Reduction in energy dissipation rate with increased effective applied field and variation in energy stored and dissipated with relative phase of two sinusoidal components of the field

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***Abstract*— Dynamics of the response of the type II superconductors to the time-varying magnetic field may be dependent on the rate of change of the field or hysteretic. The rate of energy dissipation in a superconductor placed in a time-varying magnetic field depends on the wave form of the field and the vortex dynamics, which depends on the temperature. The same waveform can decrease the energy dissipation rate in the critical state, while increasing the energy dissipation rate in a flux creep state or normal state. In the case of hysteretic non-linearity, the energy stored and dissipated in the applied field varies with the relative phase of the sinusoidal field components, although the magnitude of these components, and hence the effective field value, are constant. The data obtained by numerical modeling of the energy stored and dissipated over the fundamental field cycle show dependence on the wave-form of the AC field, which was synthesized using the fundamental and higher harmonic field components. These simulations were experimentally confirmed by measuring coated 2G HTS wire made by SuperPower Inc. using a continuous reading SQUID magnetometer. The results obtained show that it is possible to increase the RMS current in the superconductor while reducing the energy dissipated per field cycle. We believe that these results can be practically used.**

Keywords—stored and dissipated energy, critical state, hysteresis, nonlinearity, field waveform

[1] Z. Janu and F. Soukup, “Reduction in energy dissipation rate with increased effective applied field”, Supercond. Sci. Technol., vol. 28, pp. 085016 (5pp), July 2015. doi:10.1088/0953-2048/28/8/085016

[2] Z. Janu and T. Chagovets, “Variation in energy stored and dissipated in type-II superconductor in applied ac magnetic field with relative phase of two sinusoidal components of the field”, Physica B vol. 504, pp. 9–12, 2017. doi: 10.1016/j.physb.2016.10.003