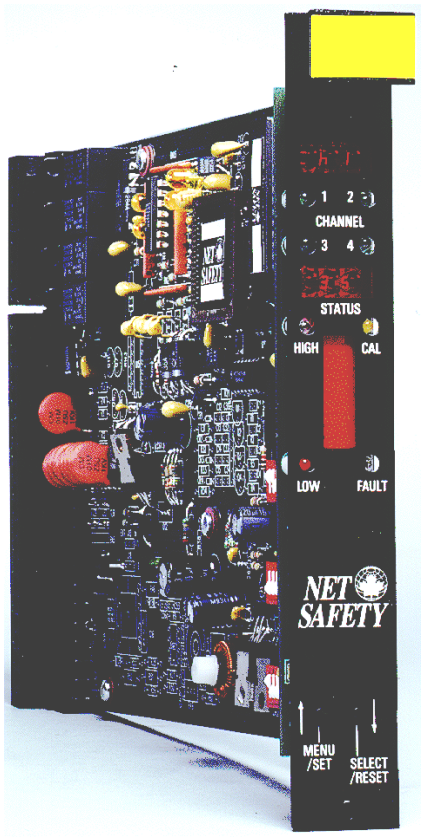
NET SAFETY MONITORING INC.

MODELS: R1G, R2G and R4G

UNI-TROL™ GAS CONTROLLER

One, Two and Four-Channel Rack-Mount Controller



ISO 9001 Certified Company

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This manual is a guide for the use of a Gas controller and the data and procedures contained within this document have been verified and are believed to be adequate for the intended use of the controller. If the controller or procedures are used for purposes other than as described in the manual without receiving prior confirmation of validity or suitability, Net Safety Monitoring Inc. does not guarantee the results and assumes no obligation or liability.

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No other warranties or liability, expressed or implied, will be honored by Net Safety Monitoring Inc.

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UNIT IV - SYSTEM MAINTENANCE

Unit I
GENERAL INFORMATION

DESCRIPTION

The Uni-Trol R1G, R2G and R4G Controllers accept 4-20 mA DC analog input signals from Net Safety Combustible and toxic gas sensors. Controller response includes actuation of relays for direct control of field response devices, 4-20mA outputs and a full array of faceplate indicators. The type of controller and its range can be determined from the model number as shown below:

RXG-100-LEL = 0 to 100% LEL controller
RXG-100-H2S = 0 to 100ppm H_2S controller
RXG-1000-CO = 0 to 1000ppm CO controller
RXG-20-SO2 = 0 to 20ppm SO_2 controller

NOTE

The controller displays the gas concentration in parts per million (p.m.) for all types of gases unless it is a combustible gas controller which shows the gas concentration as % of lower explosive limit (LEL).

FEATURES

- Controller accepts 4 to 20 mA analog inputs from Net Safety Combustible and toxic gas sensors.
- Two digital displays, one bar graph display, and high intensity LEDs indicate important system status.
- AutoCal feature provides easy and accurate calibration.
- Microprocessor-based controller is easily field programmable.
- 4-20mA current outputs to send important system information to other devices.
- Relay alarm and fault outputs.

SPECIFICATIONS

- **Operating Voltage**:
  24 Volts DC. Device can operate between 18 and 32 Volts DC

- **Power Consumption** (Controller only):
  2.4 Watts nominal, 4.4 Watts maximum (100 mA nominal, 180 mA maximum at 24 Volts DC)
  Maximum start-up current is 1.5 Amperes for 10 milliseconds. Power supplies with foldback current limiting are not recommended

- **Maximum Ripple:**
  Ripple should not exceed 5 Volts peak-to-peak. The sum of DC plus ripple must be ≥18 Volts DC and ≤32 Volts DC

- **Temperature Range:**
  Operating: -40ºC to +85ºC (-40ºF to +185ºF)
  Storage: -55ºC to +150ºC (-65ºF to +302ºF)

- **Relay Contacts:**
  Normally open/normally closed contacts rated at 5 Amperes at 30 Volts DC/250 Volts AC

- **Current Outputs:**
  Two 4-20mA DC current, with a maximum external loop resistance of 600Ω at 18-32 Volts DC

- **Dimensions**:
  Refer *to Figure 1*

- **Shipping Weight** (approximate):
  2 lbs. (0.9 kilograms).

