

Protecting Low Voltage ADC - Improved Solution

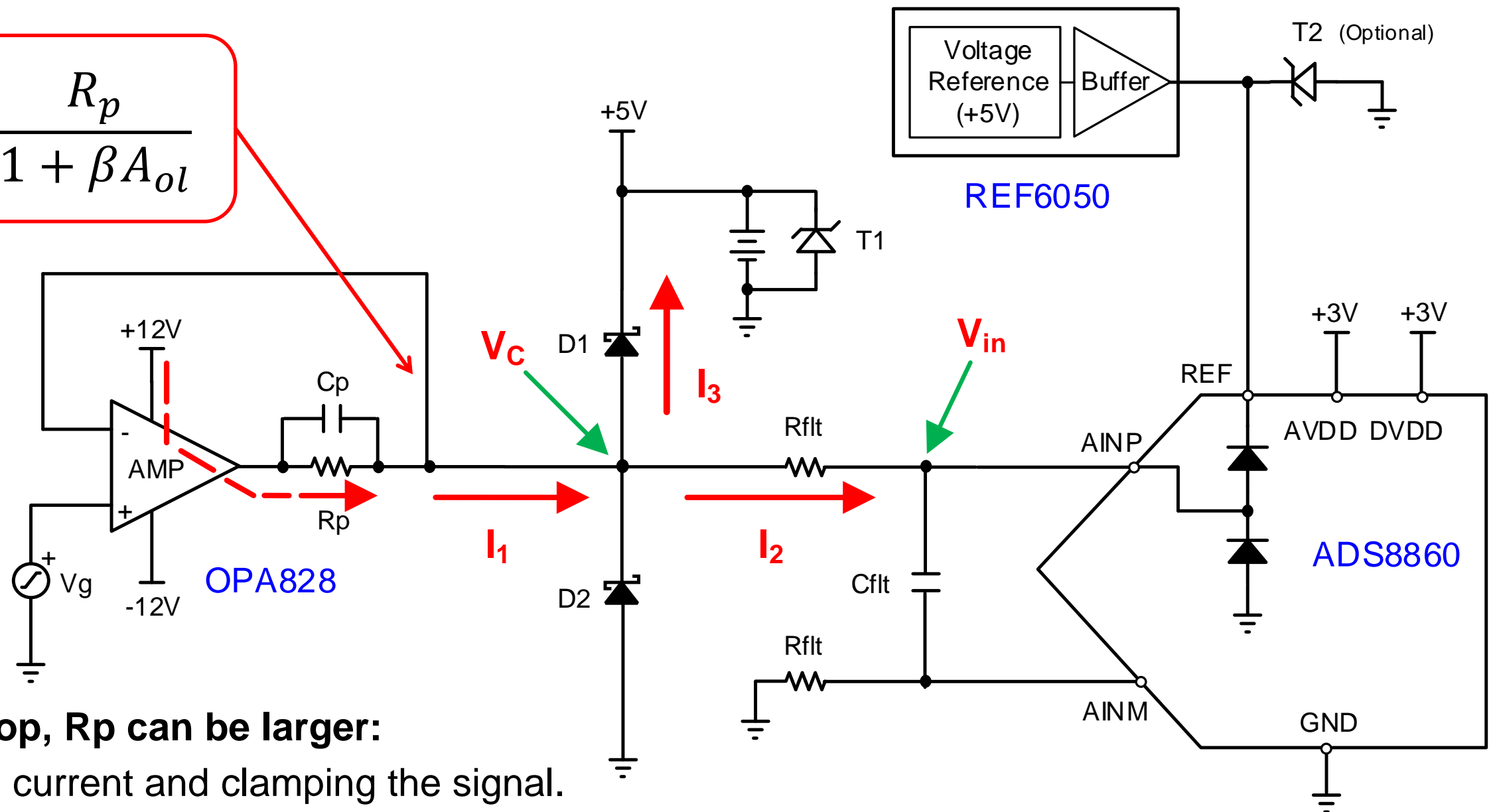
TI Precision Labs – ADCs

Presented by Alex Smith

Prepared by Dale Li

Solution to Improve Settling

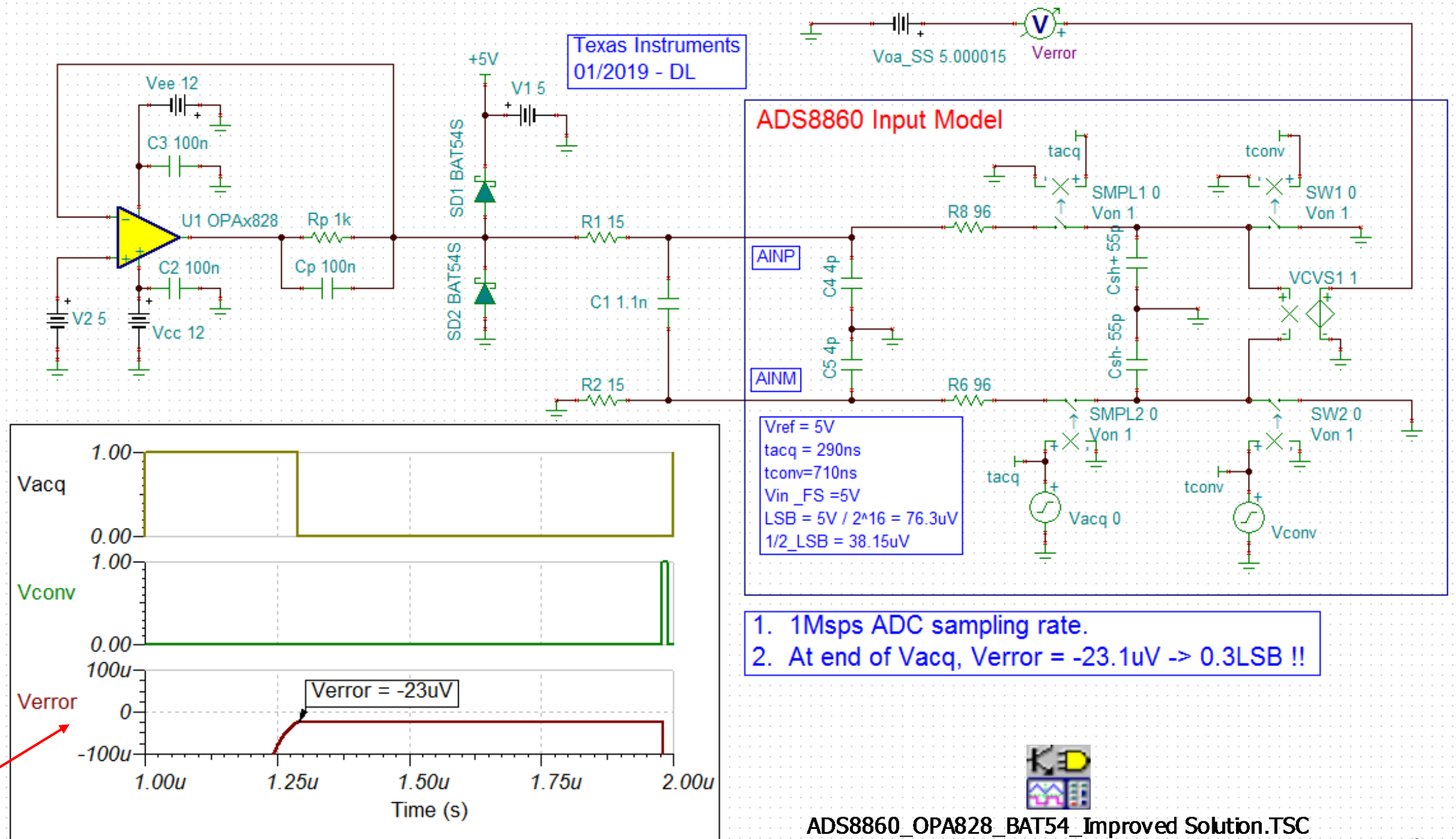
