Environmental Assay Inc.

Assessment and Remediation Consulting

EMF (Electromagnetic Field) Irritants

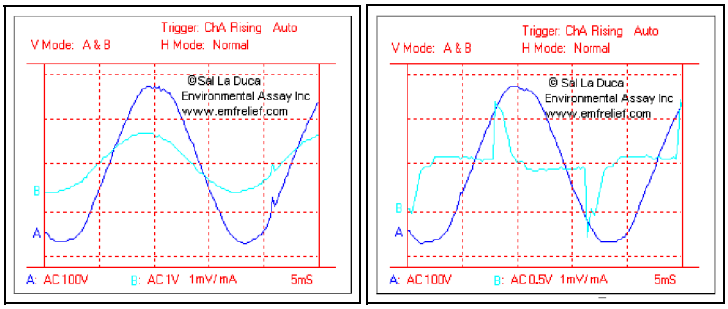
Capacitive Filters
a.k.a. Questionable means to "clean" Harmonics

Fluorescent lighting has been around abundantly since the 1940s. They are a primary source of non-linear current usage. This is intimately associated with an ongoing stream of Harmonics (whole-number multiples of the input frequency). Within the last twenty years or so, perhaps less, some individuals have begun to address this as "dirty" electricity, with the immediate implication that they have a filter they can sell you to "clean" it up.

Maybe.

By exposure to Harmonics, the central nervous system may meet with electrical waveforms that have similarities to its own messaging, causing interference (pain, irritation, etc.). TENS instruments can do the same thing, but in a controlled fashion. TASER guns can do the same things in extreme, to quickly immobilize an individual. How the interference gets to you is not usually noted, but in reality any system that allows **Alternating** Electric or Magnetic Fields (the carrier of the electrical "dirt") to occur in free space has the same "dirty" characteristics, even if it is an absolutely smooth (sinusoidal) waveform. So **electrical "Dirt" is just a marketing name for a feature of the electrical system that has been in existence since its inception,** and buying some gimmicky "filters" will not "harmonize, or clean" your living space from it / them.

With the advent of modern electrical devices, some are found to produce lots of electrical "jitter" / waveform distortion (due to non-linear current consumption), or what I will refer to as "electrical noise", but more classically defined as **EMI** (ElectroMagnetic Interference). This **is produced by anything that does not use Current in a smooth fashion, similar to the constantly changing Voltage waveform provided to it (the 50 / 60 Hz power), because its current is composed of many Harmonics (or whole number multiples) of the fundamental frequency.** To provide a fuller perspective, consider a common incandescent lamp. It will consume power smoothly and continuously as long as power is applied. Graphically it would look like the picture below left. In contrast, the consumption from a Compact Fluorescent bulb is similar to that below right.



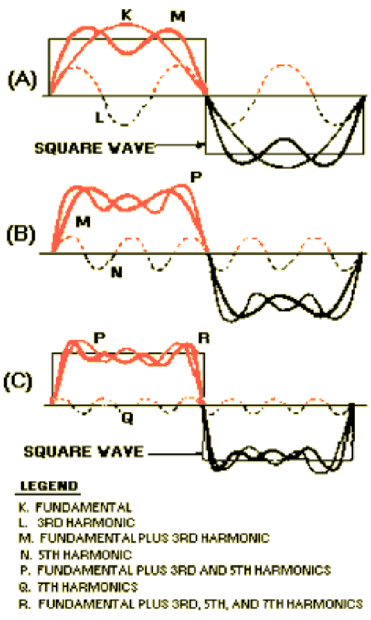
Note that the two waveforms in each graph are synchronized in time, and their vertical scales are different. The dark blue waveform is the Voltage supplied, the light blue waveform is the Current demanded by the device. The Current waveform on the right will be rich in Harmonics of 60 Hz, similar to those needed to produce a square wave.

