

## Application Notes

### AN1 Understanding and Applying the LT1005 Multifunction Regulator

This application note describes the unique operating characteristics of the LT1005 and describes a number of useful applications which take advantage of the regulator's ability to control the output with a logic control signal.

### AN2 Performance Enhancement Techniques for 3-Terminal Regulators

This application note describes a number of enhancement circuit techniques used with existing 3-terminal regulators which extend current capability, limit power dissipation, provide high voltage output, operate from 110VAC or 220VAC without the need to switch transformer windings, and many other useful application ideas.

### AN3 Applications for a Switched-Capacitor Instrumentation Building Block

This application note describes a wide range of useful applications for the LTC1043 dual precision instrumentation switched-capacitor building block. Some of the applications described are ultra high performance instrumentation amplifier, lock-in amplifier, wide range digitally controlled variable gain amplifier, relative humidity sensor signal conditioner, LVDT signal conditioner, charge pump F/V and V/F converters, 12-bit A/D converter and more.

### AN4 Application for a New Power Buffer

The LT1010 150mA power buffer is described in a number of useful applications such as boosted op amp, a feed-forward, wideband DC stabilized buffer, a video line driver amplifier, a fast sample-hold with hold step compensation, an overload protected motor speed controller, and a piezoelectric fan servo.

### AN5 Thermal Techniques in Measurement and Control Circuitry

Six applications utilizing thermally based circuits are detailed. Included are a 50MHz RMS to DC converter, and anemometer, a liquid flowmeter and others. A general discussion of thermodynamic considerations involved in circuitry is also presented.

### AN6 Applications of New Precision Op Amps

Application considerations and circuits for the LT1001 and LT1002 single and dual precision amplifiers are illustrated in a number of circuits, including strain gauge signal conditioners, linearized platinum RTD circuits, an ultra precision dead zone circuit for motor servos and other examples.

### AN7 Some Techniques for Direct Digitization of Transducer Outputs

Analog-to-digital conversion circuits which directly digitize low level transducer outputs, without DC preamplification, are presented. Covered are circuits which operate with thermocouples, strain gauges, humidity sensors, level transducers and other sensors.

### AN8 Power Conditioning Techniques for Batteries

A variety of approaches for power conditioning batteries is given. Switching and linear regulators and converters are shown, with attention to efficiency and low power operation. 14 circuits are presented with performance data.

### AN9 Application Considerations and Circuits for a New Chopper-Stabilized Op Amp

A discussion of circuit, layout and construction considerations for low level DC circuits includes error analysis of solder, wire and connector junctions. Applications include sub-microvolt instru-

mentation and isolation amplifiers, stabilized buffers and comparators and precision data converters.

### AN10 Methods for Measuring Op Amp Settling Time

The AN10 begins with a survey of methods for measuring op amp settling time. This commentary develops into circuits for measuring settling time to 0.0005%. Construction details and results are presented. Appended sections cover oscilloscope overload limitations and amplifier frequency compensation.

### AN11 Designing Linear Circuits for 5V Operation

This note covers the considerations for designing precision linear circuits which must operate from a single 5V supply. Applications include various transducer signal conditioners, instrumentation amplifiers, controllers and isolated data converters.

### AN12 Circuit Techniques for Clock Sources

Circuits for clock sources are presented. Special attention is given to crystal-based designs including TXCOs and VXCOs.

### AN13 High Speed Comparator Techniques

The AN13 is an extensive discussion of the causes and cures of problems in very high speed comparator circuits. A separate applications section presents circuits, including a 0.025% accurate 1Hz to 30MHz V/F converter, a 200ns 0.01% sample-hold and a 10MHz fiber-optic receiver. Five appendices covering related topics complete this note.

### AN14 Designs for High Frequency Voltage-to-Frequency Converters

A variety of high performance V/F circuits is presented. Included are a 1Hz to 100MHz design, a quartz-stabilized type and a 0.0007% linear unit. Other circuits feature 1.5V operation, sine wave output and a nonlinear transfer functions. A separate section examines the trade-offs and advantages of various approaches to V/F conversion.

