



DATA COM

KNOWN PATTERN WITH MARKER AND PM50

Applications of Known Pattern with Marker Tool

- Analyze a data pattern and decompose or separate the various jitter components to better understand and improve system performance
- Measure the Deterministic Jitter (DJ) components: Duty-Cycle Distortion and Intersymbol Interference (DCD+ISI), Periodic Jitter (PJ)
- Measure the Gaussian—or Random Jitter (RJ) component
- View DCD+ISI relative to pattern transition density
- Compliance testing Fibre Channel, Gigabit Ethernet, Infiniband and XAUI devices
- Advanced (not covered in this guide): View jitter data and model the signal as seen by the receiver, filtering RJ and PJ or altering acquisition configuration

Introduction

The use of a known, repeating pattern with a separate pattern marker provides the fastest and most accurate analysis of a data signal. This tool separates jitter into components of DCD+ISI, PJ and RJ as well as calculates TJ for specification compliance testing.

The focus of this paper is to describe the dataCOM Known Pattern with Marker (KPWM) tool including basic setup for most common tests. Setup using the PM50 is also described. This guide will highlight the menus and setup required to perform measurements under the most common circumstances. It will also provide a summary of the theory of operation. Refer to the SIA-3000 User's Guide and the Online Help files for a more in-depth description.

This paper is divided into 5 major sections:

1. Theory of operation
2. Understanding Views, Plots or Results
3. Making a measurement
4. Using the PM50
5. Dialog Bars (instrument settings)

dataCOM Panel

Dialog Bar

Contains tool settings menus.

Plot area

Zoom in—hold down left mouse button, expand zoom

box over area of interest.

Zoom out—double click left mouse.

VISI Status

Cursor coordinates - Displayed in the box at lower right portion of the VISI Panel. Units are same as those in plot.

Statistics View

Shows data from the most recent run.

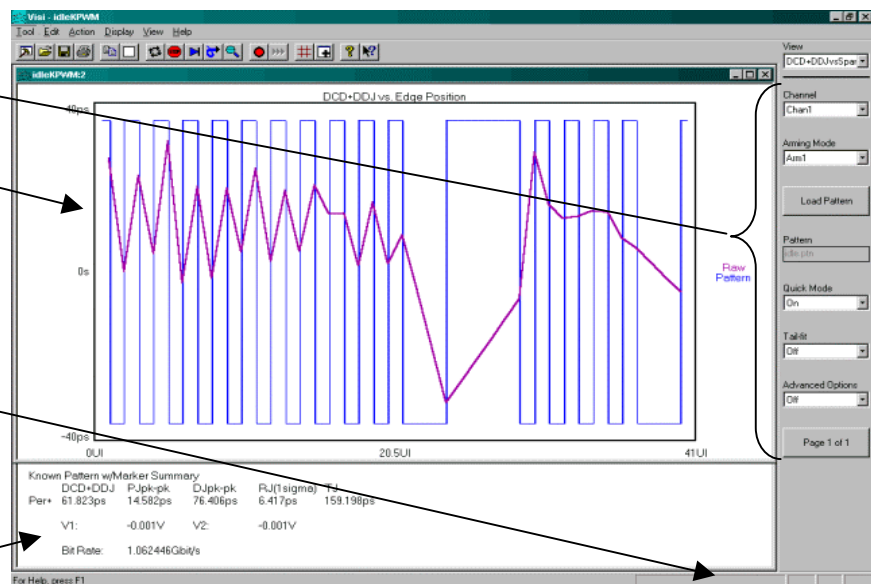


Figure 1. Example DataCom Plot

Theory of Operation

This section will give a basic overview of the methodology behind the measurement. In addition to the data signal, this tool requires a pattern marker to be connected to a measurement channel. The Marker signal has an edge relative to the same bit of the pattern each time the marker occurs. Since no bit-clock is used, analysis of jitter is independent of clock-jitter effects, and because the Arm is not a trigger, any jitter on the marker will not transfer to the measurement of the Data.

The following steps are performed automatically when a measurement is acquired using this tool. The first step is to accurately measure the unit interval (UI). This is done by making a series of pattern length measurements, calculating the mean and dividing that time by the length of the pattern in UI. This results in the average or ideal UI and an accurate bit rate. Subsequent measurements and analysis will compare to this ideal UI and the jitter is displayed as the deviation from this ideal bit time.

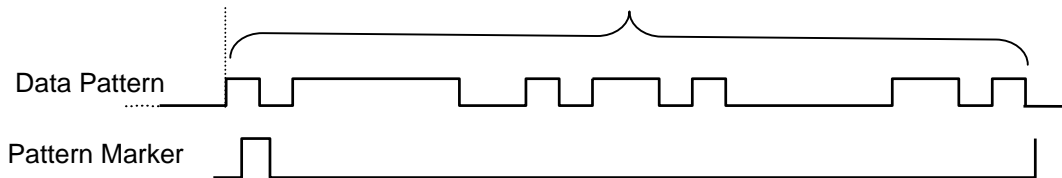


Figure 2. Calculating UI and Bit rate

After the UI measurement, a pattern match of the data must be done to identify the measured data stream relative to the expected bit sequence as well as the phase relationship to the pattern marker. This eliminates the need to have the pattern marker at the beginning of the expected pattern. The expected pattern is rotated against the measured pattern until it matches. See figure 3.

