BROADCOM®

White Paper

Sensitivity Calibration with Broadcom Spectrometers

Introduction

Spectrometry involves the measurement of the intensity of light, and it is important to ensure that the spectrometer provides accurate results. In this white paper, we discuss the process of sensitivity calibration of our Qmini, Qwave, and Qneo NIR spectrometers.

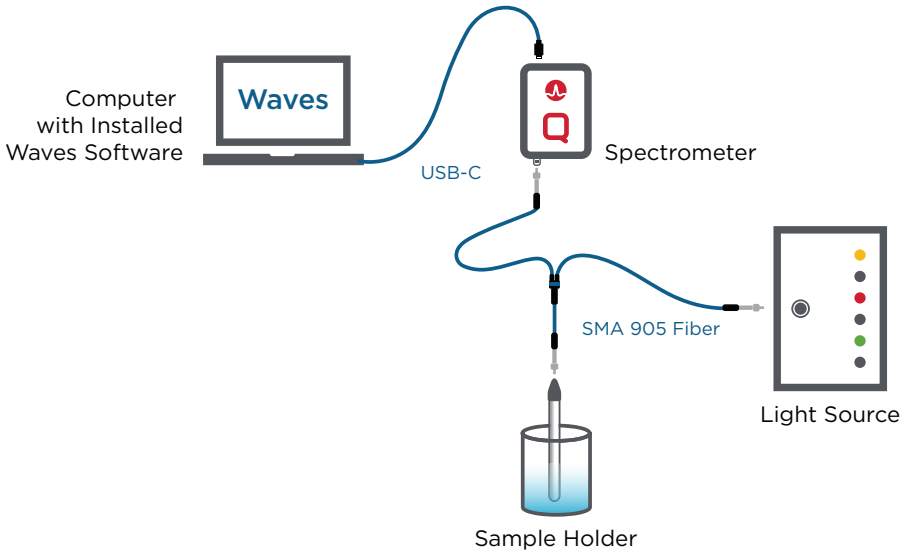
All our compact spectrometers are calibrated individually in production for wavelength, sensitivity, nonlinearity, and dark spectra, which are stored in the internal memory of each device.

Like all spectrometers, the sensitivity of a spectrometer is not uniform across the spectrum but depends on the wavelength. This is called *spectral sensitivity* and can be corrected by dividing each value of the spectrum by the corresponding sensitivity. When the sensitivity is corrected, the noise level is unevenly distributed across the spectrum.

Sensitivity calibration is a process that determines the response of a spectrometer to different light intensities. The purpose of this kind of calibration is to ensure that the spectrometer produces accurate and repeatable results for different samples.

NOTE: We always recommend a full system calibration, including all optical components that you are going to use in your application.

Figure 1: Measurement Setup



How to Calibrate Broadcom Spectrometers with Our Free Waves Spectrometer Software

Calibrating Broadcom spectrometers involves the following tasks:

- Prepare the Setup
- Calibrate the Spectral Sensitivity
- Calibrate the Absolute Scale of the Intensity Axis
- Verify the Calibration

Prepare the Setup

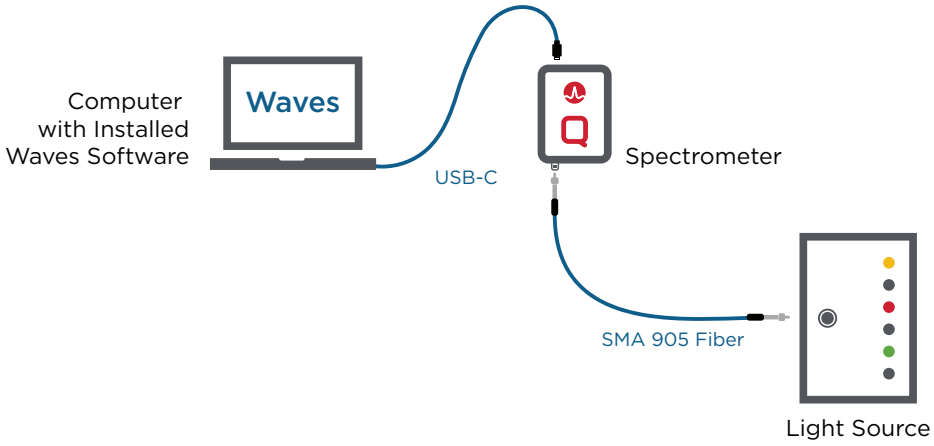
To perform a sensitivity calibration with the Qseries spectrometers, you need a broadband light source (such as a tungsten halogen or deuterium lamp) that covers the spectral range of the spectrometer, and you need a spectrum file that contains the actual spectrum for this lamp.

Depending on the required optical setup (such as using a fiber or a collimator), place the spectrometer in front of the light source at a distance where the spectrum data is valid, or connect the fiber between the light source and the spectrometer.

