Proposal for a Simple PD Classification

In conjunction with the 25K slope discovery process, the classification process consists of measuring a single point.
A PSE can either drive out a current, and measure a voltage, or it can drive out a voltage, and measure a current. The PSE determines the class based on either of these single point measurements

There are a total of 5 classes defined here, one or more of which could be reserved for future use. Also, future revisions could add more classes at higher currents

Class 0	no class, a plain 25K signature, the PSE must assume it's full power
Class 1	definition is TBD, a single box, 2ma to 3ma, and 19V to 21V
Class 2	definition is TBD, a single box, 4ma to 5ma, and 19V to 21V
Class 3	definition is TBD, a single box, 6ma to 7ma, and 19V to 21V
Class 4	definition is TBD, a single box, 8ma to 9ma, and 19V to 21V

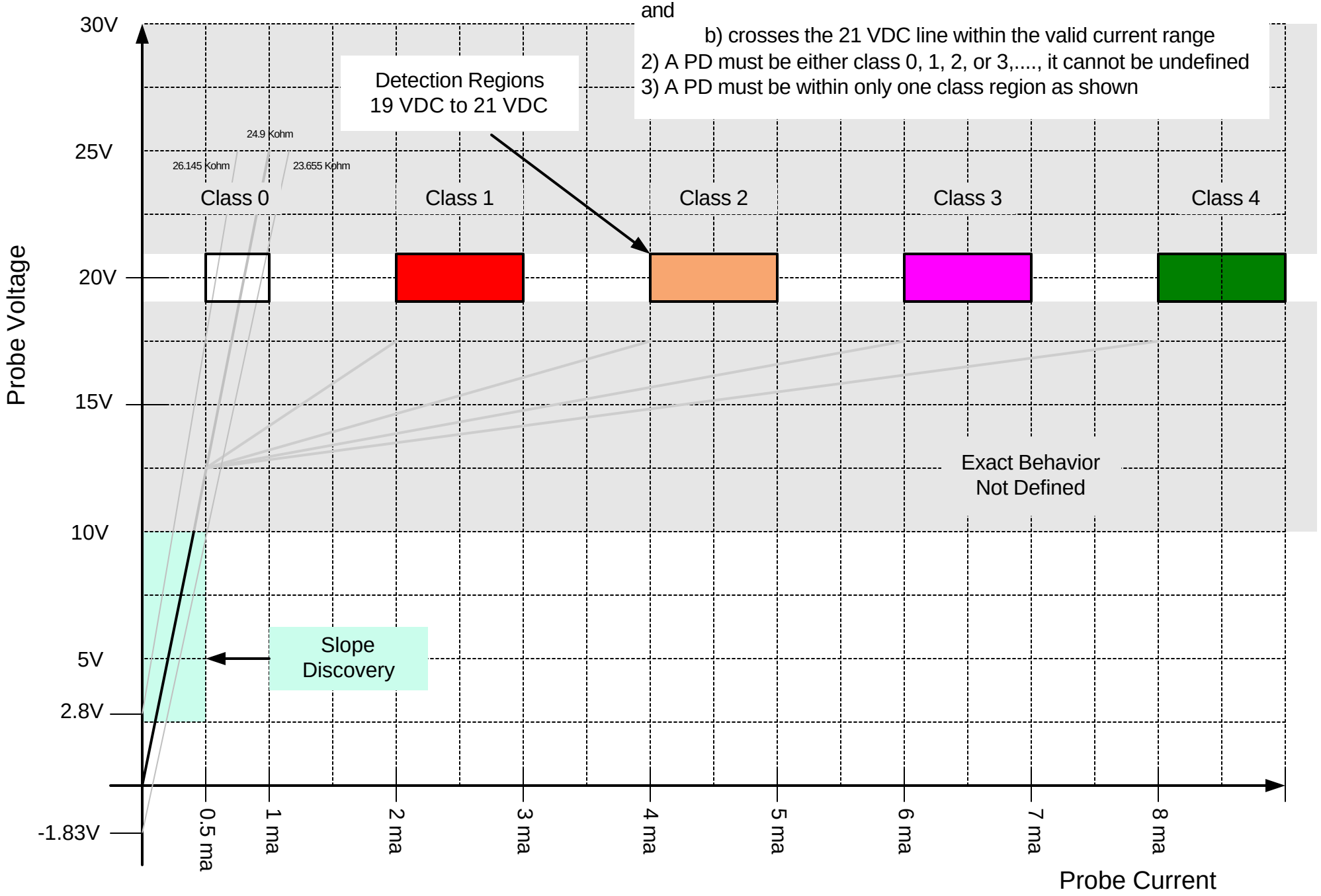
Rules which apply at the RJ-45 PD connector (voltage and current):

1) The behavior of a PD can only be within a single class

2) for a PD class to be valid both of these must hold true:
   a) for any driven voltage from 19V to 21V, the measured current must remain within the valid range for the applicable class
   b) for any driven current within the valid range for the class, the measured voltage must remain within 19V to 21V

