BrightTEK™

ST9x / BrightTEK Operator Manual

Wireless Tank Monitoring System

AMETEK®

LEVEL MEASUREMENT SOLUTIONS

Read this Manual Before Installing

This manual provides information on the BrightTEK tank monitoring system. It is important that all instructions are read carefully and followed in sequence.

Conventions Used in this Manual

Certain conventions are used in this manual to convey specific types of information. General technical material, support data, and safety information are presented in narrative form. The following styles are used for notes, cautions, and warnings.

NOTES

Notes contain information that augments or clarifies an operating step. Notes do not normally contain actions. They follow the procedural steps to which they refer.

Cautions

Cautions alert the technician to special conditions that could injure personnel, damage equipment, or reduce a component's mechanical integrity. Cautions are also used to alert the technician to unsafe practices or the need for special protective equipment or specific materials. In this manual, a caution box indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

WARNINGS

Warnings identify potentially dangerous situations or serious hazards. In this manual, a warning indicates an imminently hazardous situation which, if not avoided, could result in serious injury or death.

FCC Statement

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device must not be allowed to cause harmful interference
2. This device must accept any interference that may cause undesired operation.

WARNING **– For Your Safety**

- Read these installation and operation instructions carefully. Failure to follow these instructions may result in death or serious injury.
- Only qualified service personnel must install or repair this equipment.

Caution: The battery pack used in this device may present a fire or chemical burn hazard if mistreated. Do not recharge, disassemble, heat above 100 °C (212 °F) or dispose of in fire. Replace Battery pack with AMETEK LMS P/N 089-WRL9-001 only. Use of another battery pack may present a risk of fire or explosion.

- Do not open the housing unless the area is known to be non-hazardous. Remove the Electronics Caddy from the hazardous area prior to changing the battery pack. Refer to section 2.0 for installation details.
- Substitution of parts may impair the intrinsic safety of this equipment.
- This equipment must be installed in accordance with local requirements and the National Electric Code.

Warranty

BrightTEK products are warranted free of defects in materials or workmanship for one year from the date of original factory shipment.

If returned within the warranty period; and, upon factory inspection of the control, the cause of the claim is determined to be covered under the warranty; then, AMETEK LMS will repair or replace the control at no cost to the purchaser (or owner) other than transportation.

AMETEK LMS shall not be liable for misapplication, labor claims, direct or consequential damage or expense arising from the installation or use of equipment. There are no other warranties expressed or implied, except special written warranties covering some AMETEK LMS products.

Performance specifications are effective with date of issue and are subject to change without notice. AMETEK LMS reserves the right to make changes to the product described in this manual at any time without notice. AMETEK LMS makes no warranty with respect to the accuracy of the information in this manual.

AMETEK®
LEVEL MEASUREMENT SOLUTIONS

BrightTEK™ ST9x Wireless Tank Monitoring System

Table of Contents

1.0 ST95 Uplink

The BrightTEK™ ST95 Cellular Uplink Host by AMETEK provides remote wireless connectivity of Magnetrol®, Orion Instruments®, Drexelbrook® and SWI® level measurement sensors to the AMETEK cloud-enabled BrightTEK web server, allowing remote data monitoring and system processing.

The battery-powered uplink can be used to provide power and monitoring to sensors in remote locations and tank farms without the need to install wired data and power connections, reducing installation cost. They can also be added to existing (already wired) sensors without interfering with existing PLC and DCS systems to provide remote access to sensor data.

The ST95 Cellular Uplink Host can power and communicate with up to two 4-20mA Sensors. It is compatible with either AT&T® or Verizon® cellular services and certified intrinsically safe for Class 1 Division 1 Group D locations once installed as outlined in this manual. It can be installed with a standalone sensor or in a tank farm environment supporting up to 12 ST95 Uplink Clients with one cellular connection.

WARNING: Read these installation and operation instructions carefully. Failure to follow these instructions may be dangerous or illegal.

Only qualified service personnel must install or service this equipment or installation.

Record the model and serial numbers for future reference.

____

Model Number

____

Serial Number

2.0 Installation

2.1 Overview

The BrightTEK ST95 Cellular Uplink Host is available alongside LMS level sensors or can be purchased separate and integrating with existing LMS sensors already in use. The uplink interfaces to industry standard 4–20mA devices and may be used with Programmable Logic Controllers or other such devices. The uplink ships pre-wired with 50 feet of cable to allow installation of the ST95 Uplink Client in a convenient location. This is desirable especially for battery changes where tanks are high and difficult to get to without a ladder or lift.

Carefully follow and adhere to the instructions below. The ST95 Uplink Client must be mounted in a location where it will be protected from activities which may subject it to damage. A mounting kit has been selected to firmly secure it to your chosen location.

The ST95 Cellular Uplink Host or the ST95 Uplink Client may be used in this product. Determine which type you have to avoid communications issues. A host uses cellular signals like a Cellphone and needs to have cellular coverage wherever it is located. Likewise, the client needs to talk to the host that it is assigned to. It has a limited range that it can communicate over. If you are not familiar with wireless devices, contact AMETEK LMS Customer Support at **fieldservice.magnetrol@ametek.com**.

2.2 Safety Precautions

- This product must be installed and maintained in strict accordance with the National Electrical Code and any other applicable local electrical code. Refer to the System Control Drawing (906-00017) in the appendix of this manual for specific installation information. Failure to observe this warning could result in serious injuries or damages.
- If you are not familiar with Industrial Hazardous Location Standards, consult with a safety expert before you attempt to install this device.

2.3 Initial Inspection

When you receive the ST95 Cellular Uplink Host and/or Uplink Client, thoroughly inspect it for any damage which may have occurred during shipping. If there is any damage to the devices contact AMETEK LMS Customer Support at 1 (630) 969-4000 as soon as possible or email to **fieldservice.magnetrol@ametek.com**.

Locate the packing checklist in the shipping container. Check for any missing items before you begin installation.

Tools Required for Installation:

- Phillips Screwdrivers
  - #0 Tip (⅛" D), 2½" large blade
  - #2 Tip (¼"D), 4" large blade
- Adjustable slip-nut wrenches
  - 1"– 3" jaw cap × 10¼" or
  - Adjustable pliers 1"– 3" jaw cap (channel-lock type)
- Open end wrench (⅜")

WARNING: The ST95 Cellular Uplink is certified for Class 1 Division 1 Group D hazardous locations only

2.4 Wiring the ST95 to a Sensor

- The ST95 Uplink Client is designed to be installed directly to specific sensor assemblies and equipment that conforms to industry 4–20mA standards. When the Uplink is connected to multiple devices the total loop resistance must be calculated and understood. The Uplink itself has a resistance of 350 ohms at 21 Volts. Contact Customer Support for technical help with your unique installation.
- Refer to the System Control drawing for a visual of the installation. Before you begin, read all the steps involved. Note that the picture in the drawing portrays a Remote Mount Configuration. The equipment shown on the left side does not pertain to the Uplink.
- When routing the cable down the side of a tank, secure it using cable ties or other fasteners as required. Mount the Uplink Housing at the chosen site within the 50-foot range of the cable. See “Mounting the Electronics Housing” on the following page.
- Refer to the System Control Drawing in this document. The table at the end of the drawing identifies the colors of the Uplink cable and their function.

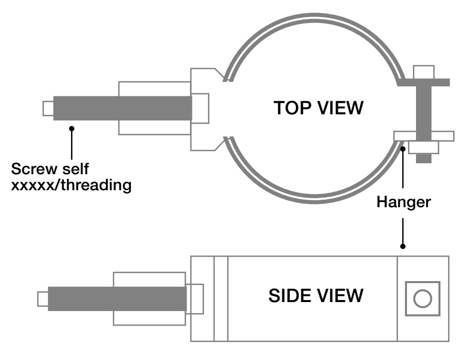
- Wire the Sensor positive and negative wires to the colors marked (CKT1, 21V+) and (CKT1, Input) respectively.
- If using a second Sensor, wire the Sensor positive and negative wires to the colors marked (CKT2, 21V+) and (CKT2, Input) respectively.

ST95 UPLINK CABLE TERMINATION

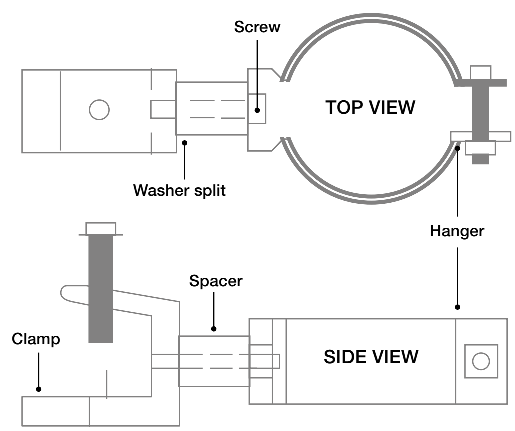
To Customer Sensor Using Uplink Cable (Wire Color)	4–20 Loop Function
Orange	Circuit 1, 21V+
Yellow	Circuit 1, Input
Black or Brown	Ground
White	Circuit 2, Input
Green	Circuit 2, 21V+

2.5 Remote Universal Mounting Parts (all ST9x)

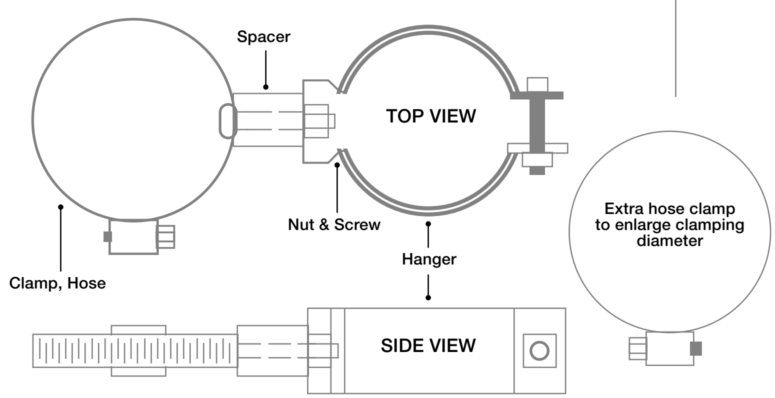
STYLE **1** SCREW MOUNT



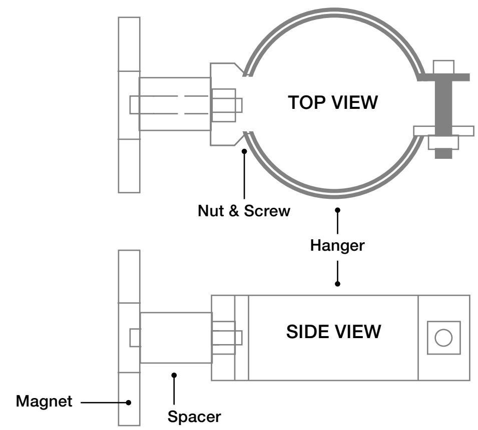
STYLE **2** CLAMP MOUNT



STYLE **3** PIPE CLAMP



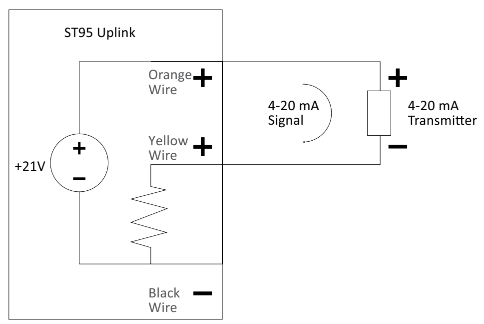
STYLE **4** MAG MOUNT



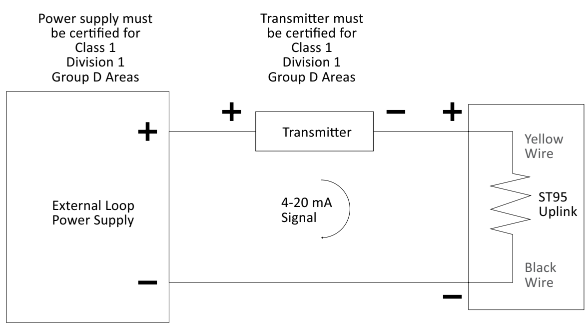
Only one style of installation configuration can be built from this kit. For customer assembly & installation

