Protecting Low Voltage ADC - Improved Solution

TI Precision Labs – ADCs

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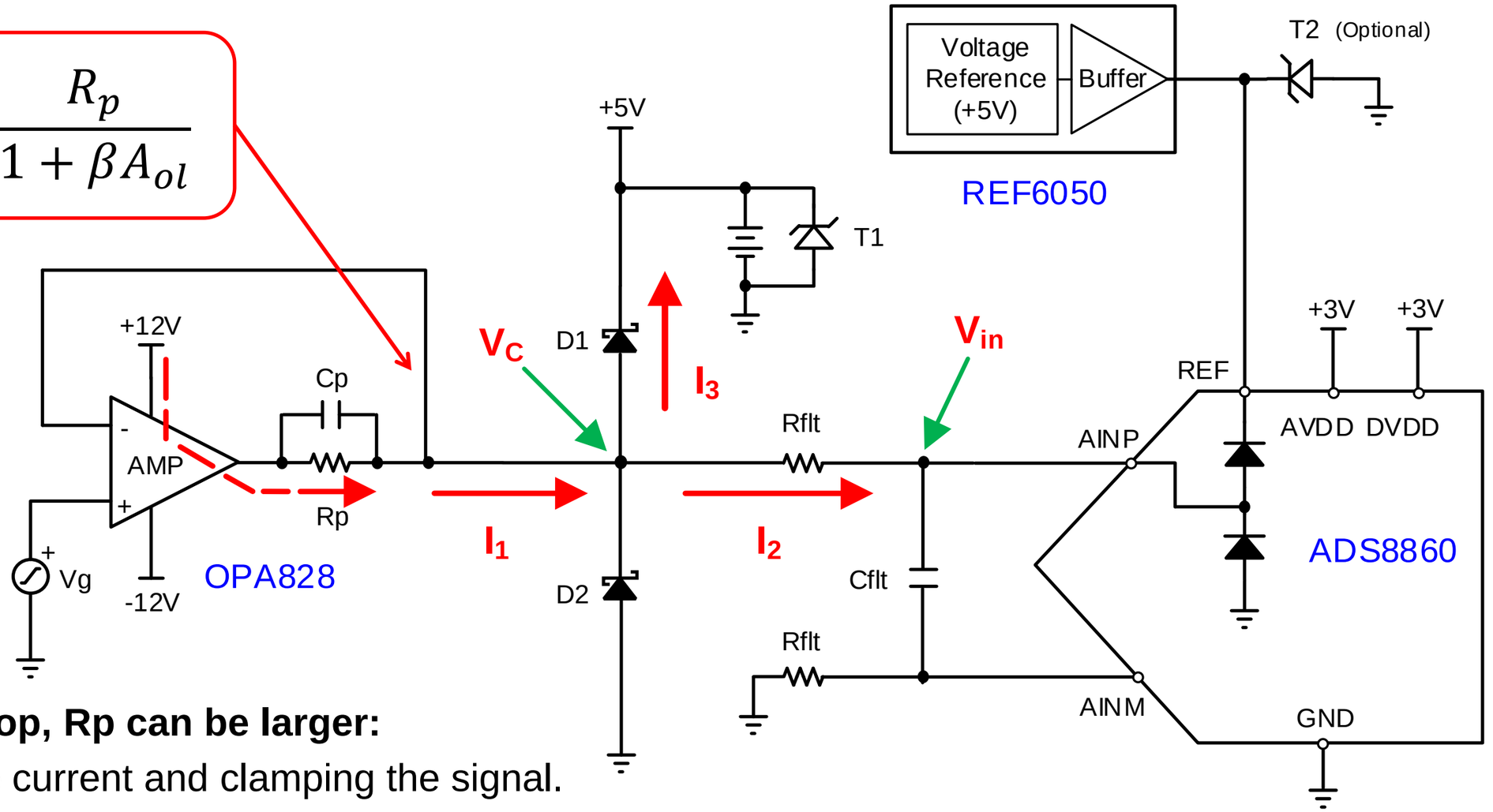
Solution to Improve Settling

