

Evaluation Form ECE 3042
Application Note
(With Mandatory Consultation)

Print clearly and legibly.

Student Name _____ GT# _____

Lab Section _____ Writing Consultant _____

Writing Assignment Number (circle one) 1st 2nd Did you attend a writing consultation? _____

Pledge of Academic Honesty: *On my honor, I pledge I have neither given anyone else assistance or information on this lab nor have I received assistance or information from anyone other than Dr. Brewer, Dr. Robinson, or Instructor Laughter, the UTA lab assistants, or the GTA writing consultants. I further pledge I am in full compliance with every statute and codicil of the Georgia Tech Honor Code and all of the work that appears in this report is my own, unless it is attributed to another source. I understand and agree that any violations of the Georgia Tech Honor Code will be forwarded to the Dean of Students for adjudication.*

Student's Signature _____

Date _____

Technical Writing Grading Rubric: 100%

SECTION	POINTS POSSIBLE	POINTS EARNED
Content / Flow / Organization (effective use of headings and subheadings; ample and logical flow of content; no grammar or mechanics problems)	25	
Effective Use of Graphics (integrated, useful, cited properly, size appropriate, used enough)	15	
Usability / Audience Considerations (written in conversational and friendly manner; contains all necessary information)	15	
Group Consultation Attendance (Did you attend on time and with a somewhat-completed draft?)	15	
Overall Effectiveness of Document (Does your application note do what it's supposed to do?)	10	
Technical Clarity and Content	10	
Completed Homework Assignment	10	
TOTAL	100	

Note: Any assignment handed in without this stapled signed grade sheet is penalized 10 points.

Grading Rubric *Application Note*

Section	Points
Content / Flow / Organization	25
Effective Use of Graphics	15
Usability / Audience Considerations	15
Technical Correctness / Clarity	10
Overall Effectiveness of Report	10
Attendance at Group Consultation	15
Homework	10

Total

100

Content / Organization / Flow: Is your note divided into accessible sections? Does each section contain *enough* information, and is it appropriate to that section? Are your sections, and the information within them, ordered in a logical and easy-to-follow manner? *Did you anticipate reader's questions?*

Effective Use of Graphics: Did you integrate and explain all your graphics? Did you follow formatting guidelines? Have you used ample illustrations?

Usability / Audience Considerations: Can your audience use your document? Is it written in a friendly, conversational manner? Can readers learn from it? Have you defined terms and procedures as needed? Is your procedure systematic and leaves nothing out? Have you been helpful?

Technical Correctness / Clarity: Are all necessary functions and procedures included and analyzed? Do you explain theory as needed? *Are your results verifiable?*

Overall Effectiveness: Does your document succeed in meeting the parameters of the assignment? Does it satisfy readers' questions?

Attendance at Mandatory Group Consultation: Were you on time? Bring more than an outline?

Homework: Did you complete and print your homework before lab and turn it in on time?

3042 WA2 Required Homework Assignment for Application Note Lecture

Due Date: Assigned lab time
Note: No late homework accepted.

Please bring both completed homework assignment and application note of your choice to lab.

Your assignment is to find and print out an application note from any electronic manufacturer. You can check out a specific manufacturer's website (National Instruments, TI, and many others), or you can Google *application note* and print out a brief example. Check the page length before you print so you don't end up with one over 15 pages. You will then write a *full paragraph* response to the set of questions below about your application note.

Examine and read or skim all sections of the app. note, and write a paragraph that answers the following questions:

- Who is the audience for this application note?
- What is the level or levels of expertise of the audience? How does that affect the instructions and the writing in general?
- How is the application note written? In what order are the sections? Is the arrangement logical to you?
- What would you have done differently as the technical writer and editor?
- Does the note include graphics? Are they effective? Integrated into the text and explained? Are there enough?
- Is the app. note thorough about the particular procedure? Does it include enough information or too much?
- How would you rank it as reader-friendly and accessible? What kind of language does it use?

Your response should be typed, double-spaced, and approximately one page in length; responses to these questions require MORE than just half a page. More than a page is not necessary, but you must provide detailed answers to the questions posed to receive credit. This homework is part of the overall grade you will receive on your application note assignment I will discuss with you next week.

