

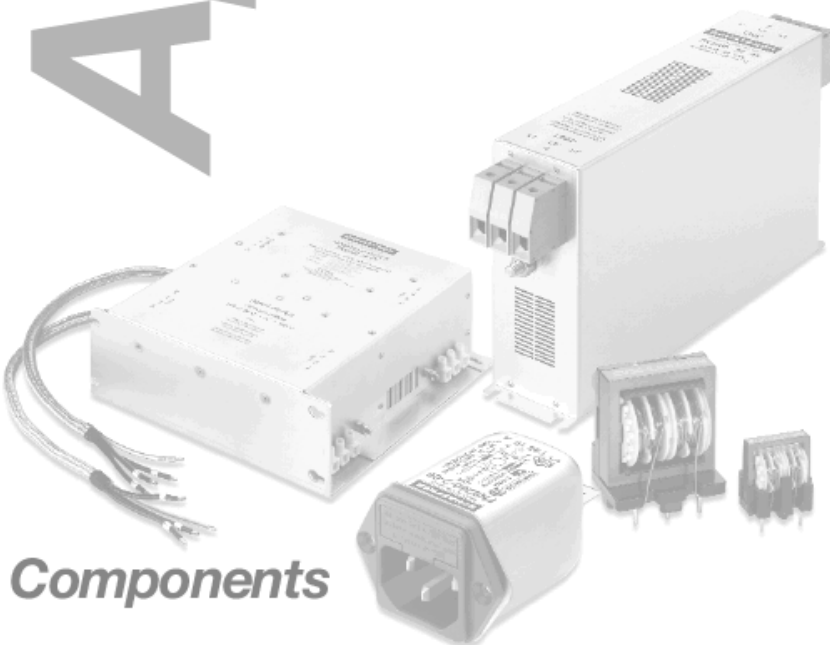
MOTOR DRIVES

EMC-FILTERS IN

INDUSTRIAL APPLICATIONS

(Diese Applikationsnotiz ist auch auf Deutsch erhältlich)

Application
Note



Components

Motor Drives – EMC Filters in Industrial Applications

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Amendment A11 to the EMC product standard EN61800-3 for variable speed electrical power drives brought about a large number of changes and more precise definitions as compared to the standard published in 1997. Since conformance with the EMC legislation is a decisive selection criterion for most users of frequency converters, drive manufacturers are urged to interference suppress their products in accordance with the prescribed limiting values. To simplify this task, Schaffner offers optimized filter solutions which, apart from compliance with the limiting values, also prove their worth through improved connection technology, simplified handling, low space requirement and high practical usability.

1. Explanations regarding the current standards situation

1.1 The EMC product standard for variable speed electrical power drives EN61800-3:1996

The European standard came into force in 1997 for regulating EMC phenomena in conjunction with adjustable speed electrical power drive systems that are connected to a public low-voltage supply network. To determine the relevant interference voltage limits for the respective drives, the following criteria have to be considered:

- The environment (site of deployment of the drive)
- The method of sales distribution (general or restrictedly available)

The following two environments are defined in the standard:

1.1.1 First environment: Domestic area

The first environment is for drives which could be connected to a power supply network which also supplies buildings used for domestic purposes. In this environment, the power drive system has to be EMC emission tested, and show compliance with the limits which are the same as all products which are used in domestic, commercial and light industrial environments.

1.1.2 Second environment: Industrial area

The definition for the second environment refers to drives that are deployed in purely industrial environments. What must then be remembered is that the corresponding low-voltage network does not also additionally supply to domestic areas. With regard to this second environment, the standard states that the definition of limiting values is still under consideration (status as of 1997).

However, "under consideration" does not mean that no limiting values have to be applied. Rather, it needs to be carefully considered whether nonetheless, the corresponding measurements and measures are indicated, to ensure the electromagnetic compatibility under the prevailing conditions. For this reason, the criterion of the method of sales distribution is also applied additionally.

