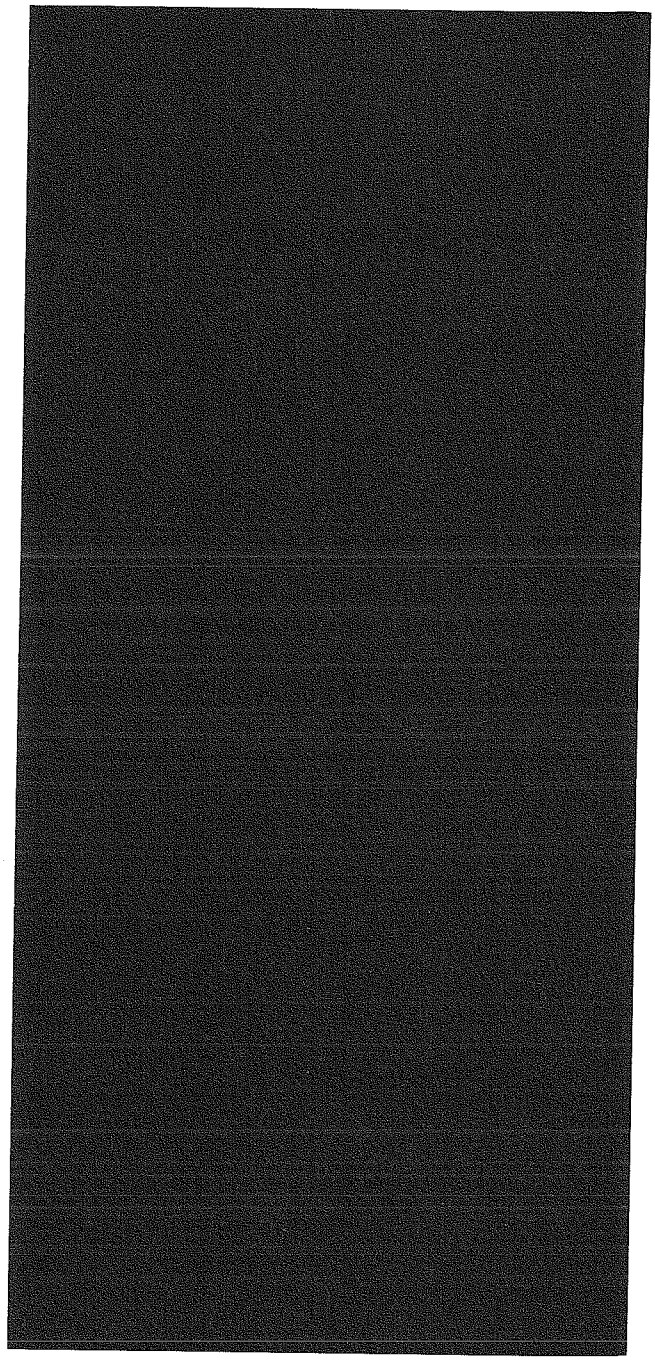
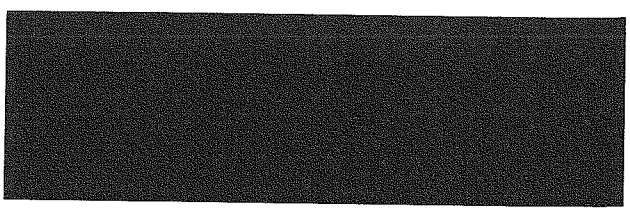
DET TRONICS



INSTRUCTIONS

H_2S Transmitter

Model 410



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Form 95-8339-01

WARRANTY POLICY

Detector Electronics Corporation products are manufactured from high quality components and the completed device is rigorously inspected and tested before shipment; however, any electronic device is subject to failure beyond the control of the manufacturer. To ensure system reliability, it is important for the user to maintain the system as recommended by the instruction manuals and to determine the frequency of functional checking of the system required for each specific installation. The more frequent the checking, the greater the system reliability. For the highest reliability, a completely redundant system is necessary. The manufacturer warrants its products against defective parts and workmanship, and will replace or repair equipment returned to the manufacturer for these reasons within 12 months after purchase date. See manufacturer's Standard Terms and Conditions on the invoice for complete details. Please note that no other warranties, written or implied, will be honored by the manufacturer.

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H_2S Transmitter

Model 410

APPLICATION

The Model 410 H_2S Transmitter is designed to interface directly with a computer, programmable controller, or various other monitoring devices without first going through a control module. The unitized device uses microprocessor based circuitry to monitor the output of a Metal Oxide Semiconductor (MOS) Hydrogen Sulfide (H_2S) Sensor. The output signal consists of a linear 4 to 20 ma dc current output that corresponds to H_2S levels from 0 to 100 parts per million (ppm). An optional relay board is available to enable the Model 410 to function as an independent single channel detection system. All electronic circuitry is housed in an explosion-proof metal enclosure and is located at the point of detection.

In addition to continuously monitoring the output of the sensor, the Model 410 simultaneously checks continuity of external wiring and functioning of electronic circuitry to assure proper response to the presence of hydrogen sulfide. If a fault should occur in the system, it is indicated by a decrease in the dc current output.

Calibration of the Model 410 is accomplished using a remote calibration feature that allows one person to calibrate the sensor in a hazardous location without having to remove the enclosure cover. Calibration is performed using the Det-Tronics Calibration Meter, which is attached to the glass window on the Model 410 housing. The transmitter and calibration meter exchange information in both directions through an optical coupling arrangement. The calibration meter provides a digital reading of the gas concentration being applied to the sensor. It also inhibits the output signal to prevent an unwanted alarm. In addition, the calibration meter allows the operator to determine the approximate sensor life remaining by directly reading the signal output of the sensor during calibration. This method of calibration requires that only the detector under calibration be taken off line, allowing the remainder of the detection system to function normally.

FEATURES

- Linear 4 to 20 ma output corresponds to H_2S concentration of 0 to 100 ppm.
- Calibration can be performed by one person without opening the housing.
- Digital display on calibration meter provides important calibration information.
- Non-volatile memory retains calibration and setpoint data during loss of input power.
- Optional relay board provides two SPDT relays for controlling alarm response devices.

GENERAL APPLICATION INFORMATION

Hydrogen sulfide is a colorless, highly toxic gas. It is heavier than air and is frequently found in oil and nat-

ural gas, sewage disposal or treatment systems, as well as a variety of industrial processes. Typical operations that encounter H_2S include:

- Oil and natural gas exploration and production
- Refineries
- Sewers
- Sewage treatment plants
- Chemical plants
- Paper mills.

The ability to electronically monitor the level of H_2S is essential in many potentially hazardous environments. In low concentrations hydrogen sulfide has the odor of rotten eggs, however, it also deadens the sense of smell. Therefore, depending on human senses alone to estimate the concentration of H_2S is totally unreliable.

The actual effects of H_2S on an individual depend on several factors:

1. Concentration level of the exposure
2. Length of time exposed
3. Exposure frequency
4. Ability to tolerate H_2S.

Table 1 shows some of the effects of breathing H_2S gas.

Table 1—Effects of H_2S

Concentration	Effect
1 ppm	Detectable by odor.
10 ppm	Allowable for 8 hours exposure (OSHA).
Over 20 ppm	**Protective equipment required.**
100 ppm	Kills smell in 3 to 15 minutes. May burn eyes and throat.
200 ppm	Kills smell rapidly. Burns eyes and throat.
500 ppm	Victim loses sense of reasoning and balance. Respiratory disturbances in 2 to 15 minutes. Prompt artificial resuscitation needed.
700 ppm	Victim becomes unconscious quickly. Breathing will stop and death will result if not rescued promptly. Immediate artificial resuscitation required.
1,000 ppm	Unconscious at once. Permanant brain damage or death will result unless rescued promptly.

DESCRIPTION

The Model 410 Transmitter functions as the interface between the H_2S sensor and the control device. The sensor detects the presence of H_2S gas. The transmitter monitors the output from the sensor and generates a linear 4 to 20 milliampere dc signal that corresponds to H_2S concentrations from 0 to 100 ppm. If the transmitter is equipped with the optional relay board, it can independently generate an alarm output.

SENSOR

The MOS Hydrogen Sulfide Sensor is a thin film, metal oxide semiconductor device. When it is exposed to hydrogen sulfide gas, its electrical resistance decreases in proportion to the level of H_2S gas present. Exposure to most other gases has little, if any, effect on the sensor. The sensor generates a non-linear signal, which is then made linear by the microprocessor in the transmitter.

Since the sensing element operates at a high temperature, it is enclosed by a sintered metal flame arrestor to prevent the possibility of ignition of flammable atmospheres. The porous flame arrestor must be kept free of water, dirt, or other contaminants at all times to allow H_2S gas to reach the sensing element.

To respond properly to the presence of hydrogen sulfide, the sensor must be operated only in environments having a minimum concentration of 10% oxygen.

Interfering Gases

Interfering gases are those which, when mixed with hydrogen sulfide, enhance, attenuate, or inhibit the sensor response to H_2S. The following are commonly encountered substances that can affect sensor response. By no means should this list be considered complete. Ethylene, hydrogen, methylmercaptan, and chlorine increase the sensor response to H_2S, while sulfur dioxide and ammonia have an attenuating effect on the sensor. At concentrations above 1 ppm, nitrogen dioxide temporarily desensitizes the sensor to H_2S.

TRANSMITTER

The Model 410 Transmitter functions as the interface between the sensor and the monitoring device. The transmitter converts the resistance change of the sensor to a linear 4 to 20 milliampere output signal, which is proportional to the level of H_2S at the sensor.

This dc current output is calibrated so that the output is 4 ma when no H_2S is detected and 20 ma when 100 ppm H_2S is present. The maximum output of the transmitter is 26 ma. A signal below 4 ma indicates a trouble condition. If any of the three connecting wires (power and current signal) should break or become disconnected, the current output signal will be 0 ma.

Relay Board (Optional)

If the application requires the use of relay contacts, a Relay Board with two alarm relays is available as an option. Two relay status LEDs are provided to signal actuation of their corresponding relay. The relays have SPDT contacts that are rated at 2 amperes and can be programmed for either normally energized or normally de-energized operation. Each relay has separate set and reset setpoints, which are adjustable in one ppm increments. The relays are automatically reset when power is first applied to the transmitter and when a trouble signal is being generated. Latching and reset options for the alarm relays are programmed at the time of installation using the calibration meter. See "Operating the Calibration Meter" section of this manual for details.

Calibration

The transmitter has two calibration points. During routine calibration, two accurate concentrations of H_2S (10 and 40 ppm) are applied to the sensor. These values are entered into the microprocessor in the transmitter via the calibration meter. The microprocessor then makes the necessary calculations to assure proper output. If the sensor output is too high or too low, the message "bad" will be displayed on the calibration meter to inform the operator that the sensor should be replaced. Refer to the "Calibration" section of this manual for complete calibration information.

CALIBRATION METER

The calibration meter enables one person to perform a system calibration without opening the transmitter enclosure. (See Figure 1.) When the calibration meter is communicating with the transmitter, the signal to the controller is set to –2 ppm (3.68 ma) to indicate that the transmitter is being calibrated and to prevent unwanted alarms. The calibration meter uses a liquid crystal display (LCD) to allow the user to see

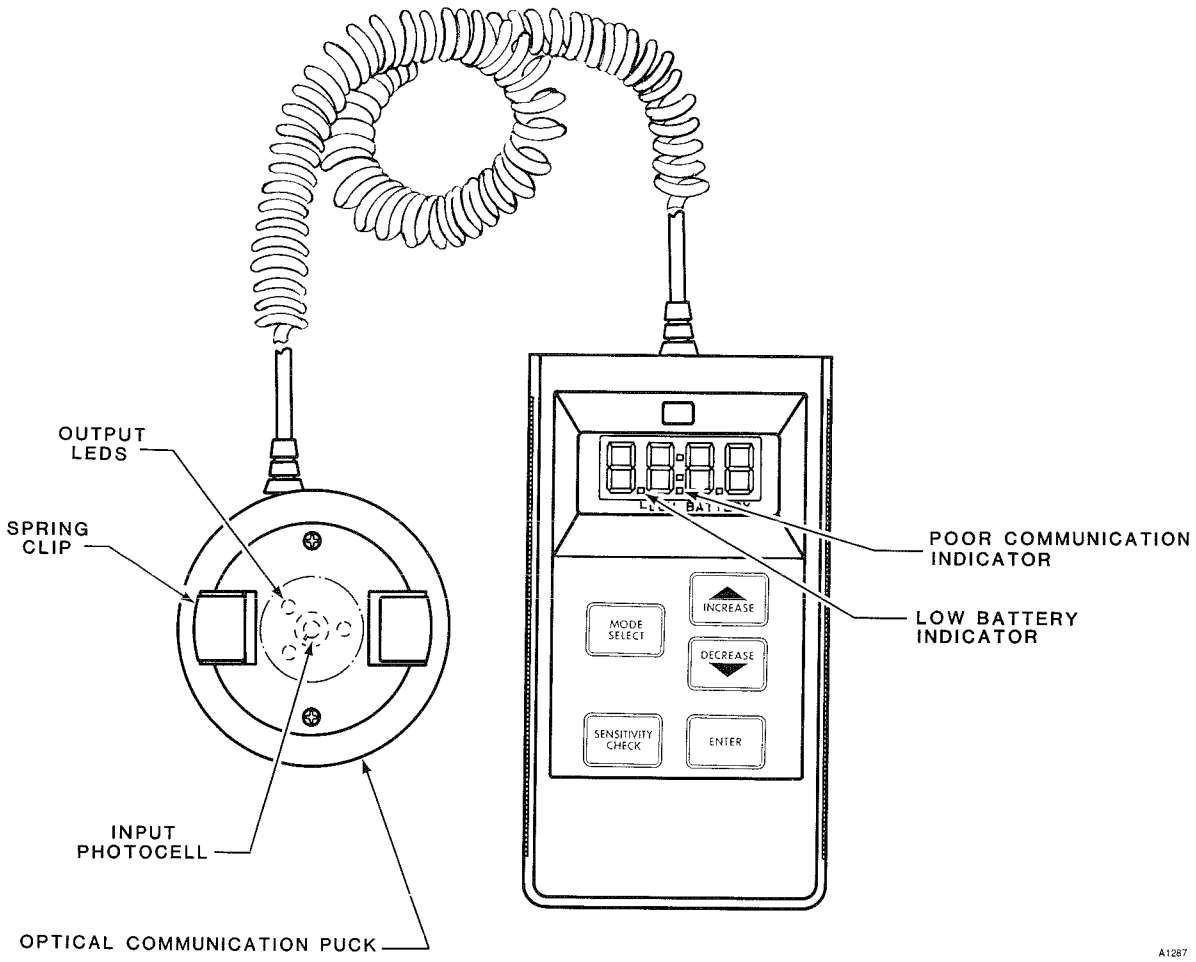

Figure 1—Optical Calibration Meter

the actual response of the sensor to the calibration gas mixture. In addition to routine calibration of the sensor, the calibration meter can also be used to select various options and to aid in identifying system problems.

