

# Installation and Instructions Manual



## MP SERIES CONTROLLER

For Models: MP-202, MP-204, MP-24 and MP-220EX



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## **IMPORTANT — READ FIRST!**

This manual contains operating instructions for stationary gas monitoring instruments designed for area air quality and safety applications, and should be STUDIED CAREFULLY by all persons responsible for the operation and maintenance of the instruments. All International Sensor Technology (IST) equipment described herein is designed or manufactured for use only as set forth herein and by the labels affixed, or other literature accompanying the product.

Where WARNINGS or CAUTIONS are herein set forth, they must be followed. If IST equipment is used in a manner or under conditions not specifically authorized or prescribed by this manual, or by other materials or written instructions either accompanying the product or authorized by IST in writing, or if it is used or maintained by unqualified or improperly trained personnel, International Sensor Technology disclaims all responsibility of every kind for said equipment.

While basic connection installation instructions are included. The equipment are must be installed by the qualified electrician. ALL THE ASPECTS OF THE LOCAL CODE REQUIREMENTS MUST BE FOLLOWED. Also, the instruments must be calibrated and alarms tested periodically by trained personnel for proper functioning of the instruments.

### **CAUTION:**

The overall system, especially where gas monitoring sensors are used, must be CALIBRATED BY QUALIFIED PERSONNEL. Initial calibration should be performed after installation, then weekly for at least the first month of operation. Thereafter, a monthly calibration check is recommended to assure reliability and accuracy. Please call the factory if any problems are encountered.

### **WARRANTY**

IST sensors and instruments are designed for area air quality and safety applications. IST gas monitoring instruments are provided with a one-year warranty (commencing on the shipment date from the factory). This warranty covers only defective parts or workmanship in normal use and service. Instruments which fail to function due to factory defect within one year of date of shipment are to be returned to International Sensor Technology for warranty repair. IST will determine the nature and responsibility for the defect. In all cases the warranty is limited to the original cost of the equipment. Any misuse of equipment is the customer's responsibility. IST will either repair or replace (at IST's option) returned instruments subject to the warranty, at no charge. No field service is included in this warranty. For field service requirements please contact IST.

In addition to the one-year warranty on instruments, IST warrant the SENSOR ELEMENT itself against failure due to deterioration or defect, as follows:

1. Solid-State Sensors — 3 years
2. Catalytic Sensors — 1 year
3. Electrochemical Sensors (including O<sub>2</sub>) — 1 year
4. Infrared (IR) — 1 year

This warranty is voided by:

1. Improper application of instrument.
2. Misuse of instrument.
3. Intentional or accidental damaging of instrument.
4. Not returning the sensor to factory for warranty validation.

For any queries regarding warranty repair or replacements, please include the instrument model and serial number in any transmittals to IST. All equipment returned to IST (including warranty repairs) must be accompanied by an RMA number. IST instruments are supplied with operating and installation manuals and other literature. These are the only source of specific details regarding proper operation and maintenance of the equipment. These instructions must be carefully read and the precautions followed in detail. Instruments must be calibrated and alarms checked periodically to assure proper equipment operation. Please refer to the manual for details.

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# INSTRUCTION MANUAL FOR MP SERIES CONTROLLER

## 1. DESCRIPTION:



Fig. 1 Model Identification

This manual describes the installation and operating instructions for International Sensor Technology's (IST) model MP-202, MP-204, MP-24 and MP-220EX controllers. The MP-202 and 204 are housed in a weather proof NEMA 4 enclosure while the MP-24 is designed to go in a rack assembly. The MP-220EX is similar to the MP-202, with the exception being that it has been modified to be housed in a Class 1, Division 2, Group B,C and D housing and uses a non-intrusive magnetic wand to control the functionality. Major components of the circuits are as following:

A) **CPU Card:** This circuit consists of a digital display, alarm LED and all functional switches to set alarms and calibration etc. for two channels or two sensor transmitters. It accepts a 4 to 20 mA or 1 to 5 VDC signal from transmitters. It contains an EPROM, which allows linear display of transmitter signal. However, all IST transmitters have linear output. MP-204 is duplex of MP-202 and both share the same motherboard.

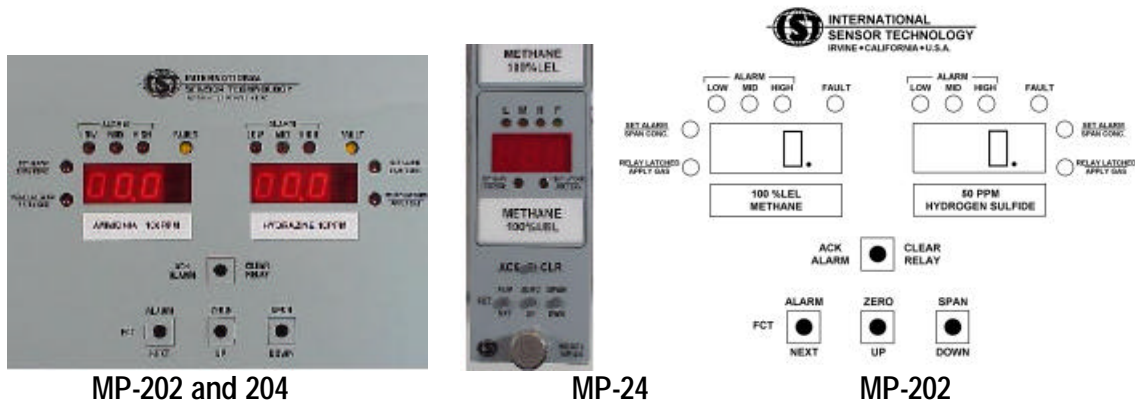
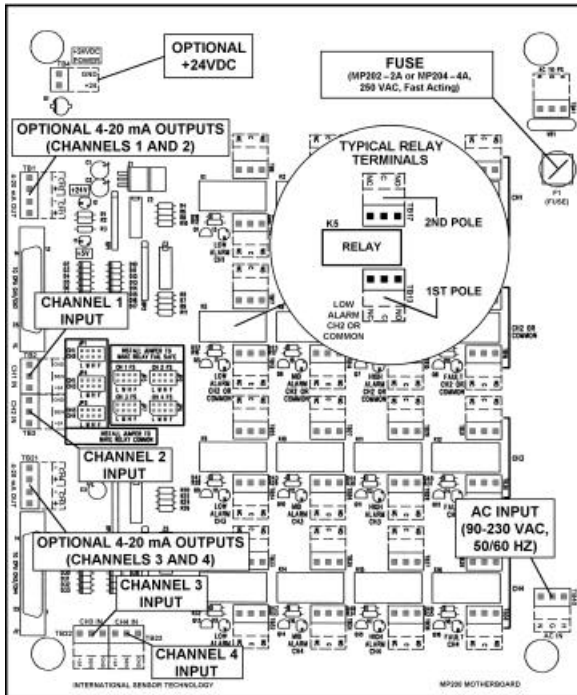


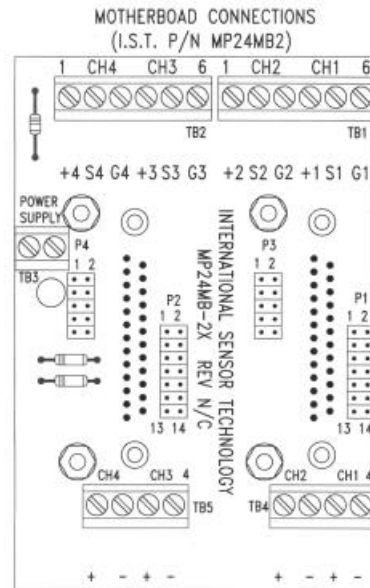
Fig. 2 Display Layout  
(See page 20, Fig. 8 for MP-220EX)

B) **Relay Card:** This is the circuit where alarm signals are processed and the relay contact outputs are connected. The common "LOW, MID, HIGH and FAULT" relays are standard equipment with MP-202 and MP-204 controllers. Individual relays for each channel is optional. Please check your order before attempting to make connections. For MP-202 and 204 the relays are installed on the motherboard. There are two different cards for MP-24; one for common relays and one for individual relays.

C) **Motherboard:** For MP-24, the CPU and Relay Boards both plug into the motherboard. The MP-24 motherboard also provides terminals for connecting power, sensor transmitter inputs and optional 4 to 20mA output. Connections: The MP-202 and MP-204 share the same motherboard. When making connections for MP-202, make sure only CH.1 & 2 are used.



MP-202 and 204 Motherboard



MP-24 Motherboard

Fig. 3 Motherboard Layout  
(See page 20 Fig. 9 for MP-220EX)

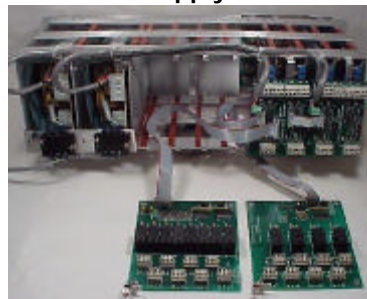
D) Power Supply: Accepts 90 to 230 VAC, 50/60 Hz and provides 24 VDC to power controller.

