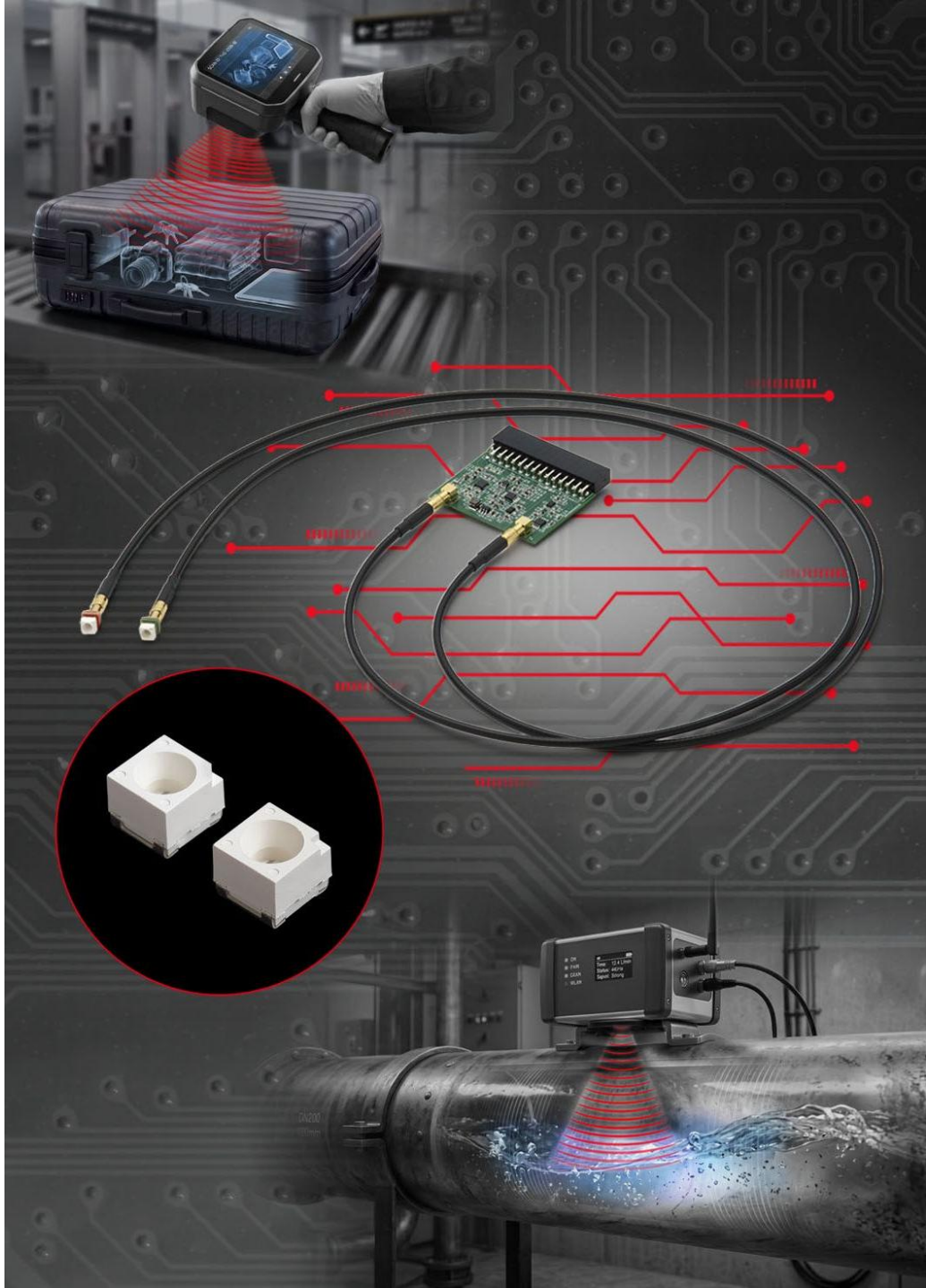
ROHM SEMICONDUCTOR

Electronics for the Future

ROHM's New 2nd Generation Terahertz Wave Oscillation Device Delivers 4 Times Higher Output Power



