TEXAS INSTRUMENTS

AMC7820
Evaluation Module

User's Guide

2001 Data Acquisition Products

SBAU074

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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.

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During normal operation, some circuit components may have case temperatures greater than 60°C. The EVM is designed to operate properly with certain components above 60°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.

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Preface

Read This First

About This Manual

This user's guide describes the function and operation of the AMC7820 Analog Monitoring and Control circuit evaluation module. This manual will help you quickly set up the evaluation board and its accompanying software so that you may rapidly test and evaluate the AMC7820. A complete circuit description, as well as a schematic diagram and bill of materials, is included.

How to Use This Manual

This manual begins with an introductory chapter that describes the EVM and what it can do. If you're anxious to set things up and start testing, we suggest you read at least the first two chapters. These two chapters introduce you to the board and how to set it up to start working with it. Later chapters go into more detail on the board's design and how to access its many features.

Information About Cautions and Warnings

This book may contain cautions.

CAUTION

This is an example of a caution statement.

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

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

Related Documentation From Texas Instruments

Data Sheets	Literature Number
AMC7820	SBAS231
SN74AHC244	SCLS226
REG711EA	SBVS027

If You Need Assistance

If you have questions about this or other Texas Instruments data converter evaluation modules, feel free to e-mail the data converter application team at dataconvapps@list.ti.com. Include the product name in the subject heading.

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Chapter 1

Introduction

The AMC7820 is a complete analog monitoring and control unit, which includes an 8-channel, 12-bit Analog-to-Digital (A/D) converter, three 12-bit Digital-to-Analog (D/A) converters, nine operational amplifiers, an internal 2.5V reference, and an SPI™ serial interface. The evaluation board for this multifunction device, the AMC7820-EVM, is designed to ease the digital interface to the AMC7820 by connecting to a personal computer running easy-to-use software which allows total access to the AMC7820's various control functions. A large prototype area on the board provides space to connect circuitry to the AMC7820 and connections to configure the internal components.

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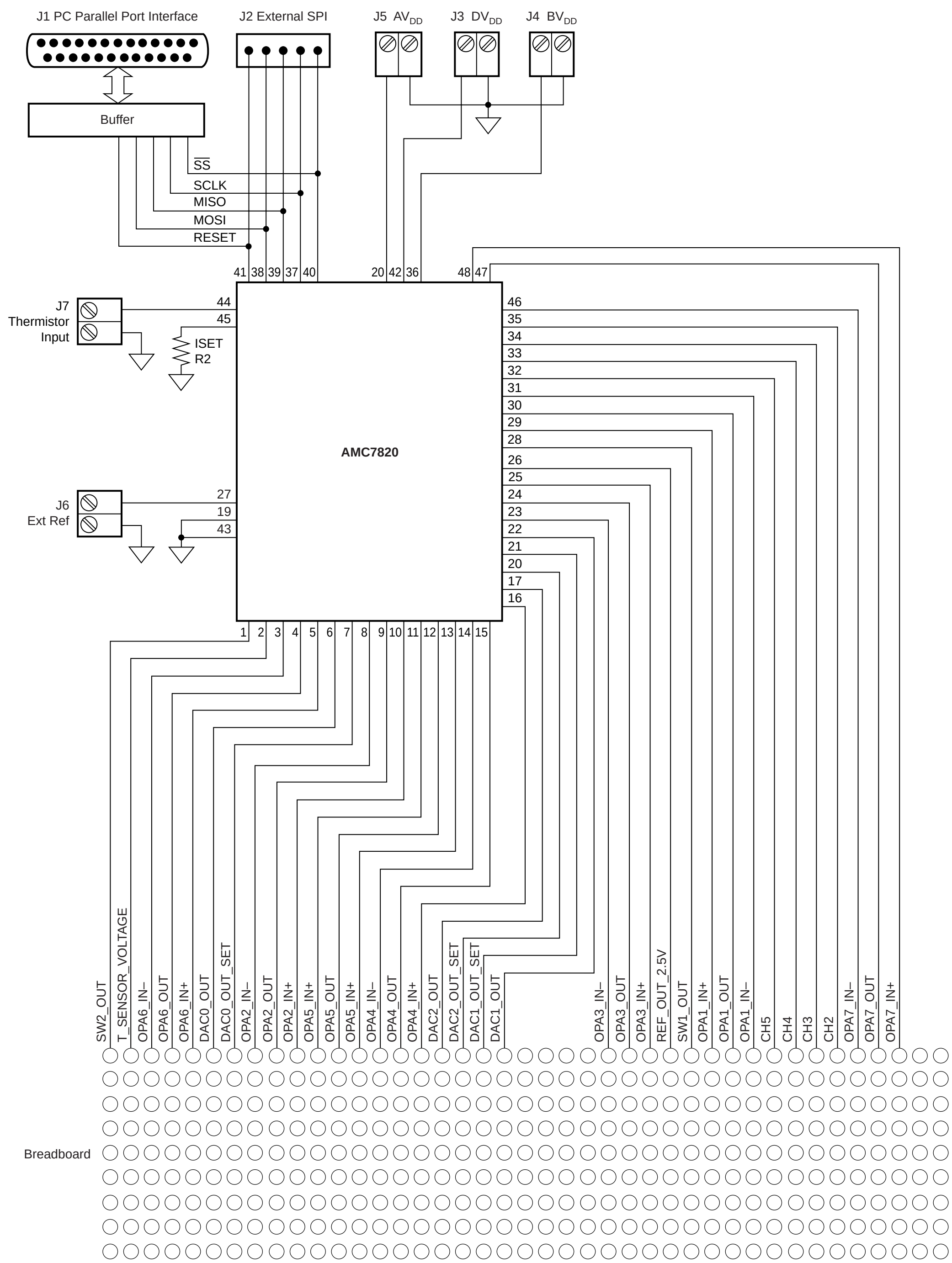
1.1 Device Characteristics