Top MP-204 Power Supply



CPU Boards (L) & Mother Board

MP-24 Power Supply Mother Board



Individual Relays (L) & Common Relays (R)

Fig. 4 Main Circuit Boards

## 2. INSPECTION AND GENERAL INFORMATION

- A) Inspect the instrument for any shipping damage. Claims for shipping damage should be made as soon as possible with the shipping company.
- B) **IMPORTANT** – The Controller is calibrated and the EPROM is installed at the factory with the gas specified for each channel corresponding to specified gases and transmitters on your purchase order. Please read the tag attached with each transmitter and make sure to connect to the appropriate channel at the controller. Interchanging sensors will result in incorrect readings.

### 3. CONNECTING POWER

**Note: Unless specifically noted, the MP-220EX is the same as the MP-202 or MP-204, except the minor variation in layout (see page 20). For simplicity, the MP-220EX will not be mentioned specifically in the following instructions, although these instructions still apply to the MP-220EX.**

To access connectors and terminals, on MP-202 and MP-204, open the enclosure and remove the two fasteners and the metal plate covering the motherboard.

The MP controller is designed to accept 90 to 230 VAC, 50/60 Hz or 24 VDC power. For MP-202 & 204, both AC and DC connection terminals are located on the motherboard. AC terminal connection is at the lower right corner, marked TB40. For 24 VDC the terminal is on the upper left corner, marked TB4 (see Fig.3). For MP-24 the AC connection is directly behind power supply board and 24 VDC is at the left on the motherboard, marked TB3 and POWER SUPPLY (see Fig. 3).

#### A) Replacing the fuse

The MP-202 and 204 requires either a 2 Amp for (MP-202) or 4 Amp for (MP-204), 250 VAC, fast acting fuse. See Fig.3 for the location of the fuse. To replace or check the fuse, do the following:

1. Make sure that the power is disconnected from the unit.
2. Use a small screwdriver and insert it into the slot on top of the fuse holder. Turn the screwdriver counterclockwise and lift the fuse from the fuse holder.
3. If the fuse is blown, replace it with a 2 Amp for (MP-202) or 4 Amp for (MP-204), 250 VAC, fast acting fuse.
4. Re-insert the fuse in the fuse holder and use the screwdriver to turn the fuse clockwise to re-install the fuse.

#### B) Connecting to AC Power

The terminals are labeled "H" for "Hot", "G" for "Ground", and "N" for "Neutral". The power supply is designed to operate on 90 to 230 VAC, 50/60 Hz. For the MP-24, there is a cover over the power terminal. Make sure it is securely covered after making the connection to prevent accidental electric shock.

#### C) Connecting to 24VDC Power

#### **IMPORTANT!**

**When 24 VDC is used, an inline external 2 Amp fast acting fuse (not supplied) for each controller (or two transmitters) must be installed.**

The power supply should be able to provide 1.5Amp for each CPU (two transmitters). Thus, for the MP-202, 1.5 Amps are required and for the MP-204, 3.0 Amps are required. For the MP-24, the requirement is 1.5 Amps for each CPU card (2 channels).

On all MP series controllers, the connecting terminals for DC power are located on the motherboard. The connecting socket is provided and terminals are clearly marked. Make sure you connect the terminal labeled "+24" to the "+" or positive output terminal of the power supply, and connect the terminal labeled "GND" to the ground terminal of the power supply.

### 4. CONNECTING SENSOR TRANSMITTERS

Each CPU is designed to accept two sensor modules. Therefore, the MP-202 will accept up to 2 sensor modules while the MP-204 can handle up to 4 sensor modules. The sensor modules can be equipped with solid state, catalytic bead, IR or electrochemical sensors, or any transmitter that has an output of either 4 to 20 mA or 1 to 5 VDC analog signals.

**Each sensor transmitter is calibrated at IST to match with a specific control channel. Please read the attached documents carefully. Make sure each transmitter is only connected to its designated channel.**

There are 3 wires required for each sensor transmitter. For the MP-202, these connections are made to the terminal TB2 (far left, ribbon connector), marked "CH1 IN and CH2 IN". For the MP-204, there are additional connections at TB22 (left lower corner) marked "CH3 IN and CH4 IN" on the motherboard (see Figure 3) which are for channels 3 and 4. For the MP-24, there are TB1 and TB2 on top of the motherboard, marked +1, S1, G1 for transmitter 1 and +2, S2, G2 for transmitter 2 (see Figure 3). The connectors for those connections are included. The terminal designations are as follows:

- 1) + 24 or + 1 for the MP-24: + 14 to + 24 VDC input
- 2) SEN or S1 for MP-24: Linear 4 to 20 mA signal in
- 3) GND or G1 for MP-24: Ground

### **WIRE DISTANCES**

The maximum distance which wires can be run for the transmitter is dependent on the wire size, transmitter power consumption and power supply voltage. The SM95 and 4-20IQ can operate on any voltage between 14 and 24 VDC. When used in conjunction with IST's MP Series of controllers, these controllers provide 24 VDC to the sensor transmitters. Following are maximum wire distances vs. wire gauge for a 24 VDC power supply.

<b>AWG</b>	<b>One-Way Distance (Feet)</b>	<b>One-Way Distance (Meters)</b>
#18	2300	710
#16	3700	1100
#14	5900	1800
#12	9400	2800

Using an 18 VDC supply, the maximum one-way distances are approximately HALF of the above values. IST does not recommend using 14 VDC supplies unless the wiring distances are very short.

NOTE: If the installation is in an exceptionally noisy area with regard to electrical interference, the maximum practical line length may be less than that indicated.

### **CONNECTING TO THE 4 to 20 mA OUTPUTS**

The MP series controller is capable of supplying **optional** linearized 4 to 20 mA outputs, per channel. For the MP-202 and MP-204, these connections are located on the TB1 (upper left next to socket for CH1 and CH2) and TB21 (lower left next to lower socket for CH3 and CH4). See Figure 3.

## **5. RELAYS**

**Note: SPDT relays for "Common LOW, MID, HIGH and FAULT" are standard for the MP-202 and MP-204 controllers. Individual LOW, MID and HIGH relays for each channel are optional. These optional relays for the MP-202 and MP-204 can be either SPDT or DPDT. For the MP-24, the relay cards are optional. Common alarm relays can be ordered as SPDT or DPDT. For individual channel alarms, the relay card only accommodates one pole. If DPDT is required, then another relay card is needed. Relays are installed only as ordered! Make sure connections are made correctly.**

### **A) MP-202 and MP-204:**

The rows of relays are clearly marked on the motherboard. The row labeled "CH1" is the channel 1 individual relays (relays K1-K4), the row labeled "CH2 OR COMMON" is the channel 2 individual relays or as common relays (relays K5-K8), the row labeled "CH3" is the channel 3 individual relays (relays K9-K12), and the row labeled "CH4" is the channel 4 individual relays (relays K13-K16). If the optional individual relays were not ordered, the row labeled "CH2 OR COMMON" will be installed.

Each relay will have a set of 3-pin connectors above and below it. The lower connector is the first set of poles for SPDT relay, and the upper connector (if installed) is the second set of poles for DPDT relay. The connectors are labeled "NC", "C", and "NO", and have the following meanings:

**NC = Normally Closed, NO = Normally Open, C = Pole.**

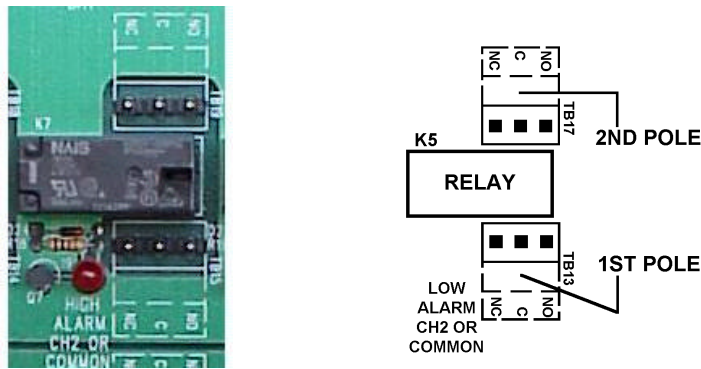


Figure 5 Relay Terminals

Figure 5 shows a close up of one of the relay connectors. Note that each relay is clearly labeled on the motherboard, and that an LED indicating the status of the relay sits below each of the relays. If the LED for the relay is on, then the relay is energized; otherwise, if the LED is off, then the relay is de-energized.

