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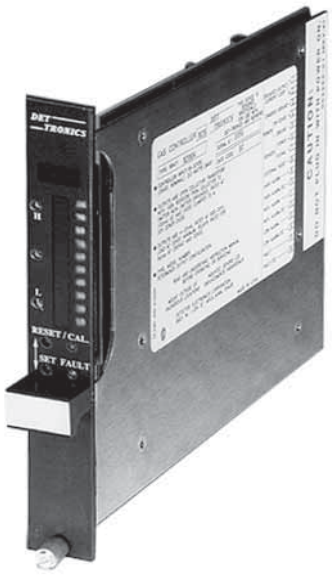
Instructions 95-8405

Oxygen Controller
R8471C



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INSTRUCTIONS

Oxygen Controller
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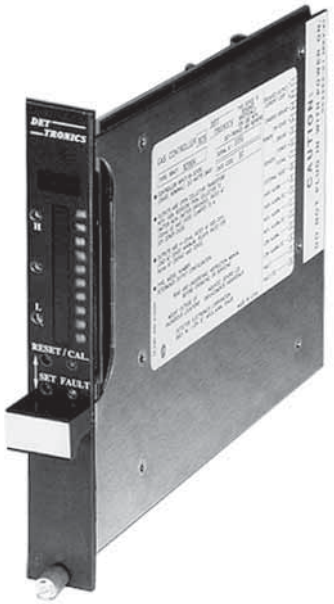
Section I
General Information



APPLICATION

The R8471C Oxygen (O_2) Controller is a single channel analog signal receiver, providing continuous indication of the detected O_2 concentration for life safety and facility protection purposes. The measurement range is 0-25% by volume. Controller outputs include a digital LED display with corresponding bar graph showing the detected O_2 level, solid state or optional relay contact outputs, and optional isolated/non-isolated 4-20 mA output. The R8471C can be rack or panel mounted and is intended for installation in controlled, non-hazardous environments. It is compatible with the Model C7065E oxygen detector, used either with or without the Model U9500C Infiniti Gas Transmitter.

FEATURES

- Three independent alarm outputs with adjustable setpoints
- Automatic calibration (Autocal) feature enables system calibration from controller faceplate
- Base model provides solid state, open collector outputs
- Premium model provides 4 relay outputs (3 alarm and 1 fault) plus analog 4-20 mA output
- Available in rack or panel mount configuration
- Rack compatible with other R8471 Series gas controllers for detection of multiple gases.

DESCRIPTION

The R8471C controller functions as the signal receiver in an oxygen detection system, and is normally used to generate alarm outputs for either O_2 deficiencies or O_2 enrichment conditions. It is intended for use with the model C7065E oxygen detector, either directly or in combination with the model U9500C Infiniti gas transmitter. The model C7065E oxygen detector provides only a 4-20 mA output (no local display, relays, or calibration function), while the model U9500C Infiniti transmitter offers an on-board LCD display of detected oxygen level, plus non-intrusive calibration capability and optional relay outputs.

The Q4004 Series Mounting Rack is typically used to house the R8471C controller, and is available in sizes accommodating from 2 controllers up to 16 controllers maximum in a single 19 inch wide rack. Panel mounted R8471C controllers, which do not require any mounting rack, are also available. This version is mounted on a flat surface, and is identical in features, functions, and wiring.

When the R8471C controller is used directly with the C7065E oxygen detector, system calibration must be performed using the automatic calibration function of the R8471C controller. When the R8471C is used with the U9500C Infiniti transmitter, calibration is normally performed using the U9500C calibration function.

The R8471C / C7065E oxygen detection system is intended for open-area, safety monitoring applications. It is not intended for use in smoke stacks, scrubbers, or similar process monitoring applications.

SPECIFICATIONS

CONTROLLER

OPERATING VOLTAGE—
24 vdc. Can operate in the range of 18 to 32 vdc.

POWER CONSUMPTION (CONTROLLER ONLY)—
Base model: 0.7 watt nominal, 1.3 watts maximum (25 mA nominal, 50 mA maximum at 24 vdc.)

Premium model: 1.2 watts nominal, 3.5 watts maximum (50 mA nominal, 145 mA maximum at 24 vdc.)

Maximum startup current is 0.6 amperes for 10 milliseconds. Power supplies with fold back current limiting are not recommended.

MAXIMUM RIPPLE—
Not to exceed 5 volts peak-to-peak.

TEMPERATURE RANGE—
Operating: +32°F to +140°F (0°C to +60°C)
Storage: -49°F to +185°F (-45°C to +85°C).

OPERATING RANGES—
0 to 25% oxygen in ambient air.

SOLID STATE OUTPUTS (BASE MODEL ONLY)—
The outputs are open collector transistors with a 100K resistor from the collector to emitter with the emitter grounded, rated 100 milliamperes at 32 volts dc maximum.

RELAY CONTACTS (PREMIUM MODEL ONLY)—
SPST relays with selectable normally open/normally closed contacts, rated 5 amperes at 30 vdc/250 vac.

CURRENT OUTPUT (PREMIUM MODEL ONLY)—
4 to 20 milliamperes, with a maximum external loop resistance of 600 ohms at 20 to 32 vdc.

DIMENSIONS—
See Figure 1.

SHIPPING WEIGHT (APPROXIMATE)—
2.0 pounds (0.9 kilogram).

SYSTEM APPROVAL—
The R8471C Controller, base and premium model in 3U and 4U height, has been tested and approved by FMA. It can be used with any FMA approved sensing device capable of generating a 4 to 20 ma input. FMA approval of the R8471C Controller, however, does not include or imply approval of input devices such as sensors or transmitters, or devices connected to the controller outputs. To maintain FMA system approval, **all equipmen**t connected to the controller must be FMA approved.

NOTE

Ensure sensor hazardous (classified) location rating is applicable for the intended use.

C7065E O2 DETECTOR

TEMPERATURE RANGE—
Continuous operation: +5°F to +104°F (-15°C to +40°C)
Intermittent operation: +5°F to +131°F (-15°C to +55°C).

TEMPERATURE RESPONSE—
±3% of oxygen concentration from -15°C to +40°C.

BAROMETRIC PRESSURE RANGE—
Ambient pressure ±10%.

HUMIDITY RANGE—
Non-condensing atmosphere, 0 to 99% RH. The O_2 percentage in air can vary with changes in relative humidity. The effect of extremely high humidities on the sensor output is minimal, unless extremely high humidity is combined with very high temperatures. Contact the factory for details.

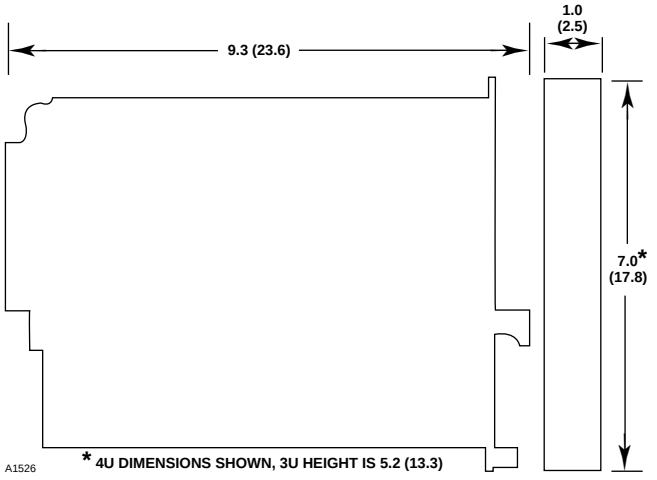


Figure 1—Controller Dimensions in Inches (Centimeters)

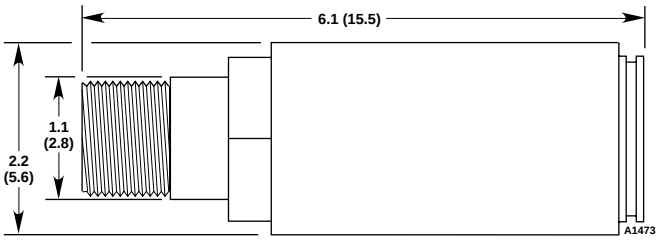


Figure 2—Sensor Dimensions in Inches (Centimeters)

DRIFT—
Less than 2% of oxygen concentration per month.

REPEATABILITY—
±2% of oxygen concentration or ±0.2%, whichever is greater.

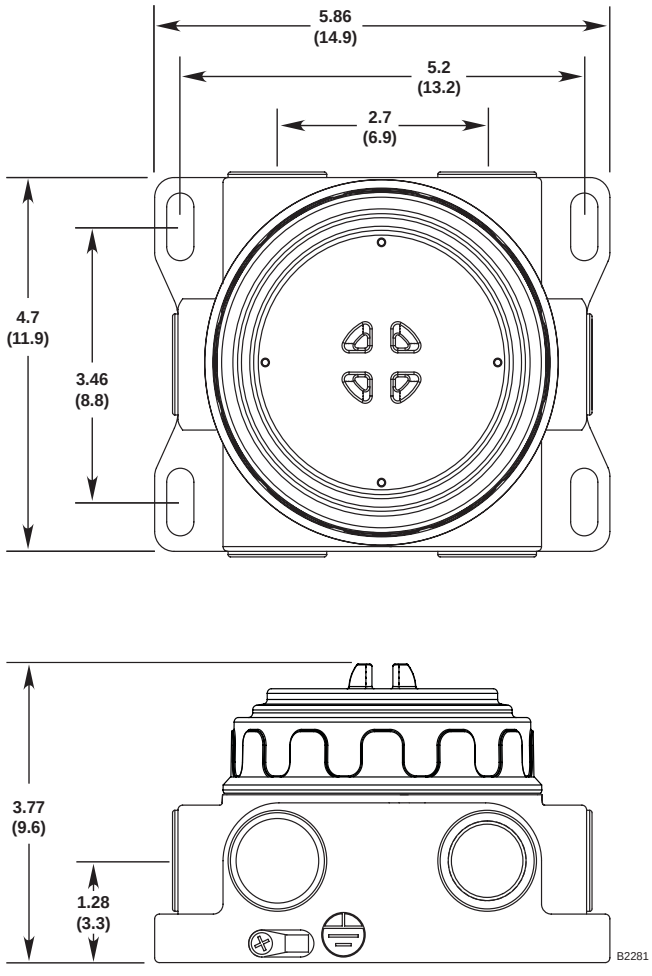


Figure 3—Sensor Termination Box Dimensions in Inches (Centimeters)

ACCURACY—
±5% of oxygen concentration or ±0.5%, whichever is greater.

RESPONSE TIME—
95% of final reading from a step change in less than 60 seconds. Step change from 20.9% O_2 to 0% O_2 indicates 16% O_2 within 5 seconds. Step change from 20.9% O_2 to 40% O_2 indicates 25% O_2 within 5 seconds.

SERVICE LIFE—
One year when operated within specified operating conditions.

STORAGE LIFE—
6 months.

DIMENSIONS—
See Figure 2 for dimensions of the C7065E Sensor and Figure 3 for dimensions of the sensor termination box.

SENSOR RATINGS—
Designed to meet FM and CSA requirements for use in Class I, Division 1, Groups C and D hazardous locations.

SHIPPING WEIGHT (APPROXIMATE)—
2.0 pounds (0.9 kilogram).

