

TLS RF Wireless System

Site Prep & Installation Manual



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This equipment complies with the requirements in Part 15 of the FCC rules for a Class A computing device. Operation of this equipment in a residential area may cause unacceptable interference to radio and TV reception requiring the operator to take whatever steps are necessary to correct the interference.

WARRANTY

Please see next page, iii.

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Warranty

TLS-350R, TLS-350 PLUS, TLS-350J AND TLS-300I/C, AND TLS-2 MONITORING SYSTEMS

We warrant that this product shall be free from defects in material and workmanship for a period of one (1) year from the date of installation or twenty-four (24) months from the date of invoice, whichever occurs first. During the warranty period, we or our representative will repair or replace the product, if determined by us to be defective, at the location where the product is in use and at no charge to the purchaser. LAMPS, FUSES, AND LITHIUM BATTERIES ARE NOT COVERED UNDER THIS WARRANTY.

We shall not be responsible for any expenses incurred by the user.

This warranty applies only when the product is installed in accordance with Veeder-Root's specifications, and a Warranty Registration and Checkout Form has been filed with Veeder-Root by an authorized Veeder-Root Distributor. This warranty will not apply to any product which has been subjected to misuse, negligence, accidents, systems that are misapplied or are not installed per Veeder-Root specifications, modified or repaired by unauthorized persons, or damage related to acts of God.

If "Warranty" is purchased as part of the Fuel Management Service, Veeder-Root will maintain the equipment for the life of the contract in accordance with the written warranty provided with the equipment. A Veeder-Root Fuel Management Services Contractor shall have free site access during Customer's regular working hours to work on the equipment. Veeder-Root has no obligation to monitor federal, state or local laws, or modify the equipment based on developments or changes in such laws.

MODULES, KITS, OTHER COMPONENTS (PARTS PURCHASED SEPARATE OF A COMPLETE CONSOLE)

We warrant that this product, exclusive of lithium batteries, shall be free from defects in material and workmanship for a period of fifteen (15) months from date of invoice. We warrant that the lithium batteries shall be free from defects in material and workmanship for a period of 90 days from date of invoice. We will repair or replace the product if the product is returned to us; transportation prepaid, within the warranty period, and is determined by us to be defective. This warranty will not apply to any product which has been subjected to misuse, negligence, accidents, systems that are misapplied or are not installed per Veeder-Root specifications, modified or repaired by unauthorized persons, or damage related to acts of God.

We shall not be responsible for any expenses incurred by the user.

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Introduction

This manual describes site preparation and installation procedures for the Veeder-Root TLS RF Wireless System. This system is designed for standard tank monitoring and leak detection* applications in which in-ground probe wiring is either impractical or non-existent.

Procedures contained within this manual include:

- Mounting the TLS RF Wireless Interface Unit (TLS RF) and connecting power wiring.
- Installing TLS RF Wireless System's receiver, transmitter, and repeater components throughout the site.
- Connecting the TLS RF to the TLS console.

Other required devices, such as the TLS console and necessary magnetostrictive (mag) probes/mag sump sensors, are to be installed following instructions shipped with those devices.

After installing the TLS RF Wireless System, you must configure the probes and sensors in the TLS console following instructions contained in the console's System Setup Manual.

**Certified SLD (Static) & CSLD (Continuous) Leak Detection for single tanks and Mag Sump Sensor monitoring, where ambient interference is not a factor.*

Component Compatibility

The Veeder-Root Form Number/Part Number TLS RF Wireless System compatible components are as follows:

- 8466 TLS-IB console
- 8469 TLS-50 console
- 8470 TLS-350 console
- 8482 TLS-350R console
- 8485 TLS-300 console
- 8560 TLS2 console

332235-011 Transmitter with 332425-011 Battery Pack will monitor probe/sensor form numbers listed below:

- 8462, 8463 and 8563 Mag Plus Probe
- 8468 Global Mag Probe
- 8570 Mag Sump Sensor

Contractor Certification Requirements

Veeder-Root requires the following minimum training certifications for contractors who will install and setup the equipment discussed in this manual:

Installer Certification: Contractors holding valid Installer Certification are approved to perform wiring and conduit routing; equipment mounting; probe, sensor and carbon canister vapor polisher installation; wireless equipment installation; tank and line preparation; and line leak detector installation.

TLS-350 Technician Certification: Contractors holding valid TLS-350 Technician Certifications are approved to perform installation checkout, startup, programming and operations training, system tests, troubleshooting and servicing for all Veeder-Root TLS-300 or TLS-350 Series Tank Monitoring Systems, including Line Leak Detection and associated accessories.

Wireless TLS Technician Certification: Contractors holding valid Wireless TLS Technician Certifications are approved to perform installation checkout, startup, operations, troubleshooting and servicing for all Veeder-Root TLS Wireless Systems, including the RF Console and associated accessories such as transmitters, receiver and repeater.

Warranty Registrations may only be submitted by selected Distributors.

Probe Transmitter Considerations

Installation of this equipment in wet or below grade locations requires that the installer take steps to ensure that the equipment is mounted above the maximum water level and install a suitable water pump for removing water inside the applicable sump.



CAUTION! – The transmitter will not function properly in water. Also, submersion of the transmitter in water can cause permanent damage to the internal electronics.

Related Documents

576013-623 TLS-3XX System Setup Manual

331940-012 TLS RF System Control Drawing

Safety Precautions

FAILURE TO COMPLY WITH THE FOLLOWING WARNINGS AND SAFETY PRECAUTIONS COULD CAUSE DAMAGE TO PROPERTY, ENVIRONMENT, RESULTING IN SERIOUS INJURY OR DEATH.

Retain and follow all product safety and operating instructions. Observe all warnings on the product and in the operating instructions. To reduce the risk of bodily injury, electric shock, fire, or damage to the equipment, observe the following precautions.

GENERAL PRECAUTIONS

Heed service markings: Opening or removing the console cover may expose you to electric shock. Servicing of Veeder-Root equipment must be done by Veeder-Root authorized service contractors.

Use product with approved equipment: This product should be used only with Veeder-Root components identified as suitable for use with the TLS RF Wireless System.

Use the correct external power sources: This product should be operated only from the type of power sources indicated on the electrical ratings labels affixed to the components. If you are not sure of the type of power source required, consult your Veeder-Root authorized service contractor.







SPECIAL TOOLS REQUIRED

- #15 Torx driver
- Small blade screwdriver (maximum blade width 3/32")
- Wire strippers

Although not required for installation, a laptop computer, RS-232 serial communication cable (TLS RF has a female DB9 connector) and terminal mode software may be necessary for troubleshooting.

SAFETY SYMBOLS

The following safety symbols are used throughout this manual to alert you to important safety hazards and precautions:

	EXPLOSIVE Fuels and their vapors are extremely explosive if ignited.		FLAMMABLE Fuels and their vapors are extremely flammable.
	ELECTRICITY High voltage exists in, and is supplied to, the device. A potential shock hazard exists.		TURN POWER OFF Live power to a device creates a potential shock hazard. Turn Off power to the device and associated accessories when servicing the unit
	WARNING Heed the adjacent instructions to avoid equipment damage or personal injury.		READ ALL RELATED MANUALS Knowledge of all related procedures before you begin work is important. Read and understand all manuals thoroughly. If you do not understand a procedure, ask someone who does.

Site Considerations - Control Drawing

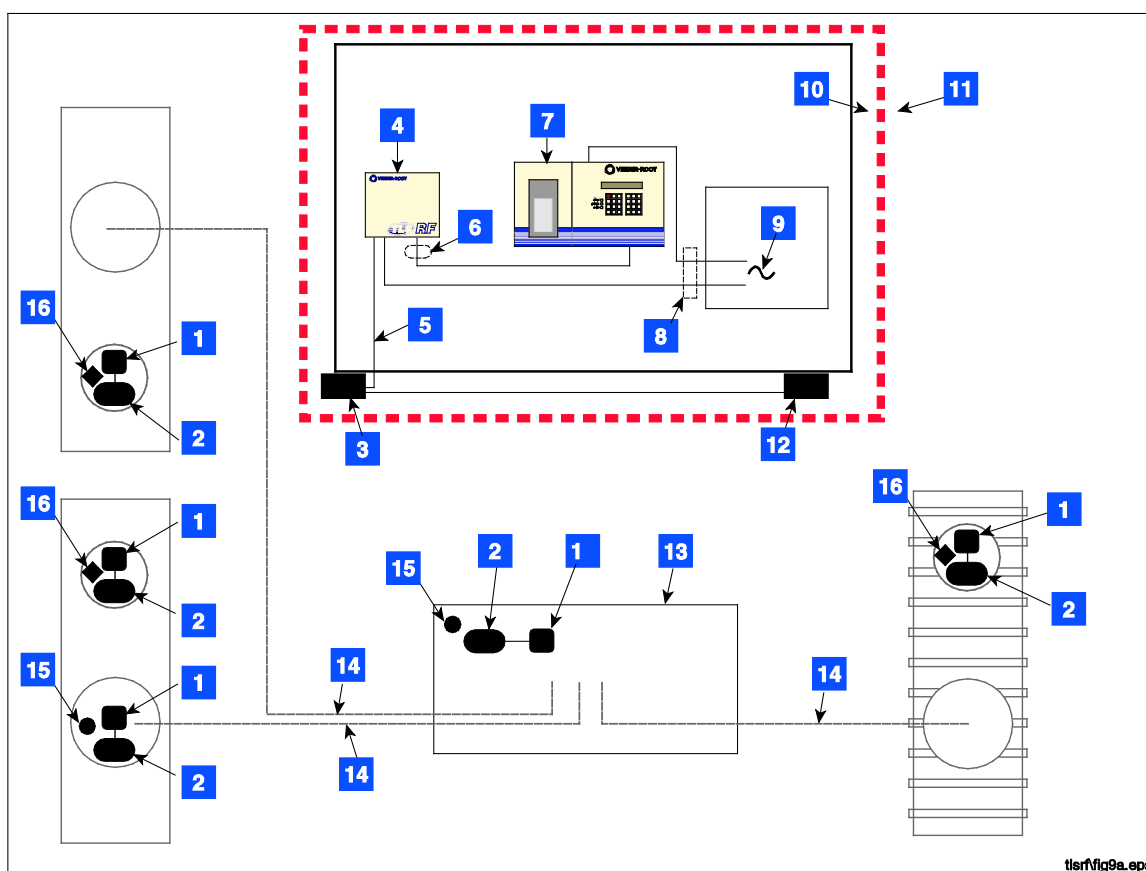


Figure 1. Control Drawing - Example TLS RF Wireless System Site Layout

LEGEND FOR NUMBERED BOXES IN FIGURE 1


To be installed in accordance with the National Electrical Code, NFPA 70 and the Code for Motor Fuel Dispensing Facilities and Repair Garages (NFPA 30A), or other local code such as the CEC, Canadian Electrical Code.



 **WARNING! Substitution of components may impair intrinsic safety.**

Circuitry within the console barrier forms an intrinsically safe, energy-limited system. This system is intrinsically safe for use in a Class I, Group D hazardous location.

1. **Battery Pack**
2. **Transmitter**
3. **Receiver**
4. **TLS RF ($V_m = 250\text{ V}$)**
5. **RS-485 Cable (Belden #3107A or equiv.)**

-  **NOTE:** Intrinsically safe wiring shall be installed in accordance with Article 504-20 of the NEC, ANSI/NFPA 70. Maximum probe/sensor cable length 1000 ft. (304 m).
- 6.
 7. **TLS console ($V_m = 250\text{ V}$)**
 8. **Conduit that enters power wiring knockout.**
 9. **120 or 230 Vac from power panel.**
 10. **Non-hazardous area**
 11. **Hazardous area (Class I, Div. 1, Group D)**
 12. **Repeater (1)**
 13. **Dispenser sump**
 14. **Underground product line**
 15. **Sump sensor**
 16. **Mag probe**

National Electrical Code Compliance

The following information is for general reference and is not intended to replace recommended National Electric Code (NEC) procedures. It is important for the installer to understand that electrical equipment and wiring located in Class I, Division 1 and 2 installations shall comply with the latest appropriate articles found in the National Electric Code (NFPA 70) and the Code for Motor Fuel Dispensing Facilities and Repair Garages (NFPA 30A), or other local code such as the CEC, Canadian Electrical Code.

TLS RF UNIT-TO-TLS CONSOLE WIRING

Wire Type

To ensure the best operating systems available, Veeder-Root **REQUIRES** the use of shielded cable for probe outputs regardless of conduit material or application. In these installations, shielded cable must be rated less than 100 picofarad per foot and be manufactured with a material suitable for the environment, such as Carol™ C2534 or Belden™ 88760, 8760, or 8770.

Wire Length

Improper system operation could result in undetected potential environmental and health hazards if the TLS RF-to-TLS Console wire runs exceed 1000 feet. Wire runs must be less than 1000 feet to meet intrinsic safety requirements.

Splices

Veeder-Root recommends that no splices be made in the wire run between the TLS RF and the TLS Console. Each splice degrades signal strength and could result in poor system performance.

Wire Gauges - Color coded

Shielded cable must be used in all installations. TLS RF-to-TLS console wires should be #14-#18 AWG stranded copper wire and installed as a Class 1 circuit. As an alternate method when approved by the local authority having jurisdiction, 22 AWG wire such as Belden 88761 may be suitable in installations with the following provisions:

- Wire run is less than 750 feet
- Capacitance does not exceed 100 pF/foot
- Inductance does not exceed 0.2 μ H/foot

TLS RF POWER WIRING

Wires carrying 120 or 240 Vac from the power panel to the TLS RF should be #14 AWG copper wire for line, neutral and chassis ground (3); and #12 AWG copper wire for barrier ground (1).

TLS RF Wireless System Overview

Figure 2 illustrates an example TLS RF Wireless System installation. In the figure only one tank is shown, but each tank being monitored by a Mag probe would require a battery pack/transmitter pair. The repeater component may be required if the system receiver, mounted on building's outside wall, has difficulty receiving signals from any of the transmitters.

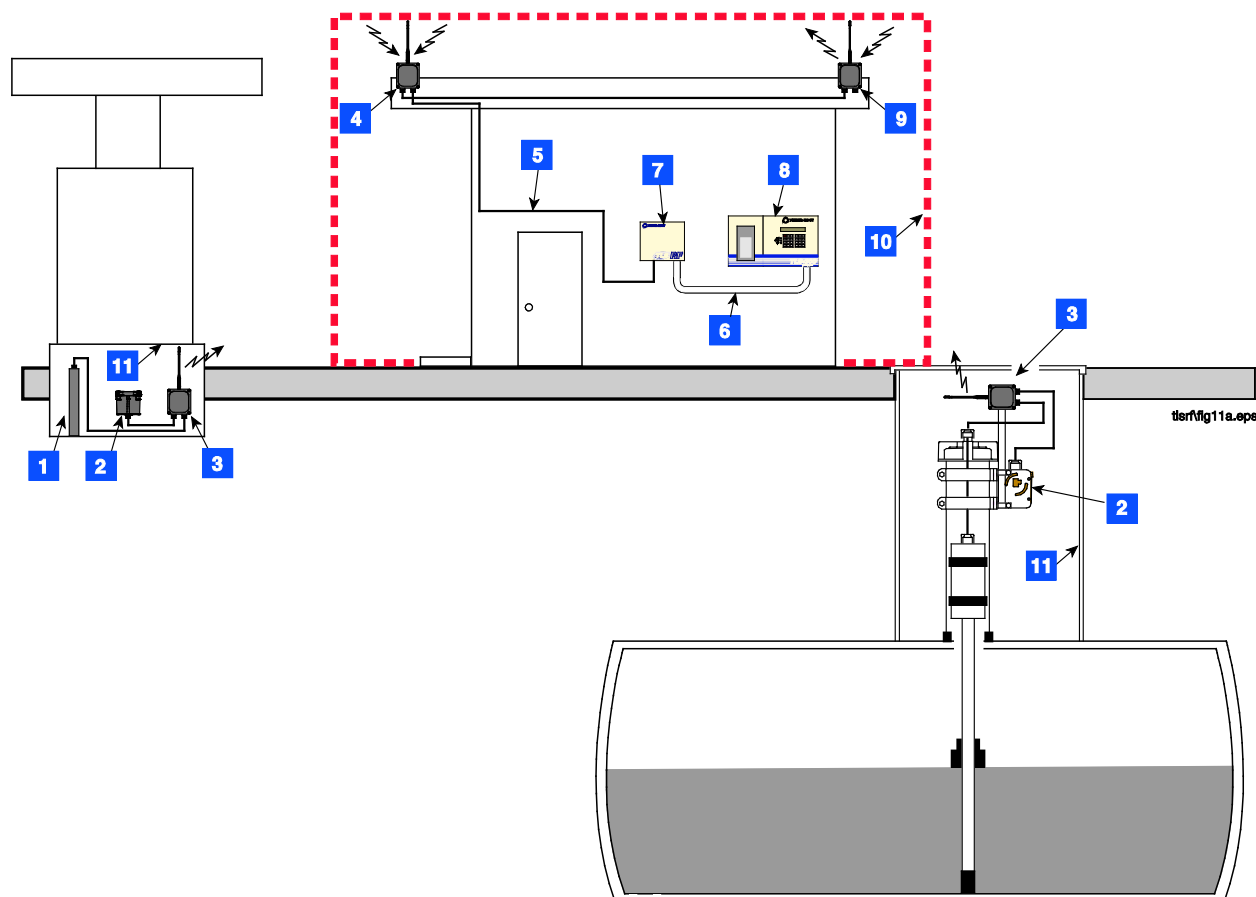


Figure 2. Example TLS RF Wireless System component installation

LEGEND FOR NUMBERED BOXES IN FIGURE 2

- | | |
|---|--|
| 1. Dispenser pan Mag Sump sensor | 7. TLS RF |
| 2. Battery Pack | 8. TLS console |
| 3. Transmitter | 9. Repeater |
| 4. Receiver | 10. Non-hazardous area |
| 5. RS-485 cable (Belden #3107A or equiv.) | 11. Hazardous area, Class I, Div. 1, Group D |
| 6. Probe wiring (up to 8 Mag probes/Mag Sump sensors) - conduit connects via intrinsically safe knockouts on both consoles. | |



NOTE: Intrinsically safe wiring shall be installed in accordance with Article 504-20 of the NEC, ANSI/NFPA 70.

Equipment Dimensions

Dimensions of the TLS RF are shown in Figure 3.

