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NIS5112 Transient Performance

Prepared by: Alan Ball & Ed Mejia
ON Semiconductor

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APPLICATION NOTE

General Description

The NIS5112 is an electronic fuse that incorporates a number of protection features. These include current limiting, thermal protection, and overvoltage protection. This device can replace a fuse/zener combination to add increased reliability and functionality along with the ability to reset automatically. A diode/zener network can clamp both positive and negative spikes on the input line. This device works differently, but can also accomplish the same functions. This application note describes the functions of this chip in this regard.

Postitive Transients

Positive transients are limited by the overvoltage circuit. The positive voltage clamp circuit is not designed to absorb energy from the transient, but rather to protect the load from the transient voltage.

This circuit clamps the output by adjusting the conductivity of the internal FET rather than simply shutting the part down. This increases reliability by maintaining a usable output voltage during a positive transient event rather than shutting down the output and causing a system restart.

The internal amplifier will respond to limit the voltage excursion to the limit level within a microsecond as can be seen on the oscilloscope traces. After the settling time of the amplifier, the maximum voltage during the transient is defined by the data sheet and is nominally 15.5 volts.

If a transient occurs for a long enough duration of time such that the die reaches the thermal shutdown point, the part will shut down. There are two versions of the thermal protection circuit available. If the latching device is used, the part will have to be restarted by either recycling the input power or toggling the enable pin. The auto−retry part will reapply power to the output as soon as the die temperature has reached the lower thermal threshold.

The output voltage is filtered from fast rise times on the input due to the impedance of the electronic fuse coupled with the load capacitance. This creates a low pass filter, which is very effective at removing the fast edges of the transient.

Negative Transients

There is an internal diode in the NIS5112 from V_{CC} to ground, that will conduct if the voltage is reversed. Figure 5 shows the forward drop of that diode vs. current. Figure 4 shows the maximum pulse that the diode can conduct before failure as well as the associated peak voltage for that current pulse with a 25°C ambient temperature.

Figures 6 & 7 show the test current waveforms and resulting voltage profile for several pulses. These are at intermediate current levels and not necessarily the maximum rated current which is shown in Figure 4.

Test Circuit

The test circuit that was used for the positive transient tests is shown in Figure 1. The voltage was switched between two sources with a diode to block the voltage of the 12 volt source. Waveforms show the input and output voltages of the chip. Two traces were taken; one with a 10 μF capacitor on the output and one with a 100 μF capacitor. The voltage was stepped from 12 to 20 volts.