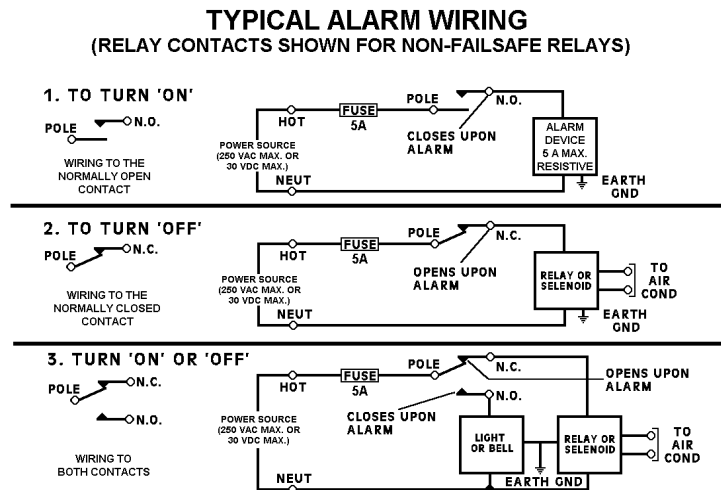


Figure 6

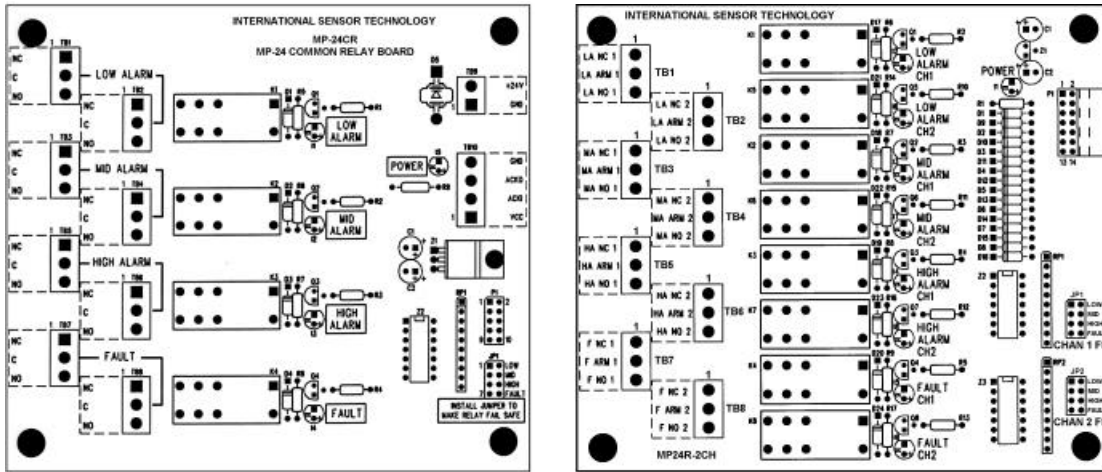
Figure 6 shows a typical wiring to a non-failsafe relay. The relays are designed to handle 5 A at 250 VAC or 30 VDC maximum. Do not overload the relay with devices that draw more power than the relay is rated for. To supply power to a high power device, use another relay that can handle the load. Please contact IST if there are any questions regarding the wiring, or visit IST at: [www.intlsensor.com](http://www.intlsensor.com) for more details about alarm processing. On our website there is also an excerpt from the book "Hazardous Gas Monitors" about relay connections.

When making connections, it is important to note whether the relay has been set for failsafe or not. If a relay is made failsafe, then the "NO" (normally open) contact will be closed in the normal or non-alarm condition, and the "NC" (normally closed) contact will be open in the normal condition.

- B) The MP-24 has either a common relay card shared by all the channels or it can be configured with individual relays card, one card for each 2 channels. These circuit cards are interconnected on the motherboard (see Figure 3). The connectors P3 & P4 (10 pin connector) are for common relays and either connector can be connected to another motherboard or common relay card, while P1 & P2 (14 pin connector) are for individual relays. The connectors below the relays are for the first set of poles, and the connectors above the relays are for the optional second set of poles. Figure 7 shows MP-24 relay cards.

For common relay cards the connectors on the left row are for SPDT relays. If DPDT relays are purchased, the connectors on the right row will be used.

The individual alarm card on the right is for two channels. Each channel has a LOW, MID, HIGH and FAULT alarm. The left row is for channel 1 and right row is for channel 2.



MP-24 common relay board

MP-24 Individual relay board

Figure 7: MP 24 Relay boards

C) **SETTING ALARM SETPOINTS**

To set alarm setpoints, press and hold the [FCT] key until three decimal points appear in each of the displays. At this point, immediately release the [FCT] key. If you do not release the key quickly enough (you have about 1 second to release the key), then the MP-202 or MP-204 will not recognize the key press.

After you release the [FCT] key, the three decimal points in each display will remain lit. At this point, press and release the [ALARM] key. The "LOW ALARM" LED should illuminate and the "SET ALARM" LED should flash for channel 1 (see Figure 2). At this point use the [UP] and [DOWN] keys to set the low alarm setpoint for channel 1. After you are done setting the low alarm setpoint for channel 1, press and release the [NEXT] key. The "MID ALARM" LED should illuminate and the "SET ALARM" LED should remain flashing for channel 1. Now, set the mid alarm for channel 1. Again, press the [NEXT] key when you are done setting the mid alarm setpoint for channel 1.

Now, the "HIGH ALARM" LED should illuminate and the "SET ALARM" LED should remain flashing for channel 1. Now, set the high alarm for channel 1. Finally, press the [NEXT] key when you are done setting the high alarm. You will now move on to setting the alarm setpoints for channel 2, and a sequence similar to the one for channel 1 will follow. Note that you can abort from setting alarm setpoints by pressing and holding the [FCT] key; however, any changes that you have made will remain.

Note that the microprocessor will automatically limit the values that can be set for certain alarms. For example, if alarms are ascending and the low alarm setpoint is set for 10% of full-scale, then the microprocessor will limit the value of the mid alarm setpoint from 10 to 100% of full-scale.

6. **CALIBRATION**

To prevent false alarms, the alarm and fault processing of the instrument are disabled when the calibration function is activated.

A) **For 4-20IQ:** 4-20IQ transmitters have a display and it is easily calibrated at the transmitter without opening the transmitter cover. To calibrate 4-20IQ transmitter, please follow the following:

- 1) At the controller "Press" and "Hold" the [FCT] key until three decimal points appear in both displays. Immediately release the key.
- 2) "Press" the [SPAN] key. The **LOW ALARM, MID ALARM, HIGH ALARM, and FAULT** LED's will flash for both channels. At this point, all alarms are disabled for both channels. Follow the calibration instructions that came with your 4-20IQ transmitter and proceed with calibration of the sensor.

- 3) After calibrating the 4-20IQ, at the controller “Press” and “Hold” the [FCT] key and the unit will return to normal operating mode.

For SM 95 follow AUTOMATED CALIBRATION below.

#### B) Automated calibration for SM95 transmitter

The unique automated calibration feature of the MP series controller allows you to calibrate sensors without having to open sensor transmitter covers or adjust potentiometers. Essentially, automated calibration allows the MP controller to automatically adjust to changes in the sensitivity of the sensor. You can continue to use automated calibration as long as the sensitivity of the sensor remains within a certain predetermined range. However, once out of this range, the sensor needs to be manually calibrated. Thereafter, automated calibrations can be resumed.

The “FAULT” LED on a channel will flash (1 time per second for a zero adjustment fault, and 3 times per second for a span adjustment fault) when the sensitivity of a sensor is out of range. Use the following procedure to perform an automated calibration:

#### Zero adjustment

The following procedure should be used to set the zero point:

- 1) Make sure that the sensor(s) that are to be zeroed are in a clean air environment (i.e., no gas is present). If not, expose the sensor(s) to clean air by putting a bag or canister (P/N: 9905) filled with clean air over the sensor(s).
- 2) Press and hold the [FCT] key until three decimal points appears {0.0.0.} on each of the displays. Immediately release the key.
- 3) Press, the [ZERO] key. The “APPLY GAS” LED should illuminate for each channel. If a channel is in fault, the “APPLY GAS” LED will not illuminate.
- 4) Now, press the [UP] key to zero channel 1 and/or press the [DOWN] key to zero channel 2.
- 5) If the zero adjustment made for a channel is out of range, then the “FAULT” LED will flash at a rate of approximately 1 time per second. To clear this, try re-zeroing starting from step 1. If this does not work, you will need to perform a manual recalibration on the sensor (please refer to Section “C”).
- 6) Press and hold the [FCT] key when you are finished to return to normal operating mode.

#### Span adjustment

To perform the span adjustment, do the following:

- 1) Press and hold the [FCT] key until three decimal points appears {0.0.0.} on each of the displays. Immediately release the key.
- 2) Press the [SPAN] key. The “SPAN CONC” LED will illuminate for the first channel. Use the [UP] and [DOWN] keys to adjust the span concentration value (the gas concentration that you are going to exposes the sensor to). When done, press the [NEXT] key.
- 3) Now adjust the span concentration value for channel 2. Again, use the [UP] and [DOWN] keys to adjust the span concentration value, and press [NEXT] when you are done.
- 4) The “APPLY GAS” LED will illuminate for both channels.
- 5) In the field, apply the appropriate calibration gas to each sensor, **ONE AT A TIME**. Leave the calibration gas on the unit for approximately 10 to 15 seconds longer than what the Span Timer value is set to.

