SPECIFICATIONS

SOFTWARE FEATURES

- SETUP — 8 Analog Setpoints per analog channel. All analog and digital channel titles are user entered and easily changed.

- PROGRAM — User programming is menu driven and very friendly. User responds to prompts displayed on screen.

- LOGIC SYSTEM — AND/OR logic functions. Separate ON and OFF logic setups for digital outputs. 4 Analog Setpoints per digital output. 8 internal status outputs store intermediate logic results.

- TIMED FUNCTIONS — 8 Real Time Clock setpoints. User selects time, day of week and month for setpoints to be active. Time delay functions use absolute time from real time clock or elapsed time from an event. Time Delay range: 10 seconds to 12 hours.

- CALIBRATION — Analog transducers are digitally calibrated. User enters HIGH and LOW calibration values in engineering units.

CONTROL CARD FEATURES

- 8 ANALOG INPUTS — Eight bit A/D. User configurable for 0-5VDC or 4 to 20 mA DC. Total error (offset, full-scale, linearity, and multiplexer errors) < 1 LSB. Offset and full-scale errors eliminated with digital calibration.

- 8 DIGITAL INPUTS — TTL — CMOS — Dry Relay Contact compatible.

- 8 DIGITAL OUTPUTS — Can drive 150 MA DC loads at up to 50VDC.

- REAL TIME CLOCK — Crystal controlled, .005% drift. Lithium battery backup for 2 years of continuous power down operation.

- TI COMPATIBLE — Gold plated edge connector. Compatible with TI's Peripheral Expansion Box. Power requirements: +7.5VDC to +11VDC at 0.500 AMPS. Operating ambient temperature 0°C to 70°C.

ACCESSORIES

- INTERFACE UNIT — Provides terminations for analog and digital inputs. Provides 8 relay switched 120VAC, 6 AMP. output receptacles.

- INTERFACE CABLE — Interconnects control card to interface unit.

- TEMPERATURE PROBES — 3 ranges available with 10 Ft. cable.

- USERS MANUAL

For more information call or write A/D ELECTRONICS

Dealer pricing to fallow.
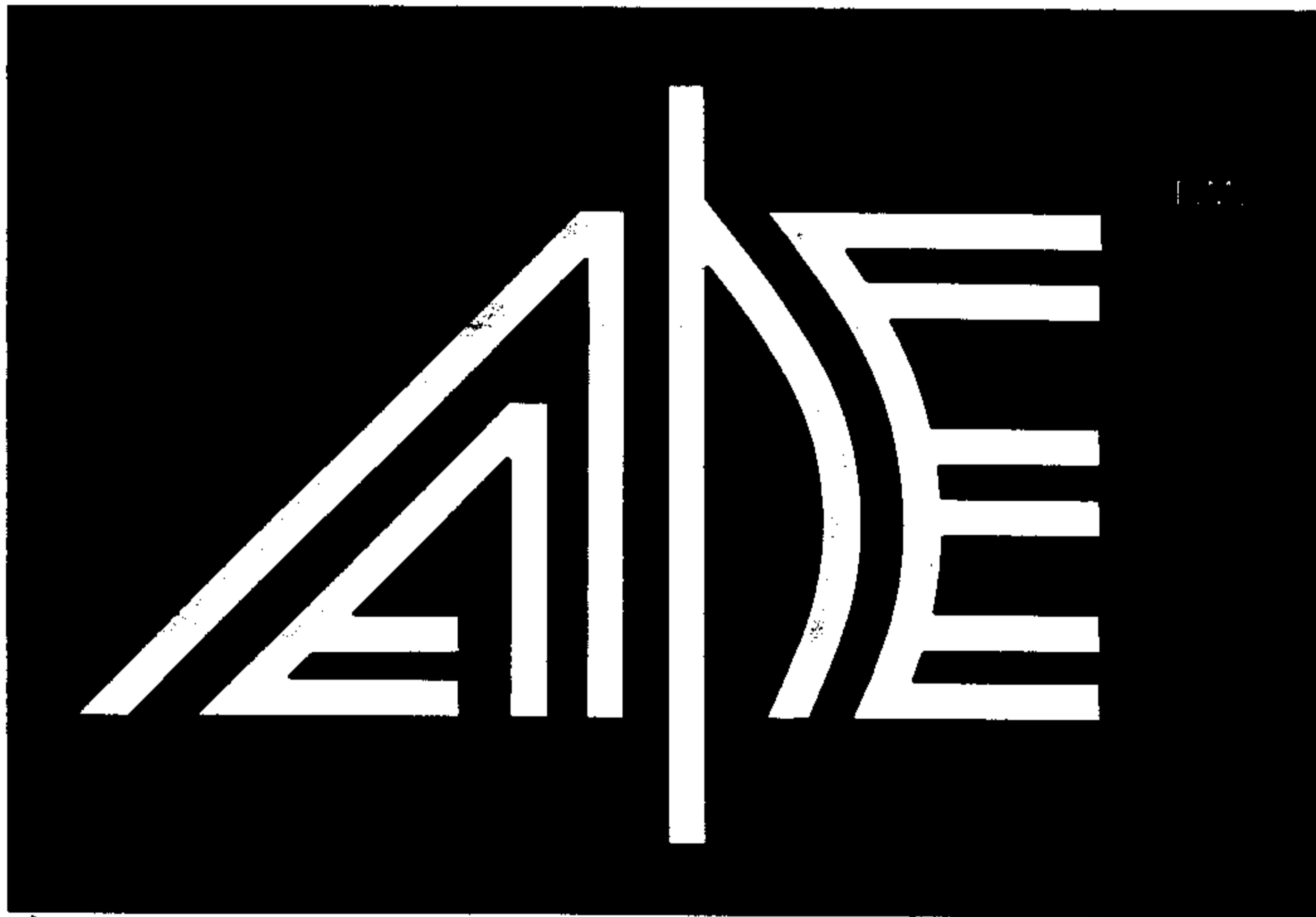
FIRST ADE™ **users manual**

FIRST ADE ™ USERS MANUAL

BY

A/D ELECTRONICS

Minimum equipment requirements are: computer console, TI extended basic command module, TI peripheral expansion box, 32K extended memory, disk controller and disk drive and a monitor or TV set.

TI EXTENDED BASIC, TI EXTENDED BASIC COMMAND MODULE and TI PERIPHERAL
EXPANSION BOX are registered trademarks of Texas Instruments Inc.

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INTRODUCTION

Congratulations!

You are now a proud owner of FIRST ADE™, a complete 8 bit data acqui-sition and control card that plugs into your TI peripheral expansion box.

The control card combined with FIRST ADE™ VERSION 1.2 disk based software gives you an extremely powerful programmable controller enabling you to switch up to 8 digital outputs on and off. Output control is based on logical setups of the digital inputs and/or digital outputs, time of day, day of week and month and/or programmed setpoints on the analog bar graphs.

In addition to having complete control, the main running screen gives you complete status information on all 8 analog inputs, and on all 8 digital inputs and digital outputs. There is even the time of day dis-played on the screen for your convenience.

The capabilities of this powerful package are limited only by the users imagination.

GETTING STARTED

Inserting The Controller Card

CAUTION

The electronic components on this card can be
damaged by static electricity discharges. To
avoid any possible damage, handle the card by
the edges whenever possible and avoid touch-
ing the contacts.

1. First turn off the computer console and all devices attached.

2. WARNING: TO AVOID DAMAGING THE CONTROLLER CARD, WAIT TWO (2) MINUTES
   AFTER TURNING POWER OFF BEFORE PROCEEDING.

3. Remove the top from the TI peripheral expansion box.

4. The controller card has an indicator light on the front that can be
   seen from the front of the TI Peripheral Expansion Box when the card
   is active.

5. Align the card with the desired slot and carefully slide the card
   down the guides until the contacts touch the slot. Press the card
   firmly down into the slot.

6. Replace the top on the TI Peripheral Expansion Box.

Removing The Controller Card

1. Repeat steps 1, 2 & 3 from above.

2. Firmly pull the controller card from its slot in the peripheral
   expansion box.

Connecting The Controller Card To The FIRST ADE™ Interface

The FIRST ADE™ interface is an accessory unit (sold separately) that
provides terminations for the eight analog inputs and the eight digital
inputs. There are 8 pairs of terminals for the analog inputs. Each ana-
log input has a + (positive) and - (negative) terminal for the analog
transducer to terminate on.

There are 8 terminals for the digital inputs and 1 terminal for the
digital common. Connecting the digital common to any of the 8 digital
inputs is a closed or ON circuit, and is a logic "low." Any digital in-
puts not connected to the digital common are open, or OFF circuits, and
are a logic "high."

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CONNECTING THE RIBBON CABLE TO THE CONTROL CARD AND INTERFACE UNIT

   Care should be taken when connecting the ribbon cable to the control
card and interface unit to insure that the connectors are plugged into
the sockets the right way. Some ribbon cables have connectors that are
keyed, i.e., they can only be inserted into the sockets one way.

   If the connectors on the cable are not keyed, they will each have a
mark at one end on one side only identifying pin #1. The mark is usually
a ∇ triangle or □ rectangle. Line up the mark on the connector with the
mark on the socket and insert the connector firmly into the socket.

PIN#1

BROWN OR ODD
  COLOR WIRE

TYPICAL MARKS
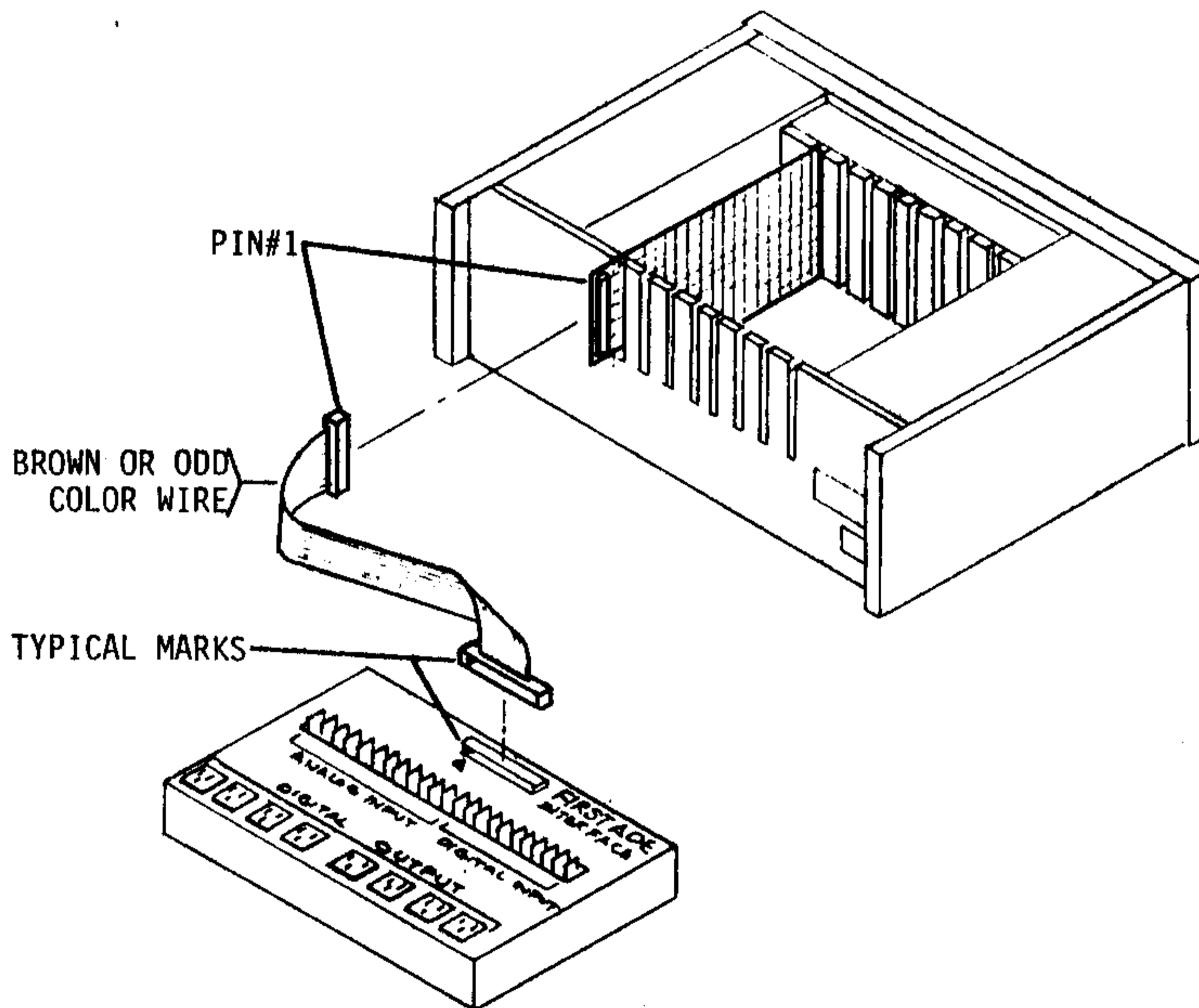
FIGURE 1

   If the connectors on the cable are not marked and have a multi color-
ed ribbon cable, a brown wire will always be at the end of the connectors
identifying pin #1. Insert the connector into the socket with the brown
wire nearest the end of the socket having the pin #1 identifying mark.

