



TGAES Open Path Combustible Gas Detector Operating Manual

820-0007 R01



ESP SAFETY INC

Technology of the Future...Protection for today

TGAES Open Path Combustible Gas Detector Operating Manual 820-0007 R01

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It is important that this entire manual be thoroughly read and understood prior to installing or operating the TGAES. Any deviation from this manual may impair system performance and compromise safety.

Introduction

The TGAES is an open path (line-of-sight) gas monitoring apparatus that senses the presence of combustible gas or vapor concentrations in air in the range of 0-5.0 LEL•meters over a distance of 5 to 200 meters.

The function of the TGAES is to provide an alarm, the purpose of which is to give warning of the possible presence of potentially flammable concentrations of gas or vapor. ***The device is NOT intended for use as 1) a laboratory or scientific instrument for analysis or precise measurement, 2) an apparatus for process control and monitoring, or 3) an apparatus for residential use.***

The TGAES consists of a transmitter module (TGAES TX) and a receiver module (TGAES RX). The explosion proof, stainless steel housing of the TGAES detectors allows for the devices to be used in Type 1 and Type 2 classified areas. The TGAES can be used as a stand-alone detection system or as a component of a Fire & Gas System, Emergency Shutdown System, or other integrated process controls.

The TGAES is capable of detecting most hydrocarbon gases and vapors including methane, propane, butane, propylene and others. No direct electrical connection between the two modules is required. In some applications, one TGAES detection system can provide protection equivalent to as many as eight to twelve point detectors.

Features and Benefits

- Standard system outputs include 4-20mA and RS-485 MODBUS RTU serial communication and dry contact relays for Alarm & Fault signals
- Detects methane and most common hydrocarbon gases including ethane, propane, butane and propylene with equal sensitivity
- Detection range of up to 200m
- T90 less than 10 seconds
- Corrosion-resistant 316 stainless steel enclosure
- Operating temperature range: -40° F to 140° F (-40°C to 60°C)
- Heated optics protect against condensation and icing
- Tri-color status LED or full graphical indication w/ ESP Field Control Unit (Vector or SSS-903)
- Primary heater protects the optics from ice and the secondary heater protects the internal electronics
- Able to operate even when obscured by fog, rain, dust, snow, or blowing sand
- On site zero calibration with magnetic wand and TGAES configuration software
- Onboard memory provides recording of operational data and device functions including factory settings and gas readings

Applications

The TGAES system is designed for installation in hazardous areas where combustibles and flammables are both present and require immediate and accurate detection. Typical applications include:

- Drilling and production platforms
- Fuel loading facilities
- Refineries, bulk terminals, and tank farms
- LNG/LPG processing and storage facilities
- Compressor stations and pipeline facilities
- Petrochemical, paint, and fertilizer plants
- Power plants and gas turbine facilities
- Aircraft hangars

Our Mission

ESP Safety, Inc.'s mission is to provide complete turn-key protection solutions beginning with the design stage, through system installation and commissioning, and on-going field service in hazardous environments. Our line of industry-leading products, services, and systems benefits society, saves lives, and preserves capital resources.

ESP Safety, Inc. Contact Information

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2.0 Description**Principle of Operation**

The TGAES monitors levels of combustible gases or vapors, in ambient air, by measuring the spectral absorption by the gases or vapors between the transmitter and receiver modules. Measurement of the combustible gas absorption is performed in the infrared (IR) regions of the electromagnetic spectrum. The transmitter module illuminates a direct linear path ending at the receiver module. As flammable hydrocarbon gases intersect the light beam between the two modules, certain IR wavelengths are absorbed by the gas while other IR wavelengths are not. A pair of optical detectors and associated electronics located in the receiver module measures the absorption for both the active wavelength and the reference wavelength. The ratio of absorption between the active and reference wavelengths determines the amount of gas intersecting the beam along its entire length. A microprocessor computes the gas concentration and converts the value into a 4-20mA signal and MODBUS RTU register value.

Transmitter TGAES - TX

The flash source of the TGAES transmitter is a highly reliable pulsed xenon lamp. The service life of the lamp is 950,000,000 flashes or 15 years of continuous operation at a flash rate of 2 Hz.

The beam angle over a distance of 200 m results in a beam diameter of 1.5-2 meters at the TGAES receiver (Fig 2.1). The high efficiency and the wide beam allow for ease of adjustment of the system and immunity to minor misalignment

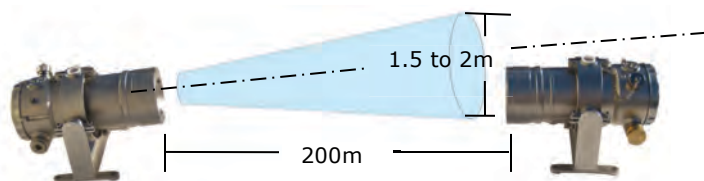


Figure 2-1: Functionality during Off-Center Alignment

Receiver
TGAES - RX

The TGAES receiver collects and processes the IR energy from the transmitter. The energy is measured at two distinct channels. The first channel measures energy in the gas absorption wavelength (referred to as the *Working Channel*). The second channel measures energy in a wavelength unaffected by hydrocarbon gases (referred to as the *Reference Channel*). Both channels are subject to ambient conditions such as temperature, moisture, dust, etc. Therefore, the only variance between the two channels is limited to the gas absorption. Furthermore, filter algorithms reduce or eliminate false alarms.

Because of the varying distance between the receiver and transmitter (path length), the resulting gas concentration is expressed in terms of LEL•m (See Figure 2.2). The LEL•m digital value is converted into a 4-20 mA current signal proportional to the chosen measurement range (Range). In addition, two alarm and one fault relays and digital RS-485 MODBUS signal outputs are standard with the TGAES system.

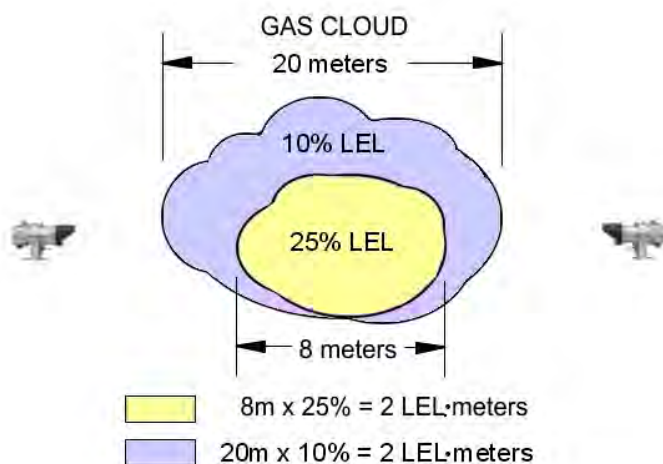


Figure 2-2: LEL•meter

The units of measurement and range of the TGAES detector are a mathematical integral of the gas concentrations along the optical path. The units of measurement are expressed as full concentration of the lower explosive limit (100% LEL or 1 LEL) multiplied by the distance (in meters) at that concentration (e.g., LEL•meter)

Gas Selection

The TGAES system is able to detect gas concentrations for a majority of hydrocarbons including methane, ethane, propane, butane, propylene, ethylene and others. The gas type may be selected from a list of pre-programmed gases either through ESP Safety's PC-based configuration software.

The standard calibration gases for the TGAES system are methane and propane.

The default sensitivity range of the TGAES system is 0-5 LEL•m. The sensitivity of the TGAES system can also be adjusted for 0-1.0 LEL•m and 0-2.5 LEL•m.

When switching between the selectable gases that have been factory-programmed into the gas detector, no additional calibration is required. Conversion factors will adjust for the selected gas.

3.0 Specifications






Operational Characteristics	
Detected Gases	Methane, Propane, Ethane, Butane, Isobutane, Pentane, Cyclopentane, Propylene, Hexane, Methanol, Ethanol, other combustible gases including complex hydrocarbons. (The target gas is factory-configured according to customer request.)
Gas Detection Range Settings	0 to 1 LEL•m 0 to 2.5 LEL•m 0 to 5 LEL•m (factory default setting)
Accuracy	±.25 LEL•m or 10% of the applied gas concentration, whichever is greater
Response Time	T90 < 10.0 seconds
Humidity Range	up to 100%, non-condensing
Measuring Distance	15 ft to 650 ft (5m to 200m) * A set of apertures, mounted on the transmitter, is provided for operation at distances less than 60m
Temperature Range	Operating temperature: -40° F to 140° F (-40°C to 60°C)
Ingress Protection	IP66
Warm Up Time	Time from power-up to operational state: Transmitter: 5 Seconds Receiver: 15 Seconds
Self-testing	Transmitter self-testing: 2x/sec, Receiver self-testing: 2x/sec.
Real-Time Clock & Non-Volatile Memory	The TGAES receiver and transmitter have real time clock (RTC) and nonvolatile memory for up to 16,000 pages. Each page saves a single screenshot containing all the current system operational conditions data complete with time/date stamp for the following events: <ul style="list-style-type: none"> - Power on - alarm - failure - beam blocking - disrupted temperature conditions - power disruption History can be accessed with ESP Safety's PC-based TGAES programs.

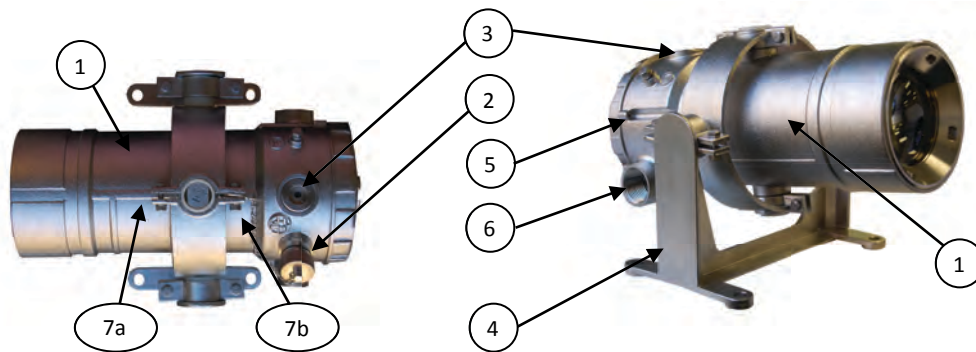
Calibration	<p>Manufacturing calibration – methane and propane up to 5 LEL.m. Calibration of the range is not required in the field. Zeroing can be performed in the field by using one of the following ways:</p> <ul style="list-style-type: none"> - via a magnetic wand - via PC and TGAES Software using MODBUS RTU protocol
Optics Heating	The optics heater maintains a temperature 25°C higher than the ambient temperature.
Mean Time Between Failures, minimum	35,000 hours

Electrical Characteristics	
Input Voltage	+24VDC Nominal (+18 to 32VDC)
Power Consumption, Maximum (w/ Optics Heating ON)	<p>Transmitter 15.0W @ 24V DC Receiver 15.0W @ 24V DC</p>
Output From TGAES (receiver unit)	<p>+4-20mA industry standard analog Digital RS-485 MODBUS RTU 3 relays:</p> <ul style="list-style-type: none"> • 2 User Programmed Alarm Relays • 1 Fault Condition Relay • All Relays Contact Rating 1Amp 60VDC
Alarm Relays	<p>2 User Programmed Alarm Relays 1 Fault Condition Relay</p>

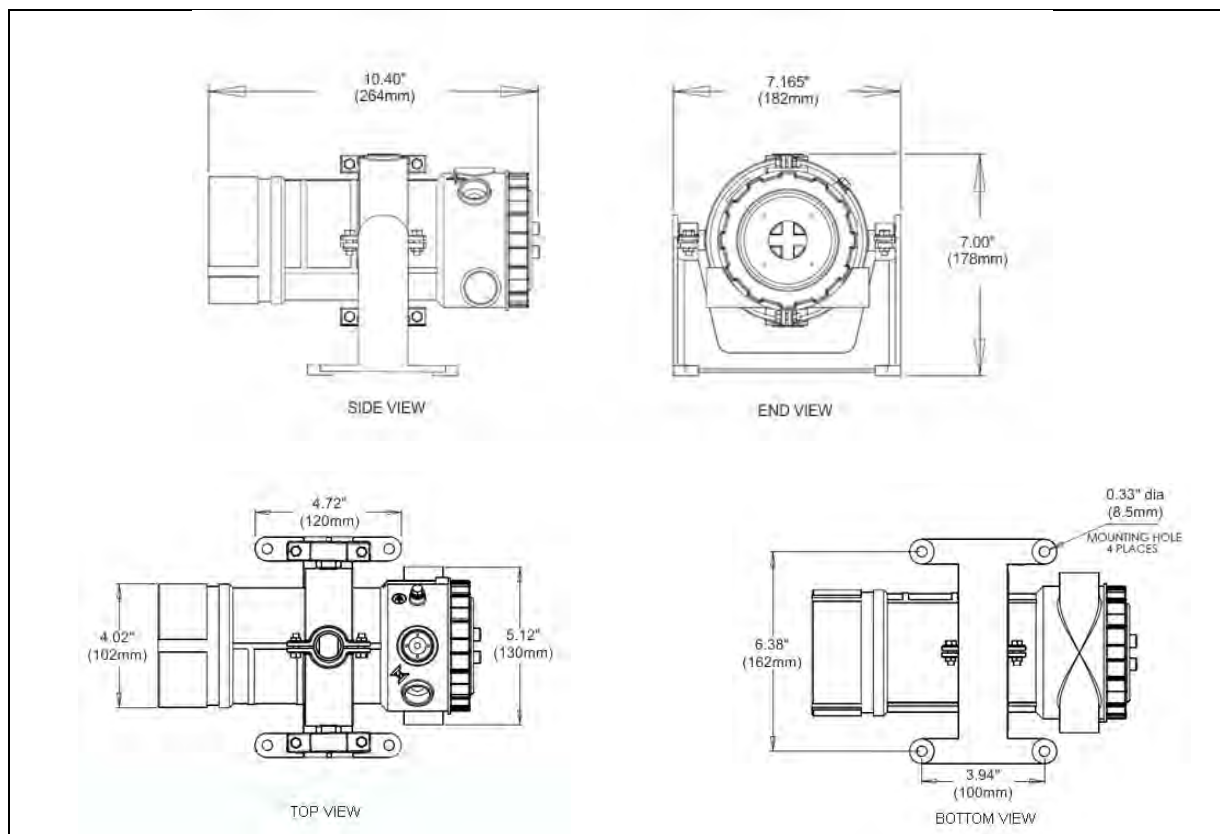
Mechanical Characteristics	
Material of Construction: TGAES transmitter & receiver housings and associated mounting brackets	Stainless Steel Type 316
Cable Entry	2 Cable Entries ¾" NPT
Weight With Bracket	16.5lb (7.5kg), each module
Physical Dimensions	10.43" x 6.96" x 7.17" (262mm x 176mm x 182mm)
Optics Protection	The lenses are protected from rain and wind by a weather hood (supplied).

