ITECH

YOUR POWER TESTING SOLUTION

ITECH Test Solution - eVTOL

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Low-altitude economy, leading a new life in the future

Low-altitude economy refers to an economic model in which commercial activities and service provision take place within a lower range of air altitude. With the continuous development and innovation of aviation technology, low altitude economy is gradually becoming a hot topic in the aviation field. In the low-altitude economy, new types of aircraft such as drones and electric vertical take-off and landing aircraft eVTOL play an important role. They are able to carry out a variety of commercial activities at low altitude, such as express delivery, logistics transportation, agricultural spraying, environmental monitoring and so on. This economic model has the advantages of high flexibility, low cost and high efficiency, which brings new development opportunities for modern commercial activities.

In order to ensure the smooth development and safe operation of low-altitude economy, the testing of related technologies and systems is especially critical. The testing of low-altitude economy covers various aspects, including the performance testing of aircraft, the reliability testing of autopilot systems, and the accuracy testing of communication and navigation systems. In addition, testing is critical for testing flight control, obstacle avoidance and collision avoidance technologies for UAVs and other aircraft.

Our test solutions are designed to provide up-to-date and reliable test solutions for the development of the low altitude economy. It covers a number of key areas, including the aircraft's power system, charging unit, power battery and flight control sensors. Through comprehensive and in-depth testing of these areas, we are able to provide efficient, stable and reliable testing solutions for the research and exploration of new aircraft, thus providing strong support for the development and application of low-altitude economy and laying a solid foundation for the commercialization of low-altitude economy.

Figure 1: Low-altitude airspace not exceeding 3,000 vertical meters (note: helicopters theoretically fly at a maximum altitude of 6,000 meters, but in practice they mainly fly at 1,000-2,000 meters).

	Aircraft type	Aircraft spec.		
		Range	Payload	Speed
1000-6000 meters	▪ **Manned vehicles** (helicopters/eVTOL)	~600km	~3000kg	~70m/s
300-1000 meters		~30km	~200kg	30-40m/s
120-300 meters	▪ **Industry-grade drones for express logistics**	~15km	10-20kg	10-15m/s
Below 120 meters	▪ **Industry-grade drones for instant logistics and distribution, city management, etc.**	~10km	<10kg	10-15m/s
	▪ **Consumer Drones**	15-30km	n/a	15-20m/s

eVTOL - Power System Test Solution

Electric Drone ESC & Motor Testing

The Electronic Speed Controller (ESC) and the motors are critical components of the UAV power system that work together to ensure that the vehicle executes commands stably and accurately in the air in order to realize the vehicle's maneuvers and actions. The ESC is mainly responsible for accepting commands from the flight control system to regulate the speed and steering of the motors, thus controlling the attitude and flight path of the vehicle. Their stability and accuracy are critical to the flight performance and safety of the UAV.

In general, ESC currents for drones usually range from 10A to 80A, depending on the size and purpose of the drone. Smaller consumer-grade drones may only require 10A to 20A, while larger, high-performance drones may require higher current drive capabilities. The voltage range of ESCs is generally in the 7.4V to 52.5V range, which can meet the needs of a wide range of battery sizes from 2S to 14S. In the testing process, engineers need to rely on battery simulators with different power specifications to achieve comprehensive monitoring and evaluation of the ESC and motor's efficiency, load capacity, command response speed, power consumption and other parameters.

Choosing a suitable battery simulator is the challenge engineers face today. Traditional battery simulators can only achieve basic battery voltage and current output, but cannot simulate the characteristic curve of the battery. In addition, for small power consumer UAVs, because of the small battery specification, the bi-directional battery simulators integrating source and sink usually have a starting power of 6kW, which cannot be applied to the simulation of small power batteries.ITECH provides hundreds of watts, tens of kilowatts, and even MW-level battery simulation solutions for pure electric UAV ESCs & motors.