The following Excerpted from http://www.tpub.com/neets/book9/37g.htm

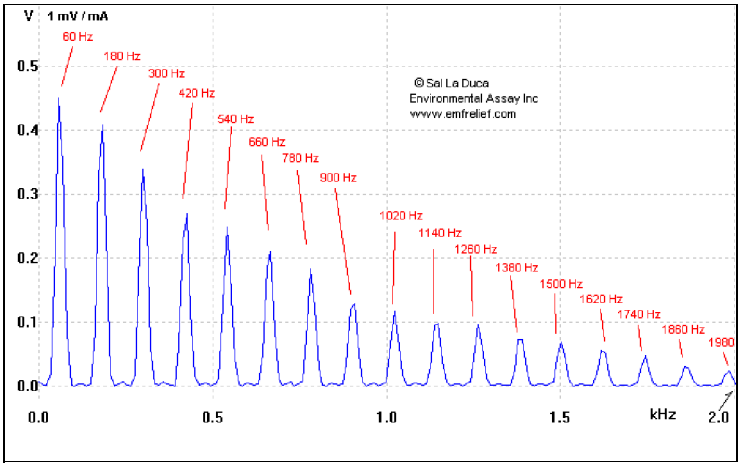
COMPOSITION OF NONSINUSOIDAL WAVES

Pure sine waves are basic wave shapes from which other wave shapes can be constructed. Any waveform that is not a pure sine wave consists of two or more sine waves. Adding the correct frequencies at the proper phase and amplitude will form square waves, sawtooth waves, and other nonsinusoidal waveforms. A waveform other than a sine wave is called a COMPLEX WAVE. You will see that a complex wave consists of a fundamental frequency plus one or more HARMONIC frequencies. The shape of a nonsinusoidal waveform is dependent upon the type of harmonics present as part of the waveform, their relative amplitudes, and their relative phase relationships. ***In general, the steeper the sides of a waveform, that is, the more rapid its rise and fall, the more harmonics it contains.*** *The sine wave which has the lowest frequency in the complex periodic wave is referred to as the FUNDAMENTAL FREQUENCY. The type and number of harmonics included in the waveform are dependent upon the shape of the waveform. Harmonics have two classifications - EVEN numbered and ODD numbered. Harmonics are always a whole number of times higher than the fundamental frequency and are designated by an integer (whole number). For example, the frequency twice as high as the fundamental frequency is the SECOND HARMONIC (or the first even harmonic).*

View (A) of the figure to the right compares a square wave with sine waves. Sine wave K is the same frequency as the square wave (its fundamental frequency). If another sine wave (L) of smaller amplitude but three times the frequency (referred to as the third harmonic) is added to sine wave K, curve M is produced. The addition of these two waveforms is accomplished by adding the instantaneous values of both sine waves algebraically. Curve M is called the resultant. Notice that curve M begins to assume the shape of a square wave. Curve M is shown again in view (B). As shown in view (B), when the fifth harmonic (curve N with its decreased amplitude) is added, the sides of the new resultant (curve P) are steeper than before. In view (C), the addition of the seventh harmonic (curve Q), which is of even smaller amplitude, makes the sides of the composite waveform (R) still steeper. The addition of more odd harmonics will bring the composite waveform nearer the shape of the perfect square wave. ***A perfect square wave is, therefore, composed of an infinite number of odd harmonics.***



Then taking a spectrum analysis of a Personal Computer power supply's Current, whose waveform is very similar to that of a compact fluorescent bulb, you get a display similar to that below. Uncanny how well it fits the description of those frequencies needed to produce a square wave just described, eh!



Ecerpted from http://www.tpub.com/neets/book9/37g.htm

Note that the spectrum is purposely only displayed to 2 KHz (2000 Hz), to prevent approaching the limitations of the sensing equipment. Yet there are many more "bumps" in the higher frequencies, which can be inexpensively detected with an AM radio, whose reception range (540 Khz to 1600 Khz (0.54 to 1.6 Mhz)) will be blanketed anywhere near the power supply, indicating that the frequencies produced (the Harmonic "bumps") saturate the region from 60 Hz up to and beyond 1 Mhz (1,000,000 Hz). Note also that although the PC power supply is a SMPS operating at higher frequency than 60 Hz, it appears as if the square waves are produced at 60 Hz.

Characteristics of SMPS (Switch-Mode Power Supplies)

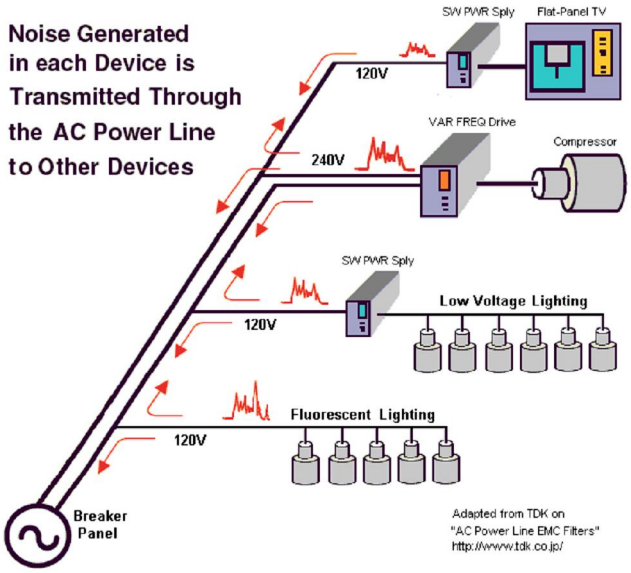
A Transformer is composed of two or more wire windings. In general one is called the Primary, and all the others are called the Secondaries. When a voltage is applied to the Primary wires, a current will flow, producing a Magnetic field that envelops the Secondaries. When the Primary voltage and current are Alternating, or continuously changing with time, the Secondaries will produce Alternating voltages, that when connected to a suitable load will produce desired Voltages. Great effort is made to ensure that there is the greatest amount of coupling between the windings to maximize efficiency. Some of these can be small, as the ones powering small appliances, while some can be as large as a house and require forced cooling (those needed to power a town). Their emissions consist of a Magnetic field at the exact frequency of excitation. The span of this field may be a few inches for the smaller units.

