IEEE P802.3at Task Force
Power Via MDI Enhancements

Midspan 100BT ALT A TX output signal template
Addressing Draft D3.2 comment #76

Yair Darshan / Microsemi Corporation,
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Comment #76

- *Comment #76*
- We are doing the same mistake we did in the past in which the 350uH adhoc was formed to resolve by allowing the droop method (implementation independent) as alternative to the OCL (specific implementation). In order to achieve 350uH (or its equivalent droop numbers) operation when Type 2 100BT ALT A Midspan is connected we forced implementation (regulating Iunb to Type 1 levels) instead of specifying the Midspan output TX signal requirements so legacy receivers in the Switch will work.
- *SuggestedRemedy*
- Set the Midspan ad hoc to discuss it and propose a solution. See attached file "Midspan 100BT ALT A TX output signal template" with possible alternative.

Objectives

- To find implementation independent method for Type 2 100BT Midspan ALT A Midspan to output TX 350uH signal performance when it is fed by 120uH signal transmitter.
- It will be an alternative for requiring Type 2 100BT Midspan ALT A Midspan to regulate Iunb to Type 1 levels

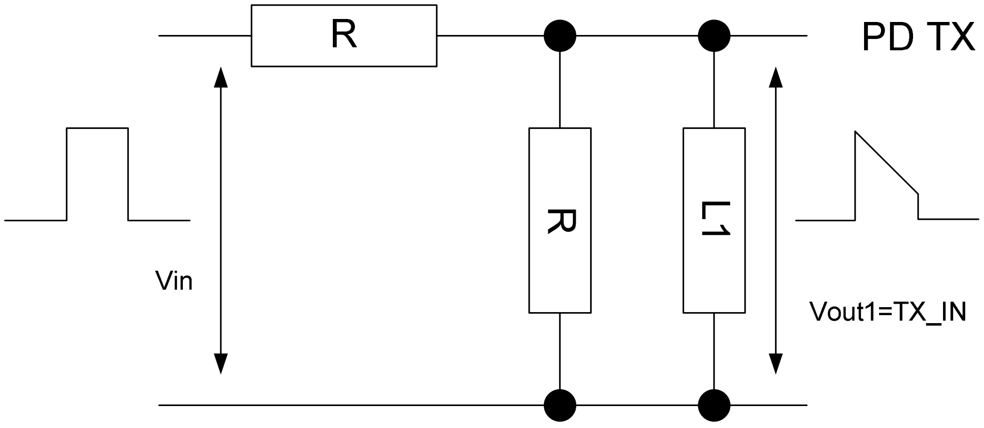
Background

- In September 2008 meeting we have decided to require Type 2 100BT ALT A Midspan to regulate Iunb to Type 1 levels
  - This requirement allow connecting the Midspan to channel when PD is using 120uH minimum.
  - Switch has no PD load current hence its OCL is 350uH minimum.
- Regulating current is one of the possible implementation. We should not force implementation, we need implementation independent definition as we did in the 350uH ad hoc, Transformer and channel ad hoc and Midspan ad hoc.
- In addition the decision made in September 2008 was based on rebalancer data that shows less than 1 ohms balancing resistor on one of the wires due to the assumption that the user will measure the wires in the pair and will know where to locate the missing difference balance resistor. Due to the fact that the final decision was to locate the rebalancer in the Midspan, the Midspan can not "measure" who is Rmin or Rmax. As a result the balance resistor need to be on each wire and values get to ~8 ohms which infringe most of the system parameters (Voltage, current, signal performance etc). IEEE802.3AF Acknowledge this problem and move this kind of solution to the informative Annex and never mandate it. There are some hardware solutions however they are not cost effective.

Proposed Strategy

- Midspan gets a signal from PD TX with a droop generated by 120uH equivalent OCL.
- Midspan output a signal with a droop equivalent to 350uH OCL.
- This approach defines new Midspan ALT A Transfer Function which will replace Eq 33-18 when this alternative will be used
  - We can not use the droop method based on transmitting data packets since Midspan has no access to data. It is easier for Midspan to use frequency domain template i.e. Transfer Function approach.

