INTRODUCTION

This section is intended to give you an understanding of the standard acquisition, triggering, and measurement features of the PXD 222 Digitizer. Detailed descriptions of how to operate the PXD222 Digitizer can be found in the Driver Help file.

A. Acquisition Modes

The PXD 222 Digitizer has two modes of operation NORMAL and MIN/MAX. These are defined as follows:

NORMAL: In Normal mode, the PXD 222 Digitizer operates as a typical digitizer. The module will digitize the input signals during a specified time window and create a data array with the digitized data that can be read out by the controller. The user programs the number of points (maximum of 1000) as well as the time window to be digitized. The maximum sample rate is 2.5 GS/s, and will vary depending on the time window setting. Table 1 gives the sample rates that are achieved.

MIN/MAX: There are two MIN/MAX modes, which are referred to as **Glitch Capture** and **Scope Record**. In these modes, the PXD 222 Digitizer outputs two arrays; a MIN array with the minimum values detected during each sample interval, and a MAX array with the maximum value detected during each sample interval. Here's how it works. In MIN/MAX mode, the time window is divided into sampling intervals. During each interval, the digitizer oversamples the input at high speed (see tables 2 and 3 on the following pages) and stores the MIN and MAX values in data arrays. This technique allows you to detect and record glitches in the waveform that would not be found if only 1 sample were taken during each sampling interval. The Acquisition type is programmed by means of the function **LcPXD222_ConfigureAcquisitionType**. (**Note:** This mode is sometimes also referred to as a Peak Detect mode.)

When in Min/Max mode, and for time windows of 10 seconds or less, the digitizer is in Glitch Capture Mode, and will record MIN/MAX arrays of roughly 255 points. For time ranges of 11 seconds and higher, the digitizer is in Scope Record Mode, and will store min-max arrays of roughly 27kpts.

Understanding the difference between Normal and MIN/MAX modes

Take an example where the time window is set to 1 ms. In Normal mode, the time between samples would be 1 µs (1 ms/1000 = 1 µs), corresponding to a sample rate of 1 MS/s because exactly one sample is acquired per sample interval in this mode.

When setting the time window to 1 ms in MIN/MAX mode, the sampling interval is approximately 4 µs. This is roughly 4X longer than the corresponding value in Normal mode because 255 points are stored instead of 1000. The PXD 222 Digitizer, however does not take only 1 sample in this 4 µs time interval, but instead samples at the higher speed of 20 MS/s. Of the 80 samples that are taken (20MS/s * 4 µs = 80), the min and max points are retained. This is done for each of the 255 time intervals to create the Min and Max data arrays.

Table 1: Normal Mode Time Windows, Intervals, and Sample Rates

Time Window	Sampling Time Interval for Each Point	Real Time Sampling Rate	Nominal # of Samples[a]
100 ns	400 ps	2.5 GS/s	250
200 ns	400 ps	2.5 GS/s	500
500 ns	2 ns	500 MS/s	250
1 µs	2 ns	500 MS/s	500
2 µs	2 ns	500 MS/s	1000
5 µs	10 ns	100 MS/s	500
10 µs	10 ns	100 MS/s	1000
20 µs	20 ns	50 MS/s	1000
50 µs	50 ns	20 MS/s	1000
100 µs	200 ns	5 MS/s	500
200 µs	200 ns	5 MS/s	1000
500 µs	500 ns	2 MS/s	1000
1 ms	1 µs	1 MS/s	1000
2 ms	2 µs	500 kS/s	1000
5 ms	5 µs	200 kS/s	1000
10 ms	10 µs	100 kS/s	1000
20 ms	20 µs	50 kS/s	1000
50 ms	50 µs	20 kS/s	1000
100 ms	100 µs	10 kS/s	1000
200 ms	200 µs	5 kS/s	1000
500 ms	500 µs	2 kS/s	1000
1 s	1 ms	1 kS/s	1000
2 s	2 ms	500 S/s	1000
5 s	5 ms	200 S/s	1000
10 s	10 ms	100 S/s	1000

