Scoping the Diagnosis of Electronics' Problems

Radioactivity-2022

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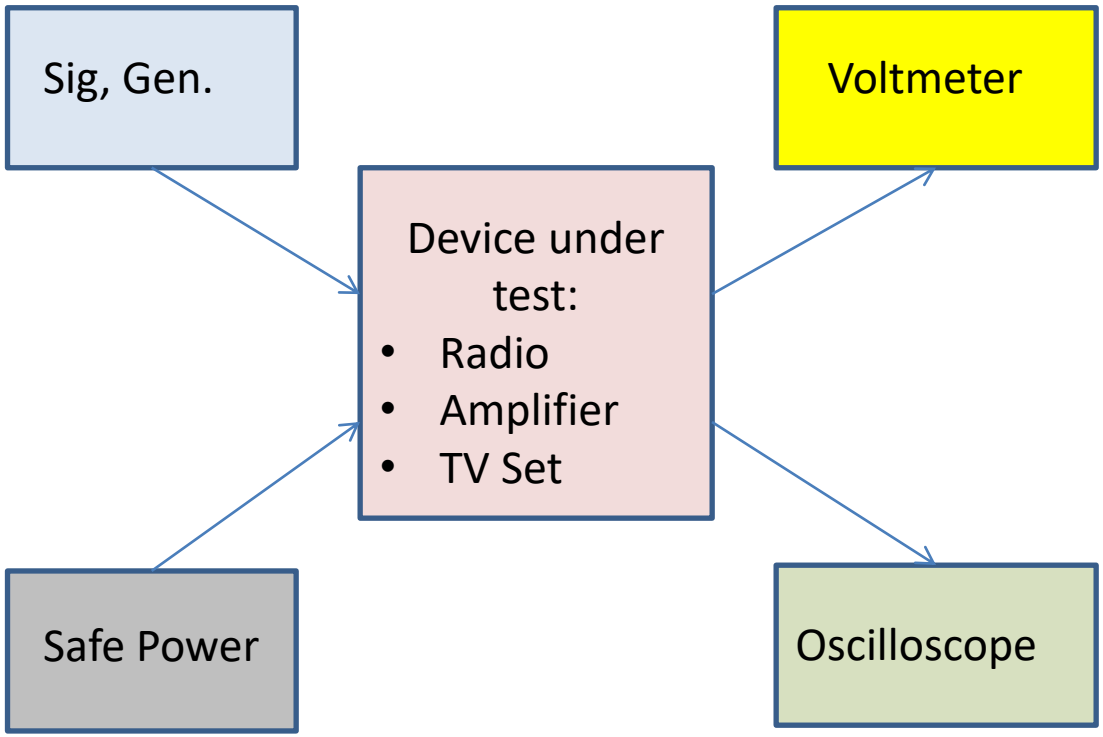
What we will be doing for the next 45 minutes or so:

- Examine the tools of the trade
  - Meter (volts, ohms)
  - Oscilloscope
  - Device undergoing test
  - Power source
  - Test signal generator
- Run through a typical AA5 diagnosis

Our Block Diagram:



And, for a victim, an AA5 radio, as is.

Teletone Slant-Front AC-DC AA5, our DUT.

Of course we could always put one of these “Signal Tracer” units to work. They supply the input signal and then capture it after passing through all or part of the radio. This lets you find the part that doesn’t operate properly.

We need to feed the DUT with:

- Signals we can rely on
- Signals/DUT reactions that are diagnostic
- Power that is safe

Krohn Hite 1200A generator

Fused Isolation Transformer

What ‘scope to use?

