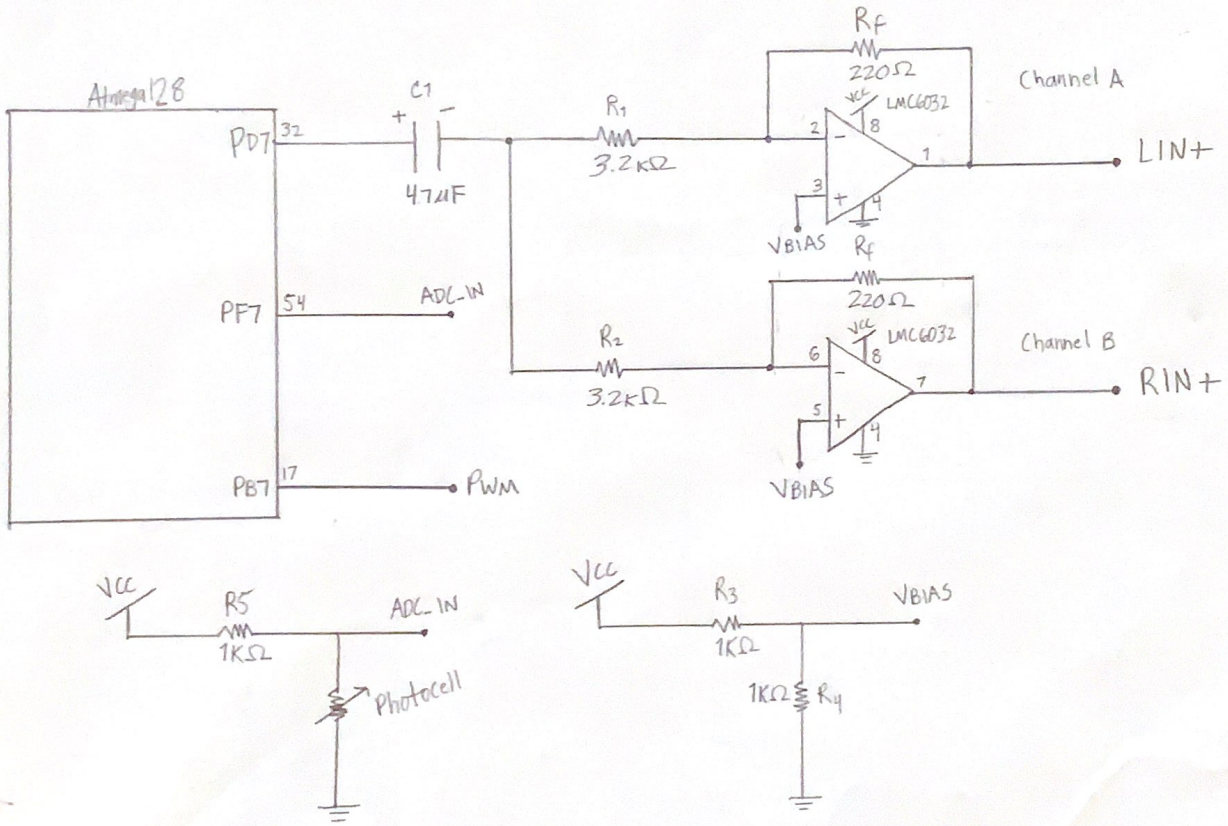
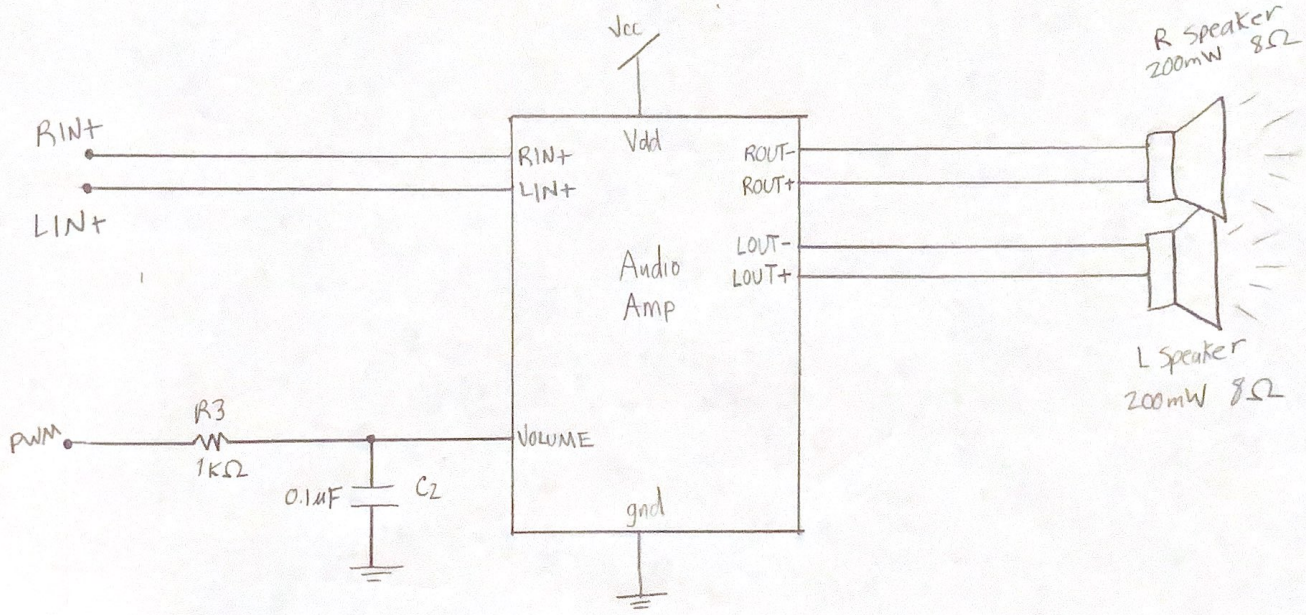

