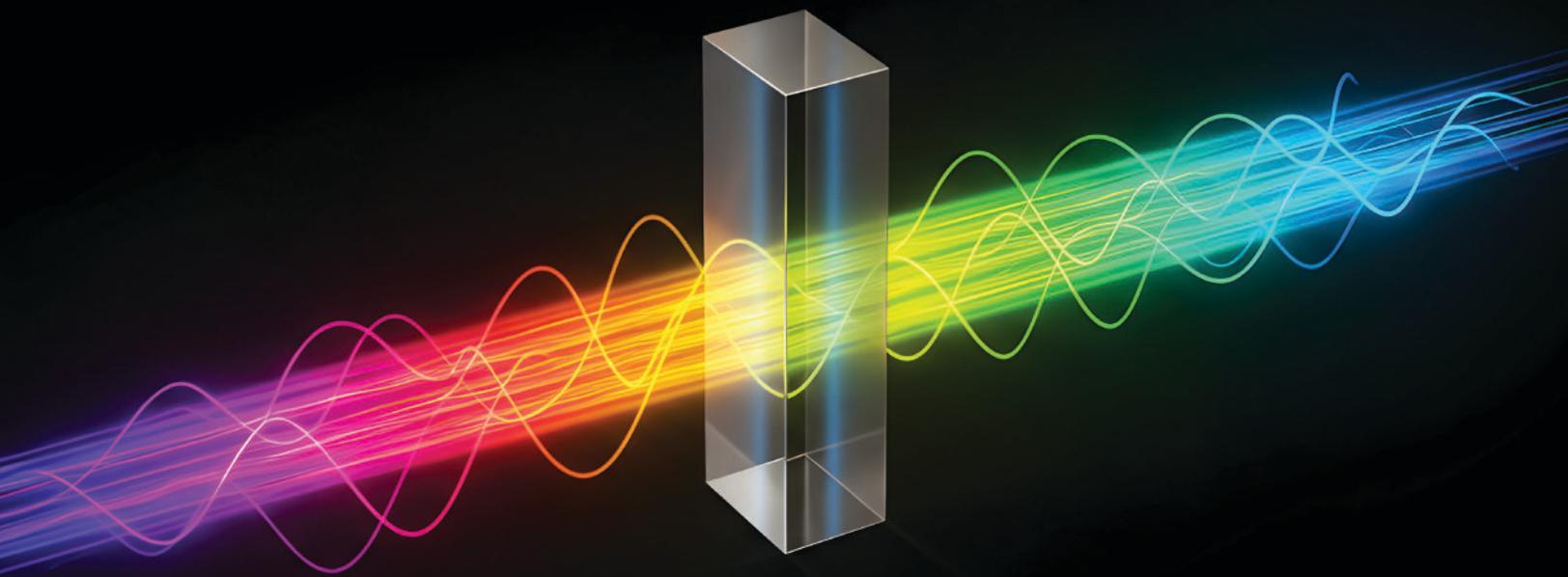


SPECTRAL TIPS AND TECHNIQUES: GUIDE TO TRANSMITTANCE AND REFLECTANCE IN AVASOFT SPECTRUM MODULE



INTRODUCTION AND GUIDE

The Spectrum module is the default measurement mode in AvaSoft 8. In this module, the user can perform many standard measurement techniques, including Scope, Absorbance, Transmittance, Reflectance, and Irradiance measurements. Transmittance measurements are, as the name implies, used to determine the amount of light that is transmitted through a sample material at specific wavelengths, while reflectance measures the amount of light that is reflected off a sample material. Similar to absorbance, both techniques have broad uses in medical, commercial, and industrial applications, and can be used across a wide spectral range, from the UV to the NIR. Below is a short guide covering the Transmittance and Reflectance Measure Modes in the Spectrum module in AvaSoft 8.