Refer to the "Calibration" and "Operating the Calibration Meter" sections of this manual for complete information regarding the use of the calibration meter.

SPECIFICATIONS

TRANSMITTER

OPERATING VOLTAGE—
24 vdc nominal, total range 18 to 30 vdc, measured at the transmitter.

OPERATING CURRENT—
75 milliamperes nominal, 120 milliamperes with both relays energized, 350 milliamperes during power-up.

OPERATING RANGE—
0 to 100 ppm.

TEMPERATURE RANGE—
Operating: –40°F to +167°F (–40°C to +75°C).
Storage: –67°F to +212°F (–55°C to +100°C).

CURRENT LOOP OUTPUT—
4 to 20 milliamperes dc nominal, 0 to 26 milliamperes total range, capable of driving a 600 ohm load at 24 vdc input voltage.

RELAY CONTACT RATINGS—
2.0 amperes at 24 vdc.

DIMENSIONS—
See Figure 2.

SHIPPING WEIGHT (Approximate)—
6.0 pounds (2.7 kilograms).

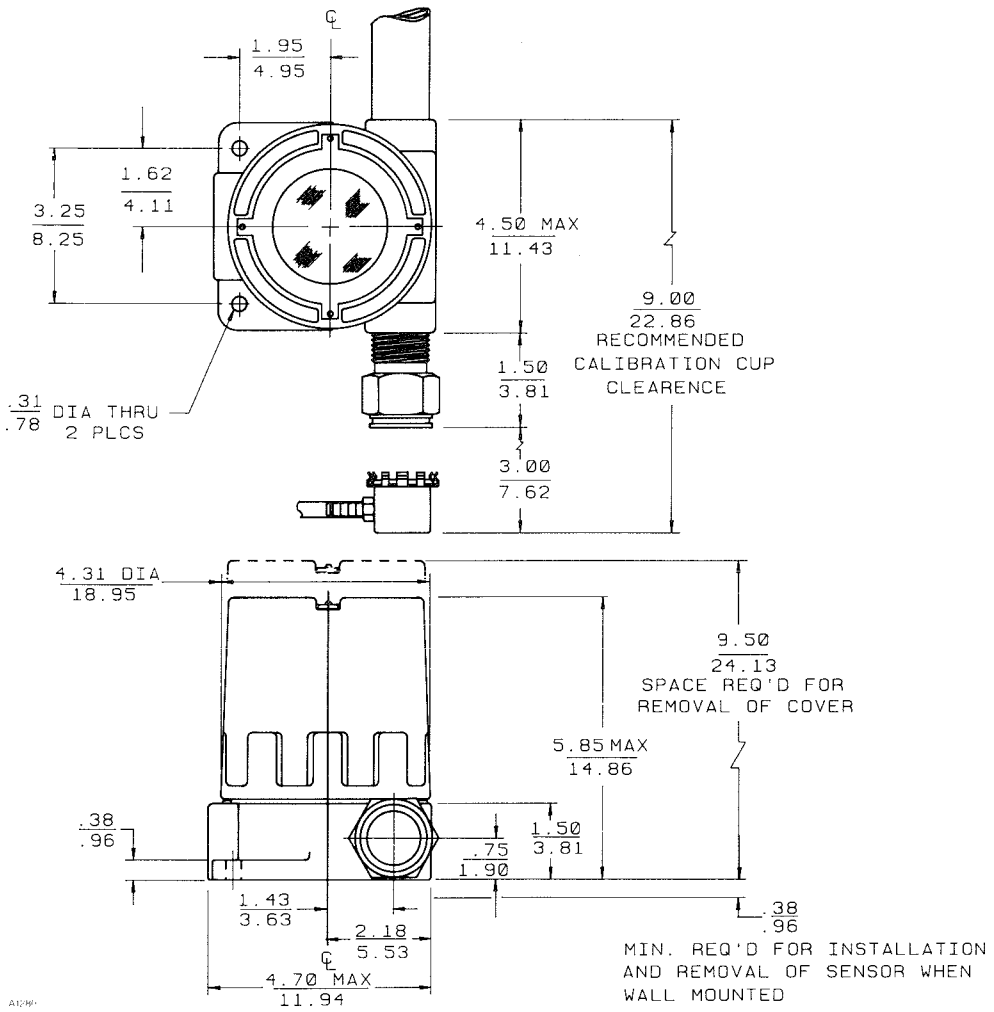

Figure 2—Dimensions in Inches (Centimeters)

SENSOR

TEMPERATURE RANGE—
Operating: –40°F to +185°F (–40°C to +85°C).
Storage: –67°F to +257°F (–55°C to +125°C).

SENSOR HUMIDITY RANGE (Non-condensing)—
0 to 99% RH.

SENSOR RESPONSE TIME—
Less than 30 seconds to reach 20 ppm given 40 ppm H_2S in still air.

SENSOR RECOVERY TIME—
Less than 30 seconds after exposure to 100 ppm H_2S.

LINEARITY—
±5% from 5 to 60 ppm.

SENSOR STORAGE LIFE—
Indefinite.

CALIBRATION METER

TEMPERATURE RANGE—
Operating: –4°F to +130°F (–20°C to +55°C).
Storage: –40°F to +130°F (–40°C to +55°C).

CALIBRATION METER BATTERY—
Eveready No. 522.
Approximate life: 200 hours or 2000 calibrations.

INSTALLATION

SENSOR POSITIONING

It is essential for the sensor to be properly located to enable it to provide maximum protection. Unfortunately, there is no fool-proof formula for determining the most effective number and placement of sensors. Therefore, the individual who is responsible for the installation must rely on experience and common sense to determine the best sensor locations for the area to be protected.

The following factors should be considered for every installation:

1. How rapidly will the H_2S gas diffuse into the air? Select a location for the sensor as close as practical to an anticipated source.

2. Since H_2S has a density greater than air, it will normally tend to settle near the floor or ground, unless it is heated or prevented from doing so by air movement.

3. Ventilation characteristics of the immediate area must also be considered. Movement of air will cause the H_2S gas to accumulate more heavily in one area than another. The sensors should be placed in the areas where the most concentrated accumulation of hydrogen sulfide gas is anticipated. Also take into consideration the fact that some ventilation systems do not operate continuously.

4. The sensor opening should be pointed down to prevent the buildup of moisture or contaminants and to ensure proper operation.

5. The sensor must be accessible for testing and calibration.

6. The sensor should be located in an area where it is safe from potential sources of contamination.

7. Exposure to excessive heat or vibration can result in pre-mature failure of any electronic device and, therefore, should be avoided if possible.

Remember, the finest detection system is of little value if the H_2S gas cannot readily come into contact with the sensors.

WIRING REQUIREMENTS

The use of shielded cable is required to protect against interference caused by extraneous electrical "noise." In applications where the wiring cable is installed in conduit, the conduit must not be used for wiring to other electrical equipment. To assure proper operation of the transmitter, the resistance of the connecting wire must be within the specified limits. The maximum distance between the transmitter and power source (controller) is determined by the minimum supply voltage and wire size. See Figure 3 to determine the proper size wire and/or maximum wiring distance allowed.

Since moisture can be detrimental to electronic devices, it is important that moisture not be allowed to come in contact with the electrical connections of the system. Moisture in the air can be trapped within sections of conduit, therefore the use of conduit seals is required to prevent damage to electrical connections caused by condensation within the conduit. These seals must be water-tight and explosion-proof and are to be installed even if they are not required by local wiring codes. A seal must be located as close to the transmitter enclosure as possible. In no case should this seal be located more than 18 inches (46 cm) from the detector.

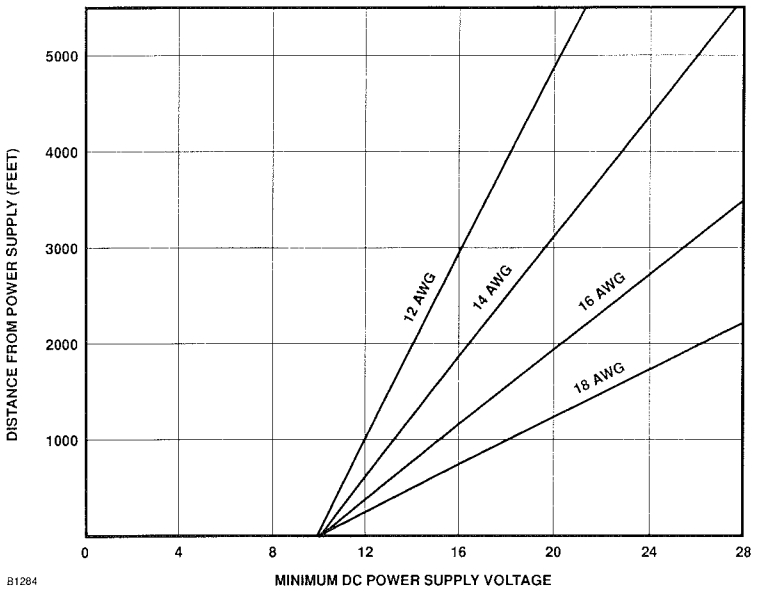

Figure 3—Transmitter Wiring Requirements

When an explosion-proof installation is required, an additional seal is also required at any point where the conduit enters a non-hazardous area. When pouring a seal, the use of a fiberdam is required to assure proper formation of the seal. The seals should never be poured in temperatures that are below freezing, since the water in the sealing compound will freeze and the compound will not dry properly. Contamination problems can then result when temperatures rise above the freezing point and the compound thaws. The shielding of the cable should be stripped back to permit the seal to form around the individual leads, rather than around the outside of the shield. This will prevent any siphoning action that might occur through the inside of the shield.

WIRING PROCEDURE

The following procedure should be used for mounting and wiring the Model 410 Transmitter.

NOTE

Do not remove the enclosure cover while power is applied.

1. The unit should be installed in a location that is best suited for covering the area to be protected, following the previously discussed guidelines. Whenever practical, it should be placed where it is easily accessible for calibration. For proper operation, the sensor should be oriented with the sintered metal opening pointing down. See Figure 2 for mounting dimensions.

2. Remove the cover from the enclosure.

3. Connect the enclosure to the conduit so that the external wiring can be installed and trimmed. The enclosure should be electrically connected to earth ground.

4. If the optional relay board is used, plug the ribbon cable on the relay board into terminal J2 on the transmitter module. Attach the relay board to the side of the transmitter module using the five screws provided.

NOTE

The transmitter contains semiconductor devices that are susceptible to damage by electrostatic discharge. An electrostatic charge can build up on the skin and discharge when an object is touched. Therefore, use caution when handling, taking care not to touch the terminals or elec-

tronic components. For more information on proper handling, refer to Service Memo form 75-1005.

5. Loosen the three mounting screws on the transmitter module, then install the module in the mounting bracket inside the enclosure and tighten the screws. See Figure 4.

6. Attach the sensor to the detector enclosure as shown in Figure 4. The sensor should be tight to ensure an explosion-proof installation, however, do **not** overtighten. Route the wires as shown. Attach the sensor plug to the transmitter module.

NOTE

Coat the sensor threads with an appropriate grease to ease both the initial installation and future replacement of the sensor. The recommended lubricant is a silicone free polyalphaolefin grease, which is available from Detector Electronics. If catalytic type combustible gas sensors are being used in conjunction with the H_2S sensors, ***silicone based lubricants should never be used,*** *since inadvertent use of a silicone lubricant on or near the combustible gas sensor will cause irreversible damage to the sensing element.*

7. Connect the power and current output leadwires to the screw terminals on the plug that is provided. Proper wire locations are indicated on the sideplate of the transmitter and also in Figure 5. See Figure 4 for proper wire length and routing. Connect the shield to earth ground at the power supply. Under normal conditions, the other end of the shield should not be connected at the transmitter unless such a connection is required by local wiring codes.

8. If an optional relay board is being used, continue with steps 9 to 11. If a relay board is not used, go to step 12.

9. See Figure 6 for connecting external loads to the relay outputs.

NOTE

Direct connection of 120/240 vac to the relay terminals inside the transmitter enclosure is

