Measurement of Installed Ground Resistance

Central Texas DXCC

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K4HJU Ground Ohms Test Set

This Talk

- Was to be about the test set
- To be about:
  - The need for measurement of installed grounds, such as tower grounds.
- Not about:
  - Installing grounds
  - Soil resistivity.
  - Etc.

First Why Is Good Grounding Important?

- Lightning damage
  - Protect equipment and property
  - Potential life safety
- Power ground integrity
- In central Texas – difficult to achieve

Lightning Strike!

- In the vicinity of 18 k Amps has to go some place in a short amount of time.
- Due to resistance and inductance many paths are possible.
- One of the more important items is the primary ground and its relation to the attracting structure.

My Interest

- I have recovered from two lightning strikes

Measurement of Installed Ground Resistance

- Why do it?
- What do you need to do it with?
- How do you go about it?
- What are the problems?
- Install and verify.
- My test set.

Why Measure Installed Grounds?

- Did you achieve your design and installation objectives?
- What is the integrity of the ground system?
- Maintenance.

One Objection to Measurement

Doesn't tell you what you need to know because of unknown inductance.

That is true; however the system can never be better than the DC/LF resistance. Therefore, measurement gives you a baseline and you have to apply some intelligence to the problems of inductance. There are a number of good resources to deal with the inductance problem.

Two Categories

- Primary earth ground
- Inductance, wire routing, lightning arrestors etc.

Here I am concerned about the primary earth ground. The whole system integrity is based on this!

Considerations

Soil resistance behavior is anything but uniform and varies with type of soil, moisture and dissolved salts content. It can be non-linear. It can vary from day to day and month to month.

Dynamic Surge Resistance

In the case of a lightning strike the performance of the ground may be significantly better than the measured resistance might indicate. This due to the high voltage and current in the lightning strike breaking down the earth and effectively increasing the ground effectiveness.

Measurement Methods

- Simple Ohmmeter
- AC or DC four terminal measurement
- Clamp on inductive measurement

Simple Ohmmeter

- Must open the circuit
  - Inconvenient and potentially dangerous
- Potentially erroneous due to:
  - DC earth currents
  - Induced power utility currents