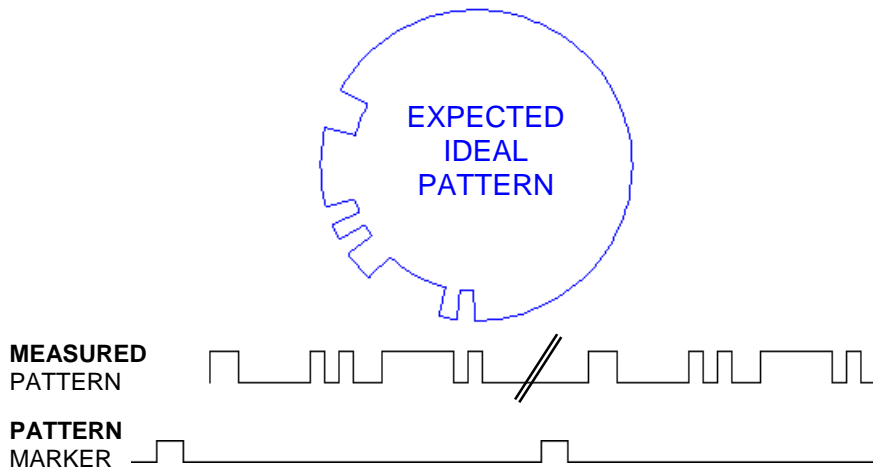


Figure 3. Performing pattern match (K285)

Next, the total DCD + ISI is calculated. Histograms are made of every edge in the pattern. The mean values of these histograms are compared to the ideal edge locations. The measured mean location is subtracted from the calculated ideal edge location. The worst-case positive edge location is added to the worst-case negative edge location giving the total DCD+ISI. This can also be thought of as comparing the earliest edge to the latest edge. See Figure 4.

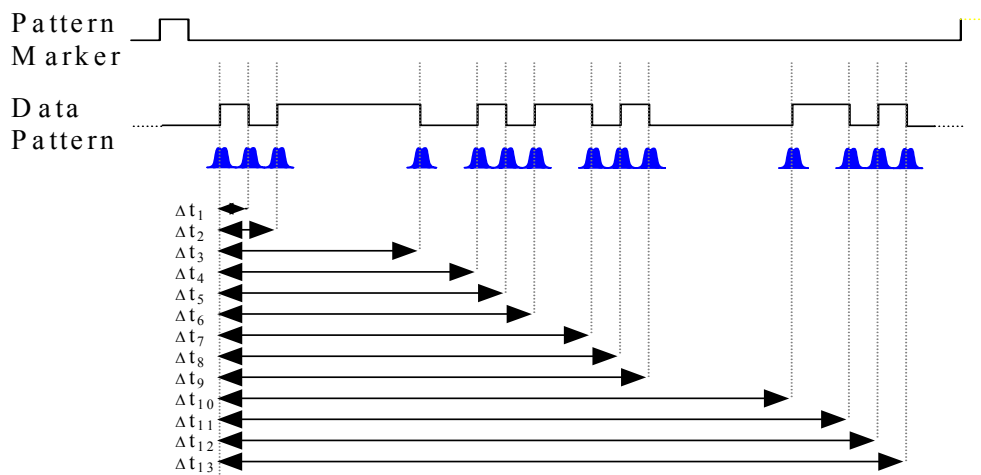


Figure 4. DCD+ISI Measurement

Lastly, data is gathered to show PJ and RJ frequency components. PJ and RJ components are determined by taking the variance of timing measurements from the histogram at each UI. The variance is the square of the standard deviation of the histogram at each UI. If any “holes” in the variance record exist, they will be interpolated by either a cubic or linear fit. The plot of the 1-sigma values versus UI (1-Sigma view) shows if modulation is present. Refer to the “High Frequency Modulation” Getting Started Guide for further information about this concept.

An FFT of the autocorrelation function is used to determine the periodic components. The Fast Fourier transform of the autocorrelation function is commonly referred to as the power spectral density or power spectrum. The largest magnitude periodic component represents the PJ contribution to TJ. The RJ component is determined by subtracting the spectral components, summing the background then taking the square root to provide a 1-sigma value.

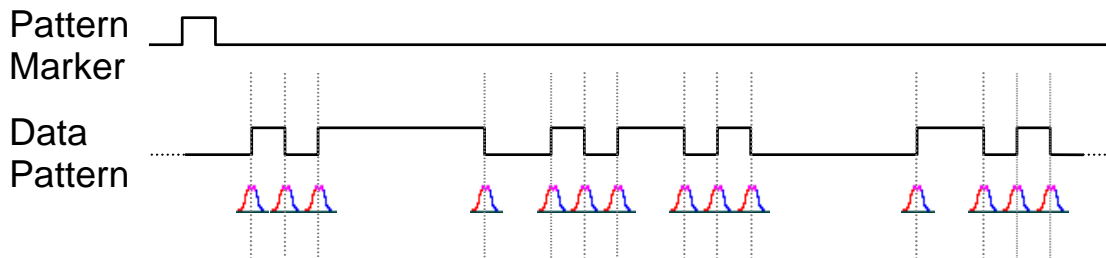


Figure 5 Using TailFit™ to determine Random Jitter (RJ)

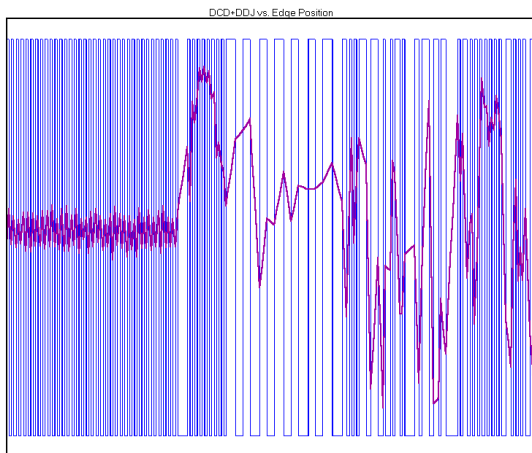
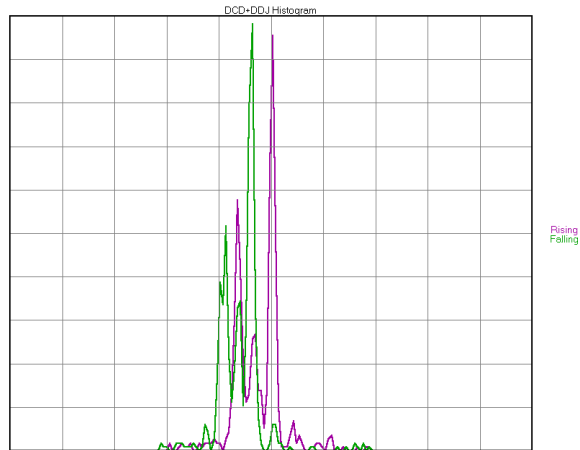
Optionally, Tail-Fit allows the accurate determination of random jitter when there is a significant amount of periodic jitter. Refer to Histogram Getting Started Guide for more about Tail-Fit and RJ.