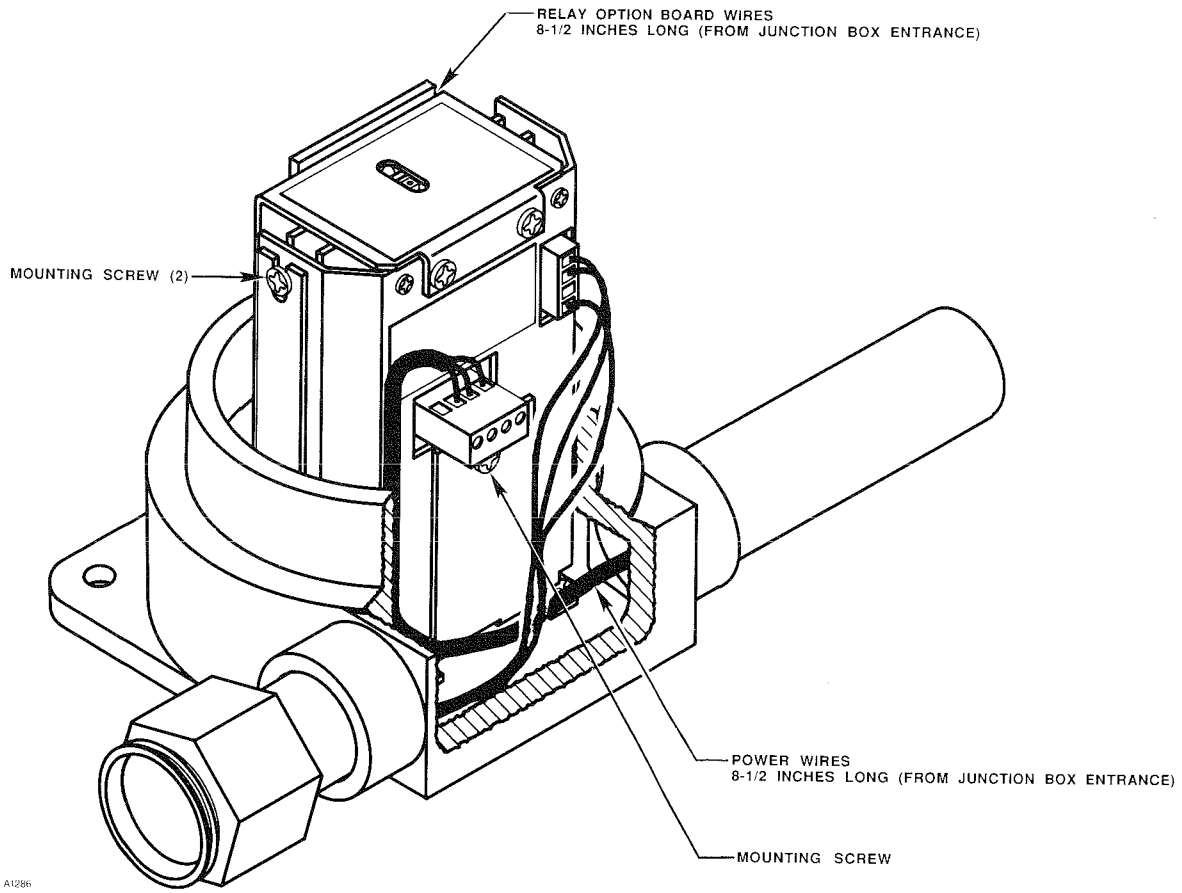

Figure 4—Detector Wiring

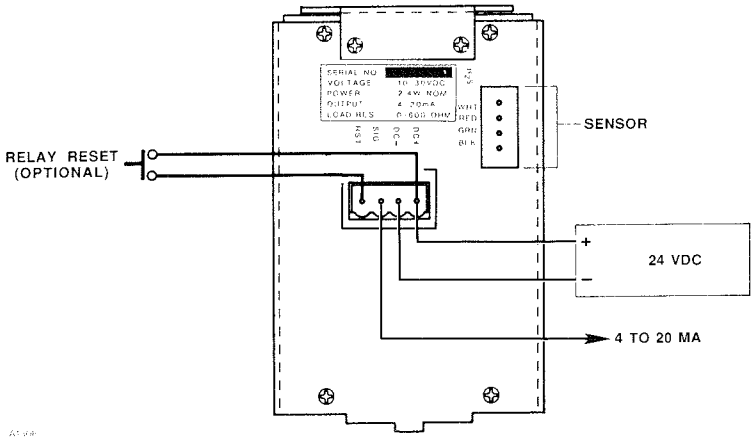

Figure 5—Transmitter Wiring

not recommended, since switching relay contacts can induce electrical noise into the electronic circuitry, possibly resulting in a false alarm or other system malfunction. If the application requires that ac powered equipment be controlled by the Model 410 Transmitter, the use of externally located relays is recommended.

10. If the optional relay board is being installed, a remotely located relay reset switch can be wired as shown in Figure 5. (The relays can also be reset using the calibration meter.) The transmitter resets the relays when the switch changes from open to closed, therefore, the switch can have either normally open or normally closed contacts. The switch must be held for approximately one second before the transmitter resets the relays.

11. The relays are programmed for normally energized or de-energized operation by placing jumper plugs on the appropriate pins at locations W1 and W2 on the relay board. W1 controls Relay No. 1 and W2 controls Relay No. 2. For normally de-energized operation, place the jumper across pins 1 and 2. For normally energized operation, place the jumper across pins 2 and 3. See Figure 6.

12. Check all field wiring to ensure that the proper connections have been made, then pour the conduit seals and allow them to dry.

13. Place the cover back on the enclosure.

NOTE

The wiring procedures in this manual are intended to ensure proper functioning of the device under normal conditions. However, because of the many variations in wiring codes and regulations, total compliance to these ordinances can not be guaranteed. Be certain that all wiring complies with applicable regulations that relate to the installation of electrical equipment in a hazardous area. If in doubt, consult a qualified official before wiring the system.

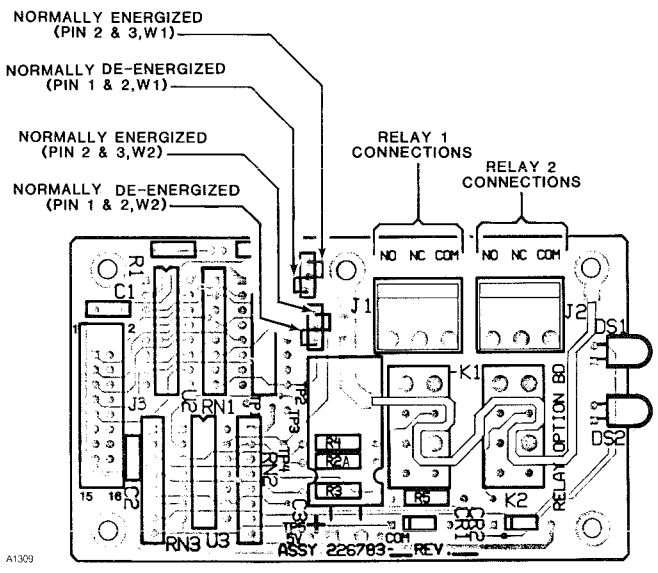

Figure 6—Relay Wiring Terminals and Programming Jumpers

TYPICAL APPLICATIONS

Various alarm indicators and response devices can be connected to the optional alarm relays. Recorders, computers, PLCs (programmable logic controllers), etc. are typically connected to the 4 to 20 ma current output. Figure 7 shows an example of typical user connections.

Refer to Figure 8 for an illustration of a typical system using a Model 410 Transmitter with either a Model 1100 or 2100 Controller. The controller can be powered by either 24 volts dc or 120 volts ac. The Model 410 receives power by direct connection to the controller.

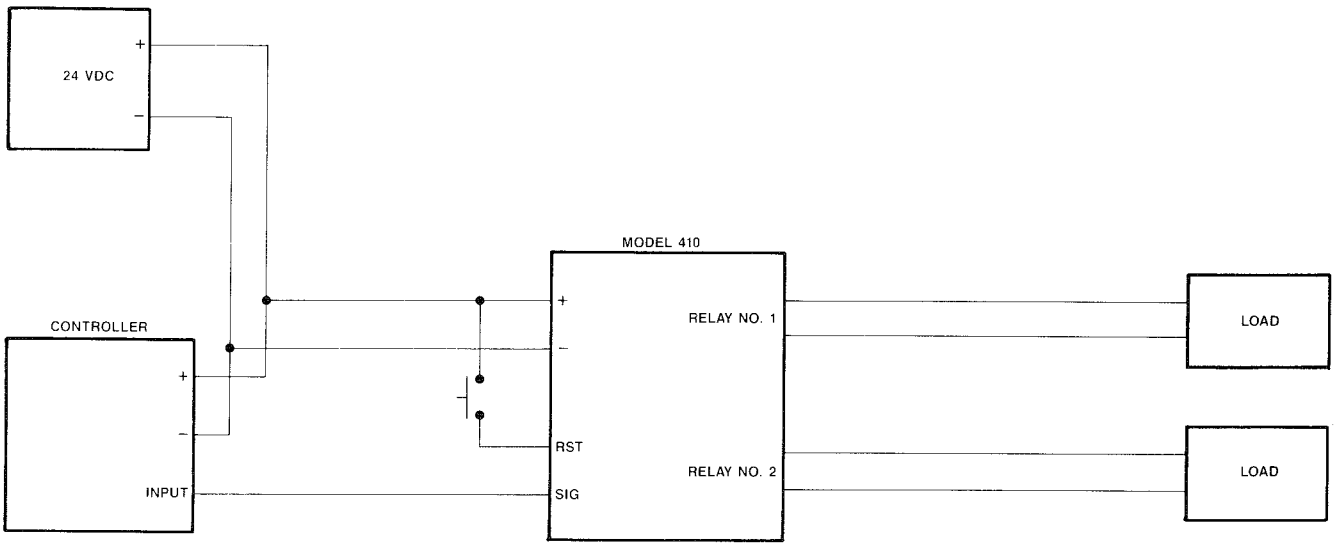

Figure 7—A Typical System

Figure 9 shows a typical system using four Model 410 Transmitters connected to a Model 8100 Controller. (A Model 8100 Controller can accommodate up to eight transmitters.) The controller is powered by an external ac input source. The transmitters are powered by connection to the controller.

For assistance in adapting a system to your individual requirements, contact the Field Support Group at Detector Electronics.

STARTUP PROCEDURE

1. Since the transmitter has not been calibrated, it is possible for a controller or other output device that is connected to it to generate an alarm output when power is applied. Therefore, output loads that are normally actuated by the system should be secured (remove power from all output devices) to prevent undesired activation of these devices.

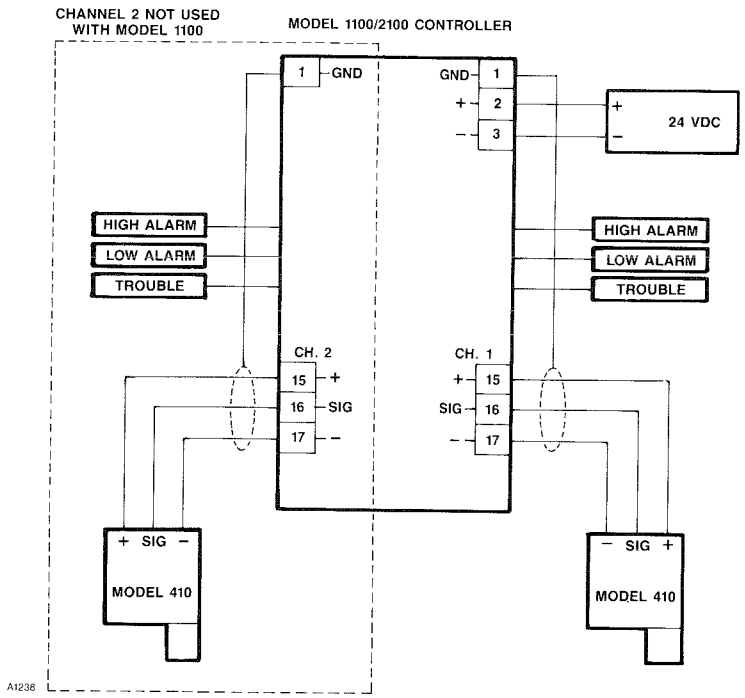

Figure 8—Model 410 with 1100/2100 Controller

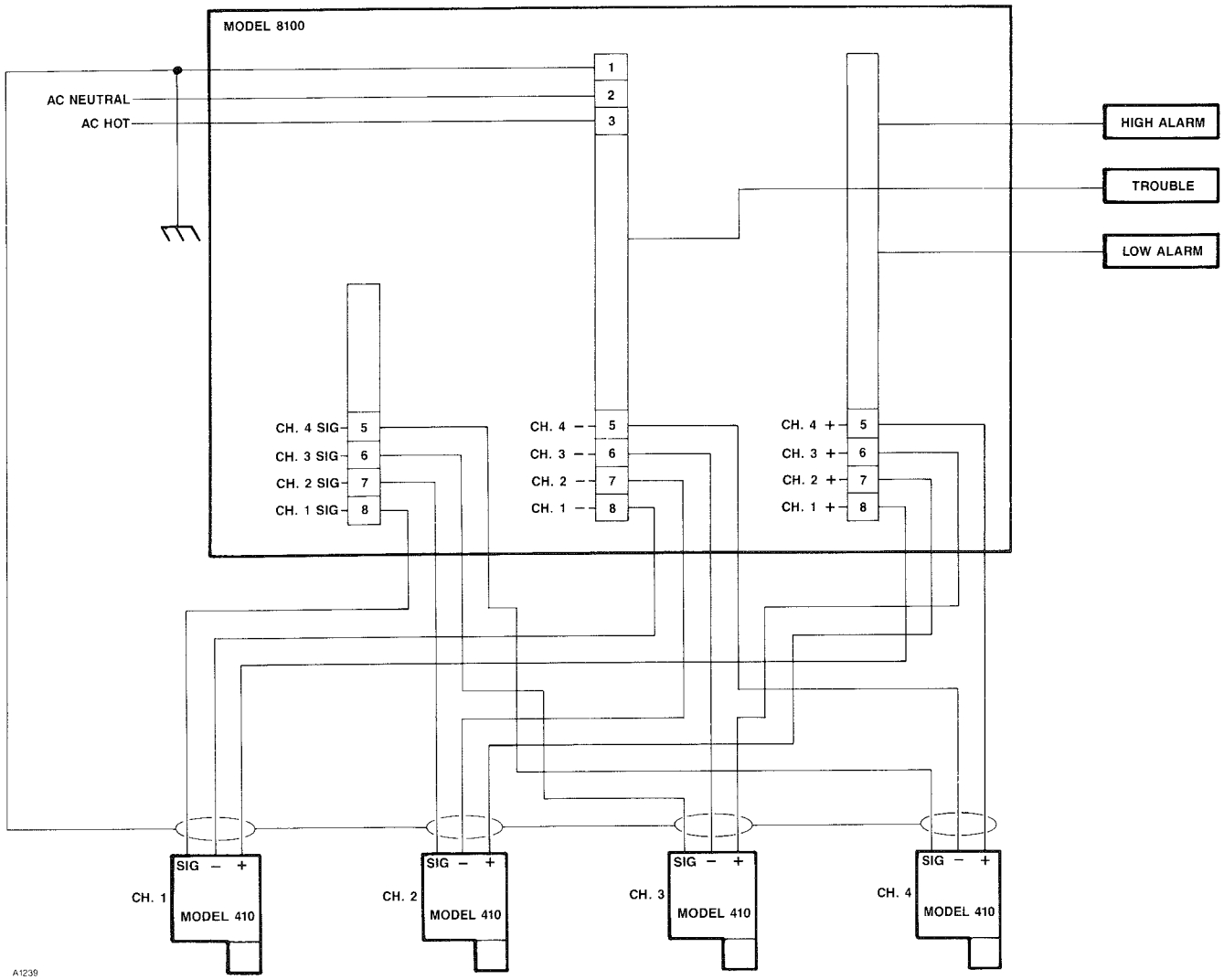

Figure 9—Model 410 with 8100 Controller

2. Double check to be sure that all external wiring has been installed properly and that the sensor has been connected properly. Be sure that the transmitter has been properly mounted inside the enclosure.

3. Apply power. The LED on the transmitter will flash several times as the transmitter performs its initialization procedure.

4. Allow the sensor to operate for about an hour, then perform the calibration procedure. Refer to the "Calibration" section of this manual for a recommended calibration schedule.

5. If the optional relay board is being used, the desired relay operation must be programmed into the transmitter using the procedure described in the "Operating the Calibration Meter" section of this manual.

NOTE

The operator can use the calibration meter to test the transmitter output signal and/or the optional relay board and reset switch functions by performing tests T4 and T2, respectively. Refer to the "Operating the Calibration Meter" section of this manual for details regarding these optional tests.