All of these are good candidates

Tektronix analog

BK Precision analog

Tektronix analog

Owon digital

Tektronix analog

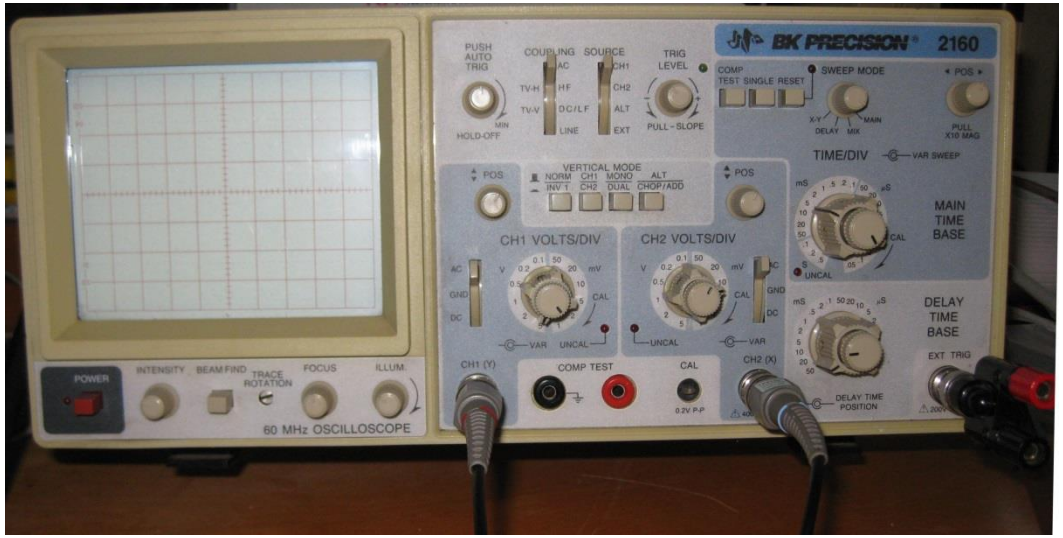
Analog ‘scopes

- $100 to #400
- 10 MHz to 500 MHz
- Time base down to nsec
- 2 to 4 Y-axis channels
- Screen shows waveshapes
- Many other perks
- Separate controls

Digital ‘scopes

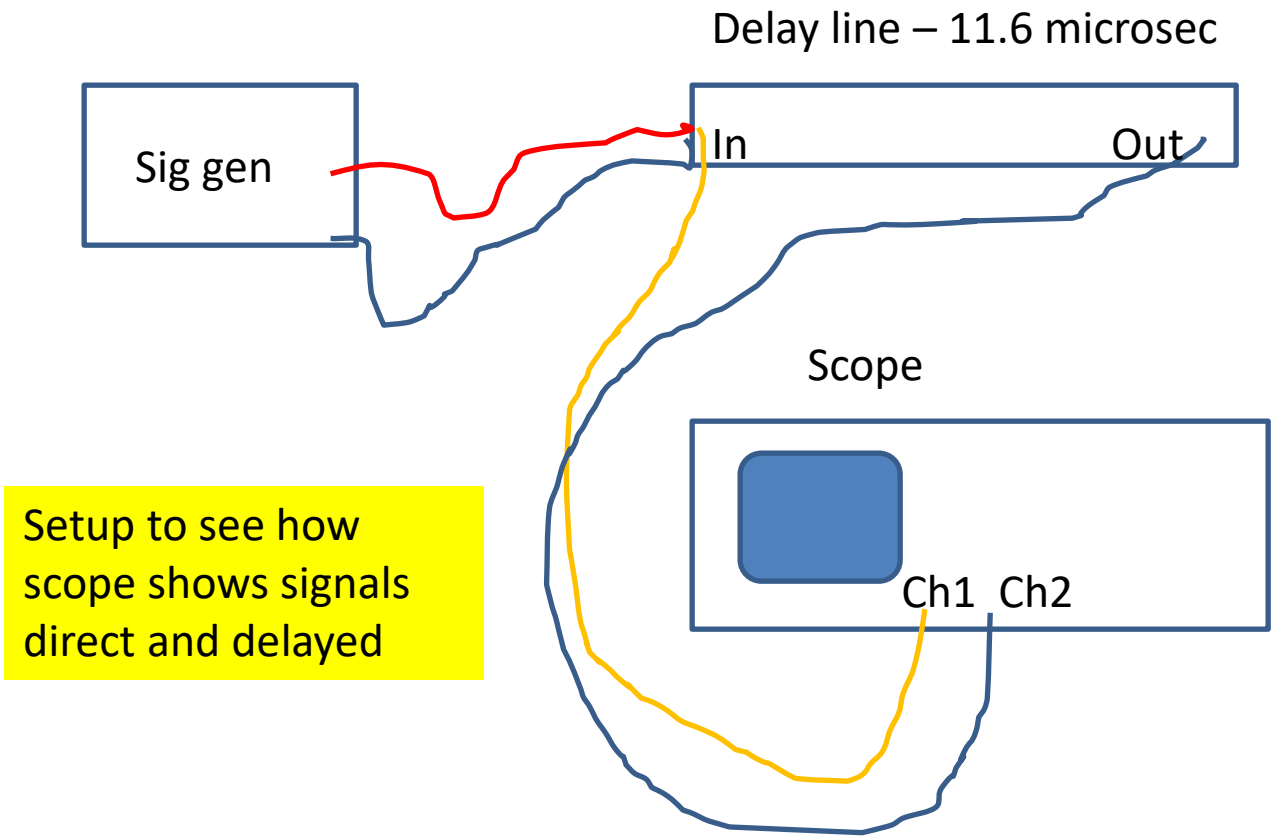
- $175 to $150,000
- 10 MHz to 3 GHz
- Outputs freq., time values
- Screen shows waveshape
- Many, many, other perks
- Waveshapes are synthetic
- Most controls multi-purpose

