Digital Filtering

Digital Filter Option Offers Both FIR And IIR Filters

The Digital Filter option package (DFP2) for the WaveMaster™ series of oscilloscopes broadens the offering of filters of the older DFP option by including infinite impulse response (IIR) filters in addition to finite impulse response (FIR) filters. IIR filters allow users to select digital filter types identical in response to well known analog filters. As shown in figure 1, the user can select Butterworth, Bessel, Chebyshev, or Inverse Chebyshev filter configurations. The trace displays show the impulse response (trace F2) and the frequency response (trace F3) for a 75 MHz Butterworth low pass filter.

Figure 1- The selection of filter types in the DFP2 filter option

These are the most commonly used analog filter types. The Butterworth or 'maximally flat' filter has the flattest amplitude response of all the available filters. The Bessel filter is noted for its uniform phase response as a function of frequency. If you need the fastest rolloff the Chebyshev filters have the narrowest transition region for a given number of stages. On the negative side, the Chebyshev filter has amplitude ripple in the passband, while the inverse Chebyshev filter exhibits a flat passband respond but has ripple in the stop band.

Figure 2 shows the impulse (trace F2) and frequency (trace F3) responses of a Butterworth band pass filter. The user can

Figure 2 - Filter cutoff frequencies, transition width, and stop band attenuation controls in the DFP2 filter option for the WaveMaster series oscilloscopes

select from low pass, high pass, band pass, or band stop filter types. The user has control of the cutoff frequencies, transition region width, and stop band attenuation.

A very common application, for filters, is to condition signals to remove aberrations. In figure 3 a Bessel low pass pass filter has been applied to a 2.4Gbps serial communications signal in order to reduce overshoot and ringing. This type of processing used to convert raw optical signals intto electrical signals with a well defined frequency and time domain repsonse. The combination of the optical to electrical converter, filter and measurement system is called a reference receiver.

Figure 4 contains a closer view of the differences between the input and output signals.

This is a simple example of the power of having user selectable FIR and IIR filters available to condition signals within the oscilloscope. It gives the user the power to simulate system elements, eliminate interfering signals, and separate spectral components.

Figure 3 - Applying a Bessel low pass filter to a 2.4Gbps serial communications signal to reduce overshoot and ringing

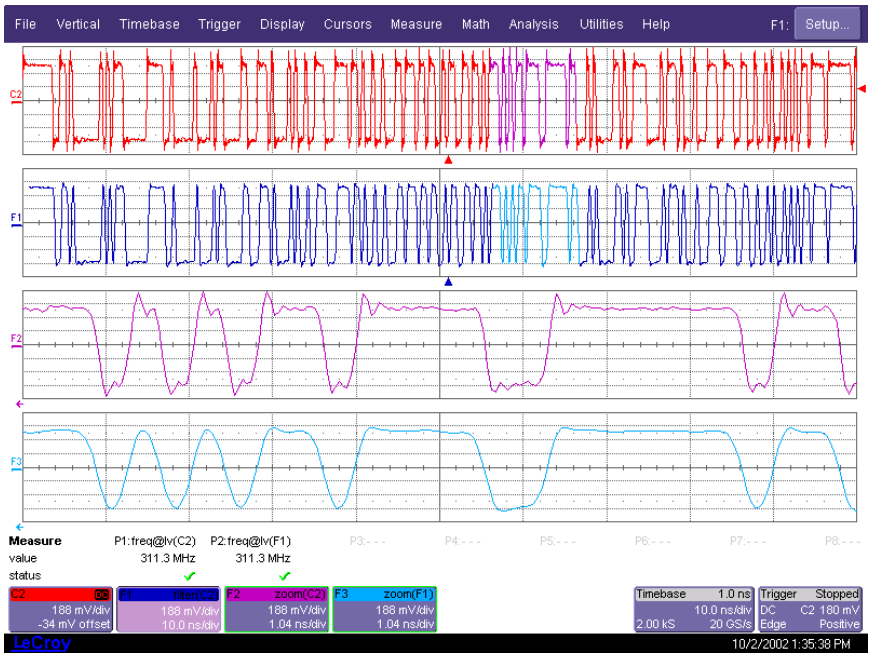

Figure 4 A zoomed display of the effect of the Bessel low pass filter on the 2.4 Gbps signal