

SAFETY GUIDELINES

Safety requirements refer mainly to the 240 V mains voltage, but also to the temperature of touchable parts and fire protection. Most problems connected with a mains power supply can be prevented by the use of approved and correctly rated mains adaptors. As regards mains-operated equipment, there are two classes of insulation: Class I: single insulation, which always requires a three-core supply cable with earth, and Class II: double insulation, which requires no earth and only a two-core supply cable. Thus, the requirement is always for double protection. With the enclosure shut, all touchable, conducting parts must be at earth potential.

Class I

Class I requires insulation between the mains voltage and each and every touchable part that withstands a flashover voltage of 2120 V. To prevent flash-over, the distance between mains voltage carrying parts and touchable parts must be > 3 mm. All touchable, conducting parts must be properly earthed.

Class II

The requirements of Class II are identical to those of Class I except that the test voltage is 4240 V and the flashover distance is > 6 mm.

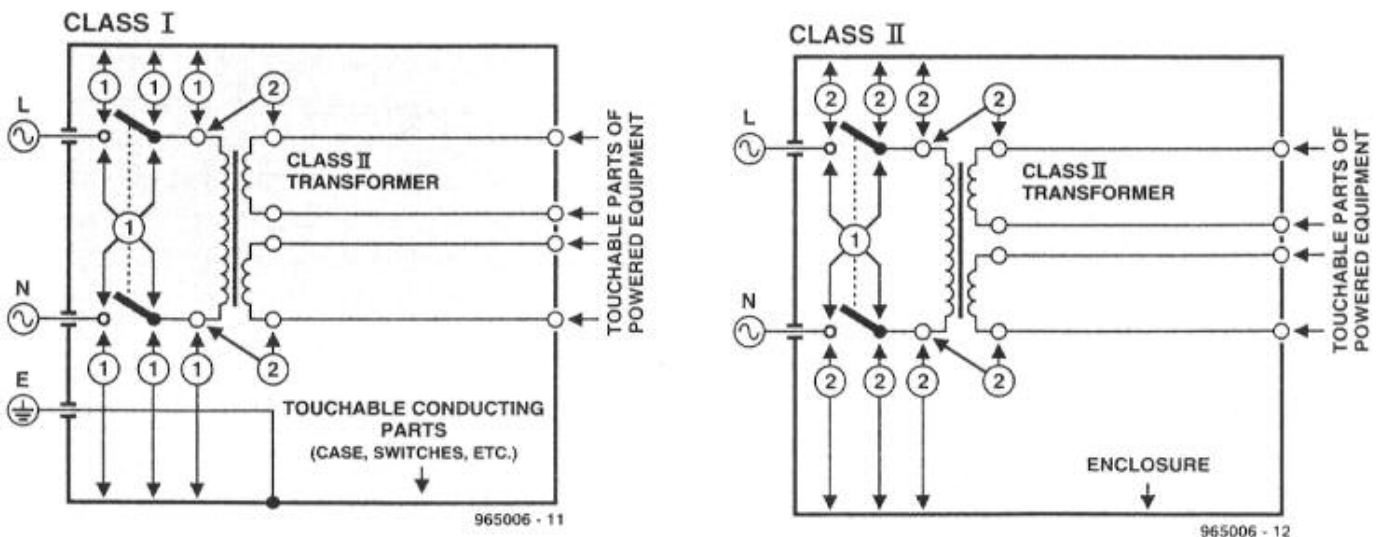


Figure 1. At the left a Class 1 equipment powered by a double -insulated transformer. All touch able, conducting parts must be properly earthed: outputs need not. At the right a Class II equipment also powered by a double - insulated mains transformer.

Practical considerations

A safe rule of thumb is to keep the distance between mains carrying parts and other parts as large as possible, but never less than required. Try to make the mains carrying part as compact as possible. Use an approved mains entry with integrated fuse holder and on/off switch. Note that the manufacturer's statement 'suitable for 250 V' does not mean that insulation of the switch is approved, merely that it does not break down at 250 V

If you do not use an integrated entry, use a strain relief on the mains cable at point of entry.

(1) A single-pole mains on/off switch is allowed on equipment that is powered by transformers with isolated primary and secondary windings.

(2) An on/off switch not in the mains circuit is allowed if the transformer has isolated primary and secondary windings, and the power consumption in the 'off' position is not more than 10 W. There must be a visible indication that the equipment is plugged into the mains.

(3) An on/off switch is not required if the power consumption of the equipment is ≤ 10 W or if the equipment is intended for continuous use, such as an antenna amplifier.

Equipment not meeting these three conditions must have a double-pole on/off switch.

Fuses, inductors, capacitors and resistors for interference suppression need not be switched off. It is advisable, though not mandatory, to precede the switch by a fuse.

Never solder mains carrying wires directly to a printed-circuit board: use solder tags. The use of crimp-on tags is also good practice.

The mains earth must be connected to other parts that need to be grounded by a yellow/green wire. Pay particular attention to the metal spindles of switches and potentiometers: if touchable, these need to be earthed as well.

Close to each and every fuse, even if fitted on a ace, must be a label stating its rating and type.

One of the side panels, or the rear panel, must have a label stating the identity of the equipment, for instance, EE power supply from no. 213, the mains voltage, and mains frequency. If operation from a.c. only is possible, the label must carry the symbol \sim . In case of a failure, there should not be any danger to the user.

The temperature of touchable parts must not be so high as to cause injury or create a fire risk.

