

MACCOR

THE RIGHT CHOICE!

Maccor, Inc. has over 28 years of experience in supplying high-reliability, high-performance test equipment for energy storage devices (batteries, capacitors, fuel cells, etc.). We have a worldwide presence with equipment in more than 40 countries. Considered as the industry leader in automated test equipment, Maccor supplies more test channels than all competitors combined for this type of equipment.

Maccor's test systems are used for research & development, quality assurance, production, formation and grading, as well as many other applications requiring precise control and measurement of current and voltage.

Maccor's automated test systems are used daily to perform industry standard tests including: ANSI, IEC, IEEE, etc.

Maccor has supplied test systems to just about every industry imaginable including: Aerospace (Jet Propulsion Laboratory, NASA, United Space Alliance, Lockheed Martin Corporation, Boeing Satellite, Saft); Government Test Facilities (Lawrence Berkeley National Laboratory, Argonne National Laboratory, Idaho National Engineering and Environmental Laboratory, Sandia National Laboratories); Military (US Army, US Navy, US Air force); Manufacturers (RBC Technologies, Wilson Greatbatch, Motorola, Eagle Picher, Guidant Corporation, St. Jude Medical, Duracell, Energizer, Rayovac, Flextronics, Batteries Plus, Nokia, Varta, Valence, Exide, Ryobi); Universities (Oklahoma University, Tulsa University, MIT, Rutgers University, George Washington University, Florida A&M University, Toronto University, Michigan University, Cornell University, Ohio State University) and many, many more.

Each system is configured to meet the customer's specifications. Maccor, Inc. offers the widest range of capability and features of any manufacturer of this type of equipment. If our standard equipment does not meet your exact needs, the system can be customized to meet your specific requirements.

The Maccor **Series 4000 Automated Test System** is a computerized fully automated multiple channel test system, with each test channel operating independently of the other channels with a 16-bit voltage and current resolution. The Maccor Series 4000 ranges in size from 1 to 192 test channels. Also available are the **Model 4304** four-channel Desktop Automated Test System, the **Model 4300** eight-channel Desktop Automated Test System, and the **Model 4200** sixteen-channel Desktop Automated Test System. The **Model 4600** is a secondary cell testing system that offers high capabilities for single-cell testing at a very economical price. The Maccor **Model 3600 Primary Cell Test System** is a computerized fully automated multi-current range test system ranging in sizes from 32 cell positions to thousands of cell positions. The **Series 8500 EV HEV PHEV Automated Test System** is a computerized fully automated test system with B₂G technology in-which battery energy is recycled to the AC grid in discharge. The **Model 5302 Advanced Production System** is a fully automated turn-key formation system ranging in sizes from 512 cell positions to greater than 100,000 cell positions.



Maccor's standard test software presently operates under Windows® XP and Windows® 7 operating systems.

All programming and selecting of procedures, test initiating, data viewing, printing test results, and exporting of data are accessible from one location. With a minimum of keystrokes and / or mouse clicks, our MacTest32 software can perform a simple one step discharge test, or a complex procedure with repeated cycles, nested loops, pulse load profiles and multiple end conditions. A graphical display of data in real time can be viewed at any point during a test in process. Multiple tests can be performed at the same time, operating under different test programs.

The test program is entered through an on screen menu by filling in a sequence of blanks (steps) in the system computer. Each test program is comprised of a number of steps, which can be either charge, discharge or rest operating in either constant current, constant voltage, constant power, or constant resistance mode. There are over 20 different end conditions to choose from and each step can have up to 8 end conditions. The system will then branch to the appropriate step depending on the end condition that is met.

The unique design of the Maccor system enables us to offer the following features:

VOLTAGE ACCURACY	-	Typically 0.02% of full scale.
CURRENT ACCURACY	-	Typically 0.02% of full scale for multi-current range channels, 0.05% of full scale for single range channels.
SPEED	-	Time resolution is 10 milliseconds standard with 5 milliseconds or 1.2 millisecond optional.
PULSING	-	10 millisecond pulses on standard system with optional hardware capable of performing the following pulse profiles: GSM single-slot, GSM multi-slot, CDMA, IDEN, and Multi-current level (up to sixteen different levels in increments of 100 microsecond slots).
RIPPLE	-	No measurable ripple on battery power supply.
RANGE	-	Current ranges to meet your specifications, up to 2000A.
	-	Voltage ranges to meet your specifications, up to 900V.
FLEXIBILITY	-	Systems configured to customer requirements, with each test channel operating completely independently.
OPERATING	-	Constant current, constant voltage, constant power, constant resistance modes, pulse mode, or ramp voltage (cyclic voltammetry).
WAVEFORM	-	Allows the streaming of an external text test file (i.e. FUDS drive cycle test) to the test system.
END CONDITIONS	-	Multiple programmable end conditions for each step or test.
SOFTWARE	-	Maccor's Windows based test software provides extensive programming, display and processing capabilities, including real time graphics.