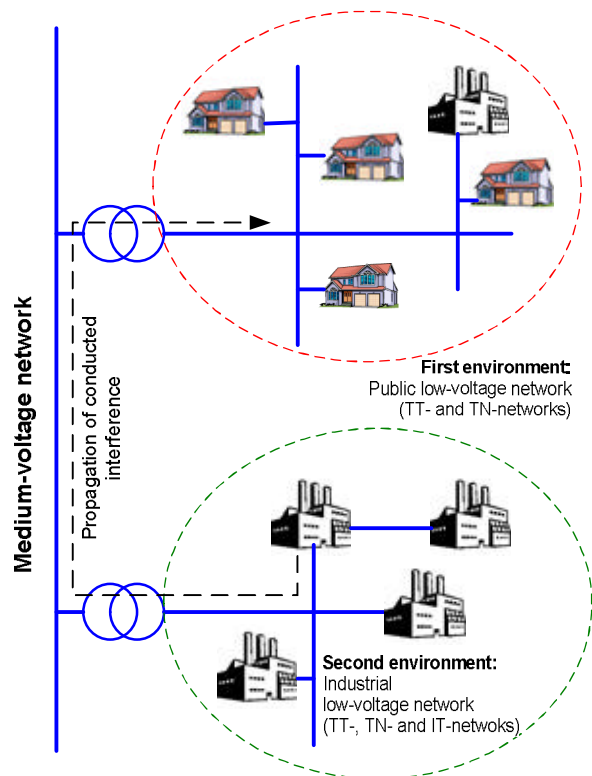


Fig. 1: Environments according to EN61800-3

As can be seen from figure 1, conducted interference does not only occur within the relevant low voltage network. In the case that has been depicted, the source of interference is located in the second environment; the interference drain (the "victim") is in the first environment. The propagation of interferences takes place via the medium voltage network.

1.1.3 Unrestricted sales distribution (unrestricted availability)

A method of sales distribution in which the supply of equipment is not dependant on the EMC competence of the customer or user for the application of drives. This implements restrictive emission limits in accordance with the essential EMC protection requirements. Limits should be equivalent to EN50081-1 (1992). Measures to comply with these limits are in the responsibility of the drive manufacturer.

1.1.4 Restricted sales distribution (restricted availability)

A method of sales distribution in which the manufacturer restricts the supply of equipment to suppliers, customers or users who separately or jointly have technical competence in the EMC requirements of the application of drives. They should ensure the essential EMC protection requirements for the specific installation, by choice of suitable emission class, by measurement in situ with actual boundary conditions and by taking appropriate measures.

1.2 The enhancement with Amendment A11:2000

Amendment A11, which has come into force on 1st January 2002, contains enhancements and more precise definitions as compared to the standard that has existed since 1997. With regard to conducted interference, A11 contains a clear tightening of the requirements and not, as is often wrongly assumed, a relaxation of the existing limits. So far, for example, in the case of drives with unrestricted availability for deployment in the industrial environment, no interference voltage limits had been defined at all. It was enough to place the following warning notice in the user manual and on the drive:

Warning !
This product can cause high-frequency interference. It is not intended for use on public low-voltage networks that supply to households, without taking appropriate measures.

Depending on their availability, the use of drives for the second environment was simply restricted.

Now, amendment A11 also defines mandatory limits for conducted interference's in the frequency band from 150kHz up to 30MHz. A distinction is made according to the rating class of the drive as follows: $I \leq 100A$ or $I > 100A$ (nominal input current).

