CBI
Ministry of Foreign Affairs

CBI Product Factsheet:

Resistors in Germany

Introduction

Germany's electrical and electronics sector is developing positively, and it is benefiting from its export orientation. Manufacturers in the automotive industry have a high demand for resistors, as do their counterparts in other industrial sectors (e.g. medical technology). These companies are constantly striving to optimise their supply, thus opening opportunities for exporters from developing countries. Although there is a demand for cost-efficient solutions, these solutions must meet the prevailing quality requirements.

Product Definition

Resistors are elements of electrical circuits that resist and reduce the flow of current through the electrical circuit. They can also be used to provide specific voltages to active components. Resistors are available with either fixed or variable resistance values. Fixed resistors are those in which resistance never changes. Variable resistors, sometimes called potentiometers, allow resistance to be adjusted. Resistor values are measured in ohm (Ω), and the amount of resistance offered is determined by the composition and construction of the resistor. Most resistors are constructed of metal or carbon, and they are available in a variety of mounting styles, although through hole and surface mount are the most common. Resistors are widely used in all common electrical devices that have electrical circuits. The following types of resistors are typically sold in Europe:

- carbon (HS code 85331000),
- power (HS code 85332100, 85332900),
- wire-wound variable (HS code 85333100, 85333900),
- variable (HS code 85334010, 85334090).

Resistors are applied across many industries, including automotive, automation, lighting, energy, communication, medical technology and consumer electronics.

Brand names are of little significance for resistors; product quality and design are of greater importance. In some applications, however, brand names can play a significant role. Established brands in electronic components are known for their superior quality and design. For this reason, industrial users may prefer established brands. The number of global suppliers of resistors exceeds 100. The following are amongst the leading suppliers of resistors: IRC/TT Electronics, Kamaya, Ohmite, Panasonic and TE Connectivity/Neohm.

Product Specifications

***Quality**:*
Companies typically look for resistors that fulfil the current market requirements.

- Resistors have a wide range of specifications, and they can be classified according to performance materials or shape/method of construction.
- Current market requirements for resistors include:
    - performance;
    - accuracy or precision with regard to performance level;
    - ability to handle high voltages and currents;
    - humidity resistance (especially important in the automotive industry);
    - durability/lifetime.
- To assure durability and safety, products must comply with the relevant EU regulations and standards. The materials used, and especially any hazardous substances, must comply with RoHS, and they must fulfil the REACH requirements (see the heading 'Legislative requirements' in this document).

***Labelling**:*

- Resistors are typically labelled with the description of content, including the following types of information:
    - type of product;
    - model type;
    - supplier/manufacturer name;
    - supplier/manufacturer location;
    - serial number.

  All of the information listed above is noted on the packing.

***Packaging**:*

- Resistors are typically packaged in plastic bags and cardboard boxes.

Legislative Requirements

To assure the durability and safety, products must comply with the relevant EU regulations and standards. Compliance with European legislative and non-legislative requirements is a basic necessity for all exporters in the electronics and electrical engineering sector. The most important requirements that apply to your products are discussed below. Be sure that you are familiar with the applicable legal requirements with regard to labelling, hazardous substances, product safety and liability. Your products must comply with all EU directives.

Liability for defective products. The liability applies to all products manufactured or imported into the European market. Although the company that brings the product onto the European market is usually responsible, claims can be passed along to producers or exporters.

Tip:

- Be familiar with standards that apply specifically to your products. To ensure that your products are of high quality, review your quality assurance and testing procedure (e.g. by implementing an accredited quality management system; ISO 9001). Formulate labels, instructions for use and disclaimers carefully. Finally, be sure that your insurance covers product liability. Additional information is available in the document on EU legislation: Liability for defective products. Other resources include the EU Export Help Desk and the ITC standards map.

