Thick Film Flat Chip Pulse Withstanding Resistors vs. Melf Type Resistors

Kory Schroeder
Director of Marketing & Product Engineering
kschroeder@seielect.com

When application requirements call for a resistor with superior pulse handling and stability, it is important to know the available options. Melf resistors have been the "go to" option for many years. More recently, the development of thick film pulse withstanding flat chip resistors have been introduced to offer good stability, low cost, and improved pulse handling over standard general purpose chip resistors. Understanding the strengths and limitations of each option will ensure optimal design from an electrical and cost standpoint.

Melf Resistors

MELF resistors have been around for many years, Melf resistors were a logical step when electronics designs began migrating to surface mount components. Essentially, a MELF resistor can be manufactured with much of the same equipment that was used for axial leaded resistors up to the coating process. The metal film element for the MELF is a very dense pure metal as opposed to the random structure of conductive and non-conductive media that a thick film element provides, meaning greater electrical stability. The MELF cylindrical shape also inherently has twice the amount of area for resistor element material thereby increasing the energy handling capability and further improving the electrical stability. Performance characteristics for the MELF show better results for the MELF compared to a thick film element in most key stress tests. From an overall electrical stability standpoint, the MELF resistor is superior to the pulse handling thick film chip.

Fig. 1 Metal Film Melf Resistors

Because of the proportionally large termination for the MELF, the thermal characteristics are also noticeably better compared to flat chip resistors, as shown in Fig. 2. For more information on the benefits of MELF technology, please refer to the article "Why MELF Resistors Have Excellent Environmental and Electrical Stability".

