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Screen Shots - July 2005

Welcome to the Cleverscope screen shots resource.

This resource shows typical screen shots to illustrate various screen configurations while using Cleverscope

Cleverscope has, at a minimum, two widows open: the Cleverscope Control Panel, and the Scope Graph.

Further windows such as the Tracking Graph, Spectrum Graph, Digital Graphs, Information Display, Maths equation builder and Sig Gen Control can be opened and closed as desired.
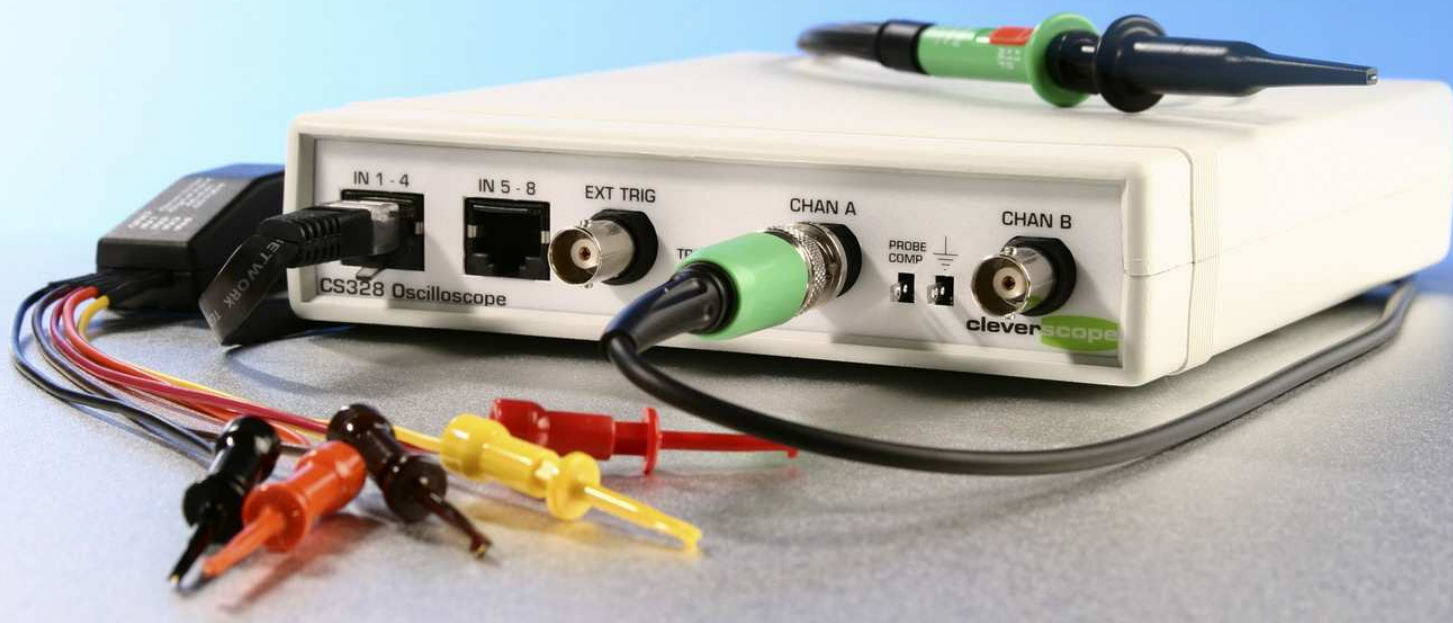
Using the Tracking Graph

Here we have captured a number of USB frames. The Scope graph defines the capture specification; – 2500 usec capture before the trigger (which is always time 0), and 8500 usecs of post trigger capture. We captured from –1 to +11 V on the A channel, and –6 to +6V on the B channel. We are triggering on the B channel, at 1V, with a rising trigger. We are using x10 probes. You can see the USB D- and USB D+ signals have been labelled. Each 1 msec frame is clearly visible. From the Cleverscope Control Panel we can see that we captured 14 ms of signal with 10 ns resolution. The markers (1 and 2) show the frame period: 1msec.

