

Current-Feedback Amplifiers – Part 3

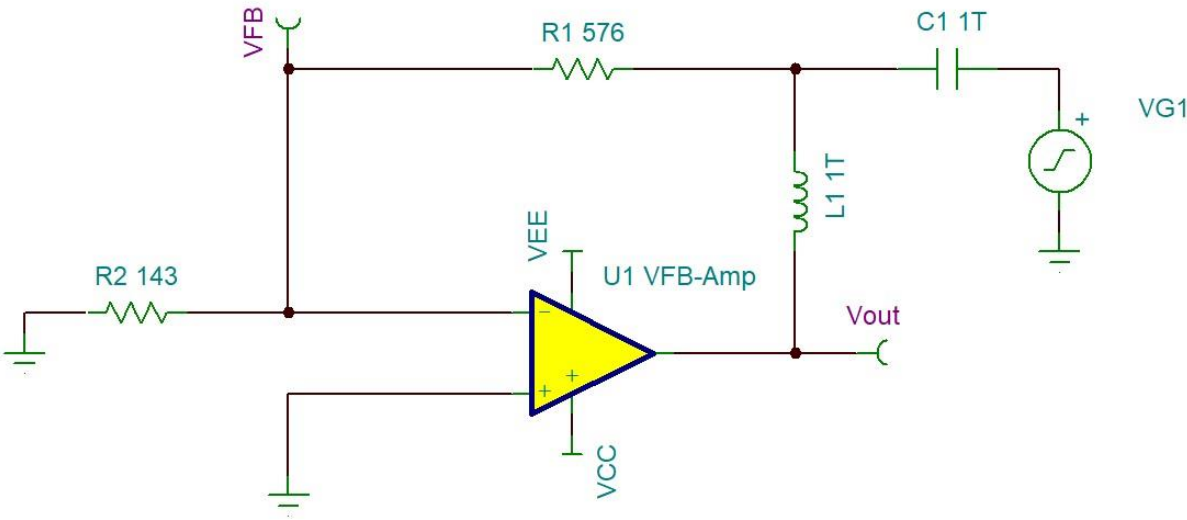
TI Precision Labs – Op Amps

Prepared and Presented by Hasan Babiker

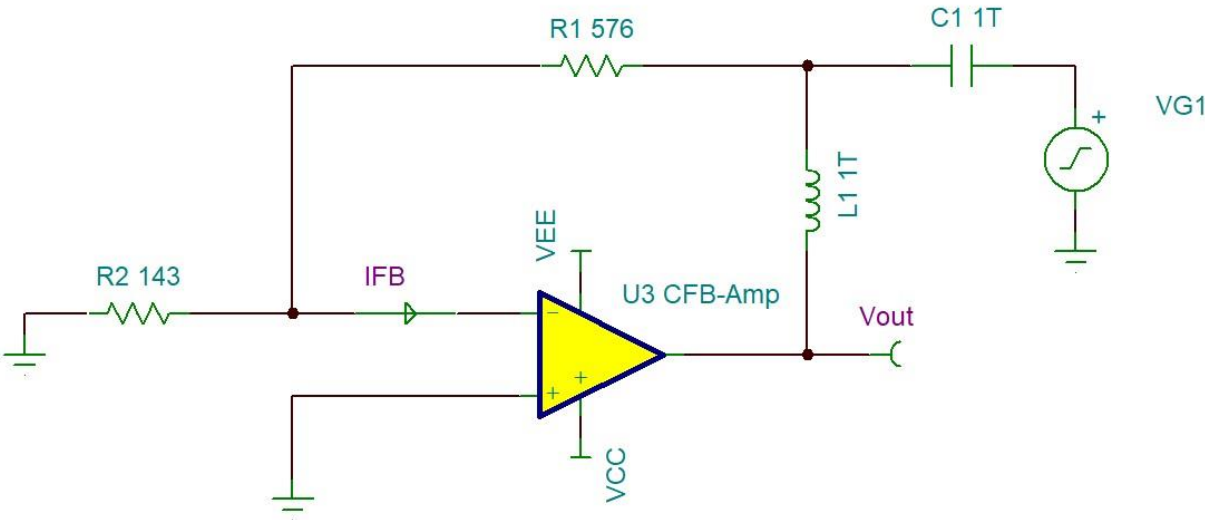
Voltage Feedback to Current Feedback Translation

