Current-Feedback Amplifiers – Part 3

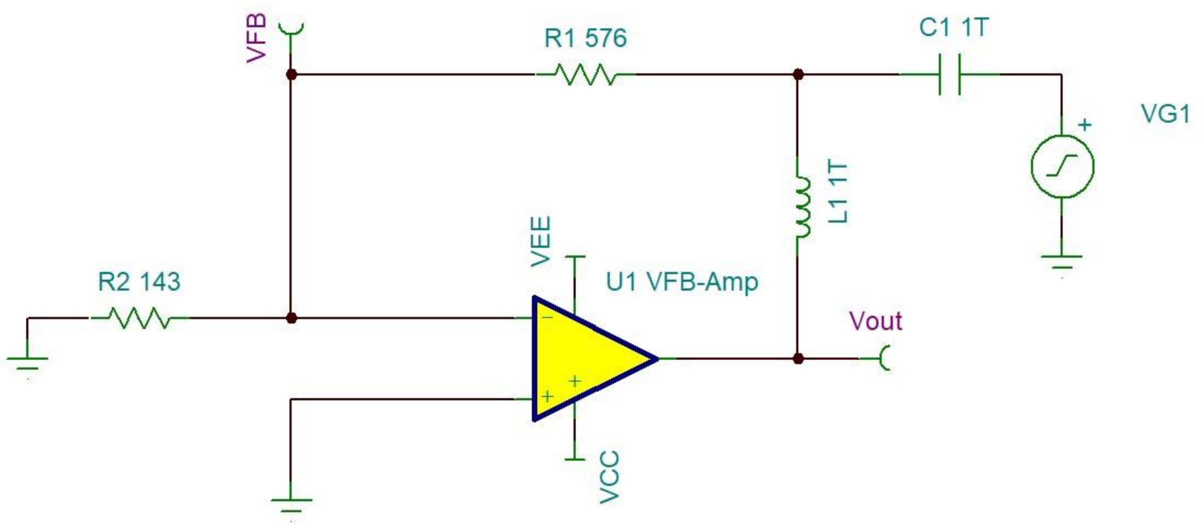
TI Precision Labs – Op Amps

Prepared and Presented by Hasan Babiker

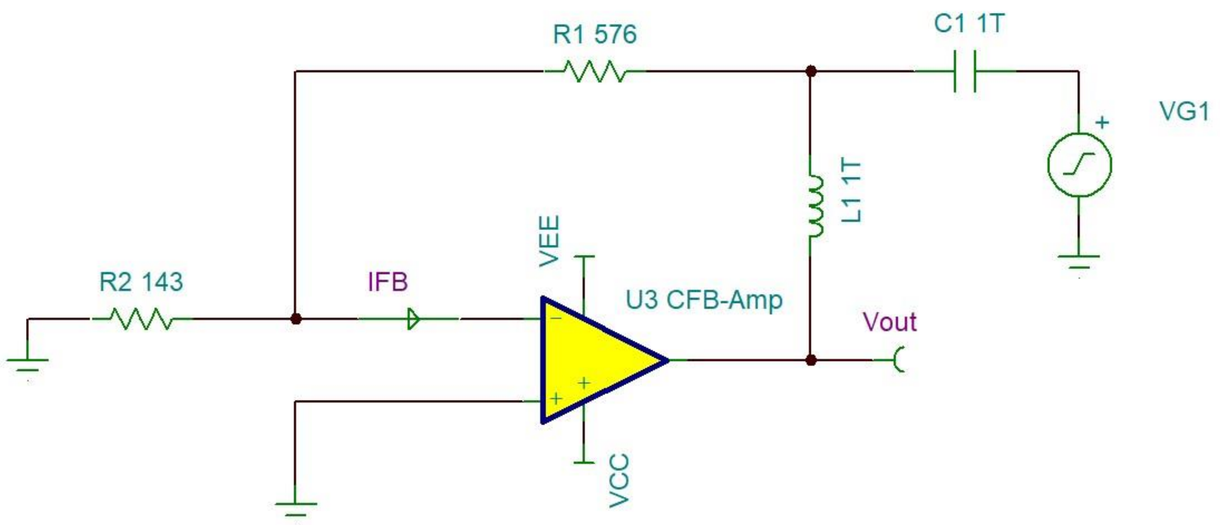
Voltage Feedback to Current Feedback Translation

Amplifier	β	$1/\beta$	A_{ol}/Z_{ol}	$Loop\ Gain$
Voltage Feedback	V_{FB}	$\frac{1}{V_{FB}} = NG$	$\frac{V_o}{V_{FB}}$	V_o
Current Feedback	I_{FB}	$\frac{1}{I_{FB}} = R_F + (R_i * NG)$	$\frac{V_o}{I_{FB}}$	V_o

