

**AVO** INTERNATIONAL

AVTM654000  
Revision C  
October 2000

**Instruction Manual**  
**DART<sup>®</sup> Analysis System**  
**Software Version 4.1**  
Catalog No. 654000  
Including Instructions  
for  
**AVO<sup>®</sup>Link**  
Data Management Software

**HIGH-VOLTAGE EQUIPMENT**  
Read this entire manual before  
operating.

**APARATO DE ALTO VOLTAJE**  
Ante de operar este producto  
lea este manual enteramente



# ***DART<sup>®</sup> ANALYSIS SYSTEM***

---

***Instruction Manual***

Copyright © 2000 AVO International. All rights reserved.

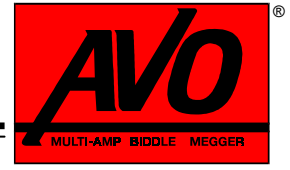
The information presented in this manual is believed to be adequate for the intended use of the product. If the product or its individual instruments are used for purposes other than those specified herein, confirmation of their validity and suitability must be obtained from AVO International. Refer to the warranty information included at the end of this instruction manual. Specifications are subject to change without notice.

DART<sup>®</sup> and BIDDLE<sup>®</sup> are registered trademarks of AVO International.

## ***WARRANTY***

Products supplied by AVO International are warranted against defects in material and workmanship for a period of one year following shipment. Our liability is specifically limited to replacing or repairing, at our option, defective equipment. Equipment returned to the factory for repair must be shipped prepaid and insured. This warranty does not include batteries, lamps, or other expendable items, where the original manufacturer's warranty shall apply. We make no other warranty. The warranty is void in the event of abuse (failure to follow recommended operating procedures) or failure by the customer to perform specific maintenance as indicated in this manual.

**AVO INTERNATIONAL**  
P.O. Box 9007  
Valley Forge, PA 19485-1007  
610-676-8500



**AVO** INTERNATIONAL

---

# CONTENTS

1	INTRODUCTION.....	1
	About the DART <sup>®</sup> Analysis System.....	1
	Upon Receipt of Product.....	2
	Safety First.....	2
	How to Use This Manual.....	2
2	SAFETY.....	5
	Introduction.....	5
	General Safety Precautions.....	5
	Safety in Using the DART Analysis System with a Surge Generator or Other Safety Device.....	6
	Protective Clothing and Equipment.....	6
	Special Considerations for Personnel.....	7
	Safety Precautions for Connecting to the Power Source.....	7
	Special Grounding Considerations for Fault-Locating Systems.....	7
	For More Information.....	8
3	SPECIFICATIONS.....	9
4	INSTALLATION AND SETUP CONFIGURATIONS.....	11
	Introduction.....	11
	Stand-alone unit with hanging mounts (PFL-1000) and stand-alone unit for general use.....	11
	Mounted in lid of cable fault system (PFL-4000).....	13
	Rack-mounted in cabinet of cable fault system (PFL-5000 and PFL 6000).....	14
	Making the Connections.....	14
5	OVERVIEW OF OPERATING MODES.....	17
	Introduction.....	17
	TDR Mode.....	17
	ARC Mode.....	18
	SURGE Mode.....	18
	Use in Decay Method.....	19
6	USING THE DART ANALYSIS SYSTEM.....	21
	Before You Begin.....	21
	How to Use the Touch Screen.....	21
	How to Read the Status Bar.....	22
	How to Use the Cursor.....	23
	Using the Screens.....	24
	Start.....	25
	Select Operating Mode.....	26
	DART Setup.....	26
	Control.....	29

Options .....	30
Save .....	31
Recall.....	32
Delete .....	33
Range.....	34
Gain .....	38
Velocity .....	42
Cursor Adjustment .....	45
Sample Screens .....	47
Surge Sample Screen.....	53
Quit.....	54
Turn Off Screen.....	54
Operating Notes.....	55
Calibrating the Left Cursor Offset .....	55
Working with Unknown Propagation Factors.....	57
Troubleshooting .....	61
Technical Assistance .....	62
7 MAINTENANCE.....	63
Cleaning .....	63
Repairs.....	63
GLOSSARY .....	65
INDEX .....	67
ADDENDUM: Instructions for Using AVOLINK	

# 1

## INTRODUCTION

### *About the DART<sup>®</sup> Analysis System...*

Thank you for selecting an AVO International product. This instrument has been thoroughly tested and inspected to meet rigid specifications before being shipped. It is ready for use when set up as described in this manual.

The DART Analysis System is a fault locating system designed to prelocate cable faults on underground systems. It incorporates Windows<sup>®</sup> based software and uses touch screen operation. A complete system includes an arc reflection filter, a surge generator, and the DART Analysis System.

The DART Analysis System operates

- as an integral part of BIDDLE<sup>®</sup> Power Cable Fault Locating (PFL) systems, or
- as a stand-alone time domain reflectometer (TDR).

It can also be connected to

- a linear coupler and surge generator or
- a voltage coupler and dc test set.

The DART Analysis System is available in four different configurations:

- Stand-alone unit with hanging mounts (PFL-1000)
- Stand-alone unit for general use with existing cable fault systems
- Mounted in lid of cable fault system (PFL-4000)
- Rack-mounted in cabinet of cable fault system (PFL-5000 and PFL-6000)

**NOTE:** *This manual describes the DART Analysis System. For operating information about BIDDLE surge generators, dc test sets, and arc reflection filters, refer to the respective instruction guides for those products.*



Grounding systems and procedures described in this manual are designed specifically for BIDDLE equipment. If other manufacturers' equipment is used with the DART<sup>®</sup> Analysis System, the user is responsible for verifying that the grounding and interconnections between the systems comply with each manufacturer's instructions. The user is also responsible for observing the appropriate safety precautions when working with such equipment. Incompatible grounding systems may prove hazardous.

## ***Upon Receipt of Product***

Check the equipment received against the packing list to ensure that all materials are present. Notify AVO International of any shortage (tel: 610-676-8500).

Examine the instrument for damage received in transit. If you find damage, file a claim with the carrier at once. Also notify AVO International or its nearest authorized sales representative, and describe the damage in detail.

## ***Safety First***

Be sure to read the safety information in Section 2 thoroughly and observe all safety precautions and recommendations. Also, before operating the DART Analysis System, be sure to read and understand the "Safety" section of the manual for your specific PFL system or arc reflection filter.

## ***How to Use This Manual***

### Organization

- Description of the DART Analysis System
- Safety precautions
- Product specifications
- Installation and setup configurations
- Description of the unit, the touch-screen interface and connections
- How to use the DART Analysis System
  - Screens
  - Operating notes



- Troubleshooting
- Maintenance
  - Cleaning
  - Repair
- Glossary
- Index

### Typographic conventions

- Figures and tables are numbered in sequence by section
- Numbered lists show procedural steps
- Bullets list items and options
- Buttons represent elements on the touch screen.

A rectangular button with a blue gradient background and a dark border. The word "Start" is written in white, bold, sans-serif font in the center.

- A symbol alerts you to information that applies specifically to one or more modes.

A red, rounded rectangular symbol with a dashed border. The letters "TDR" are written in white, bold, sans-serif font in the center.

- Cautions, warnings and notes
  - *Cautions* alert you to possible damage to equipment.

A yellow rectangular symbol with a black border. The word "CAUTION" is written in black, bold, sans-serif font in the center.

- *Warnings* alert you to conditions that are potentially hazardous to people

A rectangular symbol with a white background and a black border. The word "WARNING" is written in black, bold, sans-serif font in the center.A rectangular symbol with a white background and a black border. The words "SHOCK" and "HAZARD" are written in black, bold, sans-serif font, stacked vertically in the center.

- *Notes* provide important explanation or assistance



# 2

## SAFETY

### *Introduction*

AVO International has designed the DART Analysis System and the recommended operating procedures with careful attention to safety. It performs formal safety reviews of the initial design and any subsequent changes to all new BIDDLE products, including the DART Analysis System. The safety review covers areas over and above those included in applicable ANSI standards.

Regardless of these efforts, it is not possible to eliminate all hazards from electrical test equipment or to foresee every possible hazard. You are therefore urged not only to follow the safety rules in this manual, but also to consider carefully all safety aspects of the test before proceeding. **Safety is the responsibility of the user.**

The design of this equipment follows safety specifications IEC 1010-1 and ANSI/ISA S82.01 and meets the requirements for Class I, Installation Category II equipment.

AVO International recommends that a qualified operator attend the system at all times while it is in operation. Only qualified service personnel should replace components or make internal adjustments.

### *General Safety Precautions*

The DART Analysis System is a low-voltage device that is typically used with a high-voltage arc reflection system, dc test set, or surge generator. The test systems and the cable to which they connect are sources of high-voltage electrical energy. Therefore, the proper safety guidelines for high voltage apply to the operation of this equipment. Observe the following safety precautions:

- Observe all safety warnings on the equipment. They identify areas of immediate hazard that could result in injury or death.
- Use this equipment only for the purposes described in this manual.

- Use all practical safety precautions to prevent contact with energized parts of the equipment and related circuits.
- Use suitable barriers, barricades, or warnings to keep persons not directly involved with the work away from test activities.
- Do not connect to a charged line (induced voltages.)
- Do not operate with the ventilation holes blocked.
- Do not connect to energized equipment or use in an explosive atmosphere.
- Use the grounding and connection procedures recommended in this manual.
- Observe strictly the warnings and cautions used throughout this manual (see Introduction).
- Always follow your company's safety procedures.

### ***Safety in Using the DART Analysis System with a Surge Generator or Other Safety Device***

- Do not use this equipment to locate faults on direct-buried unshielded or secondary cable. Dangerously high differences in potential may be developed in the current return path.
- Do not use this equipment to locate faults on any cable that may be close enough to an energized cable to allow a burn-through of the insulation of the energized cable. Cables located in a common trench, duct or tray (for example, three-phase systems) are susceptible to burn-through.)
- Do not operate any high-voltage equipment with covers or panels removed. Operation without these protective covers presents an electric shock hazard.
- Remain at least 3 ft (0.91 m) away from all parts of the complete high-voltage circuit, including connections, unless the equipment is de-energized and all parts of the test circuit are grounded.
- Use the grounding and connection procedures recommended in this manual.
- Use the grounding and connection procedures recommended in the appropriate PFL system or arc reflection filter manual.

### **Protective Clothing and Equipment**

If the equipment is operated as recommended in this manual, if all safety precautions are observed and if all grounds are correctly made, rubber gloves are not necessary. As a routine safety procedure, however, some users require that rubber gloves be worn, not only when making

---

connections to the high-voltage terminals, but also when manipulating controls. AVO International considers this an excellent safety practice.

## Special Considerations for Personnel

High-voltage discharges and other sources of strong electric or magnetic fields may interfere with the proper functioning of heart pacemakers. Personnel using heart pacemakers should obtain expert advice on the possible risks before operating this equipment or being close to the equipment during operation.

## Safety Precautions for Connecting to the Power Source

The DART Analysis System operates from a single-phase power source. It has a three-wire power cord and a two-pole, three-terminal grounding type connector. The voltage to ground from either pole of the power source must not exceed the maximum rated operating voltage of 110/220 V ac. Before making connection to the power source, verify the following:

- That the voltage of the power source is correct
- That the power source has a suitable two-pole, three-terminal grounding type connector
- That the power source has a high-rupture fuse or circuit breaker rated no higher than 15/7.5A.

The power input plug must be inserted only into a mating receptacle with a ground contact. Do not bypass the grounding connection. Any interruption of the grounding connection can create an electric shock hazard. Confirm that the receptacle is correctly wired before inserting the plug.

## Special Grounding Considerations for Fault-Locating Systems

High-voltage electrical impulses generated by fault locating systems and resultant current pulses create special safety problems. Large, rapidly changing currents, even across small values of impedance, can generate high voltage levels. BIDDLE PFL systems provide two separate and distinct grounds: **star ground** (the system chassis ground) and **surge ground**. The **surge ground** is designed to return the surge current directly back to the surge capacitor through the coaxial shield of the high-voltage output cable. The operator is isolated from any transient voltage rise along the **surge ground** by insulation in the PFL system or arc reflection filter and by the insulated jacket of the high-voltage output cable.

The fault-locating system should be operated only with the ground connections described in the appropriate manual for your PFL system or arc reflection filter.

### **Safety Ground Jumper**

Treat all terminals of high-voltage power equipment as a potential electric shock hazard. Potential always exists for voltages to be induced at these terminals because of proximity to energized high-voltage lines or equipment. Before connecting any test leads, you must install a **safety ground jumper** between the high-voltage conductor and ground of the cable under test (**specimen ground**). This discharges any potentially hazardous voltages in the cable under test.

### **Disconnecting the Test Equipment**

Always disconnect test leads from power equipment before attempting to disconnect them at the test equipment. The safety ground connections must be the first made and the last removed. Any interruption of the safety grounding connection can create an electric shock hazard.

### **Maintaining Safety After Test Completion**

On completion of a test, even after power has been removed, energy can still be stored in the capacitor of the surge generator, the filter output cable, the cable under test, and the capacitor in the arc reflection filter. For this reason the arc reflection system should be grounded after use as described in the arc reflection filter manual.

## ***For More Information***

For additional information, refer to IEEE 510-1983 "IEEE Recommended Practices for Safety in High-Voltage and High-Power Testing."

# 3

## SPECIFICATIONS

Operating modes:	ARC Basic, ARC Extended, SURGE and TDR
Ranges: (ARC and Surge)	U.S.: 500, 1000, 2000, 5000, 10,000, 20,000, 50,000 ft Metric: 150, 300, 600, 1500, 3000, 6000, 15,000 m Time: 0.5, 1, 2, 5, 10, 20, 50 $\mu$ s
Ranges: (TDR)	U.S.: 100, 200, 500, 1000, 2000, 5000, 10,000, 20,000, 50,000 ft Metric: 30, 60, 150, 300, 600, 1,500, 3,000, 6,000, 15,000 m Time: 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50 $\mu$ s
TDR pulse widths:	80, 160, 320, 640 ns, 1, 2, 5, 10 $\mu$ s
Cursors:	Selectable format: feet, meters, $\mu$ s Dual, independent cursors with both positions displayed Differential cursor position displayed
Resolution:	5 ft (1.50 m), depending on range and mode
Horizontal zoom:	Selectable from X1, X2, X4 and X8
Velocity selectable:	0 to 99% 0 to 983.6 ft/ $\mu$ s 0 to 299.8 m/ $\mu$ s 0 to 491.8 ft/ $\mu$ s (Vp/2)
Inputs:	Input 1: channel one acquisition (TDR and ARC) Input 2: channel two acquisition (SURGE)
TDR pulse amplitude:	10 V nominal, into 50 $\Omega$

Gain:	1, 2, 3, 4, 5, 10, 20, 50, 100
Input impedance:	50 $\Omega$ , all inputs
Max. signal input:	250 V peak for transients
Display:	Monochrome Active matrix color (optional)
Operating system:	DOS 6.22 Windows 3.1
External interfaces:	Serial port Parallel port
Printer support:	Hewlett Packard LaserJet II Hewlett Packard Inkjet IBM Graphics
Memory:	Stores up to 20 waveforms internally
Power:	115 V (90 to 132 V) or 220 V (180 to 250 V) sinusoidal power source at 45 to 66 Hz, automatic switching, 200 VA maximum
Temperature range:	32 to 122°F (0 to 50°C) operating -4 to 158°F (-20 to 70°C) storage
Humidity:	<80 percent noncondensing
Dimensions:	11.5 x 16.25 x 5.5 in. (29.2 x 41.3 x 13.9 cm) (H x W x D)
Weight:	18.6 lb (8.5 kg)
Accessories supplied:	Power cord, 6 ft (1.82 m), for 120 V ac grounded receptacle  Cable for connecting the DART Analysis System to the arc reflection filter, 3 ft (0.91 m) RG-58  Instruction manual  Ground cable, 18 in. (0.46 m) for connecting the DART chassis ground to the arc reflection filter ground
Optional Accessory:	AVOLink software to download and upload traces to and from a PC and to emulate DART operation on a PC for trace analysis and viewing



# 4

## INSTALLATION AND SETUP CONFIGURATIONS

### *Introduction*

The DART Analysis System is available in four different configurations:

- Stand-alone unit with hanging mounts (PFL-1000)
- Mounted in lid of cable fault system (PFL-4000)
- Rack-mounted in cabinet of cable fault system (PFL-5000 and PFL-6000)
- Stand-alone unit for general use with existing cable fault systems

**NOTE:** *This manual describes the DART Analysis System. For operating information about BIDDLE PFL systems, surge generators, dc test sets, and arc reflection filters, refer to the respective instruction guides for those products.*

### **Stand-alone unit with hanging mounts (PFL-1000) and stand-alone unit for general use**

#### **Front Panel**

The front panel of the unit is shown in Figure 4-1.

Display screen:      Indicates reflections from impedance changes in the cable. Contains an integrated touch-screen interface. Displays are available in monochrome or active matrix color

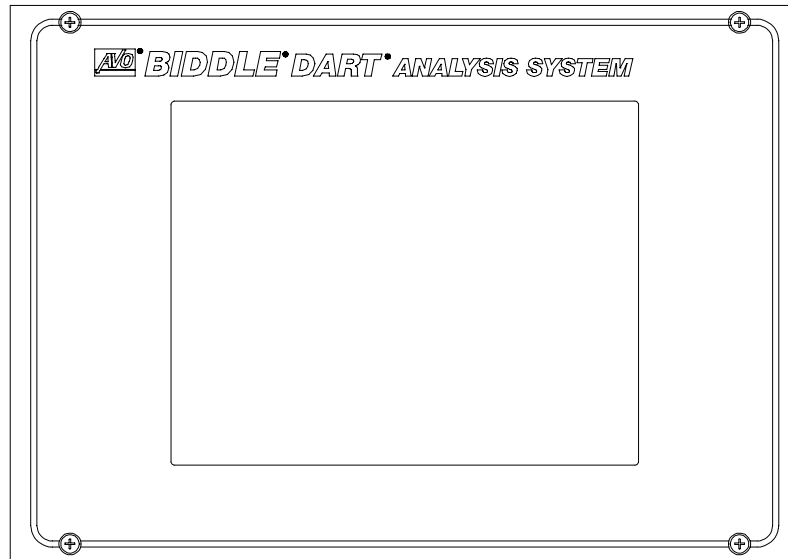
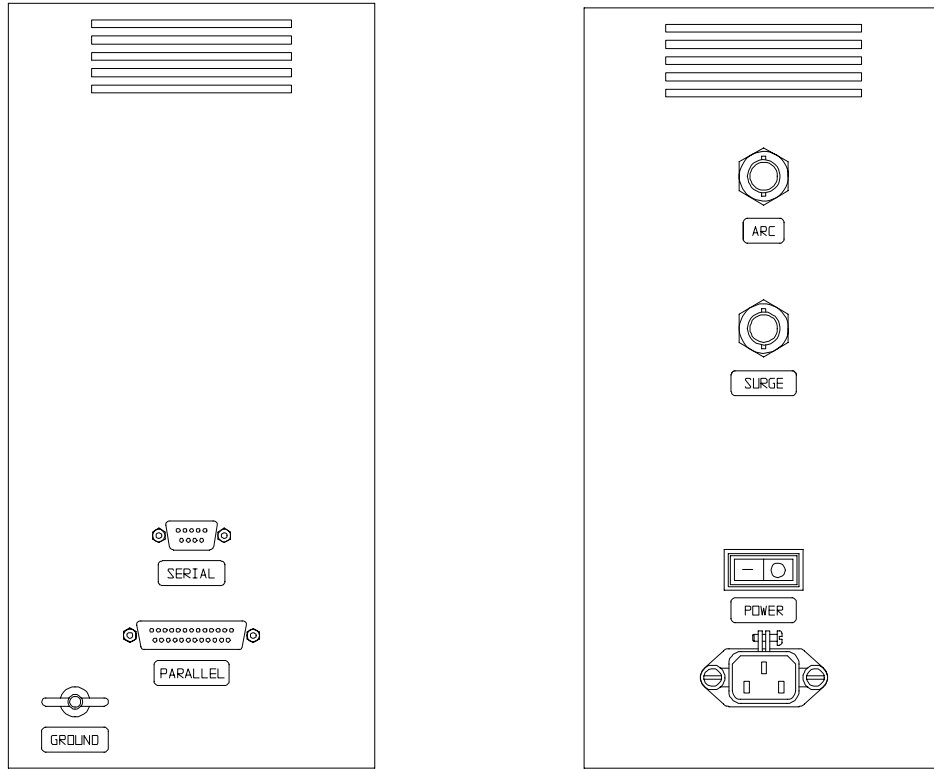


Figure 4-1 DART Analysis System Front Panel

### **Side Panels**

The features on the side panels of the unit are shown in Figure 4-2.

