Part I
Ammonia (NH3) Sensor Design
Hua Harry Li, Ph.D

ammonia/ammonium electrode

Cat No. S-05722-16 model 9512BNWP

Ammonia
(NH_3)
Ammonium
(NH_4^+)

1. For both drinking water and wastewater applications
2. EPA-approved for ISE analysis of wastewater
3. The Orion ammonia electrode is extremely durable with a chemical-resistant translucent body.
4. The easy-to-fill electrode comes marked with a fill line to avoid overfilling and to monitor the fill solution level without disassembling the electrode.
5. Membrane replacement options include cost-saving loose membranes or preassembled electrode body with membrane for the convenience of not having to install your own membrane.

20 replacement membranes, preassembled electrode body with membrane, 60-mL of filling solution, and 1-m cable with BNC connector.

620

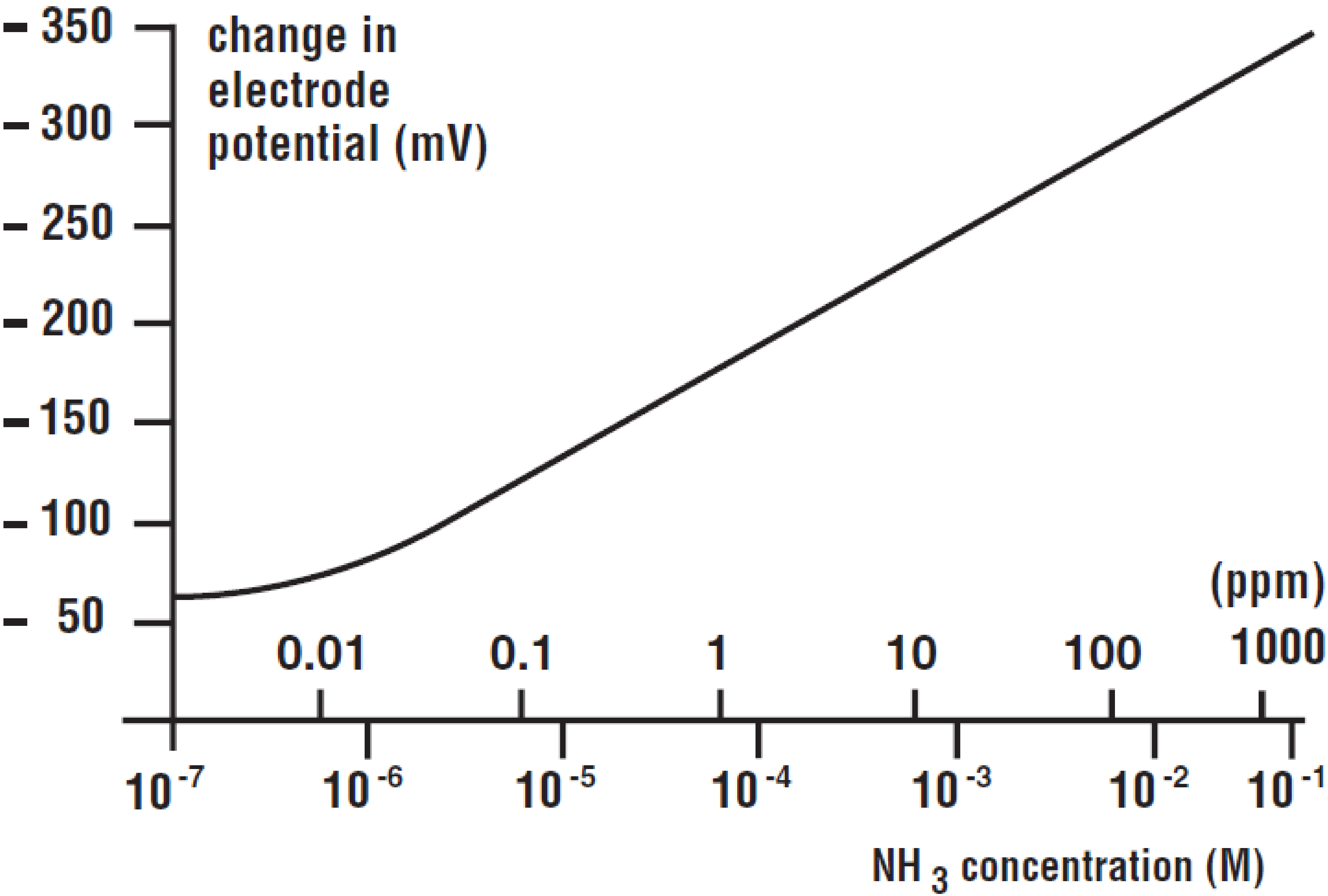
http://www.coleparmer.com/Product/Thermo_Scientific_Orion_ISE_ammonia_ammonium_electrode_with_BNC_connector/EW-05722-16