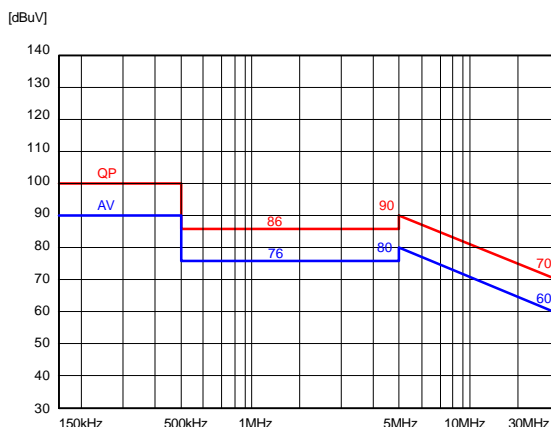


Fig. 2: Limits according to A11 for $I \leq 100A$

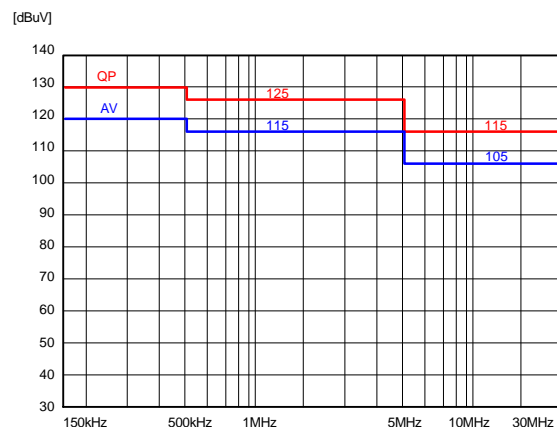


Fig. 3: Limits according to A11 for $I > 100A$

Further on, the principle of protection of the neighboring installation applies. What this means specifically is that as before, in neighboring low-voltage networks, the previous limiting values for residential or industrial areas have to be complied to.

