

Ultimate Wireless Luber 100

Operational Description

Introduction

The Ultimate Wireless Luber 100 is an automated wireless lubing device that has been built on top of already proven lubing technology. The Wireless luber extends the basic function of a pre-set timing based system, to allow functional monitoring over a wireless link.

System Description

The Ultimate Wireless Luber is an End Device in a portion of a wireless network meant to operate within the 433 Mhz RF Frequency band. Specifically in this current form the device operates on a single channel at 434.375 MHz. The system consists of, in its basic form, an device acting as an Access Point (AP) in a star network, connecting with an RF based monitoring Luber.

All transmissions are initiated in the Ultimate Wireless Luber. The AP devices only respond to messages initiated by a luber device. Status and control messages are only returned (from the AP) to the luber device after a communication has been initiated by the luber. This is done as an ACKnowledge event so that the luber and AP understand a logical connection exists.

While the luber is acting as a non-periodic transmitter, it only transmits at randomly generated (non-predictable) intervals. Upon Luber initiated transmission, the next luber transmission event is performed at some randomly generated time later. It is however within a window of 500 to 800 seconds and sufficiently short enough to guarantee the total transmission time is less than 2 seconds per hour.

The luber does intend to wake up every 20 seconds to perform local status and dispense control; however it does not transmit until some randomly generated interval later than the previous transmission event. The controlling software is intended to have sufficient local control to prevent excessive transmissions within each hour. If the transmission time is approaching a maximum allowable, the luber backs off and skips events until the former hour has expired to begin a new period.

The AP in this system, only serves to acknowledge the logical connection and occasionally return a status or control message. The AP never initiates a status or control message. In fact, the luber mainly sleeps, reducing operating power, only waking to serve local dispense events, or the random transmission event. Therefore the AP would never be aware of when a Luber may be active.

Device (Wireless Luber) Operational Description

The core process for the Ultimate Wireless Luber (UWL) is to dispense lubrication into a fitting by way of a power drive unit turned on at predetermined intervals. Those intervals are set by a series of switch positions contained on the operating device printed circuit board.

The UWL can operate in either RF Wireless mode, or non-wireless mode, based on a switch position setting on the device. The benefit of operating in non-wireless mode is reduced battery usage (ie: no RF transmission), however monitoring would not be available. A site technician would be required to inspect the luber for proper operation and grease level.

In wireless mode, the UWL transmits functional operating parameters and permits remote monitoring. In this mode, remote operators can determine operating temperature, grease level, motor current and other parameters. When an operator assess there is perhaps a need for additive injections of grease, the operator can 'key up' additional injections on the next transmission.

On the next transmission cycle, randomized between 500 and 800 seconds, the UWL will cause a transmission to occur reporting it's current operational status. When the AP responds with an ACKnowledge message, any current updates are embedded within the reply. For example, the reply ACKnowledge may also contain a bit to command the luber to dispense another level of grease.

Package

Each UWL comes with it's battery unattached, switch positions set to Non-RF based, normal operating mode but programmed with appropriate addressing such that it can be utilized in an RF Wireless network. Trained personnel are required for installation, configuration and assurance of proper operating conditions.

Installation

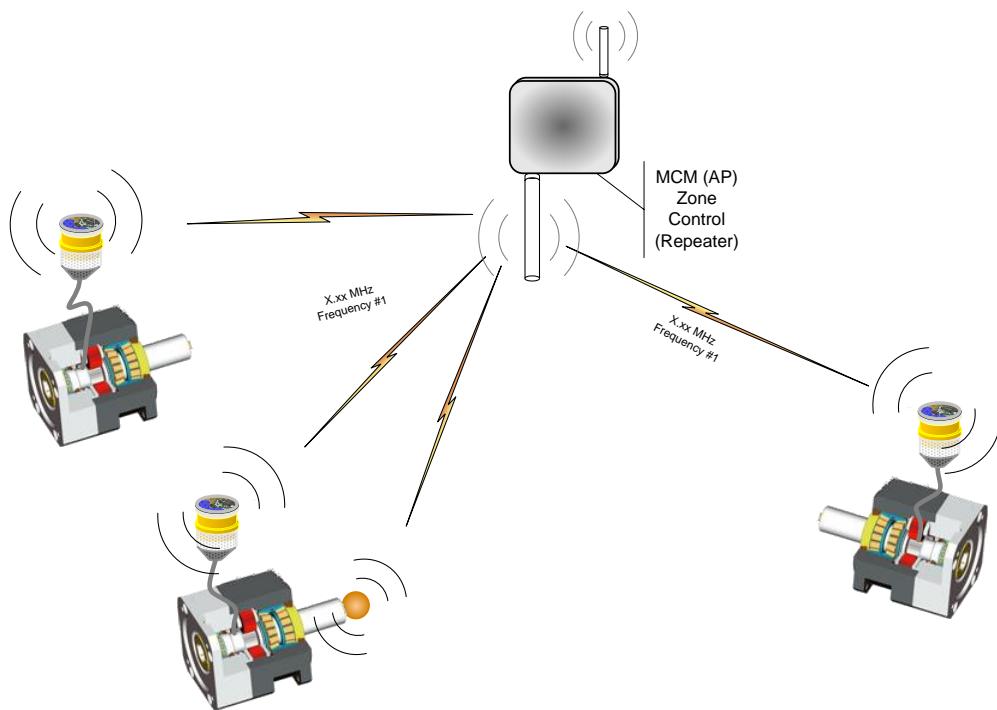
During installation and setup, if wireless mode is to be enabled, the device must run through a series of steps to permit connection with an AP device. Only at this time may the device transmits more information and at intervals less than the normal operating 500 to 800 seconds.

