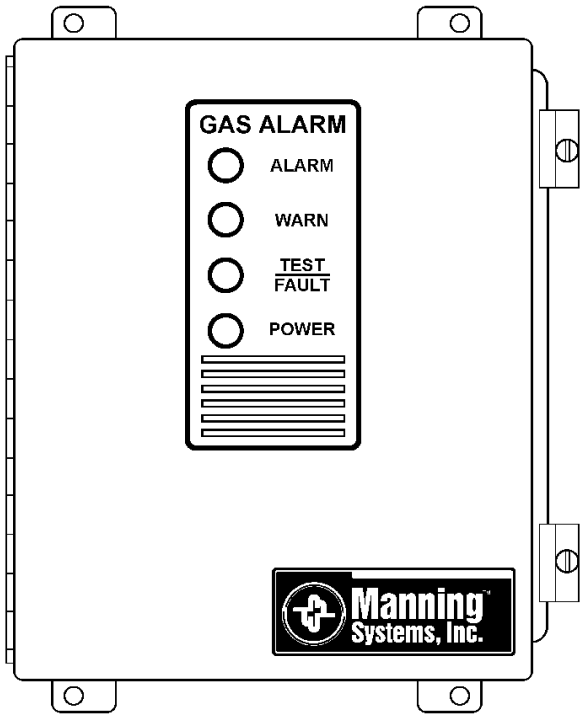
# INSTRUCTION AND INSTALLATION MANUAL

## MODEL 21-DSP
## GAS MONITORING ALARM SYSTEM

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**Serial Number** _____

# 1 SYSTEM DESCRIPTION

## A Introduction

This manual has been prepared to help in the use and installation of the Manning Systems M21-DSP Gas Monitoring Alarm System. This manual will convey the operating details of the alarm system, ensure proper installation, and demonstrate power-up and routine maintenance procedures.

**This manual must be carefully followed by all individuals who have or will have the responsibility for using or servicing the M21-DSP alarm system.**

Warranties made by Manning Systems, Inc. with respect to this equipment will be voided if the equipment is not used and serviced in accordance with the instructions in this manual. If in doubt about a procedure, please contact Manning Systems before proceeding.

## B System Description

The Manning Systems' M21-DSP Gas Alarm System is a gas sensing instrument which gives two adjustable alarm level indications in response to Ammonia and other vapors. It is suitable for use with one or two sensors, either or both of which can actuate the alarm circuits at the same gas concentrations. If two sensors are used, only the higher of the two signals activates the alarm circuits. The sensors may be direct mounted in the control unit, or remote from it. Enclosures for remote sensor mounting are available.

The M21-DSP is assembled into a wall mounted enclosure designed for installation in a non-hazardous indoor location. The gas-sensitive sensor (one or two) is installed at the specific location(s) where gas is to be detected, and is connected electrically to terminals in the control unit.

The M21-DSP includes 2 dry contact relays, which may be used to control ventilating fans or dampers, or permit connection to other auxiliary equipment.

To reduce unnecessary cycling, the M21-DSP is equipped with electronic timers that delay the action of the alarms and the alarm relays. Both alarm levels are held off for 10 seconds after their trip points have been exceeded.

The low alarm (warning) level is held on for about 60 seconds after the contaminating gas concentration is reduced below the trip point. This keeps the fan running longer to further clear the contaminating gas and makes an immediate fan restart unlikely.

The high alarm (alarm) level is held on for 10 seconds after the contaminating gas concentration is reduced below the trip point.

The immediate (non-delayed) state of the alarms are indicated by LED's on the circuit card inside the enclosure.

The control unit continuously monitors the sensor's operation and, when a sensor fault is detected, immediately turns on the *TEST/FAULT* light and the alarm relay will switch over. (The Fault Select Jumper can also be configured to switch over the warning relay instead.) See *Fault Logic* section for details.

The M21-DSP is available in the following versions:

**M21A** - Ammonia sensor - suitable for use in some freezers and engine rooms. Normal trip points are approximately 150 ppm warning and 250 ppm alarm.

**M21H** - Hydrogen sensor – suitable for use in battery room and charging stations. Normal trip points are approximately 300 ppm warning and 500 ppm alarm.

**M21F** - Halocarbon sensor - for detection of CFC, HCFC, and HFC refrigerants. Normal trip points are approximately 500 ppm warning and 1000 ppm alarm.

**M21CO** - Carbon Monoxide sensor - suitable for use in garages/docks for vehicle exhausts. Normal trip points are approximately 50 ppm warning and 100 ppm alarm.

The M21-DSP is also available for monitoring **vent lines**, with special vent line sensor enclosure and installation kit. Normal trip points are approximately 700 ppm warning and 1000 ppm alarm. (Note: Manning Systems recommends only one vent line sensor per M21-DSP.)