### AN15 Circuitry for Single Cell Operation

1.5V powered circuits for complex linear functions are detailed. Designs include a V/F converter, a 10-bit A/D, sample-hold amplifiers, a switching regulator and other circuits. Also included is a section of component considerations for 1.5V powered linear circuits.

### AN16 Unique IC Buffer Enhances Op Amp Designs, Tames Fast Amplifiers

This note describes some of the unique IC design techniques incorporated into a fast, monolithic power buffer, the LT1010. Also, some application ideas are described such as capacitive load driving, boosting fast op amp output current and power supply circuits.

### AN17 Consideration for Successive Approximation A/D Converters

A tutorial on SAR type A/D converters, this note contains detailed information on several 12-bit circuits. Comparator, clocking, and preamplifier designs are discussed. A final circuit gives a 12-bit conversion in 1.8 $\mu$ s. Appended sections explain the basic SAR technique and explore D/A considerations.

### AN18 Power Gain Stages for Monolithic Amplifiers

This note presents output state circuits which provide power gain for monolithic amplifiers. The circuits feature voltage gain, current gain, or both. Eleven designs are shown, and performance is summarized. A generalized method for frequency compensation appears in a separate section.

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## AN19 LT1070 Design Manual

This design manual is an extensive discussion of all standard switching configurations for the LT1070; including buck, boost, flyback, forward, inverting and "Cuk." The manual includes comprehensive information on the LT1070, the external components used with it, and complete formulas for calculating component values.

## AN20 Applications for a DC Accurate Lowpass Switched-Capacitor Filter

Discusses the principles of operation of the LTC1062 and helpful hints for its application. Various application circuits are explained in detail with focus on how to cascade two LTC1062s and how to obtain notches. Noise and distortion performance are fully illustrated.

## AN21 Composite Amplifiers

Applications often require an amplifier that has extremely high performance in several areas. For example, high speed and DC precision are often needed. If a single device cannot simultaneously achieve the desired characteristics, a composite amplifier made up of two (or more) devices can be configured to do the job. AN21 shows examples of composite approaches in designs combining speed, precision, low noise and high power.

## AN22 A Monolithic IC for 100MHz RMS/DC Conversion

AN22 details the theoretical and application aspects of the LT1088 thermal RMS/DC converter. The basic theory behind thermal RMS/DC conversion is discussed and design details of the LT1088 are presented. Circuitry for RMS/DC converters, wideband input buffers and heater protection is shown.

## AN23 Micropower Circuits for Signal Conditioning

Low power operation of electronic apparatus has become increasingly desirable. AN23 describes a variety of low power circuits for transducer signal conditioning. Also included are designs for data converters and switching regulators. Three appended sections discuss guidelines for micropower design, strobed power operation and effects of test equipment on micropower circuits.

## AN24 Unique Applications for the LTC1062 Lowpass Filter

Highlights the LTC1062 as a lowpass filter in a phase lock loop. Describes how the loop's bandwidth can be increased and the VCO output jitter reduced when the LTC1062 is the loop filter. Compares it with a passive RC loop filter.

Also discussed is the use of LTC1062 as simple bandpass and bandstop filter.

## AN25 Switching Regulators for Poets

Subtitled "A Gentle Guide for the Trepidatious," this is a tutorial on switching regulator design. The text assumes no switching regulator design experience, contains no equations, and requires no inductor construction to build the circuits described.

Designs detailed include flyback, isolated telecom, off-line, and others. Appended sections cover component considerations, measurement techniques and steps involved in developing a working circuit.