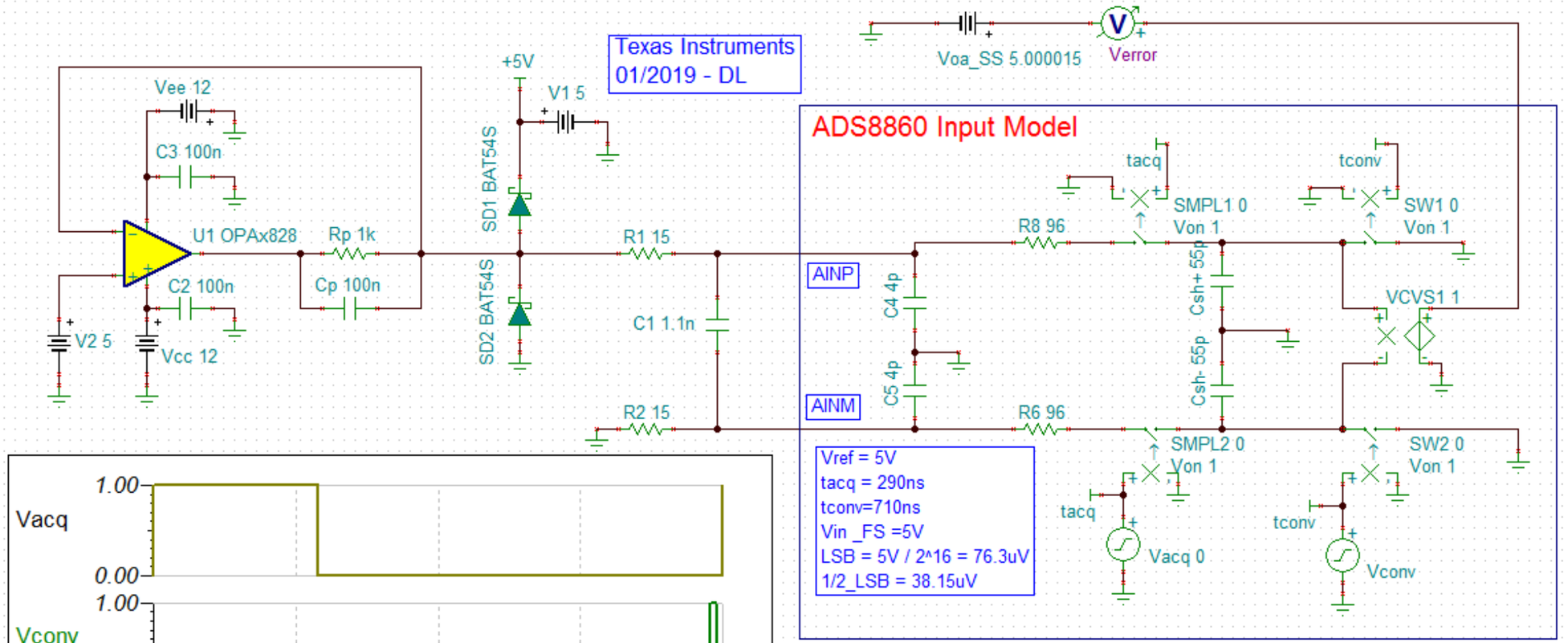
$$Z_{Out(Rp)} = \frac{R_p}{1 + \beta A_{ol}}$$

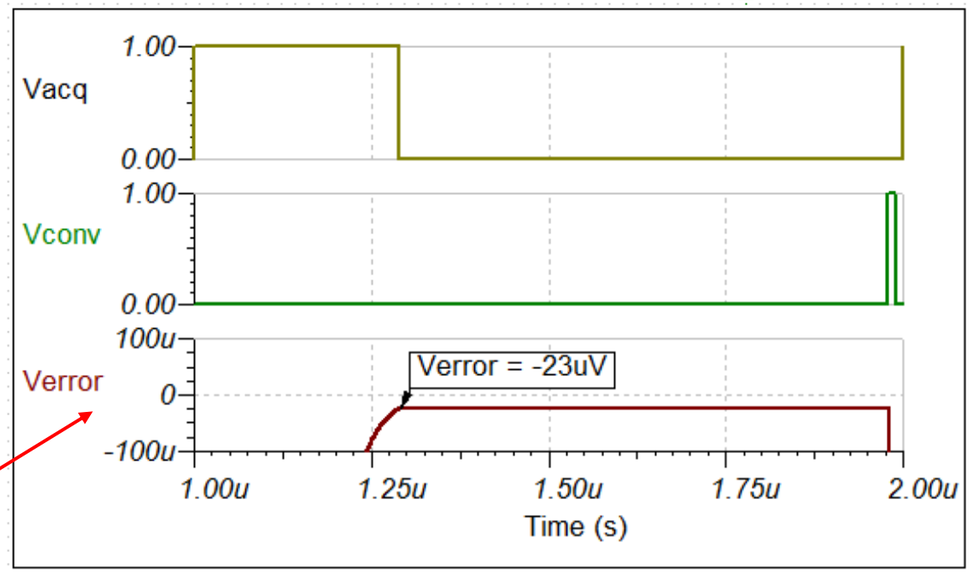


Within the feedback loop, Rp can be larger:

- Better for limiting the current and clamping the signal.
- No impact on settling the signal on the sample-hold capacitor of the ADC.
- A small size and low power dissipation resistor can be used.