CE marking. As components, resistors are typically sold to equipment manufacturers. With a few exceptions, resistors are not required to be marked with the CE mark. Resistors that are sold within assemblies, sub-assemblies or finished goods are not legally required to bear a CE mark. Driven by market requirements, however, many customers continue to demand the CE mark for most components, particularly those that are critical to the application. The following directives may be relevant for resistors:

- Electromagnetic compatibility (EMC Directive 2004/108/EC),
- Low-voltage equipment (LVD 2006/95/EC),
- Eco-design for Energy-related products (Directive 2009/125/EC),
- Equipment for use in a potentially explosive atmosphere (ATEX Directive 94/9/EC),

Restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS Directive 2002/95/EC). Additional details are available in the section on RoHS below.

Tips:

- Apply for CE marking, which is required by many customers, even if your product is a sub-system or part of a finished good and is thus not legally required to bear a CE mark. If you are a manufacturer, you should be familiar with the process of affixing the CE marking to resistors. The European Commission's insightful website 'Export Helpdesk' illustrates the key steps to take from the beginning to the trading of the product. The following documents provide additional information on EU legislation: CE marking for Electromagnetic compatibility
- CE marking for Low-Voltage Devices
- CE marking for Eco-design of energy-related products
- Directive 94/9/EC (ATEX)

Waste of Electrical and Electronic Equipment (WEEE). If you are considering exporting electronic or electrical products to the EU, you be aware that EU buyers have obligations regarding the waste of these products. Producers in the EU are obliged to participate in product take-back schemes. Although this does not directly affect exporters from developing countries, such requirements may have an impact when EU buyers ask their suppliers to meet specific design requirements or provide certain information.

Tip:

- Ensure that your product design complies with WEEE and enables product recycling, recovery or dismantling (note that these requirements may differ from one EU Member State to another). Formulate labels carefully, and mark products in accordance with WEEE (e.g. the symbol of the crossed-out wheeled bin). Obtain additional information on the EU legislation concerning Waste Electrical and Electronic Equipment (WEEE).

Labelling of energy-related products. Producers and exporters in the EU are obliged to indicate energy consumption by household appliances and other energy-related products (the list is being extended to include products used for industrial purposes. Be sure to check this when importing your products, and discuss it with your European customers).

Tip:

- Be sure to indicate all product details (e.g. energy class, performance, capacity, noise level) required by the EU. Consult the EU legislation on energy labelling for energy-using and energy-related products on the EU website.

The ***REACH regulations*** are intended to manage risks relating to chemicals and to provide safety information on such substances. This legislation restricts the use of certain hazardous chemicals. It also established requirements regarding information on chemicals that have been used. Manufacturers are required to provide buyers with information on the properties of any chemical substances used.

Tip:

- Ask your buyer about their requirements regarding REACH. List all chemicals, including raw materials and additional materials, used in your production process. The EU legislation REACH on chemicals is available on the EU website.

Restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS). The directive bans the placing on the EU market of electrical and electronic equipment containing more than the agreed levels of lead, cadmium, mercury, hexavalent chromium, polybrominated biphenyl and polybrominateddiphenyl ether flame retardants.

Tip:

- Be sure that none of the hazardous substances referred to in the RoHS Directive is used in your production process. Exporters of electronic components are required to meet the standards specified under both the RoHS and the REACH directives, as they are complementary. The EU legislation on the Restriction of Hazardous Substances (RoHS) is available on the EU website.

Non-legislative Requirements

Although compliance with non-legislative requirements remains voluntary, buyers often request such compliance. Many 'private' or 'voluntary' standards were originally established by industry players themselves. Although producers often perceive such standards as a barrier entering a market, compliance also constitutes an opportunity to enhance the export competitiveness of your products.

Quality management systems (QMS) – ISO 9001. If you plan to export to Europe, all products must meet the quality demands of the buyer. The ISO 9001 system was designed to ensure that products manufactured in and/or exported to Europe meet the needs of customers.
For automotive applications, components within assemblies, sub-assemblies and finished goods must meet the quality demands outlined in ISO/TS 16949 QMS.

Tips:

- Apply for ISO 9001 as quickly as possible. Understand the requirements of your target customers and, if you plan to target the automotive industry, obtain ISO/TS 16949.
- Consult the document ISO Quality management systems.
- Requirements relating to automotive applications with regard to quality-management systems are also available on the ISO website.