Ammonia/Ammonium Electrode Technical Specs

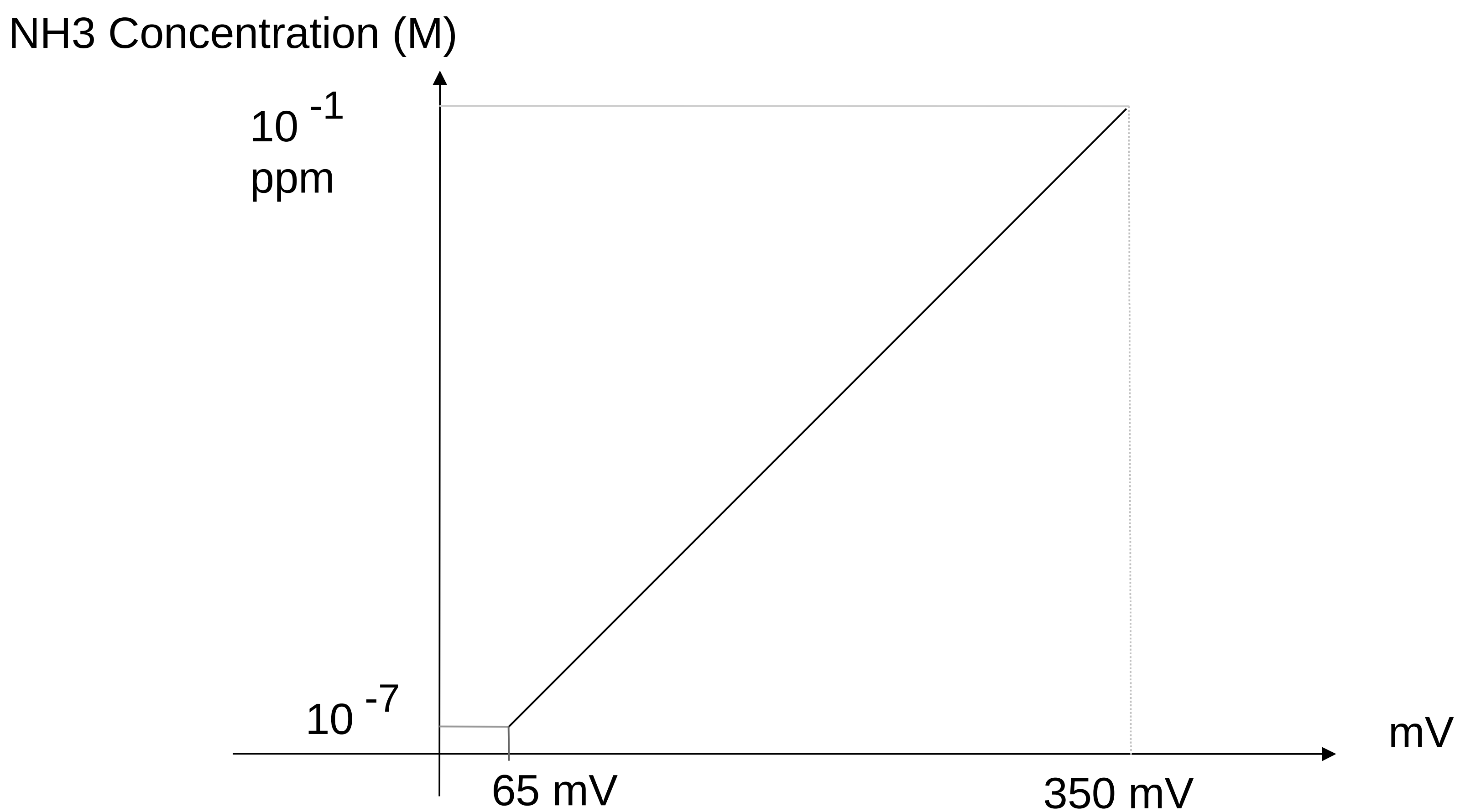
Product Type	Ion-Selective Electrodes, Gas Sensing
Model and connector	9512BNWP; BNC connector
Concentration	5 x 10–7 to 1 M (10.00 to 17,000 ppm)
Temperature	0-60 degree C
pH range	1 – 12
Interference	Volatile amines

