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BTD Series: Principle of Operation

Dr Alec Bennett PhD MInstP FRMetS CMet

The Biral BTD series Thunderstorm Detectors provide real-time detection and ranging of thunderstorm activity. The maximum warning range is 35 km for the BTD-2XX and 83 km for the BTD-3XX variants. In addition to lightning detection, the sensors also detect the presence of a strong electric field and electrically charged precipitation occurring at the installation site. The strong electric field and charged precipitation provide the ability to warn of the potential for nearby lightning activity before the occurrence of the first flash. An optional lightning direction finding module is also available for some models, allowing lightning locations to be mapped in real-time.

Lightning flashes of all types (cloud-to-ground, cloud-to-cloud ad 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 series 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 lighting flash is used to estimate its distance from the sensor.

When a thunderstorm is over the site, the strong electric field causes ions to be released into the air from nearby tall object 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-3XX variants have three electrostatic antennas positioned vertically above each other. The top one is spherical, above two toroidal antennas. The smaller BTD-2XX variants have only two electrostatic antennas; a spherical one at the top and a flat disc-shaped antenna located directly below it, inside the domed rain shield. 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 over 10 years' experience in research and development of lightning detection systems, including working at the UK Met Office and being a visiting Research Fellow at the University of Bath. He has written over 30 papers in atmospheric electricity, published in peer-reviewed international journals.