VIVAX METROTECH

Fiber Optic Locate System 2 (FLS-2) User Handbook
(English Edition)

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$\mathsf{C}\,\mathsf{E}$

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Table of Content

1.   General Safety

This document contains essential advice for installing and operating the Vivax-Metrotech FLS-2 transmitter. Follow these safety instructions when handling the transmitter, its modules, or troubleshooting.

NOTE
The manufacturer is not liable for damages to materials or harm to humans due to the non-observance of the instructions and safety advice provided in this document. Therefore, this document should be provided and reviewed by all personnel associated with its installation and use.

- **Intended personnel**
  Vivax-Metrotech utility line locators are intended for use by utility and contractor professionals. Safety hazards for underground utility access areas include electrical shock, explosive gases, toxic fumes, and a potential influence on communications and control systems such as traffic control and railroad crossings.

- **Intended application**
  A safe operation is only achieved by using the transmitter for its intended purpose. Using the transmitter for other purposes may lead to human danger and equipment damage. Do not exceed the limits described in this document.

- **Output Signal and fiber optic cables**
  The transmitter output signal is high voltage. When the transmitter sends a signal, the fiber optic cable sheath and connections may be energized up to 300V AC TO 450V DC. Keep a safe distance from these cables and connections.

- **Lightning strikes**
  The transmitter must be installed with proper lightning protection. Damage to the transmitter may occur if it is not correctly installed and protected from lightning strikes. We do not recommend that you operate or perform maintenance on the transmitter if there is a pending electrical storm near the transmitter or the buried cable.

- **Modules**
  Before removing any modules, turn the rear power switch off. The modules were not designed to be hot-swappable.

- **Malfunctioning behavior**
  Use the transmitter only when it is working correctly. When irregularities or malfunctions appear that this document cannot resolve, the transmitter must immediately be put out of operation and marked as not functional. Contact technical support. Only operate the transmitter after resolving the malfunction.

- **Repair and maintenance**
  Service and repairs can be performed only by Vivax-Metrotech Corporation.

2.   Service and Support

2.1   Serial Number and Software Revision Number

Serial Number: The transmitter serial number can be found on a label fitted on the lower-left corner of the top of the chassis. The serial number for the hand-held unit is found on its back.

Software Revision Number: The firmware revision of the transmitters and hand-held units can be found in the **About** section of the hand-held unit.

Before contacting Vivax-Metrotech technical support, have the following information: station ID, station name, and chassis serial number (optional).

1	Serial number

2.2   Distributors and Service Centers Closest to You:

Worldwide Sales Offices and Service Centers	
World Headquarters, United States of America	**Central/South America and the Caribbean**
Vivax-Metrotech Corporation 3251 Olcott Street, Santa Clara, CA 95054, USA T/Free : 1-800-446-3392 Tel : +1-408-734-1400 Fax : +1-408-734-1415 Website : www.vivax-metrotech.com Email : SalesUSA@vxmt.com	**Ventas para América Latina** 3251 Olcott Street, Santa Clara, CA 95054, USA T/Free : 1-800-446-3392 Tel : +1-408-734-1400 Fax : +1-408-743-5597 Website : www.vivax-metrotech.com Email : LatinSales@vxmt.com
Canada	
Vivax Canada Inc. 41 Courtland Ave Unit 8, Vaughan, ON L4K 3T3, Canada Tel : +1-289-846-3010 Fax : +1-905-752-0214 Website : www.vivax-metrotech.ca Email : SalesCA@vxmt.com	**France**
Germany	**Vivax-Metrotech SAS** Technoparc – 1 allée du Moulin Berger, 69130 Ecully, France Tel : +33(0)4 72 53 03 03 Fax : +33(0)4 72 53 03 13 Website : www.vivax-metrotech.fr Email : SalesFR@vxmt.com
Metrotech Vertriebs GmbH Am steinernen Kreuz 10a, 96110 Schesslitz,Germany Tel : +49 9542 77227-43 Website : www.vivax-metrotech.de Email : SalesEU@vxmt.com	
China	**United Kingdom**
Vivax-Metrotech (Shanghai) Ltd. 3/F No.90, Lane 1122 Qinzhou Rd.(N), Shanghai, China 200233 Tel : +86-21-5109-9980 Fax : +86-21-2281-9562 Website : www.vivax-metrotech.com Email : SalesCN@vxmt.com.cn	**Vivax-Metrotech Ltd.** Unit 1, B/C Polden Business Centre, Bristol Road, Bridgwater, Somerset, TA6 4AW, UK Tel : +44(0)1793 822679 Website : www.vivax-metrotech.co.uk Email : SalesUK@vxmt.com
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Vivax-Metrotech AUS Unit 1, 176 South Creek Road, Cromer NSW 2099, Australia Tel : +61-2-9972-9244 Fax : +61-2-9972-9433 Website : www.vivax-metrotechaus.com Email : Sales@vxmtaus.com	**Shanghai Vimap Technology Co. Ltd.** 9/F, Building 89, Xinhuiyuan, No.1122 Qinzhou North Road, Shanghai, China 200233 Tel : 4000-999-811 Website : www.vimap.cn Email : info@vimap.cn

3.   Document Conventions

This section describes the document text conventions, document icons, symbols, and the icons and symbols on the hand-held display screens.

Document Convention	Description
Bold type	Command names, keywords, and button names

Table 3-1 Document Convention Description

Several symbols are used in this document that highlights important notes, functional purposes, or potential hazards that could cause severe injury or death. Please pay attention to these symbols when you see them.

Symbol	Meaning	Descriptions
	Caution and Warnings	This symbol appears next to important information, indicating a potentially hazardous situation for you or the system if ignored. Take every precaution to follow these statements.
	Note	This symbol appears next to useful or important information.

Table 3-2 Symbol Descriptions Used

The hand-held display unit shows graphic icons and symbols on several screens. For your convenience, they are summarized here.

Symbol	Meaning	Descriptions
8K 8K	**Mode selected**	When a mode or option is selected or available to be selected, it will have a black background. Modes or options that are not available will have a grey background.
ACTIVE STANDBY	**Status**	When the transmitter is in active mode, the word ACTIVE will be shown green in the Status field. When the transmitter is in Standby mode, the word STANDBY will be shown in black in the Status field.

Reinstall	**Option enabled**	The button for an enabled option appears with white text over a black background.
Next	**Command unavailable**	The button for an unavailable command appears dimmed, having white text over grey background.
Next	**Command available**	The button for an available command appears with white text over a black background.
Clear	**Clear**	Clear the entire entry.
⌫	**Delete**	Delete one character at a time.
《 》	**Large number adjustments**	Large adjustments up or down for the programmable number.
‹ ›	**Small number adjustments**	Small adjustments up or down for the programmable number.
ShDn	**Shut down**	When selected, the options to restart or power off the unit are shown.

Table 3-3 Symbol Descriptions in Hand-Held Screen Display

4.   Introduction

This chapter contains the following sections:
- System Overview
- Features
- Transmitter Signals
- Modular Design
- Specifications

4.1   System Overview

The Vivax-Metrotech FLS-2 transmitter and vLoc series receivers locate underground fiber optic cables. This user manual covers the FLS-2 transmitter. For instructions about using the vLoc series receivers, see their instruction manuals.

The FLS-2 transmitter sends a predefined signal lower than 10 kHz along the metallic sheath surrounding the fiber optic cable, generating an electromagnetic field for the length of the cable.

The receiver is outside to locate the electromagnetic field around the underground cable. When using one of the predefined transmitter signals, the receiver can estimate the relative position and path of the cable.
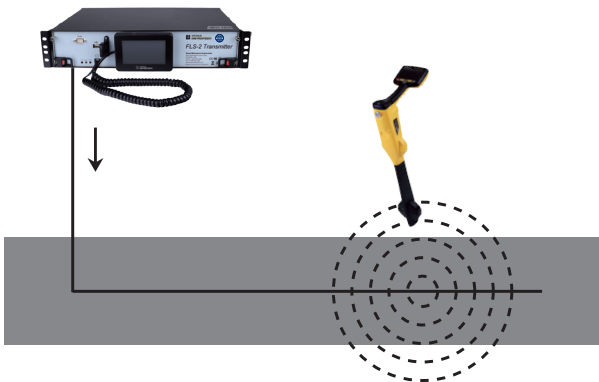
Figure 4-1 FLS-2 Transmitter and Receiver

4.2   Transmitter Signals

The transmitter is a signal generator that consists of one or more programmed frequencies that allow you to locate and trace the fiber optic cable. The predefined frequencies are:

Signal Direction (SD):	SD512 (256 Hz and 512 Hz)
Locate Signal (LS):	LF512 (512 Hz)
Extremely Low Frequencies (ELF):	• ELF10 • Other ELFs available upon request

Note: Other frequencies may be available upon request.

Table 4-1 Predefined Transmitter Frequencies

4.3   What's in the Box

Figure 4-2 FLS-2 Transmitter – What's in the box

No.	Description
1	FLS-2 transmitter (with 19-inch brackets installed)
2	Hand-held Control Unit
3	AC or DC power cord, per order
4	Mounting bracket sets for 23-inch or 24-inch installation (with hardware)
5	Operating manual

4.4   Modular Design

The transmitter is a 2U chassis that contains removable front and rear modules. Figure 4-3 shows the locations of the front-accessible module and where to store the hand-held display unit when not being used.

NOTE
See section 5.4, "Overview of the Modules for information about the modules."