2.6 Wiring Guides

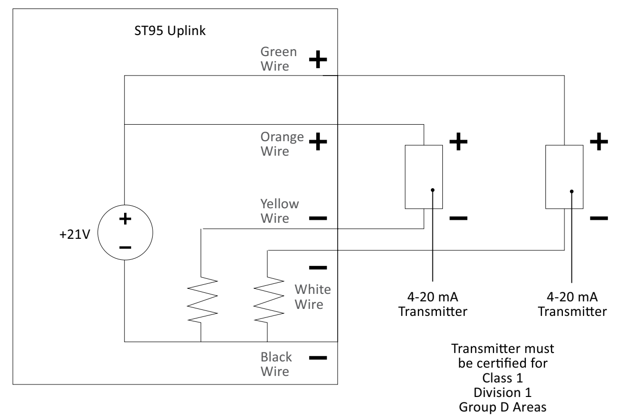
Powering Single Loop from ST95 Uplink Client



Using External Power Source for Single Loop Power with ST95 Uplink Client

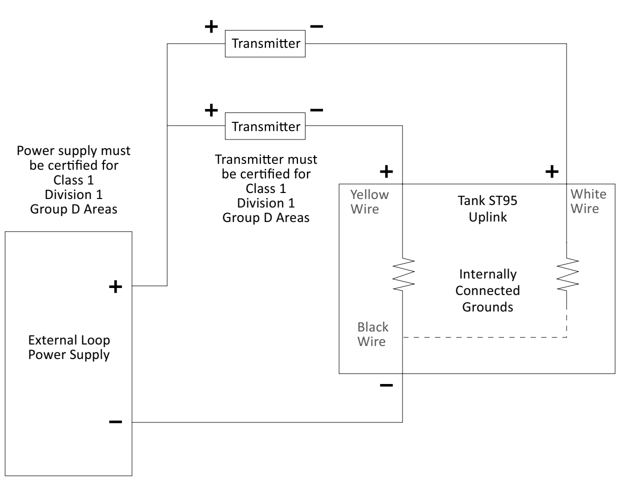


Powering two transmitters from ST95 Uplink Client



Using both ST95 Uplink Client 4-20mA Inputs

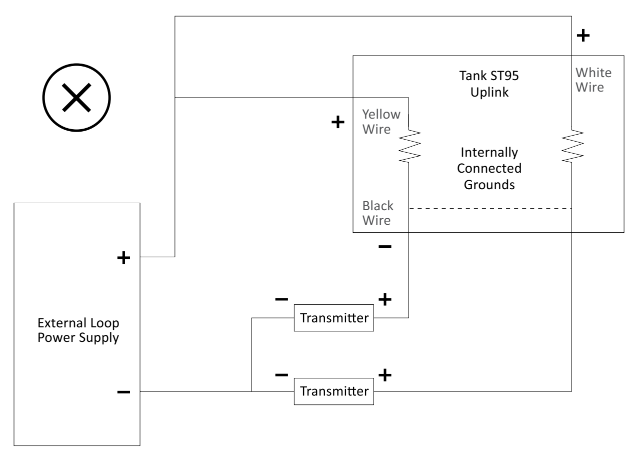
Powering 2 ST95 loops from the same external power supply



Correct Wiring Configuration

Incorrect wiring of both loops

with shared external power supply



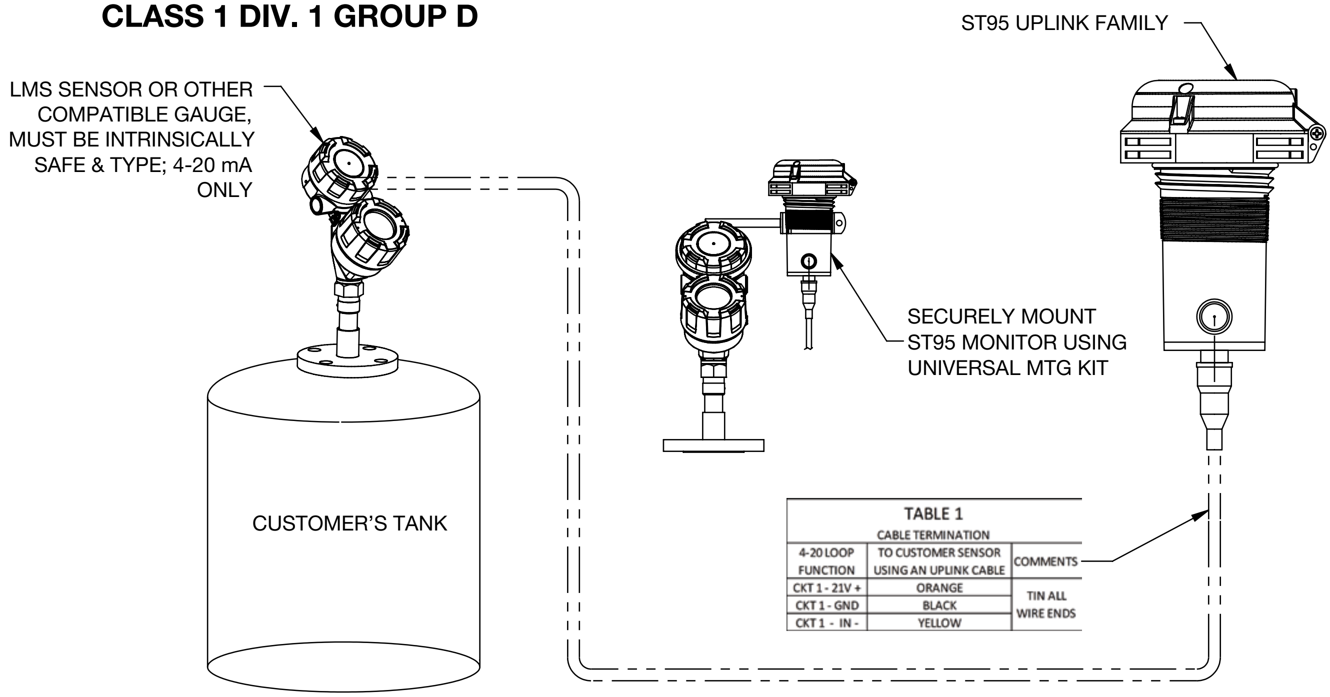
Incorrect Wiring Configuration

Both inputs will read the same value

2.7 System Control Drawing

HAZARDOUS LOCATION

CLASS 1 DIV. 1 GROUP D



4-20 LOOP FUNCTION	TO CUSTOMER SENSOR USING AN UPLINK CABLE	COMMENTS
CKT 1 - 21V +	ORANGE	TIN ALL WIRE ENDS
CKT 1 - GND	BLACK	
CKT 1 - IN -	YELLOW	

NOTES:

1. DO NOT INSTALL THE ST95 WHERE HAZARDOUS VAPORS ARE PRESENT.
2. INSTALLATION TO BE IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS. REFER TO ST95 INSTALLATION MANUAL. IF USING THE UPLINK MODEL ON PAGE 1 OF THIS DRAWING SEE ALSO CONNECTION CHART.
3. INTRINSICALLY SAFE CIRCUITS MUST BE WIRED AND SEPARATED IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE (ANSI/NFPA 70), OR OTHER LOCAL CODES, AS APPLICABLE.
4. THE REMOTE ST95M HOUSING MUST BE SUPPORTED FIRMLY USING THE OPTIONAL MOUNTING BRACKET. LOCATE THE HOUSING IN A NON-CLASSIFIED AREA DEEMED TO BE SAFE.
5. TABLE 1 DEFINES THE INTRINSICALLY SAFE ENTITY PARAMETERS

TABLE 1:

I.S. Equipment		Associated Apparatus	
V max (or Ui)	≥	Voc or Vt (or Uo)	= 27.45V
I max (or Ii)	≥	Isc or It (or Io)	= 0.077A
P max, Pi	≥	Po	= 0.524W
Ci + Ccable	≤	Ca (or Co)	= 1.12uF
Li + Lcable	≤	La (or Lo)	= 24mH

6. THIS ASSOCIATED APPARATUS MAY ALSO BE CONNECTED TO A SIMPLE APPARATUS AS DEFINED IN ARTICLE 504.2 AND INSTALLED AND TEMPERATURE CLASSIFIED IN ACCORDANCE WITH ARTICLE 504.10(B) OF THE NATIONAL ELECTRICAL CODE (ANSI/NFPA 70), OR OTHER LOCAL CODES, AS APPLICABLE.
7. CAPACITANCE AND INDUCTANCE OF THE FIELD WIRING FROM THE INTRINSICALLY SAFE EQUIPMENT TO THE ASSOCIATED APPARATUS SHALL BE CALCULATED AND MUST BE INCLUDED IN THE SYSTEM CALCULATIONS AS SHOWN IN TABLE 1. CABLE CAPACITANCE, CCABLE, PLUS INTRINSICALLY SAFE EQUIPMENT CAPACITANCE CI MUST BE LESS THAN THE MARKED CAPACITANCE, CA (OR CO), SHOWN ON ANY ASSOCIATED APPARATUS USED THE SAME APPLIES FOR INDUCTANCE (LCABLE, LI AND LA OR LO, RESPECTIVELY). WHERE THE CABLE CAPACITANCE AND INDUCTANCE PER FOOT ARE NOT KNOWN, THE FOLLOWING VALUES SHALL BE USED:
   CCABLE = 60 PF/FT., LCABLE = 0.2 uH/FT.
8. WHERE MULTIPLE CIRCUITS EXTEND FROM THE SAME PIECE OF ASSOCIATED APPARATUS, THEY MUST BE INSTALLED IN SEPARATE CABLES OR IN ONE CABLE HAVING SUITABLE INSULATION. REFER TO ARTICLE 504.30(B) OF THE NATIONAL ELECTRICAL CODE (ANSI/NFPA 70) AND INSTRUMENT SOCIETY OF AMERICA RECOMMENDED PRACTICE ISA RP12.6 FOR INSTALLING INTRINSICALLY SAFE EQUIPMENT.
9. THIS ASSOCIATED APPARATUS HAS NOT BEEN EVALUATED FOR USE IN COMBINATION WITH ANOTHER ASSOCIATED APPARATUS.
10. THE ST95 UPLINKS ARE SUPPLIED WITH A FACTORY WIRED CABLE OF 50 FT. IN LENGTH HAVING THE FOLLOWING. CHARACTERISTICS:
    - TYPE: 8 CONDUCTOR SHIELDED CABLE
    - RATED VOLTAGE: 300 Vrms
    - SHIELD: ALUM/MYLAR FOIL
    - TEMPERATURE RANGE: 80 DEG C
    - CONDUCTOR SIZE: 24 (7/30) AWG
    - INSULATION TYPE: PVC
    - JACKET INSULATION THICKNESS: 0.030 INCHES
    - CERTIFICATIONS: UL AWM/STYLE 2464. LISTING AVLV2-E319028
11. SUITABILITY FOR INSTALLATION IN PARTICULAR APPLICATIONS IS AT THE DISCRETION OF THE AUTHORITY HAVING JURISDICTION (AHJ).
12. THE UPLINK CONFIGURATION IS TERMINATED ON THE LEFT SIDE OF THE DWG. THE CABLE IS 10 FEET LONG. THE CUSTOMER SENSOR MUST BE DEFINED AND WIRED BY THE CUSTOMER.

2.8 Host Startup

Use the magnet to start the Host. Hold the magnet over the magnet symbol on the lid for one second, then remove.

