

## Multichannel SQUID Systems for Magnetocardiogram

Y. H. Lee\*, J. M. Kim, K. Kim, H. Kwon, K. K. Yu, C. S. Kang,  
S. K. Lee, C. M. Lim, I. S. Kim and Y. K. Park

*Bio-signal Research Center, Korea Research Institute of Standards and Science, Yuseong, Daejeon, Korea*

Magnetocardiography (MCG) is a noninvasive technology to provide dynamic information on the myocardium current. In order to detect myocardial ischemia and conduction anomaly in a short time, we need a multichannel MCG system measuring the magnetic field distribution of the heart in a single measurement. Several MCG systems measuring tangential components of MCG fields were fabricated and installed in the hospitals. These systems have 64-channel first-order planar gradiometers with a baseline of 40 mm, and have been operating inside moderately shielded rooms (MSR). In order to reduce the cost of MSR, we also fabricated 64-channel SQUID planar gradiometers of second-order with baselines of 35 mm and 50 mm, respectively. The second-order systems can be operated inside a partially shielded room having a wall thickness of 13 mm in total (aluminum 12 mm and permalloy 1 mm). In order to compare field maps and waveforms measured from different pickup coil structures and measuring components, and to make transformation of data between different systems, an MCG system measuring vertical components of MCG fields was also fabricated using 61 magnetometers. All the SQUIDs were fabricated using Nb/Al-oxide/Nb thin film process on Si wafers. The SQUIDs are based on double relaxation oscillation SQUID with large flux-to-voltage transfer coefficients and large modulation voltages. From the several MCG systems, measured field distributions and waveforms were compared, and transformed into other data forms of different pickup coil structures.

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