The tracking graph is very useful for looking at the detail of a signal. The tracking graph follows the black tracer on the scope graph. It can have a completely different time base. Here we see the end of packet sequence. You can see the Single Ended Zero state (both signals at 0) marked by markers 1 and 2, followed by return to idle (D+ hi, D- low).

Peak Captured sampling
The display has been captured with peak captured sampling, in which the minimum and maximum analog values for all the samples represented by one pixel are displayed by the pixel. As an example the scope graph is 700 pixels wide (the screen is 1280 x 1024), over 11 msecs. Each pixels represents 15.71 usec, or 1571 samples. Thus the min and max values of those 1571 samples have been plotted onto each pixel, and we can clearly see the structure of the USB message.

The tracking graph can display the full resolution (in this case 10 ns) while the scope graphs displays the big picture (here 11 msecs of duration).
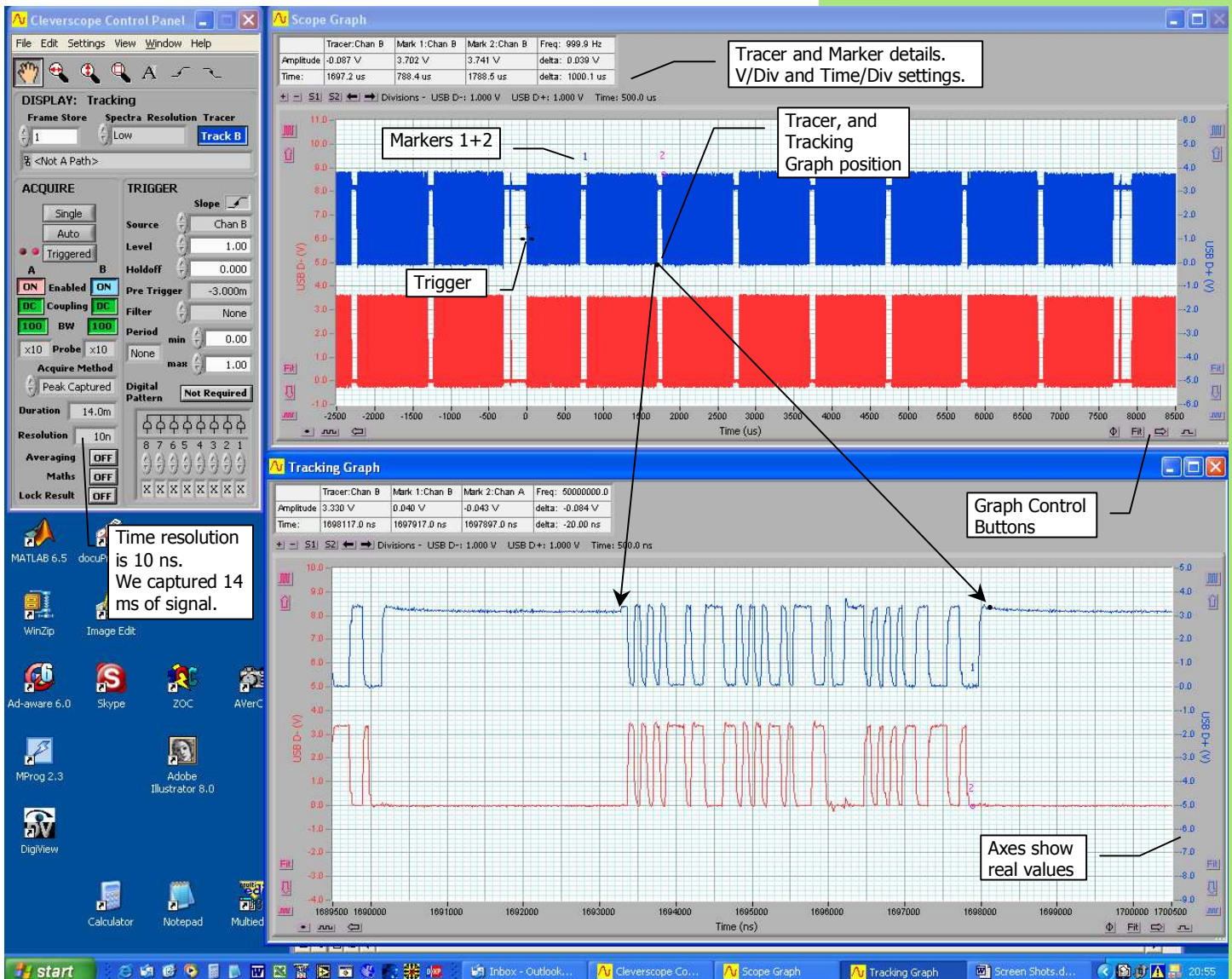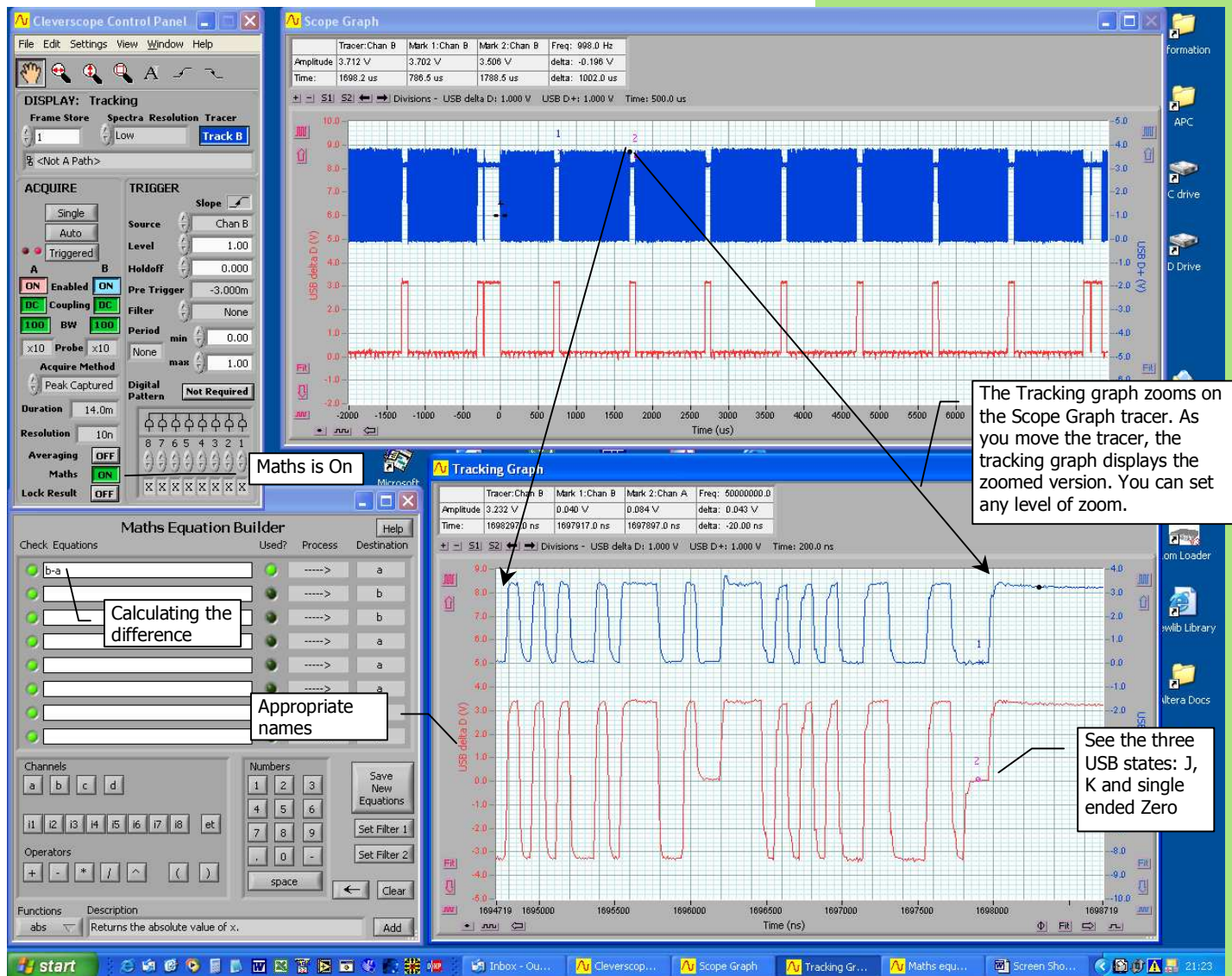
Using Maths

When looking at USB signals it is much easier to look at the differential value. Here we display the Maths module with the equation B-A (which is the same as D+ - D-). You can see the Maths is ON. The A channel now shows the differential value, and the single ended 0 is represented by 0V (see marker 2 on the tracking graph).