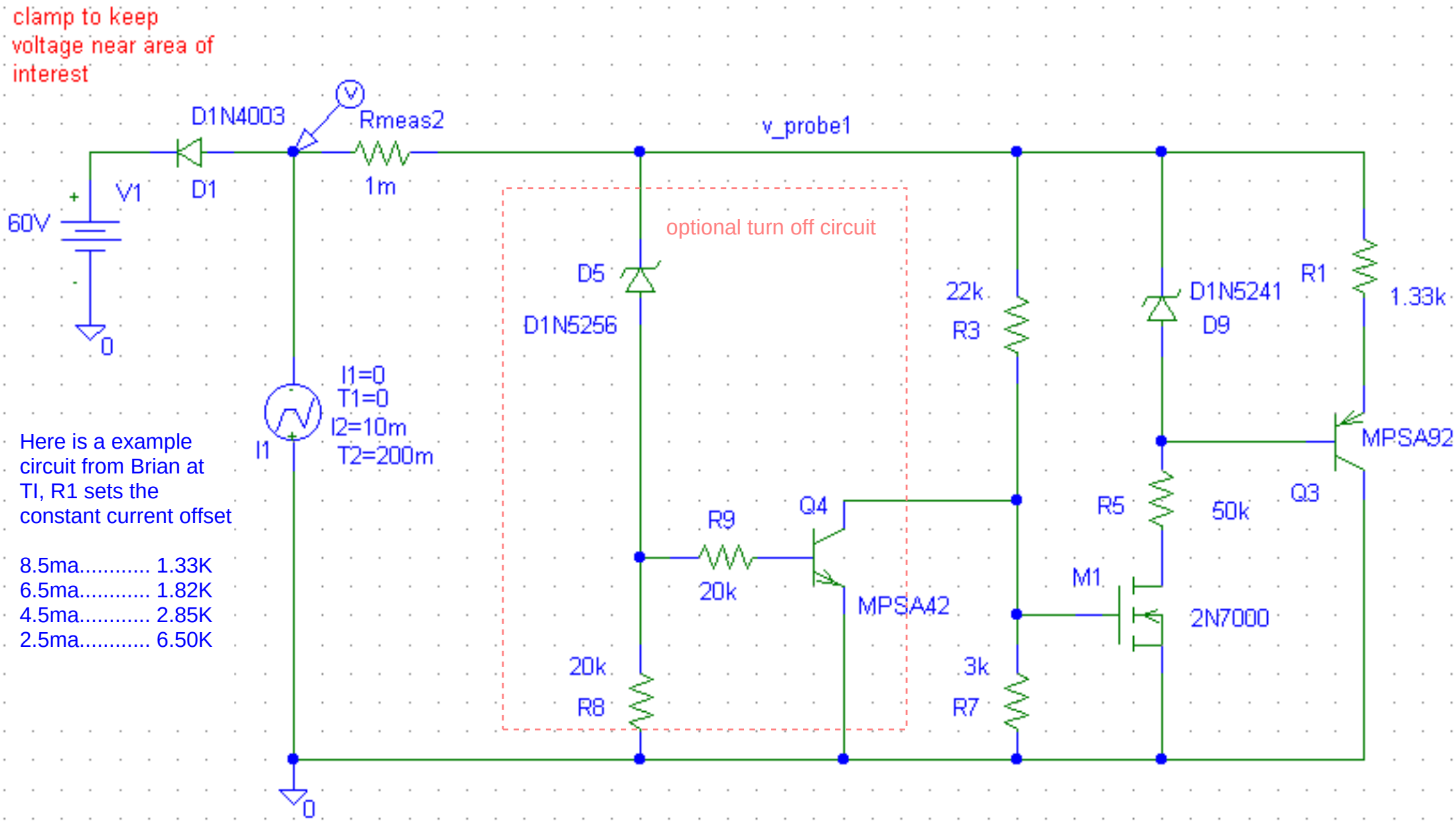
PD Classification Proposal

Rules for PD Classification:
1) a PD must have a classification load line that
   a) crosses the 19 VDC line within the valid current range
and
   b) crosses the 21 VDC line within the valid current range
2) A PD must be either class 0, 1, 2, or 3,...., it cannot be undefined
3) A PD must be within only one class region as shown

