

SPM 30035 Series Quick Start Experiment Guide

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This document will assist a new user of SPM detectors to make observations and measurements that will verify that the detector is set-up and functioning correctly. The experiments below yield results that could be useful in the set up of the users own experiment and illustrate some of the important characteristics of the device. Since this document is focused on the practical side, the user may find it beneficial to download the “*Introduction to SPM*” document from the SensL website which explains the theory behind the results that will be observed here.

The SPM should first be set up as per the instructions given in the *User Manual* that arrives with the detector. This will cover the various connections and power supply settings required. In all cases, the experiments require the detector to be biased at +2V above breakdown.

These experiments are suitable for the following detectors:

Mini-30035
MicroSL-30035

1. Observation of Mains Frequency in Fluorescent Lighting

Here the SPM will be set up to make a very simple observation - that of the inherent modulation in the photon flux from fluorescent lighting due to the mains frequency. Since most laboratories have fluorescent lighting as standard, the equipment list is very short and simple and should be within the reach of anyone in possession of an SPM detector.

Equipment List

- SPM detector with amplifier and power supply (see *SPM User Manual*)
- Signal cable with appropriate connectors
- Oscilloscope
- Semi-translucent material (such as a sheet of thin paper)
- Some completely opaque material or container to shield the SPM from ambient light
- A source of overhead fluorescent lighting

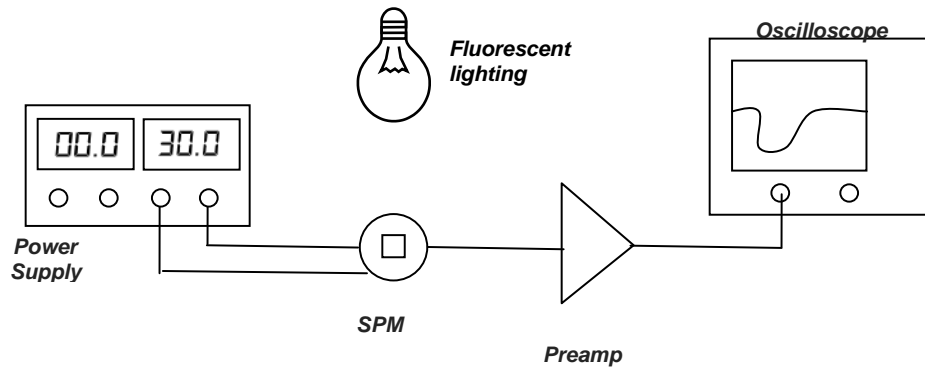


Figure 1, Experimental arrangement

Set-up

- Using Figure 1 as a reference, connect the cable to the output socket on the SPM preamp and then to the oscilloscope (set to 50Ω input)
- Connect the power supply leads to the power supply
- Cover the SPM with the opaque material, so that it is shielded from ambient light
- Power on the SPM and amplifier
- Switch on the oscilloscope, and set the scales to 1V and 5ms.

Observations

- Locate the SPM signal on the oscilloscope. While the SPM is powered but not exposed to light, the signal should be at or close to 0V. Its exact position will depend on the type and size of SPM, and therefore its dark current.
- The SPM is NOT damaged by exposure to ambient light and so the opaque material/cover can now be removed and the signal on the oscilloscope should saturate at some level close to 2V. This shows that the detector is light sensitive and connected properly.
- If there is fluorescent lighting available, the mains frequency should be visible within the light source. Turn off any other sources of light if possible. The overall light level arriving at the SPM will need to be reduced in order to avoid saturation. To do this, cover the SPM with a sheet of paper or other thin, semi-translucent material, one layer at a time until the characteristic frequency is revealed in the signal, as in Figure 2. With each layer, the voltage scale on the oscilloscope will likely require adjusting.
- The observed frequency will be 120Hz in the US and Canada (where the mains frequency is 60Hz) and 100Hz in most of the rest of the world (where the frequency is 50Hz). This is because there is a light emission peak from the fluorescent light for each peak and trough of the AC mains cycle.

