ILT1000 Application Note

# Wireless Light-Level Monitoring

The affordability, accessibility, and ease of use of wireless technology combined with the All New ILT1000 enables remote monitoring and measuring for most light measurement applications. The light meter, monitor & datalogger can be used anywhere a wired or wireless network can reach. The ILT1000 takes advantage of readily available, cost effective, wireless devices and provides ISO17025 & NIST -traceable UV, VIS & IR light measurements. Wireless configurations provide users with the necessary flexibility and portability required for measurements in locations where cables are impractical. The ILT1000 uses a standards-based USB interface for power and communication and works with most new and or existing wireless networks.

This application note will describe specific components that were tested at International Light Technologies (ILT) for single- and multi-point light monitoring.  While the paper is focused on wireless monitoring, the same principles apply to wired-Ethernet monitoring.

Disclaimer: The application note below describes ILT's experience integrating 3rd-party devices with its ILT1000.  ILT has no affiliation with these companies, and does not provide any warranty, guarantee for fit and function, or support of the products below.

## Wireless Configurations

Two configurations developed and tested to achieve wireless light-monitoring are described in the table and figures below.

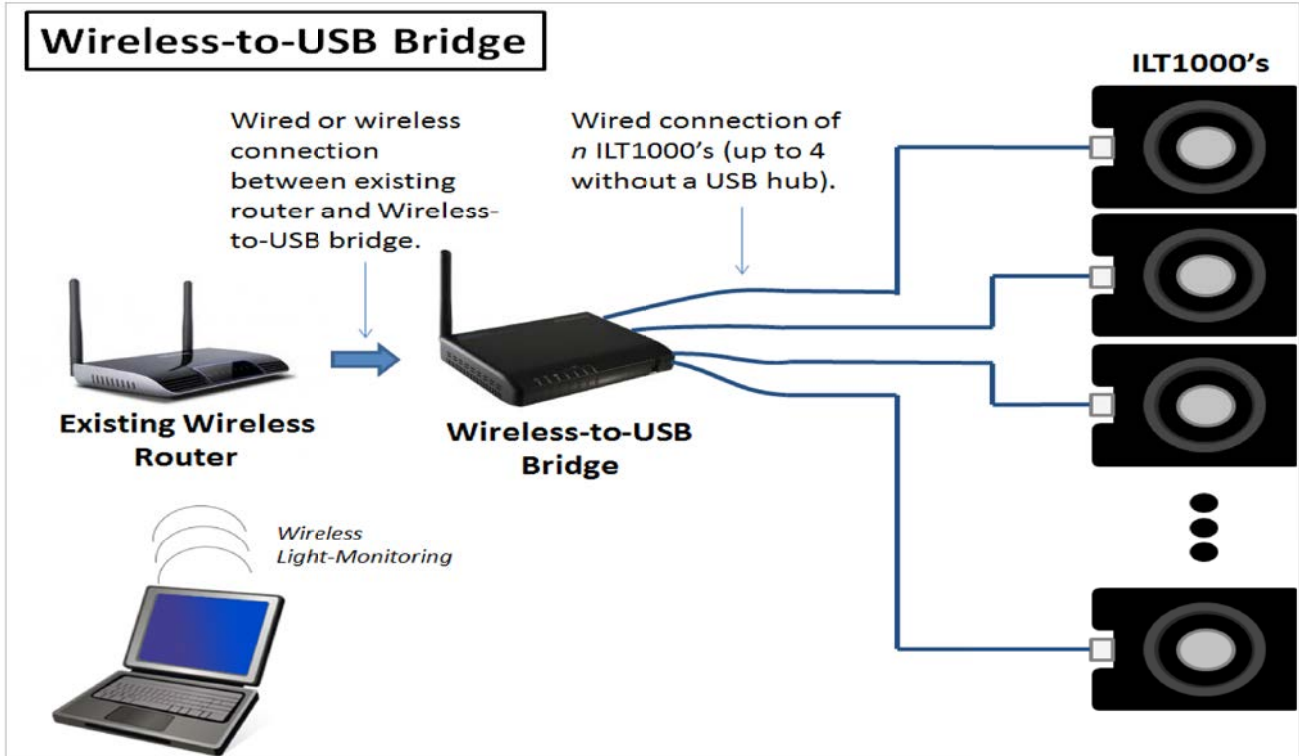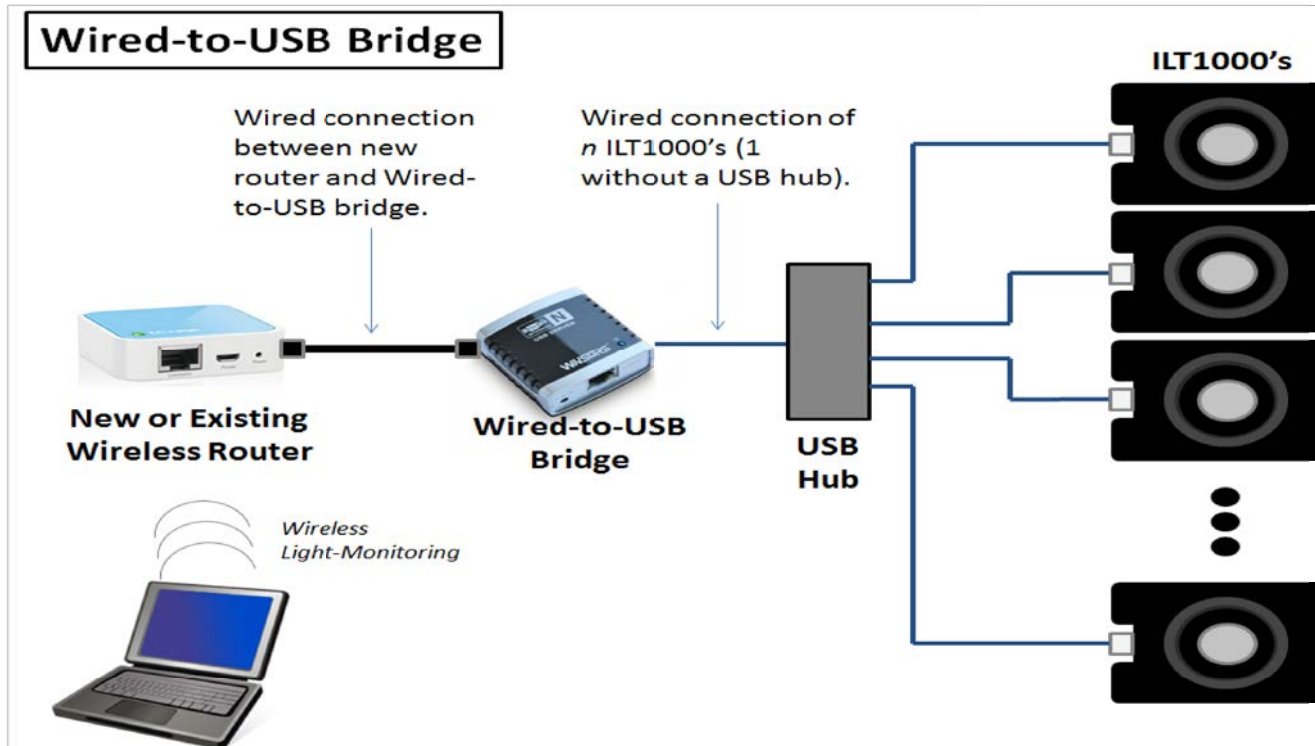| Configuration | Wireless "Path" | Key Benefits |
|---|---|---|
| Wireless-to-USB Bridge | Monitoring server, wirelessly talking to existing network, wirelessly talking to USB bridge, wired to ILT1000's | - Simple integration into existing wireless network.<br>- 4 USB Ports on the Wireless-to-USB device eliminates the need for a USB hub. |
| Wired-to-USB Bridge | Monitoring computer, wirelessly talking to new or existing network, connected via wired-Ethernet cable to USB bridge, wired to ILT1000's. | - Allows installation of new/dedicated wireless network<br>- "Travel Routers" provide small footprint for adding wireless connectivity to multiple ILT1000's that are not close to each other. |