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

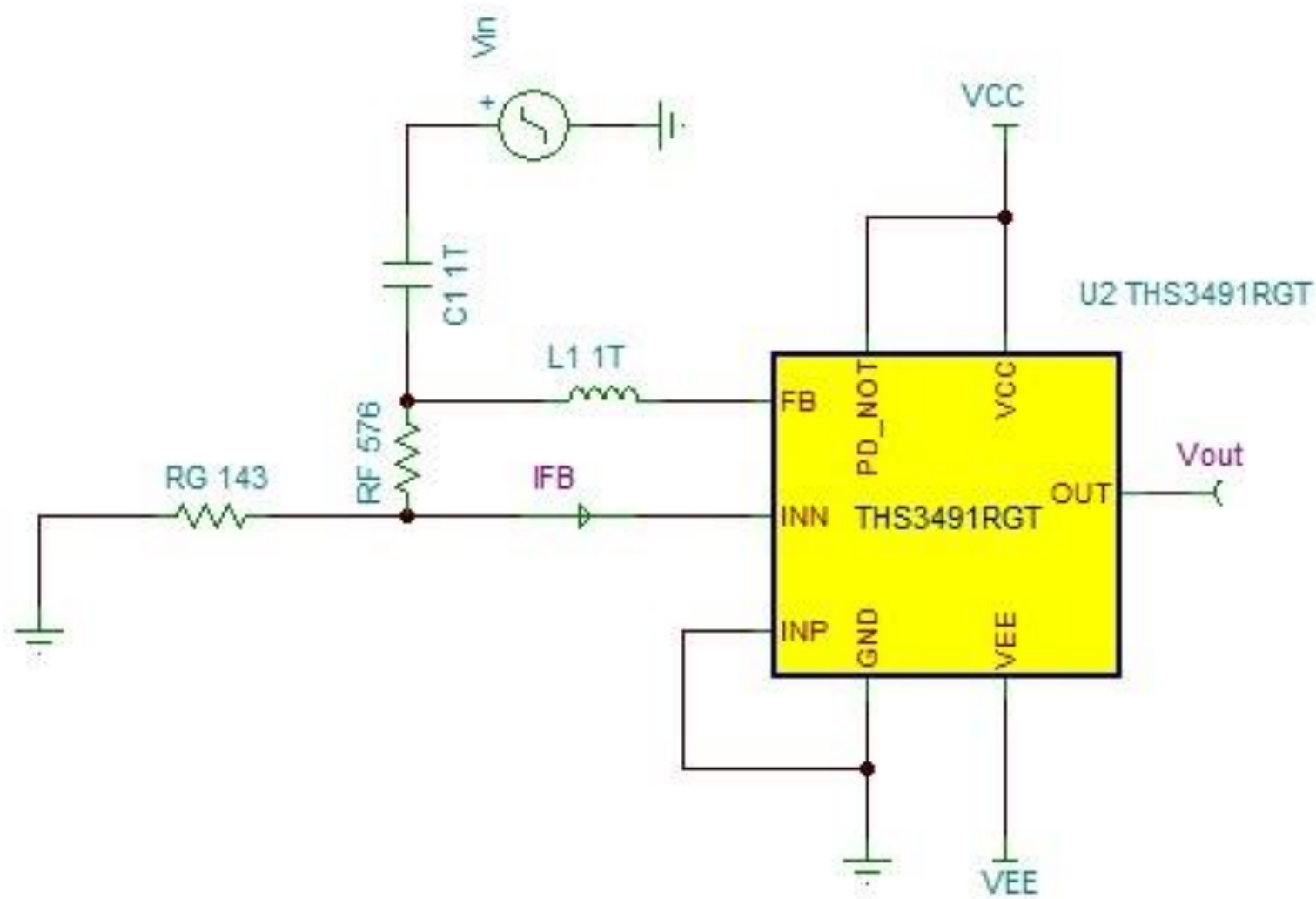


Current Feedback



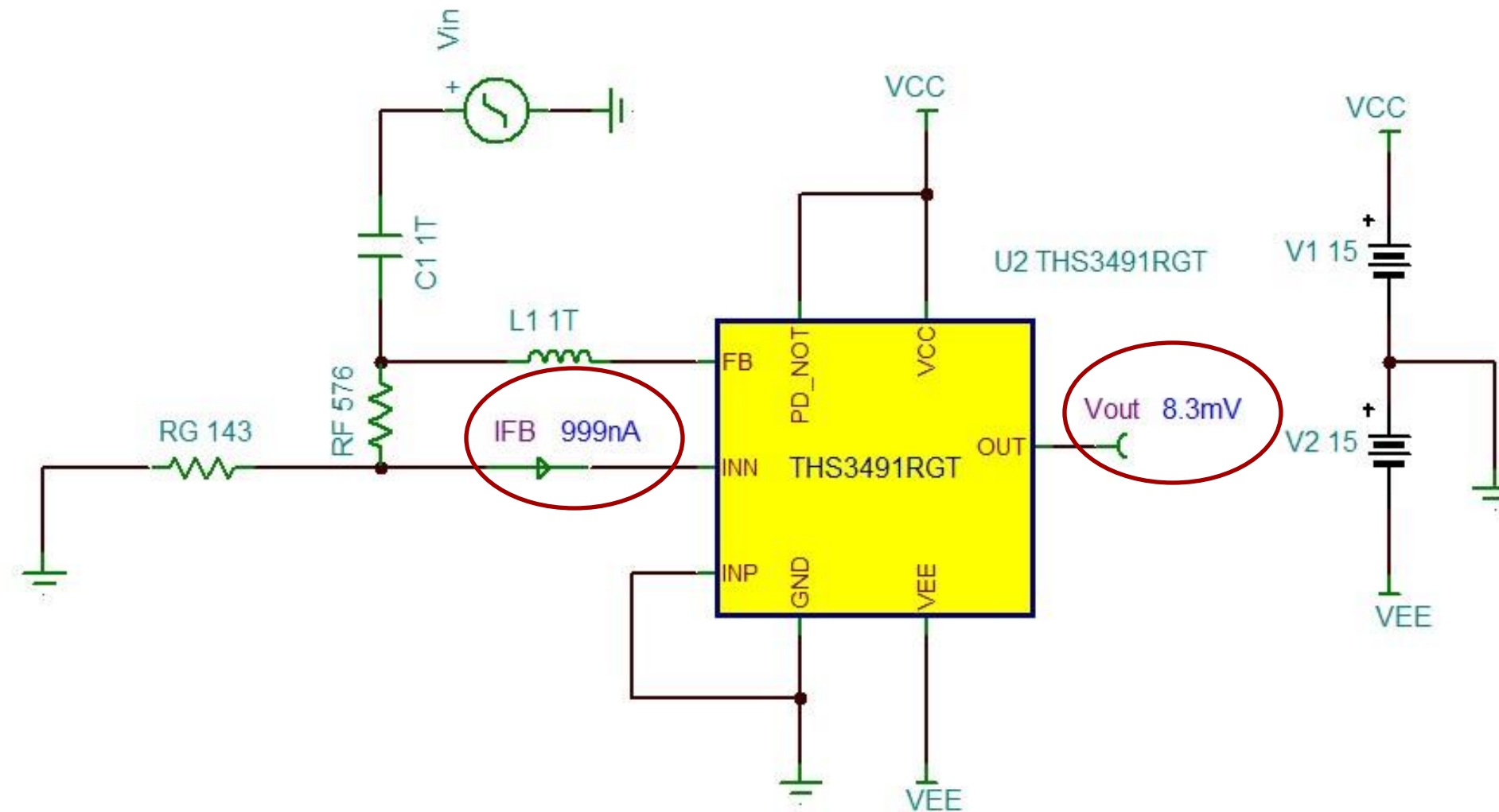
THS3491 Model

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**

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

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

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

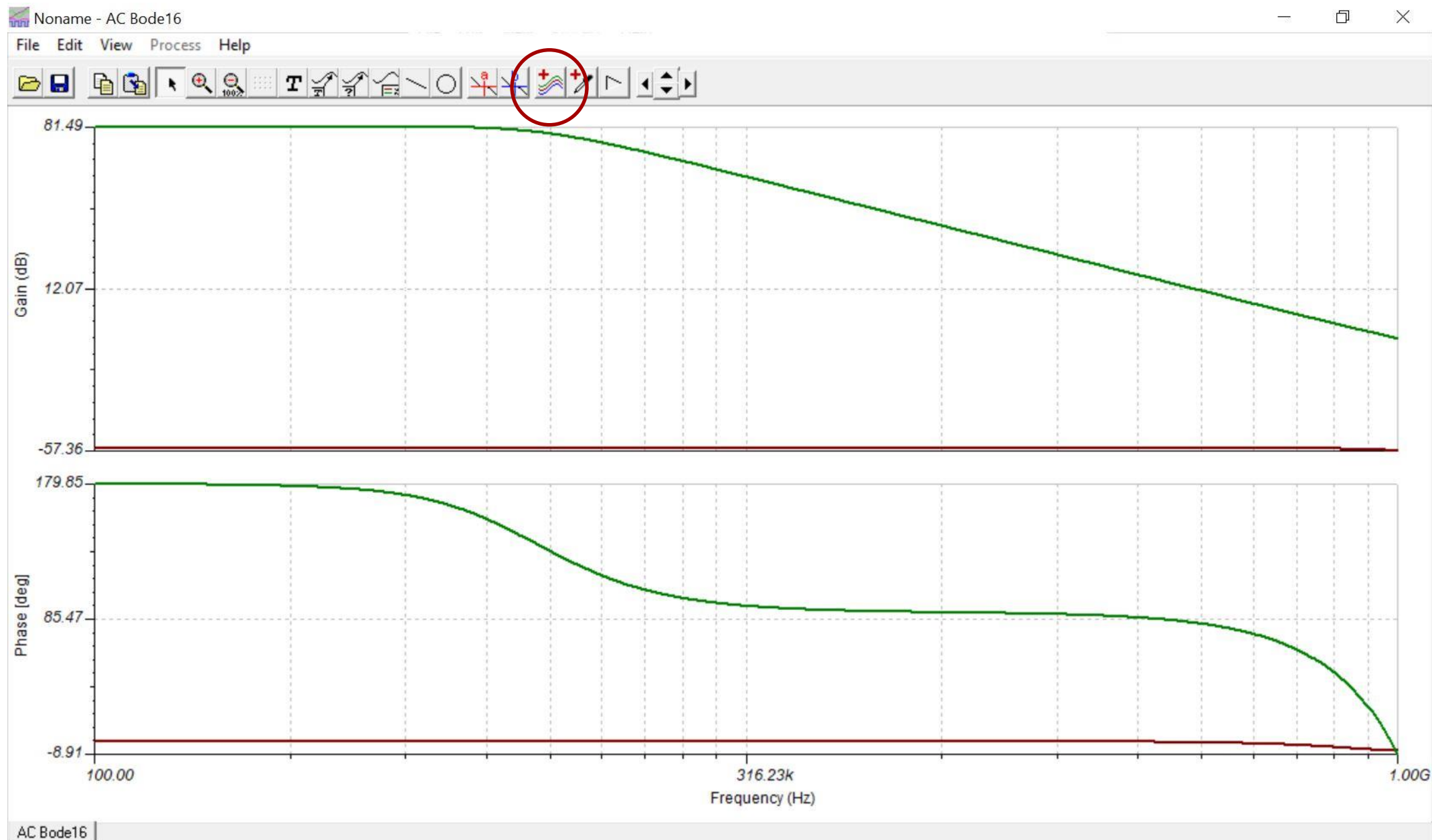
The screenshot displays the TI Schematic Editor interface. The 'Analysis' menu is open, and the 'AC Analysis' option is selected, which has opened a sub-menu where 'AC Transfer Characteristic...' is highlighted. The main workspace shows a schematic diagram of a two-stage op-amp circuit. The first stage is a common-emitter amplifier using a THS3491RGT op-amp, with a feedback network consisting of a resistor (RG 143), a capacitor (C1 1T), and an inductor (L1 1T). The second stage is a voltage follower using another THS3491RGT op-amp. The circuit is powered by VCC and VEE rails. A status bar at the bottom indicates 'Open-Loop Generation' and 'Exit' buttons.

AC Transfer Characteristic dialog box settings:

- Start frequency: 100 [Hz]
- End frequency: 1G [Hz]
- Number of points: 1000
- Sweep type: ☒ Logarithmic
- Diagram: ☐ Amplitude, ☐ Nyquist, ☐ Phase, ☐ Group Delay, ☒ Amplitude & Phase