   If the ribbon cable is a solid color, there will usually be a unique
or (odd) colored wire identifying pin #1. Insert the connector into the
socket with the odd colored wire nearest the end of the socket having the
pin #1 identifying mark.

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The FIRST ADE™ interface also provides the user with the necessary hardware to switch 8-120V AC devices ON and OFF. The hardware consists of 8-AC receptacles and 8 relays that switch the power to the receptacles. The 8 relays are controlled by the 8 digital outputs on the controller card.

The interface unit is connected to the control card with a 40 conductor ribbon cable (sold separately). See Figure 1, page 4.

Using The Controller Card and Software

Once the controller card is inserted into the peripheral expansion box and the top replaced, the card is ready to use.

1. Make sure the TI Extended Basic Command Module is pluged in.
2. Turn on the monitor, peripheral expansion box and console.
3. When the computers title screen appears, insert FIRST ADE™ VERSION 1.2 diskette into disk drive one.
4. Press any key, then press 2 for TI EXTENDED BASIC.

The software will load automatically.

NOTE: If TI EXTENDED BASIC has already been selected, insert the diskette into disk drive one and type OLD DSK1.LOAD, and press 'ENTER'. Then type RUN and press 'ENTER'.

The main menu will be displayed as follows:

FIRST ADE 1.2 - MAIN MENU

1 SET-UP
2 PROGRAM
3 RUN
4 CALIBRATE
5 TIME SET

?=EXIT PROGRAM

YOUR CHOICE: 1

You can use this menu to access the five main functions provided by your FIRST ADE system. You use items 1, 2, 4 and 5 to tell FIRST ADE how to interpret the measurements it makes and how to display them; and of course, how to control the outputs. Item 3 tells FIRST ADE to do what you've described for it to do.

Briefly, these functions are:

1. SET-UP - You use this mode to define the end values of the analog bargraphs, the engineering units (PSI, FT. DEGS etc), and the analog setpoints (analog values at which you want something to happen, i.e., turn an output on or off). The digital input and output channel titles are also defined. This mode also includes a disk file initialization

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option which enables you to erase all setup, program and calibration information on the diskette, or to selectively delete any analog channel information.

2. PROGRAM - With this mode you describe what set of conditions you want to exist before you switch an output on or off. As with any program, you should define in detail exactly what setpoints or status inputs you want to effect each output you intend to use.

3. RUN - This mode causes the bargraphs, status blocks and time of day to be displayed; and initiates the ADE system control of digital outputs based upon setup and program information you've entered.

4. CALIBRATE - This mode allows you to tell the ADE system how to convert a measured quantity (voltage or current) into units familiar to you (temperature, PSI, feet, etc.). It also provides a means of obtaining the greatest system accuracy since the calibration process directly establishes the correspondence between the measured value and the displayed value without intermediate adjustments.

5. TIME SET - This mode enables you to set the time of day clock; i.e., the time of day, day of the week and month of the year. The clock runs whether the ADE circuit board is powered or not.

How To Use The Menus

Almost all user entries to the ADE system employ menus that will be presented on the screen as lists from which you may choose one entry. Simply choose one from the list and key it in each time you are prompted. This results in the fewest keystrokes to enter data. Sometimes a default value will be presented, such as "ANALOG CHANNEL NO.:1". Here, ADE is asking you to define which of the eight analog channels you wish to use and the default value is channel 1. If you wish to use a different channel you must change the "1" to another number. In many cases, entering a question mark "?" will send you back to the next higher level menu.

RETURNING TO TI EXTENDED BASIC

In order to return to TI Extended Basic you MUST return to the FIRST ADE main menu and then press a question mark "?". Leaving the FIRST ADE software by pressing QUIT or CLEAR may cause the computer and control card to LOCK-UP. If this should happen, turn the computer off and reset the control card with the reset switch located under the 40 PIN I/O Connector. Slide the switch in toward the expansion box. The red LED indicator on the front of the control card will go out. Slide the reset switch away from the expansion box to the normal position. See page 7 figure 2 for details.

If the computer console LOCKS-UP, it may cause the control card to lock-up also. This can be detected by the indicator light which will stay on all the time if the card is locked up.

If this should happen, turn the computer off and slide the reset switch in toward the expansion box to the reset position. The red indicator light on the front of the control card will go out. Slide the reset switch away from the expansion box to the normal position.

NOTE: The control card will not function when left in the RESET position. If you try to run the FIRST ADE™ software with the control card left in the reset position, error codes may result.
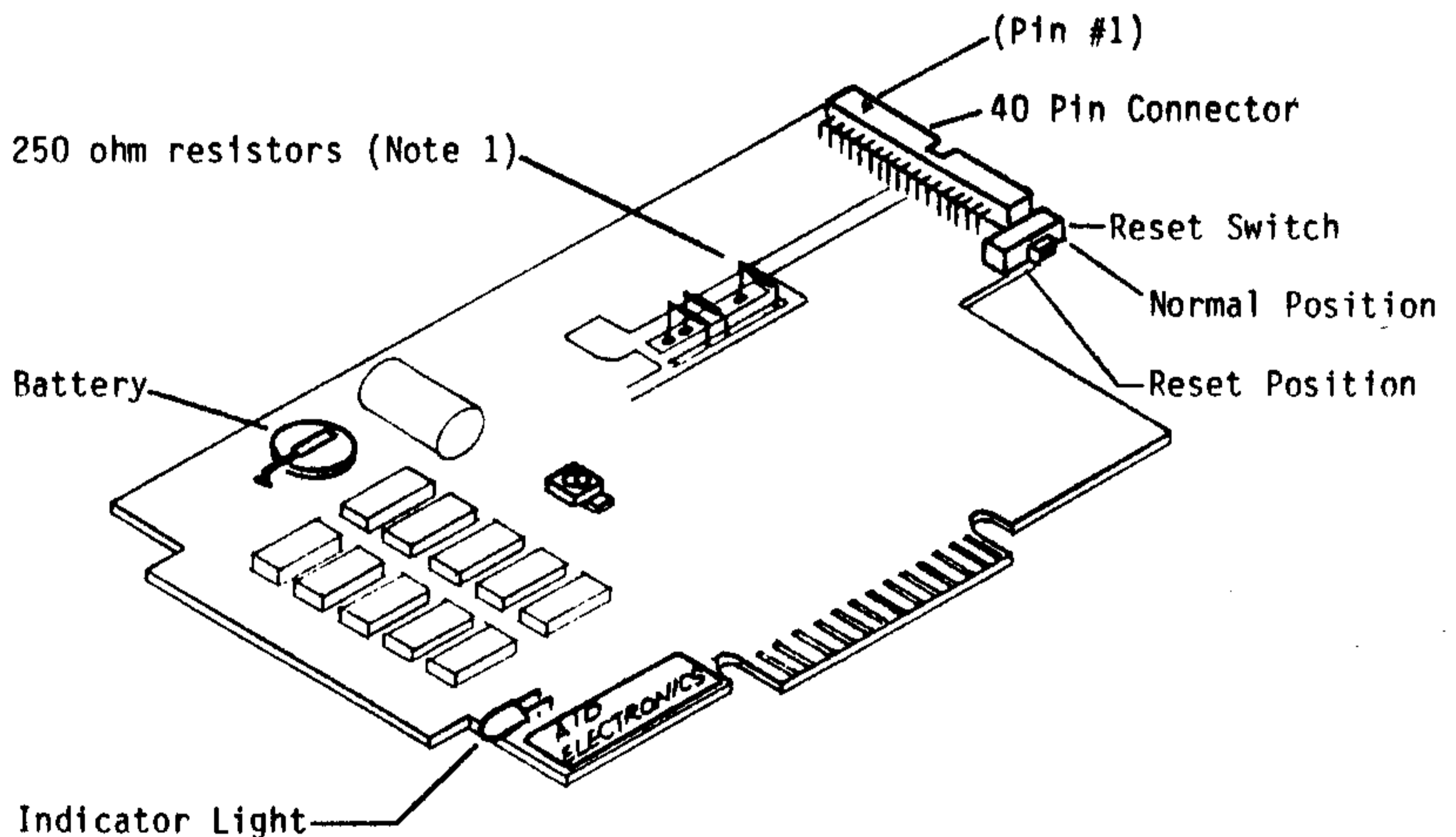
Figure 2

NOTE 1:   To change the standard 0-5VDC analog input to a 4-20mADC input, a 250 ohm, 1/4 watt, 1% tolerance resistor must be added for every channel you wish to change to 4-20mA. (See Figure 2)

MODE DESCRIPTION

SET-UP

Choosing 1 from the main menu loads the setup routines. Type '1' and press 'ENTER'. The following menu will be displayed:

CHANNEL SETUP MODE

1   CHANNEL SELECTION
2   SETPOINT PROG
3   INITIALIZE FILES

?=RETURN TO MAIN MENU

YOUR CHOICE: 1

This mode has 3 selections to choose from in its menu. These selections will be described in separate subsections. Press 'ENTER' for channel selection. The following display will appear:

CHANNEL SETUP PROGRAM

CHANNEL TYPE:A

TYPE A '?' TO END ENTRY

This routine allows you to choose which type of channel you wish to setup - analog or digital. Channel type 'A' is for an analog channel. Choosing 'D' is for a digital channel. No other entries are allowed other than A or D and a '?' to exit. Press 'ENTER' to setup an analog channel. The following display will appear:

CHANNEL SETUP PROGRAM

CHANNEL TYPE:A

ANALOG CHANNEL NO.:1

TYPE A '?' TO END ENTRY

Analog channel NO. 1 through 8 may be selected. No other entries are allowed. Pressing 'ENTER' will select analog channel No. 1. 'DESCRIPTION: CHANNEL DESC' should be displayed below the analog channel No. In setting up an analog channel the user chooses the channel number, and types in the channel description. Up to 15 characters may be used to describe an analog channel. These characters will be displayed near the bargraph.

NOTE: A comma CANNOT be used in any channel or units description.

Press 'ENTER' to continue.

```
ZERO SCALE VALUE: 0
FULL SCALE VALUE: 0
UNITS DESCRIPTION:UNITS
```

is displayed below the channel description. Now the zero scale value may be entered. The zero scale value is the lowest value in engineering units represented on the bargraph. The zero scale value may be up to a 6 digit value and must be less than the full scale value. Press 'ENTER'. Now the full scale value may be entered. The full scale value is the highest value represented on the bargraph. The full scale value may be up to a 6 digit value and must be greater than the zero scale value. Press 'ENTER' to continue.

Now the units description is entered. The units description is the unit of measurement for a particular analog transducer. For instance, if a temperature probe is the analog input, the units would be degrees. If the analog input is from a flow meter, the units might be gallons per minute (GPM).

The units description is limited to 5 characters in length. Press 'ENTER' to continue.

```
CHANNEL TYPE: A
```

is displayed again. This sequence is repeated until you have setup all of the analog channels you wish to use.

Now type 'D' for digital and press 'ENTER'.

```
CHANNEL SETUP PROGRAM

CHANNEL TYPE:D
INPUT OR OUTPUT(I/O):I
DIGITAL


TYPE A '?' TO END ENTRY
```

is displayed on the screen. Now a digital input (I) or a digital output (O) may be chosen. I or O and a '?' are the only entries allowed. Press 'ENTER' to choose an input.

```
CHANNEL SETUP PROGRAM

CHANNEL TYPE:D
INPUT OR OUTPUT(I/O):I
DIGITAL CHANNEL NO.:1


TYPE A '?' TO END ENTRY
```

is displayed on the screen. You may now choose any one of the eight digital inputs. Only 1 through 8 may be entered. Press 'ENTER' to select digital input channel number 1.

'DESCRIPTION: CHANNEL DESC' is displayed below the digital channel number.

You may now type in up to 15 characters to describe a digital input channel. A comma CANNOT be used in the description.

Press 'ENTER' to continue.