Figure 1. Wireless-to-USB Bridge Configuration.



Figure 2. Wired-to-USB Bridge Configuration.

## Wireless Products Tested

Testing consisted of the products listed in the table below.

| Product | Hawking Technology Wireless HMPS2U | Monoprice Networking USB2.0 Server (NUS), believed to be same-as Winstars Technology Networking USB 2.0 Server | TP-LINK TL-WR702N | Edimax BR-6258n |
|---|---|---|---|---|
| Pic | | | | |
| Manufacturer | Hawking Technology | Monoprice / Winstars | TP-LINK | Edimax |
| URL | www.hawkingtech.com | www.monoprice.com, www.win-star.com | www.tp-link.com | www.edimax.com |
| Product Type | Wireless Ethernet-to-USB | Wired Ethernet-to-USB | Wireless N Router | Wireless N Router |
| Top Speed | 150 Mbit/s | 100 Mbit/s (10/100 interface) | 150 Mbit/s | 150 Mbit/s |
| Wireless Security | WEP(64/128),WPA-PSA (TKIP/AES), and WPA2-PSK(AES) | N/A | 64/128/152-bit WEP, WPA/WPA2, WPA-PSK/WPA2-PSK | 64/128-bit WEP encryption and WPA-PSK, WPA2-PSK |
| Antenna | External | N/A | Internal | Internal |
| Dimensions | 3.39 x 3.31 x 1.30 in. (86.5 x 86.2 x 32 mm) | Approx. 2.2 x 2.2 x 0.9 in. (57 x 57 x 23 mm). | 2.2 x 2.2 x 0.7 in. (57 x 57 x 18 mm) | 2.0 x 1.7 x 0.7 in (51 x 42 x 17 mm) |
| Power | 12V/1.5A | 5V/2A | 5V/1A | 5V/1A |
| Windows | Yes | Yes | Yes | Yes |
| MAC | Yes | No | Yes | Yes |
| USB Comm+Power Ports | 4 | 1 (4 with USB hub) | N/A | N/A |

The products above were tested in the following configurations:

| Product(s) | Wireless Configuration |
|---|---|
| Hawking Technology HMPS2U | Wireless-to-USB Bridge |
| TP-LINK TL-WR702N + Monoprice NUS | Wired-to-USB Bridge |
| Edimax BR-6258 + Monoprice NUS | Wired-to-USB Bridge |

## Wireless-to-USB Bridge Configuration

### Hawking Technology HMPS2U

Testing was performed on a Windows 8.1 system.

This testing was performed based on Figure 1 above. Installation was performed in accordance with the HMPS2U *Quick Installation Guide*. The only ambiguity in the installation was "Step 2, Hardware Installation". This step shows a picture of the HMPS2U being connected to a laptop computer, with an Ethernet cable, for initial setup including setting wireless credentials. The

text for item (1) of Step 2, however, indicates connection between the HMPS2U and "an available LAN Port on your network router."  When following the text, and not the picture, the installation proceeds as documented and is fairly simple.  Of course, access to your network router is a requirement.  Other notables during installation:

1. The installation calls for a wired Ethernet connection for the initial configuration, but an Ethernet cable is not provided in the package.
2. A reboot is required after installation.
3. The tested configuration included Software Version 2.23 and Driver Version 1.71.25. Both of these were found via the Hawking Control Center (HCC) "About" menu.

After following the installation steps, including connecting of USB devices (three ILT1000's in this example), the HCC software automatically discovers the ILT1000's and presents the screen below in Figure 3.

**Figure 3. Hawking Control Center. Devices discovered but not connected.**

The ILT1000's show up based on their interface, which utilizes the Texas Instruments XDS100 protocol. While HCC discovers the devices automatically, it does not automatically connect to them. Note that HCC also displays printer icons as opposed to something more generic for the ILT1000's. To connect to an ILT1000, the particular device is selected as shown below. This enables the "Connect" icon. It also enables the "Network Scanner" button, but this control serves no purpose for the ILT1000.

**Figure 4. Device selected and Connect icon activated.**

After selecting the "Connect" icon, HCC shows the device as connected.