SYSTEM OPERATION

C7065E OXYGEN DETECTOR (STAND-ALONE)

The C7065E O_2 detector is a two-wire, explosion-proof oxygen detector with a field replaceable electrochemical O_2 sensor cell. The output of the C7065E is a 4-20 mA analog signal that is proportional to 0-25% by volume oxygen concentration. In normal clean air, a new C7065E O_2 detector generates a signal level of 17.4 milliamperes. The C7065E uses a weatherproof aluminum housing and is approved by CSA for use in Class I, Division 1, Groups C & D hazardous locations. A replaceable hydrophobic filter is provided on the C7065E nosepiece to protect the sensor cell from dirt, moisture, and other contaminants.

For direct controller interface applications, the C7065E O_2 detector should be installed with the Sensor Termination Box, Model STB Series. The STB Series termination box is an explosion-proof, approved electrical junction box available in aluminum or stainless steel, and is designed for use with the C7065E.

Table 1—Cross Sensitivity to Other Gases

Gas	Concentration	Signal
Hydrogen	100%	<2%
Methane	100%	0
Hydrocarbons	100%	0
Carbon Monoxide	20%	<0.5%
Carbon Dioxide	<25%	+0.3% of O_2 signal per 1% CO_2

When the C7065E O_2 detector is wired directly to the R8471C controller, all calibration functions are initiated at the controller faceplate. In most cases this is a two-person calibration procedure.

C7065E OXYGEN DETECTOR WITH U9500C INFINITI TRANSMITTER

When a local display of the detected O_2 level is desired, the model U9500C Infiniti transmitter is recommended for use with the C7065E O_2 detector. The U9500C Infiniti is available with optional on-board alarm relays to provide local contact outputs for alarm or signaling purposes.

When the C7065E/U9500C O_2 detector/transmitter is wired to the R8471C controller, calibration functions are initiated at the U9500C Infiniti. This is a non-intrusive, one-person calibration procedure in most cases.

SENSOR CROSS SENSITIVITY

See Table 1.

CONTROLLER

Setpoints

The R8471C Controller has three independent alarm outputs with field selectable setpoints.

The low alarm responds to oxygen deficiencies and the high alarm responds to oxygen enriched conditions. The auxiliary alarm can be set to respond to either.

The programmed calibration gas concentration is also displayed and adjusted with the alarm setpoints. This value must be equal to the oxygen percentage of the calibration gas used for the span adjustment. When clean ambient air is used for calibration, the calibration gas concentration should be set at 20.9%.

The adjustment range is:

Low alarm:	1 to 20.7%
High alarm:	21.1 to 25%
Auxiliary alarm:	1 to 20.7% or 21.1 to 25%
Calibration gas:	15 to 25%

NOTE

To avoid the possibility of nuisance alarms, the controller cannot be programmed for alarm setpoints in the 20.8 to 21.0% range. The high alarm setpoint should be set no lower than 23% to avoid the possibility of F92 faults.

The alarm setpoints and calibration gas concentration can be checked and/or changed using pushbuttons located on the faceplate of the controller. Refer to the “Setpoint Adjustment” section.

Outputs

The R8471C controller provides the following outputs: (see Figure 4.)

- Digital display of detected oxygen concentration in % by volume
- Bar graph display - matches the digital display
- High LED - flashes to indicate detected level is in excess of high alarm setpoint
- Auxiliary LED - flashes to indicate detected level is in excess of auxiliary alarm setpoint
- Low LED - flashes to indicate detected level is in excess of low alarm setpoint
- Cal LED - illuminated when controller is in calibrate mode
- Fault LED - flashes when a system fault is detected; on steady during power-up.

Optional Versions

The R8471C is available in a Base version and a Premium version. The Base version provides open collector transistor outputs only (rated 100 mA at 32 vdc) for the three alarms and one fault output. The Base version alarm outputs are all normally de-energized with no alarms present, and are non-latching with the exception of the high alarm, which is latching. The Base version fault output is normally energized with no faults, and is de-energized in the event of a system fault. It is non-latching only.

The Premium R8471C version provides SPST contact relay outputs only (rated 5 amps at 30 vdc / 250 vac) for the three alarms and one fault output. The Premium version relay outputs are programmable as shown in Table 2.

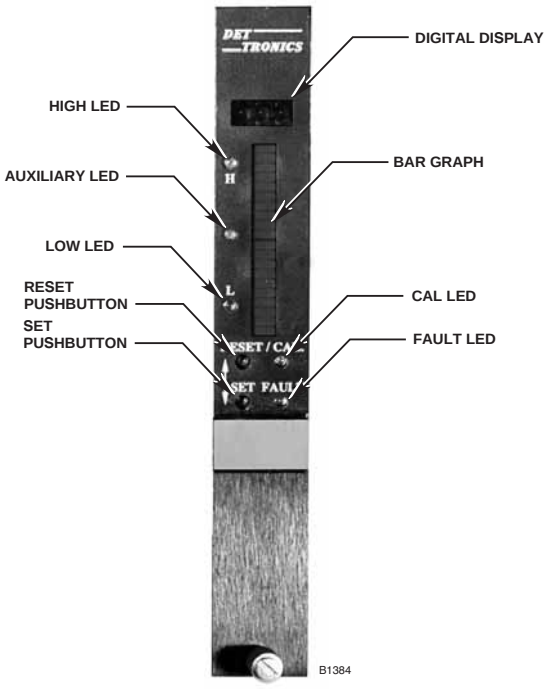
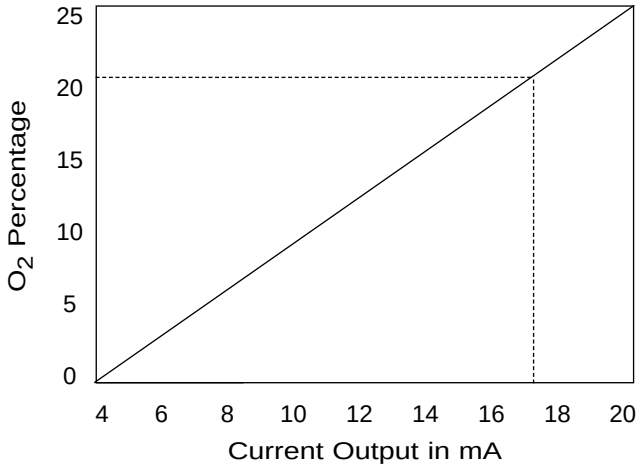


Figure 4—Controller Front Panel

The Premium version also includes a selectable isolated/non-isolated 4-20 mA current output for routing detected O_2 gas level information to other systems. See Figure 5. The R8471C Premium version analog output can be calibrated to ensure accuracy. See "Calibration" section of this manual.



Note: When monitoring clean ambient air (20.9% O_2 content) the controller output is 17.4 mA.

Figure 5—Relationship Between Controller Output and Oxygen Concentration (0 to 25% Range)

Table 2—Selectable Relay Options

Relay	Selectable Normally Open/Closed	Selectable Normally Energized/ De-Energized	Selectable Latch/ Non-Latch
Low	Y	Y[1]	Y[1]
High	Y	Y[1]	N[2]
Auxiliary	Y	Y[1]	Y[1]
Fault	Y	N[3]	N[4]

Y = Yes N = No
[1]Selectable as a group, not individually [2]Latching only
[3]Normally energized only [4]No latching option

Programming Options (Premium model only)

Each of the four relays is field selectable for either normally open or normally closed contacts using jumper plugs located on the printed circuit board inside the controller. (See Table 2.)

The alarm relays are also switch programmable for either normally energized or normally de-energized operation (programmable as a group only, not individually). The fault relay is normally energized.

The low and auxiliary alarm relays are programmable for either latching or non-latching operation. The high alarm relay is always latching and the Fault relay is non-latching. Latching relays are reset using either the Reset pushbutton on the front panel of the controller or an external reset switch.

The 4 to 20 mA circuit is selectable for isolated or non-isolated operation.

Automatic Diagnostics and Fault Identification

The R8471C controller is self-monitoring for problems that could prevent proper response. In the event of a fault:

- The Fault LED flashes
- The digital display identifies the nature of the fault using an alphanumeric code
- The fault output de-energizes
- The analog output drops to less than 1 mA (premium version only).

An alarm condition will normally over-ride a fault condition unless the fault condition occurred first. F10 and F2X will not over-ride an alarm. Faults that affect the actual function of the controller (F50, F60, F70, F9X) may impair the ability of the controller to maintain an alarm output.

All faults automatically reset except the F9X, F20, and F10 faults. After the fault condition has been corrected, the fault output automatically switches to the normal (energized) state, the dc current output returns to normal, and the Fault LED turns off. Clearing F9X faults requires removing operating power from the controller for approximately one second.

CAUTION

The fault detection circuitry does not monitor the operation of external response equipment or the wiring to these devices. It is important that these devices be checked periodically to ensure that they are operational.

OPERATING MODES

The R8471C controller has eight operating modes:

1. Power-up time delay
2. Normal operation
3. Reset
4. Setpoint display
5. Calibrate
6. Sensor replacement
7. Setpoint adjust
8. DC current output calibration (premium model only)

Operating modes other than Normal are selected by pressing the appropriate faceplate pushbutton (either the Set or Reset pushbutton). See Figure 6.