TINA Simulation for Improved Solution





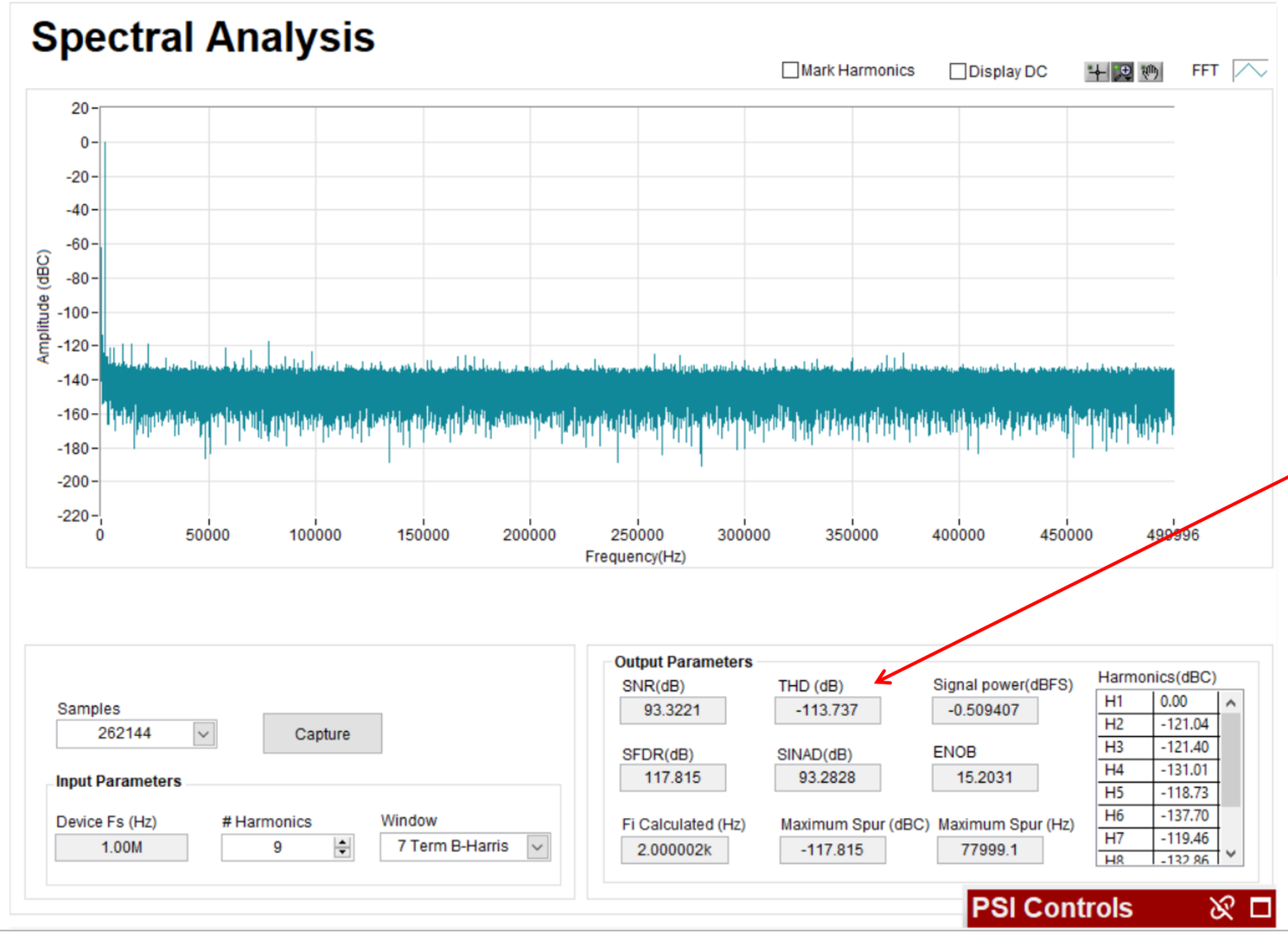
1. 1Msps ADC sampling rate.
2. At end of Vacq, Verror = -23.1uV -> 0.3LSB !!

The settling error target is 38µV, so -23µV meets the requirement.