CHANNEL TYPE:D

is displayed again. This sequence is repeated until you have setup all of the digital input channels you wish to use. Press 'ENTER'. Now press 'O' for digital output and press 'ENTER'.

CHANNEL SETUP PROGRAM

CHANNEL TYPE:D
INPUT OR OUTPUT(I/O):O
DIGITAL CHANNEL NO.:1

TYPE A '?' TO END ENTRY

is displayed on the screen. You may now choose any one of sixteen digital outputs. Only 1 through 16 may be entered.

It should be noted that only digital outputs 1 through 8 are available to drive external devices. Outputs 9 through 16 are internal status outputs and need not be used. The enthusiast however, will use these internal status outputs (9 through 16) to set up additional logic to turn a drive output (1 through 8) on or off. These 8 internal status outputs (9 through 16) will be discussed further in the program description.

Now press 'ENTER' to select digital output channel number 1.

'DESCRIPTION: CHANNEL DESC' is displayed below the digital channel number.

You may now type in up to 15 characters to describe a digital output channel. A comma CANNOT be used in the description.

Press 'ENTER' to continue.

CHANNEL TYPE:D

is displayed again. This sequence is repeated until you have setup all of the digital output channels you wish to use.

Now type a '?' to end entry. ADE will return you to this menu:

CHANNEL SETUP MODE

1 CHANNEL SELECTION
2 SETPOINT PROG
3 INITIALIZE FILES

?=RETURN TO MAIN MENU

YOUR CHOICE: 1

Now type '2' to select setpoint program and press 'ENTER'.

SETPOINT MODE

ANALOG CHANNEL NUMBER:1

TYPE A '?' TO END ENTRY

is displayed on the screen. This mode is used with the analog inputs only. It allows you to program up to 8 setpoints, (4 ON/OFF) pairs per analog channel. These setpoints can be programmed within any range, but are of no use if programmed outside the range of the analog transducer that is being used.

Because separate logic setup routines are used in the program mode to turn a digital output ON or OFF, the "ON" half of the setpoint pair can be used to turn an output either ON or OFF, or the 'OFF' half of the setpoint pair can be used to turn an output either ON or OFF. This will be described further in the program mode.

Now you may choose analog channel number 1 through 8 in which to set setpoints. No other entries are allowed.

Press 'ENTER' to select analog channel number 1. The following display will appear:

SETPOINT MODE

ANALOG CHANNEL NUMBER:1

CHANNEL DESC

NO.	ON		OFF
1 >	0	<	0
2 >	0	<	0
3 >	0	<	0
4 >	0	<	0

TYPE A '?' TO END ENTRY

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The cursor should now be blinking over the "greater than" (>) symbol next to the 'ON' point of setpoint number 1. At this time the (>) symbol can be changed to the "less than" (<) symbol for the 'ON' point. The "less than or greater than" (< or >) symbol for the 'OFF' point will automatically change to the opposite of what is used in the "ON" point. Example: Let us say that a temperature probe is used to generate the analog input signal (0-5V DC). The bargraphs zero scale value is 32 degrees, and the full scale value is 120 degrees. A setpoint is set as follows: The cursor is blinking over the (>) symbol next to the 'ON' point of setpoint number 1. Press 'ENTER'. The setpoint can now be entered for the 'ON' point. Type 90 and press 'ENTER'. Now the cursor is blinking next to the (<) symbol of the 'OFF' point. Type 70 and press 'ENTER'. Setpoint number 1 is now set for analog channel number 1. This can be described as: The setpoint is 'ON' if the temperature is greater than (>) 90 degrees, and the setpoint is 'OFF' if the temperature is less than (<) 70 degrees. This setpoint can now be used in the program mode when setting up the logic to turn a digital output on or off. A fan may be connected to a digital output. When setting up the 'ON' logic, the on setpoint is used. When setting up the 'OFF' logic, the off setpoint is used. When programmed this way, the fan will turn on when the temperature is greater than 90 degrees, and will turn off when the temperature is less than 70 degrees.

All 4 setpoint pairs can be used this way. For setpoints that are not used, press enter to skip over them. After setpoint 4 is used or skipped over,

ANALOG CHANNEL NUMBER:2

is displayed. This sequence is repeated until setpoints are set for .any of the 8 analog channels you wish to use.

Now type a '?' to end entry. You should see this display:

CHANNEL SETUP MODE

1 CHANNEL SELECTION
2 SETPOINT PROG
3 INITIALIZE FILES

?=RETURN TO MAIN MENU

YOUR CHOICE: 1

Now type '3' to select initialize files and press 'ENTER'.

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INITIALIZATION ROUTINE

1=INITIALIZE ALL FILES
2=DELETE AN ANALOG CHANNEL

?=RETURN TO MENU

YOUR CHOICE: 1

is displayed on the screen. This routine has two selections in its menu.
Initialize all files and delete an analog channel. Press 'ENTER' to ini-
tialize all files. Choosing 1 allows the user to completely erase all
the user entered information. Zeros are entered into the variables and
all the default values are set.

ARE YOU SURE YOU WANT TO?
YOUR CHOICE (Y OR N): N

is displayed on the screen. This gives you a chance to change your mind.
Type 'Y' and press 'ENTER'.

After initialization is complete, the 'CHANNEL SETUP MODE' menu is
displayed. Type '3' for initialize files and press 'ENTER'. Now type
'2' to delete an analog channel and press 'ENTER'.

SELECTIVE DELETE

ANALOG CHANNEL NUMBER: 1

TYPE A '?' TO END ENTRY

is displayed on the screen. Choosing '2' allows you to selectively
delete any analog channel. Any channel number from 1 through 8 can be
entered.

Press 'ENTER' to delete channel number 1.

CHANNEL NUMBER 1

DESC: CHANNEL DESC

ZERO= 0

FULL= 0

UNITS: UNITS

IS THIS THE CORRECT CHANNEL
TO DELETE (Y OR N) : N

is displayed on the screen.

You again have a chance to change your mind. Type 'Y' and press 'ENTER'. The analog channel information is erased and the initialization routine menu is displayed.

Type a '?' and press 'ENTER'.

The channel setup mode menu is displayed.

Type a '?' and press 'ENTER'.

The main menu is now displayed.

MODE DESCRIPTION

PROGRAM

Choosing 2 from the main menu loads the program routines. Type '2' and press 'ENTER'. The following should be displayed:

PROGRAM MODE

WHICH DIGITAL OUTPUT: 1

```
 1  CHANNEL DESC
 2  CHANNEL DESC
 3  CHANNEL DESC
 4  CHANNEL DESC
 5  CHANNEL DESC
 6  CHANNEL DESC
 7  CHANNEL DESC
 8  CHANNEL DESC
 9  CHANNEL DESC
10  CHANNEL DESC
11  CHANNEL DESC
12  CHANNEL DESC
13  CHANNEL DESC
14  CHANNEL DESC
15  CHANNEL DESC
16  CHANNEL DESC
```

TYPE A '?' TO END ENTRY

The 16 digital output channel descriptions that can be entered in the setup mode will be displayed in place of the 16 'CHANNEL DESC'. You may now choose any one of the sixteen digital outputs to program a logical set of 'ON' or 'OFF' conditions. Only 1 through 16 may be entered. Press 'ENTER' to select digital output channel number 1.

PROGRAM MODE

      CHANNEL DESC

WHICH DIGITAL OUTPUT: 1
LOGIC FOR ON(N) OR OFF(F):N

TYPE A '?' TO END ENTRY

is displayed on the screen. ON or off logic can now be chosen. Choosing
'ON' means that when the programmed conditions being entered are met, the
output will turn on (logic low). The output will stay on until the off
conditions are met. Choosing 'OFF' means that when the programmed condi-
tions being entered are met, the output will turn off (logic high). Like-
wise the outputs will stay off until the on conditions are met. It does
not matter whether the ON logic or the OFF logic is programmed first.
Press 'ENTER' to select ON logic.

PROGRAM MODE

      CHANNEL DESC

WHICH DIGITAL OUTPUT: 1
LOGIC FOR ON(N) OR OFF(F):N
LOCICAL AND(A) OR OR(O):I

TYPE A '?' TO END ENTRY

is displayed on the screen. Now either AND or OR logic can be selected.
The prompt defaults with an I for inactive. Whenever an output is not
being used, it should be set to inactive by typing an I instead of an A
or O and pressing 'ENTER'. Selecting AND means that to turn a selected
output ON or OFF, you must have digital input 1 on, AND digital input 2
on, AND digital input 3 off. Selecting OR means that to turn a selected
output ON or OFF you must have digital input 1 on OR digital input 2 on,
OR digital input 3 off. (The digital channel numbers used above are only
examples). Type 'A' and press 'ENTER' to select AND logic.

PROGRAM MODE

      CHANNEL DESC

WHICH DIGITAL OUTPUT: 1
LOGIC FOR ON(N) OR OFF(F):N
LOCICAL AND(A) OR OR(O):A
EDIT ANA SETPT PROG (Y/N):N

TYPE A '?' TO END ENTRY

is displayed on the screen. The prompt 'EDIT' analog setpoint is display-
ed next. Choosing 'N' for no indicates that you do not wish to use set-
points from an analog channel in the logic setup to turn the output on or
off. Choosing 'Y' for yes indicates that you do. Type 'Y' and press
'ENTER'.

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```
MAXIMUM OF 4 ANALOG CHANNEL
SETPOINTS PER DIGITAL OUTPUT
CH# 0 SP# 0 ON/OFF F
CH# 0 SP# 0 ON/OFF F
CH# 0 SP# 0 ON/OFF F
CH# 0 SP# 0 ON/OFF F
```

is displayed below the prompt 'edit analog setpoint program'. All 4 set-points can be from 1 analog channel; or 4 analog channels can have 1 set-point each; or any combination. Type '1' and press 'ENTER'. Now the setpoint number 1 through 4 will be from analog channel number 1. The setpoint number for the particular pair of (ON/OFF) setpoints that were entered in the setpoint mode of the set-up routine can now be entered. Type '1' and press 'ENTER'. You now have the option of choosing OFF(F) if you want the off half of the setpoint pair to turn the output on or you can choose ON(N) if you want the on half of the setpoint pair to turn the output on. The programming procedures are the same when programming the 'OFF' logic. Press 'ENTER' to continue. Now type a '?' to end entry.

```
PROGRAM MODE

        CHANNEL DESC

WHICH DIGITAL OUTPUT: 1
LOGIC FOR ON(N) OR OFF(F):N
LOGICAL AND(A) OR OR(O):A
EDIT ANA SETPT PROG (Y/N):Y
EDIT DIG SETPT PROG (Y/N):N

TYPE A '?' TO END ENTRY
```

is displayed on the screen. Type 'Y' and press 'ENTER' to edit the digital setpoints. The prompt

```
DIGITAL IN OR OUT (I/O):I
```

is displayed next. Press 'ENTER' to choose the digital inputs.

```
DIGITAL INPUT SETPOINTS
CHAN# 0 ON/OFF(N/F) F
CHAN# 0 ON/OFF(N/F) F
CHAN# 0 ON/OFF(N/F) F
CHAN# 0 ON/OFF(N/F) F
CHAN# 0 ON/OFF(N/F) F
CHAN# 0 ON/OFF(N/F) F
CHAN# 0 ON/OFF(N/F) F
CHAN# 0 ON/OFF(N/F) F

TYPE A '?' TO END ENTRY
```

is displayed below the prompt 'edit digital setpoint program'.

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Up to 8 digital inputs may be used in the logic setup. Some of the inputs may have to be OFF (open or logic high) while other inputs may have to be ON (closed or logic low) to turn an output either on or off. Type '1' to choose digital input channel number 1 and press 'ENTER'. Now a 'F' may be entered if you want the output to turn on when the input is off (open) or a 'N' may be entered if you want the output to turn ON when the input is on (closed). Zeros should be placed after the 'CHAN#' for the digital inputs that are not used.

Now type a '?' to end entry.

  DIGITAL IN OR OUT (I/O):I

is displayed again. Type '0' and press 'ENTER' to choose the digital outputs.

