

Battery Monitoring for Hybrid Vehicles

Batterieüberwachung für Hybridfahrzeuge

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Saucisse aux Choux

- Spécialité du Canton de Vaud
- Protégé par Indication Géographique Protégée depuis 2004
- Préparé à base de viande de porc, de couennes cuites, de foie de porc et de choux.
- Conditionnée dans un boyau naturel de bœuf de 38 à 44 mm
- Souvent accompagnée par le papet vaudois.



Source: http://fr.wikipedia.org/wiki/Saucisse_aux_choux

Papet Vaudois



- 300g de Pommes de terre farineuses;
- 600g de poireaux;
- 20 cl de crème liquide;
- 4 dl de vin blanc;
- 1 cube de bouillon;
- sel, poivre.
- une saucisse aux choux par personne (selon taille)

- Découper les poireaux en tronçons de 2-3 cm, et les faire suer (mais pas dorer) dans un peu d'huile d'olive;
- Ajouter le vin blanc et le cube de bouillon. Saler, poivrer, et laisser mijoter 10 minutes;
- Ajouter les saucisses sur les poireaux et laisser mijoter;
- Découper les pommes de terre en cube, et les ajouter à la préparation. Mijoter pendant 15-20 minutes à feu moyen;
- Ajouter la crème fraîche et laisser mijoter 5 minutes de plus;
- Écraser les pommes de terre sans les réduire totalement en purée, et servir.

Source: <http://www.topio.ch/papet.php>; http://fr.wikibooks.org/wiki/Livre_de_cuisine/Papet_vaudois

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Who is LEM

Traditional Markets



- **Industry**

- All areas of reliable current measurement
- Motor drives, power conversion AC/DC, power supplies, UPS, welding, medical scanners, new energies, leakage currents



- **Traction & Trackside**

- On-board applications, inverters
- Trackside and energy monitoring

New Markets



- **Automotive**

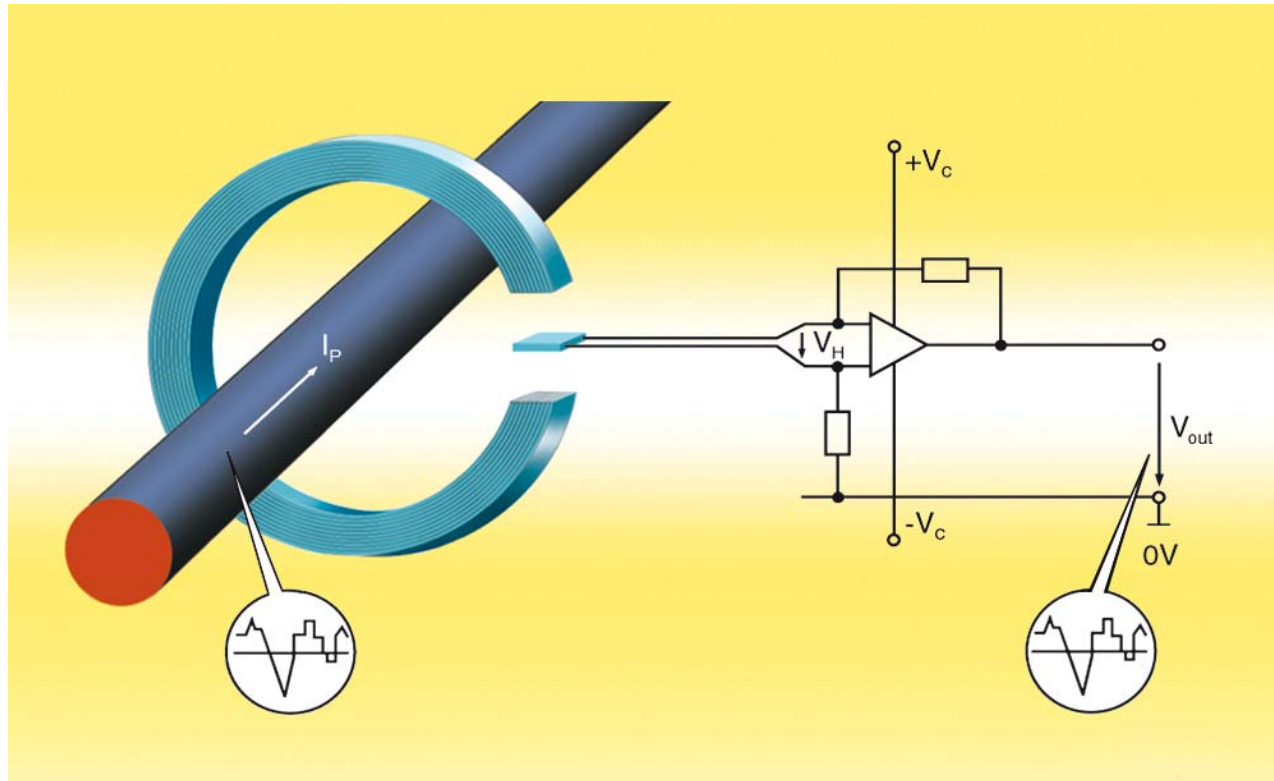
- Battery Management in IC, HEV, & EV
- Motor Drive Control