a. # of points will vary slightly from the nominal value

Table 2: Glitch Capture Mode Time Windows, Intervals, and Sample Rates

Time Window	Sampling Time Interval for Each Point	Real Time Sampling Rate[a]
100 ns	400 ps	2.5 GS/s
200 ns	800 ps	2.5 GS/s
500 ns	2 ns	2.5 GS/s
1 µs	4 ns	2 GS/s
2 µs	8 ns	1 GS/s
5 µs	20 ns	200 MS/s
10 µs	40 ns	100 MS/s
20 µs	80 ns	50 MS/s
50 µs	200 ns	20 MS/s
100 µs	400 ns	20 MS/s
200 µs	800 ns	20 MS/s
500 µs	2 µs	20 MS/s
1 ms	4 µs	20 MS/s
2 ms	8 µs	20 MS/s
5 ms	20 µs	20 MS/s
10 ms	40 µs	20 MS/s
20 ms	80 µs	20 MS/s
50 ms	200 µs	20 MS/s
100 ms	400 µs	20 MS/s
200 ms	800 µs	20 MS/s
500 ms	2 ms	20 MS/s
1 s	4 ms	20 MS/s
2 s	8 ms	20 MS/s
5 s	20 ms	20 MS/s
10 s	40 ms	20 MS/s

a. Waveform is oversampled at the real time sampling rate. Within each time interval, the minimum and maximum values are stored. A total of roughly 27 kpts are stored in the MIN and MAX arrays.

Table 3: Scope Record Mode Time Windows, Intervals, and Sample Rates

Time Window	Sampling Time Interval for Each Point	Real Time Sampling Rate[a]
11 s	400 µs	20 MS/s
22 s	800 µs	20 MS/s
55 s	2 ms	20 MS/s
110 s	4 ms	20 MS/s
220 s	8 ms	20 MS/s
9 min	20 ms	20 MS/s
18 min	40 ms	20 MS/s
36 min	80 ms	20 MS/s
90 min	200 ms	20 MS/s
3 h	400 ms	20 MS/s
6 h	800 ms	20 MS/s
9 h	1200 ms	20 MS/s
18 h	2400 ms	20 MS/s
36 h	4800 ms	4 MS/s

a. Waveform is oversampled at the real time sampling rate. Within each time interval, the minimum and maximum values are stored.

B. Run Modes

The digitizer can be set to run in either **Continuous** or **Single-shot** mode. This is done through the function **LcPXD222_ConfigureInitiateContinuous**.

C. Trigger Modes

The PXD 222 Digitizer supports the following trigger types: EDGE, GLITCH, WIDTH, TV, and IMMEDIATE.

EDGE: An edge trigger occurs when the trigger signal crosses the specified trigger level with the specified slope. The trigger level and slope are configured with the function **LcPXD222_ConfigureEdgeTriggerSource**.

GLITCH: A glitch trigger occurs when the trigger signal has a pulse width that is less than the glitch width. The trigger does not actually occur until the edge of the pulse that corresponds to the specified glitch width and polarity crosses the trigger level. The trigger level is configured with the function **LcPXD222_ConfigureGlitchTriggerSource**.

WIDTH: A width trigger occurs when the oscilloscope detects a positive or negative pulse width between or, optionally, outside the width thresholds. The trigger does not actually occur until the edge of a pulse that corresponds to the specified width thresholds and polarity crosses the trigger level. The width thresholds, whether to trigger on pulse widths that are within or outside the width thresholds, the polarity of the pulse, and the trigger level are configured with the function **LcPXD222_ConfigureWidthTriggerSource**.

TV: The PXD 222 Digitizer can trigger on NTCS, PAL and SECAM video signals. The TV signal type, the field and line number on which to trigger, and the signal polarity are configured with the function **LcPXD222_ConfigureTVTriggerSource**.

IMMEDIATE: In this mode, the oscilloscope does not wait for trigger event and instead immediately begins the digitization process.

