



## John F. Kennedy Space Center's Integral Battery Power Limiting Circuit for Intrinsically Safe Applications



### BENEFITS

- Offers rapid response time for clamping circuits.
- Helps protect critical and expensive equipment with minimal voltage drop.
- Extends the life of power circuits with no significant drain on the current.
- Offers robust performance through an auto-restart feature that kicks in once a fault is removed or corrected.

NASA Kennedy Space Center (KSC) invites companies to license this innovative power-limiting circuit for batteries. This technology is designed to limit the power output from a battery without compromising battery lifetime in situations where there is little headroom for dropping voltage or wasting current. The invention was developed to ensure that the full power of the battery will not be available in the event of a short circuit, cut in a cable, or similar event. This technology prevents a spark emitted from a battery during a short circuit from possibly igniting volatile chemicals, while not drawing much additional power in the process. The device can shut off a circuit within 55  $\mu$ s, 20 times faster than the fastest rated fuse.

## APPLICATIONS

The circuit technology is primarily useful in battery-powered applications for hazardous environments, where a circuit might have to be shut down immediately to avoid a dangerous situation due to a short circuit or other fault. Specific applications include:

- Transportation of natural gas or other potentially hazardous materials
- Offshore rigs and pipelines
- Mining applications, such as drilling and tunneling
- Gasoline pumps and hybrid vehicles
- Agricultural uses, such as grain elevators
- Medical monitoring equipment
- Field-based applications for military or other hazardous environments

## TECHNOLOGY STATUS

- Patent pending
- U.S. patent
- Copyrighted
- Available to license
- Available for no-cost transfer
- Seeking industry partner for further codevelopment

## Technology Details

The power-limiting circuit offers a very fast response time with minimal added voltage drop and no significant extra current drain on the battery. When deployed, the technology monitors and clamps the current if it exceeds a predetermined threshold voltage, thus shutting down the application. While the current is disabled, the circuit periodically sends out a small test current to detect whether the fault has been corrected or removed. Once the fault is resolved, the circuit can restore full current to the application (if desired).

This unique innovation overcomes the shortcomings of prior methods of creating safety barriers for battery-circuit monitoring. For example, a common approach uses a diode or intrinsic safety barrier to protect against reverse polarity as well as a resistor with an inserted fuse. This is problematic because the added voltage drop due to the diode, fuse, and current-limiting resistor is too great, leaving the remaining battery voltage insufficient for most applications.

This power-limiting circuit produces a much smaller voltage drop, thus sidestepping this problem. In one test case using a 3.6 V lithium battery, the added voltage drop in standby mode from the power-limiting circuit was 10 mV, compared to roughly 700 mV in more conventional approaches. In addition, tests indicate no detectable reduction in battery lifetime using the power-limiting circuit. Where a typical battery might experience a drain of 30 mA, the power-limiting circuit would add about 10  $\mu$ A to that drain, which is typically less than the battery's self-drain.

## Partnership Opportunities

NASA has applied for a U.S. patent on the Integral Battery Power Limiting Circuit for Intrinsically Safe Applications and is seeking licensees of the technology. NASA has the authority to grant licenses on its domestic and foreign patents and patent applications pursuant to 35 U.S.C. 207-209. NASA has implemented this authority by means of the NASA Patent Licensing Regulations, 37 CFR §404.

All NASA licenses are individually negotiated with the prospective licensee, and each license contains terms concerning commercialization (practical application), license duration, royalties, and periodic reporting. NASA patent licenses may be exclusive, partially exclusive, or nonexclusive.

If your company is interested in the Integral Battery Power Limiting Circuit for Intrinsically Safe Applications (KSC-12703-1), or if you would like more information on licensing NASA Kennedy Space Center technologies, please contact:

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