MODULE 05

OP-AMPS III

PREREQUISITES: MODULE 04: OP-AMPS II.

OUTLINE OF MODULE 05:

What you will learn about in this Module:

- Function generators: sine wave, ramp, square wave & pulse
- Output Power Amplifiers
- Norton Amplifier (Current Feedback)
- Instrumentation Amplifiers
- Noise Reduction, grounding techniques
- Performance Enhancement
- PCB Layout considerations for precision, low noise, high performance

What you will design and/or build in the lab:

You research (and will build at least one) of the following circuits:

- A sample and hold circuit
- A peak detector
- A zero-crossing detector
- A Schmidt trigger with hysteresis
- An instrumentation amplifier (using individual op-amps)

INTRODUCTION:

You learned in previous modules about basic op-amp circuits, and the amazing versatility of op-amps as a universal building block for linear electronic circuits. In this module, you will return to some of the reading assignments from previous op-amp modules, as well as additional readings and internet research, to design and build several interesting and useful op-amp circuits.

READINGS FROM HOROWITZ AND HILL (H&H): *ART OF ELECTRONICS*

1.07-1.13, review 2.15-2.16, 4.09, 4.29, 5.12-5.14, 5.17

Read all of Chapter 7. Pay particular attention to sections:

- 7.22-7.23 (noise sources)
- 7.24-7.25 (grounding)

ADDITIONAL READINGS & INTERNET RESEARCH:

Application Note AN: Current Feedback Amplifiers (National Semiconductor)
App Note OA-07: Current Feedback Op-Amp Applications (National Semiconductor)
App Note OA-30: Current vs. Voltage Feedback Amplifiers (National Semiconductor)

You should also find on the web several op-amp cookbooks. You will want to search the application notes for major manufacturers of op-amps. Look for op-amp circuit collections, et al.

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MODULE 05

SELF QUIZ

Each of the following circuits can be built using operational amplifiers. Briefly (a) describe the function of each of the following op-amp circuits, (b) list at least one application for each.

1: Sample and hold

2: Peak detector

3: Zero crossing detector

4: Schmidt trigger with hysteresis (define *hysteresis*, why is hysteresis useful in this circuit?)

5: Instrumentation amplifier

6: Which of the above circuits might benefit by being designed using a Norton (current-feedback) amplifier? Why?

7: On an op-amp spec sheet, what does "CMRR" mean? How is it measured? Why is it important? (you may need to review assigned readings or search the Internet to answer this)

PLEASE ANSWER THE ABOVE QUESTIONS AND E-MAIL TO THE INSTRUCTOR
"I have neither given nor received aid on this examination, nor have I concealed any violation of the Honor Code"

X_____

MODULE 05

LABORATORY PROJECTS

1- Using ExpressSCH, design a circuit using an LM324 op-amp to perform each of the following functions. Where applicable, define how the external components, such as discrete resistors and capacitors, are used to tune the performance of each circuit. Assume the LM324 is powered at +/- 15 VDC.

   A sample and hold circuit
   A peak detector
   A zero-crossing detector
   A Schmidt trigger with hysteresis
   An instrumentation amplifier (using individual op-amps)

2- Select at least one of the above circuits and build it using an LM324 op-amp. Discuss with your instructor how to test and validate the function of your circuit. You may need to use a function generator or other special device to see the interesting behavior of each of these types of circuits.

FEEDBACK

Was this Module useful and informative?

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Is there a topic that should get more or better coverage?

_____

In what way can this Module be improved:

Content: _____

Depth of Coverage: _____

Style: _____

Any additional comments that will help us to improve this course:

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If you prefer, you may e-mail comments directly to Bob Dennis: yoda@umich.edu