Thermal and Power Management

August 2003 THE ANALOG DEVICES SOLUTIONS BULLETIN

IN THIS ISSUE

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All prices in this bulletin are in USD in quantities greater than 1,000 (unless otherwise noted), recommended lowest grade resale, FOB U.S.A.

ANALOG DEVICES

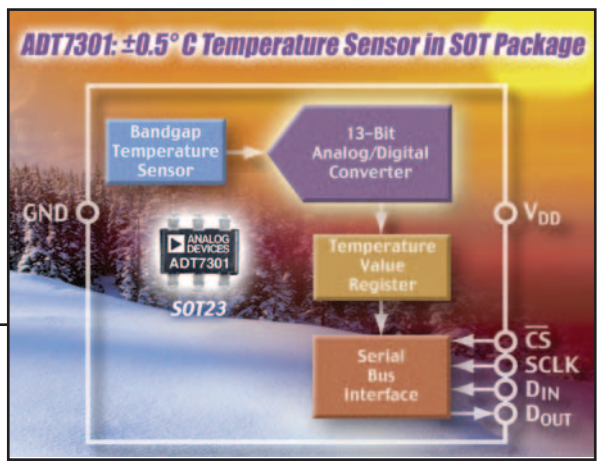
Among Small Footprint Temperature Sensors Stands One Giant in Accuracy

±0.5°C from 0°C to 70°C

The complexity of today's printed circuit boards is ever increasing, driven principally by shrinking board space. This makes heating problems more serious, and, as a result, designers are beginning to realize that temperature is a major factor that cannot be neglected.

Traditional temperature sensing solutions included thermistors, RTDs, and thermocouples—favored for their space and power saving features, high accuracy, and wide temperature range. Today advances in silicon IC technology offer designers alternative solutions. The latest digital temperature sensor from Analog Devices is a perfect example of this advanced IC technology. The ADT7301 offers the high accuracy, wide temperature range, and value demanded of even the hottest applications.

The ADT7301 is an accurate, 13-bit digital temperature sensor specified to ±0.5°C from 0°C to 70°C. It operates from a 2.7 V to 5.5 V supply and is fully specified up to 150°C. With its high accuracy, low power consumption, and small package options (6-lead SOT-23 and 8-lead MSOP), it is easy to see why the ADT7301 has become the temperature sensor of choice for everything from high precision medical equipment to portable and battery-powered applications. This is just one of several ADI temperature sensors that come in SOT-23 packaging.



Part Number	Interface	Accuracy (°C)	Temperature Range (°C)	Supply (V)	Package	Price ($U.S.)
ADT7301	SPI	±0.5	–40 to +150	2.7 to 5.5	SOT-23	1.20
AD7814	SPI	±2	–40 to +85	2.7 to 5.5	SOT-23	0.90
AD7816	SPI	±2	–40 to +125	2.7 to 5.5	SOT-23	1.30
AD7314	SPI	±2	–35 to +85	2.35 to 3.3	SOT-23	0.59
AD7414	I²C®	±1.5	–40 to +125	2.7 to 5.5	SOT-23	0.93
AD7416	I²C	±2	–40 to +125	2.7 to 5.5	SOT-23	0.90

Visit our website for samples, data sheets, and additional product information.
www.analog.com/bulletins/thermal-power

They're Super, They're Small, and They're Simple

Ever designed and laid out a board and realized at the last minute that you needed to measure temperature in a certain location? Would you like to use as many temperature sensors on a board as possible, but due to cost and space constraints you have to settle for too few?

Solution

The TMP05 and TMP06 aren't just small—they're tiny. They are the world's smallest digital temperature sensors and are housed in a 5-lead SC70 package that takes up nearly 50% less board space than a SOT-23 package requires. They are accurate to ±1°C from 0°C to 70°C and operate at up to 150°C. These pulsewidth modulation (PWM) temperature sensors output a waveform that contains the temperature information in the duty cycle, the square wave of which is proportional to the absolute temperature. The single-wire interface makes it simple to interface with any microcontroller. The sensors offer a daisy-chain mode of operation, which allows the user to connect an infinite number of TMP05 and TMP06 sensors in a single-wire chain. Last but not least, they offer all these advantages at a competitive price (from $0.74 to $0.95, depending on grade).