August 4, 2026

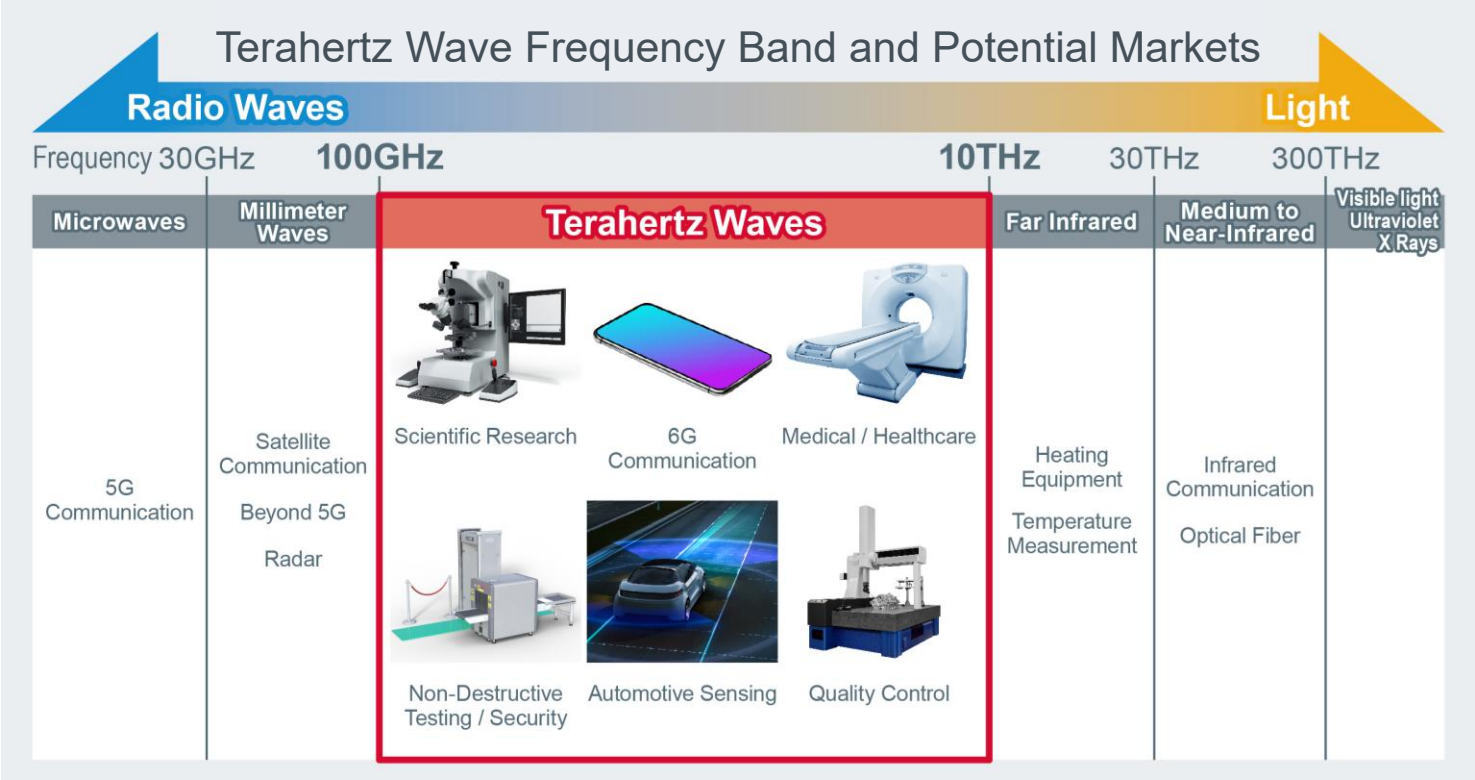
ROHM Co., Ltd.

Marketing Communications Division.

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What are Terahertz Waves?

A frequency range long regarded as the last frontier (THz gap)



Terahertz (THz) waves are electromagnetic waves that lie in the frequency range between radio waves and light.
Their unique combination of high penetration capability, strong directivity, and safety makes them promising for a broad range of applications.

History of ROHM's THz Research
(Key research partners indicated in parenthesis)

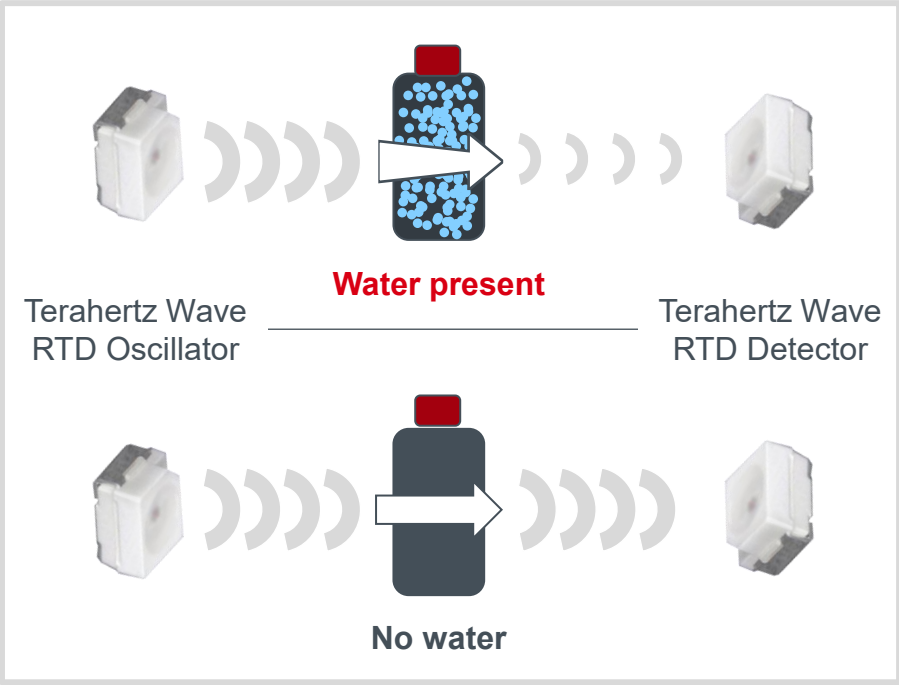
2008: Began RTD research (Tokyo Institute of Technology)
2009: Successfully achieved basic oscillation using ROHM's in-house process
2010: Began research on THz wireless communication (Osaka University)
2011: Achieved the world's first* wireless communication using an RTD
2013: World's first* imaging using an RTD (Pioneer Corp, Japanese version Only)
2016: Demonstrated uncompressed wireless transmission of 4K video
2017: Began RTD oscillation control (Kyoto University)
2018: Achieved observation of injection-locking in an RTD
2019: Began development of an evaluation board for sensing applications
Achieved 10,000x higher receiver sensitivity and 30Gbps uncompressed transmission (Osaka University)
2021: Achieved the world's first* uncompressed wireless transmission of 8K video (Osaka University)
2023: Research breakthrough in RTD oscillation dynamics analysis and control
Published in Nature Communications (Kyoto University)
2024: Began trial sales of R&D samples