Certifications

	<p>Explosion-proof for Class 1, Zone 1, Group B, C, D (T4) Hazardous (classified) locations per FM 3600, 3615, 6325; CSA C 22.2 # 0.4, 0.5, 30, 157, 1010-1 and Ex d [ib] IIC T4 per CSA E 60079-0, CSA E 60079-1, CSA E 60079-11;</p> <p>Dust ignition-proof for Class I, Zone 1, Group B, C, D Hazardous (classified) locations per FM 3615, 6325; CSA C 22.2 # 25;</p> <p>Non-incendive for Class 1, Zone 1, Group B, C, D (T4), Class 2, Div.2, Group E, F, G (T4) Hazardous (classified) locations per FM 3610; CSA C 22.2 # 213; Performance verified in accordance with FM 6325; CSA C 22.2 # 152;</p>
<p>ATEX IEC </p> <p>94/9/EC</p>	<p> CE 0470 II 2 G</p> <p>Ex d [ib] IIC T4 (T_{amb} 60°C)</p> <p>IP 66</p>
	<p>Ex d [ib] IIC T4</p> <p>(T_{amb}: 60°C)</p> <p>IP 66</p>
	<p>Ex d [ib] IIC T4 Gb</p> <p>T = -60°C to 70°C</p> <p>IP 66</p>
<p>EN Standards</p>	<p>EN 60079-0: 2006; EN 60079-1: 2007</p> <p>EN 60079-11: 2007; EN 60079-29-4: 2010</p> <p>EN 61779-1: 2000</p> <p>EN 60529: 1991+A1: 2000; EN 50270: 2006.</p>

TGAES Components

- | | |
|---------------------|--|
| 1. Detector Housing | 6. Cable Entry |
| 2. * | 7. Magnetic hull switch location when setting up the receiver (7a) or transmitter (7b) modules using the magnetic wand |
| 3. 3-color LED | |
| 4. Mounting Bracket | |
| 5. Locking Screw | |

Dimensions

4.0 Safety Considerations

Guidelines



Before installing and operating the TGAES Open Path Combustible Gas Detector, be sure to read this entire manual. Failure to follow these guidelines could result in impaired product performance and safety hazards.



The TGAES System does not have any user-serviceable parts. Do not try to repair the TGAES if it is damaged or in need of service. Repair should only be performed by ESP Safety, Inc., or ESP certified technicians.



Any unauthorized service or repair of the TGAES System by personnel not hired or appointed by ESP Safety, Inc. will void the product warranty and the user assumes all responsibilities for the proper functioning of the TGAES System.

For maximum safety:

- Only persons who have thoroughly read and understood this manual, are trained in safety techniques, and have electric-safety certificates are permitted to install and operate the TGAES Open Path Combustible Gas Detector.
- Never operate the TGAES if the casings to either the transmitter or receiver are damaged.
- Do not separate the TGAES detector units when energized.
- Refer to the Appendices and diagrams in this manual to ensure that the wiring is in compliance with local ordinances and the NEC.
- Perform regular testing and maintenance as outlined in the Maintenance section.
- Ensure that fire-alarm and fire-extinguishing systems and controls are switched off before any testing or maintenance to avoid unwanted operation of alarms and fire-extinguishing equipment.

Also see the individual sections in this manual for relevant specific safety guidelines.

Explosion Protection Means

The table below describes design features that protect the TGAES against explosions. Additional details are shown in Appendix C:

Feature	Protection Means
<i>Enclosure of Current Carrying Parts</i>	The casing includes spigot joints with controlled gaps to meet explosion-proof requirements for installation in Class I, Division I, Group B, C and D, and T4 locations.
<i>Case Mechanical Strength</i>	The high mechanical strength of the case is able to withstand high explosive pressures without rupture or failures of mechanical parts. The case design is in accordance with FM 3600 and FM 3615.
<i>Manufacturing Control Of Casing</i>	Refer to Appendix A1 for manufacturing details. Important parameters include: <ul style="list-style-type: none"> • Maximum width and minimum length of spigot joints • Surface roughness of the joined parts • The number of complete intact threads at the conduit entry point
<i>Ignition Temperature</i>	The ignition temperature of the surrounding environment is limited by the outside surface temperature of the housing, which does not exceed 275°F (135°C).
<i>Securing of Bolts, Joints and Grounding</i>	Spring washers, lock washers, and lock nuts maintain the integrity of the bolted connections by preventing loosening of the bolts.
<i>Joined Parts Protection</i>	Anti-seize lubricant is applied on the critical joints as described on Appendix A1.
<i>Casing Ingress Protection</i>	The design of the casing is protection class IP 66 in accordance with IEC 60529-004.
<i>Sealing Cables at Conduit Entry</i>	Use approved hazardous location sealed conduit fittings. For outdoor installations, ensure sealing meets IP66 requirements.

5.0 Installation**Important Safety Information**

Be sure to read and understand the entire instruction manual before installing or operating the gas detector.

The products described in this document can be used with a variety of ESP-Safety gas detector models to provide early warning of the presence of a toxic or explosive gas mixture. Proper device installation, operation, and maintenance is required to ensure safe and effective operation. If this equipment is used in a manner not specified in this manual, safety protection may be impaired.

Preparation for Use

The TGAES transmitter and receiver units are packaged in separate boxes allowing for shipment via air or ground transportation.

Unpacking

Unpacking of the TGAES gas detector system:

1. Carefully remove or cut the tape that seals the shipping box and open the top of the box.
2. Remove the foam packaging material from the box.
3. Carefully remove the detector module from the box.

Unit Components

Following is a list of items included in the delivery set for the TGAES Open Path Combustible Gas Detector:

1. One (1) Transmitter (TGAES TX) & One (1) Receiver (TGAES RX) with associated mounting brackets and protective hoods (visors)
2. Optical test filter
3. Magnetic Wand
4. Cable Gland Assembly (1 set for RX, 1 set for TX)
5. Aperture Set
6. PC-based Configuration Software
7. Operating Manual

Inspect for Damage from Transit

1. Key items to inspect when removing the TGAES units from their boxes:
 - a) Inspect the TGAES unit housing and the optical lens for damage. Ensure that all bolts and screws are in place.
 - b) Inspect all threaded surfaces for damage or paint overspray (if applicable)
 - c) Ensure that all accessories detailed in the packing list are included and undamaged.

If detector housing is damaged, or there are missing items, please contact ESP Safety, Inc. for further assistance.



To ensure proper installation and power/signal wiring layout, detailed plans and specifications showing the placement of the TGAES, including mechanical & electrical design shall be completed prior to installation and provided to installer prior to installation.

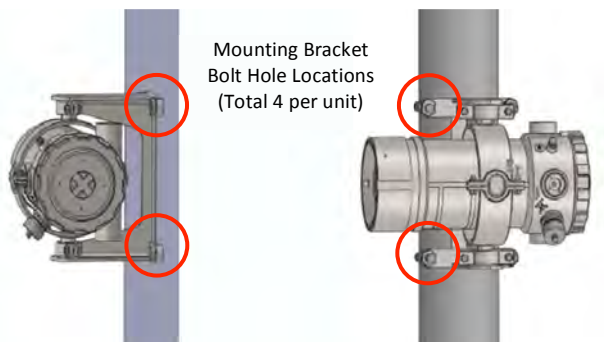
Mounting

STEP 1: At their respective mounting locations, orient the transmitter and the receiver so that they are facing one another.

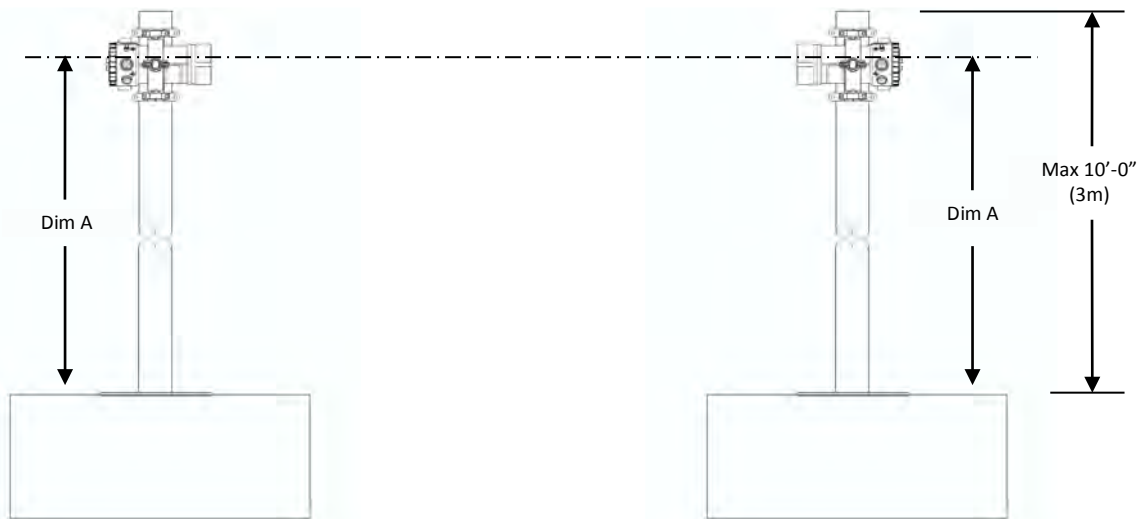


Note: When installing more than 1 set of TGAES detectors, ensure that each receiver obtains only the signal from its paired transmitter.

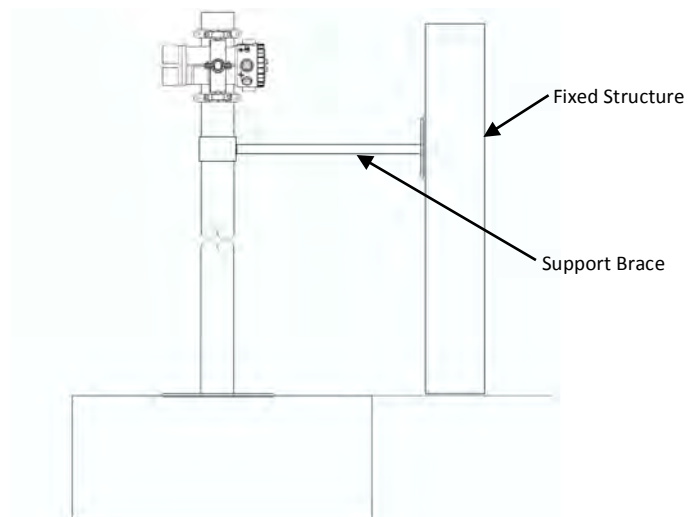
STEP 2: Secure the TGAES mounting brackets to the mounting surface or posts. Do not fully tighten to allow for elevation adjustment of the receiver and transmitter units. When mounting the TGAES units on poles, use the ESP Safety-supplied u-bolts.



STEP 3: Adjust the mounted elevations of the transmitter and receiver so that they are equal distances above grade.



Proper operation of the TGAES requires that the receiver and transmitter units be mounted on stable surfaces that allow for a continuous beam path. When mounting the TGAES on posts, standoffs or stabilizing braces are recommended.



Wiring

Power Requirements

The TGAES gas detector requires 24 VDC power.

The TGAES system has a power draw of 6 Watts in an active alarm state with all relays active (Fault, Alarm1, Alarm2). Select a power supply with adequate capability for the calculated load. The minimum voltage required is 18 VDC for the TGAES to function properly.

Cabling Guidelines

If installing connection cables in an explosion proof conduit, do not use the same conduit to carry wiring for any other purpose or equipment.