In AvaSoft, transmittance and reflectance measurements are calculated the same way by using the raw scope count measurements received by the spectrometer along with stored dark and reference measurements. This calculation from scope to transmittance or reflectance is done using the formula below:

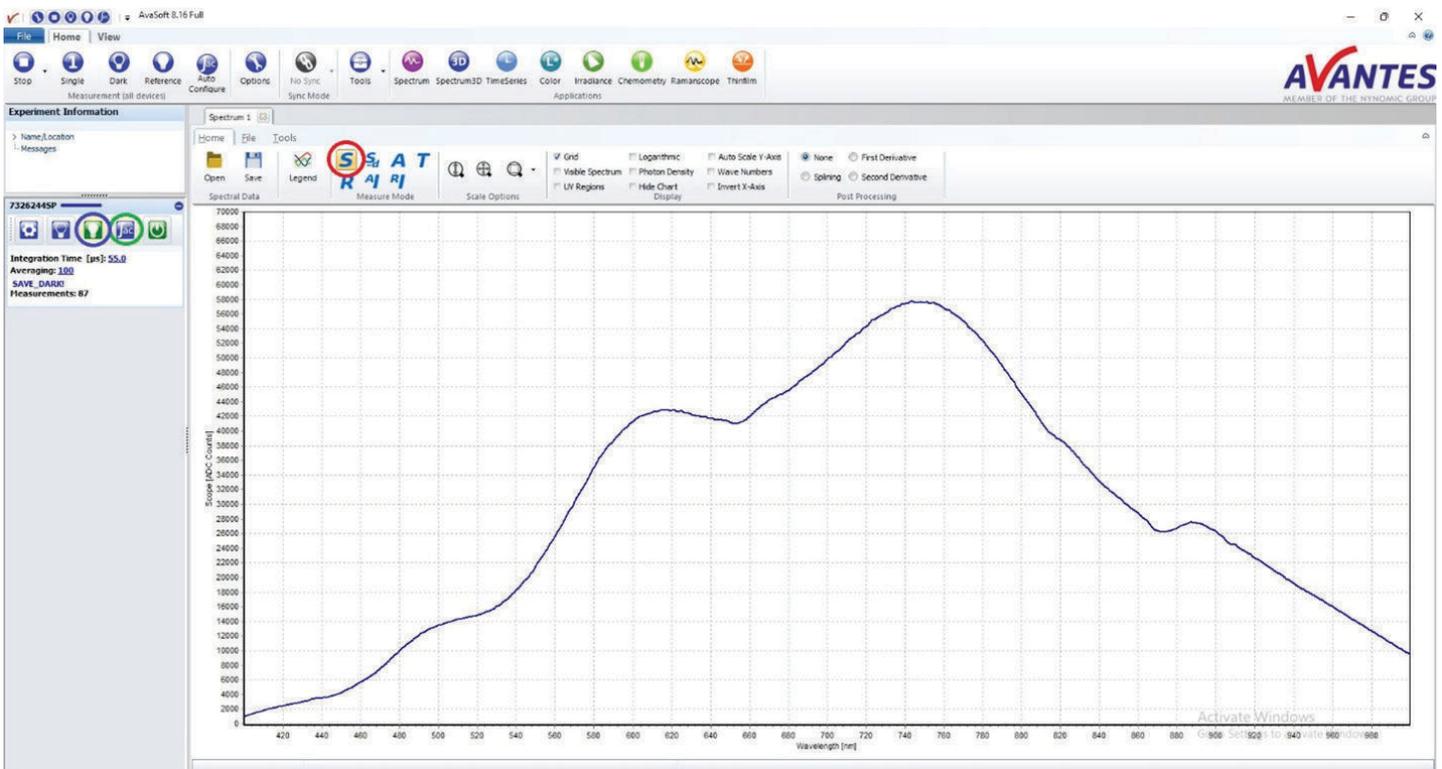
$$T_n = 100 * \left(\frac{\text{sample}_n - \text{dark}_n}{\text{ref}_n - \text{dark}_n} \right)$$

$$R_n = 100 * \left(\frac{\text{sample}_n - \text{dark}_n}{\text{ref}_n - \text{dark}_n} \right)$$

