DEM-ADS7870
DATA ACQUISITION SYSTEM

FEATURES

- ● **EASY INSTALLATION AND USE**
- ● **WINDOWS® BASED GRAPHICAL USER INTERFACE**
- ● **SAMPLE EXCITATION SIGNALS GENERATED ON-BOARD**
- ● **BUILT-IN 9V BATTERY POWER OR EXTERNAL POWER**
- ● **FAST SERIAL DIGITAL INTERFACE**
- ● **INTERACTIVE DEVICE REGISTER CONFIGURATION**
- ● **SAVE 64 POINT DATA SET TO DISK FILE**

DESCRIPTION

The DEM-ADS7870 is a demonstration fixture that allows for easy evaluation of the ADS7870 low-power data- acquisition system on a single chip. On-board stimulus generation is provided to demonstrate several ADS7870 functions. The card can also be configured to digitize external signals.

Software provided with the DEM-ADS7870 runs under Windows 95 or 98 only, on an IBM compatible PC. The software can be quickly "installed". The user interface can set all of the configuration variables within the ADS7870 as well as select various stimulus signals.

Power for the DEM-ADS7870 can be derived from the on-board 9V battery or from an external supply of at least 8VDC.

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HARDWARE SET-UP

The DEM-ADS7870 uses two embedded "PIC" controllers. The configuration jumpers are set in the manner described in Table I.

JUMPER	DEFAULT	FUNCTION
P1	EXT	Power Source
P2	1-2	V_{REF}/BUF_IN Select
P3	Open	Configuration U2
P4	Open	Configuration U2
P5, P6, P7	5-6	DIO Select
P8	1-2	CCLK Source
P9, P10, P11	9-10	Signal Source
P12	1-2	LED0
P13	1-2	LED1
P14	1-2	LED2
P15	1-2	LED3
P16	Open	Stimulus Programming Port

TABLE I. Configuration Jumpers with Default Factory Settings.

An initial demonstration can be run by simply installing a 9V battery and moving the P1 jumper to the BAT position. Jumper configurations can be changed later to show other features.

The test points on the E1 header allow monitoring of the digital interface signals between the DUT and the host controller.

TEST POINT	SIGNAL
E1	Interface Logic
E2	V_{REF} Input
E3-E8	Ground Points

TABLE II. Test Point Description.

SOFTWARE INSTALLATION

User-interface software is installed in the normal Windows manner. Close all other applications. From the "Start" button on the task-bar select "Run". In the window that opens, type:

d:\setup

Where: "d" is the letter designation of the CD-ROM drive on the computer.

Follow the prompts to install the software.

To run the program, left-click on "Start" from the task-bar and then expand the "Programs" menu. The application program is titled "Burr-Brown ADS7870 Application".

To remove this application, use the Control Panel "Add/Remove software" utility, in the Windows system.

APPLICATION SOFTWARE OPERATION

Figure 1 shows the opening window of the application with the data display inner window. The system status is displayed in the banner of the data display window. To configure the communications section, activate the "Setup" pulldown and select "Communications Setup". From this dialog box select the appropriate COMx port. When communication is established, the word "Disconnected" will change to "Connected".

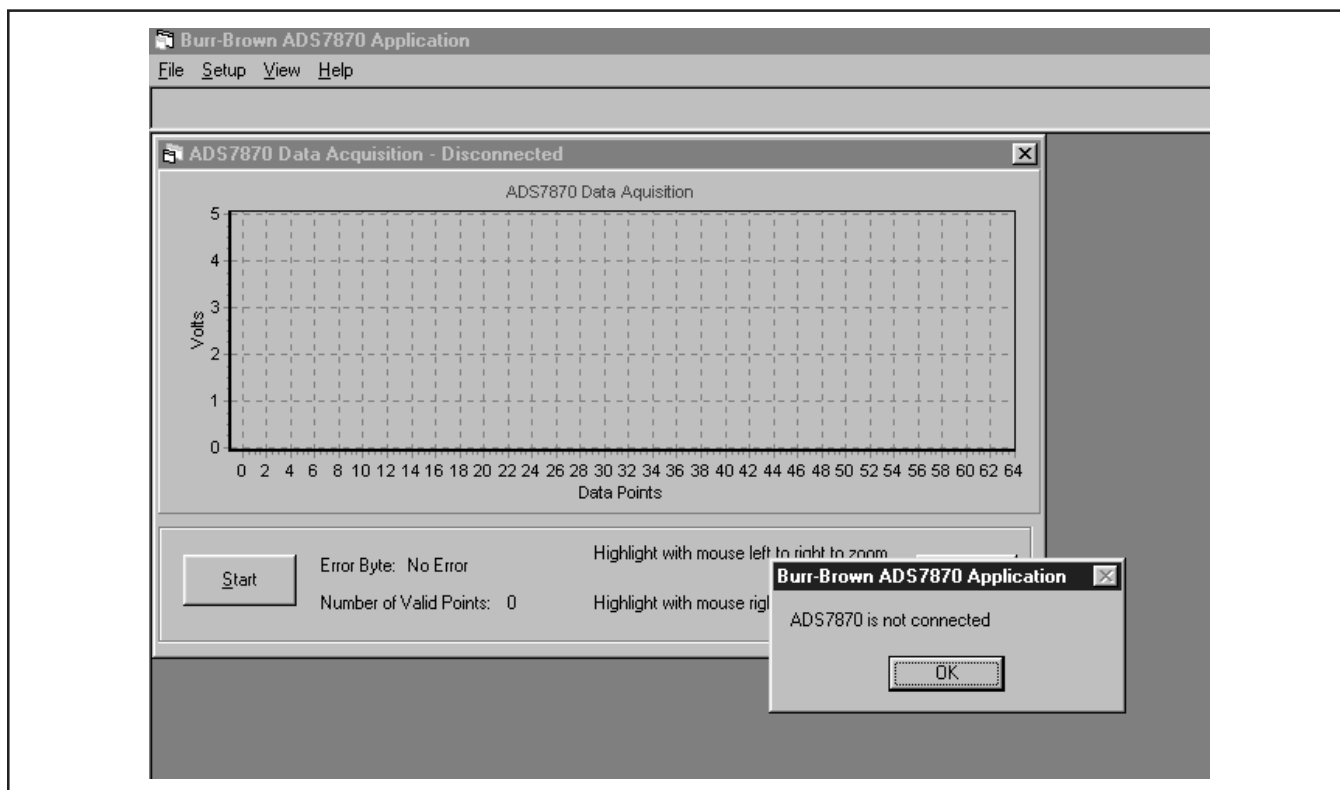Once communication is established, left-click the "Start"

FIGURE 1. Opening Screen from the Burr-Brown ADS7870 Application Program.

button to get the display as shown in Figure 2. The sine wave generator is not synchronized with the conversions of the ADS7870, so each data set may start at a different point in the waveform.
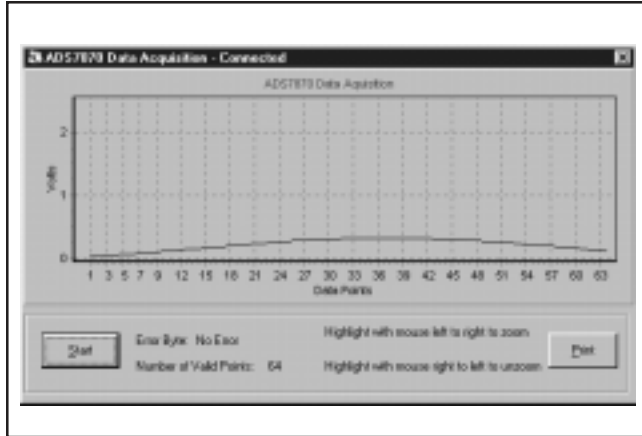
ON-BOARD STIMULUS OPTIONS

FIGURE 2. Typical Data Display with Default Configuration.

