

A Second-order Gradiometer to Measure MCG in Unshielded Environments

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We fabricated a low- T_C second-order SQUID gradiometer to measure magnetocardiography(MCG) in unshielded environments. The gradiometer consists of two parts; one is three series pickup coils formed by two side single-turn coils and a double-turn center coil. The coupling polarity of two side coils is opposite to that of the center coil. The other one is a SQUID based on double relaxation oscillation SQUID (DROS). Each part was fabricated on separate wafers and connected superconductively using an ultrasonic bonding of Nb wire. The overall size of the gradiometer is 94 mm×12 mm with a baseline of 35 mm. The measured average field noise was about 7 fT/ $\sqrt{\text{Hz}}$ at 100 Hz, which has similar value for the inside and outside a magnetically shielded room. This noise property was low enough to measure MCGs in an unshielded environment. In this paper, we describe noise characteristics of the second-order gradiometer and the MCG measurements in an unshielded environment.

keywords : SQUID, second order gradiometer, MCG