

TERADAR



Security

— **Unlocking the Potential of
Advanced Security Screening
with Terahertz Vision**

Executive Summary

As security threats become more sophisticated, the world's busiest transportation hubs, stadiums, and shipping centers demand screening that's not just increasingly faster, but smarter and safer. Terahertz vision sensors deliver real-time, accurate detection, spotting threats that conventional systems miss, and raising the bar for public safety and operational efficiency. This white paper highlights research and industry case studies that showcase the advantages terahertz can bring to next-generation screening and inspection.

Physical Principles and Unique Properties of Terahertz Waves

Terahertz (THz) waves reside between microwaves and infrared on the electromagnetic spectrum, typically spanning 0.1–10 THz (wavelengths of 3 mm–30 μm). Unlike X-rays, THz photons are non-ionizing and have an energy of about 4 meV at 1 THz, far below even the energy of visible light. This makes them inherently safe for human exposure.

THz waves offer distinct technical advantages:

- **Light Material Penetration:** THz can pass through clothes, paper, plastics, ceramics, and some composite materials, revealing hidden threats or contraband without requiring direct exposure or physical contact.
- **Fingerprint Spectroscopy:** THz photons excite molecular rotational and vibrational transitions, yielding unique absorption “fingerprints” for detecting explosives, narcotics, weapons, and hazardous chemicals.
- **High Spatial and Spectral Resolution:** Short wavelengths achieve sub-millimeter resolution, enabling differentiation of small concealed items, even within layered packages or under clothing.

Security Screening Effectiveness

Peer-reviewed studies have demonstrated THz imaging's unmatched ability to identify explosives, weapons, and hazardous chemicals in a mixture or concealed under barriers:

- Spectroscopic databases have mapped THz fingerprints for explosives (RDX, TNT, ammonium nitrate), chemical warfare agents, hoax substances, pharmaceuticals, and common container materials.
- THz systems achieve >90% sensitivity for chemical identification in laboratory and field tests, rapidly distinguishing explosives, narcotics, and controlled substances, including those found in complex, multi-component samples.
- THz imaging detects threats through non-metallic barriers (e.g., clothing, plastics, packaging) with minimal sample preparation, making it ideal for rapid mass screening.

Real-World Applications

- **Airport, Stadium, and High-Traffic Environments:** Several peer-reviewed and market reports highlight early deployments of THz scanners in European and US airports, stadiums, and border checkpoints, with the potential for robust market growth.
- **Port Deployments:** THz technology offers significant advancements in port cargo inspection by providing a non-invasive, rapid, and highly sensitive method for detecting concealed materials and identifying cargo contents. This capability can differentiate between organic and inorganic substances, making it easier to identify illicit items such as drugs or explosives, as well as potential customs violations hidden within legitimate cargo.
- **Mail Security:** Advanced THz-AI systems deliver 100% in-line, non-destructive inspection of packages made of light materials, regardless of size or configuration. Sub-THz scanners have already begun implementing robust inspection protocols and are being deployed in high-speed mail processing facilities.

Peer-Reviewed Applications

- Campbell et al. (2003) demonstrated non-destructive detection of explosives and chemical agents using THz spectral databases, validating use in governmental threat environments.
- Trofimov VA et al. (2015) reported robust analysis methodologies for pulsed THz spectroscopy, supporting layered security monitoring at large venues and transportation nodes.

Safety and Human Health: Comparison to X-ray and Millimeter Wave

Unlike X-rays, which can damage tissues or DNA and are subject to strict regulatory controls, terahertz radiation is non-ionizing. It carries insufficient energy to alter molecular bonds or induce harmful biological changes.

Teradar's Competitive Edge

As a result of Teradar's mass-volume focus, the mass silicon-first approach enables a competitive advantage over pure technology innovation:

- Proprietary semiconductor integration and scalable AI-driven threat recognition drive Teradar's superior performance versus legacy systems.
- Miniaturized silicon architectures enable cost-effective sensors for distributed installations, from individual mail processing facilities to entire airport or stadium complexes.

Conclusion and Recommendations

Teradar's terahertz vision empowers government agencies, airports, and sports venues to set a new gold standard for public safety by delivering rapid, non-invasive mass screening and comprehensive threat detection at every scale. By dramatically reducing operational workloads while elevating protection for critical infrastructure and public events, Teradar's terahertz vision technology offers potential next-generation security with minimal risk and maximum peace of mind

References:

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