

Hydrogen Sulfide Prevention and Contingency Plan Sundance Services West, Inc.

Prepared for
Sundance Services West, Inc.
Eunice, New Mexico

Prepared by



6501 Americas Parkway NE, Suite 200
Albuquerque, New Mexico 87110
www.dbstephens.com
DB18.1209

August 31, 2026



Hydrogen Sulfide Prevention and Contingency Plan Sundance Services West, Inc.

Table of Contents

1.	Introduction	1
1.1	Site Location	1
1.2	Facility Description	1
1.3	Purpose.....	2
1.4	Characteristics of Hydrogen Sulfide and Sulfur Dioxide.....	4
1.4.1	Hydrogen Sulfide Characteristics	4
1.4.2	Sulfur Dioxide Characteristics	5
1.5	Regulatory Requirements: 19.15.36 and 19.15.11 NMAC	5
2.	Emergency Coordinators	7
3.	Personnel Training.....	8
4.	Plan Amendment	8
5.	Monitoring	9
5.1	Incoming Loads	9
5.2	Evaporation Pond Monitoring	9
6.	Contingency Plan Activation	9
6.1	Activation.....	9
6.2	Assessment	10
6.3	Site Evacuation Procedures.....	10
6.4	Notification of Authorities and General Public	11
7.	Emergency Equipment.....	12
7.1	Internal Communications	14
7.2	External Communications.....	14
7.3	Personnel Protection, First Aid, and Safety Equipment.....	14
8.	Recordkeeping.....	15
9.	Coordination Agreements.....	15



List of Figures

1	Site Location Map
2	Site Plan
3	Evaporation Ponds Stationary Monitoring (September 2025 to Present)
4	Site Evacuation Map
5	Hospital Location Map

List of Tables

1	Sundance Services West Facilities.....	2
2	Emergency Response Agencies and Contacts	3
3	Hydrogen Sulfide Exposure Health Risks	4
4	Emergency Response Equipment	13

List of Appendices

A	Safety Data Sheets
B	Immediate Action Plan
C	Personal H ₂ S Gas Monitor Specifications
D	WaveNet User Manual
E	Incident Report Form (Typical)



Hydrogen Sulfide Prevention and Contingency Plan Sundance Services West, Inc.

1. Introduction

Daniel B. Stephens & Associates, Inc. (DBS&A) has prepared this hydrogen sulfide (H₂S) prevention and contingency plan for Sundance Services West Inc. (SSWI or the facility), a commercial surface waste management facility for oil field waste processing and disposal services owned and operated by SSWI. The facility is subject to regulation under the New Mexico Oil and Gas Rules administered by the Oil Conservation Division (OCD), specifically Section 19.15.36 of the New Mexico Administrative Code (19.15.36 NMAC) pertaining to surface waste management facilities. The facility has been designed and constructed in compliance with 19.15.36 NMAC and operates in compliance with a surface waste management facility permit NM1-62 issued by OCD.

1.1 Site Location

SSWI is located approximately 3 miles east of Eunice, New Mexico, 18 miles south of Hobbs, New Mexico, and approximately 1.5 miles west of the Texas/New Mexico state line in unincorporated Lea County, New Mexico. SSWI consists of a 320-acre± tract of land located in the South ½ of Section 30, Township 21 South, Range 38 East. Site access is provided through New Mexico Highway 18 (NM 18) and Wallach Lane. A site location map is provided as Figure 1.

1.2 Facility Description

SSWI is a commercial surface waste management facility located on a 320-acre± tract of land that will include two main components: a liquid oil field waste processing area (80 acres±) and an oil field waste landfill (180 acres±). Oil field wastes are delivered to the facility from oil and gas exploration and production operations in southeast New Mexico and west Texas. Figure 2 identifies the locations of the processing area and landfill facilities. The facilities are detailed in Table 1.



Hydrogen Sulfide Prevention and Contingency Plan Sundance Services West, Inc.

Table 1. Sundance Services West Facilities

Description	No.
Oil field waste disposal landfill	1
Produced water load-out points	2
Produced water tanks	3
Mechanical oil/water separation unit	2
Evaporation ponds	10
Stabilization and Solidification Area	1
Oil treatment plant	1
Oil sales tanks	2
Customer jet wash	1 (6 bays)

1.3 Purpose

H₂S is a colorless, toxic gas that may be present in produced fluids and gases processed and disposed of by SSWI. The purpose of this H₂S prevention and contingency plan is to enhance awareness and establish measures to protect employees from occupational exposure to these gases while allowing them to perform their assigned duties. The plan is also designed to protect customers and visitors of SSWI, as well as the general public and nearby landowners. The plan prescribes measures for the following:

- Assigning responsibilities and duties to personnel during a hydrogen sulfide emergency
- Constant personnel monitoring
- Stationary monitoring points at the facility evaporation ponds
- Augmenting the monitoring procedures in the event that H₂S is detected at concentrations in excess of 10 parts per million (ppm)
- Minor, major, and critical alarm levels and actions
- Notifying authorities and general public in the unlikely event of a release as defined in 19.15.11.16 NMAC

SSWI will invite the local emergency response authorities identified in Table 2 to the site for a briefing on this plan. During this briefing, SSWI will discuss notification requirements, emergency response procedures, and evacuation plans. The H₂S monitoring program will be implemented during the active life of the facility.



Hydrogen Sulfide Prevention and Contingency Plan Sundance Services West, Inc.

Table 2. Emergency Response Agencies and Contacts

Agency/Organization	Emergency Number
<i>Fire:</i> Eunice Fire Department	911 or (575) 394-3258
<i>Police:</i> Lea County Sheriff's Department New Mexico State Police	911 or (575) 396-3611 911 or (575) 392-5580
<i>Medical/Ambulance:</i> Lea Regional Medical Center 5419 N. Lovington Highway Hobbs, NM 88240	(575) 492-5000
<i>Emergency Response Firm:</i> Phoenix Environmental LLC 2113 N French Drive Hobbs, NM 88240	(575) 391-9685
<i>OCD Emergency Response Contacts:</i> Oil Conservation Division (District 1/Hobbs Office) 1625 N. French Drive Hobbs, NM 88240 Oil Conservation Division (Main Office) 1220 S. St. Francis Drive Santa Fe, NM 87505	(505) 629-6116 (505) 476-3441 (505) 670-8745
<i>State Emergency Response Contacts:</i> Environmental Emergency 24 hr. (NMED) New Mexico Environment Department Solid Waste Bureau, Santa Fe	(505) 827-9329 (505) 827-0197
<i>Local Emergency Response Contacts:</i> Lea County Office of Emergency Management	(575) 391-2983
<i>Federal Emergency Response Contacts:</i> National Emergency Response Center (U.S. Coast Guard) Region VI Emergency Response Hotline (U.S. EPA)	(800) 424-8802 (214) 665-2200



1.4 Characteristics of Hydrogen Sulfide and Sulfur Dioxide

1.4.1 Hydrogen Sulfide Characteristics

H₂S is a colorless, flammable gas with a distinct odor likened to rotten eggs at low concentrations and described as smelling sickeningly sweet at high concentrations. As H₂S is heavier than air, the gas tends to accumulate at the floor of poorly ventilated spaces. It is naturally found in petroleum and natural gas and is sometimes present in groundwater. The odor of hydrogen sulfide gas can be perceived at levels as low as 10 parts per billion (ppb), or 0.01 ppm. At levels of 50 to 100 ppm, it may cause the sense of smell to fail (often referred to as olfactory fatigue). Limited exposure to low concentrations of H₂S may cause eye irritation, sore throat, coughing, shortness of breath, and fluid in the lungs. These symptoms usually recede in a few weeks in the absence of continued exposure. Acute exposure to hydrogen sulfide over long periods of time at low concentrations may result in fatigue, loss of appetite, headache, irritability, poor memory, and dizziness. Exposure to high concentrations of H₂S can lead to eye injury, loss of sense of smell, pulmonary edema (swelling and/or fluid accumulation in the lungs), asphyxia, and death. General risks associated with H₂S exposure are summarized in Table 3. More detailed chemical hazard information for H₂S is provided on the safety data sheet (SDS) provided in Appendix A.

Table 3. Hydrogen Sulfide Exposure Health Risks

H ₂ S Exposure Level ^a	Health Risk
Low (0–10 ppm)	Irritation of the eyes, nose, and throat, coughing, shortness of breath, fluid in the lungs
Moderate (10–50 ppm)	Headache, dizziness, nausea, vomiting, coughing, difficulty breathing, loss of sense of smell
High (50–200 ppm) ^b	Severe irritation of the respiratory tract, loss of sense of smell, eye injury, shock, convulsions, coma, pulmonary edema (swelling and/or fluid accumulation in the lungs), asphyxiation, death

^a General data obtained from www.osha.gov/hydrogen-sulfide/hazards

^b NIOSH Immediate Danger to Life or Health (IDLH) is 100 ppm

Oil field waste types, engineering design, and operating procedures specific to the SSWI facility will mitigate the potential release of H₂S into the environment. Measures deployed by SSWI that minimize the potential for releases include the following:

- General screening of existing and new deliveries of waste



Hydrogen Sulfide Prevention and Contingency Plan Sundance Services West, Inc.

- Stationary monitoring points at the Facility evaporation ponds
- Personnel monitoring
- Employee training

The cornerstone of this plan is routine H₂S monitoring conducted near SSWI's evaporation ponds to verify that the regulatory limits for H₂S are not exceeded. This approach to monitoring has proven effective and has thus far eliminated the need for H₂S contingency plan implementation as described in 19.15.11.9 NMAC (i.e., to address H₂S > 100 ppm). Appendix B provides an immediate action plan containing specific actions to address H₂S concentrations greater than 10, 30, and 100 ppm should these concentrations be detected by H₂S gas monitoring devices.

1.4.2 Sulfur Dioxide Characteristics

Sulfur dioxide (SO₂) is a colorless gas with an irritating and pungent odor likened to a freshly burnt match. SO₂ generally forms when H₂S or other fuels containing sulfur are burned. Exposure to SO₂ may cause health effects such as wheezing, shortness of breath, and chest tightness. Exposure to high levels of SO₂ at a continuous rate can cause reduced lung function. Control measures that reduce SO₂ are generally expected to reduce exposures to other sulfur oxides (SO_x). More detailed chemical hazard information for SO₂ is provided in the SDS (Appendix A).

SO₂ may also cause environmental impacts. At high concentrations, sulfur oxides can damage plant foliage and decrease flora growth rates. SO₂ and other sulfur oxides may contribute to acid rain, which can be harmful to certain ecosystems. Sulfates, major particulate pollutants, can form in the atmosphere from SO₂. These particulates can be visible in the form of haze or reduced visibility.

The largest sources of SO₂ are from fossil fuel combustion at power plants and other industrial facilities that process fossil fuels. SO₂ is not expected to form in significant amounts at SSWI, as it is not a combustion-based facility. Transport trucks, on-site vehicles, and heavy equipment that run on diesel can be expected to emit SO₂ in small quantities.

1.5 Regulatory Requirements: 19.15.36 and 19.15.11 NMAC

The rule for surface waste management facilities (19.15.36 NMAC) addresses monitoring and management requirements for H₂S in 19.15.36.8(C)(8) NMAC:



Hydrogen Sulfide Prevention and Contingency Plan Sundance Services West, Inc.

19.15.36.8 SURFACE WASTE MANAGEMENT FACILITY PERMITS AND APPLICATION REQUIREMENTS

C. Application requirements for new facilities, major modifications and permit renewals. An applicant or operator shall file an application, form C-137, for a permit for a new surface waste management facility, to modify an existing surface waste management facility or for permit renewal with the environmental bureau in the division's Santa Fe office. The application shall include:

- (8) a hydrogen sulfide prevention and contingency plan that complies with those provisions of 19.15.11 NMAC that apply to surface waste management facilities;

Additionally, requirements in 19.15.11 NMAC apply to this facility:

19.15.11.2 SCOPE:

19.15.11 NMAC applies to a person subject to the division's jurisdiction, including a person engaged in drilling, stimulating, injecting into, completing, working over or producing an oil, gas or carbon dioxide well or a person engaged in gathering, transporting, storing, processing or refining of oil, gas or carbon dioxide. 19.15.11 NMAC does not exempt or otherwise excuse surface waste management facilities the division permits pursuant to 19.15.36 NMAC from more stringent conditions on the handling of hydrogen sulfide required of such facilities by 19.15.36 NMAC or more stringent conditions in permits issued pursuant to 19.15.36 NMAC, nor shall the facilities be exempt or otherwise excused from the requirements set forth in 19.15.11 NMAC by virtue of permitting under 19.15.36 NMAC.

As supported by 19.15.11.9(B)(1) NMAC, paragraph 7.6 of the American Petroleum Institute (API) Recommended Practice 55 (RP-55) is referenced to prescribe an immediate action plan for the detection of H₂S concentrations in excess of 30 ppm. Should monitoring results identify unexpected concentrations of H₂S in excess of 30 ppm (RP-55 limit) in a public area, notification will be required in accordance with the immediate action plan (Appendix B). The RP-55 limit of 30 ppm will result in a radius of exposure (ROE) of 250 feet from the point of release, assuming a release rate of 100 standard cubic feet per hour (scfh) (Figure C-2 of RP-55). This ROE is depicted on Figure 1, and there are no "public areas" as defined by 19.15.11.7(I) NMAC within this ROE. Additionally, an assessment of public roads was completed as required by 19.15.11.9(B)(2)(a) NMAC. There are no public roads as defined by 19.15.11.7(J) NMAC in the 30 ppm ROE; therefore, none will be impacted in the event of an emergency.



Hydrogen Sulfide Prevention and Contingency Plan Sundance Services West, Inc.

2. Emergency Coordinators

SSWI has designated specific individuals with the responsibility and authority to implement response measures in the event of an emergency that threatens fresh water, public health, or the environment per 19.15.11.9(B)(2)(a) NMAC. The primary, alternate, and on-site emergency coordinators (ECs) will be thoroughly familiar with all aspects of this plan, operation and activities at the facility, locations and characteristics of waste to be managed, the repository of all records within the facility, and the facility layout. The following list provides names, designations, titles, and phone numbers for each EC who will be formally identified to OCD prior to commencing facility operations:

- Primary Emergency Coordinator: Joe Carrillo
Corporate Plant Manager
605 Avenue J
Eunice, NM 88231
Work: (575) 394-2511
Cell: (575) 390-0342
- Alternate Emergency Coordinator: TBD
- On-Site Emergency Coordinator: TBD

The ECs are responsible for coordinating emergency response measures and have the authority to commit the resources required for implementation of this plan. A designated EC will be available to respond to emergencies 24 hours a day, 7 days a week. The SSWI employee who identifies an emergency situation will contact an EC directly by phone or radio. Contact will be attempted with each EC (primary, alternate, and on-site) until communication is established. Upon arrival at the scene of an emergency, the first EC to arrive will assume responsibility for initiating response measures. If more than one EC responds, authority is assigned to the highest-ranking EC.

In the rare case that an EC cannot be contacted in an emergency, the SSWI employee who identifies the emergency will make every effort to follow the emergency procedures outlined in this plan until an EC or emergency authority (local, state, or federal) (Table 2) arrives to assist or take charge. The term "EC" as used throughout this plan references the responsible EC at the scene of an emergency regardless of whether that EC is the primary EC, alternate EC, on-site EC, or EC designee. This plan will be amended as described in Section 4.



Hydrogen Sulfide Prevention and Contingency Plan Sundance Services West, Inc.

3. Personnel Training

As required of 19.15.11.9.B(2)(d) NMAC, the EC or facility training representative will ensure that all new and existing employees are trained on the H₂S prevention and contingency plan at least annually or when significant changes to the plan have been made (whichever is more frequent). Prior to any new employee commencing work, a training session separate from the standard annual training will be conducted to provide specific proficiency in H₂S safety and procedures. Training will include both classroom drills and field exercises simulating H₂S monitoring, potential releases, and evacuation procedures. Included in this training are H₂S hazards identification and detection, personal protection, and contingency procedures.

Training will be provided to residents, as appropriate, on the proper protective measures to be taken in the event of a release. Briefings will be provided to public officials on issues such as evacuation or shelter-in-place plans.

4. Plan Amendment

The EC will be responsible for ensuring that updates or amendments to this plan are conducted and recorded in the event of any of the following (19.15.11.9.F NMAC):

- The facility permit is revised or modified with potential impacts on this plan.
- The OCD mandates it, including responses to regulatory updates.
- The plan fails in an emergency.
- There are modifications to the facility design, construction, operation, or maintenance, or other circumstances that change the potential circumstance or locations for fires, explosion, or releases of hazardous oil field waste constituents, or related changes in the appropriate emergency response.
- The list of ECs changes.
- The list of emergency equipment changes significantly.

The updated plan will be distributed to OCD and made available to the organizations identified in Table 2 with a cover letter highlighting any substantive changes. Proposed changes will be in compliance with 19.15.36 NMAC.



5. Monitoring

5.1 Incoming Loads

SSWI personnel will wear H₂S personal monitors under circumstances where H₂S may be present. Per the specifications sheet, the monitors will issue a visual and auditory signal upon detection of 10 ppm of H₂S in the ambient air (Appendix C). The immediate action plan (Appendix B) shall be followed in the event of an H₂S detection of 10 ppm or greater.

5.2 Evaporation Pond Monitoring

Facility evaporation ponds are monitored for H₂S by an RC Systems continuous monitoring network called WaveNet, which is maintained along the outside perimeter of the pond area (Figure 3). These monitors can be observed remotely over the internet and measurements are recorded every minute on a datalogging system. A user manual for the WaveNet monitoring system is provided as Appendix D.

Wind socks are placed at the east and west ends of the northern fence (shown in Figure 3), which will be visible from all principle working areas at all times. Wind speeds and direction will be monitored and recorded regularly when feasible.

6. Contingency Plan Activation

The following subsections present a series of procedures for activation, assessment, and notification of appropriate authorities in the unlikely event that an H₂S emergency develops (19.15.11.9 NMAC).

6.1 Activation

This H₂S contingency plan will be activated when an imminent or actual emergency situation develops that represents a potential impact to fresh water, public health, or the environment. As required by 19.15.11.9(B)(2)(f) NMAC, the plan activation level for H₂S is 100 ppm. Provisions listed in the immediate action plan (Appendix B) include protective measures that will be taken when concentrations of H₂S above 30 ppm are measured continuously for longer than 10 minutes (although not full activation of the contingency plan).



Hydrogen Sulfide Prevention and Contingency Plan Sundance Services West, Inc.

Activation of the plan would most likely occur due to an unexpected release of H₂S from waste, pits, tanks, treatment units, or associated gas-handling equipment at SSWI. As the purpose of this plan is to protect site personnel, visitors, the public (including neighboring landowners), and the environment, activation of the contingency plan is not reliant upon human presence within the area(s) of measured activation level exceedance(s). This plan, as well as the immediate action plan (Appendix B), shall be followed in their entirety regardless of date, time, and ongoing site operations.

The immediate action plan (Appendix B) lists the implementation, assessment, and notification procedures that will be followed in the event of a minor, major, and critical alarm. Only a critical alarm is considered an activation of the contingency plan (as defined in 19.15.11.9.C). Assessment and notification are discussed further in Sections 6.2 and 6.4.

6.2 Assessment

In the event of a release, the EC or their trained designee will immediately identify the character, source, amount, and extent of released materials, if possible, and will assess the potential impact to fresh water, public health, or the environment. SSWI personnel should not attempt to assess a release beyond the scope of their training and available safety equipment. The EC will also assess the circumstances of an emergency situation and determine the actions required to accomplish the following:

- Provide notifications to appropriate agencies and the general public
- Implement appropriate response and recordkeeping procedures

The assessment provides the EC with critical data needed to determine whether an evacuation is necessary, whether emergency authorities and OCD should be contacted in accordance with the reporting requirements of 19.15.11.16 NMAC, and whether SSWI should attempt to control the release with on-site personnel and equipment.

6.3 Site Evacuation Procedures

Based on the type of waste materials received and treatment processes conducted at SSWI, the potential for a facility evacuation is unlikely. However, various circumstances could arise warranting a facility evacuation. In an emergency situation, the EC is the individual responsible for determining when evacuation of the facility is required.



Hydrogen Sulfide Prevention and Contingency Plan Sundance Services West, Inc.

When conditions warrant immediate evacuation, on-site persons (e.g., facility personnel, haulers, visitors, vendors, etc.) will be directed to proceed immediately to evacuate through the main gates following the primary evacuation route. Appendix B provides detailed procedures for evacuating the facility. SSWI personnel will exercise good judgment and common sense in using the primary evacuation route to exit the facility or selecting the most appropriate alternative evacuation route, if necessary. Assembly points and primary/secondary evacuation routes are provided on Figure 4. Driving directions to the nearest hospital are included as Figure 5.

6.4 Notification of Authorities and General Public

This section provides a series of procedures for notification of appropriate authorities in the event that a hydrogen sulfide emergency develops and requires activation of this contingency plan (19.15.11.16 NMAC). Whenever there is an imminent or ongoing emergency, the EC will immediately contact on-site persons (facility personnel, visitors, vendors, haulers, etc.) using on-site communication systems and notify appropriate state and local agencies (Table 2). OCD will be notified within 4 hours after the contingency plan has been activated. SSWI shall submit a full report of the incident to the OCD no later than 15 days following the release using form C-141 (filed electronically through OCD Permitting).

Table 2 provides a list of emergency response agencies and contacts that may need to be notified depending on the character and extent of an emergency. Table 2 will be posted as appropriate and near on-site telephones for easy access by SSWI personnel. Fire, police, and medical authorities will be contacted as necessary in an emergency situation. SSWI shall coordinate with local authorities to facilitate notification of the general public, as necessary.

In accordance with 19.15.11.9(B)(2)(e) NMAC, SSWI shall coordinate emergency response actions with OCD and New Mexico State Police consistent with the New Mexico hazardous materials emergency response plan. This shall include integration of any applicable requirements stated within the Lea County All-Hazard Emergency Operations Plan (EOP) as maintained by the Lea County Office of Emergency Management.

Additional state, federal, and other local emergency contact numbers are provided in Table 2 and should be used as deemed appropriate to the situation. If the EC determines that the incident could threaten fresh water, public health, or the environment beyond the limits of the facility, the EC will notify the National Response Center (NRC) and the U.S. Environmental Protection Agency (EPA) at the following phone numbers (also included in Table 2):



Hydrogen Sulfide Prevention and Contingency Plan Sundance Services West, Inc.

- National Response Center, 24-hour hotline: (800) 424-8802
- U.S. EPA Region VI emergency response hotline: (214) 665-2200

The EC's notification to authorities will include the following information, as listed on the incident report form (Appendix E):

- Name and telephone number of person reporting the incident
- Name and address of facility
- Time and character of incident (e.g., hazardous material release, fire)
- Name and quantity of material(s) involved, to the extent known
- Extent of injuries, if any
- Possible hazards to human health or the environment
- Other information requested by the response entity

7. Emergency Equipment

The following subsections describe equipment and systems at SSWI that will be available for emergency response. Emergency response equipment, as well as their quantities, locations, and uses, are listed in Table 4.



Hydrogen Sulfide Prevention and Contingency Plan Sundance Services West, Inc.

Table 4. Emergency Response Equipment

Equipment Description	Quantity	Location	Use(s)
10 lb ABC rated fire extinguisher	2	Facility Gatehouse	Firefighting
10 lb ABC rated fire extinguisher	2	Trucks	Firefighting
10 lb ABC rated fire extinguisher	1	Heavy Equipment	Firefighting
20 lb ABC rated fire extinguisher	1	Crude Oil Recovery Tanks	Firefighting
20 lb ABC rated fire extinguisher	1	Centrifuge Building	Firefighting
20 lb ABC rated fire extinguisher	1	Oil Sales Tanks	Firefighting
20 lb ABC rated fire extinguisher	1	Produced Water Tanks	Firefighting
20 lb ABC rated fire extinguisher	1	Diesel Storage Tank	Firefighting
Loader	1	Facility	Berm Repair
Oil Booms	4	NE Corner of Pond	Oil Containment
Self-contained breathing apparatus	1/employee	Facility Gatehouse	Employee PPE
Pair leather gloves	1/employee	Assigned to employee	Employee PPE
NOMEX Coveralls	7/employee	Assigned to Employee	Employee PPE
Pair safety glasses	1/employee	All employee workstations	Employee PPE
Round-point shovels (wood-handled)	2	Process Area Building	Contain spillage, putting out fires
First Aid Kit	1	Facility Gatehouse	First Aid
First Aid Kit	1/vehicle	Facility Vehicles	First Aid
Eye Wash Station	1	Produced Water Receiving Tanks	First Aid
Emergency Shower	1	Produced Water Receiving Tanks	First Aid
Portable 2-way radio	1/employee	Base unit at Facility Gatehouse	Communications
Cell Phones	Min. 3	Facility Manager Facility Operator Facility Operator	Communications
Emergency Phone Number Pocket Cards (laminated)	1/employee	Facility Operators	Communications
Office Phone	2	Facility Gatehouse	Communications
Mobile pressure washer	1	Mobile	Decontaminating equipment
H ₂ S personal monitors	1/employee	Facility Operators	Monitoring for H ₂ S gas
GDS Stationary H ₂ S Monitors	6	Perimeter of Evaporation Ponds	Monitoring for H ₂ S gas
Wind Socks	2	NW & NE of Evaporation Ponds	Monitoring wind direction



Hydrogen Sulfide Prevention and Contingency Plan Sundance Services West, Inc.

7.1 Internal Communications

Communications at SSWI will be accomplished using cellular telephones, land lines, and two-way radios. These systems provide facility personnel with immediate emergency notification capabilities and the opportunity to receive instructions in the event of an emergency or incident. Any mechanical difficulties with the communications equipment will be promptly repaired. Internal communication devices are also listed in Table 4.

7.2 External Communications

The landline telephones and cell phones located at SSWI will have outside access in the event that notification of the local emergency response authorities is required (i.e., fire department, ambulance, etc.). Key facility personnel including the ECs and Facility Manager will carry cellular telephones for contacting outside agencies. The cellular telephones also provide a backup means for contacting emergency authorities in the event they cannot be reached by conventional telephone lines. Emergency phone numbers will be posted in the Facility Gatehouse and provided to employees on laminated pocket cards. External communication devices are also listed in Table 4.

7.3 Personnel Protection, First Aid, and Safety Equipment

Personal protective equipment (PPE) necessary for responding to a potential release of hazardous materials is maintained in on-site buildings (Facility Gatehouse and the Produced Water Facility) and/or issued to each employee (Table 4). These items include Tyvek suits, gloves, safety glasses, hearing protection, self-contained breathing apparatus (SCBA), etc.

First aid and safety equipment are maintained at strategic locations at SSWI as shown in Table 4. Safety equipment located at the facility includes industrial first aid kits, fire extinguishers, an eye wash station, etc. An emergency shower is located at the Produced Water Facility. First aid kits are placed in the Facility Gatehouse and the Produced Water Facility. In addition, first aid kits are maintained in all facility vehicles, including heavy equipment. Prominent signs will be placed identifying the location of safety equipment and emergency response items (e.g., fire extinguishers).



Hydrogen Sulfide Prevention and Contingency Plan Sundance Services West, Inc.

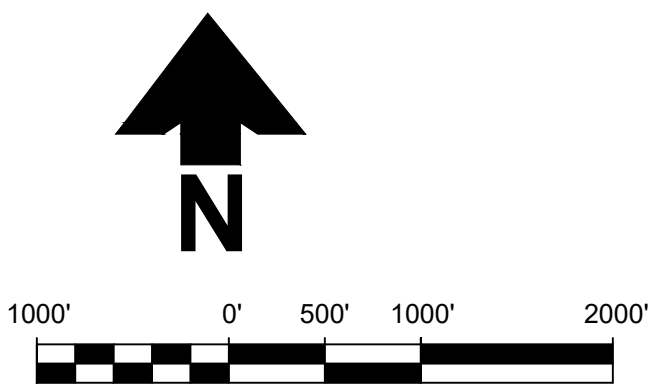
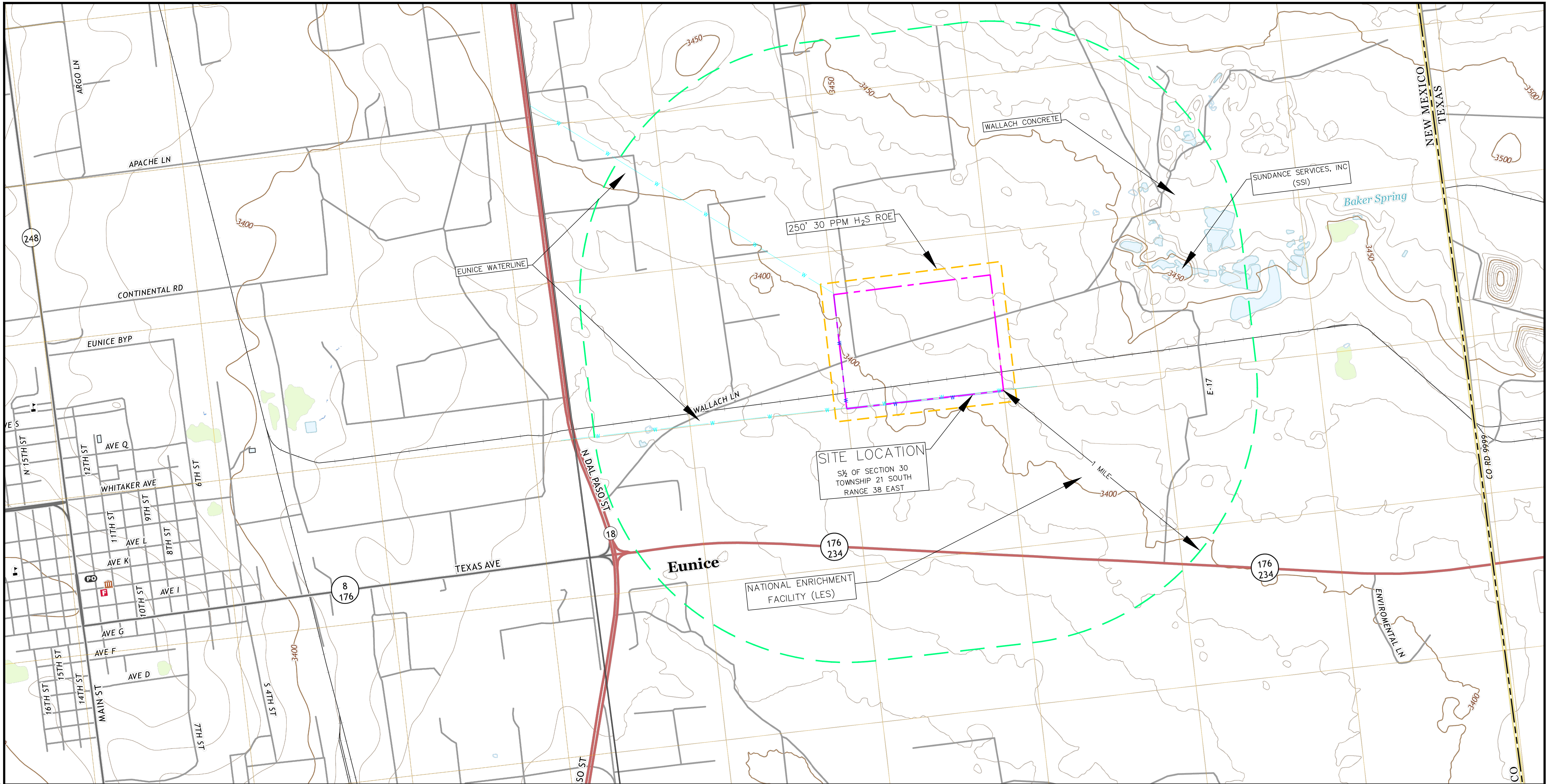
8. Recordkeeping

The EC will be responsible for ensuring that emergency response actions are fully documented. The primary EC may complete the documentation requirements or delegate these tasks to another EC. The incident report form (Appendix E) illustrates the information that will be recorded by the EC as a result of any emergency incident and related response action. This form will be signed by both the employee who reported the incident and the EC. Copies of the incident report form filed for each incident will be retained for OCD review as part of the facility operating record. In addition, online filings of form C-141 for each incident will be retained as part of the facility operating record.

9. Coordination Agreements

A copy of this plan will be made available to the organizations identified in Table 2. This plan serves to familiarize each of the identified organizations with the operations of the facility and types of emergencies and responses that may be required. Each agency will be encouraged to visit the facility for purposes of assessing site operations and providing input regarding emergency response procedures [19.15.11.9(B)(2)(e) NMAC].

Figures



Explanation



8/27/2026 Project DB18.1209

LEGEND

- FACILITY BOUNDARY
- 250' 30 PPM H2S ROE BOUNDARY
- 1 MILE RADIUS
- RELOCATED WATERLINE
- EXISTING WATERLINE

Note:
No streams, springs or water courses within 1/2 miles of site

Based on Eunice NW (2020)
Eunice NE, TX, NM (2022)
Quadrangles, USGS 7.5' SERIES (1:24,000 SCALE)

SSWI
SITE LOCATION MAP

Figure 1

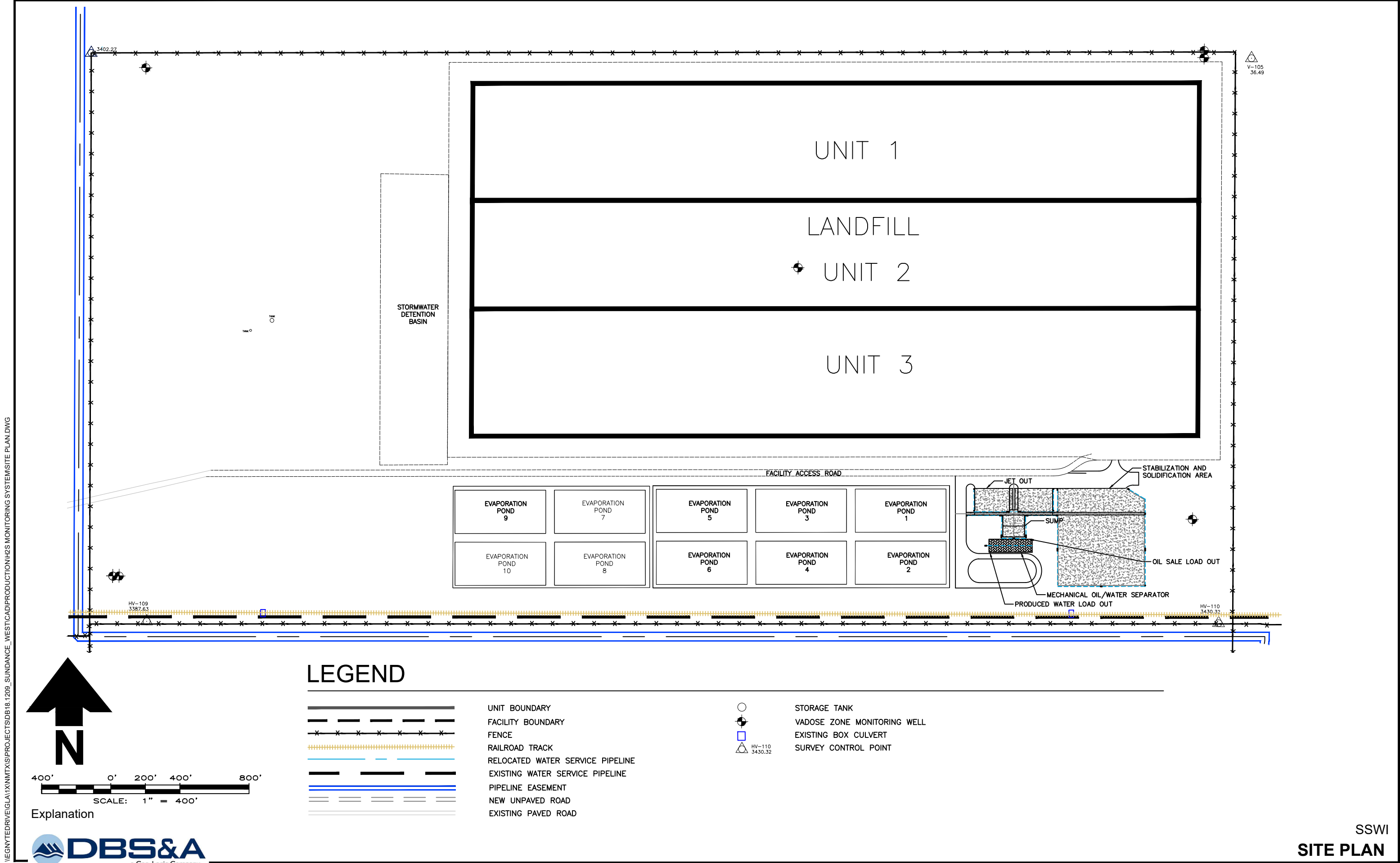


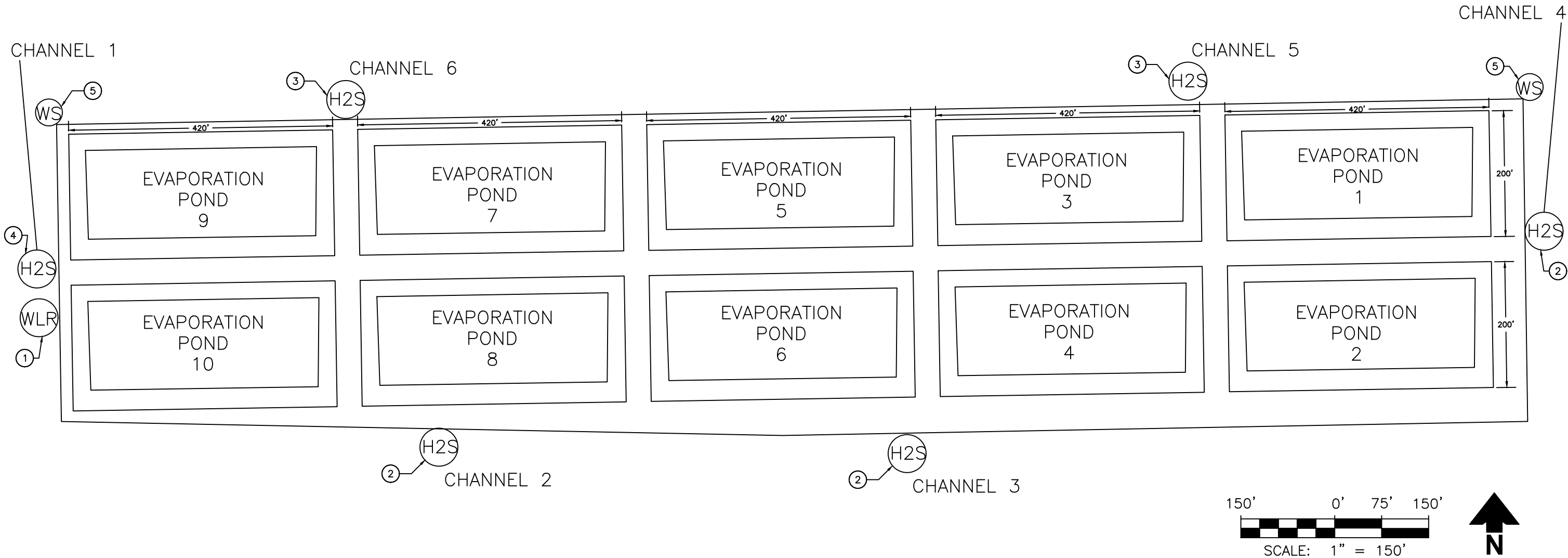
Figure 2

GENERAL NOTES:

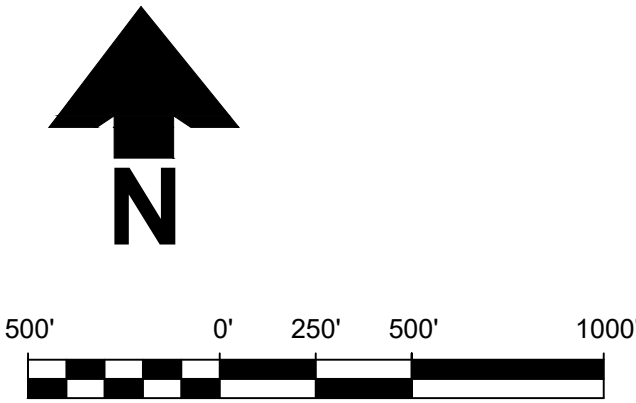
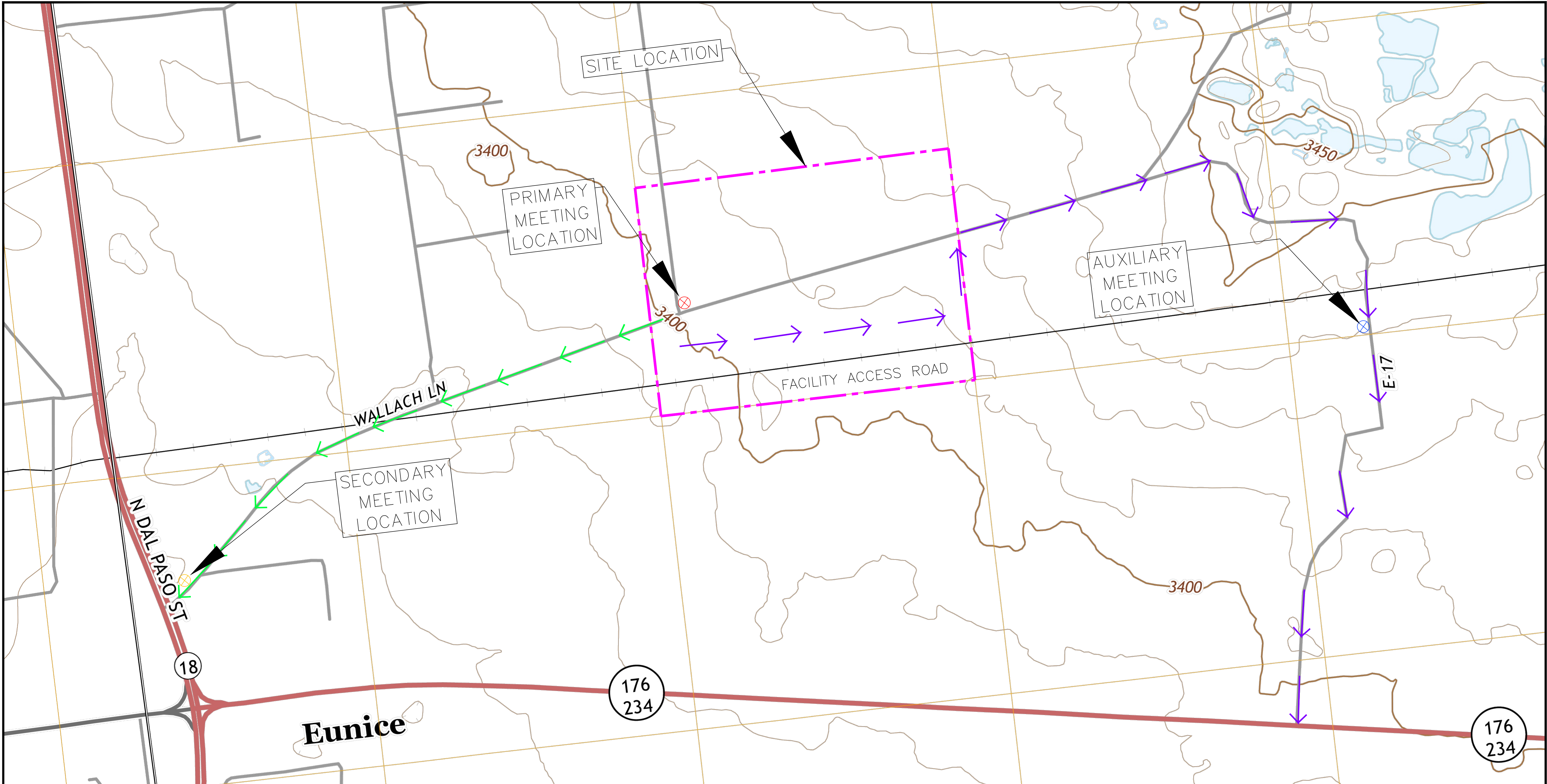
- 1. HYDROGEN SULFIDE (H₂S) MONITORING SYSTEM INCLUDES 6 H₂S SENSORS (0-100 PPM).
- 2. CHANNEL 1 H₂S SENSOR IS CO-LOCATED WITH THE WLR CONTROLLER.
- 3. 110/220 VAC POWER REQUIRED FOR THE WLR CONTROLLER AND THE CHANNEL 6 SENSOR.

KEY NOTES:

- ① RC SYSTEMS 32-CHANNEL WAVELINK RECEIVER (WLR) WIRELESS CONTROLLER WITH OMNIDIRECTIONAL ANTENNA, PIEZO BUZZER, AND RED STROBE. MOUNTED ON A POLE IN THE GROUND.
- ② RC SYSTEMS SENSMART 7100 EC BATTERY POWERED WIRELESS GAS MONITOR W/ OMNIDIRECTIONAL ANTENNA MOUNTED ON WEIGHTED SENSOR STAND WITH MOUNTING PLATE.
- ③ RC SYSTEMS SENSMART 7100 EC BATTERY POWERED WIRELESS GAS MONITOR W/ OMNIDIRECTIONAL ANTENNA MOUNTED ON THE EXISTING CHAIN LINK FENCE.
- ④ RC SYSTEMS SENSMART 7100 EC BATTERY POWERED WIRELESS GAS MONITOR W/ OMNIDIRECTIONAL ANTENNA MOUNTED ON THE ELECTRICAL RACK.
- ⑤ 18" X 60" WIND SOCK WITH SOLAR POWERED LIGHT.



