
Engineering Note

Topic: JAZ-PX Lamp Module
Product Affected: Jaz
Date Issued: 08/27/2010

Description

The Jaz PX lamp is a pulsed, short arc xenon lamp for UV-VIS applications such as absorbance, bioreflectance, fluorescence and phosphorescence. The lamp has a specified pulse frequency of 200 Hz (maximum 500 Hz) and spectral response from 190 – 1100 nm.

The JAZ-PX module operates in both free running and triggered modes, allowing its pulses to coordinate with other devices in the Jaz stack. Flash-to-flash stability is typically 1% CV at 200 Hz. (CV is defined as the standard deviation of 20 samples divided by the mean of 20 samples.) The module contains an SMA connector to couple to other Ocean Optics accessories such as optical fibers, cuvette holders, probes, etc.

The JAZ-PX is ideal for field applications such as bioreflectance that require a high -intensity, low-power UV-VIS light source. In fact, no external power supply is required to operate the JAZ-PX. When used in battery power mode in the field, the lamp will operate from the power of the battery for approximately 3 hours. Additional power is available through an optional 50 Watt-hour Jaz battery extender (item JAZ-EXT-BP50WH). See [Battery Considerations](#) for more information.

Jaz-PX System Overview

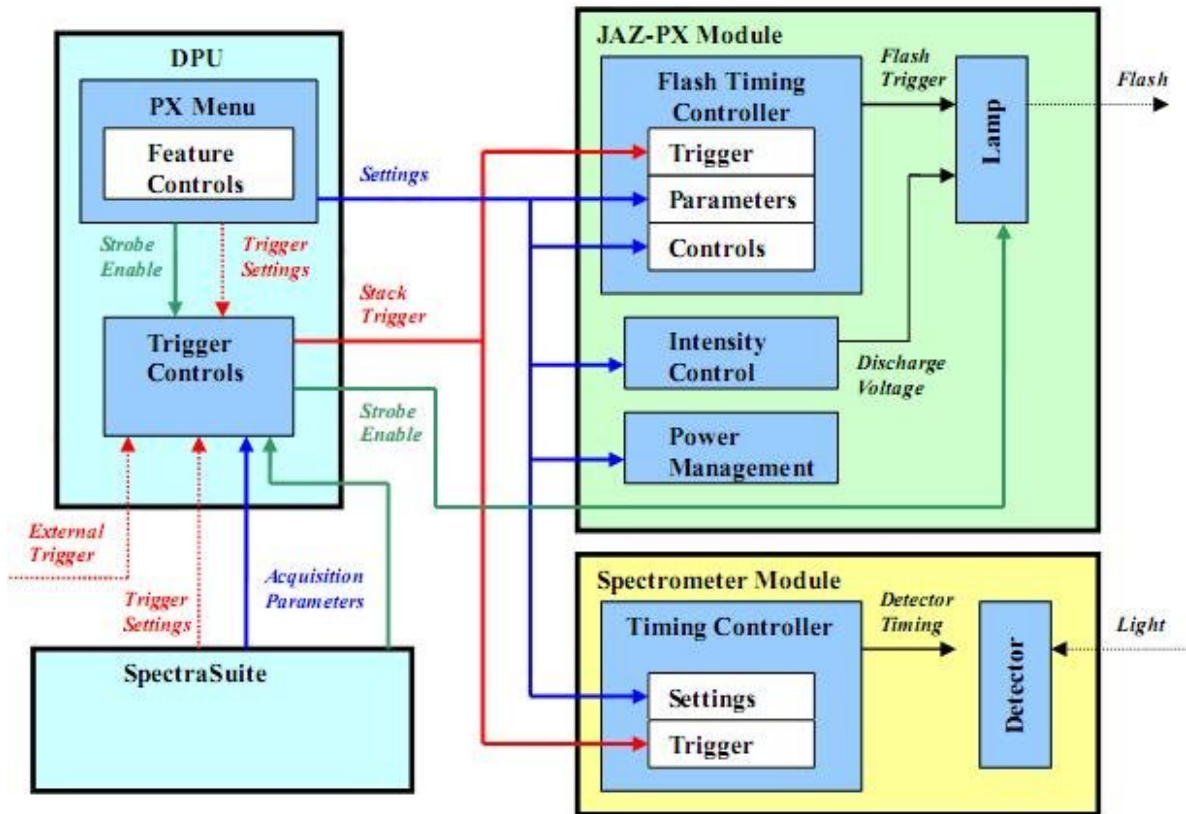
The user can interact with Jaz either directly through the DPU or indirectly via SpectraSuite (see the simplified JAZ-PX functional block diagram shown below).

With SpectraSuite, the user sets triggering parameters, toggles Strobe Enable, and synchronizes these events to a specific spectrometer channel. These parameters are passed from SpectraSuite into the DPU and then subsequently to the PX module itself.

