

# Application Note PE003

## Linearity curves

Linearity curve.....	1
Hall Effect Sensor Type 1 .....	1
Hall Effect Sensor Type 2 .....	3
Hall Effect Sensor for highly precise Devices (Type 3).....	5
Variation .....	7

### Linearity curve

#### Hall Effect Sensor Type 1

Most probes, delivered by Projekt Elektronik GmbH, use a Hall Effect sensor. Hall Effect sensors show a linearity error. This means that between the signal of a theoretically ideal sensor and the signal which is issued by the real sensor a difference exists. The subsequent diagram shows a typical error of a sensor in dependence of the penetrating field, like it may be determined in the receiving inspection.

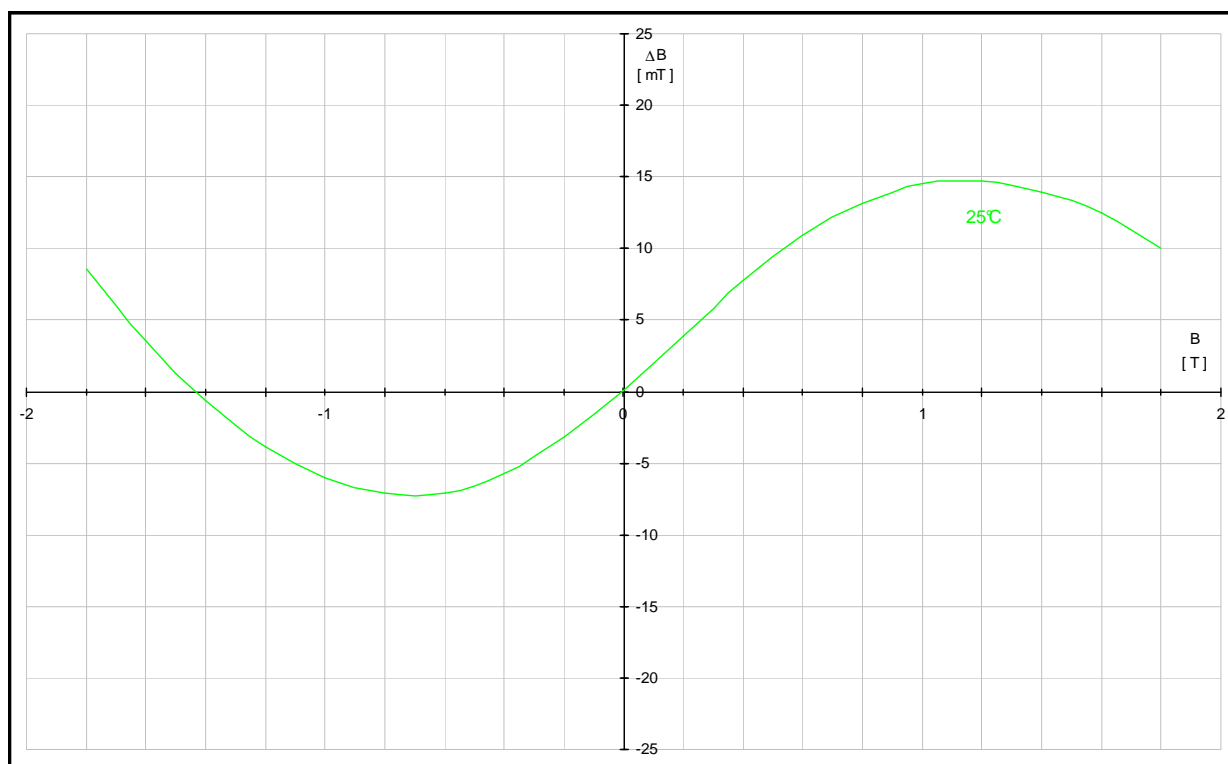


Fig. 1: Error of a Hall Effect Sensor type 1, not corrected

For attainment of demanded measurement accuracy this error must be corrected as well as possible. In the diagram below, a typical error plot of a handheld set is shown after correction. Beyond that, the error was determined here at two extra temperatures. It is recognizable well, how the error and concomitantly the output signal will be changed by temperature.