ADS8860_OPA828_BAT54_Improved Solution.TSC

Hardware Performance Check for Improved Solution

(BAT54, Riso=1kΩ, C_comp=100nF, Rflt=15Ω, Cflt=1.1nF, OPA828+ADS8860 at 1Msps sampling rate)



ADS8860 Data Sheet (1Msps)

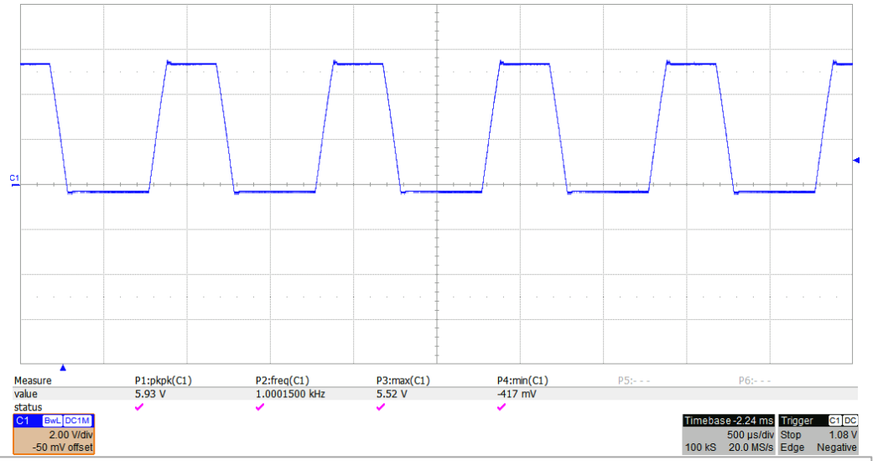
Parameter	Min	Typ	Max	Unit
SNR	92	93		dB
THD		-108		dB

Measured Performance:

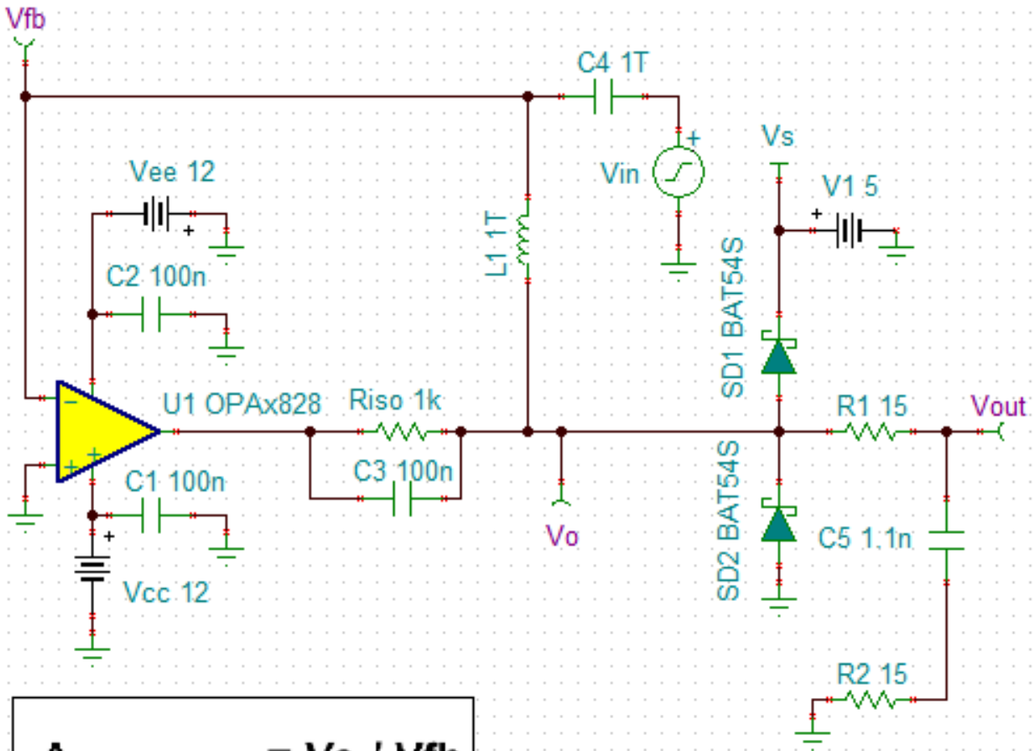
SNR = 93.3dB

THD = - 113.7dB

HV Sinewave Input Signal Clamped:



OPA828 Stability Check - Improved Solution



$A_{OL\_LOADED} = Vo / Vfb$

$1/\beta = 1 / Vfb$

$A_{OL}\beta = Vo$

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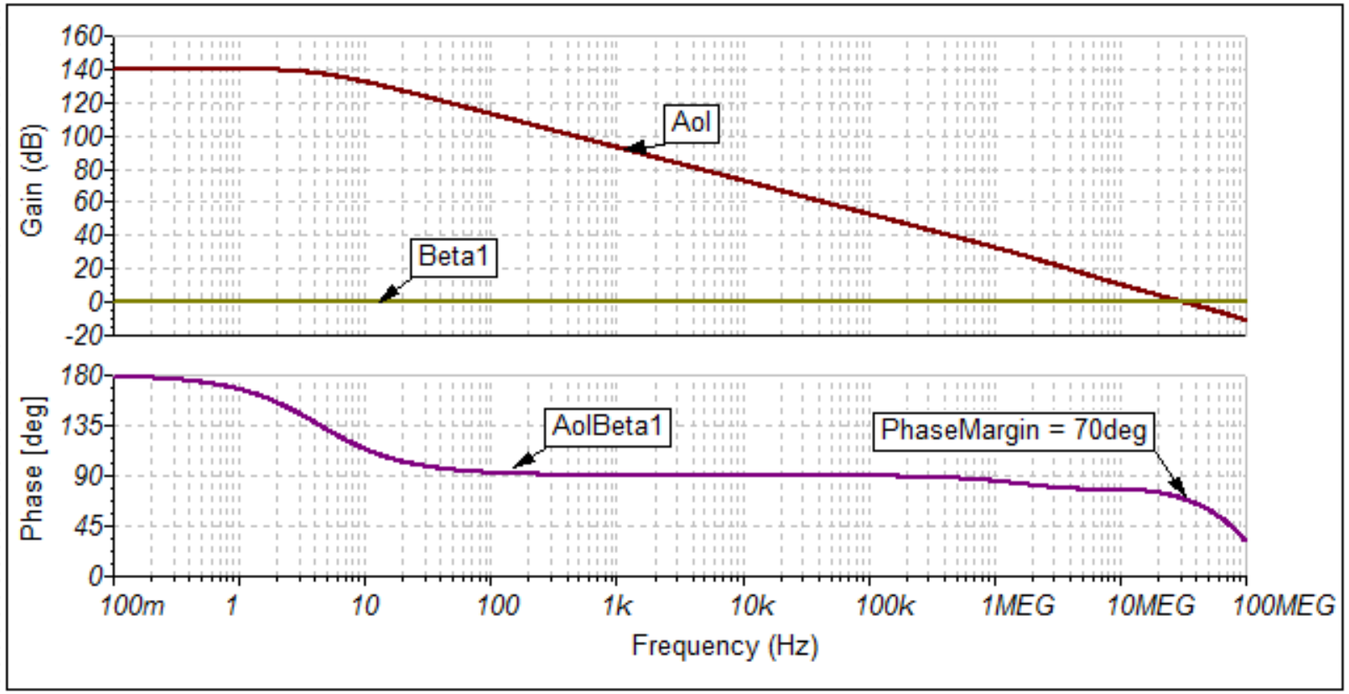
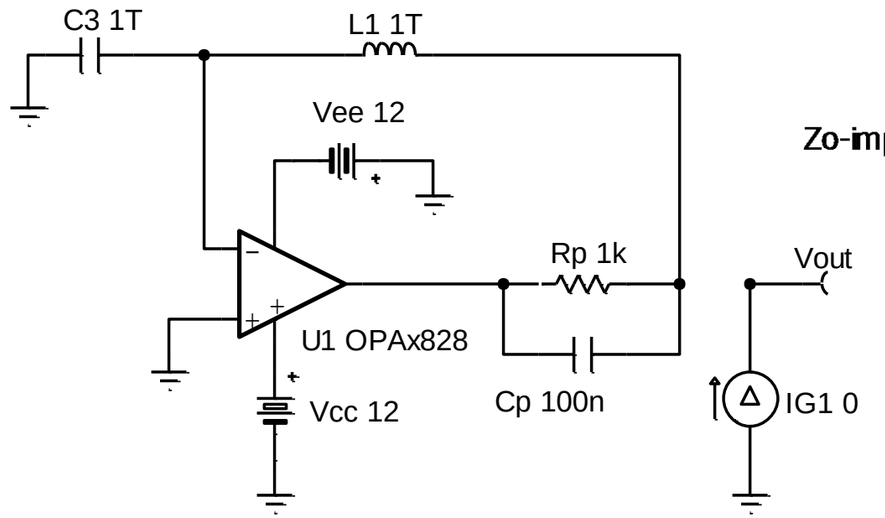
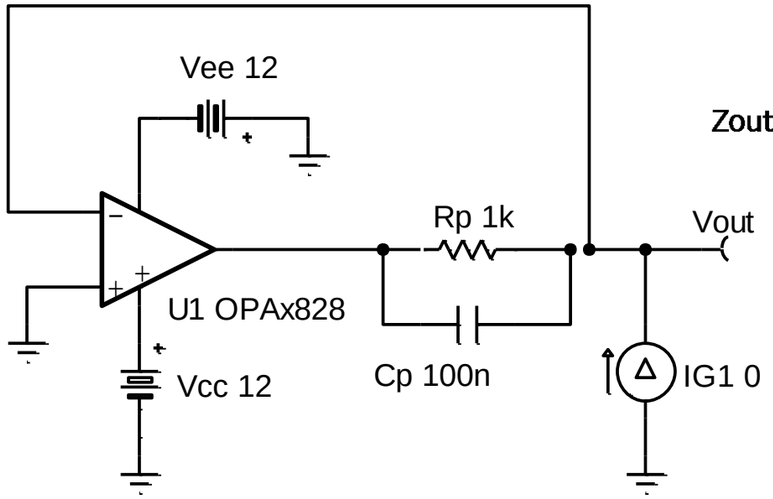