Understanding Views, Plots or Results

Including the summary view, there are seven plots or views of the same data set. Each of the plots gives insight into the measurements of different components of jitter. In this section, the available views are briefly described. To change views, use the pull-down menu at the top of the VISI dialog bar or use the “PageUp” or “PageDn” keys on the keyboard.

DCD+ISI Histogram

Displays the “normalized accumulation” of all the DCD+ISI measurements taken during each run. The width of this plot is normalized to one Unit Interval of the data period. Ideally, all measurements would fall at zero on the x-axis with no jitter present. In actuality, the measurements show a distribution of measured times. There are two histograms plotted, one for rising and one for falling edges of the data pattern. There is often a difference in the absolute time of rising edges vs. falling edges. An indication of DCD or Duty Cycle Distortion—a difference in the width of a ‘1’ vs. a ‘0’— can be seen when the two histograms are not over one another but have some distance between them.

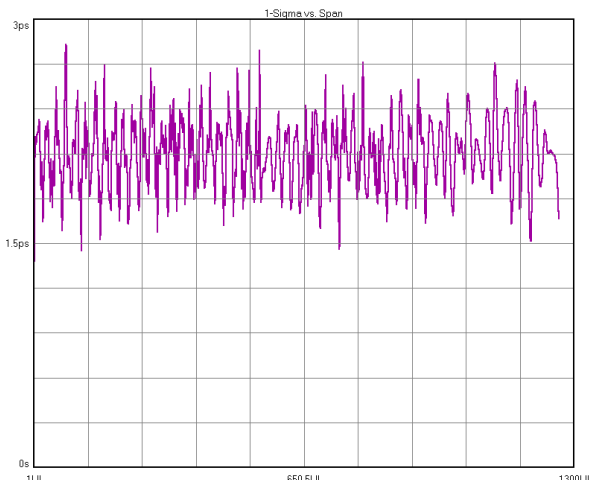


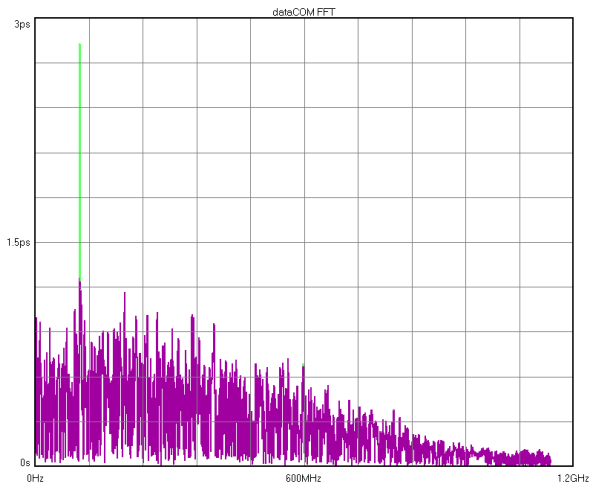
DCD+ISI vs. Unit Interval

Plots the DCD+ISI relative to the pattern. The “Pattern” line shows a representation of the entire pattern—zooming in on any edge will show three line that represent the min, mean, and max time measurements from the histogram of each edge. The “Raw” line shows how the measured mean varied from the Ideal UI. The y-axis pk-pk is the value reported for DCD+ISI in the statistics area. This plot also shows how the transition density affects jitter. Bandwidth limiting effects on the signal, as well as reflections, can be identified using this plot.

1-Sigma vs. Unit Interval

This view shows the 1-sigma values for the histograms of each binned UI measurement, allowing jitter accumulation to be seen. If modulation is present, it shows up as a periodic variation of 1-sigma values. This information is used by the FFT view to show the actual frequency components and amplitude of the modulation. When there is a PLL imbedded in the device transmitting the data, a characteristic curve is often present. Refer to the “High Frequency Modulation” Getting Started Guide.



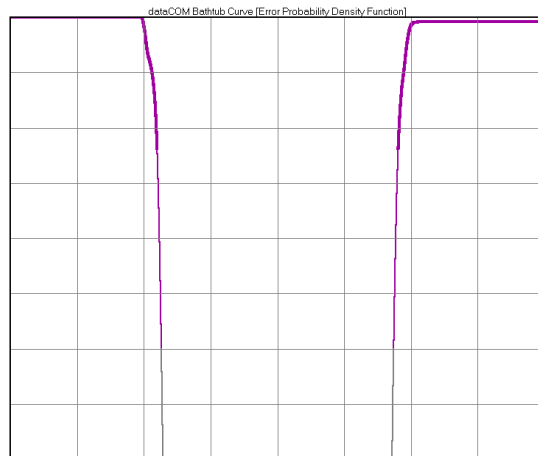


FFT

This is the FFT of the autocorrelation of the variance from the 1-sigma vs. UI view. The plot shows the spectral power density of the uncorrelated jitter frequencies from the corner frequency specified to the Nyquist of the bit rate. The largest peak is displayed as the Periodic Jitter (PJ) number in the statistics area.

Bathtub Curve

Shows the “error probability density plot” of a data signal. The plot is normalized to one UI and the Total Jitter (TJ) number in the statistics area is derived from this view. The thick part of the line represents actual measurements. The thin part indicates extrapolated information based on RJ and DJ values. The point at which the color stops is the BER that TJ is determined.



Making a Measurement

This tool requires a Pattern Marker. The Pattern Marker can be generated by many pattern generators and is often called a “Pattern Trigger” or “Pattern Sync”. In some cases, the device under test cannot create a marker. The PM50 is an SIA-3000 hardware option that will create this marker internally so that only a repeating data pattern needs to be supplied to the SIA-3000. The PM50 greatly simplifies the process of making dataCOM measurements.

This section will describe set up without a PM50; the next section (Section 4) will describe setup with a PM50.

The tool defaults to a Single Rate Fibre Channel setup. The description covers a basic measurement and configuration.