INDICATOR LIGHTS

Condition	LED Description
Power ON	A slow green LED flashes followed by the green & red LEDs alternating flashes.
Active on Cellular Network	Red LED will go out and the green LED will begin to flash slowly while attempting to register on the cellular network.
Connected to Cellular Network	Green LED will remain on
Successful Call	Green LED will flash, then remain off
For Unsuccessful Calls, the Red LED will remain on and the Green LED will flash the amount of times corresponding to the error number.	

2.9 Wiring the ST95 (Host/Client) to a PLC/DCS

- When a Programmable Logic controller is used it normally provides the +24 Volts. In this case you must be aware that the grounds in the ST95 are common. Connecting two channels of the PLC to the channels of the ST95 will likely result in a ground loop. For this reason, an external 4/20mA Isolator should be used. An Isolated Channel Card in the PLC may also be used.
- Wire channel 1 of the PLC positive and negative wires to the colors marked (CKT1, IN1-) and (CKT GND).
- Wire channel 2 of the PLC positive and negative wires to the colors marked (CKT2, IN1-) and (CKT GND).

2.9.1 Installation for Clients

Do not open the lid to start the activation process.

Determine if you have an ST95 Cellular Uplink Host or ST95 Uplink Client:

- Hosts units begin with 95H or 95W and have the magnet icon on the label
- Client units begin with 95L and do NOT have the magnet icon on the label.

If you have a 95L, the device must be opened to activate.

On Host/Client Pairing, always set up the host units first.

Host Units: Use the magnet by placing it on the lid where the magnet symbol is shown.

- After one second, remove the magnet and you should observe the GREEN LED light flashing through the cover.
- For BrightTEK updates that are not scheduled, use the magnet for this purpose. Magnetic operation is permissible in the hazardous area.

Clients Units: requires to open the lid and push the button to manually activate the unit.

2.9.2 Connecting One or Two Sensors

- The ST95 Uplink Client is designed to be installed directly to specific sensor assemblies and equipment that conforms to industry 4–20mA standards.
- It is the customers responsibility for sensor selection and compatibility with these standards.
- When the uplink is connected to multiple devices the total loop resistance must be calculated and understood.
- The ST95 Uplink Client itself has a resistance of 350 Ohms at 21 Volts.
- Refer to the System Control Drawings for a picture of the installation. Route the sensor cable to the Tank Sensor and select the appropriate wire colors to connect to the Sensor per the Termination Table.
- When routing the cable down the side of a tank, secure it using cable ties or other fasteners as required.
- Refer to ST95 Family wiring guides for better illustration (see previous pages).
- Wire the Sensor positive and negative wires to the colors marked Circuit 1, 21V+ (Orange) and Circuit 1, Input (Yellow) respectively.
- For the second sensor, wire the sensor positive and negative wires to the colors marked Circuit 2, 21V+ (Green) and Circuit 2, Input (White) respectively.

NOTE: The customer will need to supply any additional cabling as appropriate within safety limits.

2.10 Mounting the Electronics Housing

Determine the best place to mount the Electronics/ Housing one of the optional mounting kits. The ST95 can be mounted using the included universal mounts or a sensors specific mount. The ST95 kit contains both Hose Clamps and a Pipe Clamp to hold the ST95. Select the combination of parts suited to your space. Use the 2” Brass spacer to extend the pipe or Hose clamp away from the mounting surface if needed. The hose clamps can be used to secure the mount to a pole if desired. Both clamps can be connected for a larger diameter pole. For wall mount you can screw one of the clamps directly to it. Once you have selected the location, mount the ST95 and route the cable from the tank to that location and secure it appropriately.

The sensor specific mount (if ordered) can be mounted to the sensor electronics housing.

- Remember to follow the National Electric Code or other local codes and the System Control Drawing in this manual. If you are unfamiliar with these regulations consult the appropriate personnel before installation.
- Insert the housing into the mounting bracket and tighten the clamp around it.

2.10.1 Testing

- For ST95 Cellular Uplink Hosts, start up the unit with the magnet. The green LED on the circuit card will begin to flash. Examine the LED sequence and verify proper communications with the BrightTEK Data Center. If a red light is observed, an error has occurred. Contact Customer Support for help.
- Allow the unit to complete the communications process. This could take several minutes, and the LEDs will go dark when the process is complete.
- Call BrightTEK Customer Support or access the BrightTEK online portal to verify the tank level and the initialization process has successfully completed.
- Verify the key calibration parameters are properly configured via the Tank Data Online web portal.
- Verify the product level is properly configured via the website.
- If technical support is required, please call BrightTEK Customer Support at 1(630) 969-4000 or email fieldservice.magnetrol@ametek.com.

3.0 Specifications

ST95 Cellular Uplink Host / Uplink Client

Hardware	
Hazardous Classification	Class 1 Div. 1 Group D, Temperature Code T3C
Weight	Without Sensor Assembly: 2.0 lbs. (0.91 kg)
Construction	ROHS Compliant
Enclosure	CPVC w/Lexan Cover, Weatherproof, NEMA 4X/IP56, UL94V-0
Performance	
Output Voltage	Nominally 21V ±5%
Output Current	Rated from 0-50mA
Sensor	Intrinsically Safe 4-20 mA
Battery	6V - SmartTank Battery Pack, P/N 394-00023
Expected Battery Life	Up to three years depending on website settings
Wireless Communications	
Mode	LTE Digital Wireless Radio / Satellite RF Approval: FCC Part 15 Approved GPS Receiver: Internal Antenna, Optional External GSM Antenna
Cellular Specifications	LTE Cat-1 with 3G fall back (Verizon is LTE only)

Environmental	
Operating Temperature	-4 to +104 °F (-20 to +40 °C)
Storage Temperature	-40 to +185 °F (-40 to +85 °C)
Installation Requirements	
Secure Mounting	Mount the ST95 Uplink in a location shielded from potential external damage. Use the designated mounting kit for stability and protection.

ST95 Satellite Uplink Host

Hardware	
Weight	Without Sensor Assembly: 2.0 lbs. (0.91 kg)
Construction	ROHS Compliant
Enclosure	CPVC w/Lexan Cover, Weatherproof, NEMA 4X/IP56, UL94V-0
Performance	
Output Voltage	Nominally 21V ±5%
Output Current	Rated from 0-50mA
Sensor	Intrinsically Safe 4-20 mA
Power Input	Solar-powered via AP4 module
Wireless Communications	
Mode	Iridium Satellite Network
Environmental	
Operating Temperature	-4 to +104 °F (-20 to +40 °C)
Storage Temperature	-40 to +185 °F (-40 to +85 °C)
Installation Requirements	
Secure Mounting	Mount the ST95 Uplink in a location shielded from potential external damage. Use the designated mounting kit for stability and protection. ST9X requires line of sight to sky.

ST90 AC Powered Cellular Uplink Host

Physical	
Construction	ROHS Compliant
Enclosure	Polypropylene w/ Lexan Cover, Weatherproof, NEMA 4X, UL94V-0
Wireless Communications	
Mode	GSM Digital Wireless Radio / 900MHz Wideband WLAN
RF Approval	FCC Part 15 B approved
Frequency bands	GSM Digital Wireless Radio / 900MHz
GPS Receiver	Internal Antenna, Optional External GSM Antenna
Performance	
Output Voltage: Nominally 14V/24V	GSM Digital Wireless Radio / 900MHz Wideband WLAN
Output Current	Rated from 0-50mA
Load Regulation	0.5% from 30mA load
Ripple	50mV Peak-to-Peak
Environmental	
Operating Temperature	-13 to +158 °F (-25 to +70 °C)
Storage Temperature	-40 to +185 °F (-40 to +85 °C)

4.0 ST95 (Host/Client) Battery Replacement

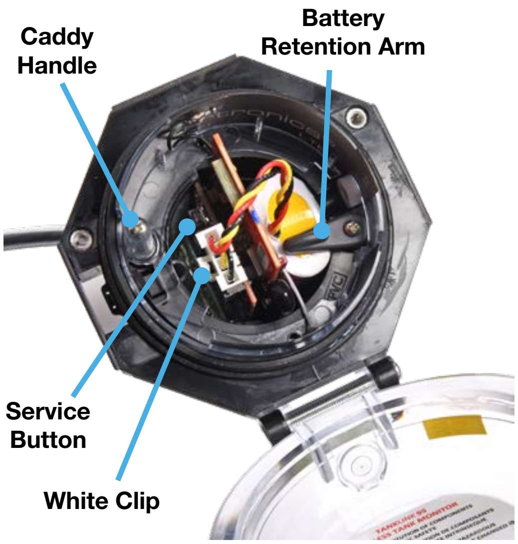
WARNING: TO PREVENT IGNITION OF A HAZARDOUS ATMOSPHERE, THE BATTERY MUST ONLY BE CHANGED IN AN AREA KNOWN TO BE NONHAZARDOUS. If you are unsure as to whether the area is hazardous, consult the appropriate personnel who has knowledge of Class 1 Division 1 hazardous areas before proceeding. Alternately, assume the area is hazardous and do the following:

WARNING: If the tank contains flammable liquid or vapor, extinguish all flames and smoking material before performing the battery replacement procedure.

4.1 Step-by-step Procedure

Discharge any static charge on your person by grounding yourself, either by wearing an anti-static wrist strap (preferred) or by touching a grounded metal object.

To replace the battery in the ST95 Host and/or Client, follow these steps:



4.1.1 Opening the Lid

- To access the battery pack, unscrew the two screws off the lid until they are loose.
- Very carefully open the lid.

  TIP: The lid will not come off easily, as it is vacuum sealed. You might want to use the notch, located right next to the hinge, and carefully push up to open it up. That will remove the vacuum seal and allow you to open the lid.

4.1.2 Remove Battery Caddy and Battery

- Rotate the Retention Arm to the side to release the battery and caddy (do not unplug or remove battery at this time).
- Loosen screw on Caddy Handle.
- Grasp the caddy assembly firmly by the Caddy Handle and pull it straight up.
- Transport the caddy with the battery out of the hazardous area before proceeding with the battery replacement procedure.
- It is recommended to have a static bag available to place the caddy into. Do not use ordinary plastic since it produces static electricity. Close the lid of the instrument to keep dirt out.
- Once you are in a non-hazardous area discharge any static electricity you may have accumulated on your person by grounding yourself again.

- Unplug the battery cable from the connector by squeezing the white clip and pull it straight up and out of the mating connector.

a. ***WARNING:*** Substitution of components may impair intrinsic safety.

AVERTISSEMENT : LA SUBSTITUTION DE COMPOSANTS PEUT COMPROMETTRE LA SECURITE INTRINSEQUE"

b. ***WARNING:*** TO PREVENT IGNITION OF A HAZARDOUS ATMOSPHERE, BATTERY PACK MUST ONLY BE CHANGED IN AN AREA KNOWN TO BE NONHAZARDOUS."

"***WARNING:*** TO PREVENT IGNITION OF A HAZARDOUS ATMOSPHERE, BATTERY PACK MUST ONLY BE CHANGED IN AN AREA KNOWN TO BE NONHAZARDOUS." and "AVERTISSEMENT: AFIN DE PREVENIR L'INFLAMMATION D'ATMOSPHERES DANGEREUSES, NE CHANGER LE JEU DE BATTERIES QUE DANS DES EMPLACEMENTS DESIGNES NON DANGEREUX.".

4.1.3 Replace Battery – Part #089-WRL9-001

- Insert the new battery. Make sure the black rubber pad is facing the circuit board and gently drop it in.
- Plug the new battery pack white clip into the same connector until the catch clicks and is flush with the matting connector.
- The GREEN LED light should begin to blink.
- Open the lid to the horizontal position and lower the caddy into the vertical tracks on the inside center of the housing.
- Tighten screw on Caddy Handle.
- Rotate the Retention Arm over the top of the battery.
- Make sure the antenna is in the proper position to the side.