Minimum 14 AWG (2.08 mm²) shielded cable conductors are required for optimal performance. The gauge of the wire used determines the maximum distance between the 24VDC (18-32 VDC) power source. REFER TO APPENDIX B WIRE SIZE CHART

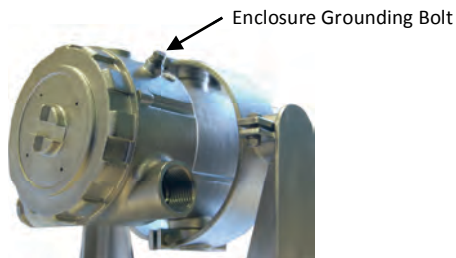
When using Modbus, twisted pair wiring is required for both the power and signal wires. Each pair must be shielded to eliminate electromagnetic interference.



WARNING: System ground must be provided at the point of origination for 24 VDC. Failure to do so may result in loss of range and/or signal integrity. Avoid low frequency, high voltage, and non-signaling conductors to prevent EMI

Grounding

The enclosures of the TGAES system must be earthed/grounded for electrical safety and to limit the effects of radio frequency interference. An earth/ground point is provided on the outside each of the TGAES units' explosion proof enclosures.



Loosen the nut sufficiently to enable wrapping of the wire or wire terminated with a crimped lug around the thread in a "U" shape. Raise the flat and lock washers and place the wire between the 2 flat washers and ground base.

Wire Section and Maximum Length

Refer to APPENDIX B: WIRE SIZE CHART

**Electrical
Connections**

Remove the TGAES gas detector from the shipping container and inspect the equipment for completeness and any visible damage per the Unpacking and Inspection procedures detailed in the Operating Manual.

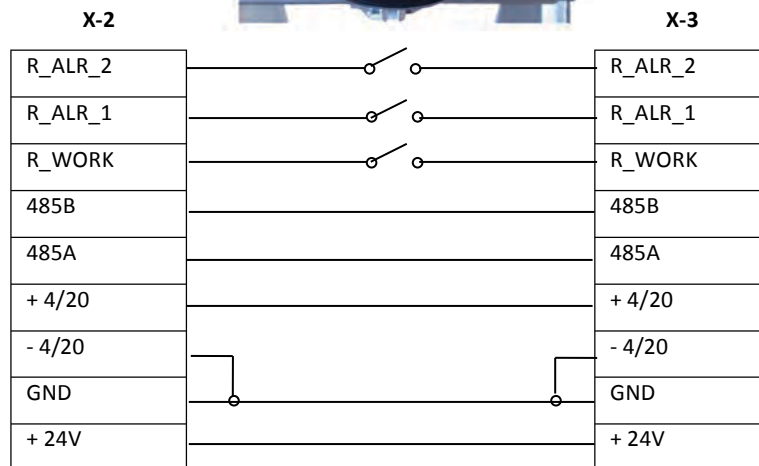
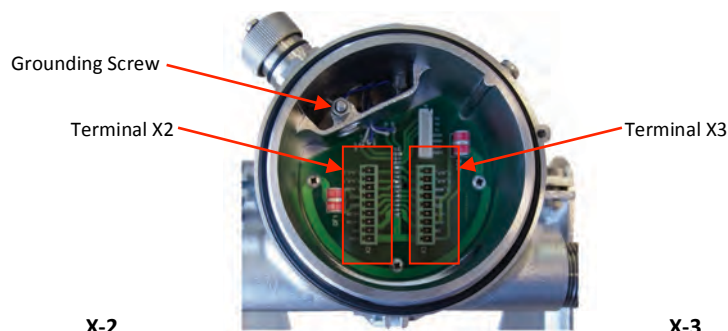


Table of Terminal Connectors & Functions for the TGAES Receiver and Transmitter

X-2	
LABEL	FUNCTION
R_ALR_2	Connector 1 Alarm relay 2
R_ALR_1	Connector 1 Alarm relay 1
R_WORK	Connector 1 Work relay
485B	RS485-
485A	RS485+
+ 4/20	Current output +
-4/20	Current output -
GND	Minus power supply
+ 24V	Plus power supply 24V

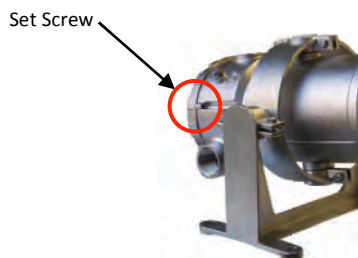
X-3	
LABEL	FUNCTION
R_ALR_2	Connector 1 Alarm relay 2
R_ALR_1	Connector 2 Alarm relay 1
R_WORK	Connector 2 Work relay
485B	Backup
485A	Backup
+ 4/20	Backup
-4/20	Backup
GND	Backup
+ 24V	Backup



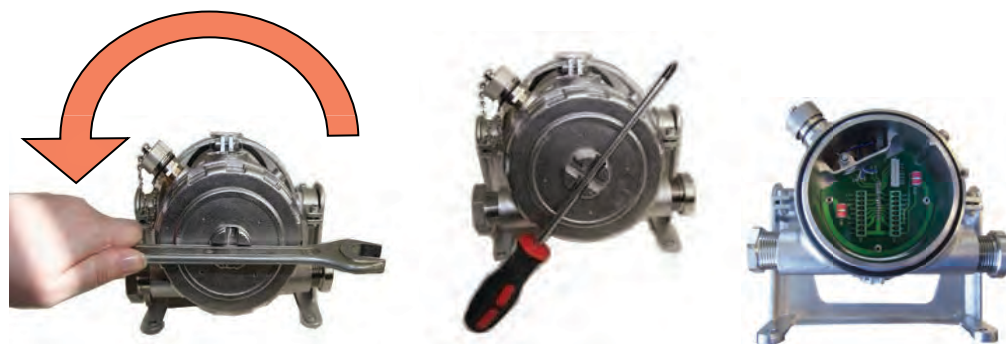
WARNING: The connections labeled "GND" are not for earth grounding. The earth grounding termination is a screw connection on the side of the detector housing.

STEP 1: Remove Protective Cover

Loosen the set screw of the rear cover with a Phillips head screwdriver.



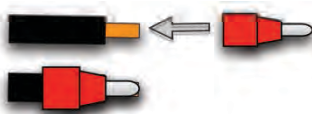
Using the edge of a box-end wrench, screwdriver or solid steel rod, loosen the TGAES end cap counter-clockwise and remove to expose the wire connection terminals.



STEP 2: Wire Preparation

Use a stripping tool for the selected wire gauge to remove ¼-inch (6mm) of the insulating jacket for each conductor to be inserted in the terminal blocks of the Connector PCBA.


Shielded 14 or 16 AWG Stranded wire
(Recommended) based on cable length

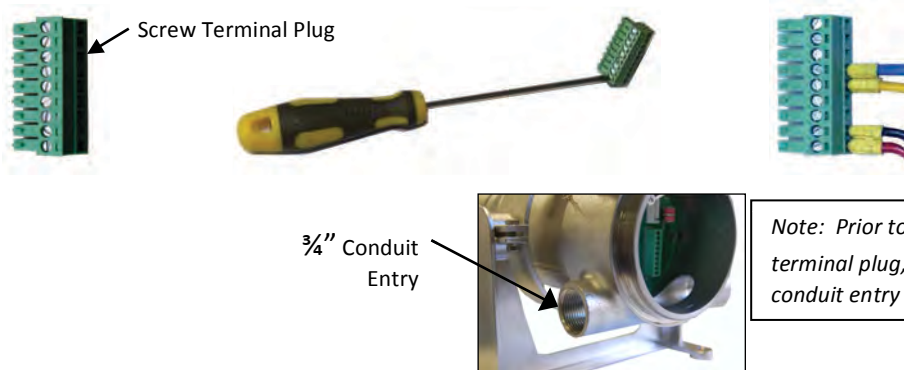

6mm Insulated Crimp-On Ferrule

Note: ESP safety recommends a Ferrule that is crimped onto the wire for better connectivity and ease of insertion into the terminal block.

STEP 3: Electrical Connections

Separate the screw terminal plug from the screw terminal header.

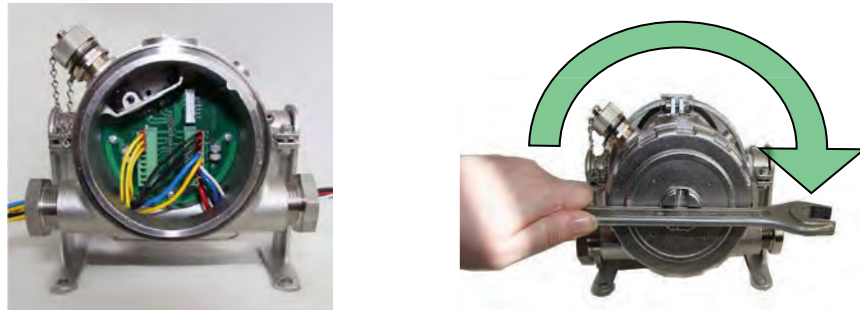
Use a flathead screwdriver to unscrew the appropriate contacts on the removable terminal plug and wire the power supply. Secure the wires by tightening the screws.



For wiring the 4-20mA, RS-485 MODBUS RTU and/or the relay outputs, use the screwdriver to unscrew the appropriate connector pins on the removable terminal plug. Refer to the Terminal Block Legend (above) for X2 & X3 connector assignments.

STEP 4: Replace Screw Terminal Plugs & Secure Cover

Re-attach the screw terminal plugs to the screw terminal headers on the PCBA.



Replace the TGAES threaded rear cover. Tighten with a wrench or a screwdriver enough to seal the O-ring. Secure by tightening the set screw.

6.0 Setup and Alignment

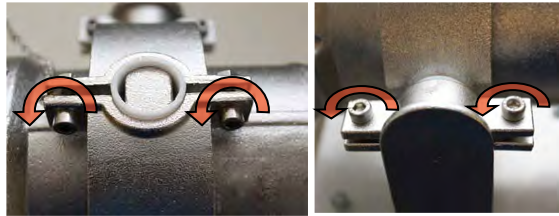


WARNING: Prior to setup and alignment of the TGAES System, ensure that the TGAES detector is offline from any alarming devices connected to the detector signal outputs.

Rough Alignment

The TGAES transmitter and receiver units must be properly aligned during the installation process before normal operation can be attained.

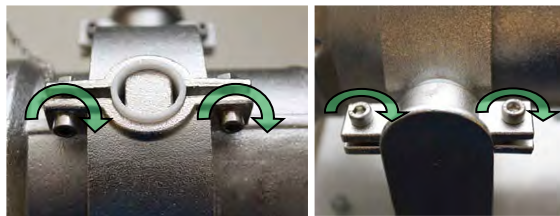
STEP 1: Loosen the screws of the positional alignment system of the transmitter and receiver modules.



STEP 2: Visually align the receiver and transmitter units as well as possible. Confirm the optical path is free from obstructions.



STEP 3: Tighten the screws of the positional alignment system. Do not overtighten.



Fine Alignment

The alignment procedure requires a user-supplied Windows-based PC with pre-installed ESP Safety, Inc. TGAES RX software (included). An intrinsically safe, EX-rated PC is required for calibration in classified locations using RS-485 communications.

Note: For more information about the TGAES RX program please refer to the Software section of the Operating Manual.

Ensure that the TGAES transmitter and receiver units are at least 16 ft (5m) apart, but do not exceed the maximum 650 ft. (200m) optical path length and that they are securely mounted. Prior to performing the alignment procedure, bypass all external alarm devices that are connected to the unit's outputs.

TGAES Alignment and Calibration Methods

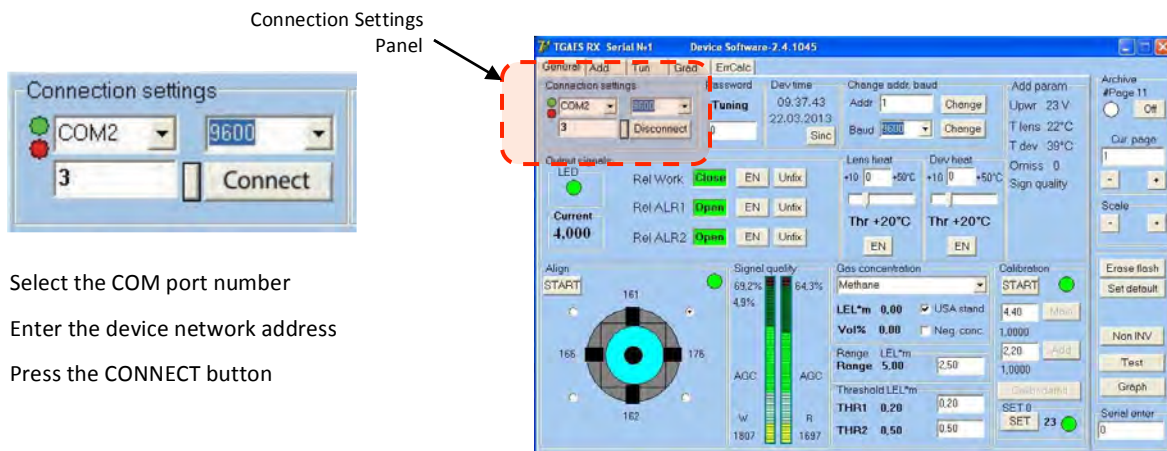
Method	Required Equipment	Note
RS-485	PC w/ Windows RS-485 to USB Converter TGAES Software	Not Ex-rated Max 19200 baud rate High functionality
Current Loop	Ex-rated PC w Windows Ex-rated HART to USB Converter TGAES Software	Intrinsically safe Max 1200 baud rate High functionality

Fine Alignment using TGAES Software

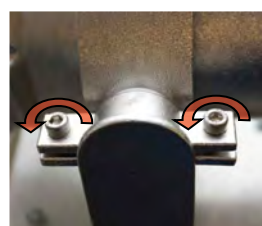
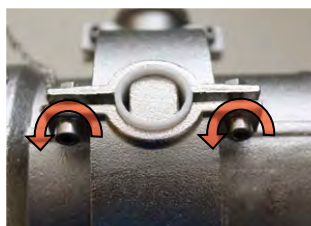
STEP 1. Connect a PC with Windows and the pre-installed TGAES software to the TGAES receiver unit.