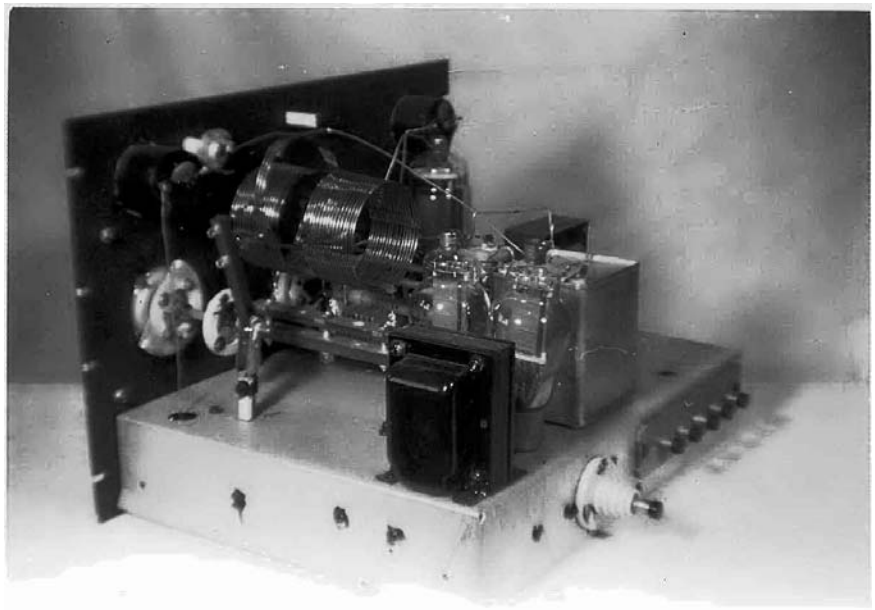
AC or DC Four Terminal Measurement

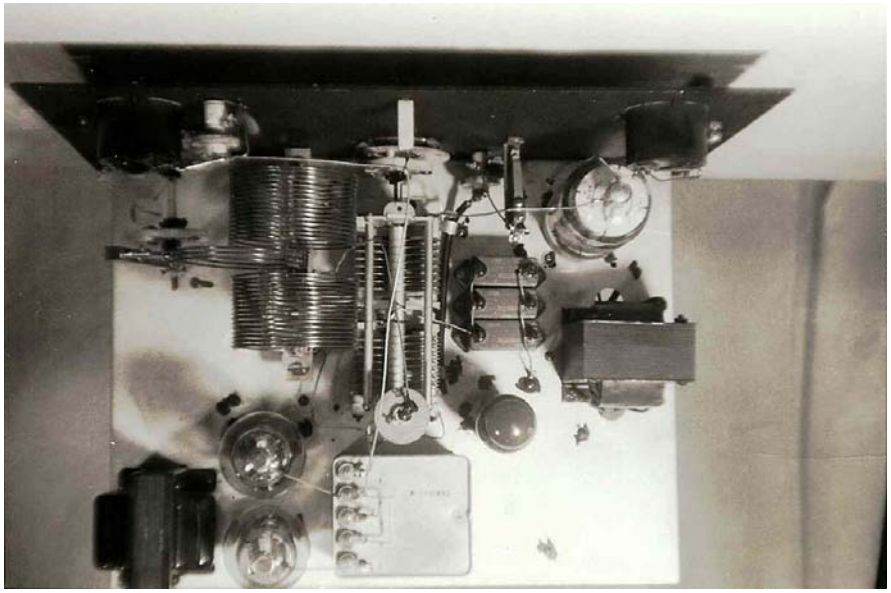
- Must open the circuit
  - Inconvenient and potentially dangerous
- Probably the most accurate – if accomplished correctly
- Requires special setup and calculations

Clamp On Inductive

- Convenient and accurate
- Requires a competently designed and constructed instrument
- Does not require opening the circuit in most cases

Ham Radio





My first rig circa 1953/54

My Qualifications

- I am not an expert in this area.
- I have considerable experience in designing telephone outside test equipment.
- For me it is a curiosity and hobby that I have applied my design skills to.
- I would like to share what I have learned.

My Career

- Missile guidance systems technican
- EMP studies
- Missile guidance system design resp.
- Telephone outside plant test equipment
- Memory systems testing
- Buried electronic marker location

