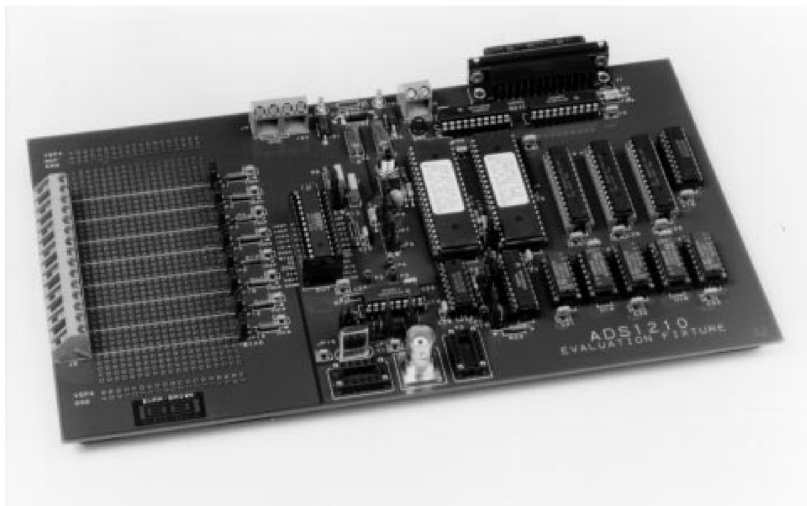
BURR - BROWN ®

DEM-ADS1210/11

EVALUATION FIXTURE



FEATURES

- EASY TO USE IBM INTERFACE
- MOUSE OR KEYBOARD CONTROL
- COLLECTS UP TO 32,768 CONVERSIONS
- CIRCUIT LAYOUT IS OPTIMIZED FOR LOW NOISE APPLICATONS
- FOURIER ANALYSIS WITH 7 CHOICES OF FFT WINDOWS
- DATA CAN BE STORED ON DISK OR PLOTTED TO LASER JET II
- DATA CAN BE DISPLAYED AND ANALYZED IN TIME OR FREQUENCY

NOTE: This document pertains to REV B of the hardware. See Appendix A of this data sheet for details.

DESCRIPTION

The DEM-ADS1210/11 is an evaluation fixture that allows for the easiest possible evaluation of the ADS1210, ADS1211, ADS1212 or ADS1213 $\Delta\Sigma$ analog-to-digital converters.

This evaluation board turns an IBM PC into a full-featured data acquisition device. Recovered data can be analyzed using either time or frequency plots. The frequency domain analysis uses conventional FFT plots. The FFT analysis can also be modified with a user selectable FFT window.

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

All of the features and functionality of the ADS121X family can be exercised using the pull-down menus available from the ADS121X software.

Included with the DEM-ADS1210/11 is the interface hardware, which controls the PC to ADS121X converter interaction, and memory, which can store up to 32,768 data points or conversions. Additionally, an ADS1211P and ADS1213P is provided for immediate evaluation.

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HARDWARE INSTALLATION

The DEM-ADS1210/11 comes with the four-channel ADS1211 and ADS1213, to be installed by the user into the DUT (Device Under Test) socket. The demonstration board is also compatible with the ADS1210 and ADS1212, which can be ordered separately. Since the ADS1210 and ADS1212 are 18-pin devices and the ADS1211 and ADS1213 are 24-pin devices, care must be taken to orient the ADS1210 and ADS1212 devices correctly. Place pin 9 of the ADS1210 or ADS1212 in the lower left-hand corner or pin 12 (DGND) of the DUT socket.

The only necessary hardware connections to the DEM-ADS1210/11 demonstration evaluation fixture is a single +5V source, the computer interface connector and the input signal source.

The +5V source should be well regulated and bypassed at the supply. A switching supply will add noise to the converter's output and limit its low input level performance. The power supply should be capable of 800mA of supply current plus any additional current used for external input circuitry. There are two separate supply connections on the board; the analog supply is connected through jack J4 and the digital supply is connected through jack J5 (see Figure 1). The analog supply has three ground connections, only one of which needs to be connected.

The connection to the IBM-PC is made with a 25-pin ribbon cable to an unused parallel port. If the computer does not have two ports, all output plots may be saved as a file and printed later. This option is discussed in the Software Features section of this data sheet.

The input signals are applied to the J3 connectors on the board. Care must be taken not to exceed the maximum input voltages of the A/D converter (DUT). Refer to the ADS1210/ADS1211 or ADS1212/ADS1213 data sheets for input voltage ranges and restrictions.

HARDWARE DESCRIPTION

The DEM-ADS1210/11 system board is a single, self-contained board that contains all of the necessary hardware and support circuitry to allow the user to evaluate the converter and store up to 32K, 24-bit conversions of results. The system board is laid out with low noise and optimal performance in mind. The board uses separate analog and digital power and ground sections as well as a breadboarding section.

Figure 1 shows the parts location for the system board. The board can be broken down into the following sections; breadboarding, clock configuration, signal conditioning, DUT digital interface, PC interface (Figure 2), power, memory (Figure 3), and DUT (Figure 4).

Breadboarding Section

This section of the board is used to build application circuits or front-end conditioning circuits for the A/D converter. The entire area is laid out on 0.1" plated centers. The analog power supply, reference, and ground points used by the DUT are available on the left-hand side of the board.

The terminal block, J3, uses screw terminals to connect analog inputs to jumpers JP1, 2, 3, 5, 8, 10, 12, and 14. Consult the jumper list, Table I, for the configuration of these jumpers. Each input jumper is also connected to three of the through-hole contacts in the breadboard section of the board.

JUMPER NUMBER	FACTORY PLACEMENT	FUNCTION
JP1	Installed	Selects Built-in Aliasing Filter for Channel 4P.
JP2	Installed	Selects Built-in Aliasing Filter for Channel 4N.
JP3	Installed	Selects Built-in Aliasing Filter for Channel 3P.
JP4	Not Installed	External (A)/Internal Reference (B).
JP5	Installed	Selects Built-in Aliasing Filter for Channel 3N.
JP6	Not Installed	SSI (A)/SPI (B) Interface Mode.
JP7	Not Installed	Self (A)/External (B) System Clock.
JP8	Installed	Selects Built-in Aliasing Filter for Channel 2P.
JP9	Not Installed	Master (A)/Slave (B) Clock Mode.
JP10	Installed	Selects Built-in Aliasing Filter for Channel 2N.
JP11	Not Installed	SSI (A)/SPI (B) Chip Select Mode.
JP12	Installed	Selects Built-in Aliasing Filter for Channel 1P.
JP13	Not Installed	External (A)/Self (B) System Clock.
JP14	Installed	Selects Built-in Aliasing Filter for Channel 1N.
JP15	Not Installed	Self (A)/External (B) System Clock.
JP16	Not Installed	Clock Source and Type.
JP17	Not Installed	Clock Source and Type.
JP18	Not Installed	X_{OUT} (A)/Oscillator (B) Processor Clock Source.
JP19	Not Installed	Self (A)/External (B) System Clock.
NOTE: JP1, 2, 3, 5, 8, and 10 are used for the 4-channel input, ADS1211. The remainder of the jumpers are used for both the ADS1210 or ADS1211.		

TABLE I. Factory Jumper Placements for DEM-ADS1210/11.

Signal Conditioning Section

This section consists of passive single pole, low pass filters for all the inputs of the DUT (as shown in Figure 4). Each input filter consists of a 200Ω resistor and 47pF capacitor. If a different filter frequency is desired, the components can be replaced with different values. Additionally, a 0.1µF to 1µF capacitor can be placed between the DUT positive and negative inputs to reduce noise. Table II indicates the reference designator and channel designation for these components.

ANALOG INPUT CHANNEL	INPUT PIN	JUMPER NUMBER
Channel 1 Positive	$A_{IN}1P$	JP12
Channel 1 Negative	$A_{IN}1N$	JP14
Channel 2 Positive	$A_{IN}2P$	JP8
Channel 2 Negative	$A_{IN}2N$	JP10
Channel 3 Positive	$A_{IN}3P$	JP3
Channel 3 Negative	$A_{IN}3N$	JP5
Channel 4 Positive	$A_{IN}4P$	JP1
Channel 4 Negative	$A_{IN}4N$	JP2

TABLE II. Analog Input vs Jumper.

CLOCK CONFIGURATION

The oscillators that have been installed in the evaluation fixture are: Y1 = 10MHz, Y2 = 1MHz, and Y3 = 8MHz. The ADS1210 and ADS1211 are capable of running with a 10MHz clock. In the case where the ADS1210 and ADS1211 are being evaluated, the first jumper setting shown in Table III is appropriate. The ADS1212 and ADS1213 are not capable of running with a 10MHz clock, as is the case with the ADS1210 and ADS1211. A 1MHz oscillator is installed in the Y2 socket. Additionally, the µC are not able to operate at less than 4MHz. In order to evaluate the reset function, the ADS1212 and ADS1213 (DUT) should be clocked by a 1MHz X_{IN} clock (use Y2) and the µC (U4 and U5) clocked by an 8MHz clock (use Y3). The evaluation fixture can be configured to change the clock source for the converter and processors. The jumper settings are listed in Tables III, IV, and V.

JUMPER	Y1 TO BOTH µC AND DUT	Y2 TO BOTH µC AND DUT	Y3 TO µC Y2 TO DUT	EXT CLK TO BOTH µC AND DUT	Y3 TO µC EXT CLK TO DUT
JP16	A, B	A, B	A, B	A, B	A, B
JP17	C	A	A	B	B
JP18	A	A	B	A	B

TABLE III. Jumper Settings for Clocks.

JUMPER	SPIMC	SPISC	SSISC	SSIEC
J6	B	B	A	A
J7	A	B	A	B
J9	A	B	A	B
J11	B	B	A	A
J13	B	A	B	A
J15	A	B	A	B
J19	A	B	A	B
DUT Output Port(1)	SDOUT	SDIO	SDOUT	SDIO

NOTE: (1) Programmed in Setup portion of software.

TABLE IV. Jumper Setup for Digital Interface. SPIMC = SPI Master Mode, SPISC = SPI Slave Mode, SSISC = SSI Master Mode, SSIEC = SSI Slave Mode.

JUMPER	EXTERNAL	INTERNAL
J4	A	B

TABLE V. Jumper Setup for Voltage Reference.