Switch-Mode Power Supplies (SMPS), or Switching Regulators make use of the concept that if one increases the frequency of transformer excitation, then the size of the transformer decreases dramatically. A direct application of transformer size reduction is in aircraft, which use 400 Hz, instead of 50 or 60 Hz. However, the transformer in these smaller units is rapidly being miniaturized in many applications by Switch-Mode Power Supplies, the transformer used to power a CFL is about the size of a chick pea.

In order to do this, there are necessary electronics to convert the commonly available alternating power to DC, because the electronics require DC to operate and produce the needed (faster than 60 Hz) oscillations, typically chosen to be above the hearing range (> about 20 kHz.). Conversion from AC to DC is mostly a noise-free process. After the rectifiers are one or more capacitors that serve as energy storage, and filter(s) in an attempt to reduce oscillations from going back into the AC supply. However, given that these storage/filter capacitors charge up ridiculously fast, copious amounts of Harmonics of the supply AC frequency are produced, because the capacitors cause a less than millisecond non-linear inrush of current every 1/2 cycle as they charge. The resulting Harmonics can span the entire frequency range of 60 Hz to the MHz region, generally available every 120 Hz, as usually only the Odd harmonics will be present, as noted in the spectrum sketch above.

Most small appliance SMPS use 120 Volts as the supply, yet their labeling suggests they will work with any input from 100 to 240 Volts AC, suggesting an international compatibility. "Smart Meter" SMPS use the same wide range of input voltages, making their design universal and applicable globally. The issue with this may have to do with the voltage values available to the SMPS as DC. **When the AC is converted to DC, the DC value climbs to the peak value of the AC voltage. For 120 that would be 170 Volts. For 240 that would be 340 Volts peak.** Thus the instantaneous spikes generated from the charging of the DC-storage capacitor will have much steeper rise time, covering a much greater span of Harmonics reaching into the Radio Frequency (RF) region, even when the smart meter is not transmitting data, even though the output through the SMPS transformer may only be a few Volts and a few Watts.

By Ohm's law such an instantaneous current demand causes an instantaneous voltage to appear on the energized supply wire (120 V or 240 V) that reduces the available voltage, while simultaneously causing an instantaneous voltage to appear on the return / Neutral wire electrically elevating it higher than zero volts (if used on 120 systems). By the same law, if there is any distance between the point of origin in the residence and the supply transformer, then every Neutral wire in the residence will be affected, as every energized wire on the same bus as the supply wire. What this translates into, is that a local electrical noise source becomes a global electrical noise source, as implied in the sketch below. Where for small appliance SMPS this may mean a noise source associated with 1/2 of the indoor electrical distribution, for smart meter SMPS this may mean a noise source associated with every energized wire (if the meter uses 240V as the source). Since usually more than one customer is supplied power by a common transformer, one customer's SMPS abundance may well be detectable at all nearby customers' residences.



One of these SMPS is installed in the AMR metering, discussed at some length at smart-meters.html, **and "ravaging the senses" of the occupants.** While there may be a kernel of truth to the highlighted portion of that statement, its impact needs to be compared to other residential SMPS use. While a typical AMR SMPS may only need as little as 5 Watts of power, a common PC SMPS may use as much as 50 Watts, and although its SMPS may be detectable everywhere within the residence, it may be of minor impact relative to all the other customer-owned sources, with the caveat being that the variable of 120 or 240 as the source voltage may make a great difference in harmonic availability throughout a residence, as well as the frequency span of those harmonics. As just previously stated, small transformers are going by way of history and being miniaturized into SMPS. If you are reading this online, your computer is most likely using an SMPS, instead of running on battery. Your phone answering machine may have an SMPS. Your cell-phone battery charger is one, etc. The list goes on.

Inexpensive Detection of SMPS

The way to identify whether a wall-wart is a transformer or an SMPS is to use an AM radio. Due to the copious harmonics required to generate a square wave, SMPS easily traverse into the reception range of an AM radio and beyond (they saturate the spectrum between the SMPS AC supply frequency and 1.6 Mhz, and somewhere beyond). *Turning on an AM radio and approaching a transformer, there should be no detectable difference in the received signal or background noise. If the unit is an SMPS, the radio will easily be swamped with noise / static on all frequencies on approach to the unit. In order to be accurate, however, one needs to understand their AM radio. It should be battery-powered for maximum portability, it should be Analog rather than Digital (that is with a dial that lets you tune between stations),and the user should be familiar with its behavior between received stations, which is where one would use it to hunt down EMI. Some AM radios are absolutely silent between stations, some are not, and this varies by engineering design. To find out which is which, take your AM radio for a walk in the park and get familiar with its behavior distant from things electrical. Then take it home and locate the various noise sources available in your residence, and you will be surprised, as some are not easily eradicated, as some may be embedded within your installed oven, or other permanently attached appliances.*