Figure 4-3 FLS-2 Transmitter – Front and Side View

No.	Description	No.	Description
1	RS232 Connector (for factory use)	4	Hand-Held display unit
2	USB port for software updates	5	Main control module
3	USB Host connector cover	6	LED • Fail (Red) • Status (Yellow) • Power (Green)

Figure 4-4 shows the locations of the rear-accessible modules.
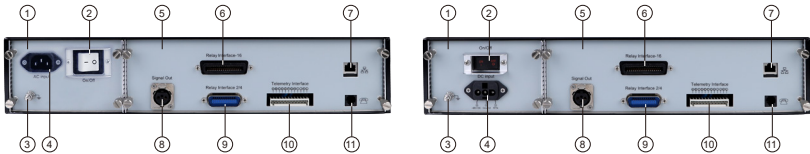
Figure 4-4 FLS-2 Transmitter Rear View (AC-Left Figure., DC-Right Figure.)

No.	Description	No.	Description
1	Power Module (AC or DC, depending on the configured system)	7	RJ-45 Network Connector
2	Power On/Off Switch	8	Signal Output Connector
3	Ground Stud	9	Relay interface for 2-way or 4-way
4	Power Input Connector	10	Telemetry Interface
5	Rear Module		
6	Relay Interface for 16-ways	11	RJ-11 Phone Line Connector

5.   Overview

This chapter contains the following sections:
- Operating Modes
- Methods for Controlling the Transmitter
- Hand-Held Display Unit
- Overview of the Modules
- LED Status Indicators

5.1   Operating Modes

Table 5-1 list the transmitter's operating modes. You can trigger the modes locally and remotely.

NOTE
The term "local control" refers to the hand-held display unit in this document. "Remote control" refers to using a touch-tone telephone, mobile device or Ethernet.

Mode	Description
Active	Normal operation
Standby	In Standby mode, the high-voltage circuit on the Power Amplifier module and the output signal is off.

Table 5-1 FLS-2 Transmitter Operating Modes

5.2   Controlling the Transmitter

Figure 5-1 shows the various methods for controlling the transmitter. See Chapter 7, "Local Transmitter Control," and Chapter 8, "Remote Transmitter Control, for details."
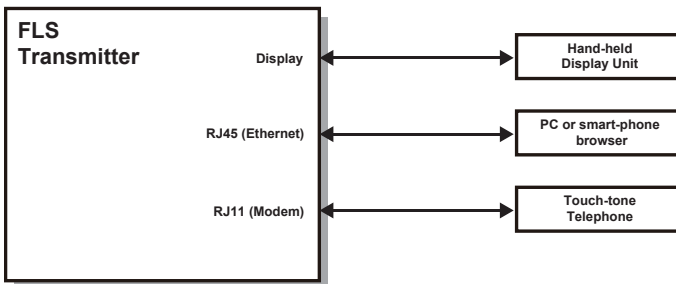

Figure 5-1 Method of Controlling the Transmitter

5.3   Hand-Held Display Unit

The hand-held display unit controls the transmitter through its touch screen. The display unit's coiled cord plugs into the "Display" RJ11 connector on the front of the control module, as shown in Figures 5-2. When not in use, store the display unit on the bar in front of the Main Control module.

NOTE
For information about using the attached hand-held display unit, see section 7.1, "Using the Hand-Held Display Unit."

5.4   Overview of the Modules

This section briefly describes the transmitter modules, including differences between the AC and DC systems. For information about removing or installing the modules, see section 11.2, "Removing or Installing Modules."

5.4.1   Main Control Module

The transmitter has a main control module installed horizontally in the front of FLS-2. Two screws and two ejector handles secure it, figure 5-2 shows the main control module.

This module mainly controls the transmitter. It contains the firmware, memory, and modem circuit. The front connectors are for an optional computer and the hand-held display unit. The modem circuit connects to the telephone line through the rear RJ11 connector.

Figure 5-2 Main Control Module

5.4.2   Power Supply Module

The FLS-2 provides the flexibility to choose either AC or DC power supply. It is located at the back of the transmitter and secured by screws.
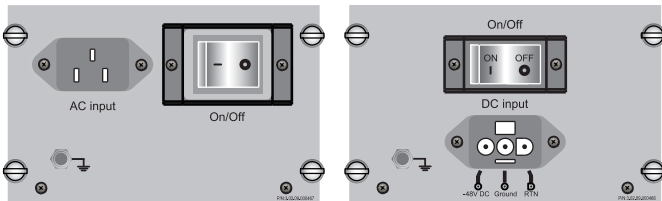

Figure 5-3   AC and DC Power Supply Module

5.4.3   Rear Module

The FLS transmitter has the option of 2-way, 4-way, or 16-way transmissions. This module has the RJ-11 phone line connector for the modem, an RJ-45 network connector for local area network (LAN) connection, a connector for 2-way or 4-way relays, and the connector for the 16-way relay interface.

This module also contains the high-voltage output connector and the telemetry connector.

WARNING
Turn the rear power switch off before handling this module's connectors. The high-voltage output may be at 300V AC or 450V DC.
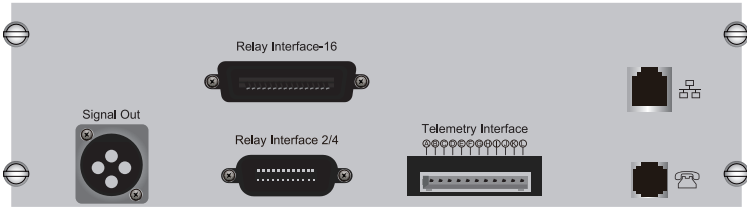
Figure 5-4 Rear Module

5.5   LED Status Indicators

Table 5-2 Describes the module status indicated by the displayed LEDs. Before removing any module, turn the rear power switch off.

LED	LED Colors	Description
Power	None	The module is off.
	Solid green	The module is on.
Status	Solid yellow	An alarm was triggered. **NOTE: For detail, see Chapter 6, "Alarm Messages."**
	Blinking yellow	Software is updating or flash programming, the phone ringing.
Fail	Solid red	System failure – over current or temperature, etc.

Table 5-2 LED Status Indicator

The LED colors shown are after the system boot up, which takes approximately 30 to 60 seconds. There may be some flashing or changing LEDs during the system boot-up.

6.   Rack Installation of the Transmitter

This chapter contains the following sections:
- Installation Site
- Required Tools and Test Equipment
- Output Connector Pin-Out
- Attaching the Rack Mounting Brackets
- Installing or Replacing the Transmitter
- Testing the Transmitter.
- Telemetry Interface

NOTE
Read the General Safety instructions and this entire chapter before installing the transmitter.

6.1   Installation Site

The installation site for the transmitter should meet the environmental and power requirements for the transmitter. Follow the customer's specific company policies and procedures.

6.2   Required Tools and Test Equipment

We recommend that the tools below be available during the transmitter installation.

Name	Image
Crescent wrench, or 7/16 open-end wrench or nut drive	
Cutters	
#2 Philips-head Screwdriver	
Voltmeter	

Table 6-1 Tool and Test Equipment

6.3   Output Connector Pin-Out

Table 6-1 shows the high-voltage output jack's pin-out and mating connector. Determine the conductor length needed to connect the transmitter output to the external signal protection relay and ground control unit assemblies. Use a minimum of 18 AWG conductors rated minimum 600 V, minimum 80ºC, and the colors specified in Figure 6-1.

NOTE
Discharge the above if the relay box is installed.

WARNING
Turn the rear power switch off before handling this module's connectors. The high-voltage output may be at 300V AC or 450V DC.

Output Jack   Mating Connector

Pin	Connection	Wire color
1	Signal High	Blue
2	Signal Low	White
3	N.C.	----
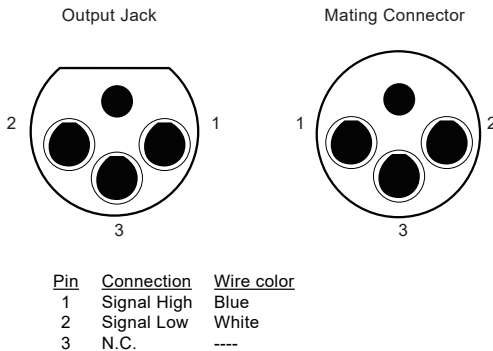
Figure 6-1 Pin-Out for the Output Jack and Mating Connector

6.4   Attaching the Rock Mounting Brackets

The transmitter ships with three sizes of standard and adjustable mounting brackets, allowing for installation in 19, 23, or 24-inch racks. The FLS-2 transmitter ships with the 19-inch standard rack mounting brackets already attached. The adjustable rack mounting bracket kit allows you to adjust the horizontal front-to-back position of the transmitter up to 5.25-inches (133.4mm). Figure 6-2 shows the left bracket for the adjustable brackets.

Measure the rack width and use the following instructions if you need to change the bracket size.

To remove and install the rack mounting brackets:
1.   Remove the attached mounting brackets using the Philips-head screwdriver and save the flat-head screws.
2.   Attach the new brackets to the same place with the flat-head screws.

To attach the adjustable rack mounting brackets:
1. Remove the attached mounting brackets using the Philips-head screwdriver and save the flat-head screws.
2. If not attaching the new brackets to the same front location, remove the two pan-head screws from the side center locations and secure them in the side front screw locations.
3. Attach each bracket to the center screw openings with the flat-head screws. Verify that the installed bracket position is the same for both sides.
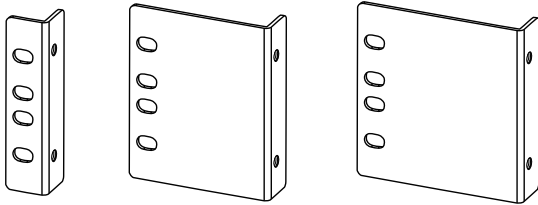

Figure 6-2 Adjustable Rack Mounting Brackets (19-inch, 23-inch, and 24-inch).