**System Specifications**

**Enclosure:** CEMA/NEMA 1 gasketed box, 16-gauge steel

**Dimensions:** 11 5/8" high x 8 5/8" wide x 4 3/4" deep

**Weight:** 11 pounds

**Power Input:** 110 Volt, 60 Hz, 10 VA

**Outputs:** Audible and visual alarm. Two unpowered relay contacts, Form C, 3 Amp at 24 VDC or 110 VAC

**Sensor(s):** Solid-state, metallic oxide type

**Time delays:** "On" and "Off" delays on both output relays

**Audible alarm:** Sound level 73 dBA at 10 feet on high alarm

**Temperature Range for Control Unit:** $0^{o}$ F to $120^{o}$ F ($-20^{o}$ C to $50^{o}$ C)

**Temperature Range for Sensors:** -15° F to 120° F (-26° C to 50° C)

## C Sensor Description

The M21-DSP utilizes a heated resistive metallic oxide sensor element, which undergoes a drastic reduction in electrical resistance when exposed to a reducing atmosphere such as Ammonia gas. This resistance change is used to trigger an electronic switching circuit, which in turn activates the alarm circuits.

Each sensor has four electrical leads. Two red wires carry 5 VDC to the sensor's internal heater coil. Two orange wires "report" back to the control unit any change in the resistance of the sensor element.

A sensor's resting voltage under ordinary ambient conditions can be expected to range from 0.4 to 1.4 VDC. These sensors have a **non-linear** output and, in most cases, become more sensitive as they age.

It is very important to note that all of the solid-state sensors are not totally selective to the gas being measured. These sensors must be considered "broad spectrum," i.e., they will smell other gases. Therefore, always make sure the area to be monitored is reviewed for possible interference gases.

These sensors are designed to be more sensitive to the desired target gases, but such gases as paints, solvents, hydrogen from battery chargers and exhaust fumes from fork lifts, cars, and trucks are just a small example of possible interference gases.

Solid-state sensors are normally long-lived (3-5 years), unless physically damaged or wetted with water or other liquid.

# 2 INSTALLATION

## A Locating Model 21-DSP

The Model 21-DSP is designed to be mounted on a solid (non-vibrating) wall through four holes in the two mounting flanges. While the physical location must be determined in part by local conditions, it is important to consider the following:

• Protect the Model 21-DSP from rain, snow, water sprays, cleaning crews, and physical damage.

• Mount the unit on a solid wall (non-vibrating) at eye level for convenience in taking readings, servicing, etc.

• The Model 21-DSP is **NOT** explosion proof. **DO NOT MOUNT** in a hazardous atmosphere.

• Operating temperature for the 21-DSP is $0^{o}$ F to $+120^{o}$ F.

• Pre-punched holes are provided in the bottom of the enclosure for cable access. **DO NOT** drill holes in the top of the cabinet as this will void the warranty.

• If hole drilling is required, be sure to remove all metal filings.

• Mounting dimensions are included in Figure 1.

## B Locating the Sensor

Because each sensor can only "report" what it seeing at the moment, it is very **important that the sensor is located where leaks are most likely to occur.**

**Most sensor failures are caused by water damage**. The location should be chosen to protect the sensor from water, excessive humidity, and vibration. Protect sensors from hose-down by clean up and maintenance crews.

**Give special attention to sources of potential interference gases** such as hydrogen (battery chargers), diesel fumes, carbon monoxide (propane lifts), ethylene (flowers and produce), smoke, solvents, paint, cleaners and alcohols. If these noise gases present a problem, contact Manning Systems for information on special sensor designs that eliminate these interferences.

The following guidelines must be considered when determining sensor mounting locations:

• Take air movement and ventilation patterns into account when locating sensors.

• If two sensors are used, both sensors must be located in similar environments.

• Always remember that someone (maybe you) will have to periodically work on the sensor, so make sure it is easily accessible.

• Mounting dimensions are included in Figure 1.

• Target gas mounting location guidelines are outlined in the following paragraphs.

**Vent Line mounting recommendations:**

If the Model 21-DSP is provided with a vent line sensor, see the Vent Line - Model 21 manual for mounting instructions.

**Ammonia sensor mounting recommendations:**

Because ammonia vapor is about one-half the weight of ambient air, the sensor should normally be located near the ceilings of equipment rooms, cold rooms, etc. While keeping in mind the general guidelines for sensor mounting, also consider the following for ammonia applications:

• As a general rule, locate sensors no closer than 3 feet to the ceiling.

• Do not mount the sensor over a door in a refrigerated area, as moisture will cause false trips.

**Evaporators:**

Do not mount the sensor in front, back, or on top of evaporators. When installing sensors near evaporators in re-