I have one digital ‘scope, an OWON, which now expresses all data in Chinese characters. It is <$200, but not recommended.



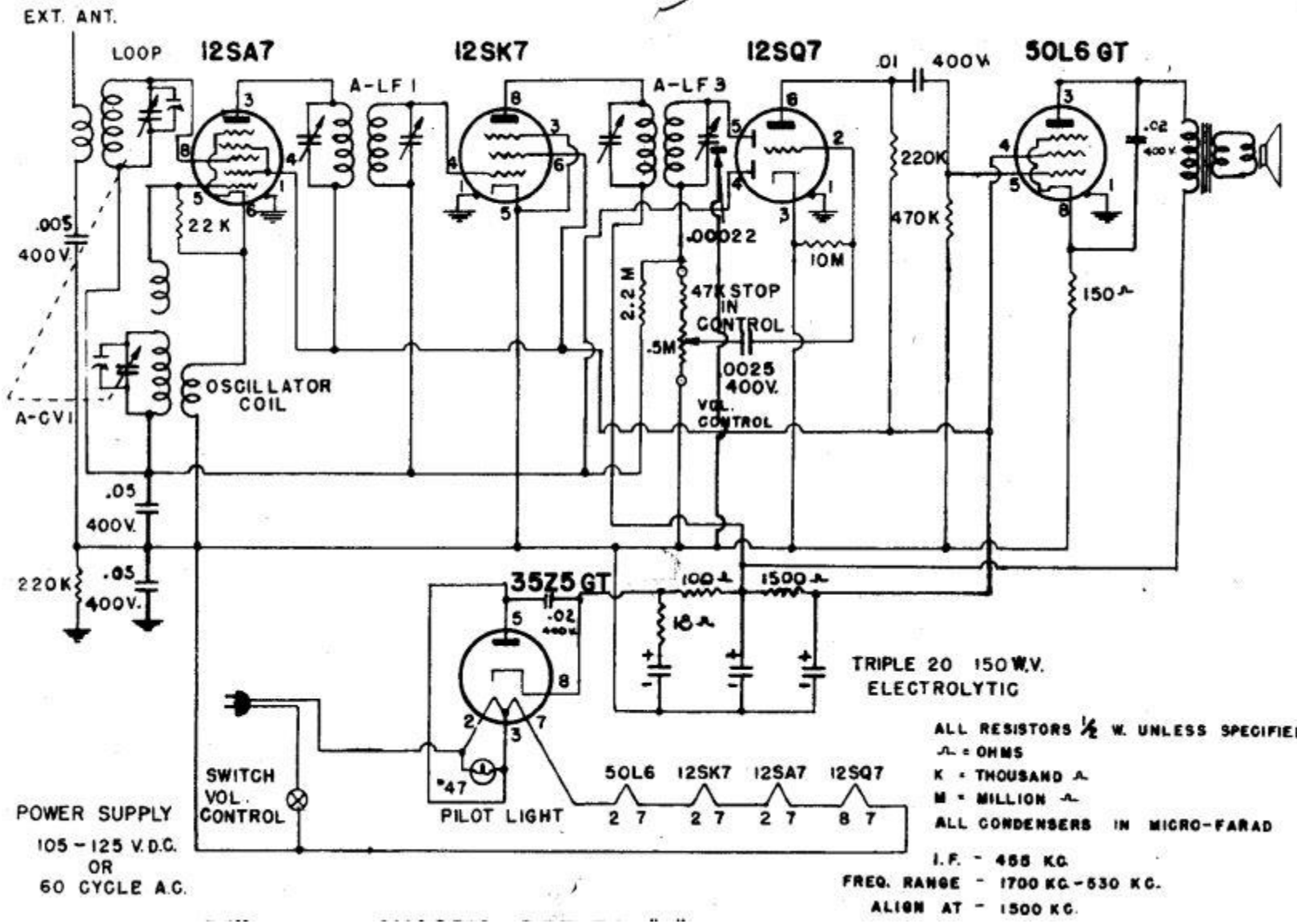
The ‘scope will be our diagnostic instrument in the following measurements on a typical radio undergoing repair.

