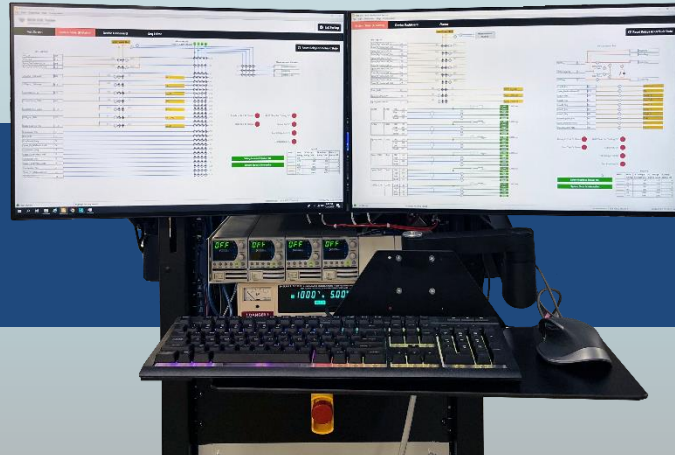


# The DMC Battery Production Test (BPT) System

The fully automated, high performance, and forward-looking system for production (EOL) and warranty/remanufacturing test of your battery packs and modules.



Tell us about your test needs and see why today's battery test leaders are choosing DMC



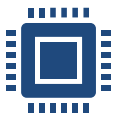
The DMC Battery Production Test (BPT) System meets the dynamic needs of a startup battery producer while readily scaling to very high-volume production. DMC's modular, fully automated, feature-rich, and platform-based solution enhances quality today via rigorous production test regimens and anticipates tomorrow's emerging requirements to keep your testing processes simple.

## Assembly / Electrical Verification Tests



- Pack Connection Verification
- Ground Bond Test
- Hipot - Insulation Test
- Contactor Control Verification
- High Voltage Interlock Verification
- AC Internal Resistance (ACIR) Test
- Terminal Continuity / Resistance / Capacitance / Protection Verifications

## BMS Verification Tests



- BMS Wake / Sleep Current Verification
- CAN Bus Verification
- Cell and Pack Voltages Reporting / Accuracy Verification
- Pack Current / SOC Verification
- Cell / Pack Temperatures Verification
- Diagnostic Trouble Code Check / Clear
- Cell Balancing Verification
- BMS Firmware Flashing / Calibration
- BMS SW Version Verification

## Power Capability Tests



- DC Internal Resistance (DCIR)
- Pre-Charge Contactor Functional Verification
- Peak Power Test
- Auxiliary / DCDC Power Output Verification
- Outgoing SoC Pre-Shipment Test

## Test Applications

- Production End of Line (EOL)
- Remanufacturing / Warranty Service
- Field or Lab Diagnostics

## Notable Features

- Flexible, modular, configurable HW Schema
- Sleek, Intuitive User Interfaces
- Powerful Test Executive Framework (built upon NI TestStand)
- Integrates with your MES / SCADA system
- Test Points and Fault Codes
- Customizable test workflows
- Continuous DAQ for Traceability and Visualization
- Complete RX/TX CAN Port Trace Logs
- Device Plugin Framework supports numerous Cyclor Models (NHR, EA, etc.)
- Self-Test ensures test stand integrity
- Data Analytics via [NI SystemLink](#)
- IT-synced User Permissions Management
- Soft-front panel HMIs for manual device control and diagnostics

# A Trusted Solution

Designed by DMC's Battery Test experts and leveraging over a decade's worth of battery test experience, the BPT is a highly capable pack and module testing solution designed to enhance test coverage and to scale with your organization. All stakeholders have been considered, from the operator using the intuitive software interface, to the test engineer developing a test script for multiple product variants, to the product engineer reviewing the data to determine root cause analysis.

