TEXAS INSTRUMENTS

ADS8364EVM

User's Guide

April 2002 *Data Acquisition Products*

SLAU084

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Mailing Address:

Texas Instruments
Post Office Box 655303
Dallas, Texas 75265

EVM IMPORTANT NOTICE

Texas Instruments (TI) provides the enclosed product(s) under the following conditions:

This evaluation kit being sold by TI is intended for use for **ENGINEERING DEVELOPMENT OR EVALUATION PURPOSES ONLY** and is not considered by TI to be fit for commercial use. As such, the goods being provided may not be complete in terms of required design-, marketing-, and/or manufacturing-related protective considerations, including product safety measures typically found in the end product incorporating the goods. As a prototype, this product does not fall within the scope of the European Union directive on electromagnetic compatibility and therefore may not meet the technical requirements of the directive.

Should this evaluation kit not meet the specifications indicated in the EVM User's Guide, the kit may be returned within 30 days from the date of delivery for a full refund. THE FOREGOING WARRANTY IS THE EXCLUSIVE WARRANTY MADE BY SELLER TO BUYER AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE.

The user assumes all responsibility and liability for proper and safe handling of the goods. Further, the user indemnifies TI from all claims arising from the handling or use of the goods. Please be aware that the products received may not be regulatory compliant or agency certified (FCC, UL, CE, etc.). Due to the open construction of the product, it is the user's responsibility to take any and all appropriate precautions with regard to electrostatic discharge.

EXCEPT TO THE EXTENT OF THE INDEMNITY SET FORTH ABOVE, NEITHER PARTY SHALL BE LIABLE TO THE OTHER FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.

TI currently deals with a variety of customers for products, and therefore our arrangement with the user **is not exclusive**.

TI assumes **no liability for applications assistance, customer product design, software performance, or infringement of patents or services described herein**.

Please read the EVM User's Guide and, specifically, the EVM Warnings and Restrictions notice in the EVM User's Guide prior to handling the product. This notice contains important safety information about temperatures and voltages. For further safety concerns, please contact the TI application engineer.

Persons handling the product must have electronics training and observe good laboratory practice standards.

No license is granted under any patent right or other intellectual property right of TI covering or relating to any machine, process, or combination in which such TI products or services might be or are used.

Mailing Address:

Texas Instruments
Post Office Box 655303
Dallas, Texas 75265

EVM WARNINGS AND RESTRICTIONS

It is important to operate this EVM within the input voltage range of ±12 VDC and output voltage range of 3.3 VDC and 5 VDC.

Exceeding the specified input range may cause unexpected operation and/or irreversible damage to the EVM. If there are questions concerning the input range, please contact a TI field representative prior to connecting the input power.

Applying loads outside of the specified output range may result in unintended operation and/or possible permanent damage to the EVM. Please consult the EVM User's Guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative.

During normal operation, some circuit components may have case temperatures greater than 30°C. The EVM is designed to operate properly with certain components above 40°C as long as the input and output ranges are maintained. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors. These types of devices can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during operation, please be aware that these devices may be very warm to the touch.

Mailing Address:

Texas Instruments
Post Office Box 655303
Dallas, Texas 75265

Preface

Read This First

About This Manual

This users guide describes the characteristics, operation, and use of the ADS8364EVM 16-bit parallel analog-to-digital converter evaluation board. A complete circuit description as well as schematic diagram is included.

How to Use This Manual

This document contains the following chapters:

Chapter 1—EVM Overview

Chapter 2—Analog Interface

Chapter 3—Digital Interface

Chapter 4—Power Supply

Chapter 5—Initial Setup of the Board

Chapter 6—EVM Schematic

Information About Cautions and Warnings

This book may contain cautions and warnings.

This is an example of a caution statement.

A caution statement describes a situation that could potentially damage your software or equipment.

CAUTION

This is an example of a warning statement.

A warning statement describes a situation that could potentially cause harm to you.

WARNING

The information in a caution or a warning is provided for your protection. Please read each caution and warning carefully.

Related Documentation From Texas Instruments

To obtain a copy of any of the following TI documents, call the Texas Instruments Literature Response Center at (800) 477-8924 or the Product Information Center (PIC) at (972) 644-5580. When ordering, please identify this booklet by its title and literature number. Updated documents can also be obtained through our website at www.ti.com.

Data Sheets	Literature Number
ADS8364	SBAS219
OPA2132	SBOS054
OPA2350	SBOS099
TPS2104	SLVS235
SN74CBT3257	SCDS017

FCC Warning

This equipment is intended for use in a laboratory test environment only. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to subpart J of part 15 of FCC rules, which are designed to provide reasonable protection against radio frequency interference. Operation of this equipment in other environments may cause interference with radio communications, in which case the user at his own expense will be required to take whatever measures may be required to correct this interference.

Contents

Figures

Tables

Chapter 1

EVM Overview

The ADS8364 is a high-speed, low power, dual 16-bit A/D converter that operates from independent 5-V AV_{DD} and DV_{DD} supplies. The digital output is delivered through a built-in buffer circuit that can be powered from DV_{DD} or separate 2.7-V to 5.25-V (BV_{DD}) sources. This allows for flexibility when designing within mixed voltage environments.