```
DIGITAL OUTPUT SETPOINTS
CHAN# 00 ON/OFF(N/F) F
CHAN# 00 ON/OFF(N/F) F
CHAN# 00 ON/OFF(N/F) F
CHAN# 00 ON/OFF(N/F) F
CHAN# 00 ON/OFF(N/F) F
CHAN# 00 ON/OFF(N/F) F
CHAN# 00 ON/OFF(N/F) F
CHAN# 00 ON/OFF(N/F) F
```

is displayed below the prompt 'edit digital setpoint program'. There are 16 digital outputs. Any 8 of the 16 outputs may be used in the logic set-up to turn an output on or off. Only outputs 1 through 8 can drive external devices and can also be used as status output indicators in the logic setup for another output. Outputs 9 through 16 are internal status output indicators and cannot drive external devices. They are usually used to store intermediate logic results in a setup for a drive output (1 through 8). Any combination of 'real' or 'status' outputs may be used in a logic setup and both are programmed and used in the same way. Now type '03' to choose digital output channel number 3 and press 'ENTER'. Now a 'F' may be entered if you want an output to turn on when output 3 is off, or a 'N' may be entered if you want an output to turn on when output 3 is on. An example of this might be in operating a primer pump and a main pump. A unique set of logical conditions can be setup to turn on output 3 (the primer pump). Another unique set of conditions can be set-up to turn on output 4 (the main pump). Output 3 can be a part of this unique set of conditions, and may have to be on before output 4 (the main pump) can turn on.

        Press 'ENTER' to continue.

        Now type a '?' to end entry.

NOTE: The outputs are processed in numerical order during each cycle, therefore output #1's logic is tested first, then output #2, etc.

PROGRAM MODE

CHANNEL DESC

```
WHICH DIGITAL OUTPUT: 1
LOGIC FOR ON(N) OR OFF(F):N
LOGICAL AND(A) OR OR(O):A
EDIT ANA SETPT PROG (Y/N):Y
EDIT DIG SETPT PROG (Y/N):Y
EDIT TIM/DAY/MO PROG (Y/N):N
```

TYPE A '?' TO END ENTRY

is displayed on the screen. After the analog inputs, digital inputs and digital outputs are programmed, you now have the option of also using the real time clock in the logic setup. The real time clock gives you the ability to turn an output either on or off according to the time of day, day of the week and month of the year.

Time setpoints may be entered as equal (=), greater than (>) or less than (<). SEE EXAMPLES:

The (=) setpoint causes a true condition only at the exact time selected. 1 to 4 (=) setpoints may be selected. See example below:

```
1 TIME = 10:00 A
2 TIME = 11:00 A
3 TIME = 12:00 P
4 TIME = 01:00 P
```

The above example will be a true condition exactly at those 4 times. If an output were programmed to turn ON at the above times, that output could then be programmed to turn OFF by other setpoints (digital or analog) or by other time setpoints between those shown. The output would then turn ON again at the following time setpoint.

The greater than (>) setpoint causes a true condition to exist at anytime (>) the selected time. Although 1 to 4 > setpoints may be entered, it makes logical sense to enter only 1. See example below:

```
1 TIME > 11:00 P
```

The above example causes a true condition to occur at anytime between 11:00 PM and 11:59 PM.

The less than (<) setpoint causes a true condition to exist at any-time (<) the selected time. Although 1 to 4 < setpoints may be entered, it makes logical sense to enter only 1. See example below:

```
1 TIME < 11:00A
```

The above example causes a true condition to occur at anytime between 12:00 AM and 11:00 AM.

A range may be entered, that is a greater than (>) setpoint and a less than (<) setpoint. This causes a true condition to exist anytime > and < the selected times. Only 1 range (pair) may be entered per digital output, however the pair may be used with equal (=) setpoints as well.

```
1 TIME > 09:00 A
2 TIME < 09:00 P
```

The above example causes a true condition to exist anytime between 9:00 AM and 9:00 PM.

The equal (=) condition may be used with the > and/or the < condition. See example below.

```
1 TIME = 10:00 A
2 TIME > 01:00 P
```

The above example causes a true condition at 10:00 AM or anytime between 1:00 PM and 11:59 PM.

```
1 TIME < 02:00 P
2 TIME = 09:00 P
```

The above example causes a true conditon anytime between 12:00 AM and 2:00 PM or at 9:00 PM exactly.

```
1 TIME = 05:00 A
2 TIME = 07:00 A
3 TIME > 09:00 A
4 TIME < 11:00 A
```

The above example causes a true condition to exist at exactly 5:00 AM or at exactly 7:00 AM or at anytime between 9:00 AM and 11:00 AM.

Now type 'Y' and press 'ENTER' to edit the time/day/month program.

```
TIME OF DAY SETPOINTS
MAXIMUM OF 4
   1   TIME > 00:00 A
   2   TIME > 00:00 A
   3   TIME > 00:00 A
   4   TIME > 00:00 A

TYPE A '?' TO END ENTRY
```

is displayed below the prompt 'edit time/day/month program'. If ON logic is being programmed you would interpret the setpoint as: output will be ON if 'TIME < (is less than) or > (is greater than) or = (is equal to) 00:00 A' (the entered time). Enter 'A' for AM or 'P' for PM. If OFF logic is being programmed you would interpret the setpoint as: output will be OFF if 'TIME < (is less than) or > (is greater than) or = (is equal to) 00:00 A' (the entered time). Up to 4 setpoints for the ON logic and 4 setpoints for the OFF logic can be used for each digital output.

Type a '?' and press 'ENTER' to continue.

```
        DAY OF WEEK
          SUNDAY          (Y/N):Y
          MONDAY          (Y/N):Y
          TUESDAY         (Y/N):Y
          WEDNESDAY       (Y/N):Y
          THURSDAY        (Y/N):Y
          FRIDAY          (Y/N):Y
          SATURDAY        (Y/N):Y

          TYPE A '?' TO END ENTRY
```

is displayed below the prompt 'edit time/day/month program'. After each day of the week, you have the option of entering a 'Y' for yes or a 'N' for no. The logic setup, that is the analog, digital, or time clock setpoints will be active only on the days of the week that are followed by a 'Y'. Any day that is followed by a 'N' at the time a setpoint is reached, the output will be inactive and will remain in the same state as it was before the setpoint was reached.

NOTE: Because separate ON and OFF logic setups are used, consideration must be given to the ON and OFF logic of the program when skipping days of the week or months of the year.

Type a '?' and press 'ENTER' to continue.

```
        MONTH OF YEAR
          JANUARY     (Y/N):Y
          FEBRUARY    (Y/N):Y
          MARCH       (Y/N):Y
          APRIL       (Y/N):Y
          MAY         (Y/N):Y
          JUNE        (Y/N):Y
          JULY        (Y/N):Y
          AUGUST      (Y/N):Y
          SEPTEMBER   (Y/N):Y
          OCTOBER     (Y/N):Y
          NOVEMBER    (Y/N):Y
          DECEMBER    (Y/N):Y
     '  TYPE A '?' TO END ENTRY
```

is displayed below the prompt 'edit time/day/month' program. After each
month of the year, you have the option of entering a 'Y' for yes or a
'N' for no. The output will be active only on the months of the year
that are followed by a 'Y'. Any month that is followed by a 'N', the
output will be inactive and will remain in the same state as it was be-
fore the setpoint was reached.

Type a '?' and press 'ENTER' to continue.

PROGRAM MODE

CHANNEL DESC

```
WHICH DIGITAL OUTPUT: 1
LOGIC FOR ON(N) OR OFF(F):N
LOGICAL AND(A) OR OR(0):A
EDIT ANA SETPT PROG (Y/N):Y
EDIT DIG SETPT PROG (Y/N):Y
EDIT TIM/DAY/MO PROG (Y/N):Y
EDIT TIME DELAY PROG (Y/N):N
```

TYPE A '?' TO END ENTRY

is displayed on the screen.   Type a 'Y' and press 'ENTER' to edit the
time delay program.

TIME DELAY(IN SEC):00000

is displayed below the prompt 'edit time delay program'.

You now have the option of programming a time delay. This delay when
programmed with the ON logic, will prevent an output from turning ON for
(N) seconds after the set of ON conditions are met.

If the delay is programmed with the OFF logic, the output is pre-
vented from turning off for (N) seconds after the set of off conditions
are met.

The delay can be from 10 seconds to 43,200 seconds or 12 hours.

Press 'ENTER' to continue.   Now the whole program mode sequence
starts over.   The 16 digital output channel descriptions are displayed,
and another digital output is ready to be programmed.

Now type a '?' to return to the main menu.

MODE DESCRIPTION

RUN

Choosing 3 from the main menu loads the run routines and causes the user entered program to be executed. This mode causes the analog bargraphs, titles and zero and full scale values to be displayed. It also displays the status blocks and time of day and initiates the ADE system control of the digital outputs based upon setup and program information you've entered.

The status of the digital inputs are black numbers 1 through 8 on a grey screen when they are OFF (open). When a digital input is ON (closed) the number of that input turns grey with a black box around it (reverse video). The status of the digital outputs 1 through 8 are recognized the same way. When an output is OFF the number of that output is black on a grey screen. When an output is ON the number of that output turns grey with a black box around it.

Although there are no prompts displayed on the screen, you can exit the RUN MODE and return to the main menu by holding down a question mark '?'. To return to EXTENDED BASIC you MUST return to the FIRST ADE main menu and then hold down a question mark '?'. Leaving the FIRST ADE software by pressing QUIT or CLEAR may cause the computer and control card to LOCK-UP. If this should happen, turn the computer off and reset the control card with the reset switch located under the 40 pin I/O connector. See page 7 figure 2 for details.

MODE DESCRIPTION

CALIBRATE

Choosing 4 from the main menu loads the calibration routines. Type '4' and press 'ENTER'.

CALIBRATION MODE

ANALOG CHANNEL NO: 1

TYPE A '?' TO END ENTRY

is displayed on the screen. In the calibration mode, what we are actually calibrating is the particular transducer that is being used to generate the 0-5VDC analog input signal. EXAMPLE: Say you have a temperature transducer whose output voltage is 0VDC at 32 degrees, and 5VDC at 212 degrees. You must have a way of telling the computer that 0VDC = 32 degrees, (the approximate temperature of cold ice water) and that 5VDC = 212 degrees (boiling water). To accomplish the calibration you must have 2 calibration references. The low value calibration for 32 degrees can be a glass of cold ice water with ice chips. The high value calibration for 212 degrees can be boiling water.

Press 'ENTER' to continue. You are now ready to calibrate the transducer that is connected to analog channel number 1.

CALIBRATION MODE

CHAN #1-CHANNEL DESC
            UNITS=UNITS
LOW CALIBRATION VALUE IN
ENGINEERING UNITS   0

is displayed on the screen. Channel description will be the description that was entered in the SET-UP mode for analog channel number 1. The units will also be what was entered in the SET-UP mode. Type '32' and press 'ENTER'.

WHEN LOW CAL VALUE READY
ENTER R/READY OR A/ABORT:R

is now displayed. The temperature probe is now placed in the ice water. When you think it has reached the temperature of the ice water, press 'ENTER'.

```
CALIBRATION MODE

CHAN #1-CHANNEL DESC
        UNITS=UNITS
LOW CALIBRATION VALUE IN
ENGINEERING UNITS 32

THE A/D READING FOR LOW
CAL VALUE IS  0

HIGH CALIBRATION VALUE IN
ENGINEERING UNITS  0
```

is displayed on the screen. The A/D reading for the low calibration value may not necessarily be 0. It can be any number from 0 to 255. It will only be 0 if the output voltage from the transducer is 0. If the output voltage of the transducer is 1 volt, the A/D reading for the low calibration value would be about 51. Now type '212' and press 'ENTER'.

```
WHEN HIGH CAL VALUE READY
ENTER R/READY OR A/ABORT:R
```

is now displayed. You can stop calibration by typing 'A' for abort and pressing 'ENTER'.

The temperature probe is now placed in boiling water. When you think it has reached the temperature of the boiling water press 'ENTER'. If the calibration is successful, the following is displayed:

```
CALIBRATION MODE

CHAN #1-CHANNEL DESC
        UNITS=UNITS
LOW CALIBRATION VALUE IN
ENGINEERING UNITS 32

THE A/D READING FOR LOW
CAL VALUE IS  0

HIGH CALIBRATION VALUE IN
ENGINEERING UNITS 212

THE A/D READING FOR HIGH
CAL VALUE IS  255

THE CALIBRATION IS COMPLETE
THE SLOPE  (M)  =    .71
THE OFFSET (B)  = 32.00

HIT ANY KEY TO PROCEED
```

The A/D reading for the high calibration value may not necessarily be 255. It will only be 255 if the output voltage from the transducer is 5 volts. If the output voltage from the transducer is 4 volts, the A/D reading for the high calibration value would be about 204.

If the calibration is unsuccessful:

```
    CALIBRATION MODE

CHAN #1-CHANNEL DESC
         UNITS=UNITS
LOW CALIBRATION VALUE IN
ENGINEERING UNITS 32

THE A/D READING FOR LOW
CAL VALUE IS  0

HIGH CALIBRATION VALUE IN
ENGINEERING UNITS 212

THE A/D READING FOR HIGH
CAL VALUE IS  0

CALIBRATION UNSUCCESSFUL
PLEASE REDO THIS CALIBRATION

HIT ANY KEY WHEN
READY TO PROCEED
```

is displayed on the screen.

An analog channel's calibration will be unsuccessful if the High Cal A/D Reading minus (-) the Low Cal A/D Reading is less than (<) 25.

Press any key.