When interacting directly with the Jaz through the DPU interface, the PX parameters are set using the PX Lamp menu and then subsequently passed to the JAZ-PX module. At the module level, the JAZ-PX accepts as inputs a trigger signal (Stack Trigger), the Settings of the Features, and the Strobe Enable signal. The combination of the Settings and Stack Trigger govern the frequency and intensity of the xenon flash. The Strobe Enable signal provides the ability to enable and disable the lamp flashes without altering the Settings.

JAZ-PX Lamp Module

Jaz can be run on either external or battery power. Therefore, the JAZ-PX module was designed with a power management subsystem (Power Management) to ensure stable lamp behavior at all battery charge levels. Power Management can be set to Battery Power or External Power mode. In Battery Power mode, the default mode, the JAZ-PX is restricted to 400V Intensity and flash rates <math><200\text{ Hz}</math> (5 ms).



Triggering

The Jaz PX lamp is a pulsed xenon light source, and in many spectroscopic applications the flash timing is extremely important. To make the JAZ-PX both easy to use and extremely flexible, the module includes a configurable internal timing generator capable of generating the high precision lamp trigger. The timing generator has two basic operating modes:

- Free Running Mode
- Triggered Mode

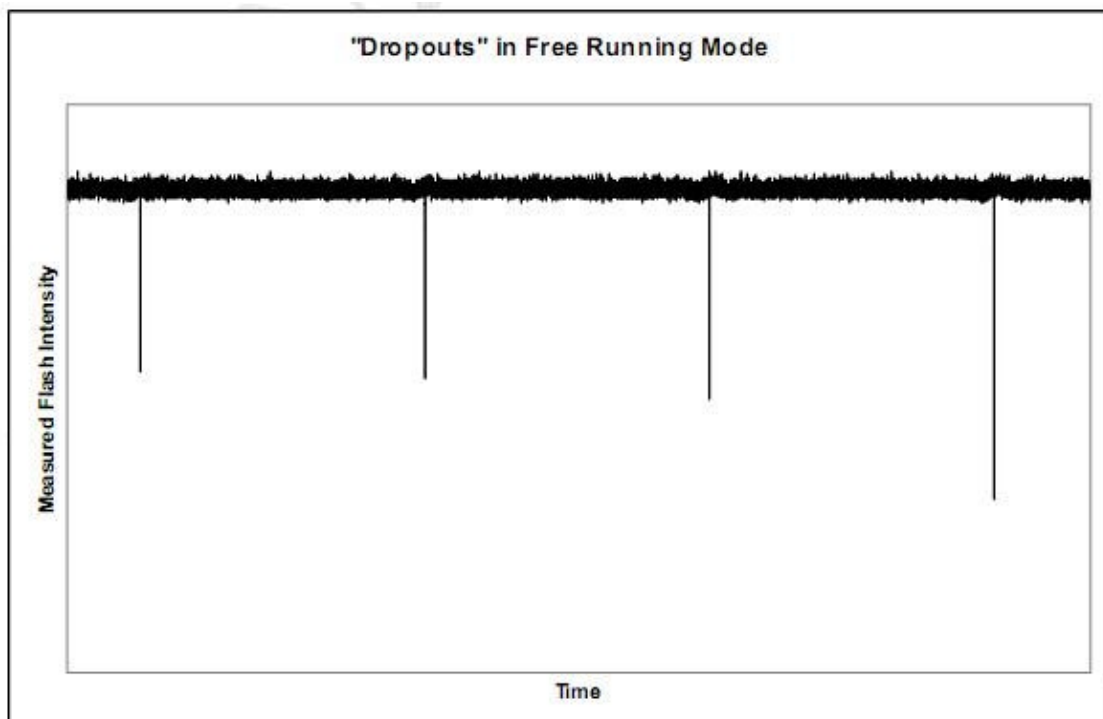
Free Running Mode

Free Running mode is the simplest mode of operation and is suitable for most users, but there are some drawbacks to running a spectrometer and pulsed light system asynchronously. When the integration time is larger than the flash frequency, each integration period will collect light from multiple pulses, increasing the amount of light that is measured. Therefore, the more pulses per integration period, the more light is collected. Users generally try to adjust the integration time and flash rate parameters to produce a suitable amount of light for their application. This approach is simple and works well when the integration period is much larger than the flash period.

In Free Running mode (Free Running Enabled), the module will ignore all trigger events and simply flash at the frequency specified in the Flash Rate menu. It will ignore any triggers, forced or external and is not synchronized with any other timers, spectrometers, or modules. Free Running mode can be selected in the PX Lamp | Setup | Timing Controls | Free Running menu by setting this option to Yes.