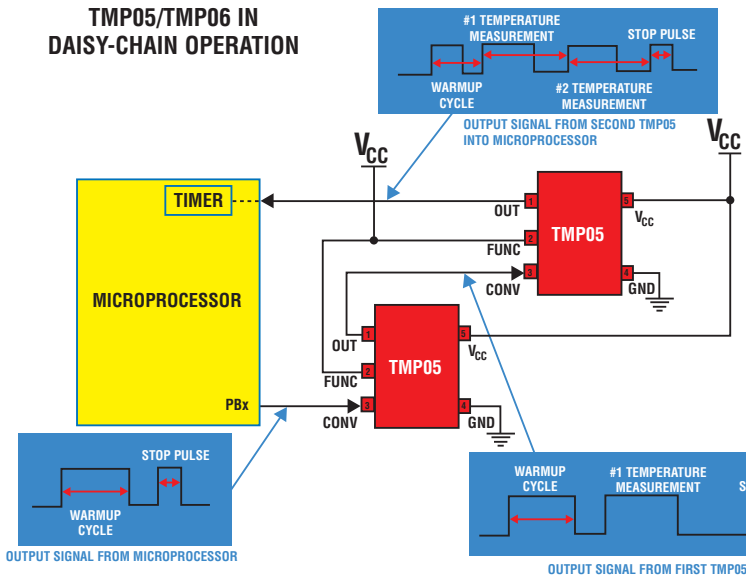
- 5-lead SC70 package
- ±1°C accuracy from 0°C to 70°C
- –40°C to +150°C temperature range
- CMOS/TTL output on TMP05; open drain on TMP06

APPLICATIONS

- Portable
- Consumer
- Medical
- Industrial
- Instrumentation

TMP05 Price $0.74
TMP06 Price $0.74

TMP05/TMP06 IN DAISY-CHAIN OPERATION

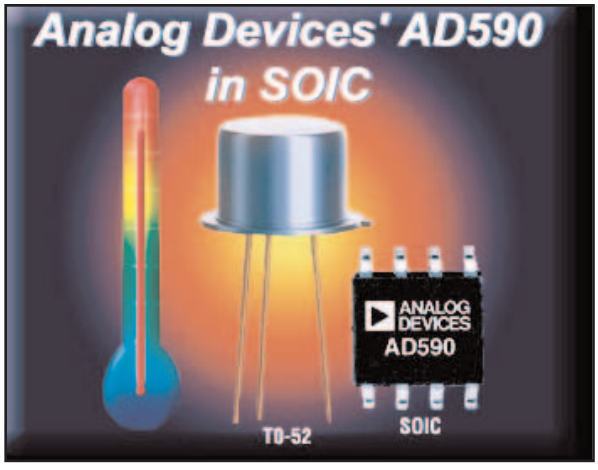


A Classic Dressed Up in a New Package—AD590 in 8-Lead SOIC

Solution

Analog Devices' widely used AD590 temperature sensor is now available in a modern 8-lead SOIC package, in addition to its original metal can (TO-52) and flatpack packages. Introduced in 1975, the AD590 has retained its popularity because of its accuracy, stability, and low noise—as well as its immunity to line voltage drops, which is particularly useful in remote sensing applications.

The AD590 is an integrated circuit temperature transducer that produces an output current proportional to absolute temperature over a broad temperature range (–55°C to +150°C). For supply voltages between 4 V and 30 V, the device acts as a high impedance, constant-current regulator passing 1 µA/K. Laser trimming is used to calibrate the device to 298.2 µA output at 298.2 K (25°C).



AD590 in SOIC Price $1.50
AD590 in TO-52 Price $3.47

ANALOG DEVICES

Visit our website for samples, data sheets, and additional product information.

Core Ambient and Remote Temperature Measurement, Plus High Performance ADCs and DACs

