JCI 504 SYSTEM
FOR ADVANCE WARNING OF LIGHTNING

A system providing advance warning of the risk of local lightning on the basis of observations of local atmospheric electric field, of radio noise and of lightning impulse signal activity [1]. Combinations of measurements of these three parameters provide two levels of warning to enable action to be taken to protect personnel and equipment.

INTRODUCTION

The JCI 504 Lightning Warning System [1] comprises two main parts: a Sensor Unit and a Base Unit. The Sensor Unit is mounted on open ground well away from nearby buildings and sources of physical pollution and electrical noise.

The Sensor Unit comprises an electrostatic fieldmeter, suitable for continuous operation in adverse environmental conditions, mounted on top of a 2m tall antenna tube that is used to pick up radio noise signals (at 27kHz) and lightning impulse signals (over the band 2-200kHz).

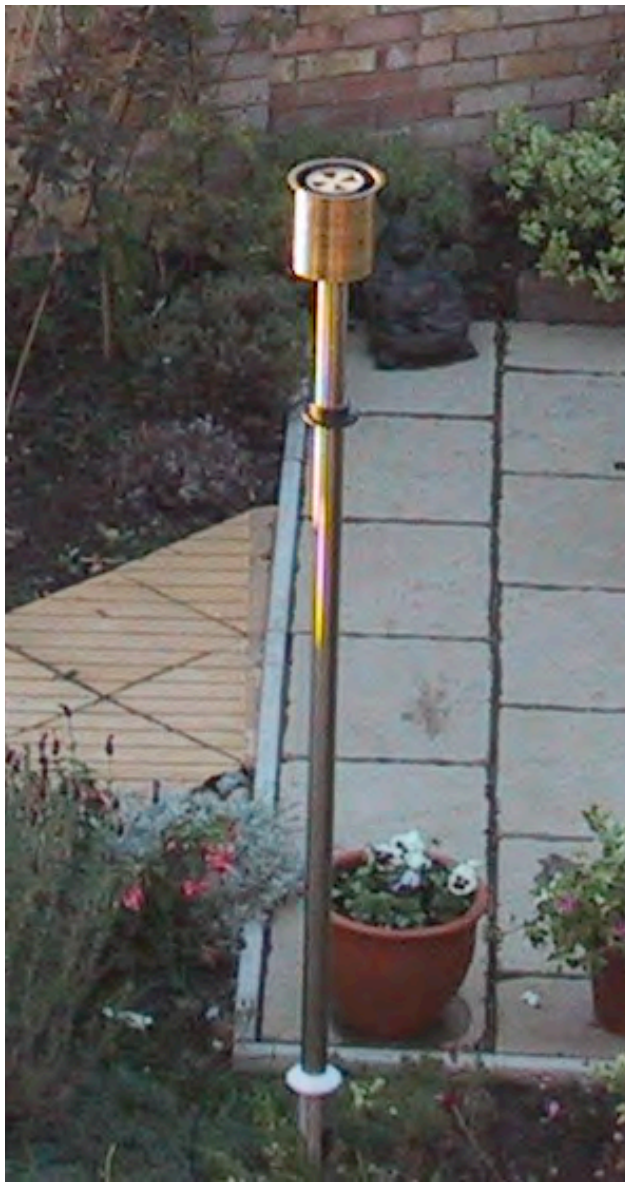
Operational health monitoring facilities are included to continuously check the performance of all three observations.

The Sensor Unit is cable connected (up to 100m) to the Base Unit which is mounted in a convenient nearby monitoring location. The Base Unit provides power supplies for the Sensor Unit and analysis and display of atmospheric electric field, radio noise measurements and alarm status.

Electric field observations:

The atmospheric electric field is measured by an electrostatic fieldmeter (JCI 131) acting as a potential probe a known height above ground level. The voltage sensitivity can be directly calibrated by application of known voltages - so with the known probe height, the volts per metre is known for the ambient atmospheric electric field. The advantage of this approach is simplicity of mounting, the avoidance of interference by ground level dust and debris and the enhancement of the effective sensitivity of the electric field measurement capability.

The fieldmeter used for electric field measurements is based on well tried proprietary JCI design features [2]. This instrument provides high useable sensitivity, wide dynamic range and long operational life even in adverse weather conditions. Physical design features of JCI 131 fieldmeter (large gaps and long insulation tracking paths) are based on previous experience of overcoming problems of operation in wet and dirty environments [3].



Sensor Unit mounted on antenna tube

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Radio noise and lightning impulse signals:

The 2m tube mounting the Sensor Unit also provides the antenna for the radio signal observations.

Noise signals at 27kHz and/or impulse signals within the 2 to 200kHz band indicate lightning activity around. Low frequency signals travel with fairly low attenuation so existing lightning activity can be detected at large distances. These signals are processed by the radio circuits mounted within the casing of the JCI 131 fieldmeter and all signals pass through a single multicore cable to the Base Unit for assessment and alarm status display.

Base Unit:

Measurements of electric field, radio noise and impulse signal levels are assessed in a microprocessor included within the Base Unit. This is an Arcom GX533 running JCI 501 software in MSDOS. The risk criteria are:

Green: No risk & system operating normally

Amber: Four alternative risk criteria:

1) (Electric field E > 1.5 kV m^{-1}) & (Noise > Noise threshold)
2) (Noise > Noise threshold) & (1 lightning event)
3) (Electric field E > 3 kV m^{-1})
4) (2 lightning events < 100s)

Red: Five alternative risk criteria:

1) (Electric field E > 1.5 kV m^{-1}) & (Noise > Noise threshold) & (1 lightning event)
2) (Noise > Noise threshold) & (2 lightning events < 100s)
3) (Electric field E > 3 kV m^{-1}) & (1 lightning event)
4) (3 lightning events < 100s between successive events)
5) (Electric field E > 4.5 kV m^{-1})

The alarm status is displayed on large LEDs on the Base Unit and made available for remote replication.

In addition to the above facilities the Base Unit includes power supplies and a number of displays. LEDs are used to show the alarm status and the operational health status of the system operation. Liquid crystal displays show the atmospheric electric field and the level of radio noise observed. Observations can be reviewed and a summary of data is archived.

The system can be operated from a mains supply (110-250V) or via an uniterruptable power supply unit to cover the event of mains power supply failure.

Operational health:

The operational health of the fieldmeter and the two radio detection channels are assessed continuously with status signals available remotely.

The operational health of the fieldmeter is monitored by a small value a.c. field applied from a surrounding shield electrode and superimposed on electric field observations. As the signal is at half the fieldmeter chopping frequency and phase related to the chopping it does not interfere with normal fieldmeter operation. Separate phase sensitive detection circuits separate the health signal and allow comparison to the value expected. Similarly, with the two radio channels, low level signals are introduced via the antenna that are detected and assessed separately from the main 27kHz and 2-200kHz signals.

References:

[1] J. N. Chubb, J. Harbour *"A system for the advance warning of risk of lightning"* Paper presented at the Electrostatics Society of America 'ESA 2000' meeting, Niagara Falls, June 18-21, 2000

[2] J. N. Chubb *"Experience with electrostatic fieldmeter instruments with no earthing of the rotating chopper"* 'Electrostatics 1999' Conf, Cambridge, March 29-31, 1999. Inst Phys Confr Series 163 p443.

[3] I. E. Pollard; J. N. Chubb *"An instrument to measure electric fields under adverse conditions"* Static Electrification Conference, London, 1975. Inst Phys ConfrSeries 27 p1

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