DC OUTPUTS and SCALING

The SR830 has X and Y outputs on the rear panel and Channel 1 and 2 (CH1 and CH2) outputs on the front panel.

X and Y Rear Panel Outputs

The X and Y rear panel outputs are the outputs from the two phase sensitive detectors with low pass filtering, offset and expand. These outputs are the traditional outputs of an analog lock-in. The X and Y outputs have an output bandwidth of 100 kHz.

CH1 and CH2 Front Panel Outputs

The two front panel outputs can be configured to output voltages proportional to the CH1 and CH2 displays or X and Y.

If the outputs are set to X or Y, these outputs duplicate the rear panel outputs.

If they are set to Display, the output is updated at 512 Hz. The CH1 display can be defined as X, R, X Noise, Aux Input 1 or 2, or any of these quantities divided by Aux Input 1 or 2. The CH2 display can be defined as Y, θ, Y Noise, Aux Input 3 or 4, or any of these quantities divided by Aux Input 3 or 4. If a display is defined as simply X or Y, this display, when output through the CH1 or CH2 output BNC, will only update at 512 Hz. It is better in this case to set output to X or Y directly, rather than the display.

X, Y, R and θ Output scales

The sensitivity of the lock-in is the rms amplitude of an input sine (at the reference frequency) which results in a full scale DC output. Traditionally, full scale means 10 VDC at the X, Y or R BNC output. The overall gain (input to output) of the amplifier is then 10 V/sensitivity. This gain is distributed between AC gain before the PSD and DC gain following the PSD. Changing the dynamic reserve at a given sensitivity changes the gain distribution while keeping the overall gain constant.

The SR830 considers 10 V to be full scale for any output proportional to simply X, Y or R. This is the output scale for the X and Y rear panel outputs as well as the CH1 and CH2 outputs when configured to output X or Y. When the CH1 or CH2 outputs are proportional to a display which is simply defined as X, Y or R, the output scale is also 10 V full scale.

Lock-in amplifiers are designed to measure the RMS value of the AC input signal. All sensitivities and X, Y and R outputs and displays are RMS values.

Phase is a quantity which ranges from -180° to +180° regardless of the sensitivity. When CH2 outputs a voltage proportional to θ, the output scale is 18°/Volt or 180°=10V.

X, Y and R Output Offset and Expand

The SR830 has the ability to offset the X, Y and R outputs. This is useful when measuring deviations in the signal around some nominal value. The offset can be set so that the output is offset to zero. Changes in the output can then be read directly from the display or output voltages. The offset is specified as a percentage of full scale and the percentage does not change when the sensitivity is changed. Offsets up to ±105% can be programmed.

The X, Y and R outputs may also be expanded. This simply takes the output (minus its offset) and multiplies by an expansion factor. Thus, a signal which is only 10% of full scale can be expanded to provide 10 V of output rather than only 1 V. The normal use for expand is to expand the measurement resolution around some value which is not zero. For example, suppose a signal has a nominal value of 0.9 mV and we want to measure small deviations, say 10 µV or so, in the signal. The sensitivity of the lock-in needs to be 1 mV to accommodate the nominal signal. If the offset is set to 90% of full scale, then the nominal 0.9 mV signal will result in a zero output. The 10 µV deviations in the signal only provide 100 mV of DC output. If the output is expanded by 10, these small deviations are magnified by 10 and provide outputs of 1 VDC.

The SR830 can expand the output by 10 or 100 provided the expanded output does not exceed full scale. In the above example, the 10 µV deviations can be expanded by 100 times before they exceed full scale (at 1 mV sensitivity).