6.5 Installing or Replacing the Transmitter

This section describes installing a new FLS-2 transmitter or replacing an already installed transmitter.

CAUTION
We recommend that two people install or remove the transmitter. To help prevent injury when lifting the transmitter, bend your knees, and keep your back straight.

6.5.1 Installing the Transmitter

Follow these instructions when installing the transmitter into a rack.

To install the transmitter:
1. Attach the rack mounting brackets compatible with the rack width.
2. For instructions, see section 6.4, "Attaching the Rack Mounting Brackets." Have one person lift and hold the transmitter in the selected rack position.
3. Have the second person secure each mounting bracket to the rack using the Philips-head screwdriver and two screws per bracket.

To attach the cables and cords:
1. Turn the rear power switch off.
2. Connect an external ground conductor to the rear ground stud between the second and third lock washer.

CAUTION
The ground stud is secured to the chassis by the first lock washer and nut – do not loosen or remove these. The external ground conductor should be a minimum of 12 AWG.
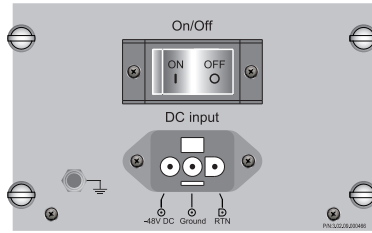
Figure 6-3 Rear DC Ground Connection of Ground Stud

3.   Plug the connector end of the input power cord into the rear input receptacle.
4.   Use the AC or DC cord shipped with the system.
5.   Plug or attach the other end of the input power cord to the appropriate power source.

CAUTION
The connection of the transmitter to the power sources should be made ONLY by authorized personnel.

6.   Attach the coiled cord for the hand-held display unit to the front "Display" connector, and then place the unit on the front storage bracket.
7.   Attach the phone line to the RJ11 socket or the Ethernet cable to the RJ45 socket.
8.   Attach the connector end of the assembled output cable to the rear high-voltage output connector if not using the ACT associated relay box.
9.   Figure 6-1 shows the output connector pin-out.

6.5.2   Replacing a Rack Mounted Transmitter
Follow these instructions when removing and replacing an already installed transmitter with a new one.

To replace a transmitter:
1.   Turn the rear power switch off.
2.   Carefully disconnect all cables and cords.
3.   Have one person hold the transmitter while the second person removes the mounting brackets from the rack using the Philips-head screwdriver.
4.   Lift the old transmitter out of the rack and move it to a designated area.
5.   Install the new transmitter by following section 6.4, "Attaching the Rack Mounting Brackets," and section 6.5.1, "Installing the Transmitter."

6.6   NEBS Specific Installation
NEBS (Network Equipment Building System) describes the environment of a typical United States RBOC Central Office. NEBS is the most common set of safety, spatial, and environmental design guidelines applied to telecommunications equipment in the United States, and it is an industry requirement.

> ⚠ **WARNING**
> **The intra-building ports of the FLS-2 or subassembly are suitable for connection to intra-building or unexposed wiring or cabling only. The intra-building ports of the FLS-2 or subassembly MUST NOT be metallically connected to interfaces that connect to the OSP or its wiring. These interfaces are designed as intra-building interfaces (Type 2 or Type 4 ports as described in GR-1089-CORE, Issue 6) and require isolation from the exposed OSP cabling. Adding Primary Protectors is insufficient protection to connect these interfaces metallically to OSP wiring.**

6.6.1   NEBS Installing the Transmitter with grounding

Follow these instructions when installing the transmitter into a rack with grounding:

1. Select the right bracket set for the rack width.
2. The brackets' unpainted sides (facing chassis and rack) should be cleaned and coated with an anti-oxidant solution.
3. Attach the bracket on each side of the chassis with the supplied screws.
4. Attach the rack mounting brackets to the rack with a paint-piercing washer.
5. For instructions, see section 6.4, "Attaching the Rack Mounting Brackets." Have one person lift and hold the transmitter in the selected rack position.
6. Have the second person secure each mounting bracket to the rack using the Philips-head screwdriver and two thread-forming screws per bracket.

Other details can refer to 6.5 Installing or Replacing the Transmitter.

6.6.2   NEBS Requirements

*   The FLS-2 shall be located in a restricted access location where only crafts personnel are allowed access.
*   The FLS-2 shall be installed and connected to the CBN (Common Bonding Network).
*   The FLS-2 is suitable for connection to the Central Office.
*   The battery returns of the FLS-2 shall be connected as DC-I (Isolated DC return).
*   The FLS-2 shall be grounded via a copper ground conductor.
*   All bare grounding connection points to the FLS-2 shall be cleaned and coated with an anti-oxidant solution before connections are made.
*   All surfaces on the FLS-2 that are un-plated shall be brought to a bright finish and treated with an anti-oxidant solution before connections are made.
*   To ensure electrical continuity, all non-conductive surfaces on the FLS-2 shall be removed from all threads and connection points.
*   The FLS-2 utilizes two side rack mounting brackets with two thread-forming screws and two paint-piercing washers on each side to secure it on the frame. The grounding is through the rack frame.
*   The FLS-2 can operate from 48 Vdc at a maximum current level of 3 A with a 10 A built-in circuit breaker protection.

7.   First Time Installation and Setup

7.1   Installation Types

The Install menu has two options:

- Select **Install** for a new installation, a new telecom line connection, or if the line changes. The Install sequence displays the hardware status followed by 10 steps.

- Select **Reinstall** to reinstall the system in two steps. See section 7.3 for more information on when to perform a reinstall.

NOTE
After entering the Install sequence clicking the Prev and Abort buttons will return to the Main Operating Screen.

7.2   Performing a New Installation

When the transmitter is powered on for the first time, the below **Unit is not installed** screen will appear.

1.   Click **Install** to start the installation process. The first part of the installation is for the transmitter to run a hardware check on itself.
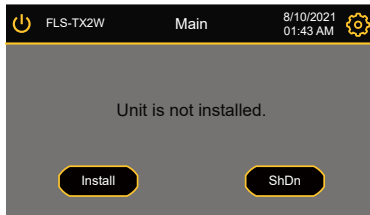
Figure 7-1 Unit not installed screen

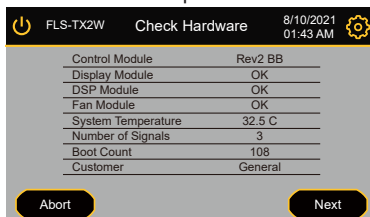2.   Click **Next** after the Check Hardware process has run.

Figure 7-2 Check Hardware screen

3.   Enter a Station ID number and click next. Enter a Station Name and click **Next**.
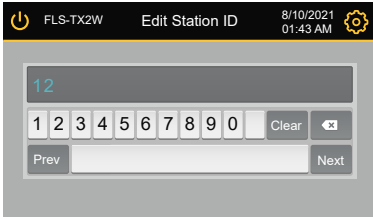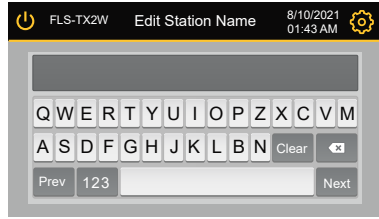
Figure 7-3 Edit Station ID

Figure 7-4 Edit Station Name

4.   Configure the **Line(s) to Drive** by selecting **West**, **East**, **West and East** together, or L1-L4 (for the 4-way version and click **Next**.
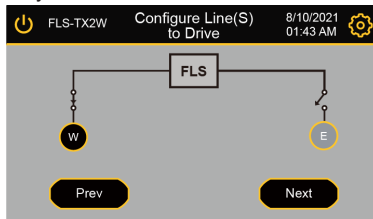
Figure 7-5 Configure Line to Drive

5.   Select the Maximum Line Voltage, and click **Next**.

Figure 7-6 Set Maximum line Voltage

6.   Touch the **TIME, ZONE** and **DATE** fields to install the local time. Use the scroll wheels to set them up and click **Next**. If the network cable is connected, you can click **Sync Time** to synchronize the time through the internet.
      If desired, turn on the Daylight Savings time option.
      Click **Next**.
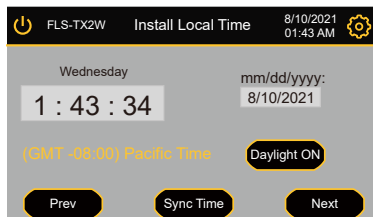
Figure 7-7 Install Local Time Settings

7.   Enter an area code and **Phone Number** for the unit, click **Next**.
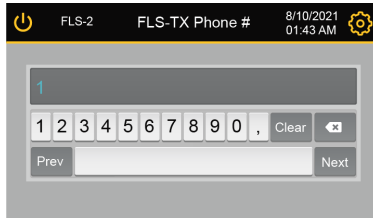
Figure 7-8 Enter Area Code and Phone Number

8.   Enter the **Number of Rings** for the unit to answer after and click **Next**.

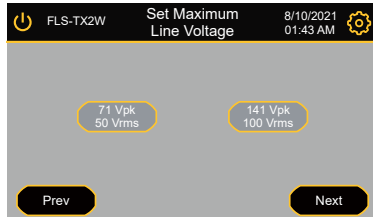**Figure 7-9 Enter the Number of Rings**

9.   Select the desired frequencies at the **Select Frequencies to Install** screen and click **Next**.
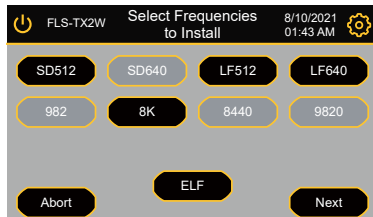
Figure 7-10 Select Frequencies to Install

10.   The System Summary screen will allow you to review the previous choices. Click **Prev** to make any adjustments or click **Next** if all is okay.

