“More than Moore” Engineering Services

SITRI Shanghai Industrial μTechnology Research Institute

About Shanghai Industrial µTechnology Research Institute

Shanghai Industrial µTechnology Research Institute (SITRI) is a new kind of international innovation center, focused on globally accelerating the innovation and commercialization of “More than Moore” (MtM) technologies to power the Internet of Things (IoT). SITRI provides a complete ecosystem of resources, services and expertise to support the wide range of IoT technologies, markets and applications.

To enable innovations in the field of "More than Moore", SITRI consists of five key sectors, including an advanced "More than Moore" pilot line under research and development, the early investment funds focused on the new generation of information technology and the application of IoT, the comprehensive "More than Moore" engineering technical service platform, a comprehensive supply chain and ecosystem in the process of common improvement, and the extensive and professional marketing support .

We offer the resources, support and services for the whole product life cycle of innovation – from commercialization of new technologies, to engineering complete products and systems, to engaging with the supply chain, customers and partners domestically and internationally. With SITRI and SITRI’ s global innovation network, you get access to the industry’ s best resources and an efficient and effective path to success.

SITRI has expertise drawn from across the industry in key technology areas, resources, and industry related services with a global network of SITRI offices and talent. This is augmented by SITRI’ s extensive partnerships and industry associations across the university, research, supply chain, and OEM sectors, and acts as the hub for efficient global development of the IoT and MtM markets.

"More than Moore" Engineering Technical Service Platform

SITRI's engineering technical service platform aims at "More than Moore" technologies and enterprises in the field of IoT, relying on the advanced analysis and test equipment, in-house developed EDA software and an international and experienced team to provide professional technical analysis services, testing services, design services and intellectual property services.

The platform is dedicated to providing professional services to help enterprises address the challenges facing early IoT startups, namely a lack of supporting industries, unclear market direction, confusing ecosystem of products and technological solutions, a slow and costly dependence on repeated trial and error development path, and subsequent high costs for development and penalties for mistakes. SITRI's engineering services aim to improve China's IoT and "More than Moore" industrial ecosystem, reducing the entry barriers, enhancing the vitality of enterprise competition, so as to provide all-around support for the rapid and robust development of the IoT industry. With the aid of this platform, SITRI and our partners can maximize the respective advantages of your technology and allocate the technology and market resources so we can jointly promote the innovation within your IoT technology.

√ Support engineering test
√ MEMS wafer level test and final test
√ IGBT testing
√ Analog and mixed IC testing

√ Domestic leading technical service capability
√ Comprehensive and professional technical service portfolio:
- System analysis
- Process analysis
- Circuit analysis
- Industry consulting

√ Provide various design services Covering IoT related requirements
√ CMOS design services
√ MEMS design services
√ RF design services

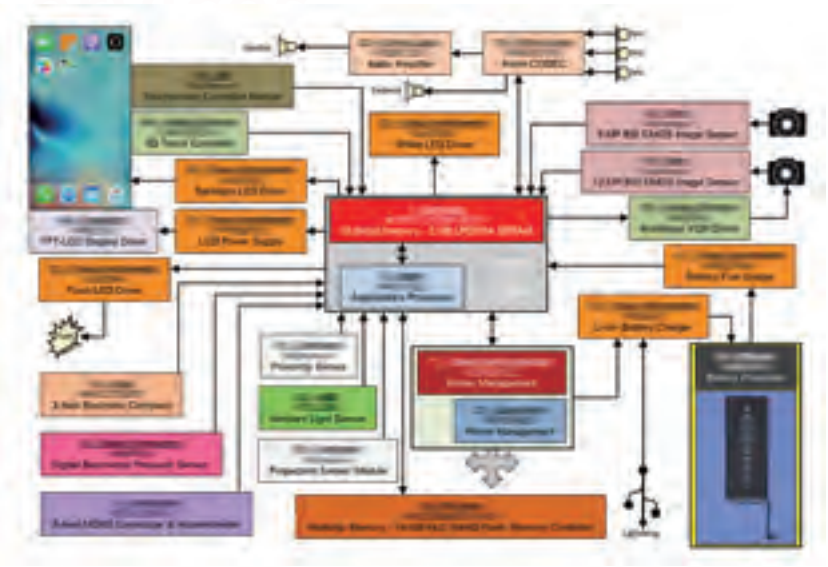
√ Patent infringement analysis
√ Patent strategic layout
√ Defense of publicly known technique
√ Patent value evaluation
√ Patent and technology transfer

