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Customer Inquiries

Media Inquiries

Information Technology R&D Center
Mitsubishi Electric Corporation

Public Relations Division
Mitsubishi Electric Corporation

www.MitsubishiElectric.com/ssl/contact/company/rd/form.html

prd.gnews@nk.MitsubishiElectric.co.jp
www.MitsubishiElectric.com/news/

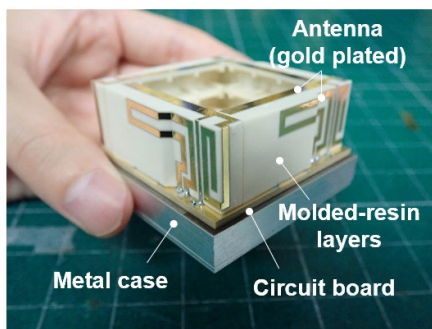
Mitsubishi Electric Develops World’s Smallest Antenna Prototype for High-precision Satellite-based Positioning in Four Frequency Bands

Will accelerate highly accurate positioning for autonomous driving and much more

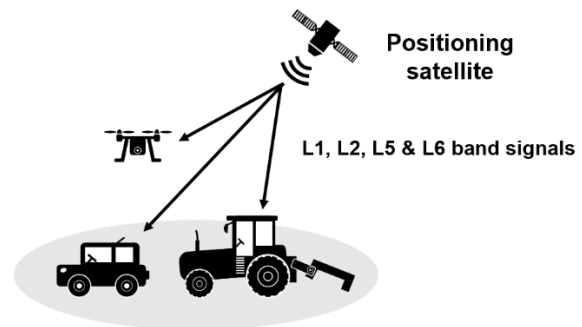
TOKYO, January 17, 2022 – [Mitsubishi Electric Corporation](http://www.mitsubishielectric.com) (TOKYO: 6503) announced today that it has developed a prototype of the world's smallest* antenna for high-precision satellite-based positioning in four frequency bands used by the world's main satellite-positioning systems and positioning-augmentation services.** The highly compact antenna, which is expected to be installed in diverse vehicles and even drones, will accelerate high-precision satellite-based positioning for autonomous driving and many other applications.

* As of January 17, 2022, among antennas for high-precision satellite-positioning in four frequency bands (according to Mitsubishi Electric)

** Services that provide information for correcting positioning errors and confirming positioning reliability



Prototype of compact antenna for satellite-positioning devices



Examples of satellite-positioning applications

Features

1) Proprietary technology achieves world’s smallest 4-band antenna for diverse vehicles

- The antenna’s two folded linear elements are wired three dimensionally and symmetrically on each of four molded-resin layers, which are perpendicular to the module’s horizontal surface. This unique design has resulted in the world’s smallest four-band antenna for the high-precision satellite-based positioning of diverse autonomous vehicles, including drones and small tractors as well as automobiles.

- The prototype's L1 bandwidth, which is about triple that of the company's existing model, is achieved with three-dimensional wiring*** and an antenna configuration optimized for space limitations. Also, the new antenna supports major positioning-satellite systems and positioning-augmentation worldwide.

*** Achieved with a molded interconnect device (MID) in which electrodes, circuits, etc. are formed on the surfaces of three-dimensional molded-resin layers

2) **Unique structure achieves multipath wave suppression for more precise positioning**

- Positioning precision is enhanced with the antenna's unique structure, which combines both straight and loop elements to reduce back lobe radiation, thereby suppressing multipath waves reflected from the ground.
- Compactness and multipath wave suppression are achieved without increasing the antenna's size, unlike conventional multipath-wave suppression methods.

Future Development

Going forward, Mitsubishi Electric will research practical applications by evaluating the prototype's positioning precision in outdoor trials.

Antenna Specifications

		New antenna	Company A's	Company B's	Company C's
Size (including case)	Horizontal surface	59 mm×59 mm	140 mm×140 mm	160 mm diameter	76 mm diameter
	Height	33 mm	62 mm	60 mm	35 mm