Figure 7-11 System Summary Screen

The system will now start to measure the line impedances. Click **Abort** to return to the **Main** Operating Screen.

At the end of the process, the **Finish** button will appear. Click on **Finish** to complete the process.

FLS-TX2W	Measuring Line Impedances	8/10/2021 01:43 AM	

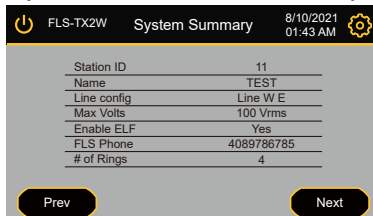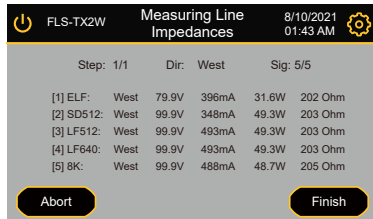| Step: 1/1	Dir: West	Sig: 5/5		
[1] ELF:	West	79.9V	396mA	31.6W	202 Ohm
[2] SD512:	West	99.9V	348mA	49.3W	203 Ohm
[3] LF512:	West	99.9V	493mA	49.3W	203 Ohm
[4] LF640:	West	99.9V	493mA	49.3W	203 Ohm
[5] 8K:	West	99.9V	488mA	48.7W	205 Ohm

Abort   Finish

Figure 7-12 Measuring Line Impedances - Installing

The installation process is now complete and the **Main** screen will appear.

FLS-TX2W   Main   8/10/2021 01:43 AM

Lines   W   Status: STANDBY
Mode   SD512 + ELF-10   Health: OK
Timer   04:00   ELF: 1:00   Active

Figure 7-13 Main Screen

7.3   Performing a Reinstall Installation
A Reinstall may be done if:
- An event takes place on the network.
- Maintenance work was done on the network
- Side-Legs, Filters or Grounds were added
- To add additional frequencies

7.3.1   Update the installed line frequencies (Reinstall)
From the Main Screen, click the **Setup icon** to enter the **Settings** screen, click **Utilities, Install** and then **Reinstall**.Check section 8 for more information.

FLS-TX2W   Main   8/10/2021 01:43 AM

Lines   W   Status: STANDBY
Mode   SD512 + ELF-10   Health: OK
Timer   04:00   ELF: 1:00   ACTIVE

FLS-TX2W   Install Menu   8/10/2021 01:43 AM

Reinstall   Install

Back

Figure 7-14 The Main Screen and Install Menu Screen

1.   Select the frequencies to reinstall and select **Next** to start the reinstall.

Figure 7-15 Select Frequencies to reinstall

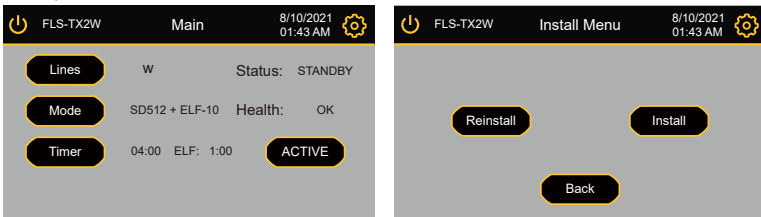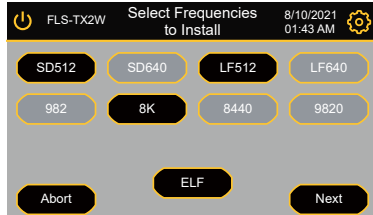2. Parameters for each installed frequency will be displayed as the new installation is performed. At the end of the process the screen will automatically go back to the **Main** Operating screen. You must complete this step to reinstall the new frequency selection. You can also click the **Abort** button to abort the reinstallation sequence at any time or click the **Finish** button to accept the new installation when the button becomes enabled.
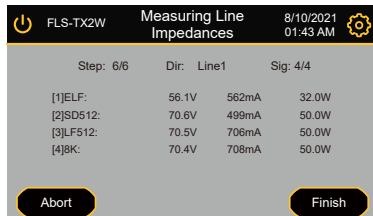
Figure 7-16 Summary of the newly installed parameters

NOTE: All the other setup information is kept the same.

7.4   Reboot and Turn Off

Go to the **Main** screen and press the on/off ⏻ icon on the top left side to reboot the system. Then select **Reboot** and **Yes** to confirm the Reboot.

Also, use this menu when you want to power down the unit and press the **Yes** button before flipping the on/off button to shut down correctly.
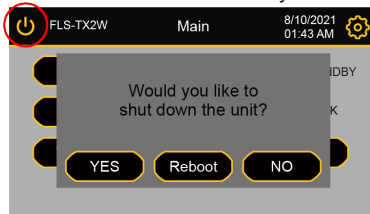
Figure 7-17 Reboot or turn off FLS System

7.5   Testing the Transmitter

After installing the transmitter, line protection, and control equipment, conduct the following tests to ensure that the transmitter is operating properly:

*   Check the modules' LEDs for normal operation per section 5.5, "LED Status Indicators."
*   Use a receiver to locate the energized line to ensure the signal transmits correctly.

8.   The Hand-Held Display

8.1   Setup using the Hand-Held Display Unit

This section describes how to program the transmitter and view the status of its functions using the hand-held display.

The Main Menu screen will appear approximately 40-seconds after the splash screen.


Figure 8-1 The FLS-2 Splash Screen

After three minutes of inactivity, the display unit enters sleep mode with a dimmed screen.
Touch the screen to resume use.

8.2   The Settings Menu

After the transmitter has run through the installation sequence, the below Main Screen will appear.

2-Way Main Screen   **4-Way Main Screen**   **16-Way Main Screen**
Figure 8-2 The FLS-2 Main Screens

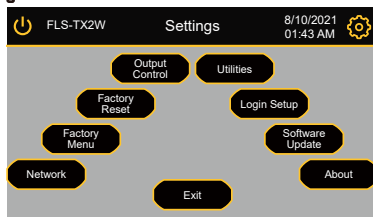Press the **Setup icon** ⚙ in the top right corner to enter the **Settings** Menu.

Figure 8-3 The Settings screen
The Settings screen allows access to the following FLS-2 settings:

1. Network	**5. Utilities**
2. Factory Menu	**6. Login Setup**
3. Factory Reset	**7. Software Update**
4. Output Control	**8. About**

8.2.1   Network Configuration
The transmitter can use DHCP or Static IP protocols.

A.   DHCP IP Address Setup
From the Settings Menu click on the **Network** icon and a screen similar to the below Network Config screen will appear if the unit is already connected to an activated Ethernet port.

1.   To set up DHCP **click on the DCHP field** and the DHCP field will change from Off to On.
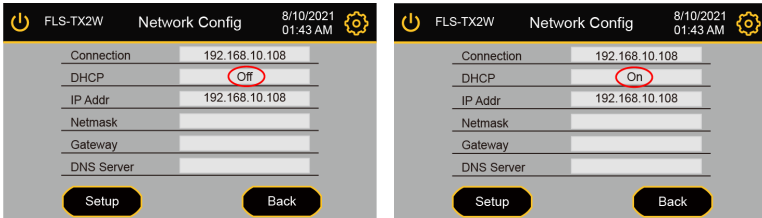
Figure 8-4 Clicking on the DHCP Field turns DHCP on or off

2.   Click on the **Setup** icon to **send this network setting** to the transmitter hardware.
3.   Press the **YES** button on the below screen.
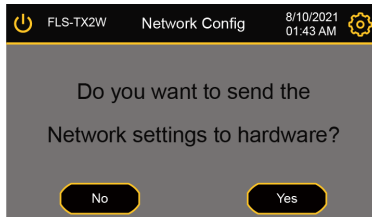
Figure 8-5 Save the DHCP Settings

B.   Static IP Address Setup
1.   From the **Settings** Menu click on the **Network** icon and the below Network Config screen will appear. Choose **Off** in the DHCP field.
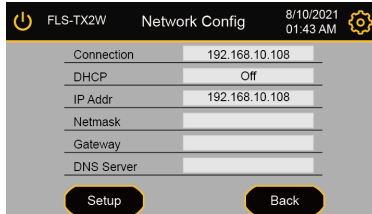
Figure 8-6 Network Conf Screen

2.   Click on the IP Address field and the IP Address edit screen will appear. Enter the assigned IP Address and click on **Enter**.
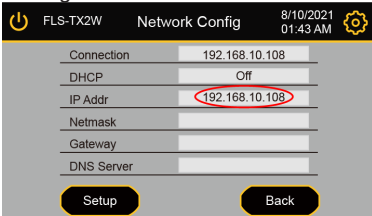
Figure 8-7 Click on the IP Address field   **Figure 8-8 Enter the IP Address**
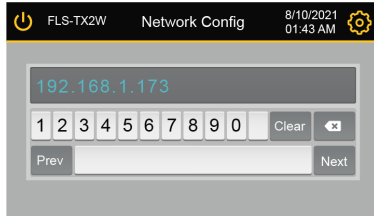
3.   Repeat step 2 and populate the **Netmask**, **Gateway** and **DNS Server** addresses.
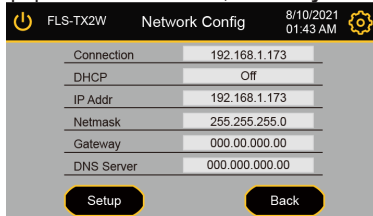
Figure 8-9 Populate the Netmask, Gateway and DNS Server fields

4.   Click on the **Setup** icon and then click on the **Yes** icon to send these network settings to the transmitter hardware.
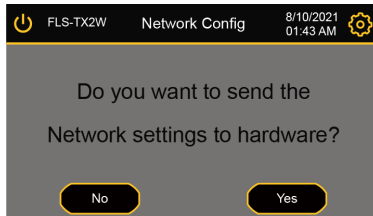
Figure 8-10 Send DHCP settings to hardware

8.2.2   Factory Menu
This menu option is accessible only by Vivax-Metrotech and its authorized repair centers.

8.2.3   Factory Reset
This menu option will return the transmitter to the default (factory setup) configuration.

 This change cannot be undone; performing a Factory Reset will force a new installation.

