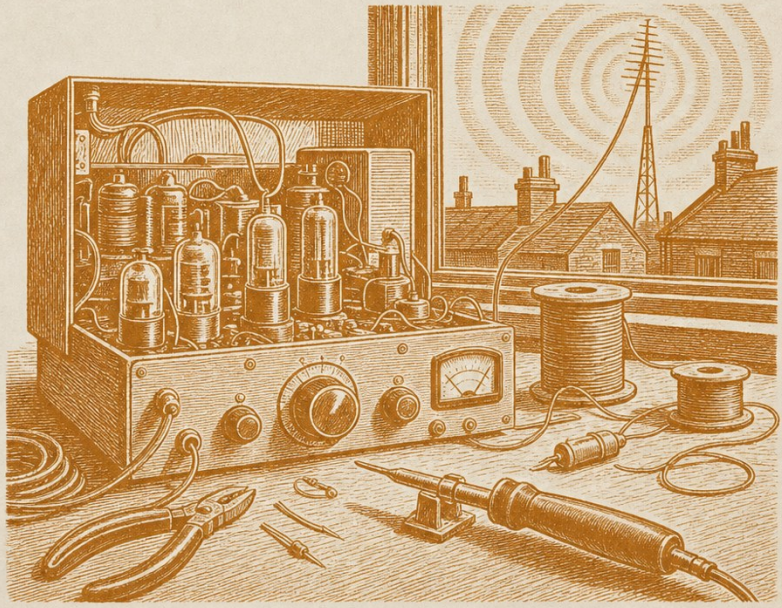
Meridian Works

Signal and Noise

Idris Hallam



MW

SIGNAL AND NOISE.

a field manual for small radio

by

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1 What a receiver actually does

A receiver hears everything and must be taught to ignore almost all of it. The air at any moment carries broadcast, aviation, weather, the switching supply in the next room, and the sun. The work of a receiver is not to find a station; it is to reject the rest of the band well enough that one station is left standing.

That rejection happens in stages, and each stage costs something. A sharp filter early in the chain protects everything after it, but a filter is never free: it removes some of the wanted signal along with the unwanted, and it adds noise of its own.

1.1 The chain, front to back

Every small receiver has the same order, whatever its age:

Stage	What it does	What it costs
Antenna	Turns a field into a voltage	Nothing, if matched
Preselector	Removes far-off frequencies	A little wanted signal
Amplifier	Raises the level	Adds its own noise
Mixer	Shifts the frequency down	Distortion if overdriven
Filter	Removes the neighbours	Ringing, if too sharp
Detector	Recovers the audio	Depends on the mode

The order matters more than the quality of any one part. An excellent amplifier placed after a poor mixer amplifies a signal that has already been spoiled.

1.2 Impedance, and why it is not optional

An antenna delivers power to the receiver only when the two agree about impedance. A quarter-wave wire against a good ground plane presents roughly 36 ohms; most receivers expect 50. That mismatch alone is minor. A random length of wire clipped to a terminal may present several hundred ohms at one frequency and a few at another, and the receiver's response will rise and fall across the band for reasons that have nothing to do with the stations.[1]

[1] A simple resistive pad will hide a mismatch by throwing away power in both directions. It is a legitimate repair when the alternative is an unstable amplifier, but it is attenuation, not a match.

Attenuation is the honest instrument here. A switchable pad of 10 dB in front of the receiver tells you immediately whether a problem is coming from outside or from within: if the interference falls by 10 dB along with the station, it arrived through the antenna; if it does not move, it is being made inside the case.

2 Tuning by measurement

Measure twice, because the meter is cheaper than the part. A tuned circuit that is adjusted by ear will land somewhere near correct and stay there for years, quietly costing a few decibels. A tuned circuit adjusted against a meter lands where the design intended.

2.1 The three numbers

Almost every alignment reduces to three readings taken in order.

Reading	Instrument	Typical target
Supply voltage	Meter, at the regulator output	Within 5% of stated
Oscillator frequency	Counter, at the buffer	Within 100 Hz at band edge
Recovered audio	Meter, across the load	Peak, with input held constant

Take them in that order every time. An oscillator that reads low because its supply is low will be adjusted onto the correct frequency at the wrong voltage, and will move again the moment the battery recovers.

2.2 What a capacitor is doing while you turn it

A variable capacitor changes the resonant frequency of the circuit it sits in, but it also changes the loaded quality factor, and therefore the bandwidth. Tuning for maximum output at one setting can leave the circuit broader than intended, which is why a stage that peaks beautifully on a strong local station may be unusable next to a stronger neighbour.