- Connect a data signal to Channel 1
- Connect a Pattern Marker to Channel 2.
- Select the appropriate channels in the “Acquire Options” menu (See Section 5 for details).
- Choose the -3dB corner frequency—default is 637kHz for 1x Fibre Channel (use 1274kHz for 2xFC).
- Press “Back” to return to the main dialog bar. Press “Pattern Options” to verify that the pattern to be measured appears under “Pattern”. If not, use one of the 3 options below for choosing the pattern to be analyzed

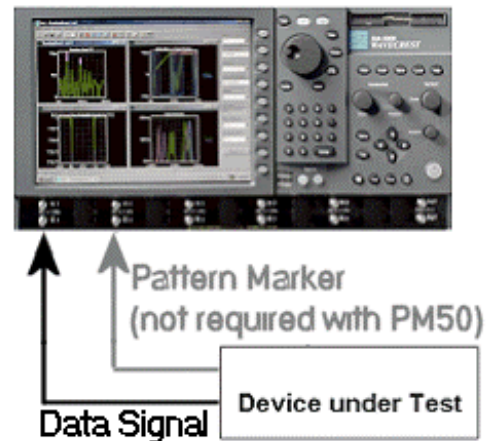


Figure 6. Typical Setup





OR

A dialog box will appear allowing you to choose a previously stored pattern (*.ptn) file.

OR

A dialog box opens allowing you to edit the current pattern or create a new one in binary or hexadecimal. You will be prompted to save this file.

This function assumes that you have a repeating pattern on the measurement channel and a pattern marker on the channel selected as the Arm. Enter the number of bits in the pattern and the bit rate and press learn. You will be prompted to save this file. In some cases, there may be difficulties learning the pattern at high data rates. If using a generator as the source, you can lower the bit rate and learn the pattern at that lower rate. Then after saving the pattern, make the measurement at the previous rate. Learning the pattern does not need to be performed before every acquire, only if a pattern is changed or is not available in the Load dialog box.

- Press Pulsefind 
- Press Acquire 
- You may get an error if the Arm is not placed properly, if so, go to the Acquire Options, Arm Delay menu, and press “Perform Placement”. Now reacquire your measurement.

In cases where there are over 20 ps of PJ, enable Tail-Fit to determine an accurate RJ. Tail-Fit is located in the “RJ+PJ Options” menu. Choosing ‘All’ or ‘Auto’ may significantly increase test time because Tail-Fit is applied to the histograms of all edges. To Tail-fit a fixed number of edges, choose 3, 5, 9, or 17.

If you wish to decrease test time, “Quick Mode” may be used. Use caution when interpreting results with “Quick Mode” turned on. This mode samples more sparsely and will not show high frequency (HF) information. Or, if HF content is present, aliasing may occur in the FFT view. Therefore, “Quick Mode” should not be used unless there is no HF present (near $\frac{1}{2}$ the bit rate).

Possible Errors and solutions

“Failed bit rate calc – bad pattern or signal” or “Failed DCD+ISI Measure – bad pattern or signal”

This error generally indicates that the pattern that the SIA-3000 is measuring at the input channel is not the same as the pattern chosen. Check that the signal is present and the input pattern matches the chosen pattern. Press “Perform Placement” in the “Arm Setup” selection to place the marker again.

Making a Measurement Using the PM50

- Connect a repeating data signal to the channel with a PM50 (Channel 1 for this example). A channel with the Pattern Marker option will be labeled “Pattern Marker Enabled” on the front of the SIA 3000.
- Choose **Pattern Options** and **Load Pattern** to load the pattern file (*.ptn). Note that “Learn Pattern” cannot be used unless an external pattern marker is supplied (see details in Section 3)

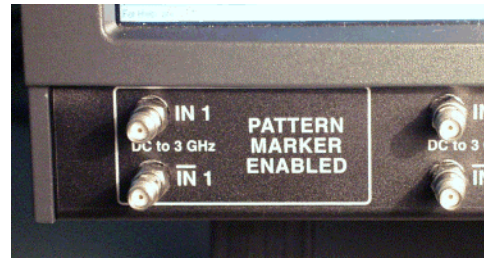


Figure 7. Showing SIA-3000 with PM50 option

- Go to the **Acquire Options** menu
- Select **Arm Number**. A Dialog Box will open. Select Channel 1. Check “Pattern Marker”, this enables the PM50.
- Select **Add/Del Channel** and ensure Channel 1 is checked.
- Choose the –3dB corner frequency—default is 637kHz for 1x Fibre Channel (1274kHz for 2xFC).

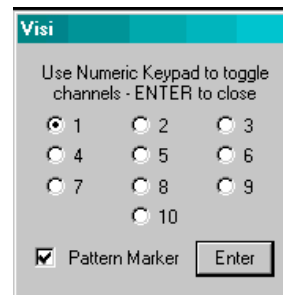



Figure 8. PM50 selected

- Now configure the PM50: Press **Arm Setup**.
- Choose “Edge Count” from “Ptn Mkr Mode”. The PM50 can be used in either of two modes Edge Count and Pattern Match. For most setups, Edge count should be used. A description of the differences follows these setup instructions.
- Press **Perform Placement** which will optimize the marker location.
- Now you can make your Measurement: Press Acquire 

Differences between Pattern Match and Edge count

Edge Count mode counts a number of edges and then generates the marker. By choosing the pattern, the number of rising edges in that pattern is automatically calculated and used as the number of edges to count.

Pattern Match mode has some restrictions and is used to generate a marker when the data has occasional insertions of bits (idles, for example). The data must be at one of the specific rates in the “Ptn Mkr Standard” pull-down menu such as 1x FC, 2x FC, etc. Additionally, the pattern must be 10, 20, 40 bits or divisible by 40. The pattern match word must contain a K28.5 character; So, the *.PTN files that are stored in the SIA-3000 such as CRPAT, CJTPAT, K28.5 will work. If you have created a custom pattern, or learned a pattern, you must ensure that the *.PTN file starts with the K28.5 word.

“Pattern Match” mode must be used with the Bit Error Counting (BEC) capability in the PM50 utility; “Edge Count” Mode will not allow BEC measurements.

Using the PM50 Utility to Count Bit Errors

The PM50 option also has the capability to detect bit errors in the pattern. The capability of logging bit errors is useful for capturing low probability events. The user can view the errors and their location in the pattern as illustrated in Figures 9 and 10. The ability to detect bit errors provides additional information about low probability errors, BER, and pattern dependent errors. Bit error counting can be performed at distinct frequencies in Pattern Match mode.

To access the PM50 utility, go to **Acquire Options**, **Arm Setup**, and press **Open PM Utility**.

If the PM50 has already been setup in the “Known Pattern with Marker” tool, the only change that may need to be made is to change to “Pattern Match” mode and Press **Perform Placement**. *Note the requirements of the pattern to be used in “Pattern Match” mode.*

To measure bit errors, press **Display Errors**. Select “Pattern” view to see the bits in error (see Figure 9). The summary view shows BER and which bits were in error (Figure 10). Pressing **Reset Counter** will clear the counted errors and allow the measurement to be made again. The bit error counter has the ability to display up to 63 errors from the buffer. These errors are displayed graphically in Figure 9. These errors are logged on the bottom of the summary in Figure 10.

The bit error counter (BER on the summary page) can count up to $2^{20}-1$ errors for accurate BER calculations.

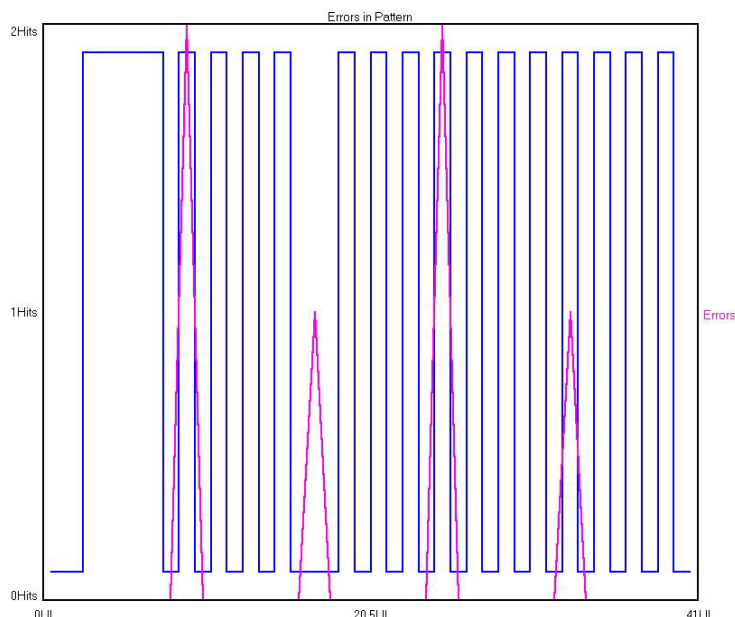


Figure 9 shows a plot of the pattern and the number of errors for each bit in the pattern. In this example there are six bit errors at four different bits in the pattern.

Pattern Marker Summary

Pattern Marker PM1	Mode Pattern Match	Standard 2X FC 2.125 Gb/s
Pattern File <u>idle.ptn</u>	Total Delay 0s	Edge Count 16
20-bit Errors 6	Total Compares 29.267258e9	BER 2.050072e-010
Pattern Repeat 596859123 615776191 634502766 652095529 669976830 685542942	Frame Number 0 0 0 1 1 1	20-bit Data In Error 00111110 ⁰ 0 1010100010 00111110 ⁰ 0 1010100010 0011111010 101010 ⁰ 010 1010101010 10 ⁰ 0101010 1010 ⁰ 01010 1010101010 1010 ⁰ 01010 1010101010

Figure 10 shows the summary of the Bit Error Count information. This table shows the number of bit errors, BER, pattern repeat of the error, 20 bit frame in the pattern where the error occurred and the specific bit that was in error (indicated by a ^ above the number)

Dialog Bars—Menus and Instrument Settings

dataCOM Known Pattern with Marker Main Menu



View

The View pull-down menu provides the user with several different ways to see the acquired measurement data, within the active tool.

Channel View

Select a specific channel to view signal measurements.

Acquire Options

Opens the Acquire Options menu.

Pattern Options

Opens the Pattern Options menu.

Bitrate Setup

Opens the Bitrate Setup menu.

DCD+ISI Setup

Opens the DCD+ISI Setup menu.

RJ+PJ Options

Opens the RJ+PJ Options menu.

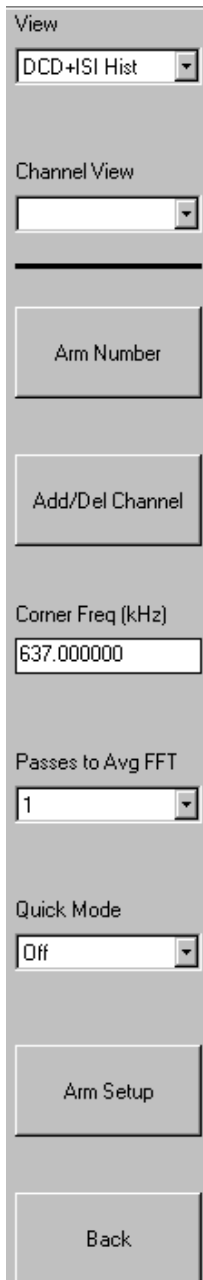
Voltages

Opens the Voltages menu.

View Options

Opens the View Options menu.

Acquire Options Menu



Arm Number

The Arm channel is enabled when External Arm is selected from 'Arming Mode'. Use the keypad to select one channel to be used to arm the measurement. If the SIA-3000 has the PM50 installed, you can use this to internally generate the arm or marker from a repeating signal. To do this, select the channel with the PM50 and check "Pattern Marker".

Add/Del Channel

Opens Add/Delete Channel menu.

Corner Frequency

Refers to the highest possible frequency component that will be displayed by the FFT and used for data calculations. This value normally is the measured clock frequency/2.

The Corner Frequency is the Frequency of the Half Power Point (or -3dB Point), so the choice of this frequency will determine the low frequencies visible on the FFT. The Corner Frequency is used to determine the maximum measurement interval to be used in sampling and is entered in kHz. A low corner frequency extends the time required to acquire the measurement set because histograms over many more periods must be acquired. Below the corner frequency, a natural roll-off of approximately 20dB per decade is observed. The default value is 637kHz, a Fibre Channel standard, except for the High Frequency Modulation Tool, which is 100kHz. Corner frequency affects how much data is acquired and, therefore, the choice of this value also affects the test time.

