

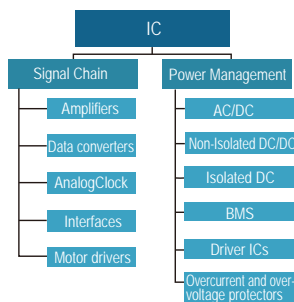




# Semiconductor Test Solutions

Equipment and facilities used in various sectors including automotive, green energy etc., are becoming smarter and electrified. A largely electrified and automated world places greater demands regarding electrical safety than ever before. To ensure safety while further reducing power consumption and size, semiconductor products with advanced power and analog technologies are often used. From wide bandgap. (WBG) materials such as silicon carbide (SiC) or gallium nitride. (GaN), power MOSFETs and gate drivers to state-of-the-art imaging, depth sensing and connectivity devices, ITECH products can help semiconductor manufacturers and system integrators to test discrete semi conductor devices, power semiconductor devices, power management chips and other downstream products, not only to improve the system-level performance of semiconductor products, but also to improve design efficiency and facilitate market launch. ITECH's main test areas for semiconductors are in the areas of automotive electronics, optical communications, new energy management, motor drives, LED drives for commercial and automotive lighting, and continued efforts in energy infrastructure, industrial automation, smart buildings and power conversion.

Classification and applications of IC

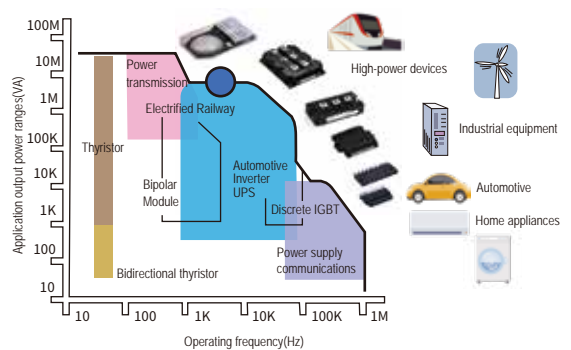


Leading Analog IC Suppliers(\$M)

2020 Rank	Company
1	Texas Instruments
2	Analog Devices
3	Skyworks Solutions
4	Infineon
5	ST
6	NXP
7	Maxim
8	ON Semi
9	Microchip
10	Renesas

Figures include sales from acquired companies in 2019 and 2020. Source:IC Insights,company reports

Power Device Applications



Analog chips are divided into the power management chips and the signal chain chips, the former include LED drive circuits and linear regulators, ADC/DAC converters, CPU power monitoring circuits, lithium battery charging management chips, the overvoltage protection circuits, and load switches, etc. non-driven power management products. The latter include amplifier chips (such as operational amplifiers, audio amplifiers, video drivers, etc.), analog switches, and interface circuits, etc. It is widely used in the fields like communications, automobiles, computer peripherals, and consumer electronics, among them the consumer and communications sectors account for the largest proportions. Systems that require power need the power management chips basically, this chip takes the largest proportion among all the analog chips, around 53%, it is an important component of power semiconductors.

Throughout the world's IDM leading or fabless companies of analog chips, ITECH already provides solutions directly or indirectly to these leading chip companies.

Power semiconductors are the core of power conversion and circuit control in electronic devices, mainly refers to semiconductor discrete devices that can withstand high voltage or high current, and also used to change the voltage and frequency in electronic devices, DC to AC conversion, etc. For the development of the third-generation semiconductors, which is led by SiC and GaN, thanks to the market demand for hybrid and electric vehicles, power supplies and photovoltaic (PV) inverters, they will enter a period of rapid development. For the Key Players in the Global Power Semiconductor Market, Including Infineon Technologies, Texas Instruments, ON Semiconductor, Fuji Electric, STMicroelectronics Semiconductor, Mitsubishi Electric Group, Semikron International, and Toshiba Corporation.

