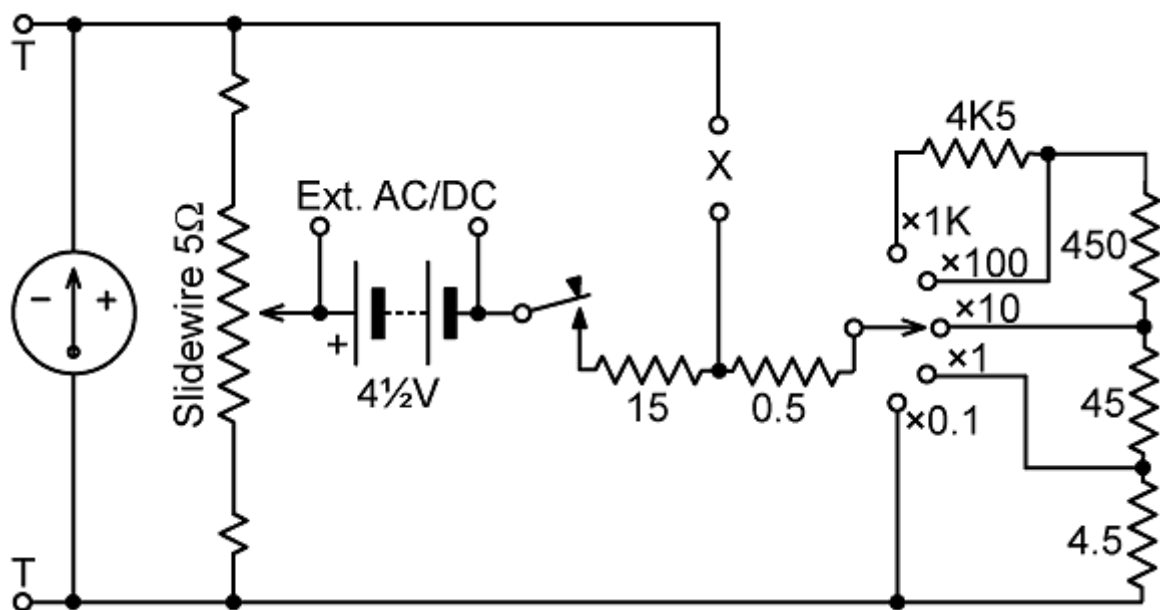


Hartmann & Braun Compact Wheatstone Bridge



This compact Wheatstone (Christie) bridge, Manufactured by Hartmann & Braun of Frankfurt^{1 2}, was purchased from an English amateur-radio flea-market stall in March 2010 for 50 pence. The unit, as received, was in extremely poor condition; with the original galvanometer movement³ missing, various holes drilled in the top casing, and parts of the casing filed away (the damage being evidence of an abortive attempt to mount another meter). The 4500 Ω standard resistance was also open-circuit and had been bypassed by a collection of low-tolerance metal-film resistors. The fact that the instrument had remained in use despite its appalling state of repair attests to its remarkably good performance.

The moulded casings are made from filled phenol-formaldehyde resin (Bakelite). The top casing was restored by filling the holes and file damage using Araldite rapid epoxy resin mixed with black dry-powder poster paint. The filler resin was held in place during setting using clear self-adhesive tape, allowed to cure for about a day, then cut back flush to the case contour by rubbing with a paper towel lightly wetted with MEK (butanone, CH₃-CO-C₂H₅).

A new meter window was made from polystyrene sheet. The internal movement from a small Sinohara (SEW) 50-0-50 μ A meter was then mounted on an aluminium plate and attached internally to the original window-retainer screw sockets. The replacement meter is positioned somewhat low in the window in order to engage it with the original zero-adjuster.

The standard resistances are wound with silk-covered Constantan wire on ceramic bobbins. The lead going into the start of the 4500 Ω standard was broken off. Hence the coil had to be unwound completely in order to re-make the connection. That was done by improvising a coil-winder using a wheel-brace (hand-drill). About 81 Ω was lost in the rewinding process, and that was made-up by placing a 1W wirewound resistor (nominal 82 Ω , measured 81 Ω) in series.

The exact age of this example is unknown. Laboratory instruments principally destined for the Russian market were imported into the UK by the Technical and Optical Equipment Company (London) Ltd. T&OE was founded in 1962, and this particular bridge still appeared in the company's catalogue in the early 1990s.

Notice, from the circuit diagram, that the bridge uses the reciprocal Wheatstone configuration (i.e., the battery and the galvo are transposed). This configuration avoids placing the 5 Ω slidewire potentiometer directly across the battery, but has the disadvantage that sensitivity varies according to range. With an internal 4½ Volt battery, the sensitivity is sufficient to give an accuracy of about $\pm 0.5\%$ on the $\times 0.1$, $\times 1$ and $\times 10$ ranges. With the internal battery removed, an external power supply of about 4 to 25 V can be attached via a pair of 4mm sockets in the side of the case. With increased voltage, the higher ranges give about $\pm 1\%$ accuracy; and the accuracy of the lower ranges can be improved to about $\pm 0.25\%$.

When using an external power source, there is some risk of damage to the meter in the event that the resistance under test should become disconnected or the range should be changed without first turning down the voltage. This ergonomic flaw probably accounts for the absence of the original meter movement. The problem was eliminated in the refurbished unit by connecting a pair of Schottky power rectifiers ($V_f \approx 0.45$ V) back-to-back across the meter.

The bridge can also be used for AC measurements at power-line frequency by connecting the output of a 6.3V filament transformer to the external power sockets. In that case, a telephone earpiece is connected to the terminals marked 'T'.

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Thanks to Niklaus Berchten for the link to the Swiss Technical Museum.

1 <http://www.technik-museum.ch/geraete/paging.asp?p=87> , Item 004694.

2 http://www.radiomuseum.org/r/hartmann_pontavi.html

3 See photo at: <http://public.beuth-hochschule.de/hamann/telefon/wheatstone.html>