The AMC7820-EVM supports the AMC7820, which is soldered onto the EVM. The AMC7820's 8-channel A/D converter, three D/A converters, voltage reference, and nine operational amplifiers are all available for connection to the sizeable prototyping area on the board. Connectors are provided for the three power supplies needed by the AMC7820, as well as for a thermistor input and external reference input. An onboard 3V to 5V DC/DC converter can create the 5V analog supply needed by the AMC7820 if an external 5V supply is not available.

1.2 EVM Block Diagram

Figure 1 shows a block diagram of the AMC7820-EVM.

Figure 1. AMC7820-EVM Block Diagram.



The digital control interface is either through the PC parallel port, or an external SPI bus. The PC parallel port can be disabled, allowing the external SPI bus to control the AMC7820. When using the PC parallel port, the digital interface voltage is 5V; when the external SPI bus is used, the digital interface voltage may be 5V or 3V.

Power supplies are to be provided to the AMC7820-EVM through external connectors from an external, user-supplied laboratory power supply. AV_{DD} and DV_{DD} must be supplied at +5V, while BV_{DD} can range from +2.7V to +5V.

A thermistor can be connected to the AMC7820 through a terminal block. The thermistor is driven by a current source on the AMC7820, which is derived from the reference and set by the ISET resistor. The ISET resistor (see Figure 1) is identified as R2 on the AMC7820-EVM, and is socketed on the EVM so that the user can change its value.

All the remaining pins of the AMC7820 (i.e., all the analog inputs and outputs) are brought out to a large prototype area on the AMC7820-EVM, so that external connections and circuitry can be made in any manner the user wishes.

1.3 Analog Inputs/Outputs

The analog inputs and outputs of the AMC7820 are available on the prototyping area and are identified on the silkscreen. These include the op amps, A/D converter inputs, and D/A converter outputs. Note that the direct inputs to the A/D converter (CH2-CH5) are not buffered inside the AMC7820, and so should connect only to extremely-low impedance sources, or should be buffered externally.

An external reference may be provided to the AMC7820 through J6. This reference voltage must remain within the specifications of the AMC7820. Consult the AMC7820 data sheet (SBAS231) at www.ti.com for these and other device specifications.

The AMC7820 connects to a thermistor through J7. The nominal value of this thermistor is typically 10kΩ.

Since the AMC7820's A/D converter runs at 100kHz, and must scan through eight channels, each channel's effective conversion time is 80µs. This means that each channel's effective sampling rate is 12.5kHz. Input signals above 6.25kHz, therefore, would result in aliasing, unless external anti-aliasing filters are provided.

The voltage range of all the analog inputs and outputs of the AMC7820 are from 0V to 5V. Note that the D/A converters' outputs may be configured to range from 0V to V_{REF} or from 0V to $2V_{REF}$. See the AMC7820 data sheet for details on the operating ranges of the analog inputs and outputs.

1.4 Prototyping Area

The large prototype area of the AMC7820 provides plenty of room for external circuitry to be connected to the AMC7820. Every analog signal from the AMC7820 (except for the reference and thermistor connections, which are available on J6 and J7) is brought out to the edge of the prototype area. Five holes at each signal point are connected together to allow several connection points for external circuitry.

Six large areas of copper are available for use as heatsinks for power devices. These copper areas are isolated from all other signals.