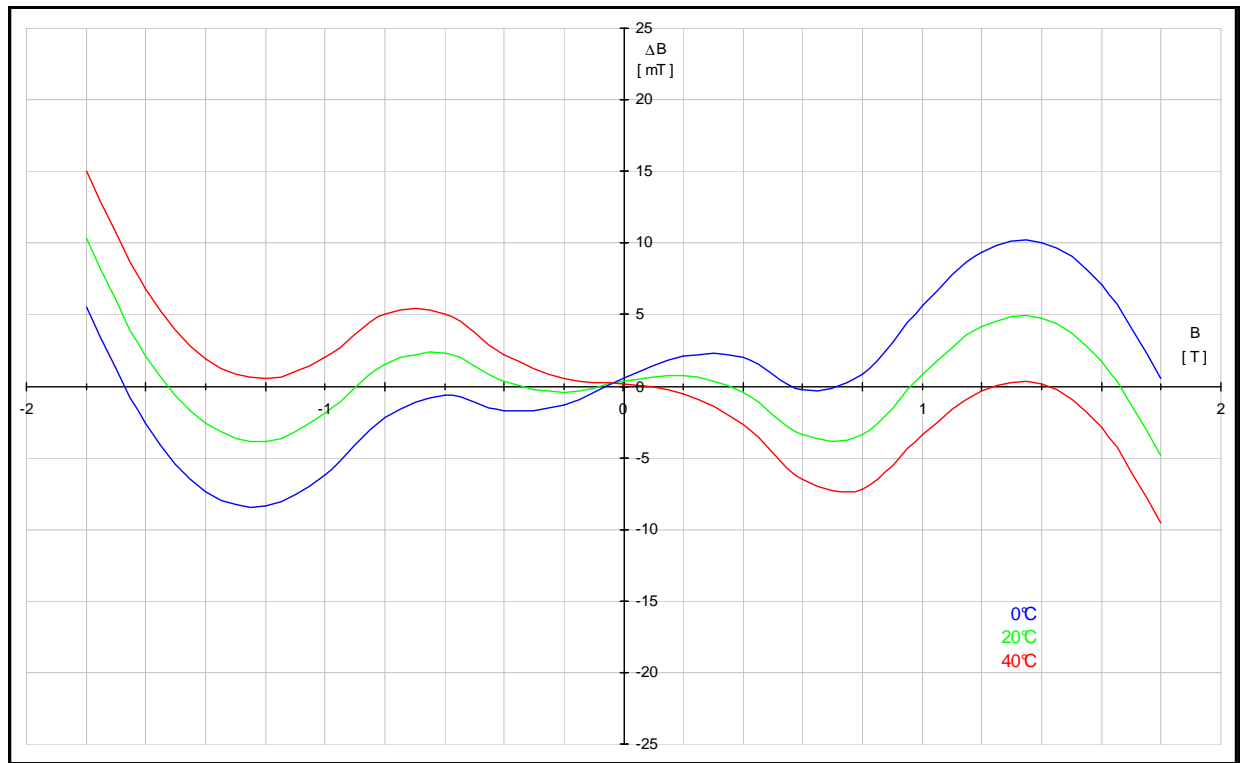


Fig. 2: Error and temperature drift of a compensated Hall Effect Sensor type 1

## Hall Effect Sensor Type 2

The appearance of the error curve before correction depends on the specific type of the Hall Effect sensor. Hall Effect sensors of the same type exhibit also for instance the same form and strength of the error curve, strew however around the typical curve.

Hall Effect sensors of other type have a different characteristic of the error curve, which in turn is characteristic for this Hall Effect sensor type. The following diagram shows the initial curve of a further type of Hall Effect sensor. In comparison, the different course of the curve may be seen clearly.

