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HIPOTRONICS®
THE MEASURE OF A LEADER

ROBINSON
INSTRUMENTS

USER'S GUIDE

Model Number: DDX-7000 ®

Part Number: DS12-1545

WARNING

This publication describes a product engineered and designed to measure or operate with **HIGH VOLTAGES**. Accordingly, maximum safeguards have been built into the equipment and the best safety techniques possible are described in the unit's operating instructions. These instructions caution the user to exercise great care when using certain controls at appropriate points in the operating procedures. In addition to following these written warnings, the operator of this equipment is strongly advised to maintain safety consciousness. The following rules are particularly relevant and must be followed at all times.

- Ground the system before connecting input power.
- Disconnect power before un-grounding the system.
- Never approach or touch a potentially live **HIGH VOLTAGE** circuit without solidly connecting an appropriate ground conductor first.

Hipotronics, Inc. - P.O. Box 414 - Route 22 - Brewster, N.Y. - 10509-0414 – (845) 279-3644 – Fax: (845) 279-2467

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General Information

Introduction

The Hipotronics DDX™ Series of Digital Partial Discharge Detectors represents a remarkable leap forward in terms of technical capability, price, and ease of use. The unit builds on the highly successful Robinson 700 Series, Robinson 803 Series, Hipotronics CDO77 Series, and Robinson licensed CDA-3.

This manual provides a description of the **Hipotronics DDX-7000 Digital Discharge Detector,** and how it may be used to detect and measure Partial Discharge activity in high voltage insulation. Information on the operation of the high-voltage supply and other ancillary equipment should be found by reference to the appropriate operation manual.

Partial Discharge Overview

Partial Discharge (PD) is defined as localized breakdown of a gas near an electrode that is located in an electric field. Examples include a void in a solid piece of insulating material, an area along the surface of an insulating material, or an electrode in free air. The term "corona" is frequently used to refer to a discharge in free air.

Several important terms regarding partial discharge are as follows:

Operating Voltage	The voltage at which the insulation system or finished product is normally operated.
Inception Voltage	The voltage at which partial discharges begin to occur.
Extinction Voltage	The voltage at which partial discharges end.
Picocoulomb (pC)	A measure of electric charge. An ampere is one coulomb/second. A picocoulomb is 10^{-12} coulombs, a very small amount of charge.
Ellipse	A common pattern to show partial discharge superimposed on a phase representation of a voltage waveform.

All electrical insulation materials will have some degree of partial discharge. Any item that contains electrical insulation materials will have some degree of partial discharge. Depending on the application, the customer, and the reliability needed, acceptable partial discharge levels will vary. Below is a partial list of some finished goods that are commonly tested for partial discharge and what some common typical levels are:

Power Cable	<2pC
Switchgear	<100pC
Power Transformers	<500pC
Bushings	<20pC

Excessive partial discharge will result in serious degradation of the quality of the insulation system and will cause premature failure of the insulation system. The presence of partial discharge may be detected by visual, audible, ultrasonic, or electrical methods. All Hipotronics partial discharge detectors utilize the electrical method to detect partial discharge. The electrical method is most often used when partial discharge must be quantified.

Partial discharge is measured by measuring the flow of electric charge in an insulating material during a breakdown (in a void, along a surface, or in free air). Since electric charge is flowing through a resistive insulator, a voltage can be measured. This voltage is proportional to the partial discharge present in the insulator. Since the discharge (i.e. flow of electrical charge) is a breakdown, the discharge signal is a pulse. The measured signal has commonly been displayed on an oscilloscope as a pulse on an "ellipse". When alternating current is used during testing, the discharges will usually reappear continually in the same place on the ellipse (i.e. sinewave).

The Hipotronics DDX Series digital partial discharge detector utilizes the same method to measure partial discharge as conventional analog partial discharge detectors (Hipotronics CDO77, Robinson 700 Series, etc.) except that the measurement signal is digitized. In addition, advanced software and digital signal processing replaces the bulky, expensive digital electronic circuits used in analog systems. Therefore, much more extensive data analysis can be performed and additional capability can be added at very low cost. The result is a PD measurement package with high performance to price characteristics.

Certification

Hipotronics, Inc. certifies that the calibration measurements are traceable to industry accepted standards.

Initial Inspection

Hipotronics' instruments are carefully checked before shipping. Visually inspect your instruments for shipping damage. Immediately notify the carrier and Hipotronics, Inc. if any damage is found.

Standard Equipment

The DDX-7000 Digital Partial Discharge Detector comes equipped with the following:

Mainframe, including PC, display, module rack, and power supplies

5 Modules: Amplifier, Display, Measure, Capture, and Calibrate

Keyboard, Mouse and Mousepad

Windows 95™ Operating System (installed)

Hipotronics DDX-7000 software (installed)

Transient Filter Unit

3 15-meter coaxial cables

3 2-meter coaxial cables

Line Cord

User's Guide

Description

The **Hipotronics DDX-7000 Digital Discharge Detector** is a computer controlled measuring instrument which takes the small signals generated by partial discharge activity in an insulator and processes them such that they can be measured and displayed. It also contains facilities for measuring the applied high voltage and for generating calibration signals.

The computer display is an LCD screen on the front of the instrument. It provides information in graphical form for the operator, who can select and control many operations by means of a standard mouse and/or keyboard. Most of the control and readout functions are implemented in the software. The operating system is Windows 95™ running on a Pentium™ processor. The **DDX-7000** software is the property of **Hipotronics.**

The **DDX-7000** consists of a computer controller, display and power supplies, together with a number of hardware modules; all mounted in a 6U case. The modular design eases maintenance, and enables the user to upgrade the instrument as new modules are introduced.

There are 5 modules required for the base model. These are the Amplifier, Calibrate, Display, Measure and Capture modules. These hardware modules have many parameters which can be set by the operator interacting with the **DDX-7000** software.

The operator can control the amplifier characteristics, the calibrator output, and the signal gating and display format. There is also a facility to allow the partial discharge measurement system to be set up automatically.

For voltage measurement, readings can be taken from a **Type 970** automatic controller; or the output from a capacitive divider can be connected directly for manual systems. If required, an external CRO (analog X-Y) display can be connected to give an analog elliptical timebase display similar to that found on the **Hipotronics Models 700 and 803**.

Mainframe

The mainframe, which is a standard 6U x 19 in. case; consists of a cabinet containing a front panel assembly, a rear panel assembly, and a 3U module rack with proprietary backplane.

The front panel assembly houses the LCD display, embedded PC, the floppy and hard disk drives, and PC power supply.

The lower rear panel assembly houses the module rack power supply and connectors for printers and other external equipment.

The module rack mounted in the upper section of the rear of the mainframe holds the modules required for a particular function. Unused module slots are fitted with blank panels. Interwiring has been kept to a minimum for ease of assembly and maintenance.

PC

The PC is a single board computer (SBC) housing a **Pentium 200 mmx™** with 16MB of RAM as standard. The board is mounted vertically on a 4 Slot ISA Passive backplane, to which the PC power supply cables are attached. The interface between the module rack and the PC is via a proprietary PC104 interface board which is mounted on the SBC. The keyboard and mouse connections are brought out to the front panel. The serial and parallel port connections, monitor connection, and optional network connection, are brought out to the rear panel and labeled appropriately. The pin connections are detailed in the appendices, and are industry standard for these devices.

Software

The instrument is supplied with **Windows 95™** and the **DDX-7000** software already installed. On boot up, the **DDX-7000** software is automatically started. For a full description of the software, please refer to the printout of the Online Help File under Appendices.

Power Supplies and Fuses

The DDX-7000 utilizes two separate power supplies: the PC supply and the module rack supply. The former is a standard PC power supply, complete with connectors, and is mounted on the front panel underneath the PC. The module supply is mounted on the lower section of the rear panel. The 4A fuse, F1, is contained in the IEC supply connector, and is accessible from the back of the unit.

Access to the module power supply can be gained by loosening the five captive screws which secure the panel to the mainframe.

Display

The display is a 10.4 inch Liquid Crystal type, with SVGA resolution (800x600) in full color. It is mounted immediately behind the front panel.

Floppy and Hard Disk Drives

The floppy disk drive is a standard 3 1/2 inch drive, mounted vertically on the front panel to the right of the LCD. The hard disk drive is 2Gb or larger in size, and is mounted on the same brackets as the floppy drive. (There is no hard disk access LED.)

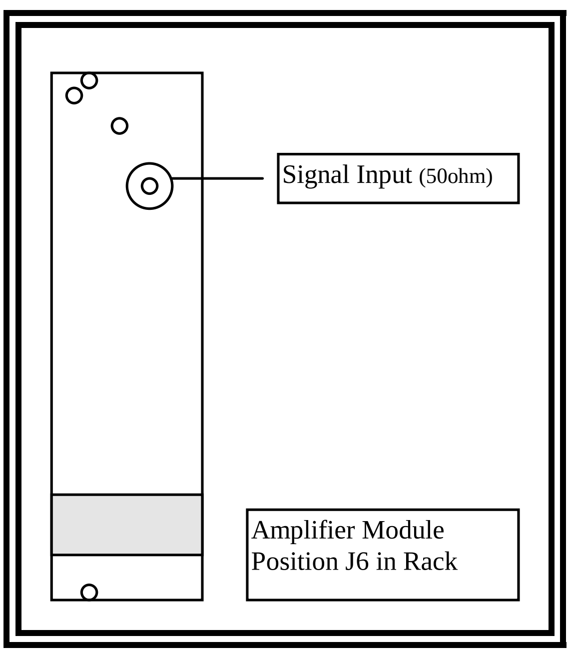
Modules - General

The **DDX-7000** is modular in design for ease of maintenance and future expansion. Each module plugs into the 19 in. rack which is mounted in the upper section of the instrument. The rack can accommodate up to 10 modules. The module slots are numbered J1-J10 from left to right as viewed from the rear of the instrument. A standard **DDX-7000** requires 5 modules in the following slots:

- Amplifier J6
- Display J7
- Capture J8
- Measure J9
- Calibrate J10

All have connections via the module front panel (rear of the instrument), except the Capture Board, which has no connections. The connections are listed in the appropriate section.

Amplifier

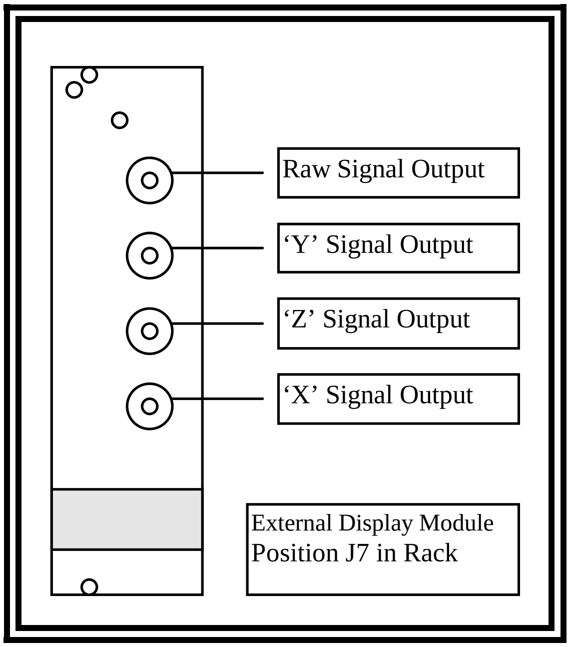


Connections:

Signal Input: Connect to Input Unit

This module takes the PD output from the input unit, and amplifies and filters it before passing the signal to the measure and capture modules. The input has a 50 ohm input impedance.

Display Module



Connections:

Raw Signal Output: Connect to oscilloscope to monitor raw PD pulses.

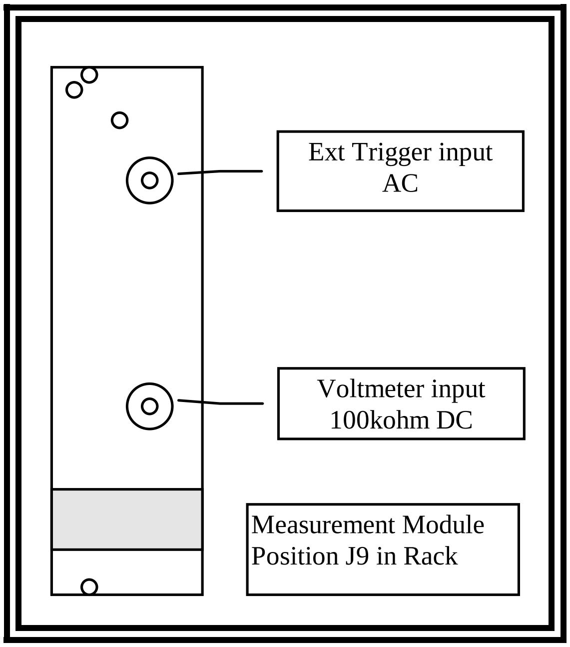
Y Signal Output: Connect to oscilloscope vertical channel 1.

Z Signal Output: Connect to oscilloscope 'Z' input.

X Signal Output: Connect to oscilloscope vertical channel 2 (select for X deflection).

This module provides analog outputs to produce an elliptical display identical to that given by the Hipotronics Models 700 and 803. The Raw Signal Output is provided so that the PD pulses can be viewed on an oscilloscope conventionally, i.e. with the X sweep being driven by the Time Base control. The X,Y and Z outputs are provided so that an elliptical display can be obtained using an analog scope. The Y output should be selected for vertical deflection and the X output for horizontal deflection. The Z output is used to dim the sections of the ellipse which are gated out with the horizontal gate. Because of the variation in sensitivity of different oscilloscopes, it may be necessary to insert a voltage divider (e.g. 10k potentiometer) between the output and the oscilloscope 'Z' input. (Note that some oscilloscopes have do not have a 'Z' input.)

Measure Module



Connections:

External Trigger Input: Connect to external trigger source
(50V max.)

Voltmeter Input: Connect to voltmeter source.
(50V max.)

The measure module measures the PD magnitude and applied voltage. The PD magnitude is measured by an analog peak capture circuit, the output of which is digitized. The voltage input is continuously sampled and stored.

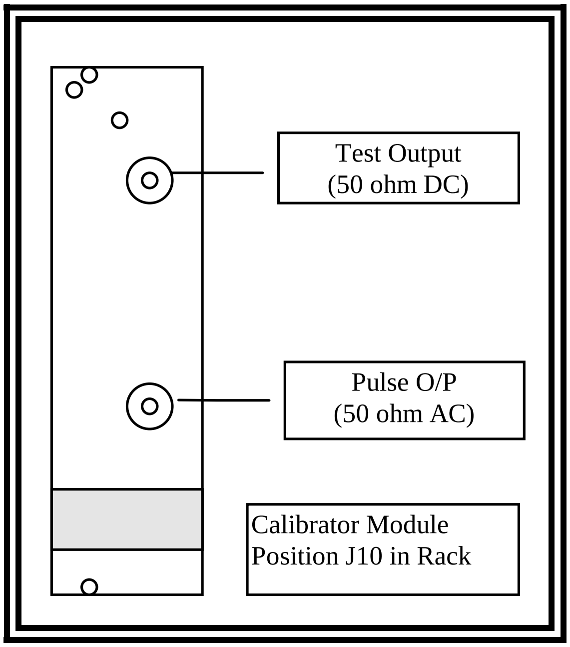
This module is also responsible for synchronizing the system clock to the appropriate source. The synchronizing priority is External Trigger, Voltmeter, Line (i.e. External has the highest priority and Line the lowest). In the absence of External and Voltmeter inputs, the system will synchronize to the Line (Mains) frequency.

The most common mode of operation is with just the voltmeter input connected. With no applied voltage, the system synchronizes to the line frequency. If voltage is applied, the system will synchronize to the voltmeter input when it is greater than about 100mV peak. Both the voltmeter and external inputs have 100mV sensitivity.
Inputs should not exceed 50V peak.

Capture Module

The capture module occupies slot 8 in the rack, and has no front panel connections. The capture board digitizes the PD pulses at high speed for display and/or analysis. The module can operate in one of several modes, controlled by software, depending on the type of measurement being made.

Calibrate Module



Connections:

Test Output: Unattenuated 10V pulse (DC coupled). Monitor only.

Pulse Output: Connect to injection capacitor. Terminate in 50 ohm.

The calibrate module is used to inject PD pulses of known magnitude into the HV circuit to calibrate the instrument. The rise time of the pulse output is very small, so the bandwidth of the system from the calibrator to the amplifier output is dominated by the input unit/amplifier frequency characteristic. The **DDX-7000** instrument has an automatic calibration facility, internal or external, which will calibrate the instrument at a PD level specified by the user.

The unattenuated output is intended as a monitor output only. It has a 50ohm source impedence, but it is recommended that this output should only drive a high impedence load (>1000 ohms). The attenuated output should be terminated in 50 ohm, at the input to the HV injection capacitor.

Warning

Do not attempt to use the DDX calibrator without the 50 ohm termination fitted. A BNC "T" piece and a BNC 50 ohm termination are provided for this purpose.

This assembly must be fitted at the calibration capacitor input. To test correct operation of the termination. First calibrate the DDX with the termination connected, and then remove the termination leaving the calibration capacitor connected. Select a calibration signal of 10pC, it should now read on the magnitude meter approximately 19pC. If this is not the case, contact Hipotronics immediately. **DO NOT USE THE EQUIPMENT.**

1. Ensure that the 50 ohm termination is fitted to the calibration capacitor along with the supplied "T" piece.
2. Switch on the DDX and load the DDX software.
3. You may get a message the first time saying, voltage calibration invalid or calibration file corrupt. Ignore this and continue. Once you have calibrated voltage and saved it and calibrated PD and saved the settings (from the file menu) to the default filename this message will not appear.
4. You should now have the DDX running, and the ellipse should be thin or show noise "grass" depending on the amplifier and filter settings.
5. If the ellipse is thick or thick on one side flashing to the other, or appears too clean to be true, switch off the DDX, ensure that the earthing is correctly fitted and that the supply line and neutral are correctly wired. The neutral input must be the actual neutral or ground referenced for the DDX to perform initial synchronization of the time-base first time around. The synchronization of the time base is derived in three ways with the following priority dependent on signal level:

    a) The aux. input on top of the measure module has the highest priority.

    b) Next is the voltmeter, which will take priority when the signal level is greater than approximately 200mV.

    c) Finally in the absence of these two signals the DDX will synchronize to the incoming mains supply.

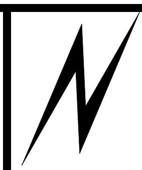
    This can sometimes cause some odd displays if a high frequency signal is connected when the unit is synchronized to the mains the switches to the line frequency say 400Hz. To prevent this transition switching, a reference from the input frequency should be connected to the aux. Input on the measure module so that the DDX stays at line frequency even when the voltmeter signal is not present (max. input signal is 6.5V ac (rms.).

6. On the measurement window, ensure that the following are checked: Auto range (If manual control is not required). Extreme load gain correction and measure rms voltage.
7. Open the amplifier window and set the bottom and to filters to 20kHz and 400kHz respectively.
8. Open the calibration window, select the required calibration level in pC and switch on the calibrator. Ensure that the calibration capacitor value is entered as 100pf and calibration is direct (bottom of the calibration window).
9. You should now see two cal pulses 180 degrees apart. If these pulses are not more than twice the background noise level, the auto calibration will not be possible and the message “Unable to adequately resolve pulses” will be displayed. If this occurs, either reduce the HV load for more gain, reduce background noise, or calibrate at a higher calibration level. If cal pulses do not appear, check wiring, HV connections, and check that the calibration and power separation filter capacitors are connected and not shorted. Check all connections to the DDX. As a quick check of the DDX, connect a short BNC from the cal out to the amp in connections on the DDX. You should now have big pulses and a low gain requirement. Provided this is all right, you can then short together the cable to the cal capacitor and the cable to the scope input of the power separation filter with the “T” piece. If the external connections are good again, cal pulses are present if all is all right the problem is at the high voltage end, either too much load (low gain) or low impedance to ground in the HV circuit. Also check the filter components in the 600138 PCB in the base of the PSF and the connection to the base of the PSF capacitor via the short internal BNC cable.
10. When a sufficiently large cal pulse is visible, you can then perform calibration.

Installation and Set-Up

Safety Precautions

The voltages associated with partial discharge testing are potentially lethal. Care must be taken to ensure that an operator cannot be exposed to high voltages even under fault conditions.



It is strongly recommended that all the high voltage components of a test facility should be located within an enclosure, all entrances to which should be fully interlocked with suitably certified switches which will prevent the mains power being applied while any switch is open. A dual circuit interlock is recommended to prevent a single fault from disabling the protection.

The common low voltage point of the test circuit should be connected to a low impedance ground point. The impedance between this point, the supply safety ground connection, and all metalwork exposed to the operator, must also be low and able to carry likely fault currents.

This electrical system should be supplemented by appropriate mechanical locks and fences. The construction of the enclosure must prevent the approach of any part of a person to within a dangerous distance from any high voltage component while energized.

Provision should be made for grounding all high voltage components after use, to prevent injury from stored charge while adjustments are made.

For maintenance purposes the main power supply to the test facility should be fitted with a lockable isolator switch.

When the equipment is being used as a temporary installation for on-site testing, the same considerations listed above apply; and great care must be taken to ensure that all personnel are kept out of the area while a hazard is present. Physical barriers should be used as well as electrical interlocks.

An easily accessible emergency shut-down switch is essential.

There should always be at least two operators, one of whom keeps a watch for anyone straying into the hazard area. All operators should be familiar with first aid, especially in the area of electric shock.

Operation of high voltage equipment by one person alone is strongly discouraged.

Supply Voltage

The instrument is fully tested and calibrated before leaving the factory. No other adjustments should be necessary. The operating voltage should have been specified at the time of ordering, and will also have been set at the factory.

Voltage Selection

<u>If it is necessary to change the supply voltage from the factory setting, the following steps should be carried out by a suitably qualified technician.</u>

Analog supplies:

- Disconnect all power and signal connectors (if present) from the outside of the **DDX-7000**.
- Carefully remove the rear lower panel (5 captive screws) to expose the analogue power supply module. Use a small flat-blade screwdriver.
- Set the selector switch on the PCB to the voltage range required.
- Replace the analog power supply module and rear lower panel. Use a small flat-blade screwdriver. Do not over-tighten the screws.

Digital Supplies:

- Carefully remove the front panel (6 captive screws) to expose the computer, display and digital power supply modules. Use a small flat-blade screwdriver.
- Set the selector switch on the power supply module to the voltage range required. (The switch is between the supply inlet and outlet connectors.)
- Replace the front panel assembly. Use a small flat-blade screwdriver. Do not over-tighten the screws.

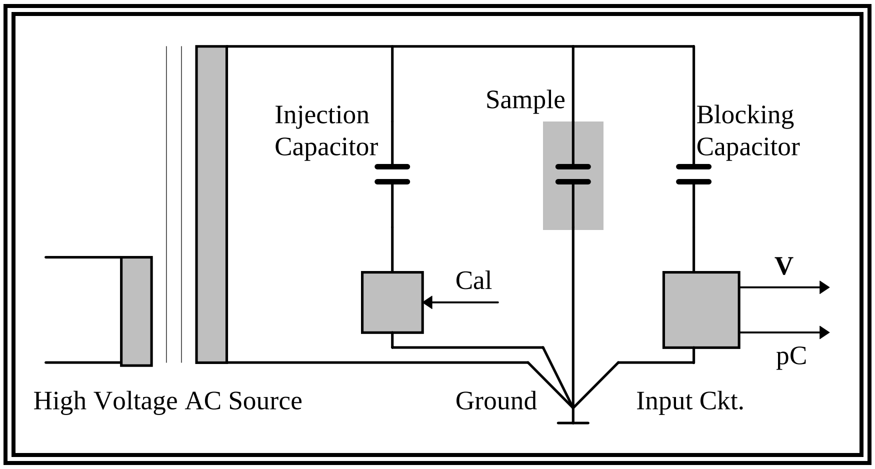
***Note*:** Both adjustments must be made, and the resulting switch settings should match.

Grounding

The mains supply connection is made via the IEC connector mounted on the lower section of the rear panel. The ground pin of this connector is connected to the terminal post labeled ‘Supply Ground’. The terminal post labeled ‘System Ground’ is connected to the internal analog supply common, the PC common, and the instrument case. The two terminals are normally connected via a link. This link can be removed if it results in lower system noise.

