



Application Note

# Electric Vehicle Motor Control Unit Test

Electrically Powered Vehicles pose unique challenges to test systems: in particular, MCU's utilize high power and sometimes high voltages. This application note explores how Intepro Systems programmable power products makes testing and characterizing MCU's easy while reducing emissions and footprint.

Figure 1 is an example of a typical MCU. Typical EV batteries operate at a nominal 360 Vdc with a high line of 403 Vdc. Battery power is then provided to the power source which is controlled by the MCU. The MCU provides a PWM signal to the power source which amplifies the signal to the motor (or load).

The challenge in testing an MCU is creating repeatable test results using actual batteries and motor. Batteries require charging, discharging, take-up valuable lab space and at 360V and up to 90kW are lethally dangerous to use, and potentially lethal.

Likewise, using an actual motor requires the motor to be loaded by a 'dyno' to simulate real world driving conditions. This entire set up is cumbersome and makes it difficult to create repeatable test results. This application note describes how to use a programmable DC source to simulate batteries and DC loads to simulate the motor.

This application note describes how to use a programmable DC supply to simulate batteries, and DC loads to simulate the motor.

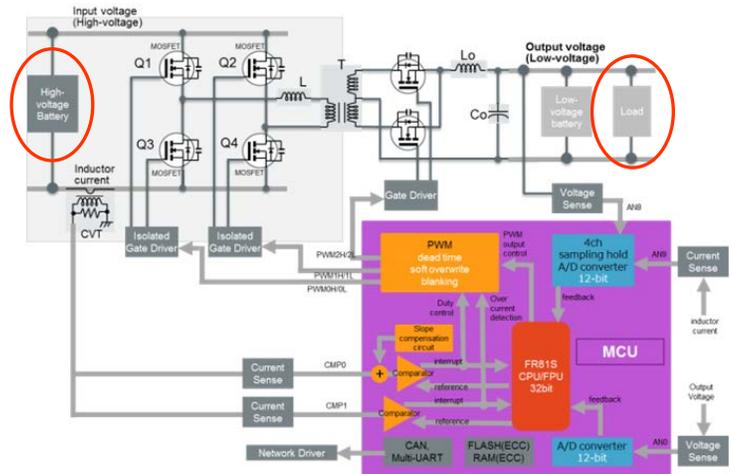


Figure 1: Typical MCU Layout

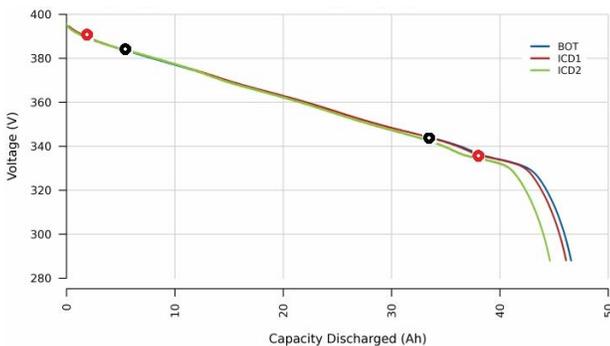


Figure 2: Discharge Example

Intepro's PSI 9000 Series of [Auto-Ranging Programmable DC](#) supplies are DSP-controlled and MOSFET-driven that provides up to 1,500Vdc and 120kW of power. The PSI Series features low output capacitance (<100  $\mu$ F) which means the supply creates fast voltage variations (<15 msec) required to accurately simulate batteries. With its embedded Arbitrary Waveform Generator and Programmable Impedance, the source allows users to create voltage anomalies that is representative of the motor pulling full power which creates voltage drop to the MCU. The supply is also capable of creating long term battery discharge. curves represented by figure 2.



The DSP controlled power supply provides 1msec programming resolution, so users can accurately create complex and repeatable DC voltage waveforms which is used for testing dynamic behavior, motor startup cycling, and thermal testing.