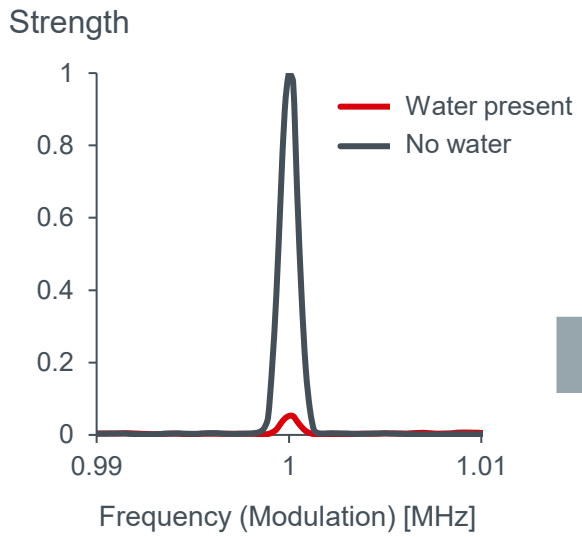
*ROHM August 4, 2026 studies, respectively.

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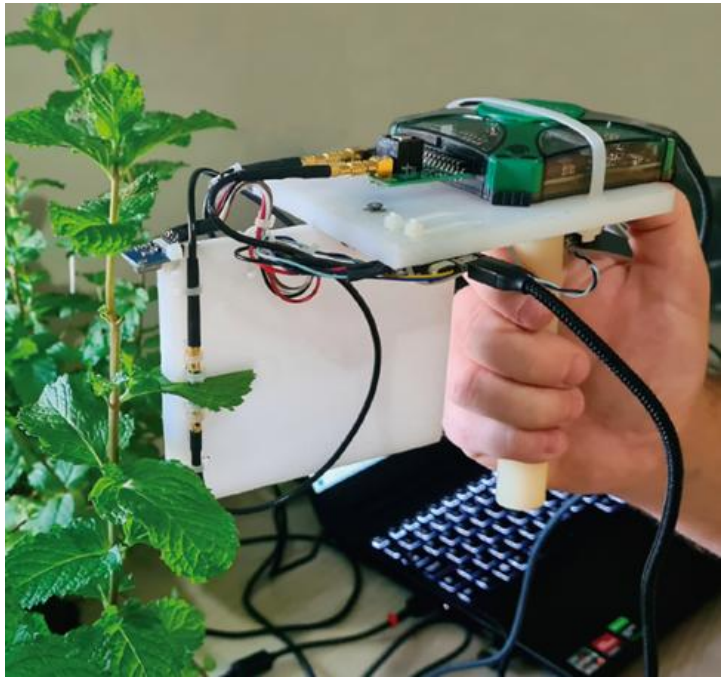
Terahertz Applications ①: Moisture Detection and Material Identification (Sensing)

Terahertz waves can penetrate plastic resins but are absorbed by water





Moisture Content Measurement (Ref. 1)



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Enables non-destructive detection of water inside opaque plastic containers

Differences in terahertz-wave transmissivity can also be used to identify materials such as plastics (polyethylene and polypropylene) and oils

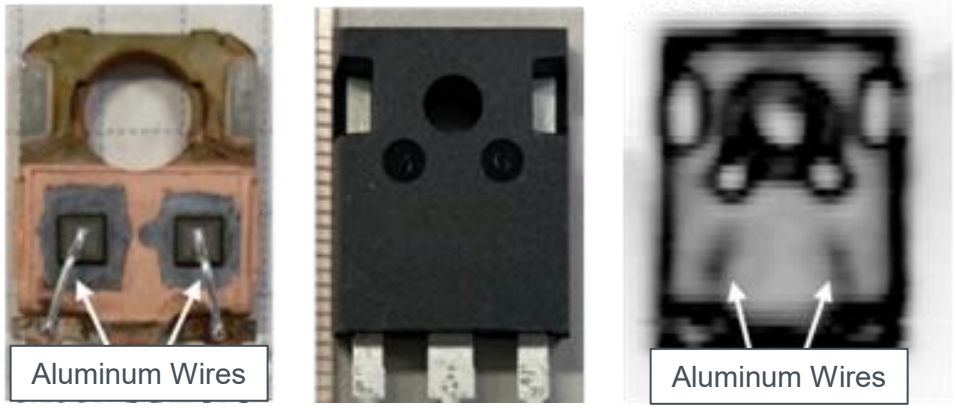
Detects liquid inside opaque objects.
Plants, gasoline, wood, paper, dried foods, etc.

1. E. L. Chuma, L. Lorenzo Bravo Roger and B. Mikhail, "In Situ Leaf Water Status Sensor Using Resonant Tunneling Diodes as Terahertz Source and Sensor," in IEEE Sensors Journal, vol. 24, no. 12, pp. 19073-19081, 15 June15, 2024

Terahertz Applications ②: Imaging

Transmission Imaging (Ref. 2)