The drawback of operating in Free Running mode is that as the difference between integration period and flash period gets smaller, the lamp's pulses may not be evenly distributed across integration periods. This condition can produce unstable measurements of light levels. For instance, if the spectrometer's integration time is set to 20 ms and the flash period is set to 15 ms, then consecutive periods would receive either one flash or two flashes and the measurement would appear to bounce up and down. An additional drawback is that even when using the same flash rate and integration period, a flash may occur during the period of indeterminate exposure between integration periods, resulting in periodic integration cycles which do not register any light at all. Due to this effect, it is recommended that you operate the JAZ-PX lamp in Triggered mode when possible.

The following figure shows a strip chart with the undesirable "dropout" effect that is observed the spectrometer module and the JAZ-PX module are not synchronized. Dropouts occur when the PX flash happens to fall in between the spectrometer's integration periods.



Triggered Mode

In Triggered mode (Free Running disabled and Run Forever disabled), the following events occur in the timing generator:

1. A trigger event occurs.
2. The lamp enters a “holdoff” period.
3. The lamp flashes immediately and continues to flash at the rate specified by the Flash Rate parameter. The number of flashes that it asserts after each trigger is determined by the Number of Flashes parameter set via the Jaz menu.
4. Once the lamp has asserted the specified number of flashes, it will stop flashing until the next trigger event is detected.

Trigger Sources

The JAZ-PX module has two potential sources of trigger events:

- **Jaz stack trigger** – can be configured to be driven by the internal source or an external source (System Tools | Triggering | Trigger Source). To register trigger events from the stack trigger, the trigger must be enabled (PX Lamp | Settings | Controls | Trigger Enable) and the device must not be in Free Running mode.
- **Forced trigger** – available from PX Lamp | Settings | Controls | Force Trigger. Selecting **yes** from this menu will cause a trigger event, even if Trigger Enable is not on – but not if the device is in Free Running mode.

Run Forever Mode

When the Jaz PX is not in Free Running mode and the Run Forever control is set to enabled, the device is said to be in Run Forever mode (Free Running Disabled and Run Forever Enabled). In this mode, the device operates in exactly the same way that it does in Triggered mode, except that it ignores the Number of Flashes parameter setting and continues to flash forever. The difference between this mode and Free Running mode is that it will restart its trigger-holdoff-flash sequence whenever it detects a trigger event. In other words, the timing generator re-syncs its continuous timing to the trigger signal. This behavior is extremely useful when keeping many elements of a timed system synchronized.

Spectrometer Behavior in Hardware Trigger Mode

A spectrometer can be set to Hardware Trigger mode via DPU menus or via Spectrasuite. In the DPU menus, this is selected from Spectroscopy|Module x|Tools |Synchronization|Trigger|Mode|Hardware. In SpectraSuite, the trigger mode can be selected as **External Hardware** from the Trigger Mode dropdown box in the menu bar when the spectrometer’s graph is active.

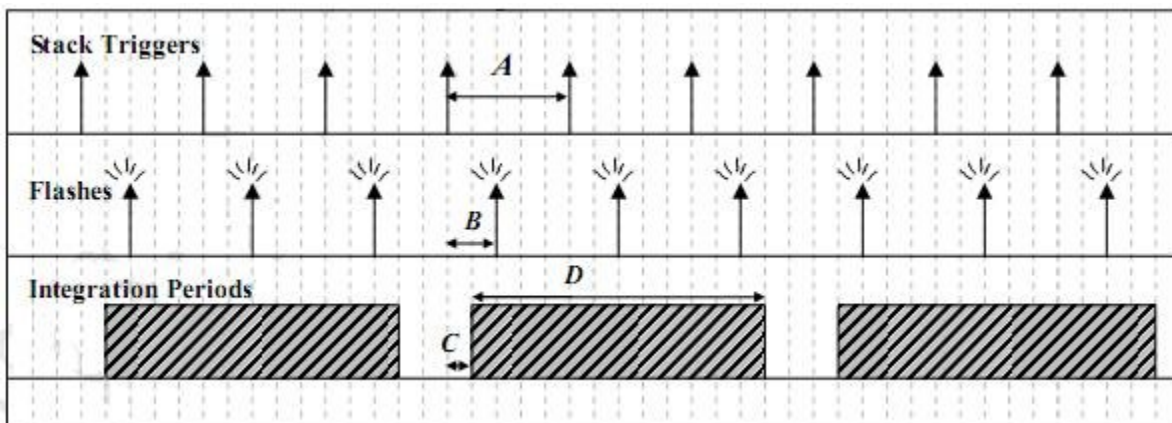
When the spectrometer is in Hardware Trigger mode, it will wait for a stack trigger event before starting an integration period (the stack trigger can come from either an external trigger or the DPU’s internal trigger generator). When the spectrometer detects a stack trigger, it will begin an integration period with the duration specified by its **Integration Time** parameter. It will ignore subsequent stack trigger events until the integration time has completed.

This behavior can be used to synchronize the PX to the spectrometer. By setting the PX to flash once per stack trigger and the spectrometer to operate in Triggered mode, the flashes and the integration periods become synchronized. No matter what the integration time is set to, the number of flashes per period is constant and “dropouts” should not occur.

The figure below shows an example of timing parameters with a spectrometer in Hardware Trigger mode and the JAZ-PX in Triggered mode (Free Running and Run Forever Controls disabled). Suppose that the scale is 1 ms per division. In this case, the settings for this graph would be as follows:

- Stack trigger period (usually driven by the DPU internal trigger) generator frequency: 5ms (*A*)
- PX holdoff time: 2 ms (*B*)
- Spectrometer trigger delay: 1ms (*C*)
- Spectrometer integration time: 12 ms (*D*)

In this example, you can see that each integration period will collect 3 flashes of light.



Setting Up a Triggered Experiment

The following is a general procedure for setting up an experiment with the JAZ-PX module and a spectrometer module being synchronized. More detailed operating instructions can be found in the [Jaz Installation and Operation Manual](#).

► Procedure

1. Select the “internal” timing generator as the source of the stack trigger instead of the external trigger pin.
2. Set the internal timing generator frequency. This will be the flash frequency.
3. Set the PX lamp’s holdoff time.
4. Set the PX lamp’s Trigger Enable control to enabled and be sure that its Free Running control is disabled.

5. Set the PX lamp's Output Enable control to enabled. The lamp should start flashing.
6. Set the spectrometer's trigger delay (optional)
7. Set the spectrometer's integration time.

Timing Reset

The timing reset is available from PX Lamp | Settings | Timing Controls | Timing Reset. A timing reset event causes the counters in the JAZ-PX to reset. This can be useful when you want to reset the timing controller. For instance, if you erroneously set the Number of Flashes parameter to 1000 with a period of 5 seconds and then did a force trigger, you would have to wait approximately 15 hours before the lamp stopped flashing. A timing reset stops the flashing immediately without turning off the unit.

After a Timing Reset, the timing controller will immediately begin flashing at the specified rate when it is in Free Running mode, and it will wait for a trigger event to begin flashing.

Intensity Control

The JAZ-PX has an intensity control to adjust flash intensity. Between flashes, the lamp charges a high voltage capacitor and then discharges that capacitor to power the flash. The intensity of each flash is dependant on the voltage of that discharge capacitor. The intensity control works by adjusting this discharge voltage from 400V to 600V. The intensity can be set in the PX Lamp | Setup | Parameters | Intensity menu. By default, the intensity is set to 400V. To use intensities above 400V, the unit must be operating in External Power mode.

Strobe Enable /Disable

The strobe enable/disable (output enable/disable) feature allows you to quickly stop the lamp from flashing. This feature can be used to maintain lamp life, and take reference and dark measurements. Disabling the output simply prevents the lamp from flashing. It does not turn the module off or reset any parameters.

Battery Power Operation

Battery Power / External Power

As part of the Jaz suite of modular instruments, the JAZ-PX can be run on either external power or battery power. Due to power supply limits of the Jaz battery module, the intensity and flash rate parameters have been restricted during battery power operation to reduce power consumption and ensure proper lamp operation. Unfortunately, the Jaz does not have the inherent ability to detect whether or not external power is present in the system and the unit defaults to the more restrictive Battery mode at startup. To override these restrictions, you must manually select to External Power Mode by navigating to PX Lamp | Settings | Advanced Settings | Power Mode.

The restrictions are as follows:

- External Power Mode – the maximum intensity value = 600V and the maximum flash rate is 500 Hz (2 ms).
- Battery Power Mode – the intensity can not be set higher than 400V and the maximum flash rate = 200 Hz (5 ms). You will not be able to enter values that exceed these maximums, and if you switch from External Power to Battery Power, the JAZ-PX module will automatically adjust the parameters to their maximum allowed values.

Notes

It is possible to set the Jaz PX module to External Power mode (Advanced Settings | Power Mode | External Power) even when it is not plugged in. However, this is not recommended since your device can experience lamp instability at low battery levels and/or high flash rates. Additionally, the high power consumption of the lamp can even affect the performance of other modules in the Jaz stack. If you want to use the higher power settings off of battery power, you may want to purchase the Jaz Battery Extender, which plugs into the DPU power supply jack.

The JAZ-PX module includes its own external power jack for future development. This jack is currently not connected to the hardware and will not power the unit.

Battery Considerations

Jaz does not have the inherent ability to detect if external power is present in the system and the unit defaults to the more restrictive Battery Power mode at startup. The restrictions are as follows:

- External Power mode: the intensity is selectable in the range 400 to 600 V and the maximum flash rate is 500 Hz (2 ms).
- Battery Power mode: the intensity is restricted to 400 V and the maximum flash rate is 200 Hz (5 ms).

The user will not be able to enter values that exceed these maximums. If the user switches from External Power mode to Battery Power mode in the Power Mode menu, the device will automatically adjust the parameters to their maximum allowed values.