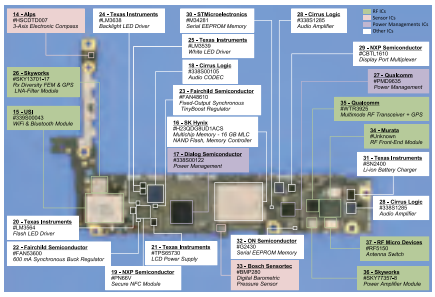
Technical analysis and Consulting

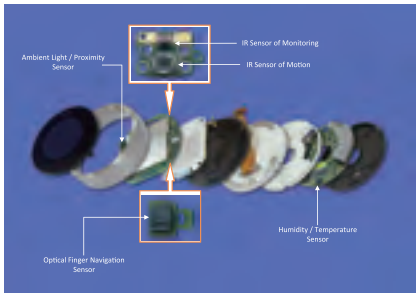
Technical analysis services including four parts of system analysis, process analysis, circuit analysis and industry consulting services to provide professional analysis and consulting services to the industry on device level, chip level and system level.

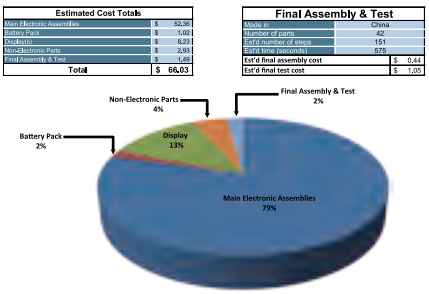
System Analysis

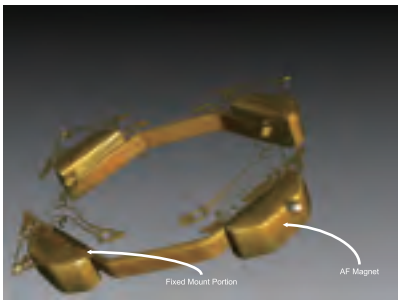
SITRI' s system analysis provides valuable information on system design and material cost of electronic products for innovative enterprises and research institutes, through technical analysis on various products including smart phones, wearable devices, smart home and other smart terminals based on the comprehensive product analysis database SITRI develops.











System Analysis Services

- Physical component structure analysis
- Material list analysis
- System design analysis
- Manufacturing cost analysis
- Chip level analysis

Customer Needs Addressed

- Competing products analysis
- Design reference
- Patent intelligence
- Product definition

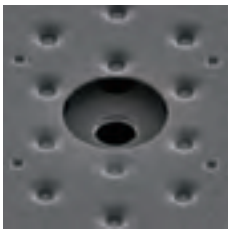
Customers Served

- Electronic product manufacturing enterprises: Mobile phone, smart home, wearable electronics, etc
- Electronics module and component suppliers: IC suppliers, module suppliers, solution providers, etc
- IC design houses, industrial media, intellectual property rights institutions

Process Analysis

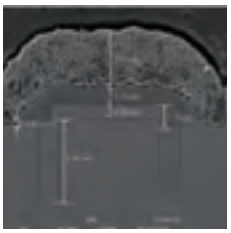
Process analysis helps users to obtain a comprehensive understanding of chip encapsulation design, process workflow, material composition and other various aspects of information. Analysis is performed on devices as MEMS and sensors, RF circuits, power management ICs, power devices and computing ICs, and analysis items include semiconductor process, material composition, packaging technology and manufacturing cost, so as to provide solutions to the users.

Encapsulation analysis



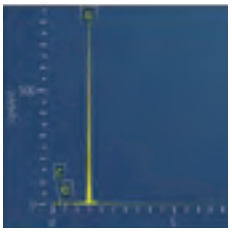
Microstructure analysis

Chip process analysis

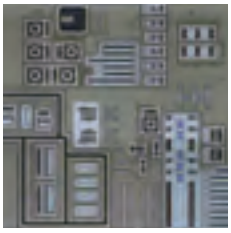


Device type analysis

PCB analysis



Material analysis



Dyeing analysis

Process analysis

Process Analysis Services

- Encapsulation analysis
- Microstructure analysis
- Chip process analysis
- Device type analysis
- PCB analysis
- Material analysis
- Dyeing analysis
- Process analysis
- Storage unit analysis

Technical Ability

- Able to handle BGA encapsulation, LGA encapsulation, QFN encapsulation, ceramic encapsulation, flip chip and various types of encapsulation
- Use of physical and chemical methods to perform layer de-processing on the dies for up to 12 layers of copper process
- Apply advanced SEM, OM and IR photography equipment for device observation
- Minimum line width processed down to 14 nanometers
- Applicable to CMOS Bipolar BiCMOS, MEMS, III – V group, optical electronic, etc.