Sample (Visible-Light Image) | **Terahertz Image**

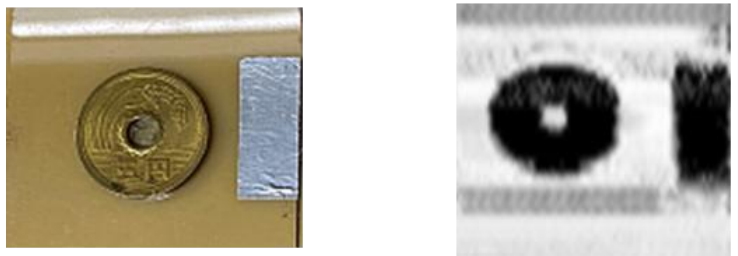


(Reference) Before Encapsulation | After Encapsulation

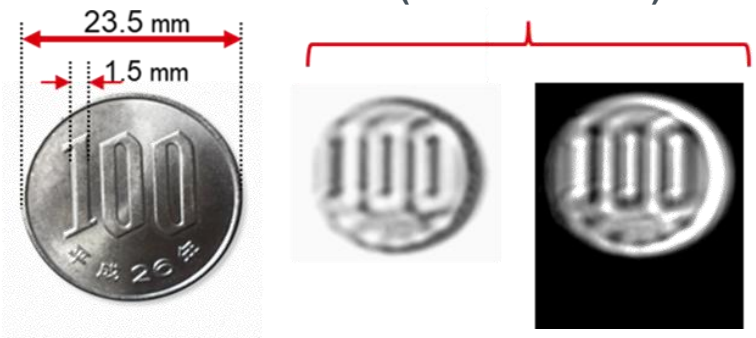
See-through imaging can be performed using transmitted / reflected terahertz waves

Light metals that are difficult to distinguish with X-rays due to low contrast can also be visualized. And unlike X-rays, terahertz waves are non-ionizing and do not affect the inspected object.

Object | **THz Image (Transmission)**



Object | **THz Image (Transmission)**



1. Manago, G.; Okubo, K.; Yu, J.; Tanabe, T.; Sasaki, T. Identification of the Compounds Used in Waste Bottle Caps Using Terahertz Radiation for Sustainable Resource Recycling to Benefit International Cooperation. Sustainability 2024, 16, 10864.

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2. K. Tsuruda et al., "Development of Practical Terahertz Packages for Resonant Tunneling Diode Oscillators and Detectors," 2020 IEEE International Symposium on Radio-Frequency Integration Technology (RFIT), Hiroshima, Japan, 2020, pp. 193-195,

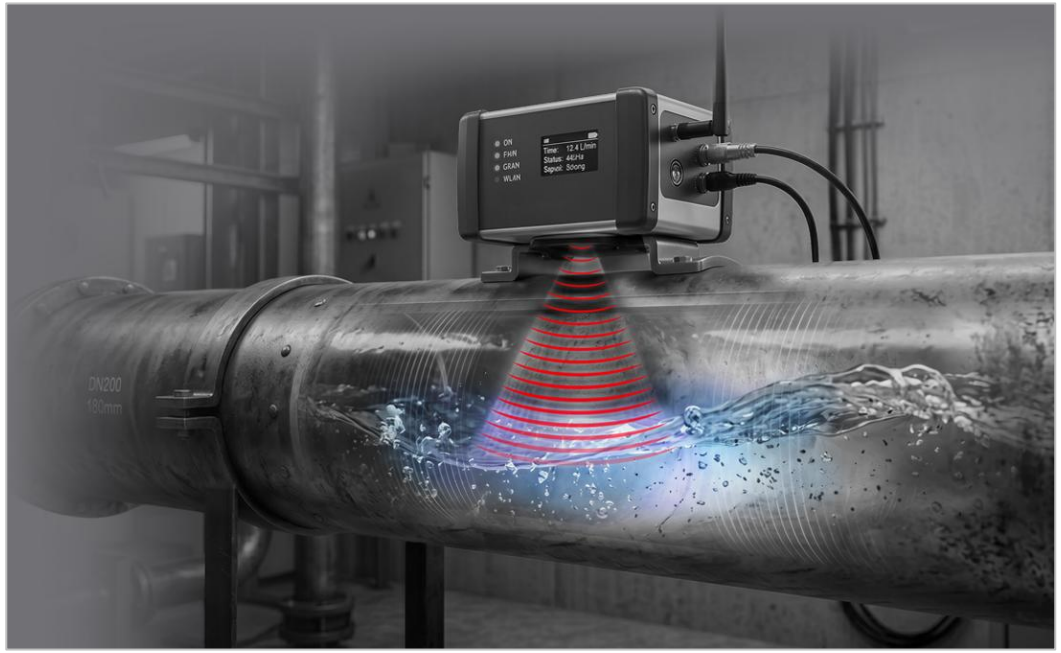
Terahertz Applications ③: Potential Uses

Baggage Inspection with See-Through Imaging



The use of compact devices may lead to the development of handheld inspection equipment. As THz waves do not involve radiation exposure like with X-rays, they are also expected to find uses in security screening.

Liquid Detection and Flow Rate/Velocity Measurement in Pipes

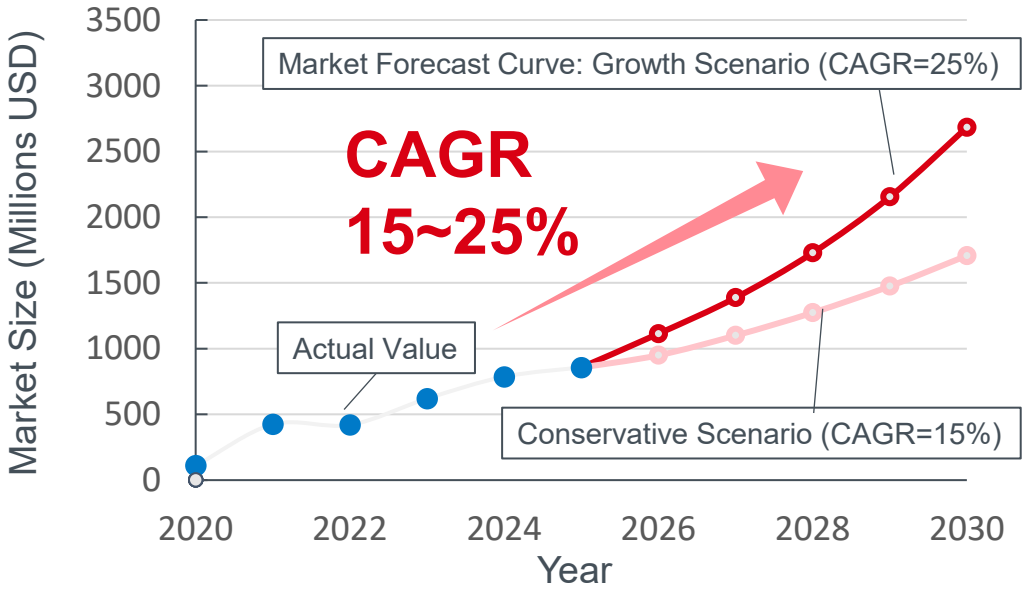


THz waves can detect whether liquids or air bubbles are present inside pipes. They can also safely detect the presence of potentially hazardous chemicals. Furthermore, combining this technology with an ultrasonic sensor allows for more accurate measurement of liquid flow rate and velocity.

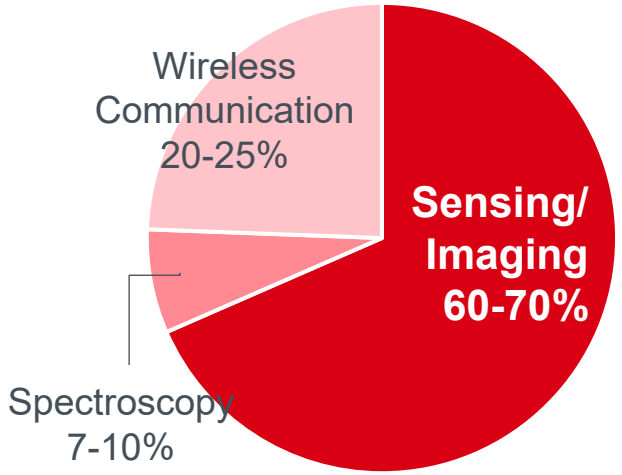
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Global Terahertz Device Market

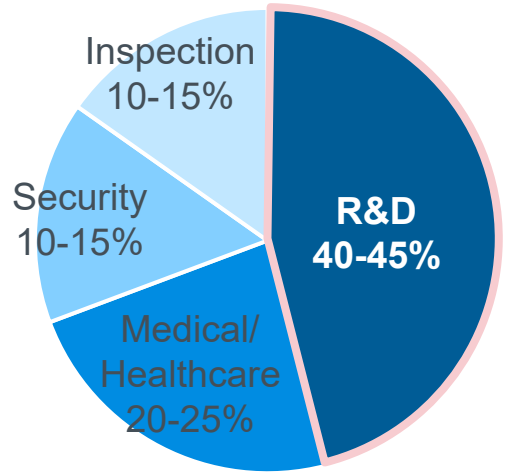
Market Size



Breakdown by Application



Breakdown by Usage



- The terahertz market is valued at approximately $800 million (FY2025)
- CAGR: 15-25%
  (Forecast for 2024-2030)

- Sensing and imaging applications account for approximately 70%
- R&D activities account for approximately 50%

➡ **The general-purpose market is still in the early stages of development**

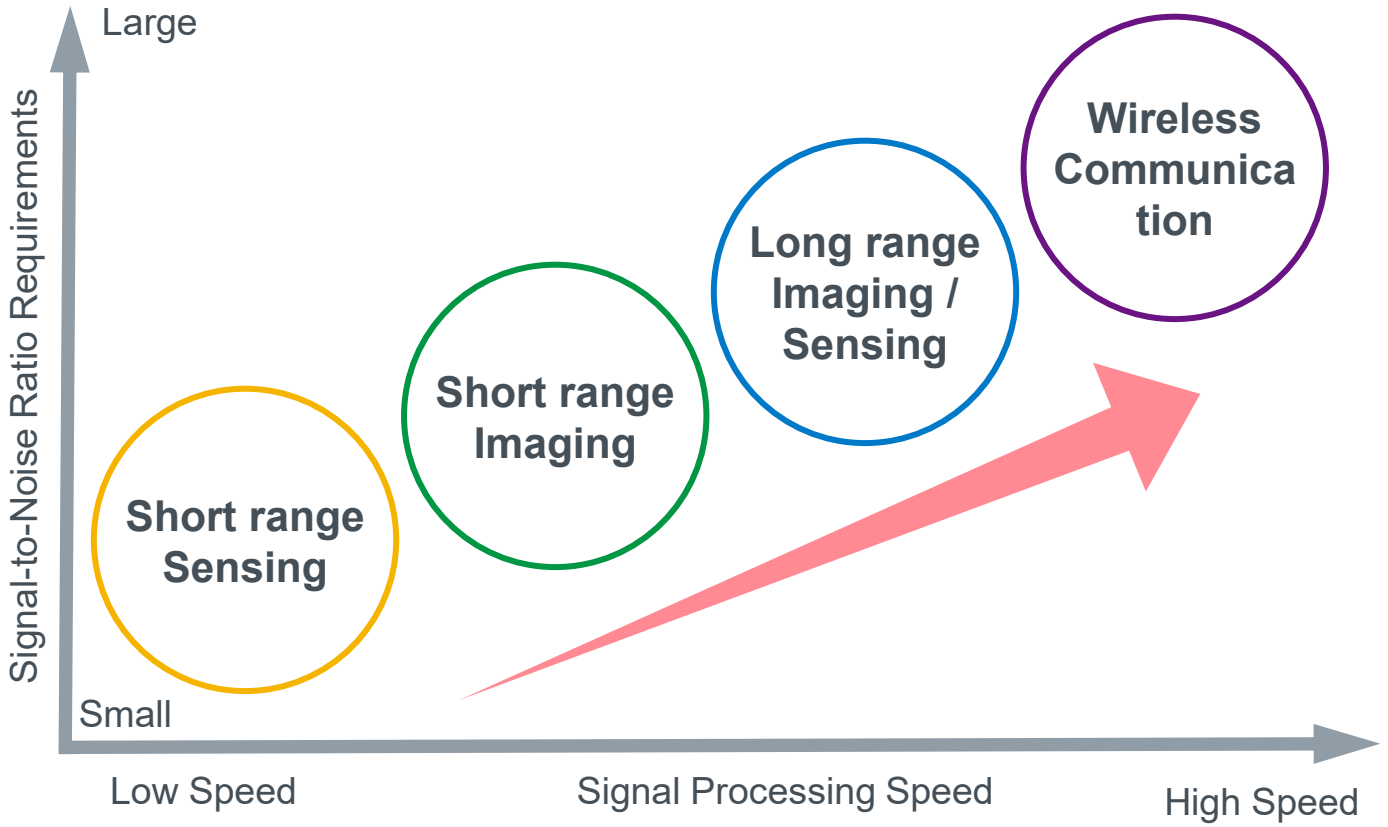
*The charts were created by ROHM based on publicly available information.