From the top menu bar open the "Setup" menu and then select "Inputs". A window, as shown in Figure 3, will be presented. From this window, it is possible to select the signal to be digitized and change the relevant register contents that configure the ADS7870.

The C-Clock Divisor panel in the lower right hand corner of the Inputs window must be set to 8 when the device is operated with the on-board oscillator.

An internally generated signal can be selected from the Waveform pull down menu, as shown in Figure 4.

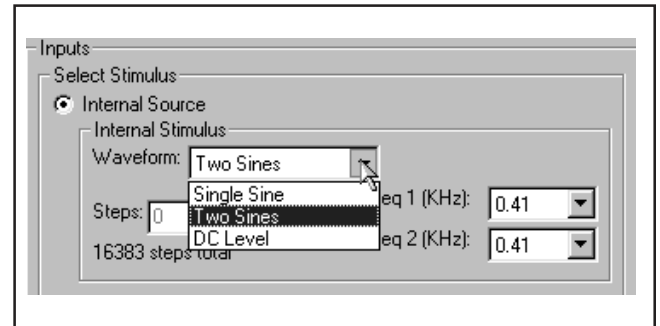To digitize a complex waveform, select two sine waves,
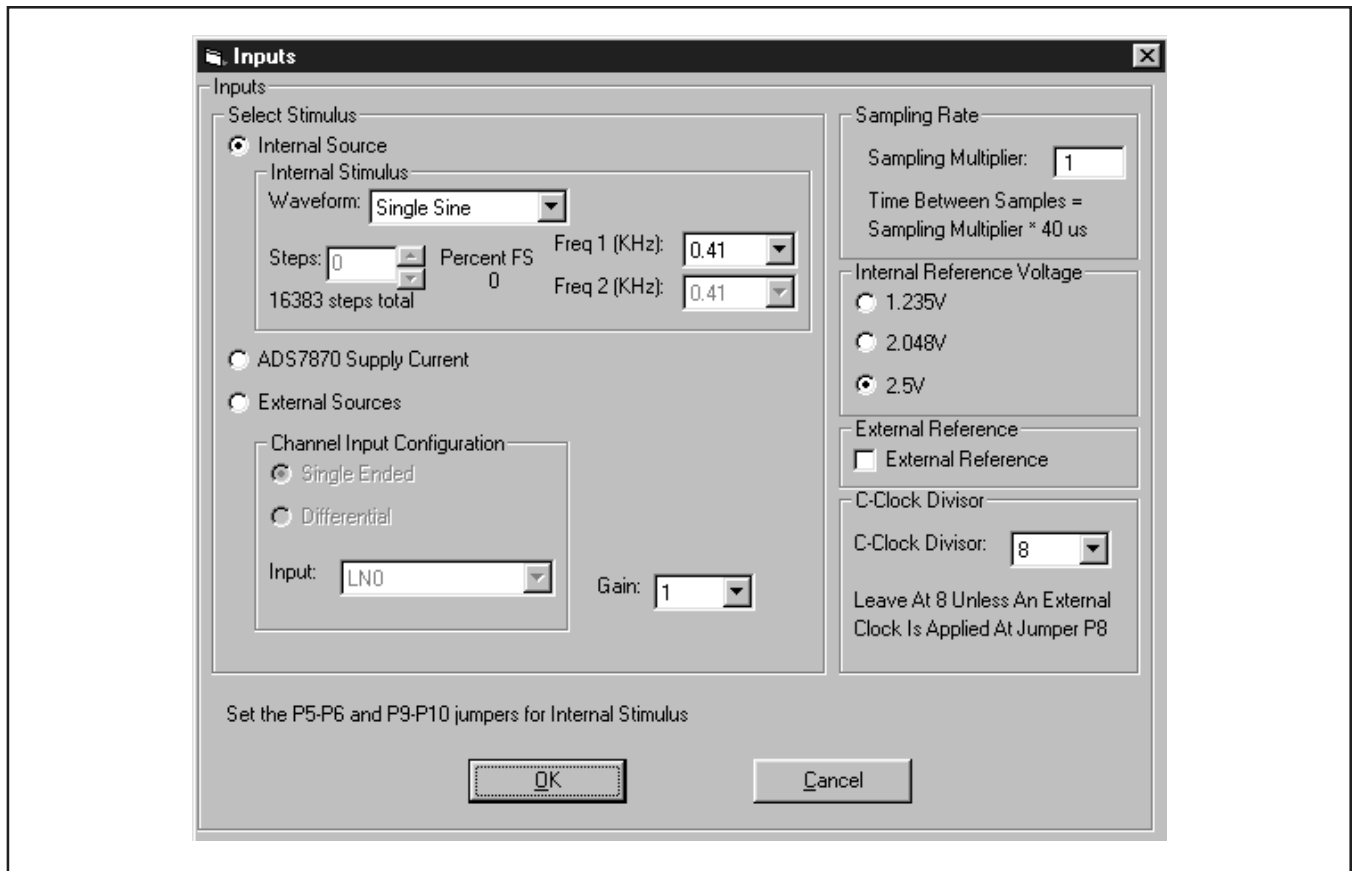

FIGURE 4. Waveform Selections.

FIGURE 3. Setup...Inputs... Screen Start-up Default Values.

DEM-ADS7870

setting Freq 1=0.82 and Freq 2 =4.01 for a ratio of 5:1. The result is shown in Figure 5.

In Figure 5, there is a box drawn around the waveform. This is a zoom window. Place the cursor just to the left of the first data point. Holding the left mouse button down, draw a box as shown. The result of the zoom operation is shown in Figure 6, below.

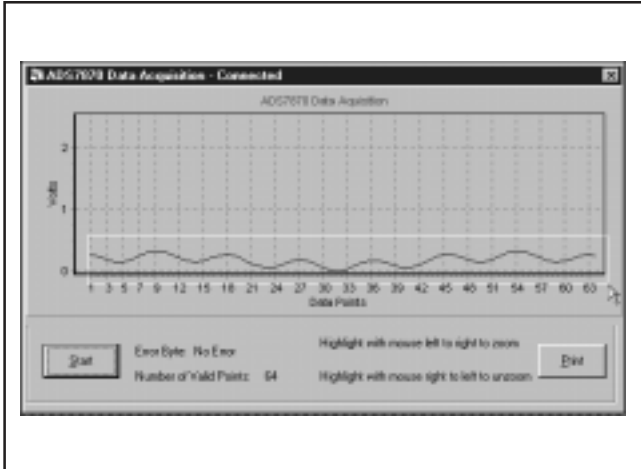Acquisition of a DC voltage can also be demonstrated by
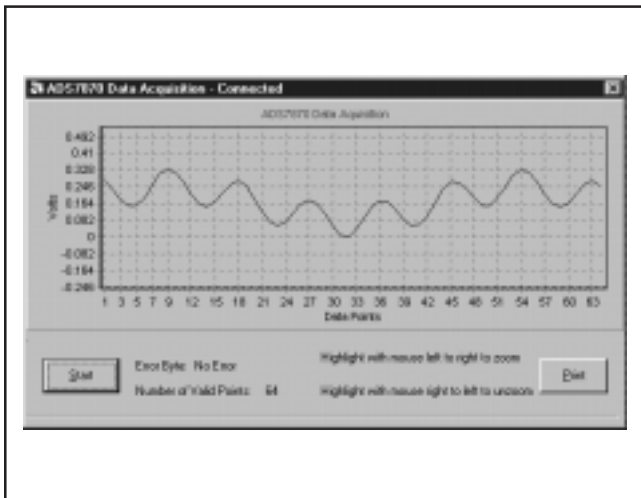

FIGURE 5. Two Sine Waves.

