

UL Class 2 vs. IEC Class II

UL Class 3 vs. IEC Class III

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UL CLASS 2 VS. IEC CLASS II UL CLASS 3 VS. IEC CLASS III

- What are Class 2 and Class 3 transformer?
- How are Class 2 and Class 3 transformers categorized?
- What defines Class I, Class II and Class III transformers?
- How do Class 2 and Class II transformers differ?
- Are Class 2 & Class 3 transformers interchangeable with Class II & Class III?

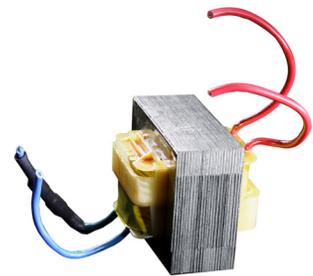
This article explains the unique attributes that define Class 2, Class 3, Class I, Class II, and Class III transformers while clarifying similarities, differences and applications.



Class II Transformer



Class 2 Transformer



Class 3 Transformer

The National Electrical Code, American National Standards Institute, (ANSI) 70 / UL 5085-3, identifies the requirements for Class 2 and Class 3 transformers for use in Class 2 and Class 3 circuits respectively.

For applications not related to the North American code based standards, the Class 2 and Class 3 transformer have no home internationally.

Class 2 and Class 3 transformers are by definition, inherently limited, (self-limiting by impedance or PTC devices) or non-inherently limited, (relying on over current and or over temperature protection). The protection devices for Non-Inherently Limited transformers, (current fuses or circuit breakers), may not necessarily be inclusive to the transformer. These transformers have maximum open circuit output voltage and power limitations:

Class 2 transformers: Maximum 30Vrms, (42.4V peak), maximum power is 100VA.

Class 3 transformer Inherently Limited: Greater than 30V but less than 100V.

Class 3 Non-Inherently Limited transformer maximum voltage is 150V.

Class 2 maximum output current <8.0A, (measured at 60 seconds under any load condition, including short circuit). However, when PTC components are utilized for protection, maximum current is measured at 5.0 seconds.

Class 3 Non-inherently limited, the output current is limited by the formula: $1000/V$.

Class 3 Inherently limited, the output current is limited by the formula: $150/V$.

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Class 2 and Class 3 transformers are not only limited in output current, output voltage and output power, they must not cause a shock or fire hazard when exposed to continuous overload or short circuit or conditions.

Class 2 transformers are often installed in low voltage control circuits, lighting fixtures, doorbells, alarm systems, HVAC systems, home appliances, video systems, garage door openers, furnace controls or any place Class 2 circuits are required.

Class 3 transformers are utilized in mid voltage control Class 3 circuits such as home theater, sound systems, public address, central alarm and security systems. Class 3 circuits are less common than Class 2 circuits.

IEC Type Class I, II & III Transformers



Class I and Class II transformers do not have similar voltage or power limitations as the UL / ANSI type Class 2 and Class 3 transformers and are not required to be inherently limited or non-inherently limited. Class III transformers do have output voltage limits.

Class I transformers are designed and constructed so that protection against electrical shock hazards relies not only on basic insulation but which includes an additional safety feature to provide earthing, (grounding), of accessible conductive parts in the fixed wiring of the installation. In the event basic insulation should fail, the conductive parts cannot become live as they are grounded or earth protected.

Class II transformers are designed and constructed to prevent electrical shock hazards by relying on *double insulation* or *reinforced insulation*, (terms common to many IEC and EN standards, including IEC 60664, IEC 61140 and IEC 61558-1)

Double Insulation is defined as insulation comprising *basic insulation* plus *supplementary insulation*.

Reinforced Insulation is defined as a single insulation system applied to hazardous live parts, which provides a degree of protection against electric shock equivalent to *double Insulation*.

To protect against electric shock, a Class II transformer does not rely on *basic insulation* only but includes additional safety precautions such as *double insulation* or *reinforced insulation*.

Class II transformers have no provision for grounding, protective earthing, or reliance upon installation conditions.

Class III transformers rely on output voltage levels at **Safety Extra Low Voltage (SELV)**, in which voltages higher than SELV are not generated.

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The maximum voltage value in a SELV circuit is <50V AC. or 120V ripple-free DC.

IEC type Class I, II and III transformers may be designed to offer short circuit proof and non-inherent short circuit proof features. If such features are designed in, the appropriate symbols are displayed on the marking label.

The IEC test requirements to verify short circuit proof and non-inherent short circuit proof transformers, differ from those tests for North American Class 2 and Class 3 transformers.

Summary

Easily identifiable. In addition to markings for input voltage and frequency, output voltage and current, all North American Class 2 and or Class 3 transformers include the marking; **“Class 2 or Class 3”** respectively. In addition, Class 2 and Class 3 transformers having an open circuit output voltage exceeding 15Vrms or 21.2 peak are marked with the following: **“Class 2 not wet” Class 3 wet”**. This marking indicates when wet contact is likely, Class 3 wiring methods in accordance with Article 725 of the National Electrical Code, (NEC) are to be utilized. The NEC Article 725 and ANSI/NFPA 70 specify the requirements for Class 2 and Class 3 circuits that are defined as the: **“wiring system between the power source and the appliance”**.

Class 2 power circuits are limited and do not pose fire initiation risk while providing an acceptable level of protection from electrical shock. Class 3 circuits are limited in output power however, they can and do operate at higher voltage levels and, therefore, can present a shock hazard. In locations where wet conditions are likely to occur.

Class 2 and Class 3 transformers having multiple output windings, (if when interconnected) exceed 30Vrms or 42.2V peak, must be marked with: **“Warning Risk of electrical shock or fire, do not interconnect secondary windings”**.

IEC Type Class I, Class II and Class III transformers are marked with details indicating the input voltage and frequency, output voltages and current ratings as well as symbols defining insulation type, and if applicable, protection means. Outlined in the table below are the symbols for Class I, Class II and Class III transformers, and symbols for transformers having various types of protection, i.e. Short Circuit Proof and Non-Short Circuit Proof.

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Symbols for IEC Type Transformers

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

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