Z:\1\NM\TX\PROJECTS\DB18.1209_SUNDANCE_WESTCADI\PRODUCTION\H2S MONITORING SYSTEM\SITE LOCATION.DWG



Explanation



LEGEND

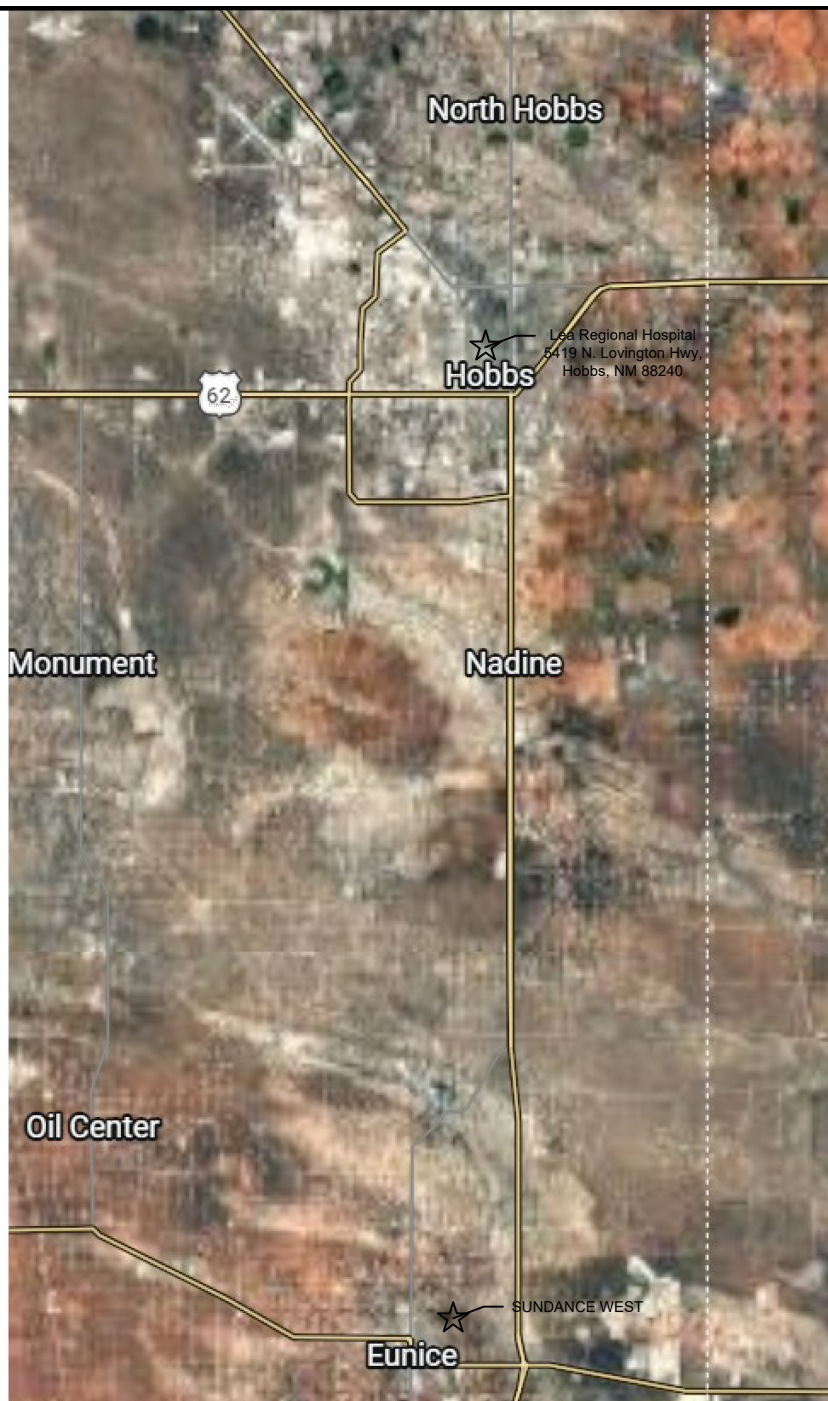
- FACILITY BOUNDARY
- PRIMARY MEETING LOCATION
- PRIMARY EVACUATION LOCATION
- SECONDARY MEETING LOCATION
- AUXILIARY MEETING LOCATION
- AUXILIARY EVACUATION LOCATION

Based on Eunice NW (2020)
Eunice NE, TX, NM (2022)
Quadrangles, USGS 7.5' SERIES (1:24,000 SCALE)

SSWI
SITE EVACUATION MAP

Figure 4

Z:\1\NM\TX\PROJECTS\18.1209_SUNDANCE_WEST\CAD\PRODUCTION\H2S MONITORING SYSTEM\HOSPITAL LOCATION MAP.DWG



A: Sundance West, Wallach Lane & NM-18, Eunice, NM 88231

1. Head north on NM-18 N for 15 mi
2. Turn left on S bypass for 0.9 mi
3. Turn right onto S Grimes St for 3.9 mi
4. Turn left onto N Turner St for 0.2 mi
5. Continue onto NM-18 N for 3.2 mi
6. Turn left onto Gerry St for 0.2 mi
7. Arrive 5419 N Locington HWY

B: Lead Regional Medical Center, 5419 N Lovington Hwy, Hobbs, NM 88240-9100

Note: A to B Travel Estimates: 31 minutes / 24.3 miles

SSWI
HOSPITAL LOCATION MAP

Figure 5

Appendix A

Safety Data Sheets

MSDS Code: 001909

Status: Final

Page 1/7

Date of Issue: 13-Oct-2005



MATERIAL SAFETY DATA SHEET

Hydrogen Sulfide

1. PRODUCT AND COMPANY IDENTIFICATION

Product Name: Hydrogen Sulfide
Synonyms: H₂S
Sour Gas
Sulfuretted Hydrogen
Hepatic Gas
Hydrosulfuric Acid
Alliance - Hydrogen Sulfide - 1605
Ferndale - Hydrogen Sulfide - 1605
LAR - Acid Gas
LAR - Sour Gas
Santa Maria - Acid gas
Santa Maria - Sour Gas
Trainer - Hydrogen Sulfide - S173
Wood River - Hydrogen Sulfide - 100240
Intended Use: Refinery by-product
Chemical Family: Inorganic Gas

Responsible Party: ConocoPhillips
600 N. Dairy Ashford
Houston, Texas 77079-1175

MSDS Information: 800-762-0942
MSDS@conocophillips.com

Emergency Overview

24 Hour Emergency Telephone Numbers:

Spill, Leak, Fire or Accident Call CHEMTREC:

North America: (800) 424-9300

Others: (703) 527-3887 (collect)

California Poison Control System: (800) 356-3219

Health Hazards/Precautionary Measures: Poisonous hydrogen sulfide gas. Harmful if inhaled. Causes severe eye irritation. Use with ventilation adequate to keep exposure below recommended limits, if any. Do not breathe gas. Avoid contact with eyes. Wash thoroughly after handling.

Physical Hazards/Precautionary Measures: Flammable gas. Can cause flash fire. Keep away from heat, sparks, flames, static electricity or other sources of ignition. Do not enter storage areas or confined space unless adequately ventilated.

Appearance: Colorless
Physical Form: Gas
Odor: Rotten egg (odorless at high concentrations or after prolonged exposure at low concentrations)

NFPA 704 Hazard Class:

Health: 4 (Extreme)
Flammability: 4 (Extreme)
Instability: 0 (Least)

MSDS Code: 001909

Status: Final

Page 2/7

Date of Issue: 13-Oct-2005

2. COMPOSITION / INFORMATION ON INGREDIENTS

HAZARDOUS COMPONENTS					
Component / CAS No:	Percent (%)	ACGIH:	OSHA:	NIOSH:	Other:
Hydrogen Sulfide 7783-06-4	100	10 ppm TWA 14 mg/m ³ TWA 15 ppm STEL 21 mg/m ³ STEL	20 ppm CEIL 50 ppm 10 min. peak	100 ppm IDLH	---

Note: State, local or other agencies or advisory groups may have established more stringent limits. Consult an industrial hygienist or similar professional, or your local agencies, for further information.

1%=10,000 PPM.

NE=Not Established

3. HAZARDS IDENTIFICATION

Potential Health Effects

Eye: Severe eye irritant. Contact may cause stinging, watering, redness, swelling, and eye damage.

Skin: Skin contact is unlikely. No information available on skin absorption.

Inhalation (Breathing): Toxic. May be harmful if inhaled.

Ingestion (Swallowing): This material is a gas under normal atmospheric conditions and ingestion is unlikely.

Signs and Symptoms: Effects of overexposure may include irritation of the eyes, nose, throat, and respiratory tract, blurred vision, photophobia (sensitivity to light), and pulmonary edema (fluid accumulation in the lungs). Severe exposures can result in nausea, vomiting, muscle weakness or cramps, headache, disorientation and other signs of nervous system depression, irregular heartbeats (arrhythmias), sudden collapse, respiratory failure, convulsions and death.

Cancer: There is no information available on the cancer hazard of this material.

Target Organs: No data available for this material.

Developmental: Inadequate data available for this material.

Other Comments: Hydrogen sulfide is a poisonous gas with the smell of rotten eggs. The smell disappears rapidly because of olfactory fatigue so odor may not be a reliable indicator of exposure.

Pre-Existing Medical Conditions: Conditions aggravated by exposure may include respiratory (asthma-like) disorders.

4. FIRST AID MEASURES

Eye: Immediately move victim away from exposure and into fresh air. If irritation or redness develops, flush eyes with clean water and seek immediate medical attention. For direct contact, immediately hold eyelids apart and flush the affected eye(s) with clean water for at least 20 minutes. Seek immediate medical attention.

Skin: First aid is not normally required. However, it is good practice to wash any chemical from the skin.

Inhalation (Breathing): Immediately move victim away from exposure and into fresh air. If respiratory symptoms or other symptoms of exposure develop, seek immediate medical attention. If victim is not breathing, clear airway and immediately begin artificial respiration. If breathing difficulties develop, oxygen should be administered by qualified personnel. Seek immediate medical attention.

Ingestion (Swallowing): This material is a gas under normal atmospheric conditions and ingestion is unlikely.

MSDS Code: 001909

Status: Final

Page 3/7

Date of Issue: 13-Oct-2005

Notes to Physician: In high doses hydrogen sulfide may produce pulmonary edema and respiratory depression or paralysis. The first priority in treatment should be the establishment of adequate ventilation and the administration of 100% oxygen. Animal studies suggest that nitrites are a useful antidote; however, documentation of the efficacy of nitrites in humans is lacking. If the diagnosis of H₂S is confirmed and the patient does not respond rapidly to supportive care, the use of nitrites is an alternative treatment. For adults the dose is 10 ml of a 3% NaNO₂ solution (0.5 gm NaNO₂ in 15 mL water) I.V. over 2-4 minutes. Dosage should be adjusted in children or in presence of anemia. Follow blood pressure, methemoglobin levels, arterial blood gases, and electrolytes closely in serious cases.

5. FIRE-FIGHTING MEASURES

Flammable Properties:

Flash Point:	10°F / -12°C
Test Method:	Test Method Unknown
OSHA Flammability Class:	Flammable Gas
LEL%:	4.0
UEL%:	46.0
Autoignition Temperature:	500°F / 260°C

Unusual Fire & Explosion Hazards: This material is flammable and can be ignited by heat, sparks, flames, or other sources of ignition (e.g., static electricity, pilot lights, or mechanical/electrical equipment, and electronic devices such as cell phones, computers, calculators, and pagers which have not been certified as intrinsically safe). Vapors may travel considerable distances to a source of ignition where they can ignite, flash back, or explode. Vapors are heavier than air and can accumulate in low areas. May create vapor/air explosion hazard indoors, in confined spaces, outdoors, or in sewers. If container is not properly cooled, it can rupture in the heat of a fire. Closed containers exposed to extreme heat can rupture due to pressure buildup.

Extinguishing Media: Dry chemical or carbon dioxide is recommended. Carbon dioxide can displace oxygen. Use caution when applying carbon dioxide in confined spaces.

Fire Fighting Instructions: For fires beyond the incipient stage, emergency responders in the immediate hazard area should wear bunker gear. When the potential chemical hazard is unknown, in enclosed or confined spaces, or when explicitly required by DOT, a self contained breathing apparatus should be worn. In addition, wear other appropriate protective equipment as conditions warrant (see Section 8).

Isolate immediate hazard area, keep unauthorized personnel out. Stop spill/release if it can be done with minimal risk. If this cannot be done, allow fire to burn. Move undamaged containers from immediate hazard area if it can be done with minimal risk. Stay away from ends of container.

Water spray may be useful in minimizing or dispersing vapors and to protect personnel. Cool equipment exposed to fire with water, if it can be done with minimal risk.

6. ACCIDENTAL RELEASE MEASURES

Flammable. Keep all sources of ignition and hot metal surfaces away from spill/release. The use of explosion-proof electrical equipment is recommended.

Stay upwind and away from spill/release. Notify persons down wind of the spill/release, isolate danger area and keep unauthorized personnel out. Stop spill/release if it can be done with minimal risk. Wear appropriate protective equipment including respiratory protection as conditions warrant (see Section 8).

Water spray may be useful in minimizing or dispersing vapors (see Section 5).

Notify fire authorities and appropriate federal, state, and local agencies. If spill/release in excess of EPA reportable quantity (see Section 15) is made into the environment, immediately notify the National Response Center (phone number 800-424-8802).

MSDS Code: 001909

Status: Final

Page 4/7

Date of Issue: 13-Oct-2005

7. HANDLING AND STORAGE

Handling: The use of explosion-proof electrical equipment is recommended and may be required (see appropriate fire codes). Refer to NFPA-704 and/or API RP 2003 for specific bonding/grounding requirements.

Do not enter confined spaces such as tanks or pits without following proper entry procedures such as ASTM D-4276 and 29CFR 1910.146. The use of appropriate respiratory protection is advised when concentrations exceed any established exposure limits (see Sections 2 and 8).

Use good personal hygiene practices.

Storage: Keep container(s) tightly closed. In a tank, barge, or other closed container, the vapor space above materials that contain hydrogen sulfide (H₂S) may result in concentrations immediately dangerous to life or health (IDLH). Use and store this material in cool, dry, well-ventilated areas away from heat, direct sunlight, hot metal surfaces, and all sources of ignition. Post area "No Smoking or Open Flame." Store only in approved containers. Keep away from any incompatible material (see Section 10). Protect container(s) against physical damage. Outdoor or detached storage is preferred.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Engineering controls: If current ventilation practices are not adequate to maintain airborne concentrations below the established exposure limits (see Section 2), additional engineering controls may be required. Where explosive mixtures may be present, electrical systems safe for such locations must be used (see appropriate electrical codes).

Personal Protective Equipment (PPE):

Respiratory: Use a NIOSH approved self-contained breathing apparatus (SCBA) or equivalent operated in a pressure demand or other positive pressure mode in oxygen deficient environments (oxygen content <19.5%) or if exposure concentration is unknown or if conditions immediately dangerous to life or health (IDLH) exist.

A respiratory protection program that meets OSHA's 29 CFR 1910.134 and ANSI Z88.2 requirements must be followed whenever workplace conditions warrant a respirator's use.

Skin: Not required based on the hazards of the material. However, it is considered good practice to wear gloves when handling chemicals.

Eye/Face: The use of a face shield and chemical goggles to safeguard against potential eye contact, irritation, or injury is recommended.

Other Protective Equipment: A source of clean water should be available in the work area for flushing eyes and skin. Impervious clothing should be worn as needed.

Suggestions for the use of specific protective materials are based on readily available published data. Users should check with specific manufacturers to confirm the performance of their products.

9. PHYSICAL AND CHEMICAL PROPERTIES

Note: Unless otherwise stated, values are determined at 20°C (68°F) and 760 mm Hg (1 atm).

Appearance:	Colorless
Physical Form:	Gas
Odor:	Rotten egg (odorless at high concentrations or after prolonged exposure at low concentrations)
Odor Threshold:	0.0047 ppm
pH:	Not applicable
Vapor Pressure (mm Hg):	554.6 psia @ 100°F (38°C)
Vapor Density (air=1):	1.20
Boiling Point:	-60°F / -12°C
Melting/Freezing Point:	-86°F / -66°C
Solubility in Water:	Slight
Partition Coefficient (n-octanol/water) (Kow):	No data
Specific Gravity:	1.2 (Gas)
Heat Value (BTU):	-6552 (BTU/lb)

MSDS Code: 001909

Status: Final

Page 5/7

Date of Issue: 13-Oct-2005

Percent Volatile:	100%
Evaporation Rate (nBuAc=1):	>1
Molecular Weight:	34.08
Flash Point:	10°F / -12°C
Test Method:	Test Method Unknown
LEL%:	4.0
UEL%:	46.0
Autoignition Temperature:	500°F / 260°C

10. STABILITY AND REACTIVITY

Stability: Stable under normal ambient and anticipated storage and handling conditions of temperature and pressure. Flammable gas.

Conditions to Avoid: Avoid high temperatures and all sources of ignition (see Sections 5 and 7). Toxic fumes can be released on heating.

Materials to Avoid (Incompatible Materials): Avoid contact with nitric acid, strong oxidizing agents.

Hazardous Decomposition Products: Combustion can yield sulfur oxides.

Hazardous Polymerization: Will not occur.

11. TOXICOLOGICAL INFORMATION

Chronic Data:

No definitive information available on carcinogenicity, mutagenicity, target organ, or developmental toxicity.

Acute Data:

Hydrogen Sulfide - CAS: 7783-06-4

Dermal LD50 = Not Applicable

LC50 = 600 ppm, 30 min. (Human)

Oral LD50 = Not Applicable

12. ECOLOGICAL INFORMATION

Not evaluated at this time.

13. DISPOSAL CONSIDERATIONS

This material, if discarded as produced or spilled to soil or water, would be a RCRA "listed" hazardous waste, as would any soils or waters contaminated by spills of the material. This material is listed as hydrogen sulfide (U135). Further, this material, once it becomes a waste, is subject to the land disposal restrictions at 40 CFR 268.40 and must be treated prior to disposal to meet specific standards. Consult state and local regulations to determine whether they are more stringent than the federal requirements.

Container contents should be completely used and containers should be emptied prior to discard. Container rinsate could be considered a RCRA hazardous waste and must be disposed of with care and in full compliance with federal, state and local regulations. Larger empty containers, such as drums, should be returned to the distributor or to a drum reconditioner. To assure proper disposal of smaller empty containers, consult with state and local regulations and disposal authorities.

14. TRANSPORTATION INFORMATION

DOT

Note: This material normally remains in plant and does not enter the public transportation system. i.e. rail, highway, air or water.

IMDG

ICAO/IATA

MSDS Code: 001909

Status: Final

Page 6/7

Date of Issue: 13-Oct-2005

	LTD. QTY.	Passenger Aircraft	Cargo Aircraft Only
Packaging Instruction #:	---	---	---
Max. Net Qty. Per Package:	---	---	---

15. REGULATORY INFORMATION

U.S. Regulations:

EPA SARA 311/312 (Title III Hazard Categories)

Acute Health: Yes
Chronic Health: No
Fire Hazard: Yes
Pressure Hazard: No
Reactive Hazard: No

SARA - Section 313 and 40 CFR 372:

This material contains the following chemicals subject to the reporting requirements of SARA 313 and 40 CFR 372:
Hydrogen Sulfide.....7783-06-4.....100%

EPA (CERCLA) Reportable Quantity (in pounds):

Petroleum Exemption applies to this material.

CERCLA/SARA - Section 302 Extremely Hazardous Substances and TPQs (in pounds):

This material contains the following chemicals subject to the reporting requirements of SARA 302 and 40 CFR 372:
Hydrogen Sulfide.....7783-06-4.....500

California Proposition 65:

Warning: This material contains the following chemicals which are known to the State of California to cause cancer, birth defects or other reproductive harm, and are subject to the requirements of California Proposition 65 (CA Health & Safety Code Section 25249.5):
-- None Known --

Carcinogen Identification:

This material has not been identified as a carcinogen by NTP, IARC, or OSHA.

TSCA:

All components are listed on the TSCA inventory.

International Regulations:

Canadian Regulations:

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR.

Domestic Substances List: Listed

WHMIS Hazard Class:

B1 - Flammable Gases

D1A - Materials Causing Immediate and Serious Toxic Effects - Very Toxic Material

D2B - Materials Causing Other Toxic Effects - Toxic Material

16. OTHER INFORMATION

Issue Date:

13-Oct-2005

Previous Issue Date:

28-Dec-2000

Revised Sections or Basis for Revision:

Responsible party (Section 1)

Added facility synonyms - SEE SECTION 1.

MSDS Code:

001909

MSDS Code: 001909

Status: Final

Page 7/7

Date of Issue: 13-Oct-2005

Disclaimer of Expressed and implied Warranties:

The information presented in this Material Safety Data Sheet is based on data believed to be accurate as of the date this Material Safety Data Sheet was prepared. HOWEVER, NO WARRANTY OF MERCHANTABILITY, FITNESS FOR ANY PARTICULAR PURPOSE, OR ANY OTHER WARRANTY IS EXPRESSED OR IS TO BE IMPLIED REGARDING THE ACCURACY OR COMPLETENESS OF THE INFORMATION PROVIDED ABOVE, THE RESULTS TO BE OBTAINED FROM THE USE OF THIS INFORMATION OR THE PRODUCT, THE SAFETY OF THIS PRODUCT, OR THE HAZARDS RELATED TO ITS USE. No responsibility is assumed for any damage or injury resulting from abnormal use or from any failure to adhere to recommended practices. The information provided above, and the product, are furnished on the condition that the person receiving them shall make their own determination as to the suitability of the product for their particular purpose and on the condition that they assume the risk of their use. In addition, no authorization is given nor implied to practice any patented invention without a license.

SAFETY DATA SHEET

Sulfur Dioxide

Airgas
an Air Liquide company

Section 1. Identification

GHS product identifier	: Sulfur Dioxide
Chemical name	: sulphur dioxide
Other means of identification	: Sulfur dioxide; Sulfur oxide; Sulfurous oxide; Sulfurous acid anhydride; E 220; sulphurous acid anhydride; Sulfur superoxide; Sulfurous anhydride; Sulfur dioxide, anhydrous; Dioxide of sulfur; Sulphure dioxide; SULFUR DIOXIDE, LIQUID
Product type	: Gas.
Product use	: Synthetic/Analytical chemistry.
Synonym	: Sulfur dioxide; Sulfur oxide; Sulfurous oxide; Sulfurous acid anhydride; E 220; sulphurous acid anhydride; Sulfur superoxide; Sulfurous anhydride; Sulfur dioxide, anhydrous; Dioxide of sulfur; Sulphure dioxide; SULFUR DIOXIDE, LIQUID
SDS #	: 001047
Supplier's details	: Airgas USA, LLC and its affiliates 259 North Radnor-Chester Road Suite 100 Radnor, PA 19087-5283 1-610-687-5253
24-hour telephone	: 1-866-734-3438

Section 2. Hazards identification

OSHA/HCS status	: This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).
Classification of the substance or mixture	: GASES UNDER PRESSURE - Liquefied gas ACUTE TOXICITY (inhalation) - Category 3 SKIN CORROSION - Category 1 SERIOUS EYE DAMAGE - Category 1

GHS label elements

Hazard pictograms**Signal word**

: Danger

Hazard statements: Contains gas under pressure; may explode if heated.
Causes severe skin burns and eye damage.
Toxic if inhaled.**Precautionary statements****General**

: Read and follow all Safety Data Sheets (SDS'S) before use. Read label before use. Keep out of reach of children. If medical advice is needed, have product container or label at hand. Close valve after each use and when empty. Use equipment rated for cylinder pressure. Do not open valve until connected to equipment prepared for use. Use a back flow preventative device in the piping. Use only equipment of compatible materials of construction. Always keep container in upright position.

Prevention

: Wear protective gloves. Wear protective clothing. Wear eye or face protection. Use only outdoors or in a well-ventilated area. Avoid breathing gas.

Response

: Immediately call a POISON CENTER or doctor. IF INHALED: Remove person to fresh air and keep comfortable for breathing. IF SWALLOWED: Rinse mouth. Do NOT induce vomiting. IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water. IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

Storage

: Store locked up. Protect from sunlight. Store in a well-ventilated place.

Sulfur Dioxide

Section 2. Hazards identification

Disposal : Dispose of contents and container in accordance with all local, regional, national and international regulations.

Hazards not otherwise classified : None known.

Section 3. Composition/information on ingredients

Substance/mixture : Substance
Chemical name : sulphur dioxide
Other means of identification : Sulfur dioxide; Sulfur oxide; Sulfurous oxide; Sulfurous acid anhydride; E 220; sulphurous acid anhydride; Sulfur superoxide; Sulfurous anhydride; Sulfur dioxide, anhydrous; Dioxide of sulfur; Sulphure dioxide; SULFUR DIOXIDE, LIQUID
Product code : 001047

CAS number/other identifiers

CAS number : 7446-09-5

Ingredient name	%	CAS number
sulphur dioxide	100	7446-09-5

Any concentration shown as a range is to protect confidentiality or is due to batch variation.

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

Occupational exposure limits, if available, are listed in Section 8.

Section 4. First aid measures

Description of necessary first aid measures

Eye contact : Get medical attention immediately. Call a poison center or physician. Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 10 minutes. Chemical burns must be treated promptly by a physician.

Inhalation : Get medical attention immediately. Call a poison center or physician. Remove victim to fresh air and keep at rest in a position comfortable for breathing. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband.

Skin contact : Get medical attention immediately. Call a poison center or physician. Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. Wash contaminated clothing thoroughly with water before removing it, or wear gloves. Continue to rinse for at least 10 minutes. Chemical burns must be treated promptly by a physician. Wash clothing before reuse. Clean shoes thoroughly before reuse.

Ingestion : As this product is a gas, refer to the inhalation section.

Most important symptoms/effects, acute and delayed

Potential acute health effects

Eye contact : Causes serious eye damage.
Inhalation : Toxic if inhaled.
Skin contact : Causes severe burns.
Frostbite : Try to warm up the frozen tissues and seek medical attention.
Ingestion : As this product is a gas, refer to the inhalation section.

Over-exposure signs/symptoms

Eye contact : Adverse symptoms may include the following:, pain, watering, redness

Sulfur Dioxide

Section 4. First aid measures

- Inhalation** : No specific data.
- Skin contact** : Adverse symptoms may include the following: pain or irritation, redness, blistering may occur
- Ingestion** : Adverse symptoms may include the following: stomach pains

Indication of immediate medical attention and special treatment needed, if necessary

- Notes to physician** : Treat symptomatically. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled.
- Specific treatments** : No specific treatment.
- Protection of first-aiders** : No action shall be taken involving any personal risk or without suitable training. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Wash contaminated clothing thoroughly with water before removing it, or wear gloves.

See toxicological information (Section 11)

Section 5. Fire-fighting measures

Extinguishing media

- Suitable extinguishing media** : Use an extinguishing agent suitable for the surrounding fire.
- Unsuitable extinguishing media** : None known.

- Specific hazards arising from the chemical** : Contains gas under pressure. In a fire or if heated, a pressure increase will occur and the container may burst or explode.
- Hazardous thermal decomposition products** : Decomposition products may include the following materials: sulfur oxides

- Special protective actions for fire-fighters** : Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Contact supplier immediately for specialist advice. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool.

- Special protective equipment for fire-fighters** : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Section 6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

- For non-emergency personnel** : No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Do not breathe gas. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment.
- For emergency responders** : If specialized clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

- Environmental precautions** : Ensure emergency procedures to deal with accidental gas releases are in place to avoid contamination of the environment. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

Methods and materials for containment and cleaning up

- Small spill** : Immediately contact emergency personnel. Stop leak if without risk.

Sulfur Dioxide

Section 6. Accidental release measures

- Large spill** : Immediately contact emergency personnel. Stop leak if without risk. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

Section 7. Handling and storage

Precautions for safe handling

- Protective measures** : Put on appropriate personal protective equipment (see Section 8). Contains gas under pressure. Do not get in eyes or on skin or clothing. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Do not puncture or incinerate container. Use equipment rated for cylinder pressure. Close valve after each use and when empty. Protect cylinders from physical damage; do not drag, roll, slide, or drop. Use a suitable hand truck for cylinder movement.

Empty containers retain product residue and can be hazardous. Do not breathe gas.

- Advice on general occupational hygiene** : Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.

- Conditions for safe storage, including any incompatibilities** : Store in accordance with local regulations. Store in a segregated and approved area. Store away from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10). Cylinders should be stored upright, with valve protection cap in place, and firmly secured to prevent falling or being knocked over. Cylinder temperatures should not exceed 52 °C (125 °F). Store locked up. Keep container tightly closed and sealed until ready for use. See Section 10 for incompatible materials before handling or use.

Section 8. Exposure controls/personal protection

Control parameters

Occupational exposure limits

Ingredient name	Exposure limits
sulphur dioxide	California PEL for Chemical Contaminants (Table AC-1) (United States). PEL: 2 ppm 8 hours. STEL: 5 ppm 15 minutes. ACGIH TLV (United States, 3/2019). STEL: 0.25 ppm 15 minutes. OSHA PEL 1989 (United States, 3/1989). TWA: 2 ppm 8 hours. TWA: 5 mg/m³ 8 hours. STEL: 5 ppm 15 minutes. STEL: 10 mg/m³ 15 minutes. NIOSH REL (United States, 10/2016). TWA: 2 ppm 10 hours. TWA: 5 mg/m³ 10 hours. STEL: 5 ppm 15 minutes. STEL: 13 mg/m³ 15 minutes. OSHA PEL (United States, 5/2018). TWA: 5 ppm 8 hours. TWA: 13 mg/m³ 8 hours.

- Appropriate engineering controls** : Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits.

- Environmental exposure controls** : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

Sulfur Dioxide

Section 8. Exposure controls/personal protection

Individual protection measures

- Hygiene measures** : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.
- Eye/face protection** : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If contact is possible, the following protection should be worn, unless the assessment indicates a higher degree of protection: chemical splash goggles and/or face shield. If inhalation hazards exist, a full-face respirator may be required instead.
- Skin protection**
- Hand protection** : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary. Considering the parameters specified by the glove manufacturer, check during use that the gloves are still retaining their protective properties. It should be noted that the time to breakthrough for any glove material may be different for different glove manufacturers. In the case of mixtures, consisting of several substances, the protection time of the gloves cannot be accurately estimated.
- Body protection** : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.
- Other skin protection** : Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.
- Respiratory protection** : Based on the hazard and potential for exposure, select a respirator that meets the appropriate standard or certification. Respirators must be used according to a respiratory protection program to ensure proper fitting, training, and other important aspects of use. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

Section 9. Physical and chemical properties

Appearance

- Physical state** : Gas. {NOTE: A LIQUID BELOW 14 F. SHIPPED AS A LIQUEFIED COMPRESSED GAS.}
- Color** : Colorless.
- Odor** : Pungent.
- Odor threshold** : Not available.
- pH** : Not available.
- Melting point** : -72°C (-97.6°F)
- Boiling point** : -10°C (14°F)
- Critical temperature** : 156.85°C (314.3°F)
- Flash point** : [Product does not sustain combustion.]
- Evaporation rate** : Not available.
- Flammability (solid, gas)** : Not available.
- Lower and upper explosive (flammable) limits** : Not available.
- Vapor pressure** : 34 (psig)
- Vapor density** : 2.25 (Air = 1)
- Specific Volume (ft³/lb)** : 5.9172
- Gas Density (lb/ft³)** : 0.169
- Relative density** : Not applicable.
- Solubility** : Not available.
- Solubility in water** : Not available.

Sulfur Dioxide

Section 9. Physical and chemical properties

Partition coefficient: n-octanol/water	: Not available.
Auto-ignition temperature	: Not available.
Decomposition temperature	: Not available.
Viscosity	: Not applicable.
Flow time (ISO 2431)	: Not available.
Molecular weight	: 64.06 g/mole

Section 10. Stability and reactivity

Reactivity	: No specific test data related to reactivity available for this product or its ingredients.
Chemical stability	: The product is stable.
Possibility of hazardous reactions	: Under normal conditions of storage and use, hazardous reactions will not occur.
Conditions to avoid	: No specific data.
Incompatible materials	: No specific data.
Hazardous decomposition products	: Under normal conditions of storage and use, hazardous decomposition products should not be produced.

Hazardous polymerization : Under normal conditions of storage and use, hazardous polymerization will not occur.

Section 11. Toxicological information

Information on toxicological effects

Acute toxicity

Product/ingredient name	Result	Species	Dose	Exposure
sulphur dioxide	LC50 Inhalation Gas.	Rat	2520 ppm	1 hours

Irritation/Corrosion

Product/ingredient name	Result	Species	Score	Exposure	Observation
sulphur dioxide	Eyes - Mild irritant	Rabbit	-	768 hours 6 ppm	-

Sensitization

Not available.

Mutagenicity

Not available.

Carcinogenicity

Not available.

Classification

Product/ingredient name	OSHA	IARC	NTP
sulphur dioxide	-	3	-

Reproductive toxicity

Not available.

Teratogenicity

Sulfur Dioxide

Section 11. Toxicological information

Not available.

Specific target organ toxicity (single exposure)

Not available.

Specific target organ toxicity (repeated exposure)

Not available.

Aspiration hazard

Not available.

Information on the likely routes of exposure : Not available.

Potential acute health effects

Eye contact : Causes serious eye damage.
Inhalation : Toxic if inhaled.
Skin contact : Causes severe burns.
Ingestion : As this product is a gas, refer to the inhalation section.

Symptoms related to the physical, chemical and toxicological characteristics

Eye contact : Adverse symptoms may include the following:, pain, watering, redness
Inhalation : No specific data.
Skin contact : Adverse symptoms may include the following:, pain or irritation, redness, blistering may occur
Ingestion : Adverse symptoms may include the following:, stomach pains

Delayed and immediate effects and also chronic effects from short and long term exposure

Short term exposure

Potential immediate effects : Not available.
Potential delayed effects : Not available.

Long term exposure

Potential immediate effects : Not available.
Potential delayed effects : Not available.

Potential chronic health effects

Not available.

General : No known significant effects or critical hazards.
Carcinogenicity : No known significant effects or critical hazards.
Mutagenicity : No known significant effects or critical hazards.
Teratogenicity : No known significant effects or critical hazards.
Developmental effects : No known significant effects or critical hazards.
Fertility effects : No known significant effects or critical hazards.

Numerical measures of toxicity

Acute toxicity estimates

Route	ATE value
Inhalation (gases)	1260 ppm

Sulfur Dioxide

Section 12. Ecological information

Toxicity

Not available.

Persistence and degradability

Not available.

Bioaccumulative potential

Not available.

Mobility in soil

Soil/water partition coefficient (K_{oc}) : Not available.

Other adverse effects : No known significant effects or critical hazards.

Section 13. Disposal considerations

Disposal methods : The generation of waste should be avoided or minimized wherever possible. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction. Empty Airgas-owned pressure vessels should be returned to Airgas. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Empty containers or liners may retain some product residues. Do not puncture or incinerate container.

Section 14. Transport information

	DOT	TDG	Mexico	IMDG	IATA
UN number	UN1079	UN1079	UN1079	UN1079	UN1079
UN proper shipping name	SULFUR DIOXIDE	SULFUR DIOXIDE; OR SULPHUR DIOXIDE	SULFUR DIOXIDE	SULPHUR DIOXIDE	SULPHUR DIOXIDE
Transport hazard class(es)	2.3 (8) 	2.3 (8) 	2.3 (8) 	2.3 (8) 	2.3 (8) 
Packing group	-	-	-	-	-
Environmental hazards	No.	No.	No.	No.	No.

“Refer to CFR 49 (or authority having jurisdiction) to determine the information required for shipment of the product.”

Additional information

DOT Classification : Toxic - Inhalation hazard Zone C
Limited quantity Yes.
Quantity limitation Passenger aircraft/rail: Forbidden. Cargo aircraft: Forbidden.
Special provisions 3, B14, T50, TP19

Sulfur Dioxide

Section 14. Transport information

TDG Classification : Product classified as per the following sections of the Transportation of Dangerous Goods Regulations: 2.13-2.17 (Class 2), 2.40-2.42 (Class 8).

Explosive Limit and Limited Quantity Index 0

ERAP Index 500

Passenger Carrying Vessel Index Forbidden

Passenger Carrying Road or Rail Index Forbidden

IATA : **Quantity limitation** Passenger and Cargo Aircraft: Forbidden. Cargo Aircraft Only: Forbidden.

Special precautions for user : **Transport within user's premises:** always transport in closed containers that are upright and secure. Ensure that persons transporting the product know what to do in the event of an accident or spillage.

Transport in bulk according to IMO instruments : Not available.

Section 15. Regulatory information

U.S. Federal regulations : **TSCA 8(a) CDR Exempt/Partial exemption:** Not determined

Clean Air Act (CAA) 112 regulated toxic substances: sulphur dioxide

Clean Air Act Section 112 : Not listed

(b) Hazardous Air Pollutants (HAPs)

Clean Air Act Section 602 : Not listed

Class I Substances

Clean Air Act Section 602 : Not listed

Class II Substances

DEA List I Chemicals : Not listed

(Precursor Chemicals)

DEA List II Chemicals : Not listed

(Essential Chemicals)

SARA 302/304

Composition/information on ingredients

Name	%	EHS	SARA 302 TPQ		SARA 304 RQ	
			(lbs)	(gallons)	(lbs)	(gallons)
sulphur dioxide	100	Yes.	500	-	500	-

SARA 304 RQ : 500 lbs / 227 kg

SARA 311/312

Classification : Refer to Section 2: Hazards Identification of this SDS for classification of substance.

State regulations

Massachusetts : This material is listed.

New York : This material is listed.

New Jersey : This material is listed.

Pennsylvania : This material is listed.

California Prop. 65

⚠ WARNING: This product can expose you to sulfur dioxide, which is known to the State of California to cause birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov.

Sulfur Dioxide

Section 15. Regulatory information

Ingredient name	No significant risk level	Maximum acceptable dosage level
sulfur dioxide	-	Yes.

International regulations

Chemical Weapon Convention List Schedules I, II & III Chemicals

Not listed.

Montreal Protocol

Not listed.

Stockholm Convention on Persistent Organic Pollutants

Not listed.

Rotterdam Convention on Prior Informed Consent (PIC)

Not listed.

UNECE Aarhus Protocol on POPs and Heavy Metals

Not listed.

Inventory list

Australia	: This material is listed or exempted.
Canada	: This material is listed or exempted.
China	: This material is listed or exempted.
Europe	: This material is listed or exempted.
Japan	: Japan inventory (ENCS) : This material is listed or exempted. Japan inventory (ISHL) : Not determined.
New Zealand	: This material is listed or exempted.
Philippines	: This material is listed or exempted.
Republic of Korea	: This material is listed or exempted.
Taiwan	: This material is listed or exempted.
Thailand	: Not determined.
Turkey	: Not determined.
United States	: This material is active or exempted.
Viet Nam	: This material is listed or exempted.

Section 16. Other information

Hazardous Material Information System (U.S.A.)

Health	/	3
Flammability		0
Physical hazards		3

Caution: HMIS® ratings are based on a 0-4 rating scale, with 0 representing minimal hazards or risks, and 4 representing significant hazards or risks. Although HMIS® ratings and the associated label are not required on SDSs or products leaving a facility under 29 CFR 1910.1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered trademark and service mark of the American Coatings Association, Inc.

The customer is responsible for determining the PPE code for this material. For more information on HMIS® Personal Protective Equipment (PPE) codes, consult the HMIS® Implementation Manual.

National Fire Protection Association (U.S.A.)

Sulfur Dioxide

Section 16. Other information

Reprinted with permission from NFPA 704-2001, Identification of the Hazards of Materials for Emergency Response Copyright ©1997, National Fire Protection Association, Quincy, MA 02269. This reprinted material is not the complete and official position of the National Fire Protection Association, on the referenced subject which is represented only by the standard in its entirety.

Copyright ©2001, National Fire Protection Association, Quincy, MA 02269. This warning system is intended to be interpreted and applied only by properly trained individuals to identify fire, health and reactivity hazards of chemicals. The user is referred to certain limited number of chemicals with recommended classifications in NFPA 49 and NFPA 325, which would be used as a guideline only. Whether the chemicals are classified by NFPA or not, anyone using the 704 systems to classify chemicals does so at their own risk.

Procedure used to derive the classification

Classification	Justification
GASES UNDER PRESSURE - Liquefied gas ACUTE TOXICITY (inhalation) - Category 3 SKIN CORROSION - Category 1 SERIOUS EYE DAMAGE - Category 1	Expert judgment On basis of test data Expert judgment Expert judgment

History

Date of printing : 9/29/2021

Date of issue/Date of revision : 9/29/2021

Date of previous issue : 2/1/2018

Version : 1.02

Key to abbreviations : ATE = Acute Toxicity Estimate
BCF = Bioconcentration Factor
GHS = Globally Harmonized System of Classification and Labelling of Chemicals
IATA = International Air Transport Association
IBC = Intermediate Bulk Container
IMDG = International Maritime Dangerous Goods
LogPow = logarithm of the octanol/water partition coefficient
MARPOL = International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978. ("Marpol" = marine pollution)
UN = United Nations

References : Not available.

Notice to reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.

Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

Appendix B

Immediate Action Plan



Appendix B. Immediate Action Plan

Overview

(This Immediate Action Plan was written following guidance provided by API RP-55.)

Six stationary gas detectors (R.C. Systems SenSmart 7100 EC detectors) with hydrogen sulfide (H₂S) sensors capable of measuring concentrations between 0 to 100 parts per million (ppm) are installed around the evaporation ponds at the Sundance Services West, Inc. (SSWI) facility. The six gas detectors communicate wirelessly to an RC Systems 32 Channel WaveLink Receiver (WLR) controller, which is installed on a steel post west of the ponds. The RC Systems WLR controller is outfitted with a rotating red strobe. These seven pieces of equipment comprise a WaveNet Wireless Monitoring System as defined by RC Systems.

The controller is programmed to send email and text notifications whenever alarm conditions are present. Alarms will include information on the sensor (channel) producing the alarm. A site map of the ponds (Figure 3 of the H₂S prevention and contingency plan [H₂S plan]) can be used to identify the location of the alarming sensor(s). Personnel monitors will also follow the same alarm conditions and actions. The alarm conditions are outlined in the following table.

Alarm Type	Alarm Condition
Minor	10 ppm ≤ H ₂ S Concentration < 30 ppm
Major	30 ppm ≤ H ₂ S Concentration < 100 ppm
Critical	100 ppm ≤ H ₂ S Concentration

Wind socks were installed on the east and west ends of the northern section of chain link fence surrounding the ponds. The purpose of the wind socks is to indicate the direction of the wind so that site personnel can move away from the potential source. Wind speeds and direction will also be monitored and recorded daily when feasible.

The plan activation level set by the H₂S plan is 100 ppm. However, H₂S may still be harmful to human health in low concentrations. Any measurement of H₂S above 10 ppm requires activation of this immediate action plan.



Minor Alarm

A minor alarm is activated when H₂S concentrations greater than or equal to 10 ppm but less than 30 ppm are measured by any gas monitoring sensors. If a minor alarm is activated, the following procedures must be implemented:

- Move to a location upwind of the affected area(s). Notify the emergency coordinator (EC).
- Remotely monitor downwind concentrations using stationary sensors.
- Remain upwind of the affected area until H₂S concentrations remain below 10 ppm for 10 minutes. Notify the EC if H₂S concentrations remain above 10 ppm for more than 10 minutes.

Major Alarm

A major alarm is activated when H₂S concentrations greater than or equal to 30 ppm but less than 100 ppm are measured by any gas monitoring sensors. In the case of a major alarm, the following procedures shall be implemented:

- Notify the EC and evacuate the area following the site evacuation procedures listed in this plan.
- Remotely monitor downwind concentrations using stationary sensors. Have the EC or other designated personnel assess the source, severity, and extent of the alarm using appropriate personal protective equipment (PPE) (i.e., personal breathing equipment). Personnel performing this assessment must have proper training to safely perform the task quickly and effectively.
- Have trained personnel wearing appropriate PPE take immediate measures to manage the present or imminent release of H₂S. Eliminate all possible sources of ignition. If H₂S concentrations remain above 30 ppm for more than 10 minutes, treat the release as a critical alarm; follow procedures listed in this immediate action plan.
- Monitor the stationary sensors to determine when the area is safe for reentry.
- If the activities of any personnel are affected by a major alarm, the EC and each affected person will complete an incident report form (Appendix E of the H₂S plan) as soon as



Hydrogen Sulfide Prevention and Contingency Plan Sundance Services West, Inc.

possible following the event. These forms will be retained as part of the facility operating record.

- Obtain analysis of dissolved sulfides in the ponds, if feasible.

Critical Alarm

A critical alarm is activated when H₂S concentrations greater than or equal to 100 ppm are observed at any gas monitoring sensors or when a major alarm remains activated for longer than 10 consecutive minutes. In the case of a critical alarm, the following procedures shall be followed:

- Close the facility. Evacuate the area following the site evacuation procedures listed in this plan. Notify the EC and activate the H₂S contingency plan.
- Remotely monitor downwind concentrations using stationary sensors. Have the EC or other designated personnel assess the source, severity, and extent of the alarm using appropriate PPE (i.e., personal breathing equipment). Personnel performing this assessment must have proper training to safely perform the task quickly and effectively.
- Have trained personnel wearing appropriate PPE take immediate measures to manage the present or imminent release of H₂S. Eliminate all possible sources of ignition. If the required action cannot be completed without exposing operating personnel or the public to hazardous concentrations of H₂S, evacuate all persons and proceed to the next steps.
- Notify authorities (New Mexico State Police, Lea County Sherriff's Department, Lea County Office of Emergency Management, and OCD) upon activation of the hydrogen sulfide contingency plan as soon as possible, but no more than 4 hours after plan activation. Recognize that a prompt response should supersede notification.
- Make recommendations to public officials regarding preventing unauthorized access to the area.
- Coordinate with authorities to assist in any necessary abatement measures.
- Monitor the stationary sensors to determine when the area is safe for reentry.
- Obtain analysis of dissolved sulfides in the ponds, if feasible.
- Submit a full report of the incident to the OCD using form C-141 (file electronically through OCD Permitting) no later than 15 days following the release.



Site Evacuation Plan

When evacuation is required, the following procedures will be followed:

1. Facility personnel will be alerted directly or using the facility telephone, cellular telephones, or radios.
2. Vehicles delivering waste will be diverted away from the location of the emergency and routed toward the facility exit (Figure 2 of the H₂S plan).
3. All facility operating equipment will be shut down.
4. Personnel will be directed to proceed to the Facility Gatehouse, which will be the primary meeting location (Figure 4 of the H₂S plan). The EC will identify missing persons at this time.
5. If the emergency involves the Facility Gatehouse or its immediate environs, the intersection of NM 18 and Wallach Lane will be the secondary assembly point and evacuation routes to this location will be used as applicable (Figure 4 of the H₂S plan). The EC will identify missing persons at this time.
6. If the emergency precludes access to both the Facility Gatehouse and the intersection of NM 18 and Wallach Lane, personnel will evacuate the site by an auxiliary access gate at the east end of the facility (Figure 4 of the H₂S plan). The EC will identify missing persons at this time.
7. Once assembled, personnel will stand by to provide assistance to response agencies and coordinate further actions.

Appendix C

Personal H₂S Gas Monitor Specifications

BW Clip Series

Maintenance-Free Single-Gas Detectors

The most user-friendly, reliable and cost-effective way to ensure safety, compliance and productivity.

The BW Clip Series of single-gas detectors provides up to three years maintenance-free operation: Just turn on the device and it runs continuously — no need for calibration, sensor replacement, battery replacement or battery charging. That means great reliability and no downtime.

Plus, with the two-year version for H₂S or CO, you can put the device in a hibernation case when you're not using it for a week or more — and extend its life by that period of time.

Choose from two detectors; both of which are compact, lightweight and easy to handle, while tough enough for harsh environments and extreme temperatures:

- BW Clip – provides standard operation and no calibration
- BW Clip Real Time – includes a real-time gas level display and the ability to calibrate the device.

Both detectors are compatible with the IntelliDoX instrument management system.

Use our unique advanced technology for safety, compliance and productivity.

- **Surecell™**: unique dual reservoir sensor design dramatically improves instrument performance, response time, and longevity compared to traditional electrochemical sensors and consistently delivers reliable instrument performance under the harshest environmental conditions
- **Reflex Technology™**: advanced automated self-test function routinely checks the operating condition of the sensor to increase safety, up-time, and overall worker confidence
- **IntelliDoX**: instrument management system
 - The quickest bump test in the industry
 - Configuration of alarm set points and more
 - Performing different tests for up to five BW Clip detectors at once — for maximum productivity
 - Easy and accurate record-keeping



Configurable Options:

- Configuration of high and low alarm set points before the device is activated
- Adjustment of alarm set points and other parameters as needed throughout the lifespan
- Option to enable the noncompliance indicator, which flashes red when a bump test is due or a gas event occurs
- Option to display gas reading during alarm (BW Clip only)
- User settable bump test reminder
- User settable calibration reminder (BW Clip Real Time only)
- Option to display the Real Time Clock

FEATURES & BENEFITS

- | | | | | |
|---|---|--|--|--|
| <ul style="list-style-type: none"> • Maintenance-free: no sensor or battery changes necessary • Compact, lightweight design with one-button operation | <ul style="list-style-type: none"> • Designed for a range of harsh environments and extreme temperatures • Hibernation mode with case accessory or IntelliDoX | <ul style="list-style-type: none"> • Automated self-test of battery, sensor and electronics • Wide-angle flash, which alerts simultaneously with audible and vibrating alarm | <ul style="list-style-type: none"> • Automatic logging of the 35 most recent gas events and bump test results • Affordable, with low cost of ownership | <ul style="list-style-type: none"> • Device Management with Honeywell SafetySuite |
|---|---|--|--|--|

BW Clip Series Specifications

BW CLIP SERIES SPECIFICATIONS	
SIZE	1.6 x 2.0 x 3.4 in. / 4.1 x 5.0 x 8.7 cm
WEIGHT	3.2 oz. / 92 g
TEMPERATURE	H ₂ S: -40 to +122°F / -40 to +50°C CO: -22 to +122°F / -30 to +50°C O ₂ : -4 to +122°F / -20 to +50°C SO ₂ : -22 to +122°F / -30 to +50°C
HUMIDITY	5% - 95% RH (non-condensing)
ALARMS	Visual, vibrating, audible (95 dB) • Low, High
TESTS	Activated detectors automatically perform one internal diagnostic test every 24 hours
TYPICAL BATTERY LIFE	Two years (H ₂ S, CO, O ₂ or SO ₂) or three years (H ₂ S or CO) depending on the version
EVENT LOGGING	35 most recent events
INGRESS PROTECTION	IP 66/67
CERTIFICATIONS AND APPROVALS	 Class I, Div. 1, Gr. A, B, C, D. Class I, Zone 0, Gr. IIC ATEX: II 1G Ex ia IIC T4 Ga IECEX: Ex ia IIC T4 Ga  European Conformity  American Bureau of Shipping ERIC CU TR Ex (Customs Union)
WARRANTY	Two or three years from activation (given normal operation), plus one year shelf life (6 months for O ₂). Up to three years for two-year H ₂ S and CO detectors when used with the hibernation feature, limited to 24 months of detector operation.

SENSOR SPECIFICATIONS

GAS	MEASURING RANGE	LOW ALARM LEVEL	HIGH ALARM LEVEL
2 OR 3 YEAR DETECTOR			
H ₂ S	0 - 100 ppm	10 ppm	15 ppm
CO	0 - 300 ppm	35 ppm	200 ppm
2 YEAR DETECTOR			
O ₂	0 - 25.0 % by vol.	19.5 %	23.5 %
SO ₂	0 - 100 ppm	5 ppm	10 ppm

ALARM SETPOINTS ARE USER ADJUSTABLE BEFORE AND AFTER ACTIVATING THE DETECTOR.
SET POINTS SHOWN ARE MOST COMMON DEFAULT VALUES. ADDITIONAL DEFAULT VALUES ARE AVAILABLE.

Optional Accessories

- Hibernation Case
- Hard Hat Clip
- IntelliDoX instrument management system

For a complete list of kits and accessories, please contact Honeywell.

For more information

www.honeywellanalytics.com

Europe, Middle East, Africa

gasdetection@honeywell.com

Americas

detectgas@honeywell.com

Asia Pacific

analytics.ap@honeywell.com

Technical Services

EMEA: HAexpert@honeywell.com
US: ha.us.service@honeywell.com
AP: ha.ap.service@honeywell.com

Easy gas identification with color coded labels and LCD indication:

H₂S

CO

O₂

SO₂

Device Management with
Honeywell SafetySuite



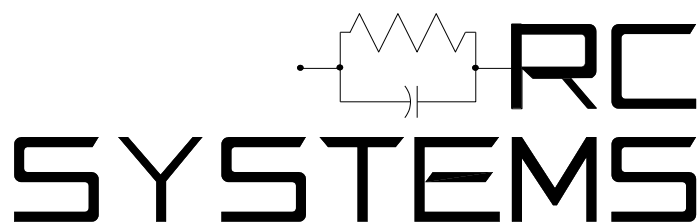
honeywellanalytics.com/SafetySuite

Honeywell

Datasheet_BW Clip Series_DS20150108-04_US-EN | 04/18
©2018 Honeywell International Inc.

Appendix D

WaveNet User Manual



INSTRUCTION MANUAL

R.C. SYSTEMS CO. INC.

WaveNet WIRELESS MONITORING SYSTEMS
(With RF Wireless Interface)



[SenSmart 7000](#)



[WaveLink Receiver](#)



[WaveNet Relayer](#)



Warning: Read & understand contents of this manual prior to operation. Failure to do so could result in serious injury or death.

Users are responsible for correct translations of this manual into their native language



Document: UM-1002

WaveNet Wireless Monitoring System User's Manual

Revision Level A

Chapter 1 – SAFETY INFORMATION	6
1.1 SAFETY INFORMATION – READ BEFORE INSTALLATION & APPLYING POWER	6
1.2 CONTACTING R. C. SYSTEMS CO. INC.	6
Chapter 2 – GENERAL DESCRIPTION	7
2.1 INTRODUCTION	7
2.2 DESCRIPTION OF WAVENET CLIENT / SERVER WIRELESS NETWORKS	7
SenSmart 7000	Error! Bookmark not defined.
Chapter 3 – SenSmart 7000 DESCRIPTION	9
3.1 SenSmart 7000 LCD READOUTS	9
3.1.1 SenSmart 7000 LCD STATUS ICONS – ZZZ, SNIFF, RNG,  ,  , 	9
3.2 SenSmart 7000 RF BROADCAST CYCLE AND CONSERVING BATTERY LIFE	10
3.3 SenSmart 7000 10-0407 BATTERY / I/O PCB	11
3.4 SenSmart 7000 10-0404-C DISPLAY / RADIO PCB	12
Chapter 4 – SenSmart 7000 INSTALLATION INSTRUCTIONS	13
4.1 RATINGS AND CERTIFICATIONS	13
4.2 SENSOR LOCATION	13
4.3 MOUNTING THE ENCLOSURE	13
4.3.1 SenSmart 7000 10-0322 MAGNETIC MOUNT OPTION	13
4.4 SPECIFICATIONS	15
4.4.1 POWER SUPPLY	15
4.4.2 POWER CONSUMPTION	15
4.4.3 MAXIMUM TRANSMIT (TX) POWER	16
4.4.4 RECEIVE (RX) SENSITIVITY	16
4.4.5 RADIO FREQUENCY	16
4.4.6 MEMORY	16
4.5 ANTENNA TRANSMISSION RANGE	16
4.5.1 ANTENNA SELECTION & LOCATION	17
4.5.2 WATER PROOFING ANTENNA CONNECTIONS	18
4.5.3 SYSTEM GROUNDING	18
Chapter 5 – SenSmart 7000 ROUTINE OPERATING INSTRUCTIONS	19
5.1 USING THE MAGNETIC KEYPAD	19
5.2 CYCLING SenSmart 7000 POWER ON/OFF	19
5.3 CAL MODE – ROUTINE CALIBRATIONS	19
5.4 ALARM OPERATION	21
5.4.1 UNDERSTANDING FAIL ALARM OPERATION	21
5.4.2 LOW BATTERY CONDITION	21
5.5 SMART SENSOR MODULES	22
5.5.1 SenSmart 7000 10-0411 SENSOR SEPARATION KIT	22
Chapter 6 – SenSmart 7000 SETUP MENUS	24
6.1 MENU STRUCTURES	24
6.2 MAIN MENU	24
Chapter 7 – SenSmart 7000 CHANNEL SETUP MENUS	26
7.1 CHANNEL ENABLE / INACTIVE	26
7.2 CONFIGURE READOUT	26
7.2.1 MEASUREMENT NAME	26
7.2.2 EUNIT	27
7.2.3 ZERO (0%)	27
7.2.4 SPAN (100%)	27
7.2.5 DECIMAL POINTS	27
7.2.6 CAL SPAN VAL	27
7.2.7 READOUT DEAD BAND	27
7.2.8 TRACK NEGATIVE	27



Document: UM-1002

WaveNet Wireless Monitoring System User's Manual

Revision Level A

7.2.9 BACKUP CONFIG 27

7.2.10 RESTORE CONFIG 27

7.2.11 LOAD DEFAULTS 28

7.3 ALARM SETTINGS 28

7.3.1 SET POINT 28

7.3.2 DEAD BAND 28

7.3.3 LOW TRIP 28

7.4 SENSOR INFORMATION 28

7.5 TECHNICIANS ONLY 29

7.5.1 SET GAIN TO UNITY (TECHNICIANS ONLY!) 30

7.5.2 PREAMP GAIN ADJUST (PGA) (TECHNICIANS ONLY!) 30

7.5.3 ZERO CAL VALUE (TECHNICIANS ONLY!) 31

7.5.4 RAW MIN / MAX COUNTS (TECHNICIANS ONLY!) 31

7.5.5 RF LINK TEST (TECHNICIANS ONLY!) 31

7.5.6 SENSOR TEMP COMP TABLE (TECHNICIANS ONLY!) 31

7.6 PACKET COUNT 32

7.7 SENSOR TEMP READING 32

Chapter 8 – SenSmart 7000 DEVICE SETUP MENUS 33

8.1 RF LINK SETUP 33

8.1.1 NETWORK ID 33

8.1.2 RMTID 34

8.1.3 *WAKEUP TIMER 34

8.1.4 *TX RETRIES 34

8.1.5 *TX CONFIG TIME 34

8.1.6 RF LINK STATUS 35

8.1.7 *RF HANDSHAKING (900MHZ MODELS ONLY) 35

8.1.8 *RF LINK 35

8.1.9 *TX POWER (900MHZ MODELS ONLY) 35

8.1.10 TX CNT (TRANSMIT COUNTER) 36

8.2 CLOCK, WARM-UP and CAL PURGE DELAYS 36

8.2.1 WARM UP TIMER 36

8.2.2 CAL PURGE TIMER 36

8.3 SYSTEM SECURITY 36

8.4 LCD CONTRAST ADJUST 37

8.5 TURN POWER OFF 37

8.6 RESET RANGE ICON 38

WAVELINK RECEIVER 39

Chapter 9 - WAVELINK RECEIVER (WLR) DESCRIPTION 39

9.1 WAVELINK RECEIVER DESCRIPTION 39

9.2 DATA DISPLAY SCREENS 41

9.2.1 EUNIT/BAR GRAPH SCREEN AND COMM ERROR TIME LINE 41

9.2.2 ALARMS STATUS CLEAR SCREEN 42

9.2.3 CHANNEL ALARM STATUS SCREEN 42

9.2.4 EVENT LOG SCREEN 42

9.3 SPECIFICATIONS 43

9.3.1 POWER SUPPLY REQUIREMENTS 43

9.3.2 RELAYS 44

9.3.3 AMBIENT TEMPERATURE RANGE 44

9.3.4 HUMIDITY RANGE 44

9.3.5 ALTITUDE 44

9.3.6 HOUSINGS / INSTALLATION CATEGORIES 44

9.3.7 APPROVALS (PENDING) 44



Document: UM-1002

WaveNet Wireless Monitoring System User's Manual
Revision Level A

Chapter 10 – WAVELINK RECEIVER OPERATION 45

10.1 OPERATOR INTERFACE 45

10.2 SETUP MENU CONFIGURATION..... 45

10.3 CHANGING MENU VARIABLES USING THE KEYPAD 46

10.4 WLR MAIN MENU 47

10.5 CHANNEL CONFIG MENU GROUP 47

10.5.1 CHANNEL ACTIVE..... 47

10.5.2 REMOTE ADDRESS 47

10.5.3 CHANNEL INFO 48

10.5.4 RX PACKETS 48

10.5.5 BATT 3.6V 48

10.6 SYSTEM CONFIG MENUS 48

10.6.1 CONFIGURE RELAYS..... 48

10.6.2 PIEZO FUNCTION 49

10.6.3 TIME/DATE SETUP 50

10.6.4 TOTAL CHANNELS 50

10.6.5 RELAY REFRESH 50

10.6.6 PIEZO REFRESH 50

10.6.7 LOCAL PIEZO 50

10.7 COMMUNICATIONS 51

10.7.1 WAVENET RADIO 51

10.7.2 RX HISTORY 52

10.8 SECURITY 52

10.9 DATA/EVENT LOG 53

10.9.1 EVENT LOG 53

10.9.2 DATA LOG(OPTIONAL) 54

10.10 TECHNICIANS ONLY 54

Chapter 11 – WAVELINK RECEIVER PCBs 55

11.1 MOTHERBOARD INTERFACE PCB # 10-0215 55

11.2 RELAY PCB # 10-0222 57

11.3 OPTIONAL 24VDC 50 WATT POWER SUPPLIES # 1000-2259 58

Chapter 12 – WAVELINK RECEIVER ENCLOSURE OPTIONS 59

12.1 WLR/PY NEMA 4X POLYESTER WALL MOUNT 59

12.2 WLR/PCS NEMA 4 PAINTED CARBON STEEL WALL MOUNT 60

12.3 WLR/SS NEMA 4X STAINLESS STEEL WALL MOUNT 60

12.4 WLR/XP NEMA 7 EXPLOSION-PROOF WALL MOUNT..... 61

Chapter 13 – 10-0410 WAVELINK RECEIVER MULTI-FUNCTION OPTION 63

13.1 MODBUS COMMUNICATIONS MENU 64

13.1.1 MODBUS REGISTER SUMMARY 64

13.2 WIRELESS MODBUS OPTION 70

13.2.1 WIRELESS MODBUS SLAVE MODE 70

13.3 WIFI COMMUNICATIONS OPTION 70

13.3.1 WAVELINK RECEIVER WIFI MENUS..... 71

13.3.2 WEBPAGE MENUS 71

13.4 DATA LOGGING AND USB OPTION 77

13.4.1 DATA LOGGING FILE STRUCTURE 77

13.4.2 WAVELINK RECEIVER DATA LOGGING MENUS 77

13.4.3 WEBPAGE DATA LOGGING MENUS 78

WAVENET RELAYER..... 79

Chapter 14 – WAVENET RELAYER DESCRIPTION 79

14.1 WAVENET RELAYER DESCRIPTION 79

14.2 WAVENET RELAYER MENUS 79



14.2.1 MAIN MENU 81

14.2.2 CHANNEL CONFIG MENU GROUP 81

14.2.3 SYSTEM CONFIG MENU GROUP 82

14.2.4 COMMUNICATIONS 84

14.2.5 SECURITY 85

14.2.6 TECHNICIANS ONLY..... 85

14.3 WAVENET RELAYER PCBs 86

14.3.1 WAVENET RELAYER 10-0404-R DISPLAY / RADIO PCB 86

14.3.2 WAVENET RELAYER 10-0425 POWER SUPPLY/RELAY PCB..... 87

Chapter 15 – WAVENET RELAYER INSTALLATION INSTRUCTIONS..... 89

15.1 RATINGS AND CERTIFICATIONS..... 89

15.2 MOUNTING THE ENCLOSURE 89

15.2.1 SenSmart 7000 10-0322 MAGNETIC MOUNT OPTION..... 89

15.3 SPECIFICATIONS..... 91

15.3.1 POWER SUPPLY 91

15.3.2 POWER CONSUMPTION 91

15.3.3 MAXIMUM TRANSMIT (TX) POWER 91

15.3.4 RECEIVE (RX) SENSITIVITY 92

15.3.5 RADIO FREQUENCY..... 92

15.3.6 MEMORY..... 92

15.4 ANTENNA TRANSMISSION RANGE 92

15.4.1 ANTENNA SELECTION AND LOCATION 92

15.4.2 WATER PROOFING ANTENNA CONNECTIONS 93

15.4.3 SYSTEM GROUNDING 93

Chapter 16 – WAVENET ANTENNA SELECTION 94

16.1 ANTENNA SELECTION..... 94

16.1.1 DIPOLE AND COLLINEAR ANTENNAS..... 94

16.1.2 YAGI ANTENNAS..... 94

16.1.3 MOUNTING NEAR OTHER ANTENNAS..... 95

16.1.4 COAX CABLES 95

16.2 SURGE PROTECTION & GROUNDING..... 95

16.2.1 ANTENNA GROUNDING 95

16.2.2 CONNECTIONS TO OTHER EQUIPMENT 96

Chapter 17 - WAVENET LEGACY MODE 97

Chapter 18 - TABLE OF FIGURES 98



Document: UM-1002

WaveNet User's Manual
Revision Level A

Chapter 1 – SAFETY INFORMATION

1.1 SAFETY INFORMATION – READ BEFORE INSTALLATION & APPLYING POWER

IMPORTANT

The WaveNet Wireless Monitoring system described in this manual consists of anywhere from 1 to 32 SenSmart 7000s (SenSmart 7000s) wirelessly sending data to any number of WaveLink Receivers (WLR) and/or WaveNet Relayers (WNR). Users should have a detailed understanding of WaveNet operating and maintenance procedures. Use the WaveNet system only as specified in this manual, or detection of gases and the resulting protection provided may be impaired. Read the following **WARNINGS** prior to use:

WARNINGS

- Calibrate SenSmart 7000 gas monitors that communicate to the WaveNet with a known value at start-up and check calibration on a regular schedule, at least every 90 days. More frequent inspections are encouraged to spot problems such as dirt, oil, paint, grease or other foreign materials on the sensor head.
- Do not paint the sensor assembly or any part of the SenSmart 7000.
- Do not use the WaveNet if any enclosure is damaged or cracked or has missing components.
- Make sure covers, internal PCBs and antenna connections are securely in place before operation.
- Use only a sensor assembly compatible with the SenSmart 7000 and approved for the monitor.
- Periodically test for correct operation of the system's alarm events by exposing the monitor to a known value above the High Alarm set-point.
- Do not expose WaveNet devices to electrical shock or continuous severe mechanical shock.
- Protect WaveNet devices from dripping liquids and high power sprays.
- Use only for applications described within this manual.

CAUTION: FOR SAFETY REASONS THIS EQUIPMENT MUST BE OPERATED AND SERVICED BY QUALIFIED PERSONNEL ONLY. READ AND UNDERSTAND INSTRUCTION MANUAL COMPLETELY BEFORE OPERATING OR SERVICING.

ATTENTION: POUR DES RAISONS DE SÉCURITÉ, CET ÉQUIPEMENT DOIT ÊTRE UTILISÉ, ENTRETENU ET RÉPARÉ UNIQUEMENT PAR UN PERSONNEL QUALIFIÉ. ÉTUDIER LE MANUE D'INSTRUCTIONS EN ENTIER AVANT D'UTILISER, D'ENTREtenir OU DE RÉPARER L'ÉQUIPEMENT.

WARNING - EXPLOSION HAZARD

**SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS I, DIVISION 2;
BATTERIES MUST ONLY BE CHANGED IN AN AREA KNOWN TO BE NON-HAZARDOUS.**

AVERTISSEMENT - RISQUE D'EXPLOSION

**LA SUBSTITUTION D'E COMPOSANTSP EUTR ENDRE CE MATERIEL NACCEPTABLE POUR LES EMPLACEMENTS DE CLASSE I, DIVISION 2;
AFIN D'EVITER TOUT RISQUE D'EXPLOSION, S'ASSURER QUE L'EMPLACEMENT EST DESIGNÉ NON DANGEREUX AVANT DE CHANGER LA BATTERIE.**

1.2 CONTACTING R. C. SYSTEMS CO. INC.

To contact R. C. Systems Co. Inc., call, fax, email or write:

Phone: 409-986-9800 FAX: 409-986-9880 Email: info@rcsystemsco.com

Address: 8621 Hwy. 6 Hitchcock, TX 77563

Or visit us on the World Wide Web: www.rcsystemsco.com

Chapter 2 – GENERAL DESCRIPTION

2.1 INTRODUCTION

R.C. Systems WaveNet is a Frequency Hopping Spread Spectrum (FHSS) **Client/Server** wireless monitoring system offered with integral 900 MHz or 2.4 GHz radio modules. Each WaveNet system may have between 1-32 battery-powered SenSmart 7000s (SenSmart 7000s), which are always “**Clients**”. SenSmart 7000s may be equipped with single or dual gas sensors and transmit two of the 32 maximum channel values to the WaveLink Receiver (WLR) and/or WaveNet Relayer (WNR). There must also be at least one WaveLink Receiver (WLR) configured as the network’s “**Server**”. Since it is often desirable to indicate readings and alarms in more than one location, multiple WLRs configured as “**Clients**” are easily added to the same wireless network, but only one may be configured as the “**Server**”. WaveNet radio configuration allows up to 26 separate FHSS hopping patterns and therefore as many as 26 separate WaveNet systems may be collocated into the same area. Each network’s Server transmits Hopping Pattern and System ID settings only to Clients assigned to its network.

900MHz model’s transmit power is adjustable between 10mW and 1W (0-30dBm EIRP; 2dBi gain antenna) and 2.4GHz model’s power is fixed at 125mW (21dBm; conducted).

SenSmart 7000s are low power devices powered by an integral lithium D cell battery. WLRs must be continuously powered by an external power source (85-240VAC or 10-30VDC) and are ideally suited for 12VDC solar power supplies.

Additional features include:

- On screen radio status icons indicate “Server In-Range”, “Server Out-of-Range”, “Server Previously Out-of-Range” and “Low Battery” conditions.
- No potentiometer or jumper settings required. Cycling of power and configuration is with menus accessed via the LCD / magnetic keypad operator interface without opening the enclosure.
- “Smart Sensor” technology keeps gas type, range, calibration, temperature compensation and other sensor related parameters on the sensor module.
- If a sensor must be replaced, new smart sensors are recognized by the SenSmart 7000 and prompts users to either upload new configuration data or continue with data from the previous smart sensor.
- Missing sensors trip the FAIL alarm.
- Smart sensors are industry proven for fast response and long life.
- Field adjustable alarm levels flash front panel LED indicators for HIGH, WARN, FAIL conditions. Alarm relays are not available on the SenSmart 7000s with this low power model, but WLRs come equipped with 8 programmable relays and WNRs come equipped with four programmable relays.
- CAL MODE provides on-screen prompts when to apply calibration gas during calibrations.
- “Sensor life” bar-graph updates after each SPAN calibration indicating when to replace old sensors.
- One hour trend screen shows rate of change of gas exposures.
- Modular design affords efficient installation and plug in sensors allow changing target gases even after installation.

2.2 DESCRIPTION OF WAVENET CLIENT / SERVER WIRELESS NETWORKS

All R. C. Systems wireless devices utilize a FHSS (Frequency Hopping Spread Spectrum) Client / Server network where multiple **Clients** synchronize their frequency hopping to a single **Server**. Each network’s **Server** transmits a beacon at the beginning of every frequency hop. **Clients** with the same **Hop Channel** and **System ID** menu settings listen for the **Server’s** beacon and upon receiving it, synchronize their hopping with the **Server**. WLR may be user configured as either **Clients** or **Servers** since many installations require more than one WLR, but only one Server is allowed per network. Battery powered SenSmart 7000 are always **Clients** because their radio is usually powered down and therefore unable to continuously broadcast beacons as required by the **Server**. When there are multiple



Document: UM-1002

WaveNet Wireless Monitoring System User's Manual

Revision Level A

WLR's on the same network, the most centrally located is usually designated as the Server. Multiple WNRs may be added to any WaveNet system in order to provide additional alarms, and/or function as repeaters for the alarm states of the SenSmart 7000s in the WaveNet network.

Each device on a WaveNet network must have its **NETWORK ID** menus configured to share the same **Hop Channel** and **Systems ID**. To simplify this setup, SenSmart 7000s, WLRs and WNRs are limited to 26 unique **Hop Channel** and **System ID** settings entered as "A" through "Z" in the **NETWORK ID** menu. All devices must have the same **Network ID** letter designated to communicate with each other (see [Section 8.1.1](#)). This also means it is possible to collocate multiple FHSS networks within the same coverage area without interference.

IMPORTANT! There should never be two servers with the same network settings within the same coverage area because interference between the two servers will severely hinder RF communication!

Correct planning and design of wireless systems are imperative for ensuring a successful installation.

SenSmart 7000

Chapter 3 – SenSmart 7000 DESCRIPTION

WARNING - EXPLOSION HAZARD

SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS I, DIVISION 2;
BATTERIES MUST ONLY BE CHANGED IN AN AREA KNOWN TO BE NON-HAZARDOUS.

AVERTISSEMENT - RISQUE D'EXPLOSION

LA SUBSTITUTION D'E COMPOSANTSP EUTR ENDRE CE MATERIEL N'ACCEPTABLE POUR LES EMPLACEMENTS DE
CLASSE I, DIVISION 2;
AFIN D'EVITER TOUT RISQUE D'EXPLOSION, S'ASSURER QUE L'EMPLACEMENT EST DESIGNE NON DANGEREUX
AVANT DE CHANGER LA BATTERIE.

3.1 SenSmart 7000 LCD READOUTS

Figure 3-1 shows the primary data display screens for displaying sensor readings, radio status and current alarm conditions. The Single Channel **Engineering Unit** and **One-Hour Trend** screens on the left side of Figure 3-1 are available even if the SenSmart 7000 (SenSmart 7000) is equipped with Dual Sensors but there is two of each. The **Engineering Unit(Eunits)** screen has a large digital value with Eunits, a bar graph with Alarm 1, Alarm 2 and Alarm 3 levels indicated across the bar and a 16 character Measurement Name field for user ID of this measurement location. The NEXT key toggles to the **One-Hour Trend** screen which indicates the alarms levels horizontally across the screen and trends the most recent one hour of readings. The right screen shows the **Dual Monitor** readout available only when two smart sensors are enabled. Single Channel screens are also available in the Dual mode which totals 5 data displays for dual channel units.

3.1.1 SenSmart 7000 LCD STATUS ICONS – Zzz, SNIFF, RNG, , ,

The upper left LCD corner displays current status of the SenSmart 7000, and provides an indication of general health of the wireless network over time. These status icons and the COM LED are useful tools for evaluating RF communication and the current state of the SenSmart 7000.

The Zzz icon indicates the sensor is asleep and saving power. Every six seconds it awakes, reads the gas sensor's signal, and updates the displayed gas value. This is called a "sniff" and is indicated by the SNIFF icon, which flashes on the screen every 6 seconds. Following a sniff, if conditions described in [Section 3.2](#) have been met, the SenSmart 7000 will wake up the radio and broadcast gas value and alarms over the airwaves to the WaveLink Receiver (WLR) and/or WaveNet Relayer(WNR). The sniff icon may be replaced by other status icons to indicate problems as described below:

-  - **Server Out-of-Range** icon appears if the server's beacon was not received at the most recent attempt to broadcast.
- The **RNG** icon appears briefly at the beginning of each broadcast attempt to indicate the radio is awaiting the Server's beacon. If the beacon is not received after a few seconds the broadcast is terminated unsuccessfully and the  icon is displayed at each sniff instead of the sniff icon. If a subsequent attempt receives the beacon and broadcasts successfully, the  - **Server Previously Out-of-Range** icon will appear.



Document: UM-1002

WaveNet Wireless Monitoring System User's Manual

Revision Level A

- The  (Server Previously Out of Range) icon is very useful in determining if intermittent communication failures are a result of this SenSmart 7000 having problems receiving the Server's beacon as opposed to the WLR not receiving the SenSmart 7000 broadcast packet. The duration and frequency of "out-of-range" conditions are stored in the WLR Event Log table described in [Section 10.9](#).
- When the 3.6 volt lithium battery is near end of life the  - **Low Battery** icon is displayed during sniffs.

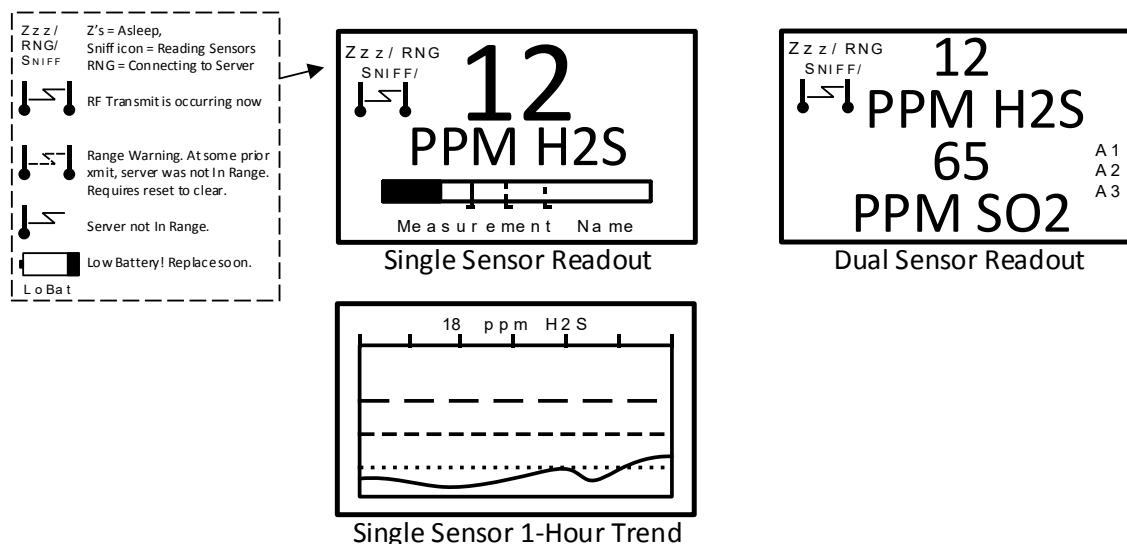


Figure 3-1 Readout Screen

3.2 SenSmart 7000 RF BROADCAST CYCLE AND CONSERVING BATTERY LIFE

Most SenSmart 7000 battery power is consumed as the radio communicates to the wireless network. Each Broadcast cycle consists of the following operations: Power up the radio; listen for the Server's beacon; synchronize to the Server's hopping pattern to become "In Range , transmit data packet out of the antenna and return to sleep mode. This sequence takes from .25 to 1 second to complete. If the SenSmart 7000 radio fails to synchronize hopping with the Server upon the initial attempt it waits 6 seconds and tries again, then waits 6 seconds and tries once more. If the third attempt fails an "Out of Range  icon is displayed and the SenSmart 7000 goes to sleep and the scheduled Broadcast cycle repeats. Transmit power levels are adjustable (900MHZ models only) and the lower the power setting the longer the battery will last (see [Section 4.4](#)).

Every 6 seconds, the monitor performs a "sniff test" to detect level of target gas present at the sensor. At each "sniff test", the Zzz's "Sleep Mode" icon is briefly replaced by a status icon as described above in [Section 3.1.1](#). At this time, the LCD readout updates to indicate gas value measured during the sniff test. The radio stays OFF and no Broadcast occurs unless the gas value trips A1, A2 or A3 alarms, the **Wakeup Timer** expires (maximum of 5-minutes) or the conditions shown below are met. The following list identifies each of the conditions that cause the SenSmart 7000 radio to Broadcast over the airwaves:

- A Broadcast occurs every time the **Wakeup Timer** menu expires (see [Section 8.1.3](#)). This is important since the WLR reports "Comm Error" for channels when no data is received after [**Wakeup Timer** X 5]. For example, if the SenSmart 7000 **Wakeup Timer** is set to broadcast every 5 minutes, the WLR will indicate a Comm Error alarm for this channel if data is not received after approximately 25 minutes.



Document: UM-1002

WaveNet Wireless Monitoring System User's Manual

Revision Level A

- Broadcasts occur after each 6 second sniff test if there is an A1, A2 or A3 alarm. "FAIL" alarms do not increase radio broadcast rates.
- A Broadcast occurs upon entry into CAL MODE, upon entry into CAL PURGE and again upon completion of the CAL PURGE. A status bit in the broadcast packet advises WaveLink Receivers(WLR) and WaveNet Relayers(WNR) this SenSmart 7000 channel is being calibrated and alarms are inhibited. NOTE: Oxygen sensors cause 20.9% WLR readings during CAL MODE while all others cause zero readings (see CAL MODE [Section 5.3](#)).
- A Broadcast occurs if the reading rises or falls by >2% of full scale since the most recent Broadcast. This is to ensure a live reading at the WLR and/or WNR even though the **WakeUp Timer** might be set for a longer interval (5 minutes max).
- A Broadcast may be forced manually by holding the UP key for several seconds until the  icon appears then RELEASING THE UP KEY.
- A Broadcast occurs at the end of a Warm Up interval (see [Section 8.2.1](#)).
- A Broadcast occurs as menu items are edited and again upon returning the LCD to the readings display.

3.3 SenSmart 7000 10-0407 BATTERY / I/O PCB

SenSmart 7000 electronics consist of the lower 10-0407 Battery / I/O PCB shown in Figure 3-2, connected by a cable to the upper 10-0404-C Display / Radio PCB shown in Figure 3-3. The 10-2465 3.6 volt lithium 'D' cell battery will continuously power the unit for up to one year and may be replaced by following the procedure in Figure 3-2.

Connectors S1 and S2 are for connecting 10-0247 Sensor Heads directly to the 10-0407 Battery / I/O PCB. Terminal blocks TB1 and TB2 are for connecting to the 10-0411 "Sensor Separation Kit" with a 15' data cable (see [Section 5.5.1](#)).

IMPORTANT: Do not turn Power ON to the SenSmart 7000 until the controller designated as Server is fully operational and ready to communicate to the SenSmart 7000s. Battery life is reduced if the SenSmart 7000 is on for long periods while unable to communicate to the Server.

IMPORTANT: DO NOT ATTEMPT TO CHARGE THIS BATTERY OR REPLACE WITH ANY OTHER THAN PART # 10-2465 FROM R. C. SYSTEMS INC.

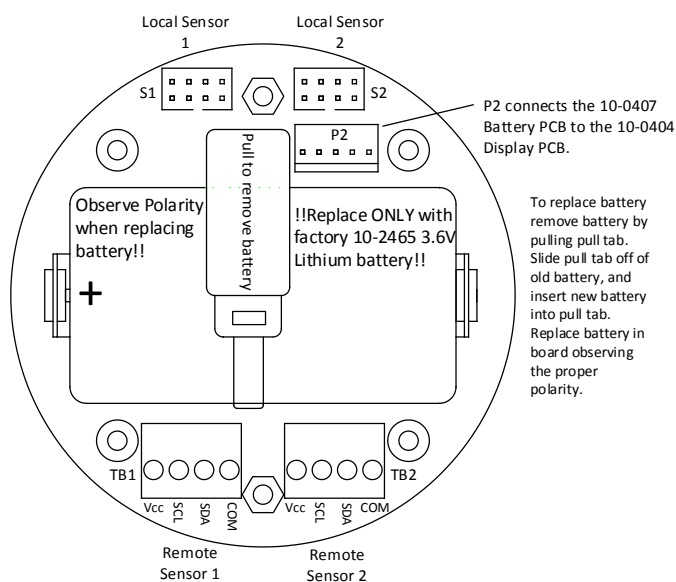


Figure 3-2 10-0407 Battery / I/O PCB

3.4 SenSmart 7000 10-0404-C DISPLAY / RADIO PCB

WaveNet systems support both 900MHz and 2.4GHz FHSS networks determined by the radio module mounted to the 10-0404-C Display / Radio PCB. The 1000-2188 900 MHz radio module mounts to the back of the 10-0404-C Display assembly as shown in Figure 3-3. Its MMCX RF connector attaches to the coax pigtail of the 10-0400 antenna fitting required for 900 MHz models.

The 1000-2454 2.4GHz radio module also mounts to the back of the 10-0404-C Display assembly as shown in Figure 3-3. Its u.FL RF connector attaches to the coax pigtail of the 10-0401 antenna fitting required for 2.4 GHz models.

A slender 5 conductor cable connects between the 10-0404-C and the 10-0407 Battery / I/O PCB bolted to the bottom of the enclosure.

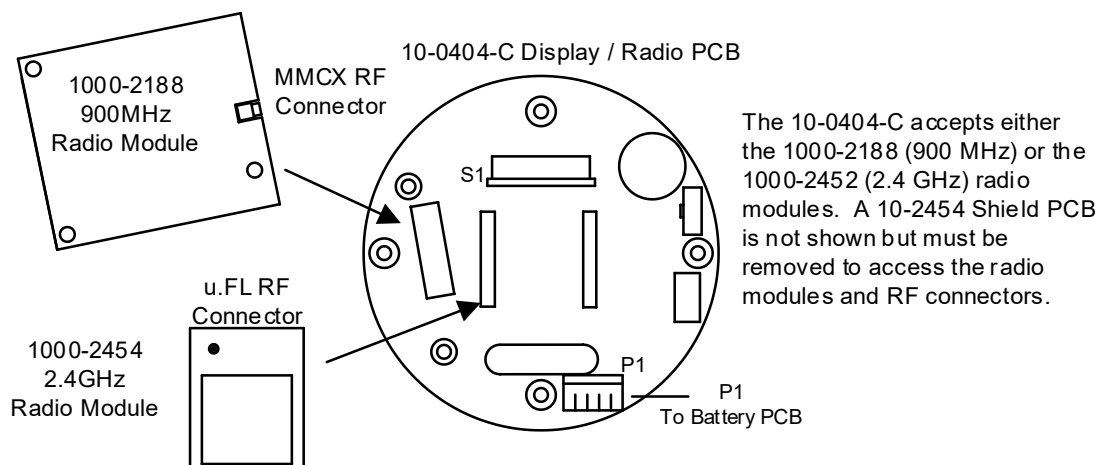


Figure 3-3 10-0404-C Display / Radio PCB

Chapter 4 - SenSmart 7000 INSTALLATION INSTRUCTIONS

4.1 RATINGS AND CERTIFICATIONS

The enclosure is NRTL certified for Division 1 hazardous area installations for explosion-proof Class 1 Groups A, B, C, D (see Figure 4-1). The SenSmart 7000 (SenSmart 7000) is designed to meet ISA 92.0.01 Part 1 for Toxic Monitors. The standard 10-0295 antenna fitting has an RP-TNC connector and is suitable for Division 2 classified areas. An optional explosion-proof dipole antenna is also available for Division 1 classified areas. Figure 4-2 shows both antenna styles.

4.2 SENSOR LOCATION

Factors such as air movement, gas density in relation to air, emission sources and environmental variables affect correct sensor location. Air movement by fans, prevailing winds and convection should be carefully evaluated to determine if a leak is more likely to raise gas levels in certain areas within the facility. Vapor density of a gas determines if it will rise or fall in air when there are no significant currents. Lighter than air gases should have the monitors mounted 12 – 18 inches (30 – 45 centimeters) above the potential gas leak and heavier than air gases should be this distance below. Even though the SenSmart 7000 is designed for rugged service, sensors should be protected from environmental damage from water, snow, shock, vibration and dirt.

4.3 MOUNTING THE ENCLOSURE

The SenSmart 7000 standard enclosures are the cast aluminum explosion-proof (NEMA 7) enclosure as shown in Figure 4-1 and the polycarbonate enclosure shown in Figure 4-2. Modular design simplifies the installation of the SenSmart 7000. The SenSmart 7000 antenna should typically be mounted with line-of-site access to the WaveLink Receiver's (WLR's) and/or WaveNet Relayer's (WNR's) antenna. If a good line-of-site angle is not possible the SenSmart 7000s will usually still function properly at ranges up to 1500 feet. However, obstructions should still be kept to a minimum.

WARNING: Qualified personnel should perform the installation according to applicable electrical codes, regulations and safety standards. Ensure correct cabling and sealing fitting practices are implemented. Install the SenSmart 7000 to a wall or bracket using the pre-drilled mounting flanges with I.D. 0.3 on 5.0 inch centers (Figure 4-1).

CAUTION: The sensor head (not shown in Figure 4-1) should never be installed pointing upwards.

4.3.1 SenSmart 7000 10-0322 MAGNETIC MOUNT OPTION

R. C. Systems offers a magnetic mounting option (10-0322) which includes two magnets affixed to the pre-drilled mounting holes securely attaching the assembly to a solid steel structure.

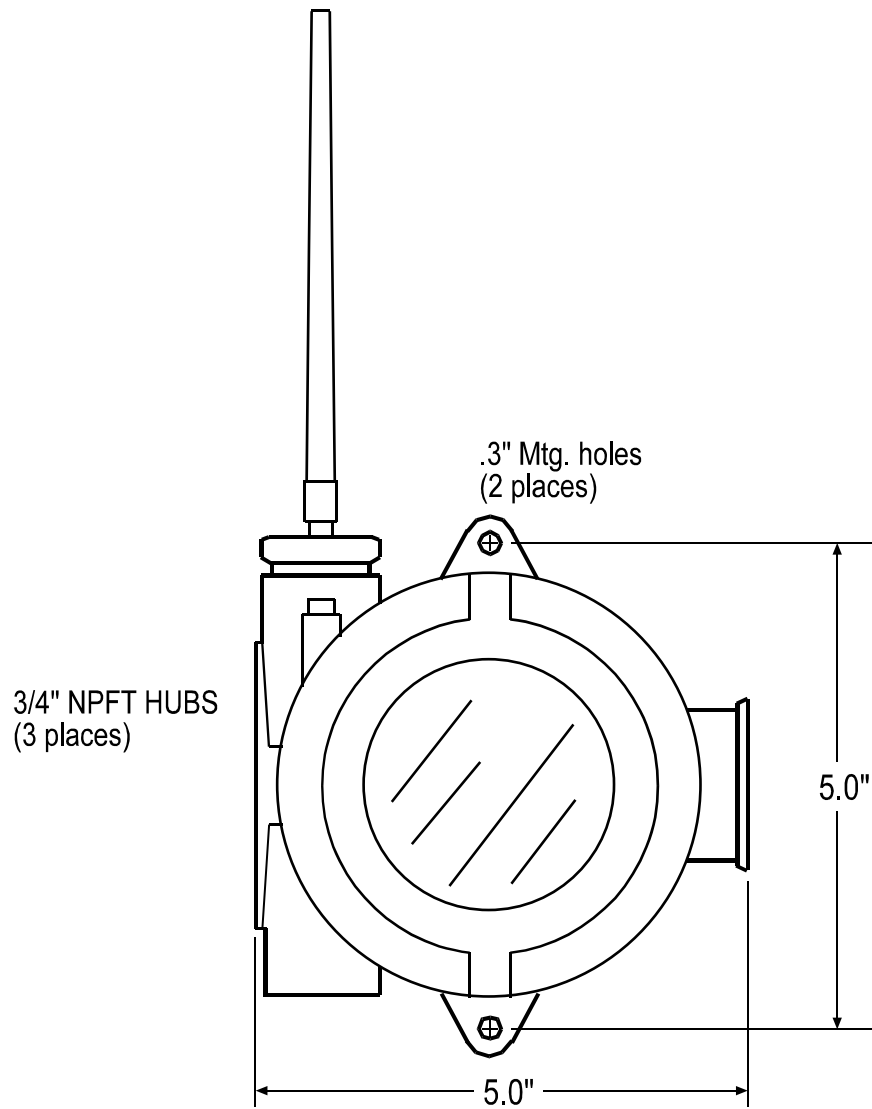


Figure 4-1 SenSmart 7000 NEMA 7 Explosion-Proof Enclosure

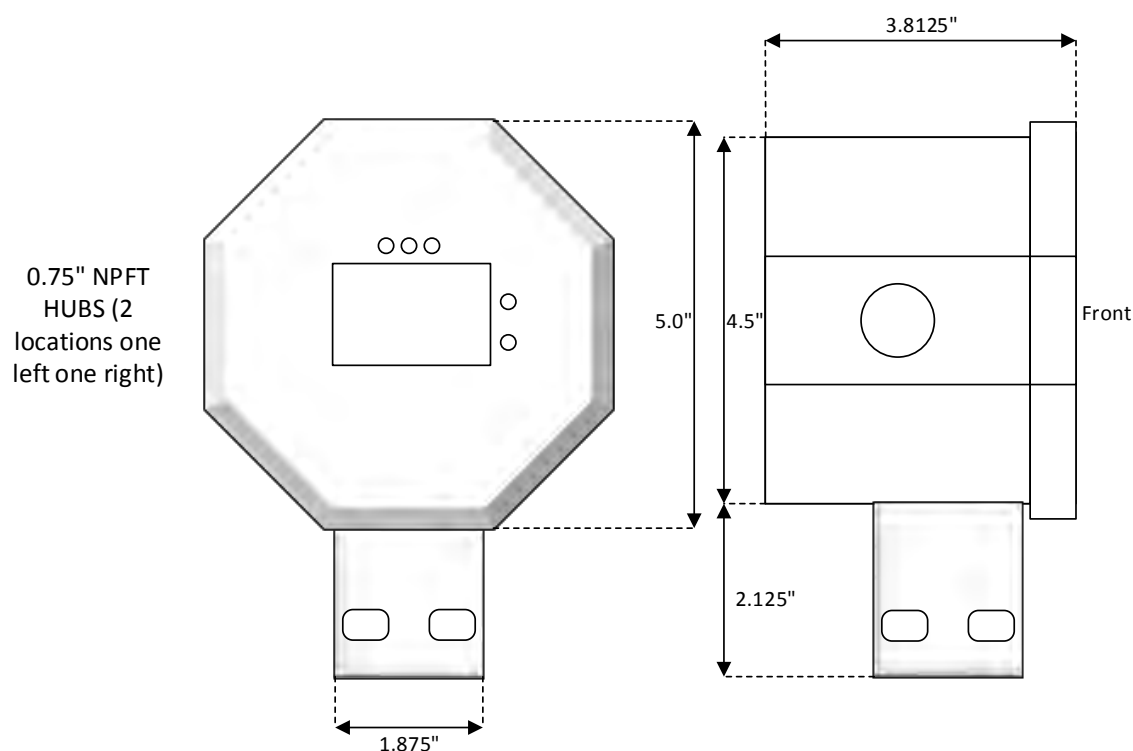


Figure 4-2 SenSmart 7000 Polycarbonate Enclosure

4.4 SPECIFICATIONS

4.4.1 POWER SUPPLY

Integral non-rechargeable 3.6 volt 19AH Lithium D-cell battery. Replacement part # 10-2465.

4.4.2 POWER CONSUMPTION

900MHz Models:

2mA during "sleep" mode, 40mA while receiving beacon, up to 1 amp during 1 watt "transmit" mode. Transmit power may be set from 10mW to 1 watt (see [Section 8.1.9](#))

Note: 1 watt operation is not recommended or necessary for most applications as it can cause an unnecessary load on the battery thereby significantly reducing battery life.

2.4GHz Models:

2mA during "sleep" mode, 170mA during 125mW broadcasts.



4.4.3 MAXIMUM TRANSMIT (TX) POWER

900MHz Models (EIRP; 2dBi gain antenna):
30dBm at highest 1W power setting. Transmit power may be set from 10mW, 200mW, 400mW and 1 watt (see [Section 8.1.9](#))

Note: 1 watt operation is not recommended or necessary for most applications as it can cause an unnecessary load on the battery thereby significantly reducing battery life.

2.4GHz Models (Conducted; no antenna):
Transmit power is fixed at 125mW (21dBm)

4.4.4 RECEIVE (RX) SENSITIVITY

900MHz Models:
100 dBm

2.4GHz Models:
95 dBm

4.4.5 RADIO FREQUENCY

900MHz Models:
Hopping occurs between 902 – 928 MHz.

2.4GHz Models:
Hopping occurs between 2400 – 2483.5 MHz.

4.4.6 MEMORY:

Non-volatile E2 memory retains configuration values in the event of power outages.

4.5 ANTENNA TRANSMISSION RANGE

The distance radio signals can travel is dependent upon several factors including antenna design, transmitter power and free-space losses. In order for a wireless link to work, the available system operating margin (**TX power - RX Sensitivity + Antenna gains**) must exceed the free-space loss and all other losses in the system. For best RF line-of-site, the combined height of both antennas must exceed the Fresnel zone diameter.

Dist. between ant's	Fresnel zone diameter	Freespace loss (dB)
1000 ft (300 m)	16 ft (4.9 m)	81
1 Mile (1.6 km)	32 ft (9.7 m)	96
5 miles (8 km)	68 ft (20.7 m)	110

Example:

- A 2.4GHz WaveNet system has following parameters:
- RF TX power setting = 21 dBm (125 mW)
 - RF RX sensitivity = -95 dBm (this is a constant)
 - Antenna gain (standard equipped rubber collinear) = 7dBi x 2 = 14dBi

So the system operating margin is $21 - (-95) + 14 = 130$ dBm. This is enough to transmit 5 miles if free-space was the only loss in the system. For this to be the case, the antennas must be mounted with a combined height greater than 68ft above all obstructions (including the ground) to keep the Fresnel zone clear. In practice, however, there are many losses in the system besides just Free-space and it is recommended there be at least 20dB extra system operating margin.

RF "Rules of Thumb":

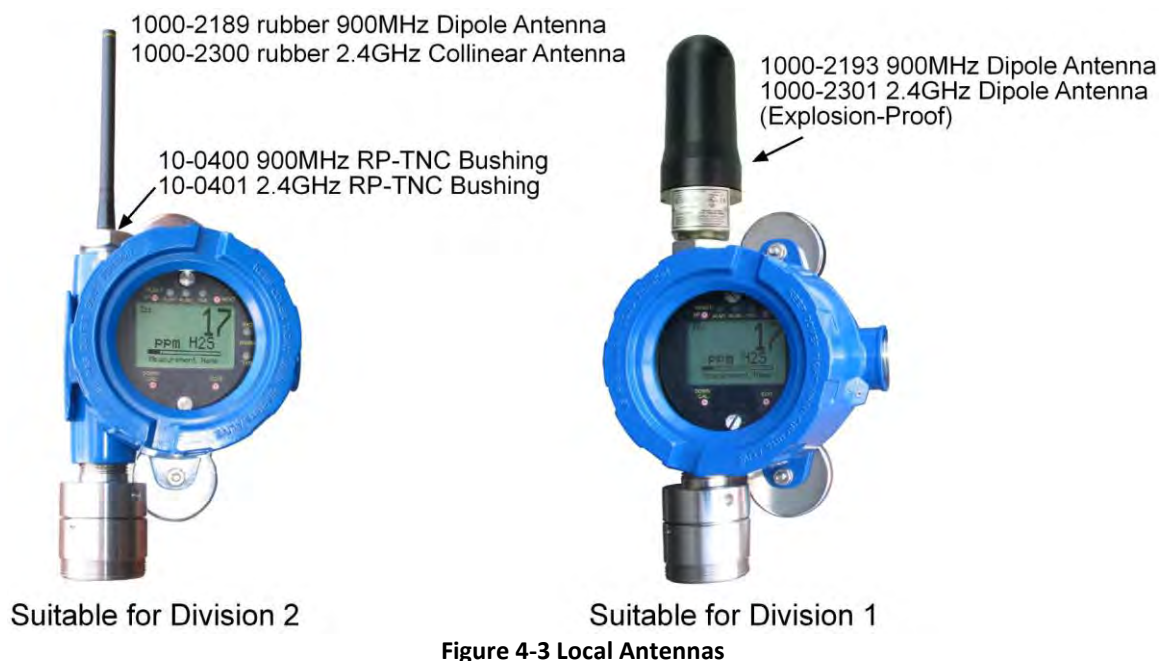
- Doubling the range with good RF "Line of Sight" (LOS) requires an increase of 6 dB.
- Doubling the range without good RF LOS requires an increase of 12 dB.
- Doubling the power increases dBm by 3.

4.5.1 ANTENNA SELECTION & LOCATION

A site survey using test radios is highly recommended.

The location of the antenna is very important. Ensure the area surrounding the proposed location is clear of objects such as other antennas, trees or power lines which may affect the antenna's performance and efficiency. It is also vital that you ensure the support structure and mounting arrangement is adequate to support the antenna under all anticipated environmental conditions. The choice of appropriate mounting hardware is also important for both minimizing corrosion and maintaining site intermodulation performance.

Most installations with ranges under 1000 feet require only the standard equipped rubber antennas as shown in Figure 4-2. Distances up to 2 miles may be achieved by equipping the SenSmart 7000s with YAGI directional antennas aimed towards a mast mounted fiberglass omnidirectional antenna at the WLR/WNR base station. Always minimize obstructions between the SenSmart 7000 and the WLR/WNR base station antenna.





Document: UM-1002

WaveNet Wireless Monitoring System User's Manual

Revision Level A

4.5.2 WATER PROOFING ANTENNA CONNECTIONS

Waterproof all outdoor coax connectors using a three layer sealing process of initial layer of adhesive PVC tape, followed by a second layer of self-vulcanizing weatherproofing tape such as 3M 23 (order # 1000-2314), with a final layer of adhesive PVC tape (see Figure 4-3).

1. Attach antenna to RP-SMA fitting
2. Wrap 20-24" strip PVC electrical tape onto hub, nut & base of antenna
3. Wrap 20-24" strip 3M 23 tape (order # 1000-2314) onto PVC tape
4. Wrap 24-28" strip PVC electrical tape over all



Figure 4-4 Water Proofing Antenna Connections

4.5.3 SYSTEM GROUNDING

Direct grounding of the SenSmart 7000 enclosure via a good electrical connection to a well-designed grounding system is essential. This will protect your system, reduce the damage that can occur during lightning strikes and reduce noise.

Chapter 5 – SenSmart 7000 ROUTINE OPERATING INSTRUCTIONS

5.1 USING THE MAGNETIC KEYPAD

Each SenSmart 7000 (SenSmart 7000) is supplied with a 1000-0078 magnetic wand for operating the non-intrusive magnetic keypad. Keys are identified as UP, DOWN, NEXT and EDIT and function similar to touch keys except a “swiping” motion of the magnet is used instead of pressing a key. In this manual, a “swipe” means: hold the magnet directly over the key’s target, close to the enclosure’s glass cover, and in the same motion move the magnet away from the target. Each “swipe” equals one press of the key, and swipes may be done rapidly to move through fields with many options. It is ok to touch the glass with the magnet but be careful not to “swipe” too close to one of the other keys and activate it by mistake.

Modify a menu item by pointing to it, press the EDIT key to display the cursor, press UP / DOWN to change that character, press NEXT to move the cursor, then press EDIT again to load the new item and remove the cursor. Press NEXT to reverse out of the sub-menu.



Figure 5-1 1000-0078 Magnetic Wand

5.2 CYCLING SenSmart 7000 POWER ON/OFF

It is not necessary to remove the instrument enclosure’s cover to cycle power ON or OFF. If the LCD readout is blank the SenSmart 7000 is OFF. Apply power by holding the magnet over the UP key in the upper left front panel for a few seconds. When the LCD shows **Release Key**, pull the magnet away and power will remain ON. Turn the SenSmart 7000 OFF by either using the Power Off menu (see [Section 8.5](#)) or by holding the magnet over the NEXT key in the upper right front panel. When the LCD shows **EDIT to Accept**, swipe the magnet over the EDIT key and power will turn off.

5.3 CAL MODE – ROUTINE CALIBRATIONS

Calibration is the most important function for ensuring correct gas readings at the SenSmart 7000. The CAL MODE (flow chart shown in Figure 5-3) is designed to make calibration quick, easy and error free. A successful ZERO and SPAN calibration requires only four keystrokes. CAL MODE is always followed by an adjustable CAL PURGE time period (see [Section 8.2.2](#)). CAL PURGE holds the output at a safe value to prevent alarms being tripped by the upscale span calibration gas.

Follow these SenSmart 7000 calibration guidelines:

- Calibration accuracy is only as good as the calibration gas accuracy. R. C. Systems recommends calibration gases with NIST (National Institute of Standards and Technology) traceable accuracy to increase the validity of the calibration.
- Do not use a gas cylinder beyond its expiration date.
- Calibrate a new sensor before use.
- Allow the sensor to stabilize before starting calibration.



Document: UM-1002

WaveNet Wireless Monitoring System User's Manual

Revision Level A

- Calibrate on a regular schedule. (R. C. Systems recommends once every 3 months, depending on use and sensor exposure to poisons and contaminants.)
- Calibrate only in a clean atmosphere, which is free of background gas.

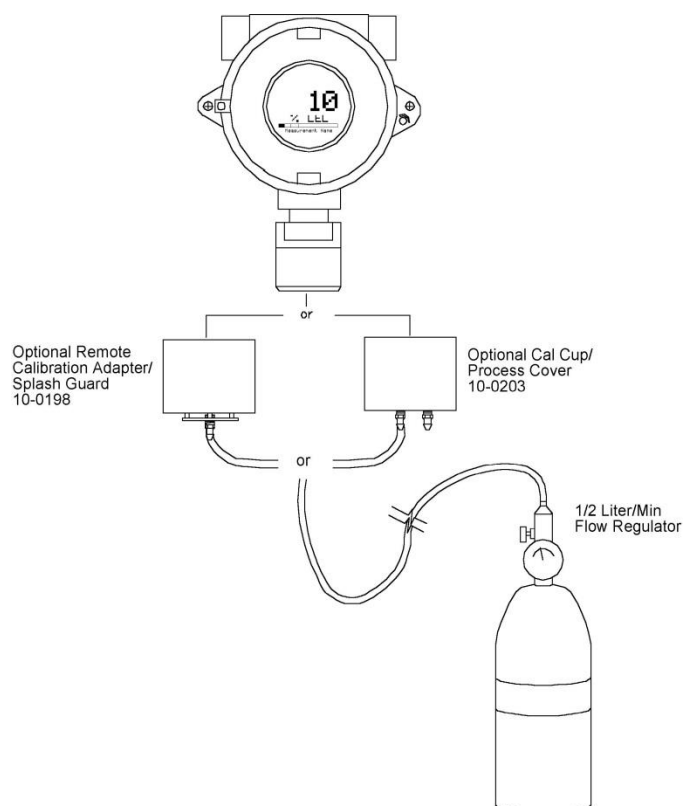


Figure 5-2 Calibration Gas Input

Use the following step-by-step procedure to perform ZERO and SPAN calibrations.

1. To enter the CAL MODE from the data displays, swipe the CAL / DOWN key and within 5 seconds swipe the EDIT key. **Note:** During SenSmart 7000 calibrations, alarms are inhibited and "CAL MODE" is displayed on the WaveLink Receiver (WLR).
2. Using the Cal-Cup (order # 10-0203) apply a clean ZERO gas or be sure there is no background target gas in the monitored area. After the reading is stable swipe the EDIT key to perform a ZERO calibration.
3. If the ZERO calibration is successful, swipe the NEXT key to proceed to the SPAN check.
4. Apply the **correct** SPAN gas at .5 liters/min. After the reading is stable swipe the EDIT key to perform a SPAN calibration.

WARNING: The SPAN gas used must match the value specified since this is what the SenSmart 7000 will indicate after a successful SPAN calibration. The **Cal Span Value** may be edited if it becomes necessary to apply a different gas concentration (see [Section 7.2.6](#)).

5. If the SPAN calibration is successful, the display flashes "REMOVE CAL GAS" and starts the CAL PURGE delay (see [Section 8.2.2](#)). **Note:** During CAL PURGE, toxic monitors transmit 0% FS to the WLR to prevent alarms by residual upscale SPAN values. Oxygen monitors transmit a 20.9% oxygen reading during CAL PURGE to avoid tripping low oxygen alarms.
6. CAL MODE is complete after the end of the CAL PURGE delay.



Document: UM-1002

WaveNet Wireless Monitoring System User's Manual

Revision Level A

The flow chart in Figure 5-3 illustrates the above procedure from left to right. UP, CAL, NEXT & EDIT labels indicate keystrokes using the magnetic wand. The CAL MODE information screen (top of the chart) is available for advanced users to see Offset / Gain calibration constants and live analog to digital converter (A/D) counts. Span Gas calibration values may also be edited from this screen. Holding the UP key, for 5 seconds during CAL MODE, displays this screen.

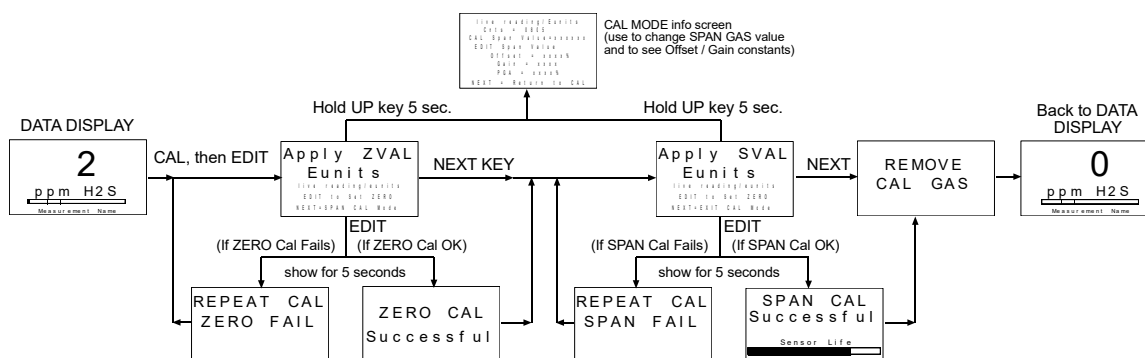


Figure 5-3 Cal-Mode Flow Chart and Menus

5.4 ALARM OPERATION

All alarm decision making is done by the SenSmart 7000 with the results broadcast to the WLR/WNR. SenSmart 7000s have five front panel LEDs to indicate Alarm 1, Alarm 2 and Alarm 3, FAIL and COM (Broadcast). Alarm LEDs only flash during alarm events to conserve battery life. **Low Battery** is indicated by an icon on the LCD and by flashing the FAIL LED. **ONLY LEVEL ALARMS (A1, A2, A3) INCREASE WIRELESS BROADCASTS TO EVERY 6 SECONDS!** Alarms may be set to trip upon increasing and decreasing readings (see [Section 7.3.3](#)).

5.4.1 UNDERSTANDING FAIL ALARM OPERATION

The **FAIL** alarm indicates system related problems such as missing sensor, sensor failures, inability to synchronize to the Server and excessive negative readings. The Fault alarm menu described in [Section 7.3](#) allows setting how far below zero (negative) the reading may fall prior to tripping the FAIL alarm. The FAIL ALARM WILL ALSO TRIP WITH MISSING OR FAILED SENSORS REGARDLESS OF THE READING!

CAUTION: Missing or failed sensors always trip the FAIL alarm. FAIL alarm conditions DO NOT cause the radio broadcast rate to increase to 6 seconds.

5.4.2 LOW BATTERY CONDITION

The nominal battery voltage is 3.6 volts, and SenSmart 7000s trip their **Low Batt** alarm at < 3.3 volts. This causes the **Low Batt** icon to appear in the upper left hand corner of the display and the **Fail** LED to flash. At 3.2 volts the SenSmart 7000 enters the replace battery mode. In this mode, there may be insufficient power to transmit a signal to the WLR/WNR it is connected to which will most likely result in a Comm Error ([Section 3.2](#)). In this mode, the SenSmart 7000 will alternate, every six seconds, between the Replace Battery Screen (Figure 5-4) and the screen which was previously being monitored. It will continue in this manner until the battery is replaced ([Section 3.3](#)) or the battery no longer carries a sufficient voltage to power the unit.

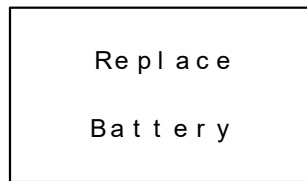


Figure 5-4 Replace Battery Screen

5.5 SMART SENSOR MODULES

Each SenSmart 7000 may be supplied with either one, or two, "Smart Sensor" gas sensor modules mounted locally to the SenSmart 7000 enclosure, or up 15 feet away with the 10-0411 "Sensor Separation Kit". "Smart Sensors" utilize a unique **Smart Sensor Interface** to transfer necessary configuration parameters from the Smart Sensor's memory to the SenSmart 7000 whenever a new sensor is installed. The "Smart Sensor Info" screen appears at power up and anytime a sensor module is removed and installed again. If a sensor is installed that does not match gas type of the previous sensor, the operator must manually approve the new sensor in order for the SenSmart 7000 to accept the new gas type (Figure 5-4).

Local sensor heads have a *Smart Sensor* cable connected to S1 (Channel 1) and/or S2 (Channel 2) of the 10-0407 Battery / I/O PCB (see Figure 3-2).

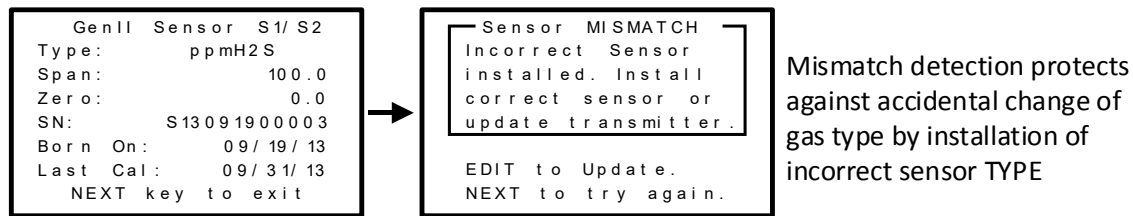


Figure 5-5 Smart Sensor Info / ERROR Screens

5.5.1 SenSmart 7000 10-0411 SENSOR SEPARATION KIT

Smart Sensor heads may be remote mounted up to 15 feet using the 10-0411 sensor separation kit connected to TB1 or TB2 of the 10-0407 Battery / I/O PCB (see Figure 3-2). The 10-0411 Sensor Separation Kit comes with 15 feet of data cable (1000-2730) and assures proper communication over the **Smart Sensor Interface**. Alternate cable types and longer distances are not approved and may result in poor performance.



Figure 5-6 Sensor Separation Kit 10-0411



Document: UM-1002

WaveNet Wireless Monitoring System User's Manual

Revision Level A

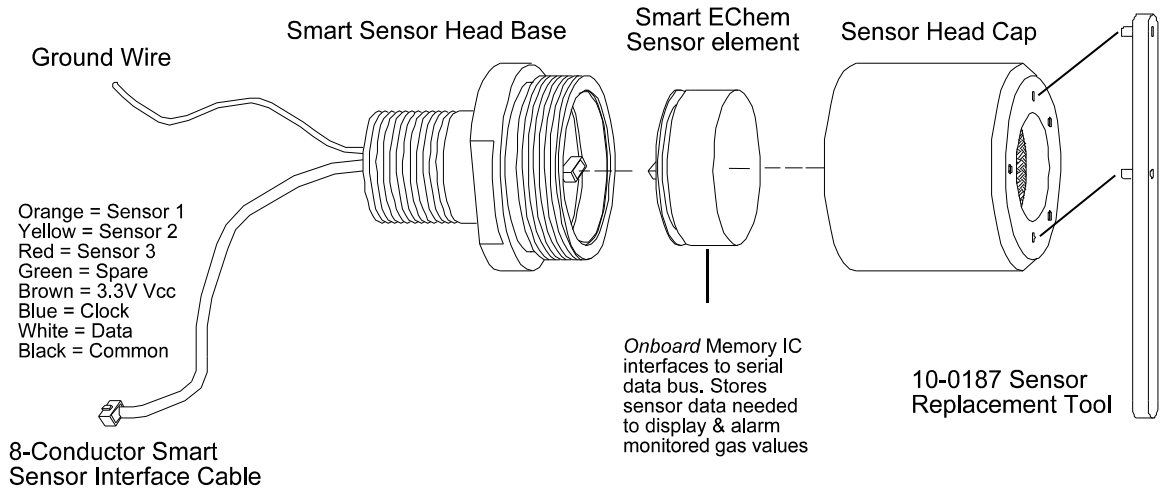


Figure 5-7 10-0247 Smart Sensor Head Assembly

Chapter 6 – SenSmart 7000 SETUP MENUS

6.1 MENU STRUCTURES

SenSmart 7000 (SenSmart 7000) configuration parameters are stored in its non-volatile menu database. Menus are accessed by swiping the EDIT key from any data display. This displays the **MAIN MENU** with a path to **Channel 1**, **Channel 2**, **Device Setup** and **Help** menus. **Channel 1** and **Channel 2** have two separate but identical menu structures which determine how readings and alarms function for each channel. Menus contain nominal default values from the factory which may be edited by the operator to better match the particular application. [Section 7](#) is dedicated to describing **Channel** menus.

Device Setup contains menus not pertaining to either channel but to the unit as a whole. These include Security, Clock/Calendar, Delays, and how the SenSmart 7000 communicates to the wireless network. [Section 8](#) is dedicated to describing **Device Setup** menus.

6.2 MAIN MENU

The **MAIN MENU** setup screen is shown in Figure 6-1. The UP / DOWN keys maneuver the pointer while EDIT enters sub-levels of menu items. All **MAIN MENU** items have at least one page of sub-menus indicated by the > symbol (right hand pointing arrow) at the end of each line. Change a menu item by:

1. Select UP/DOWN key so that the arrow on the left is pointing to the desired menu item.
2. Select the EDIT key to display the cursor.
3. Select UP / DOWN to change that character.
4. Select NEXT to advance the cursor.
5. Select EDIT again to load the new item, and remove the cursor.
6. Select NEXT to reverse out of the sub-menu.

The MAIN MENU is the pathway to **CHANNEL 1 / 2** menus, **Device Setup** menus and the **Help** pages. A channel should only be activated if it has a sensor connected to the 10-0407 Battery / I/O board. The **Device Setup** group (see [Section 8](#)) contains parameters affecting the entire SenSmart 7000 regardless of channel.

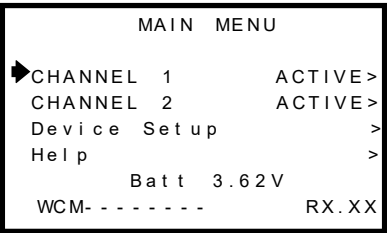


Figure 6-1 Main Menu Entry

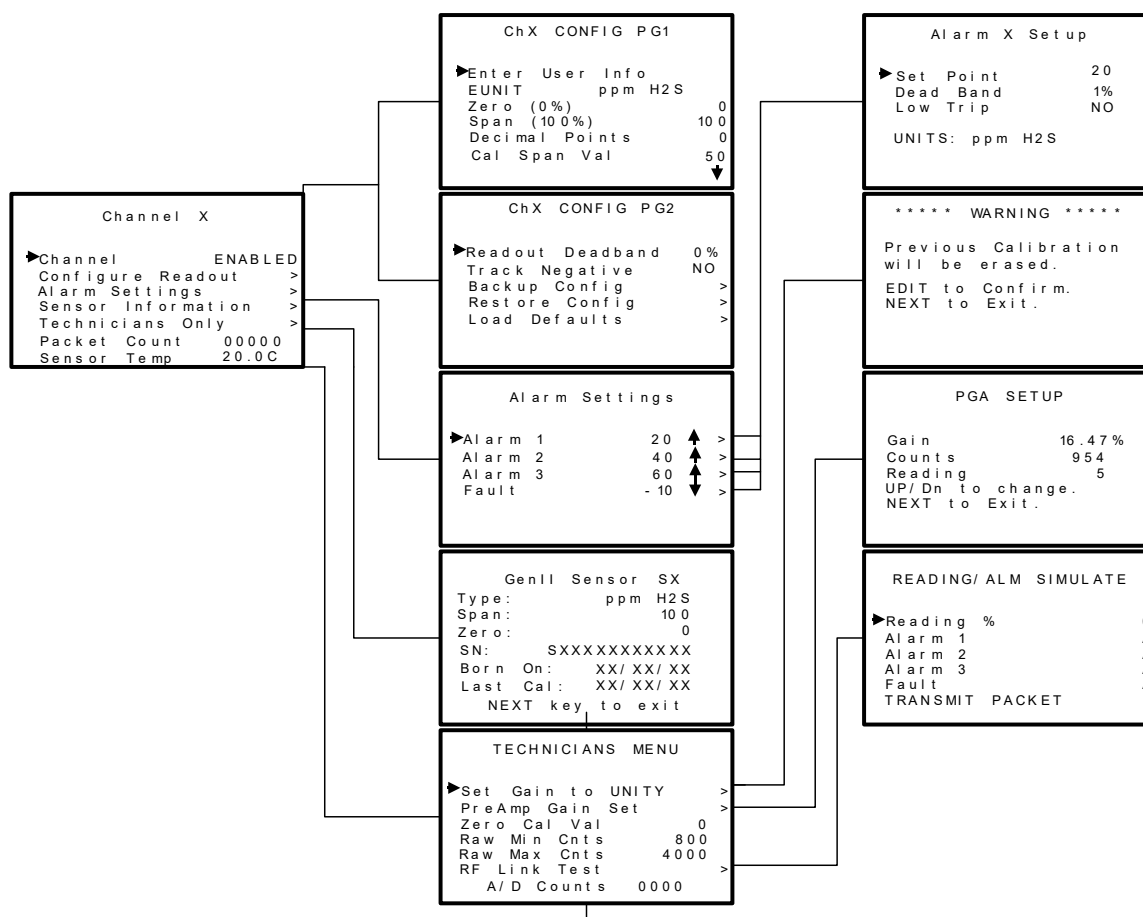


Figure 6-2 SenSmart 7000 Channel Configuration Menu Tree

Chapter 7 – SenSmart 7000 CHANNEL SETUP MENUS

The CHANNEL 1 / CHANNEL 2 menus accessed from the MAIN MENU are shown in Figure 7-1.

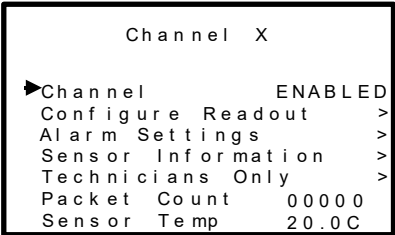


Figure 7-1 Channel Setup Menus

7.1 CHANNEL ENABLE / INACTIVE

Use the top menu in the group to make this channel either “ENABLED” or “INACTIVE”. Channels should only be activated if a sensor is connected (see [Section 5.5](#)).

7.2 CONFIGURE READOUT

The Configure Readout group shown in Figure 7-2 has 2 pages of menus for controlling how sensor signals are displayed and alarms are activated for this channel.

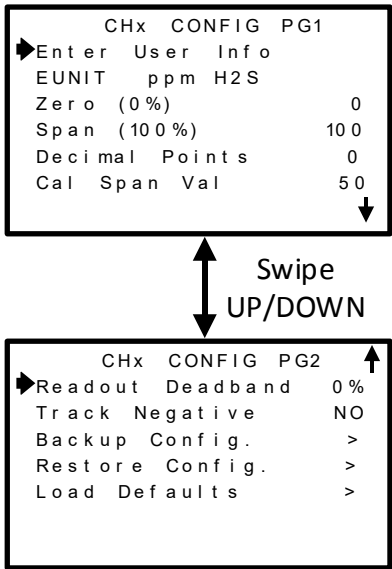


Figure 7-2 Configure Readout Setup Menus

7.2.1 MEASUREMENT NAME

The **Measurement Name** field may be edited to contain virtually any 16-character ASCII string. It is typically used to describe the monitored point by user tag # or other familiar terminology.



Document: UM-1002

WaveNet Wireless Monitoring System User's Manual

Revision Level A

7.2.2 EUNIT

Eunit (engineering unit) may have up to a 10 character ASCII field and is used to clearly identify the target gas and units of measure such as %, ppm or ppb.

7.2.3 ZERO (0%)

Zero (0%) defines the reading to be displayed when the monitored value = 0% of full scale.

7.2.4 SPAN (100%)

Span (100%) defines the reading to be displayed when the signal = 100% of full scale. The highest numeric reading allowed is 9999 including negative polarity sign and one decimal point. Polarity is only indicated for negative readings.

7.2.5 DECIMAL POINTS

Decimal Points determine the resolution of the LCD readings, and may be set to 0, 1 or 2 decimal points. Example: ZERO readings for 0, 1 & 2 DPs respectively are 0, 0.0 and 0.00.

7.2.6 CAL SPAN VAL

Cal Span Val sets the upscale gas value that must be applied when performing Span calibrations. This is typically at least 50% of the full scale range. Calibration accuracy is dependent on this setting matching the value of target gas in the span gas cylinder used during routine Span calibrations (see [Section 5.3](#)).

7.2.7 READOUT DEAD BAND

Readout Dead band allows forcing low readings to continue to read zero. This is useful when there are very small, safe, levels of background target gas that cause fluctuating readouts above zero. The highest amount of dead band allowed is 5% of the full scale range. Example: If the range is 0 – 10.0 ppm, setting **Dead band** to 3% would mean the readout continues to display 0.0 until the value exceeds .3 ppm.

7.2.8 TRACK NEGATIVE

Track Negative, set to NO, causes negative values to read the **Zero (0%)** value in data displays. The CAL MODE readout will display negative values regardless of this setting. Negative values below the Fault set point will still cause the Fault alarm to trip (see [Section 5.4.1](#)).

7.2.9 BACKUP CONFIG

Backup Config allows users to store the **CHANNEL** menu parameters into non-volatile memory for restoration later, if incorrect values are accidentally entered or uploaded.

7.2.10 RESTORE CONFIG

Restore Config restores the **CHANNEL** menu database to the values from the most recent **Backup Config** the special keystroke sequence of 4 consecutive UP keys is required to perform the **Restore** operations.

7.2.11 LOAD DEFAULTS

Users are encouraged to modify the **Channel** parameters described in this section when it helps tailor the SenSmart 7000 to their project. However, at some point it may be desirable to return all of these settings to their original factory default values. Each smart sensor has a protected database containing a copy of the original factory default values which the SenSmart 7000 user cannot modify. The **Load Defaults** menu retrieves these original factory default values from the smart sensor and repopulates all **Channel** menus to match.

7.3 ALARM SETTINGS

The **Alarm Settings** page includes the **Alarm 1, 2, 3** and **Fault** menus shown in Figure 7-3. Alarm conditions are indicated by “A1”, “A2”, “A3” and “FAULT” LCD icons on data displays and by flashing the A1, A2, A3 and FAIL LED’s. The FAIL LED also flashes if the SenSmart 7000 detects a missing or defective sensor. Up or Down pointing arrows indicate if the alarm is set for a high or low trip respectively.



Figure 7-3 Alarm Settings Menus

7.3.1 SET POINT

Set Point enters the **Eunit** value where the alarm trips. The Fault Set Point may only be set for negative values between 0% and -10% of range and is always Low Trip. This makes it function as a FAULT alarm and trip when the monitored value is out-of-range negative.

7.3.2 DEAD BAND

Dead Band for A1, A2 and A3 have a minimum value of 1% and a maximum value of 10%. **Dead Band** is useful for preventing alarm cycling when the monitored value is hovering around the set point. EXAMPLE: With a range of 0-100 ppm, if Dead-Band equals 5% and the set point is 20 ppm, after tripping at 20 ppm the value must drop below 15 ppm to reset. **Dead Band** for the Fault alarm is fixed at 1%.

7.3.3 LOW TRIP

Low Trip for A1, A2 and A3 set to YES causes the alarm to trip as the value falls below the set point. The Fault alarm is always a **Low Trip**.

7.4 SENSOR INFORMATION

The **Sensor Information** page shown in Figure 7-4 displays important values for the Smart Sensor installed. The SenSmart 7000 Smart Sensor interface automatically detects new Smart Sensors and updates this page any time a new sensor is installed.



Document: UM-1002

WaveNet Wireless Monitoring System User's Manual

Revision Level A

```

GenII  Sensor  S1/ S2
Type:      ppmH2S
Span:      100.0
Zero:      0.0
SN:        S13091900003
Born On:   09 / 19 / 13
Last Cal:  09 / 31 / 13
NEXT key to exit

```

Figure 7-4 Smart Sensor Information Screen

Type, **Span**, **Zero**, **SN** (Serial Number) and **Born On Date** are set at the factory and may not be modified. **Last Cal** date updates each time the CAL MODE is performed (see [Section 5.3](#)). **Type** indicates what kind of sensor is plugged into this SenSmart 7000 channel. **Span / Zero** indicate the nominal gas range for this sensor but not necessarily what the user's range must be. For example, the nominal Span of an H2S sensor might be 100 ppm but the user may decide to set his SenSmart 7000 Span for only 50 ppm. See **Preamp Gain** [Section 7.5.2](#) to learn how to set the SenSmart 7000 span for a different range than the Smart Sensor's nominal Span. **Born On Date** shows when the sensor was originally configured at the factory.

7.5 TECHNICIANS ONLY

WARNING! Users of these menus must have a detailed understanding of their functions. Monitoring of target gases, processing of alarms and wireless communications should not be relied upon while editing these menus! **Back-up the current configuration prior to altering any Technician menus in case Restore is required later (see [Section 7.2.10](#)).**

The **TECHNICIAN ONLY** menu group in Figure 7-5 contains items that are **factory configured** depending upon the type of sensor input connected to the SenSmart 7000. They should not be tampered with after installation. If configured incorrectly, some items will prevent accurate monitoring of target gases. **Access requires a special key sequence of four consecutive UP keystrokes** to prevent accidental modification of critical items.

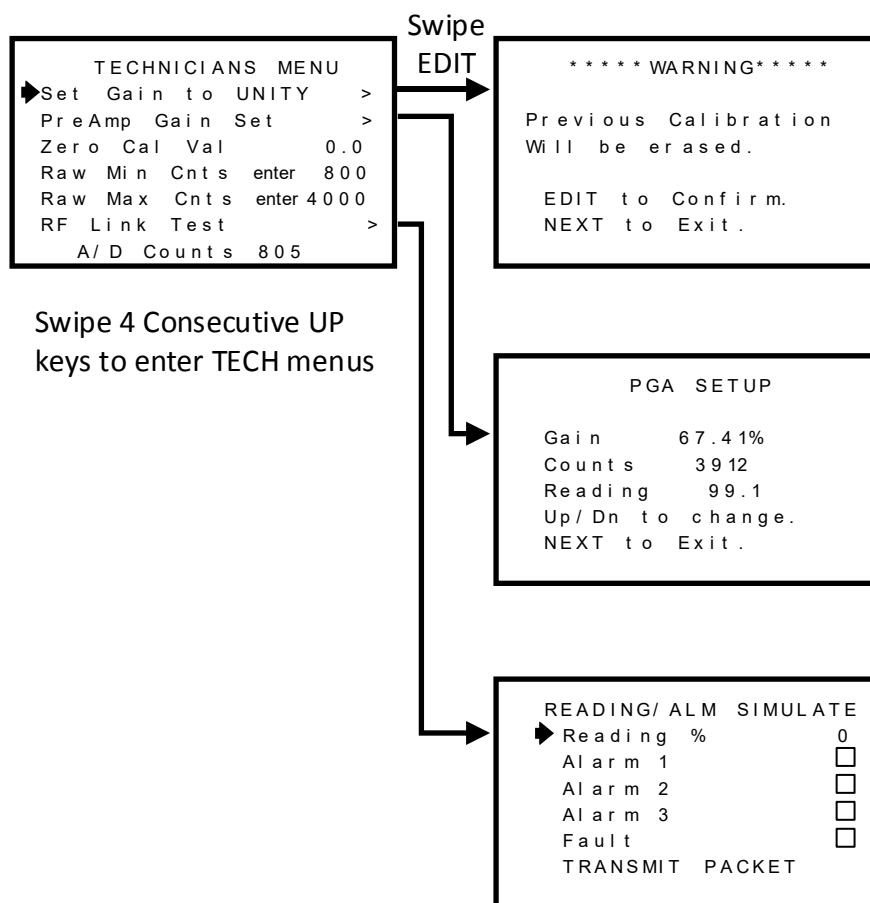


Figure 7-5 Technicians Menu Tree

7.5.1 SET GAIN TO UNITY (TECHNICIANS ONLY!)

Set Gain to UNITY allows resetting previous calibration OFFSET to zero and GAIN to one. This is the definition of UNITY. A calibration should be performed after setting UNITY (see Cal Mode [Section 5.3](#)).

7.5.2 PREAMP GAIN ADJUST (PGA) (TECHNICIANS ONLY!)

Gas sensors have a very wide output signal range, across the many gas types, and there are several full scale ranges for each type. **Preamp Gain** is the adjustment that matches the sensor element's signal range to the Smart Sensor's input signal conditioning circuits. The **Preamp Gain** value is saved into non-volatile memory on the Smart Sensor module. Altering the Preamp Gain automatically resets previous calibration OFFSET and GAIN values to UNITY as described in [Section 7.5.1](#).

If it is determined the **Preamp Gain** value is incorrect, apply the desired up-scale target gas value to the sensor and use the UP / DOWN keys to obtain the correct **Reading** value. **Counts** are the 12-bit binary A/D value with an active range value of 800 – 4000 for 0-100% of full scale.

CAUTION: For standard installations this is a factory adjustment. Do not use the **Preamp Gain** menu for calibrating sensors. It should only be adjusted if a new measurement gas or input range is required.



Document: UM-1002

WaveNet Wireless Monitoring System User's Manual

Revision Level A

7.5.3 ZERO CAL VALUE (TECHNICIANS ONLY!)

The **Zero Cal Value** menu entry allows the zero calibration value to be set for something other than a zero reading. In rare cases it may be necessary to perform Zero calibrations at some other engineering unit reading than zero. Do not exceed 25% of full scale.

7.5.4 RAW MIN / MAX COUNTS (TECHNICIANS ONLY!)

The **Raw Min / Max Counts** menus determine the range of 12-bit analog to digital (A/D) converter counts that define 0 and 100% of full scale. The default range is 800 – 4000 counts. **Raw Min A/D** counts create 0% readings, and **Raw Max A/D** counts create 100% readings. The corresponding **Zero 0%** and **Span 100%** readouts that appear on data displays are entered in the CHANNEL Configuration Menu describe in [Sections 7.2.3](#) and [7.2.4](#). Live A/D count input values may be viewed on the **Preamplifier Gain** screen and the **CAL MODE** Information screens described [Sections 7.5.2](#) and [5.3](#).

7.5.5 RF LINK TEST (TECHNICIANS ONLY!)

The **RF LINK TEST** shown in Figure 7-6 is a diagnostics tool which allows readings of 0%, 25%, 50%, 75% or 100% of the full scale range to be broadcast to any WaveLink Receiver(WLR) and/or WaveNet Relayer(WNR) on the same network. Alarms may also be sent by filling the check box. After the menu is ready, simply point to TRANSMIT PACKET menu and swipe the EDIT key. The broadcast is made every time the EDIT key is swiped. **RF LINK TEST** is very useful for troubleshooting and testing a new installation.

IMPORTANT! WLR/WNR relays do activate if alarms boxes are checked!

READING/ ALM	SIMULATE
▶ Reading %	0
Alarm 1	☐
Alarm 2	☐
Alarm 3	☐
Fault	☐
TRANSMIT PACKET	

Figure 7-6 RF Link Test

7.5.6 SENSOR TEMP COMP TABLE (TECHNICIANS ONLY!)

Signals from electrochemical sensor elements used in SenSmart 7000 Smart Sensor modules may be affected by temperature extremes. SenSmart 7000 Smart Sensors are equipped with an on board temperature sensor which monitors temperature of the sensor element. Sensor types have a matching Temperature Compensation profile which is stored with each Smart sensor in the table shown in Figure 7-7. This TEMP COMP TABLE is a hidden menu but may be accessed from the TECHNICIANS MENU by holding the DOWN key until it appears.

S1 TEMP COMP TABLE		
► Data Point		20.0 C
Gain		1.000
% Offset		0.000
Comp ed		0.0
UnComp ed		0.0
Sensor Temp		23.5 C

Figure 7-7 Temperature Compensation Table

The temperature **Data Points** scroll by in 10 degree C increments from -40C to + 60C with each swipe of the EDIT key. Each Data Point has an associated **Gain** and **Offset** value. Electrochemical sensors may be less sensitive to the target gas at lower temperatures than at higher temperatures and therefore require higher gain when cold and less gain when hot. To accomplish this, **Temp Comp Table Gain** is typically 1.000 at 20C and increases gradually at the colder Data Points and decreases at warmer. Some sensors may also have a shift in zero output at extreme temperatures. The **Offset** values add or subtract in % of full scale using the following formula: **Gain (Uncomp ed – Offset) = Comp ed**. Note that Offset values entered with a negative number actually add to the reading. **Sensor Temp** is a live readout from the current temperature of the sensor element.

7.6 PACKET COUNT

Packet Count appears at the bottom of Channel Setup menu, and is a 5 digit decimal number indicating the number of transmissions the SenSmart 7000 has transmitted since the last reset; up to 65,535 transmissions. This is a useful diagnostic tool for comparing how many times the SenSmart 7000 transmits to the number of transmissions received by receivers over a period of time

When the SenSmart 7000 is in dual channel mode each channel will display the number of transmissions for that channel independently, on its respective Channel Setup Menu (Figure 7-1).

The TX Counter is reset by moving the cursor to the Packet Count line and selecting EDIT, or by cycling power to the SenSmart 7000.

7.7 SENSOR TEMP READING

The last item on the CHANNEL menu page is a live reading of the Smart Sensor's temperature. This reading is used if the sensor element requires temperature compensation (see [Section 7.5.6](#)).

Chapter 8 – SenSmart 7000 DEVICE SETUP MENUS

The **Device Setup** group shown in Figure 8-1 contains parameters affecting the entire SenSmart 7000 (SenSmart 7000) regardless of channel. These include Security, Clock/Calendar, Delays, and how the SenSmart 7000 communicates to the wireless network.

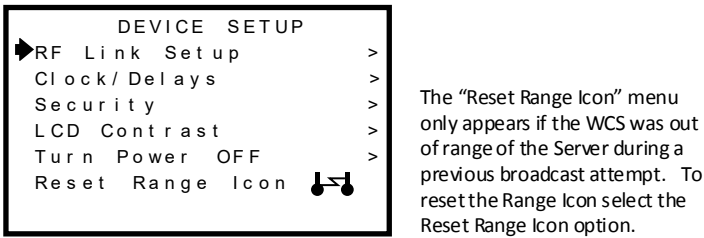


Figure 8-1 Device Setup Menus

8.1 RF LINK SETUP

RF LINK SETUP provides access to a group of menus for configuring how the SenSmart 7000 broadcasts its data to the WaveNet wireless network. Items tagged with an asterisk affect power consumption and battery life.

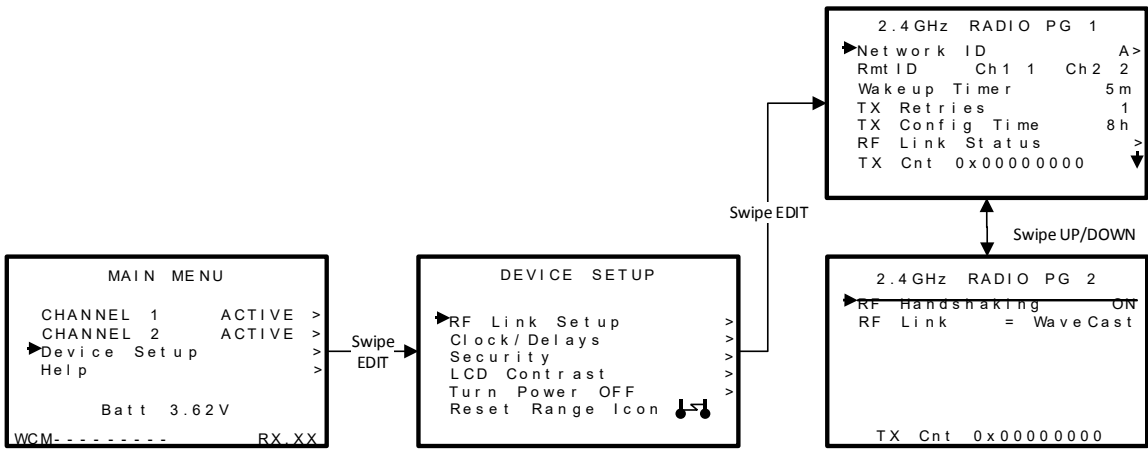


Figure 8-2 RF Link Setup Menu

8.1.1 NETWORK ID

WaveNet devices utilize the **Network ID** setting to assign up to 26 unique hopping patterns. To simplify system setup, **Network ID** is entered using letter designators "A" through "Z" where A = [Hop Channel 1, System ID 1] and Z = [Hop Channel 26, System ID 26]. A SenSmart 7000 will not indicate Server In-Range status or communicate with any WaveLink Receiver (WLR) and/or WaveNet Relayer (WNR) operating on a different **Network ID**. This feature allows multiple WaveNet wireless systems to be located within range of each other without interference.

Networks M through Z are encrypted networks. When one of these networks is selected the data will be encrypted via proprietary methods to ensure that only devices on that network, which hold the encryption key, will be able to decipher the data being transmitted.



Document: UM-1002

WaveNet Wireless Monitoring System User's Manual

Revision Level A

IMPORTANT! Explore what frequencies are appropriate for the final location of any wireless system.

8.1.2 RMTID

WaveNet systems allow up to 32 SenSmart 7000 **RTU #s** per network. **IMPORTANT!** Dual sensor SenSmart 7000s have two **RTU #s** and they are always consecutive. For example, setting the **RTU #** of Sensor 1 to 5 automatically sets this SenSmart 7000's Sensor 2 **RTU #** to 6. The SenSmart 7000 **RTU #** is used by the WLR/WNR to control which channels the sensor readings are displayed on, and how its relays are tripped. It is not necessary for SenSmart 7000 **RTU #s** AND WLR/WNR CHANNEL NUMBERS TO MATCH. A separate WLR/WNR menu allows random matching of WLR/WNR Channel numbers to SenSmart 7000 **RTU #s**. This is useful for creating "zones" where monitors with the same gas type may be displayed on consecutive WLR/WNR channels.

8.1.3 *WAKEUP TIMER

The **Wakeup Timer** menu determines how often the SenSmart 7000 broadcasts its data when there is no A1, A2 or A3 LEVEL ALARM. Active A1, A2, A3 alarms override the **Wakeup Timer** and schedule broadcasts 6-seconds after each previous broadcast. The **Wakeup Timer** range is 1 minute – 5 minutes with 5 minutes being the default value.

Note: Broadcast intervals will actually be a few seconds longer than the value entered since the SenSmart 7000 radio module must be powered up and achieve Server In-Range status prior to broadcasting.

IMPORTANT: More frequent RF broadcasts deplete the battery faster!

8.1.4 *TX RETRIES

The **TX Retries** menu allows EVERY broadcast to be repeated up to 5 times with a 200mS delay between each repeated broadcast. Each repeated broadcast will appear as a separate blink of the SenSmart 7000's TX LED and the WLR/WNRs RX LED.

The default setting of 1 should only be increased if there is no other way to improve communications success. Increasing **TX Retries** may be a viable way to improve communications if there are other high power RF radiators near WaveNet antennas, and it is not possible to relocate the antennas. Power consumption increases with radio broadcasts, and battery life will be affected by raising the **TX Retries** setting.

Transmissions will perform as follows for the TX Retries settings:

1. **TX Retries** set to **1, 2 or 3**: the SenSmart 7000 automatically transmits one, two and three times respectively.
2. **TX Retries** set to **4**: the SenSmart 7000 transmits until an acknowledgement is received from the server or four times, whichever comes first.
3. **TX Retries** set to **5**: the SenSmart 7000 transmits until an acknowledgement is received from the server or five times, whichever comes first.

8.1.5 *TX CONFIG TIME

TX CONFIG TIME may be set from 0 to 18 hours and determines how often the SenSmart 7000 broadcasts all of the CHANNEL CONFIG parameters to the WLR/WNR. Broadcasts normally include only monitored gas values and alarm status, but at least hourly, all configuration is sent to the WLRs to assure identical readings at all locations. The configuration data is also broadcast whenever any menu containing these parameters is edited or manually by holding the UP key for 5 seconds. This longer broadcast takes approximately 1 second to complete.

Setting TX Config Time to 0 means that the SenSmart 7000 will not send all of the Channel Config parameters to the WLR/WNR automatically, and these parameters must be sent by holding the UP key for 5 seconds.

8.1.6 RF LINK STATUS

RF Link Status opens another screen that shows if the SenSmart 7000 is In-Range of the Server and what the battery voltage is currently. The radio remains active during this screen so the range status is displayed in real time. Battery voltage is also displayed on the MAIN MENU.

*** TX Multiples(900MHz and 2.4GHz), RF Handshaking(900MHz) and TX Power(900MHz)** menu settings are available to improve communications reliability by increasing the quantity and power of wireless broadcasts.

IMPORTANT! Ensure proper selection and location of antennas before increasing **TX Multiples** and **TX Power** settings. Battery life will be reduced by increasing these settings. Proper selection and location of antennas is more important to successful communications and will not sacrifice battery life.

8.1.7 *RF HANDSHAKING (900MHZ MODELS ONLY)

RF Handshaking must be OFF if there is more than one WLR/WNR receiving SenSmart 7000 broadcasts. The default OFF setting causes every SenSmart 7000 broadcast to repeat 3 times in rapid succession (these appear as a single blink of the TX LED and are unrelated to **TX Multiples**). The ON setting requests an Acknowledge, or, "Handshake" from the Server. With **RF Handshaking** = ON, the SenSmart 7000 broadcasts only once if the Acknowledge is received, and up to 3 times if an Acknowledge is not received.

IMPORTANT! The ON setting allows more efficient communications but must only be utilized when broadcasting to a single WLR/WNR configured as Server. Multiple WLRs/WNRs, listening on the same **NETWORK ID**, will have acknowledge data collisions if the SenSmart 7000 **RF Handshaking** = ON.

RF HANDSHAKING = OFF may be used for any application, but is required when broadcasting to a WLR/WNR Server and other WLR/WNR Clients.

8.1.8 *RF LINK

RF Link will change the mode in which the SenSmart 7000 will communicate. The default setting is the WaveCast mode which is discussed in detail in [Section 8](#). By selecting **RF Link** the mode may be changed to Legacy Mode, which is discussed in [Chapter 17](#).

8.1.9 *TX POWER (900MHZ MODELS ONLY)

TX Power (900MHz models only) may be set for 10mW, 200mW and 400mW (EIRP based upon a 2 dBi antenna). Since SenSmart 7000s are battery powered the **TX Power** setting should be as low as possible to sustain reliable communication. The maximum **TX Power** setting is 30db (1 watt) and each time TX power is reduced by half, antenna transmit power is reduced by 3dB.

Note: 1 watt operation is not recommended or necessary for most applications as it can cause an unnecessary load on the battery thereby significantly reducing battery life.

Under normal operations the SenSmart 7000 cannot be set to 1 watt. In order to set the SenSmart 7000 to 1 watt hold the up key for 5 seconds while at the bottom of the radio menu. A1 and A3 LEDs will flash to indicate the change, and now 1 watt is an available option under TX Power.

2.4GHZ variation: The TX Power menu is not available in 2.4GHZ models and is fixed at 125mW conducted.

8.1.10 TX CNT (TRANSMIT COUNTER)

TX Cnt. (Transmit Counter) appears at the bottom of the RF LINK page and is an 8 digit hexadecimal counter that appears as 0x00000000. The highest count would be 0xFFFFFFFF, or 4,294,967,295 decimal. It is useful as a diagnostic tool for counting how many times the SenSmart 7000 broadcasts over any given period of time. To reset the TX Cnt hold the CAL/DOWN key when on the RF Link Setup menu.

When in dual channel mode this number combines the transmissions from each channel.

8.2 CLOCK, WARM-UP and CAL PURGE DELAYS

The SenSmart 7000 is equipped with a Real Time Clock and Calendar so **Time** and **Date** must be set to correctly match its location. They are set at the factory in a 24 hour format but may require adjustment to match the location’s time and date after shipment. **Warm Up** and **Cal Purge** time delays are also available to prevent unwanted alarm trips. Figure 8-3 shows the menu for these items.

8.2.1 WARM UP TIMER

The **WARM UP** timer is has a default setting of 60 seconds but may be between 0 – 254 seconds. The primary purpose of the warm up timer is to allow sensor stabilization after power up.

8.2.2 CAL PURGE TIMER

The **CAL PURGE** timer has a default setting of 60 seconds, but may be set between 0 – 254 seconds. The primary purpose is to allow sensor stabilization after a Span calibration (see [Section 5.3](#)). A purge interval is needed after the span calibration, because up-scale readings will linger until the span gas exits the sensor head. Alarms are inhibited during the **CAL PURGE** interval.

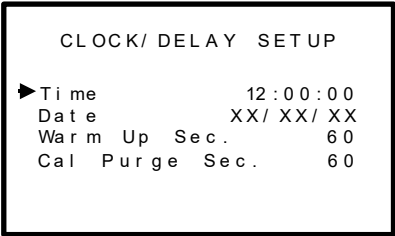


Figure 8-3 Clock & Calendar / Delay Timer Menu

8.3 SYSTEM SECURITY

The **SYSTEM SECURITY** menu in Figure 8-4 offers two levels of protection. A **LOW** level allows CAL MODE sensor calibrations, but requires the 4-digit **Pass Code** prior to altering menus. **HIGH** level locks the entire menu database, plus CAL Mode, until the correct **Pass Code** is entered. **LOW** and **HIGH** security levels always allow



Document: UM-1002

WaveNet Wireless Monitoring System User's Manual

Revision Level A

viewing of configuration menus but they may not be modified. **Contact Name** is a 12 character ASCII field available for displaying a phone #, or name, of personnel who manage the **Pass Code**.

Lost **Pass Codes** may be recovered by entering the locked security menu and holding the UP key for 5 seconds. The 4-digit code appears near the bottom of the screen.

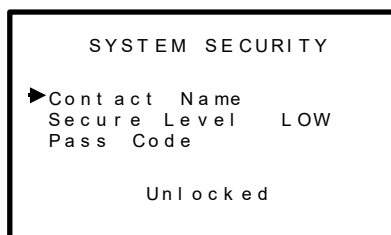


Figure 8-4 System Security Menu

8.4 LCD CONTRAST ADJUST

LCD Contrast Adj. may be set for optimum viewing using the menu shown in Figure 8-5. To adjust swipe the UP/DOWN keys, and swipe next to save and exit.

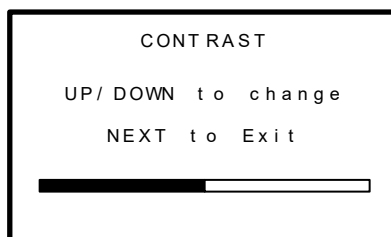


Figure 8-5 LCD Contrast Adjust Menu

8.5 TURN POWER OFF

There are three ways to power down the SenSmart 7000. Use this menu in the DEVICE SETUP group, or, with any **Data Display** on the screen hold the NEXT key for several seconds. The final way, which should only be used if the unit is not responding to any key swipes, is to hold the EDIT key until the unit powers down. Power should be turned off prior to replacing the battery. Otherwise, a large storage capacitor will keep the SenSmart 7000 powered for up to 10 minutes even after the battery is removed.

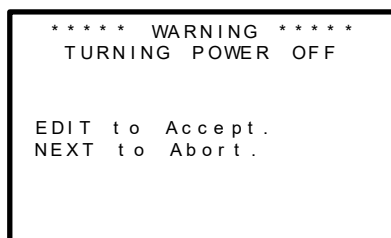


Figure 8-6 Turn Power OFF Menu



Document: UM-1002

WaveNet Wireless Monitoring System User's Manual

Revision Level A

8.6 RESET RANGE ICON

The **Reset Range Icon** menu only appears if the SenSmart 7000 has experienced an Out-of-Range () condition, but later recovered to achieve Server In-Range status. In this case, the SenSmart 7000 latches the Server Previously Out-of-Range condition and displays the associated icon () on readouts to indicate a potential problem with communications to this SenSmart 7000. It is important to Reset the unit back to the desired Server In-Range icon () either by using this menu or by cycling SenSmart 7000 power.

Following is a description how to use the range icons as wireless network troubleshooting tools:

The SenSmart 7000 displays one of three RANGE ICONS (, , ) to indicate if its radio has been achieving the Server In-Range status necessary to broadcast its data.

-  is desired since it indicates **every** attempt to broadcast since power up has been successful.
-  indicates, during the **most recent** attempt, the Server could not be found.
-  indicates the most recent attempt was successful, however, an earlier attempt was unsuccessful.

If the WLR is experiencing comm errors there are two probable causes:

1. The SenSmart 7000 is not achieving "Server In-Range" status and therefore not broadcasting.
2. The SenSmart 7000 broadcasts but the data is not received by the WLR.

SenSmart 7000 range icons help isolate #1 or #2 since if the desired  is displayed, #2 must be the problem. However, if intermittent WLR comm errors occur, and  is displayed it is likely the SenSmart 7000 is not reliably achieving a Server In-Range status.

WAVELINK RECEIVER

Chapter 9 - WAVELINK RECEIVER (WLR) DESCRIPTION

9.1 WAVELINK RECEIVER DESCRIPTION

The R. C. Systems Co. Inc. 32 Channel WaveLink Receiver (WLR) is designed to display readings and control alarm event relay switching for up to 32 SenSmart 7000s (SenSmart 7000s). The WLR receives Fail, Alarm 1, Alarm 2, Alarm 3 and Low Battery signals from each SenSmart 7000, maps them to its 8 programmable relays, while adding features such as Latching / Failsafe, Alarm Acknowledge and Refresh. A piezo driver circuit for a local audible annunciator may also be mapped to the relays. Eight standard 5-amp alarm relays may be programmed to activate based upon various alarm combinations and channel zoning. A Real-Time Clock and Calendar are also standard.

An optional 10-0410 Multi-Function module (see [Chapter 13](#)) may be integrated into any of the standard WLR enclosures to add data logging, a wired or wireless Modbus slave port, plus a Wi-Fi port with web-server. The Wi-Fi feature allows remote HMI functionality via any web enabled device. This means the WaveLink Receiver allows responders to view real time and historical data on smart phones, tablets and PCs prior to entering a potentially hazardous area.

A backlit 128 x 64 pixel graphic LCD shows monitored data as bar graphs and engineering units. System configuration is via user friendly menus, and all configuration data is retained in non-volatile memory during power interruptions. The WLR front panel is shown below in Figure 9-1 displaying the Eunit/Bar Graph data screen. The five button symbols below the display may be magnetically activated using the supplied magnetic wand without opening the enclosure. Opening the enclosure door provides access to the push button keypad as shown in Figure 9-2.

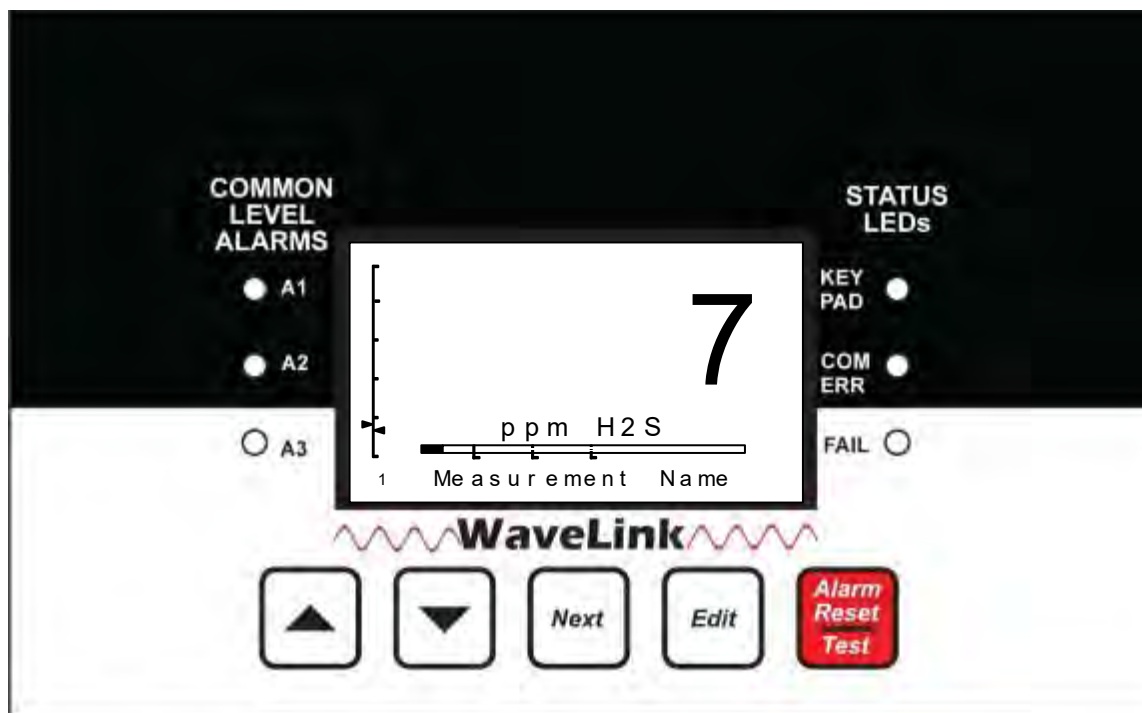


Figure 9-1 WLR Front Panel

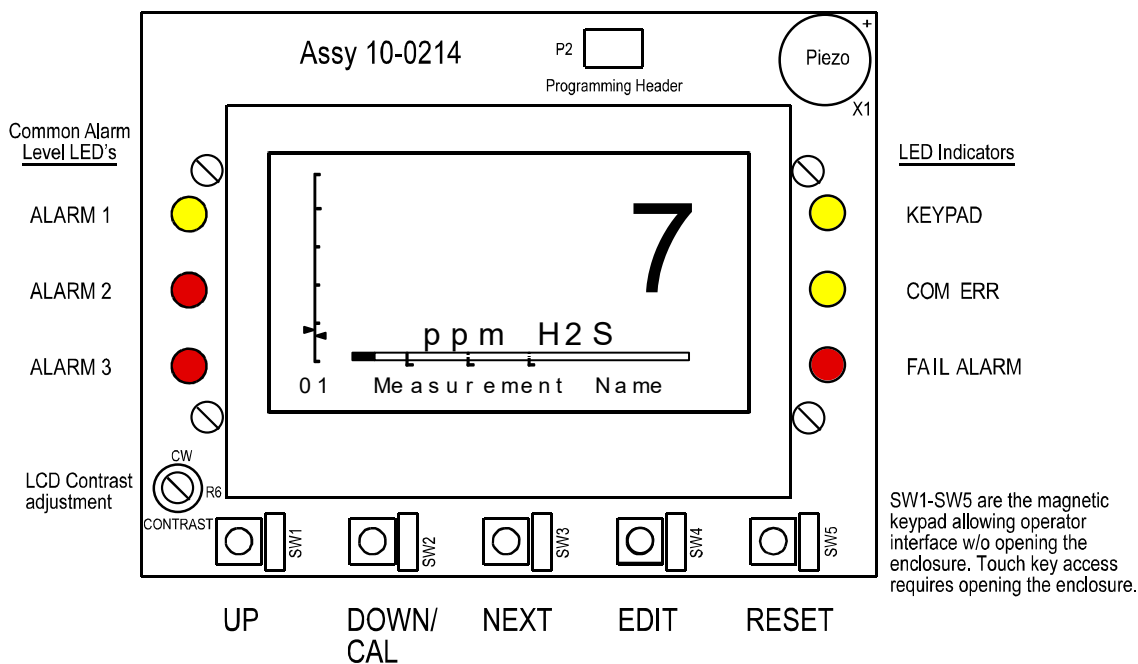


Figure 9-2 10-0214 WLR Display PCB



Document: UM-1002

WaveNet Wireless Monitoring System User's Manual

Revision Level A

9.2 DATA DISPLAY SCREENS

When there are no channels with alarm conditions the WLR displays **ALARMS STATUS CLEAR** as the main readout screen. However, pressing the **NEXT** key displays the **Event Log** screen which displays various status changing events as discussed in [Section 10.9](#). Pressing **NEXT** again displays the **Eunits/Bar Graph** screen shown in Figure 9-3, which allows scrolling past all active channels with the UP/DOWN keys. This is very useful for observing incoming SenSmart 7000 broadcasts one channel at a time. When there are channels with alarms, the **ALARMS STATUS CLEAR** screen is replaced by the **Channel Alarm Status** screen which displays any active channel in alarm, and followed by an alternating line which shows the channel's Measurement Name and the current alarm. The **EUNIT/Bar Graph** screen is also available during alarm conditions.

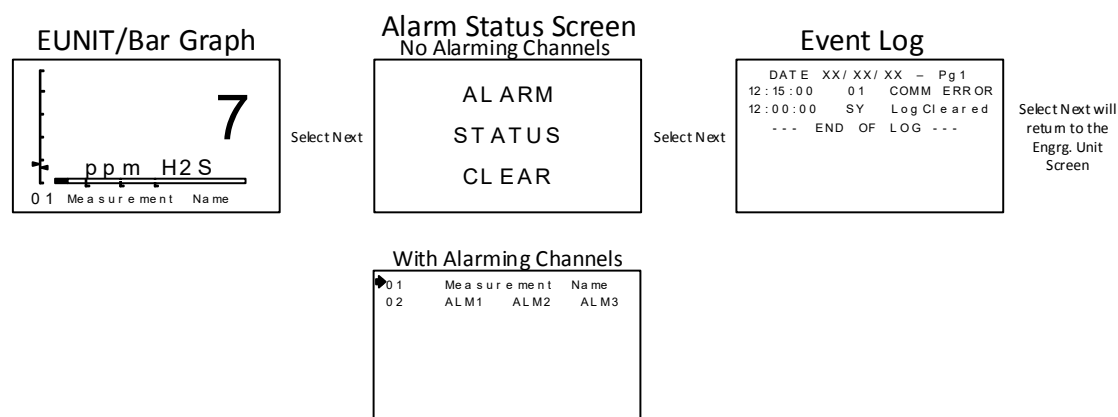


Figure 9-3 WLR Data Displays

9.2.1 EUNIT/BAR GRAPH SCREEN AND COMM ERROR TIME LINE

The WLR EUNIT/Bar Graph screen in Figure 9.4 consists of:

- Large digital value with Engineering Units
- Horizontal bar graph with A1, A2 and A3 levels indicated across the bar
- 16 character **Measurement Name** field for user ID of this SenSmart 7000's location
- The crucial Vertical **Comm Error Time Line** on the left edge of the screen

The UP/DOWN keys scroll this screen through all active channels one at a time.

The vertical Comm Error Time Line on the far left of this screen is divided into five segments, from bottom to top. Each segment equals one SenSmart 7000 Wakeup Timer interval from the SenSmart 7000 providing data to this WLR channel (see [Section 8.1.3](#)). Therefore, the entire time line is equal to 5 times the Wakeup Timer value.

The arrow on the right side of the Time Line slides up the line as time goes by for the current channel being observed. However, every time the SenSmart 7000 broadcast packet is received on this channel, the pointer resets to the bottom of the time line. If the pointer reaches the top of the time line the WLR will raise a comm error for this channel. For example, if the Wakeup Timer is set for the maximum 5 minutes it requires 25 minutes without a broadcast to raise the Comm Error alarm for the channel. If the wireless link between the SenSmart 7000 and this channel is functioning properly the pointer should never exceed the 1st Wakeup Timer line segment.

The arrow on the left side of the Time Line slides up the line as time goes by in a similar manner to the other arrow. However, this pointer represents the channel which is furthest along its time line for all of the monitored channels. This is useful in determining if any channels have missed a transmission without having to cycle through



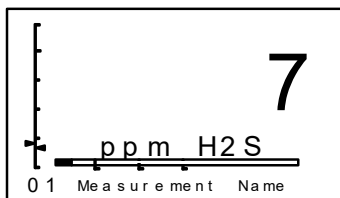
Document: UM-1002

WaveNet Wireless Monitoring System User's Manual

Revision Level A

observing all of the channels. If the arrow on the left hand side has not passed the first segment, all of the monitored channels have received their latest transmission.

EUNIT/Bar Graph Screen



The EUNIT/Bar Graph screen has flashing alarm icons for A1, A2, A3 FL (fail). Menu Item in System Menu controls if these readings display or block negative values. Number in bottom left indicates the channel currently being displayed. Use UP/DOWN to cycle through channels to be displayed. The vertical Comm Error Time Line on the far left of this screen is divided into five segments, from bottom to top. Each segment equals one WCM Wakeup Timer interval from the WCM providing data to this WLR channel (Section 8.1.3). Therefore, the entire time line is equal to 5 times the Wakeup Timer value. The arrow on the right side of the line slides up the line as time goes by. However, every time the WCM broadcast packet is received on this channel, the pointer resets to the bottom of the time line. IF THE POINTER REACHES THE TOP OF THE TIME LINE THE WLR RAISES A COMM ERROR ALARM FOR THIS CHANNEL. The arrow on the left hand side represents the channel furthest along its Time Line for all of the monitored channels.

Figure 9-4 EUNIT/Bar Graph Screen

9.2.2 ALARMS STATUS CLEAR SCREEN

The **ALARMS STATUS CLEAR** screen indicates there are no alarm conditions among the active channels and the WaveNet Monitoring System is performing normally. The **NEXT** key moves from this screen to the **Event Log** screen.

9.2.3 CHANNEL ALARM STATUS SCREEN

The Channel Alarm Status screen shows all active channel numbers, but causes any with an alarm condition to flash. Use the UP/DOWN keys to point to a channel in alarm and the EDIT brings up that channel's EUNIT/Bar Graph screen to provide more detailed information about the alarm. The pointer will automatically go to the first alarming channel when entering this screen.

If no Channel is in an alarm state this screen will not be displayed, and the Alarms Status Clear screen will be displayed in its place.

9.2.4 EVENT LOG SCREEN

The **Event Log** screen shows time and date stamped alarm events in a first in first out 99 event buffer. The **Clear Event Log** menu allows erasing of all events. The **Event Log** displays several different types of events:

1. Comm Error in and clear
2. Alarms in and clear
3. Relays energized and de-energized
4. Low battery
5. Calibration Mode
6. Warm up
7. Power up



Document: UM-1002

WaveNet Wireless Monitoring System User's Manual

Revision Level A

8. Local acknowledge
9. Cold Boot
10. RMT Ready
11. Network Configuration
12. Disabled
13. RMT Initialization
14. System locked and unlocked
15. Log Cleared
16. Push to Test
17. Remote acknowledge
18. Remote Configuration
19. Missing sensor
20. Relay Configuration

When one of the previous events occurs a new line will be displayed on the **Event Log** showing the time of the occurrence, the channel it occurred on (or SY if it is a system occurrence) and the type of event. For more detailed information refer to [Section 10.9](#).

Event Log

```

DATE  XX/ XX/ XX  - Pg 1
12:15:00 01 COMM ERROR
12:11:00 SY LogCleared
- - - END OF LOG - - -

```

Figure 9-5 Event Log Screen

9.3 SPECIFICATIONS

9.3.1 POWER SUPPLY REQUIREMENTS

WLR primary power may be either 10-30 VDC or 100-240VAC. AC power requirements are 100-240 VAC 50/60 Hz @ .80 amp max (including inrush) and 40 watts max steady state, applied to TB5 on the motherboard. If AC power is not available the primary power may be 10-30 VDC applied to TB1 on the motherboard, which is very useful for 12VDC solar powered installations. A back-up DC power source may also be connected to TB1 for automatic switchover if the AC power source fails. See Figures 11-1 and 11-2 for wiring information.

The basic WLR consumes only 3.0 watts of 10-30 VDC power (all relays energized). Optional features increase power consumption as described below:

With an AC primary power source connected to TB1 on the motherboard, TB3 terminals 1 and 2 on the motherboard provide a maximum of 10 watts output power for powering auxiliary external devices such as relays, lights and monitors (see Figure 11-1). Power consumed from TB3 must be included when calculating system power consumption.

IMPORTANT! TB3 only provides 24VDC power when AC is primary power.



Document: UM-1002

WaveNet Wireless Monitoring System User's Manual

Revision Level A

Some applications may require 24VDC power in excess of the 10 watts available from the WLR Motherboard power supply. An optional 50 watt 1000-2259 DIN rail AC/DC supply is available to increase 24VDC power (see [Section 11.3](#)).

9.3.2 RELAYS

The 8 standard Form C dry contact relays are functionally equivalent but 2 are on the 10-0215 Motherboard (see Figure 11-2) and 6 are on the 10-0222 Relay PCB (see Figure 11-3). Relays may be mapped to various alarm events as described in [Section 10.6.1](#).



All mechanical (dry contact) relays are rated at 5 Amp for 28 VDC and 250 ~VAC **RESISTIVE** loads. **IMPORTANT:** Appropriate diode (DC loads) or MOV (AC loads) snubber devices should be installed with inductive loads to prevent RFI noise spikes.



3.3 AMBIENT TEMPERATURE RANGE

-25 to 60 degrees C

9.3.4 HUMIDITY RANGE

0 TO 90% R. H. Non-Condensing.

9.3.5 ALTITUDE

Recommended up to 2000 meters

9.3.6 HOUSINGS / INSTALLATION CATEGORIES

- WLR/PY *NEMA 4X non-metallic polyester wall mount. DIV 2 Groups A,B,C,D; Category II and pollution degree 3; NEMA 4X; IP66
 - WLR/PCS *NEMA 4 painted carbon steel wall mount. DIV 2 Groups A,B,C,D; Category II and pollution degree 3; NEMA 4; IP66
 - WLR/SS *NEMA 4X stainless steel wall mount. DIV 2 Groups A,B,C,D; Category II and pollution degree 3; NEMA 4X; IP66
 - WLR/XP *NEMA 7 wall mount for DIV 1 & 2 Groups B, C, D; includes 'O' Ring in door to satisfy NEMA 4 rating.
- *Includes standard non-intrusive magnetic keypad.

9.3.7 APPROVALS (PENDING)



Chapter 10 – WAVELINK RECEIVER OPERATION

10.1 OPERATOR INTERFACE

The WaveLink Receiver's (WLR's) graphic LCD and 5-button keypad serves as its operator interface. All WLR configuration parameters are entered with this operator interface using SETUP menus accessed by pressing EDIT from any data display screen. This Setup mode may be exited manually by pressing NEXT, or automatically when no keys are pressed for 5 minutes. Alarm relays and front panel alarm LED indicators remain active during the Setup mode. A SECURITY menu offers a password feature to prevent tampering with WLR menus.

WLRs only display the readings and alarm events which are created at the SenSmart 7000 (SenSmart 7000). No Channel Alarm decision making occurs inside the WLR.

10.2 SETUP MENU CONFIGURATION

Variables in the **Channel** (see [Section 10.5](#)) and **System** (see [Section 10.6](#)) menus allow WLR configuration for a wide range of monitoring applications. Select the desired menu by scrolling with UP/DOWN and then EDIT to enter each menu. **Channel** menus affect only the specific channel selected while **System** menus are related to features not specific to any channel.

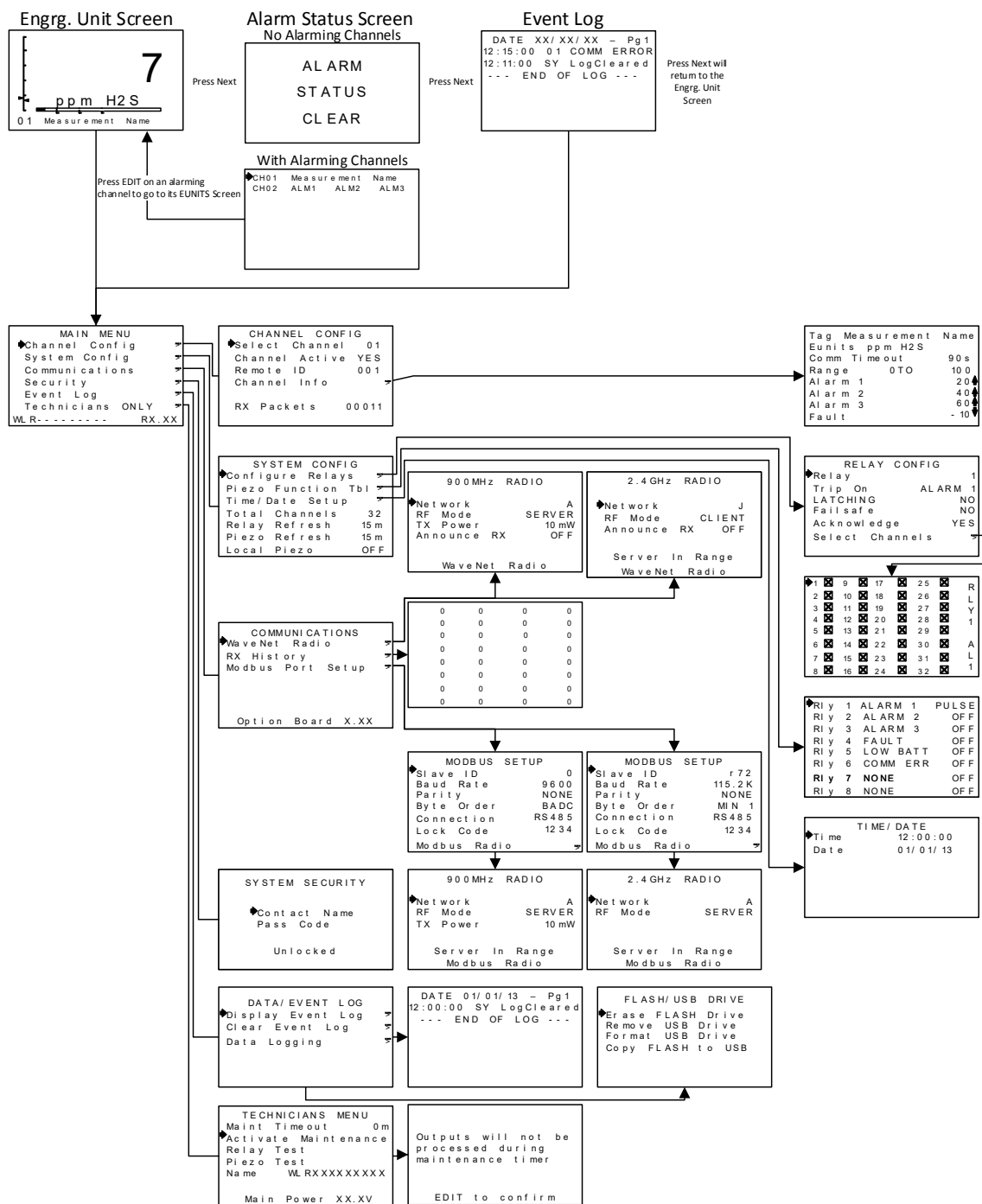


Figure 10-1 WLR Menu Tree

10.3 CHANGING MENU VARIABLES USING THE KEYPAD

After entering the menu a pointer controlled by the UP/DOWN keys indicates the selected variable. Some are simple YES/NO or ON/OFF entries toggled by pressing the EDIT key. Others have many ASCII character possibilities.

Allowed ASCII characters are as follows: ABCDEFGHIJKLMNOPQRSTUVWXYZ [] ^ _ ` abcdefghijklmnopqrstuvwxyz blank space ! " # \$ % & ' () * + , - . / 0 1 2 3 4 5 6 7 8 9 ; : < = > ? @ . Notice the often used *blank* character is located after lower case z and before the exclamation point (!). EDIT places a cursor under the item and UP/DOWN scrolls through each allowed entry. The NEXT key moves the cursor to the next position within a field. When the field is complete, EDIT clears the cursor and loads the field into non-volatile memory where it is retained indefinitely. Without a cursor present, the NEXT key closes open menus in reverse order and returns the LCD to the data display.

10.4 WLR MAIN MENU

The MAIN MENU group shown in Figure 10-2 below is reached by pressing EDIT with any data display present. This is the entry-level screen to **Channel Config**, **System Config**, **Communications**, **Security**, **Event Log** and **Technicians ONLY** menus. It also shows the serial number and firmware revision operating in the WLR. Use the UP/DOWN keys to move the pointer to the desired menu and press the EDIT key.

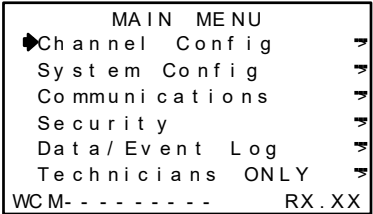


Figure 10-2 WLR Main Menu

10.5 CHANNEL CONFIG MENU GROUP

The **CHANNEL CONFIG** menu shown in Figure 10-3 allows configuration of variables specific to the selected channel. The channel to be affected is selected by pressing the **EDIT** key.

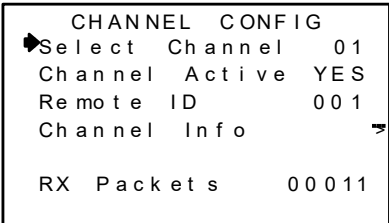


Figure 10-3 WLR Channel Config Menu

10.5.1 CHANNEL ACTIVE

Channel Active is a YES/NO field that allows temporarily deactivating channels. Channels that may be deactivated are limited to the number of **Total Channels** designated in the System Config menu group (see [Section 10.6.4](#)). If a channel is to be permanently removed then **Total Channels** should be adjusted down to reflect the number of SenSmart 7000s communicating to this WLR.

10.5.2 REMOTE ADDRESS

The **Remote Address** menu determines which SenSmart 7000 RTU number is assigned to this WLR channel. RTU numbers are limited to 1-32 but any of these may be assigned to any of the 32 WLR channels. This is useful for

arranging which WLR channels are used to display specific SenSmart 7000s. For example, dual gas SenSmart 7000s have consecutive RTU numbers. It might be desirable to separate these at the WLR in order to keep same gas types together on its readout.

10.5.3 CHANNEL INFO

It is important to understand that all **CHANNEL INFO** data is received from the SenSmart 7000. It is broadcast to the WLR at every SenSmart 7000 power up, channel edit and routinely upon expiration of the **TX Config Timer** described in [Section 8.1.5](#). Modification of the parameters on this screen may only be done at the SenSmart 7000 broadcasting to this channel.

10.5.4 RX PACKETS

RX Packets displayed at the bottom of the **CHANNEL CONFIG** screen is a counter incremented each time a new data packet is received from the SenSmart 7000. It may be reset to zero at the **RX HISTORY** screen in the **COMMUNICATIONS** menu group by pressing the **Alarm Reset** button (see [Section 10.7.3](#)).

10.5.5 BATT 3.6V

The battery voltage of the SenSmart 7000 broadcasting to this channel is also displayed at the bottom of the **CHANNEL CONFIG** screen. The nominal value is 3.6 volts, and SenSmart 7000s trip their **Low Batt** alarm at < 3.3 volts.

10.6 SYSTEM CONFIG MENUS

The **SYSTEM CONFIG** menus shown in Figure10-4 allows configuration of variables for the WLR unrelated to any specific channel. This includes programming how the relays and audible piezos function, total number of channels and time / date.

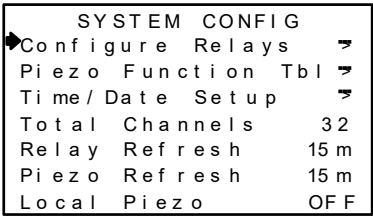


Figure 10-4 WLR System Config Menu

10.6.1 CONFIGURE RELAYS

The **RELAY CONFIG** screen shown in Figure 10-5 allows sophisticated programming of each of the eight relays. Select the relay to be configured by pointing to the Relay menu and pressing EDIT.

- **Trip On** controls what conditions will cause the relay to activate. These may be
 - o A1
 - o A2
 - o A3
 - o Fault

- o **Low Battery** (from a SenSmart 7000)
 - o **Comm Error**
 - o **Remote Edit** (someone is modifying the SenSmart 7000's settings)
 - o **Channel Disable** (a WLR channel has been disabled by an operator)
 - o **None** (this relay is not used and will never activate).
- **Latching** determines either manual or automatic alarm reset operation. **YES** requires a manual Alarm Reset button press to unlatch the relay even though an alarm condition no longer exists. **NO** allows this relay to automatically reset after the alarm condition clears.
- **Failsafe** is an ON/OFF field where ON causes the relay to energize when the condition is not present. When the **Trip On** condition becomes true the relay de-energizes. **Failsafe** is often utilized when it is desirable for loss of power to indicate the alarm condition.
- **Acknowledge** is an ON/OFF field with ON typically used when the relay controls an audible device and it is desirable to silence the horn audible while troubleshooting the alarm. Applying an Alarm Reset causes the relay to return to its inactive state even though the alarm condition remains in effect. The **Relay Refresh** menu (see [Section 10.6.5](#)) may be used to re-activate acknowledged relays.
- **Select Channels** brings up a check box (Figure 10-6) screen for assigning which of the Active Channels are assigned to this relay. This allows creating Zones among the active channels.

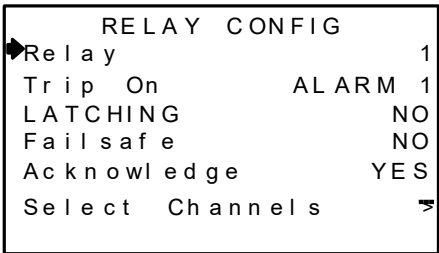


Figure 10-5 Configure Relays Menu

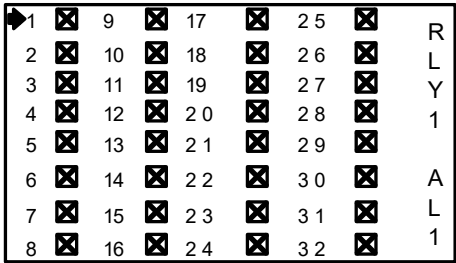


Figure 10-6 Select Channels Screen

10.6.2 PIEZO FUNCTION

The **Piezo FUNCTION** group determines behavior of the optional (part#10-0337) 100dB locally mounted piezo, related to the eight relays. Choices are **OFF**, **Chirp**, **Pulse** and **Steady**. For example, an A1 condition might be configured to **Pulse** the piezo while an A2 condition causes it to be **Steady**.

RI y 1	AL ARM 1	PUL SE
RI y 2	AL ARM 2	OF F
RI y 3	AL ARM 3	OF F
RI y 4	FA UL T	OF F
RI y 5	LOW BATT	OF F
RI y 6	COMM ERR	OF F
RI y 7	NONE	OF F
RI y 8	NONE	OF F

Figure 10-7 Piezo Functions

10.6.3 TIME/DATE SETUP

The **Time** and **Date** menus are for setting the correct time and date of the 24-hour clock and calendar. Time of day must be entered in 24 hour mode. For example, 6:00:00 PM is indicated as 18:00:00.

TIME / DATE	
Ti me	12 : 00 : 00
Da t e	01 / 01 / 13

Figure 10-8 Time/Date Menu

10.6.4 TOTAL CHANNELS

Total Channels may be 1-32 and limits the maximum number of active channels. For example, if this menu is set for 10, then only 10 channels are available in the CHANNEL CONFIG menus discussed in [Section 10.5.1](#).

10.6.5 RELAY REFRESH

Relay Refresh may be set from 0-120 minutes with 0 turning the Refresh function OFF. Each relay may be set to allow **Acknowledge** (see [Section 10.6.1](#)) which means an **Alarm Reset** deactivates the relay even though the alarm condition still exists. **Refresh** will re-activate the relay after this timer expires. This feature is useful for silencing audible devices, and then automatically activating them again if the alarm condition remains after a period of time.

10.6.6 PIEZO REFRESH

Piezo Refresh functions similarly to the **Relay Refresh** ([Section 10.6.5](#)). However, it may only be set from 1 to 60 minutes, and may not be turned OFF. **Piezo Refresh** only affects the optional (part#10-0337) 100dB locally mounted piezo, which connects to the Audible Alarm connector on the Motherboard (see Figure 11-2). This piezo is always Acknowledgeable.

10.6.7 LOCAL PIEZO

Local Piezo is an ON/OFF field where ON causes the tiny piezo on the WLR’s 10-0214 WLR Display PCB to mimic the larger piezo (part#10-0337) wired to the Motherboard. This can be useful for testing operation of the louder device even though it is disconnected. The Local Piezo always chirps as keys are depressed.

10.7 COMMUNICATIONS

The **Communications** / **WaveNet Radio** menus shown below in Figure 10-9 allow setting Network ID, Server / Client and viewing a history of how many successful wireless messages have been received by each channel. Figure 10-10 shows the WaveNet Radio Menus for both operating frequencies.



Figure 10-9 Communication Menus

10.7.1 WAVENET RADIO

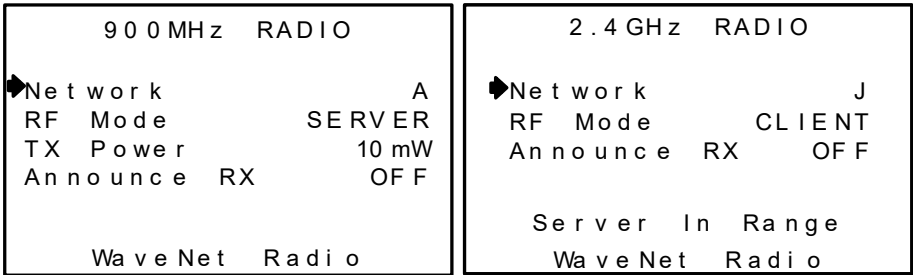


Figure 10-10 WaveNet Radio Menus

10.7.1.1 NETWORK

WaveNet devices utilize the **Network** setting to assign up to 26 unique hopping patterns. To simplify system setup, **Network** is entered using letter designators A through Z where A = [Hop Channel 1, System ID 1] and Z = [Hop Channel 26, System ID 26]. A SenSmart 7000 will not indicate Server In-Range status or communicate with any WLR/WaveNet Relayer operating on a different **Network**. This feature allows multiple WaveNet wireless systems to be located within range of each other without interference.