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The Path Toward Terahertz Commercialization and the Challenges to Mainstream Adoption

Although next-generation wireless communication is a primary focus of terahertz application research, commercialization cannot be achieved overnight

Conceptual Roadmap to the Commercialization of Terahertz-Wave Technology



1. Establish markets for sensing and imaging applications
2. Expand the markets through device evolution, including frequency lineups tailored to target applications and enhancing output power and receiver sensitivity
3. Leverage cash flow and technological advancements generated by these markets to achieve terahertz wireless communications

While the market progresses step by step, continued advances in device technology are needed.

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Key Challenges

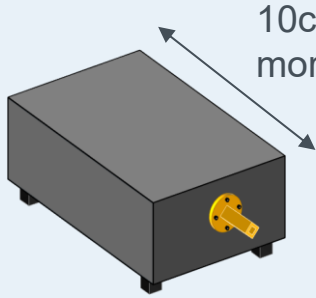
1. Regulatory Compliance and International Standardization



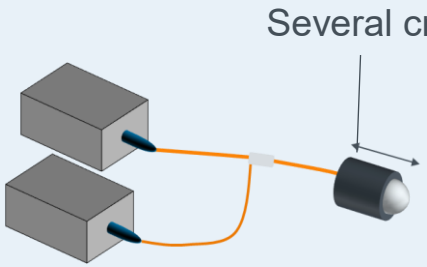
- In principle, radio waves cannot be transmitted outside an anechoic chamber
- Authorization for a low-power radio station is required even when using an unassigned frequency for non-communications purposes
- An Experimental Radio Station license is available, but obtaining one is challenging

Engagement with companies and organizations is needed to promote regulatory reform

2. Lack of Devices to Support Widespread Adoption



Frequency Multiplication Method



Photomixing Method

- Compact, low-power, and cost-effective device technology is required
  (Commercial products for research use are available if these requirements are not a concern)
- Current THz products are not as easy to use as LEDs or laser diodes

ROHM THz RTD devices address these challenges

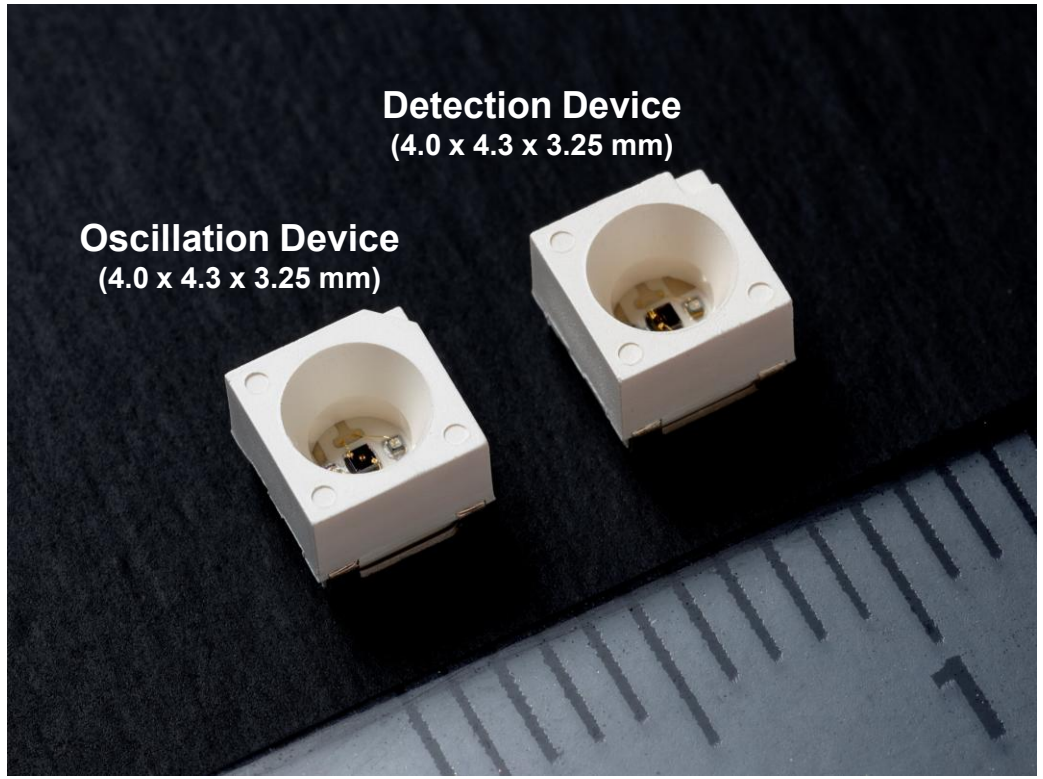
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ROHM 2nd Generation Terahertz Oscillation Devices