Voltage Feedback

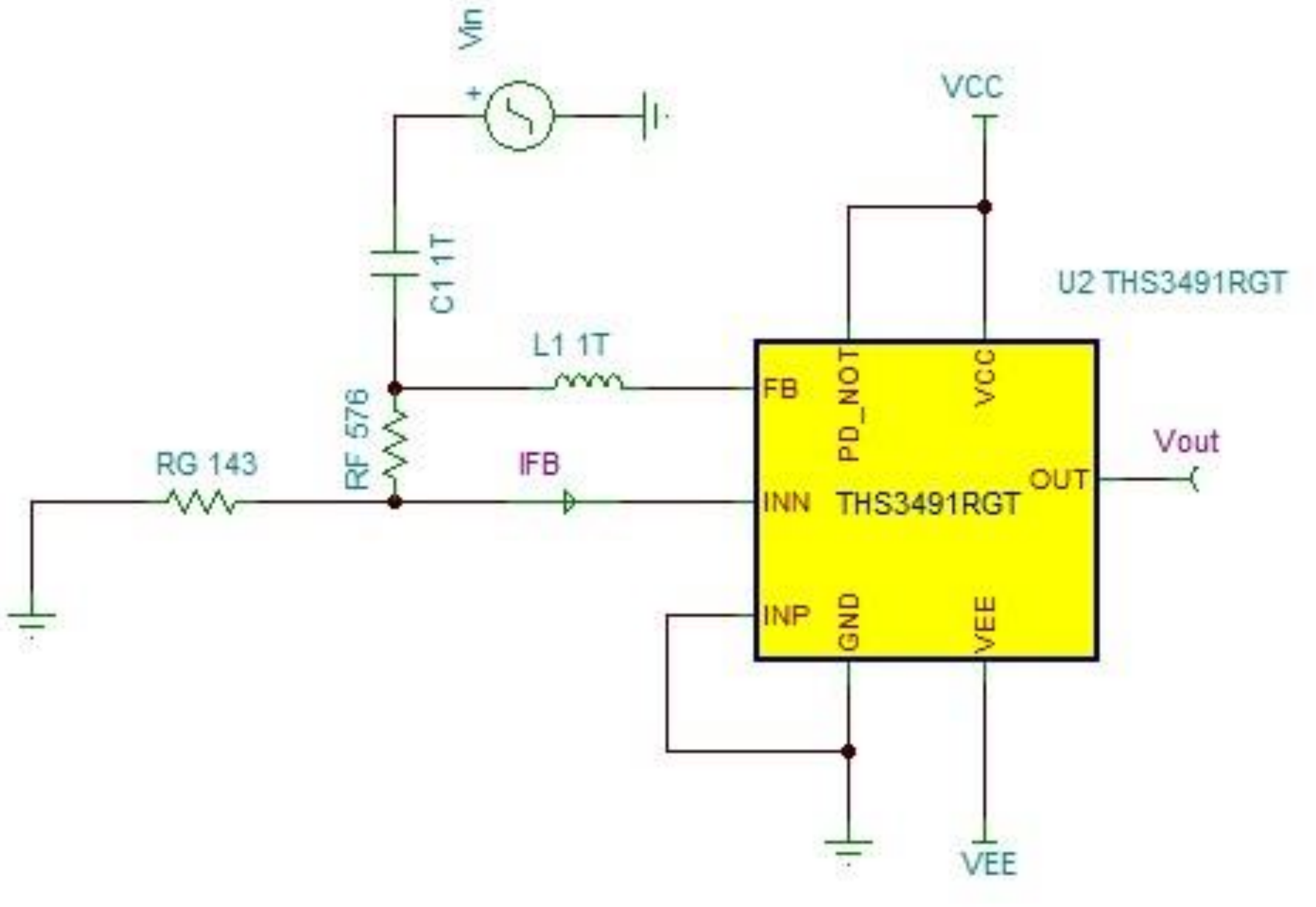


Current Feedback



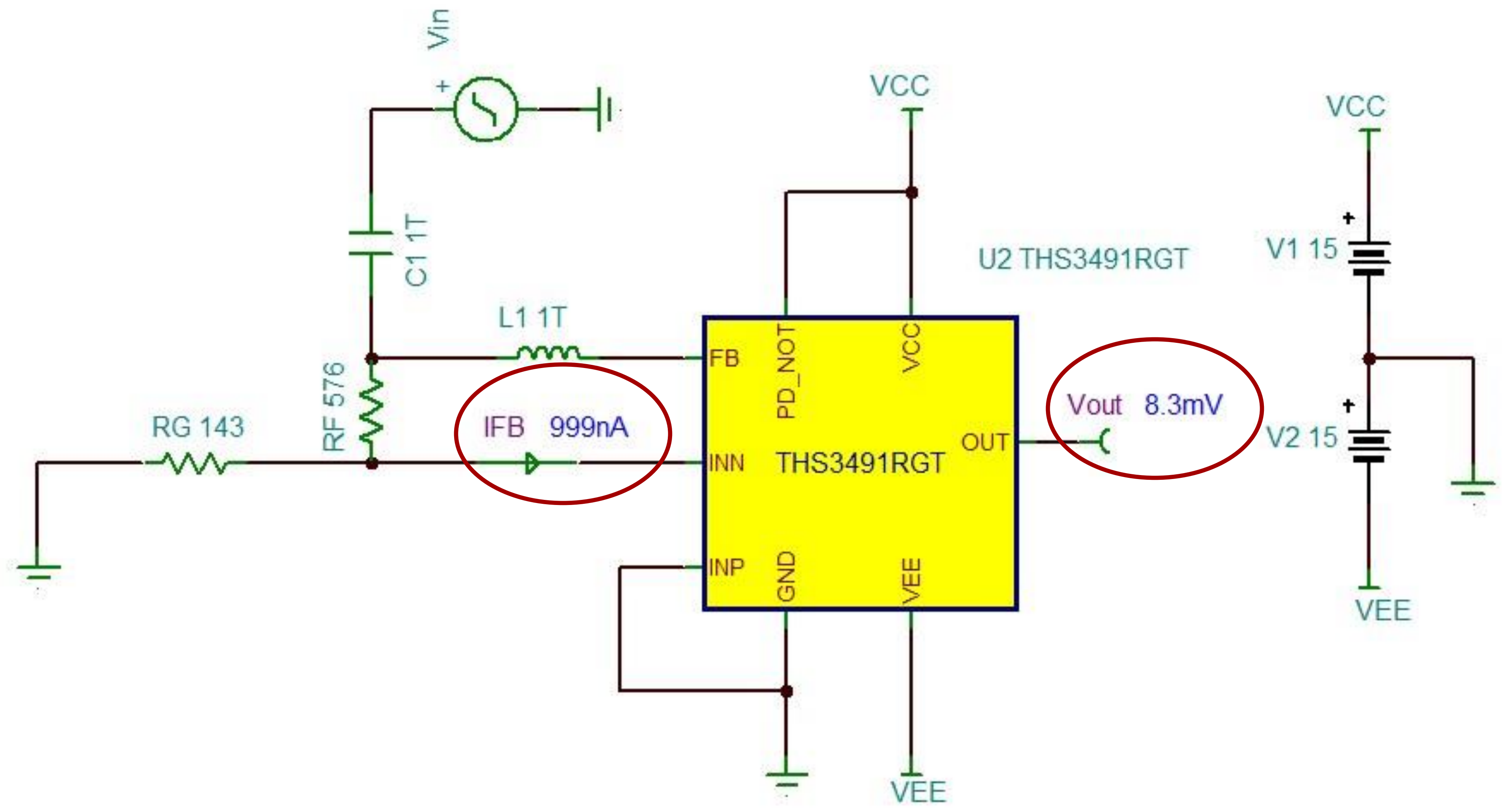
THS3491 Model

Pin	Description
INN	Inverting Input
INP	Non-Inverting Input
GND	Ground Connection
VCC	Positive Power Supply
VEE	Negative Power Supply
PD_NOT	Power-down
Out	Output
FB	Output



