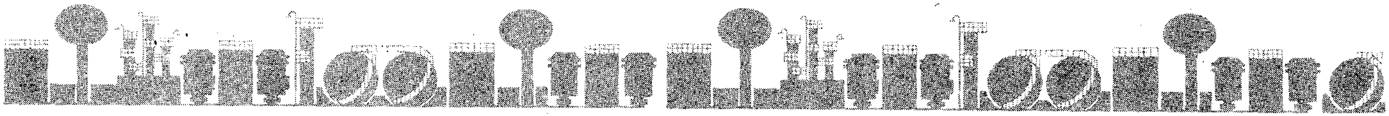

MODEL AI-1000

"Programmable" Temperature Transmitter

Operating Information

REV 9/92

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TABLE OF CONTENTS
AI-1000 PROGRAMMABLE TEMPERATURE TRANSMITTER

TABLE OF CONTENTS (CONTINUED)

TABLE OF CONTENTS (CONTINUED)

DESCRIPTION **PAGE**

LIST OF ILLUSTRATIONS

DESCRIPTION **PAGE**

INDEX

DESCRIPTION	PAGE
Accessories	2,3,4,35
Accuracy	1,33,36
Calibrate mV	14,23,31,32
Calibrate RTD	14,23,31,32
Calibrate Thermocouple	14,23,32,33
Display, Local	9,20
Keyboard & Display	9,20
Lead Resistance & Lead Length	6,29
Output Trim	16,27
Operate, Transmitter	8,9
Sensor Failsafe	15,26,29
Sensor Selection	13,21
Setup of Transmitter	11,19
Tap Mode Setup	11
Terminal Connections	5
Wiring Diagram	6

SECTION 1 INTRODUCTION

The AI-1000 is a programmable two wire, isolated temperature transmitter that accommodates any one of eight types of thermocouples, three types of RTD's, or millivolt input. The unit is precision linearized to the measured temperature over the entire usable range of the selected sensor. This transmitter is simple to set up and operates much like other high performance analog transmitters.

AI-1000 achieves its performance through the use of digital signal processing and microcontroller technologies. Many of the features, such as the automatic self calibration and the exceptional temperature stability, are transparent to the user. These features are active in the transmitter at all times.

The transmitter can also accept an optional smart local display, the LD-2, and a two key keyboard, the KB-2. These accessories facilitate local configuration and ranging of the transmitter. In operation, the local LCD display indicates the temperature and units of measurement to six digit resolution, an analog percent of range indication and also provides a seven character alphanumeric label or message indication.

This manual is divided into eight main sections. The first entitled "INTRODUCTION" describes briefly the transmitter and the organization of this manual. Section two deals with UNPACKING AND INSTALLATION. TRANSMITTER OPERATION of the transmitter is covered in section three. The next two sections deal with the CONFIGURATION of the transmitter in THE TAP MODE and the DISPLAY MODE. Section six contains additional applications information which can be useful when setting up the transmitter for a specific application. Section seven lists available accessories and eight deals with the specifications for the transmitter.

The AI-1000 temperature transmitter does not have any potentiometers or switches to set, and there are no user serviceable components inside the enclosure. Opening the enclosure will void the manufacturer's warranty. This transmitter can be reconfigured and re-ranged in the field using either one of the two methods as indicated below.

Tap Mode Setup   Display & Keyboard Setup

The Tap Mode requires no special options, and makes it possible to reconfigure and re-range the transmitter out in the field using just a calibrator and a milliammeter.

The Display and Keyboard are inexpensive options that are available and provide an exceptionally easy method of reconfiguring and re-ranging the transmitter. No calibrator and no other tools are required.

SECTION 2 UNPACKING AND INSTALLATION

2.1 UNPACKING

Remove the Packing List to check off the actual equipment received. If you have any questions on your shipment, please call ACCUTECH Customer Service Department at (508) 568 0500. Upon receipt of shipment, inspect the container for any signs of damage in transit. Especially take note of any evidence of rough handling. Report any apparent damage immediately to the shipping agent.

NOTE

The carrier will not honor any claims unless all shipping material is saved for their examination. After examining and removing the contents, save the packing material and carton in the event reshipment is necessary.

2.2 MECHANICAL INSTALLATION

2.2.1 Weather Proof Housing

Optional weather proof and explosion proof housings are available. The XP-HDC2-L accommodates a transmitter when the display option is not required. The XP-HDGC2-L, with its glass window, is used when the display option is desired. These housings have appropriate mounting plates in the bottom to attach the AI-1000 in any of four orientations 90° apart. In addition special captive 6-32 machine screws are installed on the transmitter to facilitate installation and removal. These captive screws are installed only if the transmitter and housing are ordered at the same time. Figure 2-1 indicates the dimensions of these housings.

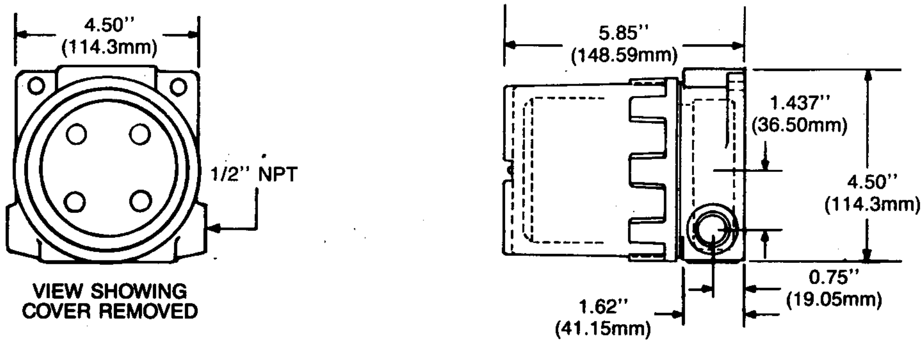


Figure 2-1
Optional Weather Proof Housing

2.2.2 Thermowell Mounting

When the transmitter is mounted in either of the optional weather proof housings, this housing can be attached directly to a an RTD or thermocouple in a thermowell. The weatherproof housing has two 1/2" female NPT conduit entries. One of these can be used to mount directly onto a 1/2" male NPT extension of an RTD or thermocouple. Alternatively, a 1/2" union coupling can be placed between the weatherproof housing and the temperature sensor.

2.2.3 Pipe Mounting

A stainless steel bracket, the PB-2, is available for mounting the weatherproof housing onto any 2" pipe in any of four orientations. The housing is attached to the bracket as shown in Figure 2-2.

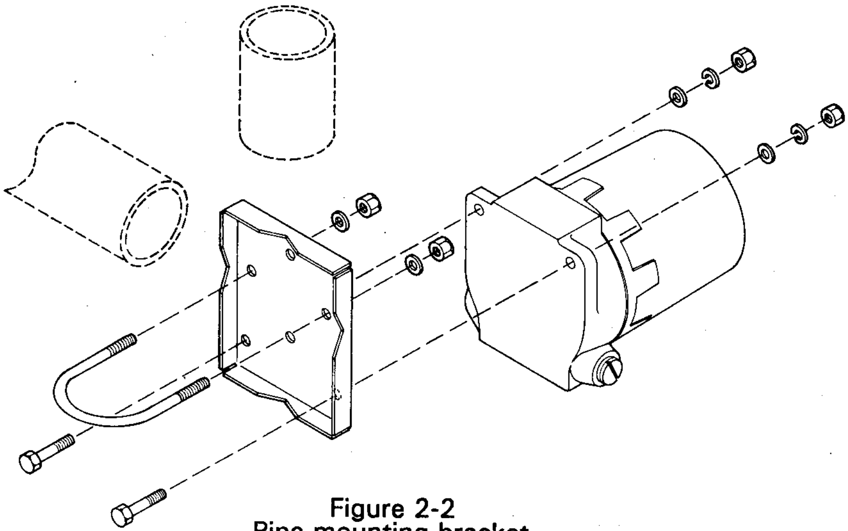


Figure 2-2
Pipe mounting bracket

2.2.4 Surface Mounting

The weatherproof housings, type XPHDC2-L and the XP-HDGC2-L, have two mounting ears allowing them to be attached to any flat surface by means of two bolts. If the additional weather resistance is not required, the AI-1000 can be mounted directly on a flat surface by the two mounting ears found on these units.

2.3 ELECTRICAL INSTALLATION

The AI-1000 has three groups of terminals. Terminals 8 and 9 are the 4 to 20mA output terminals. These are normally connected to the corresponding polarity terminals of the power supply of the current loop. Refer to figure 2-3 for the arrangement of the terminal connections.

Terminal 7 is used to ground the enclosure.

Terminals 3, 4, 5, and 6 are used in various connections to accommodate the different sensors and millivolt input.