- **Certification:**
  Designed to meet CSA and FM specifications for ordinary locations.

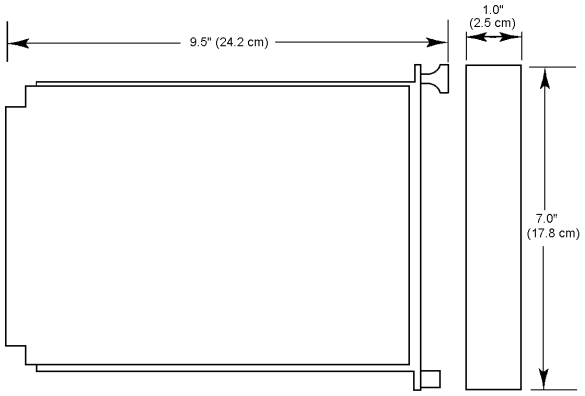

Figure 1 - Controller Dimensions

BASIC OPERATION

FACEPLATE DESCRIPTION

The controller faceplate provides LEDs for identifying status conditions, two digital displays and a bar graph display for indicating the sensor inputs, and MENU/SET and SELECT/RESET push-buttons for programming, calibrating and resetting the system. Refer to *Figure 2* for the location of indicators and push-buttons.

- **Digital Displays** - Two digital displays are used to display the sensor inputs in both the Normal and Calibrate Modes; one display indicates the channel and one display indicates the corresponding sensor input. In the event of a fault, it identifies the nature of the fault using an alphanumeric code. In the Normal Operating Mode, each channel is sequentially displayed for 5 seconds. In other operating modes, the digital displays show the alarm set-points, programmed calibration gas concentration, or the communication addresses for the Digital Communication. A negative zero drift condition is indicated by a minus sign in the left-hand digit. Since at least one display is always lit, it also functions as a power indicator.

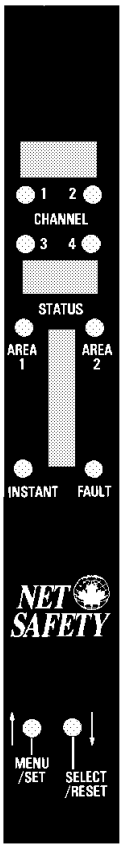

Figure 3 - Controller Face-Plate

- **Bar Graph Display** - The common 10-segment bar graph display provides readings of the four sensor inputs in 5% of full range increments (ie. for a 50ppm controller each segment represents 2.5ppm, which is 5% of the full range of 50ppm), from 0% to 50% of full range; all 10 segments are illuminated for 50% of full range and higher gas concentrations.

- **High Alarm LED (HI)** - Flashes in response to a sensor signal that exceeds the high set-point.

- **Low Alarm LED (LOW)** - Flashes in response to a sensor signal that exceeds the low set-point.

- **Calibrate LED (CAL)** - is illuminated while the controller is in the Calibrate Mode.

- **Fault LED (Fault)** - is illuminated upon detection of an overall system fault or a channel related fault.

- **Channel LEDs** - are illuminated when status on the corresponding channel is displayed on the common indicators (digital displays and bar graph). During power-up, a channel LED is on if the channel is selected for operation.

- **MENU/SET Push-Button** - is used for changing the menu display as well as other system programming and calibration functions.

- **SELECT/RESET Push-Button** - is used for menu selection and other system programming, as well as for resetting the controller.

OUTPUTS

Relay Outputs:

The relay outputs have SPDT contacts rated at 5 Amperes at 30 Volts DC or 250 Volts AC. The four relays include an Area 1 low alarm (channels 1 and 2), an Area 2 low alarm (channels 3 and 4), one common high alarm, and a fault alarm.