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New

ROHM's 2nd Generation Terahertz Wave Oscillation and 1st Generation Detection Devices



Features

- **The industry's smallest* terahertz wave oscillation and detection devices**
- **2nd Generation oscillation device delivers 4-times the output of the 1st Generation**
- Enables easy evaluation using the EVK, digital oscilloscope, and a PC
- No cooling system required

*ROHM August 4, 2026 study

Ideal Uses and Applications

- **Non-destructive inspection**
- **Imaging and sensing in the medical and healthcare fields**
- Material identification (e.g., polyethylene and polypropylene)
- Moisture detection

Product	Operating Frequency (Typ.) [GHz]	Oscillation Output (Max.) (μW)	Power Consumption (Typ.) [mW]	Element size [mm]	Package [mm]
2nd Generation Terahertz Oscillation Device	320	40	40	0.5 x 0.5	4.0 x 4.3 x 3.25

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ROHM is Pursuing THz Devices that are Easier to Use and More Cost-Effective than Other Approaches

Large

Size

Small

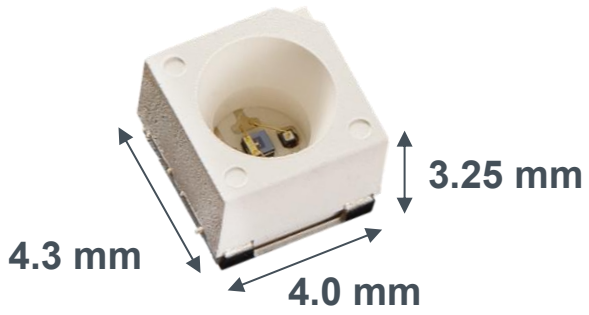
Low

Power Consumption

High

Miniaturization + Lower Power Consumption

ROHM's THz RTD Device

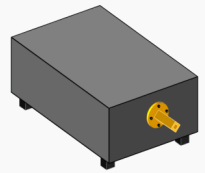


Power Consumption

New **2nd Generation: 40mW typ.**
1st Generation: 10mW typ.

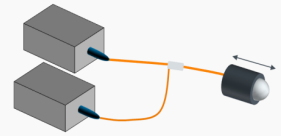
Conventional Approaches

Frequency Multiplication Method
Frequency Multiplier
+ RF Signal Generator



Power Consumption

Photomixing Method
THz Photomixer + Laser Source

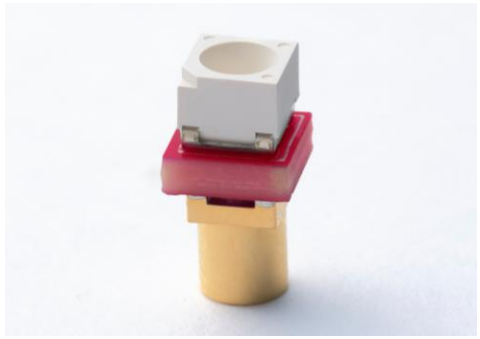
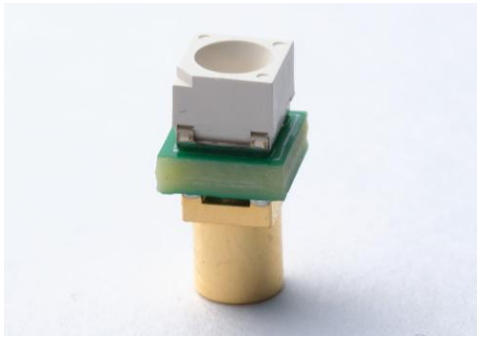


10W or more

	Resonant Tunneling Diode	Frequency Multiplication Method	Photomixing Method
Size	**Small (4.0 × 4.3 × 3.25 mm)**	Large (10cm or more)	Large (Several cm)
Cost	**Low**	High	High
Power Consumption	**Typ. 40mW (2nd Gen)**	10W or more	10W or more
Output	Max. 40μW	**~10mW**	~100μW

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Comparison of ROHM THz Oscillation Devices

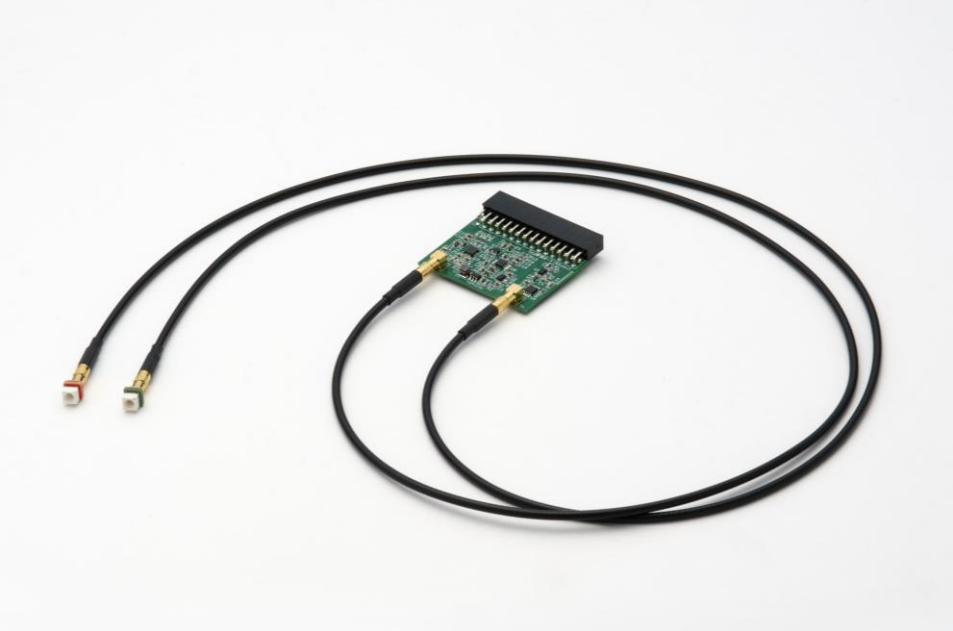
	New 2nd Generation	1st Generation
Device (For use with Evaluation Kit)		
Package Size	4.0 × 4.3 × 3.25 mm	
Oscillation Frequency	Typ. 320 GHz	Typ. 320 GHz
Oscillation Output	40μW Max.	10μW Max.
Power Consumption	40mW typ.	10 mW typ.
Features	Generates high-power, high-quality terahertz waves	Combines sufficient output with low power consumption
Target Applications	Object sensing and imaging, etc.	Moisture detection, material identification, etc.

