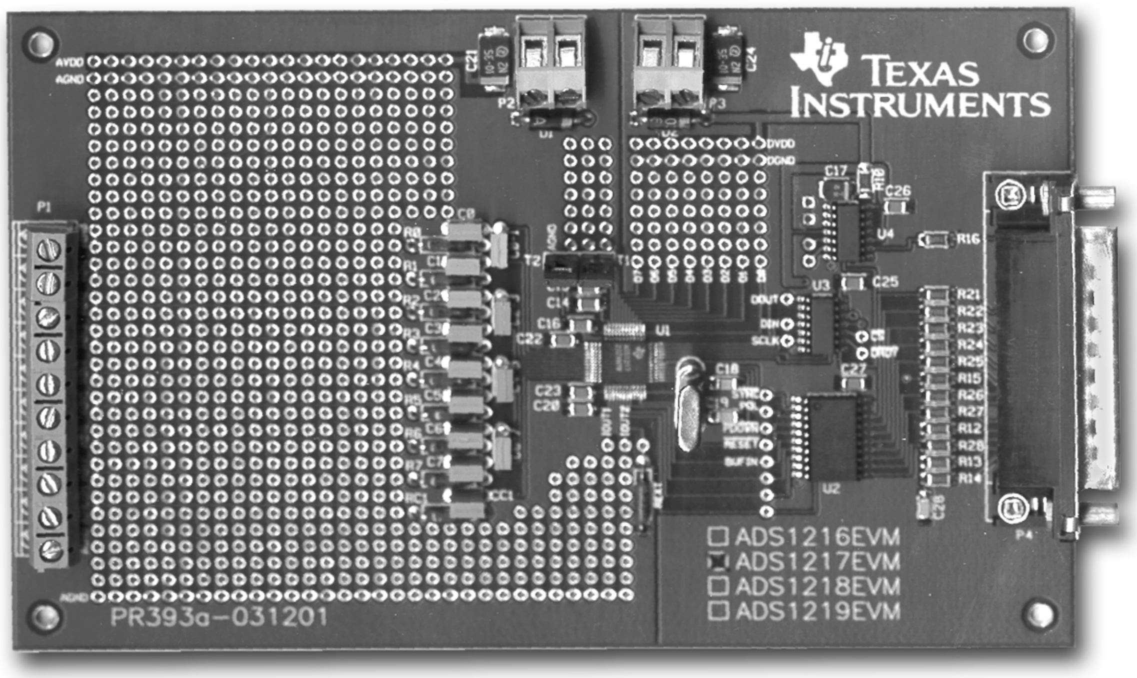
ADS1217EVM

SBAU079 – MAY 2002



FEATURES

- PROVIDES FAST AND EASY PERFORMANCE TESTING FOR THE ADS1217
- SEPARATE ANALOG AND DIGITAL POWER
- PC PRINTER PORT CONTROL
- WINDOWS® 95, 98 SOFTWARE

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DESCRIPTION

The ADS1217EVM evaluation module is designed for ease of use when evaluating the high resolution Analog-to-Digital Converter ADS1217. The ADS1217 offers 24-bits no-missing-codes performance. It has eight input channels that can be configured as up to eight differential channels. The Multiplexer is followed by a Programmable Gain Amplifier (PGA) with selectable gains of up to 128.

Hardware options include user defined clock frequency, internal or external reference, and input biasing.

All of the features and functionality of the ADS1217 can be exercised using the pull-down menus available from the ADS1217EVM software.

INITIAL CONFIGURATION

The ADS1217EVM is designed to be operational without any user configuration except for connecting the power supplies and communications cable to the PC printer port. To use the internal reference voltage, jumpers T1 and T2 should be installed.

POWER SUPPLY

The analog and digital supplies should be connected together at the power supply. That means that a pair of wires should go from V_{CC} and AGND to the power supply and a separate pair of wires should go from V_{DD} and DGND to the same +5V power supply.