## Solution Highlights

### User-Centric Station Operation

- Simple and intuitive operator workflows ensure consistent and streamlined daily production operation with minimal required interaction with the software
- Role-based access controls for screen and feature access

### Physical Station Configurations

- Available in one station rack module or decomposed into multiple station modules for optimized cycle times and throughput

### Software Configuration

- Highly flexible and powerful test scripting/sequencing tools allow test engineers to design and adapt test procedures for evolving product requirements.
- High-level, battery test-specific sequence steps for easy test configuration
- Powerful hardware abstraction layer allows hardware interoperability
- Remotely edit sequences, DUT model parameters, and other configuration files
- Deploy and synchronize entire configuration sets (workspaces) to one or more stations through a centralized configuration management system

### Reliability & Maintenance

- Advanced, integrated self-diagnostics save time for technicians and engineers by "testing the tester" to ensure integrity of all test runs and to triangulate any system maintenance needs.
- Swappable HW submodule design allows for an effective sparing strategy and calibration scheduling to maximize uptime

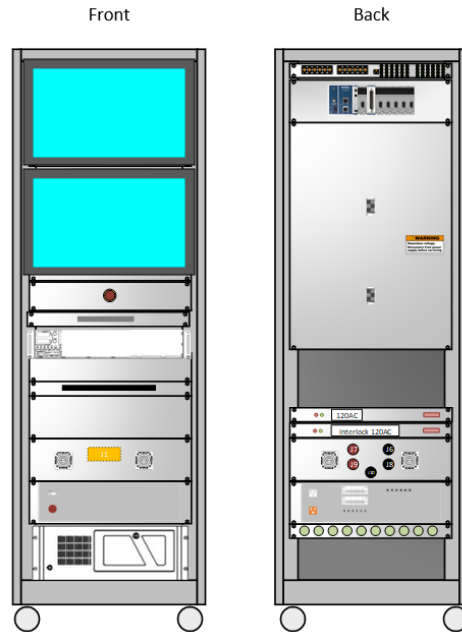
### Test Data Insights

- Live data visualizations allow immediate insights and diagnostic assistance
- Trace test results to continuously acquired waveform data for easy troubleshooting and improved test comprehension
- Detailed, lossless data logs and CAN bus logs provide necessary data records to diagnose pack issues
- **NI SystemLink** Integration: With centralized test data analytics designed as a priority rather than afterthought, test engineers can extract valuable manufacturing process and product insights from test results aggregated from facilities around the world, all from the comfort of their own desks



# System Architecture

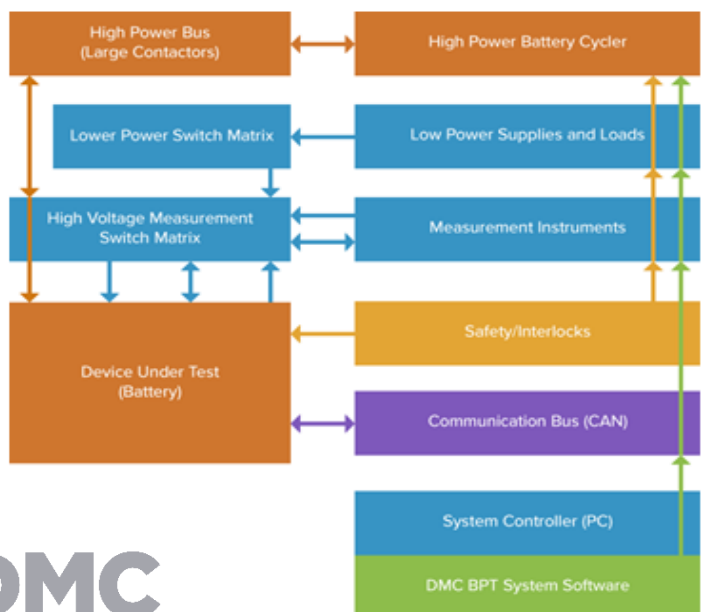
DMC's BPT Platform takes a **compositional approach to battery testing**, assembling collections of interconnectable hardware "building blocks" (including both off-the-shelf devices and DMC purpose-built modules) to create modular and scalable test stations.



DMC has designed several common BPT models for standard battery test scenarios. For unique applications, DMC can tailor a configuration anywhere on the capability spectrum to match your specific needs.

