Toxic Smarter Transmitter
Instruction Manual

Sensor Type: ________________________________
Detection Range: ___________________________
Operating Voltage: 24VDC

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no false alarms
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Ammonia, NH$_3$
Boron Trichloride, BCl$_3$
Bromine, Br$_2$
Carbon Monoxide, CO
Chlorine, Cl$_2$
Chlorine Dioxide, ClO$_2$
Dichlorosilane, SiH$_2$Cl$_2$
Fluorine, F$_2$
Hydrogen Bromide, HBr
Hydrogen Chloride, HCl
Hydrogen Cyanide, HCN
Hydrogen Fluoride, HF
Hydrogen Iodide, HI
Hydrogen Peroxide, H$_2$O$_2$
Hydrogen Sulfide, H$_2$S
Nitric Acid Vapors, HNO$_3$
Nitrogen Dioxide, NO$_2$
Oxygen, O$_2$
Ozone, O$_3$
Sulfur Dioxide
Silicon Tetrafluoride, SiF$_4$
Sulfur Dioxide, SO$_2$
Sulfuric Acid Vapors, H$_2$SO$_4$

Many More Gases

Arsine, AsH$_3$
Phosphine, PH$_3$
Diborane, B$_2$H$_6$
Hydrazine, N$_2$H$_4$
Silane, SiH$_4$

Tungsten Hexafluoride, WF$_6$
Tetrachlorosilane, SiCl$_4$
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Installation Drawings

Warranty
Smarter Toxic Gas Transmitter

I. Description:

The model TA-2100 Smarter Transmitter provides remote detection of a specific toxic gas using Mil-Ram’s patented No False Alarms electrochemical sensor technology. The transmitter features a standard 4-20mA output and additionally, an RS-485 serial output. The model TA-2100 is available with an optional relay module in the same enclosure. The smarter transmitter is available for either 12 or 24 VDC operation.

II. Smarter Features:

Self-Calibration – unattended span calibration adjustments performed every 30 days based on life curve for sensor

Auto-Calibration – non-intrusive calibrations using a magnet to activate zero and span switches located behind glass window of explosion-proof junction box – no mechanical adjustments required

LCD Display – 12 character x 2 line display provides meter readings and all configuration, alarm, calibration and diagnostic messages

Life Remaining – sensor life remaining based on calibration history, life curve for sensor and electrical characteristics of sensor

Alarm Relays (optional) – four alarm relays; low, mid, high and trouble (fault) – field selectable non-latching/latching, non-energized/energized, time delays 0-90 sec.

Calibration Mode Alarm Inhibit – transmitter outputs 4.0 mA in calibration mode, alarm relays inhibited for 5 min. after returning to normal operating mode

RS-485 Output – full-duplex serial communications for linking up to 256 transmitters on a twisted wire pair to a PC, PLC, Host computer, etc.

Analog 4-20mA Output – standard output for connection to a controller, PLC, Host computer, etc.

Diagnostics – continuous diagnostics related to both hardware and software operation with auto reset of micro-controller in the event of software failure – provide messages including REPLACE SENSOR, REMAINING SENSOR LIFE, SENSOR DISCONNECTED, RELAYS DISCONNECTED, etc.
III. **Installation:**

The sensor is provided with \(\frac{3}{4}\)' NPT external threads opposite the sensing end of the device. The sensor screws into an explosion-proof junction box which houses the *smarter* electronics. The sensor/smarter electronics/junction box assembly constitutes the transmitter.

Install transmitter as follows:

1. Unscrew cover (with glass window) from junction box.

![Junction Box with cover/glass window removed](image1)

![Removal of LCD display/main circuit board assembly from junction box](image2)

![Junction box with relay module (optional)](image3)
2. Remove LCD display/main circuit board assembly by pulling up on face plate at two locations marked **PULL** (banana jacks secure the assembly in the junction box). Carefully lift assembly from junction box and disconnect relay ribbon cable connector from main circuit board.

