Instruction Manual

Model 1220

Multi - Channel Combustible Monitor

DANGER

HIGHLY TOXIC AND OR FLAMMABLE LIQUIDS OR GASES MAY BE PRESENT IN THIS MONITORING SYSTEM.

PERSONAL PROTECTIVE EQUIPMENT MAY BE REQUIRED WHEN SERVICING THIS SYSTEM.

HAZARDOUS VOLTAGES EXIST ON CERTAIN COMPONENTS INTERNALLY WHICH MAY PERSIST FOR A TIME EVEN AFTER THE POWER IS TURNED OFF AND DISCONNECTED.

ONLY AUTHORIZED PERSONNEL SHOULD CONDUCT MAINTENANCE AND/OR SERVICING. BEFORE CONDUCTING ANY MAINTENANCE OR SERVICING CONSULT WITH AUTHORIZED SUPERVISOR/ MANAGER.

P/N M68325
ECO: #00-0203
05/25/2000

Warranty

This equipment is sold subject to the mutual agreement that it is warranted by us free from defects of material and of construction, and that our liability shall be limited to replacing or repairing at our factory (without charge, except for transportation), or at customer plant at our option, any material or construction in which defects become apparent within one year from the date of shipment, except in cases where quotations or acknowledgments provide for a shorter period. Components manufactured by others bear the warranty of their manufacturer. This warranty does not cover defects caused by wear, accident, misuse, neglect or repairs other than those performed by Teledyne or an authorized service center. We assume no liability for direct or indirect damages of any kind and the purchaser by the acceptance of the equipment will assume all liability for any damage which may result from its use or misuse.

We reserve the right to employ any suitable material in the manufacture of our apparatus, and to make any alterations in the dimensions, shape or weight of any parts, in so far as such alterations do not adversely affect our warranty.

Important Notice

This instrument provides measurement readings to its user, and serves as a tool by which valuable data can be gathered. The information provided by the instrument may assist the user in eliminating potential hazards caused by his process; however, it is essential that all personnel involved in the use of the instrument or its interface, with the process being measured, be properly trained in the process itself, as well as all instrumentation related to it.

The safety of personnel is ultimately the responsibility of those who control process conditions. While this instrument may be able to provide early warning of imminent danger, it has no control over process conditions, and it can be misused. In particular, any alarm or control systems installed must be tested and understood, both as to how they operate and as to how they can be defeated. Any safeguards required such as locks, labels, or redundancy, must be provided by the user or specifically requested of Teledyne at the time the order is placed.

Therefore, the purchaser must be aware of the hazardous process conditions. The purchaser is responsible for the training of personnel, for providing hazard warning methods and instrumentation per the appropriate standards, and for ensuring that hazard warning devices and instrumentation are maintained and operated properly.

Teledyne Analytical Instruments (TAI), the manufacturer of this instrument, cannot accept responsibility for conditions beyond its knowledge and control. No statement expressed or implied by this document or any information disseminated by the manufacturer or its agents, is to be construed as a warranty of adequate safety control under the user's process conditions.

Specific Model Information

The instrument for which this manual was supplied may incorporate one or more options not supplied in the standard instrument. Commonly available options are listed below, with check boxes. Any that are incorporated in the instrument for which this manual is supplied are indicated by a check mark in the box.

Instrument Serial Number: _____

Options Included in the Instrument with the Above Serial Number:

☐ **Dual-Sensor**

A second sensor PCB is installed to allow the Channel Module(s) to monitor two sensors simultaneously.

IMPORTANT NOTICE

The 1220 is a safety monitor. However, it is the responsibility of the user to establish whether or not the total system of instrument, environment, alarm components, and any other relevant devices actually will assure safety in his particular circumstances.

Location of the equipment and sensors to insure proper operation is responsibility of the user.

The safety checklist outlined here should be treated only as a guide. It is up to the user to establish practical safety precautions. *It is vital that the operator understand and test the operation of the total system.*

Safety Checklist:

- ❑ Verify that the instrument is powered correctly.
- ❑ Verify that the instrument works (all functions).
- ❑ Verify that alarm indications give the intended results.
- ❑ Verify that unauthorized personnel cannot tamper with the instrument or its auxiliary equipment.
- ❑ Institute routine test/calibration procedures.
- ❑ Identify and handle any sampling or location problems.
- ❑ Provide all necessary warning labels and verify that the labels are on the equipment.
- ❑ Train all operators to *understand all operations and functions of the analyzer and the system.*
- ❑ Identify and handle any environmental or other influences that could affect the operation of the instrument.

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Introduction

1.1 Overview

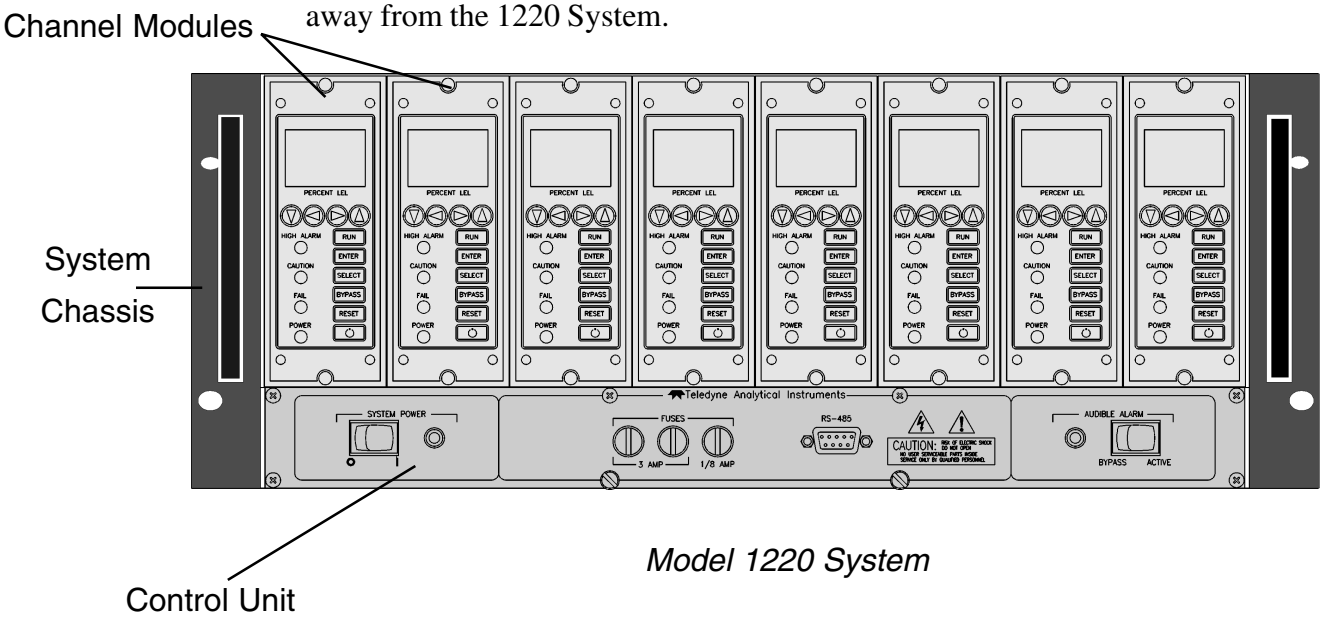
The Teledyne Analytical Instruments (TAI) Model 1220 is a multi-channel system that can be used for determining the concentration of combustible gases in an atmosphere at a number of remote locations, and provide alarm information when the combustible gas level exceeds predetermined limits at any one or all of the remote locations.

The combustible gas content of the atmosphere is determined by a number of remotely located detectors that may be strategically placed to monitor the atmosphere surrounding their location.

The system is designed to provide indications of the state of each detector and to actuate individual external alarm indicators as well as alarms common to all channels. The alarms are user-configurable.

1.2 Description

The 1220 system is comprised of a System Chassis, Control Unit, Channel Modules, and Remote Sensors. Each System Chassis contain one Control Unit and up to eight Channel Modules. Each Channel Module monitors up to two remote sensors. Since the sensors are designed for installation in hazardous locations and are suitable for use in NEC Class I, Division I, Groups B, C and D areas, they are (generally) located in an area away from the 1220 System.



Model 1220 System

1.2.1 System Chassis (19" Rack)

The System Chassis provides structural support and electrical interconnection for the Control Unit and Channel Modules (up to eight Channel Modules may be installed). These latter plug into the sockets of the system chassis. Terminal strips at the rear of the System Chassis provide for external electrical connections.

1.2.2 Control Unit

The Control Unit handles power distribution to the entire system. The main power is controlled by a switch on the front panel and the system fuses are accessible from the front. The Control Unit also contains common alarm relays, which indicate alarm conditions whenever any of the Channel Modules alarm.

