

VARIOUS MEASUREMENT METHODS APPLIED TO A SPATIAL ENERGY COHERENCE EXCITER

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Abstract--- This paper covers a number of measurement techniques that can be employed in testing and evaluating many of the SEC [1] Exciter [2] circuits designed by Dr. Stiffler while avoiding the potential for error readings caused by the powerful electric fields surrounding the Exciters [2].

I Introduction

SEC [1] Exciters [2] unless properly shielded produce both a primary and secondary set of electrical fields during operation and both of these fields can produce localized induction into low quality, improperly shielded or incorrectly connected test equipment.

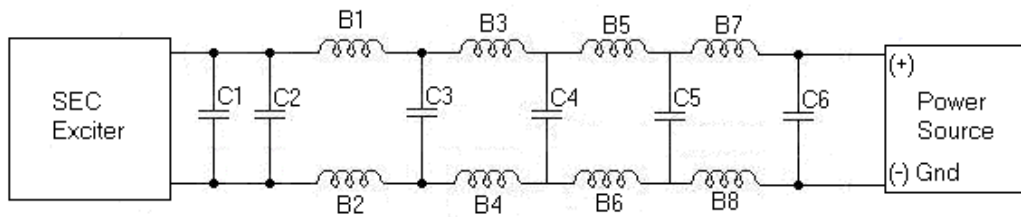
Because there is a general interest in SEC [1] Exciters [2] among Alternative Energy Groups and individuals a means to qualify and quantify operation of these circuits without costly lab equipment and specialized test environments became necessary.

II Measurement Circuits

First and foremost in working with SEC [1] Exciters [2] is the required isolation of the Exciter from its power source, regardless of the type of the source which could be one or more of; a line powered power supply, battery or solar cell. To accomplish this many different filters were tried that ranged from simple to complex with component costs to match and one general design was found that worked best and requires a small monetary investment along with a simple circuit layout.

The filter found to be most effective at providing the required decoupling was found to be a relatively simple and inexpensive multi-stage filter built from readily available RF Ferrite Beads and Ceramic Capacitors. The circuit diagram for the power supply filter is shown in Fig: 1, along with a parts list for the components.

Fig: 1



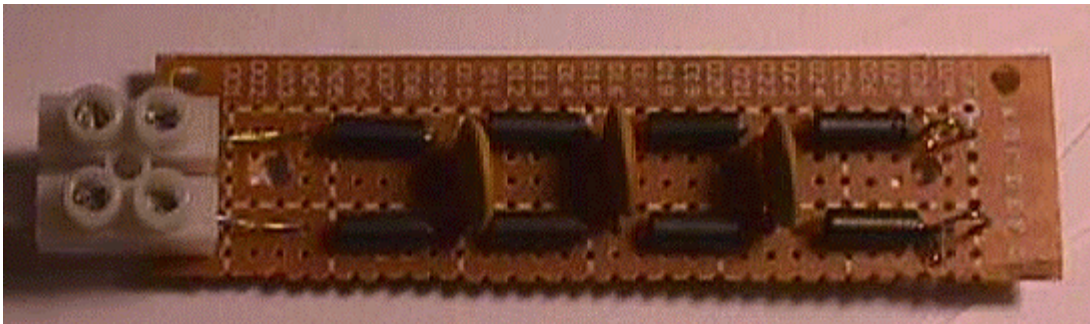
Parts List.

C1	1uF 100V, Al Radial +/-20%, Part# 158491 [4]
C2-C6	0.01uF @ 1kv Ceramic [4]
B1-B8	Ferrite Beads on leads of Z=86 ohms @ 10MHz [5]

The filter can be constructed on available prototyping circuit boards available from most electronics parts suppliers. Whatever construction method is used must take into consideration that the filter is designed to remove wideband RF energy and as a result must be constructed in a straightforward and acceptable layout.

The following picture is of a filter constructed on non-plated prototyping board. The filter shown does not include C1 or C6 as shown in the diagram of Fig: 1.

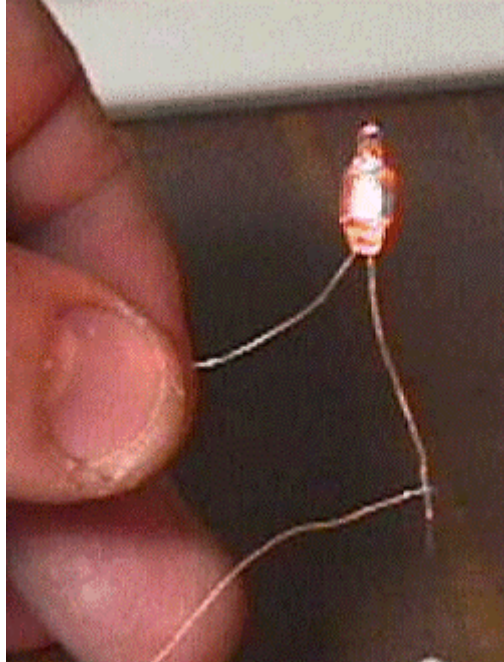
Fig: 2



This same type of filter is used in most of the voltage monitoring examples shown later in this document, although there are some minor changes in the components and construction to enhance its filtering efficiency. What is important for the power supply filter is a proper layout as seen in the above example.