Proposed Strategy

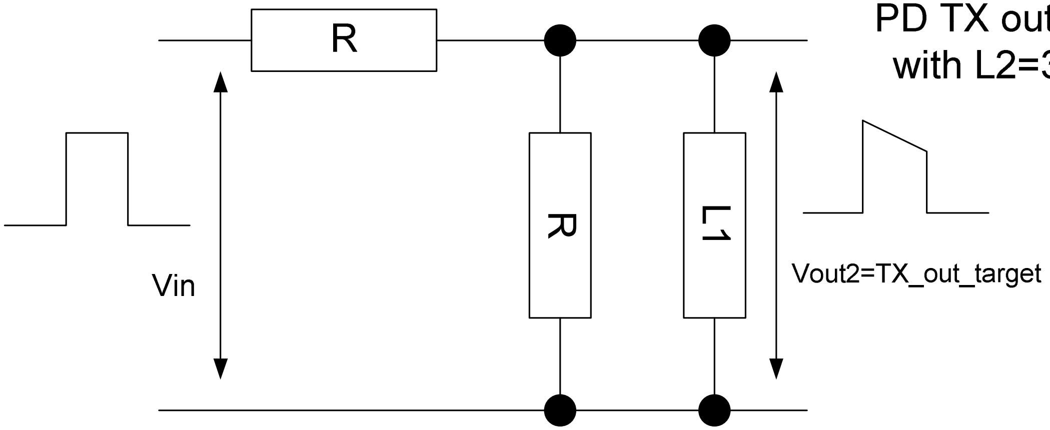


PD TX output with L1=120uH

$$Vout\_1(t) = 0.5 \cdot Vin(t) \cdot \exp^{\frac{-0.5 \cdot R \cdot t}{L1}}$$

$$L1 = 120 \cdot 10^{-6}$$

$$R = 100.0$$



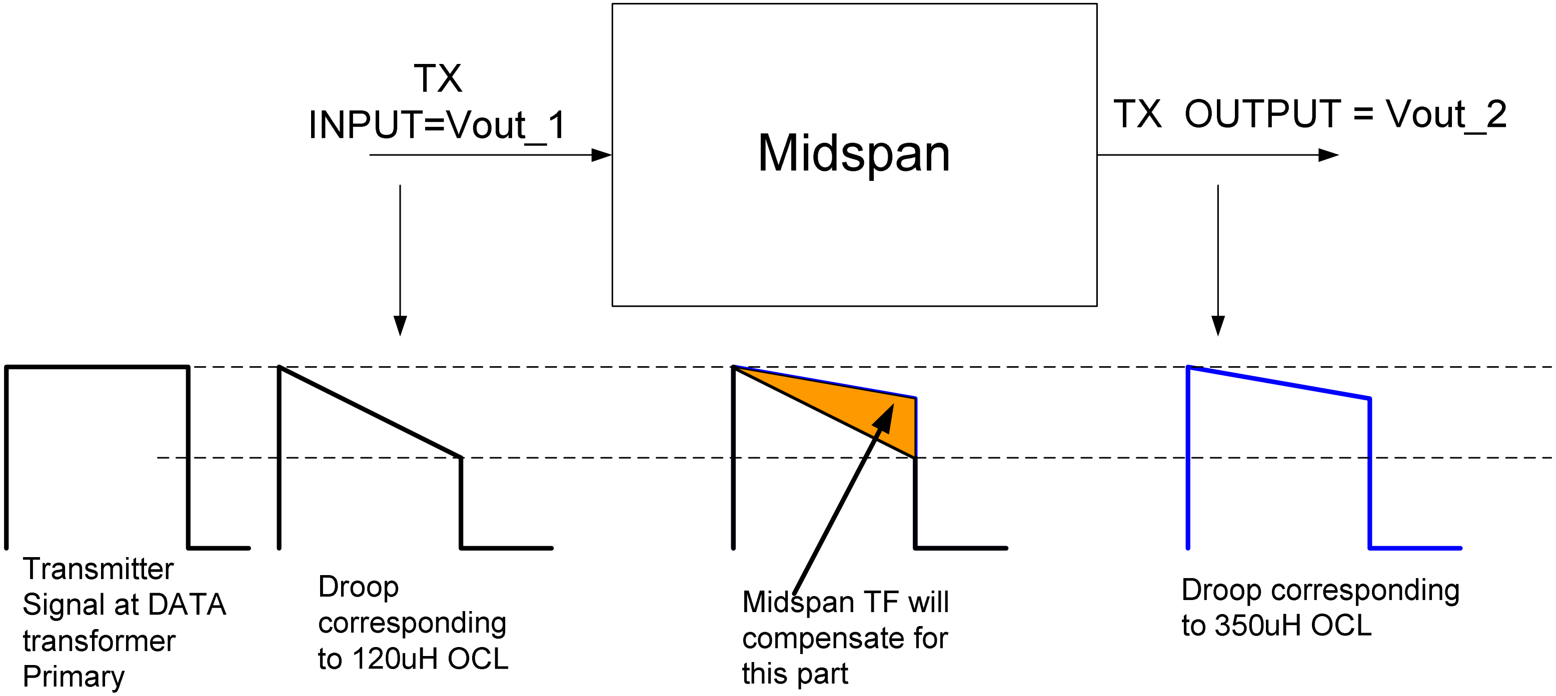
PD TX output from Midspan with L2=350uH behaviour

