National Automotive Chip Standard System Construction Guide

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Preface

The automotive chip is the core component of automobile electronic system and an important foundation for the transformation and upgrading of the automobile industry. In comparison to consumer and industrial chips, the application scenario of automotive chips is more special, and the requirements for environmental adaptation, reliability and security are more stringent. It is necessary to take the actual needs of chip applications in automobiles into full consideration, effectively carry out the standardization work of automotive chips and better meet the needs of automotive technology and industrial development. At the same time, with the vigorous development of the new energy automobile industry, the intelligence, networking and other technologies are accelerating the integration application in the automobile field, and the technical advancement, product coverage and application maturity of China's automotive chips are constantly improving, which also lays a good foundation for the standardization work of automotive chips.

To thoroughly implement the requirements of the *National Standardization Development Outline* and the *Implementation Plan for the Leading Engineering of Standardization in New Industries (2023-2035)* and other requirements, carry out scientific planning and systematically deploy automotive chip standardization work, guide and standardize automotive chip function, performance test and selection and application and promote the sound and sustainable development of the automotive chip industry, the Ministry of Industry and Information Technology sorted out and prepared the *National Automotive Chip Standard System Construction Guide* to build a standard system architecture based on the automotive chip technological structure and application scenario needs, put forward the overall architecture, content and key construction direction of standard system construction on the basis of automobile technology logical structure, give full play to the guiding and regulating role of standards in the development of the automotive chip industry and provide support for building a sustainable automotive chip industry ecology.

I. General requirements

(I) Guiding ideology

Insist on the guidance by the Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era, fully implement the spirit of the Party's 20th CPC National Congress, further promote the new industrialization, actively implement the requirements of the *National Standardization Development Outline* and the *Implementation Plan for the Leading Engineering of Standardization in New Industries (2023-2035)*, accelerate the construction of manufacturing power, build a cross-industry and cross-area national automotive chip standard system that meets the needs of China's technology and industrial development, give full play to the fundamental, guiding and normative role of the standard, promote the development and implementation of the standard in an orderly manner as well as support and guarantee the sound and sustainable development of the automobile industry.

(II) Basic principles

Basing upon the situation of China, and making overall planning. Give play to the guiding role of the government in top-level design, organization and coordination and policy setting; encourage industry institutions and upstream and downstream enterprises along the industrial chain to actively participate; establish a standardization work pattern for the coordinated development of national standards, sector standards and association standards and form an automotive chip standard system suitable for China's national conditions pursuant to the development situation and characteristics of China's automotive chip technology and industrial development.

Prioritizing the basic standards and standards on the urgent demands. Carry out phased planning and layout of automotive chip standard system construction key tasks as well as continue to improve the standard system; rationally arrange the progress of formulating and revising standards and accelerate the research and development of urgently needed standard projects (such as basic standards, generic standards and key product standards) in line with industry development status and future application requirements.

Driven by innovation and promoting integrative development. Give play to the guiding role of standards in technological innovation, achievement transformation and overall competitiveness improvement; fully integrate the advantages of the automobile and integrated circuit industries in technology research and development, industrial development and marketing on the basis of being oriented by the needs of industrial innovation and development; strengthen overall planning and coordination of the industry and promote the healthy and sustainable development of the automotive chip industry.

Openness and compatibility, as well as dynamic perfection. Strengthen the adaptation of standards to the requirements of automotive chip application scenarios and constantly optimize and improve the automotive chip standard system dynamically in light of international and domestic industrial development trends; raise the level of standard institutional openness; pay attention to the coordination and compatibility of domestic and international standards; take an active part in the formulation and coordination of relevant international standards and regulations and make contributions to the development experience of China's automotive chip standards.

(III) Construction target

Establish and improve China's automotive chip standard system by stages according to the current situation of automotive chip technology, industrial application needs and future development trends. Enlarge the strength to preferentially formulate basic, generic and key products and other urgently needed standards and build the basis of automotive chip design, development and application; And then, gradually promote the development of product application and matching test standards as per the technology maturity to effectively meet the needs of market applications. Guide and promote China's automotive chip technology development and product application, develop the China's automotive chip technology independent innovation environment, enhance the overall technical level and international competitiveness and create a safe, open and sustainable automotive chip industry ecology by establishing a perfect automotive chip standard system.

Formulate more than 30 key standards for automotive chips, clarify the basic requirements (such as environment and reliability, electromagnetic compatibility, functional safety and information security), formulate technical specifications for key products and applications (such as controller, computing, memory, power and communication chips), develop the matching test method with whole vehicle and key system and meet the basic needs of security and reliable application and pilot demonstration of automotive chip products by 2025.

