



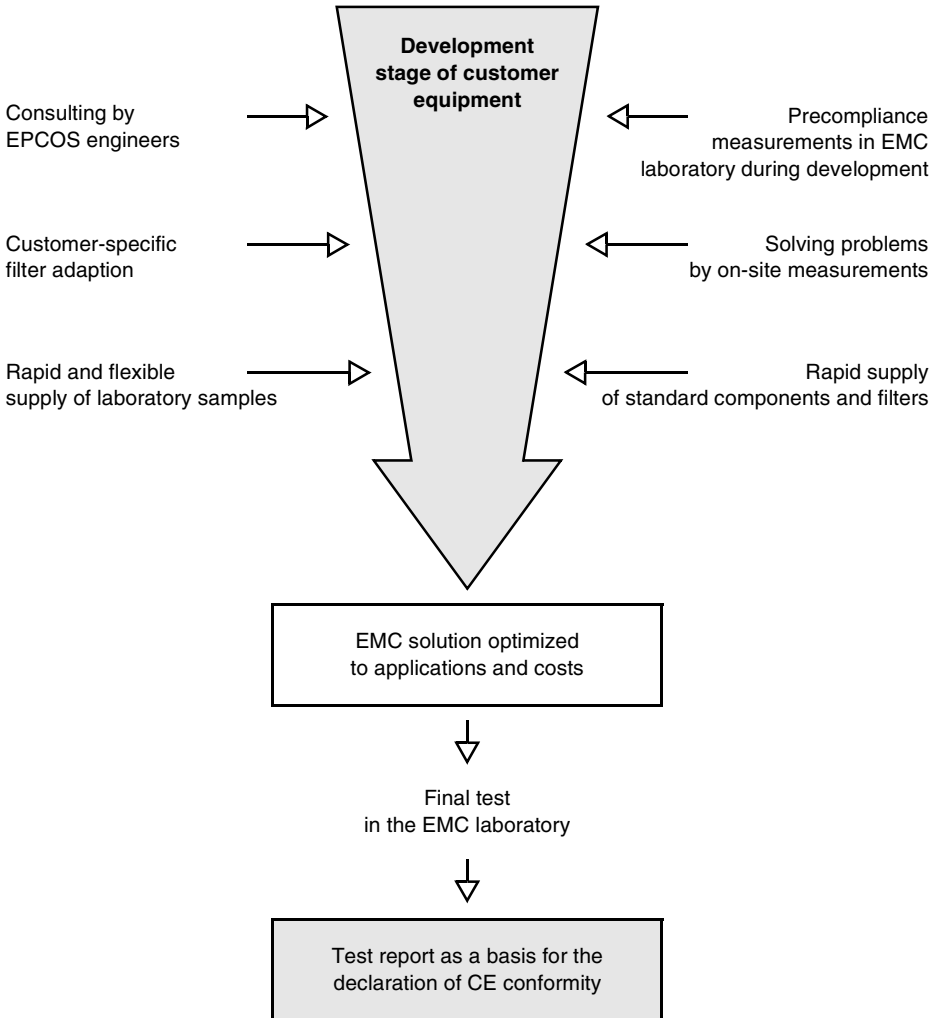
## **EMC filters**

EMC services and EMC laboratory

Date: January 2006

**EMC filters**

**EMC services and EMC laboratory**



**1 Consulting offered by EPCOS engineers**

Experienced engineers with an extensive knowledge of numerous electrical and electronic installations and equipment and their specific EMC characteristics are on hand to advise you from the very beginning of your project.

Our specialists will be pleased to prepare an individual and competitively priced EMC solution together with you, either over the telephone or on site in the event of more complex problems.

**2 Measurements in the EMC laboratory during the development process**

To support our customers with their EMC problems and to perform basic investigations on the application of EMC components, we operate a comprehensively equipped EMC laboratory in Regensburg (see Abschnitt 7). Its facilities are used to prepare EMC solutions for equipment, plants and machines which are optimized in terms of applications and costs, thus assuring compliance.

**3 Customer-specific filter adaption**

EPCOS offers a wide range of standard filters which cover most of our customers' applications. However, it may still be necessary in some cases to develop filters specifically to our customer's requirements for either technical or cost reasons.

An experienced team of engineers is at hand to advise customers in selecting a suitable solution. The decision as to whether filters must be specifically adapted or whether proven standard filters can be used must be made in each individual case.

Figure 1 illustrates the relationship between relative price and quantity. If the quantities are small, the use of standard filters is recommended in most cases. They are quickly available, have been proven in many applications and tend to be less expensive than specific solutions. If the quantities are very large, a filter matched exactly to the customer's requirements can make more sense and can also be integrated into the equipment at little cost.

