

Extraction of parameter information from data using (Excel) curve fitting

This document shows the technique. It is referenced to diode data as taken under experiment 1 and making a fit to the ideal diode equation

$$I_D = I_S \left(e^{V/nV_T} - 1 \right)$$

where the goal is to find the best fit values of

I_S = reverse saturation current

n = emission coefficient

to I-V data extracted from a diode, for which the I_D current is given by $I_D = V_Y/R_1$

and $V_D = V_X/N$ where N = number of diodes in test string

1. Typical raw data as entered into spreadsheet

Measurements (from O-scope)				
VX	VY	(for R1 = R2 shown)		
(3*VD)	1.0M	100k	10k	1k
(V)	(V)	(V)	(V)	(V)
0.6	0.005			
0.9	0.035			
1.2	0.21			
1.5		0.15		
1.8		0.75		
1.95		2		
2.1			0.4	
2.25			1.5	
2.4			3	
2.55				1.5
2.7				3

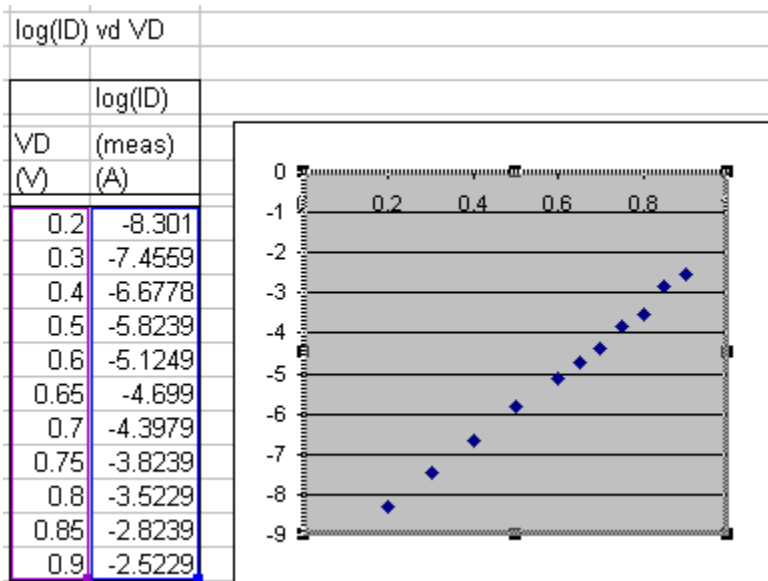
2. Use of Excel calculation to find V_D and I_D from raw data

Measurements (from O-scope)					ID vs VD	
VX	VY	(for R1 = R2 shown)			(Calc from data)	
(3*VD)	1.0M	100k	10k	1k	VD	ID(meas)
(V)	(V)	(V)	(V)	(V)	(V)	(A)
0.6	0.005				0.2	5.00E-09
0.9	0.035				0.3	3.50E-08
1.2	0.21				0.4	2.10E-07
1.5		0.15			0.5	1.50E-06
1.8		0.75			0.6	7.50E-06
1.95		2			0.65	2.00E-05
2.1			0.4		0.7	4.00E-05
2.25			1.5		0.75	1.50E-04
2.4			3		0.8	3.00E-04
2.55				1.5	0.85	1.50E-03
2.7				3	0.9	3.00E-03

3. Since I_D ranges over several orders of magnitude, use Excel to find $\log(I_D)$

Measurements (from O-scope)					ID vs VD		log(ID) vd VD	
VX	VY	(for R1 = R2 shown)			(Calc from data)		log(ID)	
(3*VD)	1.0M	100k	10k	1k	VD	ID(meas)	VD	(meas)
(V)	(M)	(M)	(M)	(M)	(M)	(A)	(V)	(A)
0.6	0.005				0.2	5.00E-09	0.2	-8.301
0.9	0.035				0.3	3.50E-08	0.3	-7.4559
1.2	0.21				0.4	2.10E-07	0.4	-6.6778
1.5		0.15			0.5	1.50E-06	0.5	-5.8239
1.8		0.75			0.6	7.50E-06	0.6	-5.1249
1.95		2			0.65	2.00E-05	0.65	-4.699
2.1			0.4		0.7	4.00E-05	0.7	-4.3979
2.25			1.5		0.75	1.50E-04	0.75	-3.8239
2.4			3		0.8	3.00E-04	0.8	-3.5229
2.55				1.5	0.85	1.50E-03	0.85	-2.8239
2.7				3	0.9	3.00E-03	0.9	-2.5229

4. Call up the X-Y plot of the data. Hopefully it will look reasonably like a straight line (consistent with $\log(I_D)$ of ideal diode equation). The Excel plot function (usually) requires that the values to be plotted are in column form, with first column = x-axis.