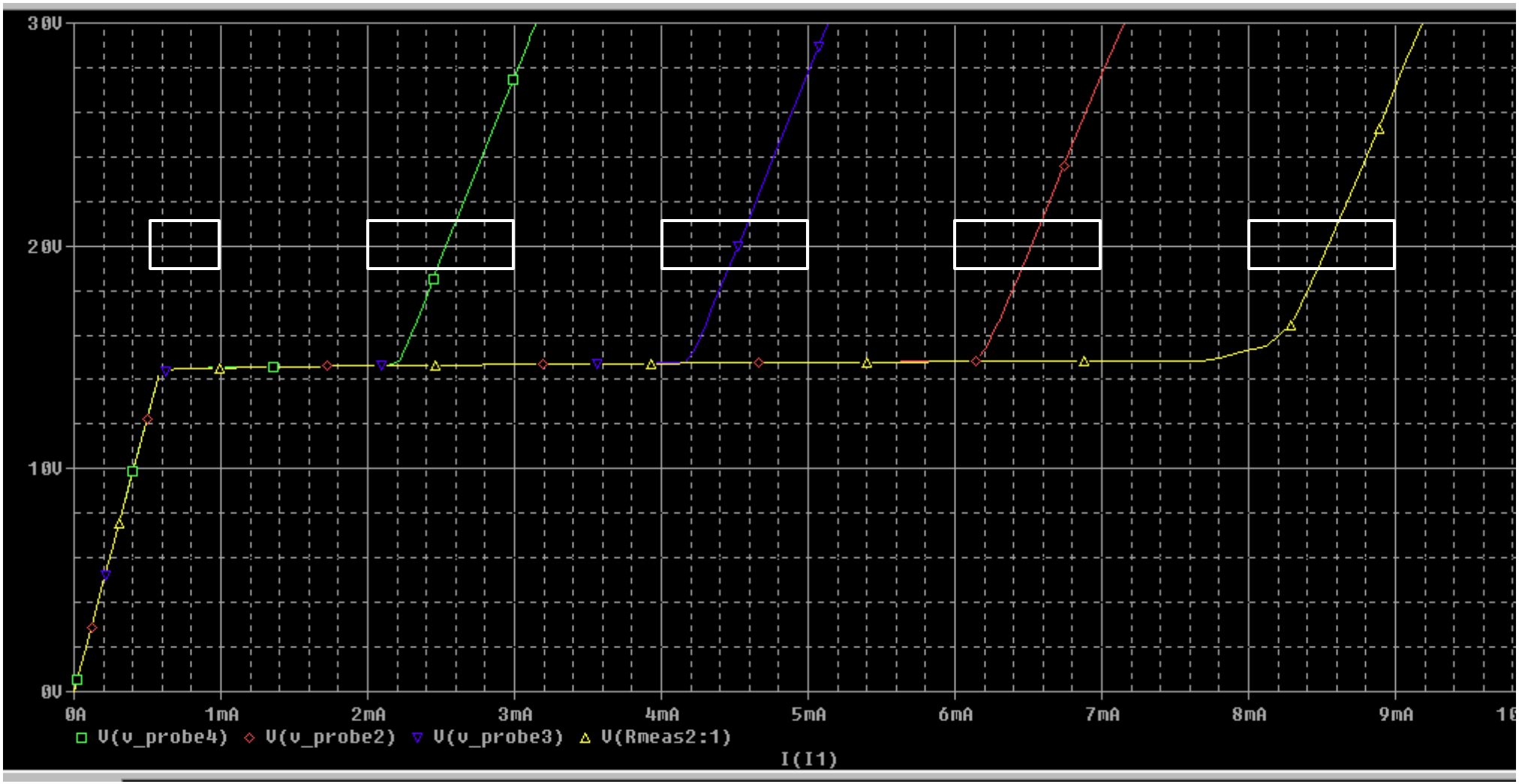


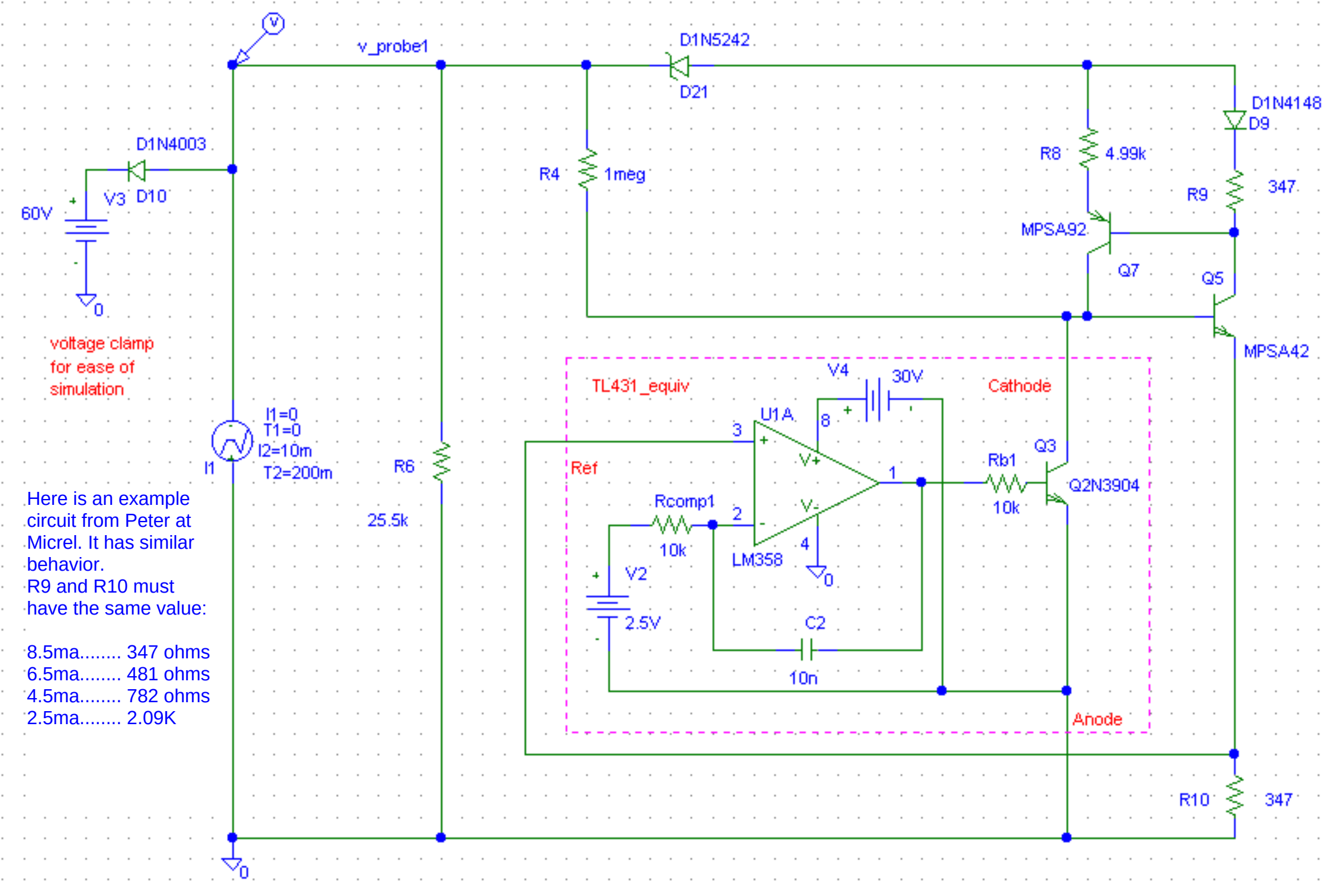
Example Circuit using a constant current and the 25K

Note that the circuit that may be required to turn off the classification above 30VDC is not considered here


clamp to keep voltage near area of interest
D1N4003
Rmeas2
v_probe1
V1
D1
1m
60V
0
optional turn off circuit
D5
D1N5256
22k
R3
D1N5241
D9
R1
1.33k
I1=0
T1=0
I2=10m
T2=200m
I1
MPSA92
Q3
R9
Q4
R5
50k
20k
MPSA42
M1
2N7000
20k
R8
3k
R7
0
Here is a example circuit from Brian at TI, R1 sets the constant current offset
8.5ma..... 1.33K
6.5ma..... 1.82K
4.5ma..... 2.85K
2.5ma..... 6.50K

Here are the simulated results in Pspice of Brian's circuit

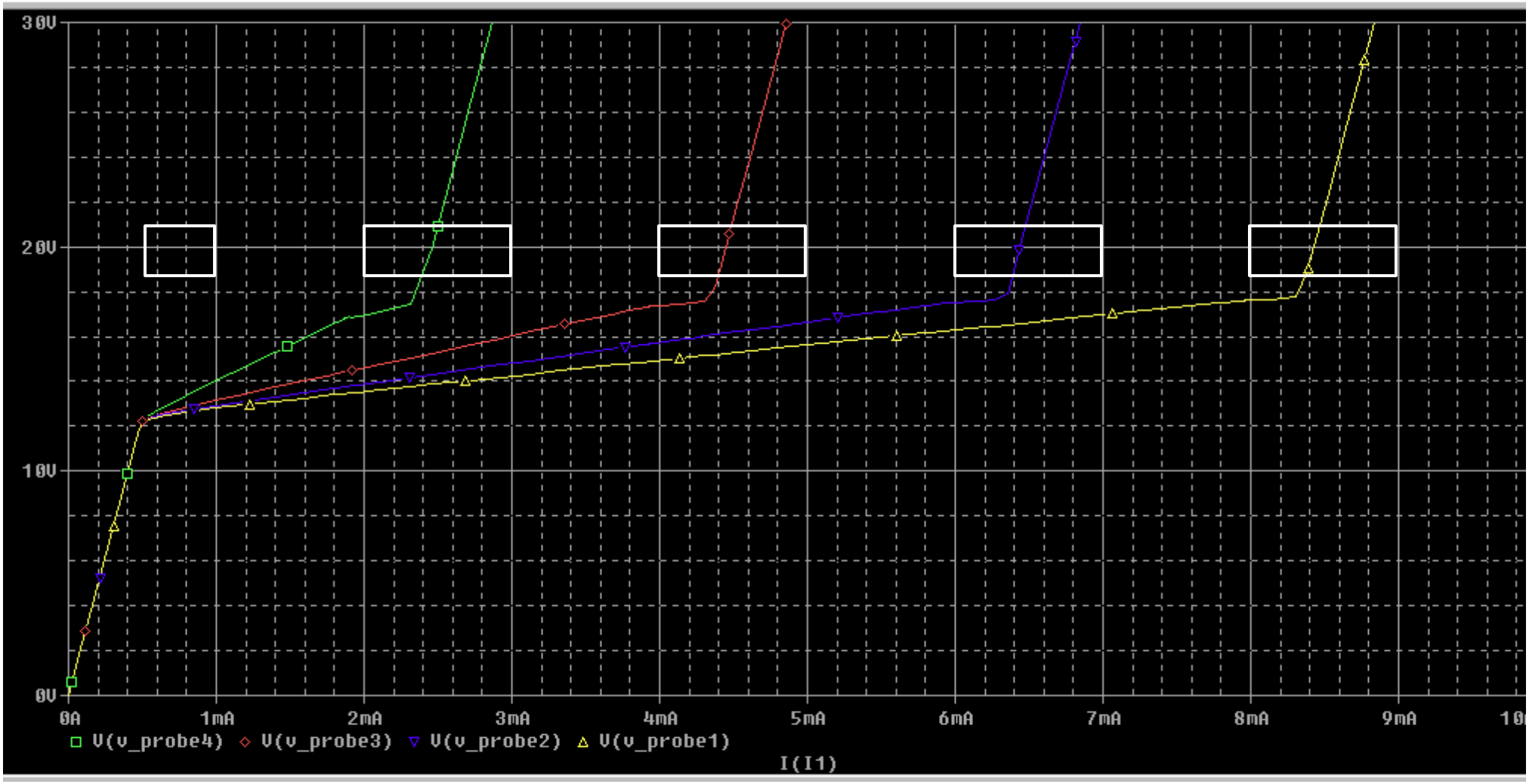




Here is an example circuit from Peter at Micrel. It has similar behavior.
R9 and R10 must have the same value:

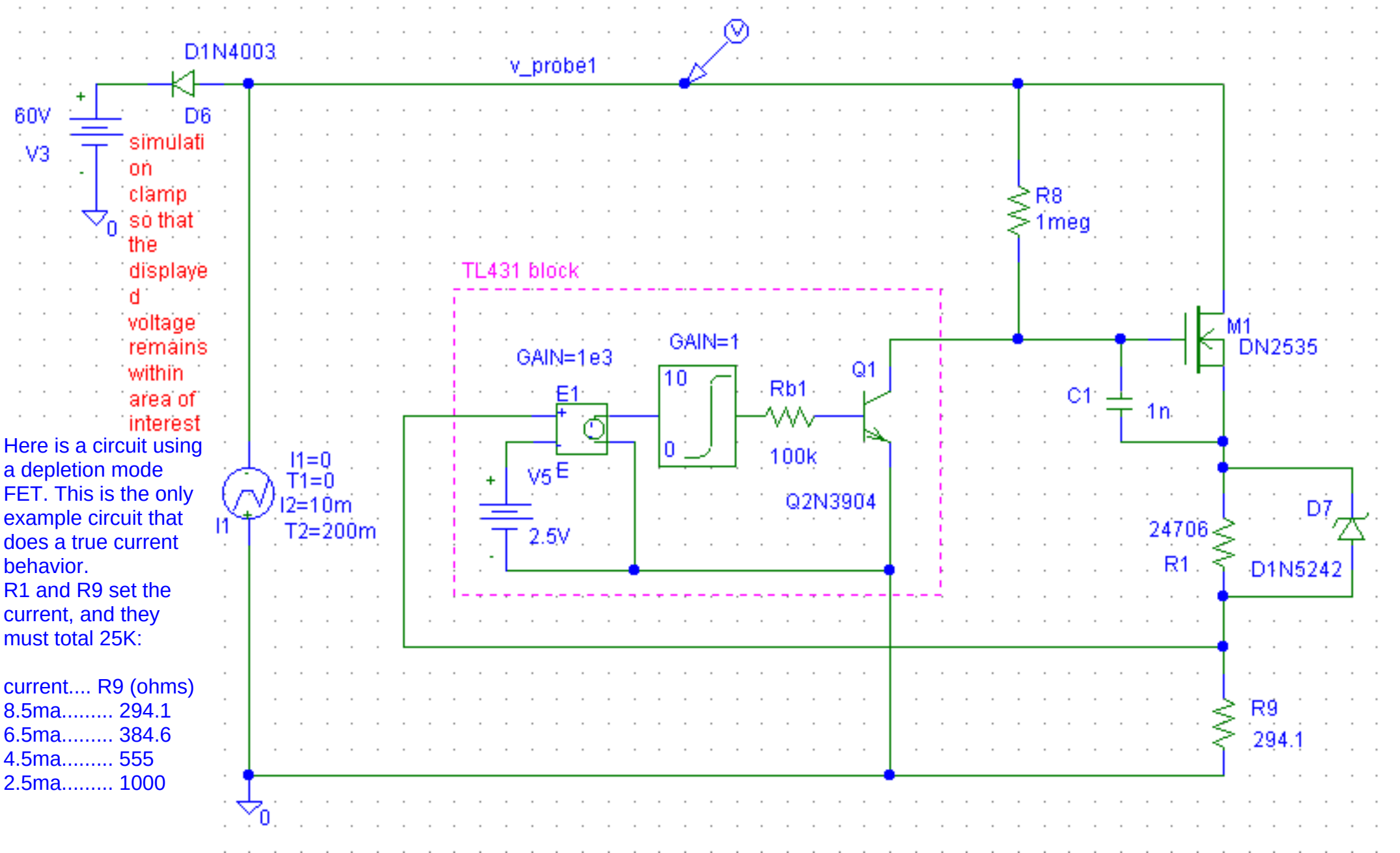
8.5ma..... 347 ohms
6.5ma..... 481 ohms
4.5ma..... 782 ohms
2.5ma..... 2.09K

Here are the simulated results in Pspice of Peter's circuit



Example Circuit using a constant current with a depletion mode FET

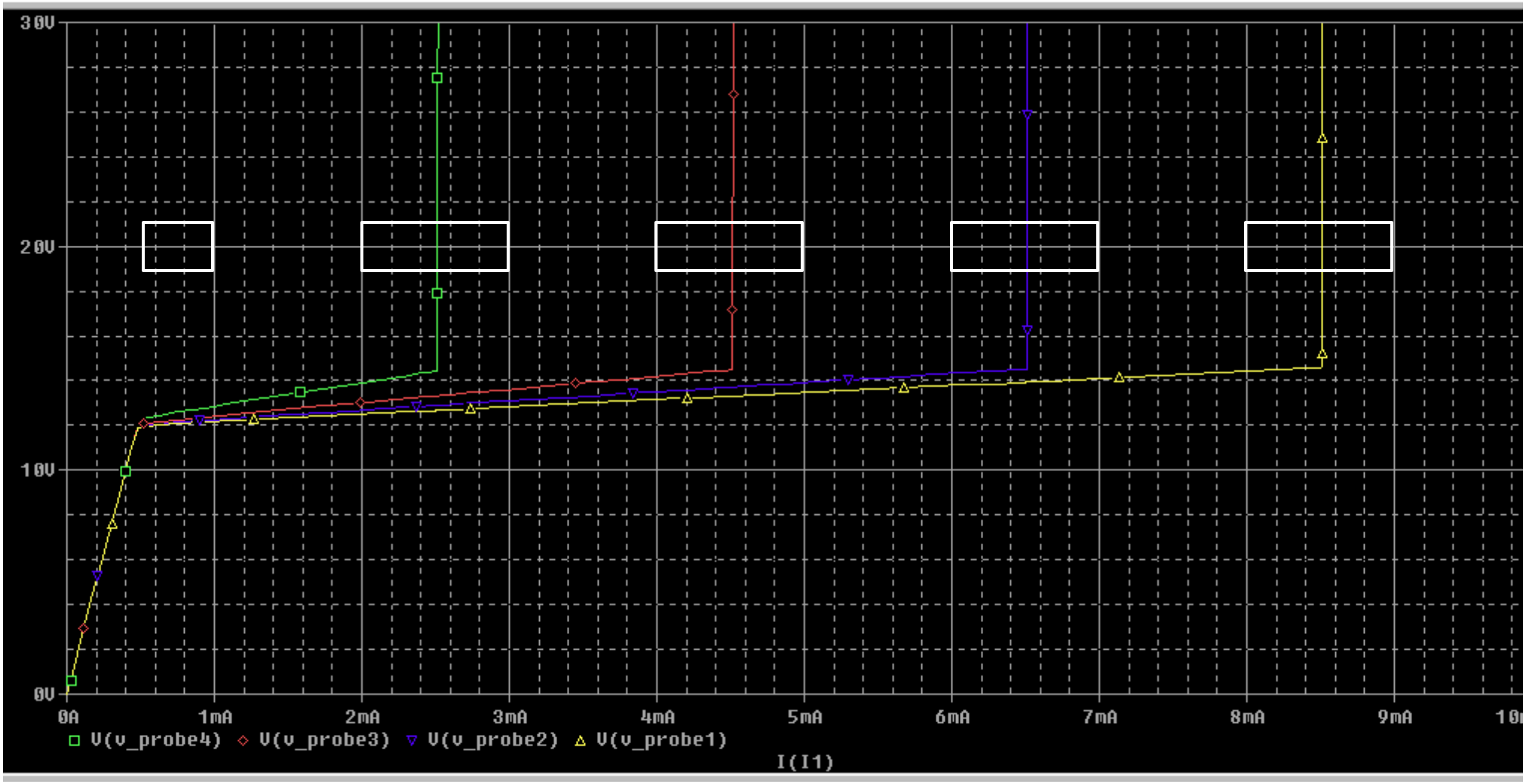
Note that the circuit that may be required to turn off the classification above 30VDC is not considered here



