AIM8
Strain Gage and DC Amplifier Module

This documentation describes the features, installation, and operation of the AIM8 Strain Gage/DC Amplifier Module for the Series 500 and System 570. This manual also contains specific programming information which is essential to understanding and using the AIM8 module.

This manual is not a general-purpose source on strain gages or DC measurement techniques. The user must select strain gage transducers and bridge configurations according to the application. For specific applications information on strain gages, consult the literature produced by strain gage manufacturers.

The AIM8 is a highly versatile module used to measure strain-related parameters. It is compatible with a wide variety of resistive and semiconductor strain gage transducers. The AIM8 includes several advanced features which contribute to its performance, accuracy, and overall flexibility.

Four channels: The AIM8 has four channels. Each can support a full, half, or quarter strain gage bridge. The AIM8 supports the use of quarter bridges with or without lead compensation.

High-gain, low-noise amplifier: The AIM8 offers software-programmable local gains of 1, 10, 100, or 1000. Local gain can be combined with global gain for total gain of up to 10,000. Maximum noise is 2μV peak-to-peak to 10Hz, and 4μV p-p from 10Hz to 1kHz.

High sensitivity: The AIM8 provides usable measurement sensitivity in the microvolt region.

Extensive transducer compatibility: The AIM8 accepts resistive and semiconductor strain gages with values from 120Ω to several thousand ohms.

On-board bridge completion facilities: The AIM8 includes spring-loaded pin sockets for quick installation of jumpers and bridge completion resistors directly on the module.

Adjustable excitation: The AIM8 provides regulated, independently-adjustable excitation of 0V-10V at up to 100mA for each of its four channels.

Internal or external excitation: Power for the on-board excitation sources is derived from the data acquisition system +15V supply. The AIM8 contains on-board terminals for connection of an external excitation power supply if necessary.

Excitation voltage readable via software: Internal AIM8 channels 4, 5, 6, and 7 read the excitation voltage of channels 0, 1, 2, and 3, respectively.

Quick-disconnect terminals: The AIM8 includes quick-disconnect terminal blocks for easy connection to strain gages and an external excitation power supply.

Selectable low-pass filter: The AIM8 offers 10Hz, 1kHz, or 3kHz (no filter) bandwidths, selectable through IONAME parameters.

Adjustable offset: An offset of up to ±100mV or ±1V is available to null bridge imbalance, or for "zero suppression" during standard DC measurements.

Compatible with Series 500 or System 570: The System 570 accepts one AIM8. The Series 500 can accept up to nine AIM8 modules. (External excitation power may be required.)

These features are important in measuring strain gages, but are also useful in many other applications which measure millivolt and microvolt signals. In addition, the bridge completion sockets permit a Wheatstone bridge to be configured for sensitive, bridge-type voltage measurements. Figure 1 shows the important features of the AIM8 module.

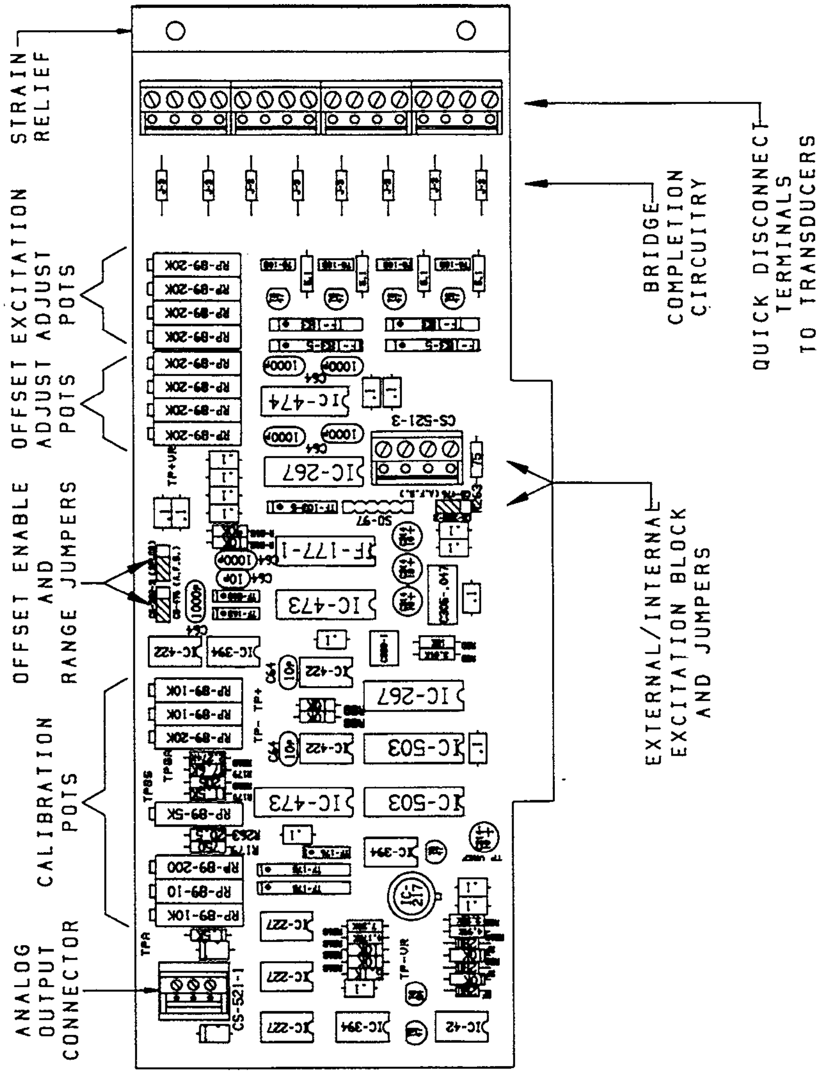


Figure 1. AIM8 Module

Requirements for Using the AIM8

The AIM8 is hardware-compatible with Keithley's Series 500 and System 570 products. When used in the Series 500, the AIM8 requires a master analog input module AMM1 or AIM1 in slot 1. The AIM1 requires either an ADM1 or ADM2 A/D module in slot 2. The System 570 already contains the master analog input and A/D functions, and is ready to accept one AIM8.

AIM8 programming is done with Soft500 Version 4.0 or later, or Quick500. Soft500 runs under IBM PC Advanced BASIC (BASICA), Compaq BASICA, or Microsoft GWBASIC. IBM DOS version 3.1 or later is recommended.

Compaq computers must run Soft500 under Compaq DOS 3.0 or later, with the matching BASICA version. Earlier versions of Compaq DOS and BASICA are not compatible with Soft500 V4.0.

Soft500 Version 4.0 or later also runs on most 100% IBM-compatible computers which use MS-DOS, Version 3.0 or later, and GW-BASIC. Regardless of the brand or rev level of the DOS, use the GW-BASIC version which accompanies or is recommended for the DOS version. Mixing DOS and BASIC versions may cause problems.

The AIM8 module can also be programmed directly using BASICA's PEEK and POKE functions, or the corresponding memory read and write functions of other programming languages. This permits the AIM8 to be programmed outside the Soft500 environment.

Installation

Install the AIM8 in slots 2-10 on the Series 500 (slots 3-10 if the AIM1 is used). For maximum immunity to noise, install the AIM8 and any other analog input modules in the lowest-numbered available slots. The System 570 can accept one AIM8 module in its option slot. For either system, update the configuration table to show the location of the AIM8 by running CONFIG.EXE.

User-Configured Features - Strain Gage Function

Before you install the AIM8 in a Series 500 or System 570, you must configure the AIM8. Install or remove jumpers and bridge completion circuitry according to the operating parameters and type of bridge connected to the module. Each of the following paragraphs discusses a feature you must configure before you use the AIM8 module.

Connecting a Bridge to the AIM8

The AIM8 card has one quick-disconnect terminal block per channel. Each block has screw terminals for (+) and (–) signal input, analog ground and shield, and excitation output Vss (see Figure 2).

Make connections to the AIM8 by first loosening the terminal screws several turns. Strip 1/4 inch of insulation from a wire lead, insert the lead in the receptacle beneath the screw, and tighten the screw.

To help with connection of leads, you can remove the terminal blocks. Pull a block off the board in a perpendicular direction with a firm, even pressure. Do not pry the terminal blocks off with a screwdriver or sharp tools or you may damage the circuit board. After you connect the wires to the terminal block, reinstall the block on the AIM8.

Completing the On-Board Bridge Circuitry

The AIM8 module contains four sets of pin socket terminals for completing bridge circuits on the AIM8. These pin sockets are organized into groups 0-3, which correspond to the AIM8's input channels. Within each group, pairs of pin sockets are labeled R1, R2, R3, R4, W1-1, W1-2, and W2 (see Figure 2).

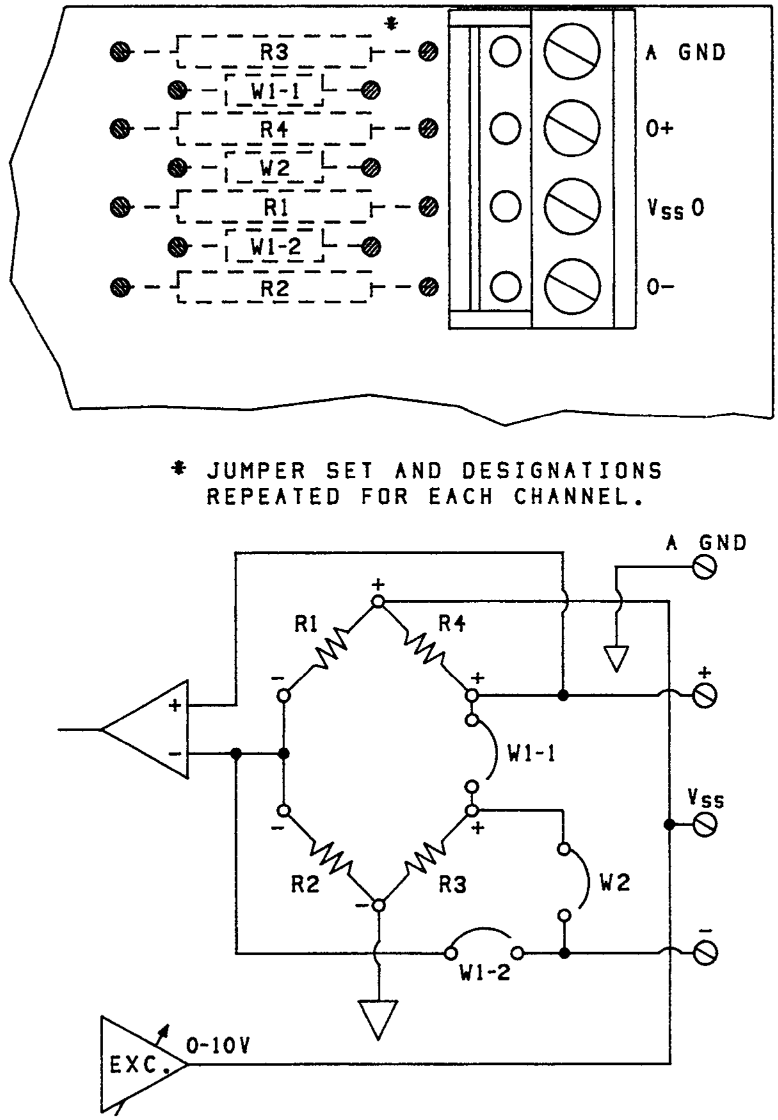


Figure 2. AIM8 On-Board Bridge Completion Circuitry

Each pin socket accepts a single, solid-wire jumper or resistor lead. Maximum acceptable lead diameter is 0.020 inch. The spacing between jumper sockets is 0.5 inches, while the spacing between resistor sockets is 0.8 inches.