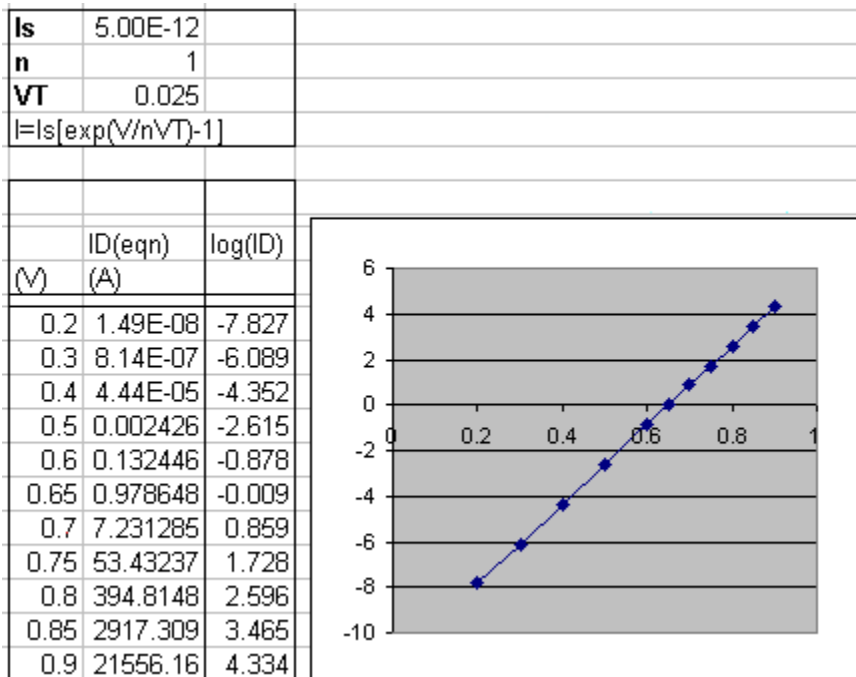


(The highlighted columns are read by the X-Y plot call)

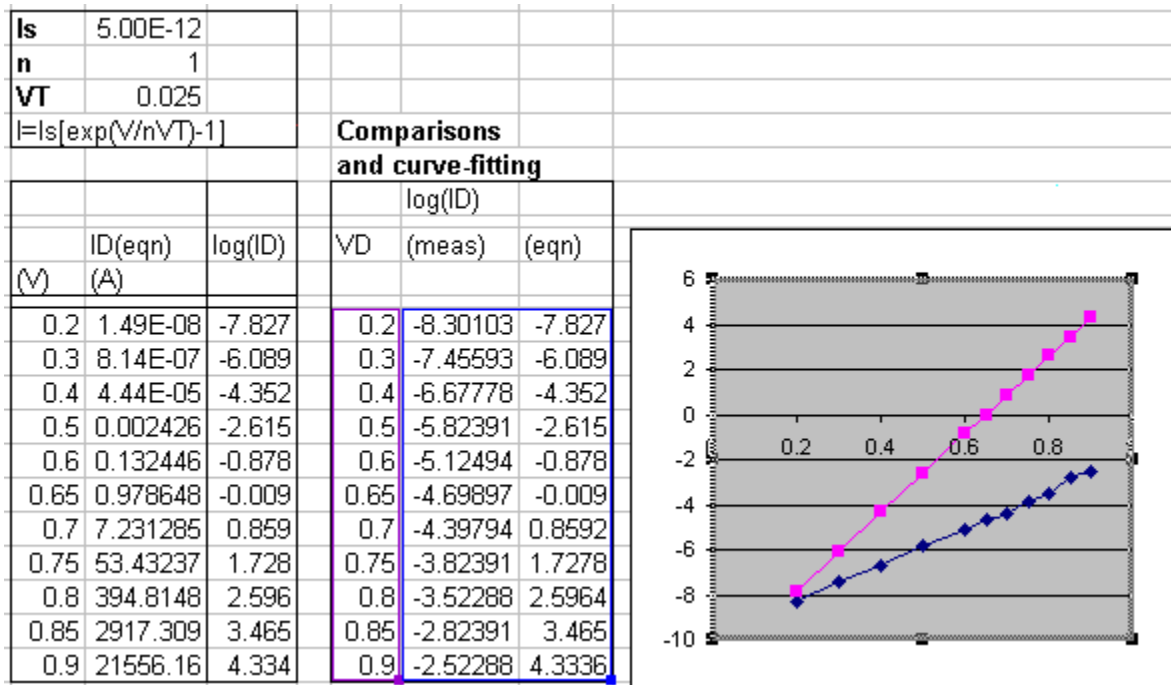
5. Make a calculation (with trial values of I_s and n) using the V_D values as obtained from data