Setup 1: Direct measurement with a free beam setup. Requires an aperture optic, such as a cosine corrector or a collimation lens.

Setup 2: Fiber setup used in this white paper.

Figure 2: Calibration Setup

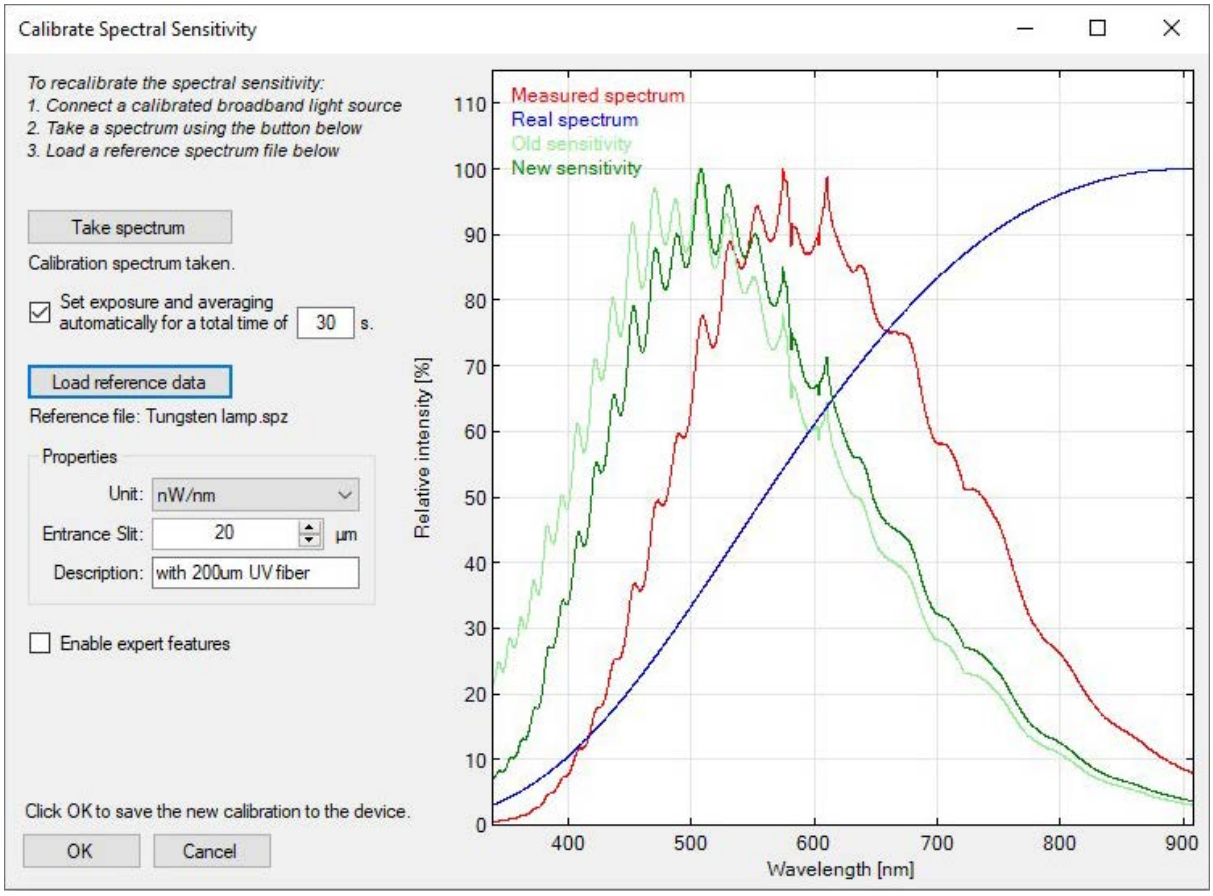


Calibrate the Spectral Sensitivity

After opening a connection to the spectrometer in the Waves software, choose **Calibrate Spectral Sensitivity** from the **Calibration** menu. Click **Take spectrum**.

To get best results, we recommend activating the automatic exposure and averaging detection. After the spectrum has been taken, click **Load reference data** to load the spectral reference data of the used light source.

Enter the physical unit of the y-axis of the corrected spectra along with a description.

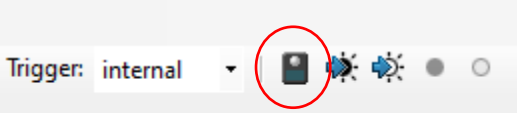


Based on the measured spectrum and the reference file, the software calculates the spectral sensitivity of the spectrometer and shows it as a dark green line.

To save this new calibration to the device, click **OK**.

