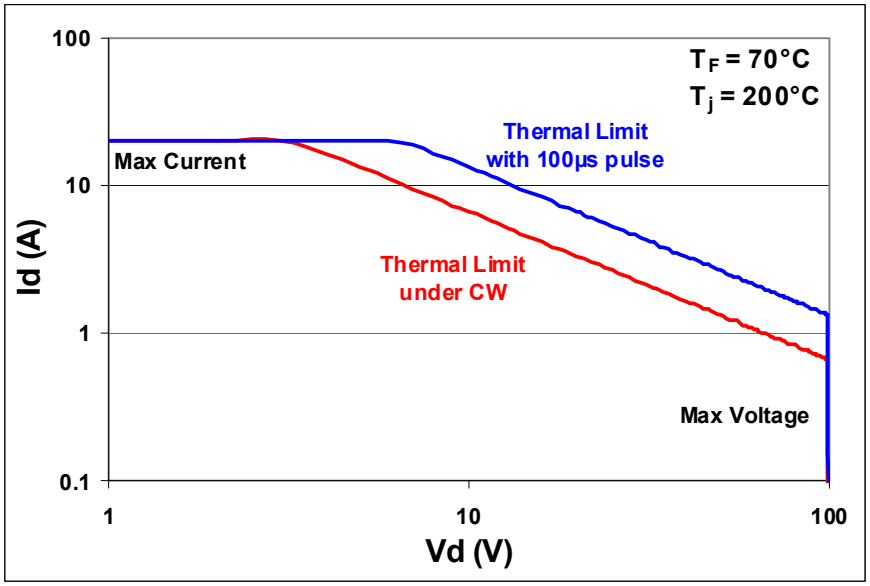
NPT35050 Safe Operating Area (SOA)

The safe operating area of a transistor gives the user some guidelines on where it is safe to bias the transistor. The graph in Figure 1 shows the NPT35050 SOA and is defined by three regions. The first region is the "Maximum Current" limit and is determined by the I_{DMAX} of the device, which is 19.5A. This region is only applicable at low V_{DS}. The second region is the "Thermal Limit" and is a line of negative slope. Any bias above this line will cause the transistor to overheat and is not considered a safe operating region. To accurately draw the thermal limit requires some assumptions. First of all the thermal resistance is needed, which is listed as 1.95°C/W. Next comes the maximum rated junction temperature, T_J, which is 200°C. Finally an assumption on the flange temperature, T_F, in this example 70°C. From this we can calculated the maximum allowed power dissipated as:

$$P_{D,MAX} = \frac{(T_J - T_F)}{R_{TH}} \rightarrow \frac{(200 - 70)}{1.95} \rightarrow 67W$$

Using this maximum power dissipated the maximum allowable current for a given V_{DS} can be calculated. The thermal limit mentioned above is applicable under CW operation, however in cases of pulsed operation the limit can be increased. For instance transient thermal simulations have shown the thermal time constant to be ~350µs, meaning



SOA graph for NPT35050 device.

the device doesn't fully heat during short pulses. A specific example is that of a transistor operating with 100µs pulse width and 1% duty cycle. Under this mode of operation simulations show the peak T_J is only 50% of the CW peak. This allows the maximum power dissipated to be increased to 133W and results the corresponding shift in the graph. The third region of the graph is the "maximum voltage" limit, which is determined by the breakdown voltage of the device. For the NPT35050 this limit is 100V.