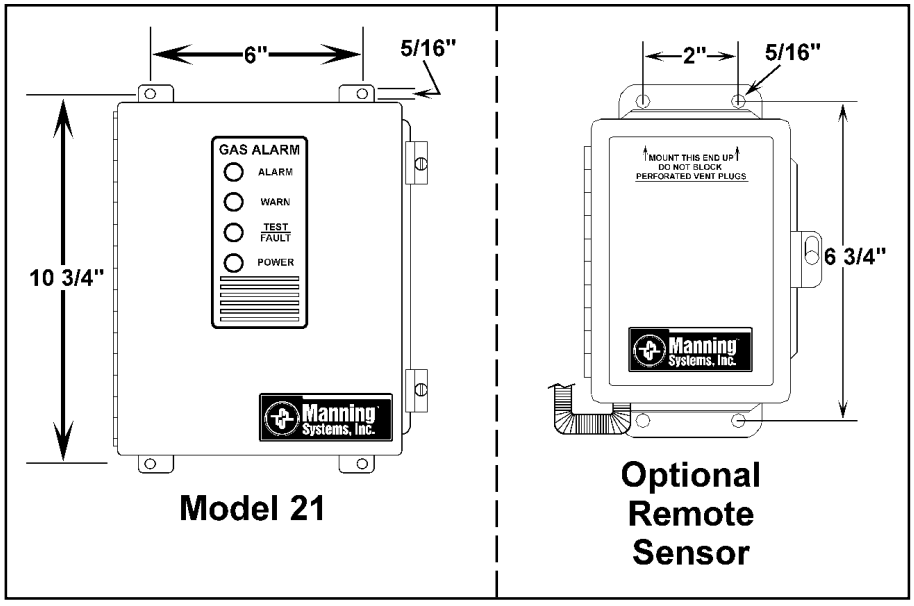


**Figure 1: Mounting dimensions for the Model 21-DSP Gas Monitoring Alarm System**

frigerated spaces, keep the airflow past the sensor below 1,200 feet/minute and away from any moisture created during defrost. The best location is usually on the piping/control side three to four feet from the evaporator and within 1½' to 2 feet from the top of the coil. Don't mount sensors any closer to evaporators than 3 feet. Do not mount the sensor on evaporators because vibration will damage the sensor.

**Blast freezers:**

Never mount sensor above the coil. The ideal location, when possible, is below the bottom of the coil. Try to put in return air and protect the unit from being damaged by product loading and unloading. Keep it away from warm, moist air during defrost.

**Penthouse:**

Sensors should be located in a multi-coil penthouse only. This sensor should **not** be mounted in a single evaporator penthouse or one where all evaporators defrost at the same time. Warm, moist air encountered during defrost will cause false alarms. The ideal location, when possible, is halfway between the ceiling and floor, out of direct airflow.

**Hydrogen sensor mounting recommendations:**

Because hydrogen vapor is much lighter than ambient air, the sensor should normally be located near the ceiling of equipment rooms.

While keeping in mind the general guidelines for sensor mounting, also consider the following for hydrogen applications:

• Give special attention to sources of interference gases such as paints, cleaners, solvents, and alcohols.

**Refrigerant (Halocarbons) sensor mounting recommendations:**

CFC/HCFC/HFC vapor is heavier than ambient air, so in a room with no air movement, it will tend to settle.

While keeping in mind the general guidelines for sensor mounting, also consider the following for refrigerant applications:

• Locate the sensor near the area where the leak is most likely to occur.

• For quickest detection, mount the sensor about 1½ to 2 feet off of the floor, close to the leak source.

• With the sensor mounted low, protect from water damage due to floor cleaning.

**Carbon Monoxide mounting recommendations:**

Carbon Monoxide vapor is about the same weight as ambient air, so for area personnel protection, consider mounting the sensor in the normal breathing zone (4 to 5 feet above the floor).

While keeping in mind the general guidelines for sensor mounting, also consider the following for carbon monoxide applications:

• Locate the sensor close to the expected source of carbon monoxide.

• Give special attention to sources of interference gases such as paints, cleaners, solvents, and alcohols.

## C Wiring

Electrical wiring must comply with all applicable codes. Plant equipment that may be involved and operating conditions should be discussed with local operating personnel to determine if any special needs should be taken into account.

Nearly all start-up problems are due to improper wiring or monitor configuration. Please follow these guidelines carefully. Figure 2 presents a wiring diagram for the Model 21-DSP.

**AC Power Wiring:**

• Use only stranded cable for both AC power, relay outputs, and sensor input cables.

• The units must have a proper third wire ground for safety and sensor shielding. Be sure to follow local codes.

• All AC cables must be kept away from the incoming sensor cables, i.e., **do not** put AC cables inside conduit containing sensor cables.

• Keep all wiring away from variable speed drives and SCR control units to minimize electrical noise exposure.

• Electrical Power: 120 VAC, 60 HZ, 10 VA.

• Electrical power ground: The unit must be properly grounded.

• Manning Systems recommends the use of an uninteruptable power supply for protection against power disturbances, outages, etc.

**Relay Wiring:**

All three (3) relays have Form C, dry contacts. Any required power source must be within the 3 amp rating and fused or current limited to keep from damaging the contacts.

• Relays are rated for 3 amps at 120 VAC or 24 VDC.

• Relay wiring must be run in separate conduit from the sensor cable if the relay circuit is AC.

**Note:** Both relays are energized during normal (no alarm) operating conditions so that a power loss to the M21-DSP will result in an alarm.

**Sensor Wiring:**

• Always use four-conductor, insulated, stranded, shielded copper cable.

• For wire runs up to 300' use #16/4 shielded cable between the M21-DSP and the sensor. Recommend Belden #9954 or equivalent.

• For wire runs up to 600' use #14/4 cable.

• Tie shield to earth ground at the M21-DSP. Tape all exposed shield wire at the sensor to insulate it from the enclosure.

• There are no polarity requirements for either the R/R or O/O connections.

• **Do not** pull sensor wiring with AC power cables. This will cause electrical interference.

Be sure there are no breaks or splices in sensor wiring runs. If cable runs cannot be made without a splice, all connections must be soldered. Soldering should be done using a rosin flux to tie the connect-

ing ends of sensor wires to ensure a positive and long-lasting contact.

All penetrations into a refrigerated room should be sealed to prevent condensate from forming in the conduit and dripping into the sensor enclosure. Silicone should not be used near the sensor, because silicone can damage the sensor.