When a peak is broad and indistinct, suspect a resistive loss rather than the capacitor: a leaking coupling capacitor, a corroded ground return, or a coil whose former has absorbed damp. Each one lowers the quality factor and flattens the peak in exactly the same way.

2.3 Drift, and how to tell its source

Frequency drift has three usual causes, and they are distinguishable by their timing:

- Warm-up drift settles within minutes and then stops.

- Supply drift follows the battery and reverses when charged.
- Thermal drift follows the room and reverses overnight.

A frequency that moves and never returns is not drift. It is a component changing value, and it will keep going.

3 Repair away from the bench

Field repair is triage. The aim is not to restore the equipment to its original condition; it is to get it working well enough to finish the task, without making the eventual proper repair harder.

3.1 Order of suspicion

Work from the most likely and cheapest to check:

1. Power. Connectors, fuse, battery under load rather than at rest.
2. Connections. Anything that was moved, flexed, or rained on.
3. Passives that fail open or leaky: electrolytics first.
4. Semiconductors, last, because they mostly fail for a reason.

Skipping to step four is the common error. A transistor replaced because of a bad ground will fail again within the hour, and the second failure will be blamed on the replacement part.

3.2 Solder in the cold

Cold hands and cold work make cold joints. Warm the board, not just the iron, and give the joint a full second after the solder flows before letting it move. A joint that looks grey and grainy has moved while setting and should be reflowed rather than reinforced.

Keep a short length of desoldering braid and a small tin of flux; nearly every field repair that goes wrong goes wrong during removal, not during fitting.

3.3 The ferrite trick

When a receiver picks up its own supply, a ferrite clamped over the lead near the case will often remove it entirely. This works because the ferrite raises the impedance of the common-mode path without affecting the differential current the circuit actually uses.

```
      supply lead
 ----[ ferrite ]------> to receiver
      clamp within 50 mm of the case
```

If the interference falls but does not disappear, add a second clamp rather than a larger one; two spaced along the lead outperform one heavy sleeve at the same total mass.

3.4 What to write down

Record the reading, not the conclusion. “Supply 11.4 V under load, drops to 9.1 V on transmit” survives being read six months later. “Battery weak” does not, because it does not say how weak, under what load, or whether it recovered.

4 Plates and placement

A manual lives or dies by its figures, and the press places them by *intent*, not by inches. You never write a width in points or a side as "left"; you name where a figure sits against the measure and against the page's binding, and the house does the geometry – so a figure that hangs on the binding side stays on the binding side whether it falls on a recto or a verso. Here is one schematic, the crystal set from Chapter 1, laid every way the vocabulary allows. Each caption is set as the placement produced it.

4.1 Inline, at the full measure

The plainest placement runs the figure in the text column at the full width of the measure – `place=inline width=full-measure`. It breaks the flow, centred, its caption beneath, which is what a bare `![caption](image)` already does; the vocabulary only makes it explicit.