1.3 Overview of the limits for conducted interference voltages (EN61800-3/A11 and EN55011)

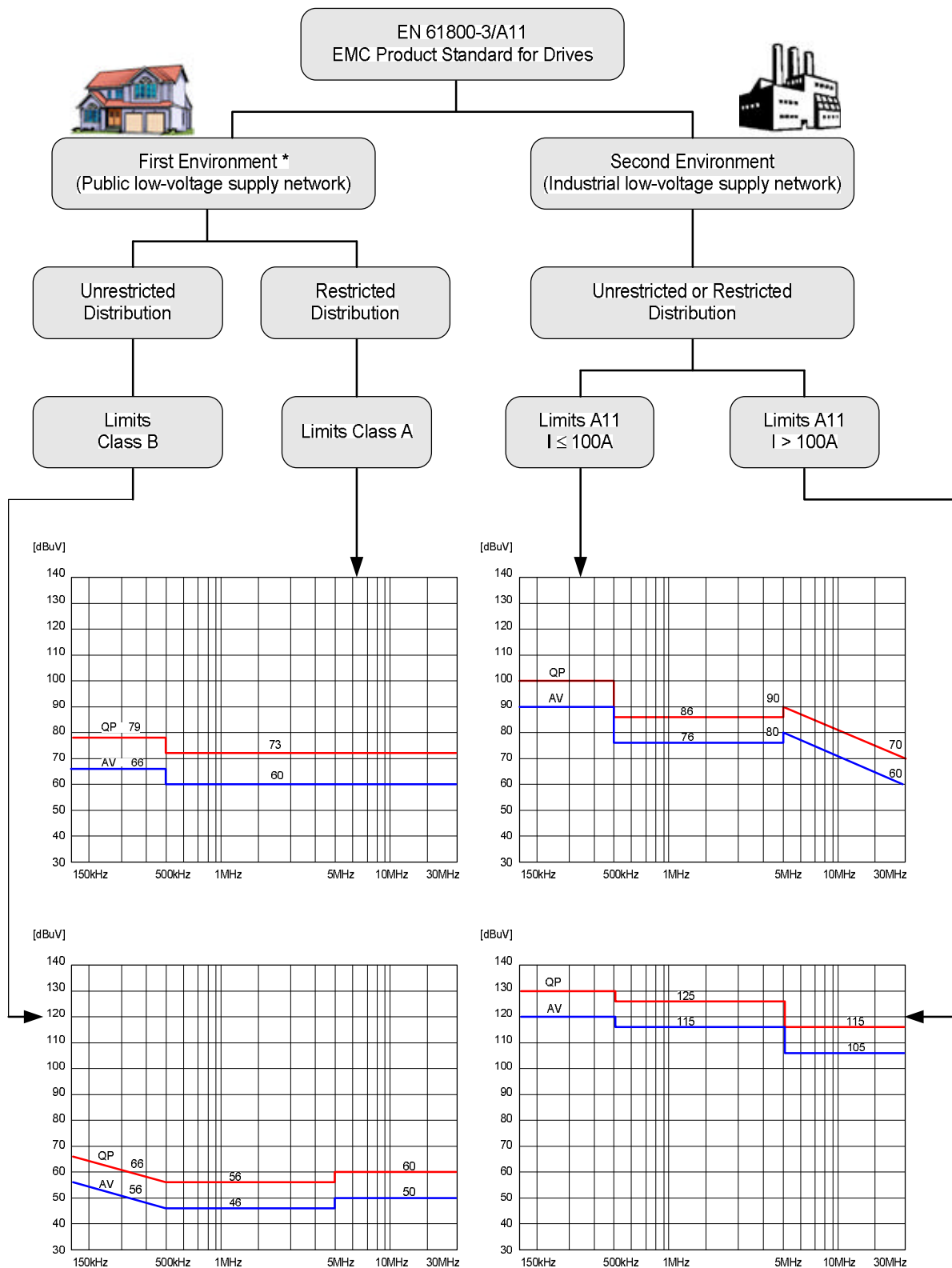


Fig. 4: Selection guide for determining the relevant interference voltage limits

*The limits for the first environment are also decisive when the source of interference acts in the first environment from the second environment.

2. Consequences for the manufacturers of variable speed drives

It must be remembered here that numerous users of converters, especially the small and medium sized companies, installation fitters and small machinery manufacturers do not have their own EMC measurement equipment and EMC specialists. Nonetheless, it is their responsibility to guarantee the reliability and the electromagnetic compatibility of their equipment to the end-user and the government authorities. Therefore, for these companies, it is of the utmost importance to purchase products that already fulfill all the applicable EMC standards. Manufacturers of variable speed electrical power drives must be conscious of this purchasing criterion that is becoming increasingly important and it is therefore in their interest to verify the electromagnetic compatibility of their converters and to provide suitable solutions for every possible case of use.

Of course, the drive manufacturers do not have to face this challenge alone. For years, the Schaffner company has striven to offer affordable and user-friendly filter solutions that facilitate the fulfillment of all the relevant limits under various conditions. Effective immediately, optimized filters for use according to amendment A11 are available.

3. New solutions for changed requirements

3.1 Optimized three-phase filters for industrial use: FN 3270H

With the development of the new three-phase motor drive filters FN 3270H for use in the industrial environment, Schaffner has been successful in unifying the experience from decades of activity in the area of EMC with the requirements of amendment A11 in a solution that is optimized in every respect.

First of all, the FN 3270H stands out because of its very compact construction and low weight. The small footprint required for installation takes into account the usually very modest space conditions in control cabinets and thus leaves more space for other components and for optimizing the cabinet structure. The following pictures illustrate the different designs of the smaller and the higher current types.



Fig. 5: Design of 10 - 100A



Fig. 6: Design of 150 - 1000A

Another advantage is the improved connection technology. All the filters up to 100A are equipped with solid safety-terminals, which are of sufficient size to be able to accommodate most of the standard conductor cross-sections which are common in industrial installations. In the current range from 150 – 1000A, connections are made with copper busbars. These can be covered with transparent protective covers of non-conducting material (optionally available) which firstly protects the installation fitter from electrical shocks and secondly retains the view of the terminals for inspection purposes etc.



Fig. 7: Optionally available plastic covers for protection from unintentional contact

3.2 Compliance with conducted interference limits

FN 3270H facilitates the compliance with the limiting values of the most varied motor drives in numerous industrial applications as defined in amendment A11. The following interference voltage measurement result was obtained with the new three-phase filter FN 3270H-400-99 and shows the compliance with the limits according to EN61800-3/A11 for currents above 100A.

