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Frequently Asked Questions

1. **What is Terahertz?**
   The 'terahertz gap' – where until recently bright sources of light and sensitive means of detection did not exist – encompasses frequencies invisible to the naked eye in the electromagnetic spectrum, lying between microwave and infrared in the range from 0.1 THz to 10 THz. Terahertz radiation, also known as T-rays, has wavelength of 3.3-333 cm^{-1}.

   Terahertz technology has entered into an era with ever-growing applications in material spectroscopy and sensing, monitoring and spectroscopy in pharmaceutical industry and science, food industry, security, aerospace, oil industry, medical imaging, biology and medicine, and high-data-rate communications. Recent advances in semiconductor, laser, and optical technologies have made terahertz spectrum accessible to many technologists and scientists in diverse areas, ranging from biology and medicine to chemical, pharmaceutical, and environmental sciences to revisit their problems under the light of terahertz waves, thanks to the substantial growth of adjacent telecom, semiconductor, and laser markets in the recent years.

2. **What is a Terahertz Photoconductive Antenna (THz-PCA)?**
   Terahertz photoconductive antennas (THz-PCAs) are among the most promising devices that are used to harness the unique properties of terahertz waves for variety of applications, such as security, biology and medicine, medical imaging, material spectroscopy and sensing, and monitoring and spectroscopy in pharmaceutical industry. Since their demonstration as practical THz sources and detectors, THz-PCAs have been the subject of a vast amount of scientific and industrial reports investigating their applications as terahertz wave transmitters and receivers. Using THz-PCAs for generation and detection of THz signals, one can achieve relatively high signal-to-noise ratio and perform fast scan for imaging and spectroscopy applications. The possibility of fabricating THz-PCAs on photoconductive materials with the band gap energy equal to the energy of the photons at the telecommunication wavelengths and using them in fiber coupled schemes make THz-PCAs attractive for several real-world applications.

3. **What is the difference between Air-coupled and Fiber-coupled Terahertz Photoconductive Antenna Sensors?**
   The air-coupled terahertz transmitter and receiver sensors are excited by a free-space optical laser beam, while the fiber-coupled THz transmitter and receiver sensors are excited by fiber-coupled optical laser beam.

4. **What is the difference between Wide Frequency Bandwidth sensors and High Frequency Resolution sensors?**
   The wide frequency bandwidth sensors are excited by femtosecond optical pulse to generate and detect terahertz pulse with bandwidth of up to 4 THz. The high frequency resolution sensors are excited by pair of continuous wave optical lasers with frequency difference in the THz frequency range to generate and detect continuous wave (CW) terahertz signal. The generated THz CW signal frequency can be precisely tuned by adjusting the wavelength difference of two single-mode optical lasers.

5. **What kind of Lasers can we use to drive the Terahertz sensors?**
   For the wide frequency bandwidth terahertz sensors, the femtosecond ultrafast lasers are used to excite the sensors. The laser generates optical pulses with pulse width less than 100 fs and enough output power to drive a pair of transmitter and receiver sensor. Please see the Technical Information about required power for each T-Era sensor.
   For the High frequency resolution sensors, two single-mode CW optical lasers with frequency difference in the THz range are employed to drive the Terahertz sensors. The line width of the lasers should be in MHz range.

6. **What is the Ultra high vacuum compatibility of this product?**
   The T-Era sensors have been used by customers in ultra high vacuum chamber.

7. **How much is the diameter of the terahertz collimated beam? How much is the focal distance?**
   It depends on the Terahertz optics but one can use off-axis parabolic mirrors or a collimating THz lens to collimate the diverging beam from the transmitter emanating from the silicon hyper-hemispherical lens. The beam coming from the transmitter is diverging with an angle of 17 degrees. For the off-axis parabolic mirrors that are used in a setup with focal length of 101.6 mm, the collimated THz beam is 50.8 mm. Please see the Applications tab for each T-Era sensor for more details.

8. **What is the Polarization of the THz beam?**
   The THz beam is linearly polarized.

9. **How much is the conversion efficiency of T-Era-20D-800- Air?**
   When excited by 100 fs optical pulses with 15 mW average power on transmitter and receiver, pair of T-Era-20D-800 receiver and T-Era-20D-800 transmitter THz-PCAs generate 100 nA peak terahertz photocurrent on the receiver antenna with more than 75 dB terahertz power spectrum dynamic range.

10. **Is there a possibility to align the silicon lens on the back side of the devices?**
    Yes, the devices are shipped with the silicon lens already aligned and packaged on the back side of the devices. The silicon lens can be re-aligned after changing the chips using our silicon lens setting fixtures.

11. **Is it easy to change the sensor chip dye?**
    Yes, the devices are packaged in a modular format so that it is easy to change the chips inside the enclosures. The terahertz chip dye is mounted on a PCB board, which is connected to the SMA connectors with wires. We can change the chip dyes and re-align the silicon lens for the best performance at a fraction of cost. To change the chip dyes one can purchase one of our silicon lens setting fixtures to align the silicon lens.

12. **Why the bandwidth of the T Era 20D 800 seems low with the energy maximum at very low frequency?**
    The T-Era-20D-800 devices are long dipoles, which generate a large terahertz signal at the expense of lower bandwidth. They are useful for the type of applications that do not need a large terahertz bandwidth but require strong terahertz signals. Using a pair of these devices, you can generate a strong THz signal that can even be measured without a lock-in technique.