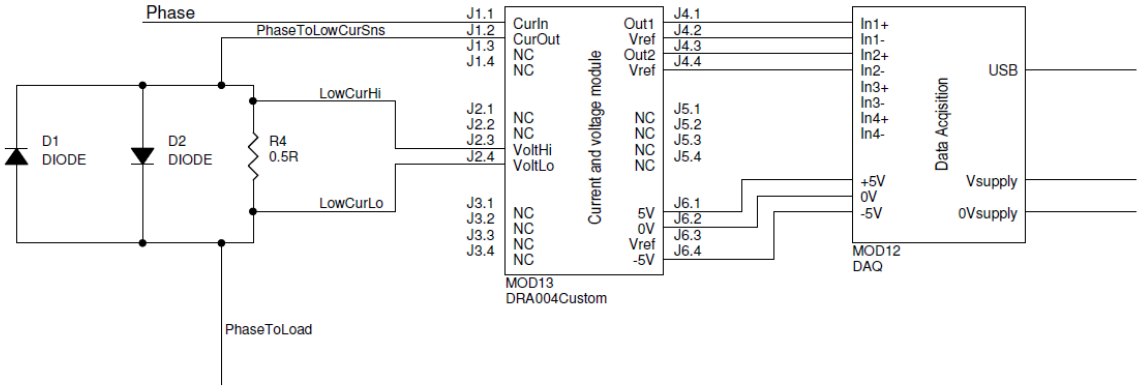
Measurement of Low Current and High Current in the Same Circuit

An Example of Customisation.

Measurement of Low Current and High Current in the Same Circuit



Some circuits run at different currents under different loading conditions. For example a solenoid drive might need to be tested and it will operate with a pull in current of say 15A, a holding current of 0.5A and a maximum leakage current of 20mA. If the current sensor is specified at 20A full scale to read the pull in current, then the 20mA leakage current cannot be measured with the same device.

In the example shown above, the AC phase voltage drives a fan and a number of heaters. The performance of the fan must be measured when it alone is switched on and the heaters must be monitored when they come on. The peak current with all the heaters on will be 20A and the fan alone will draw a peak of 180mA. There is also a requirement to measure leakage of up to 40mA and to accommodate a second fan.

A 2 channel customised version of the DRA004 is used. The phase current is passed through a standard Type B input with a 20A current shunt fitted internally – see Application Note 1 Fig 2.