WARNING: If this link is removed, the System Ground terminal MUST be connected to a low impedence ground, common to other nearby equipment, for operator safety!

Basic High Voltage Circuit



This diagram shows a basic high voltage circuit which can be used for partial discharge measurement.

The high voltage AC source must be controllable to set the test voltage applied to the sample. It should have low levels of harmonic distortion, and must not have significant levels of noise or internal discharge. Filtering may be necessary to reduce the effect of noise or internal discharge if present.

Care must be taken to exclude or reduce the effect of external noise sources on this type of circuit.

The ‘Blocking Capacitor’ and ‘Injection Capacitor’ must have an AC voltage rating equal to or greater than the highest voltage to be applied to the circuit.

The following connections are made to the **DDX-7000 :**

The **V** (or PM) signal connects to **V/M IN** on the **Measurement Module.**
The **pC** (or SCOPE) signal connects to **AMP IN** of the **Amplifier Module**.
The **Cal** signal comes from **CAL O/P** of the **Calibrator Module**.

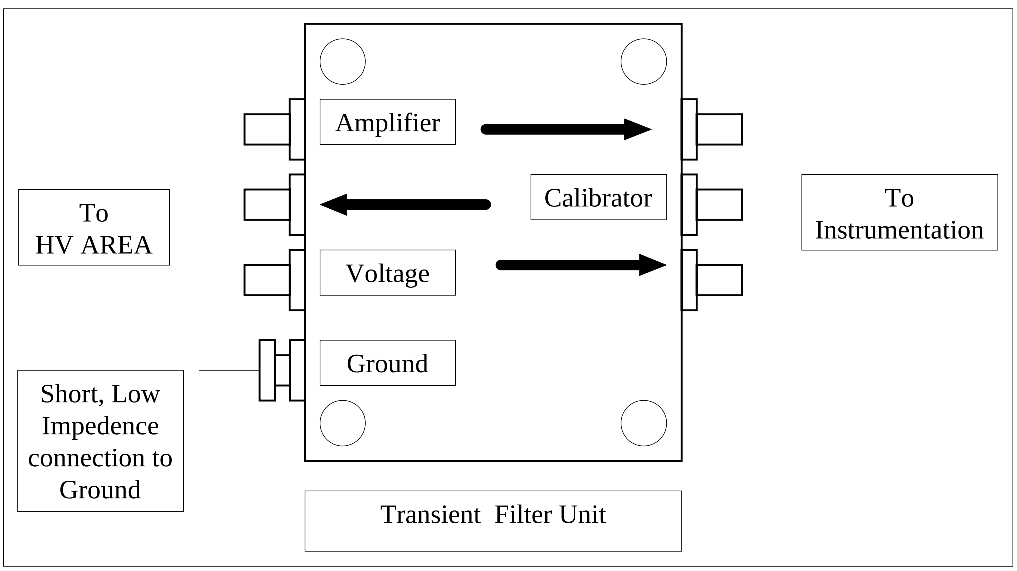
The ‘**Ground**’ point should have a low impedence to earth ground, and be able to carry fault currents without generating hazardous voltages. It may be separate from the supply ground connection. In some circumstances, it may be preferable to connect the **DDX-7000** system ground terminal to this point rather than supply ground. This connection must have full fault current rating and have a low impedence.

The ‘Input Ckt.’ shown in the diagram acts to separate the high frequency signals due to discharge activity from the supply frequency current flowing through the capacitor. This is then sent to the **Amplifier Module**. In this case, the input circuit also produces a signal proportional to the applied high voltage, which is sent to the **Measure Module**.

To calibrate the partial discharge measurements, a signal generated by the **Calibrate Module** is sent via a coupling unit to the **Injection Capacitor**. The magnitude of this signal is accurately known; and if the capacitance value of the **Injection Capacitor** is known, a defined charge can be injected into the measurement circuit. The response of the circuit to the injected charge can be measured, and used later to determine the magnitude of an unknown actual discharge.

Input Protection from Flashover Damage

In any high voltage test environment, there is a possibility of sudden catastrophic breakdown (flashover) occurring within or across any of the components. This produces large current and voltage surges which can destroy electronic components in the vicinity, whether or not they are connected to the circuit. To minimize the effects of such flashovers, a Transient Filter Unit is provided to place in series with the Voltage, Amplifier and Calibrator leads. It requires a short, low impedence connection to a good ground. Any transient voltage or current is then diverted to ground rather than being allowed to propagate out of the high voltage test area.

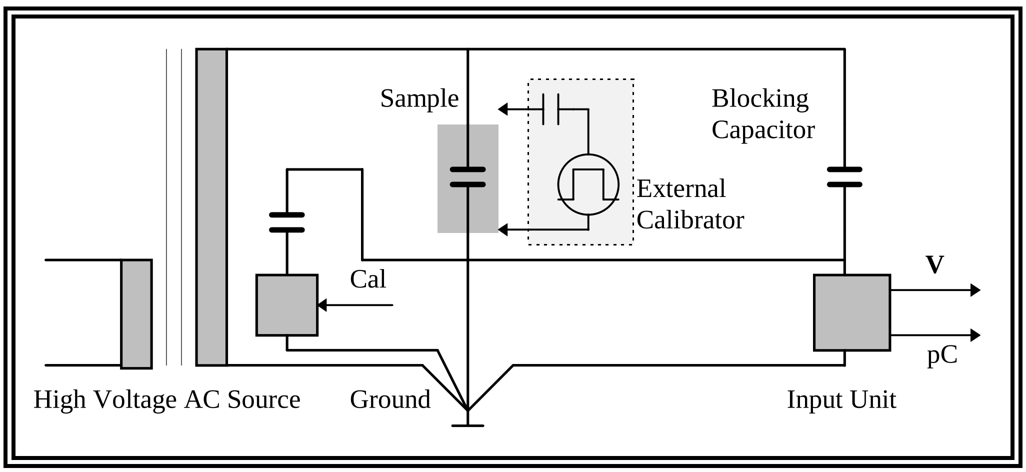


Calibration Setup

The two standard methods of calibration are:

- **Direct calibration** via injection capacitor, using the **DDX-7000** calibrator as shown in the example above. This has the advantage that the calibration signal can be applied at any time. It has the disadvantage of high cost for the capacitor.

- **Indirect calibration** (as shown below) using low voltage injection from the **DDX-7000** calibrator, via a small capacitor connected to the input unit. An external calibration pulse source must be connected across the sample to be tested, and the system response compared with that from the internal calibrator. This has the advantage of lower cost, but the disadvantage of needing to be repeated each time a significant change is made to the test circuit. In addition, the calibration value obtained may be affected if the external calibrator capacitance is not small compared to the circuit capacitance. (The facility for indirect calibration is built into the 701 input unit)



Other Circuits

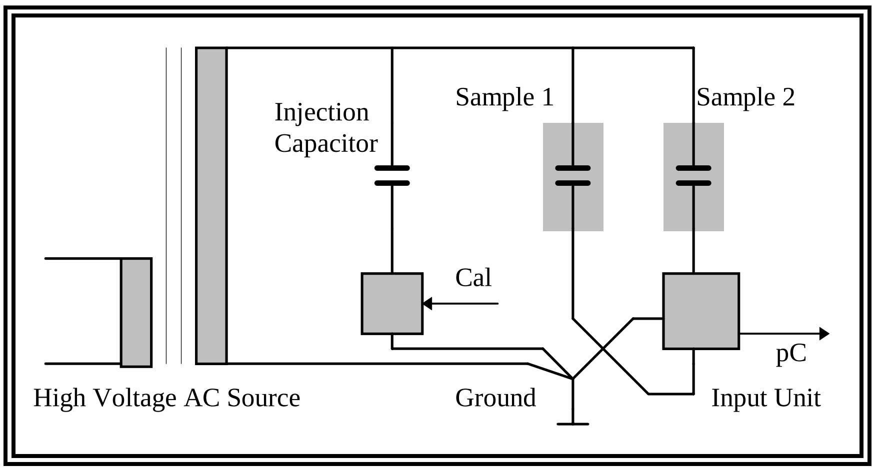
Bushings, Busbars and Rotating machines: These can often be treated as capacitors, provided that the voltage is applied in a way that stresses the insulation in a way comparable to its intended application. Bushings intended for use partly or wholly in a fluid other than air may require special fixtures.

Cables: The example circuits shown so far only show a capacitor as the test sample. Cables can be tested with the same configuration. In this case, the External Calibrator is usually applied at the remote end of the cable; as this is the worst case as far as measurement is concerned.

Transformers: Transformers can be self energized and tested as normal, provided that the supply does not introduce noise. If capacitive bushing taps are available on large units, these can be used to connect to a standard input circuit. Otherwise, a suitable external blocking capacitor can be used.

Balanced Mode: This mode of operation (shown below) is possible with the type 701 input unit. It may be of use in any of the following situations:

External noise is a problem.
Two samples need to be tested simultaneously.
No suitable blocking capacitor is available.
The current is too great for the standard connection.



The 701 type input unit has a center-tapped transformer input. For the normal connection, the center-tap is ignored, and the current through the blocking capacitor flows through it from one end to the other. In balanced mode, the center-tap is grounded; and the current from one sample flows into one end, while the current from the other sample flows into the other end of the winding. The supply currents tend to cancel by transformer action, but the partial discharge currents generated in either sample do not. The maximum current in the balanced configuration tends to be limited by thermal effects rather than by core saturation, if the samples are well matched.

(The 701 does not provide a voltmeter output - this must be derived elsewhere)

Other Frequencies

The **DDX-7000** will synchronize automatically with the voltage measurement input frequency and phase. If voltage is not being measured by the **DDX-7000,** it will use its supply as a frequency and phase reference. For use where the test frequency or phase is different from the power frequency or phase, and the **DDX-7000** is not measuring voltage, a synchronization signal should be connected to the designated input on the **DDX-7000**. This situation is most likely to occur where the test object is a self-energized transformer (high frequency), large capacitance (low frequency), or the HV circuit is in a resonant configuration.

WARNING:	**If an external CRO display is being used, its screen may be damaged if no synchronization at all is available and the brightness control is too high.**

Note that as the frequency increases, the discharge pulse width will appear to increase. This is normal, and is a result of the faster scan rate.

Software

The operating system (Windows 95™) and the DDX-7000 program are pre-installed on the hard disk, and will start automatically on power-up. Optional software modules will be supplied on floppy disk, with installation instructions in the associated manual.

For a given test setup, various parameters must be set via keyboard and mouse entry. This is considered part of operation, and is covered in the next section.

Operation

Basic Operation

Insure that the line cord, keyboard and mouse are all connected to the unit, and that an appropriate source of power is provided (see Supply Voltage, Pg. 11).

Press **POWER** ON. Within a few seconds, the PC should run the Windows 95™ startup routine. After the desktop appears, the main DDX-7000 window should open. (Startup may be interrupted for various reasons. If this occurs, see "Startup Delays" below.)

The main Detector window is shown (Pg. 34) in "System Window Elements", which describes the Windows 95™ format and commands used in the DDX-7000 program. A user who is not familiar with basic Windows 95™ operation should refer to this section, or a Windows 95™ User's Guide.

The main Detector window shows a Discharge Pulse Display using the standard elliptical format (or line, sinusoid, or sine loop formats). It also displays any combination of six sub-windows to control function groups:

Amplifier	Display Appearance and Gates
Calibrator	Quick PDSL Monitor
Measurement	Additional Test Information

These sub-windows can be displayed or minimized, and arranged as desired, to fit the test requirements. The pulse display can also be moved and resized as desired.

The system can be used immediately to detect partial discharge, by setting the Amplifier to "Autorange" in the Measurement window (see Pg. 61). To accurately measure partial discharge pulses in pC, however, the whole system (HV test circuit and DDX) must be calibrated. Refer to the following sections for instructions:

Auto Setup	Pg. 48
Direct Mode Calibration Sequence	Pg. 50
Indirect Mode Calibration Sequence	Pg. 51
Manual Calibration	Pg. 54

In most situations, the operator will want to use the Auto Setup routine. For additional information on using the DDX, refer to the appropriate sections of the On-Line Help File printout, starting on page 25. Refer to the Table of Contents for a list of sections.

Startup Delays

Any of the following messages may appear during program startup. Possible responses and their results are listed:

1. CALIBRATION INVALID. RUN ANYWAY? ___No ___Yes	No Yes	Program will shut down. Program will run. (“Uncalibrated” flag will be on continuously, even after calibration.)
2. FAULT HAS OCCURRED LOADING SETTINGS. RUN ANYWAY? ___OK	OK	Program runs with default settings.
3. ATTEMPTING TO CONNECT TO 970 CONTROLLER ___Cancel	Cancel	Program runs without 970 operations.
4. Information 970 NOT ATTACHED ___OK	OK	Program runs without 970 operations.
5. Information 970 CONTROL CONNECTED ___OK	OK	Program runs with 970 control operations.

Troubleshooting Guide

The DDX Detector is a modular package with replaceable modules accessed from the rear of the unit. This design makes it easy to troubleshoot the unit, should problems develop. The computer section is contained behind the front panel. It should be accessed only if necessary, by a qualified technician.

To gain access to the computer section, place the instrument on a flat surface. First loosen the top three screws on the front panel about 4 mm, then the two side screws on the bottom of the panel. As the bottom middle screw is loosened, support the front panel inches once the screws are undone. If additional room/access is needed, remove the case cover by first removing the two (3mm) Allen screws at the front top corners of the unit. Pull out the rail between the screws, then slide out the cover; unclipping the ground lead from the cover.

Reassemble the unit in reverse order, using extreme care in handling all cabling.

The following is a guideline to help diagnose minor problems with the DDX.

Symptom During bootup and before the Windows 95™ icon appears on the screen, a message indicates that the mouse or keyboard is not connected.

Solution Make sure the mouse and keyboard are securely plugged into the front of the unit. If they are, follow the instructions above to pull the front panel out; and make sure the internal mouse and keyboard connections are securely plugged into the computer board. (They are located on the left side near the front panel).

Symptom After normal bootup, the Windows 95™ screen appears, then the DDX System main screen. However, none of the modules operate normally.

Solution 1. Remove the top cover of the unit following the above instructions, and make sure that the recessed power plugs from the main power supply are plugged in.

2. Make sure that the power supply is outputting the correct voltages. To do this, locate the power supply (orange) 8-pin connector on the backplane. The top (vertical) two pins should have 6-8Vac power, the next two should have 5Vdc, and the next four 15Vdc.

3. Make sure that the PC104 card (a small card about 4” square that is connected to and parallel with the computer board) and all interconnecting cables are firmly seated in their mating connectors.

Symptom The calibrator module does not display calibration pulses on the ellipse.

Solution 1. Make sure that the amplifier gain is sufficient to show calibration pulses. Also, Make sure that no gating is selected (either horizontal or vertical) that would affect the display of the cal pulses.

2. Make sure that your test circuit is connected properly with the correct value of Calibration Injection Capacitor in the circuit and entered on the screen.

3. Change ranges on the calibration module and make sure that you can hear a relay operating (it will be quite obvious in a quiet room). If you can't hear a relay operating, the module is quite likely not getting input power. Hook up an oscilloscope to the CAL O/P output and make sure that, with a 100pC calibration signal and a 100pF selection for the injection capacitor, you are getting a 1V pulse output. If the signal is there, verify that there is a signal on the input to the DDX amplifier (you may have to increase the calibration pulse amplitude to see a signal.

Shutdown

Shutdown should be initiated by clicking the X in the upper right corner to close the program. Then click on the YES, START, SHUTDOWN, and YES options. Wait for the "It's now safe" message before switching POWER OFF. Failure to follow this (Windows standard) procedure will complicate the next session with additional startup steps.

Commonly Asked Questions

Can I connect an external monitor to a DDX Detector?

Yes, each DDX detector is provided with a VGA 15-pin output that can be connected to any commercially available SVGA color monitor. *

How can I be sure that this technology gives reliable, repeatable results similar to my analog detector?

Although the analog to digital conversion technology used in the DDX Detectors is well-known, Hipotronics also supplies each DDX Detector with X, Y, and Z outputs that can be connected to commercially available, off-the-shelf analog oscilloscopes to display the ellipse. The signal displayed is true analog, prior to digital conversion. You can use this feature to see that you are getting the same results.

I already have an analog partial discharge detector. What else will I need to purchase to make the DDX Detector work?

The DDX Detector was designed to be plug-in retrofittable with Hipotronics CDO77 and Robinson Type 700/Model 5 analog PD detectors. Simply remove the old detector and connect the new DDX detector, using the same power separation filters/coupling capacitors. In most cases, the separate Robinson 701 input unit should not be required. If you want to record both PD and Voltage with the DDX Detector, a new Power Separation Filter/Coupling Capacitor or Coupling Impedance will be required. For other analog discharge detectors, an additional coupling impedance may have to be purchased. Consult Hipotronics factory for details.

If I want to buy a printer, what printer do I need to buy?

There is no need to spend huge amounts of money on a specially configured “high voltage rated” printer (which other manufacturers require). Any standard laser printer that is configured to work with Windows95 will work with the DDX Detector. We recommend Hewlett Packard printers for their worldwide distribution and high quality. We recommend a color printer for best reporting of results. *

Can a backup tape drive be used with the DDX Detector?

Units are configured to accept a backup tape drive. Data can also be stored on 1.44MB floppy diskettes, or downloaded through an external communication port.

Can information be downloaded from the DDX Detector to a Network?

Windows95 has this capability, but the DDX Detector has not been configured or tested with a network interface card. There are concerns with connecting a high voltage test area to a network computer.

Can the DDX Detector drive an external plotter?

The DDX detector can generate reports that contain the same PD vs. Voltage information as a plotted report. An optional module can be purchased to drive a plotter.

How easy to use is the Quick Partial Discharge Site Location program (optional)?

The Partial Discharge Site Locator (PDSL)within the DDX-7000SL Series is very easy to use. Sites can be located within 1 minute. The sequence of operation is to turn on the PDSL amplifier, click on the PD site on the ellipse, enter cable length, set cursors and read the distance to the site. It’s the easiest to use locator on the market. Coming soon - Automated PDSL.

***** We recommend that monitors and printers be powered by an isolation box to prevent transient failures. Contact Hipotronics Sales for information on this item.

How sensitive (i.e. how well

The signal amplifier contained in the DDX PDSL is the same amplifier

can it locate faults in cable) is the DDX-7000SL Partial Discharge Site Locator?

contained in the very sensitive and very successful PDSL95. The specification for this unit is repeated below:

A self contained Partial Discharge Site Locating system designed for locating partial discharge (PD) sites in shielded cable. The fast sampling rate used in this system permits PD sites to be located with an accuracy as high as 1% of cable length or 2 meters minimum with typical power cable in an electromagnetically shielded environment. This is the usual environment for final factory tests on power cable. Excessive ambient electrical noise and/or unusually low cable impedance ($Z_o < 30\Omega$) may reduce system accuracy.

Sensitivity	5 pC
PD Range	0 - 10000 pC
PD Bandwidth	0.073 - 10 Mhz

For optimum sensitivity, the use of the specially configured Power Separation/Coupling Capacitor may be required. These units are listed below and in the price list:

Catalog No.	**Voltage (kV)**	**Capacitance (pF)**	**Height (mm)**	**Base (mm) LxD**
PDSL-CART-75	75	1000	1248	460 x 720
PDSL-CART-150	150	1000	1634	460 x 720
PDSL-CART-300	300	Consult Factory	Consult Factory	Consult Factory
PDSL-CART-400	400	500	2148	720 x 1246

Specifications

PD Measurement System

PD measurement range	0-99999pC in standard notation, higher readings in scientific notation
PD measurement resolution	9 bits plus sign
PD phase resolution	0.35 degrees

Partial Discharge Site Locator (Optional)

Time resolution	12.5ns (80mHz sampling rate)
Capture memory depth	256 cycles, 256+ samples
Amplitude capture accuracy	Better than 1%
Amplifier ranges	12 switched 5dB ranges
Amplifier frequency range	100kHz to 5MHz

Voltage Measurement System

Voltage measurement range	0-99999KV. Peak Scaled RMS and True RMS measurement modes
Voltage measurement resolution	11 bits plus sign
Voltage measurement accuracy	better than 0.5% at I/P socket
Voltage frequency sync range	5Hz to 500Hz
Voltage measurement input	10VPk input, transient protected, high impedance. Can be used with capacitive divider, resistive divider or voltmeter resistor. The system can support up to 16 different voltage sensor calibrations to allow it to be moved around to different test installations.

Internal Calibrator System

Calibrator Output	set directly in pC; output displays in PC
Calibrator maximum output	10V step (1000pC into 100pF)
Calibrator output range	1mV to 10V in 13 ranges (0.1pC to 1000pC into 100pF)
Calibrator fine adjustment	0 to range voltage in 256 steps
Calibrator output rise time	less than 25nS into 100pF; slower into higher cap.
Calibrator operating modes	direct and indirect (transfer) modes supported

Amplifier Systems

PD amplifier ranges	6 switched 20dB ranges
PD amplifier fine adjustment	10:1 in 200 steps
PD amplifier gain linearity	<1% over whole range
PD amplifier frequency range	20khz to 500KHz
PD amplifier filter settings	Low Pass: 20kHz, 30kHz, 50kHz, 60kHz, 80kHz
	High Pass: 100kHz, 200kHz, 300kHz, 400kHz, 500KHz

Data Processing System

Windows 95™ - based operating system, with Hipotronics DDX-7000 Program
Intel Pentium™ (or equivalent) Processor, 200mHz (or faster)
16MB of RAM
1.44MB floppy disk drive; 2.1GB (or larger) hard disk drive
SVGA (800 x 600) active matrix thin film LCD monitor
Standard keyboard and mouse
Parallel printer port; one uncommitted serial port (COM2)

Physical Characteristics

Power Supply	115V or 230V AC, ±10%, 50Hz or 60Hz, <250VA
Operating temperature range	10ºC to 35ºC
Operating humidity range	35% to 80% non-condensing
System approvals	CE mark
DDX Detector-7000 Size	17.5"W x 10.5"H x 18"D, 40 lbs. (445mm x 270mm x 460mm, 18 kg) 6U, 19" standard case
DDX Detector 8003 Size	17.5"W x 10.5"H x 18"D, 50 lbs. (445mm x 270mm x 460mm, 23 kg) 6U, 19" standard case

Introduction

DDX-7000 Introduction

Welcome to the Hipotronics DDX-7000 system. To find help on a specific topic, use the User Guide Table of Contents. All the information given here is available on-line, using the HELP menu. Registered users of the system can also get assistance directly from Hipotronics.

How the System Captures Data

The system uses a complex sampling system to capture the pulse data. The discharge activity is continuously sampled by a very high speed digitizer (80MHz). This is followed by a digital processing system that captures the data into a high speed RAM system. The contents of the RAM are downloaded into the PC at intervals specified by the display update interval in the Setup Data Acquisition window.

To capture a pulse, the system waits for the output to cross a specified threshold. Once this happens, it starts to search for the peak using a digital peak capture system. The crossing of the threshold is also used to capture the phase angle of the pulse. The capture unit continues the peak capture process until the signal falls back below the threshold. The highest recorded value thus corresponds to the peak of the pulse. The high sampling rate ensures that it is the peak that is caught, not just slightly off it.

Once the signal has fallen back below the threshold, a lock out period is started to prevent the system from capturing the tail of the pulse. This prevents the peak capture signal from being re-triggered by the overshoot. There is a condition that allows pulse capture in this lock-out period: when the signal crosses the same threshold as the original pulse. This occurs when a second pulse occurs close to the first and falls into its overshoot. In this case the whole of the pulse capture system is re-triggered to capture the second pulse. This allows for capture of two closely spaced pulses, where the second pulse falls into the overshoot of the first. The only case where two pulses will be treated as a single pulse is where the first pulse does not fall below the threshold before the second pulse occurs. This will occur when the pulse separation is below the pulse resolution time of the system.