$$Z_{out}(R_p) = \frac{R_p}{1 + \beta A_{ol}}$$



Within the feedback loop, R_p 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



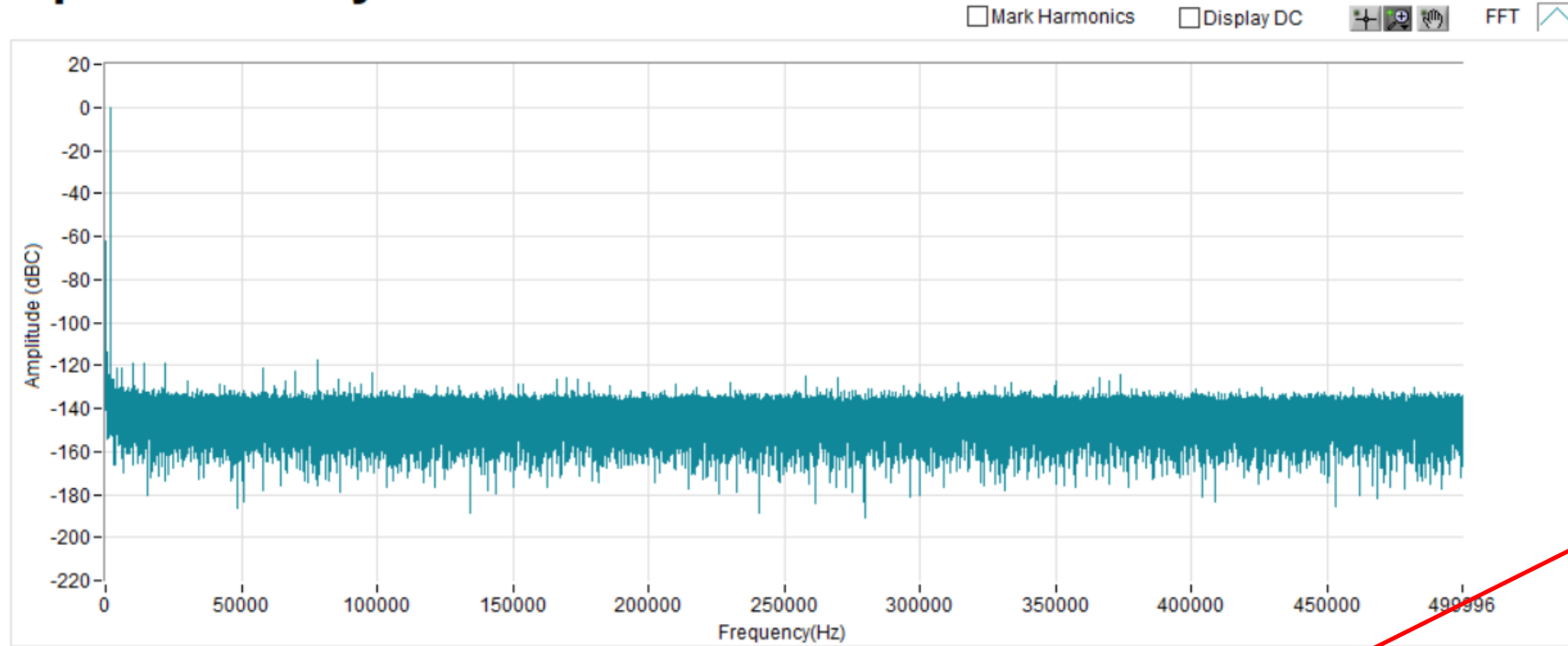
The settling error target is 38μV, so -23μV meets the requirement.

