ITS5300 Battery charge-discharge testing system

ITS5300 Battery Charge & Discharge Test System ("ITS5300 Test System") is designed for testing the performances of power batteries of all kinds (lead, Ni-MH and lithium batteries, supercapacitor, hydrogen cell, etc.), which can simulate electromobiles’ requirements on battery pack under a series of equivalent operating conditions.

In response to the demand of mass testing for a production line, ITS5300 Test System can be used in performance testing of a hundred or more battery packs or 200 cells in the battery packs at a time, remarkably improving the testing efficiency and capacity of the production line. With flexible step editing and optimized protection functions, ITS5300 Test System caters to a variety of testing demands. It is available for testing of CC/CW/CR discharge mode, CC/CV charge mode, pulse charge & discharge modes and DCIR/ACIR. Meanwhile, it can generate a charge & discharge curve and store such parameters as internal resistance ("IR"), capacity, voltage and current so as to conduct a complete analysis of battery.

ITS5300 Test System is mainly composed of ITECH power supply, electronic load, battery internal resistance tester and temperature logger as well as a piece of professional battery testing software. The system is characterized by high degree of automation and outstanding reliability, making it the best choice for users demanding battery testing.

Features

- A pulse charge/discharge function is designed for IR and capacity testing of battery module/cell.
- Charge mode: CC/CV/pulse charge
- Discharge mode: CC/CR/CW/pulse discharge
- Voltage range: 0-1200V
- Current range: 0-1500A
- Power range: 0-600KW

- High reliability and precision guarantee absolute measurement accuracy within the broad voltage/current range, making the test system more efficient in use.
  - Voltage: 0.025% +0.025% F.S
  - Current: 0.05% +0.05% F.S

- High sensibility and sample rate make it applicable for charge/discharge test on power batteries of all kinds. V/I current sample rate: 50KHZ (one point sampled every 20us).

- Online/offline ACIR and CDIR testing features are designed for analyzing battery/cell IR.

- Standard modular design not only makes it easy for hardware extension and follow-up maintenance but also expand its applications.

- Available for temperature monitor

- A complete alarm and protection setup for effectively preventing overcharge, over-discharge and other unexpected faults.

- Multi-channel independent control

- Available for charge/discharge testing on more than a hundred channels at a time.

Applications

- Battery charge/discharge performance testing
- Battery cycle number testing
- Battery capacity testing
- Ex-factory/ incoming inspection
- Production test

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IR Testing

Different types of batteries vary in IR, and even batteries of one kind have different IRs due to distinct internal chemical properties. IR is an important technical measurement of battery performance. In general, the smaller the IR, the higher the discharge rate capability will be or vice versa.

ACIR Testing

A battery pack is typically a set of any number of cells configured in a series or parallel. A sharp difference between cells may greatly impair the battery pack’s discharge performance. Therefore, measurement and systematic analysis of cell IR is also an integral part of battery performance test. IR is not a constant and may change over time during charge/discharge. The online ACIR testing feature is designed for rapidly and accurately identifying the dynamic IR variation in each cell so as to determine whether the battery has failed.

DCIR Testing

DCIR is typically a parameter used in testing high-capacity batteries or accumulators since low-capacity batteries are incapable of loading 40A-80A current within 2-3s. DC discharge is a measurement similar with battery mechanics. In DCIR testing, the DCR is calculated from the current and voltage differences between two different currents.

Battery Capacity Testing

Battery capacity is typically measured in ampere-hour. Measured battery capacities will differ with discharge rates applied. Generally, battery life will be shortened by high-rate discharge; thus, discharge capacity is usually measured at a low discharge rate (e.g. 0.2C). Meanwhile, battery tends to be damaged by deep discharge. Battery capacity refers to the effective capacity calculated from the initial voltage to the cut-off voltage.

Battery Cycle Number Testing

With the increase in charge/discharge cycles, IR will increase due to internal oxidation, preventing the battery from discharging stored power and in turn putting an end to the battery life. Battery cycle number (one charge + one discharge constitute one cycle) is influenced by discharge rate, temperature, end-of-charge/discharge voltage and other factors (see the figure below). Lithium battery typically has 300-500 charge & discharge cycles. IEC and other regulations stipulate that for a standard lithium battery, the remaining capacity after 500 charge & discharge cycles must be 60% or more of the initial capacity. Therefore, charge & discharge cycle testing is an importance means to evaluate and measure battery lifecycle.
Battery Temperature Measurement

For battery packs of different structures, temperature sensors of various quantities should be placed at different measurement points which are usually exposed to greatest variation in temperature. Since high-temperature cells are placed densely, a considerable amount of heat will accumulate at the center and less on the periphery, increasing the temperature imbalance between each two cells. As a result, battery modules and cells will differ from each other in performance, which will in turn impair the performance uniformity and service life of battery. Therefore, in an aging test of battery, real-time monitoring of temperature variation is a useful method for accurately evaluating the battery performance.