Generating Open-Loop Curves

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



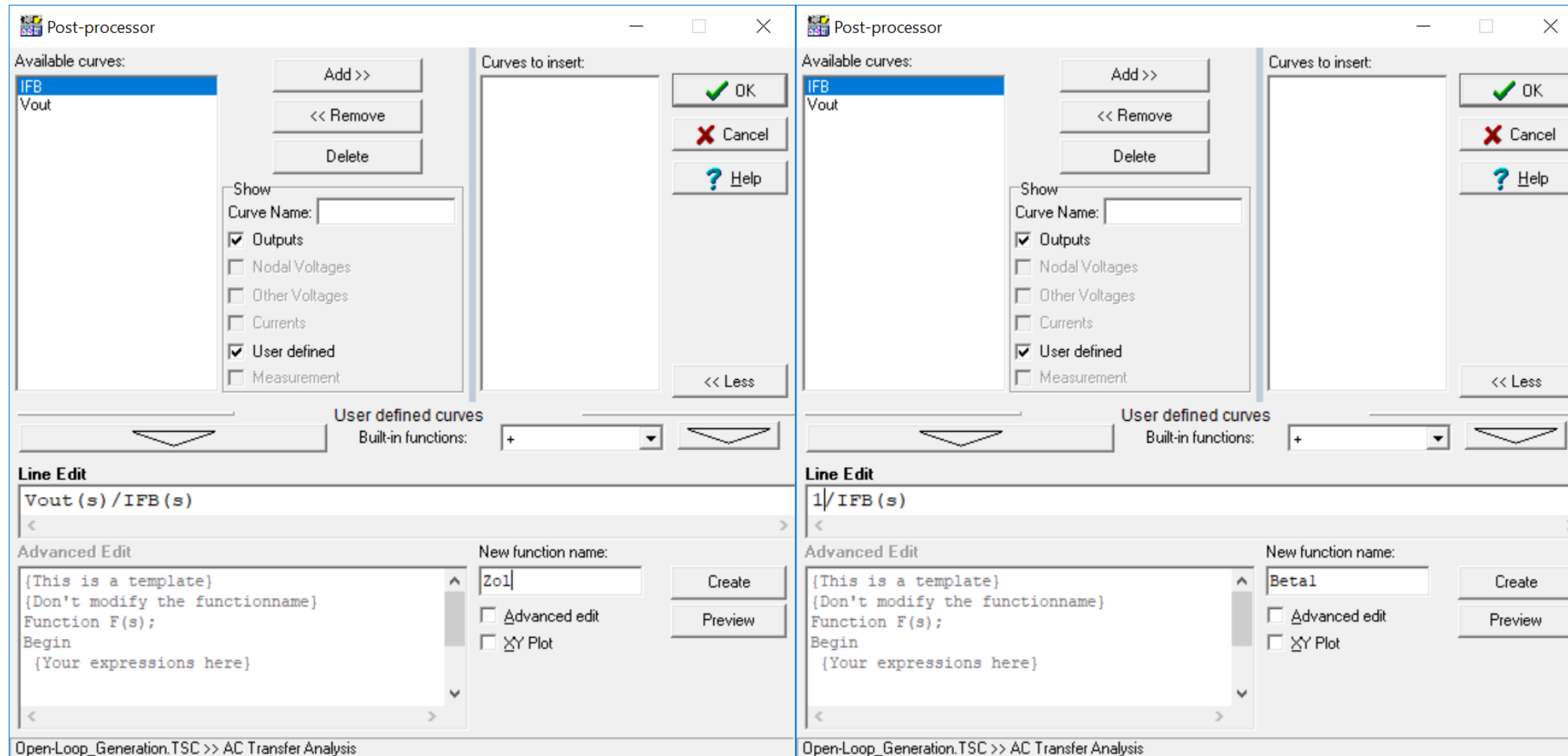
Generating Open-Loop Curves

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

$$Z_{ol} = V_{out} / I_{FB}$$