Here is a circuit using a depletion mode FET. This is the only example circuit that does a true current behavior.
R1 and R9 set the current, and they must total 25K:

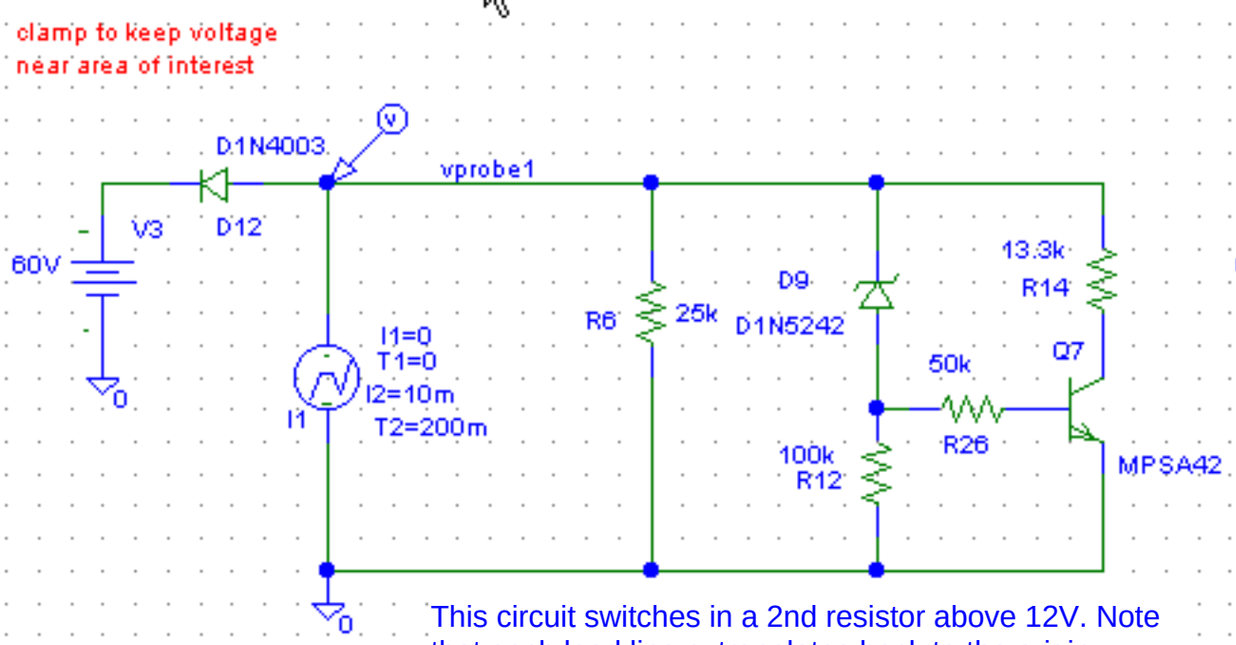
current.... R9 (ohms)
8.5ma..... 294.1
6.5ma..... 384.6
4.5ma..... 555
2.5ma..... 1000

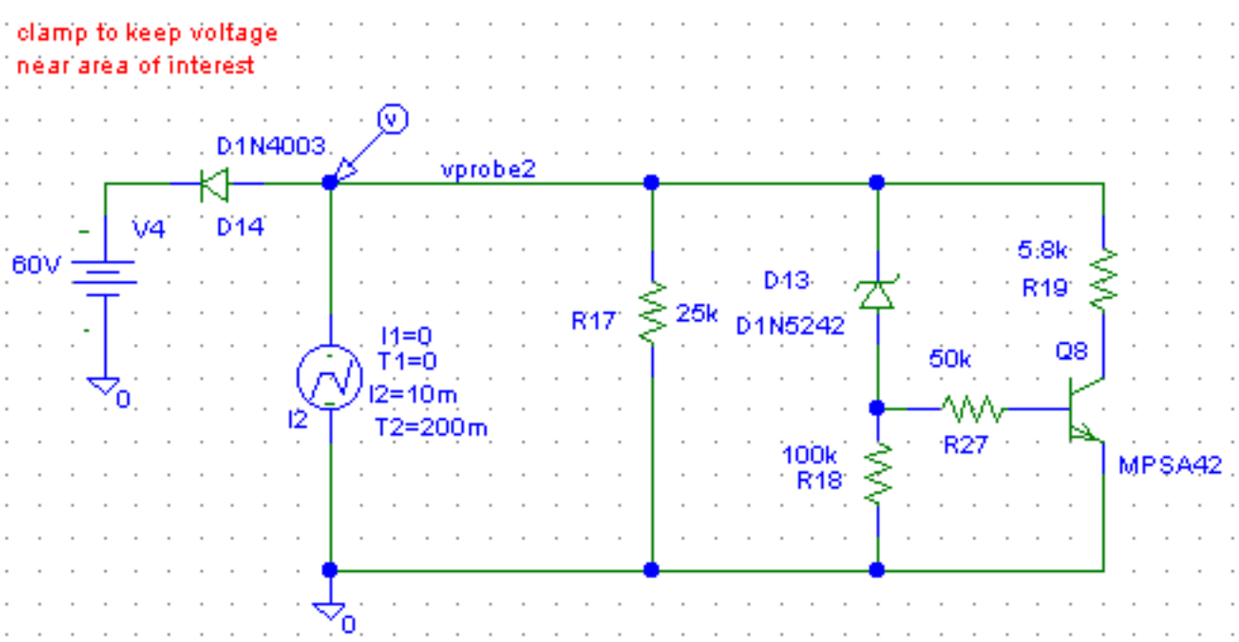
Here are the simulated results in Pspice of the depletion mode FET circuit