RF detection devices can be as simple as a Neon bulb or a few diodes and a LED. The following picture shows one end of a Neon bulb being held by the observer and the other end touching a wire with high enough RF voltage to ionize the gas in the bulb.

Fig: 3

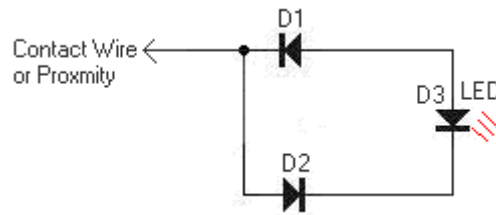


The following points are of interest when using this very simple detection method.

- 1) The bulb is indicating AC excitation as shown by ionization at both bulb electrodes.
- 2) Neon's can have different ionization (breakdown) voltages (the voltages where they show light) and a high ionization voltage may not show an indication in a circuit where a low ionization bulb does. Normally bulbs used in this way range from 68VDC to 90VDC. It would be wise to have a few of each on hand.
- 3) **DANGER.** You must be fully aware that when checking a circuit in this way your body is part of the circuit. You must be very cautious when doing this to insure you are not grounded or completing a circuit back into the unit under test. If you have any Electronic Medical Aids, implants or external, **NEVER PERFORM A TEST IN THIS WAY.**

Another simple yet effective means to check for RF in a SEC [1] Exciter [2] is with a simple set of probes made from two diodes and one White LED. The following circuit diagram shows the construction of these two probes, one is a contact probe and the other is a proximity probe.

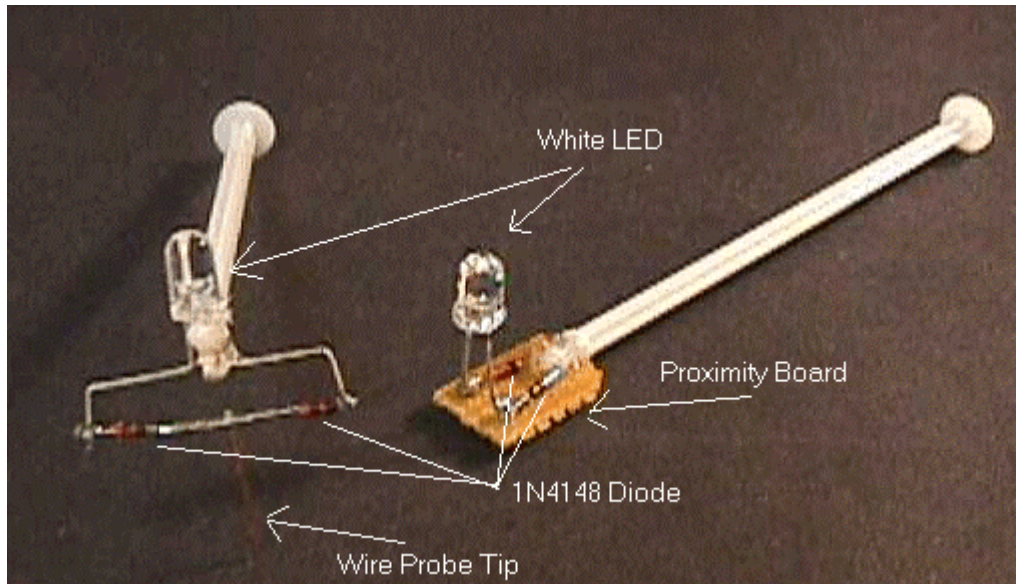
Fig: 4



Diodes D1 and D2 form a Avramenko Plug [6] and are Switching Diodes [7] while D3 is a White LED [8].

Again these probes can be assembled in two different ways as shown in the following picture.