The development of these four fields has greatly promoted the demand for semiconductor equipment



### IoT

Logic devices for computing and image processing



### Big Data Storage

Memory chips for data storage



### AI

Image sensors for light perception and imaging



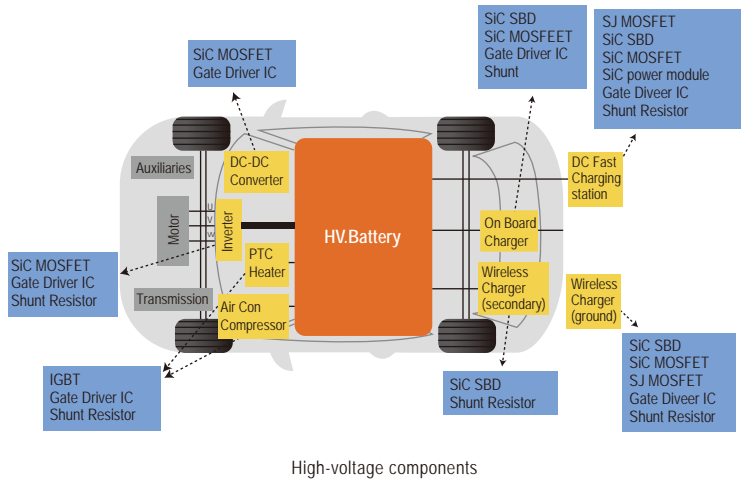
### EV and Automatic driving

Power Devices for Efficient Energy Conversion and Control

DUT	Recommended products	Advantages
<b>Automotive electronics</b>		
E-fuse	IT6000 High Power DC Power Supply	High voltage, high current, many steps
	IT-M3900 High Power DC Power Supply	Low voltage high current
	IT8900A/E High Power DC Electric Load	High power, high current, built-in timer
Mobility inverter (IGBT, MOSFET power semiconductor)	IT6000 High Power DC Power Supply	High voltage bidirectional current, high power density
	IT7900 Grid Simulator	Four quadrant, simulate grid, high power density
BMS protection board	IT6000C Bidirectional DC Power Supply BSS2000 Battery Simulator Software	Simulate battery , bidirectional current seamless switch
<b>Industrial medical field (Sensor testing, manufacturing and production)</b>		
3D Gyro Sensor	IT-M7700 High Performance AC Power Supply	Ultra-tiny size, three-phase application
Hall Effect Sensor	IT-M3900C Bidirectional DC Power Supply	Bidirectional power supply with Low voltage and high current
Semiconductor ion injection	IT-M3900 High Power DC Power Supply	Tiny volume with low voltage and high current
Semiconductor sealing test	IT8700P Multi-Channel DC Electronic Load	Multi-channel, master-slave parallel, high precision, low ripple, fast loop, no current overshoot, and load under low voltage
Solid State Relays, Photorelays	IT6000 Series High Power DC Power Supply	High power, high current, multiple steps
	IT-M3900 High Power DC Power Supply	Low voltage and high current
	IT8400 High Performance DC Electronic Load	High voltage, double power in short time with time measurement
Laser semiconductor	IT6900A Wide Range DC Power Supply	Current without overshoot
Chip and components aging	IT-M3100D Dual Channel DC Power Supply IT-M3300 Regenerative DC Electronic Load IT-M3400 Bidirectional DC Power Supply	Regenerative load, 16*16 channels synchronization, PC software control in compacted size
<b>Consumer electronics</b>		
LCD, LED, Mini-LED, AMOLED, OLED display driver IC	IT-M3100D Dual-Channel DC Power Supply	Multi-channel, high precision, low ripple, fast loop, no current overshoot, load under low voltage
	IT8700P Multi-Channel DC Electronic Load	
	IT8912E LED Test DC Electronic Load	CR-LED mode, hardware LED emulation, fast and accurate
OLED power-up test	IT-M3100D Dual Channel DC Power Supply	Multi-channel timing controllable, tiny size
Power management chip	M3100D Dual Channel DC Power Supply IT8700P+ Multi-Channel DC Electronic Load IT-M3200 High Precision DC Power Supply	Up to 16 channels, parallel operation available for high power density and high-precision testing
Power and battery management chips	IT-M3400 Bidirectional DC Power Supply	Bidirectional current with small size and multi-channel, available for simulate battery
	IT-M3600 Regenerative Power System	
IoT products	IT6400 Bipolar DC Power Supply	High accuracy, battery simulation, built-in waveform detection
	IT-M3200 High Precision DC Power Supply	Current readback resolution up to 10nA, tiny size
<b>5G and communications</b>		
Optical communication module	IT6341C Dual-Channel DC Power Supply	Low-voltage with high-current, high-voltage with low current