FIGURE 6. Two Sine Wave Trace After Zoom Operation.

selecting that option from the Internal Stimulus, ...Waveform menu, and then setting a voltage level by entering a value between 0 and 16,383. This is useful in demonstrating the treatment of negative numbers by the ADS7870.

Open the Setup...Inputs screen and set the Waveform DC at some non-zero value. Execute a data collection sequence and, using the View Register Values as described below, note the hex code of the last A/D conversion. Through the Setup...Inputs screen, change the stimulus to External Sources, but do not move any jumpers. Select Channel Input Configuration to Differential, +LN2–LN3. Close the window and execute a data collection. The value of the last

A/D conversion should be very close to the first value noted. Reset the Channel Input Configuration to Differential, –LN2+LN3, close the window and collect another data set. The A/D conversion value displayed will be the two's compliment of the first readings.

To demonstrate the PGA over-range flag, return the configuration to the Internal Source stimulus and increase the PGA gain to 20 on the Setup...Inputs control screen. Starting a data collection sequence will result in a display, as shown in Figure 7.
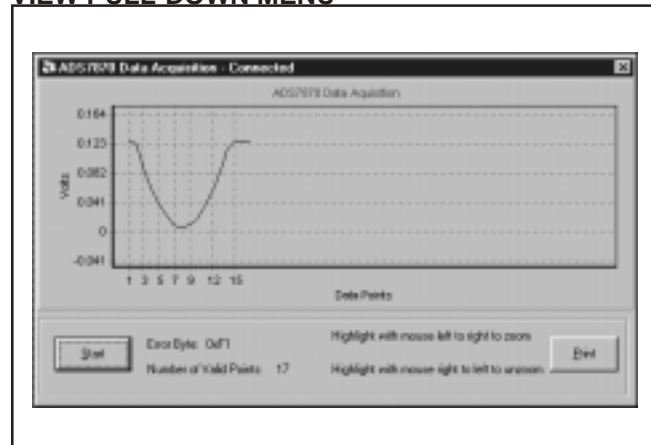
VIEW PULL-DOWN MENU

FIGURE 7. PGA Overload. Note that the number of valid data points will vary depending on the level of the sine wave at the time the data set is collected.

The internal configuration registers of the ADS7870 can be examined with the View...Register Values, as shown in Figure 8.

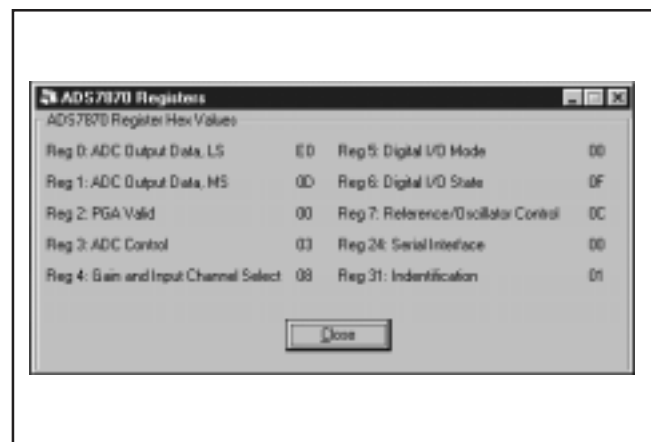The individual bits may be examined and changed where

FIGURE 8. Register Values.

valid, with the pull-down menu View...Register Details. Examples of these screens are given in the following five figures.

The contents of register 2 shown in Figure 9 report that there

was a positive over range signal at the output of the PGA.

To move from one display to another, click on the top tab. To change a bit, place the mouse arrow in the window and double left click. The resulting HEX value for that register will be displayed on the right and the operational effect of the change will be displayed in the label block.

The values will be written to the ADS7870 on "Update" or "Close" of the window.
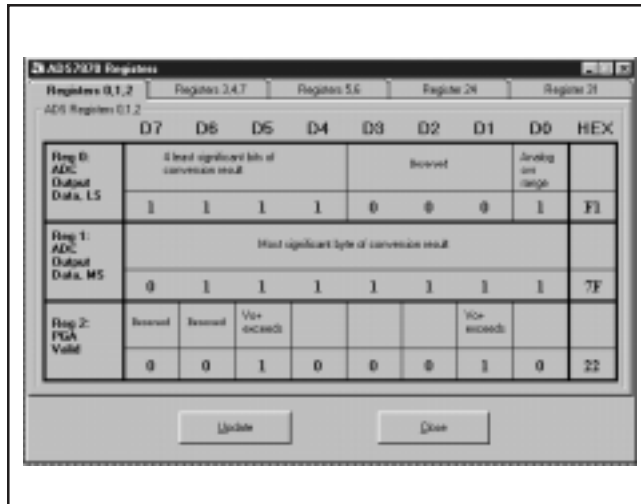
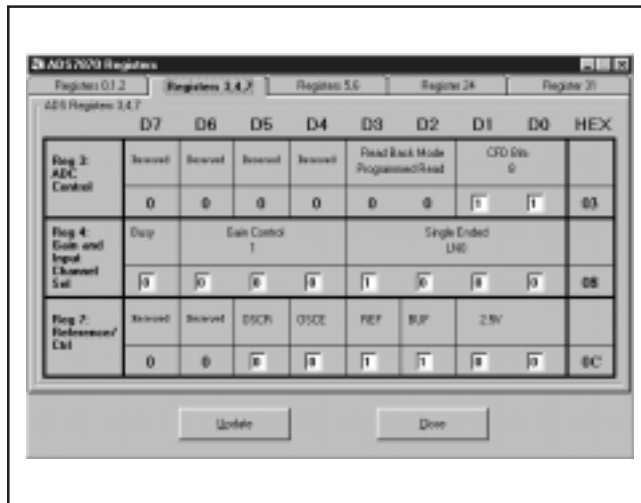# APPENDIX A: DEMO BOARD

FIGURE 9. Read-Only Registers 0, 1, and 2.

FIGURE 10. ADS7870 Configuration Registers. See the product data sheet for detailed description of the functions available.
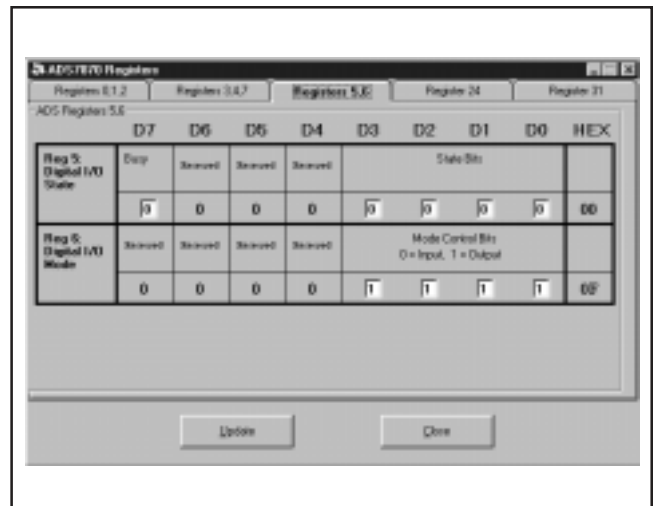
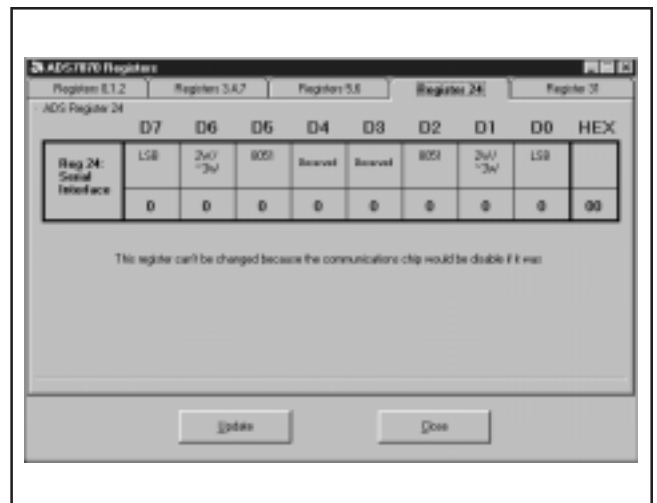FIGURE 11. Device Status in Register 5 and Control of the DIO Lines.