With n being the notation for the calculation occurring at every pixel n and sample_n being the current scope measurement. This gives a transmittance/reflectance value of 100% when measuring the reference material, and a transmittance/reflectance value of 0% when measuring the dark measurement (typically with the light source disengaged or shuttered). While transmittance and reflectance are technically two different measurements that, when in conjunction with absorbance, fully capture the interaction between a sample material and light, the true computation of both transmittance and reflectance requires multiple spectrometers to measure a sample at different points and significantly more involved calculations. This simplified method requires only one spectrometer measurement and is sufficiently accurate for most transmittance and reflectance applications, as transmittance is often measured for samples that primarily pass light through (such as coated glass) and reflectance is often measured for samples that are very opaque or significantly more reflective than transmissive (such as mirrors).

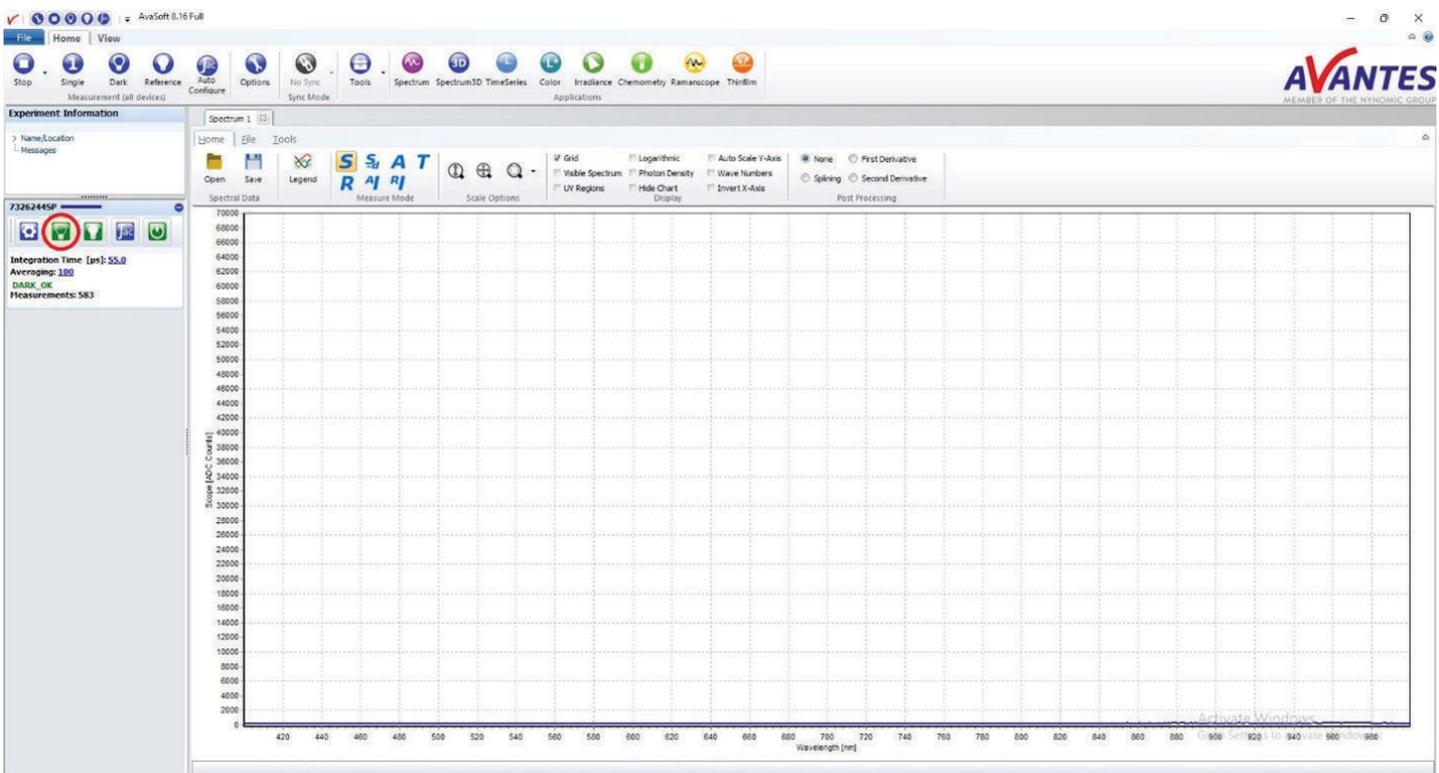
To begin taking transmittance or reflectance measurements in AvaSoft, you will want to begin in Scope mode, which is the default measurement mode in AvaSoft (circled in red below). From here, take a measurement of your reference material. This may be our WS-2 white diffuse reference tile or our RS-2 mirror specular reflectance standard for a reflectance measurement, or an uncoated sample or air for a transmittance measurement. This reference measurement will help determine the integration time for the spectrometer. While taking the reference measurement, click the "Autoconfigure" button (circled in green below) to determine an optimal integration time for the measurement. From here, we typically manually round down the integration time to the nearest whole value that's easily divisible for easier calculation of measurement time. For example, if the autoconfigure gives an integration time of 479.138ms, the integration time might be adjusted to exactly 475ms.