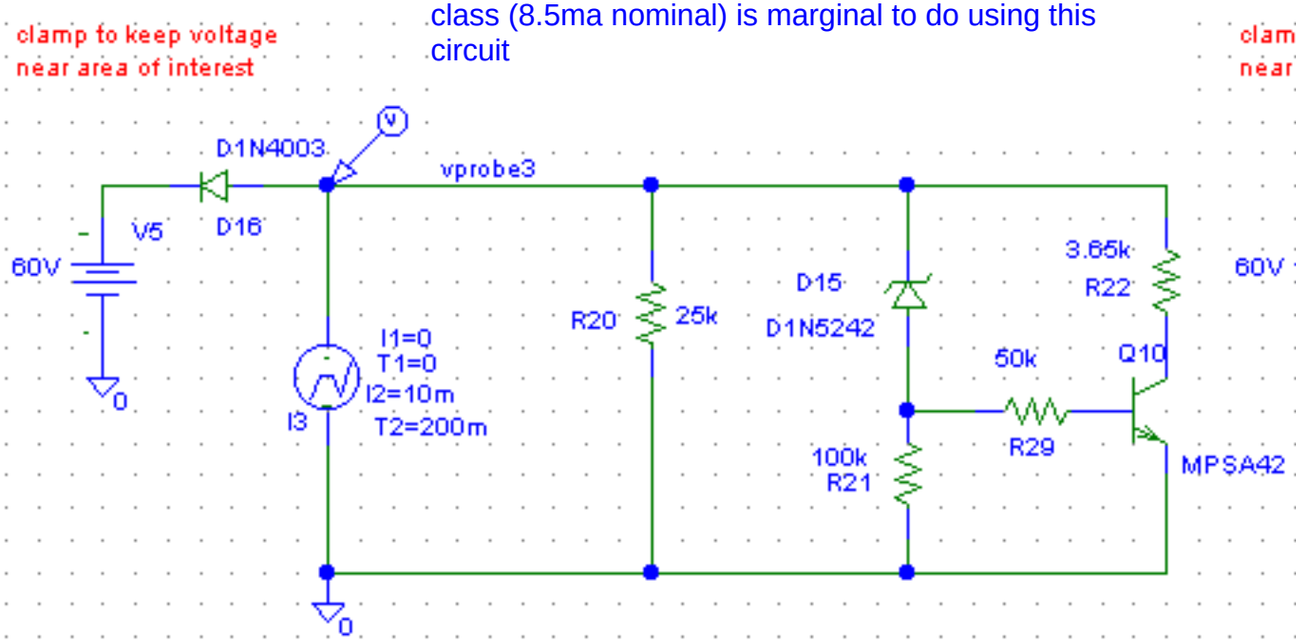
Example Circuit using a switched in resistor

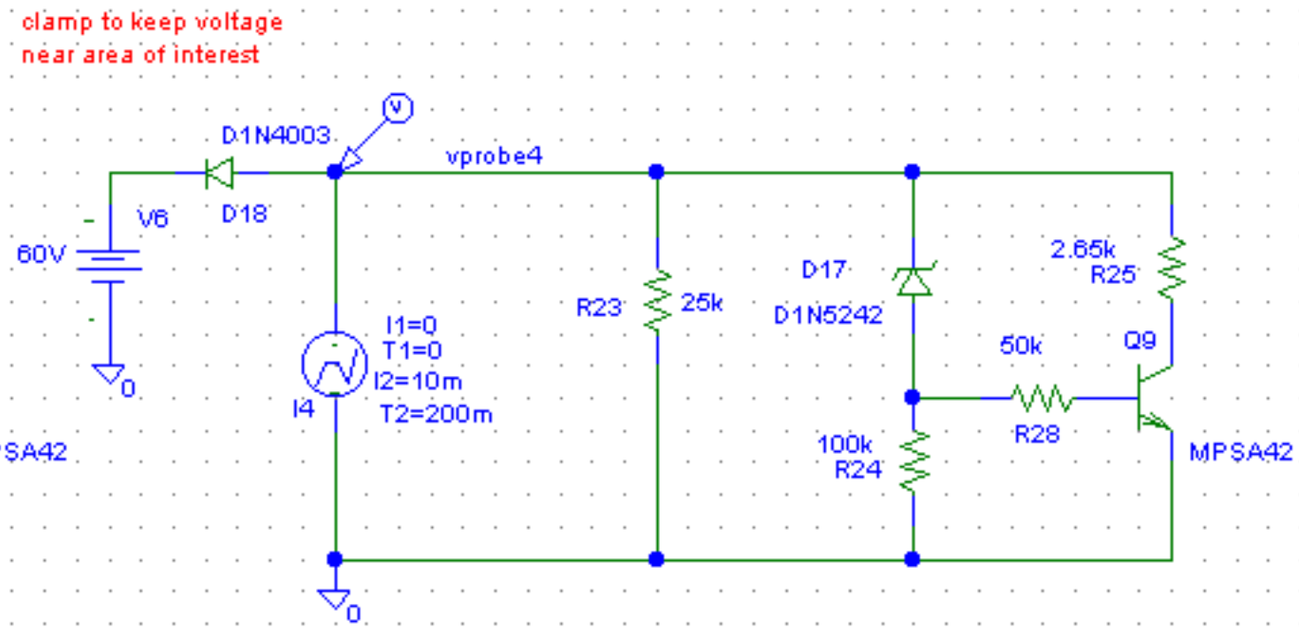
Note that the circuit that may be required to turn off the classification above 30VDC is not considered here



