

CE Marking and Technical Standardisation

Guidelines for application to Electrical Power Drive Systems



AUTOMATION
INSTRUMENTATION & CONTROL
LABORATORY TECHNOLOGY

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Foreword

This guide has been prepared by the GAMBICA Variable Speed Drives Technical Working Group. It is an update of a previous guide, taking into account the new Machinery Directive (2006/42/EC).

It represents the views of the group on the requirements applicable to variable speed power drive systems. However, this guide has no legal force, and readers are advised to consult the text of the appropriate European Directives and national enabling legislation, together with the appropriate European Commission guidance documents.

CONTENTS

1	Introduction	2
2	Power Drive Systems.....	3
3	Low Voltage Directive (2006/95/EC).....	4
3.1	Application	4
3.2	EC Declaration of Conformity	4
3.3	Harmonised standards	4
4	Machinery Directive (98/37/EC and 2006/42/EC).....	4
4.1	Introduction	4
4.2	Directive 98/37/EC.....	4
4.3	Directive 2006/42/EC	5
5	EMC Directive (2004/108/EC)	7
5.1	Application	7
5.2	EC Declaration of Conformity	7
5.3	Harmonised Standards	9
5.4	Categories of PDS defined in EN 61800-3 (2004)	9
6	Summary of responsibilities for the application of European Directives to a PDS.....	10
	Annex A Further information	11
A.1	Links	11
A.2	Glossary.....	11
A.3	Standards referenced in this document	11

1 Introduction

Electrical Power Drive Systems (PDSs), including Complete Drive Modules (CDMs) and Basic Drive Modules (BDMs), are inherently complex items of power electronic equipment (see Figure 1).

They can exist in different classes, which range from components, sold either to the general public or to professional assemblers, through to products fully incorporated into an apparatus or an installation.

For the benefit of manufacturers, integrators, installers and users alike, this document describes each class of PDS and provides clear guidelines as to the application of three relevant European Directives:

- Low Voltage Directive (LVD) – 2006/95/EC
- Machinery Directive (MD) – 98/37/EC and 2006/42/EC
- Electromagnetic Compatibility Directive (EMCD) – 2004/108/EC

This document is therefore a “Drive Specific” extension to the European Commission’s guidance on the application of each of these Directives.

This document addresses the provisions of the above Directives that apply as from 20 July 2007. For equipment that is still declared in conformity with the old EMC Directive 89/336/EEC, guidance is contained in Edition 1 of this guide.

Other European Directives (specifically the ATEX Directives ¹) are not addressed in this document.

For each Directive and, where appropriate, for each class of PDS, these guidelines define:

- Application of the Directive
- Responsibilities
- Harmonised Standards to be used
- Requirements for Declarations of Conformity and CE marking
- Recommendations for the system integrator responsible for the installation.

While the focus of this document is low voltage (LV) equipment, the requirements for the EMC Directive and the Machinery Directive are also relevant for high voltage (HV) equipment.

¹ GAMBICA/REMA Technical Guide No 4 covers the requirements of ATEX

2 Power Drive Systems

The concept of a power drive system (PDS) is used to describe an electric motor drive system within an overall installation.

The terminology is used throughout IEC and EN standards relating to electrical variable speed drives to describe a combination of components, including a power converter and motor.

The conventional illustration of a PDS and its component parts is shown in Figure 1.