1.   From the Settings menu click **Factory Reset**.
2.   Follow the steps for a **New Install**.

Figure 8-11 Factory Reset

8.2.4   Output Control
To set the Line Output Current Level
1.   Click on Output Control from the Settings menu to access the Output Current Level settings.
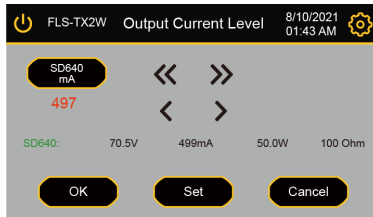
Figure 8-12 Output Current Level

2.   Program output current values by clicking the double and single arrow icons.
3.   Click **Set** to save the changes.
4.   Click **OK** to exit with changes saved or **Cancel** to exit without saving the settings.
NOTE: - This feature is available only in the **ACTIVE** mode!
          - If max limits have been already reached, higher settings will not be allowed
5.   Do one of the following:
      a) Click **Back > Exit** to return to the **Main** Operating Screen.
      b) Program the other setup features.

8.2.5   Utilities Menu
The **Utilities** menu consists of **Edit, Install and Log Info** sub-menus.

You can program all Utilities Menu functions in either operating mode, except for **Install**.
The transmitter must be in **STANDBY** mode to run an **Install**.

Figure 8-13 Utility Menu

METROTECH   VIVAX METROTECH
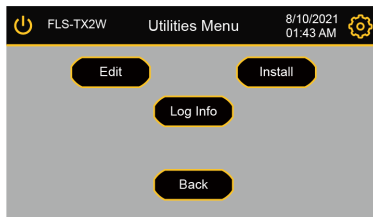
8.2.5.1   Install and Reinstall

Selecting Install will bring up the install menu with choices of performing a Reinstall or Install. **See section 7.1, Installation Types** of this manual, for instructions for both types of installations.
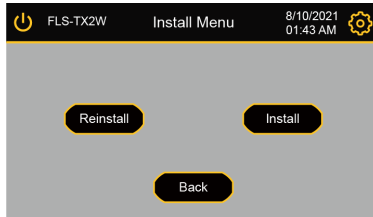
Figure 8-14 Install Menu

8.2.5.2   Log Info

1.   Click on Log Info from the Utilities Menu to view the Log Information.
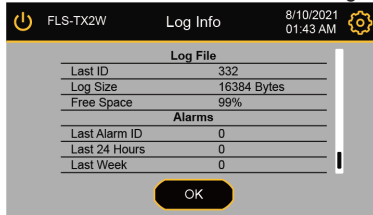
Figure 8-15 Log Info Screen

8.2.5.3   The Edit Menu

You can edit the **Station ID**, **Station Name**, **FLS-2 Phone #** and **Local time** and **Number of Rings** in this Menu. Use these instructions to edit the station information and the local time settings.
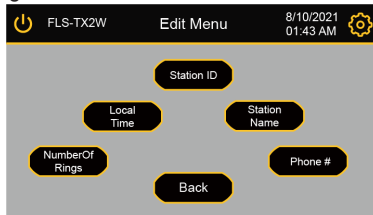
Figure 8-16 Edit Menu

A.   Edit the Station ID
1.   Click on **Station ID** from the Edit menu.
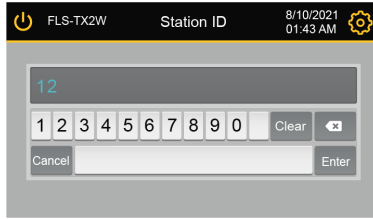
Figure 8-17 Edit Station ID

2.   Enter the Station ID and then click Enter.

B.   Edit the Station Name
1.   Click on **Station Name** from the Edit Menu.
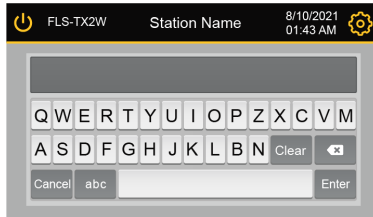
Figure 8-18 Edit Station Name

2.   Enter the **Station Name**, and then click **Enter**.

C.   Edit the Local Time
To edit the local time zone and daylight savings settings.
1.   Click on **Local Time** from the Edit Menu.
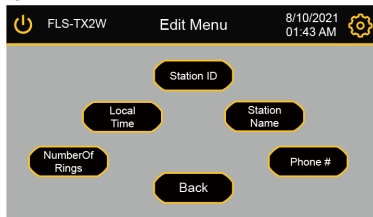
Figure 8-19 Edit Menu

2.   Touch the time window to change the local time clock.
3.   Touch the month (**MM**), day (**DD**), and year (**YY**) window to change the dates you want to adjust.
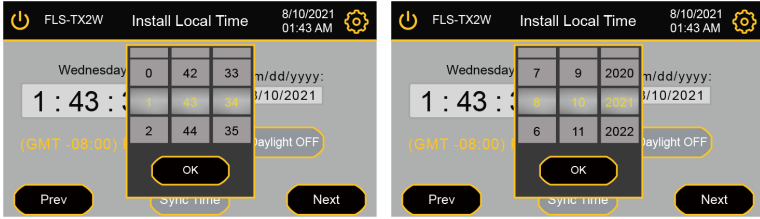
Figure 8-20 Set Local Time and date

4. Click **OK** when the selection has been made.
5. Touch the **Time Zone** icon area.
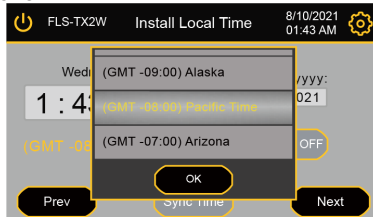
Figure 8-21 Edit Time Zone

6. Drag your finger **Up** or **Down** to select the time zone and click **OK**.
7. Use the **Daylight** button to activate or deactivate Daylight Savings.
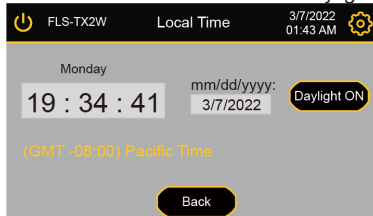
Figure 8-22 Daylight Savings

8. When finished, press the **Back** button.

8.2.6   Login Setup

This section covers the setup needed to access the transmitter remotely via an Ethernet connection.

User credentials for the **Admin** can only be entered here.

Regular users can be set up here, from the Handheld display, as indicated below, or via Ethernet once connectivity is established.

1. From the Settings menu click on **Login Setup** and the below screen will be displayed when you access this menu first time.
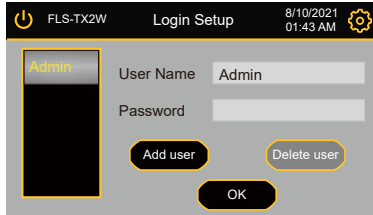
Figure 8-23 Login Setup

NOTE:
a.   **ADMIN credentials have to be setup from the Hand-held module before being able to operate remotely via Ethernet.**
b.   **Regular users (example, User1…etc.) can be added from the Hand-held or once connected via the Ethernet.**

2.   **User Credential Setup**
  a.   **ADMIN -** Touch the User Name field and enter the new name following the rules below. Press **ENTER** when done and fill the PASSWORD field. Press **ENTER** when done. Press **OK** and the new credentials will be activated for the ADMIN.
  b.   **Regular -** At the **Login Setup** menu, press the **Add user** button. Enter the User name and Password information and press **ENTER**. Press the OK button and the new user will be added to the left-side scroll wheel window.

Figure 8-24 Adding a user

  c.   Repeat step "b" if additional users have to be added.
  d.   If you want to change the credentials for a user, use the Scroll Wheel to select a user and enter its new Username and Password.

3.   **Note:** See the below screen with the Login Rules covering the Username and Password.
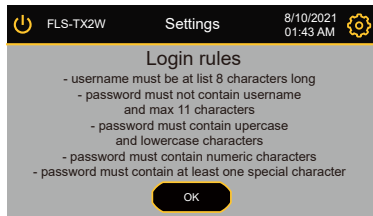
Figure 8-25 Login Rules

4.   **Press OK** and exit the screen. The credential setup is finalized.

8.2.7   Software Updates

Firmware updates come in the form of files with a .bin extension. The software files can be obtained from a Vivax-Metrotech office. Before updating the firmware, note the firmware version currently in the transmitter. After the firmware update has run, compare the firmware versions to ensure that the update ran successfully. Check the transmitter's firmware version by going to Settings > About and looking at the Control Module F/W section. Note that when a firmware update is run, the Display Module and DSP Module firmware will also be updated if needed.

FLS-TX2W	About	8/10/2021 01:43 AM
Host Name	FLS0000
IP Address	192.168.10.108
Control Module F/W	v.2.0028
Display Module F/W	v.1.1966
DSP Module F/W	v.1.1862
Chassis S/N	0102010001
Control Module S/N	N/A
Display Module S/N	0121406001
OK	
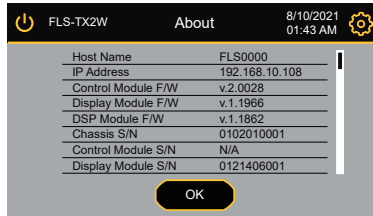
Figure 8-26   The About screen showing Firmware versions

1.   Put the .bin file on the root drive (not in any folders) of a USB stick and put the USB stick into the USB port on the transmitter's front panel.

2.   Enter the **Settings** menu by clicking on the **Settings** ⚙ icon in the top right corner of the hand-held unit's display.

3.   From the Settings menu click on the **Software Update** icon. Ensure that the USB stick is inserted into the front panel USB port and click on OK to start the firmware update.

FLS-TX2W	Software Update	8/10/2021 01:43 AM
	Please ensure that the USB Stick is inserted.
No	Yes

Figure 8-27   Insert USB Stick and click OK

4.   The Updating Software, please wait message will appear. The screen will go black and may flash a few times during the update and a Loading screen will appear.

FLS-TX2W Software Update 8/10/2021 01:43 AM	
Updating Software, please wait!	Loading...........
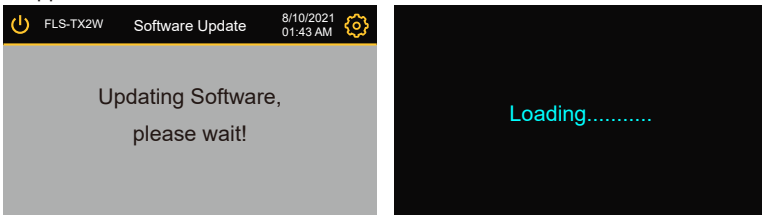
Figure 8-28   Typical screens seen during the firmware update

5.   The unit will return to the Main screen when the firmware update is finished.
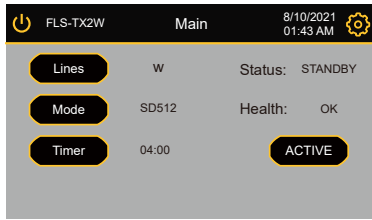
Figure 8-29 The Main screen

6.   Check the transmitter's firmware version by going to **Settings > About** and looking at the Control Module F/W section.

8.2.8   About
Information about the status of the unit can be found in this menu.
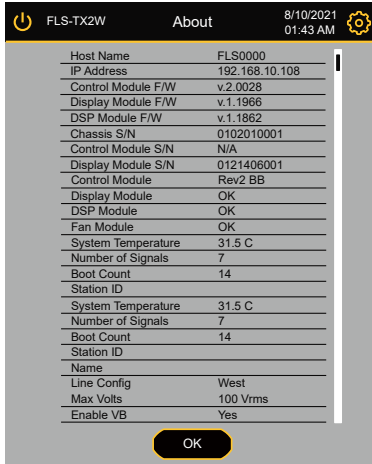
Figure 8-30 The About Screen

Click **OK** to return to the **Settings** Menu.

9.   Operating the FLS-2 Transmitter

9.1   The Main Screen

The Main screen is the home screen of the display unit. The Lines (East/West), (L1-L4),(L1-L16) Transmit Modes, and Standby/Active status can be changed from the main screen, and the timer can be set. The health of the unit is also displayed on the main page.

9.2   Select an Operation Mode

9.2.1   Standby and Active Operation Modes

The transmitter has two operating modes of Active or Standby. The Status field on the Main menu will show the status of STANDBY or ACTIVE.

Use the STANDBY and ACTIVE icons to change the status of the transmitter.
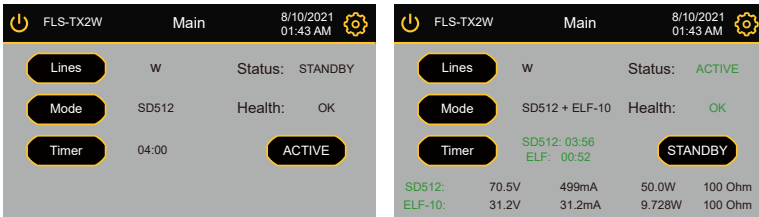
2-Way Standby and Active Screens
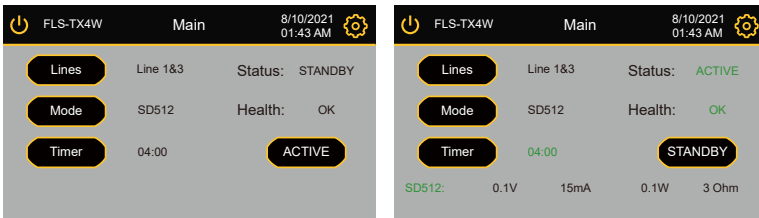
4-Way Standby and Active Screens
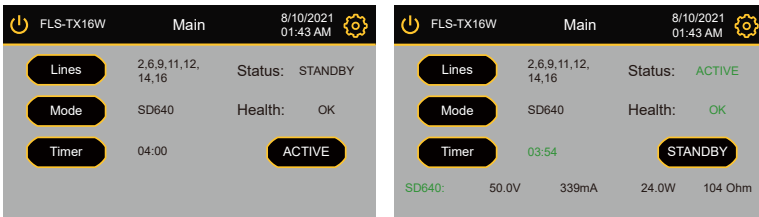
16-Way Standby and Active Screens
Figure 9-1 Main Screen (Standby and Active Modes)

9.2.2   Main Screen Alarm Status
• When the current exceeds or falls below the preset limits, the display will show an Alarm Screen.
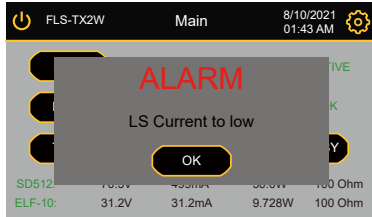
Figure 9-2 Alarm on Main Screen

9.3   Operating Mode Menu
In this section, you learn how:
• To select a line
• To select a line frequency
• To set timer
• To set the line alarm levels
• To set the line output current level

NOTE

These instructions are written using the common abbreviated method to move you from one screen to another. For example, click Start > Control Panel > Printers.

9.3.1   Selecting Lines
From the **Main** screen, click **Lines**, and then select the lines needed if installed.

Figure 9-3 Examples of lines

Click **OK** to confirm and return to the **Main** Screen.
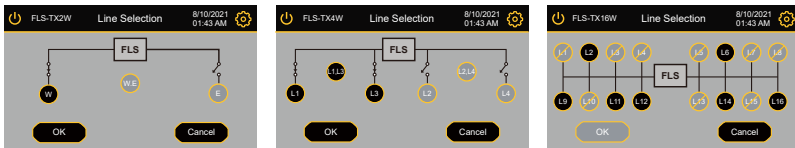
| 2-Way | 4-Way | 16-Way |

Figure 9-4 Select Lines

9.3.2   Selecting Modes (line frequency)
1.   From the Main screen select **Mode**.   Mode
2.   Use the scroll wheel to find the desired frequency.
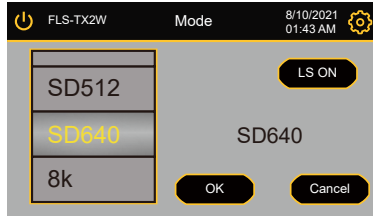
Figure 9-5 Select Mode

3.   Press the **OK** button to return to the **Main** Operating Screen.

9.3.3   Setting a Timer
1.   From the **Main** screen, click **Timer**.
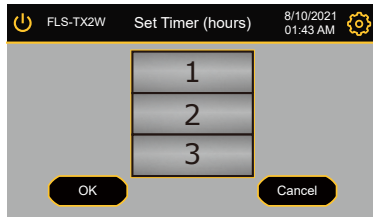
Figure 9-6 Set Timer (Hours)

2.   Use the scroll wheel to select the hours for the FLS-2 to operate.
3.   Select **OK** to confirm the selection.

9.3.4   Setting Alarm Levels
1.   To access the **Alarm Levels** settings, go to **Settings > Output Control > Alarms**.
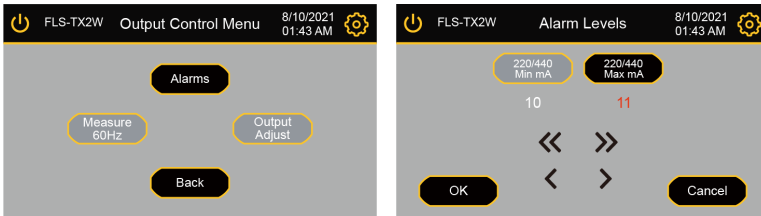
Figure 9-7 Alarm Menu and Line Alarm Levels

2.   Program each alarms current value by doing the following:
    a) Click the alarm type (Min-Max)
    b) Click the double (greater change) and single (smaller change) arrow icons to set the value.
    c) Click **OK** to save or **Cancel** to exit without saving.
        NOTE: by default, the unit will set a 20% alarm level at 20% above and below the installed output current.