The six fully differential sample and hold circuits are divided into three pairs (A, B, and C). Each pair of channels has a hold signal (HOLDA, HOLDB, and HOLDC) which, when strobed together, allows simultaneous sampling on all six analog inputs. The part accepts an analog input voltage in the range of $–V_{REF}$ to $+V_{REF}$, centered on the internal 2.5-V reference. The part also accepts bipolar input ranges when a level shift circuit is used in the analog front-end circuitry (see Figure 2-1).

Conversion time for the ADS8364 is 3.2 μs when a 5-MHz external clock is used. The corresponding acquisition time is 0.8 μs. To achieve the maximum output rate (250 KSPS), the read function can be performed during the start of the next conversion.

The ADS8364 EVM includes the following features:

- Full-featured evaluation board for the ADS8364 250-kHz, 16-bit, 6-channel simultaneous sampling analog-to-digital converter
- Analog inputs can be configured as single-ended or differential
- Direct connection to C5000 and C6000 DSK platforms through the 80-pin interface connectors
- Built-in reference
- High-speed parallel interface

Chapter 2

Analog Interface

The analog portion of the board is divided in two parts. The input buffer represents the front-end circuit of the A/D converter. Its function is to provide level and impedance changes to the input signal. The second part is the voltage reference circuit. In addition to being the conversion reference, the ADS8364's reference output is used for level shifting the analog input.

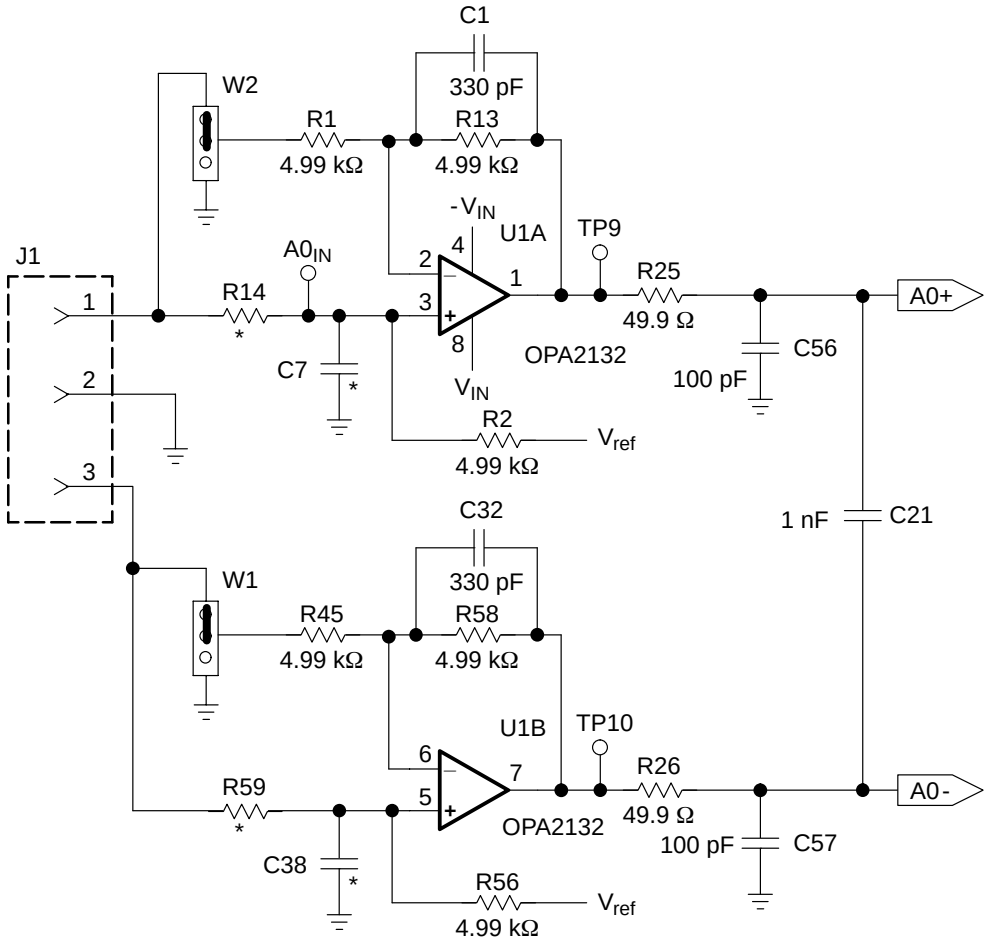
Topic **Page**

2.1 Dual Supply—Input Buffer

The analog input to the ADS8364EVM board is comprised of six independent OPA2132 operational amplifiers. The OPA2132s are powered from the ±12-V analog supply and connected as inverting amplifiers with a gain of 1. The internal 2.5-V reference voltage is applied to the noninverting input of the OPA2132s for level shifting.

Even though the ADS8364EVM board is configured at the factory for ±12-V analog operation, the EVM can tolerate maximum power supplies of ±15 VDC. However, care must be taken to ensure the ±15 VDC limit is not exceeded or potential damage to the op-amp circuits can occur.

Figure 2-1. ADS8364EVM Schematic—Analog Input Section



Note: Components marked with an asterisk (*) are NOT INSTALLED.

This configuration allows single-ended signals of ±2.5 V (5 V_{pp}) to be applied to either input of channels A, B, or C (JX pin 1 or 3 referenced to pin 2). Differential signal inputs of ±1.25 V (2.5 V_{pp}) can be applied to the channel input pairs (JX pin 1 and 3).

