

## INTELLECTUAL PROPERTY PROTECTION FOR INTEGRATED CIRCUITS

**Iskren Konstantinov, PhD student**  
*University of National and World Economy*

**Abstract.** The intellectual property (IP) protection of integrated circuits (ICs) is of key importance as the semiconductor industry has become a vital part of the advancement of technology and the development of the global economy. This is made clear by the creation of a special IP sui generis right that is meant to protect the layout design of ICs and make them harder to copy. The present article will present an overview of protection of layout designs of ICs and the experience of leading countries in the production of semiconductors. The countries are chosen based on their patenting activity in field which is an indicator of scientific and financial effort of those nations to develop their IC production capabilities.

**Keywords:** intellectual property; innovation; integrated circuits; semiconductors; chips

### Introduction

Integrated circuits have reached unprecedented importance in our more and more technological lives. This became undoubtedly evident during the chip shortage that the world experienced during the Covid-19 pandemic. According to a report by Goldman Sachs, the semiconductor supply chain disruption has affected 169 industries, such as shipbuilding, tire production, agricultural machinery production, the gas and oil industry, among others<sup>1</sup>.

The IC as an innovative product of research and development need protection in order for their creator to have return of his investment. And the industry is characterized by high investment for R&D and production. One indicator of the innovativeness of the industry is the patents applications which companies file in order to obtain protection for different technological solutions surrounding semiconductors. In a period of a year (2021/2022) there have been 69,190 patents for semiconductors. This is 9% more than the previous year<sup>2</sup>. The total number of European patent applications filed in 2022 is 193 460 of which 4366 are for semiconductors (a 19.9% increase an annual basis)<sup>3</sup>. This shows us the importance that the IC industry has and the capital that attracts in order to find new solutions to society's problems.

In a conducted European chips survey, published by the European Commission in 2022 which gathered 141 responses from companies in the IC industry, they point out that IP protection and legal security is highly prioritized<sup>4</sup>. The IP Commission in the US estimates that IP infringement costs 600 bn. \$ to the US economy<sup>5</sup>.

All this puts the focus on the IP protection of ICs as means to protect the investments and competitiveness of the companies in the industry. This paper will focus on the protection of the layout design of ICs as a right specifically created to create security for the producers of semiconductors.

The terms “integrated circuit”, “semiconductor” and “chip” will be used interchangeably in the present paper.

### **Intellectual property in the layout of integrated circuits**

The Washington Treaty on Intellectual Property in Respect of Integrated Circuits provides the defines the term integrated circuit as a product, in its final form or an intermediate form, in which the elements, at least one of which is an active element, and some or all of the interconnections are integrally formed in and/or on a piece of material and which is intended to perform an electronic function<sup>6</sup>.

As the object of protection that will be discussed in the present paper is the layout design of ICs, the Washington Treaty defines it the three-dimensional disposition, however expressed, of the elements, at least one of which is an active element, and of some or all of the interconnections of an integrated circuit, or such a three-dimensional disposition prepared for an integrated circuit intended for manufacture<sup>7</sup>.

The layout design of ICs is important because it has a practical, functional effect. It determines the quality and functionality of the IC, i.e. its competitiveness as a product.

The protection of the topology of integrated circuits is an idea of the company Intel<sup>8</sup> intended to prevent unauthorized copying of layout designs by establishing an intellectual property right over them. The arguments of Intel and other representatives of the IC industry in the 1980s point out that existing protection regimes have deficiencies when it comes to protecting ICs which are specific types of intellectual results. Which is a point that is valid to this day. What necessitated the need of this kind of protections is that other objects of IP have a different purpose and requirements: patents require an inventive step which layout designs of ICs do not meet and in principle they are not patentable (Rauch 1993). On the other hand, industrial designs protect the external appearance<sup>9</sup>, they are focused on the aesthetic features of design<sup>10</sup>. Although trade secrets are used by industry to protect valuable information, it is not applicable to all aspects of ICs because they are products that are meant to reach consumers as part of different technologies, i.e. competitors have access to them once they reach the market and can perform reverse engineering on them and gather information.

In 1984 the United States amends its Copyright Act adopting the Semiconductor Chip Protection Act. The act established a *sui generis* intellectual property right which provides protection for the layout design of ICs.

The American Act includes a “reciprocity” clause, i.e. it provides the protection under the adopted law if the country of the foreign resident provides that same protection on its territory for American citizens. This led to a widespread adoption of laws protecting IC design around the world (Wegen and Crosswhite 1989). In 1985 the Japanese adopted an act in response to this reciprocity clause. They were followed by the European Union which adopted the Directive on the legal protection of topographies of semiconductor products in 1986. Other EU countries subsequently began transposing the Directive into their national legislature. Germany approved a Semiconductor Protection Act in 1987.