4.1.4 Closing the lid

- Securely hold and press down on both sides of the lid.
- Carefully start tightening the screws down until they meet the threads.
- Press firmly down until you hear the lid seal close.
- Finish tightening the screws, but do not over tighten as this might strip the threads.

4.2 Lithium Battery Disposal

For disposal, batteries must be packaged and shipped in accordance with transportation regulations, to a proper disposal site. The U.S. Department of Transportation authorizes shipment of “Lithium batteries for disposal” by motor vehicle only in regulation 173.1015 of CFR 49 (effective January 5, 1983). For additional information contact: U.S. Department of Transportation Research and Special Programs Administration 400 Seventh Street, S.W. Washington, D.C. 20590.

WARNING: Do not incinerate or dispose of lithium batteries in general trash collection. They may explode or rupture violently. Check state and local regulations dealing with the disposal of these materials. You are legally responsible for hazards created while disposing of depleted batteries. Do the following:

- Visually inspect all batteries for damage to the battery casing or leakage of electrolyte. If a battery is damaged and/or leaking, contact your local EPA for instructions.
- If the battery has leads and is clean and undamaged, use side cutters to remove the leads as close to the body of the battery as possible.
- Contact your local Environmental Protection Agency (EPA) office for information about battery disposal companies and proper labeling of battery containers. Lithium batteries can be stored and shipped as universal waste in most states in the United States of America. Alternately, you can ship lithium batteries as hazardous waste.

LED LIGHT SEQUENCE

Condition	LED Description
Power ON	A slow green LED flashes followed by the green & red LEDs alternating flashes.
Active on Cellular Network	Red LED will go out and the green LED will begin to flash slowly while attempting to register on the cellular network.
Connected to Cellular Network	Green LED will remain on
Successful Call	Green LED will flash, then remain off

4.3 General Maintenance

The occasional battery change is an excellent time to complete basic system maintenance. This is also a good time to verify the calibration / accuracy of the telemetry system. If possible, measure the product level currently in the tank in inches from the bottom of the tank, or down from the top of the tank.

5.0 ST95 Cellular Uplink Host Troubleshooting

Nothing happens when magnetic switch is used.

✓ Note whether the green LED lights when the magnet is in place on the lid. If not, you may have a bad Battery. If it does light, then make sure you hold the magnet in place for just one second. If you exceed three seconds it will fail to start. Otherwise, call Customer Support.

Unit cannot transmit to data center.

✓ Verify that the RSSI is greater than 20 on the website.

✓ Verify that there is LTE or GSM service in the area. If you have a Verizon LTE unit be aware that they do not support GSM service any longer. You must have LTE service.

✓ Check for interfering structures such as tanks, buildings, or large equipment.

✓ Reposition the unit if possible.

✓ Verify serial number of unit on the website.

✓ Use an external antenna.

The level reading is incorrect.

✓ Verify the tank dimensions and high and low set point configurations via the website.

The level reading is correct, but volume is off.

✓ Verify the tank capacity. This should be the volume in the tank at the tank height.

✓ Verify that the correct strapping chart is used.

The unit has stopped calling.

✓ Replace the battery pack.

5.0.1 Error Codes

Troubleshooting of the Cellular communication should only be attempted from an area known to be free of hazardous vapors.

If the data transmission was not successful from the ST95 (Host and/or Client), a red LED will light, and the green LED will flash an error code.

Number of Green Flashes	Error Code Description
1, 2 or 3	**Network Error**
4	**Cellular Service Error:** The unit did not detect cellular service. Verify that there is service in your area by checking LTE coverage information on your provider website.
5	**Cellular Busy Error:** The unit could not transmit because the cellular network is busy. Retry data transmission.
6	**Radio Respond Error:** Possible Hardware failure
7, 8 or 9	**Network Error**
10	**Failed Transmission Error:** The unit has reached the maximum number of calls per day.

6.0 Obtaining Technical Support

If you are having trouble, contact AMETEK LMS Customer Service at:

1-630-969-4000

You will need the following information:

- Product Serial Number (label on the top of the unit.
- Tank location (city/state).
- Tank product

REMEMBER:
For security reasons, no one from AMETEK LMS will ever ask you for your password.

If it should be necessary to return this unit to AMETEK LMS for service:

1. You must first obtain a Return Authorization Number.
2. This number must be clearly marked on the outside of the shipping container and on the service card which was supplied with the unit.
3. Place the unit with the service card in the original container and ship it prepaid to the address on the service card.

7.0 ST95 Satellite Uplink Host

7.1 General Warnings

The ST95 Satellite Uplink is Certified for Class 1, Division 2, Group D Hazardous locations.

The Sensors and Intrinsically Safe Circuits used must be Division 1 rated: Class 1, Div. 1 Group D, as requirements in the Control Drawings (see following pages).

Division 2 means that no ignitable atmosphere normally exists and therefore you must choose a location that is normally safe.

Do not plug in or unplug the AP4 Satellite device in the Hazardous Area or when ignitable Gas concentrations are present.

This product must be installed and maintained in strict accordance with National Electrical Code and any other local Electrical Code.

If you are not familiar with Hazardous Location requirements consult a Safety Expert before attempting to install this device.

Intrinsically safe circuits must be wired and separated in accordance with Article 504.20 of the National Electrical Code (ANSI/NFPA 70), or other local codes, as applicable.

See Table 1 below for the Intrinsically safe entity parameters.

Table 1

I.S. EQUIPMENT	ASSOCIATED APPARATUS
V max (or Ui)	Voc or Vt (or Uo) = 27.45V
I max (or Ii)	Isc or It (or Io) = 0.077A
P max, Pi	Po = 0.524W
Ci + Ccable	Ca (or Co) = 1.12uF
Li + Lcable	La (or Lo) = 24mH

The Unit must be installed in accordance with the System Control Drawings 906-00018.

This associated apparatus may also be connected to a simple apparatus as defied in Article 504.2 and installed and temperature classified in accordance with the Article 504.10(B) of the National Electrical Code (ANSI/NFPA 70), or other local codes, as applicable.

Capacitance and inductance of the field wiring from the intrinsically safe equipment of the associated apparatus shall be calculated and must be included in the system calculations as shown in the Table 1. Cable capacitance, CCable, plus intrinsically safe equipment capacitance, CI, must be less than the marked capacitance, CA (or CO), shown on any associated apparatus used. The same applies for inductance (LCable, LI and LA or LO , respectively). Where the cable capacitance and inductance per foot are not known, the following values shall be used:

CCABLE = 60 PF/FT.,

LCABLE = 0.2 uH/FT.

Where multiple circuits extend from the same piece of associated apparatus, they must be installed in separate cables or in one cable having suitable insulation. refer to Article 504.30(b) of the National Electrical Code (ANSI/NFPA 70) and instrument society of America recommended practice ISA RP12.6 for installing intrinsically safe equipment.

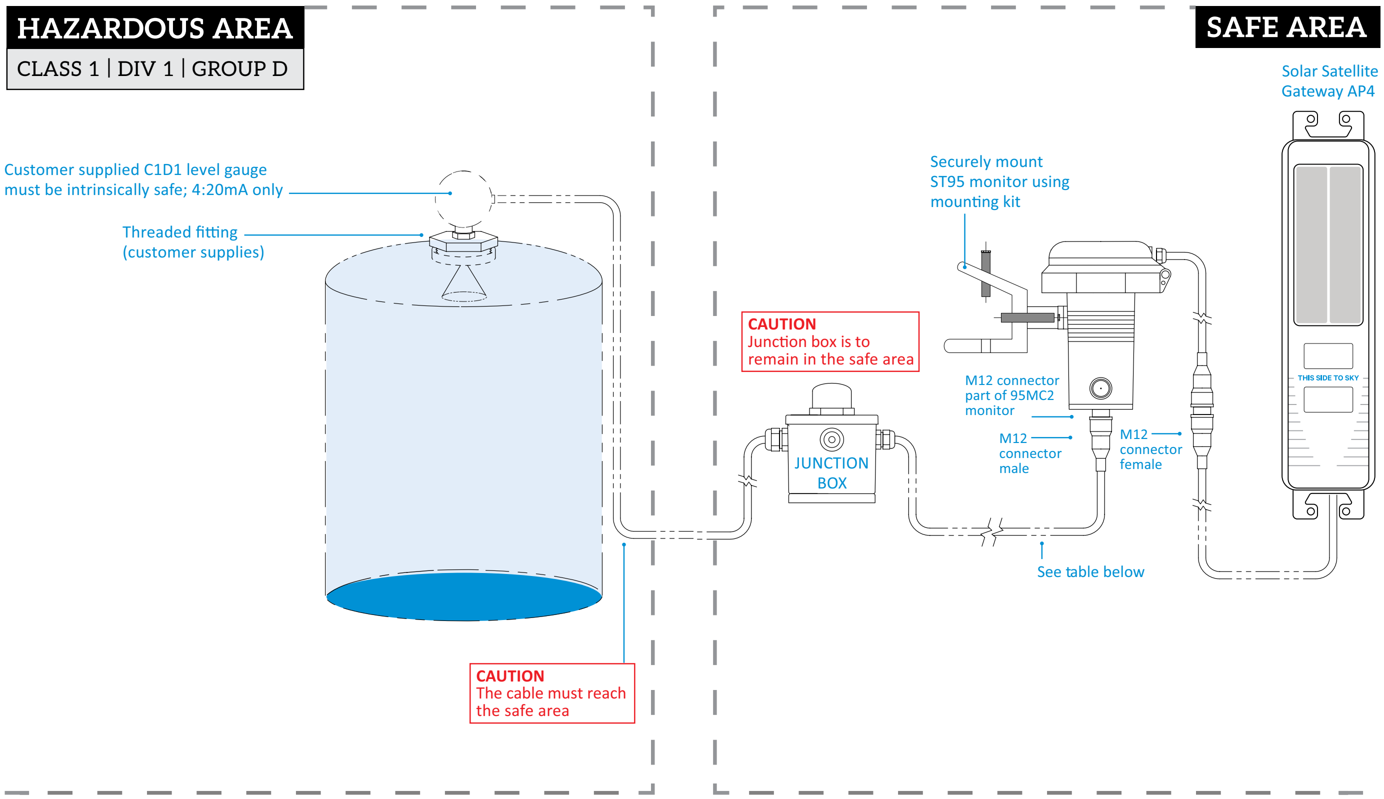
This associated apparatus has not been evaluated for use in combination with another associated apparatus.

The ST95-Sat is supplied with a factory wired cable of 10 ft. in length having the following characteristics:

- Type: 8 Conductor shielded cable
- Rated voltage: 300 VRMS
- Shield: Alum/mylar Foil
- Temperature range: 80 Degree Degrees
- Conductor size: 24 (7/30) AWG
- Insulation type: PVC
- Jacket insulation thickness: 0.030 inches
- Certifications: UL AWM/Style 2464. Listing AVLV2-e319028

Suitability for installation in particular applications is at the discretion of the authority having jurisdiction (AHJ).