2.2 Bipolar Inputs

Table 2-1 lists various combinations of resistors, capacitors and jumpers. By changing components and setting the appropriate jumper, it is possible to adapt the input buffer to accept bipolar input voltages. Table 2-1 is related to the schematic presented in Table 2-1 and represents channel A0 of the ADC. Channels B0, C0, A1, B1, and C1 follow a similar placement pattern. Refer to the schematic at the end of this document for reference description details.

The capacitors C7, C38 and C1, C32 are used only in differential signal configurations. For single-ended signals, the second operational amplifier can be used to buffer the reference voltage to the input of A/D converter.

Table 2-1. Typical Analog Input Buffer Circuit Values (A0 Shown)

	Input Voltage	R14 R59	R1 R45	R2 R56	R13 R58	C7 C38	C1 C32	W2 W1
Refer to Figure 2-1	0-5	5 kΩ	open	open	short	330 pF	open	open
	0-2.5	5 kΩ	5 kΩ	open	5 kΩ	open	330 pF	1-2
	-2.5 -2.5	20 kΩ	4 kΩ	20 kΩ	4 kΩ	open	330 pF	1-2
	-5-5	20 kΩ	4 kΩ	10 kΩ	2 kΩ	open	330 pF	1-2
	-10-10	20 kΩ	4 kΩ	5 kΩ	1 kΩ	open	330 pF	1-2
	-5–0	open	5 kΩ	open	5 kΩ	short	330 pF	2-3
	0-5	open	5 kΩ	open	5 kΩ	short	330 pF	2-3

2.3 Analog and Digital 5-V Supplies

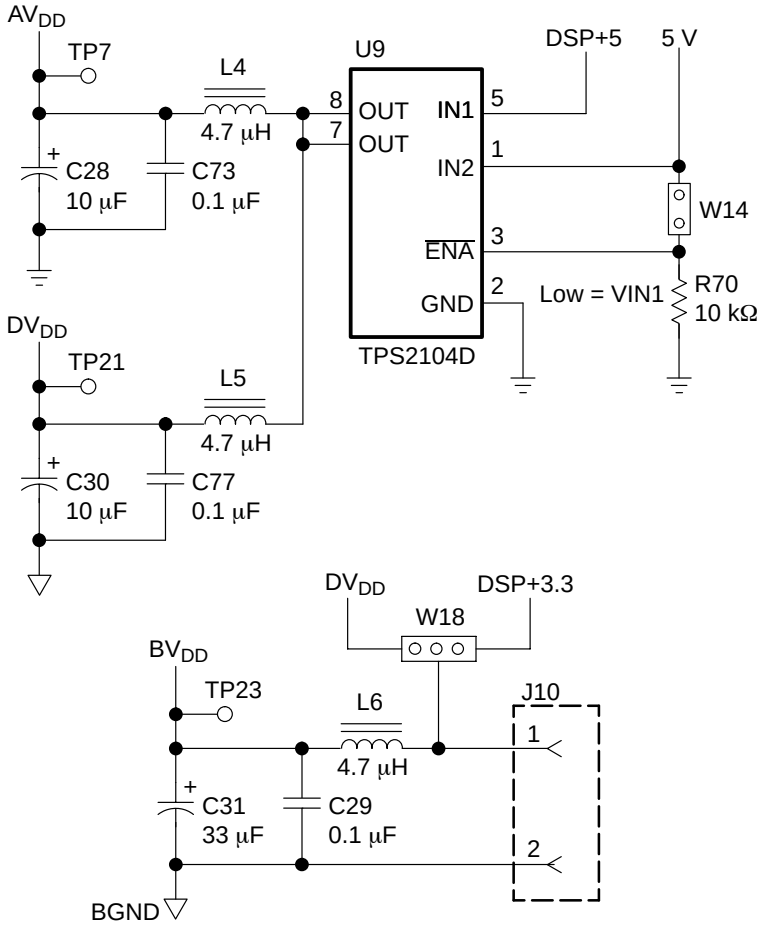
The ADS8364EVM board is configured at the factory for operation on the TMS320C6711 DSK platform. By default, W14 is open, which allows the DSP 5-V supply to be routed through U9 to the filter inductors L4 and L5. By closing W14, an external voltage source of 4.75 VDC to 5.25 VDC can be applied via J8.

2.4 Output Buffer 3.3-V Supply

As mentioned above, the ADS8364EVM board is configured at the factory for operation on the TMS320C6711 DSK platform. Since the interface to this DSP is 3.3 V, the buffer supply voltage is taken from the DSP 3.3-V source found on the interface connector at J11 (pins 41 and 42). The 3.3-V DSP supply is routed through the shunt jumper on W18 (pins 2-3). Placing the shunt on pins 1 and 2 supplys the 5-V digital source (via V9) to the buffer circuit.

The digital buffer circuit of the ADS8364 can also be powered from an external source via J10. When operated in this fashion, the shunt jumper at W18 should be completely removed in order to prevent possible damage to the EVM or DSK circuitry. The buffer voltage has a range of 2.7 VDC to 5.5 VDC maximum.