The early involvement of our EMC experts can often reduce total system costs, for instance by assuring optimal matching of the system comprising frequency converters and filters. Development times can also be reduced, the end product gets to market more quickly and the customer gains a significant competitive advantage.

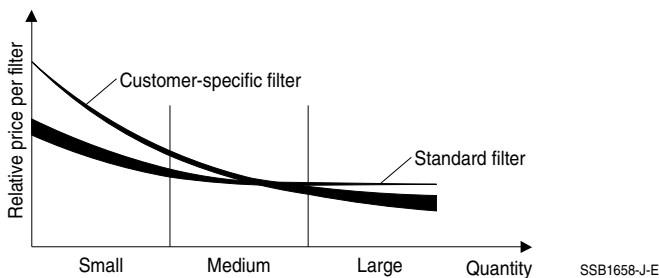


Figure 1 Relation between relative price and quantity

#### 4 Solving problems by on-site measurements

In addition to the services offered by the EMC laboratory, EPCOS also offers to work directly together with the manufacturer of the equipment or installation. Our engineers have broad-based know-how in the entire field of EMC as well as extensive experience in the application of EMC components. Optimized and cost-effective results are achieved quickly thanks to the close cooperation between EPCOS and the equipment manufacturers.

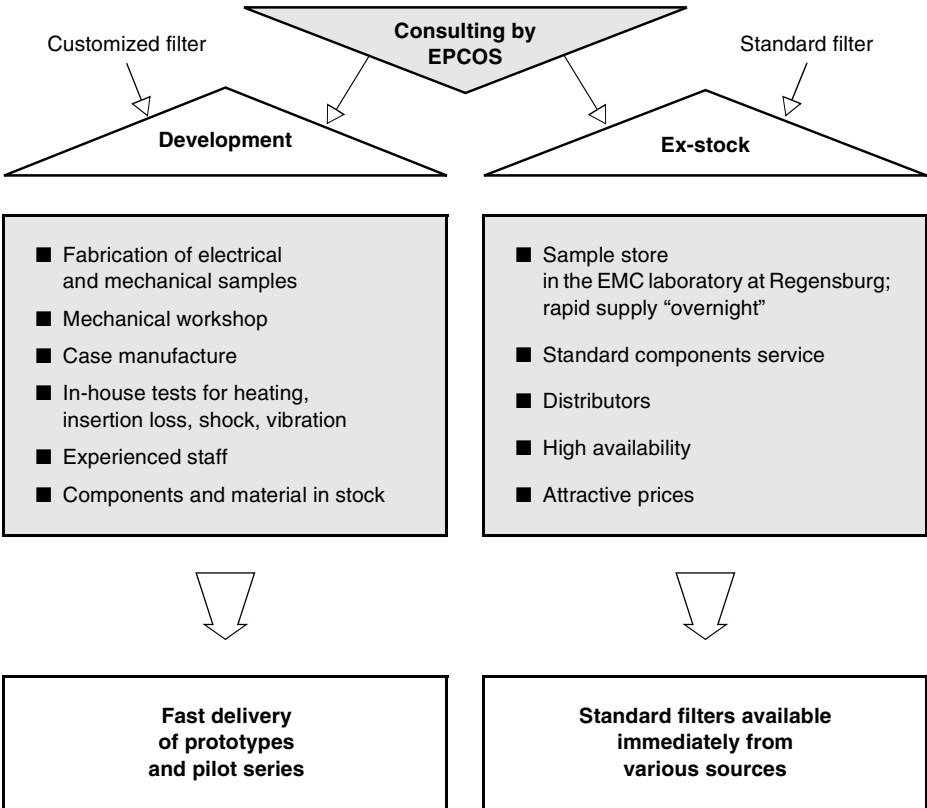
- **Help in localizing interference sources**
- **Samples for interference suppression tests are provided; material is available for trial use**
- **Rapid implementation of optimized cost-effective solutions by experienced specialists**
- **Customer-specific components can be developed more quickly**
- **Recommendations for EMC measures such as shielding, grounding, EMC components and EMC filters**
- **Close cooperation between customer and EMC engineers**
- **Reduced development times thanks to problem simulation**

A wide selection of portable equipment is available so that the measurements and services listed above may also be performed

**directly at the customer's premises.**

**5 Short-term of sample filters and standard components**

Irrespective of whether the customer opts for standard or customized filters, EPCOS can always supply the required product quickly.



## 6 Simulation as a tool for selecting and optimizing filters

Real functions are simulated by computer models using suitable software, i.e. a network simulator, a finite-element simulator or a coherent description in a computer algebra system.

