OPERATION MANUAL

DIGITAL PARTIAL DISCHARGE DETECTOR

MODEL DDX8003

HIPOTRONICS INC.

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DDX-8003 Pulse Discrimination System

Welcome to the **Hipotronics DDX-8003 Pulse Discrimination** system. To find help on a specific topic, use either the contents or the index to search for the information you require. Alternatively, you can select one of the topics listed below to get you started. Registered users of the system can also get assistance directly from Hipotronics Inc.

How the System Captures Data

The system uses a complex sampling system to capture the pulse data. A high-speed digitizer (80MHz) continuously samples the discharge activity. 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 lockout 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.

Display

The system provides a phase-resolved display of the discharge activity in the same way as a traditional analogue instrument. It is updated on at regular interval, which can be set by the user, allowing the data capture to be optimized for the application in which it is being used. The appearance of the display is set-up by clicking the right hand mouse button with the cursor in the display window. This shows the Display Appearance window. The Display Appearance 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.

When the right hand mouse button is clicked, a menu that allows the current pulse display to be exported is displayed:

When the Copy as Bitmap option is highlighted, the user has two ways of exporting the bitmap, on a black background (as it appears on the display) or on a white background (suitable for incorporating into a document to be printed). The background options are only displayed when the Copy as Bitmap option is highlighted. The Copy as CSV file option allows the pulse information to be copied out to a file for import into spreadsheets or other applications. The file is a text file with entries for each pulse recorded. The format for each pulse is:

XXXX, YYYY, ZZZZ, AAAA where

XXXX is the magnitude of the pulse in pC

YYYY is the phase angle of the pulse in degrees

ZZZZ indicates the cycle number of the pulse. This allows individual cycles to be distinguished on long acquisitions.

AAAA indicates the pulse status:

- 0 - Internal A pulse,
- 1 - Internal B pulse,
- 2 - External pulse,
- 3 - Not in above / Transient.

When the Copy as CSV file option is selected, the user is prompted to enter a file name and directory for the file so it can be loaded into another application. If the Copy as Bitmap option is selected, the image is copied onto the

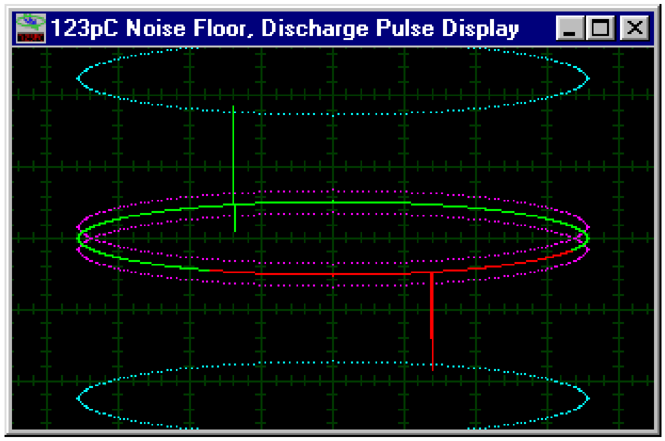
Windows clipboard. It is necessary to paste this into the required application before another export as Bitmap is made, otherwise the first one will be overwritten. Clicking outside the display window can clear the menu.

The current Noise Floor in pC is displayed on the Discharge Pulse Display window caption.

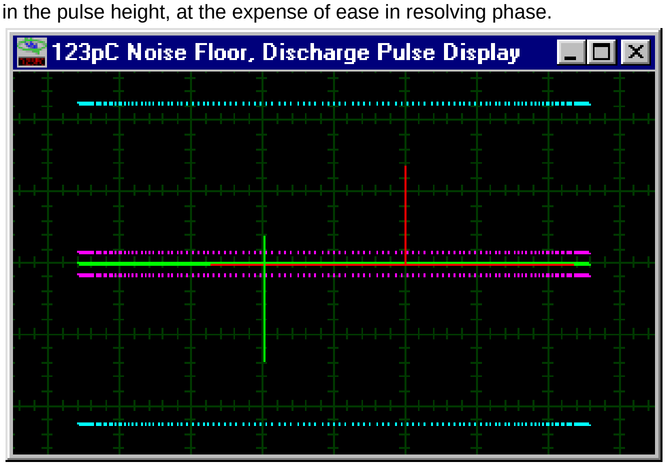
Note: The operation of the display is inhibited when an analysis module is capturing pulse information. This is to ensure that the analysis module is able to get all the pulses occurring within the test interval without losing any of them. During this period the display window indicates Capture for Analysis 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:

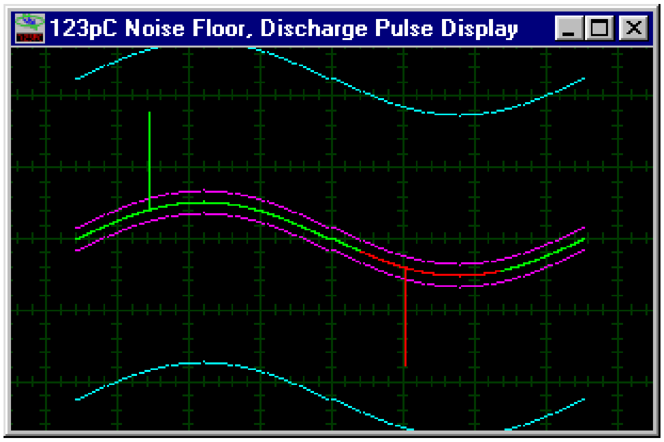
Elliptical – this gives a traditional elliptical display that can be rotated as needed. It gives a polar representation of activity, where phase position is indicated by rotation around the ellipse.



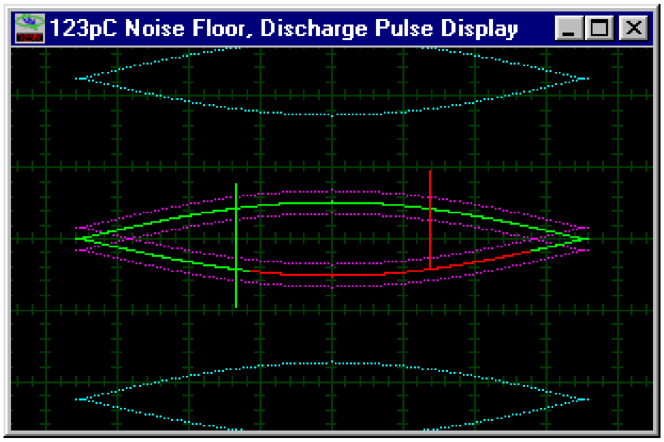
Linear – the linear display is the elliptical display collapsed to zero in the Y dimension. This makes it easier to resolve differences in the pulse height, at the expense of ease in resolving phase.



Sinusoid – The sinusoidal display places the pulses on an idealized representation of the system HV waveform. This allows the 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 slider on the speed bar controls the intensity of the graticule. 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:

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

Yellow : Internal A Pulse

Turquoise : Internal B Pulse

Pink : External pulses

White : Transient

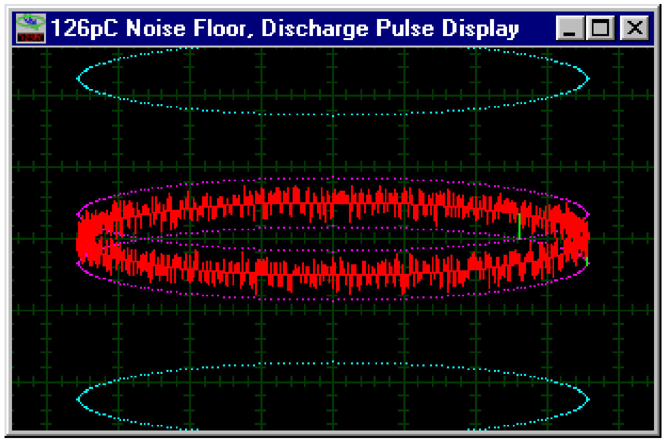
Note, this coding is carried through onto the baseline to show the position of the horizontal gates with green showing the measured sections of the cycle and red the unmeasured sections. It is possible to show the noise picked up by the system. This appears in red, because it is not measured by the system.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

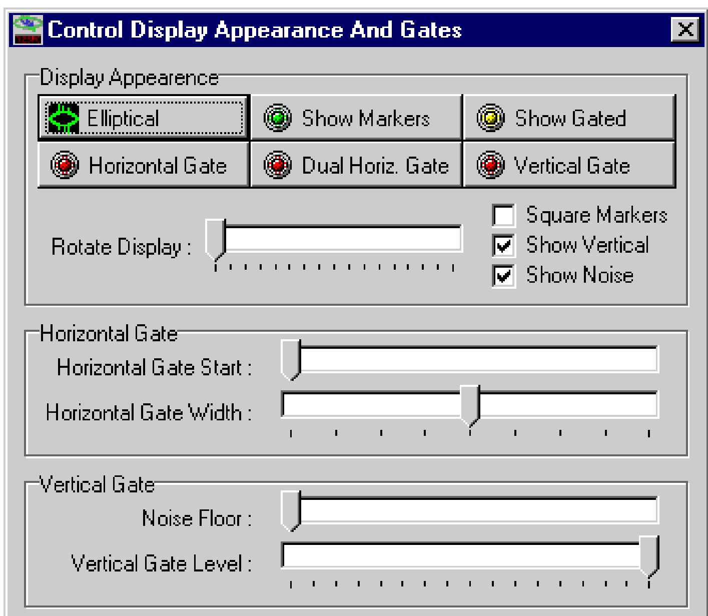
Note: If the user sets the system to show noise (i.e. all activity falling below the noise floor threshold), the display baseline will be obscured as indicated below. Operating in this mode places a heavy burden on the processor, and is not recommended for general operation.



The display window is used to the 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

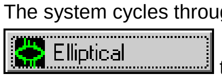
The display appearance window controls the way the pulse information is shown on the Display window. It also provides the controls to set the horizontal and vertical gating functions that prevent the measurement of invalid pulses (See Handling Unwanted Activity). When the window is de-activated, it automatically 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.

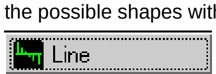


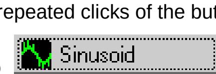
The window is divided into three sections; the display appearance control section, the horizontal gating control section and the vertical gating control section.

Clicking on the display wave shape button changes the shape of the baseline for the display. The icon in the button and its text indicate the current shape of the display baseline. If an external analogue 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:

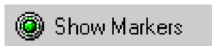


to


to


to


The Show Markers button turns on the display of zero markers on and off. These indicate the position of the zero crossings on the HV system waveform. The upwards pointing arrow indicates the start of the positive going half cycle, while the downwards 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

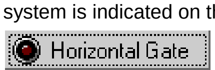
Zero markers are not displayed

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 the display of the noise floor thresholds (magenta) and the vertical gate thresholds (cyan) on the display in conjunction with the Show Vertical checkbox. If Show Gates 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 the showing of noise has been turned on). The system allows either a single gating out period over the whole cycle (Single Horizontal Gate) or two gating out period separated by 180 degrees (Dual Horizontal Gate). When a dual horizontal gate is specified, the two gate-out periods are identical in size. The state of the horizontal gating system is indicated on the buttons as indicated:

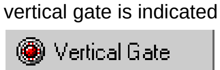


Horizontal gating system is off.

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 analogue 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 analogue 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 the 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 of 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 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) irrespective of the selected horizontal gate mode.

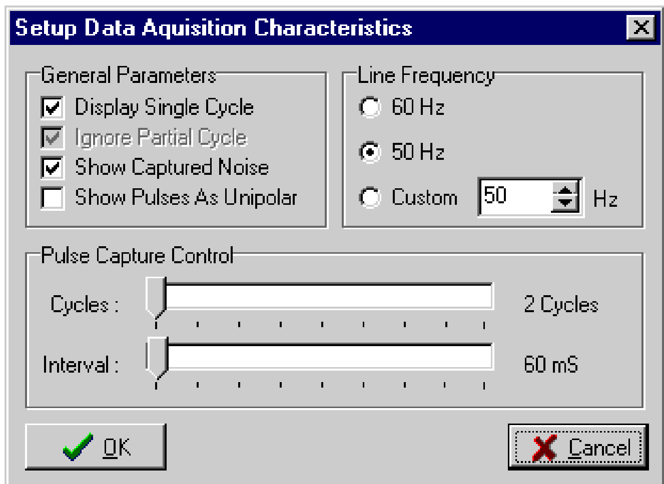
The vertical gate (See Handling Unwanted Activity) threshold is set using the Vertical Gate Level slider. It is set as a percentage of the range of the capture system. The level is limited so it cannot go below that of the noise floor.

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 is not 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 is on and the Show Vertical box is checked along with Show Noise.

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 setting prior to the window being displayed. While this window is displayed, the pulse display keeps running to allow the effect of the changes to be assessed.

The General Parameters controls 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 synchronized, the correct operating line frequency must have been entered as described above. If a certain number of cycles are 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 numbers of cycles and update rate are indicated on the right hand side 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.

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. The page layout should also be set up using the Page Setup window.

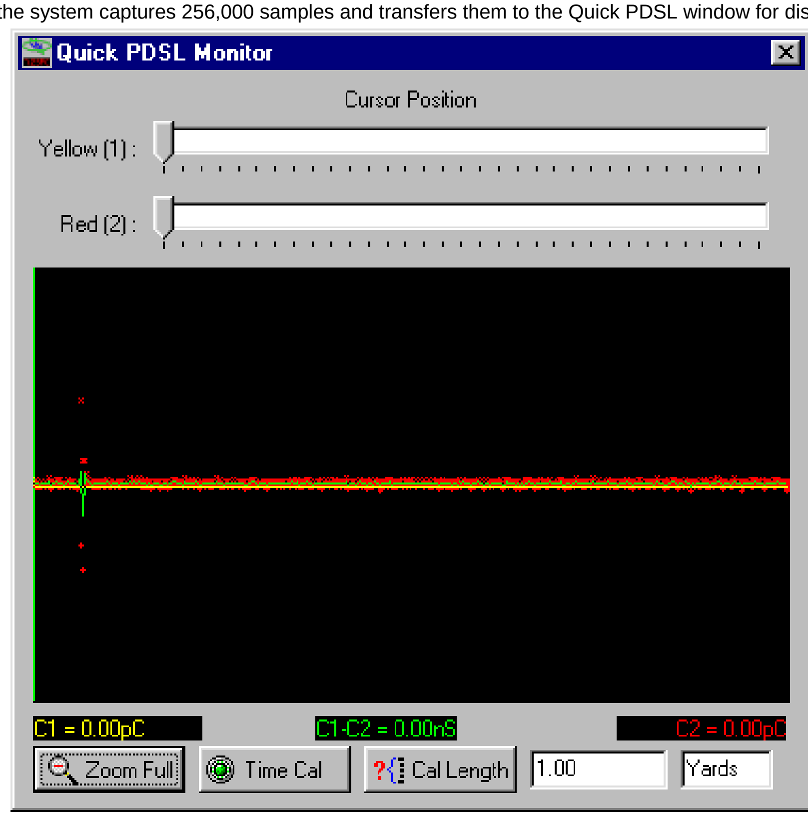
To actually print the display, select the Print Display option from either the Menu or the Speed Bar. The system displays the Print Setup window to allow the printer to be selected. If this has already been done, or the settings are acceptable, clicking ‘OK’ will continue with the printing process. Clicking ‘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 hand 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 that are gated-out are drawn with a thinner line width than those gated-in.