RECOMMENDATION

> *The fault relay output should not be used to activate an automatic shutdown procedure. The fault output indicates a potential problem with the controller, not an alarm condition.*

Current Outputs:

Two 4-20mA DC current outputs for transmitting system information to other devices are also included. The current outputs can be wired for isolated or non-isolated operation by changing the positions of J12 and J18, as shown in *Figure 3*. Refer to *Table 1* for a description of the current output signal levels.

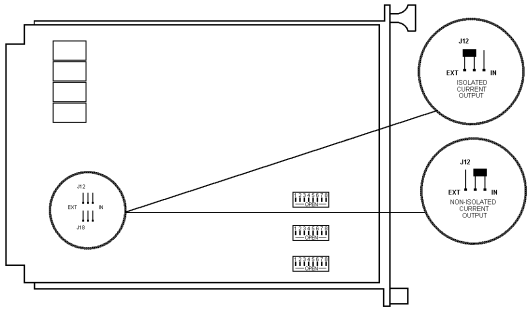

Figure 3 - Jumper Selections for an Isolated or Non-isolated Current Output

Current Output	Situation
0mA	Open or shorted signal output, or loss of power
1mA	Fault or Power up
2mA	Power Fault
3mA	Sensor Calibration
4mA to 20mA	0 to 100% of full scale

Table 1 - Current Outputs

PROGRAMMING OPTIONS

A set of dip-switches, located on the circuit board, can be used to 'program' various options and set-points, including:

- the channels selected for operation,
- low and high alarm settings,
- calibration gas concentration,
- power-up delay time (either 45 or 90 seconds),
- latching/non-latching selection, and
- energized/de-energized selection

The alarm outputs are programmable for either normally energized or normally de-energized operation (programmable as a group only, not individually). The fault output is normally energized. The low alarm outputs are programmable for either latching or non-latching operation. The high alarm output is always latching and the fault output is non-latching. Refer to *Table 2*.

OUTPUT	Selectable Normally Open/Closed	Selectable Normally Energized/De-Energized	Selectable Latching/Non-latching
LOW[1]	Y	Y[2]	Y
HIGH	Y	Y[2]	N[3]
FAULT	Y	N[4]	N[5]

Table 2 - Selectable Output Options

1 Low alarms are programmed together, not individually
2 Programmable together, not individually
3 High alarm relay is always latching
4 Fault relay is normally energized
5 Fault relay is non-latching

EXTERNAL RESET

A normally open, momentary closure switch can be connected between the external reset terminal and the negative power terminal to provide remote reset capabilities.

AUTOMATIC DIAGNOSTICS AND FAULT IDENTIFICATION

The microprocessor-based controller features self-testing circuitry that continuously checks for problems that could prevent proper system response. When power is applied, the microprocessor automatically tests memory. In the Normal Operating Mode, it continuously monitors the input signals from the sensor/transmitter to ensure proper functioning. In addition, a 'watchdog' timer is maintained to ensure that the program is running correctly. The timer resets the micro-controller if it enters erroneous processor states within a reasonable period of time.

If a fault is detected, the Fault LED illuminates, the digital display identifies that a fault has occurred, the fault relay output becomes de-energized, and the current output drops to 1 mA. The nature of the fault can be identified by a numeric code, which can be viewed in the Fault Message Display mode.

OPERATING MODES

The controller can operate in any of the modes discussed in this section. Operating modes other than Normal are selected by pressing the appropriate MENU/SET and SELECT/RESET buttons located on the controller front panel. Refer to *Figure 2* for a diagram of the controller front panel.

NOTE

This section is intended to acquaint the user with the basic operation of the controller. Refer to 'Unit III' for detailed instructions and description.

Normal Operating Mode:

If no alarms or faults are occurring, the module will be in a Level 1 Display Mode; the bar graph and digital display sequentially indicate the sensor inputs for 5 seconds on each channel, and all the LEDs are off except the appropriate channel LEDs. Relay outputs are in their normal state, and the current outputs correspond to the sensor inputs.