Cautiously Getting Free Help

The local electric utilities are obligated to provide the user with clean alternating power, generally within +/- 5% of 120 V, and generally free of offending EMI. If there is offending EMI, they have an obligation to fix it, at their own expense, until the customer is satisfied. This is generally written within their tariffs relating to **"Power Quality,"** region by region. If you are certain you have isolated, or otherwise de-energized all customer-owned SMPS, and there is still EMI coming from the utility, as notable from the breaker panel being a "screamer" even with the breakers open / off, then by all means call your electric utility and take them to task. What EMI consists of and what it can offend varies greatly, and telling them it hurts your brain will get you nowhere quick. But getting familiar with the lowest intensity AM broadcasts (those from far away), and having intolerable interference with their reception will "get their goat." They may suggest listening to noise-free FM, but who knew that those sensitives were aficionados of far-away AM? And shamelessly borrowing from Arlo Guthrie's Alice's Restaurant Massacree, where he was talking about the Draft: *"You know, if one person, just one person does it they may think he's really sick and they won't take him. And if two people, two people do it, in harmony, they may think they're both faggots and they won't take either of them. And if three people do it, three, can you imagine, three people walking in singin a bar of Alice's Restaurant and walking out. They may think it's an organization. And can you, can you imagine fifty people a day, I said fifty people a day walking in singin a bar of Alice's Restaurant and walking out. And friends they may thinks it's a movement."* **You** have lots of power, when you use their own guidelines against them, and a movement is easy to start if enough individuals participate. If you find this material useful, share it with others, and help them along and yourself. *But realizing that utilities have more pressing issues, like emergencies, be kind to them, but persistent until you get satisfaction. If it turns out to be your Smart Meter, they may have no choice but to replace it with a conventional one. Be alert also, that if you call them and they identify **your** equipment as being the cause, your credibility and their obligation toward you may evaporate instantly.* Also be alert to the possibility that getting the utility involved, and several customers being supplied in common, a blatant EMI producer may turn out to be one of your close neighbors, who may be unpleasantly alerted by the electric utility of the need to temporarily disconnect them to identify the source of electrical noise. This could shift some neighbors away from being friendly. Act tactfully!

Issues with dirty electricity "filters"

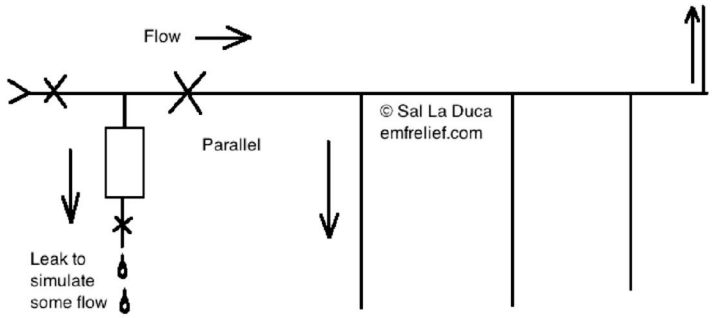
I am going to use an analogy with water that may hopefully clear up the matter.

We've lived in our home for over 20 years, and for 19 of them our water supply line meandered for about 300' through two other properties, before it met up with the water main in the street. 60 years ago, there may not have been houses on the lots where our pipe meandered through.

Be that as it may, one problem was that whenever our neighbor flushed their toilet, we would lose pressure. This is akin to a machine shop or garage down the street turning on some large compressor, and your voltage (and all lights in use) dim, and slowly come back up in intensity. Locally within your own home, you should be able to notice this every time the refrigerator comes on.

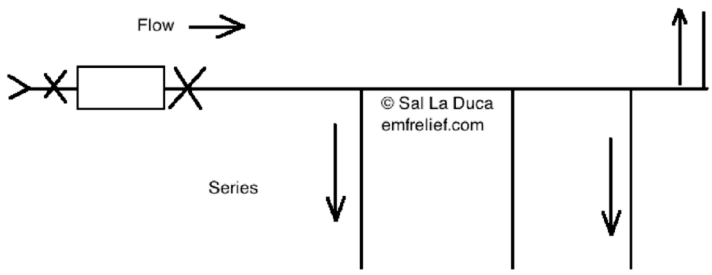
Another problem was that the 300' of pipe was internally flaking. That is, pipe slag would come into our water system. This was particularly annoying, because the pipe slag would land in the clothes washer, and cause rust stains on our clothes. So I installed a 5 micron filter to remove the pipe slag.

I could have used a Parallel install of the filter, as shown below.