7.2 System Control Drawing



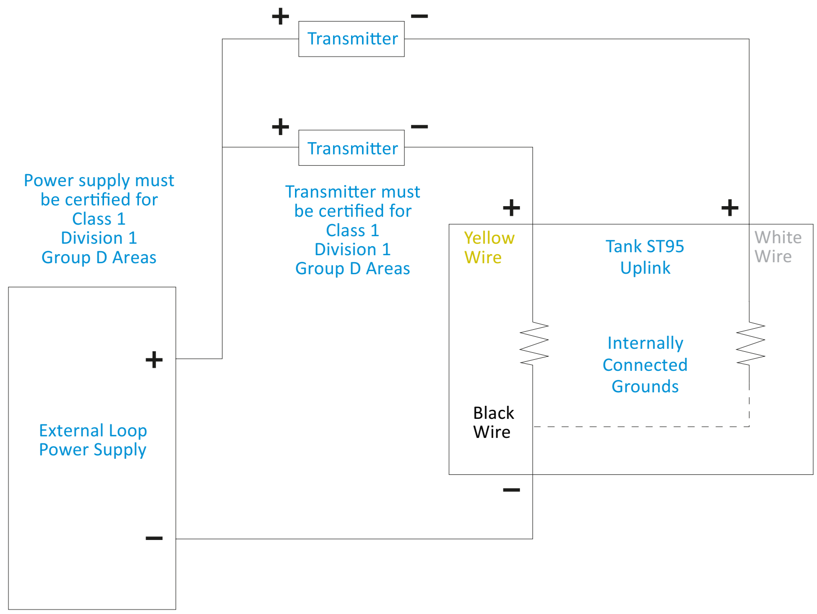
Cable Termination

4/20 LOOP FUNCTION	TO CUSTOMER SENSOR USING A UPLINK CABLE
Orange	Circuit 1 = 21 V+
Yellow	Circuit 1 = Input
Black	Circuit 1 = Ground
White	Circuit 2 = Input
Brown	Circuit 2 = Ground
Green	Circuit 2 = 21V+

7.3 Wiring Guides

Using both ST95 Uplink 4-20mA Inputs

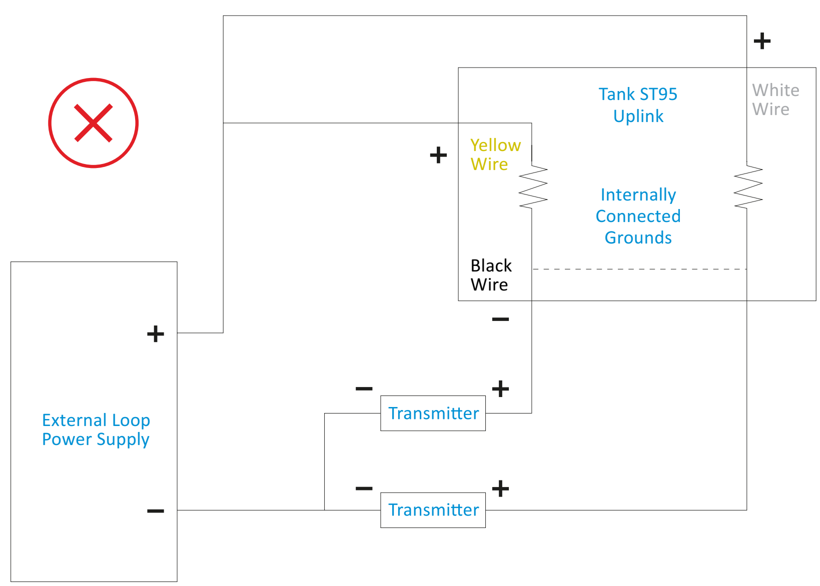
Powering 2 ST95 loops from the same external power supply



Correct Wiring Configuration

Incorrect wiring of both loops

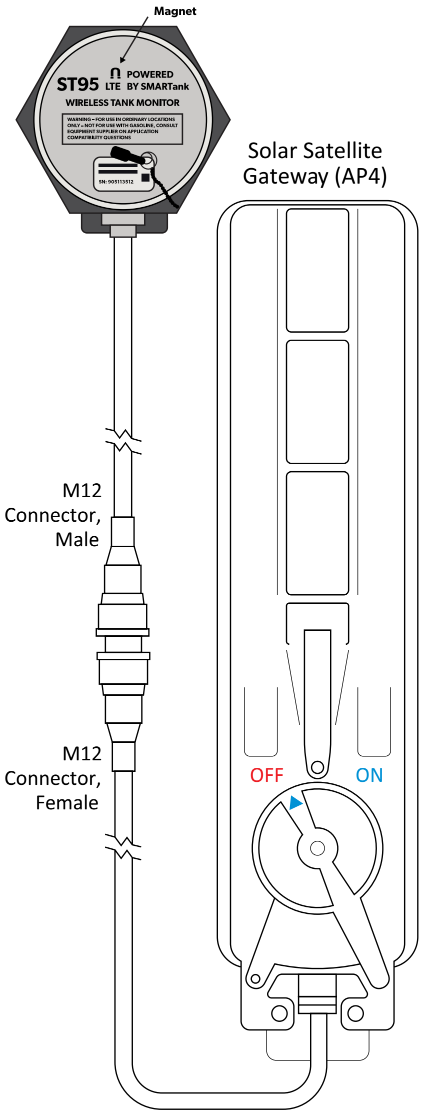
with shared external power supply



Incorrect Wiring Configuration

Both inputs will read the same value

Tank Monitor (ST95)



7.4 Installation

7.4.1 Site Layout Test (at the Office)

Open the box containing the Solar Satellite Gateway (AP4) and ST95 tank monitor.

Verify the AP4 is the mate to the ST95 unit. RTUID on AP4 must match the RTUID on ST95 lid label.

You will need to test communications first by activating the AP4: Plug in the cable attached to the ST95 lid to the cable attached to the AP4.

At the back of AP4, rotate the switch from “OFF” to “ON” position. Remove tape.

The AP4 will play a sound indicating it is powered up and then trigger the ST95 monitor to initiate its callout sequence.

Place the AP4 in a window or outside facing the open sky.

Observe the flashing green light through the lid:

- **No light is observed:** Call Customer Care.
- **Flashing light:** wait until stops and check for a callout.
- **No callout found:** initiate a second callout by swiping the magnet over the symbol on the lid and observe the flashing light. If there is still no callout, contact Customer Care.

Once finished you may check for an update on the Website. Thereafter, please use the magnet for future calls.

When the AP4 triggers the ST95 Host to initiate and complete its callout sequence **correctly**, immediately take the AP4, ST95, and mounting hardware to the tank site. **Turn off the AP4.**

7.4.2 ST95 Host Installation

The ST95 Host is ideally suited to support the needs of a Tank Farm. It can communicate with up to 32 devices and update the Website accordingly. It is also capable of supporting two Sensors remotely wired to it. The connections are industry standard 4/20 mA capable inputs.

You must use Certified 4/20 mA Sensors and they must meet the Entity requirements in the Control Drawings -n (section 7.2) and are Certified Intrinsically Safe for Class 1, Div. 1 Group D. The customer is required to determine the suitability of the Sensor and the associated wiring.

7.4.2.1 Mounting a Host Device

- The cable is 10 feet long. It must be routed and secured.
- Requires a location that will be within its operating range of 300 feet of all its assigned Clients, assuming Clients are used.
- The ST95 device is mounted with the Universal Mounting kit supplied.
- Determine from the parts the best configuration to use in your application.
- Use the 2 in. Pipe Clamp to hold the ST95.

7.4.2.2 Site Survey

We suggest a site survey to determine the possible mounting locations for the ST95 and AP4.

HOST	LED DESCRIPTION
Power ON	A slow GREEN LED flashes followed by alternating GREEN LED and RED LED flashes
Communication begins with the AP4	RED LED will go out and the GREEN LED will start to flash slowly while attempting to talking to the AP4
Data is loaded into the AP4	GREEN LED will go steady on
Successful Call	GREEN LED flashes and goes out

If the call is unsuccessful, the RED LED will light with the GREEN LED flashing with the error number.

7.4.3 Mounting the ST95 Host to Solar Satellite Gateway (AP4)

Use wire ties as the preferred method.

Start the Host with the magnet to update the Website as a test.

Make sure **all Client units** have called in with their update.

The AP4 cable and the ST95 cable plugs into each other and screws together. Make sure they are tight.

Mount the AP4 to maximize sunlight exposure with the solar panel side showing **'THIS SIDE TO SKY'** facing the sun to charge its Battery.

It has magnetic feet which can be your mounting method. The magnets may be removed and then screws can be used to secure it to the chosen mounting location if desired.

The deployed location **should not** be in any shade, under roofs, overhangs, trees, covers, etc.; along with protection from activities which may subject to damage.

Turn on the AP4 power. The ST95 Host callout will start. That could take several minutes to initially power up the ST95 Host and make that first callout.

- If the GREEN LED is not flashing after the AP4 powers on, please refer to the troubleshooting section of the Operators manual (AMETEK LMS bulletin 41-622.
- At the end of a callout attempt the ST95 Host flashes the GREEN LED 3 times to indicate success. It turns on the RED LED and flashes the GREEN LED to indicate an error number. For 1–3 flashes, contact Customer Support.
- Extended cable is available as an accessory.

7.4.4 ST95 Client Installation

If you are using the Host to communicate to Clients, it is suggested to assign each Client to the Host before installation in the tank.

Once this is done and you have tested the communications you may then mount each Client in the tank.

At this point you can choose your desired location for the Host/AP4 for a test.

Follow the LED Description table to read the strength of the WLAN signal or interpreting the lights.

Test the Host to see that it can communicate to all Clients from the location you chose.

You can start the Host magnetically.

Repeat the test again to ensure that communications are stable.

CLIENT	LED DESCRIPTION
Power ON	A slow GREEN LED flashes as the Client starts up, the GREEN LED and RED LED alternately flash indicating that the Client is attempting to contact a Host. The Client attempts to find any Host on any WLAN channel
Any Host found	The RED LED turns off and the GREEN LED flashes to indicate a Host was found. The Host will then report the Client to the Data Center. Allow three minutes before starting the next Client to allow the Host to complete the cell
No Host found	The GREEN LED and RED LED continue to flash for approximately 32 seconds and then the RED LED changes to steady on and the GREEN LED slowly flashes six times to indicate no Host was found
Note	Once the GREEN LED is blinking do not press the button. If you do the unit will re-start its signal search. You may need to press the button after the initial light sequence is finished. The button is loacted opposite the battery connector. By pressing the button, the unit will begin its search for a signal

Sequence applicable to units that have not been associated with a host device via the portal.

7.5 Troubleshooting a Failed System

7.5.1 First Time Charge Cycle Failure

1. Whenever the AP4 is turned on expect the green light to blink once per second. The Super Capacitor that is used to store energy will always need to be recharged even if only briefly.
2. Startup when a system is first energized will take up to four or five minutes to charge.
3. A system that has been started in the past may take a minute or two to reach full charge.
4. If doing an initial startup up it is possible that the AP4 will not be able to get to a full charge in one cycle. If the “once per second” blink stops before communication has occurred it will be necessary to restart the process. Use the magnet or Start Switch or cycle the power on the AP4 to start another charge cycle.

7.5.2 No Lights

1. Upon powering up the AP4 the first time a blinking green light should be visible. If no light is seen this would indicate a possible failure.
2. Inspect the cable from the AP4 to the ST95. Make sure the connector on the AP4 is securely plugged in. Ensure that the cable has no defects such as a cut in the cable sheath.
3. Open the lid and inspect the wires that are attached to the circuit board. Pull on each of the five wires to make sure they are securely fastened.
4. If a Voltmeter is available measure the voltage from the AP4. It can be measured on the red and black wires. The voltage is variable and should be in the range of 7 to 8 Volts. You should restart the AP4 by cycling it from off to on before trying to measure the voltage.
5. Measure the Wakeup signal using the Voltmeter. Measure 3.3V from the black wire to the Brown wire. If the Microprocessor is running, that is the SuperCap is still charged, then the wakeup signal is held low. If the voltage is between 3.3V and ground then a problem is indicated. Customer Service will advise you with this problem.
6. If no voltage is measured from the AP4 (Red Black) this probably indicates it needs to be charged. Leave it outside where the Sun can recharge the Battery. This could take a couple of days depending on the weather. The factory fully charges the AP4 Battery at the time of manufacturing, however it may be in storage for up to two years which is the useful life of the Battery without being charged by Solar.