**Method 1: RS-485****Method 2: Current Loop**

STEP 2. Turn on the power to the TGAES transmitter and receiver units

STEP 3. Start the TGAES program on the PC to establish a connection with the receiver unit.**STEP 4: Begin Fine Tuning Adjustments**

1. Loosen the positional adjustment screws on the TGAES receiver unit



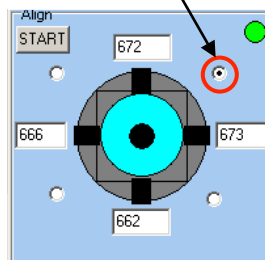
2. Locate the Alignment Panel on the TGAES program screen

Alignment Panel



Ground Screw Position Indicator

3. Select the proper quadrant for the ground screw location, as viewed from the rear of the TGAES receiver unit



Ground Screw

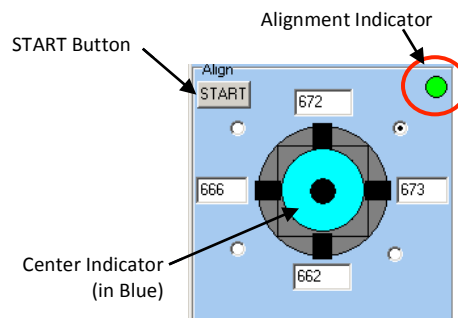


Note: It is CRITICAL that the Ground Screw Position indicator on the TGAES alignment software corresponds with the orientation of the ground screw on the TGAES receiver unit, as viewed from the rear.

Content outdated and removed. Page left as placeholder for upcoming redesign

STEP 5: Fine Tuning Adjustments

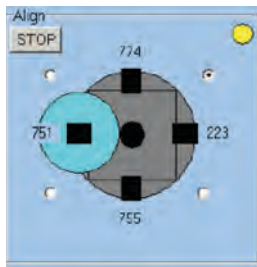
4. Press the START button on the Alignment Panel
5. Begin moving/rotating the receiver unit in small increments until the Center Indicator (blue circle) is centered on the crosshairs.

**ALIGNMENT INDICATOR**

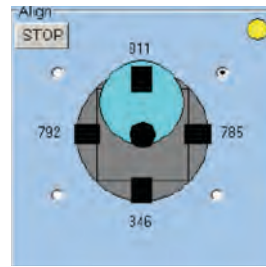
SOLID YELLOW:
Adjustment Required

SOLID GREEN:
Centered. No
adjustment necessary

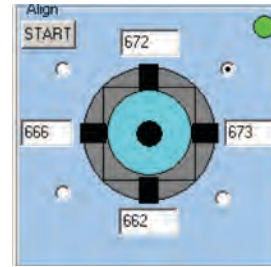
FLASHING (any color):
Unit in adjustment
mode



Example 1: Unit is oriented too far to the left. Correct by rotating to the right.



Example 2: Unit is tilted too far upward. Correct by rotating down.



Example 3: Unit is correctly centered.

STEP 6. Adjust Beam Signal Strength to 60-70%

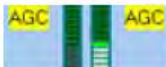
Beam Signal
Strength Panel

1. While still in Alignment Mode (flashing alignment indicator), locate the Beam Signal Strength panel on the TGAES program screen. The Beam Signal Strength Panel will most likely reflect a reading at or near 100%.
2. On the transmitter, install the appropriate size aperture (supplied) based upon the path distance.



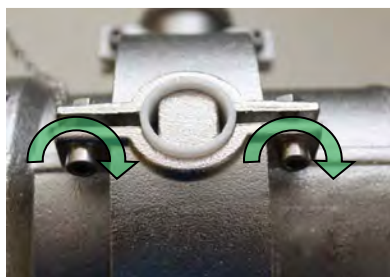
Aperture Hole Dia (mm)	Optical Path Distance (m)
1mm	5-10m
5mm	10-20m
10mm	20-30m
20mm	30-40m
40mm	50-60m

3. The signal level should read in the range of 30-95% after aperture installation.
4. If the signal level exceeds 70%, reduce the transmitter power using the TGAES program
5. If the signal level is below 60%, replace the aperture with the next larger opening size. Reduce the transmitter power until the signal level falls between 60% - 70%.
6. At distances of exceeding 60 meters an aperture is not required. At these distances, adjustments to the signal strength are performed by adjusting the transmitter power with the TGAES configuration software.

Beam Signal Strength			
Zone	Level in %	Level in mV	Description
Yellow	0 -10%	0 -250 mV	Very weak signal TGAES will not detect properly
Gray	10 -30%	250 - 750 mV	If the signal falls below 30%, the Automatic Gain Control (AGC) activates and the AGC indicator on the TGAES program screen will be highlighted in yellow. The TGAES will not detect properly. 
Green	30 - 95%	750 -2375 mV	Signal range at which the operation of all device characteristics is maximized. The ideal case is when the signal level is at 60-70%
Red	95 -100 %	2375 - 2500 mV	The analog-to-digital converter (ADC) has reached is saturation level. The TGAES will not detect properly.

STEP 7: Complete Fine Alignment Procedure

1. Confirm that the TGAES system is correctly centered and that the receiver signal level is between 60%-70%.
2. Tighten the positional alignment screws on the TGAES receiver



3. Press the STOP button on the Alignment Panel



4. Press the STOP button on the Alignment Panel. The Alignment Status Indicator will revert to SOLID GREEN.

7.0 Functional Testing & Zero Calibration

Functional Testing

Calibration parameters are written and stored onto the onboard memory of the TGAES system at the factory during configuration and calibration. Therefore, individual calibration of gas detectors with the aid of real gas mixtures during the installation and operation is not required.

However, it is necessary to perform an initial functional test of the TGAES system following installation as well as periodic functional testing and calibration of the detector.

To perform the functional test, ESP Safety, Inc. provides a set of optical test filters. The test filters simulate the presence of precise gas concentrations. The concentration range value is marked on each filter frame.



Optical Test Filters



WARNING: Prior to functional testing of the TGAES System, ensure that the TGAES detector is offline from any alarming devices connected to the detector signal outputs.

Functional Testing Procedure

- Step 1: Ensure that the optical path is free of any gas that may be detected
- Step 2: Place the optical filter on the receiver module of the TGAES gas detector.
- Step 3: Wait until the gas concentration reading stabilizes.
- Step 4: Compare the gas concentration readings with the concentration range value that is marked on the filter.

Factory Cal. Gas	TGAES MEASUREMENT RANGE (LEL.m)		
	0 - 1.0 LEL.m	0 – 2.5 LEL.m	0 – 5.0 LEL.m
Methane	Use Filter PT-1 Readings: 0.25 – 0.65 LEL.m	Use Filter PT-2 Readings: 0.85 – 1.55 LEL.m	Use Filter PT-3 Readings: 1.55 – 2.40 LEL.m
Propane	Use Filter PT-1 Readings: 0.65 – 1.00 LEL.m	Use Filter PT-2 Readings: 1.50 – 2.00 LEL.m	Use Filter PT-3 Readings: 2.35 – 3.55 LEL.m

If the gas detector concentration readings are not in the test filter concentration range, clean the optical surface of the detector units and repeat the functional test.

If the detector gas concentration readings still are not in the test filter concentration range, the TGAES gas detector has to be recalibrated using the optical filters and the TGAES software.

Zero Calibration

Even though a regular calibration of the gas detector TGAES usually is not required, the device supports an option of performing zeroing in the field.

Zeroing should be conducted every time the TGAES is relocated.

Zeroing and sensitivity control of the TGAES should be performed if the gas measurements during the Functional Testing are outside of the expected ranges.

Field Zero Calibration using TGAES Software

STEP 1. Connect a PC with Windows and the pre-installed TGAES software to the TGAES receiver unit.



RS-485 to USB
Converter



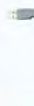
R_AIR_2
R_AIR_3
R_WORK
485B
485A
+ A/20
- A/20
GND
+ 24V



Method 1: RS-485



HART to USB
Converter



DECLASSIFIED AREA

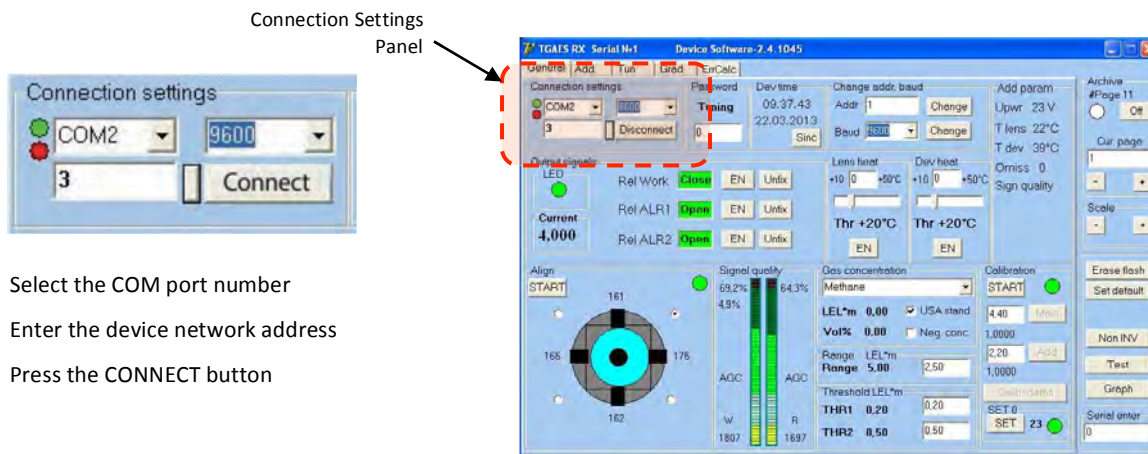
CLASSIFIED AREA



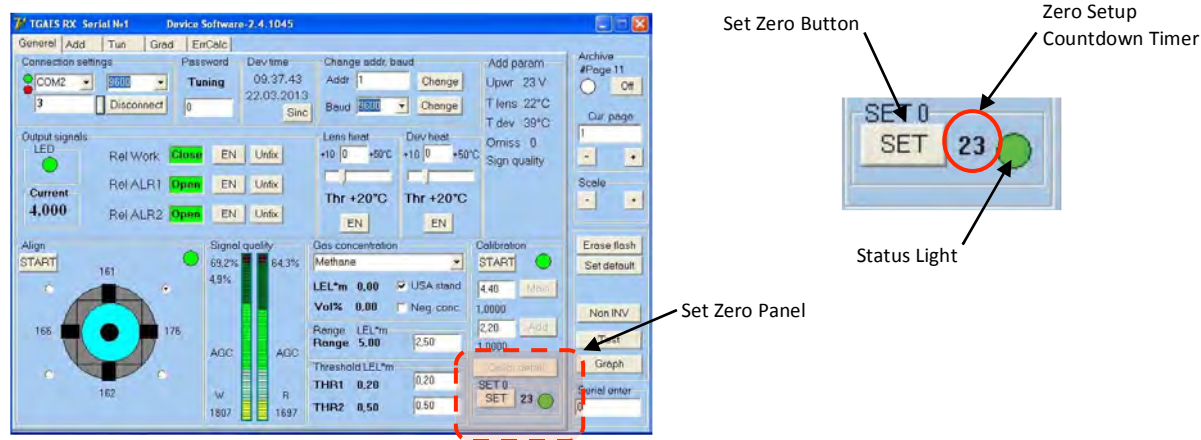
Method 2: Current Loop

STEP 2. Turn on the power to the TGAES transmitter and receiver units

STEP 3. Start the TGAES program on the PC to establish a connection with the receiver unit.



STEP 4: Ensure that the optical path is free of any gas that may be detected.



1. If the device is working properly and the readings are normal for zero gas conditions, click the "SET" button on the Set Zero Panel of the TGAES RX program.
2. The status light will display FLASHING YELLOW denoting that the zeroing process has initiated. The timer showing the number of seconds remaining for the zeroing process to complete will begin to count down. When the countdown reaches zero, the device returns to Operational status and the status light will revert to SOLID GREEN indicating that zero calibration is completed.

8.0 Troubleshooting

The TGAES gas detector troubleshooting procedure may require the following tools and materials:

- Set of screwdrivers
- Set of HEX keys/Allen wrenches
- Multimeter
- A small bottle of isopropyl alcohol
- Clean cotton cloth
- Regular Windows XP based PC or laptop
- RS485 to USB or RS232 converter.

