# 3B SCIENTIFIC® PHYSICS

...going one step further

# Pair of Resistive Cables 22 Ω, 1.5 m    1021347

## Instruction Sheet

08/17 JS


## 1. Safety instructions

The resistive cables do not meet the requirements for experiment leads. They are permitted only for experiments in Category 1. When experimenting with voltages greater than 33 V AC or 70 V DC without a current limiter (EN 61010-1), caution is advisable due to the danger of contact.

- It is important to monitor the current and voltage so as to ensure that 3 W of power dissipation per resistive cable is not exceeded.
- Use only voltage sources with a safety isolating transformer that guarantees reliable isolation from the mains supply.
- Carefully examine resistive cables for any damage before using them with dangerous contact voltages, and do not use damaged experiment leads under any circumstances.

## 2. Description

The set of 2 resistive cables, 22 Ω, 1.5 m can be used as a connection line in experiments modelling overhead or cross-country power lines for the transmission of electrical energy. They ensure a basic level of protection against contact with live parts in such experiments.

## 3. Technical data

| | |
|---|---|
| Connection: | 4 mm safety plug |
| Resistance: | 22 Ω per lead |
| Wire length: | 1.5 m |
| Wire diameter: | 0.3 mm |
| Wire material: | CrNi |
| Maximum permissible power: | 3 W |
| Maximum permissible voltage: | 300 V |
| Category: | CAT I |

## 4. Modelling experiment

### a) Equipment list:

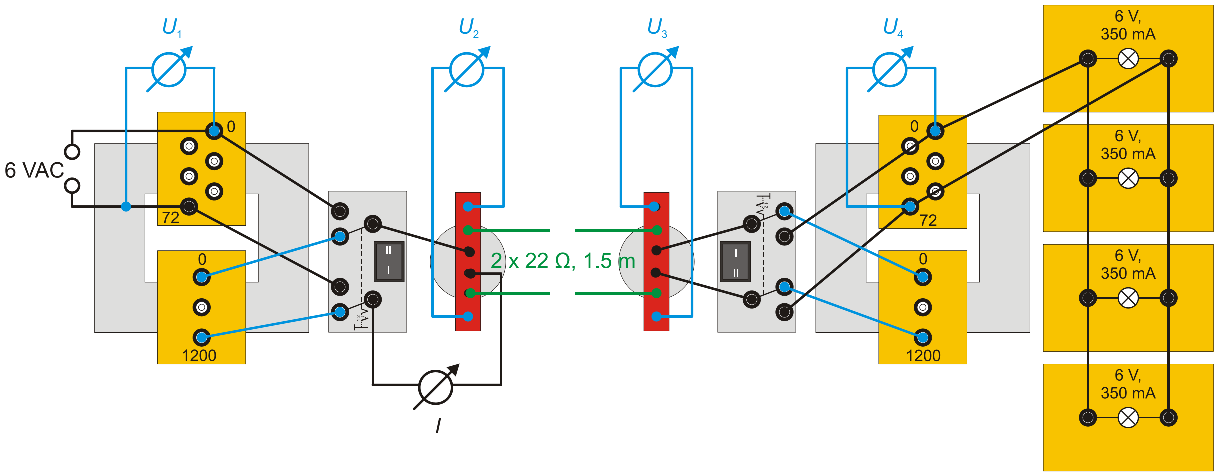
| | | |
|---|---|---|
| 1 | Set of resistive cables, 22 Ω | 1021347 |
| 1 | Extra low voltage power supply, e.g. 1003316 | |
| 2 | Transformer cores D | 1000976 |
| 2 | Extra low voltage coils D | 1000985 |
| 2 | Coils D 400/1200 | 1000989 |
| 5 | Digital multimeter E | 1018832 |
| 4 | Lamp sockets E10 on 3B box | 1010138 |
| 1 | Set of 10 lamps E10, 6 V, 350 mA | 1010145 |
| 2 | Two-pole change-over switches | 1018439 |
| 2 | Holders for plug-in components | 1018449 |
| 2 | Stand bases, 1 kg | 1002834 |
| 2 | Sets of safety experiment leads, 150 cm, 2x75 cm | 1002848 |
| 2 | Sets of 15 safety experiment leads, 75 cm | 1002843 |