**AN26** A collection of interface applications between various microprocessors/controllers and the LTC1090 family of data acquisition systems. The note is divided into sections specific to each interface. The following sections are available:

Number	A/D	Microprocessor/ Microcontroller
AN26A	LTC1090	8051
AN26B	LTC1090	68HC05
AN26C	LTC1090	63705
AN26D	LTC1090	COP820
AN26E	LTC1090	TMS7742
AN26F	LTC1090	COP402N
AN26G	LTC1091	8051
AN26H	LTC1091	68HC05
AN26I	LTC1091	COP820
AN26J	LTC1091	TMS7742
AN26K	LTC1091	COP402N
AN26L	LTC1091	HD63705VO
AN26M	LTC1090	TMS320C25
AN26N	LTC1091/92	TMS320C25
AN26O	LTC1090	Z-80
AN26P	LTC1090	HD64180
AN26Q	LTC1091	HD64180
AN26R	LTC1094	TMS320C25

These interface notes demonstrate the ease with which the LTC1090 family can be interfaced to microprocessors/controllers having either parallel or serial ports. A complete hardware and software description of the interface is included.

## AN27A A Simple Method of Designing Multiple Order All Pole Bandpass Filters by Cascading 2nd Order Sections

Presents two methods of designing high quality switched-capacitor bandpass filters. Both methods are intended to vastly simplify the mathematics involved in filter design by using tabular methods. The text assumed no filter design experience but allows high quality filters to be implemented by techniques not presented before in the literature. The designs are implemented by numerous examples using devices from LTC's Switched-Capacitor filter family: LTC1060, LTC1061, and LTC1064. Butterworth and Chebyshev bandpass filters are discussed.

## AN28 Thermocouple Measurement

Considerations for thermocouple-based temperature measurement are discussed. A tutorial on temperature sensors summarizes performance of various types, establishing a perspective on thermocouples. Thermocouples are then focused on. Included are sections covering cold-junction compensation, amplifier selection, differential/isolation techniques, protection, and linearization. Complete schematics are given for all circuits. Processor-based linearization is also presented with the necessary software detailed.

## AN29 Some Thoughts on DC/DC Converters

This note examines a wide range of DC/DC converter applications. Single inductor, transformer, and switched-capacitor converter designs are shown. Special topics like low noise, high efficiency, low quiescent current, high voltage, and wide-input voltage range converters are covered. Appended sections explain some fundamental properties of different types of converters.

## AN30 Switching Regulator Circuit Collection

Switching regulators are of universal interest. Linear Technology has made a major effort to address this topic. A catalog of circuits has been compiled so that a design engineer can swiftly determine which converter type is best. This catalog serves as a visual index to be browsed through for a specific or general interest.

- AN31 Linear Circuits for Digital Systems**  
Subtitled "Some Affordable Analogs for Digital Devotees," discusses a number of analog circuits useful in predominantly digital systems.  $V_{PP}$  generators for flash memories receive extensive treatment. Other examples include a current loop transmitter, dropout detectors, power management circuits, and clocks.
- AN32 High Efficiency Linear Regulators**  
Presents circuit techniques permitting high efficiency to be obtained with linear regulation. Particular attention is given to the problem of maintaining high efficiency with widely varying inputs, outputs and loading. Appendix sections review component characteristics and measurement methods.
- AN33 Converting Light to Digits: LTC1099 Half-Flash 8-Bit A/D Converter Digitizes Photodiode Array**  
This application note describes a Linear Technology "Half-Flash" A/D converter, the LTC1099, being connected to a 256 element line scan photodiode array. This technology adapts itself to handheld (i.e., low power) bar code readers, as well as high resolution automated machine inspection applications.
- AN34 LTC1099 Enables PC-Based Data Acquisition Board to Operate DC-20kHz**  
A complete design for a data acquisition card for the IBM PC is detailed in this application note. Additionally, C language code is provided to allow sampling of data at speed of more than 20kHz. The speed limitation is strictly based on the execution speed of the "C" data acquisition loop. A "Turbo" XT can acquire data at speeds greater than 20kHz. Machines with 80286 and 80386 processors can go faster than 20kHz. The computer that was used as a test bed in this application was an XT running at 4.77MHz and therefore all system timing and acquisition time measurements are based on a 4.77MHz clock speed.
- AN35 Step-Down Switching Regulators**  
Discusses the LT1074, an easily applied step-down regulator IC. Basic concepts and circuits are described along with more sophisticated applications. Six appended sections cover LT1074 circuitry detail, inductor and discrete component selection, current measuring techniques, efficiency considerations and other topics.
- AN36** A collection of interface applications between various microprocessors/controllers and the LTC1290 family of data acquisition systems. The note is divided into sections specific to each interface. The following sections are available:

Number	A/D	Microprocessor/ Microcontroller
AN36A	LTC1290	8051
AN36B	LTC1290	MC68HC05
AN36C	LTC1290/LTC1090	TMS370
AN36D	LTC1290	COP820C
AN36E	LTC1290	TMS7742
AN36F	LTC1290	COP402N
AN36O	LTC1290	Z-80
AN36P	LTC1290	HD64180

These interface notes demonstrate the ease with which the LTC1290 can be interfaced to microprocessors/controllers having either parallel or serial ports. A complete hardware and software description of the interface is included.

- AN37 Fast Charge Circuits for NiCad Batteries**  
Safe, fast charging of NiCad batteries is attractive in many applications. This note details simple, thermally-based fast charge circuitry for NiCads. Performance data is summarized and compared to other charging methods.
- AN38 FilterCAD User's Manual, Version 1.00**  
This note is the manual for FCAD, a computer-aided design program for designing filters with LTC's switched-capacitor filter family. FCAD helps users design good filters with a minimum amount of effort. The experienced filter designer can use the program to achieve better results by providing the ability to play "what if" with the values and configuration of various components.
- AN39 Parasitic Capacitance Effects in Step-Up Transformer Design**  
This note explores the causes of the large resonating current spikes on the leading edge of the switch current waveform. These anomalies are exacerbated in very high voltage designs.
- AN40 Take the Mystery Out of the Switched-Capacitor Filter: The System Designer's Filter Compendium**  
This note presents guidelines for circuits utilizing LTC's switched-capacitor filters. The discussion focuses on how to optimize filter performance by optimizing the printed wiring board, the power supply, and the output buffering of the filter. Many additional topics are discussed such as how to select the proper filter response for the application and how to characterize a filter's THD for DSP applications.
- AN41 Questions and Answers on the SPICE Macromodel Library**  
This note provides answers to some of the more common questions concerning LTC's Macromodel Library. Topics include hardware and software requirements, model characteristics, and limitations and interpretation of results.
- AN42 Voltage Reference Circuit Collection**  
A wide variety of voltage reference circuits are detailed in this extensive guidebook of circuits. The detailed schematics cover simple and precision approaches at a variety of power levels. Included are 2 and 3 terminal devices in series and shunt modes for positive and negative polarities. Appended sections cover resistor and capacitor selection and trimming techniques.
- AN43 Bridge Circuits**  
Subtitled "Marrying Gain and Balance," this note covers signal conditioning circuits for various types of bridges. Included are transducer bridges, AC bridges, Wien bridge oscillators, Schottky bridges, and others. Special attention is given to amplifier selection criteria. Appended sections cover strain gauge transducers, understanding distortion measurements, and historical perspectives on bridge readout mechanisms and Wein bridge oscillators.
- AN44 LT1074/LT1076 Design Manual**  
This note discusses the use of the LT1074 and LT1076 high efficiency switching regulators. These regulators are specifically designed for ease of use. This application note is intended to eliminate the most common errors that customers make when using switching regulators as well as offering insight into the inner workings of switching designs. There is an entirely new treatment of inductor design based upon simple mathematical formulas that yield direct results. There are extensive tutorial sections devoted to the care and feeding of the Positive Step-Down (Buck) Converter, the Tapped Inductor Buck Converter, the Positive-to-Negative Converter and the Negative Boost Converter. Additionally, many troubleshooting hints are included as well as oscilloscope techniques,

soft-start architectures, and micropower shutdown and EMI suppression methods.

## **AN45 Measurement and Control Circuit Collection**

A variety of measurement and control circuits are included in this application note. Eighteen circuits, including ultra-low noise amplifiers, current sources, transducer signal conditioners, oscillators, data converters and power supplies are presented. The circuits emphasize precision specifications with relatively simple configurations.

