

EE 236: Electronic Divice Lab  
Lab No. 5

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# 1 Dark forward characteristics at different temperatures

## 1.1 Prelab

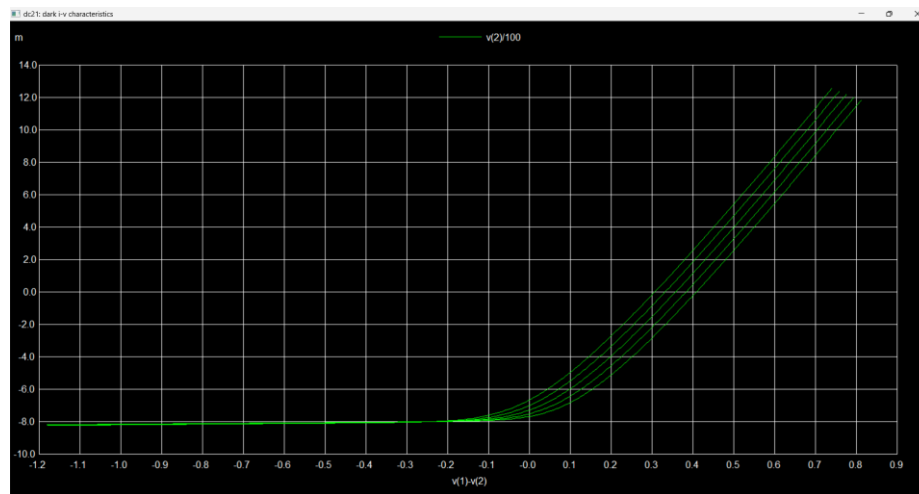


Figure 1: I-V Characteristics for Dark

In the above diagram, the graph at the bottom represents a temperature of 35 °C, increasing up to 75 °C at the top.

## 1.2 InLab

### 1.2.1 Circuit Diagram

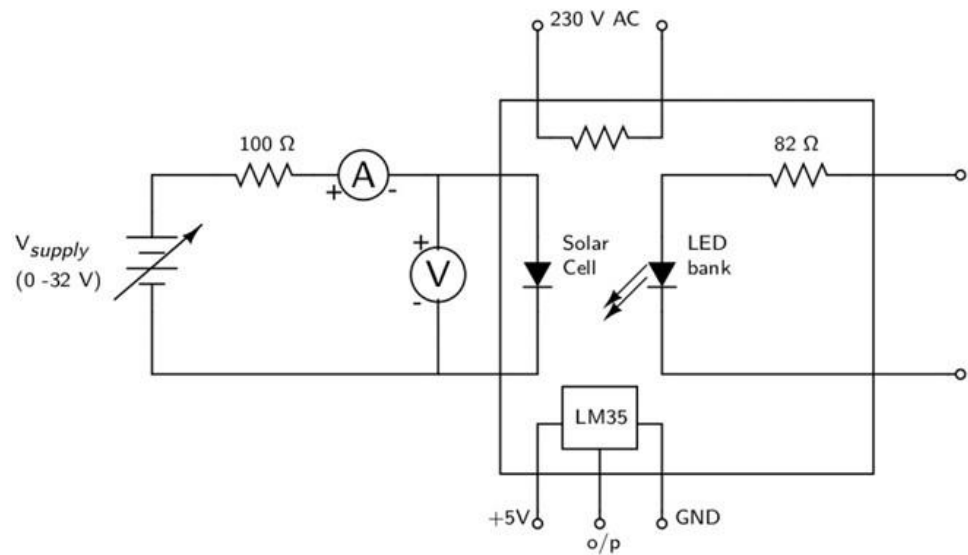


Figure 2: Circuit Diagram

### 1.2.2 Reading of $V_d$ , $I_d$ and $\ln(I_d)$ for different temperatures

$V_d$ (V)	$I_d$ (mA) at 35°C	$\ln(I_d)$ at 35°C
0	0	
0.025	0.01	-4.605
0.05	0.01	-4.605
0.075	0.03	-3.507
0.1	0.05	-2.996
0.125	0.07	-2.659
0.15	0.12	-2.120
0.175	0.15	-1.897
0.2	0.21	-1.561
0.225	0.29	-1.238
0.25	0.4	-0.916
0.275	0.57	-0.562
0.3	0.77	-0.261
0.325	1.12	0.113
0.35	1.6	0.470
0.375	2.32	0.842
0.4	3.5	1.253
0.425	5.36	1.679
0.45	8.62	2.154
0.475	14.45	2.671