**IMPORTANT:**

**APPLY THE CALIBRATION GAS TO ONLY ONE CHANNEL AT A TIME. IF GAS IS APPLIED TO BOTH CHANNELS SIMULTANEOUSLY, THE CALIBRATION WILL ONLY BE PERFORMED PROPERLY ON ONE OF THE CHANNELS.**

- 6) At the controller, once gas is detected on a channel, the **"LOW ALARM"** and **"FAULT"** LED's will illuminate indicating that the controller is in the "Timer Wait" state for that channel. The display of the channel being calibrated will show the current reading, and the display of the other channel will show the number of seconds remaining on the Span Timer.

**NOTE:**

**IF FOR SOME REASON THE CONTROLLER CANNOT PROPERLY DETECT THE APPLICATION OF CALIBRATION GAS (I.E., THE UNIT IS ALREADY SHOWING AN UPSCALE READING), THE [UP] KEY CAN BE PRESSED TO FORCE CHANNEL 1 INTO THE "TIMER WAIT" STATE, OR THE [DOWN] KEY CAN BE PRESSED TO FORCE CHANNEL 2 INTO THE "TIMER WAIT" STATE.**

- 7) After the Span Timer expires (and, presumably, the reading has stabilized), the controller moves into the "Span Adjustment" state. This is indicated by illumination of the **"MID ALARM"** and **"FAULT"** LED's. In this state, the controller will adjust the reading to match the calibration gas concentration.

**NOTE:**

**IF THE READING STABILIZES BEFORE THE SPAN TIMER EXPIRES, YOU CAN MANUALLY BYPASS THE TIMER AND GO IMMEDIATELY INTO THE "SPAN ADJUSTMENT" STATE BY PRESSING THE [NEXT] KEY.**

- 8) If all went well with the automatic span adjustment, the **"HIGH ALARM"** and **"FAULT"** LED's will illuminate to indicate the **"RECOVERY WAIT"** state. The controller will now wait approximately 60 seconds to allow the channel to recover before allowing the channel to enter normal mode. If there was a problem with the calibration, the **"HIGH ALARM"** and **"FAULT"** LED's will flash (also, once the controller returns to normal mode, the **"FAULT"** LED will flash at a rate of approximately 3 times per second to indicate a calibration fault). To rectify this, try recalibrating, making sure the Span Timer and span gas concentration values are set correctly for the channel in question. If this does not work, you will need to perform a manual recalibration of the sensor (please refer to Section "C").

**IMPORTANT:**

**YOU CAN RETURN TO NORMAL OPERATING MODE BY PRESSING AND HOLDING THE [FCT] KEY AT ANY TIME (EXCEPT DURING THE "SPAN ADJUSTMENT" STATE).**

**C) MANUAL RECALIBRATION and CLEARING BLINKING FAULT**

If you are using the automated calibration feature and the sensor sensitivity has changed to the point where the controller can no longer make the proper adjustments (**indicated by a blinking "FAULT" LED on the channel**), then a manual calibration should be performed at that time. When performing a manual calibration, calibration must be performed on BOTH sensor channels. Calibrating only one of the two sensor channels will result in the other channel being inaccurately calibrated. After performing a manual calibration, automated calibrations can once again be resumed. Use the following procedure to perform a manual calibration:

- 1) Press and hold the [SPAN] key until three decimal points appears on each of the displays. Immediately release the [SPAN] key.
- 2) Press the [ZERO] key. Both displays will show {8.8.8.} and both **"SPAN CONC"** and **"APPLY GAS"** LED's will begin to flash. The controller is now waiting for you to disable the alarms. To do so, **press** the [NEXT], then the [UP], and then the [DOWN] key in that order. Remember to release the current key before pressing the next one.
- 3) Channel 1's display will show {1.1.1.} and channel 2's display will show {2.2.2.} and the **"SPAN CONC"** and **"APPLY GAS"** LED's on both channels will begin to flash. At this point, all alarms are disabled for both of the channels. You can now go into the field and calibrate the sensors manually without activating the alarms. Follow the instructions

that came with your sensor transmitter to manually adjust the zero and span potentiometers of BOTH SENSOR CHANNELS.

- 4) After you finish manually calibrating the sensors, **press** the [UP] key, then the [DOWN] key. The unit will return to normal operating mode.

## **IMPORTANT**

**WHEN MANUALLY CALIBRATING THE SENSOR TRANSMITTER, THE 4 TO 20 mA OUTPUT SHOULD BE ADJUSTED TO 16 mA AT FULL SCALE GAS CONCENTRATION. FOR EXAMPLE, IF THE SENSOR MODULE IS 100 PPM CARBON MONOXIDE, AND YOU WANT TO CALIBRATE TO FULLSCALE, YOU WOULD APPLY 100 PPM CARBON MONOXIDE AND ADJUST THE OUTPUT TO 16 mA. IF YOU WANTED TO CALIBRATE TO HALF SCALE, YOU WOULD APPLY 50 PPM CARBON MONOXIDE AND ADJUST THE OUTPUT TO 10 mA.**

Also, if you do not wish to use the automated calibration feature of the MP series, you can always perform the calibration manually by following the above steps

### **D) Troubleshooting**

Following are some general causes of problems related to sensors:

- 1) The sensor mis-calibration is the most common problem encountered in the field. The mis-calibration may appear as high, low, slow, or erratic readings on the meter. Know and understand calibration procedures for LEL (low explosive limit) and PPM (part per million) gases. Determine if one is calibrating the instruments properly. A little time taken to study proper calibration procedure will prevent further problems.
- 2) Contamination of the sensor will cause high readings. Water, steam, oil and solvents can contaminate the sensor. Look for water marks on the base of the sensor or discoloration of the bead or the chip portion of the sensor. Contaminated sensors usually have to be replaced.
- 3) Interfering background gas is the most difficult problem to determine. Observation of fine detail is important. Chemicals used nearby for processing or smoke stack discharges are common sources. In most cases if the cause is known, sensors with a better interference ratio can be supplied.

### **E) READING WHILE NO GAS IS PRESENT**

Following are causes of upscale readings when no gas is believed to be present:

- 1) Interference gases: the sensor is not necessarily 100% specific for the gas it is designated to detect. Check the interference data available from IST. The sources of the interference gas can be many such as newly painted walls, floor polish or cleanser, air freshener, hair spray, chemical and solvent containers not covered tightly, etc.
- 2) For a Carbon Monoxide instrument, the ambient air ALWAYS has some CO present. It is normal for the instrument to read between 0 to 10 ppm in a "clean" office area. This may be true of other gases too, in a given application.
- 3) The sensor's protective sinter is dirty. If the sinter is contaminated with grease or dirt, the sensor may read the gases emitted from these contaminants. Remove the sinter and rinse it thoroughly in a clean solvent such as acetone or alcohol, then with clean water. Make certain it is totally dry and clean before replacing it. Blowing the sinter dry with clean air is recommended.

### **F) CALIBRATION or ZERO FAULTS (CANNOT PROPERLY CALIBRATE or ZERO SENSOR)**

Following is a list of possible causes if a sensor cannot be zeroed or calibrated (sensitivity too low or high):

- 1) If calibration gas is used, make certain that the correct concentration of the gas is in the calibration gas container.

- 2) Very active chemicals such as Chlorine are easily lost during handling. Make certain a proper calibration chamber is used.
- 3) Excessive zero offset: If there is some background gas and the sensor is reading it, zeroing the sensor will offset the proper reading of the instrument. The instrument must be properly re-zeroed when zero gas is applied.
- 4) Sensor loses sensitivity: An IST solid state sensor very seldom loses sensitivity and has a long life expectancy. But in some applications, the heater voltage may be increased by 0.1 volt higher than the factory setting to compensate for the environmental change. Contact IST for assistance.

Electrochemical and catalytic bead sensors, however, do have a limited life. Electrochemical sensors are typically good for about one year, whereas, catalytic bead sensors will typically last between one to two years. In environments where gas is always present, electrochemical and catalytic bead sensors could have dramatically shorter lives (depending upon the concentration of the gas that is constantly present).

**Reference Instructions: Controllers are set as ordered. Following is additional information in case changes need to be made from factory settings.**

## 7. SETTING SPAN TIMER

The Span Timer is a setting used in conjunction with the automatic span adjustment. It determines the amount of time the controller will wait, after calibration gas has been applied to the sensor, for the reading to stabilize before making the span adjustment. It is important to set this value properly in order to obtain accurate calibration results. It should be set approximately to the response time of the sensor. Since the response time varies depending on the gas being detected, this setting will likewise vary. This value will be factory set, but since every sensor responds differently, it may be necessary for you to adjust the time for your particular sensor. A good way to determine the proper time is to apply gas to the sensor and note how long it takes for the reading to reach a fairly stable value. The span timer should be set to this time, or perhaps a little longer to ensure a stable reading. Use the following steps to adjust the span timer:

- 1) Press and hold the **[SPAN]** key until three decimal points appears **{0.0.0.}** in each of the displays. Immediately release the key.
- 2) Press the **[SPAN]** key again. The **"SPAN CONC"** and **"APPLY GAS"** LED's will begin to flash for the first channel. Adjust the Calibration Timer (in seconds) using the **[UP]** and **[DOWN]** arrow keys. Press the **[NEXT]** key after you are done.
- 3) Now, the **"SPAN CONC"** and **"APPLY GAS"** LED's will begin to flash on the other channel. Adjust the second timer using the **[UP]** and **[DOWN]** keys, then press **[NEXT]** when you are done. At this time, the controller will return to normal operating mode.