Please bring *both* your completed assignment and the application note with you to lab next week. Late submissions will not be accepted. Be prepared to discuss your observations about your chosen application note.

ECE 3042 Assignment Sheet: Application Note

Variable Q Twin T Active Notch Filter

Fall 2009

<i>Length</i>	12 page maximum; 4 page minimum
<i>Point Distribution</i>	0-90 points, plus homework; regular letter grade breakpoints
<i>Lecture Dates</i>	October 27, 28, 29 in lab
<i>Due Date</i>	Monday, Nov. 23, Noon, in my office

You must bring this document to lab. You will be penalized ten points if you do not have a hard copy with you while I lecture. Success with this assignment means close attention to *all* details of this assignment sheet and careful note-taking during my lecture.

Note: This assignment contains a mandatory group consultation component. I'll provide you with details and a sign-up sheet during my lectures.

No extensions are available for this assignment. Please check the due date; it's the Monday before Thanksgiving. These application notes must be graded in a week because final exams loom. Don't ask.

Because all 3042 students will be working toward the same goal and essentially using the same procedure for this assignment, plagiarism may rear its ugly head. *I have one word of warning: don't.* Do not ask another student, copy or share even a single word or number, fact or figure, or screen capture.

All consultants will share completed assignments and cross-check to make certain no irregularities occur. Application notes are especially easy to track.

Assignment Details

Audience

Effective application notes take into consideration typical needs of their audience. You must analyze your readers, their comprehension levels and what they will need from you, the writer. Your audience is your co-workers and supervisors at Burdell Electronics. R & D has come to you and asked you to write an application note for the Twin T active notch filter and suggest a use for the one you design. Think of everything we engineers—and management—might need to know and what we will be trying to accomplish. Your purpose is to *inform* and *define* everything about equipment and procedures, and steps to avoid in your suggested application.

Report

This application note will contain all the design calculations, simulations, and experimental results about the active notch filter you design. You must fully respond to and analyze the four "Discussion" points at the end of the procedures sheet, in addition to providing a well-thought out application for your notch filter.

Description of Application Notes

The application note is a specific "document-within-a-document" that provides further information about *applying* a certain technique, explanation of **why** that technique is helpful, or instructions to complete a specific task. Application notes have become common components of user manuals, as well as stand-alone documents (especially in electronic form), as electronic equipment has proliferated and more people have joined the ranks of engineering. Also, upgrades, additions to equipment, and new applications mean that addendums to existing manuals and instruction guides are necessary for the engineer to complete his or her task.

Quite simply, an application note supplies the user with all the data and rationale needed to perform a specific duty in a certain way. You can think of it as "instructions-within-instructions." However, don't be lulled into thinking application notes are merely additional instructions and simple procedures. They provide rationale for why the user should perform the task in the recommended manner and why this method is important.

We will look at some examples in lab, but the first thing an application note-writer should know is this: the document will take whatever form necessary to provide information about completing and explaining the task at hand. **Form follows function.**

No real set rules apply with format or length, but you will find commonality between application notes.

All effective application notes contain graphics; subheadings are used; the tone is always user-friendly and conversational. Because these documents are a combination of explanatory and instructional information, regular narrative paragraphing and minimal bulleting applies. Sequential listing (enumerated instructions) is rare, or non-existent.

You must consider the following questions when both composing and selecting formatting for your application note:

- What level(s) or type(s) of engineer will read this document?
- What task(s) will the user perform? What, exactly, can the user do with this procedure or equipment?
- How much preparation by the user is needed beforehand? How much should the user already know?
- Why does the user need this information? How does this application help the user?
- Where does this application fit within the overall use of the equipment?
- How will graphics and their placement help the reader with comprehension? Will the user find enough tables, charts, graphs, screen captures, or schematics, *along with their explanations*?
- Will the reader find each subheading set up as if it were a response to a question? Can the reader tell whether or not his or her questions were anticipated?

Responding to these questions will help you write an effective application note. **This document benefits from extensive note-taking and/or outlining before it is written.**

General Reference Information

While we will go over the possible formatting for application notes, **you** will decide how best to construct this document. Many examples of well-written application notes exist, so just Google the term or look up any major manufacturer.

