



Providing Excellence in Science Education

IPC Irwin Mini National Grid Kit

Part Number ENG1050

User Instructions



INTRODUCTION.

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 230VAC (50Hz). So why not just transmit it at this voltage, rather than the higher voltages ranging from 11,000VAC (11kV) to 400,000VAC (400kV), commonly used on overhead power lines?

The answer is energy loss due to the heating effect of current versus resistance in the power lines. This is much greater at low voltages when the current must be high to transmit the required power. Hence the Electricity Suppliers transport their electricity around the country at very high voltages, which means the current can be reduced (ie. less energy loss) resulting in more power being provided.

Typically, a power station generates at 25kV, this is then transformed upto 275kV or 400kV, sent along the cables and then transformed down again near to where it is required, eventually being transformed down again to the household voltage of 230VAC.

It is obviously not practical, or safe, to replicate this at these very high voltages so the Mini National Grid Kit offers a 'scaled down' ultra-safe version, which demonstrates the principle.

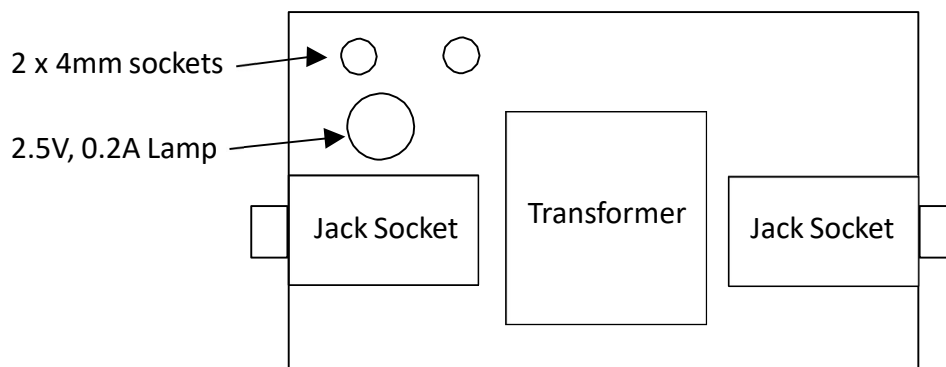
IPC Irwin

Holker School, Cark in Cartmel, Grange over Sands, Cumbria LA11 7PQ, United Kingdom

Call: 015395 58555 **Email:** sales@ipcirwin.com

DESCRIPTION.

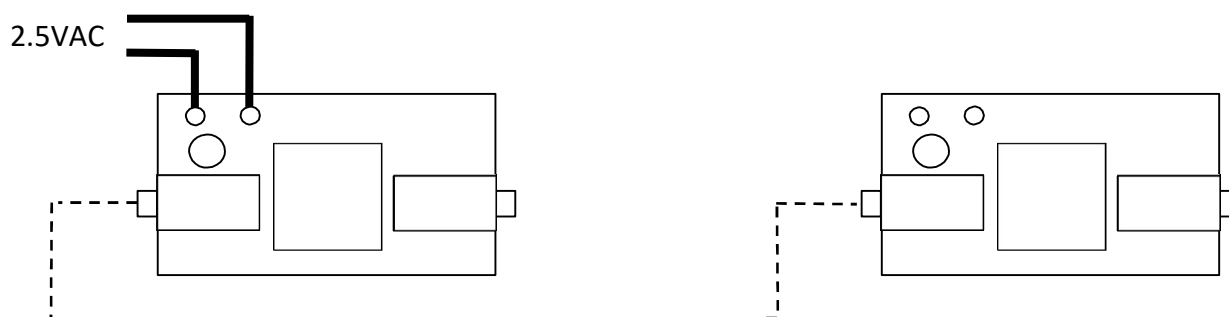
The Mini National Grid Kit comprises of two printed circuit boards (PCBs) and a dedicated Power Line Cable. To ensure that the kit is ultra-safe to use it is designed to run from a 2.5VAC power source, this voltage is readily available from most laboratory power supplies. The two printed circuit boards are identical, the component layout is shown below:



INSTRUCTIONS.

