



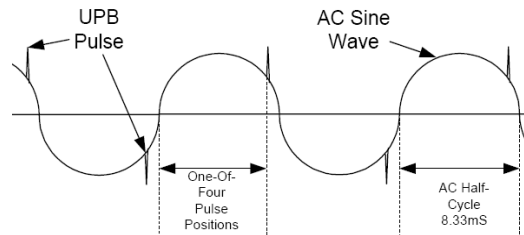
## Application Note

### Troubleshooting Communications

This document is a guide for basic troubleshooting of UPB communication issues. There are two things that can disturb UPB communications: noise and attenuation.

Noise is any large non-UPB pulses in the 4-40 kHz range that appear in the “UPB Window.” Noise sources are usually electronic ballasts or switching power supplies that do not use magnetic transformers to convert power. In some cases poor (wire-nut) connections can cause noise too.

Attenuation is the degradation of the UPB communication pulses due to abnormal capacitive impedance between line and neutral or excessive resistive impedance on one or more wires (e.g. poor wiring connections). All devices connected to a power line have impedance. Capacitive impedance devices are those with special capacitive inputs such as some uninterruptible power supplies (UPS) or some projectors with metal halide bulbs. Excessive impedance is usually caused by poor connections, which is why proper (well twisted) wiring connections are important.



Currently the best set of tools for troubleshooting UPB communication issues include: (1) a PC, (2) a Computer Interface Module (AKA; CIM or PIM) and (3) UPStart, the UPB configuration software (a free download @ [http://www.simply-automated.com/products/sa\\_upstart.htm](http://www.simply-automated.com/products/sa_upstart.htm)). We also offer the Pocket Programmer (UPP-20), which has a communication and noise level view as well as the ability to initiate and monitor UPB communications on the power line.

Some of the tools in UPStart that will assist in troubleshooting UPB communications are suspiciously found under the Tools menu. They are: (1) Signal and Noise Meters, (2) Network Communications Test and (3) the Log Viewer.

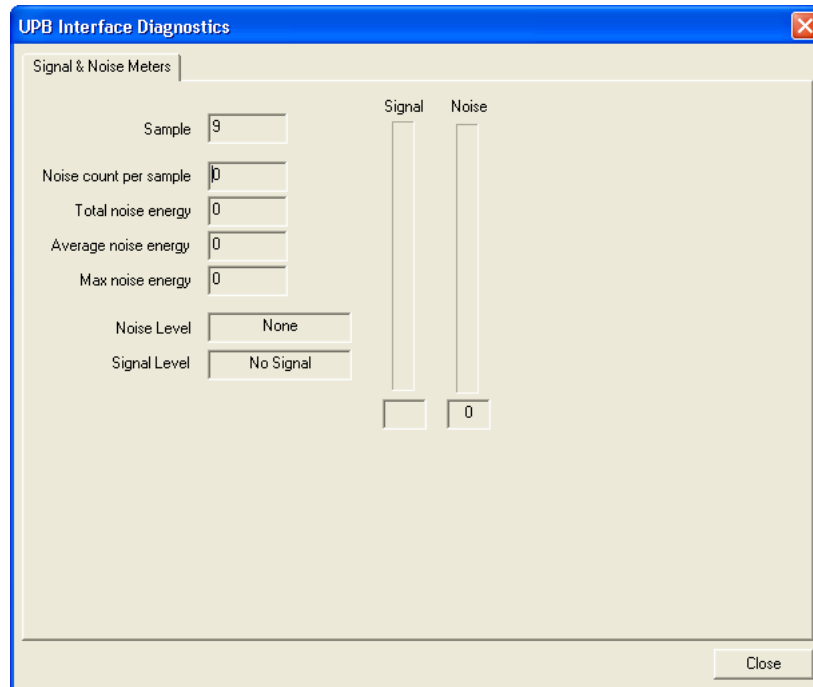
Prior to using any of the above tools ensure that:

- (1) The devices are enabled for transmission.
- (2) The devices were added to the same UPB network (i.e. devices have the same network ID).
- (3) Links exist and are entered into the desired devices, transmitters and receivers.