# Power Semiconductor Testing

- Power semiconductors, IGBTs, MOSFETs, etc. are widely used in BLDC, high power DC-DC power supplies, home appliances, step drivers, inverters, etc.
- SiC MOSFETs can penetrate any application where IGBTs are currently used. Some common uses include high voltage switching power supplies, hybrid and electric vehicle chargers, electrified rail transportation, welding machines, lasers, industrial equipment, and high-temperature operating environments where high-temperature operation is critical.
- The two main applications for SiC are solar inverters and high voltage data centers. The high DC voltage helps reduce the size of wire, junction boxes, connectors, and minimize energy losses, thereby increasing efficiency. Most large photovoltaic systems currently are moving from 1kV DC bus to 1.5kV bus.
- Similarly, data centers using 380-V distribution networks can increase DC voltage to 800 V.



Several aspects of the current-voltage relationship are studied under pulsed transient conditions. Figure 1 shows typical output characteristics at high power levels to show self-heating effect at  $T = 25^{\circ}\text{C}$ . Power semiconductors, such as IGBTs and MOSFETs are required to test the power cycle aging test and double pulse test, as shown in Figure 2, Airtex IT6000 and IT-M3900 series can meet the needs of customers with high voltage and high current. Other life tests such as high temperature and high voltage reverse bias test, high temperature gate reverse bias test can use for IT-M3200, IT-M3100, and feed-back load IT-M3300 series for test.

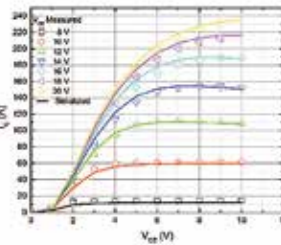


Figure 1. IGBT Ic vs Vce curve

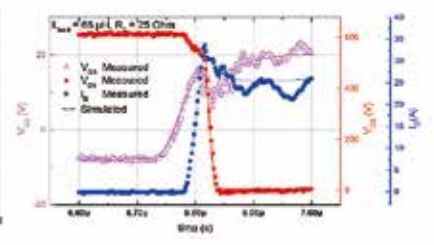


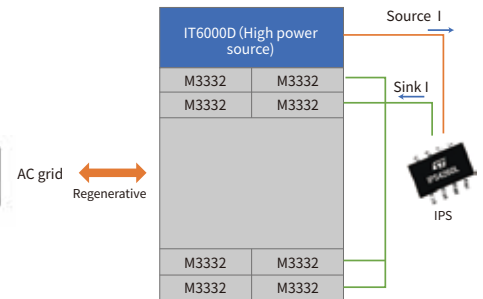
Figure 2. Double pulse circuits are widely used to evaluate switching characteristics of power semiconductors

## IT-M3300 Regenerative DC Electronic Load

- Efficient power feedback capability, suitable for long time aging test
- Ultra-tiny, multi-channel synchronous control
- Temperature measurement function
- Comprehensive protection features



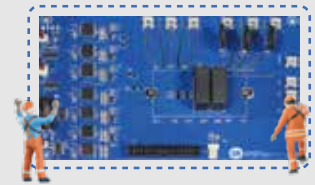
IT-M3300 Feed-back electronic load



Testing of Intelligent Power Switch (IPS)

### Testing Requirements

The MOSFET PCB has a nominal AC voltage input of 3 x 400 V/231 V AC 50 Hz.  
 The nominal voltage in the DC link is 600 V. The maximum voltage in the DC link is 800 V.  
 An AC power supply with current limiting circuit is required.