Mount sensor enclosures through the flange holes as shown in Figure 1, and always mount vertically. Make drip loops for cables going into sensor housings. Follow the mounting instructions on the enclosure *(This End UP).*

On single sensor units, a 30 Ohm, 1 Watt Ballast Resistor must be connected to the R/R terminals for #2 sensor. This resistor is used to complete the circuit left open if sensor #2 is not used. (See Figure 2) Single sensor units are shipped from Manning Systems with this resistor installed.

## D Fault Logic

The installer should determine from the user how the fault system is to be configured. The fault system is activated by most types of damage to the sensor or the sensor wiring system.

On the control unit circuit card there is a small shorting jumper (Fault Select Jumper) below and between the red and green test points. (See Figure 2)

This jumper can be pulled off its 3-prong base and re-installed either to short out the left hand or right hand pair of prongs. Shorting out the left-hand pair will cause the **Warning** relay to switch over in the event of a fault. Shorting out the right-hand pair will cause the **Alarm** relay to switch over in the event of a fault. (The circuit card is marked W and A as appropriate to the jumper position)

If the jumper is removed altogether, neither relay switches over in the event of a fault condition. The white fault light always lights up regardless of jumper position.

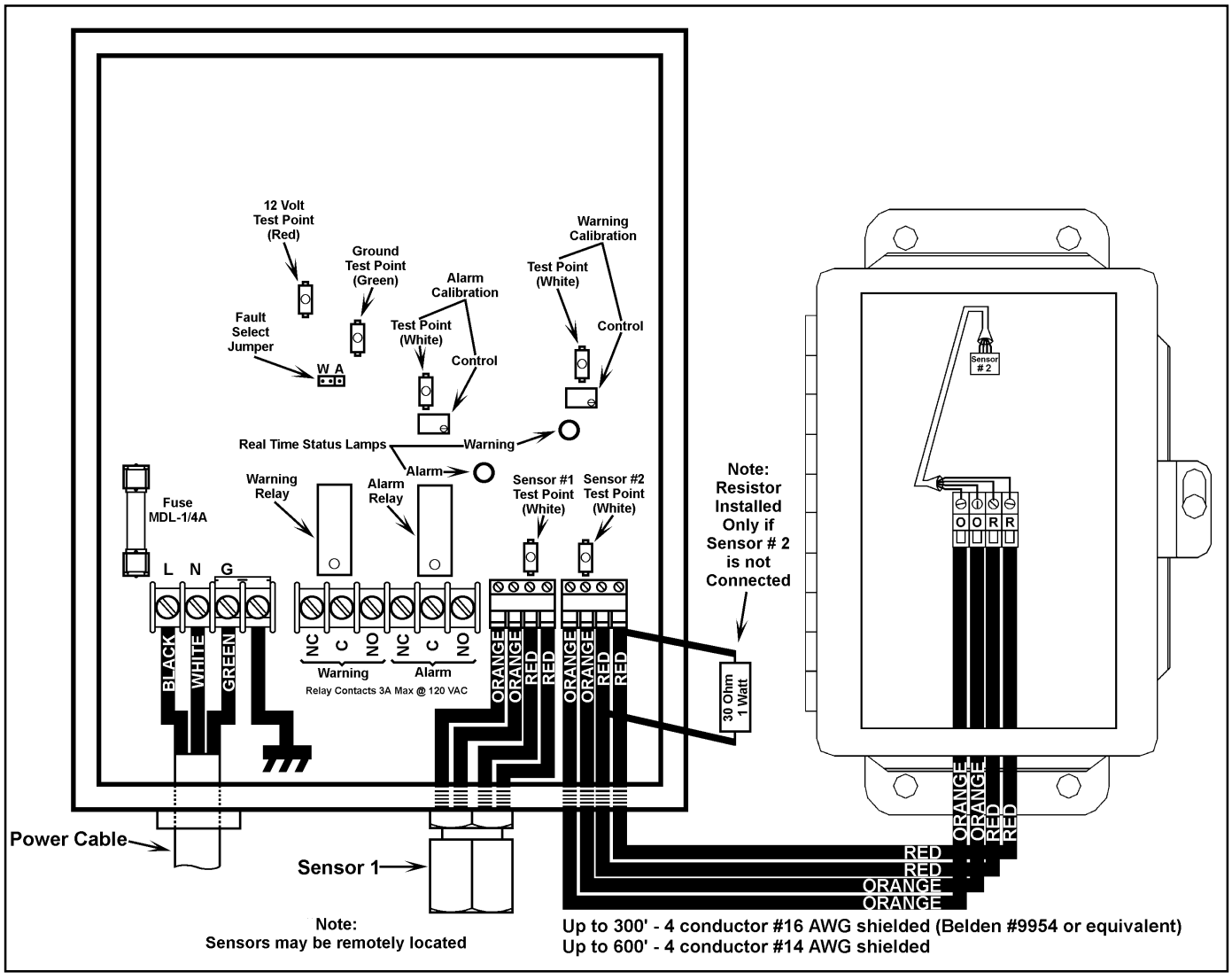


**Figure 2: Wiring diagram for the Model 21-DSP Gas Monitoring Alarm System**

# 3 OPERATION

## A Indicator Panel

The front panel of the control unit contains the audible alarm and four indicating lamps. Two of the lamps are also switches. Their functions are:

**ALARM** (red) - lamp and momentary switch - When lighted, indicates that a high alarm condition exists, and that the high alarm relay has been activated. When depressed, it will silence the audible alarm. Note, however, that a subsequent high alarm will restart the audible alarm.