When a pulse has been detected and captured, the magnitude and phase are stored into the system capture memory. The pulse is stored as four items of information, the pulse magnitude, the pulse phase, any gating information associated with the pulse and the cycle number. This is an 8 bit count that is incremented on each positive zero crossing. It is used to distinguish between cycles. The information is accumulated in the capture board memory for a specified number of cycles. This is downloaded into the computer at the end of the following update interval. The system automatically determines the optimum number of cycles to capture for any particular display update interval.

How the System Measures Discharge

The system uses one of two methods to measure the discharge magnitude, depending on whether normal or IEC-270 compliant measurement has been selected (see Measurement). The normal operating mode provides a more accurate measure of the discharge magnitude. In IEC-270 compliant mode, the system reduces the discharge reading at lower pulse repetition rates in accordance with the curve specified in section 4.3.3. Because this has to be done using an analog system, the accuracy is lower in this mode.

In the normal operating mode, the system monitors the pulses read in from the capture board on each display update interval. The system notes the highest pulse magnitudes, positive and negative, that have not been gated out since the last time the magnitude meter was updated (See Handling unwanted activity). The highest of these two figures is then scaled to read in true pC, taking into account the current amplifier setting. The scaling factor is set in the calibration process (See Calibrating the system). The magnitude meter update rate is determined by the display update interval (See Setup Data Acquisition). When the display update interval is less than 100mS, the magnitude meter is updated approximately 10 times per second. If the interval is greater than this, the system updates the magnitude meter on every display update cycle.

When operating in IEC-270 compliant mode, the system uses an analog measurement system. The use of an analog system allows the system to follow the IEC-270 4.3.3 response curve. This forces the system to reduce the reading at low pulse repetition rates, allowing the reading to be directly compared with the output of a traditional analog detector. The system uses an analog peak detector to capture the highest pulse on the input. The roll-off of this circuit provides the IEC-270 curve. When pulse trains with low repetition rates are being measured, the reading will tend to “bounce” as it would on a traditional instrument. In this case, the reading as defined by IEC-270 is at the trough of the response (i.e. the lowest reading). This affects the displayed reading only. The value passed to analysis modules on the system uses the normal mode, as analysis and processing is more concerned with individual pulse activity. When the system is running an analysis module that captures individual discharge pulses (e.g. the advanced analysis module), the operation of the display is inhibited and the system uses the IEC-270 measurement mode for discharge measurement.

How the System Measures Voltage

The DDX-7000 provides two modes of voltage measurement, Peak Scaled RMS and True RMS. The voltage measurement mode is selected from the Measurement window. The system also uses the voltage sensor input to synchronize to the HV Power supply output, so that the pulse capture and display system have the correct phase relationship to the HV. The system continuously monitors the voltage input and captures the peak voltage on each cycle, using a high speed data converter and a digital processing system. When the system is operating in Peak Scaled RMS mode, the value captured as the voltage peak is scaled using the appropriate voltage scaling factor to get a reading of the peak voltage in kV. This is then divided by $\sqrt{2}$ to give an equivalent RMS value.

The process of measuring True RMS is more complex. It requires the system to measure the waveshape of the incoming HV signal. The system does this by capturing samples over one cycle of the mains signal and storing them into a buffer. It then processes them to get the scaling factor for peak to RMS for that particular waveshape. The peak voltage measured for a cycle is multiplied by the scaling factor to get a reading in kV. This is then multiplied by the peak to RMS scaling factor that has just been calculated. The captured waveshape is also used to provide instantaneous voltage information for the individual pulses.

Handling Unwanted Activity

There are situations where it is undesirable to capture and measure discharge pulses detected on the sample, because they are invalid; due to some form of pick-up on the test circuit or noise on the supply. The DDX-7000 provides three ways of controlling the information that is captured: horizontal gating, vertical gating and noise gating. It is possible to set whether the gated information is shown on the display using the Show Gated option on the Display Appearance window. Gated pulses are shown in red on the display, and do not affect either the magnitude meter or the analysis system.

Horizontal gating provides a phase related gating function that allows specific sections of the HV cycle to be gated out. This can be used to eliminate noise that occurs at a fixed point on the HV waveform such as zero crossing noise on the regulator. The system gates out either one or two fixed portions of the waveform depending on whether single or dual horizontal gates are selected. When operating in dual horizontal gate mode, the two gate-out sections are always positioned 180 degrees apart. The width and starting position of the gated out section(s) are determined by the user, using the sliders on the Display Appearance window. Care must be exercised when setting up the windows, as some testing standards limit the amount of the waveshape that can be removed this way.

Vertical gating allows pulses that go above a defined limit to be eliminated. The threshold for this elimination is set using the Display Appearance window. The threshold is set in terms of pulse height on the display, as indicated by the cyan trace on the display window. Pulses falling above this limit are not metered. This allows the elimination of large, non-phase related pulses such as noise from variable speed motor drives. Because of the way that this system has to operate, it must not be used in conjunction with amplifier auto-ranging (See Measurement) as it will disrupt the auto-range system.

The third gating system is the noise gating function. This removes all activity below the defined threshold indicated by the magenta trace on the display (see Display). The main purpose of this gate is to eliminate activity due to the background noise of the system. There are two contributions to this noise: the amplifier and the test circuit. These are handled separately by the system, as they behave differently when the amplifier settings are changed. They are set up automatically by the automatic calibration system (see Auto Setup). The amplifier noise contribution is proportional to the amplifier fine gain only, while the circuit noise is proportional to the fine gain and the attenuator setting. The system automatically adjusts this threshold when the amplifier setting is changed. The user can set up both settings using the Manual Calibration system. It is also possible to set the circuit noise contribution using the Display Appearance window.

Calibrating the System

The DDX-7000 system is designed to read in true pC over all ranges of the system. The actual calibration is dependant on the configuration of the test circuit and the input unit system. It is necessary therefore to re-calibrate the system each time the test circuit configuration is changed. The Save Settings option allows the calibration settings to be saved, so they can be recalled for use later.

IF USING THIS FACILITY, ALWAYS ENSURE THE TEST CIRCUIT CONFIGURATION IS IDENTICAL TO THE ONE IN USE WHEN THE SETTINGS WERE SAVED. FAILURE TO DO SO WILL RESULT IN INVALID TEST RESULTS

The DDX-7000 allows two modes of calibration: Automatic and Manual. The automatic mode calibration (see Auto Setup) requires minimal user intervention, and will usually provide the best calibration of the system. In some cases this will not be adequate, particularly where there is high background noise or phase related interference. In this case the user can elect to calibrate the system manually (See Manual Calibration).

The system calibration sets up three parameters: the discharge sensitivity scaling, the system noise contribution, and the test circuit noise contribution. The discharge sensitivity scaling is set by injecting a known discharge level into the test circuit; using either direct injection via a known injection capacitor, or by indirect injection using an external reference. The calibration is set by comparing the reading on the discharge magnitude meter against the value of the injected discharge (as entered by the user). From these two figures a scaling factor is calculated to correct subsequent readings.

To prevent the digitization of spurious pulses, the system has a noise floor threshold below which pulses are not recorded for analysis. This noise floor is calculated from two components: the system noise and the test circuit noise. The system noise is the contribution of the first stage amplifier. This is normally minimal, except on the highest gain range. When calculating the noise floor, the amplifier noise contribution is scaled to be proportional to the fine gain setting.

The circuit noise contribution will normally be the dominant factor, being the portion of the noise caused by external influences. When the system scales this to calculate the contribution to the noise floor, it takes into account both the fine gain and the attenuator setting. The noise floor is readjusted each time the amplifier setting is changed.

Analysis Modules

The DDX-7000 extends the functionality of a traditional detector by means of Analysis Modules that process the discharge information. The analysis modules take the information from the magnitude meter and the pulse information from the display and process them to provide the user with more information about the discharge activity being studied. Where a DDX is being used with a 970 power supply controller, an analysis module can control the 970, allowing the implementation of automatic test sequences. All the analysis modules are implemented using the Microsoft ActiveX™ technology. This gives them all a common interface to the 970. Analysis modules effectively “Plug In” to the DDX-7000.

There are two standard modules supplied with the DDX-7000:

Discharge against Time, Discharge against Voltage. This provides the functions traditionally performed using a chart recorder.

Test Reporting. This module only operates when there is a 970 connected to the DDX-7000. It allows the automated testing of samples with the generation of test reports suitable for Q.A. applications.

Currently, there is an optional analysis module available for the system:

Discharge Analysis. This provides capture of discharge activity, generation of 3D plots, integrated quantities and discharge fingerprints.

As new modules become available, they can be purchased from Hipotronics. Because of the use of ActiveX technology, third party developers will also be able to provide analysis modules.

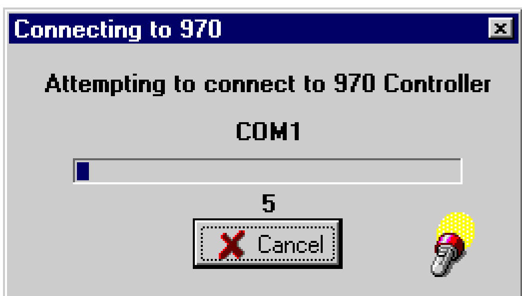
See also Select Analysis, Run Analysis, and the help files for the individual modules.

970 HV PSU Controller

Attached Controllers: The DDX-7000 is designed to integrate with both Conventional and Series Resonant HV power supplies equipped with the Hipotronics type 970 system controller. This allows the user to control the application of voltage to the sample using the DDX-7000 detector. The 970 can also be controlled from the Analysis Modules, allowing the system to be programmed to generate test profiles automatically. Manual Control of the 970 system is activated by clicking the button on the Speed Bar.

Before the system can operate with a 970 controller, it must be configured. The DDX-7000 communicates with the 970 via a fibre optic link. The 970 is supplied with a fibre optic link adapter that plugs into the COM1 port of the DDX-7000 (for details of connecting the two units, refer to the hardware manuals for the 970 and the DDX-7000). Once the units have been connected, it is necessary to configure the DDX-7000 to communicate with the 970. This is done using the Attached Controllers window. The system should be set to have a 970 attached. The Communications port must be set to 1 (unless the system has been modified and COM! Is unavailable) and the bus address should be set to the operating address of the 970. It is essential that the communications port be connected correctly; though if the bus address is entered incorrectly, it will only delay the start-up of the system. Once the system has been set up, it must be restarted for the new settings to take effect.

If the system has been configured to use a 970, it searches for a connected controller when the system is started up. It starts by checking the programmed address for a 970. If this fails, it searches through all the available addresses. The progress of this search is indicated on a status display:

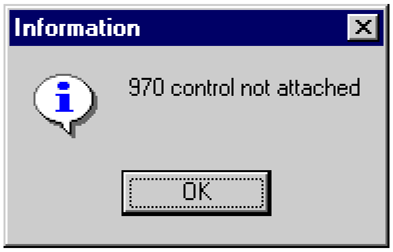


During the search process, if the user clicks the ‘Cancel’ button, the system suspends the search for a 970 and disables all the 970 controls on the DDX-7000. They will be disabled until the next time the system is started, when it will attempt to connect to the 970 again.

NOTE: If it is intended to use a 970 with the DDX-7000, the 970 should be powered and switched to ‘REMOTE’ operation before the DDX-7000 is started up.

When the DDX-7000 has found a connected 970 system, it displays a message box to indicate success. The box reports the communication port being used and the address of the 970. This must be cleared by clicking on ‘OK’ before the system can be used:

In the event that the DDX-7000 cannot find a connected 970, despite being set to do so, it displays a warning box indicating that it was unable to do so:



If this was because the communications system was not connected properly, or because the 970 was not powered up and running in "REMOTE” mode, there can be a considerable delay before the message is displayed.

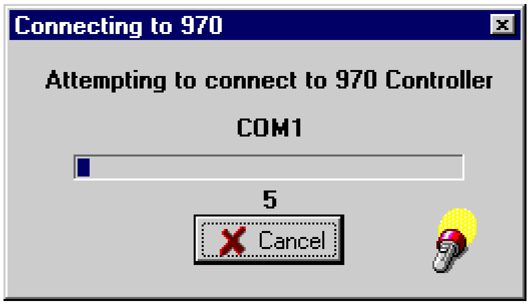
Controlling The System

System Start Up Sequence

When the DDX-7000 system is started up, it first checks the calibration information for the system. If this does not exist because the instrument is new, because the information has been deleted, or if the calibration information is corrupt (due to a system fault or tampering), a message box warns that the calibration information is invalid. The user is asked whether to run the system or not. If 'No' is selected, the DDX-7000 is shut down and the application closed. Selecting 'Yes' runs the system, but the "system uncalibrated" warning flag will always be displayed (i.e. It will not be cleared by either an automatic or a manual calibration sequence).

Once the system has loaded the calibration information, it attempts to load the Default settings (i.e. the settings that were in force when the system was closed down last). If it is unable to load the settings file, an error box indicates the fault that has occurred (see Load Settings for details of the error codes. Note error '2' indicates the file was not found. This will occur the first time the system is run. Error '3' indicates a fault in the system set up – contact Hipotronics for assistance). If the system is unable to load the default setting, it will start with a standard setup that will allow the instrument to be operated.

Once the calibration and the settings have been loaded, the DDX-7000 operating window is displayed. The next stage of the start-up sequence is only run if the system is set to use a 970 PSU controller. It scans the communications bus looking for the 970 HV PSU controller. It starts the search at the defined address for the 970 (set up using the Attached Controllers option). The progress of the search is indicated on the search progress window:



If it does not find the 970 at that address, it searches through all the available addresses. The search can be canceled at any point by clicking the 'Cancel' button, which will abandon the search for a 970 controller and disable all 970 operations on the DDX-7000.

If a 970 is found on the system, the DDX-7000 determines its capabilities. This allows the DDX-7000 to correctly control it. Once this process is complete, the DDX-7000 confirms the presence of the 970 controller:

Alternatively, if no 970 has been found or the search has been canceled, then all HV control functions on the DDX-7000 are disabled. The DDX-7000 indicates this with the following message window:

In both cases, clicking the ‘OK’ button will clear the message window and start the DDX-7000 system running.

System Window Elements

NOTE: The operations described here follow typical Windows95™ procedures.

The Hipotronics Digital Discharge Detector runs in a window under the Windows95™ operating system. It normally occupies all the available screen area, though it is possible to change this using the buttons in the top right corner of the screen. The functions of these buttons are:

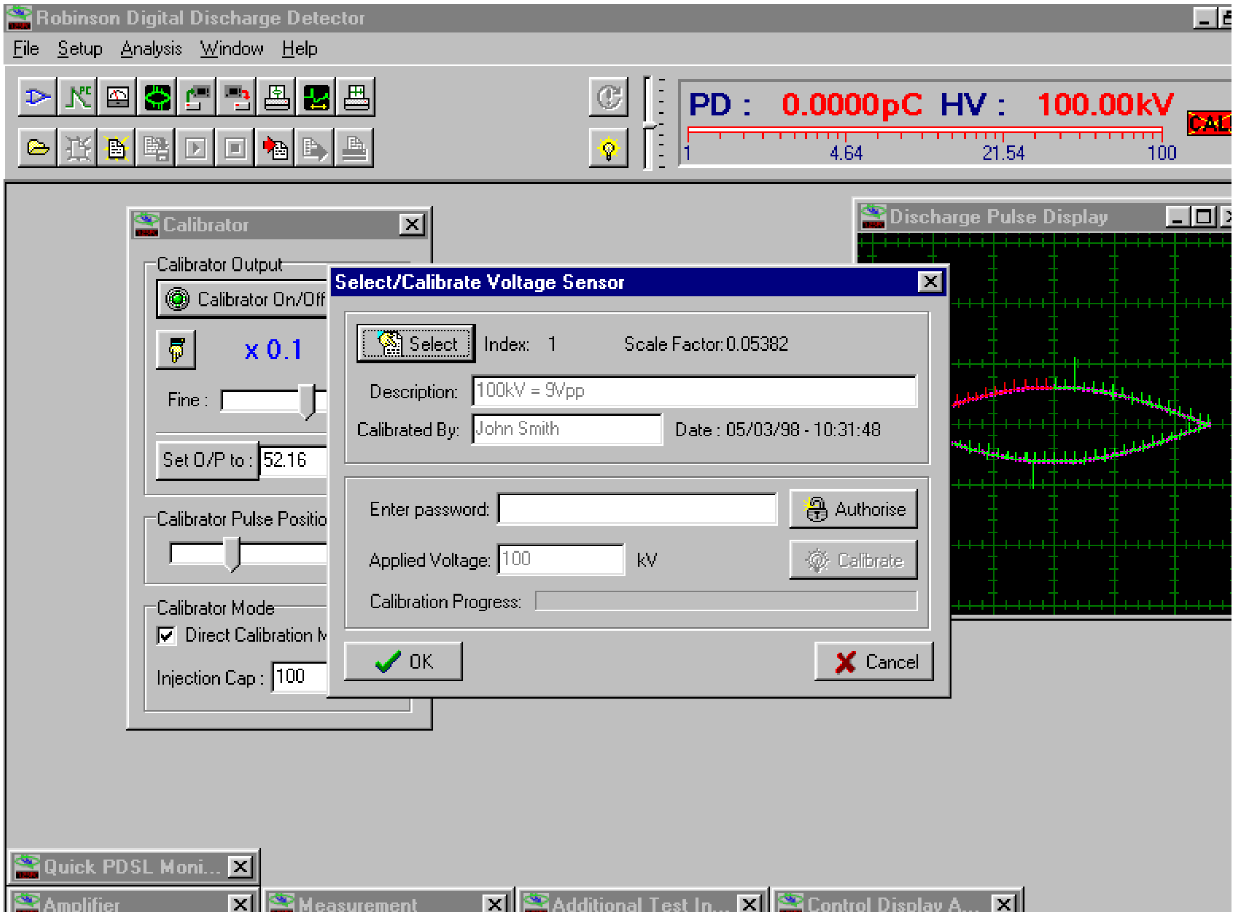
 Closes the Digital Discharge Detector down and returns to Windows95™.

 Reduces the Digital Discharge Detector Screen to an icon on the task bar. It can be restored to its previous size by double clicking on its title.

 If the Digital Discharge Detector has been reduced to less than the full screen size, this button restores it to full screen and the button changes to the one below.

 When the Digital Discharge Detector window occupies all the available screen area, pressing this button reduces it to a smaller size. The size can be set by dragging the sides of the window to the desired dimensions. Once the size of the window has been reduced, the button changes to the one above.

The main detector window appears as follows:



All operations are carried out in subsidiary windows that exist within the bounds of the main window of the system. These normally occupy one of two states: visible or minimized. Minimized windows are stacked in a row at the bottom of the screen, with only the first part of their title bars showing. They can be made visible for use by double clicking on the title A visible window can be minimized by clicking on the button in the top right corner.

Some of the available windows have three buttons in the top right corner. These windows can be resized as needed. The operation of the buttons is the same as those for the main window, except the “close” button merely minimizes the window (rather than closing it).

The system only allows one window to be active (i.e. available to receive commands from the user. This window is indicated by having its title bar highlighted. The active window can be changed by clicking on another visible window.

The windows can be positioned anywhere as required by dragging their title bars using the mouse. When the application is closed down, the size and position of the windows is saved. These are restored the next time the instrument is started. If the windows happen to overlap the available area, slider bars are placed on the screen to allow scrolling all parts of the window into view.

The menu bar lies just below the title bar. This allows access to the various sub-functions of the system. To select a menu option, click on one of the words in the menu bar to highlight it. A list of the available options drops down. Move the mouse down to highlight the required option, and click it to select it.

Some options are available directly from the keyboard. The keystrokes for these functions are listed on the right side of the menu box.

Some options, when selected, bring up a window that requires information to be entered before normal operation of the system can continue (Dialog boxes). These are indicated by an ellipsis (…) next to the title.

Below the menu bar is the speed bar. This carries buttons that provide fast access to the most commonly used functions of the system. It also carries the meter and status readouts for the system.

The bottom of the window is occupied by the status bar. This is divided into three sections. The leftmost section is used to display “hints”. If the Show Hints option is selected, the system displays a brief description of the control that the mouse is currently pointing at in the first position. The second window is used to show the status of an attached 970 HV PSU Controller. If the system has no 970 connected, this will remain blank. The third section is not currently used.

Menu Options

The menu bar provides access to all the functions that are used to control the system. They are divided up into five groups according to their function. To select a menu option, first select the group that is required by clicking it with the mouse or by pressing the ‘ALT’ key plus the underlined letter in the desired group. This highlight the group and drops down a menu with all the sub-options. Clicking on one of the sub-options with the mouse will select it. This can also be achieved by pressing the key corresponding to the underlined letter in the option name. The Setup Menu options have ‘Hot Keys’ associated with them. These functions can be accessed simply by typing the ‘Hot Key’ combination. This is usually the ‘CTRL’ key in combination with one of the letter keys. The ‘Hot Key’ combination for a specific menu option is shown on the right side of the menu box.

Some of the menu options display windows that require the user to enter information or change settings before the operation of the system can continue (Dialog Boxes). These options are indicated by an ellipsis (…) next to the menu option name.

File Menu

The file menu holds all the menu options that are used for saving and loading machine configurations and for printing information captured by the system:

Caption	Keyboard	Description
Load Settings	ALT-F, L	Load instrument setup from disk
Save Settings	ALT-F, S	Save current instrument setup to disk
Print Setup	ALT-F, R	Select the printer to be used and set its properties
Page Setup	ALT-F, G	Setup the format for the printout page
Select Font	ALT-F, F	Select the text font to be used for printing
Test Information	ALT-F, T	Enter report information for the sample under test
Print Pulse	ALT-F, D	Print out the current pulse display
Print Quick PDSL	ALT-F, Q	Print out the current PDSL display
Abort Print	ALT-F, A	Abandon the print that is in progress
Exit	ALT-F, X	Exit the application and close down the instrument

Setup Menu

The setup menu provides the control functions that allow the user to configure the operation of the instrument and its calibration:

Caption	Keyboard	Description	Hot Key
Auto Setup	ALT-S, S	Run the automated calibration procedure	CTRL+S
Amplifier	ALT-S, A	Activate the amplifier setup window	CTRL+A
Calibrator	ALT-S, C	Activate the calibrator setup window	CTRL+C
Measurement	ALT-S, M	Activate the measurement setup window	CTRL+M
Display	ALT-S, D	Activate the display appearance and gating window	CTRL+D
Select Voltage Sensor	ALT-S, V	Select the voltage sensor and calibrate voltmeter	CTRL+V
Setup Data Acquisition**Error!**	ALT-S, Q	Set up the data capture characteristics	CTRL+Q
Attached Controllers	ALT-S, T	Configure any attached 970 Controllers	None

Analysis Menu

The analysis menu provides the options to select, configure and run the analysis modules that collect and process the raw data from the detector:

Caption	Keyboard	Description
New	ALT-A, N	Set up a new analysis configuration
Select Analysis	ALT-A, S	Select the type of analysis to be used
Load Configuration	ALT-A, L	Load a previously saved analysis configuration
Save Configuration	ALT-A, C	Save the current analysis configuration to disk
Load Results	ALT-A, O	Load the results of a previously run analysis sequence
Save Results	ALT-A, R	Save the results of the last run analysis sequence
Run Analysis	ALT-A, A	Start the current analysis sequence running
Stop Analysis	ALT-A, T	Halt the currently running analysis sequence
Print Results	ALT-A, P	Print the results of the last analysis

Window Menu

The window menu provides the user with the means of selecting the required active window and how the windows are arranged on the screen:

Caption	Keyboard	Description
Tile	ALT-W, T	Arrange all active windows alongside each other
Cascade	ALT-W, C	Arrange all active windows alongside each other
Arrange All	ALT-W, A	Arrange all minimized windows neatly

Below the 'Arrange All' menu option, the system lists the title of each of the currently open windows. Clicking on the appropriate entry will activate the corresponding window. If there are too many windows open for the menu to conveniently display, it will have a 'More Windows…' option which can be used to extend the display.