- |                             |  |
|-----------------------------|--|
| <b>ARC</b>                  | Connector used for the ARC and TDR modes   |
| <b>SURGE</b>                | Connector used for the SURGE mode  |
| <b>Power on/off:</b>        | Switch that turns power on/off   |
| <b>Input for power cord</b> | Power input for the DART Analysis System   |
| <b>GROUND:</b>              | Ground lug for connecting to the PFL system. The ground is called the <b>analyzer chassis ground</b> . It connects to the <b>chassis ground</b> as described in the instruction manual for the PFL system or arc reflection filter |
| <b>PARALLEL:</b>            | Connector for a printer cable  |
| <b>SERIAL:</b>              | Nine-pin serial communications connector for a PC interface  |



LEFT SIDE PANEL

RIGHT SIDE PANEL

Figure 4-2 DART Analysis System Side Panels

**Mounted in lid of cable fault system (PFL-4000)**

**Front Panel**

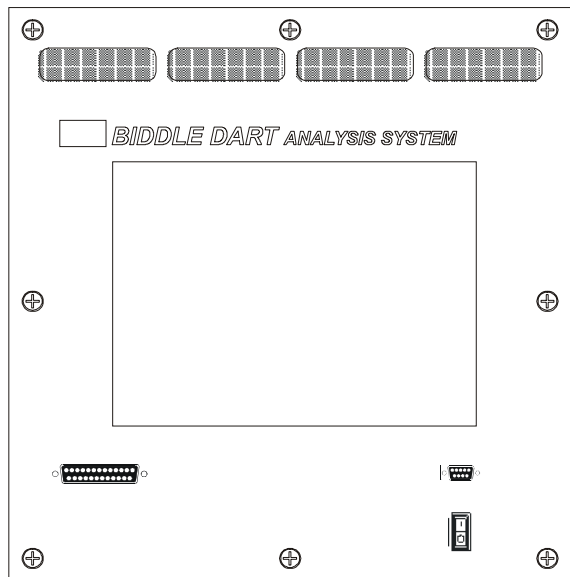


Figure 4-3 DART Analysis System Front Panel

### **Bottom Panel**

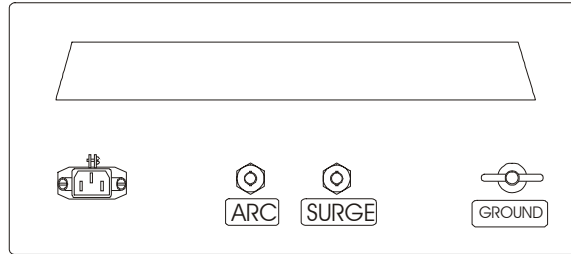


Figure 4-4 Bottom Panel

To install the lid-mount DART in the PFL-4000, refer to assembly instructions AVTI654000-4K.

### **Rack-mounted in cabinet of cable fault system (PFL-5000 and PFL 6000)**

The DART Analysis System is incorporated into the chassis of the PFL-5000 and the PFL-6000. Refer to the respective instruction manuals for complete instructions on installation and setup.

### **Front Panel**

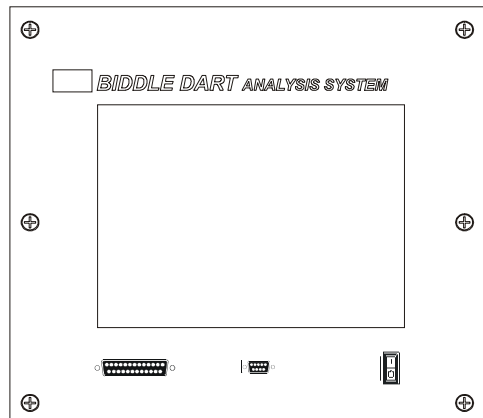


Figure 4-5 Front Panel (lid mount)

### ***Making the Connections***

The following procedures are intended as a general guide. Before operating the DART Analysis System, be sure to read and understand the "Safety" section of the instruction manual that accompanies your PFL system or arc reflection filter manual.

**WARNING**

**SHOCK  
HAZARD**

High voltages resulting from improper grounding of the DART Analysis System may cause serious injury or death.

1. As described in the PFL system manual, use the **ground cable** to connect the ground lug of the DART Analysis System (**analyzer chassis ground**) to the ground lug on the arc reflection filter (**arc reflection filter chassis ground**) or PFL system.

This ground is for maintaining the DART Analysis System chassis at the same potential as the other accessible parts in the system. Safe operation requires proper grounding. **For complete grounding details, refer to the instruction manual for your PFL system**

2. Use the supplied 3 ft (1 m) coaxial cables (RG 58) to join the **ARC connector** and the **SURGE connector** of the DART Analysis System to the **ARC REFL BNC connector** and the **SURGE connector** of the PFL system or arc reflection filter.
3. Connect the supplied **power cord** to a well-regulated sinusoidal power source capable of supplying 200 VA of power.

**CAUTION**

When using a portable generator, check the output voltage. Always turn all power switches off before shutting down a portable generator. Do not use a square-wave type dc-to-ac inverter to power the DART Analysis System.



# 5

## OVERVIEW OF OPERATING MODES

### *Introduction*

The DART Analysis System prelocates faults in underground cable systems. It has three specialized operating modes: ARC, SURGE and TDR.

### *TDR Mode*

<b>Type of fault located:</b>	Low resistance (<200 $\Omega$ )
<b>Indicated use:</b>	When an arc cannot be established or when the operator chooses not to use high-voltage techniques

The DART Analysis System displays reflections, or cable traces, of pulses that are transmitted down the cable. The positions of the reflections on the display are used to determine the distance to the physical changes in the cable.

The initial upward reflection, viewed at the left of the screen, is the change of impedance as the pulses leave the test set. Everything to the right of this pulse represents reflections from impedance changes encountered in the cable. Cable landmarks such as the cable end, splices, transformers, or taps cause reflections.

In TDR mode, the instrument captures up to three traces, allowing easy examination of a faulted phase in comparison with other, good phases. A point where phases differ is likely the fault location.

The distance to the fault is read at the top of the display.

(The analyzer actually measures elapsed time between pulse transmission and receipt of the reflection. This time is converted to distance using the velocity at which the pulse travels through the cable.)

## **ARC Mode**

**Type of fault located:** High resistance

**Indicated use:** When an arc can be sustained at the fault during the surge

In ARC mode, the instrument captures and freezes the TDR trace during the discharge from a surge generator. Then the operator can examine the fault easily.

A high-voltage impulse is applied to the defective cable. As a result, the defective cable breaks down and forms a low-impedance arc at the fault site.

As the high-voltage impulse is applied, low-voltage pulses are transmitted down the defective cable. When the low-voltage pulses arrive at the fault, they are reflected back because the arc is nearly a short circuit.

The initial upward reflection, seen at the left of the screen, is the change of impedance as the pulses leave the test set. Everything to the right of this pulse represents reflections from impedance changes encountered in the cable. Cable landmarks such as the cable end, splices, transformers, or taps cause reflections.

The low-voltage pulses that are reflected from the fault are displayed on the DART screen as downward reflections that are used to determine the distance to the fault.

The distance to any landmark or fault in the cable is determined by adjusting the cursor until it coincides with the start of the upward or downward reflection on the trace. The distance to the fault is then read at the top of the display.

The analyzer actually measures elapsed time between pulse transmission and receipt of the reflection. This time is converted to distance using the velocity at which the pulse travels through the cable.

## **SURGE Mode**

**Type of fault located:** High-resistance

**Indicated use:** When arc reflection is not effective because an arc cannot be sustained at the fault during the surge

In SURGE (current impulse) mode, the instrument captures and freezes the reflected current transients created during the discharge from a surge generator.



A current coupler detects the current impulses reflecting between the surge generator capacitor and the fault.

A high-voltage impulse applied to the defective cable causes the fault to break down and form a low-impedance arc at the fault site.

Current transients reflect between the surge generator capacitor and the fault. The current transients are detected by a current coupler and captured by the analyzer in the form of a series of impulses, which are used to determine the distance to the fault.

The distance to the fault in the cable is determined by adjusting the left and right cursors to two consecutive peaks on the captured trace. The distance to the fault is then read at the top of the display.

The analyzer actually measures elapsed time between transient reflections. This time is converted to distance using the velocity at which the pulse travels through the cable.

### Use in Decay Method

In SURGE mode the analyzer can also be used for the decay method. Use of this fault locating method is indicated when the voltage required to sustain an arc at the fault exceeds the voltage capability of the PFL system. In this case, a dc dielectric test set is used to charge the cable under test to a voltage that will cause a breakdown at the fault location.

A dc test set is used to apply high voltage to the defective cable, causing the fault to break down. The capacitive charge built up on the cable discharges through the fault and creates current impulses reflecting between the test set and the fault.

The current transients are detected by an external current coupler connected to the Surge input connector on the DART. These transients are captured by the analyzer in the form of a series of impulses, which are used to determine the distance to the fault.

The distance to the fault in the cable is determined by adjusting the left and right cursors to a positive peak and a consecutive negative peak on the captured trace. The distance to the fault is then read at the top of the display.

The analyzer actually measures elapsed time between transient reflections. This time is converted to distance using the velocity at which the pulses travel through the cable.



# 6

## USING THE DART ANALYSIS SYSTEM

### *Before You Begin*

Before using the DART Analysis System, be sure that you understand the information in Section 2, "Safety" and Section 5, "Setting Up the DART Analysis System."

When you are certain that you have made all connections and grounds safely and correctly, activate the **POWER switch** of the DART.

### How to Use the Touch Screen

The DART Analysis System uses an infrared touch screen to activate functions.



Touch the screen only with your finger. Other objects may scratch the screen.

To ensure optimum functioning of the touch-screen interface:

- Use a single extended finger to touch the screen. Keep the other fingers retracted.
- Touch the button with your finger perpendicular to the screen.
- Press only one button at a time. If buttons are pressed simultaneously, neither button will respond.
- Unless you intend to press a button, don't point at the screen or touch it. You may accidentally activate a button.
- If a button doesn't respond (become highlighted) when touched, the computer in the DART Analysis System may be busy with calculations, calibration, or data acquisition. You may have to release the button manually so that it can recognize the next touch. Take your finger off the button, then touch again. Wait a moment and try again. If the button is highlighted, then it has recognized the new touch.

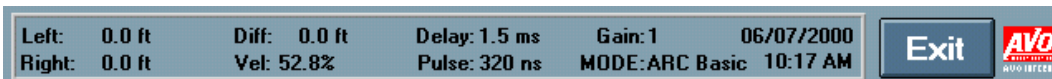
## How to Read the Status Bar

At the top of the DART screens is the status bar (Figure 6-1), which displays the important data for the screen. The values on the status bar for the three modes of operation are described below:

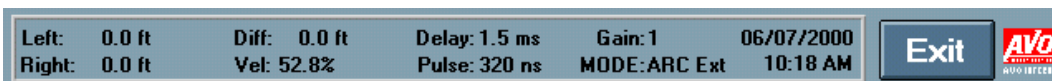
Cursor position	Left and right. (Not applicable in SURGE mode)
Diff	The difference in distance between the left and right cursors
Vel	The velocity of propagation (in units selected on the DART setup screen)
Pulse	The pulse width (in ns or $\mu$ s)
Gain	Gain of the input amplifier (expressed as a multiplier)
Mode	TDR, ARC (Basic or Extended), SURGE
Delay	For ARC mode and SURGE MODES only. Trigger delay time (expressed in ms)
Exit button	Press to exit and return to the Select Operating Mode screen



TDR Mode



ARC Basic Mode



ARC Extended Mode



SURGE Mode

Figure 6-1 Status Bar

## How to Use the Cursor

The top window on the screen displays the full measurement range. The lower window displays an expanded (zoomed) version of the trace(s) displayed in the upper window. The cursors displayed in the upper and lower windows are the same; they track each other.

Proper placement of the cursor(s) is very important in obtaining accurate measurements. In the ARC and TDR modes, the left cursor can be offset so that the cursor position is reported as zero feet (meters) at the start of the cable under test (Save Offset). For more information, refer to "Calibrating the Cursor Offset" on page 55.

**NOTE:** *The right cursor cannot move to the left of the left cursor, and the left cursor cannot move to the right of the right cursor. Instead, the cursor being moved will push the other cursor to the left or right, respectively. When an attempt is made to move the cursor off the screen, the trace(s) in the lower window will scroll if the Zoom factor is greater than one. The trace will then automatically center itself on the screen.*

### Locating the fault position

#### In TDR or ARC Mode

1. Move the cursor to the leading edge (left edge) of the upward or downward reflection from the cable landmark being measured.
2. Place the cursor as close as possible to the very beginning of the upward (downward) edge of the reflection.

**If the distance from a cable landmark is desired**, move the left cursor to the deflection at the landmark. Measurements made using the right cursor are displayed in the status bar at the top of the screen. The DIFF reading represents the distance from the left (landmark) cursor to the right (deflection of interest) cursor.

For example, to locate an open circuit, place the cursor at the very start of upward reflection. The positions of the left and right cursors are displayed in the status bar at the top of the screen. The difference between the cursors is also displayed.

**NOTE:** *In the ARC and TDR modes, the peak of the initial reflection might go off the screen vertically. This is normal and has no effect on cable reflections or measurements. Immediately to the right of the outgoing pulse will be reflections caused by the impedance change where the high-voltage output cable of the arc reflection filter or PFL system connects to the cable under test (appears as a splice on the display).*

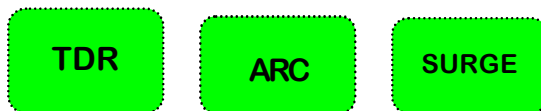
**If the length of the cable is unknown,** begin at a high range and work down until the full length of the cable is displayed. To help identify the end of the cable, alternately open-circuit and short-circuit the far end of the cable several times, if it is accessible. A reversing positive-to-negative deflection on the display should be observed. If a reversal is not observed, the cable may have an open circuit fault along its length. If the far end is not accessible, refer to cable maps to verify that you have located the far end of the cable and not an open fault.

### **In Surge Mode**

To locate the position of a fault in the Surge mode, select a high range, place the left cursor at the peak of a well-defined reflection and the right cursor at the peak of the next reflection.

## ***Using the Screens***

The screen layout and the buttons that control functions in the DART Analysis System are much the same for all three operating modes—TDR, ARC (Basic and Extended), and SURGE. If a particular screen has a specialized use in one of the modes, this manual will indicate the appropriate mode with a text reference and a graphic:



## Start

The Start screen (Figure 6-2) displays when the DART Analysis System powers up.

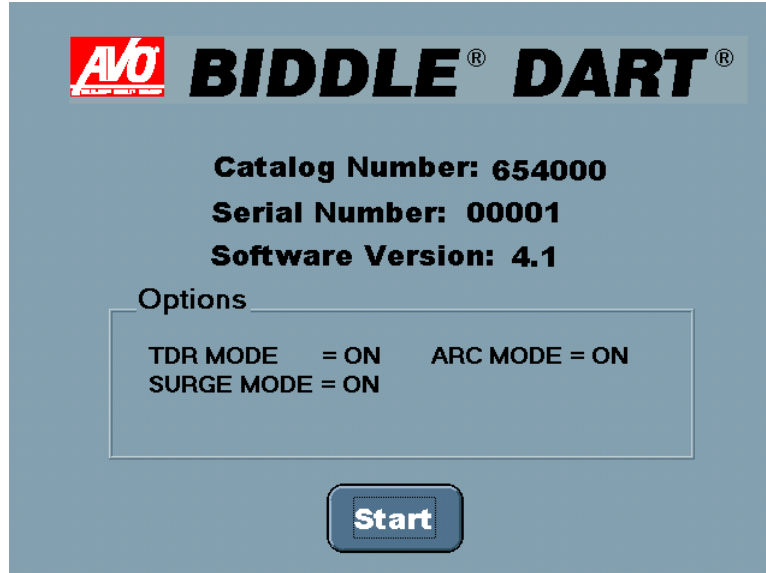


Figure 6-2 Start Screen

The screen lists:

- catalog number of the instrument
- serial number
- software version
- modes of operation installed

To adjust contrast on a monochrome display, press the upper right corner or bottom left corner of this screen

Press **Start** to go to the Select Operating Mode screen (Figure 6-3).

## Select Operating Mode

The Select Operating Mode screen (Figure 6-3) offers five options.

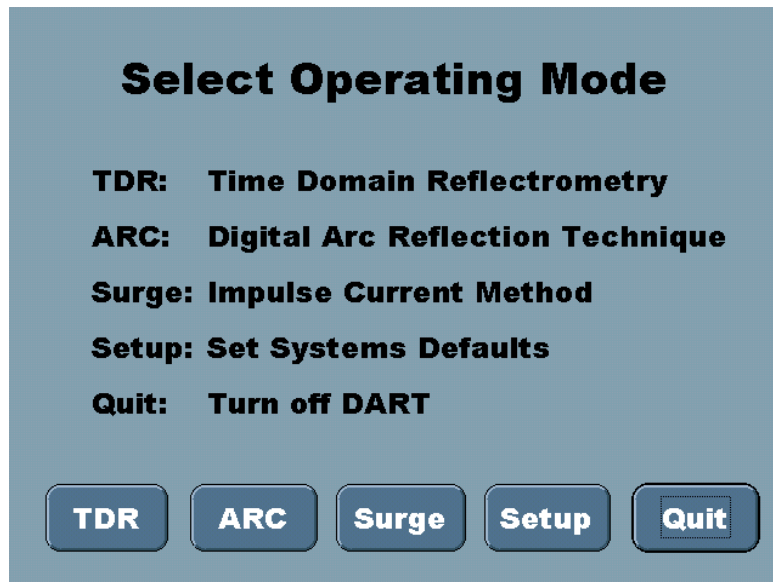


Figure 6-3 Select Operating Mode

- To select an operating mode, press **TDR**, **ARC** or **Surge**.
- To display the DART Setup screen and set up system defaults, press **Setup**.
- To begin the turn-off process, press **Quit**.

## DART Setup

Use this screen to configure the DART Analysis System.

The DART Setup screen (Figure 6-4) displays when you select **Setup** at the Select Operating Mode screen.



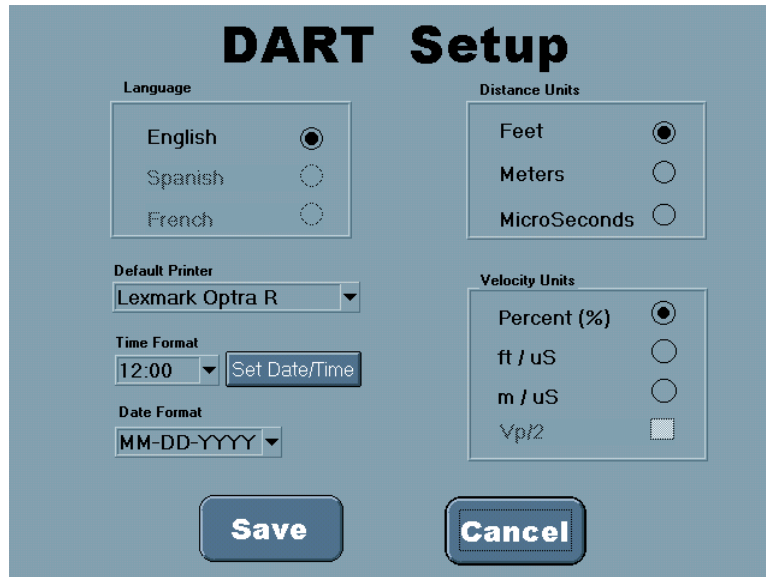


Figure 6-4 DART Setup

1. Press a radio button to select
  - a language (English is the only available language in Version 4.1),
  - the distance units
  - the velocity units
2. Use the three drop-down lists to select
  - a default printer
  - a time format (See Set Date/Time below)
  - a date format
3. When satisfied with your selections:
  - press **Save** to save the configuration settings and return to Select Operating Mode screen, or
  - press **Cancel** to return to Select Operating Mode screen without saving the settings.

### Set Date/Time

Press **Set Date/Time** and use the Set Date/Time window (Figure 6-5) to set the date and time.

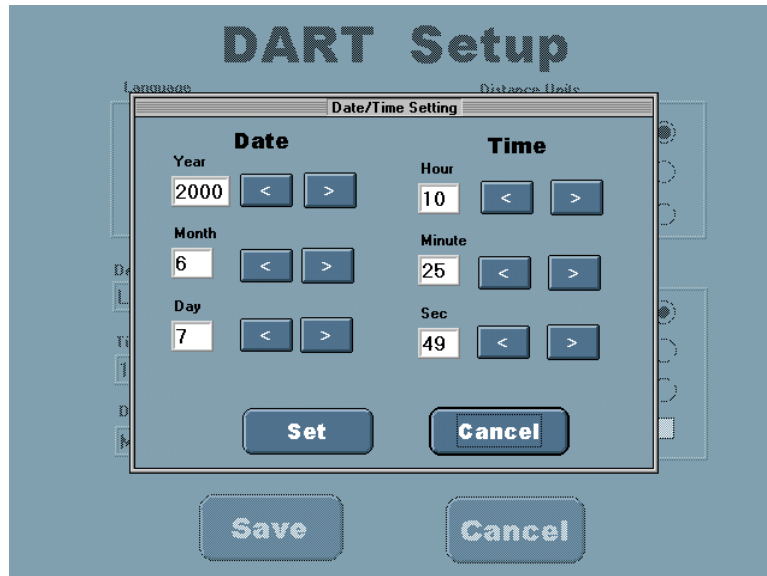


Figure 6-5 Set Date/Time

1. Press the **<** **>** buttons to change the year, month, day, hour, minutes and/or seconds.
2. When you are satisfied that the correct settings are displayed:
  - press **Set** to save the settings and return to the DART Setup screen, or
  - press **Cancel** to return to the DART Setup Screen without saving the changes.

## Control

Use the Control screen (Figure 6-6) to select a Basic or Extended ARC mode. If you do not make a selection, the mode defaults to Basic.