**WARN** (amber) - When lighted, indicates that the first (warning) alarm level has been reached and the low alarm relay has been activated.

**TEST/FAULT** (white) lamp and momentary switch - When lighted, this lamp indicates a sensor wiring fault or failed sensor. When depressed, it turns on the other three lamps and sounds the audible alarm. The alarm relays, however, will not switch over.

**POWER** (green) - When lighted indicates POWER on.

## B Taking Voltage Readings

Using a digital Voltmeter, set it to **DC** Volts and connect black (ground) lead to *TP GND*. Leave it connected there while taking readings. All voltage readings taken are in reference to *TP GND*.

Connect the red lead to *TP +12V*. This voltage should be 12 VDC +/- 0.5 VDC. (See Figure 3, Note 1).

Move the red lead to *TP WARN*. This is the warning trip level at which the unit has been calibrated. This reading will vary from 2.5 to 6 VDC depending on the PPM level at which the low alarm is set to trip. (See Figure 3, Note 2).

Move the red lead to *TP ALM*. This is the alarm trip level at which the unit has been calibrated. This reading will vary from 2.8 to 6.5 VDC depending on the PPM level at which the high alarm is set to trip. (See Figure 3, Note 3).

Move the red lead to *TP SENSOR #1*. This is the signal "reporting" voltage from sensor #l. This voltage is usually resting

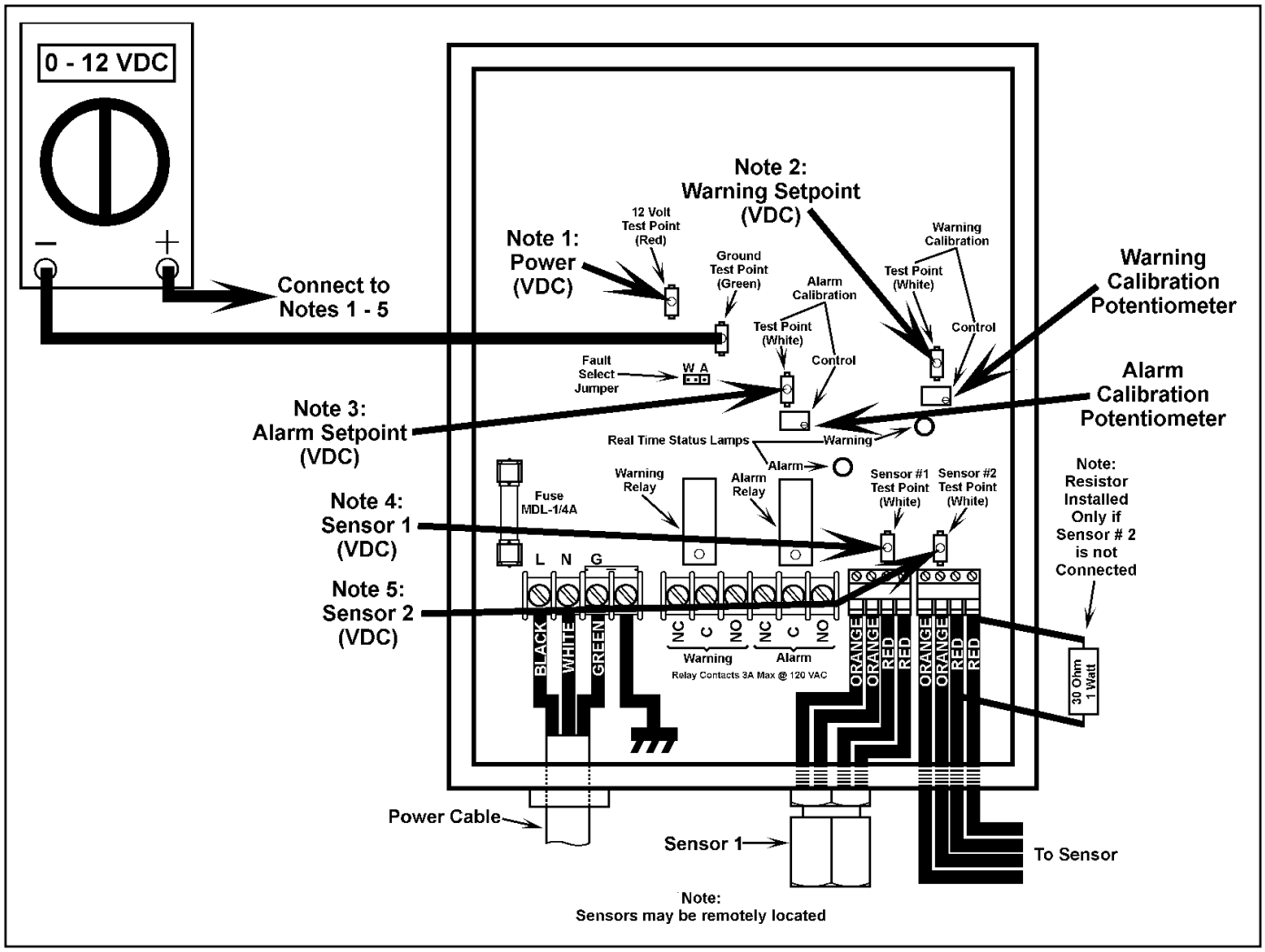


**Figure 3: Signals and Setpoints on the Model 21-DSP**

between 0.6 and 1.4 VDC. This voltage will continuously vary a few tenths of a volt. (See Figure 3, Note 4).

