

# Transformer symbols

Symbol	Standard	Explanation
	EN61558-1	DC
	EN61558-1	Single-phase AC
	EN61558-1	Three-phase AC
	EN61558-1	Three-phase with neutral AC
	EN61558-1	Class I construction (Protective earth)
	EN61558-1	Class II construction (double insulated)
	EN61558-1	Class III construction
	EN61558-1	Chassis or core
	EN61558-2-1 EN61588-2-17	Self-protecting separating transformer
	EN61558-2-1 EN61558-2-17	Non short-circuit-proof separating transformer
	EN61558-2-1 EN61558-2-17	Short-circuit-proof separating transformer
	EN61558-2-2	Non short-circuit-proof control current transformer

Symbol	Standard	Explanation
	EN61558-2-2	Short-circuit-proof control current transformer
	EN61558-2-4 EN61558-2-17	Non short-circuit-proof isolating transformer
	EN61558-2-4 EN61558-2-17	Short-circuit-proof isolating transformer
	EN60742	Safety isolating transformer
	EN61558-2-6 EN61558-2-17	Self-protecting safety isolating transformer
	EN61558-2-6 EN61558-2-17	Non short-circuit-proof safety isolating transformer
	EN61558-2-6 EN61558-2-17	Short-circuit-proof safety isolating transformer
	EN61558-2-8	Short-circuit-proof bell transformer
	EN61558-2-13	Non short-circuit-proof autotransformer
	EN61558-2-13	Short-circuit-proof autotransformer
	EN61558-2-15	Safety transformer for supplying premises containing electro-medical equipment
	EN61558-2-20	Reactor without overload protection

Symbol	Standard	Explanation
	EN61558-2-20	Reactor with overload protection
	EN61558-2-19	Isolating transformer, perturbation attenuation, short-circuit proof
	EN61558-2-19	Safety isolating transformer, perturbation attenuation, short-circuit proof
	IEC60044-1	For building-in in furniture
	IEC60044-1 IEC61558-2-14	Separating transformer with variable output voltage (Variac with separating transformer)
	IEC60044-1 IEC61558-2-14	Autotransformer with variable output voltage (Variac with autotransformer)
	IEC60044-1	Current transformer for instruments
		Ripple
		IPx2
		IPx3
		IPx4
		IPx5
		IPx7

Symbol	Standard	Explanation
	EN61558-1	Fuse
	EN61558-1	Fuse
	EN61558-1	Miniature circuit-breaker
	EN61558-1	PTC-resistor
	NEK144 IEC60617	Thermal - "cut out"
	EN61558-1 NEK144 IEC60617	Thermostat
	NEK144 IEC60617	Potentiometer (variable resistor)
	NEK144 IEC60617	Semiconductor diode
	NEK144 IEC60617	LED
	NEK144 IEC60617	Resistor
	IEC60044-1	For fluorescent lamp ballast
	NEK144 IEC617	Signal lamp
	VDE	EMC - approved

## Standards

A standard is a document which sets out guidelines for the design, testing and documentation of a product. Standards exist in virtually every field and are drawn up in step with technological development. There are both national and international standards. The purpose of international standards is to ensure that there are common rules for certification and testing to look after safety, labelling and the customer's needs and immediate environment. They also help to counteract discriminatory technical obstacles to trade in Europe, for example. Transformers have to be built in accordance with harmonised standards if possible. The standard should cover safety in normal operation, faults, upstream power system, connected electrical equipment, labelling, the customer's needs, the immediate environment and directions for use, where relevant. The most widely used standards for dry-type transformers are IEC60726 and IEC60076 for single and three-phase dry-type power transformers and EN61558 for single and three-phase small transformers. If we use Norway as an example, the build standard for a product of a specific category is determined by the supreme control authority, (in Norway the *Produkt og Elektrisitetstilsynet* (Norwegian



The Noratel LF-transformer is built in accordance with standard EN61558-2-6.

Directorate for Product and Electrical Safety)). This authority acts as a national supervisory authority for the guidelines/directives laid down by parliament and imposed by the EEA Agreement. The Norwegian Directorate for Product and Electrical Safety therefore also provides manufacturers with guidance when it comes to resolving cases of doubt and interpreting the practical application of standards. It also ensures that national peculiarities such as the Norwegian earthing system are taken into account. In Norway the Directorate for Product and Electrical Safety has published FEB 91/NEK400, which deals with electrical building installations and is based on IEC60364 and HD 384. At a global level the IEC is responsible for drawing up electrotechnical standards. The IEC has members in 53 countries around the world. In each member country there is a committee responsible for standardisation at a national level. The same committees also draw up proposals for IEC standards. The Norsk Elektroteknisk Komite (Norwegian Electrotechnical Committee) or NEK represents Norway in international standardisation work. The NEK distributes regulations for electrical plant laid down by the Norwegian Directorate for Product and Electrical Safety. CENELEC is the European standard in the EEA and EFTA countries.