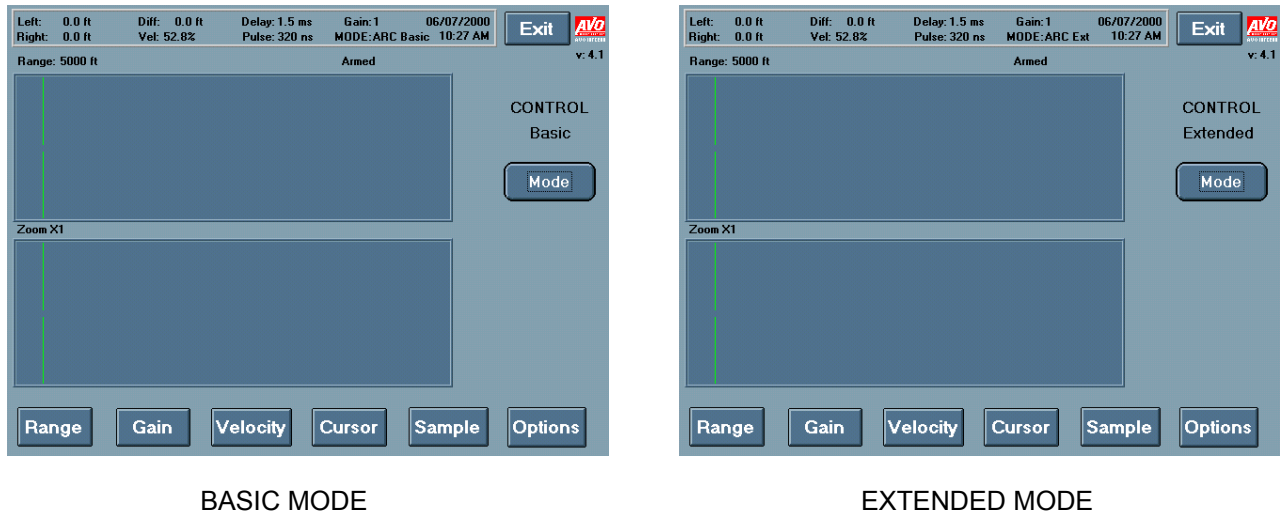


Figure 6-6 Control screen

The Control screen displays when you select ARC on the Select Operating Mode screen. Pressing **Mode** will toggle among Basic, Extended and (if available) Custom modes. The text above the **Mode** button and MODE: in the status bar indicate your selection.

- Basic mode has limited choices and functions
- Extended mode has all choices and functions
- Custom mode (if available) will have customer-designated text and functions

Press **Exit** to return to the Select Operating Mode screen (Figure 6-3).

## Options

Access the Options screen (Figure 6-7) by pressing **Options** on any screen offering that choice.

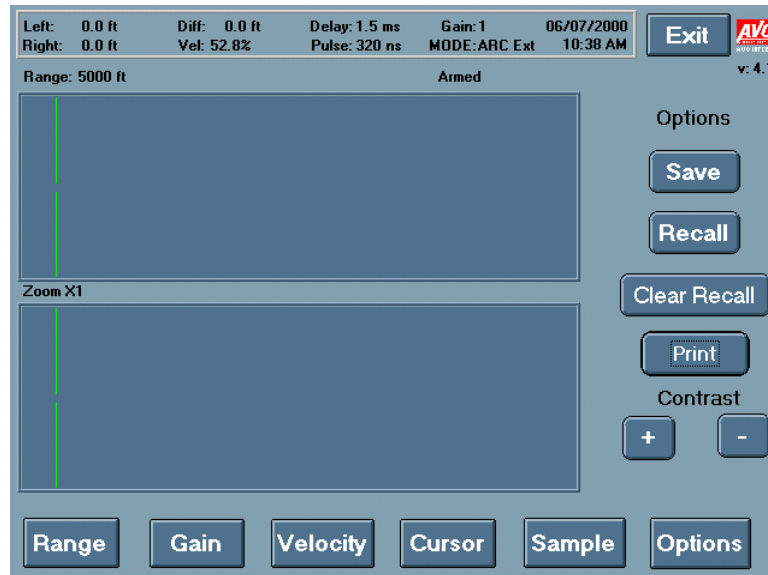


Figure 6-7 Options screen

Use the Options screen for the following functions:

- To adjust the contrast on a monochrome display if the front panel of the DART does not have a contrast control knob. (The contrast controls have no effect on the color display.) Press + for a darker screen, or - for a lighter screen, with each press.
- To select Save or Recall screens. Press **Save** to go to the Save screen (Figure 6-8). Press **Recall** to go to the Recall screen (Figure 6-9).
- To clear a recalled trace. Press **Clear Recall** to clear a recalled screen.
- To print the display. Press **Print** to print to the printer selected on the DART Setup screen. The printer must be connected to the parallel port.

The remaining buttons on the Options screen access functions that are described on the following pages.

## Save

Use the Save screen (Figure 6-8) to save traces and data to memory.

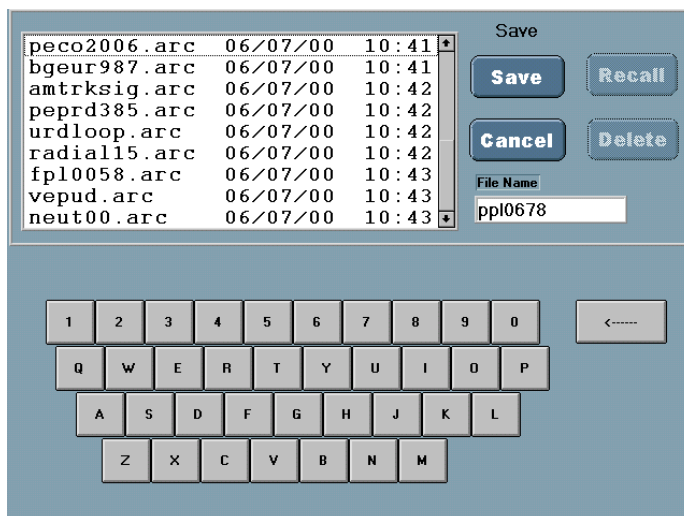


Figure 6-8 Save screen

Press **Save** on the Options screen (Figure 6-7) to display the screen. You can save high- and low-voltage traces, velocity, time delay, pulse width, gain, mode, date, and time. The window displays previously saved files, including filename, date, and time.

Use the alphanumeric keypad to assign a file name, then press **Save**. The DART will automatically assign a .tdr, .arc, or .srg extension, depending on the operating mode in use. To cancel the save process and return to the Options screen, press **Cancel**. (The **Recall** and **Delete** buttons are disabled on this screen.)

## Recall

Use the Recall screen (Figure 6-9) to recall saved traces and display them on the screen. High- and low-voltage traces, velocity, delay time, pulse width, gain, mode, date, and time will be recalled.

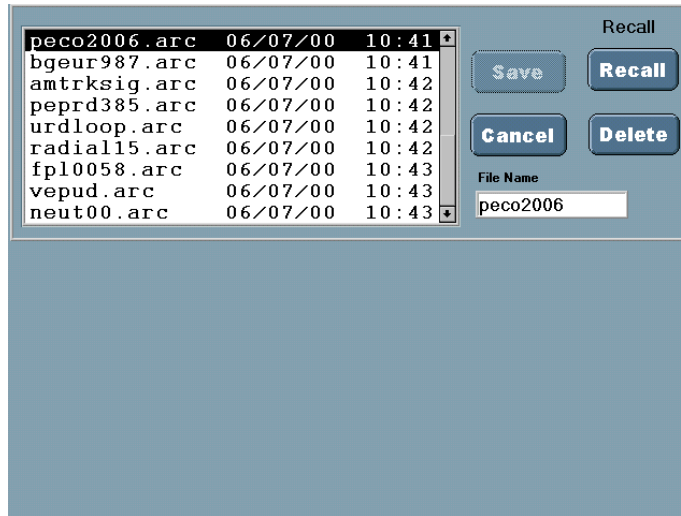


Figure 6-9 Recall screen

Display the Recall screen by pressing **Recall** on the Options screen (Figure 6-7). The screen becomes active, allowing left and right cursor movement. The recalled trace will be dashed/yellow. All settings of the real time trace will change to match those of the recalled trace.

Previously saved files with filename, date, and time are displayed in the window. To select a file, press on the filename. The filename is placed in the File Name box.

- To retrieve the selected file, press **Recall**.
- To go to the Delete screen (Fig. 6-10) and delete the selected file from memory, press **Delete**.
- To cancel the recall process and return to the Options screen, press **Cancel**.

The **Save** button is disabled on this screen.

## Delete

Use the Delete screen (Figure 6-10) to delete selected files.

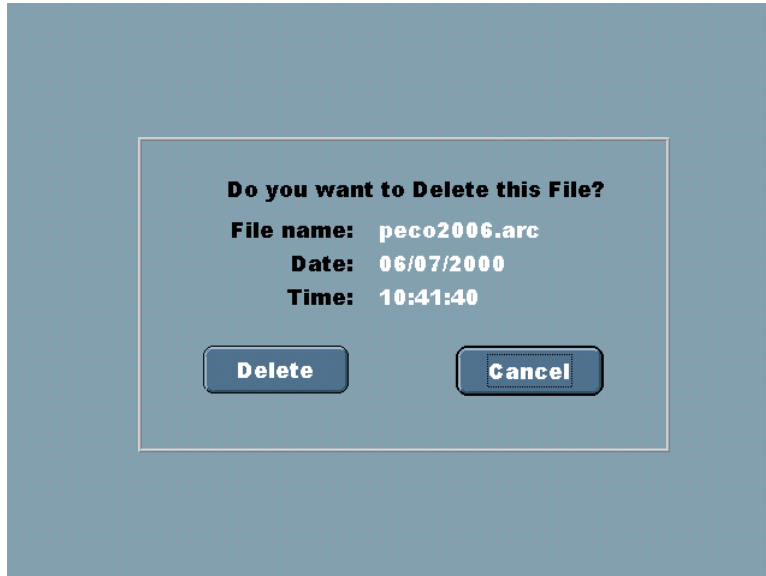


Figure 6-10 Delete screen

Display the Delete screen by pressing **Recall** on the Options screen (Figure 6-7) and then **Delete** on the Recall screen (Figure 6-9).

- To delete the file, press **Delete**.
- To cancel the delete request and return to the Options screen, press **Cancel**.

## Range

Use the Range screen (Figure 6-11) to select a full-scale upper-window range of:

**ARC SURGE**

- 50000, 20000, 10000, 5000, 2000, 1000, or 500 ft
- 15000, 6000, 3000. 1500, 600, 300, or 150 m
- 50, 20, 10, 5, 2, 1, or 0.5  $\mu$ s

**TDR**

- 50000, 20000, 10000, 5000, 2000, 1000, 500, 200, or 100 ft
- 15000, 6000, 3000. 1500, 600, 300, 150, 60, or 30 m
- 50, 20, 10, 5, 2, 1, 0.5, 0.2, or 0.1  $\mu$ s

The underlined numbers are the default settings.

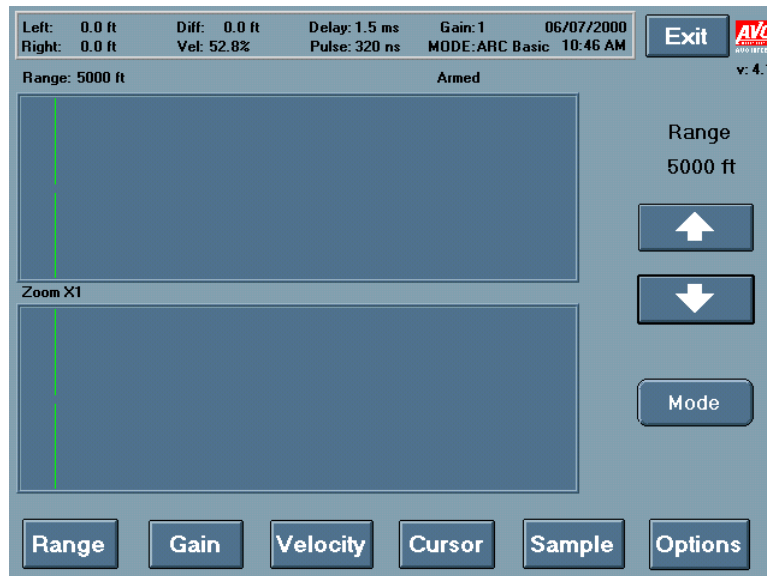




Figure 6-11 Range screen

Display this screen by pressing **Range** from any screen that offers Range as a choice. Your selection will depend on the units you selected in the DART Setup screen (Fig. 6-3).

- To increment to next longer range, press .
- To increment to next shorter length, press .



ARC

Press **Mode** to go to the Pulse Width screen (Figure 6-12).

Press **Mode** twice to go to the Delay screen (Figure 6-13).

Press **Mode** a third time to return to the Range screen.

TDR

Press **Mode** to go to the Pulse Width screen (Figure 6-12)

Press **Mode** twice to return to the Range screen.

SURGE

Press **Mode** once to go to the Delay screen (Figure 6-13).

Press **Mode** twice to return to the Range screen.

**Pulse Width**

TDR  
ARC

Use the Pulse Width screen (Figure 6-12) to change pulse width from the default selection for each range to 80, 160, 320, or 640 ns; 1, 2, 5, or 10  $\mu$ s.

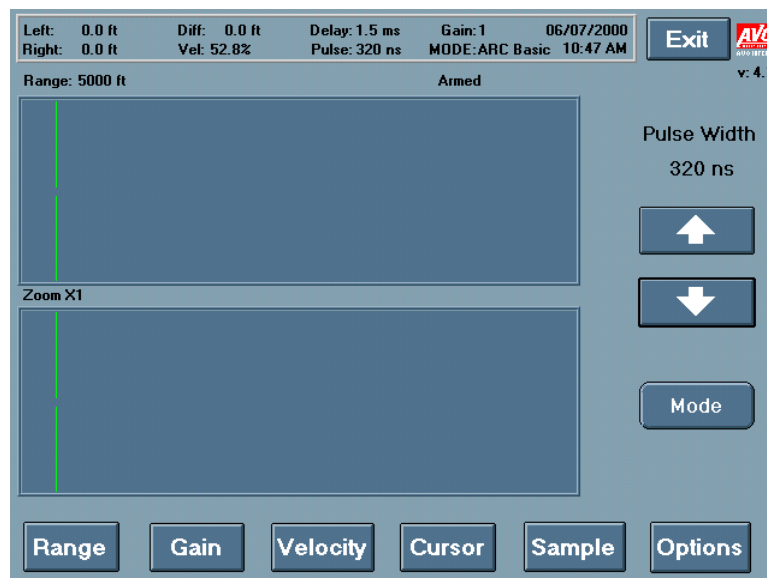






Figure 6-12 Pulse Width screen

Access the Pulse Width screen by pressing **Mode** on the Range screen (Figure 6-11) until Pulse Width replaces Range above the buttons at the right of the screen.


- Press  to increment to next wider pulse width (a wider pulse width will provide longer range capability but less resolution) or
- Press  to increment to next narrower pulse width.  
(A narrower pulse width will provide better resolution but will limit the useful range.)

The selected pulse width is indicated in text above the  button and in the status bar at the top of the screen.

**TDR**

In TDR mode, pressing  takes you back to the Range screen (Figure 6-11).

**ARC**

In ARC mode, pressing  takes you to the Delay screen (Figure 6-13).

Pulse width does not apply in SURGE mode.

**Delay**

Use the Delay screen (Figure 6-13) to change trigger delay from the default selection of 0.2 ms to 0.0, 0.1, 0.2, 0.5, 1.0, 1.5, 2.0, 5.0, 10.0, or 20.0 ms.

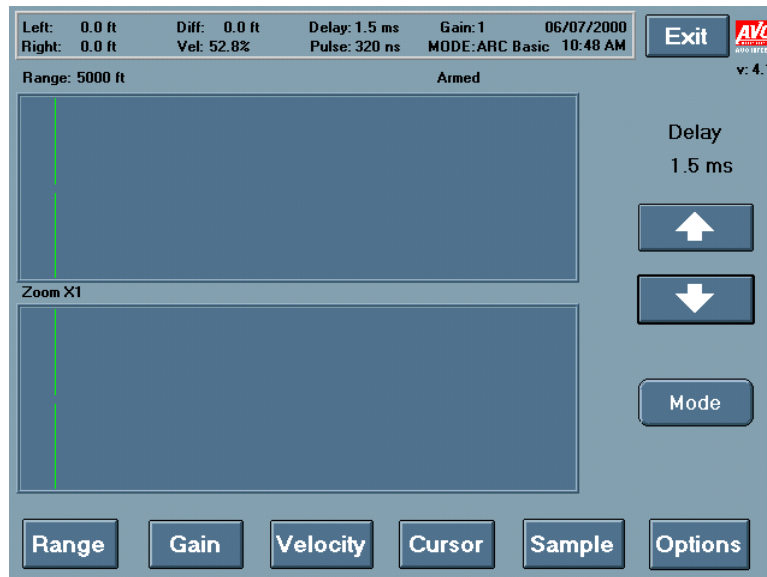




Figure 6-13 Delay screen



**SURGE**


Access the Delay screen by pressing  on the Range screen (Figure 6-11) until Delay replaces Range above the buttons at the right of the screen.


**ARC Ext**

Access the Delay screen by pressing  twice on the Range screen (Figure 6-11) until Delay replaces Range above the buttons at the right of the screen.

In ARC Extended and SURGE modes, the trigger delay adjusts the time that the DART waits before capturing a high-voltage trace. When you are working on a difficult fault, increasing the trigger delay may allow the successful capture of the fault location on the high-voltage trace.

- Press  to increment to next higher delay time.
- Press  to increment to next lower delay time.

The selected delay time is displayed in text above the  button and in the status bar at the top of the screen.

Pressing  will return you to the Range screen.

## Gain

**TDR  
ARC  
SURGE**

Use the Gain screen (Figure 6-14) to set the gain of the input amplifier to 1, 2, 3, 4, 5, 10, 20, 50, or 100 (1 is the default setting).

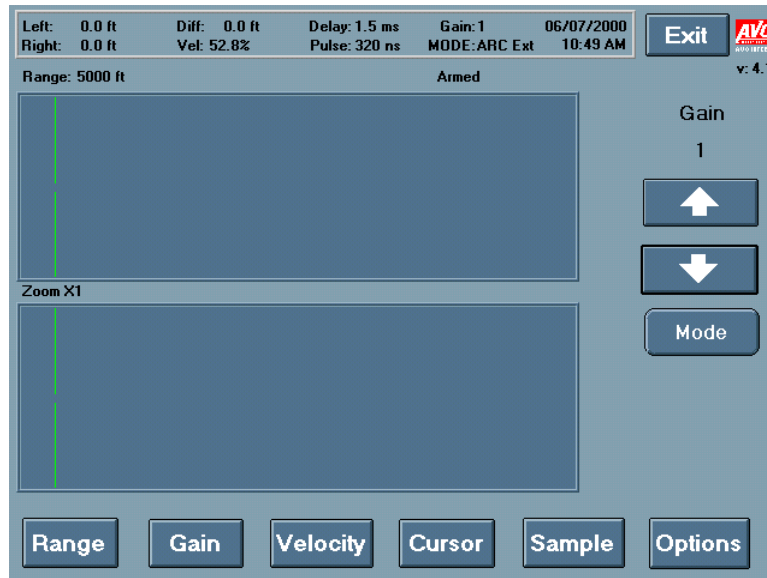


Figure 6-14 Gain screen

Access this screen by pressing **Gain** from any screen that offers it as a choice. Typically, gain is adjusted to easily identify the upward going reflection from the end of the cable run. Gain can be set to any personal preference for trace amplitude with no effect on distance measurement accuracy.

Press **↑** to increment to next higher gain multiplier. Press **↓** to increment to the next smaller gain multiplier. The selected value is displayed in text above the **↑** button and in the status bar at the top of the screen.

In ARC Extended, TDR and SURGE modes, the Gain screen provides access to additional features: Vertical Scale, Vertical Shift and Horizontal Shift screens. Press **Mode** to go to the Vertical Scale screen (Figure 6-15).

The ARC Basic mode does not access these features.

**Vertical Scale**

**TDR  
ARC Ext  
SURGE**

Use the Vertical Scale screen (Figure 6-15) to to modify the Vertical Scale of the selected Trace. Vertical Scale can be increased from 1.0 up to 100 or decreased from 1.0 down to 0.

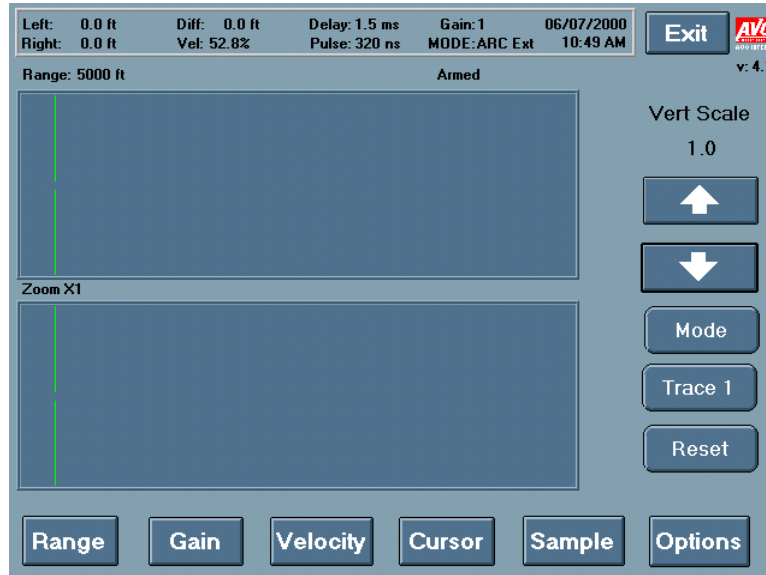


Figure 6-15 Vertical Scale screen

To access the Vertical Scale screen, press **Mode** from the Gain screen (Figure 6-14).

Press **↑** to increase the amplitude of the indicated trace. Press **↓** to decrease the amplitude of the indicated trace.

- To reset the vertical scale adjustment back to 1.0, press **Reset** at any time.
- To toggle to Trace 2 (green, captured high-voltage trace), press **Trace 1** (white, real time low-voltage trace).
- To toggle to Trace 3 (yellow, captured DART trace), press **Trace 2**.
- To toggle back to Trace 1, press **Trace 3**.

Press **Mode** to go to the Vertical Shift screen (Figure. 6-16).

**Vertical Shift**

**TDR  
ARC Ext  
SURGE**

Use the Vertical Shift screen (Figure 6-16) to move the vertical position of the selected Trace from the center base line. Vertical shift can be

- increased above the base line from 0.0 up to 100 or
- decreased below the base line from 0.0 down to -100.

