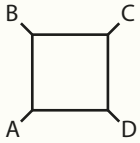
Van der Pauw Press Contact Assemblies

The method of using the PPMS to measure van der Pauw resistivity is described in *Quantum Design Application Note 1076-304*. Note that when compared with the setup described therein, the sample orientation on these assemblies is rotated 90° counter-clockwise, and Ch. 2 measures $R_{AB,CD}$ while Ch. 1 measures $R_{BC,DA}$.



This has no practical consequences for either data acquisition or analysis, but it can cause confusion on studying the connections on the boards or checking for proper electrical contact to the sample. It is a necessary alteration to achieve an efficient board layout common to all assemblies.

The equivalent of Table 1 in the *Application Note* for these assemblies is as shown.

Table 1: van der Pauw resistivity connections

Channel	Connection
Ch. 2 I+	Sample A
Ch. 2 I–	Sample B
Ch. 2 V–	Sample C
Ch. 2 V+ (V_a+)	Sample D
Ch. 1 I+	Sample B (Ch. 2 I–)
Ch. 1 I–	Sample C (Ch. 2 V–)
Ch. 1 V–	Sample D (Ch. 2 V+)
Ch. 1 V+ (V_a+)	Sample A (Ch. 2 I+)

Reversed polarity measurements

An improvement in measurement accuracy can be achieved through the elimination of offset voltages by performing reversed polarity measurements. This requires substituting $R_{AB,CD}$ with the average value $\frac{1}{2}(R_{AB,CD} + R_{BA,DC})$ and likewise substituting $R_{BC,DA}$ with the average value $\frac{1}{2}(R_{BC,DA} + R_{CB,AD})$. In practice, this simply means measuring the resistance of each channel with both positive and negative measurement currents and averaging the results.

Reciprocal measurements

A further improvement in accuracy can in principle be attained upon compensating for geometrical aberrations by making reciprocal measurements. Since in the ideal case $R_{AB,CD} = R_{CD,AB}$, by measuring both values and averaging the results (and the same for $R_{BC,DA} = R_{DA,BC}$) a more accurate final value is obtained. Reverse polarity measurements of each of these can then be implemented as described above for a total of eight measurements per data point to achieve ultimate accuracy. Unfortunately, this requires either four independent measurement channels or a means to switch the current and voltage contacts during the measurement, neither of which is built in to the PPMS. Our van der Pauw patch box provides a suitable manual switching capability, or automated switching can be implemented using a Keithley 7001-based switch system or similar.

Hall effect measurements

The otherwise unused Ch. 3 of the resistivity option is connected in an arrangement to enable users to experiment with van der Pauw Hall effect measurements. The connections for this channel, which measures $R_{BD,AC}$, are detailed in Table 2. Note that, as for reciprocal resistivity measurements, a full Hall effect measurement requires a means to switch the contacts during the measurement.

Table 2: van der Pauw Hall effect connections

Channel	Connection
Ch. 3 I+	Sample B
Ch. 3 I–	Sample D
Ch. 3 V–	Sample A
Ch. 3 V+	Sample C

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