



ABB drives

Technical guide No. 2

EU Council Directives and adjustable speed electrical power drive systems

Power and productivity
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Chapter 1 - Introduction

This guide's purpose

The aim of this Technical guide No. 2* is to give a straight-forward explanation of how the various EU Council Directives relate to power drive systems (PDSs). For an explanation of the terminology of PDSs, see pages 21 and 22.

While Electromagnetic Compatibility (EMC) is the subject of most concern within the industry, it must be realised that the EMC Directive is only part of the overall EU initiative on common safety standards.

It is the intention of this guide to offer users of AC or DC power drive systems - whether machine builders, system designers, distributors, OEMs, end-users or installers - some clear practical guidelines and courses of action.

*Notes

- 1 The content of this technical guide is ABB Oy's, Drives interpretation of events as of July 2007. However, we reserve the right to develop and evolve these interpretations as more details become available from notified bodies (see chapter 6), competent authorities (see chapter 6), organisations and from our own tests.
- 2 Other technical guides available in this series include:

Technical guide No. 1 -

Direct torque control (3AFE58056685)

Technical guide No. 3 -

EMC compliant installation and configuration for a power drive system (3AFE61348280)

Technical guide No. 4 -

Guide to variable speed drives (3AFE61389211)

Technical guide No. 5 -

Bearing currents in modern AC drive systems (3AFE64230247)

Technical guide No. 6 -

Guide to harmonics with AC drives (3AFE64292714)

Technical guide No. 7 -

Dimensioning of a drive system (3AFE64362569)

Technical guide No. 8 -
Electrical braking (3AFE64362534)

Technical guide No. 9 -
Guide to motion control drives (3AFE68695201)

Technical guide No. 10 -
Functional safety (3AUA0000048753)

How to use this guide

The guide is divided into 7 sections.

Section 4 looks at purchasing decisions for PDSs. Please note the following about the structure of this section:

Responsibilities and actions

Each type of purchaser is offered an explanation of their responsibilities. This is for awareness. No action is needed.

Following the responsibilities is a set of actions. If the purchaser follows these actions, step-by-step, then conforming to the relevant directives will be straightforward.

Tickboxes

Alongside the actions are tickboxes. Purchasers can photocopy the relevant pages and use them as a checklist with each item being ticked off as it is achieved.

Cross-referencing

Because of the complexity of conforming to each directive, this guide inevitably carries a lot of cross-references to other sections. In the margin you will come across:

Defined on page XX

You are advised to turn to the page number reference.

You will also notice other references within the text. These can be referred to if the item is unclear but is not essential for achieving compliance.

Key point:

Within the text you will see:

Key point

These are key observations that must be observed.

Chapter 2 - General questions and answers

It is very important that users of PDSs fully understand all the various rules and regulations and how they apply to PDSs. That is the purpose of this guide.

What are these EU Council Directives?

It is important to realise that EMC cannot be divorced from other European legislation. So before answering this question, we need to look at the **other** legislation and how it affects the purchase and installation of drives.

Quite simply there are **three directives** that mainly affect a drive's safety against risks and hazards. These are:

Directive	Mandatory	Page
Machinery Directive	1995-01-01	pg 55
Low Voltage Directive	1997-01-01	pg 56
EMC Directive	1996-01-01	pg 57

But more on each of these directives later. Let us first explain EMC and look at some concerns of the industry.

How does EMC affect me?

From January 1, 1996 the EU Council's Electromagnetic Compatibility Directive (89/336/EEC and it's successor 2004/108/EC) has been compulsory. It applies to all electrical and electronic equipment sold within the EU and affects virtually all manufacturers and importers of electrical and electronic goods.

Key point:

Electrical equipment that does not conform to the regulations may not be sold anywhere in the EEA (European Economic Area).

What is EMC?

EMC stands for **E**lectromagnetic **C**ompatibility. It is the ability of electrical/electronic equipment to operate problem-free within an electromagnetic environment. Likewise, the equipment must not disturb or interfere with any other products or systems within its locality.

What is an electromagnetic environment?

The electromagnetic environment is everywhere but it varies from place to place. The reason is that there are many different sources of disturbance which can be natural or man-made.

Natural sources consist of electrical discharge between clouds, lightning or other atmospheric disturbances. While we cannot influence these sources we can protect our products and systems from their effects.

Man-made disturbances are those generated by, for example, electrical contacts and semiconductors, digital systems like microprocessors, mobile radio transmitters, walkie-talkies, portable car telephones and power drive systems.

Such a variety of equipment, each with its own emission characteristics, is often used so near to other electrical equipment that the field strengths they create may cause interferences.

Key point:

It is important that all PDSs are immune to these natural and man-made disturbances. While drives manufacturers strive to make their products immune, the directive lays down minimum standards for immunity, thereby ensuring all manufacturers achieve the same basic level.

How does electromagnetic interference show up?

Electromagnetic interference shows up in a variety of ways. Typical examples of interference include a poorly suppressed automobile engine or dynamo; an electric drill causing patterning on the TV screen; or crackling from an AM radio.

The microprocessor and power electronic component, switch rapidly and therefore, can cause interference at high frequencies, unless proper precautions are taken.

What emissions can drives cause?

The normal operation of any drive involves rapid switching of high voltages and this can produce radio frequency emission. It is this radiation and emission that have been seen to have the potential to disturb other circuits at frequencies below 200 MHz.

Modern equipment contains considerable communications and other digital electronics. This can cause considerable emissions at frequencies above 200 MHz.

How is this emission seen?

The main emission is via conduction to the mains. Radiation from the converter and conducting cables is another type of emission and it is especially demanding to achieve the radiated emission limits.

How do I avoid electromagnetic interference?

You need to ensure two things:

- that the equipment generates minimum emission.
- that the equipment is immune to outside effects.

Key point:

In the case of power drive systems, a lot depends on the quality of the installation.

Electromagnetic interference needs to be conducted to earth (ground potential) and no system can work unless it is properly grounded.

Drives manufacturers must comply with EMC standards then?

Unfortunately, the process is not that simple. Virtually everyone in the supply chain has a responsibility to ensure a product, a system and an installation complies with the essential requirements of the EMC Directive.

The key is to clearly understand who has responsibility for what. In the forthcoming pages we take a look at various types of purchasers and examine the steps each should take to meet all three directives mentioned on page 11.

Everyone from manufacturer to installer to user has a responsibility in complying with EMC rules.

If a drive is CE marked, I need not worry. True?

Again this is a big misconception. Just because a drive has CE marking does not necessarily mean it meets the EMC Directive.

Key point:

This will all become clear by referring to the section **purchasing decisions for PDSs**, page 21.

CE marking according to the EMC Directive cannot normally be applied to a module that is no more than a chassis with exposed terminals.

Chapter 3 - CE marking

What is CE marking and how relevant is it for drives?

CE marking, shown below, is the official signature of the **Declaration of conformity** (see pages 43 and 44) as governed by the European Commission. It is a very specific graphic symbol and must be separated from other marks.



CE marking is a system of self certification to identify equipment that complies with the relevant applicable directives.

If a drive is the subject of several directives and, for example, conforms with the **Low Voltage Directive** (see page 56), then, from 1997, it is compulsory that it shows **CE marking**. That marking shall indicate that the drive also conforms to the **EMC Directive** (page 57). CE marking shall indicate conformity only to the directive(s) applied by the manufacturer.

Key point:

NOTE: There must be technical documentation supporting the **Declaration of conformity**.

For more on **technical documentation**, please refer to pages from 36 to 40.

What is CE marking for?

CE marking is mainly for the benefit of authorities throughout the EU and EEA countries who control the movement of goods. CE marking shows that the product complies with the essential requirements of all relevant directives, mainly in the area of technical safety, compatibility issues and conformity assessment. There are three directives that are relevant to drives, but CE marking may be attached to indicate compliance with one of them only (see the previous page).

Is CE marking a quality mark?

Most definitely not. As CE marking is self certification, you can be assured that certification has been carried out.

What is the legal position regarding CE marking?

Anyone applying CE marking is legally liable and must be able to prove the validity of his actions to the authorities. CE marking confirms compliance with the directives listed in the Declaration of conformity (see pages 43 and 44).

What is the importance of CE marking for purchasers of drives?

As far as a purchaser of a drive is concerned, anything that carries the CE mark must have a functional value to him.

Thus, a complete drive product, which can be safely cabled and powered up on its own, shall carry the CE marking.

If I buy a CE marked drive, will I meet the technical requirements of the directives?

In practice, you will see drive products with CE marking. But it is important to understand just why the product was given CE marking in the first place.

Basically a drive has no functional value. It is only of practical use when connected to, say, a motor which in turn is connected to a load.