$$Vout\_2(t) = 0.5 \cdot Vin(t) \cdot \exp^{\frac{-0.5 \cdot R \cdot t}{L2}}$$

$$L2 = 350 \cdot 10^{-6}$$

$$R = 100.0$$

Proposed Strategy



Convert from Time Domain to Frequency Domain

$$Vout1 = Vin \cdot \frac{s \cdot L1}{2 \cdot s \cdot L1 + R}$$

$$Vout2 = Vin \cdot \frac{s \cdot L2}{2 \cdot s \cdot L2 + R}$$

$$Midspan\_TF = \frac{Vout2}{Vout1} = \frac{s + \frac{R}{2 \cdot L1}}{s + \frac{R}{2 \cdot L2}}$$

Transfer Function Derivation

$$Vout1 = Vin \cdot \frac{\frac{s \cdot L1}{s \cdot L1 + R}}{R + \frac{s \cdot L1}{s \cdot L1 + R}} = Vin \cdot \frac{s \cdot L1}{2 \cdot s \cdot L1 + R}$$

$$Vout2 = Vin \cdot \frac{\frac{s \cdot L2}{s \cdot L2 + R}}{R + \frac{s \cdot L2}{s \cdot L2 + R}} = Vin \cdot \frac{s \cdot L2}{2 \cdot s \cdot L2 + R}$$

$$Midspan\_TF = \frac{Vout2}{Vout1} = \frac{s + \frac{R}{2 \cdot L1}}{s + \frac{R}{2 \cdot L2}}$$

$$Worst\_Case\_Analysis\_TF = K1 \cdot \frac{K3 \cdot L2}{K2 \cdot L1} \cdot \frac{\frac{K2 \cdot L1}{R} s + 1}{\frac{K3 \cdot L2}{R} s + 1}$$

$$s = j \cdot 2 \cdot \pi \cdot f$$

$$K1 = 0.953$$

$$K2 = K3 = 2$$

$$0.1MHz \le f < 1MHz$$

$$Worst\_Case\_Analysis\_TF\_db =$$

$$20 \cdot \log\left(K1 \cdot \frac{K3 \cdot L2}{K2 \cdot L1}\right) + 20 \cdot \log \sqrt{\frac{\left(\frac{2 \cdot \pi \cdot K2 \cdot L1}{R}\right)^2 \cdot f^2 + 1}{\left(\frac{2 \cdot \pi \cdot K3 \cdot L2}{R}\right)^2 \cdot f^2 + 1}}$$

$$= c + 20.0 \cdot \log \sqrt{\frac{\left(a \cdot f^2 + 1\right)}{\left(b \cdot f^2 + 1\right)}}$$

$$a = 227.0$$

$$b = 1932.0$$

$$c = 8.880$$

$$0.1MHz \le f < 1MHz$$

See worst case analysis parameters in

http://www.ieee802.org/3/at/public/2008/05/darshan_2_0508.pdf

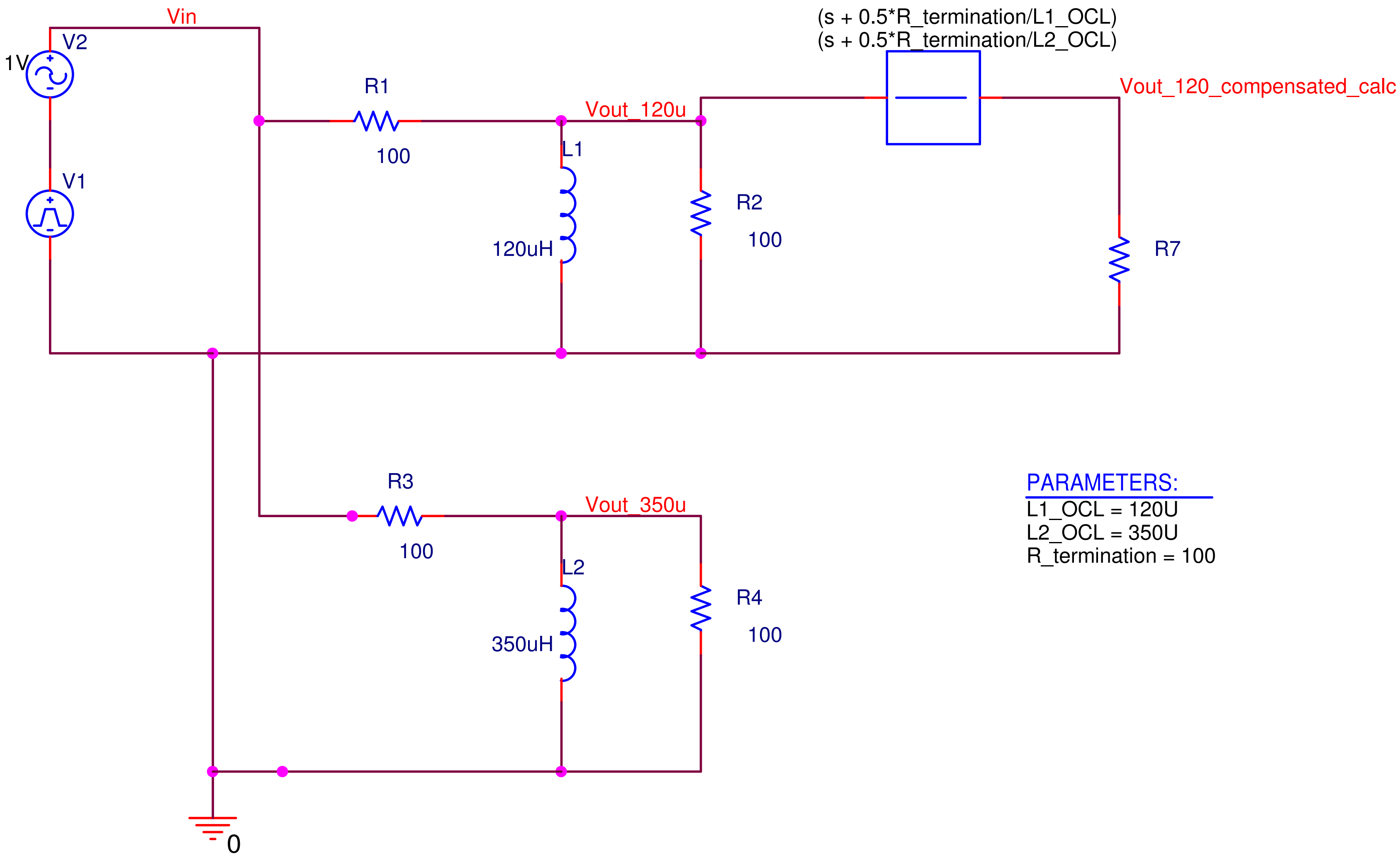
If 100BT ALT A Type 2 Midspan TF gain will be above Eq 33-18a

$$= 8.880 + 20.0 \cdot \log \sqrt{\frac{(227.0 \cdot f^2 + 1)}{(1932.0 \cdot f^2 + 1)}} \qquad \text{Eq 33-18a}$$

Than the Midspan TX output will behave as it had 350uH TX source which is our objective.

