ANALOG INPUT BOARD

OVERVIEW

The Analog Input Board provides the very important link between the user's input signal and the DSP processor. From the front panel BNC, the user's signal passes through a low distortion front-end amplifier, gain stages, notch filters, anti-aliasing filter, and finally an A/D Converter. Once converted to digital form, the input signal is ready to be processed by the Digital Signal Processor.

INPUT AMPLIFIER

The goal of any measurement instrument is to perform some given measurement while affecting the quantities to be measured as little as possible. As such, the input amplifier is often the most critical stage in the entire signal path. The design of the front end input amplifier in the SR830 was driven by an effort to provide optimum performance in the following areas: input voltage noise, input current noise, input capacitance, harmonic distortion, and common mode rejection (CMR). To provide such performance, a FET input differential amplifier with common-mode feedback architecture was chosen. The input signal is first passed through a series of relays to select input mode and input coupling. The input FETs U100A and U100B are extremely low-noise matched FETs. To improve distortion performance, the input FETs are cascoded to maintain a constant drain-source voltage across each FET. This prevents modulation of the drain-source voltage by the input voltage. U109 senses the source voltages and maintains the same voltage at the drains (via FETs U108A and B) with some DC offset determined by resistors N102 and N103. U105 provides common-mode feedback and maintains a constant drain current in each FET. The gain of the front end is fixed. U103 provides the output. The DC offset is adjusted by P101 and the CMR by P102.

GAIN STAGES AND NOTCH FILTERS

Collectively, the front end amplifier and following gain stages provide gain up to about 2000.

The notch filters are simple single stage, inverting band pass filters summing with their inputs to remove 60 Hz or 120 Hz. Each filter has a depth and frequency adjustment. (60 Hz - depth:P222 and freq:P221 120 Hz - depth:P202 and freq:P201). The 120 Hz notch filter has a configurable gain of either 1 or 3.17.

The notch filters are followed by two gain stages, each configurable up to a gain of 10.

Overloads are sensed at the input amplifier and the final amplifier outputs. Since there is no attenuation in the amplifier chain, this is sufficient.

ANTI-ALIASING FILTER

To prevent aliasing, the input signal passes through a low-pass filter so that all frequency components greater than half the sampling frequency are attenuated by at least 96 dB. This is accomplished with an 8-zero 9-pole elliptical low pass filter. The pass band of this filter is DC to 102kHz. The stopband begins at 154 kHz. Stopband attenuation is nominally 100 dB.

The architecture of the filter is based on a singly terminated passive LC ladder filter. L's are simulated with active gyrators formed by op-amp pairs (U311, U321, U331, U341). Passive LC ladder filters have the special characteristic of being very tolerant of variations in component values. Because no section of the ladder is completely isolated from the other, a change in value of any single component affects the entire ladder. The design of the LC ladder however, is such that the characteristics of the rest of the ladder will shift to account for the change in such a way as to minimize its effect on the ladder. Not only does this loosen the requirement for extremely high accuracy resistors and capacitors, but it also makes the filter extremely stable despite wide temperature variations. As such, the anti-aliasing filter used in the SR830 does not ever require calibration to meets its specifications.

Following the anti-aliasing filter is the signal monitor buffer (U386) and A/D driver stage (U301).

A/D CONVERTER

The SR830 uses a dual channel A/D converter (U407). Each channel samples simultaneously at