Passes to Avg FFT

Selects the number of passes to average for the FFT output. Averaging will generally reduce the noise floor of the FFT.

Quick Mode

This option enables a sparse sampling protocol for RJ+PJ data acquisition, which reduces the time required to obtain data. This method is appropriate for use only when there is insignificant higher-frequency jitter present. In the presence of high frequency jitter, the standard sampling protocol will reduce the amount of harmonic distortion, which can occur.

Arm Setup

Open Arm Setup menu that contains options for the PM50 pattern marker.

Back

Returns to the previous menu.



Arm Setup Menu

View

Channel View

Arm Delay (19-21ns)

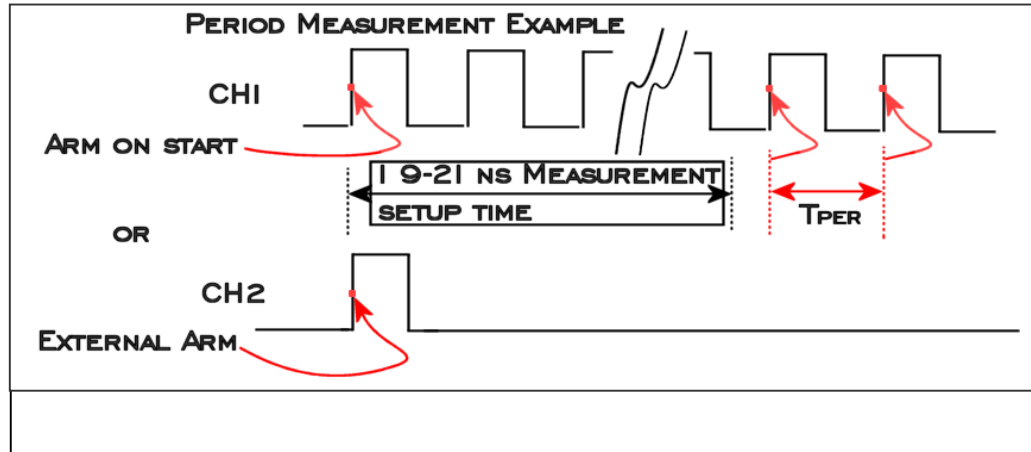
Arming Edge

Patn Mkr Standard

Patn Mkr Mode

Arm Delay (19-21ns)

The arm delay sets the minimum time from an arm event to the first measurement edge. As Figure 7 shows, there is a user selectable 19 to 21 ns delay from the Arm event to the first measurement.



Arming Edge

Choose rising or falling. This will select which edge types from the Arm Channel will be used to arm a measurement on the Measurement Channel.

Perform Placement

After the PM50 has been selected and configured, and the proper pattern is chosen, this button will optimize the placement of the marker with respect to the data. An improperly placed marker can cause errors such as “Bit Rate Measure Fail—Bad Pattern or signal” or “DCD+ISI Measure Fail—Bad Pattern or Marker”.

Patn Mkr Standard

The Following Speeds can be selected in Pattern Match Mode:

1X FC	1.0625Gb/s	Infiniband	2.5Gb/s
GBE	1.25Gb/s	2X SATA	3.0Gb/s
SATA	1.5Gb/s	XAUI	3.125 Gb/s
2X FC	2.125Gb/s	3X FC	3.1875Gb/s

Patn Mkr Mode

Select Pattern Match or Edge Count Mode. In Pattern Match mode, the Pattern Marker card (PM50) will generate a Pattern Marker when matching a unique 40-bit sequence of a pattern. The "Patn Mkr Standard" needs to be selected accordingly. In Edge Count mode, the pattern marker card will generate a pattern marker upon repetition of a user-specified number of positive or negative edges (frequency agile from XMHz to 5GHz). For PRBS patterns use Edge Count mode only.

Open PM Utility

This will open the Pattern Marker Utility window (if a PM50 is installed)

Back

Returns to previous menu.

Pattern Options Menu

View
DCD+ISI Hist

Channel View

Load Pattern

Pattern
k285.ptn

Edit Pattern

Learn Pattern

Header Offset
0

Show Ptn on Plot
On

Back

Load Pattern

Opens a browser window to load previously saved patterns.

Pattern

Displays current pattern being used.

Edit Pattern

Allows users to directly input data patterns in either binary or hexadecimal form.

Learn Pattern

A pattern may be "learned" if it is not already stored as a .ptn file or too long to be manually entered in Edit Pattern. The number of bits in the pattern must be known and the Bit Rate must be entered as precisely as possible. The data stream must be relatively jitter free and a suitable pattern marker must be available as an external arm. If there are errors trying to "learn" at a high bit rate and it is possible to have a slower, clean pattern (from a pattern generator), the pattern may be learned at this slower rate (adjusting Bit Rate accordingly). The reason the signal should be relatively jitter free is to ensure that the correct pattern is learned. Once the pattern is stored, analysis of a signal with jitter can then be made.

Note: "Include DCD + ISI calibration" is to be used only in special circumstances. Using this function assumes that "Learn Pattern" will be performed on a perfect signal (from a generator with short cables) at the intended measurement rate, then this learned pattern (now with DCD + ISI values) is stored and used for the measurement. This requires that the only part of the setup that has changed is that the device under test is inserted in the test path. Typically this setting is not used.

Header Offset

Allows user to skip a given number of edges, after the external pattern marker, before sampling. This can be helpful in applications such as Hard Drives where a header precedes a repetitive data sequence in the data stream. This option is only available when using external arming and applies to all dataCOM sampling, including Learn Pattern.

Show Pattern on Plot

Toggles the pattern on/off for the display.

Back

Returns to the previous menu.

Bitrate Setup Menu

View
DCD+ISI Hist

Channel View

Measure Bit Rate
On

Bit Rate (Gb/s)
1.062500

Bit Rate Samples
100

Bit Rate Patterns
10

Bit Rate StdErr
0.500000

Back

Measure Bit Rate

Measures the Bit Rate based on a correctly defined pattern. The bit rate is derived by measuring the total time over a number of pattern repeats and calculating an ideal unit interval.

