Application Note 3:

X-Series Recorder Smart Logging

Logging 'Intelligently' with the X-Series Recorders

The advanced features of the **X Series** recorders allow the user to gather tremendous amounts of data. The **QX** can record up to 16 channels of analog data and the **SX** 48 channels at 10 times per second. That's 160 and 480 points per second respectively. With extra Virtual Pens and fast scanning at 50 times per second, the amount of data can grow enormously.

Benefits

Faster logging speeds have huge potential benefits for users; it allows greater detail on the monitored process for improved performance and productivity, more detailed fault analysis and more accurate trend representation. The figure below shows some methods available for logging data; the faster the actual signal is sampled the closer the sampled data matches the original signal. Sampled data with slower logging rates can actually miss "glitches", faster logging rates can capture glitches, but can generate significant amounts of data. Min-Max recording can capture glitches but will typically not give the shape of the original signal because the time scale it compressed to shows a longer time period on the display. When looking at this figure, keep in mind that the scan rate for the **X-Series** recorder inputs is independent of the logging rates; scan rates can be set for 20msec, 100msec, 200msec or 500msec while logging rates can be set from 20msec per pen up to once every 60 hours.
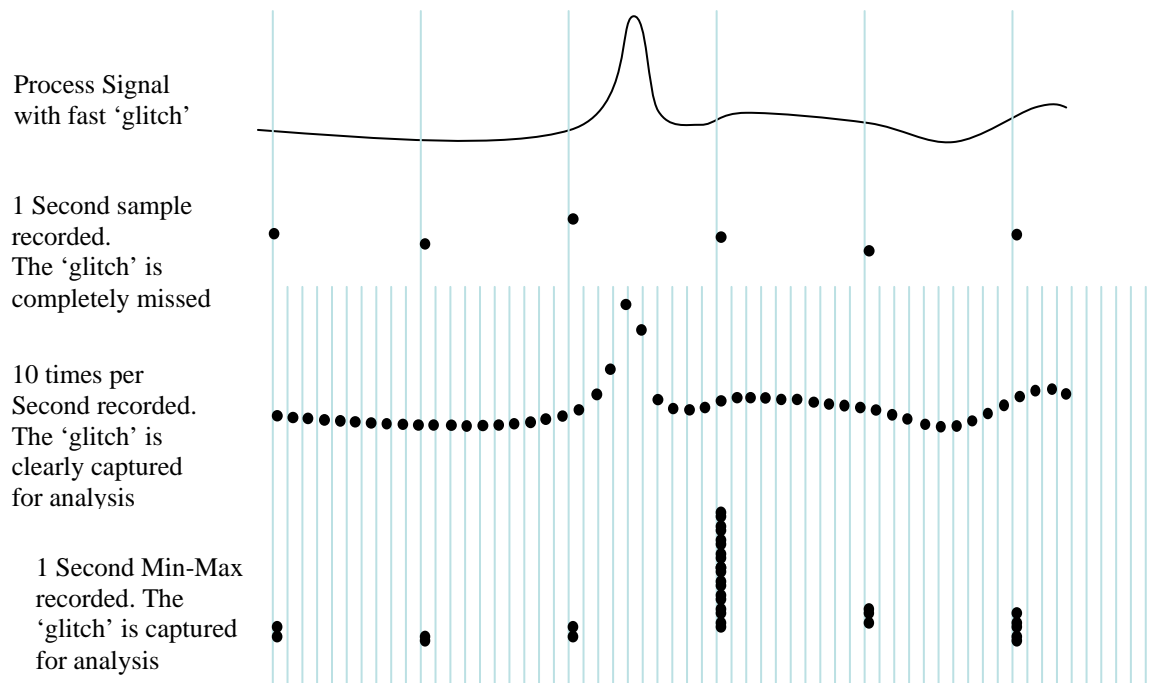

Process Signal with fast 'glitch'

1 Second sample recorded. The 'glitch' is completely missed

10 times per Second recorded. The 'glitch' is clearly captured for analysis

1 Second Min-Max recorded. The 'glitch' is captured for analysis

Figure 1

Because the **X Series** is so simple and easy to configure, the user may be tempted to choose the fastest logging speeds available, for everything – 'just because'. This approach is not always the best solution because of the total amount of data logged. This application note highlights and explains how to set up and use the recorder efficiently, to get the best results from the instrument without generating reams of data that can overwhelm the user.

Logging Trade Off

The higher the overall data acquisition rate and the number of pens being recorded for the instrument, the more memory capacity required for a given period of time. There are a number of areas to consider regarding the potential impact of using high logging rates when configuring the recorder.