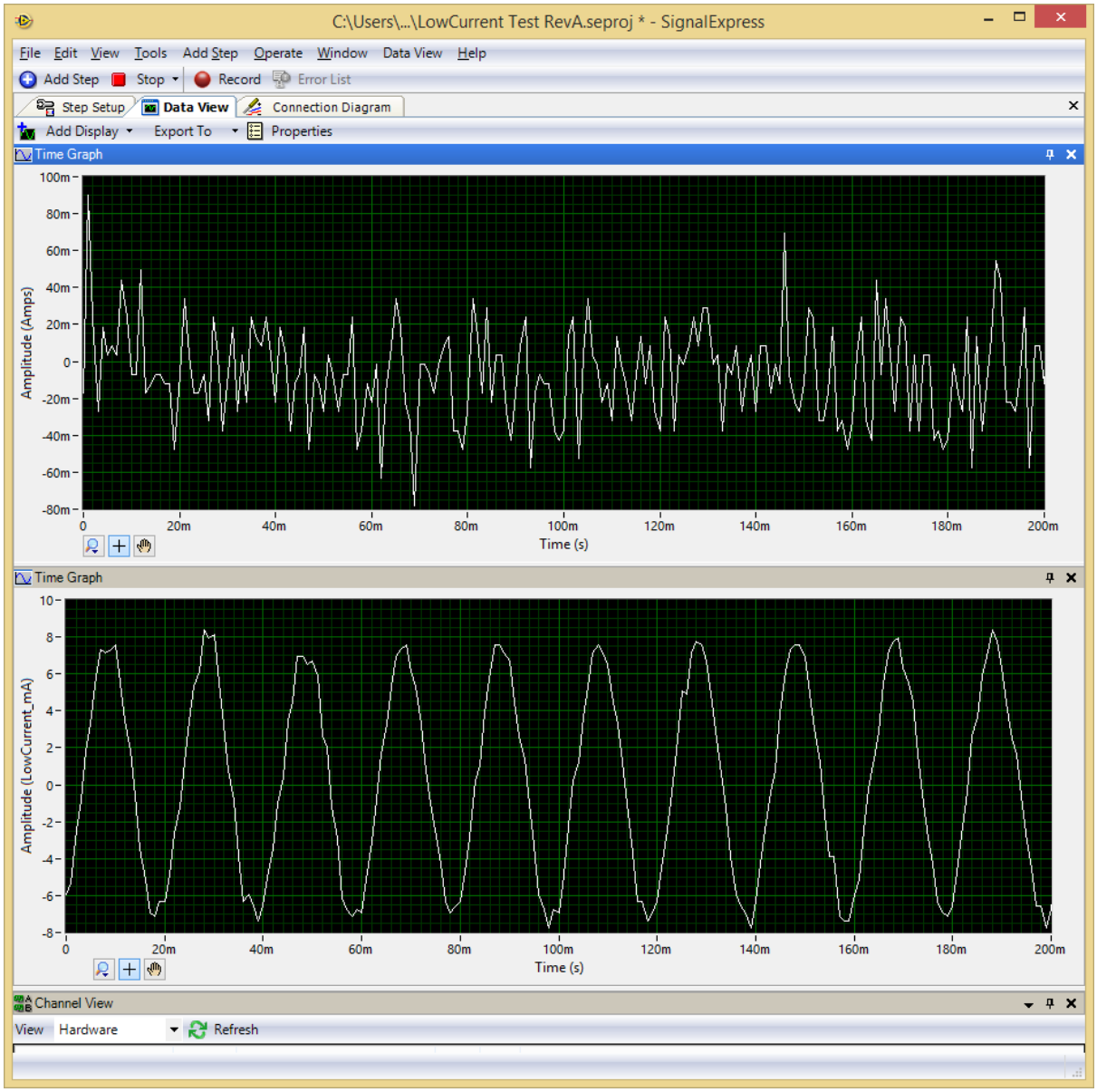
The second channel is a modified version of a Type C input which is a voltage input scaled as 200mV in for 2.00V output. RD and RE are 0R and FR is not fitted. The external current shunt is scaled as follows:

> 0.5R resistor. Full scale of 200mV input and 2V output. Full scale current of 400mA is enough to handle 2 fans. So scale factor for Signal Express is 400/2 = 200 mA/V.

The back to back diodes are used to take the 0.5R resistor out of the path at 20A current otherwise the input voltage would be 10V. The maximum measurable input voltage is ±200mV but the absolute maximum should be limited to ±2V; the diodes limit the swing on the input to ±700mV and allow full 20A current to flow in the load. Note that the diodes are non-linear devices but the characteristic allows linear operation between 0 and 200mV but saturation at ~700mV. Laboratory calibration is recommended to ensure the linear region meets the requirement. Diodes used in this example were VS-ETL1506FP-M3.

Low Current Measurement. Rev B.