## **AN46 Efficiency Characteristics of Switching Regulator Circuits**

Efficiency varies for different DC/DC converters. This application note compares the efficiency characteristics of some of the more popular types. Step-up, step-down, flyback, negative-to-positive, and positive-to-negative are shown. Appended sections discuss how to select the proper aluminum electrolytic capacitor and explain power switch and output diode loss calculations.

## **AN47 High Speed Amplifier Techniques**

This application note, subtitled "A Designer's Companion for Wideband Circuitry," is intended as a reference source for designing with fast amplifiers. Approximately 150 pages and 300 figures cover frequently encountered problems and their possible causes. Circuits include a wide range of amplifiers, filters, oscillators, data converters and signal conditioners. Eleven appended sections discuss related topics including oscilloscopes, probe selection, measurement and equipment considerations, and breadboarding techniques.

## **AN48 Using the LTC Op Amp Macromodels**

LTC's op amp macromodels are described in detail, along with the theory behind each model and complete schematics of each topology. Extended modeling topics are discussed, such as phase/frequency response modifications and asymmetric slew rate for JFET op amp models. LTC's macromodels are optimized for accuracy and fast simulation times. Simulation times can be further reduced by using streamlining techniques found throughout AN48.

## **AN49 Illumination Circuitry for Liquid Crystal Displays**

Current generation portable computers and instruments utilize backlit liquid crystal displays. The back light requires a highly efficient, high voltage AC source as well as other supply circuitry. AN49 details these circuits and also includes sections on efficiency measurements and instrumentation considerations. A separate section discusses physical and layout considerations for the display.

## **AN50 Interfacing to Microprocessor Based 5V Systems**

This application note discusses a variety of approaches for interfacing analog signals to 5V powered systems. Synthesizing a "rail-to-rail" op amp and scaling techniques for A/D converters are covered. A voltage-to-frequency converter, applicable where high resolution is required, is also presented.

## **AN51 Power Conditioning for Notebook and Palmtop Systems**

Notebook and palmtop systems need a number of voltages developed from a battery. Competitive solutions require small size, high efficiency and light weight. This publication includes circuits for high efficiency 5V and 3.3V switching and linear regulators, back light display drivers and battery chargers. All the circuits are specifically tailored for the requirements outlined above.

## **AN52 Linear Technology Magazine Circuit Collection, Vol 1**

This application note consolidates the circuits from the first few years of Linear Technology Magazine into one publication. Pre-

sented in the note are a variety of circuits ranging from a 50W high efficiency (>90%) switching regulator to steep roll-off filter circuits with low distortion to 12-bit differential temperature measurement systems.

## **AN53 Micropower High-Side MOSFET Drivers**

This application note describes the operation of high-side N-channel MOSFET switch drivers designed specifically for operation in battery-powered equipment, such as notebook and palmtop computers and portable medical instruments. A selection guide simplifies the proper choice of MOSFET and driver for a particular high-side switch application. Circuits to drive and protect load impedances ranging from large inductors to large capacitors are described and a section on surface mount and copper clad shunts is included.

## **AN54 Power Conversion from Milliamps to Amps at Ultra High Efficiency (Up to 95%)**

This application note discusses the use of the LTC1147, LTC1148, and LTC1149 ultra high efficiency switching regulators in a wide variety of applications. These controllers feature a current-mode architecture which includes an automatic low current operating mode called Burst Mode™ operation, making greater than 90% efficiencies possible at output currents as low as 10mA. This feature maximizes battery life while a product is in sleep or standby modes. In addition, the LTC1148 and LTC1149 are synchronous switching regulators which achieve high efficiency conversion from 10mA to 10A.

## **AN55 Techniques for 92% Efficient LCD Illumination**

This publication details several LCD backlight circuits which feature 92% efficiency. Other benefits include low voltage operation, synchronizing capability, higher output power for color displays, and extended dimming range. Extensive coverage of practical issues includes lay out problems, multi-lamp displays, safety and reliability concerns and efficiency and photometric measurements. Also included is a review of circuits which did not work along with appropriate commentary.