DMC's single rack platform comprehensively addresses all battery production test and warranty/remanufacturing test needs, while the same hardware modules can be distributed among numerous test stations with specific test focuses to enhance production volume and tact time. Both scenarios leverage DMC's powerful BPT Application Framework that provides a unified testing experience and centralized configuration and data management

**The DMC BPT Platform allows you to test your battery pack or module today and be ready for the changes of tomorrow.** With reliable battery test hardware based on a variety of standard rack-mount instruments and **NI's powerful PXI and cDAQ platforms**, you can readily expand your system for the evolving battery test needs of the future.

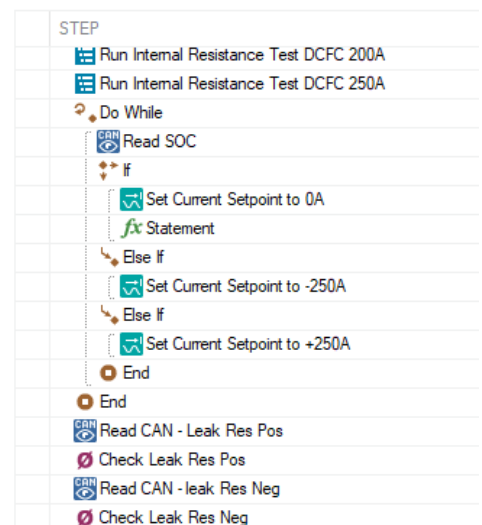




The BPT platform is designed for easy integration with a variety of off-the-shelf instrumentation and power electronics (e.g., DMMs, Power Supplies/Loads, Hipot Meters, Battery Cyclers, etc.). **DMC's BPT Platform includes support for common battery cycler manufacturers and models**, including NHR, Electro-Automatik, and many more.

Whether internal or external to your BPT test station, your battery cycler will be plug-and-play and swappable, thanks to the BPT's flexible hardware abstraction layer and configurable software plugins. DMC can even improve your cycler utilization with our BPT platform's high-power multiplexing and distribution modules to share a single cycler among numerous test stations and amplify the value of your cycler assets.

DMC's BPT Platform allows simple and repeatable end of line test operation, dynamically selected test recipes for the particular battery model coming down the line. **Multiple types of packs can be serviced by the same suite of end of line BPT testers and parameterized test sequences.**



## System Capabilities

The BPT offers both standard elements and optional upgrade modules to configure the system to desired signal types, signal counts, and required test capabilities.

Don't see what you need? **Every element of the BPT can be fully customized and extended by DMC's battery test experts to meet your specialized requirements.**

### Standard Configuration

BPT Module	Signal/Line Ratings	Signal Count	Use Case
<b>Medium Voltage Measurement Module</b>	300 VDC 2 A	18* Lines	Primary instrumentation measurements and routing
<b>Low Power Module</b>	300 VDC 5 A	12* Lines	Low power device (source/load) integration
<b>Dry Contact Module</b>	300 VDC 5 A	8* Pairs	Dry Contact relays for source/return loopback (e.g., HVIL)
<b>CAN Module</b>	Low-speed/fault tolerant, High-speed/FD	6* Ports	DUT / BMS CAN Integration: Broadcast CAN per DBC, UDS, J1939, XCP/CCP, etc. DUT Flashing/Programming
<b>Analog / Digital IO Module</b>	60 VDC 5 A	24* Lines	Analog Inputs / Outputs, Digital Inputs / Outputs for PWM
<b>High Voltage Measurement Module</b>	1000 VDC 5 A	20* Lines	High voltage instrumentation measurements and routing
<b>Medium Power Module</b>	300 VDC 30 A	20* Lines	Medium Power device (source/load) integration
<b>Hipot Test Module</b>	1 kV to 5 kV DC/AC 50 VA continuous	12* Lines	High Voltage Insulation and Withstand testing

