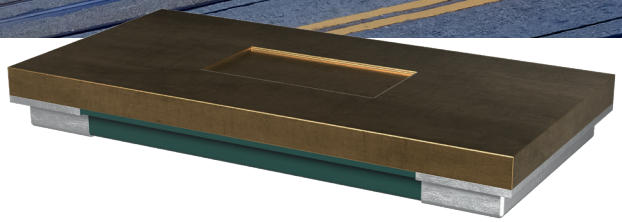
// APPLICATION REPORT

FMK IN AN ELECTRONIC PARKING BRAKE



SAFELY PARKED

Isabellenhütte precision resistors monitor current profiles in electronic parking brakes

The latest trend in the automotive industry is downsizing. Smaller and more compact components save space, reduce weight and ultimately cut fuel consumption and carbon emissions. Despite the smaller size, the components still have to meet the customary standards; miniaturisation while maintaining comparable performance is the key. Isabellenhütte Heusler GmbH & Co. KG specialises in active current sensing. A few years ago, it launched its FMx series in shunt form to cater to the demands of the market and plug a gap in its product range of low-ohm, compact resistors. The FMx series covers resistance from 2 to 6 milliohms. Using the example of the electronic parking brake, a component that has become ubiquitous in all types of new car – right down to small family vehicles – as an example, this case report demonstrates what's possible with this new range of shunt technology.

Standard mechanical handbrakes have always been susceptible to wear and tear, and could often stop working entirely. Grit on the road and wet conditions in winter would cause the handbrake cable to corrode over the years, and the system would no longer provide the necessary stopping power. With electronic parking brakes, or EPBs, these issues are a thing of the past.

Not only that, electronic systems are lighter and therefore help reduce carbon emissions from vehicles. Convenience is an added benefit, with drivers activating the system by pressing a button rather than by pulling a stiff lever.

The brake callipers on EPBs are equipped with a drive unit on the rear axle consisting of a DC motor and an actuator. The system is activated via a switch in the car's interior, triggering a mechanical spindle that presses the brake pads against the brake discs on both rear tyres and applies the EPB.

Even if the car loses electrical power (e.g. in winter due to low temperatures), it is still safe as the EPB is locked on thanks to the mechanical spindle. This also makes the system childproof; as long as the ignition is off, the EPB cannot be released.

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Monitoring the current profile via shunt
EPBs are an important part of vehicle safety that must work with 100% reliability. Drivers must be able to count on the EPB system keeping the car exactly where it is when stationary, even when parked on an incline. When the EPB is activated, its current profile must be monitored to ensure that it functions reliably over the long term.

This is where the shunt comes in. It must measure extremely precisely the current input of the actuator when the EPB is activated and released. This means that it reports the voltage drop across the resistor back to the control unit. The control unit is set up with a fixed current profile for the EPB's contact pressure, which the motor always has to reach within certain limits.
The shunt provides the feedback as to whether the motor is operating within the given limits. If the motor were to stall for some reason, the control unit would assume – without this feedback – that the EPB was active even though the brake pads were not in contact with the brake discs. This is why precision feedback on the motor current is so important for the entire life cycle of the vehicle.

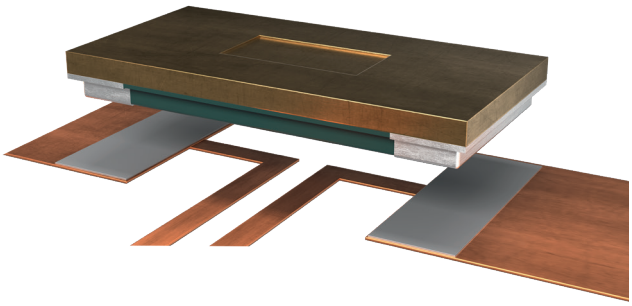
FMK shunt: halving the space required on the circuit board
One of Isabellenhütte's customers, a major automotive supplier, had been using an ISA-PLAN® component for its EPBs, but is currently working on a redesign of its parking brake system that requires a smaller, more compact component. For the shunt design, the customer opted for the FMK-V-R005, size 1206, which more than halves the amount of space required on the circuit board.

Lower total deviation across temperature and life cycle
The main requirement for a current sensor is that it has the lowest possible total deviation across its life cycle. In other words, it must always send the same signal for identical current profiles throughout its operating life. The very high temperatures in this particular case makes this more difficult to achieve. Temperatures at the terminal of the component can measure up to 135°C. There are two reasons for this: the heat generated by the component itself when the EPB is activated, and the passive heat produced by the vehicle braking, as the entire unit is mounted directly to the brake calliper. These high temperatures can exert a load on the materials used in the shunt and result in deviations in electrical measurements. With the FMK-V-R005, such deviations are extremely minor. The unit also features a low drift and therefore high long-term stability.

The touch of a button is all that's required to activate the electronic parking brake and safely park a vehicle at any location, even on an incline. Image: ©Shutterstock

High pulse load capability
The second main feature of the shunt is high pulse load capability, allowing for good heat dissipation and minimal self-heating. Activating the EPB triggers high pulse current, both when the actuator starts up and when the brake is applied. These pulses must be executed quickly; otherwise, there is a risk that the system will overheat. With its latest FMx resistor series, Isabellenhütte offers low-ohm components that meet the requirements even more effectively. ISA-PLAN® is limited to five milliohms, whereas the FMx series utilises full-metal technology to offer resistance in the six to two milliohms range.

The FMx resistors consisting of a solid plate of resistor material are the perfect complement to the established ISA-PLAN® technology, where a foil from Isabellenhütte's in-house-developed alloys is bonded to a substrate such as copper.



Shunts from the FMx series consist of a full metal plate made of resistance alloy and, thanks to their solid design, are capable of easily absorbing and dissipating high pulse energy. Image: ©Isabellenhütte Heusler GmbH & Co. KG

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This particular case report involves the FMK-V-R005, size 1206, which is manufactured using the resistance alloy NOVENTIN®. Thanks to the solid plate of resistance material and the low heat resistance (Rthi), the FMK can easily withstand higher pulses and short bursts of excess load. The side-mounted terminals, with a layer of copper and tin as a finish, are soldered directly to the circuit board.

This design makes for a particularly robust structure, which helps to absorb the energy of the short pulses, store them in the material and dissipate them in the form of heat through the junction. NOVENTIN® also has excellent temperature resistance properties. It is extremely stable under heat and has a low temperature coefficient. Thanks to NOVENTIN®, the component can withstand a maximum temperature of 135°C at the terminal with a long-term stability that only deviates by 0.3%.

AEC-Q200 certification

To achieve certification according to the AEC-Q200 automotive standard, the long-term stability of the component was established in testing at a terminal temperature of 140°C over a period of over 2,000 hours, which is roughly equivalent to its life cycle. During this testing, drift was found to be less than ±0.5%. According to this certification, the high level of precision of FMx series current sensors across their entire operating life makes them suitable for countless other automotive applications besides EPBs, including lighting, DC/DC converters and advanced driver assistance systems. The low-ohm shunts can also be used in industrial applications with brushless DC motors in power tools or in consumer goods such as household appliances, where they can offer a space-saving alternative to conventional solutions.

With an EPB, the switch in the car's interior starts up the actuator, which presses the brake pads against the brake discs. The control unit is set up with a fixed current profile for the EPB's contact pressure, which monitors the shunt when the EPB is activated. Image: ©Shutterstock

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Innovation by Tradition

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