Bit Rate (Gb/s)

The average data rate of the signal, entered in GigaBits per second. An accurate Bit Rate is crucial as it is used in the calculation of the various jitter components. The default is 1.0625 Gbit/s, which is the standard 1x Fibre Channel speed. Because the pattern and total number of UI is known, the Bit Rate that is reported is an average value derived from the total time across a number of patterns (defined by Bit Rate Patterns) divided by the total number of UI contained in the patterns times the number of Bit Rate Patterns. A good rule of thumb is the Bit Rate Patterns times the pattern length should be > ~1000 UI for an accurate bit rate calculation.

Bit Rate Samples

Determines the total number of time samples acquired for the single time measurement.

Because the pattern and total number of UI is known, the Bit Rate that is reported is an average value derived from the total time across a number of patterns (defined by Bit Rate Patterns) divided by the total number of UI contained in that many patterns times the number of Bit Rate Patterns.

Bit Rate Patterns

Determines the number of patterns over which a single time measurement is made. Because the pattern and total number of UI is known, the Bit Rate that is reported is an average value derived from the total time across a number of patterns (defined by Bit Rate Patterns) divided by the total number of UI contained in that many patterns times the number of Bit Rate Patterns.

Bit Rate Standard Error

Value used to determine error limits for Bit Rate calculation. An error message such as "Failed Bit Rate calculation" indicates when suspect measurements have been taken and is usually as a result of improper pattern selection.

Back

Returns to the previous menu.

DCD+ISI Setup Menu

View
DCD+ISI Hist

Channel View

DCD+ISI Samples
100

DCD+ISI Patterns
1

DCD+ISI StdErr
0.500000

Filter Options

Back

DCD + ISI Samples

This is the number of time samples in each histogram for each edge of the pattern. The histogram MIN, MEAN and MAX times can be seen in the DCD + ISI vs. Edge view. It is the mean value of the histogram, which is compared to an ideal unit interval for each edge.

DCD + ISI Patterns

Enter number of pattern intervals for which measurements will be taken. Defaults to 1 for compliance testing. Increase this value to see more pattern repeats on the dataCOM with Marker, DCD + ISI vs. Edge View. Note: Bit Rate Patterns should be set greater than or equal to DCD + ISI Patterns because an accurate bit rate is important for calculating the ideal unit interval; DCD + ISI is calculated as a deviation from this ideal UI.

DCD + ISI Standard Error

Indicates when suspect measurements have been taken, usually as a result of improper pattern selection. Default is 0.5 UI. Any measurements deviating from the ideal by more than this value will produce an error message and the test will stop. This value may need to be increased if the signal has more than 0.5 UI of jitter (such as tolerance testing).

Filter Options

Opens the Filter Options menu.

Back

Returns to the previous menu.

Filter Options Menu

View
DCD+ISI Hist

Channel View

DCD+ISI LPF
Off

LPF (kHz)
637.000000

DCD+ISI HPF
Off

HPF (kHz)
637.000000

Back

DCD + ISI LPF

This option applies a Low Pass Filter to the DCD+ISI data. The resulting, filtered data is plotted on top of the raw DCD+ISI data in the DCD+ISI vs. Edge plot window. This feature allows the modeling of receiver performance given the measured (transmitted) data pattern if the characteristics of the receiver are known. The filter characteristics are applied after the measurement is acquired and does not affect the acquisition.

LPF (kHz)

User defined Low Pass Filter corner frequency, in kHz, when the DCD + ISI LPF (Low Pass Filter) option is "on". Default is 637kHz.

DCD + ISI HPF

This option applies to a High Pass Filter to the DCD+ISI data. The resulting, filtered data is plotted on top of the raw DCD+ISI data in the DCD+ISI vs. Edge plot window. This feature allows the modeling of receiver performance given the measured (transmitted) data pattern if the characteristics of the receiver are known. The filter characteristics are applied after the measurement is acquired and does not affect the acquisition.

HPF (kHz)

User defined High Pass Filter corner frequency, in kHz, when the DCD + ISI HPF (High Pass Filter) option is "on". Default is 637kHz.

Back

Returns to the previous menu.

RJ+PJ Options Menu

View
DCD+ISI Hist

Channel View

RJ+PJ Samples
100

RJ+PJ StdErr
0.500000

Tail-fit
Off

Convergence
10%

Measure Options

RJ+PJ Filters

Back

RJ + PJ Samples

This is the number of samples in each histogram. The 1-sigma values used to create the 1-sigma vs. Span plot come from these histograms.

RJ + PJ Standard Error

Indicates when suspect measurements have been taken, usually as a result of improper pattern selection. Default is 0.5 UI. Any measurements deviating from the ideal by more than this value will produce an error message and the test will stop. This value may need to be increased if the signal has more than 0.5 UI of jitter (such as tolerance testing).

Tail-fit

Pull-down menu list for enabling/disabling tail-fit feature. When Tail-Fit is enabled, Random Jitter and Deterministic Jitter can be separated in order to calculate Total Jitter. To accurately predict long-term clock performance, Tail-fit is necessary when the histogram is not Gaussian.

Convergence

Determines the percentage within which consecutive Tail-Fits must comply in order to insure reasonable frequency coverage from the corner frequency. The default setting is 10%.

Measure Options

Opens the Measure Options menu.

RJ+PJ Filters

Opens the RJ+PJ Filters menu.

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Returns to the previous menu.

Measure Options Menu

View
DCD+ISI Hist

Channel View

Measure RJ+PJ Per+
On

Measure RJ+PJ Per-
Off

Measure RJ+PJ PW+
Off

Measure RJ+PJ PW-
Off

RJ+PJ Interpolation
Cubic

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Measure RJ + PJ Per+

Plots RJ+PJ time measurements for Period + (rising edges to rising edges). See Measure RJ + PJ Per-.

Measure RJ + PJ Per-

Plots RJ + PJ time measurements for Period - (falling edges to falling edges). See Measure RJ + PJ Per+.

Measure RJ + PJ PW+

Plots RJ + PJ time measurements for PW+ (pulse width rising edges to falling edges).

Measure RJ + PJ PW-

Plots RJ + PJ time measurements for PW- (pulse width falling edges to rising edges).