Move the red lead to *TP SENSOR #2*. This is the signal "reporting" voltage from sensor #2. Be sure to log these voltages on a **monthly basis**. (See Figure 3, Note 5).

## C Signal and Trip Points

The voltage between *TP Gnd and TP SENSOR #1* (or #2) indicates the signal received from the sensor. When this signal voltage exceeds the voltage at *TP WARN* (Warning trip point), the warning function will take place. When this signal voltage exceeds the voltage at *TP ALM* (Alarm trip point), the alarm function will take place. Note that the *ALM* trip point voltage should always be higher than or equal to the *WARN* trip point voltage.

**Adjusting the Trip Points:**

The *WARN* and *ALM* trip points are determined at the time of order and are factory set, as indicated on the data sheet included with your M21-DSP. However, the trip points can be field adjusted as conditions change. Never adjust the trip levels unless certified calibration gas is available to verify the trip levels.

The *ALM* trip point voltage is adjustable by measuring the voltage between *TP Gnd* and *TP ALM* and adjusting the *ALM* adjust pot until the desired trip point is reached. The *WARN* trip point is adjusted the same way. See Figure 3 for locations of testpoints and trip point adjust pots.

After trip point adjustment, always expose sensors to the gas being monitored and verify that the warning and alarm lights and relays trigger at the desired concentration.

**Never adjust these trip points higher than 6.5 volts.** Contact Manning Systems if you have any questions or want help in determining trip points for your particular sensor and application.

## D Relay Logic

There is continuity between the NC and C terminals and there is no continuity between the NO and C terminals of the warning and alarm relays when all of the following conditions are met:

- AC power is applied to the unit.
- The ambient gas level is **below** the trip point levels.
- There are no sensor or wiring faults (depending upon how the fault logic is programmed).

There is continuity between the NO and C terminals and there is no continuity between the NC and C terminals of the warning and alarm relays if any of the following conditions exist:

- AC power is lost to the unit.
- The ambient gas level is **above** the trip point levels.
- There is a sensor or wiring faults (depending upon how the fault logic is programmed).

## E Power-Up Procedures

Before applying power, make a final check of all wiring for continuity, shorts, grounds, etc. It is usually best to disconnect external alarms and other equipment from the unit until the initial start-up procedures are completed.

After power-up, allow 24 hours for the system to stabilize before testing the sensor. Because sensors are normally located at a distance from the monitoring unit, the test time required and accuracy of the response checks will be improved if two people perform the start-up procedures and use radio contact.

**Start-Up Test:** One person exposes the sensor to a small amount of the gas that is being monitored. The second person stays at the monitoring unit to determine that the sensor, when exposed to the gas fumes, is connected to the proper input, responds, and causes appropriate alarm functions. Also verify, referring to the floor plan, that the correct sensor is responding to the gas fumes.

Temporarily disconnect any one of the red sensor wires. Verify that the white fault light comes on and the correct relay (as programmed during installation) switches over.

## F Calibration

Each M21-DSP alarm system has been factory tested with a certified calibration gas sample. Calibration information is noted on the data sheet provided with each unit.

**The first thing to understand is that there are no adjustments to be made at the sensor. All calibration adjustments must be made at the control unit.**

Calibration of solid-state sensors in the field is normally performed by exposing the sensor to the certified calibration gas sample (in accordance with the "SOLID-STATE CALIBRATION PROCEDURE" included in the Manning Systems calibration kit). After exposing the sensor to a calibration gas standard for one or two minutes, set the alarm trip point to the observed signal voltage peak.

The data sheet will list a resting signal voltage. This is the signal of the sensor when it is exposed to clean air at standard room temperature (i.e., $70^{o}$ F). The sensor is then exposed to a certified calibration gas sample and its signal is logged.

Following are examples of typical calibration data for nominal sensors:

**Ammonia:**

| | |
|---|---|
| Resting Signal | 1.0 VDC |
| 250 PPM Signal | 3.3 VDC |
| 1,000 PPM Signal | 4.2 VDC |
| 10,000 PPM Signal | 5.5 VDC |

**Hydrogen:**

| | |
|---|---|
| Resting Signal | 1.0 VDC |
| 500 PPM Signal | 5.5 VDC |
| 1,000 PPM Signal | 6.0 VDC |

**R22:**

| | |
|---|---|
| Resting Signal | 1.4 VDC |
| 500 PPM Signal | 5.8 VDC |
| 1,000 PPM Signal | 6.3 VDC |

**Carbon Monoxide:**

| | |
|---|---|
| Resting Signal | 1.0 VDC |
| 50 PPM Signal | 4.2 VDC |
| 100 PPM Signal | 4.7 VDC |

The difference between the resting signal and the calibrated gas signal readings is the calibrated signal rise. It is important to note that the calibrated signal rise is **non-linear**; therefore, the sensor must be calibrated at the required trip point concentration.