Developed more than 70 standards related to automotive chip, further improve the general requirements of basic and generic, product and technology applications, as well as matching tests; achieve effective support for forward-looking and integrated automotive chip technology and product development, basically complete the full coverage of typical application scenarios and test methods of automotive chips and meet the needs of building a secure, open and sustainable automotive chip industry ecology by 2030.

II. Construction idea

As for the automotive chip standard system, it is based on the automobile chip technological structure adapting to China’s automobile chip technology’s current situation and development trends. The automotive chip standard system technical logic structure subject to automotive chip application scenario requirements, with the general automotive chip requirements as the basis, various automotive chip application technical conditions as the core and the automotive chip system and whole vehicle matching test as the closed loop, is formed. With power system, chassis system, body system, cockpit system and intelligent driving system included and the "automotive chip application scenario" as the starting point and foothold, the structure extends upward to form various technical specifications and test methods of automotive chips based on application scenarios.

According to the content of the standard divided into three types of standards: basic and generic standard, product and technology application, as well as the matching test. The basic and generic standards mainly pertains to the generic requirements of automotive chips; Product and technology application standards are divided into several parts based on the basic functions of automotive chip products, and the corresponding standards are formulated in line with the maturity and development trend of technology and products; The matching test standard includes the matching test verification requirements of the automotive chip at the system and the whole vehicle levels. The full coverage of technical standards of key automobile chips from devices-modules-systems-vehicles under different application fields is jointly realized by the three types of standards. Please refer to Figure 1 for the technical logic structure of automotive chip standard system.

