

摘要: 为了改善压电陶瓷驱动电源在高电压输出下的动态特性以及高频下的带载能力,提高频率响应范围,设计了一种基于多单元级联的压电陶瓷执行器高压驱动电源。首先,基于分立元件构建直流通式高精度驱动单元,并针对每个独立的驱动单元进行建模仿真,分析其在压电陶瓷等容性负载下的稳定性并采取了有效的双通道隔离反馈补偿策略。然后,利用多单元隔离浮地级联的方法,将多个独立的高精度驱动电源模块进行浮地级联,构成了一种组合式压电陶瓷高压驱动电源。实验结果表明,该级联驱动电源的输出幅值达0~1 000 V,最大输出功率为1 kW,满信号带宽为1 kHz/0.3  $\mu$ F,纹波小于100 mV。根据实验结果,该级联驱动电源满足低纹波,高精度,大带宽,响应时间短,带载能力强等特性。

关键词: 压电陶瓷执行器 高压驱动电源 多单元级联 稳定性

## High-voltage power amplifier based on multi-unit cascade for piezoelectric actuators

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Abstract: In order to improve the dynamic performance, load capacity and the bandwidth of a piezoelectric amplifier, a high-voltage power amplifier based on multi-unit cascade was developed. First, a high-precision amplifier unit based on discrete components was designed and a series of models for every driving units were simulated. Then, the stability of the amplifier unit in a piezoelectric capacitive load was analyzed and a effective dual-channel feedback compensation strategy was given. Furthermore, based on multi-unit floating cascade topology, a novel combined high-voltage piezoelectric amplifier was developed by cascading the multiple independent high-precision piezoelectric amplifier unit. Experimental results indicate that the cascade amplifier can offer the output voltage amplitude of 0~1 000 V, maximum output power of 1 kW, large signal bandwidth over 1 kHz/0.3  $\mu$ F, and the static ripple of 100 mV. It concludes that the amplifier can satisfy the system requirements of low ripple, high accuracy, large bandwidth, short response time and good load capacity.

Keywords: piezoelectric actuator high-voltage power amplifier multi-unit cascade stability

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