Due to environmental differences and background gases, the installed resting signal may be slightly different than the resting signal was during factory calibration.

**Sensor Life:**

Our experience has shown the resting signal in most cases will rise as the sensor ages, i.e., the sensor becomes more sensitive. Referring to the ammonia example, after some time the resting signal may rise to 1.4 VDC, at which time the trip point should be adjusted to 1.4 VDC + 2.3 VDC (250 PPM ammonia signal rise) = 3.7 VDC, the new trip point voltage. This method has proven to be a very reliable and conservative method of extending sensor life, although, the use of certified calibration gas is always recommended.

Because of these characteristics, it is extremely important to log signal voltages on a **monthly basis** to enable observation of long-term trends.

For certified calibration gas, contact Manning Systems for gases available and to discuss techniques in calibration.

## G Troubleshooting

The greatest probability for trouble is reversed or incorrect wiring. Always be consistent with color codes and double-check terminal screw tightness. When wiring has passed the initial power-up phase, there is little probability of wiring problems unless physically damaged by storm or accident.

The first step is to take a complete set of voltage readings (see *Taking Voltage Readings* section).

**Fault:**

The most common problem is a "fault" condition reported on the M21-DSP unit. The sensor has four (4) wires going to it, two are used for the internal sensor heater noted as "RR" (red-red) terminals. The M21-DSP should provide 5 VDC at these terminals. Consider the following when troubleshooting a fault condition:

- On single sensor units, a 30 Ohm, 1 Watt ballast resistor must be connected to the R/R terminals for the #2 sensor to complete the circuit.
- The resistance between the RR wires of the sensor must be approximately 30 Ohms.
- Note that these resistance measurements should be made with the sensor unpowered.

If the wiring seems correct and there is no apparent damage, follow this simple procedure to check the sensor and wiring system. (See Figure 4)

1. Disconnect the RR wires at the M21-DSP terminal strip.
2. Set your multimeter to the "Ohms" scale.
3. Measure the resistance between the RR wires going out to the sensor.
4. If the reading is not 30 Ohms, leave the RR wires disconnected (and not shorting together).
5. Take this same reading at the RR terminal blocks of the sensor to make sure the trouble is not in the wiring.
6. If the reading is 30 Ohms, then the problem is in the cable between the M21-DSP and the sensor.
7. If it is still not 30 Ohms, the sensor most likely has an internal heater failure and needs to be replaced.

Repeat the same steps for the #2 sensor if necessary.

**Signal voltage on the M21-DSP indicates a gas concentration when no apparent gas is present:**

Manning Systems uses a number of different solid-state sensors depending on the gas to be detected.

Even with this special selection, the solid-state sensor must be considered a broad spectrum device that responds to gases (which may not be the target gas) such as ammonia, hydrogen (battery chargers), diesel fumes, carbon monoxide (propane lifts), ethylene (flowers and produce), smoke, solvents, paint, high moisture levels, wash-down, etc.

"Nuisance" alarms *do* occur for no *obvious* reason. The most usual reaction to a nuisance alarm is to raise the alarm trip levels. However, many nuisance alarms can be traced to an unknown or unexpected source of a gas or vapor. Serious efforts should be made to investigate and eliminate the source before raising the alarm trip level.

If the interferences from nuisance gases cannot be eliminated, it may be necessary to reduce the sensitivity of the unit by raising the trip points (see *Signal and Trip Points* section).

If interference gases are not present, then, depending on the environment, background gases, etc., the resting signal may slowly drift upward with age. An upward trend indicates that periodic alarm trip point adjustments are required (see *Calibration* section).

If the sensor has a high resting signal voltage or is constantly showing an alarm trip voltage, it could be at the end of its useful life. A replacement sensor may be required. Contact Manning Systems.

**Special notice for odorless gases:**

Gases such as hydrogen, carbon monoxide, and refrigerants (halocarbons) are odorless and can't be sensed by the human sense of smell. Special precautions should be taken in these cases to confirm the presence of a target gas if the source of false trips appear to be coming from interference gases.

Manning Systems recommends the use of a portable instrument for verification before assuming the target gas is not present.

Manning Systems has a very complete line of portable instruments for this

purpose as well as normal plant monitoring. Please contact Manning Systems if you have this requirement.

## H Maintenance

The M21-DSP is designed for long life and high reliability. **It is essential that signal voltages be taken and logged on a monthly basis. Additionally, each sensor should be challenged with an ammonia sample at least once each six (6) months and the results logged.** During the gas challenge test, all alarm outputs should be confirmed and logged to insure system integrity. This will test the sensor and any equipment connected to the relays in addition to the M21-DSP. Manning Systems highly recommends that certified calibration gas be used once each six (6) months.

## I Replacement Parts

For replacement parts, contact Manning Systems, Inc. Be sure to give serial number and model number of unit.