3. Carefully guide brown sensor cable connector through opening in bottom of junction box. Screw sensor into junction box hand tight. Attach sensor connector to bottom of main circuit board at connector marked **SENSOR**. Seat the sensor connector fully to lock in place.

![Diagram showing sensor connector and main circuit board](image)

4. Attach relay ribbon cable to connector on bottom of main circuit board.

5. Install LCD display/main circuit board assembly in junction box by carefully aligning banana plugs on bottom of main circuit board with sockets in junction box. Gently push (directly above face-plate screws) until banana plugs seat fully in sockets.

6. Replace cover on junction box.

7. Mount junction box to a vertical surface with the perforated end of the sensor pointing downward.

**Note:** It is generally recommended that the sensor be installed at a location as close as possible to the source of gas.
IV. Transmitter Wiring:

The *smarter* transmitter can be connected as either a 3-wire or 4-wire 4-20mA device.

A. When connecting the transmitter to a controller with a 3-wire input and integral 24 VDC power supply, make connections as follows:

![Diagram showing 3-Wire Hook-Up](image-url)
Run three wires from the controller +24V, power common and signal to the corresponding power/signal terminals located on the bottom of the main circuit board.

**NOTE:** The three wires must be isolated from other wires and should therefore be shielded or run in metal conduit to avoid electrical pick-up. If a shield is used it should run continuously from the controller electronics to the inside of the transmitter junction box. The shield should be terminated at the controller power common but left floating (do not attach to anything) inside the transmitter junction box to avoid ground loop interference. Apply electrical tape to exposed shield inside junction box.

B. When connecting the transmitter to a 24VDC power supply and taking the 4-20mA signal to a meter, PLC, etc. make connections as follows:
NOTE: The two signal wires must be isolated from other wires and should therefore be shielded or run in metal conduit to avoid electrical pick-up. If a shield is used it should run continuously from the measurement instrument to the inside of the transmitter junction box. The shield should be terminated at the instrument signal common but left floating (do not attach to anything) inside the transmitter junction box to avoid ground loop interference. Apply electrical tape to exposed shield inside junction box.

The following Tables indicates maximum line lengths between controller and smarter Transmitter for standard copper:

<table>
<thead>
<tr>
<th>Wire Size (AWG)</th>
<th>Feet</th>
<th>Meters</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>21,144</td>
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<tr>
<td>14</td>
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<td>634</td>
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<tr>
<td>24</td>
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<td>398</td>
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<table>
<thead>
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<th>Wire Size (AWG)</th>
<th>Feet</th>
<th>Meters</th>
</tr>
</thead>
<tbody>
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<td>352</td>
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<tr>
<td>24</td>
<td>726</td>
<td>221</td>
</tr>
</tbody>
</table>
V. Transmitter Operation:

The *smarter* transmitter provides four magnetic switches to configure the alarms and calibrate the toxic sensor. The switches are activated using a magnet held directly over the switch outside the junction box glass window.

The switches are designated as follows:

**ENTER:** A magnet switch used to enter and exit the alarm set-up routine as well as enter (accept) various set-up parameters. Alarm set points, non-latching/latching relay function, non-energized/energized relay operation, relay time delays and relays on/off are configured in the set-up routine. The remaining sensor life (months) is displayed at the end of the set-up routine.

---

<table>
<thead>
<tr>
<th>Wire Size (AWG)</th>
<th>Feet</th>
<th>Meters</th>
</tr>
</thead>
<tbody>
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<td>22</td>
<td>763</td>
<td>232</td>
</tr>
<tr>
<td>24</td>
<td>480</td>
<td>146</td>
</tr>
</tbody>
</table>
*UP*: A magnetic switch used to increment alarm set points and relay time
delays. Switch also used to display other set-up options.

*DOWN*: A magnetic switch used to decrement alarm set points and relay time
delays. Switch also used to display other set-up options.