10.   Remote Transmitter Control by Ethernet

- **Connections to Ethernet networks should be made following all company policies and procedures.**
- **Connections behind company firewalls should offer the proper level of network safety.**
- **A company's virtual private network (VPN) connection will further increase communication security.**
- **The HTTPS server has a self-issued certificate. The web browser may display a warning!!**
- **Some menus are not available on the remote screen.**
- **After 55 seconds, the session will time out automatically if no buttons are pressed.**

1.   From a browser, enter HTTPS:// and the IP address to which the FLS-2 is connected. (See Figures 8.4 and 8.6 under Network Configure # 8.2.1 if the IP address is not known)
2.   When connected the below screen will be displayed:
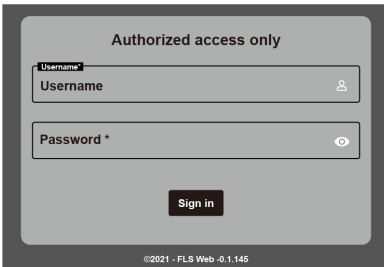
Figure 10-1 Login screen
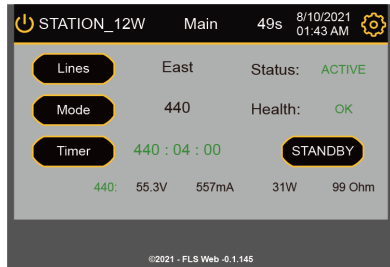
Figure 10-2 Main remote screen

3.   Enter the credentials and click **Sign in**.
4.   A remote interface screen will be displayed for controlling the transmitter when connected.
     NOTE: - The remote main screen will mirror to a large degree the Hand-held screen menus. Check the relevant sections above.
            - Some menus are not available in the remote operation mode.
5.   When done, it is a good practice to click the Logout button to close the session.

11.   Remote Transmitter Control by Telephone Line
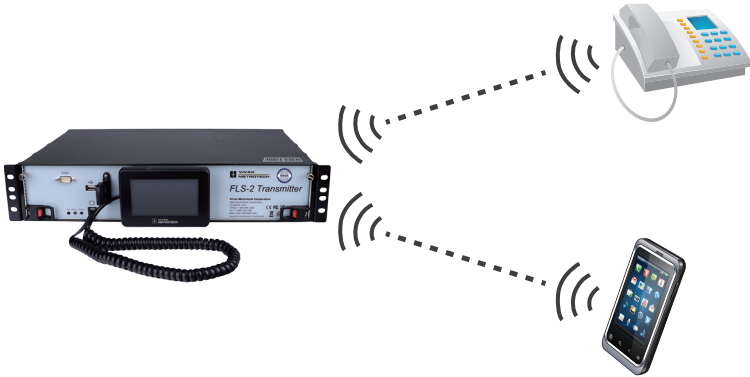
You can use any touch-tone telephone (landline or mobile) to control the transmitter remotely. Table 8-1 lists the telephone command codes for two ways FLS-2 (FLS-2-TX2W), Table 8-2 lists four ways FLS-2 (FLS-2-TX4W), and Table 8-3 lists 16 ways FLS-2 (FLS-2-TX16W). After entering the command code(s) sequence, you receive the indicated voice response(s) confirming the command.

NOTE
The hand-held display screen will show a telephone when controlling the transmitter with a touch-tone phone.

11.1   FLS-2-TX2W Telephone Remote Control

To control the FLS-2-TX2W remotely from a touch-tone telephone, proceed as follows:
1.   Dial the telephone number assigned to the FLS-2 using a touch-tone telephone. The FLS-2 will generate three beeps when it answers the call.
2.   Enter the Station ID assigned to this FLS-2, followed by the * key. This is the login sequence.
3.   Enter the Function Code. See the table below. The FLS-2 confirms all functions with voice messages.
4.   If needed enter the next Function Codes.
5.   Hang up (log out) the phone by pressing the # key.
6.   Disconnect your telephone call.

Function	Code	Speech
Login, Station ID followed by the * key Security access feature	xxxx*	"Welcome to the FLS-2 unit." "Station xxxx" Report Unit Status "Enter Code" OR "FLS-2 not available."
Toggle Active/ Standby	00	"FLS-2 {Standby / On}"
Select East Line	01	"East {Connection / not installed}"
Select West Line	02	"West {Connection / not installed}"
Select West & East Line	03	"West & East {Connection / not installed}"
Select LF1 (512Hz)	04	"Low-Frequency one."
Select 8K (8192Hz)	05	"High-Frequency Mode"
Select SD1 (256/512Hz)	06	"SD one Mode"
Select SD2	07	"SD two Mode" (if applicable)
Report Line Parameters	08	"FLS-2 Standby" or "[Report Alarm], [xx volts, xxx milliamps], [xx ELF volts, xxx ELF milliamps], [Resistance xxx Ohms]
Report Timer Value	09	"Timer x hours" or "Timer off" or "Time remaining x hours xx minutes"
Report Software Versions	10	"ARM Version x.xxxx, DSP Version x.xxxx, Handheld Version x.xxxx"
Select LF2	11	"Low Frequency two" (if applicable)
Select LF3	13	"Low Frequency three" (if applicable)
Select LF4	14	"Low Frequency four" (if applicable)
Select 273Hz	15	"Low Frequency 273" (if applicable)
Select SD3	18	"SD three Mode" (if applicable)
Select SD4	19	"SD four Mode" (if applicable)
Toggle ELF on / off	35	"ELF-x on" OR ELF {off / not available / not installed}"(if applicable)
Switch ELF ONLY on for two hours	62	"ELF-x Mode for 2 hours" OR "ELF not installed" (if applicable)
Switch ELF ONLY on for four hours	64	"ELF-x Mode for 4 hours" OR "ELF not installed" (if applicable)

		"FLS-2 Standby, {East / West / West & East} Connection, {Frequency / Mode}, [{ELF-x on / ELF off}]"
Report Unit Status	*	OR "[Report Alarm], FLS-2 On, Time remaining x hours xx minutes, {East / West / West & East} Connection, {Frequency / Mode}, [{ELF-x on / ELF off}]"
Hang-up	#	Goodbye
	Other	"Code not available / Invalid"

Table 11-1 Telephone Remote Control Commands (FLS-2-TX2W)

11.2   *FLS-2-TX4W Telephone Remote Control*

To control the FLS-2-TX4W remotely from a touch-tone telephone, proceed as follows:

1. Dial the telephone number assigned to the FLS-2 using a touch-tone telephone. The FLS-2 will generate three beeps when it answers the call.
2. Enter the Station ID assigned to this FLS-2, followed by the * key. This is the login sequence.
3. Enter the Function Code. See the table below. The FLS-2 confirms all functions with voice messages.
4. If needed enter the next Function Codes.
5. Hang up (log out) the phone by pressing the # key.
6. Disconnect your telephone call.

Function	Code	Speech
Login, Station ID followed by the * key, Security access feature	xxxx*	"Welcome to the FLS-2 unit" "Station xxxx" Report Unit Status "Enter Code" or "FLS-2 not available"
Toggle Active / Standby	00	"FLS-2 {Standby / On}"
Select LF1 (512Hz)	04	"Low-Frequency one"
Select 8K (8192Hz)	05	"High-Frequency Mode"
Select SD1 (256/512Hz)	06	"SD one Mode"
Select SD2	07	"SD two Mode" (if applicable)
Report Line Parameters	08	"FLS-2 Standby" Or "[Report Alarm], [xx volts, xxx milliamps], [xx ELF volts, xxx ELF milliamps], Resistance xxx Ohms."
Report Timer Value	09	"Timer x hours" or "Timer off" or "Tim remaining x hours xx minutes"

Report Software Version	10	"ARM Version x.xxxx, DSP Version x.xxxx, Handheld Version x.xxxx"
Select LF2	11	"Low Frequency two" (if applicable)
Select LF3	13	"Low Frequency three" (if applicable)
Select LF4	14	"Low Frequency four" (if applicable)
Select 273Hz	15	"Low Frequency 273" (if applicable)
Select SD3	18	"SD three Mode" (if applicable)
Select SD4	19	"SD four Mode" (if applicable)
Toggle ELF on / off	35	"ELF on" or "ELF {off / not available / not installed}"
Select Line 1	21	"Line 1 {Connection / not installed}"
Select Line 2	22	"Line 2 {Connection / not installed}"
Select Line 3	23	"Line 3 {Connection / not installed}"
Select Line 4	24	"Line 4 {Connection / not installed}"
Select Line 1 & 3	25	"Line 1 & 3 {Connection / not installed}"
Select Line 2 & 4	26	"Line 2 & 4{Connection / not installed}"
Switch ELF ONLY on for 2h	62	"ELF Mode for 2 hours" or "ELF not installed" (if applicable)
Switch ELF ONLY on for four hours	64	"ELF Mode for 4 hours" or "ELF not installed" (if applicable)
Report Unit Status	*	"FLS-2 Standby Line Connection, {Frequency / Mode},[ELF {on / off}]" Or "[Report Alarm], FLS-2 On Time remaining x hours xx minutes, Line Connection, {Frequency / Mode}, [ELF {on / off}]"
Hang-up	#	Goodbye
	other	"Code not available / Invalid"

Table 11-2 Telephone Remote Control Commands (FLS-2-TX4W)

11.3 FLS-2-TX16W Telephone Remote Control

To control the FLS-2-TX16W remotely from a touch-tone telephone, proceed as follows:

1. Dial the telephone number assigned to the FLS-2 using a touch-tone telephone. The FLS-2 will generate three beeps when it answers the call.
2. Enter the Station ID assigned to this FLS-2, followed by the * key. This is the login sequence.
3. Enter the Function Code. See the table below. The FLS-2 confirms all functions with voice messages.
4. If needed enter the next Function Codes.
5. Hang up (log out) the phone by pressing the # key.
6. Disconnect your telephone call.