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)

Spectral Analysis



ADS8860 Data Sheet (1Msps)

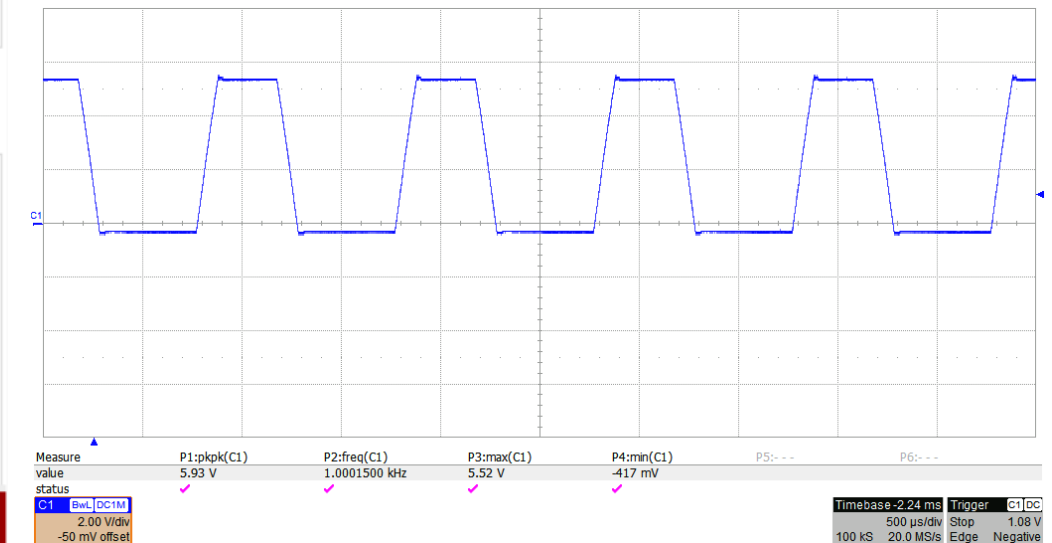
Parameter	Min	Typ	Max	Unit
SNR	92	93		dB
THD		-108		dB

Measured Performance:

SNR = 93.3dB

THD = - 113.7dB

HV Sinewave Input Signal Clamped:



Samples: 262144 Capture

Input Parameters

Device Fs (Hz): 1.00M

Harmonics: 9

Window: 7 Term B-Harris

Output Parameters

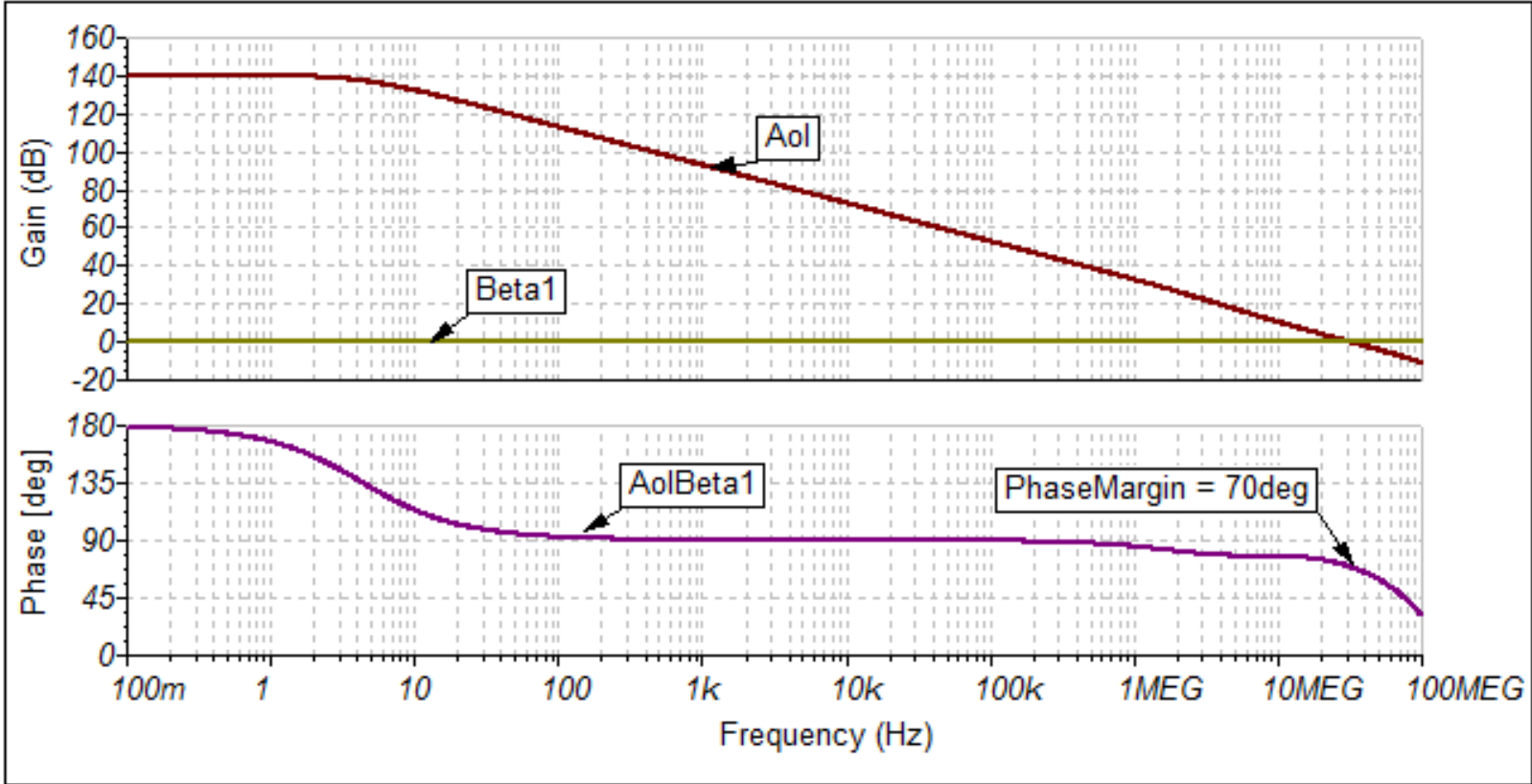
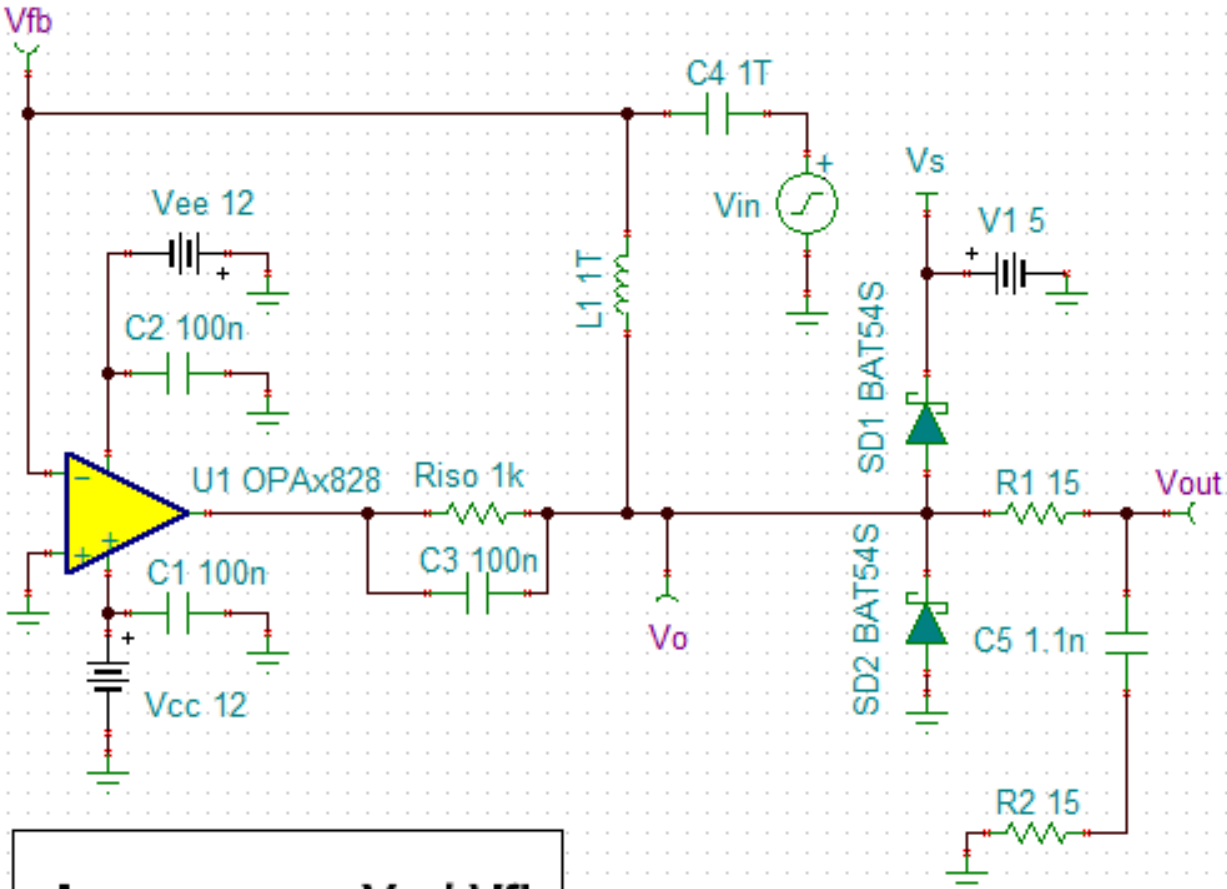
SNR(dB)	THD (dB)	Signal power(dBFS)
93.3221	-113.737	-0.509407
SFDR(dB)	SINAD(dB)	ENOB
117.815	93.2828	15.2031
Fi Calculated (Hz)	Maximum Spur (dBC)	Maximum Spur (Hz)
2.000002k	-117.815	77999.1

Harmonics(dBC)

