

The Automotive Semiconductor Market – Key Determinants of U.S. Firm Competitiveness

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The automotive semiconductor market is large and growing. Many U.S.-headquartered semiconductor companies hold leading positions in this market and are making substantial investments to retain, and expand, their market share. However, this market is unique from other traditional semiconductor markets given quality, performance, and lifespan requirements. This EBOT examines key factors which will determine the depth and breadth of adoption of semiconductors in automobiles and the extent to which U.S.-headquartered firms are poised to maintain their competitive position.

The Increasing Use of Semiconductors in Automobiles

The largest end use markets for semiconductors are computers and consumer, industrial, and communications equipment, which collectively consumed over 85 percent of all semiconductors in 2017 (the last year for which statistics are available). However, industry analysts expect that the automotive semiconductor market¹ will be the fastest growing end use market for chips from 2017–21, with a 6.4 percent CAGR and a total market value of between \$39-42 billion. Europe (33.4 percent) and Japan (24.8 percent) lead the Americas (8.4 percent) in consumption of automotive chips, though U.S.-headquartered firms have announced plans to enter or expand in this market (figures 1 and 2).²

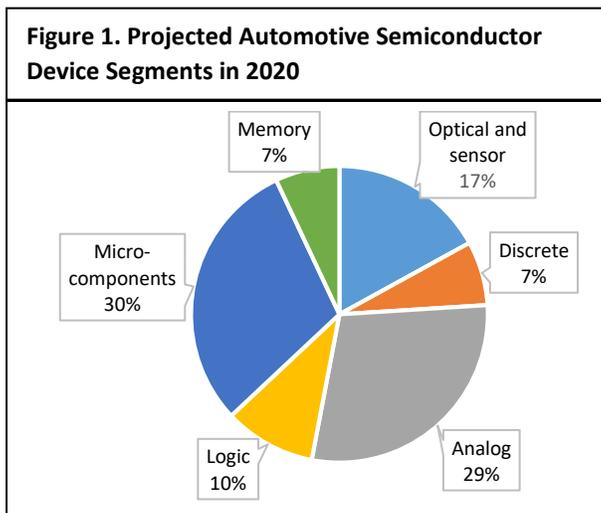


Figure 2. U.S. Headquartered Firms with Current or Announced Plans to Serve Automotive Semiconductor Device Segments

Device Type	US Firm(s)
Analog	Texas Instruments; ON Semiconductor; Maxim
Discrete	Vishay Intertechnology, ON Semiconductor
Logic	Marvell; Texas Instruments; Qualcomm
Memory	Micron; Western Digital
Micro-components	Microchip/Microsemi
Optical and Sensor	ON Semiconductor; Vishay Intertechnology

The increase in consumption of semiconductors by the auto industry is primarily driven by the market evolution toward autonomous, connected, electric, and shared (ACES) mobility. Most new vehicles now include some level of advanced driver assist systems (or “ADAS,” such as adaptive cruise control, automatic brakes, blind spot monitoring, and parallel parking), which is paving the way for fully autonomous vehicles in the future. Connectivity features such as Bluetooth, wireless internet, and navigation systems are standard in most new vehicles, with innovations moving toward vehicle-to-infrastructure and vehicle-to-vehicle connectivity. Additionally, automakers are selling an increasing share of hybrid and electric vehicles compared with traditional internal combustion engine vehicles. Higher emissions regulations and safety standards, as well as increased consumer demand for comfort, are accelerating the evolution toward ACES mobility. Conventional vehicles contain an average of \$330 value of semiconductor content while hybrid electric vehicles can contain up to \$1,000 and 3,500 semiconductors.

¹ Automotive semiconductors or “chips” include integrated circuits, graphic cards, processors, transceivers, sensors, and analog devices.

² For additional market info, see: Coffin and Kim, “[U.S. Firms Are Becoming Leaders in the Automotive Semiconductor Market](#),” June 2017. Figure 1 is from McKinsey “Mobility trends: What’s ahead for automotive semiconductors.” Figure 2, authors compilation.