With the integration time set, the reference measurement can be saved by clicking the "Save Reference" button (circled in blue below). If the reference successfully saves, this button will change from blue to green. If the integration time or any other settings that affect the reference are changed, this button will change back from green to blue, and a new reference will need to be taken and saved. This button will also appear blue if AvaSoft is restarted with no changes made, as it indicates that a reference measurement is stored on the instrument but should be updated. If no reference is stored on the spectrometer or if any settings are changed that would invalidate the reference even with no change to integration time (such as disabling dynamic dark correction), this button will be red. Do not be alarmed by this color, as it is just a warning to take a new reference measurement.

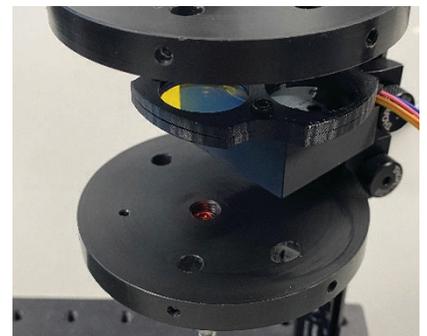
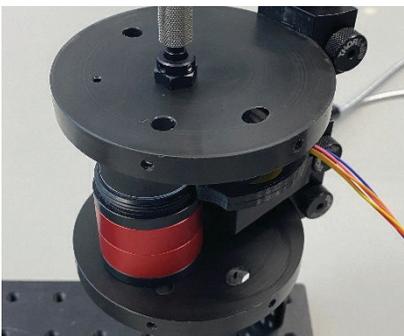
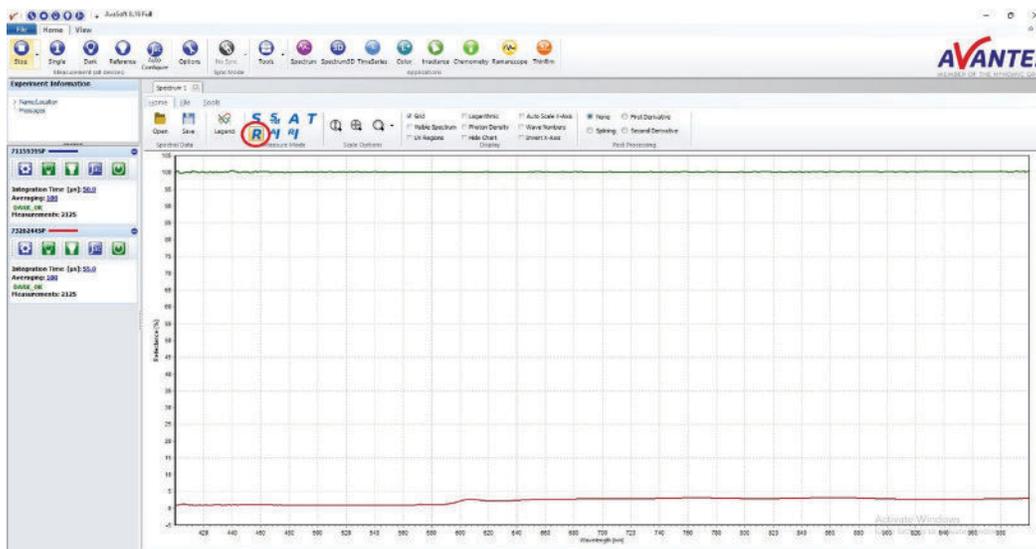