## IT7800 High Power AC/DC Power Supply

- 3u 15kVA
- AC, DC, AC+DC, DC+AC multi-mode output
- Single and three phase, inverted phase output can be set (15kVA or more)
- Arbitrary waveform generation, simulating the grid
- Programmable output impedance
- Built-in IEC standard test waveforms

## IT6000 High Power DC Power Supply

- 80V~2250V, single machine 5kW~144kW
- High power density 3u 18kW
- Bi-directional power supply, source, load and Power System family
- List programming steps are not limited, with fast voltage rises and falls speed
- Adjustable output impedance
- Arbitrary waveform generation function



IT7800 High Power AC Power Supply



IT6000 Series High Power DC Power Supply

**IT-2800 Source Meter****Coming soon**

- Set five equipment in one: voltage source, current source, voltmeter, ammeter and ohmmeter
- High precision 4 quadrant output, support 2 line and 4 line measurement
- Resolution up to 100fA, 6 1/2 Settings and display resolution
- Pulse output capacity (200V and 40V models)

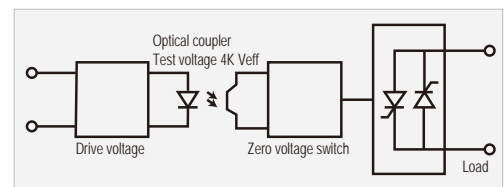


## Solid State Relay

Solid state relay, abbreviated SSR, is a new type of solid-state electronic components with relay characteristics, consisting of semiconductor components to replace traditional electrical contacts as switching devices. Single-phase SSR is a four-terminal active device, in which there are two input control terminals and two output terminals. There is optical isolation between input and output terminals. When DC or pulse signals are added to the input terminal to a certain current value, the output terminal can change from the off state to the on state. Solid state relay currently has been widely used in computer peripheral interface devices, electric heating thermostat system, CNC machinery, remote control systems, industrial automation device; Signal lamp, mixer, stage lighting control system; Instrument and meter industry, medical instruments, photocopiers, automatic washing machines; Automatic fire protection system, security system, as well as power capacitor switch with compensated power factor and so on. In addition, SSR are widely used in chemical, coal and other need explosion-proof, moisture-proof, anti-corrosion occasions. Over current is the main cause of permanent damage to SSR internal output SCR. Many loads produce a large surge current at the moment they are switched on. Therefore, when selecting solid state relay, it is extremely important to ensure a certain current margin.



SSR and Heat Sink



Functional Modules of Solid State Relays

### IT-M3900 High Power DC Power Supply

- Low voltage ,high current and wide range output, 10V can output 510A, high voltage can reach to 1500V
- Bidirectional current
- Synchronous multi-channel, system construction
- High power density, 6kW in 1U



IT-M3900 High Power DC Power Supply

### IT8400 High Performance DC Electronic Load

- Double power loading in short time (< 3s), save money for customers
- Faster dynamic loading speed, simulating driving conditions
- Master and slave parallel connection, more flexible on power and easier for expansion
- High voltage to 1200V, high power up to 600 kW, it is suitable for EV relays testing



IT8400 High Performance DC Electronic Load

## Laser Test

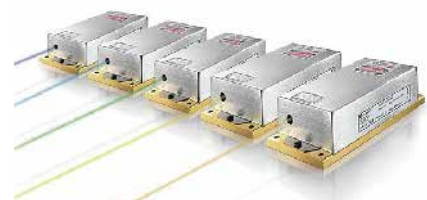
**Customer** Laser chip manufacturers, equipment manufacturers that package laser chips, such as Lidar, laser medical beauty equipment, laser display etc., driverless technology and other fast developing laser areas.

**Test Requirements** Lidar has extremely high requirements for power supply, and Lidar supplies power with constant current.

**Traditional Test** The traditional power supply defaults to CV loop priority, so the speed of suppressing current overshoot at the moment of startup is slow.