Note: *As always, plagiarism in any form will not be tolerated. Keep your data to yourself, and create your own application note from it. These notes will be electronically sorted, scanned, and archived.*

Effective technical documents complete their assigned tasks through anticipating the needs of their audience and follow a logical and easy to read format. Avoid dense text, condescending “tone,” out-of-proportion graphics, or illustrations too complicated for your average reader. Think about flow of ideas and ease of comprehension. Do not forget your audience, but **make no assumptions**. Make every word, diagram, and bit of white space work for your reader. Everything counts.

Bullets will *not* be a crucial part of this application note, so use sparingly, if at all. Effective bulleting requires simple verb-driven language for each item. When they are used, bullets should also be somewhat uniform in length and parallel in structure (verb-subject-object, etc.).

Your application note should make liberal use of graphics, including, but not limited to, charts, tables, diagrams, schematics, screen captures, and illustrations of the equipment. You are allowed to use illustrations obtained from websites and/or Dr. Brewer’s lab manual, as long as you properly cite your sources.

(See http://upcp.ece.gatech.edu/content/3041/citing_sources.pdf)

You will find student-written examples of application notes on the UPCP website, so be sure to examine these documents. Also, you should find more application notes online and analyze them for content, goals, and formatting.

Application Note

A Variable Q Twin T Active Notch Filter

Objective

To design, simulate, assemble, evaluate, and document a Twin T active notch filter.

Background

A notch filter is a circuit which has a complex transfer function that is zero at a particular frequency known as the notch frequency. The purpose of such a filter is to totally eliminate a sine wave of that particular frequency. Other considerations are how much attenuation and phase shift are imparted to other signals at different frequencies, ease of assembly, and component costs. In most applications, Q would be as large as possible so that only that frequency would be removed. However, it is impossible to make the notch frequency exactly the desired value. Consequently a finite Q may be required to attenuate the component to be rejected.

This exercise will be limited to second-order notch filters. The complex transfer function of a second-order notch filter is

$$T(s) = K \frac{\left(\frac{s}{\omega_o}\right)^2 + 1}{\left(\frac{s}{\omega_o}\right)^2 + \frac{1}{Q} \frac{s}{\omega_o} + 1}$$

where the parameter $f_o = 1/(2\pi RC)$ is the notch frequency in Hertz, K is the dc and high frequency gain, and Q is the quality factor of the filter. Both K and Q are dimensionless; K may be either positive or negative but Q is constrained to be negative. At the notch frequency the numerator of the transfer function is zero which makes the linear gain zero at that frequency (or minus infinity if the gain is expressed in decibels). The amount of gain and phase shift imparted to the other frequencies is determined by K and Q .

Shown in Fig. 1 is a Twin T notch filter. It consists of a high-pass filter in parallel with a low-pass filter each of which is known as a T filter because the circuit schematic looks like a capital letter T. It is a second-order filter which has a notch frequency in Hertz of $f_o = 1/(2\pi RC)$. At this frequency the complex transfer function is zero. A potentiometer is used so that the output of this potentiometer is αV_o . When the wiper for the potentiometer is at the ground $\alpha = 0$ and when at the top $\alpha = 1$.