6. Remove mechanical blocking devices (if used) and restore power to the output loads.

CALIBRATION

Various factors affect the time interval between periodic calibrations. Since each application is different, the length of time between regularly scheduled calibrations can vary from one installation to the next. In general, the more frequently a system is checked, the greater the reliability. Calibration **must** be performed:

— Before a new system is initially put into service
— When the sensor is replaced
— If the transmitter is replaced.

The following calibration schedule is recommended when placing a new sensor into operation and will ensure reliable operation in most applications:

1. One hour after power-up
2. 24 hours later
3. One week later
4. Every 30 days thereafter, or as determined by the needs of the specific application.

NOTE

To ensure adequate protection, ***the H_2S detection system must be calibrated on a regular basis.*** *It must be noted that only during calibration can the system be tested to assure total function. Loss of sensitivity can be caused by various factors. One common cause is by clogging of the sintered metal filter by water, dirt, oil, paint, etc. Problems of this nature will not be detected by the system's diagnostic circuitry. Therefore, it is imperative that calibration be performed regularly. To assure the greatest level of reliability, calibration should be performed at least every 30 days.*

While performing detector calibration, the operator should also examine the sintered metal cover of the sensor. If the cover is defective or missing, the sensor **must** be replaced, since the exposed sensing element can act as an ignition source. It should also be noted that a dirty cover can significantly reduce sensor sensitivity and speed of response.

To ensure accurate calibration, gas concentrations of 10 and 40 ppm are recommended. If these values are not available, the gas used for the first calibration point must be at least 10 ppm, and the ppm level of the gas for the second calibration point must be a minimum of 30 ppm greater. In no case can the calibration gas concentration ever exceed 99 ppm. Failure to use the proper gas mixture will result in either a failed calibration attempt or an inaccurately calibrated detector.

NOTE

The calibration gas mixture must consist of hydrogen sulfide mixed with ambient air. The use of hydrogen sulfide mixed with nitrogen or dry air will not produce acceptable calibration results. The recommended calibration kit is the 226515-001 H_2S Air Dilution Calibration System, available from Detector Electronics. For the highest degree of calibration accuracy, the H_2S Air Dilution Calibration System should be calibrated with the C7064 Tester/Calibrator. Consult the factory for details.

Calibrate the system using the following procedure.

1. Verify that the area is safe for entry (no dangerous levels of either toxic or combustible gas are present).

2. Hold the calibration meter puck by the spring clip and squeeze to compress the spring. Place the puck on the window of the transmitter and release the spring clip. It should grip the cover behind the red label.

3. Turn the calibration meter on by pressing the MODE SELECT button. See Figure 10. The display should show CAL. (If the display shows "Er:X" press ENTER to clear it. If a proper display does not appear, try cleaning the window or adjusting the puck.)

4. Press the ENTER button. The meter will show "SET CAL PNT, C1:XX." "XX" is the present sensor reading.

5. Apply the 40 ppm calibration gas mixture to the sensor. When a steady reading is displayed on the calibration meter (approximately 2 minutes), note the reading that is being displayed. **Make no calibration adjustments at this time.**

6. Apply the 10 ppm calibration gas mixture to the sensor. When a steady reading is displayed on the calibration meter (approximately 2 minutes), note this reading. If the meter read from 30 to 55 ppm with 40 ppm applied **and** from 7 to 15 ppm with 10 ppm applied, the sensor is already within specification and calibration is not required. To abort the calibration, press ENTER. The meter will display "C2:XX." Press ENTER again. The meter will display "NO CAL". Remove the gas, then remove the puck **after** the reading has dropped below 3 ppm. If calibration is required, continue with step 7.

7. When the calibration meter displays a steady reading (typically within 2 to 3 minutes) press the INCREASE or DECREASE button to match the reading on the display with the actual ppm value of the calibration gas being applied (10 ppm).

NOTE

When the INCREASE or DECREASE button is pressed, the display no longer tracks the gas level being detected by the sensor. ***Do not*** *press these buttons until a steady reading is obtained.*

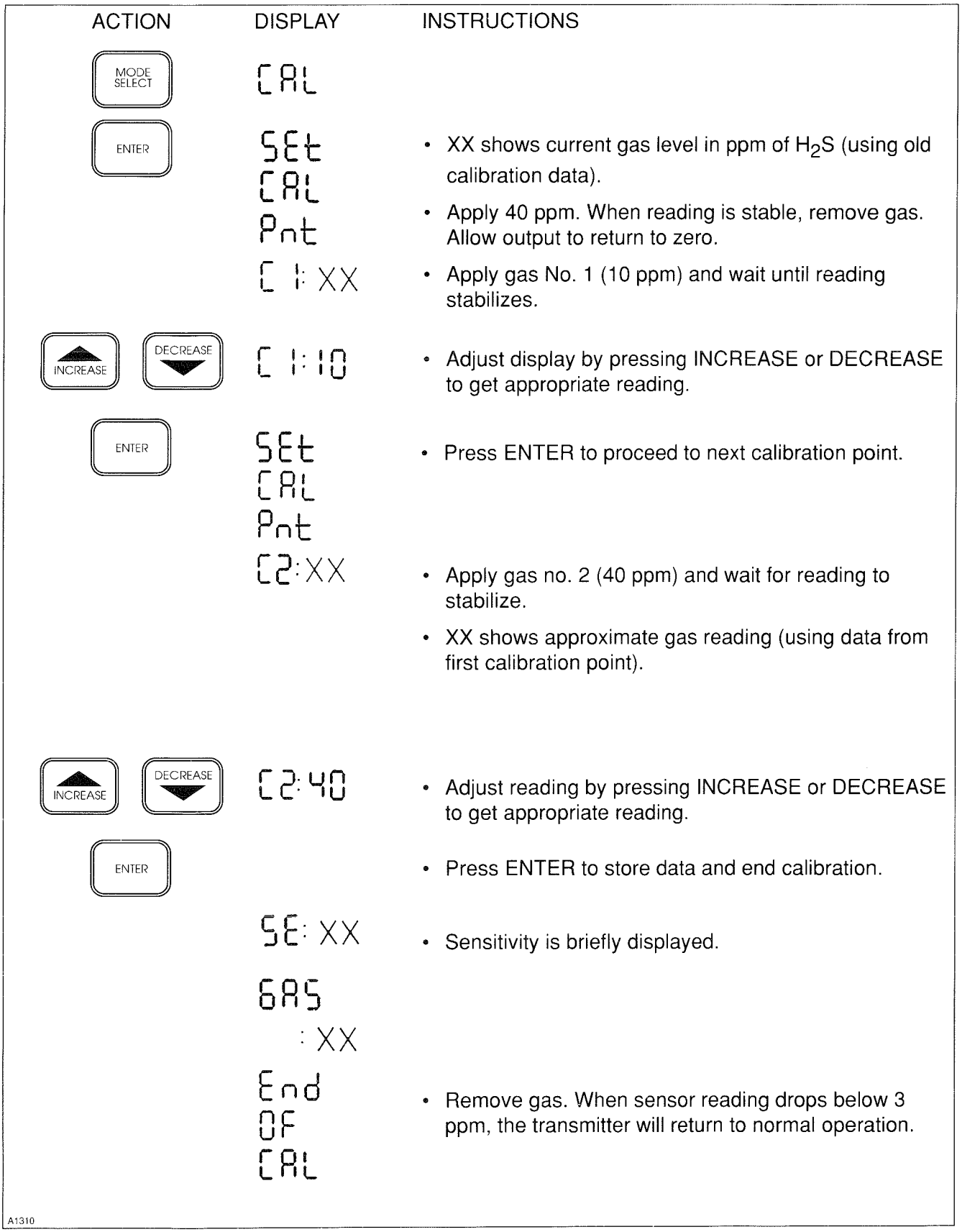

Figure 10—Transmitter Calibration

8. Press ENTER to store the data for the first calibration point. The display should now show "SET CAL PNT C2:XX."

9. Apply the gas mixture for the second calibration point (40 ppm).

10. When the reading on the calibration meter stabilizes (typically within 2 to 3 minutes), press the INCREASE or DECREASE button to adjust the reading on the display to match the level of the applied calibration gas.

11. Press ENTER to save the calibration data and end the calibration procedure. The sensor sensitivity will be displayed briefly, then the meter will alternately display "GAS" and the ppm level of the gas present at the sensor. If the display should indicate "bad," the sensor must be replaced and the calibration procedure must be repeated.

12. Shut off the gas flow and remove the cup from the sensor. The "GAS" message will continue until the gas level drops below 3 ppm or 90 seconds go by.

NOTE

An alarm indication can occur if the gas is not removed within 90 seconds after the "GAS" message appears.

13. The meter will display "END OF CAL" followed by "CAL." Press the MODE SELECT button to display "OFF," then press the ENTER button.

NOTE

The sensitivity of the sensor can be checked by pressing the SENSITIVITY CHECK button. The calibration meter then displays the sensitivity reading using a pair of two-digit numbers, separated by a colon. The value of the number on the left should be at least 10 and the number on the right should be at least 5. If ***either*** *of the readings drops below the minimum level, the sensitivity of the sensor may have decreased to an extent that a successful calibration is no longer possible.*

14. Remove the calibration meter from the transmitter.

NOTE

If the calibration meter is removed prematurely, the transmitter will automatically return to the normal operating mode after a ten minute period.

15. If a dust cover or splash shield is used, it should be checked to ensure that it is not dirty or plugged. A plugged dust cover can restrict the flow of gas to the sensing element, seriously reducing its effectiveness. For optimum performance, sensor covers/filters should be replaced at each calibration to ensure that they have not been degraded or plugged.

NOTE

If power to the transmitter is interrupted during the calibration procedure, the transmitter will automatically return to the beginning of the calibration procedure when power is restored and the calibration meter is connected.

OPERATING THE CALIBRATION METER

The calibration meter allows the operator to calibrate and program the transmitter without opening the transmitter enclosure or triggering an alarm at the controller. It can also indicate the relative sensitivity of the sensor, enabling the operator to determine when replacement of the sensor is needed. In addition, the calibration meter can be used to aid in troubleshooting sensor and transmitter problems.

The calibration meter and transmitter communicate with each other by sending and receiving a coded light signal. Message signals are generated by LEDs that are located on the "puck" of the calibration meter and on the faceplate of the transmitter. The messages are received and interpreted using photocells, along with amplifying and decoding circuitry.

The calibration meter is turned on by pressing the MODE SELECT button. It automatically turns off approximately six seconds after it stops receiving data from the transmitter.

If the light signal is weak or is blocked by dirt or other contamination on the transmitter window, the display on the calibration meter will flicker or become difficult to read. The "Poor Communication" indicator (center decimal point located below the colon on the display) will be illuminated.

Several operating modes are available for testing and programming the transmitter using the calibration meter. See Flow Chart, Figure 11. Once a mode has been entered, a number of routines can be performed before exiting that mode. The INCREASE and DECREASE buttons are used to alter the operation of the transmitter. If these buttons are not pressed, the operator can step through all the routines (except P3 and F3) without affecting the operation of the system. (The P3 and F3 routines reset the unit to the factory programmed settings.) The ENTER button is used to end a routine and return the unit to normal operation.

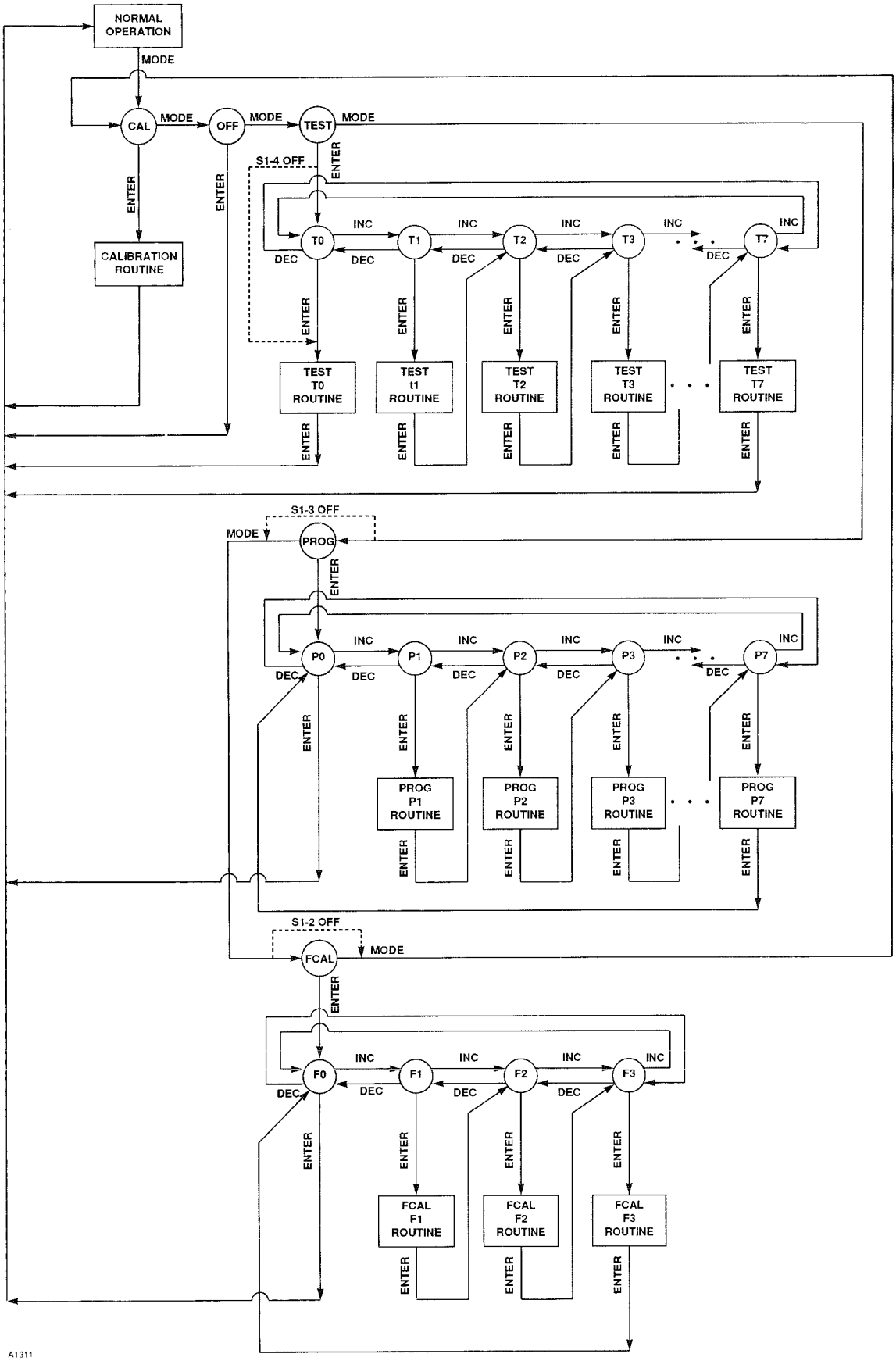

Figure 11—Calibration Meter Flow Chart

All data changes are stored in permanent memory as each routine is completed. If power is interrupted before a routine is completed, the new data is lost and the old data is retained. If the calibration meter is removed before the ENTER button is pressed for the final time to exit the last routine, the transmitter will automatically restore the old data and return to normal operation (after a 10 minute waiting period).

