rf_opamp.doc

print name (first last): _____

course: EET 257 Lab #: 10

lab date (mo/day/yr):_____

lab section (day time):_____

instructor: _____

High Frequency Op Amp Performance

Performance Checks

_____ 1 RF fabricated current feedback op amp circuit's f_H ()

_____ 2. MAR Amp performance

_____ 3. CLC 449 performance

Prelab Calculations

1. Answer the following questions about the current feedback op amp (LT1227) used in circuit Figure 1.

   a. bandwidth f_H = _____

   b. output amplitude at f_H = _____V_{RMS}

Objectives

Evaluate the frequency response and the response to a step of a current feedback op amp (LT1227) noninverting amplifier. Compare the responses when the circuit is built using a protoboard and when the circuit is built using proper rf techniques.

Approach and Results

1. Current Feedback Op Amp Amplifier's Frequency Response

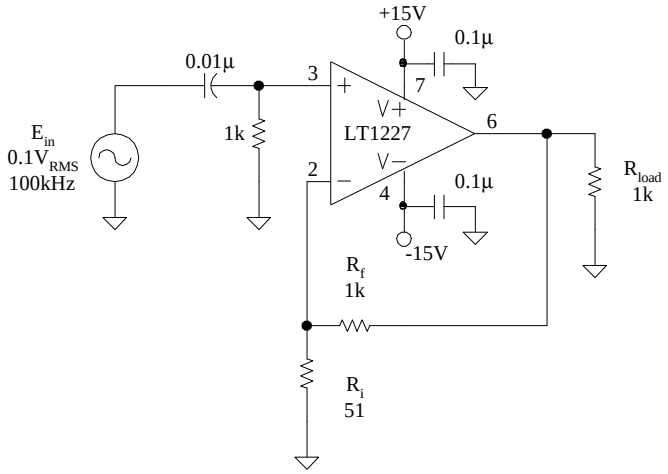


Figure 1 Current feedback op amp amplifier

a. Assure that your computer and monitor are turned *off*.

b. Build the current feedback op amp circuit in Figure 1 using your old white protoboards that you have used in the previous EET courses. You may use whatever breadboarding techniques which you have used in previous low frequency applications. You may connect the signal generator with alligator clips or bare wires.

c. Apply the following sine wave to your current feedback op amp noninverting amplifier, from the Fluke 6061A Synthesized RF Signal Generator. Beware, the generator expects a 50Ω termination, so adjust the amplitude, so that the signal measured at the op amp's input is correct.

$0V_{DC}$
$0.28V_{PP}$ (i.e. $100mV_{RMS}$)
100kHz

c. Verify that the input and output are properly displayed and measured on the oscilloscope in the time domain.

$V_{out\ RMS}$ = _____ $V_{out\ DC}$ = _____ phase = _____ gain = _____

Do *not* go on until your amplifier is working properly.

If at any point the signal becomes significantly distorted, capture that waveform and skip to the step f.

d. *Measure* the input with the oscilloscope on the protoboard, at the point where the input signal is connected to the board. Then move the wire to the oscilloscope and measure the output at the output of the op amp. Complete the measurements and the calculations at one frequency before moving to the next.

frequency MHz	input V_{rms}	output V_{rms}	gain dB	comment
0.1				
1.0				
2.0				
4.0				
8.0				
10.0				
20.0				
30.0				
40.0				
50.0				
60.0				
70.0				
80.0				
90.0				
100.0				
f_H				

Table 2 Current feedback op amp amplifier frequency response

e. In the comment column of Table 3, indicate the following:

1) f_H the frequency closest to where the gain has fallen by 3dB.

2) the frequency at which the gain peaks to its largest value.

f. Build the current feedback op amp circuit in Figure 1 using your rf breadboarding techinque. Be sure to make proper use of the ground plane, keep all leads as short as possible, and use BNC connectors and cables to bring signals onto and off of your board.

g. Repeat the measurements made above for this rf breadboard version of the circuit.

frequency MHz	input V_{rms}	output V_{rms}	gain dB	comment
0.1				
1.0				
2.0				
4.0				
8.0				
10.0				
20.0				
30.0				
40.0				
50.0				
60.0				
70.0				
80.0				
90.0				
100.0				
f_H				

Table 3 Current feedback op amp amplifier frequency response

h. In the comment column of Table 3, indicate the following:

1) f_H the frequency closest to where the gain has fallen by 3dB.

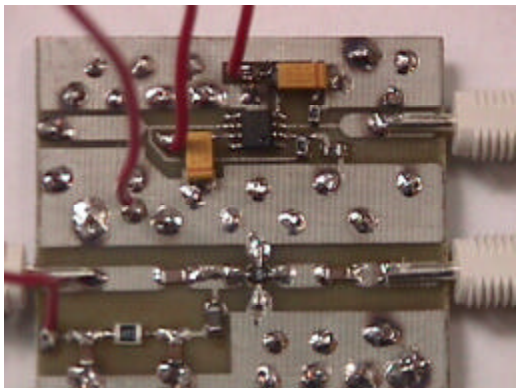
2) the frequency at which the gain peaks to its largest value.