Bridge completion resistors must have a low temperature coefficient. Keithley ships 12 low-TC 120-ohm resistors and 12 low-TC 350-ohm resistors with the AIM8. These resistors have temperature coefficients on the order of 10ppm/°C. Resistors which do not meet this specification may compromise the accuracy of the AIM8. Keithley also ships a supply of jumpers with the AIM8. These resemble resistors, and have a blue body with a single black band indicating 0Ω.

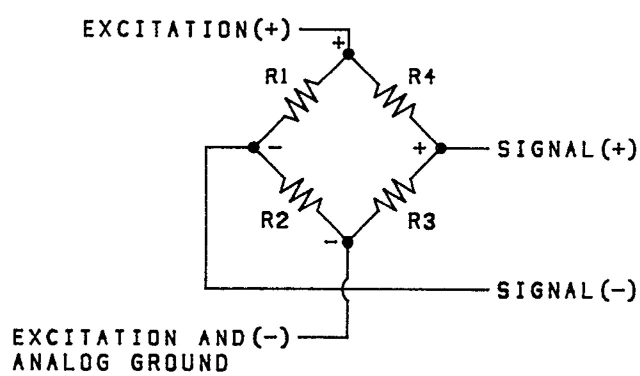
Cut the jumper or resistor to length, bend the ends at right angles, and plug the ends into the pin sockets (see Figure 2). Each pin socket is spring-loaded, and will grip the wire lead firmly until the lead is removed.

Table 1 summarizes the bridge completion information for the four common bridge configurations.

Table 1. Jumpers and Resistors for Bridge Completion

CONFIGURATION	R1	R2	R3	R4	W1-1	W1-2	W2
Full Bridge	0	0	0	0	X	1	0
Half Bridge	1	1	0	0	X	X	0
Quarter Bridge w/o lead compensation (2-wire)	1	1	1	0	1	X	0
Quarter Bridge with lead compensation (3-wire)	1	1	1	0	0	0	1
Voltage Measurement (no bridge)	0	0	0	0	X	1	0

1 = installed
0 = not installed
X = Don't Care



Full Bridge

The full bridge uses four active strain gage elements, all of which are located external to the AIM8. The full bridge circuit uses no on-board completion elements, but it does require that a jumper be installed on the AIM8.

For the full bridge circuit, install jumper W1-2. Jumper W2 should not be installed. W1-1 makes no difference. Do not install any bridge completion resistors R1-R4. See Figure 3.

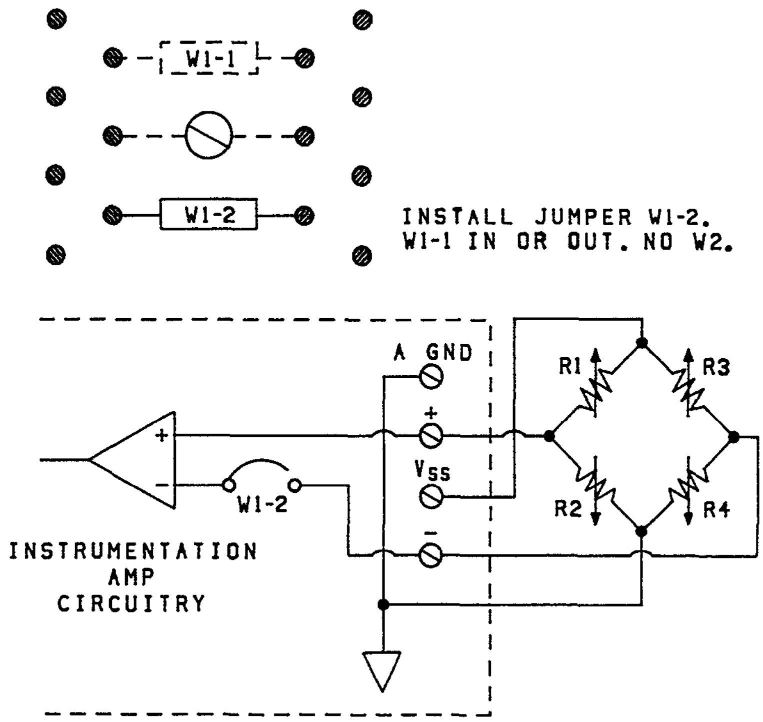


Figure 3. Full Bridge Circuit and Jumpers

Half Bridge

The half bridge uses two active strain gage elements and two passive resistors to complete the bridge. The strain gage elements are located external to the AIM8, while the completion resistors are installed on the AIM8.

To complete the half bridge on the AIM8, install bridge completion resistors R1 and R2. Do not install jumper W2. Jumpers W1-1 and W1-2 make no difference. See Figure 4.

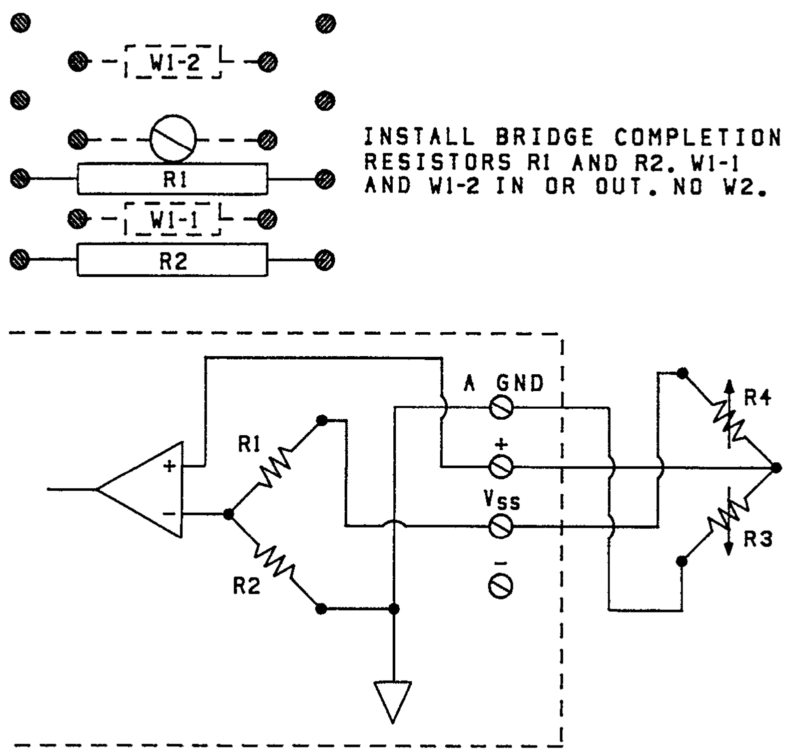


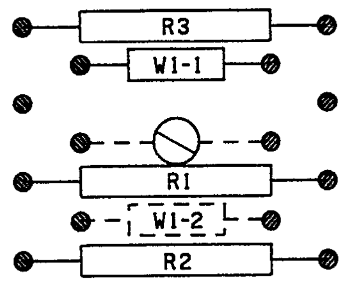
Figure 4. Half Bridge Circuit and Jumpers

Quarter Bridge Without Lead Compensation

The quarter bridge without lead compensation uses one active strain gage element plus three resistors located on the AIM8 to complete the bridge. Two leads connect the active gage to the AIM8.

Use the 2-wire configuration only for short wire runs between the data acquisition system and strain gage. Long runs can introduce resistive and thermal effects which degrade measurement accuracy.

For the quarter bridge non-compensated configuration, install bridge completion resistors R1, R2, and R3. Install jumper W1-1. Jumper W2 should not be installed. Jumper W1-2 makes no difference. See Figure 5.



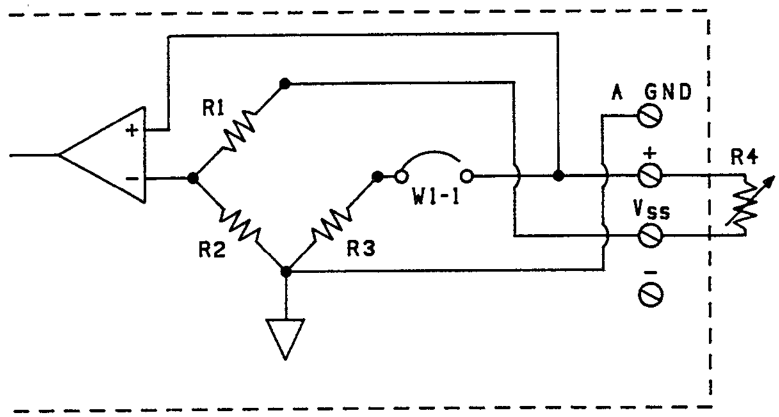


Figure 5. Quarter Bridge/2-Wire Circuit and Jumpers

Quarter Bridge With Lead Compensation

The quarter bridge with lead compensation uses one active strain gage element plus three resistors located on the AIM8 to complete the bridge. Three leads connect the strain gage to the AIM8. The three-wire configuration minimizes the errors caused by thermal effects and resistance of the connecting wires.

For the quarter bridge lead-compensated configuration, install bridge completion resistors R1, R2, and R3. Install jumper W2. Do not install jumper W1-1 and W1-2. See Figure 6.

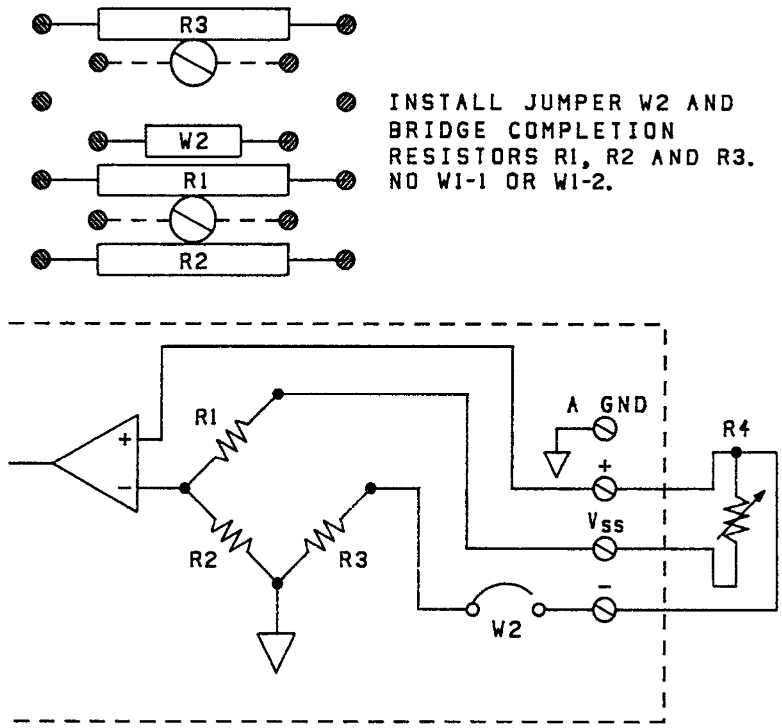


Figure 6. Quarter Bridge/3-Wire Circuit and Jumpers

Selecting Excitation Power and Adjusting Excitation Voltage

The AIM8 contains an independent excitation source for each of its channels. Each source is a voltage regulator circuit with current limiter. Potentiometers labeled Vss0-Vss3 vary the excitation voltage of channels 0-3. Each excitation source can supply 0 to 10 volts, with maximum current limited to 100mA.

