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HIGH CURRENT SENSING THROUGH FARADAY ROTATION OF POLARIZED LIGHT OF VARYING WAVELENGTHS IN FIBERS II

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Traditionally, large-amplitude, fast-rising currents and magnetic fields has been measured with electro-magnetic probes such as Rogowski coils or B-dot probes. Such probes are observed to work satisfactorily for many experimental configurations but the probe to digitizer signal is affected by cabling and cabling elements. Measurements must frequently be made in the presence of significant electromagnetic interference imposing unacceptable levels of noise on the probe signals. Furthermore, probe measurements on high voltage electrodes may be problematic if the probes are not sufficiently isolated. An alternative method for measuring currents and magnetic fields involves using the Faraday effect on linearly polarized light propagating in single mode fibers.

Probes utilizing the Faraday effect have been used for many years. Their operation, whereby the magnetic field strength is proportional to the number of probe output "fringes", is relatively immune to signal cable attenuation losses. Fibers are dielectrics and their electrical insulation reduces breakdown problems near high voltage electrodes. The probe calibration is a material property making in-situ calibrations unnecessary. Previously, the Faraday probe setup required an optical engineer to assemble and align the numerous discreet optical elements (i.e. beam expander, splitter, polarizers and focusing optics). This was time consuming work requiring realignment whenever the assembly was moved. Due to tele-communication advancements, a robust compact Faraday effect optical assembly with fixed alignments is now available at low cost.

Also, due to these advancements, measurements at many different wavelengths are now possible. Theory predicts the Faraday probe sensitivity is inversely proportional to laser wavelength, thus probes of varying sensitivities can be constructed. The authors previously presented the theory and operation of this type probe at 2017 IEEE-PPC London. However, this paper details four Faraday probes optimized for wavelengths of 450 nm, 532 nm, 632 nm & 850 nm and now includes probe calibration efforts.

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