OPA828_Stability Check.TSC

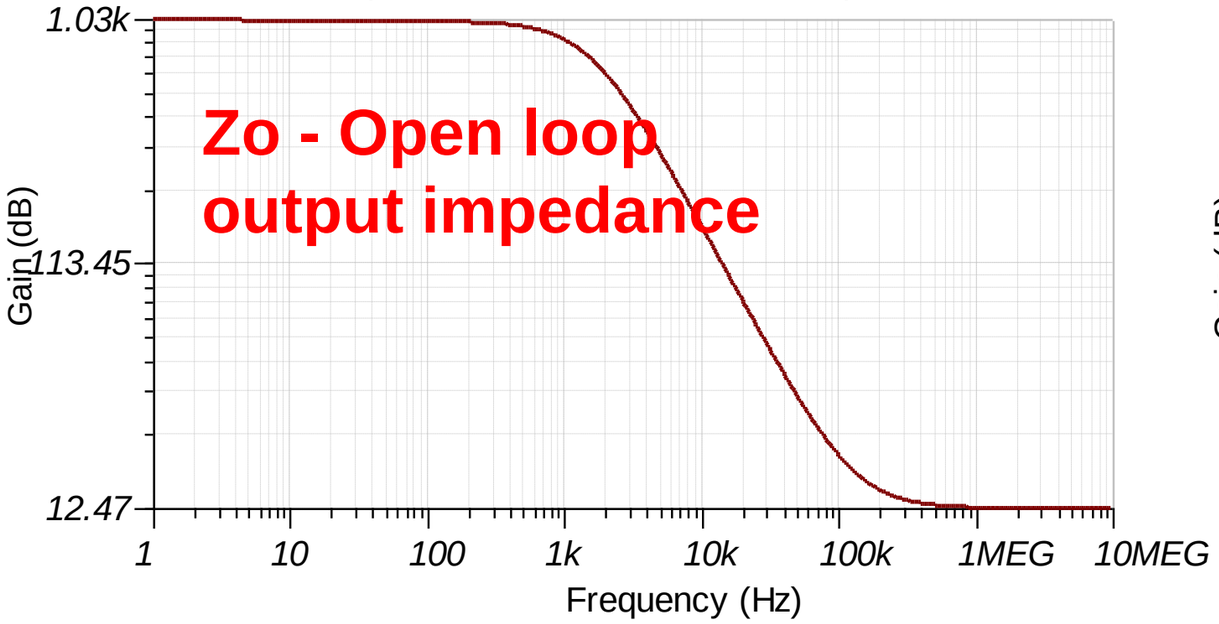
Zo and Zout with Improved Solution



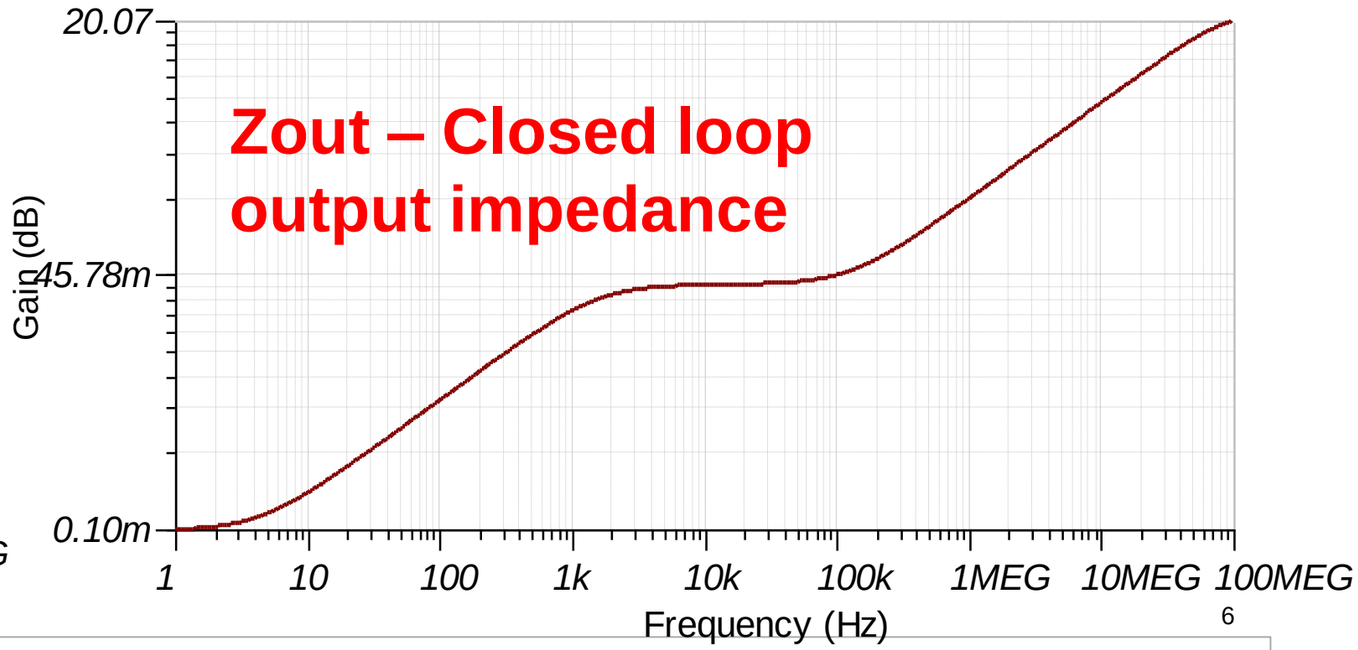
Zo-improved soluiton.TSC



Zout-improved soluiton.TSC



Zo - Open loop output impedance

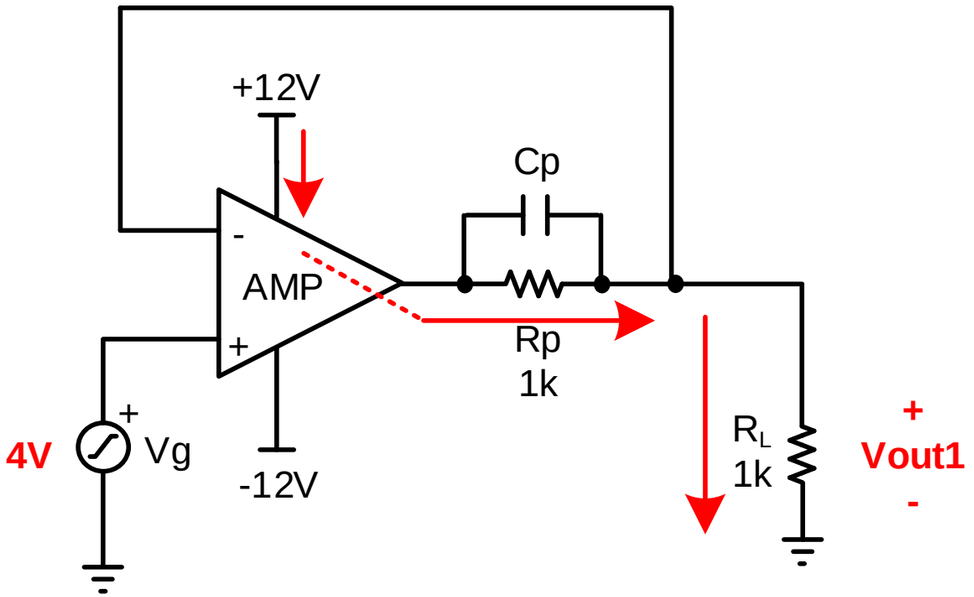


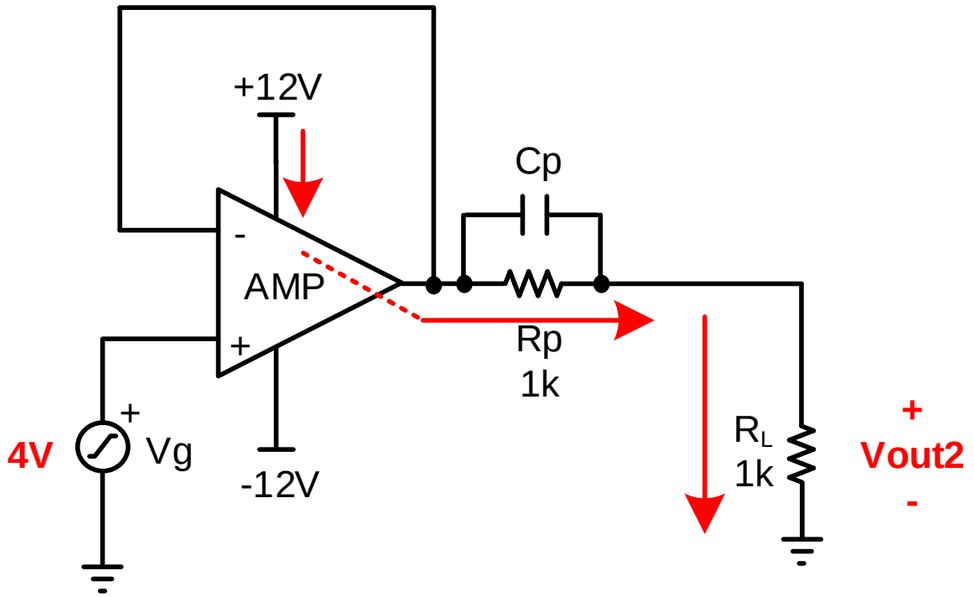
Zout – Closed loop output impedance

