

LAB06 – LOW POWER OP AMP DESIGN

Overview:

The objective of this laboratory is to design low-power op amp that will meet a given set of specifications.

The steps in the laboratory are:

- Specifications
- Approach
- Simulation/Test Benches

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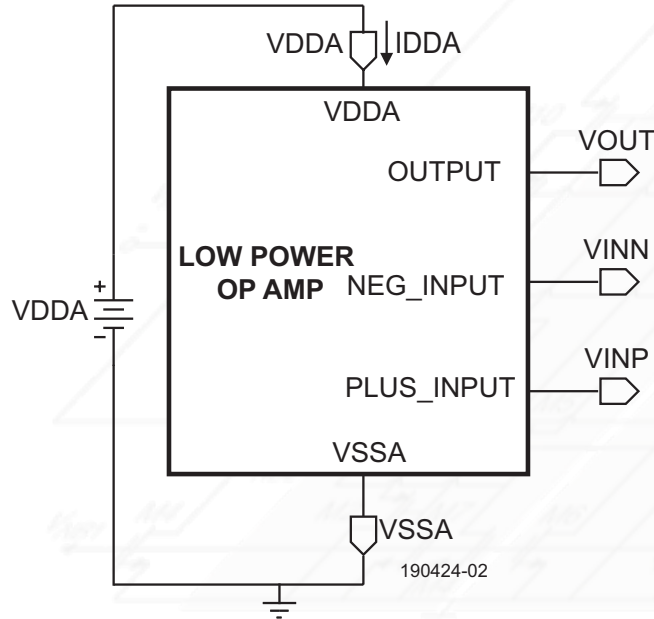
Version 190424

Lab06 - Specifications

Specifications

Technology - xFab XH035B

Block diagram:



Parameter	Symbol	Min	Typ	Max	Units
Power Supply Voltage	VDDA	3	3.3	3.6	V
Ground	VSSA	0	0	0	V
Bulk Bias Voltage	VBBA	0	0	0	V
Junction Temperature	TJ		27		°C

Note: You are only responsible for the circuits within the box labelled **LOW POWER OP AMP**

Lab06 - Specifications

Specifications – Continued

(VDDA = 3.3V, T_J = 27°C, C_L = 5pF unless otherwise specified below)

Parameter	Symbol	Condition	Min	Typ	Max	Units
Bias Current for total circuit	IDDA	VDDA = 3.3V, VINP=1.65V			50	nA
Low frequency open loop gain	AVD	VDDA = 3.3V, VINP=1.65V	60			dB
Gain-bandwidth	GB	VDDA = 3.3V, VINP=1.65V, CL = 5pF	0.1			MHz
Phase Margin	PM	VDDA = 3.3V, VINP=1.65V	50			Deg
Slew Rate	SR	VINP=1.65V, V1=1.5V, V2=2.5V	0.5			V/μs

IDDA - DC OP

1.) Determines IDDA for nominal model, t_m

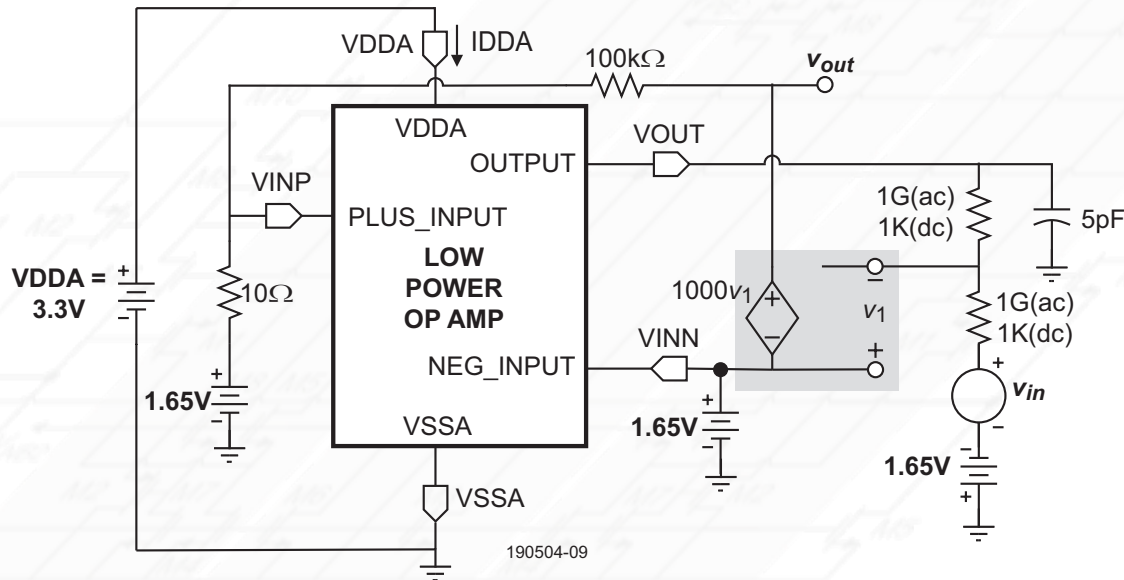


Test Bench 2

AVD, GB, and PM – AC

This Test Bench does the following:

- 1.) Measures the open loop gain when $V_{DDA} = 3.3V$, $V_{INP} = 1.65V$.