The AIM8 is normally configured so that the excitation sources are powered by the data acquisition system +15V supply. Alternately, an external excitation power supply can be connected to the AIM8 to drive the excitation sources. In this case, potentiometers Vss0-Vss3 still adjust the excitation level, and current output remains limited to 100mA.

The choice of internal vs external power for excitation depends on four factors:

1. The number and resistances of the bridges connected to the AIM8.
2. The excitation voltage level set for each strain gage channel.
3. Whether the data acquisition system is a System 570 or Series 500.
4. The types and numbers of any other modules installed in the data acquisition system.

Unless you will be connecting an external supply, move jumper W5 to the INT 15V position. To select an external excitation supply, move jumper W5 to the EXT 15V position (see Figure 7).

The AIM8 contains a quick-disconnect terminal block for connecting an external excitation power supply. This block has two screw terminals for +V and two for analog ground (A GND). The extra terminals for +V and A GND enable several AIM8's to be daisy-chained off one external excitation supply.

The voltage of an external supply should be at least two to four volts higher than the maximum excitation voltage desired from the AIM8. On the other hand, avoid running the AIM8 excitation at just a few volts with high voltages (20V or more) connected for external power. Large voltage margins require that the AIM8's regulation circuitry dissipate the excess power. This may generate excessive heat and lead to component failure on the AIM8.

To connect an external supply, first loosen an external excitation +15V screw and an A GND screw on the excitation terminal block (see Figure 7). Connect the external power supply to the terminal screws. Observe the polarity markings on the AIM8 and connect the external supply correctly or you may damage the AIM8.

To connect two or more AIM8 modules to the same external excitation power supply, you must link the external power connectors of all AIM8's. Connect a wire from one +15V terminal screw on the second AIM8 to the unused +15V terminal screw on the first AIM8. Connect a second wire from one A GND screw on the second AIM8 to the unused A GND screw on the first AIM8. Repeat these connections from a third AIM8 to the second AIM8, and so on. Be sure to move the W5 jumpers on all AIM8 modules to the external power position.

Even though the AIM8 can supply up to 10V excitation, it is common for bridges to be driven at one to a few volts. A strain gage draws less current at lower excitation voltages, which minimizes heating effects within the strain gage. A second benefit is that, at lower voltages, strain gages draw less total power from the +15V supply. This maximizes the number of strain gage bridges that can be driven without resorting to an external power supply.

Table 2 gives the current requirements for common bridge values for a single channel driven at 0.5, 1, 2.5, 5, 7.5, and 10 volts.

Table 2. Per Channel Current Requirement (mA)
(rounded up to nearest 0.1mA)

	Bridge Resistance	
Excitation Voltage	**120Ω**	**350Ω**
0.5V	4.2	1.5
1 V	8.4	2.9
2.5V	21	7.2
5 V	41.7	14.3
7.5V	62.5	21.5
10 V	83.4	28.6

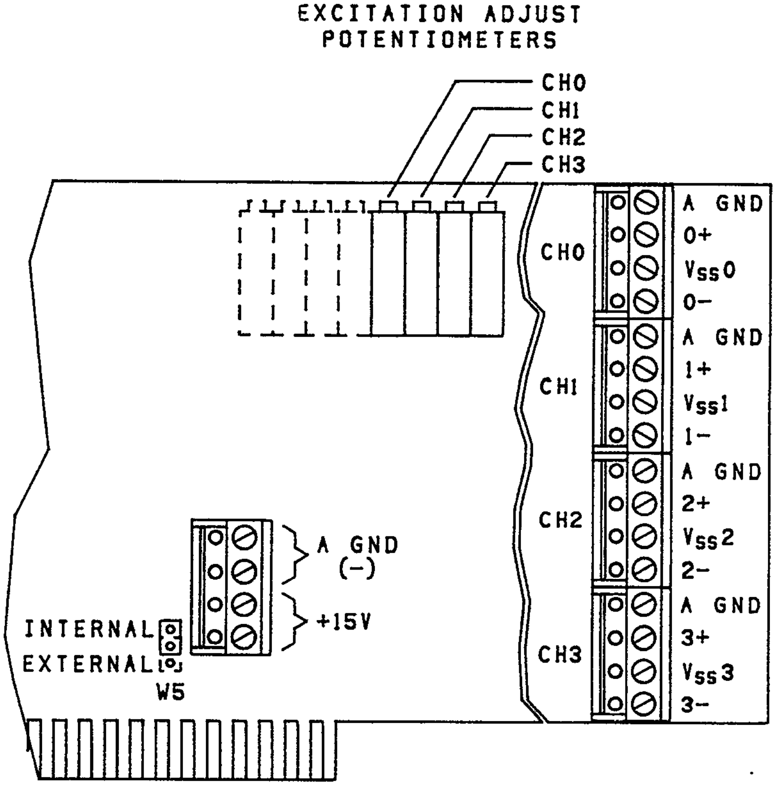


Figure 7. AIM8 Excitation Terminals, Jumpers and Adjustment

External Excitation With the System 570

The System 570 can supply approximately 100mA at +15V to its option slot. The AIM8 itself requires 75mA, which leaves 25mA for excitation. Therefore, a System 570 can drive a single 120Ω bridge or three to four 350Ω bridges at 2.5V. For other voltages, bridge resistances, or numbers of bridges, calculate the current requirement using Ohm's law. If the total required current (including 75mA for the AIM8) exceeds 100mA, an external excitation supply will be necessary.

External Excitation with the Series 500

The Series 500 can supply a total of 500mA at +15V. Approximately 250mA is available to an AIM8 module in a lightly- or normally-loaded Series 500. This leaves 175mA for excitation. However, analog output, power control, and digital output modules place heavier burdens on the Series 500's +15V supply.

If you are in doubt about the total current consumption at 15V, consult the Series 500 hardware documentation for the power requirements of each of the installed modules. Calculate the total current draw at +15V including 75mA for the AIM8, plus what is needed for bridge excitation. If this total is more than 500mA, connect an external excitation supply to the AIM8 module(s).

Setting the Excitation Voltage

Regardless of whether you select internal or external excitation power, adjust excitation potentiometers Vss0-Vss3 for the desired voltage at AIM8 terminals Vss0-Vss3 (see Figure 7).

The AIM8 excitation voltages can be read via software. Channels 4 to 7 are hard-wired within the module to read the excitation voltage set for channels 0-3, respectively. A ninth channel, channel 8, is an internal channel connected to ground, and should always read 0V. These channels are only for reading excitation, and are not accessible for monitoring external signals with the AIM8.

The following Soft500 program reads the excitation voltage set for channel 0 of an AIM8 installed in slot 8. The IONAME parameters, in order, are as follows: ION$ (signal name) = "EXV", AIM8 slot = 8, signal channel = 4 (channel 0+4), A/D accuracy = 12 (bits).

```
10 va=0
20 cls
30 call ioname'("EXV",8,4,12)
40 call anread'("EXV",va,0)
50 locate 1,1:print va
60 goto 40
```

This program continuously reads channel 4 to monitor the excitation voltage set for channel 0. Likewise, channel 5 reads channel 1 excitation, channel 6 reads channel 2 excitation, etc.

Soft500 reads the excitation voltage in the course of using engineering unit flags 70 and 71. Your application may require precise setting of the excitation; however this is not required for the benefit of Soft500.

Selecting a Filter

The AIM8 contains low-pass filter circuitry to reduce the effect of noise on the AIM8 input. Out-of-band noise shows up as spurious counts from the A/D converter. Software selects cutoff frequencies of 10Hz, 1kHz, or 3kHz. The 3kHz filter setting is the equivalent of disabling the filter. Select the lowest filter cutoff frequency which still passes the desired signal. Unless you require a particular filter, select 10Hz.

When enabled, the filter function affects all channels. However, different filter frequencies can be selected for each channel with the IONAME FILT% parameter. This parameter is part of the IONAME command structure. Consult the Soft500 IONAME documentation for information on specifying parameters. Note that beginning with Soft500 Version 4.0, IONAME's can be specified as part of the hardware configuration process.

Configuring the Offset Feature

The AIM8 dual-range offset circuit can apply offsets of up to ±100mV or ±1V full-scale against the input signal. The offset feature makes it possible to trim a bridge which is out of balance under no-load conditions. For standard voltage measurements, the offset feature facilitates measurement of minute signal variations which ride on a steady DC component of greater amplitude.

Potentiometers OS0-OS3 set the offset level for channels 0-3, respectively (see Figure 8). The offset circuitry multiplexes each offset level to the AIM8's instrumentation amplifier. This assures that each offset level is applied to the intended input channel.

Figure 9 shows a simplified equivalent of the offset circuit. Note that the offset circuitry sums the (+) signal input with the offset voltage before it is amplified by the AIM8's instrumentation amplifier.