## 8. ALARM PROCESSING

The MP controller provides three alarm setpoints (low, mid, and high alarm) per channel. Each of them settable by the user and alarm levels retained even upon power loss. Also, you have the ability to make the relays associated with an alarm setpoint latching, reset on acknowledge, or failsafe.

### NOTE:

To make a relay failsafe, the proper jumpers must be installed on the motherboard for the MP-202 and MP-204, while for the MP-24, the jumpers are located on the relay card. The latching and reset on acknowledge feature is settable via the "DIP" switches located on the CPU card. This is explained further in sections 11 ("Setting Alarm Relay Characteristics") and section 18 ("Making Relays Failsafe").

Following is a table of switches related to alarm processing:

SWITCH	FUNCTION	
	SWITCH OPEN	SWITCH CLOSED
S1-7	Channel 1 Alarms Descending <sup>1,3</sup>	Channel 1 Alarms Ascending <sup>1,3</sup>
S2-7	Channel 2 Alarms Descending <sup>2,3</sup>	Channel 2 Alarms Ascending <sup>2,3</sup>
S3-1	Alarm Hysteresis Off	Alarm Hysteresis On
S3-5	Channel 1 Normal Alarms <sup>1,3</sup>	Channel 1 Oxygen Sensor Alarms <sup>1,3</sup>
S3-6	Channel 2 Normal Alarms <sup>2,3</sup>	Channel 2 Oxygen Sensor Alarms <sup>2,3</sup>

- 1 If switch **S3-5** is closed, this overrides the setting of switch **S1-7** and causes channel 1 to have two descending alarms (low and mid alarm) and one ascending alarm (high alarm). If **S3-5** is open, then channel 1 will have ascending or descending alarms depending on the setting of **S1-7**.
- 2 If switch **S3-6** is closed, this overrides the setting of switch **S2-7** and causes channel 2 to have two descending alarms (low and mid alarm) and one ascending alarm (high alarm). If **S3-6** is open, then channel 2 will have ascending or descending alarms depending on the setting of **S2-7**.
- 3 See Section 9 for an explanation of Ascending, Descending, Normal, and Oxygen Sensor Alarms.

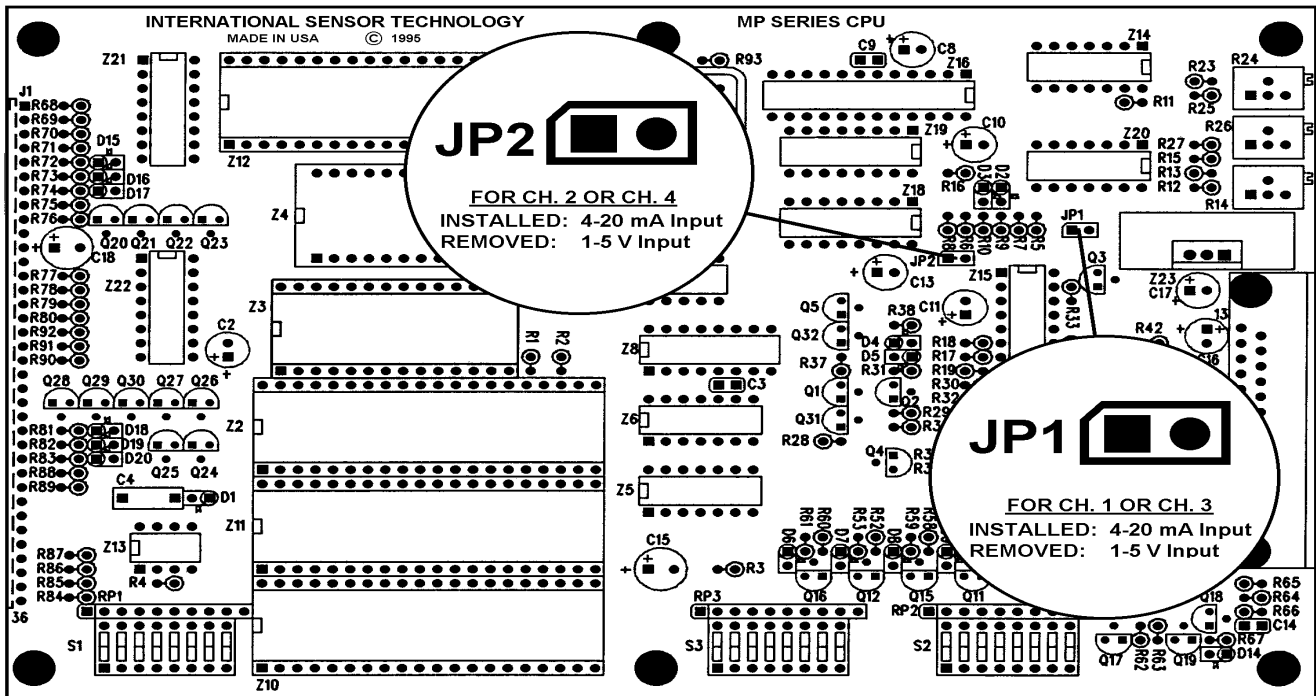


Figure 7: CPU Board Layout

## 9. SETTING ALARM TYPE

The MP has the ability to independently set for each channel whether the alarm levels are **ascending (SWITCH CLOSED)**, **descending (SWITCH OPEN)**, or a combination of both (primarily for Oxygen sensors). This is done via the switches (S1-7, S3-1, S3-5, S3-6, and S2-7) in Figure 7.

A channel with **ascending** alarms set would have the LOW ALARM < MID ALARM < HIGH ALARM (" $<$ " less than) and the alarm would trip when the current reading exceeded the alarm setpoint. Whereas, a channel with **descending** alarms set would have the LOW ALARM > MID ALARM > HIGH ALARM (" $>$ " great than) and the alarm would trip when the current reading fell below the alarm setpoint. The combination alarm type (primarily for Oxygen sensors) would have descending alarms for the low and mid alarms, and have ascending alarms for the high alarm.

**Example:**

Switch **S1-7** determines if Channel 1 has ascending or descending alarms. If **S1-7** is closed, then Channel 1 has ascending alarms; otherwise, Channel 1 has descending alarms if **S1-7** is open. Similarly, **S2-7** determines if Channel 2 has ascending or descending alarms.

Switch **S3-5** is used to determine whether Channel 1 should use a combination alarm (low and mid alarm descending, and high alarm ascending) or not. If **S3-5** is closed, then a combination alarm will be in effect for Channel 1; otherwise, if **S3-5** is open, then the alarm type is determined by how **S1-7** is set. Switch **S3-6** performs a similar function for Channel 2.

The following table outlines the possible switch settings and the effect it has on the alarm setpoints.

<b>ALARM TYPE SWITCH SETTINGS</b>				
<b>S1-7 (Ch.1) or S2-7 (Ch. 2)</b>	<b>S3-5 (Ch.1) or S3-6 (Ch.2)</b>	<b>Low Alarm</b>	<b>Mid Alarm</b>	<b>High Alarm</b>
<i>CLOSED</i>	<i>OPEN</i>	<b>ASCENDING</b>	<b>ASCENDING</b>	<b>ASCENDING</b>
<i>OPEN</i>	<i>OPEN</i>	<b>DESCENDING</b>	<b>DESCENDING</b>	<b>DESCENDING</b>
<i>DON'T CARE</i>	<i>CLOSED</i>	<b>DESCENDING</b>	<b>DESCENDING</b>	<b>ASCENDING</b>

Note that in the above table, **S1-7** and **S3-5** should be used as a pair (for channel 1), and **S2-7** and **S3-6** should be used as a pair (for channel 2). For example, if **S1-7** was closed and **S3-5** was open, then the low, mid, and high alarms for channel 1 would all be ascending.

**10. SETTING ALARM HYSTERESIS**

Switch **S3-1** controls whether or not hysteresis is used in processing alarms. If alarm hysteresis is enabled (by setting switch **S3-1** to the closed position), then the MP-24 will go into alarm at an alarm setpoint, and will go out of alarm after the reading for that channel falls 5% of full-scale below the same alarm setpoint.

For example, if the full-scale range is 100 % LEL, and the low alarm setpoint is set at 25 % LEL, then that channel will go into alarm when the reading reaches or exceeds 25 % LEL. However, the channel will not go out of alarm until the reading falls below 20 % LEL.

This feature is useful in preventing the alarm relays from setting and resetting constantly (chattering) when the reading is hovering around the alarm setpoint.

**11. SETTING ALARM RELAY CHARACTERISTICS**

The MP controller has three alarm setpoints (low, mid, and high alarm) and fault indication per channel. Also, when an alarm or fault condition occurs, the MP controller can set a relay associated with that condition. The setting or resetting of the relay associated with a condition is controlled via the DIP switches located on the CPU board. The switches on **S1** control the low, mid, and high alarm relay characteristics for channel 1; the switches on **S2** control the low, mid, and high alarm relay characteristics for channel 2; and the switches on **S3** control the fault relay characteristics for channels 1 and 2 (note that the characteristics for the fault relays cannot be programmed independently).