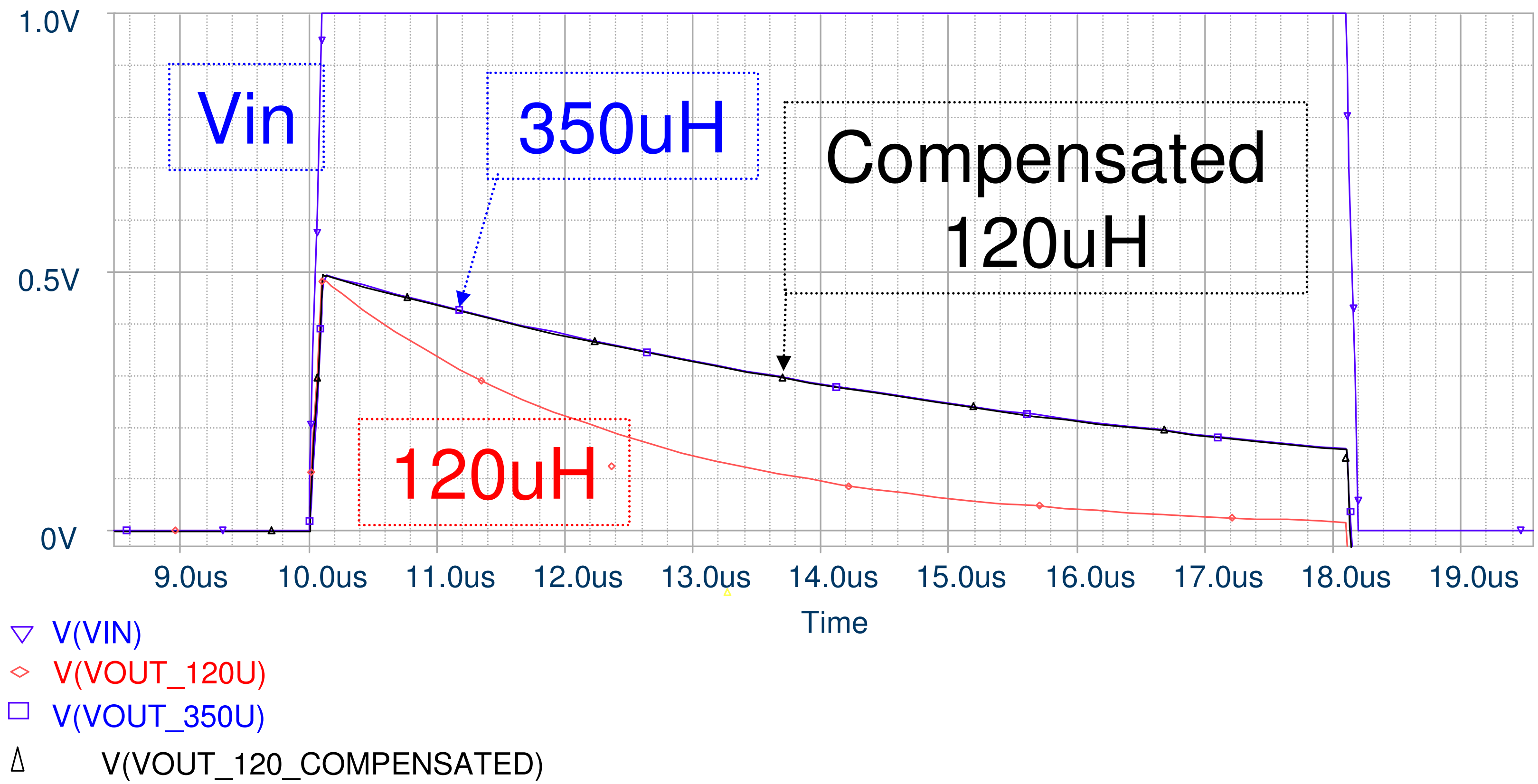
See next simulation results:
The 120uH TX signal source was connected to a Eq 33-18a.

