Technical Note #2

We bring you this technical note to provide clarification on the design rationale of our WTPLA100™ and other legacy power line adapters.

A Glimpse into the Past

Power line adapters have been around for many years. In the past, experts focused on signals in the low MHz range due to their stability and consistency. When placing these signals on the power line, it was helpful to use differential signaling, where one conductor was driven against another conductor. As such, the power line adapters were designed and built to measure between different pairs of conductors, i.e., Hot versus Neutral, Hot versus Ground, and Neutral versus Ground.

Designing the WTPLA100™

When we designed the WTPLA100™, we were focused on detecting signals at much higher frequencies. While we can detect signals down to 30 kHz, our focus is tens of MHz out to 6 GHz. Our WTPLA100™ actually performs significantly above 6 GHz, but in early testing, we could not evaluate beyond 6 GHz.

The power line is not a fixed impedance and generally does not propagate RF signals well at 100MHz and above. We came into our design with more of a TEMPEST testing standpoint, shielding and isolating our test point (or injection point) all the way to the wall receptacle where the testing is being performed. The signal shielding from the input of the spectrum analyzer is carried all the way to the test point but is not tied to any power line conductor. Our WTPLA100™ is a completely passive device, and therefore, it does not add any noise to your received signal. The WTPLA100™ is a bi-directional device and may also be used to *inject* signals on the power line.

From the TEMPEST viewpoint, we were looking to isolate emanation detection while providing direct connections to the different conductors found on the power line. In general, at higher RF frequencies, the signals will couple between the conductors and should be seen on all conductors but may be seen at a higher level on the direct connection.

For example, think of a transmitter with a monopole antenna.

- You can receive the transmitted signal with a spectrum analyzer with another monopole antenna.
- You have no shared grounds.
- If you touch the monopoles together, the signal will increase.

It is no different with the WTPLA100™, where you will see signals on all lines (Hot, Neutral, Ground) at varying levels. Therefore, it is not necessary to look for signals differentially.

In a real-world environment, the power line could be considered a long wire antenna. We have had many people tell us that they suddenly see many RF signals when using the WTPLA100™. This makes sense as we are providing a reasonable 50-ohm match to the power line or essentially connecting them to a long-wire antenna.

Fighting the Conventions of the Past

So, the question is: Why are we not providing you the means to measure Hot versus Neutral, Hot versus Ground, and Neutral versus Ground?

We are fighting an old convention set years ago and at lower frequencies (i.e. below a few Mhz) applied to *differential* signals. We do not see any value in continuing this convention, but many in industry are having trouble walking away from this convention. Originally, we had considered building a cable to measure/test using the old convention, which would tie the shields of each test cable to different power line conductors. However, if the outlet were wired backwards (Hot versus Neutral), this cable could become a major safety concern, especially since the WTPLA100™ is completely passive. In this case, especially at higher voltages, testers could be electrocuted by touching the shield of the coax.

We have also not seen any situation, through our own testing and testing by others, where one could not detect a differential signal on the power line using our methods. We believe our WTPLA100™ provides the best means possible to detect signals on the power line.