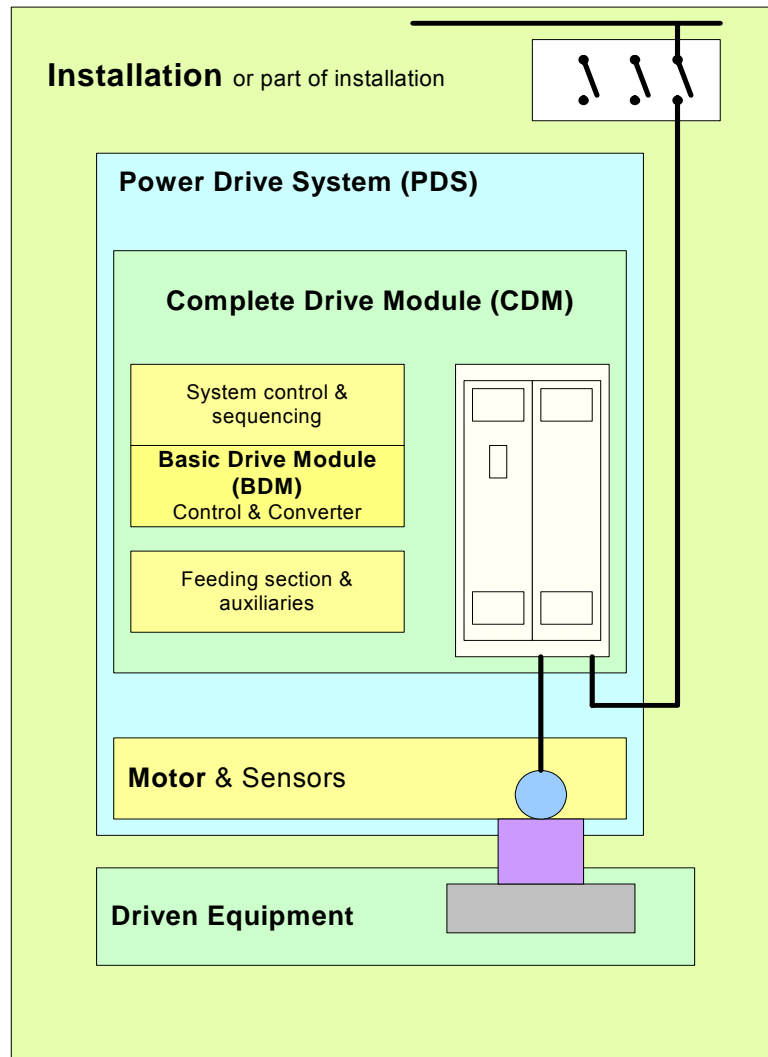


Figure 1 – The Power Drive System

BDM: Basic drive module consisting of power input, control, & power output sections

CDM: Complete drive module consisting of BDM and auxiliary sections, including devices such as incoming switches, input and output transformers and filters, etc. but excluding the motor, cables and motor-coupled sensors

PDS: Power drive system consisting of CDM, motor and sensors, excluding the driven equipment and sensors.

3 Low Voltage Directive (2006/95/EC)

3.1 Application

The Low Voltage Directive (LVD) applies to electrical equipment designed for use with a voltage rating of between 50 V and 1000 V a.c. and between 75 V and 1500 V d.c.

The Directive covers all risks arising from the use of electrical equipment, including not just electrical risks but also mechanical, chemical (such as, in particular, emission of aggressive substances) and all other risks.

NOTE This directive was originally published with the number 73/23/EEC and was subsequently amended. A consolidated version of the existing directive has been published, with no technical changes but with the new number 2006/95/EC.

3.2 EC Declaration of Conformity

Manufacturers of the BDM, CDM or PDS should affix the CE marking for conformity to the LVD to their equipment and provide a Declaration of Conformity relating to their scope of supply.

3.3 Harmonised standards

The principal harmonised standards that confer a presumption of conformity with essential requirements of the Directive are listed in Table 1.

Table 1 – Standards conferring a presumption of conformity with the LVD

BDM/CDM	PDS
EN 61800-5-1 or EN 50178	EN 61800-5-1 or EN 50178, and/or EN 60204-1

A combination of standards may be necessary to ensure that all the essential requirements are addressed.

NOTE 1 Some of the requirements in EN 60204-1 are relevant to a machine, but not to the PDS. Machines may have other requirements, outside the scope of this guide.

NOTE 2 HV equipment is outside the scope of the LVD and therefore cannot have a Declaration of Conformity or be CE marked for conformity to the LVD. However, technical guidance is available in EN 61800-5-1.

4 Machinery Directive (98/37/EC and 2006/42/EC)

4.1 Introduction

Directive 2006/42/EC (the "new" Machinery Directive) is replacing Directive 98/37/EC (the "old" or "existing" Machinery Directive). However, there is no transition period between the "old" and "new" directives, therefore:

- the "old" directive (98/37/EC) will continue to apply until 29 December 2009;
- the "new" directive (2006/42/EC) will apply from 29 December 2009.²

4.2 Directive 98/37/EC

4.2.1 Application

Directive 98/37/EC applies to complete machines, assemblies of machines, sub-assemblies intended for incorporation into machines, and safety components. Its objective is to ensure that machinery is safe, thus helping to ensure the health and safety of operators and other persons.

² There is a transition period until 29 June 2011 for portable cartridge-operated fixing and other impact machinery.

4.2.2 EC Declaration of Conformity and Declaration of Incorporation

There are 3 categories which require consideration:

4.2.2.1 Sub-assemblies that are intended for incorporation into machinery

Such equipment requires a "Declaration of Incorporation" but no CE marking for conformity to Directive 98/37/EC (Article 4(2)). In practice this may be a PDS which has specific functionality, but not a BDM or CDM.