TRANSMITTER UNIT: If the lamp does not flash every ½ second	RECEIVER UNIT: If the LED does not light up
<p>Check the power supply.</p> <p>If power supply is not working, replace it.</p> <p>If power supply is working, unscrew the removable protective back cover and connect the minus probe of the voltmeter (black wire) to the GND terminal and connect the plus probe (red wire) to the +24 Terminal - Measure the voltage.</p> <p>If the reading is 18-30 volts DC:</p> <p>Check the voltage on the Terminal Blocks. Check the voltage between GND & RS485B, between GND & RS485A. If voltmeter reads over 5 volts, remove the wire from that terminal & determine the source of the voltage. Check voltage between GND 4-20. If over .5 volts, determine the source of the voltage. If the normal working state is not restored, the device may need to be replaced.</p> <p>If the reading is <u>not</u> 18-30 volts DC:</p> <p>Confirm the correct power supply is in use and is working properly. If the normal working state is not restored, the device may need to be replaced.</p> <p>If the reading is negative change the polarity.</p>	<p>Check the power supply.</p> <p>If power supply is not working, replace it.</p> <p>If power supply is working, unscrew the removable protective back cover and connect the minus probe of the voltmeter (black wire) to the GND terminal and connect the plus probe (red wire) to the +24 Terminal - Measure the voltage.</p> <p>If the reading is 18-30 volts DC:</p> <p>Check the voltage on the Terminal Blocks. Check the voltage between GND & RS485B, between GND & RS485A. If voltmeter reads over 5 volts, remove the wire from that terminal & determine the source of the voltage. Check voltage between GND 4-20. If over .5 volts, determine the source of the voltage. If the normal working state is not restored, the device may need to be replaced.</p> <p>If the reading is <u>not</u> 18-30 volts DC:</p> <p>Confirm the correct power supply is in use and is working properly. If the normal working state is not restored, the device may need to be replaced.</p> <p>If the reading is negative change the polarity.</p>

RECEIVER UNIT FAULT CONDITION

Fault Conditions	Actions
Low 24 Volts	24 VDC operating voltage is out of range. Verify proper wiring to the detector and correct voltage output from the power source. Power supply faults are self-clearing when the condition is corrected.
Low or No Signal	Check the power on the transmitter module. Check the optical clearance of the beam path. Clear the optical beam path if required. Dirty Optics. Perform cleaning procedure, then recalibrate as required. (Refer to "Maintenance" section for details) Check the alignment. Perform the alignment procedure if required. (Refer to "Alignment" section for details)
Temperature Fault	Check the temperature of the device and lens. Enable the heater (Refer to "Software Overview" for details)

TRANSMITTER UNIT FAULT CONDITION

Fault Conditions	Actions
Low 24 Volts	24 VDC operating voltage is out of range. Verify proper wiring to the detector and correct voltage output from the power source. Power supply faults are self-clearing when the condition is corrected.
No Flash	Check the power supply. If power supply is not working, replace it. Check the power on the transmitter module. If power is not working check the wiring and cable isolation.
Temperature Fault	Check the temperature of the device and lens. Enable the heater

9.0 Maintenance



WARNING: Prior to functional testing of the TGAES System, ensure that the TGAES detector is offline from any alarming devices connected to the detector signal outputs.

Maintenance Activities

The TGAES needs very little routine maintenance; but periodic checks for proper system function are strongly advised. The frequency of these checks should be determined by the specific installation.

Although the fault-detection circuitry continuously monitors for various problems, it does not monitor external response equipment or wiring. These devices must be checked periodically in the Normal mode to ensure proper functioning.

Periodic Maintenance

Typical maintenance activities to be performed on the TGAES

- Visual examination
- Cleaning of optical elements, if needed
- Performance test.

10.0 Transportation and Storage

Transportation

When shipped in the factory-supplied carton, the model TGAES Open Path Combustible Gas Detector can be shipped via any method of transportation from the manufacturer's site to any destination regardless of distance.

Storage

Until use, store the detector in the manufacturer's original carton. The storage facility should be free of dust, acid and alkaline vapors, corrosive gases and other harmful substances.

11.0 Repair and Return

Field Repair

The TGAES is not intended to be repaired in the field. If a problem should develop, refer to Section 8.0 Troubleshooting of this manual. Please return the device to the factory for repair or replacement.

**Return Material
Authorization (RMA)
Number**

Contact ESP Safety Inc. at +1-408-886-9746 to obtain a Return Material Authorization (RMA) number. Please provide the following information during your call:

- Your Company Name
- Product Type
- Serial Number
- Date of Shipment
- Brief explanation of malfunction

Pack the unit properly to ensure that no shipping damage occurs and ship to:

ESP Safety, Inc.

555 North First Street

San Jose, CA 95112 USA

Write the RMA number on the front of the shipping carton



ESP Safety, Inc. recommends that an inventory of spare detectors be kept on hand to enable rapid field replacement and minimize downtime.

12.0 Parts Ordering Information

The following items for the TGAES may be ordered:

Accessories:

Calibration Magnet (magnetic wand), P/N 611-0005

Optical Test Filters

Protective Visor (replacement)

Aperture Set

Cable Gland Assembly

Order from:

ESP Safety, Inc.

555 North First Street

San Jose, CA 95112

USA

Ph: 408-886-9746

Fax: 408-886-9757

Website: www.espsafetyinc.com

Email: info@espsafetyinc.com

Please note that shipping charges will be added to your order.

13.0 Warranties

ESP Safety, Inc. ("ESP") warrants the TGAES to be free from defects in material and workmanship under normal use and service for a period of three (3) years, beginning on the date of shipment to the buyer. This warranty extends only to the sale of new and unused products to the original buyer. ESP's warranty obligation is limited, at ESP's option, to refund of the purchase price, repair, or replacement of a defective product or a component thereof, to the extent that the product is properly returned to ESP within the warranty period.

This warranty does not include:

- a) fuses, disposable batteries or the routine replacement of parts due to the normal wear and tear of the product arising from use;
- b) any product or component which in ESP's opinion, has been misused, altered, abused, tampered with, improperly maintained or used, neglected or otherwise damaged by accident or abnormal conditions of operation, handling or use, or to have deteriorated due to aging of any component made of rubber or any other elastomer; or
- c) any damage or defect attributable to repair of the product by any person other than an authorized dealer, or the installation of unapproved parts on the product.

The obligations set forth in this warranty are conditional on:

- a) proper storage, installation, calibration, use, maintenance and compliance with the product manual instructions and any other applicable recommendations of ESP;
- b) the buyer promptly notifying ESP of any defect and, if required, promptly making the product available for correction. No goods shall be returned to ESP until receipt by buyer of shipping instructions from ESP. A return authorization number must be obtained from ESP prior to shipment; and
- c) all warranty returns being shipped directly to ESP Safety, Inc.;
- d) the right of ESP to require that the buyer provide proof of purchase such as the original invoice, bill of sale or packing slip to establish that the product is within the warranty period.

THE BUYER AGREES THAT THIS WARRANTY IS THE BUYER'S SOLE AND EXCLUSIVE REMEDY AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. ESP SHALL NOT BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES OR LOSSES. ESP WILL NOT BE LIABLE FOR LOSS OR DAMAGE OF ANY KIND CONNECTED TO THE USE OF ITS PRODUCTS OR FAILURE OF ITS PRODUCTS TO FUNCTION OR OPERATE PROPERLY. IN NO EVENT SHALL ESP'S LIABILITY HEREUNDER EXCEED THE PURCHASE PRICE ACTUALLY PAID BY THE BUYER FOR THE PRODUCT.

To the extent any provision of this warranty is held invalid or unenforceable by a court of competent jurisdiction, such holding will not affect the validity or enforceability of any other provision.

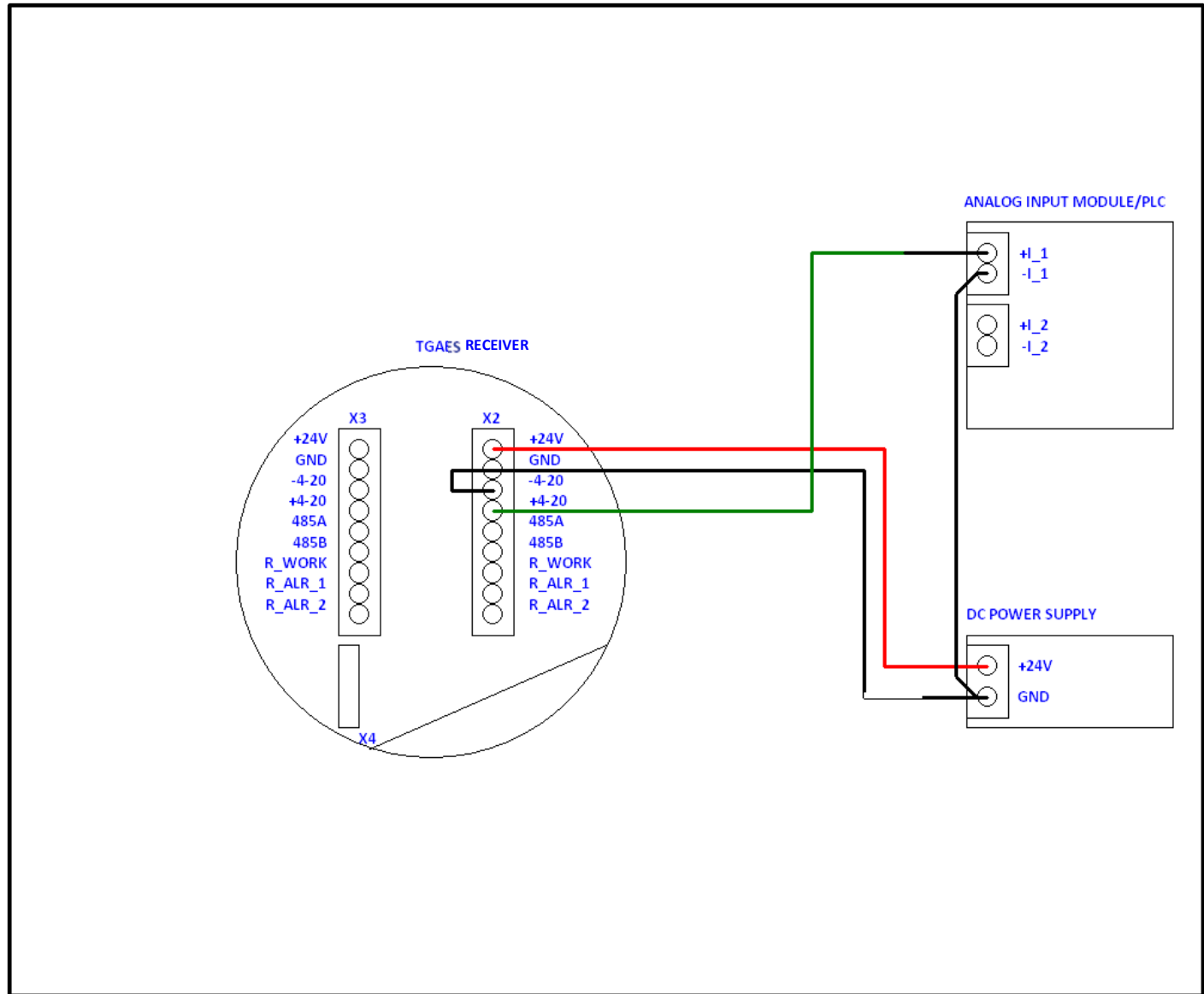
Field Repair

The TGAES is not intended to be repaired in the field. If a problem should develop, refer to the troubleshooting section of this manual. If it is determined that the problem falls within this warranty, please return the product to ESP as instructed hereunder.

