The FTF-HP is by far the highest power test system in the market today. Scalable to provide a maximum output power of 4MW, the FTF-HP automated test system is designed to provide continuous operation in high power applications where precise control of current and voltage is required.

**Applications**

- Battery Testing, including all advanced chemistries
- Inverter, UPS, Generator, and Flywheel Testing
- Fuel Cell discharge testing
- Drive Cycle Simulation Testing: FUDS, SFUDS, GSFUDS, DST and ECE-15L
- Cycle Testing of EV / HEV / PHEV Battery Packs
- Bi-directional DC Power Supply
- Microgrid Battery Conditioning: Increase lifespan, efficiency and performance battery banks
- Vehicle Drivetrain testing
- Super Capacitor and Ultra-capacitor testing

**Key Features**

- IGBT Design for efficiency and high performance operation
- Design for 100% duty cycle at max power
- Over-current, under-current, over-voltage and under-voltage protection standard on all models
- No performance loss under voltage control
- Quick disconnects on output leads
- Test control and data management with Bitrode’s VisualCN™ Lab Client Software
- Constant Current (CC), Constant Voltage (CV), and Constant Power (CP) control
- Program execution is independent from the PC with VisualCN™ software
- CE compliant
- Discharge power recycled to AC line for cooler, energy-efficient operation
- Built-in isolation transformer, AC input filter, and DC output filter
- 3rd party software control through Remote Binary Protocol (RBP) via Ethernet connection. RBP sold separately.
- Safety features include circuit shutdown when the cabinet door is open
- Dual output (FTF2) in one cabinet with independent control circuit
- FTF systems configured at time of quote so you get the exact desired system and options
FTF-HP
High Power Energy Storage Test System
Scalable to 4MW

General Specifications

<table>
<thead>
<tr>
<th>Number of circuits</th>
<th>1</th>
<th>2</th>
<th>Max 4 circuits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage configurations:</td>
<td>33-500 / 40-700 / 50-1000V (Zero volt optional)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max Current: (configurable)</td>
<td>1000A</td>
<td></td>
<td>Up to 4000A</td>
</tr>
<tr>
<td>Max Power: (per cabinet)**</td>
<td>300KW to 1MW (700V max)</td>
<td>4MW</td>
<td></td>
</tr>
<tr>
<td></td>
<td>300KW to 700KW (1000V max)</td>
<td>2.8MW</td>
<td></td>
</tr>
<tr>
<td>Accuracy:</td>
<td>0.1% of FS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peak Efficiency:</td>
<td>&gt;92%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>THD</td>
<td>≤5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power Factor</td>
<td>0.98</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current Rise Time: (10-90%)</td>
<td>≤ 4ms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pulse Width</td>
<td>10ms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Switching Time (Chg/Dchg, Dchg/Chg)</td>
<td>Zero</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overshoot</td>
<td>Zero</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data Acquisition Rate:</td>
<td>10ms (1ms optional)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interface</td>
<td>Ethernet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Noise Output Level (at 12ft distance)</td>
<td>Under 70dB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operation Temperature</td>
<td>0° to 40°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input Voltages</td>
<td>380/400/415/480V ±10% (50/60 Hz)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dimensions (approx.)</td>
<td>75&quot;W x 50&quot;D x 78&quot;H</td>
<td>108&quot;W x 50&quot;D x 78&quot;H</td>
<td>TBD</td>
</tr>
</tbody>
</table>

* All specifications are subject to change without notice.
** Maximum cabinet power output is not available for all current/voltage combinations. Contact Bitrode for more details.