DUT DIGITAL INTERFACE

THE DEM-ADS1210/11P demonstration fixture supports the serial communication protocols of SPI and SSI. In the SPI mode, the A/D converter (DUT) can be configured to operate in the master or slave mode. The jumper settings for these communication protocols are stated in Table IV. In all cases, the serial interface mode must be programmed through the "Configuration"-"ADS121X" area in the software. Additionally, the output port of the A/D converter must be programmed through the "Setup"-"Command Register" area in the software according to the output port called out in Table IV.

SUGGESTED JUMPER PLACEMENT

Some jumpers may have been removed to avoid damage during shipping. The default position for the jumpers when testing the ADS1210 or ADS1211 are as follows:

JP4 = A	JP6 = B	JP7 = A	JP9 = A
JP11 =B	JP13 = B	JP15 = A	JP16 = A, B
JP17 = C	JP18 = A	JP19 = A	

The default position for the jumpers when testing the ADS1212 and ADS1213 are as follows:

JP4 = A	JP6 = B	JP7 = A	JP9 = A
JP11 = B	JP13 = B	JP15 = A	JP16 = A, B
JP17 = A	JP18 = B	JP19 = A	

PC Interface Section

The interface between the DEM-ADS1210/11 board and a PC consists of a 25-pin connector, J1, octal buffers, U1 and U2, and microcontrollers, U4 (as also shown in Figure 2). The S1 switch is used to reset the system which is interfaced to U4 and U5. The clock to these microcontrollers must be between 4MHz and 16MHz for proper operation. If the DUT clock does not comply with this requirement, a second oscillatior can be installed on the board (Y3) or an external signal can be used. See Table III for jumper settings.

Power Section

The DEM-ADS1210/11 is designed to accommodate separate analog and digital supplies. The power section has protection diodes, CR1, CR2 and CR3 to protect the DUT against power supply violations. The analog power connector, J4, also provides power to the breadboarding section. The digital power connector, J5, provides power to the DUT digital section and the remainder of the demonstration board.

DUT and Memory Section

The DUT and memory interface is controlled by the microcontroller, U5. Fast FIFO memory is provided by U7, U8, and U9, giving up to 32K of 24-bit storage for the DUT conversions.

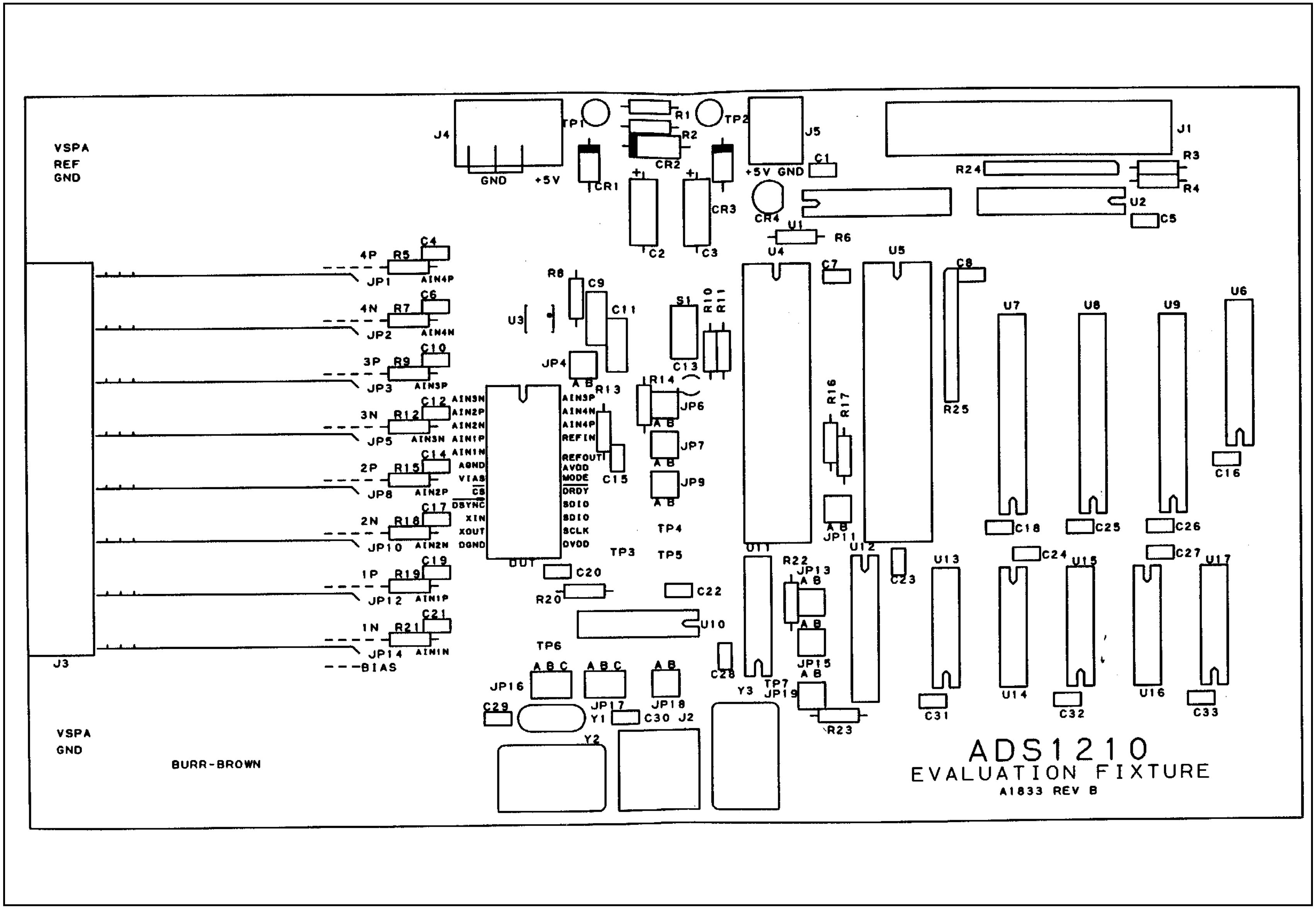


FIGURE 1. Parts Location on the DEM-ADS1210/11 Board.

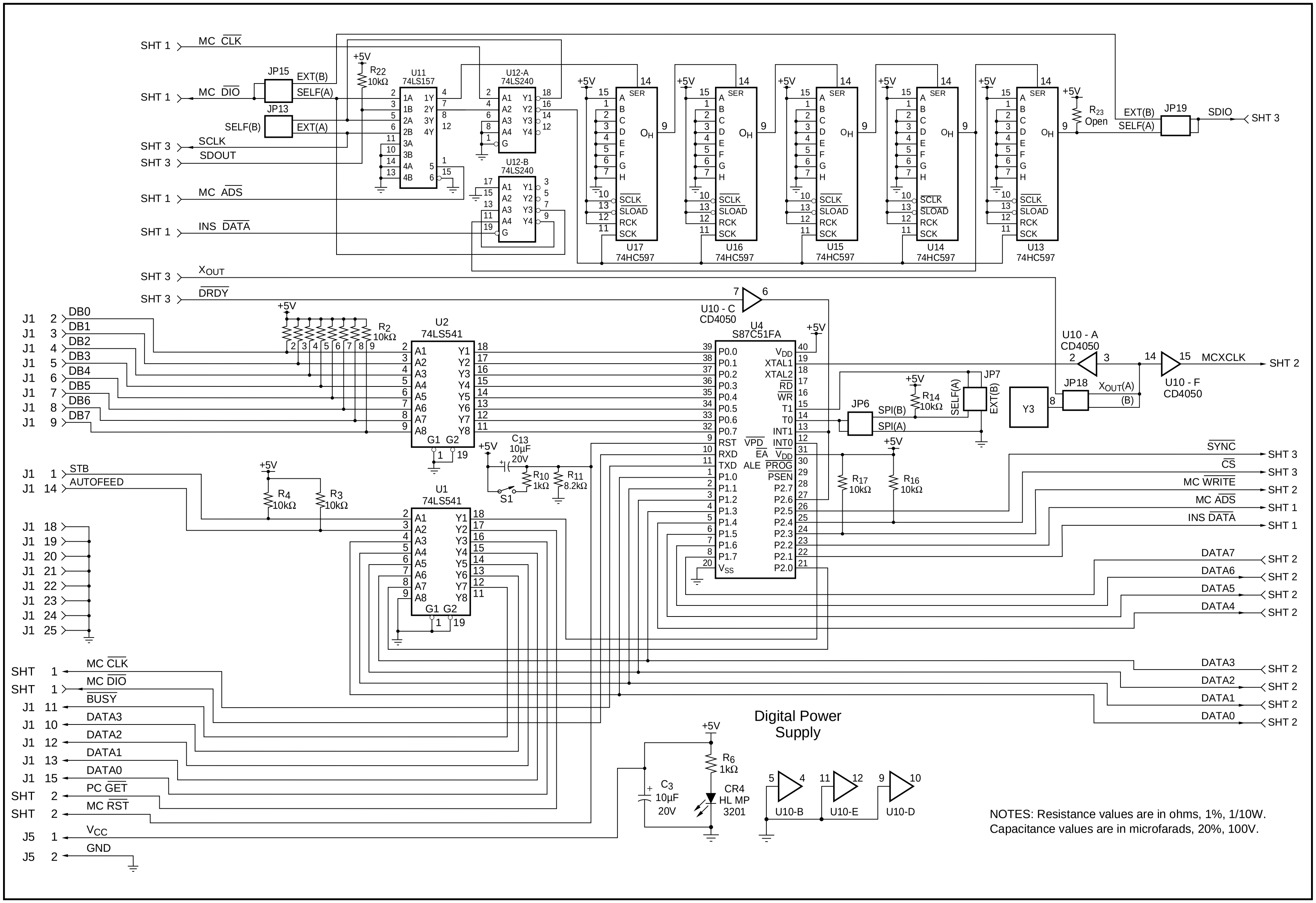


FIGURE 2. Circuitry Details of PC Interface Section of DEM-ADS1210/11 Demonstration Board (SHT1).