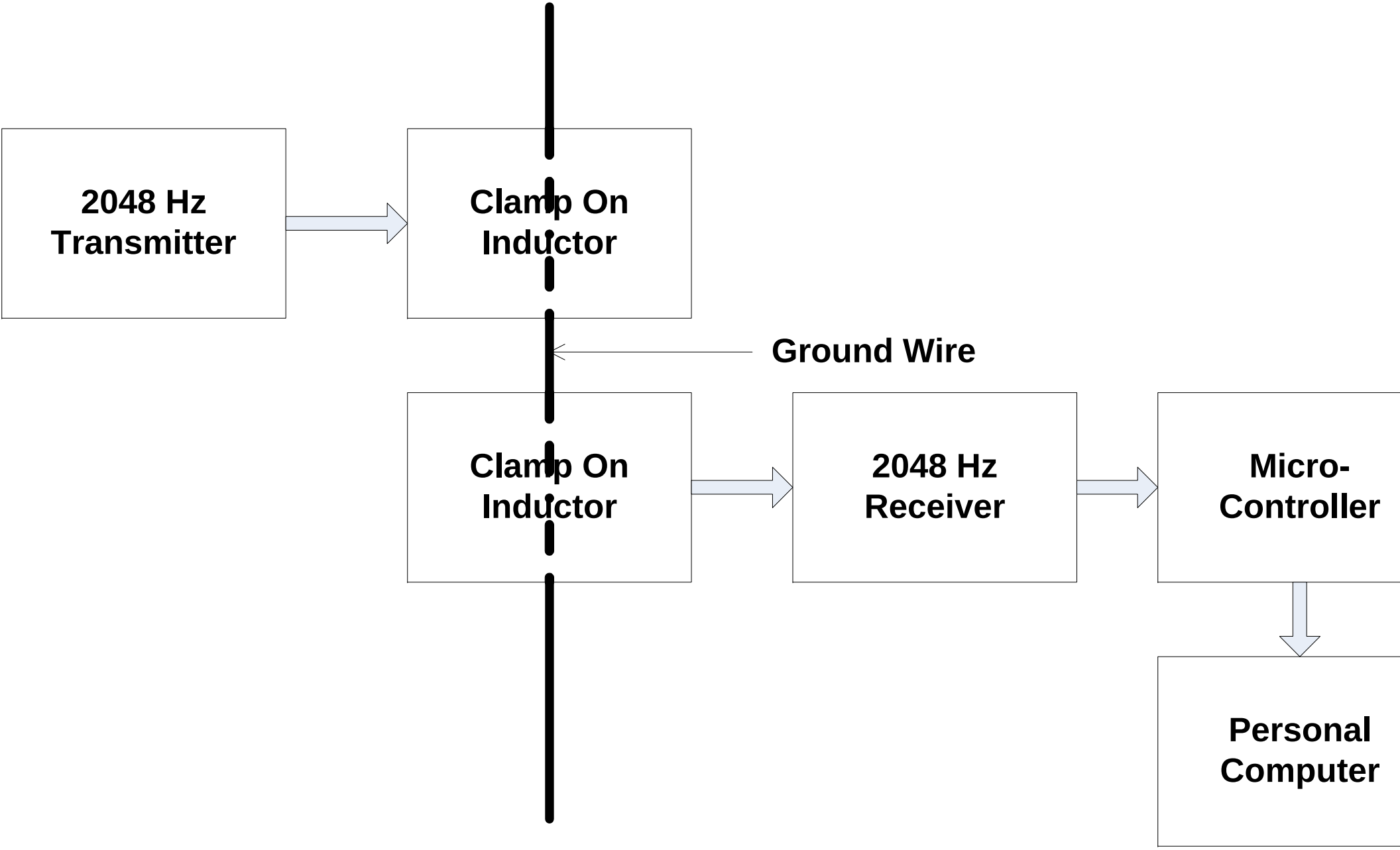
Measurement of Installed Grounds

- Open fault Locator
- Dynamic GPS position solution math
- USB implementation
- Strapdown inertial system
- Vapor deposition system power supplies
- EMC verification and analysis

