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Message from the Desk of Automotive Electronics

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1. Introduction

During 2001 over 57.5Million new automobiles were sold in the world. The figure for Japan was 5.8Million. In the future, sales of an even larger number of automobiles will continue across the globe.

Against a backdrop of rising interest in the global environment and widespread participation in environmental preservation activities, great attention is being focused on automobile resources and other environmental issues. Looking toward the future of automobile manufacturing development, a movement towards "power source revolution," "intelligent automobiles" and "information," that will transform the standard of "environment," "safety," and "comfort" has become apparent. In order to harmonize environment, safety and comfort at a far higher level, significant development of intelligent control for the various functions of the automobile is necessary. An information revolution is taking place in all social spheres, and along with this, the automobile has also begun a crucial shift toward "information." This article will discuss future developments in automobiles while focusing on three main themes—environment, safety and comfort. Furthermore, expectations related to electronics and semi-conductor technology that will be the driving force of this development will also be presented.

2. Environment

Automobile manufacturers have been developing a variety of technologies aimed at reducing exhaust emissions, improving fuel economy and developing and utilizing recyclable and reusable materials. In the future, automobile manufacturing that takes the environment into consideration at an even deeper level is essential. However, customers will not be satisfied if "environmentally friendly automobiles" are uninspiring to drive. In reality, hybrid vehicles are both environmentally friendly and extremely exciting to drive. They offer good take-off acceleration performance by using large torque from an electric motor, a smooth acceleration feeling through a continuously variable transmission mechanism, and quietness when stopped at traffic lights due to idle-stop, etc. Toyota Motor Corporation is proud to be leading the world in the manufacture of hybrid vehicles, having made a cumulative total of over 100,000 units. At present there are only three hybrid vehicle models, but we hope to increase the use of the hybrid system to all vehicle models in the near future.

3. Safety

A judgement method based on the strength of an impact exerted on the human body during collision is widely known as an evaluation method for automobile safety. The results of this evaluation method are expressed in terms of stars, for example, 5 or 6 stars. In order to raise this collision safety performance, seat belts and air bags systems are mounted in nearly all new models. However, safety is not simply about post-collision measures. According to calculations, even if collision safety performance was raised to the maximum extent possible, the number of road accident casualties would only be reduced by one-third. Toyota Motor Corporation is aiming to reduce the number of road accident casualties involving its vehicles to half by 2020. This means that it is necessary to improve active safety performance in order to prevent collisions before they happen. An Antilock Brake System (ABS), Brake Assist (BA), Vehicle Stability Control (VSC), etc., that stabilize vehicle behavior, are already in commercial use. Furthermore, an Electronically Controlled Brake (ECB) system mounted in hybrid vehicles in which every function is powered by electricity can execute control as far as vehicle behavior stabilization.

Moreover, the adoption of a vehicle surround monitoring system using a CCD camera and night-view equipment using an infra-red camera that can detect a potential collision two seconds before its occurrence, etc., are extremely useful for safety assurance. Even immediately prior to a collision, impact reduction devices contribute to raising safety performance. A pre-crash seat belt using a millimeter-wave radar is scheduled to be commercialized next year.

4. Comfort and Convenience

Navigation systems are installed in 50% of new automobiles in Japan. Navigation systems function as a

provider of dynamic road information by obtaining traffic jam information from outside. Such system are at the forefront of Intelligent Transport Systems (ITS). A fully-fledged telematic service using a next generation mobile phone, cdma 2000 1X, is scheduled to begin operation during this year. A bright future in which automobiles mounted with a communication means form a fundamental part of a ubiquitous network society is fast approaching. At first, 24 hour on-the-road service functions and security functions will become essential items. Moreover, it will no doubt be possible to obtain a wide-range of entertaining content by connecting with infrastructure at any time and in any place using an Internet connection function.

5. Electronic Devices

High reliability is required of the electronic control system that controls the fundamental functions of the automobile, such as running, turning and stopping. Accordingly, the components which are used in the electronics system must possess extremely high reliability. Furthermore, unlike the information machinery used within the passenger compartment, the electronic system requires a good environmental performance design that takes into account unique characteristics of its usage environment such as a wide temperature range, humidity, vibration, water and dirt.

1) Micro-processor

As the automobile electronics system has developed, the micro-processing unit (MPU) that is at the core of the system has also been advancing. As control expands to a larger scale and becomes more sophisticated, higher performance MPUs have become necessary. Increasing calculation speed and the adoption of flash ROMs that can easily be reprogrammed are required. Furthermore, substantial improvements in heat resistance levels are demanded since the MPU mounting position has shifted from the passenger compartment to the engine and the MPU has been integrated with the actuator.

2) Power devices

In order to address demands for energy conservation, the electrification of power steering, brakes, air conditioning, etc. that conventionally used hydraulic pressure has been proceeding, and thus the use of power chips that switch large currents is increasing. A large number of IGBTs are used in high voltage systems that switch currents of several hundreds of amperes. Thus, the requirement for such IGBTs in power devices has increased dramatically.

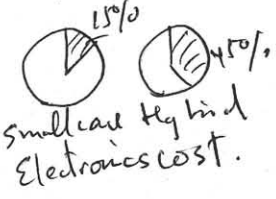
3) Sensors

Recently, semi-conductors and advanced computerization are being adopted in more and more sensors for detecting the state—engine speed, hydraulic pressure, acceleration, yaw rate, etc.—of the automobile. Semi-conductor sensors can utilize highly reliable semi-conductor manufacturing technology as well as integrate periphery circuits such as the amplifier circuit and temperature compensation circuit on top of the same chip. As a consequence, such sensors are suitable for use as automobile sensors, which require high reliability, miniaturization and low cost.

6. Conclusions

The automobile is a product that is steadily adopting a broad range of electronic technologies from power electronics to telematics. As a result, it is clear that close liaison between the automobile industry, the electronics industry and the semi-conductor manufacturing industry is essential now. It is our expectation that, by cooperating in their technological developments rather than working independently, technological developments will be further enhanced and automobile electronics will be developed more rapidly.

57.5 million unit 5700万台
15% GM, 12% Ford, 10% Toyota
Toyota. 580万台. 35% 北米, 33% 日本.



small car Hybrid
Electronics cost.