If a low alarm condition occurs on any channel, the module will be in a Level 2 Display Mode; the bar graph and digital display will display only the channel that is in alarm. If more than one channel is in alarm, the channel with the highest alarm will be displayed and the channel LED for any other channel(s) in alarm will flash. The low alarm LED will flash, the low alarm relay(s) change state, and the current outputs change to indicate the alarm. If the signal(s) decreases below the low set-point again, the corresponding alarm relays return to their normal state if programmed for non-latching operation and remain unchanged if programmed for latching operation. The current outputs will return to the normal output level. The low alarm LED will still illuminate whenever the channel which had the alarm condition is displayed.

If a high alarm condition occurs, the module will be in a Level 3 Display Mode; the bar graph and digital display will cycle through all channels with a high alarm condition. While one channel is displayed, the channel LED for any other channel in a high or low alarm state will flash.

NOTE

When 1 or more channels are in a high alarm condition and 1 or more channels are in a low alarm condition, only the channels in the high alarm condition will be cycled on the display. The channel LED for any channel in the low alarm condition will flash.

Reset Mode:

The Reset Function is entered by pressing the SELECT/RESET button located on the front panel of the controller. (Refer to *Figure 2*) When the SELECT/RESET button is activated momentarily, all LEDs turn off and all outputs return to their normal condition if no alarms or faults are occurring (basic reset).

Forced Reset Mode:

If any of the channels receives a reading beyond 100% of full scale, a reset will not clear the alarms, even if the channel has returned to levels below the low alarm set point. The error resulting from this occurrence must be cleared and a forced reset applied. To apply a forced reset, press the SELECT/RESET button for 3 second, the LEDs turn off and the outputs return to their normal condition. The remote reset performs a forced reset.

NOTE

The remote reset performs a reset function only. It cannot be used for other controller functions.

Forced Display (FdP):

This mode forces a sequential display of all the active channels. It can be used during alarm situations when the digital and bar graph display normally remain on the
channel with the highest alarm condition. This function is also useful while in menu functions that do not show the sensor readings.

Sensor Replacement Mode (SrP):

This mode inhibits all controller outputs to allow replacement of the sensor(s) without removing power from the controller. Alarm set-points and calibration gas concentration are not affected. The upper display will show 'SrP' while in the sensor replace mode. The lower display will show the status of the sensor being replaced ('NoS' means no sensor is connected). The fault LED is on and the fault relay is de-energized. The channel LED will be on for the sensor being replaced.

All other sensors remain active during sensor replace mode. If an alarm condition occurs on one of the active channels while in this mode, the appropriate channel LED will flash and relays and current outputs will act accordingly. All other display features will be inhibited. In order to exit this mode the SELECT/RESET button must be pressed. The controller will perform a power-up countdown (45 or 90 seconds) for the sensor that was replaced and the affected current output will be 1mA during this time.

Sensor Calibration Mode (CAL):

The Uni-Trol™ Controller uses a fully automatic calibration procedure that requires no adjustments by the operator. The controller displays 'Air' on the upper display and the channel status on the lower display while automatically performing the zero adjustments. Next the controller will signal the user to apply the calibration gas by alternating 'gas' and 'in' on the upper display. When the controller detects that the gas has been applied to the sensor, the upper display will read 'gas'. Once the controller has finished the gain adjustments it will alternate 'Cut' and 'gas' on the upper display, telling the user that it is time to remove the calibration gas. Upon completion of the calibration the controller will automatically return to the normal operating mode.

If the operator fails to complete the calibration procedure, if an error in the calibration procedure occurs, or if a successful calibration cannot be completed, the microprocessor will automatically return to the Normal Operating Mode and continue to use the previous calibration data. A fault indication will be displayed until a reset occurs. If the microprocessor determines that the sensor is approaching the end of its useful life, a fault code will indicate this.