Functional Safety in accordance with ISO 26262. The ISO 26262 requirements focus on the functional safety of electrical and electronic systems in vehicles.

Tip:

- Apply for ISO 26262. Even though these requirements are not mandatory, they are sure to provide you with an advantage over other exporters from developing countries. Consult the ISO website for additional information on the guidelines of ISO 26262.

Occupational health and safety in the electronic-components sector. Occupational health and safety (OHS) issues include all aspects relating to labour conditions, and they are very often part of the social requirements that EU buyers impose on their suppliers.

Tip:

- Consider implementing a management system on OHS (e.g. OHSAS 18000). European buyers are becoming increasingly sensitive and are demanding transparency in the supply chain and with regard to labour conditions at all levels. Even though these requirements are not mandatory, compliance is sure to provide you with an advantage over other exporters from developing countries. Additional information on occupational health and safety in the electronic components sector is available on the ISO website.

Electronic Industry Citizenship Coalition (EICC) Initiative. The most important sustainability initiative in the Electronics Sector, in Europe and internationally, focuses on social, ethical, health and safety, and environmental issues. Members are required to comply with the requirements of the Code. Some industry buyers can require their suppliers to follow the EICC code of conduct. This is especially relevant for first-tier suppliers.

Tip:

- Identify which of your potential clients or which industries are likely to require the EICC code of conduct. Try to implement this policy. It could provide you with an advantage over other exporters. Explain the steps that you have taken in this regard on your website and in your company's other literature. Consult the EICC website for additional information on the sustainability initiative.

IECQ/CECC The IECQ system is a widely recognised international quality-assessment system for electronic components. Its European standard is CECC. While the ISO is largely process-oriented, the ICEQ has a stronger focus on product quality. It evaluates the quality of processes and products, and it is certified by the renowned VDE (Association of German Engineers) in Germany. Product or procurement managers have a high level of self-interest in this type of certification, as it provides security when making purchase decisions with regard to corporate management.

Tip:

- Certification can build trust when looking for partners in the European or German market. Contact the VDE to learn more about the certification process. Visit the VDE website.

*AEC (Automotive Electronics Council) Q200***.** The Q200 tests recognise that demands placed on passive components in an automotive environment relate to a very high resistance to temperature and vibration, as well as to protection against short circuiting. Due to the global sourcing policies of automotive manufacturers, European manufacturers with production plants in the USA prefer to work with suppliers that also meet US standards (e.g. the AEC Q200).

Tip:

- Be sure that you meet all relevant standards when dealing with customers in the automotive industry.

Trade Statistics

Imports and Exports

Germany offers exporters from developing countries attractive potential for entering the electronic components sector, driven by the fact that Germany's economy is highly productive, innovative and export-oriented. The very positive development of the automotive sector in Germany will have a direct impact on resistors. Exporters from developing countries can develop a competitive edge based on better-priced product offerings for resistors. The ability to meet current market requirements is crucial, including with regard to the quality and design of products, as well as with regard to short production time and favourable delivery terms.

Figure 1: Imports of resistors to Germany (2014), in %

	Share of total EU imports (2014)	CAGR* of total imports (2009-2014)	Imports from developing countries as a share of total imports (2014)
Imports	25.2%	7.1%	12.7%

**Compound annual growth rate*

Source: Eurostat (2015)

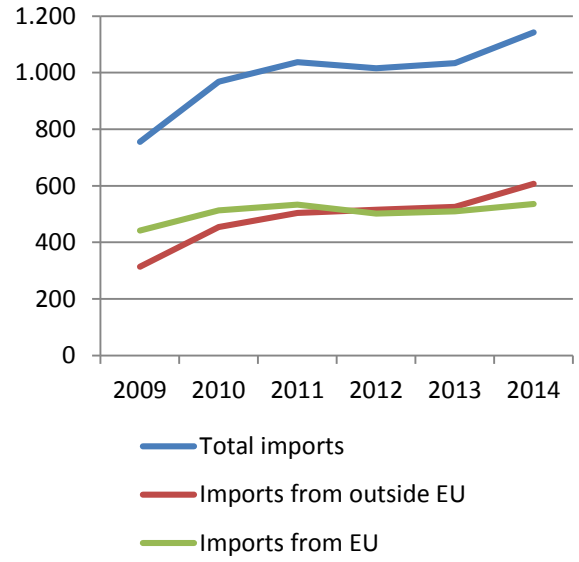
Figure 2: Exports of resistors from Germany (2014), in %

