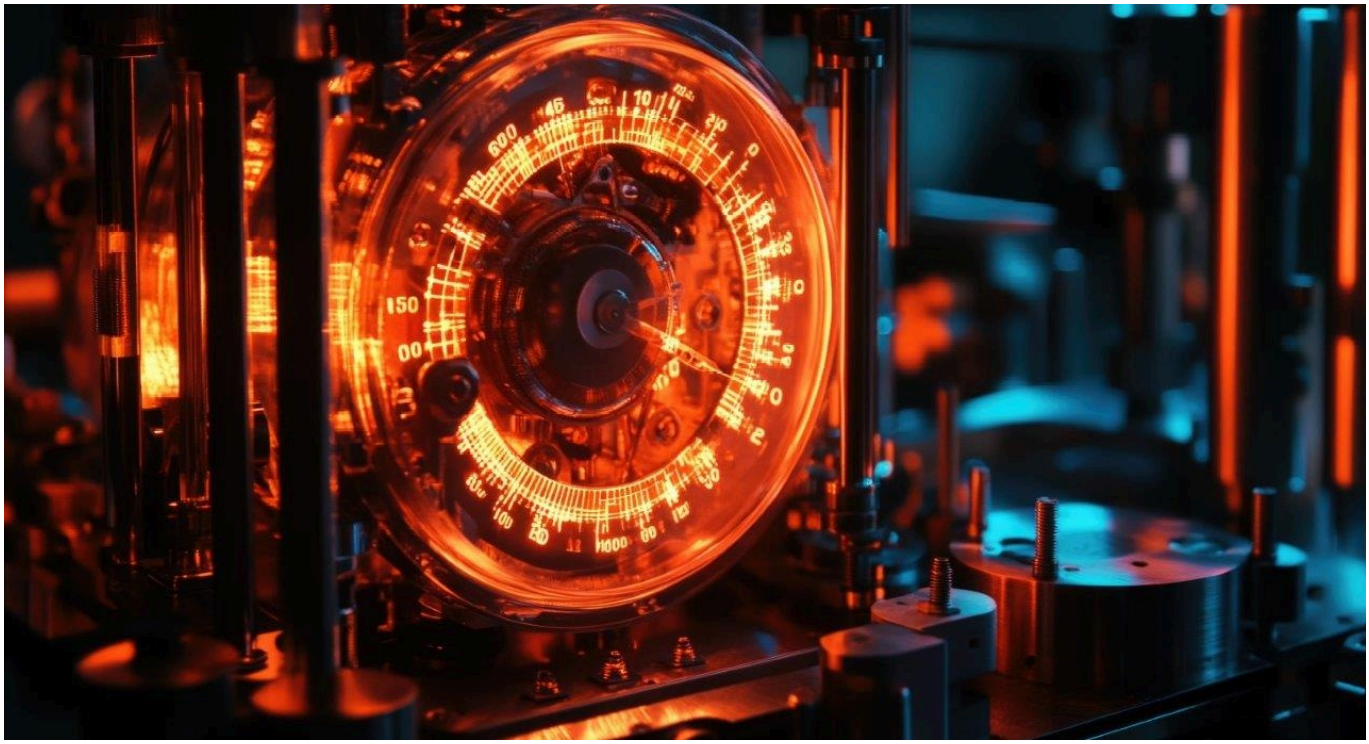
TECH OFFER

Compact Optical Lattice Clock for Precise, Accurate Timekeeping



KEY INFORMATION

TECHNOLOGY CATEGORY:
Infocomm - Geoinformatics & Location-based Services
Electronics - Lasers, Optics & Photonics

TECHNOLOGY READINESS LEVEL (TRL): TRL7
COUNTRY: JAPAN
ID NUMBER: TO175411

OVERVIEW

With the growing demand for telecommunication networks (5G networks), global navigation satellite system, GNSS, (autonomous vehicles) and geoscience (disaster monitoring), precise timekeeping is a critical piece that ensures these functions work seamlessly and efficiently. Without this vital function, these capabilities will become inaccurate, unreliable and vulnerable to attacks and tampering. Currently, this timekeeping function uses conventional caesium atomic clocks which are reaching its inherent limits in terms of synchronisation and to accommodate for a more digitalised world.

The technology owner has leveraged on their technical expertise to develop a commercialised strontium optical lattice clock as the next generation of precise timekeeping to address the existing inherent limitations. With the frequency output light stablished to the resonant frequency of strontium atoms, it provides about 1000 times higher precision compared to existing commercialised caesium atomic clocks while having a relatively compact formfactor. The system also enables a lower systematic uncertainty level, hence a higher accuracy and precise time and frequency measurement. The system is designed and engineered for being user friendly with an automatic operation and east of start-up and maintenance.

TECHNOLOGY FEATURES & SPECIFICATIONS

The technology solution in a form of a commercialised strontium optical lattice clock for ultra-precise timing have a few notable functionalities, including:

- Robust system which enables long-term operation
- Compact (W1140mm × H1093mm × D650mm) and transportable system for various locations
- Higher precision compared to state-of-the-art caesium fountain clocks/ hydrogen masers and commercialised caesium atomic clock by 2 and 3orders of magnitude respectively
- Laboratory grade accuracy, due to a sharper resonance, and systematic uncertainty level of < 1×10-17
- Built-in optical reference cavity with stability of < 2×10-15
- Less user technical expertise required for automatic operation
- User friendliness with easy start-up and maintenance of system

POTENTIAL APPLICATIONS

Given the technology solutions have the capabilities beyond the inherent timekeeping limit of existing conventional caesium atomic clocks for potential applications such as:

- **Telecommunications:** Next-generation synchronisation of global data networks with increased security and resilience to tampering.
- **Geoscience/Metrology Monitoring:** Relativistic geodesy, detection of gravitational potential differences (at cm-scale altitude changes)
- **Navigation Systems:** GNSS, optical clocks for increased positioning accuracy and resilience
- **Finance:** Supporting secure and reliable time-stamping for recordkeeping for high-frequency, high-volume trading
- **Research Development:** Testing and advancement of variations of fundamental physics constants
- **Space Operation and Deployment:** Space and satellite mission requiring precise timekeeping capabilities

UNIQUE VALUE PROPOSITION

The technology owner has leveraged on their in-depth technical expertise to develop a commercialised strontium optical lattice clock as the next generation of precise timekeeping to address the existing inherent limitations from existing caesium atomic clocks. This leap not only redefines the fundamental standard of time but also opens new applied domains. The solution bridges laboratory-grade accuracy with emerging portable implementations, allowing both fundamental research and industrial applications on-site. Unlike existing atomic clocks, the system operates at much higher frequencies, leading to sharper resonance, resulting in a higher precision and accuracy.