Function	Code	Speech
Login, Station ID followed by the * key Security access feature	xxxx*	"Welcome to the FLS-2 unit" "Station xxxx" Report Unit Status "Enter Code" Or "FLS-2 not available"
Toggle Active / Standby	00	"FLS-2 {Standby / On}"
Select LF1	04	"Low-Frequency one"
Select MF (8192Hz)	05	"High-Frequency Mode"
Select SD1 (256/512Hz)	06	"SD one Mode"
Select SD2	07	"SD two Mode" (if applicable)
Report Line Parameters	08	"FLS-2 Standby" Or "[Report Alarm], [xx volts, xxx milliamps], [xx ELF volts, xxx ELF milliamps], Resistance xxx Ohms"
Report Timer Value	09	"Timer {off / x hours}" or "Timer off" or "Time remaining x hours xx minutes"
Report Software Versions	10	"ARM Version x.xxxx, DSP Version x.xxxx, Hand-held Version x.xxxx"
Select LF2	11	"Low Frequency two" (if applicable)
Select LF3	13	"Low Frequency three" (if applicable)
Select LF4	14	"Low Frequency four" (if applicable)
Select 273Hz	15	"Low Frequency 273" (if applicable)
Select SD3	18	"SD three Mode" (if applicable)
Select SD4	19	"SD four Mode" (if applicable)
Toggle ELF on / off	35	"ELF-x on "or "ELF {off / not available / not installed}"
Line Status (individual)	401-416	"MUX N {on / off}" N=1…16
Turn all lines off	500	"MUX Line off"
Toggle line on / off	501-516	"MUX N {on/ off}", N=1…6
Line Status (identify all lines that are on)	520	"MUX Line {N1, N2,…} on", Nx = 1...16 OR "MUX Line Off"
Switch ELF ONLY on for two hours	62	"ELF-x Mode for 2 hours" or "ELF not installed."

Switch ELF ONLY on for four hours	64	"ELF-x Mode for 4 hours" or "ELF not installed."
Report Unit Status	*	"FLS-2 Standby, MUX Line Connection, {Frequency / Mode}, [ELF-x {on / off}]" Or "[Report Alarm], FLS-2 On, Time remaining x hours xx minutes, MUX Line Status, {Frequency / Mode}, [ELF-x {on / off}]"
Hang-up	#	Goodbye
	other	"Code not available / Invalid"

Table 11-3 Telephone Remote Control Commands (FLS-2-TX16W)

12.   Alarm Messages

The abbreviated alarm message listed in Table 12-1 appears on the hand-held display screen, computer terminal screen, or phone line voice prompt when an alarm condition occurs.

Screen message	Description
60Hz too High	The 50/60Hz power noise voltage on the line exceeds 50 V.
ELF Current too High	The ELF signal current is too high.
ELF Current too Low	The ELF signal current is too low.
ELF Resistance to High	The resistance of the ELF signal is too high.
ELF Resistance too Low	The resistance of the ELF signal is too low.
Fan Failed	The Fan Module failed.
LS Current too Low	The locate signal current is too low.
LS Resistance too High	The resistance of the locate signal is too high.
LS Resistance too Low	The resistance of the locate signal is too low.
PA Current Overload	The current Output of the Power Amplifier is overloaded.
Temperature too High	The transmitter's internal temperature is too high.

Table 12-1 Alarm Messages

13.   Troubleshooting

This chapter describes the more common operational issues with possible solutions. Contact technical support if your situation is not described and you need further assistance.

> ⚠️ **WARNING**
> **The high*voltage output and cable sheath may be at 300V AC or 450V DC. Be extremely careful when troubleshooting an energized transmitter.**

Issue	Possible solution
The cable sheath has no signal.	• Verify that the transmitter is in Active mode. • Verify that the programmed setting was not changed. • Verify that the output is designated for the correct line (East or West). • Turn the rear power switch off and carefully check the rear panel connections. • Verify that the external relays for the signal protection and ground control unit are energized. • Inspect the cable splice box to see if there is a signal on both sides of the splices. If not found, the problem might be in the splice area.
The hand-held display unit is blank.	• Touch the screen to resume. After three minutes of inactivity, the display screen turns off. • Verify that the cord connects to the "Hand-Held Display" connector.
LED status indicators change.	• For status definitions, see section 4.5, "LED Status Indicators."
LEDs are off.	• Verify that the rear power switch is turned on. • Verify that the input cord is fully connected. • Verify that the AC or DC power source is working.
Fan Failed	The Fan Module failed.
LS Current too Low	The locate signal current is too low.
LS Resistance too High	The resistance of the locate signal is too high.
LS Resistance too Low	The resistance of the locate signal is too low.
PA Current Overload	The current Output of the Power Amplifier is overloaded.
Temperature too High	The transmitter's internal temperature is too high.

Telephone remote access fails.	• Verify that you entered the correct telephone number and unit ID. • Verify that the transmitter is not being locally controlled or downloading firmware. These actions disconnect any attempts for remote control. Verify that the telephone line is connected to the modem.(☎)

Table 13-1 Troubleshooting Guidelines

14. Maintenance

This chapter contains the following sections:
- Calibration
- Removing or Installing Modules
- Cleaning

NOTE
Read the General Safety instructions before starting any maintenance procedure.

14.1 Calibration
Only the Main Control module requires calibration. For information, contact technical support.

14.2 Removing or Installing Modules
This section describes how to remove and install the transmitter modules.

CAUTION
These modules are sensitive to electrostatic discharge (ESD). Do not touch the board components.

To remove a module
1. Turn the transmitter's rear power switch off.
2. Use a Philips-head screwdriver to loosen the two side screws.
3. Open (unlock) the module's ejector handles by pressing the red tabs and moving the handles to the outside position.
4. Hold the handles and slowly pull out the module.

To install a module
1. Turn the transmitter's rear power switch off.
2. Open (unlock) the module's ejector handles by pressing the red tabs and then moving the handles to the outside position.
3. Hold the handles and carefully place the module into the proper slot's side guide rails.
4. Slowly push the module into the slot opening until the faceplate is flush with the classics.
5. Lock the handles by moving them to the inside position against the faceplate.
6. Use a Philips-head screwdriver to attach the two side screws.

14.3 Cleaning
Routine cleaning should not be necessary because of the installation environment. However, turn the rear power switch off and use a slightly damp cloth if cleaning is needed. Do not let water drip into the chassis or the hand-held display unit. Do not use cleaning chemicals.

15.   Acronyms

This chapter defines the acronyms used in this document.

ELF   Extreme Low-Frequency signals

FLS-2   Fiber Locating System

LS   Locate Signal

SD   Signal Direction Signals

16. Glossary

This chapter defines practical terms.

Active locating   Locating an underground line through signals generated by the transmitter.

Centerline   The imaginary line extends along the ground directly over the line to be traced. Also, the center of the display indicates the locator is to the left or right of the line.

Line direction   East, West, or Line 1…16

Common-bonded conductors   Lines or ground conductors, such as telephone lines, power cables, or pipes, are electrically connected. Conductors common-bonded to the target conductor carry the signal, making it difficult to locate the target beyond the common bond.

Current measurement   A feature on the receiver, whereby an indication is given of the current in the target line. The indication of the current does not change as the depth of the line changes. Although the indicated current decreases slowly as the distance of the receiver from the transmitter increase, an abrupt change in the indicated current may be caused by a lateral "T" or damage to the line. A current measurement may also be used in a crowded environment to confirm the signal is on the target line rather than coupled to an adjacent utility.

Frequency   The transmitter's electromagnetic field reverses its direction many times each second. The signal's frequency is the number of these cycles completed in one second. Proper frequency selection is important for successful locating.

Frequency allocation and maximum power   The permissible use of the electromagnetic frequency spectrum is mandated by the Federal Communications Commission (FCC). The Code of Federal Regulations, 47 (Telecommunications), Part 15, section 15.213. The FCC regulates the frequencies and power levels used to locate underground lines. Below 9 kHz, any power level may be used. For 9-45 kHz, a maximum of 10 watts of power may be generated by the transmitter. For 45-490 kHz, the transmitter may generate a maximum of 1 watt of power.

Gain   The amount of the signal at the receiver's antenna increases before it is processed and displayed. The signal generated by the current in the target line is very small. It must be increased in size before generating a perceptible indication on the display or sound in the receiver.

Grounding	A return path for electrical current through the soil. For example, grounding is accomplished in the direct connect mode by pushing a grounding rod into the ground. A line or pipe sticking out of the ground may be used in other cases. Grounding provides a continuous and complete path for the signal current to travel over the line and back to the transmitter. The current does not flow without a path, and the receiver receives no signal.
Job	A scheduled task, such as updating the firmware.
Magnetic field	The force field around a permanent magnet or a conductor flowing electrical current is the magnetic field detected by most electromagnetic locators.
Station	Transmitter unit.
Target line	The underground facility is the target of the location activity. It may be a power line, gas line, water pipe, telephone line, or other conducting medium buried in the ground.
Transmitter	A device that generates a current in an underground line. The transmitter is used with a receiver tuned to the same frequency.
VT100	This is the terminal emulator (modem).

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