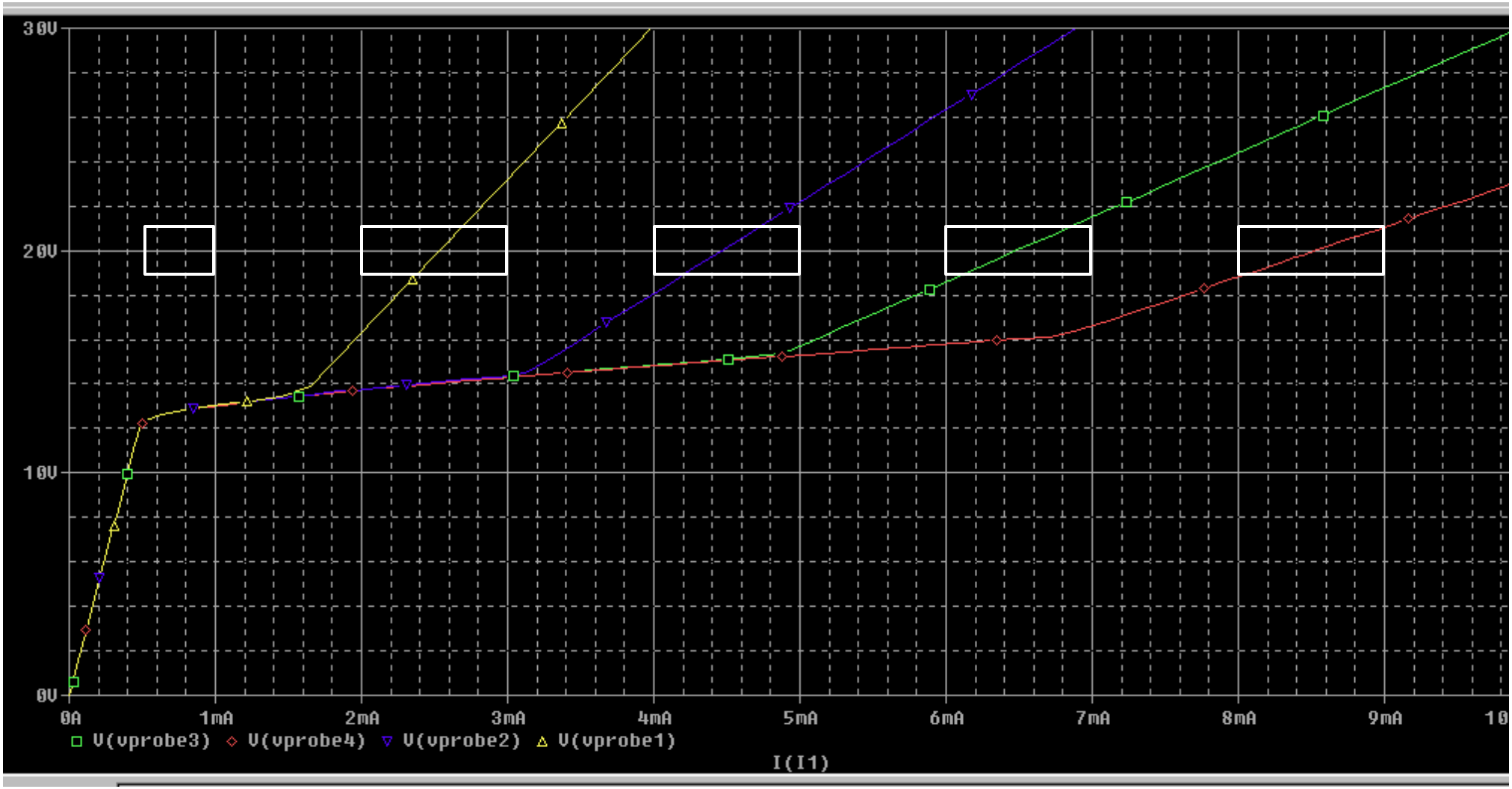


This circuit switches in a 2nd resistor above 12V. Note that each load line extrapolates back to the origin. This circuit can do the first 3 classes, but the last class (8.5ma nominal) is marginal to do using this circuit



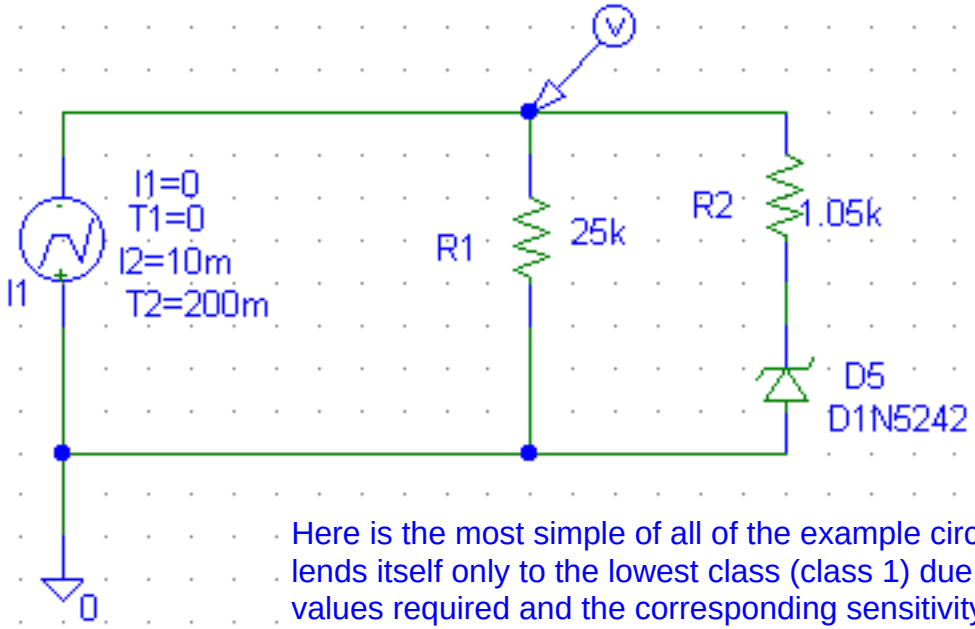


Here are the simulated results in Pspice of the switched in resistor circuit

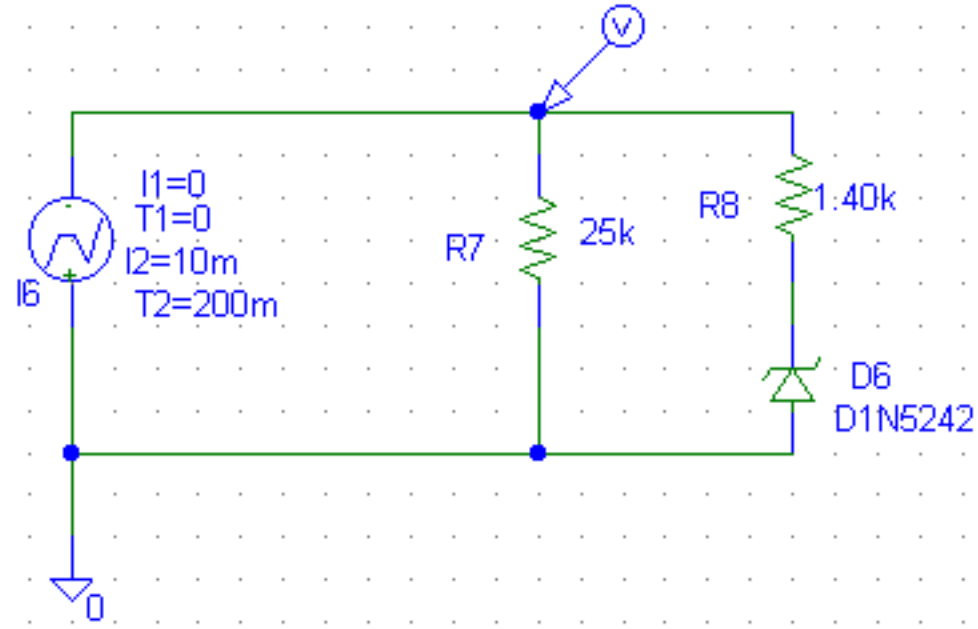


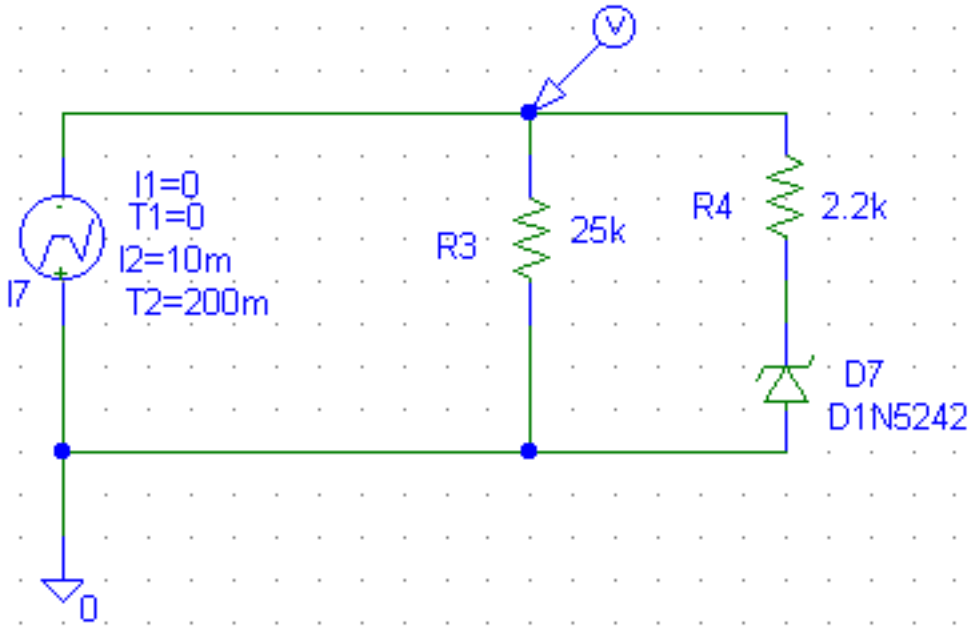
Example Circuit using a zener and resistor