- **Rate of Media collection or exchange**. No matter how large the media used is, whether it is 512Mb, 1 Gb or more, if the logging rate is increased by 10 times, say set all Pens to log at 10 times per second rather than once per second, then the user will have to change the media 10 times more often.
- **Speed of Data Transfer**. Downloading from the recorder and uploading to Trend Manager Suite will take longer. 10Mb will transfer 10 times quicker than 100Mb.
- **Management of acquired data**. Whilst today's PC's have huge hard drives, its worth remembering that sooner or later it will get full, or you will need to archive or make a back up, or transfer it to a new PC. Take an installation that has a configuration that generates 10Mb/day of data per instrument, and let's say there are 5 recorders needed in this installation…
    - That's 50Mb per day
    - Or 350Mb per week
    - Or 1.4Gb a month
    - Or 18Gb a year
- **Data Analysis speed using Trend Manager software**. Naturally the more data, for a given time period, the longer Trend Manager will take to process it. To the user this will be evident in the time the Trend Manager software takes to graph the recorded data.

The following information suggests a number of ways to minimise the amount of acquired data, while at the same time making use of the advanced features for process, productivity and efficiency improvements.

Tailoring your Recorder to the Process Requirements

To aid the user in setting the right data acquisition balance for the particular application, the **X Series** recorders have a number of essential features that can be used, in particular the logging options available, to adjust the recording to the match the process recording requirements.

Pen Specific Logging Rate

Uniquely to the **X Series** recorders, the user can configure the logging rate of each individual Pen independently. This allows the user to configure the inputs that specifically require high resolution data accordingly, and yet other inputs that do not need high resolution can be recorded much more slowly, this will help to reduce the amount of memory used.

Logging Methods

Again a unique feature of the **X Series** is ability of the user to choose from different logging Methods on a Pen by Pen basis. The user can choose from Sample, Max/Min or Average Methods of logging the data. **Figure 2** show illustrates Sample and Max/Min methods, relative to the original input signal.
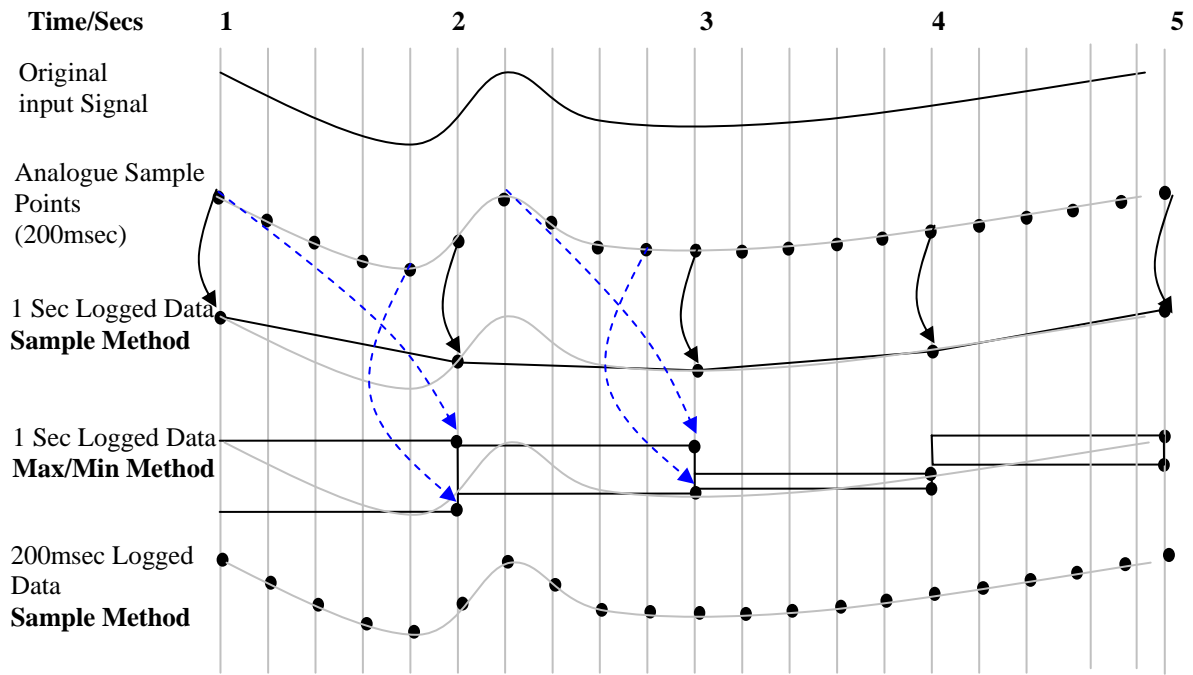
| Time/Secs | 1 | 2 | 3 | 4 | 5 |