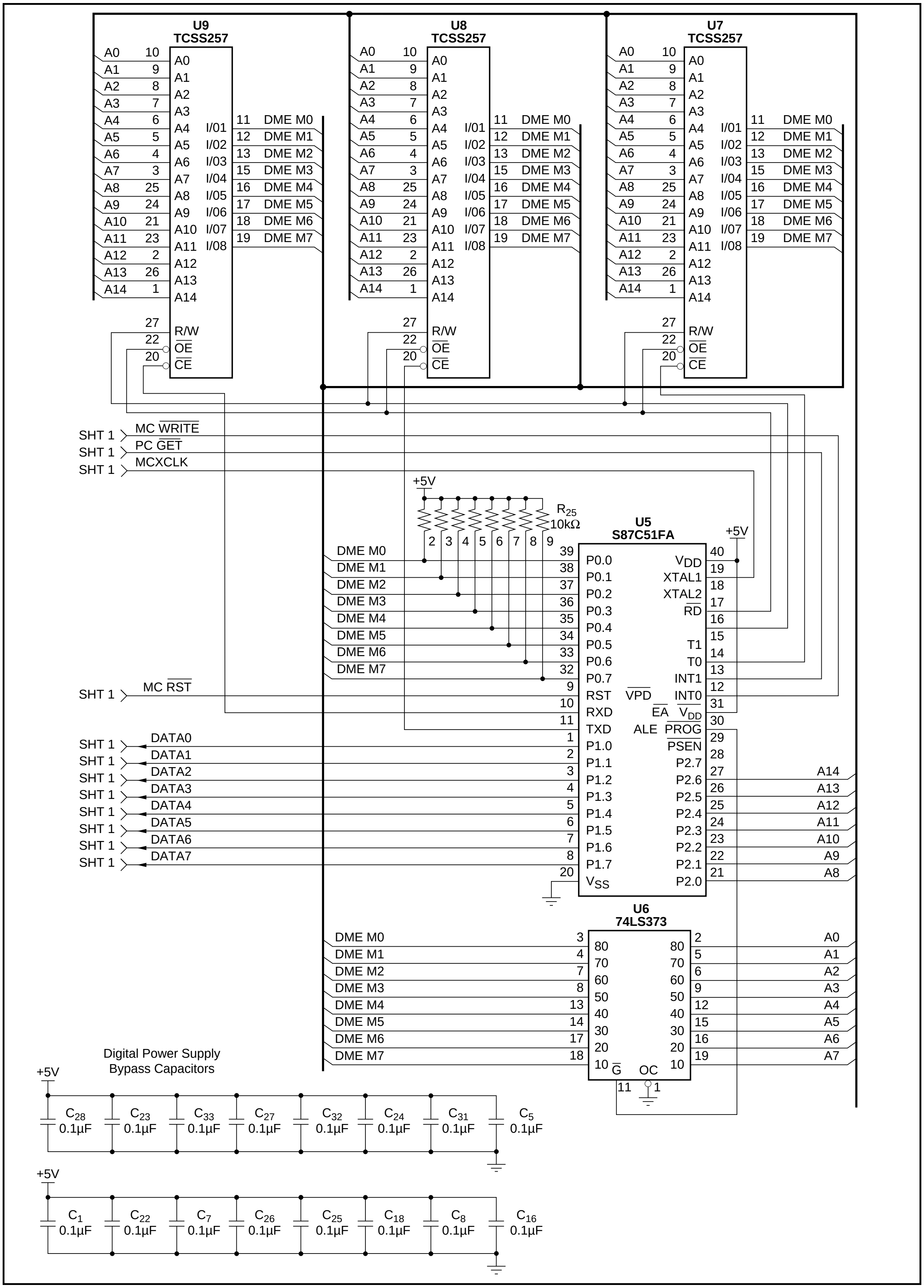


FIGURE 3. Circuit Details of Memory Portion of DEM-ADS1210/11 Demonstration Board (SHT 2).

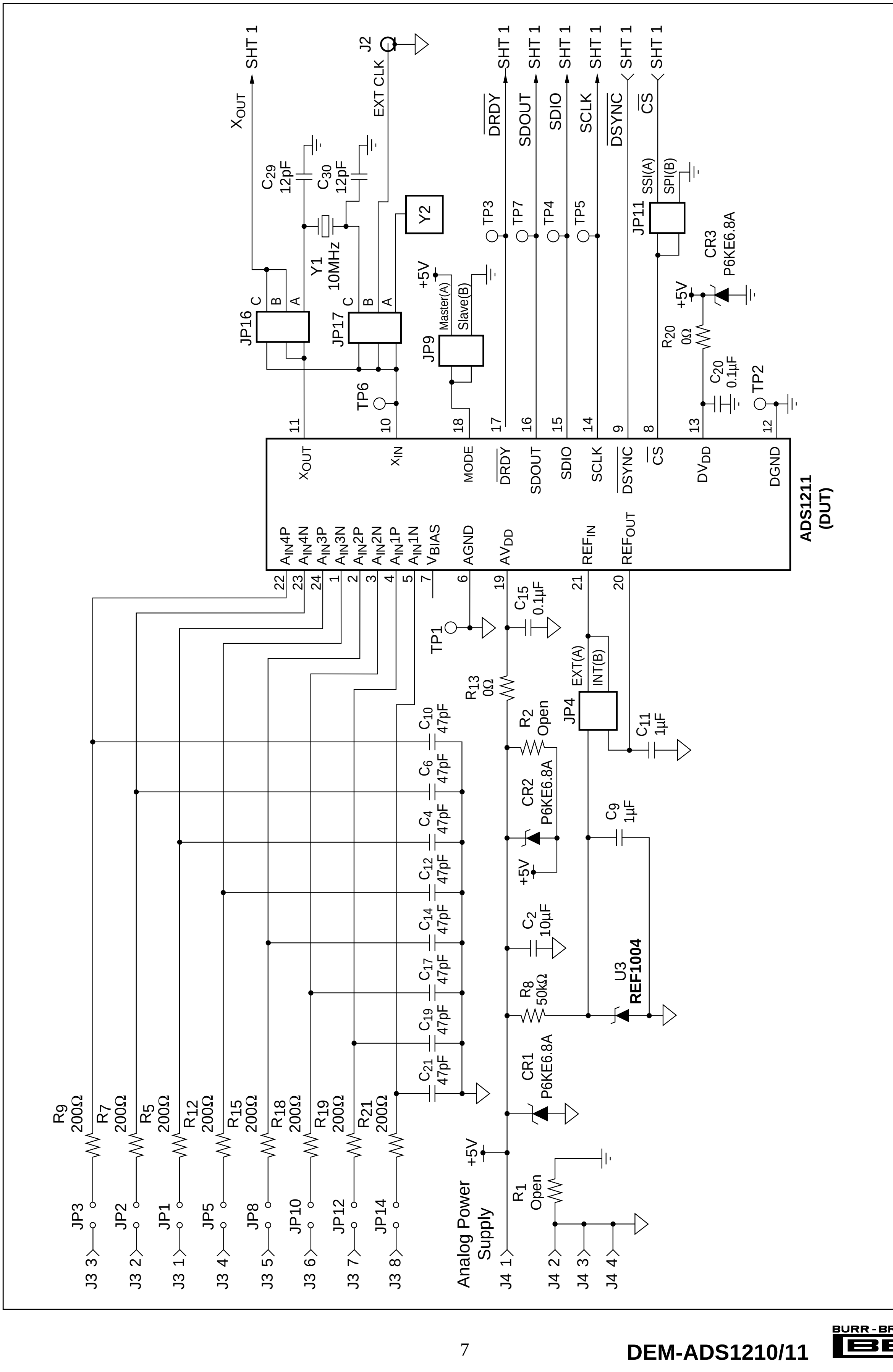


FIGURE 4. Circuit Details of DUT Portion of the ADS1210/11 Demonstration Board (SHT 3).

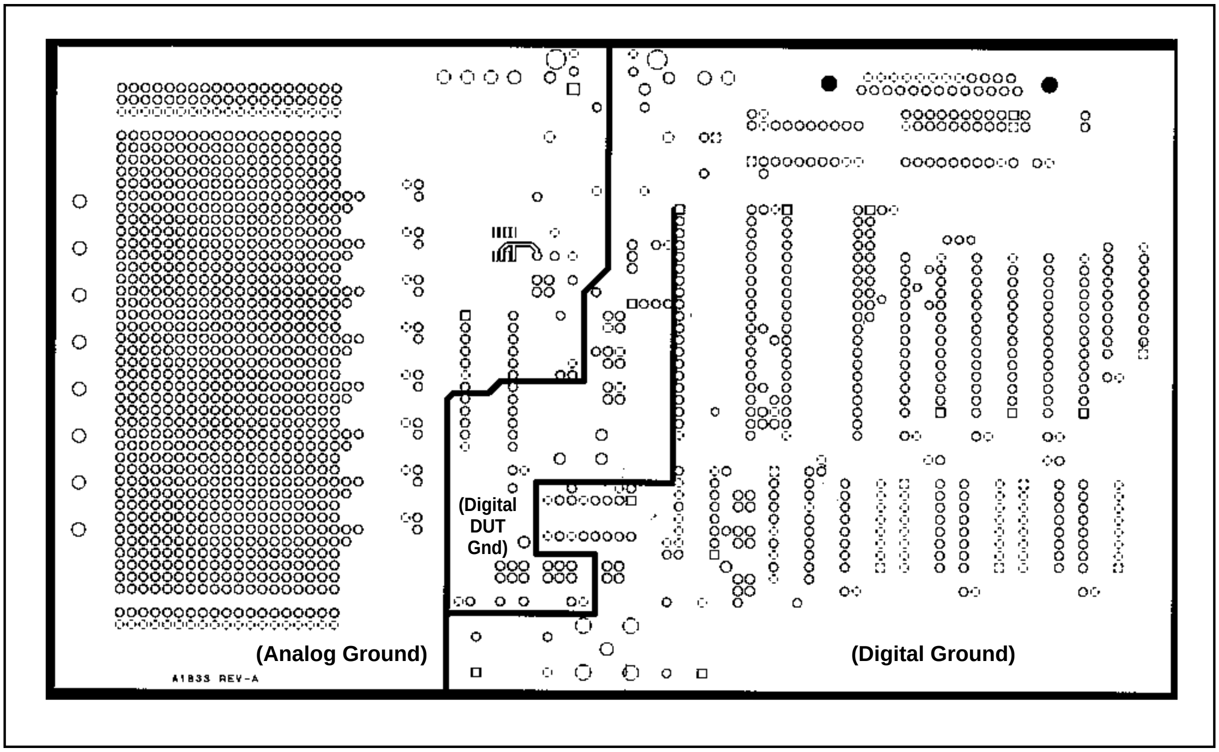


FIGURE 5. DEM-ADS1210/11 Ground Planes (Top Layer).