1.5 Power Requirements

The AMC7820 requires an analog supply voltage (AV_{DD}) of 5V, a digital supply voltage (DV_{DD}) of 5V, and an interface supply voltage (BV_{DD}) that can range from 2.7V to 5.5V.

The user should provide power-supply voltages from a lab-quality power supply. DV_{DD} is provided on J3, AV_{DD} is provided on J5, and BV_{DD} is provided on J4. If a single 3.3V supply is used (connected to BV_{DD}) to simulate the user's system supply, the onboard DC/DC converter can generate AV_{DD} and DV_{DD} if JMP1 is removed and JMP2 and JMP3 are installed.

1.6 Computer Requirements

The AMC7820-EVM software is designed to run on a PC running any Windows® platform (Windows 95, 98, NT, 2000, etc).

Minimum System Requirements:

- IBM-Compatible 486 PC or Higher
- Windows 95, 98, 2000, or NT4.0
- 32MB RAM Minimum
- 20MB Available Hard Disk Space
- CD-ROM Drive
- Available Parallel Port

Chapter 2

Getting Started

This chapter will guide you through unpacking the EVM and setting it up so you can begin working with it immediately.

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2.1 Unpacking the EVM

After unpacking the AMC7820-EVM, check to make sure you received all the material that should be in the box. The EVM kit should include the following:

- AMC7820-EVM Board, PWB 6432813
- CD-ROM, 6437057
- IEEE1284 25-Pin Parallel Cable

If any of these components are missing, contact Texas Instruments at dataconvapps@list.ti.com for a replacement.

2.2 Default Configuration

The AMC7820-EVM is a simple board and the only configuration details needed are the settings of the three jumpers and the value of R2, the resistor that sets the thermistor current.

The default settings for these items are shown in Table 1. When you unpack your AMC7820-EVM, make sure that your board is initially configured as shown here.

Table 1. Default Configuration Settings.

Board Identifier	Description	Default Setting
JMP1	DC/DC Converter Disable	Installed
JMP2	AV_{DD} = Onboard 5V	Not Installed
JMP3	DV_{DD} = Onboard 5V	Not Installed
R2	Thermistor Current Set	100kΩ

2.3 Quick Start

Once the AMC7820-EVM has been unpacked from its shipping container, and you have verified that the board is configured as shown in Table 1, it can be connected to power supplies.

Connect wires from the terminal blocks J3, J4, and J5 to a +5V laboratory power supply. Make sure to observe correct polarity; the polarity for each terminal block is marked on the printed circuit board. Do not turn on the power supply at this time.

If a thermistor is available, connect it to terminal block J7.

Connect the IEEE-1284 cable to your PC, but do not connect it to the AMC7820-EVM board yet.

Place the CD-ROM into your PC’s CD-ROM drive. Locate the Setup program on the disk, and run it. The Setup program will install the AMC7820-EVM software on your PC. Note that if you are running a Windows platform that is NT-based, you will need administrator privileges to install the software. Follow the installer’s instructions.

When the installation is complete, turn on the power supply, and then connect the parallel port cable to the AMC7820-EVM. Once these connections have been made, launch the AMC7820-EVM software on your PC.

The software should automatically determine the parallel port where the AMC7820-EVM is connected. If the board is found, the screen shown in Figure 2 will appear.

Figure 2. Main Screen with Configuration/Status Display Selected.

On this screen the Configuration/Status register bits are displayed. These bits should be as shown in Table 2.

Table 2. Configuration/Status Register Startup Values.

RST	POL1	POL2	TSC1	TSC2
1	0	1	0	1

If these bits are not as shown in Table 2, you will have an error message before Figure 2 is displayed. Generally, if this happens, a communication problem exists. Check the cables and connections and make sure they are sound. Make sure that your power is on. Correct any problems and restart the program.

Chapter 3

Operation

This chapter describes each function of the AMC7820-EVM and how to use the accompanying software to control and use the AMC7820.

3.1 Jumpers

Table 3 shows the function of each jumper on the EVM:

Table 3. Jumper/Function Reference.

Reference Designator	Setting	Function	Subsection
JMP1	Installed Open	DC/DC Converter Disabled DC/DC Converter Enabled	3.1.1 3.1.1
JMP2	Installed Open	AV_{DD} Supplied by DC/DC Converter AV_{DD} Supplied Through J5	3.1.1 3.1.1
JMP3	Installed Open	DV_{DD} Supplied by DC/DC Converter DV_{DD} Supplied Through J3	3.1.1 3.1.1

3.1.1 DC/DC Converter

The AMC7820-EVM has an onboard DC/DC converter designed to take 3.3V supplied through the BV_{DD} terminal block, J4, and step it up to 5V to supply the analog and digital supply voltages. This feature is provided to illustrate how to use the AMC7820 in a system that only has a 3.3V power supply available. To enable the DC/DC converter, JMP1 should be removed and JMP2 and JMP3 installed. If the DC/DC converter is not used, JMP1 should be installed to disable the charge pump and minimize system noise.