1-800-323-4340

Typical NH3 Calibration Curve



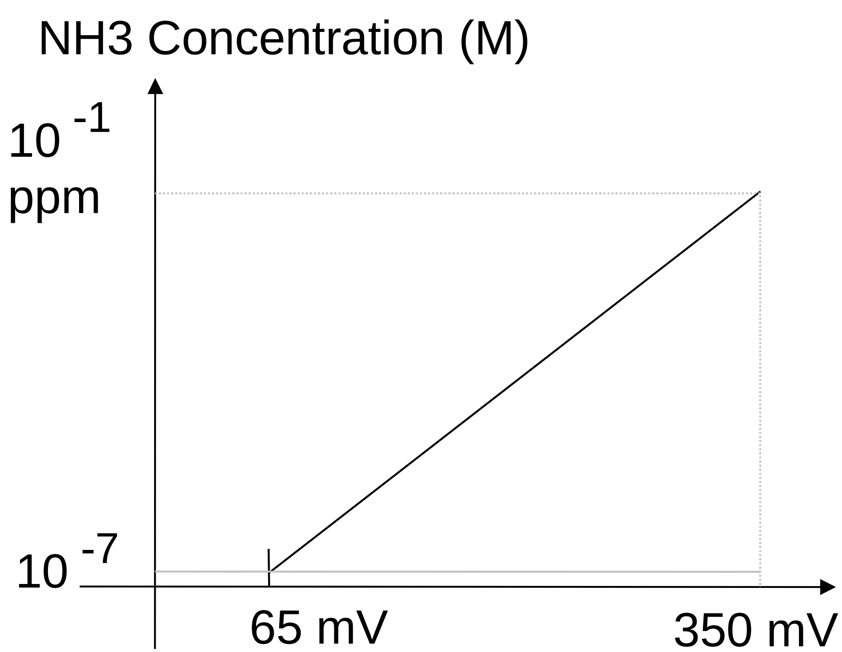
NH3 Electric Characteristics from Calibration Curve