- **Energy & Automation**

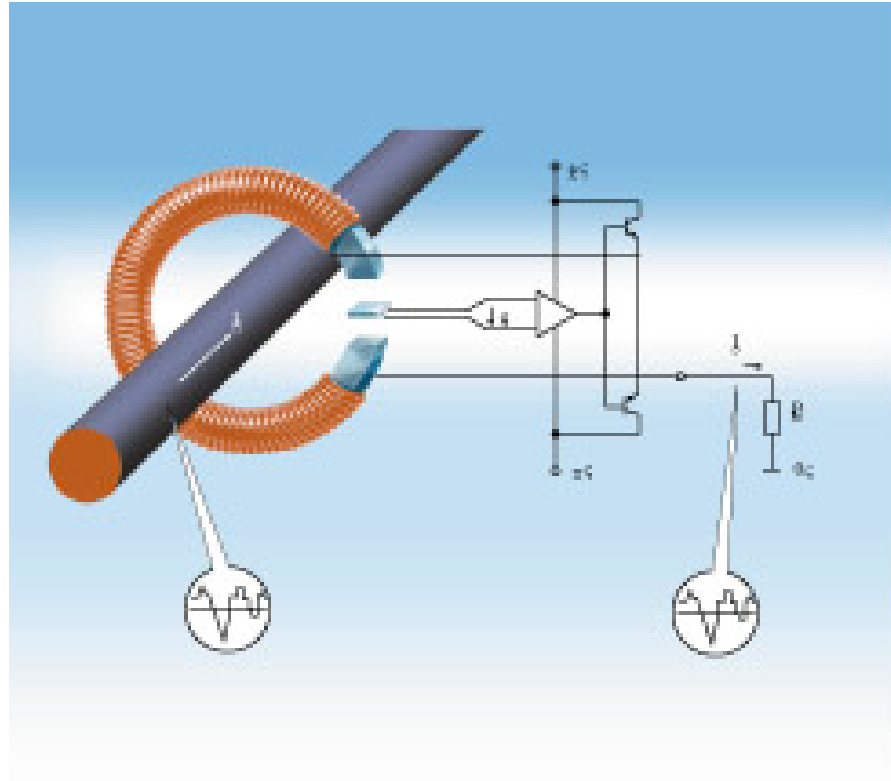
- Process control
- Battery Monitoring, Energy Metering

Open-loop Hall-effect Principle



- Concentrate magnetic field around primary with a magnetic core
- Direct field onto a Hall cell that reacts by changing potential
- Output a voltage, PWM, or LIN signal proportional to primary

Closed-loop Hall-effect Principle



- Compensate field generated by primary with an equal, opposite field generated by a secondary coil.
- Secondary coil current proportional to primary current.

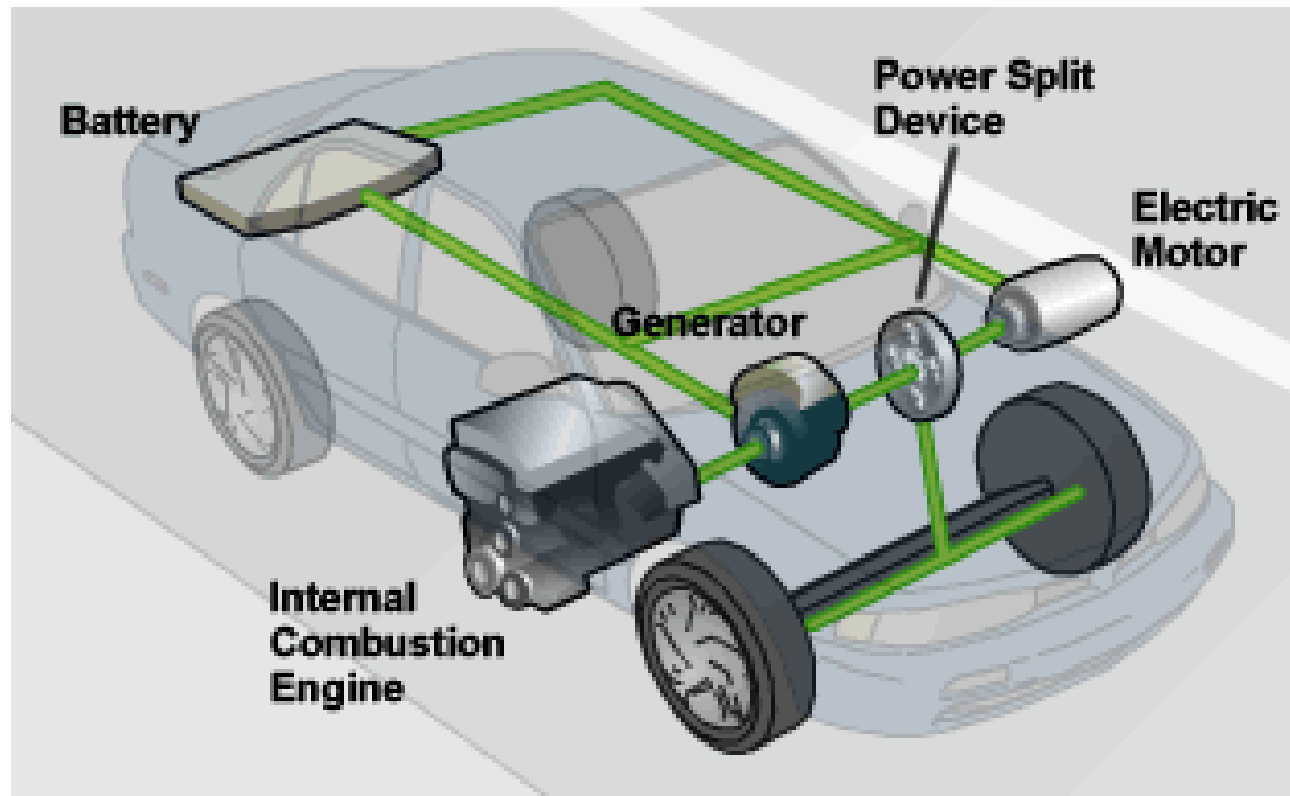
What are hybrid vehicles

- *A hybrid vehicle is a vehicle that uses two or more distinct power sources to move the vehicle. The term most commonly refers to hybrid electric vehicles (HEVs), which combine an internal combustion engine and one or more electric motors.*



* Source: Wikipedia “Hybrid vehicle”