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 their 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 on the left or anti-clockwise side of the area of interest. Once the cursor has been positioned, clicking the left-hand mouse button will 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 in terms of time, frequency or length depending on the mode.

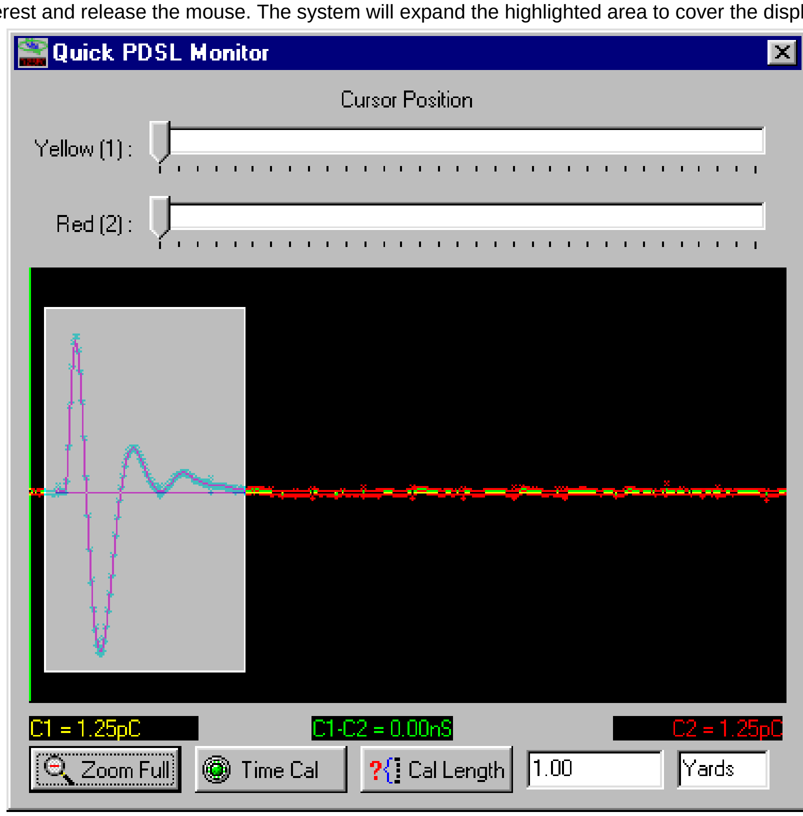
The 'Zoom Full' button, zooms the display out to its fullest extent so that all the data is shown

The measurement mode for the spacing between the cursors is selected using the mode control button. The mode cycles between time calibration, frequency calibration and length calibration. In time mode, the time difference between the cursors is indicated in nanoseconds. In frequency mode, the time difference between the two cursors is indicated in kHz (i.e. 1/Time). In length mode, the difference is in terms of length of cable to the discharge site in terms of distance. For this to read correctly a length calibration must have been performed. (See Performing Site Location with Quick PDSL)

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.

On the right of the length calibration edit box is the length units measurement edit box. Into this box, the correct units for the length measurement can be entered. The units are displayed on the printouts and on the cursor difference display when length mode is selected. The units are stored in the system registry and will be restored to the last setting each time the system is restarted.

To view the required section of the display it is necessary to zoom in on the area of interest to view it. 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 mouse. 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 hand 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 up to the system and the input unit connected to the near end of the sample, apply calibration pulses.

2). Select the length measurement mode using the mode selection button.

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

4). Position the cursor on the pulse display so that it is just before one of the calibration pulses and click the left hand mouse button to perform a QPDSL capture

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

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

7). Enter the length of the cable in the Length calibration Edit control 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.

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

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

10). Position the cursor before the start of the discharge activity on the pulse display and click the left-hand mouse button.

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

12). 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.

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, clicking ‘OK’ will 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 in the cursor positions. At the bottom of the display, it writes in the equivalent magnitudes at each of the cursor positions, their positions and the relative spacing between them in the currently selected mode (time, frequency or distance).

How the System Measures Discharge

The system uses 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 analogue 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 magnitude, both positive and negative that has not been gated out since the last time the magnitude meter was updated (See Handling unwanted activity). The higher 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). Where 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 analogue measurement system. The use of an analogue 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 directly compared with the output of a traditional analogue detector. The system uses an analogue 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.

When operating with a standard Power Separation Filter with extreme loads and load ratios, there is the possibility of non-linearities being introduced because of impedance shifts in the system. The DDX-8003 provides the means to compensate for these shifts by correcting the gain on the lower amplifier ranges. This process is carried out as part of the automatic calibration process (See Calibrating the system)

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.

There are two conventional amplifiers supplied. Each amplifier is connected to either channel A or channel B of the pulse discrimination system and each has its own set of controls. Displayed on the Amplifier dialog box, there is the option to link these channels together so that an alteration in amplifier setting on Channel A will cause channel B to change proportionally.

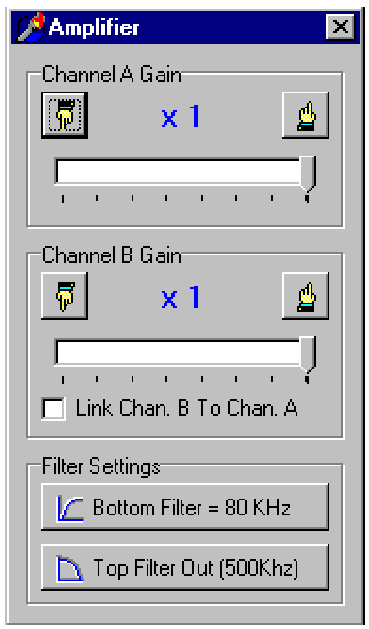
In order to calibrate the system it is necessary for the user to, initially, link the amplifier channels together.

Conventional Amplifiers

The conventional amplifier provides a wide-band characteristic 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:

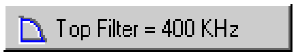


The operating range of the amplifier is controlled using the  and  buttons to switch the gain of the system up or down. The current operating range is indicated between the buttons as follows:

X1	0dB	(Zero Attenuation, Maximum Gain)
X0.1	-20dB	
X0.01	-40dB	
X0.001	-60dB	
X0.0001	-80dB	
X0.00001	-100dB	(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, it will not be possible to set the amplifier to a specific setting. The system will choose it's own, overriding the one that has been set 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 on one setting.



Adjusts the maximum frequency the amplifier passes.

Adjusts the minimum frequency the amplifier passes.

The range of settings for the filters is:

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

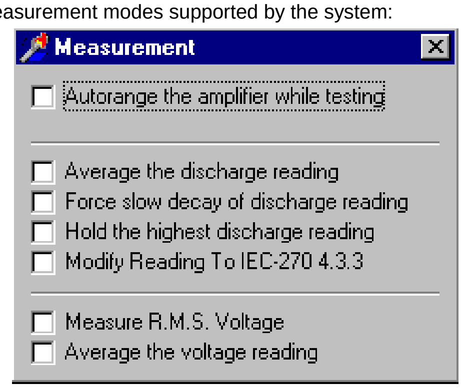
Bottom Filter = 20KHz*, 30KHz, 50KHz, 60KHz, 80KHz

The caption on the filter control buttons changes to indicate the filter settings available.

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.

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 is not used in conjunction with the vertical gate

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. This option is disabled if IEC-270 4.3.3 operation is selected

Force slow decay of the discharge reading

If this box is checked, the display simulates that of a traditional analogue 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.** This option is disabled if IEC-270 4.3.3 operation is selected

Hold the highest discharge reading

Hold the highest discharge reading, when checked, forces the system to operate a true peak detector, where the highest discharge reading is held until cleared by the user. Clicking the peak clear button on the speed bar resets the peak. 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. This option is disabled if IEC-270 4.3.3 operation is selected

Modify Reading To IEC-270 4.3.3

Modify Reading To IEC-270 4.3.3 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 and 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/√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

How the System Measures Voltage

The DDX-8003 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 the pulse capture and display system have the correct phase relation 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 √2 to give an equivalent RMS value.

The process of measuring True RMS is more complex. It requires the system to measure the wave shape 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 wave shape. The peak voltage measured for a cycle is multiplied by the scaling factor to get a reading in kV. The peak to RMS scaling factor that has just been calculated then multiplies this. The captured wave shape is also used to provide instantaneous voltage information for the individual pulses.

How the System Discriminates Between Pulses

The system collects information from several sources. There are two input units in the high voltage circuit which detect partial discharge events. There is an aerial or antenna which picks up airborne transients. Finally, the polarity of the applied voltage can be sensed.

In principle when a partial discharge event occurs in the test sample (Cx) a signal will flow around the circuit comprising Cx, Cb and the two input units. Very little will pass through the transformer. This will cause equal and opposite outputs from the input units to be sent to the **DDX-8003** input amplifiers.

Typical High Voltage Test Circuit

A similar effect will occur if the discharge event occurs in the blocking capacitor (Cb) but the polarity of the signals will be reversed. Since the polarity of the applied voltage is known and it is assumed that the discharge event always causes a drop in the terminal voltage of the relevant object, the location of the event can be deduced.

Other events occurring outside the test circuit will tend to induce signals which are of the same polarity and can thus be rejected.

A further method of interference rejection is to use an aerial to pick up external airborne interference. If any are detected then any signals from the test circuit can be ignored for a short time until the disturbance is over.

When testing cables, it can happen that signals from the an external event are rejected but energy is injected into the cable. This is reflected from the far end of the cable and appears in the test circuit a short time later. This can be prevented by ignoring all signals from the test circuit until the danger is past.

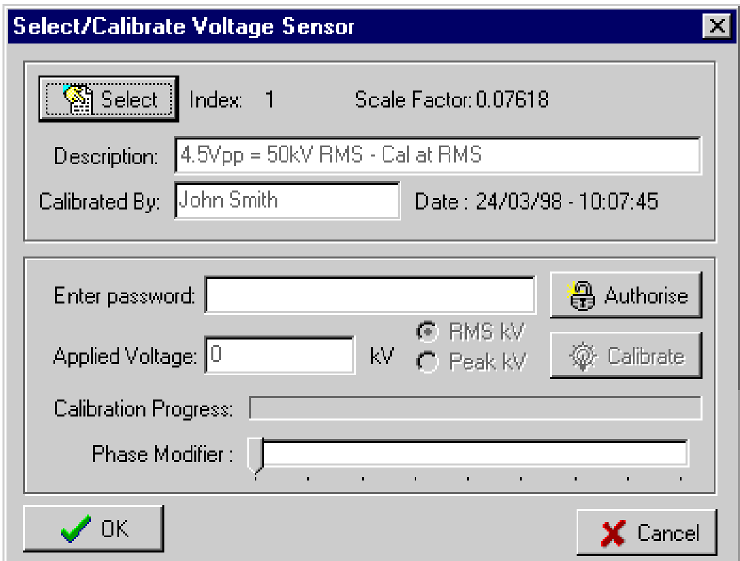
There are many deviations from this ideal scenario which are catered for by the Pulse Discrimination System as implemented in the DDX-8003 but the principle remains the same.

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 via 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 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.

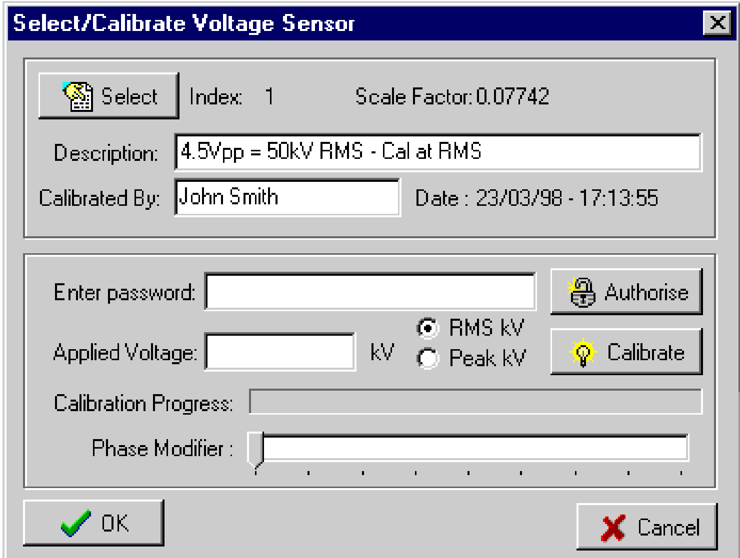
A voltage sensor is selected by clicking on the select button to step through the available sensors until the required one is indicated in the 'Description' test box. Once the required sensor has been found using the select button, clicking 'OK' will make that sensor the current one, updating the calibration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

This window is also used to calibrate the voltage sensor. To do this, the user needs to be authorized to calibrate the system. To perform the calibration process, enter the correct password in to the 'Password' edit box and then press the 'Authorise' button. If the password is entered incorrectly, access to the Voltage Sensor Calibration will not be allowed

Voltage Sensor Calibration

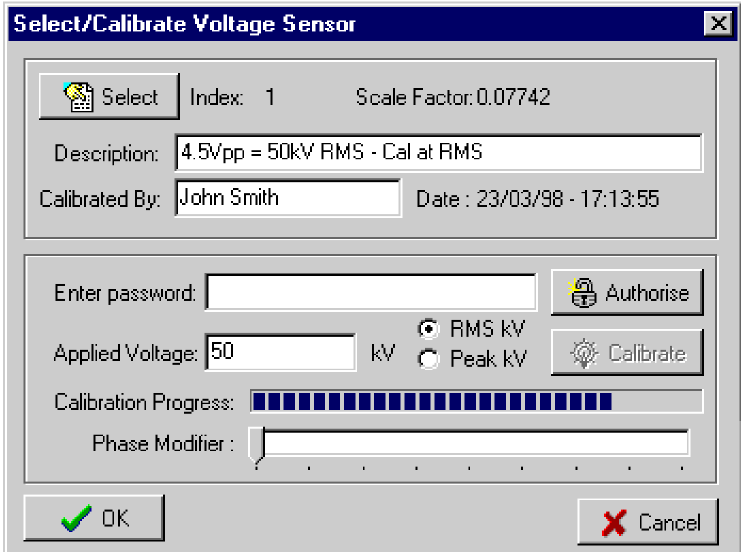
Voltage sensor calibration can be performed by those only who are authorized to do so, and have been given the password for the system. To perform voltage sensor calibration requires suitably calibrated equipment to measure the HV that is actually applied to the sensor being calibrated.