Fig: 5

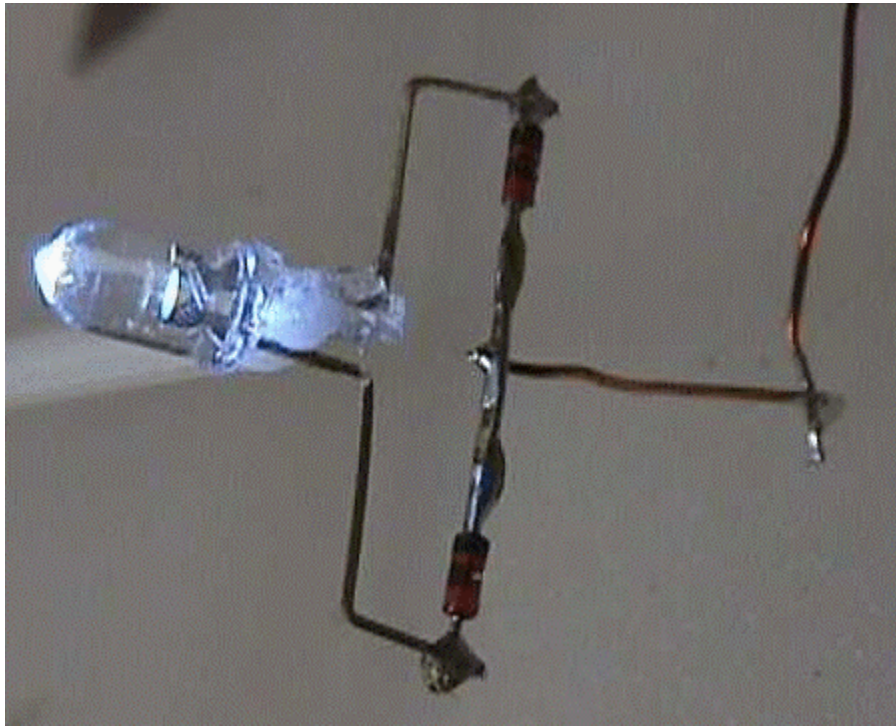


The probe on the left has a short probe wire attached to the center of the diodes and this wire is used for physical contact probing of active circuits. The probe shown on the right is built as a proximity detector and does not use a physical contact with the surface being probed.

Both probes are very handy and can provide a quick way to detect circuit locations with a high RF component. Of the two probes the proximity probe is the least sensitive, as it does not use a physical contact with the circuit and will detect the higher RF levels just by bringing the probe into range of the field.

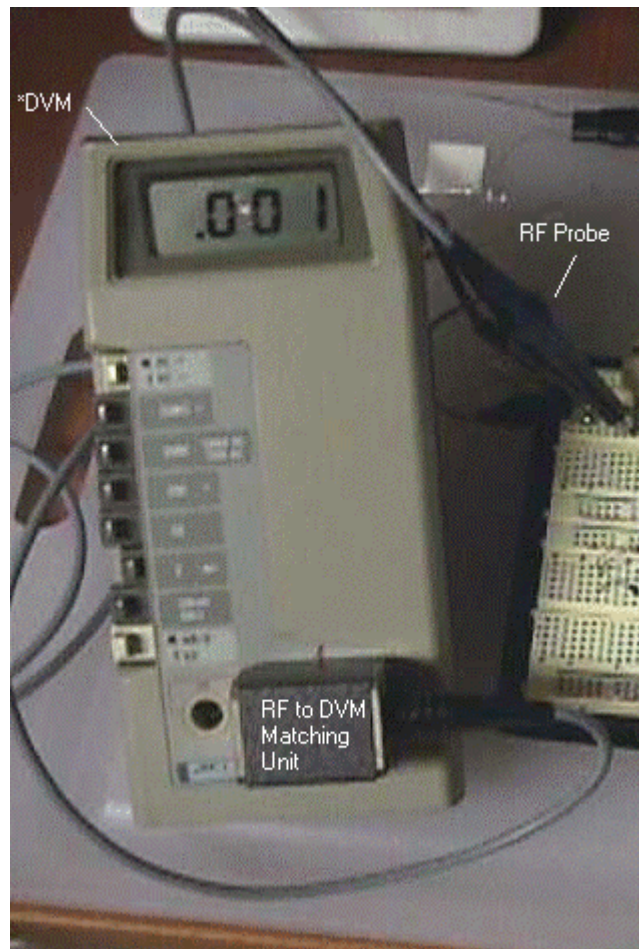
The following image shows a simple tester connected to the free end of a test point in an Exciter [2] and the simplicity yet functionality of the simple instrument is evident.

Fig: 5b



For more sophistication and accuracy there are many devices available for the measurement of RF, some can be DIY (do it yourself) detectors [9] along with off the shelf test equipment with special probes and metering methods.

Fig: 6



Without doubt to obtain quantitative RF measurement results you will be required to have a calibrated metering system.

If you only have interest in detecting how far or what shape a field is that extends from an Exciter [2] with only a relative indication of strength, then a fairly inexpensive Cell Phone Signal Detector could be used. One such detector is shown in the following image.

Fig: 7



For a research scientist a must when working with Exciters [2] is a Spectrum Analyzer and for the amateur the cost of an SA can range from one to many thousands of dollars. Although a low level instrument could be of some assistance it will require sophistication on the part of the user to make and understand the displays and what could be somewhat involved mathematics to obtain accuracy. Almost all of the professional range spectrum analyzers will contain firmware and software to do interpretation and presentation of observed spectrum.

A Spectrum Analyzer is used to display RF signals in the Frequency Domain, much different than the Time Domain displayed by an oscilloscope. The following picture was taken from a \$1000 hobbyist class spectrum analyzer that does not offer automatic display interpretation.