VOLTAGE REFERENCE

With jumpers T1 and T2 installed, the ADS1217 evaluation module will use the internal reference. These jumpers can be replaced and connections made to the pins to use an external reference.

CLOCK

A 2.4576MHz crystal is connected to the XIN and XOUT pins to provide a convenient frequency for 60Hz rejection.

PC BOARD LAYOUT

The ADS1217EVM evaluation module consists of a two-layer PC board. To achieve the highest level of performance, surface-mount components are used wherever possible. This reduces the trace length and minimizes the effects of parasitic capacitance and inductance. The evaluation module has a divided ground with all the analog signals over one portion and the digital signals in the other. Keep in mind that this approach may not necessarily yield optimum performance results when designing the ADS1217 into different individual applications. In any case, thoroughly bypassing the power supply and reference pins of the converter is strongly recommended.

The breadboard area is provided so that input filters can be added. As shipped, the board includes an R-C filter (49.9Ω and 47pF) on each input with a 0.1µF differential capacitor between adjacent channels.

WINDOWS SOFTWARE

The ADS1217 uses registers and 1-byte opcodes to control its operation. The evaluation software provides a convenient method to issue the commands and receive the results. It also can display the results of acquired data, as shown in Figure 1 and perform a frequency analysis, as shown in Figure 2.

The program is organized with pull-down menus as follows:

File
- Save Data
- Save FFT Data
- Print Data
- Exit

Configuration
- Configure Device
- Select Input Channel
- Set IDACs/PGA/V_{REF}

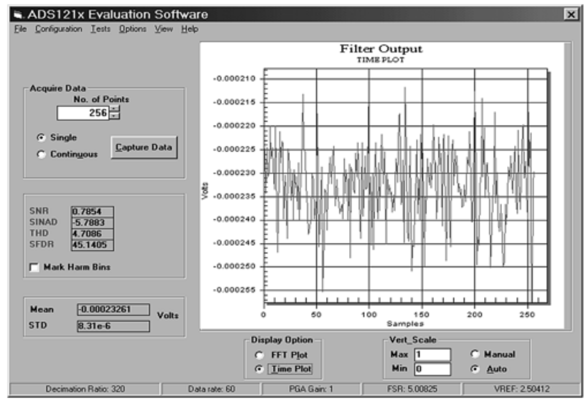

FIGURE 1. Time Plot.

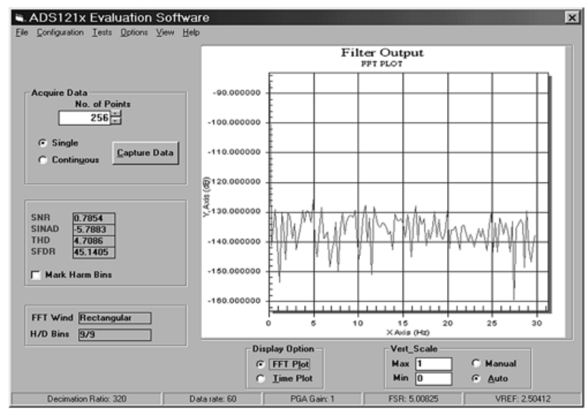

FIGURE 2. FFT Frequency Plot.

Tests
- Opcode Test
- Noise Test
- Memory R/W Test

Options
- Data List Format
  - Voltage
  - Raw Hex
  - Raw Decimal
- Set FFT Window
  - Rectangular
  - Hamming
  - Blackman
  - Blackman Harris
  - Continuous 5th Derivative
- FFT Harmonic Bins
  - Number of Harmonic Bins
  - Number of DC Bins

View
- Display Data List

Help
- About ADS1217 Demo SW

SAVE DATA

The Save Data List shows the individual data values as well as the mean and standard deviation of the data.