## **AN56 "Better Than Bessel" Linear Phase Filters for Data Communications**

The pace of the world of digital communications is increasing at a tremendous rate. Each day the engineer is requested to compact more data in the same channel bandwidth with closer channel spacing. This application note discusses some of the requirements and techniques for using the new LTC1064/1164 and LTC1264-7 filters which were designed specifically for digital communications. The terms "channel bandwidth," "eye diagrams" and "linear phase" filtering are discussed without the need for the "engineering speak" which permeates many textbook explanations of the same subjects.

## **AN57 Video Circuit Collection**

AN57, the Video Circuit Collection, features a variety of video circuits designed at LTC. The LT1204 70MHz multiplexer is featured in a number of circuits which require excellent video isolation from channel to channel. High speed voltage and current feedback amplifiers are highlighted throughout the section on video processing circuits. There is a section on applying Current Feedback Amplifiers (CFAs) and a number of articles taken from the Linear Technology Magazine.

**AN58 5V to 3.3V Converters for Microprocessor Systems**

Many popular microprocessors operate from 3.3V supplies, yet they are used in systems where the predominate source of power is 5V. AN58 presents a collection of both linear and switching regulator solutions for conversion of 5V to 3.3V at currents ranging from 100mA to 20A. Applications information and a comparison of various bypass capacitor types is included. Most of the designs can be easily modified for other intermediate voltages such as 3.45V, 3.7V, and 4.1V.

**AN59 Applications of the LT1300 and LT1301 Micropower DC/DC Converters**

This note covers operation and applications of the LT1300 and LT1301 high efficiency micropower step-up DC/DC converter ICs. Internal operation of the ICs is described in detail. A variety of applications are presented, ranging from straightforward 2-cell to 5V converters and 5V to 12V converters to exotic transducer-based circuits such as flame detectors and CCFL drivers. Converters from both 2-cell and 4-cell inputs are included. Operating hours at various load currents are presented and relative merits of different battery types are discussed.

**AN60 PCMCIA Card and Card Socket Power Management**

Most portable systems have expansion sockets conforming to the standards set by the Personal Computer Memory Card International Association (PCMCIA). This standard requires the host to perform an unusual amount of switching on both the  $V_{CC}$  and  $V_{PP}$  voltage lines. Card designers face difficult power management and DC/DC conversion issues of their own. Board real estate and component height are at a premium making design difficult and component selection critical. This application note discusses in detail both the host and card designer issues and highlights several new products designed specifically for these applications.

**AN61 Practical Circuitry for Measurement and Control Problems**

This collection of circuits was worked out between June 1991 and July of 1994. Most were designed at customer request or are derivatives of such efforts. Types of circuits include power converters, transducer signal conditioners, amplifiers and signal generators. Specific circuits include low noise amplifiers, high power single cell DC/DC converters, portable high accuracy barometers, a 10mHz 1% accuracy RMS/DC converter, and random noise generators. Appended sections cover noise theory and present a historical perspective of wideband amplifiers.

**AN62 Data Acquisition Circuit Collection**

This application note presents a wide variety of data acquisition circuits. The detailed circuit schematics cover 8-, 10-, and 12-bit ADC and DAC applications, serial and parallel digital interfaces, battery monitoring, temperature sensing, isolated interfaces, and connections to various popular microprocessors and microcontrollers. An appendix covers suggested voltage references.

**AN63 Power Supply Modules for the P54C-VR Pentium® Microprocessor**

This application note describes the design of both linear and switching regulators which provide power for 90MHz Pentium processors. The circuits are intended to comply with Intel's modular power supply specification and provide sufficient power for cache RAM and chip sets in addition to the CPU. They are also capable of providing the additional power required by an upgrade "overdrive" processor.

Burst Mode is a trademark of Linear Technology Corporation.  
Pentium is a registered trademark of Intel Corporation.

