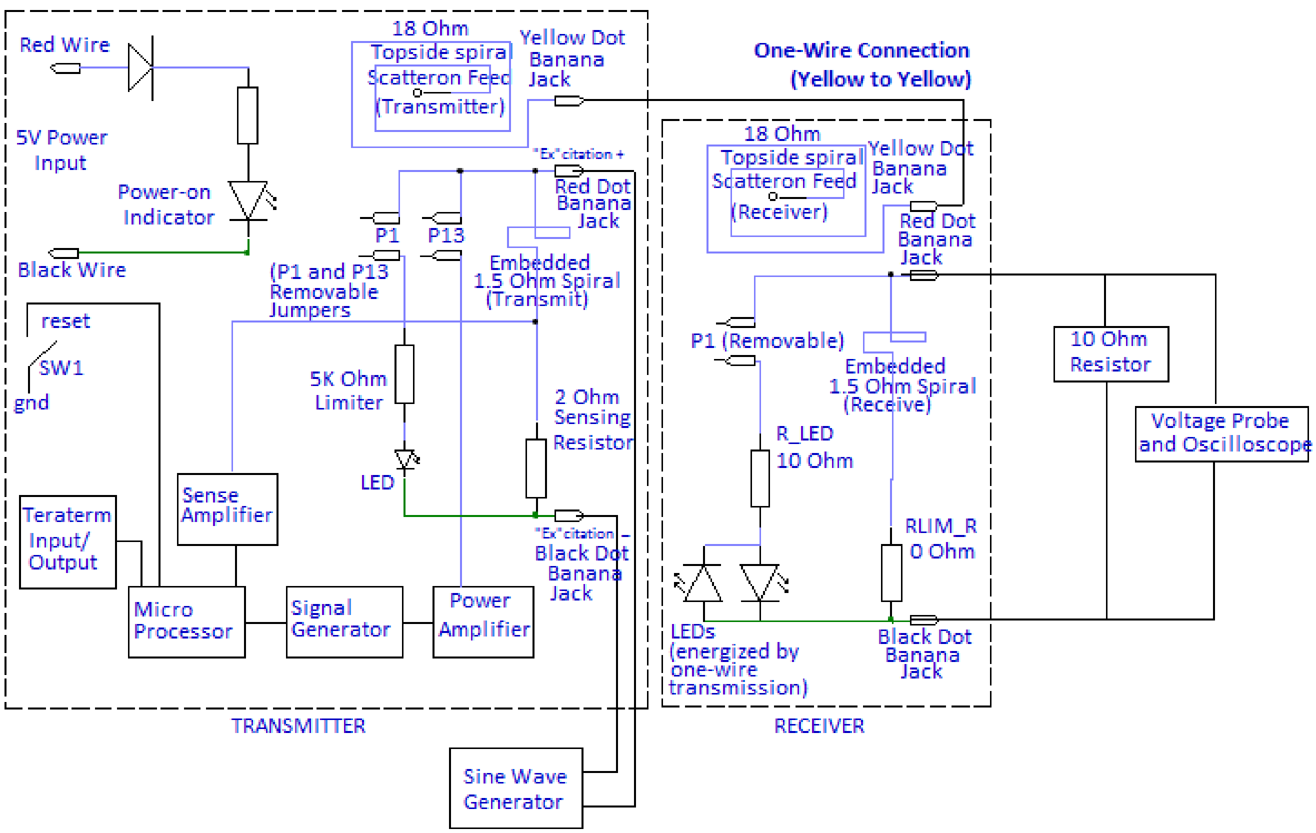
This Application Note employs the Scalar Wave Starter Kit with Externally Applied Test Equipment. Analysis includes safety and compliance considerations. Scalar Wave Starter Kit without its 5V power attached. Transmit, tune, and measure receiver power is demonstrated. This Note walks through a gyration or typical experimental session, collecting observations in an organized fashion henceforth shared with the reader. The transmitter's on-board oscillator was disabled and instead stimulated by an external low-power oscillator. The external transmitter "Yellow" banana-jack or "earthing" was likewise connected to the receiver "Yellow" banana-jack, using one-wire, as stretching from the basement to the third-floor test area. The returning power connection from the third-floor receiver to the basement where the transmitter was located, is wireless and largely independent on the distance of the wire; this enigmatic connection is the reason for great interest because it can transfer power at a distance. Nikola Tesla invented this technology in 1900 and used the physical earth as his return wire – he used large towers with deep grounding rods.

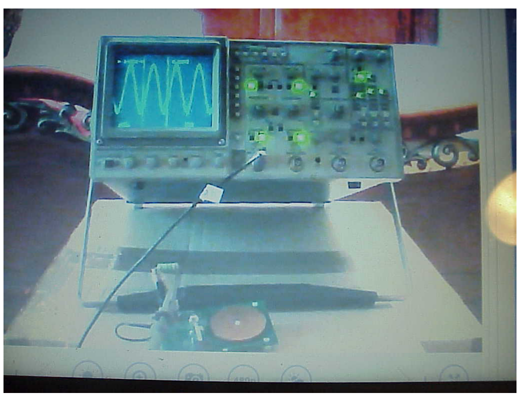
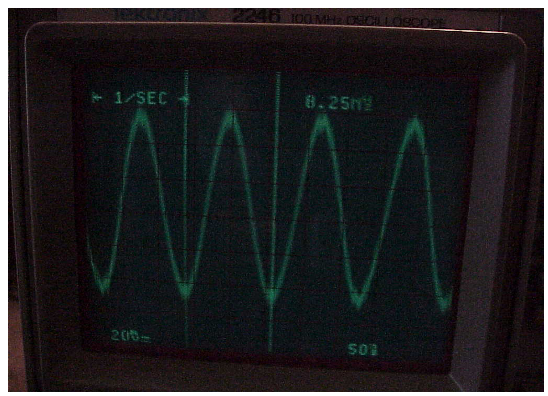
Using a different scatteron incrementally changes the tuning frequency and the energy collection efficiency. A sphere has more surface area and hence works best. Comparison by Test is performed using: firstly, a 2-inch diameter flat copper of scatterons (mounted on wood), and secondly using the superior performance 50mm steel globe of scatterons. Please refer to the schematic of the Scalar Wave Starter Kit below.Scatterons are attached to the topside spiral-feed of both the transmitter and receiver. Anything conductive can be used as a scatteron (a scatteron is the globe or disc connected to each transmitter and receiver pair). The wireless power-return connection made on both the transmitter and receiver of the Starter Kit is referred to as a scatteron. If desired, please also refer to the "Application_Note_Fabricate_Spherical_Scatteron_27AUG17.pdf".