This is the same way that ALL dirty electricity filters (Stetzer's, Greenwave's, and Quiet Island's Capacitive), and now "dissipative" filters (DNA's) are installed. Even assuming there is some flow through the "filter" (as with the leaky water valve above), I still cannot imagine for the life of me that the pipe slag would have been magically absorbed exclusively into the filter, and not also traveled through the other pipes _ and the clothes washer. However, all these electric "filter" marketers are profusely asserting that this is exactly what happens with electrical "dirt." These claims defy the laws of physics, and the real world, and are more than anything faith-based gimmicks or "magic." I have other words for them, but I'm trying to remain polite.

Instead, I installed my water filter in a Series arrangement, as below.



And you know what? The pipe slag was stopped entirely in the filter. Because we had an ongoing collection of this slag, we had to change the filter on a regular basis. An appropriate electrical filter in this application would not need to be changed, unless the exterior contributions dramatically change for the worse. Unfortunately, a proper electrical filter of this type can cost thousands, and would Not eliminate your own contributions. Call it Capacitive, Dissipative, or whatever, this is a scam instituted against the unwary.

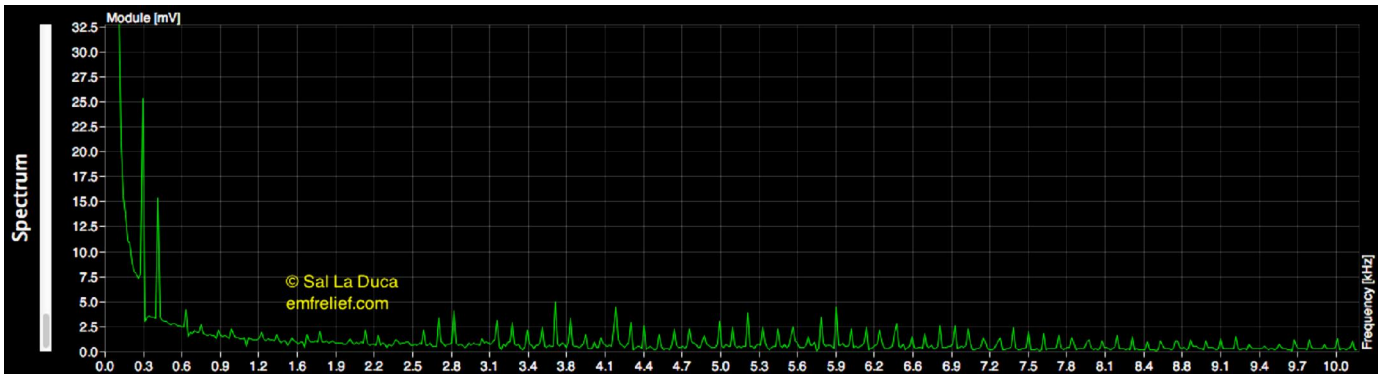
Stetzer came up with the novel GS unit for "dirty" electricity, and only his meter that can read them. Convenient.

Greenwave pointed out the obvious, that GS units don't exist in the real world, and promoted an alternative scam of their own, mV.

IBE (the Institute of Building Biology and Ecology) initially bought into the "filter" concept because they thought there was money in it, and since they've always been hurting for money, and since many of their students are ignorant of reality, the latter bought into it, lock, stock, and barrel. So hiring a Building Biologist (BBEC) to assess, and possibly suggest solutions for "dirty" electricity is a throw of the dice, unless they've received additional technical training on their own, and for some which I am trying to provide additional mentoring as time permits and the opportunity presents itself. However, for various reasons, some of these individuals do not care to be further educated. Unfortunately, the alternative is to

buy into some of these "filters" on your own, and hope for the best.

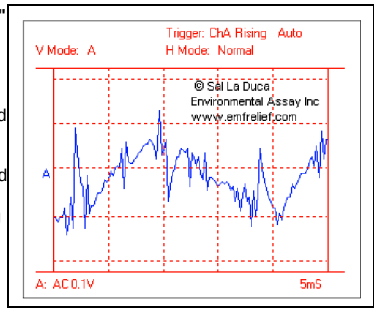
There is a standard to measure and quantify Harmonics / DE, but that is not what IBE teaches, either because they don't know, or because they think their students are too ignorant to be taught this concept.



Shown above is a spectrum of the current through a capacitive "filter" on a clean system, showing that it introduces "dirty electricity" all by its lonesome. That's because the necessary geometries used in the construction of these devices, makes them complex resonant circuits, and being fed pulsed energy, a resonant circuits rings electrically, like a bell does mechanically. But since the 60 Hz system sends pulses to these devices 120 times per second, the ringing continues, and when looked at in real-time on a spectrum analyzer, the frequency presence of the Harmonics appears "constant." I don't see the DNA "filters" to be anything different than other "capacitive filters," other than flowery "dissipative" wording. They, like others selling these "filters," simply see a money stream from a bunch of suckers (gullible public), and want their share of it.