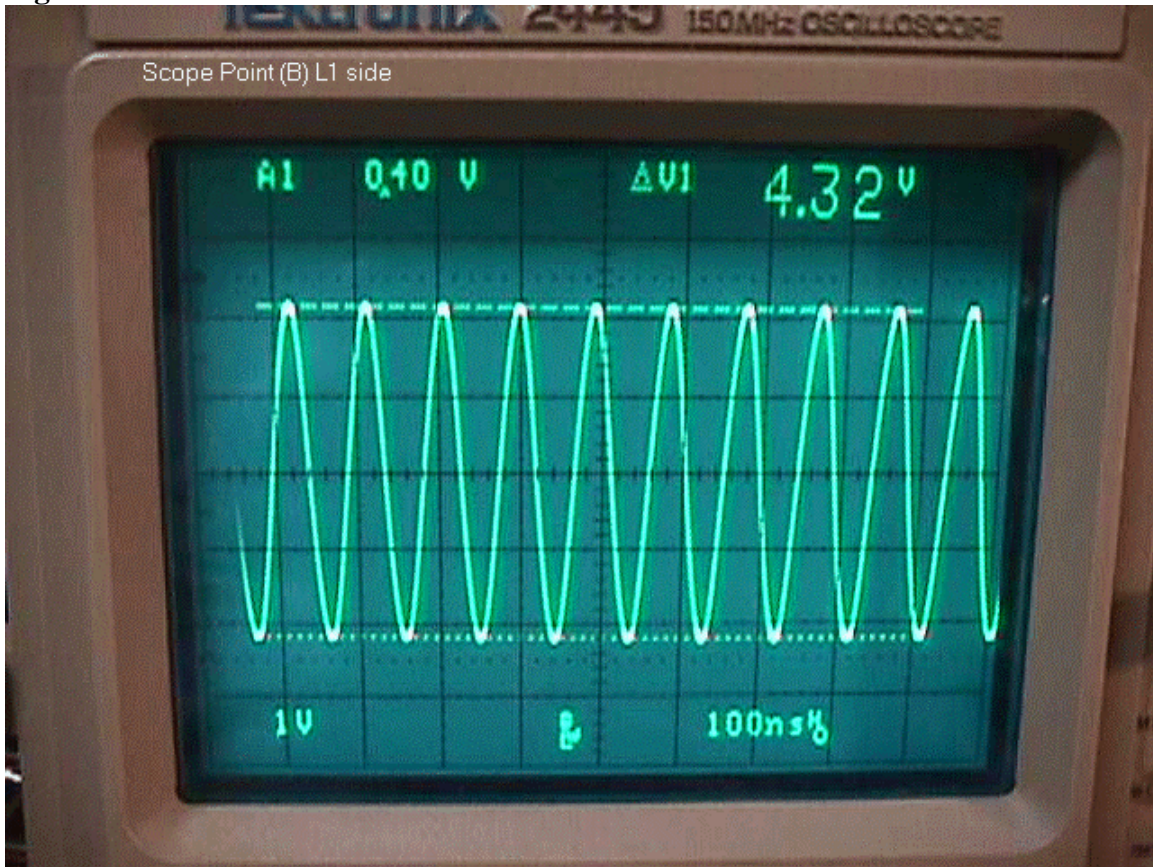
Oscilloscopes are usually a part of most electronics labs and are extremely useful devices, although when working with SEC [1] Exciters [2] what is taking place that is of special interest is not totally in Time Domain.

The following image shows a typical oscilloscope display. Compare this display with the display of Fig: 8 and you will at once see that each device displays much different information.

A spectrum analyzer is considered higher in ranking over and oscilloscope, although both are desired pieces of equipment when working with Spatial Energy Coherence [1].

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Fig: 9



Voltage measurements come into play in almost all of the analysis done on SEC [1] Exciters [2] and there are some problems involved in doing this accurately. The foremost requirement is the choice of meter used in the taking these measurements.

The following picture shows there is a meter for almost every budget and range of accuracy and reliability. Many meters are dual purpose and serve as a DMM [11] and LCR [12] for example, although more functionality in a single package may not always be the best choice.

Fig: 10



Shown in the following image is a Bench type DMM [11] with high accuracy and a USB [13] computer interface allowing automated control and recording of measurements.

Fig: 11



The quality and often the price of a DVM [10] or DMM [11] will determine not only the accuracy and repeatability of the measurements but may also determine the instruments susceptibility to the fields emitted from an Exciter [2].

Another very important point is that the meter should be battery powered (or battery capable) and not connected to the power grid or earth ground system during use with Exciters [2]. The meter should be floating and this is particularly important with bench type meters that may have a computer interface and grid power connection, even though the meter may be operating from battery power. A meter itself may be floating, but a computer connection (unless a floating portable) may not be and this along with possible grid power leakage through capacity bypassing within the meter can pose measurement problems

The following suggestions should always be considered when you are attempting to read DC voltages produced from a SEC [1] Exciter [2].

- 1) Use a meter with an accuracy of at least or better than 0.5%. With an analog meters it will be hard to obtain this accuracy as the user must interpret the reading, yet in many cases if the proper scale is used this is not a limitation to accurate and repeatable readings.
- 2) Use the shortest set of test leads possible without placing the meter too close to the Exciter [2] that the radiated field interferes with the readings. If a shielded set of meter leads is not used or available then single lead sets should be twisted to reduce the RF energy induction.
- 3) Always use one of the ferrite filters (described in this document) designed for voltage measurements.
- 4) Always move the meter to different spots during a particular reading session to insure that the reading does not change. If moving the meter changes the reading, the reading is not accurate as the radiated field is affecting the meter.