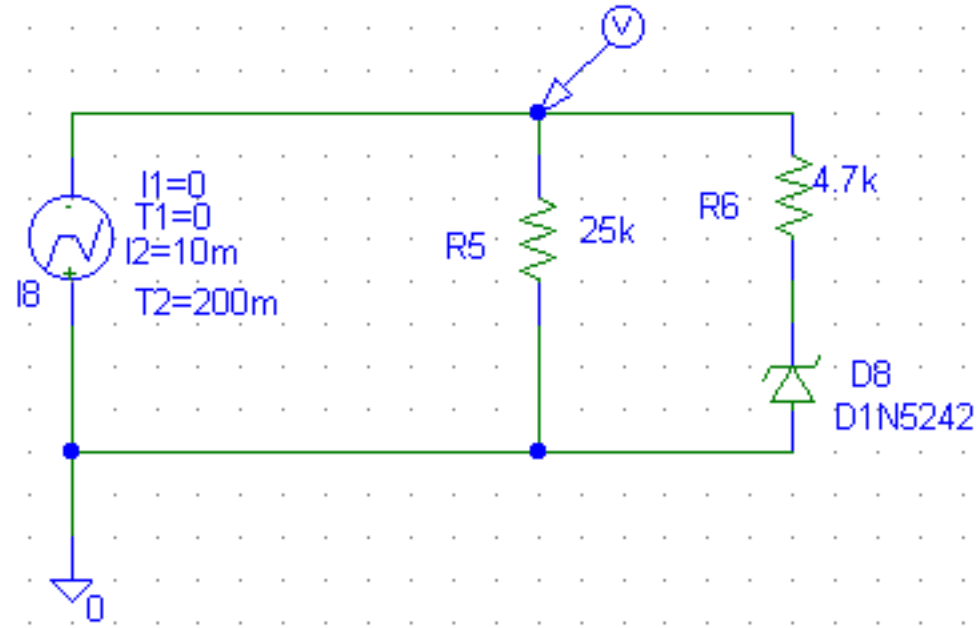
Note that the circuit that may be required to turn off the classification above 30VDC is not considered here



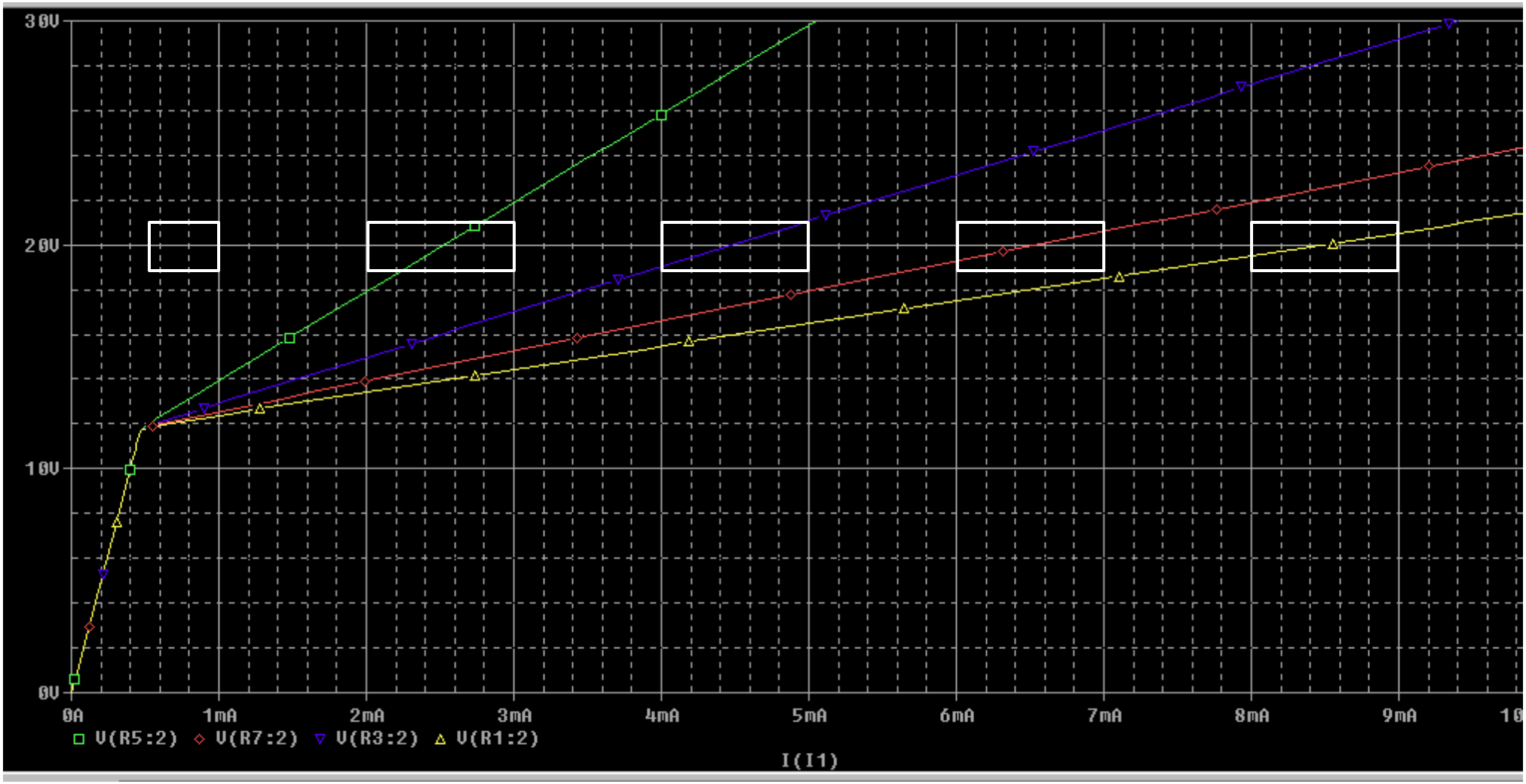
Here is the most simple of all of the example circuits. This circuit lends itself only to the lowest class (class 1) due the low resistor values required and the corresponding sensitivity to the resistance value







Here are the simulated results in Pspice of the zener, resistor circuit
Note that only the first class (class 1) can be met using this circuit



Conclusions for a Simple PD Classification

- This behavioral method can be implemented in a number of ways
- The PSE can use a stepped constant current and measure the corresponding voltage. Or the PSE can use a constant voltage and measure the current.
- The spec for the PD is to hit within the defined box
- Simple zener and resistor circuits can work for class 1
- One transistor, one zener circuits can work for class 1, 2 and 3
- Two transistor, one zener circuits can do all classes
- Integrated solutions can do all classes