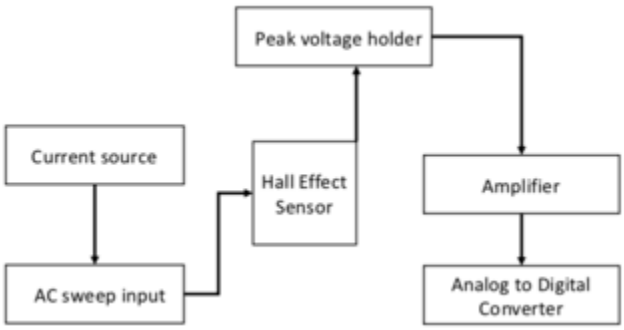
Docket #: S19-035

No-switching AC magnetic Hall-effect measurement method

Magnetic field measurements using currently available devices require complex switching circuitry to mitigate the offset and noise present in measurements. The added set of transistors for switching have fundamental limits as to which frequency they can measure and takes up valuable space on small boards/chips.

Stanford researchers have addressed these issues using a new technique to measure small magnetic fields at any frequency (low and high), enabled by a new approach to mitigating offset. This technique eliminates the need for switching, allowing potentially higher AC magnetic field measurements and reducing the space taken up by the device and supporting circuitry. Results from this new Hall-effect sensor showed that measurements are within 5% of measured results using commercial Hall-effect measurement devices, demonstrating proof-of-concept. The devices were tested with magnetic fields up to 1MHz with potential for higher frequencies.

The technique is agnostic to the Hall sensor being used and is grounded in the fundamental theory of Hall measurement. Theoretically, the technique eliminates all noise from induction - a problem persistent in high-frequency fields. The technique has the added advantage that it is more sensitive and precise to detect the magnetic field. Lastly, the technique can also be used to detect the frequency at which the magnetic field is changing.



High level block diagram.

Stage of Development:

- Proof-of concept

Applications

- **Measuring AC magnetic fields**, such as the inside of a car engine or jet engines where the AC magnetic field is generated by a rotating motor/turbine or inside nuclear fusion reactors where dynamically changing magnetic fields exist
- **End user industries: automobiles, commercial and military jets, nuclear fusion reactors**
- **Better understand the state of transformers and high power electricity lines.** Can precisely detect the change in frequency of magnetic fields allowing for improved study of the health of the transformer/electric line.

Advantages

- **Eliminates need for switching**
- **Cost savings**: Smaller chips, thus less weight and cost
- **More robust**:
  - Can potentially measure higher frequencies as it is not limited by switching circuits
  - Can measure an unknown steady frequency and back calculate the frequency of the magnetic field

Patents

- Published Application: 20200348372
- Issued: 11,035,912 (USA)

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