1.2.3 Channel Modules

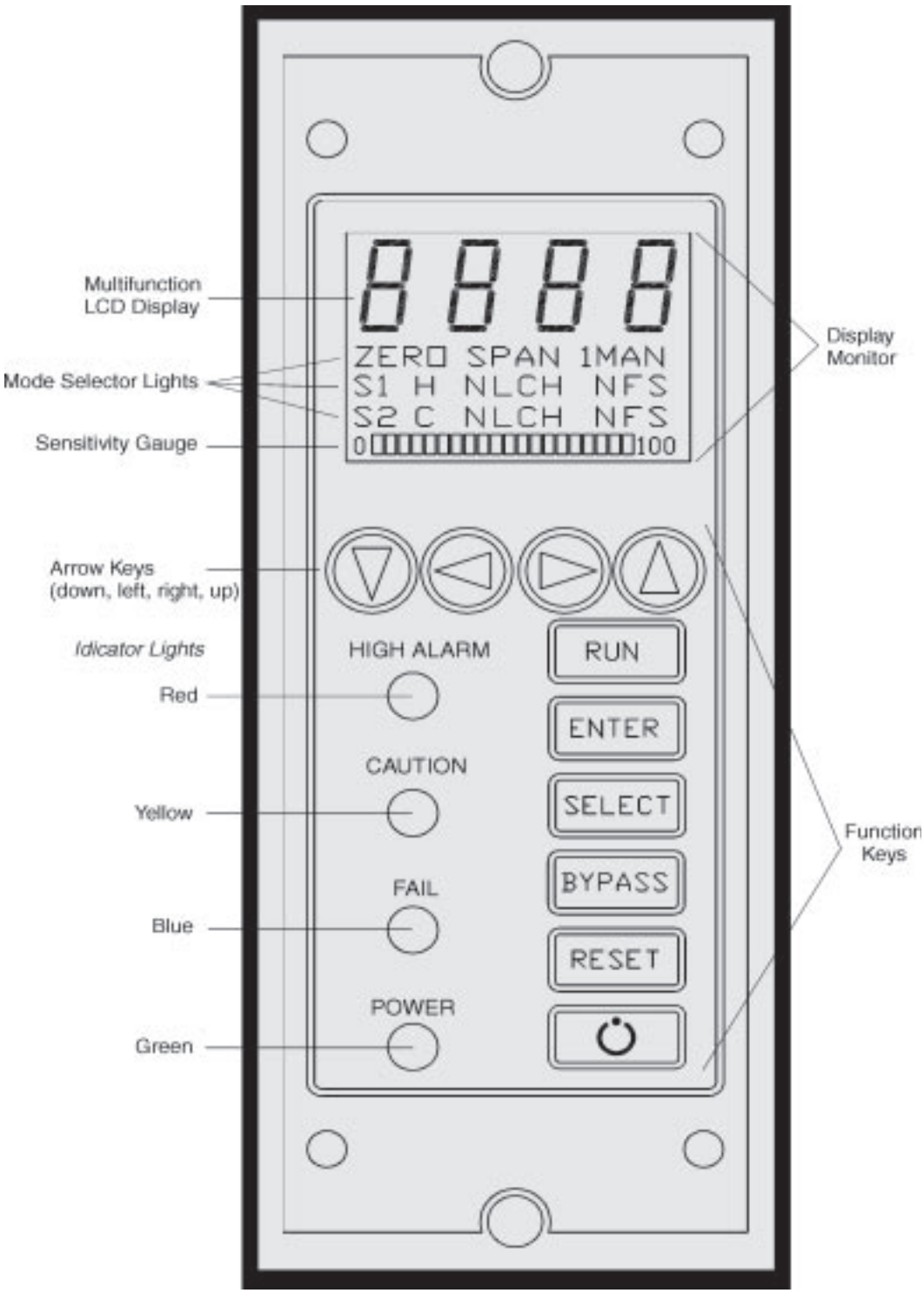
Each channel module is a complete, self-contained instrument including integral power supply, and requires only external AC power. A channel is operational simply when plugged into the System Chassis.

Because a channel module plugs into the control module, channels can easily be added after installation to monitor additional locations on any control module originally supplied with less than eight channels. Channel Modules in the same System Chassis may still be configured independently.

1.2.3.1 Main Features of the Channel Module

The main features of the Channel Module Include:

- High resolution 0-100% LEL LCD display readout
- Drop in replacement for Model 122 instruments
- 1MAN calibration capability
- Membrane switch control
- Rugged sensor design
- 2 sensors per channel option
- Microprocessor based electronics
- Two concentration alarms with adjustable set-points
- Sensor failure alarm
- User friendly touch key controls
- Passcode protection

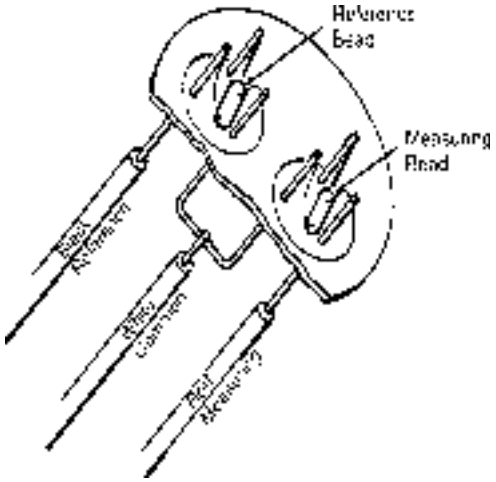


Model 1220 Combustible Monitor Front Panel

- Failure codes and testpoints
- Two selectable analog outputs (0-10VDC or negative ground 4-20mADC)
- Extensive, automatic self-test diagnostic testing during operation
- Compact and versatile design: Small footprint with accessible internal PCBs

1.2.4 Detector

The detector is a low temperature, catalytic oxidation, diffusion type sensor. Each detector contains two beads: a catalytically active bead and a thermally identical inert bead. Each bead is integrated onto a platinum heating coil and is mounted on a stainless steel support bar. With this rugged mounting system the detector is extremely vibration and shock resistant. The detectors are installed near the potential source of leaks in the region expected to be first exposed to the gas.



Combustible Gas Detector

1.2.5 Terminal Strip Housing

The terminal strip housing and probe mounts provided for this system are junction boxes having two hubs with 3/4" pipe treads. The sensor screws into one hub and the other hub will accommodate standard conduit.

A three-point terminal strip is installed within the housing for connection of the probe.

Operational Theory

2.1 Introduction

The Model 1220 combustible gas analyzer is composed of four components:

1. System Chassis
2. Control Unit
3. Channel Modules
4. Combustible Sensors

The System Chassis provides structural support and electrical interconnection for a Control Unit and up to eight Channel Modules. Each Channel Module can monitor one or two sensors (dual-sensor option).

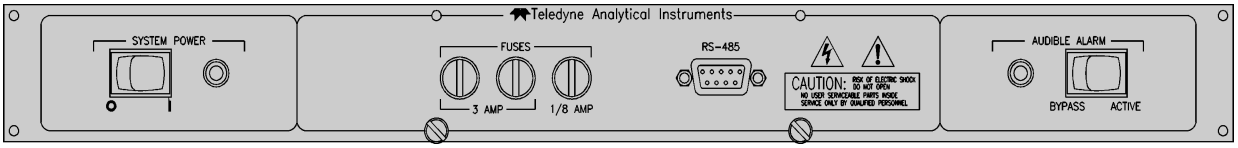
2.2 System Chassis

All electrical connections are located on the rear of the system chassis. The nine terminal strips constitute one each for the Channel Modules and one for the Control Module.

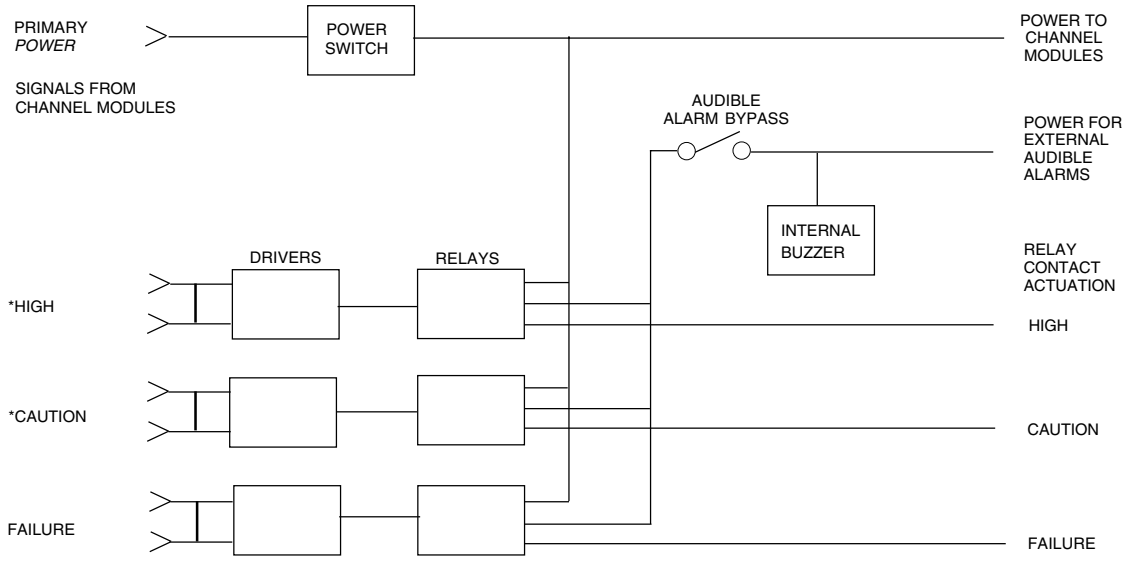
2.3 Control Unit

The Control Unit provides control of electrical power to the channel module, audio alarms and external alarms through the common alarm relays.

Alarm signals from any Channel Module trigger the corresponding relays in the Control Unit. For example, “high” alarm signals from any channel trigger the “high” alarm relay in the system control module. There are three such relays in the Control Unit, one each for high, caution and failure alarms. The failure alarm relay in the Control Unit is operated “fail-safe”; however, the gas level alarm relays can be optionally connected



Control Unit - Front Panel



Control Unit - Block Diagram

for operation in the "non fail-safe" mode by setting the configuration jumpers as indicated in the installation section 3.3.2. Each of these relays provides SPDT contacts for operation of external devices.