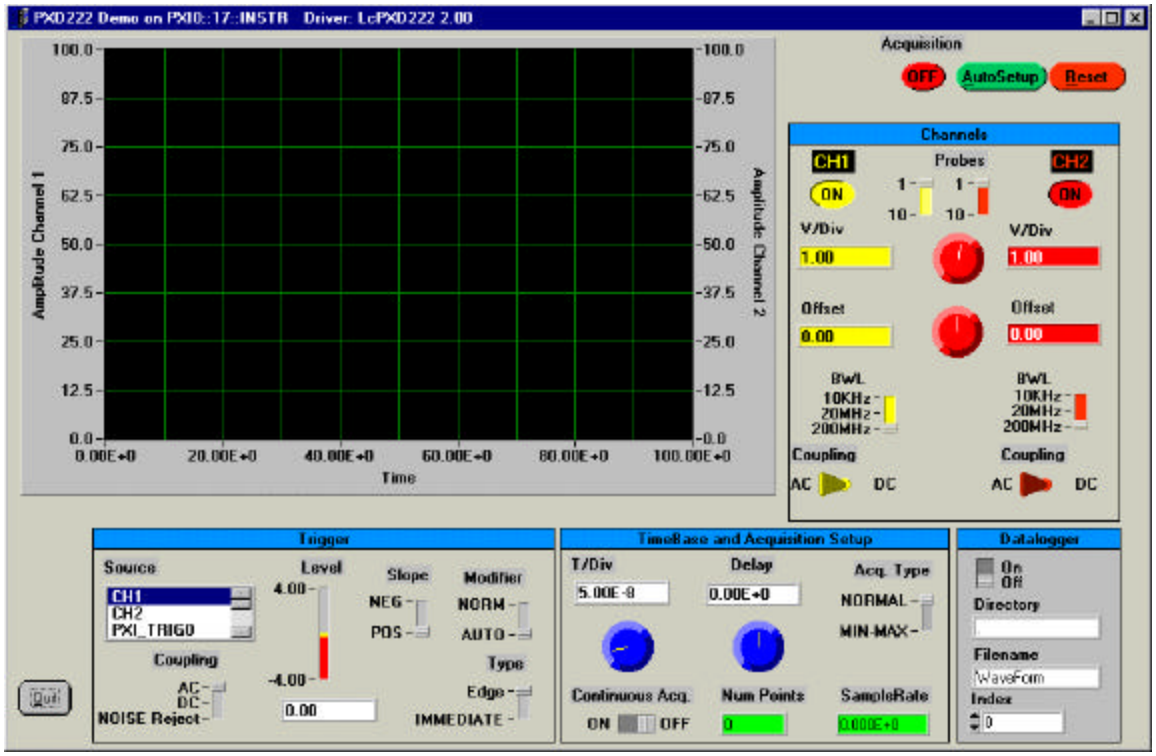
D. PXD 222 DIGITIZER WAVEFORM MEASUREMENTS

The PXD 222 Digitizer performs the following waveform measurements:

Mean Voltage	LCPXD222_VAL_VOLTAGE_AVERAGE
RMS Voltage (AC)	LCPXD222_VAL_VOLTAGE_RMS
True RMS Voltage (AC+DC)	LCPXD222_VAL_VOLTAGE_TRUE_RMS
Peak to Peak voltage	LCPXD222_VAL_VOLTAGE_PEAK_TO_PEAK
Maximum Peak voltage	LCPXD222_VAL_VOLTAGE_MAX
Minimum Peak voltage	LCPXD222_VAL_VOLTAGE_MIN
Neg Duty Cycle percentage	LCPXD222_VAL_DUTY_CYCLE_NEG
Pos Duty Cycle percentage	LCPXD222_VAL_DUTY_CYCLE_POS
Frequency	LCPXD222_VAL_FREQUENCY
Neg Pulse Width	LCPXD222_VAL_WIDTH_NEG
Pos Pulse Width	LCPXD222_VAL_WIDTH_POS
Phase Difference	LCPXD222_VAL_PHASE

To read out a waveform measurement, use the **LcPXD222_ReadWaveformMeasurement** function. To read back both the measurement and the waveform, call the function. **LcPXD222_FetchWaveform** after calling LcPXD222_ReadWaveformMeasurement.