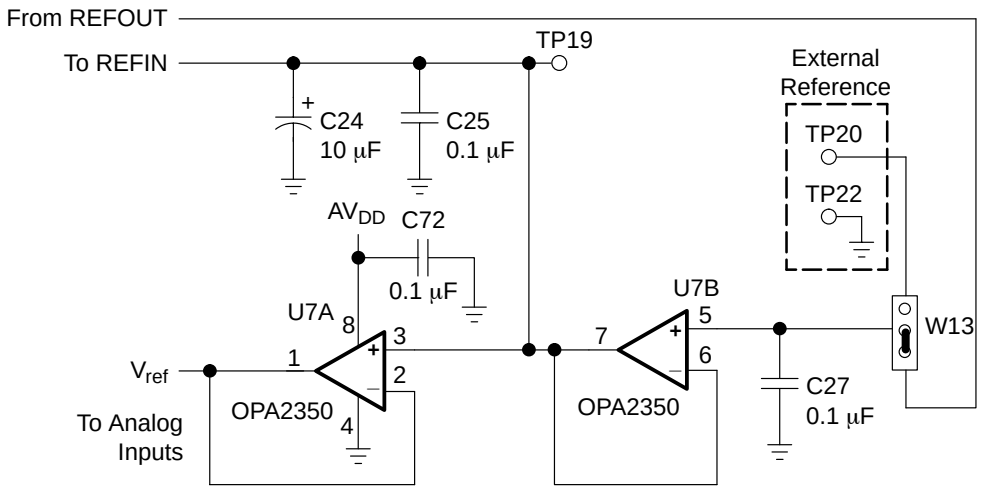
Figure 2-2. Digital Buffer Voltage Selection



2.5 Reference Voltage

The ADS8364 has an internal 2.5-V reference source, which is accessed by placing a shunt jumper on W13 pins 2 and 3 (factory default). If an external reference is desired, the shunt jumper on W13 must be moved to cover pins 1 and 2. The ADS8364EVM provides two test-points, TP20 and TP22, as a means to connect an external source. An external source should be applied to TP20, referenced to TP22. The voltage input range on this node is 1.5 VDC to 2.6 VDC. This voltage is buffered through the unity-gain noninverting buffer and fed to the REFIN pin as well as the analog input circuitry.

Figure 2-3. ADS8364EVM Reference Circuit



Chapter 3

Digital Interface

The ADS8364 EVM is designed for easy interfacing with the C5000 and C6000 series DSK platforms from Texas Instruments. Two 80-pin interface connectors located on the bottom side of the EVM allow direct plug-in to the DSK platforms.

If an alternate control system is desired, mating connector part numbers SFM-140-01-S-D or SFM-140-02-S-D can be used to wire the control and data signals. Please consult Samtec at www.samtec.com or 1-800-SAMTEC-9 for price and availability of these connectors.

Topic **Page**

3.1 Control Signals

The ADS8364EVM was developed on the TMS320C6711 DSK platform. The HOLDx signals, ADD pin control, and reset are all derived from the GPIO function of McBSP port 1. These signals are located on J12. The address and data lines are available on J11. The EVM is factory configured to use address 0xA000 0020 as its base. Channel A0 can be accessed from this location, with channels A1 through C1 located at the base address + 0x04, as listed in Table 3-1.

An alternate address base can be selected by removing the shunt jumper on W17. This assigns A17 or 0xA002 0000 as the base address of the EVM. In this configuration, channels A1 through C1 are located at the base address + 0x4000.

Table 3-1. Address Map

	W17 CLOSED	W17 OPEN
A0	0xA000 0020	0xA002 0000
A1	0xA000 0024	0xA002 4000
B0	0xA000 0028	0xA002 8000
B1	0xA000 002C	0xA002 C000
C0	0xA000 0030	0xA003 0000
C1	0xA000 0034	0xA003 4000
Cycle	0xA000 0038	0xA003 8000
FIFO	0xA000 003C	0xA003 C000

3.2 Bus Width

The ADS8364 features a byte mode in which data can be read from the ADC in two consecutive 8-bit reads. W16 controls the byte feature, which is disabled by default. To enable byte mode, remove the jumper from W16. Please consult the data sheet for a complete description of byte mode operation.

3.3 External Clock

The BNC connector (J9) and W15 allow for the selection of an external conversion clock source. Factory default settings provide the clock source via the TOUT1 signal of the DSP by placing a shunt jumper on pins 1 and 2 of W15. By moving the shunt to pins 2 and 3, the EVM user can apply an external clock source of not more than 5 MHz to J9.

Chapter 4

Power Supply

The power supply requirements for the ADS8364EVM board can be split into three categories—analog front end, ADC power, and digital interface. While filters are provided for all power supply inputs, optimal performance of the EVM requires a clean, well-regulated power source.