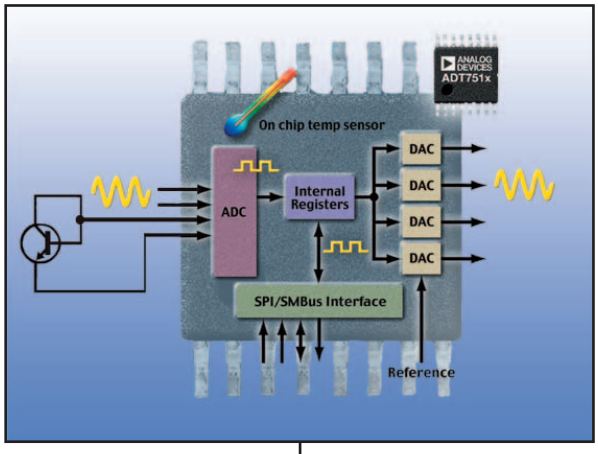
Do you need to monitor temperature in your system? Are you also monitoring different voltage levels? Do you need to turn on a relay, drive fans, and so on? If so, why not take a look at our new family of integrated temperature sensors, ADCs, and DACs? This family of temperature sensors offers all these solutions with closed-loop control in a single 16-lead QSOP.

Solution

The ADT7516/ADT7517/ADT7518 combine a 10-bit temperature-to-digital converter, 4-channel ADCs, and 12-, 10-, and 8-bit quad voltage output DACs. They feature temperature monitoring that allows local and remote temperature monitoring to be read in either digital or voltage format. These highly integrated parts are compatible with SPI® and SMBus interfaces. They operate from 2.7 V to 5.5 V over a broad temperature range: –40°C to +125°C.

A sister family provides the ADT7316/ADT7317/ADT7318 ICs. Each part combines a 10-bit digital temperature sensor with 12-, 10-, or 8-bit quad voltage output DAC. The parts provide a very flexible serial interface with both a 4-wire SPI compatible interface and a 2-wire I²C/SMBus interface, operate over broad temperature range (–40°C to +120°C), and are fully operational over 2.7 V to 5.5 V supplies.

For environmental monitoring, process control, temperature measuring, and a host of other applications, the ADT7411 offers both local and remote temperature monitoring with up to eight analog input channels. It is SPI and I²C compatible and comes in a 16-lead QSOP.



Part Number	ADC	DAC	Local and Remote Temperature Monitoring	Output	Temperature Error (Typ)	Temperature Range	Supply V/I @ 25°C (V)	Price ($U.S.)
ADT7516	10-Bit 4-Channel	12-Bit Quad	Yes	SMBus/SPI	±2°C, 0°C to +85°C	–40°C to +120°C	2.7 to 5.5/2.2 mA	6.95
ADT7517	10-Bit 4-Channel	10-Bit Quad	Yes	SMBus/SPI	±2°C, 0°C to +85°C	–40°C to +120°C	2.7 to 5.5/2.2 mA	4.35
ADT7518	10-Bit 4-Channel	8-Bit Quad	Yes	SMBus/SPI	±2°C, 0°C to +85°C	–40°C to +120°C	2.7 to 5.5/2.2 mA	3.20
ADT7411	10-Bit 8-Channel	N/A	Yes	SMBus/SPI	±2°C, 0°C to +85°C	–40°C to +120°C	2.7 to 5.5/2.2 mA	1.99
ADT7316	N/A	12-Bit Quad	Yes	SMBus/SPI	±2°C, 0°C to +85°C	–40°C to +120°C	2.7 to 5.5/2.2 mA	5.80
ADT7317	N/A	10-Bit Quad	Yes	SMBus/SPI	±2°C, 0°C to +85°C	–40°C to +120°C	2.7 to 5.5/2.2 mA	3.15
ADT7318	N/A	8-Bit Quad	Yes	SMBus/SPI	±2°C, 0°C to +85°C	–40°C to +120°C	2.7 to 5.5/2.2 mA	2.00

All are packaged in a 16-lead QSOP.

Sizzling Innovation Makes This Collection the Industry's Coolest Digital Temperature Sensors