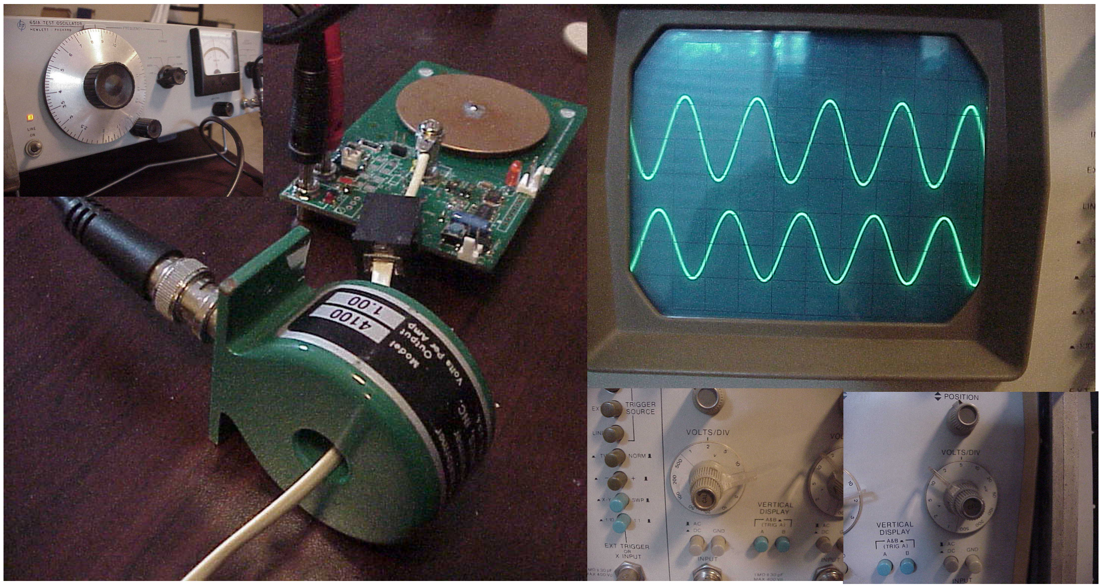
During this Application Note, the Transmitter jumper P13 was removed to isolate the external generator from its active circuits (microprocessor, amplifiers, generator), with none of the on-board active circuits being powered by 5V. In this experiment, the transmitter is instead powered by a Hewlett-Packard 651A sine wave generator. The generator is connected between the transmitter's "Black Dot" and "Red Dot" banana-jack terminal inputs. The generator amplitude is set to 4V peak-to-peak (2V Peak) and simultaneously monitored by the first input channel of a 1 MegOhm oscilloscope. The transmitter to receiver one-wire current is monitored using a wideband current probe on a second input channel of the oscilloscope. The generator's 50 Ohm source impedance drives the Starter Kit transmitter complex impedance embedded within its circuit card layers: a low-resistance 1.5 Ohm multi-turn excitation coil.

As for the receiver, an external load of 10 Ohms is connected to "Black Dot" and "Red Dot" banana-jack terminals of the receiver. The receiver's jumper P1 was initially removed to disable its LED and substitute this external resistor in its place. Testing the two different scatterons in the analysis below, it's obvious that the 50mm globe-shaped scatteron system picks up significant power from the low voltage (2V peak) transmitter at its tuned frequency, whereas the flat 2-inch diameter scatteron system picks up little power at its tuned frequency. In his Patent 645,576, Nikola Tesla whom invented this technology does say the larger surface area of a sphere is more efficient for power transfer.

Testing with Tuned 2-inch Flat Scatterons attached to both Transmitter and Receiver:

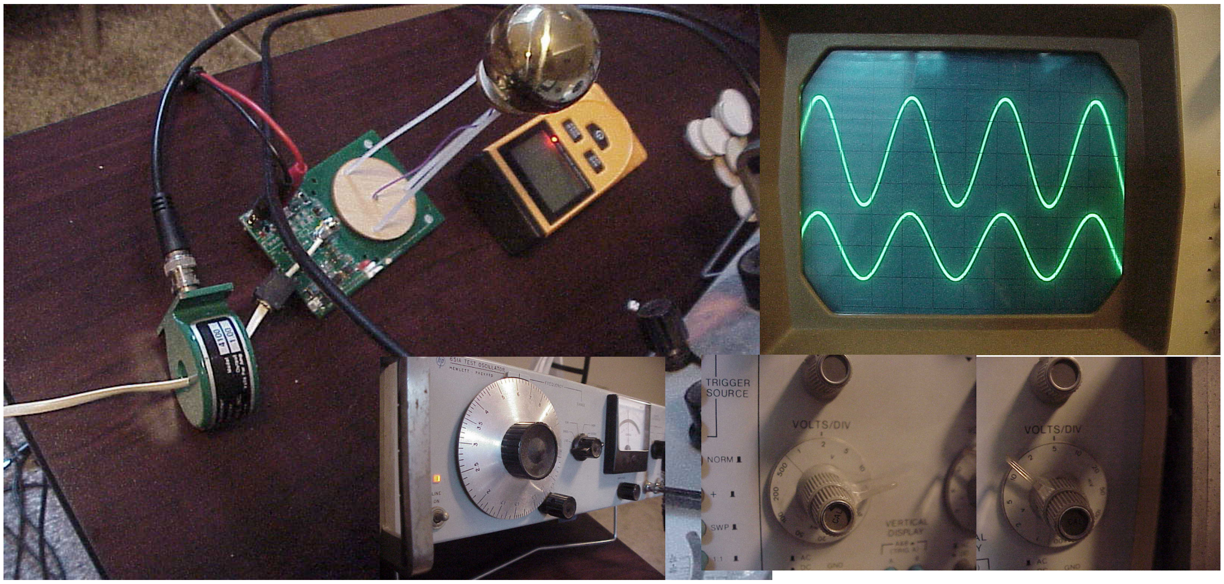



Above is a side-by-side view of a photograph of the webcam image during manual tuning of the system as seen from the basement (Left), and a photograph of the same image taken from the third floor (Right). The scope image shows the system was tuned to 8.25MHz with peak current (above Right) shown measured at the receiver. The receiver's LED has been disabled by removing its jumper P1. The oscilloscope displays via the webcam and 1-MegOhm scope probe measuring across the receiver's 10 Ohm external load resistor: 20mV/div or 100mV peak to peak. Thus the received current through the disc-shaped scatteron is (50mApeak/sqrt(2))/(10 Ohms) =3.5mArms. And the receiver power loss is [50mV/sqrt(2)]^2/(10 Ohm external load + 1.5 Ohm receiver coil resistance)=109uW in the tuned (peak current) condition, with a 10 Ohm load in place of the receiver LED. The power received is small with this flat disc scatteron, only a hundred microwatts. The spherical scatteron deliveried 4x more received power than the disc-shaped scatteron (demonstrated later in this Application Note).



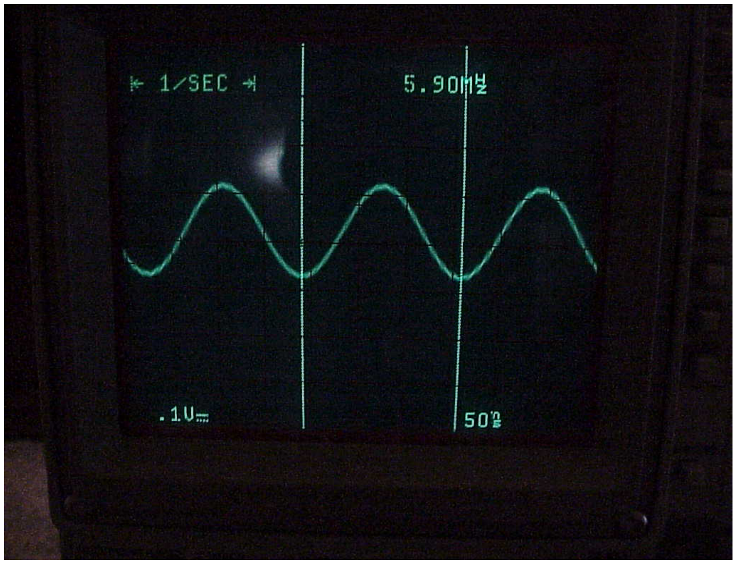
The images above are a view of the instruments presently used to tune the Starter Kit having no other power source applied to it besides the external Hewlett-Packard sine wave generator (and jumper P13 removed to protect the active circuits on the circuit card). The frequency generator was tuned by-hand while watching the receiver voltage peak-to-peak output across its external 10-Ohm load resistor, go highest using the webcam. The transmitter and test equipment are located in the basement, with a 100 foot one-wire, connecting from the Starter Kit's Transmitter in the basement to the Receiver on floor 3. The one-wire passes through a Pearson 4100 probe (shown above donut-shaped) measuring the transmitter current in this one-wire system and recorded on the upper oscilloscope trace. The lower trace is the voltage applied by the Hewlett-Packard sine wave generator.

Replace inefficient Disc-Shaped Scatterons with 50mm Globe-Shaped Scatterons:

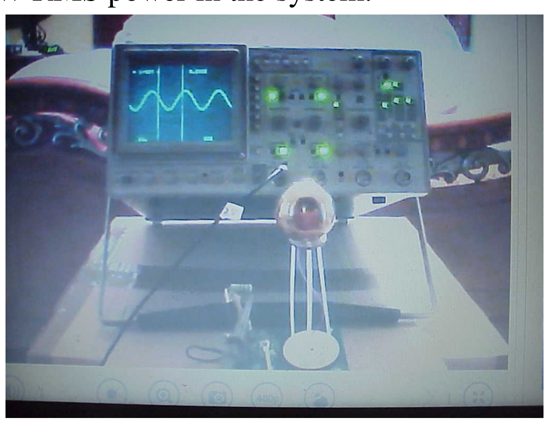


Hewlett-Packard 651A sine wave generator is utilized again (images are shown above). This time, the observed resonant or tuning frequency is at the 6.3MHz setting. The input voltage at the transmitter from the generator is monitored by the oscilloscope, where the upper channel is 5mA/division using the Pearson 4100 wide-band monitoring probe. The lower channel is monitored 2V/division. The generator excites the transmitter input “Black Dot” and “Red Dot” (banana-jack terminals of the transmitter – see accompanying schematic). The 50-Ohm generator is driving a 1.5 Ohm transmitter coil embedded within the internal layers of the otherwise un-powered receiver circuit card. Top trace = one-wire transmitted current 3.2divpp*5mV/div * 1A/V = 16mApp or 5.7mArms (measured with Pearson 4100 wideband current monitor), bottom trace = voltage generator at the receiver input, 2V/div. There is a pi/4 phase shift in voltage and current of a tuned scalar wave that can be observed at the transmitter input and left as an exercise for the student.

The receiver has a 10-Ohm resistor in place of an LED as a load. Examine the receiver using a Tektronix scope and x10 voltage probe, located on third floor through 100 feet of phone wire (all wires in the cable are soldered at the connector and adapted to a single-connection banana-plug) in the Starter Kit. The received voltage is shown below at tuned frequency of 5.9MHz, with 50mm globe-shaped scatteron.