	Share of total EU exports (2014)	CAGR* of total exports (2009-2014)	Exports from developing countries as a share of total exports (2014)
Exports	32.6%	6.8%	9.0%

**Compound annual growth rate*

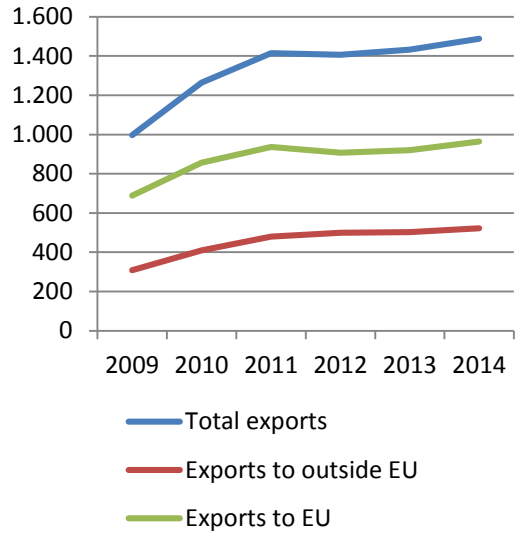
Source: Eurostat (2015)

Figure 3: Imports of resistors to Germany, value in € million



Source: Eurostat (2015)

Figure 4: Exports of resistors from Germany, value in € million



Source: Eurostat (2015)

Most important developments

After a period of recession and stagnation with regard to demand and industrial production, the German electronics industry is experiencing a rebound. Germany benefits from its strong export-oriented economy, especially for industries that have strong demand outside Europe as well (e.g. the automotive industry). Driven by lower prices and production capabilities, Germany has increasingly been sourcing its resistors from outside the EU, especially Asia (dominated by China). Imports from outside the EU increased slightly in 2014, having started to outperform those from within the EU around 2012 and 2013.

Tip:

- Enter the German market with a value-for-money proposition for resistors, which are used in nearly all electrical devices. Given that electronics and electrical engineering are expected to grow in Germany, start actively looking for partners in various industries, including automotive and energy, as well as other industrial sectors.

The import of resistors from China to Germany has been increasing again. Trade with Turkey, and Mexico expanded in the period 2009–2014, primarily due to better-priced product offerings, in addition to short production times and favourable delivery terms. Imports from China are expected to remain in the top position.

Tip:

- Any developing country with profound expertise and high product quality has opportunities for entering the European market. Optimise your production process in order to meet all current market requirements, including those relating to the quality and design of products, short production times and favourable delivery terms.

Germany's exports of resistors reflect an upward trend, both inside and outside the EU. This trend involves resistors manufactured in Germany, as well as re-exports

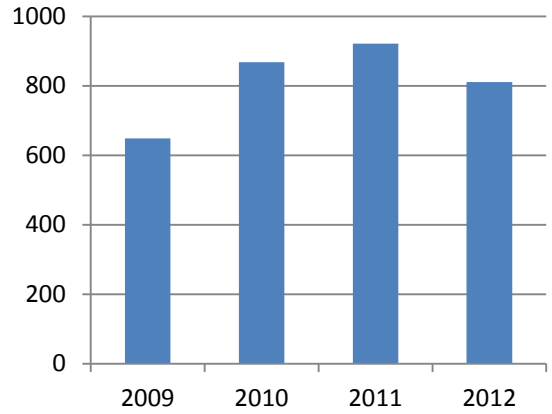
Tip:

- There is a possibility to target other European countries through re-exports. It is nevertheless important to be aware of the economic slowdown in European countries.

