ITS5300 Battery Charge & Discharge Test System

Applications

battery charge / discharge performance test, battery cycle life test, battery capacity test, quality check, production testing, etc.

ITS5300 battery charge and discharge test system is designed for a variety of power batteries (lead acid, nickel hydrogen, lithium batteries, super capacitors, hydrogen fuel cells, etc.) for performance testing. Real-time monitoring voltage, resistance and temperature and other parameters of single cell can achieve system' overvoltage, under voltage, overcurrent, overheating protection and the battery pack equalization charge and discharge on single cell, and can simulate electric vehicle's various equivalent conditions on the battery pack.

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. ITS5300 supports CC/CP/CR discharge mode, CC/CV charge mode, pulse charge & discharge modes and DCIR/ACIR. Meanwhile, it can generate a charge & discharge curve and store parameters such as internal resistance ("IR"), capacity, voltage and current so as to conduct a complete analysis of battery.

ITS5300 Test System is composed of ITECH power supply, industrial computer, electronic load, battery internal resistance tester and temperature logger as well as 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.

Feature

- Balanced charging and discharging capacity, designed for battery module / cell test.
  - Charge mode: CC / CV / pulse charge
  - Discharge mode: CC / CR / CP / pulse discharge
  - Voltage range: 0 - 1200V
  - Current range: 0 - 1500A
  - Power range: 0 - 600 kW

- Fast response and high-speed sampling rate, sampling rate and data storage time down to 1ms.

- High reliability and high 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

- With online / offline battery AC resistance test function, and with battery DC resistance test function, can analyze the internal resistance of the single or whole cell

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

- Real-time online monitoring on single module resistance, voltage and temperature. Support cell battery AC internal resistance analysis and battery pack DC internal resistance analysis.

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

- Adopt GPIB communication, support multi-system extension (ITS5300-001 adopts USB communication).

- Multi-channel independent control.

- Hundreds of channels of battery charge and discharge at the same time

- V / I current sampling rate: 50KHZ (Sample a point every 20us)

Battery resistance test

Different types of battery internal resistance is different, and even the same type of batteries have different IRs due to distinct internal chemical characteristics. Internal resistance is an important technical indicator of battery performance. In general, the smaller the internal resistance is, the higher the discharge capacity will be, or vice versa.

● ACIR Testing

A battery pack is typically a set of any number of cells configured in series. 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 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.
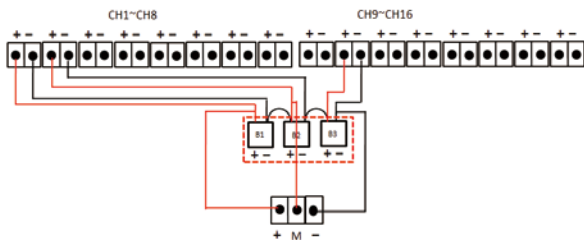

Schematic Diagram of ACIR Testing

● DCIR Testing

DCIR is typically 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 storage battery. In DCIR testing, the DCR is calculated from the current and voltage differences between two different currents.


$$R_I = \frac{\Delta V}{I} = 375$$
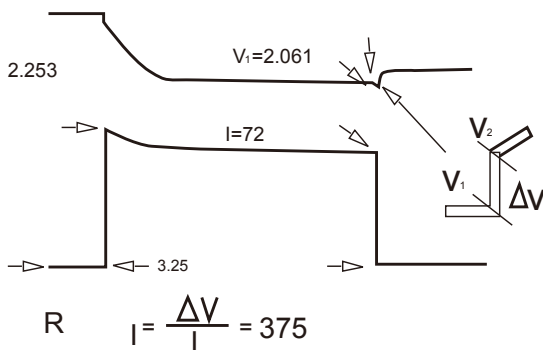
Battery Capacity Testing

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.
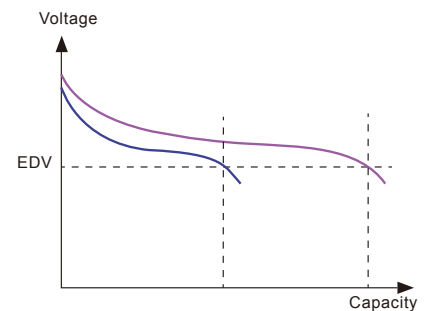
Battery Cycle Life Testing

With the increase in charge/discharge cycles, IR will increase due to internal oxidation, preventing the battery from discharging stored power and in turn end the battery life. Battery cycle lift (one charge + one discharge constitute one cycle) is influenced by discharge rate, temperature, end-of-charge/discharge voltage and other factors (see the below figure). 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 testing is an important way to evaluate and measure battery lifecycle.
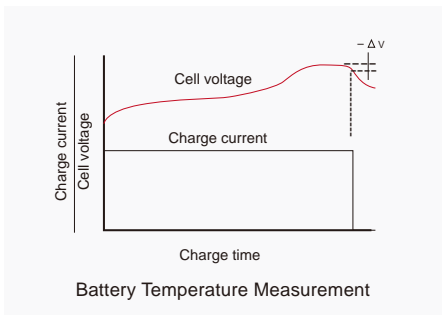

Battery Cycle Life Testing

Test System

Test System
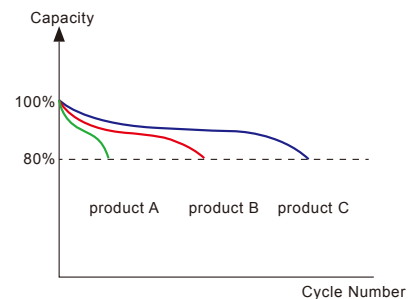
Battery Temperature Measurement

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 heat accumulate at the center and less on the edge, 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 Temperature Measurement

Battery Charge/Discharge Performance Test

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 does not tend to last 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 meet various usage requirements of the user.

Balanced Battery Fast Charging & Discharging

As one type of power source, serial battery is widely used in various fields, but the serial structure will lead to the individual cells can not be automatically equalized in charge & discharge. The only way for extra energy is dissipated in the form of heat. That not only damage the battery cell, but also greatly affect battery performance and life.

Through real-time monitoring on single battery voltage, for the unbalanced voltage battery cell which has great difference on voltage from other battery cells in the same group, ITS5300 can realize battery cell independently charging and discharging to increase the available capacity of the battery pack and prolong its life.
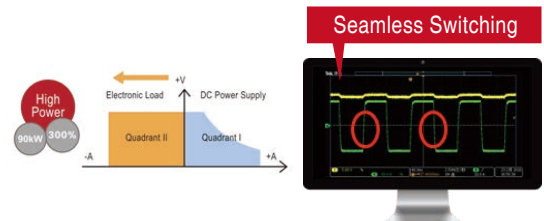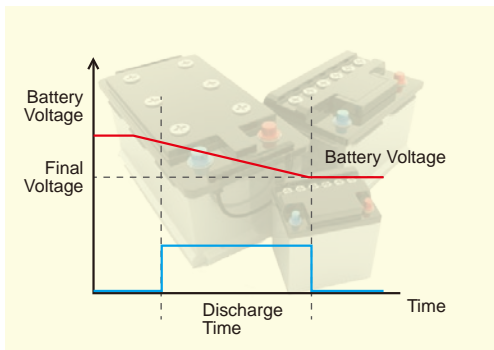
Fast charge and discharge test

In the process of battery charging and discharging, high-speed current changes can be considered almost seamless switching, in order to test the changed process of battery current, you need a machine that can both sink current and release current. As a high-speed two-quadrant power supply, IT6500C (1800W-30kW) series has Loop-Mode function so as to realize high-speed current transition between power supply mode and electronic load mode, to achieve fast switching between sourcing and sinking current, even can achieve seamless switching under certain conditions, thus avoiding overshoot of voltage or current.

Seamless Switching

Modular Design

ITS5300 Test System is composed of industrial computer, 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 a synchronous remote control of each system configuration.

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.

● DC electronic load

ITS5300 test system equips with ITECH programmable DC electronic load or power dissipater, used to discharge battery
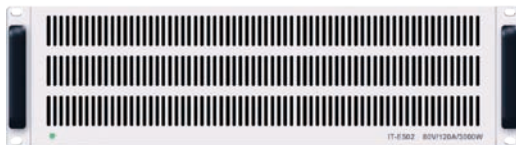

● Temperature Logger

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.