To perform the calibration, it is necessary to select the Select Voltage Sensor window from the menu bar. Once the window is displayed, the user types the password into the Password edit box and presses the authorise button. If the password has been entered incorrectly, then the system displays a message box refusing access to the calibration system. In this case the window stays in Voltage Sensor Selection mode. If the password is entered correctly and authorized, the widow enters calibration mode as indicated:



In this mode, the text in the 'Description' and 'Calibrated By' boxes can be edited, and the 'Applied Voltage' edit box and 'Calibrate' button are enabled. In this mode the select button cycles around all 16 calibration settings in turn, 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 'Calibrated By' edit box. If a sensor entry 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) To correct for any phase shift in sensor, apply HV so that voltage can be measured
6) Arrange for discharge activity using a well know phase relationship (e.g. Corona from spike)
7) Adjust the Phase Modifier slider until the discharge activity is shown in the correct phase of the display.
8) The applied value of voltage is read off 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).
9) The user clicks the calibrate button to start the calibration process.
10) The system checks that a description has been entered (No longer 'Not Set'), that a name for the person calibrating has been entered (No longer 'Not Set') and that 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.
11) 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 made current.

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-8003 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.

Calibrating the system

The DDX-8003 system is designed to read in true pC over all ranges of the system. The actual calibration is dependent 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-8003 allows two modes of calibration: Automatic and Manual. The automatic mode calibration (see Auto Setup) requires minimal user intervention and will in the majority of cases provide the best calibration of the system. In some cases, this will not be considered to 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 which is used 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 contributions: the system noise contribution and the test circuit noise contribution. The system noise is the contribution of the first stage amplifier. The contribution of 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.

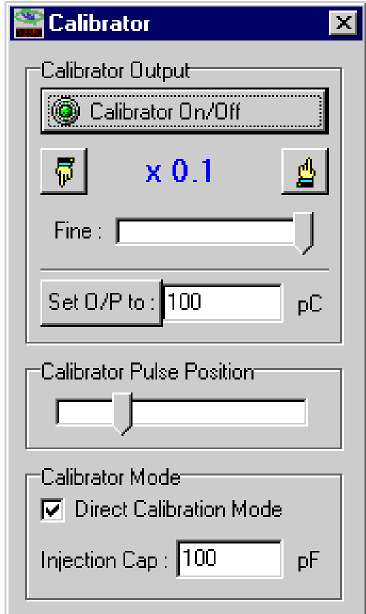
The circuit noise contribution will normally be the dominant factor, being the proportion of the noise contribution due to external influences. When the system scales this to calculate the contribution to the noise floor it takes into account both the fine gain and the attenuator setting. The noise floor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

It is possible for non-linearities to be introduced into the system as a result of operating at extreme loads and load ratios. To compensate for this, the automatic calibration process corrects for the shift in gain introduced as part of the calibration process. If this facility is not required, it can be turned off using the Measurement window.

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 control window.



The calibrator is 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 go 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.

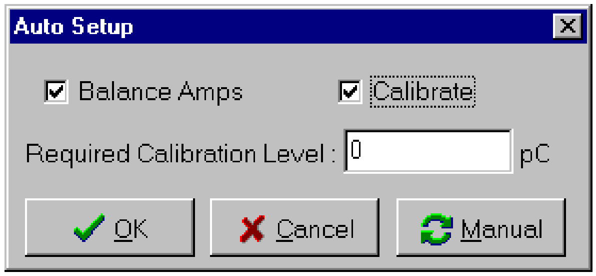
It is also possible to set the calibrator output directly in PC using the output edit box. The required value is entered into the edit box and the Set O/P to: button is pressed. This calculates the required output setting based on the calibrator configuration and sets the range and fine controls up accordingly. 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 with the negative going one 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 hand side, the pulses have been rotated a complete cycle so are back at 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 manufacturers' stated value.

Auto Setup

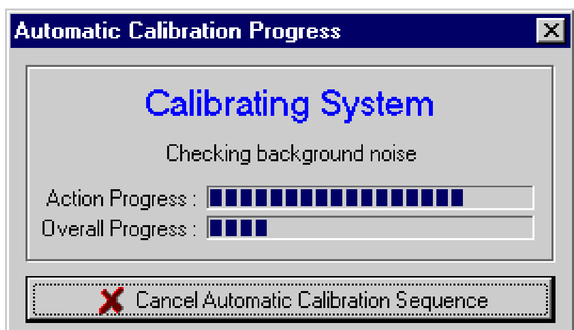
The automatic calibration sequence can be selected from both the Speed Bar and the Menu. When selected the system displays the automatic setup window which has 2 effective functions, to balance the output of the 2 standard Amplifiers and Calibrate the metering system.

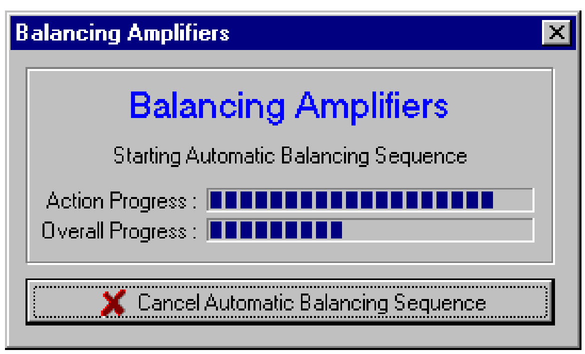


Selecting the Balance Amps checkbox, will cause the system to attempt to adjust the 2 Amplifier settings to achieve a similar average output for each, when the OK button is clicked. The user may use this automatic option, or perform the task manually from the amplifier setup window.

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 Calibrator for Gain range 0
Calculating Gain for Gain Range 0
Setting Calibrator for Gain range 1
Calculating Gain for Gain Range 1
Setting configuration for calibrate
Checking background noise
Setting configuration for calibrate
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 first four operations are part of the Extreme Load Gain correction system. These will not be performed if extreme load gain correction is turned off (See Measurement). 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 is:

Setting configuration for calibrate

The system saves the current instrument setup to file prior to the calibration being performed. 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. Once the current configuration has been saved, the system reconfigures itself for the calibration process

Setting Calibrator For Range 0

The calibrator is being set up to measure the gain shift between range 0 and range 1. The amplifier is set to range 0 and 10% fine gain. The calibrator is set to give about 75% of full scale. This operation is only performed if Extreme Load Gain Correction is selected (See Measurement)

Calculating Gain For Range 0

The amplifier is rest to range 1 and 100% fine gain (nominally the same gain as the previous stage) and the reading is compared with that from the previous stage. The correction factor for the range 1 to range 0 transition is calculated. This operation is only performed if Extreme Load Gain Correction is selected (See Measurement)

Setting Calibrator For Range 1

The calibrator is being set up to measure the gain shift between range 1 and range 2. The amplifier is set to range 1 and 10% fine gain. The calibrator is set to give about 75% of full scale. This operation is only performed if Extreme Load Gain Correction is selected (See Measurement)

Calculating Gain For Range 1

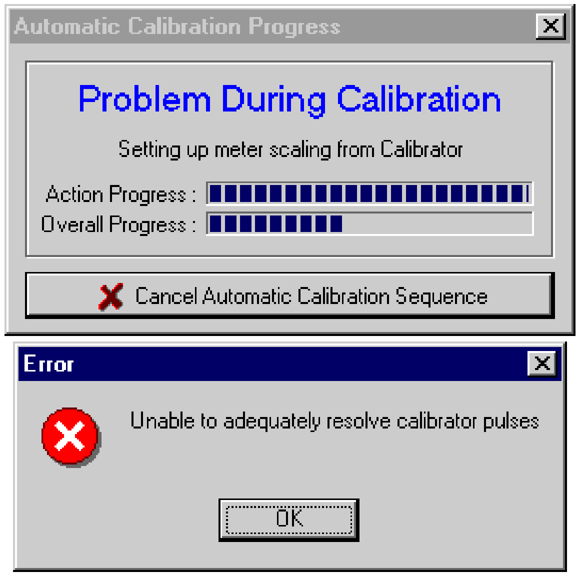
The amplifier is rest to range 2 and 100% fine gain (nominally the same gain as the previous stage) and the reading is compared with that from the previous stage. The correction factor for the range 2 to range 1 transition is calculated. The overall correction factors are calculated. This operation is only performed if Extreme Load Gain Correction is selected (See Measurement)

Checking background noise

The system then ensures 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 and then measures the background noise level.

Setting up meter scaling from calibrator

The calibrator is switched on and set to the level set on 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 it is not at least 50% greater then the calibration process is terminated with an error:



This indicates that it could not distinguish the calibrator pulses clearly enough over the background noise to get a satisfactory calibration which could be for a number of reasons:

1). The calibrator pulses are not significantly larger than the background noise. Selecting a larger calibration value can rectify this. 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 vertical gating system gates the calibrator pulses out. 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 completed, 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 is:

Setting configuration for calibrate

The system saves the current instrument setup to disk prior to the calibration being performed. 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. If the current configuration is saved successfully, the system reconfigures itself for the calibration process

Setting Calibrator For Range 0

The calibrator is being set up to measure the gain shift between range 0 and range 1. The amplifier is set to range 0 and 10% fine gain. The calibrator is set to give about 75% of full scale. This operation is only performed if Extreme Load Gain Correction is selected (See Measurement)

Calculating Gain For Range 0

The amplifier is rest to range 1 and 100% fine gain (nominally the same gain as the previous stage) and the reading is compared with that from the previous stage. The correction factor for the range 1 to range 0 transition is calculated. This operation is only performed if Extreme Load Gain Correction is selected (See Measurement)

Setting Calibrator For Range 1

The calibrator is being set up to measure the gain shift between range 1 and range 2. The amplifier is set to range 1 and 10% fine gain. The calibrator is set to give about 75% of full scale. This operation is only performed if Extreme Load Gain Correction is selected (See Measurement)

Calculating Gain For Range 1

The amplifier is rest to range 2 and 100% fine gain (nominally the same gain as the previous stage) and the reading is compared with that from the previous stage. The correction factor for the range 2 to range 1 transition is calculated. The overall correction factors are calculated. This operation is only performed if Extreme Load Gain Correction is selected (See Measurement)

Checking background noise

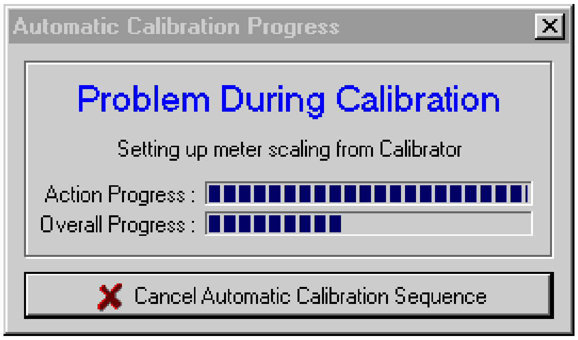
The system then ensures the internal calibrator is switched off and ranges the amplifier down to measure the background noise on the system. It allows the metering to settle and then measures the background noise level.

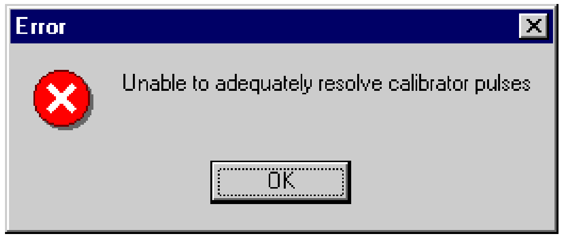
Setting up meter scaling from calibrator

Once the background noise has been measured, the system is ready to start the 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 it could not distinguish the calibrator pulses clearly enough over the background noise to get a satisfactory calibration. This could be for a number of reasons:

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

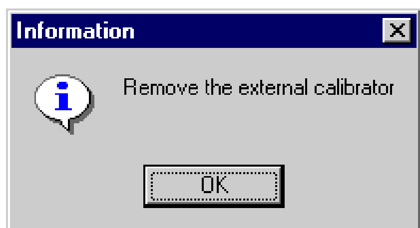
2). The calibrator pulses are not significantly larger than the background noise. Selecting a larger calibration value can rectify this. Because the system tracks the amplifier scaling and compensates for it, this will not significantly degrade the meter accuracy

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 vertical gating system gates the calibrator pulses out. 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 requests that the user removes the external calibrator:



The calibration process continues once the calibrator has been removed and the user has clicked on the OK button. 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 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.

Setting internal calibrator scaling

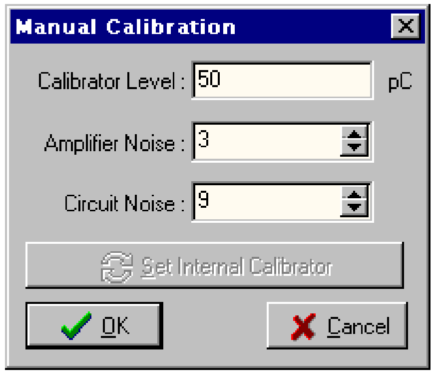
When the system has set the noise floor up, the internal calibrator is switched on and set to some arbitrary value. The system measures the magnitude of the pulses being produced and uses this to set the scaling of the calibrator so it can be set in pC. Once it has done this, the calibrator is switched off.

Updating system configuration

Once the calibration process is completed, the system recalls the original configuration. 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 the error codes see Load Settings). The calibration will be invalid in this case

Manual Calibration

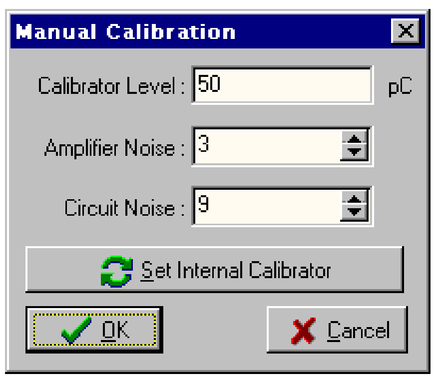
The Manual Calibration window is accessed from the Automatic Setup window by clicking on the 'Manual' button. This allows the user to set the calibration without going through the automatic setup sequence. It should not normally be used, except in those cases where the automatic calibration system is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



To calibrate the system manually, the user must provide a known calibration source to the system. If the system is in Direct Calibration mode, this is from 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 the calibration pulses are the largest pulses being seen by the measurement system and the value entered is correct. It also important, to ensure that these pulses 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 setting up of the system noise levels

If the calibrator is set to operate in indirect calibration mode, once the system has been calibrated, it is necessary to set the scaling on the internal calibrator. 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). Turn on Show Gated and Show Noise using the Display Appearance window.

2). Turn amplifier auto-ranging off using the Measurement window.

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

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

5). Enter the Manual Calibration window. Set the Calibrator Level to 0, set the Amplifier Noise 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 amplifier to settle.

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

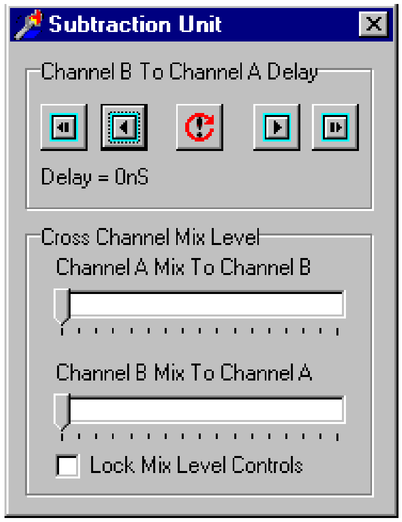
10). Adjust the circuit noise by typing in values or using the up and down buttons to adjust the noise floor on the Display until it just brackets the noise on the baseline

11). Click 'OK'

12). Set up the meter scaling as described.