Table 1: Dark I-V characteristics at 35°C

$V_d$ (V)	$I_d$ (mA) at 45°C	$\ln(I_d)$ at 45°C
0	0	
0.025	0.01	-4.605
0.05	0.02	-3.912
0.075	0.04	-3.219
0.1	0.06	-2.813
0.125	0.1	-2.303
0.15	0.13	-2.040
0.175	0.18	-1.715
0.2	0.25	-1.386
0.225	0.35	-1.050
0.25	0.52	-0.654
0.275	0.72	-0.329
0.3	1.02	0.020
0.325	1.46	0.378
0.35	2.19	0.784
0.375	3.28	1.188
0.4	5.2	1.649
0.425	8.31	2.117
0.45	13.95	2.635

Table 2: Dark I-V characteristics at 45°C

$V_d$ (V)	$I_d$ (mA) at 55°C	$\ln(I_d)$ at 55°C
0	0	
0.025	0.02	-3.912
0.05	0.03	-3.507
0.075	0.04	-3.219
0.1	0.06	-2.813
0.125	0.1	-2.303
0.15	0.16	-1.833
0.175	0.23	-1.470
0.2	0.33	-1.109
0.225	0.45	-0.799
0.25	0.68	-0.386
0.275	0.98	-0.020
0.3	1.36	0.307
0.325	2.05	0.718
0.35	3.18	1.157
0.375	5.00	1.609
0.4	8.50	2.140
0.425	14.00	2.639
0.45	19.00	2.944

Table 3: Readings of  $V_d$ ,  $I_d$ , and  $\ln(I_d)$  at 55°C

$V_d$ (V)	$I_d$ (mA) at 65°C	$\ln(I_d)$ at 65°C
0	0	
0.025	0.01	-4.605
0.05	0.02	-3.912
0.075	0.07	-2.659
0.1	0.1	-2.303
0.125	0.15	-1.897
0.15	0.21	-1.561
0.175	0.34	-1.079
0.2	0.45	-0.799
0.225	0.65	-0.431
0.25	0.95	-0.051
0.275	1.38	0.322
0.3	2.08	0.732
0.325	3.15	1.147
0.35	4.84	1.577
0.375	7.75	2.048
0.4	13.22	2.582
0.425	19.00	2.944

Table 4: Readings of  $V_d$ ,  $I_d$ , and  $\ln(I_d)$  at 65°C

$V_d$ (V)	$I_d$ (mA) at 75°C	$\ln(I_d)$ at 75°C
0	0	
0.025	0.02	-3.912
0.05	0.04	-3.219
0.075	0.08	-2.526
0.1	0.14	-1.966
0.125	0.21	-1.561
0.15	0.3	-1.204
0.175	0.41	-0.892
0.2	0.64	-0.446
0.225	0.9	-0.105
0.25	1.34	0.293
0.275	2.00	0.693
0.3	3.00	1.099
0.325	4.69	1.545
0.35	7.59	2.027
0.375	12.37	2.515
0.4	19.90	2.991

