



Electric Field Mill Operation

Electric Field Mills such as the EFS 1001 and Zebra Field Mill (see Figure 1. EFS 1001 Simplified Diagram) are designed to determine the relative strength of the electric field by comparing the level of the electric field on a known, stable, uncharged reference object. The object used in a field mill is known as the sensor plate. When an uncharged sensor plate is exposed to an electric field it becomes charged. The rate and level of this activity is what the mill is designed to determine.

Electric fields are often described and graphically represented as flux lines (see Figure 2. Flux Lines). These lines represent the area in space where the field is present, an area of electrical tension. Any object present within this area of electrical tension will accumulate electric charge at a rate which can be measured. The rate of charge accumulation on this object is a direct measurement of the strength of this electric field. Hence, measurement of this rate yields the electric field strength. The field mill measures this electric charge rate.

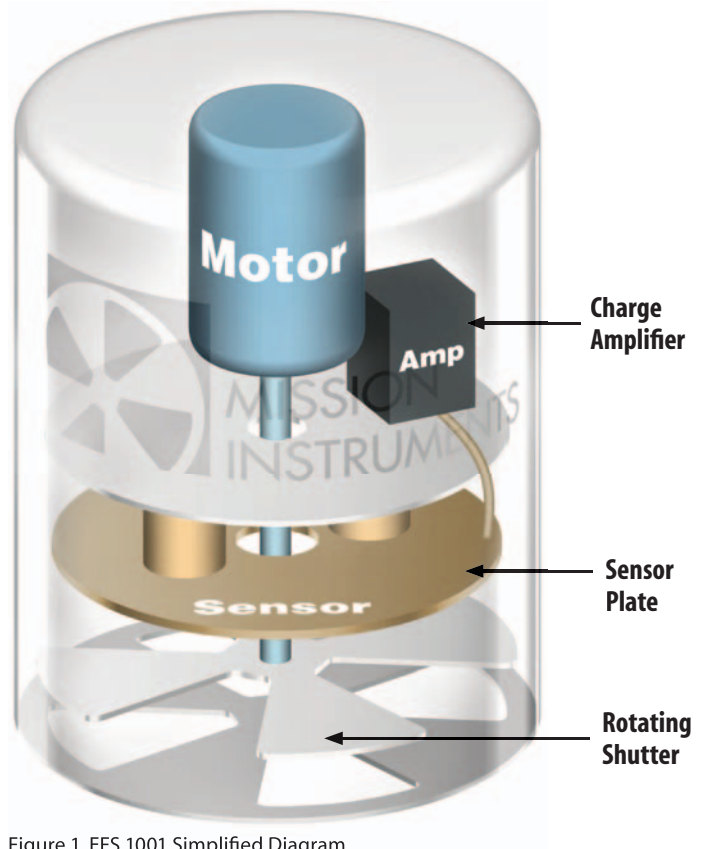


Figure 1. EFS 1001 Simplified Diagram

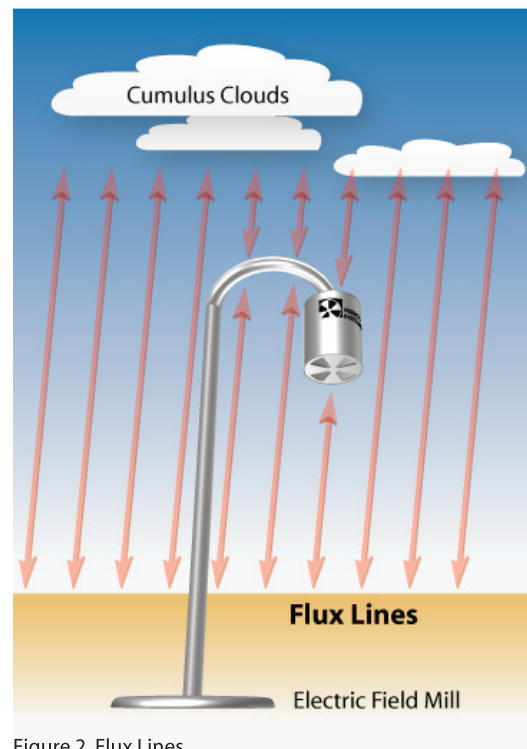


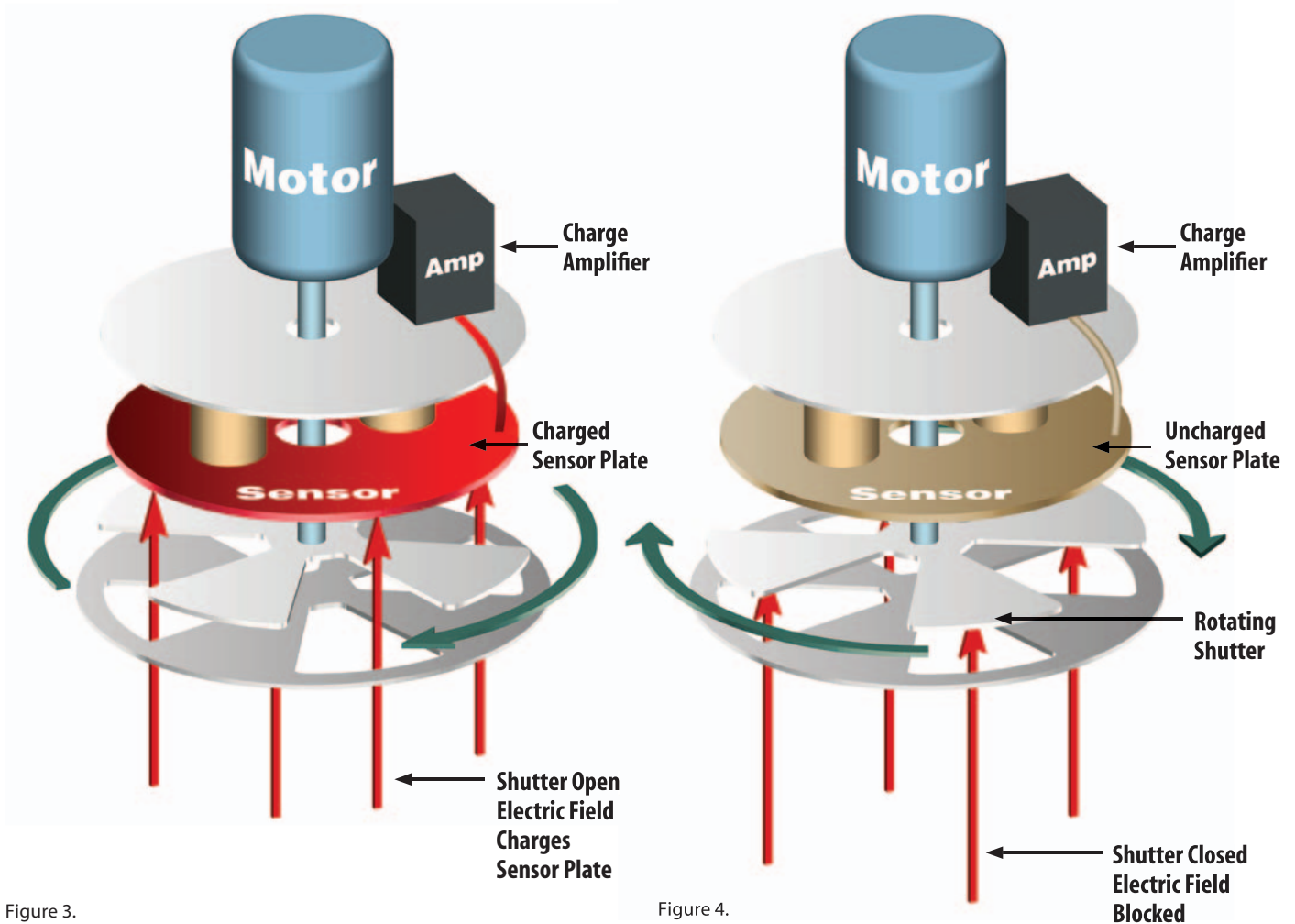
Figure 2. Flux Lines



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Because conditions are constantly changing, there exists a need to measure the strength of the electric field constantly which translates into the need to alternately read the charged state of the sensor plate, discharge it, and read again, over and over. This is accomplished by repeatedly exposing the sensor plate to the external electric field to charge it (see Figure 3.), then shielding the plate to allow it to discharge (see Figure 4.).