Therefore, as far as the Machinery Directive is concerned a drive cannot have CE marking unless it is part of a “process” comprising the drive, motor and load.

As for the EMC Directive, the equipment that make up a “process” include cabling, drives and motor. CE marking can only be affixed if all items forming such a “process” conform to the requirements of the directive. Therefore, the drive manuals include detailed instructions for installation.

However, in the eyes of the Low Voltage Directive, a built drive does have functionality. That is, through the drive’s parameters you can program the drive and obtain an input and output signal. Thus, if a drive conforms to the Low Voltage Directive it can carry CE marking. Refer to pages from 58 to 60 for explanations of the three directives.

What happens if, as an end-user, I put together a system - do I have to put CE marking on?

Yes. Anyone putting together a system and commissioning it is responsible for the appropriate CE marking.

Key point:

Turn to page 31 for more details about the end-user's responsibilities.

What about spare parts that I buy for a drive? Do I negate the CE mark if I replace a component?

Equipment supplied before the application of the directives, can be repaired and supplied with spare parts to bring it back to the original specification. However, it cannot be enhanced or reinstalled without meeting the directives.

For equipment supplied after the application of the directives, the use of the manufacturer's spare parts should not negate the CE marking. However, the manufacturer or supplier should be consulted about upgrading, as some actions could affect the CE marking criteria.

If drives are classed as components, on subassemblies they cannot be EMC certified or carry a CE mark. Is this true?

You need to first understand the terminology now being applied to drives. See below and pages 21 and 22 for this.

A complete drive module (CDM) is normally a component in a system and as such has no functional value unless it is connected to the motor when it becomes a PDS.

The CDM shall be CE marked if it is to be installed with simple connections and adjustments that do not require any EMC-knowledge.

If awareness of the EMC implication is needed in order to install a CDM, it is not considered as an apparatus. Thus, it shall not be CE marked according to the EMC directives.

If a CDM or BDM is intended for incorporation in PDS by professional manufacturers only (panel builders, machine builders), it shall not be CE marked, nor is Declaration of conformity given by the CDM/BDM manufacturer. Instead installation instructions shall be supplied in order to help the professional manufacturers.

In summary

The EMC Directive defines equipment as any apparatus or fixed installation. As there are separate provisions for apparatus and fixed installations, it is important that the correct category of the equipment is determined.

In technical-commercial classifications the following terminology is frequently used: components, sub-assemblies, finished appliances (ie, finished products), a combination of finished appliances (ie, a system), apparatus, fixed installations and equipment.

The key issue here is whether the item to be considered is for end users or not:

- If it is meant for end users, the EMC directive applies
- If it is meant for manufacturers or assemblers, the EMC directive does not apply

Components or subassemblies intended for incorporation into an apparatus by the end users

A manufacturer may place components or sub-assemblies on the market which are:

- For incorporation into an apparatus by the end-user,
- Available to end users and likely to be used by them.

These components or sub-assemblies are to be considered as apparatus with regard to the application of the EMC. The instructions for use accompanying the component or sub-assembly should include all relevant information, and should assume that adjustments or connections can be performed by an end-user not aware of the EMC implications.

Some variable speed power drive products fall into this category, eg, a drive with enclosure and sold as a complete unit (CDM) to the enduser who installs it into his own system. All provisions of the EMC Directive will apply (CE mark, Declaration of conformity and technical documentation).

Components or subassemblies intended for incorporation into an apparatus by the other manufacturer or assembler

Components or sub-assemblies intended for incorporation into an apparatus or an other sub-assembly by other manufacturers or assemblers are not considered to be “apparatus” and are therefore not covered by the EMC Directive. These components include resistors, cables, terminal blocks, etc.

Some variable speed power drive products fall into this category as well, eg, basic drive module (BDM). These are meant to be assembled by a professional assembler (eg, panel builder or system manufacturer) into a cabinet not in the scope of delivery of the manufacturer of the BDM. According to the EMC Directive, the requirement for the BDM supplier is to provide instructions for installation and use.

Note:

The manufacturer or assembler of the panel or system is responsible for CE mark, Declaration of conformity and technical documentation.

Finished appliance

A finished appliance is any device or unit containing electrical and/or electronic components or sub-assemblies that delivers a function and has its own enclosure. Similarly than components, the interpretation finished appliance can be divided into two categories: it can be intended for the end users, or for the other manufacturers or assemblers.

Finished appliance intended for the end users

A finished appliance is considered as apparatus in the sense of the EMC Directive, if it is intended for the end-user and thus has to fulfill all the applicable provisions of the Directive.

Finished appliance intended for the other manufacturer or assembler

When the finished appliance is intended exclusively for an industrial assembly operation for incorporation into other apparatus, it is not an apparatus in the sense of the EMC Directive and consequently the EMC Directive does not apply for such finished appliances.

Systems (Combination of finished appliances)

A combination of several finished appliances which is combined, and/or designed and/or put together by the same person (ie, the system manufacturer) and is intended to be placed on the market for distribution as a single functional unit for an end-user and intended to be installed and operated together to perform a specific task.

All provisions of the EMC Directive, as defined for apparatus, apply to the combination as a whole.

Apparatus

Apparatus means any finished appliance or combination thereof made commercially available (ie, placed on the market) as a single functional unit, intended for the end-user, and liable to generate electromagnetic disturbance, or the performance of which is liable to be affected by such disturbance.

Fixed installation

A particular combination of several types of apparatus, equipment and/or components, which are assembled, installed and intended to be used permanently at a predefined location.

Equipment

Any apparatus or fixed installation

Chapter 4 - Purchasing decisions for PDSs

What you need to know and do

Starting on page 23, we offer a step-by-step guide relating to your purchasing requirements for power drive systems.

Key point:

Before turning to page 23, you **need to know** the following terms for PDSs and their component parts, which may be unfamiliar to many users.

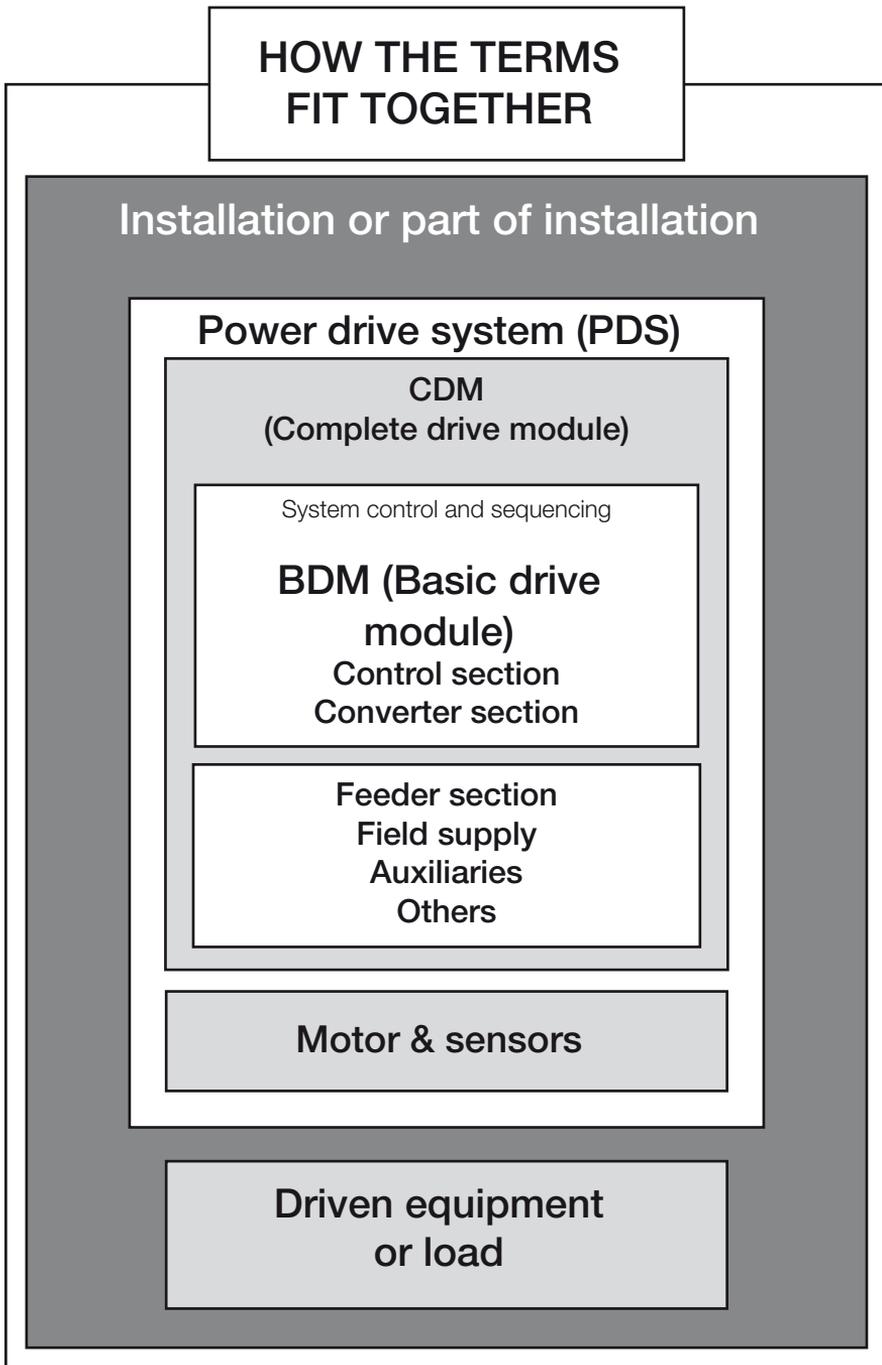
TERMS THAT YOU MUST KNOW

1. Basic drive module (BDM) consists of the converter section and the control circuits needed for torque or speed. A BDM is the essential part of the power drive system taking electrical power from a 50 Hz constant frequency supply and converting it into a variable form for an electric motor.