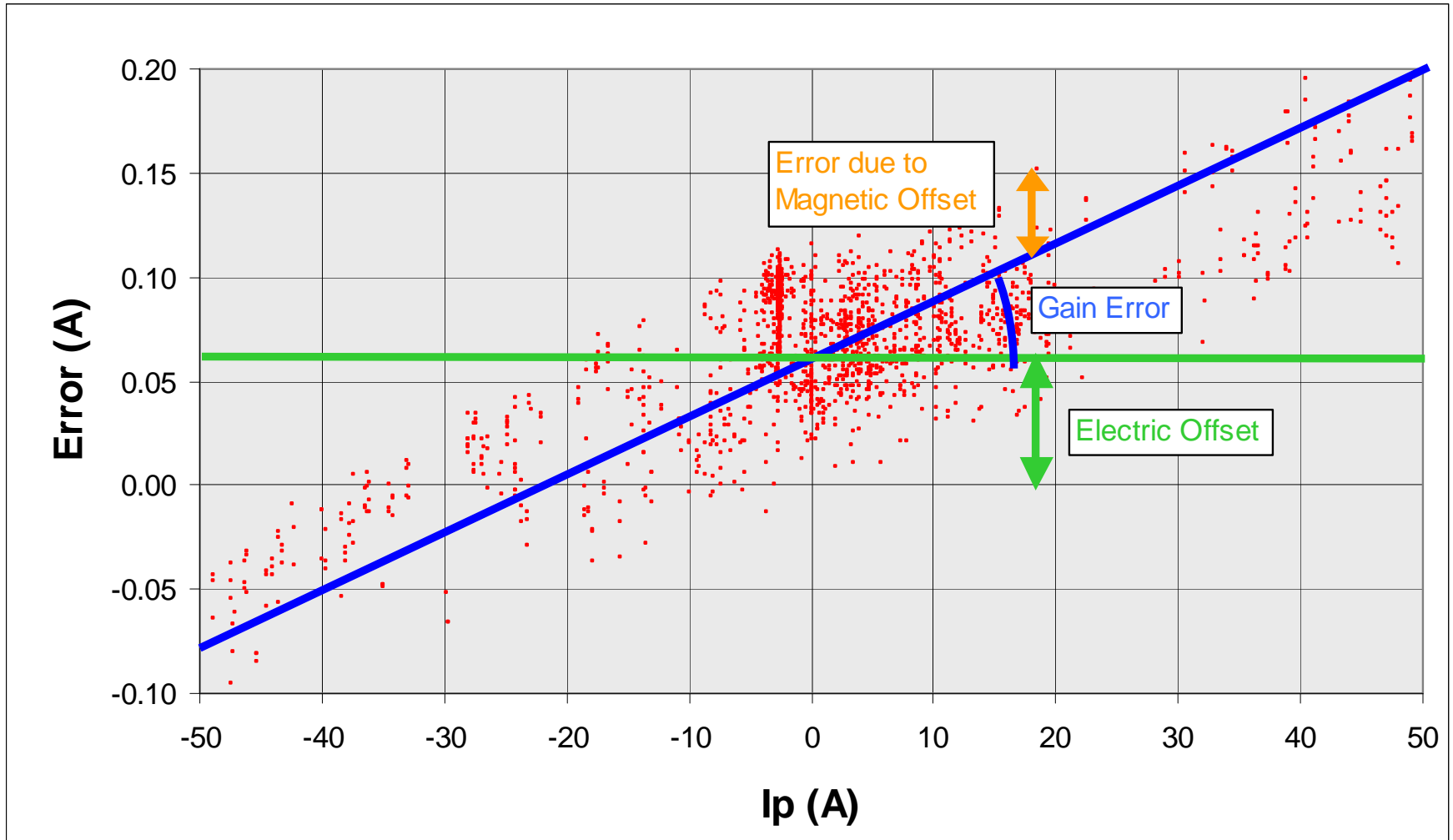
Why battery monitoring



* Source: www.fueleconomy.gov, "the official U.S. government source for fuel economy information".

- Real-time evaluation of a battery's condition
 - Current, voltage, temperature...
- Essential to the safe and efficient operation of vehicle on-board batteries.