Terminals 1 and 2, also serve as the mounting screw locations for the LCD display. These terminals, designated as SET 1 and SET 2, in conjunction with terminal 5 as common, are used for set-up, configuration and trim purposes as described under TAP MODE. The SET1 and SET2 terminals are marked as such and are located near the upper left and upper right areas of the transmitter cover. There is a slanted line pointing directly from the word SET1 towards the corresponding terminal inside a round black insulating area. The SET2 terminal can be found similarly on the right hand side of the transmitter.

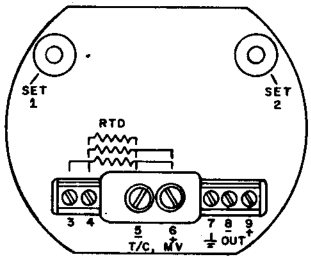


Figure 2-3
Terminal connections

2.3.1 Output Terminals

The output terminals, 8 & 9, are connected generally to a power supply having a nominal 24 Volt DC voltage and capable of supplying 21mA for the AI-1000. The +OUT and -OUT terminals of the transmitter are connected to the corresponding polarity terminals of the power supply. Optionally a load resistor, typically 250 ohms, may be connected in series with either terminal of the transmitter. Figure 3-1 shows a typical connection of the AI-1000 to the current loop.

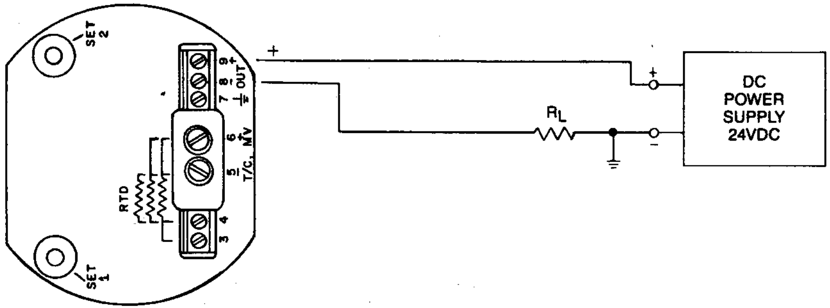


Figure 3-1
Typical Connection to the Current Loop

The maximum series resistance in the circuit (including wiring lead resistance) can be calculated using the formula:

$$Rs = \frac{Vs - 12}{0.021}$$

The following chart gives maximum series resistances:

Supply Voltage Vs	Max. Series Resistance Rs
42.0 Volts	1428 ohms
24.0 Volts	570 ohms
21.6 Volts	447 ohms
18.0 Volts	250 ohms
12.0 Volts	0 ohms

2.3.2 Case Ground

Terminal 7 provides a connection to the metal enclosure of the transmitter. For safety, optimum performance and EMI immunity the case of the instrument should be connected to a good local earth ground. When using grounded sensors which are connected to the local electrical ground, then the transmitter case should be connected to that same ground point.

2.3.3 Input Terminals

2.3.3.1 Millivolt and Thermocouple Input

Apply signal to 5(-) & 6(+).

2.3.3.2 Two wire RTD Input

Connect sensor to 4 & 5.

2.3.3.3 Three Wire RTD Input

Connect high sensor lead to 4 and the two low sensor leads to 5 and 6. High refers to the lead coming from one end of the RTD element, and low refers to the two leads coming from the other end of the RTD element.

2.3.3.4 Four Wire RTD Input

Connect the two high sensor leads to 3 & 4, and low sensor leads to 5 & 6. A four wire RTD has two leads coming from each end of the RTD element.

SECTION 3 TRANSMITTER OPERATION

3.1 IN A HURRY?

When in a hurry, these short set of instructions and references will help get the transmitter running.

3.1.1 Factory Configuration

Type J thermocouple,	Analog output
4.00mA	= 40 degree F
20.00mA	= 200 degree F
Sensor Failsafe	= 21.00mA

On special request the factory will set the transmitter to any desired configuration. Special configurations are identified on a tag attached to the unit.

3.1.2 Operation Without a Display

If the unit was ordered with the standard factory configuration the sensor required is a Type J thermocouple. The packing slip should indicate if the unit was set up to any other customer requested special configuration. If there is a need to change the configuration of the transmitter, or to re-range it, refer to the procedures described in SECTIONS 4 & 5. Even when "In a Hurry", the use of an appropriate power supply is important. A 24V DC supply having a current handling capacity of at least 0.021A is commonly used. Do not use a power supply whose output voltage drops to 20 volts or below when a 0.021 ampere load is connected to it. Always use a DC (direct current) supply, or suitable size battery. *Never connect the transmitter directly to 115VAC.*

With the power supply off, connect the + side of the power supply to the +OUT (9) terminal of the transmitter. Connect the - side of the power supply to the -OUT (8) terminal of the transmitter. Optionally a resistor, typically 250 ohms, may be added in series with either lead. See figure 3-1.

Connect a type J thermocouple to the inputs.

Thermocouple high (+IN) (6)
Thermocouple low (-IN) (5)

To connect other sensors to the input refer to paragraphs 2.3.3 for the proper sensor connections.

The output can be monitored by connecting a milliammeter in series with either of the two output terminals, or by connecting a high impedance voltmeter across the 250 ohm resistor. Now turn on the power supply. In about 5 seconds the AI-1000 loop current will settle to its normal value in the range of 4 to 20mA (Unless the input terminals are open, in which case the output current will be 21.00mA). Note that for a type J thermocouple 4.0mA=40°F and each additional 10°F increases the current by 1.0mA

3.1.3 Operation With Display

If the transmitter was ordered with the display option it will have a small local LCD display module plugged in and attached to the top of the unit. The display option can be ordered already installed on the AI-1000 transmitter. Having the display option as part of the transmitter does not affect its operation in the analog mode and the description of the previous section applies.

However, the display option does provide some very useful local indication of the measured temperature and other diagnostic functions. The figure below indicates the arrangement of the display screen and some of the symbols that are available.

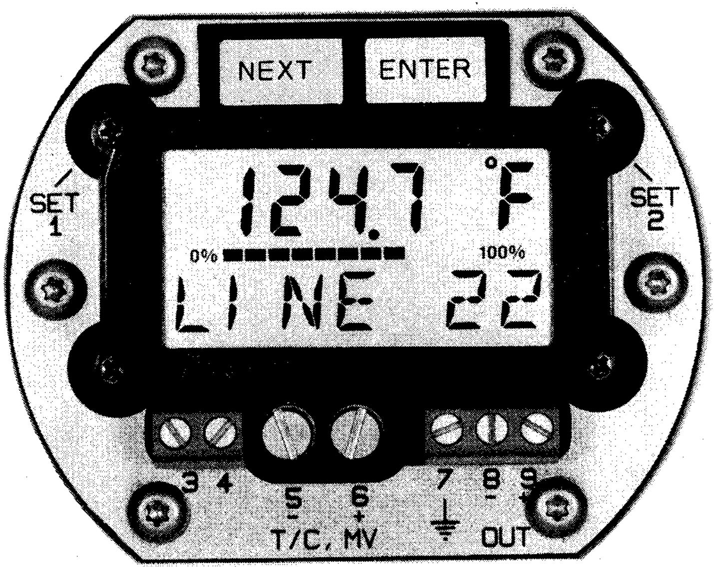


Figure 3-2
Appearance of the Local Display, LD-2

In operation the top row displays the measured temperature, the units of measurement, and a - sign if applicable. Temperature is displayed to 0.1° resolution and millivolt to 0.01mV resolution. The mid portion is an analog bar graph display showing the % of range based on the ZERO and FULL SCALE setting of the transmitter. When power is applied the leftmost segment of the bar graph, the 0% and the 100% become energized. If the measured temperature is below what the ZERO is set to, then the left arrow is energized. If the measured temperature is above the FULL SCALE setting, then the right arrow becomes energized.

The bottom portion of the LCD is capable of displaying alphanumeric messages. In normal operation this row shows a label, which is factory set to display AI-1000. In the event of a sensor failure, the indication changes to

S FAULT

In the event of certain transmitter failure modes the indication changes to

X FAULT

This LCD display takes full advantage of the precision of these transmitters. The digital display of measurement does not include the small D/A error otherwise present in the analog output. It provides highly accurate local indication of the measurement, local fault diagnostics, and transmitter identification. The LCD continues to display the measured temperature even if it is beyond the zero and span limits set for the analog output. The value of this display as a set-up, calibration and reconfiguration tool may even be greater, as will be seen in later chapters.

SECTION 4 CONFIGURATION, THE TAP MODE

4.1 Overview And Tools Required

With the TAP Mode, reconfiguration of the transmitter is accomplished by momentarily shorting of either the SET1 or the SET2 terminals to terminal (5) with a jumper wire and observing as the output current changes in 0.5mA increments after each operation. The simple flow diagram on the centerfold page indicates the options that can be selected or operation performed and the steps required to get there. In the following description, references to "short SET1" or "short SET2" mean shorting of the SET1 to terminal (5), or shorting of the SET2 to terminal (5).

The transmitter is connected as normally with its +OUT and -OUT terminals to the corresponding polarity terminals of the power supply, but with the milliammeter in series to indicate the output current. A load resistor, typically 250 ohms, may be used, but is not required.