```
    THE SLOPE  (M) =      .00
    THE OFFSET (B) =      .00

    HIT ANY KEY TO PROCEED
```

is displayed below calibration unsuccessful. Pressing any key displays the analog channel number that you were trying to calibrate. If you wish to try again, press 'ENTER' and the calibration sequence will start over. Type a '?' to end entry.

CALIBRATION NOTES:

The advantages of using this technique for calibration are twofold. First, as with most types of analog transducers, there are no potientio- meters to adjust, to make sure that there is 0VDC at 32 degrees and 5VDC at 212 degrees. The computer does not care whether the voltage at 32 degrees is 0VDC or 0.2 VDC, nor does it care whether the voltage at 212 degrees is 5VDC or 4.8 VDC. Whatever voltage is present at 32 degrees or 212 degrees when you press 'ENTER', that is the reference voltage that the computer uses to be = to the low or high calibration value that you entered.

The second reason that this type of calibration is prefered over other techniques is that no two transducers will probably have the same gain characteristics, and all transducers have zero offset error. Per- forming this type of digital calibration eliminates the zero offset error and automatically compensates for the different gain characteristics of each transducer.

NOTE:

You should be made aware that the low, and high calibration values that are displayed when calibrating a transducer are not the same as and should not be confused with the zero and full scale values used in the CHANNEL SETUP PROGRAM of the SET-UP MODE. Those values represent the low and high end of the bargraph scales.

The low and high calibration values that are displayed in this cali- bration routine represent the low and high values of the analog to digi- tal converter.

MODE DESCRIPTION

TIME SET

Choosing 5 from the main menu loads the time setting routines. Type
'5' and press 'ENTER'.

TIME: 17:30:00

DATE: WED, 07 JUN

HOLD ANY KEY TO SET TIME/DAT

OR

HOLD 'ENTER' IF DISPLAY OK

is displayed on the screen. Hold any key to begin.

TIME: 17:30:00

DATE: WED, 07 JUN

ENTER HOURS AND MINUTES AS
CURSOR DIRECTS, THEN HIT
ANY KEY TO RESET SECONDS = 0

is now displayed on the screen.

NOTE: The real time clock data displayed on your screen will be initial
values read by the real time clock and will not be the same as
that shown in this text.

NOTE: It should also be noted that the time must be set in 24 hour for-
mat. That is 1:00 PM is equal to 13:00; 3:00 PM is equal to
15:00; 5:30 PM is equal to 17:30 and 12:00 AM is equal to 00:00
Use the present time, day, month and date as an example.

Now set the hours. Type in the hours and press 'ENTER'. The cursor
moves to the minutes. Now type the minutes and press 'ENTER'. Notice
that after enter is pressed to set the minutes, the cursor disappears.
Now when you press any key, the seconds reset to zero and the clock
starts keeping time.

```
                TIME: 17:30:00

                DATE: WED, 07 JUN

        ENTER NO. OF THE DAY OF THE
                WEEK
                4

                SUN--1
                MON--2
                TUE--3
                WED--4
                THU--5
                FRI--6
              , SAT--7
```

is displayed on the screen. Type the number for the day of the week and press 'ENTER'.

```
                TIME: 17:30:00

                DATE: WED, 07 JUN

        ENTER NO. FOR MONTH OF
                THE YEAR
                06

                JAN--1
                FEB--2
                MAR--3
                APR--4
                MAY--5
                JUN--6
                JUL--7
                AUG--8
                SEP--9
                OCT-10
                NOV-11
                DEC-12
```

is displayed on the screen. Now type the number for the month and press 'ENTER'.

TIME: 17:30:00

DATE: WED, 07 JUN

ENTER DAY OF THE MONTH

07

is displayed on the screen. Type the day of the month and press 'ENTER'. The screen should now update and display the information that you have entered.

TIME: 17:30:00

. DATE: WED, 07 JUN

HOLD ANY KEY TO SET TIME/DAT

OR

HOLD 'ENTER' IF DISPLAY OK

is displayed on the screen.

If any data that was entered are incorrect, hold any key to start over. If all the data are correct, hold 'ENTER'. The main menu will return to the screen and the time, day and month will be set.

NOTE: Twenty-four (24) hour format is used ONLY in the time set mode. Twelve (12) hour format is used in the program mode in setting the time of day setpoints.

APPLICATION PROGRAMS

The application programs presented here are for those users who wish to use their programmable controller immediately without taking the time to READ THIS MANUAL. This impatience is understandable, however this user's manual contains information that should be read as soon as possible.

These programs were written very short and to the point so they could be entered FAST and with little or no thought. There is a program description that precedes each application program.

There are only two (2) requirements for entering these programs:

1. Always start from the main menu.

2. Follow the instructions at the beginning and at the end of the program carefully and enter the program EXACTLY line by line.

SPRINKLER CONTROL

DESCRIPTION:

The sprinkler control program presented here will control 4 water valves: water valve #1 through water valve #4. The valves are controlled by the real time clock and are programmed as follows:

Water Valve #1: ON at 5:30 AM; OFF at 5:40 AM
Water Valve #2: ON at 5:45 AM; OFF at 5:55 AM
Water Valve #3: ON at 6:00 AM; OFF at 6:10 AM
Water Valve #4: ON at 6:15 AM; OFF at 6:25 AM

The program is active 7 days a week, 12 months a year. The user may change the ON-OFF times or skip days of the week or months of the year to suit particular needs. The four water valves #1, #2, #3 and #4 use digital outputs #3, #4, #5 and #6 respectively.

NOTE:

Sprinkler solenoid valves are usually 24 volts AC. 120 Volt AC relays will have to be plugged into the interface unit (if used) to switch the 24 volts AC to the sprinkler valves. If the interface unit is not used, the 24 volts AC can be switched to the sprinkler valves with DC relays operated directly from the control card.

The operating voltage and current of the DC relays should not exceed the output drive capability of the control card.

5VDC to 24VDC relays drawing 40 to 80mA(milliAmp) or less are recommended.

SPRINKLER CONTROL
PROGRAM:

NOTE: When entering this program, you will get to some line numbers
(marked with an *) that give you a choice between ON or OFF logic. Pro-
gram the ON logic first. At the end of the program you will be directed
back to line number 22 to begin programming the OFF logic.

```
 1  Press ENTER (selects SET-UP mode)
 2  Press ENTER (selects CHANNEL SELECTION)
 3  Type D press ENTER (selects digital channels)
 4  Type O press ENTER (selects digital outputs)
 5  Type 3 press ENTER (selects channel #3)
 6  Type Water Valve #1 press ENTER (enters description)
 7  Press ENTER (selects digital channels)
 8  Press ENTER (selects digital outputs)
 9  Press ENTER (selects channel #4)
10  Type Water Valve #2 press ENTER (enters description)
11  Press ENTER (selects digital channels)
12  Press ENTER (selects digital outputs)
13  Press ENTER (selects channel #5)
14  Type Water Valve #3 press ENTER (enters description)
15  Press ENTER (selects digital channels)
16  Press ENTER (selects digital outputs)
17  Press ENTER (selects channel #6)
18  Type Water Valve #4 press ENTER (enters description)
19  Type ? press ENTER (returns to channel setup menu)
20  Type ? press ENTER (returns to main menu)
21  Type 2 press ENTER (selects PROGRAM mode)
22  Type 3 press ENTER (selects output channel #3)
*23 Press ENTER (selects ON logic) or
    type F press ENTER (selects OFF logic)
24  Type A press ENTER (selects logical AND)
25  Press ENTER (bypass analog setpoint)
26  Press ENTER (bypass digital setpoints)
27  Type Y press ENTER (selects time of day setpoints)
28  Type = press ENTER (selects time equal to)
29  Type 05 press ENTER (selects hour)
*30 Type 30 press ENTER (selects minutes for ON logic) or
    type 40 press ENTER (selects minutes for OFF logic)
31  Press ENTER (selects AM)
32  Type ? press ENTER (displays days of the week)
33  Type ? press ENTER (selects all the days of the week
                        and displays months of the year)
34  Type ? press ENTER (selects all the months of the year)
35  Press ENTER (bypass time delay program)
36  Press ENTER (selects channel #4)
*37 Press ENTER (selects ON logic) or
    type F press ENTER (selects OFF logic)
38  Type A press ENTER (selects logical AND)
39  Press ENTER (bypass analog setpoints)
40  Press ENTER (bypass digital setpoints)
```

```
 41  Type Y press ENTER (selects time of day setpoints)
 42  Type = press ENTER (selects time equal to)
 43  Type 05 press ENTER (selects hour)
*44  Type 45 press ENTER (selects minutes for ON logic) or
     type 55 press ENTER (selects minutes for OFF logic)
 45  Press ENTER (selects AM)
 46  Type ? press ENTER (displays days of the week)
 47  Type ? press ENTER (selects all the days of the week
                          and displays months of the year)
 48  Type ? press ENTER (selects all the months of the year)
 49  Press ENTER (bypass time delay program)
 50  Press ENTER (selects channel #5)
*51  Press ENTER (selects ON logic) or
     type F press ENTER (selects OFF logic)
 52  Type A press ENTER (selects logical AND)
 53  Press ENTER (bypass analog setpoints)
 54  Press ENTER (bypass digital setpoints)
 55  Type Y press ENTER (selects time of day setpoints)
 56  Type = press ENTER (selects time equal to)
 57  Type 06 press ENTER (selects hour)
*58  Press ENTER (selects minutes for ON logic) or
     type 10 press ENTER (selects minutes for OFF logic)
 59  Press ENTER (selects AM)
 60  Type ? press ENTER (displays days of the week)
 61  Type ? press ENTER (selects all the days of the week
                          and displays months of the year)
 62  Type ? press ENTER (selects all the months of the year)
 63  Press ENTER (bypass time delay program)
 64  Press ENTER (selects channel #6)
*65  Press ENTER (selects ON logic) or
     type F press ENTER (selects OFF logic)
 66  Type A press ENTER (selects logical AND)
 67  Press ENTER (bypass analog setpoints)
 68  Press ENTER (bypass digital setpoints)
 69  Type Y press ENTER (selects time of day setpoints)
 70  Type = press ENTER (selects time equal to)
 71  Type 06 press ENTER (selects hour)
*72  Type 15 press ENTER (selects minutes for ON logic) or
     type 25 press ENTER (selects minutes for OFF logic)
 73  Press ENTER (selects AM)
 74  Type ? press ENTER (displays days of the week)
 75  Type ? press ENTER (selects all the days of the week
                          and displays months of the year)
.76  Type ? press ENTER (selects all the months of the year) .
.77  Press ENTER (bypass time delay program)
```

To program the OFF logic, go back and begin at line number 22. When you get to the line numbers (marked with an *) that give you a choice for ON or OFF logic, choose the OFF logic.

The program ends at line number 77 after programming the OFF logic.

After entering line number 77, type '?' and press 'ENTER' to return to the main menu. Now you can type '3' and press 'ENTER' to run the program.

SWIMMING POOL HEAT CONTROL

DESCRIPTION:

The swimming pool heat control described here has the logic to turn the heater ON and OFF between two (2) temperature setpoints, at two (2) different times, and only on certain days of the week and certain months of the year.

Digital input #1 is used to override the time setpoints. It does not override the days of the week and months of the year that are skipped.

Digital input #2 is used to completely disable the heater regardless of the setpoints.

Analog channel #1 is used for the temperature transducer.

Digital output #1 controls the heater.

The program characteristics are as follows:

The heater is ON if the temperature < (is less than) 76 degrees. The heater is OFF if the temperature > (is greater than) 82 degrees.

The heater is allowed to turn ON from 7:00 AM to 1:00 PM and then will shut OFF.

The heater is allowed to turn ON again from 6:00 PM to 11:00 PM and then will shut OFF.

The heater is allowed to turn ON only on Fridays, Saturdays and Sundays; and only in the months of June, July, August, September and October.

Digital input #1 when ON (closed) will override the time setpoints.

Digital input #2 when ON (closed) will disable the heater completely.

The user may change the temperature setpoints, time setpoints and the days and months that are skipped to suit particular needs.

NOTE: A 120 volt AC relay may have to be plugged into the interface unit to obtain a "dry" set of contacts; that is a normally open contact with no voltage on either side. The dry contact can·then be wired into the heaters existing control circuit.

The contact should be wired in series with the control circuit and should not bypass any fail-safe circuits.

SWIMMING POOL HEAT CONTROL

PROGRAM:

NOTE: When entering this program, you will get to some line numbers
(marked with an *) that give you a choice between ON or OFF logic.
Program the ON logic first. At the end of the program you will be
directed back to line number 39 to begin programming the OFF logic.

