ABSTRACT

Impedance cardiography is a non-invasive technique for monitoring the time-varying thoracic impedance during the cardiac cycle and is used for diagnosing cardiovascular disorders. The thoracic impedance has a basal impedance and a time-varying component. A bioimpedance simulator with a settable basal value and time-varying component with selectable waveform and settable parameters is developed for testing and calibration of impedance cardiograph and other bioimpedance measuring instruments. It has four blocks: impedance variation circuit for realizing the time-varying thoracic impedance, the controller circuit for controlling the impedance variation, a wireless module connected to the controller with serial interface for setting the parameters of the control waveforms, and a battery powered power supply block. The simulator is electrically isolated from the mains. A PC-based GUI for setting the control parameters through wireless link is also developed. The impedance variation circuit consists of switch-resistor network to provide to fix basal impedance connected in parallel with a voltage-controlled resistor (VCR) circuit to provide the time-varying component. The VCR circuit has to provide precise linear variation in resistance in response to control voltages applied to it. Circuits using matched JFET and MOSFET pairs for realizing a floating precision linear VCR are studied and tested using simulation and practical implementation. For the simulator, a matched JFET pair based VCR with SD bootstrapped gate and self-tracking arrangement is implemented to extend the range of linear operation and to reduce device-parameter dependency. The switch-resistor is implemented using analog switches connected in parallel with fixed resistors. The control parameters for the switch-resistor network and the VCR circuit is set from the controller.