3.2 I/O Connectors and Signals

The various connectors on the AMC7820-EVM are described in this section.

3.2.1 Parallel Port Connector

The connector for use with the PC parallel port is described in Table 4. This connector provides a means of communicating with the PC through an IEEE-1284 cable.

Table 4. Parallel Port Connector.

Reference Designator	Description	Pin Number	Signal Name	Function
J1	Digital communication port between the AMC7820-EVM and a host PC.	1	$\overline{\text{EVM\_ENABLE}}$	Enables the SPI bus control from the PC.
		2	$\overline{\text{SS}}$	Slave Select for SPI bus.
		3	SCLK	Serial Clock for SPI bus.
		4	MOSI	Master Out, Slave In data line for SPI bus. Data travels to the AMC7820 over this line.
		5	NC	Not Connected
		6	NC	Not Connected
		7	$\overline{\text{RESET}}$	Reset line for the AMC7820.
		8-14	NC	Not Connected
		15	MISO	Master In, Slave Out data line for SPI bus. Data travels from the AMC7820 over this line.
		16-17	NC	Not Connected
		18-25	GND	Ground

3.2.2 External SPI Connector

If the SPI bus is not controlled from the PC, it may be controlled through J2. The user might connect an external microprocessor or DSP to the AMC7820-EVM through this connector.

Table 5. External SPI Connector.

Reference Designator	Description	Pin Number	Signal Name	Function
J2	Digital communication port between the AMC7820-EVM and an external processor.	1	$\overline{\text{RESET}}$	Reset line for the AMC7820.
		3	$\overline{\text{SS}}$	Slave Select for SPI bus.
		5	SCLK	Serial Clock for SPI bus.
		7	MOSI	Master Out, Slave In data line for SPI bus. Data travels to the AMC7820 over this line.
		9	MISO	Master In, Slave Out data line for SPI bus. Data travels from the AMC7820 over this line.
		2, 4, 6, 8, 10	GND	Ground

3.2.3 Power Connectors

Table 6. Power Connectors.

Reference Designator	Name	Description
J3	DV_{DD} IN	Digital (+5V) supply for the AMC7820.
J4	BV_{DD} IN	Digital I/O supply (3.3V-5V) for the AMC7820.
J5	AV_{DD} IN	Analog (+5V) supply for the AMC7820.

3.2.4 External Reference Connector

Table 7. External Reference Connector.

Reference Designator	Name	Description
J6	EXT REF IN	External reference input.

3.2.5 Thermistor Input Connector

Table 8. Thermistor Input Connector.

Reference Designator	Name	Description
J7	THERMISTOR INPUT	Connection for the thermistor input to the AMC7820.

3.3 Circuit Description

The AMC7820-EVM consists of two circuits: the SPI interface and the DC/DC converter. The board consists primarily of breadboard area around the AMC7820.

3.3.1 SPI Interface

The SPI interface to the AMC7820 can be controlled from two sources: the external SPI header, J2, or from the PC parallel port, J1. The PC parallel port connection is buffered through U1. U1's outputs are enabled only when pin 1 of U1 is LOW. This pin is pulled HIGH by R1, so that if no parallel port is connected, U1's outputs are tri-stated, allowing the external SPI bus to drive the AMC7820. When the PC parallel port is connected, the PC software will pull pin 1 of the parallel port (which is connected to pin1 of U1) LOW in order to enable the PC to control the SPI bus.

> **Do not drive the external SPI bus when the PC parallel port is connected. Disconnect the PC parallel port cable from the AMC7820-EVM if you want to use the external SPI bus.**
>
> CAUTION

3.3.2 DC/DC Converter

In order to supply the AV_{DD} and DV_{DD} supplies from a 3.3V input on BV_{DD}, the DC/DC converter circuit around U3 will boost the 3.3V input to 5V. U3 is enabled when ENABLE pin 2, is HIGH. R3 pulls this pin HIGH when JMP1 is not installed. When JMP1 is installed, the ENABLE pin is held LOW and the DC/DC converter will not operate. This helps reduce noise on the board when this feature is not needed.

With JMP1 removed, 5V will appear on the output of U3 (pin 8). JMP2 and JMP3 should be installed to connect this 5V to AV_{DD} and DV_{DD}.