Note: it is only necessary to set up the Amplifier 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.

Subtraction Unit



The Subtraction Unit window controls the RF Subtraction hardware module. This module provides the means to reduce the effect of external interference generated by radio broadcast stations or similar sources. See RF Subtraction Unit for more details.

Channel B to Channel A Delay

The set of buttons at the top of the window allows the relative delay between the A and B channels to be adjusted. The central button resets the delay to zero cancelling any previous setting. The single arrow buttons increase or decrease the delay by a factor of 10ns per click while the double arrow buttons operate in steps of 100ns. The maximum range of the controls is +/-990ns and the current setting is shown just beneath the control buttons.

Cross Channel Mix Level

There are two slider controls in this section:
Channel A Mix to Channel B
Channel B Mix to Channel A
These set the amount of one channel which is to be mixed with the other. They can be set independently to optimise the cancellation of the unwanted signal in each channel.
There is also a control button in this section:
Lock Mix Level Controls
Using this the slider controls can be locked together and operated by dragging the upper slider only.

NOTE:
There is no automatic set-up for this module so the operator must control all functions.
The recommended procedure is to set the delay and Cross Channel Mix Levels to zero and only alter this control if RF interference is preventing measurements.
Care must be taken to ensure that measurements are still valid for PD pulses when this control is not at zero since the cross-channel mix feature may disturb the PDS operation.

RF Subtraction Unit

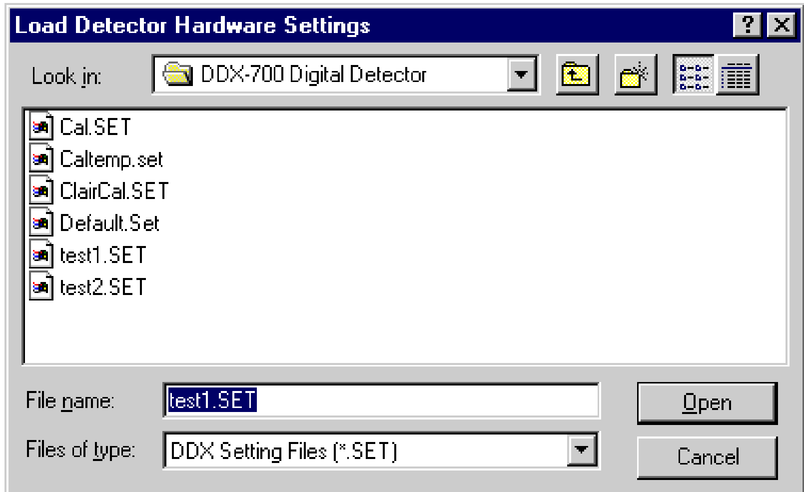
This unit takes the two signal channels of the 8003 system and processes them to cancel Radio Frequency interference. This interference is usually picked up on both input channels and often originates from a broadcast radio station. If possible the test circuit should be aligned such that the pickup is minimum in both channels.

In theory, the unit works by attempting to match the phase and amplitude of the RF signal in one channel with that in the other. The two signals can then be subtracted to cancel the RF interference. The result is that only the PD signal is left.
In practice this can only fully reject a single interference source although there is usually a position where total interference is minimised. Also the mixing process can sometimes make some types of pulse interference pass through the PDS as Internal Pulses.

The RF Subtraction Unit should only be used when RF interference would otherwise prevent PD measurements being made.

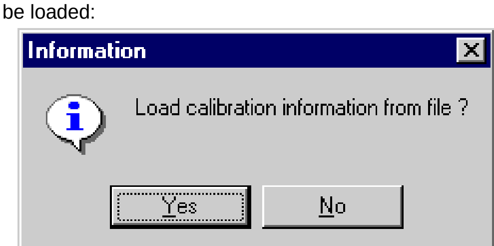
Load Settings

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 in from the file, it is essential that the test circuit configuration is 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.

In the event of there being 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

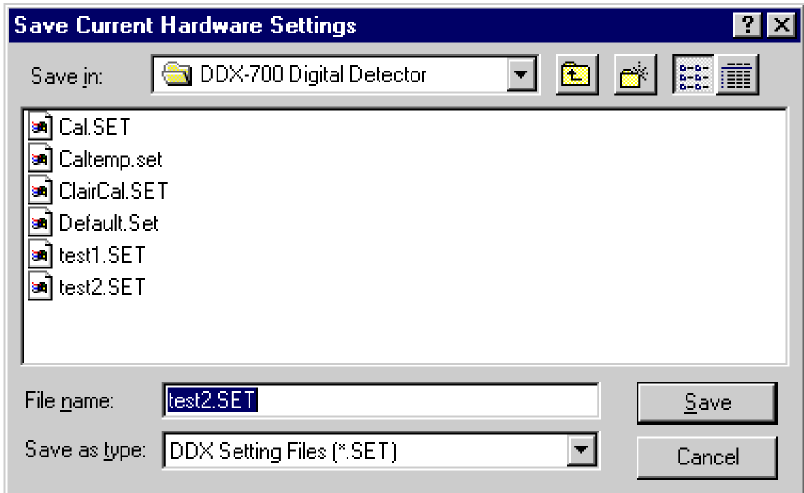
4 – **Too Many Open Files**. The system could not open the requested file.

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.

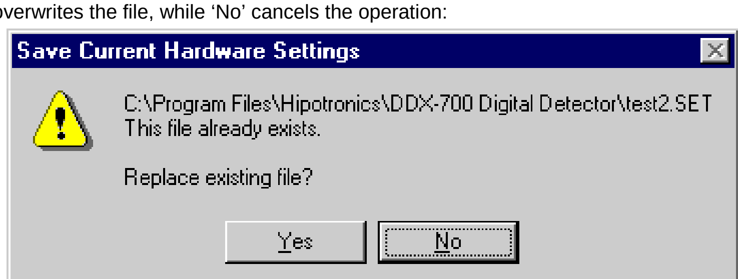
Save Settings

It is possible to save the current setup of the instrument to disk so that it can be recalled at a later date if necessary. 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 that is held in the system registry. When the Save Settings option is selected, the system displays the Save Settings window:

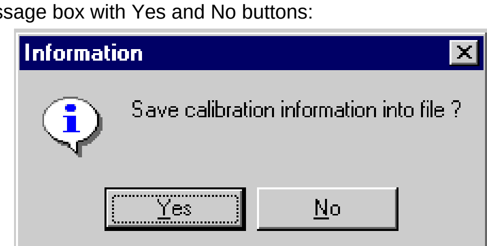


This lists the available settings file in the current directory. The controls at the top of the window allow the user to select the required directory and to change the format of the display (See Microsoft Windows documentation for more information. The file to be saved into is selected by entering its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

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

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 because of noise on the supply. The DDX-8003 provides three ways of controlling the information that is captured:

1) Horizontal gating
1) Vertical gating
1) Noise gating

It is possible to set whether the gated information is shown on the display, by using the Show Gated option on the Display Appearance window. Gated pulses are shown in red on the display and do not effect 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. Using the sliders on the Display Appearance window, the user determines the width and starting position of the gated out section(s). Care must be exercised when setting up the windows as some testing standards limit the amount of the wave shape that can be removed in this way.

Vertical Gating allows pulses that go above a define 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.

Noise Gating 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 as 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.

Analysis Modules

The DDX-8003 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 modules have the facility to 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-8003. There are two standard modules supplied with the DDX-8003:

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-8003. 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:

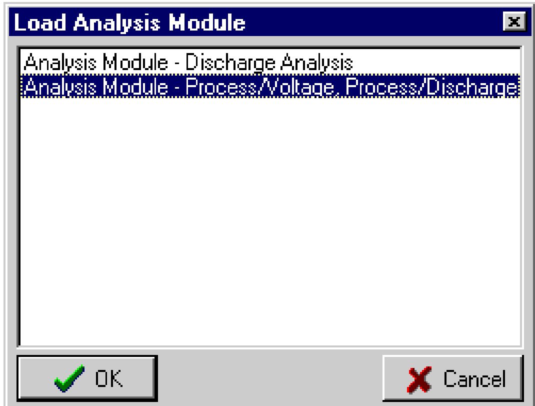
Discharge Analysis. This provides capture of discharge activity, generation of 3D plots, integrated quantities and discharge fingerprints

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

Select Analysis

The system supports Analysis Modules that extend the operation of the system by processing 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 a options to the system. The Select Analysis displays a window listing all the available data analysis modules installed on the system. The user can then select the required one. Clicking 'OK' will load the module, while 'Cancel' will abandon the operation.



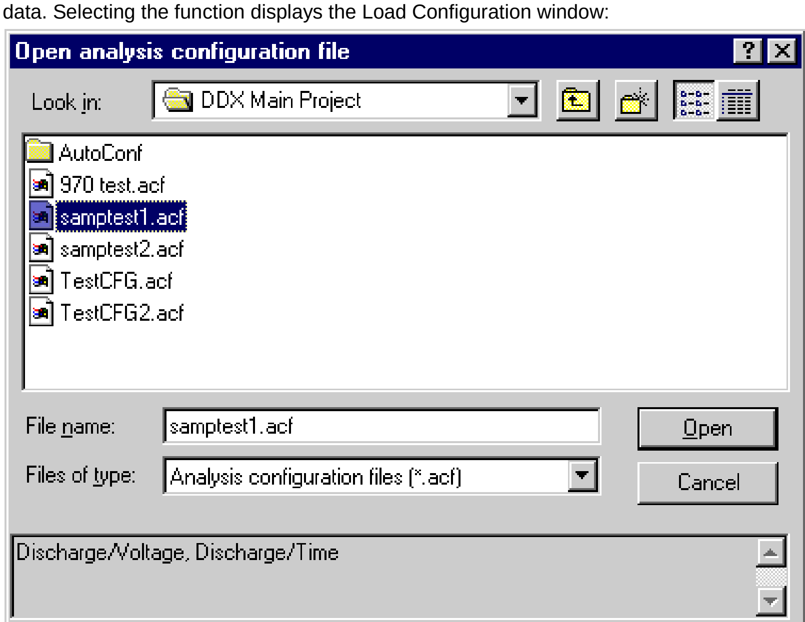
A different analysis can be selected, when one is already loaded as long as the loaded module is not in the process of capturing and processing data. During this period, the Select Analysis option on the Menu Bar and on the Speed Bar is disabled

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.

Load Configuration

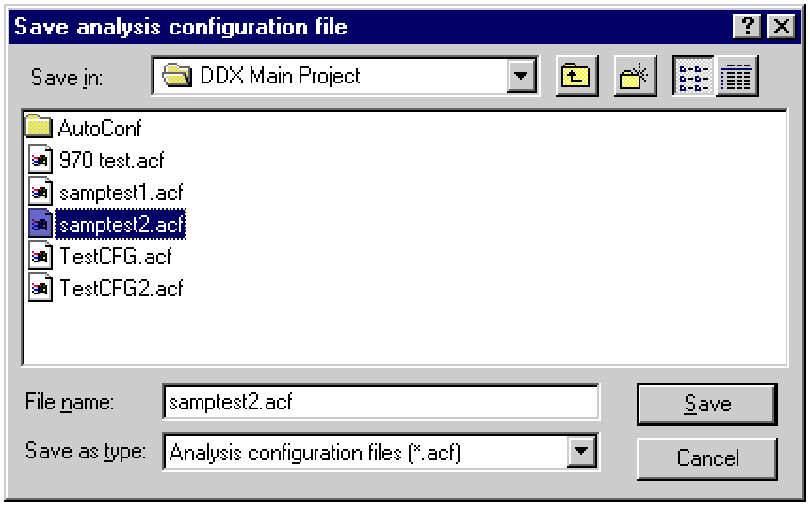
The Load Configuration function is available from the Menu Bar or the Speed Bar. It allows the user to recall an analysis configuration from disk. It is not available if there is an analysis module loaded and capturing or processing data. Selecting the function displays the Load Configuration window:



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 Configuration 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 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

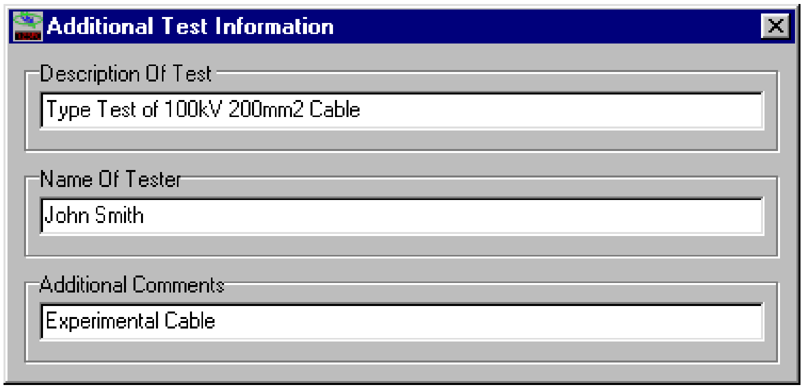
The Run Analysis function can be accessed from the Menu Bar and the Speed Bar. It also appears on the analysis module controls. It is only available for use when an analysis module is loaded and has been set up ready for use. Under all other conditions, it is disabled. Selecting the Run Analysis function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

Test Information

The user can specify additional information about the sample using the Additional Test Information window. The information entered in the three boxes on the window is printed out on the header section of the test report. It is also saved along 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).

Clicking on the ‘X’ in the top right hand corner minimizes the window. It can be activated by double clicking on its title bar or by selecting the ‘Test Information’ option from the file menu.

Print Results

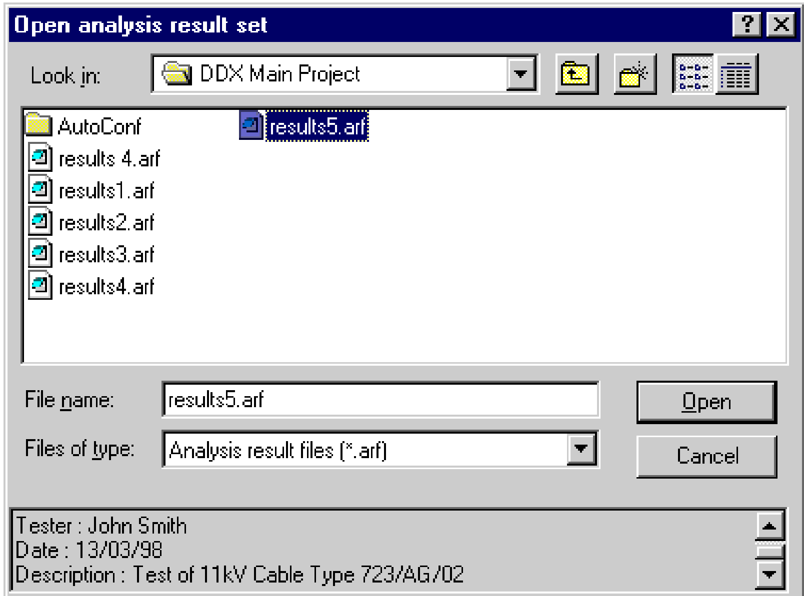
Print Results prints out the results processed by an analysis module. Before printing, any additional information should be entered using the Test Information window, or the Test Information boxes on the analysis module (if provided) to set up details of the tester and sample and any additional comments.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

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, clicking ‘OK’ will 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.

