The Use of Semiconductors in Motor Vehicles

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Summary: Although the semiconductors used in motor vehicles account for only a few percent of the total volume of semiconductors, they comply with technical and qualitative requirements of a special nature.

This situation is discussed with a description of typical products and areas of application.

1 Introduction

The automobile has always had links with the field of electrical engineering. As early as the thirties the ignition system, dynamo and headlamps were main components of the electrical system in motor vehicles. Indeed, it was the spark-ignition system which made it possible for the gasoline engine to be used in automobiles.

Electronic components, however, were relatively slow to make inroads into the field of automotive engineering. The way was paved at the beginning of the sixties by semiconductor devices which, in contrast to mechanical components, were maintenance-free and non-wearing.

The development of processes in the last ten years for the production of integrated semiconductor circuits has finally made it possible to implement complex electronic systems in motor vehicles.

The fields of application for semiconductors in motor vehicles are now very extended. It is not possible here to describe all of them.

Therefore, there will first of all be a discussion of the general current situation as regards the numbers of semiconductor devices used for various applications. This will be followed by an attempt to indicate the specific situation as regards their use in motor vehicles with reference to selected examples. Remarks will be limited to the areas of vehicle electrical system power supply, ignition system and antiskid system.
A discussion of the reliability requirements will provide information on the particular problems involved in the manufacture of the components. Finally, there will be a discussion of future demands on semiconductors for use in motor vehicles, and possible applications will be indicated.

2 Current Situation [1]

In 1981 some 37.5 million motor vehicles were produced worldwide. An annual growth rate of 2–2.5 % is expected for the coming years. Thus, the projected figure for 1985 is about 41 million vehicles. Compared with this forecast, the expected growth in the use of semiconductors in motor vehicles over the same period appears relatively modest. Although semiconductors for automobiles will play their part in increased overall production of semiconductors, their low proportion of 4 % of the total production of semiconductor devices will only rise to 4.4 % in the forecast (Fig. 1).

This clearly indicates that the direction taken by process development in the field of semiconductors will not be determined by applications in the automotive sector. Consequently, components for automobiles will be manufactured principally using known technological processes.

Another interesting aspect in this connection is shown in Fig. 2, namely the breakdown of semiconductors used in automobiles with regard to different technologies.

With an average semiconductor content of about $ 40 per vehicle about 2/3 of the components are manufactured using bipolar techniques. This fact, too, supports the above-made statement on the driving force behind the development of semiconductor technology when one considers that most technological innovations are nowadays concerned with the MOS field.

![Fig. 1 Estimated worldwide semiconductor consumption by user segment](image-url)