*\*System signal counts can be expanded to meet your test system requirements*

### Upgrade Options

- Ground Bond Test Module (Weld Integrity Test, Etc.)
- Current Shunt Monitor Module (Continuous Power Measurement)
- ACIR Test Module
- LCR Meter, Source Measure Unit (SMU), Programmable Resistive Load, Etc.
- **\*Hardware to Achieve Your Custom Test Requirements\***



# BPT System Software

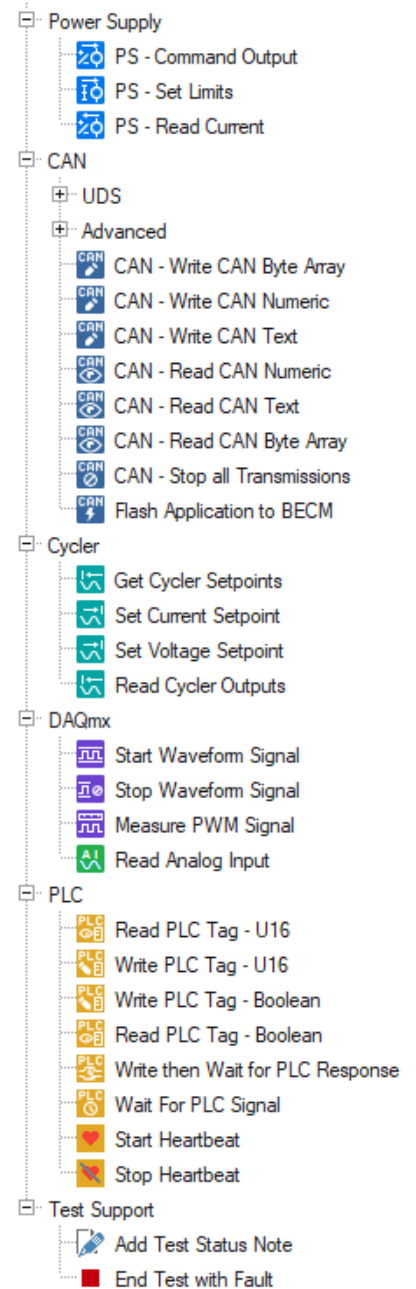
The BPT software strikes a **perfect balance of ease of use by operators with the flexibility and capability test engineers need to scale** their operations. The test executive backbone of the BPT software is developed on top of NI TestStand.

The platform abstracts the detailed intricacies of test into simple sequence step “building blocks” that Test Engineers can intuitively use without extensive programming knowledge.

One primary benefit of the BPT software is that in addition to all the powerful functionality NI TestStand provides out of the box, it comes with a **suite of sequence steps that provide easy access to common operations required for battery testing**. Examples include turning on power supplies for powering the pack, reading or writing CAN signals or DIDs, settings or reading feedback from a cycler, and handshaking with a line PLC. Using these built-in step types specific to production battery testing, Test Engineers are just a few clicks away from quickly developing new test recipes.

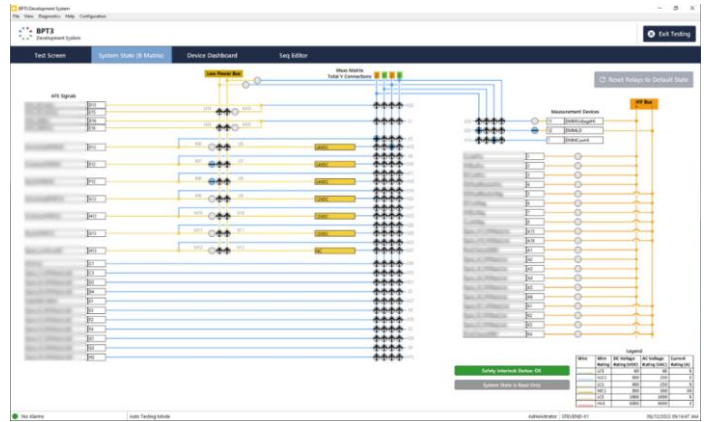
The BPT’s plugin framework combined with a Hardware Abstraction Layer allows for easy addition of new hardware or models of battery cyclers, power supplies, DMMs, and other instrumentation as your production scales and test requirements change, **without needing to modify your test sequences**.