The relay associated with an alarm or fault condition can be set to act in one of three ways, as follows:

**NORMAL**- relay sets (closes) when the alarm/fault condition appears, relay resets (opens) when the alarm/fault condition disappears.

**RESET ON ACKNOWLEDGE** - relay sets (closes) when the alarm/fault condition appears, relay resets (opens) when the operator pushes the **[ACK ALARM]** key or when the alarm/fault condition disappears.

**LATCHING** - relay sets (closes) when the alarm/fault condition appears, and relay resets (opens) when the alarm/fault condition disappears and the operator presses the [CLEAR RELAY] key after the alarm/fault condition disappears. Following are tables of the switches and how they affect the relays associated with them:

<b>S1-1</b>	<b>S1-2</b>	<b>RELAY and ATTRIBUTE</b>
<i>OPEN</i>	<i>OPEN</i>	Channel 1 Low Alarm Relay Normal
<i>CLOSED</i>	<i>OPEN</i>	Channel 1 Low Alarm ROA*
<i>OPEN</i>	<i>CLOSED</i>	Channel 1 Low Alarm Relay Latching
<i>CLOSED</i>	<i>CLOSED</i>	Channel 1 Low Alarm Relay Latching

<b>S1-3</b>	<b>S1-4</b>	<b>RELAY and ATTRIBUTE</b>
<i>OPEN</i>	<i>OPEN</i>	Channel 1 Mid Alarm Relay Normal
<i>CLOSED</i>	<i>OPEN</i>	Channel 1 Mid Alarm ROA*
<i>OPEN</i>	<i>CLOSED</i>	Channel 1 Mid Alarm Relay Latching
<i>CLOSED</i>	<i>CLOSED</i>	Channel 1 Mid Alarm Relay Latching

<b>S1-5</b>	<b>S1-6</b>	<b>RELAY and ATTRIBUTE</b>
<i>OPEN</i>	<i>OPEN</i>	Channel 1 High Alarm Relay Normal
<i>CLOSED</i>	<i>OPEN</i>	Channel 1 High Alarm ROA*
<i>OPEN</i>	<i>CLOSED</i>	Channel 1 High Alarm Relay Latching
<i>CLOSED</i>	<i>CLOSED</i>	Channel 1 High Alarm Relay Latching

\*ROA = Reset On Acknowledge

**NOTE:** The same attribute tables above hold true for Channel 2, except the applicable switches for channel 2 are labeled S2-1 through S2-6.

From the above tables, note that the fault relay attributes (controlled by S3-3 and S3-4) are not independently settable for channels 1 and 2. The tables on page 17 give an overview of each of the switches and their functions.

**12. RECONFIGURING THE MP CONTROLLER**

Typically, the MP controller will be setup at the factory to the customer's specifications; however, it may become necessary to make changes to this configuration. This section details how to do this.

**NOTE:** If changes are made to the configuration switches while power is on, the changes made will not take affect until after the power is removed from the MP controller and then re-applied. For the MP-24 pull out the CPU from the motherboard, made changes then re-installing it. For MP-202 and MP-204 the CPU boards are located on the door.

When the CPU is unplugged from the motherboard, power will be lost to the unit. Do not worry. All necessary parameters and configuration information will be preserved. After the switches are set, and the CPU is plugged back into the motherboard, the microprocessor will re-read the configuration switches and make any necessary changes at that time.

**"POWER MUST BE RESET FOR THE CONFIGURATION CHANGE TO TAKE AFFECT"**

**13. CONFIGURATION SWITCHES**

On the bottom of the CPU are three DIP configuration switch packages, labeled S1, S2, and S3. Each of the switch packages contains eight independent two-position (OPENED and CLOSED) switches. For MP-24 the CPU can be most easily accessed by removing the screws securing the CPU to the chassis and unplugging the CPU from the motherboard. These switches are used to set various options and parameters associated with the operation of the MP controller.

Following are the functions associated with each of the switches:

<b>Switch S1 and S2 (S1 is for Channel 1 and S2 is for Channel 2)</b>		
<b>Position</b>	<b>Function</b>	
	<i>Switch Position Open</i>	<i>Switch Position Closed</i>
1	Low Alarm NOT ROA*	Low Alarm ROA*
2	Low Alarm NOT Latching	Low Alarm Latching
3	Mid Alarm NOT ROA*	Mid Alarm ROA*
4	Mid Alarm NOT Latching	Mid Alarm Latching
5	High Alarm NOT ROA*	High Alarm ROA*
6	High Alarm NOT Latching	High Alarm Latching
7	Alarms Descending	Alarms Ascending
8	Channel Disabled	Channel Enabled

\*ROA = Reset On Acknowledge

#### 14. EXPLANATION OF S1 & S2 SWITCH FUNCTIONS

Switch **S1** sets parameters that are for channel 1, switch **S2** sets parameters that are for channel 2, and switch **S3** sets parameters that apply to both channel 1 and 2. Note that for switches **S1** and **S2**, positions **1** and **2** are for the **low** alarm, **3** and **4** are for the **mid** alarm, and positions **5** and **6** are for the **high** alarm.

Switch positions **1**, **3**, and **5** on **S1** and **S2** set whether the alarm relay associated with that alarm setpoint is **reset**, or **not**, if the alarm is **acknowledged**. For example, if switch **S1-1** is closed, then when a low alarm occurs for channel 1, the alarm relay will close. If the operator acknowledges the alarm (by pressing the **[ACK]** key), then the low alarm relay will open, even though the alarm condition still exists.

Switch positions **2**, **4**, and **6** on **S1** and **S2** set whether or not the alarm relay associated with that alarm is **latching**. A latching relay is a relay that must be manually cleared (by pressing the **[CLR]** key) after an alarm condition has disappeared. For example, if switch **S1-2** is closed, then when a low alarm occurs for channel 1, the alarm relay will close. Pressing the **[ACK]** key will do nothing. When the alarm condition disappears, the **<RELAY LATCHED>** LED will flash. At this time, the operator can press the **[CLR]** key to open the low alarm relay.

**IMPORTANT NOTE: Reset On Acknowledge and Latching are mutually exclusive, that is only one of the functions can be in effect at a time. If both switches for an alarm point are set, then the Latching feature will override the Reset On Acknowledge feature for that alarm setpoint.**

If both **Latching** and **Reset On Acknowledge** are not enabled for a channel (Normal mode), then the alarm relay for that channel will close when an alarm condition appears, and will open when the alarm condition disappears. For example, if switch **S1-1** and **S1-2** are both open, then when a low alarm occurs for channel 1, the alarm relay will close. Pressing the **[ACK]** key will momentarily open, then re-close the alarm relay. When the alarm condition disappears, the alarm relay will open. The accompanying table in this section summarizes the effects of the Latching and Reset On Acknowledge switches.

**Switch position 7 determines if the alarm setpoints are ascending or descending** (for Oxygen sensors that need ascending alarms for Oxygen enrichment, and descending alarms for Oxygen depletion, see the next section detailing switch S3 functions). Ascending alarms are such that the low alarm is the lowest and the high alarm is the highest. This is the most common type of alarm situation. For instances where there is a constant amount of gas in an area and you want to determine if there is a depletion of the gas, then you would use descending alarms. With descending alarms, the low alarm has the highest value and the high alarm has the lowest value.

**Switch position 8 determines if the channel is enabled or disabled.** If a channel is not being used, or if a channel needs to be temporarily taken out of service such that there is no alarm processing done, then you will need to set this switch position to the open setting. **Under normal operation, switch position 8 should be in the closed state to enable the channel. (see Section. 19)**

ALARM SWITCH SETTINGS					
ROA*	Latching	Alarm Relay State ( <i>OPEN</i> or <i>CLOSED</i> )			
		Enter Alarm	Press [ACK]	Exit Alarm	Press [CLR]
<i>OPEN</i>	<i>OPEN</i>	<i>CLOSED</i>	<i>CLOSED</i>	<i>OPEN</i>	<i>OPEN</i>
<i>CLOSED</i>	<i>OPEN</i>	<i>CLOSED</i>	<i>OPEN</i>	<i>OPEN</i>	<i>OPEN</i>
<i>OPEN</i>	<i>CLOSED</i>	<i>CLOSED</i>	<i>CLOSED</i>	<i>CLOSED</i>	<i>OPEN</i>
<i>CLOSED</i>	<i>CLOSED</i>	<i>CLOSED</i>	<i>CLOSED</i>	<i>CLOSED</i>	<i>OPEN</i>

\*ROA = Reset On Acknowledge

SWITCH S3		
Position	Switch Position <i>Open</i>	Switch Position <i>Closed</i>
1	Alarm Hysteresis Disabled	Alarm Hysteresis Enabled
2	Spare	Spare
3	Fault NOT ROA*	Fault ROA*
4	Fault NOT Latching	Fault Latching
5	Channel 1 NOT an Oxygen Sensor	Channel 1 an Oxygen Sensor
6	Channel 2 NOT an Oxygen Sensor	Channel 2 an Oxygen Sensor
7	Channel 1 Auto-Calibration Disabled	Channel 1 Auto-Calibration Enabled
8	Channel 2 Auto-Calibration Disabled	Channel 2 Auto-Calibration Enabled

\*ROA = Reset On Acknowledge

## 15 EXPLANATION OF S3 SWITCH FUNCTIONS

Position **1** on switch **S3** controls whether or not a 5% of full-scale alarm hysteresis is used for both channels. If hysteresis is enabled, then the MP controller will go into and out of alarm at different points. For example, if channel 1 is 100 PPM full-scale, the low alarm setpoint is set for 20 PPM, alarms are ascending, and alarm hysteresis is enabled, then when the reading reaches 20 PPM, the channel 1 will go into low alarm. If the reading were to drop to 16 PPM, the unit would still be in low alarm. Only after the reading drops to 15 PPM or below does the low alarm indication disappear. This feature is primarily used to prevent the reading from hovering back and forth at the alarm setpoint and causing the unit to go into and out of alarm constantly.