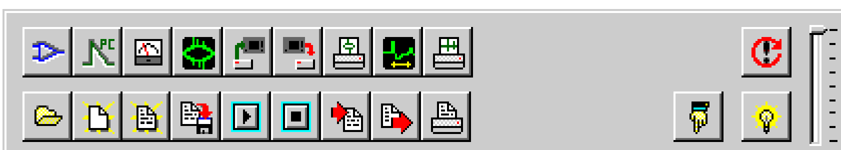
Help Menu

The help menu provides the options for accessing the on-line help system:

Caption	Keyboard	Description
Show Hints	ALT-H, O	Turn on or off the display of control function hints
Contents	ALT-H, C	Show the help file contents page
Search For Help On	ALT-H, S	Show the help file contents page
How to use Help	ALT-H, H	Display the instructions for using Windows help
About	ALT-H, A	Display software version and support information

Speed Bar

The speed bar provides fast access buttons to the most commonly used functions on the system. It also carries the metering and status indication panel. It sits just below the menu bar on the display.
The control section carries the speed buttons to control the operation of the system:

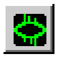


Clicking any of the buttons with the mouse activates the corresponding control function. The speed buttons do not have any keyboard control associated with them. To use the keyboard to access the functions, use the key sequences or hot keys defined on the menu bar. Some of the buttons may be disabled (indicated by a gray image on the button). When they are in this state, clicking on them will have no effect. This prevents the activation of invalid functions. The buttons on the speed bar are:

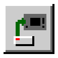
Activates the amplifier set-up window. This allows the characteristics of the input amplifier to be adjusted as required. When a system supports both conventional and PDSL amplifiers, the form of the window will change according to the selected mode of operation.

Activates the calibrator set-up window. This gives the user control of the internal calibration pulse generation system, including the selection of calibration mode.

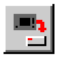
Activates the measurement set-up window. This allows the user to set the operating characteristics of the metering system to suit the measurements being made.



Activates the discharge pulse display window and brings it to the front. This allows the current discharge activity to be monitored.



Loads a new instrument configuration from disk. This can include previously stored calibration information when the system is being used for long term testing.



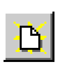
Saves the current instrument configuration to disk. The user has the option to save the current configuration, so the system can be moved between active testing systems.

Prints out a snapshot of the pulse display. When selected, the system pops up a dialog box to select the printer to be used for output. If printing has not been performed previously, the user is also prompted to select the font to be used for printing.

Activates the Quick PDSL window. This allows the inspection of pulse shape and the manual measurement of fault location.

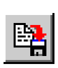
Prints out the current results on the Quick PDSL window. When selected, the system pops up a dialog box to select the printer to be used for output. If printing has not been performed previously, the user is also prompted to select the font to be used for printing.

Select a new analysis module. This allows the user to select which analysis module is to be used. When a module is selected, it is loaded into the system with a blank configuration which must be set up before use.

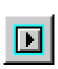


Clear the analysis configuration. This clears the current configuration of the loaded analysis module.

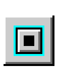
Loads an analysis configuration from disk. Allows the user to load a previously saved analysis configuration for re-use.



Saves an analysis configuration to disk. Allows the user to save the current analysis configuration for later use.



Runs the current analysis. Starts the analysis sequence running and logs data from it.



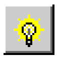
Halts the current analysis. Terminates the running analysis sequence immediately.

Saves analysis results to disk. Allows the user to save the results of the last analysis run to disk, for later recall and processing.

Load analysis results from disk. Allows a previously saved set of results to be recalled into the system for printing or processing.

Prints the last set of analysis results. When selected, the system pops up a dialog box to select the printer to be used for output. If printing has not been performed previously, the user is also prompted to select the font to be used for printing.

Reset the last held peak. When the measurement system is configured to hold the highest peak recorded, pressing this button clears the reading to allow it to be re-acquired.

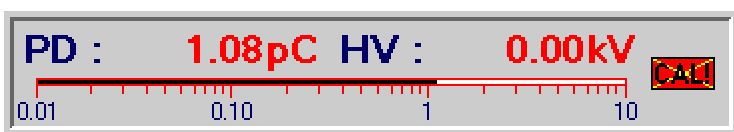


Run the Automatic set-up sequence. When pressed runs the automated system calibration sequence setting up the instrument metering.

Manual HV System control . This button is only visible if the system has a 970 HV PSU controller attached to it. Pressing the button places the 970 into manual operation mode, and displays a tool box that allows the user to control the HV from the detector.

The slider on the speed bar next to the metering display controls the intensity of the graticule on the pulse display window. Moving the slider upwards increases the graticule intensity, while downwards reduces it. If the slider is all the way to the bottom, the graticule is not displayed on the screen. The graticule is printed if a screen snapshot is taken; unless the intensity has been set to zero, which disables it.

The meter readouts for the system are displayed on the metering and status indication panel as shown below:



The panel displays the recorded PD level and the applied HV on digital readouts. The scaling of the discharge meter is linked to the amplifier setting. Once the system is calibrated, it reads out correctly; regardless of the setting of the amplifier. If the system is being over-ranged, the discharge meter is not reliable; and prefixes the reading with '>' to so indicate.

Below the digital meter readouts is a bar-graph display of the discharge reading. This is logarithmically scaled. The scaling is adjusted to read out the true discharge level, which means that full scale on the system will not correspond to full scale on the meter.

On the right side of the metering panel are the status indication lamps:

When illuminated, this indicates that the amplifier system is being overloaded and the discharge reading is saturated. This means that the system is unable to display the true discharge reading. Reducing the amplifier gain will clear this readout.

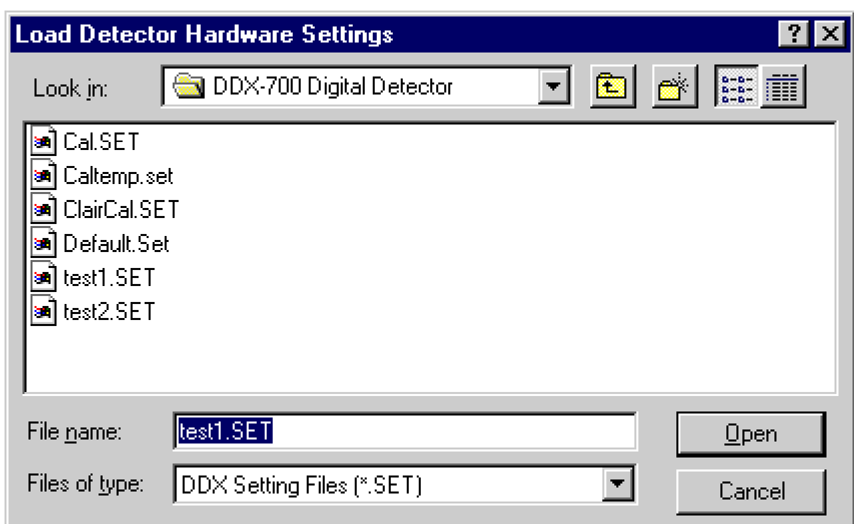
Indicates that the discharge reading is not calibrated. When it is illuminated solidly, the system calibration is not valid and the PD reading does not represent the true value. While the automatic calibration sequence is in progress, the indicator flashes on and off to indicated that the system is calibrating.

Indicates the system is auto-ranging the amplifier to get the best reading for the current discharge activity. The indication is cleared once the process is complete. If the average discharge reading option is selected, there will be a delay before the reading settles to the true value.

See also How the System Measures for details of the measurement procedure.

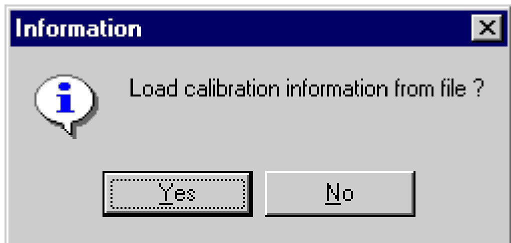
Load Settings

The detector allows the user to load an instrument configuration from disk for use in a test, making setup for a measurement much quicker than manually re-entering the settings. The system set-up files held on disk contain all the settings used by the hardware and the measurement system with the exception of the data acquisition parameters which are held in the system registry. When the Load Settings option is selected, the system displays the Load Settings window:



This lists the available settings files in the current directory. The controls at the top of the window allow the user to select the required directory and to change the format of the display (See Microsoft Windows documentation for more information). The file required is selected by entering its name in the File name edit box or by clicking on it. The settings are loaded by clicking the Open button.

It is possible to save the system calibration information with the settings information to allow calibration for a sample to be carried over several measurement runs. If the selected file contains calibration information, the system asks whether it is to be loaded:



Selecting 'Yes' re-calibrates the system using the information from the file, while 'No' retains the existing calibration.

Note: If calibration data is loaded from the file, it is essential that the test circuit configuration be identical to that in use when the information was saved. If not, the calibration will not be valid; and any measurements taken will be wrong.

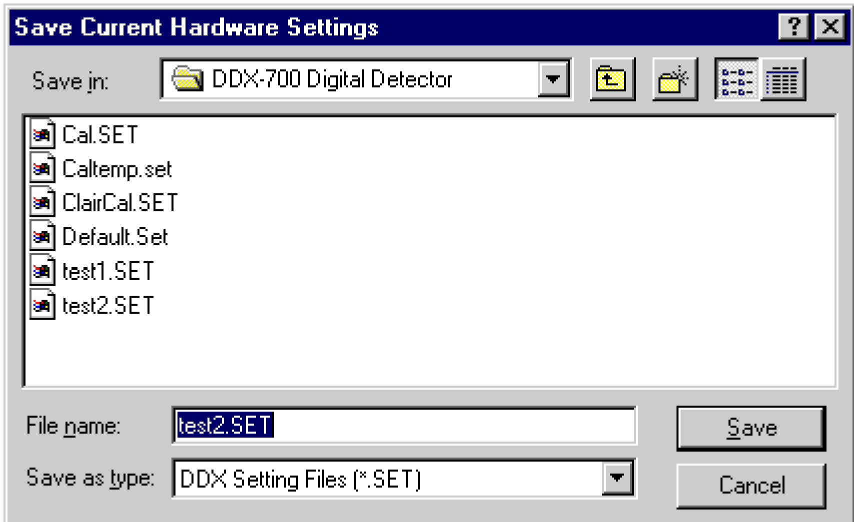
Should there be a problem loading the file, the system will report an error. If the file is not a valid settings file, or is from a different version of the software, the system will report that the file is of the wrong version and will not attempt to load it. In the event of a system error when trying to load the file, the system will report an error number as follows:

2 – **File Not Found**.	The system was unable to locate the file in the directory.
3 – **Path Not Found**.	The system was unable to locate the requested directory.
4 – **Too Many Open Files**.	The system could not open the requested file.
5 – **Access Denied**.	The system was unable to read the requested file.

If an error occurs during loading, the setup of the instrument will be indeterminate.

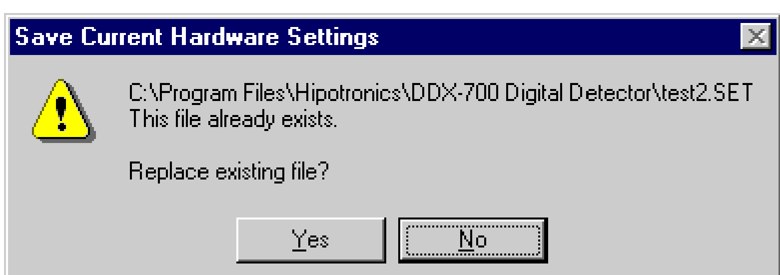
Save Settings

It is possible to save the current setup of the instrument to disk, so that it can be recalled at a later date. The information saved to the file holds the configuration of the hardware and the measurement system; but does not include the current setting of the data acquisition system, which is held in the system registry. When the Save Settings option is selected, the system displays the Save Settings window:

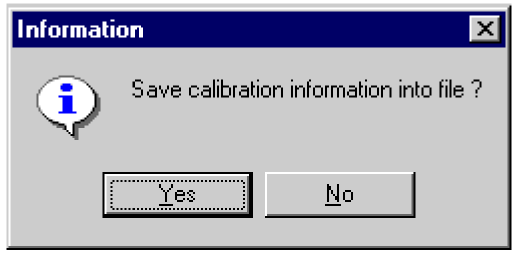


This lists the available settings files in the current directory. The controls at the top of the window allow the user to select the required directory and to change the format of the display (See Microsoft Windows documentation for more information). The file to be saved into is selected by entering its name in the File name edit box, or by clicking on the required file. The settings are saved by clicking the Save button.

If the user has specified a file that already exists, the system prompts for whether the file is to be overwritten. It displays a message box indicating the name of the file, asking if it is to be replaced with the new information. Clicking 'Yes' overwrites the file, while 'No' cancels the operation:



Before the system saves the data, it checks to see if the user wishes to save the current calibration information into the file. It displays a message box with Yes and No buttons:

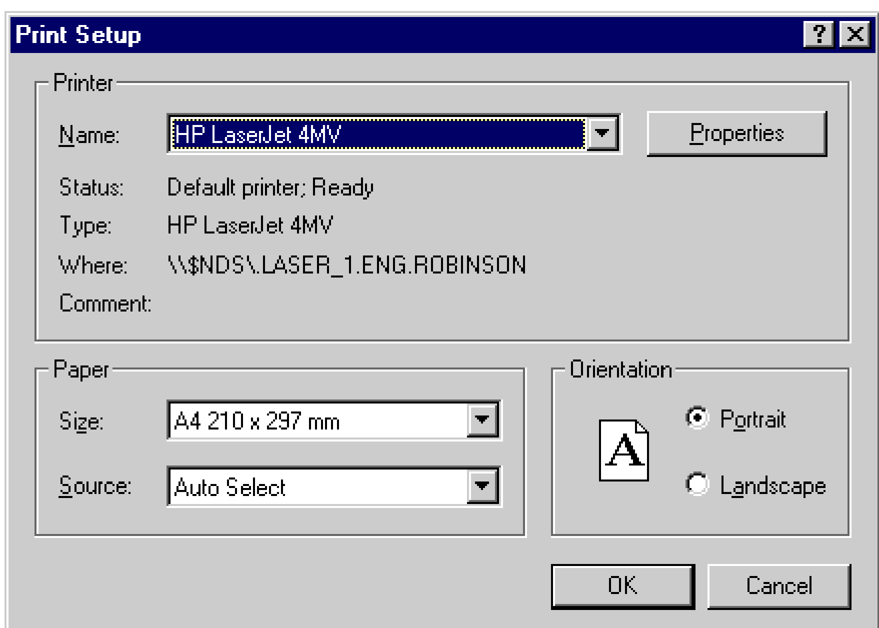


If an error occurs during the save process, the system reports the fact that the save has failed; with an error number indicating the cause of the error:

2 – **File Not Found**.	The system was unable to locate the file in the directory.
3 – **Path Not Found**.	The system was unable to locate the requested directory.
4 – **Too Many Open Files**.	The system could not open the requested file.
5 – **Access Denied**.	The system was unable to read the requested file.

Print Setup

The Print Setup window allows the user to select the printer that is used to print out data. If there are no printers set up on the system, it will display an error message; and the print setup box will not be displayed.

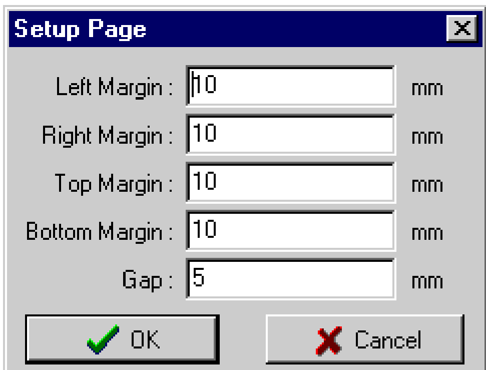


The printer is selected using the drop down box to display a list of available printers for the system. To set up the specific aspects of the printer, click the properties button. The options that are available depend on the printer type.

The paper size can be selected, and should match the size that is in the printer. The orientation of the paper can also be set: portrait (long edge down the side) or landscape (long edge along the top). Clicking ‘OK’ updates the settings, while ‘Cancel’ returns them to their previous settings.

Page Setup

The Page Setup window allows the user to specify the way information is printed out. All the settings are stored in the system registry so they are retained when the system is shut down:



“Left Margin” sets the distance from the left hand edge of the page

“Right Margin” sets the distance from the right hand edge of the page

“Top Margin” specifies how far down the page the starts printing information

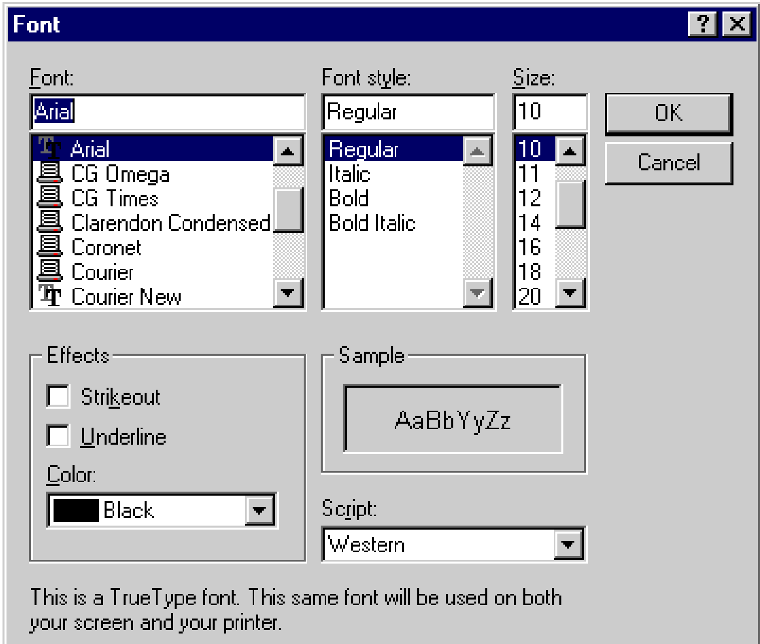
“Bottom Margin” specifies how much space is left at the bottom of the page

“Gap” specifies the space the system leaves between the header block, which holds the details of the sample; and system settings and the data block where the system draws the actual results.

Once all the parameters have been set, clicking the OK button stores them ready for use.

Select Font

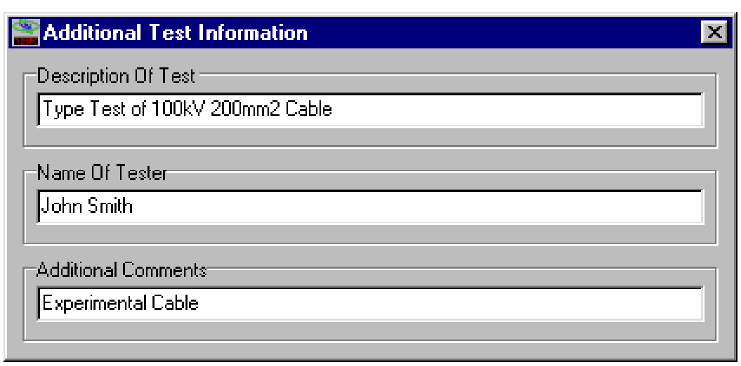
The Font selection window is used to choose the typeface, size and style of the text on printouts from the system:



When the box is displayed, it shows the currently selected font for the system. This can be changed using the controls in the box. An example of the selected font is shown in the Sample box. It is recommended that the font size be restricted to a maximum of around 10 points to prevent the printed text from overlapping. If larger paper or landscape printing is used, then a larger font size can be used.

Test Information

The user can specify additional information about the sample using the "Additional Test Information window. The information entered in the three boxes in the window is printed out on the header section of the test report. It is also saved with the test results when an Analysis is run.



The three fields are:

1 A description of the test being performed. This is used to give a brief outline of the test procedure.

2 The name of the person performing the test.

3 A space for any comments to be added to the report (for example, a note of a problem during the test).

The window is minimized by clicking on the 'X' in the top right corner. It can be activated by double clicking on its title bar, or by selecting the 'Test Information option from the file menu.

Print Pulse Display

Print Pulse Display outputs a copy of the information on the pulse display to the currently selected printer. Before printing the display, any additional information should be entered using the Test Information window. The page layout should also be set up using the Page Setup window.

To actually print the display, select the Print Display option from either the Menu or the Speed Bar. The system displays the Print Setup window to allow the printer to be selected. If this has already been done, or the settings are acceptable, click 'OK' to continue with the printing process. Clicking 'Cancel' will abandon printing. If this is the first time the system has printed since it was started up, it will display the Select Font window. Select a suitable font and click 'OK' to continue. The system will then print out the data.

When the data is printed out, it will use the same display settings as the pulse display. If the display graticule is turned on (slider off zero), a graticule will be printed out. This will be scaled so that there are the same number of squares as on the display (i.e. each square corresponds to 1cm on the display). In the bottom left corner of the printout, it prints the current discharge magnitude and the currently applied voltage. When a color printer is used, the color scheme matches that on the display. If a monochrome printer is used, the sections of the display which are gated-out are drawn with a thinner line width than those gated-in.

Print Quick PDSL

Print Quick PDSL outputs the information on the Quick PDSL display to the printer. Before printing the display, any additional information should be entered using the Test Information window to set up details of the tester and sample and any additional comments. The page layout should also be set up using the Page Setup window.

This option can be selected from either the Menu or the Speed Bar. The system displays the Print Setup window to allow the printer to be selected. If this has already been done, or the settings are acceptable, click 'OK' to continue with the printing process. Clicking 'Cancel' will abandon printing. If this is the first time the system has printed since it was started up, it will display the Select Font window. Select a suitable font and click 'OK' to continue. The system will then print out the data.

The system prints out the section of the Quick PDSL information that is currently on the display, re-scaled to fit the page. It also draws the cursor positions. At the bottom of the display, it writes the equivalent magnitudes at each of the cursor positions, as well as their positions and the relative spacing between them in the currently selected mode (time, frequency or distance).

Abort Print

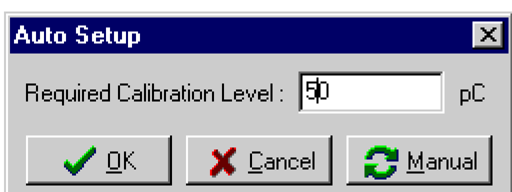
If the system is in the process of printing information, selecting the Abort Print option from the Menu Bar will cause the system to halt the printing process. Transfer of data to the printing system will be stopped. If the printing system has data in transit to the printer, it will still be transmitted.

Exit

Selecting the Exit option from the menu bar or clicking on the close button in the top right corner of the display closes down the DDX-7000 application software. Before the system shuts down, it asks 'Is it OK to shut down?'. If the user clicks the 'No' button, operation of the system will continue. Clicking 'Yes' will start the system closedown procedure. When it closes down, it attempts to save the current configuration of the system into a file so it can be re-loaded when the system is next started. Once this is done, it closes all the application windows and returns to the operating system.

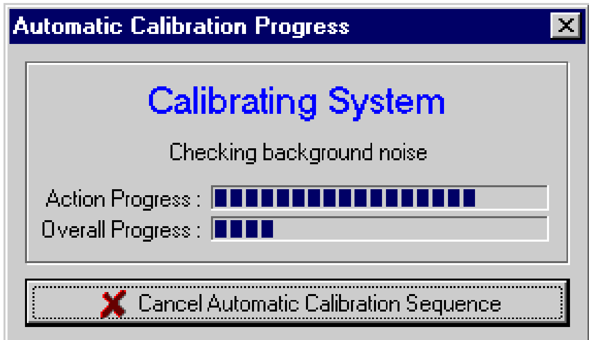
Auto Setup

The automatic calibration sequence can be selected from either the Speed Bar or the Menu. When selected, the system displays the automatic setup window:



The edit box is used to enter the required calibration level in pC. If the calibrator is operating in direct injection mode, this value specifies the output that the calibrator should produce. In indirect calibration mode, the value is the output that the external calibrator will be set to. Once the required calibration level has been set up, clicking ‘OK’ will run the automatic setup process. ‘Cancel’ will cancel the automatic setup sequence and close the window. Clicking ‘Manual’ selects the Manual Calibration process.

While the Automatic calibration process is running, the system displays the Automatic Calibration Progress window. This window can only be closed and deactivated by clicking the “Cancel Automatic Calibration Sequence” button.



The window shows that the system is calibrating and gives the overall progress of the calibration process, along with the progress of the current stage. It also indicates the current process being performed:

Setting configuration for calibrate

Checking background noise

Setting up meter scaling from calibrator

Evaluating system noise contribution

Evaluating circuit noise contribution

Setting internal calibrator scaling

Updating system configuration

Each stage of the process takes a little time, as the system auto ranges itself and settles the output reading using a measurement averaging process. The sequence of operations depends on whether the calibrator is set to operate in direct or indirect mode. See Direct Mode Calibration Sequence or Indirect Mode Calibration Sequence for details of the sequence.