An audible alarm is actuated when any alarm state occurs. This audible alarm may be disconnected by switching the AUDIBLE ALARM control switch to the BYPASSED position. When this is done, the red lamp on the system module is illuminated as an indication that the audible alarm is not functioning.

The Control Unit is the power entry and distribution point. The 1220 system contains universal power supplies that operate on 100-240 VAC, 50/60Hz. The power switch on the Control Unit switches power for the entire system. The line is protected by two 3 Amp fuses, accessible from the front panel.

A 1/8 A fuse is furnished for the electronic circuitry of the Control Unit. The green power LED indicates that the Unit is ON.

Alarm switch S2 has two positions. Normally, the switch is set to the ACTIVE position which provides for audible alarm when any of the Channel Modules goes into the alarm state. When set to the BYPASS position, the local audible alarm is turned off.

2.4 Channel Module

The Model 1220 Combustible Gas Analyzer uses an Intel Microcontroller with on-board RAM and ROM to control all signal processing, input/output, and display functions for the analyzer. The channel power is supplied from two separate universal power supply modules (100-240 VAC), designed to be compatible with most international power sources. The first power supply (triple outputs) supplies the voltages for logic devices. The second power supply (dual outputs) supplies voltage for the detector(s).

The power supply for the detector is provided with a stable current of 300mA.

Each detector is connected in a bridge circuit with the output signal feeding an operational amplifier.

A block diagram of the functional relationships of the Channel Module is shown in Figure 2-3.

2.5 Combustible Sensors

The basic elements of the combustible gas detector are shown in Figure 2-1. The two beads each consist of a small coil of wire coated with an appropriate material. The measuring bead coating is a mixture of a catalytic material with an inert binder. This catalytic material is selected to enhance the oxidation of combustible gases. The reference bead coating is an inert material having similar thermal properties to the other bead.

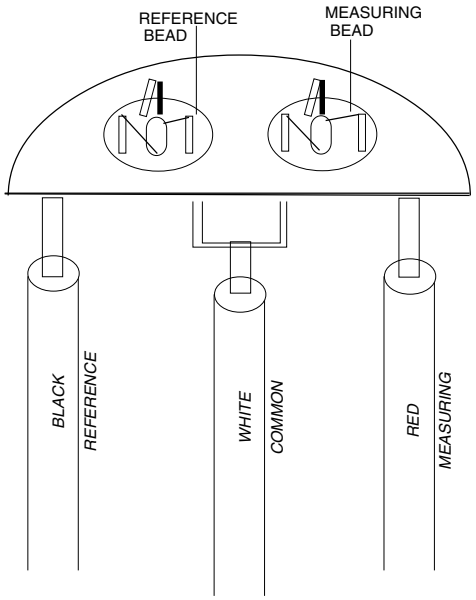


Figure 2-1 Combustible Gas Detector

When exposed to a mixture containing gases and oxygen, the measuring bead coating allows the oxygen and combustibles to combine at its surface. The energy produced by this reaction heats the measuring bead. The rise in temperature changes the bead's resistance and is related to the concentration of the combustible gas. The reaction rate is dependent upon the nature of the particular combustible gas. Raising the temperature of the bead increases the reaction rate, which increases the sensitivity of the sensor and reduces the observed differences of various gases. This rise in temperature is generated by a constant-current supplied to the sensor.

The temperature of the measuring bead will be influenced by other factors such as initial gas temperature, gas thermal conductivity, flow rates and the temperature of its housing. The reference bead, having similar electrical and thermal properties and being heated by the same current, but lacking the catalytic material will be similarly affected by these extraneous factors but not significantly affected by oxidation of the combustible gas.

These two beads are placed in close proximity to one another so that they are affected by the same environmental factors. Thus the differences between the changes in resistance of the two coils are directly related to the concentration of combustible gases.

For area monitoring applications, these two beads are installed in a metal housing as shown in Figure 2-2. Wires connected to the beads are brought out the back of the detector through potting which provides mechanical retention of the wires and provides a gas-tight seal. A stainless-steel flashback arrestor screen at the front of the detector covers the beads and is held in place by a retaining cylinder pressed onto the housing. This retaining cylinder is threaded internally to accept a flow-through adapter for calibration.

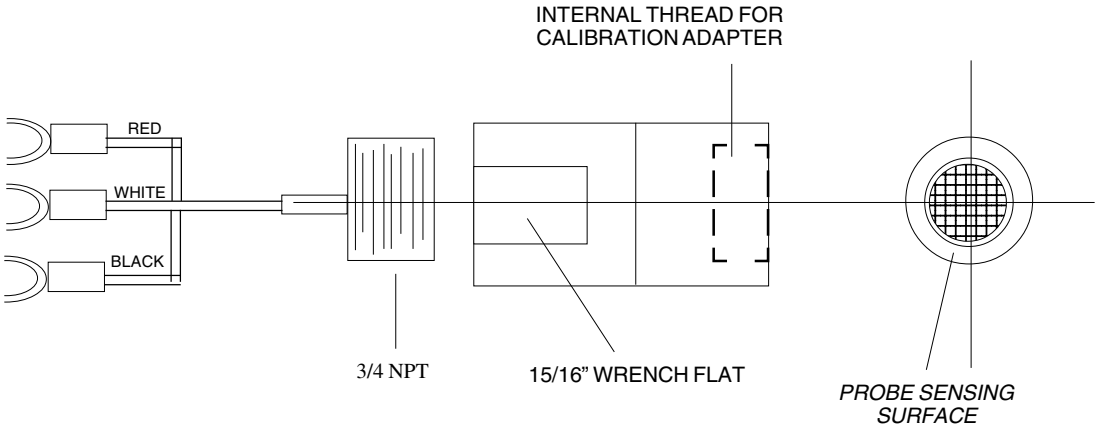


Figure 2-2 Remote Combustible Probe

The response of a catalytic bead detector to a number of gases is shown in Table 1.

For lighter than air gases, the detectors are generally installed above the source; for heavier than air gases, detectors are generally installed below the source.

Table 1

Detector Response to Gases

COMPOUND	LEL*	RESPONSE FACTOR
Methane	5.0	1.00
Hydrogen	4.0	0.86
Carbon Monoxide	12.5	0.32
Ethane	3.0	1.20
Ethylene	2.7	1.26
Acetylene	2.5	1.39
Propane	2.2	1.42
Propylene	2.0	1.33
Butane	1.9	1.54
Hexane	1.1	1.50
Cyclohexane	1.3	1.44
Heptane	1.05	1.59
Benzene	1.3	1.50
Toluene	1.2	1.48
Ethylene Oxide	3.6	0.76
Methyl Ethyl Ketone	1.8	0.96
Methyl Acrylate	2.8	0.59

* Taken from Fire Hazard Properties of Flammable Liquids, Gases and Volatile Solids, National Fire Protection Agency.