All laws established a *sui generis* right based on accepted principles in the international intellectual property system but without explicitly relying on the already established protection for one specific object of intellectual property.

The established model for regulating the protection of layout designs provides protection for the layout of elements, and it introduces a registration process for obtaining protection, as well as a typical length for protection of ten years. As with other object of IP this *sui generis* right provides its holder with the exclusive right to use the design for commercial purposes, to assign or sell the design, and to forbid others from using it without permission.

The trend in providing protection for the layout of ICs is later put into international treaties such as the Washington Treaty on Intellectual Property in Respect of Integrated Circuits (which has not come into effect), as well as the Agreement on Trade-Related Aspects of Intellectual Property Rights, which was signed in 1994 by the members of the World Trade Organization and is in effect.

A notable deficiency in the *sui generis* right that has been widely adopted is that the protection doesn’t cover the functionality of the IC, only the design.

### **Experience in the legal protection of the layout of integrated circuits by leading innovator countries**

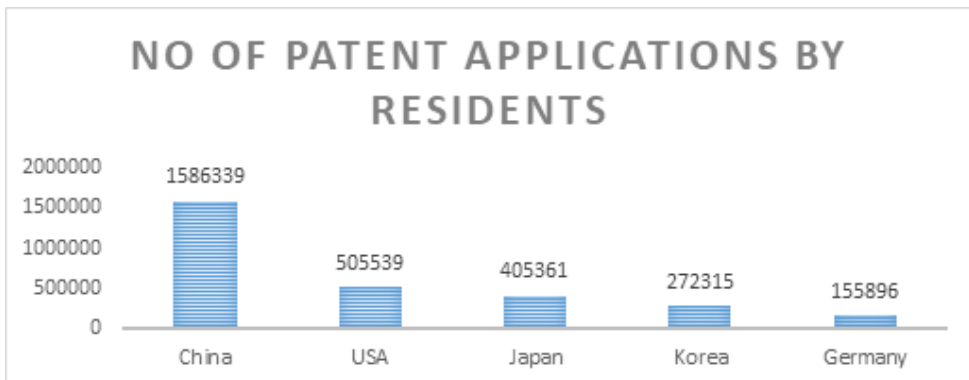
The countries which we research have been chosen on the basis of the number of filed patent applications in 2022 by residents of countries everywhere in the world. This is done for several reasons. Although the patent as a legal means of protection for the results of research and development is different than the protection of the layout design of integrated circuits it is a valuable indicator of the:

- importance of the market of the resident country,
- the existence of innovativeness and competitiveness of local companies which consider their innovations important enough to seek protection;
- the possibility of having registered designs of the layout/topology of ICs.

The chosen countries which we will research with regards to their protection of

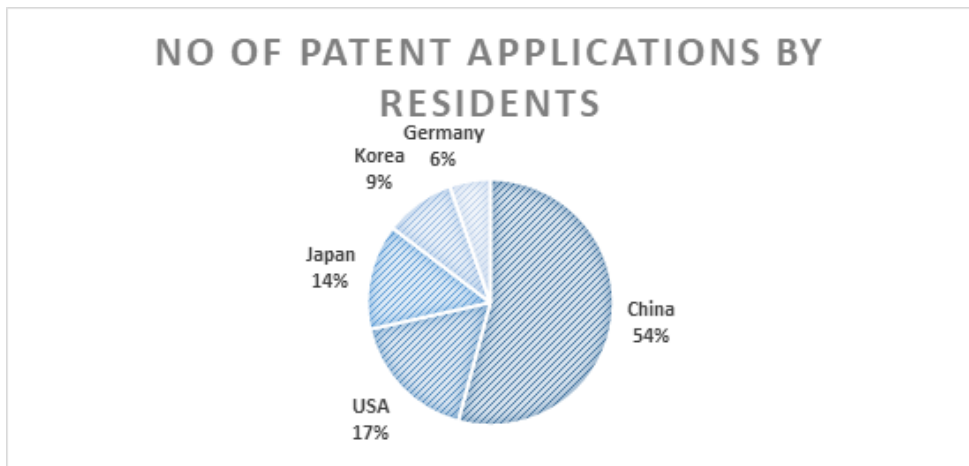
layout design registration are 4 and are located in North America, Europe and Asia, as follows:

- People’s Republic of China;
- United States of America;
- Republic of Korea;
- Germany.