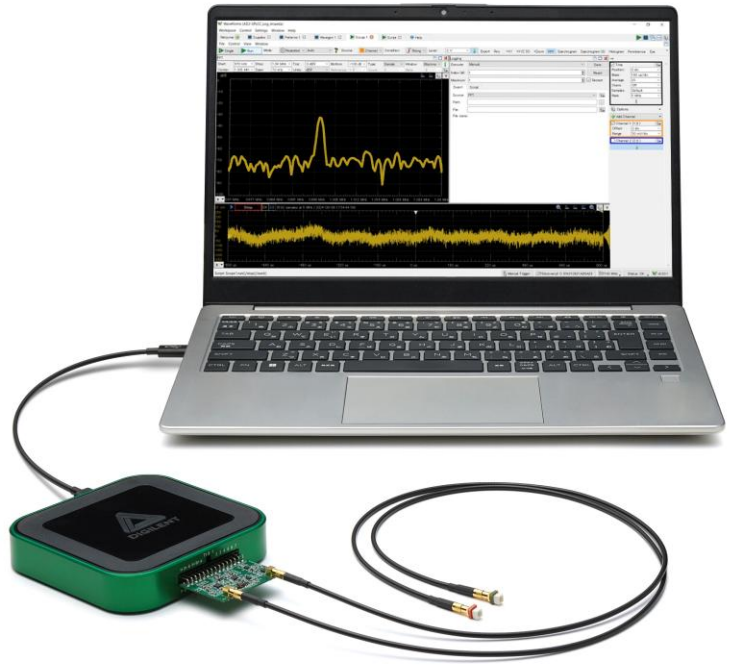
ROHM offers both the high-output 2nd Generation and low-power 1st Generation devices to address a wide range of customer needs

New

Terahertz Oscillation Devices Are Provided in a User-Friendly Evaluation Kit

Evaluation Kit
(Photo shows the RTD-EVK-G2)





The evaluation kit includes the oscillator/detector devices, evaluation board, and cables

*Purchase requires signing an NDA (Non-Disclosure Agreement) with ROHM

Evaluation can be performed using the evaluation kit, Analog Discovery 3™, and a PC

Analog Discovery 3™ is a trademark or registered trademark of Digilent, Inc

Ecosystem Centered on THz RTD Devices

Collaborate with ecosystem partners to accelerate the development and commercialization of terahertz applications

ROHM

R&D

Materials

Devices



Modules



Collaborative Creation

Collaborative Partners

System

Service

Processing / Manufacturing

Distributors / Wholesalers

ROHM and its partners work together to solve terahertz challenges

1. Promote terahertz application development
2. Customize hardware and software tailored to specific needs
3. Deliver legal and distribution support for commercialization and deployment
4. Provide guidance on regulatory compliance, certification, etc.

Toward the development of compliant high-performance next-generation products

Government and Public Institutions

Develop legal frameworks and international standards for real-world deployment

Consumers and Users

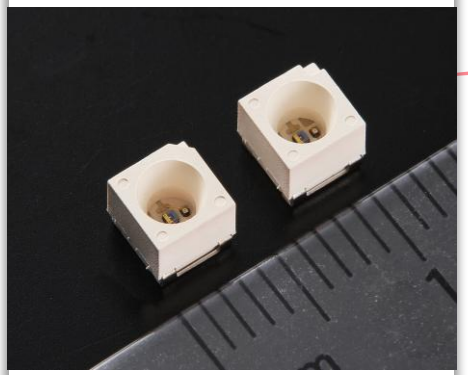
For more information,
please visit the contact page on ROHM's website.

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Future Development Roadmap

Expanding our product lineup with a dual focus on higher output power and operating frequencies

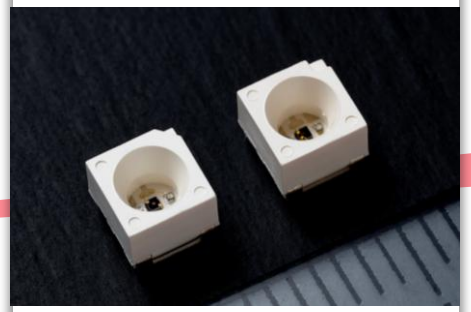
1st Generation



Industry's smallest size
Low power consumption

Higher output

2nd Generation



Industry's smallest size 4-times higher output power

Pursuing even higher output power

Higher frequency

3rd Generation

Under development

High frequency (450GHz~)

Toward higher frequencies

2024 → 2025 → 2026 → 2027 → 2028

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Electronics for the Future

Notes

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