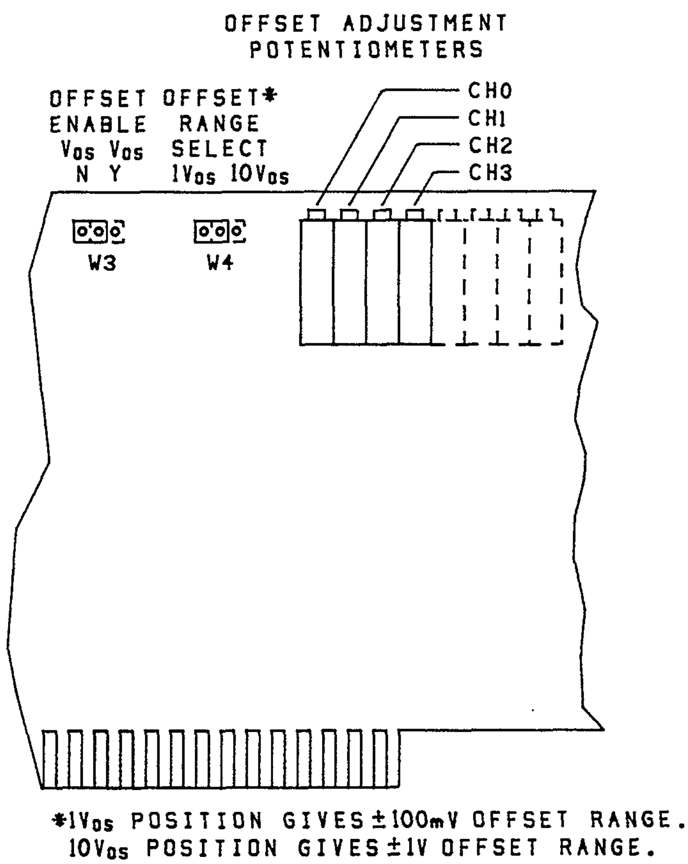


Figure 8. AIM8 Offset Adjustment Potentiometers and Jumpers

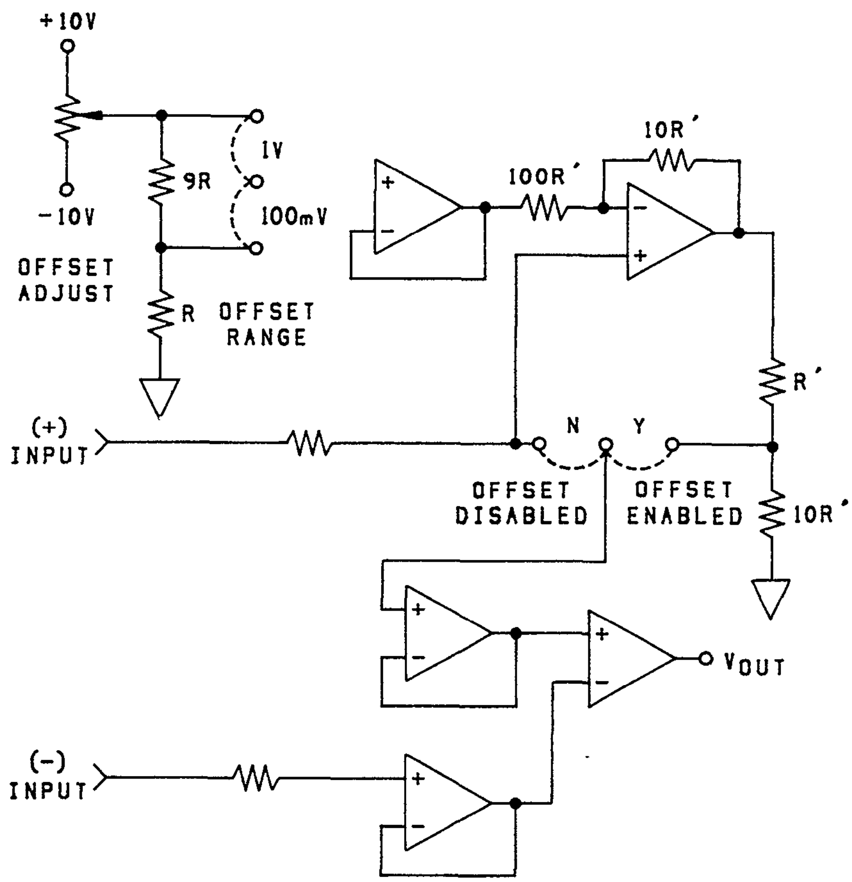


Figure 9. AIM8 Offset Simplified Circuit

Software selects or deselects the offset function. However, you must first enable the offset hardware and select the range by positioning jumpers on the AIM8 (see Figure 8). Jumper W3 selects between Voltage Offset Enabled (Vos-Y) or Voltage Offset Disabled (Vos-N). Jumper W4 selects either the 1V offset or 100mV offset levels. The positions of jumper W4 are labeled "VOS 10" and "VOS 1" The "10" position sets a final maximum offset of ±1V, and the "1" position sets a final maximum offset of ±100mV.

Normally, you should select the lowest offset range suitable for the application. This will assure the lowest temperature coefficient, which improves the overall stability of the offset adjustment. Thus, if the maximum offset to be applied is 100mV or less, select the ±100mV offset range.

Unless you have a specific application in mind, enable the offset feature by moving jumper W3 to the "Vos-Y" position and jumper W4 to the "VOS10" position. Later, you can move W4 to the "VOS1" position if the lower offset range will be adequate.

Setting Offset for Strain Gage Bridges

For nulling bridge imbalance, first connect the strain gage bridge to the AIM8. Configure the AIM8 according to the instructions in the previous sections for full, half, and quarter bridges. Set up the strain gage experiment as it will be used during data acquisition, with no load applied.

Adjust the offset level for channels 0-3 with potentiometers Vos0-Vos3, respectively. The following Soft500 example program assumes a strain gage bridge connected to channel 0 of an AIM8 in slot 8. IONAME parameters, in order, are as follows: ION$ (signal name) = "OFFSET", AIM8 slot = 8, Signal channel = 0, A/D accuracy = 12 (bit), GA% (global gain) = 1, LGA% (AIM8 local gain) = 10, FILT% = 0 for no filter, and OFFE% = 1 for offset enabled.

```
10 va = 0
20 call ioname'("OFFSET",8,0,12,1,10,0,1)
30 call anread'("OFFSET",va,0)
40 locate 1,1:print va
50 goto 30
```

Adjust the offset level for channel 0 with potentiometer Vos0 until the voltage reading is 0. Generally, a total gain of 10 to 1000 will give sufficient sensitivity for offset adjustment. For more precise zeroing of offset, increase the gain by increasing the value entered for the GA% parameter (1, 2, 5, 10) or the LGA% parameter (1, 10, 100, and 1000), and readjust for 0V. The optimum adjustment will often produce a small non-zero reading with flashing polarity sign, rather than a reading of 0.

Note: After you have experimented with jumper W4 in the "VOS10" position, move W4 to the "VOS 1" position and rerun the program. If you can zero the bridge with W4 at VOS 1; use that position.

Voltage Measurement with the AIM8

The AIM8 can be used for general-purpose voltage measurements. Its instrumentation amplifier features low noise, high gain, and differential input. The AIM8 full-scale voltage input ranges are ±10mV, ±100mV, ±1V, and ±10V full-scale. These ranges correspond to local gain (LGA%) parameters of 1000, 100, 10, and 1.

The AIM8's local gains (LGA%) can be programmed in combination with the global gain (GA%) of the AIM1 or AMM1. This gives equivalent gains of 1, 2, 5, 10, 20, 50, 100, 200, 500, 1000, 2000, 5000, or 10,000. The ADM1 and ADM2 A/D modules offer 12- and 14-bit resolution, respectively, with input ranges of ±10V, ±5V, ±2.5V, 0-10V and 0-5V. These give the AIM8 a versatile range of bit resolution and full-scale sensitivities.

With 12-bit A/D conversion, resolution of the ±10mV range (GA% = 1 and LGA% = 1000) is 20mV/4096, or 4.88 microvolts/step. Programming GA% = 10 gives a ±1mV full-scale input and a theoretical resolution of 488nV. Fourteen bit A/D gives 122nV resolution. However, system and environmental noise limit the usable low-level threshold to a few microvolts, regardless of A/D range.

For voltage measurement, connect the input signal directly to the (+) and (−) input terminals of an AIM8 channel. Install jumper W1-2 to complete the path from the (−) input terminal to the amplifier. Do not install jumper W2; jumper W1-1 makes no difference (see the full-bridge diagram, Figure 3).

For single-ended operation, connect the (−) channel input to the analog common (A GND) terminal. Apply the signal to the AIM8 (+) and (−) input terminals. For differential operation, connect the signal high to the AIM8's (+) input, and connect signal low to the AIM8's (−) input.

To return readings which are expressed in voltage units, use an engineering unit flag of 0 for volts, 1 for millivolts, or 2 for microvolts with ARGETVAL, ANREAD, or ARWRITE commands.

Of the AIM8's various strain-related features, the Local Gain, Filter, and Offset are also useful for standard voltage measurements. Program the Local Gain and Filter functions the same as for strain gage measurements. Refer to the following instructions for using the offset function during voltage measurements.

Using Offset for Voltage Measurements (Zero Suppression)

For straight voltage input, the offset feature facilitates measurement of minute signal variations which ride on a steady DC component of greater amplitude. The offset voltage can be set to cancel the larger voltage component, leaving only the signal of interest for amplification. This technique is often called "zero suppression".

A typical example would be a ±30mVp-p fluctuation which is impressed on a steady 0.5V DC component. The AIM8 can apply a −0.5V offset, leaving only the 30mV signal. Greater gain can then be applied to the 30mV signal without saturating the AIM8 instrumentation amplifier.

The easiest method for setting such an offset is to use Soft500's graphing capability. Visually check the DC component of the signal, and then adjust the offset control until the signal fluctuates symmetrically about 0V.

The following program uses the analog input command ANIN and the real-time graphing command HGRAPHRT to acquire and plot voltage readings. The data acquisition and graphing run continuously. You can stop the program at any time by pressing the escape ("Esc") key.

The program assumes the following conditions and parameters:

> The AIM8 module is in slot 8, with the signal connected to channel 0. 12-bit A/D accuracy is specified, with the gain (GA%) set to 1 and the local gain (LGA%) set to 10. FILT% is set to 1 to select the 10Hz filter. Initially, OFFE% is set to 0 to disable the offset feature. Later, you will be instructed to enter a 1 for OFFE% to enable the offset.

```
10 SCREEN 2:CLS:KEY OFF
20 CALL IONAME'("offset",8,0,12,1,10,1,0)
30 LOCATE 25,31:PRINT "PRESS Esc TO EXIT";
40 LOCATE 13,1:PRINT "0";
50 CALL ANIN'("arg%",1.,"offset",1,-1,"grph")
60 CALL INTON'(1,"mil")
70 CALL HGRAPHRT'("grph","1","scroll","-1, "1","0",-1,1,"grid")
80 CLS
90 CALL INTOFF
```

As a starting point, apply the signal to the (+) and (−) inputs of channel 0. Run the program and check the overall level of the signal. If necessary, increase the GA% and LGA% parameters to get a good picture of the input.

NOTE: There are only a few parameters to be changed if you need to experiment with different offsets and voltage inputs.

In line 40:

```
                              GA% (1, 2, 5, 10)
                              | LGA% (1, 10, 100, 1000)
                              |  |  OFFE% (0, 1)
                              |  |  |
CALL IONAME'("offset",8,0,12,1,10,1,0)
```

The GA% parameter controls the gain of the master analog input module. The LGA% parameter controls the gain of the of the AIM8 instrumentation amplifier. As set, these parameters give an overall gain of 10, and the system will accommodate a signal-plus-offset range of ±1V. Alter one or both gains to match AIM8 input range to other signal or offset levels.

In line 90:

```
                                  MINYL$
                                  |  MAXYL$
                                  |  |  EUF%
                                  |  |  |
CALL HGRAPHRT'("grph","1","scroll","-1","1","0",-1,1,"grid")
```

The "MINYL$" and "MAXYL$" parameters set the lower and upper limits of the graph. You may change these values to make the graph match the input signal range. The EUF% of 0 specifies that the graph will be plotted as volts, Therefore, MINYL$ and MAXYL$ must also be entered as volts. If EUF% is specified as −1, MINYL$ and MAXYL$ must be entered as A/D counts.

After you have produced a satisfactory graph of the input signal, press the escape key ("Esc") to stop the program. The OFFE% parameter was set to 0 for initial investigation of the signal. Next, you will enable the offset and perform the offset adjustment.

First, check the status of the offset jumpers. These are located near the top edge of the module, and are accessible without removing the module from the system. Make sure that the offset enable jumper W3 is set to the "Y" position.

If you observed a total signal offset of less than ±100mV, move the offset range jumper W4 to the ±100mV (Vos 1) position. If the total offset you observed is between ±100mV and ±1V, select the ±1V (Vos 10) offset range. If the offset is greater than ±1V, use a divider at the AIM8 input terminals to reduce the signal-plus-offset presented to the AIM8.

Change the OFFE% parameter in line 40 to 1. Rerun the program, and adjust the offset potentiometer OS0 until the signal fluctuates symmetrically around 0V.