3.4 Program Description

After having installed the software for the AMC7820-EVM as described in section 2.3, you may begin using it to evaluate and develop with the AMC7820.

3.4.1 Configuration and Control

The program's interface is a simple, three-tab interface. Clicking on a tab will take you to the functions associated with that tab. The default tab that the program begins on is the Configuration and Control tab (see Figure 3).

Figure 3. Configuration and Control Screen.

This screen gives you access to the Configuration/Status register and the Shutdown register. You may also reset the AMC7820 from this screen.

3.4.1.1 Reset

The Reset section, in the lower left hand corner of this screen, allows you to reset the AMC7820 by writing the correct code to the AMC7820's Reset register. Pressing the Write to Reset Register button will cause the AMC7820's registers to be returned to their default states.

3.4.1.2 Shutdown

The Shutdown section of this screen lets you determine if SW1 and SW2 are disabled. This is done by writing the AMC7820's Shutdown register. If the checkbox is checked, the corresponding switch inside the AMC7820 is placed in its disabled state. Refer to the AMC7820 data sheet for more information on these switches and their function.

3.4.1.3 Configuration/Status

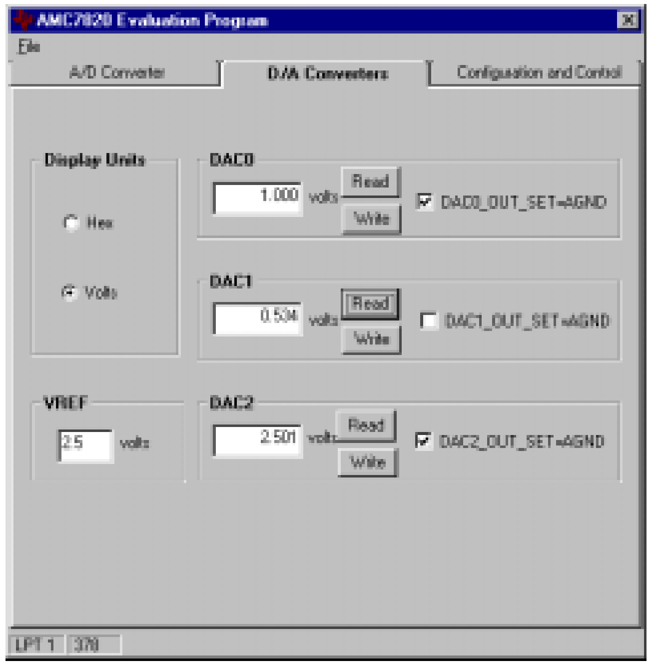
This part of the screen allows you to see the bits in the AMC7820's Configuration/Status register. When the program is started, this register is read and its value displayed here. To read the register at any time, simply press the Read button and the program will read the current data out of the AMC7820.

To change the bit settings, you may either use the radio buttons below the bit display to set specific modes of operation, or you may simply type the bit values into the fields displayed. Anytime a change is made, the change is NOT written to the AMC7820 device until the Write button is pressed. This allows you to see the effects of changes in the bit patterns without actually changing the configuration of the part until you are certain you have what you want.

3.4.2 D/A Converters

This screen allows you to control the D/A converters in the AMC7820. You may read and write the D/A register values and specify or display these values in either hexadecimal format or in volts, as shown in Figure 4.

Figure 4. D/A Converter Screen.



3.4.2.1 DAC0, DAC1, DAC2

These controls enable you to write a value to the D/A converters and read that value back. To set a D/A converter's output level, type the value into the box in the units you have chosen in the Display Units—either Hex or Volts. The value is not written to the D/A converter until you push the Write button.

Pressing the Read button will cause the program to read the D/A converter register and display its value.

The checkbox in this section tells the program how you have configured the hardware—is the DACx_OUT_SET pin grounded? If so, then the D/A converter's output range is from 0V to $2V_{REF}$, whereas if it is not grounded, the range is 0V to V_{REF}. These are the two typical cases; if you have external circuitry that changes these nominal gains, the program cannot take that into account for you directly.

3.4.2.2 VREF

This section of the D/A converter screen allows you to specify the reference voltage you are using. Typically, this will be 2.5V from the internal reference of the AMC7820. However, if you supply an external reference, your voltage may be different and you may enter it here so that voltage calculations shown on this screen are correct.