*ALARM RESET*: A magnetic switch used to manually reset latching relays. Latching relays
can only be reset when the meter reading falls below the corresponding
alarm set point.

**Alarm Set-Up Mode:**

The *smarter* transmitter is available with an optional on-board relay module. If the
relay module is installed, the following alarm set-up procedure is used to configure
setpoints and relays (non-latching/latching, non-energized/energized, 0-90 sec. time
delays). During normal operation, the transmitter will display appropriate alarm messages
on the LCD related to low, mid or high alarm conditions.

If the *smarter* transmitter is provided without the relay module option, a jumper is
factory installed on the main circuit board to similarly allow access to alarm set-up. In this
case, however, set points are selected for the sole purpose of obtaining appropriate alarm
messages on the LCD related to low, mid or high alarm conditions. In this configuration it
is recommended that all alarms be configured non-latching, non-energized with 0 sec. time
delay. This will ensure the alarm messages appear immediately and self-reset when
readings drop below corresponding setpoints.

1. To enter set-up mode, momentarily hold magnet directly over *ENTER* switch until
   LCD display shows the low alarm set point

   ![LO AL = 1.0](image)

   Momentarily hold magnet directly over *UP* or *Down* switch to increment or
decrement low alarm set point as desired. When proper alarm point is displayed,
hold magnet directly over *ENTER* switch to advance to next selection
2. Momentarily hold magnet directly over **UP** or **Down** switch to change relay function (eg. change from non-latching NL to latching L). When proper relay function is displayed, hold magnet directly over ENTER switch to advance to next selection

![LO RELAY NL]

NL=non-latching
L=latching

3. Momentarily hold magnet directly over **UP** or **Down** switch to change relay operation (eg. change from non-energized NE, to energized E). When proper relay operation is displayed, hold magnet directly over ENTER switch to advance to next selection

![LO RELAY NE]

NE=non-energized
E=energized

4. Momentarily hold magnet directly over **UP** or **Down** switch to increment or decrement relay time delay (seconds). When proper time delay is displayed, hold magnet directly over ENTER switch to advance to next selection

![LO DEL 1.0]

5. Momentarily hold magnet directly over **UP** or **Down** switch to increment or decrement mid alarm set point as desired. When proper alarm point is displayed, hold magnet directly over ENTER switch to advance to next selection.
6. Momentarily hold magnet directly over **UP** or **Down** switch to change relay function (e.g., change from non-latching NL to latching L). When proper relay function is displayed, hold magnet directly over **ENTER** switch to advance to next selection

6. Momentarily hold magnet directly over **UP** or **Down** switch to change relay function (e.g., change from non-latching NL to latching L). When proper relay function is displayed, hold magnet directly over **ENTER** switch to advance to next selection

7. Momentarily hold magnet directly over **UP** or **Down** switch to change relay operation (e.g., change from non-energized NE, to energized E). When proper relay operation is displayed, hold magnet directly over **ENTER** switch to advance to next selection

7. Momentarily hold magnet directly over **UP** or **Down** switch to change relay operation (e.g., change from non-energized NE, to energized E). When proper relay operation is displayed, hold magnet directly over **ENTER** switch to advance to next selection

8. Momentarily hold magnet directly over **UP** or **Down** switch to increment or decrement relay time delay (seconds). When proper time delay is displayed, hold magnet directly over **ENTER** switch to advance to next selection

8. Momentarily hold magnet directly over **UP** or **Down** switch to increment or decrement relay time delay (seconds). When proper time delay is displayed, hold magnet directly over **ENTER** switch to advance to next selection
9. Momentarily hold magnet directly over **UP** or **Down** switch to increment or decrement high alarm set point as desired. When proper alarm point is displayed, hold magnet directly over **ENTER** switch to advance to next selection.

   ![HI AL = 3.0](image)

10. Momentarily hold magnet directly over **UP** or **Down** switch to change relay function (e.g., change from non-latching NL to latching L). When proper relay function is displayed, hold magnet directly over **ENTER** switch to advance to next selection.