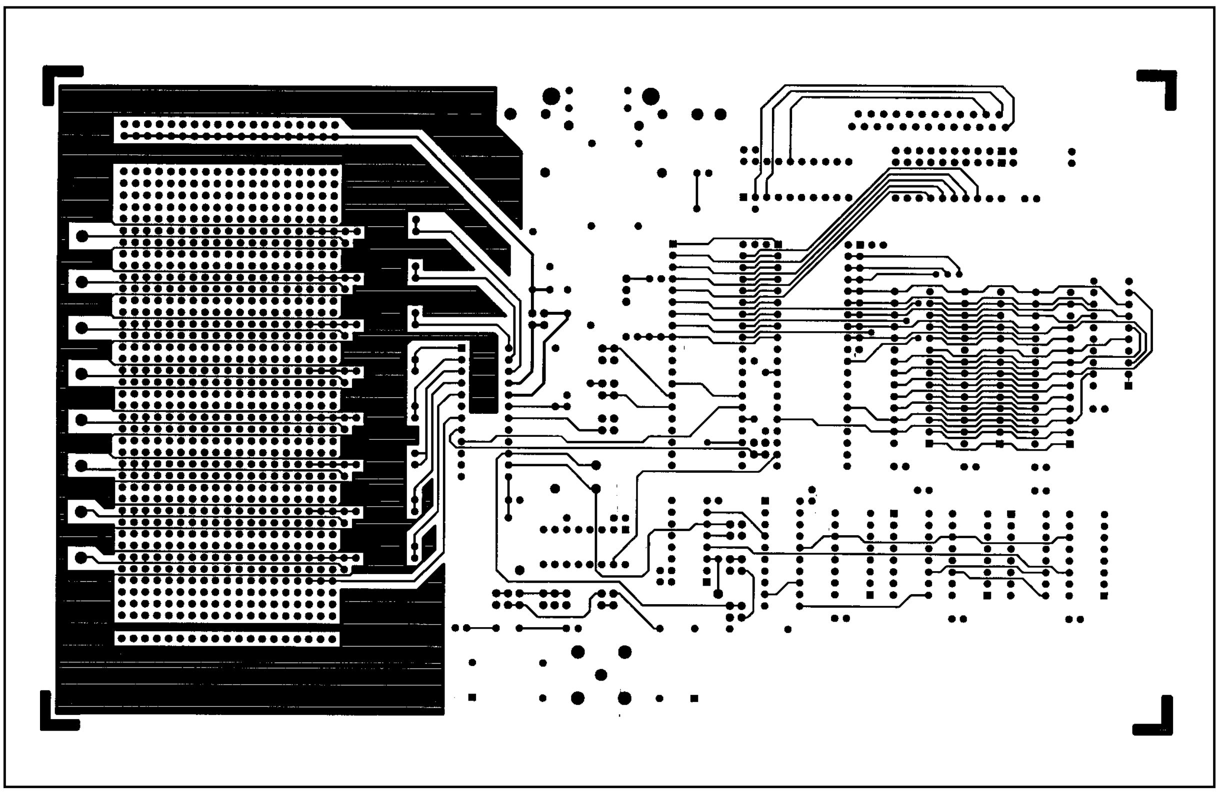


FIGURE 6. DEM-ADS1210/11 Interconnections (Inner Layer).

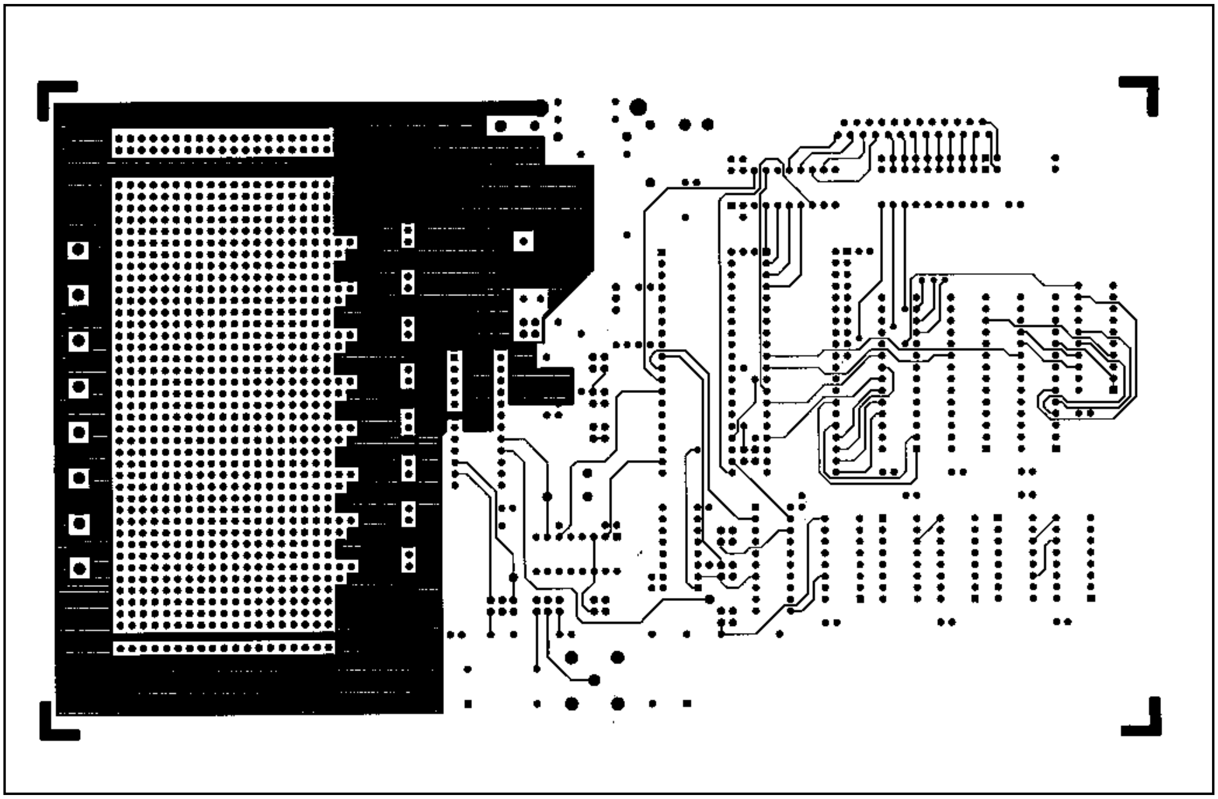


FIGURE 7. DEM-ADS1210/11 Interconnections (Inner Layer).

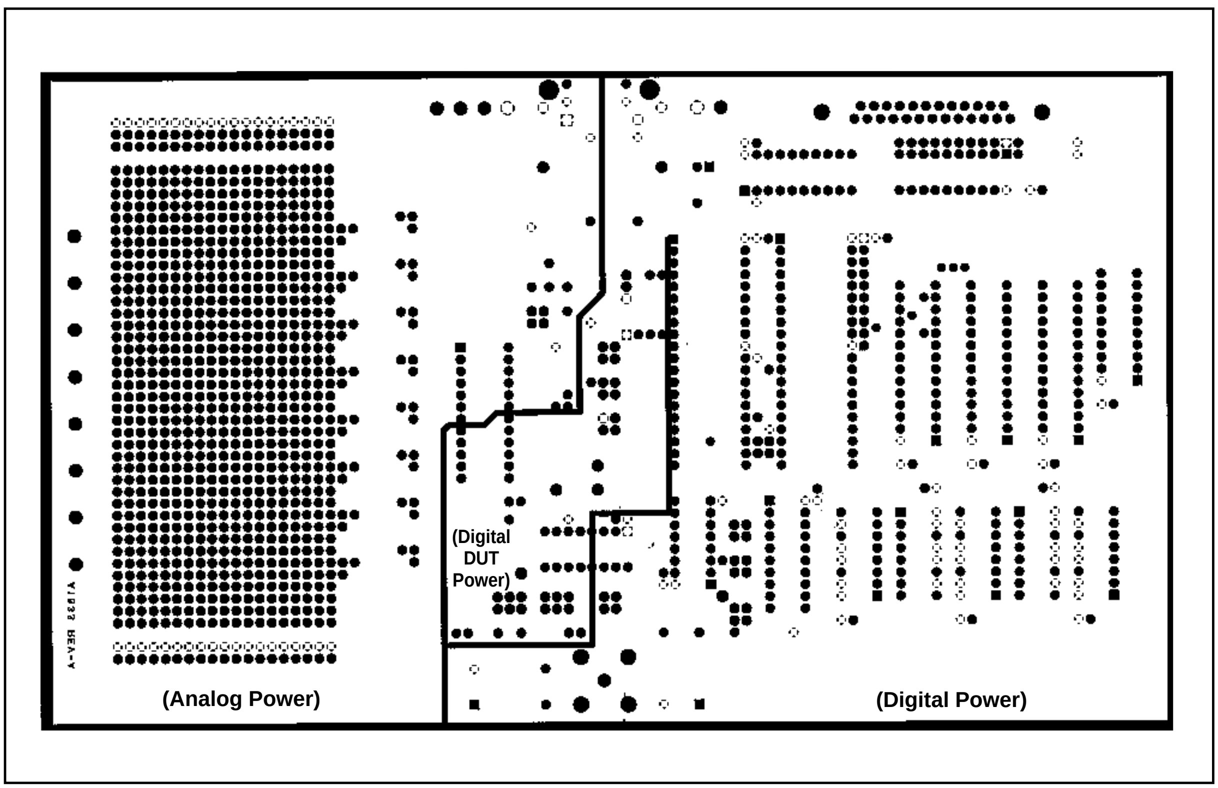


FIGURE 8. DEM-ADS1210/11 Power Planes (Bottom Layer).

SOFTWARE INSTALLATION

The software used for running the DEM-ADS1210/11 evaluation fixture is included on a 3 1/2" floppy. The first step is to make a directory on your hard drive for this software by executing the command:

MKDIR C:\ADS

If a hard drive other than C is to be used, then substitute the appropriate letter for that drive.