The next step is to save a dark measurement. Often, this will be a measurement of the reference material with the light source disengaged. Other times, this may be a different reference surface with the light source still enabled, such as our BS-2 black reference tile for a reflectance measurement or a reference sample material (such as uncoated glass) for transmittance measurements. It is important to consider the range of transmittance/reflectance of the sample measurements as well as other environmental factors when defining the dark and reference measurements, as this will define the range available in the transmittance and reflectance measurements. For example, measuring transmittance of a glass sample with a reflective coating may reflect ambient light into a transmission measurement, so taking a measurement in a dark room would be more accurate. On the other hand, measuring reflectance of the same sample could account for the ambient light in the reference measurement, depending on the reference material and application.

To save the dark measurement, simply take the measurement of the dark material and click the “Save Dark” button (circled in red below). It is important to note that AvaSoft will cycle through 5-7 measurements to ensure a proper dark is saved, so if a long measurement time is used, this process may take some time. It is also important to note that this step uses the same integration time as the reference measurement and should not have the integration time changed, as that would require taking and saving a new reference measurement. Similarly to the reference measurement, if a successful dark measurement is saved, the dark measurement light bulb icon will change color from blue to green. If any settings are changed that affect this measurement, the icon will change from green to blue and a new dark must be taken. If the icon is red, either no dark measurement has been saved to the spectrometer, or a setting has been changed that invalidates the saved dark even with no other settings changed.



With both a dark and reference measurement saved, we can navigate to either the Transmittance or Reflectance mode by clicking the “T” or “R” icon, respectively, in the Measure Mode section (circled in red below) and begin taking measurements of the sample. The example below shows the transmittance and reflectance spectrum of a 565nm longpass filter. In this example, the two spectra look different due to the difference in reference measurement, where the transmittance measurement used air as a reference and the reflectance measurement utilized our RS-2 specular reflectance standard. The green spectrum is displayed to show the reference spectrum in both modes. Additionally, photos of the setup are included to demonstrate differences in the reference measurement.



With these steps complete, Transmittance Mode and Reflectance Mode in the Spectrum module of AvaSoft can be utilized to measure and record transmittance and reflectance data. Please reach out to our support team at support@avantes.com for further explanation or troubleshooting options.

CONTACT

WE'RE HAPPY TO HELP

Curious how spectroscopy can help you reveal answers by measuring all kind of materials, in-line, at your production facility, in a lab or even in the field? Please visit our website or contact one of our technical experts, we're happy to help you.

Avantes Headquarters

Phone: +31 (0) 313 670 170
Email: info@avantes.com
Website: www.avantes.com

Avantes Inc.

Phone: +1 (303) 410 866 8
Email: infousa@avantes.com
Website: www.avantesUSA.com

Avantes China

Phone: +86 (0) 108 457 404 5
Email: info@avantes.com.cn
Website: www.avantes.cn

Follow us on social media:

