

Investment Opportunities in the Autotronic Products Industry in Taiwan

I. The development background of autotronics industry

Affected by the oil crisis and global warming and so on factors, energy saving and environmental protection issues have received global attention. In order to respond to the slow economic growth, the growth ratio of car ownership has gradually reduced. With the arrival of the aging society, and in response to the elderly population and traffic congestion problems, vehicles are becoming more digital and intelligent with electronic control and more human-friendly, they will be able to improve traffic safety and transport efficiency, to achieve environmental protection, energy saving, comfort, safety, to reduce of environmental burden caused by traffic. Thus, the objectives of industrial innovation and economic revitalization can be achieved.

The demand in the global automotive markets has moved towards diversified, customized development. The traditional mechanical approaches have failed to meet people's desire to own a safe, environmentally friendly, and comfortable car. As a result, the automobiles have been integrated with electronic control technologies such as sensors, micro-controller unit (MCU), the image and display (camera & display), on board unit (OBU), satellite positioning, wireless communications, semiconductors, power devices, and even portable devices are used to connect vehicles with the customer service center via wireless links. These components provide features or services such as cleanliness, low pollution, comfort, active and passive safety, security, emergency rescue, road guidance, and so on to meet the demand from the vehicles and people. A dense supply chain of automotive electronics industry has been formed, and the applications and development of autotronics product development have brought new

opportunities for the automotive industry.

Autotronics is entering a rapid growth stage, the reasons why product quantity and values have been increasing each year are (1) Automotive sensors and the semiconductor technology are mature, and their costs have been reduced. (2) Car manufacturers use the autotronics products to increase competitive advantages, and to meet the demands of product differentiation. (3) To improve engine efficiency and to lower fuel burn through mechanical or electronic control. (4) Consumers improved their awareness of vehicle safety (active, passive safety). (5) The increased demand for wireless information and communication for cars.

(I) The definition of autotronics

The definition of autotronics can be divided into two kinds: one is the automotive electronic control devices which were integrated with the mechanical system in the vehicle applications. Automotive electronic control is a combination of mechanical and electrical devices, they include engine power, sensor system control (images, acceleration, pressure or temperature, etc.), electro-mechanical control (X-by-wire, electronic fuel injection systems, ABS, skid control, electronic control suspension, electronically controlled automatic transmission, etc.); the other kind is the on board autotronic devices which are electronic devices that can be operated independently in a car environment, they're not directly related to the automobile's performance, safety, or control, they include integrated on board machines, satellite navigation systems, audio-visual entertainment systems, etc.

Autotronic components include IC components, CPU, memory, micro-processor controller, various sensors, and so on basic components. A wide range of automotive electronics industry includes six areas: engine/transmission system (such as electronic ignition system, automatic transmission, etc.), suspension/chassis system (including power steering, chassis control, ABS braking system, etc.), car body systems (including lamps, air conditioning,

sunroof, etc.), on board information and communications, active or passive safety systems (airbags, anti-collision radar, etc.), and anti-theft security system.

(II) Product categories of autotronics

The classification of associated autotronic products and technology includes the system integration of key components such as sensors, micro-controller, camera & display, actuators, semiconductors, power components (power devices) and other key components; according to their features, they're used in intelligent vehicles' body, engine/transmission, active/passive safety, security, on board data and communication, electronic control of electrical power, suspension and chassis systems, etc.

The examples of associated products and technical classification of autotronics are: (1) Car body: for example, LED front lights; (2) Engine/transmission: electronically controlled fuel injection; (3) Active, passive safety: for example, adaptive cruise control system (ACC), adaptive front light system (AFS), smart airbag, tire pressure monitoring system (TPMS), reversing radar, etc; (4) Security: keyless entry; (5) On board information and communication (Telematics): GPS Navigation and various on board units, head up display (HUD), night vision system (NVS), on board audio-visual entertainment system, etc.; (6) Power electronics: for example, the current converters, power components of various clean vehicles such as hybrid electric vehicles (HEV), fuel cell electric vehicles (FCEV), etc.; (7) Suspension and chassis systems: electronic suspension, X-by-wire, as so on.

II. The development trends of autotronics industry

(I) The characteristics of autotronics industry

1. The demanding product application environment

Compared with the ordinary electronic products or even airplanes, the application environment of autotronics is very stringent, the requirement of

adaptability for temperature and climate is even higher, and various car manufacturers have different requirements on autotronics. The complexity of automotive functional requirements has increased, a very high ratio of autotronics and vehicle sensors must pass a stringent mechanical properties or physical verification, such as dust, humidity, salt, fuel additives, vibration and severe impact. Thus, it's necessary to have stringent standards; temperature is also an important factor to be considered, typically, automotive sensors must be able to withstand a temperature variation of $-40^{\circ}\text{C} \sim 120^{\circ}\text{C}$, and need to maintain a certain accuracy.

2. Careful division of labor and modularized products

Autotronics industry is moving toward a systematic, modularized manufacturing direction, and a product rarely exists as a single component. Take the on board monitor of vehicle information and communication products as an example, the upstream key components include glass, mask, color filters and other materials, the midstream modules include the display panel, driver IC, PCB, LCM, and so on, car factories, dealers or distributors are in the downstream. When observed from the industrial association of the products, there is a high degree of association among semiconductors, electronic components, monitors, etc.

3. Diversified products with low quantities

The automobile industry has been developed for over a hundred years, the automotive components have few types with high quantities and are standardized, with the development and integration of communication, electronics, optoelectronic, and so on technologies, the ratio of applications of autotronic components and products have been increasing daily, and the product demand usually do not have common standards and appear to have the characteristics of customization. For example, the protocol standard between the on board information and the communication products differ, and to increase

differentiation, car manufacturers consider the R&D of autotronics as a symbol of technical capacity. Their production modes usually follow the principal of large variety with small quantities, the cost of autotronics products is high, and their compatibility is low. Initially, they're used in special high-end vehicles, the key to introduce them in large quantity depends on whether the production cost can be reduced.

4. Product verification is time-consuming

There is a close relationship among car, driving, and the safety of passenger life. Autotronics and general electronics industry are absolutely different, each car manufacturer has a special specification that requires the operating temperature range, power consumption, and anti-interference and noise capability. The stringent standards of each car manufacturer must be met, it is also a basic technical skill that manufacturers in the autotronics arena must possess.

Because autotronic components usually require at least a few years of development time, autotronics products have evolved from the past single component product to system products integrating mechanical, optical, system, and electronic control, and so on. There is a wide range of associated technologies. During the development process, it needs to work with automotive or mechanical system control parameters, autotronic products have special attributes, they must have excellent shock resistance, weather resistance, and reliability, and autotronics products are closely related to a vehicle's travel safety. The product development cost is high and the product verification time is long. Autotronics products need to be tested continuously on the vehicle over tens of thousand of kilometers or a long time of real vehicle testing, problems can then be found in a continuous testing process, once a problem is encountered in the testing process, proper troubleshooting must be done. Repeated testing and verification is time-consuming and it is the most significant characteristic of autotronics products.

5. An industry with high barriers of entry

The current development of autotronics industry is mostly led by world class manufacturers. The primary technology leading countries are the U.S., Japan and Germany, large automotive electronics manufacturers include Visteon, Nippon Seiki, Delphi, Robert Bosch, Siemens VDO, Denso. There are automotive semiconductor manufacturers such as Motorola, Infineon, STM, Renesas, Toshiba, and so on. They all have gathered certain R&D results and experience, thus, the barrier is high to enter the autotronics industry.

6. Special product supply chains

In order to reduce the costs of direct materials and indirect materials, major car manufacturers speed up the procurement cycle, the autotronics industry gradually emphasizes international procurement and even joint procurement, after the reintegration, consolidation, merger, and alliance of the international car industries, the global automotive supply chains will face the issues of reorganization, shuffling, and so on, it's foreseeable that the international car manufacturers will shift their sourcing focus to the Asia-pacific regions, there is a trend for them to increase the OEM orders.

7. Long product life cycle

Automobiles are durable, consuming items with a long service life. The development period of general consumer electronics is 3 months, and their product life is 6 months. The product life cycle of autotronics products is long, the durable performance is demanding, the development and certification require several years, and the product life-cycle is between 10-20 years.

(II) The market driving factors of hot autotronics products

1. The supply side

A. Vehicle assembly plant, component plant, product system plant: to create product differentiation, the vehicle assembly plant, component plant, product

system plant are developing new products actively.

- B. Value added applications: vehicles are equipped with value added or new value creation products that improve safety, comfort and provide information. For example, ABS, vehicle navigation information, X-by-wire, etc.
- C. Product popularization: after the continuous progress and introduction of on board semiconductor and sensors, and so on electronic control technologies, a large amount of electronic products have been derived, some products became popular after mass production, e.g., car navigation unit, etc.
- D. Price segmentation: in response to consumer demand, the car electronics equipment, functions and types, etc. differ to form price segmentation. For example, the direct, indirect tire pressure monitoring systems.

2. The demand side

- A. Consumer: the consumer acceptance of autotronics products has been enhanced.
- B. Safety and comfort: the demand to improve the vehicle control safety and ride comfort.
- C. Performance: apply dynamic control products to improve car performance.
- D. Information and communication: due to the technical progress in wireless communication (GRPS, 3G) and the demand for real time information and mobile office, telematics service providers (TSP) which provides on board information and communication including call centers have become available.
- E. Audio and video entertainment: metropolitan areas, long distance travel and so on factors are causing congestion and delay, and there is a demand for entertainment for passengers in the back seats (movies, games).
- F. Environmental protection and energy-saving: with the applications of autotronic control products (engine after-treatment device, X-by-wire), there

is a high demand from the consumers for low pollution and energy-saving vehicles.

G. Remote diagnostics and security: there is a high demand for vehicle breakdown and safety protection, the on board and communication products have relevant features, and they can meet the demand from the consumers.

3. Policy side (public domain)

A. Regulations: Euro IV fuel consumption and pollution regulations, US mandatory tire pressure regulation, U.S. mandatory installation of smart airbag (FMVSS 208), E911, advanced countries to implement a carbon tax, COP3 (Kyoto Protocol), and so on are important factors that promoted the rapid development of autotronics.

B. The implementation of intelligent transportation system (ITS): Europe, U.S. and Japan actively developed intelligent transportation system, the popularization of infrastructure and advanced safe vehicles, are helpful to the promotion of car power products.

The future driving forces of automotive semiconductor markets came from various countries' regulations, competition, the demand from consumption, etc. and the rapid development of audio-visual entertainment and multimedia application development, car navigation system and on board controller area network (CAN) all promote the development of automotive semiconductor markets.

With the popularization of autotronics control, mechanical control will gradually be replaced by semiconductor components, the semiconductor components technology will provide a variety of features for car such as obstacle collision detection (vertical or horizontal collision detection), on board electronic equipment, auto PC, remote information processing system and anti-theft device, etc. In the next few years, the on board semiconductor market will grow

significantly. The degree of electronic control is higher in advanced countries such as Europe, North America and Japan, the demand for autotronics is high, on board semiconductor and sensor markets grew significantly; the number equipped in emerging countries is lower than that of the advanced countries, the demand for autotronics products is lower than that of the advanced countries.

III. The development status of Taiwan's autotronics industry and the investment opportunities for manufacturers

(I) Industry status of manufacturers that entered autotronics

The development of Taiwan's autotronics is limited by the original vehicle technology and the relationship with parent company of foreign technology, the manufacturers rarely invest in the engine/transmission, suspension/chassis, and so on. They're mostly confined to the vehicle electronics, automotive information and communications, and the security products; Table below shows the manufacturers in Taiwan that have entered the R&D of autotronics.

Table 1. The Manufacturers in Taiwan in Autotronics Industry

Field	Company
Active Safety	Cowearth Precision Technology, ATBS TECHNOLOGY, JOSN ELECTRONIC, LYSSSEN, Remostar Technology, TUNG THIH, VSS ENGINE MANAGEMENT SYSTEM, Argus Security, Universal Scientific Industrial, Zero One Technology, SHINEX ELECTRONIC, Long In Tech, Geroge Tang, HI SHARP ELECTRONICS, Neotech Photoelectric, Flexmedia Electronics, JJ INTERNATIONAL, KINGDOM COMMUNICATION, H.P.B. OPTOELECTRONICS, Nienhai Technology, WHETRON ELECTRONICS, AUTOEQUIPS TECH, Photic Electronics, WAIN DART, Fuho Technology, Mintron, Daiwoo, Epistar, DEPO AUTO PARTS, TYC BROTHER, Digimax, Chan Mao Technology, FUKUTA ELEC. & MACH., Tesor Plus, Vision Automobile Electronics, EPOCH ENERGY TECHNOLOGY, Taigene Electric, SHIHLIN ELEC RIC & ENGINEERING
Battery / Power	FUJITSU SEMICONDUCTOR, RESOURCE ELECTRONICS, TD HITECH