$$1/\beta = 1/I_{FB}$$

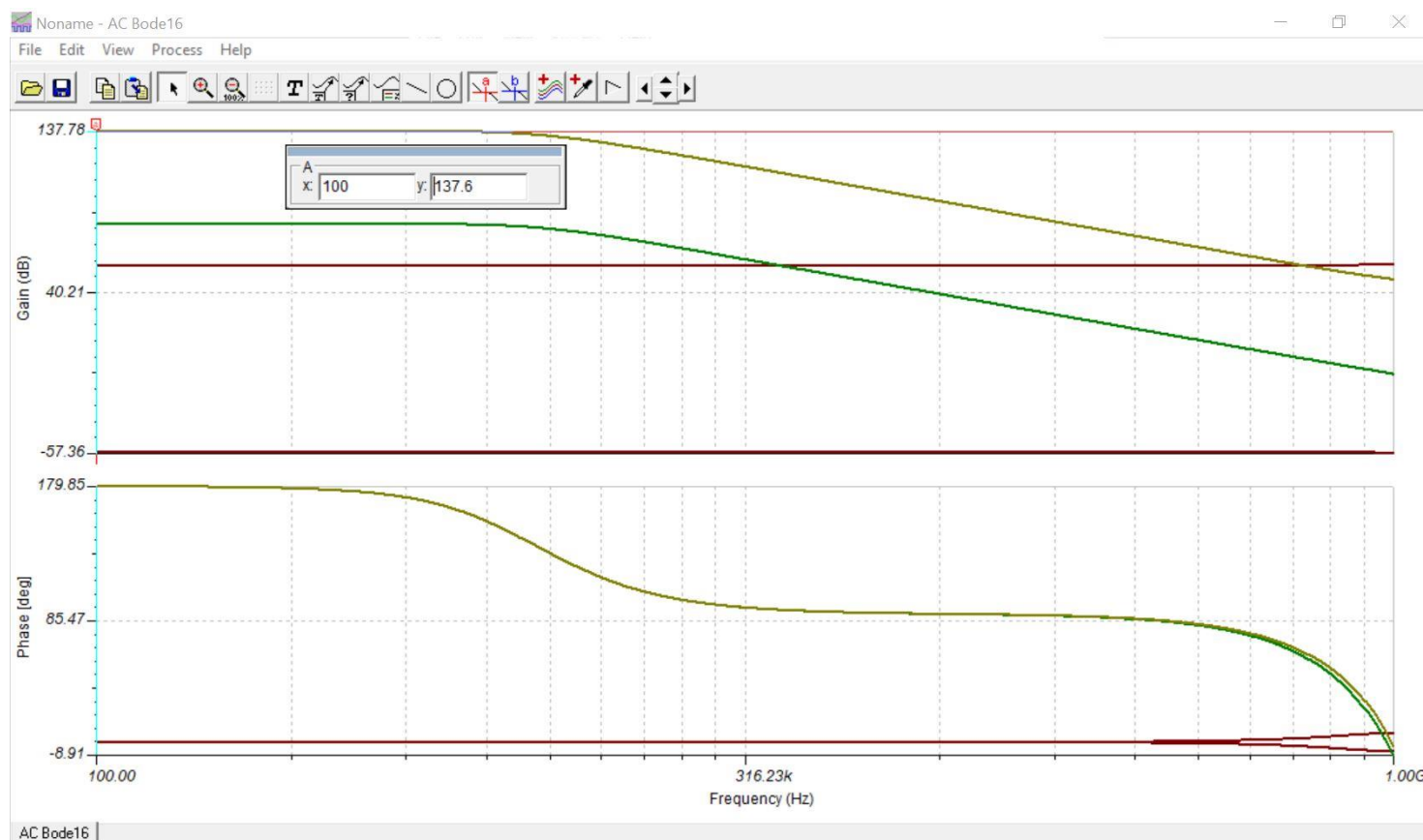
$$Z_{ol}\beta = V_{out}$$



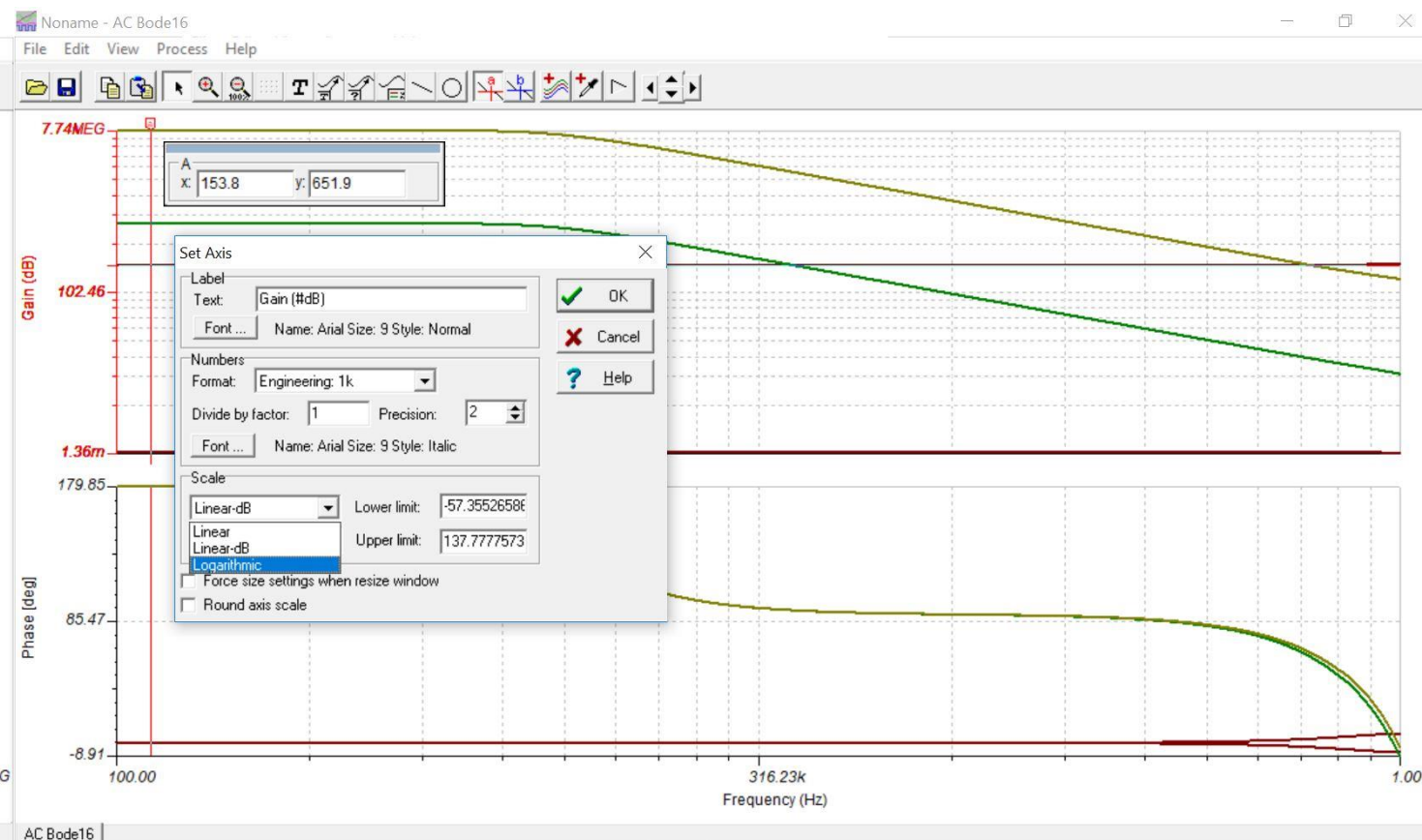
Generating Open-Loop Curves

Confirm Zol and Beta1 curves meet parameters of the datasheet