Battery Charge/Discharge Performance Testing

By evaluating a battery’s charge/discharge performance, we may effectively simulate the actual working conditions of the battery. The charge process of a battery typically consists of four stages, including the preliminary charge, constant current charge, topping charge and trickle charge. During the discharge process, high-rate discharge doesn’t tend to continue for long. Therefore, simulation of variable pulse discharge current has emerged as a new tendency for developing novel battery charge/discharge testing systems. What’s more, the simulation must be so flexible that it can satisfy various usage requirements of the user.

Modular Design

ITS5300 Test System is composed primarily of electronic load, power supply, IR tester and temperature logger. By addressing the limitation of conventional single test, the system develops professional test steps to help users radically improve the testing efficiency. Moreover, the system software can be used to conduct synchronous remote control of each system component. With a modular design, the system allows users to select out of their true testing demands the most suitable devices for integration into an automated test platform, thus producing system architecture with highest flexibility and extendibility.

Programmable DC Power Supply

ITS5300 Test System is supplied with an optional ITECH programmable DC power supply used for battery pack or cell charge.

<table>
<thead>
<tr>
<th>Serials</th>
<th>Voltage</th>
<th>Current</th>
<th>Power</th>
<th>Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>IT6800</td>
<td>0~72V</td>
<td>0~10A</td>
<td>100W~180W</td>
<td>1mV/1mA</td>
</tr>
<tr>
<td>IT6900</td>
<td>0~150V</td>
<td>0~25A</td>
<td>100W~600W</td>
<td>1mV/0.1mA</td>
</tr>
<tr>
<td>IT6500</td>
<td>0~160V</td>
<td>0~240A</td>
<td>800W~6KW</td>
<td>1mV/1mA</td>
</tr>
<tr>
<td>IT6700</td>
<td>0~120V</td>
<td>0~110A</td>
<td>850W~3KW</td>
<td>10mV/10mA</td>
</tr>
<tr>
<td>IT22000</td>
<td>0~150V</td>
<td>0~510A</td>
<td>5KW~15KW</td>
<td>10mV/100mA</td>
</tr>
</tbody>
</table>

DC Electric Load

ITS5300 Test System is furnished with an optional ITECH programmable DC electric load mainly used for battery discharge.

<table>
<thead>
<tr>
<th>Serials</th>
<th>Voltage</th>
<th>Current</th>
<th>Power</th>
<th>Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>IT9500</td>
<td>0~500V</td>
<td>0~480A</td>
<td>120W~6KW</td>
<td>1mV/0.1mA</td>
</tr>
<tr>
<td>IT8800</td>
<td>0~800V</td>
<td>0~1500A</td>
<td>150W~600KW</td>
<td>1mV/0.01mA</td>
</tr>
</tbody>
</table>

IR Tester

ITS5300 Test System is provided with an optional ITECH IR tester used for monitoring the voltage and IR of cells in a battery pack. The ITECH IR tester works with the most sophisticated AC discharge testing technology, capable of accurately measuring battery voltage and IR and having an automatic evaluation on battery parameters.

- High resolution, Max. 0.1mV, 0.1mΩ
- Accuracy: (1KHz; 500Hz)
- Single instrument is available for 16 channels simultaneously testing
- Supporting 17 sets master and slave extension connection

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- **Temperature Logger**

  ITS5300 Test System integrates an ITECH multi-channel temperature logger used for temperature monitoring. ITECH multi-channel temperature logger is available for monitoring temperature via 24 channels at a time. The specifications of the temperature logger are as follows: measurement range -200°C - 2000°C, measurement accuracy 0.5°C and resolution 0.01°C. 
  - Support maximum 24 channel synchronous testing 
  - Measuring range 200°C~2000°C 
  - Accuracy 0.5°C, resolution 0.01°C 
  - Supporting for multiple types thermocouple

- **Professional System Software**

  ITS5300 Test System is equipped with a battery charge/discharge testing software developed on the basis of user specifications. By editing test steps, the user may perform constant current charge, constant pressure charge and constant current/power/resistance discharge tests on multi-channel cells or battery packs. Furthermore, the software will help the user monitor cell voltage, temperature and IR, produce charge/discharge curves and monitor and store relevant data.