2. Complete drive module (CDM) consists of the drive system without the motor and the sensors mechanically coupled to the motor shaft. The CDM also includes the Basic Drive Module (BDM) and a feeder section. Devices such as an incoming phase-shift transformer for a 12-pulse drive are considered part of the CDM.

3. Power drive system, or PDS, is a term used throughout this technical guide. A PDS includes the frequency converter and feeding section (the CDM and BDM), motors, sensors, all cabling, filters, panels and any other components needed to make the PDS work effectively.

Note: The load is not considered part of the PDS, but the CDM can incorporate the supply sections and ventilation.



Now we strongly advise you turn to page 23, to discover the type of person you are.

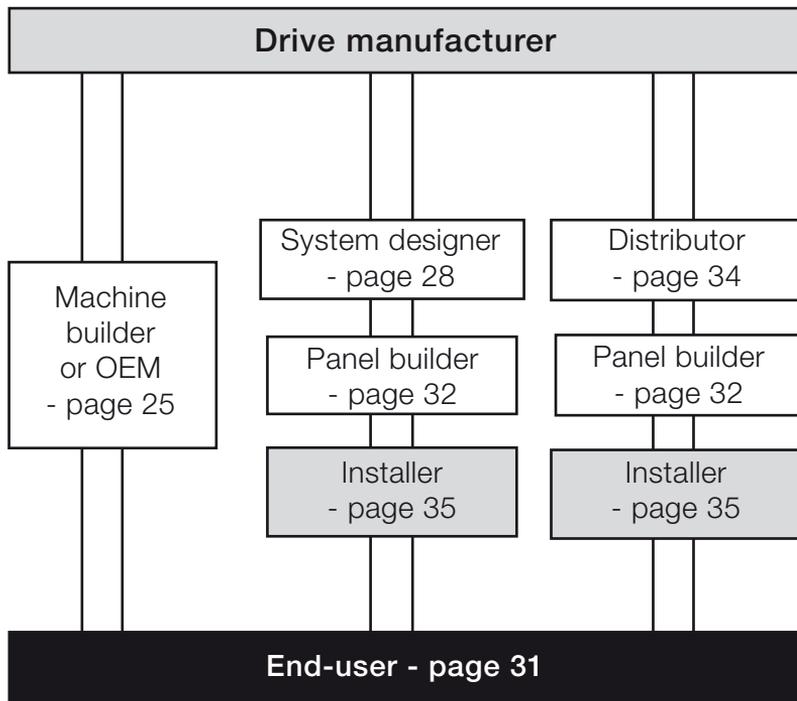
To make this technical guide easy to use, we have also identified certain types of people who will be involved in the purchasing of drives.

Please identify the type nearest to your job function and turn to the relevant section

WHO ARE YOU?	
	IF THIS IS YOU, TURN NOW TO PAGE...
<p>Machine builder is a person who buys either a PDS, CDM or BDM and other mechanical or electrical component parts, such as a pump, and assembles these into a machine. Note: A machine is defined as an assembly of linked parts or components, at least one of which moves. It includes the appropriate actuators, control and power circuits joined together for a specific application, in particular for processing, treatment, moving or packaging of a material.</p>	25
<p>System designer carries out all the electrical design of the power drive system, specifying all component parts which comprise a PDS.</p>	28
<p>End-user is the final customer who will actually use the machine, PDS or CDM/BDM.</p>	31
<p>Panel builder constructs enclosures into which a panel builder will install a variety of components, including a CDM/BDM and sometimes the motor. However, the built enclosure does not constitute a machine.</p>	32

Continued overleaf...

WHO ARE YOU?		IF THIS IS YOU, TURN NOW TO PAGE...
<p>Distributor acts as the sales distribution channel between the CDM/ BDM manufacturer and the end-user, machine builder, OEM, panel builder or system designer.</p>		34
<p>Installer carries out the entire electrical installation of the PDS.</p>		35
<p>Original equipment manufacturer (OEM) For the purposes of purchasing drives, an OEM will normally fall into the category of a machine builder, system designer or panel builder. Therefore, if you identify yourself as an OEM, refer to the relevant pages for each of these job functions.</p>		25 28 32



NOTE: Before reading this section we strongly urge you to familiarise yourself with the terms explained on pages 21-24.

If you are a machine builder buying a PDS...

...You have the following responsibilities:

1. Because you are building a complete machine, which includes coupling up the motors to the PDS and providing the mechanical guarding and so on, you are liable for the total mechanical and electrical safety of the machine as specified in the **Machinery Directive**.

Therefore, the PDS is ultimately your responsibility. You need to ensure that the entire PDS meets the **Machinery Directive**. Only then can **CE marking** be applied to the whole machine.

2. You are also responsible for the electrical safety of all parts of the PDS as specified in the **Low Voltage Directive**.
3. You must ensure electrical equipment and components are manufactured in accordance with the **EMC Directive**. The manufacturer of these parts is responsible for EMC for that particular part. Nevertheless you are responsible for EMC for the machine. You may choose electrical parts not in accordance with the EMC directive, but then you have the responsibility for compliance of parts.

Note: Be aware that combining CE marked sub-assemblies may not automatically produce an apparatus that meets the requirements.

4. You must ensure that the PDS or its component parts carry **declarations of conformity** in accordance with the electrical safety requirements of the **Low Voltage Directive**.
5. You must be able to assure an **authority** and customers that the machine has been built according to the **Machinery Directive**, the **Low Voltage Directive** and the **EMC Directive**. It may be necessary to issue technical documentation to demonstrate compliance. You must keep in mind that you and only you have responsibility for compliance with directives.
6. A **Declaration of conformity** according to the directives above must be issued by the **machine builder** and **CE marking** must then be affixed to the machine or system.
7. Any machine that does not comply must be withdrawn from the market.

Actions you must take

To meet the **Machinery Directive** (see page 55) you need to:

a. Comply with the following mechanical safety checklist.

The aim is to eliminate any risk of accident throughout the machinery's life. This is not a complete list, the detailed list is contained within the Machinery Directive:

- Eliminate risk as far as possible, taking the necessary protective measures if some risks cannot be eliminated.
- Inform users of the residual risks; indicate whether any training is required and stress the need for personal protective equipment.
- Machinery design, construction and instructions must consider any abnormal use.
- Under the intended conditions of use, the discomfort, fatigue and stress of the operator must be reduced.
- The manufacturer must take account of the operator's constraints resulting from the use of personal protective equipment.
- Machinery must be supplied with all essential equipment to enable it to be used without risk.

b. Comply with the following electrical safety checklist: **To ensure the electrical safety of all parts of the PDS as specified in the Low Voltage Directive (refer to page 56) you need to comply with the following safety checklist, which is not necessarily complete.**

- The electricity supply should be equipped with a disconnecting device and with emergency devices for prevention of unexpected startup.
- The equipment shall provide protection of persons against electric shock from direct or indirect contact.

The equipment is protected against the effects of:

- overcurrent arising from a short circuit.
- overload current.
- abnormal temperatures.
- loss of, or reduction in, the supply voltage.
- overspeed of machines/machine elements.

The electrical equipment is equipped with an equipotential bonding circuit consisting of the:

- PE terminal.
 - conductive structural parts of the electrical equipment and the machine.
 - protective conductors in the equipment or the machine.
- The control circuits and control functions ensure safe operation including the necessary inter-lockings, emergency stop, prevention of automatic re-start, etc.