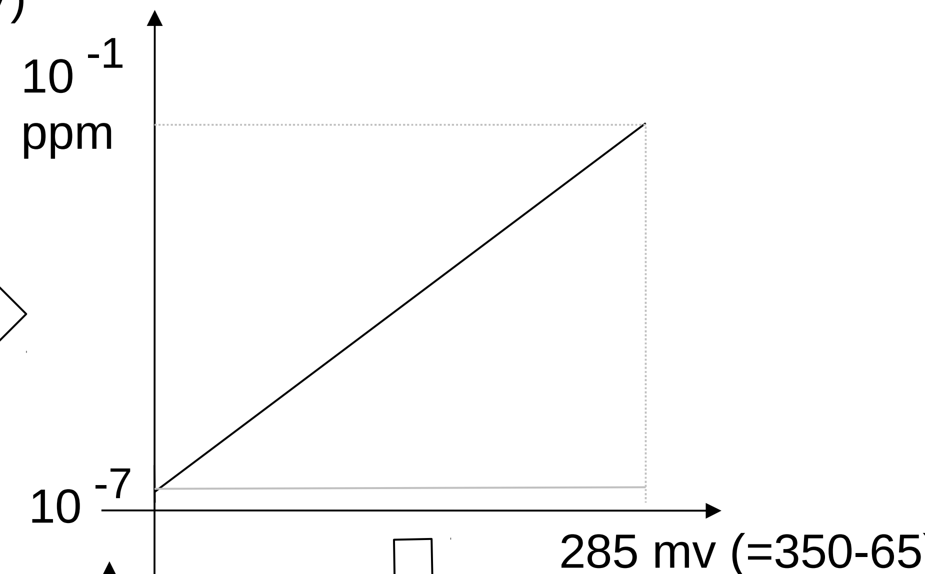
Note: (1) no external power supply for the electrode.

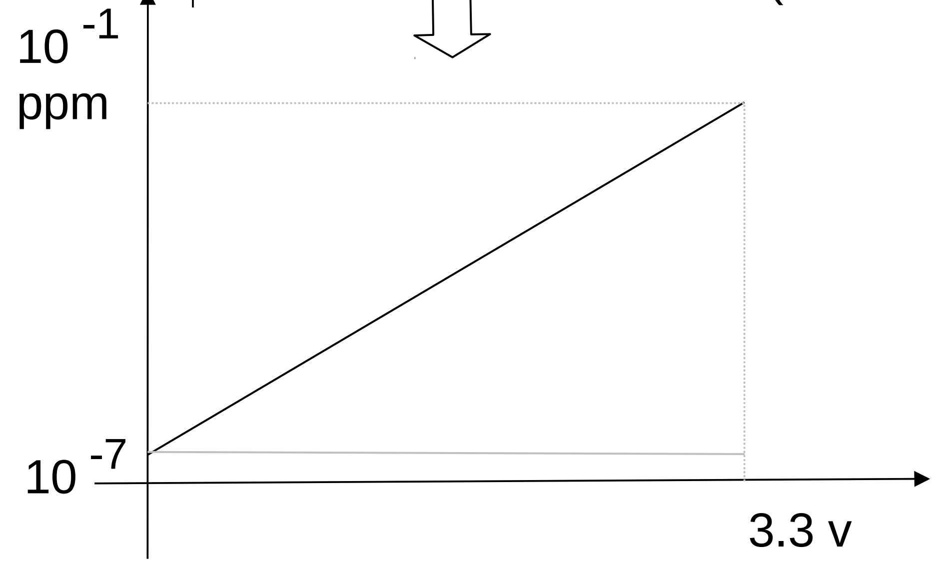
http://www.coleparmer.com/Product/Oakton_pH_electrode_epoxy_body_sealed_single_junction_general_purpose_3_ft_0_9_m_cable_BNC_connector/S-35801-00#Brochure

OpAmp Circuit Design for NH_3



STEP 1: Remove the offset (65 mV)

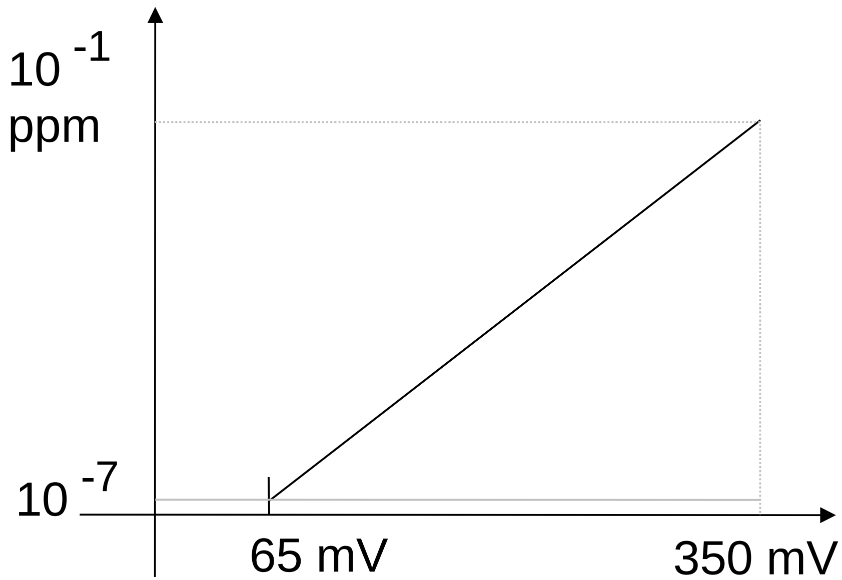




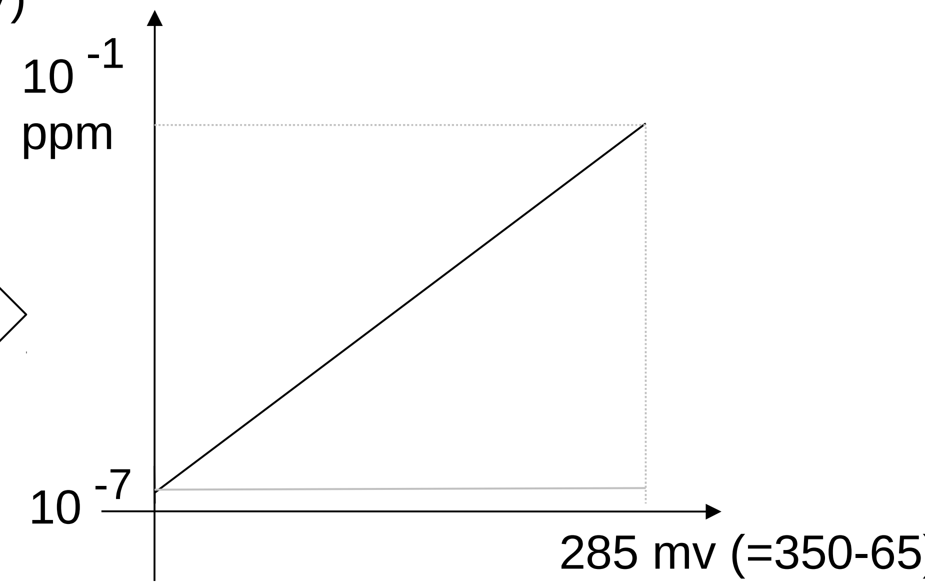
STEP 2: Enlarge the dynamic range from [0,285mV] to match ADC's [0,3.3v] range

OpAmp Design for Step 1

NH3 Concentration (M)



STEP 1: Remove the offset (65 mV)



Summing OpAmps as level shifter to shift offset 65 mv to 0v. (1) Using inverting configuration, A = - (Rf/R1+Rf/R2), where R1 and R2 are resistors for the input 1 and 2; (2) input 1 is for level shifting; e.g.

Vo = V1 (- Rf/R1) … (1)

Where Vo = 65 mV; V1 = 5v;
So

$$65 \times 10^{-3} = -(Rf/R1)\ 5 \quad \ldots \quad (2)$$

Let

Rf = 1 k Ohm

Hence

R1 = 77 k Ohm (=76.923 k Ohm)