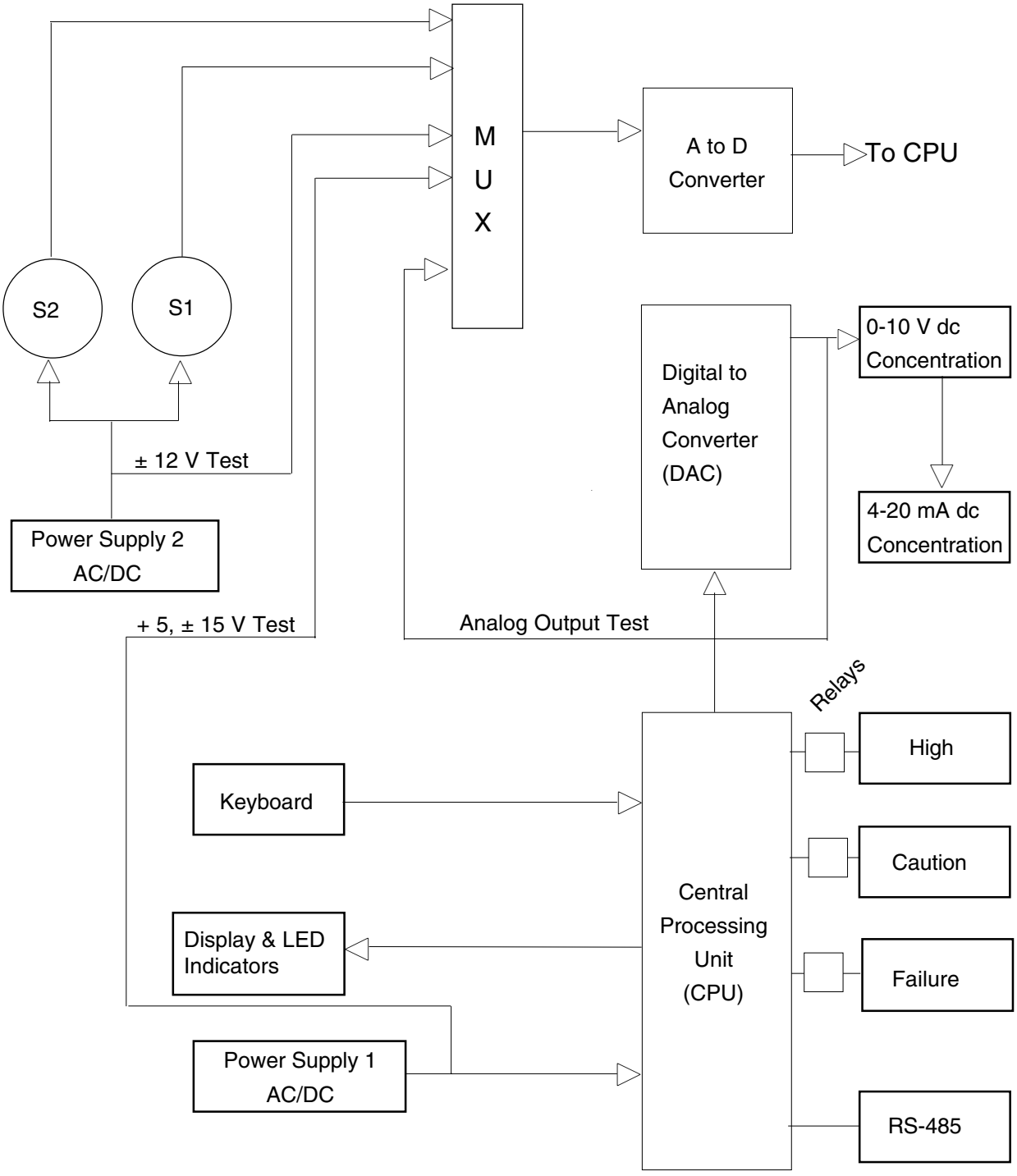


Figure 2-3: Block Diagram of the Signal Processing Electronics

2.5.1 Response of Combustible Sensor to Various Gases

Response factors have been determined to relate the sensor output of a specific compound to the output obtained using methane. A list of some typical compounds is given in Table 1, along with their LEL (Lower Explosive Limit) values. To determine the output of the sensor to any of the gases listed, compared to the same concentration of methane, multiply the reading obtained by the factor listed.

For example, if the output is calibrated with methane at 2%, the output for ethylene at 2% would be 2.0% X 1.26 = 2.52% methane equivalent.

NOTE: The LEL and the response factors cannot be used directly for calibration. See Table II on page 4-16 for calibration of the instrument to gases other than Methane.

CAUTION: In most cases, the concentration of any particular compound that the sensor is exposed to should not exceed the LEL of that compound, or sensor damage could occur.

The concentration of combustibles should never exceed that which will react completely with the available oxygen present in the sample (stoichiometric burning), otherwise "coking" (the deposition of carbon from incomplete combustion) will occur at the sensor, and drift and a loss of sensitivity will result.

CAUTION: Exposing the sensor to lead, silicone, or acidic gases may damage the sensor.

NOTE: For compounds not listed, consult TAI.

Installation

Installation of the analyzer includes:

1. Unpacking the system
2. Mounting the Channel Module and Control Module
3. Making the electrical connections
5. Making the gas connections
6. Testing the installation

3.1 Unpacking the Analyzer

Each TAI Model 1220 Combustible Gas Monitoring System is generally shipped with the channel modules and control module installed.

Since the system is intended as a safety monitor for detecting the presence of combustible gases in industrial environments, the system enclosure is normally installed in a safe area, while the remote sensors are installed at potentially hazardous areas up to 12 thousand feet distant. Numerous case options are available, however. One optional configuration involves a purgeable case for installation in hazardous areas. This type of case, which is maintained under a positive pressure, is purged with combustible-free air.

3.2 System Chassis

The physical dimensions and mounting hole spacing for the System Chassis are given on Drawing D-67849. The System Chassis is designed to fit into a standard 19" rack. It requires 7" panel height and 12.3" depth plus allowance for cabling behind the panel.

3.2.1 Location

The System Chassis is designed for installation in a **NON HAZARDOUS** Environment.

3.2.2 Power

The model 1220 is designed to operate from 100/240VAC @ 50/60 Hz. Ventilation must be provided to dissipate heat generated within the control unit. Natural convection is sufficient to cool 16 Channel Modules. However, if more are mounted in the same chassis, forced ventilation should be used.

3.2.3 Electrical Connections

The primary power terminals are designated H(hot), N (neutral) and GND (ground). Connections should be made in accordance with these designations.

All electrical connections are available at the barrier-type terminal strips located at the rear of the control unit. These facilities are shown on the user interconnection drawing D-67850.

WARNING: Disconnect primary power before making or changing connections to any of the terminal strips.

Relay contact connections are indicated as NC (normally closed), NO (normally open) and C (common). These designations refer to the contact state when the relay is de-energized.

Sensor connections are indicated as RD (red), WH (white) and BK (black). These designations refer to the color of the sensor lead wires.

NOTE: The cable shield should be connected to ground only at one end of the cable (this applies for each sensor connection). See Figure 3.1.

Care must be observed to ensure that the sensor leads are not inadvertently connected to the signal common (C) or to the power ground while energized. (See Figure 3-1)

Note: The maximum loop resistance for cabling to each sensor is 35 W, i.e. the cabling and connections should not exceed 35 W total, or 35 W/2 = 17.5 W on each side of the sensor (See Figure 3-2).

Note that the white wire resistance is not a limiting factor in the Loop Resistance, i.e. its resistance is not included in the Loop Resistance measurement. To measure the Loop Resistance directly, short the RED and BLACK Connections at the Sensor and measure the resistance between RED and BLACK at the channel module end of the cable.

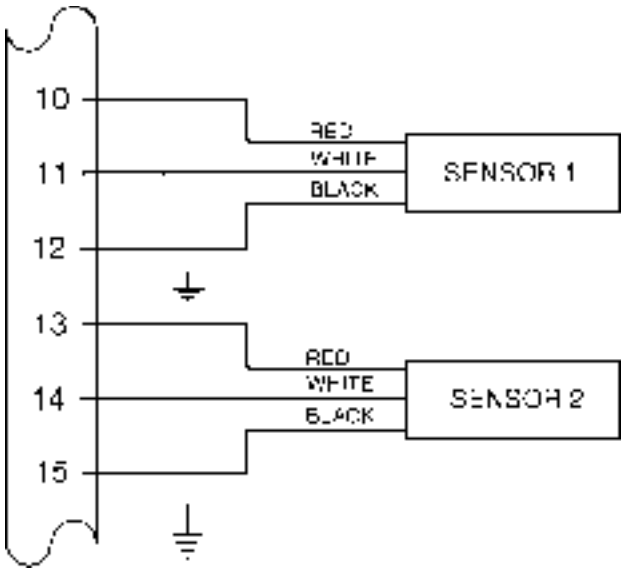


Figure 3-1 Sensors Connections

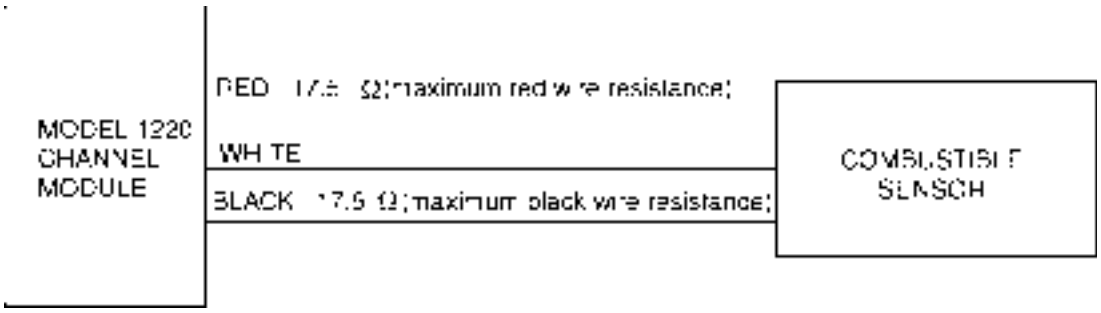


Figure 3-2 Maximum Loop Resistance for Sensor Connection

The terminals marked "Ext. Audible Alarm" provide an external signal that is activated whenever the audible alarm is activated. By setting jumpers on the Control Unit PCB (see section 3.3), the external signal can be either (1) a contact closure, or (2) a powerline level signal.

Reactive loads connected to the relay contacts must be equipped with appropriate transient suppression networks to prevent spurious triggering of sensitive alarm circuits.

Analog output from each channel module should be connected to monitoring equipment as shown in Figure 3-3. Note that the monitoring equipment inputs should be floating (not grounded). The cable shield should be connected to ground only at one end of the cable.

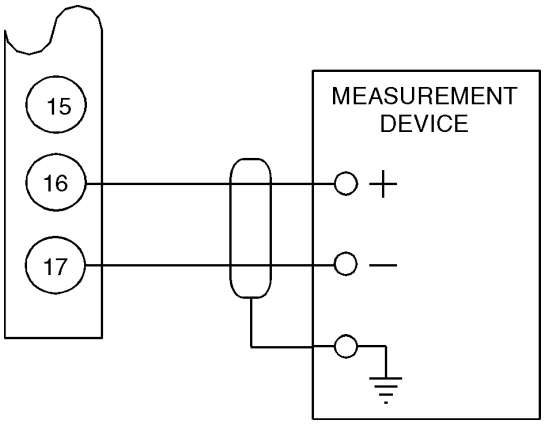


Figure 3-3 Analog Output Connection

3.3 Control Unit

In the event that it becomes necessary to remove the Control Unit, primary power to the System Chassis must first be disconnected, and the six small screws around the periphery of the Control Unit front panel removed. The two knurled, slotted jack screws may then be backed out to pull the Control Unit out until it is disengaged from its socket. It may then be slid out of the chassis.

Reinstallation of the Control Unit simply requires that it be slid into the system chassis, making certain that the circuit board lines up with the connector. The circuit may be seated in the connector by tightening the jack screws. The six retaining screws may then be reinstalled and the primary power reconnected to the System Chassis.

Do not hotswap (remove or install with power on) the channel modules to system chassis. Failure may occur by causing power shorts while lining up the circuit board with the backpanel connector.