The tools required to change sensors or otherwise change the configuration consist of 1) a jumper wire, 2) a milliammeter with a full scale range of 25 to 50mA, and 3) a 24 VDC power supply. To set the Zero and Span an additional calibrated and stable millivolt source, or a thermocouple simulator is also required.

4.2 Timing of Inputs

When shorting the SET1 and (5) terminals, or the SET2 and (5) terminals the connection should be held a minimum of one second, but can be held indefinitely or until the expected change in output current has occurred. Subsequently removing this short does not produce any further action. Repeated reconnection of the SET1 and (5) terminals will cause the output current to change as indicated in the flowchart on the centerfold page.

4.3 Selecting the Function

As seen in the flowchart on the centerfold page, the reconfiguration process is started by shorting the SET1 terminal. This causes the output current, to change to Iout=21.00 mA indicating that the transmitter has entered the main menu. Each subsequent shorting action of the SET1 terminal will sequence the unit to the next function through the main menu, as the arrow in the left portion of the flow diagram indicates. The milliammeter reading, Iout, confirms each new selection. When the output current reaches Iout=16.00 mA the next shorting of the SET1 terminal starts the main menu over again at Iout=19.50 mA. Sequencing through the main menu selections does not change the configuration or calibration of the transmitter and, if desired, the transmitter can be returned to the operate mode from the main menu through either one of the two methods described below. Once the desired main menu function is reached, a momentary shorting of the SET2 terminal will select that function.

4.3.1 Getting In; Iout=21.0mA

As was just described in reference to the flow chart, the first time the SET1 terminal is shorted, the main loop of the chart is entered at the top left corner. Subsequent shorting of the SET1 terminal sequences down the main loop on the left side of the chart. CAUTION! JUST AFTER FIRST SHORTING OF THE SET 1 TERMINAL, WHEN THE LOOP CURRENT BECOMES 21.0mA, DO NOT SHORT THE SET 2 TERMINAL, BUT INSTEAD SHORT SET 1 A SECOND TIME! SHORTING SET 2 AT THIS TIME CAUSES THE TRANSMITTER TO ENTER THE DISPLAY/KEYBOARD SET-UP MODE, AND THEN FURTHER SHORTING OF THE SET 1 AND SET 2 TERMINALS NO LONGER FOLLOWS THE TAP MODE FLOW CHART.

4.3.2 Getting Out; Iout=16.0mA

When reaching the last position on the bottom of the chart, signified by Iout=16.0mA of loop current, a shorting of the SET2 terminal returns the transmitter to its normal operating mode.

One can also abort the set up procedure by simply turning off the loop power for about 30 seconds and then turning it back on again.

It is also possible to just do nothing for about 2 1/2 minutes after entering the setup menu. After this period of time the transmitter simply returns to its previous operating mode.

4.3.3 Select Sensor Type; Iout=19.5mA

This function is used to set the desired type of sensor. Sensor selection should always be done before setting the zero or the span. After reaching the corresponding main menu selection, short the SET2 terminal momentarily. The output current will change to a level corresponding to the existing sensor selection as seen on the right hand portion of the flowchart. Each subsequent shorting of SET1 advances in the sub menu to the next sensor selection as indicated by the arrow. The output current follows these selection steps as a confirmation of the selection. After the desired sensor has been selected, a second shorting of the SET2 terminal reconfigures the unit to the new sensor and returns it to the corresponding main menu selection with the output current, Iout=19.50 mA, as a confirmation.

4.3.4 Set Output Zero; Iout=19.0mA

This function is used to set the zero output, or lower range value, LRV, (4.00mA) of the output current range to correspond to a desired input. The LRV set function should be used only after the desired sensor (Thermocouple, RTD, or mV) has been selected.

Apply the signal to the input that is to correspond to 4.00mA of output current. This can be a millivolt signal if the selected sensor is a thermocouple or a known resistance in the case of an RTD. Set the unit to the corresponding main menu selection, Iout=19.0mA, and then momentarily short the SET2 terminal. The flowchart indicates that this function is now entered and the output current Iout=4.00mA is a confirmation. Then momentarily short the SET2 terminal again. The output current will change to Iout=15.00mA for about 30 seconds and then return to Iout=19.00mA confirming that setting the zero of the output range has been accomplished. During these 30 seconds the transmitter is making an accurate measurement of the input, measurements of its internal references, and then storing in its non-volatile memory the appropriate readings. See section 6 for a discussion on determining the correct millivolt input for thermocouple calibration.

When setting the range limits for an RTD sensor, use a resistor decade box instead of an RTD calibrator. The AI-1000 transmitters do not emit a steady state RTD excitation current. This may cause erroneous results when using some of the RTD calibrators designed for analog transmitter calibration. When setting the range limits for a T/C sensor then first turn off the sensor failsafe. The sensor failsafe function periodically emits 4uA of current which may disturb some calibrators.

4.3.5 Set Output Full Scale (Span); Iout=18.5mA

This function is used to set the full scale, or upper range value, URV, (20.00mA) of the output current range to correspond to a desired input. The URV set function should be used only after the desired sensor (Thermocouple, RTD, or mV) has been selected.

Apply the signal to the input that is to correspond to 20.00mA of output current. This can be a millivolt signal if the selected sensor is a thermocouple, or a known resistance in the case of an RTD. Set the unit to the corresponding main menu selection, Iout=18.50mA, and then momentarily short the SET2 terminal. The flowchart indicates that this function is now entered and the output current Iout=20.0mA is a confirmation. Then momentarily short the SET2 terminal again.

The output current will change to Iout=15.00mA for about 30 seconds and then return to Iout=18.5mA confirming that setting the full scale of the output range (span) has been accomplished. See section 6 for a discussion on determining the correct millivolt input for thermocouple calibration. Also see the comments in paragraph 6.2.2 about calibrating RTD sensors.

4.3.6 Set Sensor Failsafe; Iout=18.0mA

This function is used to set a high or a low indication in the event of a sensor malfunction, or to turn off this indication. A high setting will drive the output to 21.00 mA when a sensor failure is detected; a low setting will drive the output to 3.90 mA under similar conditions. Sensor failure is an open thermocouple, open or shorted RTD, or any open RTD lead.

Set the unit to the corresponding main menu selection, Iout=18.0mA, then short the SET2 terminal. The output current will change to Iout=21.00mA or Iout=3.90mA, or Iout=15.00mA depending on where the failsafe is presently set. At this time, SET1 can be shorted to sequence the setting between the 3.90 mA, signifying low, or 15.00mA signifying that the feature is being turned off, or the 21.00 mA limits, signifying a hi failsafe, as the arrow in the flowchart indicates. When the desired setting has been selected a second shorting of the SET2 terminal changes the unit to the new setting and returns it to the corresponding main menu selection as confirmed by an output current of Iout=18.00mA.

4.3.7 Set Transmitter Failsafe; Iout=17.5mA

This function is used to set a high or a low indication for certain internal transmitter malfunctions, or to turn this feature off. A high setting will drive the output to 21.00 mA when a malfunction is detected; a low setting will drive the output to 3.90 mA under similar conditions.

Set the unit to the corresponding main menu selection, Iout=17.5mA, then short the SET2 terminal. The output current will change to Iout=21.00mA or Iout=15.00mA, or Iout=3.90mA depending on where the failsafe is presently set. At this time SET1 can be shorted to sequence the setting between the 3.90 mA limit, signifying low, the 15.00mA signifying off condition, and 21.00 mA, signifying a high failsafe limit, as the arrow in the flowchart indicates. When the desired setting has been selected a second shorting of the SET2 terminal changes the unit to the new setting and returns it to the corresponding main menu selection as confirmed by an output current of Iout=17.50mA.

4.3.8 Trim 4.00 mA; Iout=17.0mA

This function is used to check or adjust the trim of the low end of the output current which is required to be 4.00 mA. The AI- 2000 has a calibrated stable output current of 4.00 mA, when the output is "pegged" at the low limit. This calibration step, if performed, should always be done prior to setting of the output range zero. ***Do not change this factory calibration unless a suitably accurate milliammeter is available. Do not use this function to set the "Output Zero" which is described in Paragraph 4.3.4.*** To check the transmitter output and select the proper Increment, Decrement, or no change necessary function, first, set the unit to the Trim 4.00mA main menu selection as described. Then short the SET2 terminal momentarily. The transmitter output current will change to Iout=4.00mA. If the output current measures lower than 4.00mA it needs to be incremented. If the output measures within its specification, no change needs to be made. If the output measures above 4.00mA, it needs to be decremented.

To Increment

With the output measuring slightly lower than 4.00mA, repeated shorting of the SET1 terminal will increment the output current in approximately 2uA steps.

After reaching the correct output current, shorting the SET2 terminal again stores the new output current setting and returns the unit to the main menu with the output current Iout=17.00mA, confirming the action.