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New 500ksps and 600ksps ADCs Match Needs of High Speed Applications

## DESIGN NOTE 89

Applications of the LT1366 Rail-to-Rail Amplifier

## DESIGN NOTE 90

High Efficiency Power Sources for Pentium™ Processors

## DESIGN NOTE 91

5V to 3.3V Circuit Collection

## DESIGN NOTE 92

An Adjustable Video Cable Equalizer Using the LT1256

## DESIGN NOTE 93

PCMCIA Socket Voltage Switching (Why Your Portable System Needs SafeSlot™ Protection)

## DESIGN NOTE 94

Interfacing to V.35 Networks

## DESIGN NOTE 95

Capacitor and EMI Considerations for New High Frequency Switching Regulators

## DESIGN NOTE 96

LTC1451/52/53: 12-Bit Rail-to-Rail Micropower DACs in an SO-8

## DESIGN NOTE 97

Flash Memory VPP Generator Reference Designs

## DESIGN NOTE 98

Highly Integrated High Efficiency DC/DC Conversion

## DESIGN NOTE 99

LT1182 Floating CCFL with Dual Polarity Contrast

## DESIGN NOTE 100

Dual Output Regulator Uses Only One Inductor

## DESIGN NOTE 101

A Precision Wideband Current Probe for LCD Backlight Measurement

## DESIGN NOTE 102

RS485 Transceivers Reduce Power and EMI

## DESIGN NOTE 103

New LTC1266 Switching Regulator Provides High Efficiency at 10A Loads

## DESIGN NOTE 104

LTC1410: 1.25Msps 12-Bit A/D Converter Cuts Power Dissipation and Size

## DESIGN NOTE 105

LTC1265: A New, High Efficiency Monolithic Buck Converter

## DESIGN NOTE 106

The LTC1392: Temperature and Voltage Measurement in a Single Chip

## DESIGN NOTE 107

C-Load™ Op Amps Conquer Instabilities

## DESIGN NOTE 108

250kHz, 1mA IQ Constant Frequency Switcher Tames Portable Systems Power

## DESIGN NOTE 109

Micropower Buck/Boost Circuits, Part 1: Converting Three Cells to 3.3V

## DESIGN NOTE 110

Micropower Buck/Boost Circuits, Part 2: Converting Four Cells to 5V

## DESIGN NOTE 111

LT1510 High Efficiency Lithium-Ion Battery Charger

## DESIGN NOTE 112

LTC1390: A Versatile 8-Channel Multiplexer

## DESIGN NOTE 113

Big Power for Big Processors: The LTC1430 Synchronous Regulator

## DESIGN NOTE 114

The LTC1267 Dual Switching Regulator Controller Operates from High Input Voltages

## DESIGN NOTE 115

Create a Virtual Ground with the LT1118-2.5 Sink/Source Voltage Regulator

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LocalTalk is a registered trademark of Apple Computer, Inc.

# DESIGN TOOLS

## Applications on Disk

### NOISE DISK

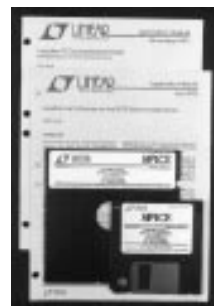
This IBM-PC (or compatible) program allows the user to calculate circuit noise using LTC op amps, determine the best LTC op amp for a low noise application, display the noise data for LTC op amps, calculate resistor noise, and calculate noise using specs for any op amp.



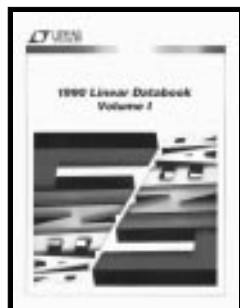
### SPICE MACROMODEL DISK

This IBM-PC (or compatible) high density diskette contains the library of LTC op amp SPICE macromodels. The models can be used with any version of SPICE for general analog circuit simulations. The diskette also contains working circuit examples using the models, and a demonstration copy of PSpice™ by MicroSim. Also included are Application Notes 41 and 48 which describe the macromodels.

PSpice is a trademark of MicroSim Corporation.



## Technical Publications



### 1990 Linear Databook, Vol I —

This 1440 page collection of data sheets covers op amps, voltage regulators, references, comparators, filters, PWMs, data conversion and interface products (bipolar and CMOS), in both commercial and military grades. The catalog features well over 300 devices.