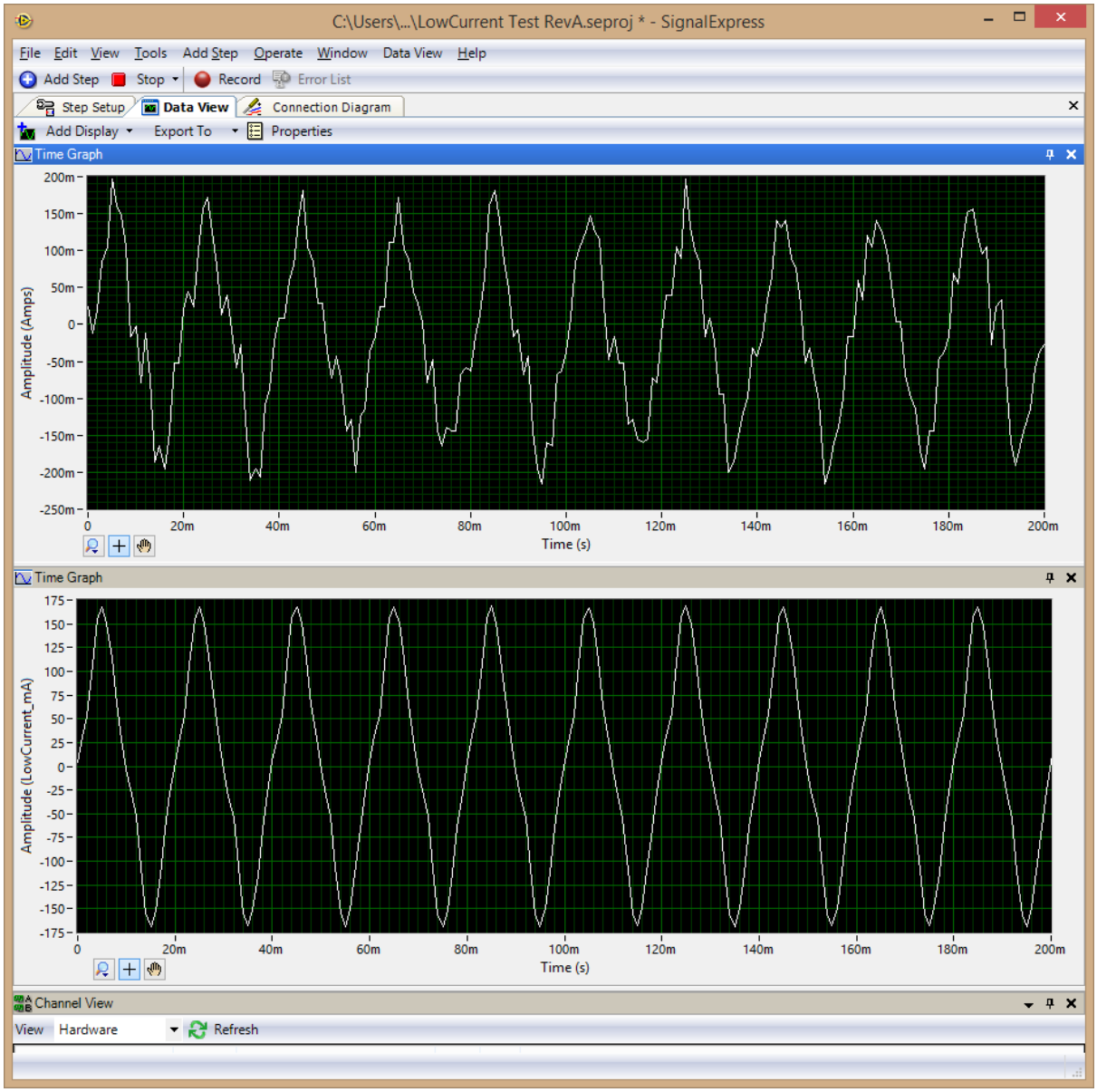
The baseline measurement has only the DRA module PSU in the load circuit.



The 20A channel cannot measure the DRA supply but the 400mA channel shows around 7mA peak.

Low Current Measurement. Rev B.