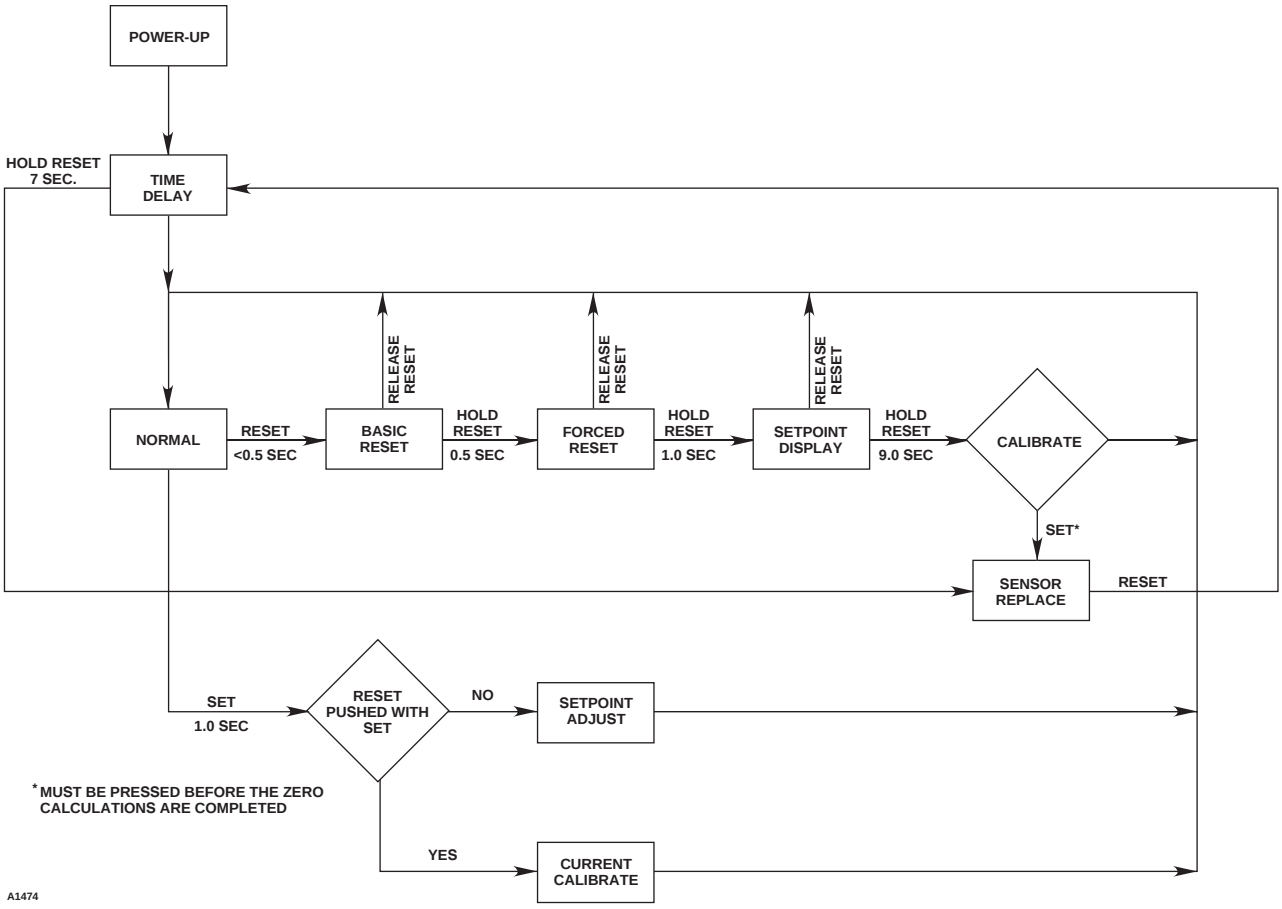


Figure 6—R8471C Controller Flow Chart

Power-up Time Delay Mode

When power is applied to the controller, it enters a time delay mode to allow the sensor output to stabilize before beginning normal operation. During this time the outputs are inhibited, the FAULT LED is illuminated, and the current output indicates a fault condition. This time delay can last up to four minutes, but will end earlier if the sensor output is in a no alarm condition.

Normal Mode

The controller enters the Normal operating mode when the power-up time delay has been completed and an acceptable detector signal level (17.4 mA) has been received by the controller. In the Normal operating mode with no alarm condition:

- Digital display is on and indicates the O_2 level at the sensor.
- Bar graph display reads the same as the digital display.
- All LEDs are off.
- Alarm outputs are in their normal state (energized or de-energized as programmed).
- Dc current output signal level corresponds to sensor input.
- Fault output is energized.

In the Normal operating mode with a low and/or auxiliary alarm condition occurring:

- Digital display and bar graph display indicate the sensor input.
- Low and/or Auxiliary LED flashes.
- Low and/or Auxiliary alarm output changes state.
- Dc current output signal level corresponds to sensor input.
- Fault output energized and LED off.

When the low or auxiliary alarm is no longer occurring:

- Digital display, bar graph display, and 4 to 20 mA output continue to track the sensor input.
- With latching operation programmed: No change to alarm outputs.
- With non-latching operation programmed: Alarm outputs return to their normal state.
- Low and Auxiliary LEDs are on steady until reset.

In the Normal operating mode and a high alarm condition occurring:

- Same as a low or auxiliary alarm condition, but High LED and high alarm output are affected.

When the high alarm is no longer occurring:

- The high alarm output is always latching and unaffected by the latching/non-latching programming for the low and auxiliary alarms. High LED is on steady until reset.

In the event of a system fault:

- The normally energized Fault output is de-energized and the Fault LED is illuminated.

Reset Mode

The Reset mode is entered by pressing the Reset button located on the front panel of the controller. When the Reset button is **momentarily depressed**, all LEDs turn off and all outputs return to their normal condition if no alarms or faults are occurring (basic reset). When the Reset button is **held for 0.5 second**, the LEDs turn off and the outputs return to their normal condition even if an alarm or fault condition still exists (forced reset). Remote reset capability is also provided. (Remote reset performs a forced reset.)

NOTE

The remote reset performs a reset function only. It cannot be used for entering other controller operating modes.

Setpoint Display Mode

If the Reset button is held for approximately one second, the controller enters the Setpoint Display mode. In this mode, the digital display sequentially shows the programmed alarm setpoints and calibration gas concentration. Each value is displayed for approximately 2 seconds. After completing the sequence, the controller automatically returns to the Normal operating mode if the Reset button is no longer being depressed.

This mode is used only for displaying the setpoints. Use the “Setpoint Adjust” mode for changing setpoint and calibration gas values.

Calibrate Mode

If the ambient oxygen concentration at the C7065E is verified to be at a normal level prior to calibration, it is generally not necessary to apply compressed 20.9% oxygen calibration gas to the C7065E detector. However, if there is any question regarding the oxygen concentration at the detector, then 20.9% volume oxygen calibration gas should be applied to the C7065E detector during span calibration.

When in the Calibrate mode, all R8471C controller outputs are inhibited, the CAL LED is illuminated, and the DC current output (premium model only) goes to a level preset by the user (adjustable from 0-20 mA, with a default of 4.0 mA.)

C7065E Detector Wired Directly to R8471C

The R8471C controller provides automatic calibration (Autocal) capability that adjusts the controller indications and outputs to the programmed calibration levels. The controller does not adjust the oxygen detector's 4-20 mA output signal in any way. As described previously, when the R8471C controller is used directly with the C7065E oxygen detector, system calibration must be performed using the automatic calibration function of the R8471C controller. There are two R8471C controller Autocal options:

1. INITIAL CALIBRATION OF NEW SENSOR

This procedure should be used for initial calibration of a new sensor or anytime an existing sensor has been replaced with a new or different sensor. This is a two step calibration requiring both zero and span adjustments, and is always performed with the controller in the "Sensor Replacement Mode". It requires removal of the C7065E detector cover in order to activate the "zero switch" located on the oxygen sensor cell. In some cases this may be a two-person procedure (one person located at the controller and one person located at the C7065E). This procedure will expose live DC circuits to the surrounding environment during switch activation.

2. ROUTINE CALIBRATION

This is a one-step calibration requiring only span adjustment. Removal of the C7065E detector cover and activation of the "zero switch" are not required. This calibration is normally a one person procedure, provided a normal oxygen level is present at the C7065E detector during calibration. No live circuits will be exposed.

R8471C/C7065E Used with Infiniti Transmitter

When the R8471C is used with the U9500C Infiniti transmitter, field calibration is typically performed using the U9500C calibration function. It is possible to configure the U9500C so that the analog output level remains at 4 mA during calibration, ensuring that the R8471C does not indicate a fault or alarm condition during the calibration. If it is noted that the R8471C digital display and the U9500C digital display are not displaying identical values, it is recommended to perform a controller Autocal calibration after the U9500C calibration has been completed.

Refer to the U9500C instruction manual for additional information.

New Sensor/Sensor Replacement Mode

This mode inhibits all controller outputs to allow replacement of the C7065E oxygen sensor cell. The sensor may be removed from the C7065E housing without removing power from the controller.

After replacing the sensor, a two-step calibration (zero and span) is required for initial calibration of new oxygen sensors. This two-step calibration is normally only required at initial commissioning of the oxygen sensor. Subsequent calibrations may be performed using the Routine Calibration procedure.

NOTE

If the R8471C is inadvertently placed into sensor replacement mode, the controller resets the C7065E zero default value. Detector calibration must be performed even if the sensor was not replaced.

Setpoint Adjustment Mode

The Setpoint Adjust mode is entered by depressing the Set button for approximately one second. In this mode the alarm setpoints and calibration gas concentration are sequentially displayed on the digital display for approximately 7 seconds and the corresponding LED flashes. To change the setpoint, depress the Reset button to increase the displayed value or the Set button to decrease the value. If no changes are made for 7 seconds, the microprocessor automatically advances to the next setpoint. At the end of the sequence, the microprocessor automatically returns to the Normal operating mode.

DC Current Output Calibration Mode

This mode is used to calibrate the 4 to 20 mA dc output. To enter this mode, hold the Set button, then press Reset. First 4.0 mA (15% or 0% O_2, depending on range) is generated for approximately 7 seconds while the Low LED flashes. Then 20.0 mA (25% O_2) is generated while the High LED flashes. Finally the current output level during calibration is generated while the CAL LED flashes. The microprocessor automatically returns to the normal operating mode at the end of the sequence. Adjustments to the current output level are made by pressing the Reset (increase) or Set (decrease) button. This procedure requires a dc current meter to monitor the actual controller dc milliampere output.

Section II
System Installation

CAUTION

The wiring procedures in this manual are intended to ensure proper functioning of the device under normal conditions. However, because of the many variations in wiring codes and regulations, total compliance to these ordinances cannot be guaranteed. Be certain that all wiring complies with the NEC as well as all local ordinances. If in doubt, consult the authority having jurisdiction before wiring the system. Installation must be done by a properly trained person.

INSTALLATION

SYSTEM INSTALLATION AND WIRING OVERVIEW

1. Determine the best installation locations for the detectors. Ensure that the proper termination box is available.

2. The STB-series termination box or U9500C Infiniti transmitter housing is intended for flat-surface mounting, such as on a wall or post. The termination box should be electrically connected to earth ground.

NOTE

Coat the junction box cover and detector threads with an appropriate grease to ease installation and future removal. The recommended lubricant is a silicone free polyalphaolefin grease, part number 005003-001, available from Detector Electronics.

NOTE

The 005724-001 electrochemical O_2 sensor cell does not need to be installed within the C7065E housing until after installation and wiring of the detector/termination box has been completed. To ensure maximum service life of the sensor cell, it is recommended to store the sensor cell in the manufacturer's sealed shipping bag in a cool environment until actual power-up and system commissioning are to be performed.

3. Install the C7065E detector in the proper opening in the termination box. Terminate all wire conductors at the proper terminals. The detector should be oriented with the filter pointing down whenever possible to minimize exposure to contamination.

4. After all electrical connections are made, double check the terminations against the wiring diagrams to ensure proper wiring.

5. The C7065E is recommended to operate at 24 VDC. Before proceeding with system commissioning, measure the voltage at the C7065E detector to ensure that possible voltage drops have not compromised the necessary 24 VDC operating voltage.

NOTE

Do not apply power to the system with the junction box cover removed unless the area has been de-classified.

6. After confirming that all wiring is properly terminated and any other installation requirements such as conduit seals are installed as necessary, the sensor cell can be installed within the C7065E detector. Begin by removing the cap from the sensor base. See Figure 7.

7. Remove the sensor cell from its packaging. Determine proper orientation for the assembly, then **carefully** plug it into the sensor base.

NOTE

Handle the sensor cell carefully. To avoid possible damage, observe the normally accepted procedures for handling electrostatic sensitive devices.

