Re: Calc. energy harmonics

Source: http://sci.tech−archive.net/Archive/sci.physics/2007−11/msg00855.html

- *From*: "Androcles" <Engineer@xxxxxxxxxxxxxxxxx>
- *Date*: Mon, 12 Nov 2007 10:01:44 GMT

"Jim Slatter" <jimslatter@xxxxxxxxxxxxx> wrote in message
news:uklfj3l7ee7tht7aft7s365ttk3ht2mjfv@xxxxxxxxxx
:
: >> > For example, an RF fundamental and the frequency obtained by dividing
: >> > it in successively in two 20 or 30 times.
: >>
: >> > Thank you,
: >>
: >> > Jim Slatter
: >>
: >> Wouldn't that depend on the shape of the waveform?
: >
: >Indeed it does. Pure sine waves, for example, have no harmonics. A
: >distorted sine wave has harmonics proportional to the percentage of
: >distortion.
: >
: >Harry C.
: >
:
: I am referring to a "resonant" frequency irrespective of waveform.
: Here is a specific example. I have two separate signals of equal
: amplitude. One is a 1GHz sinewave, the other is 1GHz divided by 2
: twenty times to produce a distant lower octave.
:
: How do I calculate the _proportion_ of energy density of the distant
: octave compared to that of the fundamental, assuming all else is
: equal?
:
: Jim Slatter

Let's begin by getting some terminology at least consistent.
The "fundamental" is the lower frequency of the two, the
1 GHz is a harmonic of that.
Next comes "resonant". One tine of a tuning fork is
resonant with the other at one frequency only, and that is
the fundamental. Normally tuning fork tines are identical
in shape, but they do not have to be in order to be resonant
at the fundamental, for if one is (say) tapered you need

not have resonance at a harmonic.
The sounding board radiates the sound energy and damps the vibration of the tuning fork (why?) but is not itself resonant.
There is no such animal as a "resonant frequency irrespective of waveform", you need to state what it resonates with.

Now let's get to your question.
One again we need to be pedantic with terminology, many people confuse energy with power and that is crucial to what you ask.
If I lift a brick and place it on a shelf I've given it sufficient energy to break my toe, should it fall. If I repeatedly lift and let it fall it can break 10 toes. If I lift it and lower it gently it doesn't break any toes. Note that I can do this rapidly or spend a lifetime lifting and lowering very slowly, the energy transfer is no different.
Now lets move up a step. We put a current through an incandescent light bulb (lift the brick) and the filament glows, radiating light (breaks a toe). Next we reverse the current and the same thing happens, the filament radiates. Without changing the voltage (height of the shelf) we can change the frequency and the bulb will glow at a temperature which is approximately proportional to the frequency as it heats, radiates and cools. ALSO, the heating depends on the mark / space ratio. We can have (say) a 60 Hz sine, or we can have a 60 Hz square or triangular signal, and the square wave can be forward for 99% of the time and 1% off and still be 60Hz, or it can be 1% forward and 99% off. A dimmer switch (thyristor or triac) typically controls part of a sine wave, switching the current on at some point in the cycle. What you are interested in and the answer to your question is the area under the curve.
http://static.howstuffworks.com/gif/dimmer−switch−diagram−6.gif

So... the power radiated is a function of
1) Voltage
2) Current
3) Frequency
4) Waveform shape
5) Duty cycle
6) Time.
The energy radiated is the area under the curve for half a cycle and includes heat, not just light.
Incandescent bulbs do not resonate.

.