FIGURE 12. Communication Configuration Bits. This setting is necessary to work with the on-board PIC controller.
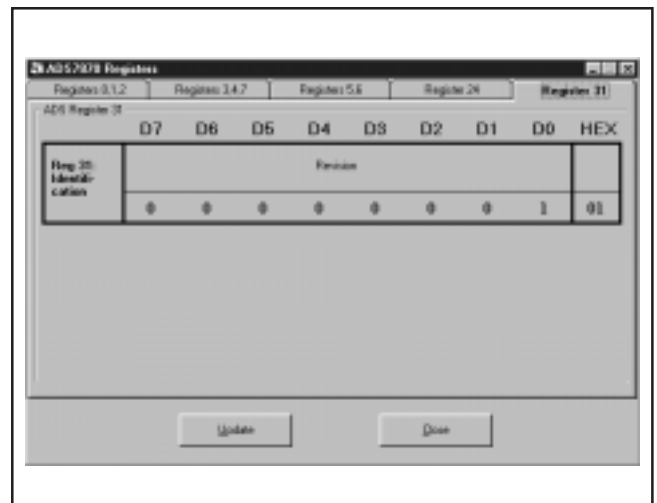
FIGURE 13. Revision Code for the Device is Displayed in this Register.

DEM-ADS7870

CONSTRUCTION DETAILS

CIRCUIT DIAGRAM AND PC BOARD

The circuit diagram is presented in three sections. Figure 14 covers the RS232 communications through to the ADS7870. Figure 15 depicts the on-board stimulus generator. Figure 16 shows the interconnect between the sections and the power supply.

Figures 17 through 21 show the artwork for the four-layer PCB and top silk screen. Table III is the bill of material for the entire assembly.

ITEM	QTY	REFDES	MAKE	Part Number	VALUE	PACKAGE	DIGIKEY
1	1	B1	KEYSTONE	1294K		BH9V-1	1294K
2	3	C1, C12, C14	PANASONIC	ECS-T1AX106R	10µF	3528	PCS2106CT
3	5	C2, C4, C8, C13, C19	PANASONIC	ECU-V1H104KBW	0.1µF	CC1206	PCC104BCT
4	1	C3	PANASONIC	ECU-V1H103KBG	0.01µF	CC0805	PCC103BNCT
5	4	C5, C6, C10, C11	PANASONIC	ECU-V1H220JCV	22pF	CC0603	PCC220ACVCT
6	5	C7, C9, C15, C16, C18	PANASONIC	ECS-T1EY474R	0.47µF	3216	PCS5474CT
7	1	C17	PANASONIC	ECU-V1H121JCV	120pF	CC0603	PCC121ACVCT
8	2	D1, D2	LITEON	LLSD103A	LLSD103A	MLL34	LLSD103ACT
9	4	D3, D4, D5, D6	CHICAGO_MLI	CMD91-21VRC/TR7	—	CMD91-21	L62901CT
10	1	D7	DIODES	ZMM5232B	5.6V	MLL34	ZMM5232BCT
11	5	E1, P5, P6, P7, P16	NORCOMP	2163-08-01-P2	—	HDR8/2MM-1	2163S-08
12	7	E2, E3, E4, E5, E6, E7, E8	NORCOMP	2163-01-01-P2	—	EPOINT-M	2163S-01
13	1	J1	OST	ED555/2DS	—	ED555/2DS	ED1514
14	1	J2	AMP	520250-2	—	AM6-520250	—
15	1	J3	OST	ED555/16DS	—	ED555/16DS	ED1526
16	7	P1, P3, P4, P12, P13, P14, P15	NORCOMP	2163-03-01-P2	—	HDR3/2MM-1	2163S-03
17	2	P2, P8	NORCOMP	2163-02-01-P2	—	HDR2/2MM-1	2163S-02
18	3	P9, P10, P11	NORCOMP	2163-06-01-P2	—	HDR6/2MM-1	2163S-06
19	1	R1	PANASONIC	ERJ-6ENF4752V	47.5k	CR0805	P47.5KCTR
20	3	R2, R4, R5	PANASONIC	ERJ-6ENF2002V	20.0k	CR0805	P20.0KCTR
21	2	R3, R13	PANASONIC	ERJ-6ENF4022V	40.2k	CR0805	P40.2KCTR
22	5	R6, R7, R8, R9, R10	PANASONIC	ERJ-6ENF3011V	3.01k	CR0805	P3.01KCTR
23	1	R11	PANASONIC	ERJ-6ENF1823V	182k	CR0805	P182KCTR
24	1	R12	PANASONIC	ERJ-6ENF10R0V	10	CR0805	P10.0CTR
25	1	U1	NATIONAL	LM2936M-5.0	—	SO8	—
26	1	U2	MICROCHIP	PIC16C63-20/JW	—	DIP28-300	PIC16C63/JW
27	1	U3	BURR-BROWN	ADS7870	—	SSOP28	—
28	1	U4	MAXIM	MAX3320LCAP	—	SSO20	—
29	1	U5	MICROCHIP	PIC16F84-10/SO	—	SO18W	PIC16F84-10/SO
30	1	U6	BI_TECH	628L104TR	—	SO16RP	—
31	1	Y1	ECS	ECS-200-20-4	20.000MHz	XTALV	X439
32	1	Y2	ECS	ECS-100-S-4	10.000MHz	XTALV	X422
33	1	—	—	—	PCB	—	—
34	1	—	MILL-MAX	115-93-328-41-001	Socket, 28-pin, 300 mil for U2	—	ED58283
35	7	—	Specialty Elect	2JM-G	Jumper shunt, 2mm	—	SPE1302
36	1	—	Comm Con	MIJ2MM-06	Jumper shunt block, 2mm, 2 x 6	—	—
37	1	—	Comm Con	MIJ2MM-08	Jumper shunt block, 2mm, 2 x 8	—	—
38	4	—	—	—	Mounting pins - battery clip	—	—
39	1	—	—	—	Serial cable per drawing	—	—

TABLE III. Parts List.

FIGURE 14.

DEM-ADS7870

BURR - BROWN®

BB

FIGURE 15.

FIGURE 16.