Effect of peak capture
The Peak Captured process means that pixels with multiple values will show a differential value of 0.

Maths is On

Calculating the difference

Appropriate names

The Tracking graph zooms on the Scope Graph tracer. As you move the tracer, the tracking graph displays the zoomed version. You can set any level of zoom.

See the three USB states: J, K and single ended Zero

The Maths Equation Builder can be used to build equations of considerable complexity. All the standard mathematical functions (abs, log, power, trig functions, thresholding functions), and standard operators + - * / ^ ( ) are supported. In addition Process supports integration, differentiation and filtering. You can store intermediate results in any channel (a-d, i1-i8), and use them in the next equation.

We set the analog names using the Settings/Analog analog names and units dialog, shown to the right.
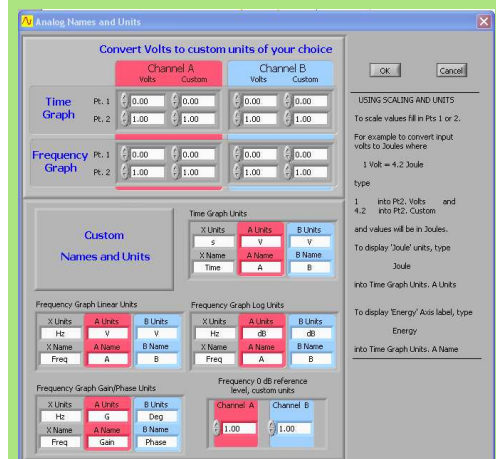
Using the Digital Inputs

The digital inputs are a very useful tool for determining state, and verifying the correct behaviour of peripherals in micro controlled applications. Here we have captured the SPI control signals going into a TI DAC7616 Quad 12 bit DAC, and looked at the buffered output signal from DAC A.

The digital inputs 1-4 have been renamed SDI, CLK, nCS and nLDAC to equate to the names on the data sheet. Channel A shows the DAC output. The scope graph has captured 12 ms with 10 ns resolution. We can see the data transfer where the tracer is, and this is being displayed by the tracking graph. We can see 16 clocks (data is transferred on the rising edge). nCS (Chip Select) is active for the transfer. nLDAC strobes the data from the input latch to the DAC, and we can see the DAC output change.