Note

Although it is possible to put the device into External Power mode even when the device is not plugged in, it is not recommended. Doing so may cause lamp instability at low battery levels and/or high flash rates.

Additionally, the high power consumption of the lamp can also affect the performance of other modules in the Jaz stack. Users who want to use the higher power settings off of battery power should purchase the Jaz Battery Extender (JAZ-EXT-BP-50WH), which plugs into the DPU power supply jack. Additionally, it is important to note that even when the strobe enable is off, the lamp must continue to be powered. As a result, even with strobe enable off, the JAZ-PX module draws power (comparable to a spectrometer module). Hence, including a PX module in a Jaz stack will cause a decrease in battery life, even when the lamp is not flashing.

Low Battery Monitor

The Jaz PX module includes an undervoltage monitor to prevent operation at battery voltages that are too low for reliable operation. When the monitor detects an undervoltage condition, it will immediately stop flashing the lamp. It will not start flashing again until after the module has been restarted (usually by turning off the system).

Characteristics

Testing Conditions (unless otherwise noted):

- Flash rate: 200 Hz
- Intensity: 400 V
- Triggered Mode (1 flash per period)
- Ambient laboratory temperature (~25 °C)

JAZ-PX Lamp Characteristics					
Parameter	Units	Min.	Typical	Max.	Notes
Flash rate	Hz	--	--	200	
Spectral range	nm	190	--	1100	
Optical Stability	CV	--	1%	--	The coefficient of variation (CV) is defined here as the standard deviation of 20 samples divided by the mean of 20 samples. Stability and intensity may decrease at frequencies above 200 Hz
Warm up	Flashes	--	10	--	
Lamp life	Flashes	10 ⁸	5 X 10 ⁹	--	Number of flashes before intensity is reduced to 50%. Lamp behavior not characterized by lamp life.
Jaz battery life	Hours	--	3	--	Operating the lamp on battery power at frequencies above 200 Hz or intensities above 400 V may result in unexpected behavior from the JAZ-PX module and may affect other modules in the stack.
Operating temperature	°C	0	--	55	Lamp intensity may drift approximately 5% over operating temperature.