Simulation Model



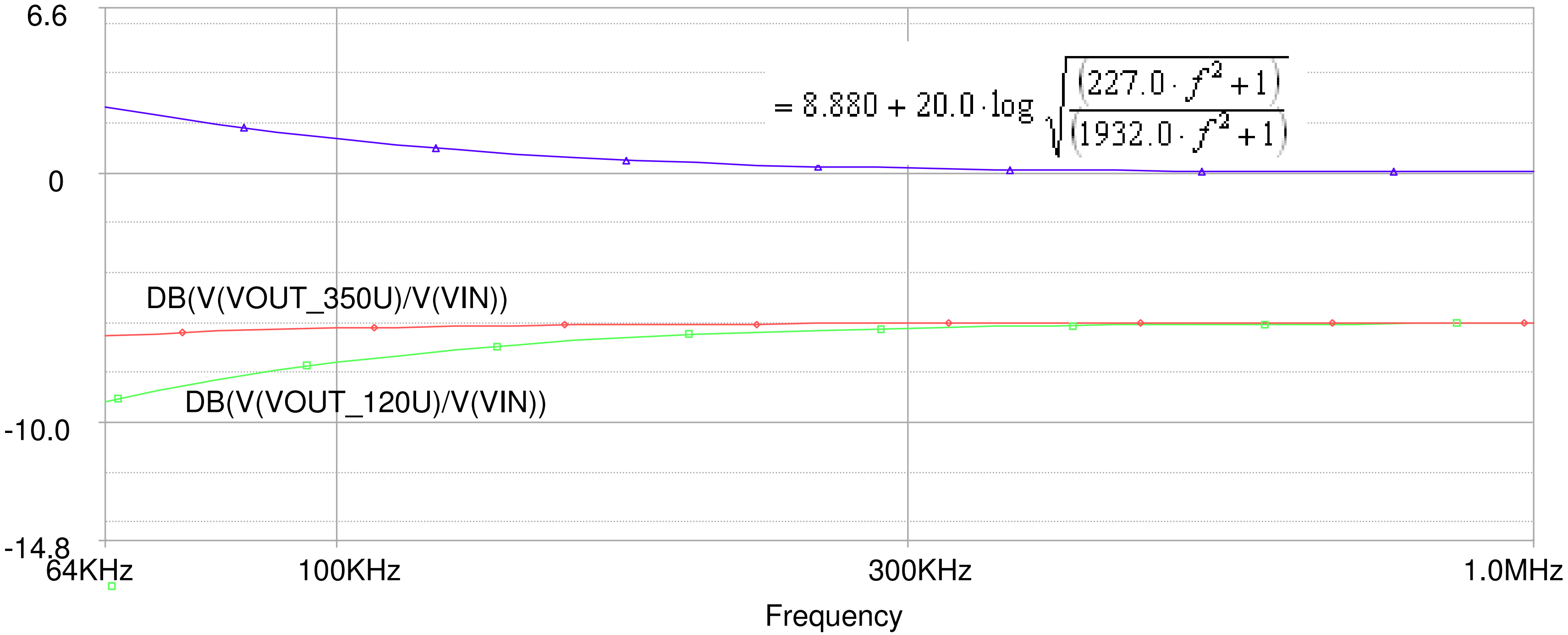
PARAMETERS:
L1_OCL = 120U
L2_OCL = 350U
R_termination = 100

Simulation Results



- Applying the TF to the 120uH signal source results with 350uH signal behavior

In the frequency domain we got the exact same results as it should be..



△ DB(V(VOUT_350U)/V(VIN)) -(DB(V(VOUT_120U)/V(VIN))) $= 8.880 + 20.0 \cdot \log \sqrt{\frac{(227.0 \cdot f^2 + 1)}{(1932.0 \cdot f^2 + 1)}}$

Summary

- Implementation Independent Alternative has been demonstarted
- We can:
  - – Regulate Midspan Current or
  - – Using and black box that meet the TF template gain
- See attached PDF file:

  "Suggested Remedy for comment #76.pdf" for detailed remedy for comment #76

Discussion