Positions **3** and **4** are used to control whether the **Fault** relays on channels 1 and 2 are **Reset On Acknowledge**, **Latching**, or **regular**. They function in exactly the same way as the alarm relay switches, except they define the settings for both channels 1 and 2.

Positions **5** and **6** define whether channels 1 and 2, respectively, have an **Oxygen sensor or not**. If one of these switches is set, then the corresponding channels will have two descending alarms (low and mid) and one ascending alarm (high). Note that if switch **S3-5** is closed, it overrides switch **S1-7** (channel 1 ascending or descending alarms) and if switch **S3-6** is closed, it overrides switch **S2-7** (channel 2 ascending or descending alarms).

Positions **7** and **8** define whether channels 1 and 2, respectively, will use the MP controller's built-in auto-calibration feature. The MP controller has the ability to perform zero and span adjustments at the control unit without opening the cover of the sensor module in the field (even for non-intelligent transmitters).

**NOTE:** If you are using an IST 4-20IQ Intelligent Transmitter, you should definitely disable this feature by setting the switch position open for every channel that uses a 4-20IQ. The 4-20IQ already has a non-intrusive calibration feature, and this should not be used in conjunction with the MP controller's auto-calibration feature.

For more information on this feature, please see Section 6.

## 16. SELECTING INPUT TYPE (4 to 20 mA OR 1 to 5 VDC)

The MP series is capable of accepting 4 to 20 mA or 1 to 5 VDC input signals. This is controlled via jumpers J1 and J2 on the CPU board(s). Jumper J1 on the top CPU board is for channel 1, J2 on the top CPU board is for channel 2, J1 on the bottom CPU board is for channel 3, and J2 on the bottom CPU board is for channel 4.

The MP-202 and MP-204 the CPU boards are located on the inside cover of the weatherproof enclosure, and MP-24 the CPU board is connected to the display board. Install the jumper for a channel if the sensor module outputs a 4 to 20 mA current signal, or remove the jumper if the sensor module outputs a 1 to 5 VDC signal. The standard IST sensor module outputs a 4 to 20 mA signal. If you are not sure, please contact IST for assistance.

## 17. SELECTING COMMON OR INDIVIDUAL RELAYS

Whether the relays act as common or individual relays is controlled via the jumpers.

### INSTALL JUMPER TO MAKE RELAY COMMON

For MP-202, MP-204 and MP-220EX **these jumpers are located on the motherboard**. In a standard configuration, all of the channels share a common set of relays. For MP-24 these jumpers are located on the relay card, and the relay card must be purchase as needed.

If you have all individual relays, then none of the jumpers should be installed, and you would wire the alarm devices to the appropriate set of individual relays as indicated on the motherboard.

It is also possible to make pairs of channels common by installing jumpers selectively. If jumpers are installed on JP1, then channel 1 and channel 2 relays are common. Similarly, if jumpers are installed on JP5, then channel 3 and channel 4 relays are common. Finally, if jumpers are installed on JP4, then channel 1 and channel 3 relays become common. Contact IST if you have any questions regarding this and we will be glad to assist you.

## 18. MAKING RELAYS FAILSAFE

The relays on the MP controller can be made to either operate normally (i.e., energize upon an alarm/fault condition) or failsafe (de-energize upon an alarm/fault condition or power failure). This is controlled via the jumpers. For MP-202, MP-204 and MP-220EX **these jumpers are located on the motherboard**. For MP-24 these jumpers are located on the relay card. Each relay can be individually controlled whether it operates as a normal or failsafe relay. When a relay is made failsafe, the normally closed (NC) contacts are typically used because the relays are energized during normal operation. To make a relay failsafe, install the jumper across the appropriate relay and channel. For example, for MP-202 and MP-204 to make channel 1 low alarm relay failsafe, install a jumper across the "CH 1 FS -- L" (JP3) connectors. If all of the relays are common, use the channel 2 failsafe jumper pins (JP2).

Note that all of the relay characteristics set via the DIP switches are still valid for failsafe relays. However, whether the relay is set or reset is opposite of a non-failsafe relay.

**NOTE: IF A RELAY IS MADE FAILSAFE, BOTH POLES OF THAT RELAY WILL BE FAILSAFE.**

## 19. DISABLING A CHANNEL

- 1) **Power down the MP controller**, and locate the CPU board of the channel to be disabled. For the MP-204, the top CPU board is for channels 1 and 2 while the lower CPU board is for channels 3 and 4.
- 2) To disable channel 1 or 3, flip switch **S1-8** of the appropriate CPU board to the or "OPEN" or "OFF" position, to disable channel 2 or 4, flip switch **S2-8** of the appropriate CPU board to the "OPEN" or "OFF" position.
- 3) **Power the MP controller back on**. After the power-on warm-up, the disabled channel will be blank.

## 20. DIAGNOSTICS

The MP controller includes built-in diagnostic functions to help you diagnose and troubleshoot the control unit. To access the diagnostic functions, press and hold the **[ZERO]** key until three decimal points appear in each display. Immediately release the key. The MP controller will then enter the first diagnostic. You can move through the various diagnostics by pressing the **[NEXT]** key, or press and hold the **[FCT]** key to exit to normal mode. The diagnostics are as follows:

- 1) **Display and LED Test** -- Illuminates all LED's and shows {8.8.8.} in both displays. Press [NEXT] to go to next diagnostic.
- 2) **Display and Flash LED Test** -- Flashes all LED's and shows {8.8.8.} in both displays. Press [NEXT] to go to next diagnostic.
- 3) **Analog Output Test 1 (12 mA Output)** -- Displays {12.} in both displays, flashes "SET ALARM" and "RELAY LATCHED" LED's on both channels, and sets analog outputs on both channels to 12 mA (must have 4 to 20 mA output option). Press [NEXT] to go to next diagnostic.
- 4) **Analog Output Test 2 (4 mA Output)** -- Displays {4.} in both displays, flashes "SET ALARM" and "RELAY LATCHED" LED's on both channels, and sets analog outputs on both channels to 4 mA (must have 4 to 20 mA output option). Press [NEXT] to go to next diagnostic.
- 5) **Analog Output Test 3 (20 mA Output)** -- Displays {20.} in both displays, flashes "SET ALARM" and "RELAY LATCHED" LED's on both channels, and sets analog outputs on both channels to 20 mA (must have 4 to 20 mA output option). Press [NEXT] to go to next diagnostic.
- 6) **Relay Test** -- Displays {1.1.1.} in channel 1 display and {2.2.2.} in channel 2 display, flashes "SET ALARM" and "RELAY LATCHED" LED's, and one of the "LOW ALARM", "MID ALARM", "HIGH ALARM", or "FAULT" LED's will be on for the relay currently under test. Use the [UP] key to select the relay to be tested, and then press [DOWN] to open/close the currently selected relay. Press the [NEXT] key to return to normal mode.

## 21. TROUBLESHOOTING (ELECTRONICS)

- 1) Make sure the fuse is not blown (see Figure 3). If it is, replace it with a 2 Amp (MP-202) and or 4 Amp (MP-204 and MP-24), 250VAC fast acting fuse. (MP-220EX see Figure 9)
- 2) Make sure all wires are properly connected and there is power to the system.
- 3) Make sure that the "+ 24VDC" and the "+ 5VDC" LED's on the motherboard illuminate, indicating proper DC voltage is being applied to the system (LED's are next to TB1).
- 4) Enter diagnostics mode and run through the diagnostic tests to make sure that the unit is operating properly (see sec. 20).
- 5) On the motherboard, measure the + 24VDC and the sensor input signals from each sensor module (for MP-202 and MP-204, TB2, TB3, TB22, and TB23) and make sure they appear correct. The sensor's input signals should range from 1 to 5 VDC.
- 6) Measure the DC input power, the sensor heater, and output signal voltage at the sensor module (see sensor module instruction manual for details). This will show if power is going to the sensor, if the heater voltage is correct, and if the sensor module is outputting a signal. The DC input power should be between +12 to +24VDC, the output signal should be between 1 to 5 VDC, and the heater voltage should match the value on the tag attached to the sensor module (if this is missing, contact IST for assistance).