**Figure 5. Device connected.**

After manually connecting the remaining two devices, all show as connected (Figure 6) and all show up within Windows Device Manager as USB-to-Serial devices (Figure 7).
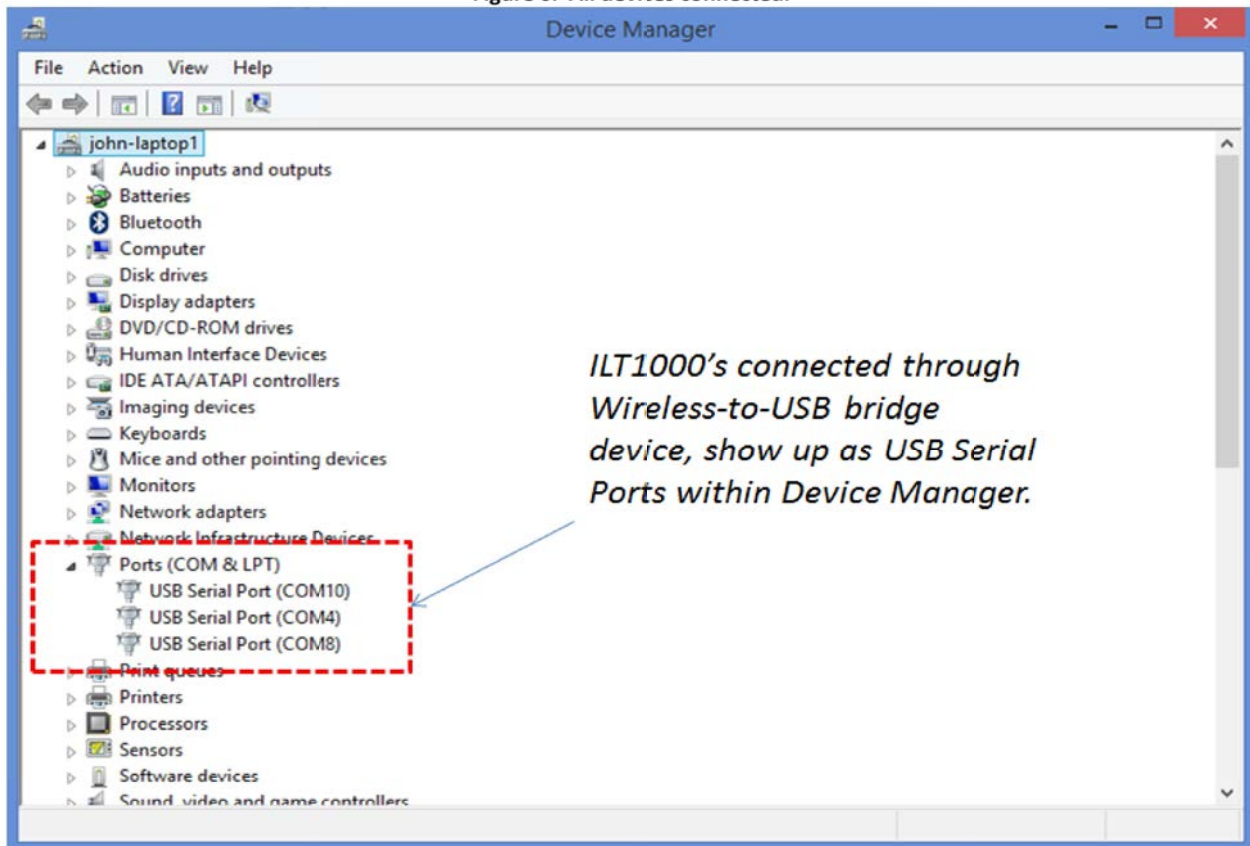
**Figure 6. All devices connected.**



ILT1000's connected through Wireless-to-USB bridge device, show up as USB Serial Ports within Device Manager.

**Figure 7. Windows Device Manager showing ILT1000's as USB Serial Port devices.**

At this point, any of the ILT applications can be run*, connecting to the ILT1000 over the wireless network.  Figure 8 below shows the resulting "Bar" screen, while Figure 9 demonstrates the wireless monitoring.  All functionality is available, including recording/ reporting.  Custom applications can also be developed to perform such activities as continuous light-level monitoring with lamp-hour and lamp-outage alerts, delivered via eMail or other mechanisms that integrate with existing safety monitoring systems.

*Note: While the "FW Update" application can be run, ILT does not recommend wireless firmware updates due to risk of error should the network connection be interrupted.
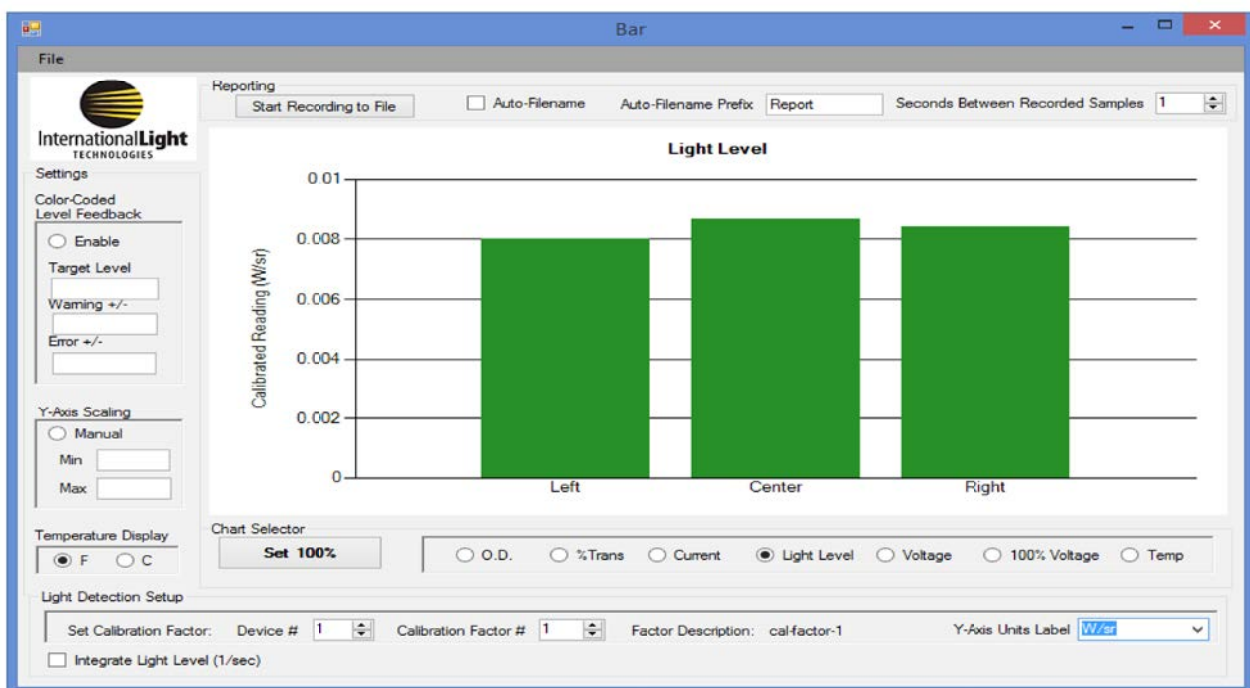