Next, copy all of the files from the DEM-ADS1210/11 floppy to this directory using the command:

COPY A:*.* C:\ADS

If the floppy drive being used is different than A, substitute the appropriate letter for that drive. The following files are included with the software:

ADS1210.EXE	Main Program for ADS1210 and ADS1211
ADS1210.CFG	Configuration File for ADS1210
ADS1211.CFG	Configuration File for ADS1211
ADS1212.EXE	Main File for ADS1212 and ADS1213
ADS1212.CFG	Configuration File for ADS1212 and ADS1213
EVCTRL.ASM	Assembly Language File
EVMEM.ASM	Assembly Language File

To execute the software, type "ADS1210" for an ADS1210 or ADS1211 evaluation or type "ADS1212" for an ADS1212 or ADS1213 evaluation. Faster computers may have difficulty with communicating with the DEM-ADS1210/11P demo board. See the Trouble Shooting Guide in Appendix A of this data sheet.

SOFTWARE FEATURES

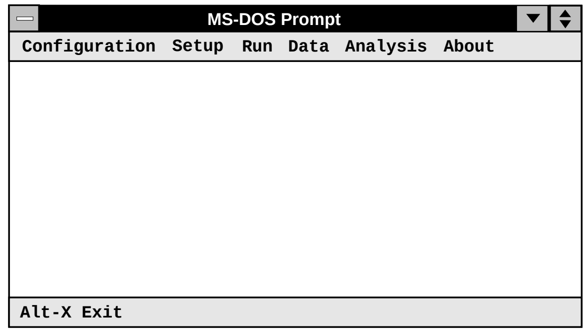
The pop down menus are activated with a mouse or by typing the first letter of a desired menu together with the ALT key. For example, to activate the Configuration Menu type "ALT-C". Once the desired menu has been activated, menu selections can be made either with a mouse or by using the arrow keys until the desired menu option is highlighted and pressing the carriage return.

Embedded in the desired menu is further options which can be selected by using the mouse, or using the Tab key to move through the various fields. Again, the carriage return or Enter key is used to select the desired item.

Any menu can be exited by using either the Escape key or "ALT-X" keystroke combination. Once the desired changes have been made in a menu, choose the OK option to accept the changes or Cancel option to ignore the changes.

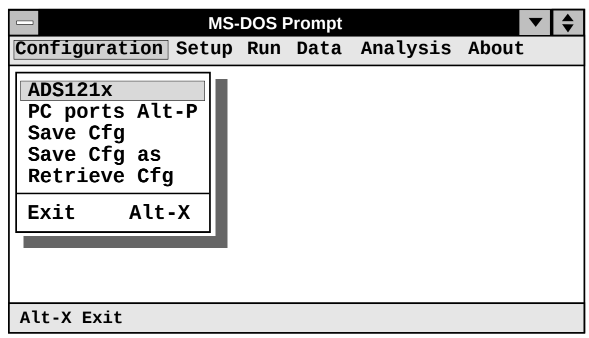
Main Window

The following options are available from the Main Menu: Configuration, Setup, Run, Data, Analysis, and About. Exiting from the software is done by executing the "ALT-X" command from the Main Menu.



Configuration Menu

This menu provides the tools to configure the computer ports and to manipulate board configuration files.



ADS121X—From this option, the X_{IN} clock frequency is selected and the type of serial interface. This is a software setting and does not change the oscillator frequency on the board. This must be done on the board with jumpers and oscillator installation in Y1, Y2, Y3, and EXT CLK.

PC Ports—From this option, the user highlights which Parallel PC port is being used for the PC Interface Board and the Graphics Hardcopy Port. The option also exists for sending a hardcopy to a file via the File option.

Save Cfg—This option allows the user to save changes made to the setup menus (Command register, Offset register and Gain register). The configuration files are saved as the file name with a .cfg extension, such as ADS1210.cfg.

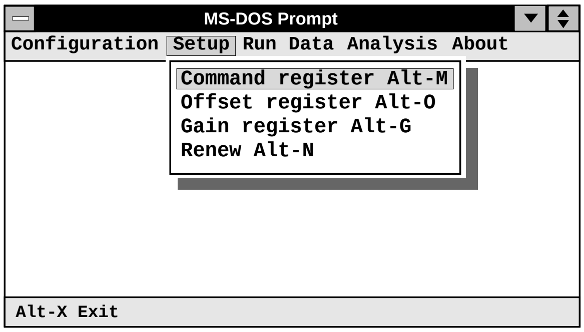
Save Cfg As—This option allows the user to specify an alternate name for the configuration file.

Retrieve Cfg—This option allows the user to retrieve a configuration file.

The serial interface is also programmed in this option. This does not change the hardware interface on the board. This must be done with the jumpers in the DUT digital interface section per Table IV.

Setup Menu

From this menu, changes are made to the DUT's Command, Offset, and Full Scale Registers. These registers will change the configuration file in RAM. To save to the hard drive, see the Configuration Section of this data sheet. Refer to the ADS1210/ADS1211 and ADS1212/1213 data sheets for a full description of the function of these registers.



Command Register—The Command Register (CMR) is 32 bits in length and controls the calibration mode, PGA gain, Turbo Mode, data format, digital filter decimation ratio , and channel selection of the DUT. The calibration section controls MD2, MD1 and MD0, which controls the calibration of algorithm of the DUT. A total of eight calibration selections can be made regarding the operation of the DUT and they are:

—Normal: (0, 0, 0) When set, the converter performs conversion in a normal manner or without a calibration.

—Selfcal: (0, 0, 1)When set, the inputs to the DUT are disconnected and the offset and fullscale calibrations are performed. On completion, MD2, MD1 and MD0 are set to "0".

—Sysocal: (0, 1, 0) When set, causes the System Offset Calibration to perform at the selected gain on the present differential input voltage. On completion, MD2, MD1 and MD0 are set to "0".

—Sysfcal: (0, 1, 1) When set, causes the System Fullscale Calibration to perform with the voltage present on the differential input of the selected channel. On completion, MD2, MD1 and MD0 are set "0".

—Psycal: (1, 0, 0) When set, causes the Pseudo System Calibration mode to be performed. This mode provides offset calibration for the selected channel relative to the internal reference. On completion, MD2, MD1 and MD0 are set to "0".

—Backcal: (1, 0, 1) When set, causes the converter to calibrate every 7th conversion. This reduces the data rate by a factor of six.

—Sleep: This function is not available at this time.

—PGA: The PGA can be set to a gain of 1, 2, 4, 8, or 16 by setting the appropriate bit.

—Turbo: The Turbo rate can be set to 1, 2, 4, 8, or 16 by setting the appropriate bit. Higher settings of this selection increases both overall bandwidth and power dissipation.

NOTE: The product of the PGA setting and the Turbo setting must be less than or equal to 16 for proper operation of the DUT. The software *WILL NOT* produce an error message if this guideline is violated. The converter will automatically default both settings (PGA and Turbo) to 1.

—Digital: This portion of the CMR sets the output data format. Either Binary Two's Complement or the Offset Binary number system can be selected.

In addition to selecting the number system to be used, the output data format is also selected from this menu. All possible choices are available for both byte and bit MSB and LSB orientations.

The pin used for output data format is the next bit that can be set in this register. Either SDIO pin is used both for output data and input commands, or the SDIO pin is used command codes only and the output data is placed on the SDOUT pins. The first mode allows for two-wire interfacing.

With this demonstration board, if the Master Clock (SPIMC, SSISC) is selected, the user must select SDOUT for data output. If the Slave Clock (SPISC, SPIEC) is selected, the user must select SDIO for data output. The SSI interface can be implemented, however, data must be retrieved once in order to continue to get data.

—Decimation Ratio: The Decimation Ratio is entered next. This number must be between 20 and 8000 for proper magnitude and frequency response. Use the formula shown on the screen and enter the closest integer value from the calculation.

The analog section of the CMR controls the operation of the analog section of the converter.

—V_{BIAS}: Allows the user to turn on a 3.3V internal bias voltage that is necessary for measuring a ±10V input signal.

—V_{REF}: By selecting the appropriate section, the internal +2.5V reference or the external +2.5V reference can be used by the DUT. When the internal reference is selected (V_{REF} ON), any external voltage on the REF_{IN} pin of the converter is ignored. If the internal reference (V_{REF} OFF) is turned off, an external reference, U3 is connected through J4 to REF_{IN} of the converter (factory setting).

—Bipolar/Unipolar: By selecting the appropriate section, the inverting input voltage pin of the converter can be set to ground (unipolar), or the inputs can be configured as differential (bipolar). The converter inputs are restricted to 0V to +5V. With an external resistive network, together with the V_{BIAS} source, the bipolar mode input voltage range can be extended to –10V to +10V. In the bipolar mode, the converter output is signed binary.

—Channel: This section allows the user to select one of four channels as the input of the DUT. If the ADS1210 or ADS1212 is used as the DUT, Channel 1 should be selected.

When leaving the Command Register portion of the software, the computer sends the 32-bit digital word to the DUT on the DEM-ADS1210/11 board. The software then queries the board for the code that has been programmed into the DUT and displays both 32-bit words on the screen. The two 32-bit digital words should match bit for bit except for the first 3 digits of the second 8-bit byte. Figure 9 shows the results of writing four 8-bit bytes to the Command register using the default ADS1210.CFG configuration file. See the Operations section of the ADS1210/ADS1211 or ADS1212/1213 data sheet for details. This feature is useful when verifying that the demonstration board is actually receiving the code that is programmed in the Command Register.

Offset Register—The Offset register is a 24-bit register which contains the offset correction factor that is applied to the conversion result before it is placed in the Data Output Register. In most applications, the contents of this register will be the result of either a self-calibration or a system calibration.

The Offset register is both readable and writeable via the serial interface (also see “Run Menu”). For applications requiring a more accurate offset calibration, multiple calibrations can be performed. Each resulting Offset register value that is read is averaged, and a more precise offset calibration value written back to the Offset register. This value is typed in as the decimal equivalent and converted into the appropriate binary value by the program. This typed in value can be written to the Offset register by selecting the Write command from this menu.

Gain Register—The Gain register is a 24-bit register which contains the full-scale correction factor that is applied to the conversion result before it is placed in the Data Output Register. In most applications, the contents of this register will be the result of either a self-calibration or a system calibration. This value is typed in as the equivalent decimal and converted into the appropriate decimal value by the program. The value typed into this window can be written to the Gain register by selecting the Write command from this menu.

Renew Command Option—Selecting this register will cause the contents of the three registers—Command, Offset and Fullscale, to be read back. Toggling through these three registers is done by selecting the enter key.

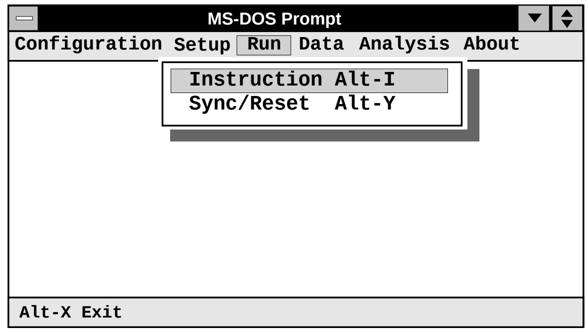
Run Menu

This register controls the transfer of data in and out of the various internal registers in the DUT.

If the write command is invoked from any of the Run options, the register will be written to the converter.

If the cancel command is invoked from any of the Run options, the software will return the user to the previous menu and will not write any new information to the converter.

Commands under this menu allow the user to read and write instructions or data directly to the DUT registers. A synchronization or reset pulse can also be directed out of the DUT.



Instruction Option—This option of the Run Menu allows the user to either read or write data into any of the five ADS1210/11 registers. The user must specify whether data is being written or read, the number of bytes, and which register. Once this information has been selected, then selecting the OK command will cause the data to be read or written.

Sync/Reset Option—Selecting this option will cause the controller, U4, to send a Software Reset command to the converter. Consult the ADS1210/11 or ADS1212/13 data sheets for exact timing details of this feature. This Reset function allows the user to quickly default to the power-up setting of the individual converter. The clock to the processors U4 and U5 must be 10MHz to reset the ADS1210/11 and 8MHz to reset the ADS1212/13. Reset can only be implemented in the Slave mode (SPISC).

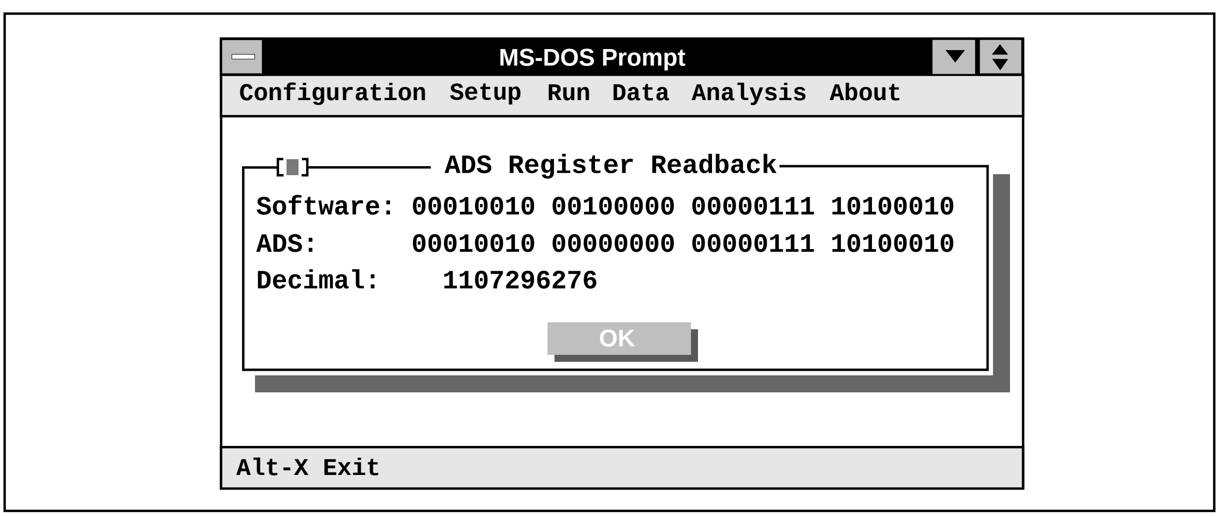
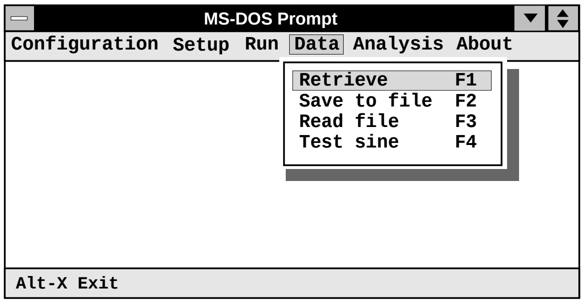


FIGURE 9. Verification of Command Register Instructions Sent to the ADS1210, ADS1211 (DUT).

DATA Menu

This menu is used for actual data collection, retrieval, storage, and generation.



Retrieve Data—This option retrieves data from the selected channel of the ADS1211, ADS1213 or the single channel of the ADS1210, ADS1212. In this menu, the user can select from a pre-determined number of data points or select a specific number of less than 1000 points. Note that if FFT analysis is to be performed on the data collected, the number of data points must be one of the pre-defined quantities and must be less than 32768 points.

Save to File—This option stores the present data on disk. After selecting this option a file name must be given. The data from this file can be retreived at a later time into a graphics-oriented program, such as Excel or MathCAD for a graphical printout.

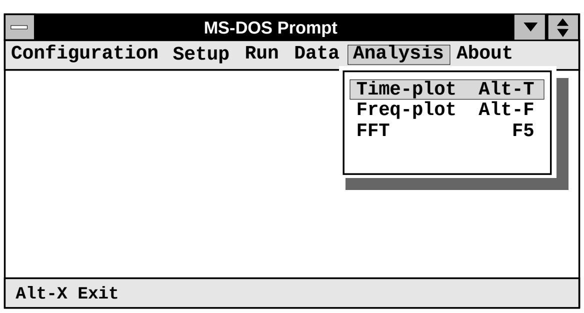
Read File— This option retrieves data from disk. A list of valid file names on the current disk and path is displayed.

Test File—This option numerically generates a sine wave that can be used to test the software's graphing and analysis capability. It is also useful for comparing measured data to theoretical results.

Executing this command causes the user to enter the number of data points to generate, then asks for the number of data points per cycle to generate and the starting phase angle. Finally, the Time Plot screen is brought up and the data can be plotted using the Plot command. The Time Plot screen is discussed in the Analysis Menu Section.

Analysis Menu

This menu is used to plot data and execute FFT analysis.



Time-Plot Option—This command will plot the collected data in the time domain. The first menu that appears is used for setting up the X- and Y-axes scaling. The software will automatically scale the axis based on the data extremes or the axis can be scaled manually. The X-axis represents the sample number. For example, if the user determines that 256 samples be taken from the converter, the X-axis will display 1 to 256 along the X-axis. The Y-axis represents the digital output code in decimal form, normalized to 1. The full-scale range of the Y-axis is –0.5 to +0.5 if the DUT is configured in the bipolar mode and 0 to +0.5 for DUT unipolar mode. The maximum, minimum, average, and rms (standard deviation of the data) values of all of the samples are displayed at the top of the screen. All of these numbers are decimal representations of the digital output, normalized to 1.

Interpretation of the digital output codes and calculations shown in the timing diagram can easily be translated into a the input voltage with the following formula:

Voltage (RTI) = (Demo Board Result) • 10/PGA

Effective Number of Bits =

$$\frac{20 \bullet \log\left(\dfrac{1}{(\text{Demo Board rms}) \bullet \text{PGA}}\right) - 1.76}{6.02}$$

A good approach to setting the axes manually is to view the data using the automatic scaling utility. Once viewed, the manual scaling can be fine tuned to look at the areas of interest. If a long duration of periodic signals is acquired, the signal can be reduced to just a few cycles by using the manual scaling.

Once the scales have been set the next command to issue is the Plot command from the Time Plot window. The data is then displayed and more options are available.

—Retrieve: This option allows the user to return to the Retrieve Data window. Retrieving data from the graph mode will display data that is saved in the RAM on the demonstration board. To obtain current data, the user must return to the DATA menu and run "Retrieve" at that level.

—Display: This option toggles the results between displaying the data points, "connect the dot" format or data smoothing.

—Scales: This option returns to the Time Plot window. All changes to the graph scale will be saved until manually changed again.

—Y-Auto: This option is equivalent to setting the Auto-Scale option in the Time Plot window. The data is now redisplayed using the new scale settings.

—Cur1 and Cur2: These options invoke the cursors. The active cursor can be moved to any part of the screen by using either the mouse and clicking the left mouse button on that part of the screen or by using the arrow keys. Once this is done the position of the cursor and the value of the data at that point is displayed in the upper right-hand corner of the screen.

Activating the other cursor and moving it to another part of the waveform causes the display in the upper right-hand portion of the screen not only to display information about this cursor, but also shows the different data information between the two cursors.

This feature makes it easy to determine periods, frequencies and peak-to-peak values of the data.

—FFT: This option is equivalent to invoking the FFT option and is discussed later.

—Cancel: This option returns the user to the Main Menu.

NOTE: A printout of the screen may be obtained using ctrl-print screen or, by saving the data in a file and retrieving the data into a graphics program, such as Excel or MathCAD.

Frequency-Plot Option—This option is used to test and plot data in the frequency domain. Both magnitude and phase information can be displayed versus frequency. Before this option can be executed, data must first be gathered and displayed in the time domain.

The first menu that appears allows the user to select the FFT algorithm used on the data.

—Execute FFT on Time Data: The FFT Windows available are Hamming, Hanning, Blackman, Blackman-Harris, Continuous 5th Derivative, Triangle and Rectangle.

The next window which appears is similar to the Time-Plot window in that Y- and X-axis scaling can be entered manually or generated automatically by the software.

The Y-axis settings are used to display the data either in absolute values (Lin), Logarithmic values (Log), or decibels relative to the reference being used (dB). The number of divisions used along the Y-axis can also be chosen. For instance, when the dB option is chosen, it is convenient to choose a division number that breaks the screen into 20dB divisions. Also shown for Y-axis settings is the option for displaying phase information in either degrees or radians.

The X-axis settings are used to display the data versus Bin or frequency.

In addition to displaying information about the Magnitude and Phase of gathered data, the Signal-to-Noise ratio can be calculated on the data. This information will be displayed on the Plot Screen if the option is turned on.