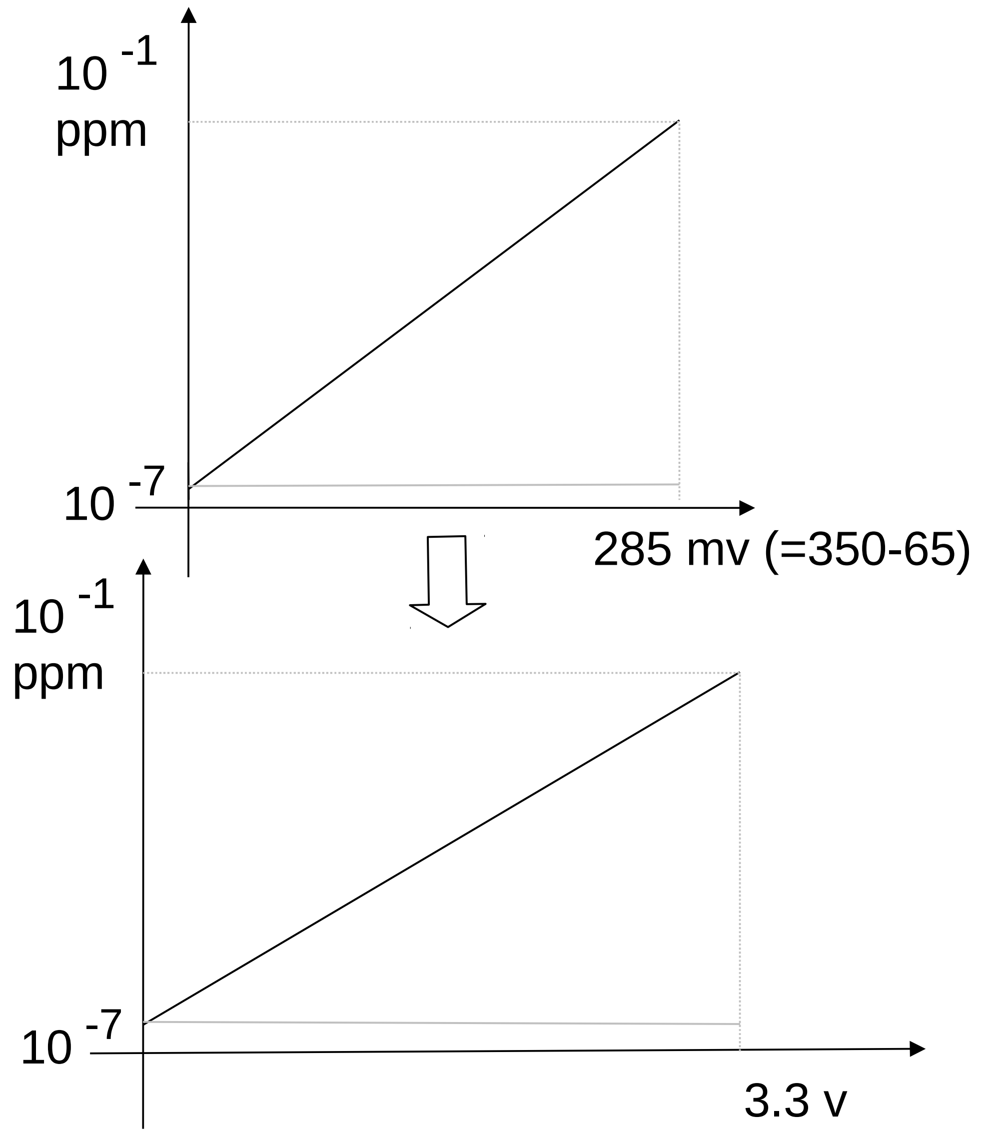
While for input 2, use voltage follower, R2=Rf (=1 k Ohm)