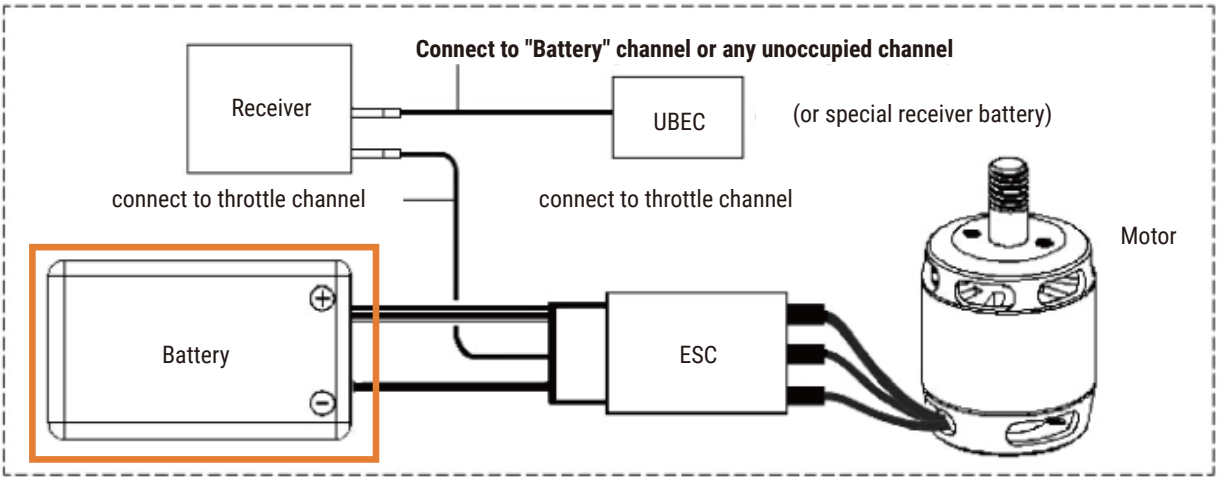
ITECH test solution

- IT-M3600 Bidirectional DC power supply can simulate small UAV batteries ≤800W
- IT-M3900C Bidirectional DC power supply can simulate 1700W~12kW drone battery(Low voltage and high current design, 10V/32V/80V/150V/300V...output)
- IT6000C Bidirectional DC power supply can simulate 5kW~2MW large UAV battery
- Seamless switching between positive and negative current, dynamic response <2ms
- Bidirectional and regenerative, power feedback efficiency up to 95%

IT-M3600
1/2 1U 200W~800W

IT-M3900C
1U~2U 1700W~12kW

IT6000C 3U@18kW 5kW~2MW



Fuel Cell UAV ESC & Motor Testing

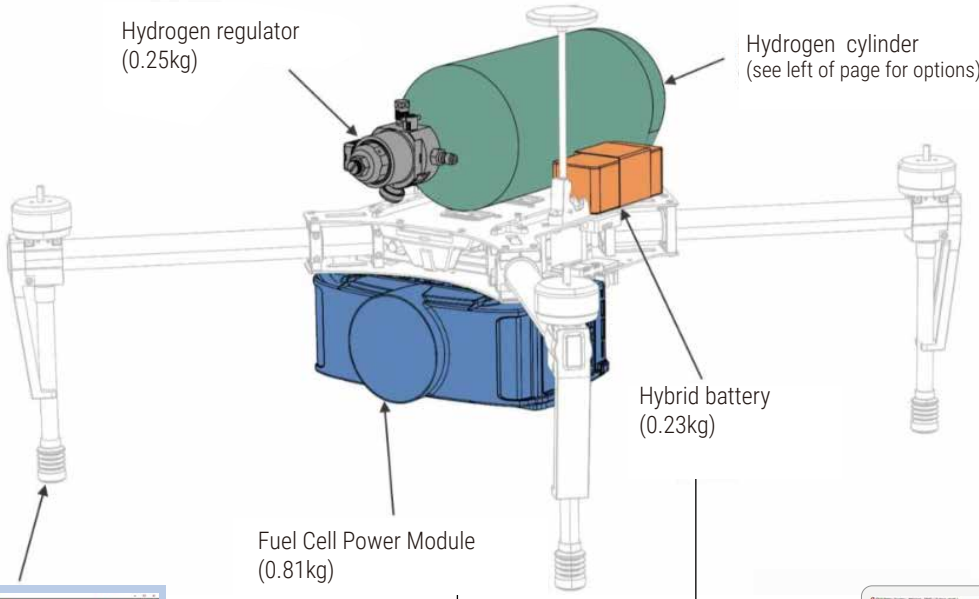
Fuel cell drones are unmanned aircraft systems that using fuel cells as a power source. Compared to traditional battery-powered UAVs, fuel cell UAVs generate electrical energy by reacting hydrogen with oxygen to drive motors. It has the advantages of long flight time, high efficiency, environmental protection and energy saving, and is suitable for a variety of applications with long flight time and high efficiency requirements, such as plant protection UAVs.

