

Section 1

SPECIFICATIONS

A. General:

The Model 238A Portable Differential AC Electric Fieldmeter is a small, battery operated instrument designed for use in general physical and biological testing for safe electric field intensity levels in the vicinity of high voltage AC transmission equipment. The plates attached to the top and bottom of the instrument are the sensing electrodes with an axis of sensitivity normal to the plates. A four foot long handle is supplied to reduce field distortion created by the presence of the individual performing the measurement.

B. Features:

- Measures high AC electric fields near AC transmission equipment.
- Small, lightweight, portable.
- Accuracy ~ 5%.
- Essentially drift free.
- Battery operated.

C. Specifications:

Range: Up to 25 Kilovolts/Meter (RMS). Full scale meter ranges of 5, 10, and 25 KV/M.

Accuracy: $\pm 5\%$ of full scale.

Frequency Response: Independent of frequency for normal power distribution frequencies (50 Hz to 1000 Hz).

Stability: This design exhibits excellent stability. Instability as a function of time, temperature, and battery voltage is included in the overall accuracy specification.

Battery: a) Type - Standard 9 volt transistor radio battery (Eveready No. 216 or equivalent) - one required.

b) Life - 100 hours minimum.

Physical Dimensions: 4 1/4" deep X 6 1/2" wide X 5 3/4" high not including handle.

Calibration: Factory calibration is stable and does not shift significantly with time or battery voltage.

Section 2

OPERATION

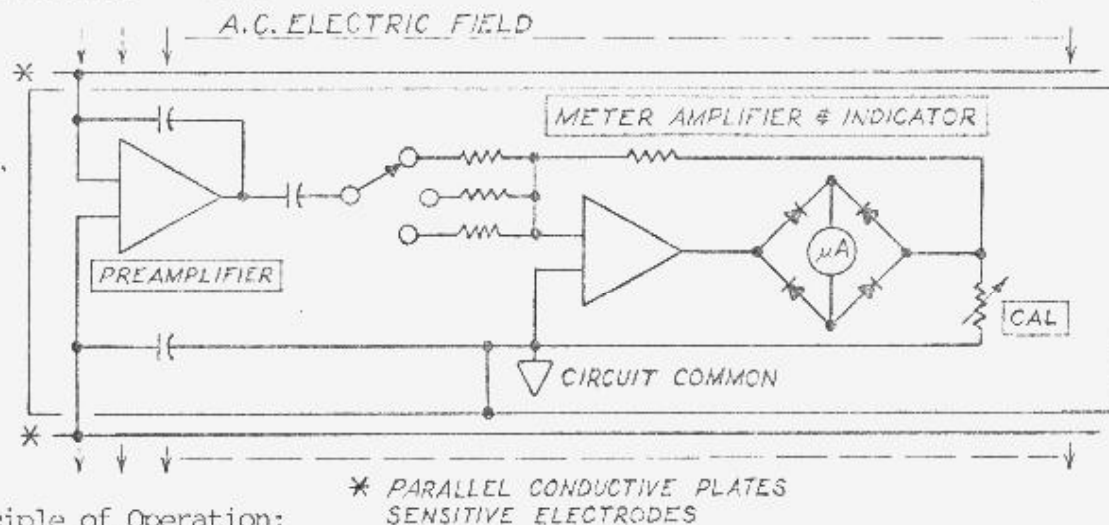
The Model 238A AC Electric Fieldmeter is held or mounted in such a manner as to align the sensitive electrode plates perpendicular to the incident AC field and removed from objects which will distort the field to be measured. The handle supplied can easily be adjusted to align the instrument with the incident field, and when held at arms length, will exhibit minimal error due to field distortion from the operators body.

Meter Range/Power Switch:

OFF - The OFF position turns the instrument off, disconnects the battery from the circuit and shorts the meter terminals for maximum meter damping.

BATT. CK - The BATT. CK position tests the battery under normal load conditions and should produce a meter deflection of half scale or greater.

The remaining switch positions select the maximum full scale meter ranges.



Principle of Operation:

Please refer to the simplified block diagram figure 1.