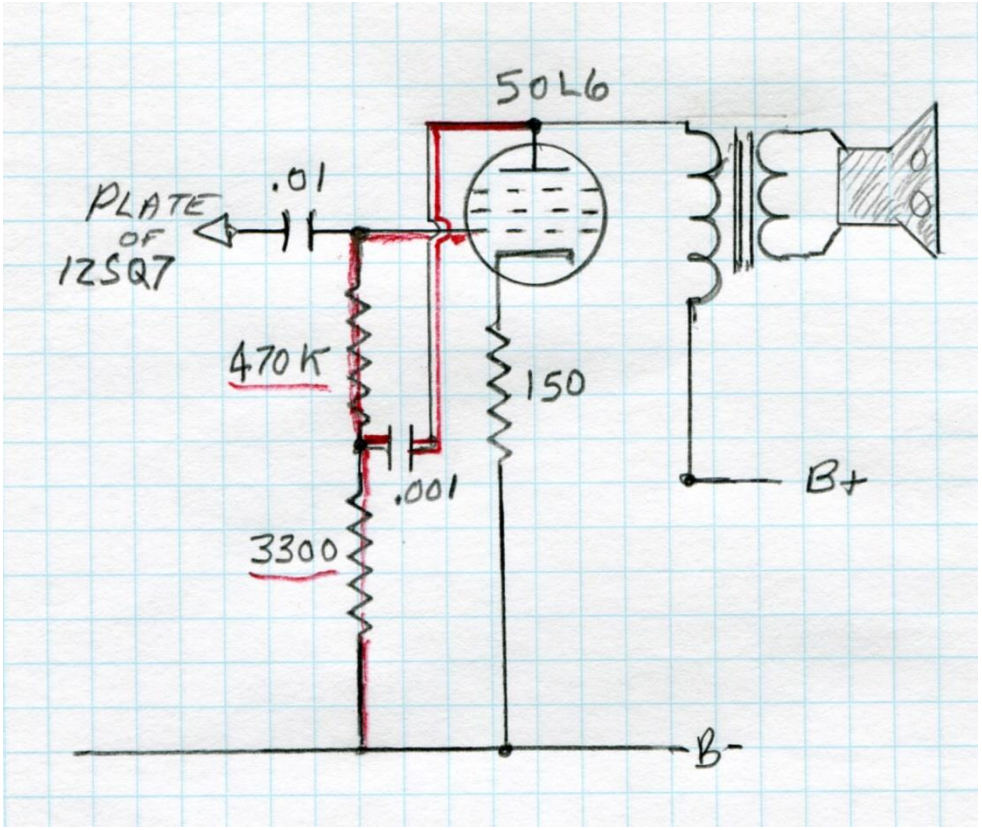
These are the oscilloscope controls you have to master.



Setup to see how scope shows signals direct and delayed

TELETONE RADIO CORP.





The output stage had a factory revision that added a bit of negative feedback from plate to grid as shown above. It was effective only at treble audio frequencies, to try to boost the bass end a little.

Note that the ‘scope always plots the DUT’s voltage waveform as a function of **TIME**.

If the waveform is periodic, we often would like to know what fundamental frequency the waveform represents.

So that , in the case of the AA5 superhet, we can check that the incoming signal ***frequency***, the LO ***frequency***, and the IF signal ***frequency*** are all consistent, and correct.

So it’s handy to have a small pocket calculator to convert **waveshape time** period to **frequency**.

And, that's not tough:

Freq. = 1/wave repeat time

Or

Freq. = (repeat time)^(-1)

