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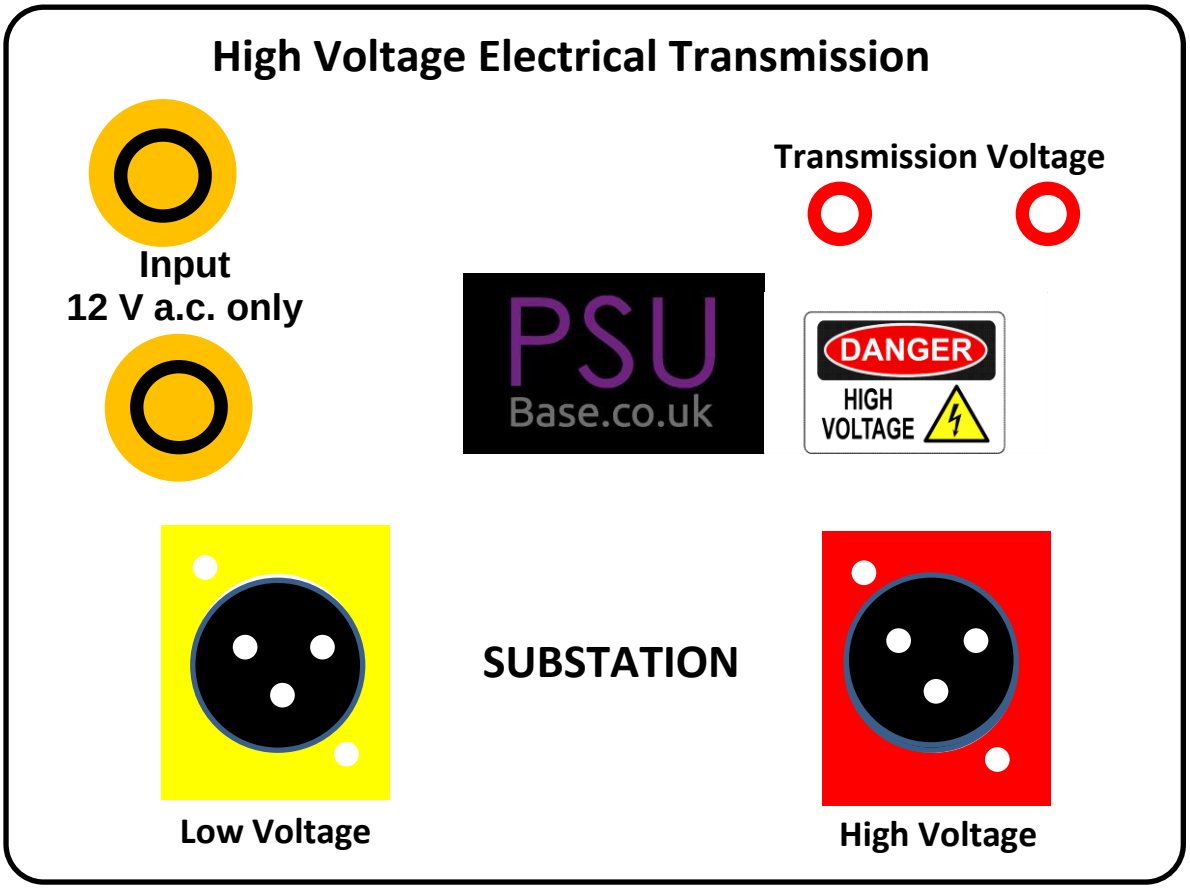
# National Grid Simulation Kit




**The kit comprises:**
**2 x substation box**
**2 x SBC lamp holder with 12V, 21W lamp**
**1 x set of resistances wires**
**2 x cardboard Pylon kit**

**High Voltage Power Lines Why Bother?**

The National Grid is familiar to us all. Just look around and you will see pylons with cables strung between them. Electricity used in our homes is at 230V. Why not just transmit it at this voltage, rather than the higher voltages ranging from 11,000V (11kV) to 400,000V (400kV), commonly used on overhead power lines? The answer is energy loss due to the heating effect of current in the power lines. This is much greater at low voltages, when the current must be high to transmit enough power. Hence the electricity suppliers transport their electricity around the country at very high voltages, in order to reduce the current, and hence the energy loss. Typically, a power station generates at 25kV. This is transformed up to 275kV/400kV, sent along the cables and then transformed down again near to where it is to be used. It is obviously not practical, or safe, to demonstrate at these voltages so the following is a "scaled down" version, which demonstrates the principle.