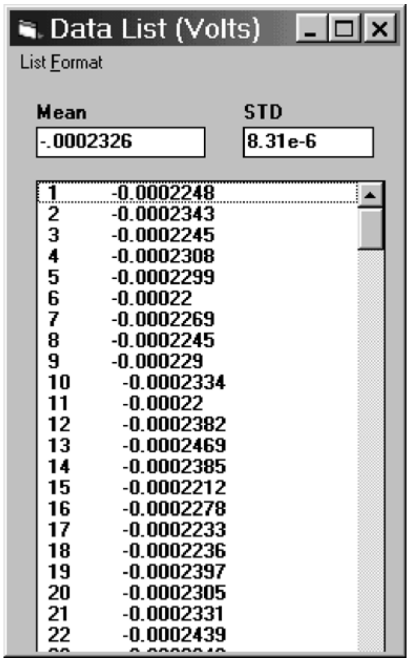

FIGURE 3. Data List.

CONFIGURATION

The Configure Digital Filter opens a window that provides many options, as shown in Figure 4.

Filter Decimation Ratio

The Filter Decimation Ratio box allows you to adjust the decimation ratio with the scroll bar or by entering the value in the box at the bottom. Additionally, as you change the decimation ratio, you can observe the resulting data rate.

Calibration Registers

The current values of the Offset, Full-Scale Output Data registers can be read and displayed. Additionally, these values can be changed by entering a new HEX value in the field and pushing the set button.

Calibration

Five types of calibration can be performed. When the button is pushed, the ADS1217 performs the calibration and then reads back and displays the results in the calibration registers. The five types of calibration are:

1) Selfcal—Both Offset and Gain Calibration

2) Selfocal—Only Offset Calibration

3) Selfgcal—Only Gain Calibration

4) Sysocal—Offset Calibration, Input = 0V

5) Sysgcal—Gain Calibration, Input = V_{REF}

Set I/O Direction

The eight pins of I/O can be individually set for output or input. The output pins will be set to the HEX value entered in the “Write I/O” field when the “Write I/O” button is selected. The value of all pins will be displayed in the box next to the “Read I/O” button when it is selected.

Status

The various control bits can be set and monitored in the Status box. Additionally the revision ID of the ADS1217 will be displayed. The Status bits and their function are shown in Table I.

	0	1
LSB_1st	Send MSB First	Send LSB First
EN_Buff	No Input Buffer	Input Buffer Enabled
V_{REF}_HI	V_{REF} = 1.25V	V_{REF} = 2.5V
EN_V_{REF}	V_{REF} OFF	V_{REF} ON

TABLE I. Control Bits.

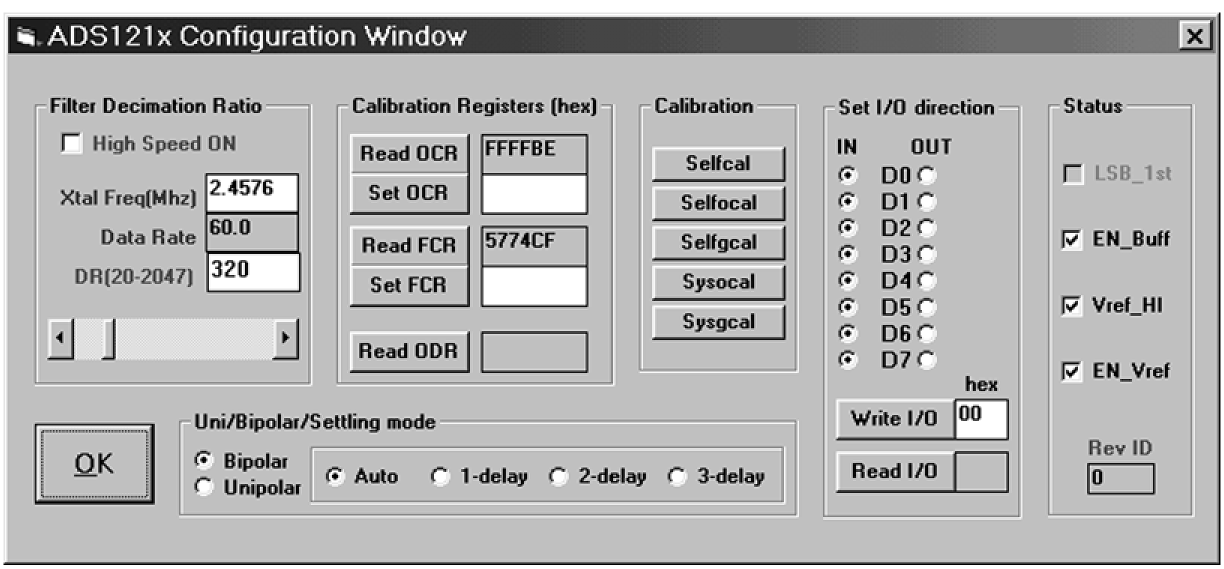

FIGURE 4. FFT Frequency Plot.

Unipolar/Bipolar

The results of the unipolar/bipolar selection are shown in Table II.

	ANALOG INPUT	DIGITAL OUTPUT
Bipolar	+FSR Zero –FSR	0x7FFFFF 0x000000 0x800000
Unipolar	+FSR Zero –FSR	0xFFFFFF 0x000000 0x000000

TABLE II. Unipolar/Bipolar Selection Results.

Settling Mode

Three Sinc filters can be selected. When the input changes the fast settling filter settles in one data output interval, $Sinc^2$ settles in two periods, and $Sinc^3$ takes three periods to fully settle. However, the $Sinc^3$ filter has the highest resolution. The desired filter can be selected. Auto mode selects the fast fettling filter when the input changes, then it changes to the $Sinc^2$ filter for the third period, and on the forth data out period it will use the output of the $Sinc^3$ filter. This gives fast settling when the input channel changes, but the same high resolution results after the necessary number of conversion periods.

OK

Selecting OK will save the selected setup.

SELECT INPUT CHANNELS

Figure 5 gives a graphical method to select the multiplexer channel. This also shows the full flexibility of the ADS1217 multiplexer which allows any input to be selected as the positive or negative input for a measurement. The mouse selects which switch to close. Additionally, the internal diode can be connected which uses IDAC1 as the current source. By measuring the voltage on the diode, a temperature measurement can be made.

Calibrate Internal Temp Sensor

The Calibrate Temp button opens the Internal Temp Sensor Calibration window for calibration of internal temperature diode, as shown in Figure 6. This allows you to force the temperature readout to match the temperature you enter. This is not intended to give a high-accuracy temperature readout, but will give a reading that is reasonable for a single diode voltage measurement.

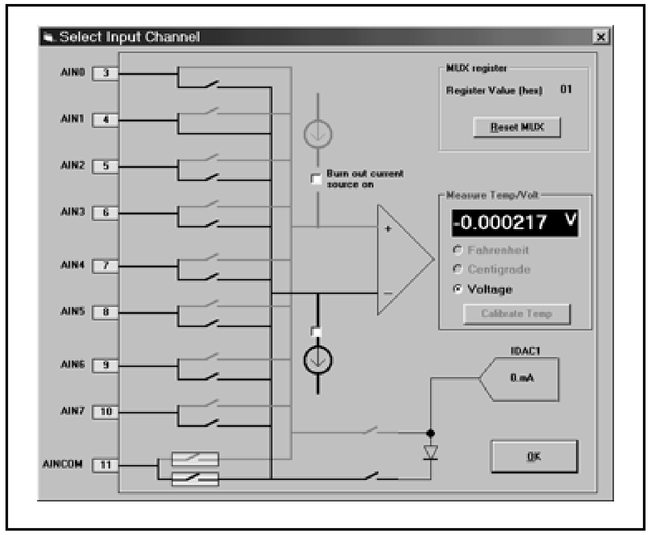

FIGURE 5. Input Multiplexer.