Networks M through Z are encrypted networks. When one of these networks is selected the data will be encrypted via proprietary methods to ensure that only devices on that network which hold the encryption key will be able to decipher the data being transmitted.

2.4GHZ used in EU countries: Hop channels on 2.4 GHZ models may be set between 1 and 26. Hop channels A-R include EU “low band” frequencies 2406 – 2435MHZ. Hop channels S-Z include EU “high band” frequencies 2444 – 2483.5MHZ.

IMPORTANT!! EXPLORE WHAT FREQUENCIES ARE APPROPRIATE FOR THE FINAL LOCATION OF ANY WIRELESS SYSTEM.

10.7.1.2 RF MODE

RF Mode determines if the WLR is a Server or a Client. ONLY ONE SERVER IS ALLOWED PER WIRELESS NETWORK ID. Numerous WLRs may share the same Network ID but only one may be the Server. Networks with multiple WLRs should have the most centrally located unit designated as the Server (see [Section 2.2](#)).

10.7.1.3 TX POWER

The **TX Power** menu is only available on 900MHz systems, and allows the setting of the **TX Power** for the radio. The settings for this are 10mW, 200mW, 400mW and 1W.

2.4GHZ variation: The TX Power menu is not available in 2.4GHZ models and is fixed at 125mW conducted.

10.7.2 RX HISTORY

RX History is provided as a wireless network diagnostics tool. It simply counts how many broadcasts are received by each channel. It always displays 32 channels regardless of how many active channels the WLR is configured for currently. All 32 totals may be reset to zero by entering the screen and pressing the Alarm Reset key.

0000	0000	0000	0000
0000	0000	0000	0000
0000	0000	0000	0000
0000	0000	0000	0000
0000	0000	0000	0000
0000	0000	0000	0000
0000	0000	0000	0000
0000	0000	0000	0000
0000	0000	0000	0000

Figure 10-11 RX History

10.8 SECURITY

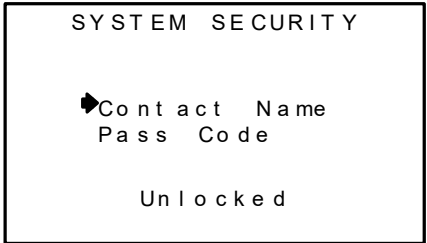


Figure 10-12 Security Menu

The **SECURITY** menu in Figure 10-13 requires the 4-digit **Pass Code** prior to altering menus. Entering a Pass Code and locking the menu locks the entire menu database until the correct **Pass Code** is entered. **Contact Name** is a 12 character ASCII field available for displaying a phone # or name of personal who know the **Pass Code**. Lost **Pass Codes** may be recovered by entering the locked security menu and holding the UP key for 5 seconds. The 4-digit code appears near the bottom of the screen.

10.9 DATA/EVENT LOG

10.9.1 EVENT LOG

The **Display Event Log** pages show time and date stamped alarm events in a first in first out 99 event buffer. The **Clear Event Log** menu allows erasing of all events.

The **Display Event Log** displays several different types of events:

Event	Abbreviation
1 Communication Error in and clear	COMM ERROR, COMM OK
2 Alarms in and clear	Alarm1 IN, Alarm2 IN, Alarm 3 IN, Fault IN, Alarm1 OUT, Alarm2 OUT, Alarm3 OUT, Fault OUT
3 Relays energized and de-energized	Relay1 CLR, Relay2 CLR, Relay3 CLR, Relay4 CLR, Relay5 CLR, Relay6 CLR, Relay7 CLR, Relay8 CLR, Relay1 SET, Relay2 SET, Relay3 SET, Relay4 SET, Relay5 SET, Relay6 SET, Relay7 SET, Relay8 SET
4 Low battery	LOW BAT
5 Cal Mode	CAL MODE
6 Warm up	WARM UP
7 Power up	POWER UP
8 Local acknowledge	LOCAL ACK
9 Cold Boot	COLD BOOT
10 RMT Ready	RMT READY
11 Net Configuration	NET CONFIG
12 Disabled	DISABLED
13 RMT Initialization	RMT INIT
14 System locked and unlocked	SYS LOCKED, UNLOCKED
15 Log Cleared	LogCleared
16 Push to Test	PushToTest
17 Remote acknowledge	Remote ACK
18 Remote Configuration	RMT CONFIG
19 Missing sensor	MIS SENSOR
20 Relay Configuration	RLY CONFIG

```

DATE 01/01/13 - Pg 1
12:00:00 SY LogCleared
- - - END OF LOG - - -

```

Figure 10-13 Display Event Log Pages

10.9.2 DATA LOG(OPTIONAL)

When the optional 10-0410 Multi-Function Board with Data Logging Capabilities is installed, this menu (Figure 10-15) is available, and performs the following functions:

- 1. **Erase FLASH drive** – Erases the onboard FLASH of the Multifunction Board
- 2. **Remove USB drive** – Allows safe removal of any attached USB drive
- 3. **Format USB drive** – Reformats any attached USB drive
- 4. **Copy FLASH to USB** – Copies the information from the onboard FLASH memory to any installed USB drive

For a more detailed description of the Data Logging capabilities of the 10-0410 Multi-Function Option Board refer to [Chapter 13](#).

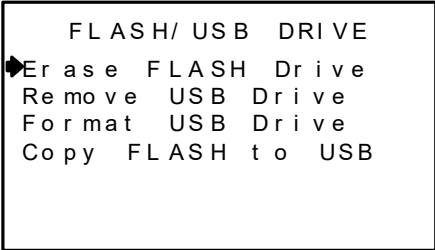


Figure 10-14 Flash/USB Drive Menu

10.10 TECHNICIANS ONLY

WARNING! Users of this menu must have a detailed understanding of its function.

The **TECHNICIAN** Menu in Figure 10-15 **requires a special key sequence of four consecutive UP keystrokes** to access, in order to prevent accidental modification of these items.

Maint Timeout and **Activate Maintenance** are options designed specifically to work together. By selecting **Activate Maintenance** all alarms will not be processed and relays are disabled. **Maint Timeout** allows a timer to be set which causes maintenance mode to be exited after a specified amount of time has passed. This is very helpful in preventing inadvertently disabling alarms for extended periods of time.

Relay Test allows each of the 8 relays to be energized manually. This is helpful for ensuring relays are set up properly. The **Piezo Test** cycles the Piezo on and off when selected until another key is selected.

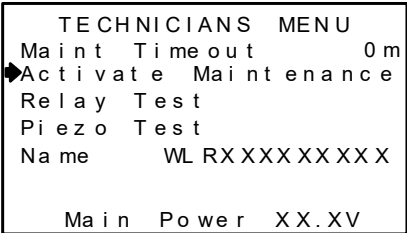


Figure 10-15 Technicians Only Pages

Chapter 11 – WAVELINK RECEIVER PCBs

11.1 MOTHERBOARD INTERFACE PCB # 10-0215

The WLR Motherboard shown below in Figure 11-2 is the interface between the Display / CPU assembly and all other system I/O devices. The Display / CPU assembly attaches to the motherboard with 4-standoffs and connects via ribbon cable to S1. The optional 10-0410 Multi-Function option plugs into the P1 and P2 Motherboard option connectors. The P3 connector on the right side is for the 10-0222 Relay PCB.

The Motherboard PCB contains a 24 VDC universal input (100-240 VAC) switching power supply with up to 350mA available at the TB3 Auxiliary Power Output terminals. If AC power is unavailable, or if a DC battery back-up supply needs to be connected, TB1 provides terminals for DC power input. Blocking diodes isolate internal and external DC supplies as shown in Figure 11-1. See [Section 9.3.1](#) for additional power source information.

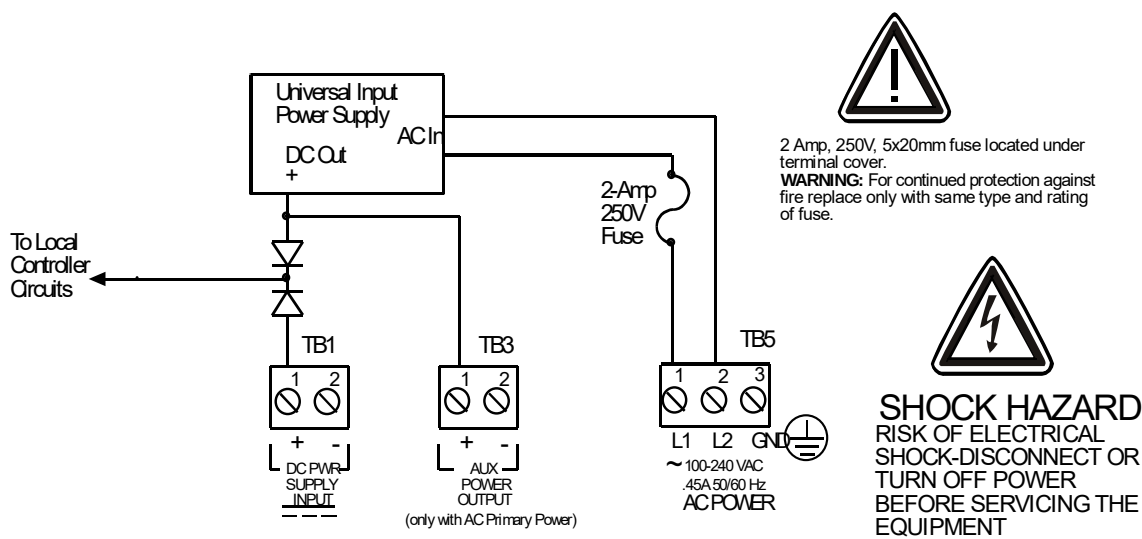


Figure 11-1 AC/DC Power Schematic

TB2 offers field terminals for a remote alarm reset switch. The Motherboard also includes alarm relays 1 and 2 (K1 and K2) and their indicating LEDs. TB4 provides field wiring terminals for these relays. TB5 is for connection to the 100-240 VAC power source. J2 is a 2-pin connector for powering the optional part # 10-0337 100dB audible annunciator.

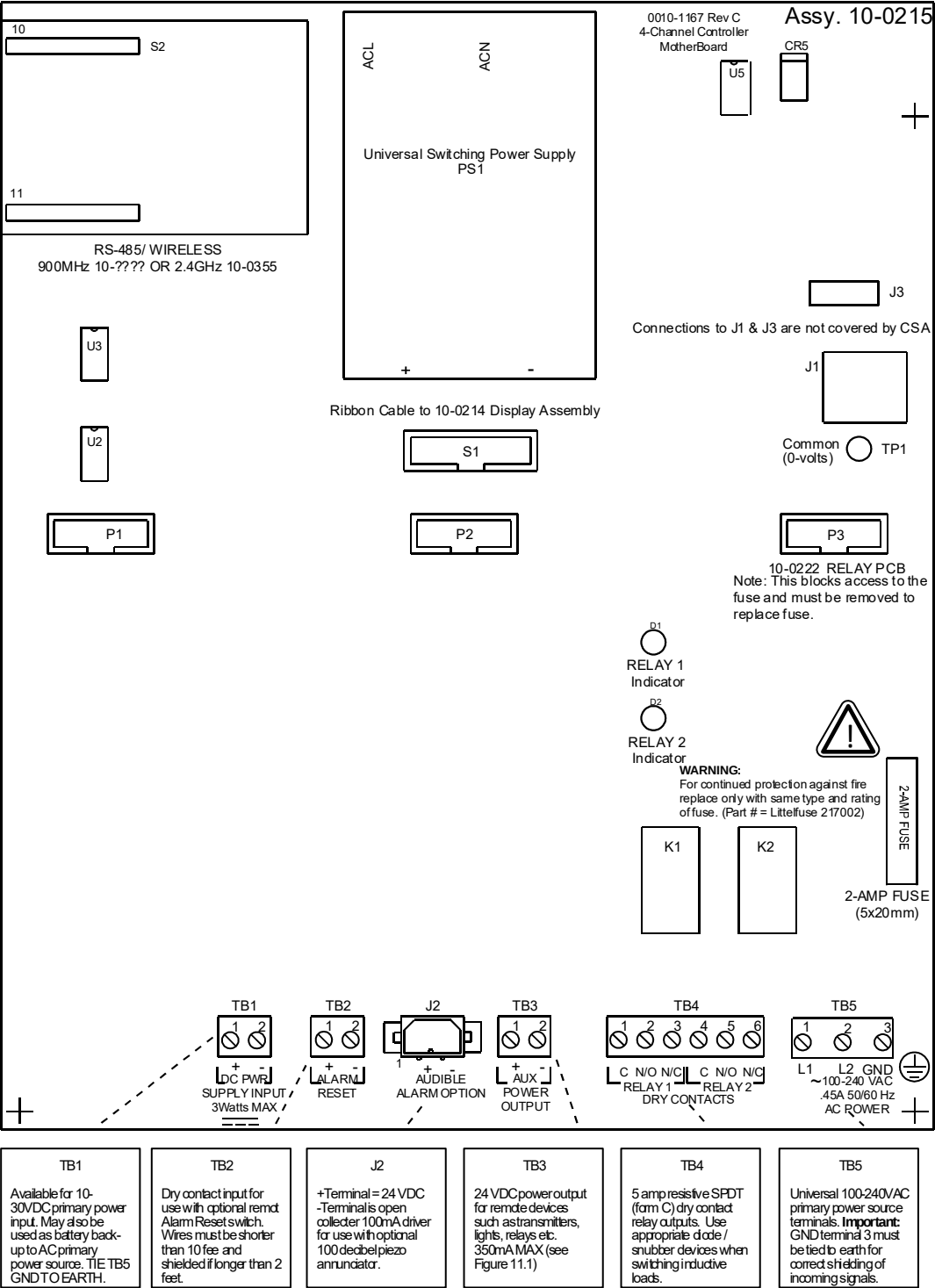


Figure 11-2 10-0215 Motherboard

11.2 RELAY PCB # 10-0222

Important! 10-0222 PCB may only be installed into motherboard position P3.

The Relay PCB, shown in Figure 11-3, adds six 5 amp form C relays. Each relay is programmable as described in [Section 10.6.1](#).

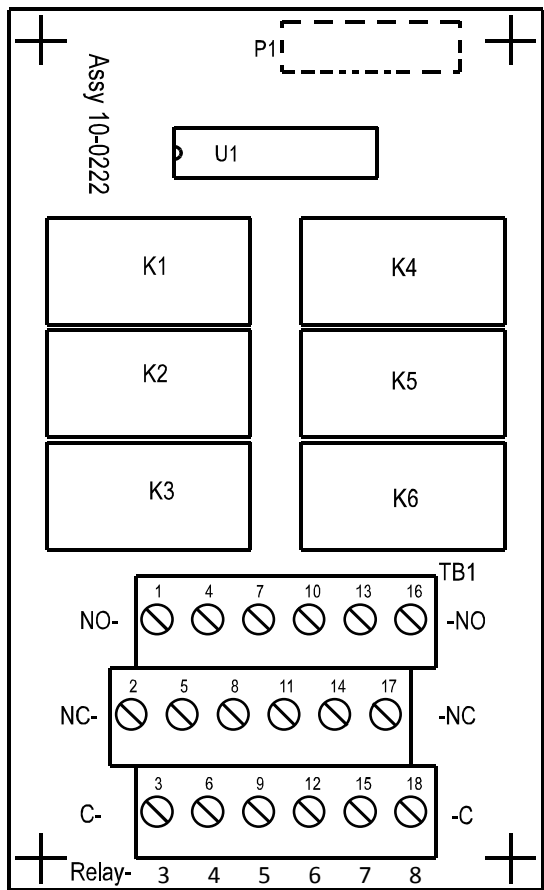
All mechanical (dry contact) relays are rated at 5 Amp for 28 VDC and 250 ~VAC **RESISTIVE** loads.



IMPORTANT: Appropriate diode (DC loads) or MOV (AC loads) snubber devices must be installed with inductive loads to prevent RFI noise spikes.



or DC power supplies to relays on the 10-0222 Relay PCB must be the same for each relay. Example: 24VDC should not be the power switched by one relay and 115VAC by others.



Note:
This board blocks access to the fuse and must be removed to replace a blown fuse.

Warning: For continued protection against fire replace only with same type and rating of fuse.

K1, K2, K3, K4, K5 & K6 are programmable as described in Section 10.6.1

TB1 terminals 1, 4, 7, 10, 13, & 16 are Normally Open Contacts for K1-K6

TB1 terminals 2, 5, 8, 11, 14 & 17 are Normally closed Contacts for K1-K6

TB1 terminals 3, 6, 9, 12, 15 & 18 are Common (pole) Contacts for K1-K6

Contacts are rated for 5 amp resistive loads. Arc suppressing snubber devices should be used for switching inductive loads.

Figure 11-3 10-0222 Relay Board



Document: UM-1002

WaveNet Wireless Monitoring System User's Manual

Revision Level A

11.3 OPTIONAL 24VDC 50 WATT POWER SUPPLIES # 1000-2259

Some applications require 24VDC power in excess of the 10 watts supplied by the PS1 power supply located on the motherboard (see Figure 11-2). WLR enclosures (see [Chapter 12](#)) may be equipped with an integral 1000-2259 NEC Class 2 FIFTY WATT (see Figure 11-4).

"EXTENDED" series enclosures described in [Section 12](#) of this manual may include the 1000-2259 DIN rail mounted 50 watt Power Supply module. Not available in NEMA 7 Explosion Proof wall mount enclosure.

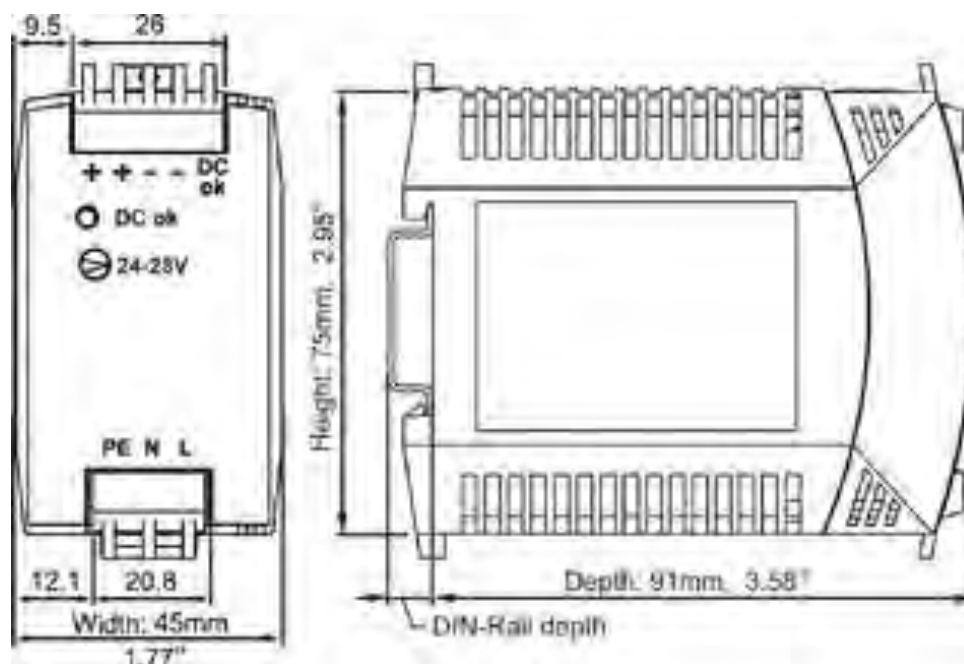


Figure 11-4 1000-2259 50 Watt Power Supply

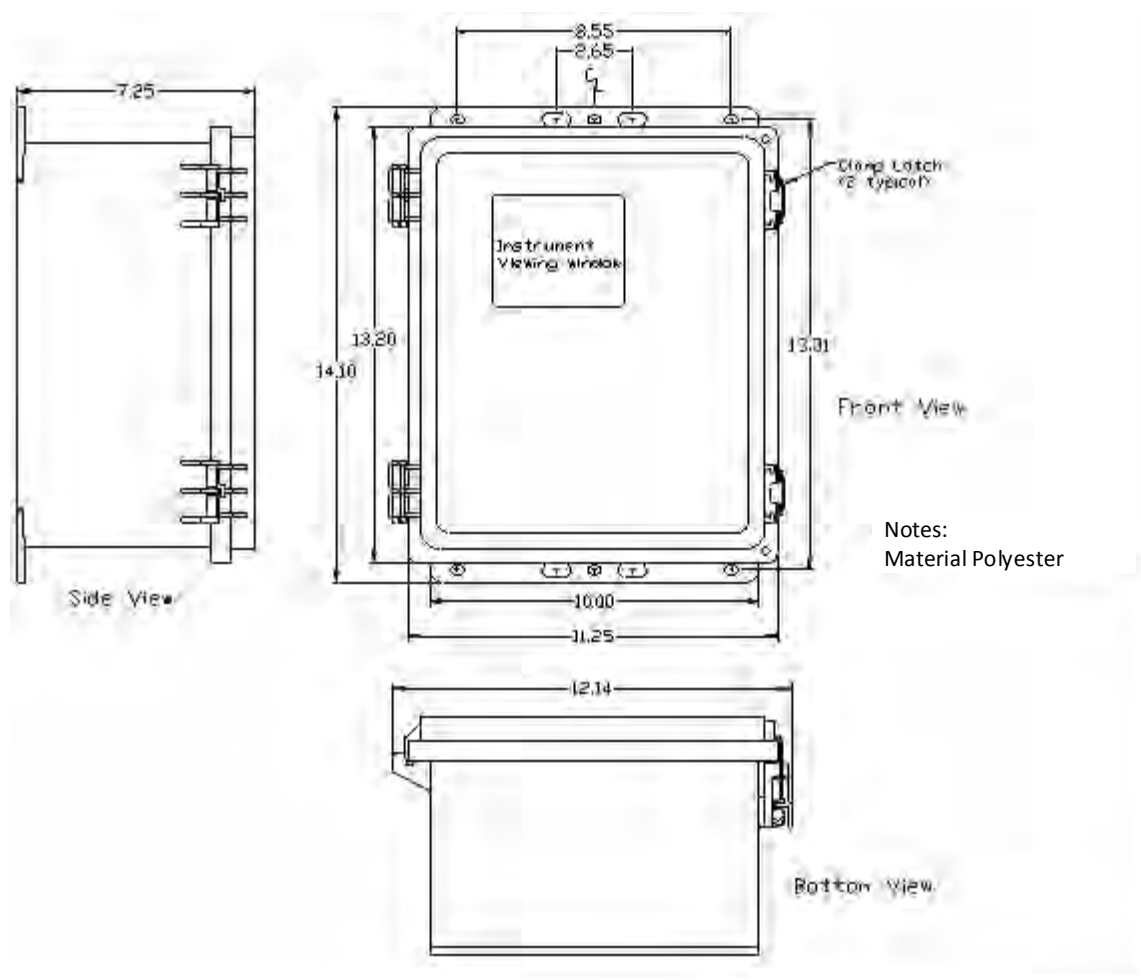
Chapter 12 – WAVELINK RECEIVER ENCLOSURE OPTIONS

12.1 WLR/PY NEMA 4X POLYESTER WALL MOUNT

The WLR/PY wall mount NEMA 4X enclosure is shown in Figure 12-1. Non-metallic enclosures are not grounded by metal conduit. For internal ground points to be grounded to earth, the TB5 – 3 GND terminal must have a proper earth ground connection (see Figure 11-2).

WLR/PY NEMA 4X non-metallic polyester wall mount. DIV 2 Groups A, B, C, D; Category II and pollution degree 3; NEMA 4X; IP66

CAUTION: NONMETALLIC ENCLOSURES DO NOT PROVIDE GROUNDING BETWEEN CONDUIT CONNECTIONS. USE GROUNDING TYPE BUSHINGS AND JUMPER WIRES. ALL FIELD WIRING MUST HAVE INSULATION SUITABLE FOR AT LEAST 250V.



12.2 WLR/PCS NEMA 4 PAINTED CARBON STEEL WALL MOUNT

The WLR/PCS shown in Figure 12-2 is a Painted Carbon Steel NEMA 4 wall mount enclosure designed for non-corrosive installations.

WLR/PCS NEMA 4 painted carbon steel wall mount. DIV 2 Groups A,B,C,D; Category II and pollution degree 3; NEMA 4; IP66

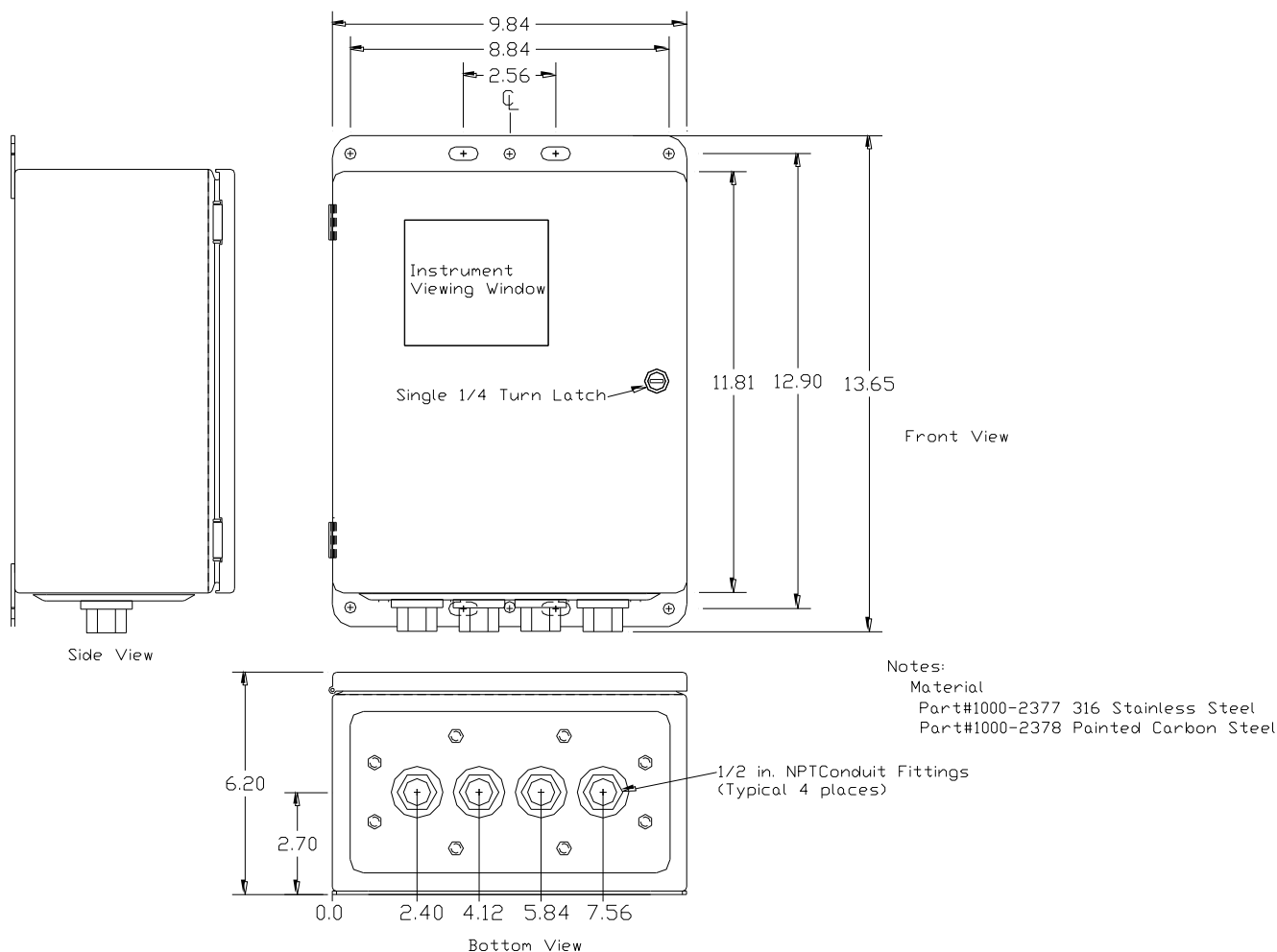


Figure 12-2 WLR/PCS NEMA 4 Painted Carbon Steel Wall Mount Enclosure

12.3 WLR/SS NEMA 4X STAINLESS STEEL WALL MOUNT

The WLR/SS shown in Figure 12-3 is a 316 Stainless Steel NEMA 4X wall mount enclosure designed for corrosive installations.

WLR/SS NEMA 4X stainless steel wall mount. DIV 2 Groups A,B,C,D; Category II and pollution degree 3; NEMA 4X; IP66

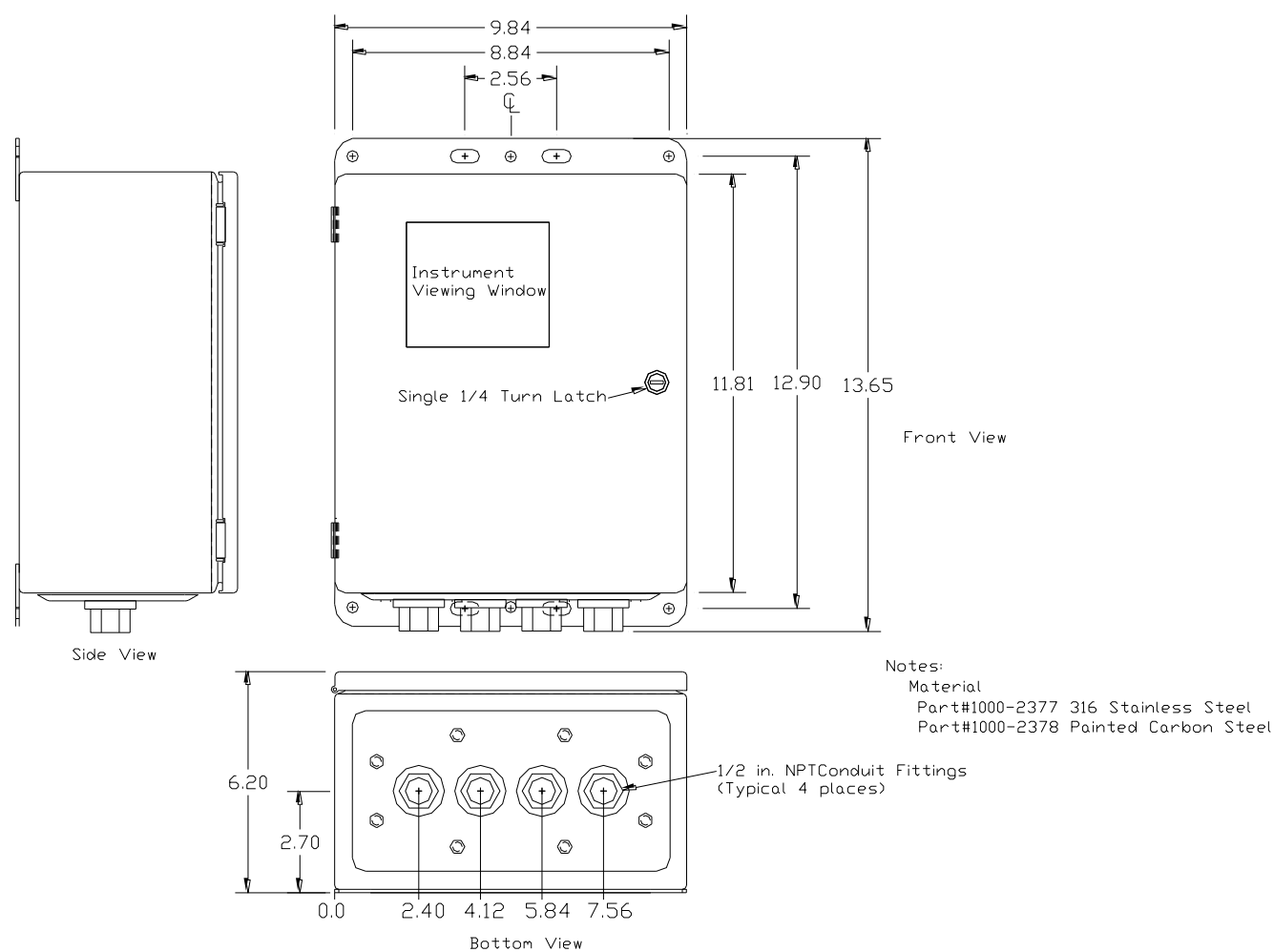


Figure 12-3 WLR/SS NEMA 4X Stainless Steel Wall Mount Enclosure

12.4 WLR/XP NEMA 7 EXPLOSION-PROOF WALL MOUNT

The WLR/XP shown in Figure 12-4 is aluminum NEMA 7 wall mount enclosure designed for mounting into potentially hazardous areas. (Note: 1000-2259 DIN rail mounted 50 watt Power Supply module is not available for this enclosure.)

WLR/XP NEMA 7 wall mount for DIV 1 & 2 Groups B, C, D; includes 'O' Ring in door to satisfy NEMA 4 rating.

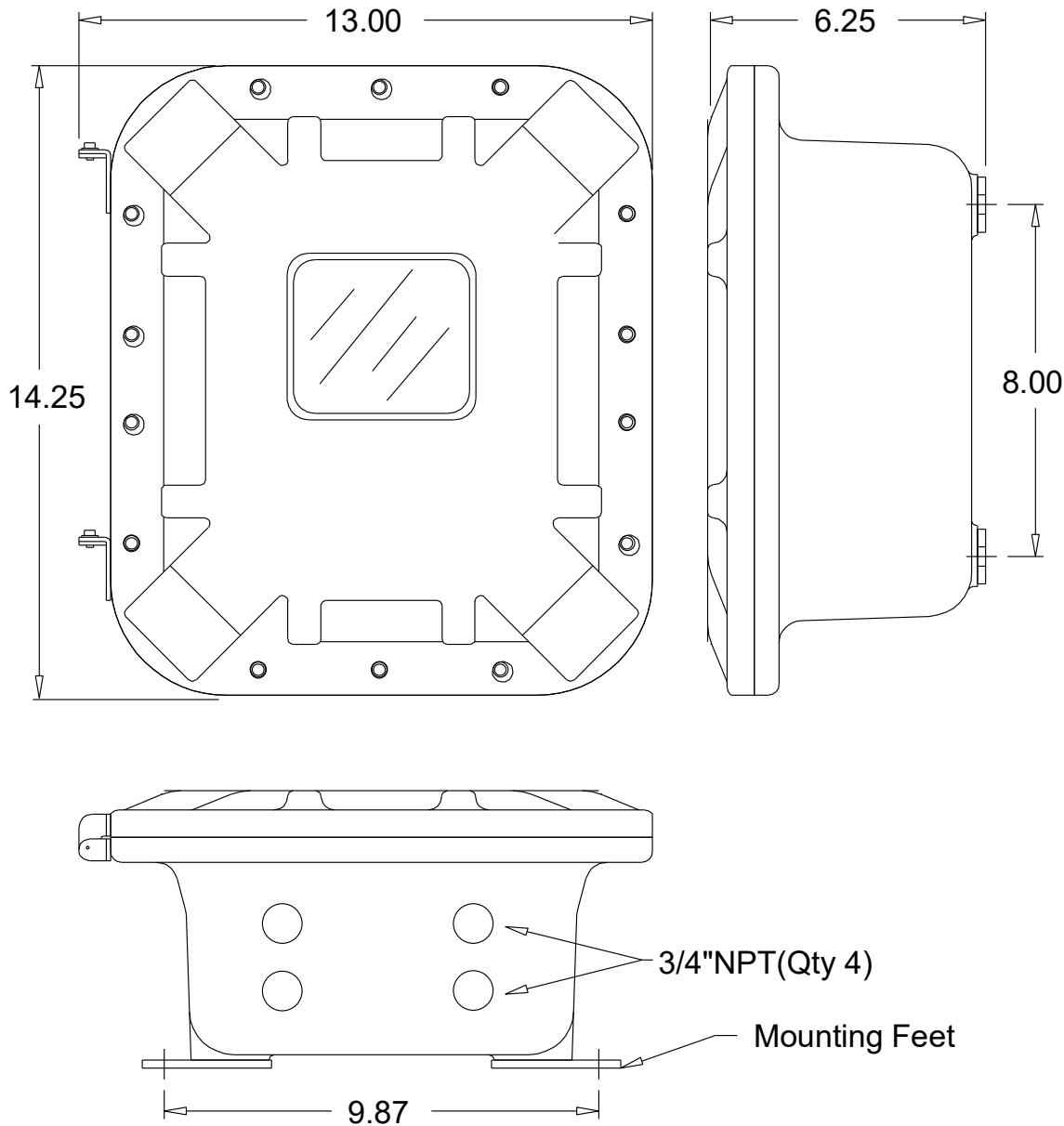


Figure 12-4 WLR/XP NEMA 7 Explosion Proof Wall Mount Enclosure

Chapter 13 – 10-0410 WAVELINK RECEIVER MULTI-FUNCTION OPTION

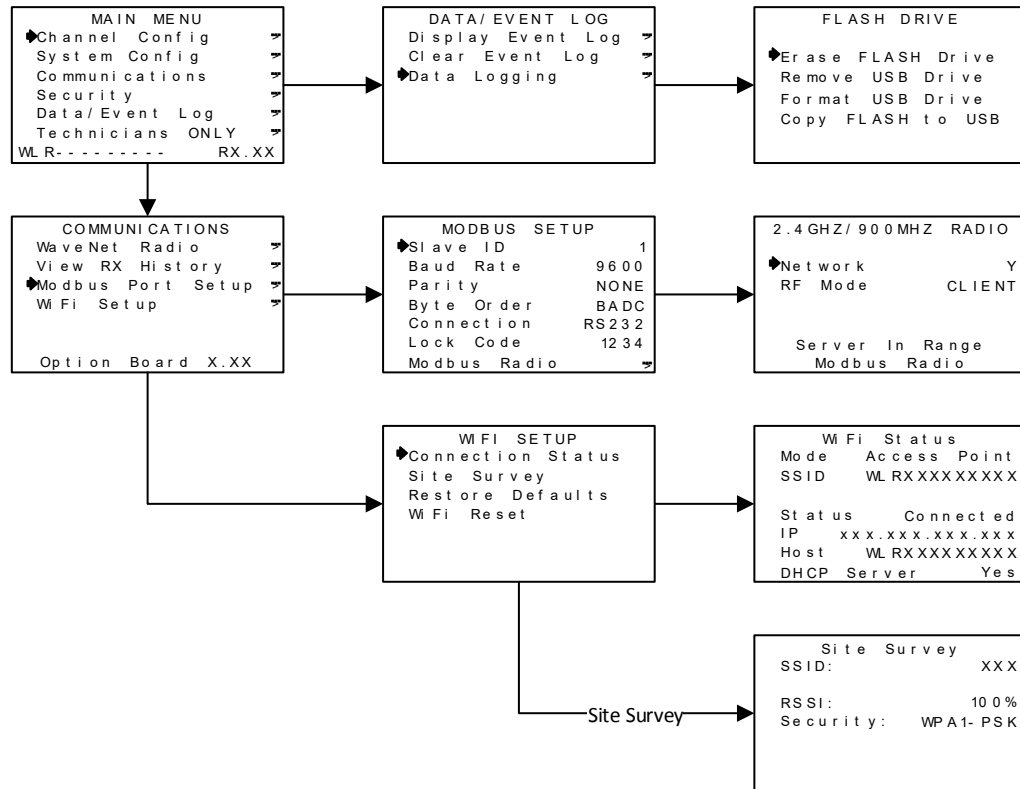


Figure 13-1 WLR Multi-Interface Option Board Menus

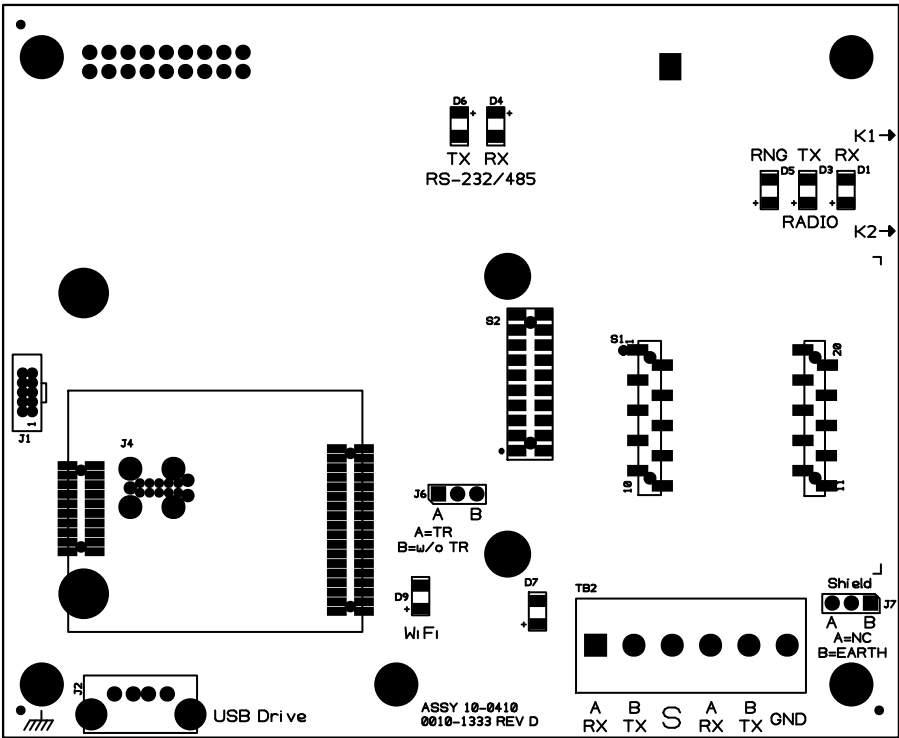


Figure 13-2 10-0410 WaveLink Receiver Multifunction Option Board

13.1 MODBUS COMMUNICATIONS MENU

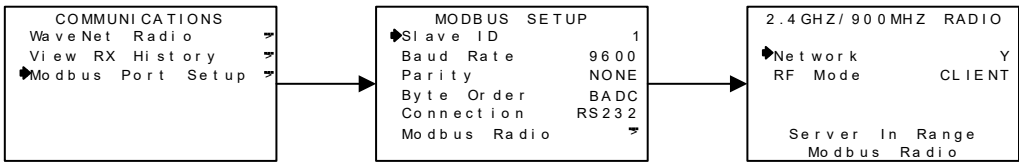


Figure 13-3 Modbus Communication Menu

The **MODBUS SETUP** menu allows setting of the system’s Modbus port. It may function as a wired **Modbus Slave** or wireless **Modbus Slave**.

Modbus Slave mode allows the communication port to be polled by any **Modbus Master** device using the Modbus RTU protocol. This setting is also utilized for Wireless Modbus Slave. This *slave* port may be used to transfer WLR data to a Modbus *master* device such as a PC, PLC, DCS or even other R. C. Systems Controllers such as the 16 Channel ST-71. The slave port is addressable, allowing many WLR controllers to be connected to a single RS-485 cable. A converter is available to make this port also compatible with Ethernet TCP/IP networks.

The entire Modbus database register list, is documented in [Section 13.1.1](#).

13.1.1 MODBUS REGISTER SUMMARY

The following table identifies the available Modbus RTU register locations.