### b) Information:

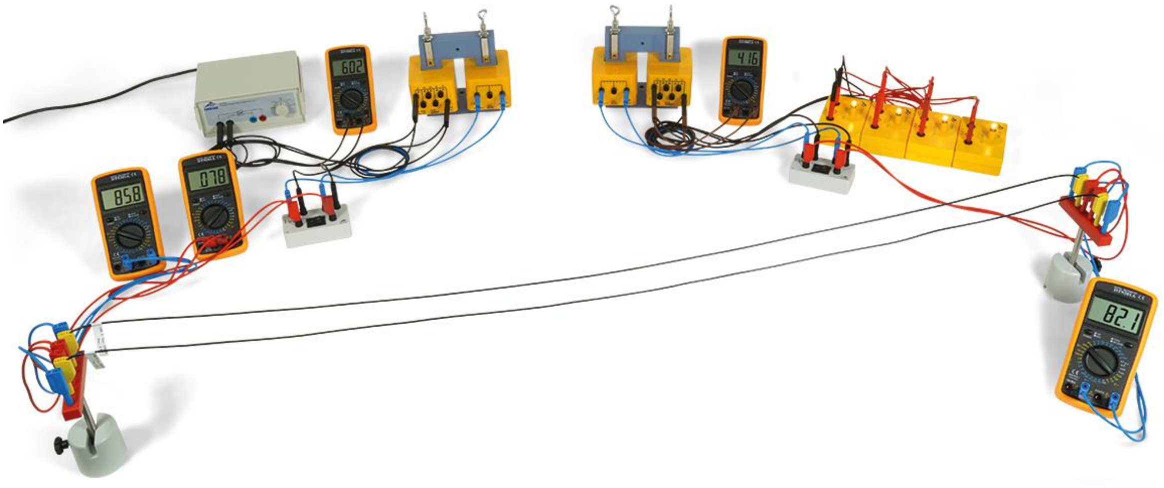
If both switches are in position I, the input voltage is stepped up on the left and stepped down on the right. In position II, a direct connection is created in each case that bypasses the transformer. Stepping up results in the generation of voltages of over 80 V, which would destroy the light bulbs immediately.

- When stepping up, it is therefore necessary to first switch the right switch to position I so as to step down the voltage on the right side, and then switch the left switch to position I so as to step up the input voltage on the left side.
- To switch off the step-up transform, first switch the left switch back to position II, so that the untransformed input voltage is applied to the input of the transmission line, and then switch the right switch to position II, so that the voltage at the output of the transmission line is also applied to the consumer.

### c) Layout sketch:



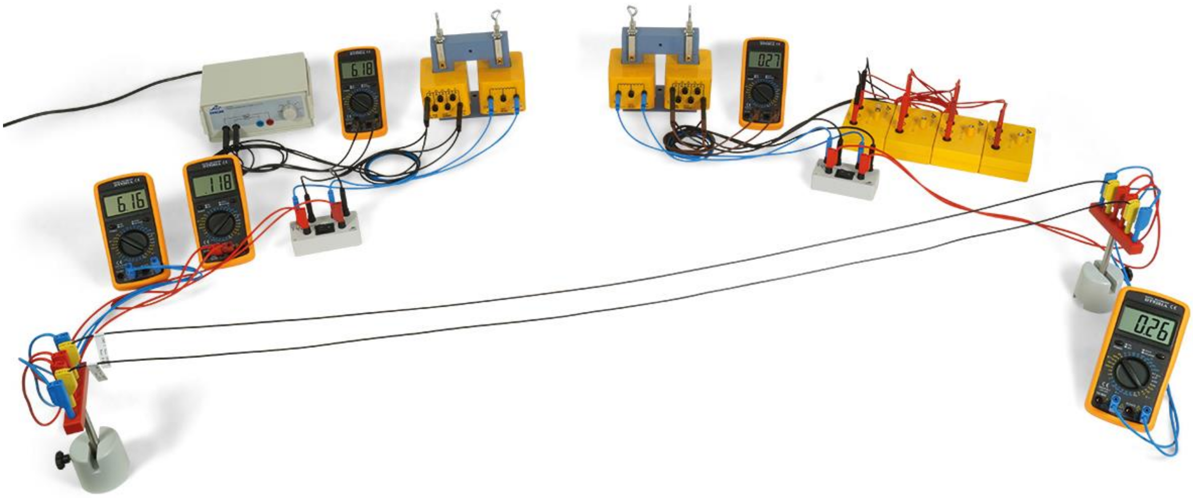
**d) Model of transmission line with high line resistance using stepped-up voltage**



- Use the set of 2 resistive cables as a model transmission line
- Switch on the voltage source and observe how the lamps light up.
- Measure the voltages $U_1$, $U_2$, $U_3$ and $U_4$ as well as the current $I$.