Customers Served

- Fabs, OSAT and semiconductor materials suppliers
- IC design houses and Research Institutes
- IC designers, testers and intellectual property management personnel

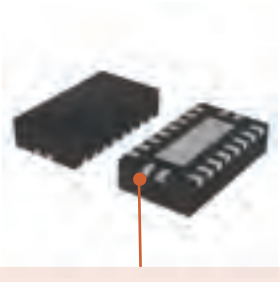
Customer Needs Addressed

- Competing products analysis, market research and strategy formulation
- Product definition, design reference, cost
- Patent infringement analysis

Circuit Analysis

For circuit analysis, SITRI adopts professional physical and chemical methods to perform precise layer processing, takes pictures on dies layer by layer with high magnification optical microscope and scanning electron microscope (SEM), merges and aligns images of each layer, annotates devices and extracts net list, and then organize the net list into hierarchical and functional circuit diagram based on analysts' knowledge and understanding, in RCAD™, SITRI in-house developed software,

Analysis Methodology



Sample Preparation

Remove encapsulation and perform processing layer by layer. Encapsulation removal is applicable to general plastics, BGA, ceramics and other kinds of forms of encapsulation. Obtain dies from package and remove layer by layer the metal and oxide isolation layers.

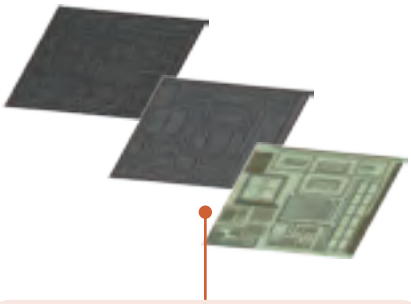
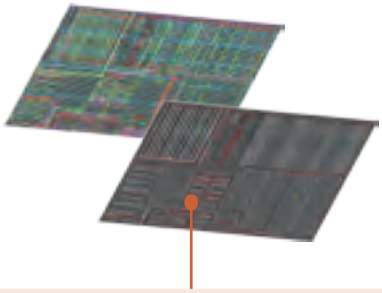


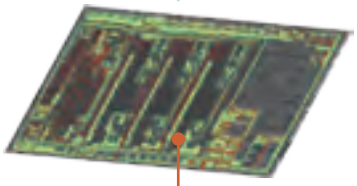
Image Acquisition and Alignment

Perform high-magnification shooting on metal layers, polycrystalline layer and substrate layer. Conduct stitching and alignment of each layer to obtain the complete photo database.



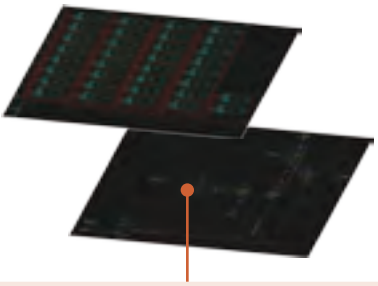
Device and Connection Annotation

Based on analog and digital cell database, identify the chip unit and path or via on the picture of the chip being stitched and aligned, and the process is called "Marking".



Net List Extraction

RCAD™ software automatically converts the "Marking" into circuit connection relations and forms the "Net list". RCAD™ provides net list checking tools to perform DRC, ERC and other inspections on the "Net list", so as to ensure the correctness of the net list.



Circuit Arrangement

Based on the "Net list", establish clear circuit diagram at the transistor/device unit level, and create the functional unit for the repeated same function module, so as to improve the readability of the circuit.

System Analysis

Through the analysis on the mechanism of circuit, arrange for the function module on the basic circuit diagram to form the hierarchical circuit from the system block diagram to the underlying transistor level.