DIGITAL OUTPUT

SPI

Local

AD7314 AD7816
AD7814 ADT7301

Local with ADC

AD7817: 4-Channel
AD7818: 1-Channel

I²C/SMBus

Local and Remote

AD7414 ADM1032
AD7415 ADM1023
AD7416 ADM1021A
ADT7461

Local and Remote with ADC

AD7417: 4-Channel
AD7418: 1-Channel
ADM1025

Local and Remote with Fan Control

PWM	DAC
ADM1030/ADM1031	ADM1022
ADM1033/ADM1034	ADM1028

Local and Remote with Fan Control,DAC, and ADC

ADM1024
ADM1026
ADM1029
ADT7460/ADT7463

SPI and I²C/SMBus

Local and Remote with ADC

ADT7411: 8-Channel ADC

Local and Remote with DAC

ADT7316/ADT7317/
ADT7318: Quad DAC

Local and Remote with DAC and ADC

ADT7516/ADT7517/
ADT7518: Quad DAC
and 4-Channel ADC

1-Wire

Local

TMP05 TMP06
TMP03 TMP04

Set-and-Forget

Local and Remote with Fan Control

ADT7550

Whether you're designing industrial equipment, PCs, medical devices, portable electronics, or home appliances, you'll find that ADI provides the right temperature sensor to meet even the most demanding specifications. To view our complete portfolio of more than 50 sensors for all temperatures and applications, please visit *www.analog.com/temp-sensors*.

For Your Toughest Thermal Challenges, Look to ADI's Portfolio of System Management Tools

Analog Devices has the broadest range of thermal and system management solutions to meet form factors ranging from the smallest hand-held PDAs to room size, rack mounted communications or industrial systems. Our portfolio of products ranges from the smallest, lowest cost precision temperature sensors to the most integrated temperature sensors with a high level of system management features. As a system level manufacturer, you look for one supplier that can provide solutions to meet the spectrum of applications, from measuring a single thermal zone detecting an overtemperature condition to highly integrated, processor based thermal solutions measuring several thermal zones and simultaneously controlling fan speed and/or automatically compensating thermal drift.

Identify which ADI solutions best serve your needs by using the chart below.

INCREASING LEVELS OF FUNCTIONALITY

SYSTEM MANAGEMENT TOOLS PARTS AND SPECIFICATIONS

Additive Feature Set	Application	Part Number	Interface	Temperature Accuracy	Temperature Range	Supply V/I @ 25°C	Packages	Features	Price ($U.S.)
Local Temperature Sensor with Serial Output	One Thermal Zone	ADT7301	SPI	±0.5	–40°C to +150°C	2.7 to 5.5	SOT-23	Most Accurate SOT-23 12-Bit Temperature-to-Digital Converter Available	1.20
		AD7414	I²C/SMBus	±1.5°C, –40°C to +70°C	–40°C to +85°C	2.7 V to 5.5 V/ 0.1 mA	SOT-23-6, MSOP-8	10-Bit Temperature Sensor, Supports SMBus Alert Function	0.93
		AD7415	I²C/SMBus	±1.5°C, –40°C to +70°C	–40°C to +85°C	2.7 V to 5.5 V/ 0.1 mA	SOT-23-5	Same as AD7414 without SMBus Alert	0.93
		AD7314	SPI	±2°C, –35°C to +85°C	–35°C to +85°C	2.65 V to 3.3 V/1 mA	MSOP-8	10-Bit Temperature Sensor, Low Voltage	0.59
		TMP05	PWM/1-Wire	±2°C, 0°C to +70°C	–40°C to +150°C	2.7 V to 5.5 V/ 0.5 mA	SOT-23-5, SC70-5	Pulsewidth Modulation Output, Smallest Temperature Sensor Available	0.95
Remote/ Multichannel Remote Temperature Sensor	Up to Three Thermal Zones, *dB*COOL	ADM1028	I²C/SMBus	±2°C, 60°C to 100°C	0°C to 100°C	3.3 V to 5 V/3.2 mA	QSOP-16	1-Channel TDM + Linear Fan Control	3.40
		ADT7460	I²C/SMBus	±3°C, 0°C to 100°C	0°C to 100°C	3.3 V to 5 V/3 mA	QSOP-16	±1°C, Dual-Channel, Remote TDM + PWM Automatic Fan Control	2.80
		ADT7461	I²C/SMBus	±1°C, 60°C to 100°C	–40°C to +150°C	3 V to 5 V/170 mA	SO-8, MSOP-8	Wide Temperature Range Autocalibration of Thermal Offset	1.75
Multichannel Voltage Measurement (ADC)	Voltage Monitoring with Programmable Upper/Lower Limit Windowing	ADT7411	SMBus/SPI	±1.5°C, +85°C	–40°C to +120°C	2.7 V to 5.5 V/ 2.2 mA	QSOP-16	10-Bit, 8-Channel ADC with Local and Remote Temperature Monitoring	1.30
		ADM1025A	I²C/SMBus	±3°C, 0°C to 100°C	0°C to 100°C	3.0 V to 5.5 V/ 1.4 mA	QSOP-16	1-Channel Thermal Diode Monitor + 6 V Inputs	3.50
Multichannel Voltage Output (DAC or PWM) for Fan or Setpoint Control with Fan Tachometer	Monitoring and Control, Voltages, Fans, *dB*COOL	ADT7516/ ADT7517/ ADT7518	SMBus/SPI	±3°C, 0°C to 85°C	–40°C to +120°C	2.7 V to 5.5 V/ 2.2 mA	QSOP-16	12-/10-/8-Bit Quad DAC, 10-Bit, 4-Channel ADC, Local and Remote Temperature Monitoring	6.95/ 4.35/ 3.20
		ADT7316/ ADT7317/ ADT7318	SMBus/SPI	±3°C, 0°C to 85°C	–40°C to +120°C	2.7 V to 5.5 V/ 2.2 mA	QSOP-16	12-/10-/8-Bit Quad DAC, 10-Bit, 4-Channel ADC, Local and Remote Temperature Monitoring	6.95/ 4.35/ 3.20
		ADT7463	I²C/SMBus	±3°C, 0°C to 100°C	0°C to 100°C	3.3 V to 5 V/2.5 mA	QSOP-24	Complete Systems Monitor and Multiple Fan Controller	4.25
EEPROM (Up to 8 KB), GPIO, and Power-on-Reset	Stores System Configuration Status or Variables, GPIO Always Needed, POR for Hard System Reset	ADM1026	I²C/SMBus	±3°C, 0°C to 100°C	0°C to 100°C	3.3 V to 5 V/2.5 mA	LQFP-48	Highly Integrated Thermal and System Monitor	4.95

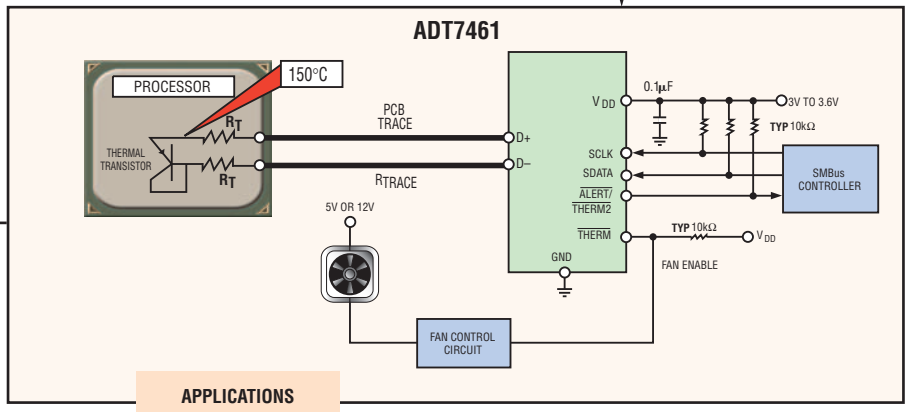
Dual-Channel Temperature Sensor Features Wide Temperature Range and Automatic Thermal Offset Calibration

Today's processors, and in particular graphics processors, are manufactured using fine line wafer fabrication processes and have millions of transistors packed closely together. This makes for an environment that gets extremely hot very quickly. The latest generation of graphics processors requires an extended temperature measurement range up to 150°C, but standard temperature monitors can only measure to 120°C. Thermal offset due to resistance in series with the temperature monitor and the thermal diode gives rise to errors in temperature measurement. The series resistance can be a combination of board trace resistance, package/lead resistance, and resistance between the IC bond pad and the thermal diode device.

Solution

The ADT7461 is a ±1°C accurate remote temperature monitor with a serial interface, capable of measuring temperatures on a remote thermal diode to +150°C and beyond. It also has an on-chip temperature sensor for measuring ambient temperature. The ADT7461 has an extended temperature range, giving the user more flexibility to run the processor at a higher temperature while still getting ±1°C accuracy and ensuring that any cooling system can be triggered correctly.

The device also can automatically cancel resistances seen in series with the thermal diode. This series resistance cancellation (SRC) feature eliminates offset errors in temperature measurement with no need for characterization of the resistance by the user. The part typically can cancel 1 kΩ of series resistance. It also has two interrupt outputs that can be used to implement a cooling system. An $\overline{\text{ALERT}}$ output signals when the on-chip or remote temperature is out of range and can be used as an SMBus $\overline{\text{ALERT}}$. A $\overline{\text{THERM}}$ output is a comparator output, and the interrupt pins can be used for CPU throttling or on/off control of a fan.