Zol Check

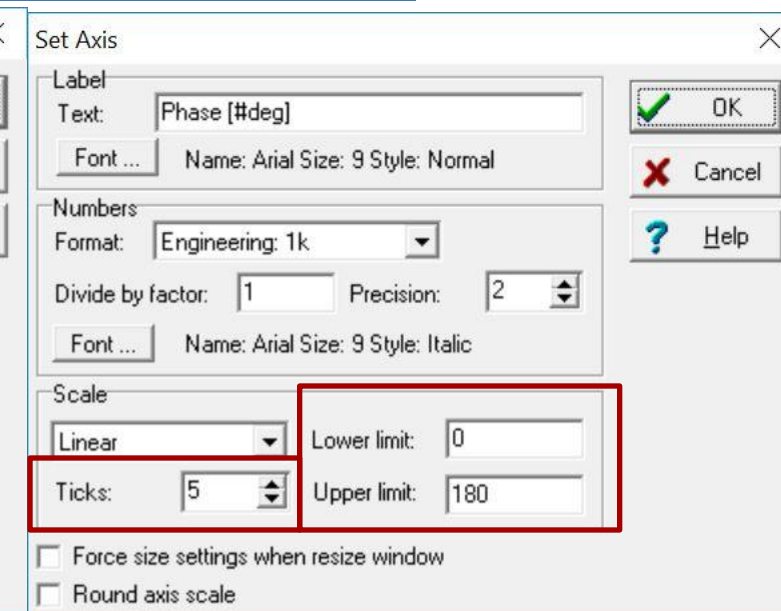
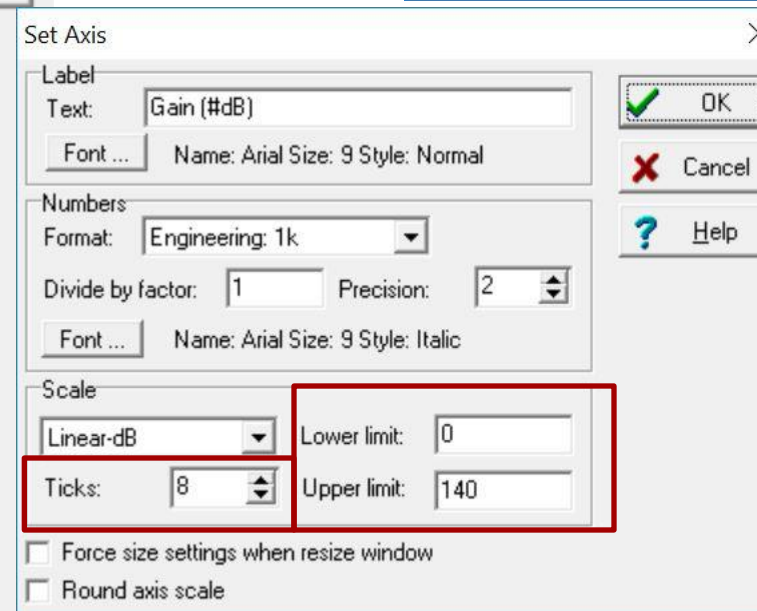
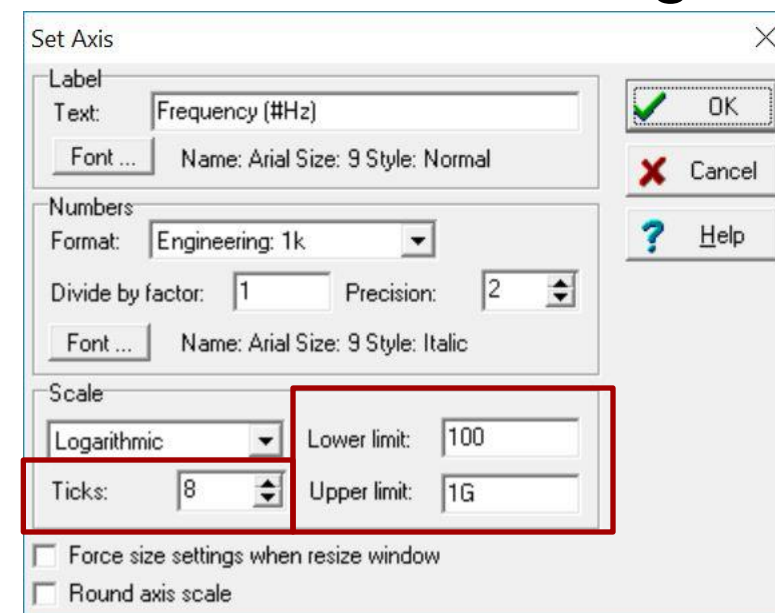
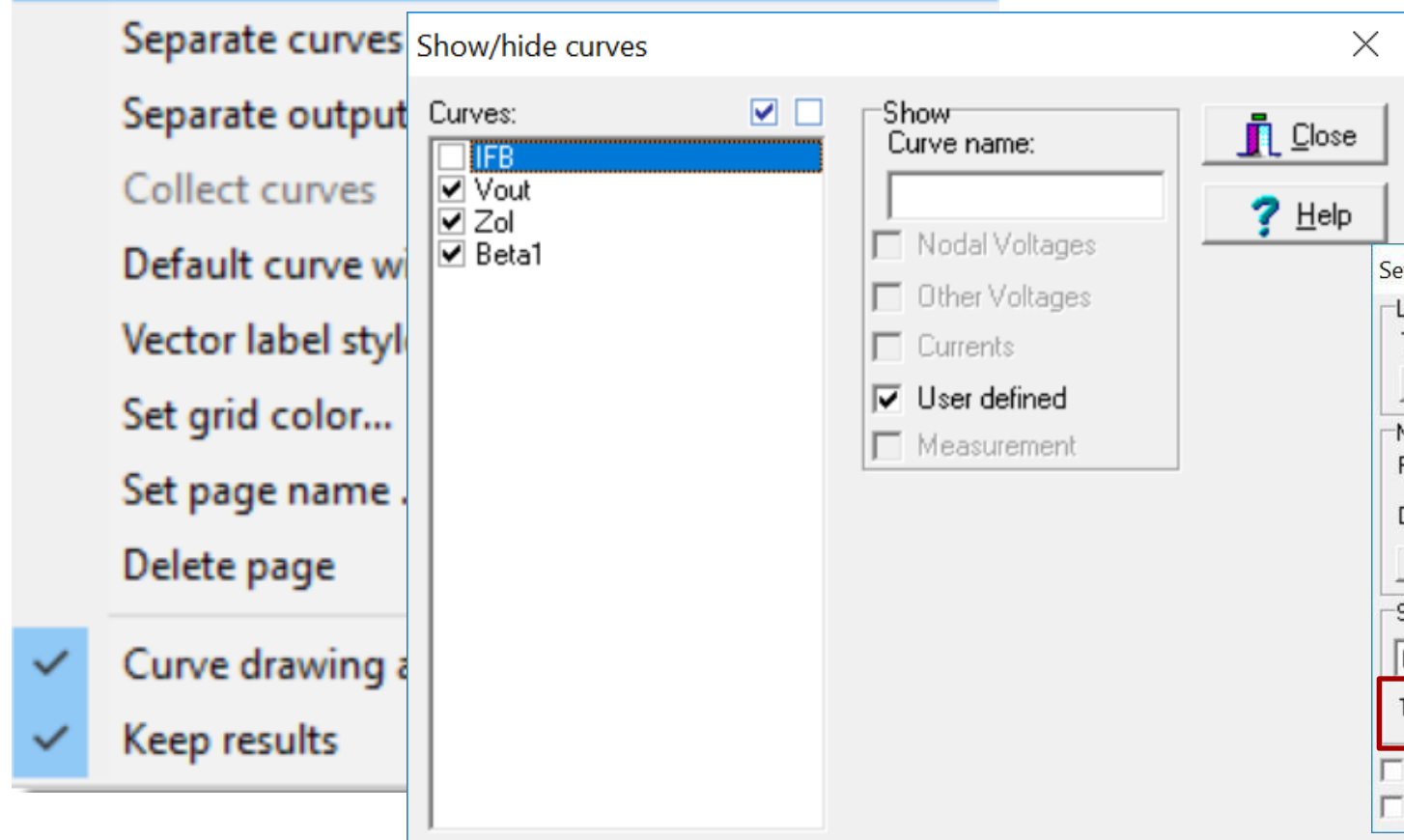
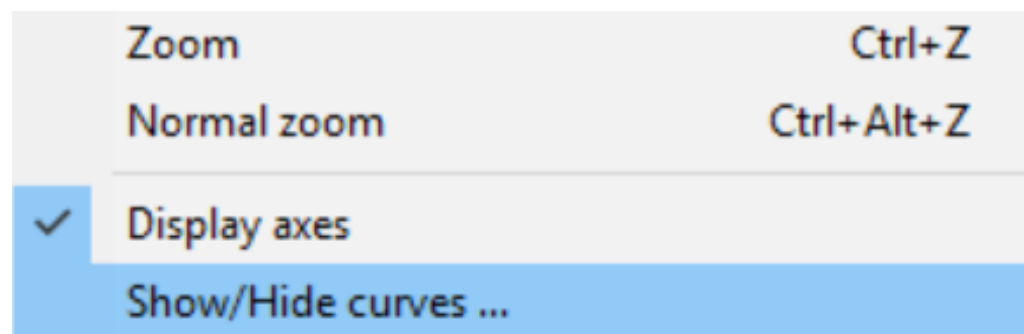