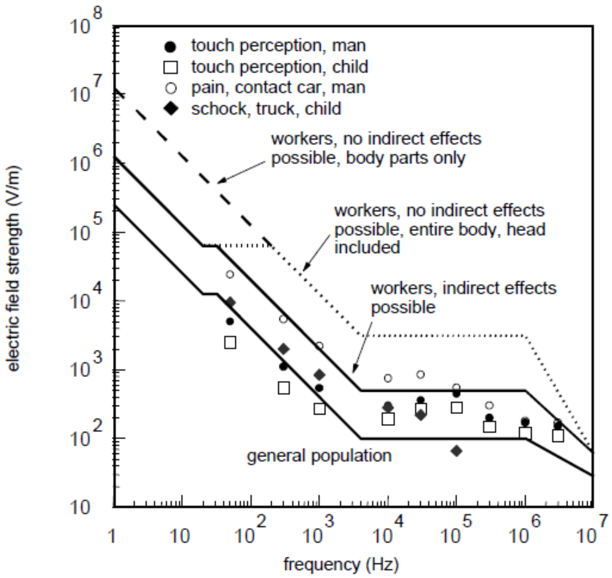
Above is an image of the receiver voltage, Tektronix oscilloscope and x1 scope probe reading the tuned result: 5.9MHz and 0.1V/div* 1.8div *1probe = 180mVpp. The current received according to the scope voltage measurement across 10 Ohms is 18mApp, or RMS value of 6.4mA. Interesting that the received current of 6.4mArms in this inductively coupled 10-Ohm resistive load is on the order of the one-wire current measured at the transmitter of 5.7mArms. Received AC power = [9mApeak/sqrt(2)]^2 x 10 Ohms = 0.4mWrms. Transmitted power was not measured, although it is estimated by adding received power of 0.4mW and transmit path loss = (5.7mArms)^2 * 36 Ohms = 1.2mW; a total of at least 1.6mW RMS power in the system.

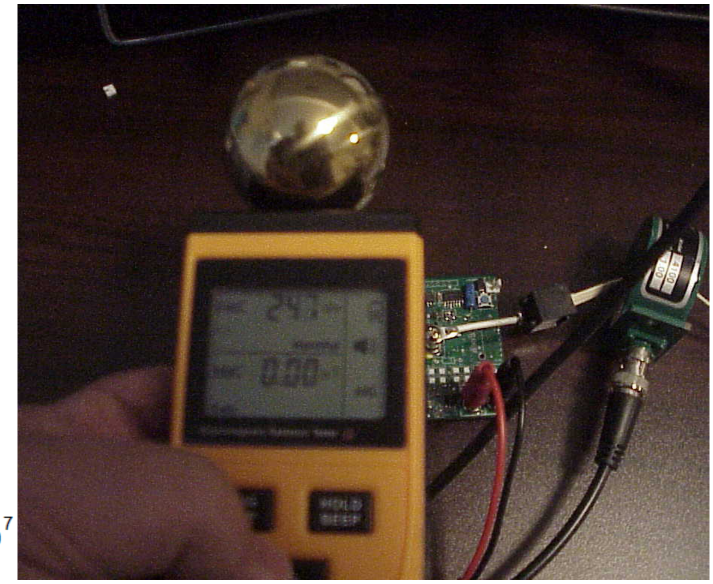


A view of the receiver located on the third floor is used to tune and maximize the power transferred from the receiver. There is a 10 Ohm external-load-resistor and voltage-measuring-probe in this webcam view, and the scope image is used to maximize the power reading in the 10 Ohms. Evaluating the Transmit path losses (through one-wire connected between transmitter to receiver coils): Each of the transmitter and receiver one-wire path has 18 ohms of DC resistance (see schematic), hence there are 36 Ohms of resistance in the receiver path from scatteron to scatteron. Estimated transmit path losses = (36 Ohms)*[8mApeak/sqrt(2)]^2 = 1.2mW.

Evaluate Safety and Compliance: Electric Field Strength

with maybe 1.5mW radiated power there is no need for Safety concern based on the following data:





Using the field strength meter (above Right), measure approximately 250V/m with hand-held meter (part of the Starter Kit) in contact with the transmitter globe – Radiated fields decrease rapidly from the surface when measured with the handheld meter. The safe level is below 1000V/m accordng to the graph above Left, from "Health Council of the Netherlands: ELF Electromagnetic Fields Committee. Exposure to electromagnetic fields (0 Hz - 10 MHz). The Hague: Health Council of the Netherlands, 2000; publication no. 2000/06E.", or "Safety_Study_Electric_Magnetic_Field_upto_10MHz.pdf". proximity of the handheld meter reduces the tuning and observed peak current value, making accurate readings difficult to measure. Notice the plot shows 250V/m falls below the possible effects at 8MHz.

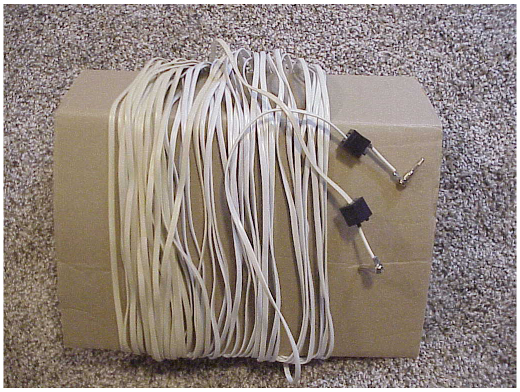
Part 15 low-power transmitter frequency table

Frequency Band	Type of Use	Emission Limit	Det	47 CFR
6.31225-8.291 MHz	Any, when 6 dB bandwidth ≥ 10% of center frequency	100 μV/m @ 30 m	A	15.223
	Any, when 6 dB bandwidth < 10% of center frequency	15 μV/m @ 30 m or bandwidth in (kHz) / f(MHz)	A	15.223
	Any	30 μV/m @ 30 m	Q	15.209

APPLICABLE FREQUENCY FROM OET BULLETIN NO. 63

The table above is from "FCC_Restricted_Bands_Including_7-8MHz.pdf". Conclude that the radiated emissions at 30m are much less than 30uV/m for compliance because the hand-held meter reads zero outside of several inches. The actual values could conceivably be measured in an RF Chamber with an antenna and spectrum analyzer; however at low frequencies a standard receiving antenna is typically a loop antenna or active monopole antenna; neither of which are suited to measure a vortex wave which should look like noise but we shall eventually see once it becomes published by an interested engineer.