Transducer Output Error for Given Current Cycle

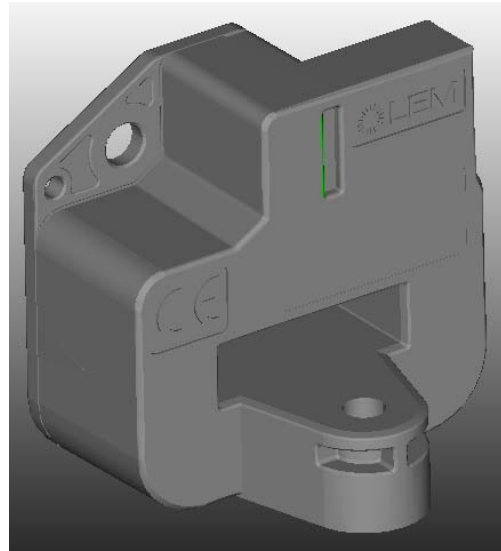


Hall-effect sensors for hybrid vehicles



HAB

- Single FeNi core
- Up to +/- 120 A
- Ratiometric V or PWM output



HAH1

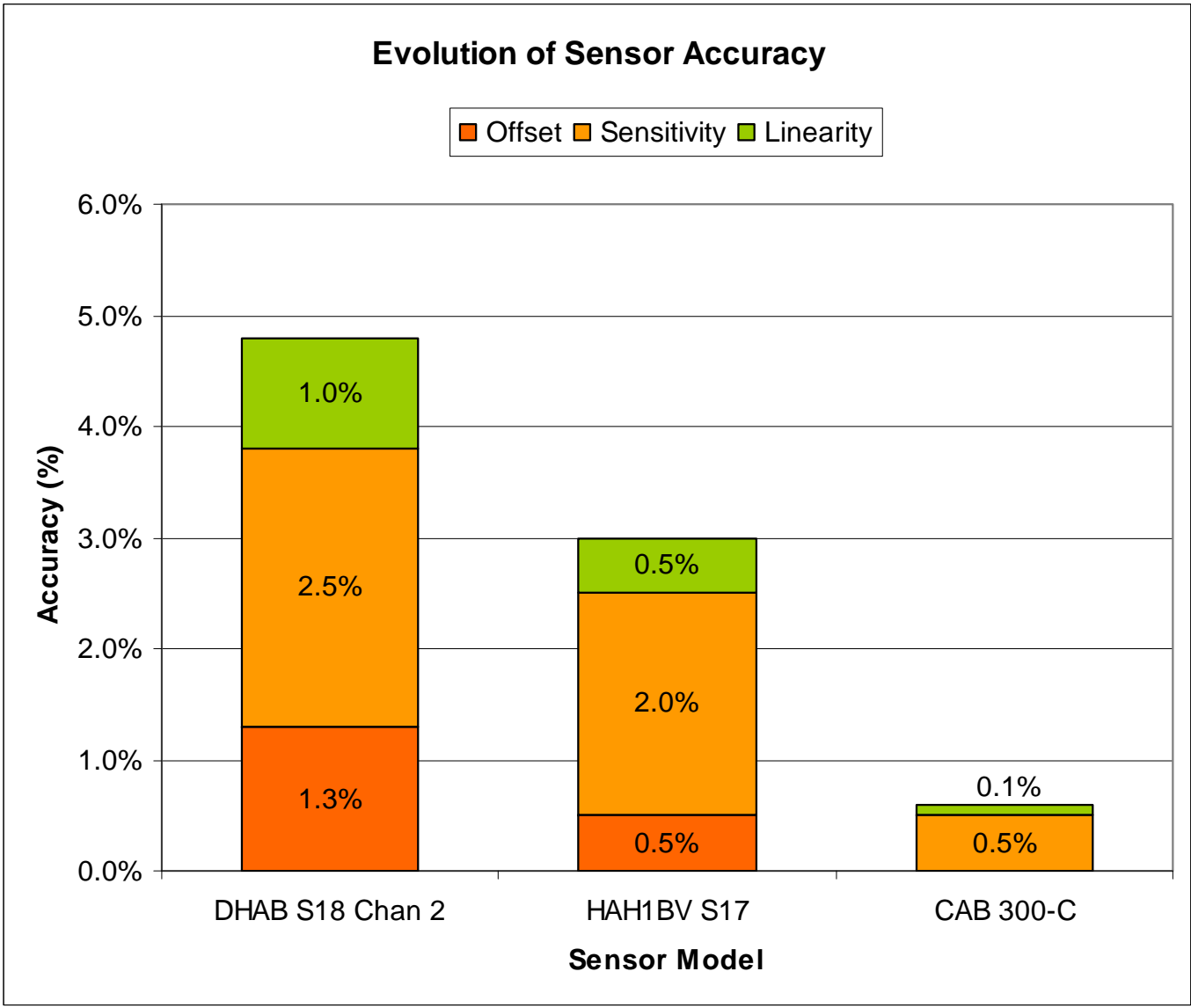
- Single FeSi core
- Up to +/- 900 A
- Ratiometric V output
- Slow or fast-sensing applications



DHAB

- Double core
- I_{P1} up to 100 A
- I_{P2} up to 1000 A
- Ratiometric V output

Evolution of LEM Sensor Accuracy



Fluxgate sensor for hybrid vehicles

- Features

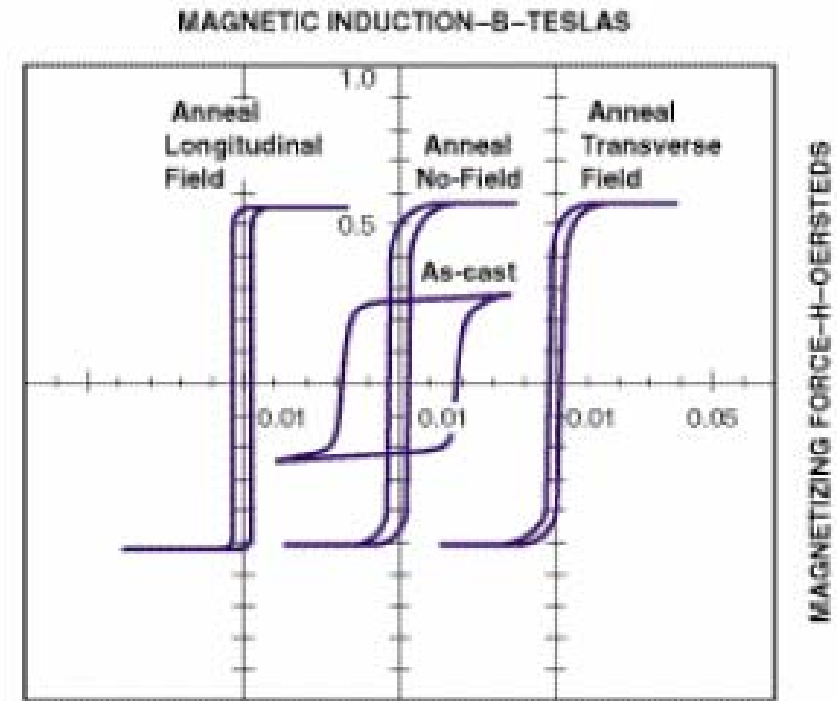
- Full galvanic isolation
- Vehicle 12V battery supply
- Current range up to +/- 300A
- Ambient temperature: -40° C... +105° C
- Global error < 1% (over temperature)
- Linearity error < 0.1%
- Digital output (CAN)
- Offset error lower than 10mA
- Sensor can provide either instantaneous or average value