Table 5: Readings of  $V_d$ ,  $I_d$ , and  $\ln(I_d)$  at 75°C



### 1.2.3 Plots

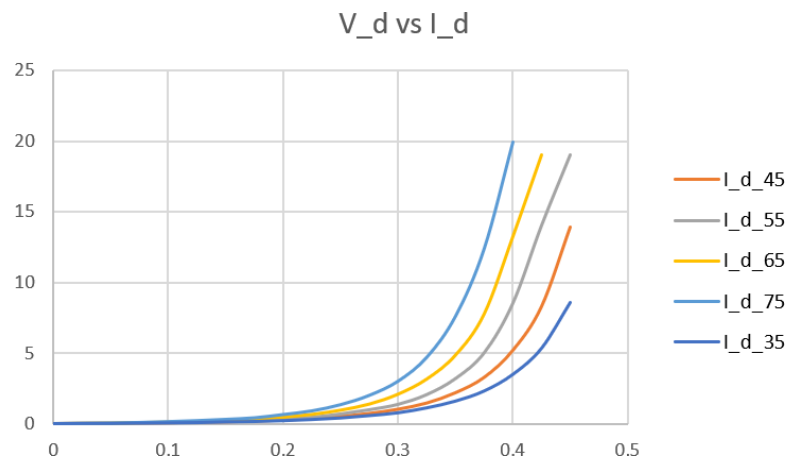


Figure 3:  $I_d$  vs  $V_d$

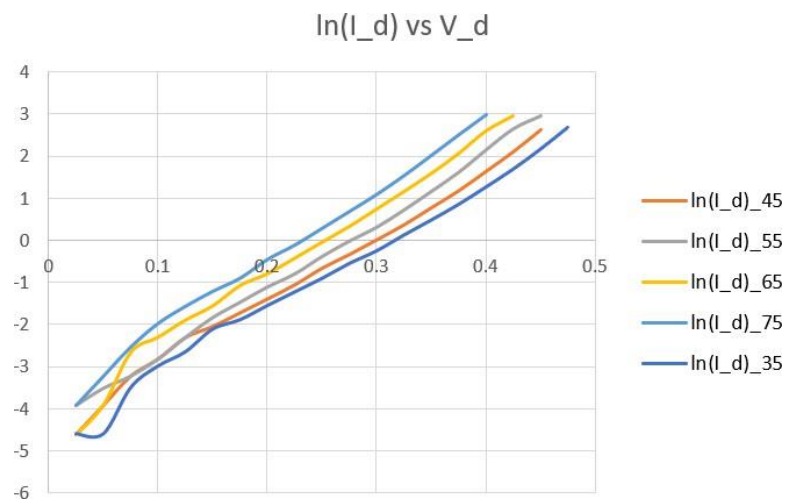


Figure 4:  $\ln(I_d)$  vs  $V_d$

### 1.2.4 Observations

Temperature	$V_d$ for $I_d = 1mA$	$V_d$ for $I_d = 2mA$	$V_d$ for $I_d = 5mA$	$\eta$ for low forward bias	$\eta$ for high forward bias
35°C	0.316	0.364	0.420	2.25567657	2.394703098
45°C	0.296	0.344	0.397	2.322294623	2.278348585
55°C	0.276	0.323	0.375	2.413137831	2.17533318
65°C	0.253	0.297	0.352	2.184456668	2.159706264
75°C	0.23	0.275	0.328	2.155205116	2.074932653

Table 6: Observation Table

## 2 Lighted I/V at different temperatures

### 2.1 Prelab

#### 2.1.1 Plot

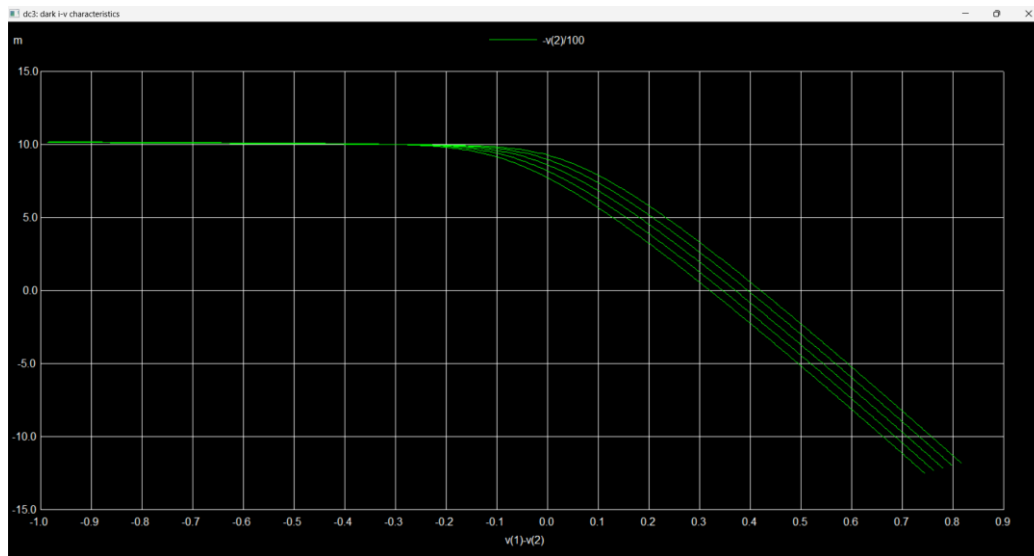


Figure 5: Lighted I-V characteristics

#### 2.1.2 Calculated Values

Temperature (°C)	VM (V)	I'm (mA)	Isc (mA)	Voc (V)	F
35	0.2612	-0.0076	-0.0099	0.4159	0.4831
45	0.2410	-0.0074	-0.0099	0.3944	0.4582
55	0.2209	-0.0072	-0.0099	0.3728	0.4330
65	0.2005	-0.0072	-0.0098	0.3513	0.4182
75	0.2019	-0.0061	-0.0098	0.2790	0.4526