Results:
$U_1$ = 6.02 V, $U_2$ = 85.8 V, $U_3$ = 82.1 V, $U_4$ = 4.16 V, $I$ = 78 mA
The voltage drop along the transmission line of 85.8 V to 82.1 V is relatively small. Losses arise during the reverse transform. The remaining voltage $U_4$ = 4.16 V is sufficient for the lamps to light up brightly.

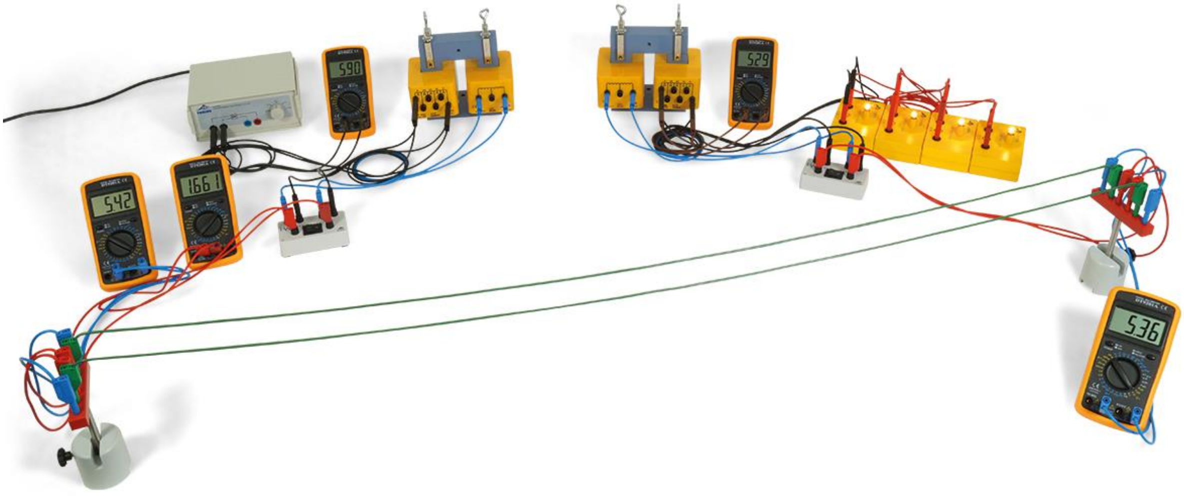
**e) Model of transmission line with high line resistance using untransformed voltage**



- First switch off the step-up transform on the left and then the reverse transform on the right.
- Observe that the lamps are no longer lit and, if necessary, reduce the number of consumers by unscrewing them.
- Measure the voltages $U_1$, $U_2$, $U_3$ and $U_4$ as well as the current $I$.
- Calculate the resistance of the transmission line for comparison.

Results:
$U_1$ = 6.18 V, $U_2$ = 6.16 V, $U_3$ = 0.26 V, $U_4$ = 0.26 V, $I$ = 118 mA $R$ = (6.16 V - 0.26 V)/118 mA = 50 Ω
The voltage drop along the transmission line of 6.16 V to 0.26 V is so large that the light bulbs can no longer light up.

**f) Use of a low-resistance connector lead with untransformed voltage**

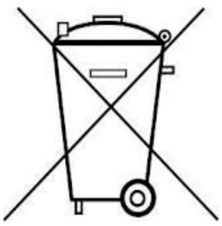


- Replace the set of 2 resistive cables with the two 150 cm long green experiment leads.
- Observe how the lamps light up.
- Measure the voltages at points 1, 2, 3 and 4 as well as the current *I*.
- Calculate the resistance of the experiment leads for comparison.

Results:
$U_1$ = 5.90 V, $U_2$ = 5.42 V, $U_3$ = 5.36 V, $U_4$ = 5.29 V, $I$ = 1.66 A     $R$ = (5.42 V - 5.36 V)/ 66 mA = 0.036 Ω

The resistance of the experiment lead is so small that only a relatively small voltage drop occurs. Hence the light bulbs shine brightly.

## 5. Disposal



- When the time comes for the device itself is to be scrapped, it does not belong in the normal domestic waste. If the device is used in private households, it may be disposed of at the local public disposal facilities.
- Observe the applicable regulations for the disposal of electronic waste.