Ophir 3A-P THz meter

Dr Ephraim Greenfield, CTO
What is THz

- Frequency: 0.1 – 10THz
- Wavelength: 0.03 – 3mm
- Power Level: 10E-9 to 10E2 W

3A-P characteristics
- Aperture - φ12mm
- Power Range: 20μW - 3W
- THz Spectral Characteristics: ??
Can the 3A-P measure THz?

Depends on absorption of absorber

- Laser
- Heat Sink
- TEC detector
- Absorber plate
Can the 3A-P measure THz?

Depends on absorption of absorber

- Aluminum heat sink
- Silver epoxy
- Absorber plate

0.6mm
Absorption of the Absorber

Measurements at Ariel University

FTIR BRUKER 113v

Transmission is very low above 0.6THz
Absorption of the Absorber

Measurements at Ariel University

Absorbance (OD)
Absorption of the Absorber

Measurements at Ariel University

Reflectance

![Graph showing reflectance and transmittance against frequency]
Terahertz time-domain spectroscopy (THz-TDS) is a technique in which the properties of a material are probed with short pulses of THz radiation. The generation and detection scheme is sensitive to the sample material's effect on both the amplitude and the phase of the terahertz radiation. In this respect, the technique can provide more information than conventional Fourier transform spectroscopy, which is only sensitive to the amplitude.
Absorption of the Absorber

Measurements at Rensselaer Polytech Inst
Absorption of the Absorber

Measurements at PTB Standards Institute

![PTB logo]

### Kalibrierschein

**Physikalisch-Technische Bundesanstalt**

Braunschweig und Berlin

**2.52 THz**

<table>
<thead>
<tr>
<th>Measurement No.</th>
<th>Aperture diameter / mm</th>
<th>Spot size FWHM / mm</th>
<th>Laser power range</th>
<th>$c$ (2.52 THz)</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>5.8</td>
<td>2.5</td>
<td>high</td>
<td>1.09 ± 0.17</td>
</tr>
<tr>
<td>2</td>
<td>12</td>
<td>2.5</td>
<td>high</td>
<td>1.09 ± 0.17</td>
</tr>
<tr>
<td>3</td>
<td>5.8</td>
<td>4</td>
<td>medium</td>
<td>1.09 ± 0.17</td>
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<td>4</td>
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<td>6</td>
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<tr>
<td>8</td>
<td>5.8</td>
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<td>low</td>
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</tr>
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</table>

The reading multiplied by the correction factor yields the result according to the calibration.
Combining Results

Calculations:

\[ R = \text{Reflection} = \left[ \frac{n-1}{n+1} \right]^2 \text{ where } n \text{ is index of refraction} \]

\[ T_i = \text{Internal Transmission} = e^{-\alpha \cdot 2 \cdot d} \]

\( \alpha \) is the absorption coefficient, \( d \) is thickness

\[ T = \text{Transmission} = (1 - R) \cdot T_i \]

\[ A = \text{Absorption} = 1 - T - R \]
Example: Absorption at 532nm is 0.95, absorption at 2.55THz is 0.87 so calibration factor is $0.95/0.87 = 1.09$