Production and Consumption

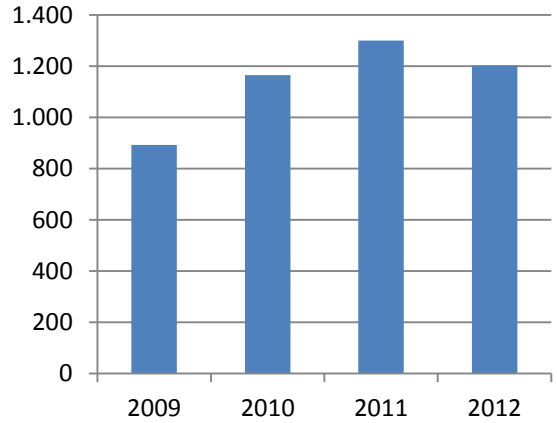
In Germany, the penetration of electronic content into the automotive, automation and lighting industries will be beneficial to many suppliers of passive components, including resistors. The consumption of resistor types varies, due to differences in applications.

Figure 5: Production of resistors in Germany, value in € million



Source: Eurostat Prodcom (2015)

Figure 6: Consumption of resistors in Germany, value in € million



Source: Eurostat Prodcom (2015

Most important developments

The most current data provided by Eurostat/Prodcom are from 2012. Nevertheless, the production and consumption of resistors in Germany are expected to increase. Industrial production in the automotive and electronic industry has been strong, with annual growth exceeding 5%.
The production of resistors is expected to develop positively between 5% and 7% in the coming five years, as the production of applications in the automotive, automation, energy, lighting and medical sectors is expected to experience continuous growth in Germany. The focus of the production in Germany will be on high-end products.

Tip:

- Cost pressure is an ongoing phenomenon that always provides opportunities on the market. Consider supplying Germany with low-cost resistors, thereby benefiting from the growth of the electronic industry. Be sure that your products meet the exact requirements of the customer, as competition between suppliers is intense. In addition to product quality, short production and favourable delivery times are often essential to placing a successful offering.

The demand for resistors is driven by the growing amount of electronic content in the automotive sector, the growing demand for energy and the development of renewable energy, as well as by the increasing importance of new markets (e.g. electronic lighting and the automation of manufacturing processes).

Tip:
- Consider specialising, and focus on the application segments with which you have the most experience and for which you are certain that you can offer an attractive deal.

For additional information on trade statistics, consult CBI Trade Statistics for Electronics and Electrical Engineering.

Market Trends

Most important developments

***Technological development*:** Technological development has led to the creation of minimised resistors and those that incorporate multiple functions.

Tip:
- Consider offering resistors to industries in Germany that tend to make high investments in R&D, including the automotive industry (electric vehicles), the energy industry (wind, solar and other renewable energy projects) and the electronic lighting industry. Consider sharing your knowledge and participating in pilot projects.

***Product innovation and design*:** Product developers are striving to decrease the size of resistors. This allows them to occupy less space on printed circuits, thus making the design easier and saving material. A network of thin-film resistors can replace several conventional resistors, although it is more expensive.
Thin film is the best fit for applications in which precision is a key aspect. Expensive ultra-thin film resistors are more likely to be used in systems associated with higher costs for malfunctions and damage. Examples of applications include measurement instruments in production plants and medical technology. In these contexts, ultra-thin film resistors are able to increase calibration intervals significantly.

Tip:
- Continue innovating and investing in new product designs, in addition to launching resistors that meet the market trends. Expand your product range by introducing thin-film resistors.

***Product quality*:** Expectations with regard to product lifetime have significantly increased in recent years. This has resulted in more than doubling the lifetime of resistors from 2,000 hours to 5,000 hours. Moreover, customers are demanding high levels of thermal resistance or low levels of calefaction, depending upon the relevant application. This is particularly applicable to the automotive industry.

Tip:
- Meet the safety and quality demands by incorporating a quality-assurance programme into your production process. Work to optimise the production process and reduce delivery time. Increase the efficiency and flexibility of the production process by introducing a modular production approach and using different technologies. Minimise the risk of damage during production, and meet customer requirements in terms of product quality and delivery time.