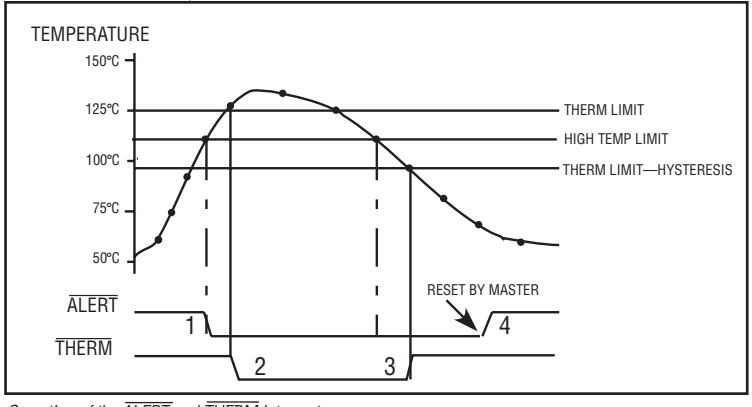


ADT7461

Price $1.75

APPLICATIONS

- CPU and graphics processor thermal monitoring
- Communications systems
- Notebooks
- Desktop computers
- Consumer



Operation of the $\overline{\text{ALERT}}$ and $\overline{\text{THERM}}$ interrupts

Features

- Extended temperature measurement range up to 150°C
- Cancels temperature dependent offsets using SRC
- ±1°C accuracy on the external temperature channel
- Configurable $\overline{\text{ALERT}}$ output and $\overline{\text{THERM}}$ output
- Pin compatible with the ADM1032
- SMBus interface
- 8-lead SOIC or MSOP

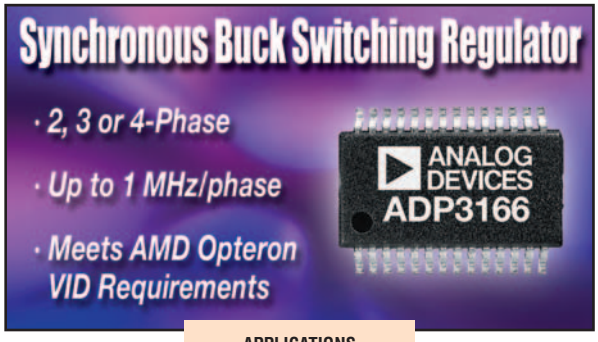
New Multiphase, Synchronous Buck Switching Regulators for Highly Efficient Power Management for Microprocessors

ADP3166 Features Selectable 2-, 3-, or 4-Phase Operation at Up to 1 MHz Per Phase

High performance microprocessors, such as the newest releases from AMD™, require the conversion of a 12 V main supply into the core supply voltage. The ADP3166 is a highly efficient, multiphase, synchronous buck switching regulator controller optimized not only for high performance microprocessors but also for voltage regulator modules (VRMs) and desktop PC power supplies.

The ADP3166 uses an internal 5-bit programmable DAC to read a voltage identification (VID) code directly from the processor, which is used to set the output voltage between 0.8 V and 1.55 V. The ADP3166 also contains a current-mode PWM architecture to drive the logic level outputs at a programmable switching frequency that can be optimized for VRM size and efficiency. The phase relationship of the output signals can be programmed to provide 2-, 3-, or 4-phase operation, at up to 1 MHz per phase, allowing for the construction of as many as four complementary buck switching stages.

The ADP3166 buck switching regulator is available in a 28-lead TSSOP (thin shrink small outline package) and is specified over the commercial temperature range of 0°C to 85°C.