While in the calibration mode, all controller outputs for the affected channel are inhibited, the current output is 3mA, and the 'Cal' LED is illuminated. All other channels remain active, however if an alarm condition occurs, the only display indication will be a flashing channel LED, all other display features will be inhibited.

Set-Point Display (Spd):

In this mode, the digital display sequentially shows the programmed low and high alarm set-points, calibration gas concentration, and communication addresses. Each value is displayed for approximately 2 seconds.

Address Set (Adr Set):

The communication addresses for Digital Communications are set in this mode, which is found in the main menu. The MENU/SET and SELECT/RESET buttons are used to raise and lower the address. This mode can only be exited by allowing ten seconds to go by without pressing either button.

Error Message Display (Err Chc):

The microprocessor-based controller features self-testing circuitry that continuously checks for problems that could prevent proper system response. As a diagnostic and troubleshooting tool, identifiable faults are displayed on the digital display, using error codes, during the Error Message Display Mode. The controller will also display an error message after the last channel in the cycling routine.

Channel Display (Chd):

In this mode, the displays can be forced to monitor only one channel, as long as no alarms are occurring, on other channels. If an alarm occurs on the channel that is being monitored, the controller will remain in the manual display mode. If an alarm occurs on any other channel the controller will automatically return to the Normal Operating Mode.

Unit II
SYSTEM INSTALLATION

INSTALLATION

SENSOR LOCATIONS

Proper location of the sensors is essential for providing maximum protection. The method for deciding the most effective number and placement of sensors varies depending on the conditions at the job site. The individual performing the installation must rely on experience, common sense, and knowledge of plant operations to determine the number of sensors needed and the best controller locations to protect the area adequately.

The following factors are important and should be considered for every installation:

- Sensors should be located where they are safe from potential sources of contamination
- Refer to sensor application manuals and follow guidelines for sensor installation
- Sensors must be accessible for testing and calibration
- Exposure to excessive heat or vibration can cause premature failure of electronic devices, and should be avoided if possible

GENERAL WIRING REQUIREMENTS

NOTE

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 applicable regulations that relate to the installation of electrical equipment in a hazardous area. If in doubt, consult a qualified official before wiring the system.

The use of shielded cable is highly recommended for any signal wires to protect against interference caused by extraneous electrical 'noise'. This includes power and current outputs; relay outputs do not require shielded cable. In applications where the wiring cable is installed in conduit, the conduit must not be used for wiring to other electrical equipment.

Water will damage electronic devices. Moisture in the air can condense within electrical conduit and drain into the enclosure, therefore, water-proof and explosion-proof conduit seals are recommended to prevent water accumulation within the enclosure. Seals should be located as close to the device as possible and not more than 18 inches (46 cm) away. Explosion-proof installations may require an additional seal where conduit enters a non-hazardous area. Conform to local wiring codes.

When pouring a seal, use a fibre dam to assure proper formation of the seal. The seals should never be poured at temperatures below freezing.

The jacket and shielding of the cable should be stripped back to permit the seal to form around the individual wires. This will prevent air, gas and water leakage through the inside of the shield and into the enclosure.

It is recommended that explosion-proof drains and conduit breathers be used. In some applications, alternate changes in temperature and barometric pressure can cause 'breathing' which allows moist air to enter and circulate inside the conduit. Joints in the conduit system are seldom tight enough to prevent this 'breathing'.

CONTROLLER WIRING

NOTE

The 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 the Appendix.

The Uni-Trol™ controllers can be wired for isolated or non-isolated current outputs by changing the positions of ‘J12' and ‘J18', as shown in *Figure 3. Figures 4a, 5a, and 6a* show the terminal proper wiring of the controller for non-isolated current outputs with 2 and 3 wire sensors. Figures 4b, 5b and 6b show the proper wiring of the controller for isolated current outputs with 2 and 3 wire sensors.

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 (negative side of power supply terminal 13, to chases ground, terminal 8).