Install channel modules starting at the end of the system chassis, working toward the middle to prevent missalignment problems.

3.3.1 Control Unit Fuses

The Control Unit contains three fuses. Two 3 Amp fuses protect the entire system (one fuse for Hot, one for Neutral). An independent 1/8 Amp fuse protects the Control Unit circuitry. To change any of the fuses, twist the fuse holder knob counterclockwise and slide the holder out until the fuse is visible, install the new fuse, slide the holder back in, and turn the knob clockwise.

3.3.2 Control Unit Jumper Settings

The Control Unit may be configured by changing the installation of the jumpers on the PCB. See the following sections for complete jumper installation information. The default jumper installation is:

Jumper	Installation	Function
JP1	Pins 1 & 2	Fail-safe Failure Alarm
JP2	Pins 1 & 2	Fail-safe High Alarm
JP3	Pins 1 & 2	Fail-safe Caution Alarm
JP4	Pins 1 & 2	Normally closed ext. aud. Alarm
JP5	Pins 1 & 2	Fail-safe ext. aud., Alarm
JP6	Pins 1 & 2	Ext. aud contact closures output
JP7	Pins 2 & 3	Ext. aud. contact closures output
JP8 THRU JP16	OFF	RS485 connections not routed
JP17	ON	Internal Audible Alarm enabled
JP18 & JP19	ON	Ground planes connected

Three alarms (CAUTION, HIGH, and FAIL) may be configured for either fail-safe (default) or non-fail-safe operation per the following table:

Alarm	Jumper	Failsafe	Non-failsafe
CAUTION	JP3	Pins 1 & 2	Pins 2 & 3
HIGH	JP2	Pins 1 & 2	Pins 2 & 3
FAIL	JP1	Pins 1 & 2	Pins 2 & 3

The external audible alarm may be configured to operate in either the fail-safe (default) mode or the non-fail-safe mode. It may also be configured to provide either a contact closure (default) or the incoming line voltage to the external connections. Additionally, the contact closure can be normally opened or normally closed (when the relay is de-energized). The following tables summarize the jumper settings for the external audible alarm configurations:

Function	JP5 Installation
Failsafe	Pins 1 & 2
Non failsafe	Pins 2 & 3

Function	JP4 Installation
Normally Closed (NC)	Pins 1 & 2
Normally Opened (NO)	Pins 2 & 3

Function	JP6 Installation	JP7 Installation
Contact closures output	Pins 1 & 2	Pins 2 & 3
Incoming line voltage	Pins 2 & 3	Pins 1 & 2

The internal audible alarm may be disabled by removing JP17.

WARNING: It is not recommended to remove JP17 unless there is an external audible alarm in use. With the jumper removed, the audible alarm will not warn personnel about alarm conditions.

3.4 Channel Modules

Channel Modules may be removed by first unscrewing the top (retaining) screw and then unscrewing the bottom (jack) screw. As the jack screw is backed out, it will pull the module from its socket. When the jack screw is free, the module may be slid out by pulling on the two screws. In the event it is desired to remove a channel module without disturbing the common alarm circuits, the channel module may be switched into standby mode, by pressing the ⏻ switch, before removal. Reinstallation of the channel

module may be accomplished by sliding the module into the chassis until the top and bottom screws can be engaged, engaging them, tightening the bottom (jack) screw to reconnect the module, and then tightening the top (retaining) screw.

WARNING: Disconnect power before performing any of the following. These operations should only be performed by a qualified service technician.

3.4.1 Removing the Channel Module Cover

In order to perform the actions in the following sections 3.4.2, 3.4.3 and 3.4.4, the cover of the channel module must be removed. To remove the cover, unscrew the two 6-32 screws that hold the cover in place, then slide out the cover.

3.4.2 Changing the Fuse

Remove the channel module cover as in section 3.4.1. The fuse is located as shown in the Figure 3-4

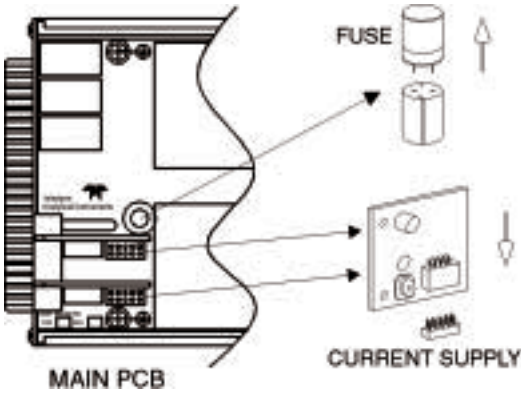


Figure 3-4 Fuse and Sensor PCB Locations

3.4.3 Adding or Removing the Second Sensor PCB

The model 1220 channel module may be configured for operation with either one or two combustible sensors. Each sensor's power supply resides on a sensor PCB. The location of the two sensor PCBs is shown in Figure 3-4. The single sensor PCB is factory installed at location SENSOR 1. In order to use two sensors with a single channel module, an additional sensor PCB must be installed at location SENSOR 2.

To add or remove the SENSOR 2 PCB, first remove the channel module cover as in section 3.4.1 and add/remove the second sensor PCB as shown in Figure 3-4.

3.4.4 Configuring the Internal Jumper Connections

The Channel Module outputs may be configured by setting the internal jumpers. In addition there are several factory preset jumpers configured as shown in the following table. Changing the internal jumpers requires removing the channel module cover as in section 3.4.1.

	Standard Jumper Settings (Factory preset)
JP8	On (Analog/Digital GND)
JP9	On (Analog/Digital GND)
JP10	Pins 1 & 2 "A" (Model Select)
JP11	Pins 1 & 2 "A" (Model Select
JP12	Pins 1 & 2 "A" (Model Select
JP13	Pins 1 & 2 "A" (Model Select
JP15	On (Mode Control)
JP16	On (Mode Control)
JP17	On (Chassis/Digital GND)
JP18	On (Chassis/Analog GND)

The Channel Module is configured to provide an RS485 communication link with the Control Unit (not available at this time). This communication link is not compatible with Control Units having the Common Meter. In order to use the Channel Module with a Control Unit that has a Common Meter, remove jumpers JP1 and JP3 as indicated in the following table:

	RS485	Used with Model 1220 With common meter (normal)
Jp1	On	Off
Jp3	On	Off

The Channel Module can provide one of three forms of output. The output appears at terminal 16 and 17 of the terminal strip, and is selected by jumper setting as in the following table:

	0-10V Output (Normal)	4-20mA Output	RS485 Output
JP2	Off	Off	On
JP4	Off	Off	On
JP5	On	On	Off
JP6	Off	On	Off
JP7	On	Off	Off
JP14	Off	Off	On

3.5 Combustible Sensors

The sensors should be mounted with their long axis vertical and the sensing surface downward. It is recommended that any terminal lugs be attached to the sensor by soldering as well as by crimping. However, care must be observed to insure that solder does not flow onto the area where the terminal screws must seat, as that can make it difficult to get firm, permanent seating of the screws. If conduits carrying the sensor leads to the control unit also carry other electrical wiring, the sensor leads must be shielded.

The Channel Modules may support one or two sensors (dual-sensor option). When the dual-sensor option is used, the two sensors connected to a Channel Module should monitor related areas. For example, in an area where wind may cause leaking combustible gases to drift in different directions, the two sensors can be placed on opposite sides of the monitoring area. Then, in the event of a leak, either of the sensors may activate the Channel Module alarm.

Operation

4.1 Introduction

Once the System has been Installed, check all wiring to make certain that it is correct. Check that the POWER switch on the Control Unit is in the "OFF" position, then apply primary power to the system. Continue start-up as follows:

1. Check that AUDIBLE ALARM switch is set to BYPASS mode on the Control Unit.
2. Set the Control Unit POWER switch to ON. The *green* power lamp and *red* bypass lamp should be illuminated. All the green Power LEDs on the channel modules should be illuminated.

   Each channel goes thru the process of a self-diagnostics test for the following:

   Checks the power supply 5V output

   Checks the power supply +/-15V outputs

   Checks the power supply +/-12V outputs

   Checks the analog outputs

   Checks for one sensor or two sensor mode

   Checks for sensor installation

   Checks that the ADC is responding
3. The Channel Modules are shipped with the ZERO and SPAN preset, and the alarm setpoints at 50% and 80% LEL (Lower Explosive Limits). The Channel Module relays revert to normal state after start-up.
4. After verifying that the Control Unit, and each Channel Module are operating normally, allow the system to stabilize over a 24 hour period.

4.2 Control Unit Operation

4.2.1 System Power Switch and LED

The power to the entire 1220 system is controlled by the System Power Switch.

The green System Power LED indicates system power status (ON/OFF).

4.2.2 Audible Alarm Switch and Bypass LED

The Audible Alarm Switch overrides the audible alarm when in the Bypass position. The red Bypass LED lights when the audible alarm is bypassed.