The following circuit shows a filter that should always be used between an Exciter [2] and the measurement meter. When properly used the filter will significantly reduce or eliminate interference caused by RF field.

Fig: 12

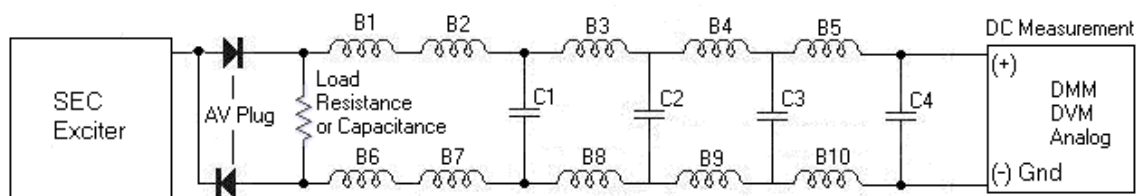
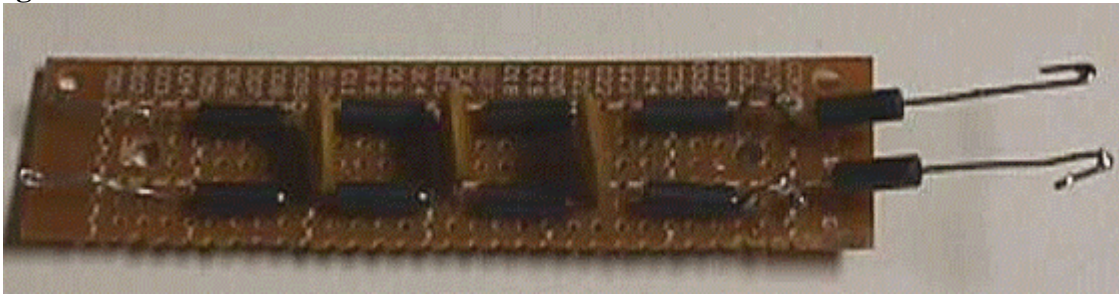


Fig: 13



Parts List.

C1-C4 0.01uF @ 1kv Ceramic [4]

B1-B10 Ferrite Beads on leads of Z=86 ohms @ 10MHz [5]

In Fig: 12 you can calculate the dissipation of a load resistor in the following manner.

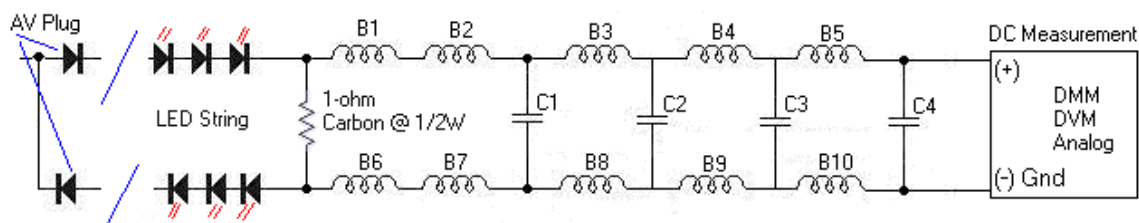
Eq: 1

$$P_{load} = (V_r / R)^2 * R$$

Where; V_r = the voltage measured across the load resistor
 R = the resistance of the load resistor

If you are measuring the current in a series string of LED's, you do not want to upset the impedance of the Exciter [2] output, and one acceptable way is to insert the 1-ohm monitoring resistor at the mid point of the LED string. The following picture shows an example of how this is done.

Fig: 14



The current in the series LED string is derived from the voltage drop across the 1-ohm resistor. Each 0.001-volt drop across the 1-ohm resistor is equal to 0.001mA of current; therefore if the reading is 0.024 volts, the current is 24mA.

You can calculate the power of the LED string by knowing the forward voltage drop of the LED's being used and multiply the number of LED's times the voltage drop across one LED, times the current from your reading across the sample resistor.

Eq: 2

$$P_{LEDs} = (V_{LED} * n * I_s) + (D_{AV} * I_s)$$

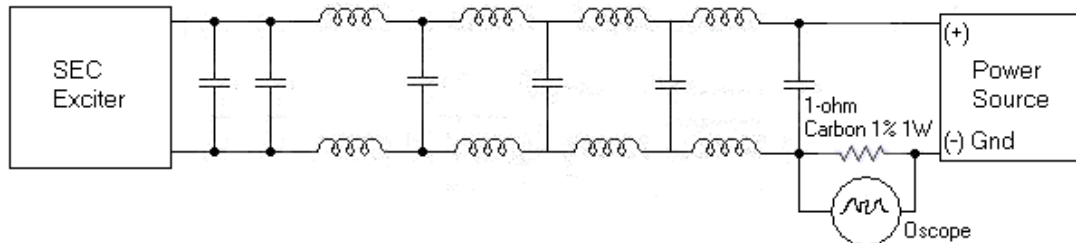
Where;
 V_{LED} = forward drop across one of the LED's (assume all the same)
 n = the total number of LED's in the string
 I_s = the current measured in the string, $0.001V = 0.001mA$
 D_{AV} = AV plug diode forward drop, ~ 0.6 volts

It is also necessary to insure that reliable input readings from the power source are obtained so that load power can be calculated along with overall efficiency of the Exciter [2] under test.