Background

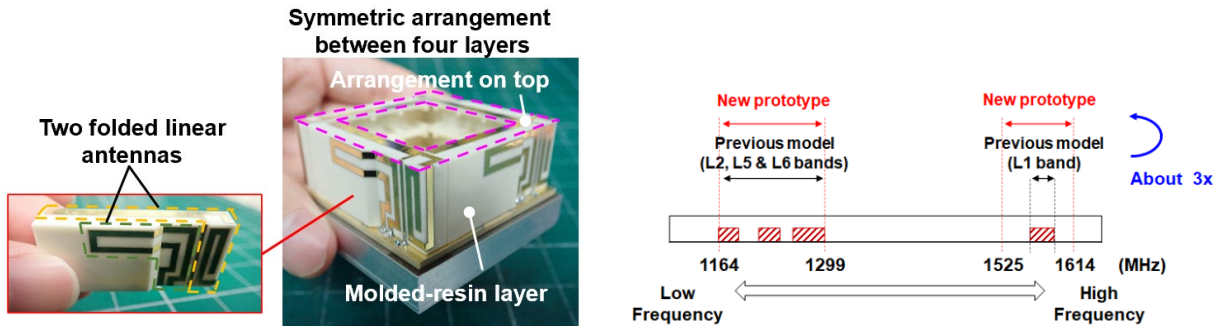
Japan's Cabinet Office authorized the launch of a centimeter-level positioning-augmentation service using the Quasi-Zenith Satellite System from November 2018. Positioning systems and services using the Quasi-Zenith Satellite System are now operating in various fields, including for driving support and autonomous driving. Antennas used in these systems can exceed 100 mm in diameter, so more compact designs are in demand. Mitsubishi Electric's new antenna is not only the world's smallest, it also is compatible with four frequency bands. By expanding the bandwidth of the L1 band, the antenna can support popular positioning-satellite systems and positioning-augmentation services worldwide. The antenna, which can be used in very small vehicles, including drones, will accelerate high-precision positioning in diverse fields.

Details

1) **Proprietary technology achieves world's smallest 4-band antenna for diverse vehicles**

Generally speaking, an antenna's horizontal surface must be broad enough to satisfactorily receive signals from positioning satellites. Mitsubishi Electric's unprecedentedly small antenna arranges elements three dimensionally, with two sets of folded linear elements placed symmetrically on each of four molded-resin layers. Also, since performance is proportional to an antenna's volume, the prototype's three-dimensional

element wiring and its space-optimized shape achieve high-frequency L1 band that is triple that of the existing model, enhancing support for major positioning-satellite systems and positioning-augmentation worldwide. Also, compactness will enable installation in diverse vehicles, including drones.

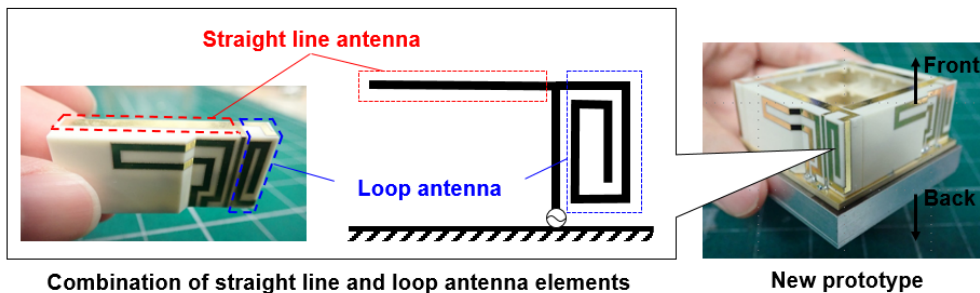


Antenna size-reduction technology

Expansion of frequency band:
(L1: 1560–1591 MHz, L2: 1213–1244 MHz,
L5: 1164–1189 MHz and L6: 1257–1299 MHz)

2) **Unique structure achieves multipath wave suppression for more precise positioning**

In satellite-based positioning, precision can be degraded by multipath waves, i.e., electromagnetic waves reflected from the ground. Such waves can be suppressed by reducing back-lobe radiation in the direction of the antenna's back, so Mitsubishi Electric developed a unique antenna structure for this purpose. Since one of the prototype's two folded linear antennas incorporates both straight and loop elements, Mitsubishi Electric utilized the elements' different radiation mechanisms to combine their respective radiated waves. As a result, back-lobe radiation is reduced without increasing antenna size, unlike conventional methods.



Antenna elements for reducing back-lobe radiation

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About Mitsubishi Electric Corporation

With 100 years of experience in providing reliable, high-quality products, Mitsubishi Electric Corporation (TOKYO: 6503) is a recognized world leader in the manufacture, marketing and sales of electrical and electronic equipment used in information processing and communications, space development and satellite communications, consumer electronics, industrial technology, energy, transportation and building equipment. Mitsubishi Electric enriches society with technology in the spirit of its “Changes for the Better.” The company recorded a revenue of 4,191.4 billion yen (U.S.\$ 37.8 billion*) in the fiscal year ended March 31, 2021. For more information, please visit www.MitsubishiElectric.com

*U.S. dollar amounts are translated from yen at the rate of ¥111=U.S.\$1, the approximate rate on the Tokyo Foreign Exchange Market on March 31, 2021