**Figure 1.** Number of patent applications by residents

*Source:* World Intellectual Property Indicators 2023



**Figure 2.** Number of top 5 countries with patent applications by residents as a percentage

*Source:* World Intellectual Property Indicators 2023

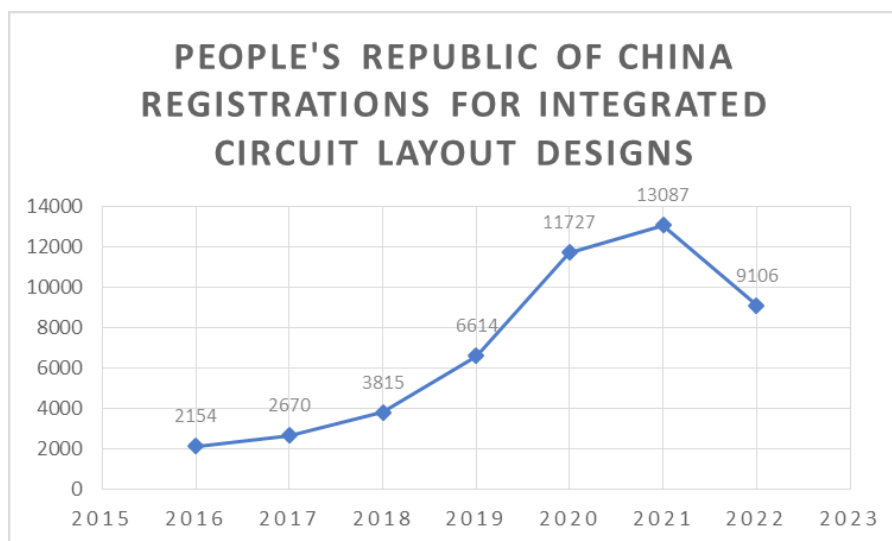
### **People's Republic of China**

Although the layout designs of integrated circuits are mentioned as objects of intellectual property in the Civil Code of the People's Republic of China, alongside inventions, trademarks, etc., the act specifying the protection of layout designs set in the Regulations on the Protection of Layout-designs of Integrated Circuits adopted in 2001.

The Regulations provide the following definition for layout-design “the three-dimensional disposition of the elements, at least one of which is an active element, and some or all of the interconnections of an integrated circuit, or such a three-dimensional disposition prepared for an integrated circuit intended for manufacture”<sup>11</sup>.

In order to acquire protection, the Regulations require that the layout design be original and not common place among creators of designs and producers of ICs. According the law the duration of protection shall is 10 years from the date of registration or from the date of the first commercial use. The exclusive right that the owner acquires allows him to reproduce and commercially exploit the design. The Regulations allow for the conduct of reverse engineering on a protected layout-design, i.e. conducting analysis or evaluation on a protected design.

To obtain protection the layout design has to be registered. The institution that administers the layout designs of ICs is the intellectual property administration department of the State Council.



**Figure 3.** Registrations for integrated circuit layout designs in China

*Source:* China National Intellectual Property Administration Statistics

We can see from the number of registrations done by the National IP Administration it is evident that the country has a high registration rate and it relies on the protection that is being provided by the sui generis right.

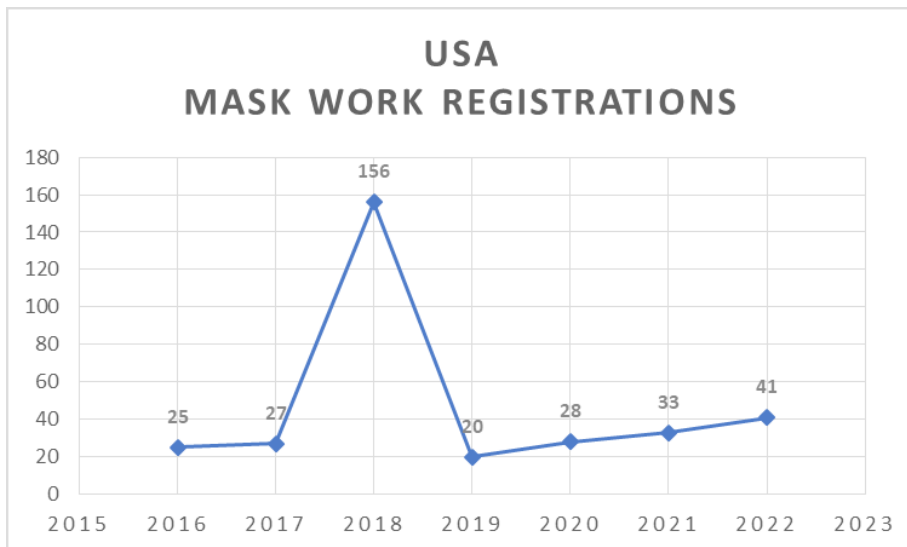
### United States of America

The main intellectual property legislative act that regulates the protection of the layout design of integrated circuits is the Copyright Act of 1976, Chapter 9 – protection of semiconductor chip products. The changes were introduced in 1984 under the name Semiconductor Chip Protection Act.