Defined on page 40

c. Compile a **technical file** for the machine, including the PDS.

Key point:

Generally, must carry **CE marking** and have a **Declaration of conformity**.

For machines that pose a high risk of accident, a **type certification** (see page 46) is required from a **notified body**. Such machinery is included in Annex IV of the **Machinery Directive**.

The **type certificate** issued should be included in the **technical file** for the machine or safety component. Refer now to page 40.

- 2. Declarations of conformity from each of the component suppliers whose products make up the PDS and incorporate them into the technical documentation, referring to all three directives. If buying a PDS from a system designer (see below), he should be able to provide all declarations. If system designer or component supplier cannot provide a Declaration of conformity, the responsibility of demonstrating compliance according to EMC Directive or Low Voltage Directive lies on machine builder.

- 3. Pass this technical documentation to a notified body. The machine builder **SHOULD NOT** pass the file on to an end-user. Based on the technical documentation, obtain a Certificate of Adequacy or technical report from a notified body.

Defined on pages 43, 45 and 46

- 4. Issue a Declaration of conformity for the entire machine. Only then can you apply CE marking.
- 5. Pass the Declaration of conformity related to all three directives on to the end-user of the machine.
- 6. Apply **CE marking** to the machine.
- 7. Congratulations! You have successfully complied with the main requirements for safe and efficient operation of a machine.

If you are a system designer buying a PDS

You have the following responsibilities:

1. The PDS is a complex component of the machine. Therefore, the **Machinery Directive** has to be complied with by issuing a **Declaration of incorporation**.
2. Because a PDS is not a machine, the only directives which need to be complied with are the **Low Voltage Directive** and the **EMC Directive**.
3. The responsibility for **Declaration of conformity** and applying **CE marking** rests with both the system designer and the supplier of the component parts which make up the power drive system.

The system designer has to decide if he is going to place his delivery on the market as a single functional unit or not

- if the answer is YES, the delivery shall be classified as a system.
- if the answer is NO, the delivery shall be classified as an installation.

- A.** If the delivery is classified as a system, the system designer has to choose one of two paths to follow:

Path 1

All components have EMC compliance

1. **EMC behaviour is based on a component's performance.**
2. Responsibility lies with the **component suppliers** for CE marking of individual **complex** components
3. PDS is an system according to the **EMC Directive** (as placed on the market as a single functional unit).
4. The **Declaration of conformity** as well as the instructions for use must refer to the system as whole. The system designer assumes responsibility for compliance with the Directive.

Note 1: The system designer is responsible for producing the instructions for use for the particular system as whole.

Note 2: Be aware that combining two or more CE marked sub-assemblies may not automatically produce a system that meets the requirements.

5. No **CE marking** is required for a system as whole, as long as each part bears the CE mark.

Actions you must take

- 1. Follow all **installation guidelines** issued by each of the component suppliers.
- 2. Issue **instructions for use** in order to operate the system.
- 3. Issue technical documentation for the system.
- 4. Issue a **Declaration of conformity**.
- 5. **DO NOT** issue a **CE mark**.

Path 2

Components without EMC compliance

1. EMC behaviour is designed at the system level (no accumulated cost by device specific filters etc).
2. Responsibility lies with the **system designer** who decides the configuration (place or a specific filter, etc).
3. PDS is a system according to the **EMC Directive** (as placed on the market as a single functional unit).
4. **Declaration of conformity** and **CE marking** are required for the system.

Actions you must take

- 1. Follow the **installation guidelines** issued by each of the component suppliers.
- 2. Optimise the construction of the installation to ensure the design meets the required EMC behaviour, ie, the location of filters.

Defined on pages 36 - 46

- 3. Issue **instructions for use** in order to operate the system.
- 4. Issue **technical documentation** for the system.
- 5. Issue a **Declaration of conformity** and **CE mark**.

B. If the delivery is an installation, the system designer has one path to follow:

All components have EMC compliance

1. **EMC behaviour is based on a component's performance.**
2. Responsibility lies with the **component suppliers** for CE marking of individual **complex components**.
3. PDS is an **installation** according to the **EMC Directive**.
4. No **Declaration of conformity** or **CE marking** is required for a fixed installation, (such as an outside broadcast radio station) DOC and CE marking are needed.

Actions you must take

- 1. Follow all **installation guidelines** issued by each of the component suppliers.
- 2. Transfer all installation guidelines and Declaration of conformity for each of the components, as issued by suppliers, to the machine builder.
- 3. **DO NOT** issue a **Declaration of conformity** or **CE marking** as this is not allowed for **fixed installations**.

If you are an end-user buying a CDM/BDM or PDS

Key point:

An **end-user** can make an agreement with the drive's supplier so that the supplier acts as the **machine builder**. However, the **end-user** is still responsible for the machine's safety.

The supplier who acts as the **machine builder** will issue a **Declaration of conformity** when the work is complete.

Once an intermediary **panel builder** incorporates a CDM/BDM into a panel, he creates a part of a PDS.

The panel builder then has the same responsibilities as the drive's manufacturer.

...You have the following responsibilities

1. For the total mechanical and electrical safety of the machine of which the drive is part of, as specified in the **Machinery Directive**.
2. For the electrical safety of the drive as specified in the **Low Voltage Directive**.
3. To ensure the drive carries a **Declaration of conformity** in accordance with the electrical safety requirements of the **Low Voltage Directive**.
4. To be able to demonstrate to the authorities that the machine to which the drive is being fitted has been built to both the **Machinery Directive** and **Low Voltage Directive**.
5. The manufacturer of the drive is responsible for determining the EMC behaviour of the drive.
6. The resulting EMC behaviour is the responsibility of the assembler of the final product, by following the manufacturer's recommendations and guidelines.

Actions you must take

The following needs to be completed by either the end-user directly or the third party engaged to build the machine.

1. To meet the **Machinery Directive** (refer to page 55) you need to **follow the actions listed for a machine builder on pages 25-28.**
2. Follow installation instruction issued by manufacturers in order to fulfill the requirements of the **EMC Directive** and the **Low Voltage Directive.**
3. Ensure that equipment (CDM/BDM/PDS) is operated according to manufacturer's instruction in order to guarantee right way of operation.

If you are a panel builder buying a CDM/BDM

...You have the following responsibilities:

1. The panel builder has two options:

Option A - To buy non-CE marked components

This could save the panel builder money because he buys components which are not tested for EMC or safety. However, the responsibility is then the panel builder's and this will incur considerable costs as the entire panel needs to be tested.

If the panel builder buys non-CE marked components, the drive may be made to conform without further testing if the components themselves have been tested. However, tested components do not carry the CE mark but must carry suitable instructions for installation. It is these instructions which must be demonstrably met.

Option A - Actions to meet these responsibilities

1. Follow the **installation guidelines** issued by each of the component suppliers.
2. Optimise the construction of the installation to ensure the design meets the required EMC behaviour, ie, the location of filters.
3. Issue **technical documentation** for the system. Defined on pages 36-46.

4. If you choose to assess yourself you must make reference to EMC Directives:

2004/108/EC

And to harmonised standard:

EN 61800-3

And you must make reference to LVD Directive:

2006/95/EC

And corresponding harmonized standard:

EN 61800-5-1 or EN 50178

5. Once testing is completed, the results need to be included in the **technical documentation (TD)** for the panel.

6. **Technical documentation** shall be assessed by yourself in order to demonstrate compliance. You may use **Notified Body** for assessment as well.

7. You must then issue the **Declaration of conformity** and **CE marking** for the panel.

Option B - To buy CE marked components

Option B - Actions to meet these responsibilities

1. Buying CE marked components creates a system or an apparatus (refer to page 17-20) depending on the nature of the panel.

2. Although the panel builder does not have to carry out tests, he must ensure he conforms to the installation guidelines given by each of the component manufacturers.

Note: Be aware that combining two or more CE-marked components may not automatically produce a system, which meets the requirements.

3. Beware! These guidelines could differ greatly from those given for normal installation purposes because the components will be in close proximity to each other.

4. Issue **instructions for use** in order to operate the system or **apparatus**.

- 5. Issue **technical documentation**.
- 6. Issue a **Declaration of conformity**.
- 7. Apply **CE marking** to your panel in the case of an apparatus. In the case of a system **DO NOT** apply **CE marking**.

Additional actions

The panel can be either sold on the open market or use as part of a machine. For each option there is a different requirement:

- 1. If you know that the panel is to be used as part of a machine then you must request from the CDM / BDM manufacturer a **Declaration of incorporation**.
- 2. The **Declaration of incorporation** must be supplied with the panel to the **machine builder**, but **CE marking** based on Machinery Directive MUST NOT be affixed. This is because **CE marking** always needs a **Declaration of conformity**.