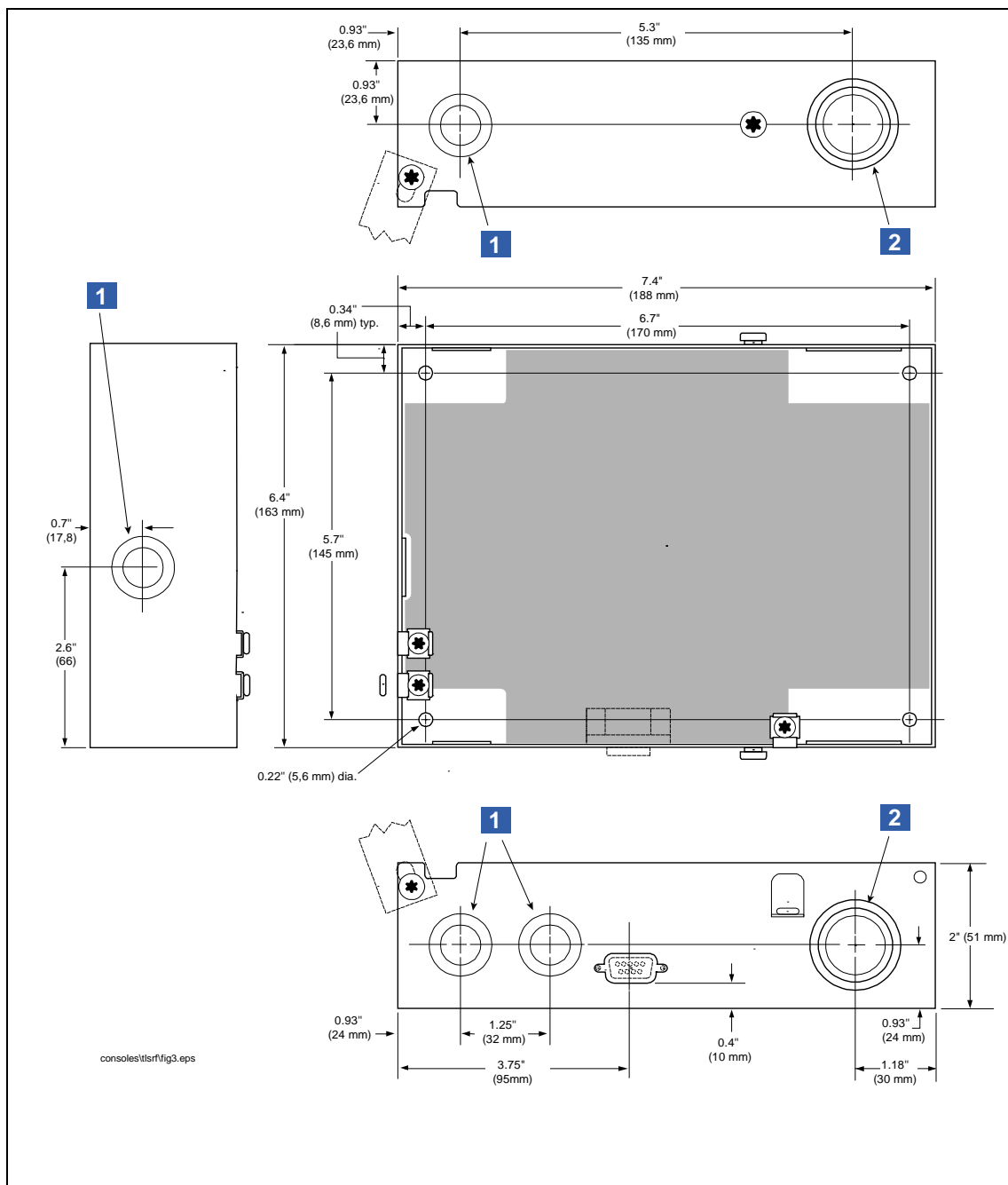


Figure 3. TLS RF dimensions and designated conduit knockouts

LEGEND FOR NUMBERED BOXES IN FIGURE 3	
1. Designated power wiring knockouts.	2. Designated intrinsically-safe wiring knockouts.

Dimensions of the receiver, transmitter, repeater, and battery housing are shown in Figure 4.

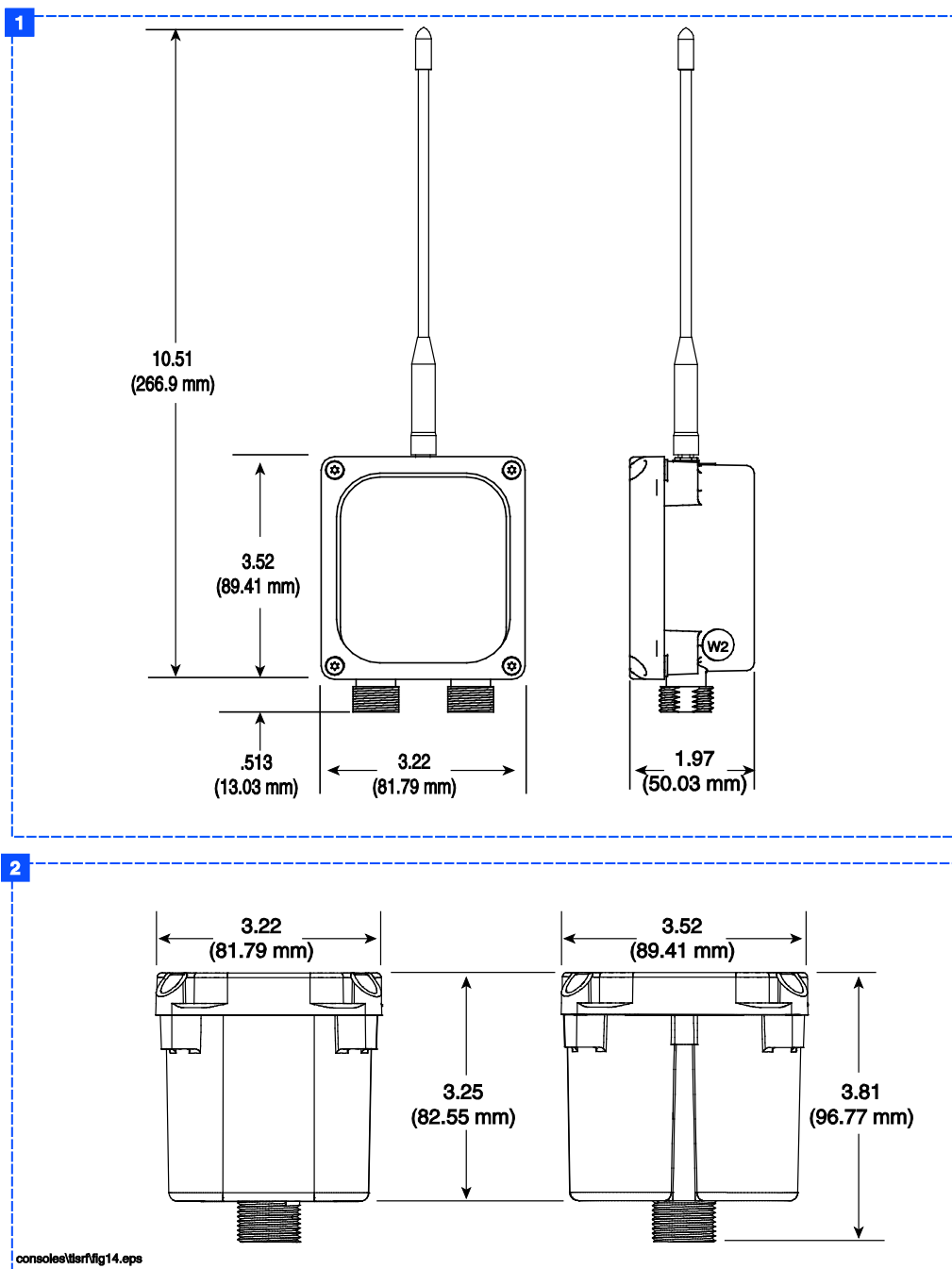




Figure 4. Wireless component dimensions

LEGEND FOR NUMBERED BOXES IN FIGURE 4	
1. Receiver, transmitter, and repeater dimensions	2. Battery housing dimensions

TLS RF Installation

Selecting a Location for the TLS RF

 WARNING	
	<p>Explosive vapors or flammable liquids could be present near locations where fuels are stored or being dispensed. The TLS RF is not explosion proof.</p> <p>An explosion or fire resulting in serious injury or death, property loss and equipment damage could occur if the console is installed in a volatile, combustible or explosive atmosphere (Class I, Division 1 or 2).</p> <p>Do not install this unit in a volatile, combustible, or explosive atmosphere..</p>

The TLS RF must be mounted indoors, protected from severe vibration, extremes in temperature and humidity, and other conditions that could harm computerized electronic equipment.

Ensure that the TLS RF is located where neither it nor its associated cabling will be damaged by doors, furniture, etc. Consider the ease of routing wiring, and ducting to the TLS console. Check that the mounting surface is strong enough to support the unit's weight of about 4 pounds.

Mounting the TLS RF

Install the unit's fastening devices to the mounting surface using the hole pattern (6.7" x 5.7") shown in Figure 3. Mounting screws up to 3/16" diameter may be used.

Install metal conduit (1/2-inch I.P.S.) between the upper power side knockout on the unit and the power panel. Figure 3 shows the three designated knockouts (one each on top, left side, and bottom) through which power wiring can safely enter the unit.

Also install metal conduit (1/2-inch I.P.S.) between the lower intrinsically-safe wiring knockout on the TLS RF and an intrinsically-safe wiring knockout on the TLS console for device data wiring.

Wiring the TLS RF

WARNING



The unit contains voltages which can be lethal.

Connecting power wires to a live circuit can cause electrical shock that may result in serious injury or death.

Turn power off at the circuit breaker before connecting wiring to the TLS RF.

Attach conduit from the power panel to the unit's power wiring knockouts only (1 on top and 1 on bottom, ref. Figure 3)

To connect power wiring see Figure 5. To connect receiver wiring see Figure 6. To daisy chain two TLS RFs, see Figure 8 and

Figure 9. To connect TLS RF data output wiring to the TLS console see Figure 10.

LEGEND FOR NUMBERED BOXES IN FIGURE 5	
1.	Attach chassis ground wire (#14 AWG) to ground lug.
2.	Protective earthing conductor (green and yellow). Attach #12AWG barrier ground wire to ground lug. Ground must be the same as the supply and less than 1.0 ohms to ground.
3.	AC power input wires (#14 AWG) to AC INPUT terminals.
4.	POWER WIRING NOTES: <ul style="list-style-type: none"> - Barrier ground must be #12 AWG or larger diameter. - Check to be sure that the electrical resistance - between the unit ground lug and a known good earth ground is less than 1 ohm. - Connect the power supply wires in the power panel to a separate dedicated circuit. - Electrical rating power input - 120 Vac or 240 Vac, 50/60 Hz, 2 A max. - See Figure 3 for actual locations of power conduit knockouts into the unit. Power wiring must enter only in one of these knockouts.
5.	Intrinsically-safe side
6.	Power side
7.	RS-232 diagnostic port: <ul style="list-style-type: none"> - Baud rate - 9600 - Data length - 8 - Parity - None - Stop bits - 1

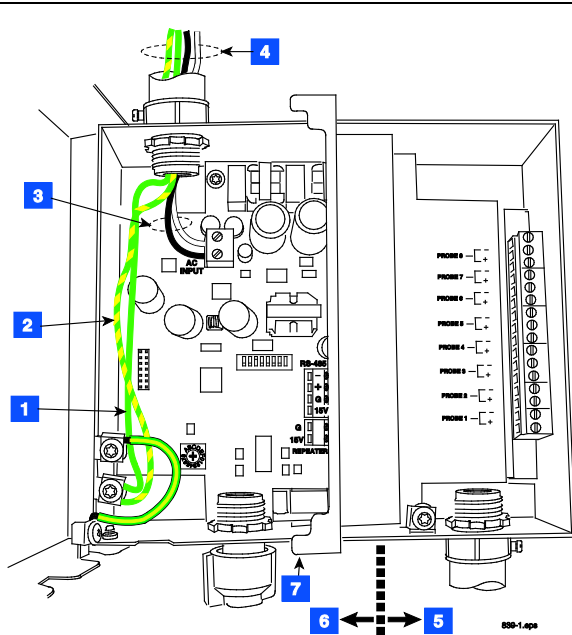
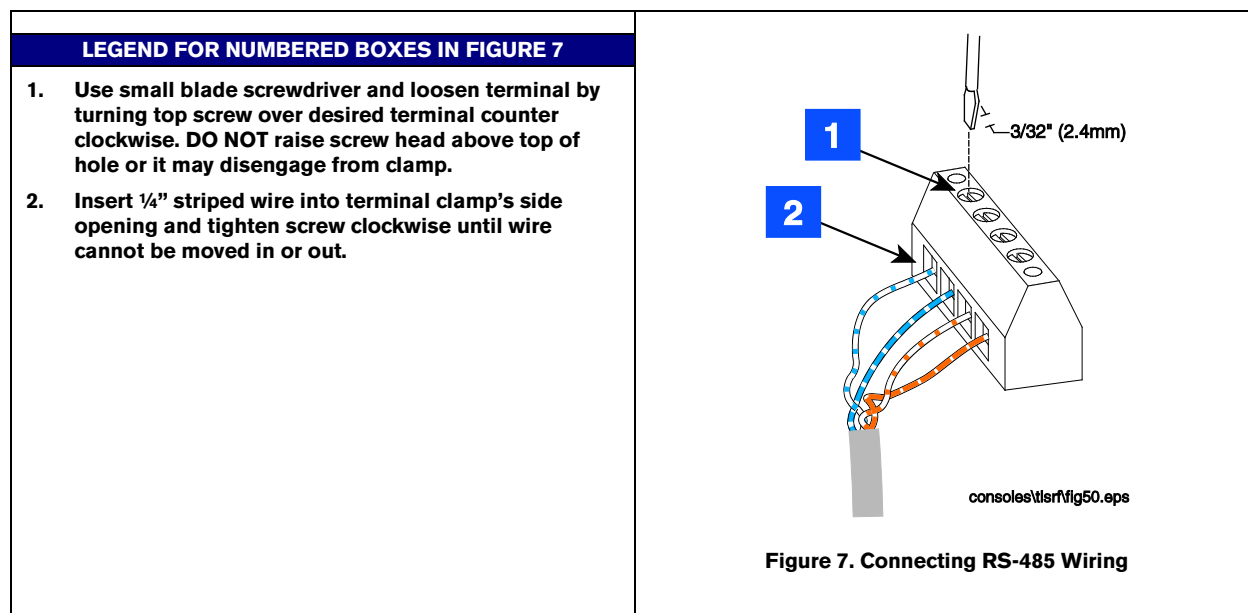
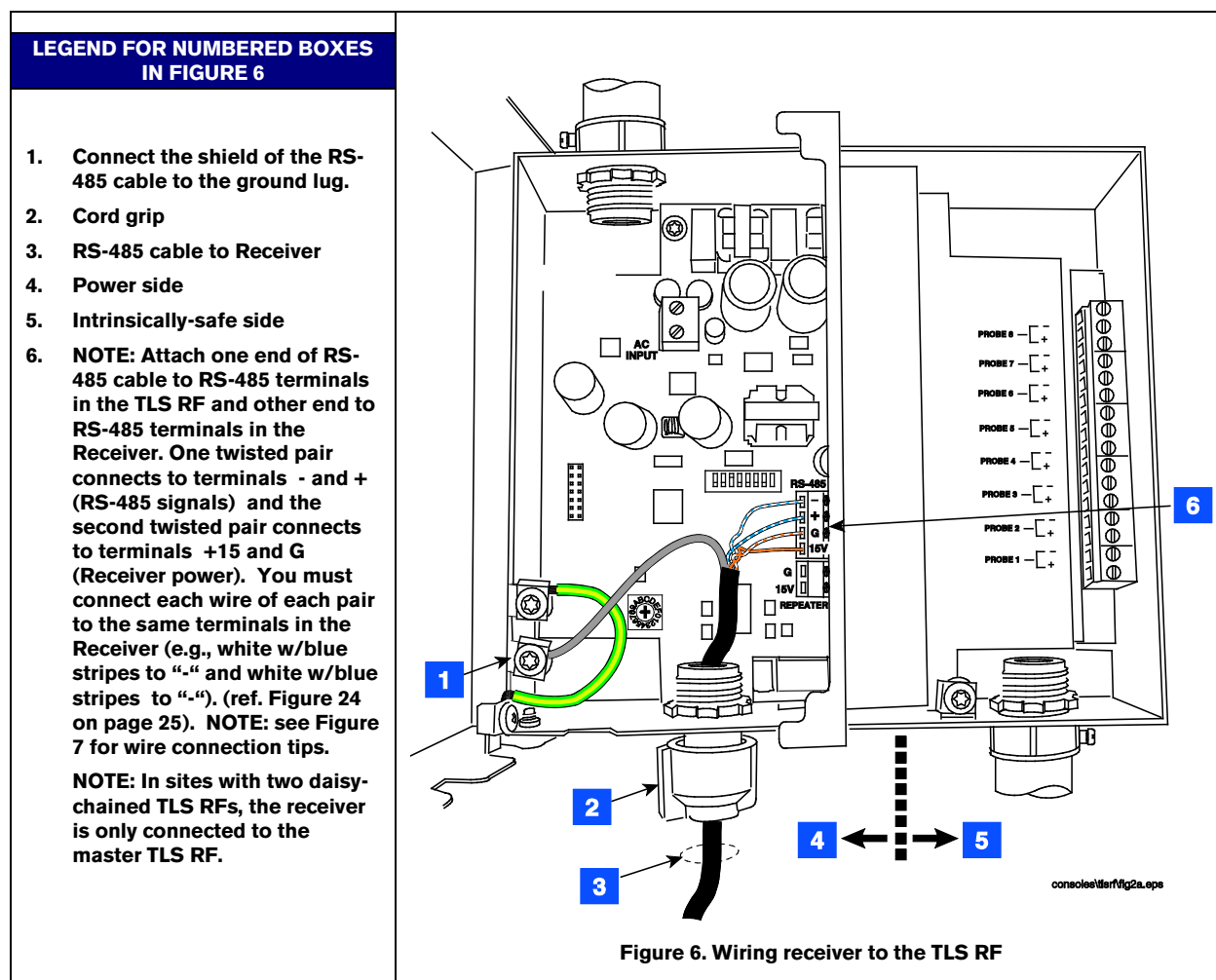


Figure 5. Wiring AC power to the TLS RF



**LEGEND FOR NUMBERED BOXES
IN FIGURE 8**

1. **POWER WIRING NOTES:**
 - Barrier ground must be #12 AWG or larger diameter.
 - Check to be sure that the electrical resistance - between the unit ground lug and a known good earth ground is less than 1 ohm.
 - Connect the power supply wires in the power panel to a separate dedicated circuit.
 - Electrical rating power input
 - 120 Vac or 240 Vac, 50/60 Hz, 2 A max.
 - See Figure 3 for actual locations of power conduit knockouts into the unit. Power wiring must enter only in one of these knockouts.
2. AC power input wires (#14 AWG) to AC input terminals.
3. Protective earthing conductor (green and yellow). Attach #12AWG barrier ground wire to ground lug. Ground must be the same as the supply and less than 1.0 ohms to ground.
4. Attach chassis ground wire (#14 AWG) to ground lug.
5. Connect the shield of the RS-485 cable to the ground lug.
6. RS-485 cable from master TLS RF.
7. See Figure 9 for connections.

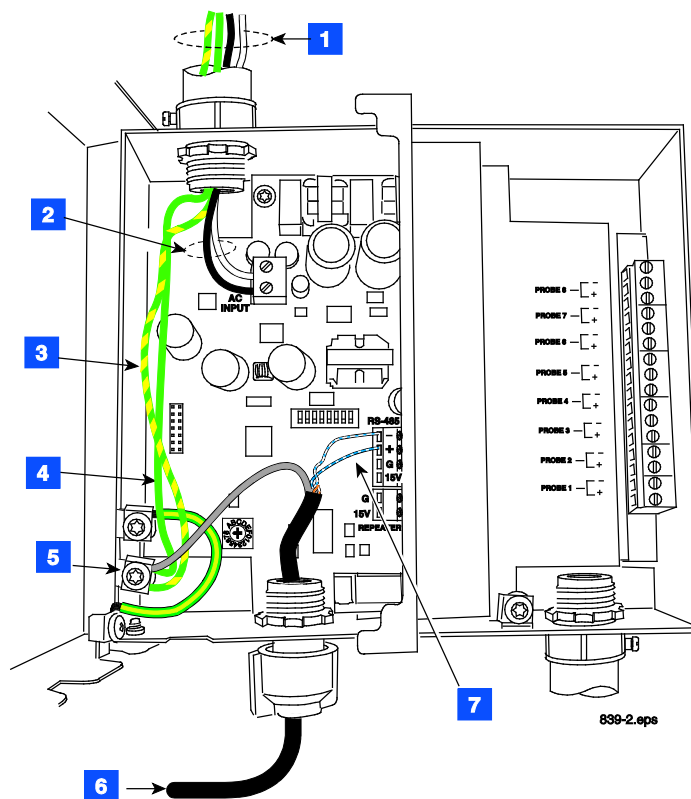


Figure 8. Power connections to a daisy chained TLS RF

FIGURE 9

1. TLS RF Master
2. RS-485 cable to Receiver.
3. RS-485 cable to TLS RF. Cut the unused twisted pair back to the cable's jacket at each end of the cable.
4. TLS RF Auxiliary
5. Connect the shield of the RS-485 cable to the ground lug.
6. Connect like colored wires of the twisted pair to like

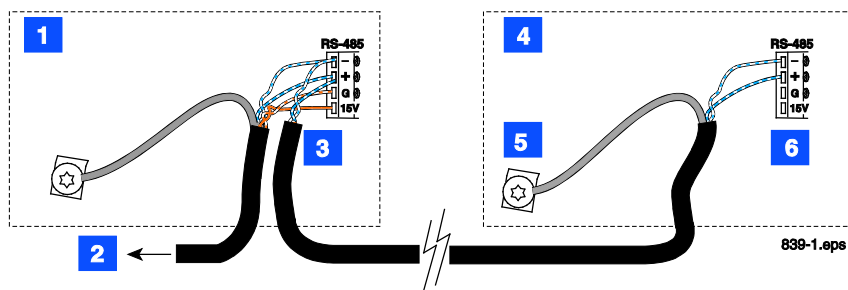
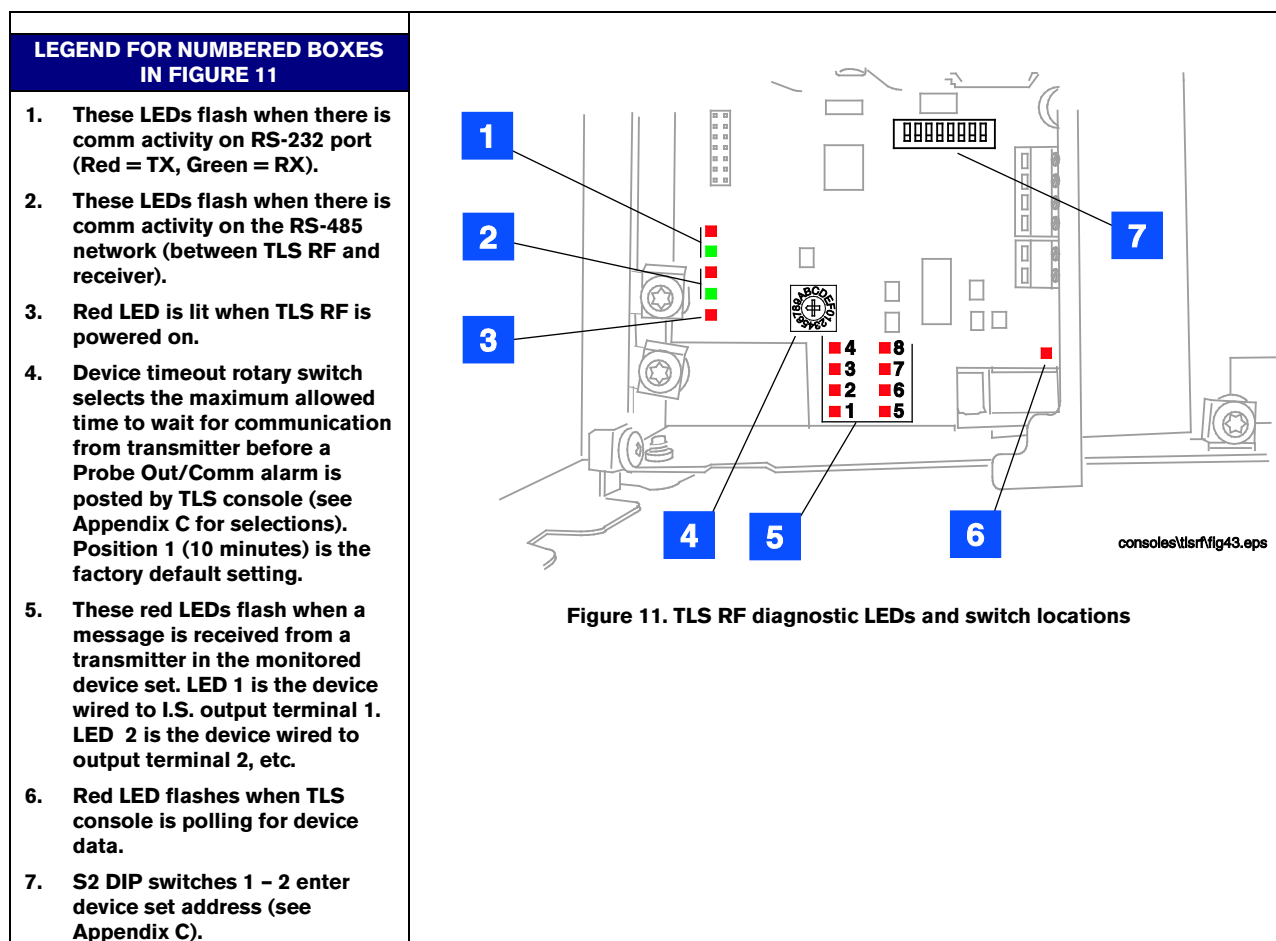


Figure 9. RS-485 cable connections when daisy chaining two TLS RFs



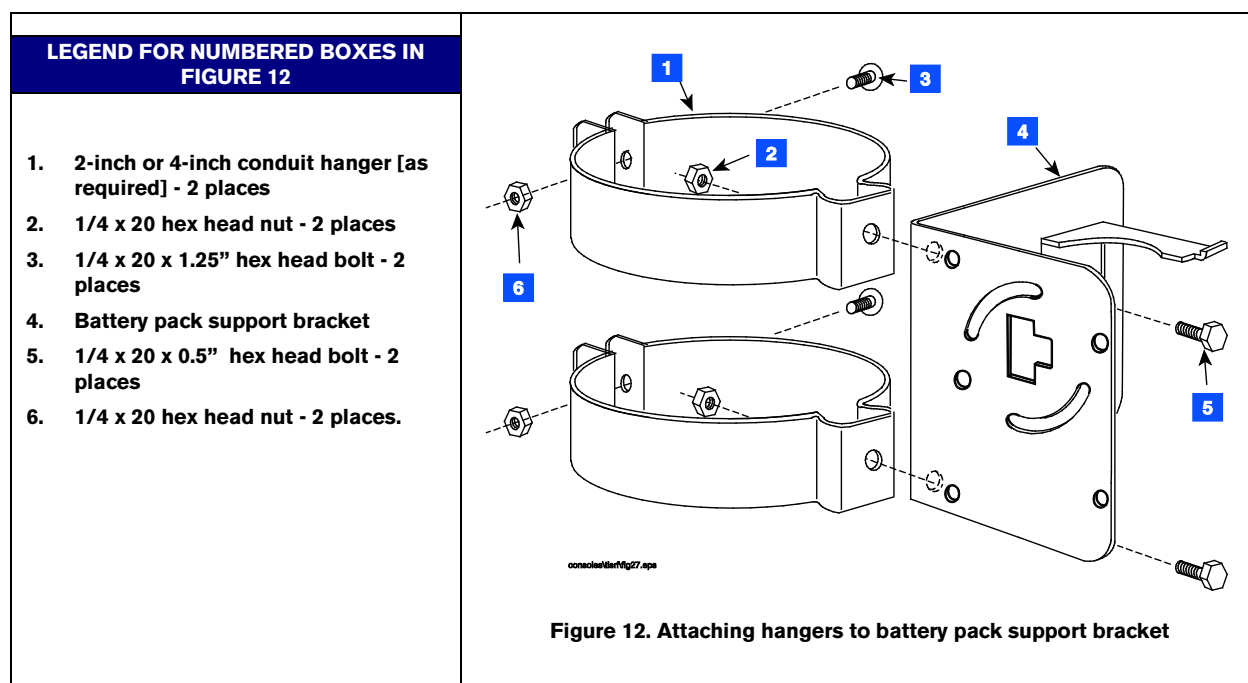
Wireless Component Installation

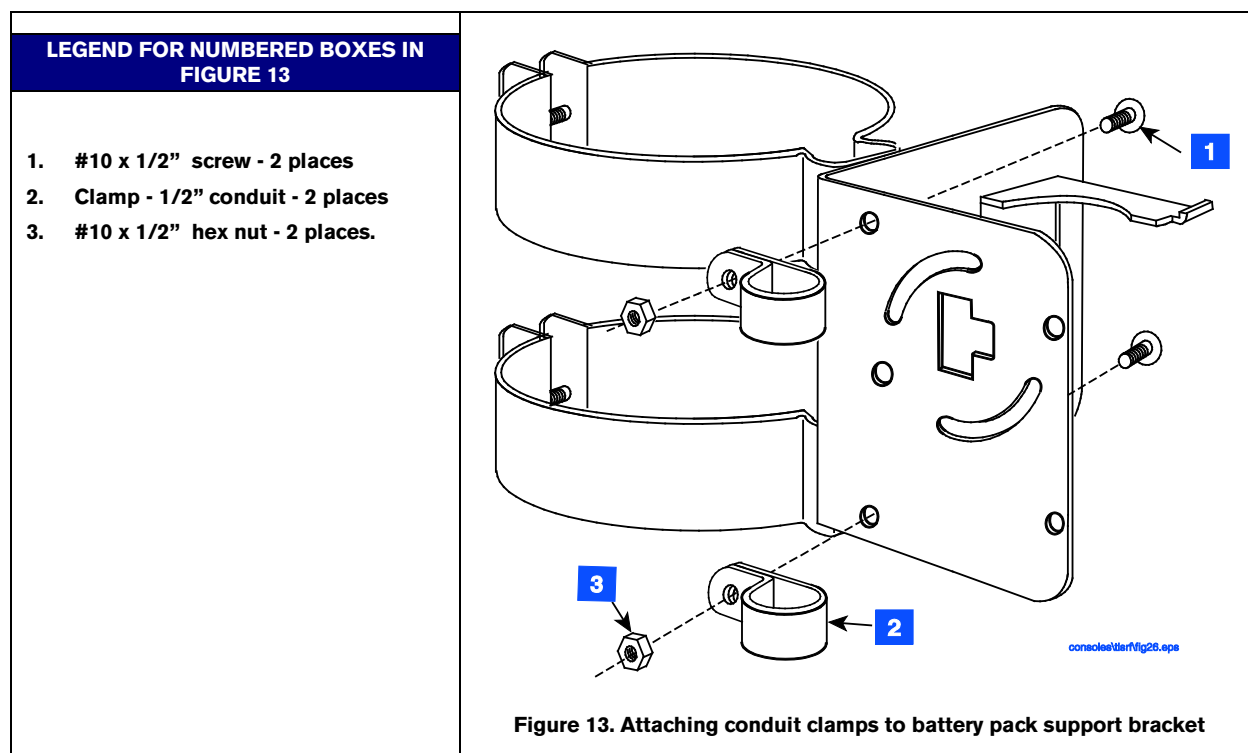
Transmitter Installation

MAG PROBE SUMP

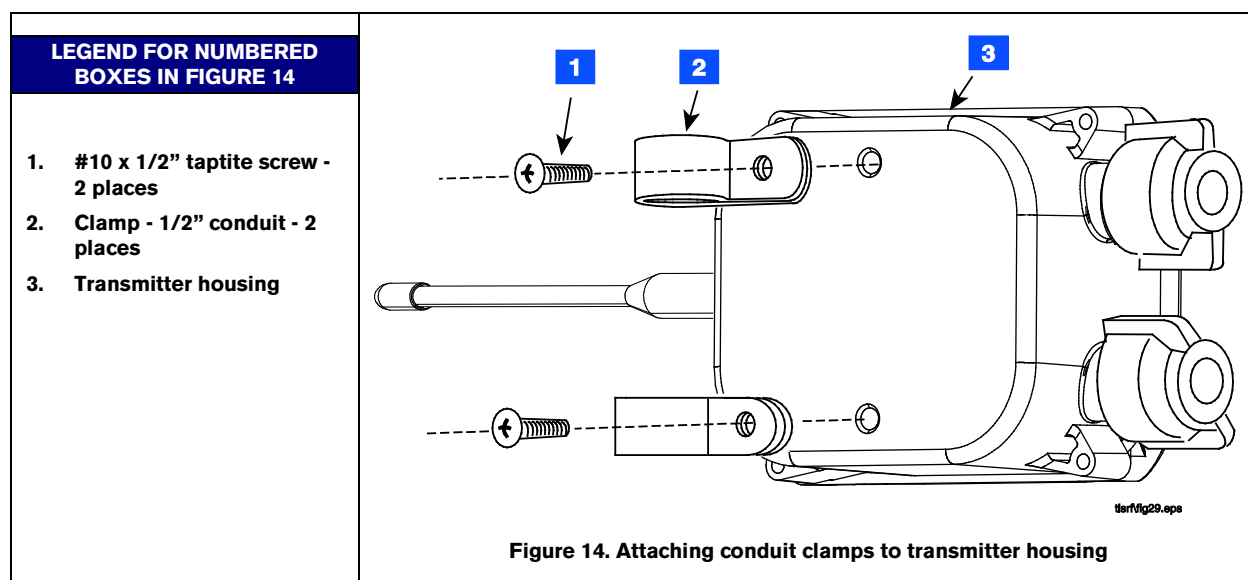
A transmitter / battery pack pair must be installed in every tank's probe/dispenser pan that will be monitored by the TLS RF. Follow the steps below to install the transmitter assembly.

1. Connect the two conduit hangers from the kit (2- or 4-inch as required) to the battery pack support bracket as shown in Figure 12.
2. Attach two conduit clamps to the battery pack support bracket as shown in Figure 13. Do not tighten screws at this time.



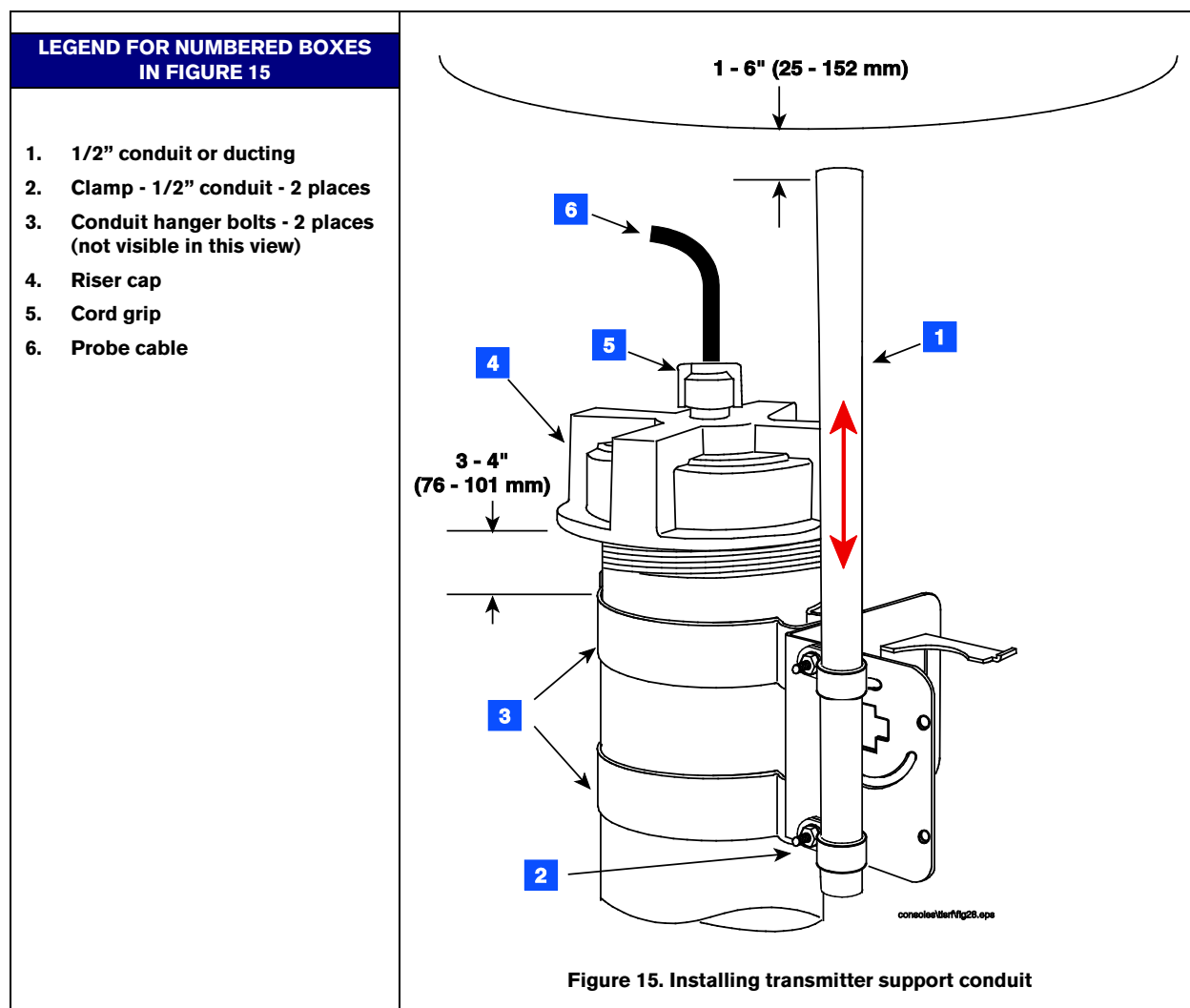


3. Attach two conduit clamps to the transmitter as shown in Figure 14. Do not tighten screws at this time.

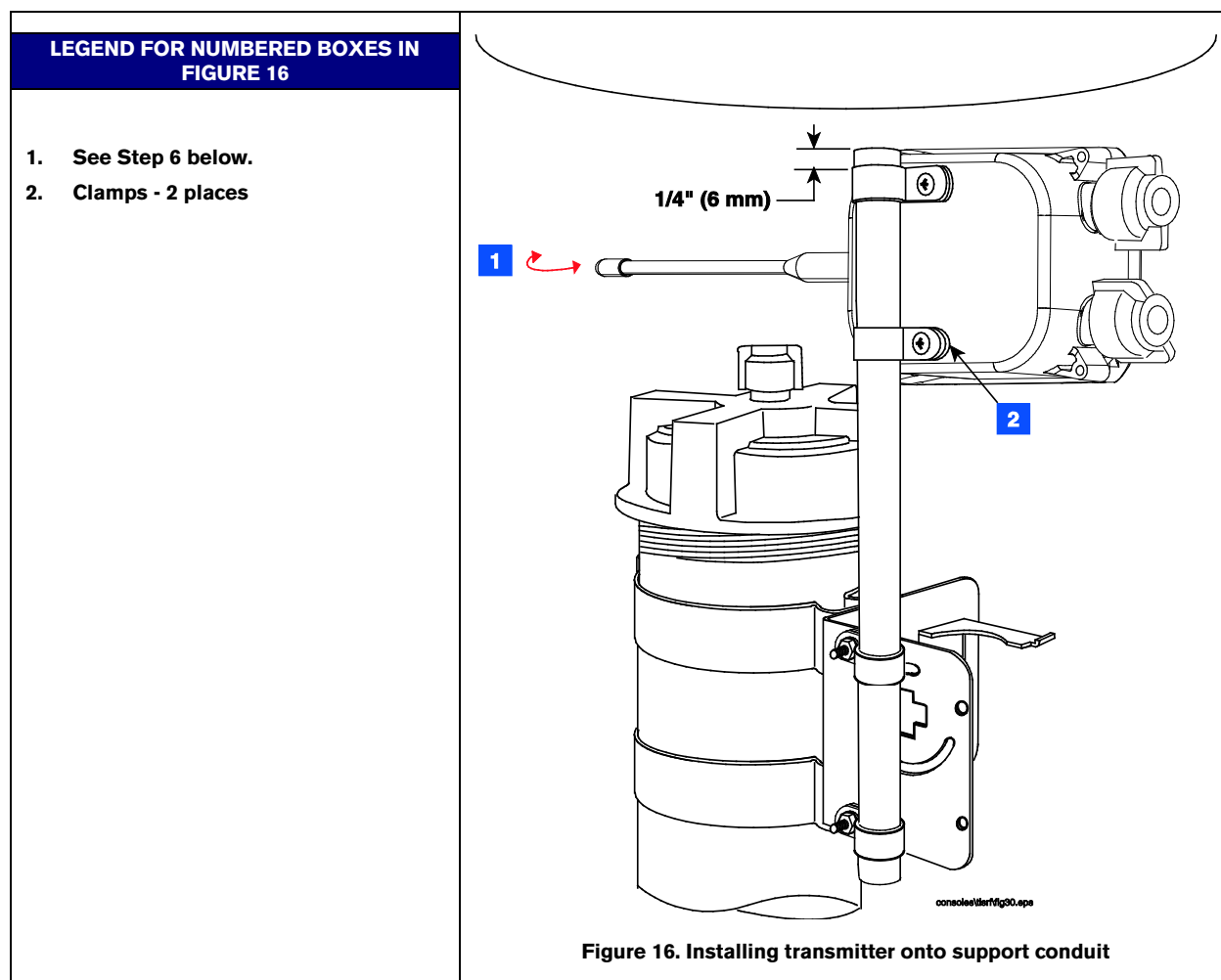


4. Loosen the probe cable cord grip and remove the riser cap. Thread the probe cable through the two conduit hangers as you slide the hanger/bracket assembly onto the riser. Adjust the conduit hangers until the top one is 3 - 4 inches below the top of the riser as shown in Figure 15. Tighten the two conduit

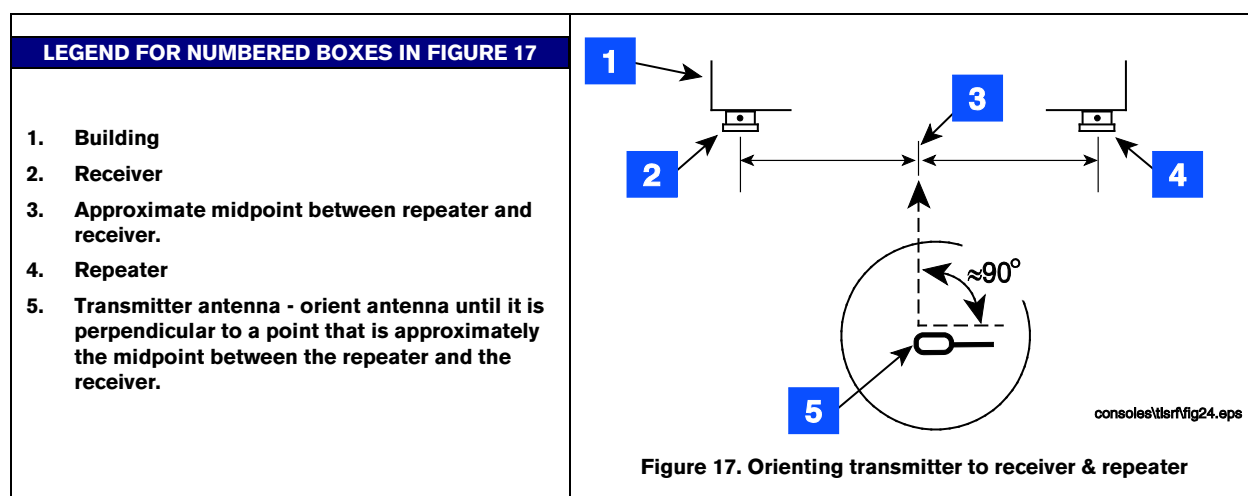
hanger bolts to secure the bracket on the riser. Loosen the cord grip in the top of the riser cap and push the probe cable up through the cord grip and replace the riser cap and tighten the probe cable cord grip. Insert a piece of 1/2-inch conduit or ducting into the loosened conduit clamps in the battery pack support bracket. The conduit can be positioned below the manhole cover from 1 to 6 inches, as required for best signal reception. Place a mark on the conduit above the top clamp. Remove the conduit to a non-hazardous location and cut off the excess length. Push the conduit down through the two clamps until the top clamp is below the mark on the conduit and tighten the two clamps.



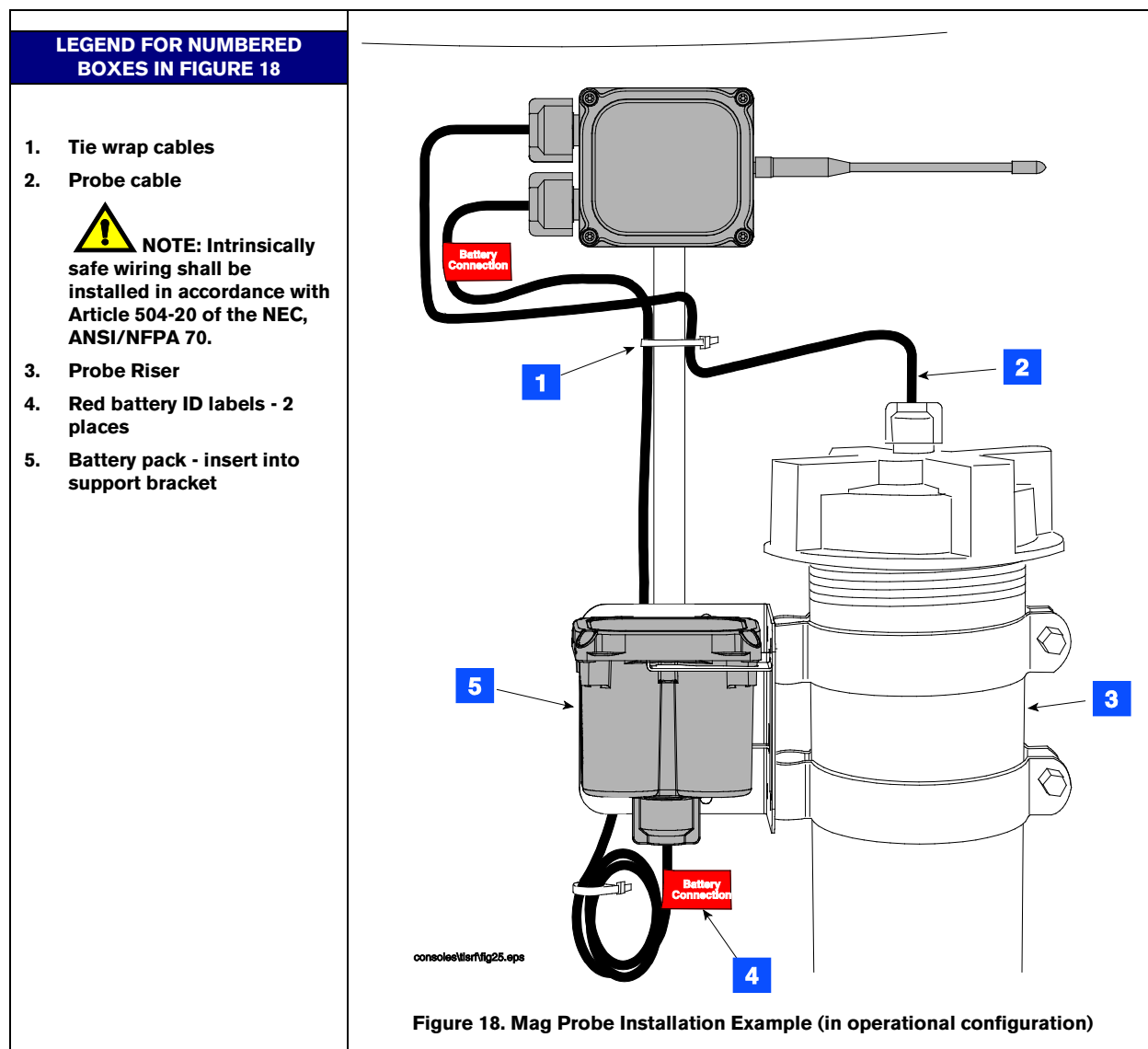
- Loosen the clamps on the back of the transmitter and slide the two clamps down over the conduit as shown in Figure 16. Position the transmitter until the top clamp is about 1/4" below the top of the conduit and tighten the clamps just enough to keep the transmitter from sliding down.



6. Rotate the transmitter until its antenna is oriented relative to the repeater/receiver antennas as shown in Figure 17 and tighten the two clamps on the back of the transmitter.



7. Insert the battery pack into the battery support bracket as shown in Figure 18.
8. Attach power/probe cables as described in the section below entitled "Connecting cables to the Transmitter".



Mag Sump Sensor Installations - STP Sump

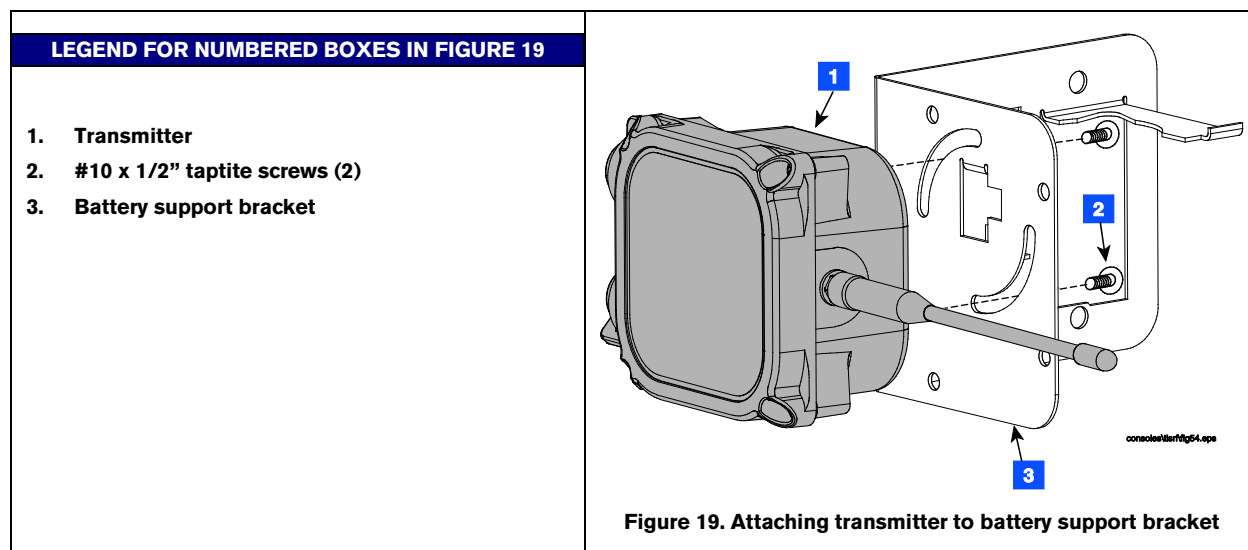
A transmitter/battery pack pair can be installed with a Veeder-Root Mag Sump sensor within the STP sump. The transmitter /battery pack installs similar to the way it installs in probe sumps. The exception is that the support brackets will attach to the pump's 2-inch discharge piping rather than to the STP's 4-inch riser as shown in Figure 18.

Install the Mag Sump sensor using the included universal sensor mounting kit and following the instructions included with the sensor.

Once the sensor/battery pack is installed, attach power/sensor cables as described in the section below entitled "Connecting cables to the Transmitter".

Mag Sump Sensor Installations - Dispenser Pan Sump

1. A transmitter /battery pack pair can be installed with a Veeder-Root Mag Sump sensor within the dispenser sump.
2. Install the Mag Sump sensor in the dispenser's pan area following instructions accompanying the sensor.
3. Using two taptite screws from the kit, attach the transmitter housing to the side of the battery support bracket that has the two circular slots (see Figure 19). Do not tighten screws at this time.
4. Get the 1 inch by 6 inch slotted flat bar from the kit and two 1/4 x 3-inch bolts and two nuts. Clamp the bracket to a section of the square support tubing in the sump, below the shear valve (see Figure 20).
5. Rotate the transmitter antenna as close as possible to a horizontal position then tighten two mounting screws in housing.
6. Insert the battery pack into its support bracket - do not connect battery cable to battery pack at this time.
7. Attach power/sensor cables as described in the section below entitled Connecting cables to the Transmitter.



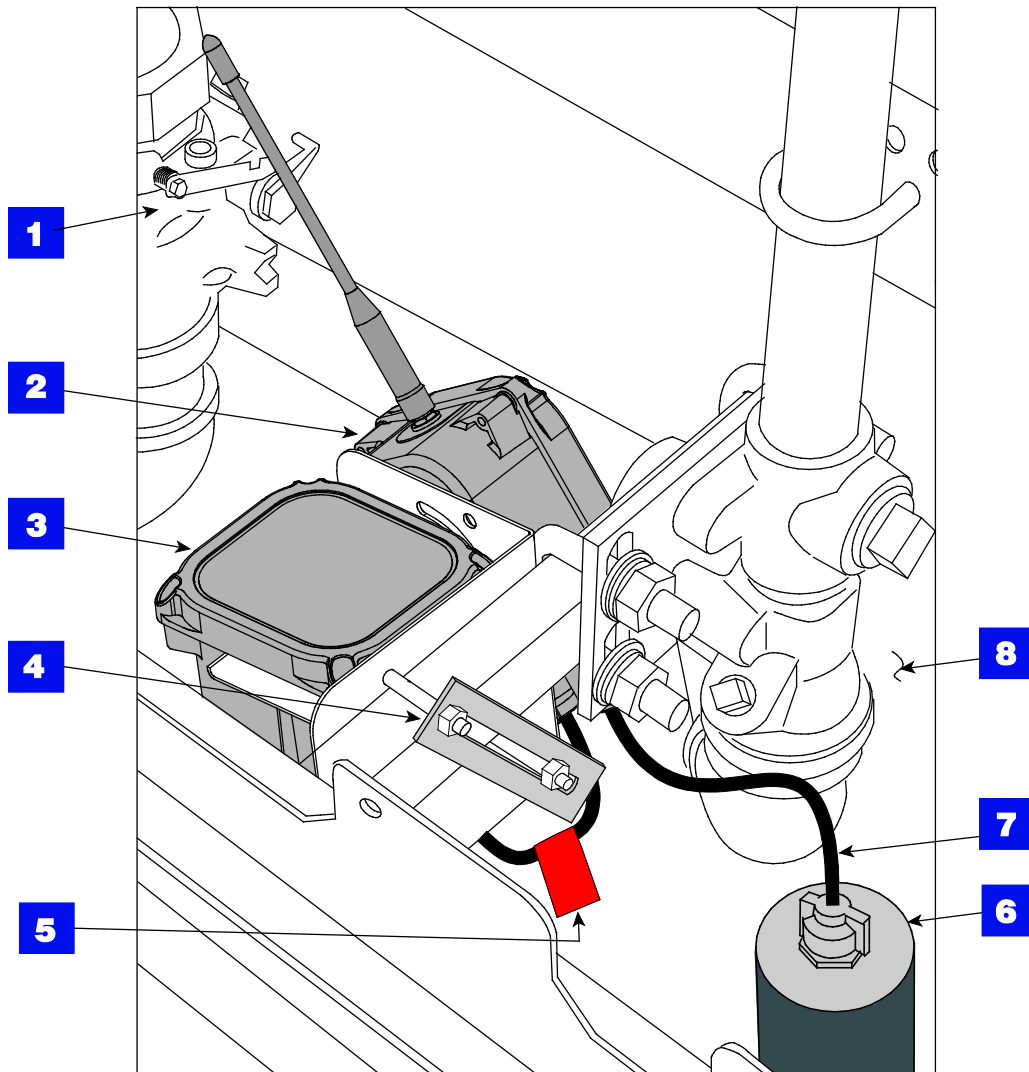


Figure 20. Example transmitter installation in dispenser sump (in operational configuration)

LEGEND FOR NUMBERED BOXES IN FIGURE 20

1. Shear valve
2. Transmitter
3. Battery pack
4. Using 1 x 6 slotted flat bar and two ¼ x 3 bolts from kit, clamp battery support bracket to square tubing support.
5. Battery caution label attached to battery cable (2 places)
6. Dispenser mag sump sensor
7. Sensor cable



NOTE: Intrinsically safe wiring shall be installed in accordance with Article 504-20 of the NEC, ANSI/NFPA 70.

8. Dispenser sump

CONNECTING CABLES TO THE TRANSMITTER

1. Remove the cover of the transmitter and set it aside. Make sure the battery/dc power cable is not connected to the battery pack or dc power source at this time.
2. Push the probe/sensor cable through the left cord grip bushing and the battery cable through the right cord grip (see Figure 21). Strip the cable leads as shown in Figure 22.

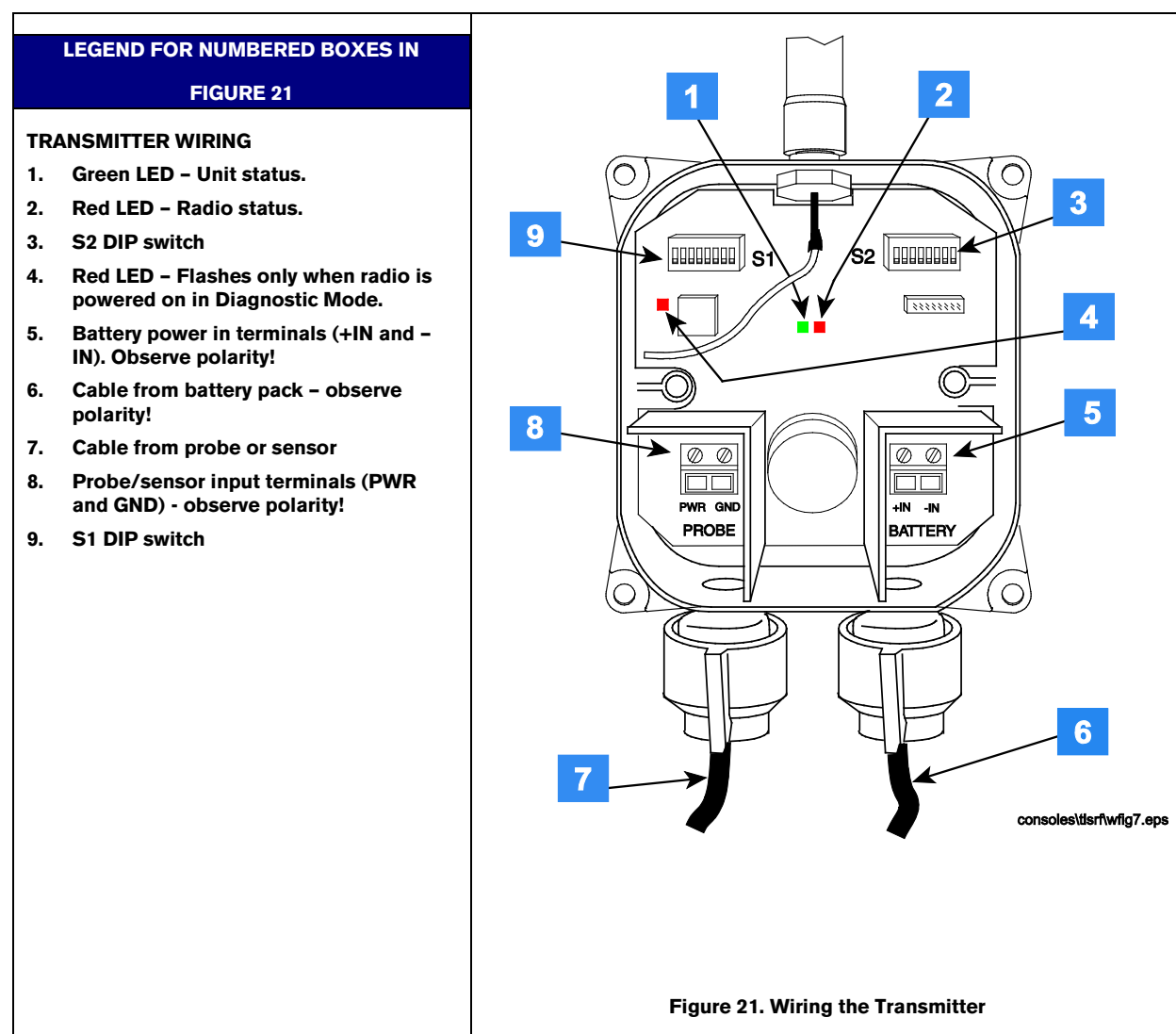


⚠ WARNING! To prevent ignition of flammable or combustible atmosphere disconnect power before servicing.

3. Set S1 and S2 DIP switches as desired (ref. Appendix C).
4. Connect the Mag probe/Mag Sump sensor cable to the PROBE terminal block (white to PWR and black to GND) and the battery pack/dc power cable to the BATTERY terminal block (white to +IN and black to -IN) as shown in Figure 21.



5.  **Hand tighten both cable entry cord grip nuts to prevent water entry!**



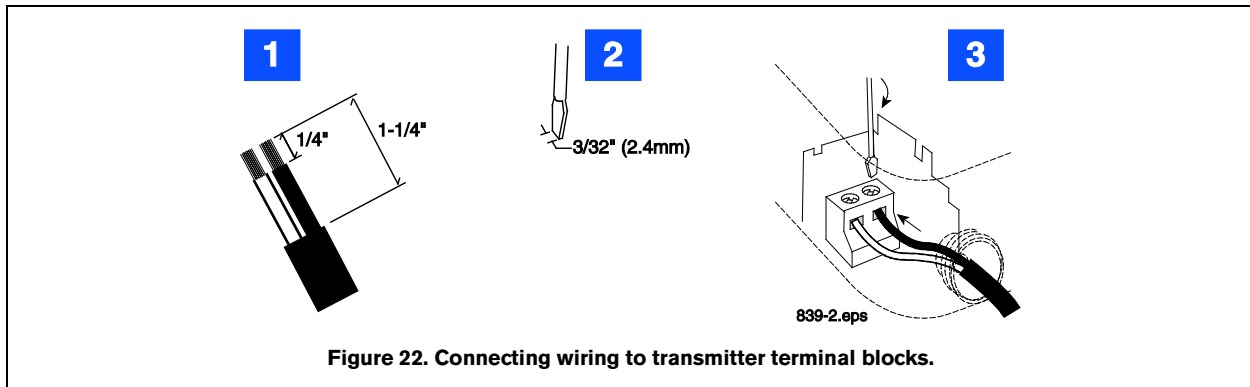


Figure 22. Connecting wiring to transmitter terminal blocks.

LEGEND FOR NUMBERED BOXES IN FIGURE 22

1. Strip back cable and wire jackets the amount shown.
2. Use a screwdriver with the proper blade width
3. Insert the probe cable ends through the housing and into the proper lower openings in the terminal block as you tighten down the retaining screws.



Both wires must be tight in terminals!

6. To assure a water-tight seal between the cover and the enclosure, follow these steps:
 - a. Insert the four cover screws through the cover and then press on the retaining washers to hold the screws in place.
 - b. Make sure that the cover gasket is free of dirt and debris on both sides of the gasket and that the inside of the cover is clean in the gasket area.
 - c. Position the gasket into the cover groove, assuring that it is pressed fully into the groove and sitting completely flat.
 - d. Assemble the cover onto the enclosure, tightening the screws in a couple of turns each. Using an alternating 'X' pattern, continue to tighten the screws until they are all tight.
7. Attach the red battery ID labels from the installation kit to the battery cable at both ends as shown in Figure 18.
8. Refer to the Site Startup Procedure before attaching battery cable to battery pack connector.

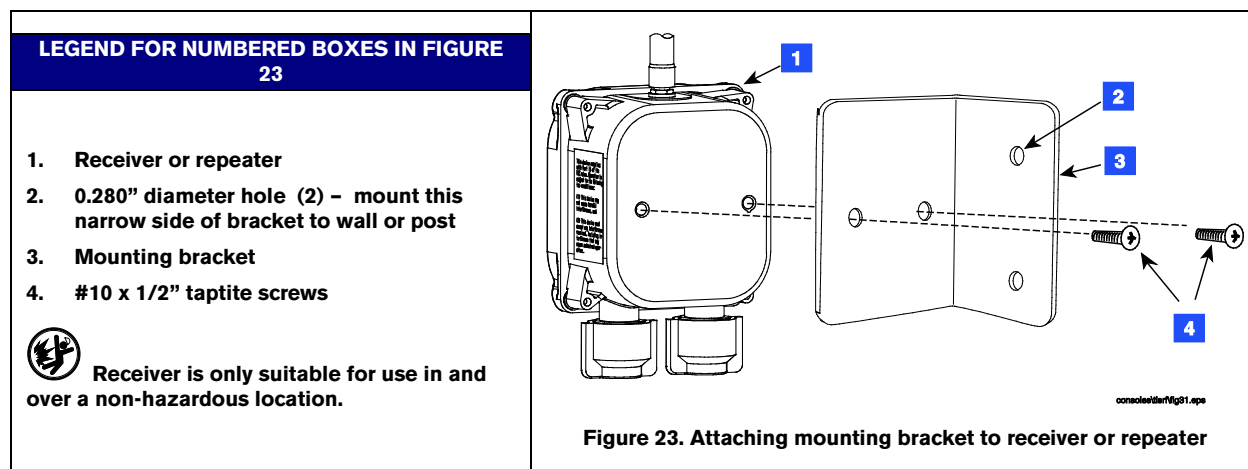
Receiver Installation


1. One receiver is required per site and it is mounted in the vertical position (antenna up) on the outer wall of the same building housing the TLS RF. The receiver is attached to its mounting bracket with #10 x 1/2" tapite screws from its install kit (see Figure 23). The L-bracket is then mounted on the outer wall of the building using appropriate fasteners (customer supplied). NOTE: Locate the receiver on the side of the building facing the tanks to provide an unobstructed signal path. When locating the mounting position, keep in mind that the RS-485 cable connecting the receiver to the TLS RF must be less than 250 feet in length. Avoid placing the receiver near motors (e.g., power roof vents), fluorescent lighting (min. 1 foot separation), pumps, welders.
2. Run the RS-485 cable (Belden #3107A or equiv.) from the TLS RF through the building's wall to the receiver. Caulk the cable where it passes through wall openings. Use cable clamps at appropriate intervals to secure the cable to the walls.

3. Note that the receiver cover label indicates the cord grip to be used for the RS-485 cable from the TLS RF. Loosen that cord grip then remove the cover of the receiver and set it aside.
4. Note that the Receiver cover label indicates the cord grip to be used for the RS-485 cable from the TLS RF and the cable to the Repeater (if used). If you are installing a Repeater in this site, loosen both cord grip nuts, otherwise loosen the TLS RF cord grip, then remove the cover of the Receiver and set it aside.
5. Push the TLS RF RS-485 cable through the loosened cord grip. Strip back the jacket from the end of the cable as shown in Figure 22. Note that there are two twisted pair color-coded wires in the cable (e.g., a white with blue stripe and blue with white stripe pair and a white with orange stripe and orange with white stripe pair).
6. One of the pairs is for RS-485 communication (- & + terminals) and the other pair is for receiver power (+15 Vdc & Gnd). Using Figure 24 as a guide, connect the wires of the two twisted pairs to the RS-485 terminals.

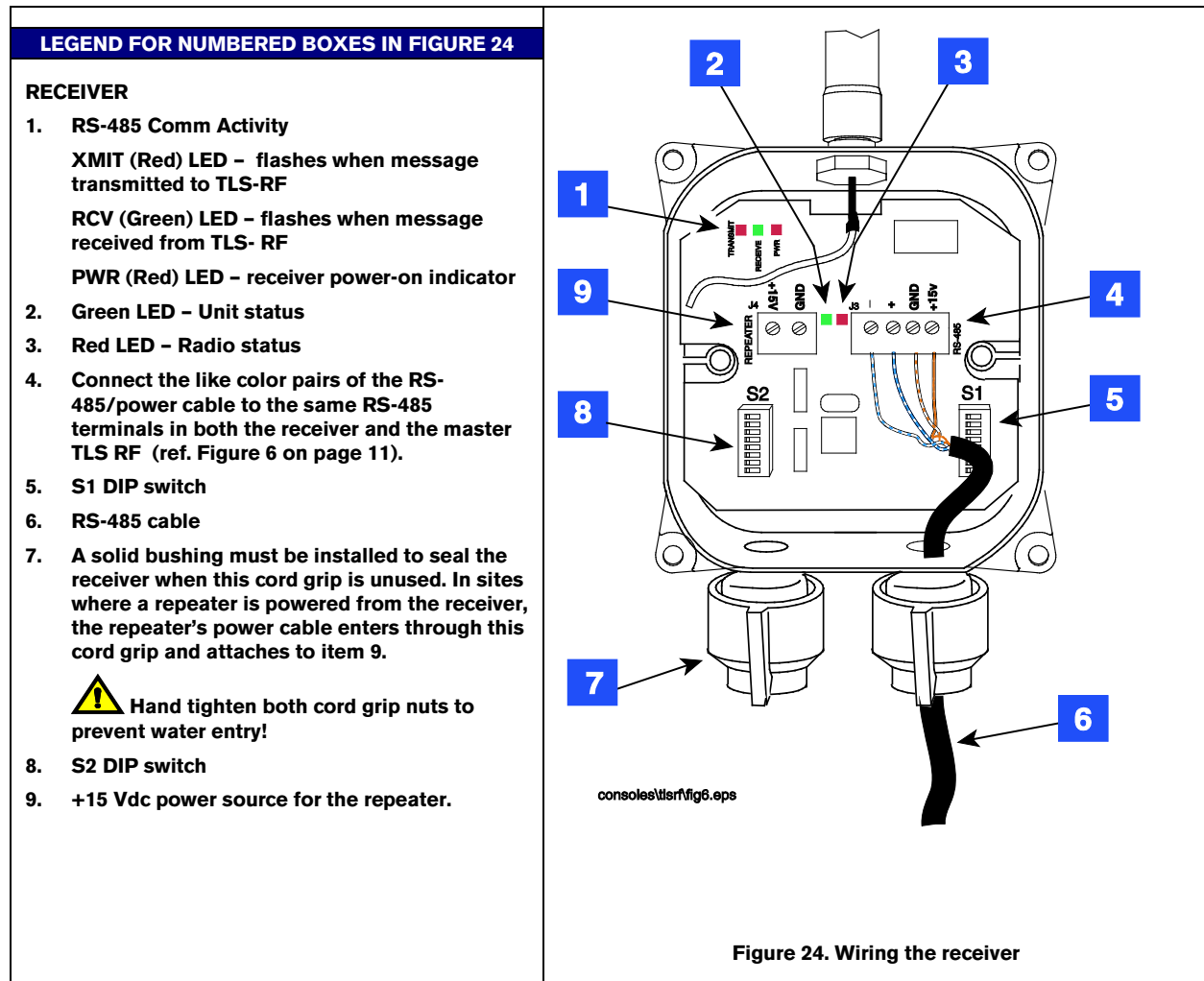
Record which wire attaches to each terminal to help you attach the other end of that wire to the identically marked terminal in the TLS RF.

7. Referring to your connection notes in step 5 above, connect the other end of the RS-485 cable to the RS-485 terminal block in the TLS RF (ref. Figure 6 on page 11).
8. If a Repeater is used and powered by the Receiver, push the two wire power cable (to Repeater) through the +15 Vdc cord grip of the Receiver. Strip back the jacket from the end of the cable as shown in Figure 22. Attach the dc power cable (white to +15 and black to GND) to the Repeater terminal block (item 9 in Figure 24).



9. Set S1 and S2 DIP settings as desired (ref. Appendix C).
10.  **Hand tighten both cord grip nuts to prevent water entry!**
11. To assure a water-tight seal between the cover and the enclosure, follow these steps:
 - a. Insert the four cover screws through the cover and then press on the retaining washers to hold the screws in place.
 - b. Make sure that the cover gasket is free of dirt and debris on both sides of the gasket and that the inside of the cover is clean in the gasket area.
 - c. Position the gasket into the cover groove, assuring that it is pressed fully into the groove and sitting completely flat.

d. Assemble the cover onto the enclosure, tightening the screws in a couple of turns each. Using an alternating 'X' pattern, continue to tighten the screws until they are all tight.



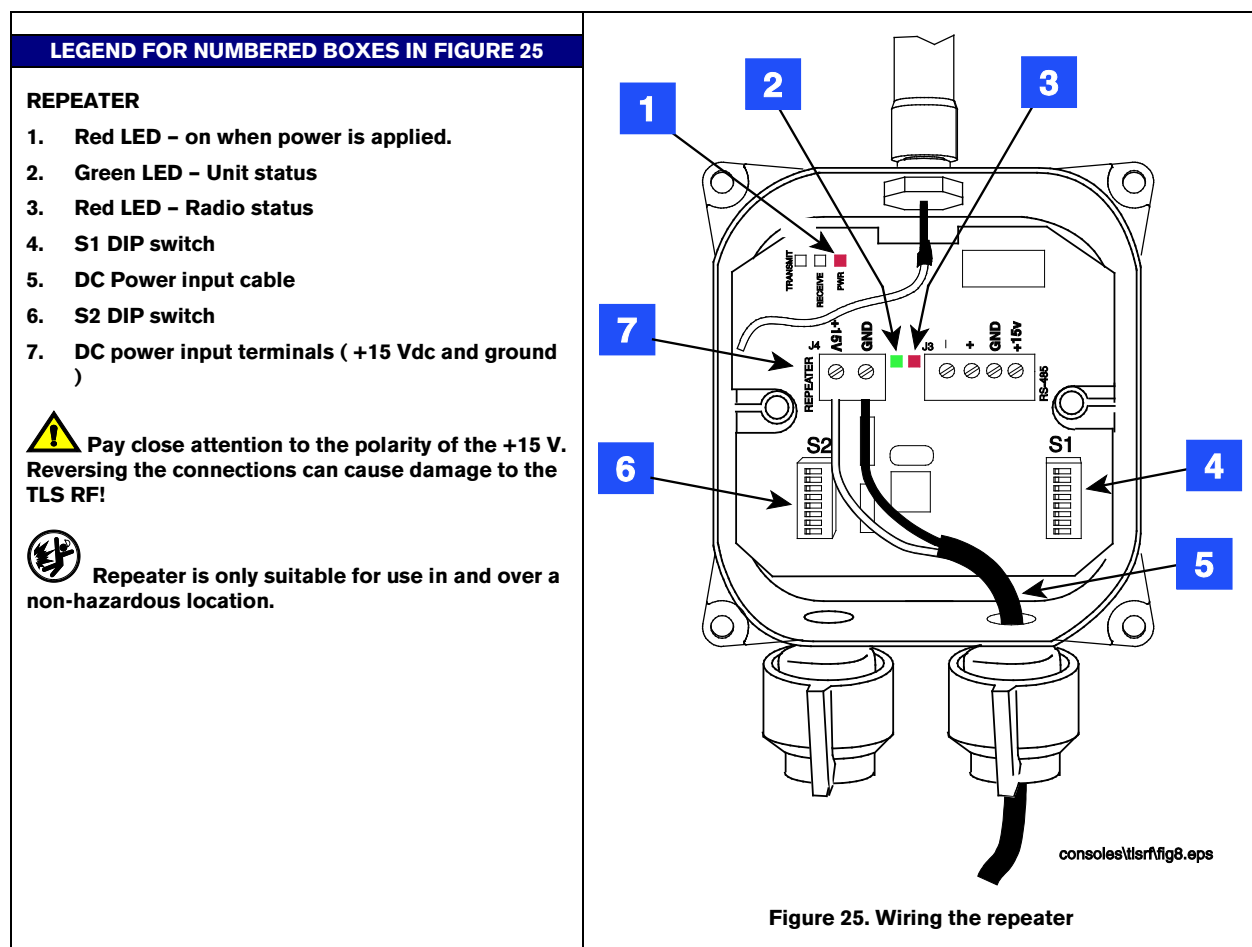
Repeater Installation

- One repeater is installed per site which relays transmitter signals to the site's receiver. The repeater is mounted in a vertical position on same side of the building as the receiver (preferably), and in a direct line of sight with the receiver (ref. Figure 17 on page 18).
- The repeater is attached to its mounting bracket with #10 x 1/2" taptite screws from its install kit (ref. Figure 23 on page 24). The L-bracket is then mounted on the outer wall of the building using appropriate fasteners (customer supplied).
- Note the cover of the repeater indicated the cord grip to be used for the cable connecting the repeater to its dc power source. Loosen the +15 Vdc labeled cord grip, then remove the cover of the repeater and set it aside. Push the 2-wire power cable through the power cable cord grip and into the Repeater.
- Set S1 and S2 as desired (refer to Appendix C).
- Connect the 2-wire dc power cable to the repeater terminal block white to +15 and black to GND (see item 7 in Figure 25).

6. To assure a water-tight seal between the cover and the enclosure, follow these steps:
 - a. Insert the four cover screws through the cover and then press on the retaining washers to hold the screws in place.
 - b. Make sure that the cover gasket is free of dirt and debris on both sides of the gasket and that the inside of the cover is clean in the gasket area.
 - c. Position the gasket into the cover groove, assuring that it is pressed fully into the groove and sitting completely flat.
 - d. Assemble the cover onto the enclosure, tightening the screws in a couple of turns each. Using an alternating 'X' pattern, continue to tighten the screws until they are all tight.

7.  **Hand tighten both cable entry cord grip nuts to prevent water entry!**

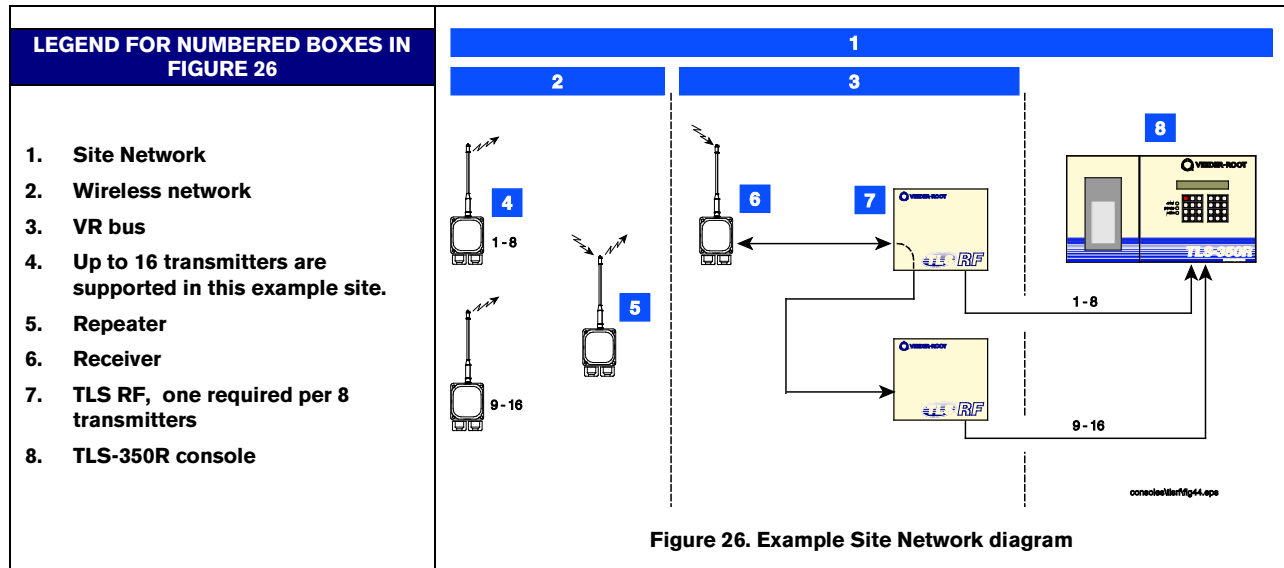
8. The other end of the repeater's dc power cable connects to the receiver's +15 Vdc output terminal (ref. item 9 in Figure 24), or to a non-interruptible, Class 2, 15 Vdc power source.



Network Setup

Hardware Overview

An example TLS RF site network illustrating a 16 transmitter configuration is shown in Figure 26. The maximum number of transmitters permissible in a TLS RF Wireless site is 16 (requires 2 TLS RF units).



NOTE: The device type (i.e., mag probe or mag sump sensor) and quantity permissible in your site's network is dependent on the capabilities of the installed TLS console.

Identifying Devices in the TLS RF Site Network

The Site ID must be identical for all transmitters, the repeater, and the receiver in the site's wireless network.

Each transmitter in the site's wireless network must have a unique device ID number (from 1 – 16)

Each repeater in the site's wireless network must have a unique repeater ID number (from 0 – 15)

The receiver on the site's VR bus must have a unique VR bus address (from 0 – 3).

Each TLS RF in the site's network must have a unique Device Set address (Master at 0 and Auxiliary at 1).

All ID numbers are converted into binary form and entered using DIP switches located in each device.

You must enter the IDs in each device before it is installed.

Create a site network worksheet in which you list each transmitter, its location and its Site ID. Using this worksheet when setting device DIP switches and connecting signal wires will help ensure the TLS console is receiving the intended data transmissions.

Site Startup Procedure

After installing and wiring all equipment, follow the startup steps below.

1. Open the cover of the TLS RF, then power it up. The green/red LEDs indicating RS-485 network activity between the receiver and TLS RF should be flashing rapidly (ref. item 2 in Figure 11 on page 14). If **Yes**, continue to the next step. If **No**, check the red LED. If it is not flashing, replace the TLS RF. If the green LED is not flashing, the receiver is not responding. Go to the receiver and remove its cover. Check the RS-485 wiring connections to verify that each wire of the twisted pairs is connected to the same terminal in the receiver that its other end is connected to in the TLS RF. If the wiring connections are correct, the PWR LED (item 1 in Figure 24) and green LED (item 2 in Figure 24) should be lit. If the PWR LED is lit, but the green LED is not lit, the receiver is inoperative and needs replacing. If the PWR LED is not lit, measure the voltage across the twisted pair power wires, it should be +15 Vdc. To isolate a faulty cable, measure the voltage across the +15 and GND terminals of the RS-485 terminal strip in the TLS RF (ref. Figure 6 on page 11). Replace the cable, TLS RF, or receiver as necessary.
2. Referencing your site network worksheet, go to the first transmitter and connect its power cable to the battery pack. This will put the transmitter into the continuous mode, 'forcing' it to transmit every 6 seconds for 30 minutes (default).
3. At the TLS RF, you should see one of the 8 red transmission received LEDs flashing every 6 seconds, indicating receipt of each transmission from the transmitter (item 5 in Figure 11 on page 14). If yes, record on your site network worksheet which number LED is flashing for this transmitter and then go to step 3a. If one of the LEDs is not flashing, go to step 3b.
 - a. Go back to the transmitter and replace the sump lid, or if a dispenser, close the sump's access cover. Return to the TLS RF and verify that the same LED continues to flash every 6 seconds. If yes, the receiver is continuing to communicate with the transmitter after the manhole cover or other obstruction was replaced. Go back to the same transmitter, remove the manhole cover and disconnect the power cable from the battery pack and continue to step 4. If the LED is not flashing every 6 seconds, the receiver is not picking up the transmitter's signal. Return to the transmitter and remove the obstruction. Referring to your site network worksheet, verify that the correct Site ID is entered. Verify that the transmitter's antenna is oriented to the receiver as shown in Figure 17 on page 18, if it is move it around and recheck at the TLS RF to see if the new position helps. Replace the obstruction and recheck the LED in the TLS RF. If it is not flashing, try moving the transmitter down in the sump, then replace the obstruction and recheck the LED in the TLS RF. If reorienting the antenna or moving the transmitter doesn't help, make a note on your worksheet that the signal from this transmitter is not being received, disconnect the transmitter power cable at the battery pack, and continue to Step 4.
 - b. Remove the cover of the problem transmitter. The green LED (item 1 in Figure 21 on page 22) should flash indicating that the probe is being read. The red LED should also flash indicating the transmitter linked with the receiver and transmitted the probe's data. This green/red flash sequence should occur every 6 seconds while the transmitter is in continuous mode. If there is no green flash, check the probe cable's wiring connections. If the green LED flashes every 6 seconds, but the red LED doesn't flash, then the transmitter is reading the probe data, but for some reason is not linking with, and transmitting to the receiver. However, you will have to wait until you check additional transmitters before determining that the receiver is not functioning correctly. If the green LED is blinking quickly (about a tenth of a second) every 6 seconds, it can mean one of several probe errors depending on the number of blinks. Before continuing to step 4, disconnect the transmitter power cable at the battery pack.

4. Repeat Steps 2 and 3 for each of the remaining transmitters. As you power up each of the remaining transmitters and check their reception at the TLS RF, make notes on your site network worksheet as to whether the transmitter signals are being received successfully, which one of the 8 red transmission received LEDs in the TLS RF is flashing every 6 seconds, probe problems, etc., for later troubleshooting.
5. If each transmitter is being received at the TLS RF(s), go around to each transmitter, reconnect the transmitter's power cable to the battery, and replace the sump or dispenser cover as appropriate. Go to the TLS console and configure all site probes and mag sump sensors. Check for any probe out/comm alarms. If none are observed, the startup is complete.

If some transmitters are not being received at the TLS RF, you will have to install additional repeaters as necessary. The repeater requires a Class 2, 15 Vdc power source.

Troubleshooting

Antenna Propagation Basics

The Veeder-Root TLS RF Wireless site consists of one Master (Receiver) and one or more Slave units (Transmitters/Repeaters) and uses the Frequency Hopping Spread Spectrum (FHSS) method of signal transmission in which each transceiver is programmed to follow a set of channels called the 'Hopset'. Federal Communication Commission (FCC) regulations state that for FHSS: each transceiver may dwell on any given frequency in the Hopset for no more than 400 milliseconds in any 30 second period. Authorized channel bandwidth is 1 MHz and channel spacing is 25 kHz.

The propagation of radio waves in FHSS applications, i.e., the TLS RF Wireless System, is influenced by several factors:

ANTENNA OPERATION

The antenna is a *transducer*, which converts radio frequency electrical energy fed to it (via the transmission line) to an electromagnetic wave propagated into space. Assuming that the operating frequency in both cases is the same, as in the TLS RF Wireless System, *this process is reciprocal in nature - the antenna will perform identically in Transmit or Receive mode*. The same Antenna and Transmission Line path is used for both transmit and receive functions.

FREE SPACE LOSS

Signal power is diminished by geometric spreading of the wavefront, commonly known as Free Space Loss (FSL). For TLS Wireless sites having relatively small distances between the Receiver and Transmitters, FSL is not an issue.

ATTENUATION

When the RF signal passes through solid objects, some of the signal power is absorbed. The most convenient way to express this is by adding an "allowed loss" to the Free Space loss. Attenuation can vary greatly depending upon the structure of the object the signal is passing through. Metal in the barrier greatly increases the attenuation. Thickness also increases the loss. General rules of thumb for attenuation are:

- Trees account for 10 to 20 dB of loss per tree in the direct path. Loss depends upon the size and type of tree. Large trees with dense foliage create greater loss.
- Walls account for 10 to 15 dB depending upon the construction. Interior walls are on the low end and exterior walls, especially those with stucco, create more loss.
- Floors of buildings account for 12 to 27 dB of loss. Floors with concrete and steel are at the high end and wood floors are at the low end.
- Mirrored walls have very high loss because the reflective coating is conductive.

SCATTERING

RF signals can reflect off of many things and the direct signal combines with signals that have reflected off of objects that are not in the direct path. This effect is usually described as multipath, fading, Rayleigh fading or signal dispersion. When RF signals combine they can be distorted. The distortion degrades the ability the receiver to recover the signal in a manner much like signal loss.

RADIO LINE OF SIGHT

Radio Line of Sight (LOS) refers to the ability of the receiver to 'see' the transmitter. In TLS RF Wireless sites, the preferred positioning of the Receiver is one that is visible from the Transmitter's location. When Radio line of sight is impossible, e.g., tanks are on opposite sides of the building, a Repeater should be installed that is positioned at a point that is both visible from the Transmitter and from the Receiver.

ANTENNA POLARIZATION

Polarized omni-directional antennas (used in the TLS Wireless System) are subject to severe pattern distortion in the direction of their mounting (vertically or horizontally). For this reason, the TLS RF Wireless System Receiver's antenna must be mounted vertically and the Transmitter's antenna mounted horizontally (90 degrees apart).

INTERFERENCE

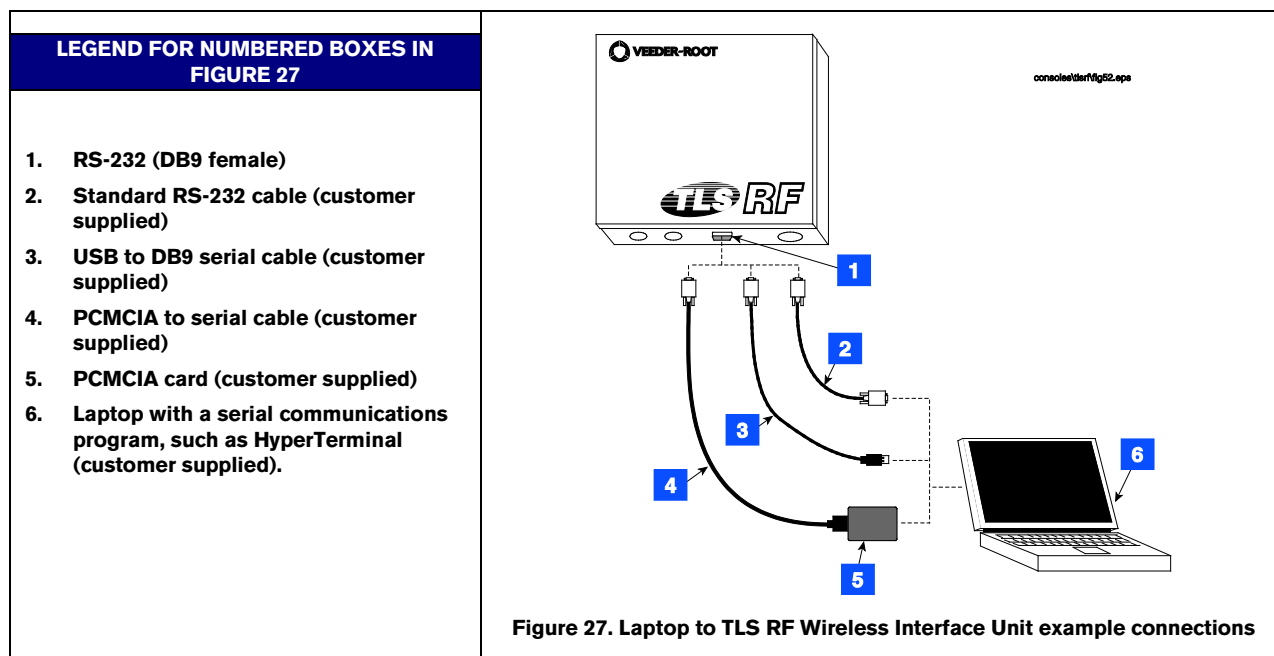
Interference may be caused by several possible sources:

- In-band signals originating from other systems
- Reflections, multipath
- Receiver front-end overload, produced by adjacent transmitters such as a microwave tower, etc.

The nature of Frequency Hopping Spread Spectrum systems is such that interference would tend to degrade throughput, rather than cause the cessation of link operation. Even in such instances, the inherent immunity to interference provides that extra margin of safety. When all antenna orientation possibilities are tried and one or more transmitters still cannot be received, additional repeater(s) will have to be installed.

Probe Troubleshooting

1. Attach your laptop to the TLS RF's RS-232 serial port (see Figure 27).



Open a serial communications program, such as HyperTerminal (available in Windows under Start\Programs\Accessories\Communications). Set the comm port settings to: 9600 Baud, 8 data bits, no parity, 1 stop bit.

2. Perform the following steps on a PC with the HyperTerminal application program running. TLS commands are case sensitive and use a Control-A to identify the start of a command. Enter a Control-A by holding the Ctrl key down while pressing the A key, then release the Ctrl key. Next, type in the command, I31500 and click on the SEND button. An example of the 315 command response in a site with 8 transmitters is shown below.

```
I31500
SMART DEVICE STATUS
```

DEV	TXID	STATE	REASON	TYPE	S/N	TOTL COMMS	REPT COMMS	LAST COMM
01	01	OK		PROBE	999553	161	80	0000:00:00:03
02	02	OUT	NO_DATA	PROBE	999569	0	0	9999:99:99:99
03	03	OUT	TIMEOUT	PROBE	999503	0	0	0000:13:21:13
04	04	OUT	NO_READ	MAGSN	999023	360	180	0000:00:00:01
05	05	OUT	NO_CNST	?????	000000	0	0	9999:99:99:99
06	06	OUT	NO_CNST	?????	000000	0	0	9999:99:99:99
07	07	OUT	NO_CNST	?????	000000	0	0	9999:99:99:99
08	08	OUT	NO_CNST	?????	000000	0	0	9999:99:99:99

NOTE: MAG SN = Mag Sump Sensor

DEV column

The TLS RF supports 8 devices (Mag probes or Mag Sump sensors), numbered 01 thru 08. The device number corresponds to its I.S. data-out terminal wiring position on the TLS RF unit.

TXID Column

A site's wireless system can support up to 16 transmitters and each must have a unique ID. This column shows the ID that was set in the transmitter when it was installed.

STATE Column

The device state is OK or OUT. When the state is OUT, the TLS RF unit will not respond to the TLS console polling for this device. The OUT state will cause the TLS console to post a Probe-Out or Comm alarm for this device.

REASON Column

There are four reasons for a device to have an OUT state:

NO_CNST

In order to conserve energy the transmitter sends messages in 3 groups: constant data, fuel/water data, and fuel/water/temperature data.

For a given sensor, constant data never changes so it only needs to be transmitted once. It is however transmitted for two-minutes following transmitter power-up, or the triggering of its service switch (magnetically activated reed switch) and then settles down to once every 4-hours. The TLS RF unit will store the constants in non-volatile memory so that the constant data can be restored after a power cycle. The status of a device will be OUT if the constant data has not been received (NO_CNST).

NO_DATA

Fuel/Water data is transmitted at different rates depending on activity and power-up/service switch status. The maximum transmission period is 2-minutes, the minimum 5-seconds.

Temperature does not have to be read as often as fuel/water data. It is transmitted once every 2 minutes along with the fuel/water data. The status of a device will be OUT if it has not received fuel/water/temperature data (NO_DATA).

TIMEOUT

If no transmissions are received for the timeout duration programmed in the TLS RF unit, the device OUT status's reason will be set to TIMEOUT. This state overrides all other states.

NO_READ

The transmitter can detect when a device is not responding correctly. In this case the transmitter will transmit a device-out message. In turn the TLS RF will set the status of a device to OUT (NO_READ).

On power-up the TLS RF unit will read its non-volatile memory to restore constant data. If the constant data is available it will then set the device to the OUT condition with the reason code: NO_DATA. When fuel/water level and temperature data are received the NO_DATA condition will be removed and the device will be set to the OK status. If there is no constant data the device OUT reason code will be NO_CNST. The device will be removed from this state when constant and fuel/water/temperature data are received. If no transmissions are being received from the device the TIMEOUT reason code will replace the previous reason code.

TYPE and SN Columns

If the device constants are available, the device type and device serial number will be placed in these columns. If the constants are not available the type column will be filled in with '?????' and the serial column with all zeros (000000).

TOTL COMMS

A running total of all messages received from this device. This includes messages that were repeated by a repeater(s).

REPT COMMS Column

This column displays a running total of all messages received from this device that were repeated from a repeater. Subtracting the repeated total from the total comms value will result in the total number of direct messages received: $\text{Total Direct Messages} = \text{TOTL COMMS} - \text{REPT COMMS}$.

LAST COMM Column

This column displays the duration since the last message received from this device. Display is in days:hours:minutes:seconds format. The 9999:99:99:99 time indicates no messages have been received since the TLS RF unit has been powered on.

Resetting Data in the TLS RF Unit

NOTE: The data is reset when the TLS RF unit is power cycled or reset with the serial command S001 (except Constants which are stored in flash memory).

It is also possible to reset the Total and Repeater Comms totals remotely with the following command: S315ss149.

Appendix A: Site Survey for Wireless Probes

OBJECTIVE

The objective of the site survey are:-

- To acquire information that will ensure that all the items necessary to complete the installation are ordered and supplied.
- To establish where the system assemblies will be best located, so that this information can be passed on to the installation team.
- To establish any site conditions or anomalies that will affect the installation
- Ultimately to ensure the completed installation is of the required high standard

METHOD

A trained person certified by GVR should undertake the site survey: this person will collect the necessary information and then submit this information in a specified format.

Instructions to Survey Engineer

OBJECTIVE

The Survey engineer needs to provide accurate site information so that when the System is installed and commissioned it will function reliably, and meet the requirements of the customer.

METHOD

The need for a survey will be triggered by a sales enquiry: The surveyor will require the following basic information:-

- Site name and address.
- Customer
- Telephone number
- Gauge type
- Number of tanks to be gauged
- Additional sensors
- Special instructions

Completion of Site Survey Form

OBJECTIVE

The aim of the survey sheets (or PC software) is to record data collected at the time of the survey to enable correct equipment specification, identify all works necessary before the installation date, special tools or equipment required for installation, and site specific data required for a successful commissioning.

METHOD

Take all details and measurements necessary to complete the site survey.

The form has to be completed in the same format by all surveyors. This is so that when or orders are placed with the local distributor the administrator will understand clearly the information on the survey, and will be able to compile an accurate parts list.

Note: The local installer will be responsible for the labor element and any locally supplied parts, the survey should provide enough information for them to be able to do this successfully.