The behavior of devices marketed as "dirty electricity filters," which are nothing more than capacitors, when exposed to a changing waveform, is to convert the impressed changing Voltage to changing Current flow, the amount of current flow determined by its electrical capacitance value. Additionally, since no capacitor is perfect, such a conversion will add harmonics that are solely generated by the capacitor. This Current is then partially impressed onto the Electrical System Ground (ESG) / Neutral, which, albeit "grounded," will develop a Voltage directly proportional to the amount of Current used *(whether from capacitor filters alone or other devices)*, due to the physics relationship described by Ohm's Law, that is now made available through every cable within a residence.

So **a capacitor filter, by whatever name, will suppress some Harmonics, and add some of its own, which is Not a "cleaning" effect.**

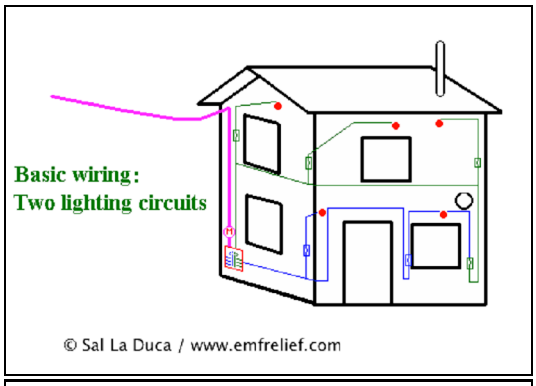


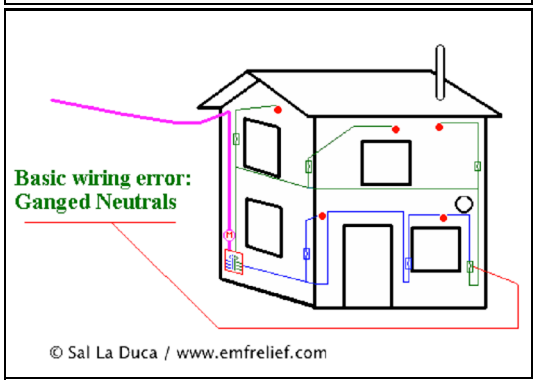
To the right is a graph of Voltage measured on the Electrical System Ground compared to an Isolated Earth Ground, in a residence with several digital or otherwise non-linear devices *(note there is still a faint resemblance to 60 Hz)* - your guess as to how much "dirt" (harmonics) there is. So anyone who tries to sell you a capacitor "filter," without telling you all of the implications, is uneducated at best, or a robber waiting for a chance to take your hard-earned resources at worst.

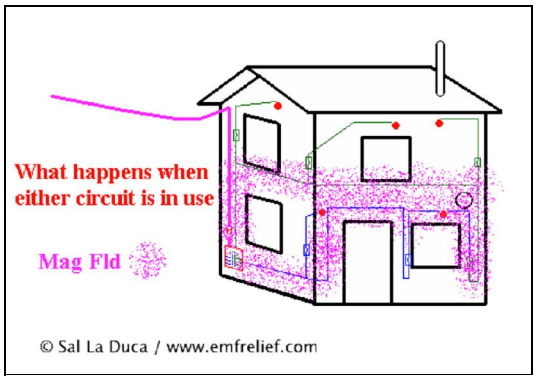
This EMI is impressed onto the supporting Power System. The power system, being what it is, allows circulating currents that should not exist, but do, because of wiring errors, redundant Neutral current paths, and system degradation over time. Since the typical electrical system is not subject to regular inspections, these problems can exist for years (or decades) undetected, possibly causing biological damage, or possibly more immediate physical damage (such as death) due to maintenance on related systems that "unexpectedly" carry some of the shared neutral current.

The associated problems are typically 1) Neutral to Neutral wiring errors (with any type of wiring system, including Knob-and-tube), 2) Neutral to Ground wiring errors (with either Romex (NM-xx-x) or BX/MC), or 3) conventionally shared Neutral paths between adjoining users (with any type of wiring).

Graphically, isolated detached errors exist as follows:
(with only the Neutral (return) wire shown for clarity)