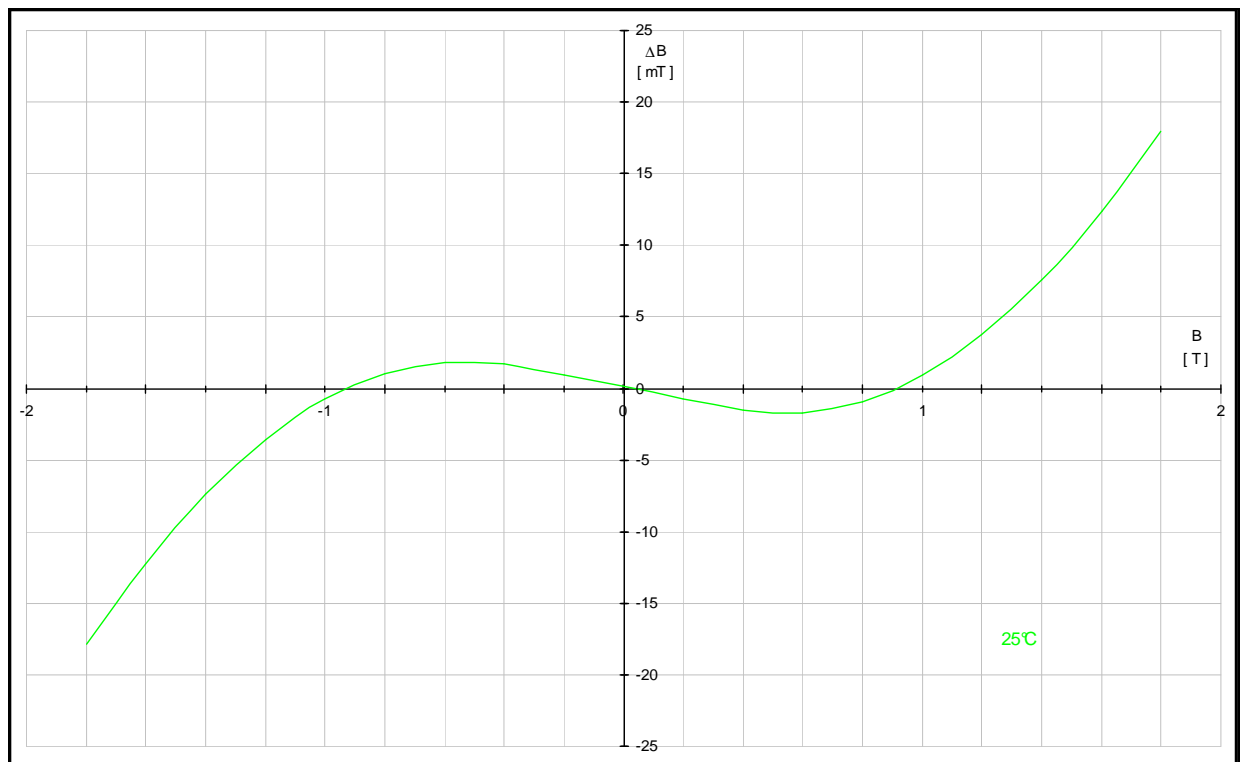


Fig. 3: Error of a Hall Effect Sensor type 2, not corrected



Although the error is just as large in the starting situation as with type 1, this type of sensor can be corrected much better. Here, the error still remaining is clearly smaller than it would be possible by the same expenditure with a sensor of the type 1. The following diagram shows the typical error curve of equipment with corrected sensor of type 2.