H1	0.00
H2	-121.04
H3	-121.40
H4	-131.01
H5	-118.73
H6	-137.70
H7	-119.46
HR	-132.86

PSI Controls

OPA828 Stability Check - Improved Solution



$$A_{OL_LOADED} = V_o / V_{fb}$$

$$1/\beta = 1 / V_{fb}$$

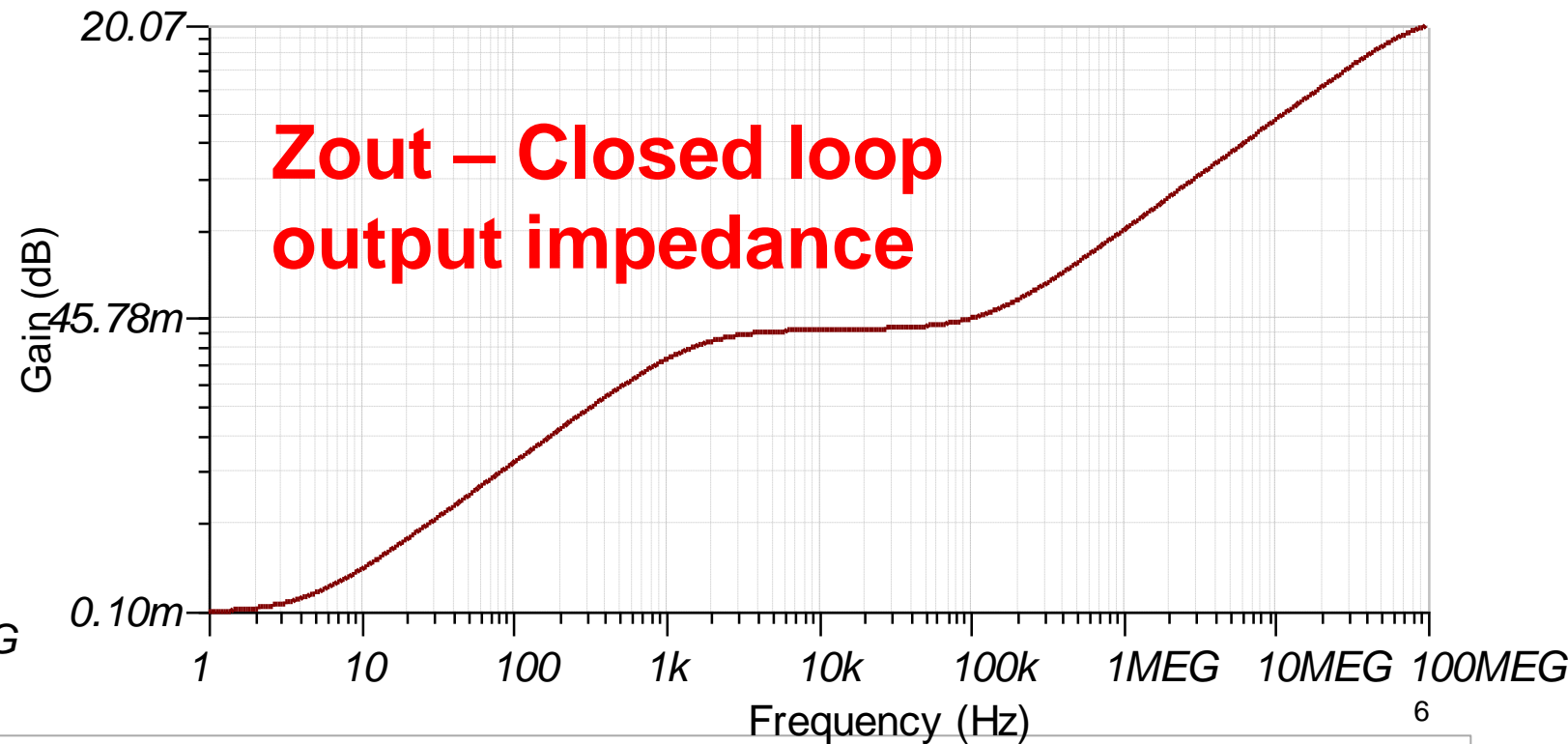
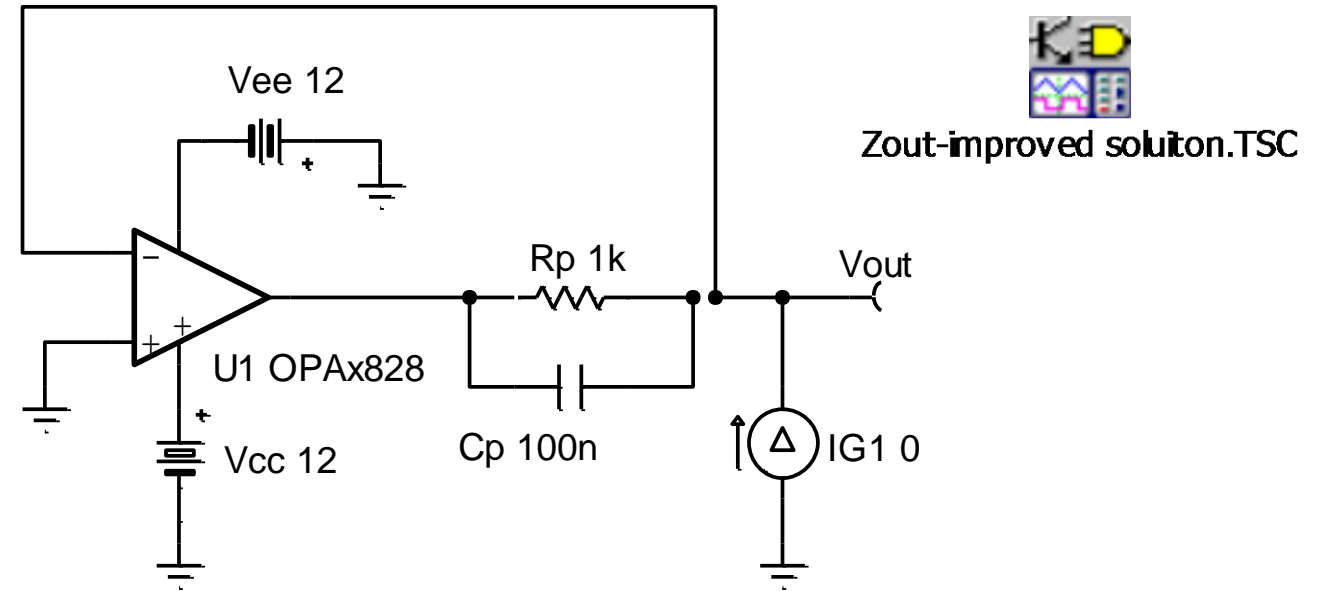
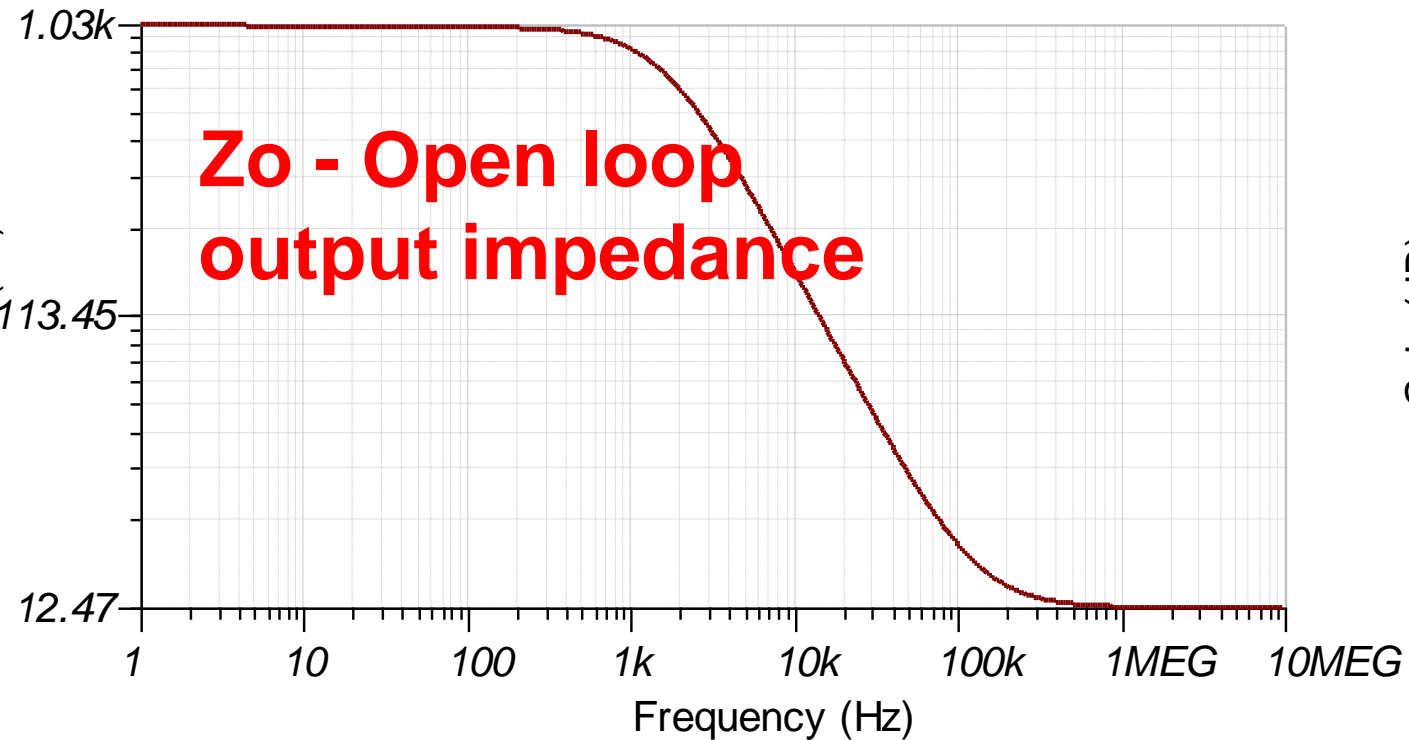
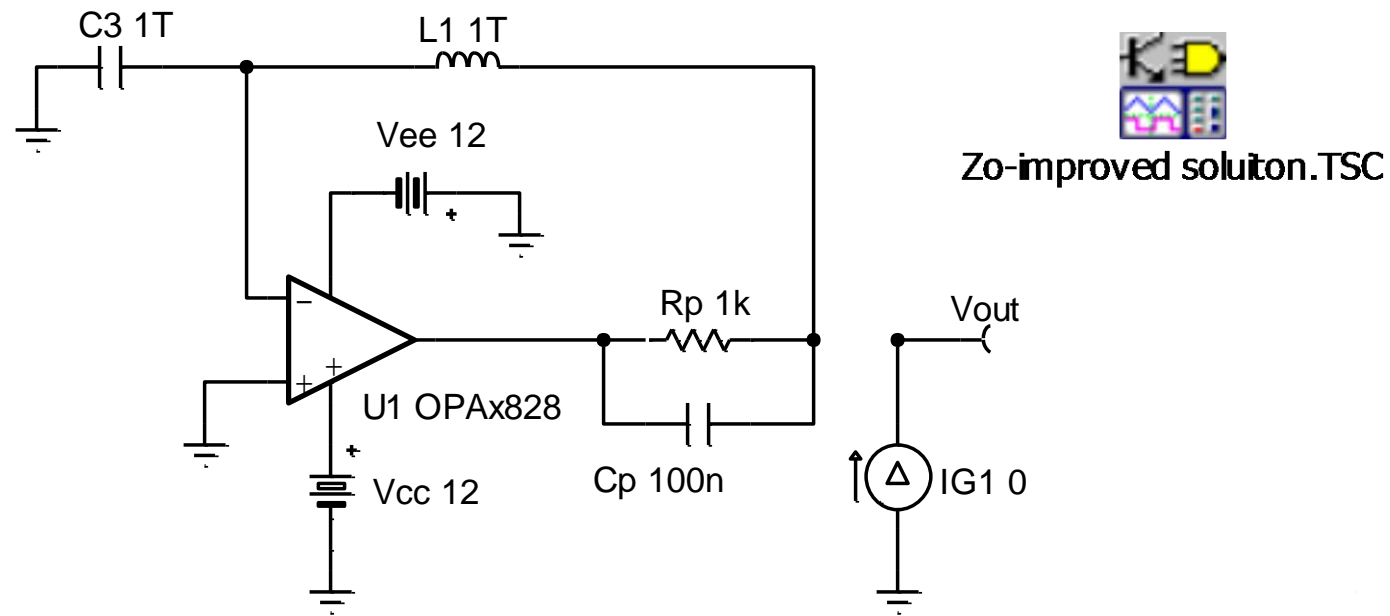
$$A_{OL}\beta = V_o$$