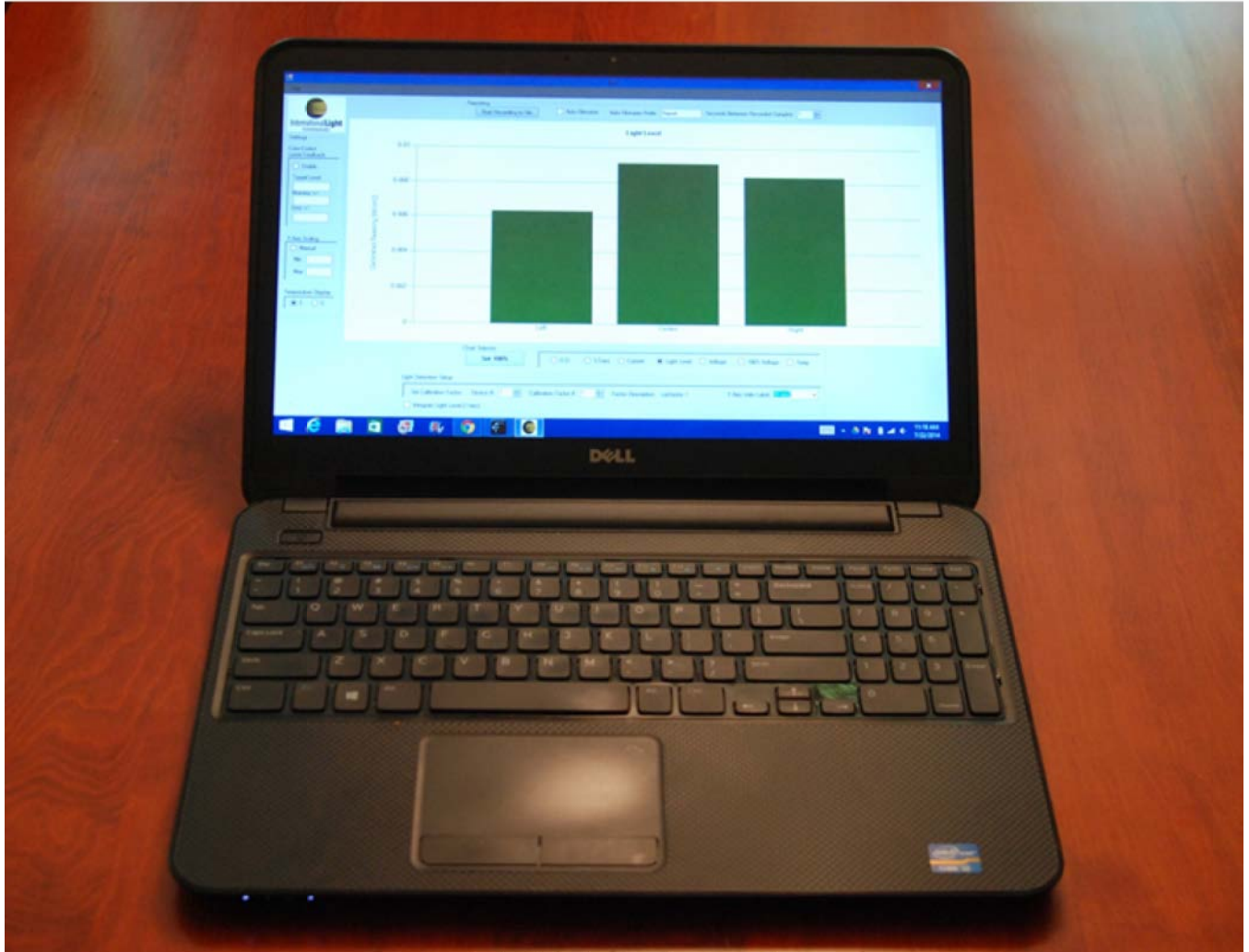Figure 8.  "Bar" program, wirelessly monitoring ILT1000 radiometers.

**Figure 9. Wireless light-level monitoring via laptop.**

Results of testing:

Speed

With the Trend program, and a single ILT1000 connected, the device produced 20 readings in 9.2 seconds, or about 2 readings/second.

Error Handling

Three types of error handling scenarios were tested for each of the wireless configurations. The HMPS2U results are as follows:

| Error Handling Condition | Result |
|---|---|
| Wireless access point goes out of range | When the monitoring computer was moved out of the wireless network range, while actively accessing the ILT1000 devices, the HMPS2U required power-cycling to properly re-identify the ILT1000 devices. This monitoring computer did not experience any errors or reboot requirements, but HCC needed to be run after power cycling the HMPS2U to reconnect the devices. Under normal conditions, based on accessing the HMPS2U via the existing wireless network, this condition should not occur normally. Nonetheless it is recommended that system design ensures wireless network range is maintained. |
| Monitoring station/computer returns from power down mode. | HCC finds the devices, but requires manual "Connect" action on each device before connection can be reestablished. |
| Reboot of the monitoring station/computer. | HCC finds the devices, but requires manual "Connect" action on each device before connection can be reestablished. |

Summary:

- Pros
    - Works as advertised, providing robust wireless-to-USB bridging and supporting the ILT1000.
    - Simple installation and setup, after making initial connection to the router and not a laptop as depicted in the instructions.
    - Fairly good speed (multiple readings per second when interfacing to 3 ILT1000's) through the wireless interface.
- Cons
    - Devices, other than printers, cannot be auto-connected upon reboot or return from low-power modes.


## Wired-to-USB Bridge Configuration

For all configurations below, testing was performed on a Windows 8.1 system.