8. Replace the cap back on the sensor base. Ensure that the O-ring is present and in good condition. Tighten the cap only until snug. **Do not over tighten.**

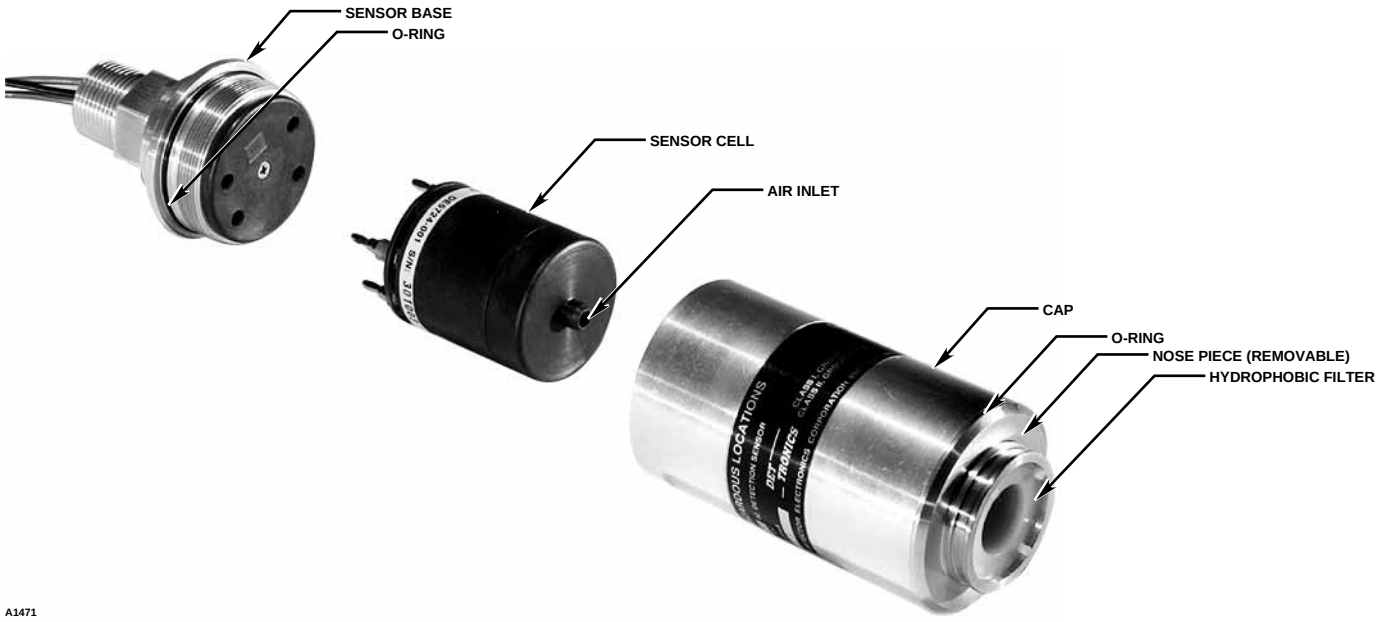


Figure 7—C7065E Sensor

DETECTOR POSITIONING

Proper sensor location is required to provide maximum protection. The most effective number and placement of sensors varies depending on the application parameters. The individual performing the installation must rely on common sense and experience to determine the number of sensors needed and the best sensor locations to adequately protect the area. The following factors are important and should be considered for every installation:

1. Since adequate oxygen is essential for health and life safety, a primary consideration in determining optimum sensor locations is to identify where people are most likely to first come into contact with the low-oxygen environment. This contact point is typically a primary location to install an oxygen gas sensor.

2. Ventilation characteristics of the immediate area must also be considered. Air movement may cause oxygen-displacing gases to accumulate more heavily in one area than another. Sensors should be placed where the most concentrated accumulation of oxygen-displacing gas is anticipated. It is recommended to identify times when ventilation systems do not operate continuously, as well as areas with poor circulation.

3. The sensor should be located where it is safe from potential sources of contamination.

4. The sensor should never be oriented with the sensor opening straight up in order to prevent the buildup of contaminants on the filter.

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

6. Exposure to excessive heat or vibration can cause premature failure of electronic devices, and should be avoided if possible. Shielding the device from intense sunlight will reduce solar heating and can increase the life of the unit.

Table 3—Maximum Wiring Distances - Controller to Sensor

Wire Size (AWG)	Maximum Sensor to Controller Distance	
	Feet	Meters
18	5700	1750
16	9000	2800

GENERAL WIRING REQUIREMENTS

The use of shielded cable is highly recommended to protect against interference caused by extraneous electrical “noise”. In applications where the detector cable is installed in conduit, the conduit should not be used for wiring to other electrical equipment whenever possible. If other equipment power wiring is run in the same conduit, the detector cabling **must** be shielded.

Cable with a foil shield is recommended for connecting the detector to the controller. The shield of the cable should be open at the detector junction box and connected to earth ground at the controller.

The electrochemical sensor contains semiconductor devices that are sensitive to electrostatic discharge. Damage caused by electrostatic discharge can be virtually eliminated if the equipment is handled only in a static safeguarded work area and if it is transported in a package that will provide the necessary protection against static electricity (such as the original factory packaging). Since a static safeguarded work area is usually impractical in most field installations, handle the device by the housing, taking care not to touch electronic components or terminals.

CAUTION

The use of proper conduit installation techniques, breathers, glands, and seals is required to prevent water ingress and/or maintain the explosion-proof rating.

DETECTOR WIRING

C7065E Oxygen Detector (Stand-Alone)

Two-conductor, shielded cable is recommended for connecting the C7065E detector directly to the R8471C controller. Continuous, non-spliced electrical conductors of the proper size are also strongly recommended. The maximum allowable cabling distance between the C7065E detector and R8471C controller is limited by the resistance of the cabling used. Table 3 shows the maximum cabling distance allowed for a given wire size.

The Det-Tronics Model STB-Series sensor termination box is designed for use with the C7065E detector in stand-alone applications. It provides an approved means of properly terminating the electrical conductors to the C7065E. Note that the green wire from the C7065E detector is an earth ground conductor that is normally landed at the STB-series internal earth ground lug.

Refer to Figures 8 and 9 for typical examples of a stand-alone C7065E wired to a R8471C controller.

The wiring code is:

Red lead	=	“+”
Black lead	=	“-”
Green lead	=	Chassis (earth) ground

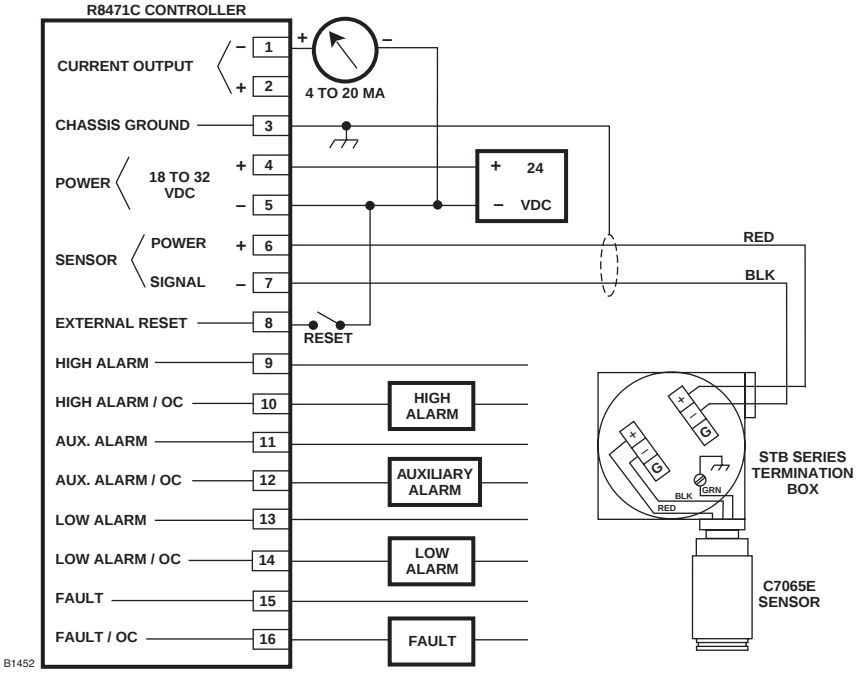


Figure 8—A Typical System - R8471C with Relay Outputs, Non-isolated Current Output and C7065E Sensor

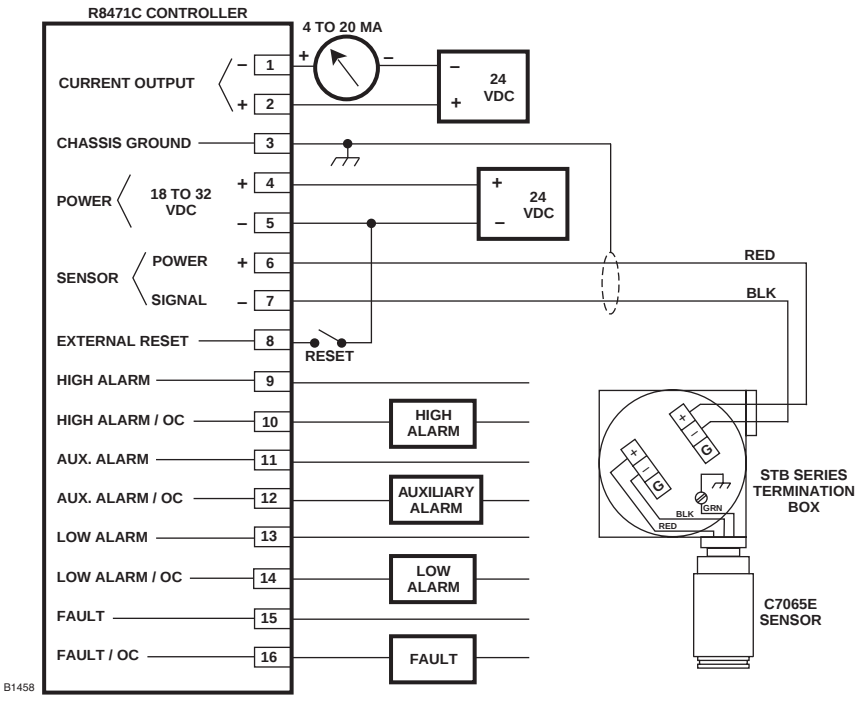


Figure 9—A Typical System - R8471C with Isolated Current Output

C7065E Oxygen detector with U9500C Infiniti Transmitter

Typically, three-conductor shielded cable is used for connecting the U9500C Infiniti directly to the R8471C controller. Continuous, non-spliced electrical conductors of the proper size are also strongly recommended.

Refer to Figure 10 for typical U9500C to R8471C controller interconnection wiring.

Refer to the U9500C Infiniti instruction manual for detailed guidance on wiring the U9500C Infiniti.

CONTROLLER WIRING

NOTE

The R8471C Controller contains semiconductor devices that are susceptible to damage by electrostatic discharge. An electrostatic charge can build up on the skin and discharge when an object is touched. Therefore, use caution when handling, taking care not to touch the terminals or electronic components. For more information on proper handling, refer to Service Memo form 75-1005.

Field Wiring Connector

The controller is furnished with a field wiring connector backplate that incorporates pressure type screw terminals for connecting the external wiring and a circuit board edge connector for attaching to the controller.

The use of a mounting rack is recommended for mounting the controller. The backplate is attached to the back of the rack to allow easy removal of the controller without disturbing the wiring. See Figures 11 and 12.

The controller is designed for installation in a non-hazardous area.