The European standard (ENxxxxx) must reflect the international standards as far as practically possible.

Code	Country	Standardisation body	Abbreviation
ANSI	USA	American National Standards Institute	ANSI
BS	United-Kingdom	British Standards Institution	BSI
CEI	Italy	Comitato Elettrotecnico Italiano	CEI
DIN/VDE	Germany	Verband Deutscher Elektrotechniker	VDE
EN	Europe	Comité Européen De Normalisation Electrotechnique	CENELEC
GOST	Russia	Gosudarstvennoe Komitet Standartov	GOST
IEC	Whole world	International Electrotechnical Commission	IEC
JIS	Japan	Japanese Industrial Standard	JISC
NBN	Belgium	Institut Belge De Normalisation	IBN
NEN	Holland	Nederlands Normalisatie Instituut	NNI
NFC	France	Union Technique De l'Electricité	UTE
SAA	Australia	Standards Association Of Australia	SAA
UNE	Spain	Nacional De Racionalizacion Y Normalizacion	IRANOR

The Norwegian parliament and the authorities adopt the directives laid down by the EEA and ensure that they are introduced and implemented in Norway. The Norwegian Directorate for Product and Electrical safety is responsible for their introduction in Norway. It administrates the areas of electrical safety and the safety of products and consumer services. There are also several supervisory bodies such as NEMKO, for example. They perform technical testing and certification of electrical equipment and machinery. A standardisation project is started on the basis of a defined need on the market and the interest of member countries in the work. A committee is appointed to be responsible for drafting the standard(s). The national standardisation organisations arrange for Norwegian participation in the international work and appoint Norwegian representatives from trade and industry, authorities, consumers, research and employees. A new proposal for a standard is always sent to all the member countries for consultation, a procedure which ensures openness and information for interested parties on the standardisation work in progress.

## Certification

In some countries the certification of certain electrical equipment is required by law. In such cases a certificate is issued by a government-approved testing laboratory. Where there is a legal requirement the relevant certification system must be marked on the product. In case of voluntary certification the component can be marked with the certification symbol if desirable.

Symbol	Country	Certifying body
	Switzerland	ASE / SEV Association Suisse des Electriciens
	Canada	CSA Canadian Standards Association
	Denmark	DEMKO Danmarks Elektriske Materielkon- trol
	Finland	FIMKO Sähkötarastuskeskus Elinspektion Centralen
	Norway	NEMKO
	Germany	VDE Verband Deutscher Elek- trotechniker
	USA	UL Underwriters Laboratories

There are two levels of UL certification: **Recognized** components are approved for use in workshop-produced equipment if the producer knows the operating restrictions and use of the component under these restrictions is certified by UL. The component is not certified as a "product for general use" because it is incomplete in terms of its structure or has limited possibilities. A recognized component is not always furnished with a certification symbol. **Listed** components satisfy all current classification requirements and can therefore be employed both as a "product for general use" and as part of installed equipment. A listed component must have a **certification symbol**.

Symbol	Country	Certifying body
	Holland	KEMA-KEUR Keuring van Electrotechnische Materialen
	Belgium	CEBEC Comité Electrotechnique Belge
	France	NF-USE Frankrike Union Technique de l'Electricité
	Sweden	SEMKO Svenska Elektriska Materiel Kontrollanathalten
	Austria	ÖVE Österreichischer Verband für Electrotechnik
	GS	GS Geprüfte Sicherheit

## Ship classification authorities

To be used on board ships, electrical equipment normally has to have been approved in advance by specific ship classification authorities. These authorities also lay down the rules and standards for the classification, certification and verification of fixed installations offshore.

Code	Country	Classification authority
BV	France	Bureau Veritas
DNV	Norway	Det Norske Veritas
GL	Germany	Germanischer Lloyd
LROS	United- Kingdom	Lloyds Register of Shipping
NKK	Japan	Nippon Kaiji Kyokai
RINA	Italy	Registro Italiano Navale
RRS	Russia	Register of Shipping

## Transformer testing

Transformers are tested during and after production. A transformer can be built according to many different standards, depending on what it is to be used for. Testing must be based on current standards, with any agreed deviations.

Test equipment used to measure values at final inspection must be tested and calibrated by approved certifying laboratories.

