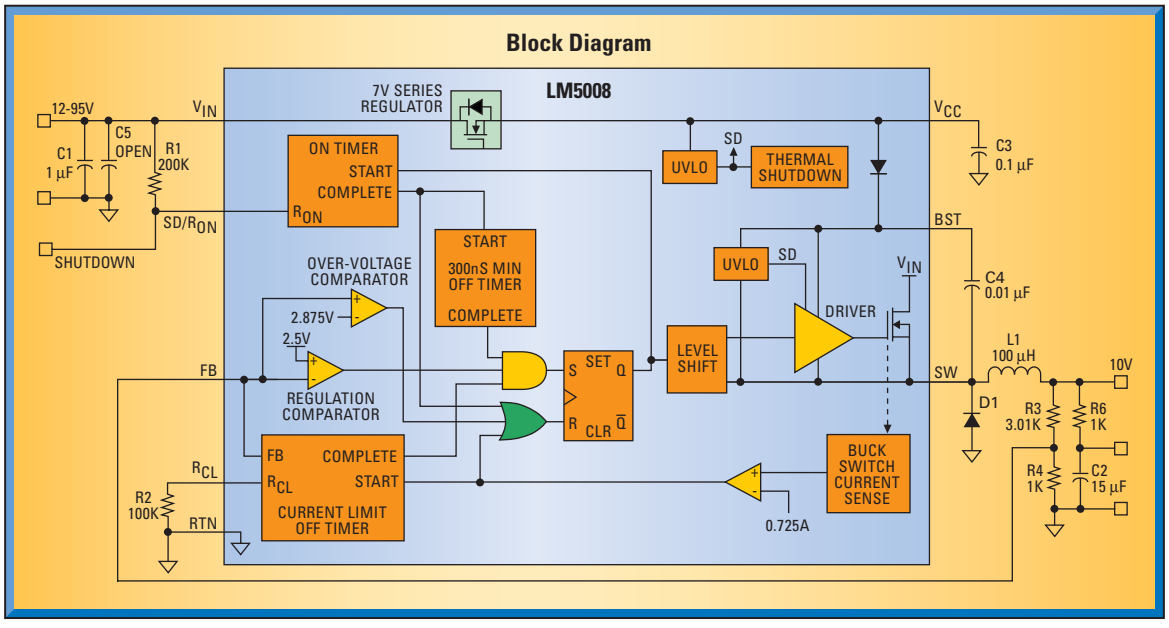
Tools

- WEBENCH® online simulation tool
- Evaluation board:
  - LM5008EVAL at $18.00
- Application notes available online
- Samples available online

Further Information

- **www.national.com/see/power**

Block Diagram



LM5020 100V Current Mode PWM Controller

Description

The LM5020 high voltage pulse-width-modulation (PWM) controller contains all of the features needed to implement single ended primary power converter topologies. Output voltage regulation is based on current-mode control, which eases the design of loop compensation while providing inherent line feed-forward. The LM5020 includes a high-voltage start-up regulator that operates over a wide input range up to 100V. The PWM controller is designed for high speed capability including an oscillator frequency range to 1 MHz and total propagation delays less than 100 ns.

See Also:

LM5104 - 100V Dual high-side / low-side MOSFET driver

LM5110 - Dual high current (5A) low-side MOSFET driver

LM5030 - 100V PWM controller for push-pull and bridge topologies

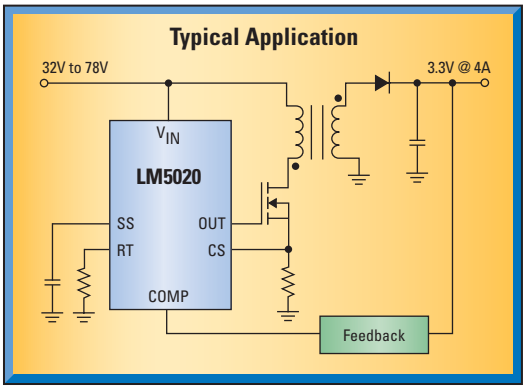
Features

- Internal start-up bias regulator
- Error amplifier
- Precision voltage reference
- Programmable softstart
- 1A peak gate driver
- Maximum duty cycle limiting (80% for LM5020-1 or 50% for LM5020-2)
- Programmable line under-voltage lockout (UVLO) with adjustable hysteresis
- Cycle-by-cycle over-current protection
- Slope compensation (LM5020-1)
- Programmable oscillator frequency with synchronization capability
- Current sense leading edge blanking
- Thermal shutdown protection

Applications

Ideal for use in:

- –48V distributed power systems
- DC/DC converter for Power-Over-Ethernet devices
- Flyback and forward DC/DC converters
- Industrial power supplies
- Networking equipment power systems
- Telecommunications power systems



Competitive Edge

The LM5020 is highly integrated and offers major advantages over competitive controllers, such as, oscillator synchronization, high-speed 1.5A peak power MOSFET driver, integrated wide range (15V-to-100V) high-voltage start-up regulator, and user programmable soft-start features, all integrated into a tiny 10-pin MSOP or LLP package

Packaging

- LLP-10
- MSOP-10

Tools

- Evaluation board:
  - LM5020EVAL at $39.00
- Samples available online
- Application notes available online

Further Information

- **www.national.com/see/power**

LM5033 100V Push-Pull Voltage Mode PWM Controller

Description

The LM5033 high voltage PWM controller contains all the features needed to implement push-pull, half-bridge, and full-bridge topologies. Applications include closed loop voltage mode converters with a highly regulated output voltage, or an open loop "DC transformer" such as an Intermediate Bus Converter (IBC) with an efficiency >95%. The small 10 pin LLP-10 package with exposed pad provides for efficient thermal management. Two alternating gate driver outputs with a guaranteed deadtime are provided.

The LM5033 includes a start-up regulator that operates over a wide input range of 15V to 100V. This high speed IC has total propagation delays less than 100 ns and a 1 MHz capable oscillator.

See Also:

LM5100: 100V Half-bridge driver used as chipset with LM5033 in half and full bridge converters

LM5030 - 100V Push-pull "current-mode" PWM controller (for those preferring I-mode over LM5033 V-mode)

LM5041: 100V Current-fed push-pull controller (this controller is used in very high-power intermediate bus converters)

Features

- Internal high voltage (100V) start-up regulator
- Single resistor oscillator setting
- Synchronizable
- Precision reference output
- Adjustable soft-start
- Over-current protection
- Direct optocoupler interface
- 1.5A peak gate drivers
- Remote shutdown
- Thermal shutdown

Applications

- +42V Automotive systems
- Industrial power converters
- Intermediate DC/DC bus converters
- Telecommunication power converters

Competitive Edge

The LM5033 is the only 100V push-pull or bridge topology controller fully integrated with a 100V start-up regulator, dual mode current limiting and 1.5 Apk gate drivers.

Packaging

- LLP-10

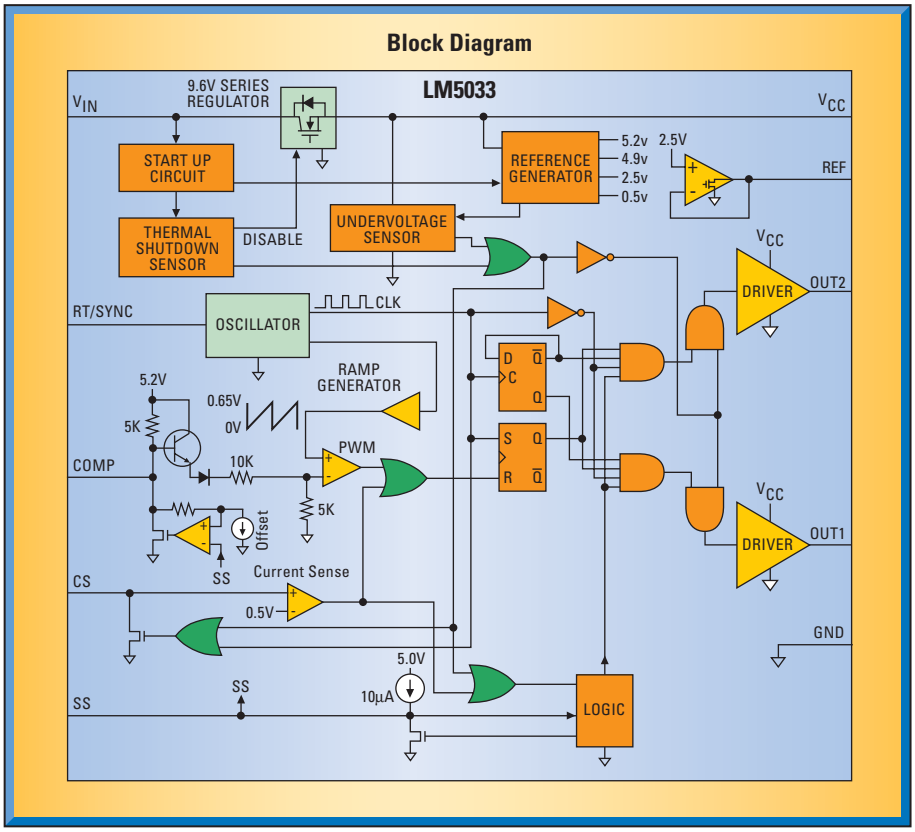
Tools

- Samples available online
- Evaluation board:
  - LM5033SD-EVAL at $90.00
- Application notes available online

Further Information

- **www.national.com/see/power**

Block Diagram



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