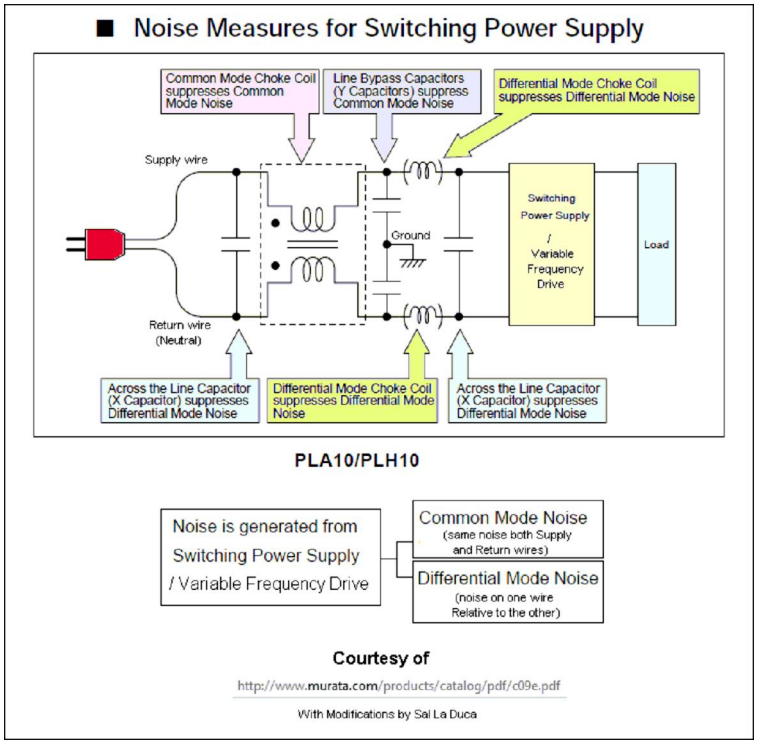


The magnetic field (when there is one) will exist and broadcast into free space regardless of the wire type. This shows a wiring error regarding lighting, which may be more common than for Power circuits. Nonetheless due to uncle Floyd and cousin Jack doing "creative wiring" over the years, any type (and mixture) of circuit can be involved.

Field Types

Wiring Scheme	Normal Operation Emissions	Wiring Errors
Knob-and-Tube	wide-area Electric and Magnetic	wide-area Electric and Magnetic
NM / Romex	wide-area Electric	wide-area Electric and Magnetic
BX / MC	**No emissions**	wide-area magnetic
Redundant Neutrals	wide-area magnetic	wide-area magnetic

If there is EMI associated with a cable, it will broadcast unimpeded into free space via other interconnected circuits as an Electric field component if the wiring type is either knob-and-tube or NM (Romex), even when those other circuits are not in use. If the circuits are in use, then the EMI will additionally become manifest as a Magnetic field component regardless of the wire type installed. Of note should be that Harmonics on Voltage (producing an Electric field) may only constitue 3 to 10% of the Electric field, whereas the Harmonics on Current (producing a Magnetic field) may constitute as much as 50% of the Magnetic field, making the latter much more irritating (or capable of irritating), when it occurs. All "dirty" electricity filters, by definition, only address the Voltage Harmonic content (that 3 to 10%, the tip of the iceberg, as it were), suggesting that somehow muddling an effect onto it, makes all things better.



A proper EMC (electromagnetic compatibility) filter is shown above. The filters commonly sold as "dirty" electricity filters, are simply the "across the line" capacitor as shown in the sketch, a rather incomplete application. Proper filter application would have the power (supply AND return wiring) go through the filter, not in parallel with it, as with all capacitive "filters" sold. If any type of Capacitive filter is installed in an attempt to ameliorate the EMI, without the knowledge that there is a wiring error, then the formerly intermittent field will exist as a Magnetic field component continuously regardless of the type of wire, AND as an Electric field component, depending on the wire type. That is because a capacitive filter will, by virtue of its physical characteristics, change a portion of the voltage pulsations (depending on frequency) impinging on it to current pulsations. So the process fundamentally involves a conversion, not an elimination.

Various capacitive filters are available. Some allow five amps per filter, some allow one amp per filter, and others allow a current based on whatever the individual capacitance value is, and how many are installed in the circuit. Thus the magnetic field presence can vary by the various factors just noted.

Capacitors used for Power-Factor Correction

A characteristic of Alternating Power is that the power conveyance system (the transmission and distribution systems) and load systems are somewhat elastic, in that as voltage is applied the current does not flow immediately at the same instant, but a short time after (somewhere between 1 and 3 milliseconds). While this may seem like a small value, and it is, it can have a big financial impact on the producer and the user. The reason is that ideally both want the same amount of power produced as is being used, instantly and continuously. However, the small amount of time delay allows circulating currents known as Volt-Amperes Reactive (VARs) which, depending on their amount (and whether they Lag, or Lead the Applied Voltage) can provide system stability, reduce system efficiency, or bring about a system collapse.

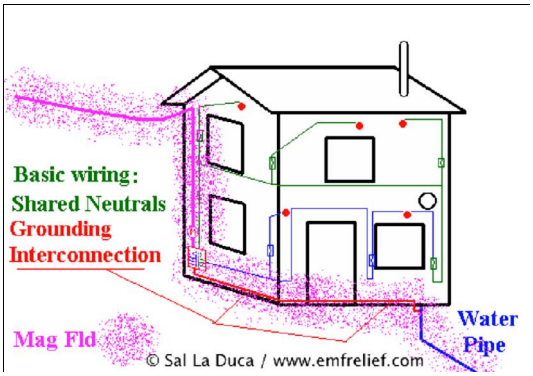
The time delay occurs because most user loads have Inductive elements. That is, the electrical qualities that foster the buildup of voltage but hamper the passage of current (such as motors or transformers). With too much inductance, the voltage begins to drop because there is too much opposition to flow between the source and the user. One of the remedies is to add Capacitive elements. These devices foster the passage of current, but hamper the buildup of voltage. As capacitive elements compensate for the inductive

elements, the conveyance system becomes more efficient, and the voltage goes back up. Power System Operators (of which I was one for six years) customarily bring Large Capacitors (35,000V to 230,000V) online regulraly and daily to boost voltage when it begins to sag, and do the opposite when it begins to go too high.