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How the Automotive Market Differs from Traditional Semiconductor Markets: Performance

The various uses of semiconductors in automobiles necessitates a wide variety of semiconductors (figure 2) and also presents a unique set of requirements that differ from the traditional markets chipmakers serve (figure 3). Unlike semiconductors intended for use in consumer electronics, automotive semiconductors must retain functionality in more extreme environments (colder and hotter temperatures) for longer periods of time (the lifetime of a car, which averages 11.6 years on the road). Consumers also have varied preferences, necessitating a wide variety of semiconductors ranging from advanced electronics (for in-seat entertainment) to basic technologies (in windows). In addition, given the safety issues involved, automotive manufacturers expect that semiconductors they incorporate in their systems will have a zero parts per billion-failure rate for 15 years and a supply of replacement parts for up to 30 years.

Figure 3. Different Requirements of Consumer and Automotive Semiconductor End Use Markets

Semiconductor Feature	Consumer Electronics	Automobile Electronics
Process Technology	28 → 7 nanometers	180 → 7 nanometers
Temperature Range	32 – 100 Degrees Fahrenheit	-40 – 300 Degrees Fahrenheit
Operating Lifetime	3 – 5 Years	15 Years
Tolerated Failure Rate	<1,000 parts per million	Zero parts per billion
Long Term Supply Needed?	No	Yes, up to 30 years' worth

Automotive Semiconductors: Stickiness, Reputation, and Time to Qualify

The unique performance requirements of automotive manufacturers may help U.S. headquartered semiconductor suppliers gain and maintain market share. One U.S.-headquartered chip manufacturer reported that it can take up to six months before their semiconductors are qualified by an auto OEM for use in vehicles. During this six-month qualification time, the chips are subject to stress tests of 2,000 hours, where a chip is exposed to higher voltages and temperatures than its rated specifications. Even after meeting these stringent performance requirements, the chips will be further tested by the OEM at the system (automobile) level, making the entire process take well over one year. Because of the long qualification time and high quality expected, demand for automotive chips are more “sticky” than standard consumer electronic chips. In general, auto OEMs maintain the same sourcing throughout the model run of a vehicle (approximately 5 years) and consider new suppliers only when they are launching new models. Auto OEMs are likely to be repeat customers of companies and brands that they have previously qualified both for use in existing vehicles as well as future models, given the expectation that the supplier supports their product for the lifetime of a given vehicle. U.S. headquartered semiconductor firms that are qualified suppliers for automakers will benefit from this stickiness, customer loyalty, and reputation for quality.

Automotive Standards and Semiconductors

U.S.-headquartered chipmakers may also benefit from developing semiconductors that comply with global automotive standards. As a component of electric and/or electronic (E/E) control systems in vehicles, automotive semiconductors must adhere to the automotive industry’s International Organization for Standardization (ISO) 26262 standard. ISO 26262 addresses the functional safety of automotive systems comprised of E/E and software elements.³ It is a voluntary standard and is widely adopted in the automotive and automotive semiconductor market.⁴ ISO 26262 prescribes a systems engineering process and assesses risks based on severity, exposure, and controllability. It also considers the lifecycle of the system, including production, operation, service, and decommissioning. U.S. semiconductor manufacturers that work with their customers to develop E/E systems that comply with the rigorous standards of ISO 26262 required by auto OEMs will benefit from having input in both standards setting process and designing products which adhere to those standards.

Sources: Coffin and Kim, [U.S. Firms Are Becoming Leaders in the Automotive Semiconductor Market](#); Mutschler, [Cracking the Auto IC Market](#); ON Semiconductor, Section 301 Comments; SIA, Semiconductor End Use Survey; Burghardt et al, [Mobility trends: What’s ahead for automotive semiconductors](#); NHTSA, [Assessment of Safety Standards for Automotive Electronic Control Systems](#); Cappel, [Automotive IC Industry Trends](#); EPSNews, [Outlook Remains Bright for Automotive Electronics](#).

³ Functional safety is the absence of unreasonable risks due to hazards caused by malfunctioning electrical/electronic systems.

⁴ Motor vehicles in the United States are regulated by the National Highway Transportation Safety Administration (NHTSA), which issues federal safety standards (Federal Motor Vehicle Safety Standards, or FMVSS) as minimum-performance requirements.

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