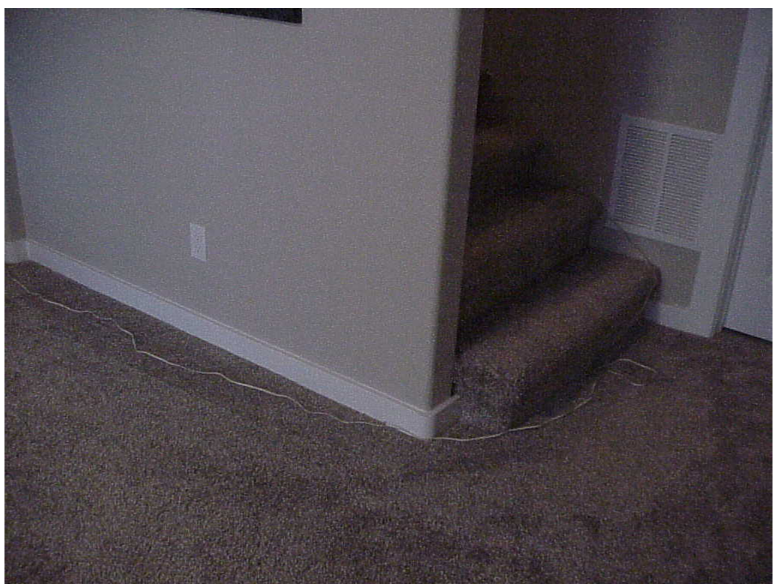
Examine the one-wire path from transmitter on basement floor to receiver on third floor:

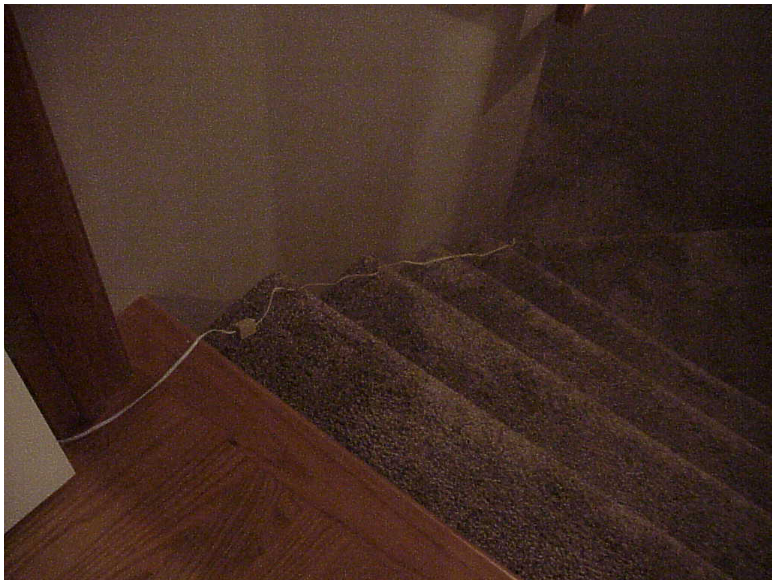
Ordinary telephone extension wire (stored on cardboard above Left) is used to make the 100-foot long one-wire that extends from the basement-floor transmitter to the third-floor test area. The custom RJ-11 phone plug to Banana-Plug adapter (two of them shown above Right) allows a phone cable attachment to a single-wire banana-plug. One set of two adapters shown above Right are included as part of the Starter Kit.

The ordinary telephone-wire is connected to the basement transmitter and strung-up to the third floor test area. Jumper P13 was removed from the transmitter to prevent the external generator from driving into the un-powered Starter Kit transmitter logic. The one-wire drops down from the transmitter table before exiting the room and connecting to the receiver on the other end of 100 feet of wire. The transmitter frequency was adjusted to obtain peak output measured at the remotely located receiver, with the webcam viewing the receiver on the third floor, and observing the scope trace of the received Voltage or Power.

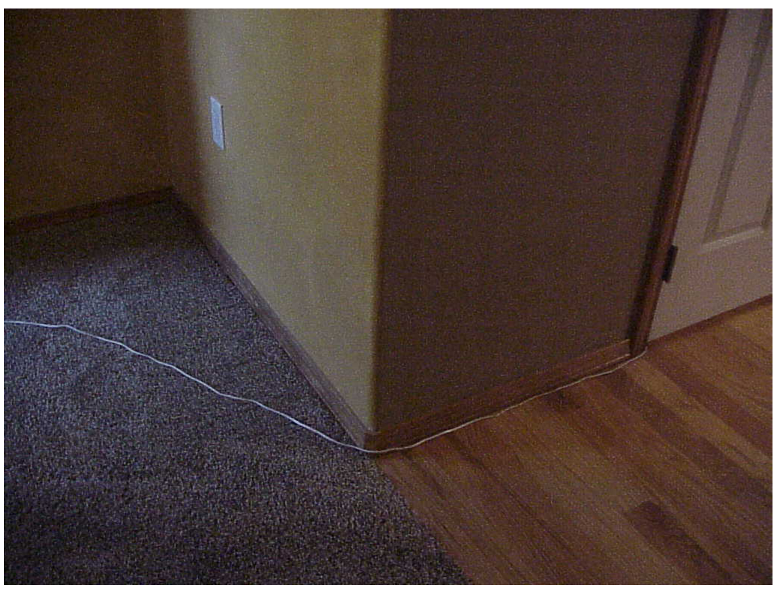
One-wire connection exits the transmitter area with sine wave generator and test instruments, onto the floor and out of the basement area.