   ![HI RELAY NL](image)

   **NL**=non-latching  
   **L**=latching

11. Momentarily hold magnet directly over **UP** or **Down** switch to change relay operation (e.g., change from non-energized NE, to energized E). When proper relay operation is displayed, hold magnet directly over **ENTER** switch to advance to next selection.

   ![HI RELAY NE](image)

   **NE**=non-energized  
   **E**=energized

12. Momentarily hold magnet directly over **UP** or **Down** switch to increment or decrement relay time delay (seconds). When proper time delay is displayed, hold magnet directly over **ENTER** switch to advance to next selection.

   ![HI DEL 1.0](image)
13. Momentarily hold magnet directly over **UP** or **Down** switch to change relay on/off selection (ON=Enabled, OFF=Disabled). When proper relay state is displayed, hold magnet directly over **ENTER** switch to advance to sensor **LIFE REMAINING** indication.

After approximately 5 sec. LCD display will automatically advance to the next screen.

After approximately 10 sec. LCD display will return to normal operating mode to provide gas readings and acknowledge enabled alarms.
VI. **Diagnostic Messages:**

The LCD display provides the following fault messages during normal operation:

- **REPLACE SENSOR**
  - Sensor cannot be calibrated—Requires immediate replacement

- **SENSOR DISCONNECTED**
  - Sensor has been disconnected from main circuit board—transmitter outputs 2.4mA—install sensor as described in Section III, steps 1-6, above

- **RELAYS DISCONNECTED**
  - Relay module has been disconnected from the main circuit board—transmitter outputs 2.4mA—install relay board ribbon cable between relay module circuit board and main circuit board

VII. **Relay Module (optional):**

The relay module consists of a circuit board with four SPDT 12 (or 20) amp. relays and connector blocks for accessing Common—C, Normally Open—NO and Normally Closed—NC contacts for each relay. The relays are designated as follows:

- **Relay #1:**  
  - *Low Alarm Relay:* Activated when the low alarm set point is reached and exceeded.

- **Relay #2:**  
  - *Mid Alarm Relay:* Activated when the mid alarm set point is reached and exceeded.

- **Relay #3:**  
  - *High Alarm Relay:* Activated when the high alarm set point is reached and exceeded.

- **Relay #4:**  
  - *Trouble (fault) Relay:* Activated when the transmitter looses power or sensor is disconnected.
The trouble (fault) relay is factory set normally energized and non-latching. The low, mid and high alarm relays can be configured in the field for non-latching/latching function, non-energized/energized operation and each has a separate time delay (refer to Section V, Operation).

**Relay Definitions:**

**Non-latching:** when alarm set point is reached and exceeded, relay is activated (open contacts close and closed contacts open). When gas concentration falls below alarm set point, relay automatically resets to original state.

**Latching:** when alarm set point is reached and exceeded, relay is activated (i.e. open contacts close and closed contacts open). When gas concentration falls below alarm set point, relay does not reset to original state. The relay must be manually reset by activating the **RESET** switch.
**Energized:** Power is normally applied to relay such that normally open contacts are closed and normally closed contacts are open. When the alarm set point is reached or exceeded, the relay changes to the power down state.

**Non-Energized:** Power is normally not applied to relay such that normally open contacts are open and normally closed contacts are closed. When alarm set point is reached or exceeded, the relay changes state.

VIII. **External Alarms and Devices:**

External alarms and devices can be connected to relay module for activation by low, mid, high and trouble (fault) relays. The relays are rated 12 amps, non-inductive.

IX. **Rain/Splash/RF Shield (Optional)**

A black anodized aluminum shield offers protection to the sensor from rain, splashing, radio frequency (RF) and mechanical shock.
The upper portion of the housing is provided with internal and external 3/4” NPT threads. The external threads screw into the explosion-proof junction box which houses the remote amplifier. The sensor screws into the 3/4” NPT internal threads.