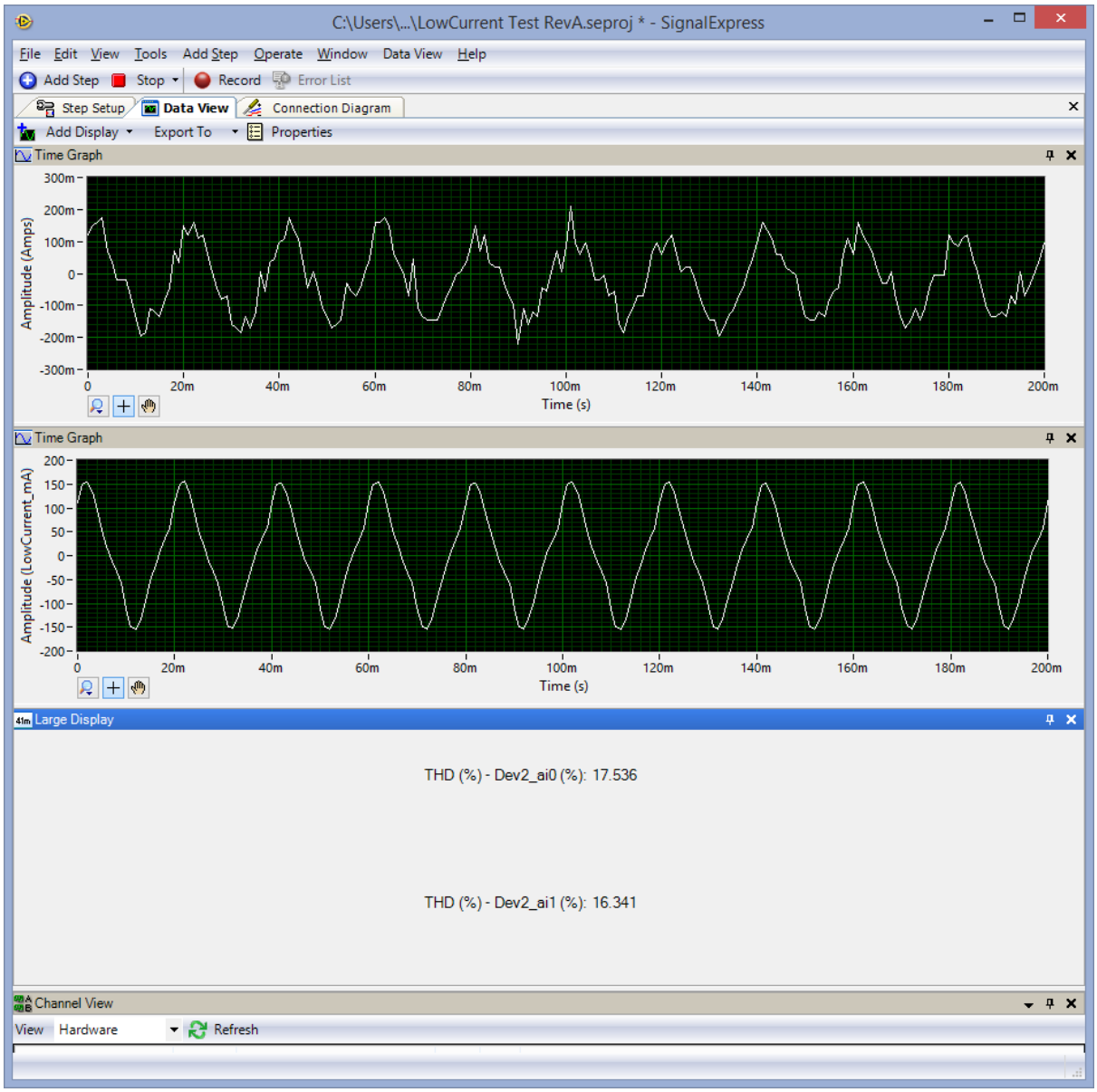
These traces show the fan current.



The current in the fan is not sinusoidal and peaks around 160mA. The fan current can be seen in the 20A channel but the waveform and performance can be measured with greater reliability in the low current channel.