Check DC Operating Point

Click **Analysis → DC Analysis → Calculate Nodal Voltages**



Check DC Operating Point

Click **Analysis** → **DC Analysis** → **Calculate Nodal Voltages**

$$V_{os} * NG = V_{out}$$

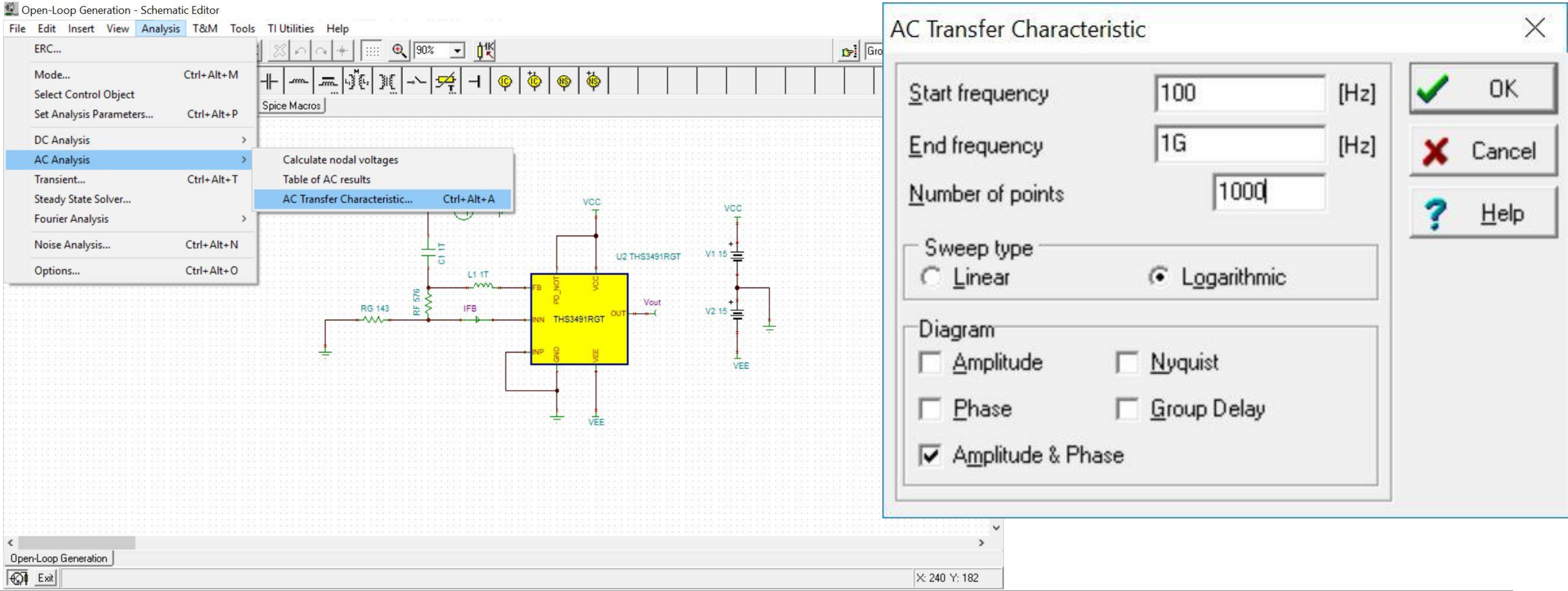
$$V_{os} = \frac{8.3\ mV}{5.028} \approx 1.65mV$$

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT	Test Level(1)
I_{B-}	Inverting input bias current(3)		–20	–7	20	µA	A
V_{OS}	Input offset voltage	DDA package only	–2	1	2	mV	A
		RGT package only	–2.5	1	2.5	mV	A

Generating Open-Loop Curves

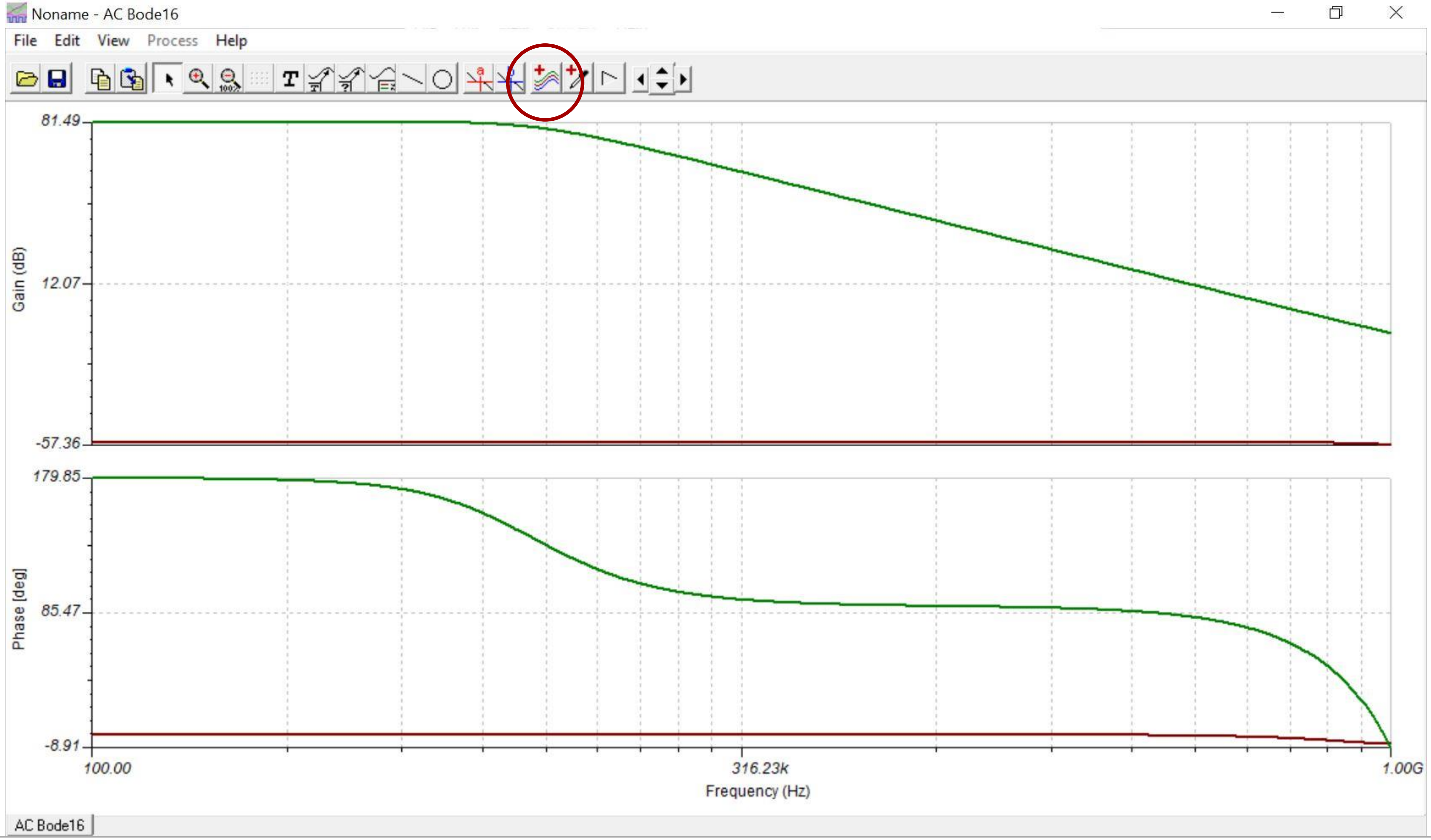
Run an AC transfer characteristic analysis over the appropriate frequency range:

Click **Analysis** → **AC Analysis** → AC Transfer Characteristic



Generating Open-Loop Curves

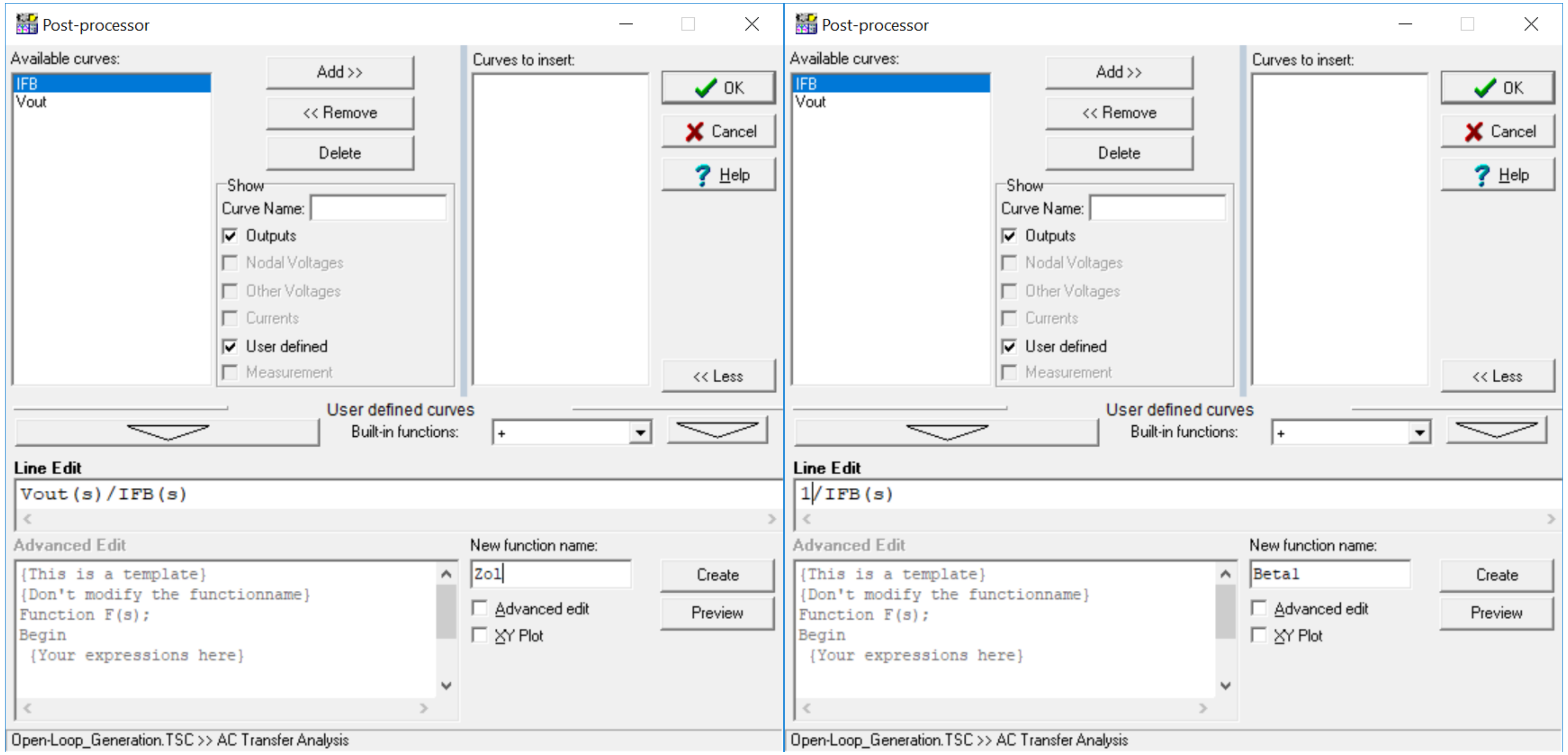
Click the “Post-Processor” button to add the desired curves



Generating Open-Loop Curves

Use “Post-Processor” and input equations of desired curves

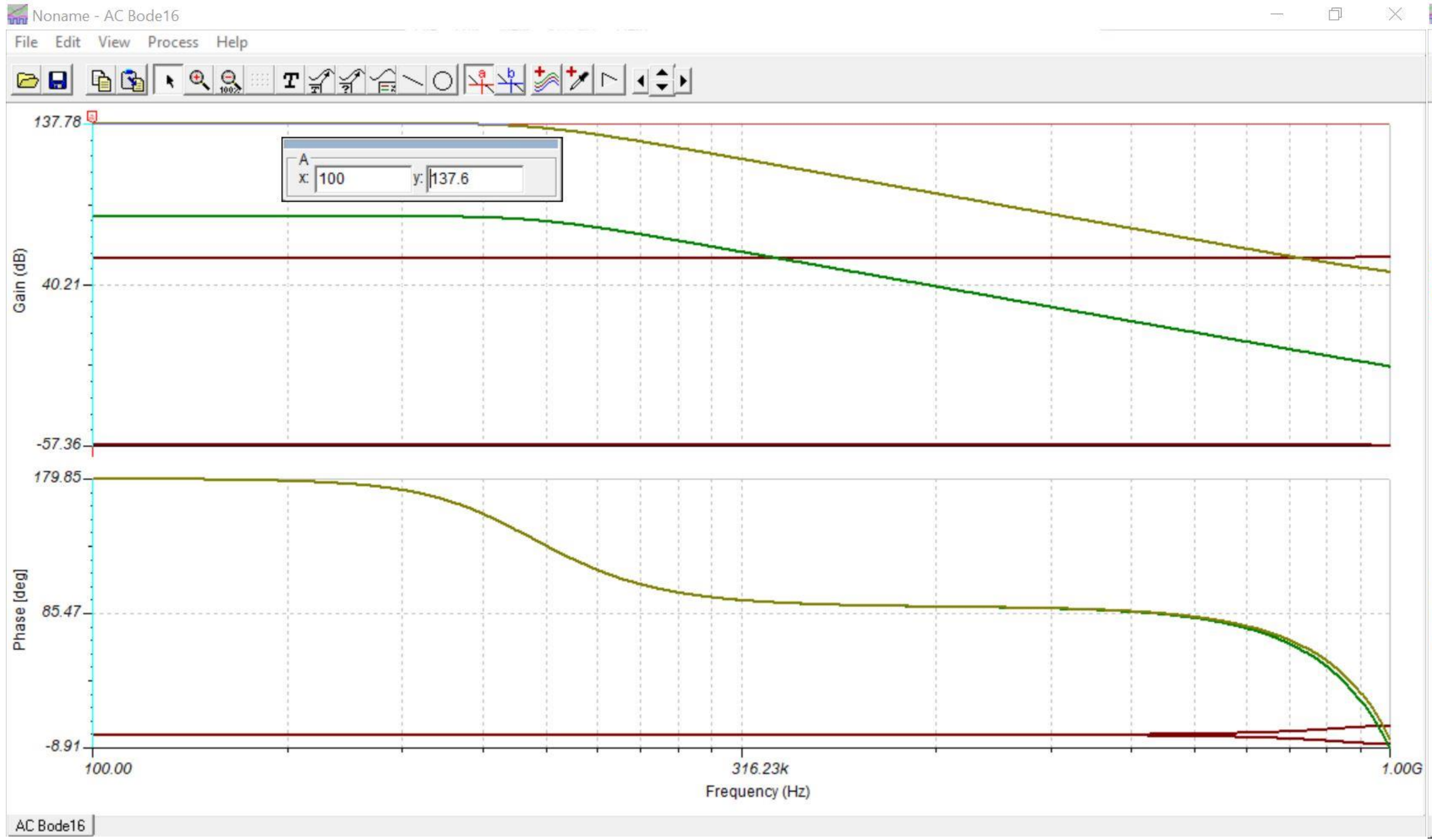
$$Z_{ol} = V_{out}/I_{FB}$$
$$1/\beta = 1/I_{FB}$$
$$Z_{ol}\beta = V_{out}$$