Reduce your time spent managing multiples copies of test sequences by writing your test script once. Use the abstraction layer to execute the same test script on different BPT test stations that connect to different types of battery cyclers. Parameterize your test sequence to run the same test on two different batteries that have different cell configurations, test limits, or other parameters.





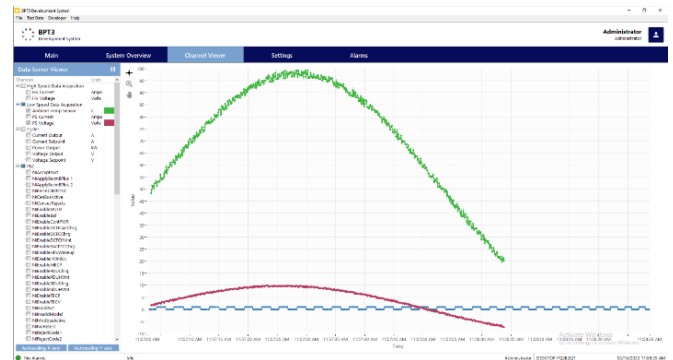
Test with peace of mind by **verifying test system integrity using the equipment's Self-Diagnostics tool**. This powerful and differentiating feature of the DMC BPT can quickly identify equipment failures and provide insights to act and reduce downtime. Technicians and test engineers have access to an advanced user interface that visually represents the electrical connection paths in the hardware, allowing for better system comprehension and faster issue diagnostics.



The screenshot shows the 'Test Execution Console' with a 'Test Status' section indicating 'Running'. Below this, there is a list of test items with their respective status (Pass/Fail) and details. For example, 'CAN Communication Test' is 'Pass', 'CAN Voltage Level Test' is 'Pass', and 'CAN Speed Level Test' is 'Pass'. The interface also includes buttons for 'Resume', 'Pause', and 'End Test'.

Live visualizations through the BPT software provide operators with high level feedback on the test execution status and control options to pause, abort, and debug the test. For more detailed overview of the test status, DMC can add custom operator views or even allow your engineering team to develop and plugin custom screens that render visuals of test data.

Live parameter plotting is also a built-in feature, with configurable channel selections and loss-less data buffers. View data in a single overlaid chart or in a channel-by-channel stacked chart. Everything seen in the viewer is also recorded to lossless TDMS log files that are automatically pushed up to a specified network location or SystemLink server for easy remote access.



The screenshot shows the 'Workspace Editor' with a list of workspace files. Each file has a status indicator (Approved/Not Approved) and a 'Rescind Approval' button. The files listed include 'CAN Configuration', 'DUT Model Parameters', and 'Sequence File'. The interface also includes buttons for 'Approve' and 'Rescind Approval'.

Ensure proper testing and traceability with BPT's workspace configuration management that provides a documented link between the input configuration files that go into test and the output data. Checksums of files are recorded with test results for traceability. All

deployed test systems can get networked to leverage the same set of centrally maintained test specification and DUT model parameters. Systems can also integrate with NI SystemLink to easily centralize, manage, and view all your test assets and data remotely.



# About DMC

## Company Overview

DMC is a well-known and established controls engineering & consulting firm focused on automation, engineering, product development, and business consulting. We develop and implement solutions for a wide range of industries using a variety of technologies. DMC has successfully delivered solutions for hundreds of companies including 3M, Abbott Laboratories, Argonne National Labs, Bosch, BRP, Caterpillar, Chrysler, Fermilab, Ford, John Deere, UL, Wrigley, and Yaskawa. Every solution we develop is based upon a solid understanding of engineering principles with the primary objective of helping our client increase profitability and productivity with world-class solutions.

DMC is a certified member of the Control Systems Integrators Association (CSIA). DMC passed a rigorous third party audit of 200 criteria that span all aspects of business performance in the areas of:

General Management	Project Management
Human Resources Management	System Development Lifecycle
Marketing & Business Development	Quality Assurance Management
Financial Management	



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