Digital Inputs

8 digital inputs are captured simultaneously with the analog inputs and external trigger. A common threshold applies to the digital inputs; it can be set from 0- 10V.
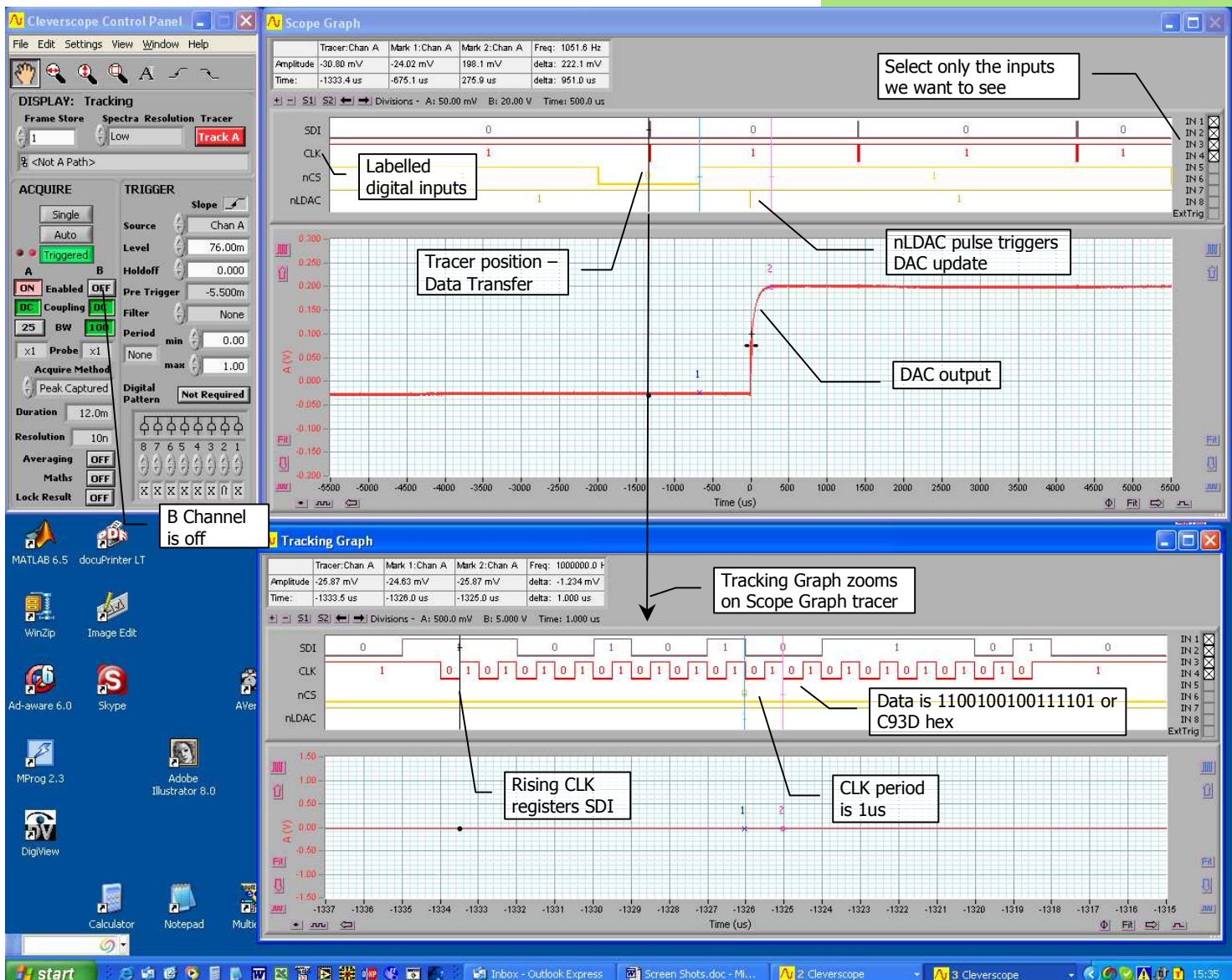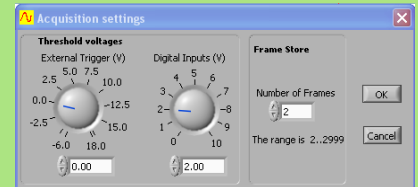
Looking at Analog Signals

