



## -Technical Specifications 3 Maccor Bidirectional Battery Testers - Summary



Three different Maccor cyclers had been purchased (C111007) together with a Frequency response analyser FRA 0355. Subsequently, an upgrade of two of the cyclers which includes the addition of extra channels and of internal multiplexers was procured (C199308). The multifunction Series 4000 is a range of fully automated, computerized test systems that provide the highest level of specifications and features available in the industry. From the base system that provides the highest level of accuracy and time resolution, features can be added to allow the Series 4000 test system to perform virtually any type of test, with any type of products (i.e. battery materials, batteries, super-capacitors, etc.) and chemistries.

All the cyclers can be connected to Maccor's Frequency Response Analyzer (FRA 0355). The FRA with a built-in eight (8) position multiplexer add full AC impedance analysis to a test system allowing frequency scans without disturbing the device under test or its connections at any time during the test. The positions on the multiplexer are assignable to any test channel in the system. The FRA's frequency range is 1 mHz to 30 kHz, the impedance range is 100  $\mu\Omega$  to 200  $\Omega$  (with an accuracy of 0.1 % of reading or 0.00005 % of full scale, whichever is larger). The maximum current and maximum voltage are 3000 mA and 55 V, respectively.

### Electrical characteristics

The three cyclers will provide the following channels after upgrade (in total 96):

Cycle type	Channels	Voltage range (V)	Current range (A)	Multiplexer	Auxiliary IO
Maccor 4000 (with Maccor FRA)	32	-2 to 8	20	8 channel (external)	16 Voltage 32 Temperature 8 DIO
Maccor 4000 (with Solartron FRA)	48	-2 to 8	from 150 $\mu$ A to 5 A	24 channel (internal)	16 Voltage 32 Temperature 16 DIO

Maccor 4000 (with Solartron FRA)	16	0 to 18	25 A	16 channel (internal)	16 Voltage 16 Temperature 8 DIO
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The current accuracy is 0.025 % of full scale and the voltage accuracy is 0.02% FS. The current rise time from 10 to 90 % of full range is less than 10 ms. Data can be sampled in every 10 ms.

### **Input/output**

The voltage inputs are high impedance, fully isolated, with a range:  $\pm 5$  volts. Any combination of voltage inputs can be assigned to any test channel. Data measured by these inputs becomes part of the data record for the test channel assigned and voltages measured can control flow of the test procedure (schedule).

Reference voltage inputs may be used for: 3 or 4 reference electrode experiments; differential capacity experiments, measuring individual cells within a pack, monitoring external voltages, etc. Readings may be viewed or plotted in real time, or plotted either as a single input or overlay all the inputs associated with the experiment.

Any combination of type 'T' thermocouple inputs can be assigned to a test channel. Data measured by these inputs becomes part of the data record for the test channel assigned creating a historical record of temperature for the test schedule. Temperature functions can be used to control flow of the test schedule on channels with thermocouple inputs on the basis of absolute temperature,  $\Delta T/\delta t$ ,  $\Delta T$ , and several others.

### **Software**

Maccor's Windows based software suite combines, control, and high speed data acquisition and analysis into a simple to use package. The software suite consists of six applications:

- MacTest32 - the interface between the operator and the hardware
- BuildTest - the organized menu driven test editor
- ViewData - the data file viewer
- MIMSCClient - the powerful graphical and statistical data analysis tool
- MIMSServer - the automatic data backup tool

The MIMS Client is a powerful statistical and analysis tool. The MIMS Client charts (graphs) test data or displays a statistical table for a single or group of data files.

The MIMS Server automatically gathers test data from multiple systems to a local hard drive creating a back-up of the raw binary data, an indexed data file, and optionally an ASCII data file. Users analyzing data using the MIMS Client program can access this now centralized data.

### **Dimensions/weight**

The dimensions of the Maccor 4000 series are 81 cm (depth), 260 cm (height), 64 cm (width). The weight is approximately 400 kg per cyclor.

### **Further auxiliary equipment**

3 PCs (running on Windows 7) are used for controlling the equipment. 3 19" screens are used for the visualisation of the control software and data acquisition (the cyclers will be located at different locations). 3 uninterruptible power supplies (UPS) will ensure operation of the control PCs for at least 10 min at main power failure.

For the two cyclers with internal multiplexers, auxiliary input/output cabinets are available with the following dimensions each: 23 cm x 45 cm x 60 cm

### **Operation conditions**

The temperature range for operation is 10 °C to 40 °C. The maximum relative humidity for operation is 90 % (without condensation).

The maximum electrical power consumption of the 3 cyclers is 15 kW (required power 230 V @ 50 Hz).