X10 Noise from a Cellet Cellphone Charger

Jeff Volp (Links updated 4/22/2015)

In this day and age, most people with anything more than a minimal X10 system often encounter some type of signal reliability issue. This is often due to the interaction between the X10 signals and the various "Signal Suckers" and "Noise Generators" that are found in a typical home today.

A Particular Nasty X10 Noise Source

An experienced X10 user who also has an XTB reported things started going haywire in his home with lights coming on randomly, and no control to some areas even with an XTB at the main controller. He traced the problem to an inexpensive cellphone charger from a no-name Chinese factory. His Monterey X10 signal monitor reported a continuous string of BSC (bad start code) messages. He graciously offered to send me the offending unit for further analysis.

The charger is a light-weight Cellet charger with the model number TCNOK6101. The label says it will provide 4.5V to 9.5V at 0.8A maximum.

I have a "private" circuit used for testing XTB products without interfering with X10 communication throughout our house. That circuit is isolated from the remainder of the house with an X10 filter. I plugged an XTB-IIR, the Cellet charger, and an ESM1 signal monitor into that circuit.

I made my measurements at the XTB-IIR input bandpass filter before the active gain stage. That is a convenient place to monitor X10 signals on the powerline because it removes the 60Hz component, and avoids having to deal with powerline voltages. There is some "in band" gain due to the filter, so my measurements at that point are about double what would be seen directly on the powerline.

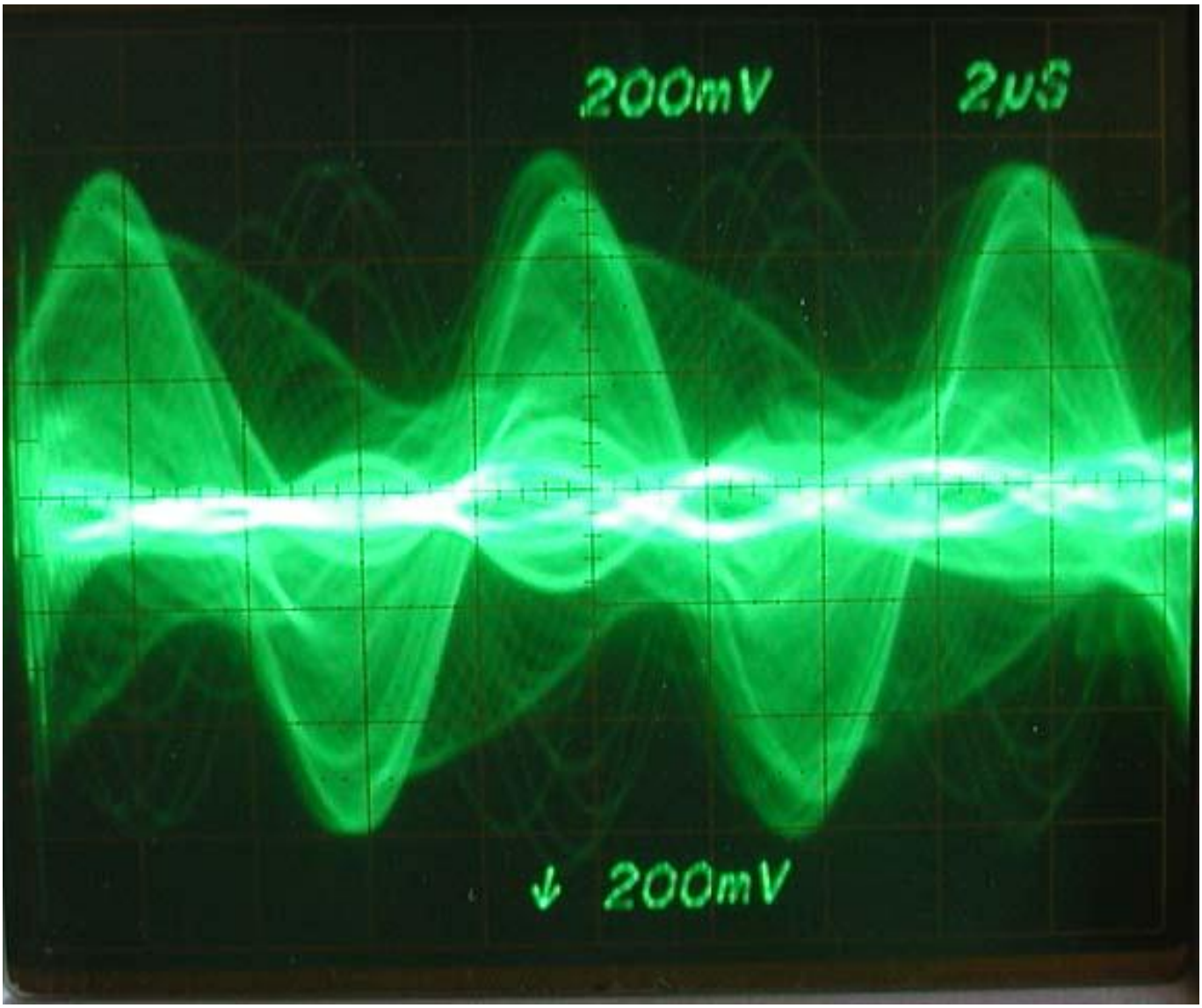
This is clearly a very nasty device for X10 communication. When loaded to about half its rating, I measured bursts of 125KHz exceeding 1Vpp immediately after the zero crossing, which would be about 0.5Vpp on the powerline. That is exactly where X10 signals are transmitted. Under load, the bursts are constant, but the noise pattern will change, depending on the load current. Unloaded, the bursts appear at random throughout each half cycle. The frequency remains around 125KHz.