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BURR - BROWN®
BB
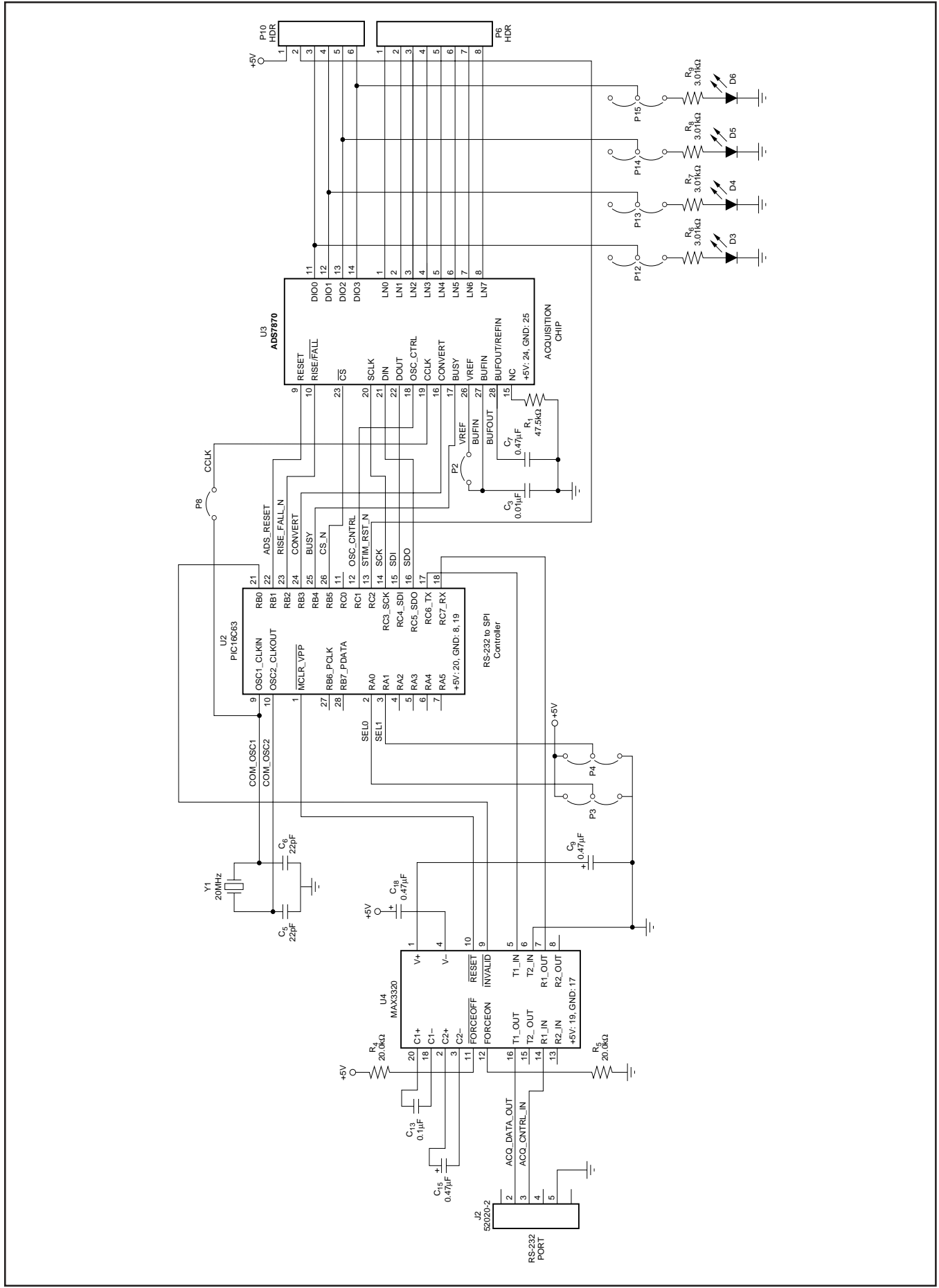