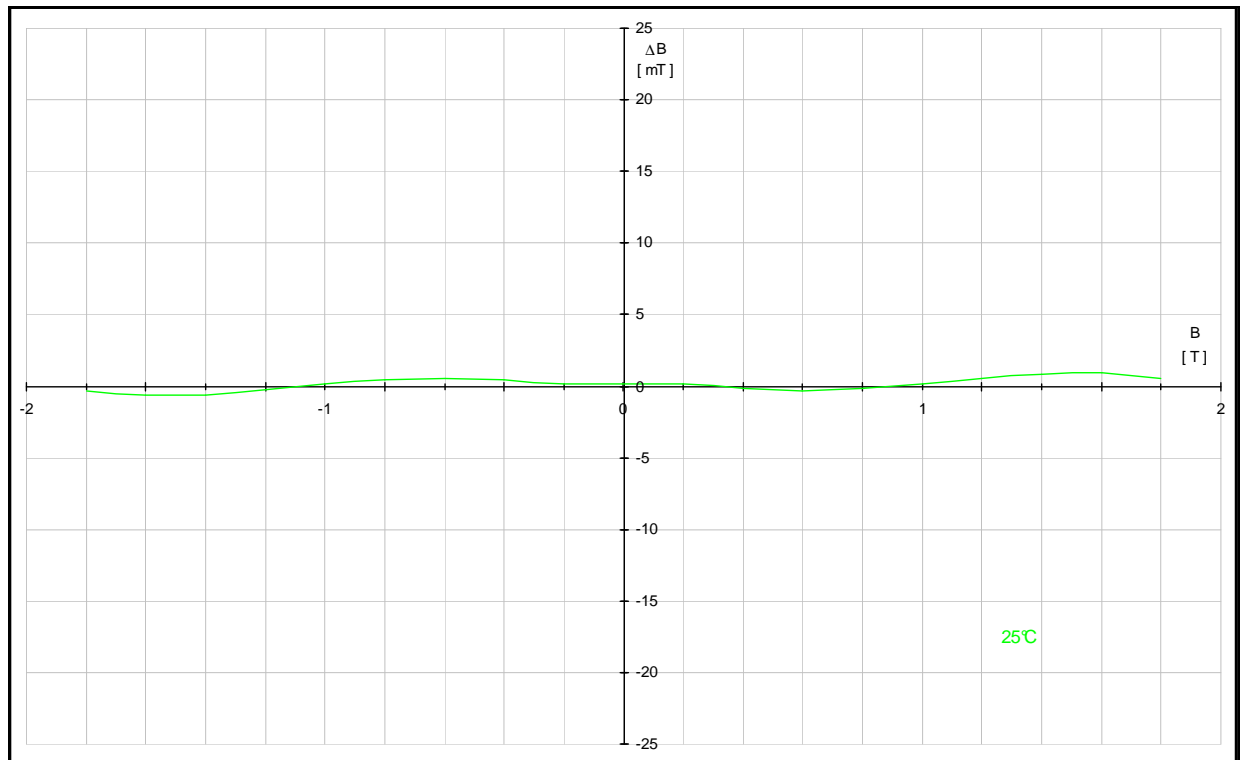


Fig. 4: Error of a corrected Hall Effect Sensor type 2

## Hall Effect Sensor for highly precise Devices (Type 3)

The error-curves, shown above after correction, are totally sufficient for the low measurement accuracy of handheld sets. For the highly precise desktop devices however another approach is necessary. As the following curve shows, Hall Effect sensors used here, in original state show a form of error similar to type 1.