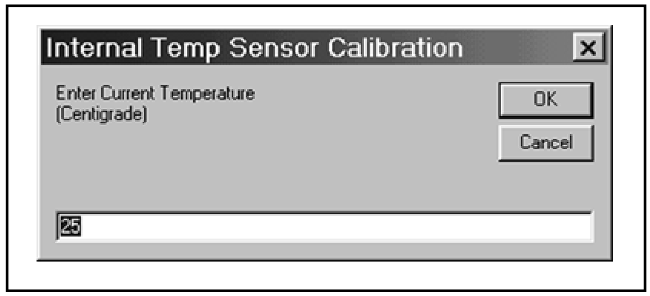

FIGURE 6. Temperature Calibration.

Set IDACs/PGA/V_{REF}

This screen provides the means to observe the interaction of the IDAC settings, R_{EXT} and V_{REF}. Additionally, the PGA can be set from this screen.

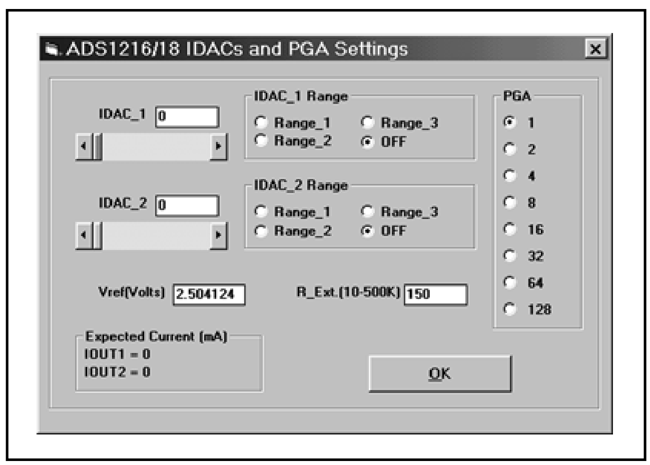

FIGURE 7. PGA Settings.

TEST SCREENS

Opcode Test

This screen in Figure 8 allows all the opcodes to be tested and the results observed.

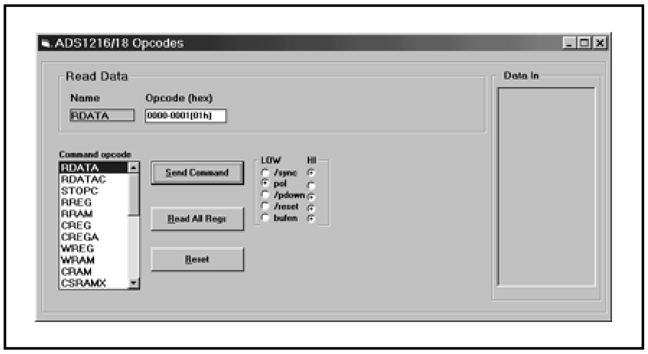

FIGURE 8. Opcode Control.

One convenient way to test the communications and operations of the ADS1217 Demo software is to go to this screen, select "Reset", and then "Read all Regs". You should end up with a register dump that looks like Figure 9.

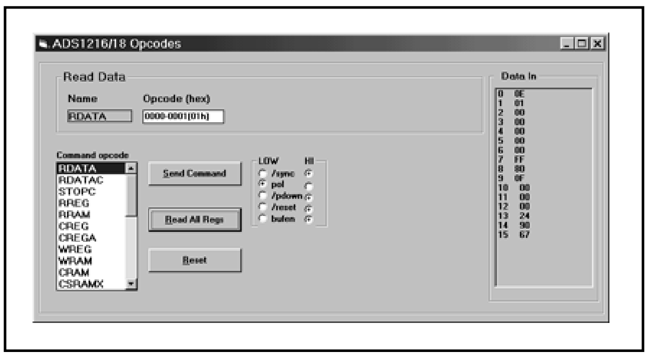

FIGURE 9. Reset Condition.