Atmega128
PD7
32
C1
4.7uF
R1
3.2kΩ
Rf
220Ω
LMC6032
Channel A
LIN+
VBIAS
PF7
54
ADC_IN
R2
3.2kΩ
Channel B
RIN+
PB7
17
PWM

VCC
R5
1KΩ
ADC_IN
Photocell

VCC
R3
1KΩ
VBIAS
1KΩ
R4


Vcc
R Speaker
200mW 8Ω
RIN+
LIN+
RIN+
LIN+
Vdd
ROUT-
ROUT+
LOUT-
LOUT+
Audio
Amp
L Speaker
200mW 8Ω
PWM
R3
1kΩ
0.1μF
C2
VOLUME
gnd

Calculations

$P_{speaker} = 200mW$ Rms

$R = 8\Omega$

$\frac{V_{RMS}^2}{R} = P_{speaker}$

$V_{RMS} = \sqrt{P_{speaker}(R)}$

$V_{pp} = 2\sqrt{2}\, V_{RMS}$

$V_{pp} = 2\sqrt{2}\sqrt{P_{speaker}(R)}$

$Gain_{dB} = 20\ dB$ (Datasheet)

$\frac{20}{20}\log_{10}\left(\frac{V_{pp}}{V_{pre}}\right) = \frac{20}{20}\ dB$

$10 \qquad 10$

$\frac{V_{pp}}{V_{pre}} = 10$

$V_{pre} = \frac{V_{pp}}{10}$

$V_{pre} = \frac{2\sqrt{2}\sqrt{P_{speaker}(R)}}{10}$

$V_{pre} \cong 0.35778\, V_{pp}$

$\left|\frac{V_{pre}}{V_{in}}\right| = \frac{R_f}{R_1}$

$\left|\frac{0.35778 V_{pp}}{5 V_{pp}}\right| = \frac{R_f}{R_1}$

$R_1 = \frac{5}{0.35778} R_f$

Choose $R_f = 220\Omega$

$\Rightarrow R_1 = R_2 \cong 3075\Omega$

Choose $R_1 = R_2 = 10k\Omega \,||\, 47k\Omega \cong 3.2k\Omega$

C_1 + R_1 form a high pass filter:

$f_c = \frac{1}{2\pi R_1 C_1}$

$C_1 = \frac{1}{2\pi f_c R_1}$

We want to play a wide range of tones, so we want the lowest f_c possible.

$C \propto \frac{1}{f_c}$

$\Rightarrow$ we want the biggest C possible.

Choose biggest value in kit:

$C_1 = 47\mu F$

Calculations

R_3 + C_2 form another high pass filter

$$f_c = \frac{1}{2\pi R_3 C_2}$$

Choose $C_2 = 0.1\,\mu F$, $R_3 = 1K\Omega$:

$$f_c = \frac{1}{2\pi (1K\Omega)(0.1\,\mu F)} \cong 1592\,Hz$$

Using a PWM frequency of 16 MHz and cutoff of 1592 Hz ensures good ripple for the volume.