The Response of Commercial Limiters to Transient Signals

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In this paper we study the response of commercial limiters to transient signals. We do so with the intent of using the limiters as devices to protect oscilloscopes or digitizers in UWB radar systems. Normally, limiters are characterized by their manufacturer only for CW performance, but we are interested here in the response of limiters to transient voltages. We study the limiters' abilities to pass low-level voltages without distortion, and to quickly limit a high-level signal to a maximum value. We also study the input impedance of the limiters while they are turned on, or limiting a signal. We found a surprising variety in the responses of these limiters, and we observed a number of behaviors that are undesirable for the proposed application. We provide recommendations for the best commercially available limiters for the application of UWB radar.

Two of the limiters tested here were best suited for our application of UWB radar, the Agilent models 11867A and 11930B. However, neither of these were ideal. Both of these exhibited soft limiting rather than hard limiting, so the clamping voltage is higher when driven by a higher input. The 11867A exhibited a small voltage spike in the transmitted voltage. The 11930B exhibited a small amount of droop in the step response at late time.

The other limiters were either less suitable or unsuitable for our application for a variety of reasons. These include limiting for only one of the two polarities, or limiting that turned on too late to protect the digitizer. We also observed transmission of large voltage spikes at the leading edge.

We also observed that the limiter looks like a short circuit when it is turned on, which may cause spurious reflections in the data.

As a result of this research, we can suggest additional areas of investigation. First, it would be useful to investigate the possibility of building a custom limiter design that addressed the non-ideal characteristics cited above. Second, it would be useful to have a better understanding of the peak voltages and voltage durations that can be tolerated by oscilloscopes and digitizers. Since it would be prohibitively expensive to test oscilloscopes to failure, we should investigate the use of buffer amplifiers to be inserted between the limiter and oscilloscope. Buffer amplifiers can be tested to failure, but it will be necessary to characterize their response to transient signals in precisely the same way we have done here with limiters.