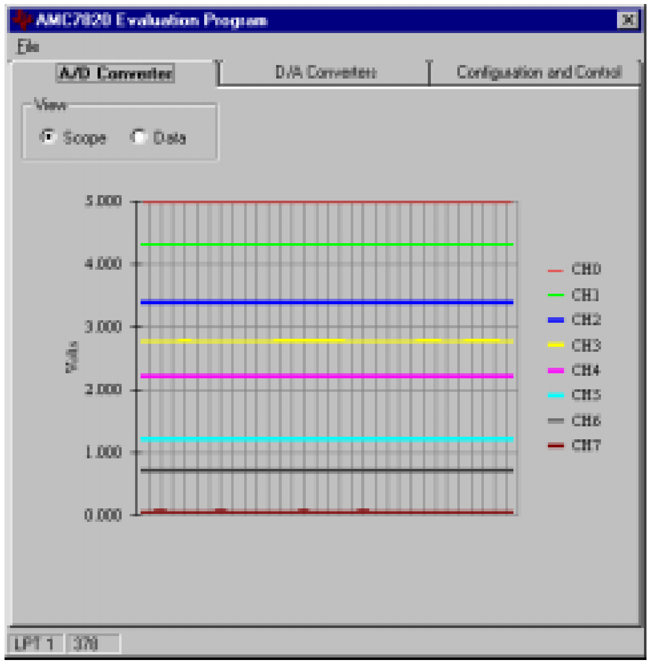
3.4.2.3 Display Units

You may select whether to display the D/A converter values as hexadecimal numbers (Hex) or voltage (Volts). If voltage is chosen, the voltage shown will be determined by the value of the reference voltage specified in the VREF section, and the value of the DACx_OUT_SET checkbox associated with each D/A converter. See the D/A converter section for more information.

3.4.3 A/D Converter

This screen, shown in Figure 5, displays the readings from the onboard 8-channel A/D converter.

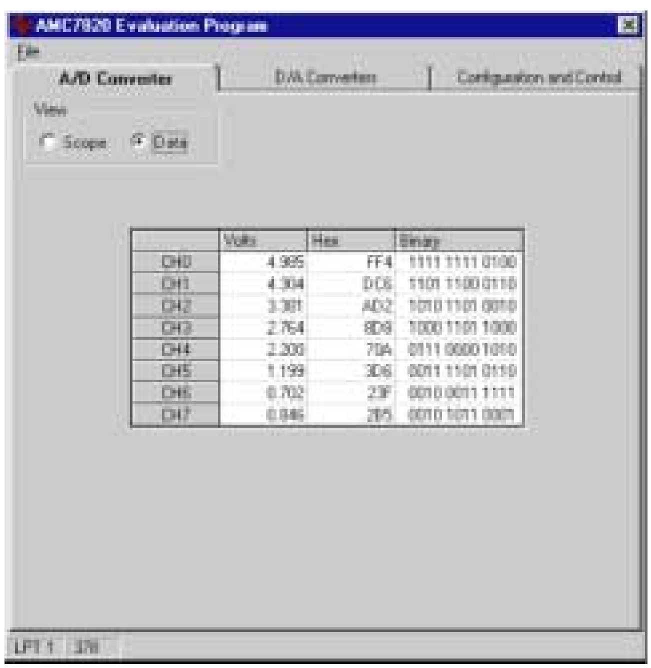
Figure 5. A/D Converter Scope Mode.



This screen gives you the option of viewing the converted data either in a Scope mode, as shown in Figure 5, or in Data mode. In Scope mode, all 8 channels of the A/D converter are displayed in a graphical format.

Data mode displays a listing of the most recent samples, as shown in Figure 6.

Figure 6. A/D Converter Data Mode.



The data values are shown in volts, hexadecimal, and binary units.