### 6.1 Simulation at EPCOS

The circuit simulations performed during the development process are based on the SPICE program.

If a particular problem can be solved more quickly by simulation than by a laboratory set-up, initial data about the simulation object must be acquired. The accuracy of the ambient parameters as well as determination of the permissible tolerance of the results are particularly important in this case.

### 6.2 Simulation environment

The filters are modeled on the basis of real simulations of their components by means of suitable resistor, choke or capacitor models. If the accuracy is insufficient, side-effects are matched to and integrated with the measured reality by extending the simulation models.

At EPCOS, the following tasks are increasingly being solved with the aid of simulation.

- Speeding up development programs:  
highly focused procedures are possible;  
fewer trials are required
- Cost reduction:  
use of components can be optimized;  
more compact designs are possible
- Investigation and elimination of undesired side-effects:  
complex test configurations are avoided
- Simulation of the filters in their environment as a decision-making aid:  
helping customers to select components for new developments;  
smaller number of different filter samples
- Statistical evaluation with failure investigation for series manufacture:  
fewer rejects;  
improvement of quality

### 6.3 Simulation level at EPCOS

When a component is modeled at EPCOS, the data records are automatically compared iteratively with the simulation results. As a result, our choke and filter models are not only increasingly accurate but their equivalent circuit diagrams are also continuously improved.

Very high expenditures are required to provide our customers with component data to our usual high quality. In order to extend our know-how and experience in the field of simulation, we are very interested in working together in the sectors of simulation and modeling both with our customers and with external partners.

We can currently generate reliable models in the sector of small-signal analysis of chokes and filters. Although we do perform time-domain simulations, they do not yet satisfy our specified quality requirements.

## 7 EMC laboratory Regensburg

The EMC laboratory in Regensburg has been accredited as a test laboratory since October 1994 and is a member of the Competent Body of Siemens AG. It was initially accredited according to the guidelines of the German Accreditation Committee (DAR) to DIN EN 45001, as was the first re-accreditation in 1999. It was then converted in 2002 to the new quality standard for laboratories DIN EN ISO/IEC 17025, on which the 2003 re-accreditation was also based. This accreditation assures the consistent independence, impartiality and integrity of the measurement and test results. The laboratory's many years of experience in the entire sector of EMC (first anechoic chamber in Europe 1963) and active cooperation in national and international EMC standardization committees represent an outstanding basis for satisfying customer requirements.

A distinction should be made at this point between the terms "test laboratory" and "certification institute". The EMC laboratory in Regensburg is an accredited test laboratory which tests products and produces test reports for them so that the manufacturer can issue the declaration of conformity. However, as a matter of principle, this does not include measurements performed during the development stage, although these measurements can of course be performed as well. A certification of products is not prescribed by the EMC Directive.

### 7.1 Installations

The laboratory is equipped with an anechoic chamber with a 10-meter test section, three test units for conducted emission measurement in shielded cabins, and a remote-controlled 4.8 m turntable which can be loaded up to 4 tons.

### 7.2 Equipment

*Measurement and test equipment for conducted EMC phenomena:*

Emission		Immunity	
Measurement receivers	10 kHz to 30 MHz	Signal generators	10 kHz to 230 MHz
Network simulators	Up to 350 A, 690 V	Power amplifiers	25 W to 250 W
Oscilloscopes		Pulse generators	ESD EN 61000-4-2
Probes			Burst EN 61000-4-4
Clip-on probes			Surge EN 61000-4-5
Harmonics test unit	3 × 16 A	Coupling networks	
		Capacitive coupling clamp	
Flicker test unit	3 × 16 A	Inductive coupling clamp	

*Measurement and test equipment for radiated EMC phenomena*

Emission		Immunity	
Measurement receivers	10 kHz to 26 GHz	Signal generators	10 kHz to 1000 MHz
Antennas	10 kHz to 18 GHz	Power amplifiers	25 W to 250 W
Absorbing clamps	30 MHz to 1000 MHz	Antennas	
		Directional couplers	
		Supplementary absorbers	

The comprehensive range of equipment available at the laboratory permits almost all applicable national and international EMC standards (see Chapter „General“, Section 1.9) to be tested.

A selection of the tests which we offer is shown in Figure 2. We can naturally also perform tests on the basis of other relevant EMC specifications and will be happy to discuss your individual EMC testing needs with you.