The lower portion of the housing consists of a cylinder with bottom plate; the housing is perforated to allow gas entry. The cylinder is secured to the upper housing with four set screws.

Install the shield as follows:

1. Screw upper portion of housing into junction box.

2. Carefully guide brown sensor cable connector through housing into junction box. Screw sensor into housing hand tight. Attach sensor connector to bottom of main circuit board at connector marked SENSOR. Seat the sensor connector fully to lock in place.

3. Position lower portion of housing (cylinder) around sensor. Push upper edge of cylinder over upper housing. Tighten four set screws to secure cylinder.
X. SENSOR CALIBRATION:

NOTE: A routine program of calibration should be employed to ensure proper operation/performance of the sensor and system. Although the sensors are normally quite stable, it is generally recommended that calibration be performed monthly in the interest of safety.

Sensor calibration is performed at the smarter transmitter using a gas sample of known concentration. To calibrate the sensor, follow the steps outlined below.

NOTE: The sensors are factory calibrated with gas prior to delivery. Field calibrations must be performed with an appropriated gas sample of known concentration.

Zero Calibration:

1. In clean gas-free air, momentarily hold magnet over ZERO CAL switch until LCD display shows

   ![ZERO CAL APPLY AIR]

   When zero calibration is complete, the transmitter will return to normal operation to provide meter readings.

   Note: If ambient air is not known to be gas-free, apply zero air (cylinder) using calibration Cup
Span Calibration:

1. Momentarily hold magnet over SPAN CAL switch until LCD display shows

   CalGas=10.0

2. Momentarily hold magnet directly over UP or Down switch to increment or decrement calibration gas concentration. When proper gas concentration is displayed, hold magnet directly over ENTER switch to advance to next display

   SPAN CAL
   APPLY 10.0
3. Apply span calibration gas of exact concentration shown on LCD display using calibration cup.

4. When span calibration is complete, the transmitter will return to normal operation to provide meter readings. **Note:** during span calibration and for a period of 5 minutes after calibration, the smarter transmitter outputs 4.0mA to prevent activation of alarms at the controller electronics. The **smarter** transmitter on board relays are also inhibited for 5 minutes after calibration.

5. Remove calibration cup and allow sensor to recover. LCD display will show recovery of sensor to zero.

**XI. Off-Site Sensor Calibration:**

The **smarter** transmitter toxic gas sensors include an EEprom encapsulated inside the sensor housing. The EEprom retains all set-up parameters (alarm set points, relay operation/function, etc.) and sensor calibration factors. Therefore, the sensors can be calibrated in the instrument shop (i.e. off-site) with Mil-Ram **Remote Calibration Electronics** (contact factory) and the sensors re-installed in the field without further calibration. Upon installing the sensors, the field installed transmitter electronics automatically up-loads the calibration data to properly configure the transmitter.
XII. **Self-Calibration:**

The *smarter* transmitter provides unattended *self-calibration* features whereby every 30 days the micro-controller electronics increments the span calibration based on the typical life curve for the sensor type. When a field calibration is performed with a gas sample of known concentration, the life curve is re-extrapolated based on actual calibration data.

*Note:* The *self-calibration* feature is intended to supplement and not replace a regular calibration program using a certified gas sample of known concentration. Although the sensors are normally quite stable, it is generally recommended that calibration be performed monthly in the interest of safety. Unusually harsh or severe environments may require more frequent calibration checks.

XIII. **Remaining Sensor Life:**

The *smarter* transmitter determines *Remaining Sensor Life* based on actual field calibration data, sensor life curve and specific electrical characteristics of the sensor. The remaining sensor life is an approximation and does not replace a regular calibration program using a certified gas sample of known concentration to validate sensor response. Near the end of sensor service life, the transmitter will indicate *Replace Sensor*. At that time the sensor must be replaced with a new sensor to ensure proper calibration.
Main Circuit Board (bottom view)

3-Wire Hook-Up

Unused 4-20mA SIGNAL COM POWER COM Unused +24 VDC

Shield

<475 ohms Total Load Resistance

Controller Electronics WITH INTEGRATED POWER SUPPLY (e.g., Gas Detection Controller, PLC with integrated power supply)

Power Supply

Operating Voltage: 15-30VDC
Power Consumption: 15-30VDC @2.1W max.