### IT-M3100D Dual-Channel DC Power Supply

With CC / CV priority, users can adjust the loop speed according to test requirements. For example, setting it in CC priority mode can quickly suppress the current overshoot.



IT-M3100D Dual-Channel DC Power Supply

### IT6900A DC Power Supply

- Special model, no current overshoot
- Switch + linear structure, low ripple, low noise



IT6900A DC Power Supply

## Hall Current Sensor

Hall effect principle, using the isolation method to convert the current within  $\pm 100A$  into linear voltage output, suitable for a variety of isolated current sampling occasions, such as DC input side of photovoltaic string inverter, MPPT (maximum power point) tracking current detection, bus current and each bridge arm current sampling in industrial inverter devices, UPS and Server power and isolated current sampling in charging station.

### IT-M3900B/C Series Regenerative Power System

- Modular design, single unit current up to 510A  
Current up to kA class when connected in parallel
- High power density, 5kW in 1U size
- Bi-directional current



**Measurement Method Of  
Currentmagnetic Field**

current lead  
magnetic core

Measuring range: 0A~ $\pm 2000A$

Advantage: no heat generation,  
no energy loss  
Disadvantages: large footprint

## Photovoltaic Power Optimizer

Power optimizer industry standard: IEC62109-1 IEC61000-6-1 IEC61000-6-3 NB/T 42143

### Regulatory Testing Requires — Basic Performance And Functionality

- Static MPPT efficiency test
- Dynamic MPPT efficiency test
- Transition Efficiency
- Input/output parameter test
- Rated power voltage range test
- Control component output power
- DC input overvoltage protection/overload protection test
- Reverse polarity protection
- Short circuit protection test
- Automatic startup/shutdown test
- Overcurrent protection function test

Output power range: 300W~1100W  
Voc voltage range: 60V~125V  
Voltage rang: 60V~80V

#### Product

- IT-M3300 Regenerative DC electronic load
- IT-M3800 Regenerative DC electronic load
- IT-M3400 Bi-directional DC power supply
- IT-M3900C Bi-directional DC power supply
- SAS1000L PV simulation software



## LCD, LED, Mini-LED, AMOLED, and OLED Display Drive IC

### Battery Simulation

- IT-M3400 Bidirectional DC Power Supply
- IT-M3600 Regenerative Power System
- IT6400 Series Bipolar DC Power Supply / Battery Simulator

### Test Advantages

- Maximum output power of single channel up to 15 W ,  
output voltage max.  $\pm 60 V$ , output current max.  $\pm 10A$
- Bipolar dual-range output
- Accurate Battery Simulation
- Ultrafast transient response time < 20  $\mu s$
- Current display resolution up to 1nA
- Waveform display function

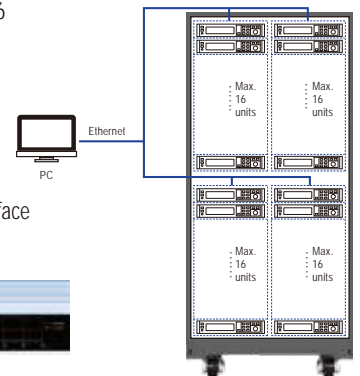


### R&D Test and Aging Test

- IT-M3100D dual-channel DC power supply
- IT-M3100 Ultra-compact Wide Range DC Power Supply
- IT-M3200 High Precision DC Power Supply
- IT-M3300 Regenerative DC Electronic Load

### Test Advantages

- Multi-channel design supports maximum 16\*16 channels with synchronous operation function
- High precision and high resolution, 1mV/1mA
- Current readback is up to 10nA
- 1U half rack only
- Support various optional communication interface



## Ki Cordless Kitchen Standard

Under the new Ki Cordless Kitchen Standard, wireless charging transmitters can be concealed under the countertop, and the cordless transmitter can be placed simply and intuitively on the countertop to receive up to 2.2kW of power safely and efficiently .

