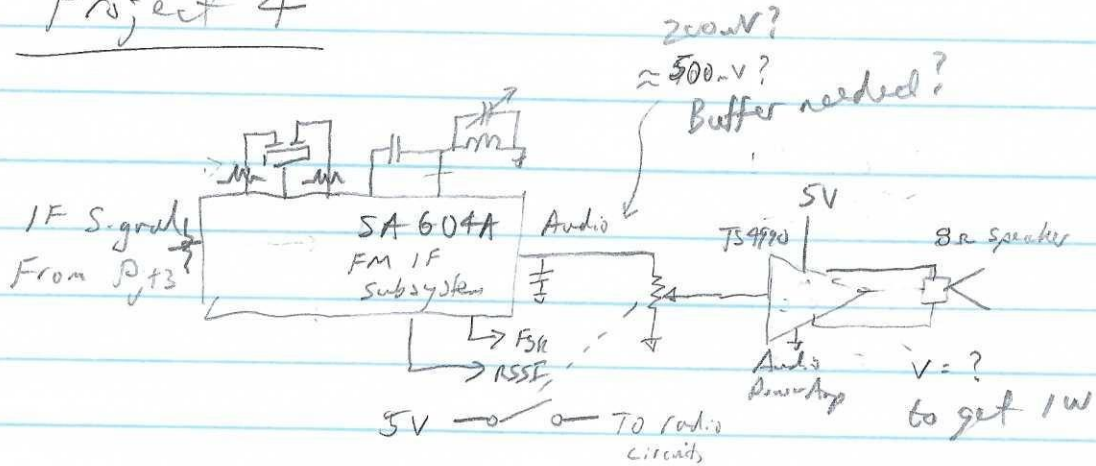


Project 4



Output voltage to speaker:

Assume we want 1/2 watt

$$P = \frac{V^2}{R} \Rightarrow V_{RMS} = \sqrt{RP} = \sqrt{8 \cdot 0.5}$$

$$\Rightarrow V_{pp} = 6V \quad \checkmark \text{ OK for 9V battery}$$

See LM386 Datasheet

Gain needed: $\frac{V_o}{V_i} = \frac{2V}{0.5} = 4$ Prefer 10 or more, WHY?

Suppose we want 1 watt: $\Rightarrow V = \sqrt{8 \cdot 1} = 2.8 V_{RMS}$

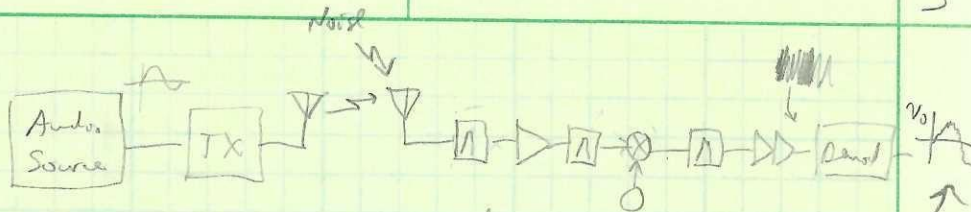
$\Rightarrow 8V_{pp}$

Use Bridge-Tie technique - see LM4950 Datasheet and more gain ...

Additional Considerations

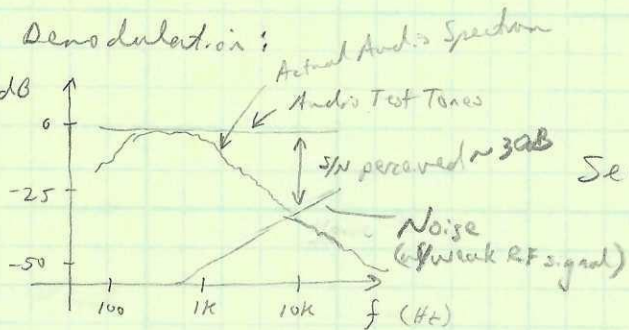
- 0) Inductor implementation
- 1) AC coupling & pin terminations/connections!
- 2) Alignment of quadrature network!
- 3) Lay out dangers (80 dB of gain in IF Amp!)
- ~~4) Terminating unused pins on ICs~~
- 5) AC coupling to Audio Amp
- 6) Bypass caps & other stability considerations!
- 7) Delay lines
- 8) RSSI & FSK outs

Pre/De-emphasis



S/N in FM Demodulation:

Audio out Spectrum: $|V_o|$ dB

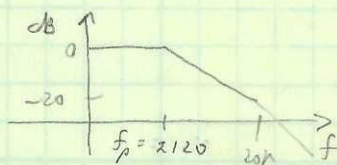
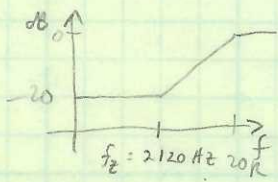
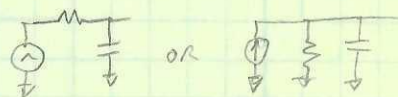
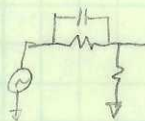
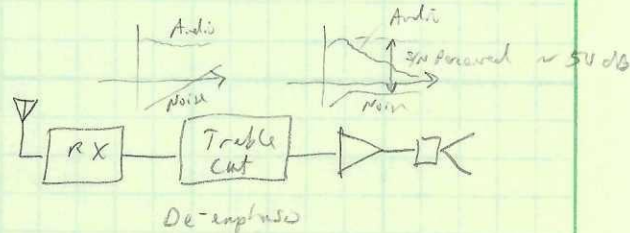
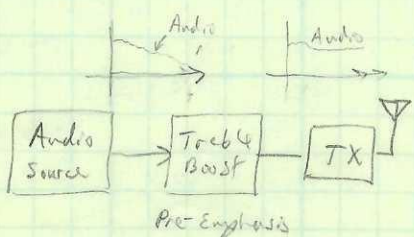