Technical Advantages

- Excellent circuit analysis capability on the aspects of MEMS, Power, RF, ADC/DAC, PA, and etc., with appropriate physical and chemical methods to perform de-processing on dies, up to 12 layers for copper process.
- Equipped with advanced SEM, OM and IR photography equipment and provide high-definition pictures on dies layer by layer
- Independently developed RCAD™ software for image acquisition, processing and stitching, device and connection annotation, net list extraction and hierarchical circuit analysis, so as to ensure the correctness of device identification and circuit analysis
- With MEMS, RF, SoC and other fields of circuit design experts to provide technical support for the circuit analysis, so as to ensure the quality of circuit analysis
- Capable analyst team of proven experience in circuit analysis

Deliverables

- RCAD™ format circuit analysis report
- Original picture data
- EDA compatible format, such as EDIF

Customers Served

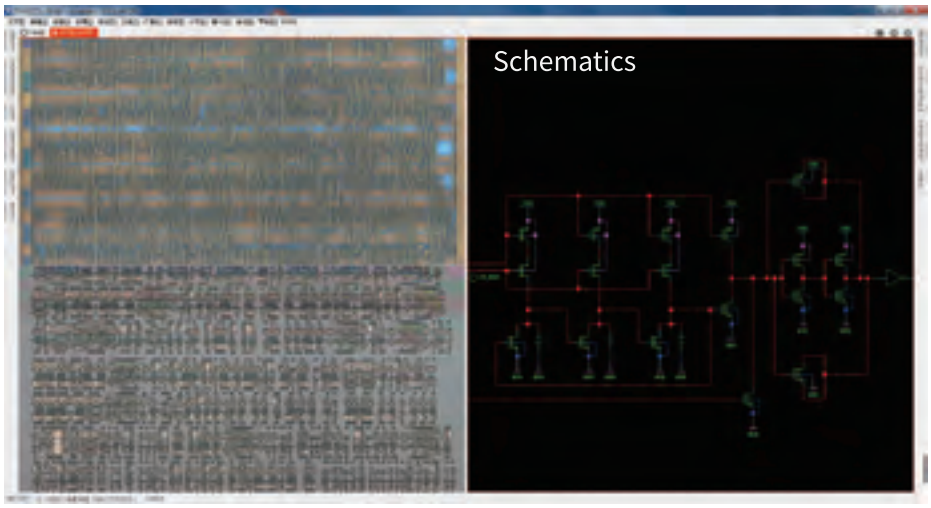
- Fabs, OSAT and semiconductor materials suppliers
- Chip design enterprises and research institutes
- Chip designers, testers, and intellectual property management personnel

Customer Needs Addressed

- Competing products analysis, market research and strategy formulation
- Product definition, design reference and cost analysis
- Patent infringement analysis

RCAD™ (Reconstruction of Circuit Schematics for Analysis of the Design) suite is developed independently by SITRI to provide a full range of software support for analysis on end products, integrated circuits and MEMS devices.

As an EDA software, RCAD™ supports the entire analysis cycle of product disassembly and chip/MEMS analysis, from picture taking, de-processing to image merging, to net list and circuit extraction, and to final data delivery.



Featured with advanced image recognition algorism, various cell database and user-friendly interface, RCADTM has considerably improved the work efficiency for circuit analysis, proven to be an effective tool for technical personnel to better understand the development trend and shortened the product development cycle; at the same time, RCAD™ is also handy for intellectual property professionals to understand the technical details of the released products, so as to protect clients' own technology

Industry Consulting Services

SITRI' s technical service platform also offers customized technical consulting services for partners, in addition to one-stop services concerning technical analysis.

Industry Research Services

The industry research services of SITRI applies the new generation of information technology as the core, with the IoT application area as the research scope, combines with the influence and complete research and development layout of SITRI in the industry and gathers the experienced industrial expert advisory committee and analyst team to provide professional industry research and information services for industrial development, government policy, investment and financing, etc., with the commission to becoming the think tank of the information technology and the IoT industry of China. Currently the industry research of SITRI provides two major types of consulting services: One is customized market consulting or industry planning, the other is industry analysis report update, and at present the key areas covered include:
MEMS/sensors, IGBT/power semiconductors, BioMEMS/microfluidics, automotive electronics, etc.

Technical Expert Consulting Services

As the innovation and industrialization center of "More than Moore" technology and IoT application, SITRI has established an R&D team with wide coverage of technical fields and outstanding technical abilities, and can provide a full range of technical consulting services in multiple fields including sensing technology, radio frequency technology, SoC technology, new energy technology, biological medical technology and so on for the partners. At the same time, SITRI continually builds the global talent pool, which can position the top experts in more fields rapidly and assist the partners to solve all kinds of technical problems, break through the key technology and speed up the industrialization process.