Because SEC [1] Exciters [2] can disrupt readings from both analog and digital meters installed in (and part of) power supply units, a second method can be used to verify the PSU [14] reading as accurate. In this case an oscilloscope is used and is placed across a 1-ohm sample resistor as shown in the following image.

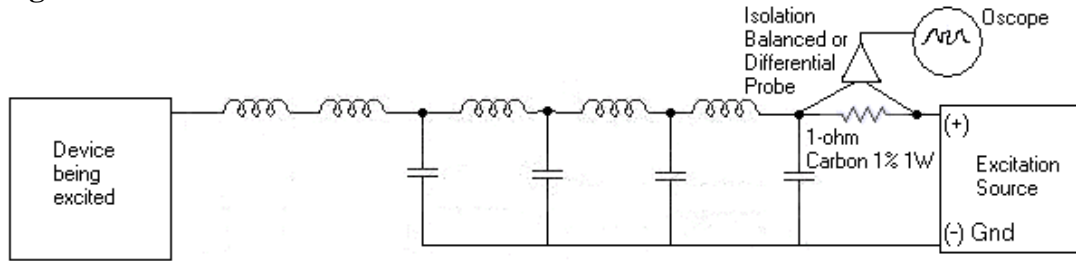
*Even though the filter does a very adequate job of filtering out return RF to the power supply through the supply leads, an oscilloscope will show that it is not pure DC. By far the most accurate measurement of input power to the Exciter [2] is by integration of the signal seen across the 1-ohm sample resistor.

Fig: 15



In certain SEC [2] circuits a single wire is used to supply excitation and a specific return wire is not used as shown in Fig: 15. In the case of single wire excitation input energy can still be measured, but it requires a special approach and a probe that can run into the hundreds of dollars. The following diagram shows an example of this measurement configuration.

Fig: 16



Using either one of the two methods shown in figures 15 and 16 for the measurement of input energy or some other acceptable method, allows the calculation of input energy to the unit under test.

Eq: 3

$$U_{\text{input}} = \text{Avg} (\Delta V_{\text{in}} * \Delta I_{\text{in}}) \text{ or integrate } V_{\text{in}} * I_{\text{in}}$$

If you are using a steady state set of readings that are obtained from a DMM for example, equation (3) would simply be $U_{\text{in}} = V_{\text{in}} * I_{\text{in}}$ otherwise equation (3) would be required for the methods shown in figures 15 and 16.

Once the input energy is determined and the Exciter [2] output energy is known, the Coefficient of Cohered Energy [15] or CEC can be calculated.

Eq: 4

$$\text{CEC} = U_{\text{out}}/U_{\text{in}}$$

It should be noted that the equations for calculation of energy do not include a value for Time, which would be appropriate for the calculation of Power. The calculation of Power is not necessary for deriving CEC, which is the primary focus in the investigation of SEC [1] Exciters [2]. What this means is that if you measure a $U_{\text{CEC}} > 1$ then you will have a $P_{\text{CEC}} > 1$.

Because the added capacity of a standard 1:1 or 10:1 oscilloscope probe can alter the operational characteristics of a SEC [1] Exciter [2] it is not recommended that direct probe connections be made to a running oscillator.

A less invasive method involves a Sniffer Coil [20] that can received a small amount of coupled energy and displayed on an oscilloscope without direct connection to the operating circuit. The following two images show how this is done.

Fig: 17

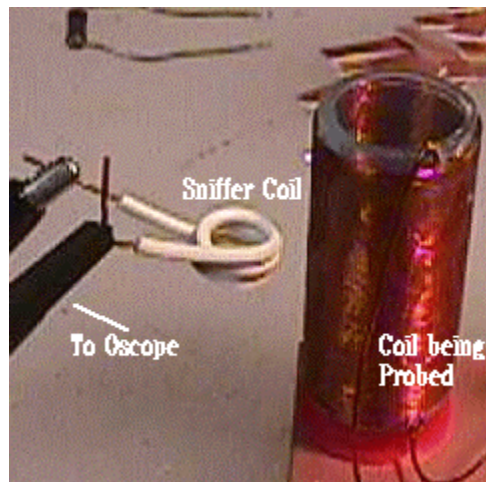
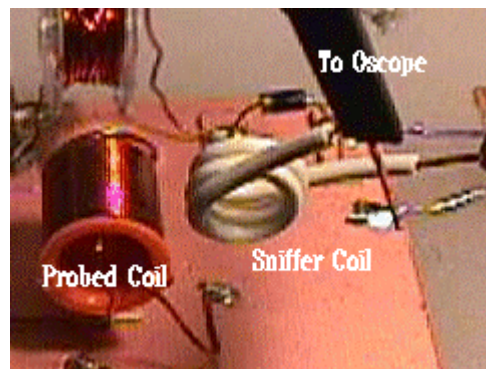


Fig: 18



A very simple and non-invasive way to see a coils signal component is to use a capacitance coupling of just placing the tip of the probe up next to the coil. In this method the neither the probe or the probe ground connection is connected to any part of the circuit.