RJ + PJ Interpolation

This option selects the means of filling the gaps in the autocorrelation function that naturally occur in a pattern. Generally, the “cubic” interpolation will produce the best results in the presence of periodic jitter. Selection of “linear” interpolation may be preferred in the presence of purely random jitter. In which case, the presumption of a smooth autocorrelation function cannot be made.

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RJ+PJ Filters

View
DCD+ISI Hist

Channel View

RJ+PJ HPF
Natural Rolloff

High Pass Freq (MHz)
0.637000

RJ+PJ LPF
Nyquist

Low Pass Freq (MHz)
531.250000

+/-0.5 UI Filter
Off

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RJ + PJ High Pass Filter (HPF)

A post-processing filter that is applied to the data after acquisition. The filter affects the determination of what are considered peaks in the FFT views. The highlighted peaks are then reported among the values displayed in the Summary View. Choices are Natural Rolloff and Brickwall. User can enter value in box labeled Min Filter (MHz) only when the Brickwall selection is enabled. The values shown when options are deselected are not used.

Natural Rolloff – When selected, does not add any filtering but refers to the natural – 3db rolloff, or high pass corner frequency, determined by how much data the tool is allowed to acquire. The corresponding user entry box is deselected and the value in the box is not used.

Brickwall – is a high pass filter. It does not allow the RJ or PJ to be calculated below this user-selected value. A user entry box allows entering a frequency value. Any value entered MUST be above the frequency that is set for the –3db freq. The –3db frequency setting controls how much data is acquired and the Brickwall filter value is applied to that data.

High Pass Freq (MHz)

Lower frequency limit for the window over which RJ and PJ is calculated. Default is Corner Frequency. This setting cannot be set lower than the corner frequency.

RJ + PJ Low Pass Filter (LPF)

A post-processing filter that is applied to the data after acquisition. The filter affects the determination of what are considered peaks in the FFT views. The highlighted peaks are then reported among the values displayed in the Summary View. Choices are Nyquist and First Order. User entry is possible in box labeled Low Pass Freq Filter (MHz) only when First Order selection is enabled.

Nyquist – when selected, does not add any filtering but refers to the highest possible frequency component that will be displayed by the FFT and used for data calculations. This value normally is the measured clock frequency/2.

First Order – is a low pass filter, it does not allow the RJ or PJ to be calculated above this user-selected value. The Low Pass Freq (MHz) field allows entry of the filter rolloff frequency.

The displayed values are not used when options are deselected.

Low Pass Freq (MHz)

Upper frequency limit for the window over which RJ and PJ is calculated. Default is Nyquist. See RJ + PJ max filter.

+/- 0.5 UI Filter

Available when a pattern marker is being used and quick-mode is not enabled. Eliminates stray errors due to insertion of extra IDLE characters compensating for device re-clocking, which disrupts standard Fibre Channel test patterns. Filters are automatically calculated and applied to throw away any measurements, which are more than +/- 0.5 UI away from their expected positions. If more than 5% of the edges are filtered, an error will be reported.

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Voltage Options Menu

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DCD+ISI Hist

Channel View

Threshold Voltage
Auto

Channel
Chan1

Channel Voltage
0.000000

Arm Voltage
0.000000

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Threshold Voltage

When set to "AUTO", the start and stop threshold reference voltages are based on the 50% point of minimum and maximum voltage level found on each channel. The voltages are shown in the voltage display boxes after a pulsefind is completed. Select "USER VOLTS" to manually enter threshold voltages in the voltage display boxes. A pulsefind cannot be performed when User Volts is selected.

Channel

When "Threshold Voltage" is set to AUTO, you can use the "channel" control to view the threshold voltages derived from PULSEFIND to be used by that channel for a measurement. Voltages are displayed under "Start Voltage", "Stop Voltage", and "Arm Voltage".

When "Threshold Voltage" is set to USER VOLTS, use the "channel" control to select a channel and specify or fix the threshold voltages to be used for the measurement on that channel.

Channel Voltage

Enter channel voltage trigger level.

Arm Voltage

This is the voltage threshold used to Arm the chosen measurement. This value is derived from PULSEFIND when "Threshold Voltage" is in AUTO. If "Threshold Voltage" is in USER VOLTS, you can enter a fixed value to be used. In USER VOLTS, PULSEFIND will have no effect on the threshold voltages.

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View Options Menu

View
DCD+ISI Hist

Channel View

X-axis
UI Spans

Summary Units
Time

Effective Jitter
Off

High Limit
0.0001

Low Limit
1e-12

Bit Error Rate
1e-12

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X-axis

Select the horizontal plot axis unit of measure.

Delay Time - Shows time from Arm

Delay Periods - Shows number of periods from Arm

Elapsed Time - Shows elapsed acquisition time

Event - Take a measurement for each event from START event to STOP event and plot these values versus the count.

Hit Number - Low Frequency Modulation: Hit number is integer value assigned to each measurement as it is made.

Measurement - Shows number of total measurements

Span Periods - Shows number of periods measured

Span Time - Shows units of time measured

Time - Take a measurement and plot the value versus time.

UI Spans - Shows number of UI spans measured

Summary Units

Select unit of measure.

Effective Jitter

Several Bit Error Rate Testers (BERT) offer the ability to derive Deterministic Jitter and Random Jitter from a Bathtub Curve. Since this method is based on a pure DCD+ISI jitter model, it tends to generate lower DJ and higher RJ values. This option is offered in the event values are desired that are determined on a comparable basis to a BERT.

The "Effective Jitter" algorithm uses a total jitter (TJ) value to derive both DJ and RJ. This is opposite of the Tail-Fit algorithm which determines DJ and RJ to derive TJ.

High Limit

Upper limit of Bit Error Range over which the Effective Jitter is derived.

Low Limit

Lower limit of Bit Error Range over which the Effective Jitter is derived.

Bit Error Rate

Determines the Bit Error Rate to be used when extracting total jitter from the Bathtub Curve. The default value is 1e-12. This setting has a direct effect on the TJ value that is calculated. For example, TJ at 1e-6 will be lower (smaller) than TJ at 1e-12.

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FOR MORE INFORMATION CONTACT:

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