The superior performance of temperature logger makes it possible for ITS5300 Test System to acquire temperature data effectively and accurately and for wide application of the system in testing of batteries of all kinds.
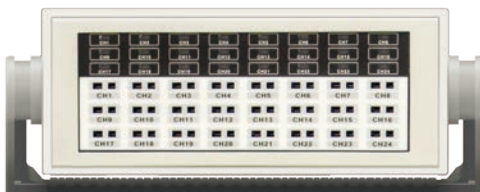
● Programmable DC Power Supply

ITS5300 test system equips with ITECH programmable DC power supply, used to charge single cell or battery pack

● 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.

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.

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.

Test System

## Various security measures

● Power-off Memory Protection

ITS5300 Test System is superior over integrated charge & discharge device in which 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 perfect protection function developed by ITECH and designed for time-consuming aging tests. With the protection function, previously acquired data can be effectively stored intactly in case of unexpected power off 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 back to normal. In this way, repeated tests are avoided for higher efficiency.

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.

● 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 in 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.
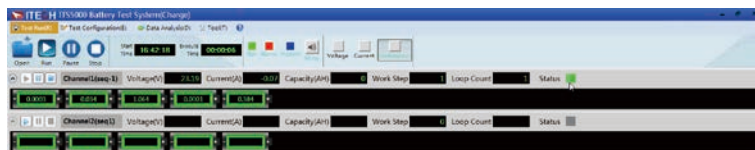
● User-defined Balanced Charging & Discharging Conditions

ITS5300 battery test system provides settable charging and discharging conditions in each work step. Including the parameters of each cell in battery pack, e.g. voltage, current and differential voltage. Once the differential voltage among the battery cells reach its pre-set value, the bipolar power supply in the system will operate independently charging and discharging automatically to the unbalanced cell.
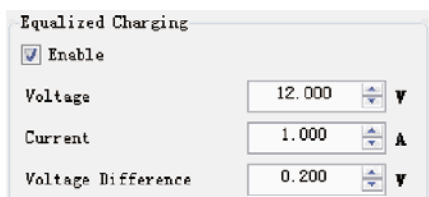

● Real-time Charging & Discharging Monitor of Each Channel

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 test system may install a thermograph and IR tester to realize real-time monitoring of cell voltage, IR and temperature.

During the test, user can clearly observe the test information of each channel through the software. The software has intuitive colored block charts to symbolize normality or abnormality of cell characteristics and give early warning where necessary, including channel configuration, cell voltage, current, discharge capacity and other parameters. That is not only easy for observation and record, but also improves the testing reliability.
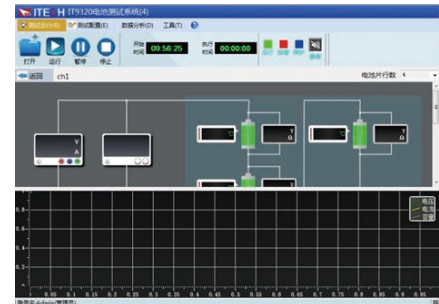
● User-defined Protection Conditions

ITS5300 battery 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.
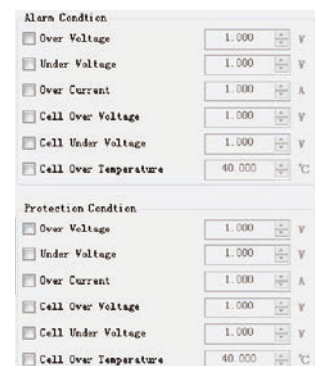
● Data Backup Function

Adopt database, ITS5300 battery test system is much more reliable and stable. That not only improves testing data safety, but also prevents testing data loss 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 personnels with different access levels so as to prevent unauthorized modification or system program and in turn guarantee the system reliability and safety.

User Name	User Type	Test Run	Test Config	Data Analysis	Template	Test Data	User Manager
Admin	Administr...	Allow	Allow	Allow	Allow	Allow	Allow
Admin	Administr...	Allow	Allow	Allow	Allow	Allow	Allow
zd	Common User	Not Allow	Not Allow	Not Allow	Not Allow	Not Allow	Not Allow
ss	Common User	Allow	Not Allow	Allow	Not Allow	Not Allow	Not Allow

Variety in Step Editing

ITS5300 Test System provides the users with an array of charge/discharge modes such as CC/CP/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.

Order	Step Command
1	Simulation Test
2	CV Charge
3	CC Charge
4	CC Discharge
5	CP Discharge
6	Loop
7	Simulation Test

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.