Key point:

The **Declaration of incorporation** CAN NOT be used to apply **CE marking**.

- 3. The **machine builder** will need this **Declaration of incorporation** because he has to construct a **technical documentation (TD)** for the machine and in that file all the declarations need to be included.

If you are a distributor buying a CDM/BDM...

...You have the following responsibilities:

- 1. If a distributor is selling boxed products, like CDMs and BDMs (drives), direct from the manufacturer, his only responsibility is to pass on the **installation guidelines** to the end-user, **machine builder** or **system designer**. In addition, the **Declaration of conformity** must be passed to the **machine builder** or **system designer**.
- 2. Both the **installation guidelines** and the **Declaration of conformity** are available from the manufacturer.

Actions you must take to meet these responsibilities

1. Pass all **installation guidelines** and **declaration of conformities** to either the **end-user, machine builder** or **system designer**.

If you are an installer buying a CDM/BDM or PDS...

...You have the following responsibilities:

1. You must ensure that the **installation guidelines** of the **machine builder** and/or **system designer** are adhered to.

Actions you must take to meet these responsibilities

1. Follow **machinery builder** and/or **system designer Installation guidelines**.
2. See Technical guide No. 3 for recommended installation guidelines.

Chapter 5 - Terminology

Technical documentation (TD)

APPLIED TO:	electrical equipment
RESPONSIBILITY:	electrical equipment manufacturer, system designer, panel builder, OEM, installer
REQUIRED BY:	EMC Directive, Low Voltage Directive

What is technical documentation?

Technical documentation (TD) must be provided for the entire equipment or system and, if required, is used to show a **competent authority** that you have met the essential requirements of the **EMC Directive** (see page 57) and Low Voltage Directive (see page 56).

The TD consists of three parts:

1. A description of the product.
2. Procedures used to ensure conformity of the product to the requirements.
3. A statement from a notified body, if third party assessment route is chosen.

Note: Using a notified body is voluntary and can be decided by the manufacturer

Key point:

The full content of the technical documentation are given on pages 36-39.

Why is technical documentation deemed to be important?

Anyone placing a product onto the market within the EU must be able to show that the product meets the requirements of the appropriate **EU Council Directive** and must be able to demonstrate this to a **competent authority** without further testing.

Technical documentation allows the appropriate **Declaration of conformity** to be drawn up.

Will customers always receive a copy of technical documentation?

The content of the technical documentation is meant for the authorities, and thus the electrical equipment manufacturer does not have to give the technical documentation or any part of it to the customer.

However, as the customer needs to know whether the product is in conformance, he will obtain this assurance from the documentation delivered with the product. It is not required to supply a declaration of conformity with the product, but the end-user may ask for this from the manufacturer.

What is the shelf life of technical documentation?

Any technical documentation must be accessible to the appropriate authorities for 10 years from the last relevant product being delivered.

How do I ensure that tests are always carried out?

The whole system is based on self certification and good faith. In various parts of Europe the methods of ensuring compliance will vary. Supervision of these regulations is achieved through market control by a competent authority. If the equipment fails to meet the requirements of the EMC and Low Voltage Directives competent authorities can use the safeguard clause of the Directives (withdraw the product from the market, take legal action).

Can drive manufacturers help more?

Manufacturers accept that there is a need to work more closely with OEMs and machine builders where the converter can be mounted on the machine. A standard assembly or design should be achieved so that no new parts of technical documentation need to be created.

However, the idea of mounting several drives in motor control centres (MCCs) must be much more carefully thought out by system specifiers, as the summing of high frequency emissions to determine the effects at the MCC terminals is a complex issue and the possibilities of cross coupling are multiplied.

How to make up a TD

1. Description of the product

(Note: You can photocopy these pages and use as a tickbox checklist)

i. identification of product

- a. brand name.
- b. model number.
- c. name and address of manufacturer or agent.
- d. a description of the intended function of the apparatus.
- e. any limitation on the intended operating environment.

ii. a technical description

- a. a block diagram showing the relationship between the different functional areas of the product.
- b. relevant technical drawings, including circuit diagrams, assembly diagrams, parts lists, installation diagrams.
- c. description of intended interconnections with other products, devices, etc.
- d. description of product variants.

2. Procedures used to ensure product conformity

i. details of significant design elements

- a. design features adopted specifically to address EMC and electrical safety problems.
- b. relevant component specifications.
- c. an explanation of the procedures used to control variants in the design together with an explanation of the procedures used to assess whether a particular change in the design will require the apparatus to be re-tested.
- d. details and results of any theoretical modelling of performance aspects of the apparatus.

- e. a list of standards applied in whole or part.
- f. the description of the solution adopted in order to comply with the directive.

ii. test evidence where appropriate

- a. a list of the EMC and electrical safety tests performed on the product, and test reports relating to them, including details of test methods, etc.
- b. an overview of the logical processes used to decide whether the tests performed on the apparatus were adequate to ensure compliance with the directive.
- c. a list of the tests performed on critical sub-assemblies, and test reports or certificates relating to them.

3. If chosen a statement from notified body

This will include:

- i. reference to the exact build state of the apparatus assessed
- ii. comment on the technical documentation.
- iii. statement of work done to verify the contents and authenticity of the design information.
- iv. statement, where appropriate, on the procedures used to control variants, and on environmental, installation and maintenance factors that may be relevant.

4. Actions by the notified body

The **notified body** will study the **technical documentation** and issue the statement and this should be included in the **technical documentation**.

Note: When compiling the **technical documentation** you may need all **Declarations from suppliers**, ie, **Declaration of conformity** and **Declaration of incorporation** depending on the parts, to ensure they carry **CE marking**.

Technical file (for mechanical safety aspects)

APPLIED TO:	machines and safety components
RESPONSIBILITY:	machine builder / system designer
REQUIRED BY:	Machinery Directive

What is a technical file?

A technical file is the internal design file which should show how and where the standards are met and is all that is needed if self certifying the equipment by the standards compliance route.

If a Declaration of incorporation is included in a set of papers and this claims to meet the appropriate parts of the standards and simply instructs the user to meet the standards with other parts of his machine, it is possible to use this as a part of a technical file.

How to make up a technical file

Drawings and diagrams

1. Overall drawings of the machine.
2. Control circuit diagrams.

Health and safety

1. All drawings, calculations and test results used to check the machine's conformity with essential health and safety requirements.

Machine design

1. Lists of the essential health and safety requirements, **harmonised standards**, other standards and technical specifications used when designing the machine.
2. Description of methods used to eliminate hazards presented by the machine.

Other certificates required

1. A technical report or certificate issued by a **notified body** - if required.
2. A copy of the instructions for the machine.

3. For series produced machines, the control measures that are used to ensure that subsequent manufacture remains in conformity with the directive.

Certificate of Adequacy

APPLIED TO: machines / safety components

RESPONSIBILITY: notified body / machine builder

REQUIRED BY: Machinery Directive

What if standards cannot be wholly implemented?

In this case the adequacy of the **technical file** is proved by a **Certificate of Adequacy** issued by a **notified body**.

How to obtain a Certificate of Adequacy

The **Certificate of Adequacy** is a document drawn up by a **notified body**. Once the body has established that the **technical file** contains all the necessary information, the **Certificate of Adequacy** will be issued.

Key point:

The **Certificate of Adequacy** provided should be included in the **technical file**.

Statement

APPLIED TO: electrical equipment

RESPONSIBILITY: notified body

REQUIRED BY: EMC Directive

When the statement is needed

The primary way for manufacturer (or his authorised representative in the Community) to demonstrate the compliance is to use internal production control method. If the manufacturer chooses, he may use other method based on an assessment of a **notified body**.

How to obtain the statement

The manufacturer shall present the **technical documentation** to the **notified body** and request the **notified body** for an assessment thereof. The manufacturer shall specify to the **notified body** which aspects of the essential requirements must be assessed.

The **notified body** shall review the **technical documentation** and assess whether the **technical documentation** properly demonstrates that the requirements of the **Directive**. If the compliance of the apparatus is confirmed, the **notified body** shall issue a statement confirming the compliance of the apparatus.

Key point:

The **statement** provided shall be included in the **technical documentation**.

Report

APPLIED TO: electrical equipment

RESPONSIBILITY: notified body / competent body

REQUIRED BY: Low Voltage Directive

What if standards cannot be wholly implemented?

In the event of a challenge the manufacturer or importer may submit a report issued by a notified body. This report is based on the technical file.

How to obtain a report

The report is a document drawn up by a notified body. Once the body has established that the technical documentation contains all the necessary information and the equipment fulfils the requirements of the Low Voltage Directive, the report will be issued.

Key point:

The report provided should be included in the technical documentation.