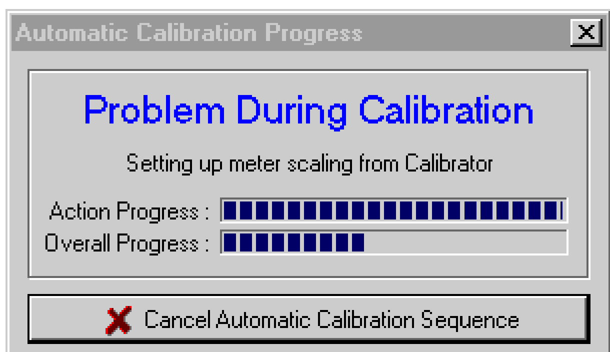
Direct Mode Calibration Sequence

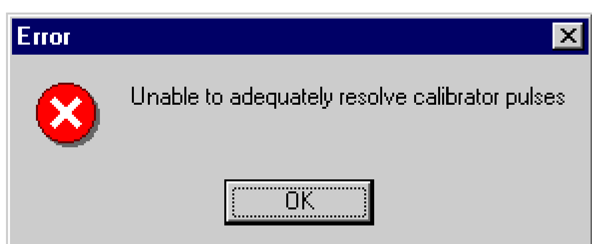
The stage of the calibration process during Automatic Setup is indicated on the Automatic Calibration Progress window. For Direct Calibration, the sequence of operations for the automatic calibration are:

Setting configuration for calibrate: The system saves the current instrument setup to disk, then reconfigures itself for the calibration process. If there is an error trying to write the settings file, the system will first display a message box indicating the error number that occurred (for a list of error numbers see Save Settings). It then displays a message box with the message ‘Unable To Save System Settings’. Once the user has clicked the OK button, the automatic calibration system is terminated.

Checking background noise: The system then ensures that the internal calibrator is switched off, and ranges the amplifier down to measure the background noise on the system. It allows the metering to settle, then registers the background noise level.

Setting up meter scaling from calibrator: The calibrator is switched on and set to the level in the Automatic Setup window. The amplifier is ranged to get the best reading. Once the amplifier has settled, the reading is compared with the measured background noise level. If the signal is not at least 50% greater than the noise, the calibration process is terminated with an error:





This indicates that the system could not distinguish the calibrator pulses clearly enough over the background noise to get a satisfactory calibration. Possible reasons are:

1). The calibrator pulses are not significantly larger than the background noise. This can be rectified by selecting a larger calibration value. Because the system tracks the amplifier scaling and compensates for it, this will not significantly degrade the meter accuracy

2). The calibrator pulses are gated out by the horizontal gating system. Rotate the pulses until they appear in green on the display.

3). The calibrator pulses are gated out by the vertical gating system. This system should not be used during calibration, or when auto-range is being used; as it interferes with their operation.

4). The calibrator is incorrectly connected or is faulty. Check the connections, and check that the pulses are visible on the display before trying the calibration process again.

If the calibrator pulses are satisfactorily recognized, the metering is scaled to the set calibrator output level.

Evaluating system noise contribution: Once the metering is set, the system attempts to determine how much of the background noise is actually being generated in the system. The amplifier is scaled to maximum fine gain on the highest attenuator range to minimize the effects of circuit noise. The noise level is measured and stored to give the system noise contribution.

Evaluating circuit noise contribution: Once the system noise has been measured, the amplifier is set to minimum attenuation and then auto-ranged to measure the contribution of noise from the test circuit. To get the circuit noise contribution, the system removes the system noise contribution after correcting for the fine gain setting. The circuit noise contribution is stored after being corrected for the amplifier fine gain and attenuator setting.

Updating system configuration: Once the calibration process is complete, the system resets itself to the state it was in before the start of the calibration process. If there is an error restoring the configuration, the system will terminate the calibration process with an error 'Unable to restore system settings'(For a list of error codes, see Load Settings). The calibration will be invalid in this case, and the configuration of the system will be indeterminate.

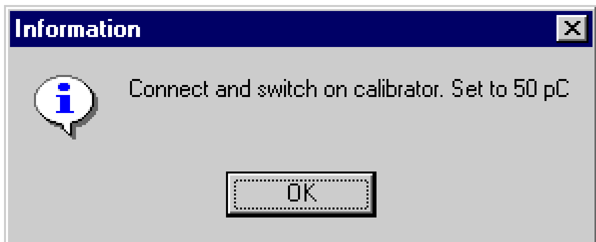
Indirect Mode Calibration Sequence

The stage of the indirect calibration mode process during Automatic Setup is indicated on the Automatic Calibration Progress window. For Indirect Calibration, the sequence of operations for the automatic calibration are:

Setting configuration for calibrate: The system saves the current instrument setup to disk, then reconfigures itself for the calibration process. If there is an error trying to write the settings file, the system will first display a message box indicating the error number that occurred (for a list of error numbers see Save Settings). It then displays a message box with the message 'Unable To Save System Settings'. Once the user has clicked the OK button, the automatic calibration system is terminated.

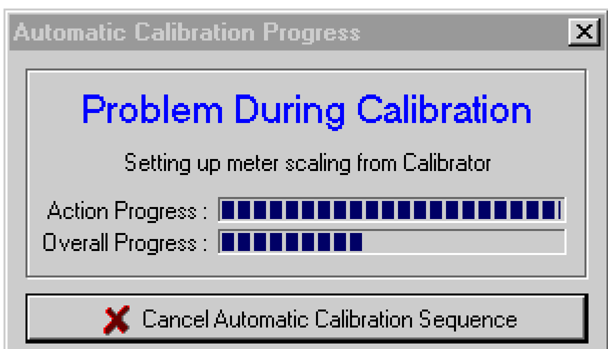
Checking background noise: The system then ensures that the internal calibrator is switched off, and ranges the amplifier down to measure the background noise on the system. It allows the metering to settle, then registers the background noise level.

Setting up meter scaling from calibrator: Once the background noise has been measured, the system is ready to start the actual calibration process. The system displays a message box prompting the user to connect a calibrator set to the required value to the test circuit and switch it on:



The calibration process is continued when the user clicks 'OK'. It is important that the external calibrator is not switched on until requested to do so by the system as indicated above.

Once the calibrator is switched on and the user has clicked 'OK' the amplifier is ranged to get the best reading. Once it has settled, the reading is compared with the measured background noise level. If it is not at least 50% greater then the calibration process is terminated with an error:



This indicates that the system could not distinguish the calibrator pulses clearly enough over the background noise to get a satisfactory calibration. Possible reasons are:

1). The external calibrator was switched on while the system was measuring the background noise. Repeat the calibration process, following the system's instructions exactly.

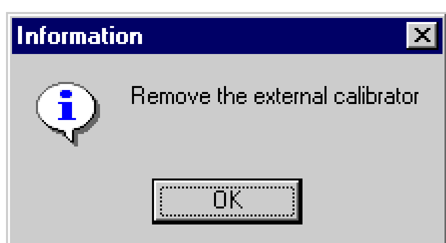
2). The calibrator pulses are not significantly larger than the background noise. This can be rectified by selecting a larger calibration value. Because the system tracks the amplifier scaling and compensates for it, this will not significantly degrade the meter accuracy

3). The calibrator pulses are gated out by the horizontal gating system. Rotate the pulses until they appear in green on the display.

4). The calibrator pulses are gated out by the vertical gating system. This system should not be used during calibration, or when auto-range is being used, as it interferes with their operation.

5). The calibrator is incorrectly connected or is faulty. Check the connections and check that the pulses are visible on the display before trying the calibration process again. If it is battery operated, check the battery condition.

If the meter scaling process is successfully completed, the system halts and prompts the user to remove the external calibrator:



When the calibrator has been removed and the user has clicked the OK button, the calibration process continues. If the box is 'OKed' without removing the external calibrator, the noise floor will be incorrectly set; and it will be impossible to make meaningful measurements below the calibration level.

Evaluating system noise contribution: Once the metering is set, the system attempts to determine how much of the background noise is actually being generated in the system. The amplifier is scaled to maximum fine gain on the highest attenuator range, to minimize the effects of circuit noise. The noise level is measured and stored as the system noise contribution.

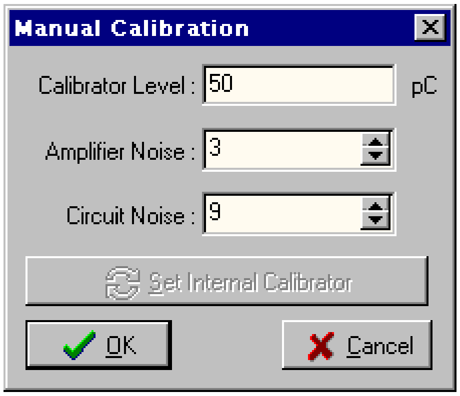
Evaluating circuit noise contribution: After the system noise has been measured, the amplifier is set to minimum attenuation, then auto-ranged to measure the contribution of noise from the test circuit. To get the circuit noise contribution, the system removes the system noise contribution after correcting for the fine gain setting. The circuit noise contribution is stored after being corrected for the amplifier fine gain and attenuator setting.

Setting internal calibrator scaling: When the system has set the noise floor up, the internal calibrator is switched on and set to some arbitrary value. The system measures the magnitude of the pulses being produced, and uses this to set the scaling of the calibrator to read in pC. Then the calibrator is switched off.

Updating system configuration: Once the calibration process is complete, the system resets itself to the state it was in before the start of the calibration process. If there is an error restoring the configuration, the system will terminate the calibration process with an error 'Unable to restore system settings' (For a list of error codes, see Load Settings). The calibration will be invalid in this case, and the configuration of the system will be indeterminate.

Manual Calibration

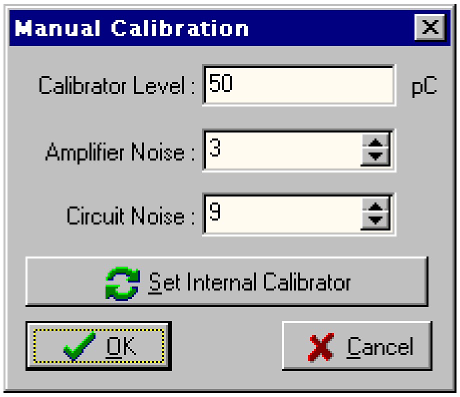
The Manual Calibration window is accessed from the Automatic Setup window by clicking on the 'Manual' button. This allows the user to set the calibration without going through the automatic setup sequence. It should not normally be used, except in those cases where the automatic calibration system is found to be inadequate.



To calibrate the system manually, the user must connect a known calibration source to the system. If the system is in Direct Calibration mode, this can be the internal calibrator. In Indirect Calibration mode, an external source must be provided. The value of the calibration source is entered in the Calibration Level box. The metering is scaled to read this value when the OK button is clicked, and the system marks itself as being calibrated.

No checking is made to ensure the validity of the calibration. It is the responsibility of the user to ensure that the calibration pulses are the largest pulses being seen by the measurement system, and that the value entered is correct. It also is important to ensure that these pulse are not gated in any way. Manual calibration is aborted without updating the calibration when ‘Cancel’ is clicked. If the Calibrator Level is set to 0, when OK is clicked, the calibration is not updated. This allows the system noise levels to be set up.

If the calibrator is set to operate in indirect calibration mode; it is necessary to set the scaling on the internal calibrator once the system has been calibrated. To do this, turn on the internal calibrator and adjust it to give clearly visible calibration pulses. Select ‘Automatic Setup’ and then ‘Manual’ to display the manual calibration. The manual calibration window will now have the Set Internal Calibrator button enabled:



Clicking the ‘Set Internal Calibrator’ button will set the scaling of the internal calibrator.

The Amplifier and Circuit noise buttons allow the system noise floor to be set. The process requires several steps to be performed:

1). In the Display Appearance window, turn on Show Gated and Show Noise.

2). In the Measurement window, turn amplifier Autorange off.

3). Set the amplifier to maximum fine gain and maximum attenuation.

4). Ensure all calibration sources are off, and all noise to be gated is on.

5). Enter the Manual Calibration window. Set the Calibrator Level to 0, Amplifier Noise to 0, and Circuit Noise to 0.

6). Adjust the amplifier noise by typing in values or using the up and down buttons to adjust the noise floor on the Display, until it just brackets the noise on the baseline.

7). Exit the Manual Calibration window by clicking on OK.

8). Turn on amplifier Autorange in the Measurement window. Allow the amplifer to settle.

9). In the Manual Calibration window, set the Calibrator Level to 0.

10). Adjust the circuit noise by typing in values or using the up and down buttons to adjust the noise floor on the Display, until it just brackets the noise on the baseline

11). Click ‘OK’

12). Set up the meter scaling as described.

Note: it is only necessary to set up the Amplifer and Circuit noise when the test configuration is changed. Once they have been set up it is only necessary to set up the meter scaling.

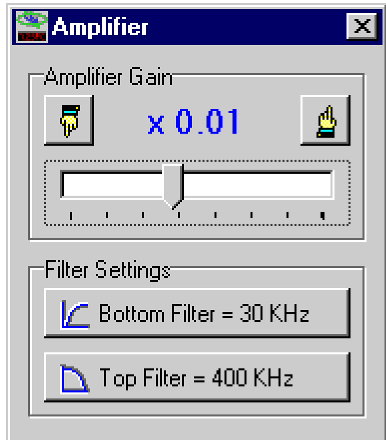
Amplifier

The discharge detector has two amplifier options available: the standard wide-band amplifier which is supplied as standard, and an extra wide band amplifier optimized for PD fault location operation. When both amplifiers are fitted to the system, the selection of which amplifier is used is made on the measurement set-up window. The amplifiers differ in their capabilities, so the software adapts itself to suit the selected option.

Conventional Amplifier: **T**he conventional amplifier provides a wide-band character-istic suited to the measurement of partial discharge activity. It provides seven ranges of operation in 20dB steps. In addition it has a fine gain control which provides an additional 20dB of adjustment to allow the sensitivity of the amplifier to be optimized for the measurement being made.

The setting of the amplifier is linked to the Noise Floor; so that when the amplifier settings are changed, the Noise Floor is changed accordingly (See Handling Unwanted Activity).

In addition, it provides the facility to switch the corner frequencies of the amplifier response to compensate for the presence of RF noise or resonance in the test circuit. The control window for the amplifier is shown below:

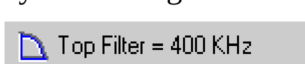


The operating range of the amplifier is controlled using the  and  buttons to switch the gain of the system up or down. The current operating range is indicated between the buttons as follows:

X1	0dB	(Zero Attenuation, Maximum Gain)
X0.1	-20dB	
X0.01	-40dB	
X0.001	-60dB	
X0.0001	-80dB	
X0.00001	-100dB	
X0.000001	-120dB	(Maximum Attenuation, Minimum Gain)

Below the range controls is the slider that controls the fine gain adjustment. When this is on the extreme right of its travel, the amplifier gain is at its maximum. When it is on the extreme left, the gain is reduced by a factor of 10 (20dB). The gain scales linearly between these two extremes. When the system is switched to auto-range mode or when the automatic calibration sequence is being run, the settings of the amplifier are changed automatically. This will be seen on the amplifier control display. While operating in auto-range mode, the system will choose it's own amplifier setting, overriding the one that has been preset by the user.

Below the amplifier gain controls are the filter controls for the amplifier. These allow the corner frequency of the amplifier characteristic to be adjusted to compensate for any noise being picked up by the test circuit. Clicking a button moves the appropriate filter by one setting.



adjusts the maximum frequency the amplifier passes.

adjusts the minimum frequency the amplifier passes.

The available filter settings filters are:

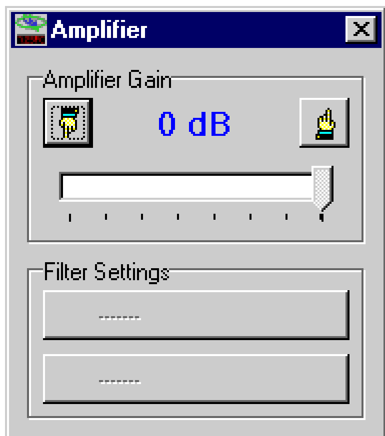
Top filter = 100KHz*, 200KHz, 300KHz, 400KHz, 500KHz*

Bottom Filter = 20KHz*, 30KHz, 50KHz, 60KHz, 80KHz

The caption on each filter control button changes to indicate the filter setting selected.

NOTE: using any of the starred settings will mean that the system will not be compliant with the requirements of section 4.3.4 of IEC-270.

PDSL Amplifier: The PDSL amplifier has an extremely wide-band characteristic which has been optimized for fault location in cables. It provides a more limited range of facilities than the conventional amplifier, having no filter settings or fine gain control. These options are disabled when operating in PDSL mode:

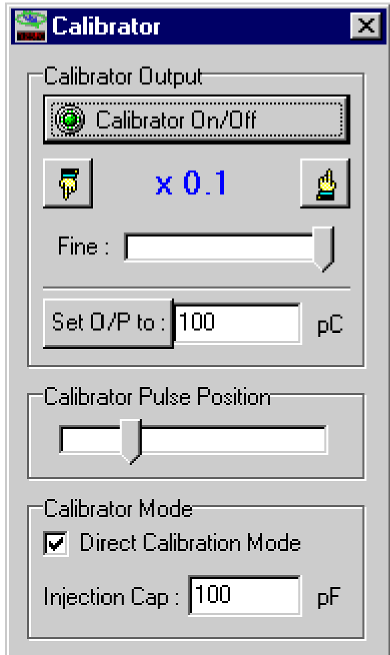


The gain is adjusted using the  and  buttons as before, with the selected range being indicated between the buttons. This time the gain is indicated in dB. The gain is adjustable between 0dB (minimum attenuation, maximum gain) and 55dB (maximum attenuation, minimum gain) in 5dB steps.

Calibrator

A calibration pulse generator is included on the system. This allows a calibrated discharge pulse to be injected into the test circuit to allow the metering to be set up and verified (See Calibrating the system). The calibrator is capable of operating in two modes, Direct Calibration and Indirect Calibration.

All the control functions for the calibrator are accessed from the Calibrator window.



The calibratoris switched on or off using the control button. The LED on the button indicates the current state of the calibrator. If it is illuminated the calibrator is on.

Calibrator is switched on

Calibrator is switched off

The output of the calibrator can be set in two ways, either by directly adjusting the output or by specifying an output discharge level required from the calibrator. The output of the calibrator is controlled using the range select buttons to step through the output ranges.

 reduces the output of the calibrator by switching to the next range down, while  increases the output by moving to the next range up. The currently selected range is indicated between the two buttons. There are a total of 13 ranges from x1 (highest output range) to x0.0001 (lowest output range). The ranges step in a 1-2-5-10 sequence.

As well as setting the output range, it is possible to adjust the output using the fine control. This allows a 256 step fine adjustment of the output between 0 and 100% of the currently selected range. As the calibrator output is changed, the value in the output edit box (just to the right of the set output button) is changed to indicate the current calibrator output. If the system is being operated in indirect calibration mode, and the system is not calibrated, the value in this box will be meaningless. In some cases the value in the box will be zero irrespective of the settings on the other controls. This is because the user is operating in indirect calibration mode, but a calibration sequence has not been run.

It is also possible to set the calibrator output directly in PC using the output edit box. The required value is entered into the edit box and the Set O/P to: button is pressed.

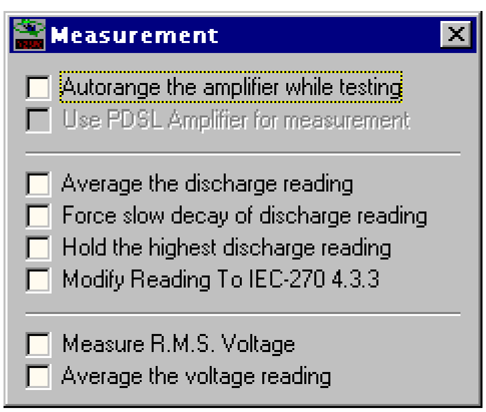
This calculates the required output setting based on the calibrator configuration and sets the range and fine controls up accordingly. If the value entered into the box is not a number or the number is outside the system capabilities the user is given an error box, indicating the error. The box is cleared from the screen by clicking the 'OK' button. Once that is done, the system changes the contents of the box to a valid value and returns the cursor to it. The value in the edit box may change slightly when the Set O/P button is pressed. This is because the control of the output is not continuous, but stepped. It will always indicate the value of the closest step to the value entered in the box.

The calibration pulses generated by the system consist of alternating positive and negative pulses of equal magnitude, spaced 180 degrees apart. These can be positioned anywhere on the display using the 'Calibrator Pulse Position' slider. When the slider is in the leftmost position, the positive going pulse is at 0 degrees and the negative going one is at 180. As the slider is moved over to the right, the pulses are moved clockwise around the mains cycle. When the slider is on the extreme right side, the pulses have been rotated a complete cycle back to the starting point.

It is possible to set the operating mode of the calibrator using the "Direct Calibration Mode" check box. If the box is checked, the system will operate in direct calibration mode. When operating in this mode, it is necessary to enter the value of the injection capacitor in the "Injection Cap:" Edit box so it can scale the output correctly. For maximum accuracy, the value entered must be the measured value of the injection capacitor rather than the manufacturer's stated value.

Measurement

The Measurement window controls the way the system measures voltage and discharge. For information on the way the system measures and the way the settings on this window influence the measurement, see How the System Measures Discharge and How the System Measures Voltage. The Measurement window carries check boxes to set up the various measurement modes supported by the system:



Autorange the amplifier while testing When this box is checked, the system will automatically adjust the amplifier to get the best reading out of it. This adjustment is based on the magnitude of the valid pulses. If pulses are gated out, they do not affect the autorange process. If the vertical gate is active (See Display Appearance), the system will not be able to autorange correctly. It is recommended that autorange not be used in conjunction with the vertical gate.

Use PDSL Amplifier for measurement If a wideband PDSL amplifier is installed in the system, checking this box will cause the system to use it for measurement rather than the conventional amplifier. This amplifer is designed for Site Location application rather than general discharge testing, so discharge measurements made with the PDSL amplifier will not be as accurate or sensitive as with the conventional amplifier. If the box is un-checked, the system will use the conventional amplifier. On systems that do not have the PDSL amplifier installed, this box is disabled and cannot be set.

Average the discharge reading If this box is checked, the discharge reading averages over the last 16 measurements taken. This gives a steadier reading than other conditions, but the readout does not respond well to transients because of the damping introduced.

Force slow decay of the discharge reading If this box is checked, the display simulates that of a traditional analog instrument with a rapid rise time and a more gradual fall time. Slow decay makes it easier to measure the peaks of the discharge activity. This setting takes precedence over **Average the discharge reading.**

Hold the highest discharge reading Checking this box forces the system to operate a true peak detector, where the highest discharge reading is held until cleared by the user. The peak is reset by clicking the Peak Clear button on the speed bar. This function takes precedence over **Force slow decay of the discharge reading** and **Average the discharge reading** . This mode is not intended for use with automated data analysis functions, as it requires manual intervention to clear the peak.

Modify Reading To IEC-270 4.3.3 A check in this box forces the metering to comply with all the requirements of the IEC-270 standard. This forces the system to degrade the discharge measurement at lower repetition rates. The implementation of this roll off imposes a limit on the accuracy of the system, reducing it when compared to the other measurement modes. When selected, this mode takes precedence over the other modes of the discharge measuring system. If this mode is selected, the selection boxes for Average Discharge, Force Slow Decay an Hold highest reading are disabled and cannot be reset. They are re-enabled when this selection box is cleared.

NOTE: When operating in IEC-270 4.3.3 compliant mode, the discharge reading should be measured by taking the lowest reading exhibited by the system; not the highest as with the standard mode. This ensures that the modification of the reading follows the IEC-270 4.3.3 curve.

Measure R.M.S. Voltage When checked, the system performs a true R.M.S. measurement voltage on the incoming HV signal from the sensor. If this box is not checked it performs a Peak scaled RMS (Peak/$\sqrt{2}$) measurement.

