Quantum Design electrical transport user training seminar

part 3: interpreting the data

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outline of seminar

- Resistivity option
- AC Transport option
- Electrical Transport Option
- transport applications topics
- subtopics for each option:
 - what is reported in .DAT file?
 - what is actually measured?

Resistivity data file (.DAT)

- resistivity (R*A/L)
 - A/L entered by user when creating new .DAT file
- Excitation
- Std. Dev. – sigma from 25 readings
- Number of Readings
- Resistance (R)
- no .RAW data
- no error reporting for:
 - railed current source
 - voltmeter overflow

	Field Name	Field Value
1	Time Stamp (minutes,relative	2.782
2	Status (code)	4881
3	Temperature (K)	4.20024991035461
4	Magnetic Field (Oe)	-0.0949999988079071
5	Sample Position (deg)	0
6	Bridge 2 Resistivity (Ohm)	17509.03875
7	Bridge 2 Excitation (uA)	0.800999999046326
8	Bridge 2 Std. Dev. (Ohm)	1.86902650745856
9	Number of Readings	25
10	Bridge 2 Resistance (Ohms)	17509.03875

Resistivity: what is actually measured?

- voltage from sample
 - converted to resistance R=V/I
- voltage across Vishay resistors
 - used to calibrate current
 - not done in Fast mode

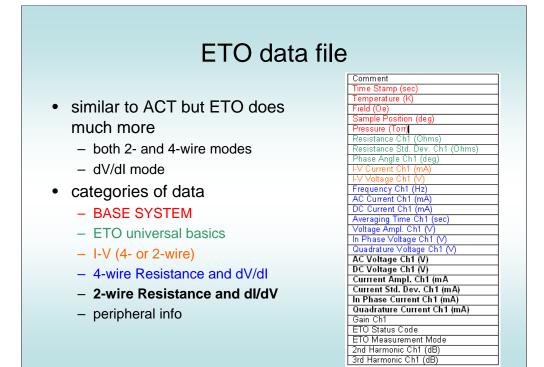
ACT data file

- more diagnostics here
 - harmonics
 - quad. error
 - ACT status
 - ACT gain
- see app note 1084-403

	Field Name	Field Value
1	Time Stamp (minutes,relative	0.345
2	Status (code)	4369
3	Temperature (K)	299.99695
4	Magnetic Field (Oe)	0
5	Excitation (mA)	10.3445784652368
6	Frequency (Hz)	100
7	Volts ch2	0.206970494356627
8	V Std.Dev. ch2	1.39597931637484E-5
9	Res. ch2 (ohm-cm)	20.0080414418348
10	Res. Std.Dev. ch2	0.00134949919699346
11	ACT Status (code)	0
12	ACT Gain	10
13	2nd Harm. ch2 (dB)	-90.5550939126767
14	3rd Harm. ch2 (dB)	-88.1096826882046
15	Quad.Error ch2 (ohm-cm-rad	0.000118352628304117
16	Drive Signal ch2 (V)	0.206971683096952

ACT: what is actually measured?

- voltage from sample
 - for I-V and c.c., the accumulated d.c. voltage reported
 - all others, a.c. component from lock-in calculation
- source current NOT measured
 - very stable current source
 - source compliance errors are reported to user
 - unless "Constant Current Mode" turned off!!
 - see ACT app. note 1084-402



ETO: what is actually measured?

- similar philosophy with ACT:
 - 4-wire mode: only voltage measured
 - source current assumed stable
 - 2-wire mode: only current measured
 - source voltage assumed stable
 - source compliance errors are reported
- in I-V dialog, "Disable Drive Feedback" is like turning off constant current mode in ACT
 - in ETO, however, we DO correct the current

transport applications topics

- * indicates there is an app note on this topic
- all options: common mode leakthrough in longitudinal resistance measurements *
 - symptom: noticed more in low R measurements, leads to false shift (+ or -) in reported resistance ("negative resistance")
 - avoid unsymmetric placement of sample voltage leads relative to current leads
 - avoid contact resistance at I+ or I- lead: biases sample voltage
- all options: non-ohmic contacts; some common symptoms:
 - R being dependent on drive current
 - I-V (scan excitation) clearly shows nonlinearity
 - in .RAW file V(t) is not sinusoidal (high Res.Std.Dev. in .DAT)
 - negative reported resistance