4.2.2.2 Application independent equipment

This category typically relates to a general purpose BDM or CDM, which is application independent – such equipment does not require a Declaration of Incorporation or Declaration of Conformity and does not require a CE mark for conformity to Directive 98/37/EC.

4.2.2.3 Safety components

Safety components (as defined in Article 1(2) of Directive 98/37/EC) could be particular BDM, CDM or PDS that "fulfils a safety function when in use and the failure or malfunctioning of which endangers the safety or health of exposed persons."

Such equipment requires a Declaration of Conformity but not a CE mark for conformity to Directive 98/37/EC.

4.2.3 Harmonised Standards

For electrical control systems of machinery, the principal harmonised standards that confer a presumption of conformity with the essential requirements of Directive 98/37/EC are listed below.

- EN 954-1
- EN ISO 13849-1
- EN 60204-1
- EN 60204-11
- EN 62061
- EN 61800-5-2

EN 61508 is the basic standard for functional safety, but is not listed in the Official Journal of the European Union under the Machinery Directive.

A combination of standards may be necessary to ensure that all the essential requirements are addressed.

4.3 Directive 2006/42/EC

4.3.1 Application

Article 1(1) of Directive 2006/42/EC states that it applies to the following:

- a) machinery;
- b) interchangeable equipment;
- c) safety components;
- d) lifting accessories;
- e) chains, ropes and webbing;
- f) removable mechanical transmission devices;
- g) partly completed machinery.

Its objective is to lay down the essential health and safety requirements in relation to design and manufacture in order to improve the safety of machinery placed on the market.

4.3.2 EC Declaration of Conformity and Declaration of Incorporation

There are 3 categories which require consideration:

4.3.2.1 Partly completed machinery

Such equipment (as defined in Article 2(g) of Directive 2006/42/EC) requires a “Declaration of Incorporation” but no CE marking for conformity to Directive 2006/42/EC. In practice this may be a PDS which has specific functionality, but not a BDM or CDM.

4.3.2.2 Application independent equipment

This category typically relates to a general purpose BDM or CDM, which is application independent – such equipment does not require a Declaration of Incorporation or Declaration of Conformity and does not require a CE mark for conformity to Directive 2006/42/EC.

4.3.2.3 Safety components

A safety component could be a particular BDM, CDM or PDS provided it meets the following definition as given in Article 2(c) of Directive 2006/42/EC:

- “which serves to fulfil a safety function,
- which is independently placed on the market,
- the failure and/or malfunction of which endangers the safety of persons, and
- which is not necessary in order for the machinery to function, or for which normal components may be substituted in order for the machinery to function.”

Such equipment requires both a Declaration of Conformity and a CE mark for conformity to Directive 2006/42/EC.

4.3.3 Harmonised Standards

For electrical control systems of machinery, the principal harmonised standards that confer a presumption of conformity with the essential requirements of Directive 2006/42/EC have not yet been listed in the OJ. However, it is expected that, when published, the following standards will all be included:

- EN ISO 13849-1
- EN 60204-1
- EN 60204-11
- EN 62061
- EN 61800-5-2

EN 61508 is the basic standard for functional safety, but is not listed in the Official Journal of the European Union under the Machinery Directive.

A combination of standards may be necessary to ensure that all the essential requirements are addressed.

5 EMC Directive (2004/108/EC)

NOTE Unless otherwise stated, all references to the "EMC Directive" refer to the new Directive 2004/108/EC, not to the old Directive 89/336/EEC.

5.1 Application

The Electromagnetic Compatibility Directive (EMCD) applies in principle to all electrical and electronic equipment. Its purpose is to ensure an acceptably low level of occurrences of electromagnetic interference.

As a result of experience with the first EMC Directive, 89/336/EEC, the Directive was subjected to a review under the SLIM (Simpler Legislation for the Internal Market) process. The replacement Directive, 2004/108/EC, was published at the end of 2004. It clarifies existing practices, but also refines some requirements. In particular, there are some new requirements for fixed installations.

At each stage of the entire life cycle, from the component to the apparatus, system or installation, each manufacturer or installer has the responsibility to apply the EMC Directive.