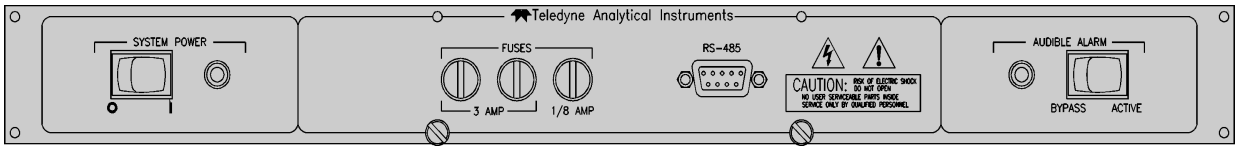
4.2.3 Fuses

For fuse replacement/installation, see section 3.3.1 and 3.4.3

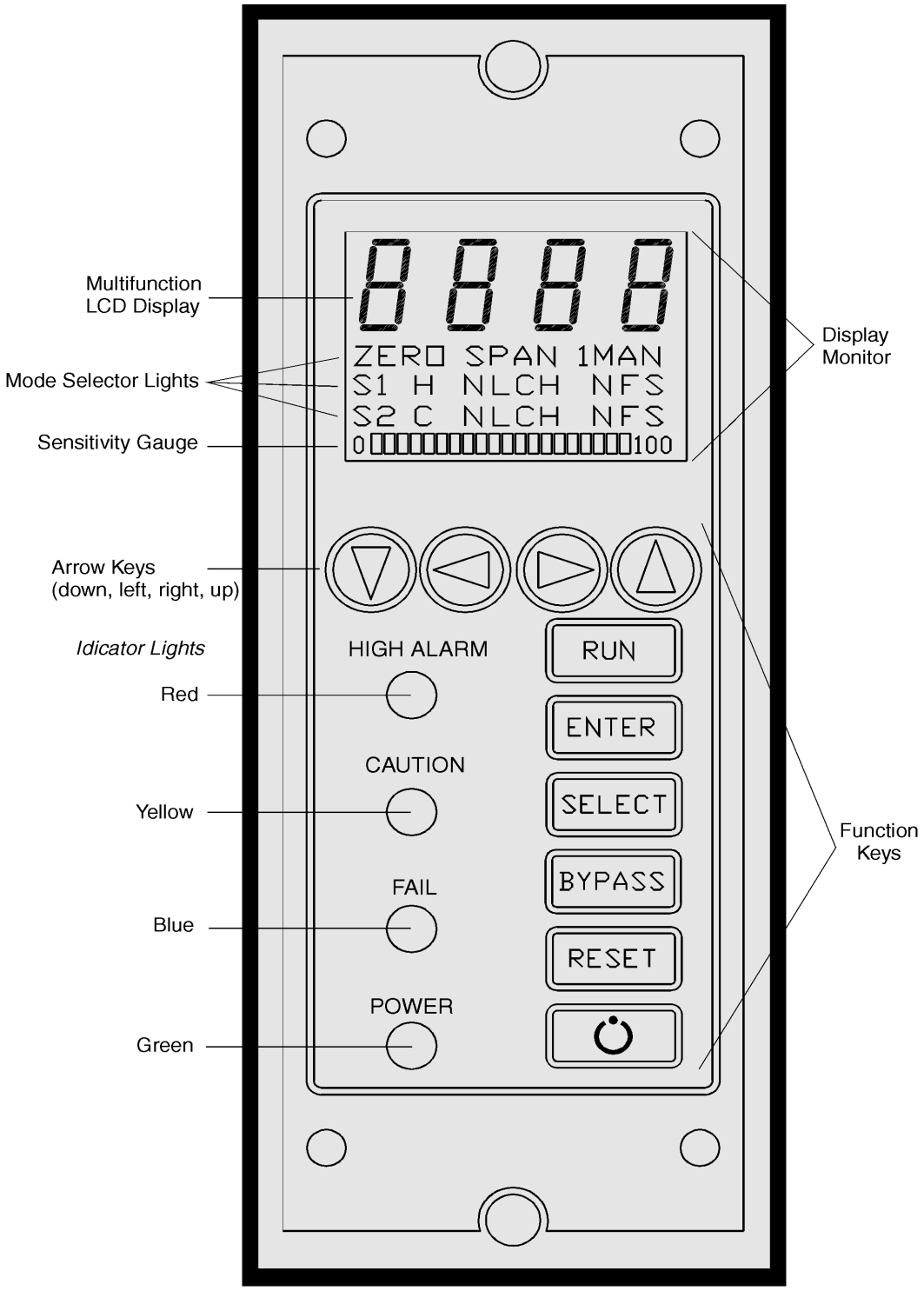
4.2.4 RS485 Port

NOTE: This feature is not presently supported--contact the factory for application assistance.

An RS485 port is provided at the 9-pin D-sub connector. The RS485 port is connected internally to all of the Channel Modules in the system.



Control Unit - Front View



Channel Module Front Panel Controls and Indicators

4.3 Channel Module Front Panel Controls and Indicators

STANDBY Switch - When pressed, this membrane switch places the Channel Module in the standby mode, i.e., removes power from the sensor(s) and extinguishes the LCD display.

NOTE: If the relays are configured for fail-safe operation, they will remain energized. If an alarm condition exists, the Channel Module will return to a non-alarm state.

RESET Switch - After an alarm condition is no longer present, as indicated by the concentration value shown on the display, press this membrane switch to return the relay or relays to the non-alarm (normal) state.

BYPASS Switch - When in an alarm condition, pressing this membrane switch disables the Control Unit audible alarm.

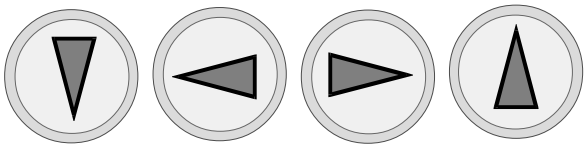
NOTE: The red, yellow and blue alarm LEDs begin to flash. They remain flashing until the alarms are reset or the BYPASS switch is pressed again.

SELECT Switch - Use this membrane switch to access any of the Channel Module's four user-configurable modes and their options. The four modes are:

1. Sensor and Calibration Mode - This mode allows you to select sensor 1 (**S1**) or sensor 2 (**S2**) and then set the ZERO and SPAN values. It also is used during the "One-Man" (**1MAN**) calibration option.
2. Alarm Configuration Mode - This mode allows you to adjust the set points of the High and/or Caution alarms as well as define the configuration for the alarms as "Fail-Safe" / "Non-Fail-safe" and/or "Latching" / "Non-Latching".
3. Identification (ID) Code Set Mode - This mode allows you to define the unique ID for each Channel Module for use with RS-485 communication (Special option, contact factory).
4. Passcode Enable/Disable Mode - This mode allows you to enable or disable the factory-defined passcode.

ENTER Switch - Use this membrane switch in conjunction with the SELECT Switch to select a user-configurable mode and then the option highlighted.

RUN Switch - Pressing this membrane switch places the Channel Module in the analysis mode, i.e., the unit is operational.



When in one of the four user-configurable modes, all arrows allow you to navigate through the options. In addition, the Up/Down arrow keys can be used to set the values shown on the display for ZERO and SPAN and also increase/decrease the value of the HIGH and CAUTION alarms.

HIGH ALARM

Red LED indicates High alarm condition. Flashes when bypassed.

CAUTION

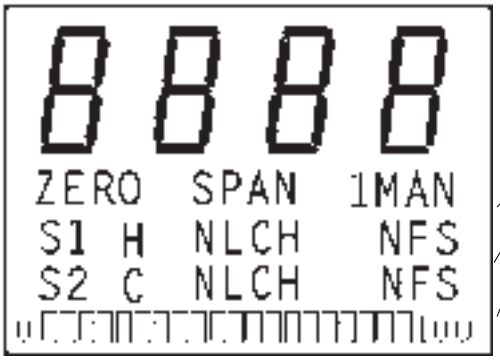
Yellow LED indicates Caution alarm condition. Flashes when bypassed.

FAIL

Blue LED indicates a Channel Module or Sensor failure. Flashes when bypassed.

POWER

Green LED remains on during operation, turns off in STANDBY Mode.



NOTE:
When one of these modes are selected, the field light flashes indicating which mode the monitor is on.

Configuration Display Panel Fields

S1 "**S1**" highlighted indicates that Sensor 1 options may be set.

S2 "**S2**" highlighted indicates that Sensor 2 options may be set.

ZERO This option is used to zero ("0") calibrate the Channel Module.

SPAN This option is used to span calibrate the Channel Module.

1MAN This option enables a single person to perform both a span and zero calibration.

H "**H**" highlighted indicates that the High Alarm value can be set by using the Up/Down Arrow Keys.

C "**C**" highlighted indicates that the Caution Alarm value can be set by using the Up/Down Arrow Keys.

LCH NLCH When the instrument goes into an alarm condition, the alarm relay switches. If "**LCH**" (latched) was selected, the alarm relay remains switched (latched) even after the alarm condition has been cleared. Using this configuration, you must press the RESET switch to unlatch (unlock) the relay.

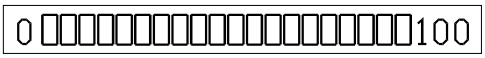
When the instrument goes into an alarm condition, the alarm relay switches. If "**NLCH**" (non-latched) was selected, the alarm relay switches (unlatches) when the alarm condition is cleared.

FS NFS

If "**FS**" is selected, the associated relay is in the Fail-safe Mode, i.e., the relay is "normally energized".

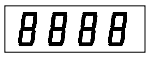
If "**NFS**" is selected, the associated relay is in the Non-Fail-safe Mode, i.e., the relay is "normally de-energized".

Sensitivity Gauge



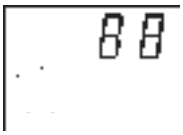
The Sensitivity Gauge monitors the life of the sensor. It does so by monitoring successive span procedures throughout the life of the sensor. As the sensor gets older it's resistance builds, lessening the sensitivity.

LCD Display



The LCD Display shows the LEL in monitor (RUN) mode, alarm settings during the configuration mode, and calibration values during Span and Zero operations.