If in the process of incrementing, the desired output current was overshot, then return to the main menu. Then select the Decrement function, as described below, to make the correction.

To Decrement

With the output measuring slightly higher than 4.00mA, short the SET2 terminal a second time. No change will be observed in the output current, which will continue to read slightly higher than 4.00mA. Shorting the SET1 terminal now decrements the output. Repeated shorting of the SET1 terminal will decrement the output current in approximately 2uA steps.

Do not use the decrement function to reduce the output current below 3.90mA. The transmitter will fail to function properly when reduced to this minimum current level.

After reaching the correct output current, shorting the SET2 terminal again stores the new output current setting and returns the unit to the main menu with the output current, Iout=17.00mA, confirming the action.

If in the process of decrementing, the desired output current was overshot, then return to the main menu. Then select the Increment function, as described above, to make the correction.

To Make No Change

With the output measuring within specification, shorting the SET2 terminal two successive times will return the unit to the main menu. No change will be observed in the output current at these two taps, which will read 4.00mA until returning to the Iout=17.00mA which confirms the return to the main menu.

4.3.9 Trim 20.00 mA; Iout=16.5mA

This function is used to check or adjust the trim of the high end of the output current which is required to be 20.00 mA. The AI- 2000 has a calibrated stable output current of 20.00 mA, when the output is "pegged" at the high limit. This calibration step, if performed, should always be done prior to setting of the output range zero. ***Do not change this factory calibration unless a suitably accurate milliammeter is available. Do not use this function to set the "Output Full Scale" which is described in Paragraph 4.3.5.*** To check the transmitter output and select the proper Increment, Decrement, or No Change Necessary function, first, set the unit to the Trim 20.00mA main menu selection as described. Then short the SET2 terminal momentarily. The transmitter output current will change to Iout=20.00mA. If the output current measures lower than 20.00mA it needs to be incremented. If the output measures within its specification, no change needs to be made. If the output measures above 20.00mA, it needs to be decremented.

To Increment

With the output measuring slightly lower than 20.00mA, repeated shorting of the SET1 terminal will increment the output current in approximately 2uA steps.

After reaching the correct output current, shorting the SET2 terminal again stores the new output current setting and returns the unit to the main menu with the output current Iout=16.50mA, confirming the action.

If in the process of incrementing, the desired output current was overshot, then return to the main menu. Then select the Decrement function, as described below, to make the correction.

To Decrement

With the output measuring slightly higher than 20.00mA, short the SET2 terminal a second time. No change will be observed in the output current, which will continue to read slightly higher than 20.00mA. Shorting the SET1 terminal now decrements the output. Repeated shorting of the SET1 terminal will decrement the output current in approximately 2uA steps.

After reaching the correct output current, shorting the SET2 terminal again stores the new output current setting and returns the unit to the main menu with the output current, Iout=16.50mA, confirming the action.

If in the process of decrementing, the desired output current was overshot, then return to the main menu. Then select the Increment function, as described above, to make the correction.

To Make No Change

With the output measuring within specification, shorting the SET2 terminal two successive times will return the unit to the main menu. No change will be observed in the output current at these two taps, which will read 20.00mA until returning to the Iout=16.50mA which confirms the return to the main menu.

4.3.10 Return to Normal Operate Mode; Iout=16.0mA

After the desired changes in settings have been made and calibrations performed the transmitter can be returned to the normal operate mode in one of three ways.

1) Sequence to the menu selection "Return to Operate Mode" in the main menu, Iout=16.00mA, and then short terminal SET2 momentarily. In about 5 seconds the transmitter returns to the normal operate mode.

2) At any point in the flowchart simply abandon the setup process for about 2 to 3 minutes. After that period the transmitter returns to the operate mode.

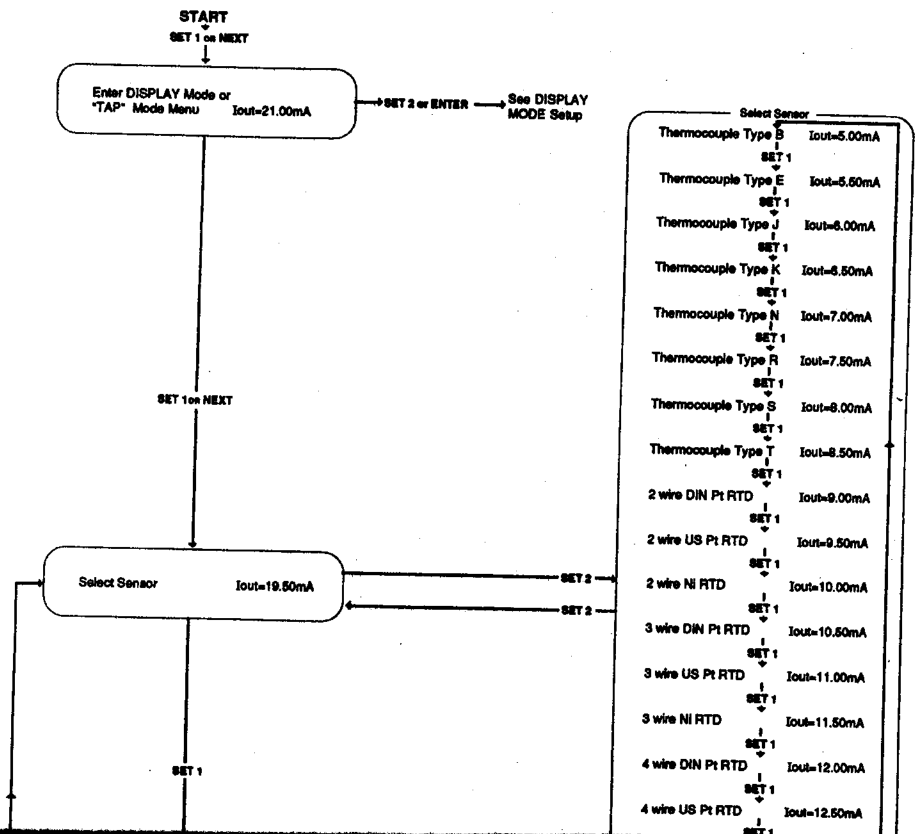
3) Disconnect the power to the transmitter for at least 30 seconds. The next time power is applied the transmitter will operate in its newly set mode.

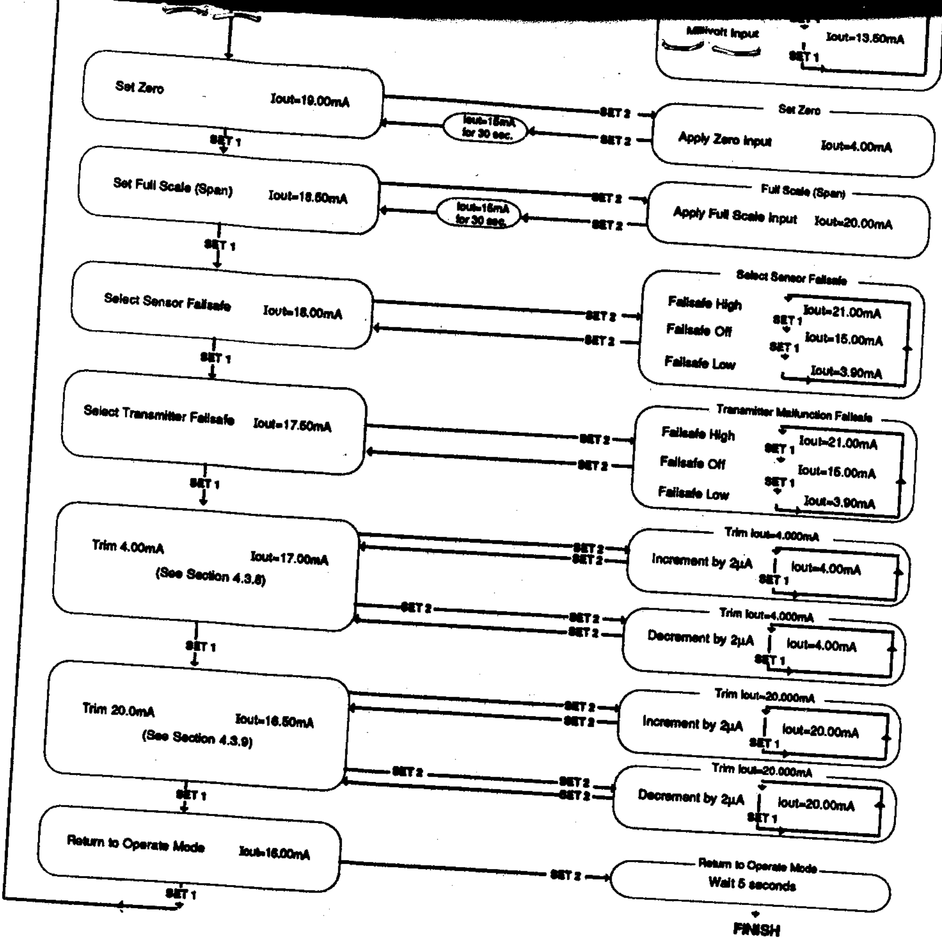
SECTION 5 CONFIGURATION, THE DISPLAY MODE

A local LCD display and a two key keyboard are available as an option and can be plugged into the top of the AI-1000 transmitter. The transmitter can also be purchased with these options already installed. These inexpensive options make the reconfiguration, or re-ranging of the transmitter very simple and easy to follow. Without the use of a calibrator, or any other tools, the transmitter can be set up for a different sensor, or the new range limits can be set much like one would set the time on a digital watch.