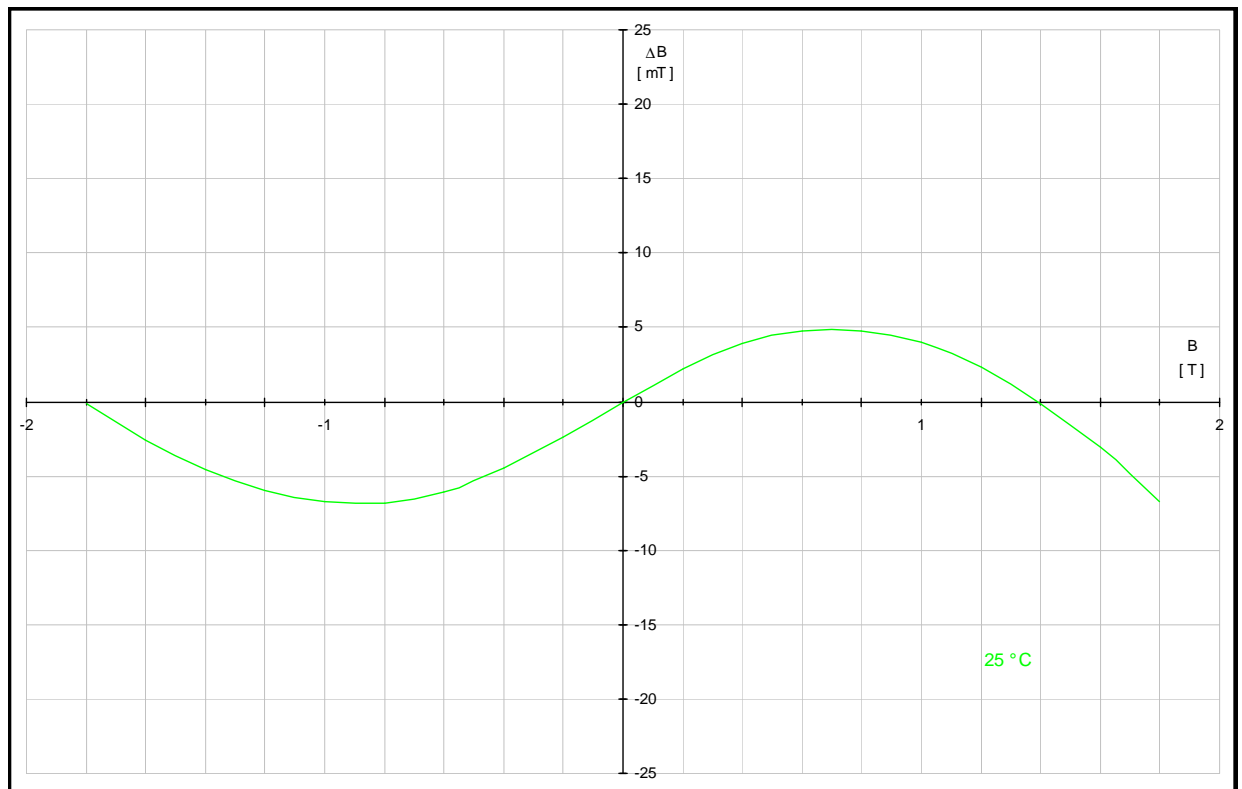


Fig. 5: Error of a Hall Effect Sensor type 3, not corrected

Therewith the desired measurement accuracy of 0.01% will be reached, it is necessary for correction of this error a substantial greater expenditure than with the sensors of type 1 and 2 for handheld devices. Here, the correction takes place concerning both the field value and the temperature drift. The following diagram shows the result after correction. Note that now the unit of y-axis is  $\mu\text{T}$  and no longer mT.