Industrial Resources Consulting Services

As the important industry platform in the "More than Moore" field, SITRI has extensive influence worldwide. We have industry partners all over the world in the major industrial cluster areas, and have established extensive cooperation with the leading institutions and enterprises mainly in the industry-university-research cooperation, supply chain, contract manufacturing, marketing and other aspects. SITRI provides consulting services, shares with partners the global industrial chain resources, allocates the technology and market resources more efficiently so as to jointly promote the innovation of the IoT technology.

Testing Services

The testing service platform provides MEMS, power device and integrated circuit product testing services, covering the test scheme formulation, test program development, mass production test and device/wafer level testing. In addition, SITRI' s senior technical experts can provide professional advice in the product design, manufacturing and other processes to speed up the product performance optimization and shorten the product time to market.

MEMS testing services include MEMS wafer level test, MEMS final test, IGBT test, IC wafer level test and IC final test.

Test Type	Device Type
MEMS wafer level testing	Accelerometer, gyroscope, microphone and pressure sensor
MEMS final testing	Accelerometer, gyroscope, humidity sensor, pressure sensor, magnetic sensor and temperature sensor
IGBT power component testing	Single chip MOSFET, single chip IGBT, single chip diode and IGBT module
Analog and mixed signal testing	LED driver, power management IC, analog switch, operational amplifier, lithium battery protection

MEMS Wafer Level Test

MEMS Wafer Level Test

SITRI offers the only automation MEMS dynamic and static wafer testing system that provides services to the public in Asia, dedicated to testing the capacitor structure of MEMS devices, including gyroscopes, accelerometers, pressure sensors, microphones, etc. It mainly collects the dynamic and static parameters of the main measurements of MEMS, including resonant frequency, quality factor, attenuation coefficient, cohesiveness, orthogonal error, as well as the capacitance, leakage current, etc.

Advantages of SITRI' s MEMS wafer test system:
- Dynamic measurements on wafer level MEMS
- Applicable to a wide range of wafer
- No special requirement for power or size
- Compatible with traditional capacitance test

MEMS Final Test

MEMS Final Test

SITRI' s MEMS final test system is the first 11-axis MEMS final test system that provides services to the public in Asia, dedicated to the MEMS sensor + ASIC circuit post encapsulation testing system. The system integrates triaxial rotation, triaxial flip, triaxial electromagnetic excitation and temperature control and other functions, can also be converted into pressure test mode. It supports post encapsulation testing on devices including gyroscopes, accelerometers, magnetic sensors, pressure sensors, temperature sensors, etc.. Key parameters of MEMS devices can be measured and collected, including zero output, noise, sensitivity, cross axis sensitivity, linearity, temperature drift, and etc.

Advantages of SITRI' s MEMS final test system:
- Automatic loading and unloading
- Provide three temperature test environment
- Rapid pressure generating setting time < 2S
- High test efficiency, with up to 144-site for parallel testing
- Integrate gyroscope, accelerometer and magnetometer 9DOF testing
-Support encapsulation sizes ranging from 1mm to 5mm

IC Test

IC Test

SITRI' s high performance automatic IC testing system aims at analog/mixed tests on all kinds of linear circuits, power management ICs, LED drivers, SIM card control circuits, analog switches, lithium battery protection ICs, operational amplifiers and a series of large module decimal products. It can collect product operating current, frequency, reference voltage, reference current, conduction resistance, saturation conduction voltage drop, threshold voltage, switching time, offset voltage, open loop gain and etc..

Main characteristics of SITRI' s IC test system:
– High precision floating V/I source
– High voltage, large current source option
– AC source table, arbitrary waveform generator and digitizer
– Multi range optional
– With up to 16-site for parallel testing
– Substation concurrent test function
– Fully improve the test efficiency to reduce cost

IGBT Module Test

IGBT Module Test

SITRI' s IGBT test platform is based on the world leading IGBT module testing system, and is a high power test system with the integration of dynamic and static parameters. The system can provide a dynamic and static test current of up to 4000A, a dynamic voltage of up to 4500V, a static voltage of up to 7000V, and can be applied to dynamic and static testing on household electric cars, commercial electric cars, photovoltaics, wind energy, smart grid, rail transportation and high-speed rail and other IGBT modules.

Main characteristics of SITRI' s IGBT test system:
– Parameter test complies with IEC60747-9
– Circuit parasitic inductance < 90 nH
– Short circuit current of up to 6000A
– Provide high temperature test environment
– Cycle test mode can be set
– DIY test conditions according to test plans

Mixed Signal Test

Mixed Signal Test

SITRI' s mixed signal test system is a new generation of test machine with both SoC and RF support. It offers a comprehensive solution for high speed and radio frequency applications. Configured with different sorting machines, it can be switched between wafer level testing and device final test.

