RCD Clamp Design

- Step 1: Select maximum voltage, Vmax that we are going to allow on our FET
  - The higher this voltage the lower the losses in the snubber, we would like the maximum spike possible without damaging the FET
    - Typically 66% of the FET's maximum allowable voltage or 85% of FETs maximum allowable voltage minus 20V to allow for overshoot is a good compromise
    - As an alternative you can calculate exactly how much power loss you are willing to tolerate in the clamp and make sure and then reverse calculate the maximum clamp voltage
      - Please see Basso's book for exact equations
- Step 2: Calculate Vclamp
  - From previous slides: Vclamp = Vmax - Vin
- Step 3: Calculate Rclamp from this*:

From Step 2

Vout reflected to input

From WDS

$$R_{clamp} = \frac{2\,V_{clamp}\left(V_{clamp} - N\,V_{out}\right)}{F_s\;L_{leakage}\;I_{peak}^2}$$

From our transformer measurement test

* See Basso "Switch-Mode Power Supplies Spice Simulations and Practical Designs" for full proofs of equations

RCD Clamp Design

- Step 4: Calculate Cclamp
  - Unlike the RC snubber, the value of RCD capacitor does not impact the losses
  - Its value therefore is not crucial; it just needs to be large enough such that voltage remains constant during the snubber operation
  - It is essentially an RC circuit so a good compromise would be to allow 2.5 to 5 time constants*:

$$C_{clamp} = \frac{5}{R_{clamp} F_s}$$

  - Step 5: Calculate total power loss in the snubber*

$$P_{loss\_clamp} = \frac{1}{2} L_{leakage} I_{peak}^2 F_s \left(\frac{V_{clamp}}{V_{clamp} - N V_{out}} \right)$$

- If power loss is too much then you need to increase the clamping voltage which could mean buying a bigger FET

* See Basso "Switch-Mode Power Supplies Spice Simulations and Practical Designs" for full proofs of equations