Key Information

SURVEYORS DETAILS

- Name of surveyor
- Company
- Date of survey
- Name/address/telephone number of installation company

GENERAL SITE DETAILS

- Site name and address (include country and local postcode)
- Telephone number (s)
- Site contact name
- Oil company (or group company name)

TANK INFORMATION

- Number of tanks to be monitored
- No of any tanks not to be monitored
- State available probe entry size for each tank
- Check that there are no internal obstructions to the probe
- Determine the tank diameter (height) and probe length required
- Identify any tank lid that has no entry and advise action required
- Note product type of each tank
- Note SWC's for each tank
- Note max tank capacity of each tank if available (e.g. dipstick top mark or dipchart)
- State whether the tank is single tank, and indicate the end shape if known
- State if the tank is siphon or line manifolded
- Indicate the number of lids on the tank
- Indicate if the tank has a STP fitted
- State whether the tank is single or double wall
- State the material the tank is made of

- If double walled, does it have a leak monitoring device fitted, or are we to provide same
- State whether the tank is direct fill or offset fill
- State the approximate age of the tank

MANHOLE CHAMBER INFORMATION

- Manhole construction
 - Shape (circular, square etc.)
 - Wall material (concrete, etc.)
 - Wall profile (smooth, ribbed)
- Manhole depth (Underside of cover to top surface of lid)
- Indicate if the manhole is less than 18 inches in depth
- Lid material
- Ease of removal (Two-man, special lifter required etc.)
- Accessibility (any restrictions?)
- Vehicle parking (are vehicles regularly parked for long periods)

PROBE RISER SPECIFICATION

- Fittings required to adapt a 2" riser to the riser entry orifice
- Max allowable riser length (formula = manhole depth – [transmitter unit height – 3 inches])

PROBE TRANSMITTER CONSIDERATIONS

- The transmitter needs to be installed towards the centre of the manhole chamber, away from metal edges.
- They should be installed as high up in the chamber as possible, but no closer than 1 inch from the cover.
- Manholes that have vehicles parked over them for any length of time should be avoided.
- The antenna will need to be horizontal and bisecting the angle between the receiver and the repeater
- The most suitable type of fixing bracket will need to be specified for each manhole.

TLS CONSOLE

State the pre-specified location for the TLS and indicate this on your site plan. Note: If the position for the new TLS has not been specified the Survey engineer should advise and agree with the customer the most suitable location for the console. (Note to survey compiler: Add a list of the normal considerations in the reference notes section)

RECEIVER LOCATION

You should choose a suitable site for the receiver, based on the following guidelines:

- One receiver is required per site
- The receiver is mounted with its antenna in a vertical position on the outer wall of the building in which the TLS RF unit is installed. Locate the receiver on the side the structure facing the tanks to provide an unobstructed signal path to all transmitter units.

- The RS-485 cable (Belden #3107A or equiv.) connecting the receiver to the TLS RF must be less than 250 feet.
- Avoid placing receiver near fluorescent lighting (min. 1 foot) or other source of electrical interference.

TLS RF UNIT LOCATION

You should choose a suitable location for the TLS RF unit, this would normally be within close proximity to the TLS console, with consideration given to the following guidelines:

- The TLS RF unit must be protected from severe vibration, extremes in temperature and humidity, rain, and other conditions that could harm computerized electronic equipment. Select a mounting location on the inside of the same building housing the TLS console.
- The distance between the TLS RF unit and the receiver can not exceed 250 feet.
- Once you have tagged the ideal mounting position for the TLS RF unit and the receiver, measure the RS-485 cable run between the two. If the connecting cable's length would exceed 250 feet, it would be better to move the TLS RF unit's mounting position closer to the receiver (i.e., within the 250 foot limit) since the receiver must have close proximity (ideally line of sight) to the sump transmitter.

REPEATER LOCATION

You should choose a suitable location for each repeater, based on the following guidelines:

- The repeater is mounted in a vertical position so as to establish a line of sight between it and the transmitter in the probe sump, and, if possible, between the it and the receiver as well.
- The most important concern is to ensure an unobstructed secondary path for data transmission between the transmitters and receiver.

SITE CONDITIONS OR SPECIAL NEEDS

State any site conditions or special requirements that will be needed to complete the installation and commissioning, for example:

- Suitable water pump for removing Manhole water
- Two men and specialist equipment for deep manholes
- Tower scaffold or ladders for fixing the repeater and receiver
- Additional lighting if working in dark rooms etc.
- Heavy or abnormal manhole covers
- Accessibility - Locked rooms, etc.

Sketches

The surveyor should produce sketches that show the locations of the transmitters, repeaters, receiver, TLS RF unit and TLS console relative to each other. These sketches to include distances were appropriate, traffic flow and parking areas for vehicles including fuel and other delivery vehicles to site.

Appendix B: Regulatory Information

Federal Communications Commission Notice

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna
- Increase the separation between the equipment and receiver
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected
- Consult the dealer or an experienced radio or television technician for help.

MODIFICATIONS

The FCC requires the user to be notified that any changes or modifications made to this device that are not expressly approved by Veeder-Root Company may void the authority to operate the equipment.

CABLES

Connections to this device must be made with shielded cables with metallic RFI/EMI connector hoods in order to maintain compliance with FCC Rules and Regulations.

DECLARATION OF CONFORMITY FOR PRODUCTS MARKED WITH THE FCC LOGO—UNITED STATES ONLY

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

For questions regarding your product, contact:

Veeder-Root Company
125 Powder Forest Drive
Simsbury, CT 06070
Or, call 1-800-652-6672

For questions regarding this FCC declaration, contact:

Veeder-Root Company
125 Powder Forest Drive
Simsbury, CT 06070
Or, call 1-800-652-6672

To identify this product, refer to the Part, Series, or Model number found on the product.

Canadian Notice

This Class B digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

AVIS CANADIEN

Cet appareil numérique de la classe B respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

Battery Warning



WARNING: The TLS RF Battery Pack contains lithium batteries. To reduce the risk of fire or burns, do not disassemble, crush, puncture, short external contacts, or dispose of in fire or water.



Because of the type of batteries used in TLS RF System, follow local regulations regarding the safe disposal of the battery. Consult Appendix D of this manual for more information on battery disposal.

Airline Travel Notice

Use of electronic equipment aboard commercial aircraft is at the discretion of the airline.

Wireless Notices

In some environments, the use of wireless devices may be restricted. Such restrictions may apply aboard airplanes, in hospitals, near explosives, in hazardous locations, etc. If you are uncertain of the policy that applies to the use of this device, please ask for authorization to use it prior to turning it on.

U.S. Regulatory Wireless Notice

WARNING: Exposure to Radio Frequency Radiation The radiated output power of this device is below the FCC radio frequency exposure limits. Nevertheless, the device should be used in such a manner that the potential for human contact during normal operation is minimized. To avoid the possibility of exceeding the FCC radio frequency exposure limits, human proximity to the antenna should be minimized.

Canadian Regulatory Wireless Notice

Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device. The term "IC:" before the certification/registration number only signifies that the Industry Canada technical specifications were met.

System Specifications

Note: Not all models described are available in all regions.

Appendix C: Device DIP Switch Settings

Use this appendix for DIP switch settings for all devices in the site.

TLS RF Device Number Settings

The Dip Switch Locations to set the unique Device number for the TLS RF unit are shown in the Figure C-1. The TLS RF that monitors the Receiver and transmitter IDs 1 - 8 is considered the site's master TLS RF unit and must have its Device ID set to 0 (default).

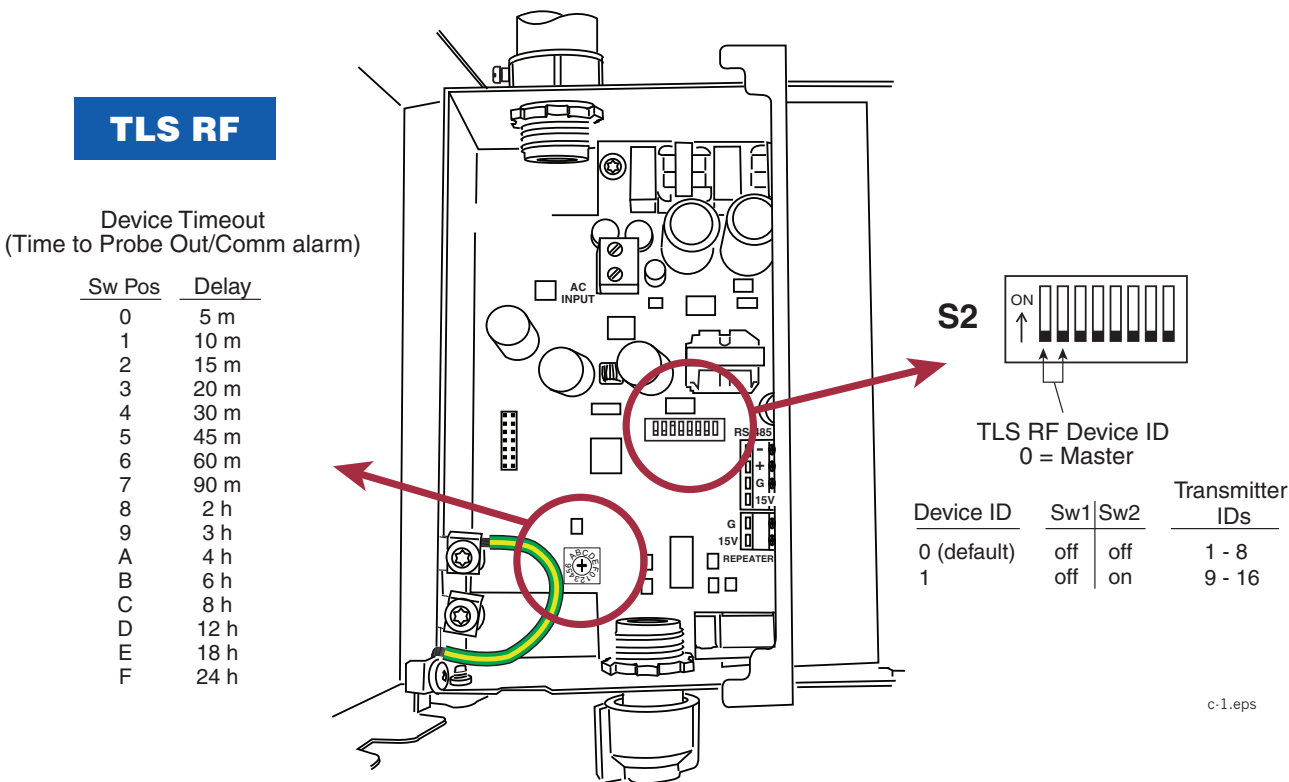


Figure C-1. TLS-RF switch settings

Transmitter/Receiver/Repeater DIP Switch Settings

DIP switch locations for the Transmitter, Receiver and Repeater are shown in Figure C-2. Device DIP switch settings for these devices are listed in Figure C-3 through Figure C-6 (use the appropriate settings for your software version 1 or 3).

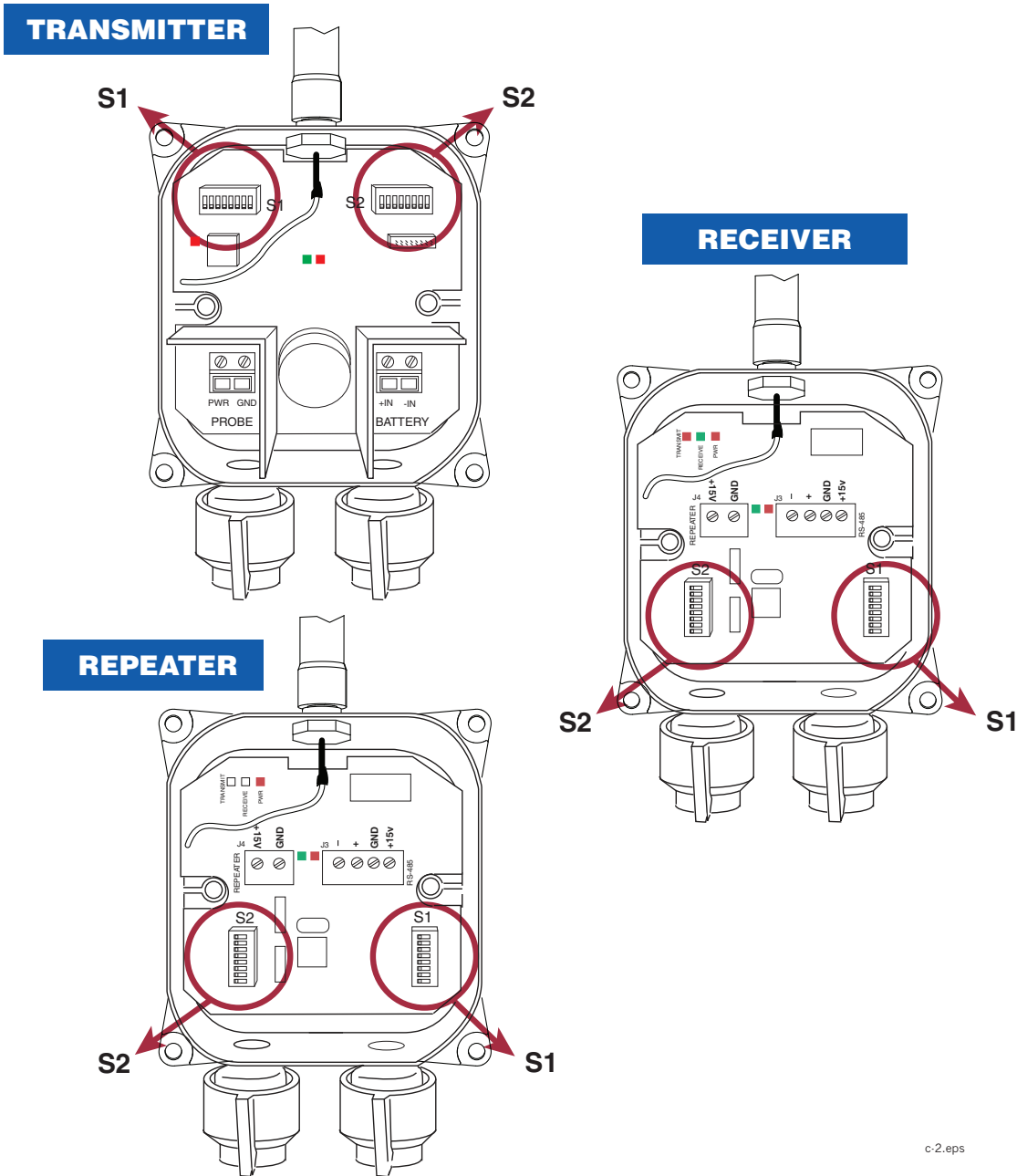


Figure C-2. DIP switch settings

Version 1 (NA/EMEA)									
S1: SW1-3			XMTR: Diagnostic Time Out (Minutes)		RPTR		RCVR		
1	2	3	900MHz Radio	869MHz Radio	900MHz Radio	869MHz Radio	900MHz Radio	869MHz Radio	
OFF	OFF	OFF	30	30	Always	Always	Always	Always	
OFF	OFF	ON	Do Not Set	Do Not Set	Do Not Set	Do Not Set	Do Not Set	Do Not Set	
OFF	ON	OFF	60	60	Do Not Set	Do Not Set	Do Not Set	Do Not Set	
OFF	ON	ON	Do Not Set	Do Not Set	Do Not Set	Do Not Set	Do Not Set	Do Not Set	
ON	OFF	OFF	10	10	Do Not Set	Do Not Set	Do Not Set	Do Not Set	
ON	OFF	ON	Do Not Set	Do Not Set	Do Not Set	Do Not Set	Do Not Set	Do Not Set	
ON	ON	OFF	240	240	Do Not Set	Do Not Set	Do Not Set	Do Not Set	
ON	ON	ON	Do Not Set	Do Not Set	Do Not Set	Do Not Set	Do Not Set	Do Not Set	
Version 3 (Australia/Italy)									
S1: SW1-3			XMTR		RPTR		RCVR		
1	2	3	900MHz Radio	869MHz Radio	900MHz Radio	869MHz Radio	900MHz Radio	869MHz Radio	
OFF	OFF	OFF	Do Not Set	Do Not Set	Do Not Set	Do Not Set	Do Not Set	Do Not Set	
OFF	OFF	ON	Australia	Italy	Australia	Italy	Australia	Italy	
OFF	ON	OFF	Do Not Set	Do Not Set	Do Not Set	Do Not Set	Do Not Set	Do Not Set	
OFF	ON	ON	Do Not Set	Do Not Set	Do Not Set	Do Not Set	Do Not Set	Do Not Set	
ON	OFF	OFF	Do Not Set	Do Not Set	Do Not Set	Do Not Set	Do Not Set	Do Not Set	
ON	OFF	ON	Do Not Set	Do Not Set	Do Not Set	Do Not Set	Do Not Set	Do Not Set	
ON	ON	OFF	Do Not Set	Do Not Set	Do Not Set	Do Not Set	Do Not Set	Do Not Set	
ON	ON	ON	Do Not Set	Do Not Set	Do Not Set	Do Not Set	Do Not Set	Do Not Set	

c-3.eps

Figure C-3. S1:DIP switches 1-3

Version 1 and 3									
S1: SW4-8					XMTR	RPTR	RCVR		
4	5	6	7	8	Tank / Device Number	(Unused)	(Unused)		
OFF	OFF	OFF	OFF	OFF	Do Not Set	Always	Always		
OFF	OFF	OFF	OFF	ON	1 (Master TLSRF Port 1)	Do Not Set	Do Not Set		
OFF	OFF	OFF	ON	OFF	2 (Master TLSRF Port 2)	Do Not Set	Do Not Set		
OFF	OFF	OFF	ON	ON	3 (Master TLSRF Port 3)	Do Not Set	Do Not Set		
OFF	OFF	ON	OFF	OFF	4 (Master TLSRF Port 4)	Do Not Set	Do Not Set		
OFF	OFF	ON	OFF	ON	5 (Master TLSRF Port 5)	Do Not Set	Do Not Set		
OFF	OFF	ON	ON	OFF	6 (Master TLSRF Port 6)	Do Not Set	Do Not Set		
OFF	OFF	ON	ON	ON	7 (Master TLSRF Port 7)	Do Not Set	Do Not Set		
OFF	ON	OFF	OFF	OFF	8 (Master TLSRF Port 8)	Do Not Set	Do Not Set		
OFF	ON	OFF	OFF	ON	9 (2nd TLSRF Port 1)	Do Not Set	Do Not Set		
OFF	ON	OFF	ON	OFF	10 (2nd TLSRF Port 2)	Do Not Set	Do Not Set		
OFF	ON	OFF	ON	ON	11 (2nd TLSRF Port 3)	Do Not Set	Do Not Set		
OFF	ON	ON	OFF	OFF	12 (2nd TLSRF Port 4)	Do Not Set	Do Not Set		
OFF	ON	ON	OFF	ON	13 (2nd TLSRF Port 5)	Do Not Set	Do Not Set		
OFF	ON	ON	ON	OFF	14 (2nd TLSRF Port 6)	Do Not Set	Do Not Set		
OFF	ON	ON	ON	ON	15 (2nd TLSRF Port 7)	Do Not Set	Do Not Set		
ON	OFF	OFF	OFF	OFF	16 (2nd TLSRF Port 8)	Do Not Set	Do Not Set		