MODE DISABLE SWITCHES

A set of four switches is provided to prevent accidental alarms or changes to the programmable features. These switches are located on the printed circuit board inside the calibration meter as illustrated in Figure 12. All switches are set in the "off" position and must be switched on to enable the desired function.

S1-1 is not used and should remain off.
S1-2 must be on to calibrate the 4 to 20 ma output (FCAL routines).
S1-3 must be on to allow adjustments to the relay setpoints or other user programmable options.
S1-4 must be on to enable various system tests.

LOW BATTERY INDICATOR

The decimal point on the left side of the digital display flashes when the battery in the calibration meter needs to be replaced. The meter will continue to operate until the output of the LED is too low for the transmitter to detect.

NOTE

The battery should never be replaced in a hazardous area.

ERROR MESSAGES

Error codes are displayed on the calibration meter to identify various system problems. See Table 2.

Press ENTER or MODE SELECT to clear the error message and resume normal operations. All error messages except "ER:0" will be lost if the sensor is unplugged or power is removed.

TRANSMITTER PROGRAMMING

If the transmitter is equipped with the optional relay board, it must be programmed before being placed in service. Each relay must be programmed for the ppm level at which it will set (change state upon reaching the alarm setpoint level) and reset (return to its non-alarm state). In addition, four different operating modes are available for each relay to provide the set/reset characteristics required for the specific installation. The following operating modes are available:

1. **Non-Latching, Remote Reset Switch Disabled**—The relay is set when the gas concentration at the sensor reaches the alarm setpoint level and automatically resets when the gas concentration drops below the programmed reset level. The remote reset switch has no effect on relay operation in this mode.

2. **Latching, Switch Reset *Below* Reset Level**—The relay is set when the gas concentration at the sensor reaches the alarm setpoint level. The relay can be reset using the external reset switch when the level of gas goes *below* the programmed reset level.

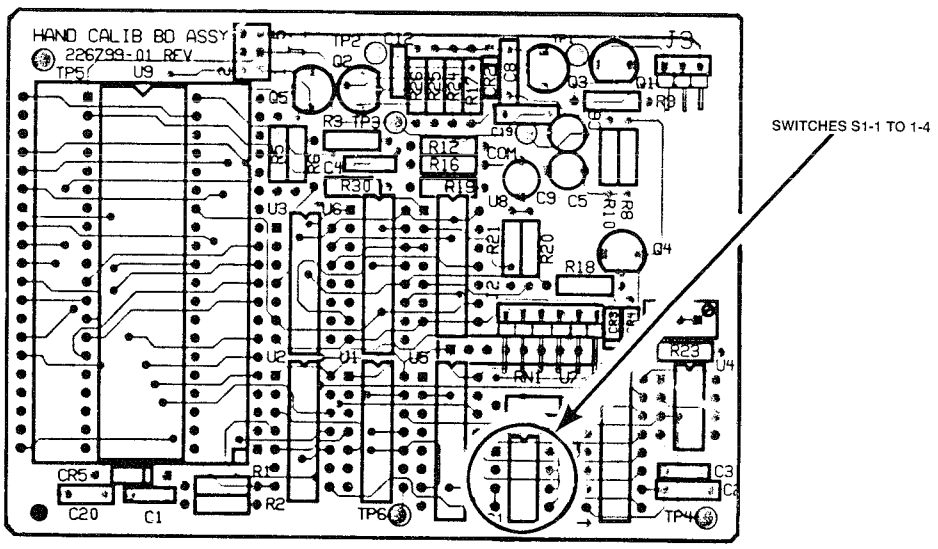

Figure 12—Mode Disable Switches

Table 2—Error Codes

Display	Possible Cause	Corrective Action
ER:0	Sensor is unplugged, Power is interrrupted.	Press ENTER or MODE SELECT
ER:1	Calibration was attempted and not completed. (The transmitter will return to normal operation using the previous calibration data after 10 minutes.)	Press ENTER or MODE SELECT to clear, then calibrate.
	Puck removed without exiting.	Press ENTER or MODE SELECT to clear.
ER:2	Noise interference problem.	Press ENTER or MODE SELECT. Locate and remove source of noise, use shielded cable.
	Communication problem between the transmitter and Calibration Meter.	Clean window on detector cover and adjust the position of the puck on the window.
ER:3	Component or EPROM failure.	Press ENTER or MODE SELECT.
ER:4	EPROM failure	Simultaneously press ENTER and MODE SELECT. If normal operation is restored, the transmitter must be recalibrated and all programming options must be checked.
ER:5	Non-recoverable PROM/RAM failure.	Remove power and try a restart. If the failure persists, the unit must be returned to the factory for repair.

3. **Latching, Switch Reset at *Any* Level**—The relay is set when the gas concentration at the sensor reaches the alarm setpoint level. The relay is reset using the external reset switch at any time, even if the gas level is above the reset level. However, after the relay is reset, it cannot be set again until the gas concentration at the sensor drops below the reset level and then rises to the programmed set level.

4. **Latching, Calibration Meter Reset**—The relay is set when the gas concentration at the sensor reaches the alarm setpoint level and must be reset using the calibration meter.

Calibration Meter Reset

When resetting the relays with the calibration meter, the gas concentration at the sensor must be below the programmed reset level for the relays to remain reset. If the gas concentration is above the reset level, the relay will return to the alarm condition when the calibration meter is removed. To reset the relays, attach the calibration meter to the transmitter enclosure and turn on the meter by pressing the MODE SELECT button. The relays will reset. The meter can be turned off by pressing MODE SELECT until "OFF" is displayed, and then pressing ENTER.

Factory Settings

The factory settings for the transmitter are as follows. (To return the transmitter to the factory settings, perform routine P3 or F3.)

Relay 1	Set level =	20 ppm
	Reset level =	15 ppm
	Operating mode =	Auto Reset with Reset Switch Input Disabled

(Use routine P1 for changes.)

Relay 2 Set level = 40 ppm
Reset level = 35 ppm
Operating mode = Auto Reset with Reset Switch Input Disabled
(Use routine P2 for changes.)

Signal Output During Calibration = –2 ppm
Alternating Signal Feature = Off
(Use routine P4 for changes.)

Operating Range = 0 to 100 ppm full scale.
(Use routine P5 for changes.)

Mode Selection

The calibration meter operates in any of the following modes.

Calibrate — Used to calibrate the system.

Off — The only mode in which the puck can be removed without generating a fault indication.

Test — Used to perform various system tests (switch S1-4 must be on to enable this mode.)

Program — Used to select setpoints, relay reset options, and various other system options. (Switch S1-3 must be on to enable this mode.)

FCAL — Used to calibrate the 4 to 20 ma output. (Switch S1-2 must be on to enable this mode.)

To turn the calibration meter on, press the MODE SELECT button. See Figure 11. The meter displays "CAL." To enter the calibrate mode press "ENTER." To enter one of the other modes, press the MODE SELECT button until the desired mode is indicated on the display, then press "ENTER" to enter that mode.

After exiting a mode, the unit will return to the "CAL" mode. The operator can then select and enter the desired mode, or **turn the calibration meter off** by selecting "OFF" and pressing ENTER.

NOTE

If the calibration meter is removed before selecting "OFF", the transmitter will automatically return to the normal operating mode after a 10 minute waiting period.

Programming Procedures

Programming changes are made to the Model 410 Transmitter by performing the following routines using the Program mode. (Switch S1-3 inside the calibration meter must be on.)

P0

The P0 routine is used to exit the Program mode. With "P0" displayed on the calibration meter, press ENTER. The meter will show "CAL." Press MODE SELECT to select the desired mode, or select "OFF" to turn the calibration meter off.

P1

The P1 routine allows the operator to program the set and reset levels for relay number 1 and also determines the method of resetting the relay.

1. Press the MODE SELECT button to show "prog" on the display. See Figure 13.
2. Press ENTER. The display shows "P0."
3. Press INCREASE to advance to "P1."
4. Press ENTER. The display shows "relay.1," "St:XX." Press INCREASE or DECREASE to display the desired relay set level.
5. Press ENTER. The display shows "rt:XX."
6. Press INCREASE or DECREASE to display the desired relay reset level.
7. Press ENTER. The display shows "r1:XX."
8. Program the relay operating mode by pressing INCREASE or DECREASE to achieve the desired reading.
9. Press ENTER. The display shows four dashes and then "P2."
10. To continue with routine P2, press ENTER (step 4 below). To exit, press DECREASE to show "P0" on the display. (The display must show "P0" to exit this operating mode.) Press ENTER. The display shows "CAL." (See the "Mode Selection" section for information regarding selection of a different operating mode or turning off the calibration meter.)

P2

The P2 routine allows the operator to program the set and reset levels for relay number 2 and also determines the method of resetting the relay.