If necessary, increase the gain by increasing the value entered for the GA% or LGA% parameters. Repeat the adjustment for maximum symmetry of fluctuation about 0V. For a given input voltage, you will ultimately reach a maximum usable gain, after which the AIM8 output will saturate. Use the gain which gives an output which fits within the A/D converter's selected input range (±10V default).

Software Considerations

The IONAME command in Soft500 Version 4.0 and later versions has been expanded to give full control of all AIM8 operating parameters. The format of IONAME when programmed specifically for the AIM8 is as follows:

CALL IONAME'(ION$, SLOT%, CHAN%,ACC% [,GA%] [,LGA%] [,FILT%] [,OFFE%] [,UMEAS%])

If no parameters beyond GA% are programmed, default values are assumed for LGA%, FILT%, OFFE%, and UMEAS%. These values are LGA%=1, FILT%=0, OFFE%=1, and UMEAS%=1. If you must change any of these parameters, you must list all parameters which come before it in the IONAME parameter list. For instance, if you disable offset by specifying OFFE% = 0, you must also enter parameters for LGA% and FILT%, even if what you enter are the default values.

Entering a Calibration Factor into the Configuration Table

Normally, a calibration factor is supplied with a strain gage based transducer. This factor is typically expressed as:

millivolts signal / 1 volt excitation / full-scale units of measure

(30mV / V / 100psi, for example)

You can enter a transducer's calibration factor and full-scale units of measure directly into the configuration table using the CONFIG.EXE program (see the Soft500 documentation). This will enable you to use an Engineering Unit Flag of 71 in ANREAD or ARGETVAL commands to return strain measurements directly in the measured units of the calibration factor. No additional calibration or conversion will be required within the program.

Manufacturers normally specify a "full-scale" load value for a transducer as part of a calibration factor shipped with the transducer (6mV / V / 30g, for example). Such a full-scale value represents the maximum permissible load for the transducer. Loads beyond the suggested full-scale value may give inaccurate readings, and may damage some types of transducers. For the following program, neither the calibration load nor the maximum expected load should exceed the manufacturer's suggested full-scale value.

The following program calculates the calibration factor for a strain gage transducer. It provides for adjustment of the excitation, and both coarse and fine balancing of the bridge with the offset adjustment. Use this program to find or confirm the calibration factor of a transducer.

The program assumes that the AIM8 is in slot 8, and that the transducer is connected to channel 0. Twelve-bit A/D is specified. Gain is 1 for the excitation voltage reading, 10 for the low-gain adjustment of balance, and 1000 for the high-gain adjustment of balance. Optimal offset adjustment is shown by a flashing polarity sign and a reading of a few microvolts or less.

Strain measurements are made at a gain of 100. If too low a gain is programmed, the reading may be lack resolution and suffer in accuracy. Too high a gain will saturate the amplifiers on the AIM8 or analog input module. This condition will be indicated by a frozen reading. If you encounter either condition, alter the GA% or LGA% parameters in line 110 and rerun the program.

The calibrating force must be an integer number of units, i.e. 100lb, 25g, 50psi, etc. This is because the CONFIG program requires an integer entry of the full-scale calibrating force.

```
 10 CLS:LOCATE 3,5:PRINT"EXAMPLE PROGRAM WHICH GENERATES A
    CALIBRATION FACTOR FOR A STRAIN GAGE
 20 KEY OFF
 30 LOCATE 10,5:INPUT"What is the calibrating force to be applied (integer only)";F%
 40 LOCATE 12,5:INPUT"What are the units of measure (lb, psi, etc.)";U$
 50 CLS
 60 ' Call INIT and set up IONAME's
 70 CALL INIT
 80 CALL IONAME'("EXCITE",8,4,12,1,1,1,0)
 90 CALL IONAME'("OFFSETL",8,0,12,1,10,1,1)
100 CALL IONAME'("OFFSETH",8,0,12,10,100,1,1)
110 CALL IONAME'("VOLTS",8,0,12,10,10,1,1)
120 ' Adjust excitation
130 CLS
140 PRINT"Adjust the EXCITATION potentiometer for desired excitation level."
150 LOCATE 3,1:PRINT "When adjustment is completed, press any key to continue..."
160 VEX=0
170 CALL ANREAD'("EXCITE",VEX,0)
180 LOCATE 5,1:PRINT"Excitation = ";VEX;" volts          "
190 R$=INKEY$:IF R$=""THEN 170
200 ' Adjust bridge balance
210 PRINT:PRINT "Make sure the bridge is unload and press any key when ready..."
220 R$=INKEY$:IF R$=""THEN 220
230 CLS
240 PRINT"LOW-GAIN Adjust: Adjust the OFFSET potentiometer for a reading of 0."
250 LOCATE 3,1:PRINT "After offset is 0, press any key to continue..."
```

```
260 VOS=0
270 CALL ANREAD'("OFFSETL",VOS,1)
280 LOCATE 5,1:PRINT "Offset = ";VOS;" millivolts          "
290 R$=INKEY$:IF R$=" "THEN 270
300 LOCATE 1,1:PRINT"HIGH-GAIN Adjust: Adjust the OFFSET potentiometer for a
    reading of 0."
310 LOCATE 3,1:PRINT "After offset is 0, press any key to continue..."
320 CALL ANREAD'("OFFSETH",VOS,1)
330 LOCATE 5,1:PRINT "Offset = "";VOS;" millivolts "
340 R$=INKEY$:IF R$=""THEN 320
350 ' Read calibrating force
360 PRINT:PRINT "Load the bridge with calibration weight, force, or pressure".
370 PRINT:PRINT "Press any key when ready..."
380 R$=INKEY$:IF R$=""THEN 380
390 CLS
400 PRINT "After reading settles, press any key to continue..."
410 VCAL=0
420 CALL ANREAD'("VOLTS",VCAL,1)
430 LOCATE 3,1:PRINT "Strain voltage = ";VCAL;" millivolts          "
440 R$=INKEY$:IF R$=""THEN 420
450 CLS
460 CF = -((VCAL-VOS)/VEX)
470 PRINT "Cal Factor = ";CF "mV signal / V excitation /";F%;U$;" load"
500 END
```

The calibration factor derived with this program can be entered into the configuration table as part of an IONAME. The configuration program (CONFIG.EXE) will accept a CALIBRATION entry, and expects the calibration factor in millivolts per unit volt. After you enter this information, CONFIG.EXE asks for full-scale units. This corresponds to the measured units of force applied to the bridge during calibration, and must be entered as an integer.

As an example, you may have calibrated a strain gage load cell with 25 grams. The calibration program might return a cal factor of 5.1148mV signal per volt of excitation with the load of 25 grams. The CONFIG program will accept three decimal places for the calibration factor, so enter "5.115". Enter "25" for the full-scale units. Subsequent readings of unknowns with the EUF%=71 will be expressed as grams.

The following short programs demonstrate the simplicity of reading a strain gage directly in measuring units (grams, in this case) once the cal factor has been entered into the configuration table. An IONAME has already been programmed as part of the configuration table with the following parameters: ION$="test", SLOT%=8, CHANNEL%=0, ACC%=12, GA%=10, LGA%=10, FILT%=1, and OFFE%=1. A second IONAME "excite" has been programmed to read the excitation voltage. Its parameters are as follows: ION$="excite", SLOT%=8, CHANNEL%=4, ACC%=12, GA%=1, LGA%=1, FILT%=1, and OFFE%=1.

The first program uses ANREAD. It displays the excitation voltage ("EX") so that it may be adjusted. The program then reads the residual imbalance of the bridge ("OF") with no load applied. It saves this offset and uses it to correct subsequent readings of grams ("VA"). Use of EUF%=71 in the ANREAD's of offset and signal yields readings in grams. The difference between VA and OF is the corrected load in grams applied to the bridge.

```
 20 CLS
 30 CALL INIT
 40 VA=0:OF=0:EX=0
 50 LOCATE 1,1:PRINT"Reading excitation - press any key to continue"
 60 CALL ANREAD'("excite",ex,0)
 70 LOCATE 3,1:PRINT"Excitation = ";EX;" volts               "
 80 R$=INKEY$:IF R$=""THEN 60
 85 CLS
 90 LOCATE 1,1:PRINT"Reading offset - press any key to continue"
100 CALL ANREAD'("test",of,71)
110 LOCATE 3,1:PRINT"Offset = ";OF;" grams               "
120 R$=INKEY$:IF R$=""THEN 100
130 CLS
140 LOCATE 1,1:PRINT"Reading load - press any key to exit"
150 CALL ANREAD'("test",va,71)
160 LOCATE 3,1:PRINT "Load = ";VA-OF;"grams               "
170 R$=INKEY$:IF R$=""THEN 150
180 end
```

The next program reads 20 values and writes them to an array using the ANIN command. It demonstrates the retrieving of data values from the array directly in measuring units using ARGETVAL with EUF%=71. The IONAME information for "excite" and "test" from the previous example also applies to this program.

The program first displays the excitation voltage for adjustment, and then reads the balance of the bridge with no load applied. The no-load offset reading is used to correct the bridge readings under load. ANREAD's are still used to read the excitation and balance.

Note the use of the IONAME's "excite" and "test" in the IONAME list of the ANIN statement. Soft500 requires the excitation voltage to calculate the load directly in measurement units. The IONAME for reading excitation must be the first IONAME in the ANIN's IONAME list.

```
 20 CLS
 30 CALL INIT
 40 KEY OFF:VA=0:OF=0:EX=0:STAT=0: LP=0
 50 LOCATE 1,1:PRINT"Reading excitation - press any key to continue"
 60 CALL ANREAD'("excite",ex,0)
 70 LOCATE 3,1:PRINT"Excitation = ";EX; " volts               "
 80 R$=INKEY$:IF R$=""THEN 60
 90 CLS
100 LOCATE 1,1:PRINT"Reading offset - press any key to continue"
110 CALL ANREAD'("test",of,71)
120 LOCATE 3,1:PRINT"Offset = ";OF;" grams               "
130 R$=INKEY$:IF R$=""THEN 110
140 CLS
150 LOCATE 1,1:PRINT"Apply load - press any key to exit"
155 R$=INKEY$:IF R$=""THEN 155
160 CALL ANIN'("ary%",20.,"excite,test",1,"done")
170 CALL INTON'(100,"mil")
180 CALL STATUS'("done",stat]
190 IF STAT%<>0 THEN 180
200 CALL INTOFF
```

```
210 CLS
220 LOCATE 1,1:PRINT "Sample ---- Grams"
230 FOR T=1 TO 20
240 CALL ARGETVAL'("ary%",t,"test",va,71)
250 PRINT T,VA-OF
260 NEXT T
270 END
```

Calibration Directly Within a Soft500 Program

A second method is available for reading a strain gage bridge directly in measurement units. It does not require that the calibration factor be entered into the configuration table. Instead, calibration is done within the program. This type of program must use Engineering Unit Flags 70 (calibration request), 71 (conversion request), and IONAME's UMEAS% parameter.

A calibrating force must also be applied to the bridge each time the program is run. The following example program uses 25 grams to calibrate the transducer, so 25 is entered as the UMEAS% (last) parameter in lines 50 and 60. The UMEAS% parameter is used in an IONAME command when the calibration factor is to be derived within a program, rather than entered in the configuration table.