4.4 Calibration Procedures



4.4.1 Zero Calibrating a Single Sensor Channel Module

NOTE: ***To accomplish the following task, two operators are needed. Operator one at the Control Unit and operator two at the probe. Both operators are involved in the calibration process. They must be in constant communication, by phone or other means.***

(**A**) = Operator One at the Control Unit

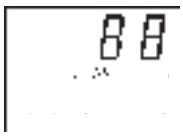
(**B**) = Operator Two at the probe

1. (**A**) At the Front Panel of the Channel Module to be calibrated:
   a. Press **SELECT**.
   b. Use the right or left arrow key to highlight the **ZERO** option.
   c. Press **ENTER**.

   Result: Alarms are deactivated and the **ZERO** display option flashes.
2. (**B**) Introduce zero gas into the sensor.
3. (**A**) After the reading has stabilized:

a. Press the up or down arrow key until the display reads "**0**".
b. Press **ENTER**.

4. (**B**) Disconnect the zero gas from the sensor.
5. (**A**) If necessary, proceed to the previous or next procedure. Otherwise, press **RUN** to place the instrument in the analysis mode.



4.4.2 Span Calibrating a Single Sensor Channel Module

NOTE: ***To accomplish the following task, two operators are needed. Operator one at the Control Unit and operator two at the probe. Both operators are involved in the calibration process. They must be in constant communication, by phone or other means.***

(**A**) = Operator One at the Control Unit

(**B**) = Operator Two at the probe

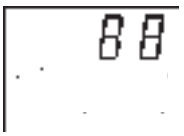
1. (**A**) At the Front Panel of the Channel Module to be calibrated:
   a. Press **SELECT**.
   b. Use the right or left arrow key to highlight the **SPAN** option.
   c. Press **ENTER**.
   Result: Alarms are deactivated and the **SPAN** display option flashes.
2. (**B**) Introduce span gas into sensor.
3. (**A**) After the reading stabilizes:
   a. Press the up or down arrow key until the display reads the value that corresponds to the LEL of the certified span gas used.

   NOTE: Information about calibration valves for various combustible gases appears in Table 1 on page 2-5 and in Section 4.11 on page 4-14

NOTE: ***If you need to adjust the Sensitivity Gauge, see Paragraph 4.8 for recommendations.***

   b. Press **ENTER**.
4. (**B**) Disconnect the span gas from the sensor.
5. (**A**) If necessary, proceed to the previous or next procedure. Otherwise, press **RUN** to place the instrument in the analyze mode.

4.4.3 Zero Calibrating a Dual Sensor Channel Module



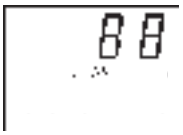
NOTE: ***To accomplish the following task, two operators are needed. Operator one at the Control Unit and operator two at the probe. Both operators are involved in the calibration process. They must be in constant communication, by phone or other means.***

(**A**) = Operator One at the Control Unit

(**B**) = Operator Two at the probe

1. (**A**) At the Front Panel of the Channel Module to be calibrated:
   a. Press **SELECT**.
   b. Use the up or down arrow key to highlight the appropriate sensor to be calibrated (**S1** = Sensor 1 or **S2** = Sensor 2).
   c. Press **ENTER**.
   d. Perform the procedure listed in Paragraph 4.4.1 beginning with Step "1b" and then return here.
2. To calibrate the second sensor, perform this procedure again beginning with Step "1b".

4.4.4 Span Calibrating a Dual Sensor Channel Module



NOTE: ***To accomplish the following task, two operators are needed. Operator one at the Control Unit and operator two at the probe. Both operators are involved in the calibration process. They must be in constant communication, by phone or other means.***

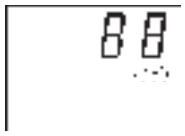
(**A**) = Operator One at the Control Unit

(**B**) = Operator Two at the probe

1. (**A**) At the Front Panel of the Channel Module to be calibrated:
   a. Press **SELECT**.
   b. Use the up or down arrow key to highlight the appropriate sensor to be calibrated (**S1** = Sensor 1 or **S2** = Sensor 2).
   c. Press **ENTER**.
   d. Perform the procedure listed in Paragraph 4.4.2 beginning with Step "1b" and then return here.
2. To calibrate the second sensor, perform this procedure again beginning with Step "1b".

4.4.5 Using the "1MAN" Calibration Option

The two following calibration procedure can be performed by one technician.



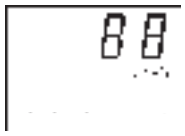
4.4.5.1 Zero and Span Calibrating a Single Sensor Channel Module

1. At the Front Panel of the Channel Module to be calibrated:
   a. Press **SELECT**.
   b. Use the right or left arrow key to highlight the **1MAN** option.
   c. Press **ENTER**.
2. At the remote probe site, introduce certified span gas to the sensor.
3. Wait 60 seconds so that the reading can stabilize.
4. Remove the span gas and introduce zero gas to the sensor.
5. Wait 60 seconds so that the reading can stabilize.
6. At the Front Panel of the Channel Module being calibrated:
   a. Press the up or down arrow key until the display reads "**0**".
   b. Press **ENTER**.
   c. Press the up or down arrow key until the display reads the value that corresponds to the value of the certified span gas used.

NOTE: Information about calibration values for various combustible gases appears in Table 1 on page 2-5 and in Section 4.11 on page 4-14

NOTE: ***If you need to adjust the Sensitivity Gauge, see Paragraph 4.8 for recommendations.***

   d. Press **ENTER**.
7. If necessary, proceed to the previous or next procedure. Otherwise, press **RUN** to place the instrument in the analysis mode.

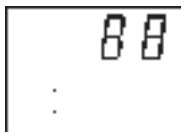


4.4.5.2 Zero and Span Calibrating a Dual Sensor Channel Module

1. At the Front Panel of the Channel Module to be calibrated:
   a. Press **SELECT**.
   b. Use the up or down arrow key to highlight the appropriate sensor to be calibrated (**S1** = Sensor 1 or **S2** = Sensor 2).
   c. Press **ENTER**.
   d. Use the right or left arrow key to highlight the **1MAN** option.
   e. Press **ENTER**.
   f. Perform the procedure listed in Paragraph 4.4.5.1 beginning with Step "2" and then return here.

2. To calibrate the second sensor, perform this procedure again beginning with Step "1b".

4.5 Alarm Configuration Procedures

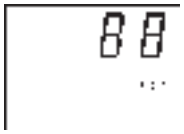


4.5.1 Defining the Setpoint for the High or Caution Alarm

NOTE: ***(Applies to Dual Sensor Instruments Only)*** **The High and Caution Alarm relays are shared by both sensors, i.e., only one setpoint for the High Alarm and one setpoint for the Caution Alarm can be defined.**

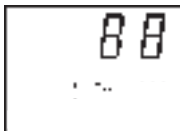
1. At the Front Panel of the Channel Module to be configured:
   a. Press **SELECT** twice to enter the "Alarm Configuration" Mode. ("**H**" {High} will be flashing.)
   b. Use the up or down arrow key to highlight the appropriate alarm to be defined ("**H**" = High Alarm or "**C**" = Caution Alarm).
   c. Press **ENTER** to select the alarm.
   d. Use the up or down arrow key to adjust the displayed value to the desired percentage for the alarm selected.
   e. Press **ENTER**.
2. If necessary, proceed to the previous or next procedure. Otherwise, press **RUN** to place the instrument in the analysis mode.

4.5.2 Configuring Alarm Relay Settings



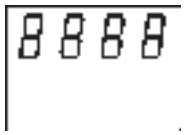
4.5.2.1 Setting the Fail-safe or Non-Fail-safe Mode

1. At the Front Panel of the Channel Module to be configured:
   a. Press **SELECT** twice to enter the "Alarm Configuration" Mode. ("**H**" {High} will be flashing.)
   b. Use the up or down arrow key to highlight the appropriate alarm to be defined ("**H**" = High Alarm or "**C**" = Caution Alarm).
   c. Use the left or right arrow key to highlight the "**FS**" option.
   d. Press **ENTER**.
   e. Use the up or down arrow key to switch to the desired configuration for the alarm ("**FS**" = Fail-safe and "**NFS**" = Non-Fail-safe.)
   f. Press **ENTER**.
2. If necessary, proceed to the previous or next procedure. Otherwise, press **RUN** to place the instrument in the analysis mode.



4.5.2.2 Setting the Latching or Non-Latching Mode

1. At the Front Panel of the Channel Module to be configured:
   a. Press **SELECT** twice to enter the "Alarm Configuration" Mode. ("**H**" {High} will be flashing.)
   b. Use the up or down arrow key to highlight the appropriate alarm to be defined ("**H**" = High Alarm or "**C**" = Caution Alarm).
   c. Use the left or right arrow key to highlight the "**LCH**" option.
   d. Press **ENTER**.
   e. Use the up or down arrow key to switch to the desired configuration for the alarm ("**LCH**" = Latching and "**NLCH**" = Non-Latching.)
   f. Press **ENTER**.
2. If necessary, proceed to the previous or next procedure. Otherwise, press **RUN** to place the instrument in the analysis mode.



4.6 Setting the ID Code

1. At the Front Panel of the Channel Module to be configured:
   a. Press **SELECT** three times to enter the "ID Code" Mode. (The current ID code will be displayed.)
   b. Press **ENTER**.
   c. Use the left and right arrow key to select the digit to be modified and the up and down arrow keys to modify the selected digit.
   d. Repeat Step "c" to modify the remaining digits.
   e. Press **ENTER** to save the ID Code.
2. If necessary, proceed to the previous or next procedure. Otherwise, press **RUN** to place the instrument in the analysis mode.