The Wired-to-USB Bridge configuration testing was performed as illustrated in Figure 2 above and reiterated below in Figure 10 (showing the TP-LINK TL-WR702N as the wireless router). In this configuration, the monitoring computer is talking to a new or existing wireless network, which has a wired connection to a USB bridge.
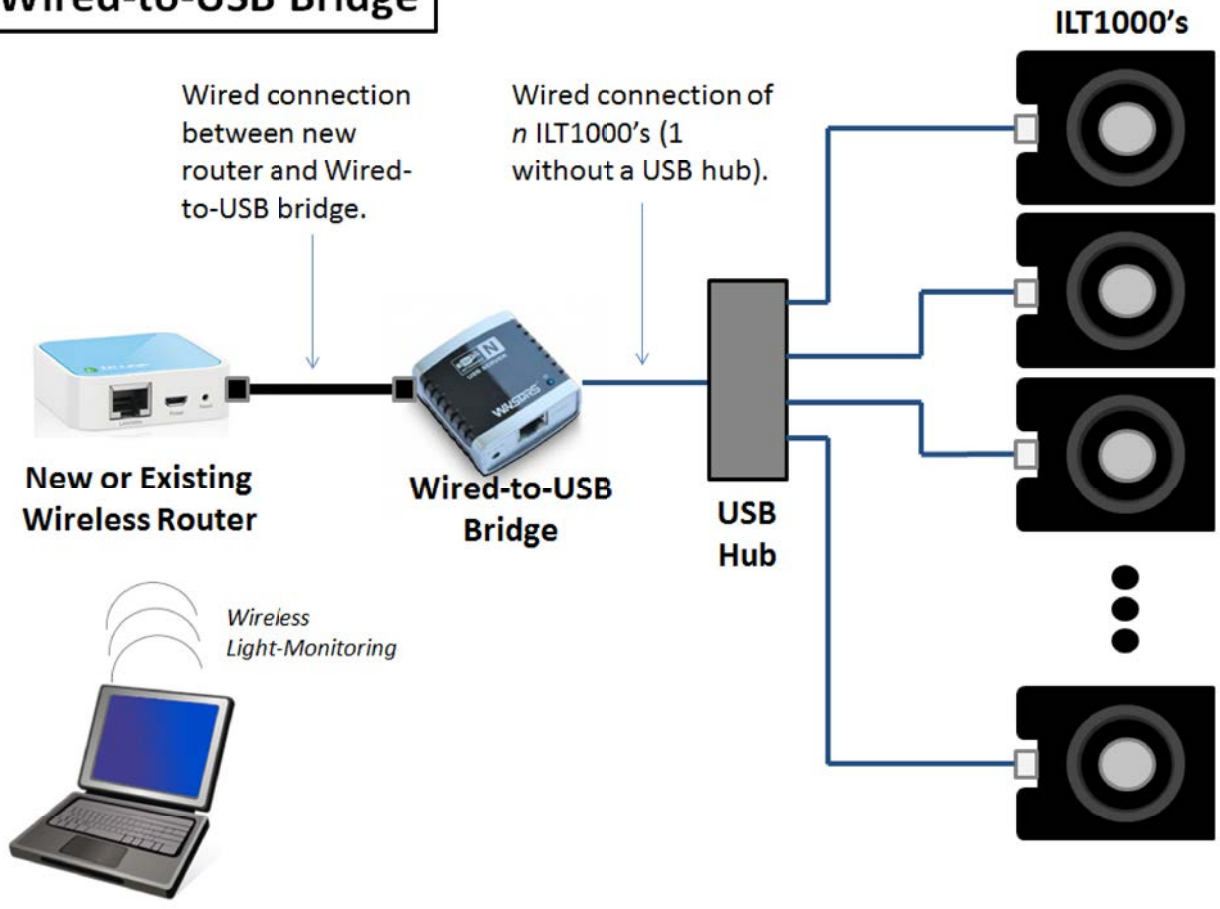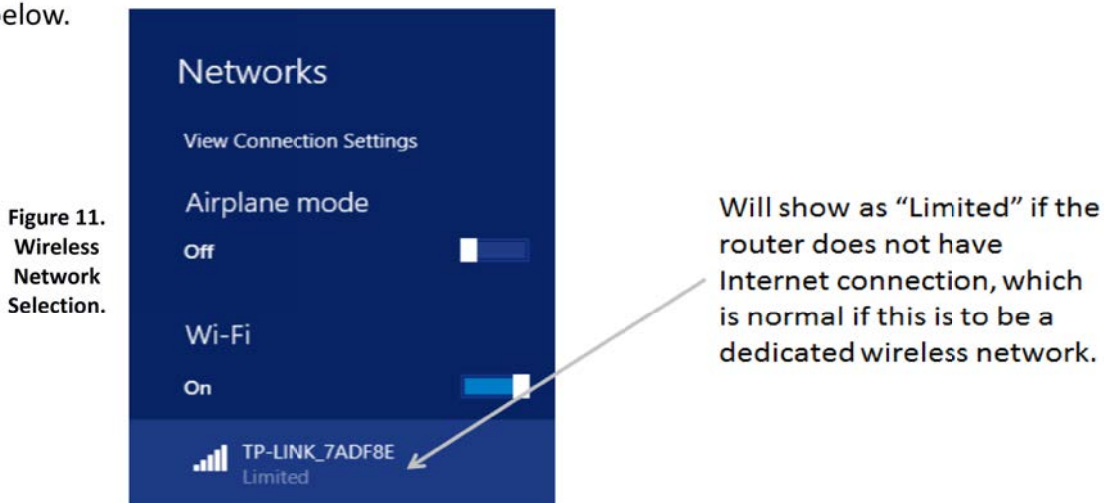
## Wired-to-USB Bridge

ILT1000's

Wired connection between new router and Wired-to-USB bridge.

Wired connection of *n* ILT1000's (1 without a USB hub).