Document: UM-1002

WaveNet Wireless Monitoring System User's Manual

Revision Level A

<u>Register Name</u>	<u>Register</u>	<u>Number of Values</u>	<u>Number of Registers Per Value</u>	<u>Description</u>
<u>Input Registers</u>				
Read with function code 4				
MBREG_CH1_BINARY_OUTPUT	31001 - 31032			Unsigned integer 800-4000
MBREG_VERSION	32002			Integer (version multiplied by 100)
CONTROLLER_NAME	32005 - 32010			12 character ASCII name
<u>Relay States</u>				
RELAY_1_STATE	32100 - 32107	8	1	0 = Not Energized, 1 = Energized
<u>Channel Data</u>				
BATTERY_VOLTAGE	33001 - 33064	32	2	32 floating points
FLOAT Value	33065 - 33128	32	2	32 floating points
VALUE_STRING	33129 - 33224	32	3	6 character ascii values
COMM_STATUS	33225 - 33256	32	1	0 = OK, 1 = Error, 2 = Connecting, 4 = Waiting for config
SENSOR_LIFE	33257 - 33288	32	1	0-100% Integer
COMM_TIMEOUT	33289 - 33320	32	1	
<u>Channel Flags</u>				
A1_STATUS	33449 - 33480	32	1	0 = No Alarm, 1 = Alarm
A2_STATUS	33481 - 33512	32	1	0 = No Alarm, 1 = Alarm
A3_STATUS	33513 - 33544	32	1	0 = No Alarm, 1 = Alarm
FAULT_STATUS	33545 - 33576	32	1	0 = No Fault, 1 = Fault
IN CAL	33577 - 33608	32	1	0 = Normal, 1 = In Cal
LOW_BATTERY	33609 - 33640	32	1	0 = Battery Ok, 1 = Low Battery
IN CAL_PURGE	33641 - 33672	32	1	0 = Normal, 1 = In Cal Purge
IN WARMUP	33673 - 33704	32	1	0 = Normal, 1 = In Warmup
EDIT_MODE	33705 - 33736	32	1	0 = Normal, 1 = Edit Mode Active
MISSING_SENSOR	33737 - 33768	32	1	0 = Normal, 1 = Missing Sensor
CAL_ERROR	33769 - 33800	32	1	0 = Normal, 1 = Cal Error



Document: UM-1002

WaveNet Wireless Monitoring System User's Manual

Revision Level A

<u>Register Name</u>	<u>Register</u>	<u>Number of Values</u>	<u>Number of Registers Per Value</u>	<u>Description</u>
DATA_ERROR	33801 - 33832	32	1	0 = Normal, 1 = Data Error
CHANNEL_STATUS	33833 - 33864	32	1	0 = Normal, 1 = Any of the Following States : Low Battery, In Cal, In Cal Purge, Warmup, Edit Mode, Cal Error, Data Error

Channel Flag Bit Field Registers :

Bit0 = Channel 1, Bit31 = Channel 32

These should be read as 32bit unsigned integers. Byte order will affect these registers. 0 = State Inactive, 1 = State Active

PACKED_A1_STATUS	34000	1	2
PACKED_A2_STATUS	34002	1	2
PACKED_A3_STATUS	34004	1	2
PACKED_FAULT_STATUS	34006	1	2
PACKED_LOW_BATT	34008	1	2
PACKED_CAL	34010	1	2
PACKED_CAL_PURGE	34012	1	2
PACKED_WARMUP	34014	1	2
PACKED_EDIT_MODE	34016	1	2
PACKED_MISSING_SENSOR	34018	1	2
PACKED_CAL_ERROR	34020	1	2
PACKED_DATA_ERROR	34022	1	2
PACKED_CHANNEL_STATUS	34024	1	2
PACKED_CHANNEL_ENABLE	34026	1	2
PACKED_COMM_ERROR	34028	1	2

Holding Registers

Read with function code 3

ALARM_RESET	40001			Write 1 to Reset. Function code 6
DATE_YEAR	40020	1	1	Unsigned integer
DATE_MONTH	40021	1	1	Unsigned integer
DATE_DAY	40022	1	1	Unsigned integer
TIME_HOUR	40023	1	1	Unsigned integer
TIME_MINUTE	40024	1	1	Unsigned integer
TIME_SECOND	40025	1	1	Unsigned integer



Document: UM-1002

WaveNet Wireless Monitoring System User's Manual

Revision Level A

RELAY_REFRESH_TIME	40026	1	1	Unsigned integer (Minutes)
<u>Register Name</u>	<u>Register</u>	<u>Number of Values</u>	<u>Number of Registers Per Value</u>	<u>Description</u>
CHANNEL_COUNT	40027	1	1	Unsigned integer (1 - 32)
PIEZO_REFRESH	40028	1	1	Unsigned integer (Minutes)
PIEZO_ENABLE	40029	1	1	0 = Not Enabled, 1 = Enabled
<u>Serial Port Registers</u>				
COM1_MODE	40034	1	1	TBD
COM1_BAUDRATE	40035	1	1	0 = 9600, 1 = 19200, 2 = 38400, 3 = 57600, 4 = 115200
COM1_PARITY	40036	1	1	0 = None, 1 = Even, 2 = Odd
COM1_SLAVE_ID	40037	1	1	Unsigned integer
COM1_BYTE_ORDER	40038	1	1	0 = ABCD, 1 = CDAB, 2 = BADDC, 3 = DCBA
COM1_PORT_TYPE	40039	1	1	0 = RS-485, 1 = RS-232, 3 = Disabled
<u>Radio Port Registers</u>				
COM2_MODE	40040	1	1	TBD
COM2_BYTE_ORDER	40041	1	1	0 = ABCD, 1 = CDAB, 2 = BADDC, 3 = DCBA
SERIAL_RADIO_NETWORK	40042	1	1	1 = Network A... 26 = Network Z
SERIAL_RADIO_TX_POWER	40043	1	1	0 = 10mW, 1 = 200mW, 2 = 400mW, 3 = 1W
SERIAL_RADIO_MODE	40044	1	1	1 = Server, 2 = Client
LOCK_CODE	40046	1	1	Unsigned integer, 4 digits
PIEZO_RLY1	40050	1	1	0 = Disabled, 1 = Enabled
PIEZO_RLY2	40051	1	1	0 = Disabled, 1 = Enabled
PIEZO_RLY3	40052	1	1	0 = Disabled, 1 = Enabled
PIEZO_RLY4	40053	1	1	0 = Disabled, 1 = Enabled
PIEZO_RLY5	40054	1	1	0 = Disabled, 1 = Enabled
PIEZO_RLY6	40055	1	1	0 = Disabled, 1 = Enabled



Document: UM-1002

WaveNet Wireless Monitoring System User's Manual

Revision Level A

PIEZO_RLY7	40056	1	1	0 = Disabled, 1 = Enabled
PIEZO_RLY8	40057	1	1	0 = Disabled, 1 = Enabled

<u>Register Name</u>	<u>Register</u>	<u>Number of Values</u>	<u>Number of Registers Per Value</u>	<u>Description</u>
<u>WiFi/Network Configuration</u>				
WIFI_IP_ADDRESS	40100 - 40101	1	2	4byte IP Fields
WIFI_GATEWAY	40102 - 40103	1	2	4byte IP Fields
WIFI_NETMASK	40104 - 40105	1	2	4byte IP Fields
IP_ADDRESS	40106 - 40107	1	2	4byte IP Fields
DHCP_START	40108 - 40109	1	2	4byte IP Fields
DHCP_END	40110 - 40111	1	2	4byte IP Fields
DHCP_SERVER	40120	1	1	0 = Not Enabled, 1 = Enabled
DHCP_CLIENT	40121	1	1	0 = Static IP, 1 = DHCP Client
WIFI_BAND	40122	1	1	0 = 802.11BG, 2 = 802.11B, 3 = 802.11G
WIFI_MODE	40123	1	1	0 = Access Point, 3 = Client
WIFI_CHANNEL	40124	1	1	0-13
WIFI_TX_POWER	40125	1	1	0-16dBm
WIFI_DATA_RATE	40126	1	1	0 = 1Mbps, 1 = 2Mbps, 2 = 5Mbps, 3 = 11Mbps, 4 = 24Mbps, 5 = 36Mbps, 6 = 48Mbps, 7 = 54Mbps
WIFI_BROADCAST_SSID	40127	1	1	0 = Not Enabled, 1 = Enabled
WIFI_AUTH_MODE	40128	1	1	0 = Open/Shared, 1 = Open, 3 = Shared, 5 = WPA/PSK, 7 = WPA2/PSK
WIFI_ENCRYPT	40129	1	1	0 = None, 1 = WEP, 2 = TKIP, 3 = AES
WIFI_KEY_LENGTH	40131	1	1	0 = None, 1 = 64bit, 2 = 128bit
WIFI_KEY_FORMAT_WEP	40132	1	1	0 = ASCII, 1 = Hex
WIFI_KEY_FORMAT_WPA	40133	1	1	0 = Passphrase, 1 = Hex
WIFI_DHCP_CLIENT	40134	1	1	0 = Disabled, 1 = Enabled
WIFI_ENABLED	40135	1	1	0 = Disabled, 1 = Enabled
SSID	40200 - 40215	1	16	32 character ASCII
HOST_NAME	40224 - 40232	1	8	16 character ASCII

Channel Configuration



Document: UM-1002

WaveNet Wireless Monitoring System User's Manual

Revision Level A

CH1_TAG	40401 - 40656	32	8	16 character ASCII
CH1_UNITS	40657 - 40816	32	5	10 character ASCII
CH1_ENABLE	41000 - 41031	32	1	0 = Disabled, 1 = Enabled
CH1_RTU_ID	41032 - 41063	32	1	Integer
CH1_DISP_DP	41064 - 41095	32	1	Integer

Register Name	Register	Number of Values	Number of Registers Per Value	Description
CH1_ZERO_VALUE	41096 - 41159	32	2	32bit Floating point
CH1_SPAN_VALUE	41160 - 41223	32	2	32bit Floating point
CH1_A1_SETPOINT	41224 - 41287	32	2	32bit Floating point
CH1_A2_SETPOINT	41288 - 41351	32	2	32bit Floating point
CH1_A3_SETPOINT	41352 - 41415	32	2	32bit Floating point
CH1_FAULT_LEVEL	41416 - 41479	32	2	32bit Floating point

Relay Configuration

RLY1_TRIP	42000 - 42007	8	1	0 = Low Trip, 1 = High Trip
RLY1_LATCH	42008 - 42015	8	1	0 = Not Latching, 1 = Latching
RLY1_FAILSAFE	42016 - 42023	8	1	0 = Not Failsafe, 1 = Failsafe
RLY1_ACKNOWLEDGE	42024 - 42031	8	1	0 = Not Enabled, 1 = Enabled

Relay enable flags for each channel

RLY1_CH1	42200 - 42207	8	1	0 = Not Enabled, 1 = Enabled
RLY1_CH2	42208 - 42215	8	1	0 = Not Enabled, 1 = Enabled
RLY1_CH3	42216 - 42223	8	1	0 = Not Enabled, 1 = Enabled
RLY1_CH4	42224 - 42231	8	1	0 = Not Enabled, 1 = Enabled
RLY1_CH5	42232 - 42239	8	1	0 = Not Enabled, 1 = Enabled
RLY1_CH6	42240 - 42247	8	1	0 = Not Enabled, 1 = Enabled
RLY1_CH7	42248 - 42255	8	1	0 = Not Enabled, 1 = Enabled
RLY1_CH8	42256 - 42263	8	1	0 = Not Enabled, 1 = Enabled
RLY1_CH9	42264 - 42271	8	1	0 = Not Enabled, 1 = Enabled
RLY1_CH10	42272 - 42279	8	1	0 = Not Enabled, 1 = Enabled
RLY1_CH11	42280 - 42287	8	1	0 = Not Enabled, 1 = Enabled
RLY1_CH12	42288 - 42295	8	1	0 = Not Enabled, 1 = Enabled
RLY1_CH13	42296 - 42303	8	1	0 = Not Enabled, 1 = Enabled
RLY1_CH14	42304 - 42311	8	1	0 = Not Enabled, 1 = Enabled
RLY1_CH15	42312 - 42319	8	1	0 = Not Enabled, 1 = Enabled
RLY1_CH16	42320 - 42327	8	1	0 = Not Enabled, 1 = Enabled
RLY1_CH17	42328 - 42335	8	1	0 = Not Enabled, 1 = Enabled
RLY1_CH18	42336 - 42343	8	1	0 = Not Enabled, 1 = Enabled
RLY1_CH19	42344 - 42351	8	1	0 = Not Enabled, 1 = Enabled



Document: UM-1002

WaveNet Wireless Monitoring System User's Manual

Revision Level A

RLY1_CH20	42352 - 42359	8	1	0 = Not Enabled, 1 = Enabled
RLY1_CH21	42360 - 42367	8	1	0 = Not Enabled, 1 = Enabled
RLY1_CH22	42368 - 42375	8	1	0 = Not Enabled, 1 = Enabled
RLY1_CH23	42376 - 42383	8	1	0 = Not Enabled, 1 = Enabled
RLY1_CH24	42384 - 42391	8	1	0 = Not Enabled, 1 = Enabled

<u>Register Name</u>	<u>Register</u>	<u>Number of Values</u>	<u>Number of Registers Per Value</u>	<u>Description</u>
RLY1_CH25	42392 - 42399	8	1	0 = Not Enabled, 1 = Enabled
RLY1_CH26	42400 - 42407	8	1	0 = Not Enabled, 1 = Enabled
RLY1_CH27	42408 - 42415	8	1	0 = Not Enabled, 1 = Enabled
RLY1_CH28	42416 - 42423	8	1	0 = Not Enabled, 1 = Enabled
RLY1_CH29	42424 - 42431	8	1	0 = Not Enabled, 1 = Enabled
RLY1_CH30	42432 - 42439	8	1	0 = Not Enabled, 1 = Enabled
RLY1_CH31	42440 - 42447	8	1	0 = Not Enabled, 1 = Enabled
RLY1_CH32	42448 - 42455	8	1	0 = Not Enabled, 1 = Enabled

13.2 WIRELESS MODBUS OPTION

13.2.1 WIRELESS MODBUS SLAVE MODE

Wireless MODBUS allows one or many WLRs to function as wireless modbus *slaves* by selecting **Wireless MODBUS** in the **COMM SETUP** menu (Figure 5.3). These wireless networks require a modbus *master* such as a DCS, HMI, or another RC Systems Controller equipped with our compatible radio modem. As in all R. C. Systems wireless networks, one transceiver must be designated as Server and all others as Clients. No special configuration is required by the *master* or *slave* since this is a standard modbus network. However, radios must have the same **Hop Channel** and **System ID** settings to communicate.

The entire WLR modbus database, including registers and supported Function Codes, is documented in [Section 13.1](#).

13.3 WIFI COMMUNICATIONS OPTION

The Wi-Fi Communications option provides a webpage interface for viewing and editing the WaveNet System Information including all alarms and set points to the particular WaveLink Receiver (WLR) being monitored.

Any web-enabled device with Wi-Fi capabilities may be used to access the WLR's webpage. Simply search for the SSID of the WLR to connect to, and enter the WLR's IP address in your device's address bar.

13.3.1 WAVELINK RECEIVER WIFI MENUS

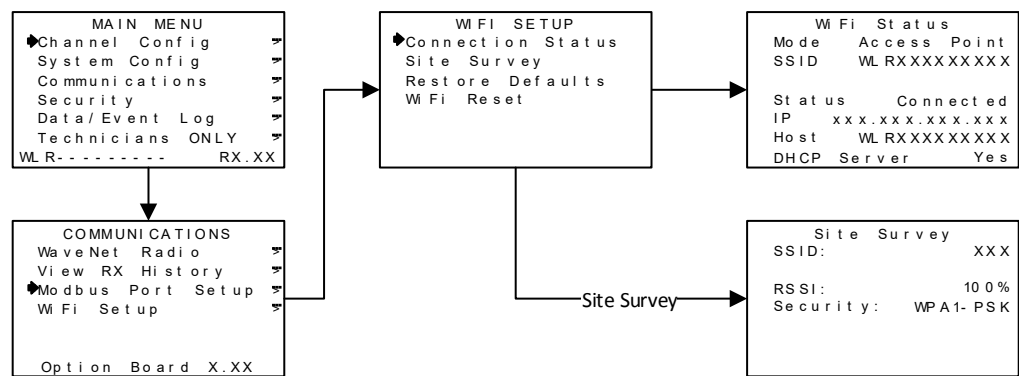


Figure 13-4 WaveLink Receiver Wi-Fi Menu Tree

When accessing the WLR via Wi-Fi, there are two modes of operation: 1. WLR as an Access Point 2. WLR as a Client. By default, the WLR will be set to Access Point. To change the WLR to client mode refer to [Section 13.3.2](#).

Connection Status provides all of the Wi-Fi settings needed to access the WLR’s webpage. **Mode** displays whether the WLR is set to Access Point or Client. **SSID** is the identification number of the Wi-Fi network for the WLR. **Status** shows the current status of the Wi-Fi module. **IP** shows the IP Address for the webpage, and is entered in the browser’s address bar to view the WLR on a web-enabled device. **Host** shows the host network for the WLR. When acting as an Access Point this will match the SSID, and when acting as a client it will display the SSID of the Host network. **DHCP Server** is a protocol which, when enabled, allows the host server to assign the IP address to the device.

Note: All fields in the **Connection Status** menu can only be viewed on the WLR, and can be edited from the webpage ([Section 13.3.2](#))

Site Survey surveys the area for any available host networks, and is useful in determining which network to use as the host network when connecting multiple WLR’s to a single Access Point. This will display the SSID of available networks in the area, the RSSI (signal strength) and the type of security protocol. To cycle through the available networks select **EDIT**.

Restore Defaults restores the Wi-Fi module to the default settings.

Wi-Fi Reset resets the Wi-Fi module.

13.3.2 WEBPAGE MENUS

The main page for the WaveLink Receiver’s Webpage is the **Status Page**. On this page, every active channel (1-32 channels) is displayed with their **Channel Number**, **Measurement Name** and **Measurement Reading**. When no alarm condition is present, the display box for that channel is Green (Figure 13-4). When a channel is in Alarm 1 its display box is yellow, and red when in Alarm 2 (Figure 13-5).

The relay display boxes indicate whether or not the relay is energized. When the relay is not energized the box is white, when the relay is energized the box is red.

Note: Any relay in Failsafe mode will be shown in red during normal operations, and white when the alarm condition is present.

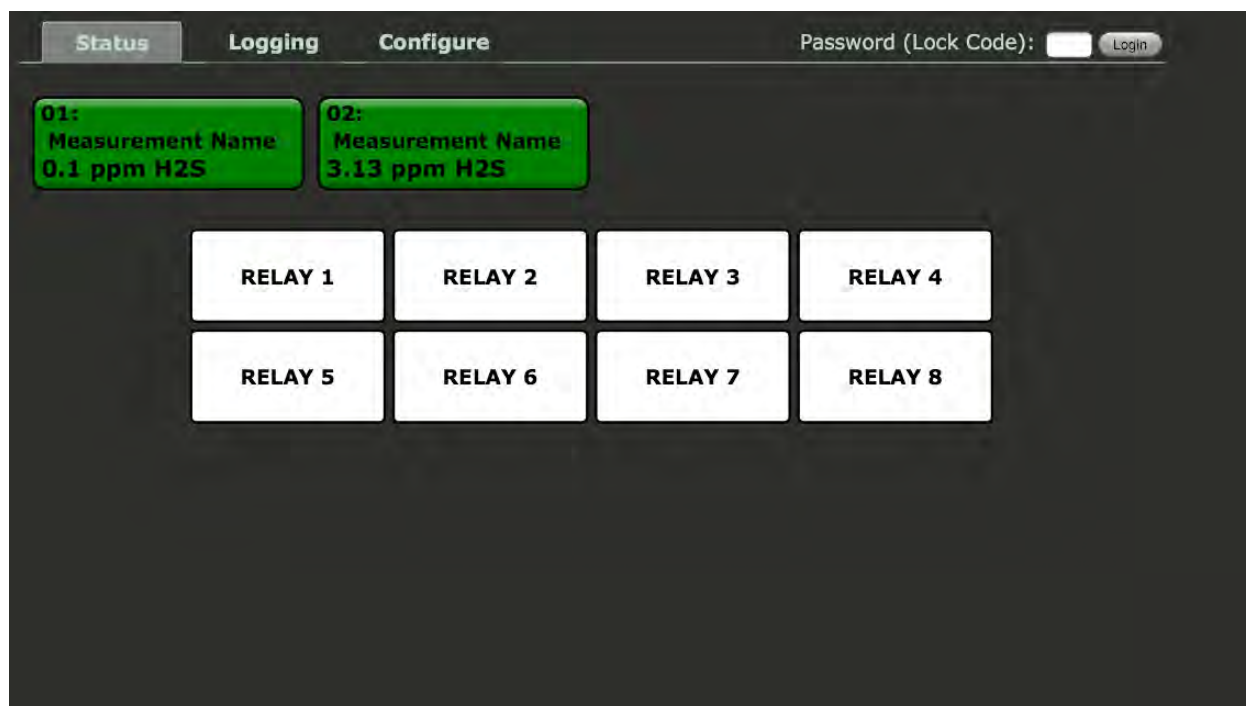


Figure 13-5 Webpage Status Screen (No Alarms)

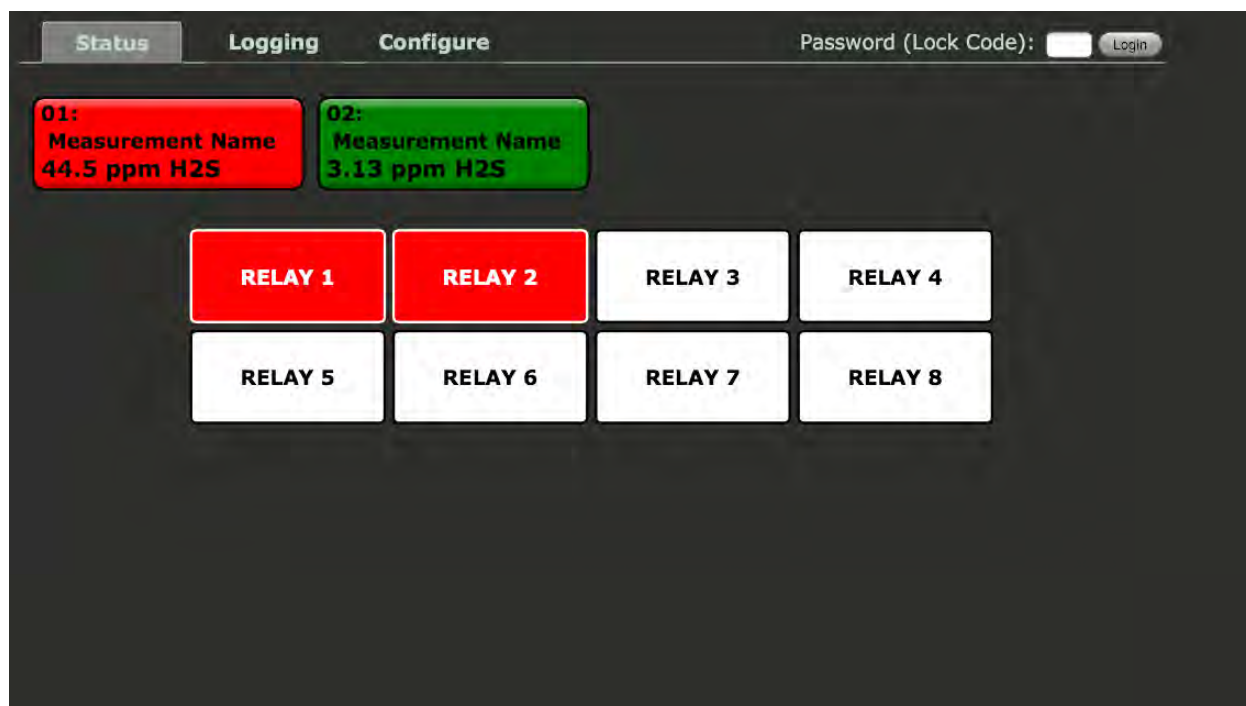


Figure 13-6 Webpage Status Screen (With Alarms)

The following Configuration Menus are reached by selecting the **Configure** tab at the top of the window and selecting the desired menu.

The **Relay Config Menu** (Figure 13-6) allows the user to change or view the settings for all 8 configurable relays of the WLR. The **Relay** to configure is selected by using the drop down menu in the upper left hand corner. The user can then select what the relay will trip on, select **Latching**, **Failsafe** and/or **Acknowledge** options. To provide zoning features the Relay can be mapped to the desired channels using the **Selected Channels** matrix on the right side of the screen. To update the relay configuration select the **Save** button at the bottom of the screen.

For detailed descriptions of the various relay settings, refer to [Section 10.6.1](#).



Figure 13-7 Relay Config Menu

The **Channel Config Menu** allows the user to activate or deactivate a channel using the **Channel Active** check box and/or change the channel's **RTU ID** number. The channel to be edited is selected using the drop down box in the upper left corner of the screen. The **Channel Info** is then displayed in the Channel Info window on the right side of the screen. To save any changes select the **Save** button at the bottom of the screen.

For a detailed description of the Channel Config Menu options refer to [Section 10.5](#).



Figure 13-8 Channel Config Menu

The **System Config Menu** (Figure 13-8) allows the user to set the number of active channels, relay refresh and piezo refresh timers and enable/disable the local piezo. The user may also set the time and date, and complete the piezo function table as in [Section 10.6.2](#). For a more detailed description of the **System Config Menu** options refer to [Section 10.6](#).

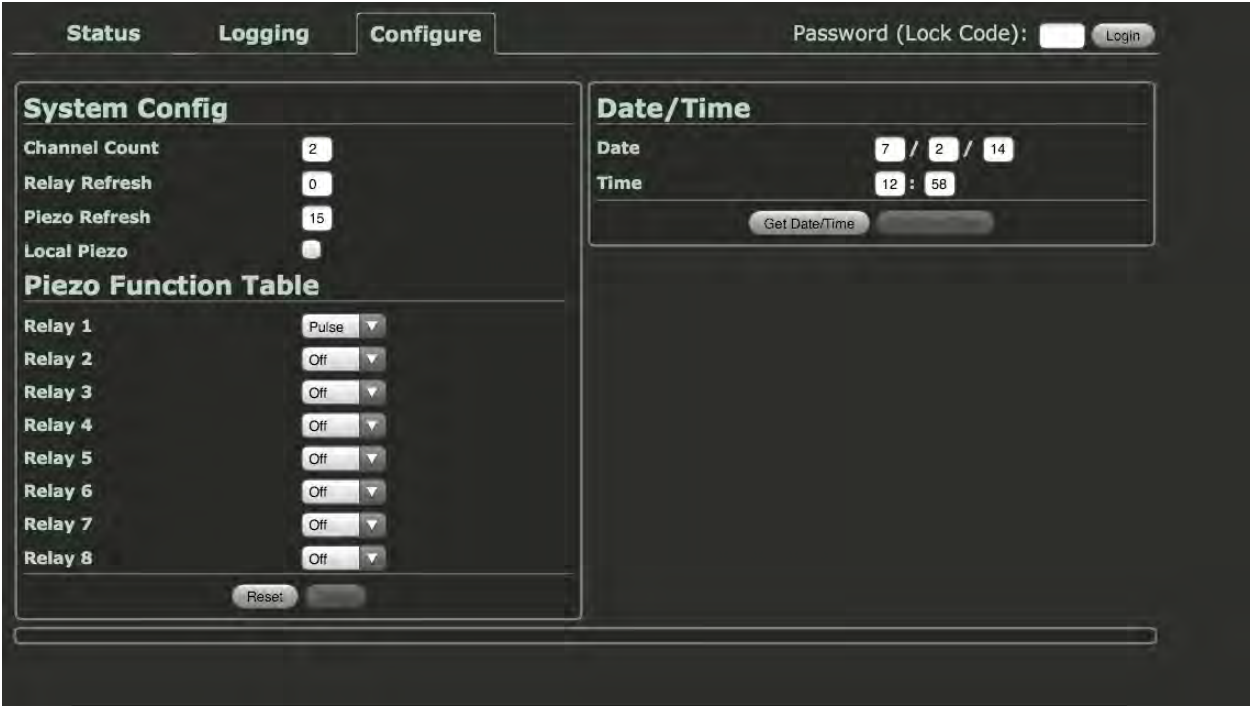


Figure 13-9 System Config Menu

WARNING: Changing Wi-Fi configuration will reset the network and this page will become temporarily inaccessible. If the new settings are invalid, the network will not restart. In this case, restore defaults from the Wi-Fi settings menu on the WLR controller.

The Wi-Fi Config Menu (Figure 13-9) allows the user to configure the Wi-Fi network for the WLR. These settings may only be changed from the webpage. A WLR may be configured as an Access Point or a Client on a Wi-Fi network. To view available Access Points a site survey must first be conducted from the WLR. Once the SSID of the desired access point is known the Wi-Fi mode may be switched to client and the settings for the Access Point network entered in the appropriate fields. An advantage to configuring multiple WLRs to a single access point is that they can each be read using their unique IP address, however, only one Wi-Fi connection is necessary.

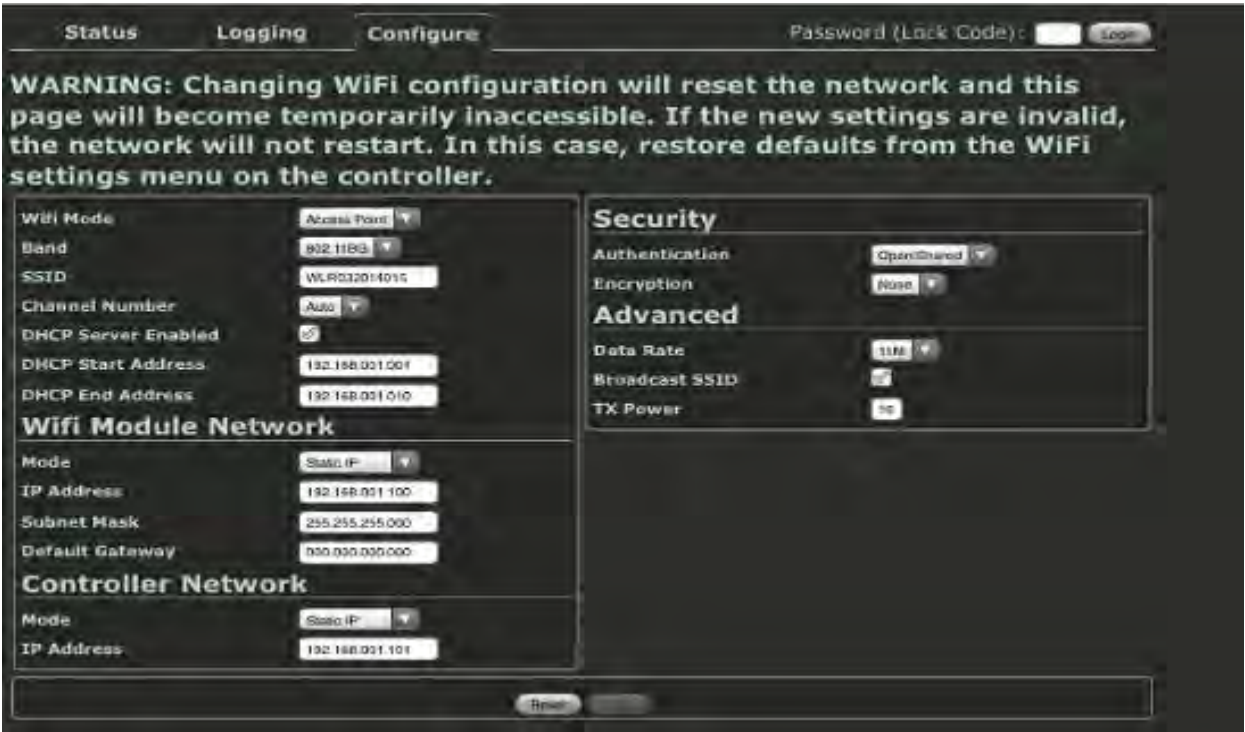


Figure 13-9 Wi-Fi Config Menu

The Serial Config Menu (Figure 13-9) allows the user to update the serial configuration settings and set the Modbus radio settings for the WLR. For details on the Modbus settings refer to [Section 13.1](#).



Figure 13-9 Serial Config Menu

13.4 DATA LOGGING AND USB OPTION

The 10-0410 Multi-Function Board (MFB) comes with onboard Flash memory for logging detailed data for the WaveLink Receiver (WLR) including channel readouts and events. The data log files can be copied from the Flash to a USB device and read as CSV files on a computer, or they can be read on a device via the webpage if the MFB is equipped with the Wi-Fi option.

13.4.1 DATA LOGGING FILE STRUCTURE

The Data Logging File structure is shown in Figure 13-9. Select the file for the WLR to be viewed. The files are then stored by year, month and finally as individual CSV files for each day and the alarm log. Opening the CSV file shows the list of readings for each channel for that day up to the point where the data log was uploaded to the memory device.

The data logger logs channel reading every 30 seconds when in alarm and every five minutes when not in alarm. The CSV files have a column for the time of the log and each active channel at that time and its reading. Each month has an evt.csv file which displays any events for that month. For a detailed description of events see [Section 10.9.1](#).

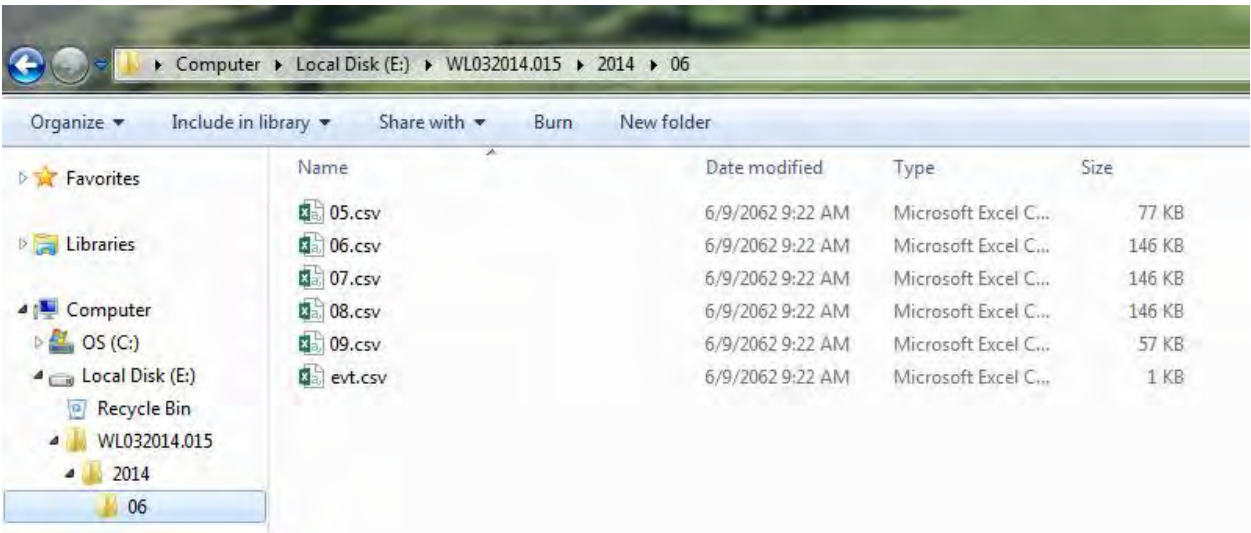


Figure 13-10 Data Logging File Structure

13.4.2 WAVELINK RECEIVER DATA LOGGING MENUS

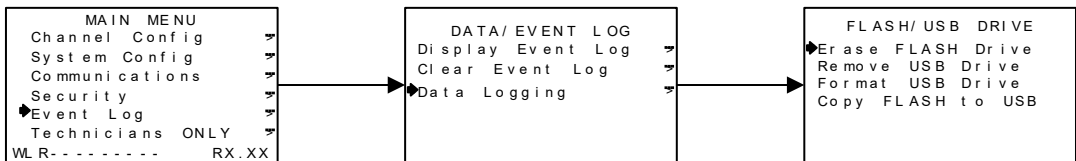


Figure 13-11 WLR Data Logging Menu Tree

13.4.3 WEBPAGE DATA LOGGING MENUS

To access the data logs via the webpage (Figure 13-11) select the Logging tab at the top of the screen. To navigate to the desired day or event log select the desired WLR, year, month and then either the event or day CSV file. To move back select up, and to update the files select refresh.



Figure 13-12 Webpage Data Logging Menu

WAVENET RELAYER

Chapter 14 – WAVENET RELAYER DESCRIPTION

14.1 WAVENET RELAYER DESCRIPTION

The R. C. Systems Co. Inc. WaveNet Relayer (WNR) is designed to control alarm event relay switching for up to 32 SenSmart 7000s (SenSmart 7000s). The WNR receives Fail, Alarm 1, Alarm 2 and Alarm 3 signals from each SenSmart 7000, maps them to its four programmable relays, while adding features such as Failsafe, Alarm Acknowledge and Refresh. Four standard 5-amp alarm relays may be programmed to activate based upon various alarm combinations. These four programmable relays may then be mapped to a single dedicated horn drive which may be set to off, pulse or steady for each of the relays.

A backlit graphic LCD and front LEDs clearly indicate the alarm status of monitored channels (Figure 14-1). When there are no channels with alarm conditions the WLR displays **ALARMS STATUS CLEAR** as the Main Screen. However, when there are channels with alarms the **ALARMS STATUS CLEAR** screen is replaced by the **Channel Alarm Status** screen which displays any active channel in alarm, and followed by an alternating line which shows the channel's Measurement Name and the current alarm. To view the alarming details enter the channel's Channel Setup Menu discussed in [Section 14.2.2](#).

On the right side of the screen is found the range indicator. One of four indicators will be displayed vertically. When the WNR has been out of range of the server for at least 30 seconds the Previously Out of Range icon will be displayed:

1. When WNR is a server:
2. In- Range:
3. Out of Range:
4. Previously Out of Range:

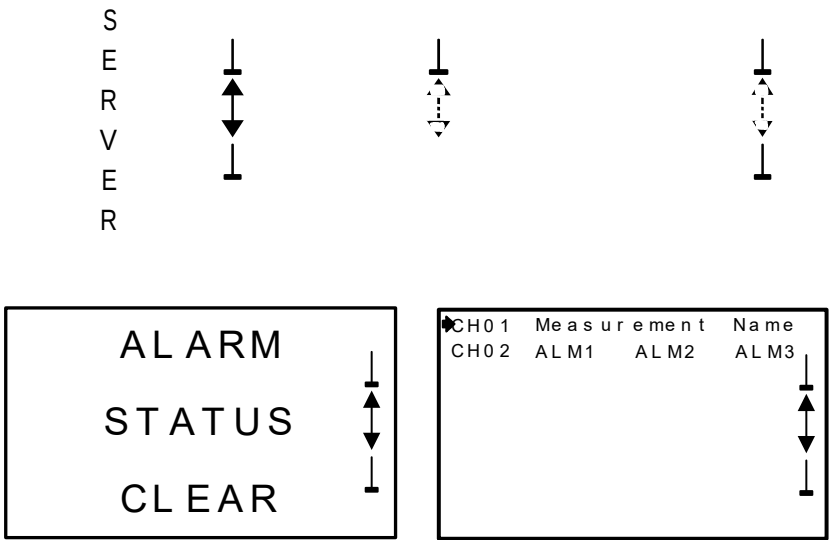


Figure 14-1 WaveNet Relayer Main Screen

14.2 WAVENET RELAYER MENUS

Below, in Figure 14.2, is the complete menu tree for the WaveNet Relayer. To navigate the menus use the magnetic keypad discussed in [Section 5.1](#).

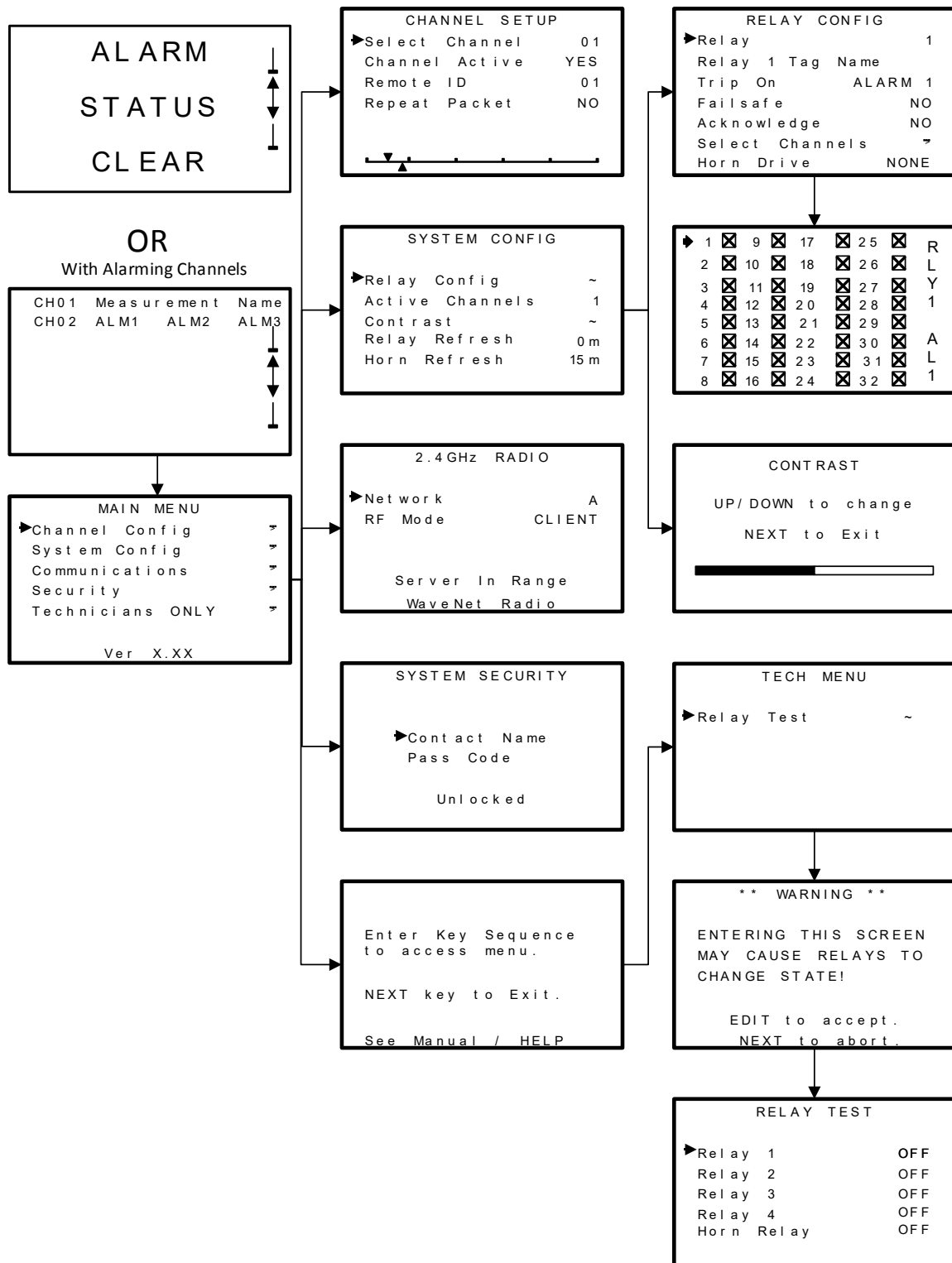


Figure 14-2 WaveNet Relayer Menu Tree

14.2.1 MAIN MENU

The MAIN MENU group shown in Figure 14-3 below is reached by swiping the EDIT key while on the Home Screen. This is the entry-level screen to Channel Config, System Config, Communications, Security and Technicians ONLY menus, and displays the current firmware version. Use the UP/DOWN keys to move the pointer to the desired menu and swipe the EDIT key.

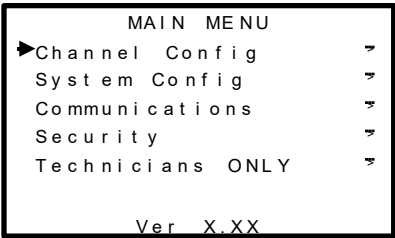


Figure 14-3 Main Menu

14.2.2 CHANNEL CONFIG MENU GROUP

The CHANNEL CONFIG menu shown in Figure 14-4 allows configuration of variables specific to the selected channel. The channel to be affected is selected by swiping the EDIT key. If the selected channel is in an alarm state the Comm Error Timeline will be replaced by an indication of the type of alarm being received.

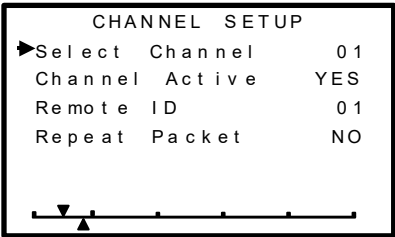


Figure 14-4 WNR Channel Config Menu

14.2.2.1 CHANNEL ACTIVE

Channel Active is a YES/NO field that allows temporarily deactivating channels. Channels that may be deactivated are limited to the number of **Total Channels** designated in the System Config menu group (see [Section 14.2.3.2](#)). If a channel is to be permanently removed then **Total Channels** should be adjusted down to reflect the number of SenSmart 7000s communicating to this WNR.

14.2.2.2 REMOTE ID

The **Remote ID** menu determines which SenSmart 7000 RTU number is assigned to this WNR channel. RTU numbers are limited to 1-32, but any of these may be assigned to any of the 32 WNR channels. This is useful for arranging which WNR channels are used to relay specific SenSmart 7000 information. For example, dual gas SenSmart 7000s have consecutive RTU numbers. It might be desirable to separate these at the WNR in order to keep same gas types together.

14.2.2.3 REPEAT PACKET

By turning the Repeat Packet option on, any received packet by the WNR will automatically be re-transmitted on the current hopping frequency. This is useful to ensure that distant SenSmart 7000 transmissions will reach all of the WLR and WNR receivers.

14.2.2.4 COMM ERROR TIMELINE

The horizontal Comm Error Time Line on the bottom of this screen is divided into five segments, from left to right. Each segment equals one SenSmart 7000 Wakeup Timer interval from the SenSmart 7000 providing data to this WNR channel (see [Section 8.1.3](#)). Therefore, the entire time line is equal to 5 times the Wakeup Timer value.

The arrow on the top side of the Time Line slides across the line as time goes by for the current channel being observed. However, every time the SenSmart 7000 broadcast packet is received on this channel, the pointer resets to the left of the time line. If the pointer reaches the right of the time line the WLR will raise a comm error for this channel. For example, if the Wakeup Timer is set for the maximum 5 minutes it requires 25 minutes without a broadcast to raise the Comm Error alarm for the channel. If the wireless link between the SenSmart 7000 and this channel is functioning properly the pointer should never exceed the 1st Wakeup Timer line segment.

The arrow on the bottom side of the Time Line slides across the line as time goes by in a similar manner to the other arrow. However, this arrow represents the channel which is furthest along it's time line for all of the monitored channels. This is useful in determining if any channels have missed a transmission without having to cycle through observing all of the channels. If the arrow on the bottom side has not passed the first segment, all of the monitored channels have received their latest transmission.

14.2.3 SYSTEM CONFIG MENU GROUP

The **SYSTEM CONFIG** menus shown in Figure 14-5 allows configuration of variables for the WNR unrelated to any specific channel. This includes editing how the relays function, total number of channels, contrast and relay refresh time.

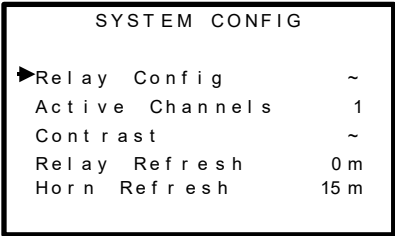


Figure 14-5 WNR System Config Menu

14.2.3.1 RELAY CONFIG

The **RELAY CONFIG** screen shown in Figure 14-6 allows sophisticated programming of each of the four programmable relays. Select the relay to be configured by pointing to the Relay menu and swiping **EDIT**.

Note: The fifth relay, the dedicated Horn Relay, is enabled by the Horn Drive setting for each of the four programmable relays.

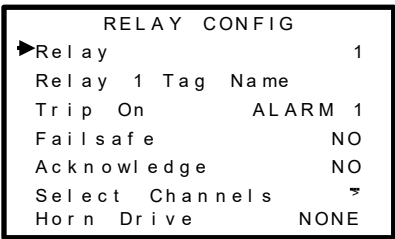


Figure 14-6 Configure Relays Menu



Document: UM-1002

WaveNet Wireless Monitoring System User's Manual

Revision Level A

- **Tag Name** may be edited to give the selected relay a name, which will help identify which SenSmart 7000s are connected to that relay or the type of alarm associated with that relay or any name of the user's choosing.
- **Trip On** controls what conditions will cause the relay to activate. These may be **A1, A2, A3, FAULT/COMM** or **Any Alarm** (from a SenSmart 7000).
- **Failsafe** is an ON/OFF field where ON causes the relay to energize when the condition is not present. When the **Trip On** condition becomes true the relay de-energizes. **Failsafe** is often utilized when it is desirable for loss of power to indicate the alarm condition.
- **Acknowledge** is an ON/OFF field with ON typically used when the relay controls an audible device and it is desirable to silence the horn audible while troubleshooting the alarm. Applying an Alarm Reset causes the relay to return to its inactive state even though the alarm condition remains in effect. The **Relay Refresh** menu (see [Section 14.2.3.4](#)) may be used to re-activate acknowledged relays.
- **Select Channels** brings up a Check Box (Figure 14-7) screen for assigning which of the Active Channels are assigned to this relay. This allows creating Zones among the active channels.