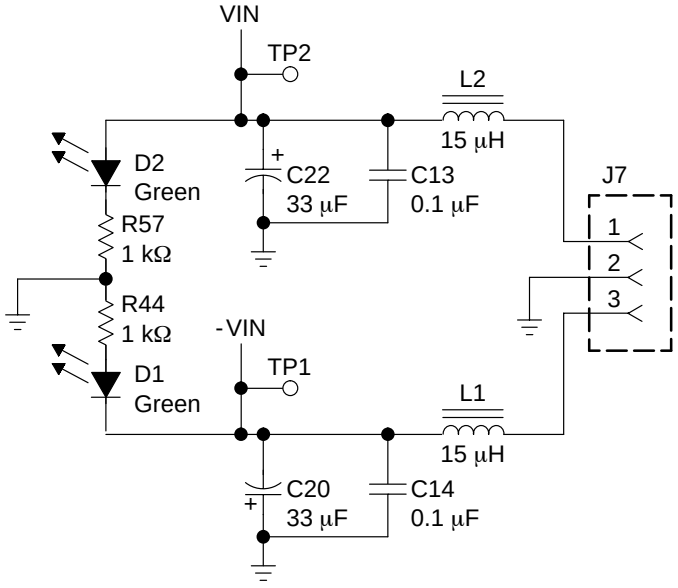
The power and ground planes on the inner layers of the EVM are split into digital and analog sections, with the ground planes tied together at a single point near the filter circuits.

Topic **Page**

4.1 Analog Front-End Supply

The analog front end of the EVM includes six OPA2132 operational amplifiers. These amplifiers are powered through J7 and are configured for bipolar operation. The circuits are designed to operate from a maximum supply voltage of ±12 VDC. Single supply operation can be achieved by applying a positive dc voltage to pin 1 of J7 (marked as +12 V on EVM) while applying a ground reference to both pins 2 and 3.

Figure 4-1. Analog Front-End Supply

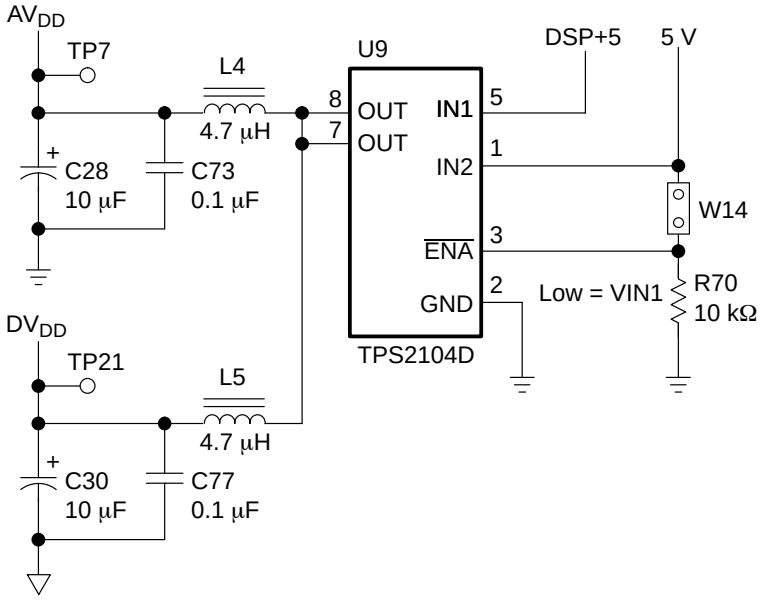


4.2 ADC Power Supply

The ADS8364 requires analog and digital supplies in the range of 4.75 VDC to 5.25 VDC. The EVM provides both analog and digital supply voltages through a single input supply source. The 5-V input supply is filtered and split into the digital and analog power planes located on the inner layer of the PCB.

W14 can be used to determine the source of the input supply. With W14 closed, the 5-V ADC power supply source is located at J8. The TPS2104 power switch at U9 directs the voltage from J8 to the analog/digital filters. With W14 open, the TPS2104 power switch directs 5-V power from the C5000/C6000 DSK board via J12, which is the factory default setting.

Figure 4-2. ADC Power-Supply Input



4.3 Digital Interface Supply

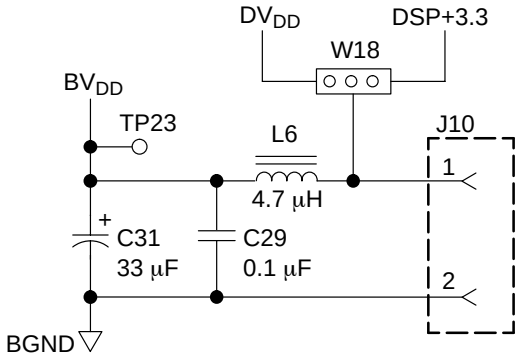
A unique feature of the ADS8364 is the built-in data buffer circuit with an independent power source. The EVM provides a jumper—W18, which allows for flexible voltage selection. When the shunt at W18 is in the factory default position (W18 pins 2 and 3 shorted), the 3.3-V DSP supply taken from J11 is applied to the BV_{DD} pins of the ADS8364. By moving the shunt jumper on W18 to pins 1 and 2, the user chooses the 5-V ADC supply as the source of the BV_{DD} voltage.

J10 provides a means of supplying an alternative independent buffer voltage. If desired, the shunt jumper at W18 can be totally removed, and a dc source of 2.7 V to 5.25 V can be applied to J10 as a means to provide BV_{DD} power.

Caution

While J10 is used, ensure that W18 remains completely open.

Figure 4-3. Digital Buffer Alternate Supply Input



Chapter 5

Initial Setup of the Board

Factory set up of the board is for a ±5-V to ±12-V analog front-end supply at J7, and 5-V ADC power provided through J8. The BV_{DD} supply is provided from the DSK platform via J11 and W18 (pins 2 and 3 shorted). The maximum analog inputs are 0-V/5-V for a differential signal. The reference circuit is connected to the internal reference of the ADC (W13 pins 2 and 3 shorted).