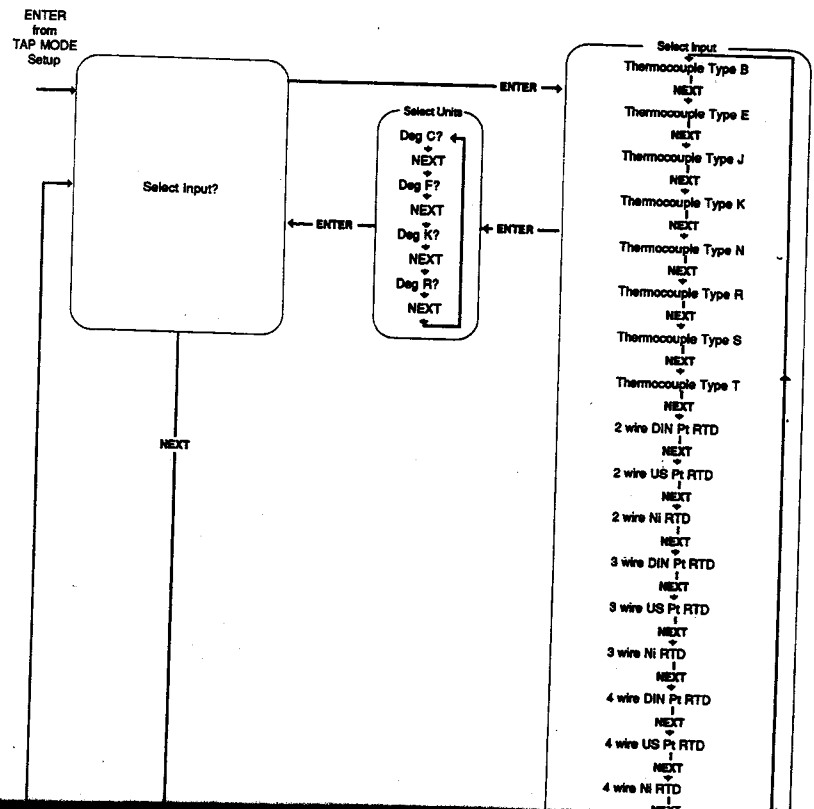
In the event that the keyboard and the local display are purchased separately, follow carefully the field installation instructions supplied to avoid damage to the transmitter or the display.

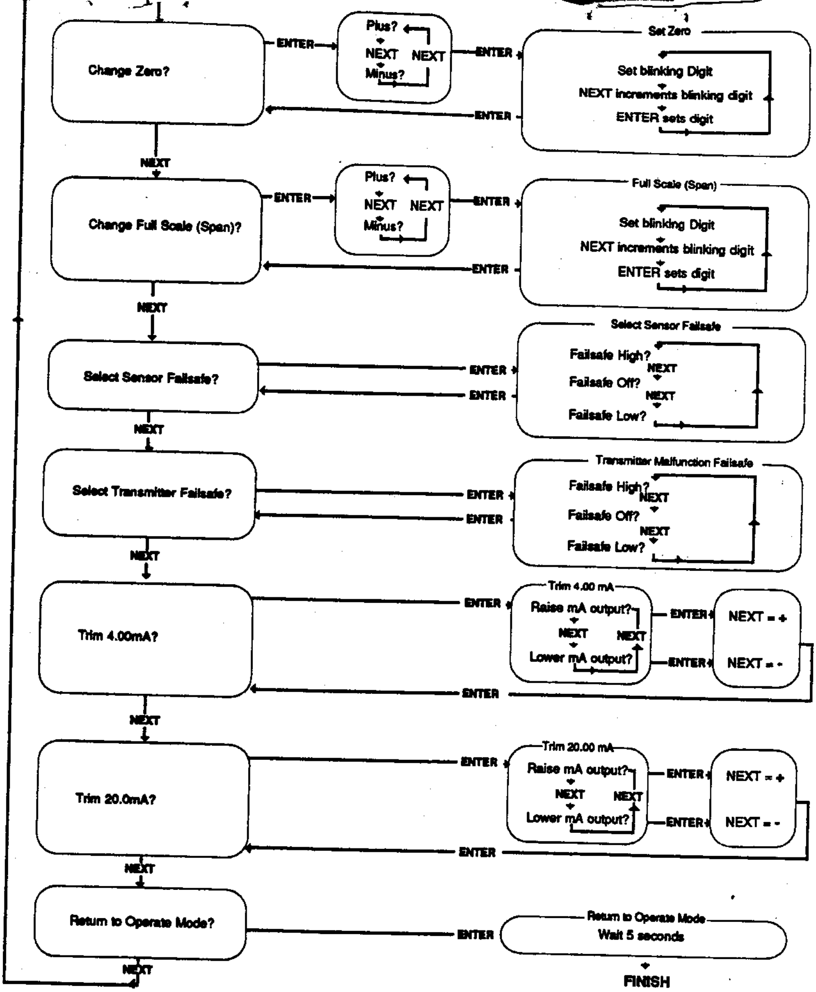
Accutech AI-1000 Programmable Transmitter "TAP" Mode Configuration Setup Flowchart




Millivolt Input
Iout=13.50mA
SET 1
Set Zero
Iout=19.00mA
SET 2
Iout=15mA for 30 sec.
Set Zero
Apply Zero Input
Iout=4.00mA
SET 1
Set Full Scale (Span)
Iout=18.50mA
Iout=15mA for 30 sec.
Full Scale (Span)
Apply Full Scale Input
Iout=20.00mA
Select Sensor Failsafe
Iout=18.00mA
Select Sensor Failsafe
Failsafe High
Iout=21.00mA
Failsafe Off
Iout=15.00mA
Failsafe Low
Iout=3.90mA
Select Transmitter Failsafe
Iout=17.50mA
Transmitter Malfunction Failsafe
Failsafe High
Iout=21.00mA
Failsafe Off
Iout=15.00mA
Failsafe Low
Iout=3.90mA
Trim 4.00mA
Iout=17.00mA
(See Section 4.3.8)
Trim Iout=4.000mA
Increment by 2µA
Iout=4.00mA
Trim Iout=4.000mA
Decrement by 2µA
Iout=4.00mA
Trim 20.0mA
Iout=16.50mA
(See Section 4.3.9)
Trim Iout=20.000mA
Increment by 2µA
Iout=20.00mA
Trim Iout=20.000mA
Decrement by 2µA
Iout=20.00mA
Return to Operate Mode
Iout=16.00mA
Return to Operate Mode
Wait 5 seconds
FINISH

Accutech AI-1000 Programmable Transmitter DISPLAY Mode Configuration Setup Flowchart





Change Zero?
ENTER
Plus?
NEXT
Minus?
NEXT
ENTER
Set Zero
Set blinking Digit
NEXT increments blinking digit
ENTER sets digit
ENTER
NEXT
Change Full Scale (Span)?
ENTER
Plus?
NEXT
Minus?
NEXT
ENTER
Full Scale (Span)
Set blinking Digit
NEXT increments blinking digit
ENTER sets digit
ENTER
NEXT
Select Sensor Failsafe?
ENTER
ENTER
Select Sensor Failsafe
Failsafe High?
NEXT
Failsafe Off?
NEXT
Failsafe Low?
NEXT
Select Transmitter Failsafe?
ENTER
ENTER
Transmitter Malfunction Failsafe
Failsafe High?
NEXT
Failsafe Off?
NEXT
Failsafe Low?
NEXT
Trim 4.00mA?
ENTER
Trim 4.00 mA
Raise mA output?
NEXT
NEXT
Lower mA output?
ENTER
NEXT = +
ENTER
NEXT = -
ENTER
NEXT
Trim 20.0mA?
ENTER
Trim 20.00 mA
Raise mA output?
NEXT
NEXT
Lower mA output?
ENTER
NEXT = +
ENTER
NEXT = -
ENTER
NEXT
Return to Operate Mode?
ENTER
Return to Operate Mode
Wait 5 seconds
FINISH
NEXT

5.1 Entering the Display Setup Mode

To start the Display Set-up Mode, first connect the transmitter to an appropriate DC power supply. Typically a 24VDC supply is connected with the + side to transmitter terminal (9) and - side to terminal (8). A series resistor in the loop is optional, but not required. A sensor may be connected to the other terminals, but this is not required for setting up the transmitter.

