

# Foreign Voltage Detector Model FVD Description and Use



A Fact Sheet prepared by CenturyLink Environmental Health & Safety

## General

**CAUTION: Read this entire document prior to operating the Model FVD, Foreign Voltage Detector**

The Foreign Voltage Detector (FVD) is a handheld test set used to detect the existence of AC voltages on a conductive surface.

The FVD is a remote measurement device. This means that electrical contact with the object being tested is not required. The outside of the FVD is all dielectric; electrical contact through the FVD is not possible.

The FVD provides visual indication of the amount of AC being detected on a 10 step bar graph. An audible alarm will sound if the detected voltage exceeds 50 volts.

The FVD is manufactured by Power Solutions, Inc. exclusively for Telco Sales, Inc., 118 Hilltop Business Dr., Pelham, AL 35124.

## Description

The FVD has a non-conductive, moisture-resistant, plastic housing. It measures 1.7 inches wide, 7.8 inches long, 0.9 inch deep and weighs 4.8 ounces.

The FVD contains one sealed power switch and has a green LED to indicate that the FVD is on and that the battery is in good condition. A 10 step LED bar graph display indicates the amount of AC being detected. All three are located on the face of the test set.

The FVD is powered by one NEDA 1604A 9-volt alkaline battery, or equivalent. One battery will provide about 9 hours of continuous usage.

The circuitry of the FVD contains built-in filters to suppress 20 Hz ringing and radio stations' signals.

The FVD is UL listed to U.S. and Canadian safety standards. UL evaluated the FVD to the following specifications:

- UL 1244, Second Edition, the Standard for Electrical and Electronic Measuring and Testing Equipment.
- CAN/CSA C22.2 No. 231 Series - M89, The Standard for Electrical and Electronic Measuring and Test Equipment.

There are two models of leather pouches available that can be attached to the technician's tool belt. The Model FVDP is for carrying the FVD, and the Model FVDP3 is for carrying the FVD, scissors and knife.

## Precautions

### WARNING - Risk of Electric Shock

- Always check proper operation of this device on a known working circuit before using.
- Never touch an object that is suspected of being energized before proper testing.
- Review the Model FVDV Training Video prior to testing for hazardous voltage with the FVD.
- The FVD detects AC voltage only, not current flow.

When the FVD test set indicates that a hazardous voltage is present, the user must follow company safety procedures. Do not touch any energized equipment.

Conductive objects can become energized by nearby power conductors by any of four methods:

- direct electrical contact
- high current power fault
- induction (electromagnetic coupling)
- capacitive coupling

Direct electrical contact is usually referred to as a power cross.



A high current power fault causes a ground potential rise where grounds are shared. This situation is very similar to direct electrical contact. Both situations are hazardous and should be treated the same.

Induction occurs when a grounded conductor (i.e., telephone cable) runs parallel to power conductors. A telephone conductor is usually grounded (through the central office battery) at the central office or remote terminal. The amount of induction on a telephone conductor is a function of the separation of the power conductor and telephone conductor, length of exposure, and phase unbalance of the power line. The presence of a shield on the telephone cable does very little to reduce the 60 Hz AC induction.

Capacitive coupling occurs where any conductive object is in close proximity to AC power and does not have a conductive path to ground. Coupling of this type will not occur in cables that have a grounded shield. This type of coupling will occur on "C" wire and open wire lines that are not grounded in the central office or remote terminal. This type of coupling is often referred to as "E" field.

Capacitive coupling will occur on ungrounded items on poles such as steps, signs, etc. if there is not a grounded conductor between these items and the power line.

Induction and capacitive coupling are often confused with each other. A conductor will not be energized by capacitive coupling if it is grounded. A conductor with induction can produce continuous current flow and is potentially hazardous. A conductor that is coupled to power through capacitance has little capability to produce current flow and should not be considered hazardous.

### Theory of Operation

The sensing circuitry of the FVD uses a ball shaped metallic electrode to form one side of a capacitor; the other side is the source conductor. The foreign voltage is sensed as a varying charge on this capacitor. It should be noted that should a foreign voltage be coupled to the body of the FVD from the hand of the user, this voltage will also cause a varying charge on the input capacitor when the sensor is brought near a ground.