1. Press the MODE SELECT button to show "prog" on the display. See Figure 14.

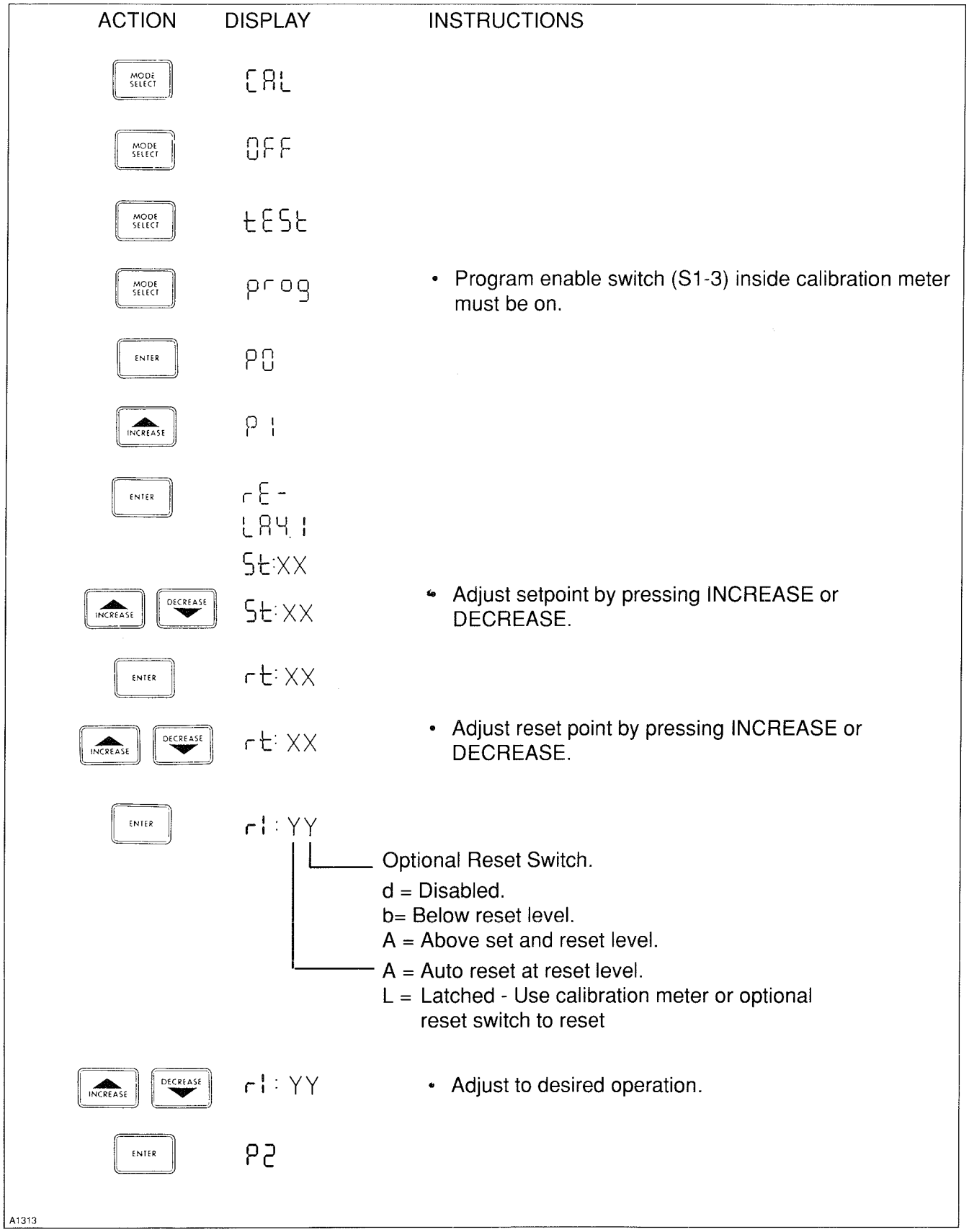

Figure 13—P1 Routine

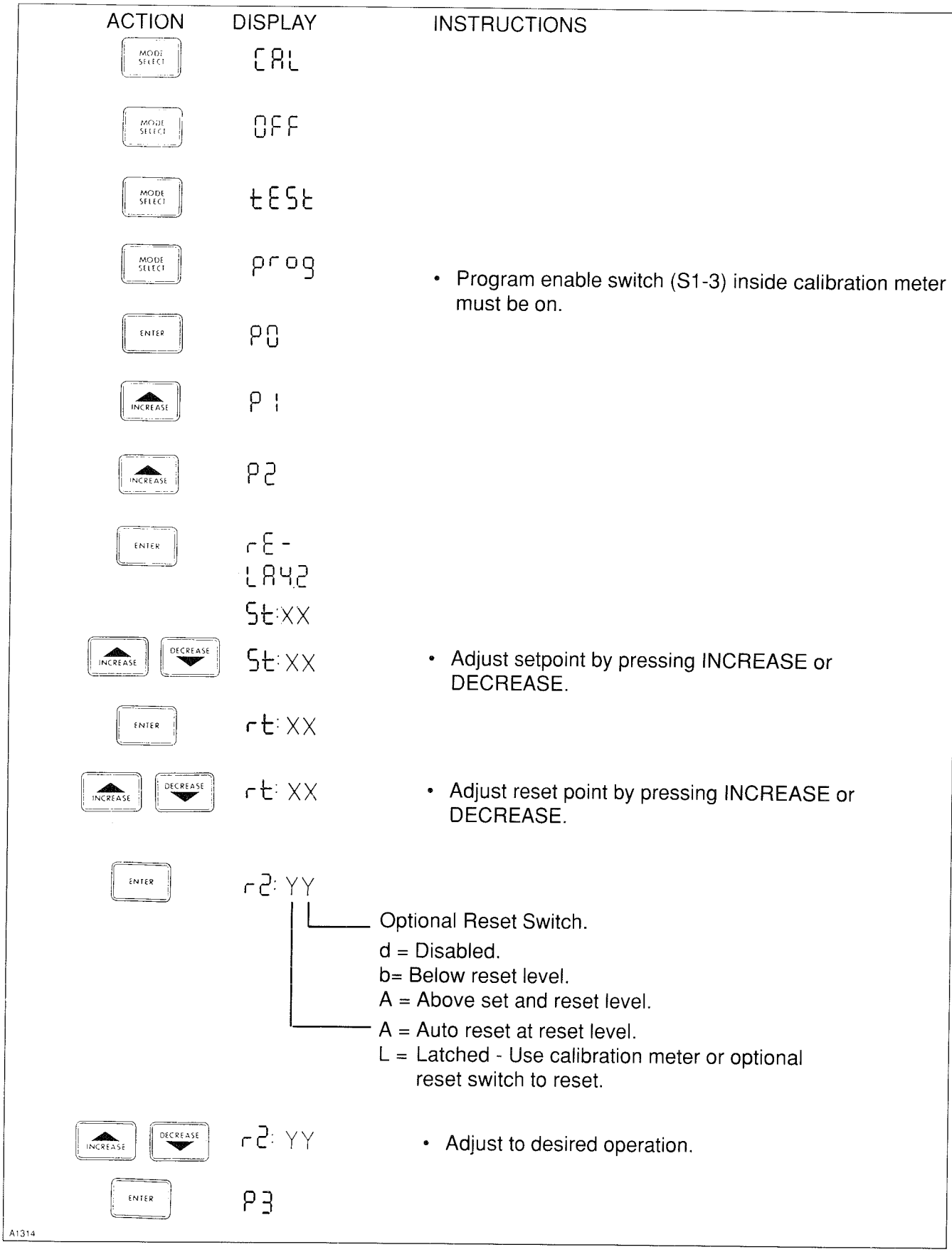

Figure 14—P2 Routine

2. Press ENTER. The display shows "P0."

3. Press INCREASE to advance to "P2."

4. Press ENTER. The display shows "relay.2," "St:XX." Press INCREASE or DECREASE to display the desired relay set level.

5. Press ENTER. The display shows "rt:XX."

6. Press INCREASE or DECREASE to display the desired relay reset level.

7. Press ENTER. The display shows "r2:XX."

8. Program the relay operating mode by pressing INCREASE or DECREASE to achieve the desired reading.

9. Press ENTER. The display shows four dashes and then "P3."

10. To continue with P3, press ENTER (step 4 below). To exit, press DECREASE to show "P0" on the display. Press ENTER. The display shows "CAL".

P3

The P3 routine is used to program the transmitter to the factory settings.

1. Press the MODE SELECT button to show "Prog" on the display. See Figure 15.

2. Press ENTER. The display shows "P0."

3. Press INCREASE to advance to "P3."

4. Press ENTER. The display shows four dashes followed by "Std OPt SEt," followed by "P4."

5. To continue with P4, press ENTER (step 4 below). To exit press DECREASE to show "P0" on the display. Press ENTER. The display shows "CAL."

P4

The P4 routine allows the operator to program the current output level that the transmitter will generate during calibration. The adjustment range is from –25 to 100 ppm (0 to 20 milliamperes). The transmitter also offers the option of alternating this signal level with 4.0 milliamperes (0 ppm) to achieve a unique "flashing" signal during calibration.

1. Press the MODE SELECT button to show "prog" on the display. See Figure 16.

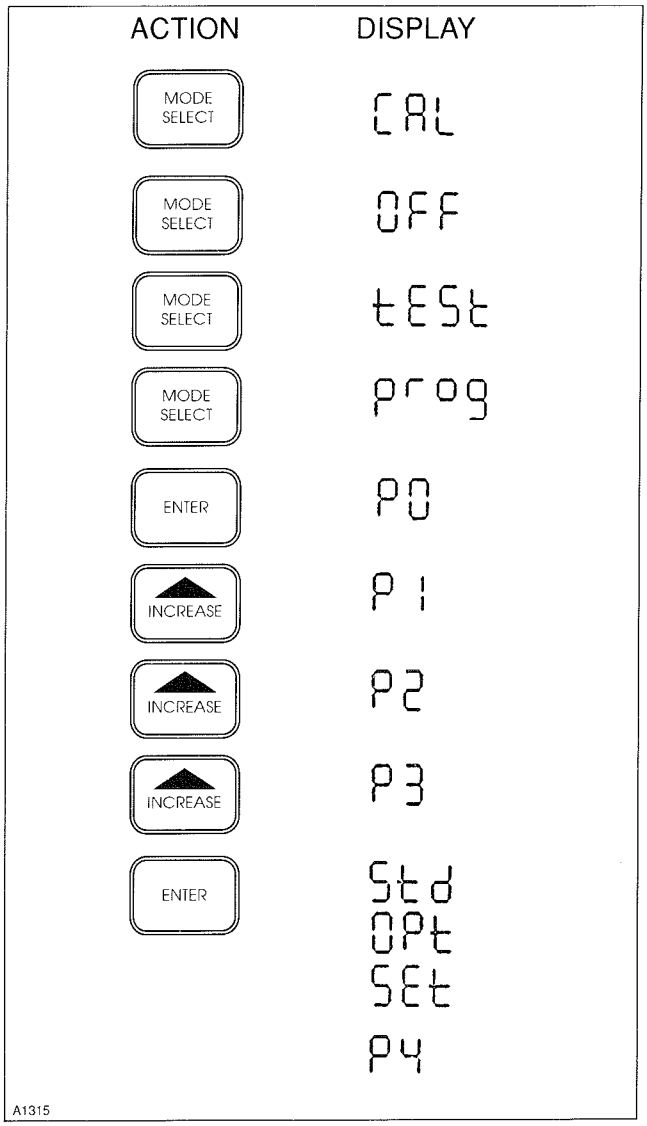

Figure 15—P3 Routine

2. Press ENTER. The display shows "P0."

3. Press INCREASE to show "P4" on the display.

4. Press ENTER. The display shows "P4:XX." "XX" is the calibration output signal level in ppm. Note that the signal output changes as this value is adjusted.

5. Press INCREASE or DECREASE to select the desired level.

6. Press ENTER. The display shows either "F:OFF" or "F:ON" to indicate the status of the flashing calibration output signal option.

7. Press INCREASE or DECREASE to select the desired option.

8. Press ENTER. The display shows four dashes followed by "P5."

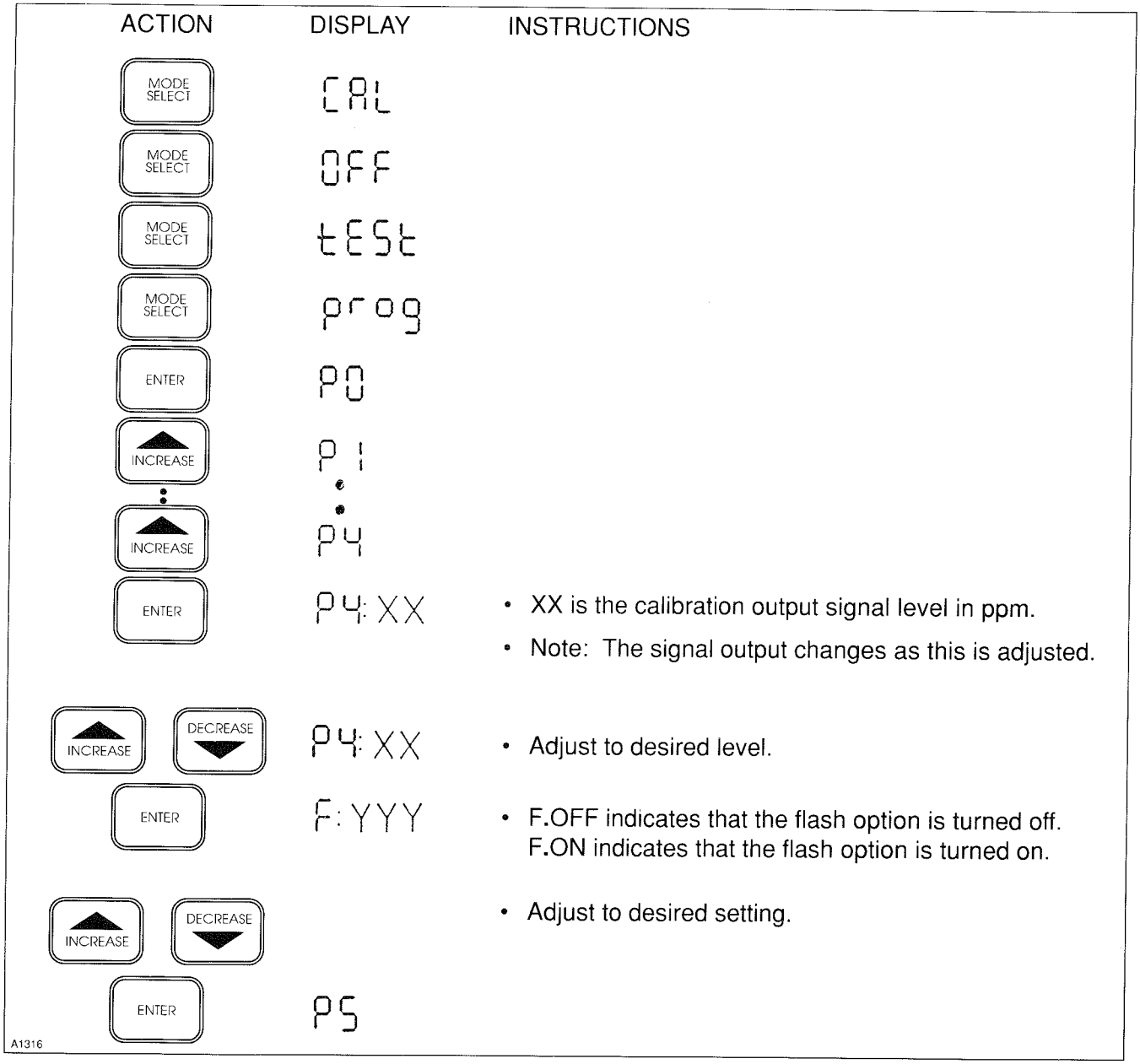

Figure 16—P4 Routine

9. To continue with P5, press ENTER (step 4 below). To exit press DECREASE to show "P0" on the display. Press ENTER. The display shows "CAL."

P5

The P5 routine allows the operator to select a full scale range of 0 to 25 ppm, 0 to 50 ppm, or 0 to 100 ppm. (Select the 0 to 100 ppm range when using Det-Tronics Model 1100, 2100, and 8100 Controllers.)

1. Press the MODE SELECT button to show "prog" on the display. See Figure 17.
2. Press ENTER. The display shows "P0."
3. Press INCREASE to advance to "P5."
4. Press ENTER. The display shows "Full SCL At: XXX." XXX is the full scale level in ppm.
5. Press INCREASE or DECREASE to select the desired operating range.
6. Press ENTER. The display shows four dashes followed by "P6."
7. To exit press DECREASE to show "P0."
8. Press ENTER. The display shows "CAL."

P6 and P7

Not used.

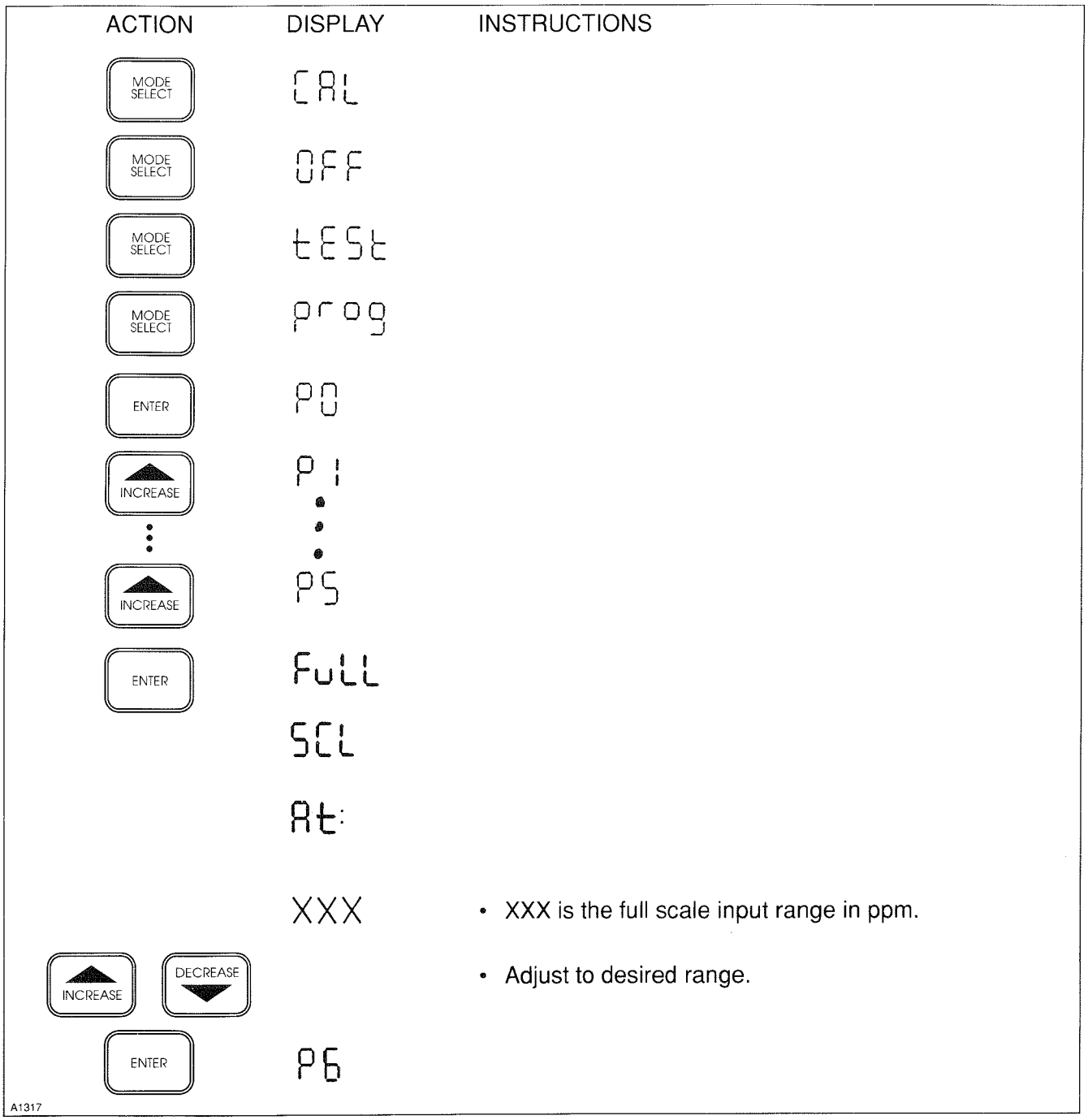

Figure 17—P5 Routine

FCAL

FCAL is a mode that is used to calibrate the 4 to 20 milliampere output signal. (Switch S1-2 inside the calibration meter must be on.)