Each PCB consists of a step-up/step-down transformer, two jack sockets, a 2.5V, 0.2A, MES lamp and two 4mm sockets. To operate the kit you will need in addition, 2 x 4mm plugged leads and a power supply capable of providing 2.5VAC at upto 0.5 amp.

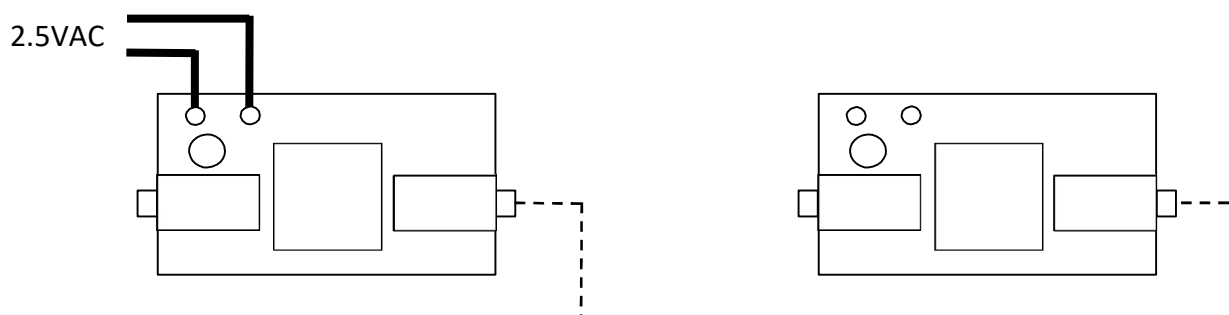
Transmitting Low Voltage Power (not using the transformers):-



First connect a 2.5VAC supply to the two 4mm sockets on the left-hand PCB. Now plug the Power Line Cable (ie. transmission wires) between the left-hand jack sockets on each PCB, as shown above. Finally switch on the power supply and observe the two lamps.

The lamp on the left-hand PCB (ie. Power Station) should be bright while the lamp on the right-hand PCB (house) should be dim. The reason for this loss of power on the right-hand lamp is because most of the energy is converted into heat, ie. heating up the transmission wires.

Transmitting High Voltage Power (using the transformers):-



With the Power Line Cable transferred to the right-hand side of the PCBs you will see straight away that the power transfer has improved. Now that the power station supply voltage has been transformed up by a factor of 20, the transmission voltage is now about 40VAC. At the house end this voltage is being transformed down again to 2.5VAC for use.

In this new circuit arrangement, the current flow in the transmission wires is 20 times lower than before, as energy loss is proportional to the square of the current the energy loss is 400 times less.

Note: the right-hand lamp will be a little dimmer than the left-hand lamp, this is because we still have some energy loss in the transmission wires, plus there is a little loss in the transformers, but you will notice this is a considerable improvement.

PLEASE NOTE: The kit is designed to work from a 2V to 2.8VAC (ideally 2.5VAC) supply, please check that only this voltage is used. If in doubt use a voltmeter to test the voltage before connecting it to the kit – DO NOT RELY ON THE PRINTED VOLTAGE ON THE POWER SUPPLY. If a voltage below 2VAC is used the 'house' lamp may not glow.

SPECIFICATIONS.

Supply Voltage = 2.0V to 2.8VAC (maximum), ideally 2.5VAC.

Supply Current = 0.5 Amps (minimum).

Transformer Voltage = 38VAC (at maximum supply voltage of 2.8VAC).

Lamp Type = MES, 2.5V, 0.2 Amps (using this lamp voltage ensures SELV compliance).

The kit is rated as SELV (Safety Extra-Low Voltage), this means that it is safe for pupils to handle under all operating conditions.

CAUTION: the left-hand side of one PCB should not be connected to the right-hand side of the other PCB as this would cause a short circuit across the 2.5VAC power supply.



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Please Note: This Equipment is for Education, Training, or research Purposes Only.

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