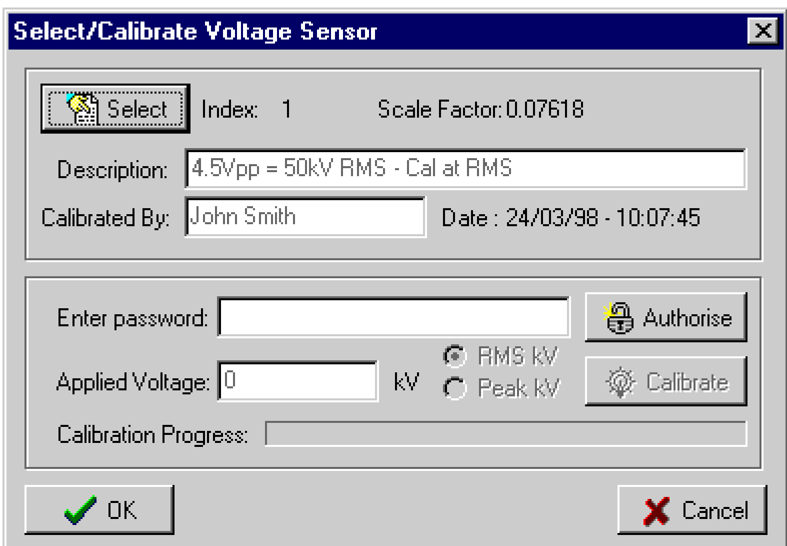
Average the voltage reading If the box is checked, the system averages the voltage reading over the last four measurements. This gives a more stable reading, but will cause a lag in measuring rapidly changing voltages. If the box is unchecked, the system uses the last reading only.

Select Voltage Sensor

The system supports up to 16 different voltage sensors, each or which has its own calibration. This allows the system to be used with several different test circuits, while being able to maintain correct voltage calibration for each. For information on the way the system measures voltage, see How the System Measures Voltage. The voltage sensor selected is stored with the system calibration information, if the user selects to save the calibration information using Save Settings. It can then be recalled using the Load Settings option and opting to retrieve the calibration information.

When using multiple voltage sensors, care must be taken to ensure that the correct one is selected for the test configuration; otherwise the system voltage calibration will be invalid. The default sensor used when the system is started is the one that was active when the system was last shut down. If the instrument has since been moved to another test system, the appropriate divider must be selected before starting to test.

The voltage sensor is selected from the Select Voltage Sensor window, which is accessed from 'Setup' in the menu bar .



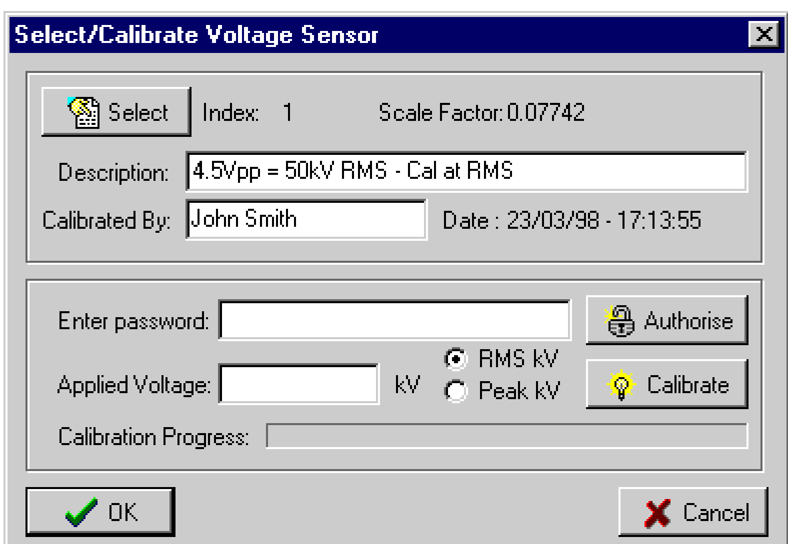
The currently selected voltage sensor is indicated in the ‘Description’ text box. The description should always uniquely identify the voltage sensor to be used. Below the description, the system indicates who performed the calibration of the system with that divider and when the calibration was performed. Next to the select button is indicated the ‘Index’ of the currently selected sensor. This will be a number between 1 and 16 indicating the position of the sensor information in the calibration record data. Next to that is indicated the scale factor for the sensor. It is not possible to change the values of any of these fields.

A voltage sensor is selected by clicking on the select button to step through the available sensors until the required one is indicated in the ‘Description’ test box. Once the required sensor has been found using the select button, clicking ‘OK’ will make that sensor the current one, updating the calibration information to suit. Clicking ‘Cancel’ will exit the window, returning to the original setting.

Voltage Sensor Calibration

This window can also be used for Voltage Sensor Calibration, by those who are authorized to do so and have the password for the system. To perform voltage sensor calibration requires suitably calibrated equipment to measure the HV that is actually applied to the sensor being calibrated.

To perform the calibration, select the Select Voltage Sensor window from ‘Setup’ in the menu bar .When the window appears, type the password into the Enter password edit box, and press the Authorize button. If the password has been entered incorrectly, the system displays a message box refusing access to the calibration system and stays in Voltage Sensor Selection mode. If the password is entered correctly and authorized, the widow enters calibration mode:



In this mode, the text in the 'Description' and 'Calibrated By' boxes become bolder and can be edited, and the 'Applied Voltage' edit box and 'Calibrate' button are enabled. In this mode the 'Select' button cycles through all 16 calibration settings, not just those that have been set. To calibrate the system, the sequence of operations is:

1). The user selects the calibration record to be set up, using the 'Select' button to select the required index

2). A description for the divider is entered into the 'Description' edit box if required. If a sensor entry has not been used previously, it will indicate 'Not Set' until edited by the user.

3). The name of the person performing the calibration is entered into the 'Calibrated By' edit box. If a name has not been used previously, it will indicate 'Not Set' until edited by the user.

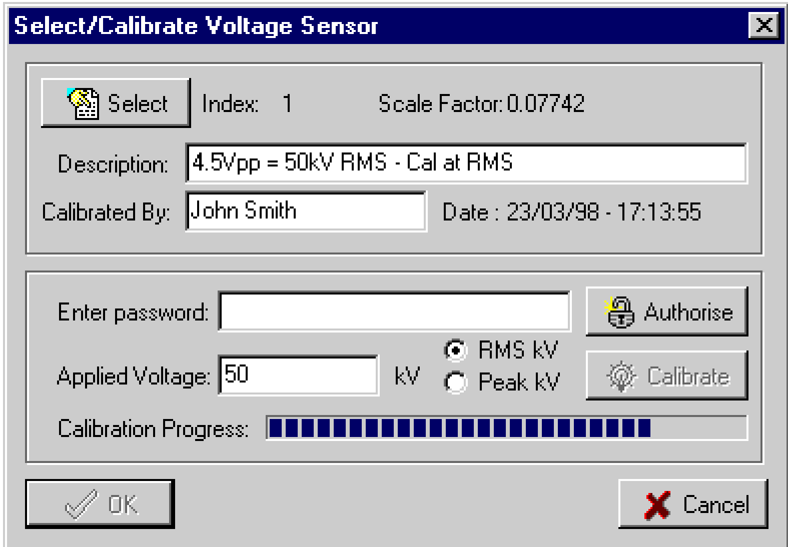
4). HV is applied to the system and ramped up to about 75% of the required full scale voltage.

5). The applied value of voltage is read from the reference meter and entered into the 'Applied Voltage' edit box by the user. It is also necessary to indicate to the system if the voltage being entered is RMS (i.e. a true RMS value) or Peak (i.e the voltage at the highest point on the waveform) using the RMS kV or Peak kV radio buttons. If Peak entry is being used, the value entered must be the peak voltage of the waveform (not Peak scaled to RMS).

6). The user clicks the 'Calibrate' button to start the calibration process.

7). The system verifies that a description has been entered (No longer 'Not Set'), a name for the person calibrating has been entered (No longer 'Not Set') and a voltage has been entered ('Applied Voltage' is not 0) If any are invalid, the system displays an error message and terminates the calibration process. The user must enter the requested data and click 'Calibrate' to restart the process.

8). The system starts the calibration process. It settles the voltmeter and sets up the scaling from the entered value. During this process, the progress is indicated on the bar at the bottom of the screen:



Once the process is complete, the calibration information file is updated and the sensor is made current.

9). If an error occurs during the calibration process, the system displays an error box and the calibration is invalidated.

The calibration is stored in the DDX-7000 application directory under the name ‘SYSCAL.INF’. Each time a calibration is performed, the file is copied to ‘SYSCAL.BAK’ before the process is started. In the event of an error, the system should be shut down and ‘SYSCAL.INF’ replaced with ‘SYSCAL.BAK’ to restore the previous configuration. If problems persist, contact the factory.

Display

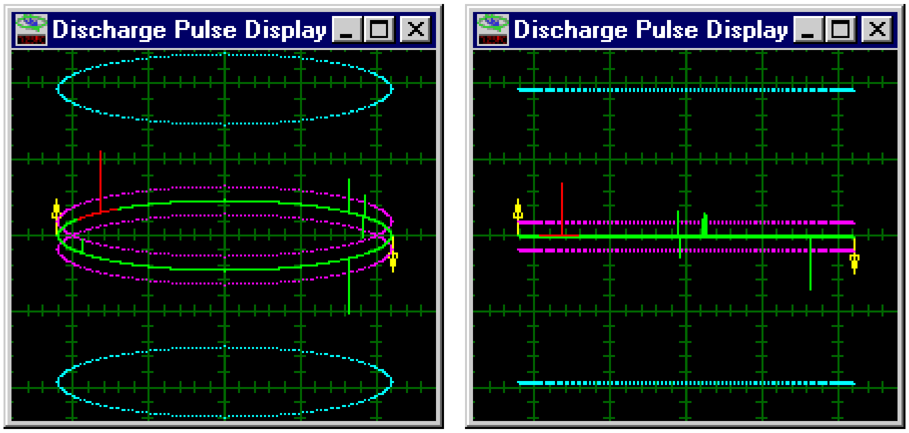
The system provides a phase referenced display of the discharge activity, in the same way as a traditional analog instrument. It is updated at a rate which can be set by the user, allowing the data capture to be optimized for the particular application. The appearance of the display is set up by clicking the right mouse button with the cursor in the display window. This shows the Display Appearance window. This window also allows the user to set up the characteristics of the gating system (See Handling unwanted activity). The update rate of the display is set using the Setup Data Acquisition window. For information on the way the system captures data, see How the System Captures Data.

Unless a small size is being used for the display window, the current Noise Floor in pC is displayed on the discharge pulse display window caption.

Note: The operation of the display is inhibited when an analysis module is capturing pulse information. This is to ensure that the analysis module is able to get all the pulses occurring within the test interval without losing any of them. During this period the display window indicates "Capture for Analysis" and no pulses are displayed. During this period, the IEC-270 compliant metering system is used for measurement, irrespective of the user settings.

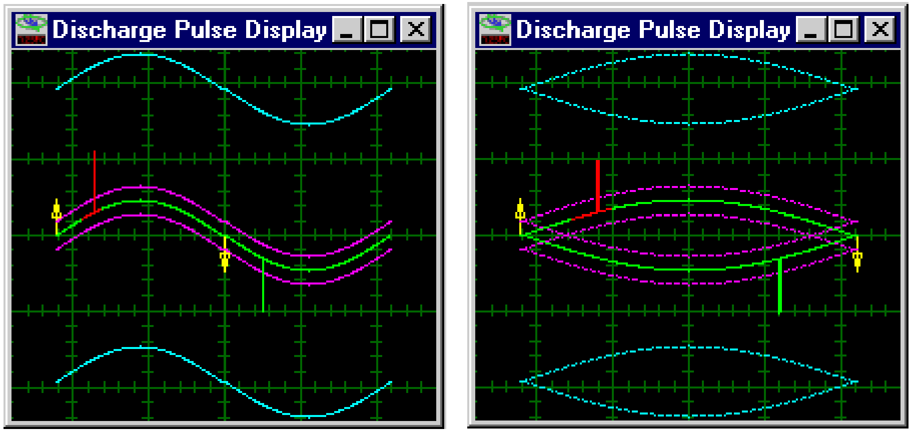
The display can be set to use one of four formats as indicated below:

Elliptical –This gives a traditional elliptical display which can be rotated as needed. It gives a polar representation of activity, where phase position is indicated by rotation around the ellipse.



Linear –The linear display is the elliptical display collapsed to zero in the Y dimension. This makes it easier to resolve differences in the pulse height, at the expense of ease in resolving phase.

Sinusoid –The sinusoidal display places the pulses on an idealized representation of the system HV waveform. This allows easy resolution of phase. It also avoids the problem of confusion when pulses on the opposite side of the display clash with each other.



Sinusoidal Loop – This is a cross between the elliptical display and the sinusoid. It is a closed loop with the X axis in terms of phase rather than time.

In all cases, it is possible to have a graticule on the display. This gives a 1cm grid with markings at 2mm intervals. The size of the grid is set up for the internal LCD display on the system. If it is being used with an external monitor, the size will differ. The intensity of the graticule is controlled by the slider on the speed bar. The graticule intensity is stored when the instrument is shut down and restored when it is powered up again. It is possible to set up the display so it is calibrated in pC/cm (e.g. for compliance with ICEA specifications), and discharge magnitudes can be approximated using the graticule.

The various elements on the display are color coded as follows:

Green : Valid Pulses (Pulses that are being measured)

Red : Invalid Pulses (Pulses that are being gated out and are not measured)

Note: This coding is carried through onto the baseline to show the position of the horizontal gates, with green showing the measured sections of the cycle and red the unmeasured sections. It is possible to show the noise picked up by the system. This appears in red, because it is not measured by the system. This tends to mask the color coding on the display baseline.

Cyan : Vertical Gate (threshold above which any activity is ignored)

Yellow : Zero markers indicating the zero points on the HV waveform.

Magenta : Noise Floor (threshold below which any activity is ignored)

Note: If the user sets the system to show noise (i.e. all activity falling below the noise floor threshold), the display baseline will be obscured as indicated below. Operating in this mode places a heavy burden on the processor, and is not recommended for general operation

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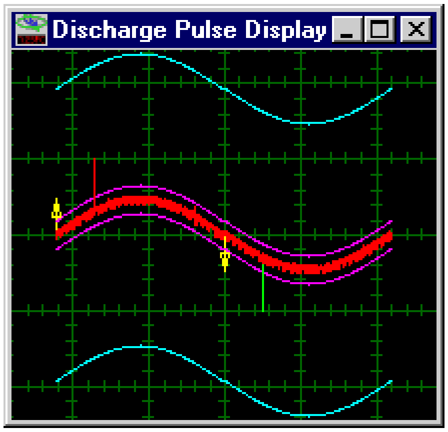
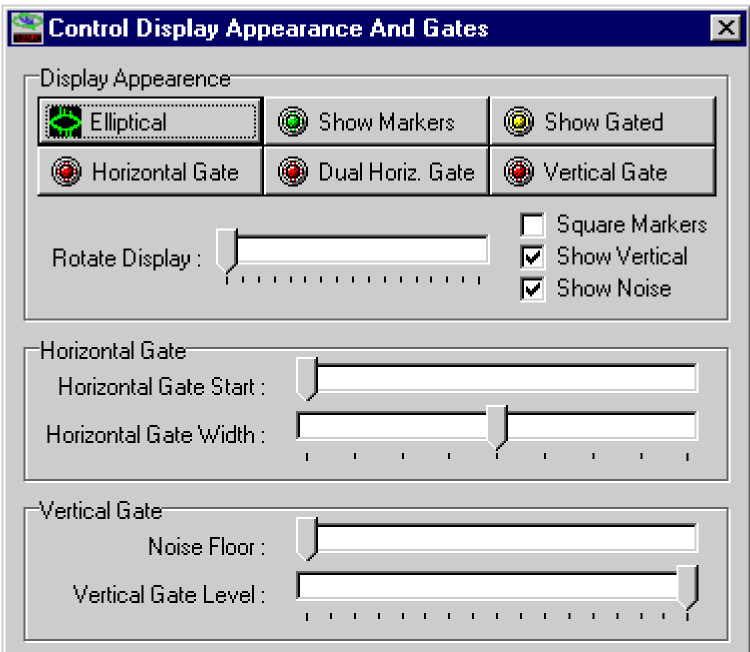


The display window is used to trigger the Quick PDSL System. To trigger a Quick PDSL acquisition, place the cross hair of the cursor over the baseline of the display at the point where the acquisition is to start and click the left hand mouse button. The display will clear (i.e. show no pulses) momentarily and then return to normal operation. The Quick PDSL information will be updated when the Quick PDSL display window is activated.

Display Appearance

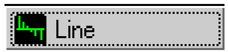
The display appearance window controls the way the pulse information is shown on the Display window. It also provides the controls to set the horizontal and vertical gating functions that prevent the measurement of invalid pulses (See Handling Unwanted Activity). When the window is de-activated, it automatically minimizes itself to keep the screen clear. It can be re-activated by right clicking in the display window or by double clicking its minimized title bar.



The window is divided into three sections: the display appearance control section, the horizontal gating control section, and the vertical gating control section.

The shape of the baseline for the display is changed by clicking on the display wave shape button. The icon in the button and its text indicate the current shape of the display baseline. If an external analog oscilloscope is being used on the system, it will switch to line mode with the main display. In all other display modes, it will have an elliptical display.

The system cycles through the possible shapes with repeated clicks of the button:

to


to


to


The Show Markers button turns the display of zero markers on and off. These indicate the position of the zero crossings on the HV system waveform. The upward pointing arrow indicates the start of the positive going half cycle, while the downward arrow indicates the start of the negative going half cycle. The state of the zero markers is indicated on the button:

Zero markers are displayed

Zero markers are not displayed

It is possible to turn the display of gated pulses (i.e. pulses that are not measured) on or off using the Show Gated button. When Show Gated is off, only valid pulses (shown in green) are displayed. If Show Gated is on, pulses gated out are shown on the display in red to indicate they are not being measured. The Show Gated control also turns on or off the display of the noise floor thresholds (magenta), and the vertical gate thresholds (cyan) in conjunction with the Show Vertical checkbox. If Show Gated is off, the thresholds are not shown on the display. The button indicates the current state:

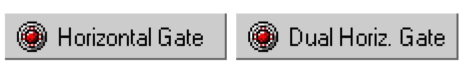
Gated out (unmeasured) pulses are displayed

Gated out (unmeasured) pulses are not displayed

The system allows the gating of sections of the HV waveform based on phase, using the horizontal gating control. The current state of the horizontal gating system is indicated on the baseline of the display (unless Show Noise has been turned on). The system allows either a single gated-out period over the whole cycle (Single Horizontal Gate) or two gated-out periods separated by 180 degrees (Dual Horizontal Gate). When a dual horizontal gate is specified, the two gated-out periods are identical in size. The state of the horizontal gating system is indicated on the buttons as indicated:

Horizontal gating system is off.

Single horizontal gate is on.



Dual horizontal gate is on.

As well as the horizontal gate, the system provides a vertical gating system. This eliminates pulses that exceed the vertical gate threshold. This provides a means of eliminating large interference pulses. The state of the vertical gate is indicated on the button:

Vertical gating system is switched on

Vertical gating system is switched on

When the display shape is switched to Ellipse or Line, it is possible to rotate the display to allow different parts of the baseline to be viewed. This is done using the **Rotate Display** slider. The display can be rotated from 0 degrees (slider on the extreme left) to 360 degrees (slider on the extreme right). If an analog oscilloscope is attached to the system, it will be rotated to match the rotation on the display.

The **Square Markers** check box is used to set the type of zero marker displayed on the external analog oscilloscope (if used). If the box is unchecked, triangular markers are used, pointing in the direction of rotation of the display. If the system is running at elevated line frequencies, the markers can spread over the display excessively. By switching to square markers, this effect is eliminated.

The **Show Vertical** check box controls the display of the noise floor and vertical gate thresholds on the display. If the box is unchecked, the thresholds are not displayed. If the box is checked, the noise floor threshold will be displayed when Show Gated is turned on. The vertical gate threshold will be displayed when this box is checked, Show Gated is turned on, and Vertical Gate is turned on. If any of these conditions is not met, the threshold is not displayed.

The **Show Noise** check box allow the display of activity falling below the noise floor threshold. If the box is checked, the noise will be displayed, as long as Show Gated is turned on. Showing the noise imposes a heavy burden on the system processor and should only be used if absolutely required. There is no effect on the measurements from having this option checked. This option is also available on the Setup Data Acquisition window.

The Horizontal Gate (See Handling Unwanted Activity) is controlled by two sliders for start and width. The Start slider determines where on the HV line the cycle starts. If the system is using a single horizontal gate, the slider allows the start to be set anywhere between 0 (leftmost position) and 360 degrees (rightmost position). In dual horizontal gate mode, it can be set anywhere between 0 and 180 degrees. The Width slider determines what proportion of the cycle is gated out. In Single Horizontal Gate mode it can be set between 0 (leftmost position) and 360 degrees (rightmost position). This is reduced to 0 to 180 degrees in Dual Horizontal Gate mode. The scale below the sliders is calibrated in 1/16 cycle intervals (22.5 degrees) regardless of the selected horizontal gate mode.

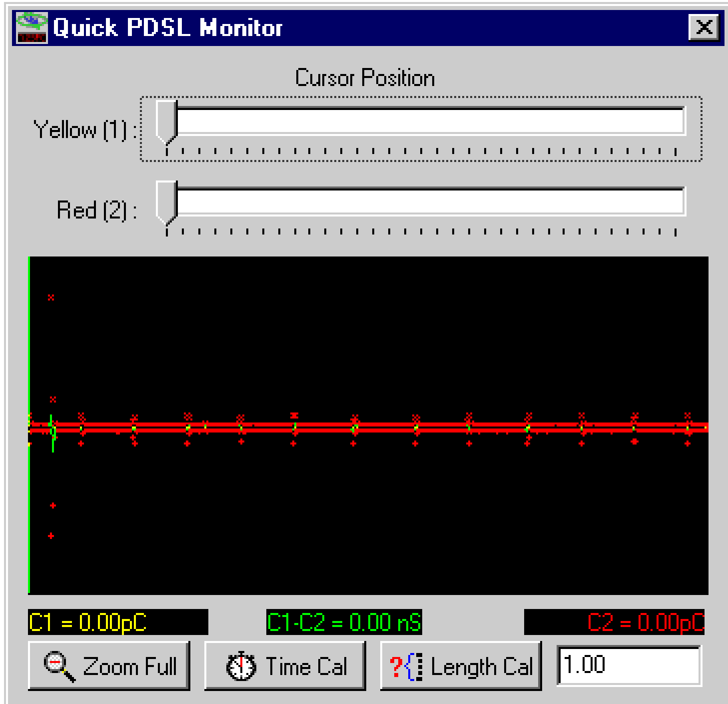
The Vertical Gate (See Handling Unwanted Activity) threshold is set using the Vertical Gate Level slider. It is set as a percentage of the range of the capture system. The level is limited so it cannot go below that of the noise floor. To set it, Show Gated must be on, along with Vertical Gate and Show Vertical. If the vertical gate is being used, it is also recommended that Autorange Amplifier not be used; as it will not operate correctly with the vertical gate active (See Measurement Settings).

The Noise Floor (See Handling Unwanted Activity) is normally set using the automatic calibration procedure, and it is not normally necessary to make further adjustments to it. In some cases, however, it may be desirable to optimize the setting: for example, when there is sporadic noise on the system. This can be done using the Noise Floor slider. Note – the noise floor is related to the amplifier setting. It will change as the amplifier setting is changed. The slider reflects the basic value that is corrected for amplifier setting. When adjusting this slider, it is recommended that Show Gated be on and the Show Vertical box be checked, along with Show Noise.

Quick PDSL

The Quick PDSL window provides a high-resolution display of the amplifier output against time. This can be used to check the pulse shape when operating in conventional discharge detector mode. In this mode it can also be used to examine any interference being picked up on the system, so steps can be taken to minimize the effects. When the system is operating in PDSL mode using a PDSL amplifier, the user can make manual measurements of the position of the fault within a cable.