Fuel UAV ESC & motor testing is different from battery UAV power system testing. It is necessary to realize not only the simulation of battery, but also the simulation and emulation of fuel cell. Moreover, in the process of power performance testing, considering that the output of the fuel cell power module has a delay lag, it needs the assistance of the battery, so the energy distribution of the two is also the research scope of the fuel cell UAV.

Advantages

- Professional fuel cell simulation solution, real reproduction of fuel cell I-V characteristic curves (with FCS3000 software)
- Provide CANOpen and CAN2.0B communication protocols to realize CAN bus data transmission and communication between various components.
- Professional lithium battery simulation solution, built-in 8 types of battery model curves (with BSS2000 simulation software)
- Fully evaluates the energy distribution between the fuel cell and lithium battery to ensure that the energy can be reasonably distributed under different working conditions.

DJI M100 fuel cell drone



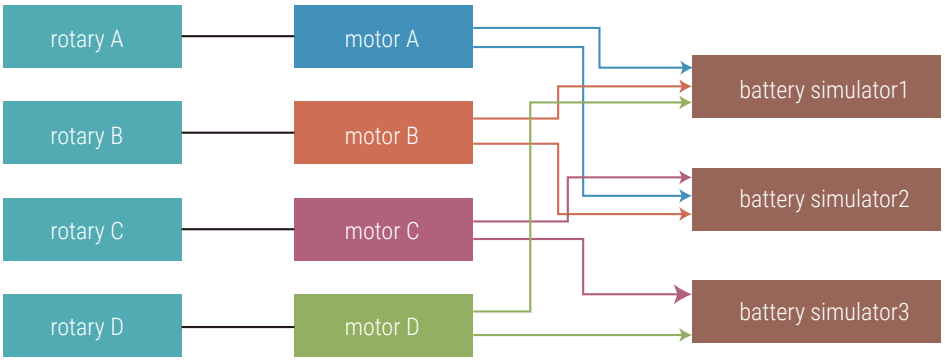
IT6000C+FCS3000 fuel cell simulator

IT6000C+BSS2000 battery simulator

eVTOL - Distributed Electric Propulsion (DEP) Powertrain Testing

Aircraft have high requirements for system redundancy. Distributed electric propulsion (DEP) technology is widely used in UAV and electric aviation due to its flexible and versatile mechanical and electrical design, which can greatly enhance the safety and redundancy of the power system, greatly increase the maneuverability during flight, and at the same time, can effectively reduce the noise of the aircraft and maximize the efficiency of the power system's energy use, among other advantages.

For example, Joby's eVTOL S4 utilizes four batteries and six propellers in a "distributed electric propulsion" system. Each propulsion motor is driven by dual redundant inverters to increase mission reliability, and each inverter in the dual redundancy for each motor is powered by two separate batteries to prevent the spread of battery failure. In the event of a failure of any of the propulsion motors, inverters or battery packs, the airplane can still be flown safely. In other words, there will be no single point of failure for the entire eVTOL.

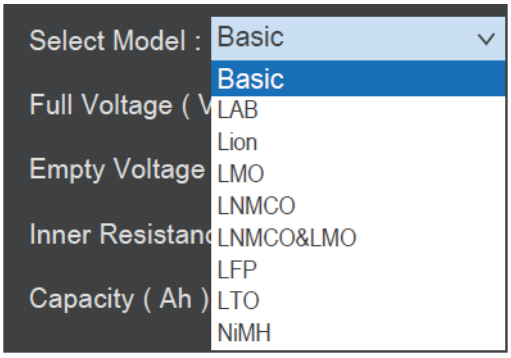


3U 42kW IT6600C

ITECH's battery simulators (IT6600 series and IT6000 series) can help eVTOL researchers and ATE integrators realize the benefits of powertrain testing:

- Simulate the charging and discharging characteristics of power batteries for a more realistic assessment of range time (optional BSS2000 Pro battery simulation software)
- Accurately measure parameters such as voltage and current, pull force and motor efficiency
- Equipped with CAN communication interface as standard, providing CANOpen, CAN2.0B and other communication protocols
- Beneficial to realize CAN bus communication of power devices 0~2250V, 0~10MW battery simulator, bidirectional and 95% power regeneration
- High power density, IT6000 (3U@18kW), IT6600 (3U@42kW)
- Built-in Digital IO to effectively control the synchronized ON/OFF of multiple units
- Redundancy function can avoid test interruptions caused by equipment failure