ADP3166

APPLICATIONS
- Desktop PC power supplies
- Next-generation AMD processors
- VRM modules

Price $1.19

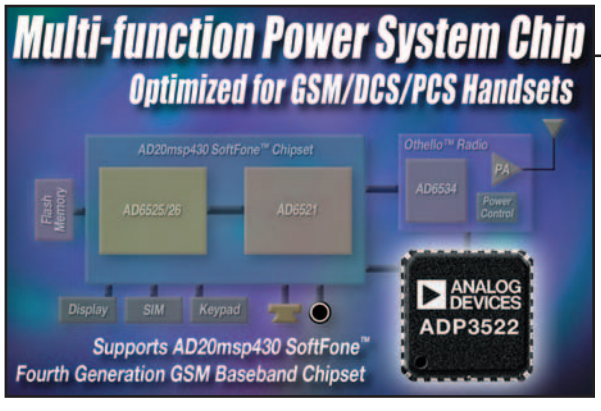
Features
- Selectable 2-, 3-, or 4-phase operation at up to 1 MHz per phase
- Differential sensing error of ±1% over temperature
- Logic-level PWM outputs for interface to external high power drivers

Power Management Chip Optimizes Battery Life and System Performance in GSM, GPRS Applications

ADP3522 Combines Charging Logic, System Protection Modes in One Cost and Space Saving Package

Integrating a number of power management functions traditionally performed by discrete components, the ADP3522 opens new possibilities for next-generation GSM (global system for mobile communications) and GPRS (general packet radio services) handset designs. The ADP3522 includes six low-dropout (LDO) power regulators for key GSM function blocks—core, analog, crystal oscillator, memory, real-time clock (RTC), and subscriber identification module. Additional features include a keypad interface, RTC alarm, reset generator, and buffered precision voltage reference.

The ADP3522 is housed in a 5 mm × 5 mm 32-lead lead frame chip scale package (LFCSP) that offers enhanced thermal conductivity with a smaller footprint and handles increased power dissipation without overheating the integrated circuit.



ADP3522

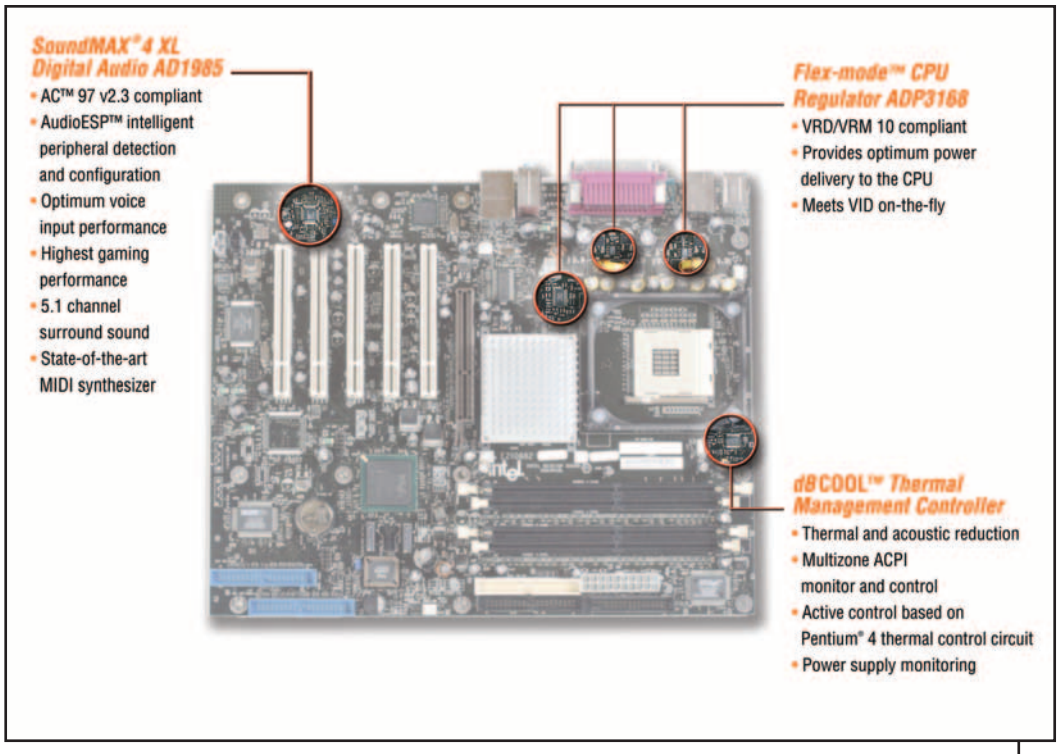
Price $3.55

Features
- Handles all GSM baseband power management
- Six LDOs optimized for specific GSM subsystems
- Li-ion battery charge function
- Reduced package size: 5 mm × 5 mm LFCSP-32

The ADP3522 is optimized for use with Analog Devices' AD6535 Othello One® and AD20msp430 SoftFone® GSM/GPRS cellular phone chipsets.