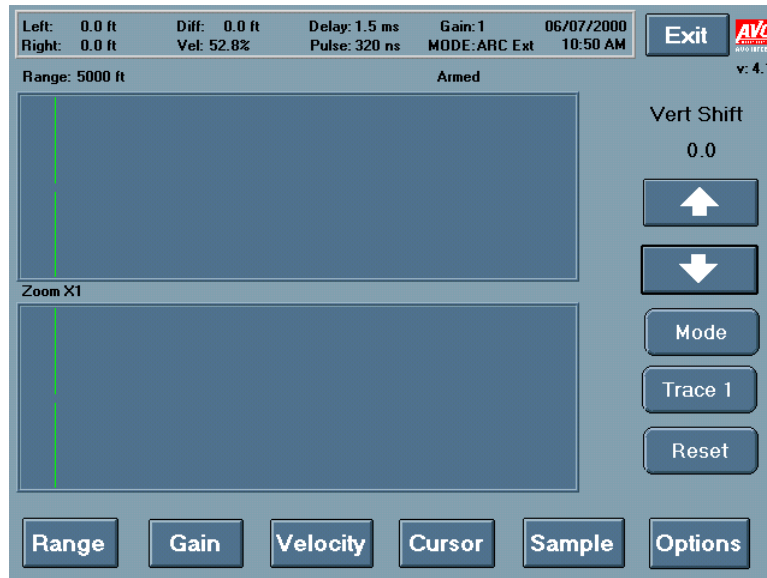


Figure 6-16 Vertical Shift screen

To access the Vertical Shift screen, press **Mode** on the Vertical Scale screen (Figure 6-15).

Press **↑** to shift the indicated Trace up. Press **↓** to shift the indicated Trace down.

- To reset the vertical shift adjustment back to the center base line (0.0), press **Reset** at any time.
- To toggle to Trace 2 (green, captured high-voltage trace), press **Trace 1** (white, real time low-voltage trace).
- To toggle to Trace 3 (yellow, captured DART trace), press **Trace 2**.
- To toggle back to Trace 1, press **Trace 3**.

Press **Mode** to go back to the Vertical Scale screen.

**Horizontal Shift**

**TDR  
ARC Ext  
SURGE**

Use the Horizontal Shift screen (Figure 6-17) to move the horizontal position of the selected Trace from left to right.

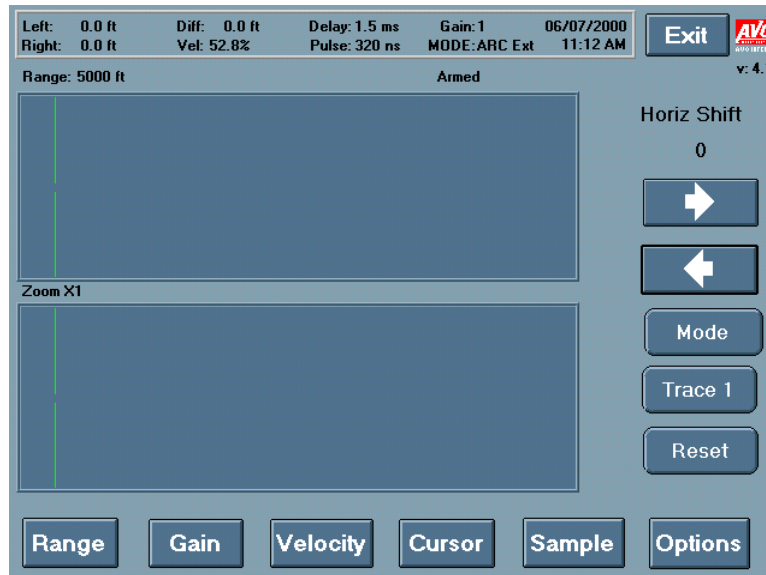


Figure 6-17 Horizontal Shift screen

Access this screen by pressing **Mode** on the Vertical Shift screen (Figure 6-17). Horizontal Shift can be increased from 0 up to 128.

Press **→** to shift the indicated Trace right. Press **←** to shift the indicated Trace left.

- To toggle to Trace 2 (green, captured high-voltage trace), press **Trace 1** (white, real time low-voltage trace).
- To toggle to Trace 3 (yellow, captured DART trace), press **Trace 2**.
- To toggle back to Trace 1, press **Trace 3**.
- To reset the horizontal shift adjustment back to 0, press **Reset** at any time .


Press **Mode** to go back to the Gain screen (Figure 6-14).



## Velocity

**TDR**  
**ARC**  
**SURGE**

Use the Velocity screen (Figures 6-17a, 17b and 17c) to set the velocity of propagation in units that correspond to your setup selections on the DART Setup screen (Figure 6-3).

- 0.0 to 100.0%
- 0.0 to 983.6 ft/ $\mu$ s
- 0.0 to 299.8 m/ $\mu$ s
- 0.0 to 491.8 ft/ $\mu$ s ( $V_p/2$ )

The Velocity screen displays when you press **Velocity**. The currently selected velocity is displayed in text above the  button and in the status bar at the top of the screen. .

- Press  to increment velocity up one least significant digit. Press and hold for 3 s to continuously increment.
- Press  to increment velocity down one least significant digit. Press and hold for 3 s to continuously increment.

To save current velocity as the default, press **Save Vel.**. This default velocity will appear each time the DART is used until the next time **Save Vel.** is pressed.

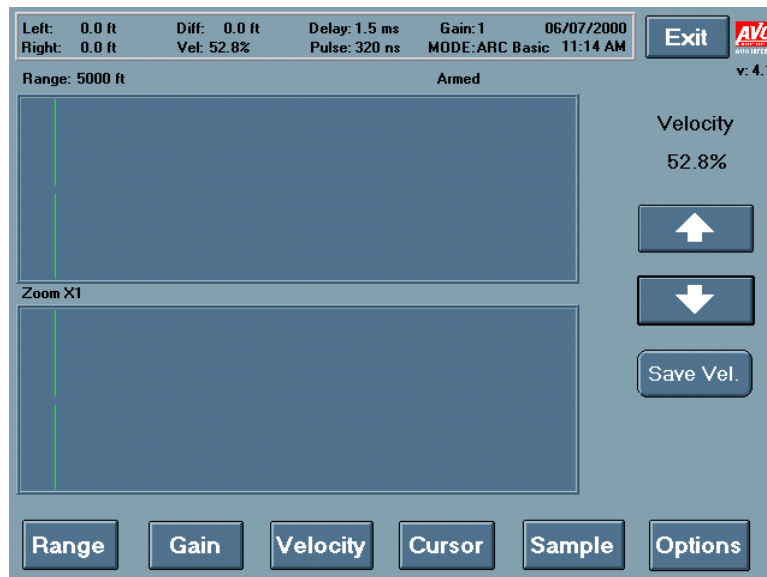


Figure 6-17a Velocity screen (ARC Basic Mode)

**TDR**  
**ARC Ext**  
**SURGE**

When operating in the ARC Extended mode, TDR mode, and SURGE mode, you can access an additional feature from the Velocity screen (Figure 6-17b):



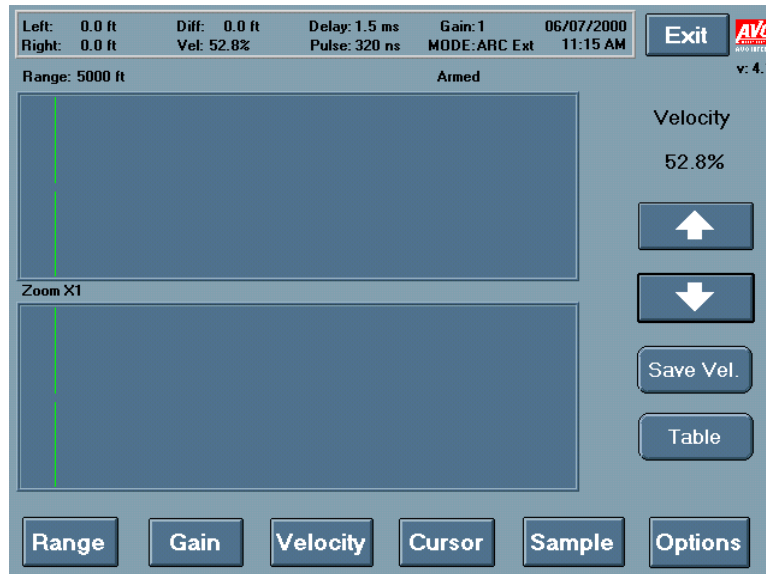


Figure 6-17b Velocity screen (ARC Extended Mode)

- To open a window showing cable descriptions and their corresponding velocities (Figure 6-17c), press **Table**.

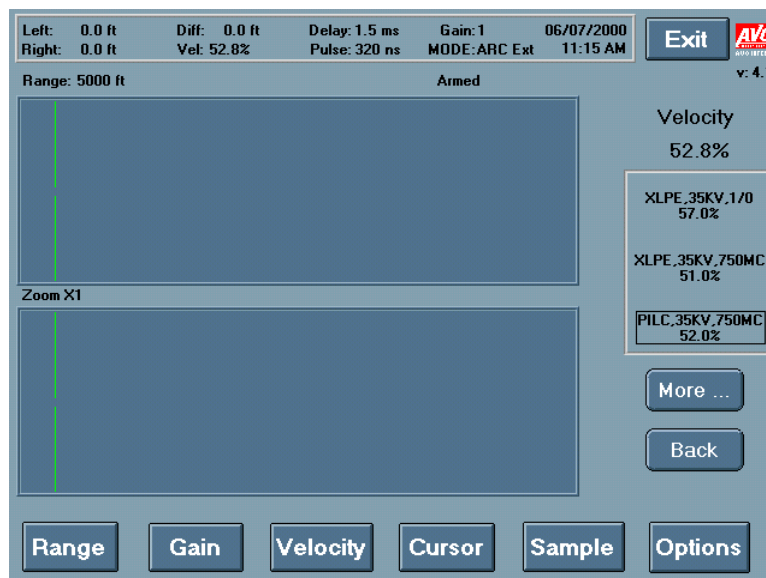


Figure 6-17c Velocity Table screen (ARC Extended Mode)

- To see the next three cable descriptions, press **More...**. Pressing the desired cable type when it appears in the window will enter the proper velocity.
- To return to the Velocity screen (Figure 6-17b), press **Back**.

Table 6-1 lists the velocity information by insulation type.

**Table 6-1: Velocity of Propagation**

Insulation Type	kV	Wire Size	Vp Percent (%)	Vp ft/ $\mu$ s	Vp m/ $\mu$ s	Vp/2 ft/ $\mu$ s
EPR	5	#2	45	443	135	221
EPR	15	#2 AL	55	541	165	271
HMW	15	1/0	51	502	153	251
XLPE	15	1/0	51	502	153	251
XLPE	15	2/0	49	482	147	241
XLPE	15	4/0	49	482	147	241
XLPE	15	#1 CU	56	551	168	276
XLPE	15	#2 CU	52	512	156	256
XLPE	25	#1 CU	49	482	147	241
XLPE	25	1/0	56	551	168	276
XLPE	35	1/0	57	561	171	280
XLPE	35	750 MCM	51	502	153	251
PILC	15	4/0	49	482	147	241
XLPE	0.6	#2	62	610	186	305
Vacuum	—	—	100	984	300	492

These values are only approximate and are meant to serve as a guide. The velocity of propagation in power cables is determined by the dielectric constant of the insulation, the material properties of the semi-conducting sheaths, the dimensions of the cable, the structure of the neutrals, the integrity of the neutrals (corrosion), the resistance of the conductors, additives in the insulation, conductance of the insulation, and the propagation characteristics of the earth surrounding the cable. With this large number of variables and a number of different manufacturers, it is impossible to predict the exact velocity of propagation for a given cable. Typically, utilities standardize on only a few cable types and manufacturers and have soil conditions that are similar from installation to installation. It is highly recommended that fault location crews maintain records of propagation velocities and true locations. Using this information, accurate, average propagation velocities can be determined.

## Cursor Adjustment

TDR  
ARC  
SURGE

Use the Cursor Adjustment screens (Figures 6-18 and 6-19 ) to position the left and right cursors.

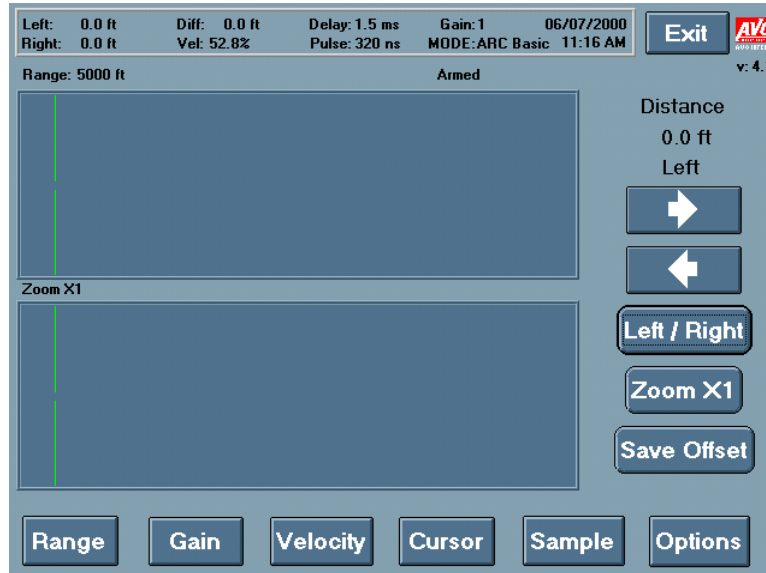


Figure 6- 18 Left Cursor Adjustment screen

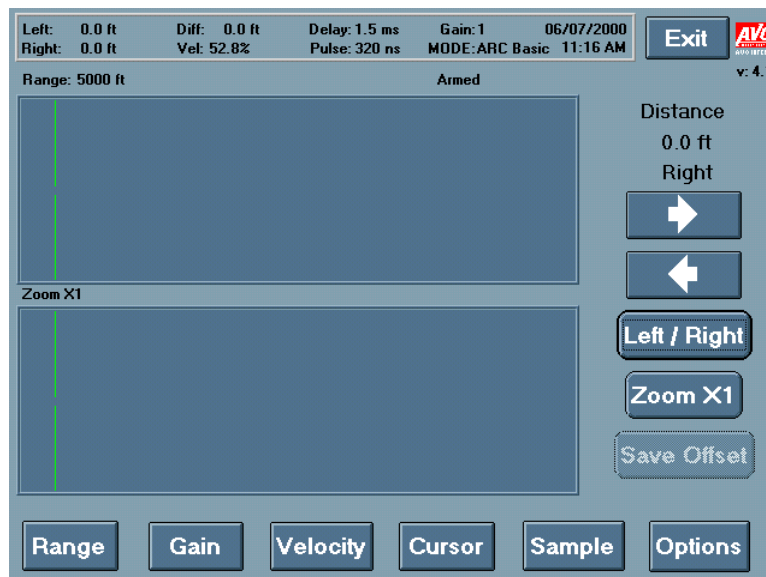






Figure 6-19 Right Cursor Adjustment screen

Access the left cursor screen by pressing **Cursor** when it is available as a choice. Press **Left / Right** to toggle to the right cursor adjustment screen and back.


- Press  to increment the position of the cursor to the right by one digit. Press and hold for 3 s to continuously increment.
- Press  to increment position of the cursor to the left by one digit. Press and hold for 3 s to continuously increment.

**To make measurements down the cable:**

1. Position the right cursor at the base of the reflection of interest just as it leaves the baseline going upward or downward.
2. Press  to access the Left Cursor Adjustment screen.
3. Read the distance in the Status Bar. In the status bar, “Left” is the absolute distance of the left cursor relative to the transmit pulse; “Right” is the absolute distance of the right cursor relative to the transmit pulse.


The difference in distance between the left and right cursors is displayed in text above the  button and in Diff in the status bar .

**Zoom**

Pressing  will expand the trace shown in the upper window of either the left or the right cursor screen by the multiplier selected. Each press of the Zoom X1 button toggles through X1, X2, X4, X8, with wraparound, and displays the expanded trace in the lower window. The selected cursor is centered in the lower window and the Zoom factor is displayed at the top of the lower window.

**Save Offset (left cursor screen)**

TDR  
ARC

In TDR and ARC modes, pressing  will save the left cursor position as the zero point. This allows you to set the left cursor zero point at the end of the test leads and save that setting as the default zero. For complete instructions, see "Calibrating the Left Cursor Offset" on page 55.

## Sample Screens

### About the Sample Screens

Each of the three modes of operation incorporates one or more sample screens. In TDR mode, the sample screen is use to compare traces from up to three phases. In ARC and Surge modes, the sample screen(s) provide options for high-voltage trace capture.



Keep test voltage levels as low as possible during testing and minimize test time. Using excessive voltage levels for testing may reduce the remaining life of the cable.



### TDR Sample Screen

In TDR mode, access the Sample screen (Figure 6-20) by pressing **Sample** on any screen that offers it as an option.



Figure 6-20 TDR Sample screen

The procedure for comparing traces is as follows:

1. Connect test leads to Phase One, which is displayed as Trace 1.
2. Press **Trace 1** to store Phase One and switch sampling to Trace 2.
3. Connect test leads to Phase Two, which is displayed as Trace 2.

4. Press **Trace 2** to store Phase Two and switch sampling to Trace 3.
5. Connect test leads to Phase Three. All three phases are now displayed on the analyzer for comparison. If the physical runs of all three phases are identical, a point of difference between the reflections of the faulted phase and the reflections of the good phases is likely the fault location.
6. Position the left cursor at this point to measure distance to the suspected fault location.
7. Press **Trace 3** to store Phase Three and switch real time sampling back to Trace 1.
8. Press **Clear 1**, **Clear 2**, or **Clear 3** to erase **Trace 1**, **Trace 2** or **Trace 3** respectively.



### ARC Sample Screens

#### Basic mode

In **ARC Basic mode**, pressing **Sample** displays the Sample screen (Figure 6-21).



Figure 6-21 Sample screen (ARC Basic Mode)

The Basic mode uses only the Continuous Acquire method. New traces are captured (continuously acquired) at every surge generator discharge (trigger), and previously captured traces are erased.

Press **Capture** to arm the unit, which will then prepare to receive a trigger to capture and store a high-voltage trace. The text “Cont Acq” appears above the **Capture** button, indicating Continuous Acquire mode (the only mode available in ARC Basic).

After **Capture** is pressed, “Armed” appears at the top right of the upper window. When a trace is acquired, “Triggered” replaces “Armed.” If no trigger is received within 15 seconds after pressing **Capture**, then “No Trigger Received” replaces “Armed.”

- To stop the continuous acquisition process, press **Stop**.
- To erase a captured trace, press **Clear**.



### Extended Mode

In **ARC Extended Mode**, you can use one of three options for high-voltage trace capture:

Continuous Acquire	New traces are captured at every surge generator discharge and old traces are erased.
Single Acquire	Acquires and stores 15 traces, which can be displayed individually.
Average Acquire	Acquires 15 new traces in succession and displays their arithmetic average.

**DART acquire mode.** From any one of the sample screens in ARC Extended mode, you can access the DART (differential arc reflection) acquire mode. This mode utilizes a patented algorithm to calculate the difference between the low voltage trace and the captured high voltage trace. The difference then displays in the lower window. Up to the fault, the traces are identical. Therefore, the first downward reflection is the fault location.

- To enable the DART acquire mode, press **DART**. The screen displays “DART On” above the **Capture** button.
- To disable the DART acquire mode, press **DART** again. “DART Off” is displayed above the **Capture** button.

**Continuous Acquire mode**

In Continuous Acquire mode (ARC Extended mode), new traces are captured (continuously acquired) at every surge generator discharge (trigger) and previously captured traces are erased. Access the Continuous Acquire screen (Figure 6-22) by pressing **Sample** in the ARC Extended mode.

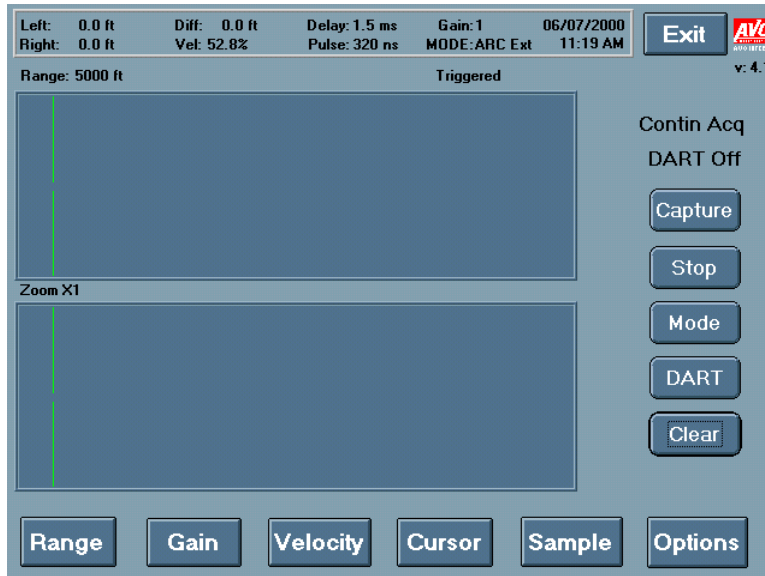


Figure 6-22 Continuous Acquire Sample screen (ARC Extended mode)

Press **Capture** to arm the unit, which will then wait for a trigger to capture and store a high-voltage trace. The text “Cont Acq” appears above the **Capture** button indicating Continuous Acquire mode.

After **Capture** is pressed, “Armed” appears at the top right of the upper window. When a trace is acquired, “Triggered” replaces “Armed.” If no trigger is received within 15 seconds after pressing **Capture**, then “No Trigger Received” replaces “Armed.”

- Press **Stop** to stop the continuous acquisition process.
- Press **Clear** to erase a captured trace.

To go to the Sample screen for the Single acquire mode, press **Mode** from the Continuous Acquire Sample screen in Extended mode.



**Single Acquire mode**

In Single Acquire mode (Figure 6-23), 15 traces are acquired and stored.

