# Regulation And Ripple

## Trend Functions Analyze Load Related Power Supply Specs

Power supply specifications include a large number of load dependent parameters including output regulation and ripple. LeCroy oscilloscopes offer an advanced math function called trending which allows the easy measurement of these types of specifications. Trending is a data gathering function very much like data logging. The user may select anyone of 40 standard or over 100 optional, application specific parameters. The trend plot graphs from 20 to 20,000 measured values, of the selected parameter in the order they are acquired.

Figure 1 is a block diagram of a test setup used to automatically characterize power supply output specifications. For load regulation measurements the electronic load is programmed to vary the load current from 0 to 3A and back to 0 in 40 steps of 100 ms duration. The scope acquires the output voltage and current waveforms. The DA1855 Differential Amplifier and associated probes allows the voltage waveform to be displayed on an expanded range of 20mV/div.

The top two traces in figure 2 show individual output current and voltage waveforms. The lower traces are trend plots of the mean (average) values over 50 acquisitions. Note that the trends show the expected (180°) phase relationship between load current and output voltage.

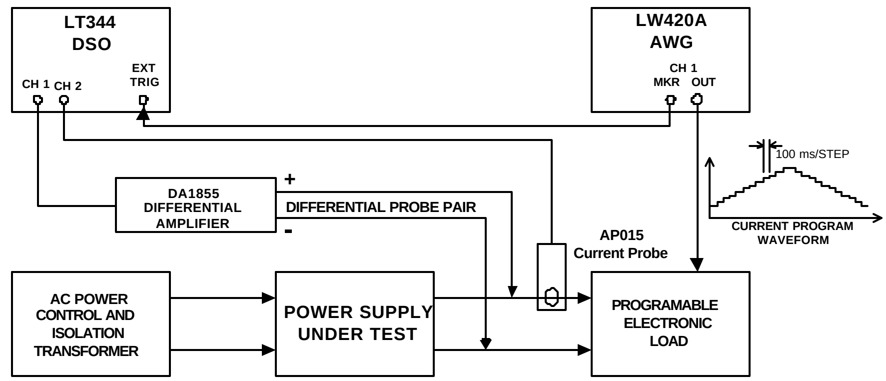


**Figure 1 - Block diagram of a test setup for measuring load regulation, ripple, and output step response of a power supply**

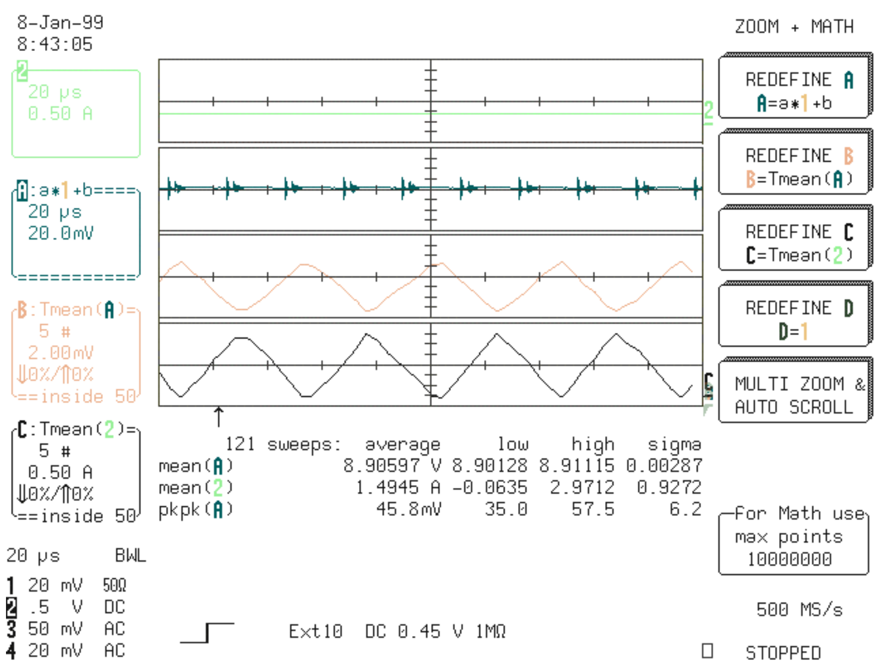


**Figure 2 – Individual acquisitions of current (CH2) and expanded voltage waveforms (Trace A) along with trend plots of mean current (Trace C) and voltage (Trace B) of 100 acquisitions.**

The parameter readouts, shown beneath the waveforms, show the average, high and low values of the parameters.

Figure 3 shows an X-Y plot of the output voltage as a function of the load current. The X-Y cursor, ΔY/ΔX, are used to measure ΔV/ΔI which is the output resistance of the supply.