JAZ-PX Typical Lamp Performance

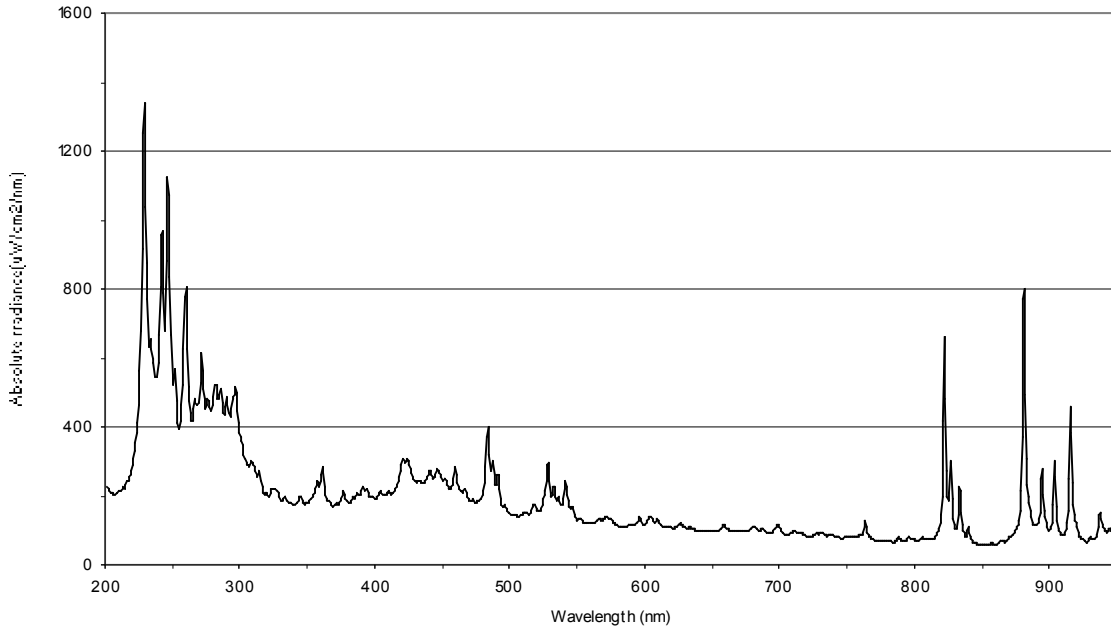


Figure 1 -Typical Lamp Flash Spectrum at 100 Hz

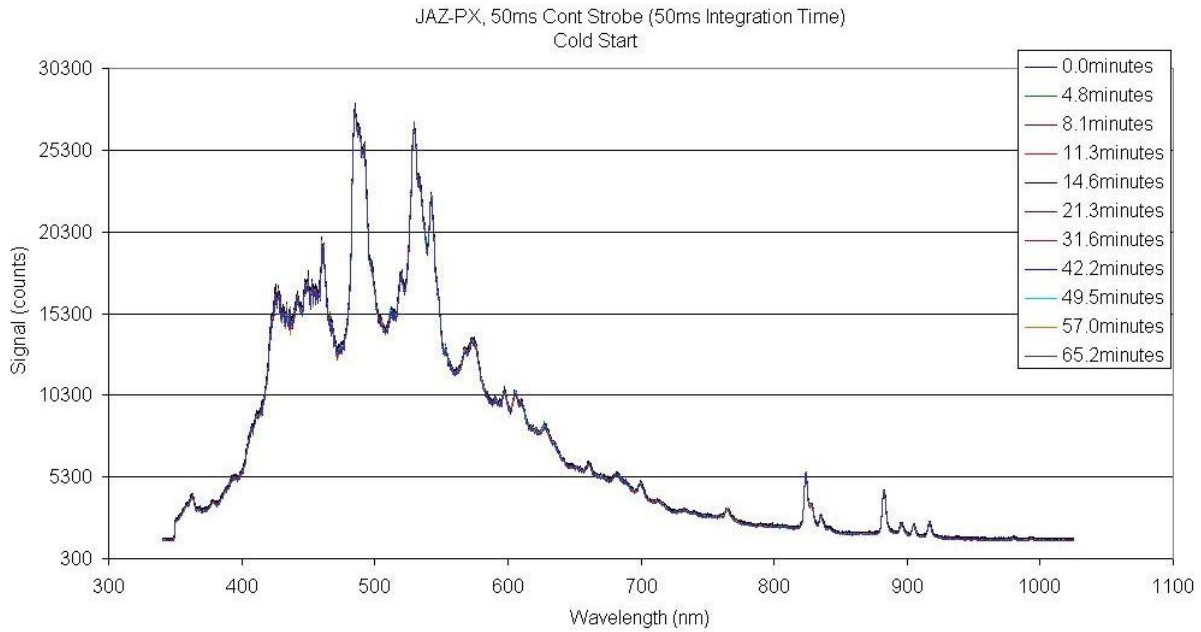


Figure 2 – Continuous Strobe (50 ms Integration Time) Cold Start (Wavelength)

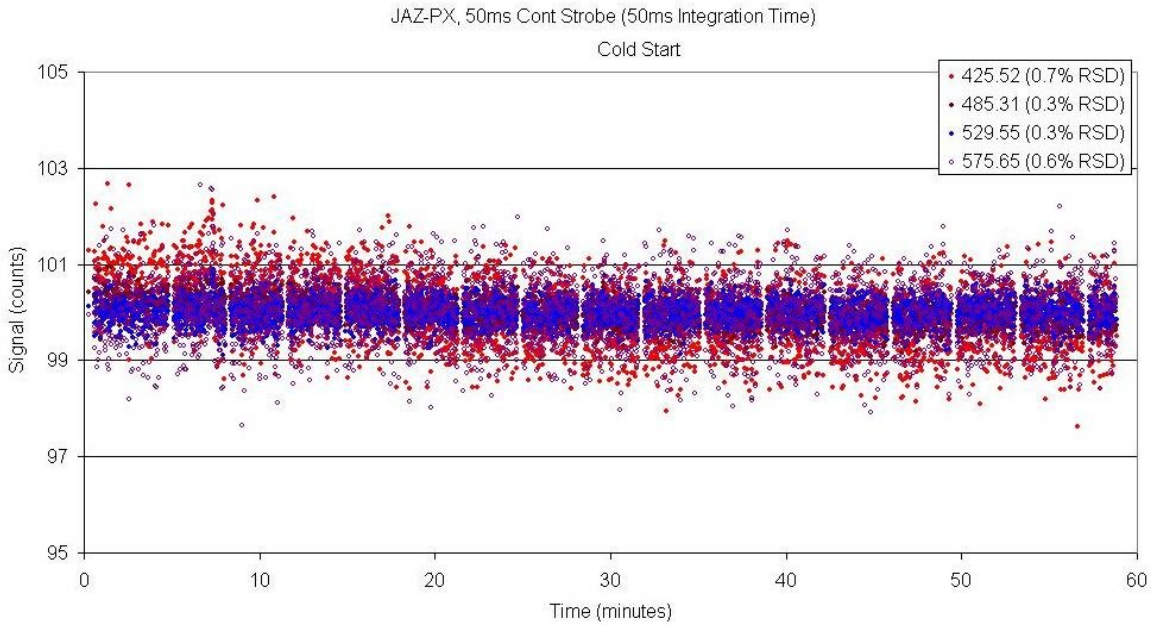


Figure 3 – Continuous Strobe (50 ms Integration Time) Cold Start (Time)