The sensitive electrodes consist of two parallel plane conductors separated by the metal instrument case. These electrodes are exposed to the AC field to be measured and are oriented with their plane perpendicular to the incident AC electric field. These electrodes are connected differentially to the inputs of the preamplifier. With capacitors connected to the preamplifier as shown, the preamplifier output is a voltage proportional to the differential AC electric field incident upon the sensitive electrodes, and is independent of the frequency of the incident AC field.

The meter amplifier and indicator consists of an operational amplifier, selectable input resistor to determine amplification, a full wave bridge rectifier connected to a microammeter, and the output feedback resistor and adjustable load resistor. The bridge rectifier is connected in series with the operational amplifier output thus eliminating non-linearities due to the bridge rectifier. The output load resistor is adjusted to calibrate the system to read correctly when exposed to a known AC electric field. Precision input resistors insure correct scaling when the range is changed.

Section 3

CALIBRATION AND MAINTENANCE

The Model 238A AC Electric Fieldmeter calibration is based on the "square meter panel" method of measuring AC electric field strength at ground level below an ultra high voltage transmission line. Since this calibration method is dependent upon system geometries and rather impractical to reproduce, an alternate calibration method has been devised. Both methods are explained below.

A. SQUARE METER PANEL Method:

The "square meter panel" is a one square meter metallic panel surrounded by and insulated from a guard ring. The center panel is slightly less than one square meter, since fringing in the air gap divides the displacement flux equally making the effective area of the center panel equivalent to the center of the gap which encloses one square meter. The guard ring extends one half meter beyond the center panel. Virtual electric ground should be less than 10cm below the "square meter panel".

The "square meter panel" is then positioned below an ultra high voltage (300 - 500KV) single phase transmission line at least 30 feet above ground and connected to true earth ground through a micro ammeter. The guard ring is connected directly to true earth ground. The magnitude of the 60-Hz phasor rms voltage gradient is obtained by

$$\bar{E} = 0.3 I \text{ (KV/M)}$$

where I is measured in micro amperes

The Model 238A AC Electric Fieldmeter is then positioned directly over but not touching the center panel. The operator should be at least one meter away from the fieldmeter while taking a reading. The fieldmeter CAL is adjusted for desired reading.

B. Alternate Calibration Method:

The alternate calibration method uses low voltage and a pair of coupling capacitors connected to the sensitive electrodes (see fig. 2). Equipment required consists of a variable source of AC power (0-25V RMS), a pair of 535 $\pm 0.5\%$ pico farad capacitors and a precision AC voltmeter.

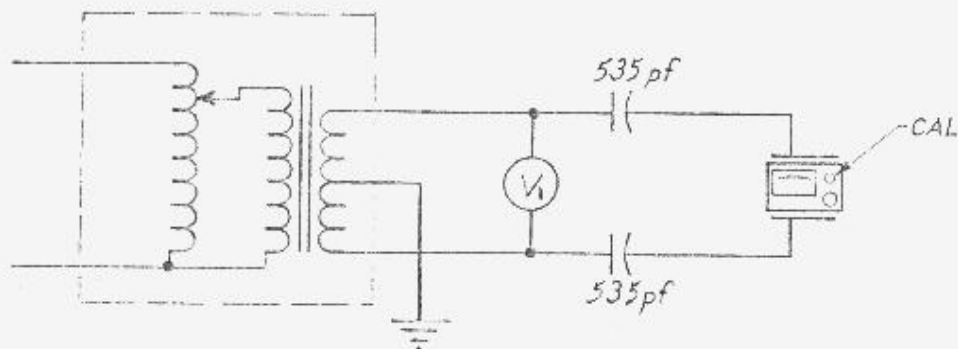


Figure 2

When properly connected as in figure 2, the fieldmeter reading in KV/M will correspond to the voltmeter reading in volts. Adjust the variable AC source for a reading on the voltmeter of 10 volts RMS, then adjust the fieldmeter CAL for 10KV/M.

C. Maintenance:

If meter ceases to function or will not calibrate properly check battery.

Place Range Switch in BATT. CK position. If meter does not read above center scale, the battery should be replaced. Remove three screws in front panel and pull panel assembly out of case. Replace battery and reassemble.

If AC fieldmeter still malfunctions return it to the factory for proper servicing.

Repairs will be made to damaged or defective instruments in accordance with the standard repair price schedule. Factory repair of defective instruments is recommended. In the event of difficulty, please contact the factory.