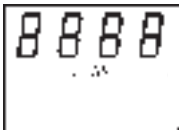
4.7 Enabling/Disabling the Pass Code

1. At the Front Panel of the Channel Module to be configured:
   a. Press **SELECT** four times to enter the "Pass Code" Mode. (The current pass code state {"**Poff**" = Passcode off or "**P on**" = Passcode on} will be displayed.)
   b. Press **ENTER**.
   c. Use the up or down arrow key to modify the state of the code.
   d. Press **ENTER** to accept the change.

2. If necessary, proceed to the previous or next procedure. Otherwise, press **RUN** to place the instrument in the analysis mode.

   Passcode: Press the Down arrow key followed by the Right arrow key.

4.8 Setting the Sensitivity Gauge



NOTE: The sensitivity gauge can only be adjusted when performing a local (Paragraph 4.3) or "1MAN" (Paragraph 4.4.5.1) span calibration.

Recommendations:

1. Upon initial installation of a new sensor, use the left or right arrow key to set the gauge to read "**100**".
2. Each time that you complete a span calibration procedure, the value of the sensitivity gauge will be updated to indicate the sensor's sensitivity (measured relative to its original sensitivity). This can be used as an estimate of the sensor's remaining life.

4.9 Routine Operation

During routine operation, the system will require no attention unless an alarm state occurs. In the event of an alarm indication, the audible alarm may be silenced in one of two ways:

1. Move the AUDIBLE ALARM switch on the system control module to BYPASS. This will immediately silence the audible alarm and also prevent an audible indication from occurring should another channel go into an alarm state.
2. Press the BYPASS button on the Channel Module. The associated alarm LED will flash and the AUDIBLE ALARM will be silenced until the ALARM condition is cleared. In this case, only the specific alarm channel will be affected. In the occurrence of an additional alarm in the same channel, or any alarm in any other channel, the AUDIBLE ALARM will again activate.

In either case, once the audible alarm has been silenced the combustible gas level may be determined by viewing the LCD display reading on the channel module. When the level has diminished to less than the alarm level, the system may be reset by depressing the RESET button.

4.10 FAIL Alarm Conditions

The possible FAIL Alarm Conditions are:

- A sensor fails.

- One of the power suppliers fails.

- 0-10V Output fails.

- The ADC times out without a proper end-of-conversion (EOC).

Whenever a failure is detected, the FAIL alarm is activated: the blue LED turns on, the alarm relay is de-energized (the FAIL relay is FAIL-SAFE, and the audible alarm is activated. The power supplies to both sensors are disabled.

Failure alarms are accompanied with a FAIL code number. The display alternates between "FAIL" and the code number.

The failure alarm may be bypassed (by pressing the Bypass Button), in which case, the blue LED flashes, and the audible alarm is deactivated.

To acknowledge a failure condition, press RESET. This restarts the instrument (as if the ⏻ button has been pressed twice). Alternatively, you may turn the unit OFF using the ⏻ button.

NOTE: The reason the failure modes require restarting the instrument is that once a failure has been detected, the unit should not be used until the error is fixed.

When a failure alarm is detected, the other two alarms (caution and high) are disabled.

4.11 Calibration of Combustible Gas Detectors to the LEL of Gases other than Methane

The lower explosive limit (LEL) varies substantially between the different explosive gases. It is, therefore, necessary to consider the LEL of a particular gas as well as the relative response of a detector to this gas in order to calibrate the detector to indicate the concentration as a percentage of the LEL. The most commonly used calibration gas contains small

amounts (percentages) of methane mixed with air. Table II lists calibration factors for the TAI Combustible gas sensor which can be used to calibrate these detectors to indicate the percent LEL of the specific gases. These calibration factors are based on the use of methane in the air as the calibration gas and take into account both relative response and LEL of the specific gases.

To use these calibration factors, multiply the percent volumeric concentration of methane in the calibration gas by the appropriate calibration factor. The number thus obtained is the meter reading to which the instrument should be spanned, in accordance with the calibration procedures, when the sensor is exposed to the calibration gas. When so adjusted, the instrument will be calibrated to indicate the percent LEL of the selected gas.

Use the following formula to determine the value to enter during the span calibration procedure:

$$V = CH4 \times CF$$

Where:

V = Value to enter during span calibration

CH4 = Percent methane in air

CF = Calibration Factor from Table II

EXAMPLE:

CH4 = Certified Calibration Gas = 2.2% methane in air

Gas for which calibration is desired = Ethane

CF = Calibration Factor from Table II = 28

V = Calibration Meter Reading = 62 = 2.2 X 28

Using the calibration procedures in this manual, adjust the span so that with calibration gas flowing through the calibration adapter, a meter reading of 62 is obtained. The instrument will then be calibrated to indicate 0 to 100% LEL of Ethane.

TABLE II

Calibration Factors for TAI Combustible Gas Sensor

COMPOUND	CALIBRATION FACTOR
Methane	20
Hydrogen	29
Carbon Monoxide	25
Ethane	28
Ethylene	29
Acetylene	29
Propane	32
Propylene	38
Butane	34
Cyclohexane	53
Heptane	60
Pentane	46
Toluene	56
Ethylene Oxide	37
Methyl Ethyl Ketone	58
Methyl Acrylate	61
Hexane	61

Failure and Error Codes

5.1 Failure Codes

Failure Code	Failure Indicated	Recommended Action
1	Sensor 1 (S1) failure	Replace the sensor. If this does not correct the problem, check the continuity of all cables and connections
2	Sensor 2 (S2) failure	Replace the sensor. If this does not correct the problem, check the continuity of all cables and connections
5	+5V supply failure	Contact factory
12	+12V or -12V supply failure	Contact factory
15	+15V or -15V supply failure	Contact factory
14	0-10V I2C output failure	Contact factory
67	A to D converter failure	Contact factory

5.2 Error Codes

Error Code	Error Indicated	Recommended Action
100	Bad zero error (the zero offset of the sensor appears to be too large)	Check that the correct zero gas was used. Perform a new zero. If this does not correct the problem, install a new sensor.
101	Bad slope error (sensitivity of the sensor measures too large or too small)	Perform a new span calibration, check that the correct span value is entered, corresponding to the certified span gas concentration. If this does not correct the problem, install a new sensor.
102	Bad zero and slope error (both the zero and slope are out-of-range)	See recommended actions for errors 100 and 101 (above).
203	Unstable span error (a stable reading could not be obtained during the span cycle of a TMAN calibration)	Check the gas connections for leaks and attempt to perform another TMAN calibration. If this does not correct the problem, install a new sensor.
213	Unstable zero error (a stable reading could not be obtained during the zero cycle of a TMAN calibration)	Check the gas connections for leaks and attempt to perform another TMAN calibration. If this does not correct the problem, install a new sensor.

Appendix

A-1 Specification

Range:	0-100% LEL Combustible Gas in Air (Methane equivalent)
Number of Channels:	Up to eight channels
Repeatability:	2 % of full scale
Accuracy:	±2% of full scale at constant temperature
Response Time:	90% in less than 15 seconds
Operating Temperature:	0 to 50°C
Temperature Stability:	±1% over 10°F
Alarms:	Two Adjustable Alarm Point plus Failure Alarm Indicators illuminate at Alarm Setpoint. HIGH-RED; CAUTION-AMBER; FAIL-BLUE.
Sensor Type:	Two element catalytic bead, anodized aluminum housing, Stainless Steel (Flame Arrestors)
Signal Output:	Internal: LCD Display External: 0-10 VDC or 4-20 mA negative ground (user-configurable)

Power Requirements: 100-240 VAC 50/60 Hz

System Enclosure: Control Module fits standard 19" Relay Rack
Dimensions: 7" H x 12.3" D x 19" W

Maximum Loop Resistance for Sensor Connections/Cabling: 35 W

Maximum Loop Resistance for 4-20 mA OUTPUT: 600 W

Sensor Probe Mounting: 2 MTG. Holes , 3/16" Diameter, 2 3/8"
C-TO-C (custom probes for special applications).

Field Connections: Barrier-Type Terminal Strips with screw connections.

Alarm Output: Form "C" Relay Contacts (SPDT)

Recommended Spare Parts List

Qty	*Part Number*	*Description*
2	A-12698	Adapter, Flow-Thru
10	A-11091	Adapter, Female
4	B-12093	Detector
5	F-1374	Fuse, Type 3AG, 1/8A
10	F-229	Fuse, Micro, 2A
5	F-1379	Fuse, Type 3AG, 3A
1	C-65446	PCB, Front Panel Display
1	C-67479	PCB, Constant Current Supply
1	C-65446	PCB, Front Panel
1	C-66910	Front Panel With Membrane

A minimum charge is applicable to spare parts orders.

Note: Orders for replacement parts should include the part number (if available) and the model and serial number of the instrument for which the parts are intended.

Orders should be sent to:

TELEDYNE Analytical Instruments

16830 Chestnut Street
City of Industry, CA 91749-1580

Phone (626) 934-1500, Fax (626) 961-2538
TWX (910) 584-1887 TDYANYL COID

Web: www.teledyne-ai.com

or your local representative.

Drawing List

C-67019	Outline Drawing, Control Unit
A-13450	Outline Drawing, Sensing Detector
B-68172	Interconnection Diagram, Model 1220
C-67478	Schematic Diagram, Constant current supply
D-65445	Schematic Diagram, Model 1220 Front Panel Display
D-65442	Schematic Diagram, Model 1220 Main PCB