Texas Instruments
01/2019 - DL



OPA828_Stability Check.TSC

Zo and Zout with Improved Solution



Thanks for your time!
Please try the quiz.

Questions: Protecting Low Voltage ADC

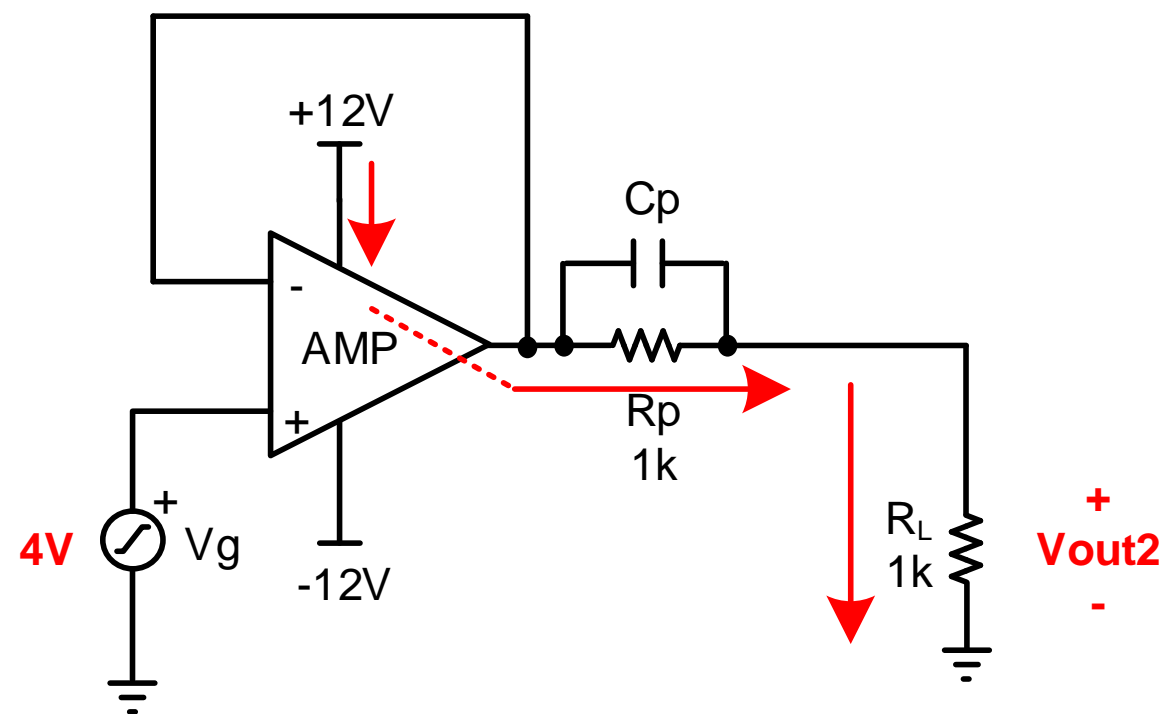
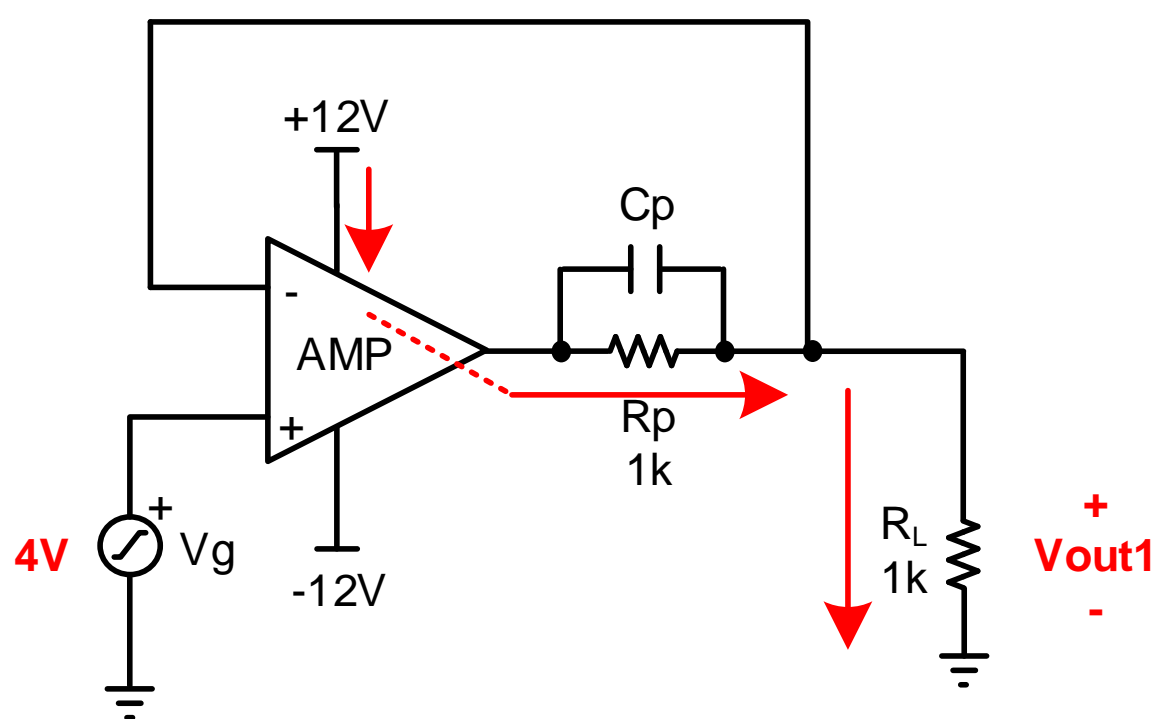
1. For the circuits below, what is the voltage delivered to the load?