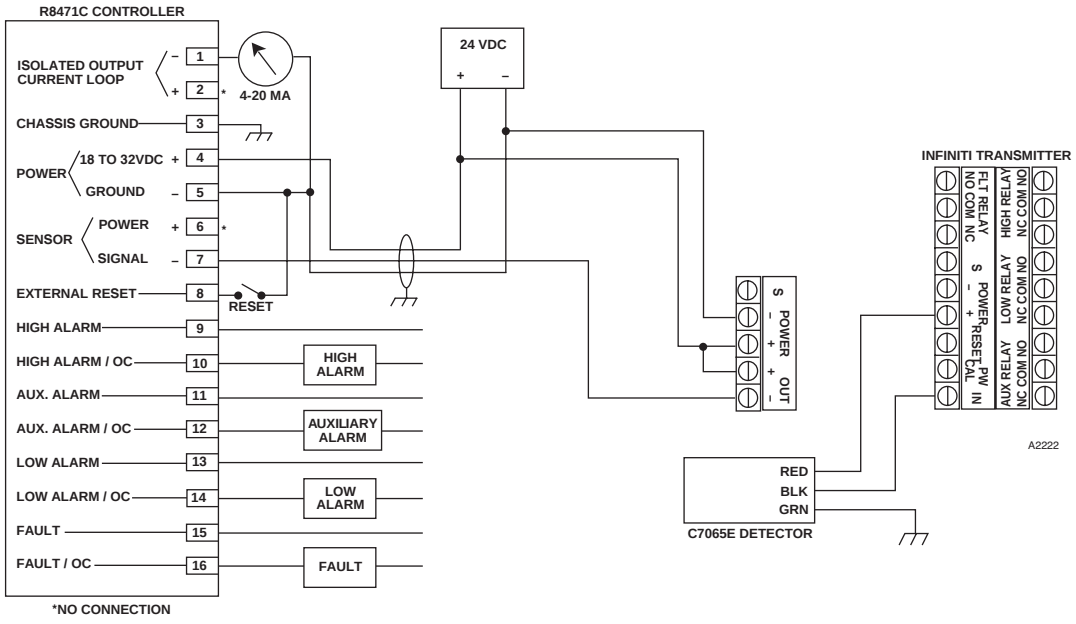


Figure 10—A Typical System - C7065E Detector with Infiniti Transmitter Wired to R8471C Controller

RACK TYPE	PART NUMBER 005269-XXX	CONTROLLER POSITIONS FOR:		HT:	DIM. (A)		DIM. (B)		DIM. (C)		DIM. (D)		DIM. (E)	
		FIRE	GAS		INCH	MM	INCH	MM	INCH	MM	INCH	MM	INCH	MM
4U	–001	8	16	4U	19.00	482.6	18.30	464.8	17.36	440.9	4.00	101.6	6.97	177.1
4U	–002	6	12	4U	15.06	382.6	14.36	364.7	13.42	340.9				
4U	–003	4	8	4U	11.13	282.6	10.43	264.9	9.49	241.1				
4U	–004	3	6	4U	9.16	232.7	8.46	214.9	7.52	191.0				
4U	–005	2	4	4U	7.19	182.7	6.49	164.9	5.55	141.0				
4U	–006	1	2	4U	5.22	132.6	4.52	114.8	3.58	90.9				
3U	–007		16	3U	19.00	482.6	18.30	464.8	17.36	440.9	2.25	57.15	5.22	132.6
3U	–008		12	3U	15.06	382.6	14.36	364.7	13.42	340.9				
3U	–008		8	3U	11.13	282.6	10.43	264.9	9.49	241.1				
3U	–010		6	3U	9.16	232.7	8.46	214.9	7.52	191.0				
3U	–011		4	3U	7.19	182.7	6.49	164.9	5.55	141.0				
3U	–012		2	3U	5.22	132.6	4.52	114.8	3.58	90.9				

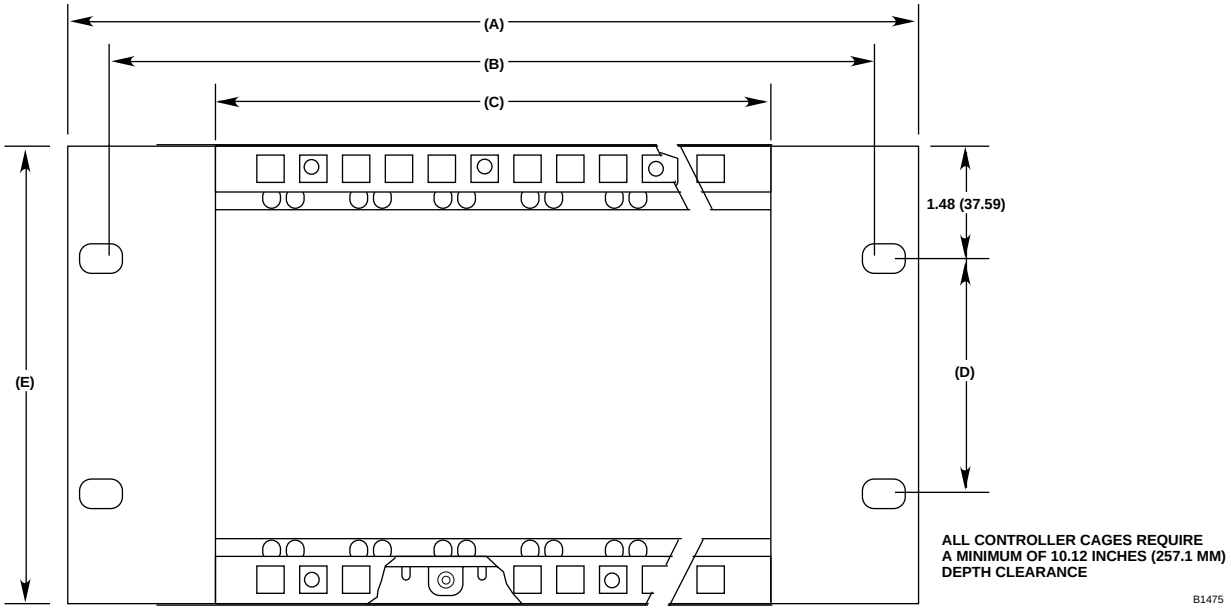
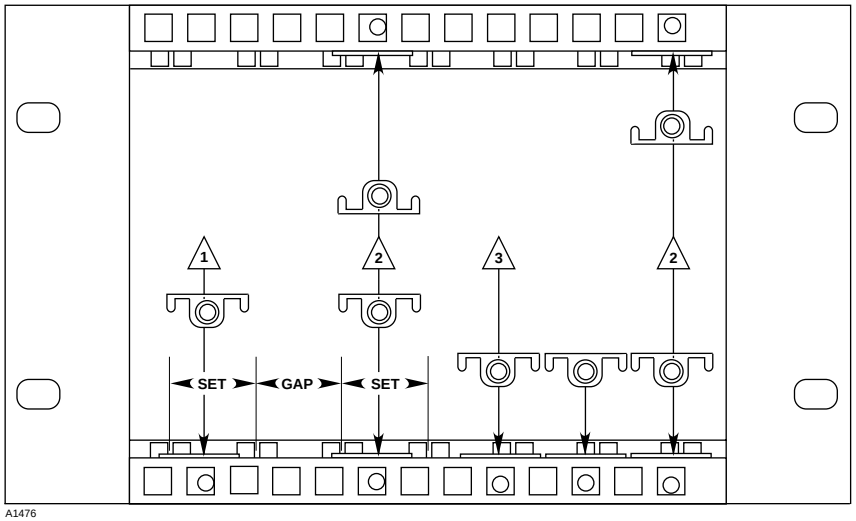


Figure 11—Dimensions of Mounting Racks

THE Q4004 CONTROLLER CAGE HAS BEEN MODIFIED TO ACCOMMODATE EITHER FIRE OR GAS CONTROLLERS OR ANY COMBINATION OF THE TWO. BY FOLLOWING THE INSTRUCTIONS BELOW, THE CAGE CAN BE SET UP TO ANY CONFIGURATION.



1. FIRE CONTROLLERS ARE APPROX. TWO INCHES WIDE AND REQUIRE TWO GUIDE RAILS FOR INSERTION. PLACE THE RETAINING CLIP BETWEEN RAILS TO FORM SETS, LEAVE A GAP BETWEEN SETS.

2. TO INSERT A BLANK PANEL, PLACE A CLIP IN THE TOP BRACKET IN LINE WITH THE CLIP IN THE BOTTOM BRACKET.

3. GAS CONTROLLERS ARE APPROX. ONE INCH WIDE AND REQUIRE ONE RAIL FOR INSERTION. PLACE CLIPS IN LINE WITH GUIDE RAILS, CAGES WILL ACCEPT AS MANY GAS CONTROLLERS AS RAILS PROVIDED.

Figure 12—Clip Positioning for Mounting Racks

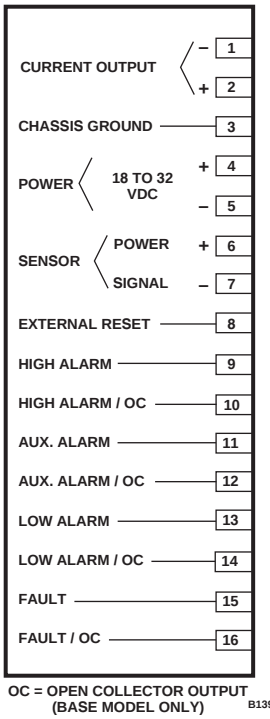


Figure 13—Terminal Configuration for R8471C Oxygen Controller

Figure 13 shows the terminal configuration for the R8471C O_2 Controller.

Terminals 1 and 2 – 4 to 20 mA dc output.

Non-Isolated Current Output - If the 4 to 20 mA current loop is to be non-isolated, wire the current loop as shown in Figure 8. Note that terminal 2 is not used with a non-isolated current loop. Program the controller for a non-isolated current loop as described in the "Controller Programming" section of this manual.

Isolated Current Output - If an isolated current loop is desired, wire the current loop as shown in Figure 9 and program the controller for an isolated current loop as described in the "Controller Programming" section of this manual. Note that this wiring scheme requires an external power source for the isolated current output.

Terminal 3 – Chassis ground. Ground the cable shield at this terminal.

Terminal 4 – Connect to the positive (+) side of the 18 to 32 vdc power source.

Terminal 5 – Connect to the negative (-) side of the dc power source.

NOTE

If local wiring codes permit and if a ground fault monitoring system is not being used, the minus side of the dc power source can be connected to chassis (earth) ground. Alternatively, a 0.47 microfarad, 100 volt capacitor can be installed (terminal 5 to ground) for best immunity against electromagnetic interference.

Terminal 6 – Connect to the red (+) lead of the C7065E Sensor.

Terminal 7 – Connect to the black (-) lead of the C7065E Sensor.

Terminal 8 – A normally open momentary closure switch can be connected between this terminal and the negative (-) side of the power source for remote reset.

Terminals 9 and 10 – High Alarm Output.

Terminals 11 and 12 – Auxiliary Alarm Output.

Terminals 13 and 14 – Low Alarm Output.

Terminals 15 and 16 – Fault Output.

BASE CONTROLLER

Connections to open collector transistor outputs are made at terminals 10, 12, 14, and 16. Terminals 9, 11, 13, and 15 are not used. See Figure 14 for an example of a typical connection to an open collector transistor output.

NOTE

External equipment that can generate transients when switching (such as relays) ***must have a transient suppression device*** *(diode) properly connected across the coil at the time of installation. This will safeguard the output transistors of the controller against possible damage. Figure 14 illustrates an inductive load with a diode used for transient suppression.*

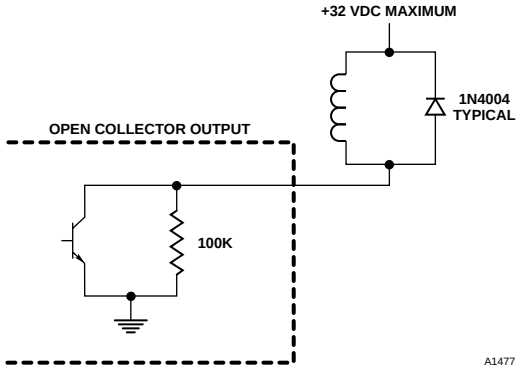


Figure 14—Open Collector Output with Inductive Load and Transient Suppression Device

PREMIUM CONTROLLER

The relay outputs (terminals 9 to 16) are programmed for the desired operation using the procedure described in the “Controller Programming” section of this manual.