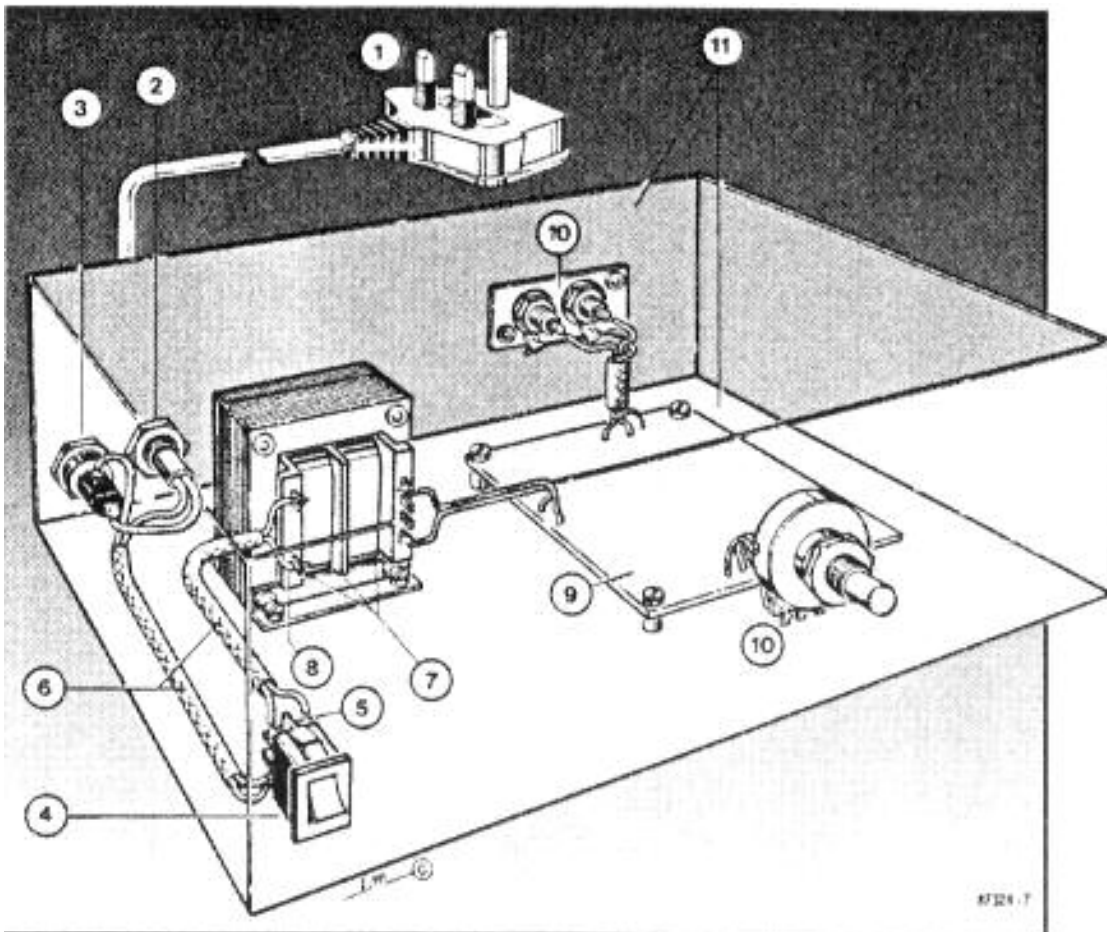


Figure 2. It is advisable, and also practical, to build equipment to Class II. Important aspects are: **(1)** Use a mains cable with molded-on plug. **(2)** Use a strain relief on the mains cable. **(3)** Attach a label near the fuse holder stating the mains voltage and frequency, and the value of the fuse. **(4)** Use an approved mains on/off switch; this should not have a metal lever since that is normally not insulated properly. **(5)** Push wires through the eyelets and solder. **(6)** Use insulating sleeves for extra protection. **(7)** The distance between transformer terminals and core and other parts must be ≥ 6 mm. **(8)** Use wire with an insulation of ≥ 4 mm and a core diameter of 0.75 mm. **(9)** There are no special requirements for the board and circuit other than that it must be secured firmly. **(10)** The earth of the circuit may be touched because the mains transformer is double insulated. **(11)** Although the enclosure may be a metal one, since the transformer is double insulated, a plastic one is preferred.

All risks can be eliminated by the use of correct fuses, a sufficiently firm construction, correct choice and use of insulating materials and adequate cooling through heat sinks and by extractor fans. The rating of a slow fuse should be not greater than 1.25 times the normal operating current, whereas that of a fast fuse should be equal to the normal operating current. Fast fuses are used, for instance, in case of several secondary windings, but if there is an electrolytic capacitor behind the secondary, a slow fuse must be used to allow for surges in the charging current.

The equipment must be sturdy: repeatedly dropping it onto a hard surface from a height of 50 mm must not cause damage. Greater impacts must not loosen the mains transformer, electrolytic capacitors and other important components. Do not use dubious or flammable materials that may emit poisonous gases.

Shorten screws that come too close to other components.

Keep mains-carrying parts and wires well away from ventilation holes, so that an intruding screwdriver or inward falling metal object cannot touch such parts.

Transformers

Figure 1 shows how a transformer should be connected in line with safety requirements. Although double-pole on/off switches are shown, these may be single-pole since in both cases the transformer is a double-insulated type. It is assumed that the transformers are short-circuit-proof, whence the absence of primary fuses. If the assumption is not true, a primary fuse must be used. The figures ① and ② indicate, respectively, whether single or double insulation is required.

Working in safety

As soon as you open equipment, there are many more potential dangers. Most of these can be eliminated by unplugging the equipment from the mains before the unit is opened. But, since testing requires that it is plugged in again, it is good practice (and safe) to fit an earth leakage switch rated at not more than 30 mA to the mains system (this may be fitted inside the outlet box or multiple socket). Earth leakage switches more sensitive than 30 mA need to be used only if the leakage current is expected to remain below 30 mA, which is rarely the case.

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