

## LB5900 Series Sensor Unattended Operation Guide

LadyBug LB5900 series sensors with option UOP, (Unattended & Autonomous Operation), are capable of fully independent operation. The self-contained, highly accurate, fully calibrated sensor includes a user programmable internal real time clock with backup, a substantial non-volatile memory for measurement storage and a programmable measurement control system. These features are complemented by Just Measure - LadyBug's patented No-Zero No-Cal system that eliminates user calibration requirements.

LadyBug's PMA-12 Precision Power Meter has a set of controls that make using Option UOP quick and easy, for more information, consult the PMA-12 user's guide at [www.ladybug-tech.com](http://www.ladybug-tech.com).

Note: Users wishing to operate Recorder Output in Unattended Mode should consult the Recorder Output for electrical specifications and operation.

### **Applications & Uses**

Unattended Autonomous applications include remote monitoring, unattended analog output applications, transmitter monitoring and triggered warning systems, portable equipment, and defense applications. The sensor is designed for use in automated test equipment as well as isolated usage. The sensor contains a very stable and accurate time base making it suitable for long term monitoring as well as short term applications.

Measurements can be triggered by the sensor's internal control system, the external TTL trigger input, by power level or by user established pass fail settings. Once setup, the sensor only requires power to operate autonomously. Sensor setup for option UOP is accomplished using LadyBug's PMA-12 software application. Setup can also be accomplished programmatically through any of the sensor's communication mechanisms. The LB5900 programming guide should be consulted for additional detail about using UOP programmatically.

Measurements are stored in the sensors non-volatile memory. Once triggered, data can be collected and stored at up to 1,000 averaged measurements per second. A typical LB5900 sensor is capable of storing over 50 million measurements in non-volatile memory. Storage capacity should be confirmed with the specific sensor's data sheet.

### **Sensor Option Compatibilities**

UOP is compatible with most sensor options, however certain options, such as Option MIL are incompatible in one or more ways. Option MIL prohibits user writes to non-volatile memory and therefore UOP cannot be used. Option SPI (SPI and I2C interface), is compatible with Option UOP; however the programmer should be aware of the potential volume of data that could be returned from the sensor. Please consult the factory prior to ordering Option UOP with SPI. Option 001, Recorder Output, is compatible with UOP, however, Recorder Out has priority regarding its update rate and requires UOP to adopt certain settings. This includes storing measurements at Recorder Out's update rate. Triggering is included with LB5900 series sensors and is compatible with UOP.

## **Sensor Power**

The sensor can be powered by a USB power only cable; or if it is equipped with option SPI it can be powered through the SPI connection. A USB battery pack of sufficient capacity may be utilized. Do not exceed the sensors upper voltage limits. In general, sensors require 5 volts with specifications similar to USB 2.0. Power requirements should be confirmed using the specific sensor's datasheet.

Brown out conditions can occur under certain conditions such as a battery powered system running for an extended period of time. Above 4.6 volts the sensor will operate normally, at a point below 4.6 volts the sensor will reset. Further, when operating from a battery, the battery voltage may increase when the sensor resets and removes its load. This could potentially repeat for many cycles. Note: Voltages should be confirmed in the sensors data sheet.

## **Functionality**

Option UOP has three basic states of operation, Off, Basic and Reset. PMA-12 software manages these states and commands using buttons and dropdown menus. When UOP mode is set to Off, the sensor functions as if the option were not installed. When UOP is active, USB, SPI or I2C activity should be avoided and will result in lost data. Only the mode commands should be sent during this time.

**Basic Operation** is designed to assure maximum functionality with minimum setup. Once active and powered up, the sensor will collect measurements until memory is full at which time it will stop making measurements; it will not overwrite memory. When UOP is active, the LED will flash green at one second intervals; a red LED indicates that memory is full. *Basic* operation uses the sensor's current measurement setup for measurement parameters. Simply setup the measurement and set UOP mode to *Basic*. PMA-12 examples are shown below.

When active, the sensor will make and store measurements whenever power is applied. If power is removed and restored at a later time, the sensor will simply start appending additional measurements. Measurements are stored in memory pages containing multiple measurements. To protect data, the sensor will store pages that are not full every 5 minutes if any measurements are present. Therefore, pages may not be full when retrieved.