The window that appears when the plot option is shown is data in the frequency domain. The options available here are as follows:

—Display: Toggles between the displaying data points, smoothed or “connect the dots”, and an area display.

—Scales: Returns to the previous menu used to set up the scales used for displaying the data.

—Prev and Next: Either selection toggles between Phase and Magnitude display.

—Cur1 and Cur2: Similar in function to the Time-Plot cursors using frequency or phase as the measured parameters.

—Time: Returns to the Time-Plot menu.

—Cancel: Returns to the Main Menu.

FFT Option—This menu allows the user to select which type of FFT window will be used in the time to frequency domain transformation for the data collected.

About Menu

This menu allows the user to see information regarding the version of the software in use. The current version is 4.0. The 4.0 version software for the ADS1210 and ADS1211 evaluations have been enhanced from the last revisions. However, version 2.4 and 3.0 software will continue to work with the ADS1210 and ADS1211 evaluations even though U4 has been upgraded.

QUICK START DEMONSTRATION

This section is meant as a tutorial for the first time user. Most of the features of the DEM-ADS1210/11 will be demonstrated.

Hardware Configuration

Insert ADS1211 as the DUT. The jumper configuration should be: JP4 = A, JP6 = B, JP7 = A, JP9 = A, JP11 = B, JP13 = B, JP15 = A, JP16 = A, B, JP17 = C, JP18 = A, JP19 = A.

Software Configuration

It is assumed that the user has attached the DEM-ADS1210/11 to an IBM-PC via LPT2. It is also assumed that a Laser Jet II is attached to same IBM-PC via LPT1. Type ADS1210 to execute the ADS1210.exe program.

From the main menu, open up the Configuration Menu and select PC-ports. Select LPT2 for PC Interface Communication Port and LPT1 for the Graphics Hardcopy Port.

Now open the ADS121X sub-menu and verify that the X_{IN} Pin Clock is set to 10MHz and that the Serial Interface is set to SPIMC.

Command Register Setup

A 1Hz, 100mV peak-to-peak square wave, with 50mV of offset, is to be measured and analyzed using the external reference with the DEM-ADS1210/11.

First, the appropriate Decimation Rate needs to be determined. Assuming that a 5Hz bandwidth is desired, a sampling frequency or Data Rate of 10Hz is required. Also, we will use the Turbo or oversampling rate of 1. Inserting this information into the Decimation Ratio equation results in:

$$\text{Decimation Ratio} = \text{Turbo} \bullet X_{IN}\text{clk}/(512 \bullet \text{DataRate}) \text{ or}$$

$$\text{Decimation Ratio} = 1 \bullet 10\text{MHz}/(512 \bullet 10\text{Hz}) = 1953.13$$

Round this number up to 1954.

Now open the Command Register sub-menu from the Setup menu and make the following entries:

Operation: selfcal

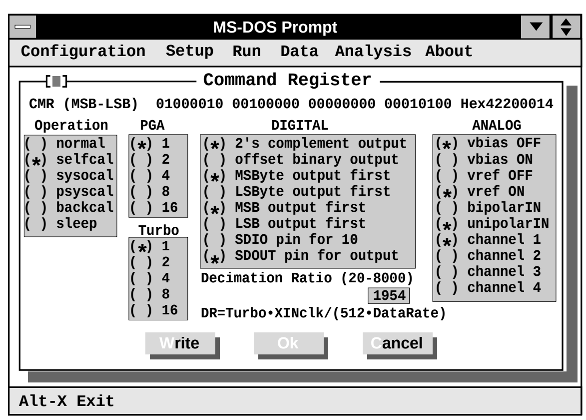
PGA: 1

Turbo: 1

Digital: Binary Two’s Complement, MSByte output first, MSB output first , and SDOUT pin for output.

Analog: V_{BIAS} OFF, V_{REF} ON, unipolar IN, channel 1.

The Command Register Screen should look like the following:



Press the Write command and this register will be written to the program and will display a screen showing what the software wrote to the command register and what the register now contains. Verify that both digital words are the same, with the exception for the 3rd bit of the second byte. Verify that the data rate has changed by using an oscilloscope on TP3.

Retrieve Data

Now that the correct code is in the ADS121X, we can collect data.

Open the Retrieve option from the Data menu. Make the following selection:

Data Points To Retrieve: 1024

Close the menu and the "working" menu should appear. It will take several minutes for all the data to be collected.

Plotting Data

Once the data has been collected, the Time-Plot window will appear showing the extent or extremes of the data collected. Since we know that the data should range between ± 50mV and it is of a period of 1 second, we will manually scale the Y-axis as follows:

$$Y_{MIN} = 0.00 \text{ and } Y_{MAX} = +0.01$$

Note that the data extremes are displayed with reference to the ADS1210/11 input voltage range. This range is 0V to +5V. Hence, on this screen, the 0 to 100mV signal is displayed as having extremes near 0 and 0.01

The X-axis divisions are taken with reference to the conversions taken during the data collection. Every increment along the X-axis scale is equal to the time between each conversion. When the Decimation Ratio was entered, recall that an integer of 1954 was entered instead of the correct value of 1953.13. Thus, instead of having data spaced at exactly 1/10Hz, we have the data spaced at (1/10Hz)•1954/1953.13 or 0.1000448s. This formula can be generalized to solve for the spacing of data points in time by the following equation:

$$\text{Time per conversion} = 1/(\text{Sampling Rate})\bullet(\text{Actual DR}/\text{Ideal DR})$$

Finally, to look at only the first 100 cycles, we enter $X_{MAX} = 100$ and $X_{MIN} = 0$ into the Time Plot menu.

Press the Plot button to display the data.

The Time-Plot screen initially shows the raw data points. Select the Display option to get a display that connects the dots and a screen similar to Figure 10. The "Cntrl-Print Screen" command will send the graph to the printer.

FFT Analysis

From the Time-Plot window, select the FFT option and the Execute FFT on Time Data window will appear. From this window the FFT Window is selected.

An FFT window is required when either a discontinuous wave form is sampled or a continuous wave is sampled at non-integer periods in order to eliminate the generation of spectral leakage. The software is capable of applying the following windows to sampled data: Hamming, Hanning, Blackman, Blackman-Harris, Continuous 5th Derivative, Triangle, and Rectangular.

Choose the Hamming Window and press OK.

The Frequency-Plot menu appears and we will use the Auto Scales and default settings to view the data in the frequency domain.

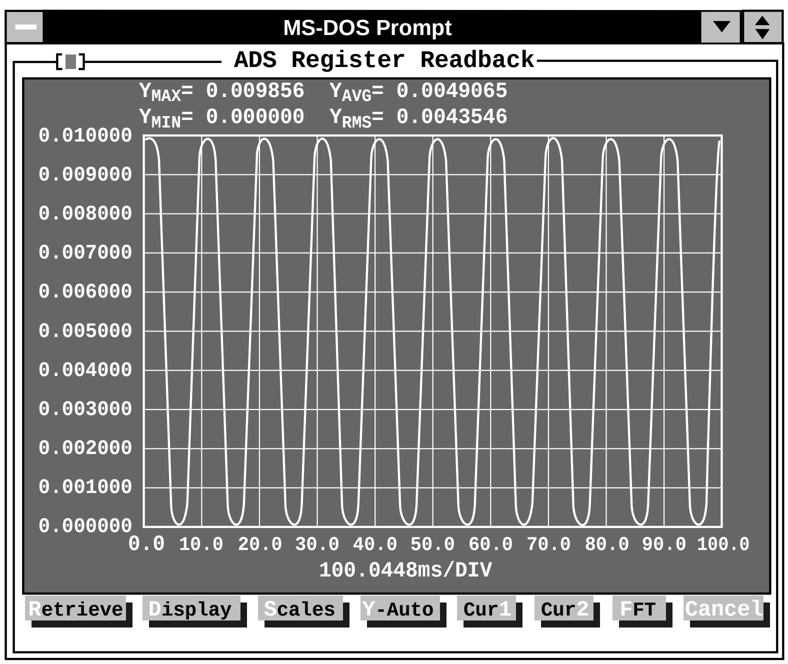


FIGURE 10. Time Domain Representation of Data Collected in this Example.

Click on the Plot button and a screen of data should appear. Now press the Display icon and all of the dots will be connected or smoothed. Pressing the display button once again causes the data to be displayed in a bar-graph manner. Clicking on FFT and executing a Hamming Window calculation will give the results shown in Figure 11.

Selecting the Next or Prev icon will bring up the phase response screen. Since the phase information was selected in radians, the displayed information is in radians as well. A screen similar to Figure 12 should be seen. Selecting the Prev or Next icon will bring up the magnitude display again. Select Cancel to return to the Main menu.

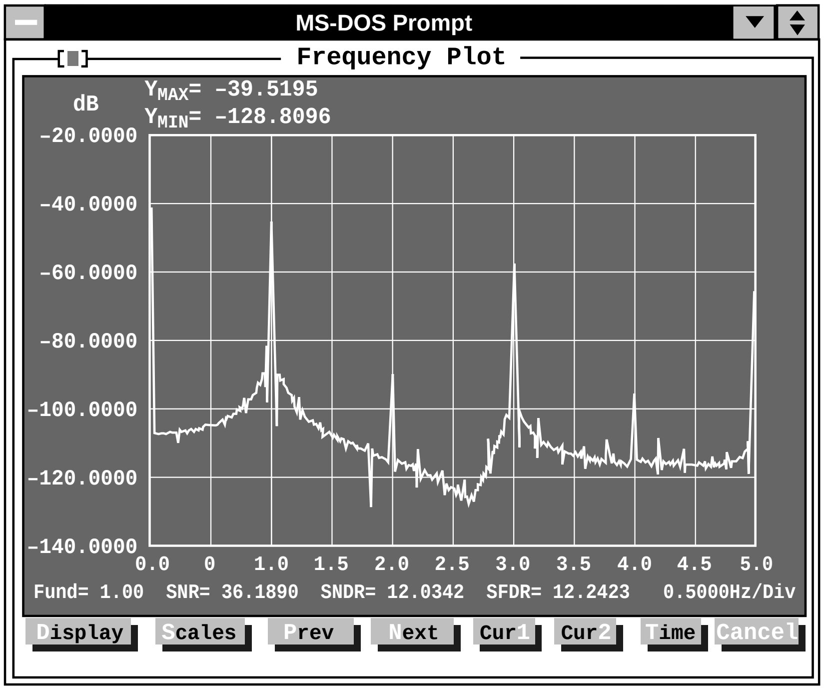


FIGURE 11. Graphical Representation of Hamming Window FFT Performed on the Data Collected in this Example.