The gage is connected to channel 0 of an AIM8 in slot 8. After the excitation voltage is read, the program does an ANREAD with EUF%=70 to read the bridge with the calibrating mass applied. This yields a calibration factor used in later ANREAD's which read the bridge with EUF%=71.

```
20 CLS:KEY OFF
30 CALL INIT
40 CALL IONAME'("exc",8,4,12,1,1,0,1)
50 CALL IONAME'("offset",8,0,12,1,1000,0,1,25)
60 CALL IONAME'("calib",8,0,12,1,100,0,1,25)
70 VA=0:OF=0:EX=0
80 LOCATE 1,1:PRINT"Reading excitation - press any key to continue"
90 CALL ANREAD'("exc",ex,0)
100 LOCATE 3,1:PRINT"Excitation = ";EX;" volts                "
110 R$=INKEY$:IF R$=""THEN 90
120 CLS
130 LOCATE 1,1:PRINT"Adjust Offset for 0 then press any key to continue"
140 CALL ANREAD'("offset",of,1)
150 LOCATE 3,1:PRINT"Offset = ";OF;" millivolts             "
160 R$=INKEY$:IF R$=""THEN 140
170 CLS
180 LOCATE 1,1:PRINT"Calibrating with EUF 70. Apply calibrating force and press any
    key."
190 CALL ANREAD'("calib",va,70)
200 R$=INKEY$:IF R$=""THEN 190
210 CLS
220 LOCATE 1,1:PRINT"Reading unloaded offset of bridge. Remove force and press
    any key."
230 CALL ANREAD'("calib",of,71)
240 LOCATE 3,1:PRINT OF;" grams                "
250 R$=INKEY$:IF R$=""THEN 230
260 CLS
270 LOCATE 1,1:PRINT"Reading loaded bridge. Apply unknown force."
```

```
280 CALL ANREAD'("calib",va,71)
290 LOCATE 3,1:PRINT VA-OF;" grams           "
300 LOCATE 8,1:PRINT"Press any key to recheck offset."
310 R$=INKEY$:IF R$="" THEN 210 ELSE 280
320 END
```

Service and Calibration Information

The AIM8 module does not contain any user-serviceable components. Therefore, normal troubleshooting consists of simple signal checking and substitution of a known good module for a suspected module.

As a first step in troubleshooting a malfunctioning AIM8/transducer system, make sure the transducer is in good condition. An ohm meter can be used to check for continuity of resistive-type strain gage transducers. If a continuity test is not appropriate, substitute a known good transducer and recheck the performance of the AIM8.

If the transducer is operating properly, you may use the calibration procedure listed later in this section to check the performance and general quality of calibration of the AIM8.

A module which malfunctions or is out of calibration should be returned to Keithley for service or replacement. If you have access to a repair facility **which is skilled in repair of multi-layer boards,** you may elect to have repairs done locally, rather than by Keithley. If so, note the following:

NOTE: The AIM8 module uses a multi-layer circuit board. Repair of multi-layer boards requires special care. Keithley recommends that you return the AIM8 to the factory for repair.

All components on the AIM8 are soldered in position. As a rule, you cannot replace a component soldered to a multi-layer board and guarantee the integrity of connections made through the internal board layers. Many of the traces on the AIM8 board are narrow and can be damaged by excessive heat during desoldering. A module damaged by the user may not be repairable by Keithley. Damage through improper repair may void the warranty.

NOTE: Calibration of the AIM8 requires a low-thermal emf voltage divider and a precision voltage calibrator. Calibration should be performed only in a climatically controlled environment. Do not attempt to calibrate the AIM8 unless you have access to these tools and requirements. Performance of the AIM8 on the most sensitive ranges may depart from specification if the operating environment is different from the environment in which the module was calibrated. See the component layout for location of adjustment pots.

If all signals on the AIM8 check out correctly, the problem may lie with the transducer or elsewhere in the data acquisition system.

Table 3. Data for Peaks and Pokes to CMDA of AIM8 Slot

D3	D2	D1	D0	DATA SELECTION	FUNCTION
X	X	0	0	Channel 0, Offset 0	Channel Select
X	X	0	1	Channel 1, Offset 1	
X	X	1	0	Channel 2, Offset 2	
X	X	1	1	Channel 3, Offset 3	
0	0	X	X	LGA Gain = 1	Gain Select
0	1	X	X	LGA Gain = 10	
1	0	X	X	LGA Gain = 100	
1	1	X	X	LGA Gain = 1000	

Table 4. Data for Peaks and Pokes to CMDB of AIM8 Slot

D3	D2	D1	D0	DATA SELECTION	FUNCTION
X	0	0	0	Analog signal output	Selected Signal to Analog Output
X	0	0	1	Filtered signal (1kHz)	
X	0	1	0	Filtered signal (10Hz)	
X	0	1	1	Ground	
X	1	0	0	Vss0 Supply	
X	1	0	1	Vss1 Supply	
X	1	1	0	Vss2 Supply	
X	1	1	1	Vss3 Supply	
0	X	X	X	Offset Enabled	Offset Enable
1	X	X	X	Offset Disabled	

Offset Adjustments

1. Set up:
   A. Short an unused channel input with copper wire between + and – inputs. Then short both inputs to ground, also using copper wire.
   B. Set Vos jumpers on N and 1.
   C. Set gain at 1000 by poking 12 plus the shorted channel number to CMDA for the AIM8's slot.
   D. Set filter on 10Hz, disable offset, and switch analog output mux to "signal out" by poking a 10 or &HA into CMDB for the AIM8's slot.
   E. Connect meter to ANALOG OUT pin of J1 and TPGS (signal gnd).
2. Adjust the IAOS pot for an output of 0.0 volts.
3. Change gain to 1 by poking 0 plus the shorted channel number into CMDA for the AIM8 slot.
4. Adjust the DAOS pot for output of 0.00 volts.
5. Change gain back to 1000 by poking a 12 plus the shorted channel number into CMDA for the AIM8's slot.
6. Adjust IAOS for an output reading of 0.000 volts.

NOTE: Repeat steps 3-6 until no further adjustment is necessary to read zero for both steps. Usually only one iteration is necessary.

7. Move Vos jumper to Y position.

8. Adjust Vos for output reading of 0.000 volts. When adjusted properly, Vos jumper position Y or N should not affect the output.

Adjusting Common Mode Rejection

1. Set up:
   A. Return Vos jumpers to N and 1
   B. Change gain to 1 by poking a 0 plus the shorted channel number into CMDA for the AIM8's slot.
2. Remove the short to ground leaving the short between the plus and minus inputs connected.
3. Apply 10V between the shorted inputs and ground in such a way that the polarity of the voltage can be reversed easily.
4. While reversing the input voltage, adjust the CMR pot for a minimum change in the reading of the output as a result of the polarity of the input voltage reversing.
5. Disconnect input short.

Gain Adjustments

NOTE: Gain adjustments must be done after offset adjustments.

1. Set up:
   A. DVM should be connected to ANALOG OUT pin of J1 and TPGS.
   B. Set Vos jumpers to N and 1.
   C. Set filter on 10Hz, offsets disabled and the analog output mux on signal out by poking a 10 or &HA into CMDB for the AIM8's slot.
   D. Apply calibrator output into + and − inputs of the channel.

Gain of 10 cal

2. Set gain to 10 by poking 4 plus the input channel number into CMDA for the AIM8 slot. Set calibrator to one volt.
3. Adjust G10 pot for a 10.000V output.

Gain of 100 cal

4. Set calibrator to 100mV output. Set GAIN to 100 by poking an 8 plus the channel number into CMDA for the AIM8's slot.
5. Adjust G100 pot for a 10.000V output.

Gain of 1000 cal

6. Set calibrator to 10mV output. Set GAIN to 1000 by poking a 12 plus the channel number into CMDA for the AIM8's slot.
7. Adjust G1000 pot for 10.000V output.

AIM8 Specifications

Input Characteristics

Input Channels (local): 4 differential and balanced to ground

Gain Selection: Software selectable Instrumentation Amplifier Gain (IAG): x1, x10, x100 and x1000.

Input Dynamic Range:

x1	±10V max
x10	±1V max
x100	±100mV max
x1000	±10mV max

Input Protection: ±15V max (powered)
±10V max (unpowered)

Input Resistance: 1MΩ, each input to common

Common Mode Voltage: ±10V

Common Mode Rejection: >90dB, dc to 60Hz

Accuracy: ±(0.01% + 10μV)

Nonlinearity: 0.01% of full scale

Bandwidth: Software selectable single pole filter (−3dB) dc to 10Hz, dc to 1kHz and wideband (dc to 3kHz)

Settling Time (to 0.01%): 0.7ms wideband
2.5ms @ 1kHz
250ms @ 10Hz

Noise: 2μVpp, 0.1 to 10Hz
4μvpp, 10 to 1000Hz

Temperature Coefficient:
Gain: ±50ppm/°C
Offset (adjustable to zero): 2.5μV/°C @ x10, x100 and x1000 IAG 4μV/°C @ x1 IAG

Balance or Zero Suppression Characteristics:

Voltage Range: Jumper selectable off, ±100mV or ±1V; On, off, or zero (ground) software selectable

Balance: Manual, multiturn potentiometer per channel

Temperature Coefficient: 2.5μV/°C on ±100mV
5μV/°C on ±1V

Excitation Characteristics:

Voltage Range: 0 to +10V, adjustable per channel and software readable

Current: +100mA max per channel

Protection: Short to ground, 20s max at full power

Temperature Coefficient: 200ppm/°C

Bridge Completion Facilities: Quarter, Half and Full Bridge

Power Requirements:

+15Vdc	75mA - No load
−15Vdc	25mA
+5Vdc	75mA

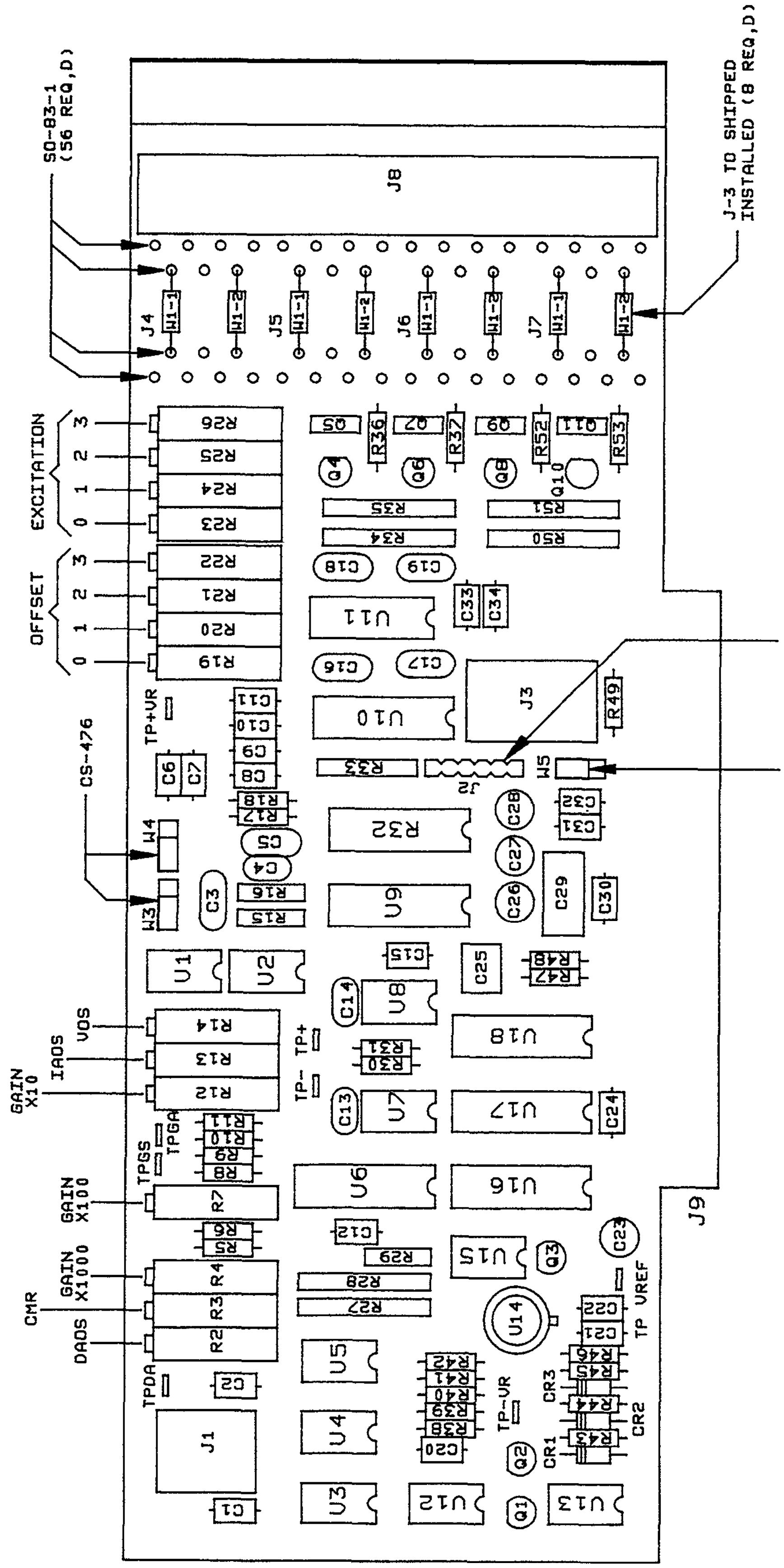
AIM8 PARTS LIST

Part Number	Title	Remarks
500-450	Component Layout	
C314-10	Capacitor	C23, C26-C28
C-365-.1	Capacitor	C1, C2, C6-C12, C15, C20-C22, C24, C30-C34
C-64-1000p	Capacitor	C3, C5, C16-C19
C-64-10p	Capacitor	C4, C13, C14
C-305-.047	Capacitor	C29
C350-1	Capacitor	C25
CS-339-3	3-Pin Berg	W1-W3
CS-476	Connector	
CS-521-1	Connector (3-pin)	J1
CS-521-3	Connector (4-pin)	J3
CS-521-6	Connector (16-pin)	J8
IC-473	Int. Circuit (IH6208)	U6, U9
IC-474	Int. Circuit (TL064	U11
IC-217	Int. Circuit (LM399)	U14
IC-227	Int. Circuit (TL061)	U3
IC-267	Int. Circuit (IH6108)	U10, U18
IC-394	Int. Circuit (LT1012)	U2, U12, U15
IC-42	Int. Circuit (741)	U13
IC-422	Int. Circuit (LT1007)	U1, U7, U8
IC-157	Int. Circuit (74LS175)	U16, U17
IC-460	Int. Circuit (OP-27)	U4, U5
R-179-11.5k	Resistor	R8
R-179-750	Resistor	R5
R-179-87.6k	Resistor	R10
R-263-10k	Resistor	R17, R39, R40
R-263-2.274k	Resistor	R11
R-263-20.5	Resistor	R6
R-263-205	Resistor	R9
R-263-4.170k	Resistor	R41
R-263-4.99k	Resistor	R45
R-263-7.39k	Resistor	R42
R-263-90k	Resistor	R18
R-76-5.1	Resistor	R36, R37, R52, R53
R-76-5.1k	Resistor	R38
R-88-10k	Resistor	R30, R31, R44
R-88-3.32k	Resistor	R46
R-88-15k	Resistor	R48
R-88-3.01k	Resistor	R47
R-263-75	Resistor	R49
R-263-350	Resistor	Not to be installed
R-264-120	Resistor	Not to be installed
RP-89-5k	Potentiometer	R7
RP-89-10	Potentiometer	R3
RP-89-100k	Potentiometer	R13, R14
RP-89-10k	Potentiometer	R2
RP-89-200	Potentiometer	R4
RP-89-20k	Potentiometer	R12, R19-R26
RF-28	Diode	CR1-CR3

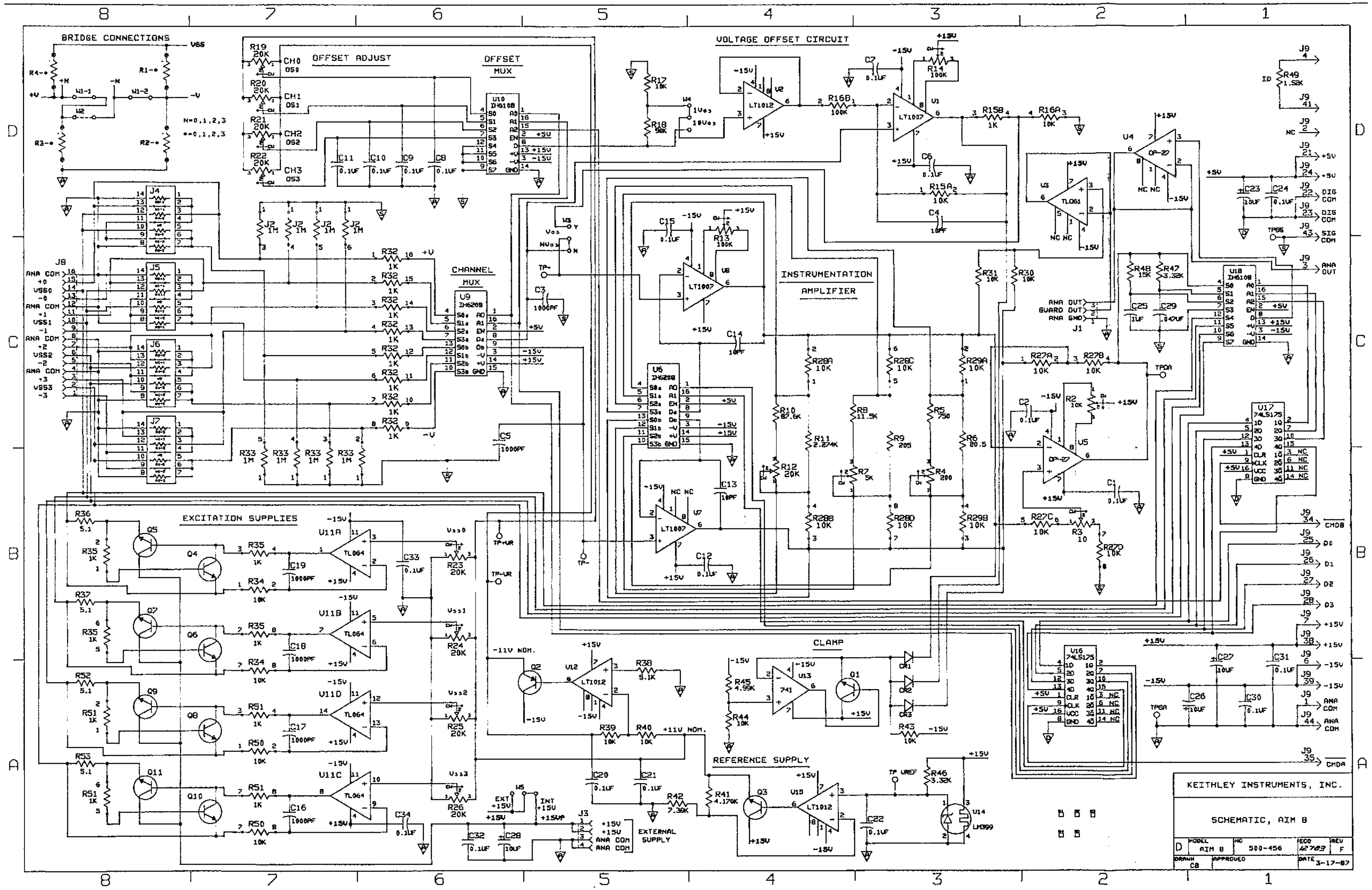
AIM8 PARTS LIST (CONT.)

Part Number	Title	Remarks
SO-83-1	Socket	
SO-97	Socket, 32-pin (cut to 6-pins)	J2
TF-163	Resistor Network	R15
TF-175	Resistor Network	R27, R28
TF-176	Resistor Network	R29
TF-177-1	Resistor Network	R32
TF-103-5	Resistor Network	R33, install one in J2
TF-183-1	Resistor Network	R35, R51
TF-183-5	Resistor Network	R34, R50
TF-208	Resistor Network	R16
TG-108	Transistor (2N5190)	Q5, Q7, Q9, Q11
TG-47	Transistor (2N5190)	Q1, Q3, Q4, Q6, Q8, Q10
TG-84	Transistor (2N5190)	Q2
CS-553	Test Point	TP+, TP+VR, TP−VR, TP−, TPDA, TPGA, TPGS, TPUREF
J15	Jumper (W1-1, W1-2) × 4	
500-323	Clamp Assembly	
500-321	Clamp	
500-322	Strip Rubber	
	Scotch 3M #411 Tape	
6-32×7/16 PPH	6-32 × 7/16 Phil Pan Head Screw	
500-456	Schematic	

LTR.	ECO NO.	REVISION	ENG.	DATE
C	11363	RELEASED		4-30-86
D	11518	REVISED	SZ	6-30-86
D1	11708	CHG,D CLAMP SCREWS FROM 6-32 X 7/16PPN	SZ	10-17-86
E	12009	REVISED;DELETED WORD(TAPE)	SZ	3-17-87
F	12783	REVISED	[illegible]	4-29-88



AIM8 COMPONENT LAYOUT



AIM8 SCHEMATIC DIAGRAM

AIM8-33/AIM8-34

Appendix A
Operation of the AIM8 with KDAC500

Introduction

All Keithley memory-mapped Data Acquisition Systems now include KDAC500/I as the standard interpreter-based (BASICA) programming language. KDAC500 is also available for programming under selected Microsoft and Borland compilers as versions KDAC500/M and KDAC500/B. The AIM8 documentation contains references to Soft500. The following information covers differences between programming the AIM8 with KDAC500 vs Soft500.