CONTROLLER PROGRAMMING

Refer to Figure 15 to determine the location of programming jumpers and switches. Table 2 shows the selectable options for each relay.

NOTE

All jumper plugs must be installed. The controller outputs will not function properly if a jumper plug is missing.

Normally Open/Closed Relays

The four relays are individually programmed for either normally open or normally closed contacts. This is accomplished by placing a jumper plug on the appropriate pair of pins. Each relay has a set of three pins. For normally open operation, place the plug on the NO and center pins. For normally closed operation, place it on the NC and center pins. The pin groups are identified as follows:

J2 – High Alarm
J3 – Auxiliary Alarm
J4 – Low Alarm
J5 – Fault

The controller is programmed at the factory for normally open relay contacts.

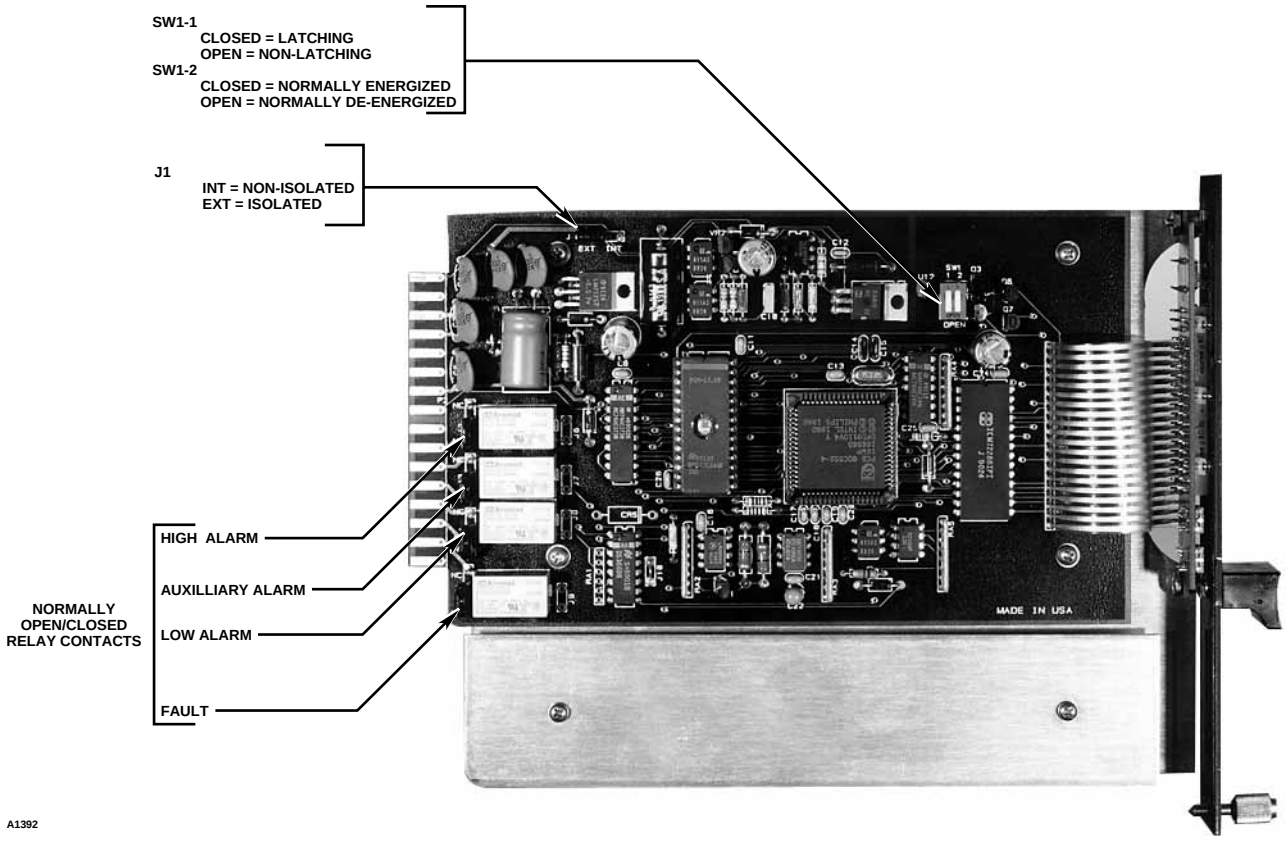


Figure 15—Programming Jumpers and Switches

Latching/Non-Latching Relays

The Low and Auxiliary alarm relays are programmable for latching or non-latching operation. The High alarm relay is always latching. Latching relay operation is programmed using rocker switch 1 at SW1 (SW1-1). For latching operation, place the switch in the closed position. For non-latching operation, place it in the open position. This switch is set at the factory for non-latching relay operation.

Normally Energized/De-Energized Relays

The three alarm relays are also programmable for normally energized (fail-safe) or normally de-energized operation. This is accomplished by setting rocker switch 2 at SW1 (SW1-2). For normally energized alarm relays, place the switch in the closed position. For normally de-energized operation, place it in the open position. This switch is set at the factory for normally de-energized operation.

The Fault relay is always normally energized, regardless of the setting of SW1-2.

NOTE

If the switch positions of SW1 are changed while power is applied, power must be cycled for the change to take effect.

4 to 20 mA Output

Isolated or non-isolated operation of the 4 to 20 mA output is selected using a jumper plug at J1. For non-isolated operation, as illustrated in Figure 8, place the jumper plug in the INT (internal power source) position. Place the plug in the EXT position for an isolated circuit, as illustrated in Figure 9. The jumper is set at the factory for non-isolated operation.

Section III
System Startup

STARTUP PROCEDURE

1. Output loads that are normally actuated by the system should be secured (remove power from all output devices) to prevent undesired activation.

2. Check all external wiring for proper connection. Be sure that the sensor has been wired properly.

3. Before installing the controller in the mounting rack, inspect it to verify that it has not been physically damaged in shipment. Check the jumper plugs and rocker switches on the controller for proper programming, then slide the controller fully into the mounting rack.

4. Apply power to the system.

   NOTE

   When power is applied to the system, the controller enters a time delay mode to allow the sensor output to stabilize before beginning normal operation. During this time the outputs are inhibited, the FAULT LED is illuminated, and the current output indicates a fault condition. The controller can remain in the time delay mode up to four minutes, however, it will automatically exit the time delay mode and begin normal operation as soon as the sensor output no longer exceeds any alarm setpoints.

5. Put the controller in the Setpoint Display mode to determine the present alarm setpoints and calibration gas concentration. If changes are required, perform the Setpoint Adjustment procedure.

6. Perform the calibration procedure.

7. Check the 4 to 20 mA current loop for proper calibration and adjust as required.

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

SETPOINT ADJUSTMENT

The adjustment ranges for the alarm setpoints and calibration gas concentration are as follows:

Low alarm:	1 to 20.7%
High alarm:	21.1 to 25%
Auxiliary alarm:	1 to 20.7% or 21.1 to 25%
Calibration gas:	15 to 25%

The factory settings are:

Low alarm:	18.0%
High alarm:	23.0%
Auxiliary alarm:	18.0%
Calibration gas:	20.9%

To check the present setpoint levels, use the "Setpoint Display Mode" described below. To change the values, use the "Setpoint Adjustment Procedure".

SETPOINT DISPLAY MODE

1. To enter the Setpoint Display mode, press and hold the Reset button until the bar graph turns off and the Low LED begins to blink (approximately one second). Release the Reset button. The low alarm setpoint will be shown for two seconds on the digital display.

   NOTE

   The Reset button should be released as soon as the controller has entered the Setpoint Display mode (after one second). If the button is still depressed at the end of the Setpoint Display mode (9 seconds), the controller will automatically enter the Calibrate mode. To exit the Calibrate mode without affecting the calibration settings, recycle power to the controller.

2. At the end of the two second interval, the Low LED goes out, the High LED blinks, and the digital display shows the high alarm setpoint.

3. Two seconds later the High LED goes out and the Auxiliary LED blinks. The digital display now shows the auxiliary alarm setpoint.

4. Two seconds later the Auxiliary LED goes out and the CAL LED blinks. The digital display now shows the programmed calibration gas concentration.

5. After displaying the calibration gas concentration for two seconds, the controller automatically leaves the Setpoint Display mode and returns to the Normal operating mode.

6. If adjustments to the setpoints are required, perform the Setpoint Adjustment procedure. When the setpoint levels are acceptable, record this information for future reference and perform the Calibration procedure.

SETPOINT ADJUSTMENT PROCEDURE

1. Determine the required alarm setpoint levels and calibration gas concentration.

2. Press and hold the Set button for one second, then release. The digital display indicates the present low alarm setpoint while the Low LED blinks. Press the Reset button to increase the reading or the Set button to decrease the reading. (Holding the button will cause the reading to change rapidly.)

3. When no changes to the setpoint level have been made for 7 seconds, the Low LED goes out, the High LED blinks, and the digital display shows the high alarm setpoint. Press the appropriate button (detailed in step 2 above) to obtain the desired reading on the digital display.

4. When no changes to the setpoint level have been made for 7 seconds, the High LED goes out, the Auxiliary LED blinks, and the digital display shows the auxiliary alarm setpoint. Press the appropriate button to obtain the desired reading on the digital display.

5. When no changes have been made for 7 seconds, the Auxiliary LED goes out, the CAL LED blinks, and the digital display indicates the calibration gas concentration. Press the appropriate button to change the calibration gas concentration as required.

6. When no changes have been made for 7 seconds, the controller automatically returns to the Normal operating mode.

7. Record the new values for future reference.

   NOTE

   The alarm setpoints, calibration gas concentration and calibration data are stored in non-volatile memory and are retained in the event of a power loss. However, if power is interrupted while performing the Setpoint Adjustment or Calibration procedure, the entire procedure must be repeated when power is restored.

CALIBRATION

To ensure optimum protection, the O_2 detection system must be calibrated on a regularly scheduled basis. Since each application is different, the length of time between regularly scheduled recalibrations can vary from one installation to the next. In general, the more frequently a system is checked, the greater the reliability.

Calibration must be performed:

- When a new system is initially put into service
- When the sensor cell is replaced
- When the hydrophobic filter is cleaned or replaced.

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

1. Immediately after the power-up time delay.

2. 24 hours later

3. Every 90 days thereafter, or as determined by the needs of the specific application.

Loss of sensitivity can be caused by various factors. One common cause is by clogging of the hydrophobic filter by dirt, oil, paint, etc. Problems of this nature will not be detected by the controller's diagnostic circuitry. While performing calibration, the operator should examine the hydrophobic filter. If it cannot be properly cleaned, it should be replaced.

NOTE

If the sensor cell is being replaced, refer to the "Sensor Cell Replacement" section (under "Maintenance") in this manual for information regarding cell replacement and sensor calibration.

CALIBRATION PROCEDURE

When the R8471C controller is used with the C7065E/ U9500C Infiniti transmitter, sensor calibration should always be performed using the U9500C Infiniti's one-person, non-intrusive calibration function. The R8471C controller functions as a remote signal display in this arrangement, and does not indicate whether or not the U9500C is in calibration mode.