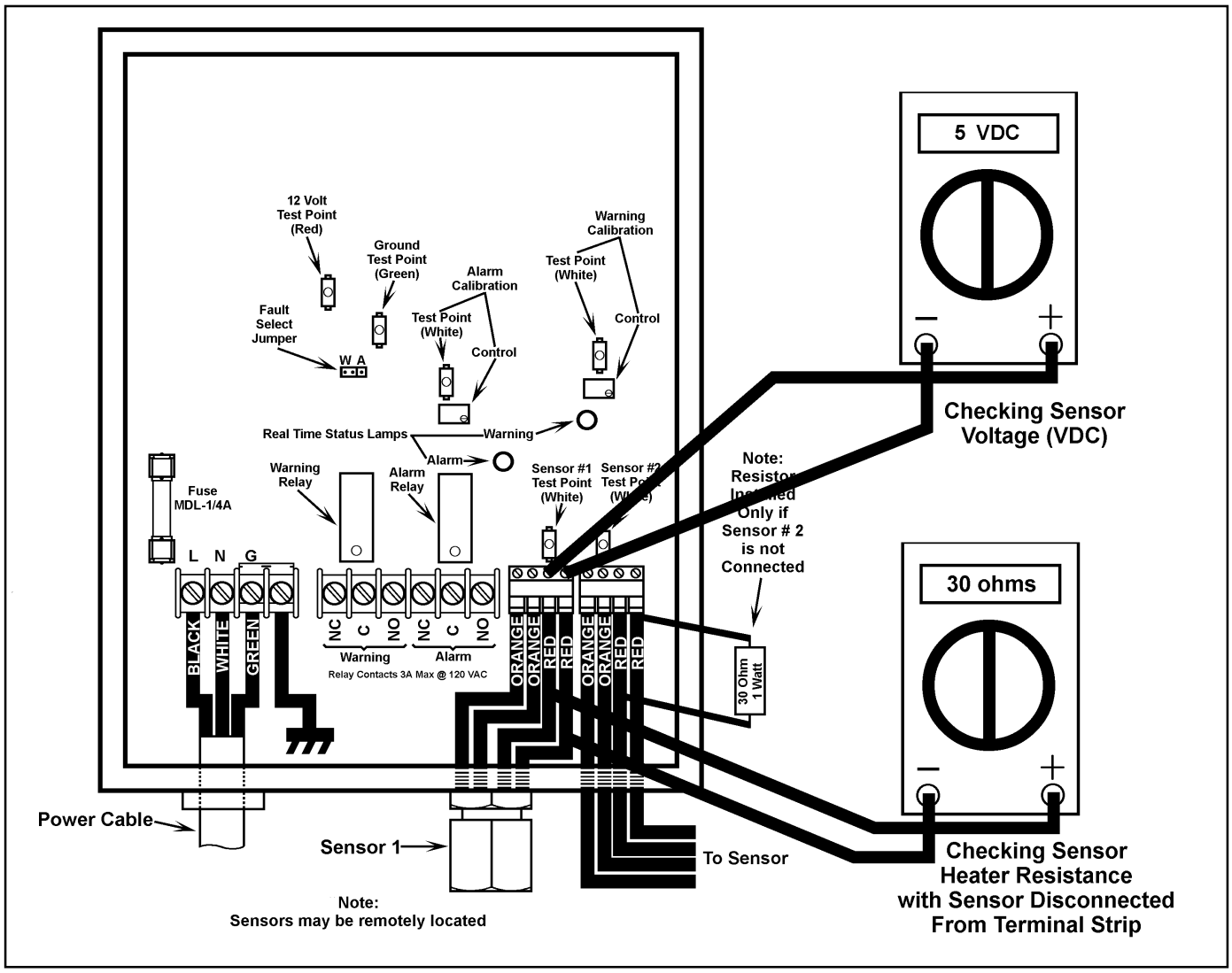


**Figure 4: Troubleshooting the Model 21-DSP Gas Monitoring Alarm System**

# Limited Warranty

**1. Limited Warranty.** Manning Systems, Inc. ("Manning") warrants to the original purchaser and/or ultimate customer ("Purchaser") of Manning's Products ("Product") that if any part thereof proves to be defective in material or workmanship within eighteen (18) months of the date of shipment by Manning or twelve (12) months from the date of first use by the purchaser, whichever comes first, such defective part will be repaired or replaced, free of charge, at Manning's discretion if shipped prepaid to Manning at 11511 W. 83rd Terrace, Lenexa, Kansas 66214, in a package equal to or in the original container. The Product will be returned freight prepaid and repaired or replaced if it is determined by Manning that the part failed due to defective materials or workmanship. The repair or replacement of any such defective part shall be Manning's sole and exclusive responsibility and liability under this limited warranty.

**2. Exclusions.**

A. If gas sensors are part of the Product, the gas sensor is covered by a twelve (12) month limited warranty of the manufacturer.

B. If gas sensors are covered by this limited warranty, the gas sensor is subject to inspection by Manning for extended exposure to excessive gas concentrations if a claim by the Purchaser is made under this limited warranty. Should such inspection indicate that the gas sensor has been expended rather than failed prematurely, this limited warranty shall not apply to the Product.

C. This limited warranty does not cover consumable items, such as batteries, or items subject to wear or periodic replacement, including lamps, fuses, valves, vanes, sensor elements, cartridges, or filter elements.

**3. Warranty Limitation and Exclusion.** Manning will have no further obligation under this limited warranty. All warranty obligations of Manning are extinguishable if the Product has been subject to abuse, misuse, negligence, or accident or if the Purchaser fails to perform any of the duties set forth in this limited warranty or if the Product has not been operated in accordance with instructions, or if the Product serial number has been removed or altered.

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