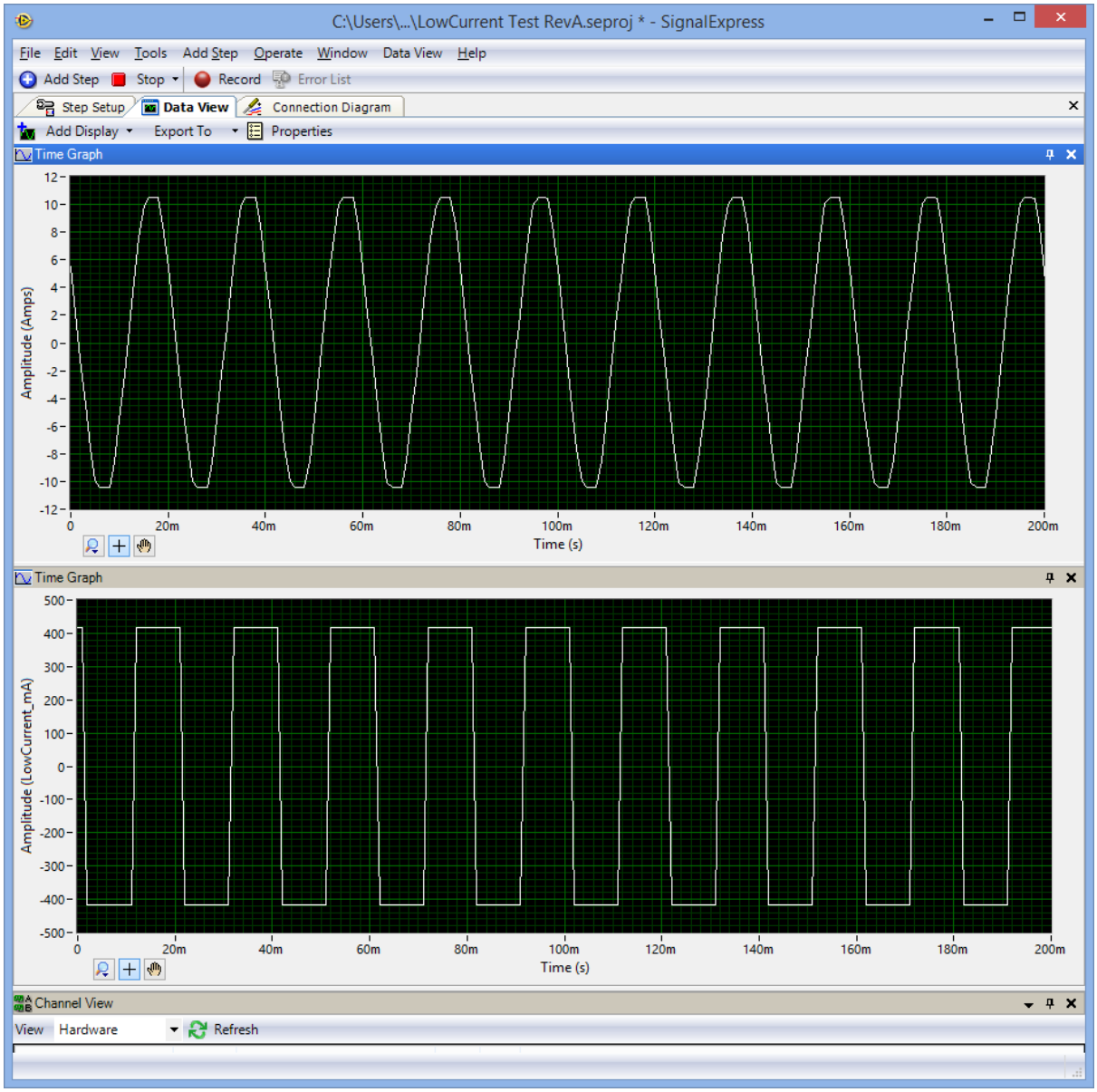
Low Current Measurement. Rev B.