Table 5-1. Factory Defaults—Analog Input Buffers (A0 Shown)

Refer to Figure 2-1 and Schematic	Input Voltage	R14 R59	R1 R45	R2 R56	R13 R58	C7 C38	C1 C32	W2 W1
	0-5	open	4.99 kΩ	4.99 kΩ	4.99 kΩ	N/I	330 pF	1-2

The analog inputs to the ADS8364EVM board can be applied to any one or all of the input channels. Single-ended inputs are to be applied between analog ground (center terminal of J1–J6) and either the positive or negative terminals. Differential signals are to be applied between the positive and negative terminals.

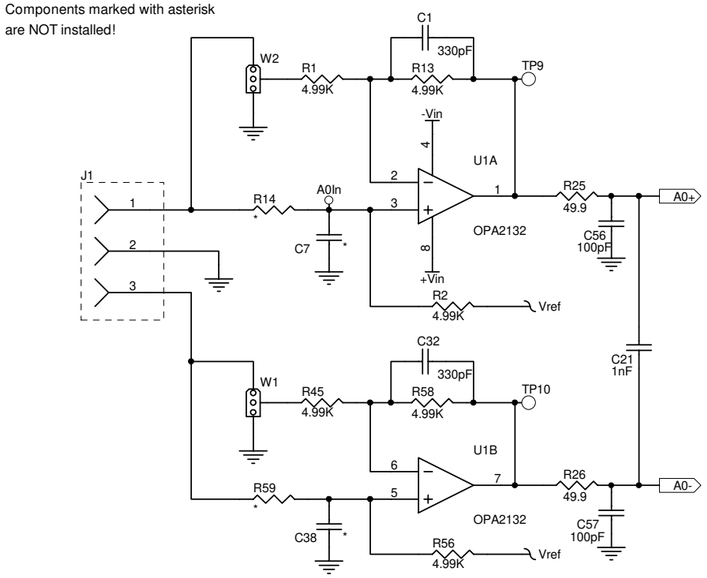
Chapter 6

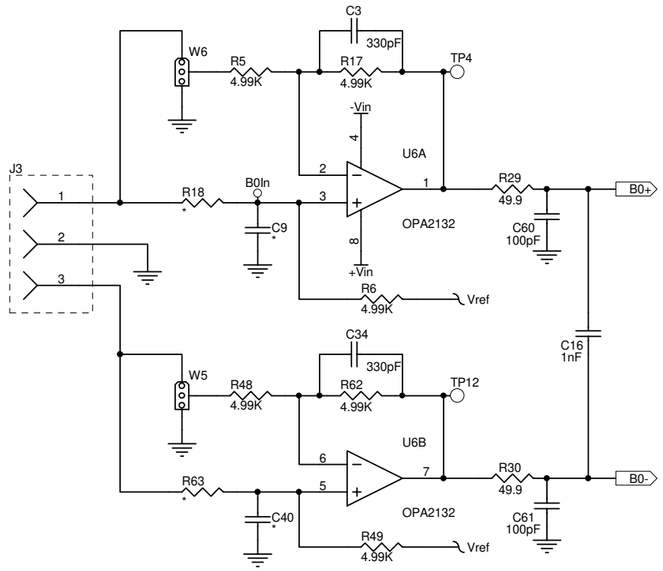
EVM Schematic

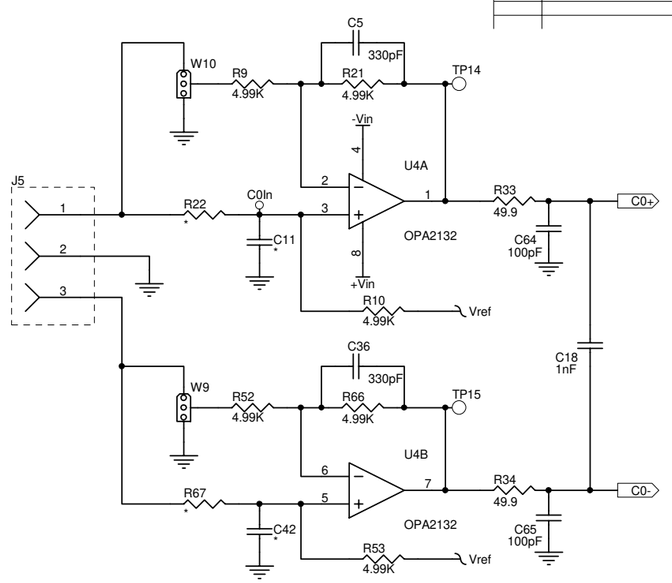
The following pages contain the ADS8364EVM circuit diagram.