AIM8 Programming Under KDAC500

The AIM8 manual includes several example programs and accompanying explanations of module operation. These example programs for the AIM8 must be edited for KDAC500. Follow these suggestions:

1. Install the AIM8 module in an available slot in the data acquisition system, and set up IONAMEs in the CONFIG table as shown below. For these examples, the AIM8 was installed in slot 3. The KDAC500 CONFIG program will automatically set the slot number in your IONAMEs according to the slot you have indicated for the AIM8. The A/D converter resolution will automatically be set to 12, 14, or 16 according to the module you have indicated as your Master Analog A/D converter.

```
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CONFIGURATION TABLE

SLOT TABLE-
   SLOT 1: AMM2, Range: 10.B, Filt: 100 KHz, SING
   SLOT 2: NONE
   SLOT 3: AIM8
   SLOT 4: NONE
   SLOT 5: NONE
   SLOT 6: NONE
   SLOT 7: NONE
   SLOT 8: NONE
   SLOT 9: NONE
   SLOT 10: NONE
```

```
CHANNEL NAMES-
   SLOT 8-
      OFFSET  : AIM8, SL 3, CH 0, 16 BIT, LOCx10, GLOx1
              FLT-NONE, OFST-ENA, A FP 7.2
      TEST    : AIM8, SL 3, CH 0, 16 BIT, LOCx10, GLOx10
              FLT-10 Hz, OFST-ENA, A FP 7.2
      OFFSETL : AIM8, SL 3, CH 0, 16 BIT, LOCx10, GLOx1
              FLT-10 Hz, OFST-ENA, A FP 7.2
      OFFSETH : AIM8, SL 3, CH 0, 16 BIT, LOCx100, GLOx10
              FLT-10 Hz, OFST-ENA, A FP 7.2
      VOLTS   : AIM8, SL 3, CH 0, 16 BIT, LOCx10, GLOx10
              FLT-10 Hz, OFST-ENA, A FP 7.2
      CALIB   : AIM8, SL 3, CH 0, 16 BIT, LOCx100, GLOx1
              FLT-NONE, OFST-ENA, CAL-1000.000mV/V/1 FSU, A FP 7.2
      EXV     : AIM8, SL 3, CH 4, 16 BIT, LOCx1, GLOx1
              FLT-10 Hz, OFST-DIS, A FP 7.2
      EXCITE  : AIM8, SL 3, CH 4, 16 BIT, LOCx1, GLOx1
              FLT-10 Hz, OFST-ENA, A FP 7.2
```

2. For KDAC500, use the following programs in place of those in the AIM8 manual. Generally, the line numbers of the new programs correspond to the line numbers in the existing programs, so most comments made in the manual text also apply.

```
5 ' KDAC Example program for AIM8 manual, page 13.
10 CALL KDINIT
20 CLS
30 DIM VA!(1)
40 CALL FGREAD'("exv","none",va!(),"c.volts","nt")
50 LOCATE 1,1:PRINT VA!(0)
60 IF INKEY$="" THEN GOTO 40
```

```
5 ' KDAC Example program for AIM8 manual, page 16.
10 CALL KDINIT
15 CLS
20 DIM VA!(1)
30 CALL FGREAD'("offset","none",va!(),"c.volts","nt")
40 LOCATE 1,1:PRINT VA!(0)
50 IF INKEY$="" THEN GOTO 30
```

```
5 ' KDAC Example program for AIM8 manual, page 18.
6 ' Adjust NPTS! according to available array memory.
10 SCREEN 2:CLS:KEY OFF
20 CALL KDINIT
30 LOCATE 25,31:PRINT "Press ESC to exit"
```

```
40 LOCATE 13,1:PRINT "0"
42 DIM WIDL%(16):WIDL%(0)=1:WIDL%(1)=0
44 DIM MINYL!(16):MINYL!(0)=-1:MINYL!(1)=0
46 DIM MAXYL!(16):MAXYL!(0)=1:MAXYL!(1)=0
48 NPTS!=100
50 CALL BGREAD'("arg%", npts!, "offset", 1, "none", 1, "nt", "")
60 CALL INTON'(100,"mil")
70 CALL HGRAPHRT'("arg%", widl%(), "scroll", minyl!(), maxyl!(), "c.volts", npts!, 1, "grid")
80 CLS
90 CALL INTOFF
```

```
5 ' KDAC Example program for AIM8 manual, page 20.
10 CLS:LOCATE 3,5:PRINT"EXAMPLE PROGRAM WHICH GENERATES A CALIBRA-
TION FACTOR FOR A STRAIN GAGE
20 KEY OFF
30 LOCATE 11,8:INPUT"What is the calibrating force to be applied (integer only)";F%
40 LOCATE 13,8:INPUT"What are the units of measure (lb, psi, etc.)";U$
50 CLS
70 CALL KDINIT
120 ' Adjust excitation
130 CLS
140 PRINT"Adjust the EXCITATION potentiometer for desired excitation level."
150 LOCATE 3,1:PRINT "When adjustment is completed, press any key to continue..."
160 DIM VEX!(1)
170 CALL FGREAD'("EXCITE", "none", VEX!(), "c.volts", "nt").
180 LOCATE 5,1:PRINT"Excitation = ";VEX!(0);" volts        "
190 R$=INKEY$:IF R$=""THEN 170
200 ' Adjust bridge balance
210 PRINT:PRINT "Unload the bridge and press any key when ready..."
220 R$=INKEY$:IF R$="" THEN 220
230 CLS
240 PRINT"LOW-GAIN Adjust: Adjust the OFFSET potentiometer for a reading of 0."
250 LOCATE 3,1:PRINT "After offset is 0, press any key to continue..."
260 DIM VOS!(1)
270 CALL FGREAD'("OFFSETL", "none", VOS!(), "c.milvlt", "nt")
280 LOCATE 5,1:PRINT "Offset = ";VOS!(0);" millivolts     "
290 R$=INKEY$:IF R$="" THEN 270
300 LOCATE 1,1:PRINT"HIGH-GAIN Adjust: Adjust the OFFSET potentiometer for a reading
of 0."
310 LOCATE 3,1:PRINT "After offset is 0, press any key to continue..."
320 CALL FGREAD'("OFFSETH", "none", VOS!(), "c.milvlt", "nt")
330 LOCATE 5,1:PRINT "Offset = ";VOS!(0);" millivolts     "
340 R$=INKEY$:IF R$="" THEN 320
350 ' Read calibrating force
360 PRINT:PRINT "Load the bridge with calibration weight, force, or pressure.
370 PRINT:PRINT "Press any key when ready..."
380 R$=INKEY$:IF R$="" THEN 380
390 CLS
400 PRINT "After reading settles, press any key to continue..."
410 DIM VCAL!(1)
```

```
420 CALL FGREAD'("VOLTS", "none", VCAL!(), "c.milvlt", "nt")
430 LOCATE 3,1:PRINT "Strain voltage = ";VCAL!(0);" millivolts          "
440 R$=INKEY$:IF R$="" THEN 420
450 CLS
460 CF = -(VCAL!(0)-VOS!(0))/VEX!(0)
470 PRINT "Cal Factor = ";CF;"mV signal / V excitation /";F%;U$;" load"
500 END
```

```
10 ' KDAC Example program for AIM8 manual page 22, top of page
20 CLS
30 CALL KDINIT
40 DIM EX!(1):DIM OF!(1):DIM VA!(1)
50 LOCATE 1,1:PRINT "Reading excitation - press any key to continue..."
60 CALL FGREAD'("excite","none",ex!(),"c.volts","nt")
70 LOCATE 3,1:PRINT "Excitation = ";EX!(0);"volts          "
80 R$=INKEY$:IF R$="" THEN 60
90 LOCATE 1,1:PRINT "Reading offset - Unload bridge and press any key to continue..."
100 CALL FGREAD'("test","none",of!(),"c.aim8.d","nt")
110 LOCATE 3,1:PRINT "Offset = ";OF!(0);"grams          "
120 R$=INKEY$:IF R$="" THEN 100
130 CLS
140 LOCATE 1,1:PRINT "Reading load - press any key to exit..."
150 CALL FGREAD'("test","none",va!(),"c.aim8.d","nt")
160 LOCATE 3,1:PRINT "Load = ";VA!(0)-OF!(0);"grams          "
170 R$=INKEY$:IF R$="" THEN 150
180 END
```

```
10 ' KDAC Example program for AIM8 manual page 22, bottom of page
20 CLS
30 CALL KDINIT
40 DIM EX!(1):DIM OF!(1):DIM VA!(1):STAT%=0:LP!=0
50 LOCATE 1,1:PRINT "Reading excitation - press any key to continue..."
60 CALL FGREAD'("excite","none",ex!(),"c.volts","nt")
70 LOCATE 3,1:PRINT "Excitation = ";EX!(0);"volts          "
80 R$=INKEY$:IF R$="" THEN 60
90 CLS
100 LOCATE 1,1:PRINT "Reading offset - unload bridge and press any key to continue..."
110 CALL FGREAD'("test","none",of!(),"c.aim8.d","nt")
120 LOCATE 3,1:PRINT "Offset = ";OF!(0);"grams          "
130 R$=INKEY$:IF R$="" THEN 110
140 CLS
150 LOCATE 1,1:PRINT "Reading load - press any key to exit...       "
160 CALL BGREAD'("ary%",20.,"excite,test",1,"none",1,"nt","done")
170 CALL INTON'(1,"sec")
180 CALL BGSTATUS'("done",stat%)
190 IF STAT%<>0 THEN 180
200 CALL INTOFF
210 CLS
```

```
220 LOCATE 1,1:PRINT "Sample ----- Grams"
230 FOR T!=1 TO 20
240 CALL ARGET'("ary%",t!,t!,"test",1,va!(),"c.aim8.d")
250 PRINT T!,VA!(0)-OF!(0)
260 NEXT T
270 END
```

```
10 ' KDAC Example program for AIM8 manual page 23, bottom of page
20 CLS:KEY OFF
30 CALL KDINIT
70 DIM EX!(1):DIM OF!(1):DIM VA!(1)
80 LOCATE 1,1:PRINT "Reading excitation - press any key to continue..."
90 CALL FGREAD'("excite","none",ex!(),"c.volts","nt")
100 LOCATE 3,1:PRINT "Excitation = ";EX!(0);"volts          "
110 R$=INKEY$:IF R$="" THEN 90
120 CLS
130 LOCATE 1,1:PRINT "Unload bridge, adjust offset for 0, and press any key to continue..."
140 CALL FGREAD'("test","none",of!(),"c.aim8.d","nt")
150 LOCATE 3,1:PRINT "Offset = ";OF!(0);"grams          "
160 R$=INKEY$:IF R$="" THEN 140
170 CLS
180 LOCATE 1,1:PRINT "Calibrating with EUF 'C.AIM8.C'. Apply calibrating force and press any key."
190 CALL FGREAD'("test","none",va!(),"c.aim8.c","nt")
200 R$=INKEY$:IF R$="" THEN 190
210 CLS
220 LOCATE 1,1:PRINT "Reading unloaded offset of bridge...Remove load and press any key.      "
230 CALL FGREAD'("test","none",of!(),"c.aim8.d","nt")
240 LOCATE 3,1:PRINT "Offset = ";OF!(0);"calibration units "
250 R$=INKEY$:IF R$="" THEN 230
260 CLS
270 LOCATE 1,1:PRINT "Reading loaded bridge...Apply load and press any key."
280 CALL FGREAD'("test","none",va!(),"c.aim8.d","nt")
281 'CALL FGREAD'("calib","none",va!(),"c.aim8.d","nt")
290 LOCATE 3,1:PRINT "Load = ";VA!(0)-OF!(0);"calibration units "
310 R$=INKEY$:IF R$="" THEN 280
320 END
```