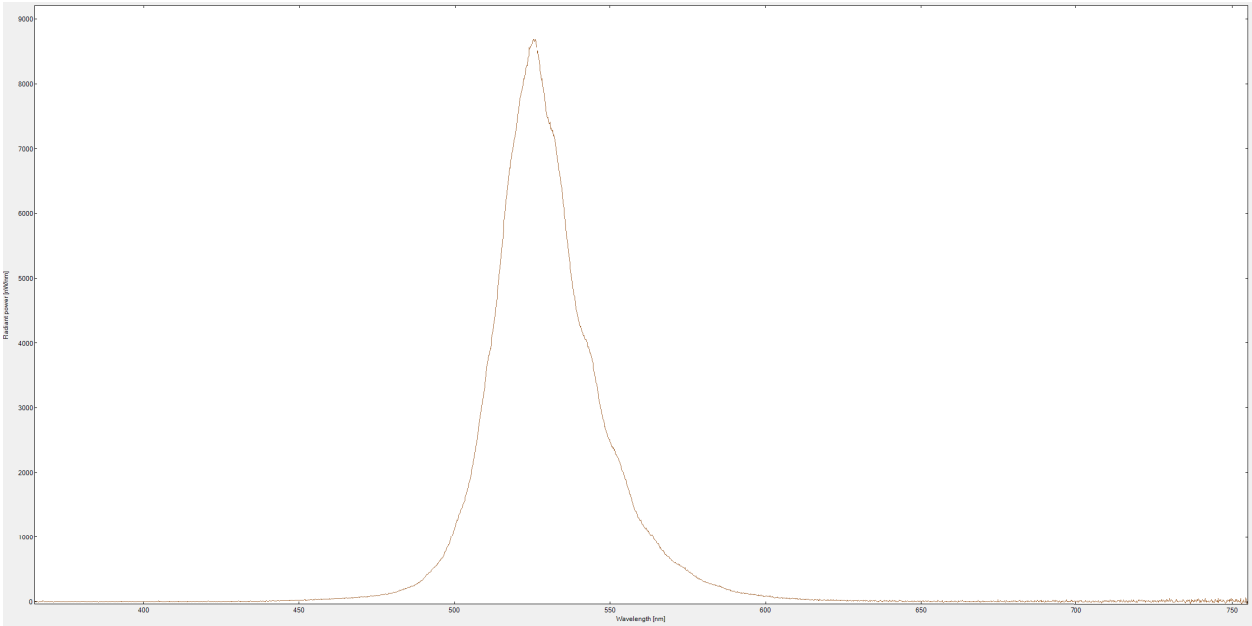
Calibrate the Absolute Scale of the Intensity Axis

Activate the spectral sensitivity correction by clicking the **photometer** symbol beside the **Trigger** menu.



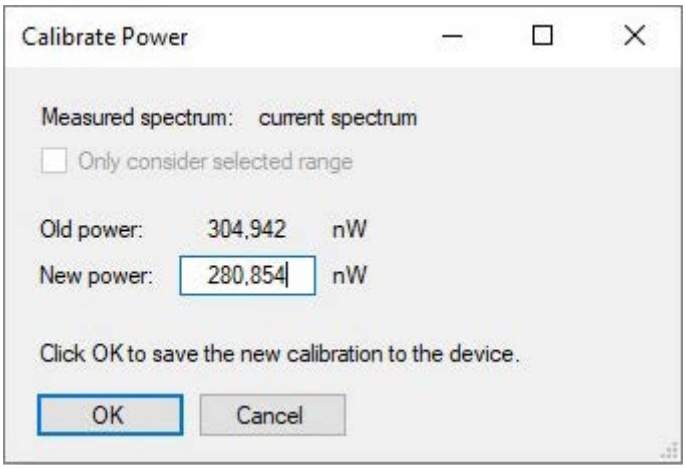
Take a spectrum and determine the absolute optical power (in watts) of this spectrum. When measuring the actual optical power with an optical power meter, ensure that the power meter detects only wavelengths that are within the wavelength range of the spectrometer (for example, by choosing a suitable light source).

Figure 3: Example Spectrum for Power Calibration



Then, choose **Calibrate power** from the **Calibration** menu, and enter the actual power in the **New power** field. Click **OK**.

The new power calibration is stored in the device and is used for scaling the intensity axis. This axis then displays the spectral power density in the physical unit that was specified in the **Calibrate Spectral Sensitivity** window.



In addition, it is possible to calibrate the power not just with respect to the spectrometer entrance, but also with respect to any other point in the optical setup. For instance, it is possible to calibrate the power that enters the measurement probe or any other power in the test setup, as long as it is proportional to the power that enters the spectrometer. Note that the optical powers and power densities displayed by the software refer to this value.

Verify the Calibration

Finally, use the spectrometer and measure the intensity of a known light source or known sample. If the spectrometer produces accurate and repeatable results, the calibration was successful.

Proper calibration of your spectrometer will help to ensure that your industrial processes runs efficiently, effectively and accurately.

If you need any help, contact us via support.spectrometer@broadcom.com.