A Quick PDSL capture is triggered from the Display window. To trigger the Quick PDSL capture, position the cross hair cursor at the point where the capture is to begin. Increasing phase goes left to right or clockwise, depending on the display. The cursor should be positioned so it is on the left or counter-clockwise side of the area of interest. Once the cursor has been positioned, click the left mouse button to trigger the capture. When triggered, the system captures 256,000 samples and transfers them to the Quick PDSL window for display:



The data captured is shown on the central portion of the window. When the window is zoomed out, many data points in the captured information correspond to one position on the screen. The highest and lowest limits recorded for each screen position are shown as red crosses, with the green line showing the average value.

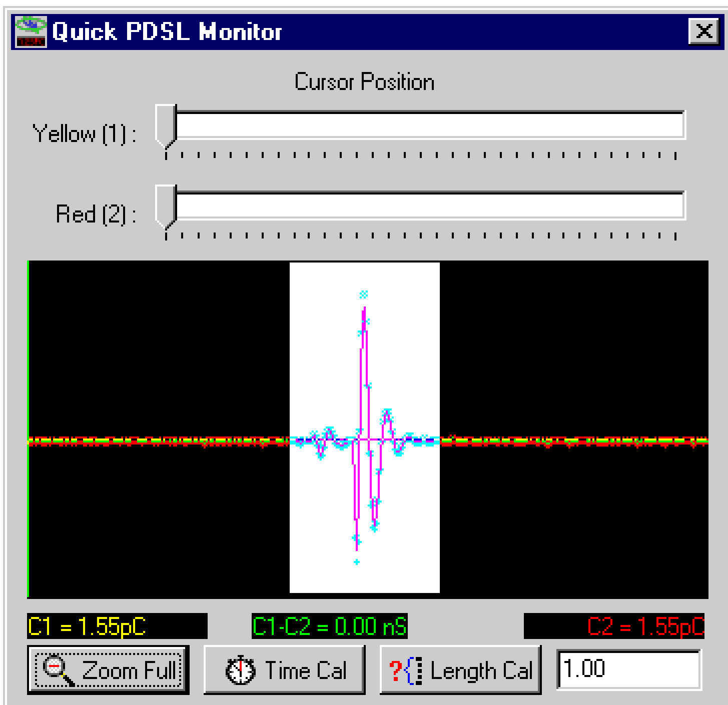
The sliders at the top of the screen allow the cursors to be adjusted to the required position. The readouts below the main display show the current magnitude at each of the two cursors (calibrated in pC taken from the metering system). The green readout indicates the distance between the two cursors. This is either in terms of time or length, depending on the mode.

The ‘Zoom Full’ button zooms the display out to its fullest extent, so that all the data is shown.

The ‘Time Cal’ button places the system into time calibration mode. In this mode, the system displays the distance between the two cursors in terms of time. This allows measurement of periods to be made, so the user can determine frequencies and intervals. Time Calibration mode indicates in two ways, either in terms of time, or in terms of frequency. Clicking the ‘Time Cal’ button switches between the two modes.

Clicking the Length Cal button switches the system into length calibration mode. When the button is clicked, the system reads the current spacing between the cursors and scales this to correspond to the distance entered in the edit box next to the button. In the event that length calibration is requested when the cursor spacing is zero, or the value in the length edit box is zero, the system will not update the system. If it was in time calibration mode, it will stay in time calibration mode; if it was in length calibration mode, the previous length calibration is held.

To view the required section of the display clearly, zoom in on the area of interest. This can be done in two ways: clicking the left mouse button will zoom in by a factor of 2, centered on the cursor. Alternatively, position the cursor on the top left corner of the area of interest, and press and hold down the left mouse button. Moving the mouse will draw out a highlighted area. Adjust the size of this area with the mouse until it covers the area of interest, and release the button. The system will expand the highlighted area to cover the display area:



To zoom back out, if the image is zoomed in too far, click the right mouse button. This will zoom the display out by a factor of 2, centered on the mouse pointer.

Performing Site Location with Quick PDSL

To perform site location on a sample, perform the following steps:

1). With the sample connected to the system and the input unit connected to the near end of the sample, apply calibration pulses.

2). Adjust the system until the calibration pulses can be clearly seen.

3). Position the cursor on the pulse display just before one of the calibration pulses, and click the left mouse button to perform a QPDSL capture.

4). Zoom in on one of the calibrator pulses, until it and its reflection from the far end of the sample can be seen.

5). Position one cursor on the start of the main pulse, and the second cursor on the start of the reflected pulse.

6). Enter the length of the cable in the Length calibration edit box, and click the ‘Length Cal’ button. The spacing between the cursors will now read in terms of distance from the far end of the sample.

7). Switch off the calibrator. If an external calibrator is being used, remove it from the system.

8). Apply voltage to the sample and increase it until the sample starts to discharge.

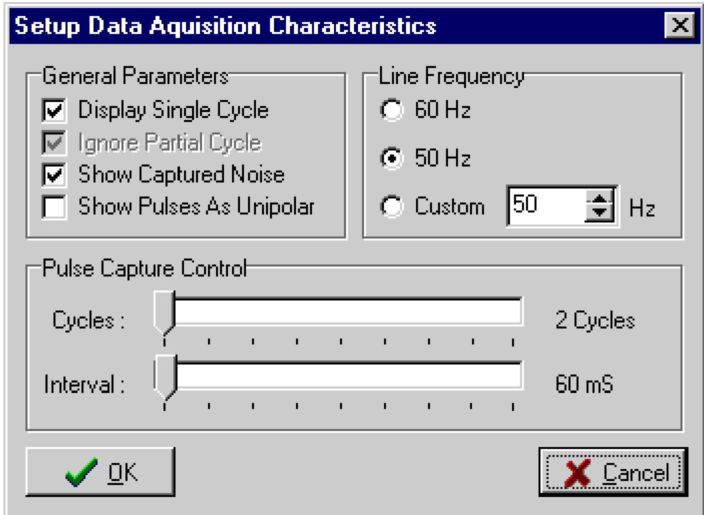
9). Position the cursor before the start of the discharge activity on the pulse display, and click the left mouse button.

10). Zoom in on one of the discharge pulses, until it and its reflection can be seen.

11). Position the cursors on the start of the pulse and its reflection. The spacing readout will show the distance of the site from the Far End of the cable. Repeat for a number of pulses to get the distance, and average the distances to get an overall figure.

Setup Data Acquisition

The Setup Data Acquisition Window allows the user to configure the way in which the system captures the pulse data from the sample. For an overview of the data capture system, see How the System Captures Data .



All other user operations are blocked while the Setup Data Acquisition window is displayed. It is cleared by pressing OK to accept the updated settings, or Cancel to return to the prior settings. While this window is displayed, the pulse display keeps running to allow the effect of the changes to be assessed.

The General Parameters control the way that data is captured and displayed:

Display Single Cycle is used to reduce the burden on the processor when multiple cycles are being captured. The system always captures data from the test circuit for the defined number of cycles before processing it. When the Display Single Cycle box is checked, the system will capture the required number of cycles, but will only display the first on the screen. Where large numbers of cycles are being captured, selecting this option avoids the pulse display being swamped with pulses, blanking out the detail. Where extremely fast update rates are being used, selecting this option minimizes the time the processor spends on the display; making more time for other processing.

Ignore Partial Cycle instructs the system to always ignore the first cycle of data captured on each acquisition. The readback of data from sampling is carried out asynchronous to the line frequency. This means that after readback, data capture will be restarted at some undefined point on the mains cycle, with only a partial cycle of information being captured. When Ignore Partial Cycle is checked, the system will ignore this first cycle, only using those cycles that have been captured fully. When Display Single Cycle is selected, this option is always selected; so the display always shows a full cycle of data.

Show Captured Noise performs the same function as the Show Noise option on the Display Appearance window. It requires the Show Gated option to be selected.

Show Pulses As Unipolar forces the display system to ignore the polarity of the captured pulses and show them all as positive. Sign information is kept internally for analysis.

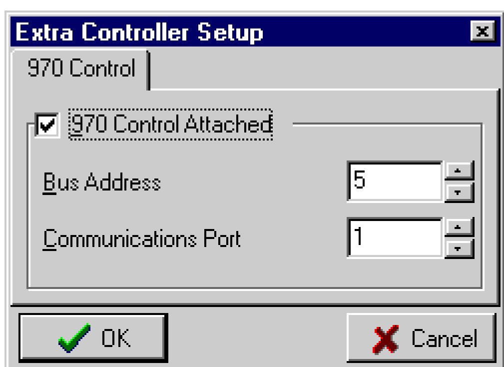
It is possible to set the operating line frequency of the system using the Line Frequency radio buttons. Either of the standard line frequencies (50Hz or 60Hz) can be selected by clicking on the appropriate button. Where a non standard frequency is being used, it is entered into the custom frequency check box and the custom button clicked. The acceptable range of values is 5 to 500Hz.

The number of cycles captured by the system, and hence the display update interval, is set using the Pulse Capture Control sliders. For them to be correctly synchronised, the correct operating line frequency must have been entered as described above. If a certain number of cycles is to be captured, the Cycles slider is adjusted. The Interval slider will track it, giving the most appropriate update rate for that number of cycles. If the user opts to set the update interval, the Cycles slider will track it setting the maximum number of cycles that can be captured at that update rate with the given line frequency. The currently selected number of cycles and update rate are indicated to the right of the sliders.

For normal use as a detector, it is better to use a short capture interval, which gives a faster update rate. If the system is being used for tests requiring statistical analysis and integrated quantities, then a longer acquisition interval is more appropriate.

Attached Controllers

The DDX-7000 system is able to communicate with a Hipotronics 970/AC or 970/SR HV Power supply controller, giving an integrated testing system. The Attached Controllers menu option allows the user to specify the communications port and the address of the 970 controller to be used:



If there is a 970 controller attached to the system, the user should check the '970 Control Attached' box; which will cause the DDX-7000 system to search for the controller when it starts up. The Bus Address box specifies the address on the communications system that the 970 control occupies. This is normally 5, though it can be anywhere from 1 to 255. Consult the 970 documentation for information on how to obtain the address of the unit. If this address is not correctly entered, the system will search all available addresses for the controller at Start Up.

The Communications Port box allows the user to specify the system communications port used for the 970 control. This should be left at '1' unless the system has been specially customized by the factory.

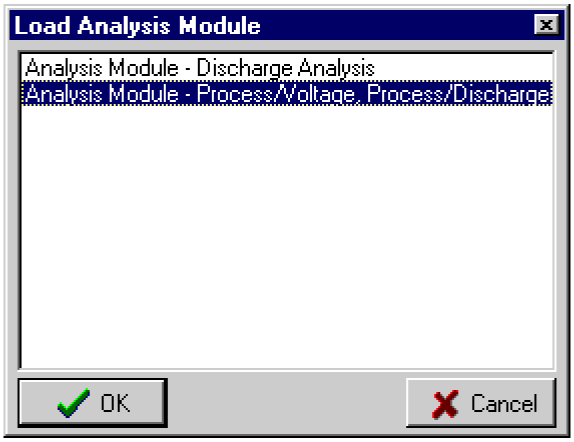
Pressing 'Cancel' abandons the changes to the configuration. Pressing 'OK' updates the settings. These will not become valid until the system is restarted. A message box is displayed warning the user of this fact.

New Analysis

The New Analysis function can be accessed from the Menu Bar or the Speed Bar. It is only available when an analysis module is loaded, and is not capturing or processing data. It clears the current test configuration in the analysis module so a new setup can be defined by the user.

Select Analysis

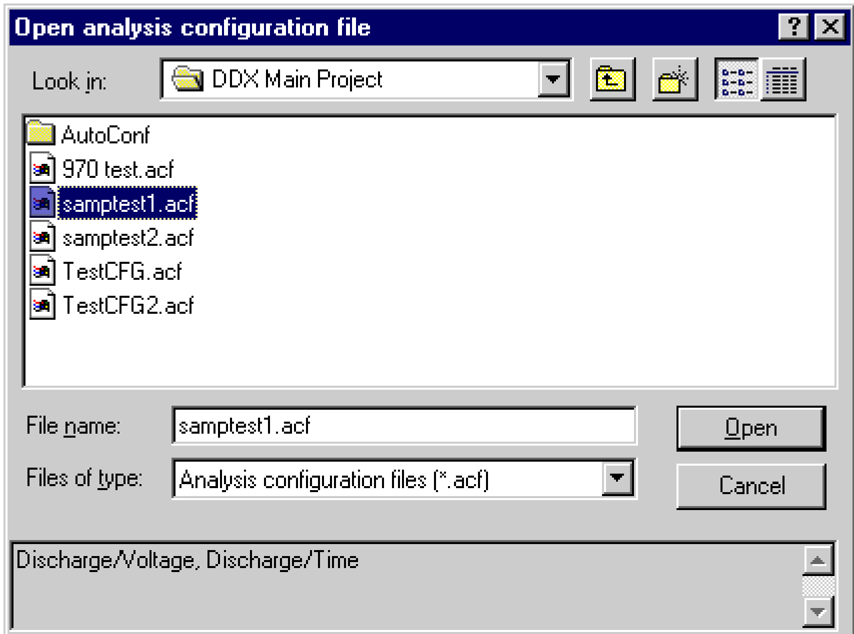
The system supports Analysis Modules that extend the operation of the system. They process the basic discharge information from the magnitude meter and the pulse display to present the information in different forms. These modules are available from Hipotronics as options to the system. The Select Analysis option opens the Load Analysis Module window, which lists all the available data analysis modules installed on the system. The user can then select the required module. Clicking 'OK' will load the module, while 'Cancel' will abandon the operation.



A different analysis can be selected, when one is already loaded, as long as the loaded module is not in the process of capturing and processing data. During this period, the Select Analysis option on the Menu Bar and on the Speed Bar is disabled.

Load Configuration

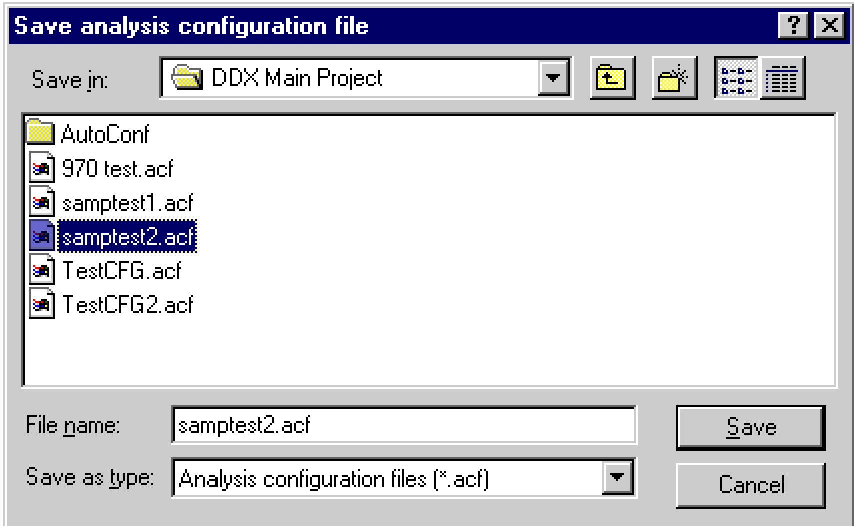
The Load Configuration function is available from the Menu Bar or the Speed Bar. It allows the user to recall an analysis configuration from disk. It is not available if there is an analysis module loaded and capturing or processing data. Selecting the function displays the 'Open analysis configuration file' window
:



This displays the available configuration files in the current directory. The controls at the top of the window allow the user to move around the directory structure, or different directories to be specified (see Windows documentation for more information). A file can be selected by clicking on the name in the list, or by typing it into the File name box. Selecting a file causes the system to display which analysis module was used to capture the data in the file, in the window at the bottom of the screen. Once a file has been selected, clicking the 'Open' button will load it into the analysis module. If the required analysis module is not loaded, it will automatically be loaded. If there is an analysis module already open, it will be closed before the new one is loaded.

Save Configuration

The Save Configuration option saves the setup of the currently loaded analysis module. It can be accessed from the Menu Bar or the Speed Bar. It is available for use when an analysis module is loaded and has been set up for use. Selecting the option displays the 'Save analysis configuration file' window:

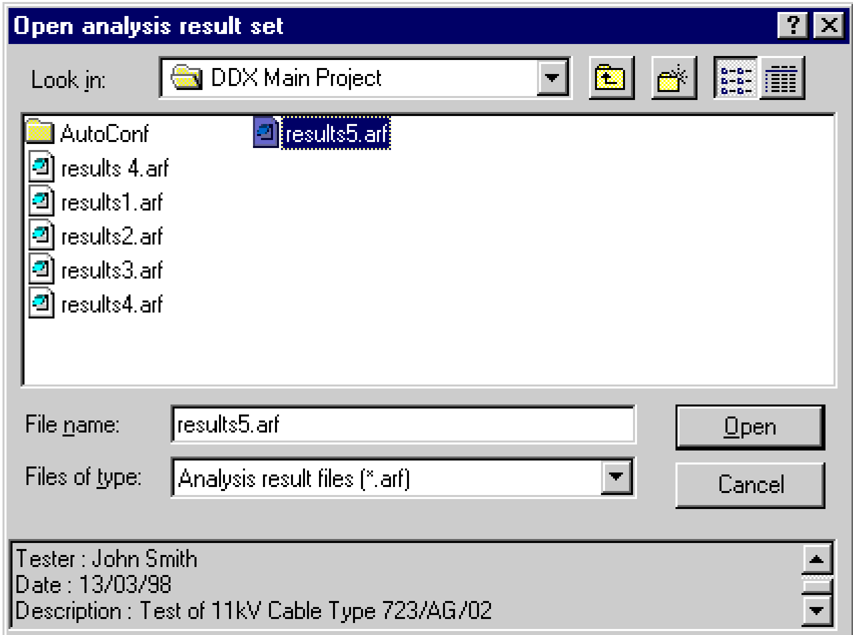


This lists the analysis configurations in the current directory. The controls at the top of the window allow the user to move around the directory structure, or different directories to be specified (see Windows documentation for more information). The filename for the setup can be typed in the filename box, or can be selected by clicking on a name in the list. Clicking the 'Save' button saves the configuration to disk, while the 'Cancel' button aborts the operation.

If the filename chosen for the configuration belongs to a file that already exists, the system requests that the user confirm that the information in the file is to be overwritten. If the response is 'Yes', the data is saved; otherwise the operation is abandoned.

Load Results

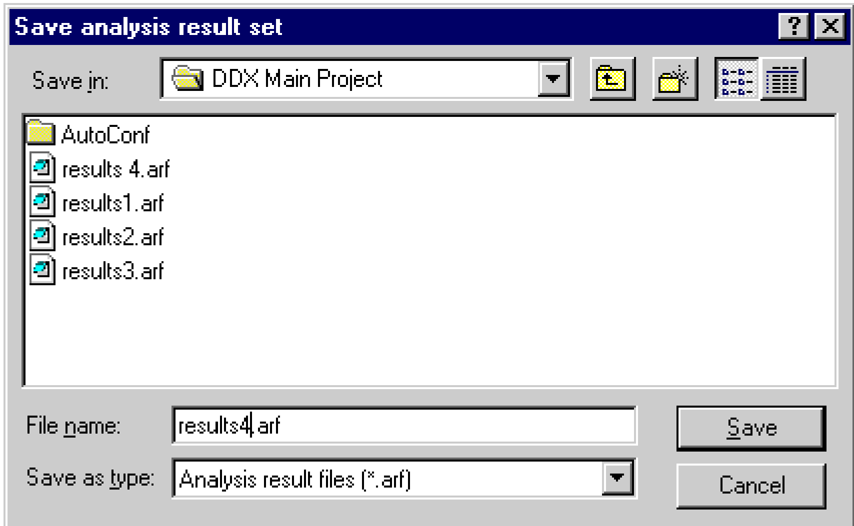
The Load Results function is available from the Menu Bar or the Speed Bar. It allows the user to recall a set of analysis results from disk. This option is not available if there is an analysis module loaded and engaged in capturing and processing data. Selecting the function displays the 'Open analysis result set' window:



This displays the available result files in the current directory. The controls at the top of the window allow the user to move around the directory structure, or different directories to be specified (see Windows documentation for more information). A file can be selected by clicking on the name in the list, or by typing it into the File name box. Selecting a file causes the system to display the test information entered when the data was captured, in the window at the bottom of the screen. Once a file has been selected, clicking the 'Open' button will load it into the analysis module. If the required analysis module is not loaded, it will automatically be loaded. If there is an analysis module already open, it will be closed before the new one is loaded.

Save Results

The Save Results function can be accessed from the Menu Bar or the Speed Bar. It is used to save the results produced by an analysis module to disk, so they can be reloaded at a later date. It is only available when there is an analysis module loaded and it has completed a sequence of capturing and processing data. When selected, the function displays the 'Save analysis result set' window:



This lists the result sets in the current directory. The controls at the top of the window allow the user to move around the directory structure or different directories to be specified (see Windows documentation for more information). The filename for the setup can be typed in the filename box, or can be selected by clicking on a name in the list. Click the ‘Save’ button to save the configuration to disk, or the ‘Cancel’ button to abort the operation.

If the filename chosen for the result set belongs to a file that already exists, the system requests that the user confirms that the information in the file is to be overwritten. If the response is ‘Yes’, the data is saved, otherwise the operation is abandoned.

Run Analysis

The Run Analysis function can be accessed from the Menu Bar or the Speed Bar. It also appears on the analysis module controls. It is only available for use when an analysis module is loaded and has been set up for use. Under all other conditions, it is disabled. Selecting the Run Analysis function starts the analysis module capturing and processing data.

Stop Analysis

The Stop Analysis control is accessed from either the Menu Bar or the Speed Bar. There is also a stop control provided in the analysis module window. The Stop Analysis function is only enabled if the analysis module is in the process of capturing and processing information. For information on the effects of stopping an analysis before it has completed, see the documentation for the analysis module in question.

Print Results

Print Results prints out the results processed by an analysis module. Before printing, any additional information (such as tester and sample details and any additional comments) should be entered using the Test Information window, or the Test Information boxes on the analysis module (if provided). The page layout should also be set up using the Page Setup window.

To print the display, select the Print Results option from either the Menu or the Speed Bar. The system displays the Print Setup window to allow the printer to be selected and set up. If this has already been done and the settings are acceptable, click ‘OK’ to continue with the printing process. Clicking ‘Cancel’ will abandon printing. If this is the first time the system has printed since it was started up, it will display the Select Font window. Select a suitable font and click ‘OK’ to continue. The system will then print out the data.

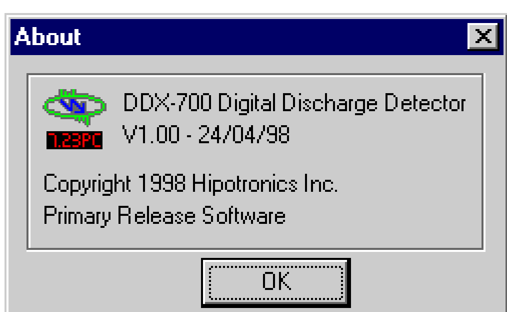
The Print Results function is only available when the analysis module has finished capturing and processing data, and has information available to print.

Show Hints

Show Hints is accessed from Help on the Menu Bar. If Show Hints is selected, the Show Hints option in the menu has a check next to it. This is toggled on and off by selecting the option. When Show Hints is selected, if the mouse is positioned over a control on the system, a small box will be dsiplayed giving a brief description of the operation of the control. The description is also displayed on the status panel at the bottom of the screen.

About

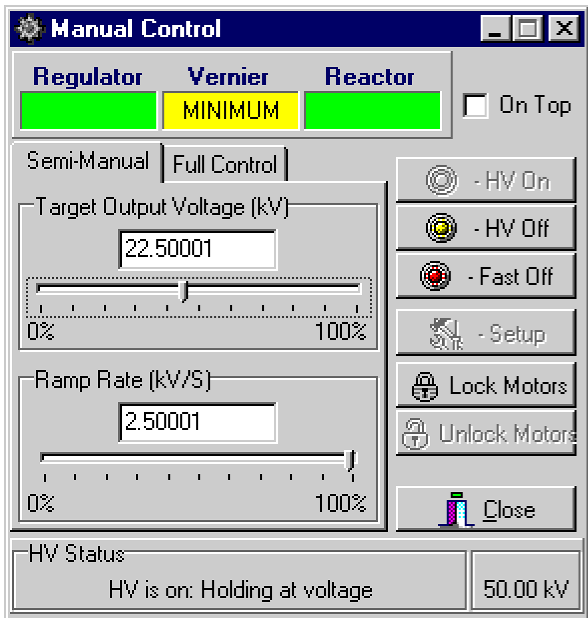
Selecting the About option from the menu bar displays the application ‘About’ box. This indicates the version of the software installed on the system, the date the software was released and details of any customizations or modifications made to the system
:



When requesting support from Hipotronics, it is necessary to describe the software version and any customizations or modifications to the software, to obtain the required information.