Table 7: Temperature dependence of solar cell parameters

## 2.2 Inlab

### 2.2.1 Circuit Diagram

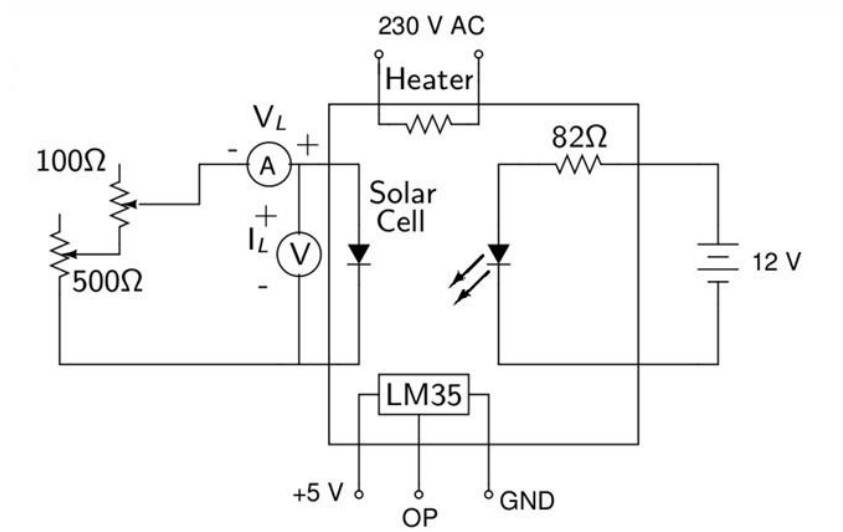


Figure 6: Circuit diagram for lighted I/V characteristics

### 2.2.2 Reading of $V_d$ and $I_d$ for Different Temperatures

$V_l$ (V)	$I_l$ (mA) at 35°C	$P_l$ at 35°C
0	10.52	0.000
0.025	10.49	0.262
0.05	10.46	0.523
0.075	10.42	0.782
0.1	10.38	1.038
0.125	10.31	1.289
0.15	10.23	1.535
0.175	10.12	1.771
0.2	10.00	2.000
0.225	9.80	2.205
0.25	9.56	2.390
0.275	9.18	2.525
0.3	8.73	2.619
0.325	8.01	2.603
0.35	7.11	2.489
0.375	5.96	2.235
0.4	4.49	1.796
0.425	2.71	1.152

Table 8: Readings of  $V_l$ ,  $I_l$ , and  $P_l$  at 35°C

$V_l$ (V)	$I_l$ (mA) at 45°C	$P_l$ at 45°C
0	10.46	0.000
0.025	10.44	0.261
0.05	10.41	0.521
0.075	10.35	0.776
0.1	10.30	1.030
0.125	10.21	1.276
0.15	10.09	1.514
0.175	9.96	1.743
0.2	9.71	1.942
0.225	9.50	2.138
0.25	9.20	2.300
0.275	8.55	2.351
0.3	7.95	2.385
0.325	7.08	2.301
0.35	5.92	2.072
0.375	4.52	1.695
0.4	2.80	1.120
0.425	0.82	0.349

Table 9: Readings of  $V_l$ ,  $I_l$ , and  $P_l$  at 45°C

$V_l$ (V)	$I_l$ (mA) at 55°C	$P_l$
0	10.40	0
0.025	10.39	0.25975
0.05	10.33	0.5165
0.075	10.27	0.77025
0.1	10.20	1.02
0.125	10.10	1.2625
0.15	10.00	1.50
0.175	9.76	1.708
0.2	9.54	1.908
0.225	9.10	2.0475
0.25	8.60	2.15
0.275	8.08	2.222
0.3	7.13	2.139
0.325	6.01	1.95325
0.35	4.55	1.5925
0.375	2.93	1.09875
0.4	0.88	0.352

Table 10: Readings of  $V_l$ ,  $I_l$ , and  $P_l$  at 55°C

$V_l$ (V)	$I_l$ (mA) at 65°C	$P_l$
0	10.32	0
0.025	10.31	0.25775
0.05	10.25	0.5125
0.075	10.16	0.762
0.1	10.05	1.005
0.125	9.91	1.23875
0.15	9.72	1.458
0.175	9.50	1.6625
0.2	9.17	1.834
0.225	8.70	1.9575
0.25	8.05	2.0125
0.275	7.20	1.98
0.3	6.11	1.833
0.325	4.64	1.508
0.35	2.92	1.022
0.375	0.92	0.345

