Digital Filter Applications

TECHNICAL BRIEF

Useful Applications of the Digital Filter Package 2 (DFP2)

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Summary

Filters are useful components in the analysis of signals in an oscilloscope. This technical brief provides examples.

Introduction

Filters are circuits or devices in which the output gain and phase vary as a function of the frequency of the input. This frequency sensitivity makes them useful in removing undesirable elements of a signal or compensating for some frequency dependent distortion within the signal. Teledyne LeCroy's Digital Filter Package 2 (DFP2) option, for oscilloscopes, offers a selection of several standard (infinite impulse response or finite impulse response) filters including low pass, high pass, band pass or band stop filters or a user defined, custom digital filter configuration. These can be applied in the analysis and measurement of waveforms as illustrated in the examples, which follow.

The first class of applications to be shown is the removal of undesirable spectral components of a signal. Figure 1 contains an example of a waveform which consists of a 4 MHz square wave combined with an unwanted 5 MHz sinusoidal component.

Figure 1: Using a band stop filter to remove a 5 MHz sinusoidal signal from a 4 MHz square wave

The time domain view of this signal is shown in trace C1 and zoom trace Z1 and the frequency spectrum is shown in trace F1. By applying a band stop filter with band limits of 4.5and 5.5 MHz the unwanted 5 MHz component is attenuated and the 4 MHz square wave is evident at the filtered output (Trace F2 and Zoom Z2). The spectrum of the filter output (Trace F3) shows the reduction in the 5 MHz component.

Figure 2 shows how a high pass filter is used to eliminate 60 Hz pickup from a 63 kHz pulse width modulated signal. The high pass filter is set to attenuate signals lower than 200 Hz thereby removing the 60 Hz signal.

Figure 2: Using a high pass filter to eliminate 60 Hz pickup

If the acquired signal has a shaped baseline, as shown in Figure 3, it is possible to use a low pass filter to separate the baseline and then subtract it from the acquired waveform. In this example a low pass filter (Trace F2) is used to extract the baseline which is then subtracted from the acquired signal (C1) in trace F3.

Figure 3: Removing baseline shaping by separating and subtracting the low frequency content of an acquired waveform

The last of our spectral separation examples, Figure 4, shows the use of a low pass filter in a detector simulation. Modulation from an amplitude modulated signal is extracted by peak detection and filtering. The absolute value function performs full wave peak detection and the DFP 2 option provides the necessary low pass filtering to remove the residual carrier form the detected waveform.

Figure 4: Using peak detection and filtering to demodulate an AM signal

These examples provide a sense of how the DFP2 filters can be applied to aid your analysis.