Once the transmitter is powered up, it comes on in the normal operate mode that it was previously set to. The standard factory set-up puts the transmitter in the analog mode. With the standard factory set-up and no sensor connected, the display will give the following indication:

0%-----------100% >
S FAULT

The transmitter is indicating Sensor FAULT, since no sensor is connected, and the analog output is indicating greater than 100%, loop current at 21.00mA, which is over range condition.Press the key marked NEXT. The display starts to alternate between

DISPLAY MODE?

asking if the user wishes to enter the display mode? The answer should be yes, therefore, press the key marked ENTER. Next the display will alternate between

SELECT INPUT?

asking if the user wishes to Select a different sensor, or Input? This is the first one of eight main menu selections. Each menu selection allows a different set-up function to be performed. As an overview, one may scan through the eight menu entries by pressing the NEXT key every time a new menu item is displayed.

Note that when more than seven characters are required to describe a menu item, the display keeps sequencing through two or three screens. In this manual, the sequencing of the display is indicated by placing the two or three parts of the message on the same line, but spaced apart. With some menu entries the display also indicates a numeric value and unit of measurement in addition to the message at the bottom.

Now keep pressing the NEXT key until the display returns to the SELECT INPUT function.

40.0°F CHANGE	40.0°F ZERO ?		
200.0°F CHANGE	200.0°F FULL	200°F SCALE ?	
SELECT	SENSOR	FAIL	SAFE ?
SELECT	XMITTER	FAIL	SAFE ?
TRIM	4 MA ?		
TRIM	20 MA ?		
RETURN	TO	OPERATE	MODE ?
SELECT	INPUT ?		

The above is the sequence of main menu entries with factory set limits of 40°F and 200°F. The flow diagram indicating all of the Display Mode menu options is also given in the centerfold of this manual.

After having sequenced through the main menu selections the transmitter is back to the first entry, which is

SELECT INPUT ?

If the Input selection does not require changing, then press NEXT, otherwise press ENTER. After pressing ENTER the display will change to

T/C J

indicating that the transmitter is set to a type J thermocouple input. If this is the desired sensor, then press ENTER, otherwise press NEXT repeatedly to sequence through the available sensors. Each time NEXT is pressed the next available sensor selection is displayed.

T/C J	(Type J Thermocouple)
T/C K	(Type K Thermocouple)
T/C N	(Type N Thermocouple)
T/C R	(Type R Thermocouple)
T/C S	(Type S Thermocouple)
T/C T	(Type T Thermocouple)
2W DINP	(Two wire Platinum RTD DIN Curve)
2W USPT	(Two wire Platinum RTD US Curve)
2W NICK	(Two wire Nickel RTD)
3W DINP	(Three wire Platinum RTD DIN Curve)
3W USPT	(Three wire Platinum RTD US Curve)
3W NICK	(Three wire Nickel RTD)
4W DINP	(Four wire Platinum RTD DIN Curve)
4W USPT	(Four wire Platinum RTD US Curve)
4W NICK	(Four wire Nickel RTD)
MV	(Millivolt)

T/C B (Type B Thermocouple)

T/C E (Type E Thermocouple)

One can stop at any one of the thermocouple, or RTD or mV selections and pressing the ENTER key allows the change of the transmitter mode to that sensor. If no sensor change is desired, then, without sequencing through the various sensor options, but just pressing the ENTER key will allow one to confirm the sensor selection and leave it unchanged. Assume that the sensor is left as T/C J. After pressing ENTER the display sequences through the following three screens

SELECT UNITS DEG F?

indicating that the transmitter is currently set to degrees F. By repeatedly pressing NEXT, the display will sequence through the following screens:

DEG K?

DEG R?

DEG C?

DEG F?

These correspond to K=Kelvin, R=Rankine, C=Celsius, and F=Fahrenheit. Stopping the selection at any one of these units and then pressing ENTER will set the transmitter to the corresponding new units. At this time the units of measure will be left at DEG F, and press ENTER. The display alternates between

SELECT INPUT ?

Now that the input selection has been completed, press NEXT and the display will start alternating as

40.0°F
CHANGE 40.0°F
ZERO ?

The numeric value seen on the upper portion of the screen is the zero value that the transmitter is currently set to. One can now changing this zero, or lower range value, LRV, totally independent of the upper range value, URV, and without the use of any calibrators or external sensor inputs. To change the ZERO, press ENTER. The display changes to

0040.0°F
PLUS ?

indicating that the current ZERO is set to "plus" 40.0 °F and asking if this value is to remain positive (PLUS ?). By repeatedly pressing the NEXT key the display will alternate

0040.0°F
MINUS ?

0040.0°F
PLUS ?

After deciding whether the zero value, LRV, is to remain positive (PLUS), press the ENTER key. In this example we assume it is to remain positive. The display changes to

0040.0°F
THOUSN?

and the leftmost digit position will start blinking asking if the thousands position needs to be changed? To change the thousands position, start pressing the NEXT key and the leftmost digit will increment through 1 2 3 4 5 6 7 8 9 0. Stop pressing the NEXT key at any of the numerals desired, then press ENTER to accept the selection. If the numeral selected before pressing ENTER was 1, then the display would change to

1040.0°F
HUNDRD?

and the second digit from the left will start blinking asking if the hundreds position needs to be changed? Like before, to change the number in this digit position press repeatedly the NEXT key until the desired numeral is reached. Then press ENTER to go to the next lower significant digit position. Each time the NEXT key cycles through the ten choices for that digit position and the ENTER key enters the selected number. The digit position being changed is the one that is blinking. The legend on the display will change to

1040.0°F
TENS ?

1040.0°F
ONES ?

1040.0°F
TENTHS?

After the Tenths digit position has also been changed to the desired value, the next pressing of the ENTER key returns the transmitter to the alternating display of

1040.0°F	1040.0°F
CHANGE	ZERO ?

Since changing of the zero has just been completed, press the NEXT key to proceed to the next menu selection, which is

200.0°F	200.0°F	200°F
CHANGE	FULL	SCALE ?

To change the full scale value press ENTER. The procedure for selecting Plus or Minus is identical to that described for changing the zero. Similarly, the procedure for changing each of the digit positions is identical to that described for changing the zero. Once the steps of changing the full scale have been completed and the ENTER key is pressed at the end of the procedure, the display returns to

200.0°F	200.0°F	200°F
CHANGE	FULL	SCALE ?

If at any of these main menu selections the indicated function need not be performed, then just press NEXT, and the next main menu selection appears sequencing on the screen.

SELECT SENSOR FAIL SAFE ?

If one desires to change the sensor fail safe condition, then press ENTER and the current failsafe setting appears on the screen

HIGH ?

The available settings can be sequenced through by pressing the NEXT key each time

OFF ?

LOW ?

When the desired failsafe condition is reached, pressing the ENTER key will change to the new setting and the screen returns to the main menu selection

SELECT SENSOR FAIL SAFE ?

Pressing the NEXT key will bring up the transmitter fail safe selection screen

SELECT XMITTER FAIL SAFE ?

Using a similar procedure as above, the transmitter fail safe condition can be changed to HIGH, OFF or LOW. When the selection is completed and the screen is back to the main menu item

SELECT XMITTER FAIL SAFE ?

press the NEXT key to bring up the main menu selection

TRIM 4 MA ?

This menu item allows trimming of the 4.0mA output current. Note that this function is only for the purpose of adjusting the 4.00mA limit of the transmitter loop current to be exactly 4.00mA according to the plant's local standard. This is NOT for the purpose of ranging the transmitter! If trimming the 4.0mA limit is still desired then press ENTER. The display will alternate

RAISE MA OUT ?

By pressing the NEXT key the display then alternates as

LOWER MA OUT ?

When it is decided whether to raise or lower the output current, then press ENTER and the display changes to one of the following

NEXT = +

or

NEXT = -

depending on whether the raise or lower function has been selected. Now every time the NEXT key is pressed, the display blinks, and the 4.0mA output limit decreases (-), or increases (+). The decrease or increase is in approximately 2 micro ampere increments. Do not arbitrarily trim the output unless a qualified and accurate local standard is available to measure the adjusted 4.0mA output! Also note that the 4.0mA limit should not be trimmed by more than about +/-50uA, or else transmitter operation may be impaired. Once the desired trim is reached, pressing ENTER will return to one of the corresponding screens

TRIM 4 MA ?

At this point one may still go back and do further trimming of the 4.0mA limit by pressing the

ENTER key, or pressing the NEXT key changes to the next menu option

TRIM 20 MA ?

Trimming of the 20.0mA current limit is done in exactly the same manner as was described for trimming the 4.0mA point. Similarly the same precautions apply. After completing the trim 20.0mA pressing the NEXT key brings up the final menu option, sequencing through

RETURN TO OPERATE MODE ?