Load Results

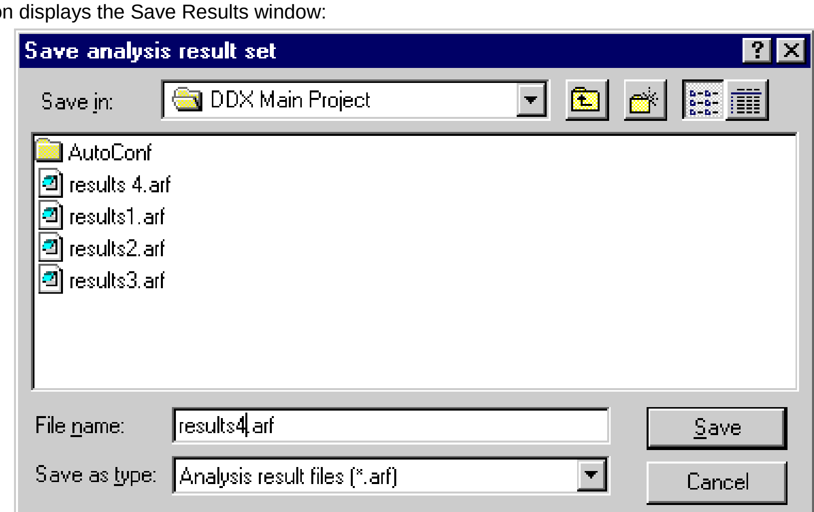
The Load Results function is available from the Menu Bar or the Speed Bar. It allows the user to recall a set of analysis results from disk. This option is not available if there is an analysis module loaded and in the process of capturing and processing data. Selecting the function displays the Load Results 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 and 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 Results 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 to be saved under 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.

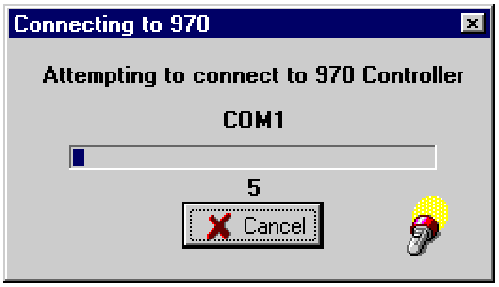
If the filename chosen for the result set belongs to a file that already exists, the system requests that the user confirms that the information in the file is to be overwritten. If the response is 'Yes', the data is saved, otherwise the operation is abandoned.

970 HV PSU Controller

The DDX-8003 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-8003 detector. The 970 can also be controlled from the Analysis Modules, allowing the system to be programmed to generate test profiles automatically. Clicking the button on the Speed Bar activates manual Control of the 970 system.

Before the system can operate with a 970 controller, it must be configured. The DDX-8003 communicates with the 970 via a fiber optic link. The 970 is supplied with a fibre optic link adapter that plugs into the COM1 port of the DDX-8003 (for details of connecting the two units, refer to the hardware manuals for the 970 and the DDX-8003). Once the units have been connected, it is necessary to configure the DDX-8003 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 COM1 Is unavailable) and the bus address should be set to the operating address of the 970. It is essential that the communications port is 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-8003. 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-8003, the 970 should be powered and switched to ‘REMOTE’ operation before the DDX-8003 is started up.

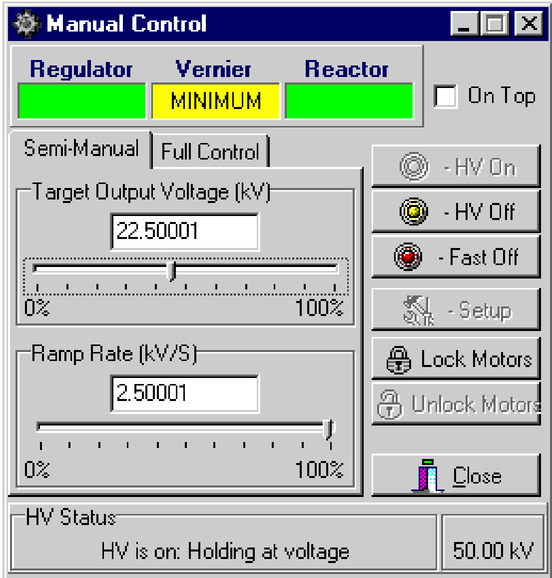
When the DDX-8003 has found a connected 970 system it display a message box to indicate success. The box reports the communication port being used to communicate with the 970 and the address of the 970. Clicking the OK button will clear this dialog box before the system can be used.

In the event that the DDX-8003 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.

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 leftmost one indicates the current 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 rightmost box indicates the currently selected 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, then 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.

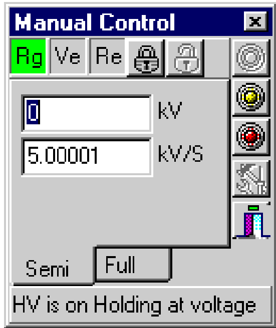
Fast Off The fast HV shut off shuts down the HV by opening the main contactor before winding the regulator and vernier to minimum. This gets the HV off as rapidly as possible, but does impose extra stress on the sample and power supply.

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.

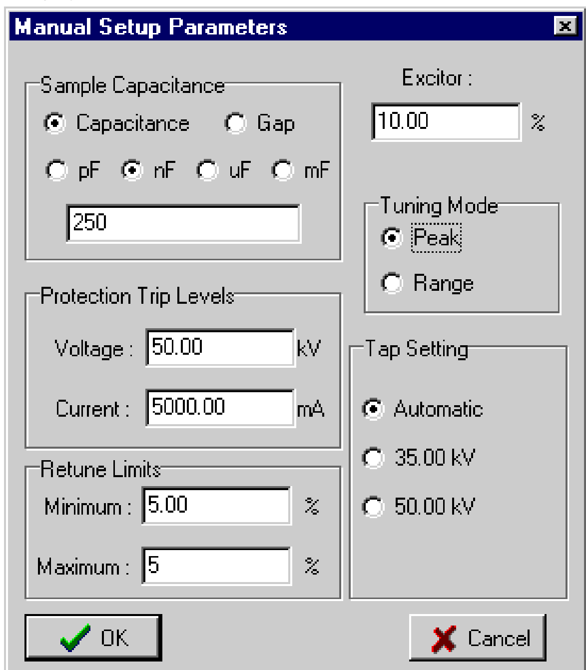
If the control window is found to be too large, clicking the minimize button (see System Window Elements) allows it to be reduced in size:



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 setup form is displayed:



When a series resonant set is being used with the system, it is necessary to set the capacitance so the system can establish a tune. The user can select to enter either a capacitance in pF, nF, uF or mF or alternatively a gap (in %). This is used by the 970 to establish the starting point for the tuning process. The Gap and Capacitance radio buttons select entry in terms of Gap or Capacitance. 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.

The system needs to be set for the safe limits of operation. 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-volting the sample. The maximum voltage is also used to determine the required tap setting if automatic tap selection mode is chosen. The maximum current 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

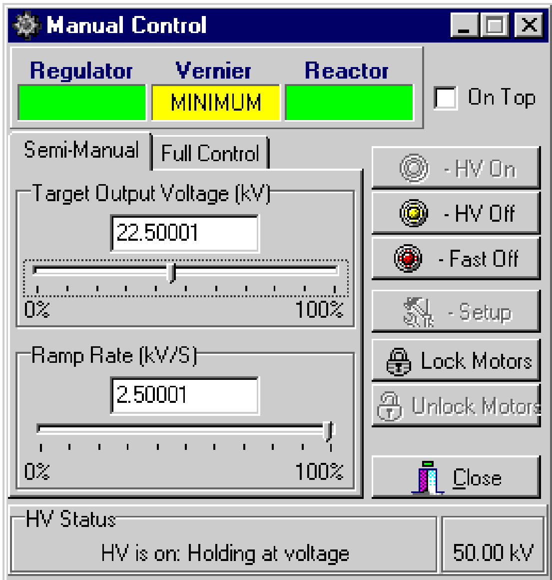
The excitor level specified the proportion of the maximum output of the excitor that is used by the system when attempting to establish a tune. This is only used for a series resonant system.

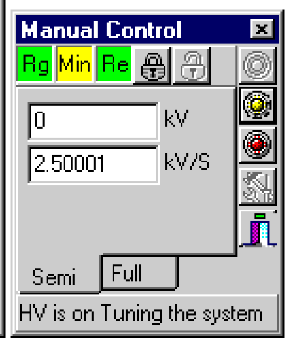
The tuning mode determines how a series resonant system tunes. 'Peak' mode forces the system to always tune to the peak of resonance, giving the purest output. 'Range' mode tunes the system off peak to give the greatest accuracy in setting the output. The amount to which the system is shifted off peak in 'Range' mode is set by the maximum safe voltage level set. 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:



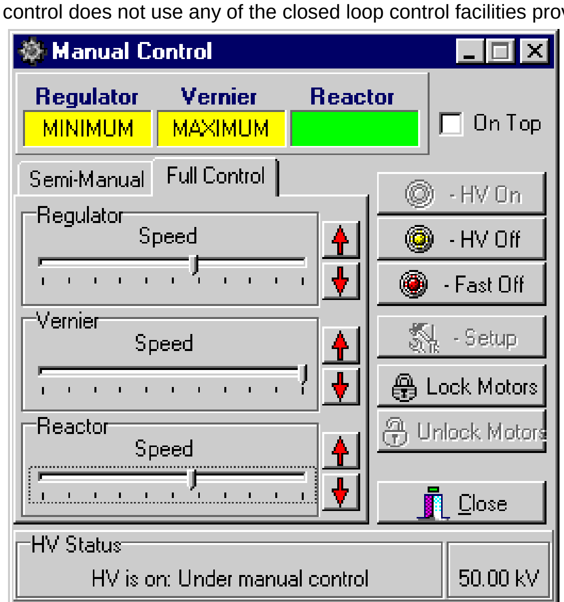


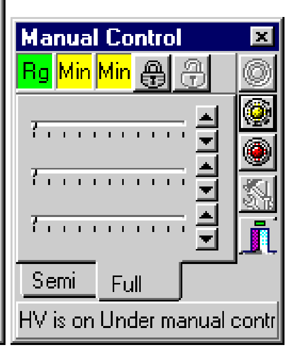
To set a specific output voltage, the user enters the required voltage using the Target Output Voltage edit box, to enter the required value in kV, or by setting the slider. The system adjusts the output to move to this voltage at the user set ramp rate. This is set using the Ramp Rate edit box to enter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



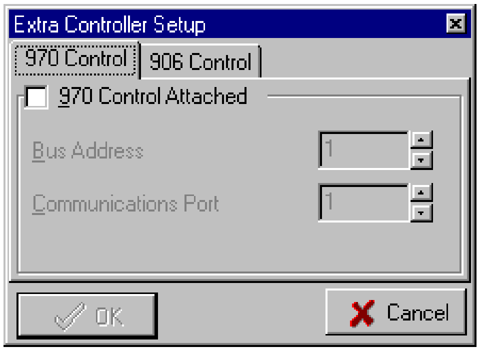


The user is provided with sliders to set the speed of travel of the regulator (top), vernier (middle, where fitted) and reactor (bottom, where fitted). These can be set between 0 and 100% of the full operating speed of the unit. To adjust the output, the user has two buttons for each control, one to 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

Attached Controllers

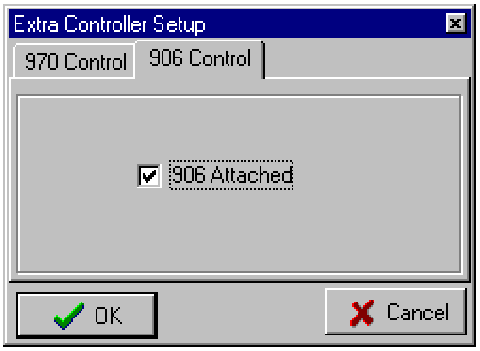
The DDX-8003 system is able to communicate with a Hipotronics 970/AC or 970/SR HV Power supply controller, giving an integrated testing system. The Attached Controllers menu option allow the user to specify the communications port and the address of the 970 controller and indicate the optional presence of a 906 controller:



970 HV Controller

If there is a 970 controller attached to the system, the user should check the '970 Control Attached' box, which will cause the DDX-8003 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 sits at. This is normally 5 though it can be in the range 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 for the controller at all available addresses on 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 factory has specially customized the system.



Hipotronics 906 Controller

An option is given, in this dialog box, for a 906 controller attached to the 8003 Pulse Discrimination system to be flagged. This controller is detected at startup of the 8003 PDS application.

The user must ensure that the 906 is fully charged and connected appropriately, to the 8003 system prior to running the application.

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.

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.

V1.03 – Update to V1.02, Released 06 August 1998.

Display of noise floor level has been modified to show on the left hand side of the caption bar not the right.

False display of the calibration warning light after automatic calibration has been rectified.

Pulse display printout routine has been modified to eliminate problem of not printing out the pulses.

Metering setup has been modified to ensure the Peak/RMS indication always displays correctly.

Wave shape capture has been modified to ensure that the correct phasing is always used

Display of the currently selected voltage sensor has been placed on the status bar.

The mode selection of the Quick PDSL window has been changed to allow the system to be toggled between length, time and frequency modes.

The Quick PDSL window now has an edit box to allow the units of length to be set.

Gain correction on the lower two amplifier ranges has been added. This facility is controlled on the measurement window. The gain correction is carried out as part of the automatic calibration

V1.04 – Internal release only

Update to the display handling system to allow pasting out of the contents of the pulse display either as a bitmap onto the clipboard or as a comma separated text file for import into other applications.

V1.05 – Update to 1.04, Released 21-September 1998

Support for external X-Y type chart recorders included. This requires the addition of a hardware module to interface with the recorder. The extensions are not active if the hardware is not installed.

Known Issues

V1.00 Program launch 24 April 1998

V1.01 Reports of errors with automatic calibration system gives 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.