Thanks for your time!
Please try the quiz.

Questions: Protecting Low Voltage ADC

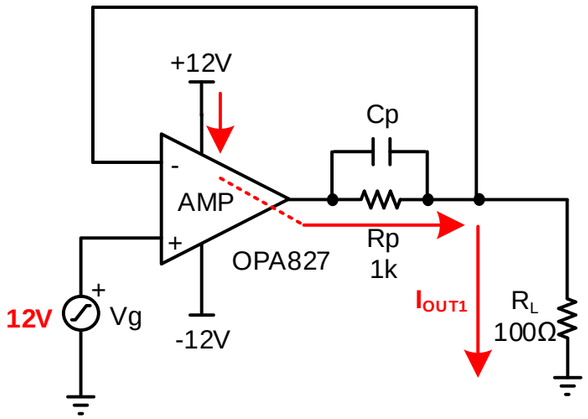
1. For the circuits below, what is the voltage delivered to the load?
   a. Vout1 = 4V, Vout2 = 4V.
   b. Vout1 = 2V, Vout2 = 4V.
   c. Vout1 = 4V, Vout2 = 2V.
   d. Vout1 = 2V, Vout2 = 2V.

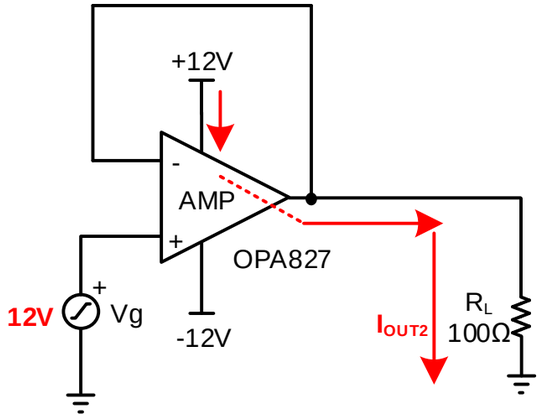




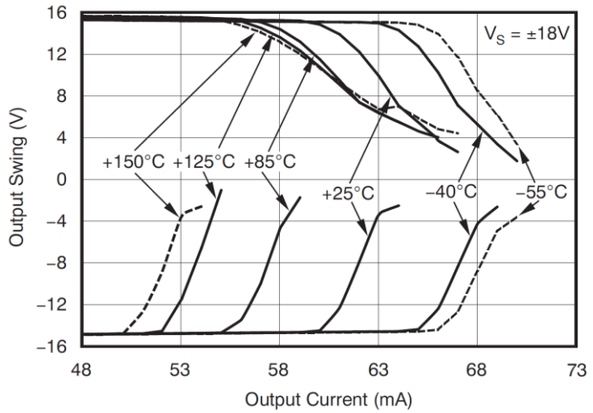
Questions: Protecting Low Voltage ADC

2. For the circuits below, what is the current delivered to the load?
   a. Iout1 = 12mA, Iout2 = 120mA.
   b. Iout1 = 120mA, Iout2 = 120mA.
   c. Iout1 = 12mA, Iout2 = 60mA.
   d. Iout1 = 120mA, Iout2 = 60mA.





OPA827 Output Swing vs. Output Current



Thanks for your time!