

# TROUBLESHOOTING TRAINING WORKBOOK

## Troubleshooting Tools

You have several tools available with the Protel<sup>®</sup> and Elcotel<sup>®</sup> phones to help you troubleshoot problems. They include:

**You:** Your thinking and analysis of the situation at the phone are the first tools you have available. It is your decision in applying the rest of the tools that will lead to the best solution.

**Voice Error Messages (Protel<sup>®</sup>):** Messages that sound in the handset when the phone restricts a phone call. The voice error messages are listed in the *Pocket Reference* as well as the phone manuals themselves.

**Voice Flag Codes (Protel<sup>®</sup>):** Codes that are stored in the phone and sent to the remote computer. You can hear the current flags set in the phone by dialing “\*#64.” The voice flag codes are listed in both the *Pocket Reference* and the payphone manuals.

**Alarm Codes (Elcotel<sup>®</sup>):** Like Voice Flag Codes they are set by the phone when a problem occurs. Using telemetry you can find out what alarms are active. They will also be reported to the computer during the next communication.

**Diagnostic Mode:** Automatic component tests using codes entered at the keypad.

**Troubleshooting Flowcharts:** Charts in the *Pocket Reference Guide* and the *Compact Field Guide* that give you a step-by-step method to find why a diagnostic test fails and why several other possible problems may exist.

The Voice Error Message list, the list of \*#64 Flags and the Alarm Code list can also be found on our website at [www.paytelephone.com](http://www.paytelephone.com) under the FAQ link.

## Standard Troubleshooting Process

These are general guidelines for using the troubleshooting tools in the phones and documentation. When you first start using the phone, you can follow these steps and the procedures to guide you through troubleshooting. However, your exact steps may vary depending on the conditions you find at the phone and your level of experience.

Each step below may uncover a problem. If so, stop and repair the problem. If you need further diagnosis, continue with the troubleshooting steps.

ALWAYS finish with the last step, the operational test, so you can leave knowing the phone is operating properly.

1. Physically inspect the phone and components. Fix any obvious problems. This includes inspecting the wiring harnesses that connect the various equipment, checking the coin path for stuck coins or defective hardware, verifying that the relay fires properly and looking over the other physical components.
2. Check the error messages and flag or alarm codes.
  - a. Come off hook and listen for any error messages.

- b. Dial a local coin number and listen for any error message. Hang up without completing the call so that the money is refunded. Try another call that you allow to go through to test collection.
  - c. If it is a Protel<sup>®</sup>, come off hook and dial “\*#64” and listen for a flag code. If you hear an error message or flag code, use your *Pocket Reference* to determine what it means. If there is a keypad diagnostic test for the trouble you find, use the keypad diagnostics to confirm the trouble.
  - d. If it is an Elcotel<sup>®</sup>, access telemetry using your Bypass code and dial “967” for a voice report of the alarm codes that are active.
3. If all physical components appear OK and you have checked for Flags/Alarms, your next step will depend on the nature of the trouble. Knowing what components are required to perform specific functions and the steps the phone goes through when making calls is very helpful. For instance, if there is no dial tone you know that only a few components could be involved (line, pigtail, board, keypad and handset) so you check their integrity. You may have to test several components together and separately before solving the problem.
  4. ALWAYS perform standard operational tests before leaving the site. This includes making different types of calls (coin, 800, 0+) and verifying the voice and coin systems are working properly. Not testing thoroughly can cause you to miss secondary problems that might not be readily apparent.

## Quality Check

Below are some useful suggestions and testing procedures. In many cases the manufacturer of the payphone equipment does not really matter in applying the testing as all of the equipment used to support the chassis board is virtually interchangeable.

Route wires out of the way of moving parts.

Ensure the coin mechanism is straight.

Place the dust cover on the relay and the trigger switch.

Check for loose screws.

Check the line current.

1. Set the multimeter to read current in milliamps.
2. At the terminal block disconnect the tip going to the phone.
3. Connect the tip wire to the black lead from the multimeter.
4. Connect the red lead to the tip connector on the terminal block.
5. Come off the hook.