V1.02 No Issues reported on interim release

V1.03 No Issues reported on interim release

V1.04 Internal Issue only

System Window Elements

The Robinson 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 right hand top corner of the screen. The functions of these buttons are:

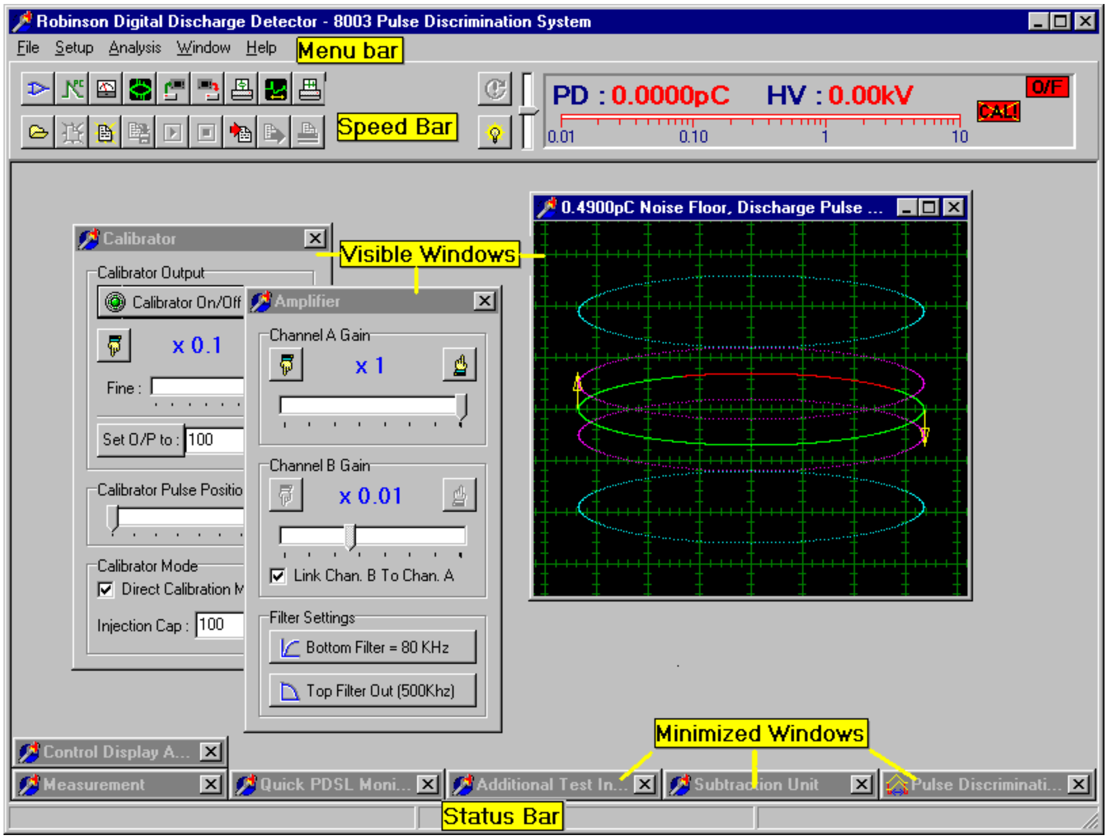
 Closes the Digital Discharge Detector software and returns to Windows95™

 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. Dragging the sides of the window to the desired dimensions can set the size. 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 by double clicking on the title. The window then becomes active. Clicking on the button in the right hand corner can minimize a visible window.

Some of the available windows have three buttons in the right hand top 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. Having its title bar highlighted indicates this window. Clicking on another visible window can change the active 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 them to be brought into full view.

The menu bar lies just below the title bar. This allows access to all the various sub-functions of the system. To select a menu option, click on one of the words in the title bar to highlight it. Below it pops up a list of the available options. Move the mouse down to highlight the required option. Clicking the highlighted option selects 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 (…) by 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 status bar occupies the bottom of the window. 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 then this will remain blank. The third section indicates the currently selected voltage sensor

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 highlights 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. Some of the options have 'Hot Keys' associated with them. Simply typing the 'Hot Key' combination can access these functions. 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 hand 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 (…) by 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	Hot Key	Description
Load Settings …	ALT-F L	None	Load instrument setup from disk
Save Settings …	ALT-F S	None	Save current instrument setup to disk
Print Setup …	ALT-F R	None	Selects the printer to be used and set its properties
Page Setup …	ALT-F G	None	Setup the format for the printout page
Select Font …	ALT-F F	None	Selects the text font to be used for printing
Test Information	ALT-F T	None	Enter report information for the sample under test
Print Pulse Display	ALT-F D	None	Prints out the current pulse display
Print Quick PDSL	ALT-F Q	None	Prints out the current PDSL display
Abort Print	ALT-F A	None	Abandons the print that is in progress
Exit	ALT-F X	None	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	Hot Key	Description
Auto Setup …	ALT-S S	CTRL+S	Runs the automated calibration procedure
Amplifier	ALT-S A	CTRL+A	Activates the amplifier setup window
Calibrator	ALT-S C	CTRL+C	Activates the calibrator setup window
Measurement	ALT-S M	CTRL+M	Activates the measurement setup window
Display	ALT-S D	CTRL+D	Activates the display appearance and gating window
Subtraction Board	ALT-S U	CTRL+U	Sets up the Subtraction board
Select Voltage Sensor	ALT-S V	CTRL+V	Selects the voltage sensor and calibrates voltmeter
Setup Data Acquisition ...	ALT-S Q	CTRL+Q	Sets up the data capture characteristics
Attached Controllers	ALT-S T	None	Configures any attached 970 Controllers

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	Hot Key	Description
New	ALT-A N	None	Sets up a new analysis configuration
Select Analysis …	ALT-A S	None	Selects the type of analysis to be used
Load Configuration …	ALT-A L	None	Loads a previously saved analysis configuration
Save Configuration …	ALT-A C	None	Save the current analysis configuration to disk
Load Results …	ALT-A O	None	Loads the results of a previously run analysis sequence
Save Results …	ALT-A R	None	Save the results of the last run analysis sequence

Save Results as CSV File	ALT_A V	None	Saves the current results to comma separated records
Run Analysis	ALT-A A	None	Starts the current analysis sequence running
Stop Analysis	ALT-A T	None	Halts the currently running analysis sequence
Print Results	ALT-A P	None	Prints the results of the last analysis

Window Menu

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

Caption	**Keyboard**	**Hot Key**	**Description**
Tile	ALT-W T	None	Arranges all active windows alongside each other
Cascade	ALT-W C	None	Arranges all active windows on top of each other
Arrange All	ALT-W A	None	Arranges 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 will display a window in which the user can select which of the available windows they wish to select as active.

Help Menu

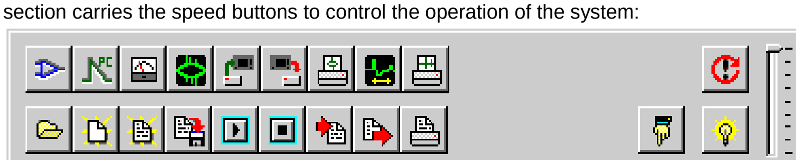
The help menu provides the options for accessing the on-line help system

Caption	**Keyboard**	**Hot Key**	**Description**
Show Hints	ALT-H O	None	Turn on or off the display of control function hints
Contents	ALT-H C	None	Show the help file contents page
Search For Help On	ALT-H S	None	Show the help file index page
How to use Help	ALT-H H	None	Display the instructions for using Windows help
About	ALT-H A	None	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:



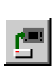
Clicking any of the buttons using the mouse activates the corresponding control function. The speed buttons do not have any keyboard control associated with them. To use the keyboard to access the functions use the key sequences or hot keys defined on the menu bar. Some of the buttons may be disabled (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 the function when it is not valid to do so. 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. Where 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 he 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.

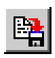
Activates the Quick PDSL window ready for use. This allows the inspection of pulse shape and the manual measurement of fault location.

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.

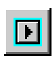
Select a new analysis module. This allows the user to select which analysis module is to be used. When a module is selected, it is loaded into the system with a blank configuration which must be set up before use.

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

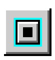
Loads an analysis configuration from disk. Allows the user to load a previously saved analysis configuration for re-use.



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 the data from it



Halts the current analysis. Terminates the running analysis sequence without waiting for it to finish

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.

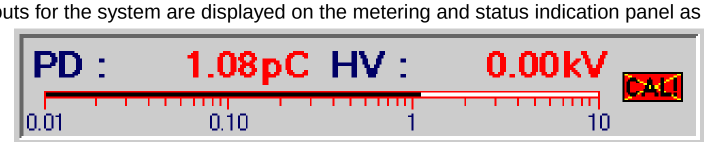
Reset the last held peak. When the measurement system is configured to hold the highest peak recorded, pressing this button clears the reading to allow it to be re-acquired.

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. When pressed 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 towards the top, 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 out if a screen snapshot is taken unless the intensity has been set to zero, when it is disabled.

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 so that once the system is calibrated, it reads out correctly irrespective of the setting of the amplifier. If the system is being over ranged, the discharge meter cannot be relied on and prefixes the reading with '>' to indicate the value is unreliable. 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. This means that full scale on the system will not correspond to full scale on the meter. On the right hand 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 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.

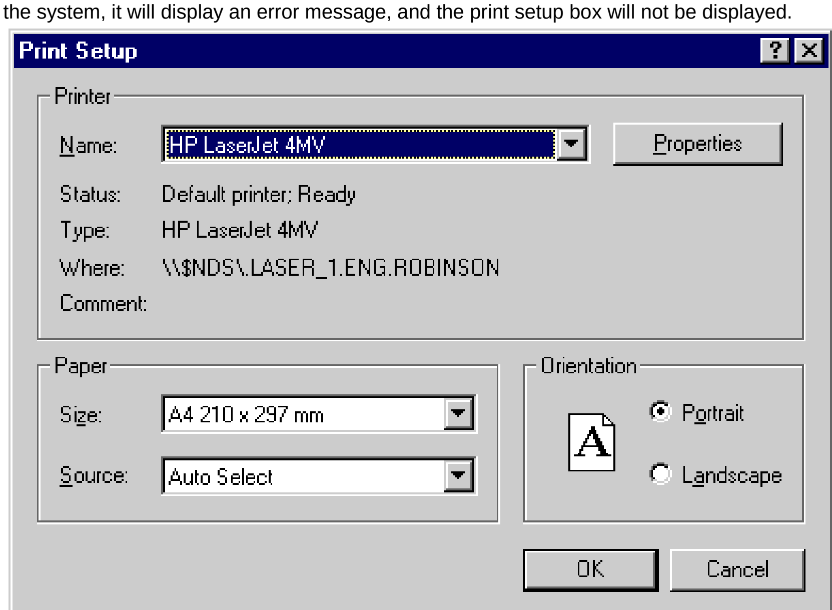
See also How the System Measures for details of the measurement procedure.

Show Hints

Show Hints is accessed from the Menu Bar. If Show Hints is selected, the Show Hints option in the menu has a tick 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 displayed giving a brief description of the operation of the control. The description is also displayed on the left hand status panel at the bottom of the screen.

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.

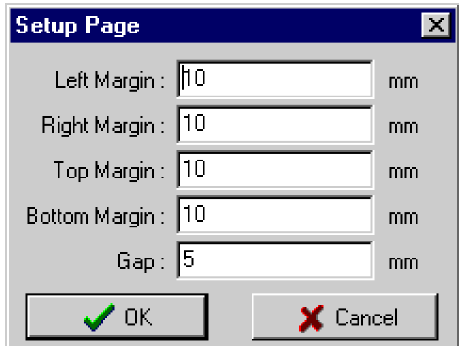


The printer is selected using the drop down box to display a list of available printers for the system. Clicking the properties button allows the specific aspects of the printer to be set up. The options that are available depend on type of printer. It is also possible to select the size of paper that is to be used. Be sure to select a size that matches that in the printer, otherwise the results may not print correctly.

It is also possible to set the orientation of the paper: 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

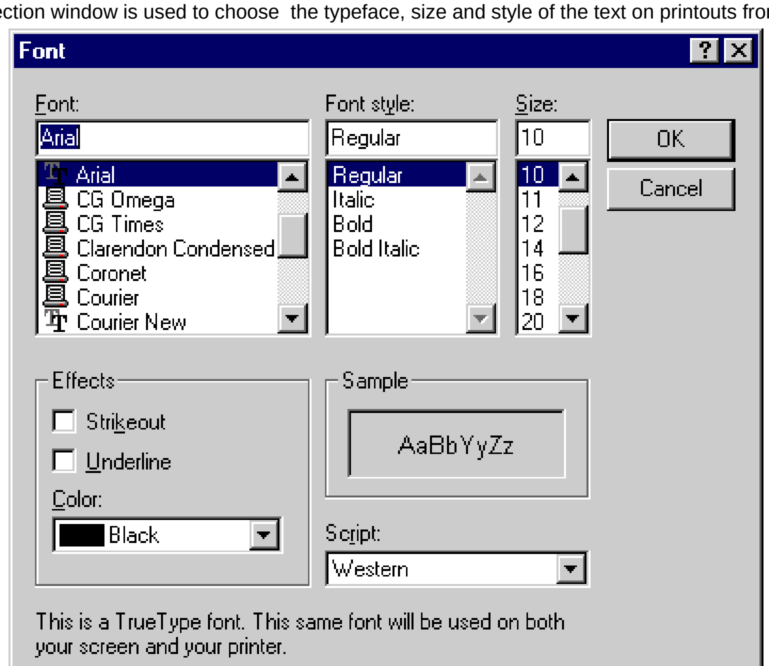
Bottom Margin specifies how much space is left at the bottom of the page

The 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 on the box. An example of the selected font is shown in the Sample box. It is recommended that the font size should be restricted to a maximum of around 10 points to prevent the text printed out from overlapping. If larger paper or landscape printing is used, then it is possible to use a larger font size.

Abort Print

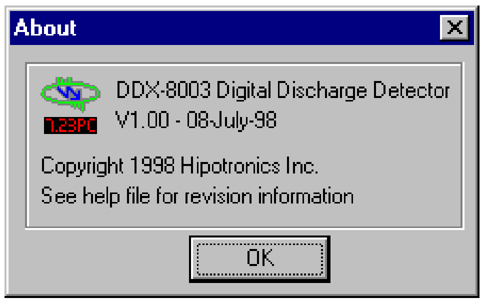
If the system is in the process of printing information, selecting the Abort Print option from the Menu Bar will cause the system to halt the printing process. Transfer of data to the printing system will be stopped. If the printing system has data that is being sent to the printer, that will still be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

Exit

Selecting the Exit option from the menu bar or clicking on the close button in the top right hand corner of the display closes down the DDX-8003 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.

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 detail the software version and any customizations or modifications to the software for them to be able to provide the required information

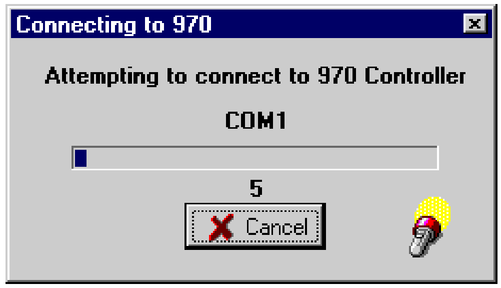
System Start Up Sequence

When the DDX-8003 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), the user is given a message box warning the calibration information is invalid. The user is asked whether they wish to run the system or not. If 'No' is selected, the DDX-8003 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) until the application is re-started.