Transformers can also be tested in co-operation with certifying bodies (e.g. DNV, Lloyd ABS, etc.) for verification. This is common in the case of large transformers for ships, for example.

In some cases factory acceptance tests (FAT), at which the customer's representatives are present to verify the tests, are also carried out.



## CE marking

The European CE mark was introduced by the EU and is intended to guarantee that a product has been designed, produced and tested in accordance with all the relevant directives. This means that the CE mark acts as a sort of passport which gives products unrestricted access to the markets in all the EU countries, as well as Norway and Iceland, which are members of the EEA. The requirements, which apply to marking, largely deal with health, environment and safety. The aim is to ensure a minimum level of safety and protection of the environment.

It is important to be aware that the CE mark is not a quality mark.

*Who is responsible for a product being CE-marked?*

According to the Norwegian Product Liability Act, every link in the chain is responsible. The manufacturer is responsible of course, but the importer will also be fully liable for what is sold.

*What products have to be marked?*

It is mainly three directives which apply to electrical and electronic products:

**Machine Directive (89/392/EEC)** - Applies to complete machines, not individual components which can be used to build such machines.

**EMC Directive (89/336/EEC)** - Applies to equipment which can cause electromagnetic interference or be affected by it. Does not apply to equipment which only transmits transients such as circuit-breakers and contactors.

**Low Voltage Directive/L.V.D. (73/72/EEC) - 73/23/EEC and 93/68/EEC**

- Applies to all electrical equipment between 500 and 1000 V AC and between 75 and 1500 V DC, apart from cables, wires and purely mechanical components.

Marking must be done directly on the product or using a marking plate. The Low Voltage Directive came into force on 1st January 1997 and means that no national deviations can be accepted and harmonised standards must be used if possible. In other words, those starting with EN6xxxx, for example. It is Noratel's responsibility as a manufacturer to be able to produce a declaration of conformity.



*Test on a Noratel transformer. Testing is done by registering the maximum operating temperature, checking that the insulation is adequate and verifying specified losses and other values specified in standards and regulations.*

## The EMC Directive

Electronic circuits are making up an ever larger part of most installations, e.g. for control and monitoring. Electrical and electronic circuits and equipment must be able to do their job without interfering with or being interfered with by other products. EMC (electromagnetic compatibility) is therefore becoming increasingly important. What is known as the EMC Directive came into force on 1st January 1996. This means that manufacturers of electrotechnical products must ensure that their products satisfy the regulatory requirements with regard to electromagnetic noise. Equipment which does not comply with the directive can no longer be sold in countries which are members of the EU or affiliated to the EU through the EEA, including Norway and Iceland.

### Regulatory requirements:

The purpose behind EU directives is to ensure the free movement of goods within the EU and EEA and improve the operating safety of electrical and electronic equipment. The EMC Directive does not lay down any requirements with regard to the general functioning of products.

#### What does the EMC Directive cover?

In principle the directive covers all types of electrical device and installation, from toys to industrial installations, which are marketed within the EEA. Its sphere of application is set out in article 2, point 1:

"This directive applies to devices which can cause electromagnetic interference or the functioning of which can be affected by such interference."

The directive defines devices as "all electrical and electronic appliances and equipment and installations which contain electrical and/or electronic components."

An installation can contain a number of individual devices or systems. Each device or system must satisfy the EMC requirements individually. But since it is not possible to predict every configuration, it is also a requirement that the complete installation must satisfy the EMC requirements.



Noratel's switch mode power supplies are a typical product which has to be approved in accordance with the EMC Directive.

The EMC Directive only lays down the overall guidelines, with the main requirement being as follows:

Devices mentioned in article 2 must be built in such a way that:

a) they do not generate strong enough electromagnetic interference to prevent radio and telecommunications equipment and other devices from being able to function in accordance with their purpose.

b) they have enough inherent resistance to electromagnetic interference to be able to function in accordance with their purpose.

The directive does not contain any technical threshold limit values or type approval requirements, but the manufacturer or party who markets the product must confirm in writing that the equipment complies with the requirements of the directive. A device is regarded as satisfying the EMC requirements if it is made in accordance with point a) or b).

a) The product is tested in accordance with the relevant European standards. Based on the test results, the producer is under an obligation to make a declaration of conformity which, among other things, refers to the standards to which the product is said to conform.

b) The EMC requirements are documented through the provision of technical material which contains a description of the product, the measures which have been taken to satisfy the EMC requirements and a test report or certificate from "a competent body" (e.g. NEMKO). The documentation must be kept for 10 years from the last production date.