a. $V_{out1} = 4V$, $V_{out2} = 4V$.

b. $V_{out1} = 2V$, $V_{out2} = 4V$.

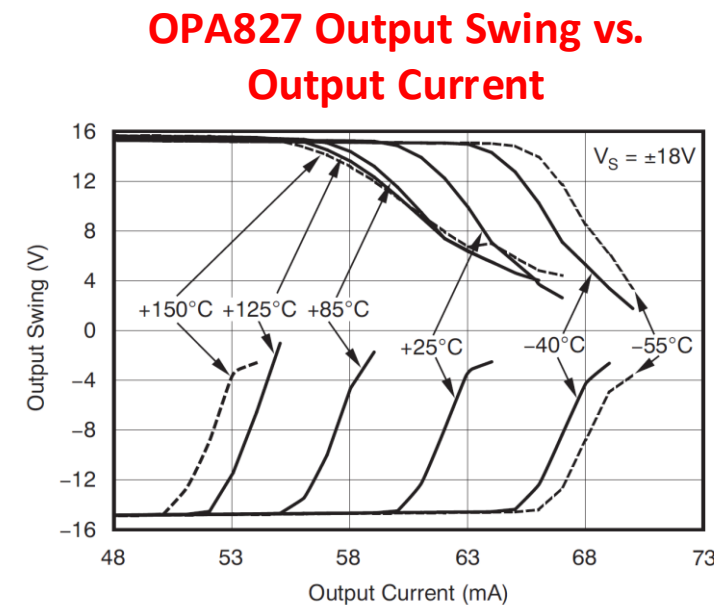
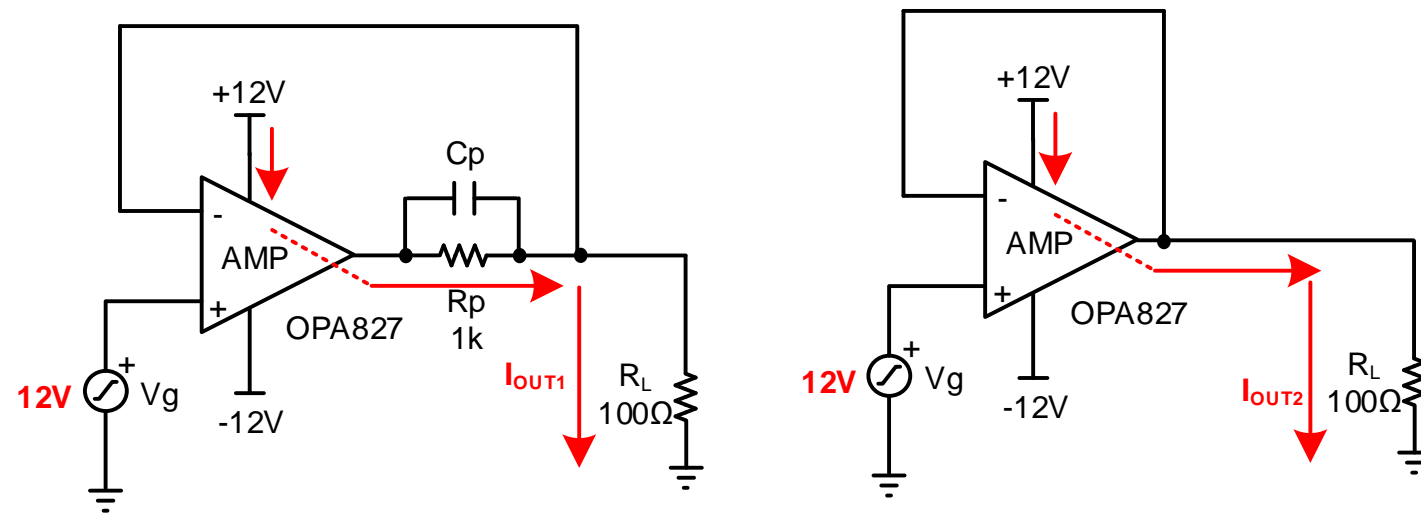
c. $V_{out1} = 4V$, $V_{out2} = 2V$.

d. $V_{out1} = 2V$, $V_{out2} = 2V$.



Questions: Protecting Low Voltage ADC

2. For the circuits below, what is the current delivered to the load?
- a. $I_{out1} = 12\text{mA}$, $I_{out2} = 120\text{mA}$.
 - b. $I_{out1} = 120\text{mA}$, $I_{out2} = 120\text{mA}$.
 - c. $I_{out1} = 12\text{mA}$, $I_{out2} = 60\text{mA}$.**
 - d. $I_{out1} = 120\text{mA}$, $I_{out2} = 60\text{mA}$.



Thanks for your time!



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