If all of the set-up and re-ranging operations have been satisfactorily completed, then pressing ENTER will return the transmitter to the normal operate mode. Pressing the NEXT key at this point will return the display to the first main menu option

SELECT INPUT ?

Note again, that whenever the transmitter is in the display set-up mode, if no activation of the keyboard occurs for approximately 2 1/2 minutes, the transmitter returns to the operate mode. One can also return to the operate mode at any point in the Display Mode by removing power from the transmitter for about 30 seconds.

SECTION 6 APPLICATIONS INFORMATION

6.1 SENSOR FAILSAFE DETECTION

The AI-1000 detects a sensor failure condition by making various measurements across its sensor input terminals. As a result of these measurements the unit can detect an open thermocouple or open RTD condition. In addition the AI-1000 can also detect if an RTD is short circuited, or if any of its terminal wires (2, 3, or 4 wire RTD's) are open. Any one of these conditions will cause a "sensor failsafe" indication.

In the process of performing these sensor failure checks the unit periodically passes about 5uA of current through the thermocouple or 0.3mA through an RTD and its connecting wires and measures the resulting voltage drop. One of the conditions resulting in a SENSOR FAILSAFE condition is if this voltage drop exceeds 180mV.

In the case of an RTD the 0.3mA current is the normal excitation for the RTD and therefore both the temperature measurement and some of the sensor failsafe detection routines are done simultaneously. In the case of a thermocouple, during the temperature measurement cycle there is no open sensor test current in the thermocouple. Thermocouple open circuit is detected by making a second measurement with the test current through the thermocouple.

This method of testing for sensor failure has the following advantages:

1) In the case of thermocouples, there is no steady current through the sensor during measurement, and therefore, accuracy is not degraded.

2) During open sensor detection the test current is sufficiently high that even if there is some leakage resistance between the sensor leads, an open sensor will be positively detected.

There are certain precautions to be observed when using this method of sensor failure detection. If the lead wire resistance is too great then a false "sensor failsafe" condition could be generated. The maximum lead wire resistance is dependent on the type of sensor being used and the maximum temperature expected to be measured. Knowing the sensor excitation current and the open sensor detection threshold, 180mV, the maximum allowable lead wire resistance can be determined for any application.

6.1.1 Maximum Lead Resistance For RTD

The maximum total resistance including the RTD and the two lead wires is

$$\frac{180mV}{0.3mA} = \frac{0.180}{0.0003} = 600 \text{ ohms}$$

If a Pt RTD is used to measure a maximum temperature of 700°C, then the RTD resistance is 345 ohms and the maximum lead wire resistance (for both leads combined) is 600-345=255 ohms.

Similarly the permissible maximum lead wire resistance can be calculated for other RTD applications.

6.1.2 Maximum Lead Resistance For Thermocouple

Assuming the resistance of the thermocouple junction to be negligible, the total resistance of the two lead wires is

$$\frac{180mV - (T/C\ mV\ Output)}{0.005\ mA} = \frac{0.180 - (T/C\ mV) \times 0.001}{0.000005}$$

Consider a type J thermocouple to be operated up to a temperature of 1200°F. The approximate output of this thermocouple is 36mV (reference junction at 32°F). The maximum lead resistance (both leads combined) is

$$\frac{0.180 - 0.036}{0.000005} = 28{,}800 \text{ ohms}$$

6.2 CONFIGURATION IN THE TAP MODE

When the Tap Mode is employed, the zero and span are set by first applying to the inputs of the transmitter the appropriate mV signal or resistance value in the case of an RTD. Then following the flow chart on the centerfold page, the applied signal can be made to correspond to either 4.00mA or 20.00mA of loop current.

6.2.1 Millivolt Input

When millivolt input is selected the zero and span setting is very simple. Dial in on the millivolt source or calibrator the desired number of mV to correspond to 4.00mA of loop current. Follow the flowchart on the centerfold page for setting the ZERO. Next dial in on the millivolt source or calibrator the desired number of mV to correspond to 20.00mA of loop current. Follow the same flowchart for setting the SPAN.

6.2.2 RTD Input

When an RTD sensor is selected the zero and span setting is very similar, but the millivolt source is replaced by a precision resistance decade box. Dial in on the resistance decade box the desired RTD resistance to correspond to 4.00mA of loop current. Follow the flowchart on the centerfold page to setting the ZERO. Next dial in on the decade box the desired RTD resistance to correspond to 20.00mA of loop current. Follow the same flowchart to setting the FULL SCALE.

Generally the ZERO and FULL SCALE need to correspond to certain temperature values. Converting from these temperature values to RTD resistance can be done readily by using the appropriate tables which are readily available. Be certain to select the table for the correct RTD curve, US or DIN and engineering units, °C °F or °K.

Note that the use of RTD simulators should be avoided unless they specifically are designed to accommodate these microprocessor based transmitters. RTD simulators generally measure the RTD excitation current generated by the transmitter and then produce an appropriate millivolt value. The AI-1000 transmitter does not produce a steady state RTD excitation current. Instead, it outputs a current pulse for only about 200mS duration repetitively. This pulsed current causes most RTD simulators to produce an erroneous calibration signal.

6.2.3 Thermocouple Input

Setting the ZERO and FULL SCALE with a thermocouple sensor requires some added steps because of the automatic cold junction compensation. Thermocouple tables are normally available for a reference junction at the ice point of water. These table entries must be adjusted for the actual cold junction temperature. In the case of the AI-1000 transmitter, the two cold junctions are the two brass terminals near the center. The temperature of these terminals is continually measured with an internal calibrated thermometer.

It is generally good practice to operate the transmitter for 30 minutes or more prior to calibration to allow it to reach thermal equilibrium.

Calibrating Using a Millivolt Source

The procedure starts with the selection of the thermocouple type. Then determine the temperature of the thermocouple terminals on top of the transmitter. This can be done by measuring with a thermometer the temperature of the thermocouple terminals on the transmitter. Or one can assume that the terminals are approximately at room temperature and then determining the room temperature.
Locate the appropriate table of temperature versus mV for the selected thermocouple.

Find the table entry for the desired ZERO, (mV @ 0°C)

Find the table entry corresponding to the terminal block temperature, (mV @ TB°)

Calculate the mV to be applied as:

(mV appl) = (mV @ 0°C) - (mV @ TB°C)

Apply the millivolts (mV appl) to the transmitter and follow the flowchart on the centerfold page to setting the ZERO (LRV). Then set the FULL SCALE (URV) using a similar procedure.

Calibrating Using a Thermocouple Calibrator

Some of the thermocouple calibrators available on the market provide a means of measuring the temperature of the terminal block and automatically apply the corrected mV to the transmitter. This procedure is rather simple. However, there can be an appreciable difference between the temperature of the simulator and the transmitter terminals. With some thermocouple types this error could be amplified 5 or 10 fold, resulting in large measurement errors.

NOTE THE FOLLOWING PRECAUTIONS!

When attempting to calibrate or check the calibration of the AI-1000 in the thermocouple mode it is generally advisable to disable the "sensor failsafe" feature.

Because the open sensor test periodically injects about 5uA of current into the input terminals, the millivolts generated by the calibration source is periodically disturbed and, depending on the characteristics of the external calibration source used, erroneous voltages may be applied to the transmitter. The "sensor failsafe" can be disabled by turning it off in the configurations menu. After the calibration has been completed this function can be re-enabled again.

6.3 FOR BEST MEASUREMENT ACCURACY

The AI-1000 transmitter is a stable instrument, precision calibrated at the factory for any operating range the user may select. However, the automatic cold junction compensation requires certain precautions to obtain best accuracy when used with a thermocouple sensor. See also Accutech technical applications note #207 for additional information.

The cold junction compensation operates by attempting to measure accurately the temperature of the thermocouple terminals on top of the instrument. If these terminals are exposed to thermal radiation or convection, the cold junction compensation will introduce an error. With certain types of thermocouples and temperature measurement ranges the sensitivity of the cold junction is greater than the sensitivity of the measurement couple. Under those conditions a one degree error in the cold junction temperature that the transmitter senses can result in greater than one degree temperature measurement error. See also Accutech tech note 203.

For best measurement accuracy with thermocouple sensors it is advisable to shield the top terminals by placing the transmitter into a weatherproof housing, such as the model XP-HDC2L. In addition, sufficient time should be allowed for the housing and the transmitter to reach equilibrium temperature in a given operating environment before best accuracy is reached.

For best accuracy with any sensor, or in the millivolt mode, it is advisable to allow the transmitter to operate with the desired fixed input signal for a period of 30 seconds before the reading is taken. The transmitter periodically measures certain internal references. These internal measurements and the external signal undergo digital averaging and the full accuracy of the instrument is only achieved after several readings have been averaged.

When using an RTD sensor, a four wire connection is generally recommended. With a three wire RTD the AI-1000 makes two separate measurements before calculating the temperature, whereas, only a single measurement is required when using a four wire RTD. Conceptually, a better accuracy is possible using a single measurement as compared with calculating the difference of two separate measurements.