Fig: 18b



Another very simple and non-invasive way to examine the area around a running Exciter [2] is to connect the oscilloscope probe to a simple 1N4148. The leads on the diode couple signal into the diode where it is rectified. This simple arrangement can also be used for obtaining relative field strengths and components as the probe is moved around.

The biggest caution when using an oscilloscope in close proximity to a running Exciter [2] is that the field energy can be easily coupled directly into the probe or probe cable and would result in meaningless relative readings. Great care must be used to insure what is being read is actually what one wants to observe.

III Near Field & Advanced Measurement Techniques

The term Near Field [17] usually applies to radiating antenna structures, although it is significant in the overall understanding of SEC [1] Exciters [2] in that it can provide valuable information that may apply to the concept of wireless energy transfer.

An Exciter [2] does not contain any one specific component that can be classed solely as an antenna or primary radiating element and because of this an Exciter [2] will not have an omni-directional radiation pattern. Therefore the radiation pattern around an Exciter [2] will indeed have a radiation pattern with lobes of high and low power density, although these lobes should only be experienced in the Far Field [18] Pattern.

The definition of Near Field [17] is for all practical purpose a basic Rule of Thumb that is loosely defined and for the purpose of examination of an Exciter [2] is considered to be $< \sim 1/3 \lambda$ (less than or approximately equal to one third wave length).

Although determining λ is slightly more complicated than usual because the Exciter [2] output is Ultra-Wideband and of course λ is a different value for each frequency.

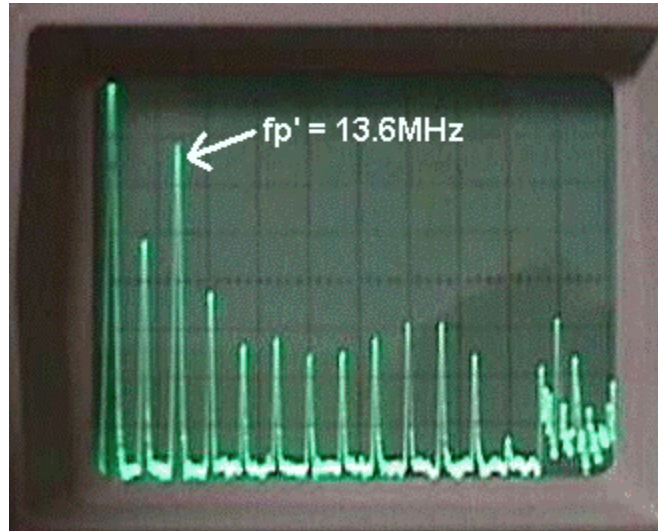
Eq: 5

$$\lambda = 300 / f_{\text{MHz}} \text{ where } \lambda \text{ is in meters}$$

Normally in the case of the Exciters [2] the frequency that is of the highest energy level (Max[dbm]) is selected for determining the working wavelength.

In the following Spectrum Analyzer view of a typical emission by a SEC [1] Exciter [2] the dominant frequency is 13.6MHz and this frequency could be used to derive some approximations on the Near Field [17] size.

Fig: 19



For the sake of example and using a loose set of approximations, what would the extend of the Near Field [17] be, using the example frequency of 13.6MHz.

Eq: 6

$$N_{\text{ext}} \sim 1/3 (300 / 13.6) = 7.353 \text{ meters}$$

There is another equation often applied in the RFID (Radio Frequency Identification) field and is used for approximating the outer edge of the reactive Near Field [17].

Eq: 7

$$r = \lambda / 2\pi \quad \text{see ref. [19], used for electrically small antennas.}$$

Comparing the results of Eq: 6 with Eq: 7 is seen in Eq: 8.

Eq: 8

$$\text{Using } f = 13.6\text{MHz}$$

$$\text{From Eq: 6, } 1/3 (300 / 13.6) = 7.353 \text{ meters}$$

$$\text{From Eq: 7, } (300/13.6) / 2\pi = 3.511 \text{ meters}$$

It is readily seen that Eq: 6 and Eq:7 are different by a factor of two.

For electrically large antennas Eq: 7 takes a different form.

Eq: 9

$$r = 0.62 \sqrt{D^3 / \pi} \quad \text{see ref. [19], used for electrically large antennas.}$$

Where D in Eq: 9 is the largest dimension of the antenna.

Once the measurement point moves out of the Near Field [17] and into the Far Field [18] the drop in signal for m^2 (square meter) can be viewed as dropping off at the rate of $1/r^2$.