```
 1  Press ENTER (selects set-up mode)
 2  Press ENTER (selects channel selection)
 3  Press ENTER (selects analog channels)
 4  Press ENTER (selects channel #1)
 5  Type SWIM POOL HEAT press ENTER (enters description)
 6  Type 32 press ENTER (enters zero scale value)
 7  Type 100 press ENTER (enters full scale value)
 8  Type DEGS. press ENTER (enters units)
 9  Type D press ENTER (selects digital channels)
10  Press ENTER (selects digital inputs)
11  Press ENTER (selects channel #1)
12  Type TIME OVERRIDE press ENTER (enters description)
13  Press ENTER (selects digital channels)
14  Press ENTER (selects digital inputs)
15  Press ENTER (selects channel #2)
16  Type POOL HEAT OFF press ENTER (enters description)
17  Press ENTER (selects digital channels)
18  Type 0 press ENTER (selects digital outputs)
19  Press ENTER (selects channel #1)
20  Type HEATER CONTROL press ENTER (enters description)
21  Press ENTER (selects digital channels)
22  Press ENTER (selects digital outputs)
23  Type 9 press ENTER (selects channel #9)
24  Type TIME STATUS press ENTER (enters description)
25  Press ENTER (selects digital channels)
26  Press ENTER (selects digital outputs)
27  Press ENTER (selects channel #10)
28  Type STATUS DO9&DI1 press ENTER (enters description)
29  Type ? press ENTER (returns to channel setup menu)
30  Type 2 press ENTER (selects setpoint program)
31  Press ENTER (selects analog channel #1)
32  Type < press ENTER (selects less than)
33  Type 76 press ENTER (selects ON temperature)
34  Type 82 press ENTER (selects OFF temperature)
35  Type ? press ENTER (returns to setpoint mode menu)
36  Type ? press ENTER (returns to channel setup menu)
37  Type ? press ENTER (returns to main menu)
38  Type 2 press ENTER (selects program mode)
39  Type 01 press ENTER (selects output channel #1)
*40  Press ENTER (selects ON logic) or
     type F press ENTER (selects OFF logic)
*41  Type A press ENTER (selects logical AND for ON logic) or
     type 0 press ENTER (selects logical OR for OFF logic)
42  Type Y press ENTER (selects edit analog setpoints)
43  Type 1 press ENTER (selects analog channel #1)
```

```
 44   Type 1 press ENTER (selects setpoint #1)
*45   Type N press ENTER (selects setpoint for ON logic) or
      press ENTER (selects setpoint for OFF logic)
 46   Type ? press ENTER (displays edit digital setpoint program)
 47   Type Y press ENTER (selects edit digital setpoints)
 48   Press ENTER (selects digital inputs)
 49   Type 2 press ENTER (selects digital input #2)
*50   Press ENTER (selects setpoint for ON logic) or
      type N press ENTER (selects setpoint for OFF logic)
 51   Type ? press ENTER (displays digital IN or OUT)
 52   Type O press ENTER (selects digital outputs)
 53   Type 10 press ENTER (selects output channel #10)
*54   Type N press ENTER (selects setpoint for ON logic) or
      press ENTER (selects setpoint for OFF logic)
 55   Type ? press ENTER (displays time/day/month)
 56   Press ENTER (bypass time/day/month program)
 57   Press ENTER (bypass time delay program and return to program mode menu)
 58   Type 9 press ENTER (selects digital output #9)
*59   Press ENTER (selects ON logic) or
      type F press ENTER (selects OFF logic)
 60   Type A press ENTER (selects logical AND)
 61   Press ENTER (bypass analog setpoints)
 62   Press ENTER (bypass digital setpoints)
 63   Type Y press ENTER (selects time/day/month program)
 64   Type = press ENTER (selects time equal to)
*65   Type 07 press ENTER (selects hour for ON logic) or
      type 01 press ENTER (selects hour for OFF logic)
 66   Press ENTER (selects minutes)
*67   Press ENTER (selects AM for ON logic) or
      type P press ENTER (selects PM for OFF logic)
 68   Type = press ENTER (selects time equal to)
*69   Type 06 press ENTER (selects hour for ON logic) or
      type 11 press ENTER (selects hour for OFF logic)
 70   Press ENTER (selects minutes)
 71   Type P press ENTER (selects PM for ON and OFF logic)
 72   Type ? press ENTER (displays days of the week)
 73   Press ENTER (selects Sunday for ON and OFF logic)
*74   Type N press ENTER (omits Monday for ON logic) or
      press ENTER (selects Monday for OFF logic)
*75   Type N press ENTER (omits Tuesday for ON logic) or
      press ENTER (selects Tuesday for OFF logic)
*76   Type N press ENTER (omits Wednesday for ON logic) or
      press ENTER (selects Wednesday for OFF logic)
*77   Type N press ENTER (omits Thursday for ON logic) or
      press ENTER (selects Thursday for OFF logic)
 78   Press ENTER (selects Friday for ON and OFF logic)
 79   Press ENTER (selects Saturday for ON and OFF logic)
*80   Type N press ENTER (omits January for ON logic) or
      press ENTER (selects January for OFF logic)
*81   Type N press ENTER (omits February for ON logic) or
      press ENTER (selects February for OFF logic)
*82   Type N press ENTER (omits March for ON logic) or
      press ENTER (selects March for OFF logic)
```