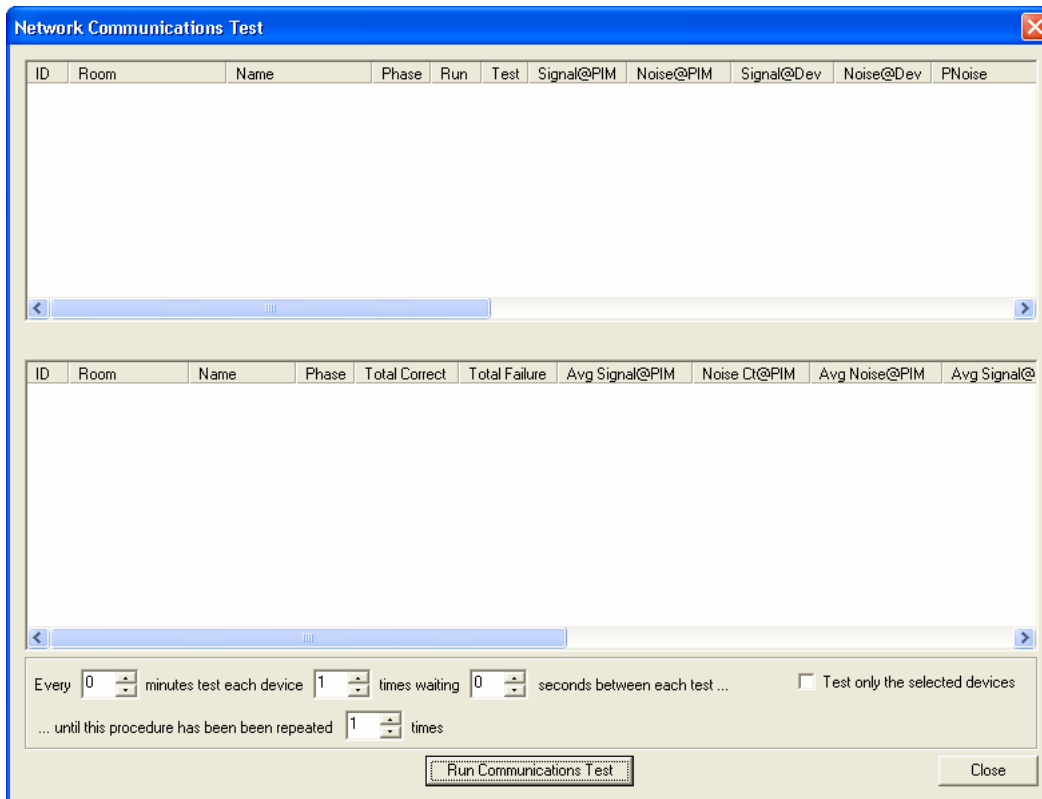
When powered and operating properly (e.g. LED is on), UPB switches emit a faint “buzz” when transmitting UPB. There are two main reasons a powered switch would not buzz: (a) it is not configured to transmit a Link or (b) there is noise present in the UPB window and the device is ‘politely’ waiting its turn to transmit, a collision avoidance technique. The devices should be configured to transmit Link packets (default), not Direct packets and not configured to “Transmit through a powerline repeater” (unless a 3 phase repeater is installed).

To start trouble-shooting connect the PC and CIM, then open UPStart, open the appropriate UPB Network file (or create one) and go to the Tools menu.

The Signal and Noise meters are found under Tools... Select "UPB Interface Device" and then "Signal & Noise Meters...". The Signal meter will display green bars when UPB messages are on the power line. The Noise meter will display red bars when noise is present in the UPB Window. When no noise or UPB communications are present the meters will appear as in the figure below.