Results: You should measure between +20 mA to +90 mA. If the line current is out of this range, contact your local telephone company.

Check the line voltage.

1. Set the multimeter to measure DC voltage.
2. Connect the red lead from the multimeter to the ring connector on the terminal block.

Results: You should measure between +44 to +56v. If the reading is negative, check the incoming wires and switch them to the correct polarity. If the voltage is out of this range, contact your local telephone company.

Check the Ni-Cad Battery.

**Note:** In troubleshooting, symptoms related to the Ni-Cad battery may be more complicated than symptoms related to other components.

For instance, it may appear that the phone correctly processes calls without the battery, but the Ni-Cad battery is needed to run the chassis and it must be plugged in to fire the relay. Also, with a Ni-Cad battery, the voltage does not necessarily indicate the battery's capacity to provide current and to recover from usage. Finally, since the Ni-Cad battery charges from the line current when the phone is in use, a low voltage may indicate low line current, low phone usage, a bad battery, or a combination of these.

1. Use other troubleshooting methods (troubleshooting flowcharts, test phone calls) to pinpoint a problem to the Ni-Cad battery. An especially helpful test is whether the phone will go into program mode or telemetry. Usually, even when other problems occur the phone should be able to enter program mode or telemetry.
2. Test the battery voltage to help confirm if the charge on the battery is causing the problem.
3. If the voltage is low, determine why:
 

To Test This	Possible Reason	Do This
Low Current.....		Check line current
Low Phone Usage.....		Get phone activity information from the computer operator.
Bad Battery.....		Replace battery with a battery of the proper voltage

### Checking Ni-Cad Battery Voltage

Set the multimeter to measure DC voltage

1. Connect the red lead of the multimeter to pin 1 of the battery connector.  
Connect the black lead of the multimeter to pin 2 of the battery connector.  
Results: A good battery on active phone on a line with adequate current should have these minimum voltages.

Express 310/2000/7000 Series:	+4.8v
200BB+:	+6v
Elcotel:	+5.8v

## Checking the Electronics with a Multimeter

These checks can tell you the equipment is not working properly if you do not get the readings indicated. However, a reading within tolerance does not confirm that a component will work properly. First use other troubleshooting methods (troubleshooting flowcharts, test phone calls) to pinpoint a problem to a specific component, and then use these tests to help confirm that the component is bad.

### CAUTION

**Never touch multimeter leads to the circuit board when the multimeter is set to measure resistance, continuity or diodes. When set to measure resistance, continuity and diodes, multimeters produce a small voltage that could damage the circuit board.**

### Relay Assembly

Before doing this test, if the board is a Protel<sup>®</sup>, you can test the relay using the Escrow Relay Test in the *Pocket Reference Guide*.

**Note:** When looking at the relay connector plugged into the Express 7000, the Express 2000, the 200BB+ chassis or the Elcotel<sup>®</sup> boards, pin 1 is on the left and pin 3 is on the right. Disconnect the relay from the chassis.

1. Set the multimeter to measure resistance.

2. Connect the multimeter leads to the pins of the connector listed below.  
**Never touch multimeter leads to the circuit board when the multimeter is set to measure resistance, continuity or diodes.**

Under the following conditions you should have the resistance indicated. Except for the first measurement, if you measure infinite resistance (an open circuit), the relay will not function properly.

Results:

Do not force the white flag down

Do not force the armature closed

Gently push on the armature and let the flag fall back on its own

Pin 1 (green wire) & Pin 3 (white wire)

White flag down: infinite resistance

White flag up: 1000Ω

Gently push and hold the relay armature closed: 1000Ω

Pin 2 (red wire) & Pin3 (white wire)

White flag in any position: 1000Ω

Gently push and hold the relay armature closed: 1000Ω

## Trigger Switch

Before doing this test you can test the trigger using the Coin Recognition Test in the *Pocket Reference Guide*.