Original input Signal

Analogue Sample Points (200msec)

1 Sec Logged Data **Sample Method**

1 Sec Logged Data **Max/Min Method**

200msec Logged Data **Sample Method**

Figure 2

Input Sampling
The raw analogue input signals from the field sensors are sampled at the input "Sample Rate", in this illustration the input Sample Rate is 5Hz or 200msecs. Each individual input can be sampled at a different and user definable rate.

Pen Log Method
(Main Menu > Configure > Setup > Edit Setup > Pens > Pen # > Logging)
Each sampled input data point is transferred to its respective Pen and can be logged at an individual and user definable rate and method.

Sample Method logging - the recorder logs the point sampled at that point in time. In the example shown above, 1 second sampling is set.

Max/Min Method logging - the recorder logs **two** points, the **Max** sampled point since the previous log, and the **Min** sampled point since the last log. In the example above, the dotted arrows illustrate which sampled points are being logged as Max and Min.
For a given application, it may be appropriate to slow the log rate down, logging less data, but switching to the Max/Min log method. For a given time period, the user will still have an indication that an excursion has occurred during the log period but without the higher sample rate and hence higher volume of data.

Average Method logging - the recorder logs the average of all the samples since the last log point. This method will tend to smooth the signal.
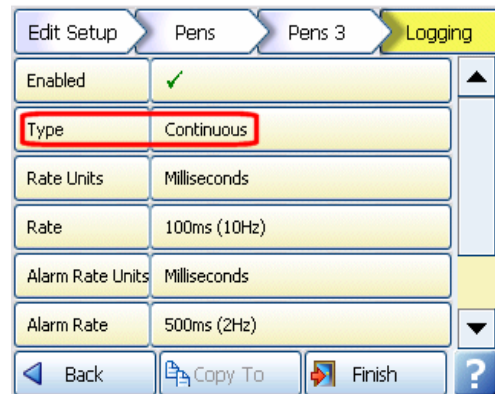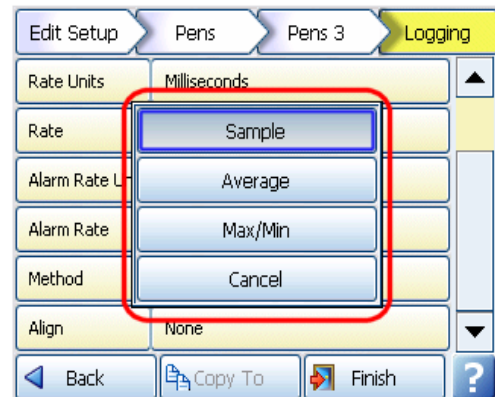
Alarm Log Rate Change

An additional option the user has to reduce the total amount of recorded data is to use the Alarm Log Rate Change. With this method, the data is logged at a slower rate until it goes into an alarm condition, at that point it immediately switches to a second (usually faster) rate, again this is programmable on a Pen by Pen basis.

Using this feature allows the user to configure all the inputs with relatively slow log rates, but should they go into an alarm condition, the log rate can be switched to a much faster and higher resolution log speed, giving improved resolution on the process.

Continuous or Fuzzy Logging

All of the examples illustrated previously have been based on **Continuous** type logging, i.e they are based on 'Log Rate' that ticks along at a constant rate. Fuzzy Logging is a Patented logging system that can significantly reduce the amount of data recorded. In short, the recorder does not store straight line non-changing data; when the data changes the recorder will log the data as long as it continues to deviate from straight line data. This data can be horizontal, increasing or decreasing data; as long as it is straight line data, recording two points or twenty points can represent the same information. Not logging all the constant straight line data significantly reduces the amount of stored data without losing information. This makes all of the processes involved with the data such as the replay of data, the transfer of data, the analysis of the data and the archiving of the data go faster.