5.2 EC Declaration of Conformity

5.2.1 Transitions of Declarations of Conformity

Directive 2004/108/EC (the "new" EMC Directive) replaces Directive 89/336/EEC (the "old" EMC Directive) as follows:

- any Declarations of Conformity issued after 20 July 2007 must reference the "new" directive (2004/108/EC);
- as from 20 July 2009, only products which have a Declaration of Conformity that references the "new" directive (2004/108/EC) can be placed on the market.

5.2.2 BDM/CDM/PDS

5.2.2.1 BDM, CDM or PDS for general sale

These products may be sold either to an end-user or to a professional assembler.

NOTE 1 Generally an end-user is deemed to have no qualifications in the field of electromagnetic compatibility.

The new EMC Directive treats this as an apparatus (Directive Article 2(2), EC Guide for the EMC Directive Clause 1.2.3.1) because it could be installed by a person with little knowledge of EMC.

The manufacturer is responsible to ensure that sufficient EMC can be achieved by any (potentially unknown) customer or layman (plug-in, switch-on).

NOTE 2 The previous version of this Guide used the term "Unrestricted distribution" - see Glossary.

CE marking and Declaration of Conformity are required.

5.2.2.2 BDM, CDM or PDS for professional assemblers

This is sold as a sub-assembly to a professional assembler who incorporates it into other equipment such as a machine, or system.

This BDM, CDM or PDS is excluded from the EMC Directive (EC Guide Flowchart 2), so it need not be CE marked nor have a Declaration of Conformity. Exchange of technical data allows optimisation of the EMC solution.

NOTE The previous version of this Guide used the term "Restricted distribution" - see Glossary.

The manufacturer should provide the relevant instructions which indicate the EMC aspects to be considered by the manufacturer of the final apparatus to help him to solve reasonably foreseeable EMC problems with the final apparatus.

5.2.2.3 BDM, CDM or PDS for fixed installations

Apparatus intended for incorporation in fixed installations is within the scope of the directive.

For apparatus that is intended for a specific fixed installation, and is not otherwise commercially available, the manufacturer may choose to apply the procedure described in Clause 4.4 of the EC Guide. The BDM, CDM or PDS need not require a CE mark or Declaration of Conformity provided that the accompanying documentation identifies the fixed installation for which it is intended, and includes the information referenced in Clause 4.4.1 of the EC Guide.

It is envisaged that manufacturers may use this option for equipment produced in low quantities for specific customers/applications e.g. large drive panels, or certain high power drives.

NOTE The requirements for apparatus not intended for a specific fixed installation are described in 5.2.2.1 or 5.2.2.2 of this document.

5.2.3 Drive Systems

In the variable speed drives industry, the term “Drive System” is generally used to refer to an assembly of BDM/CDM/PDS and other equipment intended for incorporation into a specific fixed installation, and that is not otherwise commercially available. The provisions of 5.2.2.3 apply to such a “Drive System”.

5.2.4 Installations

5.2.4.1 Fixed Installations

Fixed installations are within the scope of the directive, but do not require CE marking or a Declaration of Conformity (see Clause 4 of the EC Guide).

The types of BDM/CDM/PDS that can be directly used in a fixed installation are:

- any CE marked BDM/CDM/PDS that is suitable for the intended environment (see 5.2.2.1);
- any BDM/CDM/PDS that is intended for incorporation in the given fixed installation (see 5.2.2.3).

Other types of BDM/CDM/PDS (e.g. non-CE marked products as described in 5.2.2.2) may be incorporated in other equipment, provided that equipment meets all applicable requirements of the directive.

The person responsible for the compliance of the fixed installation shall consider the combination of the various items in the installation in order to ensure EMC.

EXAMPLE Harmonic compensation should be considered at the installation level (e.g. rolling mill, paper machine, crane, etc.) for both technical and economical reasons.

5.2.4.2 Mobile Installations

Mobile installations are deemed to be apparatus, requiring CE marking and a Declaration of Conformity - see Clause 1.2.4 of the EC Guide.

5.3 Harmonised Standards

Compliance with the following harmonised European Standards confers a presumption of conformity with the essential requirements of the EMC Directive:

Table 2 – Standards conferring a presumption of conformity with 2004/108/EC

BDM/CDM/PDS	Apparatus incorporating BDM/CDM/PDS
EMC product standard for PDS: EN 61800-3	A relevant product specific standard, or, if no product standard exists, the following Generic standards: EN 61000-6-3 or EN 61000-6-4 for emissions EN 61000-6-1 or EN 61000-6-2 for immunity. Also, where applicable: EN 61000-3-2 or EN 61000-3-12 (for harmonic emissions) EN 61000-3-3 or EN 61000-3-11 (for flicker)

As an alternative to complying with the above standards, a “Detailed technical EMC assessment” (as described in 3.2.3 of the EC Guide) may be used to demonstrate conformity.