Main Circuit Board (bottom view)

4-Wire Hook-Up

Unused 4-20mA SIGNAL COM POWER COM Unused +24 VDC

Shield

<475 ohms Total Load Resistance

Measurement Instrument & Separate Power Supply (e.g., Host Computer, PLC with separate power supply)

Note: Shield should run the entire length of the cable, but not attach to anything inside the junction box. Wrap exposed shield with electrical tape.
smart TRANSMITTER WITH ATTACHED SENSOR

EXTENSION TUBE
EEPROM ENCAPSULATED IN TUBE—STORES ALL TRANSMITTER SET-UP AND CALIBRATION DATA

EEPROM ENCAPSULATED IN SENSOR—STORES ALL TRANSMITTER SET-UP AND CALIBRATION DATA

WHEN SENSOR IS REPLACED, TRANSMITTER AUTOMATICALLY UPLOADS SET-UP AND CALIBRATION DATA FROM SENSOR EEPROM TO PROPERLY CONFIGURE TRANSMITTER

smart TRANSMITTER WITH REMOTE SENSOR

MIL-RAM TECHNOLOGY, INC.
SAN JOSE, CA 95111

TITLE: Toxic Smarter Transmitter, Ambient with sensor extender cable

DRAWN CHECKED

DATE

FILE NAME

SHEET 1 OF 1
MIL-RAM TECHNOLOGY, INC.

TOXIC GAS DETECTION INSTRUMENTS AND SENSORS - WARRANTY

Mil-Ram Technology, Inc., warrants toxic gas alarm equipment manufactured and sold by it to be free from defects in materials, workmanship, and performance for a period of one year from date of shipment from Mil-Ram Technology, Inc. Any parts found defective within that period will be repaired or replaced, at its option, free of charge, f.o.b. factory. This warranty does not apply to items which by their nature are subject to deterioration or consumption in normal service, and which must be cleaned, repaired, or replaced on a routine basis. Items included, but not limited to, are:

1. Absorbent cartridges
2. Batteries
3. Filter element
4. Lamp bulbs and fuses
5. Pump diaphragms and valves
6. Sensors - electrochemical sensors for Tox-Array 1000 Portable Monitors are covered by a warranty of 24 months.
7. Sensors - electrochemical sensors for Fixed Systems and Transmitter are covered by a warranty of 12 months.

Warranty is voided by abuse, including rough handling, mechanical damage, alteration or repair by an unqualified person and/or procedures not in accordance with the corresponding instruction manuals and specifications. This warranty indicates the full extent of our liability, and we are not responsible for removal or replacement costs, local repair costs, transportation costs, or contingent expenses incurred without our prior written approval.

Mil-Ram Technology, Inc.’s obligation under this warranty shall be limited to repairing or replacing and returning any product which Mil-Ram Technology, Inc., upon a detailed examination by Mil-Ram Technology, Inc., shall disclose to have been defective. To receive warranty consideration, all products must be returned to Mil-Ram Technology, Inc., at its manufacturing facilities with transportation charges prepaid.

This warranty is expressly in lieu of any and all other warranties and representations, express or implied, and all other obligations or liabilities on the part of Mil-Ram Technology, Inc., including, but not limited to, the warranty of fitness for a particular purpose. In no event shall Mil-Ram Technology, Inc., be liable for direct, incidental, or consequential loss or damage of any kind connected with the use of its products or failure of its products to function or operate properly.

This warranty covers instruments and parts sold (to users) only by authorized distributors, dealers and representatives as appointed by Mil-Ram Technology, Inc.