Our Commitment to Innovation is Evident on Today's Most Advanced Motherboards

Leading manufacturers of PC motherboards understand the requirements of designing a high performance, feature-rich product at a price people can afford. That's why many turn to a trio of Analog Devices' ICs to provide intelligent temperature monitoring and fan control, premium performance audio, and processor power.



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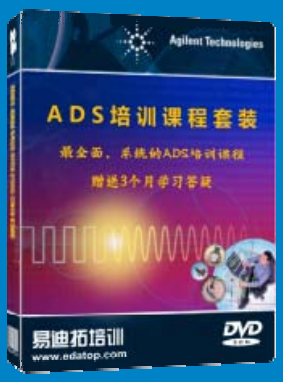
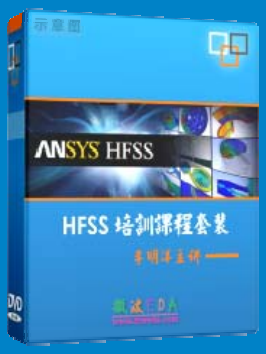
ADS 学习培训课程套装



该套装是迄今国内最全面、最权威的 ADS 培训教程，共包含 10 门 ADS 学习培训课程。课程是由具有多年 ADS 使用经验的微波射频与通信系统设计领域资深专家讲解，并多结合设计实例，由浅入深、详细而又全面地讲解了 ADS 在微波射频电路设计、通信系统设计和电磁仿真设计方面的内容。能让您在最短的时间内学会使用 ADS，迅速提升个人技术能力，把 ADS 真正应用到实际研发工作中去，成为 ADS 设计专家...

课程网址： http://www.edatop.com/peixun/ads/13.html



HFSS 学习培训课程套装

该套课程套装包含了本站全部 HFSS 培训课程，是迄今国内最全面、最专业的 HFSS 培训教程套装，可以帮助您从零开始，全面深入学习 HFSS 的各项功能和在多个方面的工程应用。购买套装，更可超值赠送 3 个月免费学习答疑，随时解答您学习过程中遇到的棘手问题，让您的 HFSS 学习更加轻松顺畅…

课程网址：http://www.edatop.com/peixun/hfss/11.html

CST 学习培训课程套装

该培训套装由易迪拓培训联合微波 EDA 网共同推出，是最全面、系统、专业的 CST 微波工作室培训课程套装，所有课程都由经验丰富的专家授课，视频教学，可以帮助您从零开始，全面系统地学习 CST 微波工作的各项功能及其在微波射频、天线设计等领域的设计应用。且购买该套装，还可超值赠送 3 个月免费学习答疑…

课程网址：http://www.edatop.com/peixun/cst/24.html

HFSS 天线设计培训课程套装

套装包含 6 门视频课程和 1 本图书，课程从基础讲起，内容由浅入深，理论介绍和实际操作讲解相结合，全面系统的讲解了 HFSS 天线设计的全过程。是国内最全面、最专业的 HFSS 天线设计课程，可以帮助您快速学习掌握如何使用 HFSS 设计天线，让天线设计不再难…

课程网址：http://www.edatop.com/peixun/hfss/122.html

13.56MHz NFC/RFID 线圈天线设计培训课程套装

套装包含 4 门视频培训课程，培训将 13.56MHz 线圈天线设计原理和仿真设计实践相结合，全面系统地讲解了 13.56MHz 线圈天线的工作原理、设计方法、设计考量以及使用 HFSS 和 CST 仿真分析线圈天线的具体操作，同时还介绍了 13.56MHz 线圈天线匹配电路的设计和调试。通过该套课程的学习，可以帮助您快速学习掌握 13.56MHz 线圈天线及其匹配电路的原理、设计和调试…

详情浏览：http://www.edatop.com/peixun/antenna/116.html

我们的课程优势：

※ 成立于 2004 年，10 多年丰富的行业经验，

※ 一直致力并专注于微波射频和天线设计工程师的培养，更了解该行业对人才的要求

※ 经验丰富的一线资深工程师讲授，结合实际工程案例，直观、实用、易学

联系我们：

※ 易迪拓培训官网：http://www.edatop.com

※ 微波 EDA 网：http://www.mweda.com

※ 官方淘宝店：http://shop36920890.taobao.com