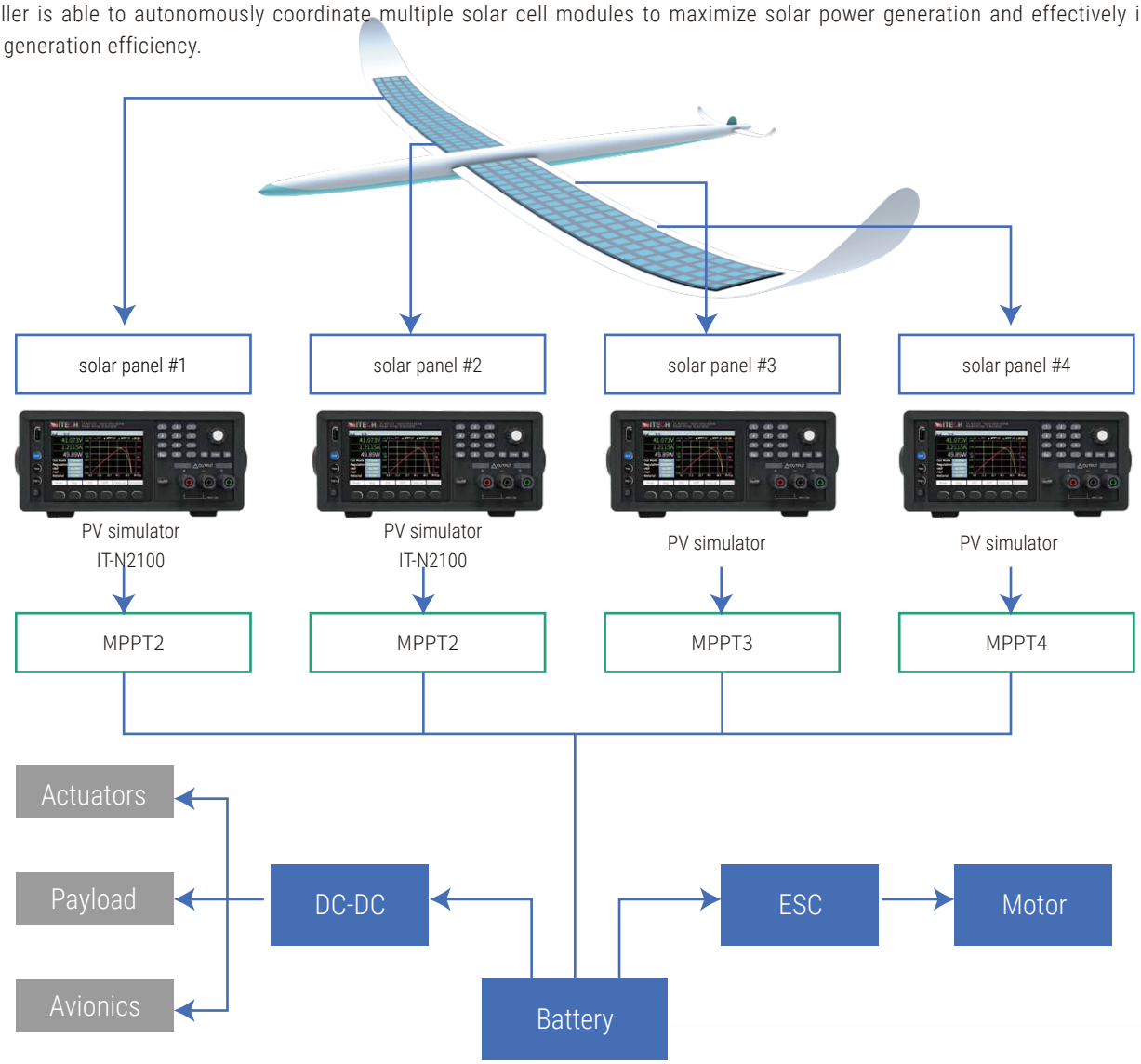
BSS2000 Battery simulation software



Built-in 8 battery types

Fixed-wing solar-powered drone testing in near-space

Solar-powered vehicles can perform long-duration aerial missions, such as border patrol and surveillance, communications relay, electronic reconnaissance and other operations, in remote and isolated areas. Fixed-wing solar-powered UAVs generally employ a distributed intelligent self-coordinated energy system management strategy. Regardless of the UAV's attitude and lighting conditions, the energy controller is able to autonomously coordinate multiple solar cell modules to maximize solar power generation and effectively improve power generation efficiency.