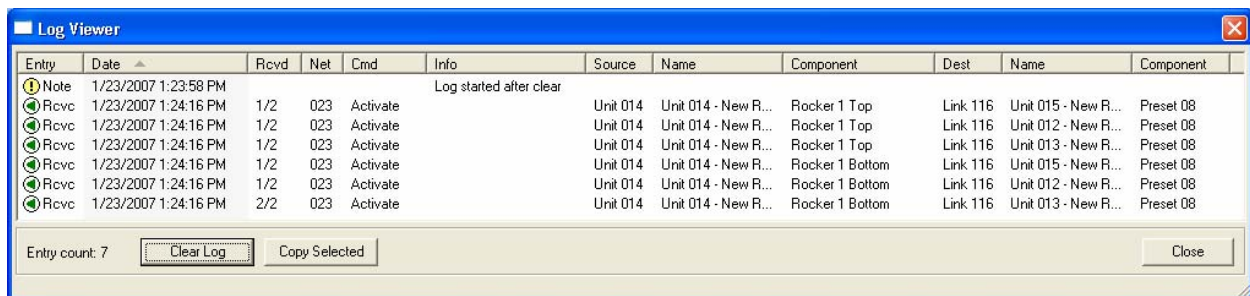


The "Network Comm Test" is also found under the Tools menu and will test two-way communications between the CIM and each installed device. It also lists the noise at both devices. It can be run once or multiple times (spanning minutes or an entire day if necessary) if troubleshooting an intermittent problem. Clicking on "Run Communication Test" pops up a window that allows saving the test as a file. Clicking on Cancel will run the test without saving a file. Clicking on Save will create a file that is time and date coded. The file may be exported to Excel for easier viewing.



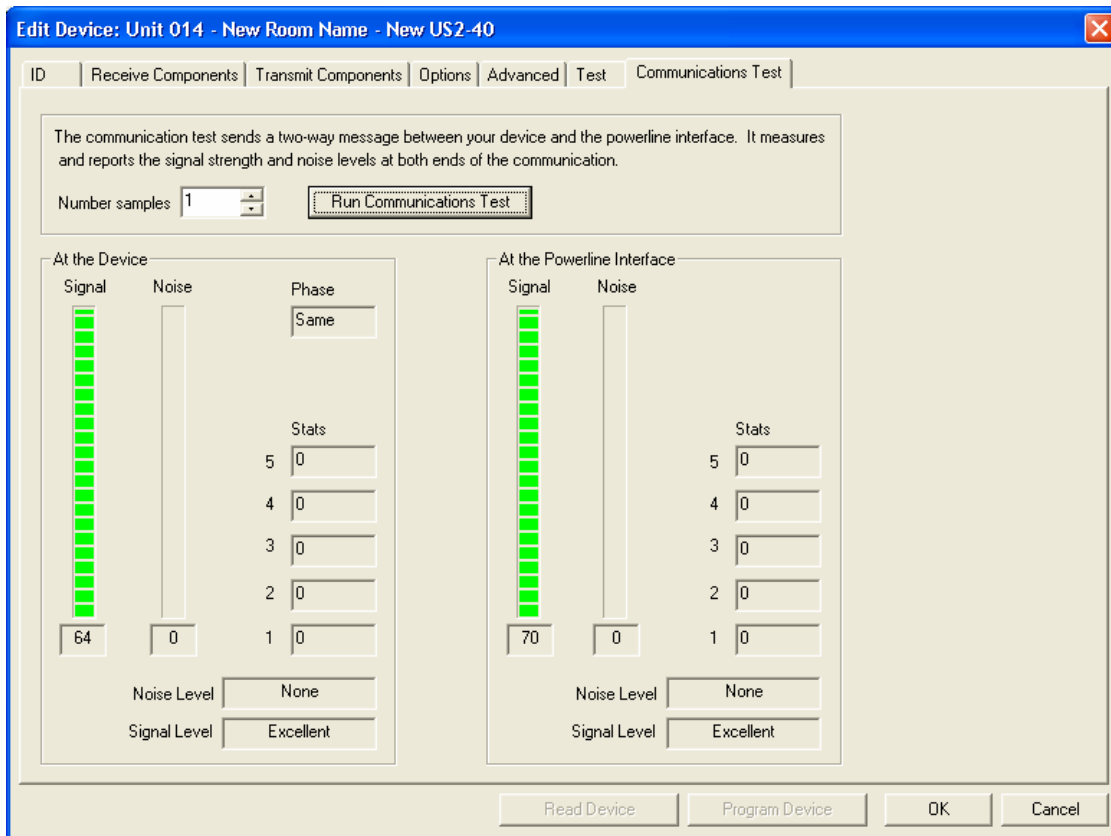
The Log Viewer is used to monitor basic communication between devices. It must be enabled before using Open Log Viewer on the Tools menu. To enable the Log Viewer:

1. Go to Tools... Options...
2. Click on the Log tab.
3. Click on the Enable UPB reception logging.
4. Click on the Browse button for the Current log file and then Save to create a log file.
5. Click on the Browse button for the Historical log file and then Save to create a log file (accepting the defaults will work for both log files).
6. If you wish to see all devices that should respond to a UPB transmission click on the check box in the Options section: Show all components...
7. Click OK
8. Go to Tools... Open Log Viewer.