970 Manual Control

The 970 Manual Control operates with both the 970SR and the 970AC systems. The 970SR has more controls than the 970AC. These controls are always displayed, even if the system has detected the presence of a 970AC; though they are disabled and cannot be used in this case. The 970 Manual Control is accessed from the Speed Bar. When the option is selected, the control panel is displayed:



The 'On Top' check box, when checked, forces the control panel to always sit on top of the other windows. If this box is not checked, the control panel will disappear when any of the detector windows are activated. It can be brought back to the front from the system task bar or using "ALT-TAB" (See Windows documentation for more details).

At the top of the window, the system indicates the status of the system regulator, reactor and vernier. If the corresponding indicator is green, it is in the operating region. If the indicator is yellow, one of the end stops has been reached. The text in the indicator shows which stop has been reached.

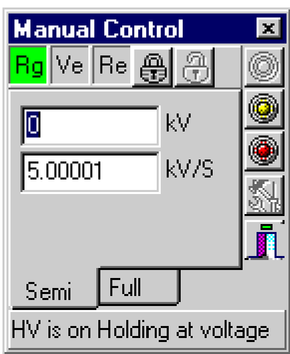
At the bottom of the screen are two boxes. The left one indicates the current HV Status of the 970 controller. For more details on the information that is displayed in this box and what it means, consult the 970 documentation. The right box indicates the currently selected voltage range for the system.

The application of HV is controlled using the buttons down the right hand side of the window:

HV On HV On turns on the HV to the sample. This control is only enabled for use when the HV system is off and the regulator and vernier (if

	fitted) are at minimum. If the system has not been set up, this control is disabled.
HV Off	The HV Off control is only enabled if the HV is switched on. It shuts down the HV by winding the regulator and vernier to minimum before opening the main contactor. The HV cannot be re-applied until the regulator and vernier are at minimum.
Fast Off	The fast HV shut off shuts down the HV by opening the main contactor before winding the regulator and vernier to minimum. This gets the HV off as rapidly as possible, but does impose extra stress on the sample and power supply.
Setup	Setup brings up a window that allows the user to specify the operating characteristics of the system. A setup must have been entered into the system before the user can apply the HV.
Lock Motors	If the test circuit is particularly susceptible to interference from the power supply controls, the Lock Motors option can be used to temporarily shut down the control system to allow measurements to be made.
Unlock Motors	If the motors have been locked, the Unlock Motors option restarts the control system to allow voltage adjustment to be made.

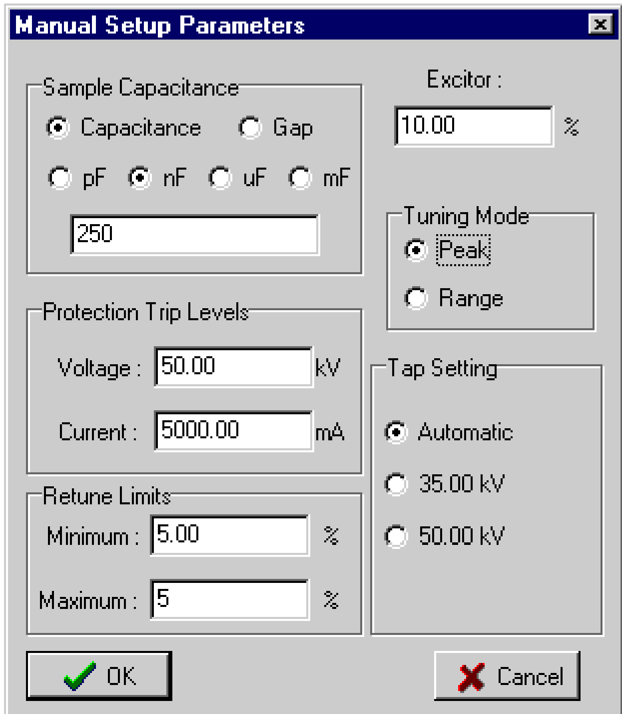
If the control window is found to be too large, clicking the minimize button (see System Window Elements) allows it to be reduced in size:



The ordering of the controls in this window is identical to its larger counterpart, except that the lock and unlock motor controls are moved to be next to the regulator, vernier and reactor status indicators, and the indication of the currently selected range. As with the larger control window, the state of the 'HV On' (Green), 'HV Off' (Yellow) and 'Fast Off' (Red) controls is indicated on the lamp image on the button.

Setting Up The 970

Before the HV can be switched on, the 970 system must be set up. This is done using the Setup button. When clicked, the Manual Setup Parameters window is displayed:



When a series resonant set is being used with the system, it is necessary to set the capacitance used so the system can establish a tune. The user can select to enter either a capacitance in pF, nF, uF or mF; or a gap (in %). This is used by the 970 to establish the starting point for the tuning process. Entry in terms of Gap or Capacitance is selected by the Gap or Capacitance radio buttons. If capacitance entry is chosen, the capacitance units are set. Once the user has chosen gap or capacitance and units, the required value can be entered in the edit box. These controls are not required for a 970AC, and will be grayed out if one is detected on the system.

Safe limits of operation need to be set for the system. These are set using the Protection Trip Level controls. The Voltage level determines the maximum safe voltage that is allowed on the sample. This is required for a series resonant supply because of the danger of over-voltaging the sample. The maximum voltage is also used to determine the required tap setting if Automatic Tap Setting mode is chosen. The Current level determines the current that is allowed to flow in the sample before the system shuts off.

The Retune Limits determine the automatic re-tuning points for the 970SR. If the tuning drifts outside the specified window, the system will retune. If a limit of 1 or less is set, that retune point is disabled. These controls are only used for Series Resonant operation.

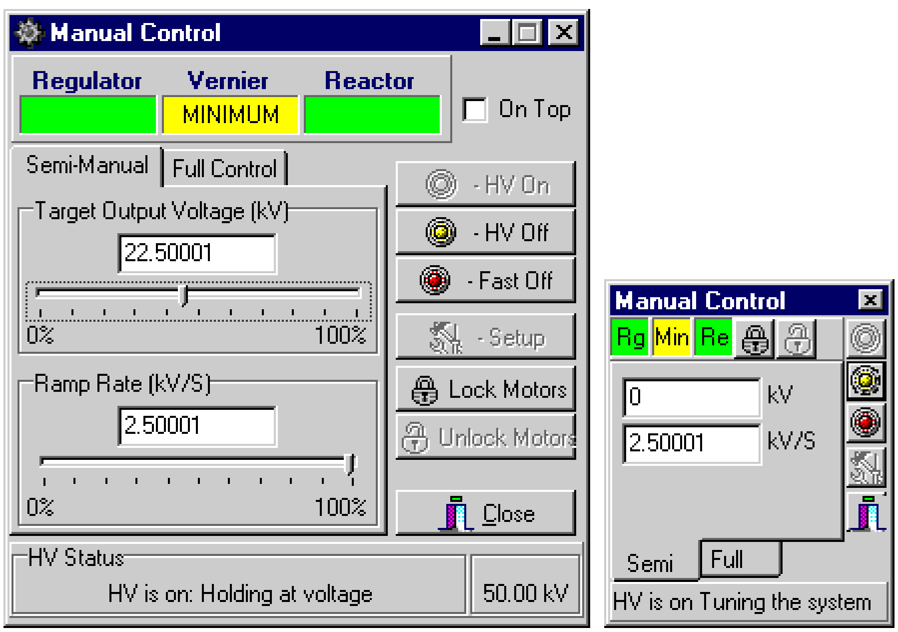
The Excitor level specifies the proportion of the maximum output of the excitor that is used by the system when attempting to establish a tune. This is only used for a series resonant system.

The Tuning Mode determines how a series resonant system tunes. 'Peak' mode forces the system to always tune to the peak of resonance, giving the purest output. 'Range' mode tunes the system off peak to give the greatest accuracy in setting the output. The Voltage level limits the maximum safe off-peak shift in 'Range' mode. These controls are not used with a conventional power supply.

The Tap Setting box indicates the available tap settings for the connected power supply. The user can select a specific tap by clicking the appropriate button. Alternatively, by clicking the automatic option, the user can let the system decide on the best setting based on the entered maximum voltage; and in the case of a series resonant supply, the sample capacitance.

Semi-Manual Control

Semi-manual control runs the power supply in closed loop control mode. This makes the setting of output voltage easier than full manual control. The user has two controls available: Output and Ramp Rate:

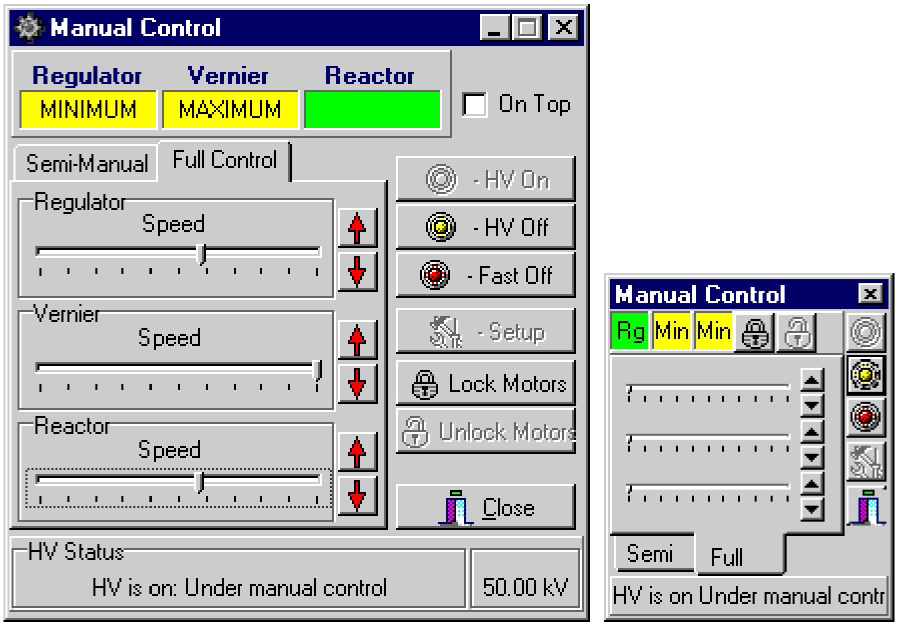


To set a specific output voltage, the user enters the required voltage using the Target Output Voltage edit box to enter the required value in kV, or by setting the slider. The system adjusts the output to move to this voltage at the user set ramp rate. This is set using the Ramp Rate edit box to enter the value in kV/S, or using the slider.

The user can switch from semi-manual to full manual by clicking on the 'Full' tab.

Full-Manual Control

Full manual control allows the user to operate the system in the same way as a traditional power supply. This control does not use any of the closed loop control facilities provided by the 970 controller.



The user is provided with sliders to set the speed of travel of the Regulator (top), Vernier (middle, where fitted) and Reactor (bottom, where fitted). These can be set between 0 and 100% of the full operating speed of the unit. To adjust the output, the user has two buttons for each control; one to raise (increase) the output and one to lower (reduce) the output.

The user can switch from full-manual to semi-manual control by clicking on the 'Semi' tab.

Revision Information

Revision History

V1.00 – Initial launch of the system 24 April 1998

V1.01 – First Production release, 06 May 1998. Modified to improve pulse capture for analysis, support for pulse capture included. Support for IEC-270 incorporated.

V1.02 – Update to V1.01, released 19 June 1998. Automatic calibration system updated to ensure the noise floor is measured correctly prior to running automatic calibration. This eliminates the "Unable to resolve calibrator pulses" error even with a valid set up, when the system is ranged off minimum. Display of the noise floor threshold is now indicated on the caption bar of the pulse display.

Known Issues

V1.00 Program launch 24 April 1998

V1.01 Reports of errors with automatic calibration systems giving false "Unable to resolve calibrator pulse errors". Workaround until fix is established is to switch amplifier onto maximum fine gain and minimum attenuation, prior to starting the calibration process.

Glossary

Direct Calibration

Direct calibration injects charge into a High Voltage Capictor of a known value. Since the output voltage of the calibrator is known, this allows the injected charge to be measured directly. The costs of direct calibration are higher than for indirect, but it is far less dependent on circuit configuration. It does not require an external reference source.

Indirect Calibration

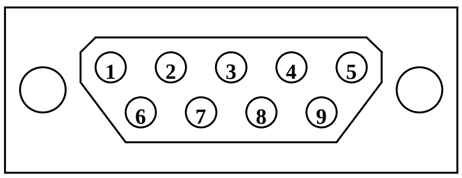
Indirect calibration injects charge across the input unit, using a small low voltage capacitor. This provides a lower cost solution than Direct Injection, but the reading is heavily dependent on the circuit configuration. In this mode, it is necessary to set the calibrator from an external reference source.

Noise Floor

The threshold above which the system considers a pulse to be valid, and not simply part of the general noise and interference in the test circuit.

Connections Diagrams:

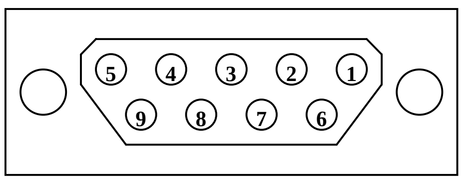
DDX-7000 Rear Panel Digital I/O Connector Diagrams



9 Pin ‘D’ connector - Male

Standard serial ‘COM’ port for serial data connection to printer or other equipment.

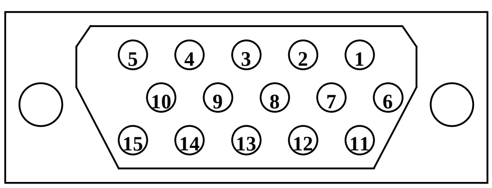
(Com 1, Com 2)



9 Pin ‘D’ connector - Female

Special control port for connection to other compatible **Hipotronics** equipment.

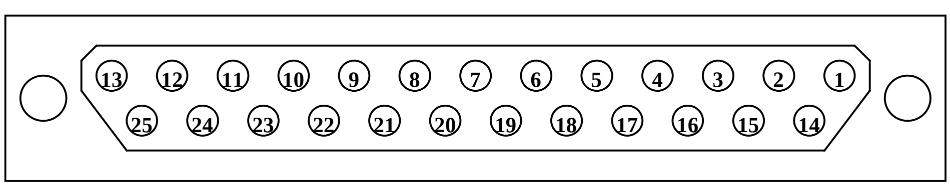
(Local Bus)



15 Pin ‘Sub-D’ connector - Female

Standard SVGA port for connection to an external video monitor.

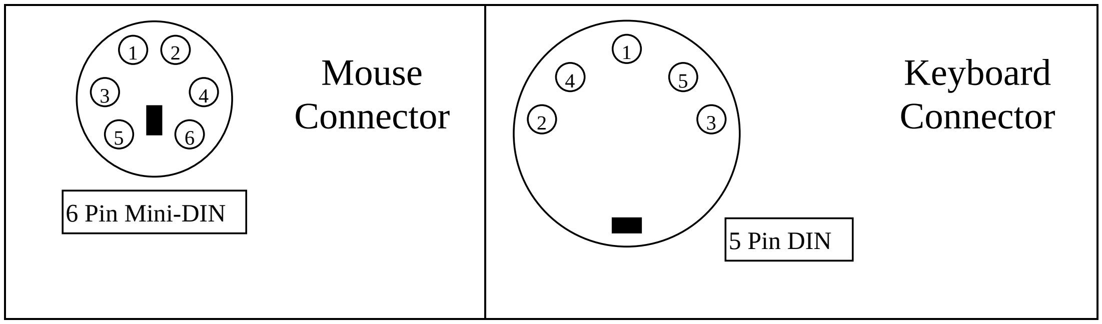
(Ext. Mon.)



25 Pin ‘D’ connector - Female

Standard parallel LPT port for connection to a parallel printer.
(LPT1)

DDX-7000 Front Panel Connector Diagrams



References and Acknowledgements:

IEC 270 Measurement of partial discharge
IEC 60 Voltage measurement

CIGRE Electra no. 11 (Extract)
Identification des Déscharges
Recognition of Discharges
Paper presented by Working Group 21.03 “Discharges”
at Study Committee No. 21 (High Voltage Cables)

Recommended reading for installers:-
IEC 204 Safety of Machinery

Pentium 200 mmx™ is a registered trademark of Intel Corporation.
Windows 95™ is a registered trademark of Microsoft Corporation.

Service/Support

Hipotronics understands the high level of service required by our customers. The DDX has had high reliability and serviceability designed into the unit. Should problems occur, they are easily diagnosed (most likely without a site visit) and the customer can be put quickly back on-line. Replacement modules can usually be quickly shipped.

Our service/support plan for the DDX is as follows:

Technical Support

The DDX is very easy to use and most questions can probably be answered in the manual or through on-line help. However, in case there are questions that cannot be answered by reviewing the manual or help menu, Hipotronics will provide factory technical support by phone or fax. (See inside front cover for phone numbers.)

Spare Parts

Should spare parts be required, Hipotronics will be able to supply replacement printed circuit boards. Each hardware module is easily opened so that replacement of printed circuit boards by even a non-technical customer will be easy.

Remanufactured printed circuit boards will be available for immediate shipment against customer purchase order (depending on their credit situation) or against VISA/Master Card. Upon receipt of the replacement board, the faulty board can be returned for partial credit.

Repairs

Repair at the Hipotronics factory should not be necessary. Most problems in the field should be correctable through simple board or component replacement. In the unlikely event that the unit needs to be repaired at our factory, repair technicians and/or manufacturing personnel will be available to repair the unit.

Warranty

HIPOTRONICS, INC. warrants to the original purchaser of any new merchandise that the merchandise is free from defects in materials and workmanship under normal use and service for a period of one (1) year from the date of shipment. The obligation of Hipotronics, Inc. under this warranty is limited, in its exclusive option, to repair, replace or issue credit for parts or materials which prove to be defective, and is subject to Purchaser's compliance with the Hipotronics, Inc. Warranty Claim Procedure as set forth below. The happening of any one or more of the following events will serve to void this warranty and any defect or damage resulting therefrom is specifically excluded from Warranty coverage:

(a) defects due to accident, negligence, alteration, modification, faulty installation, abuse or misuse by Purchaser or Purchaser’s agents or employees.

(b) attempted or actual dismantling, disassembling, service or repair by any person, firm or corporation not specifically authorized in writing by Hipotronics, Inc.

(c) defects caused by or due to handling by carrier or incurred during shipment, transshipment or other move.

This Warranty covers only those parts and/or materials deemed by Hipotronics, Inc. to be defective within the meaning of this Warranty. The liability of Hipotronics, Inc. shall be limited to the repair, replacement or issuance of credit for parts deemed defective within the meaning of this Warranty. Costs incurred by purchaser for labor or other expenses incidental to the inspection, repair, replacement or issuance of credit for such parts and/or materials shall be the sole responsibility of purchaser. This Warranty shall not apply to any accessories, parts or materials not manufactured or supplied by Hipotronics, Inc. and if, in the sole discretion of Hipotronics, Inc., Purchaser's claim relates to any materials of a component part, or of the manufacturer of a device of which the defective part is a component, Hipotronics, Inc. reserves the right to disclaim liability under this Warranty and to direct that the Purchaser deal directly with such supplier or manufacturer. Hipotronics, Inc. agrees to assist the purchaser in processing or settling any such claim without prejudicing its position as to liability purchaser in processing or settling any such claim without prejudicing its position as to liability.

Warranty Claim Procedure

Compliance with the following Warranty Claim Procedure is a condition precedent to the obligation of Hipotronics, Inc. under this Warranty.

(a) Purchaser must notify Hipotronics, Inc. in writing by certified or registered mail, of the defect claimed within twelve (12) months after the date of original shipment. Said notice shall describe in detail the defect, the defective part and the alleged cause of the defect.

(b) At the exclusive option of Hipotronics, Inc., Purchaser shall dismantle or disassemble at Purchaser's cost and expense and shall ship the defective part or material, prepaid, to Hipotronics, Inc., Brewster, New York 10509, for inspection, or permit an authorized service representative of Hipotronics, Inc. to inspect the defective part or material at the Purchaser's premises. Purchaser shall provide facilities for, and at Purchaser's cost and expense, dismantle, disassemble, or otherwise make accessible the subject part or material whether or not same is a component of, or installed in, a device other than that manufactured or supplied by Hipotronics, Inc. If disclosure shows that the defect is not one for which Hipotronics, Inc. is liable, the Purchaser agrees to reimburse Hipotronics, Inc. for all expense incurred.

(c) Upon receipt of the defective part or material, or after access to same, Hipotronics, Inc. shall inspect the part or material to determine the validity of Purchaser's claim.

The validity of any Warranty Claim, Purchaser's compliance with Hipotronics, Inc. Warranty Claim Procedure, the obligation to either repair, replace or issue credit, or direct the purchaser to deal directly with a manufacturer or supplier are to be determined solely and exclusively by Hipotronics, Inc. any determination so made shall be final and binding.

THIS WARRANTY IS EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES EXPRESSED OR IMPLIED ON THE PART OF HIPOTRONICS, INC., INCLUDING THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR USE AND CONSEQUENTIAL DAMAGES ARISING FROM ANY BREACH THEREOF AND HIPOTRONICS, INC. NEITHER ASSUMES NOR AUTHORIZES ANY OTHER PERSON, FIRM OR CORPORATION TO ASSUME ANY LIABILITY OR OBLIGATION IN CONNECTION WITH THIS SALE ON ITS BEHALF AND PURCHASER ACKNOWLEDGES THAT NO REPRESENTATIONS EXCEPT THOSE MADE HEREIN HAVE BEEN MADE TO PURCHASER.

Returned Material

If it should become necessary to return the equipment described in this publication to the factory, the Service Department of HIPOTRONICS, INC. must be contacted at (914) 279-8091. If the return of the unit is appropriate, a Return Authorization Number will be issued and you will be instructed as to the method of return. If return of the unit is *not* advisable, other inspection arrangements will be made.

Please have the following information available to help our service personnel identify the unit and determine the necessity for return.

> ***Note:*** **Material received at this plant without the proper authorization shall be held as "customer's property" and no service will be performed until the proper steps have been taken. Your cooperation is requested in order to ensure prompt service.**

MODEL: ______________________________

SERIAL NUMBER: ______________________________

TYPE (Part Number): ______________________________

(The MODEL, SERIAL NUMBER and TYPE are indicated on the black and silver tag affixed to the unit.)

REASON FOR RETURN: ______________________________

____

____

DEFECT: ______________________________

____

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Replacement Parts

To order replacement parts for this unit, please refer to the Parts List provided with this publication. Provide the number of the specific component along with the *type* (Part Number) of the unit, which is indicated on the Parts List and on the black and silver tag affixed to the unit.

Hipotronics Instruction Manual Document

1.	Cover Sheet	Yes	4	No		
2.	Return Material / Warranty Sheet	Yes	4	No		4/96
3.	CE Mark Sheet	Yes		No	4	4/96
4.	2D21 Overload Sheet	Yes		No	4	4/96
5.	CNT Sheet	Yes		No	4	
6.	Parts List	Yes	4	No		
7.	Robinson Equipment Manual	Yes		No	4	Model if yes:
8.	Other Inserts (Specify)	Yes		No	4	

9. Drawing List:

DS12-1545	
DS12-1543	
CS12-1539	
DA12-1522	

Rev. Level: O	Document #:	M DDX-7000	ECN # 37-	Date: 8/7/98	Elect. Eng Approved: D. Bruce	Mech. Eng. Approved:
Rev. Level: A	Document #:	M DDX-7000	ECN # 37-6418	Date	Elect. Eng Approved:	Mech. Eng. Approved:

<u>Do Not Include This Sheet In Manual</u>