Since the load current range spans the full range of the power supply output current rating the total change in output voltage:

$$\Delta V = V_{\text{NO LOAD}} - V_{\text{FULL LOAD}}$$

The load regulation is:

$$\Delta V / V_{\text{FULL LOAD}} \times 100\%$$

In this case it is:

9.3 mV/8.9V X 100 = 0.1%

The value ΔV is read directly from the cursor readout in the trace B label box. The no load value for the voltage is read from the low limit of the mean[A] parameter shown in figure 2.

A related measurement, a plot of peak to peak ripple voltage as a function of load current is shown in figure 4. This curve exhibits a clearly discernable "knee" as the load current increases above about 0,25 A. As the current continues to increase the ripple voltage increases linearly.

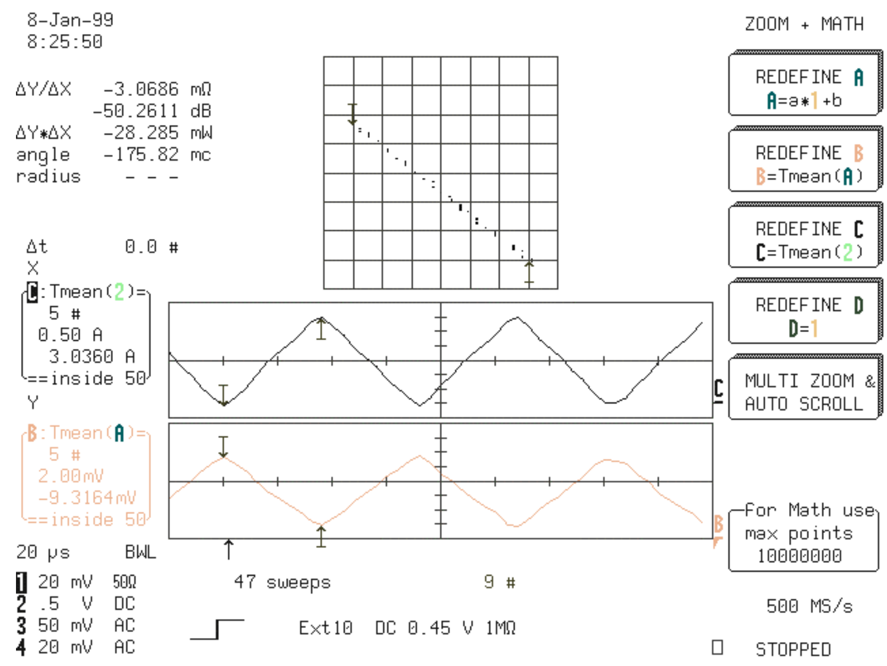


**Figure 3 - An X-Y plot of output voltage as a function of load current. Cursors measure maximum current and voltage excursions as well as output resistance (DV/DI)**

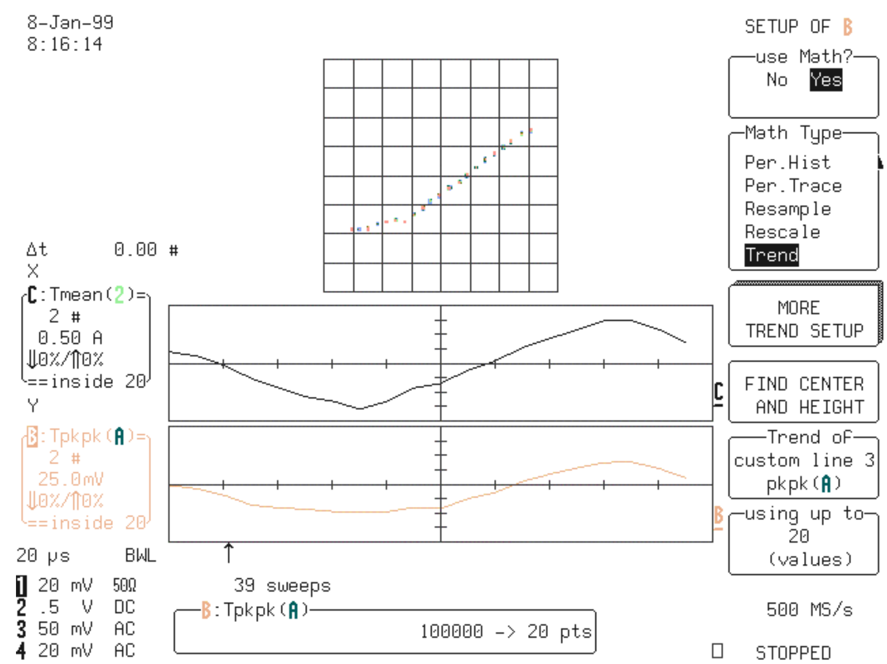


**Figure 4 – An X-Y plot of peak to peak ripple voltage as a function of load current**

These are examples of how trend plots can be applied to study functional relationships between a series of measured parameter values. This type of display eliminates the need to manually acquire and plot this data.

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