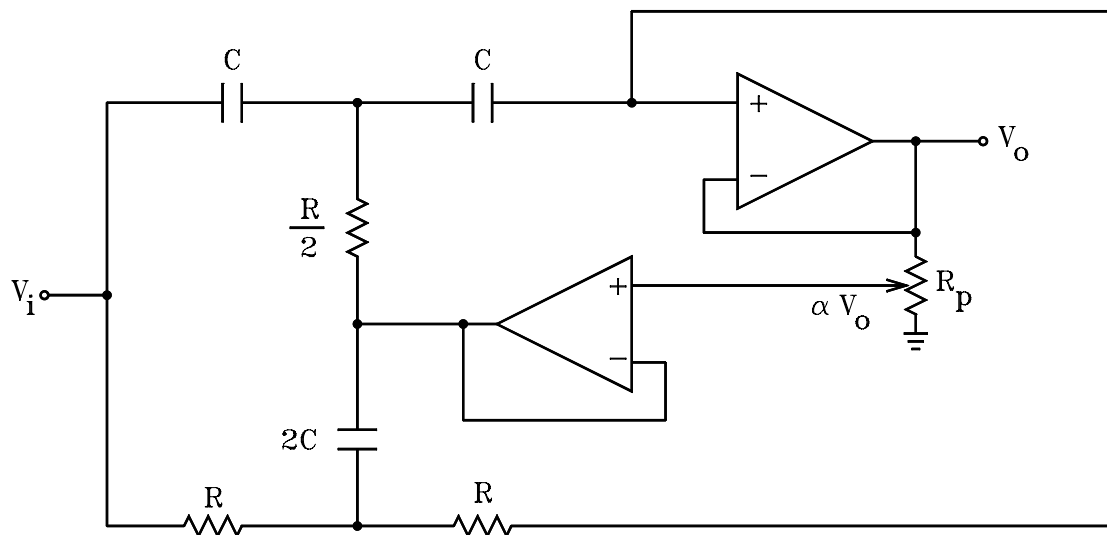


Fig. 1 Twin T Notch Filter

The K for this filter is one and the Q is

$$Q = \frac{1}{4(1 - \alpha)}$$

which permits the Q to be varied from the minimum value of 0.25 when the wiper of the potentiometer to infinity when the wiper is at the other extreme. Non ideal components and op-amps would, of course prevent a Q of infinity.

The components must be matched as shown in Fig. 1 or the notch will not be obtained or will have a linear gain of more than zero or not at the frequency f_o or the performance will otherwise be impaired. It is assumed that the load on the filter (the impedance from the output terminal to ground) is infinite, viz an open circuit.

Specifications

Design a second-order Twin T notch filter with a notch frequency equal to the experimenter's birthday in kHz. Pick practical values for the circuit components.

Procedure

Perform a SPICE simulation of the designed circuits using either Cadence or National Instruments SPICE. The appropriate analysis is AC. The start and stop frequencies should be one decade above and below the notch frequency. The number of points used should be large enough to display the notch. Plot both the magnitude (both linear and decibels) and phase of the filters. Plot the response for several representative values of the potentiometer setting α .

Make the same plots with Mathcad that were made with SPICE.

Assemble the designed circuit and measure the actual value of the circuit components with the Philips RLC meter.

Measure the frequency response of the designed circuit for several representative value of α . It is only necessary to obtain the amplitude response. If the automated measurements programs are used, select enough points to adequately display the response near the notch.

Manually measure the response at the notch frequency and record the actual depth of the notch. Measure the half-power bandwidth.

Set the function on the function generator to square, the frequency to the notch frequency, and the amplitude to 2V peak-to-peak. Observe and plot the output waveform. Change the frequency of the function generator to one tenth of the notch frequency and repeat. Change the frequency of the function generator to ten times the notch frequency and repeat.

Set the function generator to produce noise and examine the spectra of the output with the oscilloscope. Note the effect of varying the potentiometer.

Report

The report should be written in the specified format. It should include the design calculations, all computer simulations, analysis, and experimental measurements.

Explain the waveforms at the output of the filter when square waves of different frequencies were applied to the input. Explain the output spectra when the input is noise.

Discuss advantages passive notch filters have over active notch filters and vice versa.

Discuss a practical application for such a filter.

Discuss how the performance of this circuit could be improved.

Discuss anything unusual or unexpected that occurred.

Georgia Institute of Technology

School of Electrical and Computer Engineering

ECE 3042

Microelectronic Circuits Laboratory

Verification Sheet

NAME: _____ STUDENT NO: _____

Writing Assignment 2: Variable Q Twin T Active Notch Filter

Procedure	Time Completed	Date Completed	Verification (Must demonstrate circuit)
Measurement of Component Values			
Frequency Response for Several Pot Settings			
Measurement of Notch Frequency, Depth of Notch, and Half-Power Bandwidth			
Square Wave Responses			

To be permitted to complete the experiment during the open lab hours, you must complete at least **four** procedures during your scheduled lab period or spend your entire scheduled lab session attempting to do so. A signature below by your lab instructor, Dr. Brewer, or Dr. Robinson permits you to attend the open lab hours to complete the experiment and receive full credit on the report. Without this signature, you may use the open lab to perform the experiment at a 50% penalty.

SIGNATURE: _____ DATE: _____