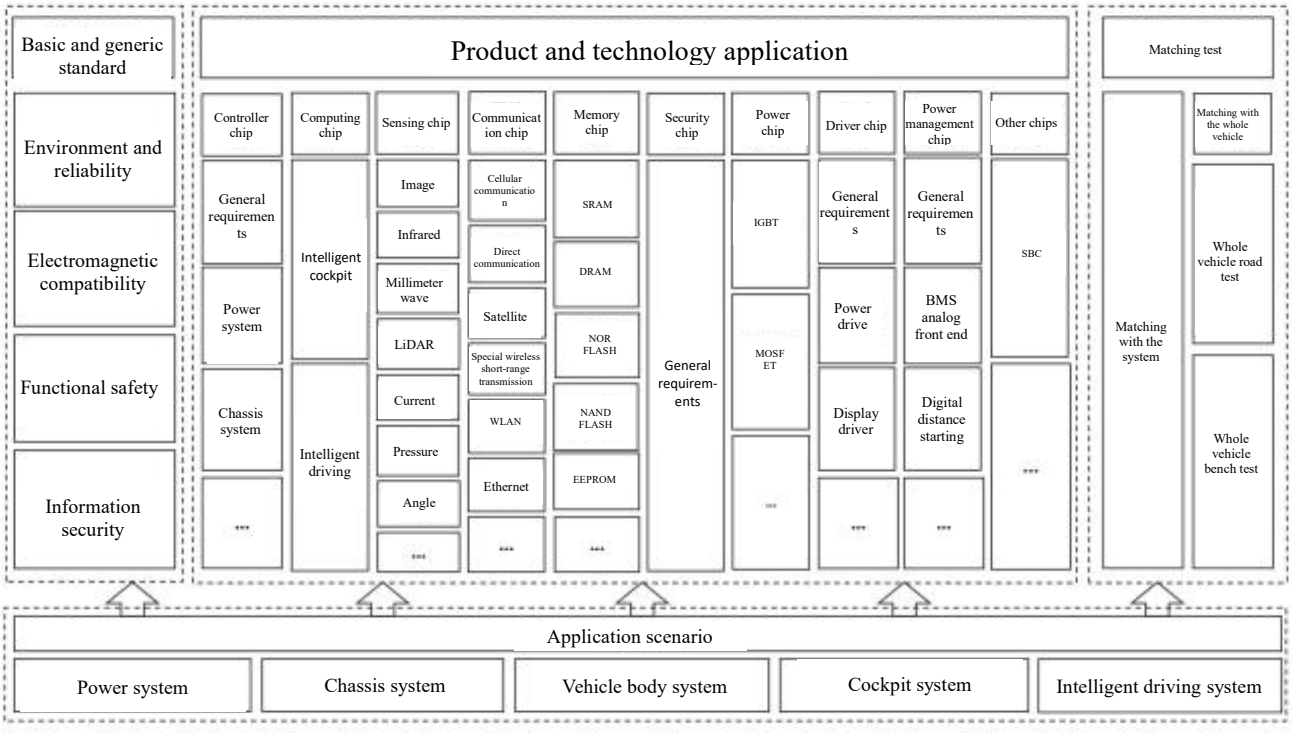

Figure 1 Structure Diagram for Automotive Chip Standard System Technical Logic

Application scenarios: The function and performance of the chip vary greatly in different component systems and different working scenarios, thus the application scenarios of automotive chips should be taken into full consideration for the technical logic of the standard system. Pursuant to the functions to be achieved for the automobile as an intelligent vehicle, the application scenarios of its chips are divided into power system, chassis system, body system, cockpit system and intelligent driving system.

Basic and generic standards: The common and generic requirements of automotive chip (mainly including the requirements of environment and reliability, electromagnetic compatibility, functional safety and information security) are extracted based on the automobile industry's application requirements for chip reliability, operational stability and security.

Product and technology applications: According to the different functions to be realized, the automotive chip products are divided into 10 categories: controller chip, computing chip, sensing chip, communication chip, memory chip, security chip, power chip, driver chip, power management chip and other chips. Furthermore, based on the specific application scenarios, implementation methods and main functions, the standard planning of various automotive chips is to be carried out. Among the various chips, the controller chip mainly involves general requirements, power systems, chassis systems and other technical directions; The computing chip includes chips for intelligent cockpit and intelligent driving; The sensing chip mainly involves the technical directions of visible light image, infrared thermal imaging, millimeter wave radar, LiDAR and all other kinds of sensors; The communication chip mainly involves in- and out-vehicle communication technology directions, such as cellular communication, direct communication, satellite, special wireless

short-range transmission, bluetooth, wireless local area network (WLAN), ultra wide band (UWB), Ethernet, etc. The memory chip mainly involves static random access memory (SRAM), dynamic random access memory (DRAM), non-volatile flash memory (including NOR FLASH, NAND FLASH and EEPROM) and other technical directions; The security chip refers to a chip that exists independently and provides information security services for the vehicle; The power chip mainly involves insulated gate bipolar transistor (IGBT), metal-oxide semiconductor field effect transistor (MOSFET) and other technical directions; The driver chip mainly involves general requirements, power drive, display drive and other technical aspects; The power management chip mainly involves general requirements, battery management system (BMS), digital isolator and other technical directions; Other chips include system basis chips (SBC), etc.

Matching tests: On the basis of meeting the general requirements of the chip and its own technical indicators, the automotive chip should also conform to the matching requirements of the component system and the whole vehicle under the automobile driving state, thus it is necessary to test and verify the matching between the chip and the system/vehicle. The vehicle matching includes two technical directions: whole vehicle road test and whole vehicle bench test.

III. Construction contents

(I) System structure

Pursuant to the technical logic structure of automotive chip standard system and the performance requirements, function requirements and test methods of various automotive chips in different application scenarios of automobiles, the automotive chip standard system architecture is defined as four parts: basics, general requirements, product and technology application, as well as matching test. At the same time, according to the similarity and differences in content scope, technical requirements and other aspects, the four parts are further subdivided to 17 subcategories with complete content, reasonable structure and clear hierarchy (as shown in Figure 2. The numbers in brackets are system codes).