OpAmp Design Step 2 for NH3

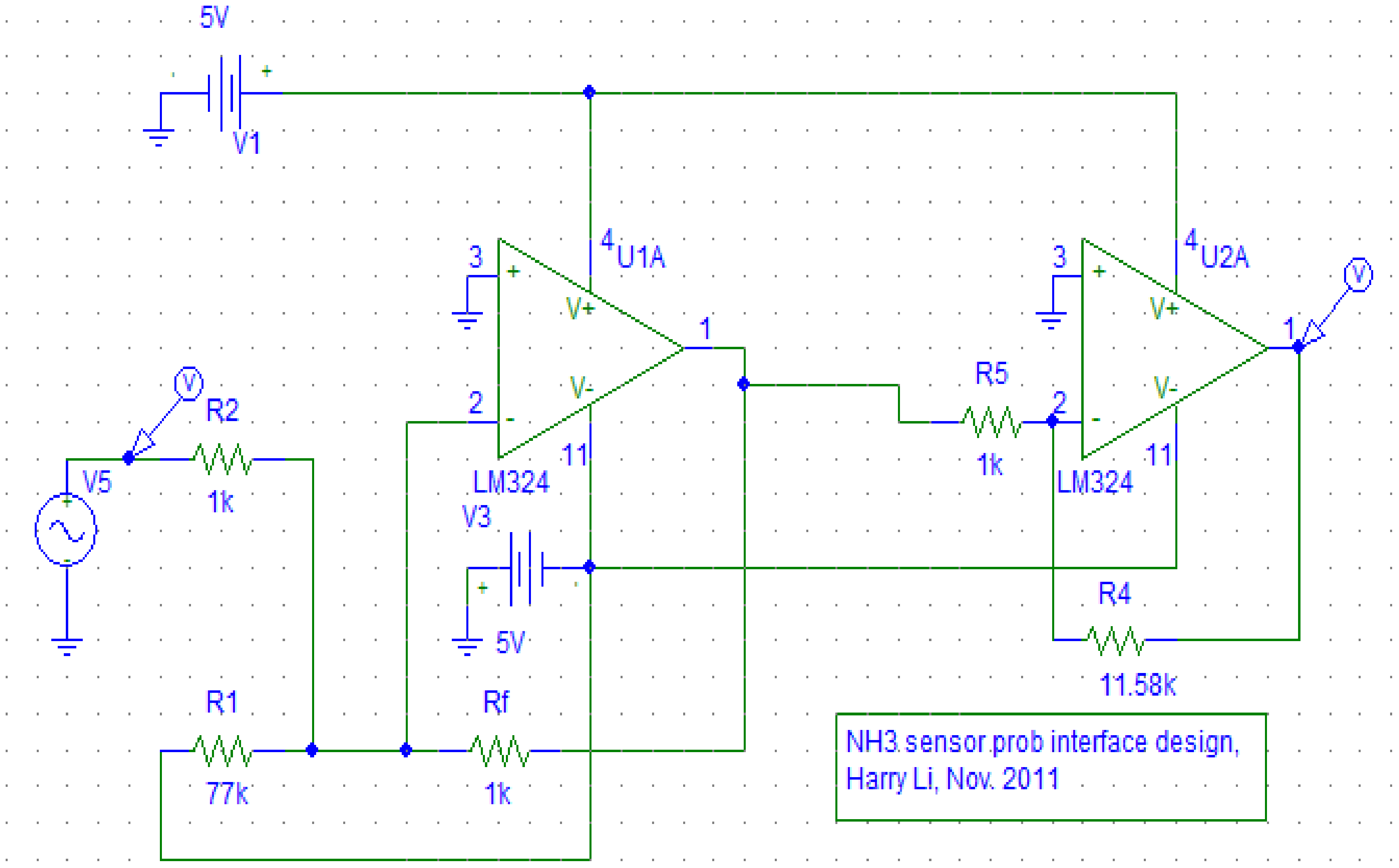
STEP 2: Enlarge the dynamic range from [0,285mV] to match ADC's [0,3.3v] range

Note: (1) the gain calculation, from 285 mv to 3.3 v, e.g., A = 11.58 choose r4 = 11.58k and r5 = 1k

The design is given on the next slide.