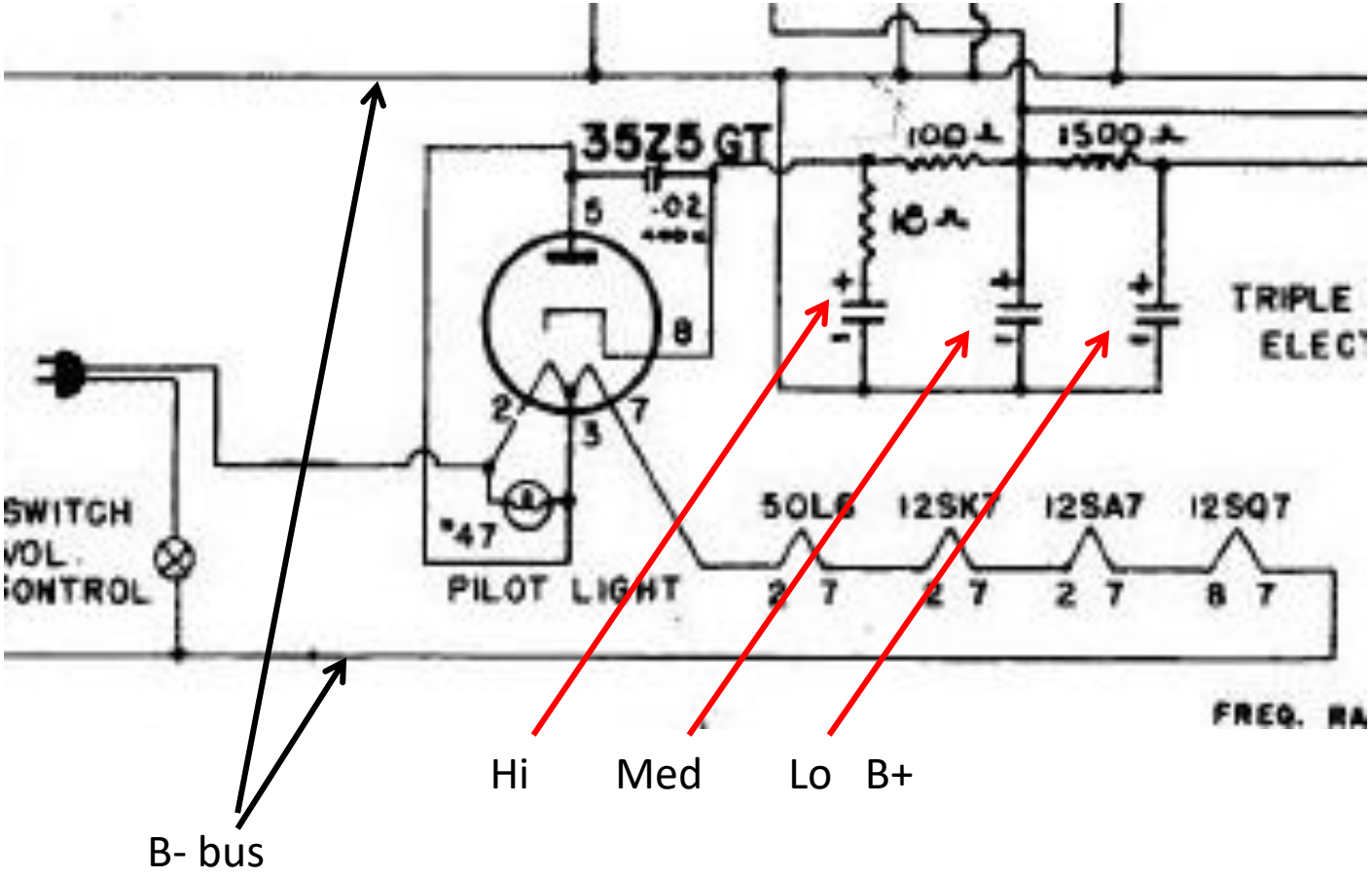
Example:
The 'scope displays a sine wave repeating every 2.2 microseconds