F1

The F1 routine allows the operator to adjust the transmitter output signal for 4.0 ma with 0 PPM at the sensor.

1. Press the MODE SELECT button to show "FCAL" on the display.
2. Press ENTER. The display shows "F0."
3. Press INCREASE to advance to "F1."
4. Press ENTER. While monitoring the current output, press INCREASE or DECREASE to adjust the output to 4.0 ma, ±0.02 ma.

5. Press ENTER. The display shows four dashes followed by "F2."

6. To continue with the F2 routine, press ENTER (step 4 below). To exit, press DECREASE to show "F0" on the display. (The display must show "F0" to exit this operating mode.) Press ENTER. The display shows "CAL." (See the "Mode Selection" section for information regarding selection of a different operating mode or turning off the calibration meter.)

F2

The F2 routine allows the operator to adjust the transmitter output signal for 20.0 ma with 100 PPM at the sensor.

1. Press the MODE SELECT button to show "FCAL" on the display.

2. Press ENTER. The display shows "F0."

3. Press INCREASE to advance to "F2."

4. Press ENTER. While monitoring the current output, press INCREASE or DECREASE to adjust the output to 20.0 ma, ±0.02 ma.

5. Press ENTER. The display shows four dashes followed by "F3."

6. To continue with F3 (F3 programs the transmitter to the factory settings), press ENTER (step 4 below). To exit, press DECREASE to show "F0" on the display. Press ENTER. The display shows "CAL."

F3

The F3 routine is used to reset the transmitter to the factory settings (same as P3).

1. Press the MODE SELECT button to show "FCAL" on the display.

2. Press ENTER. The display shows "F0."

3. Press INCREASE to advance to "F3."

4. Press ENTER. To exit press DECREASE to show "F0" on the display. Press ENTER. The display shows "CAL."

System Tests

The following system tests are performed using the Test mode. (Switch S1-4 should be on at this time.)

T0

T0 is used to exit the Test mode. To exit, with T0 displayed, press and hold the ENTER button to display four dashes, release and press ENTER again to display "CAL."

T0 is also used to display the position of the calibration meter switches.

1. Press the MODE SELECT button to display "test" on the digital display. See Figure 18.

2. Press ENTER. The display shows "t0."

3. Press ENTER. The display shows the switch positions using the pattern illustrated in Figure 18.

4. To exit, press and hold ENTER until the display shows "CAL."

TEST T1

Test T1 gives a direct ppm reading on the calibration meter and is useful for verifying proper operation of the entire system from the sensor to the controller.

1. Press the MODE SELECT button to display "test" on the digital display. See Figure 19.

2. Press ENTER. The display shows "t0."

3. Press INCREASE to advance to "t1."

4. Press ENTER. The display shows "t1:XX." XX is the ppm level of H_2S gas currently being detected at the sensor.

5. Press ENTER. The display shows "t2."

6. To continue with T2, press ENTER (step 4 below). To exit press DECREASE to show "t0." (The display must show "t0" to exit the test mode.) Press ENTER. The display shows "CAL." (See the "Mode Selection" section for information regarding selection of a different operating mode or turning off the calibration meter.)

TEST T2

Test T2 allows the operator to actuate the relays on the relay board. It also indicates a signal from the optional external reset switch.

CAUTION

This routine cause actuation of the alarm relays. Response devices that are connected to the

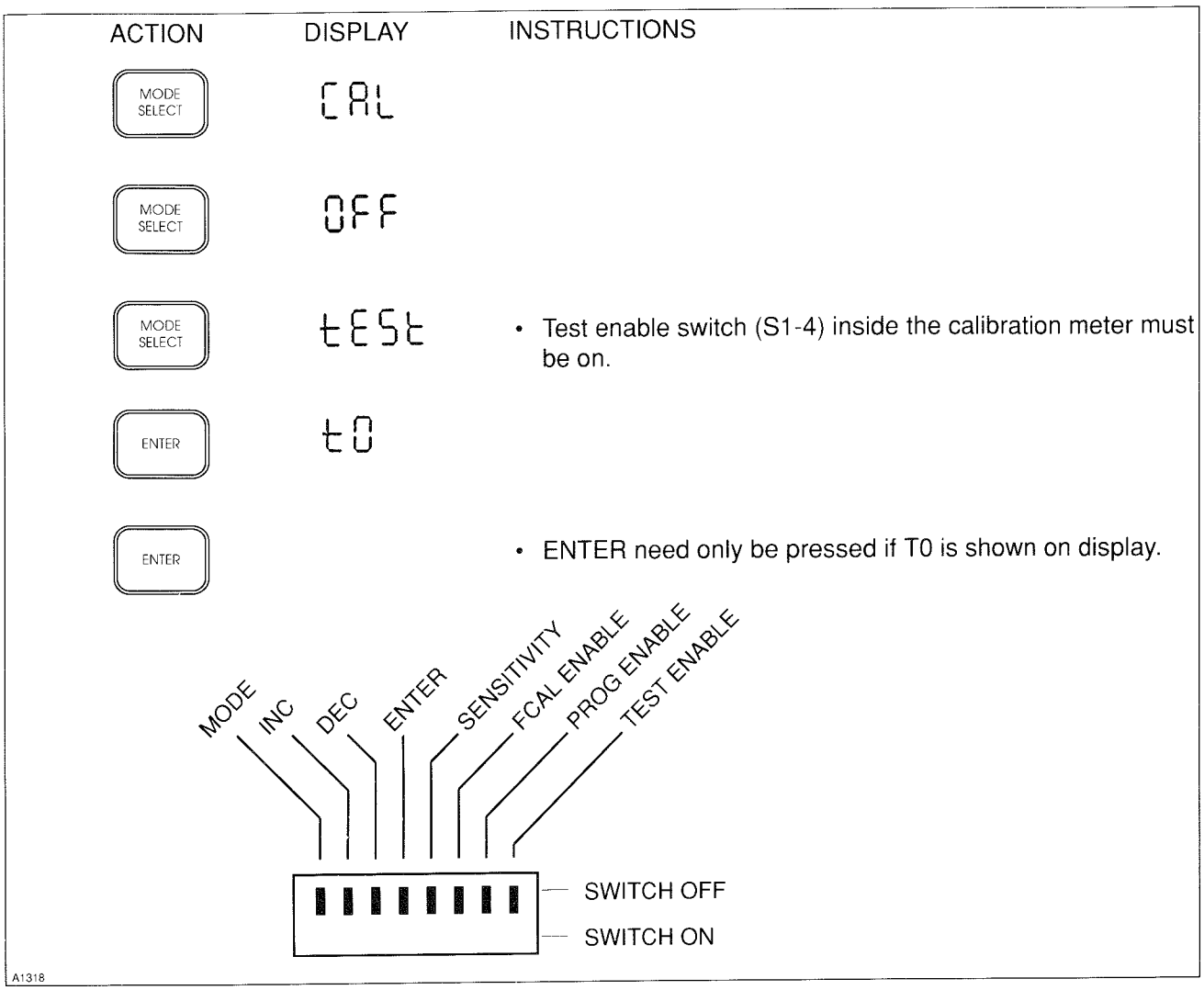

Figure 18—T0 Routine

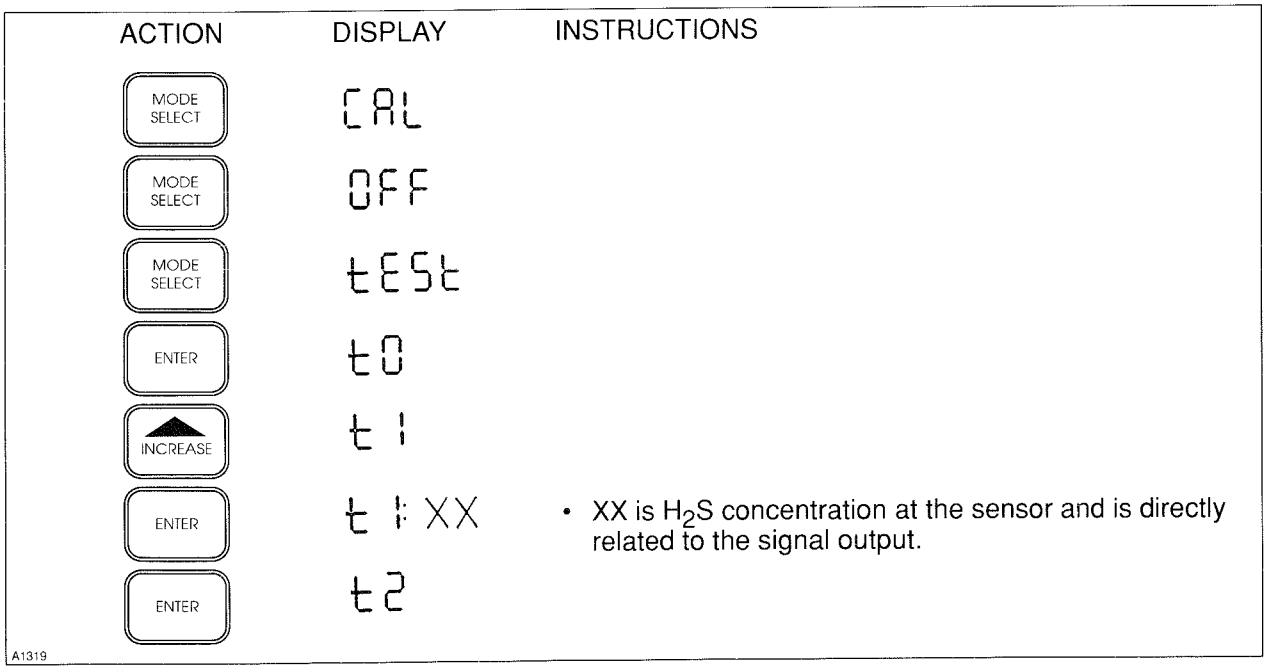

Figure 19—T1 Routine

relays should be disabled to prevent unwanted activation.

1. Press the MODE SELECT button to show "test" on the digital display. See Figure 20.
2. Press ENTER. The display shows "t0."
3. Press INCREASE to advance to "t2."
4. Press ENTER. The display shows the pattern illustrated in Figure 20. An "on" indication means

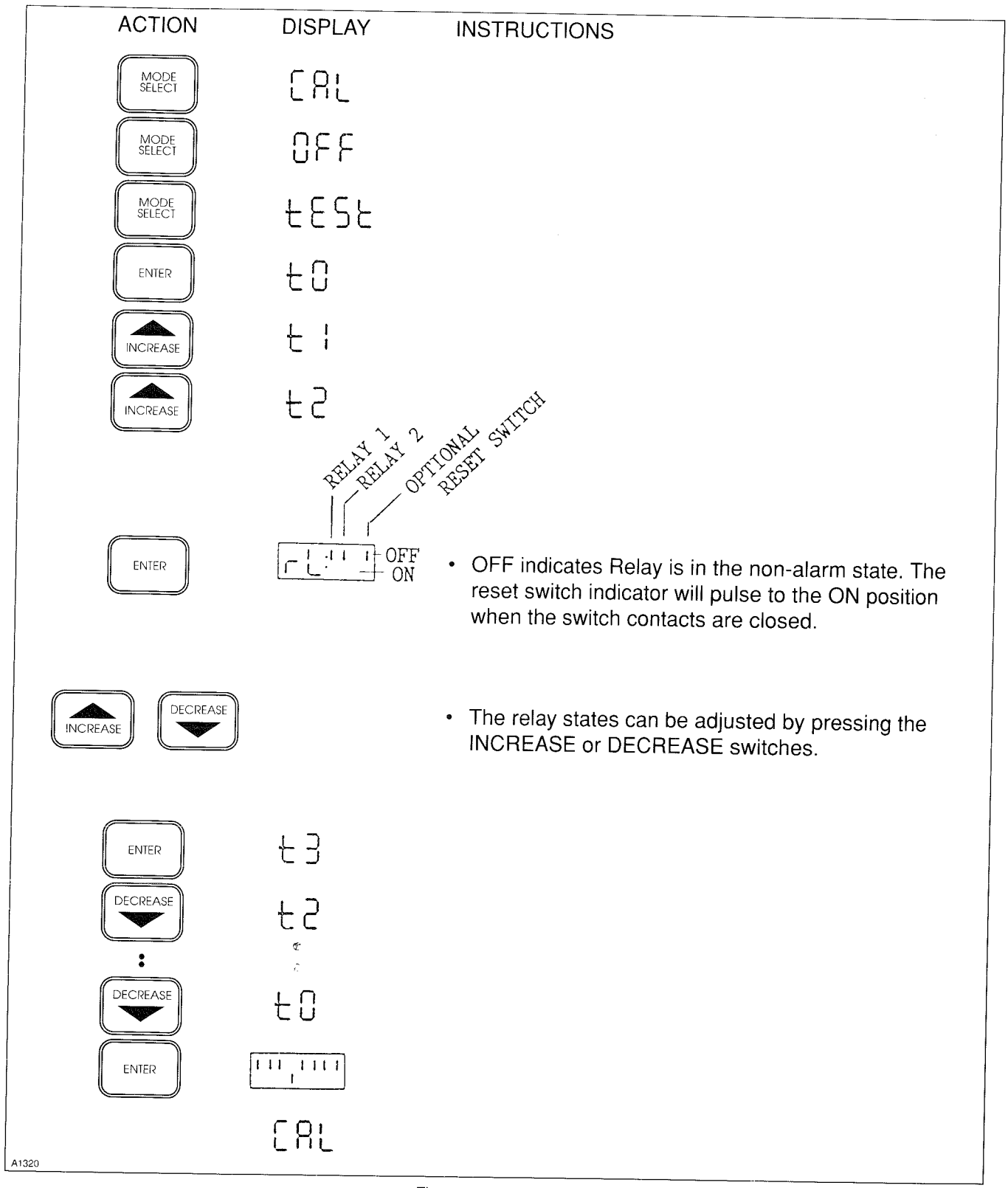

Figure 20—T2 Routine

that the relay is in its alarm state. The reset switch indicator goes to the "on" position when the reset switch contacts are closed.