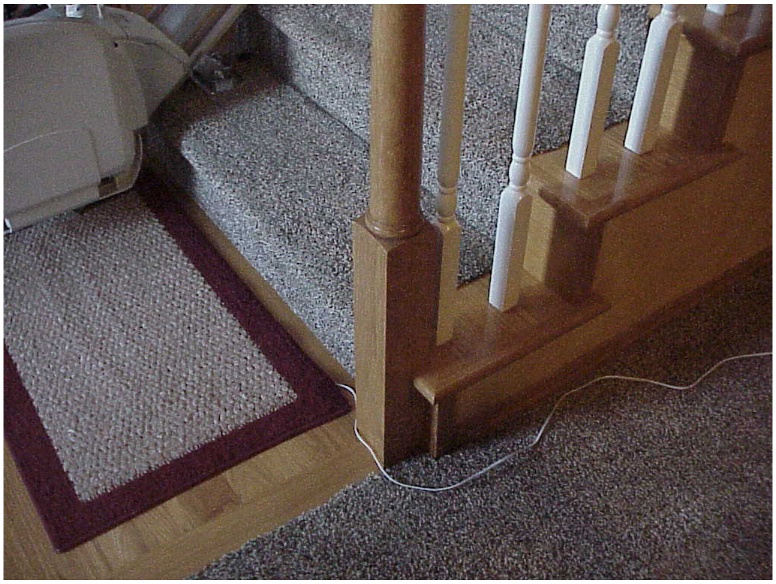
The one-wire runs along the basement floor and goes up the basement stairwell

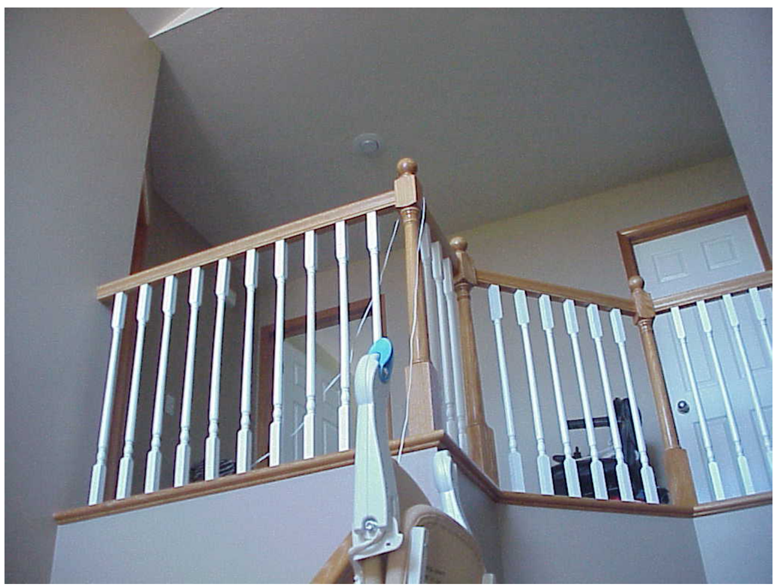


The one-wire emerges from the basement stairwell on the second floor. There is an adapter visible serving to connect the two 50-foot lengths of telephone wire together.



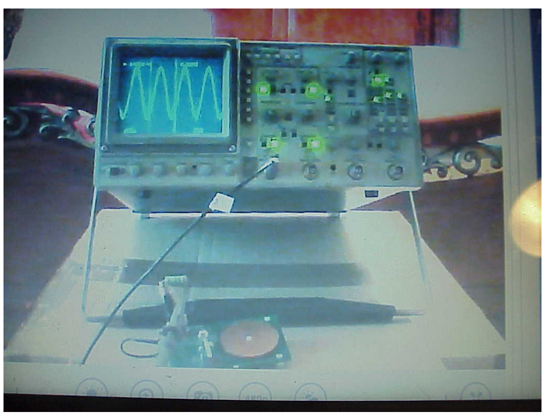
After exiting the basement stairway the one-wire continues along the dining room floor.

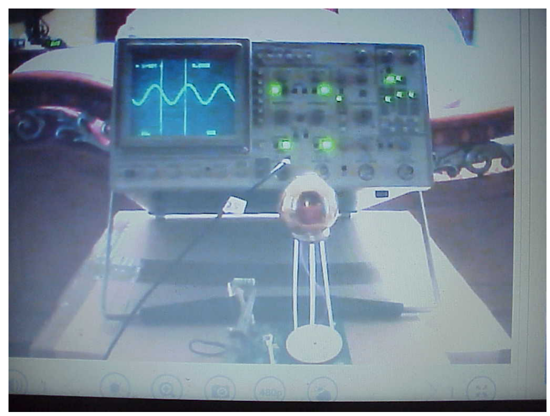

The one-wire exits the dining room and proceeds under the stairmat, and metal chairlift rail, headed upstairs to the third floor.


The one-wire that connects the transmitter and receiver together is shown above extended up the stairway railing and on top of the third-floor stairwell

Lastly, the one wire runs under the third floor doorjamb and into the third floor test area where it is connected to the receiver and viewed by the webcam.

Review of Tests performed Above: one with disc-shaped Scatteron, the other with a globe