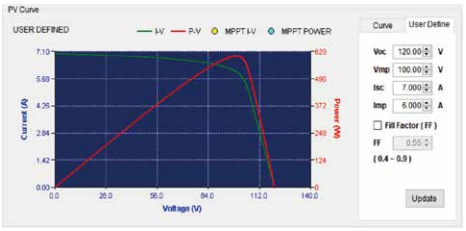


Advantages

- High speed current dynamic response, support high speed MPPT
- Up to 1500V DC output common-mode withstand voltage, support series testing
- Ultra-low current ripple, high-precision sampling, programming and measurement
- Graphical operation display interface, real-time display of MPPT
- Standard PV simulation software, simulate I-V curve under different light, temperature and cloud cover
- Simulate single peak/multiple peak curves, standard USB/LAN/digital IO interface.

IT-N2100 Series Solar Array Simulator

Four points test



EN50530 SANDIA

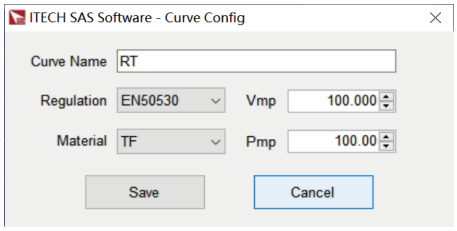
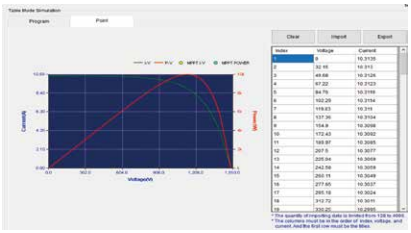
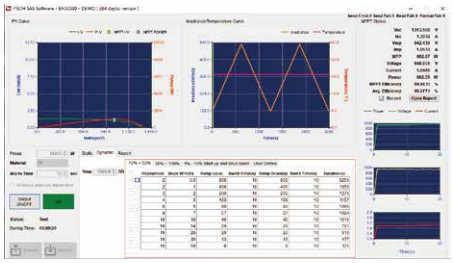


Table Program user-defined



Dynamic MPPT

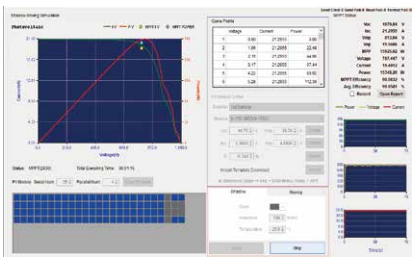


Test the MPPT efficiency of a PV inverter by varying the temperature/irradiance over time according to a standard IV curve predefined by the regulations.

Static MPPT

The MPPT efficiency of a PV inverter is tested by varying Pmp and Vmp at an irradiance of 1000 W/m2 and a temperature of 25°C.

Multi-peak I-V curve for cloud cover mode



Due to the environment impact, the output power of solar arrays tends to decrease during use, and the output characteristic curve shows multi-polar points.

eVTOL - Charging Device Test Solution

Flight control system is a control system that can stabilize and control the flight attitude of human and aircraft. It consists of MCU and IMU, etc. IMU provides the sensor raw data of the aircraft attitude in space, generally by gyroscope sensor/acceleration sensor/electronic compass/barometer/magnetometer and GPS, etc. It provides the 9DOF data of the aircraft, which is used for the calculation and decision-making of the control algorithm of the aircraft.

Advantages with IT6400 bipolar DC power supply

- High Accuracy - Ultra-low power consumption of flight sensor devices
- Ultra-high current resolution - calibrates the accuracy of gyroscope angular velocity measurement, with current set resolution up to 10uA and readback accuracy up to 1uA.
- Supports battery simulation