**New or Existing Wireless Router**

**Wired-to-USB Bridge**

**USB Hub**

*Wireless Light-Monitoring*

**Figure 10. Wired-to-USB Bridge Configuration.**

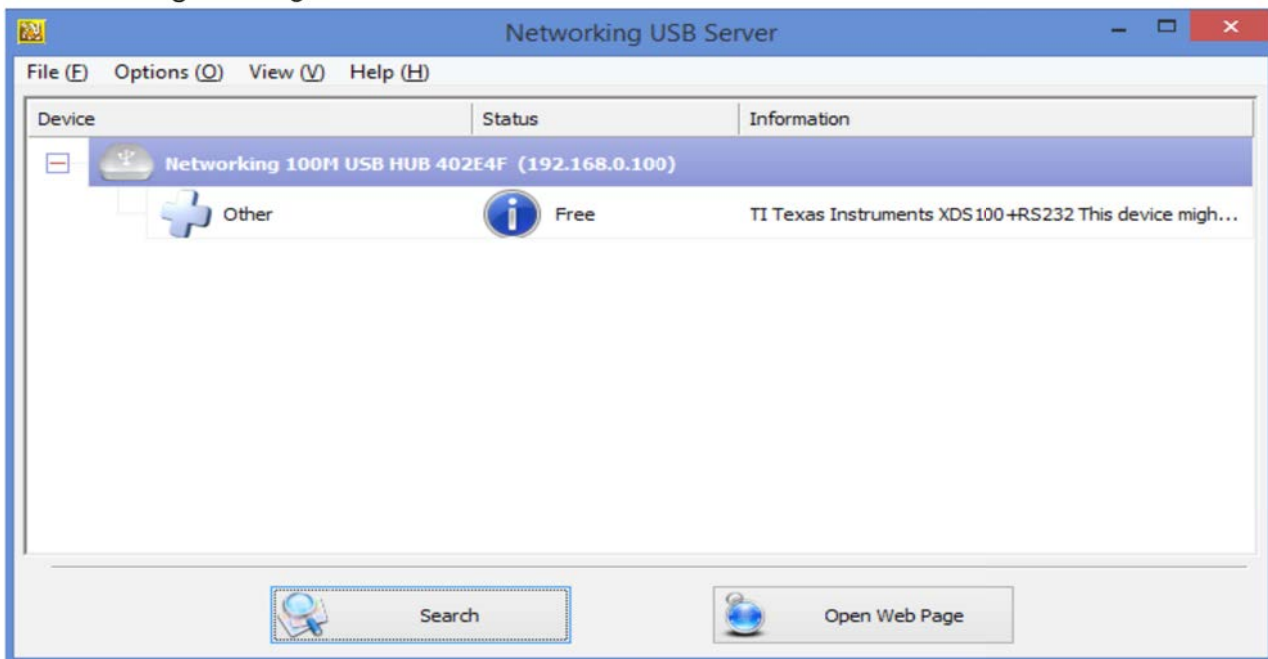## TP-LINK TL-WR702N + Monoprice Networking USB Server

The first step involves connecting the devices as shown above. The TP-LINK device should show up as an available wireless network from the monitoring computer, as shown in Figure 11 below.

**Networks**

View Connection Settings

**Figure 11. Wireless Network Selection.**

Airplane mode

Off

Wi-Fi

On

all TP-LINK_7ADF8E
Limited

Will show as "Limited" if the router does not have Internet connection, which is normal if this is to be a dedicated wireless network.

After connecting to this network, the Monoprice Networking USB Server (NUS) software must be installed.  The NUS comes with a disk for installation.

NOTE:  Software can be downloaded from www.win-star.com, as Monoprice does not seem to provide the software at their site.

Installation of the software will leave a "Launch Networking USB Server" icon on the desktop. Launching this application brings up the Networking USB Server application (NUS App), as shown in Figure 12Figure



12. NUS application showing available USB device.

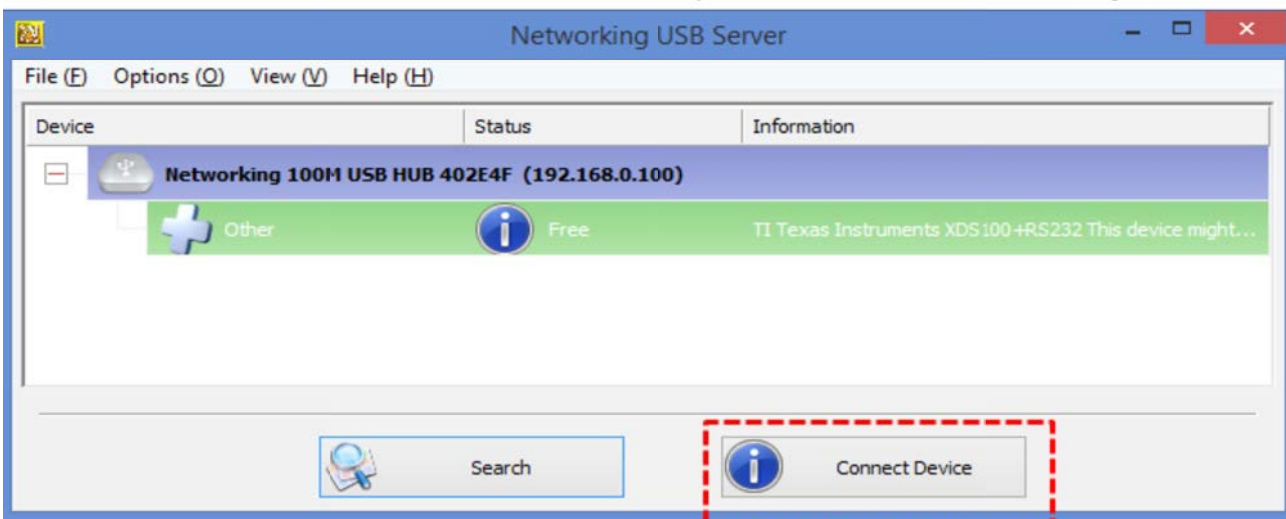Once the device is selected, the "Connect Device" option becomes available.  See Figure 13



Figure 13. "Connect Device" Option.

Once connected, the "Connect Device" becomes a "Disconnect Device" option.  See Figure 14.
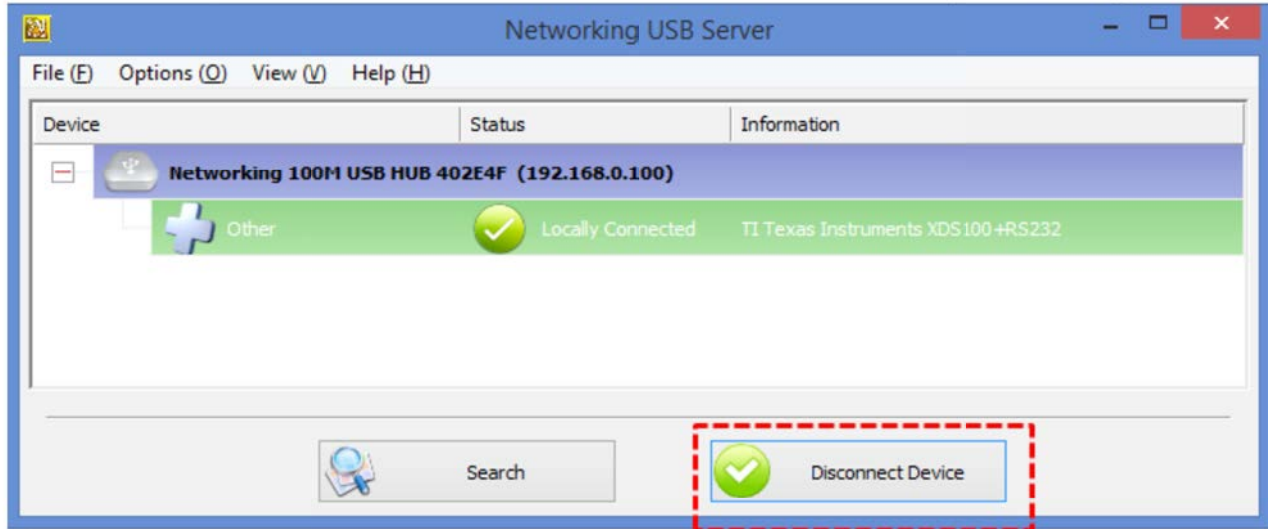


Figure 14. "Disconnect Device" option upon successful connection.