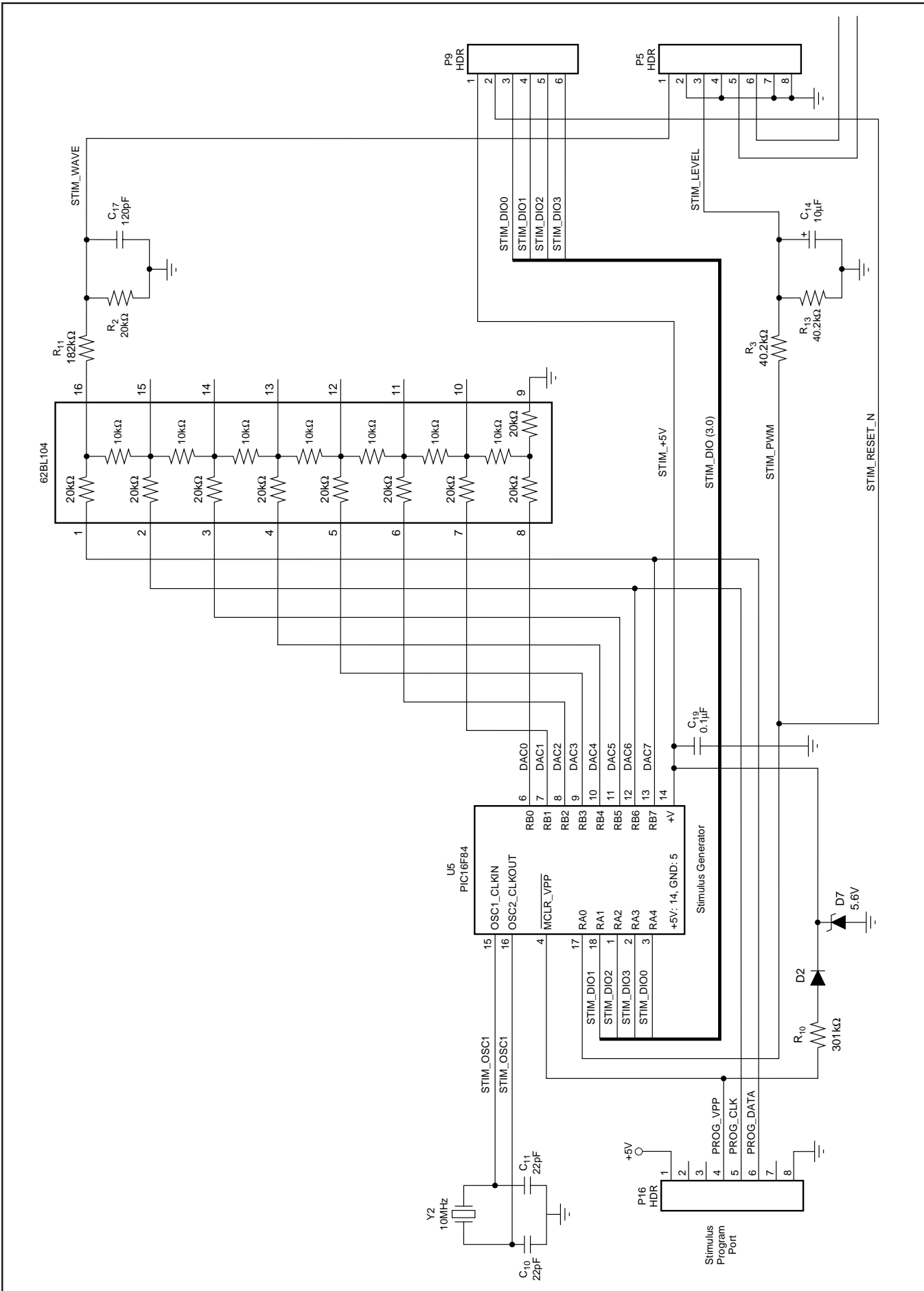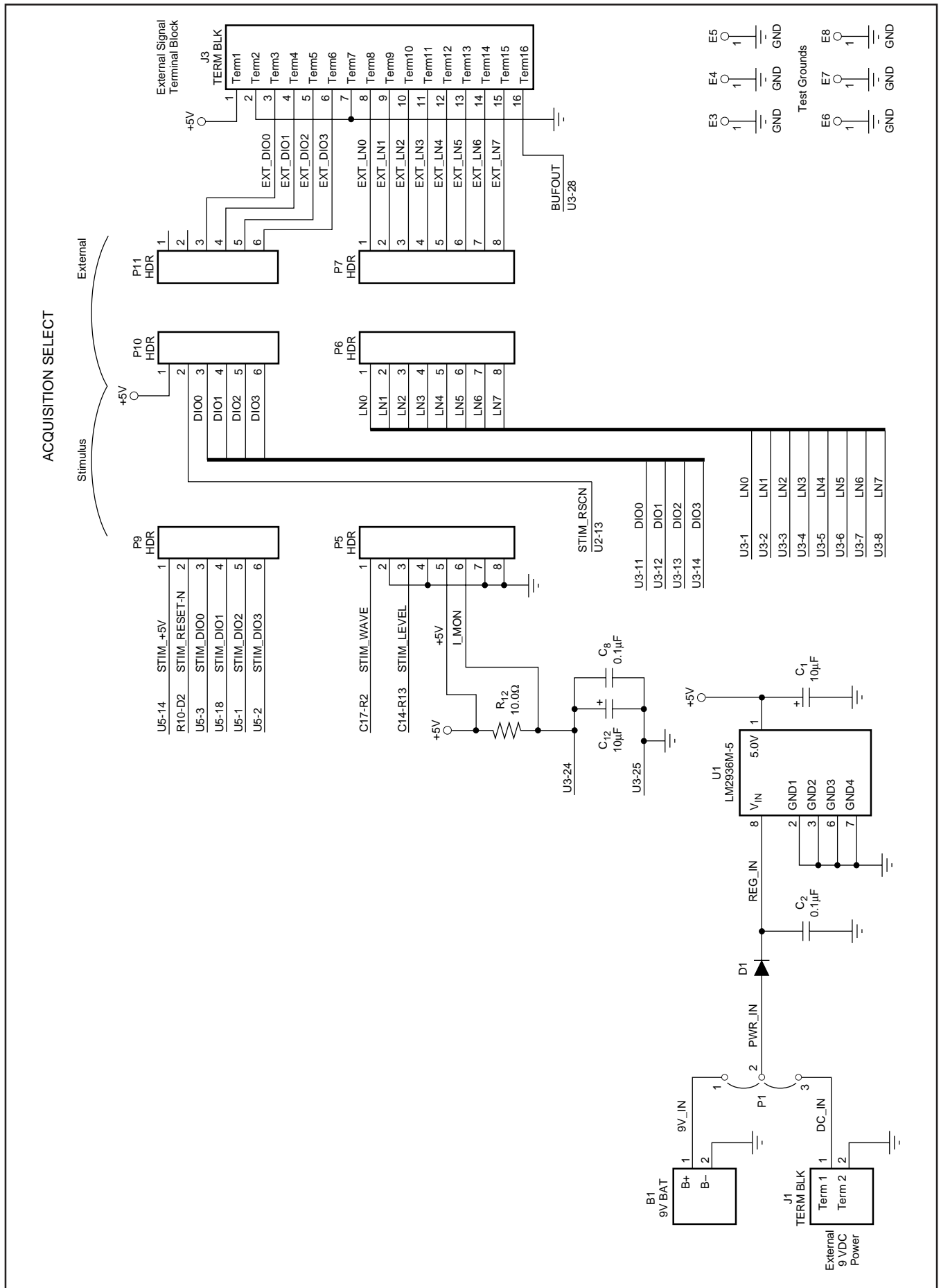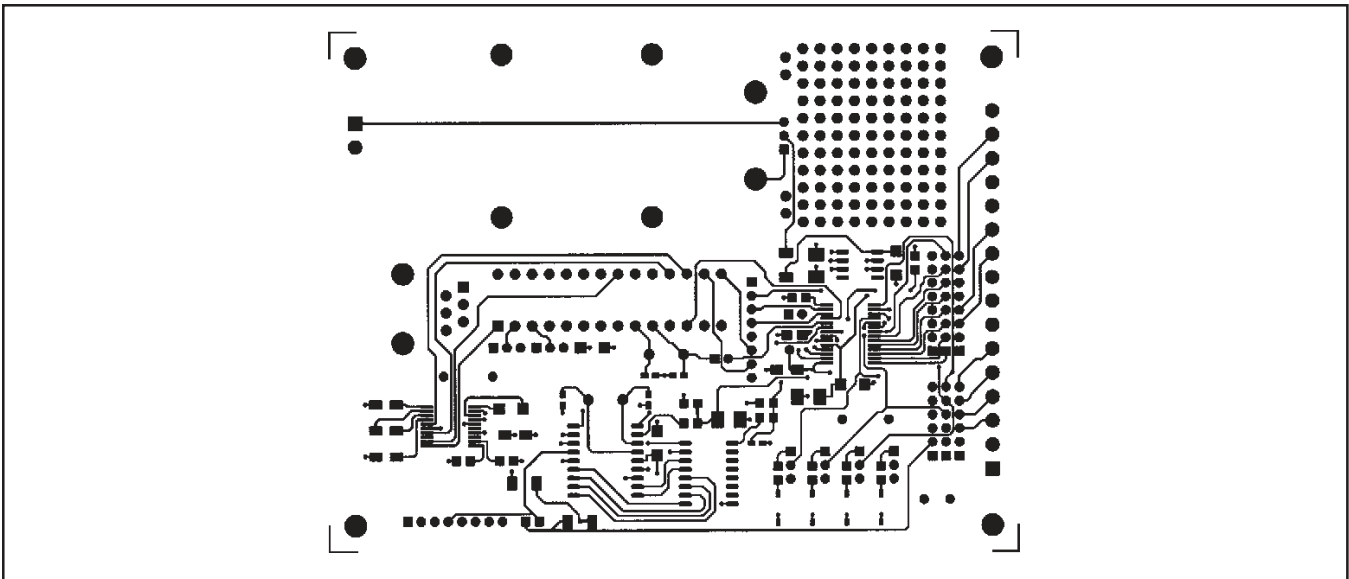
FIGURE 17. Top Layer.