5.4 Categories of PDS defined in EN 61800-3 (2004)

EN 61800-3 (2004) recognizes two EMC environments (first and second):

- first environment
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;
- second environment
includes all establishments other than those directly connected to a low voltage power supply network which supplies buildings used for domestic purposes;

and sub-divides PDS into 4 categories (C1 - C4):

- C1
PDS of rated voltage less than 1 000 V, intended for use in the first environment;
- C2
PDS of rated voltage less than 1 000 V, which is neither a plug in device nor a movable device and, when used in the first environment, is intended to be installed and commissioned only by a professional;
- C3
PDS of rated voltage less than 1 000 V, intended for use in the second environment and not intended for use in the first environment;
- C4
PDS of 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.

The relationship between these environments and categories and the application types described in 5.2 is shown in Table 3 below:

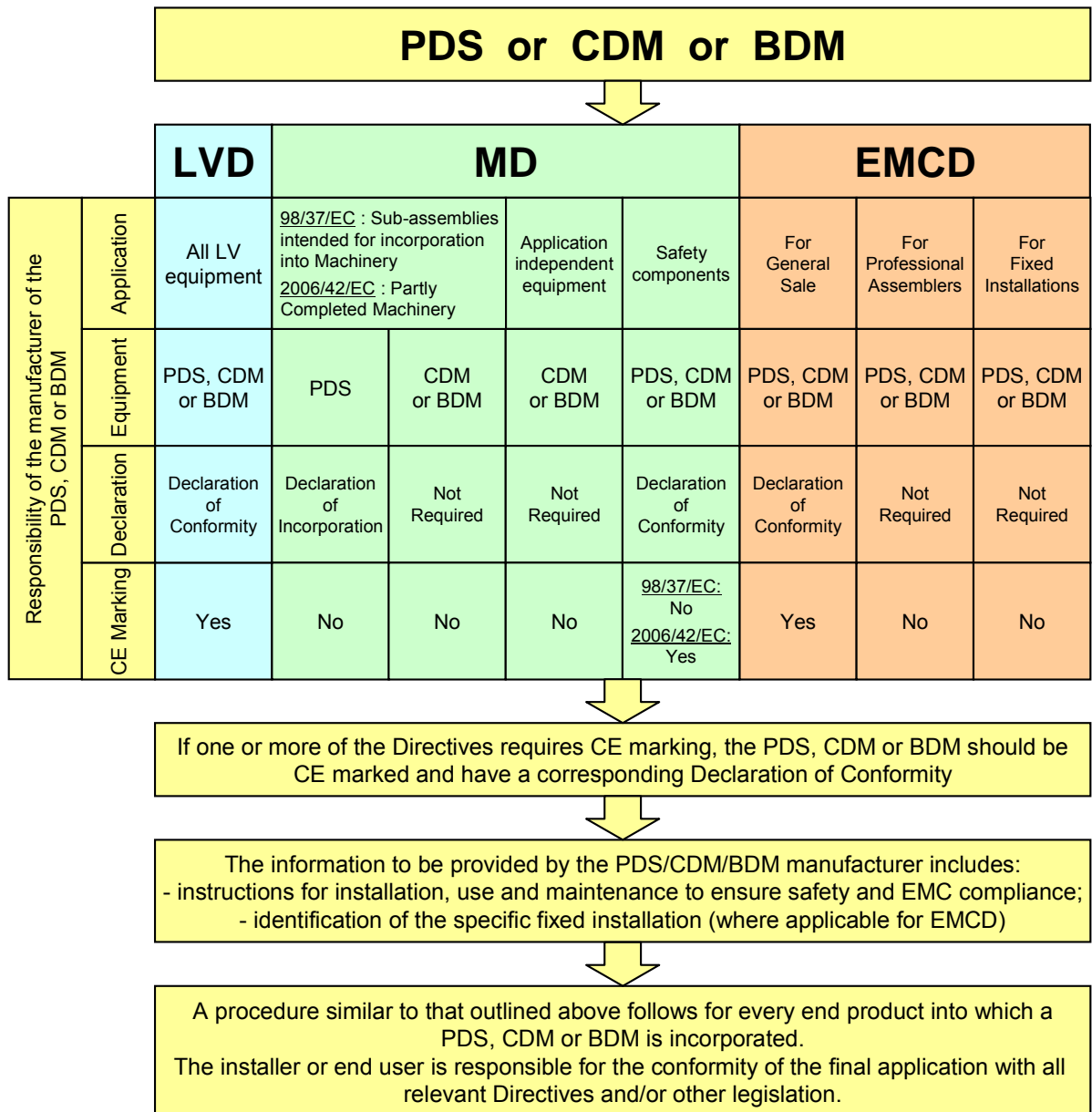
Table 3 – Relationship between categories, environments, and 2004/108/EC