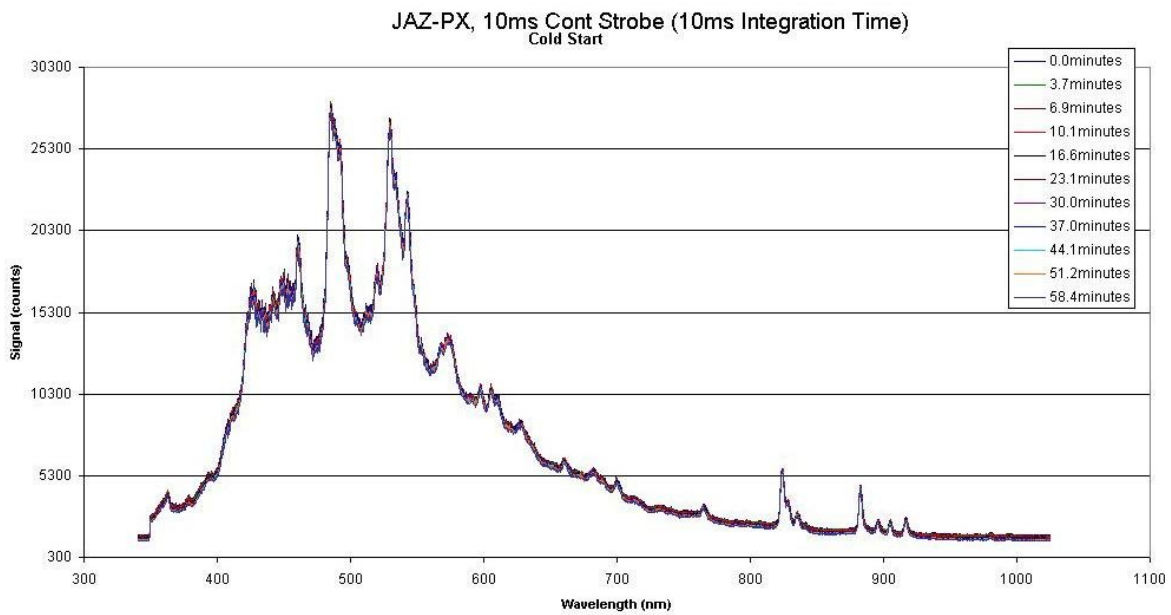


Figure 4 – Continuous Strobe (10 ms Integration Time) Cold Start (Wavelength)

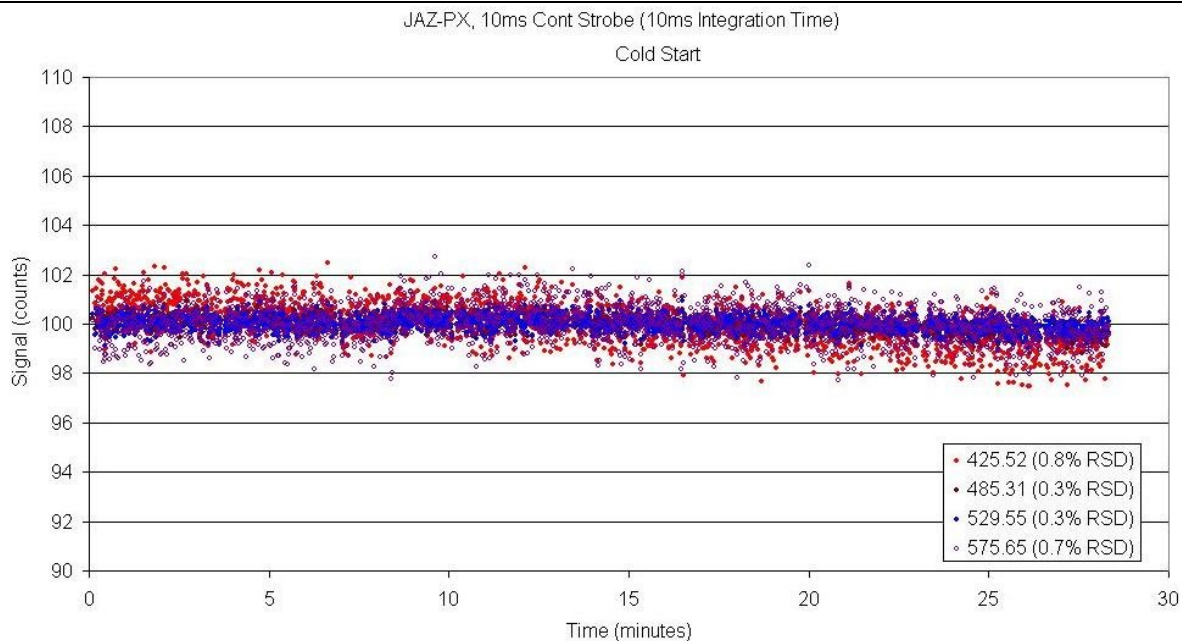


Figure 5 – Continuous Strobe (10 ms Integration Time) Cold Start (Time)