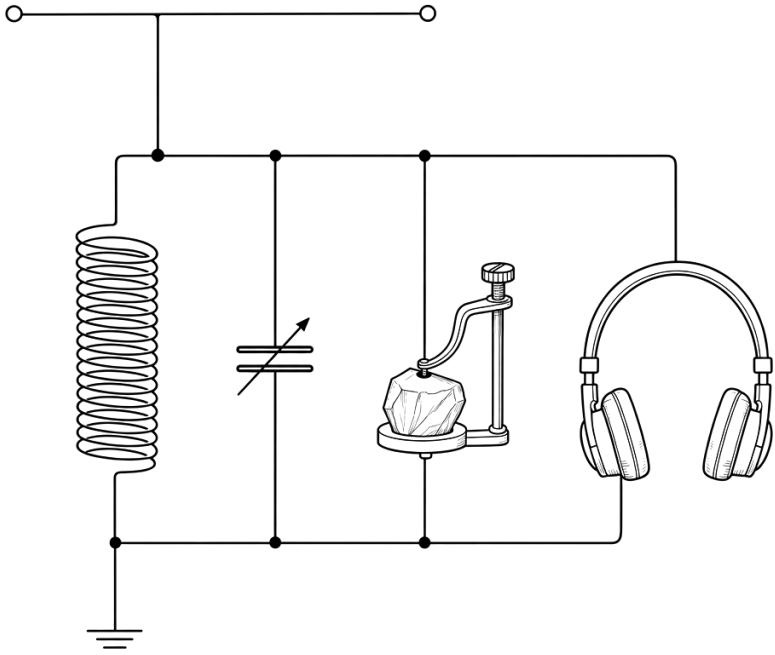


Figure 4.1. *Inline, at the full measure.*

4.2 Wrapped on the inner side

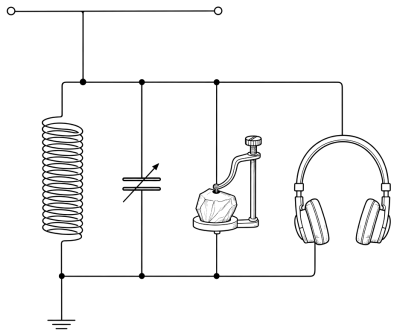


Figure 4.2. *Wrapped, inner side.*

Set smaller – a half or a third of the measure – a figure can let the text run around it. `place=wrap-inner` holds it on the binding side, and `outset` sets the gap the running text keeps from it. The paragraph beside a wrapped figure wants enough length to close beneath it, or the next heading rides up into the runaround; a manual page usually has the words to spare, as this one does, describing the set at some length so the coil and the detector both have prose to sit against while the reader's eye falls down the column and back to the diagram again.

4.3 Wrapped on the outer side

`place=wrap-outer` is the mirror: the figure hangs toward the outer edge of the page, the running text filling the binding side. On a verso this puts the diagram to the left; on a recto, to the right – the press works that out from the page number, so you never have to. Again the surrounding paragraph carries enough text to wrap the figure and close under it, which on a field manual is no hardship, since there is always one more thing to say about keeping a receiver alive in the weather: dry the coil, tin the joints, and hold the crystal's whisker light on its facet.

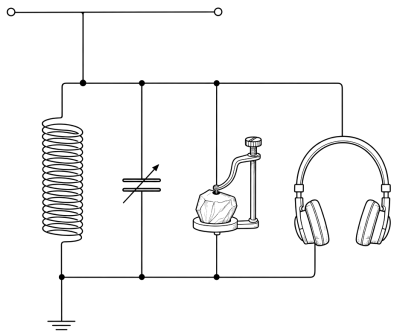
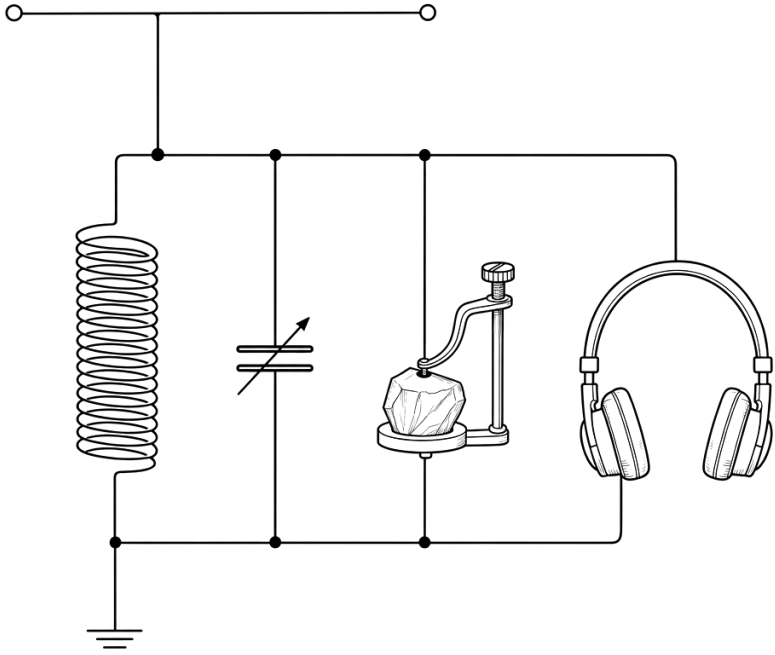


Figure 4.3. *Wrapped, outer side.*

4.4 As a plate

`place=plate` is the literary woodcut idiom: an unnumbered figure, pinned where you place it, with a quiet italic caption and no "Figure N." A bare

image with no declared kind is a plate too, so this is the house default for a picture that is illustration rather than reference.



A plate: unnumbered, pinned in place.

4.5 Full bleed

`place=full-bleed` gives the figure its own leaf and fills it. Use it for a schematic a reader will want to lay flat on the bench beside the work.