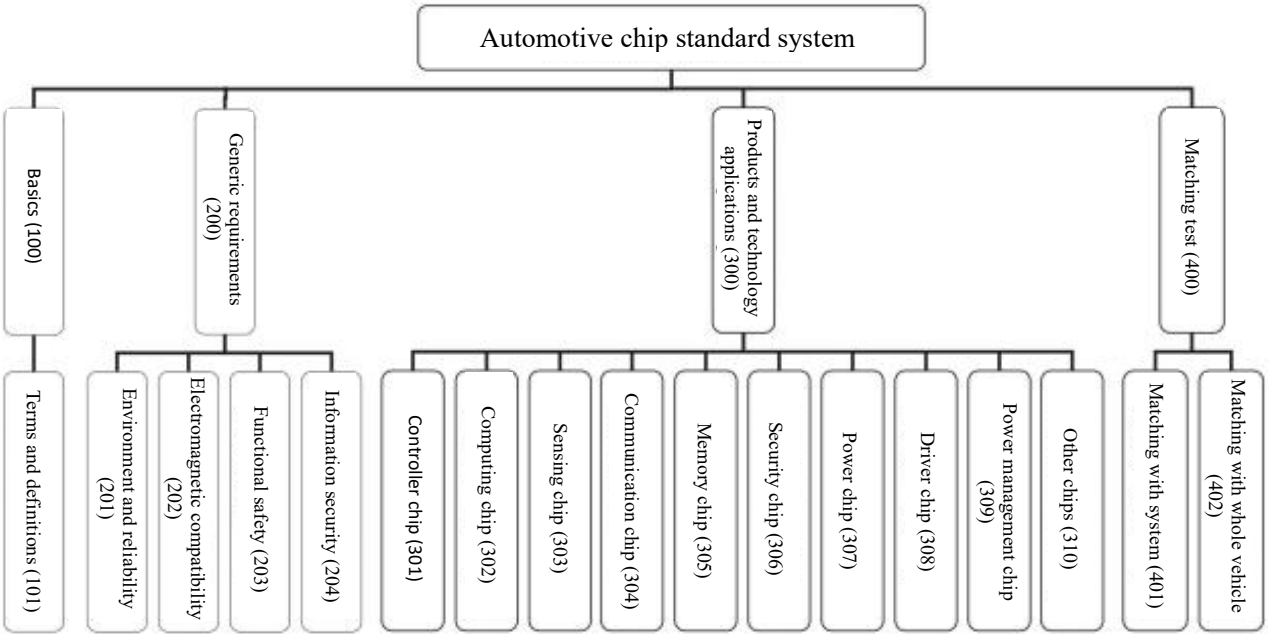

Figure 2 Automotive Chip Standard System

(II) System content

The automotive chip standard system covers the following standard types and key standard formulation directions.

1. Basics (100)

Basic standards include automotive chip term and definition standards.

The term and definition standards are used to unify the basic concepts in the field of automotive chip, and to uniformly define the commonly-used terms involved in the formulation process of automotive chip standards. The purpose is to ensure the standardization of the use of terms and the consistency of meaning and to provide standardized terminology support for the formulation of all other standards under the automotive chip system. In the automotive chip term and definition standards, specific terms will be defined and the automotive chip product classification will be reflected on the basis of current integrated circuit-related standards from the point of view of the actual function and application of the chip product mounted on the automobile.

2. Generic requirements (200)

The generic requirements and evaluation criteria of automotive chips (mainly including four aspects: environment and reliability, electromagnetic compatibility, functional safety and information security) are uniformly standardized in this category of standard: generic requirements.

The reliability requirements of automotive chip or multi-device collaboration systems under complex environmental conditions are specified in the environment and reliability standards to prevent various potential failures that may occur and thus to improve the reliability and safety of automobile products. The key construction directions of standard of this category

include general specifications for environment and reliability, test methods and requirements, conformity inspection procedures, etc. Specifically, the priority will be given to developing standards of general specifications for the environment and reliability of automotive chips and electric vehicle chips.

The functional reliability guarantee capacity of all main functional nodes of the automotive chip or multi-device collaboration system and its subordinate systems in a complex electromagnetic environment is specified in the electromagnetic compatibility standards, with two main purposes: (i) specifying the electromagnetic energy emission of the chip to avoid the effect on other devices or systems and (ii) prescribing the electromagnetic anti-interference capability of a chip or multi-device collaboration system so that it can operate reliably in an automobile electromagnetic environment. The key construction direction of standard of this category is the electromagnetic compatibility test standard of automotive chips.

The process management measures of automotive chip enterprises as well as the process management and technical measures of multi-functional modules within the chip product are specified in the functional safety standards, with the main purpose of avoiding unreasonable risks incurred by systematic failure and random hardware failure. The key construction direction of the standard of this category is the functional safety semiconductor application guide.

The information security requirements that automotive chips should meet and the information security functions that they should have are specified in the information security standards. The measures (such as chip information security design and process management) are implemented to prevent chip data, external interfaces and software and hardware security from being threatened due to attacks. The key construction direction of the standard of this category is information security technical specifications.

3. Products and technology applications (300)

The technical requirements and test methods for various chips used in automobiles are prescribed in the products and technology applications standards, which covers 10 subcategories: controller chips, computing chips, sensing chips, communication chips, memory chips, security chips, power chips, driver chips, power management chips and other chips.

The technical requirements and test methods of controller chips for various controllers, power systems and chassis systems in the automobile are stipulated in the controller chip standards.