Cleverscope provides several views of an analog signal – the time view (with zoom capability using the tracking graph), the spectral view (using the Spectrum Graph) and the statistics view (using the Signal Information Display).
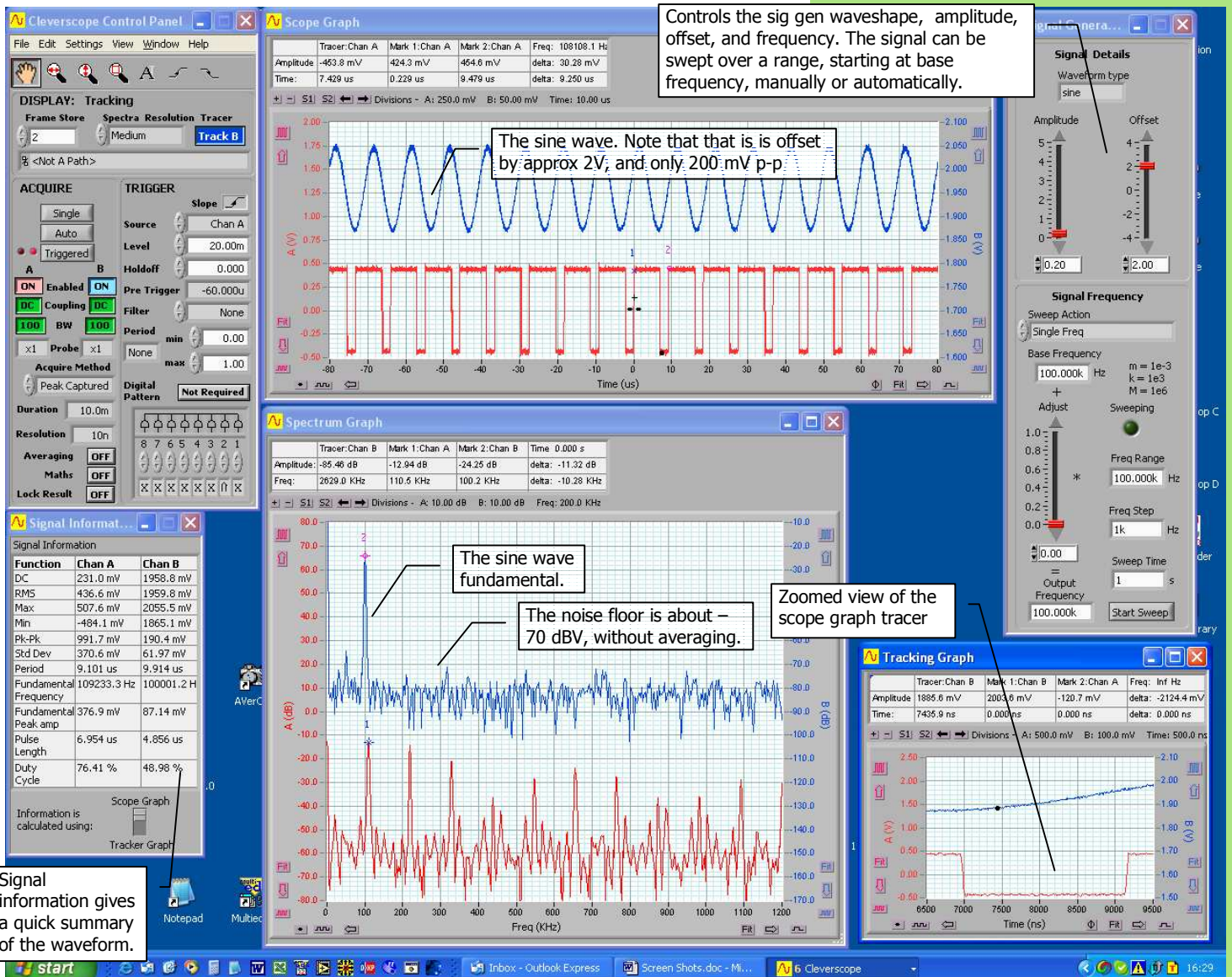
Cleverscope has a built in signal generator, which can be used as a general purpose signal source, and as the excitation for transfer response measurements.

In the view below we have captured two signals, one a sine wave from the built in sig gen, and the other a non-symmetrical square wave from an external signal generator.

Dynamic Range

To maximize dynamic range, Cleverscope automatically offsets and scales the analog inputs to match the vertical scope graph scales.

In the example, the B channel signal is offset by 2V, and only 200 mV p-p. The B channel axis extend from 1.6 to 2.1V. The scaling system will digitise waveforms in this voltage range with 10 bit resolution. Values outside the 1.6 to 2.1V range will be clipped.

Controls the sig gen waveshape, amplitude, offset, and frequency. The signal can be swept over a range, starting at base frequency, manually or automatically.

The sine wave. Note that that is is offset by approx 2V, and only 200 mV p-p

The sine wave fundamental.

The noise floor is about – 70 dBV, without averaging.

Zoomed view of the scope graph tracer

Signal information gives a quick summary of the waveform.

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Increasing Dynamic Range

To increase dynamic range we can use averaging and increased spectral resolution. Here we have captured the signal above, with averaging turned on, and 'High' spectral resolution. This leads to a reduction in the noise floor, and increase in dynamic range, and increased spectral resolution.