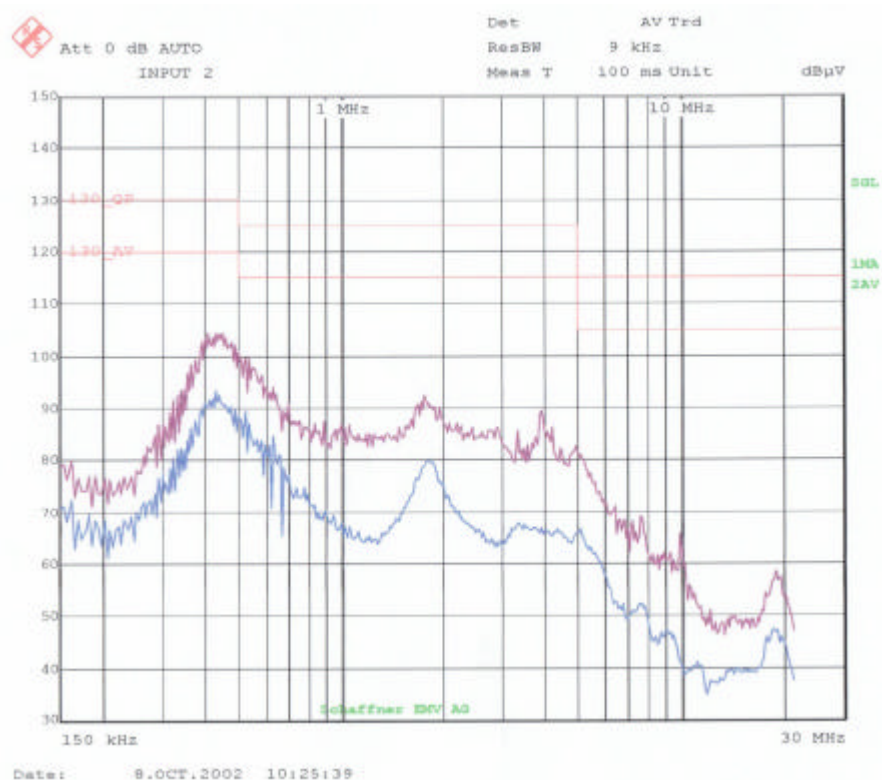
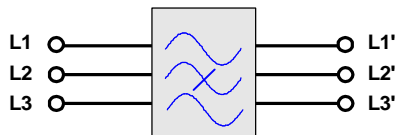



Fig. 8: Interference voltage measurement with FN 3270H-400-99 and 50m motor cable

3.3 Overview of the technical specifications

Above all, FN 3270H stands for user-friendly deployment. This includes e.g. that a filter should not be unnecessarily over-specified because of its rated values. For this reason, the new filter series includes 14 standard types in the current range from 10 to 1000A and facilitates the purposeful selection according to the motor drive rating or the fuse protection of the installation.

The technical data of the FN 3270H is as follows:

FN 3270H		
Specifications *		Block diagram
Maximum operating voltage:	3x520VAC (480VAC+10%)	
Operating frequency:	DC to 60 Hz	
Current range:	10 - 1000A at 50°C	
Cable length:	50m (A11) 25m (class A)	
Climatic classification:	25/100/21	
Safety approvals:		

* more detailed specifications can be found in the datasheet

3.4 Practically proven solutions

Owing to the many years of experience in the industrial sector, Schaffner is in a position to offer filter solutions that give the user practical advantages. The focused use of the unique full-load test setup for variable speed electrical drives at the Schaffner headquarters in Switzerland facilitates the simulation of the most varied drive systems, load conditions, cable lengths and environmental conditions. The knowledge from these measurements is continuously incorporated in the development of new filters and guarantees their practical utility. For the user, this means no unpleasant surprises in the application because of saturation effects or overheating at full load as can occur in the case of filters that have not been subjected to full-load testing.

3.5 Schaffner services

FN 3270H are standard catalogue products with high availability which are suitable for a large number of various applications in the industrial motor drive sector. Nonetheless, in certain cases it may be necessary to customize the existing filter design according to the requirements of special applications. This possibility is available, of course, both for the electrical as well as the mechanical parameters of the new filter series and can, upon inquiry, be developed in close cooperation between the customer and Schaffner.

Be it a standard or customized solution, Schaffner is the ideal partner for carrying out EMC measurements on-site and in the application, for verifying the capability of the filters, the immunity and the electromagnetic compatibility of the entire installation.

For more detailed information, data sheets, consulting or measurement services, please contact your local Schaffner partner or the head office in Luterbach, Switzerland. The corresponding contact addresses can be found at www.schaffner.com

FN 3270H advantages at a glance:

- Compact, light-weight construction
- Small footprint
- Simple, time-saving installation
- Solid, touch-safe connection technology
- Compliance with the limits given by EN61800-3/A11
- Full-load-approved filter properties
- 14 current types for easy selection
- Standard product with high availability
- On-site testing upon request