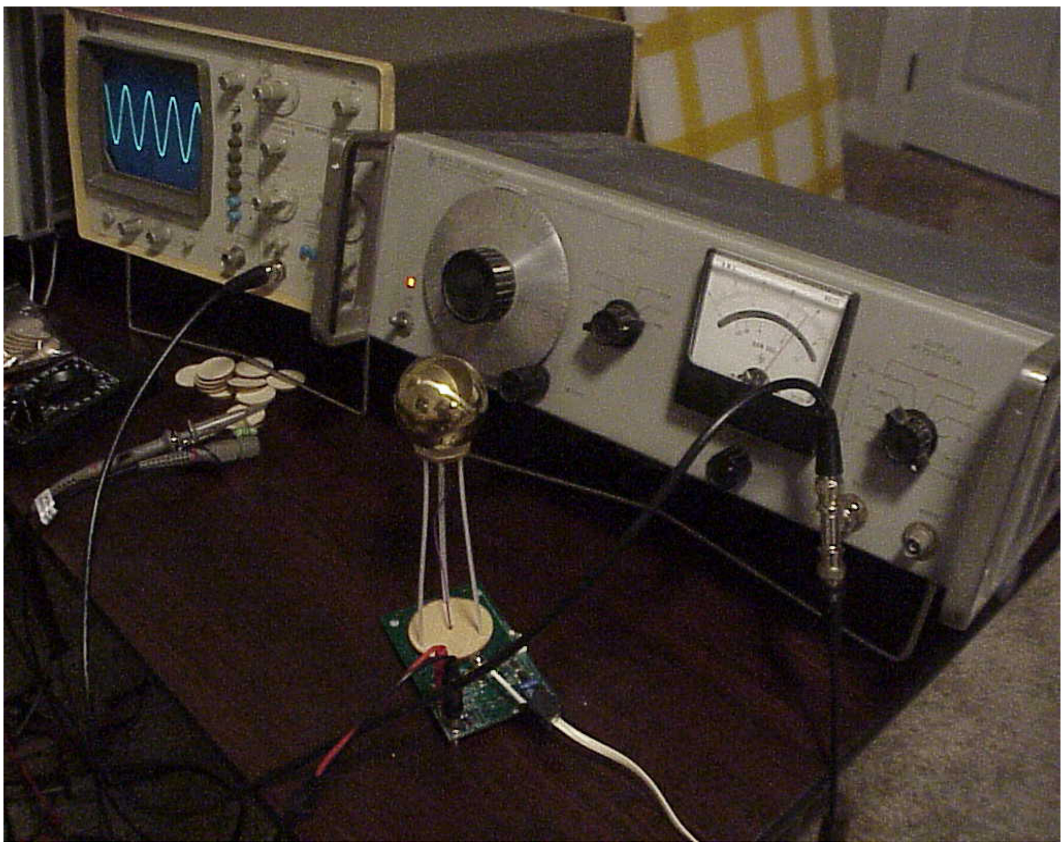


An image of the laptop displaying a webcam view of the third-floor test area is shown above where the 100 feet of 1-wire terminates on the receiver circuit card. At this third-floor test area, the receiver and test equipment are used to measure power on a 10-Ohm resistor that was connected externally in place of the receiver's LED (light emitting diode) load. The power is visualized being sent with half the electrical connection wired wherein the current is measured, and the other half of the connection is wireless from scatteron to scatteron (a scatteron is the globe or disc connected to each transmitter and receiver pair) and transformed by Nikola Tesla's invention. The receiver LED was intentionally disconnected, removing jumpers P1 of transmitter and receiver. In both Left and Right test setups above with 2-inch disc scatteron or 50mm globe scatteron cases respectively, the received voltage reading across the external 10-ohm resistor is displayed on the oscilloscope.

The test area shown above is viewed from the internet-connected (webcam recording) laptop computer display, for two different experimental set-ups. As the computer monitor views with a webcam at the far end of the one-wire, manual tuning can be performed from the basement level and observing the remote webcam image. The webcam provides the ability to adjust and maximize power transfer using external instruments, and in real-time (except for the delay in webcam response). In this manner, an experienced, skilled person can tune the transmitter frequency with a Hewlett Packard generator, while observing and maximizing the power received on the receiver that is connected through 100 feet of wire up to the third floor experiment area shown. The one-wire current is measured during the manual transmitter tuning process with a Pearson 4100 current probe and an oscilloscope.

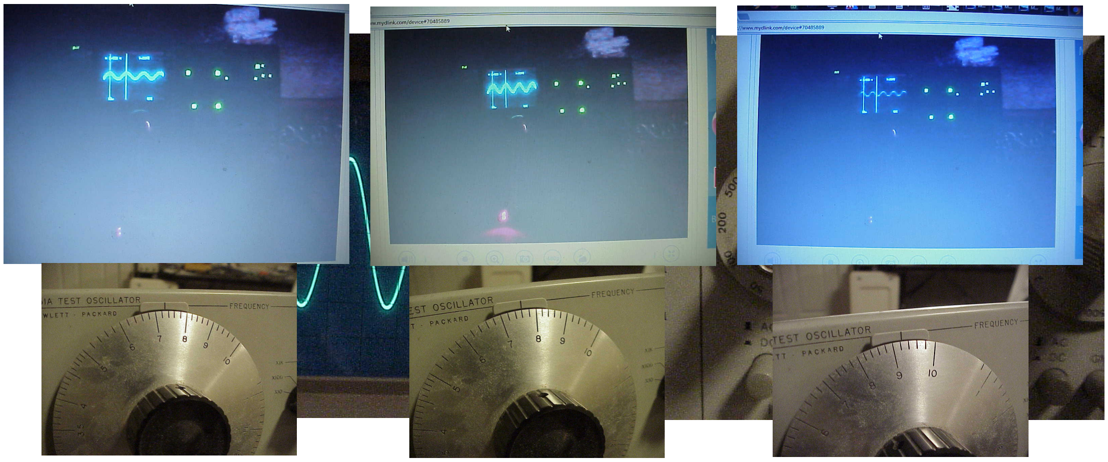
Change from an External 10-Ohm resistor load on the receiver, to its Built-In LED lamp

Subsequently, the receiver was modified while continuing to use the 50mm spherical scatterons: the 10 Ohm external resistor was removed and the LED on the receiver restored to operation by installing its jumper P1. Under these conditions, the receiver LED was observed brightest after tuning the basement transmitter near 7MHz. The receiver was observed to be tolerant of approaching and touching the receiver globe (a weak proximity effect is characteristic of tuned scalar waves) while remaining substantially in tune and with substantially constant receiver LED brightness. The Transmitter was driven with the 4Vpp (peak-to-peak), 5Hewlett-Packard sine wave generator in the basement. The Receiver was connected to the Transmitter through 100 feet of phone cable with all its wires connected together (one-wire). Details of the above descriptions follow.