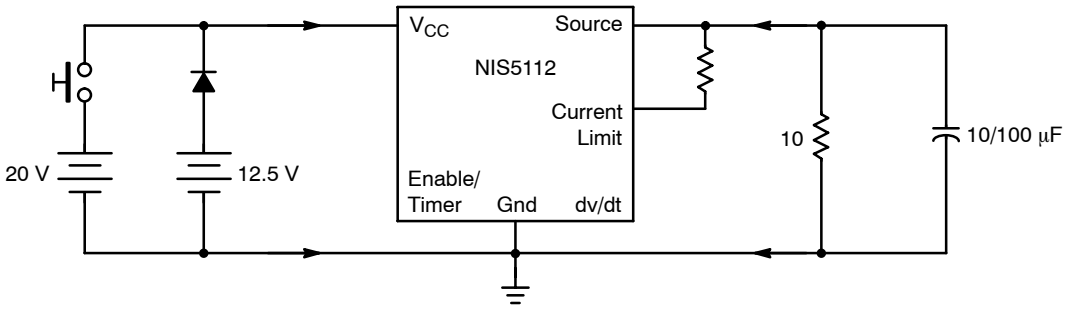

Figure 1. Positive Transient Test Circuit

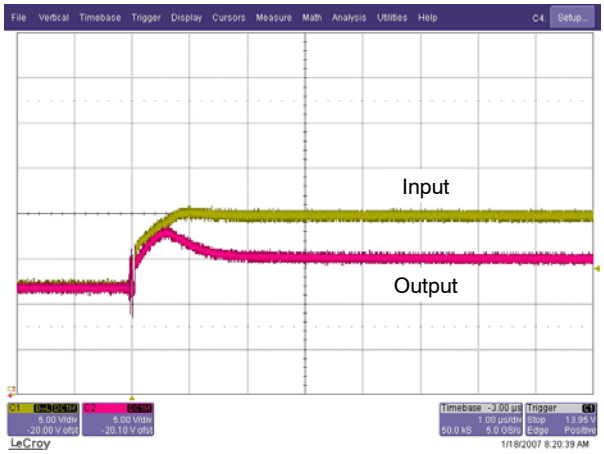

Figure 2. Pos Transient, 12 V to 20 V, 10 μF cap

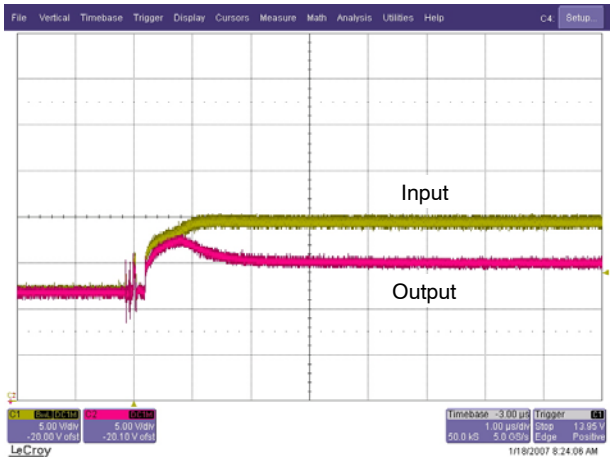

Figure 3. Pos Transient, 12 V to 20 V, 100 μF cap

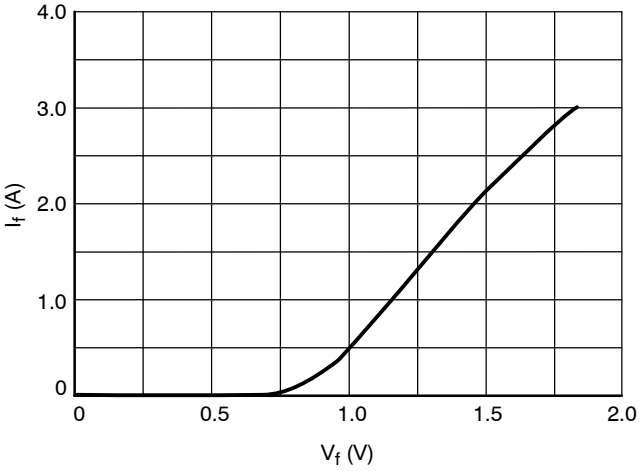

Figure 4. Reverse Transient VI Characteristics. Pulse Test

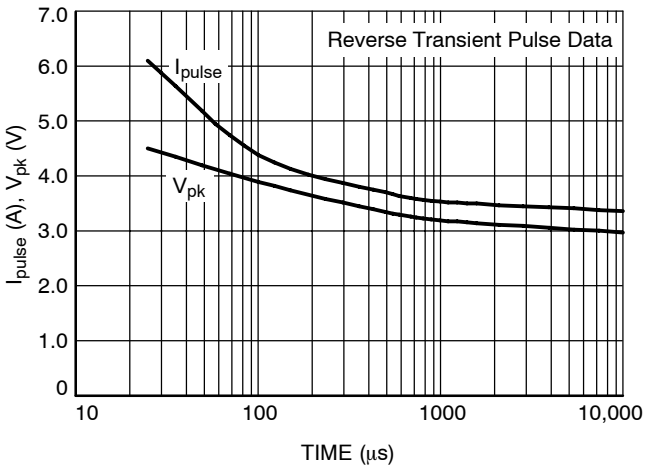

Figure 5. Maximum Allowable Reverse Current Pulse and Associated Peak Voltage

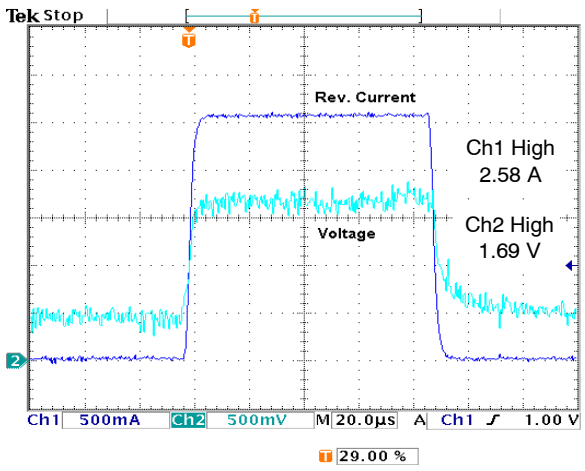

Figure 6. 2.6 A Pulse Waveforms

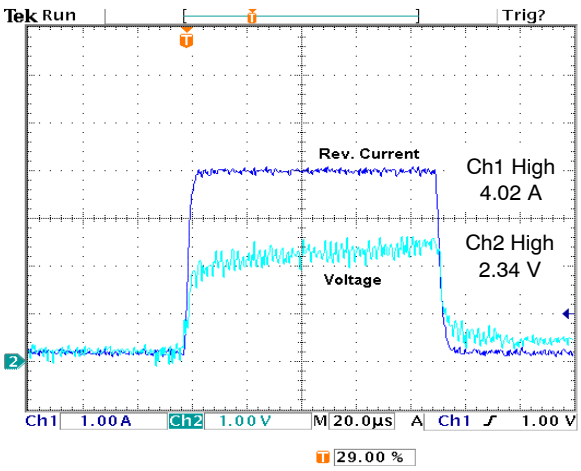

Figure 7. 4.0 A Pulse Waveforms

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