The XTB-IIR AGC rejected noise from the unit under load, but occasional "1" bits were detected when the unit was unloaded. I never saw the XTB-IIR respond to the noise as a valid X10 signal. However, it is interesting that the ESM1 gave a solid a "Good" indication when the unit had a 20 ohm load. The noise pattern is very sensitive to load current, and a couple of other examples are shown. Note that in all photographs, zero-crossing is at exact center screen, and just over 4 boxes to either side. TheXTB-IIR output is included as a timing reference. The faint burst at center is persistence from a prior scope trace.

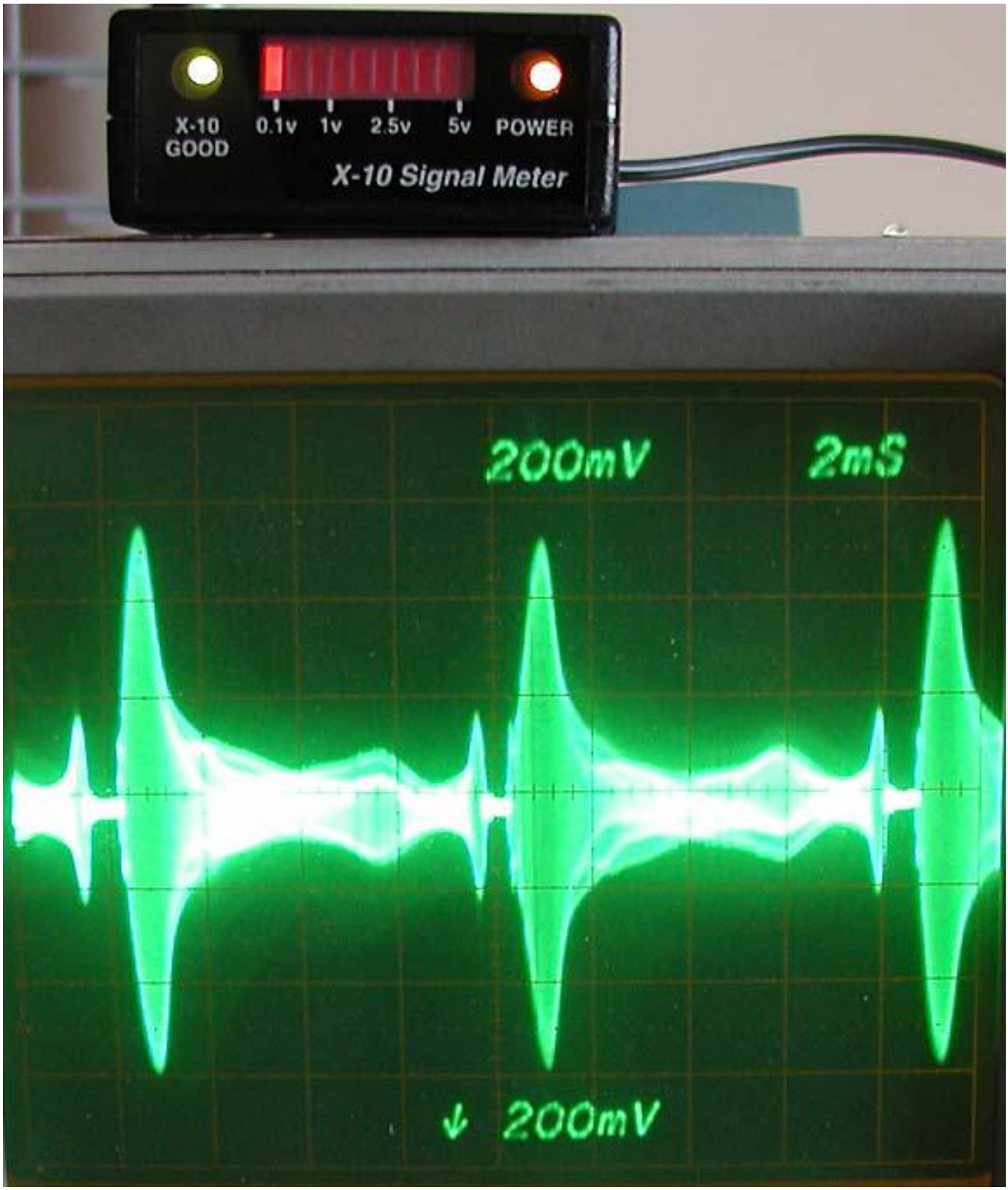
If one was trying to design an interference source to block X10 communication, one couldn't do much better than this Cellet cellphone charger. Its switching circuitry runs very near the X10 carrier frequency, and certainly within the bandpass of X10 modules. The noise bursts mimic X10 communication, and it appears to have no line filter to prevent radiation of this interference. That might cost them a few cents.

More recently I discovered another device that actually generated even more powerline noise than the Cellet Charger. It is a Lumoform 4W 120V LED light. Included at the end is a photograph of the powerline noise produced by that device. This was measured directly on the powerline through an X10 XPCP coupler, and a different scale is used on the oscilloscope to keep the noise on-screen. This noise is almost 2Vpp, almost 4 times as powerful as the noise from the Cellet cellphone charge. Another report on noise from CFL and LED lights covers that in more detail, and offers options on how to deal with it.