Features of our standard equipment include:

- Multiple, completely independent test channels
- Up to 196 channels in a single system
- Ability to combine (parallel) channels in groups of 2, 4, or 8 for increased current capability
- Automated data gathering if connected to a server PC over a LAN
- Completely unattended operation
- Queuing of test procedures so that when one procedure completes on a channel, another procedure automatically starts.
- On-line real time data display and graphics
- Unlimited number of data points per test, with operator selectable recording intervals
- Operation in a series of steps, where any step can be constant current, constant voltage, constant power, or constant resistance
- Termination of any step on functions of voltage, current, amp hours, watt hours, etc.
- Ability to repeat sets of steps until specified conditions are met
- Real-time display of all current test information, and ability to view and print new or old data and reports while tests are running
- Over-current protection, and protection against over voltage and under voltage
- Comprehensive protection against power failures
- Fixed 1kHz AC Impedance Measurement on most channels (contact Maccor for details)
- Multiple Current Range channels. With a multiple current range system you have the option to software select a current range of 150 μ A, 5mA, 150mA, and 5A. This will allow an operator the flexibility to use different current ranges in the same test on each of the multiple current range channels. Also, this channel allows you to control currents over a large dynamic range from 300 nanoAmps to 5 Amps. The software is auto-ranging, usable for example to automatically change ranges during a constant voltage step as the current tapers down to zero or a set end condition. This gives you the greatest current accuracy and resolution over the range of the test step. The voltages offered are +/-5 Volts or 0 Volts to +10 volts and will need to be specified. Additional voltage ranges are available upon request.

Maccor builds equipment with a wide range of current and voltage capacities. The smallest single current range standard channels are 100 microAmps full scale, and perform accurately down to a few microAmps. At the other end we build channels with current capacities over two thousand amps, voltages over 800 volts, and power dissipation of hundreds of kilowatts. It is common for us to configure systems with different kinds of channels (voltage and current ratings) in the same system.

The standard system comes with a pulsing feature. The standard minimum pulse width is 10ms. The pulse width is adjustable in increments of 10ms from 10 to 90ms. The standard minimum period [repeatability] is 20ms and is adjustable in increments of 10ms up to 655 seconds; this period must be at least 10ms greater than the high pulse. The optional telecom and high-speed pulsing features are available upon request.



Options for our standard equipment include:

- Temperature measurement, including ability to control or stop tests based on functions of temperature.
- Pressure measurement, including ability to control or stop tests based on functions of pressure.
- Ability to connect batteries under test to an external load or external charger supplied by you, while continuing data gathering, safety condition monitoring, and step control.
- Ability to discharge to zero volts.
- Ability to discharge to negative voltages.
- Additional voltage inputs, usable for example for monitoring individual cell voltages in a cell string or reference electrodes.
- Ability to switch out cells in a string, while continuing charge or discharge of the balance of the string.
- Ability to simulate GSM, CDMA, IDEN, and Multi-slot pulsing profiles.
- With the purchase of Maccor's compact bench top / rack mount temperature chamber, temperature dependent testing can easily be integrated with any Maccor Automated Test System operating under Windows® XP or Windows® 7 operating systems.
- The ability to communicate with specific environmental chambers such as ESPEC, Watlow, Thermotron, etc. that have an RS-232, RS-485, or IEEE-488 communications package. Please contact Maccor to determine if the Maccor system is capable of communicating with a chamber you may have purchased or are looking at purchasing.
- Custom configured Dual or Triple Current Range channels. As an example you could configure a channel with a 1 Amp range and a 500 Amp range which would allow you to control currents from 2 millAmps to 500 Amps on the same test channel.
- With the purchase of a Maccor FRA-0355 (frequency response analyzer), the system is capable of performing AC impedance sweep measurements with a frequency range of 1mHz to 30kHz and an impedance range of 100μΩ to approximately 200Ω.

Can We Help?

In summary, our standard product line has a wide range of features and capabilities, which are continuously being added to. For those applications where more specialized functions are required, we will customize. We continue to work with most of the leading manufacturers, developers, and users of batteries.

Please visit our web site or contact us if you have any questions or need any additional information.



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