Signal Express can measure the THD of these waveforms:



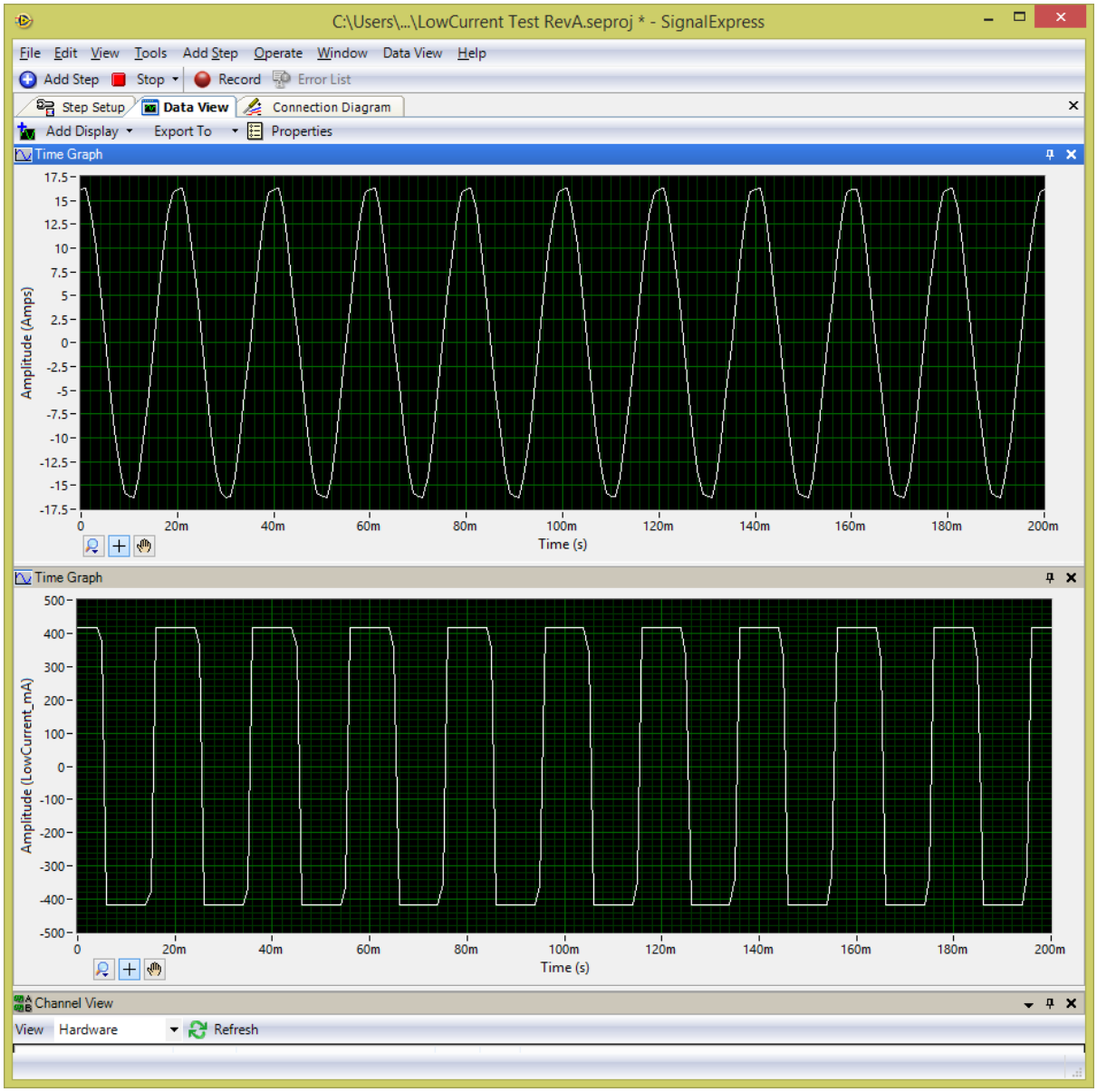
Low Current Measurement. Rev B.