If all of the electronics checked-out, then the problem is probably with the sensor.

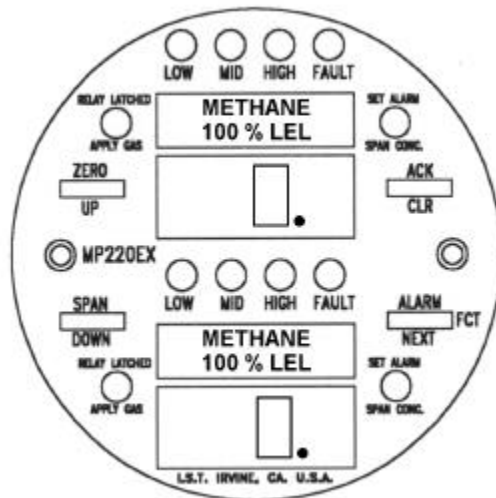


Figure 8: MP-220EX Front Panel Layout  
 Note: Use magnetic Wand for Adjustment

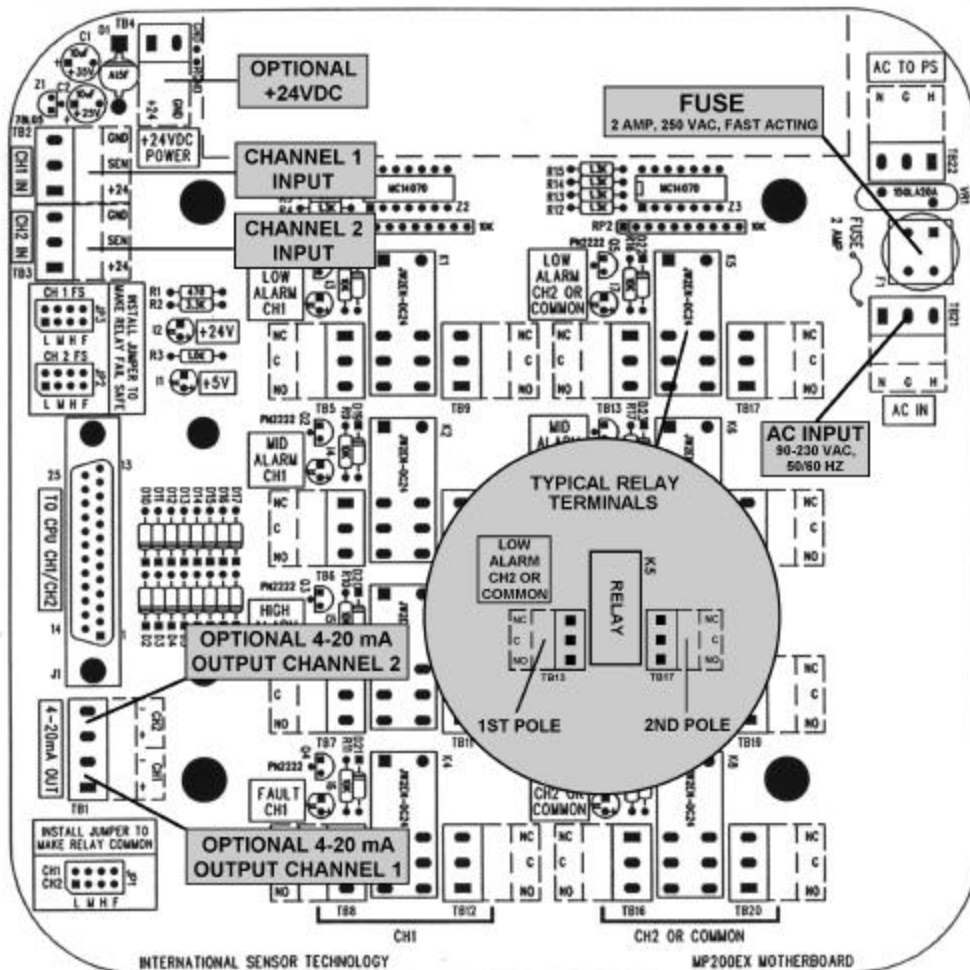


Figure 9: MP-220EX Motherboard Layout

## ***SPARE PARTS***

### **MP CONTROLLER SPARE PARTS**

#### **Spare Parts**

<b><u>Part #</u></b>	<b><u>Description</u></b>
SP-EP-MP-420	EPROM for MP Series (MP-24, 202, 204, & 220EX) Non-Isolated, Linear 4 to 20mA Output
SP-CNT-3P	Three Pins Connector
SP-CNT-JPR	Jumper Connector
SP-FUSE-2AF	2Amp Fast Acting Fuse for (MP-202, & 220EX)
SP-FUSE-4AF	4Amp Fast Acting Fuse for (MP-24, & 204)

#### **Circuit Boards**

##### **MP-24**

<b><u>Part #</u></b>	<b><u>Description</u></b>
MP-24-IR	MP-24 Individual Relay Board
MP-24-CR	MP-24 Common Relay Board
MP-24-CPU	MP-24 Two-Channel CPU Plug-in Board
MP-24-MB2	MP-24 Motherboard (Accepts Two MP-24-CPU Boards)
MP-24-PS	MP-24 +24VDC Power Supply (use with P/N: MP-24-MB)
MP-24-DISP	MP-24 Display Board
MP-24-CRCB	MP-24 6 ft. Ribbon Cable (for Common Relay Board)
MP-24-FP	MP-24 Face Plate and Label

##### **MP-200**

<b><u>Part #</u></b>	<b><u>Description</u></b>
MP-202-PS	MP-202 +24VDC Power Supply
MP-204-PS	MP-204 +24VDC Power Supply
MP-200-MB	MP-200 Series Mother Board Equipped Standard with Common Relays
MP-200-DISP	MP-202/204 Display Board
MP-200-CPU	MP-202/204 CPU Board (Does NOT Include MP-200DISP)
MP-200-FL	MP-202/204 Face Label
MP-200-CB	MP-202/204 Ribbon Cable
MP-202-ENC	MP-202 Enclosure
MP-204-ENC	MP-204 Enclosure

#### **Replacement Sensors**

<b><u>Part #</u></b>	<b><u>Description</u></b>
9910-S1	Category 1, ppm range solid-state sensor
9910-S2	Category 2, ppm range solid-state sensor
9910-SL	%LEL or % by volume solid-state sensor
9909C	Catalytic sensor
9910E	Type 1 electrochemical sensor
9922E	Type 2 electrochemical sensor
9920	Oxygen Sensor

## Sensor Sockets

<u>Part #</u>	<u>Description</u>
9744	For solid-state or catalytic sensors
9754-EI-C	For Type 1 EI sensor
9754-EI-S	For Type 2 EI sensor
9754-O2	For Oxygen Sensor

## Sensor Protective Housings and Sample Connections

Note: Parts with the F44 designation are for solid-state and catalytic sensors only. Others are as specified.

<u>Part #</u>	<u>Description</u>
F44T	Rain shield with sinter for SS and Catalytic Sensors
F44P	Plug to seal and protect sensor
F44PF	F44P with ¼" OD fitting for tube connection
F44TEF	Teflon housing for special non-hazardous areas
F44CO	Housing with charcoal filter for CO or H <sub>2</sub> gas
F44RCO	Replacement charcoal pack for F44CO
F44C	F44T with inlet fitting for calibration gas
F44CS	Inlet and outlet port for sample to flow through
F44AVS	Sampling system with compressed air vacuum system
F44-WG	Water Guard to protect sensor from hose down
9930SS	Inlet/outlet port for Type 1 EL and O <sub>2</sub> sensors
9930AV	Same as 9930SS with compressed air pump



F44T

F44P

F44TEF

F44CO

F44C

F44CS

F44AVS

F44WG

## Duct Mounting Kits

<u>Part #</u>	<u>Description</u>
F44DM	F44 with 1" NPT external thread for duct mounting
F44DMK	F44 duct mounting kits
9945DMK	Duct mounting kit for Type 1 EL and O <sub>2</sub> sensors
9945DM-1	1" NPT Duct Mount Kit for Type 1 EL and O <sub>2</sub> sensors



F44DM

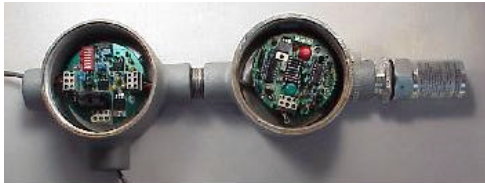
F44DMK

9945DMK

9945DM-1

**Others**

<b>Part #</b>	<b>Description</b>
S2K	Sampling system with dilution and periodic sampling
TR98M	Relay contact for transmitters with 4-20 mA signal
TR98S	Slave-additional relay contact for TR98M
-420I	Isolated 4-20 mA output for SM 95 and 4-20IQ



SM 95 Transmitter with TR98M Relay Contact.



SM95-420I, isolated 4-20mA output for SM 95