Electricians have known about capacitive elements for a long time, as they are used to start motors, and are used to improve the efficiency of the power usage in large buildings. Even in a private residence of substantial size (5000 square feet, or 400+ Amps load service rating typically, or bigger) capacitive elements may be added to improve the usage efficiency. With improved efficiency, and reduced time delay between voltage and current, the user is closer to consuming more real power (Watts), and causing less reactive power (VARs).

However, the insertion of Capacitive elements (capacitors, "Filters", etc.) within a home of average size is not warranted, as no improvement in power usage is realized, and owing to the built-in problems that may have gone unnoticed for years, the situation will most likely be made worse rather than better. Considering that Electric and Magnetic components have biological impact capability, it is unconscionable for any individual or firm to market them without disclosing the very likely negative impact.

Granted, in the example shown it would be difficult to apply capacitive filters because the circuits are strictly for lighting, but mixed-use (power AND lighting) circuits exist often enough that any one circuit may have filter attachment capability (outlets).

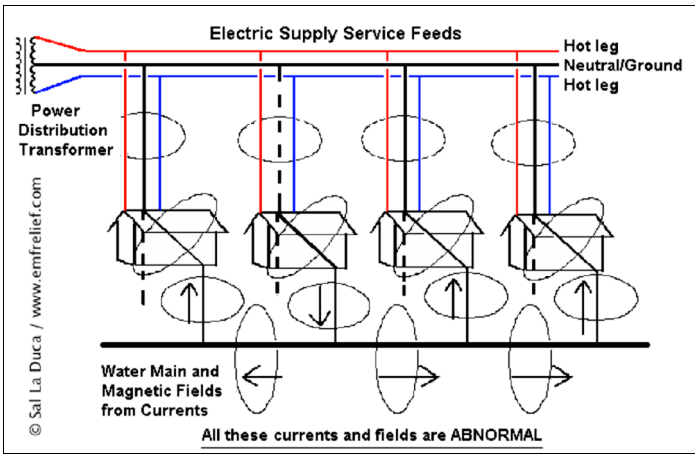


The above sketch shows the interconnection between the electrical system ground, which can consist of any number of metallic structures in contact with the soil, and a metallic water pipe. Note that a magnetic field depicted exists regardless of whether the house shown is using any power (if it is located in a residential neighborhood where several homes are fed off the same power transformer). When the house shown begins to use power, it may add to, or subtract from the current and magnetic field, depending on which bus is flowing power at any moment, because the polarities may be opposite or alike.

The size of the field may be sufficient to engulf the entire house.

Adding any capacitive filter into any circuit, will have the effect of producing a continuous current flow which will be split between the electrical system neutral and the water pipe. If there is no other NET (uncanceled) current in existence, one will be created. If there is a Net current in existence, then the newly added one will either add to, or subtract from it, possibly varying in direction and intensity from any moment in time to the next, depending on the polarity of the electric source (which will determine in which direction the current is generally flowing).

In any case, **the current produced by insertion of a capacitor of any size is Non-Linear.** That is, if you feed it 60 Hz (50 Hz) voltage, the current produced has many frequency components in addition to the original frequency. In light of this, **application of a capacitor is not inconsequential, it makes the electricity, it is meant to clean up, "dirtier"!**



When several homes are fed from the same power transformer as above, even if the water pipe and electrical service are located on the same side of the house (an ideal situation that could reduce the wide-area impact of split neutral currents), a magnetic field may exist from water piping in the street that could negate any of the considerations presented here, in that even neutral isolation would not accomplish a substantial reduction of the magnetic field presence.

While the insertion of any capacitive filter may have benefits in reducing some type of High Frequency (HF) EMI, their insertion needs to be carefully considered in light of any possible wiring errors, or even normal installation characteristics (as shown with the shared (or interconnected) neutrals) which could produce undesired Magnetic fields. Another "trivial" detail not usually mentioned is that their insertion can cause a fire due to Harmonic Resonance.

As a general rule capacitive filter installation is NOT recommended,
without a thorough evaluation of the electrical system to:

1) identify and eliminate any wiring errors, and

2) NOT recommended if the neutral current takes many divergent paths as shown in the house with the electrical service at one end of the house and the water pipe at the other end, and

3) NOT recommended if there are any other local options (like removing dimmer switches, replacing compact fluorescents or fluorescents in general with standard lamps, reducing the number of digital devices, etc.) available to eliminate the problem.

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