**Selection of tests performed in the EMC laboratory:**

- **Conducted emission test under rated load**
- **Radiated emission measurements with 10 m test distance**
- **Immunity test up to 10 V/m**
- **Harmonic current in low-voltage power supply systems up to 16 A**
- **Flicker**
- **Tests at voltage dips, fluctuations and short-time interruptions**
- **Burst**
- **Surge**
- **ESD**

Figure 2 Selection of tests performed at the EMC laboratory in Regensburg

A range of auxiliary equipment is already available on the premises to simplify the tests as far as possible for our customers while still performing measurements under real conditions. These include:

- Load installations for converter test up to 90 kW
- Power supply up to 100 A
- Exhaust gas suction
- Transformers for performing measurements at various rated voltages (up to 690 V)
- Water supply for devices under test

The laboratory is located on the ground floor. Large gates allow access for bulky or heavy installations at ground level.

Whether we perform investigations during the development process or final EMC tests – the maintenance of a high quality level is a high priority for us. Regular calibration and internal inspections of our test equipment goes without saying. However, we place just as much importance on the experience and training of our staff. The documentation of the investigations/tests may be made available in either German or English as desired.

All equipment and information which is entrusted to us by our various customers is naturally treated with absolute discretion. We can also conclude a non-disclosure agreement with you if desired.

### 7.3 Conformity assessment (EMC Directive, Annex II)

In the new EMC Directive 2004/108/EC of December 15, 2004, no provision is made any longer for the previous path via a “competent body” in the case of the non-applicability of the harmonized standards. It is also no longer mandatory to carry out the compatibility assessment exclusively on the basis of the harmonized standards. However, a “notified body” may continue to be called in on a voluntary basis in order to have the compatibility checked by competent and experienced EMC specialists.

The rules for the conformity assessment procedure are listed in Annex II of the EMC Directive:

- “1. The manufacturer shall perform an electromagnetic compatibility assessment of the apparatus, on the basis of the relevant phenomena, with a view to meeting the protection requirements set out in Annex I, point 1. The correct application of all the relevant harmonised standards whose references have been published in the Official Journal of the European Union shall be equivalent to the carrying out of the electromagnetic compatibility assessment.
2. The electromagnetic compatibility assessment shall take into account all normal intended operating conditions. Where the apparatus is capable of taking different configurations, the electromagnetic compatibility assessment shall confirm whether the apparatus meets the protection requirements set out in Annex I, point 1, in all the possible configurations identified by the manufacturer as representative of its intended use.
3. In accordance with the provisions set out in Annex IV, the manufacturer shall draw up technical documentation providing evidence of the conformity of the apparatus with the essential requirements of this Directive.
4. The manufacturer or his authorised representative in the Community shall hold the technical documentation at the disposal of the competent authorities for at least ten years after the date on which such apparatus was last manufactured.
5. The compliance of apparatus with all relevant essential requirements shall be attested by an EC declaration of conformity issued by the manufacturer or his authorised representative in the Community.
6. The manufacturer or his authorised representative in the Community shall hold the EC declaration of conformity at the disposal of the competent authorities for a period of at least ten years after the date on which such apparatus was last manufactured.
7. If neither the manufacturer nor his authorised representative is established within the Community, the obligation to hold the EC declaration of conformity and the technical documentation at the disposal of the competent authorities shall lie with the person who places the apparatus on the Community market.
8. The manufacturer must take all measures necessary to ensure that the products are manufactured in accordance with the technical documentation referred to in point 3 and with the provisions of this Directive that apply to them.
9. The technical documentation and the EC declaration of conformity shall be drawn up in accordance with the provisions set out in Annex IV.”

## 7.4 Accreditation document and site plans

Deutsche Akkreditierungsstelle Technik (DATech) e.V.  
Unterzeichner der Multilateralen Abkommen von EA und ILAC zur  
gegenseitigen Anerkennung

vertreten im

# Deutschen AkkreditierungsRat



## Akkreditierung

Die **Deutsche Akkreditierungsstelle Technik (DATech) e.V.** bestätigt hiermit, dass das  
Prüflaboratorium

**EPCOS AG**  
**Wernerwerkstraße 2**  
**D-93049 Regensburg**

die Kompetenz nach DIN EN ISO/IEC 17025 besitzt, Prüfungen in den Bereichen

**Elektromagnetische Verträglichkeit (EMV)**

nach den in der Anlage aufgeführten Normen und Spezifikationen auszuführen.

Die Akkreditierung ist gültig bis: **05.10.2009**

Die Anlage ist Bestandteil der Urkunde und besteht aus **10** Seiten.

