



AN-106

APPLICATION NOTE

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CHANGING THE FM300 SENSOR CABLE LENGTH

INTRODUCTION

Unless otherwise specified, the standard FM300 Vector Magnetometer is calibrated with a 7 foot (2 meter) sensor cable. The FM300 Instruction Manual states that anytime the FM300 sensor cable length is changed, its calibration status becomes invalid and the unit should be recalibrated. On occasion the user may wish to temporarily change the sensor cable length to make a specific measurement without having the FM300 recalibrated. This article discusses the consequences of changing the cable length so that the user can decide whether to accept these consequences or have the FM300 recalibrated.

CABLE SPECIFICATION

The standard FM300 sensor cable is an 8 conductor modular flat cable with an RJ45 modular connector on each end (L-com Part Number TCD053-7). The wire size is AWG 26. The following discussion assumes that the replacement FM300 sensor cable has the same electrical and physical characteristics as the standard cable, except for its length.

ZERO FIELD READING

The FM300 zero field reading is corrected to within the specified limits (± 20 nT) before it is shipped. Changing the cable length will change this zero field reading in a non-deterministic (unpredictable) way. Changes on the order of 70 nT have been measured. If you are making relative measurements only, this will not affect your measurements.

SENSITIVITY EFFECTS

Changing the FM300 sensor cable length changes its sensitivity. The resistance change in the wire is the cause of the sensitivity change. You can use the following formulas to estimate the change in sensitivity when changing the cable length:

$$\Delta S = 5.88 \cdot 10^{-3} \cdot \Delta L \text{ \% change (length in feet) or}$$

$$\Delta S = 0.0193 \cdot \Delta L \text{ \% change (length in meters)}$$

where ΔS is the % change in sensitivity and $\Delta L = L_2 - L_1$ is the change in length from the original FM300 cable (L_1) to the new cable (L_2).

For example, if the standard 7 foot cable is replaced by a 100 foot cable the sensitivity would increase by

$$\Delta S = 5.88 \cdot 10^{-3} \cdot (100 - 7) = 0.547\% .$$

In this case an FM300 relative field reading of 10,000 nT, using the 7 foot cable, would change to 10,055 nT with the 100 foot cable.

Likewise, if the FM300 had been calibrated with a 25 foot cable and the new cable length was 7 feet, the sensitivity would decrease by

$$\Delta S = 5.88 \cdot 10^{-3} \cdot (7 - 25) = -0.106\% .$$

Therefore, an FM300 relative field reading of 10,000 nT, using the original 25 foot cable, would change to 9,989 nT with the 7 foot cable.

Since the sensitivity change with cable length is very predictable, you can correct for the error using the above formulas.

SUMMARY

Although the FM300 calibration status is invalid if the FM300 is used with a cable that is not the one for which it was calibrated, you can still use the FM300 to make accurate relative field measurements with different length sensor cables.

The changes in zero field readings, caused by changing the sensor cable length, introduce an error in absolute field measurements that cannot be predicted. Tests have indicated that changes in the zero field readings are under 70 nT.