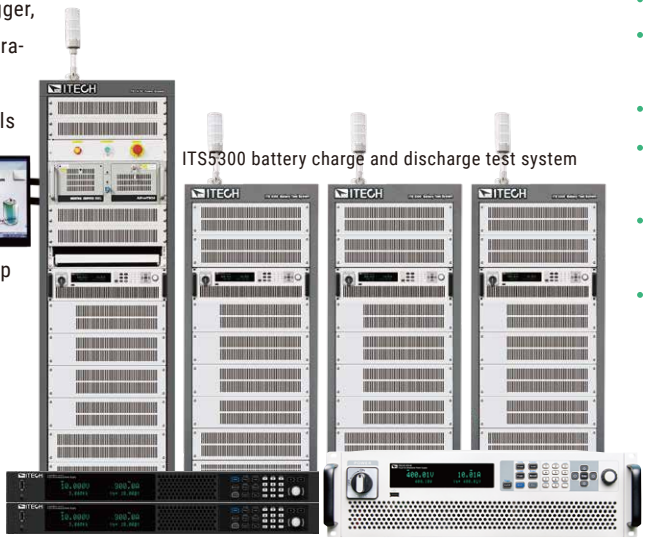
eVTOL - Power Battery Testing

UAV power battery test

ITECH provides a complete test solution for power battery from stand-alone to ATE. The solution adopts advanced bi-directional DC power supply, which can simulate the real working conditions of UAV such as take-off, hovering, flying, turning, etc., and carry out a comprehensive simulation of battery endurance, start-up transient current and other performances. Our solution not only provides advanced hardware, but also provides users with full protection, such as anti-reverse connection and anti-ignition, emergency stop and power failure prevention. Moreover, users can easily start the software operation without any programming ability.

Modular design

- Can be integrated with temperature logger, internal resistance analyzer and temperature chamber
- Connection in parallel between channels to extend higher power
- High power density, MW power can be reached
- High power density design, providing up to MW class battery testing solutions



ITS5300 battery charge and discharge test system

IT-M3900
bidirectional DC power supply

IT6600C/IT6000C
high power bidirectional DC power supply

Multiple list steps

- CC/CV/CP/CR/Pulse
- Driving simulation under real road conditions
- Goto and loop function
- Bms communication, support .Dbc file import
- Statistical analysis and data reporting
- Fast sampling, up to 1ms

Full protection

- Anti-crash after power failure
- Anti-reverse connection and anti-sparking
- Emergency stop
- Power abnormal protection
- Overcharge/overdischarge/overtemperature protection

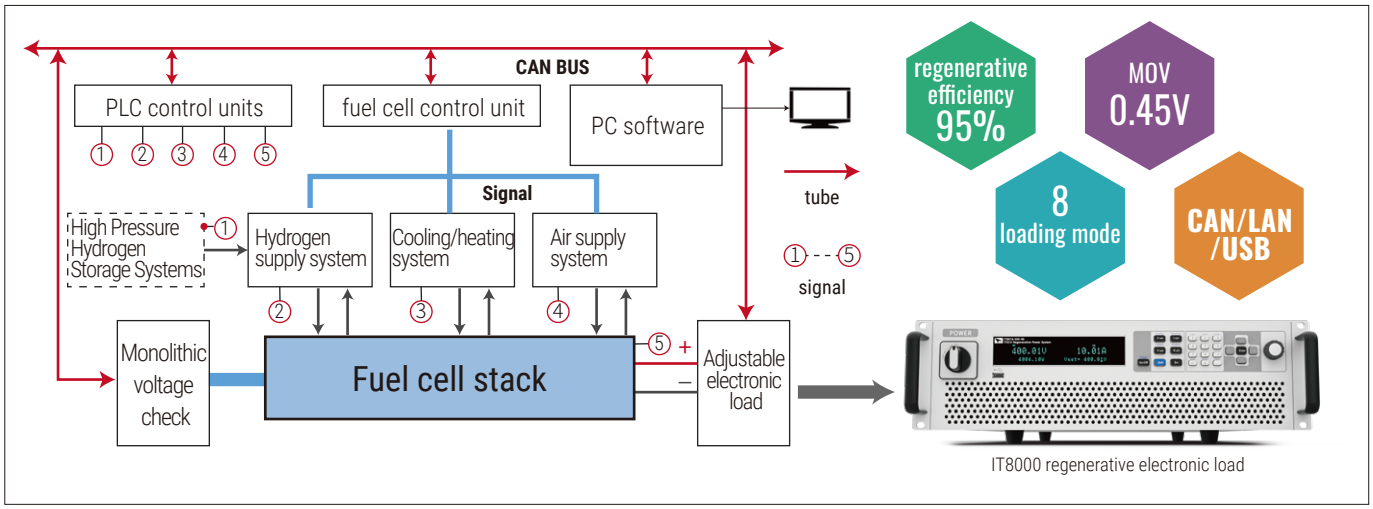
Bidirectional with current seamless switching, regenerative

- Both source and sink, regeneration efficiency is up to 95%max.
- -90%~90% current, less than 2ms of switching