Multi-Battery Pack Simultaneous Test

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.

Test battery packs with over 100 channels

Cells in one group can operate with the same program

Monitor 200 cells in a battery pack at one Time.
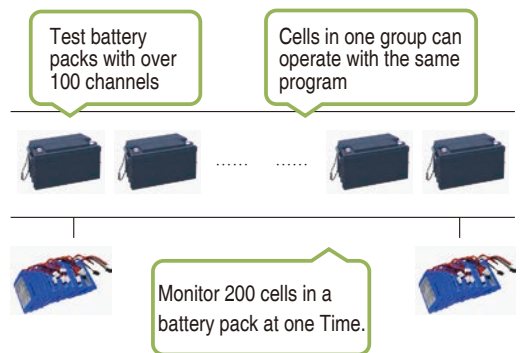
Test System

Support various data output format

Test results can be exported in various format for subsequent statistics and analysis. Such as excel, word, htm, pdf, txt formats etc.
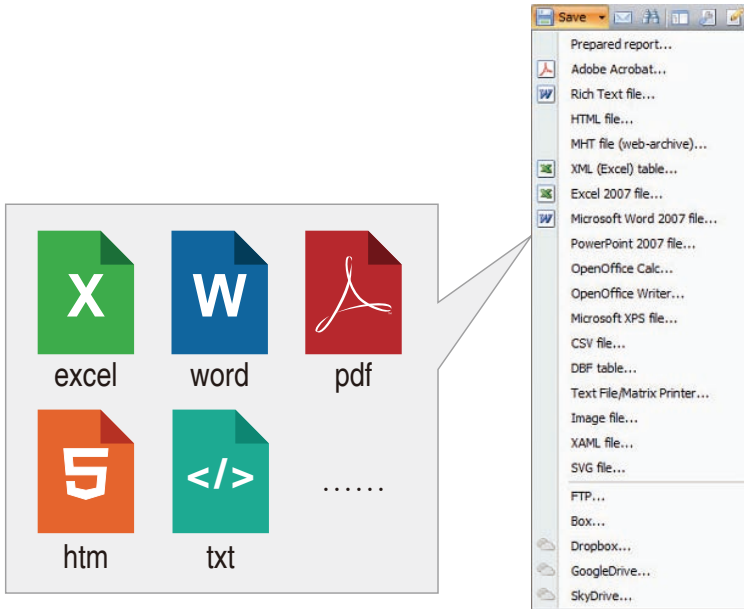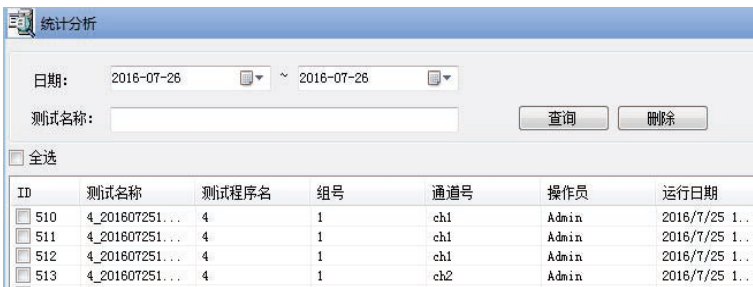

Reporting and analysis functions

The ITS5300 system provides a variety of data and curve display functions. The report can record the real-time curve of the battery test, for example, voltage, current, temperature, internal resistance curve changes over time and the original recorded data. Users can easily obtain the required chart.
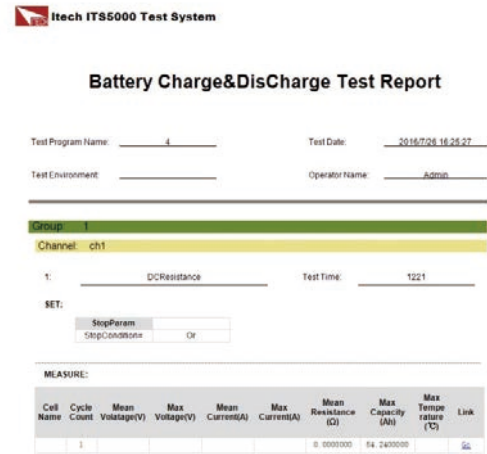
Data Query

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

Test System