System Options

- Up to three current ranges per circuit
- Optional inputs (i.e. temperature, voltage and digital inputs/outputs) assignable to any channel
- Digital I/O with functions assigned per individual test program
- Expression-based program limit conditions
- DC Internal Resistance calculation
- Integration with Battery Management Systems: CAN
- Battery Simulation (BattSim) mode for electric motor/generator testing with user-specified controls: voltage, internal resistance, maximum power. Optional protection module available offers an added layer of protection to the FTF in case the inverter, motor controller, or other DUT connected to the FTF fails, loses control, or discharges an amount of energy outside the capabilities of the FTF. The energy is absorbed until the FTF can shut down in a safe controlled manner.
- Parallel BattSim mode for higher current requirements for specific configurations.
- Ramp charge/discharge
- Insulation Monitoring Device
- Constant Resistance Discharge
- Remote Input Output (RIO) box reduces excessive cable lengths when connecting to remote test station.
- Over 300 additional sensor connections available when adding external RIO box
- External Parallel Controller (PCC) can control up to four circuits for higher power and/or higher current test requirements
- Drive Cycle Conversion utility automates test program development from acquired battery usage data
- Zero Volt option allowing discharge capabilities down to zero volts
- Power PC option that allows 1ms data acquisition and expanded number of programming Steps
- Custom Hardware and Software engineering services
- Environmental chamber control
- Ramp up/down of voltage in BattSim Mode

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The FTF is scalable to provide a maximum output power of 1.2MW. The FTF automated test system is designed to provide continuous operation in high power applications where precise control of current and voltage is required.

**Applications**

- Battery Testing, including all advanced chemistries
- Inverter, UPS, Generator, and Flywheel Testing
- Fuel Cell discharge testing
- Drive Cycle Simulation Testing: FUDS, SFUDS, GSFUDS, DST and ECE-15L
- Cycle Testing of EV / HEV / PHEV Battery Packs
- Bi-directional DC Power Supply
- Microgrid Battery Conditioning: Increase lifespan, efficiency and performance battery banks
  - Vehicle Drivetrain testing
  - Super Capacitor and Ultra-capacitor testing

**Key Features**

- IGBT Design for efficiency and high performance operation
- Design for 100% duty cycle at max power
- Over-current, under-current, over-voltage and under-voltage protection standard on all models
- No performance loss under voltage control
- Quick disconnects on output leads
- Test control and data management with Bitrode’s VisuaLCN™ Lab Client Software
- Constant Current (CC), Constant Voltage (CV), and Constant Power (CP) control
- Program execution is independent from the PC with VisuaLCN™ software
- CE compliant
- Discharge power recycled to AC line for cooler, energy-efficient operation
- Built-in isolation transformer, AC input filter, and DC output filter
- 3rd party software control through Remote Binary Protocol (RBP) via Ethernet connection. RBP sold separately.
- Safety features include circuit shutdown when the cabinet door is open
- Dual output (FTF2) in one cabinet with independent control circuit
- FTF systems configured at time of quote so you get the exact desired system and options
General Specifications

<table>
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<tr>
<th>Number of circuits</th>
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<tr>
<td>Voltage configurations:</td>
<td>33-500 / 40-700 / 50-1000V (Zer volt optional)</td>
<td>1000A</td>
<td>Up to 4000A</td>
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<tr>
<td>Max Current: (configurable)</td>
<td>1000A</td>
<td>1000A</td>
<td>1000A</td>
</tr>
<tr>
<td>Max Power: (per cabinet)**</td>
<td>Up to 300KW</td>
<td>1.2MW</td>
<td>1.2MW</td>
</tr>
<tr>
<td>Accuracy:</td>
<td>0.1% of FS</td>
<td>&gt;92%</td>
<td>&gt;92%</td>
</tr>
<tr>
<td>Peak Efficiency:</td>
<td>≤5%</td>
<td>≤5%</td>
<td>≤5%</td>
</tr>
<tr>
<td>THD</td>
<td>0.98</td>
<td>0.98</td>
<td>0.98</td>
</tr>
<tr>
<td>Power Factor</td>
<td>≤4ms</td>
<td>≤4ms</td>
<td>≤4ms</td>
</tr>
<tr>
<td>Current Rise Time: (10-90%)</td>
<td>10ms</td>
<td>10ms</td>
<td>10ms</td>
</tr>
<tr>
<td>Pulse Width</td>
<td>Zero</td>
<td>Zero</td>
<td>Zero</td>
</tr>
<tr>
<td>Switching Time (Chg/ Dchg, Dchg/Chg)</td>
<td>Zero</td>
<td>Zero</td>
<td>Zero</td>
</tr>
<tr>
<td>Overshoot</td>
<td>Zero</td>
<td>Zero</td>
<td>Zero</td>
</tr>
<tr>
<td>Data Acquisition Rate:</td>
<td>10ms (1ms optional)</td>
<td>10ms (1ms optional)</td>
<td>10ms (1ms optional)</td>
</tr>
<tr>
<td>Interface</td>
<td>Ethernet</td>
<td>Ethernet</td>
<td>Ethernet</td>
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<td>Noise Output Level (at 12ft distance)</td>
<td>Under 70dB</td>
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<td>Operation Temperature</td>
<td>0° to 40°C</td>
<td>0° to 40°C</td>
<td>0° to 40°C</td>
</tr>
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<td>Input Voltages</td>
<td>380/400/415/480V ±10% (50/60 Hz)</td>
<td>380/400/415/480V ±10% (50/60 Hz)</td>
<td>380/400/415/480V ±10% (50/60 Hz)</td>
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<td>Dimensions (approx.)</td>
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<td>75&quot;W x 50&quot;D x 78&quot;H</td>
<td>TBD</td>
</tr>
</tbody>
</table>