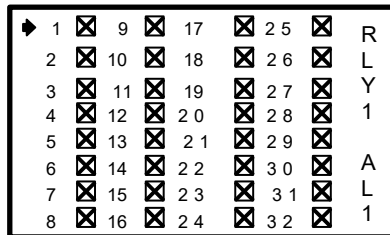


Figure 14-7 Select Channels Menu

- **Horn Drive** controls the operation of the horn drive in relation to any of the four programmable relays. **Horn Drive** selects how the horn drive will function for the relay selected. Select one of three options:
 - **None – no horn**
 - **Pulse**
 - **Steady**

Note: Steady overrides the pulse condition.

When the alarm condition is present for the selected relay the relay will energize along with the horn drive in the manner selected.

14.2.3.2 ACTIVE CHANNELS

Active Channels may be set from 1 to 32 and limits the maximum number of active channels. For example, if this menu is set for 10, then only 10 channels are available in the CHANNEL CONFIG menus discussed in [Section 14.2.2](#).

14.2.3.3 CONTRAST

LCD Contrast Adj. may be set for optimum viewing using the menu shown in Figure 14-8. Swipe the UP/DOWN keys to adjust the contrast and NEXT to save the changes.

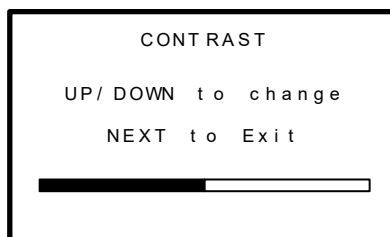


Figure 14-8 LCD Contrast Adjust

14.2.3.4 RELAY REFRESH

Relay Refresh may be set from 0 to 120 minutes with 0 turning the Refresh function OFF. Each relay may be set to allow **Acknowledge** (see [Section 14.2.3.1](#)) which means an **Alarm Reset** deactivates the relay even though the alarm condition still exists. **Refresh** will re-activate the relay after this timer expires. This feature is useful for silencing audible devices, and then automatically activating them again if the alarm condition remains after a period of time.

14.2.3.5 HORN REFRESH

Horn Refresh may be set from 0 to 120 minutes with 0 turning the Refresh function OFF. The horn relay may be set to allow **Acknowledge** (see [Section 14.2.3.1](#)) which means an **Alarm Reset** deactivates the relay even though the alarm condition still exists. **Refresh** will re-activate the relay after this timer expires. This feature is useful for silencing audible devices, and then automatically activating them again if the alarm condition remains after a period of time.

14.2.4 COMMUNICATIONS

The **Communications Menu** shown below in Figure 14-9 allow setting the *Network ID* and *RF Mode*.

For 900MHz models the power level option is also available from this screen.

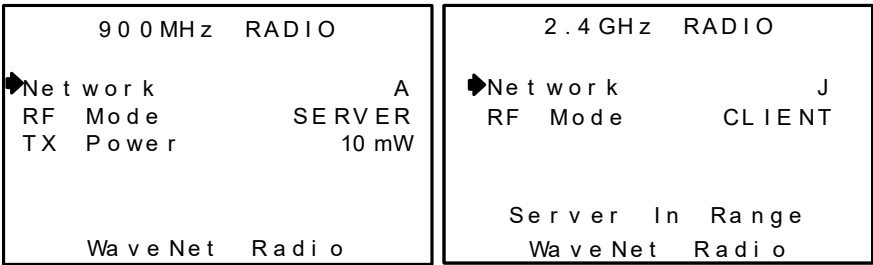


Figure 14-9 Communications Menu

14.2.4.1 NETWORK

WaveNet devices utilize the **Network** setting to assign up to 26 unique hopping patterns. To simplify system setup, **Network** is entered using letter designators A through Z where A = [Hop Channel 1, System ID 1] and Z = [Hop Channel 26, System ID 26]. A WNR will not indicate Server In-Range status or communicate with any device operating on a different **Network ID**. This feature allows multiple WaveNet wireless systems to be located within range of each other without interference.

Networks M through Z are encrypted networks. When one of these networks is selected, the data will be encrypted via proprietary methods to ensure that only devices on that network which hold the encryption key will be able to decipher the data being transmitted.

2.4GHZ used in EU countries: Hop channels on 2.4 GHZ models may be set between 1 and 26. Hop channels A-R include EU “low band” frequencies 2406 – 2435MHZ. Hop channels S-Z include EU “high band” frequencies 2444 – 2483.5MHZ.

IMPORTANT!! EXPLORE WHAT FREQUENCIES ARE APPROPRIATE FOR THE FINAL LOCATION OF ANY WIRELESS SYSTEM.



Document: UM-1002

WaveNet Wireless Monitoring System User's Manual

Revision Level A

14.2.4.2 RF MODE

RF Mode determines if the WNR is a Server or a Client. ONLY ONE SERVER IS ALLOWED PER WIRELESS NETWORK. Numerous WNRs may share the same Network, but only one may be the Server. Networks with multiple WNRs should have the most centrally located unit designated as the Server (see [Section 2.2](#)).

14.2.4.3 TX POWER

The **TX Power** menu is only available on 900MHz systems, and allows the setting of the **TX Power** for the radio. The settings for this are 10mW, 200mW, 400mW and 1W.

14.2.5 SECURITY

The **SECURITY** menu in Figure 14-10 requires the 4-digit **Pass Code** prior to altering menus. Entering a Pass Code and locking the menu locks the entire menu database until the correct **Pass Code** is entered. **Contact Name** is a 12 character ASCII field available for displaying a phone # or name of personal who know the **Pass Code**. Lost **Pass Codes** may be recovered by entering the locked security menu and holding the UP key for 5 seconds. The 4-digit code appears near the bottom of the screen.

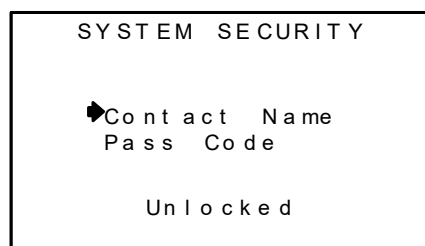


Figure 14-10 Security Menu

14.2.6 TECHNICIANS ONLY

WARNING! Users of these menus must have a detailed understanding of their functions. Processing of alarms and wireless communications should not be relied upon while editing these menus.

The **TECHNICIAN ONLY** menu group access requires a special key sequence of four consecutive **UP** keystrokes to prevent accidental modification of critical items. The **TECHNICIANS ONLY** menu tree is shown in Figure 14-11.

The **TECHNICIAN ONLY** menu group contains a **Relay Test** function which allows the user to stimulate the five relay outputs to ensure proper operation. Use the UP/DOWN keys to highlight the desired relay and select using **EDIT** to energize the relay.

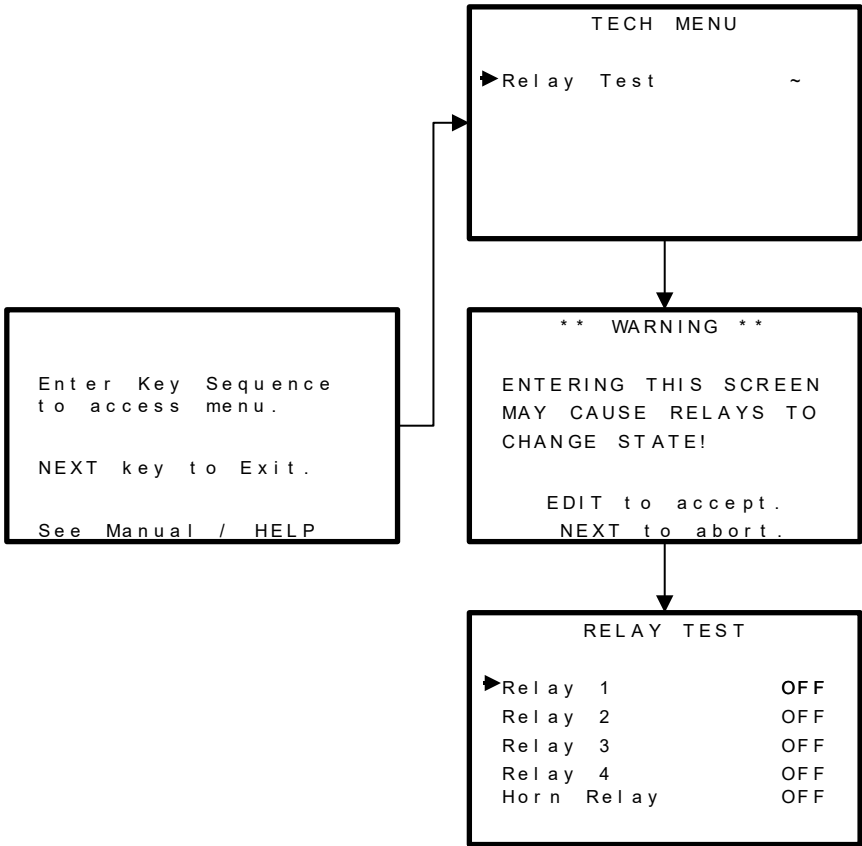


Figure 14-11 TECHNICIANS ONLY Menu Tree

14.3 WAVENET RELAYER PCBS

14.3.1 WAVENET RELAYER 10-0404-R DISPLAY / RADIO PCB

WaveNet systems support both 900MHz and 2.4GHz FHSS networks determined by the radio module mounted to the 10-0404-R Display / Radio PCB. The 1000-2188 900 MHz radio module mounts to the back of the 10-0404-R Display assembly as shown in Figure 14-12. Its MMCX RF connector attaches to the coax pigtail of the 10-0400 antenna fitting required for 900 MHz models.

The 1000-2454 2.4GHz radio module also mounts to the back of the 10-0404-R Display assembly as shown in Figure 14-12. Its uFL RF connector attaches to the coax pigtail of the 10-0401 antenna fitting required for 2.4 GHz models.

A slender 5 conductor cable connects between the 10-0404-R and the 10-0324 Power Supply/Relay PCB bolted to the bottom of the enclosure.

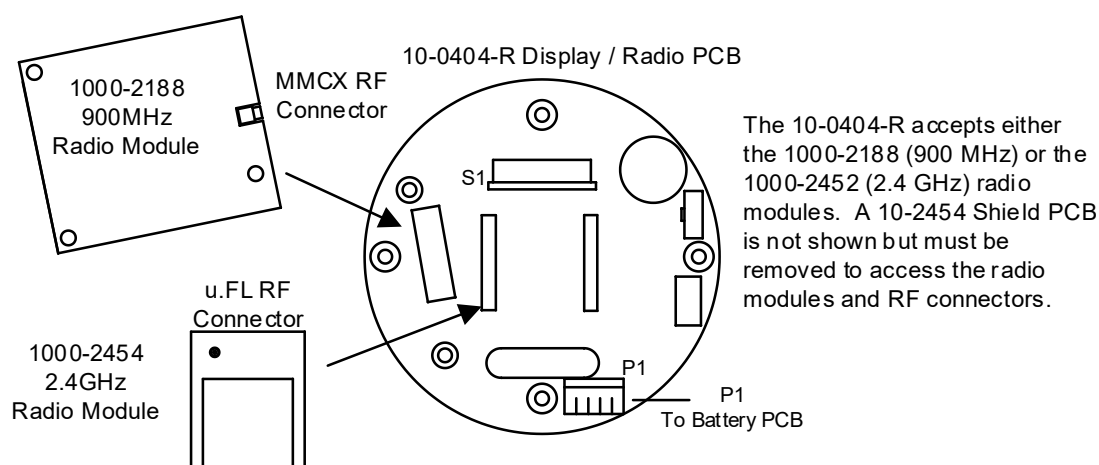


Figure 14-12 10-0404-R Display / Radio PCB

14.3.2 WAVENET RELAYER 10-0425 POWER SUPPLY/RELAY PCB

CAUTION: Alarm relays have dry contacts and power must be supplied from an external source. Contacts are rated for **RESISTIVE** loads! Inductive loads, such as contactor coils or motors, may cause contact arcing, which shortens life and emits RFI into the sensor signals. Use appropriate arcing snubbers and MOV's across inductive loads and keep wiring away from signal wires. External wiring to TB3 (Remote Alarm Reset) should be shielded and protected from noise spikes to prevent false Alarm Reset.

Relay terminals are labeled NO (normally open), NC (normally closed) and COM (common). These designators correspond to the shelf, or de-energized, state of the relays.

AC or DC power supplies to relays on the 10-0425 Power Supply/Relay PCB must be the same for each relay. Example: 24VDC should not be the power switched by one relay and 115VAC by others.

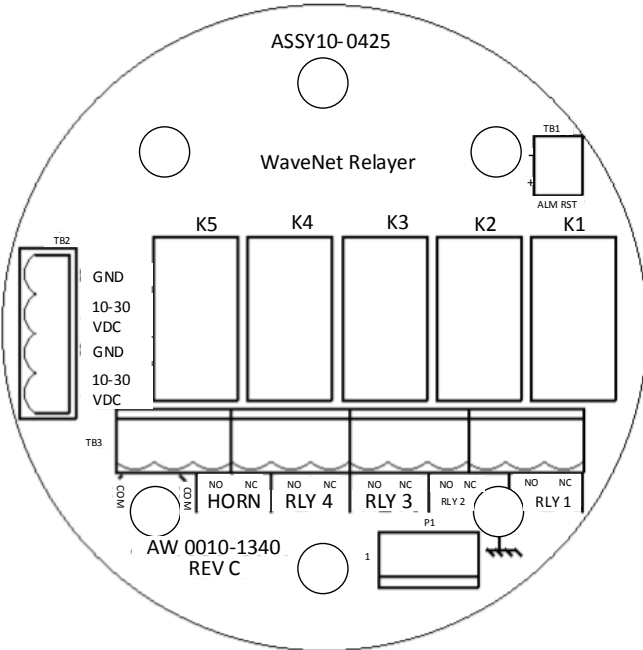


Figure 14-13 10-0425 Power Supply/Relay PCB

Chapter 15 – WAVENET RELAYER INSTALLATION INSTRUCTIONS

15.1 RATINGS AND CERTIFICATIONS

The enclosure is NRTL certified for Division 1 hazardous area installations for explosion-proof Class 1 Groups A, B, C, D (see Figure 4-1). The WaveNet Relayer (WNR) is designed to meet ISA 92.0.01 Part 1 for Toxic Monitors. The standard 10-0295 antenna fitting has an RP-TNC connector and is suitable for Division 2 classified areas. An optional explosion-proof dipole antenna is also available for Division 1 classified areas. Figure 4-2 shows both antenna styles.

15.2 MOUNTING THE ENCLOSURE

The WNR standard enclosure is a cast aluminum explosion-proof (NEMA 7) enclosure as shown in Figure 15-1. Modular design simplifies the installation of the WNR. The WNR antenna should typically be mounted with “line of sight” access to the SenSmart 7000’s (SenSmart 7000’s) antenna. If a good “line of sight” angle is not possible the WNRs will usually still function properly at ranges up to 1500 feet but obstructions should be kept to a minimum.

WARNING: Qualified personnel should perform the installation according to applicable electrical codes, regulations and safety standards. Ensure correct cabling and sealing fitting practices are implemented. Install the WNR to a wall or bracket using the pre-drilled mounting flanges with I.D. 0.3 on 5.0 inch centers (Figure 15-1).

15.2.1 SenSmart 7000 10-0322 MAGNETIC MOUNT OPTION

R. C. Systems offers a magnetic mounting option (10-0322) which includes two magnets affixed to the pre-drilled mounting holes securely attaching the assembly to a solid steel structure.

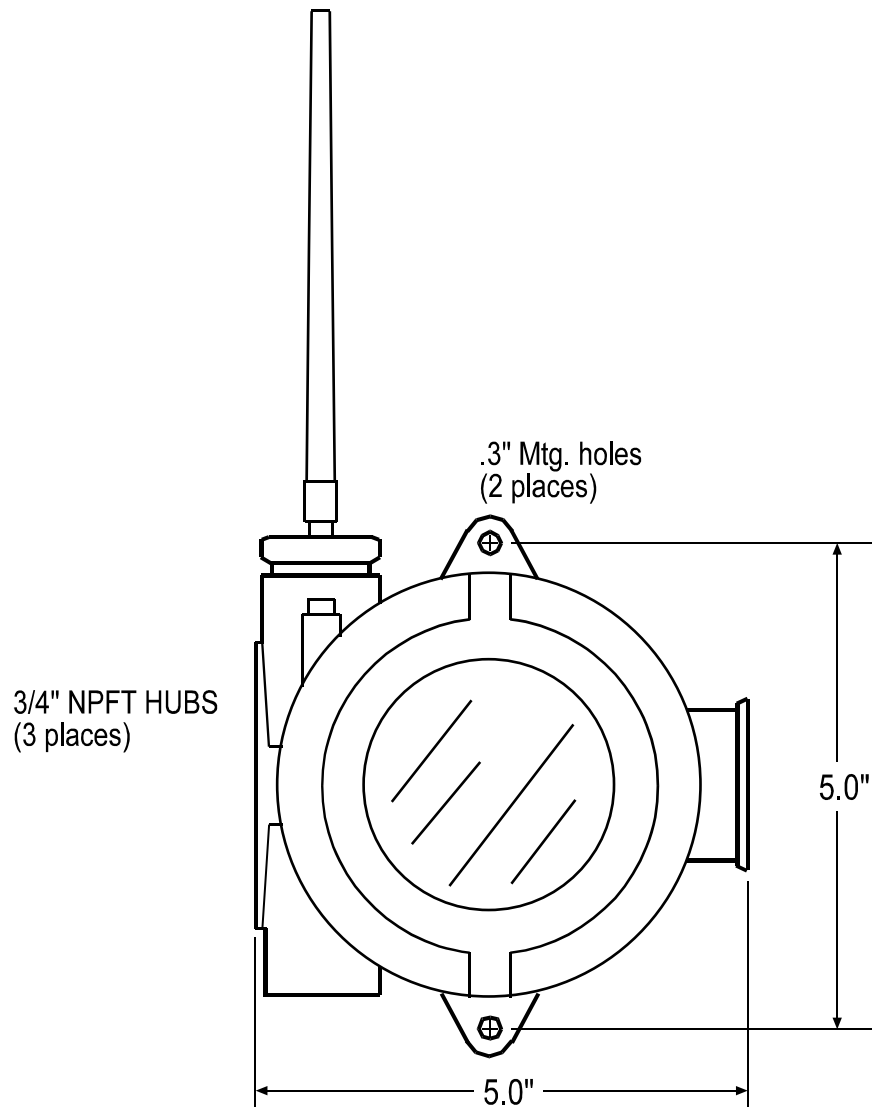


Figure 15-1 WNR Explosion-Proof Housing

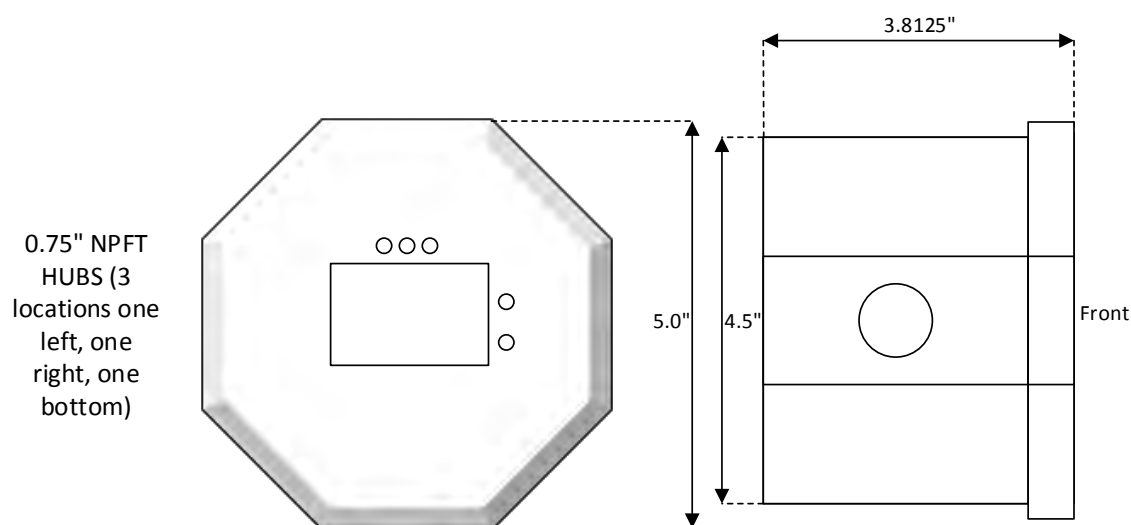


Figure 15-2 WNR Polycarbonate Enclosure

15.3 SPECIFICATIONS

15.3.1 POWER SUPPLY

10-30 VDC @ 3 watts max.

15.3.2 POWER CONSUMPTION

900MHz Models:

2mA during “sleep” mode, 40mA while receiving beacon, up to 1 amp during 1 watt “transmit” mode. Transmit power may be set from 10mW to 1 watt.

2.4GHz Models:

2mA during “sleep” mode, 170mA during 125mW Broadcasts.

15.3.3 MAXIMUM TRANSMIT (TX) POWER

900MHz Models (EIRP; 2dBi gain antenna):

Maximum transmit power is 30dBm at highest 1W power setting. Transmit power may be set from 10mW, 100mW, 400mW and 1 watt.

2.4GHz Models (Conducted; no antenna):

Transmit power is fixed at 125mW (21dBm)



15.3.4 RECEIVE (RX) SENSITIVITY

900MHz Models:
-100 dBm

2.4GHz Models:
-95 dBm

15.3.5 RADIO FREQUENCY

900MHz Models:
Hopping occurs between 902 – 928 MHz.

2.4GHz Models:
Hopping occurs between 2400 – 2483.5 MHz.

15.3.6 MEMORY

Non-volatile E2 memory retains configuration values in the event of power outages.

15.4 ANTENNA TRANSMISSION RANGE

The distance radio signals can travel is dependent upon several factors including antenna design, transmitter power and Free-space losses. In order for a wireless link to work, the available system operating margin (**TX power - RX Sensitivity + Antenna gains**) must exceed the Free-space loss and all other losses in the system. For best RF line-of-site, the combined height of both antennas must exceed the Fresnel zone diameter.

Dist. between ant's	Fresnel zone diameter	Freespace loss (dB)
1000 ft (300 m)	16 ft (4.9 m)	81
1 Mile (1.6 km)	32 ft (9.7 m)	96
5 miles (8 km)	68 ft (20.7 m)	110

Example:

A 2.4GHz WaveNet system has following parameters:

- RF TX power setting = 21 dBm (125 mW)
- RF RX sensitivity = -95 dBm (this is a constant)
- Antenna gain (standard equipped rubber collinear) = 7dBi x 2 = 14dBi

So the system operating margin is 21 - (-95) + 14 = 130 dBm. This is enough to transmit 5 miles if Free-space was the only loss in the system. For this to be the case, the antennas must be mounted with a combined height greater than 68ft above all obstructions (including the ground) to keep the Fresnel zone clear. In practice however, there are many losses in the system besides just Free-space and it is recommended there be at least 20dB extra system operating margin.

RF “Rules of Thumb”:

- Doubling the range with good RF “Line of Sight” (LOS) requires an increase of 6 dB.
- Doubling the range without good RF LOS requires an increase of 12 dB.
- Doubling the power increases dBm by 3.

15.4.1 ANTENNA SELECTION AND LOCATION

Refer to [Section 4.5.1](#) for antenna selection and location instructions.



15.4.2 WATER PROOFING ANTENNA CONNECTIONS

Refer to [Section 4.5.2](#) for instructions on water proofing antenna connections.

15.4.3 SYSTEM GROUNDING

Refer to [Section 4.5.3](#) for instructions on System Grounding.

Chapter 16 – WAVENET ANTENNA SELECTION

16.1 ANTENNA SELECTION

16.1.1 DIPOLE AND COLLINEAR ANTENNAS

These antennas are connected to the Radio via a length of coax cable. If the cable is larger than 6mm diameter (1/4 inch), be aware of sideways tension on the connection. Thick cables have large bending radii and sideways force on the connector can cause a poor connection.

The polarity of these antennas is the same as the main axis, and they are normally installed vertically. They can be mounted horizontally (horizontal polarity), however the antenna at the other end of the wireless link would need to be mounted perfectly parallel for optimum performance. This is very difficult to achieve over distance. If the antenna is mounted vertically, it is only necessary to mount the other antennas vertically for optimum “coupling” – this is easy to achieve.

Dipole and collinear antennas provide best performance when installed with at least 1 to 2 wavelengths clearance of walls or steelwork. The wavelength is based on the frequency:

Wavelength in meters = $300 / \text{frequency in MHz}$

Wavelength in feet = $1000 / \text{frequency in MHz}$

Therefore, 900 MHz antennas require at least 2/3 meter (2 feet) and 2.4GHz 15 cm (6 inches). Antennas may be mounted with less clearance but radiation will be reduced. If the radio path is short this won't matter. It is important the antenna mounting bracket to well connected to “earth” or “ground” for good lightning surge protection.

16.1.2 YAGI ANTENNAS

Yagi antennas are directional along the central beam of the antenna. The folded element is towards the back and the antenna should be pointed in the direction of the transmission. Yagis should also be mounted with at least 1 to 2 wavelengths of clearance from other objects. The polarity of the antenna is the same as the direction of the orthogonal elements. For example, if the elements are vertical the Yagi transmits with vertical polarity.

In networks spread over wide areas, it is common for a central unit to have an omni-directional antenna and the remote units to have Yagi antennas. In this case, as the omni-directional antenna will be mounted with vertical polarity, then the Yagi's must also have vertical polarity. Care needs to be taken to ensure the Yagi is aligned correctly to achieve optimum performance.

Two Yagis can be used for a point-to-point link. In this case they can be mounted with the elements horizontally to give horizontal polarity. There is a large degree of RF isolation between horizontal and vertical polarity (approx – 30dB) so this installation method is a good idea if there is a large amount of interference from another system close by transmitting vertical polarity.

An important mounting tip – if a Yagi has drainage holes in the dipole element, do not mount the antenna with the drainage.

16.1.3 MOUNTING NEAR OTHER ANTENNAS

Avoid mounting your network's antenna near any other antenna even when the other antenna is transmitting on a different radio band. High RF energy of the transmission from a close antenna can deafen a receiver. This is a common cause of problems with wireless systems.

Because antennas are designed to transmit parallel to the ground rather than up or down, vertical separation between antennas is a lot more effective than horizontal separation. If mounting near another antenna cannot be avoided, mounting it beneath or above the other antenna is better than mounting beside it. Using different polarity to the other antenna (if possible) will also help to isolate the RF coupling.

16.1.4 COAX CABLES

If a coax cable connects to the antenna via connectors, it is very important to weatherproof the connection using our 1000-2314 or equivalent sealing tape. Moisture ingress into a coax cable connection is the most common cause of problems with antenna installations. A three layer sealing process is recommended – an initial layer of electrical PVC tape, followed by a second layer of self-vulcanizing weatherproofing tape (1000-2314), with a final layer of electrical PVC tape (see [Section 4.5.2](#)).

Allowing a drip “U loop” of cable before the connection is also a good idea. The loop allows water to drip off the bottom of the U instead of into the connection, reduces installation strain and provides spare cable length in case later the original connectors need to be removed, the cable can be cut back and new connectors fitted.

Avoid installing coax cables together in long parallel paths. Leakage from one cable to another has a similar effect as mounting an antenna near another antenna.

16.2 SURGE PROTECTION & GROUNDING

Voltage surges can enter the WaveNet System via the antenna connections, power supply connections, connections to other equipment and even the earth or ground connection. Surges are electrical energy following a path to earth and the best protection is achieved by draining the surge energy to earth via an alternate path. Wireless devices need to have a solid connection to earth via a ground stake or ground grid if the soil has poor conductivity. Solid connection means a large capacity conductor (not a small wire) with no coils or sharp bends. All other devices connected to the WLR need to be grounded to the same ground point. There can be significant resistance between different ground points leading to very large voltage differences during lightning activity. As many wireless units are damaged by earth potential surges due to incorrect grounding as direct surge voltage.

It is very difficult to protect against direct lightning strikes but the probability of a direct strike at any one location is very small. Unfortunately, power line surges and electromagnetic energy in the air can induce high voltage surges from lightning activity several miles away.

16.2.1 ANTENNA GROUNDING

Electromagnetic energy in the air will be drained to ground via any and every earth path. An earth path exists between the antenna and the WaveNet, and to protect against damage this earth path current must be kept as small as possible. This is achieved by providing better alternate earth paths. It is important to ground the antenna to the same ground point as the WaveNet. Antennas are normally mounted to a metal bracket which should be grounded to the WaveNet earth connection. Surge energy induced into the antenna will be drained first by the



Document: UM-1002

WaveNet Wireless Monitoring System User's Manual

Revision Level A

mount's ground connection, second by the outside shield of the coax cable to the ground connection on the radio and third by the internal conductor of the coax cable via the radio electronics. This third earth path causes damage unless the other two paths provide a better earth connection allowing surge energy to bypass the electronics.

When an antenna is located outside of a building and outside of an industrial plant environment, external coax surge diverters are recommended to further minimize the effect of surge current in the inner conductor of the coax cable.

Coax surge diverters have gas-discharge element which breaks down in the presence of high surge voltage, and diverts any current directly to a ground connection. A surge diverter is not normally required when the antenna is within a plant or factory environment, as the plant steelwork provides multiple parallel ground paths and good earth grounding will provide adequate protection without a surge diverter.

16.2.2 CONNECTIONS TO OTHER EQUIPMENT

Surges can enter the wireless unit from connected devices, via I/O, serial or Ethernet connections. Other data devices connected to the wireless unit should be well grounded to the same ground point as the wireless unit.

Special care needs to be taken where the connected data device is remote from the wireless unit requiring a long data cable. As the data device and the wireless unit cannot be connected to the same ground point, different earth potentials can exist during surge conditions.

There is also the possibility of surge voltages being induced on long lengths of wire from nearby power cables. Surge diverters can be fitted to the data cable to protect against surges entering the wireless unit.

The same principle applies to I/O device is not close to the wireless unit, the risk of surge increases. Surge diverters for I/O wiring are available to protect the wireless unit.



Chapter 17 - WAVENET LEGACY MODE

WaveLink Receivers (WLRs) are not compatible with SenSmart 7000s in legacy mode.

When using a SenSmart 7000 (SenSmart 7000) with other R. C. Systems controllers, such as the ST-72, ST-90, ST-71, Rig Protector or other legacy type controllers, it is necessary to operate wirelessly in Legacy Mode.

To enter Legacy mode enter the **RF Link Menu** discussed in [Section 8.1.8](#). To switch from WaveCast mode to Legacy mode select RF Link and enter the special key sequence of four **UP** keystrokes. Once in Legacy mode it is necessary to enter the appropriate **Hop Channel** and **System ID** in accordance with your **Server's Network Configuration**. All other SenSmart 7000 settings function as discussed in [Section 8.1](#).

Chapter 18 - TABLE OF FIGURES

Figure 3-1 Readout Screen.....	10
Figure 3-2 10-0407 Battery / I/O PCB.....	11
Figure 3-3 10-0404-C Display / Radio PCB.....	12
Figure 4-1 SenSmart 7000 NEMA 7 Explosion-Proof Enclosure.....	14
Figure 4-2 SenSmart 7000 Polycarbonate Enclosure	15
Figure 4-3 Local Antennas.....	17
Figure 4-4 Water Proofing Antenna Connections	18
Figure 5-1 1000-0078 Magnetic Wand	19
Figure 5-2 Calibration Gas Input.....	20
Figure 5-3 Cal-Mode Flow Chart and Menus.....	21
Figure 5-4 Replace Battery Screen.....	22
Figure 5-5 Smart Sensor Info / ERROR Screens	22
Figure 5-6 Sensor Separation Kit 10-0411	22
Figure 5-7 10-0247 Smart Sensor Head Assembly	23
Figure 6-1 Main Menu Entry.....	24
Figure 6-2 SenSmart 7000 Channel Configuration Menu Tree	25
Figure 7-1 Channel Setup Menus	26
Figure 7-2 Configure Readout Setup Menus	26
Figure 7-3 Alarm Settings Menus	28
Figure 7-4 Smart Sensor Information Screen	29
Figure 7-5 Technicians Menu Tree	30
Figure 7-6 RF Link Test	31
Figure 7-7 Temperature Compensation Table.....	32
Figure 8-1 Device Setup Menus	33
Figure 8-2 RF Link Setup Menu	33
Figure 8-3 Clock & Calendar / Delay Timer Menu	36
Figure 8-4 System Security Menu.....	37
Figure 8-5 LCD Contrast Adjust Menu.....	37
Figure 8-6 Turn Power OFF Menu.....	37
Figure 9-1 WLR Front Panel	40
Figure 9-2 10-0214 WLR Display PCB	40
Figure 9-3 WLR Data Displays	41
Figure 9-4 EUNIT/Bar Graph Screen.....	42
Figure 9-5 Event Log Screen	43



Figure 10-1 WLR Menu Tree 46

Figure 10-2 WLR Main Menu 47

Figure 10-3 WLR Channel Config Menu 47

Figure 10-4 WLR System Config Menu 48

Figure 10-5 Configure Relays Menu 49

Figure 10-6 Select Channels Screen 49

Figure 10-7 Piezo Functions 50

Figure 10-8 Time/Date Menu 50

Figure 10-9 Communication Menus 51

Figure 10-10 WaveNet Radio Menus 51

Figure 10-11 RX History 52

Figure 10-12 Security Menu 52

Figure 10-13 Display Event Log Pages 53

Figure 10-14 Flash/USB Drive Menu 54

Figure 10-15 Technicians Only Pages 54

Figure 11-1 AC/DC Power Schematic 55

Figure 11-2 10-0215 Motherboard 56

Figure 11-3 10-0222 Relay Board 57

Figure 11-4 1000-2259 50 Watt Power Supply 58

Figure 12-1 WLR/PY NEMA 4X Polyester Wall Mount Enclosure 59

Figure 12-2 WLR/PCS NEMA 4 Painted Carbon Steel Wall Mount Enclosure 60

Figure 12-3 WLR/SS NEMA 4X Stainless Steel Wall Mount Enclosure 61

Figure 12-4 WLR/XP NEMA 7 Explosion Proof Wall Mount Enclosure 62

Figure 13-1 WLR Multi-Interface Option Board Menus 63

Figure 13-2 Modbus Communication Menu 64

Figure 13-3 WaveLink Receiver Wi-Fi Menu Tree 71

Figure 13-4 Webpage Status Screen (No Alarms) 72

Figure 13-5 Webpage Status Screen (With Alarms) 72

Figure 13-6 Relay Config Menu 73

Figure 13-7 Channel Config Menu 74

Figure 13-8 System Config Menu 75

Figure 13-9 Data Logging File Structure 77

Figure 13-10 WLR Data Logging Menu Tree 77

Figure 13-11 Webpage Data Logging Menu 78

Figure 14-1 WaveNet Relayer Main Screen 79

Figure 14-2 WaveNet Relayer Menu Tree 80



Document: UM-1002

WaveNet Wireless Monitoring System User's Manual

Revision Level A

Figure 14-3 Main Menu	81
Figure 14-4 WNR Channel Config Menu	81
Figure 14-5 WNR System Config Menu.....	82
Figure 14-6 Configure Relays Menu	82
Figure 14-7 Select Channels Menu	83
Figure 14-8 LCD Contrast Adjust.....	83
Figure 14-9 Communications Menu	84
Figure 14-10 Security Menu.....	85
Figure 14-11 TECHNICIANS ONLY Menu Tree	86
Figure 14-12 10-0404-R Display / Radio PCB	87
Figure 14-13 10-0425 Power Supply/Relay PCB	88
Figure 15-1 WNR Explosion-Proof Housing	90
Figure 15-2 WNR Polycarbonate Enclosure	91

Appendix E

Incident Report Form (Typical)

INCIDENT REPORT FORM**Sundance West**

Lea County, NM

Type of Incident and General Information

- | | |
|--|--|
| ☐ Work Related Injury/Illness | ☐ Unsafe Act/Near Miss |
| ☐ Property Damage | ☐ Vandalism/Criminal Activity |
| ☐ Vehicular Accident | ☐ Other _____ (i.e., spill, release, fire, explosion, hot load, etc.) |

Employee Name: _____ Job Title: _____

Phone No: _____ Date of Incident: _____ Time of Incident: _____ AM/PM

Location of Incident: _____

Start of Shift: _____ Weather: _____

Date and Time Reported to Management: Date: _____ Time: _____ AM/PM

Reported to: _____ Title: _____ Reported by: _____

What was the injury category of incident at the time it was first reported to management?

- ☐ N/A. Employee does not claim an injury associated with this incident
- ☐ Notice Only of Injury, Declined Medical Treatment at this time
- ☐ First Aid done on site, Declined Medical Treatment at this time
- ☐ Medical Treatment. Transported by _____ to _____
- ☐ Fatality, employee

Employee's Description of Incident / Declaración del empleado de los hechosWere you injured? (*Ud. se lastimó ?*) Yes ☐ No ☐Type of Injury: (*Tipo de lesión*) _____

Part of Body: _____	Left _____	Right _____
(<i>Parte del cuerpo</i>)	(<i>Izq</i>)	(<i>Der</i>)

Explain in your own words what happened. (*Explique en sus propias palabras lo que sucedió*)

Employee Signature: (*Firma del empleado*) _____Date: (*Fecha*) _____

INCIDENT REPORT FORM

Sundance West

TO BE FILLED OUT BY EMERGENCY COORDINATOR

Describe in order of occurrence the events leading to the incident and/or injury. Reconstruct the sequence of events that led to the incident. _____

Identify possible hazards to human health or the environment: _____

Identify name and quantity of material(s) involved: _____

CORRECTIVE ACTIONS. (Equipment, Practices, Environment, Retraining) Steps that have been, or will be taken to prevent recurrence: _____

Date Corrective Action Completed: _____

- I have been briefed on the corrective actions outlined above
- *Estoy consciente de las acciones correctivas mencionadas anteriormente en esta hoja*

Employee's Signature

Date

Report Reviewed and Concluded By:

Emergency Coordinator's Signature

Date

State of New Mexico
Energy, Minerals and Natural Resources Department

Michelle Lujan-Grisham
Governor

Erin Taylor
Acting Cabinet Secretary

Ben Shelton
Deputy Secretary

Albert C.S. Chang
Division Director
Oil Conservation Division



BY ELECTRONIC MAIL

September 17, 2026

Mr. Tariq Mussani
Sundance Services West, Inc.
P.O. Box 5270
Hobbs, NM 88240
MussaniUK@hotmail.com

RE: Sundance Services West, Inc., Permit NM1-62- Notice of an Administratively Complete Hydrogen Sulfide Contingency Plan

Dear Mr. Mussani:

The New Mexico Energy, Minerals and Natural Resource Department's Oil Conservation Division (OCD) has reviewed the revised Hydrogen Sulfide (H₂S) Contingency Plan dated August 31, 2026 and submitted to OCD on September 16, 2026, by Sundance Services West Inc. (SSWI) for Permit NM1-62 located in Lea County, New Mexico. The submitted H₂S Contingency Plan includes all components as required by 19.15.11 NMAC; therefore, OCD has determined that the submitted H₂S Contingency Plan is administratively complete.

Please be advised that OCD's acceptance of this plan does not relieve SSWI of responsibility should its operations fail to adequately detect, investigate, and/or undertake corrective actions to prevent or stop a hydrogen sulfide release. In addition, OCD's acceptance does not relieve SSWI of responsibility for compliance with any other federal, state, or local laws and/or regulations.

If there are any questions regarding this matter, please do not hesitate to contact me at (505) 549-5583 or Joseph.Kennedy@emnrd.nm.gov.

Respectfully,

Joseph Kennedy • Senior Environmental Scientist

1220 South St. Francis Drive • Santa Fe, New Mexico 87505
Phone (505) 476-3441 • www.emnrd.nm.gov/ocd/



Memorandum

To: New Mexico Energy, Minerals and Natural Resources
Department Oil Conservation Division

Date: August 31, 2026

From: Kelly Jayne, P.E.

Subject: Summary of Modifications to Hydrogen Sulfide Prevention and Contingency Plan
Sundance Services West, Inc.

On behalf of Sundance Services West, Inc. (SSWI), Daniel B. Stephens & Associates, Inc. (DBS&A) is pleased to submit a revised hydrogen sulfide (H₂S) prevention and contingency plan (the plan) to the New Mexico Energy, Minerals and Natural Resources Department Oil Conservation Division (OCD).

This summary highlights all changes made to the plan in accordance with 19.15.36 NMAC. The changes outlined to the plan are being implemented by SSWI. The revised plan is also being submitted to local authorities in accordance with 19.15.11 NMAC.

Changes to Emergency Response Agencies and Contacts

The Emergency Response Firm (Phoenix Environmental LLC) was removed as it is not clear whether the entity remains in operation. A third-party emergency response firm is not required by 19.15.11.9(B)(2)(a) NMAC, which specifies the inclusion of "... telephone numbers of emergency responders, public agencies, local government and other appropriate public authorities." In the case of an H₂S emergency at the facility, SSWI personnel shall consult with local and state emergency contacts.

Amendment to Characteristics of Hydrogen Sulfide and Sulfur Dioxide

Olfactory indicators of hydrogen sulfide and sulfur dioxide gases have been added to further inform personnel of early exposure warning signs.

Update to Monitoring Practices

Wording has been updated to reference monitoring system components replaced September 2025. Operation and functions of the system installed September 2025 remain equivalent to those of the previous system.



Modifications to Hydrogen Sulfide Prevention and Contingency Plan, SSWI

Update to Evaporation Ponds Stationary Monitoring Figure

Notes and channel labels have been updated to reflect the new monitoring system configuration effective September 2025.

Changes to Contingency Plan Activation

The plan activation level for H₂S has been adjusted from 10 parts per million (ppm) to 100 ppm to more closely reflect the requirements of 19.15.11.9(C) NMAC. Additional plan activation conditions have been prescribed for concentrations of 30 ppm measured for longer than 10 minutes. See "Changes to the Immediate Action Plan" for further explanation of changes in activation and response procedures.

Language has been inserted to describe the most likely events that may cause an H₂S release at the facility to further inform personnel of H₂S exposure risks. Language has also been inserted to clarify that plan activation must occur regardless of operations surrounding the evaporation ponds to sufficiently protect public health and the environment in alignment with the plan's purpose.

Changes to Notification of Authorities and General Public

Wording has been updated to reflect OCD process updates issued December 2023 regarding OCD's migration to online submittal of Form C-141.

Wording has also been updated to ensure that SSWI coordinates with OCD and New Mexico State Police consistent with the New Mexico hazardous materials emergency response plan as required by 19.15.11.9(B)(2)(e) NMAC.

Changes to the Immediate Action Plan

Language has been updated to reflect system components replaced September 2025. Response actions for each alarm level have been updated to more closely reflect guidance provided by API RP-55.

The H₂S range/threshold for a minor alarm has been adjusted from 10–20 ppm to 10–30 ppm. Language has been added to require that personnel provide additional notification to the emergency coordinator (EC) if H₂S concentrations in excess of 10 ppm are detected for longer than 10 minutes. As the plan activation level has been shifted from 10 ppm to 100 ppm, a minor alarm does not require activation of the H₂S contingency plan, and therefore will not require



Modifications to Hydrogen Sulfide Prevention and Contingency Plan, SSWI

OCD notification or submittal of Form C-141. Though these reporting actions are no longer prescribed, minor alarm procedures have been amended to require that all SSWI personnel affected by a minor alarm (as well as the acting EC) must promptly complete an incident report form (provided in Appendix E) to be retained within the facility operating record.

The H₂S range/threshold for a major alarm has been adjusted from 20–100 ppm to 30–100 ppm. Language has been added to require escalation of a major alarm to a critical alarm if H₂S concentrations in excess of 30 ppm are detected for longer than 10 minutes. Evacuation procedures have been updated to reflect the amended major alarm conditions. Response action language has been updated to ensure that all assessment and response personnel have undergone proper training for the scenario and its potential hazards. Similar to the minor alarm, a major alarm does not require activation of the H₂S contingency plan and therefore will not require OCD notification or submittal of Form C-141. Though these reporting actions are no longer prescribed, major alarm procedures have been amended to require that all SSWI personnel affected by a major alarm (as well as the acting EC) must promptly complete an incident report form (provided in Appendix E) to be retained within the facility operating record.

The H₂S threshold for a critical alarm has been amended to include major alarms that remain active for longer than 10 consecutive minutes. Response actions for a critical alarm have been updated to require closure of the facility and advise personnel to take measures for managing the hazard. Response action language has also been amended to ensure that all assessment and response personnel have undergone proper training for the scenario and its potential hazards. As critical alarm conditions are equal to the plan activation conditions, all critical alarms require submittal of Form C-141 to OCD (filed electronically through OCD Permitting), which shall be retained within the facility operating record.

Editorial Changes

Minor editorial changes have been made throughout the document to enhance readability, including formatting changes to the plan's text, tables, and figures.

Sante Fe Main Office
Phone: (505) 476-3441

General Information
Phone: (505) 629-6116

Online Phone Directory
<https://www.emnrd.nm.gov/ocd/contact-us>

State of New Mexico
Energy, Minerals and Natural Resources
Oil Conservation Division
1220 S. St Francis Dr.
Santa Fe, NM 87505

CONDITIONS

Action 625262

CONDITIONS

Operator: Sundance Services West, Inc. PO Box 1737 Eunice, NM 88231	OGRID: 371811
	Action Number: 625262
	Action Type: [UF-H2S] H2S Contingency Plan (H2S Plan)

CONDITIONS

Created By	Condition	Condition Date
joseph.kennedy	Please see approval letter emailed to Mr. Mussani on 9/17/2026	9/17/2026