1/.0000022 = 454,545 Hz

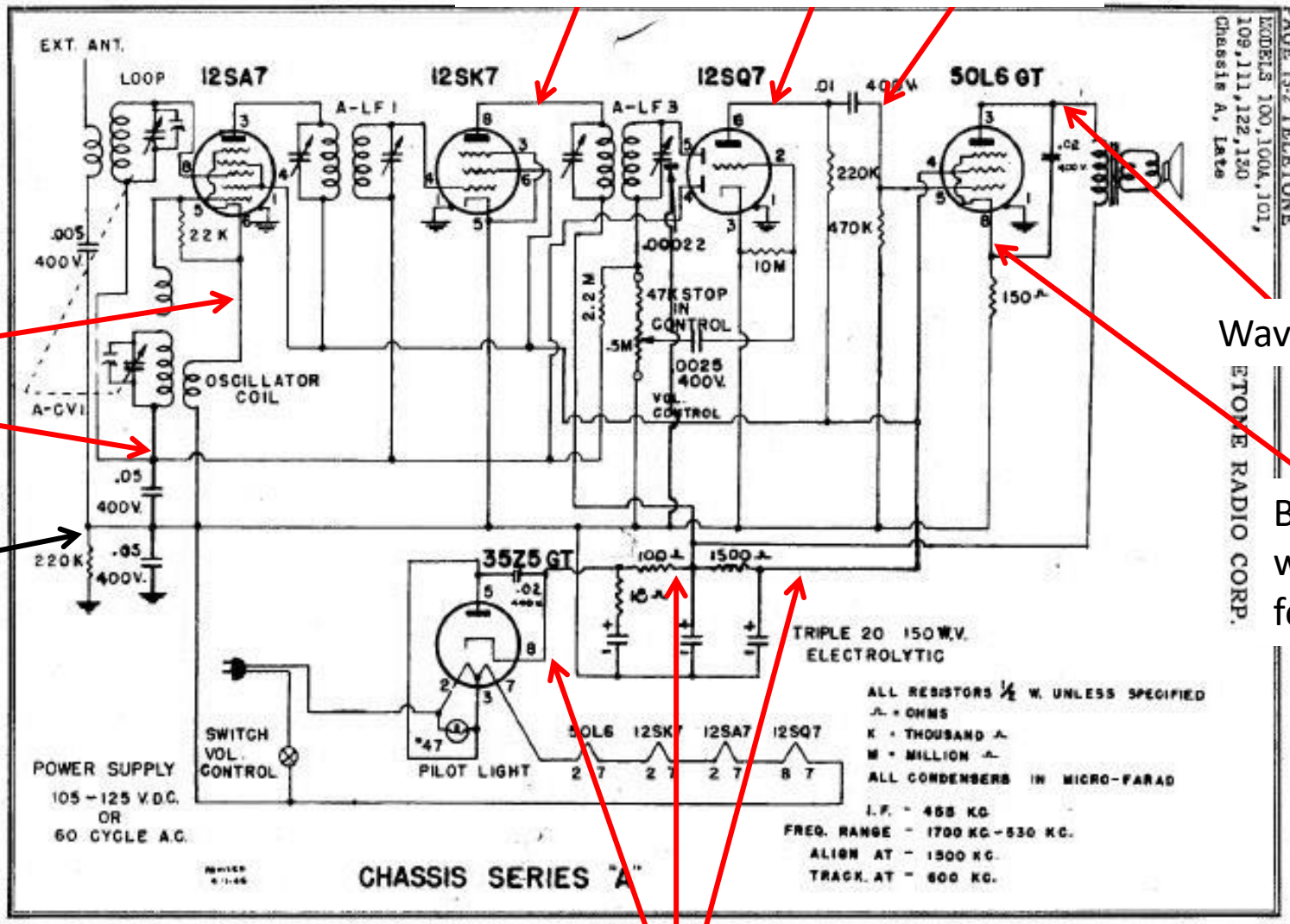
That's approximately 455 kHz

If you work on audio equipment you (or your EXCEL spreadsheet) will be doing a lot of these inversions.

To start. we can check the action of the B+ filter capacitors – those three electrolytic sections near the bottom of the schematic



Voltages and signal waveforms



L.O.

AVC

GND

Waveform

Bias & wave-form

B+ Filtering

As we work through the receiver, we take note of any waveshapes that are unusual, or voltage levels that are wrong.

Note the large 60-Hz sawtooth on top of the IF amplifier's plate voltage sine-wave.

We don't hear that because 60 Hz is way, way, out of the 455 kHz bandpass of the IF cans.

To possibly reduce that, we can clip in another electrolytic cap just in case the ones already there have dried out a tad.

Didn't help completely.

Taking another look at the B+ lines:

Note that the B+ level was lower than usual for an AA5. Something might be drawing it down, The 50L6 cathode voltage level was a bit high, meaning the cathode was passing too much current, or the resistor was wrong-sized.

But, note also that the 50L6 grid voltage was also somewhat POSITIVE.

Oh-oh, probably leaky coupling cap from 12SQ7 plate to 50L6 grid.

Cutting out that cap, and replacing it with a clip-lead cap brought the B+ back up.

That restored normal voltages throughout, allowing us to take away the added electrolytic.

But we will change out all the electrolytics and paper caps anyway, making this AA5 good-as-gnu.

Now adding that Catalin grill will make this radio worth about ten bucks at a MAARC auction.

Now:
Any Questions?

We might have answers.

Or *someone* might have them!