Once the system has loaded the calibration information, it attempts to load in 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 is displayed indicating 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 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.

The system will automatically detect an attached Hipotronics 906 controller at this stage.

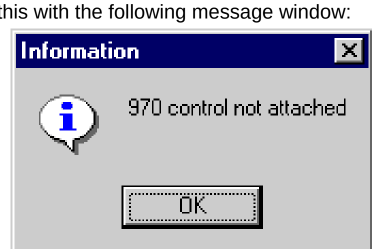
Once the calibration and the settings have been loaded up, the DDX-8003 operating window is displayed. The next stage of the start up sequence is only run if the system is set to use a 970 PSU controller. It scans the communications bus looking for the 970 HV PSU controller. It starts the search at the 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 cancelled 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-8003.

If a 970 is found on the system, the DDX-8003 determines its capabilities. This allows the DDX-8003 to correctly control it. Once this process is complete, the DDX-8003 confirms the presence of the 970 controller:

Alternatively, if no 970 was found or the search cancelled, then all HV control functions on the DDX-8003 are disabled. The DDX-8003 indicates this with the following message window:



In both cases, clicking the 'OK' button will clear the message window and start the DDX-8003 system running.

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

Direct Calibration

Direct calibration injects charge into a High Voltage Capacitor 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 dependant 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 dependant on the circuit configuration. In this mode it is necessary to set the calibrator up from an external reference source.

Chart Recorder Drive Option

When installed, the Chart Recorder Drive Option allows the DDX-8003 system to drive an X-Y chart recorder system using data from the PD and voltage meters on the display. This allows recording of information in the same way as a traditional discharge detector. It allows pre-existing report forms and systems to be maintained.

The Chart Recorder Drive Option consists of a hardware module with a 9 way D type socket mounted on it. This connects to the chart recorder as follows:

Pin 4 – Discharge Output negative

Pin 5 – Discharge Output positive

Pin 8 – Voltage output negative

Pin 9 – Voltage output positive

Both outputs are 0 to 10Vdc outputs with a 20mA drive capability and a 12bit resolution (Step size = 2.44mV).

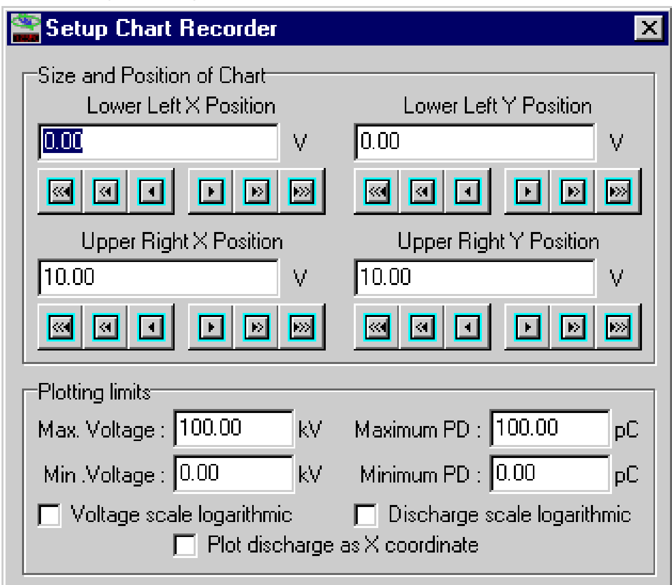
The chart recorder option allows the user to set up the plotting limits of the chart, allowing the system to be used with pre-printed chart forms. Setting the lower left and the upper right corners of the plotting area does this. Once these are set, the DDX-8003 will not drive the pen outside the limits. It is also possible to set the scaling of the plot output on both axes. Setting the magnitude of the upper and lower limits (in pC for the discharge and in kV for the voltage does this). The scaling and limits are set using the Chart Recorder Setup window which can be accessed from the setup menu or by pressing Ctrl + R on the keyboard. If the chart recorder option is not installed, the menu option is not displayed.

The Chart Recorder Drive option has three operating states. A button on the toolbar (see Chart Recorder Toolbar Control) controls these. On startup of the DDX-8003 software, the recorder drive is placed into the reset state. The outputs are set to place the recorder pen onto the lower left-hand corner of the defined plotting area. When the paper is loaded into the plotter the system is ready to start plotting. Once the user has got the system ready to start the test, they can start the chart recorder outputs running. The outputs are adjusted each time the meters are updated to position the chart recorder pen to reflect the applied voltage and discharge on the sample. Once testing has been completed, the user selects stop mode. This holds the chart recorder pen at the last output position to allow the paper to be unloaded. Once the paper has been unloaded, the pen position can be reset to its lower left corner ready for a new chart to be loaded for the next test.

The chart recorder outputs can be used to drive an X-T recorder to provide plots of voltage and discharge against time. The limits for the X and Y outputs can be set to provide separation of the two plots on the chart or to allow them to be overlaid onto a specific section of the plot.

Chart Recorder Setup

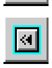
The Chart Recorder is set using the setup window below:

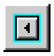


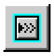
This allows the user to set up the plotting limits of the chart recorder and the scaling of the outputs. The setup window is accessed from the menu bar or by selecting Ctrl+R. If the recorder is currently running when the setup option is selected, the system will not allow the setup screen to be opened. It is necessary to stop the recorder output running before setting up. It is also recommended that any plots are removed from the chart recorder and a fresh piece of paper is inserted into it.

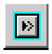
Defining the lower left and upper right corners of the plotting area sets up the size and position of the chart. This can be done in one of two ways – either by entering a voltage in the check boxes (10 volts corresponds to full scale) or by using the push buttons for each of the four coordinates. As the coordinates are adjusted, the position of the pen is changed to reflect the new position, allowing its position to be accurately set on the required limit of plot. For each of the coordinates, there are 6 buttons to allow the point to be adjusted:

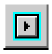
 Moves the position to the left (or down) very rapidly – full scale to zero = 16 steps

 Moves the position to the left (or down) rapidly – full scale to zero = 256 steps

 Fine position left (or down) adjust – full scale to zero = 4096 steps

 Moves the position right (or up) very rapidly – zero to full scale = 16 steps

 Moves the position right (or up) rapidly – zero to full scale = 256 steps

 Fine position right (or up) adjust – zero to full scale = 4096 steps.

The system imposes limits on the coordinates entered for the limit points. They must lie between 0 and 10volts. Additionally, the upper right corner must always be above and to the right of the lower left corner. The system will not allow the two to be crossed over.

As well as setting the plotting area, it is necessary to define the limits of the plot. Setting the maximum and minimum discharge values that will be plotted and the maximum and minimum voltage values that will be plotted does this. It is the responsibility of the user to ensure that the limits set are sensible for the tests to be performed. The system only checks to make sure that there no likelihood of mathematical errors being generated by the setting of the limits.

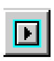
The chart recorder can be set to produce logarithmic scales for both discharge and voltage. Setting a tick in the appropriate check box does this. If logarithmic scales are selected and the lower limit is zero, it is automatically reset to be 10% of the upper limit (i.e. one decade). In logarithmic mode, it is not possible to have a zero or negative limit. In the event of one being entered, the user is warned that the limit is invalid and is prompted to re-enter it. Irrespective whether linear or logarithmic scales are set, the limits are set as true values.

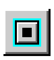
The other option for the chart recorder set up is to swap the X and Y axes, to allow a 90 degree rotation of the plot, This allows portrait plotting to be performed on a recorder that only supports landscape plotting or vice versa.

All the chart recorder settings are saved and recalled with the other instrument settings when the Save Settings or Load Settings options are selected. This allows specific chart recorder set-ups to be saved with specific test definitions.

Chart Recorder Toolbar Control

The Chart Recorder Option adds a single button onto the Toolbar. This sits just on the left of the held peak reset button for the discharge meter and just above the 970 Manual control button (see Speed Bar). The button shows the status of the chart recorder system:

 Indicates that the chart recorder outputs are reset (on the lower left corner of the plotting area) and the unit is waiting for paper to be loaded ready for plotting to proceed when the user is ready. Plotting is started by clicking the button which changes the button to:

 This indicates that plotting is in progress. This will continue until the user stops data recording by clicking the button, holding the pen in the position it held when recording was stopped. The button changes to:

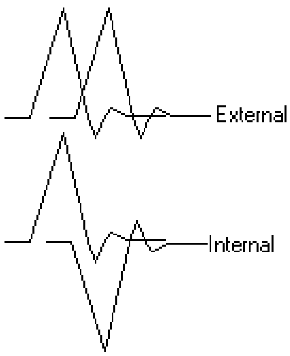
 Indicating that the paper can be removed from the plotter. When the button is clicked, the pen is repositioned onto the lower left corner of the paper. The button changes to indicate the reset state as above.

Pulse Discrimination System

The Pulse Discrimination System principle requires that two input units detect the result of a partial discharge at approximately the same instant. The user using the PDS Setup form may define this time period. A pulse is defined as valid if this condition is satisfied and if the polarities of the two detected pulses are opposite when generated within the circuit under test. Further to this, the input unit attached to the object causing the discharge can be deduced if the supply and signal polarities at the time of detection are known.

The device performs the function by allowing a short, defined, interval after the first pulse is detected during which the pulse from the other input unit can be detected. If both pulses occur within the allotted time then the pulse is deemed to be a valid discharge and can be either internal or external to the test circuit. This may be further refined by user definition of the noise threshold and gate levels. For a pulse to be valid, one polarity of each input channel only must be triggered. If both polarities of a channel are triggered, or only one polarity of one channel, the pulse is not valid (but can be selected for measurement if desired)

Internal and external pulses are differentiated by the polarity of their pulses



External Pulses
Polarities are equal

Internal Pulses
Polarities are opposite.

The Pulse Discrimination function of the DDX-8003 is based around a modularized PCB. The inputs ‘A’, ‘B’ and one transient channel ‘C’ are taken via the back plane. The other transient input ‘D’ is taken via a BNC connector on the panel.

All inputs are buffered and fed to window comparators whose thresholds are adjustable up to a signal level of 1 volt peak via local bus control.

There are two analogue outputs which have a fixed time delay of up to 2uS determined by the analog delay lines fitted on the PCB. The ‘A’ output is always taken from the ‘A’ input channel via its delay lines. The ‘B’ output channel is multiplexor selectable from any of the 4 outputs ‘A’,’B’,’C’ or ‘D’. The results from the comparators for the input channels are taken to the FPGA for digital processing.

Each of the input signals triggers a monostable that does not reset until after the Input pulse period has timed out. The state of the monostables in conjunction with supply phase information is analyzed to decide on the validity, polarity and location of the pulse.

The options for this function are adjusted via the Pulse Discrimination Set-up dialog box.

Pulse Discrimination Set-up Dialog Box

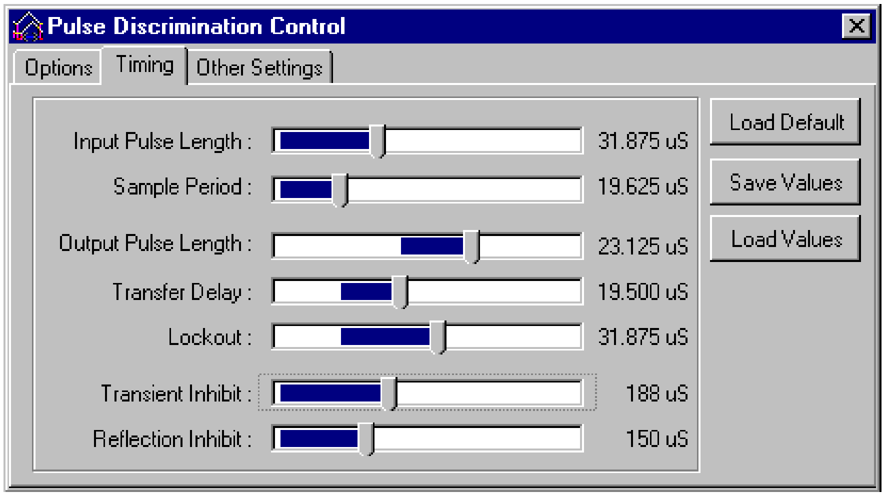
The Pulse Discrimination set-up dialog box enables the user to set various options for the Pulse Discrimination module of the DDX-8003 system. It consists of a page control of 3 tab sheets, each one controlling certain functionality of the PDS PCB.

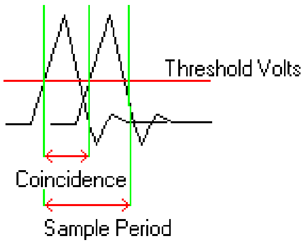
Access to the Options page is available to all users, there are two other pages in addition that offer advanced set-up options and are accessed via a password dialog box .

The following briefly outlines each of the tab sheets in turn.

Options Tab	The options tab sheet displays the most commonly used setup features for the Pulse Discrimination dialog box.
Timing Tab	The Timing tab sheet displays and allows the user to define event timings for the PDS system
Other Settings	The Other Settings tab sheet is available for some less common settings and should only be used by an official Hipotronics commission engineer.

Pulse Coincidence And Timing Issues





The first high to low transition occurring on an input line after a period of inactivity also starts the pulse coincidence detector circuit.

Coincidence

This period represents the delay between 2 discharge pulses passing through the voltage threshold. This value is not set in software and the user should adjust sample length so that it is greater than the possible coincidence period.

Analog Delay

The type determines this delay and number of delay lines fitted, and is initially 2uS.

Sample Length

The Sample period defines the time interval between the first transition of a pulse and the generation of a signal that re-samples the output. The sampled state is than stored for a short time defined by the Transfer Delay before being passed to the output drivers.

The effect of this is to determine whether one, two or more input transitions occur within the sample time window.

This time should be greater or equal to the coincidence period.

The total time taken for Sample time plus Transfer time should be less than the Analog Delay time.

The total time taken for Sample plus Transfer plus Output time should be greater than the total time taken for Analog Delay plus Coincidence times.

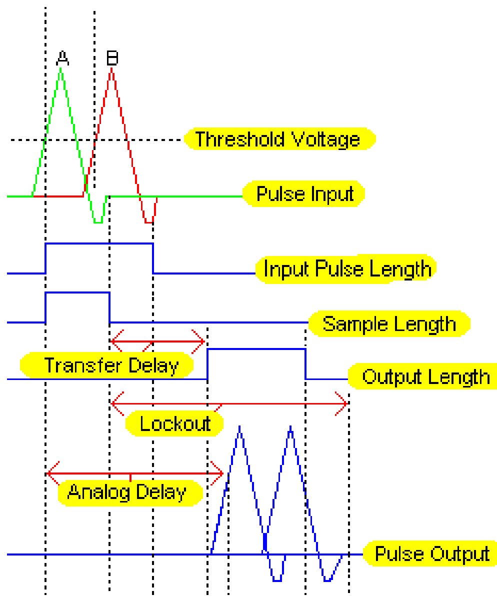
Input Pulse Length
The Input Pulse length may be described as a period during which any triggered pulses are stored before another transition is accepted and the pulses are reset.
When defining the timing periods of the PDS set-up form, Input Pulse Length must be greater than Sample Period.