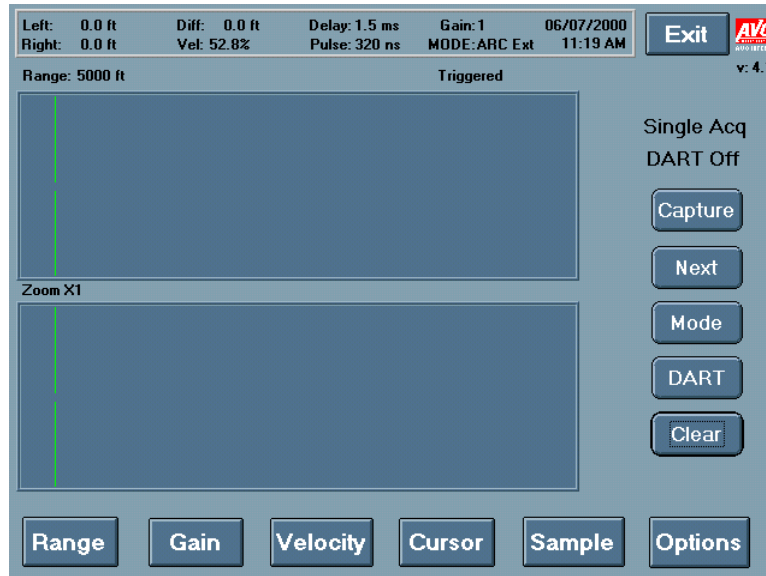


Figure 6-23 Single Acquire Sample Screen  
(ARC Extended Mode)

Access this screen by pressing **Mode** on the Continuous Acquire Sample screen in the ARC Extended mode.

1. Press **Capture** to arm the unit. The text “Single Acq” is displayed above the **Capture** button, and “Armed” appears at the top right of the upper window. The unit will then wait for a trigger to capture and store high-voltage traces.

When traces are acquired, “Triggered” replaces “Armed.”

2. Press **Next** to step through all 15 traces one by one and toggle back to Trace one. Each of the traces is acquired at a slightly different time during the high-voltage discharge at the fault.
3. Press **Capture** to acquire another 15 traces. The previously captured traces are erased. If no trigger is received within 15 seconds after pressing **Capture**, then the text “No Trigger Received” replaces “Armed.”
4. When you have completed the necessary number of captures, press **Clear** to erase the captured traces.

To go to the Average Acquire screen (Figure 6-24), press **Mode** from the Single Acquire Sample screen.

### Average Acquire Mode

In Average Acquire Mode (Figure 6-24), 15 traces are acquired, and the arithmetic average of those traces is displayed.

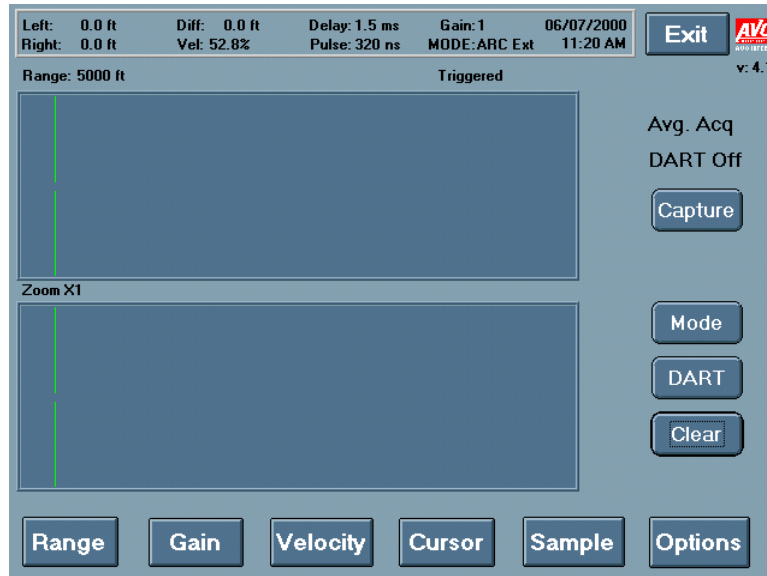


Figure 6-24 Average Acquire Sample Screen  
(ARC Extended Mode)

Access this screen by pressing **Mode** on the single Acquire Sample screen in the ARC Extended mode.

1. Press **Capture** to arm the unit. The text “Avg. Acq” is displayed above the **Capture** button, and “Armed” appears at the top right of the upper window. The unit will then wait for a trigger to capture and store high-voltage traces. When traces are acquired, “Triggered” replaces “Armed.”
2. Press **Capture** to acquire the average for another 15 traces and to erase the previously captured traces. If no trigger is received within 15 seconds after pressing **Capture**, then the text “No Trigger Received” replaces “Armed.”
3. Press **Clear** to erase the captured trace.

To return to the Continuous Acquire Sample screen, press **Mode** from the Average Acquire Sample screen.

## Surge Sample Screen



The Surge Sample screen (Figure 6-25) functions similarly to the Continuous Acquisition sample screens in ARC Basic and ARC Extended modes. New traces are captured (continuously acquired) at every surge generator discharge (trigger), and previously captured traces are erased.

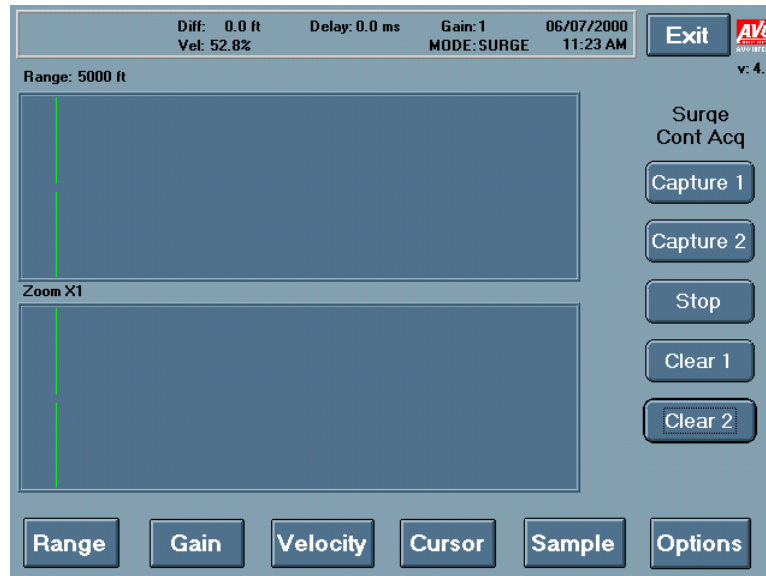


Figure 6-25 Surge Continuous Acquire Screen

Access the Surge sample screen by pressing Sample on any screen that offers Sample as an option.

1. Press **Capture 1** to arm the unit, which will then wait for a trigger to acquire and store a high-voltage trace. The text “Cont Acq” appears above the **Capture 1** button indicating Continuous Acquire mode.

After **Capture 1** is pressed, the word “Armed” appears at the top right of the upper window. When a trace is acquired, “Triggered” replaces the word “Armed” If no trigger is received within 15 seconds after pressing **Capture 1**, then the text “No Trigger Received” replaces the word “Armed.”

2. Press **Stop** to stop the continuous acquisition process. Press **Clear 1** to erase the trace acquired using Capture 1.
3. Press **Capture 2** to acquire a second trace as described for Capture 1.
4. Press **Stop** to stop the continuous acquisition process. Press **Clear 2** to erase the trace acquired using Capture 2.

## Quit

To quit the DART system, access the Quit screen (Figure 6-26) by pressing **Quit** on the Select Operating Mode screen. (Figure 6-3)

1. Press **Quit** on this screen
2. Wait until the Turn-Off screen (Figure 6-27) displays.

To return to the Select Operating Mode screen (Figure 6-3), press **Cancel**.



*Figure 6-26 Quit screen*

## Turn Off Screen

The Turn-Off screen displays only when it is safe to turn off the DART Analysis System. Do not turn off the unit until you see this message:  
"Now you can turn off your AVO BIDDLE DART®."



Figure 6-27 Turn-Off screen

## Operating Notes

### Calibrating the Left Cursor Offset



The factory calibration of the left cursor sets the zero position of the left cursor at the **output BNC connector** of the DART Analysis System. During normal operation, a fixed length of test cable connects the DART to the cable under test. When locating faults, you must either subtract this extra length of cable from the measurement or calibrate an offset in the DART Analysis System. The system then retains this zero offset until reset.

If the output cable length is changed, you must recalibrate the offset in the DART Analysis System. The offset calibration is functional, however, only in ARC and TDR modes. In Surge mode, the offset does not compensate for the output cable length, which must be subtracted from the measurement.

#### To connect and configure the DART Analysis System for cursor calibration:

1. Connect the DART chassis to the chassis of the arc reflection filter or surge generator using the supplied grounding cable.
2. Use the **3 ft (1 m) coaxial cable (RG 58)** to connect the **ARC BNC connector** of the DART to the **ARC REFL BNC connector** on the arc reflection filter or surge generator. (The coaxial cable is supplied with the unit.)
3. Connect the **power cord** of the DART (supplied) to a well-regulated power source capable of supplying 200 VA of power.

4. Position the MODE switch on the arc reflection filter or surge generator to the ARC REFLECTION position.
5. Set the DART ON/OFF switch to ON.
6. When the Start screen appears, press **Start**.
7. Press **TDR** on the Select Operating Mode screen.

**To calibrate the left cursor offset:**

1. Display the Range screen by pressing **Range** (Figure 6-28).
2. Set the range to a value greater than, but as close as possible to, the length of the output cable. Press **↑** to increase or **↓** to decrease the range. For most applications, the 500-ft (100-m) range is appropriate. The Range setting is displayed above **↑** and in the status bar.

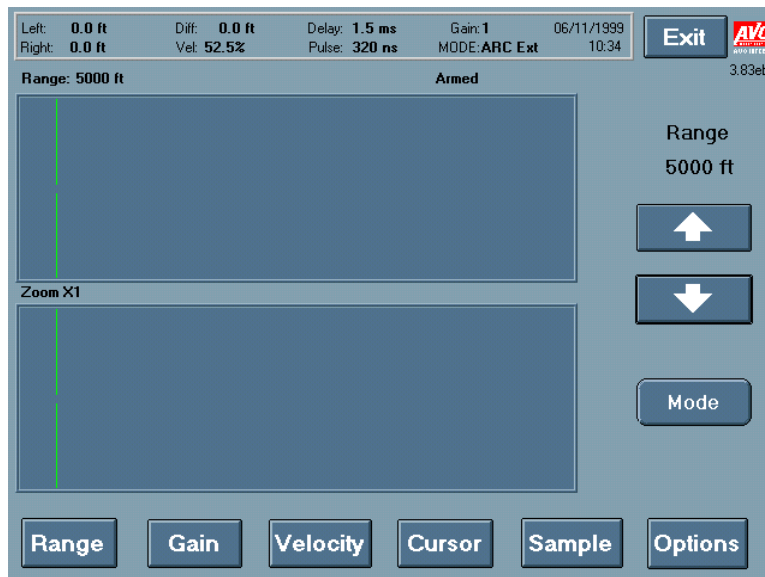


Figure 6-28 Range screen

3. Press **Cursor** and then **Left / Right** to activate the left cursor (Figure 6-29). Press **←** to move the cursor to the left and **→** to move the cursor to the right. Locate the test cable end by momentarily touching the ends of the leads together and observing the open-end reflection changing from upward to downward. Position the left cursor at the end of the test leads at the very start of the downward pulse as the lead ends are shorted.

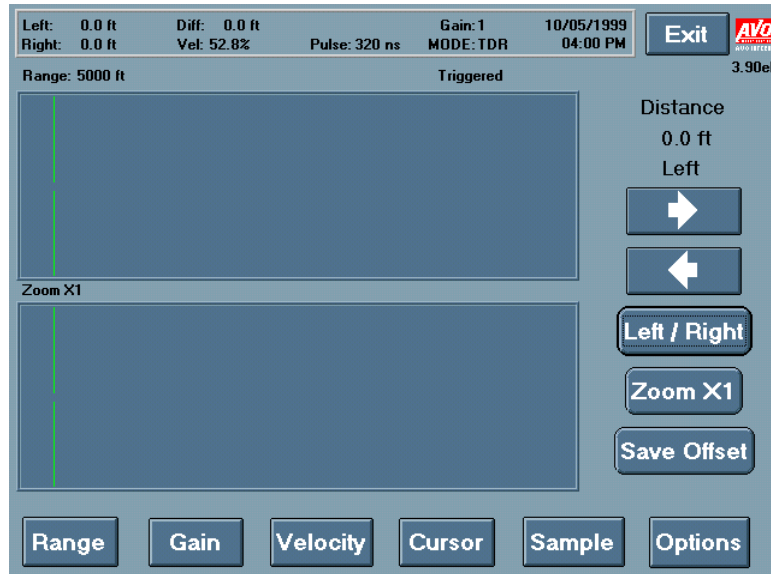


Figure 6-29 Left Cursor Adjustment Screen

4. Position the cursor more precisely by pressing **Zoom X1**. The horizontal expansion of the trace in the bottom window changes by a factor of X2, which now shows in the Zoom button **Zoom X2**. Upper window traces are expanded in the lower window. Press **←** or **→** to adjust cursor position.
5. When you have positioned the cursor accurately, calibrate the offset by pressing **Save Offset**. The left cursor position in the status bar will now show 0.0 ft. Until changed, this will be the left cursor zero default position every time the DART is turned on.
6. Cursor calibration is now complete. Press **Exit** to select another test mode or to quit and turn off the instrument.

## Working with Unknown Propagation Factors

You can determine an unknown propagation factor by using a known length of the same type of cable or the distance to a known point in the cable. If you know the total length of the cable, you can easily measure the velocity.

### Measuring the Velocity

1. Use the TDR mode to locate the end of the cable under test. Alternately opening and shorting the end of the cable may help to verify that you have located the cable end.

2. Place the right cursor at the cable end and begin adjusting the velocity. When the reported distance of the right cursor matches the known length of the cable under test, the velocity is set to its correct value. This value will be correct only if the cursor is calibrated as previously described in "Calibrating the Left Cursor Offset."

### **Proportional Locating**

If you know the actual length of the cable under test before connecting the DART Analysis System you can use *proportional locating* as an alternative method to determine or confirm the distance to a fault. Proportional locating uses simple mathematical equations and the known cable length in addition to TDR calculations. It has the advantage of increased accuracy when the exact propagation velocity factor is not known

The simple proportion is

$$\frac{\text{True Fault Distance}}{\text{True Cable Length}} = \frac{\text{Cursor Fault Distance}}{\text{Cursor Cable Length}}$$

The true fault distance is given by

$$\text{True Fault Distance} = \frac{\text{Cursor Fault Distance} \times \text{True Cable Length}}{\text{Cursor Cable Length}}$$

The proportion is easiest to use with all known quantities on the right side. True cable length is the actual total physical length of the cable.

**Example** — Assume that the known length of this primary cable is 684 ft (208.5 m). A fault (downward deflection) is indicated at 400 ft (121.9 m). The far end is open and can be seen as an upward deflection at 950 ft (289.5 m). Substituting into the proportional equation gives:

$$\text{True Fault Distance} = \frac{400 \text{ ft} \times 684 \text{ ft}}{950 \text{ ft}} = 288 \text{ ft}$$

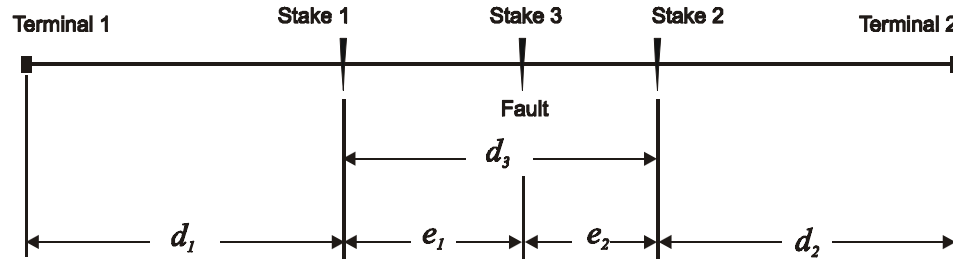
Even though the true fault distance was 288 ft (87.8 m), the propagation velocity was not correctly set. With the proportional method, however, an accurate answer is obtained. This assumes that the center conductor and neutral are continuous so that you can observe the far end as an upward reflection. If the center conductor or neutral is blown open, you will not be able to see the upward reflection at the far end of the cable.



**Three-Stake Method**

**To use the three-stake method:**

1. Take a fault distance reading from one end (terminal 1) of the cable and then place a marker (Stake 1) at that position as shown in Figure 7-1.
2. Repeat the procedure with the DART system connected at the other end of the line (terminal 2), to find the fault distance for a second marker (Stake 2). In actual practice, Stake 2 may fall short of Stake 1, may be located at the same point, or may pass beyond Stake 1 toward the Terminal 1 end of the line. In any case, the fault will lie between the two stakes. You must use the same velocity setting for both measurements; otherwise, the method will not work. Also, unless you measure distances  $d_1$ ,  $d_2$  and  $d_3$  over the actual cable route, an error will result. If you are in doubt about the actual route, trace the cable first.



You can locate the third marker (Stake 3) and the fault by taking advantage of the constant proportionality that exists for the fault distances,  $d_1$  and  $d_2$ , and their incremental-error distances,  $e_1$  and  $e_2$ , for a given type of underground cable and a given set of adjustments. To locate Stake 3:

3. Measure the distance between Stakes 1 and 2 ( $d_3$ ).

Multiply it by the ratio of distance  $d_1$  to the sum of distances  $d_1$  and  $d_2$ . Then place Stake 3 at this incremental distance,  $e_1$ , as measured from Stake 1 toward Stake 2.

$$e_1 = d_3 \frac{d_1}{d_1 + d_2}$$

Alternatively, Stake 3 can be placed at the incremental distance,  $e_2$ , as measured from Stake 2 toward stake 1.

$$e_2 = d_3 \frac{d_2}{d_1 + d_2}$$

This third stake should be very close to, if not right at, the fault.

The use of this method will automatically cancel out any error in the propagation constant used, even if the equipment is set for a constant other than the one for the cable being investigated. If you use the wrong constant, however, the incorrect constant must be applied to all distance readings on the DART. In addition, the propagation velocity for a particular fault-locating job must be constant throughout the entire job.

**Example (High-Impedance Fault)** — Ohmmeter tests show the cable is completely open at the fault point.

1. Set the Velocity to 50 percent. From the near side, the DART measures a distance,  $d_1$ , to the open (upward deflection) of 3000 ft (914.4 m).
2. Measure 3,000 ft along the cable path and place Stake 1. Because the fault has burned the conductor open, the DART cannot see the far end to get a cursor length measurement.
3. Do not change the Velocity setting, but move the DART to the far end of the cable and "shoot backwards." The far end measurement shows a fault distance,  $d_2$ , of 1500 ft (457.2 m) to the fault point.
4. Place Stake 2 at 1500 ft (457.2 m).

Now assume that the distance,  $d_3$ , between stake 1 and stake 2 is measured at 150 ft (45.7 m). The distance to the fault ( $e_1$ ) from stake 1 toward stake 2 is:

$$d_3 \frac{d_1}{d_1 + d_2} = 150 \text{ ft} \frac{1500 \text{ ft}}{1500 \text{ ft} + 3000 \text{ ft}} = 50 \text{ ft}$$

## Troubleshooting

<b>Problem</b>	No reflected pulses
<b>Indications</b>	No reflected pulses are observed
<b>Possible Cause</b>	<ul style="list-style-type: none"> <li>• The fault is beyond the range of the instrument</li> <li>• The fault is beyond the sensitivity of the instrument.</li> <li>• The PFL system or arc reflection filter is not in the arc reflection mode.</li> <li>• The connections are not correct.</li> </ul> <p>In arc reflection mode:</p> <ul style="list-style-type: none"> <li>• The voltage may not be producing a breakdown at the fault</li> <li>• The current through the fault may not be great enough</li> <li>• The arc may not last long enough to cause the downward deflection.</li> </ul> <p>These conditions occur when</p> <ul style="list-style-type: none"> <li>• The fault is a bolted fault (low impedance).</li> <li>• Voltage of the test set is not great enough to cause the fault to breakdown.</li> <li>• The fault is underwater and an arc cannot be established.</li> <li>• The fault is filled with oil and an arc cannot be established. This occurs when testing PILC type cable.</li> <li>• The fault path is too long to establish an arc for the time necessary to see the downward deflection. This can occur when the fault is at an elbow or splice.</li> <li>• The neutrals in the cable are corroded preventing the creation of an adequate arc.</li> </ul>

<b>Problem</b>	Open circuits
<b>Indications</b>	No reversing deflection observed when the cable end is opened and shorted
<b>Possible Cause</b>	<ul style="list-style-type: none"> <li>• Corrosion has eroded the neutrals so that there is an open circuit.</li> <li>• The conductor of the cable has burned open.</li> <li>• The neutrals of the cable have burned open.</li> </ul>
<b>Remedy</b>	Place a short circuit between phase and neutral at the far end of the cable. Use an ohmmeter to measure the resistance between the center conductor and the neutral. If it is greater than expected (a few ohms), then there is an open somewhere.

<b>Problem</b>	Echoes
<b>Indications</b>	Multiple (ghost) reflections
<b>Possible Cause</b>	Often, the TDR reflects back and forth several times in the cable system until it becomes so attenuated that it can no longer be observed on the screen
<b>Remedy</b>	To distinguish an echo from a fault, measure the distance from the initial pulse to the first reflection and then from the initial pulse to the second reflection (suspected echo). If the distance to the second reflection is exactly double the distance to the first reflection, it is probably an echo because echoes are evenly spaced.

## Technical Assistance

Need technical assistance? Your AVO International sales representative can put you in touch with someone who can help. For 24-hour technical assistance in North America, call 1-800-671-6822.

# 7

## MAINTENANCE

### *Cleaning*

Clean the exterior of the case using a clean dry cloth, being careful to keep foreign material from becoming lodged in the connections and controls.