Declaration of conformity (for EMC and electrical safety aspects)

APPLIED TO:	electrical equipment and electrical equipment of machines
RESPONSIBILITY:	equipment manufacturer
REQUIRED BY:	Low Voltage Directive and EMC Directive

How to obtain a Declaration of conformity

You need to provide the following:

1. a reference to the Directive(s),
2. an identification of the apparatus to which it refers (including name, type and serial number),
3. the name and address of the manufacturer and, where applicable, the name and address of his authorised representative in the Community,
4. a dated reference to the specifications under which conformity is declared,
5. the date of the declaration,
6. the identity and signature of the person empowered to bind the manufacturer or his authorised representative.

Declaration of conformity (for mechanical safety aspects)

APPLIED TO:	machines
RESPONSIBILITY:	machine builder
REQUIRED BY:	Machinery Directive

How to obtain a Declaration of conformity

You need to provide the following:

1. business name and full address of the manufacturer or, his authorised representative;
2. name and address of the person authorised to compile the technical file, who must be established in the Community;

3. description and identification of the machinery, including generic denomination, function, model, type, serial number and commercial name;
4. a sentence expressly declaring that the machinery fulfils all the relevant provisions of the machinery Directive
5. where appropriate, the name, address and identification number of the notified body which carried out the EC type-examination and the number of the EC type-examination certificate;
6. where appropriate, the name, address and identification number of the notified body which approved the full quality assurance system;
7. a list to the harmonised standards or the other technical standards and specifications used;
9. the place and date of the declaration as well as the identity and signature of the person empowered to draw up the declaration on behalf of the manufacturer or his authorised representative.

Declaration of incorporation

APPLIED TO:	machines or equipment intended for incorporation into other machinery
RESPONSIBILITY:	drives manufacturer / machine builder / panel builder
REQUIRED BY:	Machinery Directive

What is a Declaration of incorporation?

Drives manufacturers must meet the appropriate parts of the Machinery Directive and provide a Declaration of incorporation which states that the drive does not comply on its own and must be incorporated in other equipment.

This declaration will show the standards that have been applied to the parts of the system within the manufacturer's scope.

This declaration includes a statement restricting the user from putting the equipment into service until the machinery into which it is to be incorporated, or of which it is to be a component, has been found, and declared, to be in conformity with the provisions of the Machinery Directive and the national implementing legislation, ie, as a whole including the equipment referred to in this declaration.

The declaration then lists the standards relating to the Machinery and Low Voltage Directives which the manufacturer has met.

It concludes that the entire equipment must meet the provisions of the directive.

Quite simply, the manufacturer passes on the responsibility to the machine or system builder.

Is there no way out of this type of declaration?

No. You must understand that because the manufacturer may be supplying only one part in a machinery, such as the inverter, the manufacturer is legally obliged to ensure that whoever puts the system together must check that it is safe.

Only then can the machine or system builder use the Declaration of incorporation in his technical file of the machine.

Key point:

Most manufacturers will include a Declaration of incorporation covering the Machinery Directive for all built PDS products.

What a Declaration of incorporation contains

1. business name and full address of the manufacturer or his authorised representative;
2. description and identification of the partly completed machinery including generic denomination, function, model, type, serial number and commercial name;
3. a sentence declaring which essential requirements of the Directive are applied and fulfilled;
4. an undertaking to transmit, in response to a reasoned request by the national authorities, relevant information on the partly completed machinery;
5. a statement that the partly completed machinery must not be put into service until the final machinery into which it is to be incorporated has been declared in conformity with the provisions of the Directive;
6. the place and date of the declaration as well as the identity and signature of the person empowered to draw up the declaration on behalf of the manufacturer or his authorised representative.

Type certification

APPLIED TO: machines and safety components

RESPONSIBILITY: machine builder / approved body

REQUIRED BY: Machinery Directive

How to obtain type certification

Type certification is carried out by an **notified body** who will establish that the unit supplied, along with a **technical file**, may be used safely and that any **standards** have been correctly applied.

Once the **type certification** has established this, a **type examination certificate** will be issued.

Chapter 6 - Authorities and bodies

The responsibility for product conformity is given to the manufacturer. If there is any doubt about conformity, then the Authorities can demand technical documentation to show that a product complies with the directives concerning the product.

When assessing product conformity, a manufacturer can use a third party to examine the conformity.

The following types of authorities and bodies exist:

Competent authority

A **competent authority** in any EU or EEA country supervises markets to prevent hazardous products being sold and marketed. They can also withdraw such products from markets.

Notified body

A **notified body** issues type certificates for products, which have their own directives and/or require type testing.

To find a suitable competent authority or **notified body** you can contact:

EU Commission
Enterprise and Industry DG
Information and Documentation Centre
BREY 5 / 150
B-1049 Brussels
Belgium
Ph: +32 2 296 45 51

Or you may find contact through web.site: http://ec.europa.eu/enterprise/electr_equipment/

Chapter 7 - Standards and directives

The use of standards is voluntary, but compliance with directives without the use of harmonised standards is extremely difficult.

There are two ways to show that a power drive system or part of it conform:

- Use of harmonised standards (EN).
- By way of a technical documentation when no harmonised standards exist, or if all parts of a harmonised standard cannot be applied.

Key point:

It is recommended to use technical documentation even when standards are harmonised as it makes it easier to show conformity afterwards, if required by authorities.

Directive or standard?

The legislation of the European Union is defined by different directives.

The directives concerning power drive systems are known as new approach directives, which means that they do not include exact figures or limits for products. What they do include is essential requirements mainly for health and safety which make the application of the relevant harmonised standards mandatory.

The requirements of directives are firmly established in standards. Standards give exact figures and limits for products.

The responsibility for defining standards in Europe rests with three committees: CEN, for areas of common safety, CENELEC, for electrical equipment and ETSI, for telecommunications.

Harmonised standards for PDSs

To remove technical barriers to trade in EU or EEA countries, the standards are harmonised in member states.

In the harmonisation procedure, all member states are involved in developing the Committee's proposals for their own national standard. A standard becomes harmonised when published in the Official Journal of the EU.

The idea is that if a product conforms to the **harmonised standard**, it is legally manufactured and when placed onto the market in one country, it must be freely marketed in other member countries.

How to recognise a European standard

Harmonised standards come in the following format:

XX EN 60204-1

where

XX = the national prefix (eg BS = UK; SFS = Finland)
 EN = the abbreviation of Euronorm
 60204-1 = an example of a standard number

The numbering of European standards follows a well structured and organized sequence:

- EN 50225:1996 (the year of availability of the EN is separated from the number by a colon)
- EN 50157-2-1:1996 (the part number is indicated by a hyphen)

The first two numerals indicate the origin of the standard:

- 40xxx to 44xxx cover domains of common CEN/CENELEC activities in the IT field
- 45xxx to 49xxx cover domains of common CEN/CENELEC activities outside the IT field
- 50xxx to 59xxx cover CENELEC activities, where
 - EN 50xxx refer to the standards issued by CENELEC only
 - EN 55xxx refer to the implementation of CISPR documents
- 60000 to 69999 refer to the CENELEC implementation of IEC documents with or without changes

European standards are adopted and confirmed by CENELEC member countries by adding national prefix before the standard id (for example: SFS-EN 60601-1, DIN EN 60601-1, BS EN 60601-1).

There is also some clue as to a standard's status:

prEN 50082-2 = proposal for standard sent to member states
 ENV 50 = pre-standard which is in force for 3 years to obtain practical experience from member states

Your questions answered

Which standards directly relate to drives?

At the moment, there are three **Product Specific Standards** which relate to the compliance with EU directives. They are called as “EN 61800-3 Adjustable speed electrical power drive systems - Part 3: EMC requirements and specific test methods”, which relates to **EMC Directive**, “EN 61800-5-1 Adjustable speed electrical power drive systems - Part 5-1: Safety requirements - Electrical, thermal and energy”, which relates to **Low Voltage Directive** and EN 61800-5-2 Adjustable speed electrical power drive systems - Part 5-2: Safety requirements - Functional safety”, which relates to **Machinery Directive**.

In addition there are other standards, which need to be taken account:

- EN 60204-1, Electrical Equipment of Machines, which, in addition to being a **Low Voltage Directive** standard for all electrical equipment, is also an electrical safety standard under the **Machinery Directive**.
- EN 50178 according to **Low Voltage Directive** and
- EN 61800-1/2/4, which give rating specifications for Power Drive Systems (LV DC, LV AC and MV AC PDS respectively).
- EN 61000-3-2 and EN 61000-3-12, which give requirements for harmonic current caused by equipment

What are the issues of EN 61800-3 and drives?