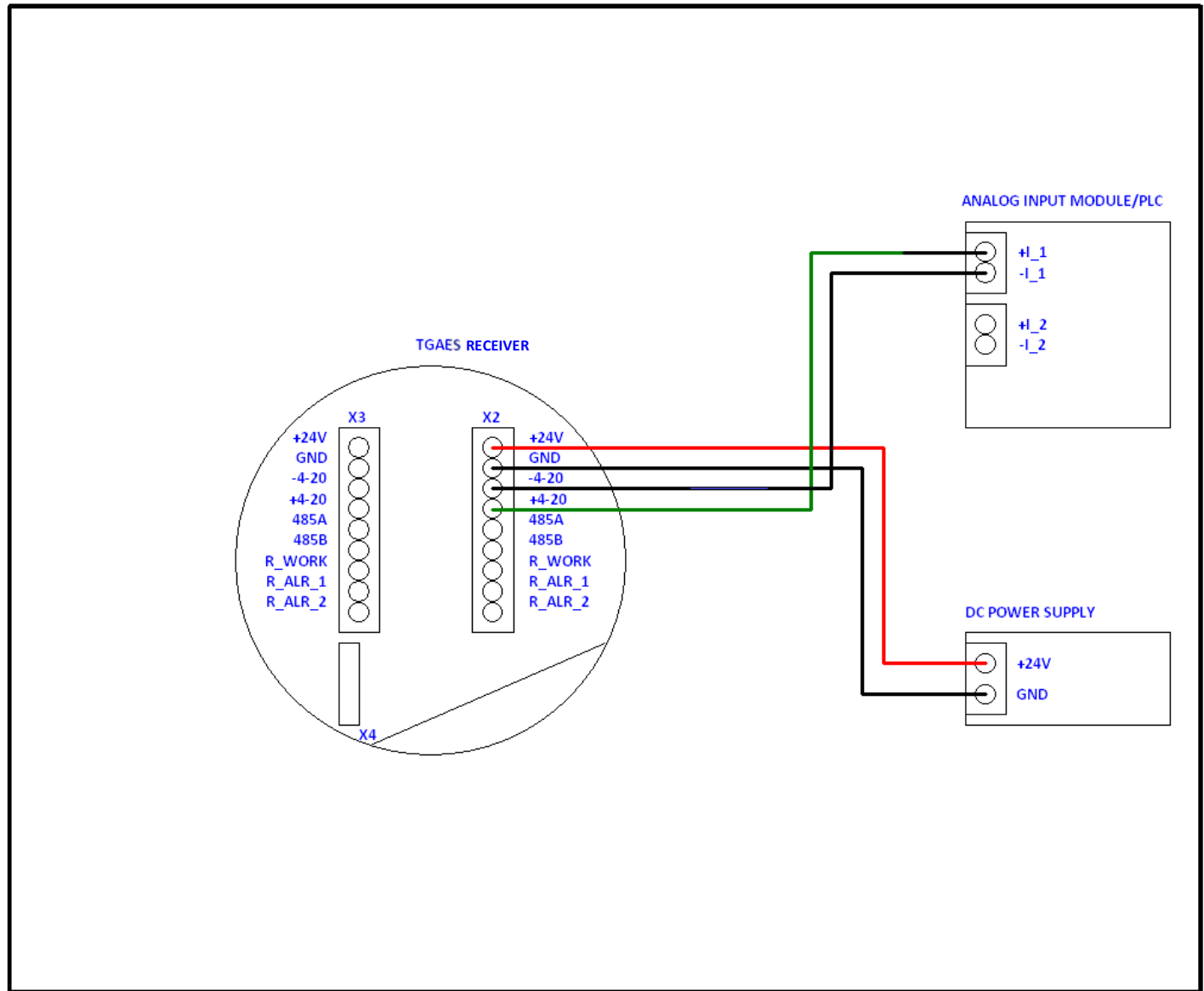
Expected Service Life of Unit

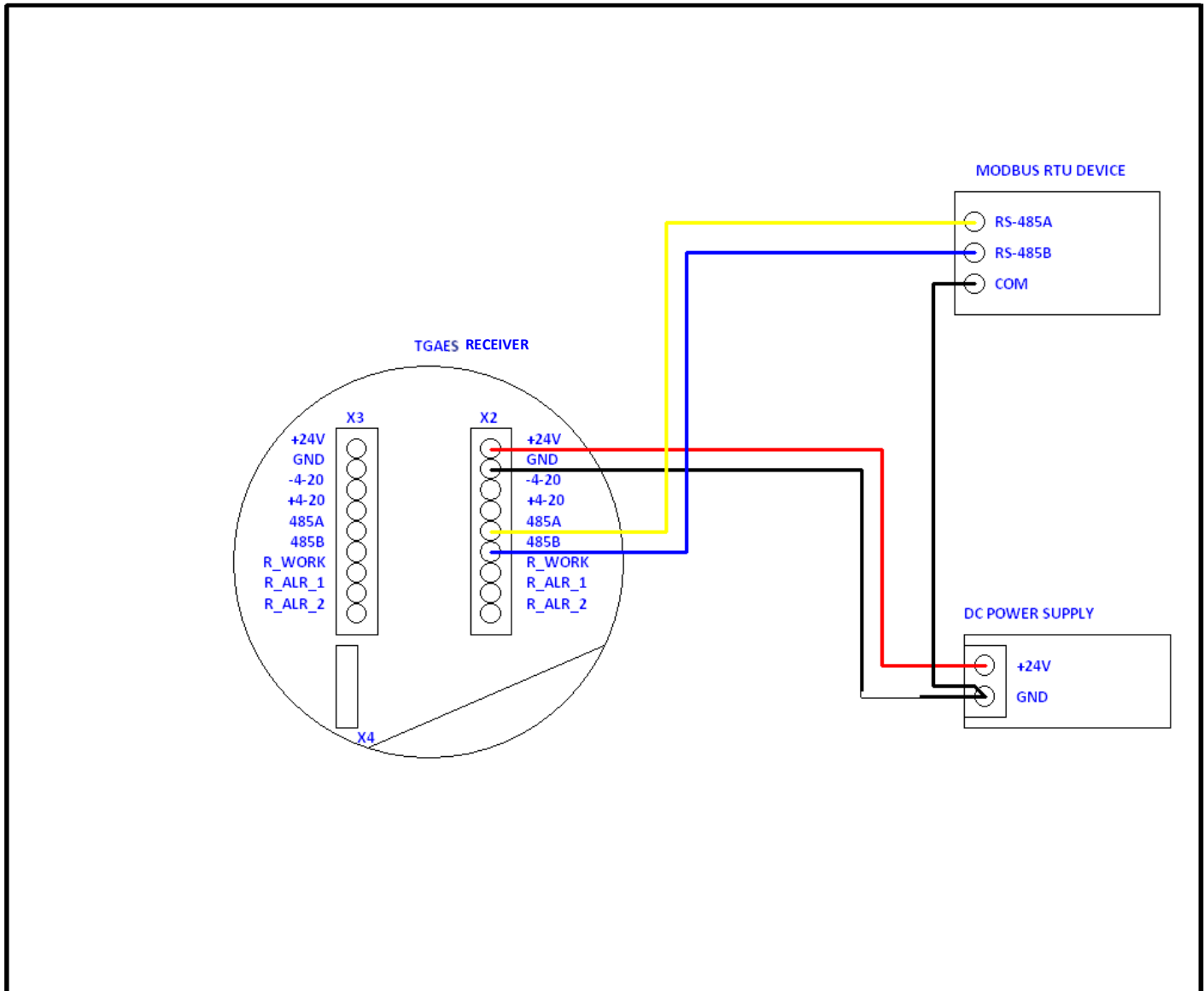
The average expected service life of the TGAES is not less than 10 years.

