



Zoltán Kiss - Endrich Bauelemente Vertriebs GmbH

SUSUMU Current sensing shunt resistors with long side terminals

Low resistance current sensing chip resistors have been introduced originally as over-current protection devices in power supply circuits. Their application range has been extended and these components become important components for power management of mobile devices and for high frequency circuits, used to measure or adjust current. As there are more and more expectations towards electronics devices, the signal processing speed increases, generating a challenge for the designers to control noise caused by high frequency. Susumu offers a wide range of current sensing low resistance chip resistors. In this article, we will focus on one of them, the RL series, which was the industry's very first long-side terminal current sensing chip resistor. This particular resistor series has been very popular due to its high power capability and low inductance at lower resistive range which helps control the noise of high frequency and high speed applications of electronics devices.

Required characteristics for current sensing components

In order to measure the current in an electric circuit, low resistance current sensing chip resistors can be used, and the voltage drop over the component is measured. The required characteristics are tight tolerance, small TCR, high power and small size. There is however another important factor on high frequencies to take in account, the low equivalent series inductance (ESL).

Reaching low ESL

The inductance of conductor (non-coil) is provided by the following equation:

$$L = 0,002h \left(\frac{2,303 \log_{10} 4h}{d} - 1 + \frac{\mu}{4} \right),$$

where

- h : conductor length
- d: conductor width
- μ : permeability

The inductance increases with permeability of the material and length of the conductor and decreases with the width of the conductor. Therefore, when the material is fixed, low ESL can be obtained by shortening the conductor length and widening the conductor width.



Susumu's long-side terminal type resistor realizes low ESL with shorter length and wider width of the resistive element by using its longer side as the terminal. The comparison of ESL among Susumu's low resistance chip resistors is shown in figure.

As expected, the long-side terminal type with shorter and wider conductor characterizes one third of ESL of the regular short-side terminal type.

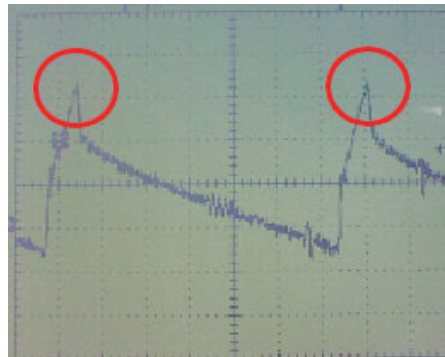
Effect of low ESL : Reduction of noise

Number of electronic devices require precise power management, that could be provided by using DC/DC converters.

These switching devices operate on several hundred kHz frequencies. If the ESL of the current sensing resistor is large, the transition switching pulses contain noise that affects the accuracy of the control.

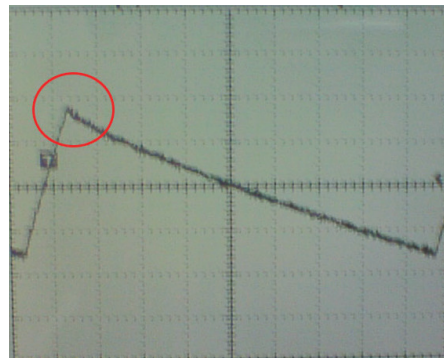
However, if ESL is small, such noise will become insignificant.

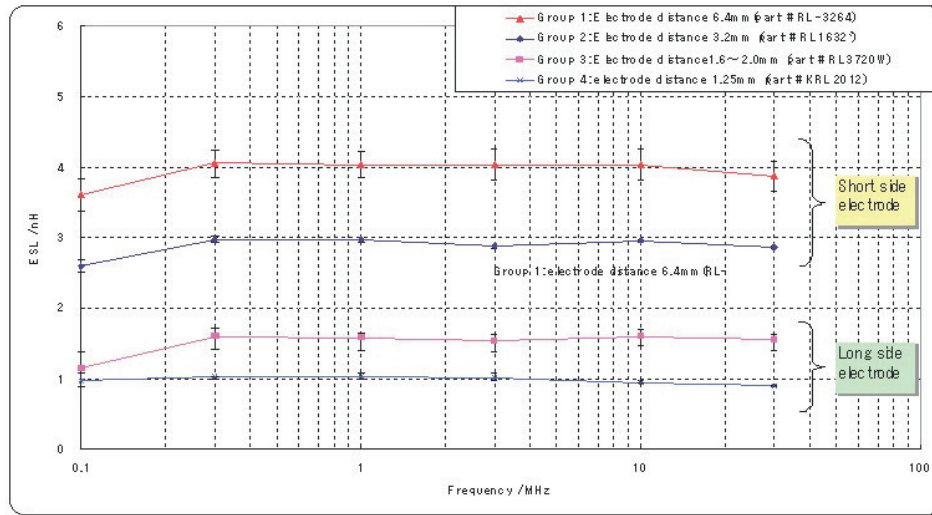
The following measuring result shows the shape of the waves using a short-side terminal resistor with the switching noise.



The next picture shows the same waves when using a long-side terminal resistor, demonstrating a clear reduction of the switching noise.

Using such low ESL current sensing resistors, the designer can avoid the need of using additional noise reduction circuits.





Summary

Susumu's long-side terminal low resistance chip resistors were developed to increase heat dissipation realizing 1W for 3.7mm×2.0mm and also for the smaller size : 1.6mm×3.2mm.

Due to this high power capability, these chip resistors have been very popular.

In addition, new demand has arisen for high frequency applications, the answer of Susumu is the low ESL series.

The table below shows summary specification data of Susumu's long-side terminal current sensing low resistance chip resistors, the RL, and the PRL series, as well as the latest low TCR KRL series.