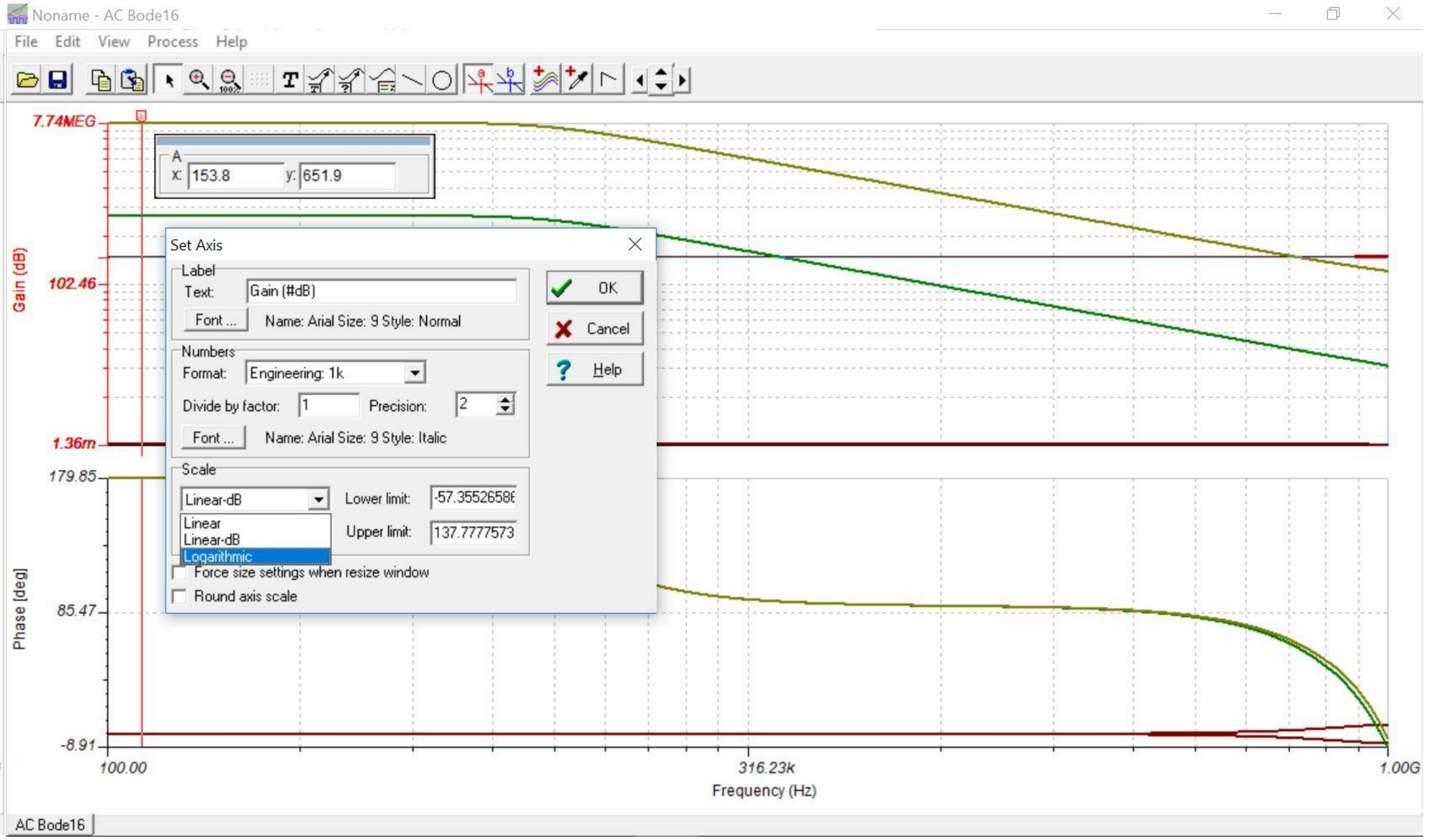
Generating Open-Loop Curves

Confirm Zol and Beta1 curves meet parameters of the datasheet

Zol Check

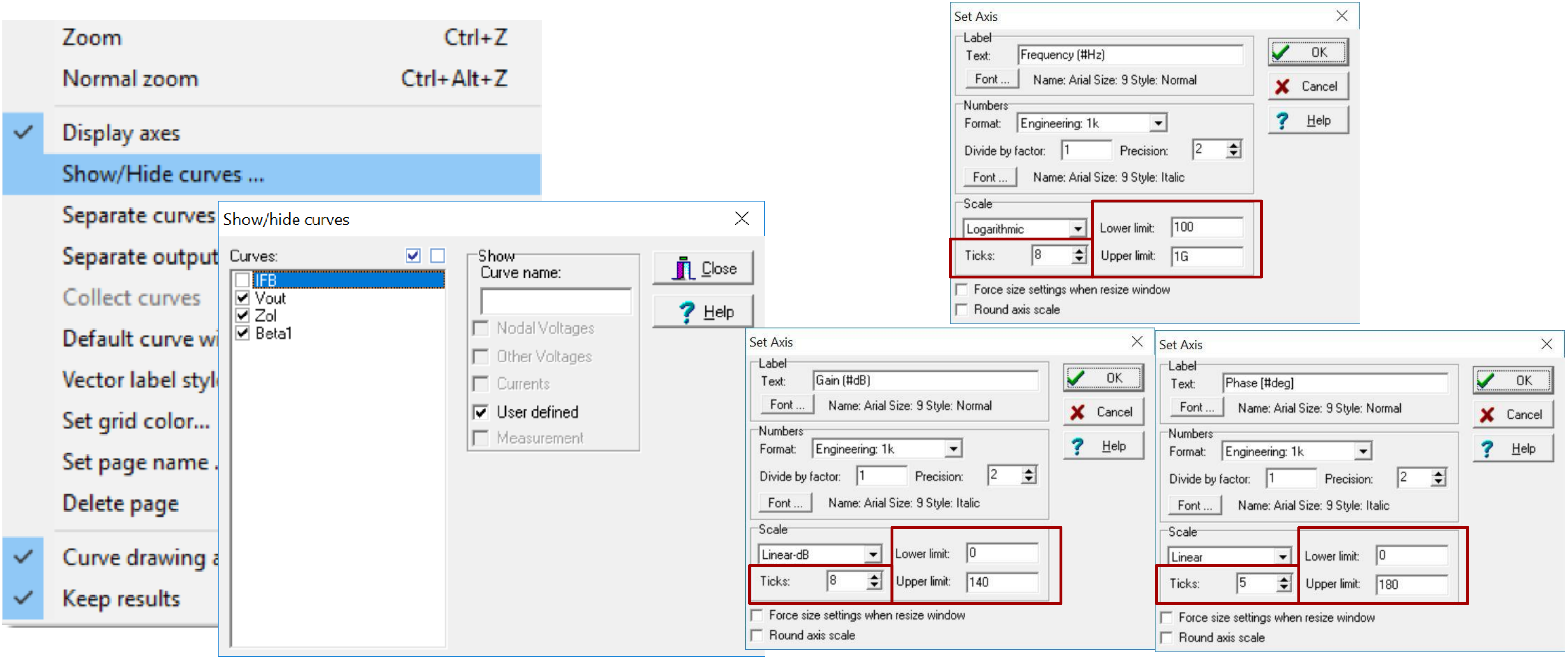


Beta1 Check



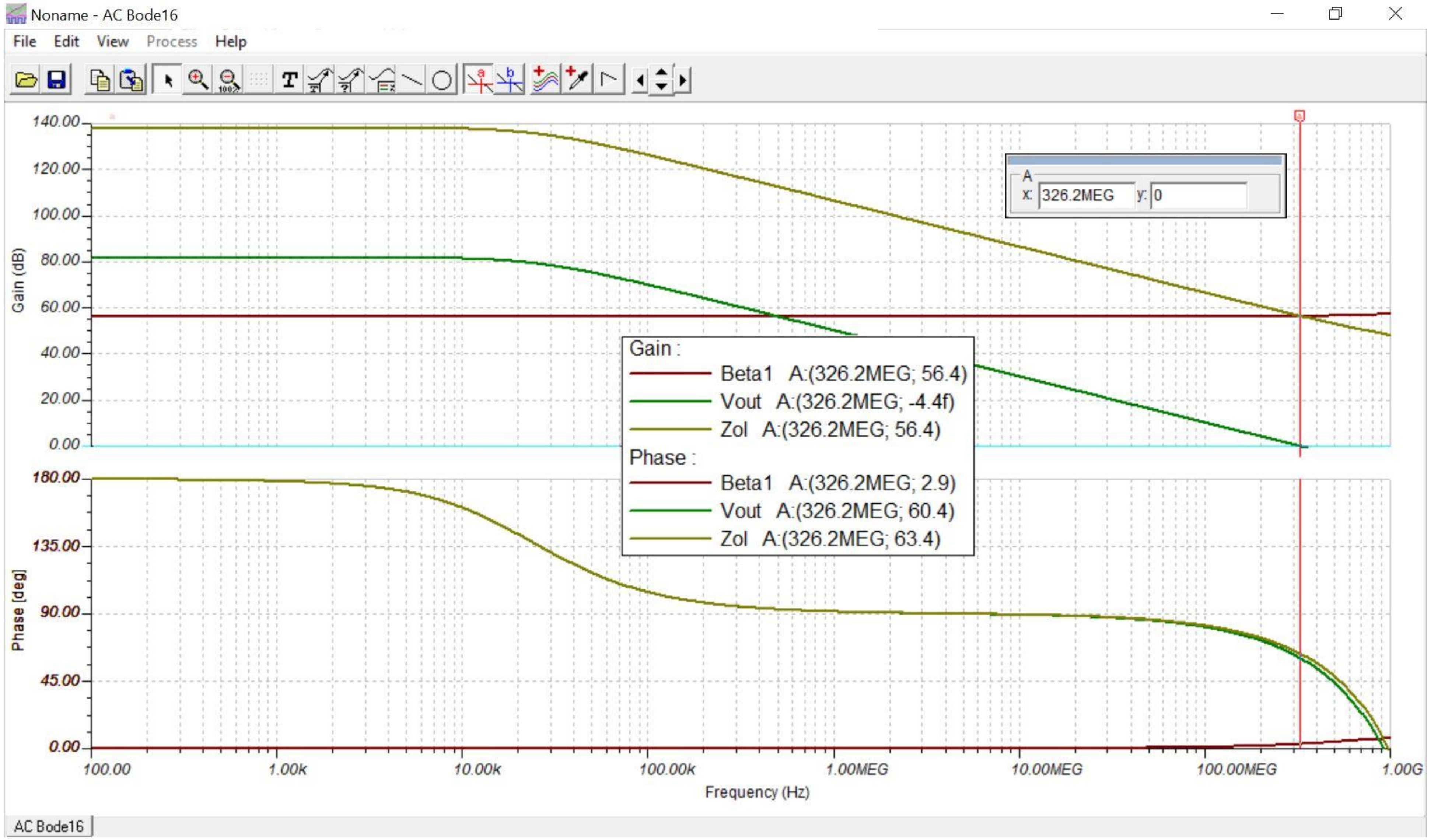
Generating Open-Loop Curves

Remove undesired curves and format axis for easier viewing:



Generating Open-Loop Curves

Use a cursor to determine the frequency where Aolβ = 0dB, f_c, and place legend to show corresponding magnitudes and phases



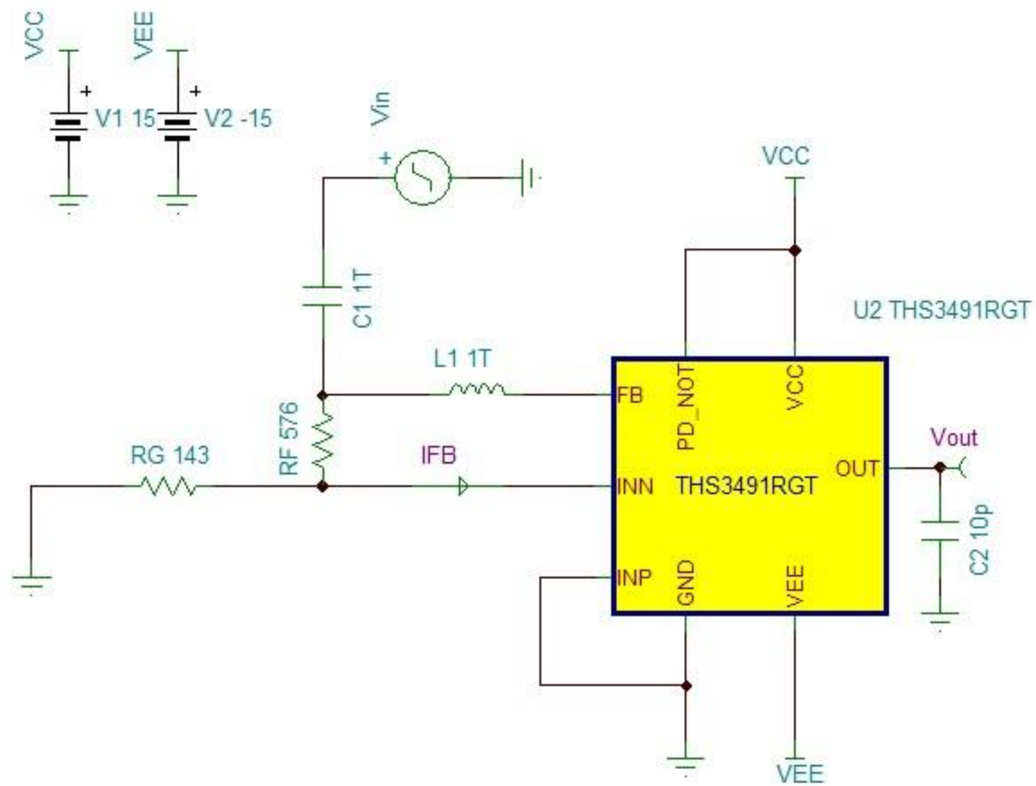
Thank you for your time and please take the quiz