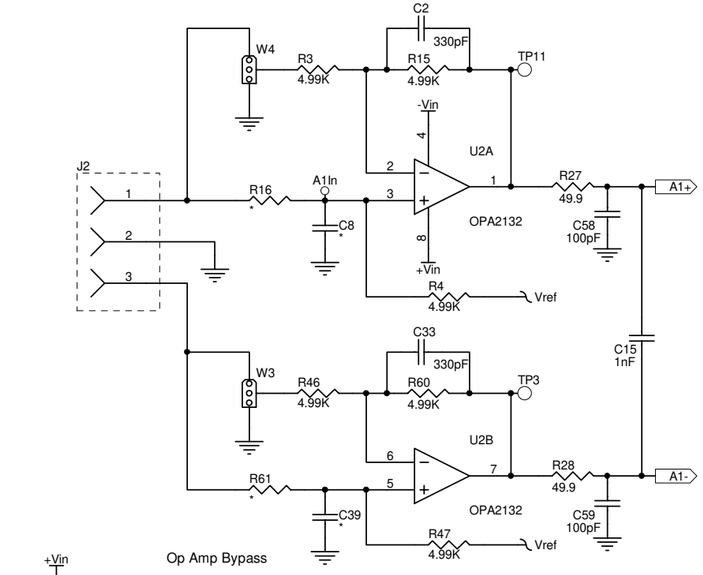
Note:
Components marked with asterisk
are NOT installed!

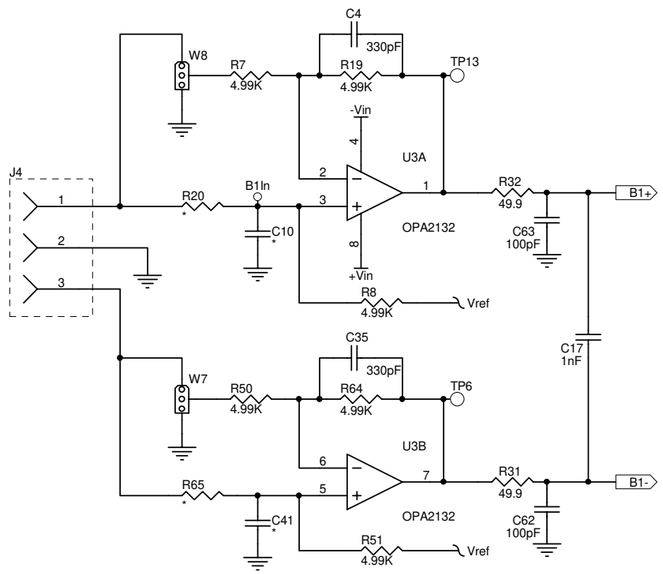
Revision History		
REV	ECN Number	Approved