Measurements (from O-scope)					ID vs VD		log(ID) vs VD		I_s	n	V_T	$I = I_s[\exp(V/nV_T) - 1]$
VX	VY	(for R1 = R2 shown)			(Calc from data)		log(ID)					
(3*VD)	1.0M	100k	10k	1k	VD	ID(meas)	VD	(meas)		ID(eq)	log(ID)	
(V)	(M)	(M)	(M)	(M)	(V)	(A)	(V)	(A)	(V)	(A)		
0.6	0.005				0.2	5.00E-09	0.2	-8.301	0.2	1.49E-08	-7.827	
0.9	0.035				0.3	3.50E-08	0.3	-7.4559	0.3	8.14E-07	-6.089	
1.2	0.21				0.4	2.10E-07	0.4	-6.6778	0.4	4.44E-05	-4.352	
1.5		0.15			0.5	1.50E-06	0.5	-5.8239	0.5	0.002426	-2.615	
1.8		0.75			0.6	7.50E-06	0.6	-5.1249	0.6	0.132446	-0.878	
1.95		2			0.65	2.00E-05	0.65	-4.699	0.65	0.978648	-0.009	
2.1			0.4		0.7	4.00E-05	0.7	-4.3979	0.7	7.231285	0.859	
2.25			1.5		0.75	1.50E-04	0.75	-3.8239	0.75	53.43237	1.728	
2.4			3		0.8	3.00E-04	0.8	-3.5229	0.8	394.8148	2.596	
2.55				1.5	0.85	1.50E-03	0.85	-2.8239	0.85	2917.309	3.465	
2.7				3	0.9	3.00E-03	0.9	-2.5229	0.9	21556.16	4.334	

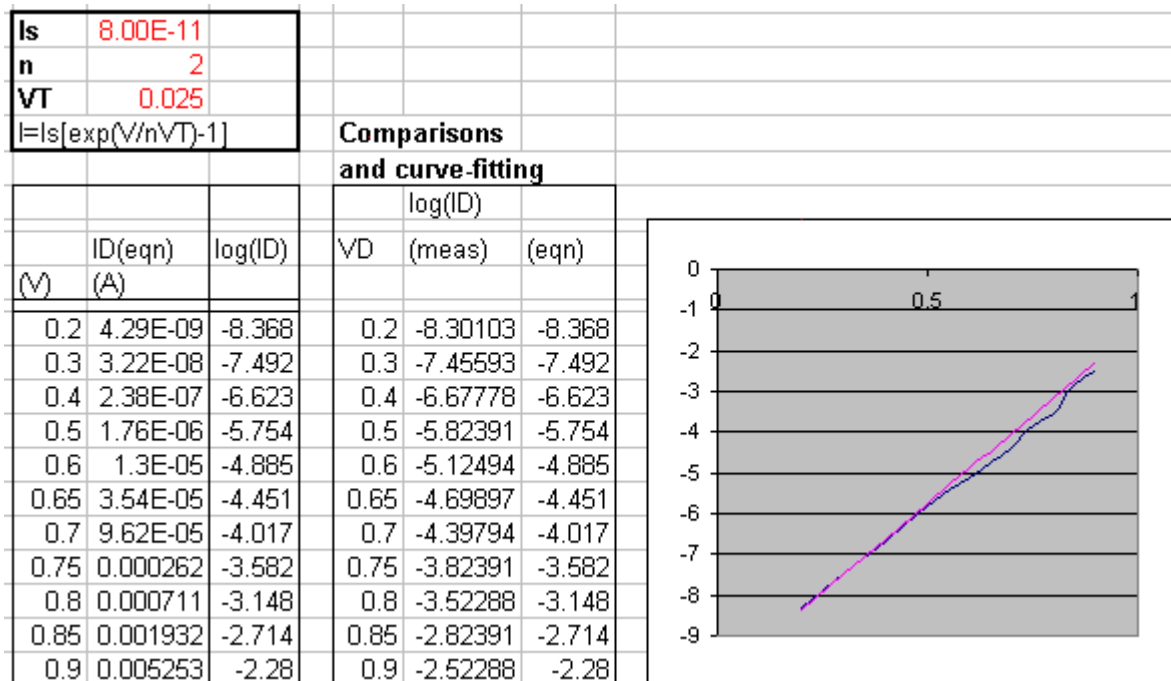
(A plot of these values can also be obtained from the X-Y plot call. Should be a straight line)



6. If the plots for I_D (equation) and I_D (measured) are overlaid, they probably will not compare that well



7. After you have tweaked the trial values for I_s and n the I_D (equation) plot can be fitted to the data (assuming that the equation and data are consistent). And the parametric values I_s and n as used to get a good fit are the goal of your measurements.



Your data may not be as clean as this example, particularly for the stranger diodes.