The basement-floor transmitter excitation voltage produced by the Hewlett-Packard generator (above Right) is recorded on an oscilloscope (above Left). The Pearson current probe is located at the receiver end on the third floor level. The transmitter input is excited by the generator with 2Vp (4Vpp) and tuned for maximum receiver current and brightness observed using the webcam. When tuned, power transfers from the globe-shaped transmitter scatteron (above Center) making a connection and transferring power to the third-floor receiver scatteron.

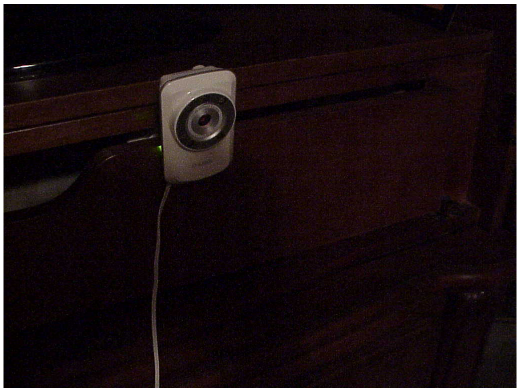
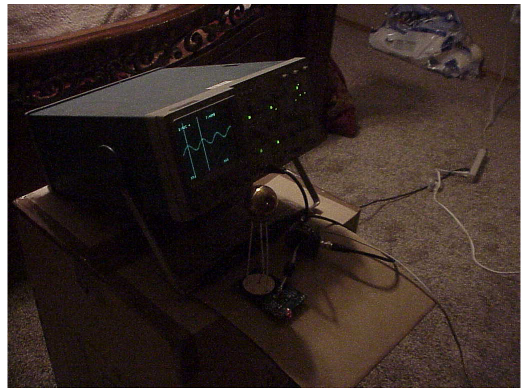
Observe the Receiver and LED below, in near darkness:



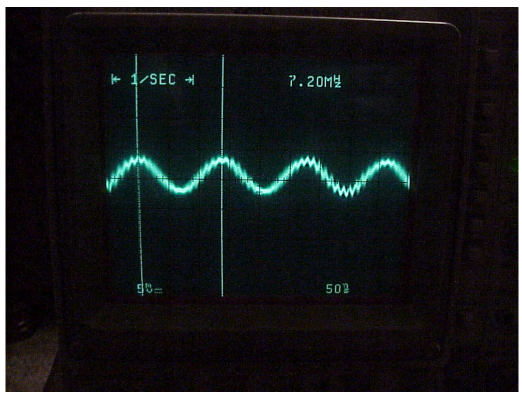
Shown above Left, Middle, Right are images of the webcam viewed with corresponding frequency control knob positions shown above, located in the basement. And 4Vpp generator output. The above photos demonstrate that the remotely-located Receiver current monitored diminishes outside of the tuned frequency near 7MHz. Above Left is hardly illuminated at dial-setting 7.3MHz, brightest at dial setting 7.6MHz, and again the LED glows dimly at 9.2MHz. The image of the LED bloom can be seen best at the bottom of the center image near 7.6MHZ. During this manual frequency tuning-step performed by hand-turning of the generator's tuning knob shown above, the transmitter frequency was intentionally de-tuned slightly to demonstrate the frequency band width for which the transmitter and receiver with the Receiver LED illuminated - 7.3MHz to 9.2MHz. The LED goes from off, to dim, to bright at dial-setting 7.6MHz, then dim, then off again as the frequency is increased. Starting at below 7MHz and then swept above 9MHz reveals its tuned condition evaluated visuallyClearly the only time power can be transferred is when the system is in-tune at such frequencies. Views from the transmitter control point of view are described below.

The tuned transmitter is at 4.4divpp * 2V/div = 8.8Vpp at 7.2MHz. The webcam images below made it possible to tune it by observing the sent and received waveforms simultaneously.

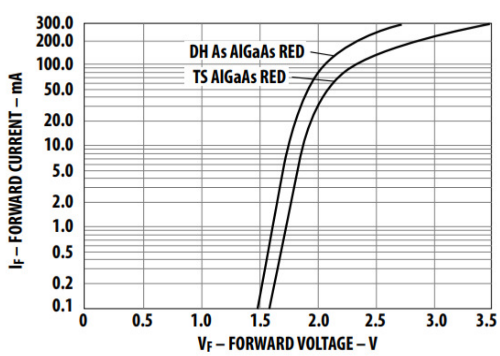
View of the webcam looking at the tuned receiver in darkness ith the Receiver LED blooming brightly, monitored by an oscilloscope and Pearson 4011 current probe. The Receiver was tuned in the darkened third-floor test area from the basement below. The receiver is evaluated and manually tuned to produce maximum receiver LED brightness and current amplitude in real-time, using webcam to view the remote oscilloscope instrument. The transmitter circuit card is driven by a Hewlett-Packard sine wave generator set to 4V peak-to-peak.

Above are images of the webcam in darkened third floor test area (above Left), as it is viewing the receiver, scope and current probe in darkened 3rd floor test area (above Right). The jumper P1 has been reinstalled on the receiver to allow its LEDs to light up. In this scene, the amount of illumination was maximum when tuned to 7.2MHZ and once tuned, hardly affected by touching the receiver globe by hand. The webcam is viewed from the laptop computer on the first floor (the basement), next to the 2Vp (Volts peak) generator in the basement.



The scope image above shows the receiver's one-wire current in its tuned condition, manually tuned in order to maximize the observed brightness of the receiver's LED. During tuning of the transmitter, the receiver current was monitored by the Pearson 401 current probe to produce the scope image above. The current probe sensitivity is 1 Amp per Volt. The current at the receiver wire is thus measured to be 5mVpp * 1A/V = 5mApp = 1.8mArms at 7.2MHz. The receiver one-wire current is not the same value as that of the LED (please consult the schematic near the beginning of this Application Note).



LED 1.5V threshold,
1.6V@500uA,
2V@70mA,
2.7V@300mA

With sphere and LED, the receiver LED current was not measured in the Starter Kit receiver. One can see that the LED voltage is on the order of 1.6V to become illuminated by a number of milliamps. Integrating the emitted energy is one way to measure the power delivered using the LED data above..