Current monitoring with the ZXCT1009 considering high voltage transients

Transients, also known as surges are changes in current or voltage which occur in short duration. These cause the power supply to operate outside what would be its normal operating condition boundaries.

Transients can be both internal and external and can not only damage components but also cause a complete system failure if the circuit doesn't have sufficient protection. Transients are such that they can cause progressive damage to components over a period of time. Internally generated transients can often be energy stored in inductive or capacitive elements which is released if operating conditions change. A transient is created every time an inductive element is switched within a circuit, for example a motor. Other transients can come from external sources such as lightning.

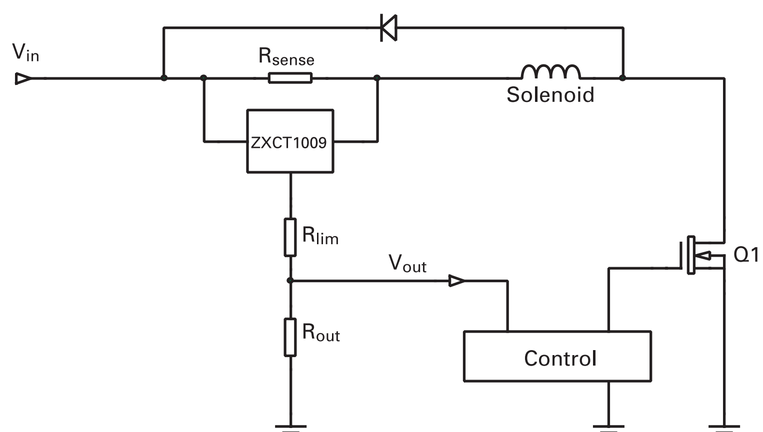
Typical internal transient sources include:

- Load dumps
- Inductive switching
- Ignition pulse

In circuits where a current needs to be measured accurately if transients are present, snubber circuits or expensive components can often be required, which increases component count.

The ZXCT1009 has the particular feature of being a three terminal device. A ground terminal is omitted from the ZXCT1009 which allows a voltage to be scaled to any reference potential. This is providing the reference is at least 2.5V below V_{in} and the device is within it normal operating range. This allows an additional resistor to be inserted between R_{out} and the ZXCT1009, when a current is required to be measured where voltage transients are present.

Figure 1 Current measurement into a solenoid



Example

Consider figure 1.0 whereby a 3 Ampere current needs to be measured into a solenoid. 130V transient spikes are present in the system and a 5V output is required to the control IC.

Conditions:

Supply voltage 12 - 16V

V_{out} = 5V

$V_{transient}$ = 130V

V_{sense} = 50mΩ

The maximum value of the limiting resistor is given by:

$$R_{lim}(max) = \frac{R_{out}[V_{in}(min) - (V_{dp} + V_{out}(max))]}{V_{out}(max)}$$

$R_{lim}(max)$ = 2.97kΩ

Based upon using a 3.3K for R_{out}.

$V_{in}(min)$ = Minimum supply operating voltage

V_{dp} = Dropout voltage

The minimum value is defined with an output voltage of 0V.

$$R_{lim}(min) = \frac{V_{pk} - V_{max}}{I_{pk}}$$

$R_{lim}(min)$ = 2.75kΩ

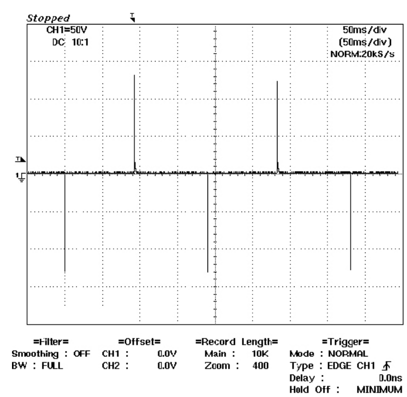
V_{pk} = Peak voltage transient to be withstood

I_{pk} = Peak output current = 40mA

Short duration high voltage surges therefore can be accommodated using the ZXCT1009, and an additional limiting resistor.

The type of system and surroundings the device is operating in will determine the duration of the transients. Figure 2.0 shows both positive and negative going 130V pulses of short duration which a ZXCT1009 was subjected to. An additional current limiting resistor was added. These simulate possible spike occurrences, which can be seen while measuring the current into a motor or other such inductive loads. The spikes are no greater than milliseconds in duration and no detrimental effects will be suffered to the monitor with the limiting resistor added.

Figure 2 Positive and negative transient spikes



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