*To clean the screen, use only a soft cloth, dampened with water or window cleaner. Abrasives and solvents will damage the screen and make it cloudy.*

Inspect the test lead occasionally to ensure that it is in good condition. There are no routine adjustments or calibrations for the DART Analysis System.

Because of the nature of the instrument and the use of custom-built elements, the DART Analysis System is not user-serviceable. It should be returned to the factory for repair or for replacement of defective parts. Refer to the "Repairs" section for instructions.

If the DART Analysis System is used with a surge generator or an arc reflection filter, follow the Troubleshooting and Repair guide provided in the instruction manual for that product.

### *Repairs*

AVO International offers a complete repair and calibration service. AVO recommends that its customers take advantage of this service in the event of any equipment malfunction.

1. Contact your AVO representative for instructions and a return authorization (RA) number.
2. Please indicate all pertinent information, including problem symptoms. Also specify the serial number and the catalog number of the unit.

3. Pack the DART Analysis System, including all cables, in a carton (original shipping carton if available) with packing materials, following recommended methods for commercial shipping. Ship the equipment prepaid and insured and marked for the attention of the Repair Department. Seal the carton with waterproof tape.

4. Ship to:

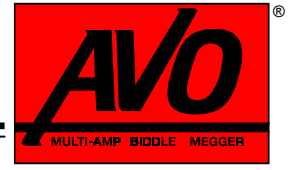
AVO International  
Valley Forge Corporate Center  
2621 Van Buren Avenue  
Norristown, PA 19403

## GLOSSARY

<b><i>analyzer chassis ground</i></b>	The ground lug on the DART that connects to the <b><i>chassis ground</i></b> of the PFL system or arc reflection filter
<b><i>arc reflection filter chassis ground</i></b>	The ground lug on the Arc Reflection Filter that permanently connects to <b><i>star ground</i></b>
cursor	A movable line used to locate a position on the screen
cursor offset	Allows you to save the left cursor position as the default zero position. This sets the length of the cable at the "electrical length," not the physical length. Then you don't have to subtract the length of the test leads from distance measurements.
DART®	A registered trademark of AVO International. DART also describes the Differential Arc Reflection patented algorithm.
deflection	A downward-moving reflection on the DART screen
GROUND	A position of the selector switch on a surge generator. Connects the high-voltage output of the surge generator to <b><i>surge ground</i></b> .
<b><i>local earth ground</i></b>	Driven earth ground made before each test. Connects to <b><i>star ground</i></b> .
lower window	The window area on the bottom of the screen. Displays zoomed traces.
No trigger received	Message displayed on Sample screen when the DART unit is not receiving a proper signal. Indicates one of the following conditions: <ul style="list-style-type: none"><li>• The equipment is not connected properly</li><li>• The surge generator is not discharging</li><li>• The fault is not creating a transient (breakdown).</li></ul>
PFL	Power Fault Locating system by AVO International

PILC	Paper Insulated Lead Covered cable
reflection	On the DART screen, a trace of the pulses that are transmitted down the cable under test
<b>safety ground</b>	A temporary ground, this connection is made before each test between <b>star ground</b> , the ground stud on the reel of 150-ft (45.7 m) cable, and <b>specimen ground</b> .
<b>safety ground jumper</b>	Temporary connection (not supplied) made between the high-voltage conductor of the cable under test to <b>specimen ground</b> .
sparkover	A disruptive discharge in the form of an arc or spark between two electrical conductors or between a conductor and earth (also called arc-over or flashover).
<b>specimen ground</b>	Ground conductor (sheath) of the cable under test. Assumed to be connected to the driven ground of the power system.
<b>star ground</b>	The central ground point of the test system.
status bar	The area at the top of most DART screens. In addition to date and time, the status bar displays the values that are critical in locating a cable fault:: cursor positions and differential, velocity, gain, and mode
<b>surge ground</b>	The shield of the coaxial high-voltage output cable, this ground is connected to <b>specimen ground</b> before each test. Permanently connected internal to arc reflection filter.
TDR	Time domain reflectometer (reflectometry) indicates and measures reflection characteristics of a transmission system
trace	A displayed measurement waveform
upper window	The window that displays traces at the top of the DART screen





AVO INTERNATIONAL

---

## INDEX

- Calibrating the left cursor offset, 55
- Cleaning, 63
- Configuration settings, 27
- Connection procedures, 14
- Continuous Acquire method, 48
- Control screen, 29
- Cursor Adjustment screens, 45
- DART acquire mode, 49
- DART Setup screen, 26, 28, 30, 34, 42
- Decay method, 19
- Delay screen, 36
- Delete screen, 33
- Electric shock hazard, 6, 7, 8
- Gain screen, 38
- Horizontal Shift screen, 41
- Operating modes, 17
- Options screen, 30, 31, 32, 33
- Pacemakers, 7
- Propagation factors, 57
- Protective clothing, 6
- Pulse Width screen, 35
- Quit screen, 54
- Range screen, 34
- Recall screen, 32
- Repairs, 63
- Rubber gloves, 6
- Safety
  - after test completion, 8
  - connecting to power source, 7
  - disconnecting test equipment, 8
  - general precautions, 5
  - interference with pacemakers, 7
  - with surge generator, 6
- Safety ground jumper, 8, 66
- Sample screens, 47
- Save offset, 46
- Save screen, 31
- Select Operating Mode screen, 22, 25, 26, 27, 29, 54, 56
- Set Date/Time window, 27
- Setup configurations, 11
- Single Acquire mode, 51
- Specifications, 9
- Specimen ground, 8
- Star ground, 7, 65, 66
- Status bar, 22
- Surge ground, 7, 65, 66
- Surge Sample screen, 53
- Technical assistance, 62
- Touch screen, 21
- Troubleshooting, 61
- Turn-Off screen, 54
- Velocity information, 44
- Velocity screen, 42
- Vertical Scale screen, 39
- Vertical Shift screen, 40
- Zoom, 46, 57



**AVO** INTERNATIONAL

# ADDENDUM

Instructions for Using  
**AVO<sup>®</sup> Link**  
Version 1.2  
*Data Management Software*  
*for*  
**DART<sup>®</sup> ANALYSIS SYSTEM**



***AVO<sup>®</sup> Link***  
***for the***  
***DART ANALYSIS SYSTEM***

---

***Instructions***

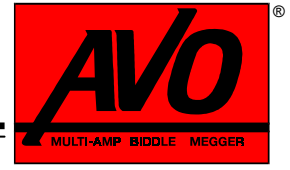
Copyright © 2000 AVO International. All rights reserved.

The information presented in this manual is believed to be adequate for the intended use of the product. If the product or its individual instruments are used for purposes other than those specified herein, confirmation of their validity and suitability must be obtained from AVO International. Refer to the warranty information included at the end of this instruction manual. Specifications are subject to change without notice.

### ***WARRANTY***

Products supplied by AVO International are warranted against defects in material and workmanship for a period of one year following shipment. Our liability is specifically limited to replacing or repairing, at our option, defective equipment. Equipment returned to the factory for repair must be shipped prepaid and insured. This warranty does not include batteries, lamps, or other expendable items, where the original manufacturer's warranty shall apply. We make no other warranty. The warranty is void in the event of abuse (failure to follow recommended operating procedures) or failure by the customer to perform specific maintenance as indicated in this manual.

**AVO INTERNATIONAL**  
P.O. Box 9007  
Valley Forge, PA 19485-1007  
610-676-8500



**AVO** INTERNATIONAL

---

# CONTENTS

1	INTRODUCTION.....	1
	About AVOLINK.....	1
	System Requirements for PC .....	2
2	INSTALLATION.....	3
3	USING AVOLINK WITH THE DART ANALYSIS SYSTEM.....	11
	Connecting the DART to the PC.....	11
	Starting AVOLINK.....	11
	The AVOLINK Window.....	11
	Exit.....	12
	Help.....	12
	About.....	12
	Select Device.....	12
	Transferring Wave Forms from the DART.....	14
	Sending Wave Forms to the DART .....	15
	The DART Wave Form Viewer.....	16
4	COMMUNICATIONS FUNCTIONS .....	23
	Setup Serial Port.....	24
	Test Communications.....	26
	Printer Setup.....	27
	AVOCOM 32 .....	28



**AVO** INTERNATIONAL



# 1

## INTRODUCTION

### *About AVOLINK...*

AVOLINK is AVO International's software program for use with:

- BITE 2, EBITE and MBITE (battery impedance testers)
- Three-Phase TTR (transformer turn ratio test set)
- DART Cable Fault Analysis System

**NOTE:** *This manual refers to any one of the above as a **remote device** and refers to the three battery impedance testers as **the BITE**.*

AVOLINK allows you to transfer test data from the remote device to a personal computer (PC). You can save test data from the remote device and view it on the PC in a viewing format appropriate for the data. With AVOLINK, you can transfer DART wave forms to a PC and save them for future use.

AVOLINK software consists of two programs—AVOLINK, which provides the interface to the remote device, and AVOCOM32, which provides the communication to the remote device. AVOLINK takes care of starting and terminating AVOCOM32. Your AVOLINK installation diskettes or CD will install both AVOLINK and AVOCOM32. For additional information, see "AVOCOM 32" on page 28.

A null-modem serial cable connects the remote device to the PC. The remote device and the PC must operate with the same communication parameters.


## ***System Requirements for PC***

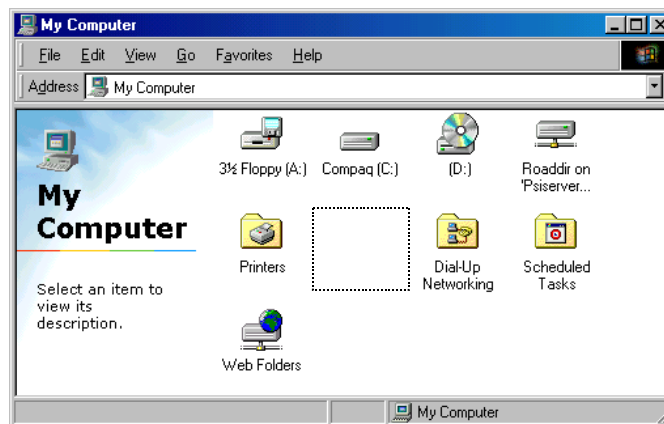
Operating system:	Windows NT 3.1 or later; Windows 95 or later
Processor:	80386 or higher
Monitor resolution:	VGA or higher
Display properties:	600 x 800 and small fonts
RAM:	16 M
Communications port:	9600 baud or better
Storage	A 3½-inch floppy disk drive or CD-ROM

# 2

## INSTALLATION

The AVOLINK software installation is typical of Windows® programs.

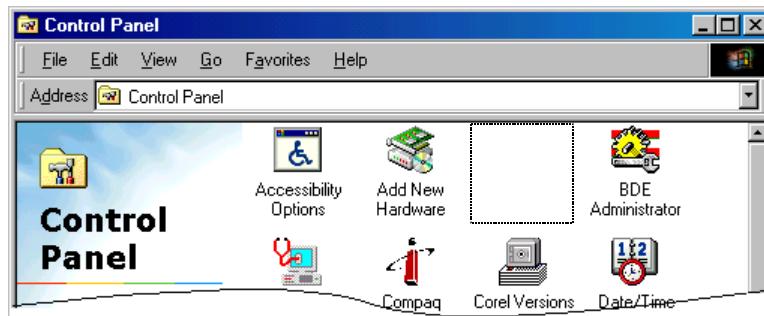
1. Close all open programs. If your virus protection program is running, disable it.
2. Insert the the AVOLINK CD in your CD-ROM drive (usually D:), or insert the AVOLINK #1 diskette in your diskette drive (A: or B:).
3. AVO Link Setup should automatically run and take you to the Welcome screen. If so, go to step 5. If not, continue with step 4.
4. Double-click the **My Computer** icon  on the Windows desktop to display the **My Computer** menu. Double-click **Control Panel**.



*My Computer Menu*

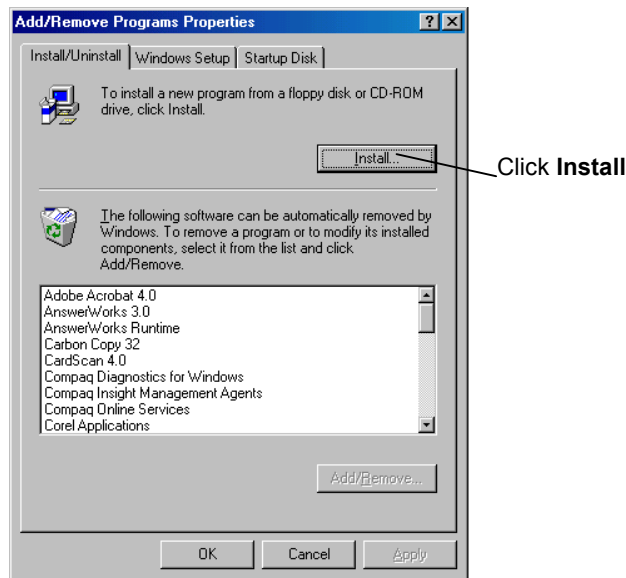
**NOTE:** Screens may be different depending on operating system.