* All specifications are subject to change without notice.
** Maximum cabinet power output is not available for all current/voltage combinations.

System Options

- Up to three current ranges per circuit
- Optional inputs (i.e. temperature, voltage and digital inputs/outputs) assignable to any channel
- Digital I/O with functions assigned per individual test program
- Expression-based program limit conditions
- DC Internal Resistance calculation
- Integration with Battery Management Systems: CAN
- Battery Simulation (BattSim) mode for electric motor/generator testing with user-specified controls: voltage, internal resistance, maximum power. Optional protection module available offers an added layer of protection to the FTF in case the inverter, motor controller, or other DUT connected to the FTF fails, loses control, or discharges an amount of energy outside the capabilities of the FTF. The energy is absorbed until the FTF can shut down in a safe controlled manner.
- Parallel BattSim mode for higher current requirements for specific configurations.
- Ramp charge/discharge
- Insulation Monitoring Device
- Constant Resistance Discharge
- Remote Input Output (RIO) box reduces excessive cable lengths when connecting to remote test station.
- Over 300 additional sensor connections available when adding external RIO box
- External Parallel Controller (PCC) can control up to four circuits for higher power and/or higher current test requirements
- Drive Cycle Conversion utility automates test program development from acquired battery usage data
- Zero Volt option allowing discharge capabilities down to zero volts
- Power PC option that allows 1ms data acquisition and expanded number of programming Steps
- Custom Hardware and Software engineering services
- Environmental chamber control
- Ramp up/down of voltage in BattSim Mode

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Bitrode’s model FTV is a life cycle test system designed to perform standard electric vehicle, standby battery and supercapacitor tests. Designed for fast switching capability and high speed data acquisitions, the FTV is the ideal solution for demanding electric vehicle drive simulations.

Additional features include:

• Constant current, power or voltage control
• Discharge power recycled to AC line for cooler, more energy-efficient operation
• Bipolar capacity for discharging to below zero volts
• Drive Cycle Conversion utility automates test program development from acquired battery usage data
• Assignable data channels
• Drive Cycle Conversion utility automates test program development from acquired battery usage data
• Parallel circuit operation for greater flexibility in test specification
• Program execution is independent from the PC with VisualCN software
• Remote Binary Protocol via Ethernet connection available for 3rd party software control

Voltage: 0-100V *
Current: Up to 1000A (2000A in parallel) up to 4000A with external PCC
Power: up to 72kW (200kW in parallel) up to 288kW with external PCC
Accuracy: ±0.1% of FS**
Circuits: up to 4
Data Sampling Rate: up to 10mS

* Higher voltages available upon request. Contact your representative.
**Accuracy values are conservative assuming operation will be through the standard temperature range of 0-40˚ C and RH from 10-90% (non-condensing). Units calibrated and maintained in a temperature and humidity controlled environment can expect an accuracy of 0.02-0.05%FS.
EV/HEV Battery Module Test System