Appendix A-2: Wiring Diagrams

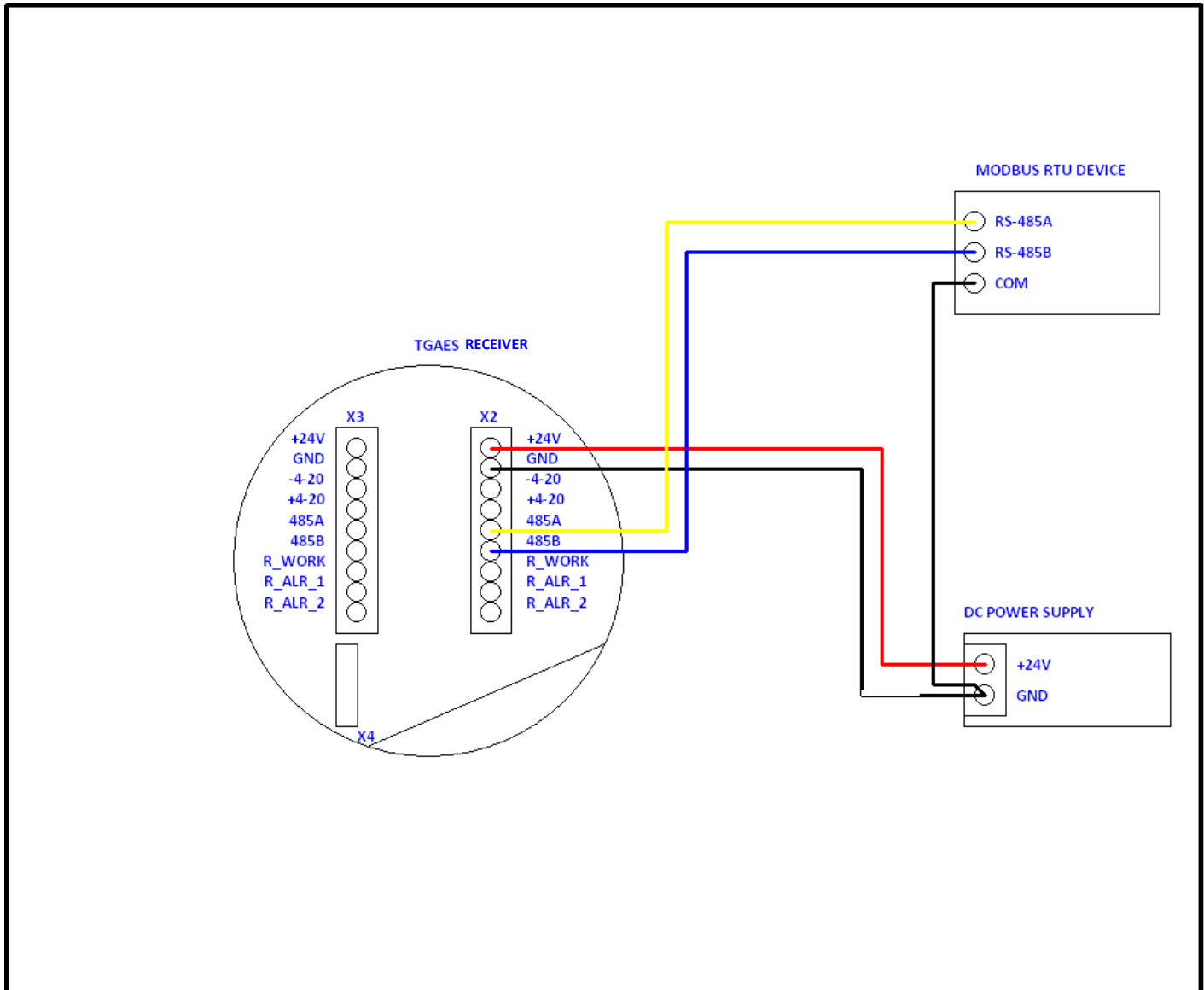


3-WIRE CURRENT OUTPUT

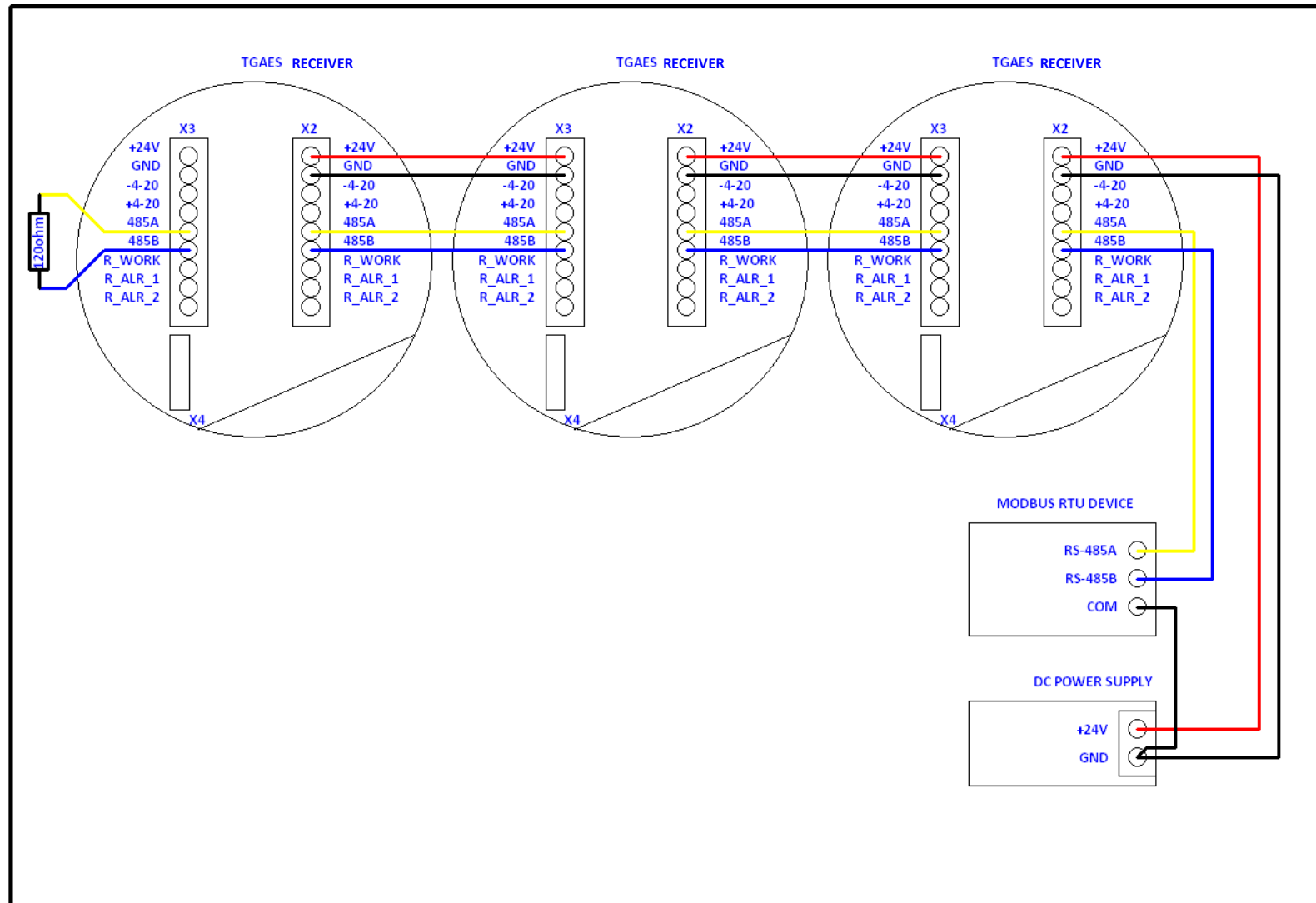
**4-WIRE CURRENT OUTPUT**



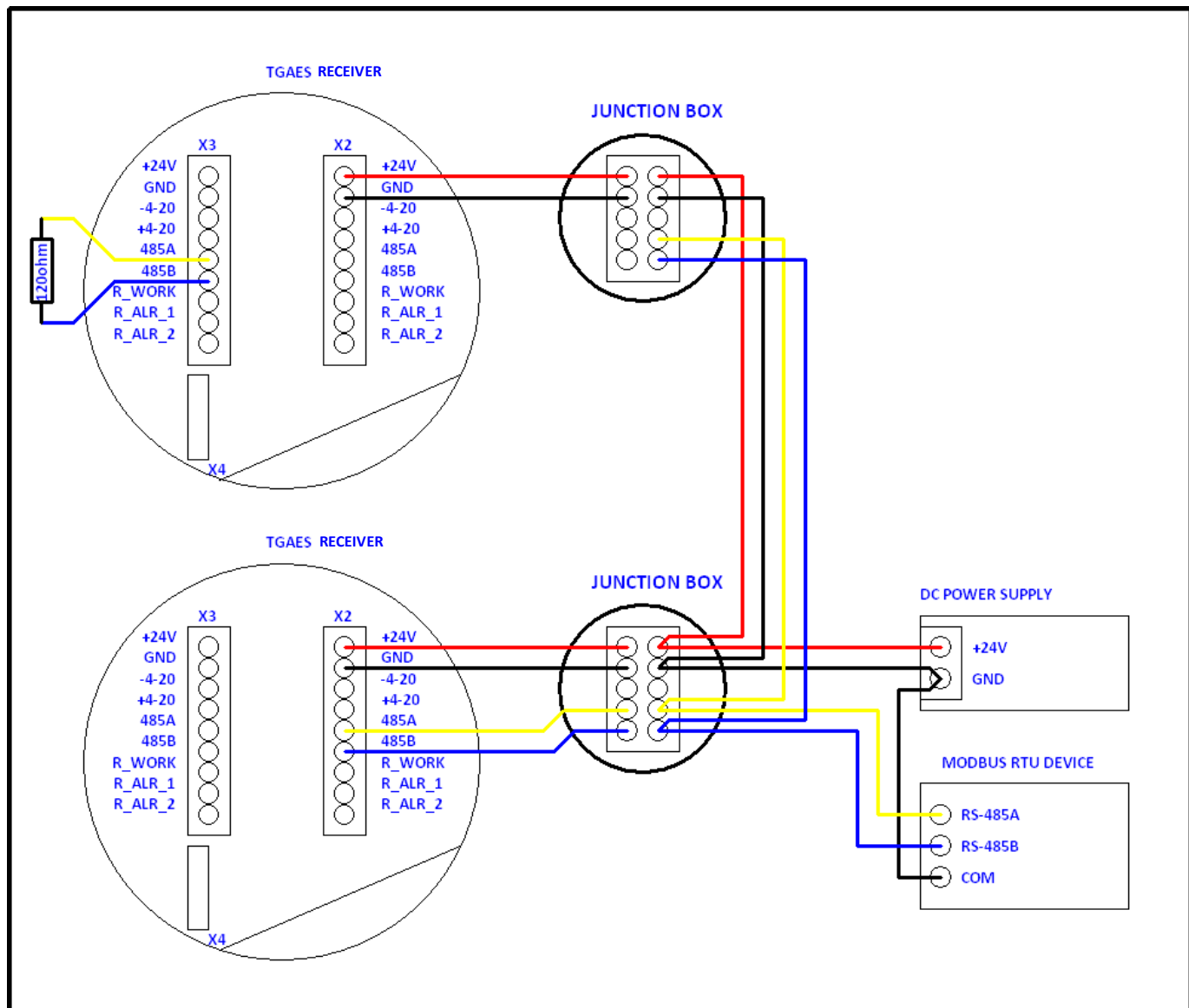
MODBUS RTU



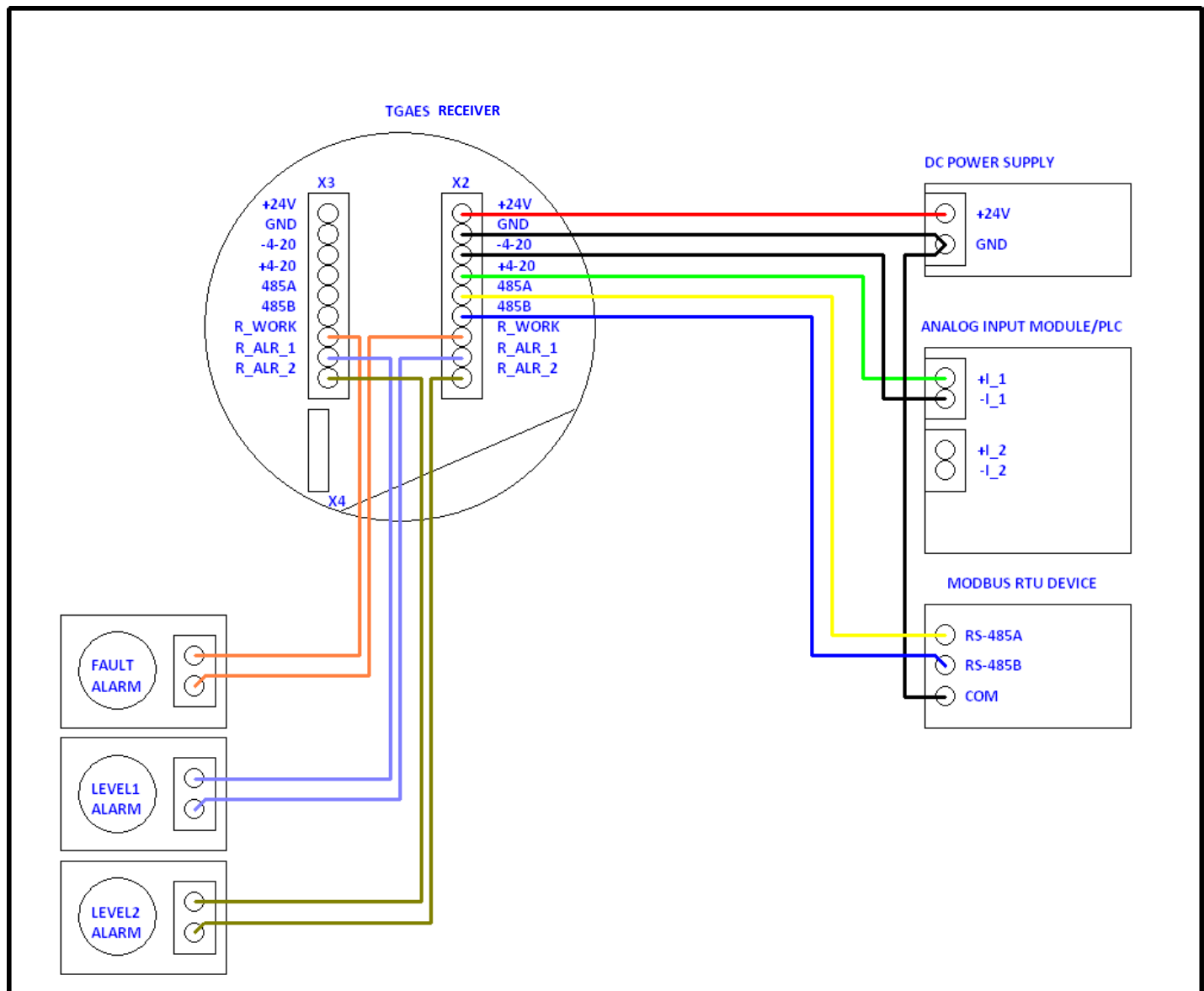
MODBUS RTU



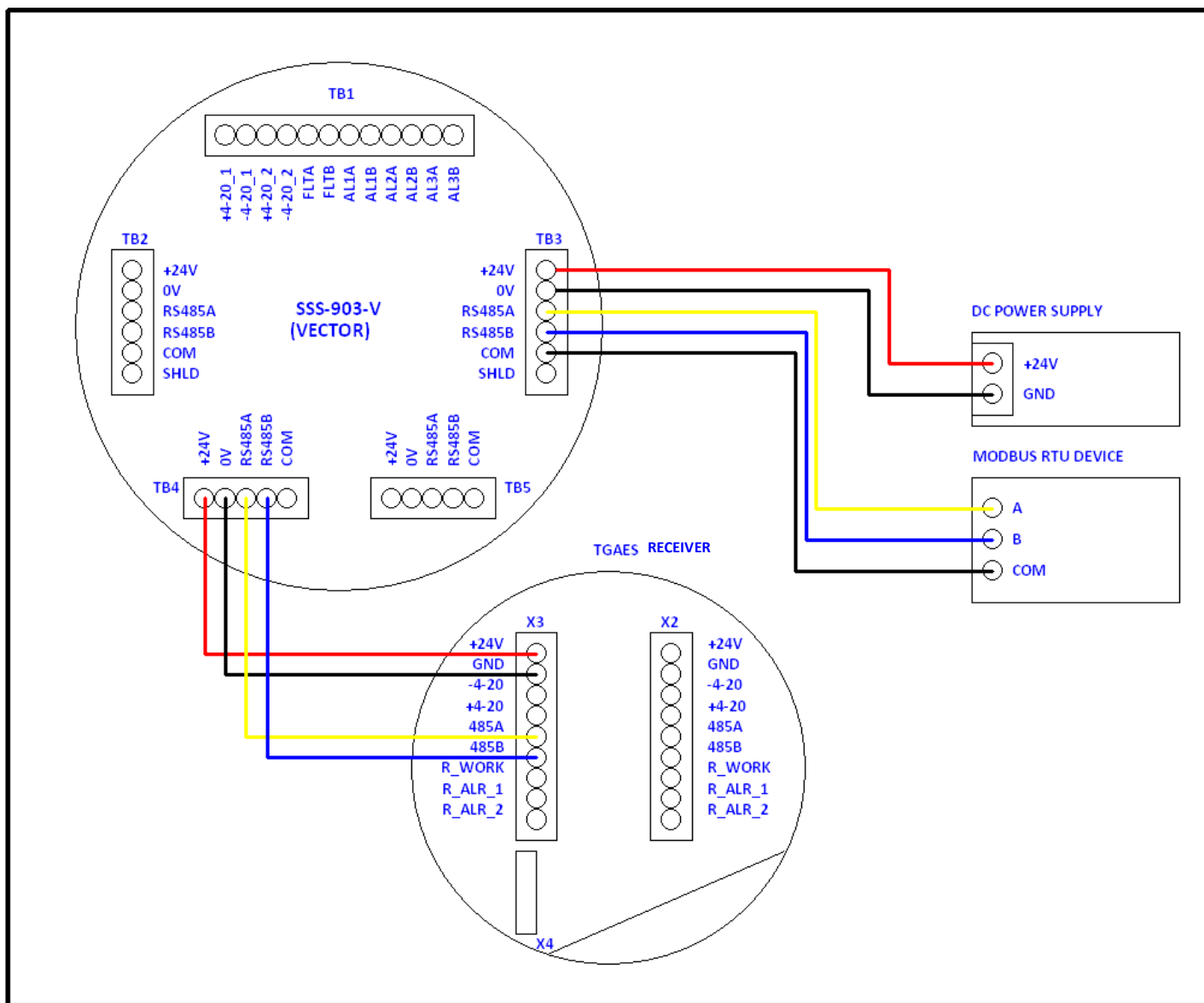
MODBUS RTU (DAISY CHAIN)