SECTION 7 ACCESSORIES & INFORMATION

Other accessories available from Accutech are:

LD-2	Local Display
KB-2	Keyboard
XP-HDC2-L	Explosion/Weather proof Housing with mounting lugs (No Display Option)
XP-HDGC2-L	Explosion/Weather proof Housing with mounting lugs (Display Option)
PB-2	Pipe mount bracket (for 2" pipe)
PS-2412	Power Supply, 24/28 VDC, 1.2/0.8A
PS-2405	Power supply, 24 VDC, 0.5A

A variety of smart transmitters, signal conditioners, thermocouples, RTD sensors and thermowells are also available.

The following Technical Application Notes are also available on special request.

Technote #203 Smart Temperature Transmitter Accuracy Considerations

Technote #207 Using the AI-1000 with thermocouples

SECTION 8 SPECIFICATIONS, AI-1000

THERMOCOUPLE SENSORS: NBS Types B,E,J,K,N,R,S,T

RTD RESISTANCE SENSORS:

100ohm	Pt NBS curve (a=0.00392)	2,3, or 4 wire
100ohm	Pt DIN curve (a=0.00385)	2,3, or 4 wire
120ohm	Nickel	2,3, or 4 wire
10ohm	Copper consult factory	2,3, or 4 wire

MILLIVOLT INPUT RANGE: -15 to 160mV DC

THERMOCOUPLE & RTD LINEARIZATION: Linearization with temperature conforms to NIST & DIN curves within +/-0.05°C over the full sensor temperature range.

OUTPUT: Two wire 4 to 20mA

OUTPUT RANGING ADJUSTMENTS:

Analog Zero: }{100% of sensor range, non interacting
Analog full-scale: }{normal or Reverse Acting

MINIMUM OUTPUT RANGE: None

OUTPUT RESOLUTION: 2.5uA

TRANSMITTER ACCURACY:
+/-0.05% of the millivolt or ohm equivalent reading, or the accuracy from the table below, whichever is greater; plus the effect of cold junction measurement error of +/-0.5°C (+/-0.9°F), if using a T/C sensor; plus +/-0.05% of span

Sensor Type		Accuracy	
E, J, K, N, T	T/C	+/-0.3°C	(+/-0.5°F)
B, R, S	T/C	+/-0.8°C	(+/-1.5°F)
mV		+/-0.010mV	
100ohm RTD Pt DIN		+/-0.14°C	(+/-0.25°F)
100ohm RTD Pt US		+/-0.14°C	(+/-0.25°F)
120ohm RTD Ni		+/-0.14°C	(+/-0.25°F)

Includes repeatability, hysteresis, load and ambient temperature. For a detailed analysis refer to Accutech Applications Note #203.

TRANSMITTER REPEATABILITY: One half of accuracy

REFERENCE CONDITION ACCURACY:
Equal to transmitter repeatability, when set-up in the "Tap" Mode. The transmitter is then referenced to the prevailing conditions and transmitter accuracy at this reference condition will include repeatability, linearity, and hysteresis effects. If using a thermocouple add 0.05°F for reference condition cold junction effect. Reference condition accuracy is comparable in scope to the accuracy generally specified for analog based transmitters.

DYNAMIC RESPONSE:
Turn On Time: Less than 5 seconds after power up
Ambient Temperature Gradient: Automatic compensation to 20°C/Hour Change
Update Time: 0.15 Seconds
Response to Step Input: 0.25 Seconds, Typical

SPECIFICATIONS AI-1000 (CONTINUED)

COLD JUNCTION COMPENSATION:
Digital self correction to +/-0.5°C

OPERATING TEMPERATURE RANGE:
Transmitter -40°F to +167°F (-40°C to +75°C) ambient.
Display unit -4°F to +158°F (-20°C to +70°C) ambient.

STORAGE TEMPERATURE RANGE:
-58°F to +185°F (-50°C to +85°C) ambient.

AMBIENT TEMPERATURE STABILITY: Self-correcting over the operating temperature range. Refer to Accutech Application Note #203 for full discussion.

LONG TERM STABILITY: Less than 0.05% of reading plus +/-5uA per year.

AUTOMATIC DIAGNOSTICS: Every 3 seconds the AI-1000 transmitter performs self-checks for zero, span, cold junction temperature, open T/C, open RTD element, shorted RTD element, each open RTD lead, and transmitter malfunction.

FAILSAFE: User settable to 21mA, 3.9mA, or OFF

INTERCHANGEABILITY: All units interchangeable without field calibration

EMI/RFI IMMUNITY: Less than 0.5% of reading (SAMA PMC 33.1c test method) 20KHz to 1000MHz, 10 V/meter.

ISOLATION: 850 VDC or peak AC

COMMON MODE REJECTION: 120dB

REVERSE POLARITY PROTECTION:
42 VDC applied with either polarity

POWER AND LOAD:
Supply voltage (no load resistance); 12 to 42VDC;
Supply voltage (with load resistance);
Vsupply=(12)+(Rload in Kohm) x (21mA)
Supply Voltage Effect: < +/-0.005% of Span per Volt

WEIGHT: 12 oz. (340g)

STANDARD CONFIGURATION:
Factory configured for Type J thermocouple, 40°F to 200°F. Configurations ca rations available to suit your requirements. See price list.

SENSOR RANGES:

Sensor Type Thermocouple, NIST Curve	Range					
Type B	+ 43	to	+1820°C	+109	to	+3308°F
Type E	-270	to	+1000°C	-454	to	+1832°F
Type J	-210	to	+1200°C	-346	to	+2192°F
Type K	-270	to	+1372°C	-454	to	+2502°F
Type N	0	to	+1300°C	+ 32	to	+2372°F
Type R	- 50	to	+1768°C	- 58	to	+3214°F
Type S	- 50	to	+1768°C	- 58	to	+3214°F
Type T	-270	to	+ 400°C	-454	to	+ 752°F

RTD Resistance Thermometers, 2, 3, or 4 wire

100ohm Pt	NIST Curve	-200	to	+ 850°C	-328	to	+1562°F
100ohm Pt	DIN Curve	-200	to	+ 850°C	-328	to	+1562°F
120ohm Ni		- 80	to	+ 320°C	-112	to	+ 608°F

SPECIFICATIONS AI-1000 (CONTINUED)

OPTIONS: LD-2 Local Display, KB-2 Keyboard, Sensors, Probes, and Thermowells. See price list.

PACKAGING: The AI-1000 is packaged in a rugged, nickel plated, aluminum enclosure suitable for mounting on a flat surface. The metal enclosure is totally sealed against moisture and provides excellent immunity to the effects of electromagnetic interference (EMI/RFI). For hazardous environments, the AI-1000 will fit within an available explosion proof housing.

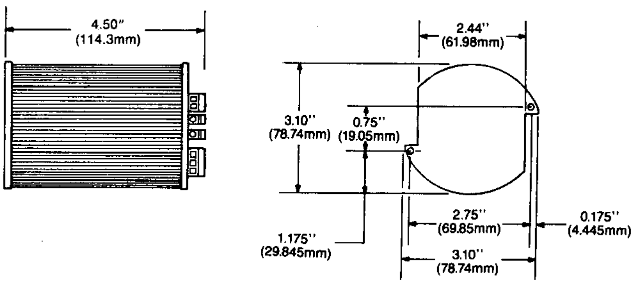


Figure 8-1
Mechanical Dimensions

LIMITED WARRANTY

This warranty is in lieu of all other warranties, expressed or implied.
The Accutech 1000 series products (Product) are warranted by Adaptive Instruments Corporation (The Seller) to be free from defects in workmanship and materials, under conditions of normal use and service, for a period of one year from the date of shipment. At its option, the Seller will repair, or replace free of charge, any Product or Products found and determined to be defective by the Seller if returned to the Seller, per the procedure below, within one year of its original purchase.

To claim a repair or replacement under this warranty, a Return Material Authorization (RMA) number must be obtained from Adaptive Instruments Corporation or its operating division, Accutech, and the Product or Products returned, postpaid to the Seller. Final warranty defect determination and determination of the cost, if any, to repair or replace will be made by the Seller upon examination of the returned Product. Returned units may be subject to an evaluation or recalibration charge as listed in the Seller's price list.

Defects arising from negligence, misuse, improper installation, accident, modification or alteration of this Product (or Products) are not warranted nor are Products that have been opened for on-site or field inspection or repair.

LIABILITY OF THE SELLER

Liability of the Seller is limited to repair or replacement of the Product or Products as outlined above. Purchaser assumes full responsibility for determining that the Product or Products purchased will meet the Purchaser's requirements or those of the Purchaser's customers. Purchaser agrees to indemnify, defend and hold the Seller harmless from any liability, loss, or damage, whatsoever, caused or alleged to be caused directly or indirectly by the Product or Products including, but not limited to any interruption of business, loss of business, personal injury or consequential damages resulting from the use or operation of the Product or Products.

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