Technical Paper

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Electric Vehicle Industry Current Sensing Needs

Sensing Options:

There are a number of ways and means of sensing current in an EV environment and as we shall see few (none) are ideal. We will cover the main contenders:

1. Shunts

A shunt capable of handling hundreds of amps has to be low resistance which means that its output at low current is minute and signals would be lost in the background noise.

Also thermocouple effects can generate significant and random offsets. An additional inconvenience is their lack of galvanic isolation.

2. Current Transformers

These devices can have a good dynamic range although low current signals are small. High current devices are bulky and hence expensive. Their most important short-fall for EVs and battery management is that they get corrupted by even modest DC currents.

3. Open/Closed Loop Hall Effect Current Sensors

Again these struggle with the dynamic range of current although do offer galvanic isolation. These sensors all have significant and random low-current errors generated by magnetic core hysteresis. Added to this, are thermally and time generated drifts of offset voltage. Even the best of these devices don't have the dynamic range needed for EVs and the battery management environment. These sensors are also vulnerable to the effects of stray magnetic fields.

4. Fluxgate Based Current Sensors

These devices have better dynamic range but are handicapped by their very small output signals at low current which can't be reliably recorded in a common noisy environment. Fluxgate sensors also don't behave well under overload. An important additional negative is their very high price.

5. Shielded Coreless Sensors

Traditionally, coreless sensors have very poor immunity to stray magnetic fields. Immunity can be improved by placing sensor elements as a pair with minimal separation but this is at the expense of their overload capability which handicaps their dynamic range. Electrostatic shielding is required to block voltage spikes carried by the primary conductor – without blocking high frequency magnetic fields.

The Challenge for Senior Designers

None of the above technologies are ideal for the EV environment. Either they don't work well enough, they are too bulky and heavy, not suitable for the environment or too expensive. It has become obvious that a whole new approach was needed – a paradigm shift in product design.

The most likely candidate looked to be shielded coreless technology despite its many handicaps. It became a research task of eliminating or minimizing each handicap in turn without adding significant cost to the product.

Assisting the task recent significant performance enhancements in magnetic field sensing technology has opened exciting possibilities in coreless sensors allowing brand new ways to sense current with sensors a fraction of the size of conventional technology. This in conjunction with carefully designed screening allowed a design that exceeded customer requirements.