Fuel cell module test

Loading mode: CC/CV/CP/CR/CV+CC/CR+CC/CC+CV+CP+CR
Communication protocol: MODBUS/SCPI/CANOpen/CAN2.0

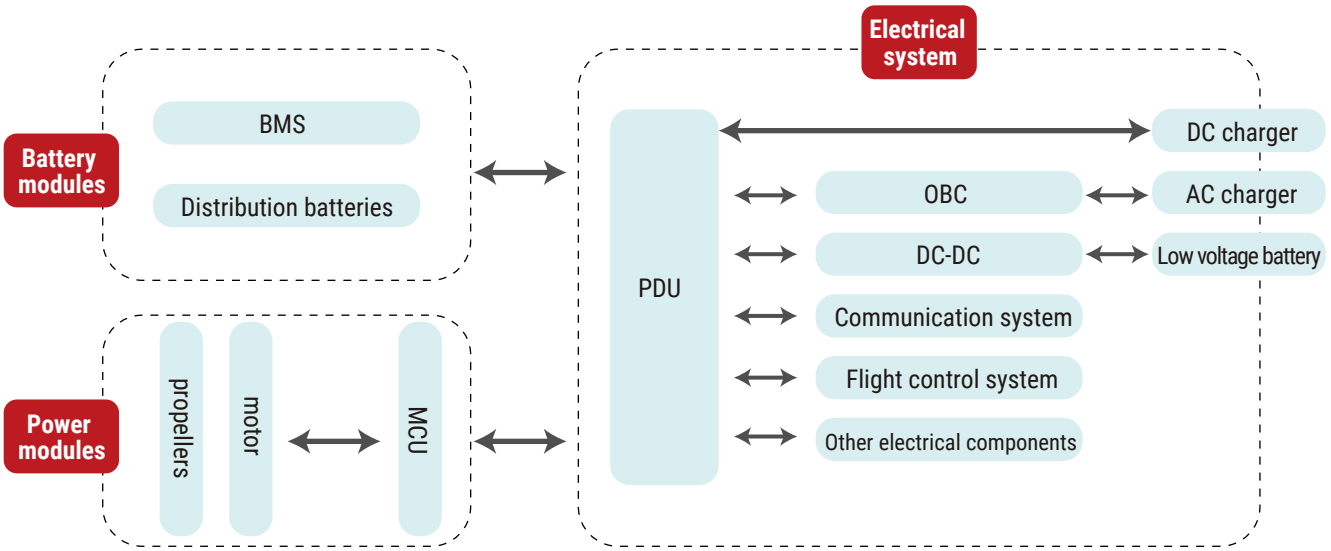
Communication interface: Built-in USB/LAN/CAN



IT8000 regenerative electronic load

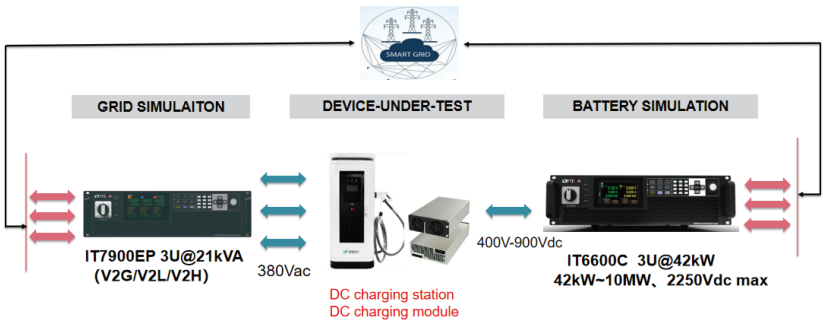
eVTOL - Charging Device Test Solution

Similar to the EV, the eVTOL has two types of charging: DC charging and AC charging. AC charging is performed by the internal on-board charger, OBC, which converts AC to DC to charge the battery.