R1G-XXXX CONTROLLER
NON-ISOLATED CURRENT OUTPUT

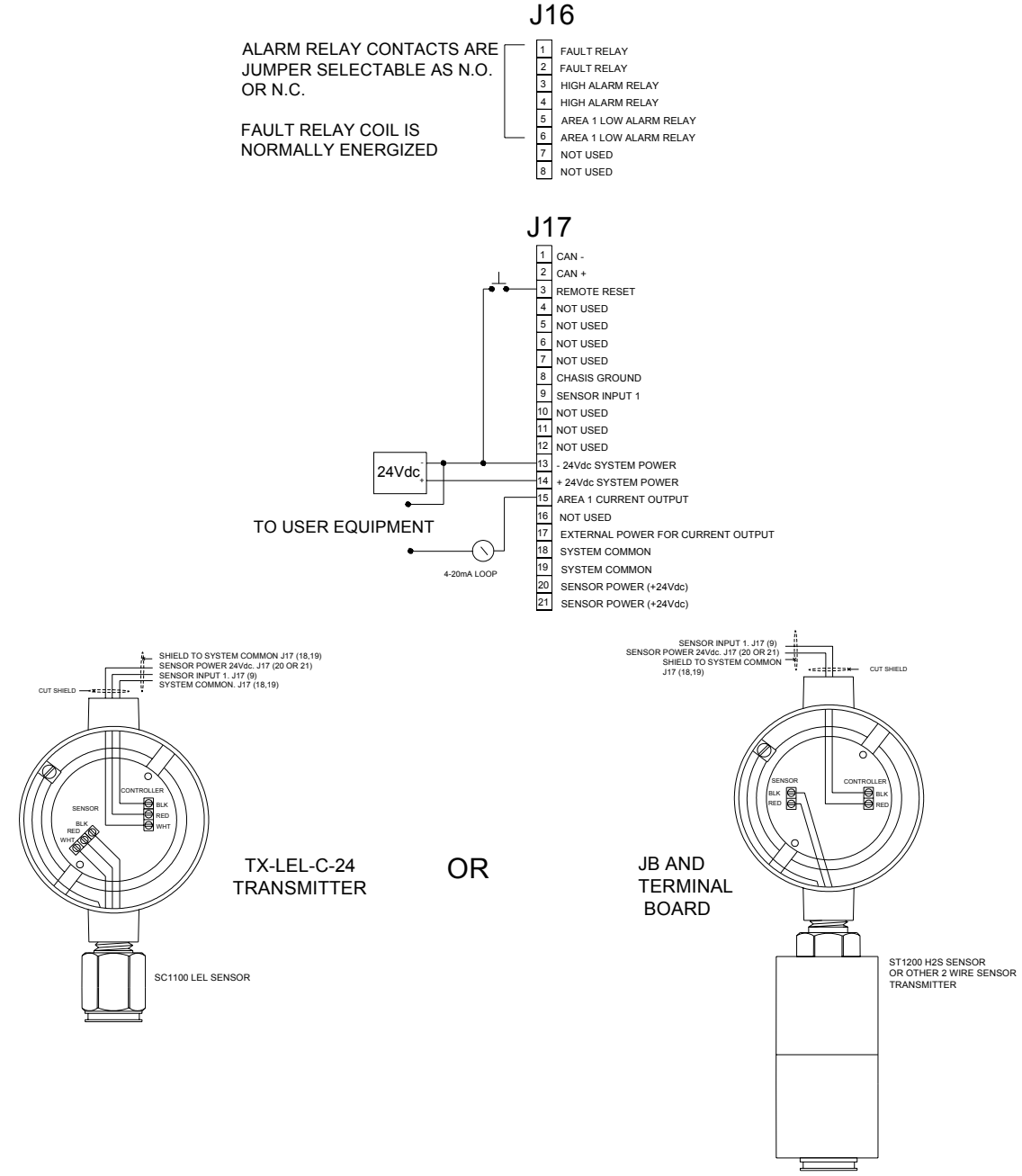

Figure 4a - Wiring for R1G with Non-Isolated Current Output