See Comm Theory Books

Perceived S/N ≈ 30 dB

(Signal mainly at 2 kHz and below)
(Noise mainly above 2 kHz)

Soln

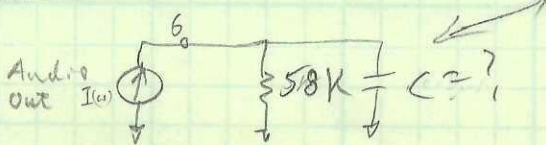


$$\begin{aligned} \text{In US } f &= 2120 \text{ Hz} = \frac{1}{2\pi RC} \\ \Rightarrow \omega &= 13.32 \text{ K rad/s} = \frac{1}{RC} \\ \Rightarrow RC &= 75 \mu\text{s} \end{aligned}$$

Called "75 μs pre/de emphasis"
Use 50 μs in Europe

SAG604A
LM3189 CAT

$$V_o = I E = I \frac{R \frac{1}{s}}{R + \frac{1}{s}} = I \frac{R}{1 + sRC}$$



$RC = 75 \mu\text{s}!$

LM1868



Squelch

Prob: FM RX outputs

- Hiss when no signal present
- Distorted audio when off station

Soln: Squelch

Detect when RSSI is too low
mute audio

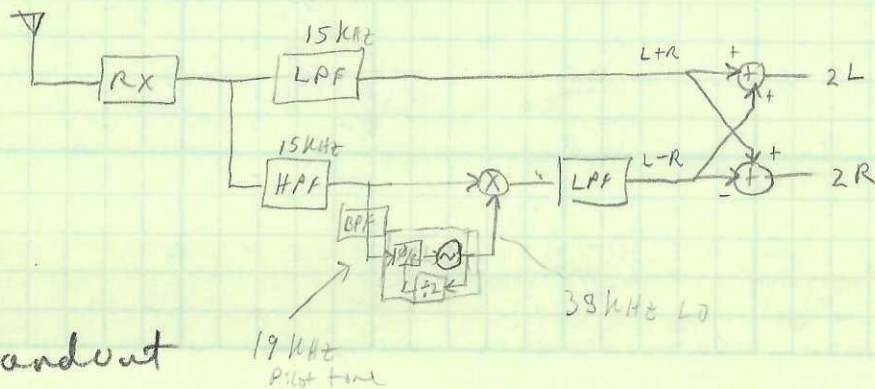
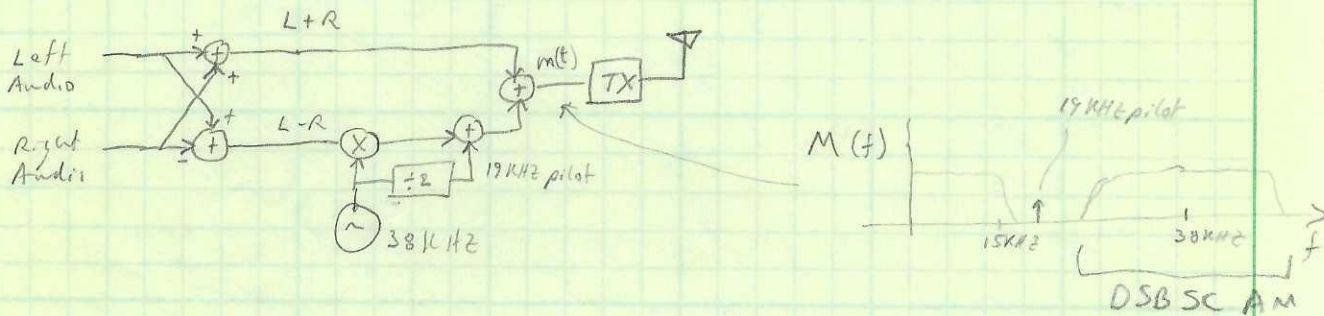
Stereo FM

mono FM dates to ~1930

Stereo Broadcast introduced in 1961

- Prob:
- Send stereo signal
 - Stay compatible w/ mono receivers

Soln:



RDS

See handout

Project 4 Testing

⑥ READ Assignment

- ① ~~Test R between Vcc and Ground for shorts~~
- ② Check resistance to ground at all pins
- ③ With chips REMOVED

apply power

check for DC voltage only on appropriate pin

- ③ Install chips (correct direction)
- ④ Apply power and check for proper current ($< 100mA$), ($\rightarrow 20mA$)
- ④ Input signal from 6:1 TRMR
w/ 1K Ω fm
75KHz Deviation
Reasonable power
10.7MHz
- ⑤ Set volume to mid range
- ⑥ Adjust C₁, L₁ and/or IF Frq until tone heard.

Troubleshooting

Too much ^{too little} current - check cap polarities
check for shorts / opens (e.g. check V at each pin)

No output

Isolate problem to IF or AF portion

IF - Input 10.7

check w/ scope w/ signal @ Quad level ch

Tune for max sig @

Drop RF power in 10 dB increments to -100 dBm

Observe ① constant output to --- 70 ② small out @ -100

- Listen for hiss
- AF - Add finger to output input - listen for buzz
- Inject small signal 100mV audio & listen

Check Track down problem in affected section
check DC Bias on pins.
Do signal tracing