The Act provides protection for “mask works” which is fixed in an IC product. Mask work is defined as “a series of related images, however fixed or encoded having or representing the predetermined, three-dimensional pattern of metallic, insulating, or semiconductor material present or removed from the layers of a semiconductor chip product; and in which series the relation of the images to one another is that each image has the pattern of the surface of one form of the semiconductor chip product”<sup>12</sup>.

The criteria for protection is that the mask work has to be original and not familiar to the IC industry. The duration of the protection is 10 years. The right that the owner acquires allows him for the given duration to exclusively use the mask. The Act allows for the conduct of reverse engineering on the protected mask.

In order to obtain protection a mask work has to be registered with the U.S. Copyright Office.



**Figure 4.** Mask work registrations

*Source:* United States Copyright Office Fiscal 2016 – 2022 Annual Report

From figure 4 we can see a relatively stable registrations rate of layouts of ICs. Only in 2018 we can see a significant increase of registered mask works which is then offset in subsequent years.

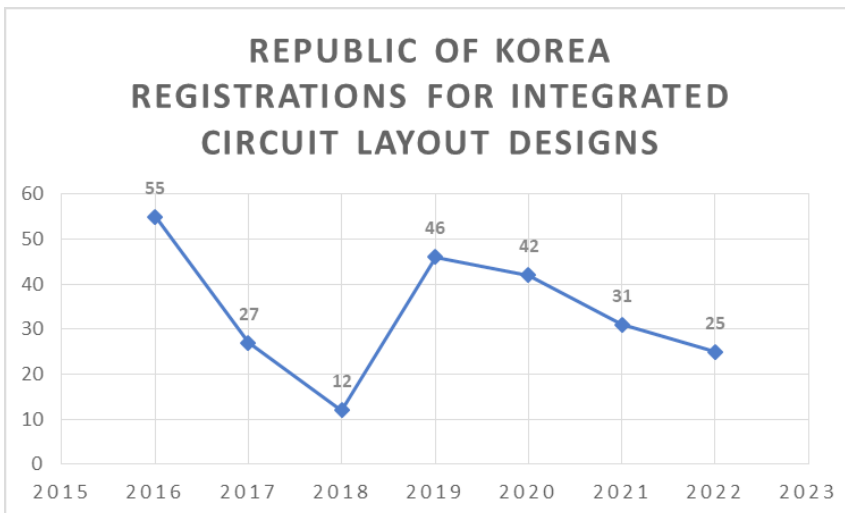
### **Republic of Korea**

The Republic of Korea also adopted a separate legislative act concerning the topology of ICs. This main intellectual property law is the Act on the Layout-Design of Semiconductor Integrated Circuits adopted in 1992.

The Act provides protection for “layout-design” unlike in the US where the term is mask work. The “Layout-design” is defined as “a design of laying out various circuit elements and wires connecting such elements in two or three dimensions for manufacturing a semiconductor integrated circuit”<sup>13</sup>.

The criteria for protection is that the layout design has to be “creative” and not familiar to the IC industry. According the law, the duration of protection shall not exceed 10 years from the date that the design was first economically exploited or 15 years from the date the design was created. The right that the owner acquires allows him for the given duration to exclusively use the design – reproduction, manufacturing of the semiconductor, import, etc. The Act allows for the conduct of reverse engineering on the protected layout-design, i.e. conducting research and analysis on a protected design.

In order to obtain protection the layout design has to be registered with the Korean Intellectual Property Office.



**Figure 5.** Registrations for integrated circuit layout designs

*Source:* Korean Intellectual Property Office Statistics

From figure 5 we can see a decrease of registrations from 2016 (55) to 2018 (12), followed by an increase in 2019 (46) and a decrease in the last three years. The overall numbers of registrations are relatively low.