CAB 300-C



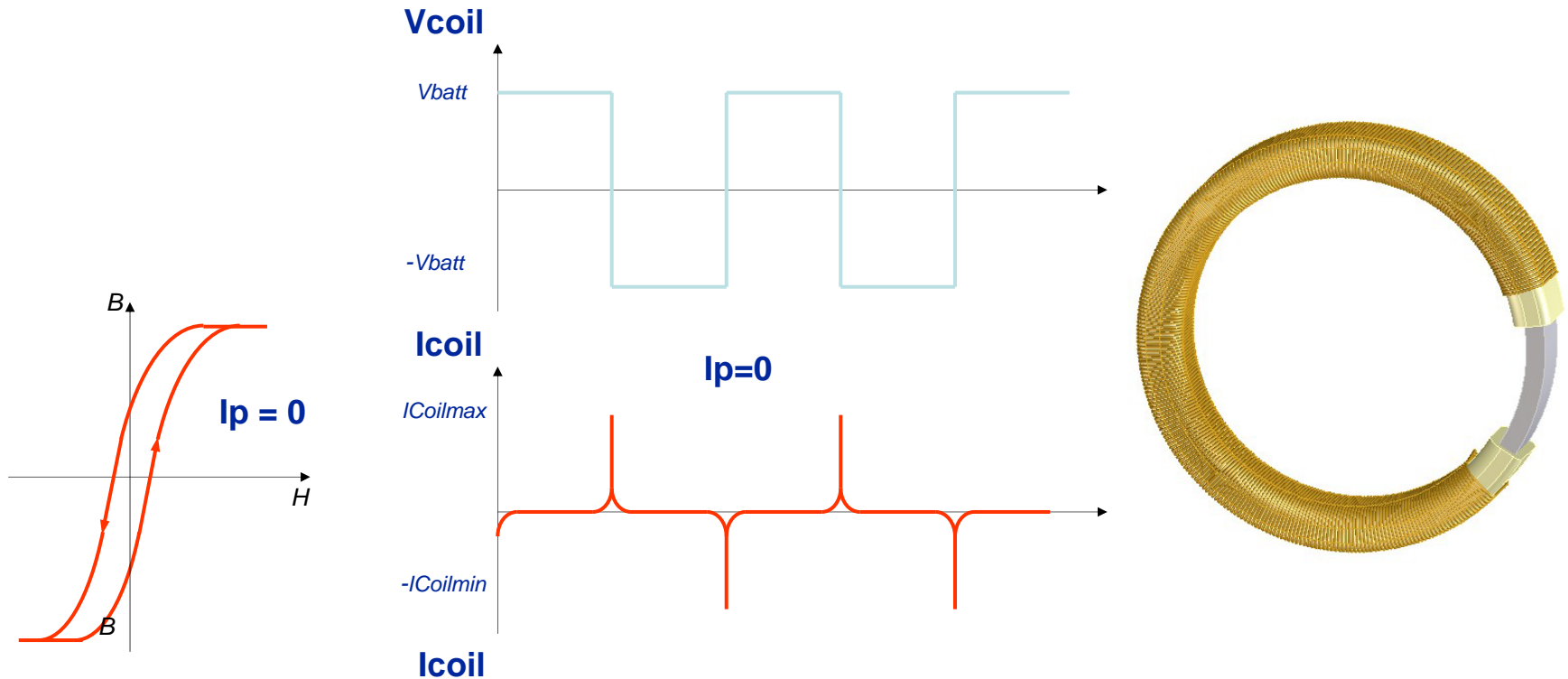
Fluxgate Current measurement principle (1/3)

- The sensing element is made of a induction-coil with particular characteristics:
 - Core material with very high permeability and low remanence (H_c)
 - Very fast transition between linear and saturated state



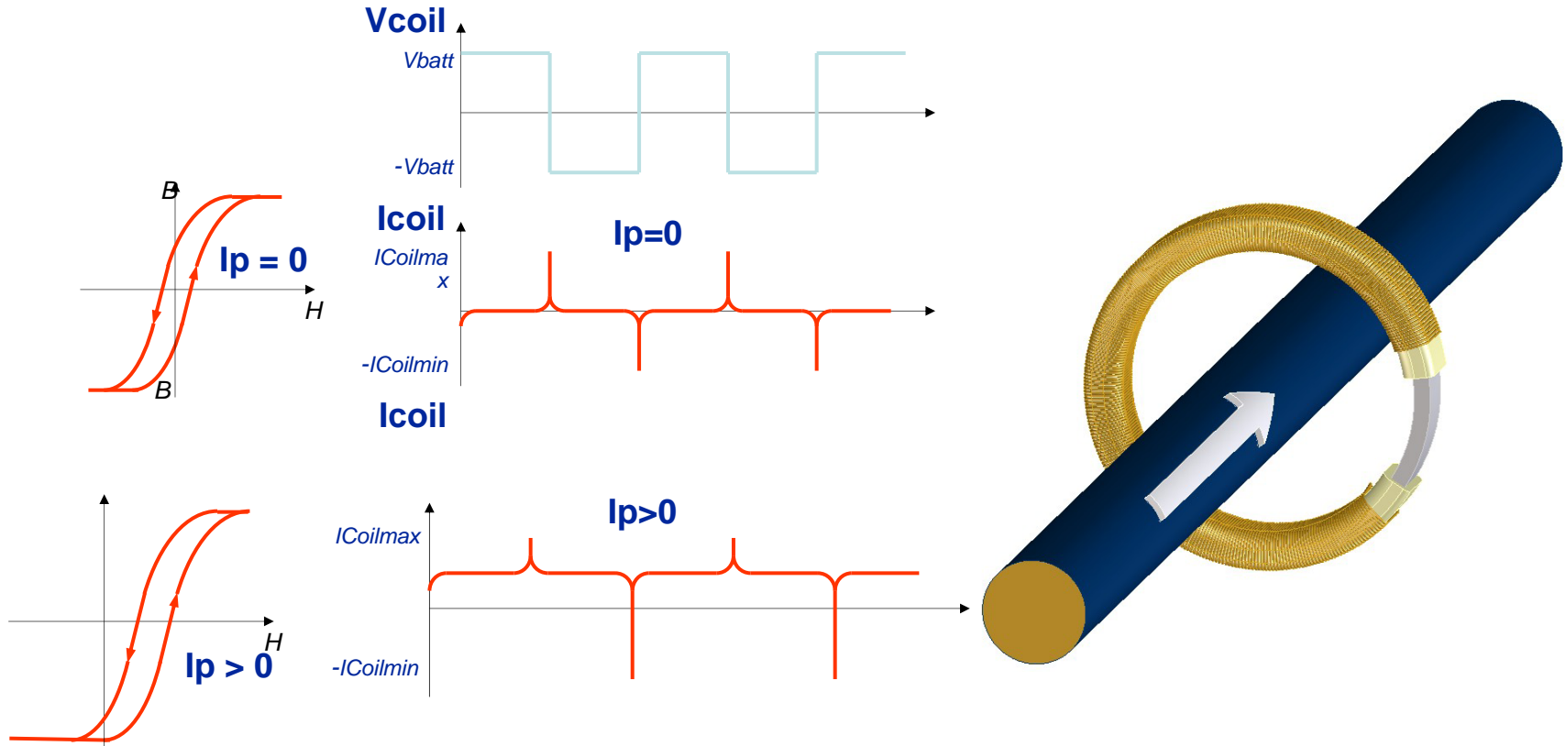
Fluxgate Current measurement principle (2/3)

