Claims

1. A broadband electromagnetic sensor comprising:

   an amplifier circuit having at least 26 dB gain through its bandwidth; and

   a sensing portion comprising a coil array structure of a plurality of coils, wherein each coil has a different length from other coils in the plurality of coils and detects signals having frequencies within its own frequency bandwidth, such that the plurality of coils are together able to detect signals having frequencies within a frequency bandwidth of the sensor, and wherein the frequency bandwidth of the sensor ranges from around 1 MHz to 100 MHz, such that the sensor is able to detect partial discharge from high voltage equipment without being in physical contact with the high voltage equipment.

2. The broadband electromagnetic sensor according to claim 1, wherein the coil array structure is provided as an integrated layout on a printed circuit board, and wherein the integrated layout is optimized to minimize area of the printed circuit board required to support the coils.

3. The broadband electromagnetic sensor according to claim 1 or claim 2, wherein each coil can be represented by an equivalent circuit model comprising a capacitor provided in parallel connection with an inductor and the inductor provided in series connection with a resistor.

4. The broadband electromagnetic sensor according to any one of claims 1 to 3, wherein the sensing portion can be represented by an equivalent circuit model that incorporates mutual inductance between every distinct pair of coils in the coil array.

5. The broadband electromagnetic sensor according to any one of claims 1 to 4, wherein the coil array structure comprises one of: a rectangular shape, a circular shape, a three-dimensional structure.