To use the Log Viewer for trouble shooting first right Click on a device or link, then activate (ON) or deactivate (OFF) the device or link (preferably a device that is communicating well) and observe the results. This will test the UPB communications between the CIM and the selected device or devices controlled by the link. To automate the testing between the CIM and a selected device, open the Edit Device window and Click on the Communications Test tab. Set

Setting the “Number samples” to greater than 1 will run the communications test repeatedly, testing communications between the CIM and the device, which can be viewed on the Log.



The Communications Test screen will show any noise on the line and communications levels in dimensionless values (9 or above is very reliable, 6-9 is mostly reliable, below 4 will not be reliable). In the Noise Level and Signal Level boxes it will provide a label for the level such as Excellent, Good or Poor. It also shows the phase relationship between the CIM and the selected device, Same or Other. Communication levels will always be lower on the “Other” phase.

The tools within UPStart assist in discovering whether the communications issue is noise or attenuation, or both. Once the problem is defined it can be solved.

Solving noise issues:

Identifying the offender is the first step. The Network Comm Test can give us a hint. The noise reading will be higher closer to the source. Those devices which have the highest noise readings are most likely close to the noise. If noise appears to be near the same level on both phases or throughout the house, then the noise source may be external to the home.

1. Run the Network Comm Test one or more times to confirm noise levels.
2. Is the noise near the same level through out the home? If so install a non-inverting phase coupler (model ZPC-W) on the main power panel, with no other phase couplers connected, to attenuate the noise coming in the home. Run the Network Comm Test again, a significant drop in the noise level should be seen if the noise source is external to the home.
3. If the noise is at different levels through the home (e.g. higher on one circuit than the other), then the source of the noise is most likely within the house. Open the Signal Noise meter and go to the nearest electrical breaker box.

4. Cycle off one breaker at a time and observe the effect, starting with the circuits that show the highest level of noise. Move the CIM to a live circuit prior to cycling off the circuit to which the CIM is connected.
5. Switching off the noisy circuit will likely drop the noise on the meter to zero and will reappear when the circuit's breaker is cycled back on.
  - a. There may be more than one source of noise. The observed noise level on the meter may drop slightly rather than significantly. In that case leave that breaker off and move on to cycle the remaining breakers. A noticeable change should appear on the meter when a noise source is eliminated.
6. To find the internal noise source, locate every device on the noisy circuit and one by one turn each off, by unplugging or otherwise removing power (i.e.: Pull the light pipe on a UPB switch).
  - a. If the noise is still present, it is likely a poor connection on a switch or receptacle.
7. If the noise persists down to the last breaker turned off, where the CIM is moved to another circuit which was turned off and on without an affect on the noise, then the source of noise may be external to the home.

Once the offender is discovered the course of action will follow. If the noise is coming from an electronic ballast it is best to replace it with a magnetic ballast or an FCC 47 CFR rated electronic ballast (or one that operates outside the UPB frequency range, > 40 kHz). A wired in filter (model ZNF15A-W) or plug in filter (model ZNF15A-P) can be used to block the noise from the power to the rest of the house.

When a filter is required it is important to install it on the load side of the UPB device. The exception is when filtering a device that is attenuating the UPB signals.

Electronic power supplies or inverting power supplies operating in the 4-40 kHz range will generate noise that affects UPB communications. Other known sources are triac controlled dimmers that are not quite off (e.g. on at 1% to 3%), variable speed motor controls, poor electrical connections and failing power transformers. A key in finding the offender is to change only one thing at a time between observations of the Signal and Noise meter.

Noise will attenuate over the length of wire it travels across. The further from the noise the less effect it will have on UPB communications. Noise that appears to be throughout the house and on both phases could be coming from a source external to the house (e.g. next door neighbor). The use of a non-inverting phase coupler, such as the ZPC-W, will reduce or eliminate this common mode noise. Common mode noise from outside the house is frequently seen on both phase at or near the same noise level. Noise within a house is usually higher on one phase, or circuit, than the other phase or circuit.