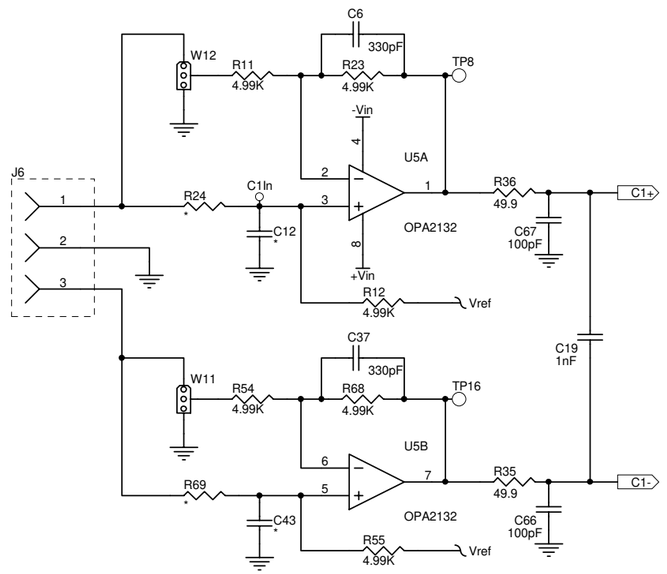


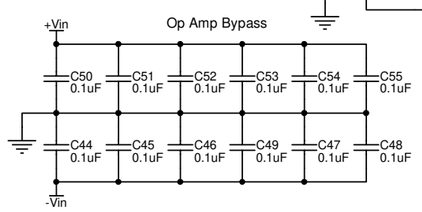










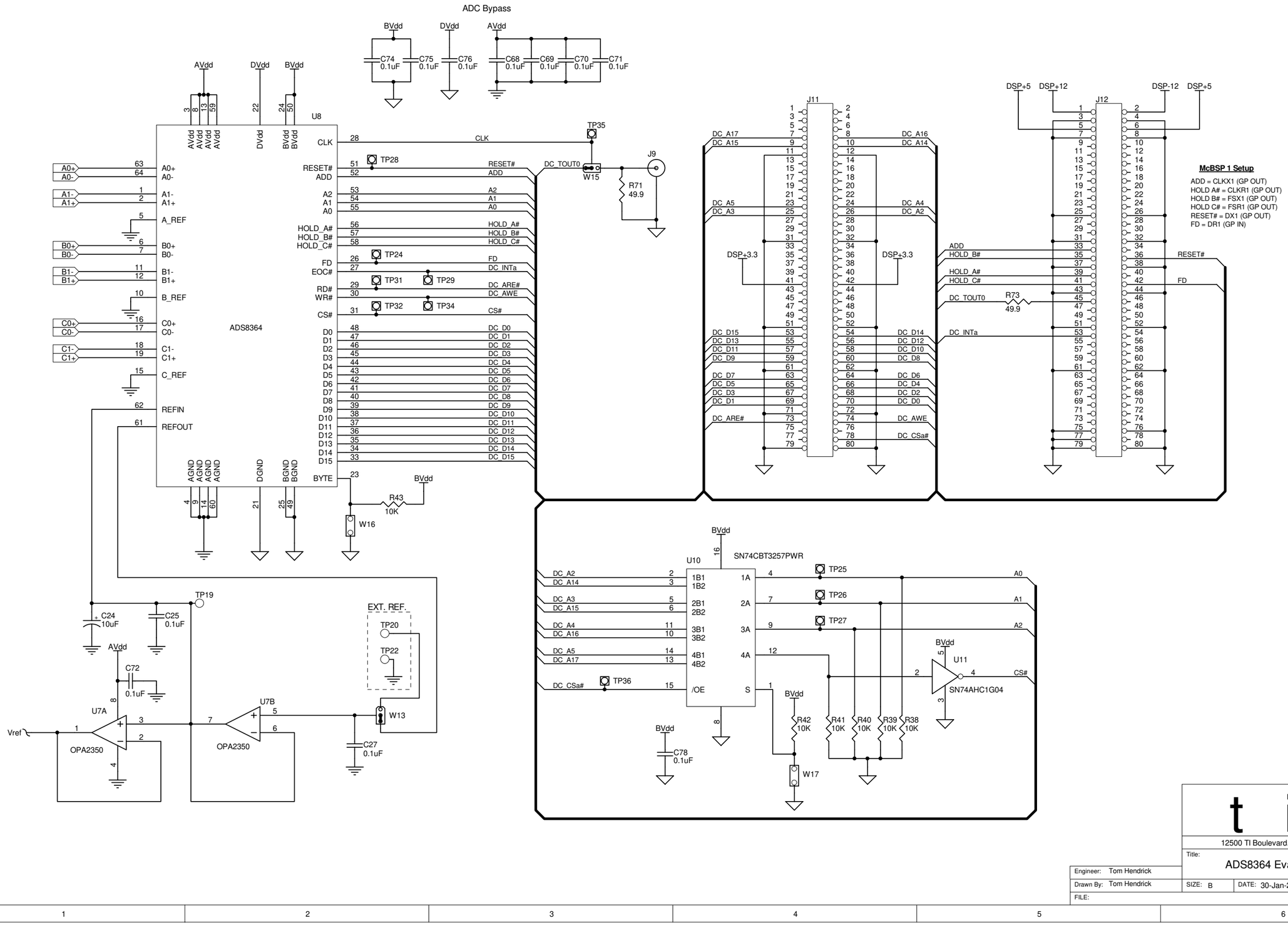


t i

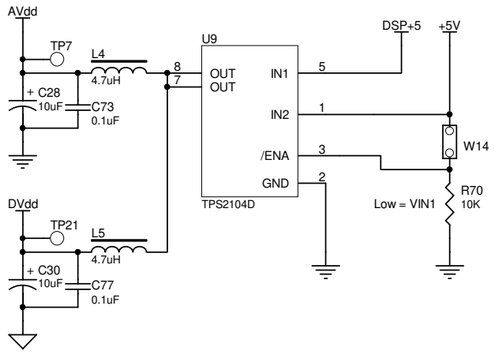
12500 TI Boulevard. Dallas, Texas 75243

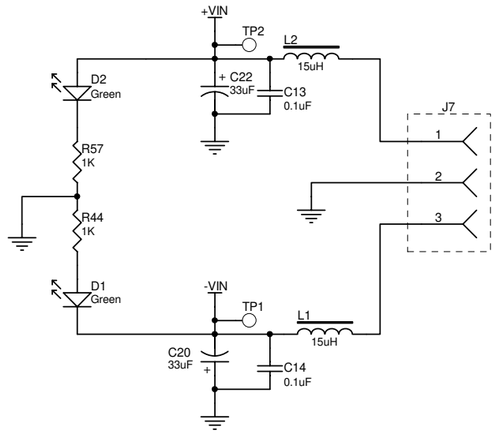
Title: ADS8364 Evaluation Module

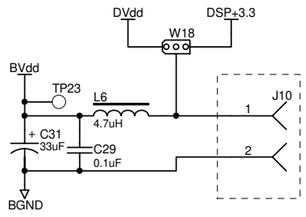
Engineer: Tom Hendrick			
Drawn By: Tom Hendrick	SIZE: B	DATE: 30-Jan-2002	REV: A
FILE: ADS8364_A_SH1.Sch			SHEET: 1 OF: 3

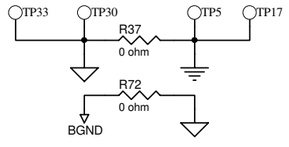


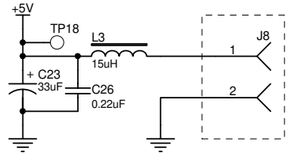
t i	
12500 TI Boulevard. Dallas, Texas 75243	
Title:	ADS8364 Evaluation Module
Engineer: Tom Hendrick	
Drawn By: Tom Hendrick	SIZE: B / DATE: 30-Jan-2002 / REV: A
FILE:	SHEET: 2 OF: 3











12500 TI Boulevard. Dallas, Texas 75243			
Title: ADS8364 Evaluation Module			
Engineer: Tom Hendrick			
Drawn By: Tom Hendrick	SIZE: B	DATE: 30-Jan-2002	REV: A
FILE:			SHEET: 3 OF: 3