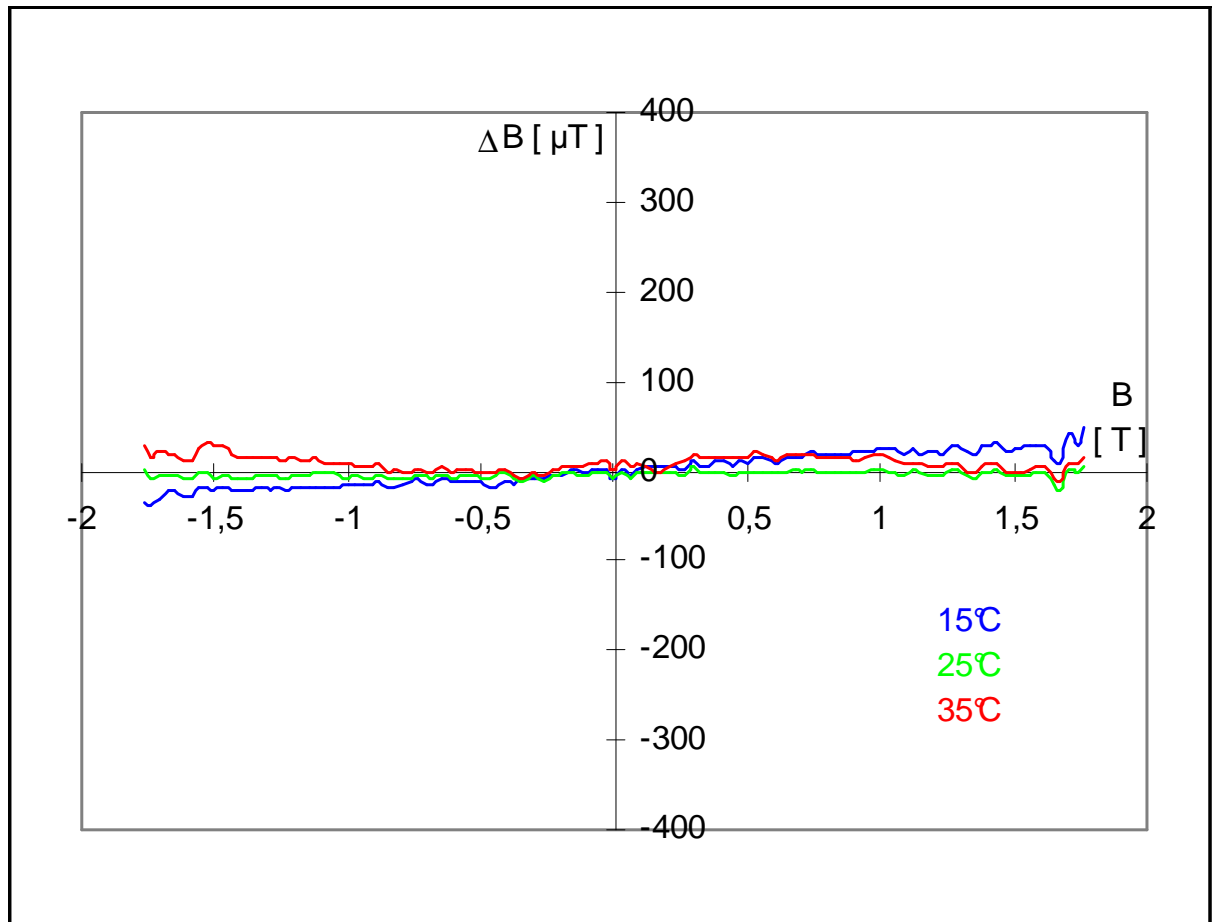


Fig. 6: Error and temperature drift of highly precise device with Hall Element sensor type 3.

## Variation

The used sensors of a specific type show to some extent a variation of their parameters. With small deviations, most sensors exhibit the typical curves shown above. Some of the sensors are slightly worse and some a little better. Now and then it may occur that one gets once a very good sensor. Here as example once the curve of such a good sensor of the type 1 after the correction. Such a thing occurs for instance with one of one hundred sensors. Here the remaining linearity error is obviously smaller and the temperature drift is nearly missing.

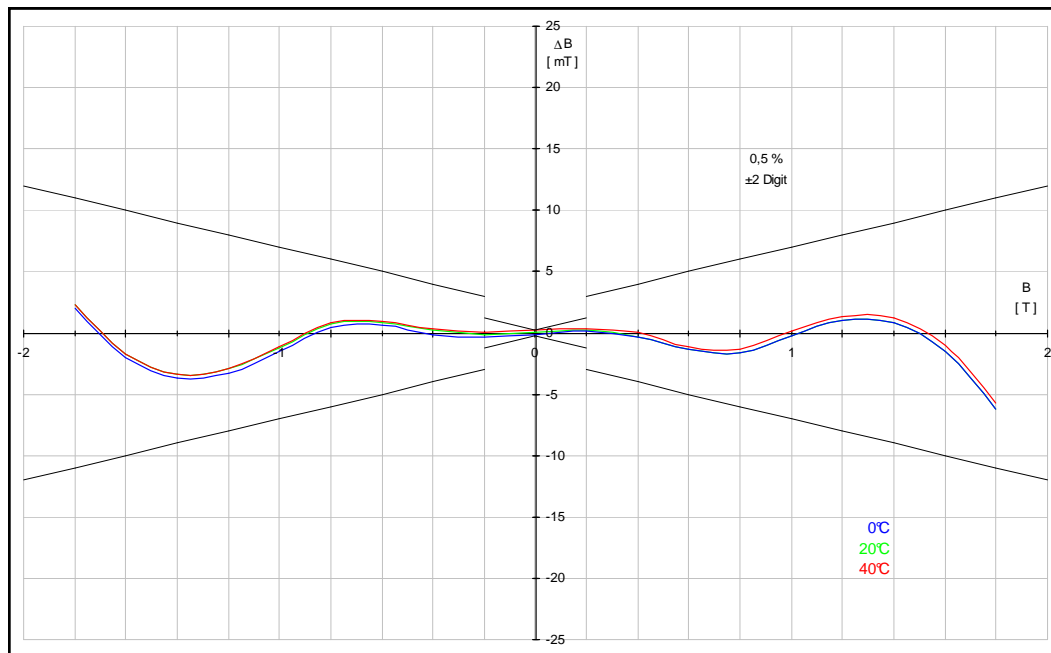


Fig. 7: Error and temperature drift of a particularly good Hall Element sensor type 1, corrected.