R1G-XXXX CONTROLLER
ISOLATED CURRENT OUTPUT

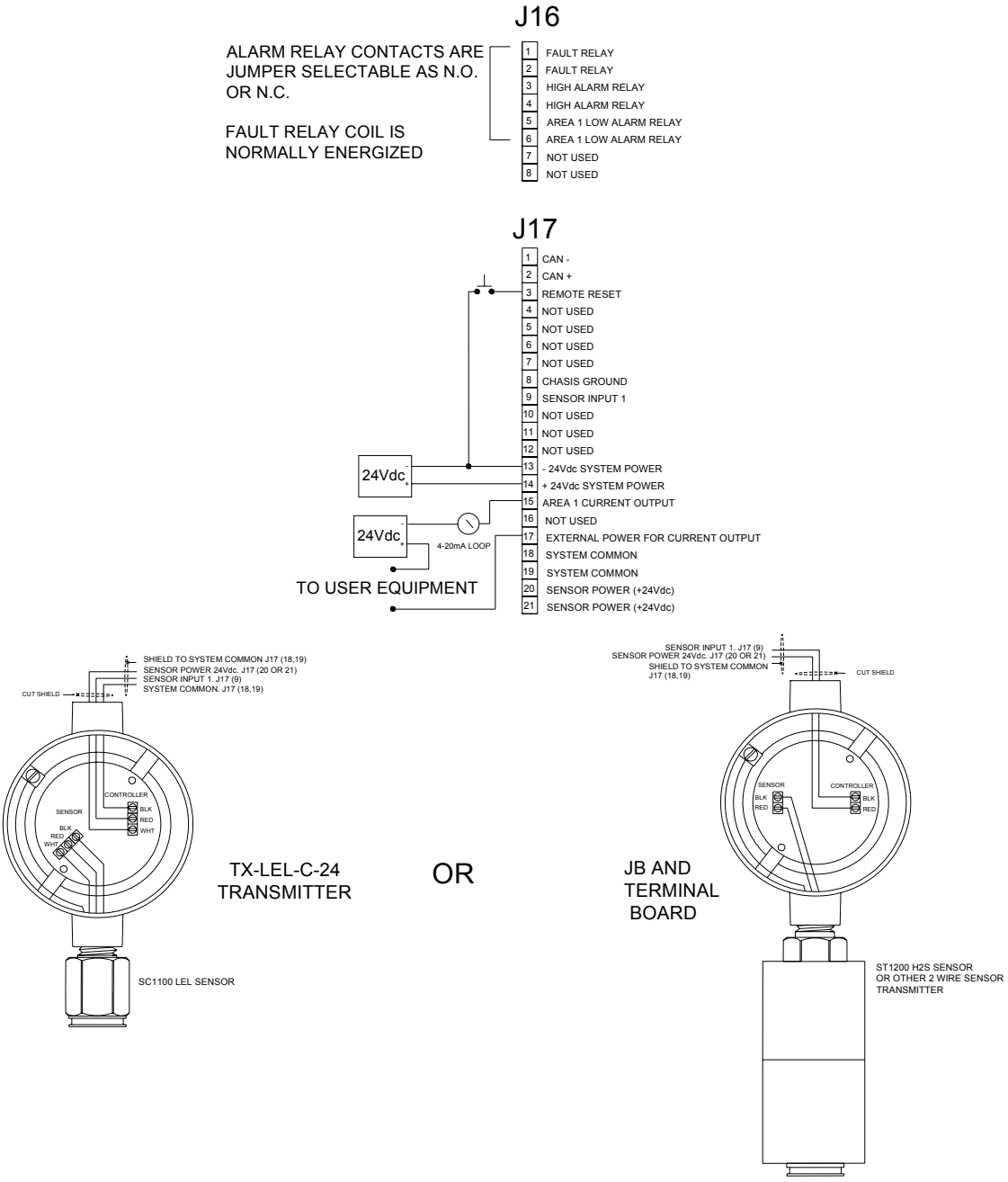

Figure 4b - Wiring for R1G with Isolated Current Output