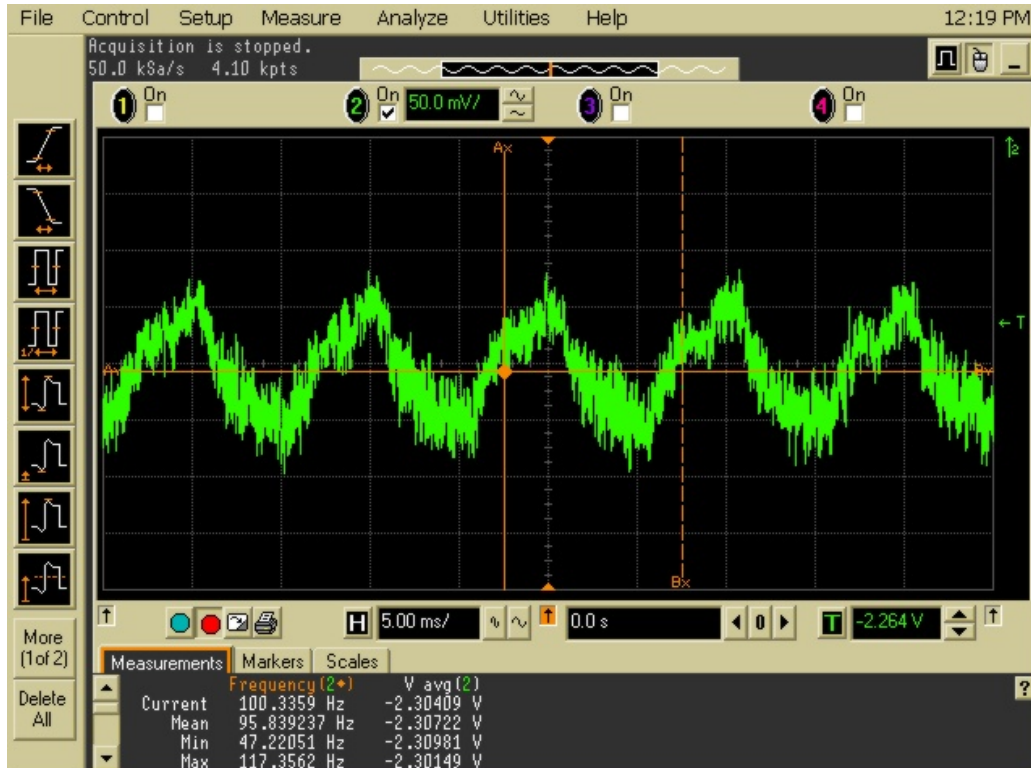


Figure 2, Screenshot of the photon modulation from fluorescent lights at 100Hz, as detected by a MicroSL-30035

2. SPM Dark Counts

This experiment will guide the user through the steps to observe the SPM's dark counts. If a dark room or dark box is available, this demo would be best performed there.

Equipment List

- SPM with amplifier and power supply (see *SPM User Manual*)
- Signal cable with appropriate connectors
- Oscilloscope
- Some completely opaque material, container or cover to shield the detector from ambient light.

Set-up

- Figure 1 can be used as a set-up reference, although for this experiment, there is no need for the fluorescent lighting – In fact, ambient lighting should be reduced as much as possible.

- Connect the cable to the output socket on the SPM amplifier and then to the oscilloscope (set to 50Ω input)
- Connect the power supply leads to the power supply
- Switch on the oscilloscope, and set the scales to 5mV and 200ns, and the triggering threshold to 2mV
- Turn off all ambient lighting and cover any bright lights from instrumentation etc
- Power on the SPM and amplifier

Observations

a) Dark counts

Find the SPM signal on the oscilloscope. It should be close to 0V but with many pulses occurring randomly in time. These are the dark pulses from the SPM and constitute the detector's noise. Figure 3 shows the dark pulses for two 3mm detectors.

The majority of the pulses should be at a uniform level (typically a few mV – specific values can be found in Table 1 below). This level can sometimes be more easily observed if the time scale is increased to $1\mu\text{s}$. The pulses at this first level are referred to as the 'singles' and are due to thermally generated electrons causing an avalanche in a single microcell.

In addition to these small pulses, there will be other pulses of greater amplitude. By gradually raising the threshold control the oscilloscope will start to trigger on these higher level pulses. It should be seen that all other pulses are some exact multiple of the amplitude of the singles – these higher signals are referred to double, triples and so on and are due to cross-talk between microcells. An example is shown in Figure 3. The origin of the dark counts and the cross-talk is explained in the SensL *Introduction to SPM Application Note*.

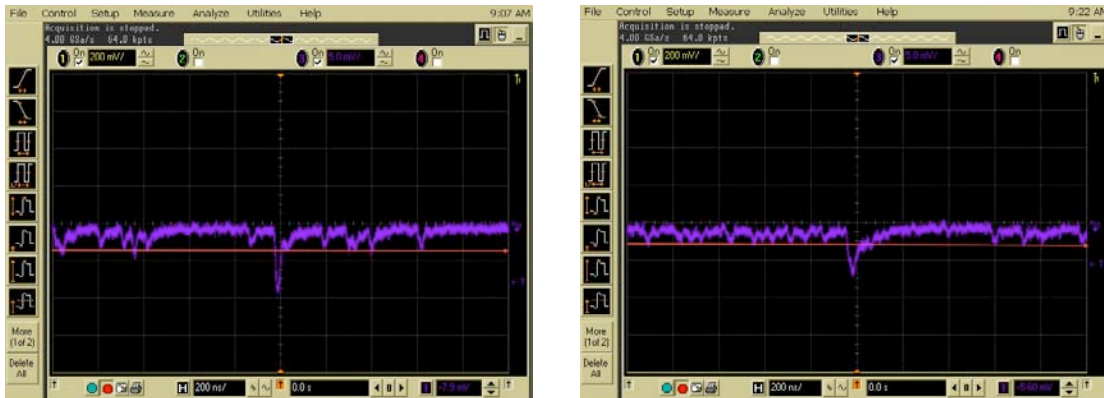


Figure 3, dark counts from a MicroSL-30035 (left) and a Mini-30035 (right) at a time scale of 200ns. The level of the 'single' pulses is marked with a red line.

b) Dark Count Rate

Most oscilloscopes have the ability to count pulses and give an average rate. This can be used to measure the dark count rate of the SPM. The threshold should be placed at half of the height of the singles pulses. If the SPM is at the nominal bias voltage ($V_{br} + 2V$) then this measured dark count rate should match that given on the datasheet, reproduced in Table 1 below.

TABLE 1 – typical pulse height and dark count rates for different SPMs
*All values are specific to operation at 2V above the breakdown voltage

Detector type	Pulse height*	Dark count rate*
MicroSL-30035	2.5mV	3MHz
Mini-30035	3mV	270kHz

More Help

If more help is required in the set-up and operation of SPM detectors, there are several SensL resources that can help.

- *Introduction to SPMs* provides an over-view of the SPM, how it works and how different parameters are affected by different settings. This is available from the website.
- The *User Manual* which arrived with your detector. This will detail how the SPM should be set up.
- The SensL website www.sensl.com . This has downloadable versions of application notes that may help in the set up of the SPM for various applications.
- If further help is needed, please contact support@sensl.com