The figure below helps to show how fuzzy logging works and the potential savings associated with not having to store all the data points while not losing any information. On the chart, points marked as an open circle: O are **NOT** logged, as they lie on an 'imaginary' straight line between two logged points; points marked as a solid dot: ● are logged. When the graph of the Fuzzy Logged data is reviewed, it looks identical to the graph of the sampled data, but has taken **less than half the points** to build it. For more details on Fuzzy Logging refer to Application note 43-TV-07-02.
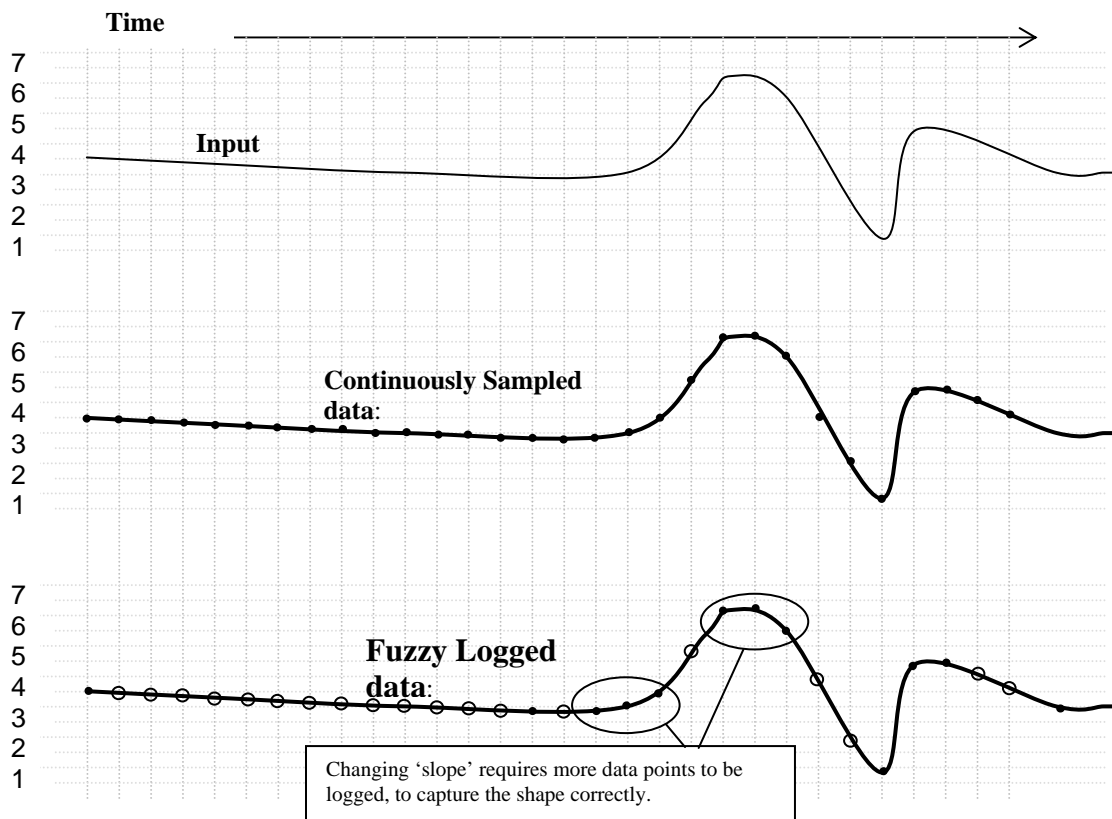
Figure 3 - Fuzzy Logging Illustration

Summary

The unique logging capabilities of the **X Series** recorders provide the tools to do smart data logging. The amount of data being recorded can be tailored to the application to prevent the user from being overwhelmed by reams of data.

- **Independent logging rates for each pen** – this provides the flexibility to set faster logging on only those process parameters that require more data such as a flow signal while slower changing signals like a temperature reading can have a slower logging rate. Independent logging rates allow you to adjust each pen logging rate to best match the process requirements.

- **Flexible Logging Method –** chose the logging method based on the instantaneous sample, the average of the samples over the logging interval or the Min-Max samples over the logging interval. This allows the user to select which method is best for their specific application. Just like the logging rates for the **X-Series** recorders, the logging method can be set independently for each pen.

- **Change the Logging based on an Alarm –** changing the logging rate based on an alarm is another method for doing smart logging, the alarm condition is set to control the total number of samples rather than using a default rate that would require you to collect more data than necessary during periods of less interest.

- **Fuzzy Logging Capability –** is a unique process that can significantly reduce the total amount of data being saved while not losing any of the information. It captures the changing data, while not storing the non-changing straight line data.

- **Expandable Buffer Memory capacity –** if you still need to store lots of data, the **X-Series** gives you a number of options for the data buffer size starting at 70Mb and allowing you to expand all the way up to 1850Mb of data. For 48 pens with a 1 sec storage rate, this would allow you to increase the data storage from 4 days (70Mb) up to 103 days (1850Mb).