This sensed voltage is then passed through a high resistance divider and into a high impedance

operational amplifier (op amp). Input circuitry is kept at a very high impedance so that the op amp is sensing the charge level on the input capacitor.

Out of the input op amp stage, the sensed voltage passes through a low pass filter that is set to begin roll-off at about 200Hz, followed by a notch filter centered at 20 Hz to remove ringing signals.

### FVD Serial Number Above 100,000\*:

The sensed and filtered signal is then passed directly to an analog input of a microcontroller. The microcontroller contains an analog to digital converter which samples the input signal at a high rate. This sampled signal is used to determine the level to display on the bar graph. The 10 step bar graph is driven directly by the microcontroller. An audible alarm is wired to activate along with the 50 volt step of the bar graph.

### FVD Serial Number Below 100,000\*:

The sensed and filtered signal is then converted to DC by a precision full wave rectifier. The rectified and filtered DC is then passed to a display driver chip, which drives the 10 step bar graph. An audible alarm is wired to activate along with the 50 volt step of the bar graph.

\*The serial number is located in the unit's battery housing on the back of the FVD. For more information on opening the battery housing see the Operating Instructions below.

The FVD is calibrated so that the alarm will activate at 50 volts when the end of the probe is against an energized source that is equivalent to a #22 AWG insulated paired conductor.

For higher voltages or large conductors, the alarm will sound before contact, giving the user advance warning of hazardous voltages. The more severe the hazard, the farther away the FVD will be when the warning activates.

The FVD is calibrated to display 200 volts full scale. The response of the bar graph circuitry is logarithmic, with each step representing a 3 decibels change from the adjacent step. This response allows greater



resolution when testing voltages at lower levels. The audible alarm activates along with the sixth step (50 volt bar).

The green power LED is driven through a 6.2 volt zener diode so that it will not illuminate when the battery voltage drops below 7.8 volts. This allows the power indicator to also function as a low battery indicator.

### Application

The FVD is a small, hand-held test set intended to detect the presence of AC voltage. It can not be used reliably to detect DC voltage. The FVD does not detect current flow.

The FVD will not directly respond to magnetic fields. It will detect voltage on conductors that is caused by nearby magnetic fields.

Although the FVD provides a bar graph display to indicate the level of AC voltage, it is not a precision measuring test set. The voltage level indicated on the bar graph will be affected by the distance between the FVD and the voltage source, the size of the source conductor, and the insulation on the conductor. The maximum resolution of the bar graph is controlled by each individual step size. **If the exact voltage level is required, a voltmeter must be used.**

### Operating Instructions

#### FVD Serial Number Above 100,000\*:

To operate the FVD, press and hold the power switch located on the face of the test set. The voltage indicator (red bar graph) will step rapidly upward and the alarm will sound as the 50 volt bar is illuminated. All ten bars should illuminate. The green LED should illuminate and stay on. After the power-up test completes, continue to hold pressure on the switch. If no AC voltage is being sensed, the alarm will go silent and all steps of the bar graph will extinguish.

#### FVD Serial Number Below 100,000\*:

To operate the FVD, press and hold the power switch located on the face of the test set. The voltage indicator (red bar graph) will activate momentarily. To test the audible alarm, release and press the power switch rapidly until at least six bars illuminate. The audible alarm must sound when the sixth bar

illuminates. After testing the alarm, hold pressure on the switch. If no AC voltage is being sensed, the alarm will go silent and all steps of the bar graph will extinguish.

The green LED will illuminate and stay on as long as the switch is depressed. The FVD automatically shuts off when the switch is released.

If the green LED does not illuminate, **the battery must be replaced before use.** If the green LED illuminates only when the bar graph steps are extinguished, the battery is becoming weakened. In this case the FVD may continue to be used, but the battery should be replaced as soon as practicable. The battery housing is located on the back of the FVD. To replace the battery, insert the blade of a small screwdriver into the slot on the battery cover and use the screwdriver to pry the cover open. Use a good quality 9 volt alkaline battery for replacement.