**PLEASE NOTE. UNDER NO CIRCUMSTANCES SHOULD THE RESISTANCE WIRES BE CONNECTED BETWEEN THE LOW VOLTAGE AND HIGH VOLTAGE SOCKETS. THIS COULD CAUSE DAMAGE TO THE UNITS.**

**The power supply unit must be capable of delivering 12 volts a.c. at 5A. Never use a d.c. power supply.**
**Wire the lamps to the 12V a.c. sockets and piggy back the power supply into the left hand unit's 12V sockets.**

**Low Voltage Transmission** The demonstration boxes are connected as follows:
• Plug the resistance wires into the **yellow** (Low Voltage) socket on each unit. The resistance wire plugs should be inserted into the relevant socket, pushing firmly.
• Switch on the low voltage power supply and observe the 21W lamps The left-hand lamp is fed directly from the power supply and glows normally. However, the right hand lamp is being powered via the resistance wires (a mock-up of long overhead transmission cables) and is very dim. This is the equivalent of transmitting at mains voltage. It should be noted that the resistance wires start to get warm– that is where a lot of the energy is being lost. The insulated resistance wires are perfectly safe to handle and should be gripped to check whether they are getting warm.

**High Voltage Transmission**
• Now switch off and plug the resistance wires into the **red** (High Voltage) socket on each unit
• Switch on the low voltage power supply and observe the 21W lamps This is now the equivalent of transmitting at high voltage. The low voltage (12V) is transformed up to high voltage (approx. 200V), sent along the transmission lines and then transformed back down to low voltage (12V) to be used.
Once again the resistance wires should be gripped to compare with low voltage transmission.

Assuming that, for the transformers, Power in = Power out (it never is, due to resistive losses in the windings, magnetostriction etc), then, because the transmission voltage is now 20 times larger, the current is 20 times smaller. (Power = Voltage x Current). The energy loss in the power lines is, therefore, 400 times lower (energy loss is proportional to current squared).

The small Transmitted Voltage sockets are designed to be used with insulated multimeter probes, so that the high voltage may be shown. Under no circumstances should bare wire or standard 2mm plugs be used**. CAUTION approximately 200V is present at these sockets and great care should be taken.**

Do not attempt to repair the resistance wires should they break, this is potentially dangerous. Simply send them back to us and we will refurbish them for a nominal charge.

**Using the Earth as one of the "cables"**
In the real world, power is sent along only one high tension cable. The second half of the circuit is achieved by driving a stake deep into the earth at each substation and using the conductivity of the earth as the return half of the circuit.
An add on kit to demonstrate this comprises a long resistance wire with connectors to which are also wired leads terminating in modified mains plugs. The mains plugs serve to connect only to the earth and allow this to complete the circuit. The add on kit is available from PSU Base or any of our suppliers.

**Pylons Kit**
The kit comprises 2, A4 sheets of printed card. Taking one card proceed as follows, referring to the small image on the card..
1. Score a folding line along the three long junctions with a pair of scissors.
2. Cut around the shapes, ensuring that you cut along the dotted tab on the main pylon.
3. Fold along the scored lines and then put a bead of paper gum along the tab.
4. Tuck the glued tab inside the far side of the pylon and allow to dry.
5. Stick the outriggers, in pairs, back to back to give 2 large and 2 small sections. Glue these to the main pylon, using the small image as reference.

Repeat for the other card.

Please note that the pylons may be folded flat for storage.