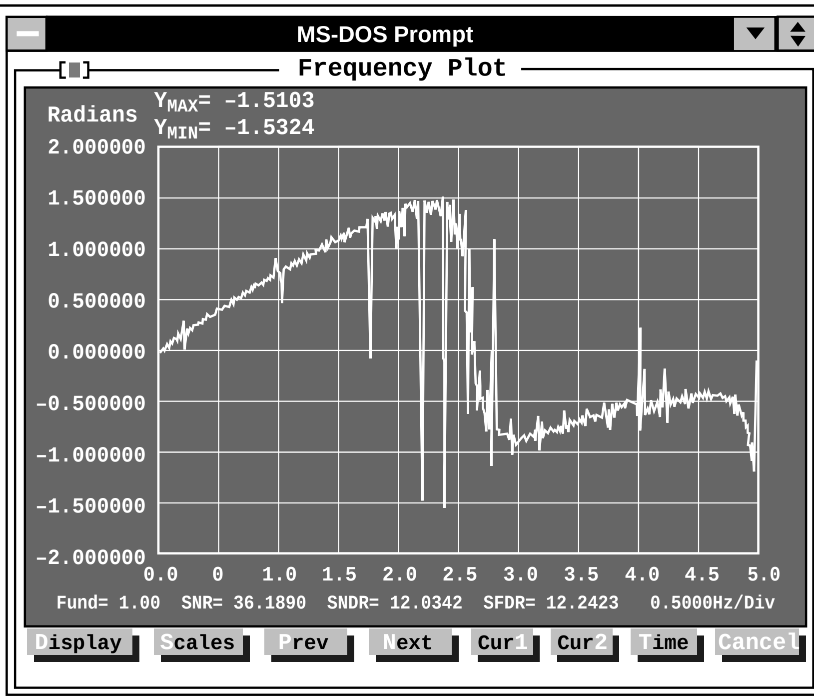


FIGURE 12. Phase Information of Data Collected in this Example.

APPENDIX A

DIFFERENCES BETWEEN DEM-ADS1210/11, REV A AND REV B

The DEM-ADS1210/11 was originally designed to demonstrate the ADS1210 and ADS1211 ΔΣ converters performance. Since the development of this demonstration fixture and the introduction of the ADS1210 and ADS1211 converters to the market, a second pair of similar products have been introduced—the ADS1212 and ADS1213.

	ADS1210	ADS1211	ADS1212	ADS1213
Bits, No Missing Codes	24	24	22	22
Effective Resolution at 1kHz	20	20	16	16
Number of Differential Inputs	1	4	1	4
Maximum Recommended External Clock	10MHz	10MHz	2.5MHz	2.5MHz

TABLE I. Key Differences of Products.

The original board that was introduced was called the DEM-ADS1210/11 Evaluation Fixture. The newly revised board is also called the DEM-ADS1210/11 Evaluation Fixture but REV B. No board layers were modified between REV A and REV B, except for the silkscreen. All remaining modifications are implemented with the microprocessor programming and PC software. Specifically, three modifications are required in order to make either board compatible with all four products mentioned above. These modifications are:

1. New software (Version 4.0 on Burr-Brown Web Site: www.burr-brown.com)
2. Replacement chip for U4 (Version 3.0)
3. Install oscillator chips in Y2 and Y3 sockets

If you have a REV A Evaluation Fixture and would like to upgrade it to also test the ADS1212 or ADS1213, order the DEM-A1210/11-1 (upgrade kit)—**free of charge**.

NOTE: This kit (DEM-A1210/11-1) is needed only if the DEM-ADS1210/11 was purchased *before* January 1, 1997 and the intentions are to evaluate the ADS1212 or ADS1213.

The followings items are included in the DEM-A1210/11-1 upgrade kit:

1 3 1/2" floppy disk, Version 4.0
1 μC chip, U4, Version 3.0*
1 1MHz oscillator, Y2
1 8MHz oscillator, Y3
1 ADS1213 ΔΣ A/D Converter
1 ADS1212/1213 Product Data Sheet
1 DEM-ADS1210/11 Product Data Sheet

*U4 version 3.0 allows user to implement software reset with version 4.0 software.

If you are purchasing the complete board (DEM-ADS1210/11, with the upgrade included), the following items are included in the DEM-ADS1210/11 kit:

NOTE: If the DEM-ADS1210/11 is purchased *after* January 1, 1997, the upgrade kit (DEM-A1210/11-1) is not necessary. The board contains all items listed for the upgrade kit as well as those listed below:

1 DEM-ADS1210/11 demonstration fixture, fully tested
1 Connection cable for the PC to the demonstration fixture
1 3 1/2" floppy disk, Version 4.0
1 ADS1211 ΔΣ A/D Converter
1 ADS1213 ΔΣ A/D Converter
1 ADS1210/1211 Product Data Sheet
1 ADS1212/1213 Product Data Sheet
1 DEM-ADS1210/11 Product Data Sheet

APPENDIX B

TROUBLESHOOTING GUIDE

Program returns to DOS when trying to send instructions to the DUT.	1. Double check all computer and power supply connections. 2. Cycle the power supplies. 3. Connect the Analog and Digital supplies together at the board. 4. Tie all floating analog inputs to a dedicated voltage within the power supply range. 5. Do not limit the power supply current at start-up until the circuit settles to where the current draw of the circuit is down to approximately 100mA to 200mA. At start-up, the boards draw more current (~300mA to 400mA) but settles very quickly. 6. Disconnect the power supply and short all four supply pins to ground. 7. Make sure the DUT XIN frequency is compliant with the device's data sheet. See Table III for jumper instructions.
Program returns from Command Register with a wrong ADS code from the DUT.	1. Try writing to the DUT one more time. 2. Check the clock input to U4 and U5 microprocessors. It must be between 4MHz and 16MHz. Disable the Turbo mode of faster computers or increase the clock rate to U4 and U5. See Table III for jumper instructions. 3. Make sure the correct software version and the correct executable file is being used for the device being tested. 4. Make sure the cable from the computer to the board is connected.
Data output looks wrong.	1. Retrieve data again via the Data menu. 2. Make sure the Command Register is programmed to the correct channel. 3. Make sure the input signal is referenced to the power supply ground.
Not able to get full functionality (RESET capability) when evaluating the ADS1210 and ADS1211.	1. Make sure the microprocessor versions are: U4 = 2.0 and U5 = 1.0. 2. Make sure the correct software is in use, version 3.0.
Not able to evaluate the ADS1212 and ADS1213 at all.	1. Make sure the microprocessor versions are: U4 = 2.0 and U5 = 1.0. 2. Make sure you are using ADS1212.exe software. 3. Verify correct clock sources per Table III.

APPENDIX C

RELATED LITERATURE

ADS1210, ADS1211 Product Data Sheet, Burr-Brown 1996, PDS-1284

ADS1212, ADS1213 Product Data Sheet, Burr-Brown 1996, PDS-1360

Programming Tricks for Higher Conversion Speeds Utilizing Delta-Sigma Converters, AB-106

Giving ΔΣ Converters a Little Gain Boost with a Front End Analog Gain Stage, AB-107

DEM-ADS1210/11 Demo Board Tricks to Evaluate the Step Response of the ADS1211 Multiplexer Switching, AB-111

Interfacing The ADS1210 with an 8xC51 Microcontroller, AB-112

Accessing the ADS1210 Demo Board with Your PC, AB-113

Browse the Internet (www.burr-brown.com) for the most current updates to this literature as well as new Application Notes.

PARTS LIST

REFERENCE DESIGNATOR	VENDOR	DESCRIPTION	PART NUMBER
J1	AMP	25-pin Male right-angle D Connector	747238-4
J2	Kings	BNC Connector	KC-79-274-MO6
J3	OST	Terminal Block	ED 400/8
J4	OST	Terminal Block	ED 300/4
J5	OST	Terminal Block	ED 300/2
U4, U5	Philips	40-pin Double Wide, μP	S87C51FA-4N40
U7, U8, U9	Fujitsu	8 x 32K Memory	84256C-10LP-SK
U10		16-pin IC	CD4050BC
U1, U2		20-pin IC	SN74LS541
U11		16-pin IC	SN74LS157N
U12		20-pin IC	SN74LS240
U13-U17		16-pin IC	MM74HC597
U6		20-pin IC	SN74LS373
U3	Burr-Brown	2.5V Reference	REF1004C-2.5
R24, R25		10kΩ Pull-up Resistor Networks	CSC10A01103G
R3, R4, R14, R16, R17, R22		10kΩ Resistors	RN55C1002F
R10		1kΩ Resistors	RN55C1001F
R11		8.2kΩ Resistor	RN55C8201F
R8		50kΩ For Reference	RN55C5002F
R5, R6, R7, R9, R12, R15, R18, R19, R21		200Ω Resistors	RN55C2000F
C1, C5, C7, C8, C15, C16, C18, C20, C22, C23, C24, C25, C26, C27, C28, C31, C32, C33		0.1μF Bypass Capacitors (murata erie)	RPE121X7R104K050
C29, C30		12pF	C315C120J1G5CA
C4, C6, C10, C12, C14, C17, C19, C21		47pF	C315C470J1G5CA
C2, C3		10μF Capacitor, 20V Axial Lead	150D106X9020
C13		10μF Capacitor, 30V Dipped Tantalum	T350G106K035AS
C9, C11		1μF (kemet)	CK06BX105K
CR1, CR2, CR3		Transient Voltage Suppressors	P6KE6.8A
S1	Augat	Momentary Switch (SPDT)	TPC11CGPC
JP4, 6, 7, 9, 11, 13, 15, 16, 17, 18, 19	Samtec	Jumper Headers	TSW-102-07-T-D
JP1, 2, 3, 5, 8, 10, 12, 14, 16, 17	Samtec	Jumper Headers	TSW-102-07-T-S
CR4		LED	HLMP3201
Y1		10MHz Oscillator	HC-49
TP1, TP2	USECO	Test Point for GND	1280B-1
TP3-TP7	MOUSER	Small Test Point	151-103