System Options

- Up to three current ranges per circuit
- Temperature, pressure, flow rate, and cell voltage monitoring
- Digital inputs and Digital outputs with function assigned per individual program
- Expression-based program limit conditions
  - Internal resistance calculation
  - Integration with Battery Management Systems: CAN
  - Ramp charge/discharge
  - Constant resistance discharge
  - Remote Input Output (RIO) box reduces excessive cable lengths when connecting to remote test stations
  - Parallel controller (PCC) can control up to four circuits from separate units for higher power or higher current programs
- Module-front LCD display
- Custom-designed test leads
- Drive Cycle Conversion utility automates test program development from acquired battery usage data
The Bitrode MCV product is a full-featured life cycle test system for development of automotive, industrial and consumer batteries.

**Applications**

- Standard Electric Vehicle Tests:
  - Federal Urban Driving Schedule (FUDS and SFUDS)
  - Dynamic Stress Tests (DST)
  - ECE-15L
- Life Cycle Testing: Perform charge/discharge cycling of cells or batteries to obtain charge and discharge capacity, energy and DC internal resistance
- Automotive Battery testing

**Key Features**

- Parallel circuit operation for greater flexibility in test specification
- Constant current, power or voltage control
- Bipolar capacity for discharging to below zero volts (optional)
- Optional inputs can be assigned to any test channel
- Program execution is independent from the PC with VisuaLCN software
- Remote Binary Protocol via Ethernet connection available for 3rd party software control
- Program headers available in software for global control
- Each circuit is operated by the Bitrode’s Windows-based VisuaLCN software program via the VisuaLCN Lab Client software
- VisuaLCN product platform allows users to:
  - create custom test profiles
  - monitor test progress of each test circuit
  - analyze the collected data in the Access database, which can be exported to Excel via a .csv file within Quick Data view
General Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duty Cycle</td>
<td>100%</td>
</tr>
<tr>
<td>Accuracy</td>
<td>± 0.1% Full Scale</td>
</tr>
<tr>
<td>Data Acquisition Rate</td>
<td>100ms max*</td>
</tr>
<tr>
<td>Rise Time (10-90%)</td>
<td>50ms*</td>
</tr>
<tr>
<td>Input Power Supply</td>
<td>3-phase, 50/60 Hz</td>
</tr>
<tr>
<td>Ambient Temperature</td>
<td>0 - 40°C</td>
</tr>
<tr>
<td>Control Software</td>
<td>VisuaLCN Lab Client</td>
</tr>
<tr>
<td>Interface</td>
<td>Ethernet</td>
</tr>
</tbody>
</table>

Technical Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Ranges (A)</td>
<td>0 to 300 (2700A in parallel) –up to three ranges per circuit optional*</td>
</tr>
<tr>
<td>Current Resolution (A)</td>
<td>0.001 to 0.1A (Based on maximum current value)</td>
</tr>
<tr>
<td>Voltage Ranges (V)</td>
<td>0 to 18</td>
</tr>
<tr>
<td>Voltage Resolution (V)</td>
<td>0.001 to 0.01V (Based on maximum voltage value)</td>
</tr>
<tr>
<td>Circuits</td>
<td>up to 96**</td>
</tr>
</tbody>
</table>

Software / Hardware Options

- Cell Voltage Monitoring
- Temperature Monitoring
- Digital Input/Output
- Pressure Monitoring
- Ramp Charge/Discharge
- Expressions-based program limit conditions
- Constant resistance discharge
- Internal resistance calculation
- Bipolar voltage capability
- Charge/Discharge AH/WH
- Real Time Clock
- Sub-step Sampling
- Remote Input Output (RIO) system
- CAN interface
- Open Protocol Interface via Ethernet connection available for 3rd party software control
- Environmental Chamber Interface
- EIS Meter Interface

*Note: Other ranges and specifications can be available on request.
** Depending on voltage and current configuration.
***All specifications are subject to change without notice.