### Testing

Check for the presence of power lines in the vicinity. If power lines are present, see 7.6 through 7.8.

To begin testing for **hazardous** voltage, first bring the FVD to within a few feet of the object being tested. While pressing the power switch, aim the probe (smaller end) of the FVD toward the object being tested. If the audible alarm sounds, **more than 50 volts is present.**

If the audible alarm does not sound, the FVD should be moved closer to the object being tested until the probe of the FVD is either in direct contact with the object or the audible alarm sounds indicating 50 volts or more has been detected. The voltage indicating bar graph will provide an indication of the voltage level present when the probe is against the voltage source.

If the voltage indicator shows more than 50 volts and the audible alarm activates while the FVD is being moved closer to the object being tested, **more than 50 volts is present.**

If the tip of the probe is in direct contact with the object being tested and less than 50 volts is indicated, the source should not be considered **hazardous.**

A user may become energized due to capacitive coupling in the vicinity of power transmission lines or under power distribution lines where the neutral is



above the phase conductors. This may cause the FVD to indicate a **hazardous** condition when it does not exist. To determine if this condition is causing a **hazardous** voltage indication, the user should provide a temporary path to ground for his body in order to remove the voltage caused by capacitive coupling to the power line and then conduct another test. If the **hazardous** voltage indication persists then the object should be considered **hazardous**. If the **hazardous** voltage indication disappears, the user was himself energized and must continue to keep himself grounded while testing with the FVD.

The recommended method for grounding the operator is for the operator to hold one end of a W1BU Ground Cord that is connected to an earth ground (a screwdriver inserted into the earth and connected to the ground cord). A W1BU Ground Cord is a 25' retractable cord with clamps on each end. Or, by the operator simply touching anything that is slightly conductive (1 megohm or less) and in contact with the earth.

Because the FVD is a **remote** detector, it will detect the presence of power lines operating at high voltages a considerable distance away. As the probe is moved near a conductive object for testing, the indications caused by the power line will diminish and the object being tested will be measured. When the probe is moved away from the object being tested, the power line will again be detected. **The indications from the power line will not affect the FVD while the probe is in near proximity to the object being tested.**

### Care and Storage

The FVD should be kept clean and dry. The FVD housing may be wiped clean with mild soap and water. When not in use, the FVD should be stored in its leather pouch.

If water gets into the battery compartment, it should be opened and allowed to dry before use.

If the plastic housing is cracked, the FVD should be returned for repair or replacement. See section 11.2 for return procedures.

### FVD Testing and Calibration

A periodic test of the FVD can be performed by turning it on and touching the end of the probe to the metal

end of a 193A Test Plug that is plugged into an active power outlet. If the audible alarm activates and over

50 volts is indicated, the FVD is operational. A properly calibrated FVD will illuminate either 6 or 7 bars on the display.

### Specifications

Technical	
Size	1.7" X 0.9" X 7.8"
Weight	4.8 ounces
Range	0 to 200 Vrms
Sensing Type	Remote, AC only
Frequency	50 to 150 Hz
Display	10 step LED bar graph, log response
Audible alarm	
Frequency	2800 +/- 300 Hz
Level	Approx. 75 dba @ 1 foot
Threshold	> 50 Vrms sensed voltages
Battery	
Type	NEDA 1604A 9-Volt Alkaline, or equivalent
Life	> 9 hours continuous when idle
Environmental	
Operating	-20° C to 50° C at 10% to 95% RH non-condensing
Storage	-40° C to 85° C at 0 to 100% RH non-condensing
Shock & Vibration	TR-EOP-000063 compliant

### Warranty and Ordering

The FVD Foreign Voltage Detector test set is warranted from manufacturing defects for one year from the date of purchase.

To return a unit for calibration or for warranty service, contact Telco Sales, Inc. for a return authorization number. The telephone number is 205-403-0113 and the fax number is 205-403-0119.

### Resources:

Information Provided by Scott Carlton of Telco Sales Inc.