Beta1 Check



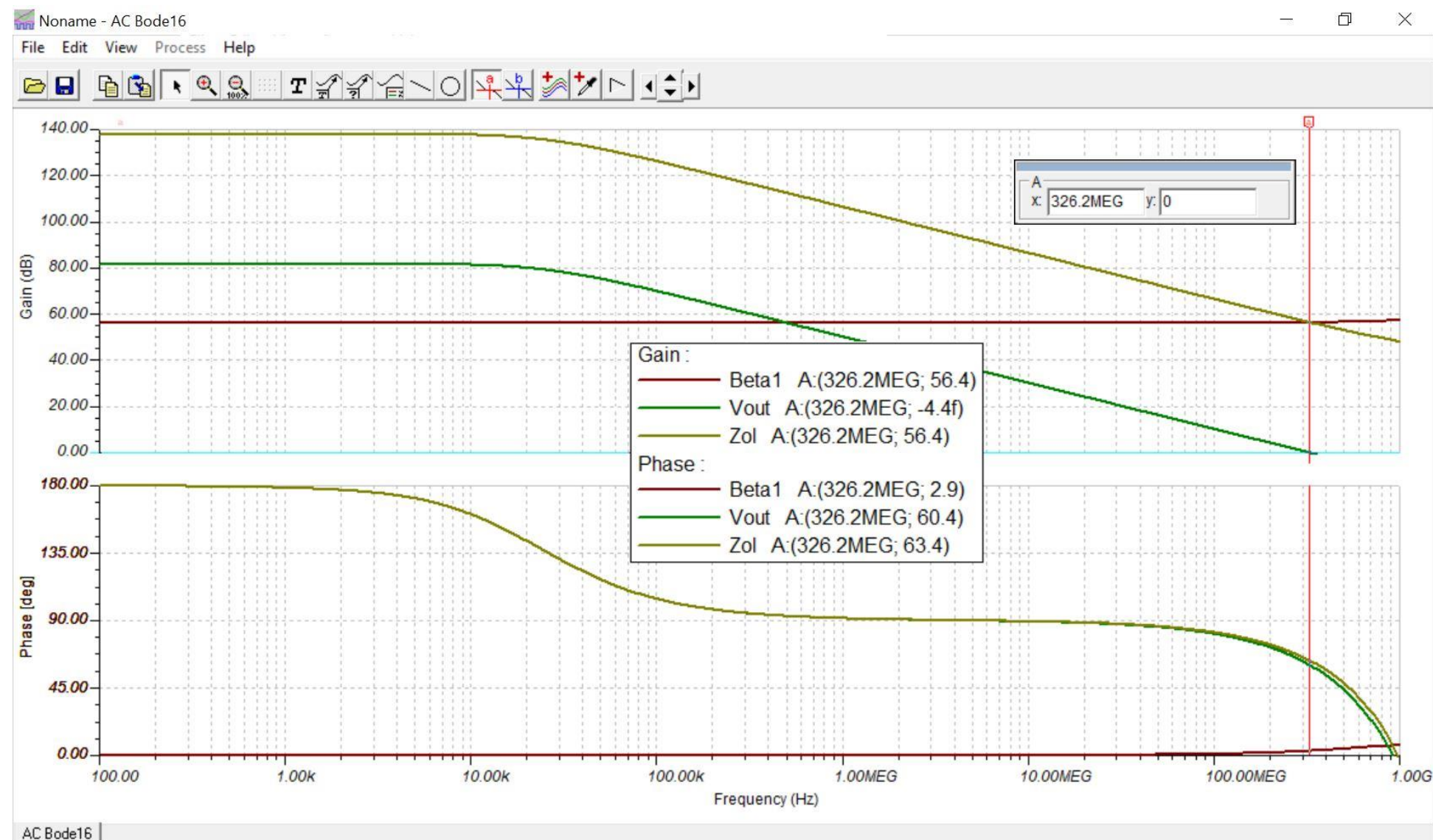
Generating Open-Loop Curves

Remove undesired curves and format axis for easier viewing:



Generating Open-Loop Curves

Use a cursor to determine the frequency where $A_{ol}\beta = 0\text{dB}$, f_c , and place legend to show corresponding magnitudes and phases