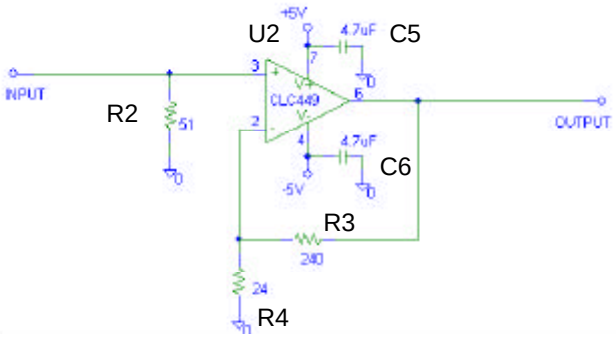
Demonstrate your circuit's performance at f_H, and the table to your instructor.

2.Surface MountedRF Op Amplifier

1. In the photo below, identify and label each of the following. (warning: the board may be oriented on the bench differently than it is in the photograph.)

   common +5V -5V input output R2 R3 R4 C5 C6





2. With the board disconnected from the supplies, verify that the power supplies are properly set to ±5V. Turn the power supply off.
3. Connect +5V is to pin 7 and –5V to pin 4.
4. Connect the input to the synthesizer with the *RF OUTPUT disabled*.
5. Apply power to the surface mount board. Measure to following DC voltages.

   V+ on the board = _____ V- on the board = _____ op amp output = _____

Do not continue until you are sure the bias is correct.

5. Disable the 50Ω feature on the channel 1 input of the oscilloscope. Connect a x 10 probe to channel 1.
7. Set the synthesizer to 10mV_{rms}, 50 MHz.
8. Measure the rms of the input and the output on the oscilloscope.
9. When the amplifier is working correctly, complete the following frequency response measurements.

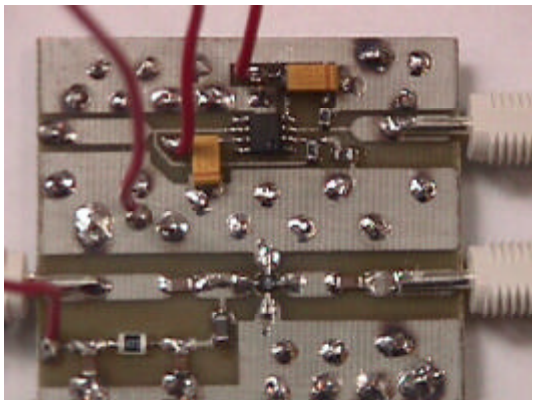
Frequency (MHz)	V_{out} (mV_{rms})	Gain (dB)
50		
100		
120		
140		
160		

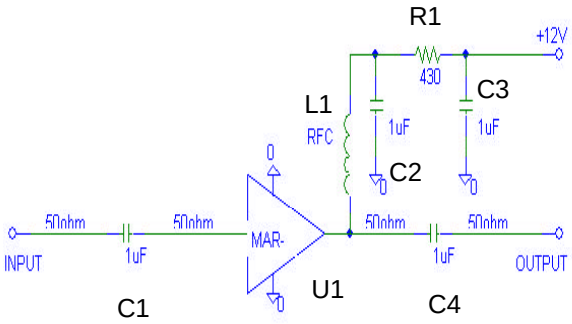
10. Find the high frequency cut-off. F_H = _____ Instructor's initials _____
11. Calculate the op amp's gain bandwidth GBW = _____

3. MAR-1 Amplifier

1. In the photo below, identify and label each of the following. (warning: the board may be oriented on the bench differently than it is in the photograph.)

common +12V input output C1 C2 C3 C4 L1 R1





2. Verify that the power supply is correctly set to +12V

3. Apply power to the surface mount board. Measure to following DC voltages.

V+ on the board = _____ junctioin of R1 & L1 = _____ MAR output = _____

Do not continue until you are sure the bias is correct.

4. Enable the 50Ω feature on the channel 1 input of the oscilloscope.

5. Set the synthesizer to $10mV_{rms}$, 50 MHz.

6. Measure the rms of the output on the oscilloscope.

7. When the amplifier is working correctly, complete the following frequency response measurements.

Frequency (MHz)	V_{out} (mV_{rms})	Gain (dB)
50		
100		
200		
300		
400		

8. Find the high frequency cut-off. F_H = _____ Instructor's initials _____

9. What is the oscilloscope's maximum frequency? How valid is your measurements in step 8?

Analysis and Conclusions

1. Protoboard Frequency Response
   a. How well did the amplifier perform at 100kHz. Express your answer in a table with theory, actual, and % error in the appropriate place in the Approach and Data.
   b. Complete Table 2 & 3 with *Excel*. Also, provide a ***plot*** of the gain versus frequency. Be sure to scale the horizontal axis logrithmically. Include theses in the appropriate place in the Approach and Data.
   c. Calculate the circuit's bandwidth, and compare it to the typical specification in a table.
   d. Discuss the ***shape*** of each frequency response plot.
   e. Discuss the effect the prototyping techniques had on the circuit's performance.
2. Surface Mounted RF Amplifiers
   a. Include the data that you recorded for each of the two amplifiers.
   b. If there was any distortion, include the screen captures.
   c. Discuss the performance of each of the two surface mounted amplifers.