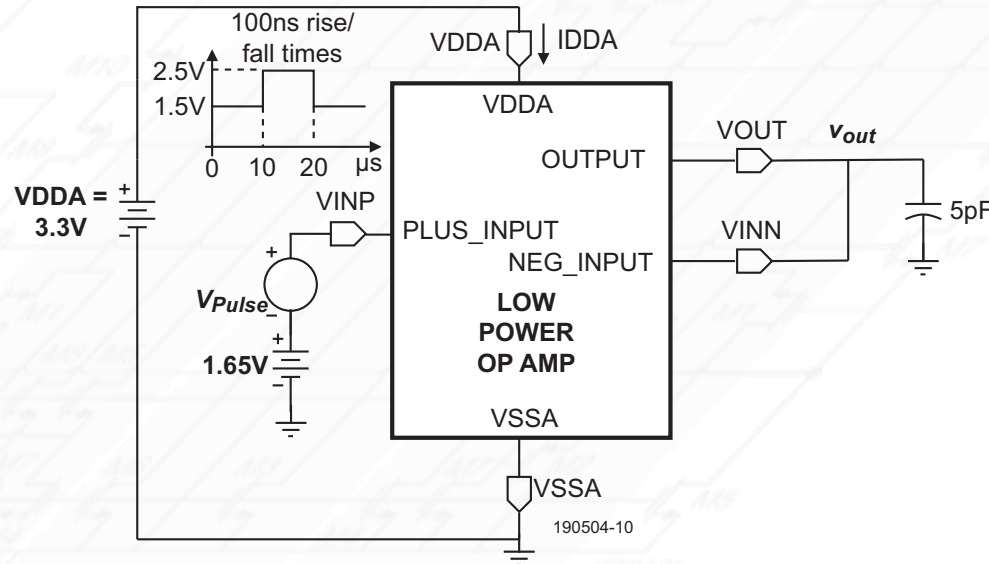


Test Bench 3

SLEW RATE - TRAN

This Test Bench does the following:

1.) Measures the slew rate of the op amp when $V_{DDA} = 3.3V$. A pulse of 1.5V to 2.5V, with rise and fall time of $0.1\mu s$, pulse width of $10\mu s$, and period of $20\mu s$ is applied.

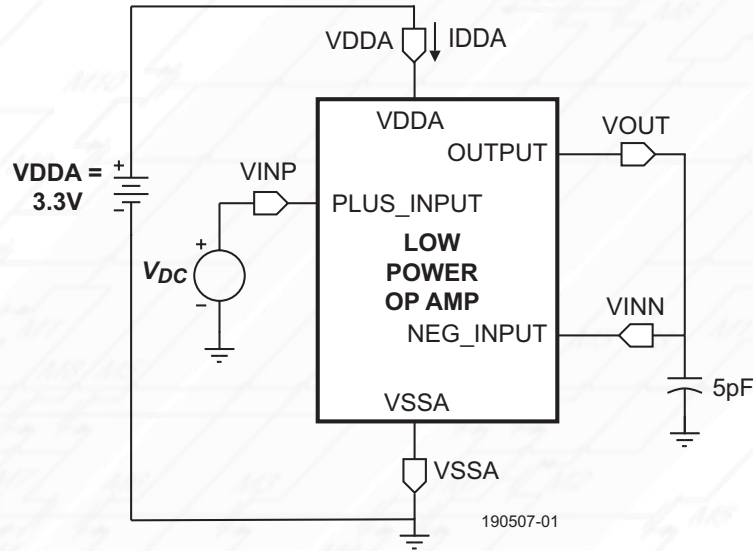


Test Bench 4

ICMR – DC SWEEP

This Test Bench does the following:

- 1.) Puts the op amp in unity gain configuration and sweeps the input voltage from 0 to 3.3V.



Electrical Design

Steps

1. Choose one of the appropriate design procedures
2. Hand design using the design procedure
3. Use the test benches to determine the performance of your design keeping your design constant from test bench to test bench
4. After you have used the test benches provided to simulate your circuit, a specification sheet will be generated to indicate how well your circuit meets the specifications.
5. If you did not meet specifications, you are encouraged to modify your circuit in an attempt to meet specifications

Tips and Tricks

Helpful Ideas for Lab06

1. W and L values have little influence on the op amp in weak inversion. Use minimum W and L to reduce capacitance and increase frequency. Increase L if you want more gain or matching.
2. When using the test benches with a negative feedback loop, make sure that under quiescent conditions that the voltage applied to the op amp under test is within its ICMR.
3. For good slew rate, make sure the capacitance from the common source point of the differential to ground is small. Otherwise, the current necessary to charge and discharge this capacitor will be taken from the sinking/source current of the differential input stage.

Summary – Lab06

Low Power Op Amp Design

- Understand the lab specifications
- Selection of an appropriate design procedure and topology
- Develop the design using the design procedure
- Use test benches to simulate and determine performance
- Modify as necessary