My Design

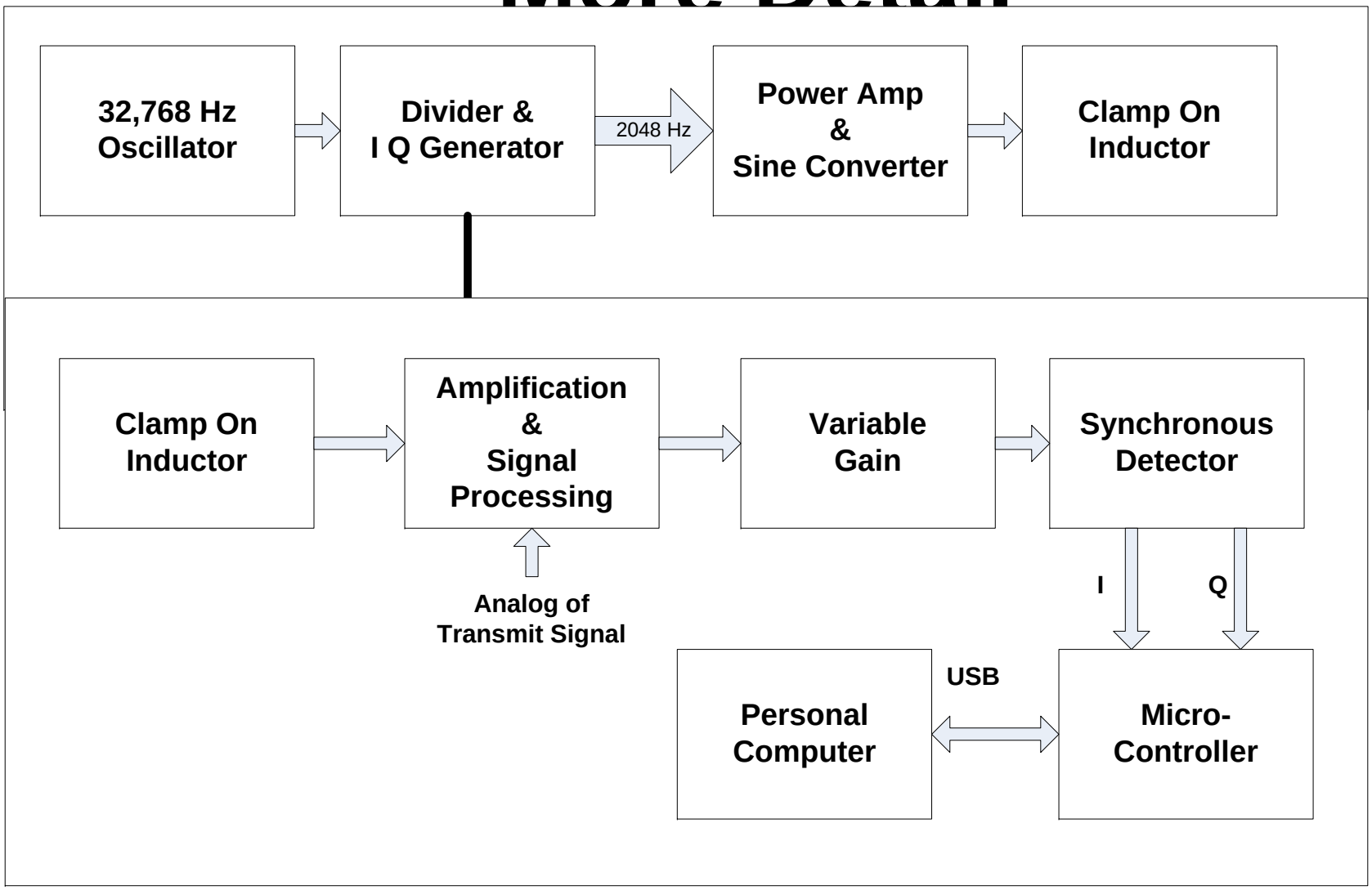
- Why did I do it?
  - Been wanting to for some time
  - Had time recovering from illness
  - Felt there was a need for such an instrument in the ham community
- Did it make sense to do this?
  - Probably not