Finding the shape and power density of the field surrounding an Exciter [2] requires some special and demanding measurement techniques and normally would not produce acceptable results when performed outside of a specially equipped RF laboratory, therefore I will only explain an overview on how this is done.

To determine the field shape requires a rotating non-inductive platform that is calibrated with a minimum of one-degree increments of rotation. The platform must be at a height above any ground surface that insures that the ground will not reflect or distort the field pattern. In SEC [1] Exciters [2], which are ultra wideband, this can require many test settings at different elevations to insure the combined readings are accurate.

There are special Anechoic Chambers [16], which greatly reduce the wavelength and ground reflection problems, although these facilities are very expensive and not generally available.

In the simplest of tests a fixed detector is used for monitoring the field strength as the table is rotated. This information is mapped on a computer into a one-dimensional shape showing the measured field.

To measure a second axis, either the detector or the device under test is rotated by 90 degrees and a new set of readings are taken for an entire 360° rotation.

The next important thing to know is the Near Field [17] and Far field [18] points and this again is very complicated because of the Ultra wideband emissions from an Exciter [2].

To measure the field drop in strength and determine when you have moved from Near to Far Field [17 & 18] regions requires moving the detector in a single dimension out from the Exciter [2] while plotting the signal strength.

The exploration of the magnetic and electro-static fields surrounding an Exciter [2] require again very specialized and costly equipment and is not something that would be done out side of an RF laboratory and is therefore not covered in this paper.

Summary

The purpose of this paper is to provide the basic information on how to obtain measurements from SEC [1] Exciter [2] circuits so that the observer can feel relatively comfortable with the observed results. With the information obtained by using these simple approaches the experimenter can tune his/her Exciter [2] for maximum Cohered Energy [1 & 15] and determine the resulting CEC [15].

This paper does not attempt to replace a basic understanding of Electronics and Physics that one needs to work with the circuits of Dr. Stiffler. To supplement or refresh ones basic skills in these areas is advisable and will allow for rewarding observations.

References

- [1] Spatial Energy Coherence or SEC, A theory developed by Dr. Ronald Stiffler on the Coherence of energy from the Energy Lattice and utilizing it as an Alternative Energy Source.
- [2] A SEC Exciter is low power Ultra Wideband Oscillator conceived and designed by Dr. Ronald. R. Stiffler that is able to exhibit Spatial Coherence.
- [4] JameCo. www.JameCo.com 0.01uF @ 1kv Ceramic. Part# 97375.
- [5] Fair-Rite Products Corp. <http://www.fair-rite.com/newfair/index.htm>
Broadband frequencies; 25-300MHz, Type 43 Material. Part Number: 2743009111, Z=86 ohms @ 10MHz.
- [6] S. V. Avramenko , titled "The Measuring of Conduction Current That is Stimulated by Polarization Current", published in the 'Journal of Russian Physical Society, No# 2, 1991'. Also see Single Wire Power Transmission <http://www.alternativkanalen.com/s-wire.htm>
- [7] Vishay Semiconductors. Part# 1N4148/1N4448
- [8] Best Hong Kong. www.Besthongkong.com 5mm T1-3/4 20 degree Water Clear 10000-12000mcd White LED. Part# BUWLC333W20BA11
- [9] A DIY RF LED field strength meter design.
http://www.qsl.net/n9zia/wireless/pics/LED_sig_meter.png or a wide band detector can be found at <http://geocities.com/ajpotts19/wavemeter.html>
- [10] DVM a designation often referring to Digital Volt Meters or single function meters used specifically for voltage measurement.
- [11] DMM a designation often referring to Digital Multi-Meters. A meter that usually is dual purpose and for example measures volt, amperes, ohms. Many DMM's will support additional functions such as diode and transistor or capacitor checking. Some DMM's even offer a frequency counter function.
- [12] LCR a designation often referring to Digital Meter with specific functionality for the measurement of Inductance (L), Capacitance (C) and Resistance (R).
- [13] USB or Universal Serial Bus is a computer interface protocol supported by almost all modern personal computers.
- [14] PSU or Power Supply Unit.

[15] 'Cohered Energy Coefficient' or CEC. Derived from a simple analysis of Output Energy divide by Input Energy, or $CEC = U_{out}/U_{in}$ and results in a CEC number indicating the efficiency of the circuit or system being analyzed. U is normally a quantity measured in Joule Seconds, Watt Hours, Kilowatt Hours, BTU's or Calories for example.

[16] Anechoic Chambers, <http://www.sonora-technology.com/?gclid=COTq8r7vuZoCFQFHFQod5BapdA> or see Wiki at http://en.wikipedia.org/wiki/Anechoic_chamber

[17] Near Field, see http://en.wikipedia.org/wiki/Near_and_far_field#Near_field

[18] Far Field, see http://en.wikipedia.org/wiki/Near_and_far_field#Far_field

[19] The World of the Near Field. EE October 2005 Feature Article. By; Tom Lecklider, Senior Technical Editor.

[20] A small low inductance coil of wire with small physical size used to pickup signals by low inductive coupling to coils containing RF energy.