- **Complete Charge & Discharge Protection**

  During the aging test of a battery, the user should perform real-time monitoring of cells and battery pack and cut off the circuit for protection purposes when the preset conditions are satisfied so as to prevent overcharge and over-discharge. ITS5300 Test System allows the user to observe the status of battery pack and cells in all channels on the same interface and to present abnormality or normality of each cell using different colors. The system is designed with such protection features as cell under-voltage, overvoltage, over-temperature and battery pack overvoltage, under-voltage and reverse polarity.

- **User-defined Protection Conditions**

  The ITS5300 Test System allows for user-defined end-of-discharge conditions. All permissible parameters of the system can be used as limiting conditions for alarm and power-off protection. In case of satisfaction of any of such conditions, the system will stop discharge automatically. In addition, the system has a fault reason display function.

Likewise, if the power-off state continues for long, the system will automatically cut off the active charge/discharge circuit so as to prevent overcharge and over-discharge and guarantee the safety and reliability of battery testing.

- **Power-off Memory Protection**

  ITS5300 Test System is superior over traditional integrated charge & discharge device in that it has a power-off memory feature while the latter has single protection configuration only. Power-off memory feature is the most cutting-edge and perfect protection function developed by ITECH and designed for time-consuming aging tests. With the protection function, previously acquired data can be effectively stored intact in case of unexpected power failure or computer crash during a time-consuming aging test and the user may proceed with the test program from the faulty link after the system is back to normal. In this way, repeated tests are avoided for higher efficiency.

- **Various safety protection measures**

- **Testing system**

  Supporting for multiple types thermocouple
Safety Protection Interface

ITS5300 Test System software has a dedicated safety protection interface that is given a priority in running over others during normal course of test so as to guarantee the safety and reliability of test.

Data Backup

ITS5300 Test System allows the user to backup test date to the storage location so as to improve data safety and prevent data loss resulting from computer crash.

Configuration of User Access Levels

System operations mainly consist of editing and operation of test program and data analysis. For better controlling operation of the system by different personnel, the system is provided with the feature of user access level configuration. With this feature, the user may assign QC, R&D and production personnel with different access levels so as to prevent unauthorized modification or undesired artificial suspension of system program and in turn guarantee the system reliability and safety.

Variety in Step Editing

ITS5300 Test System provides the users with an array of charge/discharge modes such as CC/CW/CR discharge mode and it can simulate constant voltage charge and constant current charge modes. Various end-of-discharge conditions contribute to improvement of testing safety and prevention of over-discharge and overcharge of battery. The “AND” + “OR” logical relation may be established among time, capacity and voltage end-of-discharge conditions to cater to more complex testing requirements.

Multi-Battery Pack Simultaneous Testing

Hundreds of batteries are produced a day in a battery production line. So a multi-channel test system is required for testing many batteries at a time. ITS5300 Test System can divide a battery piece into 10 groups, each group configured with 200 measurement points. Different battery groups may be configured with different test programs but all channels in one group share the same test program, which simplifies the operation and improves the productivity.
During the test, the user may clearly observe the test information of each channel on the software interface, including channel configuration, cell voltage, current, discharge capacity and other parameters, which is easy for observation and record.

A battery pack is typically a set of cells connected in series which exhibit different characteristics during charge and discharge. For this reason, monitoring of cells is of great importance. Apart from key parameters of each channel, ITS5300 Testy System may install a thermograph and IR tester to realize real-time monitoring of cell voltage, IR and temperature. The software has intuitive colored block charts to symbolize normality or abnormality of cell characteristics and give early warning where necessary, which improves the testing reliability.

- **Optimized Report and Analysis Functions**
  ITS5300 Testy System is provided with a variety of data and curve display functions, allowing users to have a real-time check-up on steps during operation. Meanwhile, the system can generate IV curve and record cell voltage, current, temperature, IR and other parameters so that the user can produce desired charts and diagrams easily.

- **Export in EXCEL Format**
  Test results can be exported in EXCEL format for subsequent statistics and analysis.

- **User-friendly and Robust Edit Interface of Test Program**
  ITS5300 Test System software is equipped with a user-friendly user interface. The simple and compact edit interface allows you to execute complex test program without mastery of any programming language, making programming as easy as filling out documents.

- **Data Query**
  Test data tables are named by date and time automatically and can be screened by different conditions for easy search.