- Energizing the coil with an alternative voltage makes the core go through a complete hysteresis loop.

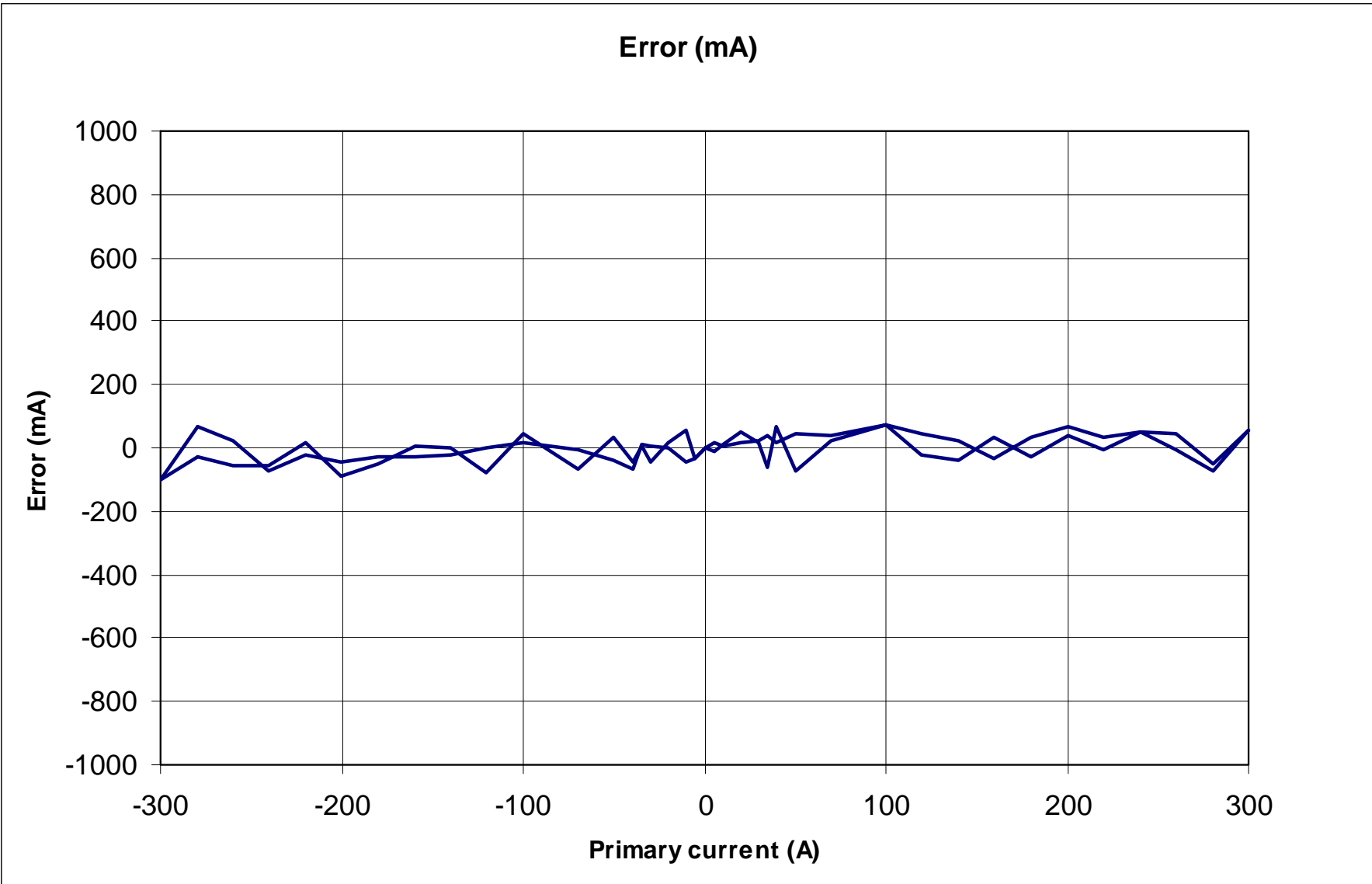


Fluxgate Current measurement principle (3/3)

- With a primary current flowing through the coil, the hysteresis loop is shifted.
- The measurement of this shift represents the the primary current



