Biral
Visibly Better

**White Paper**
February 2015

# BTD-300: Principle of Operation

Dr Alec Bennett PhD MInstP FRMetS CMet

*The Biral Thunderstorm Detector BTD-300 provides real-time detection and ranging of thunderstorm activity within 83 km (51 miles). The sensor bases thunderstorm warnings on the detection and range of lightning flashes, as well as the presence of strong electric fields and electrically charged precipitation occurring at the installation site. The strong electric fields and charged precipitation provide the ability to warn of the potential for nearby lightning activity before the occurrence of the first flash.*

*Lightning flashes of all types (cloud-to-ground, cloud-to-cloud and intra-cloud) and polarities are detected, ranged and logged within 2 seconds of their initiation. Electric field disturbances associated with potential overhead thunderstorm development produce an alert after 5 seconds of monitoring. Such sensitivity and rapid alerts allow the greatest warning time for the user of local thunderstorm development, with the unique monitoring techniques allowing an extremely low false alarm rate.*

## How does it work?

The operating principle of the BTD-300 is based upon sensing changes in the atmospheric electric field in the frequency band of 1-47 Hz. This frequency band means that the sensor is most sensitive to changes in the electrostatic field generated by a thunderstorm cloud during a lightning flash, but is not sensitive to man-made radio interference. The total change in electric field produced by the lightning flash is used to estimate its distance from the sensor.

The direction of the lightning flash is determined by the (optional) radio-frequency direction finder module for the BTD-300. This module measures the strength of the electromagnetic signal produced by the flash on three small antennas contained inside the module's box, which are sensitive to signals from different directions. Comparing these signals allows the direction of the flash to be determined.

When a thunderstorm is over the site, the strong electric field causes ions to be released into the air from nearby tall objects such as buildings and trees. The increased charge in the air is detected by the sensor, alerting it to potential overhead thunderstorm development. Charge transferred to the antennas by precipitation is also used to determine whether the overhead cloud has the potential for thunderstorm activity.

The BTD-300 has three electrostatic antennas positioned vertically above each other. The top one is spherical, above two toroidal antennas. The different shapes and heights of these antennas allow the sensor to separate signals made by lightning, precipitation and charged air from non-thunderstorm charge sources such as nearby electrical sparks or movement of people and birds.

*Further details of the main scientific techniques used by the BTD-300 can be found in the following journal publication:*
*Bennett, A. J., 2013. Identification and ranging of lightning flashes using co-located antennas of different geometry. Measurement Science & Technology,* ***24*** *(12), 125801.*

***About the Author***

*Dr Bennett is the Meteorological Products Manager for Biral, UK. He has a PhD in Atmospheric Electricity and 10 years' experience in research and development of lightning detection systems, including working at the UK Metrological Office and being a visiting Research Fellow at the University of Bath. He has written over 20 papers in atmospheric electricity, which have been published in peer-reviewed international journals.*





Biral