```
*83   Type N press ENTER (omits April for ON logic) or
      press ENTER (selects April for OFF logic)
*84   Type N press ENTER (omits May for ON logic) or
      press ENTER (selects May for OFF logic)
 85   Press ENTER (selects June for ON and OFF logic)
 86   Press ENTER (selects July for ON and OFF logic)
 87   Press ENTER (selects August for ON and OFF logic)
 88   Press ENTER (selects September for ON and OFF logic)
 89   Press ENTER (selects October for ON and OFF logic)
*90   Type N press ENTER (omits November for ON logic) or
      press ENTER (selects November for OFF logic)
*91   Type N press ENTER (omits December for ON logic) or
      press ENTER (selects December for OFF logic)
 92   Press ENTER (bypass time delay)
 93   Press ENTER (selects digital output #10)
*94   Press ENTER (selects ON logic) or
      type F press ENTER (selects OFF logic)
*95   Type O press ENTER (selects logical OR for ON logic) or
      type A press ENTER (selects logical AND for OFF logic)
 96   Press ENTER (bypass analog setpoints)
 97   Type Y press ENTER (selects digital setpoints)
 98   Press ENTER (selects digital inputs)
 99   Type 1 press ENTER (selects digital input #1)
*100  Type N press ENTER (selects setpoint for ON logic) or
      press ENTER (selects setpoint for OFF logic)
 101  Type ? press ENTER (displays digital in or out)
 102  Type O press ENTER (selects digital outputs)
 103  Type 09 press ENTER (selects output channel #9)
*104  Type N press ENTER (selects setpoint for ON logic) or
      press ENTER (selects setpoint for OFF logic)
 105  Type ? press ENTER (displays edit time/day/month)
 106  Press ENTER (bypass time/day/month program)
 107  Press ENTER (bypass time delay program and return to program mode menu)
```

To program the OFF logic, go back and begin at line number 39. When you get to the line numbers (marked with an *) that give you a choice for ON or OFF logic, choose the OFF logic.

The program ends at line number 107 after programming the OFF logic.

After entering line number 107, type a '?' and press 'ENTER' to return to the main menu. Now you can type '3' and press 'ENTER' to run the program.
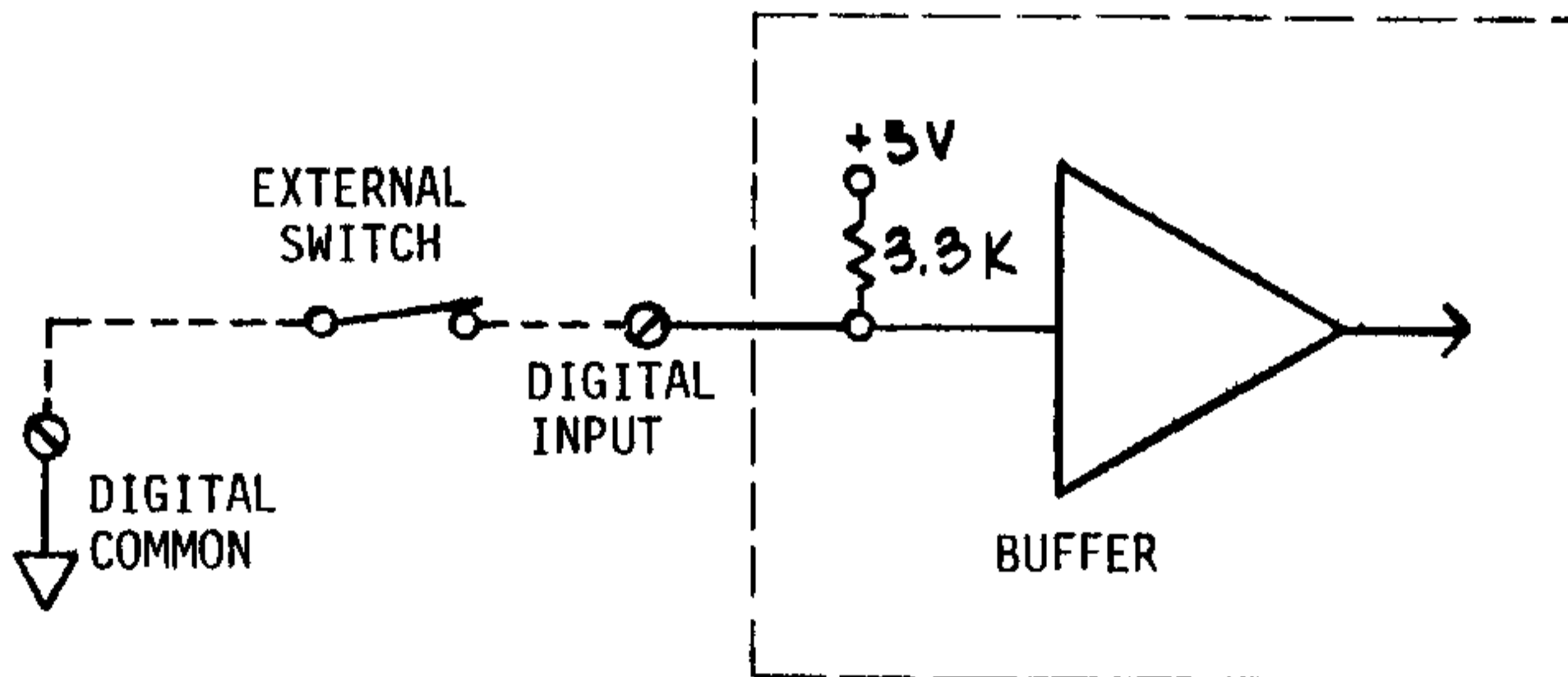
APPENDIX A

CONTROL CARD-40 PIN I/O CONNECTOR

PIN		PIN	
1	+5VDC	21	Digital Input #1
2	+5VDC	22	Digital Input #2
3	Analog Ch. #1 Common -	23	Digital Input #3
4	Analog Ch. #1 Signal +	24	Digital Input #4
5	Analog Ch. #2 Common -	25	Digital Input #5
6	Analog Ch. #2 Signal +	26	Digital Input #6
7	Analog Ch. #3 Common -	27	Digital Input #7
8	Analog Ch. #3 Signal +	28	Digital Input #8
9	Analog Ch. #4 Common -	29	Digital Output #1
10	Analog Ch. #4 Signal +	30	Digital Output #2
11	Analog Ch. #5 Common -	31	Digital Output #3
12	Analog Ch. #5 Signal +	32	Digital Output #4
13	Analog Ch. #6 Common -	33	Digital Output #5
14	Analog Ch. #6 Signal +	34	Digital Output #6
15	Analog Ch. #7 Common -	35	Digital Output #7
16	Analog Ch. #7 Signal +	36	Digital Output #8
17	Analog Ch. #8 Common -	37	+16 VDC UNREG
18	Analog Ch. #8 Signal +	38	+16 VDC UNREG
19	Digital Common	39	+ 8 VDC UNREG
20	Digital Common	40	+ 8 VDC UNREG

APPENDIX A

0-5VDC

ANALOG
INPUT

$22 \mu f$
10 V

*250
OHM

ANALOG
SWITCHES

8

COMPARATOR
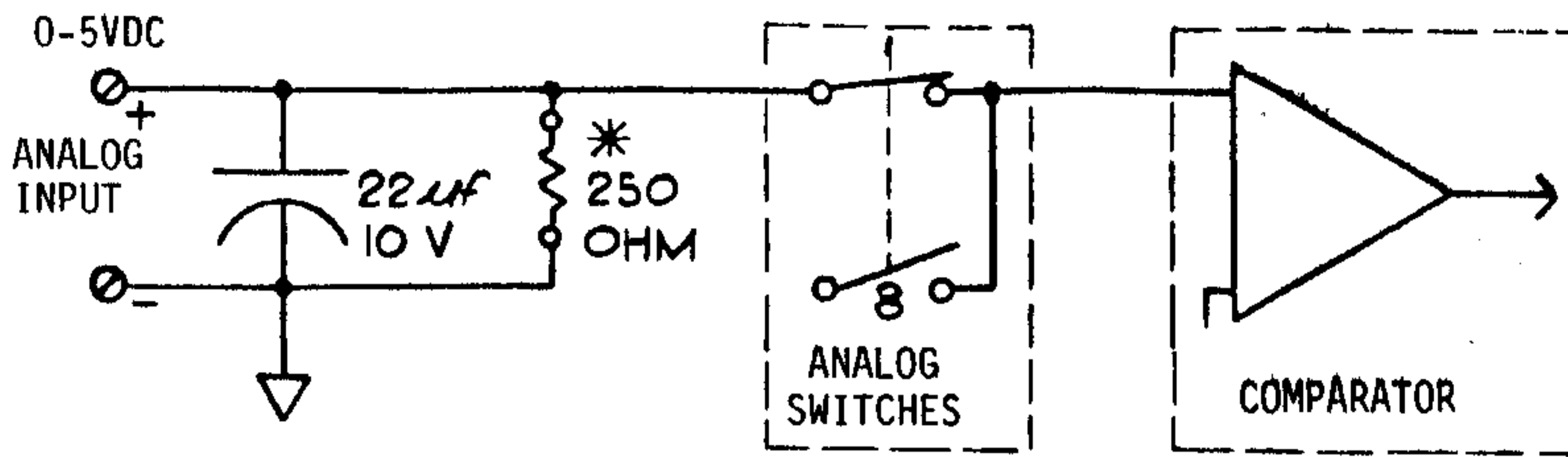
*250 ohm resistor is used for 4 to 20 mA inputs

TYPICAL ANALOG INPUT

EXTERNAL
SWITCH

+5V

3.3K

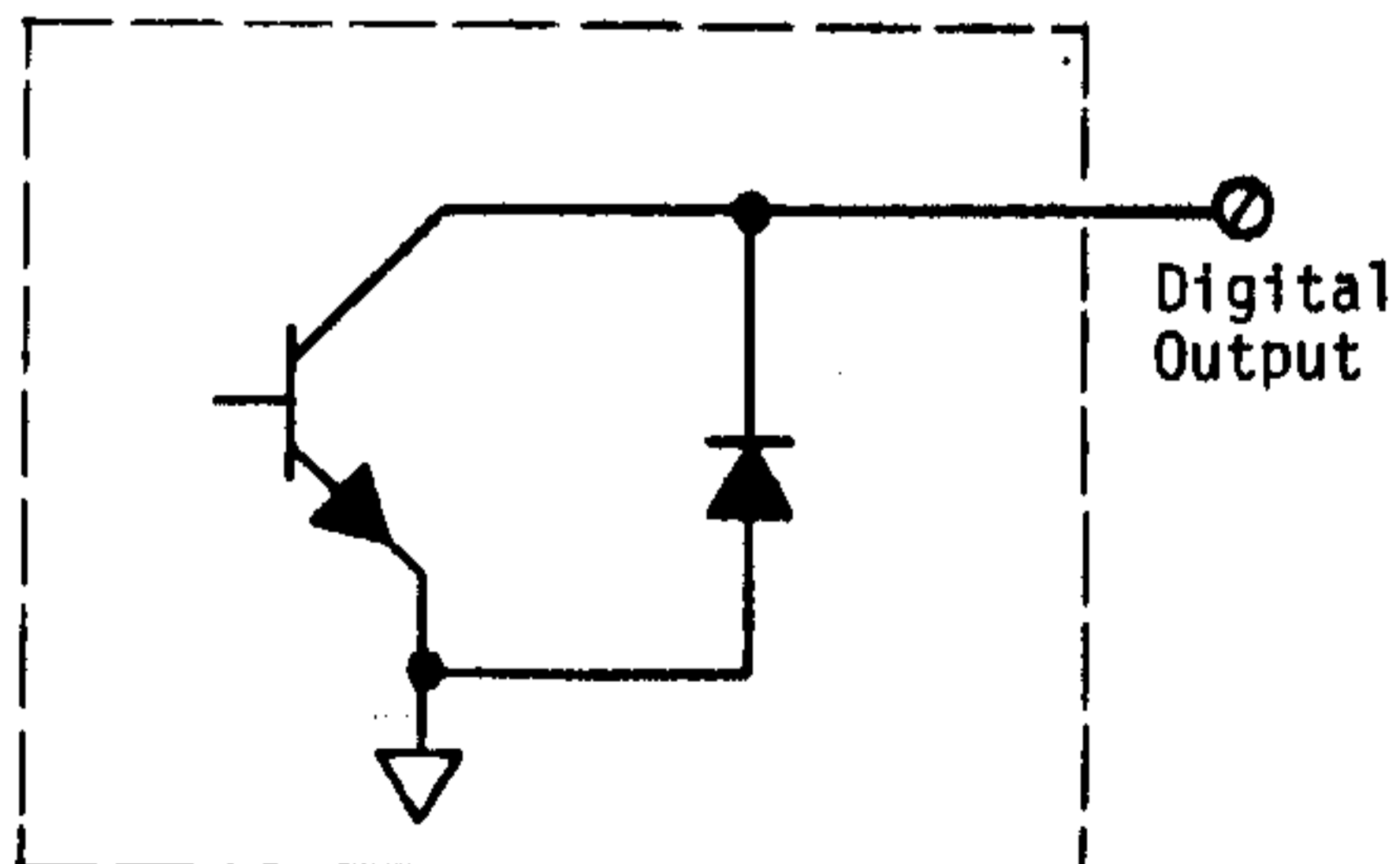DIGITAL
INPUT

DIGITAL
COMMON

BUFFER

External Switch Closed = ON (Logic Low)
External Switch Open   = OFF (Logic High)

TYPICAL DIGITAL INPUT

TYPICAL DIGITAL OUTPUT
(Open Collector)

MAXIMUM RATING:
150mADC at 50VDC

Digital
Output

46

APPENDIX B

CONNECTING ANALOG TRANSDUCERS TO THE INTERFACE UNIT

Analog transducers used with the FIRST ADE™ system must adhere to the following specifications:

OUTPUT SIGNAL: 0 to 5VDC or 4 to 20mA(milliAmp)DC (SEE NOTE 1)
SUPPLY VOLTAGE: 7VDC to 12VDC (SEE NOTE 2)
SUPPLY CURRENT: 12mA(milliAmp)DC MAXIMUM (SEE NOTE 2)
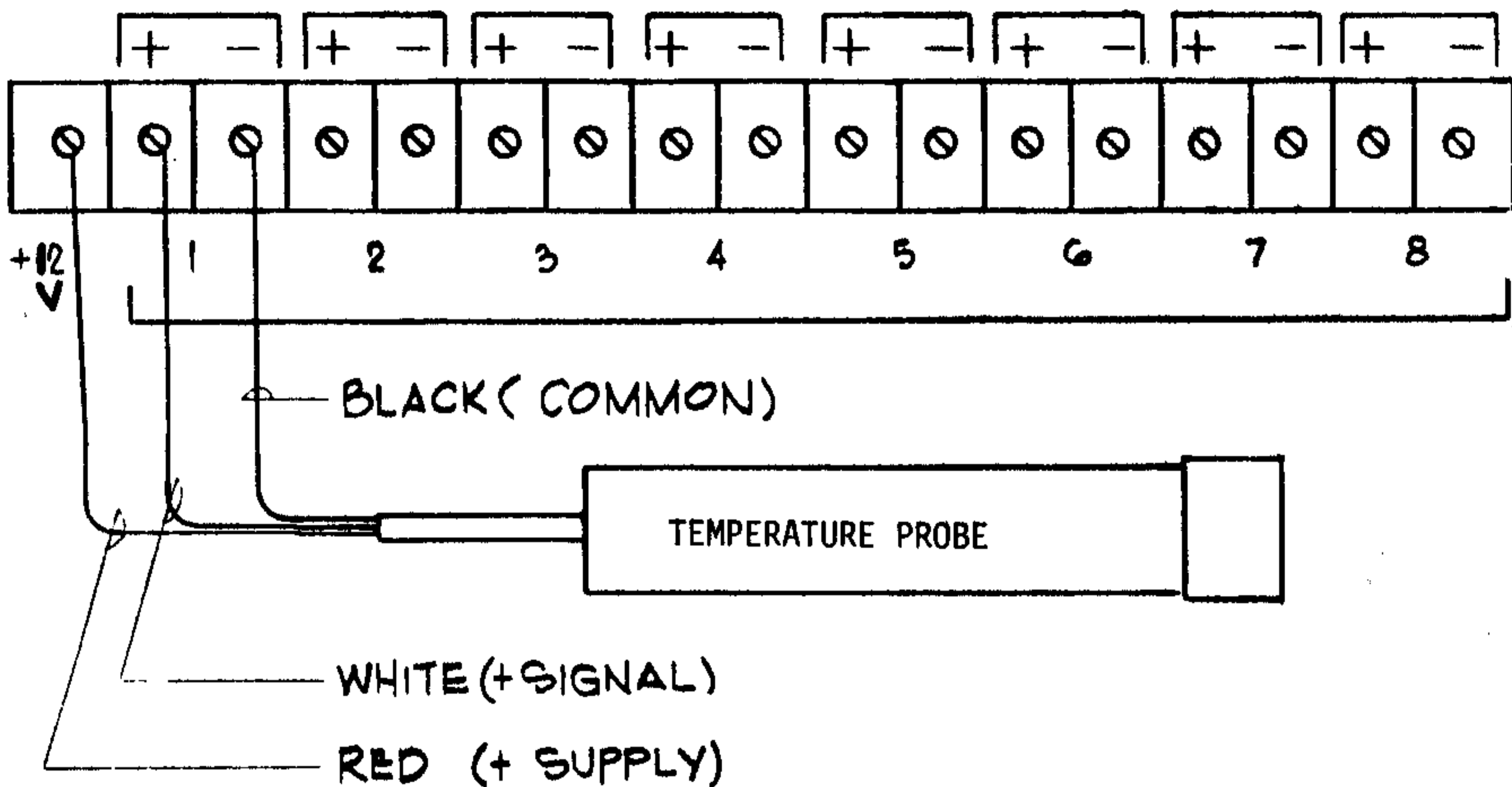OUTPUT IMPEDANCE: 250 Ohms or less

ANALOG INPUT

FIGURE 3

Figure 3 is a connection diagram of an analog transducer whose supply voltage and current are obtained directly from the control card.

NOTE 1: See page 7 figure 2 for details on changing the standard 0 to 5VDC analog input to a 4 to 20 mADC analog input.

NOTE 2: These restrictions apply only when the transducers obtain their supply voltage and current from the control card. Transducers having their own power supply or using an external power supply need not adhere to these restrictions.
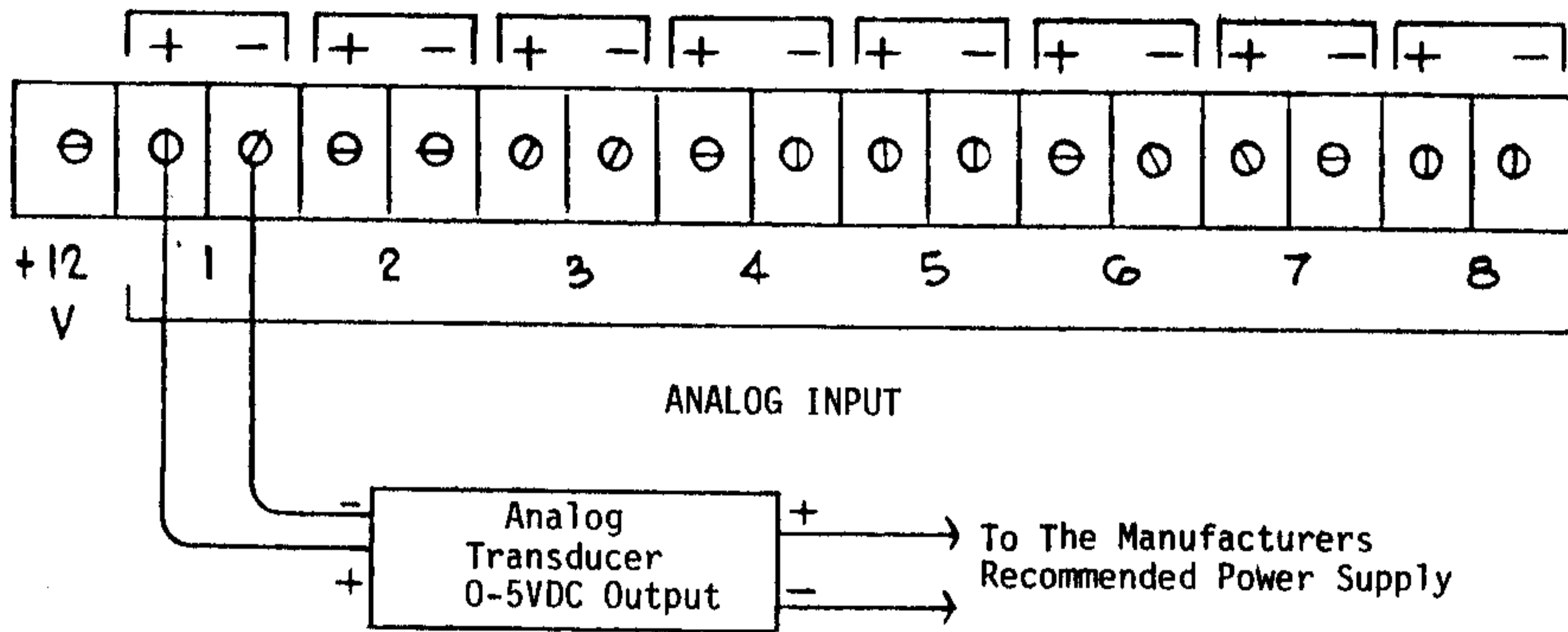
FIGURE 4

Figure 4 is a connection diagram of an analog transducer whose output signal is 0 to 5VDC. This transducer obtains its supply voltage and current from an external power supply.

The power supply used should be one that is recommended by the transducer manufacturer. The + (positive) side of the transducers output is connected to the + terminal of the analog channel being used (channel 1 in figure 4). The - (negative) side of the transducers output is connected to the - terminal of the analog channel being used.
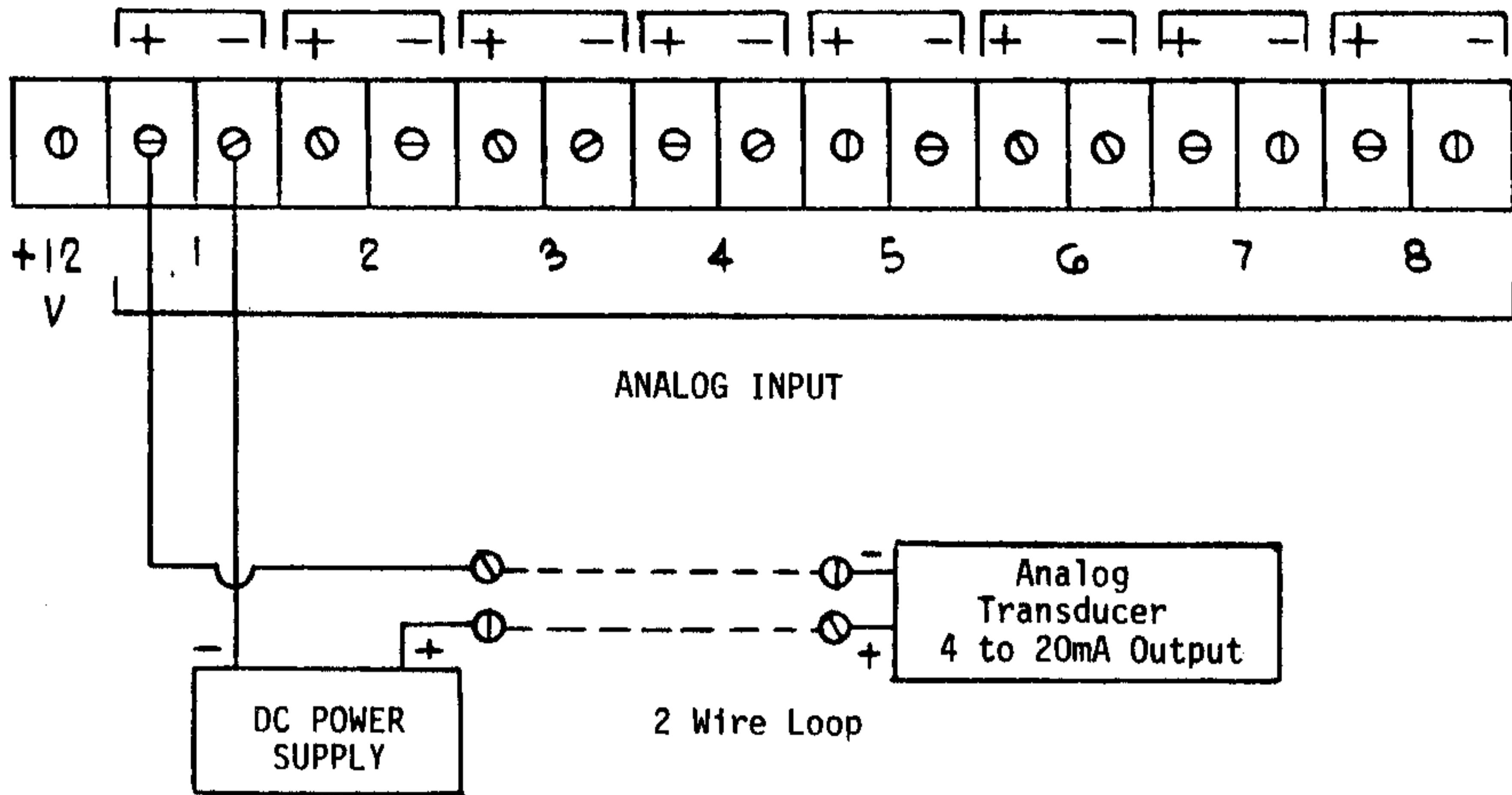
Figure 5