These traces are for the first stage of heating switched on as well as the fan:

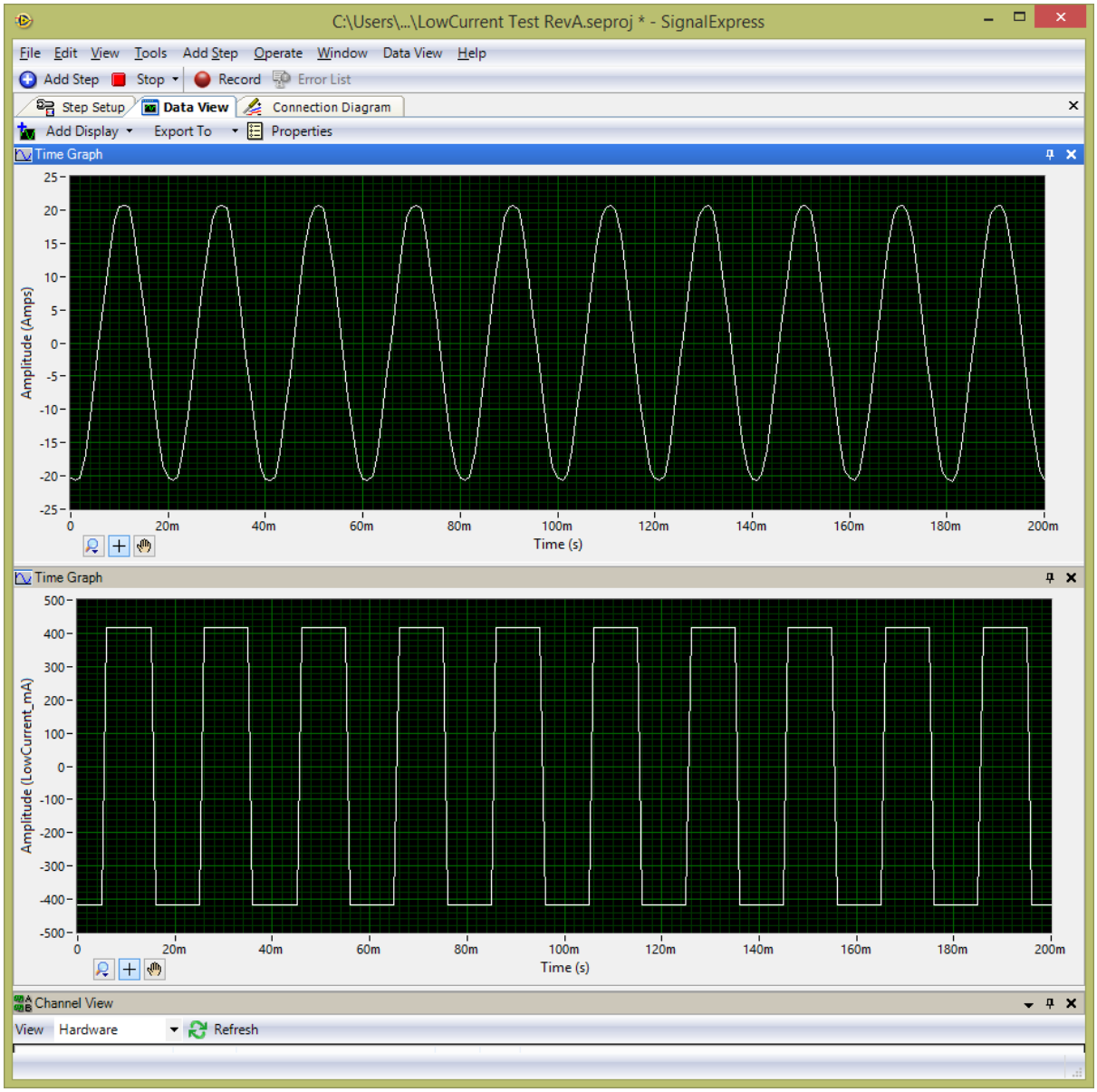


Low Current Measurement. Rev B.