Management System	ENERGY, Renesas Technology, HOLTEK SEMICONDUCTOR, E-ONE MOLI ENERGY, Amita Technologies, DELTA ELECTRONICS, DROW ENTERPRISE, EXA Energy, Phoenix Silicon International, ABLYTEK, LINKCHAMP, Hua-chuang Automobile Information Technical Center
Vehicles Interface	Fabiatech, MKD Technology, BATON DIGITAL, E-innotech, Funtoro, FUJITSU SEMICONDUCTOR, Garmin, Mio Technology, TESOR PLUS, TUNG THIH, Nuvoton Technology, HOLTEK SEMICONDUCTOR, ICM, WHETRON ELECTRONICS, VISION-ELEC, E-Lead Electronic, JET OPTOELECTRONICS, PROSENSE TECHNOLOGY, WINSTAR Display, ASUKA SEMICONDUCTOR, CHAN MAO, Daiwoo Electroni, Hua-chuang Automobile Information Technical Center

Source: NPIE Bridge Program; Compiled by CDRI (2014/06)

(II) Investment opportunities for manufacturers

The following projects have been given to explain the investment opportunities for manufacturers:

1. Telematics products

There are many manufacturers that entered the telematics products development in Taiwan, and because they mostly belong to the after sales markets, there is a high independence in product development. They can be divided into two types: hardware (such as on board navigation machine), software (human-machine interface, voice recognition, etc.) and system service manufacturers (such as Yulon TOBE, Hsing-I Technology Co., Ltd., ASMedia Technology Inc., etc.), the development of Taiwan's telematics industry focuses on hardware devices such as satellite navigation modules, receivers, various on board machines, PDA that integrates mobile phones, and the management module for commercial fleet (such as taxis or trucks), etc. The mid- and downstream telematics products produced include embedded on board navigation machines, commercial fleet monitoring/control and positioning system, portable vehicle navigation devices, PDA-based navigation system and GPS OEM modules, car audio-visual entertainment equipment, etc.

2. Semiconductors and sensors

If the manufacturers use the product attributes and advantages of Taiwan's

semiconductor manufacturers wisely to enter the R&D of semiconductor components as second-line manufacturers, there should be opportunities to enter the supply chain of the complete vehicle manufacturers. They can then use it to receive training in the aftermarkets, to develop the strengths and opportunities to penetrate the OEM markets, to promote the use of the domestic components, Taiwan has excellent advantages in all of these areas.

Taiwan's IT industry chain is complete, there are a number of information products with international competitive advantages, some key components rank among top globally. Take advantage of Taiwan's ICT vendors' IC, semiconductor and sensor design and manufacturing capabilities to integrate autotronics system power components, drive controller, and so on control technologies. In addition, Taiwan has a fairly complete industrial chains of semiconductor, many semiconductors manufacturers have emerged to actively step into the autotronics to make arrangement, with on board information/communications products as the basic development to enter the sales and services markets, there's a wide range of vehicle information/communication products and power electronics/components, the entry barriers are relatively low and the manufacturers should plan early.

3. Products of vehicle safety

Most of Taiwan's auto parts plant are small to medium enterprises, they're limited by technology and resource applications, R&D costs, time, scale, testing, time consuming verification plus the requirement to coordinate with the original vehicle factories, and so on factors, the threshold for Taiwan manufacturers to enter the products of vehicle safety is relatively higher, as a result, there was little independent R & D performance in this area. Take the market share of Taiwan's vehicle lamp for example, it does not have an absolute advantage, and it does not dominate the prices. Currently, the global after sales vehicle lamp market still remains in fierce competition. When compared between the development trends of global autotronics and the R&D structure of Taiwan's autotronics products, if Taiwan component makers can utilize the product

development capacity wisely, they should remain competitive with the applications of new technologies. How to develop competitive products quickly is a priority, take Taiwan's vehicle lamp export market as an example, there should be more opportunities to penetrate the market via after sales services. The new generation of concealed telematics host met the requirements for miniaturization and low power consumption. The product integrates the Taiwan Navigation Software and electronic map, customized multimedia framework, and communication technologies such as bluetooth, WLAN, and so on and the second-generation telematics system which adopts the ARM core framework. The product features such as remote vehicle diagnostics, lane departure warning, and so on will be added, and there should be opportunities to penetrate these markets.