For emissions there are two main aspects to be considered:

Conducted emissions: these are seen on the power supply cables and will also be measured on the control connections, while radiated emissions are air borne.

Conducted emissions at low frequencies are known as harmonics, which have been a familiar problem to many users of a PDS. Where harmonics are concerned EN 61800-3 refers to EN 61000-3-2, which applies for equipment under 16 A per phase. In addition, the harmonics standard EN 61000-3-12 applies up to 75 A per phase.

At the moment following groups can be separated

- Below 16 A per phase
 - Professional, over 1kW => No limits.
 - Other > the limits specified.
- Between 16 A and 75 A per phase
 - Equipment for public low voltage systems => the limits specified.
 - Equipment for other systems => the limits specified

Conformity with conducted emissions can be helped by good product design and is readily achieved, in most situations, using filters, providing this is for a single drive.

Radiated emissions: These are more problematic. While it is possible to make the drive enclosure into a Faraday cage and thereby have all radiation attenuated to earth, in practice it is the outgoing connections where inadequate cabling radiates emissions and cross couples with other cables in the vicinity. Important attenuation methods are shielded cables and 360° grounding.

What are the solutions to radiated emissions?

The most important solutions are good installation practice, tight enclosure, shielded cables and 360° grounding. (See Technical guide No. 3 for tips and advice).

Do I have to conform to the standards?

The use of standards is voluntary, but compliance with a Directive without the use of **Harmonised Standards** is difficult in the majority of cases.

Can I be fined for not conforming?

Yes. Failure to comply with any of the Directives will be a criminal offence.

The Product Specific Standard EN 61800-3

This standard defines the required emission and immunity levels of PDSs and the test methods to measure the levels. In Europe, the standard takes precedence over all generic or product family EMC standards previously applicable.

The standard defines two environments where equipment can be used:

First environment

- environment that includes domestic premises, it also includes establishments directly connected without intermediate transformers to a low voltage power supply network which supplies buildings used for domestic purposes. Houses, apartments, commercial premises or offices in a residential building are examples of this kind of locations.

Second environment

- environment that includes all establishments other than those directly connected to a low voltage power supply network which supplies buildings used for domestic purposes. Industrial areas, technical areas of any building fed from a dedicated transformer are examples of second environment locations

The standard divides PDSs and their component parts into four categories depending on the intended use

PDS of category C1:

A PDS with rated voltage less than 1,000 V and intended for use in the first environment. A (PDS (or CDM) sold “as built” to the end-user.

Description

Placed on the market. Free movement based on compliance with the EMC Directive. The **EC Declaration of Conformity** and **CE Marking** are required.

The PDS manufacturer is responsible for EMC behaviour of the PDS under specified conditions. Additional EMC measures are described in an easy-to-understand way and can be implemented by a layman.

When PDS/CDM is going to be incorporated with another product, the resulting EMC behaviour of that product is the responsibility of the assembler of the final product, by following the manufacturer’s recommendations and guidelines.

PDS of category C2:

PDS with rated voltage less than 1,000 V, which is neither a plug in device nor a movable device and is intended to be installed and commissioned only by a professional.

A PDS (or CDM/BDM) sold to be incorporated into an apparatus, system or installation.

Description:

Placed on the market. Intended only for professional assemblers or installers who have the level of technical competence of EMC necessary to install a PDS (or CDM/BDM) correctly. The manufacturer of the PDS (or CDM/BDM) is responsible for providing **Installation Guidelines**. The **EC Declaration of Conformity** and **CE Marking** are required.

When a PDS/CDM/BDM is to be incorporated with another product, the resulting EMC behaviour of that product is the responsibility of the assembler of the final product.

PDS of category C3:

PDS with rated voltage less than 1,000 V, intended for use in the second environment.

A PDS (or CDM/BDM) sold “as built” to the end-user or in order to be incorporated into an apparatus, system or installation.

Description

Placed on the market. Free movement based on compliance with the EMC Directive. The **EC Declaration of Conformity** and **CE Marking** are required.

The PDS manufacturer is responsible for EMC behaviour of the PDS under specified conditions. Additional EMC measures are described in an easy-to-understand way and can be implemented by a layman.

When PDS/CDM is going to be incorporated with another product, the resulting EMC behaviour of that product is the responsibility of the assembler of the final product, by following the manufacturer’s recommendations and guidelines.

PDS of category C4:

PDS with rated voltage equal to or above 1,000 V, or rated current equal to or above 400 A, or intended for use in complex systems in the second environment.

A PDS (or CDM/BDM) sold to be incorporated into an apparatus, system or installation.

Description

Category C4 requirements include all other EMC requirements but radio frequency emission. They assessed only when it is installed in its intended location. Therefore category C4 PDS is treated as a fixed installation, and thus has no requirement for **EC Declaration of Conformity** or **CE Marking**.

The EMC directive requires the accompanying documentation to identify the fixed installation, its electromagnetic compatibility characteristics and responsible person, and to indicate the precautions to be taken in order not to compromise the conformity of that installation.

In order to comply the above requirements in the case of category C4 PDS (or CDM/BDM), the user and the manufacturer shall agree on an EMC plan to meet the EMC requirements of the intended application. In this situation, the user defines the EMC characteristics of the environment including the whole installation and the neighborhood. The manufacturer of PDS shall provide information on typical emission levels and installation guidelines of the PDS which is to be installed. Resulting EMC behaviour is the responsibility of the **installer** (eg, by following the EMC plan).

Where there are indications of non-compliance of the category C4 PDS after commissioning, the standard includes procedure for measuring the emission limits outside the boundary of an installation.

Examples concerning applications of different approaches

1. BDM used in domestic or industrial premises, sold without any control of the application.

The manufacturer is responsible that sufficient EMC will be achieved even by a layman. Although the EMC Directive applies to the apparatus and fixed installations only (generally components are excluded), it states that the components which are intended for incorporation into apparatus by the end user and which liable to generate electromagnetic disturbances are included. Thus, if members of the public (**end-users**) buy a component off the shelf, they will not have to worry about compliance when they fit it to their machine. Therefore, the responsibility for compliance and **CE Marking** such components under EMC lies with the manufacturer. Depending of intended installation location category C1 or C3 equipment is allowed.

2. PDS or CDM/BDM for domestic or industrial purposes, sold to professional assembler.

This is sold as a sub-assembly to a professional assembler who incorporates it into a machine, apparatus or system. Conditions of use are specified in the manufacturer's documentation. Exchange of technical data allows optimisation of the EMC solutions. In addition of categories C1 and C3, also category C2 is allowed.

3. PDS or CDM/BDM for use in installations.

The conditions of use are specified at the time by the purchase order; consequently an exchange of technical data between supplier and client is possible. It can consist of different commercial units (PDS, mechanics, process control etc).

The combination of systems in the installation should be considered in order to define the mitigation methods to be used to limit emissions. Harmonic compensation is an evident example of this, both for technical and economical reasons.

In addition of categories C1, C2 and C3, also category C4 is allowed.

4. PDS or CDM/BDM for use in machine.

PDS or CDM/BDM combined with application device (machine) such as a vacuum cleaner, fan, pump or such like, ie, ready to use apparatus. Similarly inverters (E.Q. subassemblies of BDMs) come under this class of components. On their own they do not have an intrinsic function for the **end-user**, but are sold to professional **installers** who incorporate them into a machine, apparatus or system. They are not on sale directly to the **end-user**.

Therefore for EMC Directive point of view the PDS/CDM/BDM here is a component which is excluded from the directive. The machine builder is responsible for all EMC issues. The manufacturer of PDS/CDM/BDM is responsible for providing installation, maintenance and operation instructions to the machine builder in order to achieve compliance with EMC Directive.

Nevertheless, it is recommended to use category C1, C2, C3 or C4 PDS/CDM/BDM rather than drives without any compliance.

Machinery Directive 98/37/EC

How does the Machinery Directive affect my drive?

This directive concerns all combinations of mechanically joined components, where at least one part is moving and which have the necessary control equipment and control and power input circuits.

The directive concerns all machines but not those like lifts, which have a specific directive.

The new machinery Directive 2006/42/EC has been published. Since the old directive 98/37/EC can be used until December 29, 2009, the changes due to the new directive will be considered in the future editions of this Guide.

Key point:

As far as drives are concerned, the new version of EN 60204-1, ed. 5, is already published. The old and the new versions can be used until June 1, 2009. After that date only the new version shall be applied.

On its own, the **complete drive module (CDM)** does not have a functional value to the user. It always needs its motor coupled to the driven load before it can function effectively. Thus, it cannot carry the **CE marking** based on the **Machinery Directive**.

Where can I obtain a Machinery Directive copy?