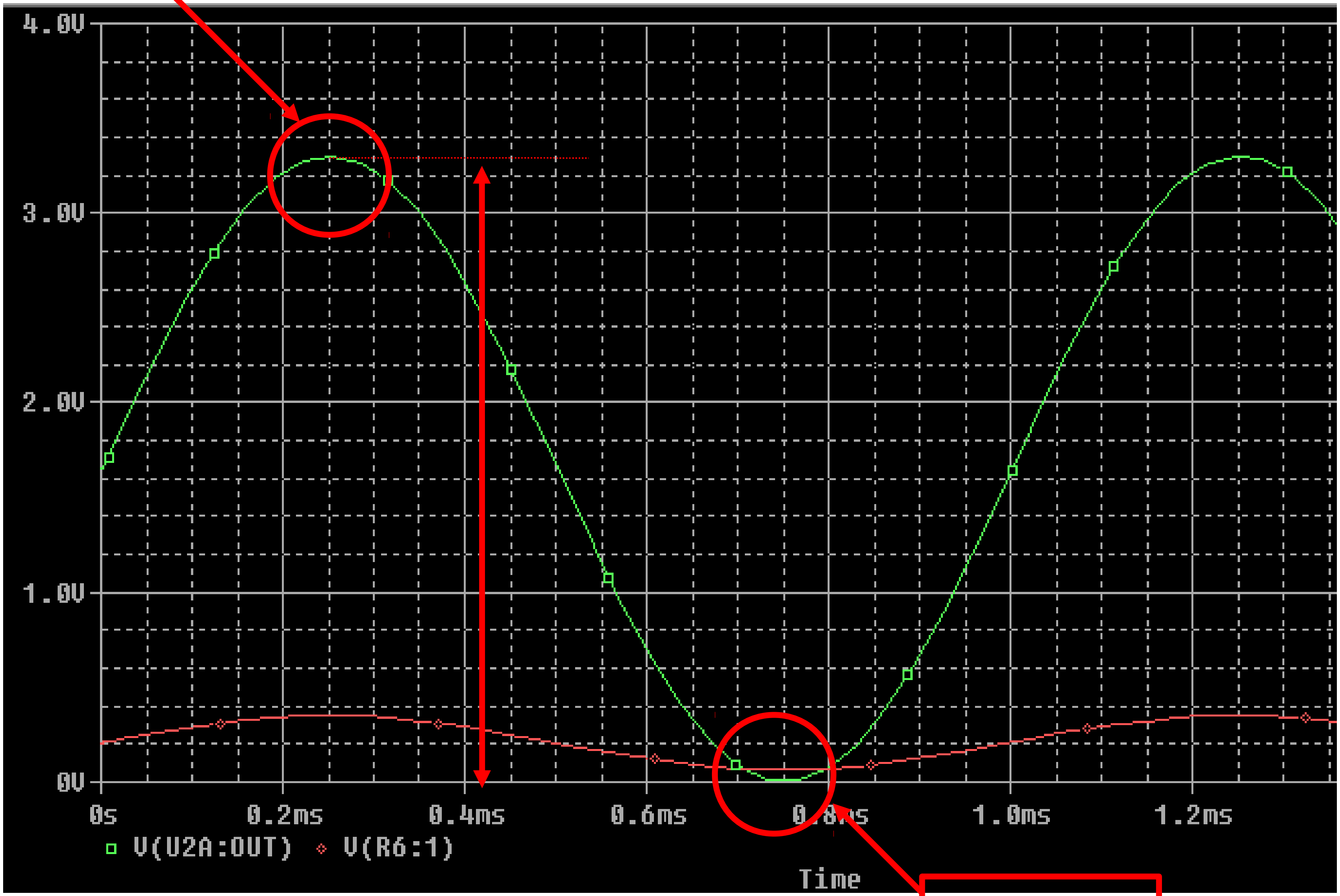


Circuit Design for NH3 Sensor



Simulation Result

The output:
3.3V



The input
offset 65mV