5. Double-click Add/Remove Programs.



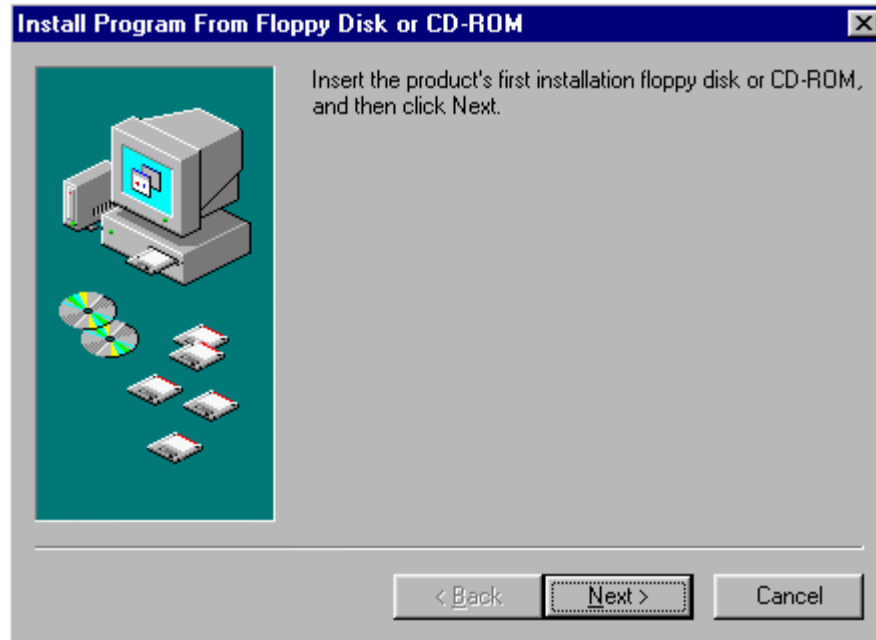
*Select Add/Remove Programs*

6. In the **Add/Remove Programs Properties** box, click **Install**.

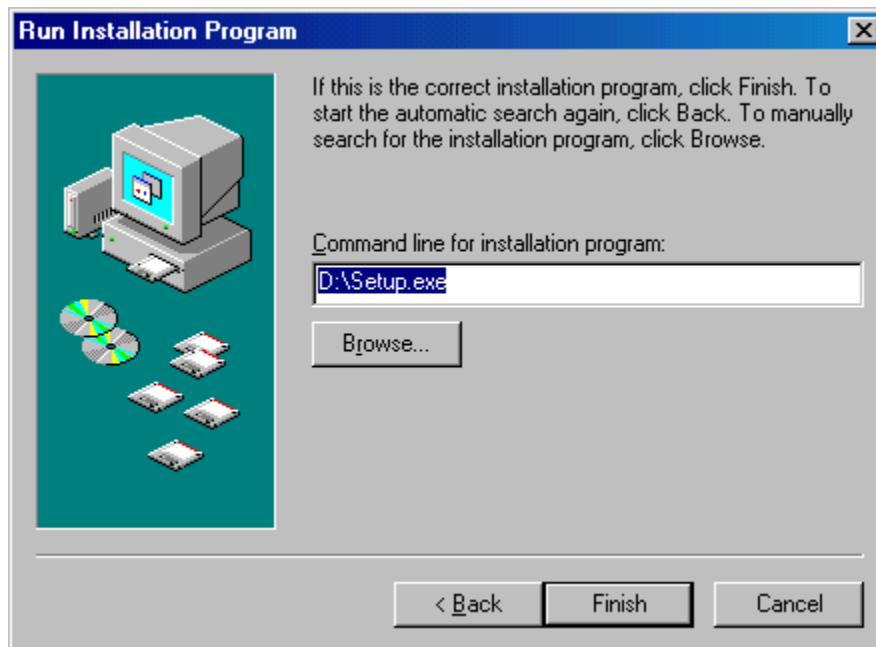


*Add/Remove Programs Properties*

7. Click **Next**, then **Finish** to begin installation.

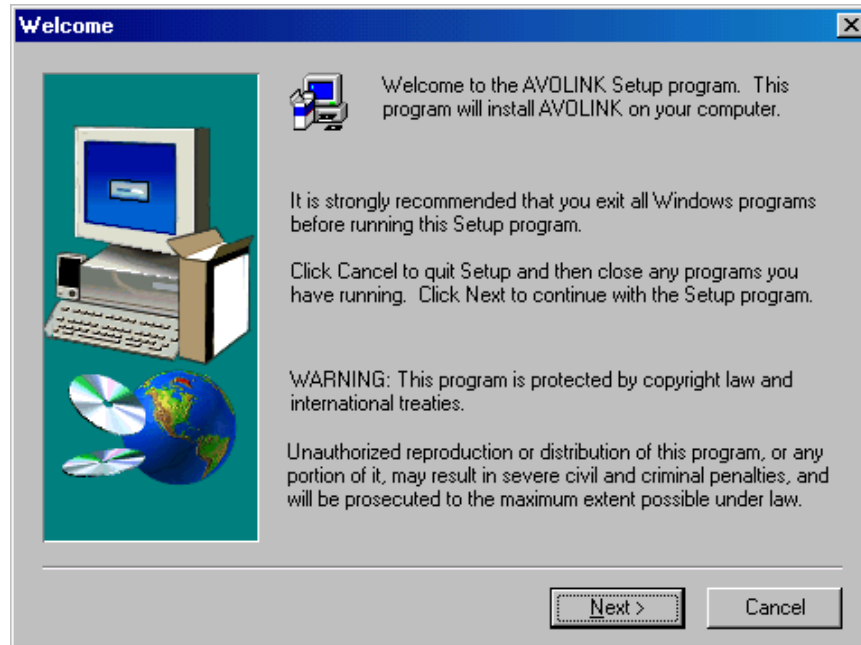


*Install Program from Floppy Disk or CD-ROM*



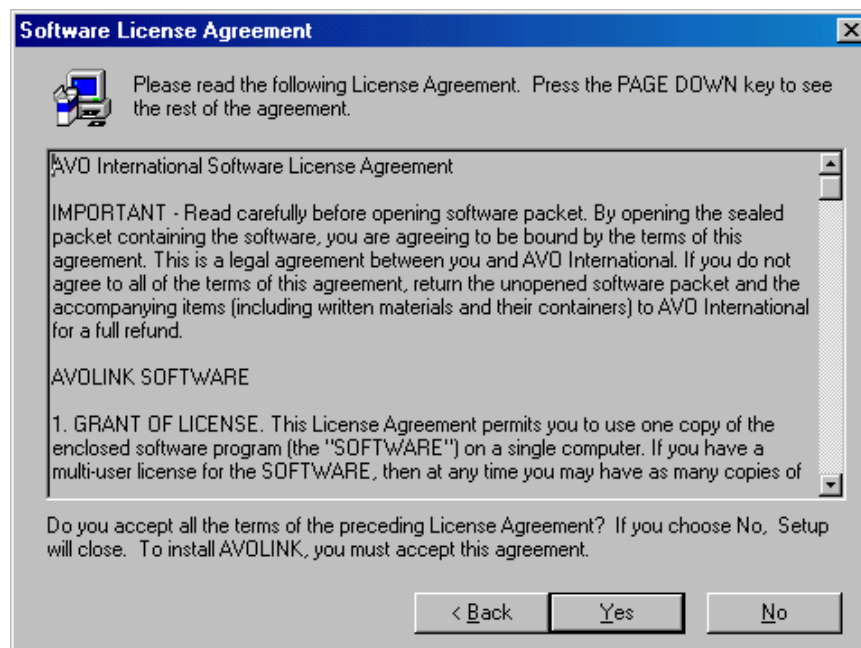
*Run the Installation Program*

8. The first screen reminds you to close all open programs if you have not yet closed them. Click Next to continue.



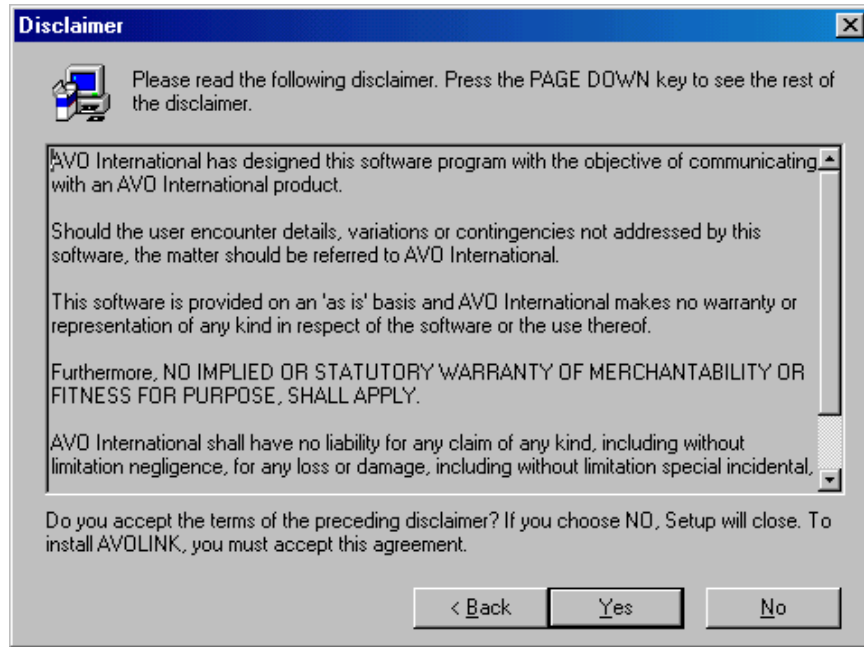
*Welcome Screen*

9. The software license agreement displays. Click **Yes** to continue.



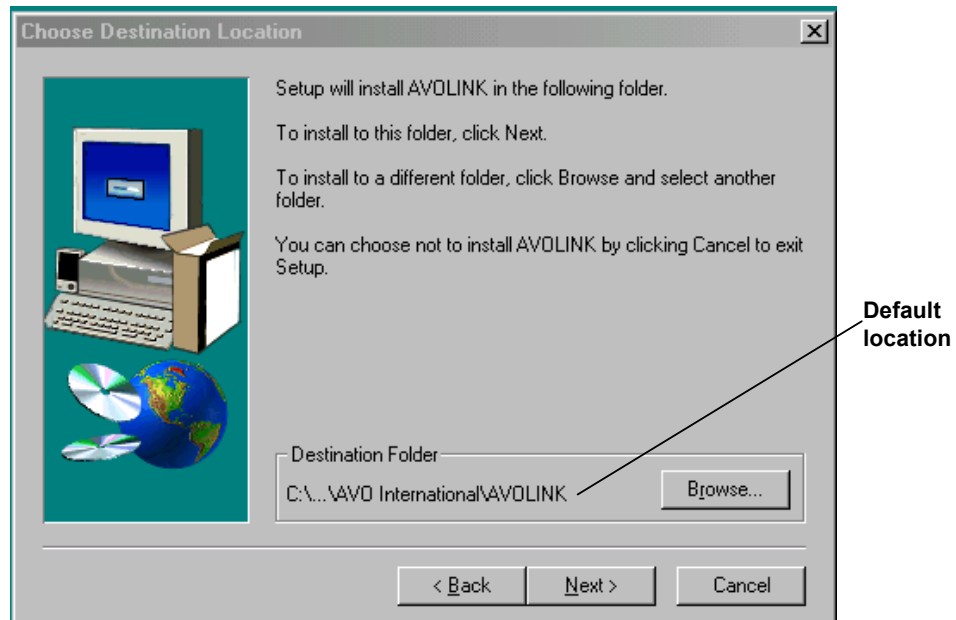
*Software License Agreement*

10. A disclaimer displays. Click **Yes** to continue with installation.



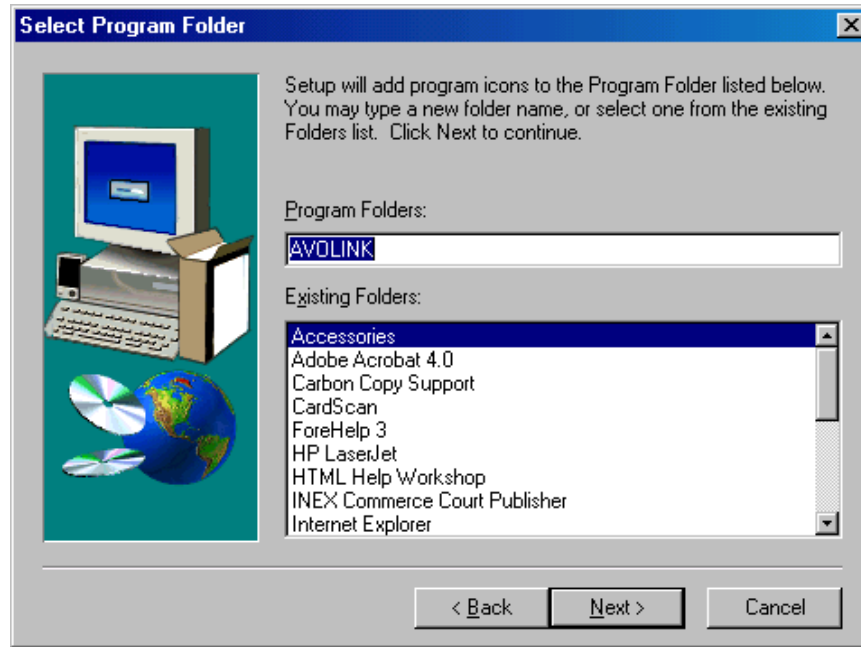
*Disclaimer*

11. The next dialog box asks you to choose the destination location—the directory where the program will reside. We recommend that you accept the default location by clicking **Next**. (If you must choose a different directory, click on **Browse** and select the desired location.)



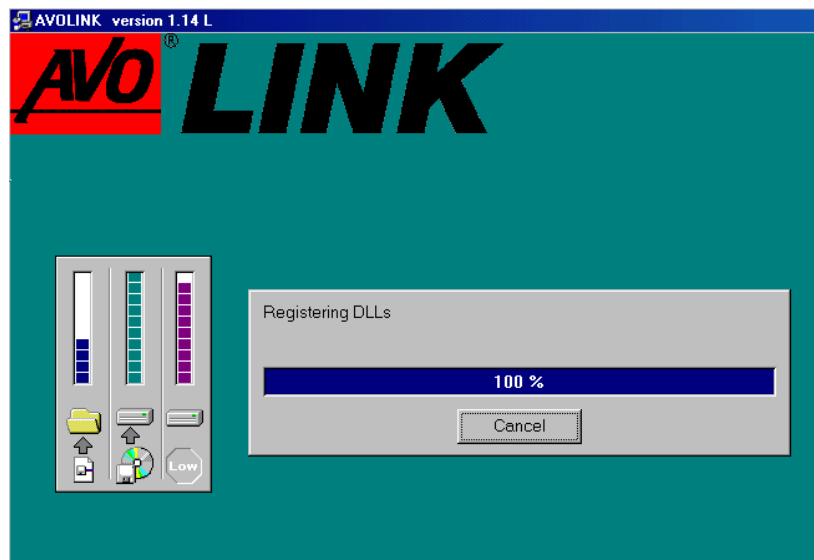
*Choose Destination Location*

12. Select the AVOLINK program folder by clicking **Next**.



*Select Program Folder*

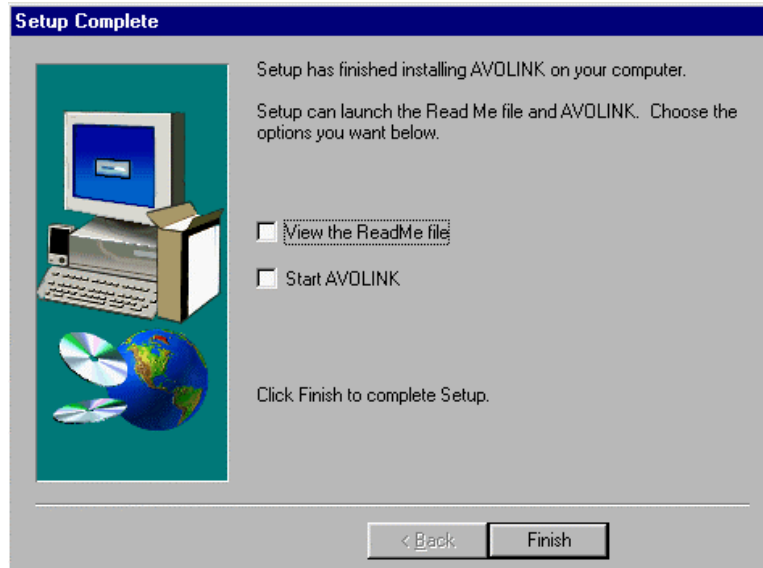
13. The program begins to copy files, as indicated by the progress bars.



*Copying Files*

14. If you are installing with diskettes, you will be prompted to insert the next floppy disk. When all files are copied, a dialog box will state that the setup is complete. Click **Finish** to exit Setup.





*Setup Complete*

- 15.** Remove the diskette (or CD) from your diskette (or CD-ROM) drive. AVOLINK is now ready to help you manage your test data.



**AVO** INTERNATIONAL

# 3

## USING AVOLINK WITH THE DART ANALYSIS SYSTEM

### *Connecting the DART to the PC*

The DART is physically connected to the PC by means of a null-modem serial cable. You may power up the DART before or after connection to the PC, but be sure the DART is properly and securely connected to the PC before starting AVOLINK.



Make sure the DART is disconnected from any BIDDLE PFL system, surge generator, or arc reflection filter before connecting the DART to a PC.

Refer to Section 4 of the DART manual for location of the serial port.

### *Starting AVOLINK*

Before starting up the AVOLINK program, be sure that the PC and the DART are securely connected by the null-modem cable.

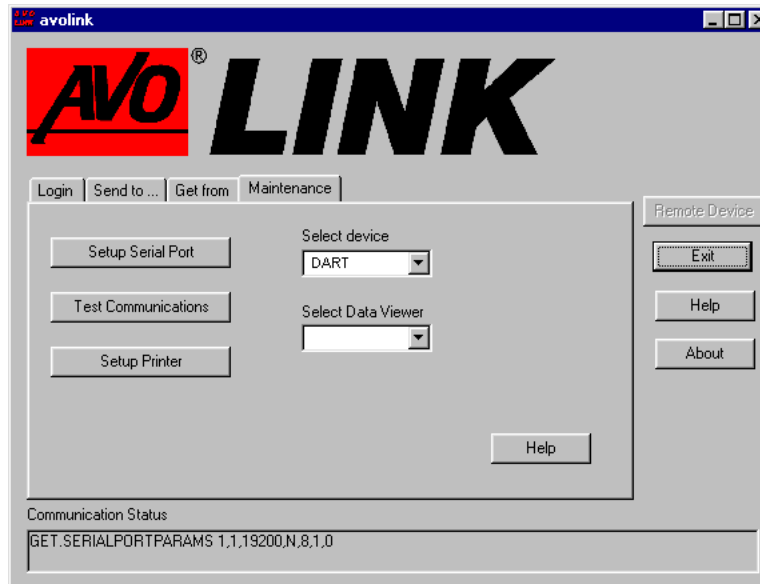
1. Access the AVOLINK program by clicking on **Start**.
2. From the Programs menu, select **AVOLINK** and then, from the submenu, **avolink**.

AVOLINK automatically sets the communication parameters at 9600 baud, 8 data bits, 1 stop bit and no parity. If you need to change the parameters, use the **Setup Serial Port** button, as described under "Setup Serial Port" on page 24.

### *The AVOLINK Window*

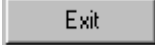
When you first access the AVOLINK program, the AVOLINK window displays. It provides the means for the operator to select the appropriate

remote device. When using the DART Analyzer, click on the **Select Device** drop-down list and select **DART**.

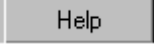


*The AVOLINK Window*


## Exit

Clicking on the  button will close the AVOLINK program.

## Help

Click on  at any time to open the AVOLINK Help file. This is a Windows Help file, which contains Contents, Index and Find tabs to assist you with the program. The Help file also provides hypertext links to help you move among topics.

## About

Click on  for information regarding the version of AVOLINK that is installed on your computer.

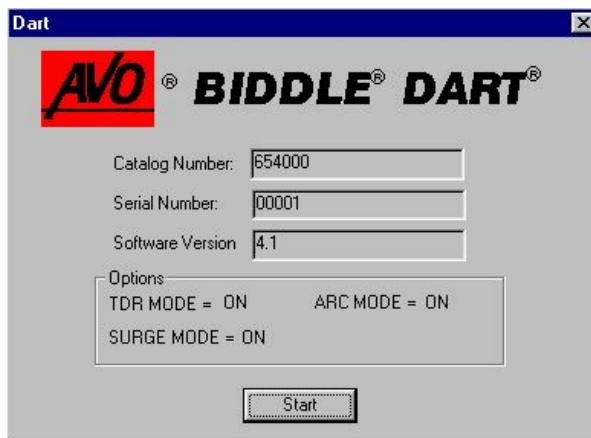
## Select Device

After selecting **DART** as the remote device, the AVOLINK program initially displays the Login tab. No password is required to use AVOLINK with the DART Analyzer. Click on **Login**.



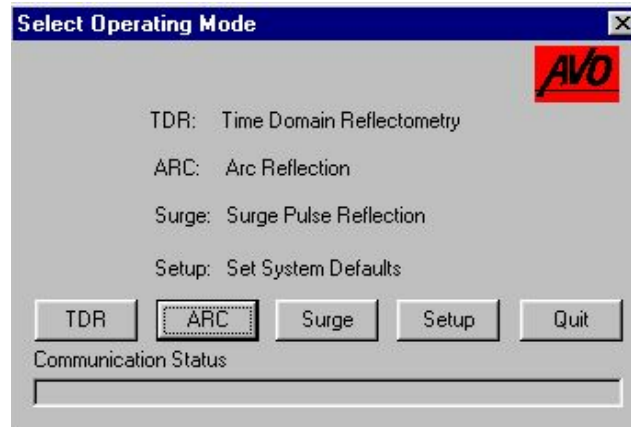
*Login Tab*

If your login is successful, the screen will display the DART Catalog number 654000, the DART Serial Number and software version. Also, the name of the **Login** tab will change to **Logout**. If your login is unsuccessful, the **Remote Device** button will remain disabled.



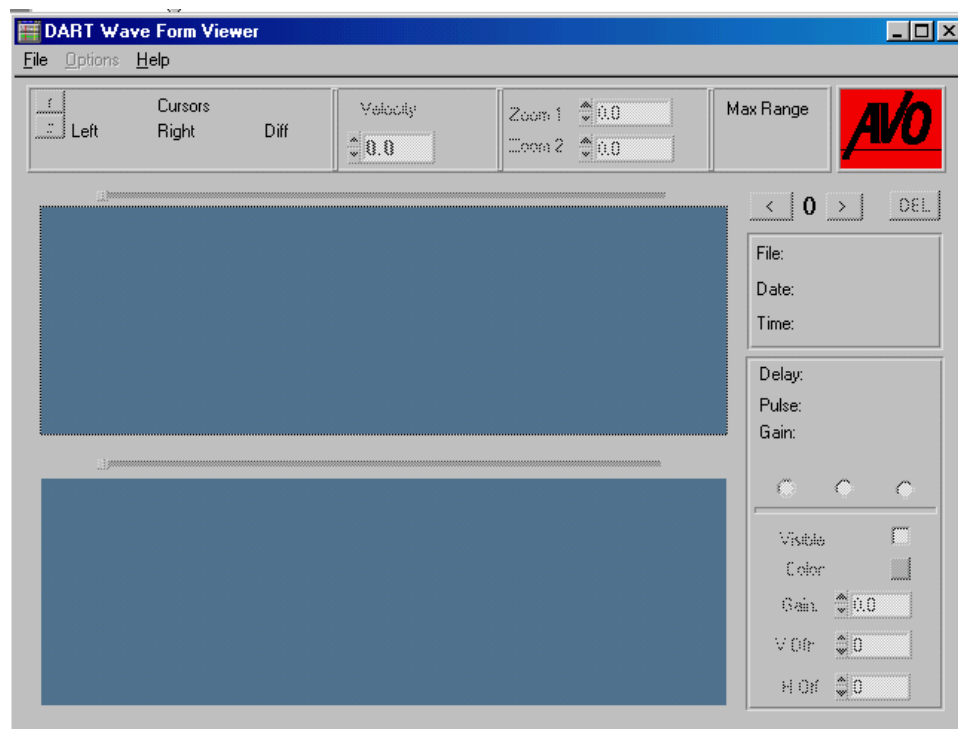
*Login Screen*

Click on **Start** and Select Operating Mode will open.



*Select Operating Mode Screen*

Click on **TDR**, **ARC** or **Surge** and DART Wave Form Viewer will start. Click on **Setup** to select the distance measurement units velocity of propagation units and printer used by DART Viewer. Click on **Quit** and DART Viewer will not start.



*DART Waveform Viewer*

## ***Transferring Wave Forms from the DART***

With AVOLINK you can access the DART to recall wave forms that are stored in the DART's memory or to load wave forms stored in the PC to the DART.

Minimize DART Viewer and click on the **Get from** tab. AVOLINK will display a screen on which you have to specify a path to the drive and directory on the PC that will store the transferred wave form files. You can either type in the full path name or you can click on the **Browse** button to select a path or create a new path.

Select the **Get File List** button to display the list of files on the DART that are available for transfer.

Select one or more files from the **List of available files to recall** to get from the DART.

When the path to store the retrieved files is displayed and at least one file is selected for retrieval from the DART, the **Get selected files from remote device** button will become enabled. Click on this button to retrieve the selected files from the DART.

If you need to stop the file transfer, select the **STOP getting files** button to stop the file transfer.

For help on the items in this window, click on the appropriate button, tab or field.



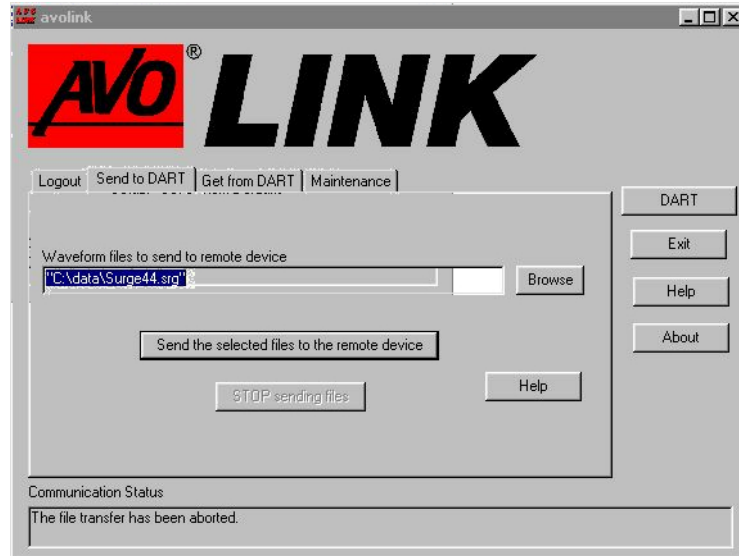
*Get From Tab*

### ***Sending Wave Forms to the DART***

You can also send wave form files from the PC to the DART.

On the **Maintenance** tab, highlight DART in the **Select device** drop-down list.

Click on the **Send To** tab.



*Send To Tab*

To select files to transfer to the DART, either type in the path and appropriate filenames or click the **Browse** button and select the path and files from a Windows standard Open File window.

Click on **Send the selected files to the remote device** to send the files to the DART.

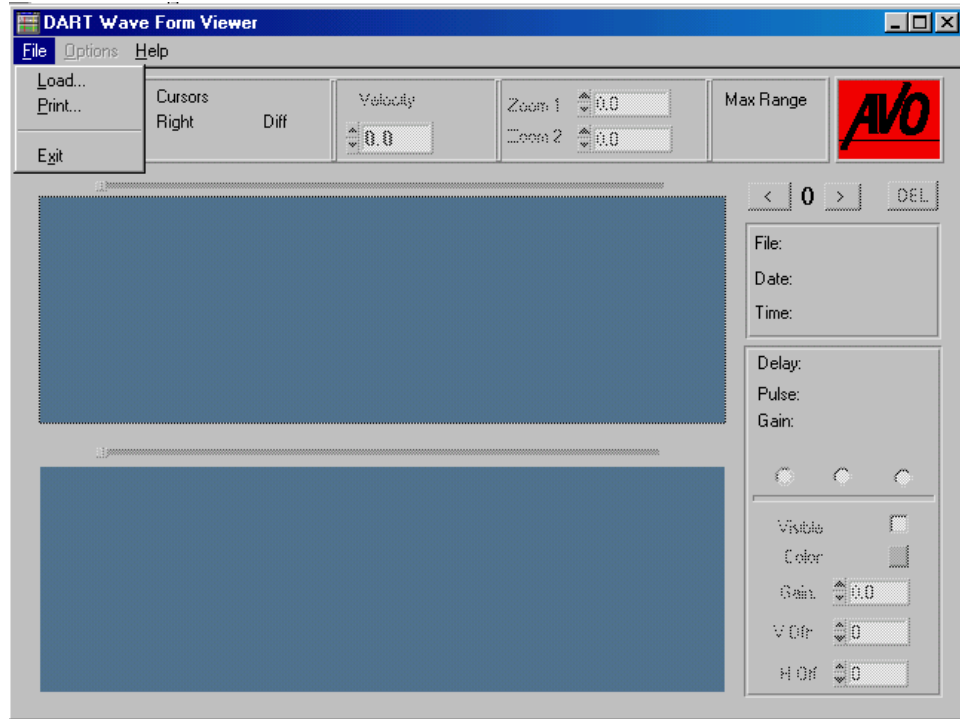
If you need to abort the file transfer, click **STOP sending files**.

For help on the items in this window, click on the appropriate button, tab or field.

## ***The DART Wave Form Viewer***

To view a wave form that is stored on the PC, click on **File** in the menu bar at the top of the screen. In the **File** menu, click on **Load**.