Dynamic Range and Noise Floor
Averaging and increasing the spectral resolution improves the dynamic range, and reduces the noise floor by using more information from the signal, while averaging out the effects of noise. We see a nearly 30 dB improvement in dynamic range, and a 4x increase in spectral resolution.
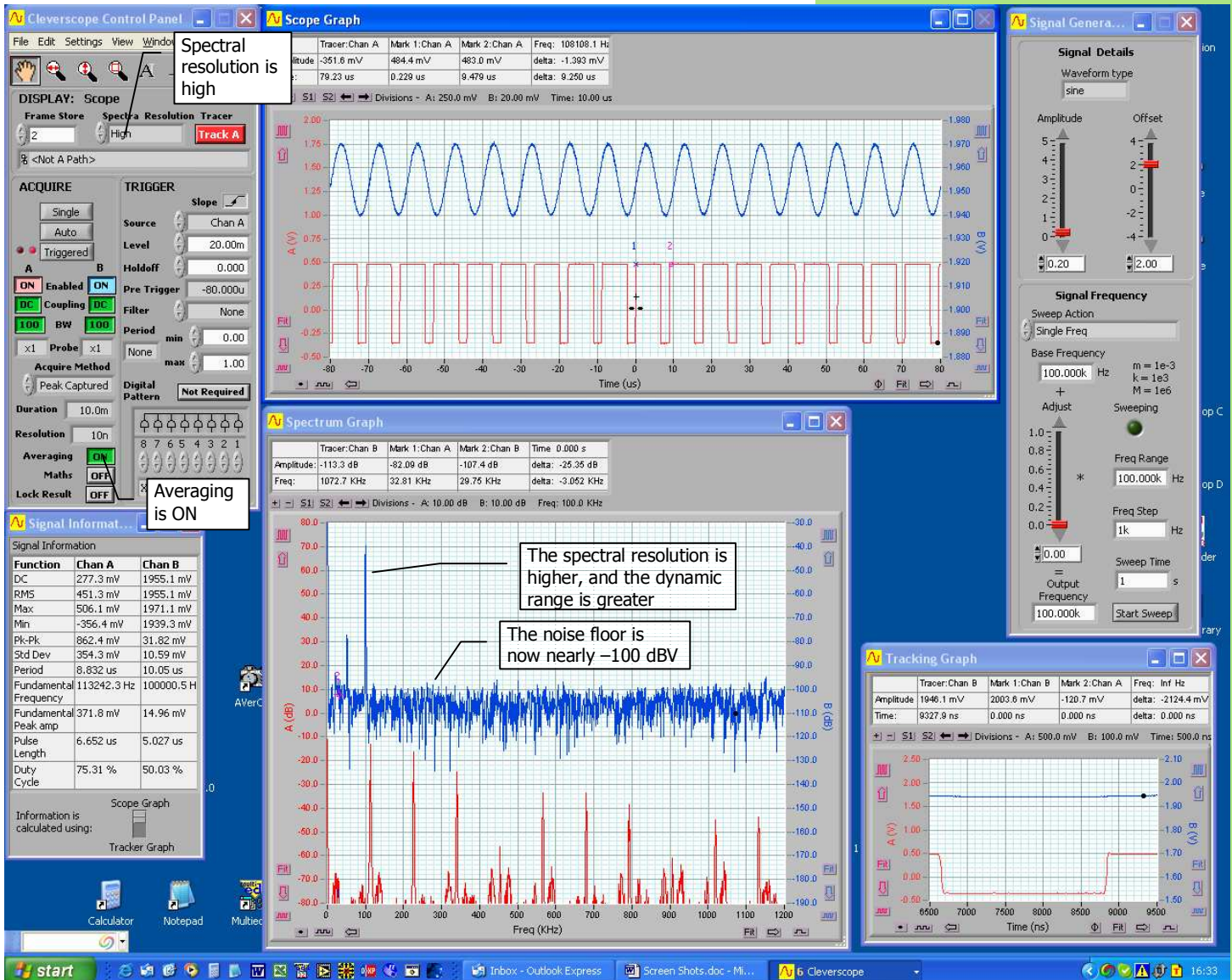
We can set the transform type (RMS Amplitude, Power, Power Density, Gain/Phase) and the FFT Window used (Hanning, Hamming, Blackman-Harris, Exact Blackman, Blackman, Flat-top, Low sidelobe) to suit the type of signals we are investigating.

In addition we can display the Gain/phase in radians or degrees, and amplitude in V or dB. The dB reference is user defined.