PXD 222 DIGITIZER QUICK START APPLICATION SOFTWARE



Soft Front Panel

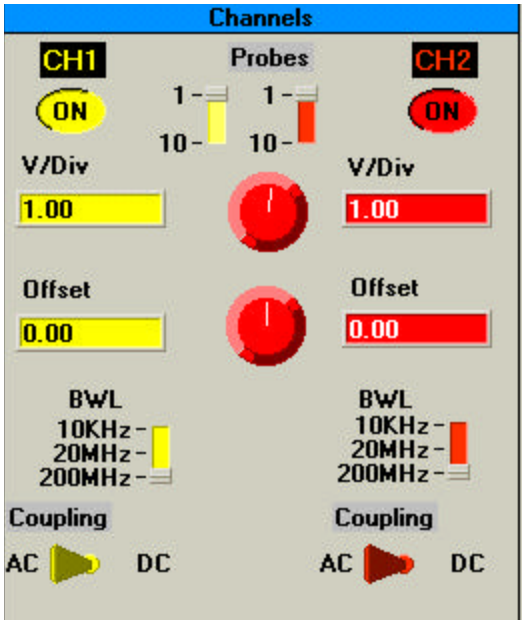
The PXD 222 Digitizer Quick Start Application software has the following features:

- Graphic Display with independent vertical axis for each digitizer input channel
- Acquisition section including autosetup and reset
- Channels section with independent control of probe attenuation, Volts/Div, Offset, Bandwidth limit, and coupling
- Timebase section including Time/Div, Delay and acquisition type as well as indicators for the number of points per acquisition and the sample rate
- Trigger section with source, coupling, slope, type, and level selectors
- Data Logger section

Acquisition: The "Acquisition" indicator is green when data is being acquired and red when the acquisition is stopped.

AutoSetup: The **AutoSetup** feature lets the digitizer display complex, unknown signals automatically. This function optimizes the position, range, time base, and triggering.

Reset: The **Reset** feature will reset the PXD 222 Digitizer hardware and the software application to a default state.



Hint: Typing values is easier that using the knob.

En CH1 and En CH2: The enable channel 1 and enable channel 2 buttons are used to turn on and off channels 1 and 2 respectively. The color of the buttons matches the color of the trace.

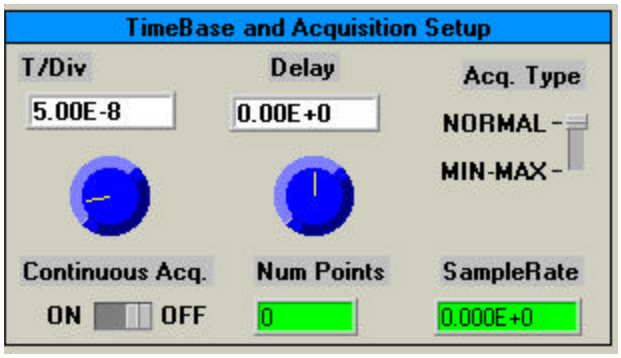
CH1 and CH2 Probes: The BNC inputs to the digitizer do not include automatic probe sensing. The CH1 and CH2 Probe switch should be set to **10** when a 10:1 probe is connected to the channel input, but it should be set to **1** when there is a direct connection.

V/Div. CH1 and CH2: Set the volts per division for each input independently by using the **V/Div** knob or by typing a value in the V/Div control box. The **V/Div** knob will change color depending on the channel selected: yellow when channel 1 is selected and red when channel 2 is selected. These colors also match the trace colors in the graphic display.

Offset CH1 and CH2: Set the Offset for each input independently using the **Offset** knob or by typing a value in the Offset control box. The **Offset** knob will change color depending on the channel selected: yellow when channel 1 is selected and red when channel 2 is selected. These colors also match the trace colors in the graphics display.