Measurement of Installed Grounds



Measurement of Installed Grounds

More Detail



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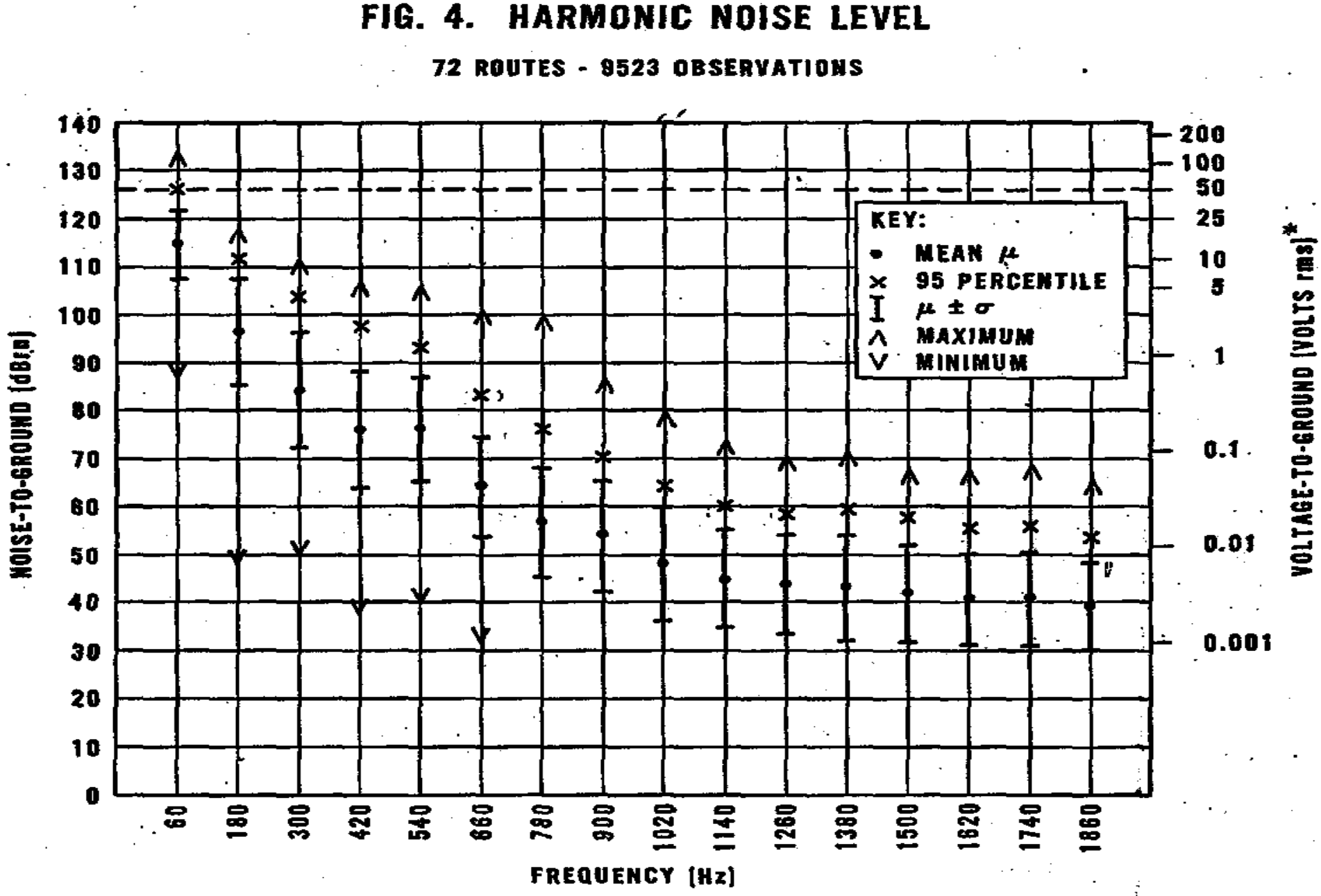
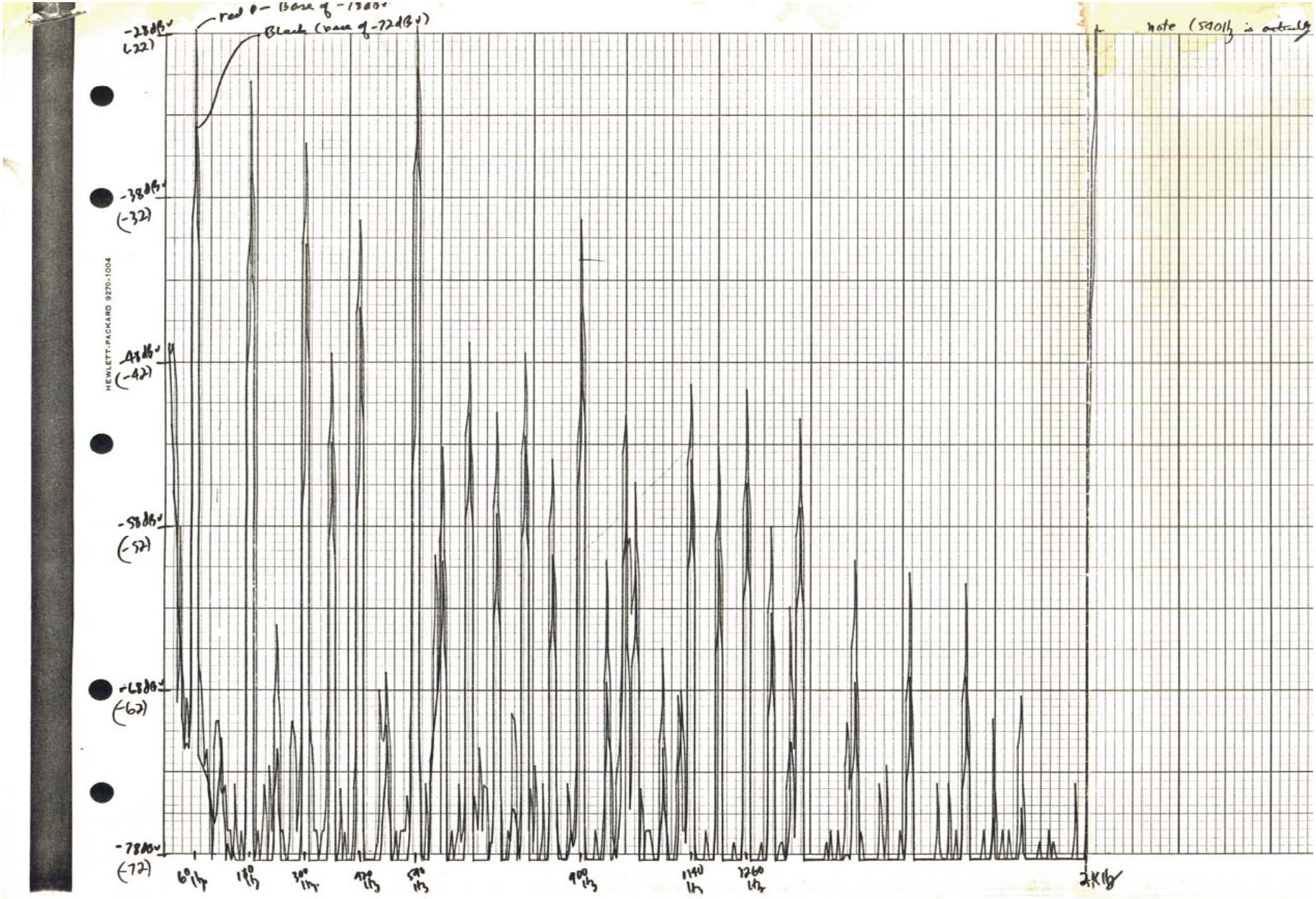
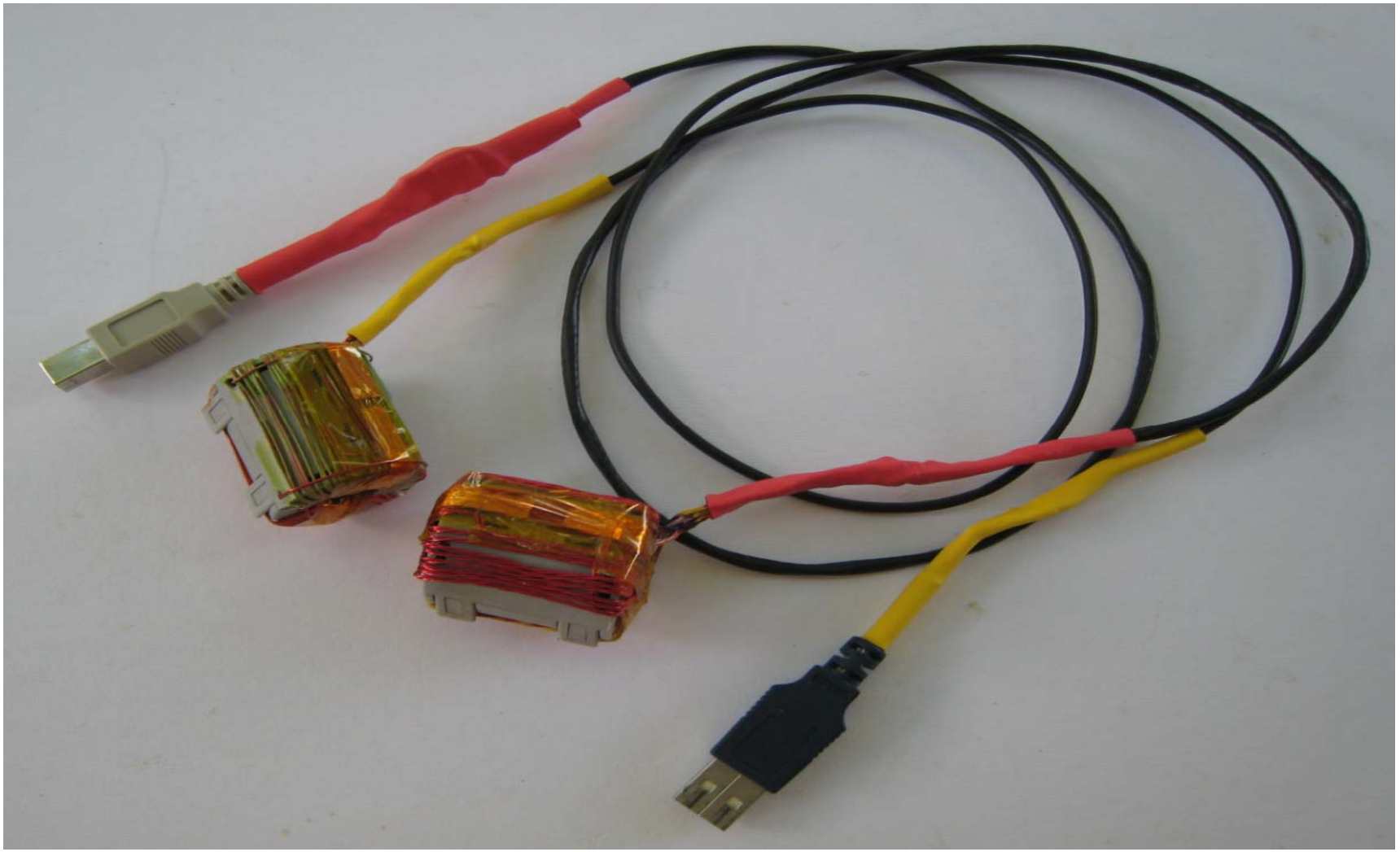