DAR-Registriernummer: **DAT-P-101/99-01**

Frankfurt/Main, 06.10.2004



i.V. Dipl.-Ing.(FH) R. Egner  
Leiter der Akkreditierungsstelle

Mitglied im EA, ILAC, IAF

Figure 3 Accreditation document for the EMC laboratory Regensburg

EMC laboratory, site plan

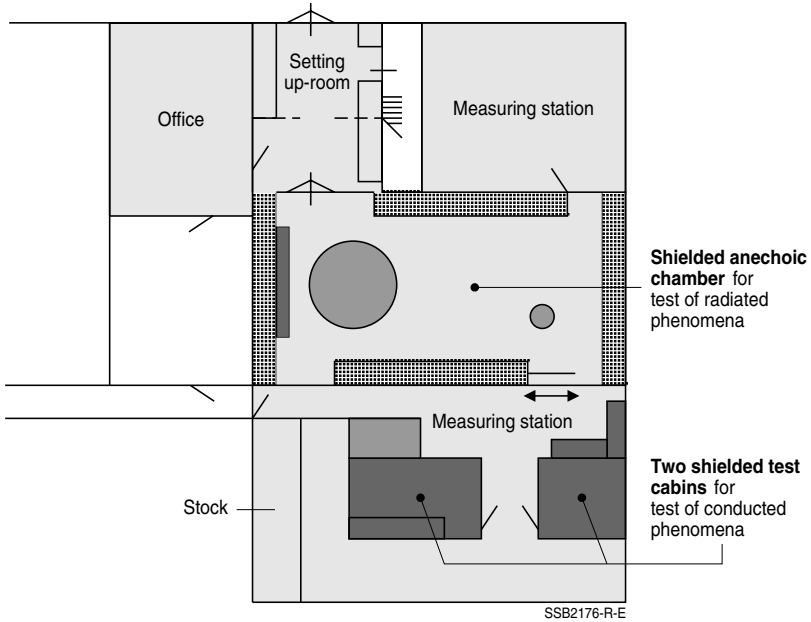


Figure 4 Site plan of EMC laboratory, Regensburg

EMC laboratory, anechoic chamber

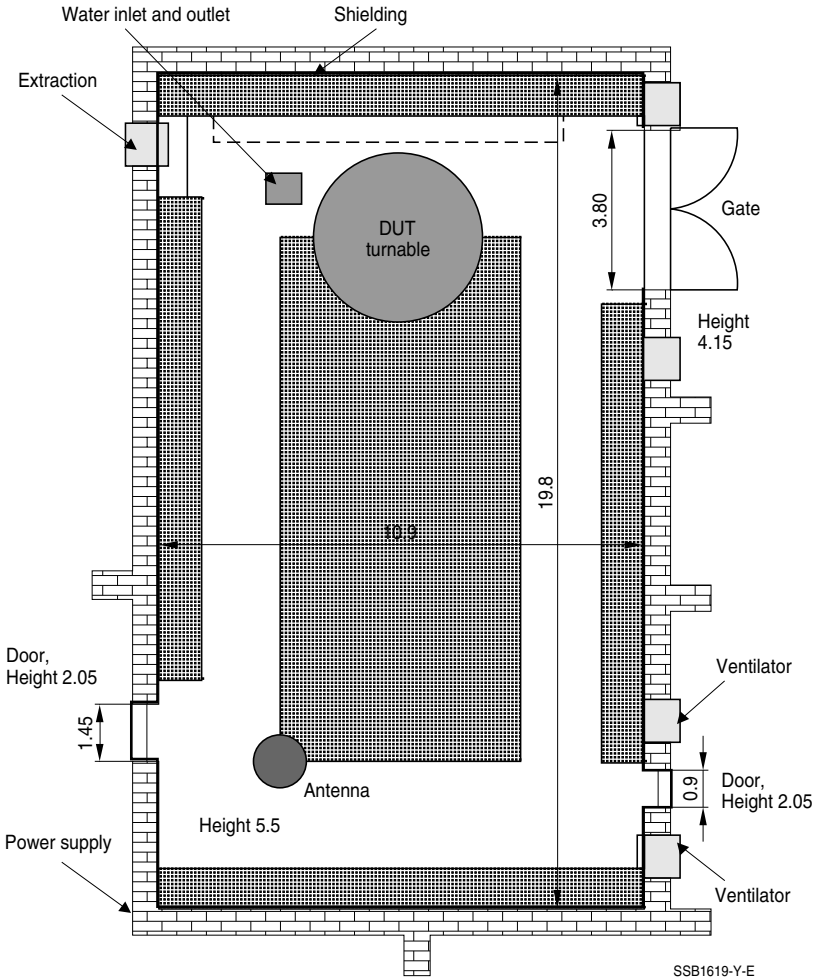


Figure 5 Anechoic chamber of EMC laboratory, Regensburg (all dimensions in m)