**Note:** When looking at the trigger switch connector plugged into the Express 7000, the Express 2000, the 200BB+ chassis or the Elcotel® boards, pin 1 is on the left and pin 4 is on the right. Disconnect the trigger switch from the chassis.

1. Set the multimeter to read resistance.
2. Connect the multimeter leads to the pins of the connector listed below.  
**Never touch multimeter leads to the circuit board when the multimeter is set to measure resistance, continuity or diodes.**

3. Put your finger under the coin slot you are testing.

4. Pin 3 (white wire) & Pin 4 (green wire)

Drop a quarter through the quarter slot (farthest to the right looking at the front of the trigger switch). Hold the quarter in the bottom of the slot with your slot.

5. Pin 2 (red wire) & Pin 4 (green wire)

Drop a dime in the dime slot (middle slot). Hold the dime in the bottom of the slot.

6. Pin1 (blue wire) & Pin 4 (green wire)

7. Drop a nickel in the nickel slot (farthest to the left looking at the front of the trigger switch). Hold the nickel in the bottom of the slot.

Results:

For each pin, observe from the following readings: The resistance before dropping a coin should be infinite.

The resistance when holding a coin in a slot should be near 0.

**Note:** Make sure you have the leads connected to the correct pin for the slot you are testing. If you connect the leads to the wrong pin, you may read infinite resistance when you hold a coin in the slot.

## Handset

**Note:** The exact colors of the handset wires vary among the many manufactures. Before doing these checks, confirm the colors of the receive wires and the transmit wires for your handset.

Wire colors for handsets normally fall in two groups. The range of colors is almost universal (green, yellow, black and red), but different manufacturers assign the wires differently.

Receive (R1 & R2)	Green & Yellow	OR	Black & Yellow
Transmit (T1 & T2)	Black & Red	OR	Green & Red

1. Set the multimeter to measure resistance.
2. Disconnect the receive wires from the circuit board on the back of the keypad-hookswitch assembly.
3. Connect the leads of the multimeter to the receive wires of the handset and read the meter.
4. Disconnect the transmit wires from the circuit board on the back of the keypad-hookswitch assembly.
5. Connect the leads of the multimeter to the transmit wires of the handset, and read the meter.
6. Talk into the transmit microphone on the handset.

Results:

Receive wires:  $50\Omega$ - $200\Omega$  (depends on manufacture).

Infinite resistance means the receiver is bad

Transmit wires:  $50\Omega$ - $200\Omega$  (depends on manufacture).

Infinite resistance means the transmitter is bad.

## Hookswitch

1. Set the multimeter to measure resistance.
2. Disconnect the hookswitch wires from the circuit board on the back of the keypad-hookswitch assembly.
3. Connect the leads of the multimeter to the hookswitch wires.
4. Go on and off hook and read the meter.

Results:

On hook: Infinite resistance

Off hook: less than  $1\Omega$

## Electronic Coin Scanner II (Protel<sup>®</sup> only)

Before doing this test, you can test the ECS using the Coin Recognition Test in the *Pocket Reference Guide*.

**Note:** Looking at the ECS connector plugged into the Express 7000 Series or the Express 2000 Series phone, pin 1 is on the right and pin 8 is on the left. Disconnect the coin scanner from the chassis assembly.

Set the multimeter to measure resistance. Check the resistance on the following pins of the connector on the ribbon cable.

**Never touch multimeter leads to the circuit board when the multimeter is set to measure resistance, continuity or diodes.**

Readings should be plus or minus 25% of those listed below. If the resistance is outside the tolerance, the coin scanner may still function properly. If you measure infinite resistance between the following pins (an open circuit), the ECS will not function properly.

Results:

Pins 1-2: $8.5\Omega$	Pins 2-3: $.4\Omega$	Pins 3-4: $1.3\Omega$
Pins 6-7: $50\Omega$	Pins 6-8: $50\Omega$	Pins 7-8: $100\Omega$