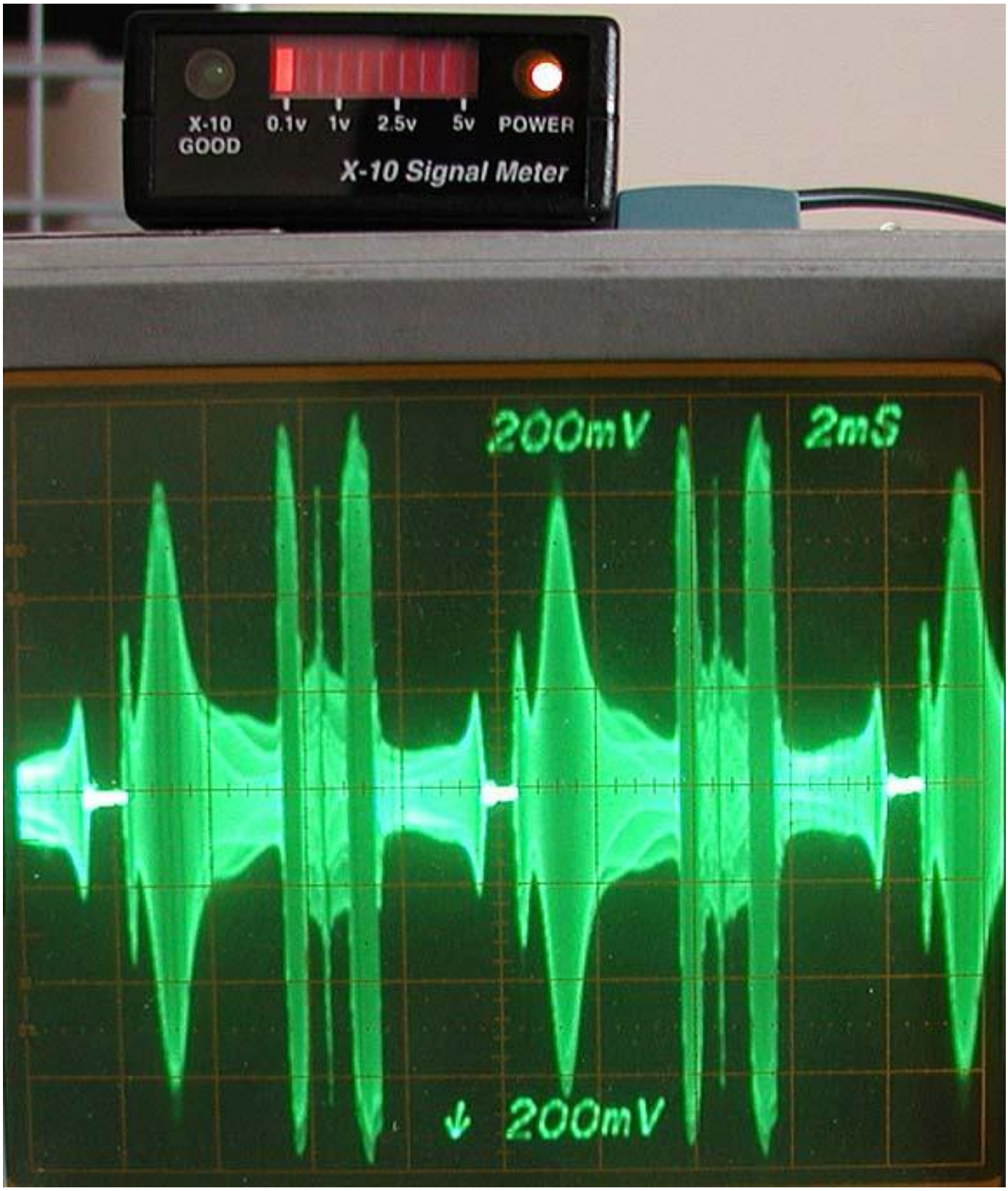
Some Photographs:



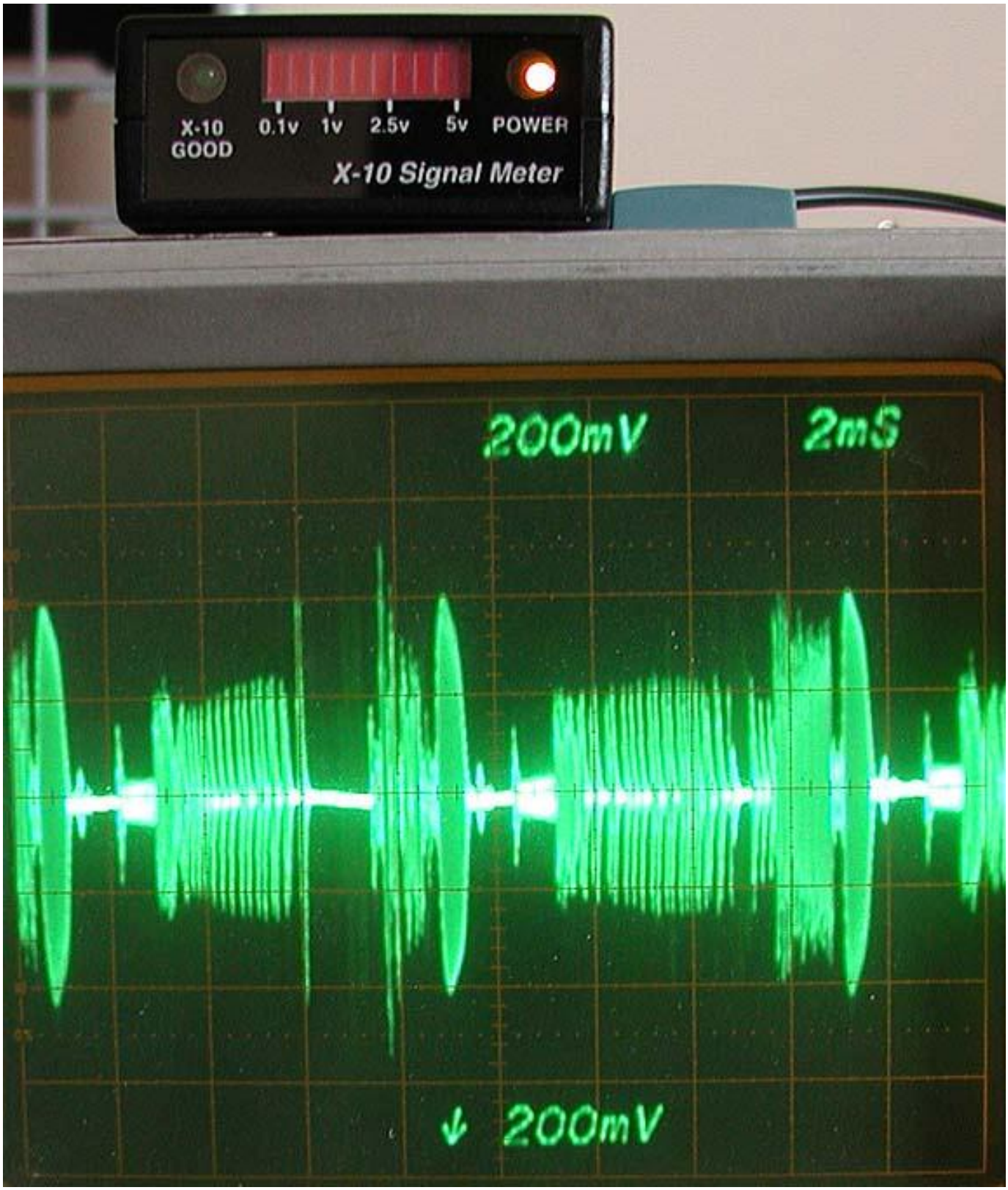
Line Noise from the Cellet charger showing 8mS period (125KHz)



