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Alive on Battery Power
Wireless Industrial Field Instruments

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Introduction

It is quite impressive – installing a wireless, battery-powered field measuring device means not needing to connect power cables, communication wires or signal wires back to a centralized piece of computer equipment. Granted, one still needs to hook-up sensor connections to the instrument, be they wires or mechanical connections, but wireless technology enables quick installation of a device and the addition of measurement points in hard to access areas and remote locations where power and wiring do not exist. Overall, pretty cool, and a nice cost savings due to eliminated wires, cables, junction boxes and the associated labor of installation.

One item of attention with wireless products is their batteries. Typically, batteries are used in wireless devices to supply the necessary power for an instrument to operate. Batteries raise a concern because they don't last forever. At some point in time their energy will be depleted, and they will need to be replaced. Battery life is impacted by the energy consumption required by the instrument to perform its normal operations for processing and converting data, displaying information on local displays, and transmitting/receiving data via its wireless radio. Device battery life is not just impacted by the data transmission update rate settings alone. The variables impacting battery life include:

- Device power consumption for standard operation (i.e., sensor power, data acquisition, conversions, CPU processing, digital output actuation, etc.)
- Initialization connects and re-connects to the system (i.e., system shutdowns, power outages, maintenance disconnect, etc.)
- Communications transmission retries due to poor RF connectivity
- Device radio power level
- Data transmission update rate frequency
- Alarming transmission frequency
- Local display power usage
- System requested polling of dynamic parameters (i.e., radio diagnostics, counters, etc.)
- System activity rate related to operator configuration changes or manual device parameter data requests
- Routing of information from other downstream field devices
- Environmental effects such as operating temperature and humidity
- Battery construction quality, born-on date/shelf time, and storage temperature

Let's take a detailed look at some of the specifics related to the above battery consuming device activities with respect to the Honeywell XYR 6000 wireless transmitter. Typical battery life estimates for this transmitter at nominal operating conditions (25ºC / 77ºF) are:

Update Rate (sec.)	Battery Life Estimate (yrs.)
60	10.0
30	7.8
10	6.0
5	5.1
1	3.3

Data Publication Period (PV Update Rate)

The Data Publication Period of the XYR 6000 should be set to the lowest value compatible with the host application. For example, if the host application polls the PV value of a transmitter once every 15 seconds, then the device should be configured to transmit the PV no faster than once every 10 seconds.

NOTE: Faster data update speeds consume battery power with no significant advantage.

Poor RF Connectivity

As long as the XYR 6000 has a good link to the wireless network, it will only transmit the PV data once a cycle and will increment its "publish success" value each time. However, if the transmitter does not receive an acknowledgement (Ack) from the wireless network following a data publication, then it immediately tries to resend again (first retry). If it does not receive an Ack back, it immediately tries a second time (second retry). If this second retry is not successful, then the XYR 6000 does not increment its publish success value and waits for the next publish cycle to try again.

NOTE: More retries result in the transmitter consuming additional power, and thus these retries reduce battery life. Second retries have the most affect on battery life, as it means the instrument has transmitted a total of three times for each publish cycle rather than just once.

Low publish success rates mean that data are not getting to the wireless network even with retries. Redundant wireless links help to reduce retries as the XYR 6000 will accept the Ack from either link, so even if one link is not working, the published data can still get through via the other link.

Wireless Network Problems

When a transmitter is first given a key or when it losses connectivity to the wireless network, it starts what is called a "discovery process," whereby it searches the airways looking to communicate with nearby wireless network nodes. The discovery process by its nature uses a fair amount of battery power, but normally this process only lasts for about a minute before the transmitter makes a secure connection with the wireless network and starts normal communications. However, if the wireless network is unstable or has poor coverage in the areas where the transmitters are located, then the device can lose connectivity with the wireless network, in which case it will start a new discovery process.

NOTE: If the transmitter is unable to connect to the wireless network, it will continue to retry until it does connect or dies trying. These repeated discovery process operations will consume significant battery life.

If the transmitter continually fails to make a connection with the wireless network, it will gradually back off from discovery attempts so that after 63 hours it will attempt a discovery process only once every 20 minutes, but prior to that time it will be consuming more battery power than it would during normal communications. However, if the wireless system is unstable and periodically drops connections to the XYR 6000, then the clock is reset and the transmitter starts the discovery process from the beginning. This will increase power consumption and reduce battery life.

Dynamic Parameters

A dynamic parameter is any non-PV value that changes frequently. If the user has the host system polling for dynamic parameters or is viewing dynamic parameters via one of the Wireless Builder or user interface screens, then these values are loaded into the cache memory of the gateway. The gateway polls all dynamic parameters in its cache from the transmitters once every 15 seconds.

NOTE: The more parameters that are polled, the greater the affect upon battery life.

After polling or viewing of dynamic parameters ends, these dynamic parameters drop out of cache after two minutes, and the gateway stops polling the transmitter for those parameters.

Temperature Extremes

Temperature changes are important to the performance of batteries and their overall life. Battery life curves vs. temperature are available from the battery manufacturers, and will provide an estimate of the life at various temperatures.

NOTE: Extreme temperatures are detrimental to battery life and can cause as much as a 30% reduction in life for units at -30º C (-22º F) or at 70º C (158º F) ambient temperatures, compared to those at a nominal 25º C (77º F).

Installers should protect transmitters from very hot or very cold processes and consider shading them from direct sunlight.

Digital Outputs

Some XYR 6000 model transmitters (STUW701) provide a digital output. By its nature, when a digital output is turned on it consumes much more battery power than when it is turned off.

NOTE: While a digital output with a 1% duty cycle will have little impact on battery life, a 50% duty cycle will reduce battery life to approximately one year, regardless of the data publication period.

Consider using the +24 V power option if you need the digital output to be on for long periods.

Low Battery Detection

The XYR 6000 battery output voltage is continuously monitored by the internal transmitter electronics, and sent to the host system. This battery monitoring makes it very easy to assess the continuing health of the battery. A "low battery" alarm message is displayed on the integral transmitter display whenever the battery voltage drops below the alarm level. The "low battery" status bit is also communicated from the transmitter to the host system for reporting or alarming on this diagnostic report.

NOTE: Depending upon the publish rate, the XYR 6000 Low Battery alarm provides two to six weeks of warning before the transmitter stops communications. This allows ample time to schedule and replace the batteries of the installed transmitter.

In summary, users seeking to get the most out of batteries used in wireless devices should:

- Select the best PV rate that matches the application requirements
- Ensure good RF communications between devices and gateways
- Try to avoid temperature extremes or minimize environmental effects
- Don't needlessly poll devices for dynamic data or leave the host polling windows open unnecessarily.

More Information

For more information on Honeywell's wireless solutions, visit www.thewirelessplant.com or contact wireless@honeywell.com.

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