Figure 5 is a typical connection diagram of an analog transducer with a 4 to 20 mA output signal. This type of transducer connected as shown is also known as a 2 wire transmitter. This is because the transducer can be located a mile or more away and transmit the 4 to 20 mA signal back to the control card over 2 wires. The loop resistance from the power supply to the transducer and back can generally be up to 500 ohms. Varying the loop resistance does not affect the 4 to 20 mA signal because the transducers have a compensating constant current source. These types of transducers are usually quite expensive. The power supply used should be one that is recommended by the transducer manufacturer. The supply voltage is generally a regulated 24 VDC.

SPECIFICATIONS

SOFTWARE FEATURES

o SETUP - Eight (8) Analog Setpoints per analog channel. All analog and digital channel titles are user entered and easily changed.

o PROGRAM - User programming is menu driven and very friendly. User responds to prompts displayed on screen.

o LOGIC SYSTEM - AND/OR logic functions. Separate ON and OFF logic setups for digital outputs. Four (4) Analog Setpoints per digital output. Eight (8) internal status outputs store intermediate logic results.

o TIMED FUNCTIONS - Eight (8) Real Time Clock setpoints. User selects time, day of week and month for outputs to be active. Time delay functions use absolute time from real time clock or elapsed time from an event. Time Delay range: 10 seconds to 12 hours.

o CALIBRATION - Analog transducers are digitally calibrated. User enters HIGH and LOW calibration values in engineering units.

CONTROL CARD FEATURES

o EIGHT (8) ANALOG INPUTS - Eight bit A/D. User configurable for 0-5VDC or 4 to 20 mADC. Total error (offset, full-scale, linearity, and multiplexer errors) < 1 LSB. Offset and full-scale errors eliminated with digital calibration.

o EIGHT DIGITAL INPUTS - TTL - CMOS - Dry Relay Contact compatible.

o EIGHT DIGITAL OUTPUTS - Can drive 150 mADC loads at up to 50VDC.

o REAL TIME CLOCK - Crystal controlled, .005% drift. Lithium battery backup for power down operation.

o TI COMPATIBLE - Gold plated edge connector. Compatible with TI's Peripheral Expansion Box. Power requirements: +7.5VDC to +11VDC at 0.500 AMPS. Operating ambient temperature 0°C to 70°C.

ACCESSORIES

o INTERFACE UNIT - Provides terminations for analog and digital inputs. Provides eight relay switched 120VAC, 6 AMP, output receptacles.

o INTERFACE CABLE - Interconnects control coard to interface unit.

o TEMPERATURE PROBES - 3 ranges available.

IN CASE OF DIFFICULTY

If the Control Card does not appear to work properly, check the following:

1. Make sure the computer and control card are not locked up. If this is the case, turn the computer off and reset the control card with the reset switch. (See page 7 figure 2 for details). NOTE: If the reset switch is left in the reset position, the control card will not function.

2. COMPUTER CONSOLE - Make sure the computer console works properly with all accessory devices disconnected.

3. PERIPHERAL EXPANSION BOX - Check the peripheral system and accessory cards as outlined in the Texas Instruments owner's manuals.

4. CONTROL CARD - Be sure that the FIRST ADE™ control card is firmly in place. (See page 3, inserting the control card and page 4 figure 1.)

5. INTERFACE UNIT - Be sure that the Interface Unit (if used), is properly connected (see page 4 figure 1 for details).

6. USER PROGRAM - If the difficulty is not corrected with any of the above procedures, check your program. The control card may appear not to work correctly if there are logic errors in the users program.

7. If the difficulty is still not corrected, the control card may require service. See page 54 for warranty information.

THREE-MONTH LIMITED WARRANTY

This Control Card and accessories are warranted for a period of three (3) months from the date of the original purchase.

THIS WARRANTY EXTENDS TO THE ORIGINAL PURCHASER ONLY AND IS NOT TRANSFERABLE.

WARRANTY COVERAGE:

This Control Card and accessories (HARDWARE) are warranted against defective materials or workmanship.

THIS WARRANTY IS VOID IF THE CONTROL CARD AND/OR ACCESSORIES HAVE BEEN DAMAGED BY ACCIDENT, ABUSE, UNREASONABLE USE, IMPROPER SERVICE, NEGLECT OR OTHER CAUSES NOT ARISING OUT OF DEFECTS IN MATERIALS OR WORKMANSHIP. THIS LIMITED WARRANTY DOES NOT EXTEND TO THE SOFTWARE (PROGRAMS) CONTAINED ON THE DISKETTE AND THE ACCOMPANYING BOOK MATERIALS. A/D ELECTRONICS MAKES NO WARRANTY, EITHER EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, REGARDING THE (HARDWARE) PROGRAMS CONTAINED ON THE DISKETTE AND THE ACCOMPANYING BOOK MATERIALS AND MAKES SUCH MATERIALS AVAILABLE SOLELY ON AN "AS IS" BASIS. IN NO EVENT SHALL A/D ELECTRONICS BE LIABLE TO ANYONE FOR SPECIAL, COLLATERAL, INCIDENTAL OR CONSEQUENTIAL COSTS, EXPENSES AND/OR DAMAGES INCURRED IN CONNECTION WITH OR ARISING OUT OF THE PURCHASE OR USE OF THE (HARDWARE), (PROGRAMS), AND/OR BOOK MATERIALS.

WARRANTY PERFORMANCE:

During the three-month warranty period, your Control Card or accessories will be repaired or replaced with a new or reconditioned unit of the same or equivalent model (at A/D ELECTRONICS' option) when the unit is returned by prepaid shipment to A/D ELECTRONICS listed below. Other than the postage and/or shipping costs, no charge will be made for the repair or replacement of in-warranty units. For out-of-warranty units, call A/D ELECTRONICS for current repair prices.

A/D ELECTRONICS recommends that the unit is insured for value, prior to shipment.

A/D ELECTRONICS
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