When the R8471C controller is used with the C7065E oxygen detector in stand-alone configuration, the R8471C controller must be used to perform sensor calibration. This calibration process does not adjust the C7065E detector signal output; the R8471C controller will lock in and map its display value and outputs as necessary to match the programmed calibration gas level. When a new C7065E detector is exposed to normal air, it normally generates a 17.4 milliampere signal that is displayed as 20.9% volume oxygen concentration on the R8471C. As the sensor ages normally and its analog signal output decreases, during routine calibration the R8471C controller will lock onto the decreased signal level and map it to indicate 20.9% volume oxygen. This process will continue until the signal output level from the C7065E is too low, at which time a new sensor must be installed into the C7065E detector.

During Calibration, all controller outputs are inhibited, the controller's CAL LED is illuminated, and the controller's DC current signal output goes to a level preset by the user.

NOTE

Be certain that the controller is properly programmed for the O_2 percentage being used for calibration. (See "Setpoint Adjustment" section.) Reprogram the controller if required. Failure to do so will greatly impair system response.

There are 2 different R8471C controller calibration routines:

1. New Sensor/Sensor Replacement Calibration
2. Routine sensor calibration

New Sensor / Sensor Replacement

New system commissioning/Sensor replacement is a two-step procedure requiring both zero and span adjustment. It typically requires (2) people to complete as the calibration command is initiated at the R8471 controller faceplate, and the C7065E threaded housing cover in the field must be removed to actuate the sensor's on-board zero switch. See Figure 16. After completion of this procedure, all subsequent calibrations are designated as routine calibrations and do not require cover removal or actuation of the sensor's on-board zero switch.

NOTE

Do not remove the C7065E detector cover when powered unless the area has been de-classified.

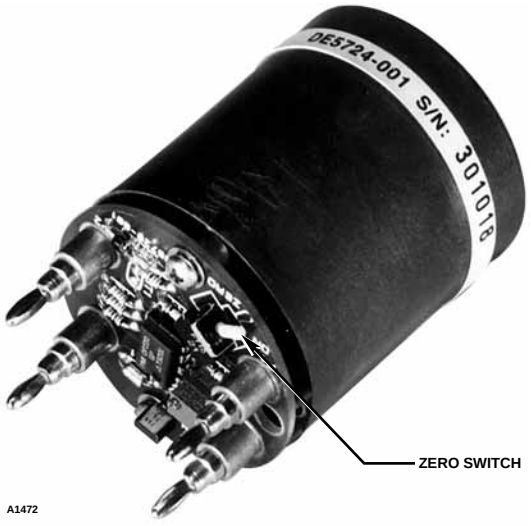


Figure 16—Electrochemical O_2 Sensor Cell

Refer to Table 4 for the New Sensor / Sensor Replacement Calibration Procedure.

Routine Calibration

Routine sensor calibration is a span only calibration that requires (1) person to perform unless it is required to purge the detector with clean compressed air to ensure that proper oxygen levels are present.

Refer to Table 5 for the Routine Sensor Calibration Procedure.

If the calibration cannot be successfully completed, a calibration fault ("F2X" status) will be generated and the system will automatically revert back to the former calibration settings (after 10 minutes or when no alarm setpoints are exceeded). If a successful calibration cannot be accomplished, replace the sensor cell and recalibrate.

Table 4—New Sensor / Sensor Replacement Calibration Quick Reference Table

Controller Status/ Command	Operator Action	Controller Faceplate Indication	Controller Current Signal Level (Default)
Normal- Ready to begin calibration	Purge with clean air if required.	Normal-no faults or calibration indicated.	4 mA
Begin Calibration	Press Reset pushbutton for 9 seconds.	Digital display flashes and CAL LED is on.	4 mA
Ready for Sensor Replacement Command	Press the Set pushbutton.	CAL LED is on. Fault LED is on. Digital display stops flashing. Bar graph is off. Three alarm LEDs flash.	4 mA
Ready for Zero adjust	Remove C7065E housing cover and place switch on sensor to Zero position.	CAL LED is on. Three alarm LEDs are off. Digital display reads "0".	4 mA
Ready for Zero accept	Press the Set pushbutton.	Bar graph display is on.	4 mA
Ready for Span adjust	Place switch on sensor to Span position. Apply clean 20.9% O2 if necessary.	CAL LED is on. Display indicates 20.9% reading.	4 mA
Ready for Span accept	Press the Set pushbutton.	Display indicates 20.9% reading. CAL LED is illuminated.	4 mA
Return to Normal mode	Press the Reset pushbutton.	Display indicates 20.9% reading. CAL LED turns off.	4 mA

Table 5—Routine Calibration Quick Reference Table

Controller Status/ Command	Operator Action	Controller Faceplate Indication	Controller Current Signal Level (Default)
Normal- Ready to begin calibration	Purge with clean air if required.	Normal-no faults or calibration indicated.	4 mA
Begin Calibration	Press Reset pushbutton for 9 seconds.	Digital display flashes. CAL LED is on. Bar graph indicates level.	4 mA
Ready for Span	No action required.	CAL LED is on. Display continues flashing.	4 mA
Span Complete	No action required.	CAL LED turns off. Display stops flashing and indicates 20.9% reading.	4 mA
Return to Normal mode	No action required.	Display indicates 20.9% reading.	4 mA

CURRENT OUTPUT CALIBRATION

The 4 to 20 milliampere output is calibrated at the factory to provide a degree of accuracy that is satisfactory for most applications. However, the highest level of accuracy can be obtained by performing the following procedure.

1. A dc current meter capable of measuring 4 to 20 milliamperes must be connected to the current loop output. This can be accomplished by connecting a dc ammeter in series with the load or by connecting a digital dc voltmeter across a known load resistance and calculating the current flow using the formula:

   I = voltage/load resistance.

2. Press and hold the Set button, then immediately press the Reset button. (The Reset button must be pressed within one second of pressing the Set button.) Release both buttons. The Low LED flashes slowly while the system generates a 4 mA output.

   NOTE
   Disregard the reading on the digital display during this procedure.

3. Press the Reset (increase) or Set (decrease) button to obtain a 4.0 mA reading on the meter. (Holding the button will cause the output to change rapidly.)

4. When no adjustments have been made for 7 seconds, the controller automatically switches to a 20 mA output. This is indicated by a flashing High LED. Press the appropriate button to obtain a 20.0 mA reading.

5. When no adjustments have been made for 7 seconds, the controller generates the current output level for the Calibrate mode. This is indicated by a flashing CAL LED. Press the appropriate button to obtain the desired current output level for the calibrate mode. (The default level is 4.0 mA.)

6. When no changes have been made for 7 seconds, the controller automatically returns to the Normal operating mode and saves the data in non-volatile memory.

7. Remove the meter from the system output and reconnect the outputs for normal operating conditions.

Section IV
System Maintenance

ROUTINE MAINTENANCE

It is important to check and calibrate the system on a regularly scheduled basis. The frequency of these checks is determined by the requirements of the particular installation.

MANUAL CHECK OF OUTPUT DEVICES

Fault detection circuitry continuously monitors for problems that could prevent proper system response. It does not monitor external response equipment or the wiring to these devices. It is important that these devices be checked initially when the system is installed, as well as periodically during the ongoing maintenance program.

CHECKOUT IN NORMAL MODE

The system must be checked periodically in the Normal mode to ensure that those items not checked by the controller diagnostic circuitry (such as output relays) are functioning properly.

CAUTION

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

HYDROPHOBIC FILTER

The hydrophobic filter on the front of the sensor housing protects the sensor cell from contaminants in the environment. The operator should frequently inspect the hydrophobic filter for cleanliness. A dirty filter can significantly reduce the ability of air to reach the sensor cell, thereby impairing the ability of the system to respond properly. If the filter becomes dirty and cannot be cleaned properly or if it is damaged, it must be replaced. Do not use solvents to clean the filter.

To replace the hydrophobic filter, simply unscrew the existing filter from the housing, then replace it with a new filter. Use care not to over tighten.

NOTE

A dirty hydrophobic filter can adversely affect the response of the sensor by blocking the flow of air to the electrochemical cell. If the sensor cannot be calibrated or responds slowly, check the condition of the hydrophobic filter before replacing the sensor cell. The hydrophobic filter should be clean and squarely seated in the housing.

SENSOR CELL REPLACEMENT

The end of life of a typical electrochemical O_2 sensor cell is characterized by a sudden drop in sensor output. This sudden decrease in sensor output can occur in as little as a few hours and will be interpreted by the controller as an oxygen deficiency.

The sensor cell is designed to provide reliable performance in clean air (20.9% oxygen) for a little over a year. Annual replacement of sensor cells on a routine basis is recommended to prevent the occurrence of a false low alarm. If sensor cells are allowed to operate in excess of a year, an alternate means must be used to verify the actual oxygen percentage in the event of a low alarm signal by the controller.

IMPORTANT

The electrochemical O_2 sensor should not be used in conditions where liquid condensation can occur. Moisture condensation within the air inlet hole of the sensor cell can restrict the passage of air to the O_2 sensor, resulting in a false low alarm at the controller. If a false alarm is suspected, use an alternate method to determine that the area is safe before entering. If a false alarm is verified, remove the sensor cap and inspect the air inlet before calibrating or replacing the sensor cell. (See Figure 7.) If moisture is found, use an absorbent tissue to dry the sensor cell. Do not dry the sensor cell by heating it.

Cell Replacement Procedure

De-classify the area or remove power to the sensor prior to replacing the sensor cell in a hazardous area.

To replace the sensor cell:

1. If the controller will remain powered during cell replacement, enter the Sensor Replacement mode before replacing the cell. To enter the Sensor Replacement mode, press and hold the Reset button for approximately 9 seconds until the digital display begins flashing and the CAL LED is illuminated. Release the Reset button.

2. Press the Set button. The FAULT LED also comes on. The controller is now in the Sensor Replacement mode.

3. Remove the cap from the sensor base. See Figure 7. (There is no need to remove the sensor housing from the junction box.)

4. Remove and discard the old cell. Check for corrosion or contamination on the terminals inside the sensor enclosure, and clean if necessary.

5. Determine proper orientation for the new cell, then carefully plug it in.

NOTE

Handle the sensor cell carefully. To avoid possible damage, observe the normally accepted procedures for handling electrostatic sensitive devices. See form 75-1005 for additional information.

6. If power was removed from the controller during the sensor cell replacement procedure, re-apply power. The controller will enter the power-up time delay. Enter the Sensor Replacement mode by holding the Reset button for 7 seconds. (If power was not removed, the controller should already be in the Sensor Replacement mode.)

7. Allow time for the sensor to warm up and stabilize (approximately 15 minutes), then calibrate using the New Sensor / Sensor Replacement Calibration Procedure.

An adequate supply of spare sensor cells should be kept on hand for field replacement. For maximum protection against contamination and deterioration, they should not be removed from the original protective packaging until the time of installation. To ensure maximum storage life, sensor cells should be stored at a temperature between 32° and 68°F (0 to 20°C) and a relative humidity between 15 and 90 percent.

A Recommended Test Form is supplied at the back of this manual for recording maintenance performed on the system.

TROUBLESHOOTING

Table 6 is intended to serve as an aid in locating the cause of a system malfunction.