Chapter 4

Physical Description

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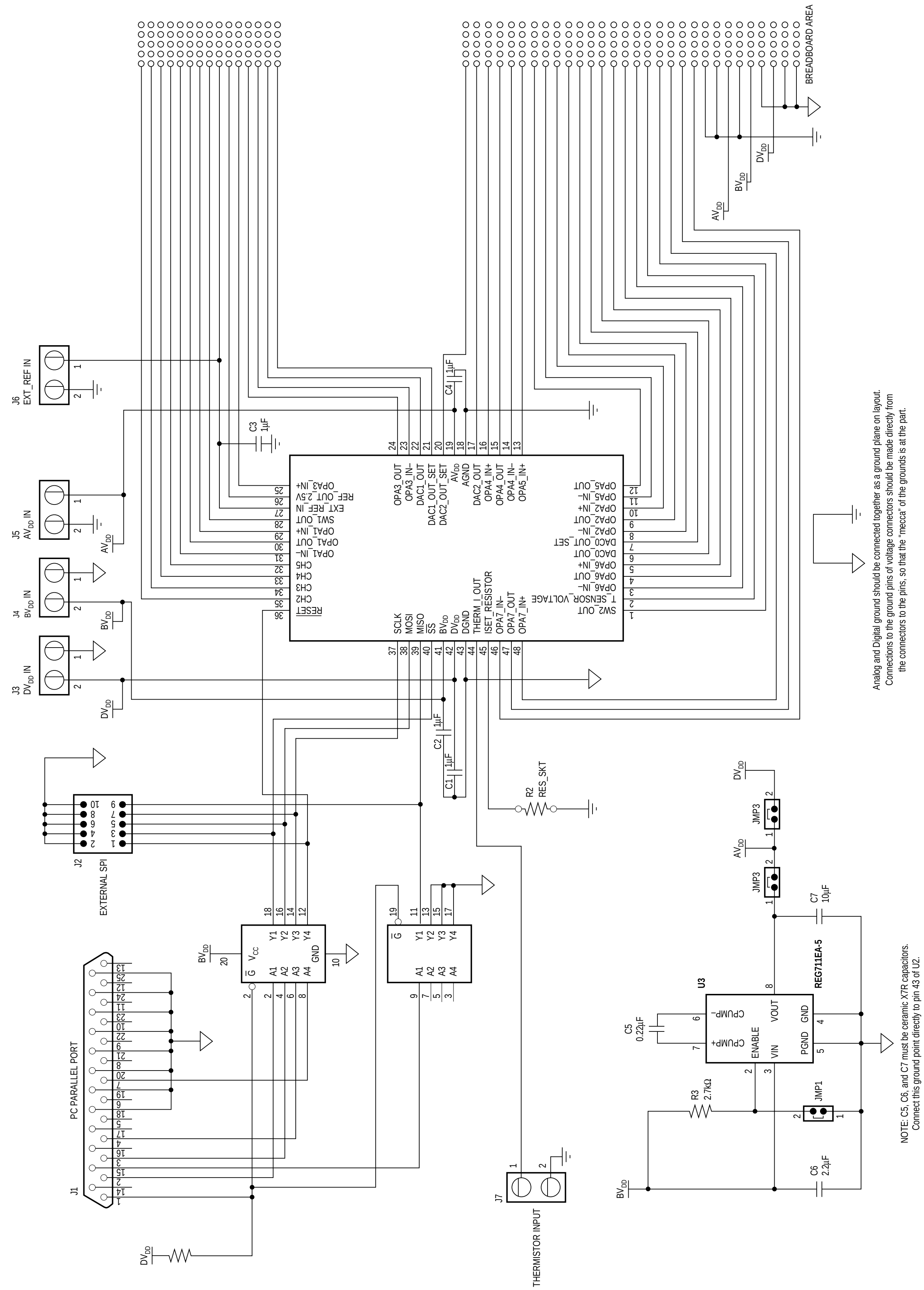
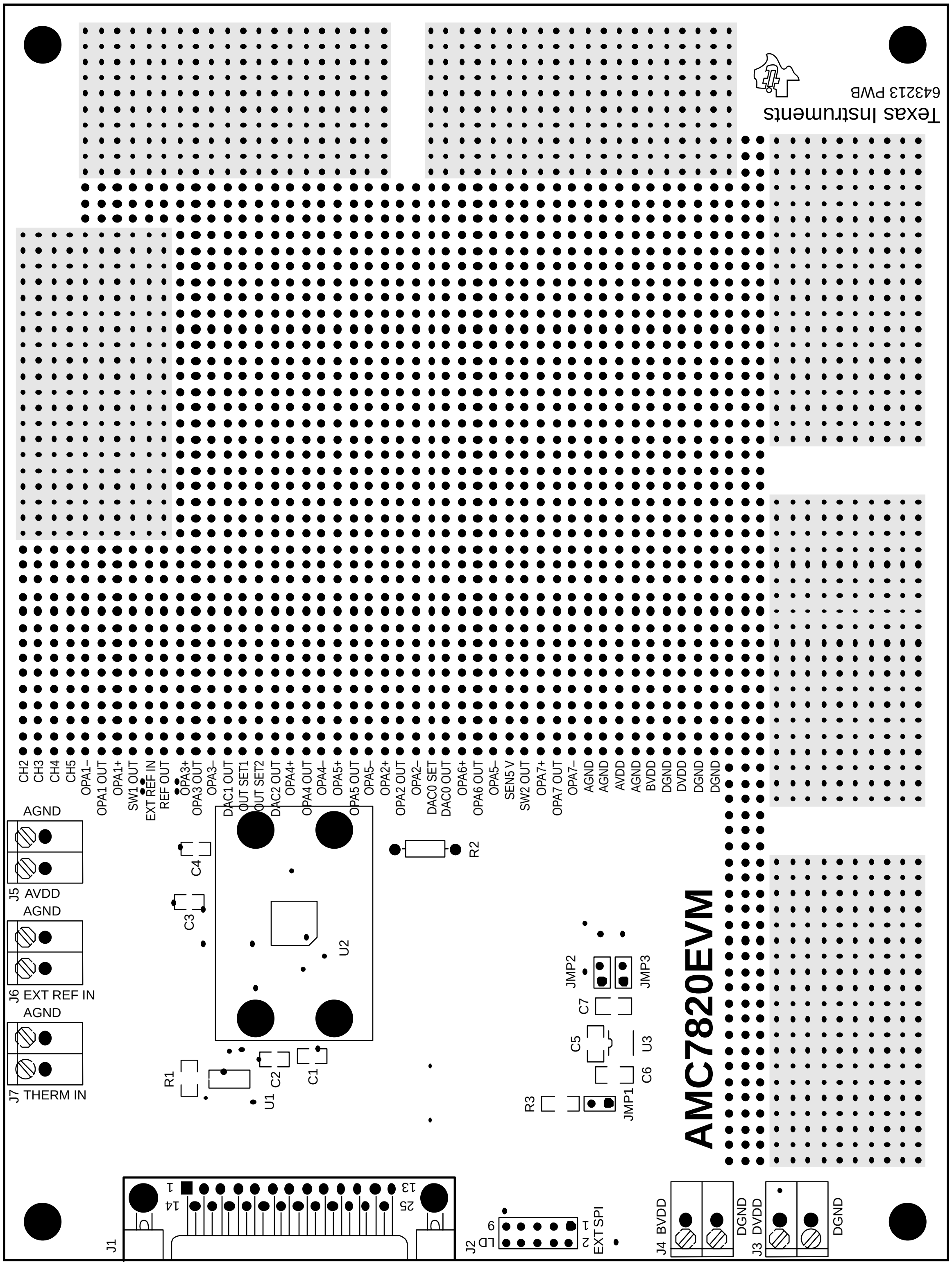
4.1 Schematic