While we expect it to work if put into service within the two year period the customer may have it in storage for an additional time which could result in the AP4 not being able to power the ST95. The customer should leave the Satellite system installed and wait to see if it starts after sufficient time has passed to recharge the Battery. It is expected that once a usable charge is obtained by the AP4 it will start the system on its own.

7.6 AP4 to ST95 Connection Troubleshooting Guide

If the ST95 Host does not flash the GREEN LED indicating a call out in progress when the AP4 powers on, then use the ST95 Host attached magnet to initiate a callout by swiping the magnet over the magnet icon on the lid.

If the above does not work, then the AP4 must be power cycled to restart the process:

- Rotate the AP4 Switch from the “ON” position to “OFF” position. The AP4 should generate a sound indicating it is powering off.
- Reconnect the ST95 Host to the AP4 by aligning the connectors, mating them and screwing together tightly.
- Turn on the AP4 power. The ST95 Host callout will start. That could take several minutes to initially power up the ST95 Host and make that first callout. Next make sure the ST95 Host cable is properly and fully connected to the AP4 connector.
- Now rotate the AP4 Switch back to “ON” position.
- The AP4 should generate a sound indicating it is powering on.
- Check the ST95 Host LEDs to verify the GREEN LED is flashing indicating the callout in progress

Reconnect the ST95 Host to the AP4 by aligning the connectors, mating them and screwing together tightly.

Turn on the AP4 power. The ST95 Host callout will start. That could take several minutes to initially power up the ST95 Host and make that first callout.

FLASHES*	FLASH DESCRIPTION
1	Generic failure. Cause undetermined.
2	Startup failure. Possible inability to communicate with the AP4.
3	Unable to get enough power from the AP4.
5	Messages already pending in AP4 (Does AP4 have a clear view of the sky?) The AP4 is waiting to send existing messages on the next satellite pass.
8	AP4 buffer could not hold all messages. Remainder of messages will be sent on an automatic retry callout on the next satellite pass.

* Number of GREEN LED Flashes while RED LED is on.

8.0 ST90 AC Powered Cellular Uplink Host

8.1 Introduction

Please read all the instructions before you begin the installation. Performing a test of your site layout is highly recommended.

Perform a site survey to determine the possible mounting locations for the host and the power box. The cable between them is 50 feet long. It must be routed and secured in a non-hazardous location. This also means that the cable shall not be routed through a hazardous location.

Mounting the host device requires a location that will be within its operating range of 300 feet of all its assigned clients.

The host device is mounted with the supplied universal mounting kit. Determine from the drawing the best configuration to use for your application.

Verify that AC power (85-130VAC) is available at the desired mounting location of the box. The line cord may be cut and the cord grip removed and replaced with a conduit hub, if it is desired to pipe conduit directly to the box. Cut the cord and leave 4 inches of wire connected to the power supply and splice them into the wires coming in from the conduit. Connect with wire nuts and tape securely.

Mounting feet are attached to the bottom of the box. Adjust them to the desired position and tighten the screws well. The box can be screwed securely to plywood or concrete with the proper anchors.

The power box has a lighted switch which has the same function as the switch in the host housing. It provides an update to the website. This light is the same as the green light in the host. The green LED should start flashing. Do not open the host as there is no battery or serviceable parts enclosed.

For more information about the host or the clients, contact Customer Service.

The AC powered host is ideally suited to support the needs of a tank Farm. It can communicate with up to 32 tanks and update the Website accordingly by pushing the button on the power box.

It is also capable of supporting two Sensors remotely wired to it. The connections are industry standard 4–20 mA capable inputs. Two cord grips are available on the front of the junction box for wiring the sensors. You may connect any 4–20 sensor to these inputs. Contact customer support for help if this is the intended application. The Website must be set up to support it.

8.2 Installation

- It is suggested to assign each client to the host before installation in the tank. Once this is done and you have tested the communications you may then mount each client in the tank.
- Check the level in the tank that it agrees with the website.
- At this point you can choose your desired location for the host. A higher position is more desirable than a low position. Because the cable is limited to 50 feet the location you choose is not easily repositioned. Temporarily mount the Host for a test. Customer Support can help you with this task by reading the strength of the WLAN signal.
- Test the Host to see that it can communicate to all clients from the location you chose. There is a push button located on the inside of the housing to upload communications manually.
- The next task is to mount the host and secure the cable along its route. Use wire ties as the preferred method.
- Next mount the box with screws as applicable. Apply power to the unit either using the line cord or other method as required.
- Push the button on the box to start a website update as a test. Make sure all the clients have called in with their update. Note that the green light is functioning.
- For external sensor wiring see below. Route the sensor cable through the cord grips and tighten securely. For installations where the customer equipment is supplying +24V DC.

8.2.1 Host Startup

INDICATOR LIGHTS

Condition	LED Description
Power ON	A slow green LED flashes followed by the green & red LEDs alternating flashes.
Active on Cellular Network	Red LED will go out and the green LED will begin to flash slowly while attempting to register on the cellular network.
Connected to Cellular Network	Green LED will remain on
Successful Call	Green LED will flash, then remain off
For Unsuccessful Calls, the Red LED will remain on and the Green LED will flash the amount of times corresponding to the error number.	

WARNING: The AC HOST is **NOT** for use in hazardous locations. Both the Host Tanklink Monitor and the power and control box must be mounted in a non-classified area.

8.2.4 Safety Precautions

The ST90 AC Host uses GSM or CDMA cellular services, using Radio Frequency (RF) waves to communicate with the nearest cellular tower. It transmits at several times the power of a hand-held cellular phone.

If you can place a cell phone call from the ST90 AC Host location, then the unit should be able to communicate properly. However, because of the inherent characteristics of RF communications, you should follow certain guidelines when positioning a ST90 AC Host using a cellular service:

- Don’t use the ST90 AC Host in hospitals or near medical equipment.
- Don’t install the ST90 AC Host where hazardous vapors are present.
- Don’t use the ST90 AC Host where blasting is in progress.
- Do be sure to touch a grounded object before working on any internal circuit board. Electrostatic discharge can damage sensitive electronic components.
- Do locate the ST90 AC Host using GSM or CDMA cellular service in an area free from overhanging metal structures, large obstructions, or equipment which could generate RF or electrical interference.
- Don’t install the ST90 AC Host using GSM or CDMA cellular service below ground level unless provisions are made for an external antenna.
- If the ST90 AC Host is installed in an area with poor signal strength, an external antenna is required for reliable performance.

- Please call for technical assistance if you have doubt about the location for the ST90 AC Host or are having difficulty transmitting. If an external antenna is required, several optional antennas are available.
- Contact Customer Support to determine your exact needs.

8.3 AC Powered Host Connection

The power must be disconnected when servicing or accessing the inside of the AC Powered Host unit.

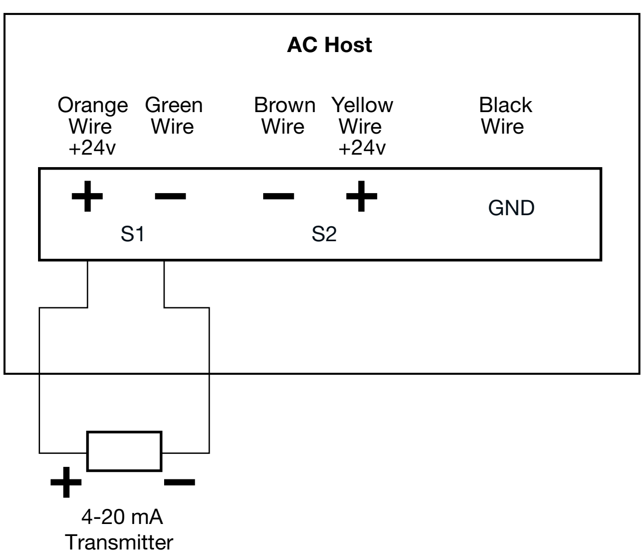
The unit has no auxiliary power switch and is permanently powered.

A dedicated circuit breaker is recommended to control AC power to the unit.

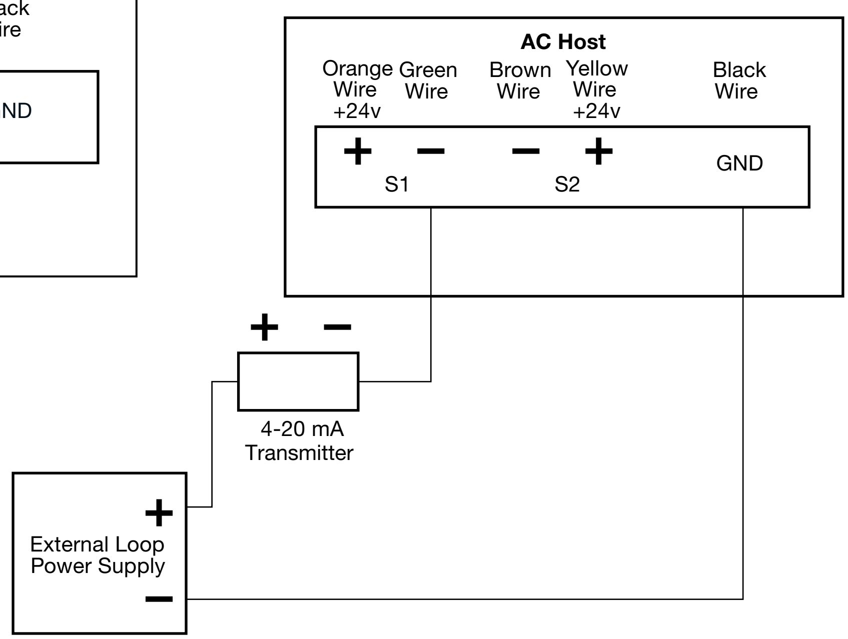
AC power to the Host is completed at connection J7, located in the right side of the lower panel of the unit. Remove the lower panel front cover to reveal J7.

Connect AC power (100 -130 VAC 50/60 Hz) single phase to J7. The conduit opening on the bottom right of AC Powered Host is provided for AC power. Only AC power wiring should pass through this single conduit opening.

