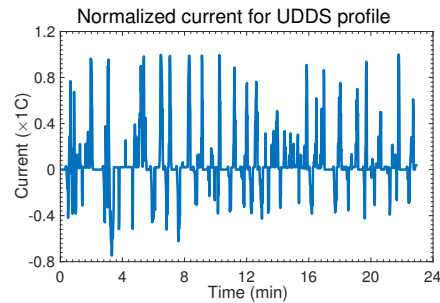




Purpose of test

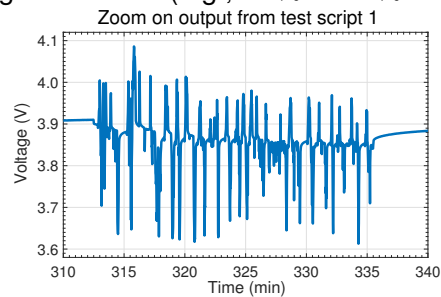
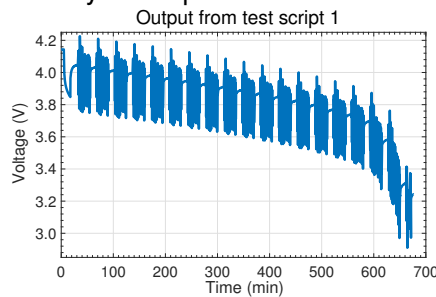
- Data must be collected to tune ESC dynamic parameters
- Data are captured while exercising cell with demand that is representative of final application
- Figure shows sample current profile for automotive application, the “urban dynamometer driving schedule” (UDDS)
- This current profile is repeated over the entire SOC and temperature range of the cell
- Voltage, current, temperature, accumulated ampere-hours discharged and charged are recorded regularly (e.g., once per second)



Dynamic “discharge” portion of test

Dynamic test script #1 (at test temperature)

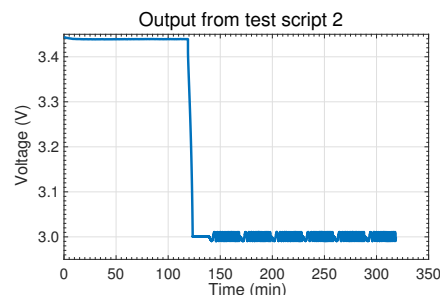
1. Soak fully charged cell at test temperature for at least two hours to ensure uniform temperature throughout
2. Discharge cell at constant-current at a C/1 rate for 6 min (avoid over-voltage later)
3. Execute dynamic profiles over SOC range of interest (e.g., 90 % to 10 % SOC)



Discharge calibration portion of test

Dynamic test script #2 (at 25 °C)

4. Soak cell at 25 °C for at least two hours to ensure uniform temperature throughout
- 5a. Bring cell terminal voltage to v_{\min} by discharging at C/30 rate
- 5b. Follow-on dither profile(s) can be used to eliminate hysteresis to the greatest degree possible

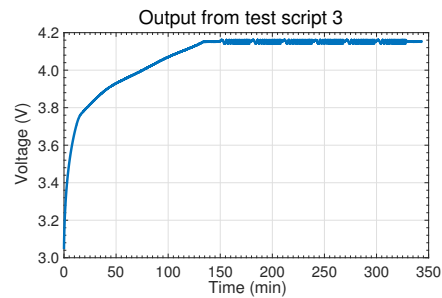




Charge calibration portion of test

Dynamic test script #3 (at 25 °C)

- 6a. Charge cell using a constant-current C/1 rate (or as specified by manufacturer) until voltage equals v_{\max} ; then, maintain voltage constant at v_{\max} until current drops below C/30
- 6b. Follow-on dither profile(s) can be used to eliminate hysteresis to the greatest degree possible



Summary

- Cell must be exercised with demand profile representative of final application to gather data for tuning parameter values of ESC model that describe dynamic effects
- Test script #1 repeats profile over final application's entire SOC range to collect data to train model so model will be able to describe all expected operating conditions
- Test scripts #2 and #3 calibrate the 0 % SOC and 100 % SOC points, for fine-tuning the cell's total capacity and coulombic efficiency applicable to *this test*
- Suite of test scripts executed for a grid of temperatures spread over final application's entire temperature range