NOTE

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

F92 FAULT

The F92 fault occurs when the controller exits its warm-up mode while generating an output level in excess of the high alarm setting. This typically occurs when the controller's high alarm setpoint is only slightly higher than the ambient O_2 level and the old oxygen sensor is replaced with a new sensor. The new sensor provides a higher output level than the old sensor. Even ambient O_2 levels can generate a 4-20 mA current output that exceeds the controller's high alarm setpoint when it is set very close to 21% volume. This "abnormal signal level" fault condition causes the controller to locked up and not display any gas indications. In addition, it is not possible to calibrate or adjust alarm setpoints.

Preventing an F92 Fault

The following procedure will prevent the F92 fault from occurring and should be completed before removing the existing oxygen sensor from service:

1. Verify that no faults are displayed on the faceplate of the R8471C.

2. Enter the Setpoint Display mode by pressing the Reset button on the controller faceplate until the Low LED begins to blink (approximately 1 second). The low alarm setpoint, high alarm setpoint, auxiliary alarm setpoint, and calibration gas concentration values will be displayed consecutively for approximately 2 seconds.

3. If the high alarm setpoint is at or above 23% O_2 level, no action is necessary. The F92 fault should not occur and you can proceed to install the new sensor and perform calibration.

4. If the high alarm setpoint is between 20.9% and 23%, the setting should be increased before installing the new sensor, as an F92 fault is likely to occur.

Table 6—Troubleshooting Guide

Problem	Possible Cause
No faceplate indicators illuminated.	1. Wiring to external power source. 2. Input power failure.
FAULT LED on, digital display blank.	1. Power-up time delay (up to 5 minutes). 2. If condition continues after 5 minutes, repeat power-up. If problem continues, replace controller.
F91 to F98 Status	1. Initialization failure. Repeat power-up. If successful, re-program and re-calibrate. If not, replace controller.
F92 Status	1. Alarm condition is present after completion of controller warm-up.
F94 Status	1. RAM failure. Return controller to factory for repair.
F96 Status	1. Input power problem (should be 18 to 32 volts). Check operation of power source and power wiring.
F97 Status	1. Controller type invalid. Error in data from RAM. Return controller to factory for repair.
F70 Status	1. External reset activated for over 15 seconds. Check external switch and wiring.
F60 Status	1. Input power out of tolerance. Check operation of power source and power wiring.
F50 Status	1. Internal power supply problem. Replace controller.
F40 Status	1. Sensor output (after startup) is over 35 ma or below 2 ma. Check sensor/transmitter wiring and calibration. 2. Faulty sensor. Replace and calibrate.
F30 Status	1. Negative zero drift. Calibrate sensor. 2. Faulty sensor. Replace and calibrate.
F20, F21 Status	1. Calibration error. Re-calibrate.
F22, F23 Status	1. Sensor sensitivity out of tolerance. Calibrate. If problem continues, replace sensor and calibrate.
F10 Status	1. Sensor failure discovered during calibration. Replace sensor cell and calibrate.

5. Enter the setpoint adjustment mode by holding the Set button for one second. When the high LED is blinking, press the Reset button to adjust the high alarm setpoint up to 23-25%. When the button is released and no other changes are made, the controller will return to the normal operating mode with the new high alarm setpoint.
6. The F92 fault should not occur and you can proceed to install the new sensor and perform calibration.
7. To prevent future F92 faults, it is recommended to program the high alarm setpoint at or above 23%.

Clearing an F92 Fault

If an F92 fault occurs after a new sensor has been installed, press the Reset button on the R8471C controller. If the reset is successful, the controller settings will return to the factory default values. Perform a new sensor calibration procedure.

NOTE

Always perform and complete a new sensor/ sensor replacement calibration procedure after pressing Reset to escape an F92 fault. This is necessary to ensure that the system readings are accurate.

If pressing the Reset button does not clear the F92 fault, it is necessary to:

1. Complete a signal simulation procedure, and
2. Re-program the controller's alarm thresholds.

The following equipment is needed to perform the signal simulation procedure:

- 4-20 mA signal generator, or 5 Kohm potentiometer
- Milliampere meter with probes/connectors
- R8471C controller with backplate wire terminal access
- 24 VDC power supply for R8471C (if not already available).

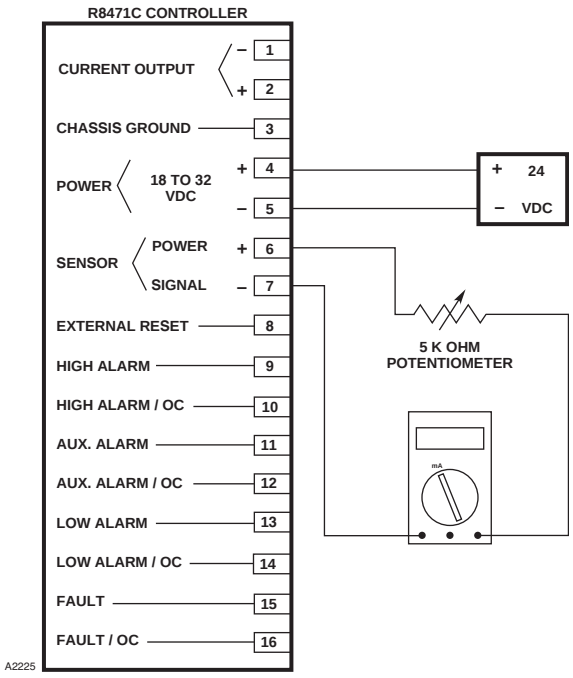


Figure 17—Potentiometer and Ammeter Used to Simulate Detector Output Signal

1. Remove power from the system.

CAUTION

If this procedure will be conducted with the R8471C controller in its normal location, bypass/disable alarm devices to prevent possible unwanted alarms.

2. Disconnect the C7065E oxygen detector wires from controller terminals 6 and 7.

3. Connect a 5 Kohm potentiometer or 4-20 mA signal generator between terminals 6 and 7. See Figure 17. Connect an ammeter in series with the potentiometer and terminal 7 to enable measurement of the milliampere output.

4. Restore power to the controller. Only the amber fault LED will be illuminated.

5. Adjust the potentiometer for 15 milliamps, and then slowly increase. The precise signal level required to bring the controller out of warm-up is expected to be at or slightly above 16 milliamps. When the controller enters the normal mode, the fault LED turns off, and the bar graph, digital display, and possibly some of the alarm LEDs turn on. The R8471C needs approximately two continuous seconds of the appropriate input value to end warm-up mode. If this procedure fails to end warm-up mode, it is likely that the adjustment was not slow enough.

6. After entering the normal mode, adjust the low alarm and auxiliary alarm setpoints to 1.0 percent oxygen and the high alarm setpoint to 25.0 percent oxygen. See “Setpoint Adjustment Procedure” for details.

7. Remove power from the system.

8. Reconnect the C7065E oxygen detector to terminals 6 and 7 observing polarity.

9. Restore power to the system.

10. Allow the oxygen sensor to warm up for a minimum of 30 minutes. This is necessary to allow stabilization of the sensor output.

11. Calibrate the system using the New Sensor/ Sensor Replacement method. It is important that the level of oxygen present during calibration is known to be at the same level as the programmed calibration gas level. If not, calibration may be inaccurate or unsuccessful. For best results, use calibration gas of a known concentration (such as is supplied with the O_2 Calibration Kit, part number 227115-006). Unsuccessful calibration may also result when the sensor has degraded beyond acceptable limits. This is identified by an F22 or F23 fault. If this occurs, replace the Electrochemical O_2 Sensor Cell (part number 005724-001)

12. Reset the controller’s low, high, and auxiliary alarm settings. The recommended alarm threshold settings are:

Low Alarm:	19.5%
High Alarm:	23%
Auxiliary:	Any value greater than 23%
	or less than 19.5%

NOTE

If the system is in alarm and power is cycled, the F92 fault will return because the detector will be producing an alarm level output once warm-up is complete. Therefore, it is not advisable to assign thresholds when any of the alarms are commonly active.

13. Restore the alarm outputs that were previously bypassed/disabled.

14. Perform a complete system check out to ensure that all connections and functions have been properly restored.

15. Recalibrate the system after 24 hours of operation.

16. Maintain a regular calibration and maintenance schedule.

REPLACEMENT PARTS

The R8471C Controller is not designed to be repaired by the customer in the field. If a problem should develop, first carefully check for proper wiring, programming and calibration. If it is determined that the problem is caused by an electronic defect, the device must be returned to the factory for repair.

NOTE

When replacing a controller, be sure that the jumper plugs and rocker switches of the replacement are the same as the original. Remove power before removing the device from the mounting cage or plugging in the replacement unit.

The electrochemical sensor cell is not intended to be repaired. To assure reliable protection, sensors used in clean air environments (20.9% oxygen) should be replaced on an annual basis.

An adequate supply of spare cells should be kept on hand for field replacement. For maximum protection against contamination and deterioration of the sensing element, they should not be removed from the original protective packaging until the time of installation. Electrochemical cells should be stored at a temperature between 32° and 68°F (0° to 20° C) and a relative humidity between 15 and 90 percent.

Always calibrate after replacing the cell.

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

DEVICE REPAIR AND RETURN

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

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

Return all equipment transportation prepaid to the Minneapolis location.

ORDERING INFORMATION

Sensors must be ordered separately from the controller. When ordering please specify:

R8471C Oxygen Controller
– Base model or premium model
– 3U or 4U rack

MOUNTING RACKS

Mounting racks are required for controller installation. 3U racks house only gas controllers. 4U racks can house gas or flame controllers in any combination. See Figures 11 and 12.

C7065E SENSOR/TRANSMITTER

Sensor housing and O_2 cell must be ordered separately.

Part Number	Description
005723-001	O_2 Sensor Housing
005724-001	Electrochemical O_2 Cell
226365-xxx	Sensor Termination Box

ACCESSORIES

Part Number	Description
005003-001	Silicone Free Grease
000507-005	Open Frame Power Supply - 24 vdc at 3.6 amperes
000507-006	Open Frame Power Supply - 24 vdc at 12 amperes
005236-001	W4810 Power Supply, mounted in explosion-proof enclosure (24 vdc at 1.0 ampere)
227115-006	O_2 Calibration Kit, contains 2 cylinders of clean air (20.9% oxygen)

REPLACEMENT PARTS

005724-001	Electrochemical O_2 Sensor Cell
004532-002	Hydrophobic filter for C7065E
226166-006	Replacement cylinder for calibration kit

For assistance in ordering a system to meet the needs of a specific application, please contact:

Detector Electronics Corporation
6901 West 110th Street
Minneapolis, Minnesota 55438 USA
Operator: (952) 941-5665 or (800) 765-FIRE
Customer Service: (952) 946-6491
Fax: (952) 829-8750
Web site: www.det-tronics.com
E-mail: detronics@detronics.com

Recommended Test Form

Detector Number	Detector Location	Date Installed	Date Checked	Date Calibrated	Remarks

Fault Record Sheet

Date	Time	Detector Affected	System Status	Operator	Comments

X3301 Multispectrum
IR Flame Detector

PointWatch Eclipse®
IR Combustible Gas Detector

Eagle Quantum Premier®
Safety System

Eagle Logic Solver
Safety System

Detector Electronics Corporation
6901 West 110th Street
Minneapolis, MN 55438 USA

T: 952.941.5665 or 800.765.3473
F: 952.829.8750
W: http://www.det-tronics.com
E: detronics@detronics.com

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