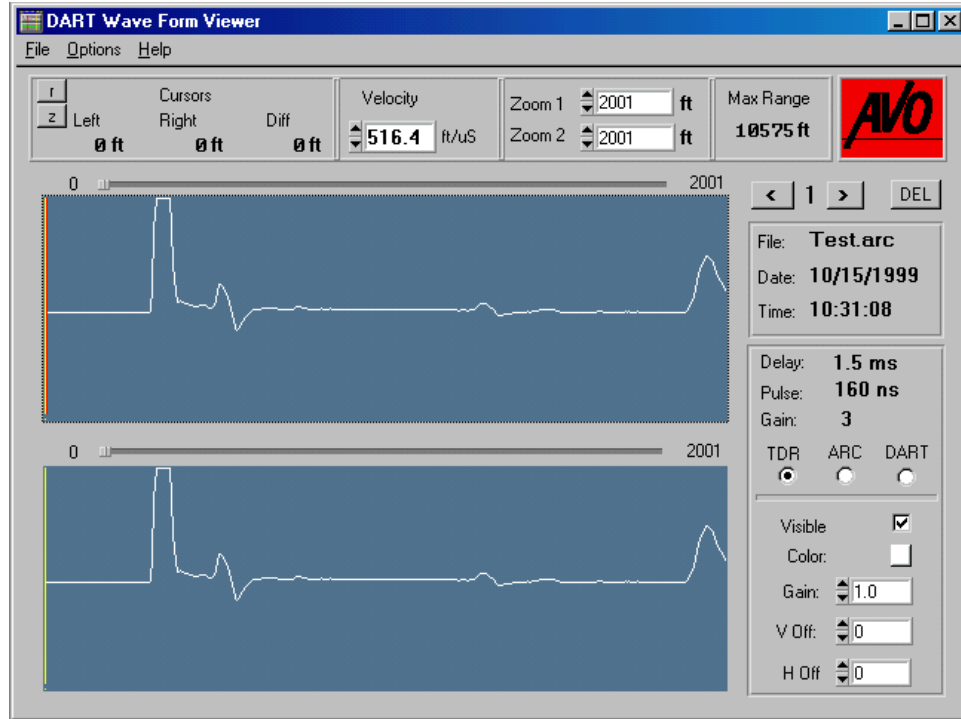




*File Menu of DART Viewer*

The **Select Wave Form** dialog box displays. Browse to the folder containing the wave form you want to view and double-click on the desired **.arc**, **.srg** or **.tdr** file. (The default location is C:\Avolink\DARTdata.) Arc reflection wave forms are stored with a **.arc** extension, surge pulse with **.srg** and tdr with **.tdr**.

The Viewer displays the selected wave form. The section on the right side of the viewer displays the filename for the wave form and the date and time it was saved in the DART.



*Wave Form Displayed*

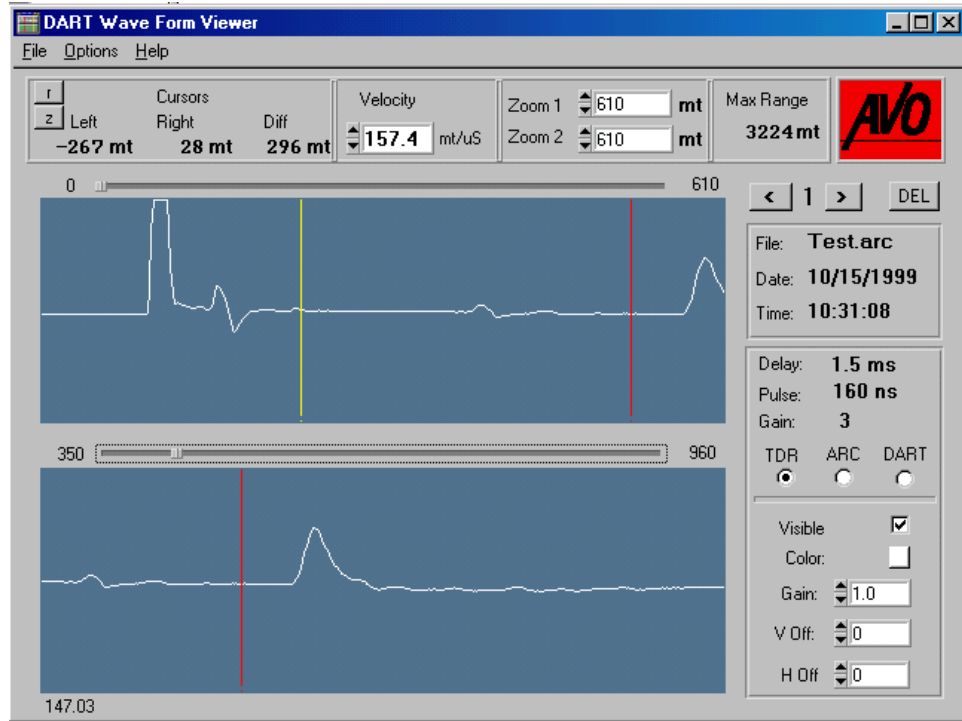
The controls across the top of the viewer allow you to alter the view by adjusting a number of variables: the left cursor zero position, the velocity of propagation, and the distance displayed in the upper or lower windows.

The left cursor (yellow) and right cursor (red) can be moved by either clicking and dragging or by clicking and using the left and right arrow keys on your keyboard. If the left cursor is moved, clicking on the **1** box will reset it to its zero position. To set a new left cursor zero position click on **2**. The **Cursors Left** and **Right** display the absolute distance measurements of the left and right cursors from the zero set point. The **Diff** measurement is the differential distance between the left and right cursors.

To adjust the velocity of propagation, click on the **Velocity** spin box and adjust the value up or down.

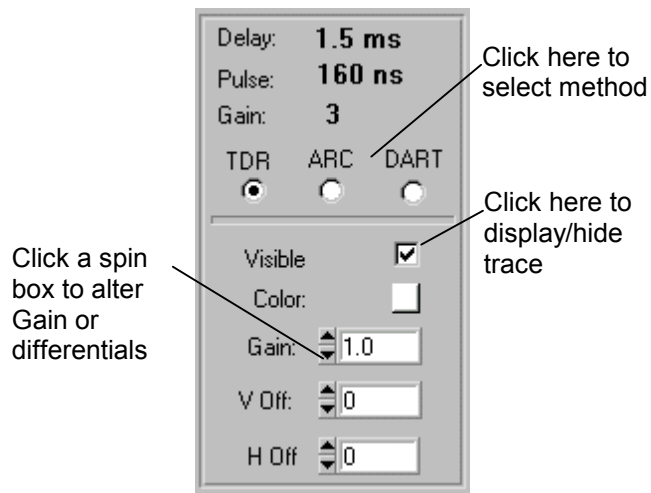
To change the total distance displayed in the upper window, click on the **Zoom 1** spin box and increase or decrease the value. To adjust the lower window distance, click on **Zoom 2**.

You can click and drag the slider bars located above the upper and lower windows to view different sections of the cable, as shown below:



*Use Sliders to View Different Sections of Cable*

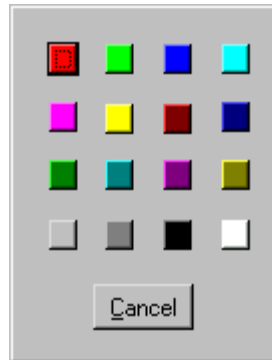
You may also view the TDR, ARC or DART traces, if available, for the wave form, individually or all at once. Click on the option button for the desired method, and then click the **Visible** checkbox to display the trace.



*Select Method and Color*

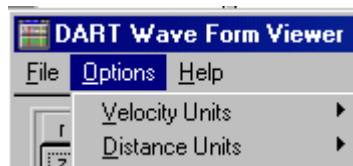
You may alter the Gain or the Vertical or Horizontal Offset of the individual TDR, ARC or DART traces by selecting a value in the spin box.

You can change the line color for any of the three types by clicking on **Color** and choosing a new color.



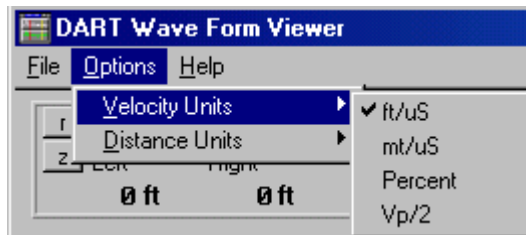
*Color Choices*

Other view options are available from the Options menu. Click on **Options** to display the menu, which has two items: velocity units and distance units.



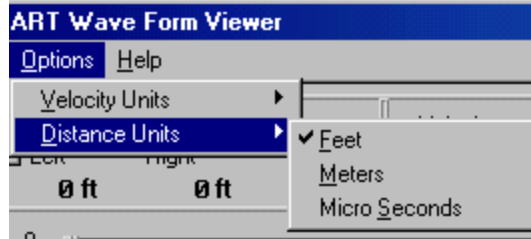
*Options Menu*

Further expand the **Velocity Units** option to select **ft/μS**, **m/μS**, **Percent** or **Vp/2**.



*Velocity Units Selection*

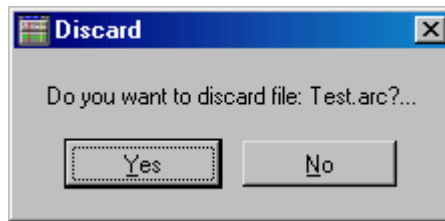
Further expand the **Distance Units** option to select **Feet**, **Meters** or **Micro Seconds**.



*Distance Units Selection*

Up to three files can be loaded into the Viewer. If the Velocity used was identical for all three traces, the arrows above the file name toggle through each of the three traces and display the appropriate file name, date, time, pulse width and gain for each trace.

Click on **DEL** only if you want to discard the wave form from the Viewer. This will not delete the file from its saved location.



*Discard Wave Form File?*

To print the Wave Form Viewer window, click on **File** and then **Print** to display the print window, which will allow you to select one of the printers connected to the PC. To print to your default printer, click on **OK**. To change to a different printer, click on **Change Printer** and select **Specific Printer** and pick the desired printer from the drop-down list.

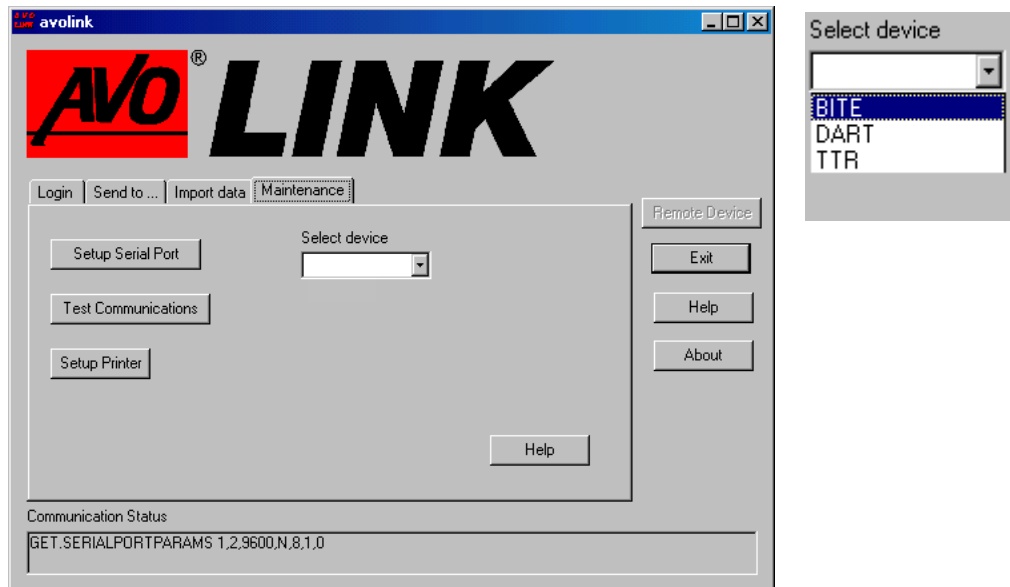


# 4

## COMMUNICATIONS FUNCTIONS

The remote device and the AVOLINK software must always operate with the same communications parameters. If you find it necessary to change the communications parameters for AVOLINK, you can do so from the Maintenance tab.

Click on **Maintenance** to display the Maintenance tab, and select **BITE**, **TTR** or **DART** from the **Select Device** drop-down list.



*Maintenance Tab*

## Setup Serial Port

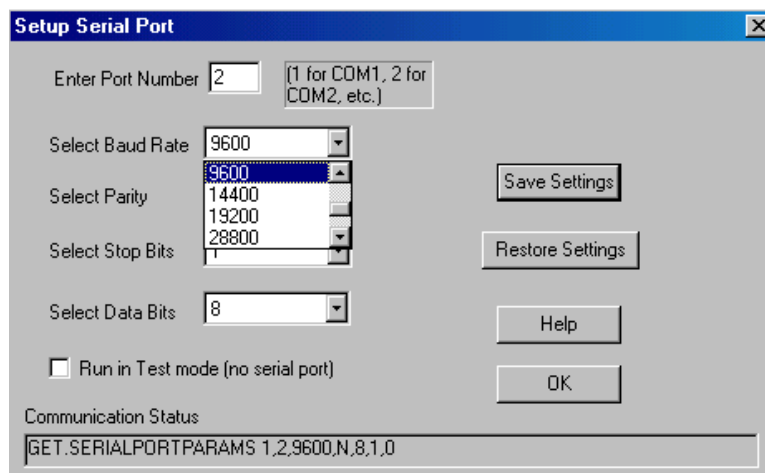
When necessary, use this feature to adjust the communications parameters.

1. Click on **Setup Serial Port**.



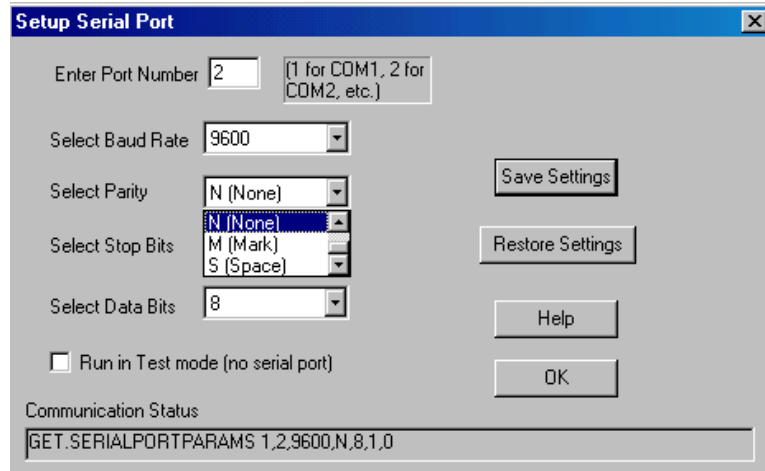
*Setup Serial Port*

2. From the drop-down lists, pick the desired communications parameters.

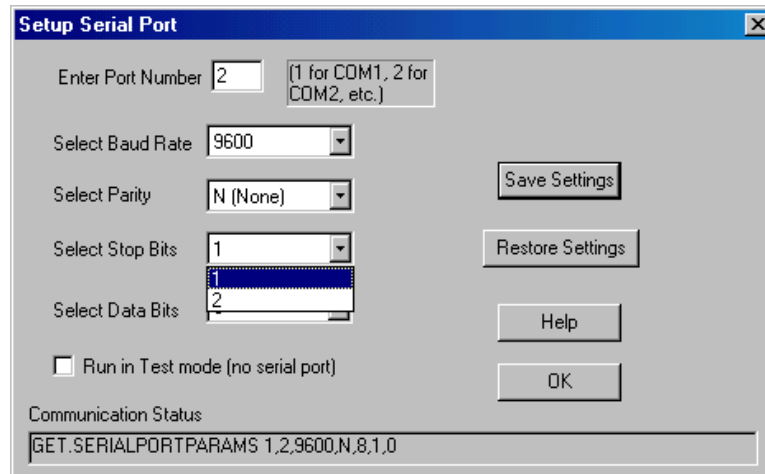


*Select Baud Rate*

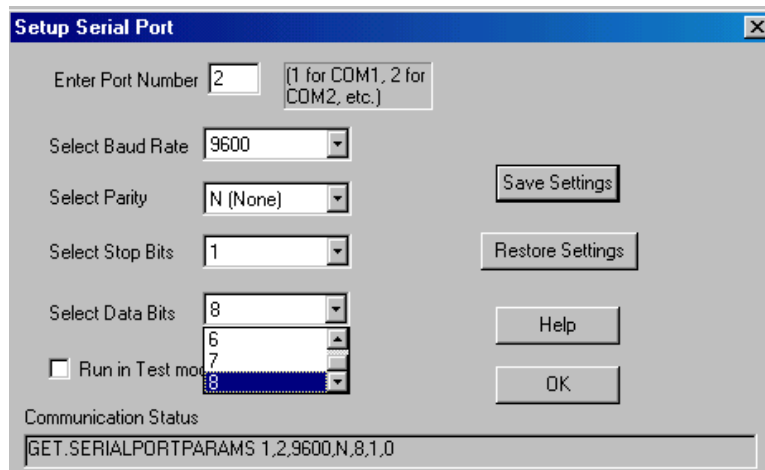




Select Parity



Select Stop Bits

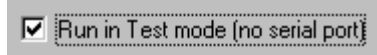


Select Data Bits

- To save the new settings and initialize the serial port, click **Save Settings**.
- To leave the parameters as they were when you accessed the tab, click **Restore Settings**.

**NOTE:** *Even if you have made changes and have clicked **Save Settings**, the settings will be restored to those in effect when you first accessed the tab.*

If the **Run in Test Mode** check box is checked, the serial port is not used and the remote device cannot be accessed.



*Run in Test Mode*

The Test mode does not support all commands. The commands currently supported are.

SET.PASSWORD

SET.SETTINGS

SET.WAVEFORM (NO FILES ARE ACTUALLY TRANSFERRED)

LOGIN

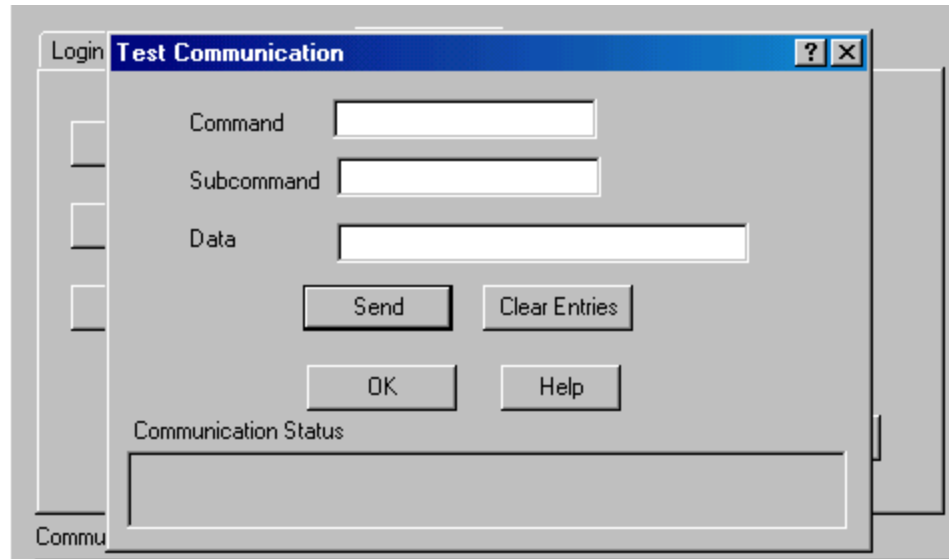
LOGOUT

GET.SETTINGS

GET.PRINTERLIST

## ***Test Communications***

The Test Communication window is strictly for testing purposes. It works independently of all the other windows. For example, if you enter the Login command here, the program will respond as it would if you were not connected to a remote device.



*Test Communication*

Enter the command, subcommand, and data that you wish to send to the remote device. If there is no subcommand or no data, just leave those fields blank. Commands and subcommands can be upper or lower case or mixed case.

The data must adhere to the following rules:

- The data items must be separated by commas.
- If a data item contains a dot (.), a comma (,) or a space, it must be enclosed in double quotes (").

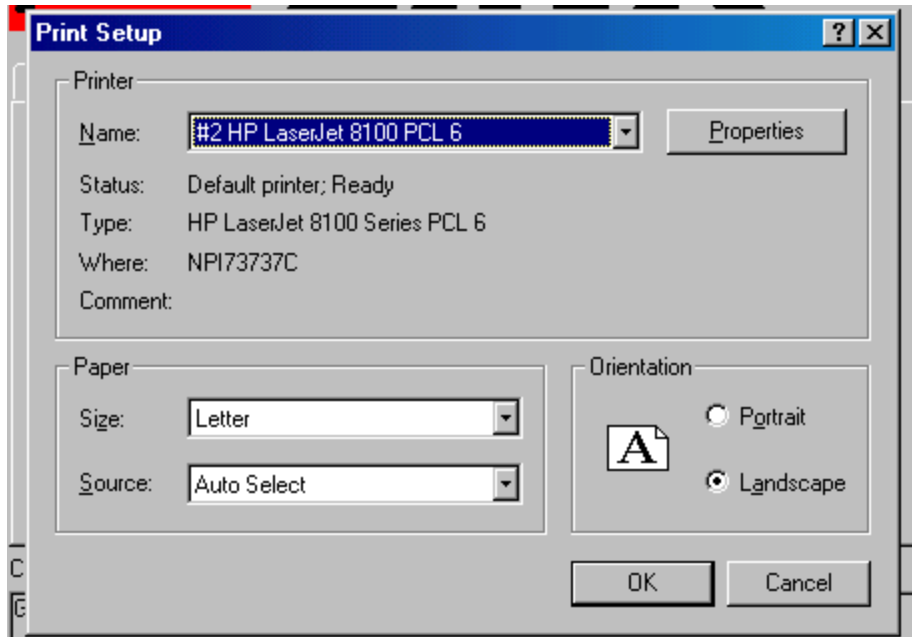
Select the **Send** button to send the command to the remote device.

The **Clear Entries** button clears the **Command**, **Subcommand** and **Data** fields.

The Communication Status window shows whether the command succeeded or failed.

## **Printer Setup**

Click on the **Printer Setup** button to display the print dialog box. The appearance of this box will vary depending on the type of printer that is connected to your PC.



*Printer Setup*

## **AVOCOM 32**

AVOCOM32 provides the communication to the remote device. AVOLINK takes care of starting and terminating AVOCOM32. If you need to view the communication status, click on **Start, Programs, Avolink, avocom32**. The resulting window shows all commands and responses to commands going between AVOLINK, AVOCOM32 and the remote device. The following abbreviations indicate where the commands and responses are coming from:

- RI: Response to command came from the remote device
- RO: Command was sent to the remote device
- CO: Response to a command was sent to the client (AVOLINK)

Other items in the window, which are generated by AVOCOM32, may or may not be preceded by one of the above indicators.