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- F. Environmental protection and energy-saving: with the applications of autotronic control products (engine after-treatment device, X-by-wire), there is a high demand from the consumers for low pollution and energy-saving vehicles.
- G. Remote diagnostics and security: there is a high demand for vehicle breakdown and safety protection, the on board and communication products have relevant features, and they can meet the demand from the consumers.

3. Policy side (public domain)

- A. Regulations: Euro IV fuel consumption and pollution regulations, US mandatory tire pressure regulation, U.S. mandatory installation of smart airbag (FMVSS 208), E911, advanced countries to implement a carbon tax, COP3 (Kyoto Protocol), and so on are important factors that promoted the rapid development of autotronics.
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Battery / Power Management System	FUJITSU SEMICONDUCTOR, RESOURCE ELECTRONICS, TD HITECH ENERGY, Renesas Technology, HOLTEK SEMICONDUCTOR, E-ONE MOLI ENERGY, Amita Technologies, DELTA ELECTRONICS, DROW ENTERPRISE, EXA Energy, Phoenix Silicon International, ABLYTEK, LINKCHAMP, Hua-chuang Automobile Information Technical Center
Vehicles Interface	Fabiotech, MKD Technology, BATON DIGITAL, E-innotech, Funtoro, FUJITSU SEMICONDUCTOR, Garmin, Mio Technology, TESOR PLUS, TUNG THIH, Nuvoton Technology, HOLTEK SEMICONDUCTOR, ICM, WHETRON ELECTRONICS, VISION-ELEC, E-Lead Electronic, JET OPTOELECTRONICS, PROSENSE TECHNOLOGY, WINSTAR Display, ASUKA SEMICONDUCTOR, CHAN MAO, Daiwoo Electroni, Hua-chuang Automobile Information Technical Center

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2. Semiconductors and sensors

If the manufacturers use the product attributes and advantages of Taiwan's semiconductor manufacturers wisely to enter the R&D of semiconductor components as second-line manufacturers, there should be opportunities to enter the supply chain of the complete vehicle manufacturers. They can then use it to receive training in the aftermarkets, to develop the strengths and opportunities to penetrate the OEM markets, to promote the use of the domestic components, Taiwan has excellent advantages in all of these areas.

Taiwan's IT industry chain is complete, there are a number of information products with international competitive advantages, some key components rank among top globally. Take advantage of Taiwan's ICT vendors' IC, semiconductor and sensor design and manufacturing capabilities to integrate autotronics system power components, drive controller, and so on control technologies. In addition, Taiwan has a fairly complete industrial chains of semiconductor, many semiconductors manufacturers have emerged to actively step into the autotronics to make arrangement, with on board information/communications products as the basic development to enter the sales and services markets, there's a wide range of vehicle information/communication products and power electronics/components, the entry barriers are relatively low and the manufacturers should plan early.

3. Products of vehicle safety

Most of Taiwan's auto parts plant are small to medium enterprises, they're limited by technology and resource applications, R&D costs, time, scale, testing, time consuming verification plus the requirement to coordinate with the original vehicle factories, and so on factors, the threshold for Taiwan manufacturers to enter the products of vehicle safety is relatively higher, as a result, there was little independent R & D performance in this area. Take the market share of Taiwan's vehicle lamp for example, it does not have an absolute advantage, and it does not dominate the prices. Currently, the global after sales vehicle lamp market still remains in fierce competition. When compared between the development trends of global autotronics and the R&D structure of Taiwan's autotronics products, if Taiwan component makers can utilize the product development capacity wisely, they should remain competitive with the applications of new technologies. How to develop competitive products quickly is a priority, take Taiwan's vehicle lamp export market as an example, there should be more opportunities to penetrate the market via after sales services. The new generation of concealed telematics host met the requirements for miniaturization and low power consumption. The product integrates the Taiwan Navigation Software and electronic map, customized multimedia framework, and communication technologies such as bluetooth, WLAN, and so on and the second-generation telematics system which adopts the ARM core framework. The product features such as remote vehicle diagnostics, lane departure warning, and so on will be added, and there should be opportunities to penetrate these markets.