All measurements are stored sequentially in memory on a real-time basis. It should be noted that if power is lost for a period of time sufficient to cause the real-time clock to reset, the last time stamp could be earlier than the first time stamp. The sensor returns an index number; time stamp; measured power and some other parameters for each measurement.

**Measurement Storage.** A Page of stored data contains 250 measurements. The sensor stores the page when 250 measurements are available. If the user is making triggered measurements or has set the measurement rate in a way that takes a relatively long period of time to make 250 measurements, some measurements may be lost if power is removed. To mitigate this issue, the sensor will store any available data once every minute. In such cases. The page will contain measurements as well as null data to fill the space. Additional measurements will be stored on the next page.

### **The collected data**

Once the data collection operation is complete, re-connect the sensor to a computer and set the UOP is halted. LadyBug's Precision Power Meter can be used to download the data to a file. Data is stored in files in CSV (Comma Separated Values) form. Data can be retrieved in various sizes for download time convenience. Large files may take a significant amount of time to download. The CSV files can be opened in Excel or other programs for review. Programmatically, data can be retrieved using the SCPI RBACK command. Consult the programming manual for further information.

Once memory is full, no additional data may be appended until the memory is cleared. Data remains in the sensor until UOP active mode is set to RESET. This clears the sensor's entire measurement memory and once complete, automatically sets the UOP active mode to *off*. Command buttons are included in LadyBug's PMA-12 application for this and other functions.

### **Stabilization time**

When UOP is active, the sensor will begin logging measurements as soon as it is powered up. It is highly likely that measurements will be made and stored prior to the sensor reaching stability. These measurements will be stored normally, however the collected data will include a column that indicates that the sensor was not fully stable when the measurement was made. Refer the sensor's data sheet for the warm-up time.

### **Glossary**

Note: Default values are listed for guidance purposes and may vary by instrument

Averaging - (default≈10ms). The process of taking the average of 1 or more samples.

Detector Mode - Mode of the detector that is sampled by the analog to digital converter.

Average - (default) General purpose measurements refer to data sheet for settling time.

Normal - Faster measurements, refer to data sheet for video bandwidth.

Triggering - The process of establishing the beginning of a measurement

Trigger - An event that starts a measurement. Modes are:

Continuous (default) Triggers are issued continuously, or is always active.

Immediate (default) No trigger delay is utilized .

Trigger Hold-Off (default=0) A time that prevents additional triggers from occurring.

Trigger Delay (default=0) Delays (seconds) the measurement after the trigger occurs.

UOP Mode - The state of the UOP module. Modes: Off, Basic, Advanced or Reset.

SCPI - Standard Commands for Programmable Instruments, the sensor's instruction set

Option MIL - Sensor security option that controls non-volatile memory access

Option SPI - Sensor communication option. Direct connection via I2C and SPI

Recorder Out - An option that provides a scalable calibrated voltage output representing power

## Unattended Measurement Examples Using PMA-12 Software

### **Example requiring no setup**

Since Unattended operation uses the sensor's current setup and the default trigger mode is continuous-immediate, the sensor will begin storing measurements "out of the box" when unattended mode is activated. You should set the frequency to match your signal. Measurements will be stored at the completion of each averaging cycle, no Latency timer is activated (described in the PMA-12 manual). Default detector type is average, averaging time (and resultant storage rate) is approximately 10 ms (Default settings for your specific sensor should be verified in the sensors data sheet).

Step 1 – Click *Preset Normal* to clear any existing setup.

Step 2 - Set the frequency and set averaging (if desired).

Step 3 - In the *Mode* dropdown, select UOP.

Step 4 - Click the *In Start UOP* button.

The sensor will begin collecting measurements.

You can connect and reconnect the sensor several times or connect it to power only.

Step 5 - Click the *In Stop UOP* button when finished storing measurements.

Step 6 - In the UOP dropdown sensors tab, select retrieve data to download measurements.

## Using Recorder Out in Unattended Mode

If both Option UOP (Unattended Operation) and Option 001 (Recorder Output) have been installed, a calibrated 0 to 1 volt analog output can be obtained from the sensor while operating in Unattended Mode. Care must be utilized if the output is used to control other equipment.