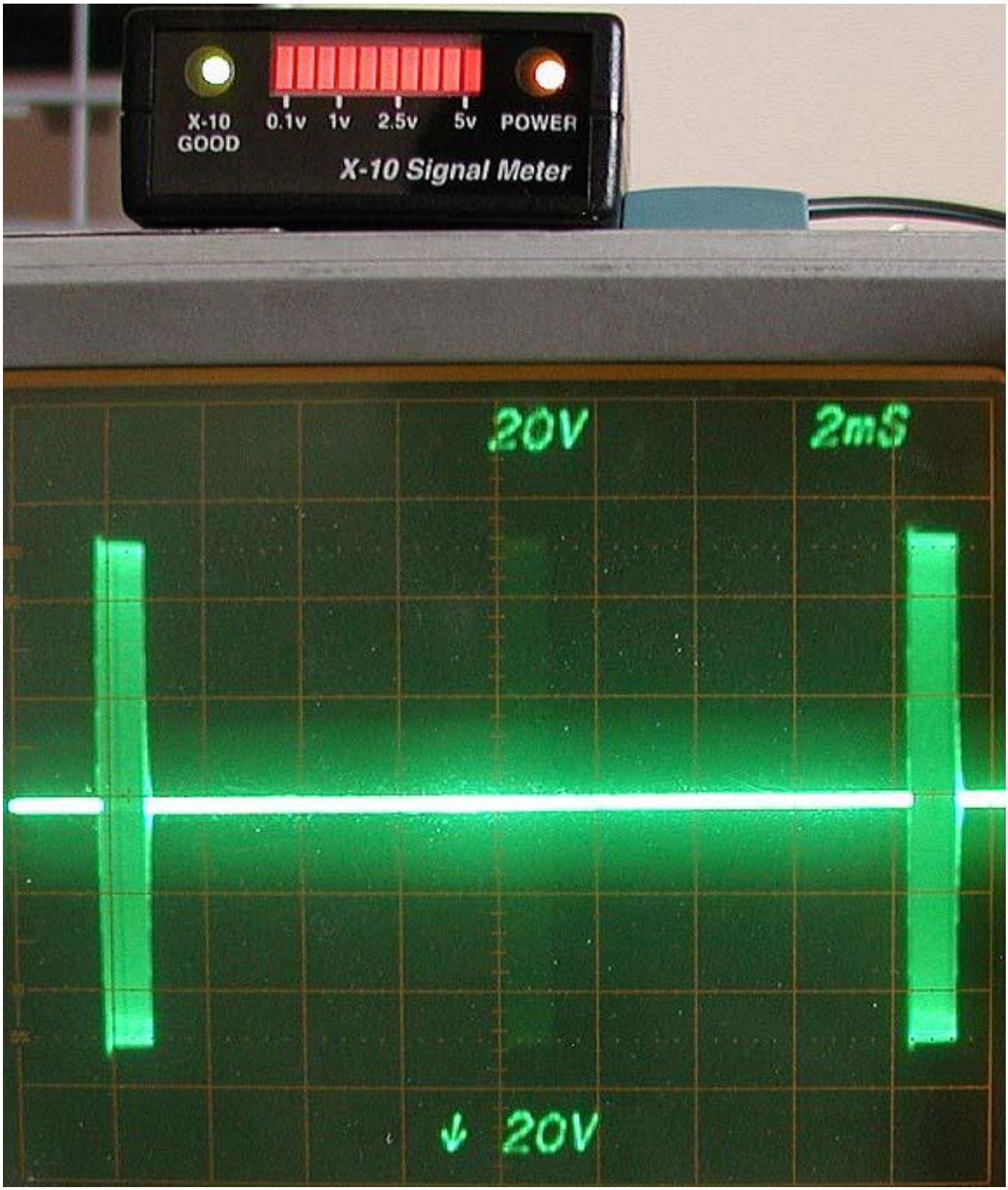
Noise Bursts with a 20 ohm load



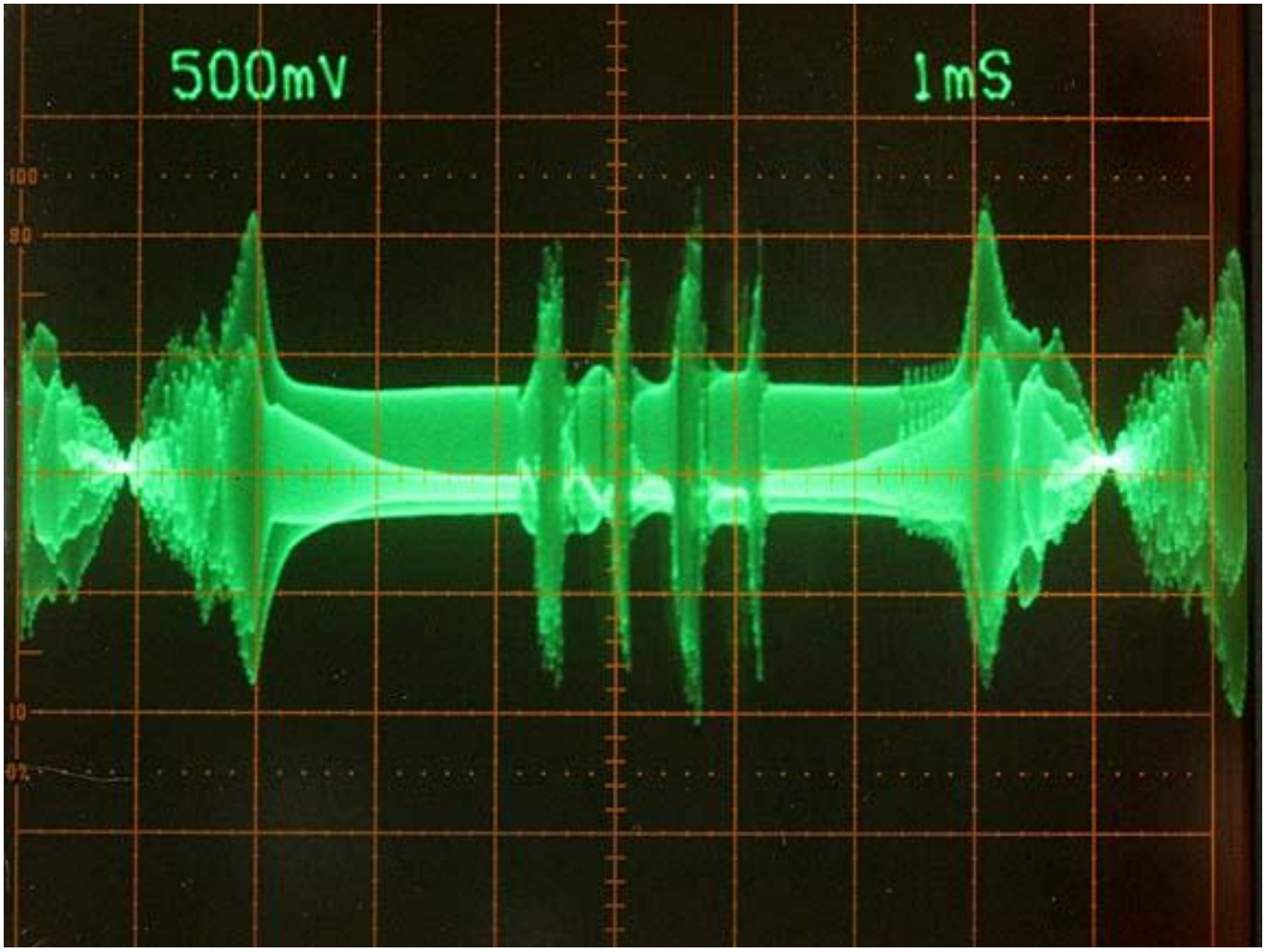
Noise Bursts with 20 & 100 ohm in parallel (about 17 ohms)



More complex noise pattern with just a 100 ohm load



XTB-IIR Output (for a timing comparison)



Noise from Lumoform 4W 120V LED light (measured through X10 XPCP coupler)

As you can see in the prior photos, commonly used electrical devices can inject large amounts of noise onto the powerline. X10 commands are sent as a series of signal bursts coupled to the powerline. Presence of a burst signifies a logic "1", and absence a logic "0". Noise near the X10 carrier frequency can fill in those blank frames, making it impossible for a receiving module to decode the command unless it includes some form of AGC to raise its detection threshold above the background noise level. For reliable X10 operation, we must find ways to either suppress that noise or prevent it from reaching the powerline. The report on noise from CFL and LED lights offers options on how to deal with powerline noise.