

# Hammerhead

## Pulse Induction Metal Detector

by Carl Moreland

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“Hammerhead” is a pulse induction (PI) metal detector design. It is intended primarily as a learning platform for experimenters, and as a base design on which to expand. This design is very much like other commercial PI detectors, which tend to have similar circuit designs, so it has the potential for good performance.

Metal detectors generally are not easy projects, especially the induction balance variety, and usually have performance that falls far short of even the least expensive commercial models. Three goals for this design were: make it easy to build, make it flexible, and get decent performance.

Pulse induction is a good choice for a do-it-yourself project because the circuitry is straightforward, and “mono” coils are easy to make. There are also very few critical internal settings — that is, it’s not hard to get the circuit to basically work — although final performance will depend heavily on a number of parameter settings. This project includes a layout for a simple single-sided PCB using common through-hole components, as well as a much smaller two-sided surface mount PCB for those with steady soldering irons.

Flexibility is achieved with several build options. They include:

- Passive or active MOSFET turn-off (through-hole only)
- Generic preamp support for NE5534, LM318, and others
- Single-ended or differential integrator
- VCO or non-VCO audio
- Extra component pads around the preamp to support experimentation (through-hole only)

This design also makes most of the important circuit parameters variable:

- Transmit pulse rate
- Transmit pulse width
- Integrator sample delay
- Integrator sample pulse width
- Secondary integrator sample delay
- Threshold
- Sensitivity
- Autotrack speed
- Volume

Any or all of these parameters can also be set to fixed values, simplifying the control interface. The various design options, and parameter adjustments, will be described as we go.

### Circuit

A simplified diagram of the circuit is shown in Fig. 1. It can be divided into five sections: power supply, clocking, transmit plus receiver front-end, receiver back-end, and audio. Each section can be built and tested sequentially. An oscilloscope is useful for probing the circuitry to see what is going on, but

is not absolutely necessary, providing the circuit is built correctly. A digital multimeter (DMM) is needed.

The complete circuit is shown in Fig. 2 and, at first glance, appears to be complicated because of all the options that were designed in. However, the design options really don’t add much complexity, and allow for different configurations and performance comparisons. Simplified circuits will be shown in the descriptions of the hook-up options.

### Power supply

Power for *Hammerhead* is provided by a single 12-volt battery pack, preferably an 8-pack of AA’s. A 9-volt pack can be used with a reduction in battery life, and even a 9-volt transistor-radio-type battery can be used, with a significant reduction in battery life, providing a proper supply tank is used at the coil switch (I’ll discuss this later). Combining the surface-mount circuit with a 9-volt transistor-radio battery, results in a very compact detector, ideal for a hand-

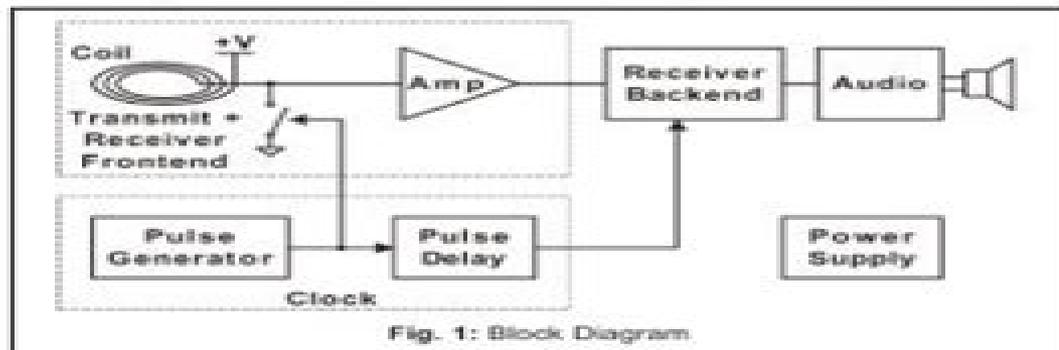


Fig. 1: Block Diagram

# Metal Detector Using A 2 Pulse Induction Coil

**Annelies Wilder-Smith**



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