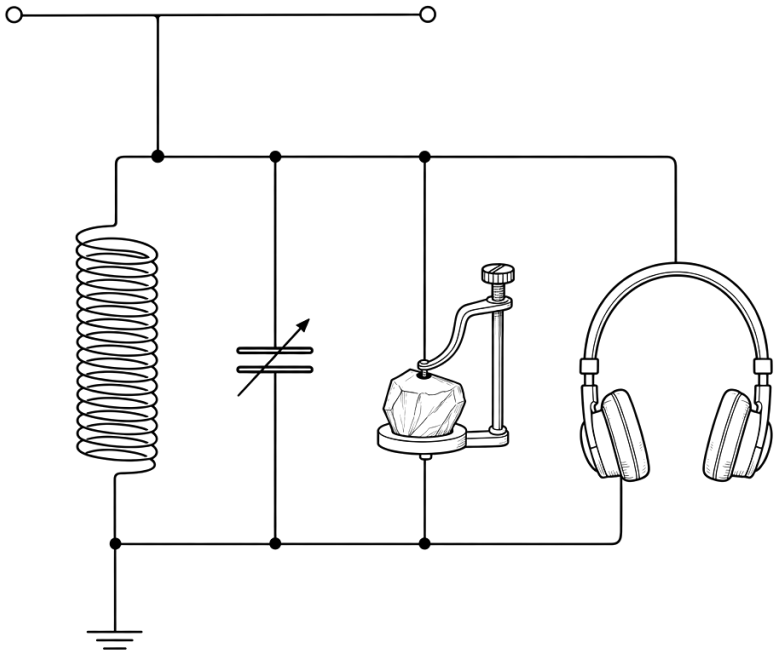


Figure 4.4. *Full bleed: the figure takes its own page.*

4.6 Frontispiece

`place=frontispiece` faces the opening of the next chapter – the plate on the verso, the chapter head on the recto across the gutter.

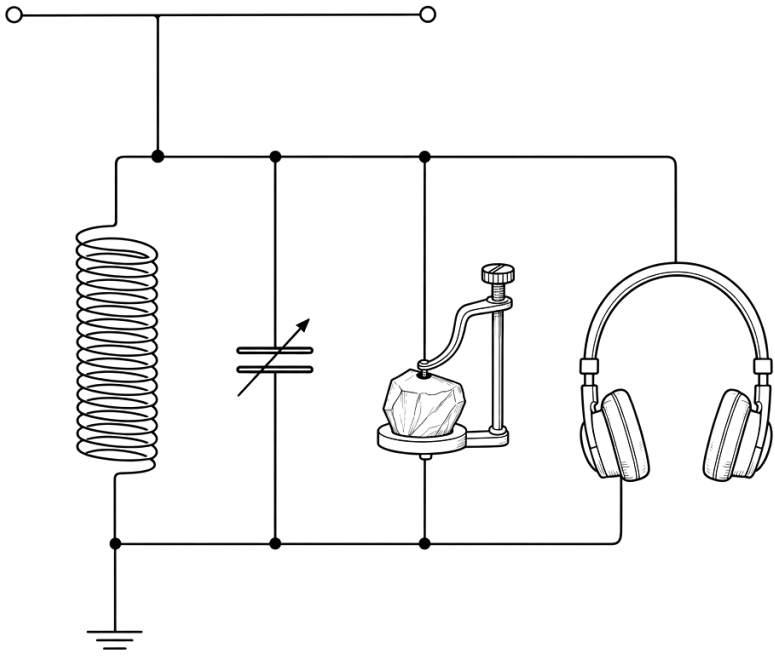


Figure 4.5. *Frontispiece, facing the next chapter opening.*

Appendix A: Index of subjects

Numbers are chapters and letters are appendices; both stay put across editions, which page numbers do not. The locations below are found in the text on every build, so the index cannot drift from the book.

Glossary

Attenuation A deliberate reduction in level, stated in decibels. Distinct from loss, which is unwanted.

Ferrite A ceramic containing iron oxide, used to raise impedance at radio frequencies without conducting.

Impedance The opposition a circuit presents to alternating current, combining resistance and reactance.

Oscillator A circuit that produces a signal at a chosen frequency, against which an incoming signal is compared.

Quality factor The sharpness of a resonance, written Q. Higher means narrower.

About the author

Idris Hallam has repaired radios on three continents, mostly in places without a bench, a manual, or a spare part closer than a day's travel. He learned electronics from an uncle's damaged set and a borrowed meter, and has been trying to give that apprenticeship back to strangers ever since. He keeps a soldering iron in his coat.