Foundational Support for Progress in Automotive Electronic Control
Releasing a String of Unique Passive Components

Panasonic Contributes to Downsizing, Environmental Resistance, and Electromechanical Integration

The presence of Panasonic's passive components is on the rise in the electronic component market for automotive electronic control units (ECUs). This is because the company's string of new products meets the future needs of ECU designers, who are faced with even more demanding requirements due to the progress in automotive electronics. Here, I’d like to introduce hybrid aluminum electrolytic capacitors, Low DCR Resistors for current sensing, and, some other products that particularly attract attention, among their numerous passive components for automotive electronic control devices.

The demand for automotive ECU designs is getting more sophisticated. In addition to higher functions and performance, downsizing is required to maximize the utilization of limited space. ECU mounting methods are also diversifying with the increasingly common notion of electromechanical integration, which allows the direct attachment of electronic modules to other mechanical components. Panasonic is releasing passive components with unique features to meet the needs of designers encountering this situation. Panasonic is one of few suppliers that provide numerous passive components. Furthermore, the company has several models of each device. Being able to provide combined products using these components is a significant advantage. Panasonic's hybrid aluminum electrolytic capacitors, Low DCR Resistors for current sensing, and automotive power inductors indicate their excellent technologies.

"Cherry Picking" the Advantages of Conventional Products

Hybrid aluminum electrolytic capacitors have advantages of coming in both liquid and solid electrolyte types (liquid and solid systems) (Fig. 1). Aluminum electrolytic capacitors have a large capacity and high voltage resistance. However, liquid system aluminum electrolytic capacitors have high equivalent series resistance (ESR) and high frequency impedance. The solid system that uses conductive polymer material as electrolyte solved this problem. Compared with the liquid system, it has lower ESR and better high frequency characteristics. Its conductivity is also more than 10,000 times higher. However, while internal failures occur in open-circuit mode in the liquid system, they can occur in short-circuit mode in the solid system. The hybrid type has conductivity equivalent to the solid system, low ESR, and low high frequency impedance. It therefore works well on ripple management. It is also safe since failures occur in open-circuit mode. Unlike conventional aluminum electrolytic capacitors whose ESR rapidly rises at temperature below 0°C, the hybrid type's ESR remains nearly the same as a normal temperature. These characteristics are all advantageous for automotive devices that are used in various environments. It also contributes to the downsizing of ECUs because it can secure a large capacity despite its small size. Through early commercialization, Panasonic has taken the initiative devices that are used in various environments.

Achieving Downsizing using Unique Materials

Power inducers for automotive applications are intended for ECU power supplies, noise filters of DC/DC converters, etc. (Fig. 3). One major characteristic is the high magnetic saturation, which is much higher than that of inductors using ferrite material, achieved by the adoption of mixed metal composite material as a core material. This contributes to the downsizing of ECUs. That is, ECUs now require inductors that can handle larger currents to be compatible with, for example, faster CPUs. To be able to handle larger currents, the core needs to be larger to prevent magnetic saturation. The adoption of composite material-type in place of ferrite material-type inductors can nearly eliminate the magnetic saturation characteristics and temperature dependency while maintaining the size. To put it the other way around, downsizing is also possible. In addition, the metal composite material made by mixing a binder, which uses highly thermostable silicone resin, and metal magnetic powder is highly heat-resistant, being able to maintain its quality even at temperatures over 200°C. Another important feature of Panasonic's power inductors for automotive applications is its highly reliable structure. Both ends of a coil embedded in the core material are connected to the outside and allow direct soldering to the print substrate together with external terminals. This eliminates the welding sections in elements where wires are likely to break due to vibration.

Function and performance requirements for automotive control system such as ECUs are increasingly more sophisticated. New issues keep emerging at development sites. For designers who tackle such issues, Panasonic, who works on the advancement of basic components of control circuits such as capacitors, resistors, and inductors, must be a reliable partner.

Achieving Small Size and High Reliability through a Unique Electrode Formation Technology

Panasonic's automotive devices also draw attention for uses other than ECUs. Film capacitors are one example (Fig. 4). Panasonic uses very thin polypropylene film for its film capacitors for automotive applications and forms unique electrodes on their surface to achieve characteristics such as small size, light weight, large capacity, as well as long service life, high voltage resistance, high current resistance, and low ESR. These capacitors were commercialized for use in inverter circuits for motor drive, etc., and have been adopted in many electric vehicles (EV) and hybrid electric vehicles (HEV) since 2003. Their high voltage resistance and current resistance characteristics are also especially suitable for inverter circuits in trains, power sources for storage devices (PCS), UPS, and industrial drive power sources.

Panasonic intends to further improve their characteristics including the small size, light weight, high voltage resistance, and high current resistance and at the same time launch factory production in China to strengthen support for global customers.

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