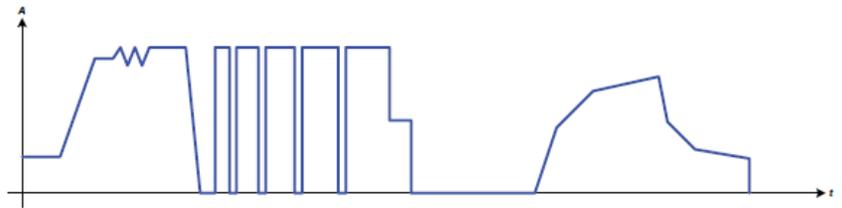


Figure 3: Waveform Generation

Next, one can simulate the EV's motor using an Intepro [ELR 9000 Series](#) of Programmable, Regenerative DC Loads. Much like the PSI 9000, the ELR 9000 offers the same MOSFET and DSP controlled load stage, up to 1,500 Vdc, 120 kW of power and Arb. Waveform Generator. The ELR loads PWM signals from 0Hz up to 25kHz. For signals >25 kHz, Intepro's [EL 9000 B](#) linear load is capable of loading signals up to 250kHz. The programmable loads tests for overload characterization, and response to dynamic changes to load conditions.

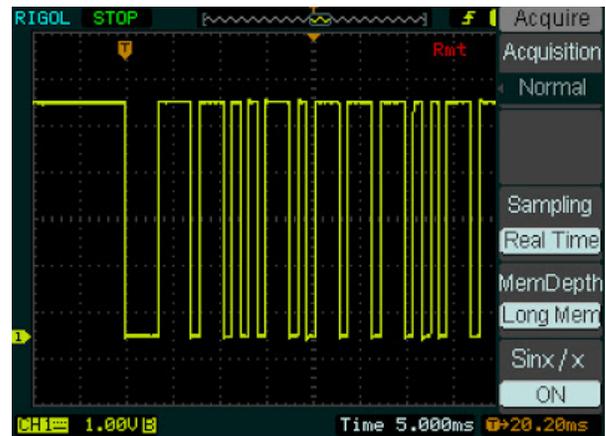


Figure 4: Example PWM Signal

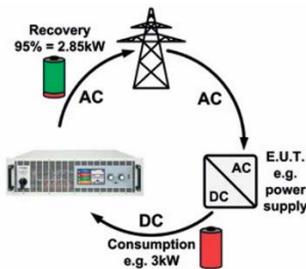


Figure 5: Regenerating Energy

One added benefit, is that the ELR 9000 regenerates loaded energy to the grid, reducing heat generated by typical air-cooled loads and packing up to 10.5kW into a 3U, 19" rack mount chassis.

Figure 6 illustrates a typical set up using both the PSI 9000 and ELR 9000.

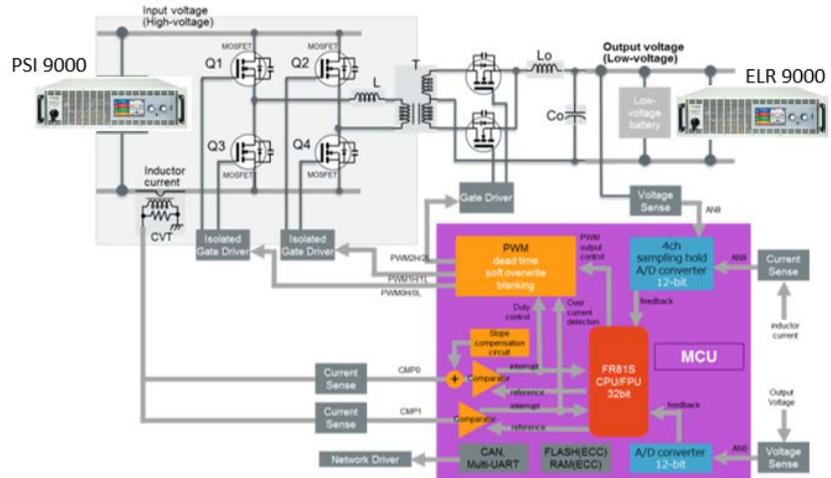


Figure 6: Test Setup, Simplified



Using programmable DC power products, such as the PSI and ELR 9000, simplifies test set up and easily creates repeatable test conditions---while adding safety into your test routine.

Interested in Automating your test?

Intepro offers turn-key power test system design and integration services across a broad range of industries. We develop quality test systems to fit your requirements. Our systems are an open architecture for hardware and software that permits complete flexibility to configure and integrate off the shelf instrumentation with a wide range of Intepro and customer hardware.

**For more information and to request a quotation, please contact Intepro Systems!**

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