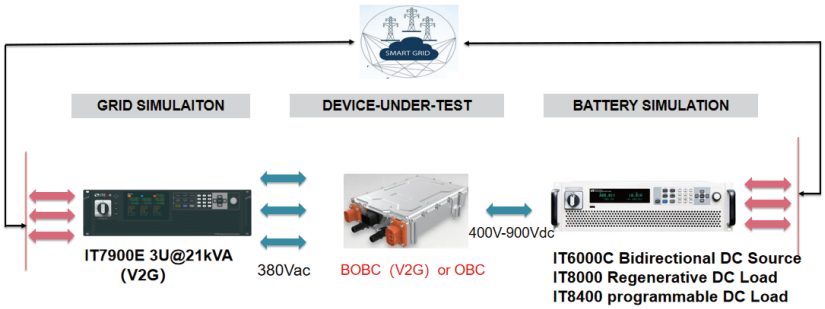


OBC test

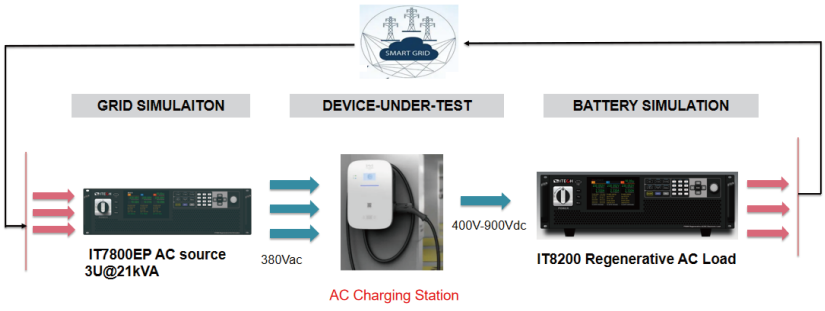
▶▶▶ DC charging pile module test



▶▶▶ OBC (AC-DC) test



▶▶▶ Electrical performance test of regenerative AC charging pile



Testing of aircraft on-board electrical equipment

In aircraft, there is always a contradiction between the power supply system and the power user: the power user requires uninterrupted, transient-free, pure sine wave AC supply and pulsation-free, transient-free DC supply, while the power supply system expects the power user to be a constant load and should not have a distorted voltage waveform due to the fluctuation of the load. In fact, neither the power supply nor the power user can satisfy the above idealized requirements, and thus only appropriate compromises can be made from the entire electrical system. Therefore, all on-board electrical equipment used in aircraft needs to pass stringent immunity tests at the very beginning of the design process to ensure that the equipment is able to maintain normal operation within the tolerable disturbance limits.

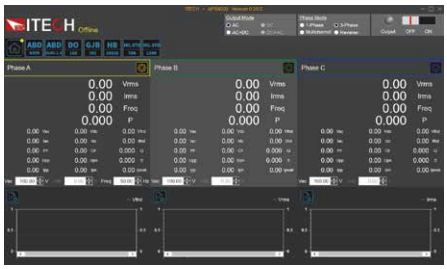
In order to accelerate the power supply adaptability verification process for aircraft power equipment, ITECH has launched the APS4000 series of aviation power system simulation software, which, together with the IT7800/IT7900P series of high-performance programmable DC power supplies, can realize a variety of DC and AC output waveforms stipulated by the aircraft power supply standard. For example, harmonic distortion, non-normal voltage transients, and so on. The software interface is simple and friendly, with built-in test item numbers corresponding to the regulations, users only need to select the corresponding regulations and standards and test numbers to open the test, saving engineers a lot of test editing time and configuration time.

APS4000 Models

Model	Regulatory Standards	Revision
APS4000-ASTD	MIL-STD-704、DO160 、ABD0100.1.8 (A380) 、ABD0100.1.8.1 (A350)、GJB181B、HB20326	MIL-STD-704：Rev A/B/C/D/E/F DO160：Rev E/F/G A380： Rev D/E A350：Rev C GJB181B：Rev B HB20326：Rev 2016
APS4000-B787&AMD	B787、AMD24C (A400M)	
APS4000-AVALL	MIL-STD-704、DO160、ABD0100.1.8 (A380) 、ABD0100.1.8.1 (A350)、GJB181B、HB20326、B787、AMD24C (A400M)	
APS4000-1399	MIL-STD-1399-300	

Application

- Cabin entertainment systems
- Aircraft lighting system
- Airborne radar system
- Communication and navigation Systems
- Flight recording system
- Cockpit display system
- Aircraft control systems
- Atmospheric data and inertial reference systems



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YOUR POWER TESTING SOLUTION

Test Instrument

- AC/DC Power Supply
- AC/DC Electronic Load
- Power Analyzer
- Battery IR Tester
- Battery Simulator
- High Precision SMU
- Battery Charge/discharge Test System

Test Solution

- Power Supply/Battery Test Solution
- Semiconductor/Electronics/LED Test Solution
- PV/Smart grid Test Solution
- EV/Automotive Electroncis Test Solution
- 5G communnication/IOT/Medical Electronics Test Solution
- Education/Commercial Aviation Test Solution

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