***Service quality*:** In addition to the essential importance of product quality, presentation and service are becoming increasingly important to OEMs in Europe. Developing countries should work to adopt European best practices in the implementation of quality standards, as well as in product presentation and service (e.g. no signs of handwork on the product surface, clean and accurate packaging, on-time delivery).

Tip:
- Work to improve the presentation and packaging of your products. Work according to European standards, and follow all of the buyer's requirements.

Political measures: Various EU Directives have been issued in recent years that are aimed at accelerating the development of renewable energy sources and diminishing industrial impact on the environment (CO2 emissions). As a result, electronic systems and components have become more efficient and environmentally friendly.

Tip:

- Work to improve the efficiency of resistors by reducing energy loss, thereby reducing the environmental burden (CO2 emissions) and increasing the cost-effectiveness of electrical systems.

***Second source*:** This ability is required, especially in the automotive industry. Resistors should be supplied from at least two different sources. In this way, automotive manufacturers are attempting to guarantee their independence from a single supplier.

Tip:

- European SMEs present better opportunities as potential customers for exporters from developing countries, although larger companies may also contact you as a potential supplier. Visibility on the market is therefore crucial. Develop your sales and marketing strategy:
    - Develop well-structured and up-to-date content on your company's website;
    - Attend trade shows several years in a row; Start preparations for the trade show far in advance;
    - Work on your *unique selling proposition* (i.e. why European OEMs should buy your product);
- Work on the product pricing.

For additional information on market trends, consult CBI Trends for Electronics and Electrical Engineering.

Market Channels and Segments

The CBI Market Channels and Segments for Electronics and Electrical Engineering provides a general overview.

Market Competitiveness

The document CBI Competition for Electronics and Electrical Engineering provides a general overview.

What are the end-market prices for resistors?

Price range for resistors

Resistors have a very wide price range. In Europe, the price for resistors ranges from €0.01 to €70, depending upon specifications. Suppliers in several European countries have harmonised their prices; any differences in pricing are due to differences in logistics, taxes and other local costs.

Most important groups of resistors for industrial, automotive, lighting, communication and consumer applications	OEM volume price range, in €
Carbon resistors	0.01 – 17.2
Power resistors	0.50 – 50.0
Wire resistors	0.38 – 53.0
Variable resistors	0.17 – 70.0

Producers in developing countries should be aware of differences in costs and value-chain margins that could add to the product price. The production and administration costs of the manufacturer usually account for 44%–51% of the end price (OEM volume price). The production and administration costs should include all costs for raw materials, development and labour, as well as other fixed and administration costs. To develop a unique selling proposition, exporters from developing countries should understand their own costs, liabilities and responsibilities, and they would do well to analyse product market price levels.

OEM volume price breakdown	Margin
Production and administration costs	45%
Marketing and sales costs in developing countries	3%
Freight to Europe and other related costs	6%
Import and other (e.g. VAT, financing) costs	5%
Marketing costs in Europe	7%
Importer margin	10%
Distributor margin	20%

Useful resources

Leading trade fairs in Europe and Germany

- Electronica, world's leading fair for electronic components, systems and applications
- Hannover Messe, world's leading fair for industrial applications and automation
- PCIM, Europe's largest fair for control electronics, intelligent power trains and energy management
- SPS IPC DRIVES, Europe's leading fair for electrical automation
- Light & Building, world's largest fair for light and building applications
- EFA, trade fair for building and electrical technology, lighting, climatisation and automation
- Embedded World, world's leading fair for embedded technologies

Important resources

- Eurostat
- Eurostat Prodcom
- ZVEI
- VDE
- FBDI
- Energie und Technik
- Future Electronics
- Trade association NMI, representing Germany Electronic Systems, Microelectronics and Semiconductor Communities
- tti – MarketEyeelektronik.net

Additional information

CBI market information:

- Trade Statistics for Electronics and Electrical Engineering;
- Trends for Electronics and Electrical Engineering;
- Market Channels and Segments for Electronics and Electrical Engineering;
- Market Competitiveness for Electronics and Electrical Engineering;
- 10 Tips for Doing Business in the Electronics and Electrical Engineering sector
- Finding Buyers in the Electronics and Electrical Engineering sector

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