**Thank you for your time and please take
the quiz**

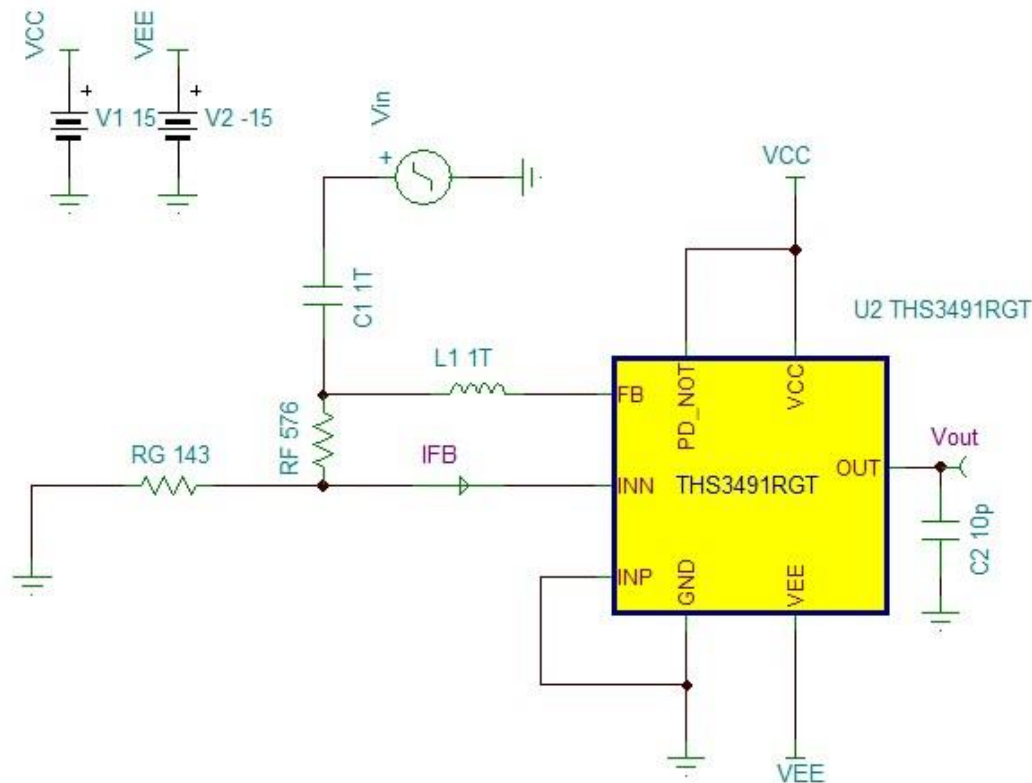
Problems

Current-Feedback Amplifiers – Part 3

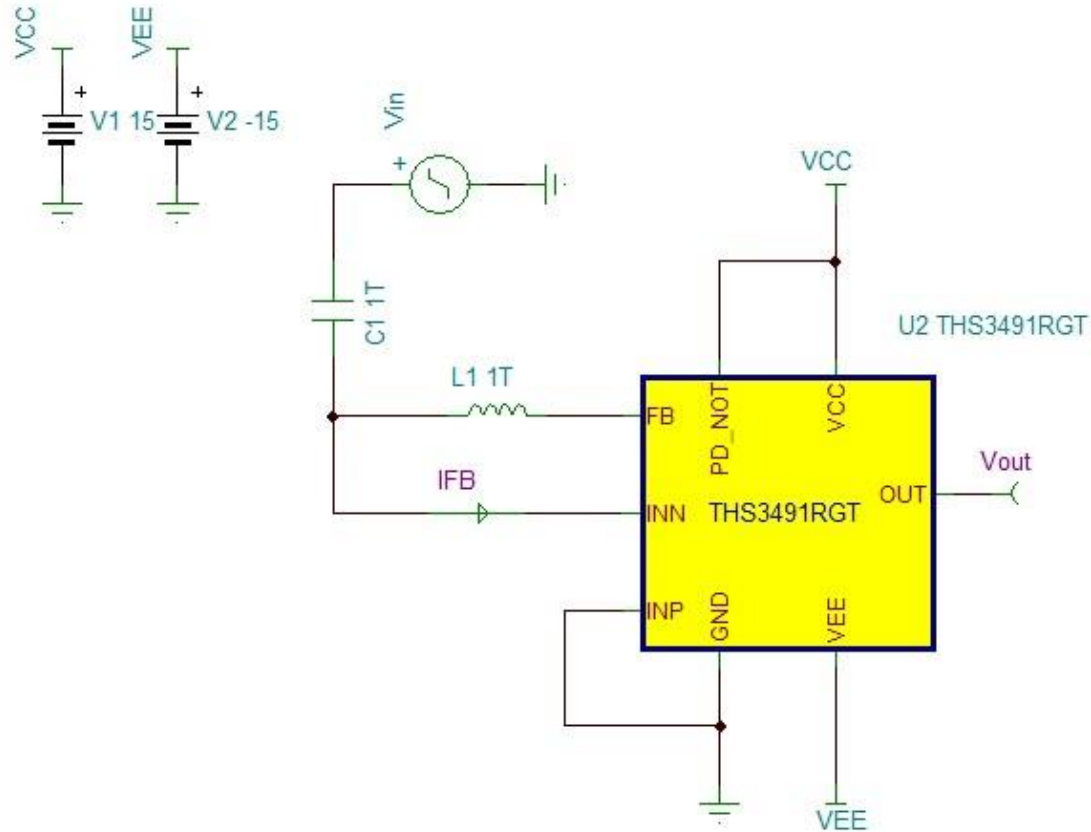
1. Simulate the Loop-Gain ($A_{ol}\beta$) Phase Margin for the circuit below with the following capacitive loads:
 - a.) 1pF
 - b.) 10pF
 - c.) 50pF



Problem1.TSC



2. Simulate the Loop-Gain ($A_{ol}\beta$) Phase Margin for the circuit below.



Problem2.TSC

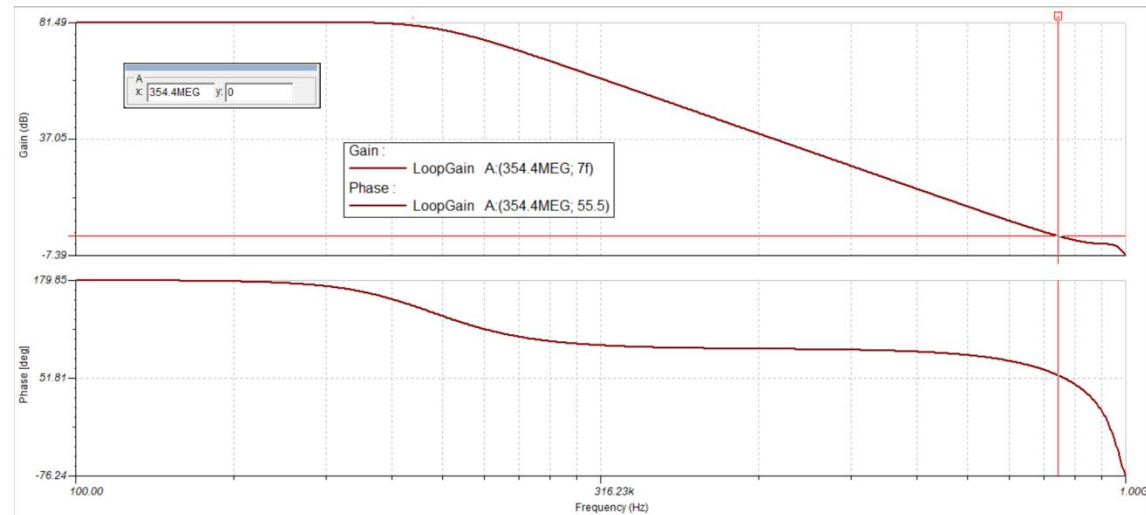
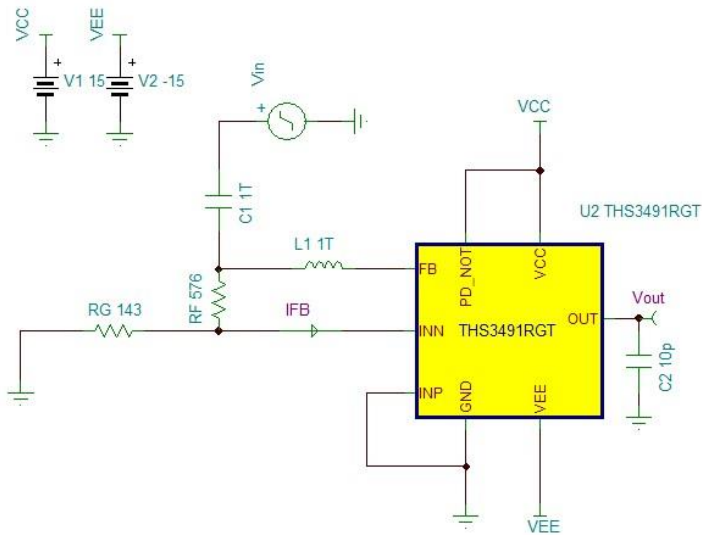
Solutions

1. Simulate the Loop-Gain ($Aol\beta$) 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 ($Aol\beta$) Phase Margin for the circuit below.

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



Problem2_Solution.TSC