Transfer Delay

The transfer delay is a period between taking the input sample and passing the data to the output drivers. The transfer delay time allows the output pulse to be positioned around the analog pulse after it has passed through the delay lines.

Output Pulse Length

During the Output period, pulse state data is held stable before being cleared.



Lockout

Lockout starts at the end of the Sample period and defines an interval during which no inputs are recognized.

Transient Delay/Transient Inhibit Time

There are two separate and independent inputs, each of which can be used with its own amplifier. The intent is that if a signal is detected on one of theses and Transient Inhibitor is enabled, the measurement system will be prevented from measuring any pulses, which occur during the transient delay period. They are re-triggerable so numerous trigger events can block the measurement system.

Reflection Inhibit Time

Reflection inhibit is triggered by input combinations which are generally similar to External pulses and is for use when testing cables. It is re-triggerable and can be used to disable measurement of any pulses while it is active. There is an option, when it is first triggered, that it only goes active after the pulse input which triggers it – thus allowing measurement of that pulse but blocking subsequently.

The user may define the period for reflection inhibition.

Hipotronics 906 Controller

When a 906 controller is attached to the system, normal operation of the 8003 amplifier and calibrator system is shut down and the controls on the Amplifier dialog box operate the 906 amplifiers instead.

If the user should wish to disable the 906 at any time, toggling the Enable 906 button 

, found on the main form toolbar, should turn off/on this feature.

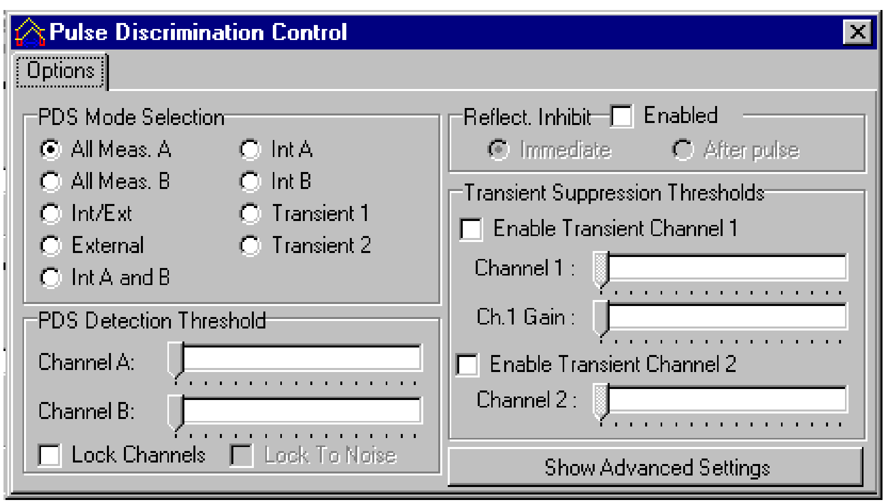
Pulse Discrimination Password entry screen

Access to either of the Advanced Settings tabs of the Pulse Discrimination function is available via a password dialog box.

To access these pages, the user should click on the Show Advanced Settings button on the Options page. By doing this a password dialog box (as shown above) is displayed to the user, requesting entry of the correct password.
If this is entered and verified as correct, the advanced options pages are displayed on the form, permitting the user access to the low-level settings for the board. These pages may be re-hidden by clicking the Hide Advanced Settings button on the Options page.

PDS Setup Options Page

The options tab displays the most commonly used setup features for the Pulse Discrimination dialog box.



PDS Mode Selection Radio Buttons

These radio buttons allow the user to select a particular PDS capture mode. These may be described as follows.

Description	*Input Source B*	*Capture Channel*	*PDS Mode*	*Description*
All Meas. A	Channel B	Channel A	Enable All Measurements	All measurements allowed, nothing blocked
All Meas. B	Channel B	Channel B	Enable All Measurements	All measurements allowed, nothing blocked
Int/Ext	Channel B	Channel A	Internal/External	Measure Internal/External pulses only
External	Channel B	Channel A	External	Measure External pulses only
Int A or B	Channel B	Channel A	Internal A or B	Measure Internal A or B pulses only
Int A	Channel B	Channel A	Internal A	Measure Internal A pulses only
Int B	Channel B	Channel A	Internal B	Measure Internal B pulses only
Transient 1	Channel C	Channel B	Enable All Measurements	Transients. All measurements allowed, nothing blocked
Transient 2	Channel D	Channel B	Enable All Measurements	Transients. All measurements allowed, nothing blocked

PDS Detection Threshold Sliders

The 2 slider bars allow the user to select the voltage threshold at which partial discharge measurements are recorded. These sliders are used in conjunction with gate and noise levels, and may be locked to the noise level automatically so that the user does not have to adjust the settings as the noise level changes. There is also the option to lock the sliders together so they move together.

Reflection Inhibit Enabled

This gives the user the option to enable/disable reflection inhibition. If reflection inhibit is enabled, the user also has the option to select immediate or inhibition after pulse. Reflection inhibitor is triggered by input combinations that are generally similar to External pulses and is for use when testing cables. It is re-triggerable and can be used to disable measurement of any pulses while it is active. If Inhibit After Pulse is selected, it only becomes active after the pulse input which triggers it. This allows measurement of that pulse but it blocks subsequent pulses.

The Reflection Inhibit delay may be set on the timings tab sheet.

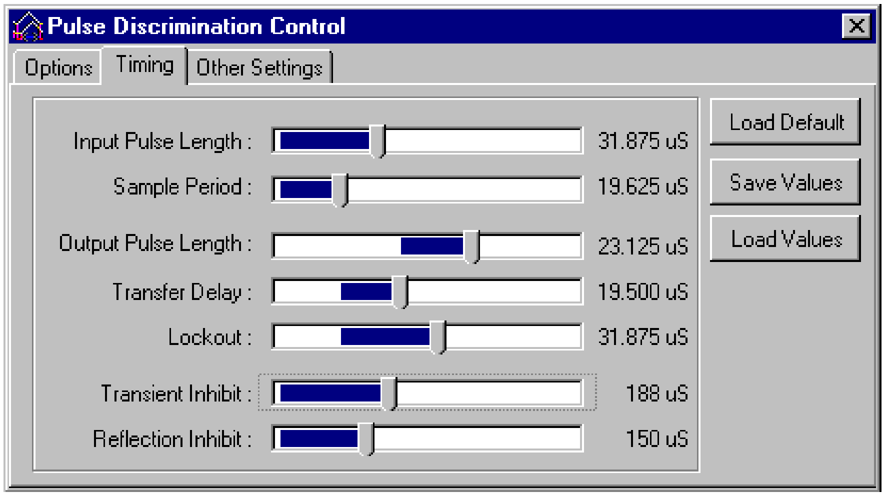
Transient Suppression Thresholds

These give the user the option to enable or disable the two transient suppressors. These are two separate and independent inputs, which can be used with their own amplifiers. The intent is that if a signal is detected on one of these and its function is enabled, the measurement system will be prevented from measuring any pulses, which occur during their time period. They are re-triggerable so numerous trigger events can block the measurement system.

The Transient Suppression delay may be set on the timings tab sheet.

PDS Advanced Settings Timing Tab

Timings Tab



The timings tab offers the user the ability to modify the event timings for the DDX-8003 PDS module. The sliders are displayed in a similar manner to the diagram above. This picture does not offer a suggested range of values, rather it attempts to ease the understanding of the timing system.

If the user examines the diagram below, certain intervals run concurrently or consecutively to each other. In a similar way, the slider controls will also shift left and right automatically, depending if their associated functions run concurrently or consecutively. The colored bands (the color will vary according to the user settings in the Windows Control Panel) indicate the length of a period, the text labels confirm the interval selected.

For the first 5 slider bars, time is incremented in periods of 0.125uS, the final two bars increment time by a factor of 2uS.

These colored bands will indicate one or other of the following options.

1) A period during which a function is performed
2) A period after which an event is fired.

For the PDS module the following intervals are described

Input Pulse Length Slider

This slider control allows the user to select the input pulse length.

The Input Pulse length may be described as a period during which any triggered pulses are stored before another transition is accepted and the pulses are reset.
When defining the timing periods, Input Pulse Length must be greater than Sample Period.

Range 0 – 31.875 uS in 0.125 uS increments.

Sample Period Slider

This slider control allows the user to select the Sample Period length.

The Sample period defines the time interval between the first transition of a pulse and the generation of a signal that re-samples the output. The sampled state is than stored for a short time defined by the Transfer Delay before being passed to the output drivers.

The effect of this is to determine whether one, two or more input transitions occur within the sample time window.

This time should be greater or equal to the coincidence period.

The total time taken for Sample time plus Transfer time should be less than the Analog Delay time.

The total time taken for Sample plus Transfer plus Output time should be greater than the total time taken for Analog Delay plus Coincidence times.

Output Pulse Length Slider

This slider control allows the user to select the Output Pulse Length.

During the Output period, pulse state data is held stable before being cleared.

Transfer Delay

This slider control allows the user to select the delay between Sample period and output of the Output Pulse.

The transfer delay is a period between taking the input sample and passing the data to the output drivers. The transfer delay time allows the output pulse to be positioned around the analog pulse after it has passed through the delay lines.

Lockout

This slider control allows the user to select the period for lockout. This period commences immediately after the Sample period and continues for the interval set by the user. During this period no pulses are recognized by the PDS system.

Transient Delay/Transient Inhibit Time

This slider control allows the user to select a period during which transient pulses are ignored, if suppression is selected.

There are two separate and independent inputs which can be used with their own amplifiers. The intent is that if a signal is detected on one of theses and Transient Inhibitor is enabled, the measurement system will be prevented from measuring any pulses which occur during the transient delay period. They are re-triggerable so numerous trigger events can block the measurement system.

Reflection Inhibit

This slider control allows the user to select a period during which Reflection inhibit is performed.

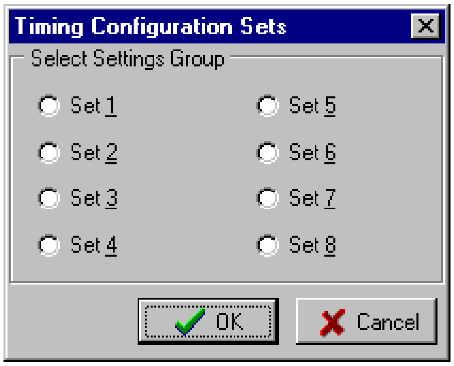
Reflection inhibit is triggered by input combinations which are generally similar to External pulses and is for use when testing cables. It is re-triggerable and can be used to disable measurement of any pulses while it is active. There is an option, when it is first triggered, that it only goes active after the pulse input which triggers it – thus allowing measurement of that pulse but blocking subsequently.

Load Default Button

This button will load several default timing settings into memory and replace the values seen in the slider controls. These values are approximate and provide a ‘starting block’ for more fine tuning by the user.

Save Values Button

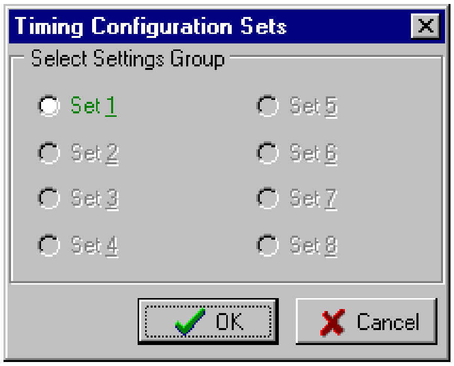
This button allows the user to save the current timing settings to file. Clicking this button causes the program to display the Timing Configuration Sets dialog box similar to the following.



There are eight possible save positions. Filled slots are indicated by Red text, empty slots by Black text. If the user selects to overwrite a previously saved set of timings, he/she will be prompted to confirmthis before the program replaces the data.

Load Values Button

This button allows the user to retrieve a previously saved set of timing configurations from file. Clicking this button causes the program to display the Timing Configuration Sets dialog box similar to the following.

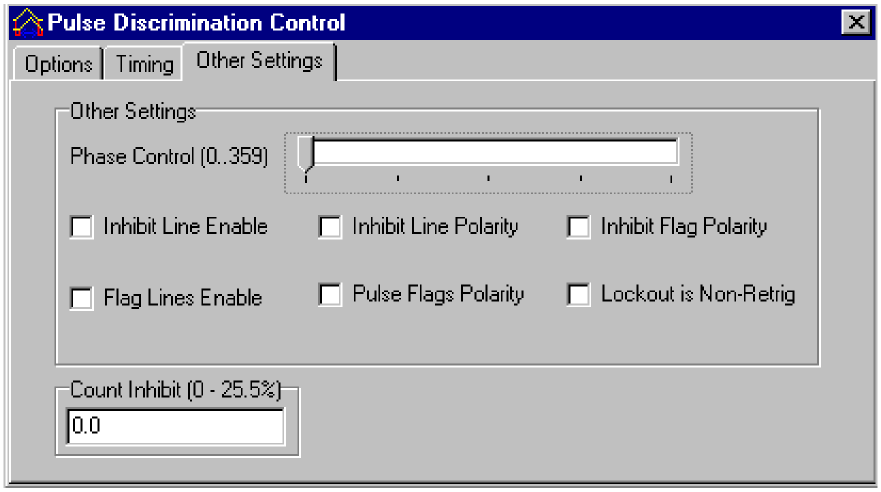


There is a maximum of eight possible saved positions. Available sets are highlighted in green, unavailable sets are disabled.

The user should click in the radio button for the set he/she wishes to retrieve and click the OK button. The timing data loaded from file will replace the data currently held in memory.

PDS Advanced Set-up Other Settings page

The Other Settings page is available to alter less used settings.



Phase Control

In order to discriminate between two samples of which one is producing discharges, it is necessary to know the polarity of the applied voltage and the polarity of the detected signal. The Phase Reference Generator takes the sync signal from the back-plane and can shift its phase in 1024 steps from 0 to 360 degrees. This allows the changeover point between A and B to be set at its optimum position where discharges are least likely to occur.

The phase control allows the user to set this angle.

Inhibit Line Enable

Enables/Disables the inhibit line.

Flag Lines Enable

Enables/Disables the flag lines

Inhibit Line Polarity

Sets the polarity of the signal to the inhibit line

Inhibit Flag Polarity

Sets the polarity of the signal to the Inhibit Flag

Pulse Flags Polarity

Sets the polarity of the signal to the Pulse flags

Lockout Is Non Retrig

Sets whether lockout is non re-triggerable.

Count Inhibit

This value may be set at any value between 0 and 25.5%.

The PDS function allows some check on the operation of the Inhibit functions. It takes the outputs from all the Inhibit functions and counts the number of sample windows (1024 per cycle) during which any Inhibit is active. The maximum count is 255 after which an overflow flag is set. This allows up to 25% of the cycle to be determined accurately – above that the system is probably not usable with confidence.