A somewhat hidden feature of the Monoprice/Winstars NUS device is its ability to automatically reconnect upon computer start-up or reboot.  This is enabled by right-clicking on the device within the NUS App and selecting "Connect Device Automatically".  See Figure 15.
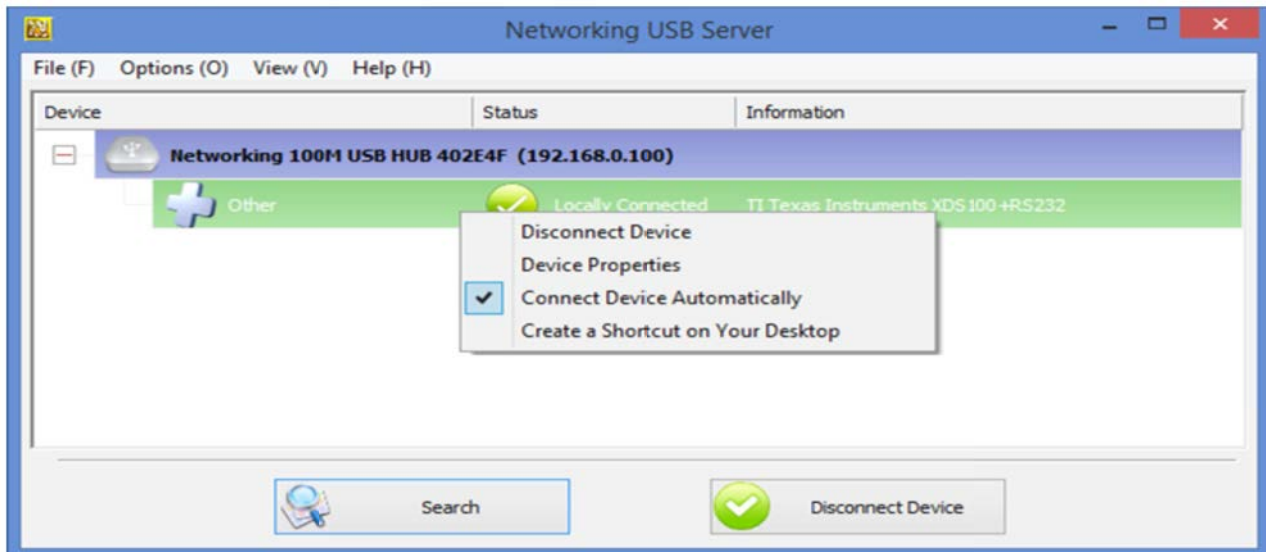


Figure 15. Configuring ILT1000 to Connect Automatically.

After the device is connected, it will show up within Windows Device Manager as USB-to-Serial devices (Figure 16). Up to four ILT1000's can be connected to each NUS device.
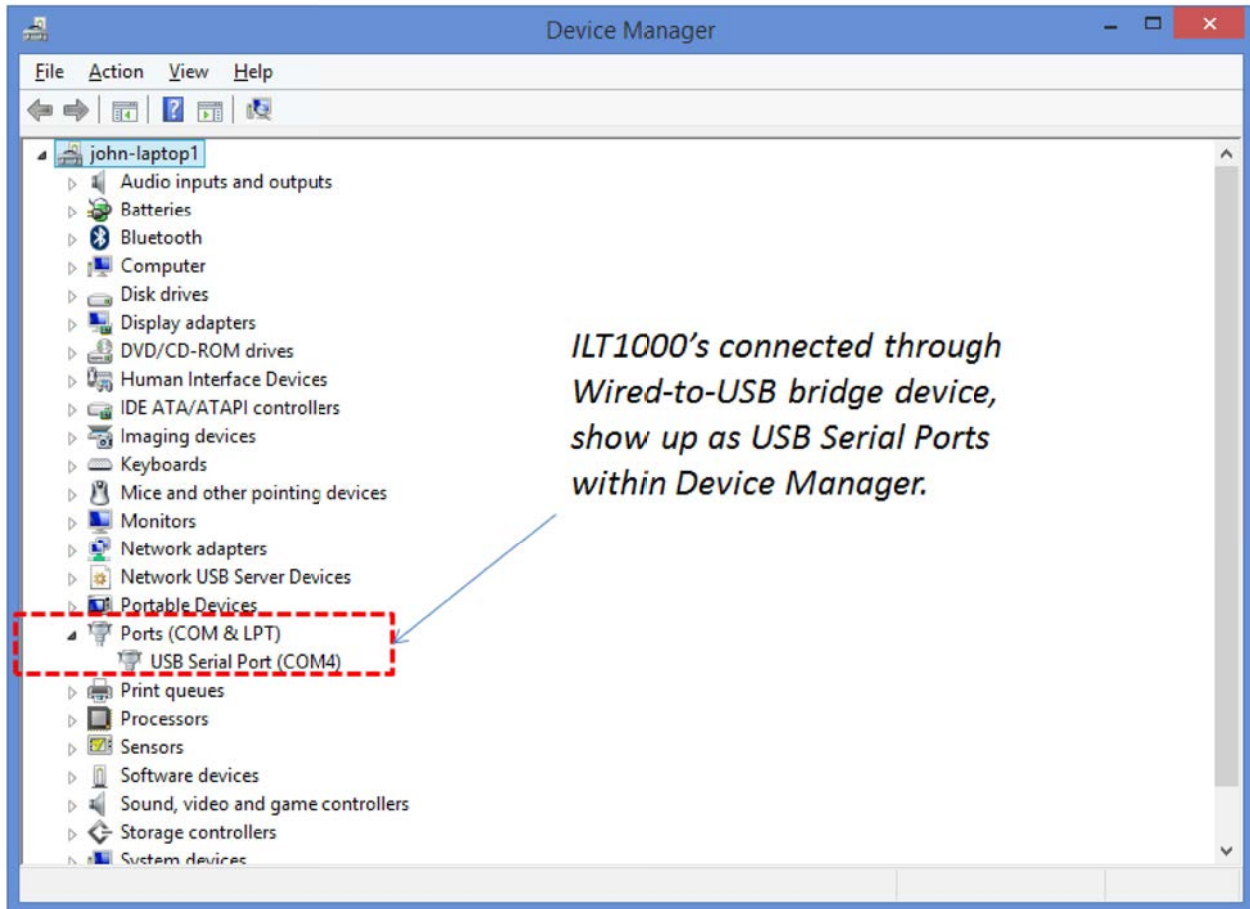
**Figure 16. Windows Device Manager showing ILT1000 as USB Serial Port devices.**