You can observe that the reset state of the registers are: 0E, 01, 00, 00, 00, 00, 00, FF, 80, 0F, 00, 00, 00, 24, 90, and 67.

This screen also shows the state of the digital control signals. Any opcode can be entered and tested to observe the results.

RAM R/W Test

The test screen in Figure 10 provides tools for testing RAM and Flash memory. Various simple operations have been assigned to a button. Additionally, a full RAM test will be executed with the "Test Ram" button. This clears RAM, generates random data, writes to the RAM, and verifies that the contents match the random data.

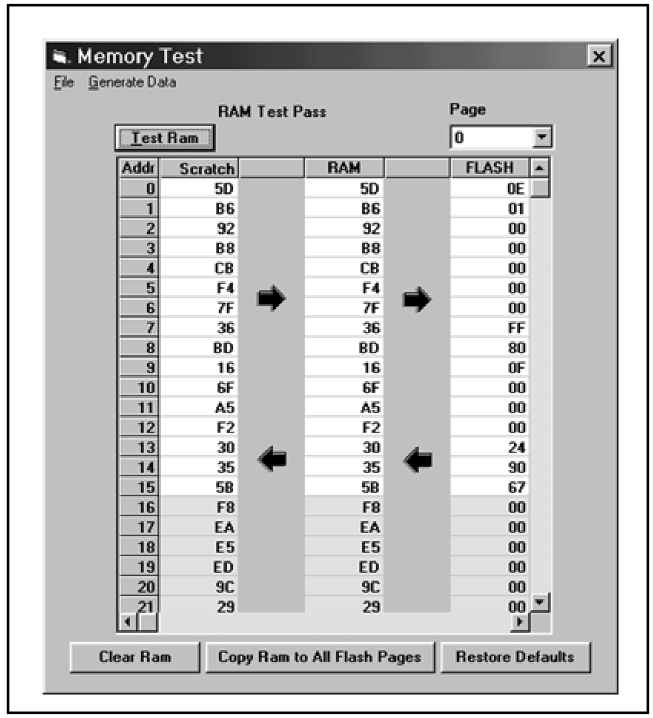

FIGURE 10. Ram Test.

Noise Test

This test provides an automated means to verify the performance of the ADS1217 across various decimation ratio values and PGA settings, and averages the results. With all the options selected, this test can take a long time to complete. The results are displayed in a tabular format which shows the PGA settings, Decimation Rate, Average Output, Standard Deviation, and Effective number of bits, as shown in Figure 11.

The "File" menu selection gives you the option to save your data. All data is saved in a comma delimited format so that it can be imported into a spreadsheet for further analysis.

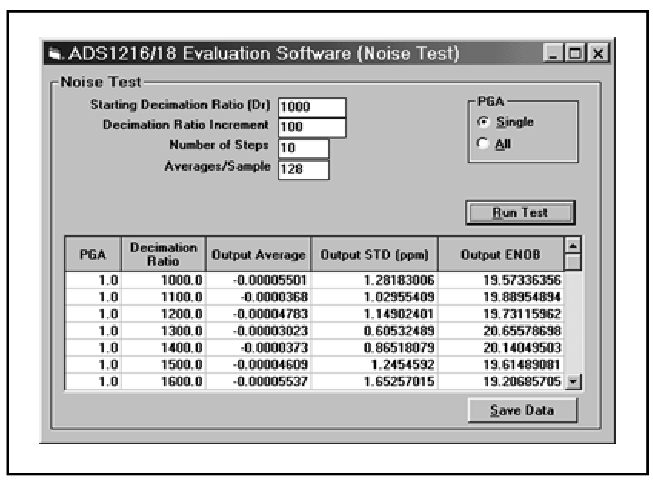

FIGURE 11. Noise Test Results.