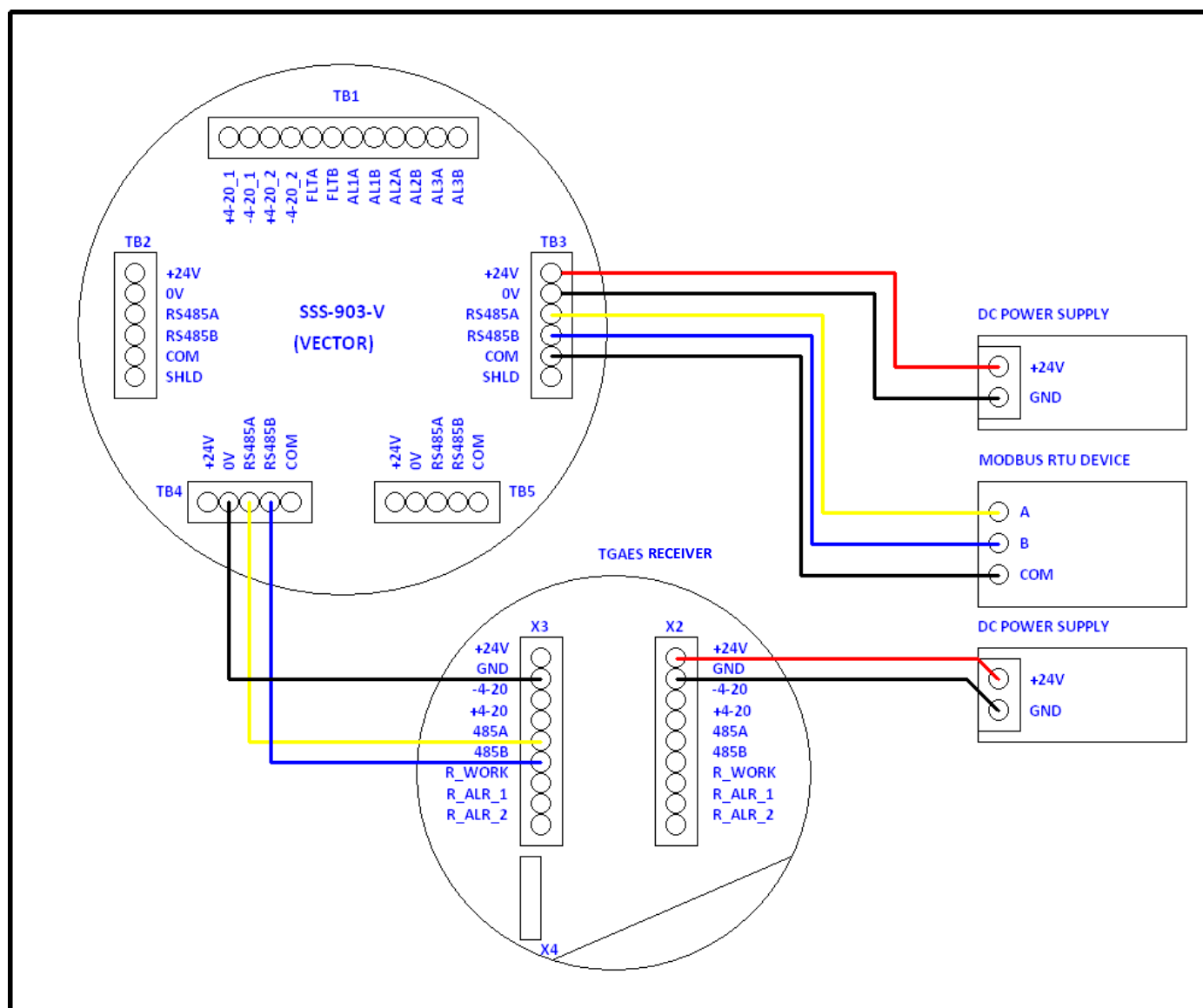
MODBUS RTU (PARALLEL DROPS)



MULTIPLE USE

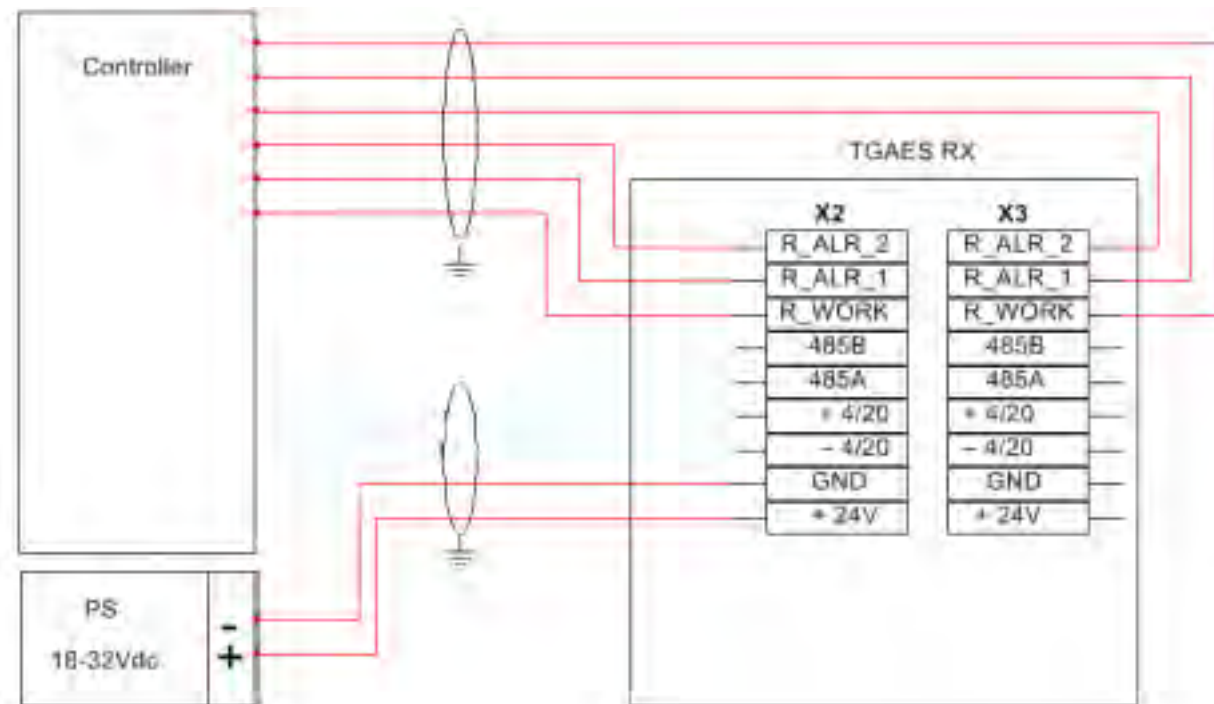


TGAES WITH VECTOR DISPLAY (SINGLE SUPPLY)

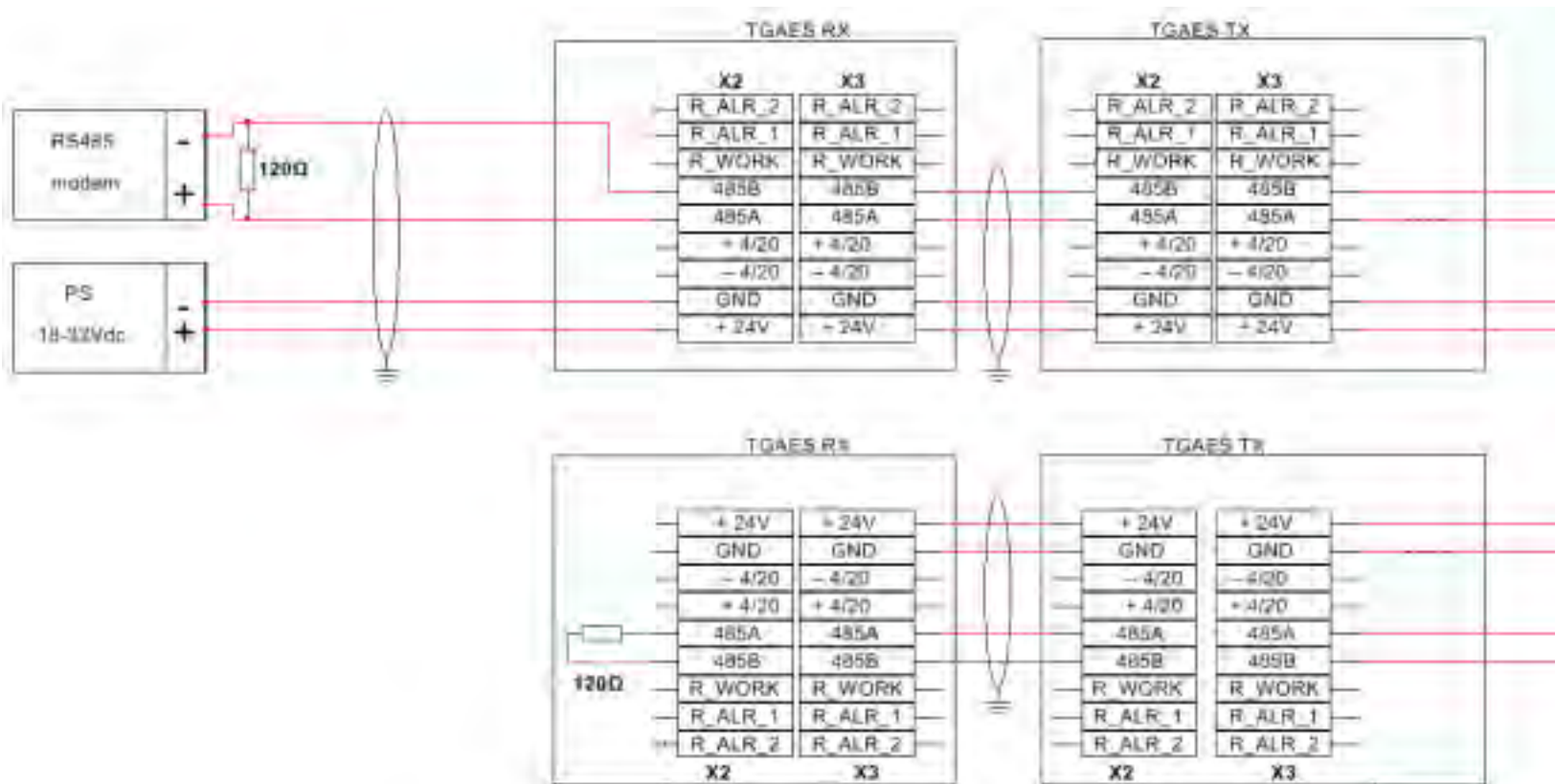


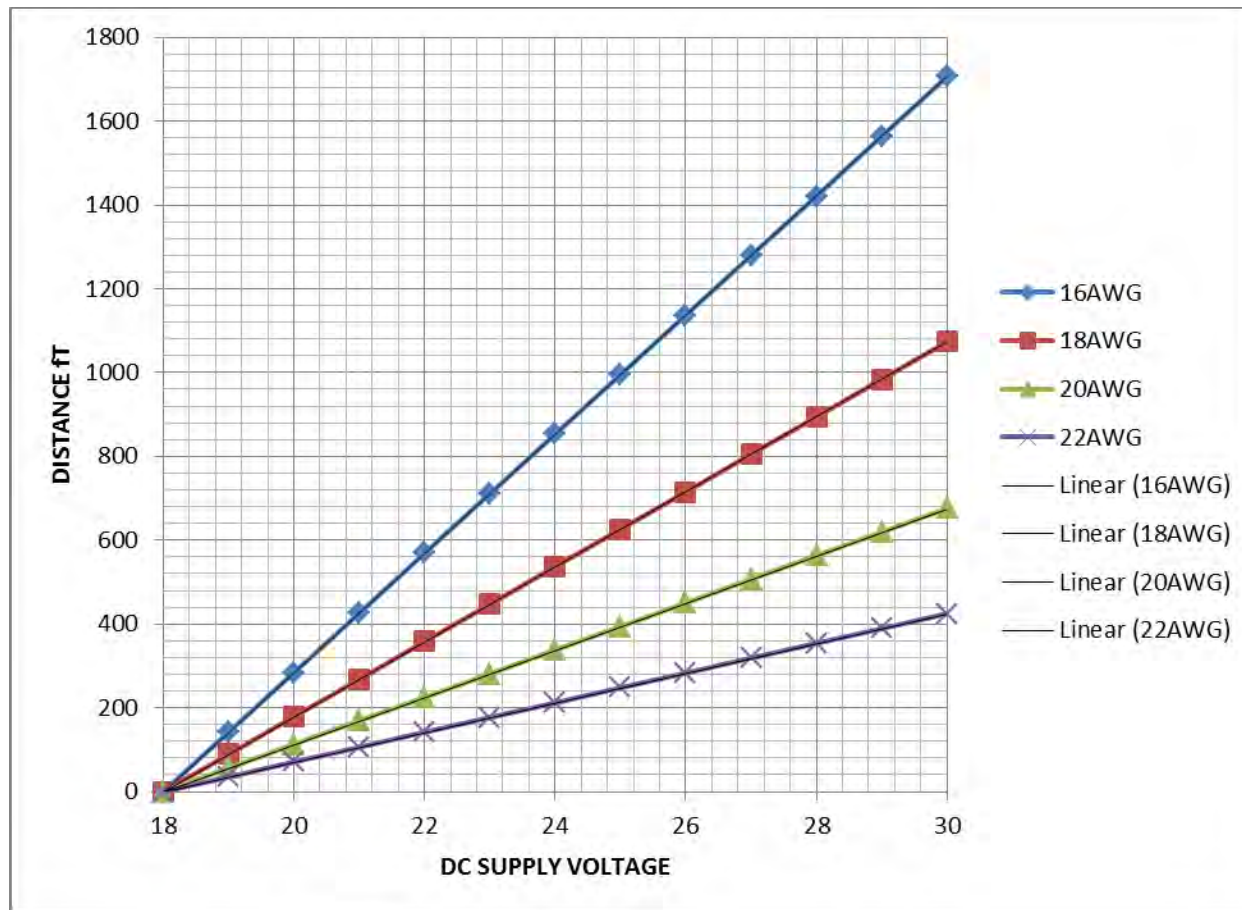
TGAES WITH VECTOR DISPLAY (SEPARATE SUPPLIES)

RELAY OUTPUTs



DIGITAL OUTPUTS



Appendix B: Wire Size Chart**TGAES WIRE SIZE CHART**

Appendix C: Explosion Protection Means