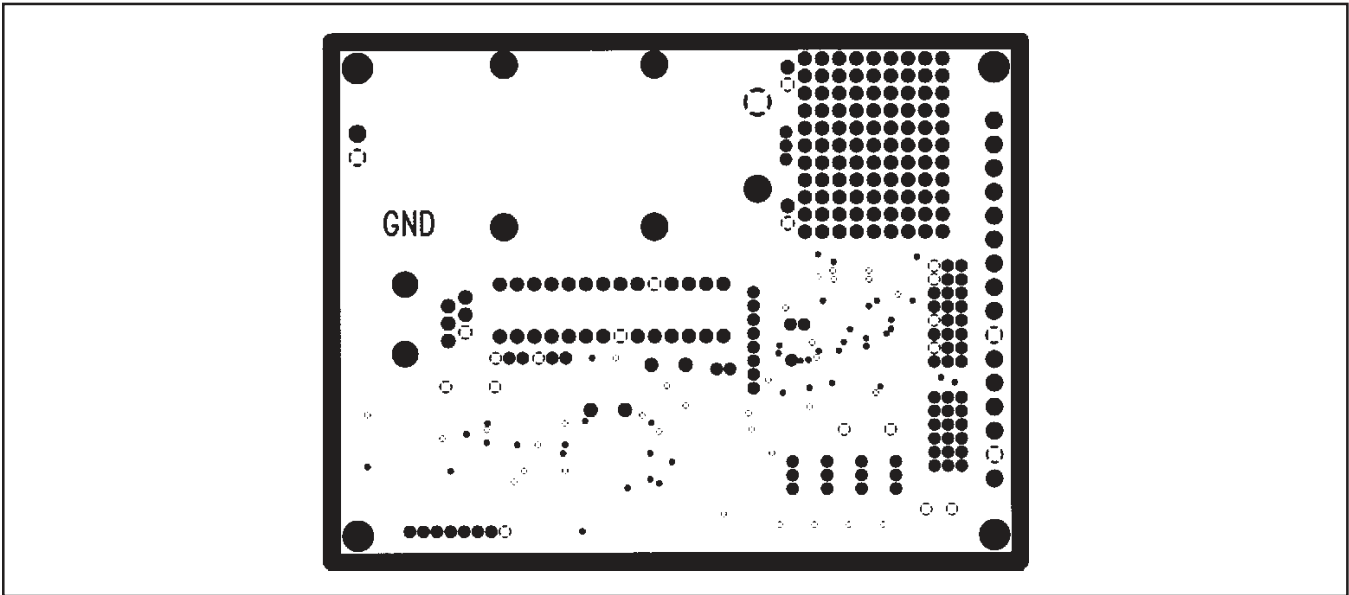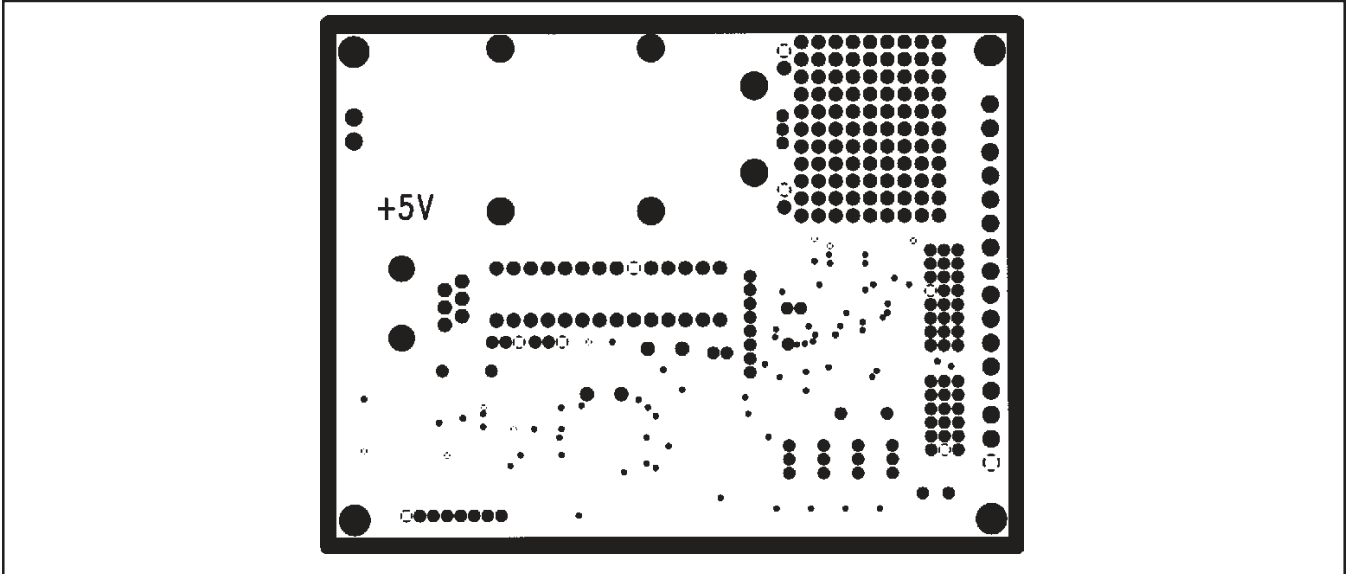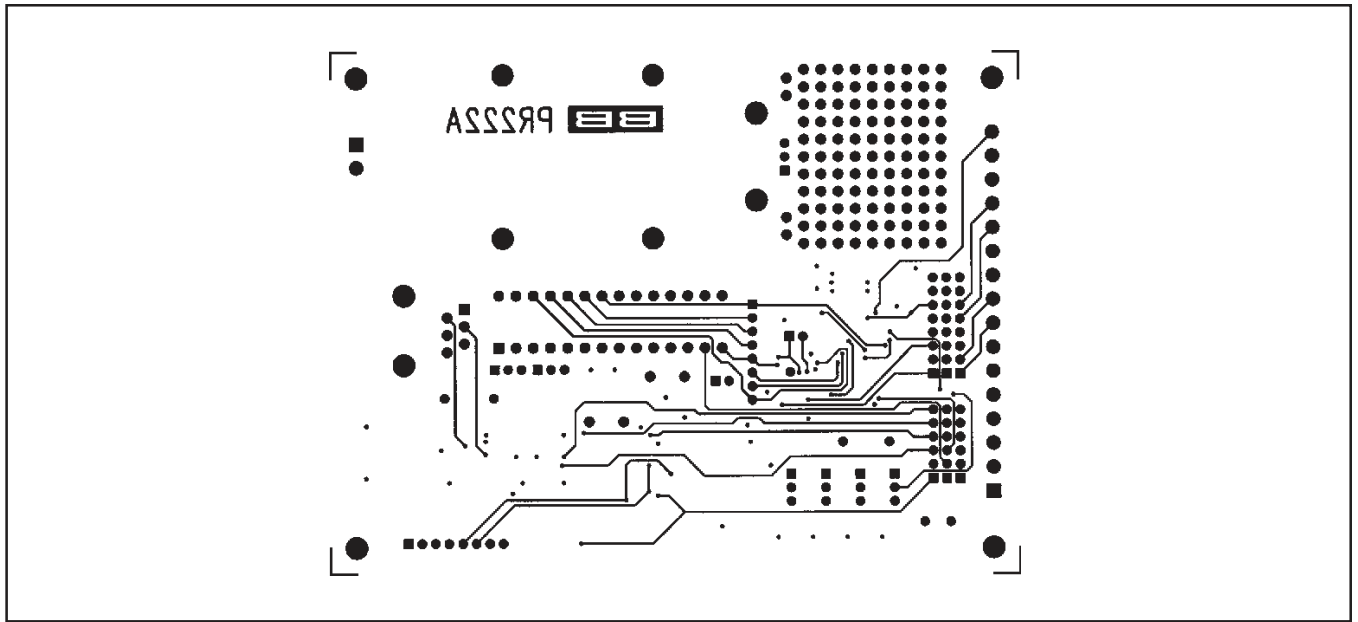