Category	BDM, CDM or PDS for general sale See 5.2.2.1		BDM, CDM or PDS for professional assemblers See 5.2.2.2		BDM, CDM or PDS for fixed installations See 5.2.2.3	
	Environment		Environment		Environment	
	1 st	2 nd	1 st	2 nd	1 st	2 nd
C1	Allowed	Depends on immunity ^a	Allowed	Depends on immunity ^a	Allowed	Depends on immunity ^a
C2	Not Allowed	Allowed	Allowed	Allowed	Allowed	Allowed
C3	Not Allowed	Allowed	Not Allowed ^b	Allowed	Not Allowed ^b	Allowed
C4	Not Allowed	Not Allowed	Not Allowed ^b	Allowed	Not Allowed ^b	Allowed

^a Allowed only if 2nd environment immunity requirements are met either inherently or by means of additional mitigation measures

^b Can be “Allowed” if additional mitigation measures are applied to achieve 1st environment emissions limits.

6 Summary of responsibilities for the application of European Directives to a PDS



Annex A Further information

A.1 Links

The following are links to official web sites that provide the text of each Directive together with official guidelines, a list of the harmonised Standards that confer a presumption of conformity with the essential requirements, details of any proposed revisions, and other relevant information.

http://europa.eu.int/comm/enterprise/electr_equipment/lv/index.htm

http://europa.eu.int/comm/enterprise/mechan_equipment/machinery/index.htm

http://europa.eu.int/comm/enterprise/electr_equipment/emc/index.htm

NOTE: The clause numbers of the EC Guide for the EMC Directive referred to in this guide are those of the version dated 21 May 2007.

A.2 Glossary

BDM	Basic Drive Module (See also Clause 2)
CDM	Complete Drive Module (See also Clause 2)
EMCD	Electromagnetic Compatibility Directive
LVD	Low Voltage Directive
MD	Machinery Directive
OJ	Official Journal of the European Union
PDS	Power Drive System (See also Clause 2)
Restricted	Restricted distribution: the mode 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.
Unrestricted	Unrestricted distribution: the mode of sales distribution in which the supply of equipment is not dependent on the competence of the customer or user for the application of drives.

A.3 Standards referenced in this document

NOTE: A complete list of Standards relevant to each Directive is available on the European Commission's web-pages (see links above).

EN 954-1	Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design
EN ISO 13849-1	Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design
EN 50178	Electronic equipment for use in power installations
EN 60204-1	Safety of machinery - Electrical equipment of machines - Part 1: General requirements
EN 61000-3-2	Electromagnetic compatibility - Part 3-2: Limits - Limits for harmonic current emissions (equipment input current up to and including 16 A per phase)
EN 61000-3-3	Electromagnetic compatibility — Part 3-3: Limits — Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current ≤ 16 A per phase and not subject to conditional connection
EN 61000-3-11	Electromagnetic compatibility — Part 3-11: Limits — Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems — Equipment with rated current ≤ 75 A and subject to conditional connection

- EN 61000-3-12 Electromagnetic compatibility - Part 3-12: Limits - Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current > 16 A and ≤ 75 A per phase
- EN 61000-6-1 Electromagnetic compatibility (EMC) - Part 6-1: Generic standards - Immunity for residential, commercial and light-industrial environments
- EN 61000-6-2 Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments
- EN 61000-6-3 Electromagnetic compatibility (EMC) - Part 6-3: Generic standards - Emission standard for residential, commercial and light-industrial environments
- EN 61000-6-4 Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments
- EN 61508 Functional safety of electrical/electronic/programmable electronic safety-related systems
- EN 61800-3 Adjustable speed electrical power drive systems - Part 3: EMC product standard including specific test methods
- EN 61800-5-1 Adjustable speed electrical power drive systems - Part 5-1: Safety requirements - Electrical, thermal and energy
- EN 61800-5-2 Adjustable speed electrical power drive systems - Part 5-2: Safety requirements - Functional
- EN 62061 Safety of machinery - Functional safety of safety-related electrical, electronic and programmable electronic control systems