The Art of Power Starving

or how to make dead battery music

It has been known since the early days of electronic music that devices such as radios, amplifiers, and musical instruments can produce unusual sound artifacts during power-up and power-down. Likewise, battery-powered devices often change their sound—or even behave completely differently—when the battery runs low.

A simple digital square-wave oscillator typically produces a dull, harsh beep. However, when power starving is applied, strange, chaotic noises and self-modulation effects emerge, transforming the sound completely.

In recent decades, this phenomenon has inspired the development of instruments within the experimental electronic music scene that deliberately exploit the effects of “power starving.” A common technique is to insert a variable resistor between the (stable) power supply and a simple CMOS oscillator. This resistor—often called a “dead battery potentiometer”—simulates the increasing internal resistance of a discharging battery. As a result, power starving can be controlled reproducibly, even in mains-powered instruments or devices equipped with fresh batteries.

Experiments have shown that it is useful not only to add such a “dead battery potentiometer,” but also to make the operating voltage adjustable within a musically interesting range. While standard CMOS oscillators are typically powered with 5–18 V DC in digital applications, the “magic range” for power starving is much lower—often between 0.5 and 2.5 V.

In recent years, members of Kulturgüterschuppen have revisited this topic and conducted new experiments. They found that a true adjustable current limiter—also known as a constant current source (CCS)—can further expand the sonic possibilities of power starving. Since CMOS oscillators operating in the magic voltage range typically consume only a few microamperes, an adjustable current limiter from 0 to 50 µA was developed to generate even more chaotic and unstable sounds.

The real fun begins when power starving is not controlled statically by potentiometers, but made voltage-controllable, as in analog modular synthesizers. This allows power-starved sounds to be modulated by any control source, including self-modulation feedback, envelopes, low-frequency oscillators, or combinations thereof. Multiple simple power-starved oscillators can be interconnected in complex, neural-network-like topologies, enabling endless sound experiments.

Power starving is not limited to dedicated oscillators. In fact, it can be applied to virtually any electronic musical instrument—from sound toys and circuit-bent devices to “Lunetta-style” synthesizers. Circuit bending can even be made safer using power starving techniques: reducing the supply voltage and/or limiting the current lowers the risk of damaging an instrument when shorting pins during experimentation. Since Lunetta synthesizers already use CMOS oscillators, applying power starving to them is a natural extension.

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