Measurement of Installed Grounds



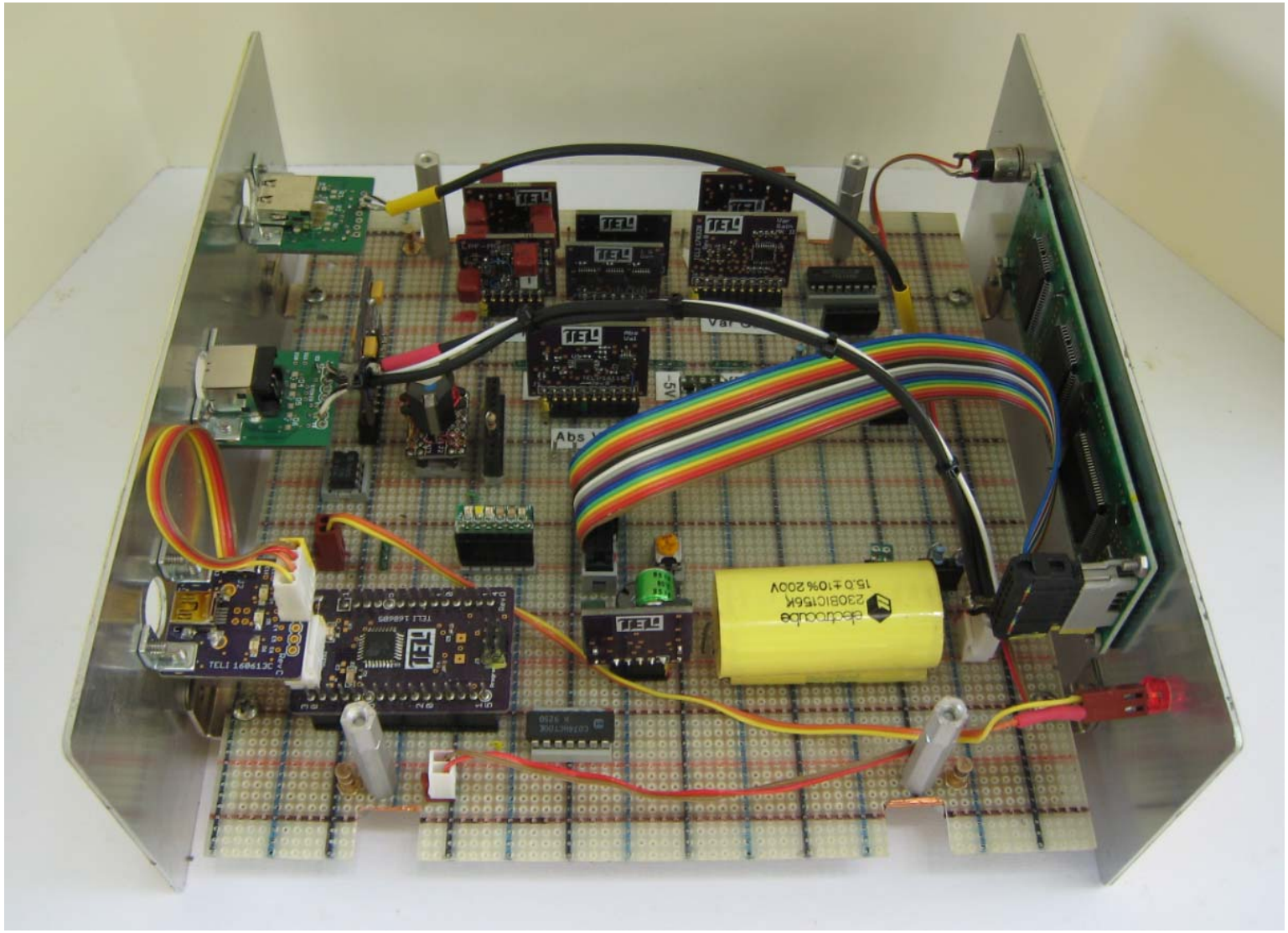
Clamp On Inductors



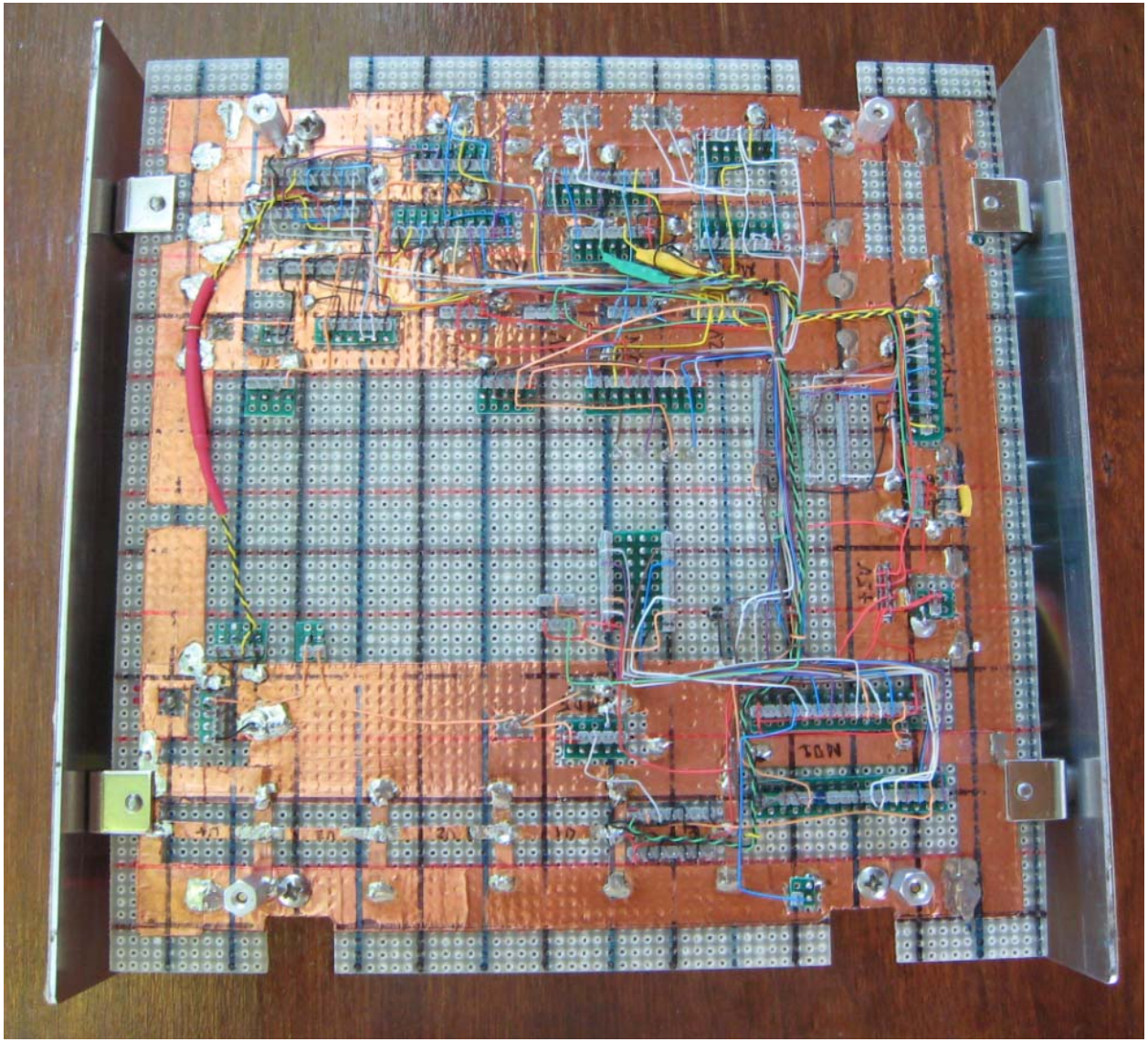
Test Set

- Test measurement hardware
- Microprocessor hardware control
- Laptop computer with Windows application

Hardware



Hardware



Demonstration

- Test Box with a loop and a number of resistance values.
- Ground Ohms Test Set
- Laptop Computer

Instruments Available

- A number of competent instruments are available
- Cost $1200 and up

Recommendations

I recommend that the club or those with a significant investment in tower structures purchase a competent ground test instrument for either for use by club members or their personal use.

The Future

- Publish the design in QEX
- Replace the laptop with a Raspberry Pi