Table 11: Readings of  $V_l$ ,  $I_l$ , and  $P_l$  at 65°C

$V_l$ (V)	$I_l$ (mA) at 75°C	$P_l$
0	10.27	0
0.025	10.23	0.25575
0.05	10.14	0.507
0.075	10.04	0.753
0.1	9.90	0.99
0.125	9.71	1.21375
0.15	9.48	1.422
0.175	9.13	1.59775
0.2	8.67	1.734
0.225	8.03	1.80675
0.25	7.18	1.795
0.275	6.07	1.66925
0.3	4.72	1.416
0.325	3.13	1.01725
0.35	1.12	0.392

Table 12: Readings of  $V_l$ ,  $I_l$ , and  $P_l$  at 75°C

### 2.2.3 Plots

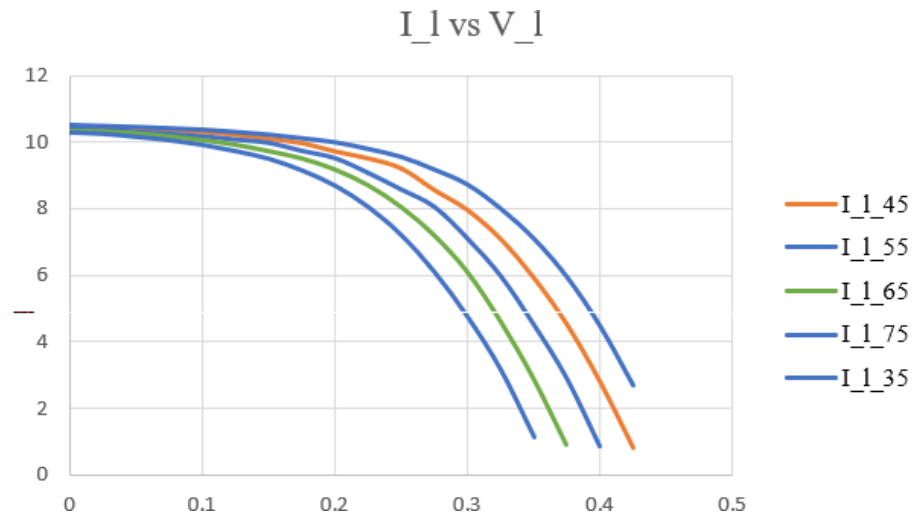


Figure 7: Caption

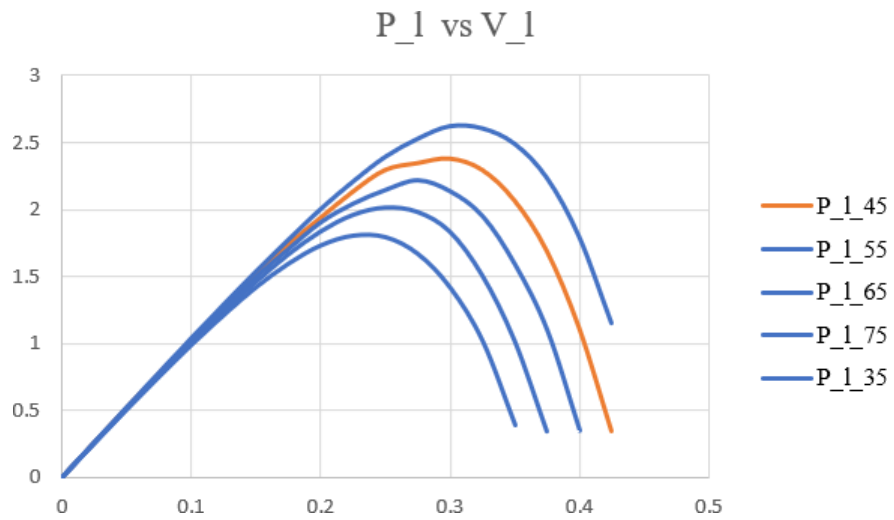


Figure 8: Caption



#### 2.2.4 Observations

Temp	35°C	45°C	55°C	65°C	75°C
$I_{sc}$	11.9378	12.2615	12.1759	12.0530	11.9037
$V_{oc}$	0.8096	0.6475	0.6024	0.5570	0.5145
$I_m \times V_m$	2.6190	2.3850	2.2220	2.0125	1.8068
$F$	0.2710	0.3004	0.3029	0.2998	0.2950

Table 13: Performance Metrics at Different Temperatures