5. Press INCREASE or DECREASE to change the relay states.

6. Press ENTER. The display shows "t3."

7. To exit press DECREASE to show "t0." Press and hold ENTER. The display shows "CAL."

TEST T3

A production test.

TEST T4

Test T4 allows the operator to vary the output signal from the transmitter. The corresponding ppm level is shown on the digital display.

CAUTION

This routine causes an increase in the dc current output signal. Alarm response devices should be disabled to prevent unwanted actuation.

1. Press the MODE SELECT button to show "test". See Figure 21.

2. Press ENTER. The display shows "t0."

3. Press INCREASE to show "t4."

4. Press ENTER. The display shows "t4:XX." XX is the ppm level of the output signal.

5. Press INCREASE or DECREASE to test controller response to the varying output signal from the transmitter.

6. Press ENTER. The display shows "t5."

7. To exit press DECREASE to show "t0" on the display.

8. Press and hold ENTER. The display shows "CAL."

TESTS T5 TO T7

Factory tests.

MAINTENANCE

To ensure that the H_2S detection system will deliver reliable protection, it is important that it be calibrated and checked on a regularly scheduled basis. The frequency of these checks is determined by the requirements of the particular installation.

VISUAL INSPECTION

The operator should frequently inspect the sintered metal filter (flame arrestor) on the sensor. If it is defective or missing, the sensor must be replaced immediately, since an exposed sensing element can act as an ignition source. This filter must also be kept clean. A dirty filter can significantly reduce the amount of H_2S gas that is able to reach the sensing element, thereby impairing the ability of the system to respond to a hazardous condition.

MANUAL CHECK OF OUTPUT DEVICES

Fault detection circuitry continuously monitors for various problems that could prevent proper response to a dangerous level of H_2S, however, it does not monitor external equipment that is actuated by the detection system. It is important that these devices be checked initially when the system is installed, as well as periodically during the ongoing maintenance program.

CHECKOUT IN NORMAL MODE

The entire system should be checked periodically to ensure that the presence of H_2S at the sensor will result in the proper system response. Refer to the "Operating the Calibration Meter" section for information regarding system tests using the calibration meter.

CAUTION

Be sure to secure all output devices that are controlled by the detector to prevent unwanted actuation of this equipment, and remember to place these same output devices back into service when the checkout is complete.

SENSOR REPLACEMENT

The area must be de-classified as non-hazardous prior to replacing the sensor. To replace the sensor:

1. Begin the normal calibration procedure as described in the "Calibration" section. Stop at step 4 when the display shows C1:XX. (With the transmitter in the calibrate mode, the controller cannot generate either a fault or an alarm output.)

2. Remove power from the transmitter. (When power is restored, the transmitter will return to the calibrate mode.)

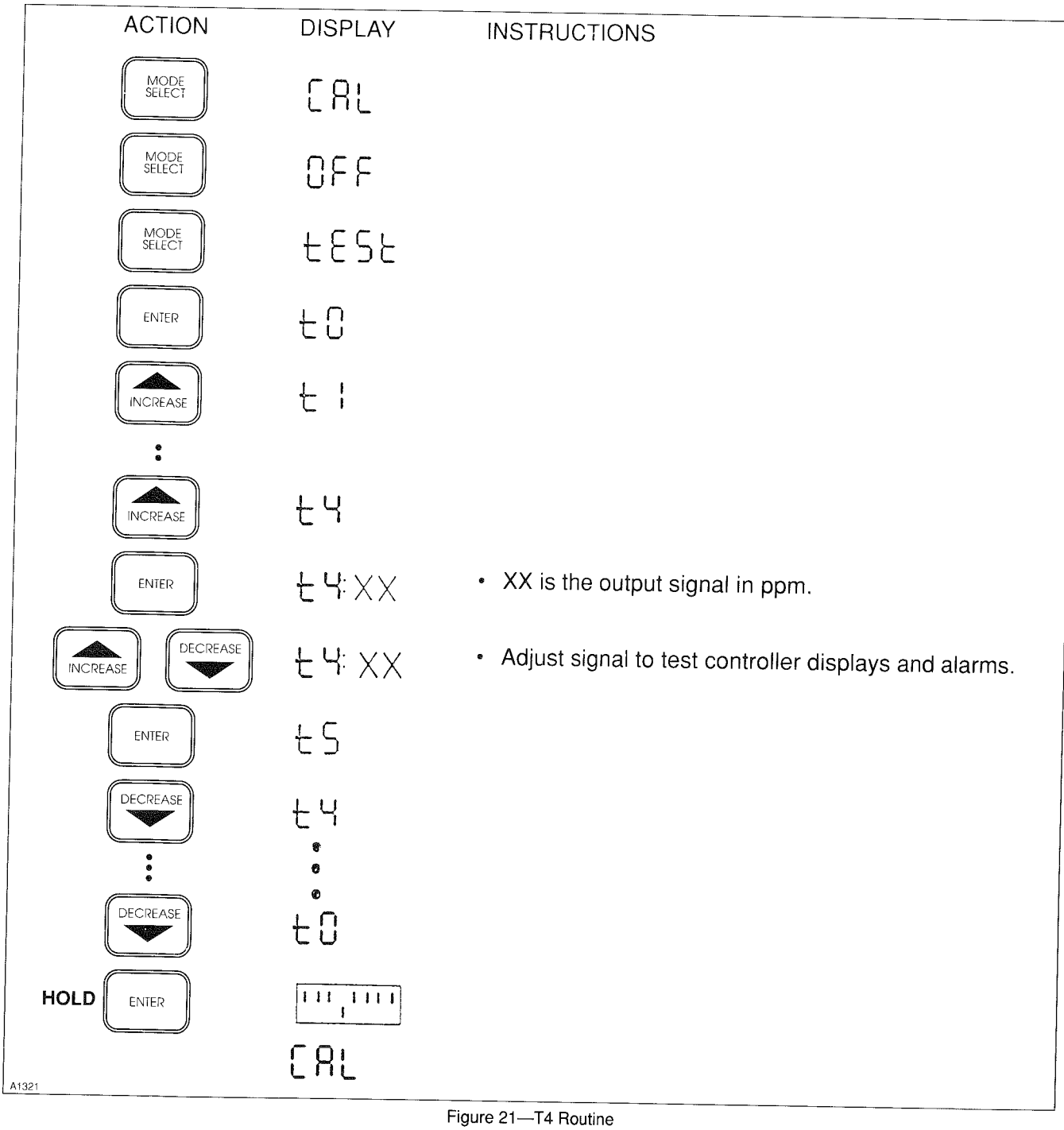

Figure 21—T4 Routine

3. Remove the cover from the transmitter enclosure. Unplug the sensor and unscrew it from the enclosure.

4. Bend the wires on the new sensor at a right angle approximately 2-1/2 inches from the plug. This will make it easier to slide the plug past the wires and electronics inside the enclosure. Screw the sensor into the enclosure and plug it into the transmitter.

NOTE

Applying a thin coating of grease to the threads of the sensor will aid in installation and future removal of the sensor. The recommended grease is a silicone free polyalphaolefin grease available from Detector Electronics.

5. Replace the transmitter cover.

6. Apply power to the transmitter.

Table 3—Troubleshooting Chart

Symptom	Possible Cause
Calibration meter display blank	Meter not properly attached to transmitter.
Calibration meter or controller reads –25 ppm	Bad sensor or sensor not connected. No power to transmitter. Open or shorted transmitter wiring.
Transmitter LED does not light briefly when power is applied.	No power, low power, or wrong polarity.
Transmitter LED stays on with no flashing.	Sensor unplugged or damaged.
Transmitter LED flashes rapidly and calibration meter does not show valid display.	Low power to transmitter. Excessive transmitter power wire resistance. Large ac ripple on power wires.
Calibration meter displays improper output or does not respond to pressed switches.	Dirty window on puck or transmitter. Poor alignment of LED and photocell.
Controller displays full scale reading.	High level of H_2S at sensor. Calibration error. Sensor wire shorted.

7. Press MODE SELECT to turn on the calibration meter. The display shows "Er: 0." Press ENTER. The display shows "C1:XX."

8. Continue with the calibration procedure as described in the "Calibration" section of this manual.

Refer to the "Calibration" section of this manual for the recommended calibration schedule for a new sensor.

A test form is supplied at the rear of this manual for recording maintenance performed on the system.

TROUBLESHOOTING

Table 3 is intended to serve as an aid in locating the cause of a system malfunction. If an error code is displayed on the calibration meter, refer to Table 2 in the "Operating the Calibration Meter" section of this manual.

NOTE

Record all faults on the Fault Record Sheet supplied in the back of this manual.

REPLACEMENT PARTS

The Model 410 is not designed to be repaired by the customer in the field. If a problem should develop, first carefully check for proper wiring, programming, and calibration. If it is determined that the problem is caused by a defect within the electronic module, it should be returned to the factory for repair.

The sensing element is mounted in a sealed housing and is not intended to be repaired or replaced. When calibration can no longer be properly performed, the sensor must be replaced. An adequate supply of spare sensors should be kept on hand for field replacement.

NOTE

For maximum protection against contamination and deterioration, the sensor should not be removed from the original protective packaging until the time of installation. In addition, power should be applied to the sensor as soon as possible after installation. If the system is not powered for more than a day, the red plastic cover should be placed back on the sensor.

Always calibrate the system after replacing either the electronic module or the sensor.

Refer to the "Ordering Information" section of this manual for a list of part numbers.

DEVICE REPAIR AND RETURN

Prior to returning devices or components, contact the nearest local Detector Electronics office so that an RMI (Return Material Identification) number can be assigned. A written statement describing the malfunction must accompany the returned device or component to expedite finding the cause of the failure, thereby reducing the time and cost of the repair to the customer.

Pack the unit or component properly. Use sufficient packing material in addition to an anti-static bag or aluminum-backed cardboard as protection from electrostatic discharge.

Return all equipment transportation prepaid to the Minneapolis location.

Office Locations

Detector Electronics Corporation
6901 West 110th Street
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Cable DETRONICS
Facsimile (612) 829-8750

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Det-Tronics Asia Pacific Office
47 Loyang Way
SINGAPORE 1750
Telephone 65-54-27 816
Facsimile 65-54-27 820

ORDERING INFORMATION

The sensor must be ordered separately from the Model 410 Transmitter. When ordering please specify:

226908-001	Model 410 Transmitter
226905-001	Junction Box with Mounting Bracket
225629-001	H_2S Sensor (aluminum housing)
225629-002	H_2S Sensor (stainless steel housing)
226783-001	Alarm Relay Board
226906-001	Calibration Meter
225312-001	Sensor Dust Cover (Stainless Steel)
226190-001	Sensor Dust Cover (Porex)
226349-001	Sensor Rain Shield
225798-001	Ampoule Calibration Kit
226515-001	H_2S Air Dilution Calibration System (not certified for use in hazardous locations)
005003-001	Silicone Free Grease
000507-005	Open Frame Power Supply, 24 vdc at 3.6 amperes
000507-006	Open Frame Power Supply, 24 vdc at 12 amperes

For assistance in ordering a system to fit your application, please contact:

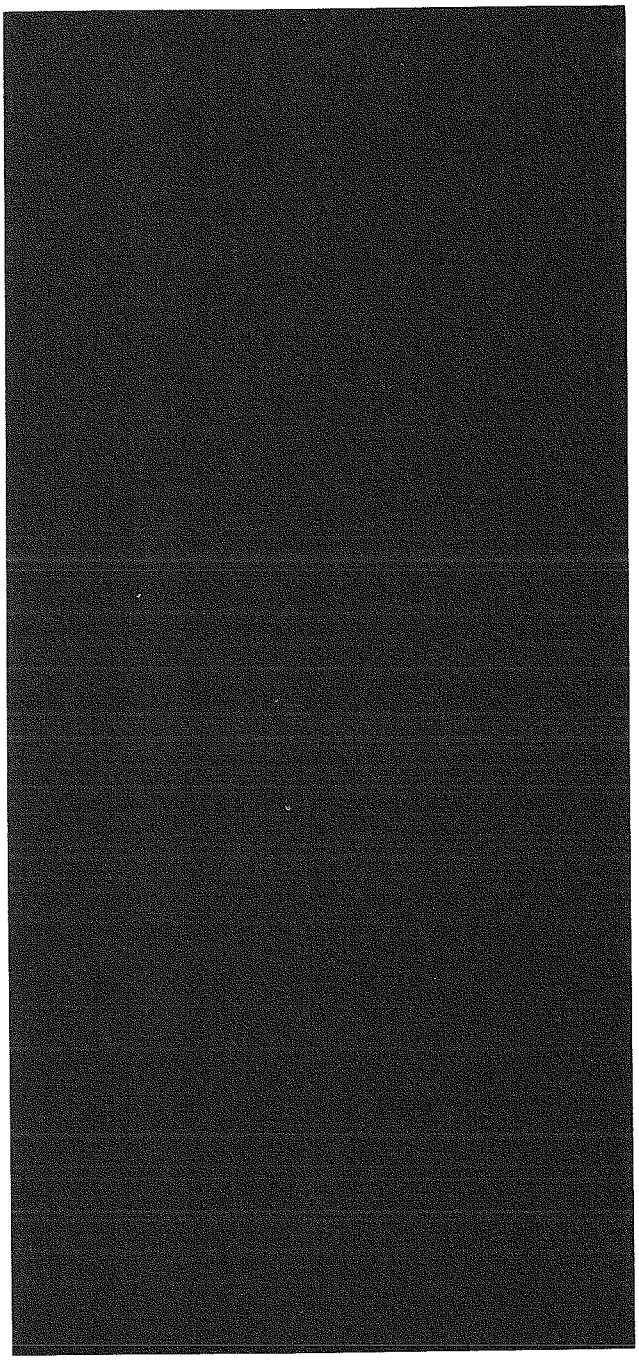
Detector Electronics Corporation
Field Support Group
6901 West 110th Street
Minneapolis, Minnesota 55438 USA
Telephone (612) 941-5665 or (800) 765-FIRE
Telex 6879043 DETEL UW
Cable Detronics
Facsimile (612) 829-8750

Fault Record Sheet

Date	Time	Detector Affected	System Status	Operator	Comments

Recommended Test Form

Detector Number	Detector Location	Date Installed	Date Checked	Date Calibrated	Remarks



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