4.2 Component Locations



4.3 Bill of Materials

ITEM NO.	VALUE	REFERENCE DESIGNATORS	QTY	MFG	MFG'S PART NUMBER	DESCRIPTION
1	0.22µF	C5	1	Panasonic or Alternate	ECJ-3VB1E224K	Cap 0.22µF 25V 10% Ceramic Chip 1206 X7R
2	1µF	C1-C4	4	Panasonic or Alternate	ECJ-2VF1C105Z	Cap 1µF 16V 20% Ceramic Chip 0805
3	2.2µF	C6	1	Panasonic or Alternate	ECJ-3YB1C225K	Cap 2.2µF 16V 10% Ceramic Chip 1206 X7R
4	10µF	C7	1	Panasonic or Alternate	ECJ-4YB1C106K	Cap 10µF 16V 10% Ceramic Chip 1210 X5R
5		J1	1	AMP Incorporated	747842-4	DB25 Right-Angle Female Conn w/Board Locks
6		J3-J7	5	On Shore Technology	ED120/2DS	2 Contact Screw Terminal Blocks
7		J2	1	Samtec	TSW-105-07-L-D	10-Pin Dual-Row Header (5x2)
8		JMP1-JMP3	3	Samtec	TSW-102-07-L-S	2-Pin Single-Row Header (2x1)
9	2.7kΩ	R3	1	Panasonic or Alternate	ERJ8GEYJ272V	Resistor, 2.7kΩ 1/8W 5% 1206 SMD
10	4.7kΩ	R1	1	Panasonic or Alternate	ERJ8GEYJ472V	Resistor, 4.7kΩ 1/8W 5% 1206 SMD
11		R2	2	AMP Incorporated	50863-5	Miniature Spring Socket
12		U1	1	Texas Instruments	SN74AHC244PWR	Octal Buffers/Drivers with 3-State Outputs
13		U2	1	Texas Instruments	AMC7820	Analog Interface
14		U3	1	Texas Instruments	REG711EA-5	50mA Switched-Cap DC/DC Converter
15		NA	3	Samtec or Alternate	SNT-100-BK-TH	Shorting Jumper
16		NA	4	Keystone Electronics or Alternate	1808	1/4” x 0.625 Hex 4-40 Threaded Standoff
17		NA	4	Building Fasteners or Alternate	PMS 440 0050 PH	Pan Head Machine Screws 4-40 x 1/2” Phillips

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