The units are battery powered and have included batteries inside of the casings. In order to activate, or begin operation, the luber's main lid must be un-screwed and the battery connected.

During the installation phase, the UWL after running through some local diagnostics would attempt to establish a connection with an AP device. If an acceptable AP is within range, the UWL will logically connect with it and begin it's normal cycle. The installer is able to monitor this progress and status by observing the 3 available status LED's on the device.

Device as an AP

A device will be used as an AP (Access Point) in a star based network without end devices acting as repeaters. The following diagram shows this in a sample network.



The AP may in some cases be connected to a gateway device for operations on a SCADA or other larger network. However, the primary radio frequency network design will remain the same.

The AP in this system, only serves to acknowledge the logical connection and occasionally return a status or control message. The AP never initiates a status or control message. In fact, the Luber mainly sleeps, reducing operating power, only waking to serve local dispense events, or the random transmission event. Therefore the AP would never be aware of when a Luber may be active

Operation

Once the device has been commissioned by trained personnel, the UWL will enter into a normal operational monitoring mode. Upon power up, the Luber powers on the GREEN LED for approximately 1 second, and then proceeds to cycle through all three LED's at a rate of approximately 1 per second. The sequence goes GREEN-RED-BLUE-RED-GREEN. After this cycle, the Luber powers up the motor, turning the shaft until the shaft count switch has been activated. This is displayed by a GREEN LED flash. After a switch 'hit' has been detected, the Luber then enters operational mode.

Operational mode depends on whether the Luber is operating as an RF device in a network, or as a local device with *no* RF capabilities. The operating mode is governed by the switch settings, primarily SW position #8. If the switch is in the "ON" position, the Luber is operating in RF mode. If the switch is in the "OFF" position, the Luber is operating in manual or local control mode.

As mentioned above, the UWL maintains a low power sleep mode for long periods of time, awaking briefly (~ every 20 seconds) to determine;

1. It's current mode of operation (RF or standalone)

2. If there are any alarming conditions
 - a. Low grease
 - b. Excessive motor current
 - c. Rotation count switch problem
 - d. Internal temperature outside of operational conditions
3. Should a dispense cycle be triggered
4. If in RF Mode, is there a transmission to be initiated.

If there is no dispense cycle, no RF transmission and no alarming conditions, the UWL simply enters back into it's sleep state. Dispense cycles and RF transmissions are independent functions however both states are determined when during the brief period the UWL awakens for operational checks.

Due to increase noise that can occur during a dispense cycle, no RF or wireless transmission are made while the internal grease dispense motor is in operation. Conversely, while sending messages to the AP, no grease dispense cycles are permitted.

While grease dispenses and wake up functions are periodic conditions, wireless transmission is not. When the luber is acting as a non-periodic transmitter, it only transmits at randomly generated (non-predictable) intervals. Upon Luber initiated transmission, the next luber transmission event is performed at some randomly generated time later. It is however within a window of 500 to 800 seconds and sufficiently short enough to guarantee the total transmission time is less than 2 seconds per hour.

The controlling software is intended to have sufficient local control to prevent excessive transmissions within each hour. If the transmission time is approaching a maximum allowable, the luber backs off and skips events until the former hour has expired to begin a new period.

Some functions within the device can be commanded via ACKnowledge reply. Those functions are; dispense (extra cycle) and purge (1 minute dispense cycle). Those commands are embedded within the reply word sent back to the UWL as an acknowledge to it's originate transmission.