Similar to the Wireless-to-USB Bridge configuration, at this point any of the ILT1000 applications can be run, connecting to the radiometers over the wireless network. All functionality is available, including recording/reporting. Custom applications can also be developed to perform such activities as continuous light-level monitoring with lamp-hour and lamp-outage alerts, delivered via eMail or other mechanisms that integrate with existing safety monitoring systems. While the "FW Update" application can be run, and it was successfully run in this testing, network errors can result in a partially updated device. This might require either getting wired-USB access to the device to load a new firmware image or return of the unit to ILT for service. As a result, if wireless firmware updates are desired or required, extensive testing should be performed in the specific environment.

Results of testing:

Speed

With the Trend program, and a single ILT1000 connected, the device produced 20 readings in 24.6 seconds, or about 1 reading/second.

Wireless Range

Testing wireless range is very dependent on the environment.  In a typical office and light manufacturing environment this solution showed a range in excess of 100 feet / 30 meters.

Error Handling

Three types of error handling scenarios were tested for each of the wireless configurations.  The TL-WR702N results are as follows:

| Error Handling Condition | Result |
|---|---|
| Wireless access point goes out of range | During this testing, a system restart was forced (Windows 8 equivalent of a BSOD) upon leaving the wireless range while accessing the NUS device.  This is likely a driver issue related to use on Windows 8.  Past testing has demonstrated the behavior on Windows XP, but not on Windows 7.  This is likely an issue related to the combination of system, OS-version, and driver.  If the wireless range is lost and re-gained while the NUS device is not being accessed, the restart does not occur.  The workaround is to ensure that wireless connectivity is maintained while accessing the NUS device. |
| Monitoring station/computer returns from power down mode. | With "Connect Device Automatically" is selected (See Figure 15), the ILT1000 is automatically connected when returning from low-power mode. |
| Reboot of the monitoring station/computer. | With "Connect Device Automatically" is selected (See Figure 15), the ILT1000 is automatically connected upon start-up or reboot. |

Summary:

- Pros
  - Works as advertised, with the combination of the wireless router and Ethernet-USB Bridge providing robust wireless-to-USB bridging and supporting the ILT1000.
  - Can be configured to automatically re-connect ILT1000's after reboot and return from low-power modes.
  - Simple installation and setup.
  - 1 reading/second sampling, which is likely good enough for most remote monitoring applications.
- Cons
  - Each Monoprice/Winstars NUS device can handle a maximum of 4 USB devices connected to it.  To expand beyond 4, multiple NUS devices are required.
  - Potential system restart requirement, based on the specific configuration tested, while accessing the USB device when network connectivity is lost.

## Edimax BR-6258n + Monoprice Networking USB Server

The testing for this combination of devices is very similar to the testing of the first Wired-to-USB Bridge configuration above.

The first step involves connecting the devices as shown in Figure 11 above. The Edimax device should show up as an available wireless network from the monitoring computer, as shown in Figure 17 below.



Figure 17. Wireless Network Selection.

The Monoprice Networking USB Server (NUS) software installation and configuration proceeds identically as described above, i.e. as described for use with the TL-WR702N device.

Results of testing:

Speed  With the Trend program, and a single ILT1000 connected, the device produced 20 readings in 24.6 seconds, or about 1 reading/second.

Wireless Range   Testing wireless range is very dependent on the environment.  In a typical office and light manufacturing environment this solution showed a range in excess of 100 feet / 30 meters.

Error Handling   Three types of error handling scenarios were tested for each of the wireless configurations.  The TL-WR702N results are as follows:

| Error Handling Condition | Result |
| --- | --- |

| Wireless access point goes out of range | During this testing, a system restart was forced (Windows 8 equivalent of a BSOD) upon leaving the wireless range while accessing the NUS device. This is likely a driver issue related to use on Windows 8. Past testing has demonstrated the behavior on Windows XP, but not on Windows 7. This is likely an issue related to the combination of system, OS-version, and driver. If the wireless range is lost and re-gained while the NUS device is not being accessed, the restart does not occur. The workaround is to ensure that wireless connectivity is maintained while accessing the NUS device. |
|---|---|
| Monitoring station/computer returns from power down mode. | With "Connect Device Automatically" is selected (See Figure 15), the ILT1000 is automatically connected when returning from low-power mode. |
| Reboot of the monitoring station/computer. | With "Connect Device Automatically" is selected (See Figure 15), the ILT1000 is automatically connected upon start-up or reboot. |

Summary:

- Pros
    o Works as advertised, with the combination of the wireless router and Ethernet-USB Bridge providing robust wireless-to-USB bridging and supporting the ILT1000.
    o Can be configured to automatically re-connect ILT1000's after reboot and return from low-power modes.
    o Simple installation and setup.
    o 1 reading/second sampling, which is likely good enough for most remote monitoring applications.
- Cons
    o Each Monoprice/Winstars NUS device can handle a maximum of 4 USB devices connected to it. To expand beyond 4, multiple NUS devices are required.
    o Potential system restart requirement, based on the specific configuration tested, while accessing the USB device when network connectivity is lost.

Conclusion

The ILT1000's industry-standard USB interface, combined with the many network-to-USB bridging solutions on the market, allows simple, low-cost methods to create wireless light-level monitoring solutions. This capability opens up the possibility for robust, continuous monitoring and alerting, particularly in applications where environmental safety may be compromised by light levels that are either too low or too high.