Bandwidth Limit CH1 and CH2: To suppress high frequency noise on waveforms, you can limit the bandwidth of the digitizer by selecting a **10 kHz** or **20 MHz** filter. This function smooths the displayed waveform by blocking frequencies above the filter's limit.

Coupling CH1 and CH2: Each channel of the digitizer is set to **DC** coupled by default so that AC and DC voltages appear on the display. Select **AC** coupling when you wish to observe a small signal that rides on a DC signal. Clicking the switch control toggles the selection.



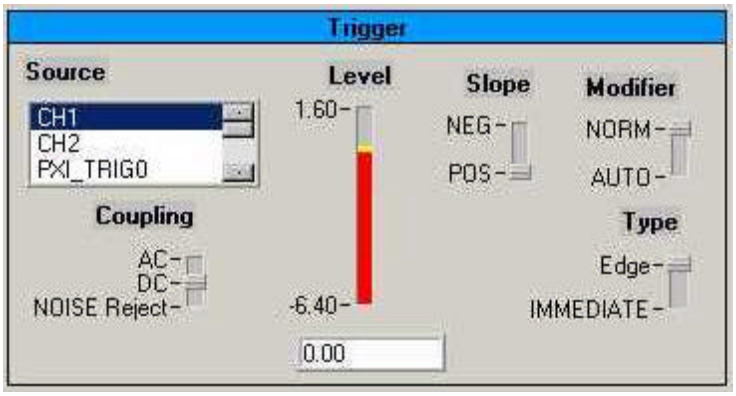
T/Div: The time per division is set by using the **T/Div** knob or by typing a value in the T/Div control box. The digitizer automatically adapts itself to use the maximum sampling rate whenever the timebase is changed.

Delay: Turn the **Delay** knob to adjust the horizontal position and the amount of pre-trigger, as desired.

Acquisition Type: In **NORMAL** type, each acquisition is a fixed number of points depending on the timebase; and the time between points is the inverse of the sample rate. In **Mn-Max** type an oversampling technique is used to detect peaks. This acquisition type is useful for detecting glitches on slow timebase settings. See the Operation chapter for more information.

Number of Points: This is an indicator that displays the number of points in each acquisition. This will vary automatically depending on the T/Div and Acquisition type.

Sample Rate: This is an indicator that displays the sample rate for each acquisition. This will vary automatically depending on the T/Div and Acquisition type.



Source: The trigger source for the digitizer may be either of the input channels or the PXI Trigger and Star Trigger lines on the PXI backplane.

Coupling: This sets the trigger coupling for the input channels. **DC** is used when all the signal frequency components are coupled to the trigger circuit. When **AC** is selected the signal is capacitively coupled, DC levels are rejected, and frequencies below 50 Hz are attenuated. **NOISE Reject** is a filter that will help reduce jitter when triggering on noisy waveforms.

Level: Defines the source voltage at which the trigger circuit will generate an event.

Slope: Determines the direction of the trigger voltage transition used to generate a particular trigger event.

Modifier: In **NORM** mode the digitizer will acquire while there is a valid trigger. In **AUTO** mode the trace will automatically be displayed regardless of a valid trigger. When a valid trigger is present in auto mode, the digitizer will behave as if in normal mode.

Type: Edge type requires a valid trigger edge. **IMMEDIATE** type will force a trigger even if the trigger conditions are not met.

On/off: turns datalogging on and off.

Directory: Sets the directory for storying waveforms. Entering a period sets the current directory of the Quick-Start Demo; entering another value (e.g., "Test 1") creates a new folder called "Test1" referenced from the current directory.

Filename: Sets prefix for filename.

Index: An auto-incrementing index is appended to the above filename. When the datalogger is turned on, and the program is in continuous Acquisition mode, each waveform will be stored.

USING THE PXD 222 DIGITIZER IVI INSTRUMENT DRIVERS

Your CD-ROM includes several example programs written in LabWindows/CVI using the PXD 222 IVI driver. Even if you are not using CVI, the ".c" files provide practical examples that will help you learn how to program the PXD 222 Digitizer.

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