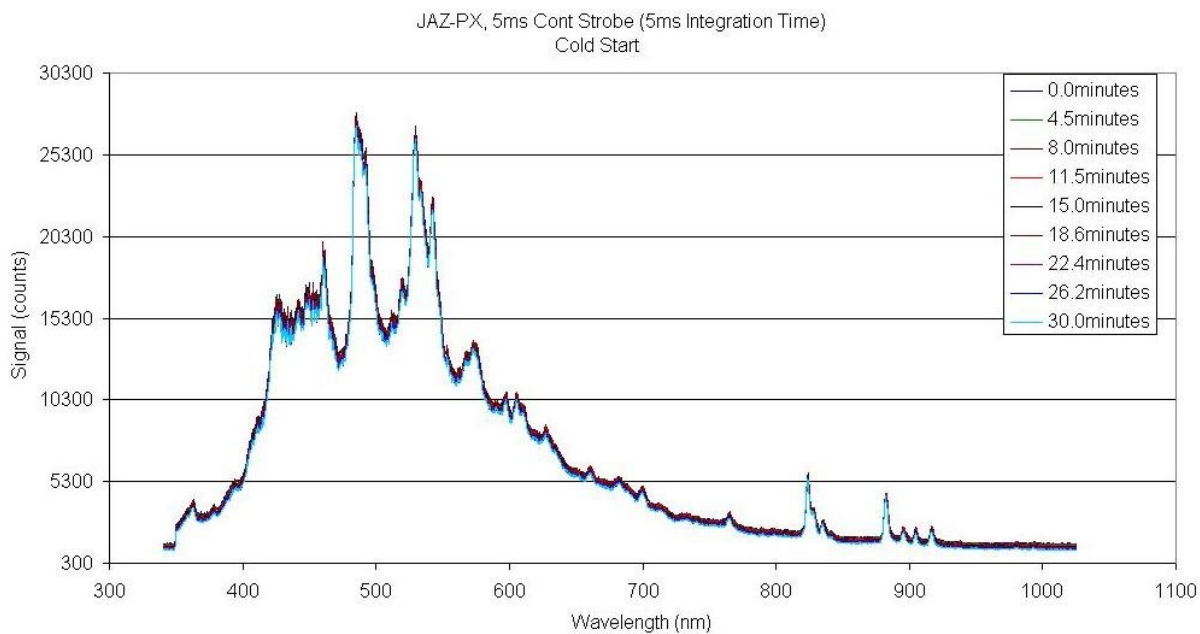


Figure 6 – Continuous Strobe (5 ms Integration Time) Cold Start (Wavelength)

Thermal Considerations

Although it has been designed to use less power than its predecessor (the PX-2 Light Source), the JAZ-PX lamp still dissipates enough power to warm up gradually over time. Since the JAZ-PX does not include a fan and the Jaz metal housing has high thermal conductivity, heat generated by the JAZ-PX will be conducted to other modules in the stack. These effects are most prevalent in applications with long term, continuous operation of the JAZ-PX at moderate to high flash rates. For short-duration experiments, these thermal effects are not as prominent.

The spectrometer module is especially sensitive to heating, so you should be aware of the effects of heating on spectrometer modules when setting up an experiment. Most significantly, heating a spectrometer module will cause that spectrometer's baseline (the measured intensity when it is not exposed to light) to drift downwards. The unfortunate effect of this is that once the baseline has drifted beneath zero, negative values will be interpreted by the DPU software as the saturation value (65,535). Hence, areas of a measurement that receive very low light levels may be interpreted as saturated. In order to mitigate the heating effects of the JAZ-PX lamp (or any other sources of heat for that matter), users should adjust their spectrometer modules' autonulling coefficients to increase the baseline. The drawback to increasing the autonulling baseline coefficient is a slight reduction in the dynamic range of the spectrometer's measurements, but this will not be a significant concern for most applications.

► Procedure

To adjust the spectrometer autonulling coefficients,

1. If you do not already have the USB Programmer, download it from:
<http://www.oceanoptics.com/technical/softwaredownloads.asp>.
2. Plug the spectrometer into the USB port.
3. Open the USB Programmer and select **File | Unlock Features**. A new window opens.
4. In this window, type **UNLOCKALL**, then click **OK**.
5. Go to Jaz Devices and expand the menu.
6. Double-click on **Jaz - JazXXXX** (your spectrometer's serial number). On the right-side window, many lines of information will be displayed.
7. Double-click on **AutoNulling Info** at the bottom of the screen. A new window will open.
8. In the new window, check the **Auto Nulling Enabled** box.
9. Decrease the **Dark Value @25C** by 2000, then click **OK**.
10. On the top menu bar, click **Save All Values**.
11. Close the program.
12. Unplug your Jaz for 10 seconds.