Main characteristics of SITRI' s mixed signal test system:
– Single test head supporting 20 slots
– Support up to 3648 digital test channels
– Support up to 6.4 Gbps high speed test
– Support a variety of voltage test and current test plates
– With direct docking connection
– Better signal transmission

Design Services

The main areas of the design services are ultra-low power SoC design services, ASIC design services, RF front-end design services and MEMS design services.

Facilitating IoT Interdisciplinary Innovation

Today the biggest challenge for the engineers in the field of IoT is the need to highly integrate the MEMS, analog, digital and RF technology in the system design so as to achieve maximum performance and efficiency. SITRI' s design service platform provides customized design services for "More than Moore" related devices, including the MEMS sensors which are with the widest market demand at current, RF devices, low power consumption embedded chips, etc., so as to realize the MEMS, RF, analog and digital technology interdisciplinary technical integration, innovation, mass production and marketization.

- **Ultra Low Power SoC Design Services**
  SITRI' s SoC design services are based on the first general 32-bit ultra-low power consumption MCU chip design platform, has realized IoT sensor information acquisition, linking and system integration, providing Turnkey design services from market specification to tape out, as well as the back-end manufacturing and project management services including the encapsulation testing.

- **ASIC Design Services**
  CMOS design services focus on the low power consumption circuits with sensor interface and cost-effective embedded logic circuits. SITRI' s ASIC design services provide Turnkey design services from market specification to tape out, as well as the back-end manufacturing and project management services including encapsulation testing.

- **RF Front-end Design Services**
  Based on the world leading RF-SOI process, SITRI' s RF design services include RF switch, low noise amplifier (LNA), power amplifier (PA) and other RF devices design services and Turnkey design services for partners, and help partners establish independent design and production capacity.

- **MEMS Design Services**
  SITRI' s MEMS design services help partners rapidly implement MEMS device prototyping and pilot production, based on which, according to the production process specification, transfer the production process to various OEM factories, so as to realize the mass production of MEMS devices. In addition, SITRI also provides the encapsulation and testing of final products, so that the partners can truly gain access to the world's top customized MEMS research and development resources.

Intellectual Property Services

Intellectual property service platform provides "More than Moore" technology fields patent value evaluation, patent infringement analysis, intellectual property strategic planning, M&A technology due diligence support, patent transaction support, patent operations and other professional advisory services.

Protect the Freedom to Operate Rights of Enterprises

Intellectual property right is the core asset of modern enterprises, and in the fierce competition of IoT, the innovation and creativity for its protection in the field of technology is particularly valuable. If there is no continuous technical innovation or the adoption of the intellectual property rights for its protection, the product/technology will be in the risk of depreciation, homogeneity or even direct copy. Effective intellectual property management can maximize the financial returns for the technology-based companies, so as to reduce the risk of patent infringement, accelerate the time to launch the product/technology to the market, simplify the intellectual property management process, reduce the cost and make more accurate business decisions.

SITRI intellectual property right services aim at the IoT and "More than Moore" enterprises in the technology field, relying on solid technical background, professional test and analysis ability, profound industry understanding with the combination of professional intellectual property rights and legal knowledge, to effectively protect the partners' innovation achievement, at the same time, to protect partners against intellectual property infringement damage, and to ensure that the partners can gain sufficient freedom to operate.

Services Offered

- Patent infringement analysis
  - √ Circuit patent infringement analysis
  - √ Process patent infringement analysis
  - √ Structure patent infringement analysis
  - √ Encapsulation patent infringement analysis
  - √ Layout patent infringement analysis
- Defense of publicly known technique
- Patent map
- Patent value evaluation
- Patent and technology transfer
- Patent strategic layout

Advantages for the Customer

- Professional and comprehensive semiconductor technology analysis ability
- Have broad and in-depth understanding of the electronic industry as a research and development platform
- Excellent team of intellectual property rights and legal team partner

Customer Needs Addressed

- Intellectual property strategic planning
- Maintain intellectual property rights benefits
- Provide support for technology and patent merger
- Patent pool forming and operations

Customers Served

- Fabs, encapsulation factories and semiconductor materials suppliers
- Chip design enterprises and research institutes
- Chip designers, testers and intellectual property management personnel

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