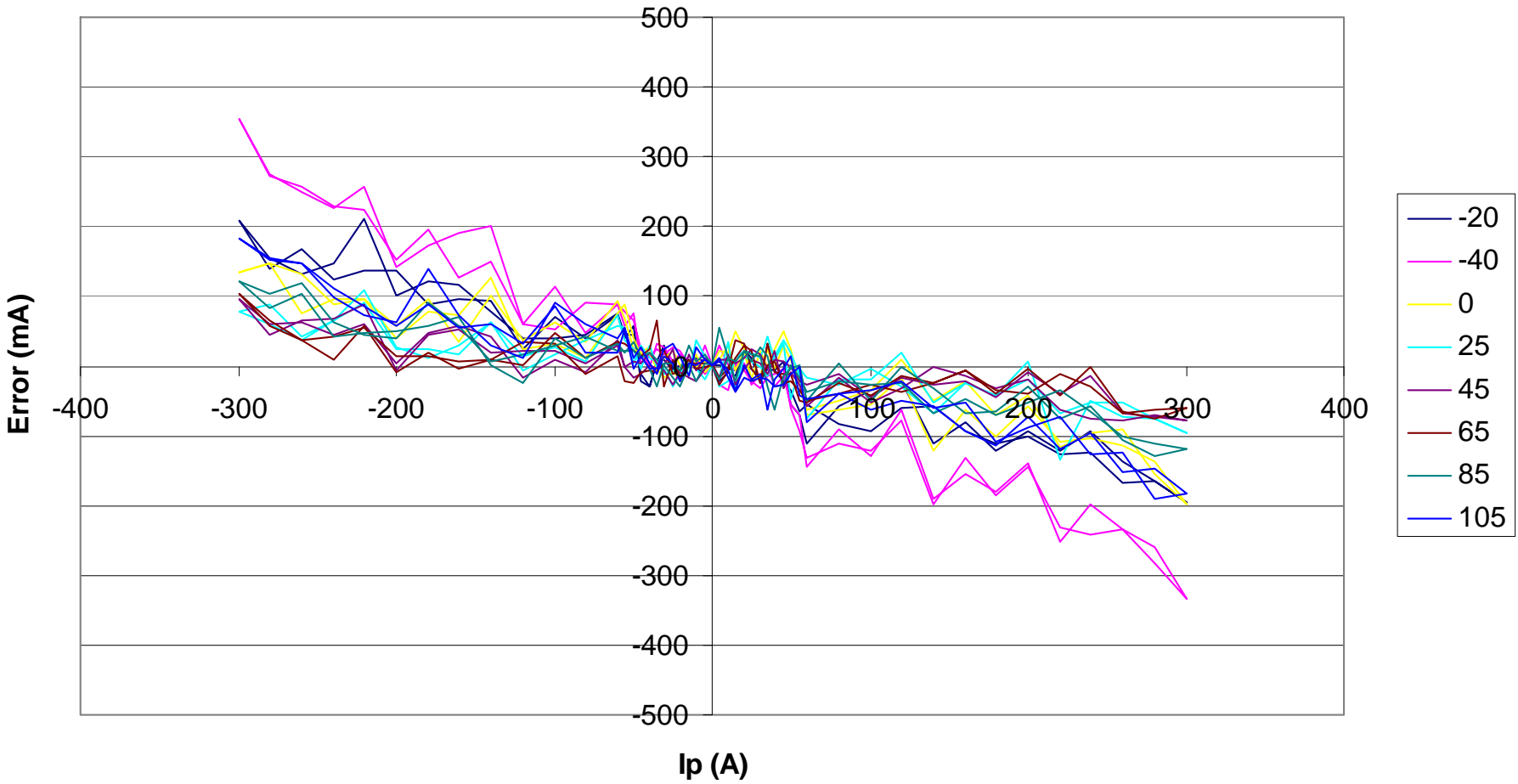
Fluxgate typical error curve at 25° C



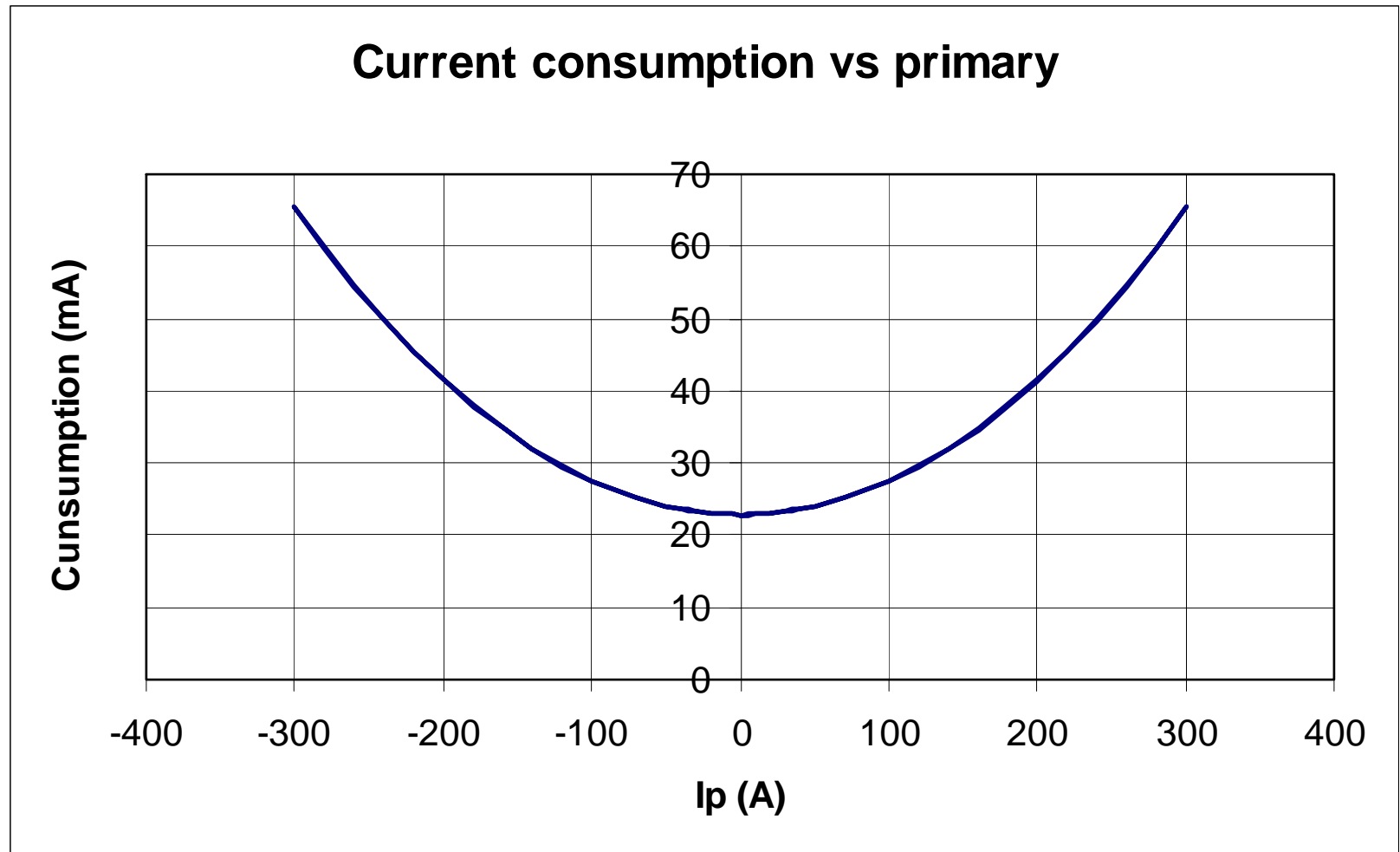
* Test on one sensor sample

Fluxgate global error in temperature

CAB global error over temperature



Fluxgate current consumption