…and with stage 2 of the heating:



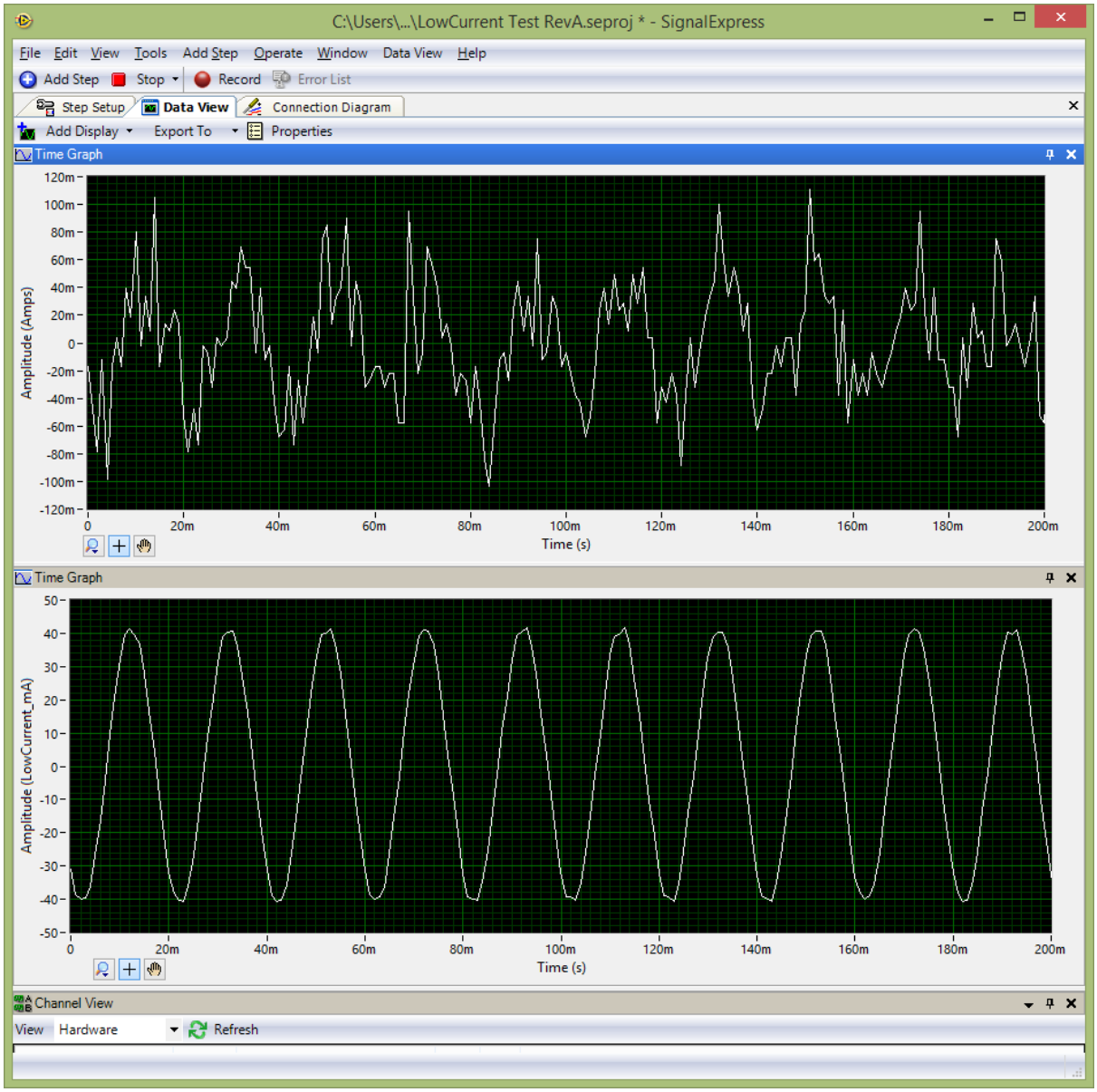
…and with stage 3 of the heating:



The low current channel saturates at ~400mA full scale but the 20A channel measures the full load.

Low Current Measurement. Rev B.

With a 10k leakage path added and no load (DRA current is measured)



Measuring 40mA leakage is easily accomplished in the low current channel. Typically with a solenoid drive the requirement is to measure leakage reliably between 5 and 20mA.