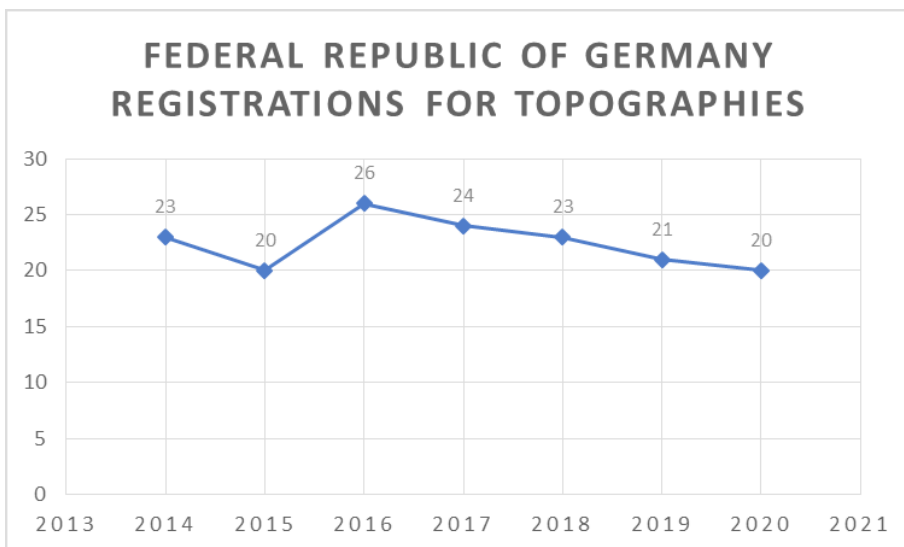
### Germany

Germany also adopted a separate legislative act concerning the topology of ICs Act on the Protection of Topographies of Microelectronic Semiconductor Products. It was adopted in 1987 and last amended in 2021.

The Act unlike China, the US, Japan and Korea instead of “mask work” or “layout design” uses the term “topography” of semiconductors. In article 1 of the law topographies are specified as “three-dimensional structures of microelectronic semiconductor products (topographies) shall be protected under this Law if and insofar as they are original”<sup>14</sup>. We see that the term carries the same meaning as the ones in the other mentioned countries.

The criteria for protection is that the topography has to be “original” and not commonplace to the IC industry. According the law the duration of protection shall not exceed 10 years. The right that the owner acquires allows him for the given duration to exclusively use the design – reproducing, offering, importing, etc. The Act allows for the use of reverse engineering on the protected topography, i.e. conducting evaluation and analysis on a protected design.

To obtain protection topography has to be registered with the German Patent and Trademark Office.



**Figure 6.** Registrations for topographies of semiconductors

*Source:* German Patent and Trademark Office Annual Report 2020

From figure 6 we can see a steady rate of registrations of topographies of semiconductors in Germany which vary between 20 and 26, which is relatively low compared to the other countries that we have viewed.

### **Conclusion**

Integrated circuits have been firmly established as a crucial resource in the modern knowledge-based technological economy. Their protection is valuable as objects of intellectual property as valuable for maintaining the competitiveness of the companies involved in the industry and for guaranteeing the further advancement of ICs and their even wider application.

The overview of the countries that were a subject of research shows that:

- They have all adopted the sui generis right to protect the layout design of integrated circuits;
- The different elements of the legal framework that they have adopted follows the normative standards set by the United States – object, formal procedure of registration, duration of protection, contents of the exclusive right, etc.;
- Different countries use different terminology – “mask work”, “layout design”, “topography” or “integrated circuit”, “semiconductor” – but the meaning that has been explained in detail in the relevant law remains the same everywhere;
- All countries have activity in the protection of the layout design of ICs;
- The number of registrations in the US, Korea and Germany during the observed period is relatively similar;
- The People’s Republic of China, unlike the other three countries, has substantially more registrations for layout designs of ICs. This may be explained by the significantly larger population of the country, the conscious effort to develop its semiconductor industry (which we also see with its patent application activity) and also the emphasis that has been put on this type of IP protection.

We can clearly see from the presented information that all countries have what is necessary from a legal and practical standpoint to develop their IC industry.

### **NOTES**

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10. For more information: [https://www.wipo.int/edocs/pubdocs/en/wipo\\_pub\\_econstat\\_wp\\_27.pdf](https://www.wipo.int/edocs/pubdocs/en/wipo_pub_econstat_wp_27.pdf).
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✉ **Iskren Konstantinov, PhD student**  
Intellectual Property and Technology Transfer Department  
Business Faculty  
University of National and World Economy  
Studentski district  
19, December 8<sup>th</sup> St.  
1700 Sofia, Bulgaria  
E-mail: [iskrenk@unwe.bg](mailto:iskrenk@unwe.bg)