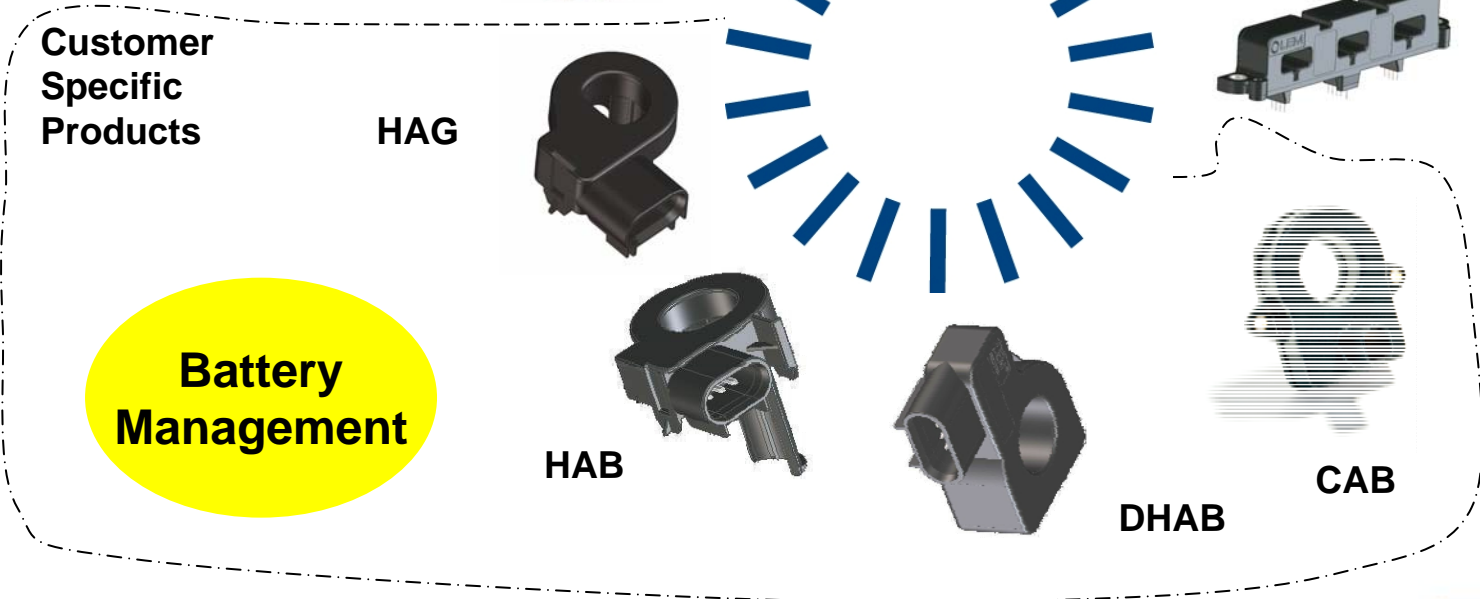
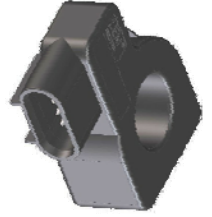
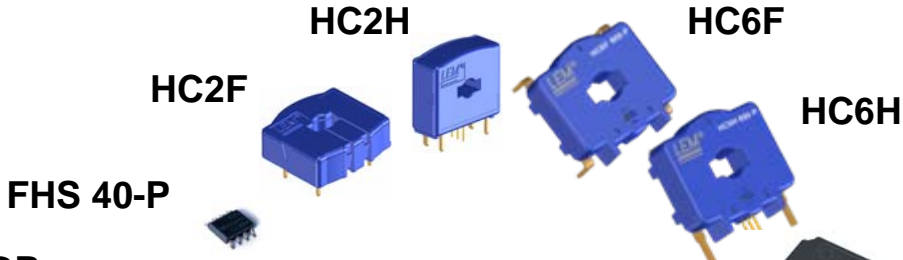


* Supplied by 12V battery

Automotive sensors

Motor Drives

DC/DC Converters



10-1000A

Thank you

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