To obtain a copy of the **Machinery Directive** you can contact a local competent authority or download it from European Unions web-site related to the legislation (<http://europa.eu.int/eur-lex/>).

Low Voltage Directive

How does the LVD affect my drive?

2006/95/EC

This directive concerns all electrical equipment with nominal voltages from 50 V to 1 kV AC and 75 V to 1.5 kV DC.

The aim of the directive is to protect against electrical, mechanical, fire and radiation hazards. It tries to ensure that only inherently safe products are placed on the market.

All parts of a PDS from converters and motors to control gear must conform with the **Low Voltage Directive**.

To guarantee that a product complies, the manufacturer must provide a **Declaration of conformity**. This is a Declaration that the product conforms to the requirements laid down within this Directive.

If a product conforms to the Directive and has a **Declaration of conformity**, then it must carry the **CE marking**.

In the case of a power drive system, the **Declaration of conformity** is needed for each of its component parts. Thus, the **Declaration of conformity** for the complete drive module (CDM) and for the motor have to be given separately by the manufacturer of each product.

Key point:

Most manufacturers will include a **Declaration of conformity** covering the **Low Voltage Directive** for all built PDS/CDMs. These are drives built into an enclosure, which can be wired up to the supply and switched on without any further work being undertaken. This is in contrast to an open chassis (BDM), which is a component and needs an enclosure.

Why is the Declaration of conformity important?

Key point:

Without the **Declaration of conformity** the CDM could not carry the **CE marking** and therefore it could not be sold within EEA countries and therefore could not be used legally in any system.

EMC Directive

How does the EMC Directive affect my drive?

2004/108/EC

The intention of the **EMC Directive** is, as its name implies, to achieve EMC compatibility with other products and systems. The directive aims to ensure emissions from one product are low enough so as not to impinge on the immunity levels of another product.

There are two aspects to consider with the **EMC Directive**:

- the **immunity** of the product.
- the **emissions** from that product.

Although the directive expects that EMC should be taken into account when designing a product, in fact EMC cannot be handled by design only – it shall be measured quantitatively as well.

Key point:

Most drives bear **CE-marking**. Nevertheless, some cases drives are part of the machinery or process equipment/system and classified as components they are not included into the EMC directive.

The **machine builder**, therefore, has the final responsibility to ensure that the machine including any PDS and other electrical devices, meets the EMC requirements.

At each stage of the manufacturing process, from component to system, each manufacturer is responsible for applying the appropriate parts of the directive. This may be in the form of instructions on how to install or fit the equipment without causing problems. It does not imply that there is a string of **Declarations of conformity** to be compiled into a manual.

Who has the responsibility to ensure CE marking?

A frequency converter is likely to be only a part of a power drive system.

Yet it is the entire system or machinery that must meet the requirements of the EMC Directive.

So, drive manufacturers are in a position to choose whether to put **CE marking** on to a frequency converter to indicate compliance with the EMC Directive or to deliver it as a component without **CE marking**.

Key point:

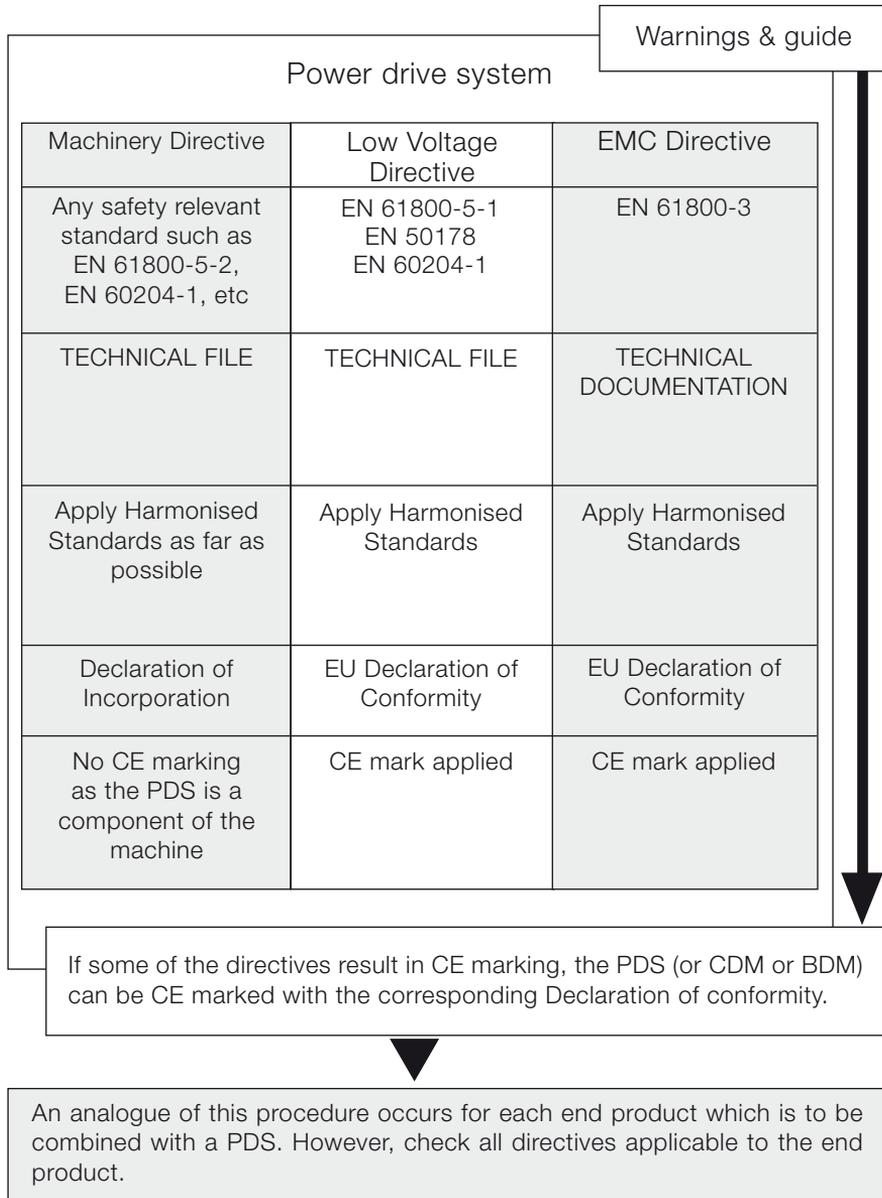
It is the responsibility of the person who finally implements the system to ensure EMC compliance.

Either the **machine builder** or **system supplier** has the final responsibility that the machine or system including the drive and other electrical and electronic devices will meet the EMC requirements.

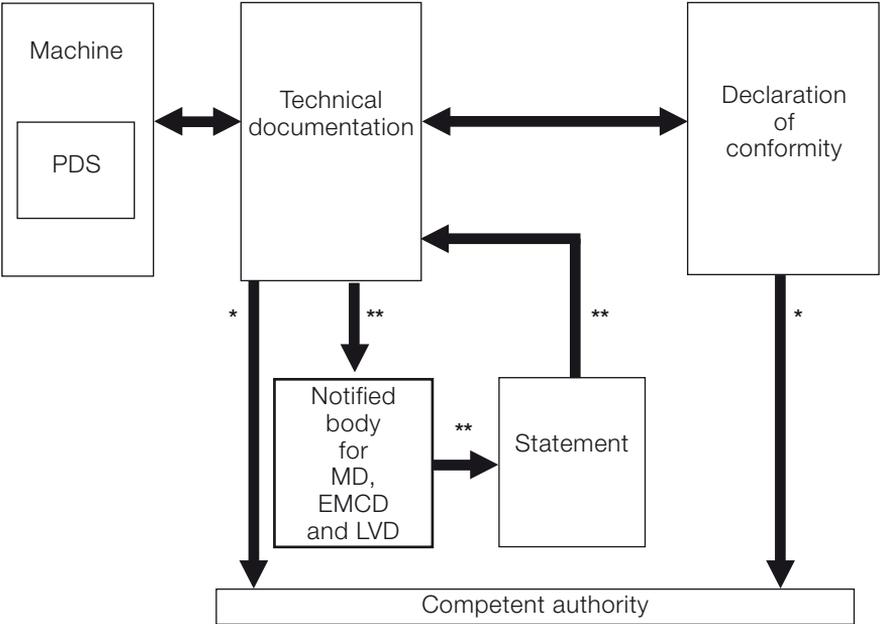
A drive manufacturer is able to help **machine builder** or **system supplier** by providing BDM/CDM/PDS which are according to the EMC directive and **CE-marked**.

Summary of responsibilities

Summary of manufacturer's responsibilities in the application of EC Directives to systems containing a PDS:



Achieving conformity with EC Safety Directives



* Only if required during market surveillance
** Optional procedure, if chosen by the manufacturer

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