Solving attenuation issues:

Attenuation issues are found in a very similar manner to noise issues. In these cases there are typically one or more attenuating devices in the house that puts a significant capacitance across the power line. The other case of attenuation is when there are poor connections that create resistive impedance which can reduce UPB signal strength. The Network Communications Test can be very helpful in locating a high attenuation device or poor wiring connections. The breaker method listed above will also work to find an attenuating device. Most often Uninterruptible Power Supplies (UPS) are a culprit, Projectors with metal halide bulbs can be an issue due to the capacitor they have in the ignition circuit. The FiberPro 150, for instance has a 55  $\mu$ F capacitor across the power lines creating significant attenuation issue. Once an attenuating device is found it can be isolated with either a wired in or a plug in filter that uses an inductor to isolate the house from the capacitive device.

## Signal strength between phases and Phase Couplers:

Signal strength will always be lower on the “Other” phase with respect to the CIM. Most houses have split phase power where the UPB signal travels from the same phase, out to the power transformer on the street and back in the house on the other phase, inverted from the original signal. The inversion and the impedance on the path reduce the sensed signal level on the other phase. Phase couplers increase signal levels between phases and are always recommended. They shorten the length of the path for the UPB pulse. Low signal levels on the “Other” phase can often be brought up into a desirable range by use of one or more phase couplers.

Currently there are two types of phase couplers, an Inverting Phase Coupler (e.g.: ZPCI) and a non-inverting Phase Coupler (e.g.: ZPC or those sold by other UPB device manufacturers).

The deployment of phase couplers is usually easy. However in some cases (> 8k sq. ft. homes) a process of trial and error is required to get optimal performance. Generally, the distance between the main electrical panel and the power transformer will define the type of phase coupler that will provide optimal performance. If the transformer is very close a phase coupler may not be required to have acceptable signal in all parts of the house. One phase coupler connected across the split phase in the main electrical breaker panel is most often all that is required. The inverting phase couplers work very well when the power transformer is close, within 150 ft. Non-inverting phase couplers work well if the power transformer is at least 200 ft from the main breaker panel. The trial and error process begins when one phase coupler does not allow strong UPB signal levels (e.g. >9) throughout the house. If using non-inverting phase couplers adding additional phase couplers on each sub-panel often delivers a stronger signal. If additional phase couplers do not add sufficient signal strength sometimes a single phase coupler must be moved from panel to panel to find the location that provides the strongest signal levels throughout the house. Moving the phase coupler and then running the Network Comm Test from the location the CIM will be installed if used with a home automation controller, or another central location, is the trial and error process.

## No communication between phases:

Most residents use split phase power where one phase of 240 VAC is split into two 120 VAC lines. In these cases the phases are mirror images of each other. In very rare cases there appears to be no connection between phases. A house or more frequently a condominium with three-phase power will create this situation. Or, if the home is improperly connected to two different secondary circuits on street side transformer, this situation may also occur. When there is no communication between phases there may be a phase difference that will prevent UPB from working properly. A volt meter or a dual channel oscilloscope is required to test the phase difference.

### Voltmeter:

1. Measure and record the voltage between phase A and neutral.
2. Measure and record the voltage between phase B and neutral.
3. Measure and record the voltage between phase A and phase B.

All three should be exactly the same. If there is a difference between phase A and B that would mean that the phases are separated by less than 180° and UPB communications will be compromised.

### Oscilloscope:

1. One channel is connected between phase A and neutral
2. One channel is connected between phase B and neutral

The AC traces on the screen should be mirror images of each other.

If the voltage between the phases is 208 VAC the residence has 3 phase power. A 3 Phase Repeater (model: UTR) is required. All devices that communicate across the phases will have to be set to "Transmit through a power line repeater"; a setting on the Advanced tab of the Edit Device window in UPStart.

If the voltages match and if the phases appear to be aligned, then the issue is most likely miss-connected power from different secondary circuits on the street side transformer. If this is the case we recommend contacting the power company to check and fix the connection. If this is not possible then a split phase repeater may be required. This product is currently available only for beta testing; to date there has not been a market need. Or, two CIMs may be used if the control system allows more than one com port connection. The phases would be communicated to separately and code written to facilitate the cross phase Links.

# Communication Troubleshooting Flowchart