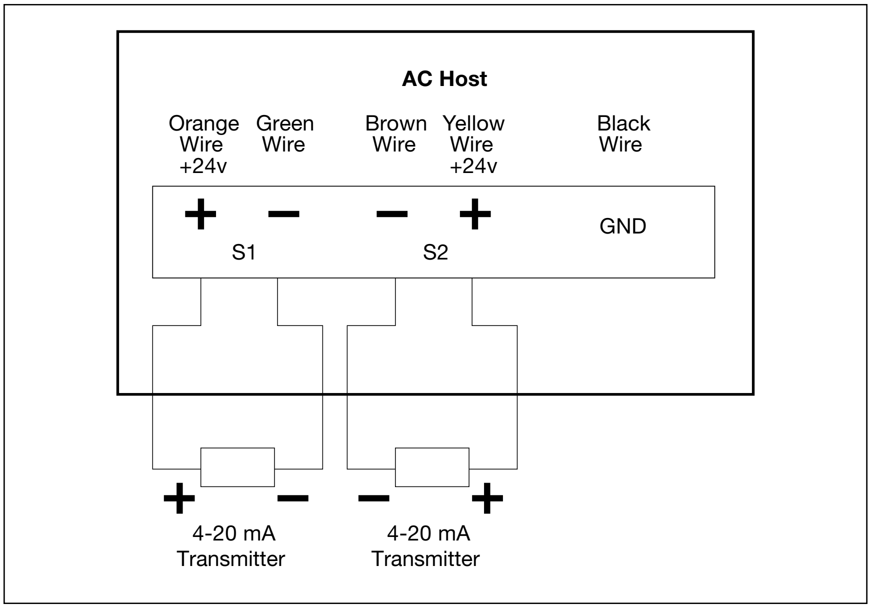
8.4 Wiring Guides



Powering Single Device from AC Host

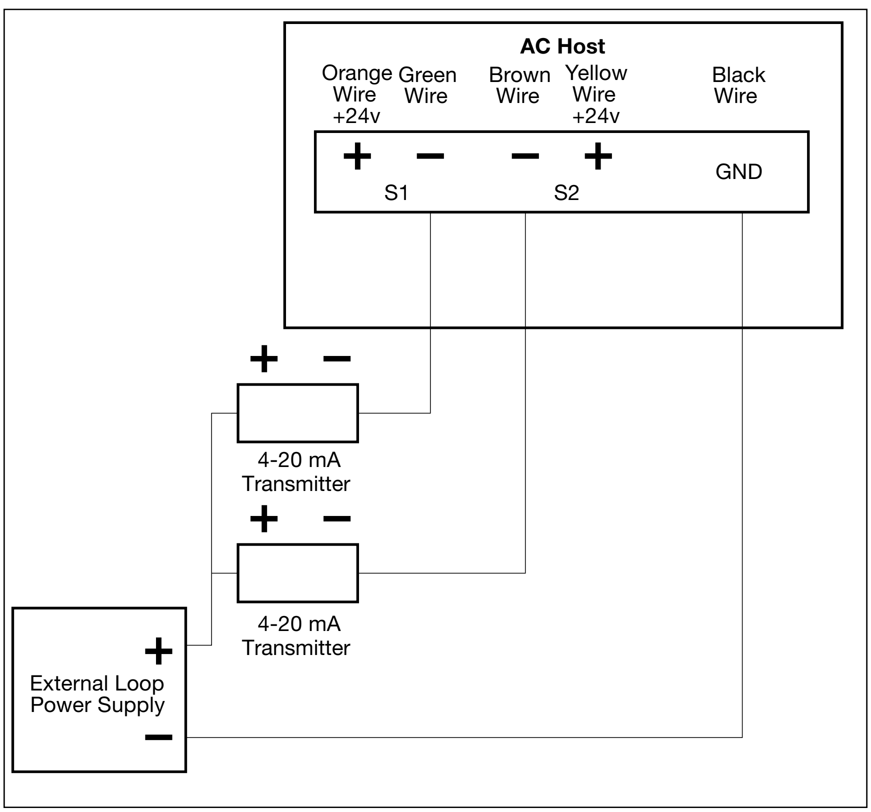


Using External Power Source for Single Loop with AC Host



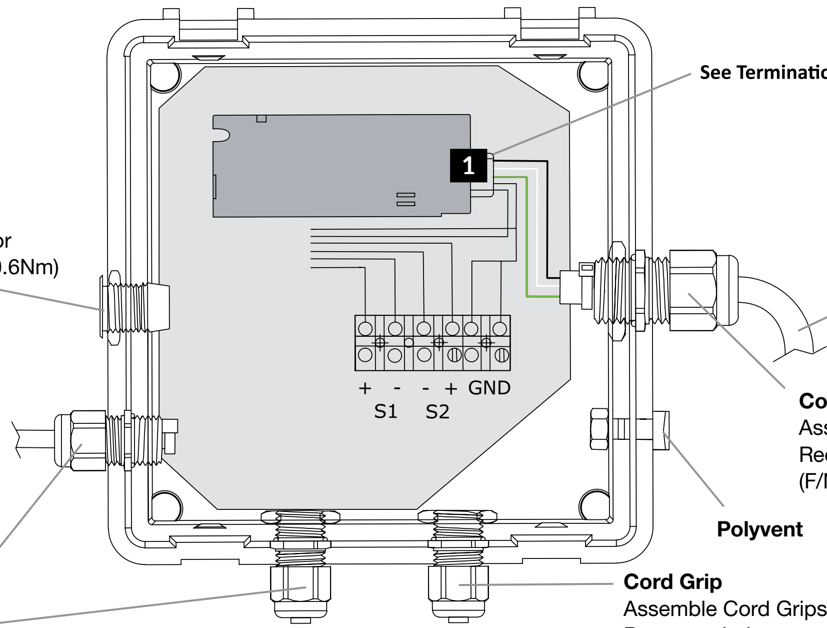
Using both AC Host 4-20mA Inputs

Powering 2 Devices from AC Host



Powering 2 AC Host Loop with External Power Supply

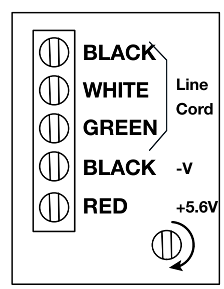
8.5 Top View Diagram



AC POWERED HOST CABLE TERMINATION TABLE			
FROM MAIN ELECT ENCLOSURE ST90 WIRING BD P/N 070-11201		TO AC POWERED HOST ELECTRONICS ENCLOSURE	
WIRE COLOR	FROM J2	FUNCTION	TO
ORANGE	J2-4	Vout-S1	Term. Block, Side B + S1 (Circuit 1 Vout, 24V+)
GREEN	J2-1	Input 1-CL	Term. Block, Side B -S1 (Circuit -1 Input)
BROWN	J2-2	Input 2 – CL	Term. Block, Side B -S2 (Circuit 2 – Input)
YELLOW	J2-10	Vout-S2	Term. Block, Side B +S2 (Circuit 2 Vout, 24V+)
BLACK	J2-5	Ground	Term. Block, Side B, position 5 and 6 from Ground

1 Detail of Front view

Power Supply detail-2



Adjust the power supply to max by rotating the adjustment fully clockwise

Line cord not included

8.6 Troubleshooting

Power Supply

1. Identify the power supply of the 4-20mA loop, which can be either an external supply or the internal supply within the ST90 (+24V).
2. If using an external power supply, use a multi-meter to measure the voltage at its output terminals. Ensure that the required voltage is present. If the voltage is lower than expected, address the power supply issue before proceeding. If using the ST90 internal supply, proceed to the next step.
3. Place multi-meter leads on the +24V output of the ST90 and GND (orange and black wires, respectively). Swipe the attached magnet across the designated area on the ST90 lid to activate the internal power supply. A +24V reading should register on the multi-meter for a few seconds. The duration of power presence, known as the “warm time,” can be configured through the BrightTEK portal. Repeat this process for the second loop if both are in use (yellow for +24V and black for Ground). If either loop fails to output 24V, there’s an issue with the internal power supply, and customer support should be contacted. Note: A slightly lower voltage (e.g., 21 or 22V) is normal and doesn’t indicate a failure.
4. If the power supply delivers the correct voltage, proceed to the next stage of troubleshooting.

Sensor/Transmitter

1. Check the 4-20mA loop wiring, ensuring alignment with the appropriate wiring guide.
2. Turn off the loop power supply. If using ST90 internal power, wait until 24 volts is no longer measured on the power lines (see Power Supply section). This typically takes 2–3 minutes.
3. Prepare to measure current through the loop using one of these methods:
   - Use a current clamp capable of measuring 4-20 mA DC signals; place the clamp around the 4–20 mA signal wire.
   - Place a multimeter in line with the loop in current measuring mode.
   - Insert a 100-ohm resistor in line with the loop and use a multimeter to measure voltage across the resistor. Current in the loop is the measured voltage divided by 100.
4. Turn on the loop power. If using ST90 internal power, press the button on the enclosure.

5. Note the measured value of the current flowing in the loop. It should be between 4 and 20 mA. If the value of the current is zero, there may be an open circuit and the wiring should be checked. If the wiring is verified to be correct and the value is outside of the 4–20 mA range, there is likely a problem with the sensor.
6. If using both ST90 current loops, repeat the process with the second loop transmitter.

ST90 Receiver

1. Check the 4-20mA loop wiring, ensuring alignment with proper wiring guide.
2. Using one of the methods for measuring loop current discussed in the Sensor/Transmitter troubleshooting section, prepare to measure the loop current.
3. With a multimeter, measure voltage across the input of the ST90 by placing the positive lead on the green wire and negative lead on the black wire. For a second loop, use brown and black wire.
4. With power supplied to the loop (see previous sections for activating internal ST90 power), note the current measurement in the loop and the voltage measurement across the input terminals of the ST90.
5. The measured voltage across the input terminals of the ST90 should be approximately equal to the measured current multiplied by 147. While it may not be precisely 147 times, it should be within ±5%. If not, there is a hardware issue with the ST90, so contact customer support. If the measured voltage is correct, proceed to the next step.
6. Check the BrightTEK portal and compare the sensor reading to the measured current value of the loop. For instance, a tank that shows 50% full on the BrightTEK portal should correspond to a value of 12 mA (4 mA = 0% and 20 mA = 100%). If the value of the measured current does not align with the tank reading, there may be an issue with the sensor configuration via the website. Contact customer support for assistance with website configuration.

9.0 Model Number

1 2 3 4 5 6 | BASE CODE

W R L S T 9	Model Series ST9X - Cellular Uplink / 900 MHz Uplink Client / Cellular AC Host / Satellite Uplink Host

7 | MODEL TYPE

0	ST90 - AC Powered Uplink Host
5	ST95 Cellular or Satellite Uplink / Uplink Client

8 | COMMUNICATIONS TYPE / SIM

H	GSM – AT&T (Host)
W	CDMA – Verizon (Host)
L	900 MHz – Radio (Client)
M	Satellite Host

9 | Sensor Input / Type / Housing

1	Single 4-20mA Input / ST95 Uplink and/or Uplink Client / CPVC
2	Dual 4-20mA Input / ST95 Uplink and/or Uplink Client / CPVC
B	Dual 4-20mA Input - AC Powered Host / ST90 AC Powers Host / CPVC with External Antenna

10 | OPEN FOR FUTURE USE

0	Standard

W R L – S T 9 _ – _ _ 0

NOTES:

1. DO NOT INSTALL THE ST95LC1 WHERE HAZARDOUS VAPORS ARE PRESENT.
2. INSTALLATION TO BE IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS.
   REFER TO 903-00021 ST95 LTE INSTALLATION MANUAL.
   IF USING THE UPLINK MODEL ON PAGE 1 OF THIS DRAWING SEE ALSO CONNECTION CHART.
3. INTRINSICALLY SAFE CIRCUITS MUST BE WIRED AND SEPARATED IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE (ANSI/NFPA 70), OR OTHER LOCAL CODES, AS APPLICABLE.
4. THE REMOTE ST95M HOUSING MUST BE SUPPORTED FIRMLY USING THE OPTIONAL MOUNTING BRACKET. LOCATE THE HOUSING IN A NON-CLASSIFIED AREA DEEMED TO BE SAFE.
5. TABLE 1 DEFINES THE INTRINSICALLY SAFE ENTITY PARAMETERS

TABLE 1:

I.S. Equipment		Associated Apparatus
V max (or Ui)	≥	Voc or Vt (or Uo) = 27.45V
I max (or Ii)	≥	Isc or It (or Io) = 0.077A
P max, Pi	≥	Po =0.524W
Ci + Ccable	≤	Ca (or Co) =1.12uF
Li + Lcable	≤	La (or Lo) = 24mH