FIGURE 18. Ground Plane.
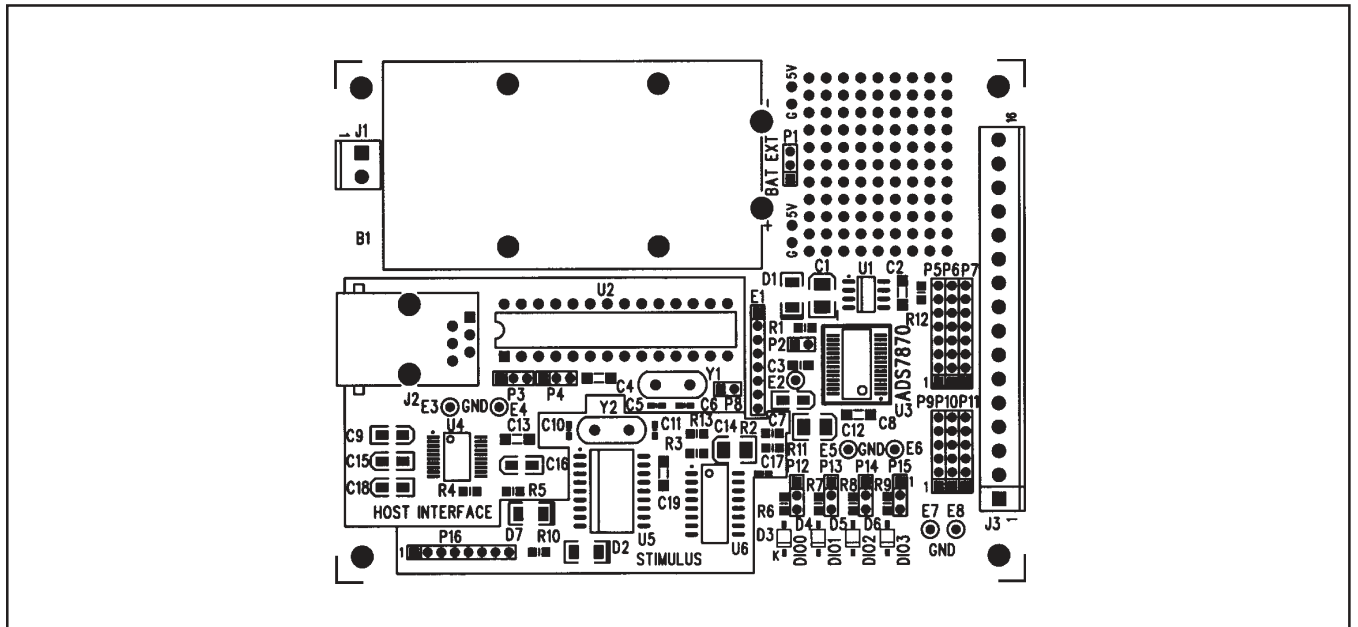

FIGURE 19. Power Plane.

FIGURE 20. Bottom Side.

FIGURE 21. Top Side (Silkscreen).

DEM-ADS7870

APPENDIX B: EMBEDDED MICRO-CONTROLLER PROGRAMMING

The embedded controllers can be reprogrammed. The source code for each of the devices is provided in the CD in the folder titled Support. The files associated with U2, the PIC16C63 are titled "adcmain".

A PIC16F84 generates the on-board signals. Source code files associated with this device contain "stimgen" in the name. Program memory in this device is flash memory and can be reprogramed.

PROGRAMMING THE STIMULUS GENERATOR

The DEM-ADS7870 stimulus generator, a Microchip PIC16F84, is programmed on board through P16, a 2mm spaced 8-pin header. Since only four connections are needed, it is easy to create an adapter for a socket programmer, such as the PICStart Plus. A diagram of the adapter is shown below.

PIC16F84 PROGRAMMING ADAPTER

The adapter consists of the following parts:

1) One 18-pin solder tail DIP socket, DigiKey ED3318 or equivalent.
2) One 8-pin 2mm solder tail SIP socket, DigiKey 2063S-08 or equivalent.
3) Four 10" long pieces of AWG 26 stranded insulated hookup wire.
4) Small heat shrink tubing.
5) Small wire ties.

To construct the programming adapter:

1) Strip and tin the ends of the wires.
2) Slide 3/4" lengths of heat shrink tubing onto the wires.
3) Solder the 10" wires to the following points.
   SIP socket pin 4 solder tail to DIP socket pin 4 top side.
   SIP socket pin 5 solder tail to DIP socket pin 12 top side.
   SIP socket pin 6 solder tail to DIP socket pin 13 top side.
   SIP socket pin 8 solder tail to DIP socket pin 5 top side.
4) Shrink the heat shrink tubing over the header pin connections.
5) Tie the wires for support.
6) Fill pin 2 of the SIP header with epoxy for keying.
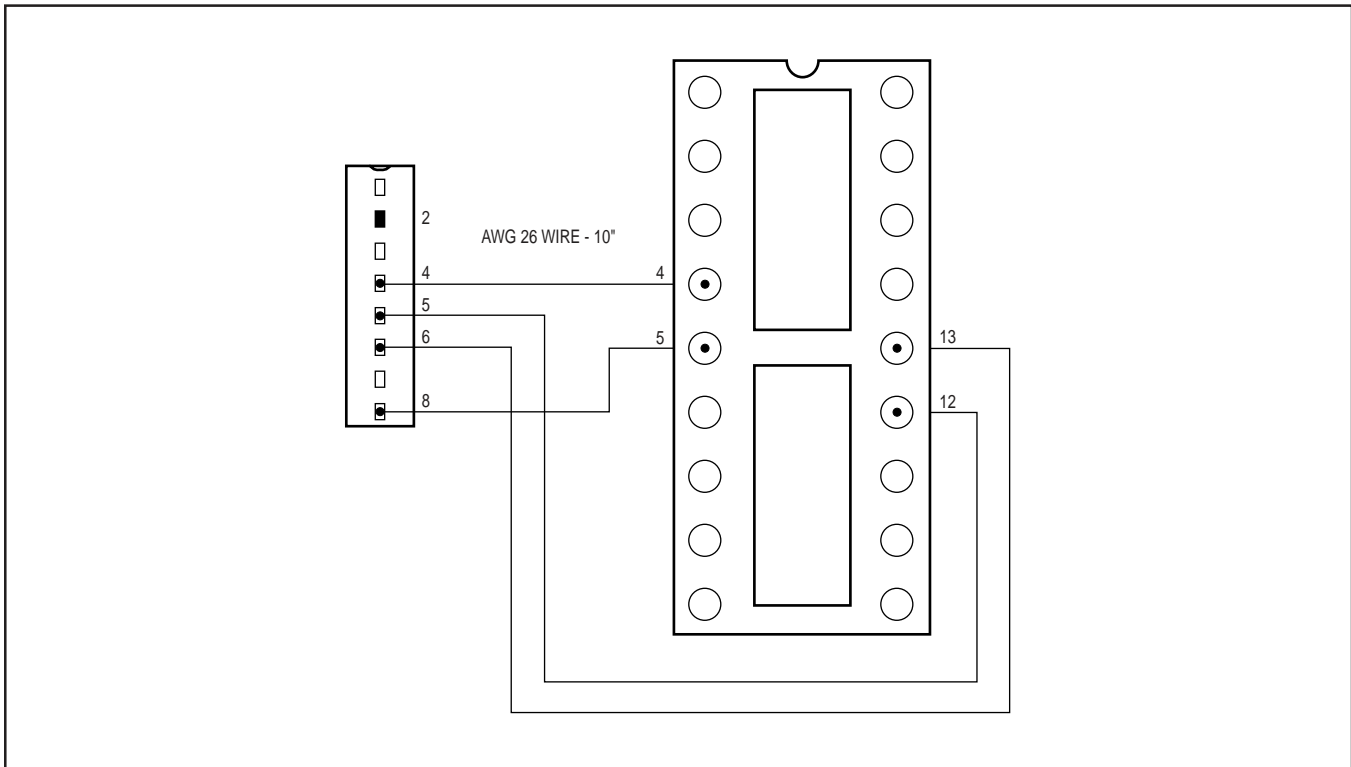   (If you plug this in wrong you may blow up the PIC.)

FIGURE 22.

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