During the power up cycle when UOP is active, Recorder Output will exhibit voltage transitions from 0 volts to 5 volts until the sensor's processor is running. After stability; and prior to measurement, the output will be at 1 volt (into its specified 1000 ohm load); after the sensor begins normal operation, the output will be stable and is updated 1000 times per second. Depending on the sensor model, firmware version and the number stored measurements, time to stability can be up to 20 seconds.

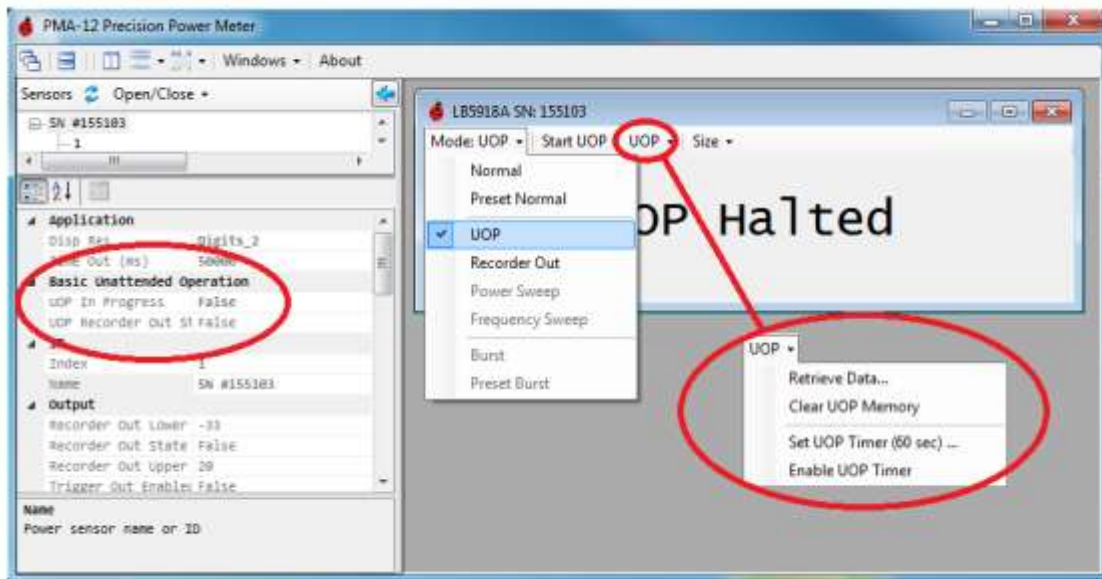


Figure 1 - Recorder Out in Unattended Operation

To protect equipment that may be controlled by Recorder Out, the default condition for Recorder Out when returning from power up is always OFF unless specifically set otherwise, this includes power up in Unattended Operation. To enable Recorder Out for use while the sensor is operating in Unattended Operation mode, a special function must be set. This parameter, *UOP Recorder Out State*, is circled at left in Figure 3. When set to True, Recorder Out will function while the sensor is running in Unattended Mode. The parameter can only be changed when the sensor is operating in Normal Mode (Figure 3 middle, Mode). While the sensor is in UOP Active (In progress) the function will remain set and the sensor can be repeatedly power cycled without losing the Recorder Out during UOP state. If the sensor is powered up while UOP is not active, *UOP Recorder Out State* will be cleared to FALSE and Recorder Out will not operate in Unattended Operation unless the parameter is set again.

### Unattended Recorder Out Example

To enable Recorder Out while in Unattended Operation, perform the following.

1. Set the sensor to Preset Normal and set your Frequency
2. Set Recorder Out Upper and Lower Limits (See Recorder Out section for info)
3. In the Sensor Window, Under the Mode Dropdown, Set the mode to *Recorder Out* (Figure 3 middle)
4. Verify Recorder Out functionality
5. Under the Mode Dropdown, Set the mode back to *Normal* (Figure 3 middle)
6. Under *Basic Unattended Operation*, set *UOP Recorder Out State* to True (Figure 3 left)
7. In the Sensor Window, Under the Mode Dropdown, Set the mode to *UOP* (Figure 3 middle)
8. In the Sensor Window, Click Start UOP
9. Recorder Out becomes active
10. Remove and Reconnect power several times to verify
11. Connect to the computer, select *Halt UOP*, set Mode to *Normal* & *UOP Recorder Out State* to *False*