6. THIS ASSOCIATED APPARATUS MAY ALSO BE CONNECTED TO A SIMPLE APPARATUS AS DEFINED IN ARTICLE 504.2 AND INSTALLED AND TEMPERATURE CLASSIFIED IN ACCORDANCE WITH ARTICLE 504.10(B) OF THE NATIONAL ELECTRICAL CODE (ANSI/NFPA 70), OR OTHER LOCAL CODES, AS APPLICABLE.
7. CAPACITANCE AND INDUCTANCE OF THE FIELD WIRING FROM THE INTRINSICALLY SAFE EQUIPMENT TO THE ASSOCIATED APPARATUS SHALL BE CALCULATED AND MUST BE INCLUDED IN THE SYSTEM CALCULATIONS AS SHOWN IN TABLE 1. CABLE CAPACITANCE, CCABLE, PLUS INTRINSICALLY SAFE EQUIPMENT CAPACITANCE CI MUST BE LESS THAN THE MARKED CAPACITANCE, CA (OR CO), SHOWN ON ANY ASSOCIATED APPARATUS USED THE SAME APPLIES FOR INDUCTANCE (LCABLE, LI AND LA OR LO, RESPECTIVELY). WHERE THE CABLE CAPACITANCE AND INDUCTANCE PER FOOT ARE NOT KNOWN, THE FOLLOWING VALUES SHALL BE USED:
   CCABLE = 60 PF/FT., LCABLE = 0.2 uH/FT.
8. WHERE MULTIPLE CIRCUITS EXTEND FROM THE SAME PIECE OF ASSOCIATED APPARATUS, THEY MUST BE INSTALLED IN SEPARATE CABLES OR IN ONE CABLE HAVING SUITABLE INSULATION. REFER TO ARTICLE 504.30(B) OF THE NATIONAL ELECTRICAL CODE (ANSI/NFPA 70) AND INSTRUMENT SOCIETY OF AMERICA RECOMMENDED PRACTICE ISA RP12.6 FOR INSTALLING INTRINSICALLY SAFE EQUIPMENT.
9. THIS ASSOCIATED APPARATUS HAS NOT BEEN EVALUATED FOR USE IN COMBINATION WITH ANOTHER ASSOCIATED APPARATUS.
10. THE ST95LC1 UPLINK VERSION IS SUPPLIED WITH A FACTORY WIRED CABLE OF 10 FT. IN LENGTH HAVING THE FOLLOWING CHARACTERISTICS:
    - TYPE: 8 CONDUCTOR SHIELDED CABLE
    - RATED VOLTAGE: 300 Vrms
    - SHIELD: ALUM/MYLAR FOIL
    - TEMPERATURE RANGE: 80 DEG C
    - CONDUCTOR SIZE: 24 (7/30) AWG
    - INSULATION TYPE: PVC
    - JACKET INSULATION THICKNESS: 0.030 INCHES
    - CERTIFICATIONS: UL AWM/STYLE 2464. LISTING AVLV2-E319028
11. SUITABILITY FOR INSTALLATION IN PARTICULAR APPLICATIONS IS AT THE DISCRETION OF THE AUTHORITY HAVING JURISDICTION (AHJ).
12. THE UPLINK CONFIGURATION IS TERMINATED ON THE LEFT SIDE OF THE DWG. THE CABLE IS 10 FEET LONG. THE CUSTOMER SENSOR MUST BE DEFINED AND WIRED BY THE CUSTOMER. SEE TABLE FOR CABLE COLORS AND FUNCTION FOR THE UPLINK.

REV	REVISION DESCRIPTION	ECO NO	DWN	APP	DATE
A	NEW RELEASE	SN426	M.H.		02-20-24

SkyBitz Tank Monitoring
- TELULAR CORP.-
200 SOUTH WACKER DRIVE, SUITE 1800, CHICAGO, IL 60606 USA.

☐ CERTIFICATION DRAWING

UNLESS OTHERWISE SPECIFIED ALL PARTS ARE TO BE FREE OF BURRS AND SHARP EDGES. DIMENSIONS ARE IN INCHES (MILLIMETERS ARE IN PARENTHESES)
TOLERANCES
FRACTIONAL ±1/64 .XX ± 0.01
ANGULAR ±1/2° .XXX ± 0.005
DO NOT SCALE DRAWING

MAT'L: SEE B.O.M.
FINISH: ---

TITLE: ST95LC1-W00N4/64HU-420 SYSTEM CONTROL DWG.
DWN: B.W. & M.H. DATE: 02-20-24
CHK: – DATE: –
APP: – DATE: –
DWG NO. 906-00020 REV A
DWG SIZE D | SCALE 1:1 | PLOT – | CAD NO. – | SHT 1 OF 3

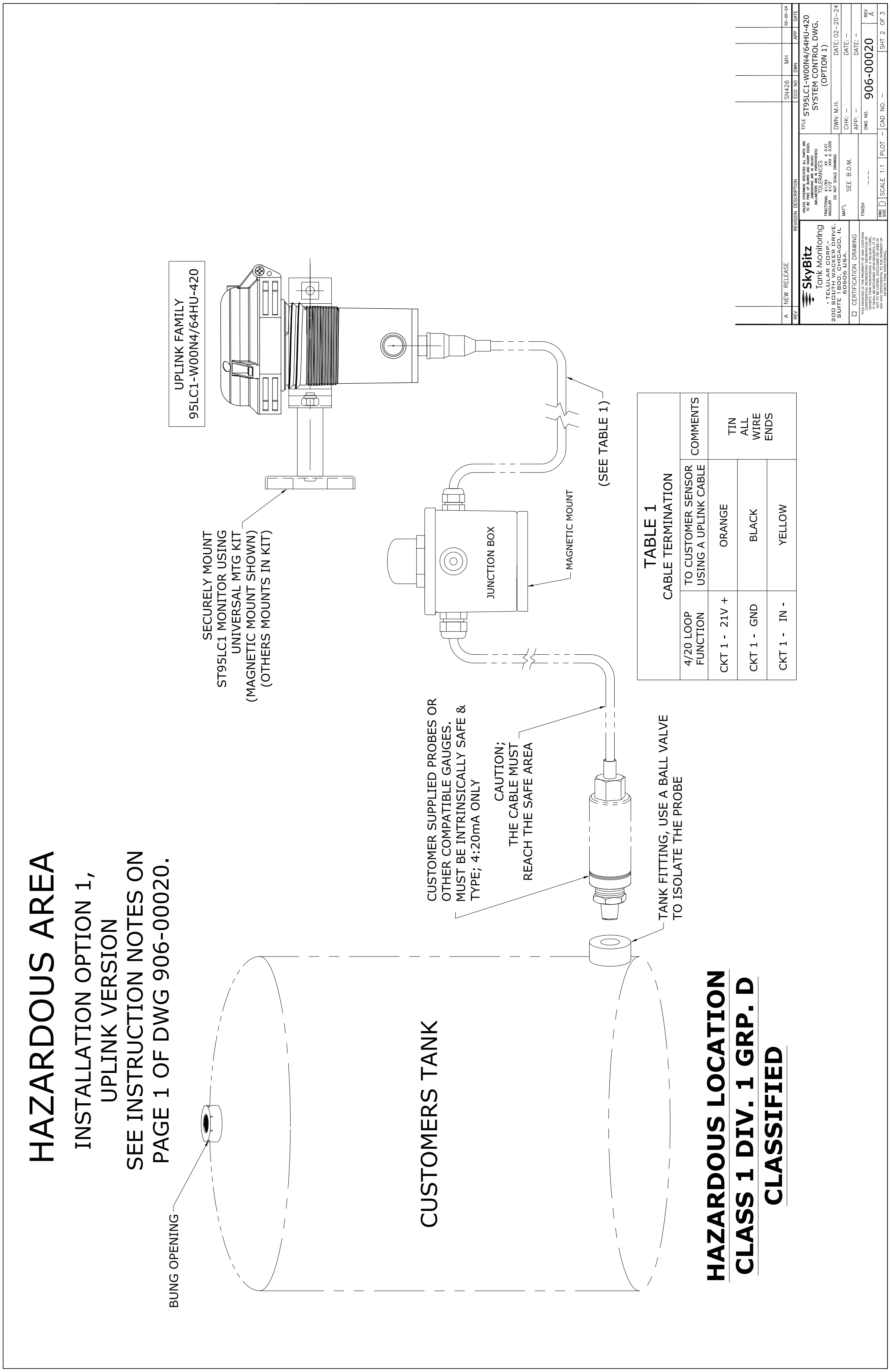
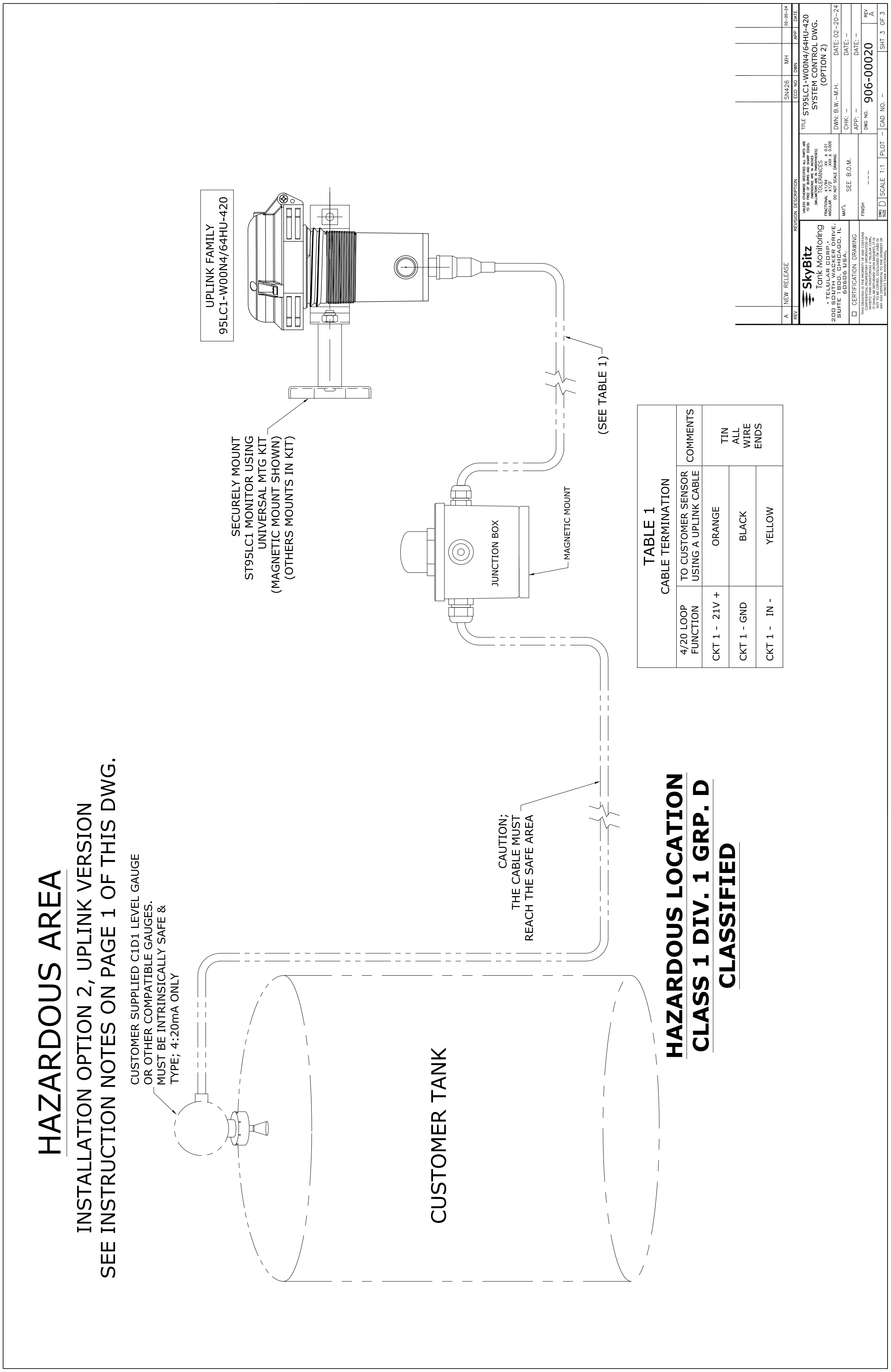


TABLE 1
CABLE TERMINATION

4/20 LOOP FUNCTION	TO CUSTOMER SENSOR USING A UPLINK CABLE	COMMENTS
CKT 1 - 21V +	ORANGE	TIN ALL WIRE ENDS
CKT 1 - GND	BLACK	
CKT 1 - IN -	YELLOW	

Appendix — Control Drawings



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BULLETIN: 41-622.4
EFFECTIVE: February 2025
SUPERSEDES: July 2024