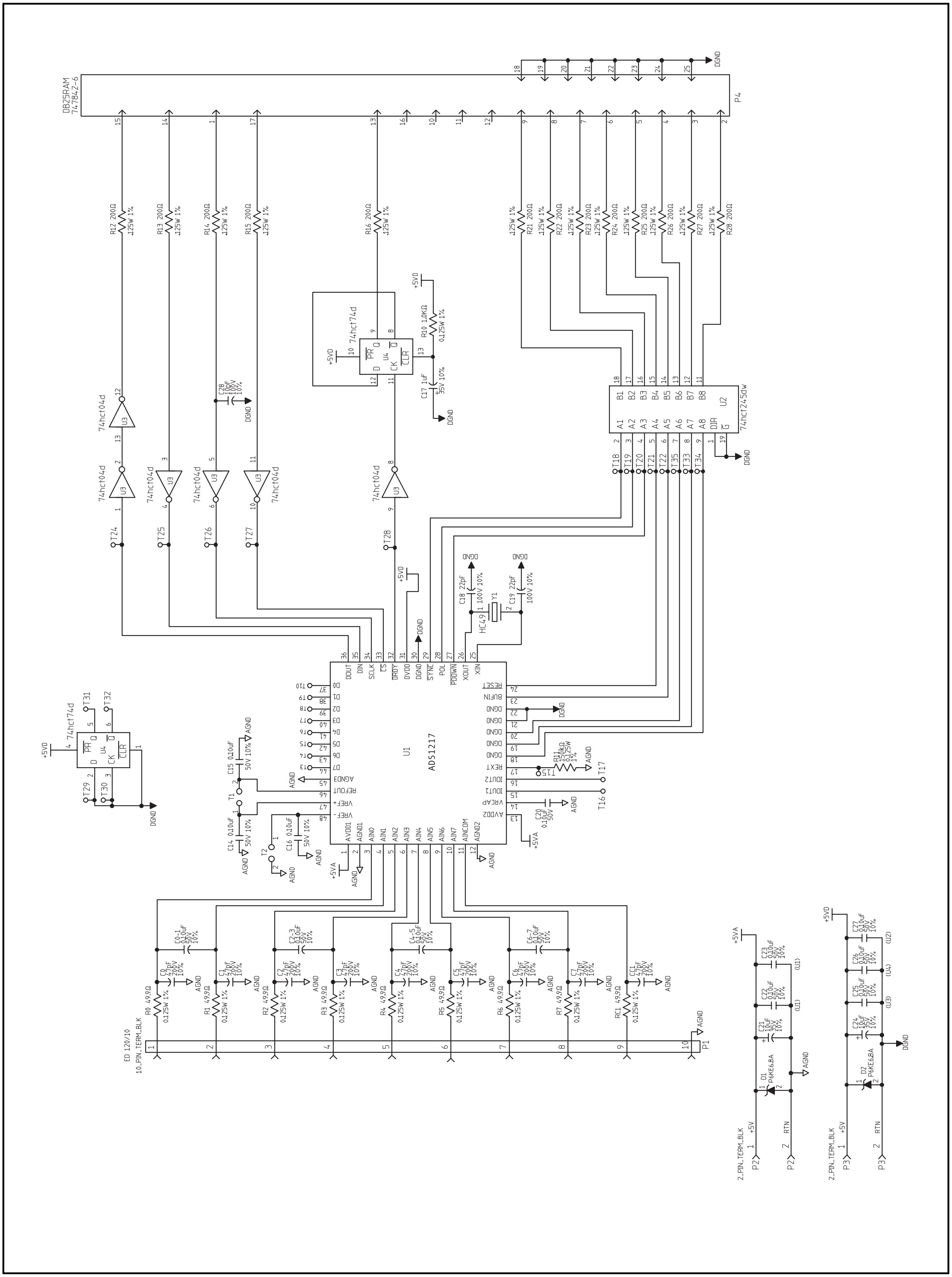

FIGURE 12. ADS1217EVM Schematic.