\$10.00

**\$10.00**

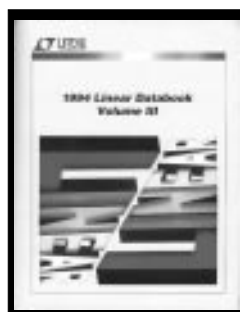


### 1992 Linear Databook Supplement (will become the 1992 Linear Databook, Vol II)

— This 1248 page supplement to the 1990 Linear Databook is a collection of all products introduced in 1991 and 1992. The catalog contains full data sheets for over 140 devices.

The 1992 Linear Databook Supplement is a companion to the 1990 Linear Databook, which should not be discarded. \$10.00

**\$10.00**



### 1994 Linear Databook, Vol III —

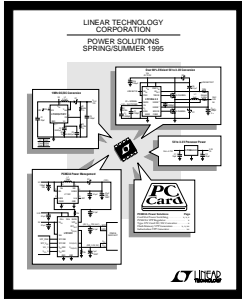
This 1826 page supplement to the 1990 and 1992 Linear Databooks is a collection of all products introduced since 1992. A total of 152 product data sheets are included with updated selection guides. The 1994 Linear Databook Vol III is a companion to the 1990 and 1992 Linear Databooks, which should not be discarded. \$10.00

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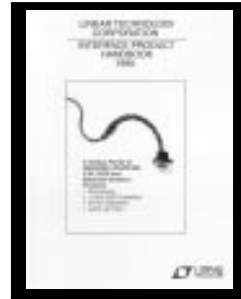


## Technical Publications



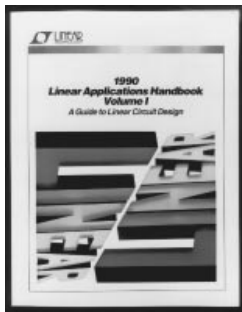
### **Power Solutions Brochure —**

This 64 page collection of circuits contains real-life solutions for common power supply design problems. There are over 45 circuits, including descriptions, graphs and performance specifications. Topics covered include PCMCIA power management, microprocessor power supplies, portable equipment power supplies, micropower DC/DC, step-up and step-down switching regulators, off-line switching regulators, linear regulators and switched capacitor conversion.



### **Interface Product Handbook —**

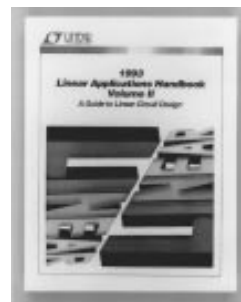
This 424 page handbook features LTC's complete line of line driver and receiver products for RS232, RS485, RS423, RS422, V.35 and AppleTalk applications. Linear's particular expertise in this area involves low power consumption, high numbers of drivers and receivers in one package, mixed RS232 and RS485 devices, 10kV ESD protection of RS232 devices and surface mount packages.



**\$20.00**

### **1990 Linear Applications Handbook • Volume I —**

928 pages full of application ideas covered in depth by 40 Application Notes and 33 Design Notes. This catalog covers a broad range of "real world" linear circuitry. In addition to detailed, systems-oriented circuits, this handbook contains broad tutorial content together with liberal use of schematics and scope photography. A special feature in this edition includes a 22-page section on SPICE macromodels. \$20.00



**\$20.00**

### **1993 Linear Applications Handbook • Volume II —**

Continues the stream of "real world" linear circuitry initiated by the 1990 Handbook. Similar in scope to the 1990 edition, the new book covers Application Notes 40 through 54 and Design Notes 33 through 69. Additionally, references and articles from non-LTC publications that we have found useful are also included. \$20.00



**\$20.00**

### **SwitcherCAD Handbook —**

This 144 page manual, including disk, guides the user through SwitcherCAD — a powerful PC software tool which aids in the design and optimization of switching regulators. The program can cut days off the design cycle by selecting topologies, calculating operating points and specifying component values and manufacturer's part numbers. \$20.00

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