c-4.eps

Figure C-4. Device ID Settings - S1:DIP switches 4-8

Version 1 (NA/EMEA)											
S2: SW1~4				Mag Probe XMTR: Read/Transmit Interval*			Mag Sump XMTR: Read/Transmit Interval*		RPTR	RCVR	
				No Change (Idle)	Fall (Dispense)	Rise (Delivery)	No Change (Idle)	Change (Leak)			
	1	2	3	4	Read/Tx	Read/Tx	Read/Tx	Poll/Tx	Poll/Tx	ID	VR Bus Address
	OFF	OFF	OFF	OFF	6/120	6/30	6/6	6/120	6/6	0	0
	OFF	OFF	OFF	ON	6/120	6/6	6/6	6/120	6/6	1	0
	OFF	OFF	ON	OFF	120/120	120/120	120/120	120/120	120/6	2	0
	OFF	OFF	ON	ON	600/600	600/600	600/600	600/600	600/6	3	0
	OFF	ON	OFF	OFF	3600/3600	3600/3600	3600/3600	3600/3600	3600/6	4	1
	OFF	ON	OFF	ON	Do Not Set	Do Not Set	Do Not Set	Do Not Set	Do Not Set	5	1
	OFF	ON	ON	OFF	Do Not Set	Do Not Set	Do Not Set	Do Not Set	Do Not Set	6	1
	OFF	ON	ON	ON	Do Not Set	Do Not Set	Do Not Set	Do Not Set	Do Not Set	7	1
	ON	OFF	OFF	OFF	Do Not Set	Do Not Set	Do Not Set	Do Not Set	Do Not Set	8	2
	ON	OFF	OFF	ON	Do Not Set	Do Not Set	Do Not Set	Do Not Set	Do Not Set	9	2
	ON	OFF	ON	OFF	Do Not Set	Do Not Set	Do Not Set	Do Not Set	Do Not Set	10	2
	ON	OFF	ON	ON	Do Not Set	Do Not Set	Do Not Set	Do Not Set	Do Not Set	11	2
	ON	ON	OFF	OFF	Do Not Set	Do Not Set	Do Not Set	Do Not Set	Do Not Set	12	3
	ON	ON	OFF	ON	Do Not Set	Do Not Set	Do Not Set	Do Not Set	Do Not Set	13	3
	ON	ON	ON	OFF	Do Not Set	Do Not Set	Do Not Set	Do Not Set	Do Not Set	14	3
	ON	ON	ON	ON	Do Not Set	Do Not Set	Do Not Set	Do Not Set	Do Not Set	15	3
Version 3 (Australia/Italy)											
S2: SW1~4				Mag Probe XMTR: Read/Transmit Interval*			Mag Sump XMTR: Read/Transmit Interval*		RPTR	RCVR	
					No Change (Idle)	Fall (Dispense)	Rise (Delivery)	No Change (Idle)	Change (Leak)		
	1	2	3	4	Read/Tx	Read/Tx	Read/Tx	Poll/Tx	Poll/Tx	ID	VR Bus Address
	OFF	OFF	OFF	OFF	6/120	6/30	6/6	6/120	6/6	0	0
	OFF	OFF	OFF	ON	6/120	6/6	6/6	6/120	6/6	1	0
	OFF	OFF	ON	OFF	120/120	120/120	120/120	120/120	120/6	2	0
	OFF	OFF	ON	ON	600/600	600/600	600/600	600/600	600/6	3	0
	OFF	ON	OFF	OFF	3600/3600	3600/3600	3600/3600	3600/3600	3600/6	4	1
	OFF	ON	OFF	ON	6/120	6/30	6/6	6/120	6/6	5	1
	OFF	ON	ON	OFF	6/120	6/30	6/6	6/120	6/6	6	1
	OFF	ON	ON	ON	6/120	6/30	6/6	6/120	6/6	7	1
	ON	OFF	OFF	OFF	6/120	6/30	6/6	6/120	6/6	0	2
	ON	OFF	OFF	ON	SystemID: Green Blinks = Software Version; Red Blinks- 1: 900MHz, 2:869MHz						
	ON	OFF	ON	OFF	RF Status: Green - On/Off with Radio power; Red: On during host to radio communication						
	ON	OFF	ON	ON	Reserved for future use						
	ON	ON	OFF	OFF	Reserved for future use						
	ON	ON	OFF	ON	Reserved for future use						
	ON	ON	ON	OFF	Reserved for future use						
	ON	ON	ON	ON	Reserved for future use						

* in seconds

c-5.eps

Figure C-5. Mode Settings - S2:DIP switches 1-4

Version 1 and 3								
S2: SW5-8				XMTR	RPTR	RCVR		
5	6	7	8	Site ID	Site ID	Site ID		
OFF	OFF	OFF	OFF	0	0	0		
OFF	OFF	OFF	ON	1	1	1		
OFF	OFF	ON	OFF	2	2	2		
OFF	OFF	ON	ON	3	3	3		
OFF	ON	OFF	OFF	4	4	4		
OFF	ON	OFF	ON	5	5	5		
OFF	ON	ON	OFF	6	6	6		
OFF	ON	ON	ON	7	7	7		
ON	OFF	OFF	OFF	8	8	8		
ON	OFF	OFF	ON	9	9	9		
ON	OFF	ON	OFF	10	10	10		
ON	OFF	ON	ON	11	11	11		
ON	ON	OFF	OFF	12	12	12		
ON	ON	OFF	ON	13	13	13		
ON	ON	ON	OFF	14	14	14		
ON	ON	ON	ON	15	15	15		

c-6.eps

Figure C-6. Site ID Settings - S2:DIP switches 5-8

Appendix D: Lithium Battery Safety Data

This appendix contains the manufacturer supplied Transportation Certificate and Material Safety Data Sheet for the lithium batteries used in the TLS RF Wireless System.

Lithium Battery Disposal Considerations

1. Waste disposal must be in accordance with the applicable regulations.
2. Disposal of the Lithium batteries should be performed by permitted, professional disposal firms knowledgeable in Federal, State or Local requirements of hazardous waste treatment and hazardous waste transportation.
3. Incineration should never be performed by battery users, but by trained professionals in an authorized facility with proper gas and fume containment.
4. Recycling of battery can be done in authorized facility, through licensed waste carrier.



TRANSPORTATION CERTIFICATE

Ref. TC-LS 33600 11/2008- 87

This is to certify that the Saft cell type, **LS 33600**, has been subjected and has met the requirements of the UN Recommendations on the Transport of Dangerous Goods, Part III, sub-section 38.3, Manual of Tests and Criteria, 4th Revised edition - 2003 - Ref. ST/SG/AC.10/11/Rev. 4), as detailed in Saft-Poitiers internal reports P 0256/03, dated 06/2003.

Concerned Part Numbers

All the part numbers relative to single LS 33600 cells, whatever their finish mode (with and without end-tabs or wiring and connector assemblies, etc.)

Product Description

Primary (non-rechargeable), Lithium-Thionyl Chloride (Li-SOCl₂) D-sized single cell

Nominal Voltage	3.6 Volts
Nominal Capacity	17.0 Ah
Lithium metal content	4.5 grams
Nominal energy	17.0 x 3.6 = 61.2 Wh
Maximum recommended continuous discharge current	250 mA

Product Classification

Worldwide, besides the United States of America

Since it passes the UN-defined transport tests but because its lithium content is above the 1 gram limit, the **LS 33600 individual cell**, in all of its finish versions, according to the current UN Recommendations on the Transport of Dangerous Goods - Model regulations, is declared **non-exempt from the Dangerous Goods Regulations**. It is restricted to transport/ assigned to **Class 9**, and must be packed in accordance with the relevant packing instructions of the applicable Handbooks and Codes issued by the bodies (IATA-ICAO, IMO, ADR, US-DOT, etc.) in charge of regulating the transportation of dangerous goods.

Within the United States of America

The U.S. DOT CFR 49 Regulations, Parts 171, 172, 173 and 175, are governing the transportation of lithium cells and batteries. Special Provision 188 (in Part 172.102) defines the **LS 33600 single lithium metal cell**, in all of its finished versions, as belonging to the **"medium primary lithium cell"** category, and details the requirements to be met for the different transportation conditions.

Signed on Behalf of Saft, Specialty Battery Group

Pascal Hans SBG Quality Manager

Alain Kerouanton SBG Lithium Product Manager

dated 23/11/08

dated 23/11/2008



Material/Product Safety Data Sheet (MSDS-PSDS)



LS/LSG/LSH/LST/LSX products	Lithium/Thionyl chloride single cells and multi-cell battery packs
Revision 8 Date 10/2008	

1. Identification of the Substance or Preparation and Company				
Product	Primary Lithium/Thionyl chloride unit cells and multi-cell battery packs (Li-SOCl ₂)			
Production sites	Saft Ltd. River Drive Tyne & Wear South Shields NE33 2TR – UK Ph. :+44 191 456 1451 Fax :+44 191 456 6383	Saft Rue Georges Leclanché BP 1039 86060 Poitiers cedex 9 France Ph. :+33 (0)5 49 55 48 48 Fax :+33 (0)5 49 55 48 50	Saft America Inc 313 Crescent Street Valdese NC 28690 – USA Ph. :+1 828 874 4111 Fax :+1 828 874 2431	Saft Batteries Co., Ltd Zhuhai Free Trade Zone Lianfeng Road Zhuhai 519030 Guangdong Province China Ph. : +86 756 881 9318 Fax : +86 756 881 9328
www.saftbatteries.com (section « Contact »)				
Emergency contact Within the USA	+1 (703) 527 3887 (CHEMTREC US Service Center) +1 (800) 494 9300			

2. Hazards Identification
Do not short circuit, recharge puncture, incinerate, crush, immerse, force discharge or expose to temperatures above the declared operating temperature range of product. Risk of fire or explosion.
The Lithium-Thionyl chloride batteries described in this Safety Data Sheet are sealed units which are not hazardous when used according to the recommendations of the manufacturer.
Under normal conditions of use, the electrode materials and liquid electrolyte they contain are not exposed to the outside, provided the battery integrity is maintained and seals remain intact. Risk of exposure only in case of abuse (mechanical, thermal, electrical) which leads to the activation of safety valves and/or the rupture of the battery container. Electrolyte leakage, electrode materials reaction with moisture/water or battery vent/explosion/fire may follow, depending upon the circumstances.

3. Composition & Information on Ingredients					
Ingredient	Content	CAS No.	CHIP Classification		
Lithium (Li)	3,5-5%	7439-93-2			F; R14/15 C; R34 R14/15, R21, R22, R35, R41, R43 S2, S8, S45
Thionyl chloride (SOCl ₂)	40-46%	7719-09-7			C; R14, R21, R22, R35, R37, R41, R42/43 S2, S8, S24, S26, S36, S37, S45



Aluminum chloride anhydrous ($AlCl_3$)	1-5%	7446-70-0			R14, R22, R37, R41, R43. S2, S8, S22, S24, S26, S36, S45
Carbon (C_n)	3-4%	1333-86-4			NONE KNOWN
Amount varies depending on cell size.					





4. First Aid Measures	
Inhalation	Remove from exposure, rest and keep warm. In severe cases obtain medical attention.
Skin contact	Wash off skin thoroughly with water. Remove contaminated clothing and wash before reuse. In severe cases obtain medical attention.
Eye contact	Irrigate thoroughly with water for at least 15 minutes. Obtain medical attention.
Ingestion	Wash out mouth thoroughly with water and give plenty of water to drink. Obtain medical attention.
Further treatment	All cases of eye contamination, persistent skin irritation and casualties who have swallowed this substance or been affected by breathing its vapours should be seen by a doctor.

5. Fire Fighting Measures	
CO ₂ extinguishers or, even preferably, copious quantities of water or water-based foam, can be used to cool down burning Li-SOCl ₂ cells and batteries, as long as the extent of the fire has not progressed to the point that the lithium metal they contain is exposed (marked by deep red flames). Do not use for this purpose sand, dry powder or soda ash, graphite powder or fire blankets. Use only metal (Class D) extinguishers on raw lithium.	
Extinguishing media	Use water or CO ₂ on burning Li-SOCl ₂ cells or batteries and class D fire extinguishing agent only on raw lithium.

6. Accidental Release Measures	
Remove personnel from area until fumes dissipate. Do not breathe vapours or touch liquid with bare hands. If the skin has come into contact with the electrolyte, it should be washed thoroughly with water. Sand or earth should be used to absorb any exuded material. Seal leaking battery and contaminated absorbent material in plastic bag and dispose of as Special Waste in accordance with local regulations.	



7. Handling and Storage	
Handling	Do not crush, pierce, short (+) and (-) battery terminals with conductive (i.e. metal) goods. Do not directly heat or solder. Do not throw into fire. Do not mix batteries of different types and brands. Do not mix new and used batteries. Keep batteries in non conductive (i.e. plastic) trays.
Storage	Store in a cool (preferably below 30°C) and ventilated area, away from moisture, sources of heat, open flames, food and drink. Keep adequate clearance between walls and batteries. Temperature above 100°C may result in battery leakage and rupture. Since short circuit can cause burn, leakage and rupture hazard, keep batteries in original packaging until use and do not jumble them.
Other	Lithium-Thionyl chloride batteries are not rechargeable and should not be tentatively charged. Follow Manufacturers recommendations regarding maximum recommended currents and operating temperature range. Applying pressure on deforming the battery may lead to disassembly followed by eye, skin and throat irritation.

8. Exposure Controls & Personal Protection				
Occupational exposure standard		Compound	8hr TWA	15min TWA SK
		Sulfur dioxide	1 ppm	1 ppm -
		Hydrogen chloride	1 ppm	5 ppm -
	Respiratory protection	In all fire situations, use self-contained breathing apparatus.		
	Hand protection	In the event of leakage wear gloves.		
	Eye protection	Safety glasses are recommended during handling.		
	Other	In the event of leakage, wear chemical apron.		

9. Physical and Chemical Properties	
Appearance	Cylindrical or prismatic shape
Odour	If leaking, gives off a pungent corrosive odour.
pH	Not Applicable
Flash point	Not applicable unless individual components exposed
Flammability	Not applicable unless individual components exposed
Relative density	Not applicable unless individual components exposed
Solubility (water)	Not applicable unless individual components exposed
Solubility (other)	Not applicable unless individual components exposed



10. Stability and Reactivity	
Product is stable under conditions described in Section 7.	
Conditions to avoid.	Heat above 100 °C (150°C for the LSH 20-150 cells and the battery packs assembled from them) or incinerate. Deform. Mutilate. Crush. Pierce. Disassemble Recharge. Short circuit. Expose over a long period to humid conditions.
Materials to avoid	Oxidising agents, alkalis, water. Avoid electrolyte contact with aluminum or zinc.
Hazardous decomposition Products	Hydrogen (H ₂) as well as Lithium oxide (Li ₂ O) and Lithium hydroxide (LiOH) dust is produced in case of reaction of <i>lithium metal</i> with water. Chlorine (Cl ₂), Sulfur dioxide (SO ₂) and Disulfur dichloride (S ₂ Cl ₂) are produced in case of thermal decomposition of <i>thionyl chloride</i> above 140°C. Hydrochloric acid (HCl) and Sulfur dioxide (SO ₂) are produced in case of reaction of <i>Thionyl chloride</i> with water at room temperature. Hydrochloric acid (HCl) fumes, Lithium oxide, (Li ₂ O), Lithium hydroxide (LiOH) and Aluminum hydroxide (Al(OH) ₃) dust are produced in case of reaction of <i>Lithium tetrachloroaluminate (LiAlCl₄)</i> with water.

11. Toxicological Information	
Signs & symptoms	None, unless battery ruptures. In the event of exposure to internal contents, corrosive fumes will be very irritating to skin, eyes and mucous membranes. Overexposure can cause symptoms of non-fibrotic lung injury and membrane irritation.
Inhalation	Lung irritant.
Skin contact	Skin irritant
Eye contact	Eye irritant.
Ingestion	Tissue damage to throat and gastro-respiratory tract if swallowed.
Medical conditions generally aggravated by exposure	In the event of exposure to internal contents, eczema, skin allergies, lung injuries, asthma and other respiratory disorders may occur.

12. Ecological Information	
Mammalian effects	None known if used/disposed of correctly.
Eco-toxicity	None known if used/disposed of correctly.
Bioaccumulation potential	None known if used/disposed of correctly.
Environmental fate	None known if used/disposed of correctly.

13. Disposal Considerations	
Do not incinerate, or subject cells to temperatures in excess of 100°C. Such abuse can result in loss of seal, leakage, and/or cell explosion. Dispose of in accordance with appropriate local regulations.	



14. Transport Information	
Label for conveyance	For the single cell batteries and multi-cell battery packs that are non-restricted to transport (non-assigned to the Miscellaneous Class 9), use lithium batteries inside label. For the single cell batteries and multi-cell battery packs which are restricted to transport (assigned to Class 9), use Class 9 Miscellaneous Dangerous Goods and UN Identification Number labels. In all cases, refer to the product transport certificate issued by the Manufacturer.
UN numbers	UN3090 (shipment of cells and batteries <i>in bulk</i>) UN 3091 (cells and batteries <i>contained in equipment or packed with it</i>)
Shipping names	Lithium Metal Batteries
Hazard classification	Depending on their lithium metal content, some single cells and small multi-cell battery packs may be non- assigned to Class 9 (Refer to Transport Certificate)
Packing group	II
Specific dispositions	IATA: A45, A88, A99, P968, P969, P970 IMDG: 188, 230, 310, P903 ADR/RID: 188, 230, 310, 636, P903, P903a
IMDG Code	3090 (Li Batteries) 3091 (Li Batteries contained in equipment or packed with it)
CAS	
EmS No.	F-A, S-I
Marine pollutant	No
ADR Class	Class9

15. Regulatory Information			
Risk phrases	Lithium (Li)	R14/15 R21 R22 R35 R41 R42/43	Reacts violently with water, liberating extremely flammable gases. Harmful in contact with skin. Harmful if swallowed. Causes burns. Risk of serious damage to eye. May cause sensitization by inhalation and skin contact.
	Thionyl chloride (SOCl ₂)	R14 R22 R35 R37 R41 R42/43	Reacts with water. Harmful if swallowed. Causes burns. Irritating to respiratory system. Risk of serious damage to eye. May cause sensitization by inhalation and skin contact.
	Aluminum chloride anhydrous (AlCl ₃)	R14 R22 R37 R41 R43	Reacts with water. Harmful if swallowed. Irritating to respiratory system. Risk of serious damage to eye. May cause sensitization by skin contact.
Safety phrases	Lithium (Li)	S2 S8 S45	Keep out of reach of children Keep away from moisture In case of incident, seek medical attention.
	Thionyl chloride (SOCl ₂)	S2 S8 S24 S26 S36 S37 S45	Keep out of reach of children. Keep away from moisture. Avoid contact with skin. In case of contact with eyes, rinse immediately with plenty of water. Wear suitable protective clothing. Wear suitable gloves. In case of incident, seek medical attention.



	Aluminum chloride anhydrous ($AlCl_3$)	S2 S8 S22 S24 S26 S36	Keep out of reach of children. Keep away from moisture. Do not breathe dust. Avoid contact with skin. In case of contact with eyes, rinse immediately with plenty of water. Wear suitable protective clothing.
UK regulatory references	Classified under CHIP		

16. Other Information

This information has been compiled from sources considered to be dependable and is, to the best of our knowledge and belief, accurate and reliable as of the date compiled. However, no representation, warranty (either expressed or implied) or guarantee is made to the accuracy, reliability or completeness of the information contained herein.

This information relates to the specific materials designated and may not be valid for such material used in combination with any other materials or in any process. It is the user's responsibility to satisfy himself as to the suitability and completeness of this information for his particular use.

Saft does not accept liability for any loss or damage that may occur, whether direct, indirect, incidental or consequential, from the use of this information. Saft does not offer warranty against patent infringement.

Signature

Alain Kerouanton
Lithium Product Manager