Problems

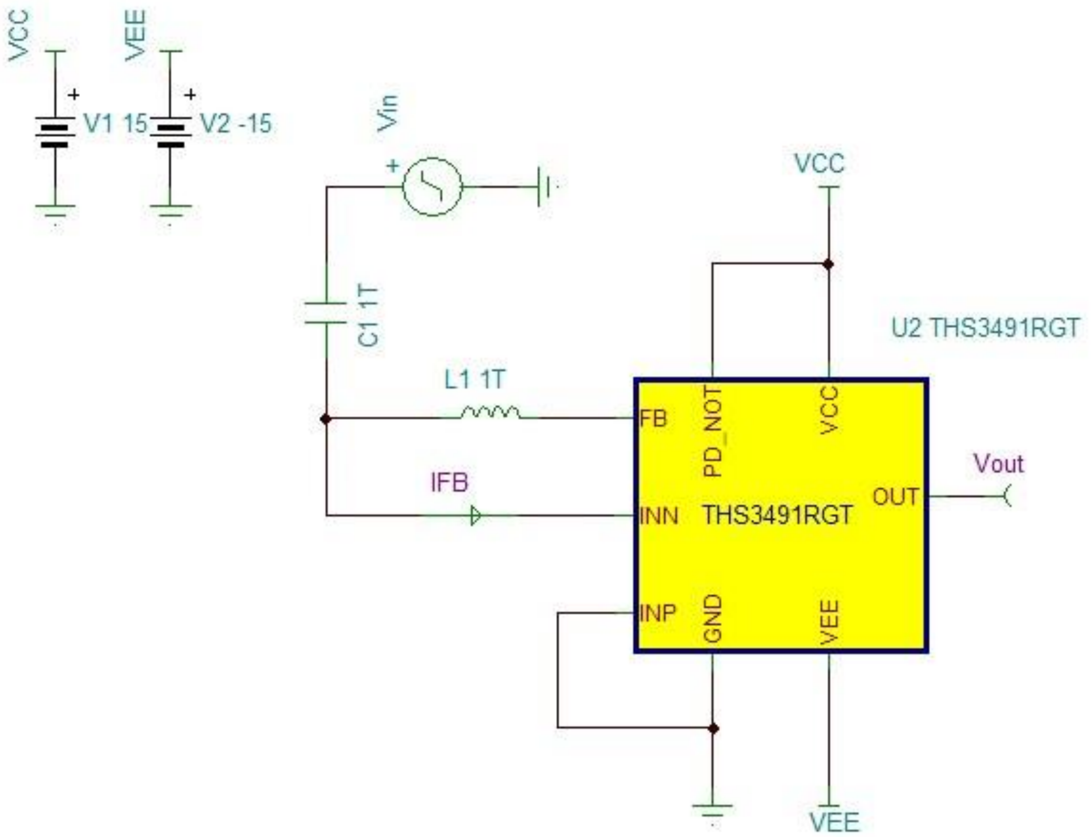
Current-Feedback Amplifiers – Part 3

1. Simulate the Loop-Gain (Aolβ) Phase Margin for the circuit below with the following capacitive loads:
   a.) 1pF
   b.) 10pF
   c.) 50pF

Problem1.TSC



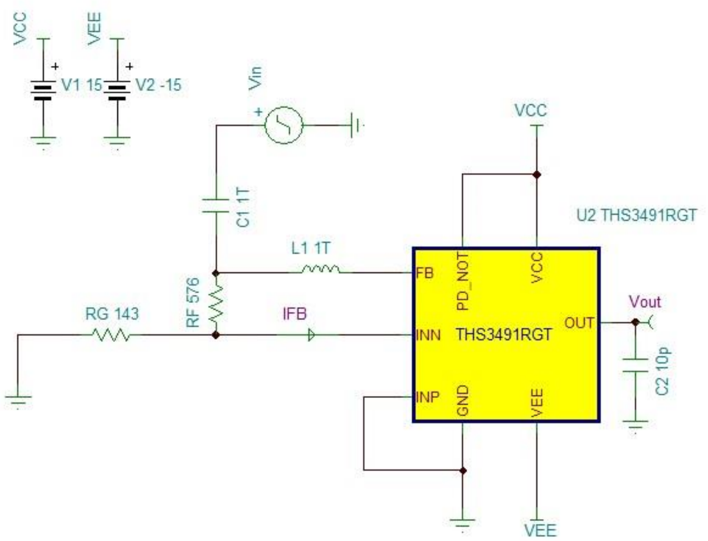
2. Simulate the Loop-Gain (Aolβ) Phase Margin for the circuit below.

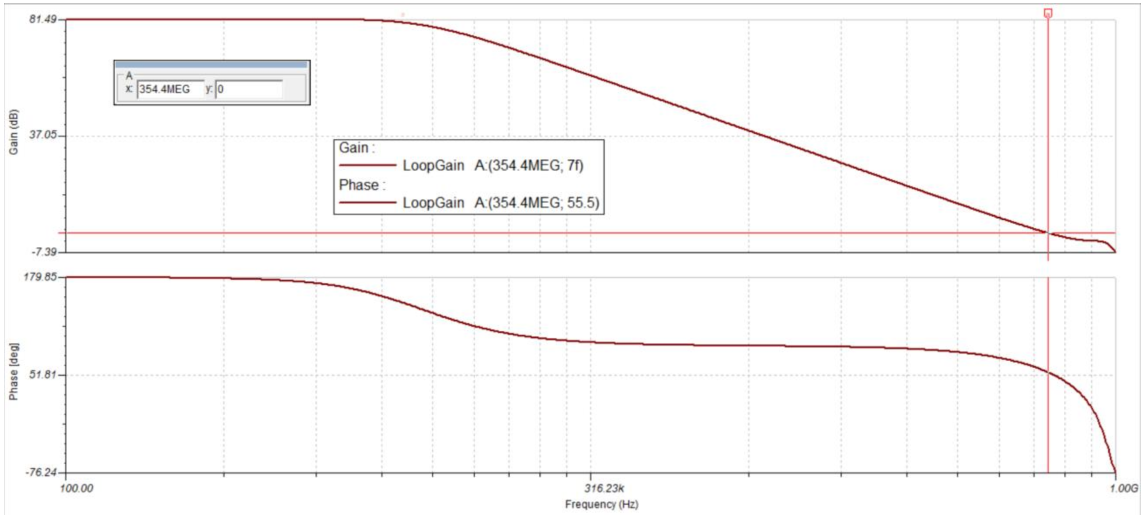


Solutions

1. Simulate the Loop-Gain (Aolβ) Phase Margin for the circuit below with the following capacitive loads:
   a.) 1pF 60.03°
   b.) 10pF 55.46°
   c.) 20pF 44.11°

Problem1_Solution.TSC





2. Simulate the Loop-Gain (Aolβ) Phase Margin for the circuit below.

Phase Margin = -151.5°. Amplifier needs feedback resistor for proper unity gain configuration.

Problem2_Solution.TSC