COMPONENT LIST

PART NUMBER	DESCRIPTION	REF. DES.	QTY	VENDOR PART NUMBER	MANUFACTURER
ADS1217	Analog-to-Digital Converter, 24-Bit	U1	1	ADS1217	Texas Instruments
CK05BX104K	Capacitor, 0.10µF, 50V, 10%, Ceramic X7R	C0-1, C2-3, C4-5, C6-7	4	CK05BX104K	Kemet
CK05BX470K	Capacitor, 47pF, 200V, 10%, Ceramic X7R	C0, C1, C2, C3, C4, C5	9	CK05BX470K	Kemet
		C6, C7, CC1			
CRCW12061001F	Resistor, 1.0kΩ, 0.125W, 1%, Chip-Thick-Film	R10	1	CRCW12061001F	Dale
CRCW12062000F	Resistor, 200Ω, 0.125W, 1%, Chip-Thick-Film	R12, R13, R14, R15, R16	13	CRCW12062000F	Dale
		R21, R22, R23, R24, R25			
		R26, R27, R28			
C1206C100K1GAC	Capacitor, 10pF, 100V, 10%, Chip-Ceramic COG	C28	1	C1206C100K1GAC	Kemet
C1206C104K5RAC	Capacitor, 0.10µF, 50V, 10%, Chip-Ceramic X7R	C14, C15, C16, C20, C22	9	C1206C104K5RAC	Kemet
		C23, C25, C26, C27			
C1206C220K1GAC	Capacitor, 22pF, 100V, 10%, Chip-Ceramic COG	C18, C19	2	C1206C220K1GAC	Kemet
ED 120/10	Terminal Block, 10-Pin	P1	1	ED 120/10	On-Shore Technology
ED 300/2	Terminal Block, 2-Pin, 5MM Pitch	P2, P3	2	ED 300/2	
HC49	Crystal, 2.4576MHz	Y1	1	HC49	CTS
P6KE6.8A	Diode, Zener 6.8V	D1, D2	2	P6KE6.8A	
REG1117-5	Voltage Regulator, +5V	Q1	1	REG1117-5	Texas Instruments
RN55C49R9F	Resistor, 49.9Ω, 0.125W, 1%, Metal-Film	R0, R1, R2, R3, R4, R5	9	RN55C49R9F	Dale
		R6, R7, RC1			
150KXBK-ND	Resistor, 150kΩ 0.25W, 1% Metal Film	R11	1	150KXBK-ND	Kemet
TSW-1-S01-06-S	Terminal, 1-Pin	T3, T4, T5, T6, T7, T8	28	TSW-1-S01-06-S	
		T9, T10, T15, T16, T17			
		T18, T19, T20, T21, T22			
		T24,T25,T26,T27,T28			
		T29, T30, T31, T32, T33			
		T34, T35			
TSW-102-07-L-S	Connector, 2-Pin, 0.1'' Center, 0.025'' Sq. Post	T1, T2, T36, T37	4	TSW-102-07-L-S	
T491B105K350AS	Capacitor, 1µF, 35V, 10%, Tantalum Chip-Molded	C17	1	T491B105K035AS	Kemet
T491D106K035AS	Capacitor, 10µF, 35V, 10%, Tantalum Chip-Molded	C21, C24	2	T491D106K035AS	Kemet
74HCT04D	IC, Inverter, Hex	U3	1	74HCT04D	
74HCT74D	IC, Flip Flop, Dual J-K with Clear & Preset	U4	1	74HCT74D	
74HCT245DW	IC, Bus Transceiver, Octal, 3-State Outputs	U2	1	74HCT245DW	
747842-6	Connector, 25-Pin, Right-Angle, Male, D-sub	P4	1	747842-6	AMP

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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.

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 50°C. The EVM is designed to operate properly with certain components above 50°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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