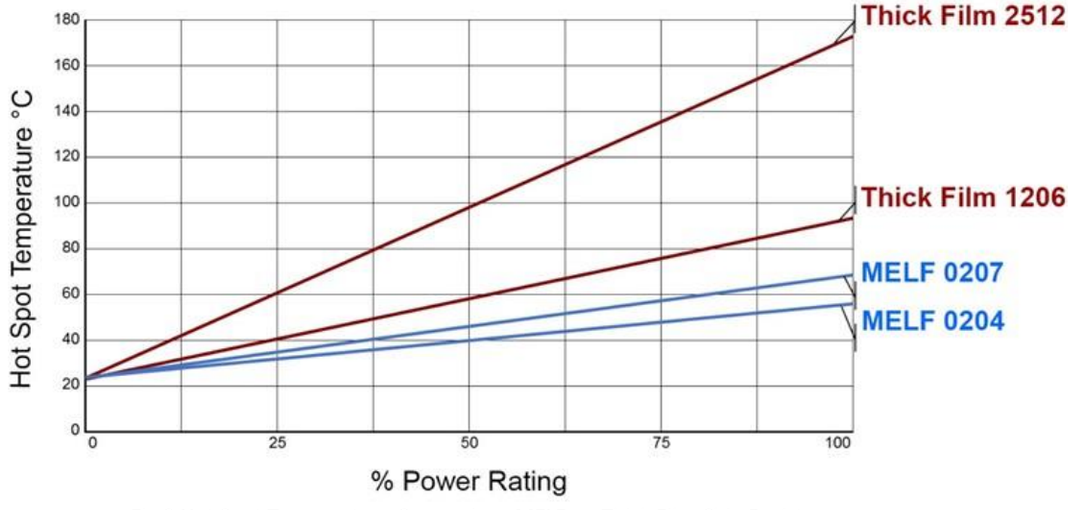

Fig.2 Hot Spot Temperature Comparison MELF vs. Thick Film Chip Resistors

Thick Film Pulse Withstanding Resistors

Another area where MELF resistors have an advantage over general purpose thick film chips, is in the calibration trim. General purpose thick film chips utilize either a double plunge trim or "L" trim. Regardless of trim type, the calibration trim forces current around a central trim area, creating current crowding and hot spots which eventually lead to premature pulse failure. The greater the length of calibration trim, the more current crowding and therefore the poorer the pulse handling. MELF resistors are trimmed in a spiral pattern which provides a uniform, long, and continuous path free of hot spots which mean improved pulse handling. Thick film pulse withstanding resistors typically are untrimmed for 5% and wider tolerances, which also removes the current crowding hot spot and vastly improve the pulse handling of the chip resistor. Fig. 3 below shows the pulse handling for pulse withstanding flat chip resistors compared to comparably sized MELF resistors. The data clearly shows that from a pulse standpoint, pulse withstanding chip resistors are superior to MELF resistors. Furthermore, with no trim allowed, the pulse handling is very reliable and repeatable and can be guaranteed where the pulse performance of the general purpose chip resistor has widely variable trim and thus widely varying pulse performance; this is the main reason many resistor manufacturers either don't provide pulse information for their general purpose thick film chips or they provide reference only information which is not guaranteed.

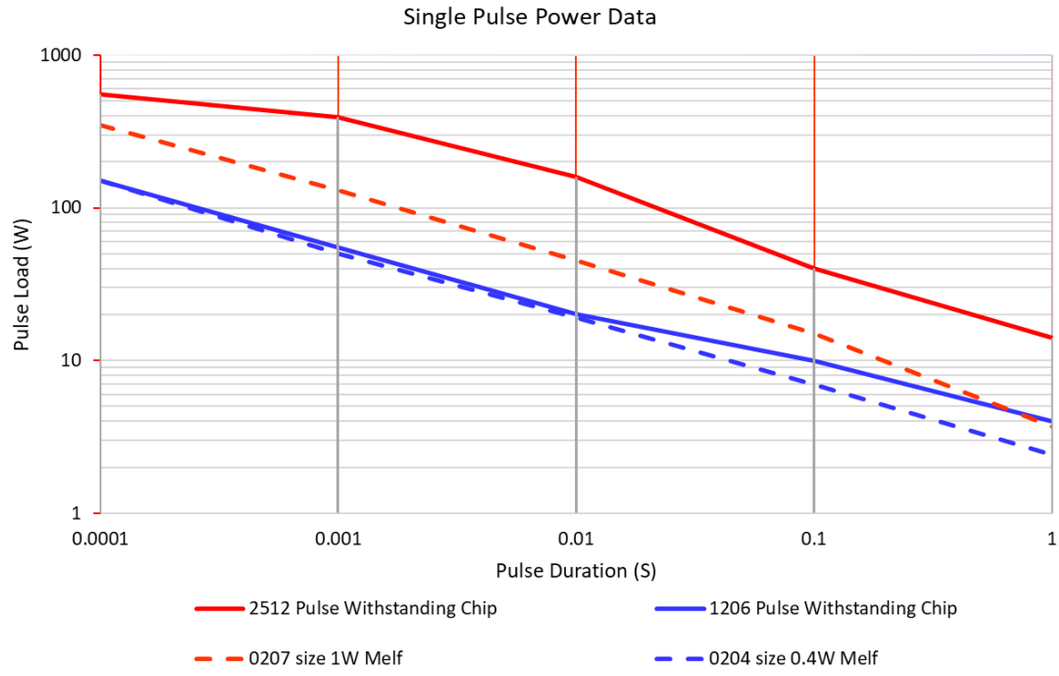

Fig. 3 Pulse Handling Comparison Between Pulse Handling Thick Film Chip Resistor vs. MELF

Summary

Design engineers looking for improved pulse handling resistors for common low power applications will frequently choose between cylindrical MELF resistors, or pulse withstanding flat chip resistors. If pulse handling and ease of manufacture are top priorities, then flat chip resistors are a great choice since their calibration trimming limitations greatly enhance their usability over standard thick film chip resistors. However, if overall stability, electrical performance, and low thermal resistance are desired, MELF resistors excel in all three areas. It should also be noted that pulse withstanding MELFS with carbon film based elements may be available with pulse handling that is better than that of any flat chip resistor. These carbon film anti-surge MELF resistors are available from only a limited number of suppliers.