Wireless Power Consortium members include Apple, ASUS, Belkin, Bosch, Canon, CPS, Dell, Delonghi, Delphi, E.G.O., Google, Haier, Huawei, Ikea, Lenovo, LG, MediaTek, Mophie, NXP, Panasonic, Philips, Samsung, Sony, TDK, Verizon Wireless, Xiaomi, and OPPO, and so on.



"Ki Cordless Kitchen"

### IT7800 AC Power Supply IT8200 AC Electronic Load(coming soon)

- Meet customer demand of 1.5KW ~ 2.4KW
- High power density
- Simulate grid fluctuation

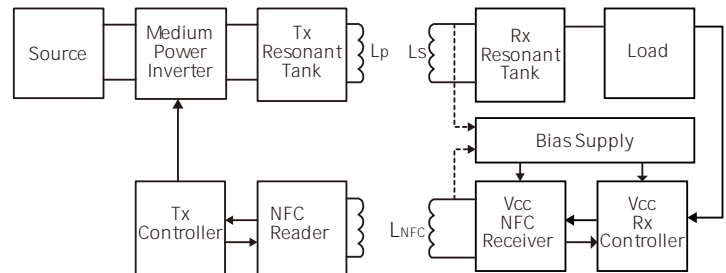


fig.3 Power Conduction and Reception

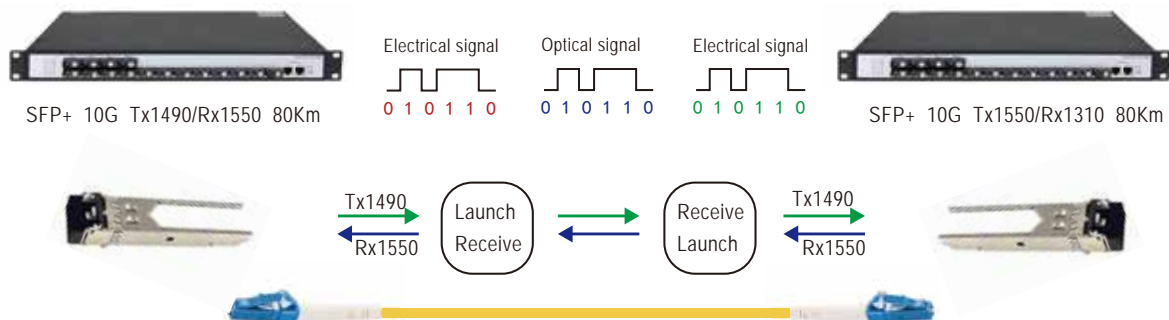
## 5G Optical Module Test

Optical fiber interconnection in the digital economy era, if there is no optical module, the data center cannot operate at all. The application of cloud computing and big data technologies has driven the acceleration of the construction of global super-large data centers, and has led to an increase in the industry's demand for high-speed optical modules, which has promoted the iterative update of optical modules. At the same time, the construction of 5G network is poised to take off, prompting the telecom optical module market to enter a rising cycle with broad prospects.

The main application range is Ethernet, Fibre Channel, SDH and SONET, etc., and can be used in equipment such as optical transceivers, switches, optical routers and optical network cards.

The electrical parameters of the chip also follow the electrical properties of the semiconductor. The threshold operating voltage is generally 0.7V, rated about 3V, and some COB chips can reach about 16V; The current is usually tens to hundreds of mA, but the maximum COB chip can reach 16A, and may be higher in the future;

The requirements of the optical module on the test equipment are as follows: low power, high speed, high precision, low ripple, and full protection function etc.;



### Test Requirements

The dynamic response time of the power supply should be less than 20us, the voltage rising and falling time should be less than 5ms, and the current accuracy should be at mA level.

### IT6341C Dual Channel High Precision DC Power Supply (5V/16A 16V/5A)

- High resolution, high precision and high stability
- Over voltage protection, over heat protection
- Series and parallel working mode, used to improve the output capacity of voltage or current
- High resolution up to 1mV/1mA
- Widely used for testing in various fields such as optical communication module, semiconductor, chip and integrated circuit, industrial ATE, laboratory, production line, maintenance, etc.



IT6341C Dual channel high precision DC power supply