The technical requirements and test methods of the automobile chip used to perform complex logical operations and plenty of data processing tasks in the field of human-computer interaction, intelligent cockpit, visual fusion processing, intelligent planning, decision control, etc. are specified in the computing chip standard. The key construction directions of the standard of this category cover intelligent cockpit and intelligent driving computing chips.

The technical requirements and test methods of the automobile chip used for sensing and detecting external signals, chemical composition, temperature and humidity and other physical conditions are specified in the sensing chip standard. The key construction directions of the standard of this category cover environmental sensing chips and sensing chips for electric vehicles. The priority will be given to developing chip standards for image sensing and processing, millimeter wave radar, LiDAR and voltage/position/magnetic field detection for electric vehicles.

The technical requirements and test methods of the automobile chip used for information exchange and processing between internal equipment and between the automobile and other external equipment are specified in the communication chip standard. The key construction directions of the standard of this category include vehicle-mounted wireless communication and in-vehicle communication chips. The priority will be given to the formulation of the standards of vehicle-mounted wireless communication chips (such as cellular communication, direct communication, satellite positioning, Bluetooth, special wireless short-range transmission, WLAN, UWB, NFC and ETC) as well as in-vehicle communication chips (such as LIN, CAN, Ethernet PHY, Ethernet switch, central gateway, serializer and deserializer, as well as audio and video bus).

The technical requirements and test methods of automotive chips used for data storage are specified in the memory chip standards. The key construction directions of the standard of this category include volatile and non-volatile memory chips. The priority will be given to the formulation of DRAM, SRAM, NOR FLASH, NAND FLASH, EEPROM and other chip standards.

The technical requirements and test methods of automotive chips used to provide information security services are specified in the security chip standards. The key construction direction of the standard of this category is the automobile security chip product standards.

The technical requirements and test methods of automotive chips used to process high voltage and large current working conditions are specified in the power chip standards. The key construction directions of the standard of this category cover IGBT modules, power modules and power discrete devices for electric vehicles.

The technical requirements and test methods of the chips used to drive the main chips, circuits or components of all systems in the automobile to work are specified in the driver chip standard. The key construction directions of the standard of this category cover driver chip, power driver chip, display driver chip, etc.

The technical requirements and test methods of the chip used for the automobile internal circuit electric energy conversion, power distribution, detection and power signal (current and voltage) shaping and processing are specified in the power management chip standards. The key construction directions of the standard of this category include power management chip, analog front end chip, digital isolator chip, etc.

Those not falling into the technical requirements and test methods of various automotive chips above mentioned are specified in the standard of other chips that generally covers new technologies and new products with no clear classification.

4. Matching tests (400)

The matching test standards include the test method of automotive chip in the state of being part of the component system or mounted on vehicles.

The function and performance test method of various automotive chips in state of being part of component system are specified in the system matching standards that are used to test the working condition of the automotive chip in the component system. The key research direction of standard of this category is matching test with the system.

The function and performance matching test method of various automotive chips in the state of being mounted on the vehicle are specified in the vehicle matching standards that are used to test the working condition of automotive chips in the vehicle working condition. The main research direction of the standard of this category is the whole vehicle bench matching test and road matching test.

IV. Organization and implementation

Strengthening overall planning, organization and coordination. Establish a working mechanism of cross-industries, cross-areas and trans-departments coordinated development and mutual promotion; integrate the superior resource and strength of the upstream and downstream of the automobile industry chain; give play to the role of such organizations as National Standardization Technical Committee for Road Vehicles (SAC/TC114), Integrated Circuits (SAC/TC599), and Semiconductor Devices (SAC/TC78); strengthen the work coordination with other relevant national standardization technical committees (such as SAC/TC485 on communication, SAC/TC28 on information technology, SAC/TC544 on Beidou Satellite Navigation) as well as coordinate and work together to promote the standardization work of automotive chips.

Promoting the implementation and application of standards. Promote the construction of the standard application capability of the whole industrial chain and improve the guiding and regulating role of standards in the research and development, testing and application of automotive chips on the basis of being guided by the actual application needs of the automobile industry; establish and improve the automotive chip test and evaluation system, support the third-party testing capacity building, effectively promote the mounting and application of automotive chip and provide support for industry management.

Deepening international exchange and cooperation. Strengthen the follow-up study on international standards and technical regulations, deepen the exchange and cooperation with international organizations, such as UNECE World Forum for Harmonization of Vehicle Regulations (UN/WP.29), the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC), etc.; promote the establishment of technical exchange mechanisms with other countries' automotive chip standardization institutions as well as contribute to the formulation of international standards relating to automotive chips.