Specially-designed charge amplifiers (see Figure 3. Charge Amplifier) within the field mill measure the amount of charge the charge plate receives from the outside electric field and converts this value to an analog voltage. Changes in this observed voltage level correspond to changes which take place in the atmosphere due to the presence of electrified storm clouds. As the observed values increase, so does the likelihood of lightning to be present in the area.





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The process of exposing (charging) and shielding (discharging) the sensor plate from the electrical field is accomplished by means of a rotary shutter (see Figure 5. Rotary Shutter.), consisting of a motor-driven, mechanically complementary rotor/stator pair. As the motor rotates, the shutter alternately opens (see Figure 6.) to allow the external electric field to charge the sensor plate, and then closes (see Figure 7.) to shield the sensor plate to allow it to discharge, or reset, in preparation for the next measurement. The shutter rotates at a speed of 1650 revolutions per minute, and opens and closes four times per revolution thus producing 6,600 samples per minute.



Figure 5. Rotary Shutter

Rotating
Shutter

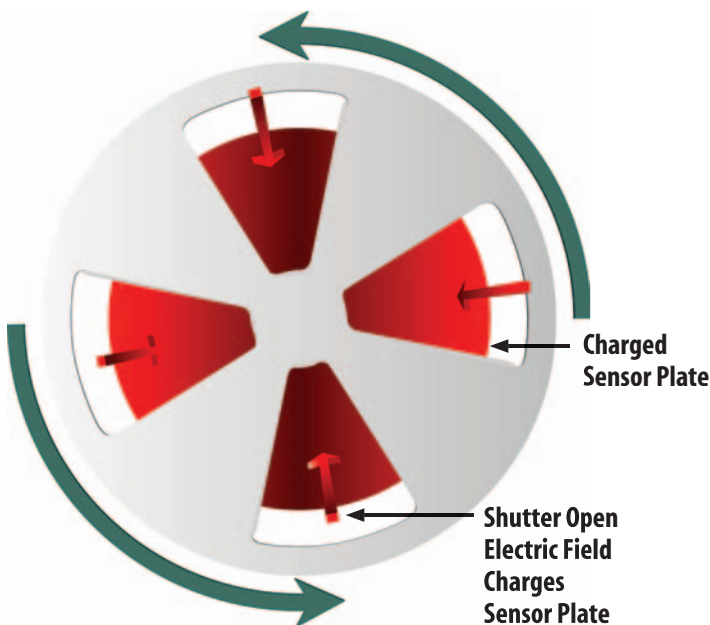


Figure 6.

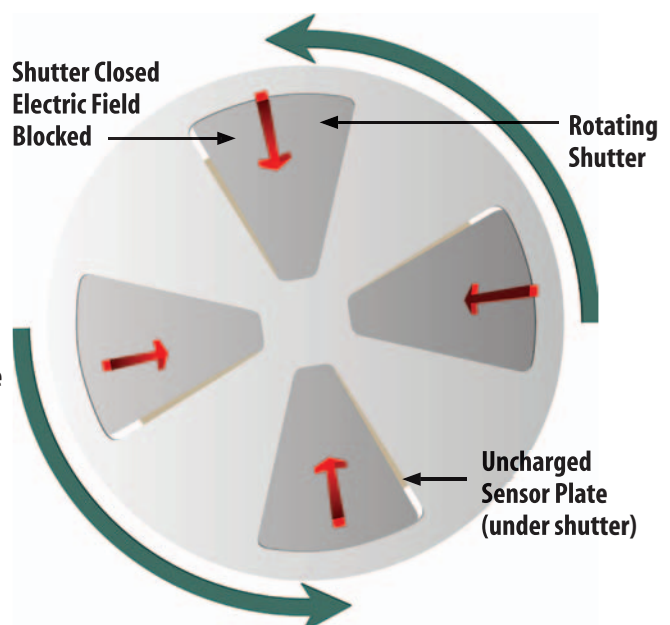


Figure 7.