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Multiband Antenna Offering Multiple Functions and Compact Design

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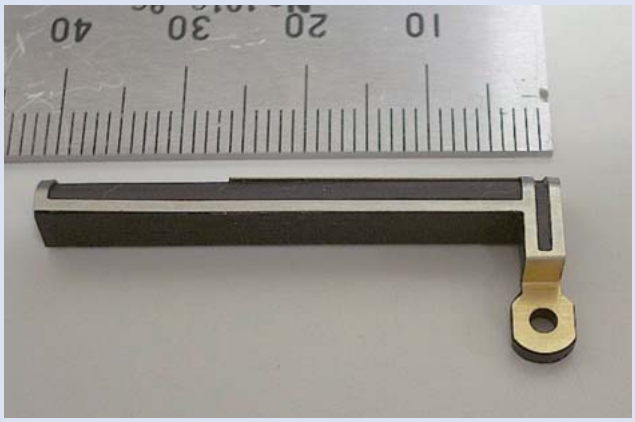
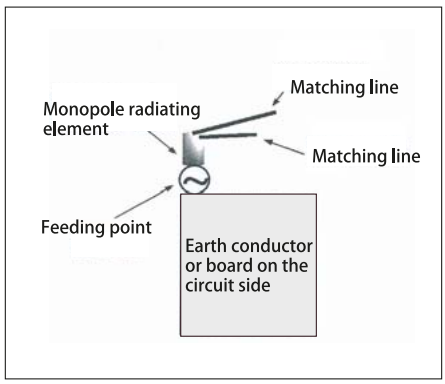


Overview of the technique

The present invention consists of technology for a built-in antenna for transmission and reception having vertical polarization characteristics, rendering it unnecessary to switch between multiple frequency bands at widely different frequencies in compact radio terminals (such as cellular phones), which are characterized by limited space. Conventional antenna matching methods are performed by either attaching lumped elements on the feed line side, employing a distributed constant circuit pattern, or by attaching lumped elements such as coils or condensers inside the antenna element. However, both of these approaches are costly and time-consuming, since they require the additional steps of mounting and adjustment of the lumped elements. Further, the mounting of lumped elements consumes valuable space inside cellular phones, which have limited component space to start with. Our present invention consists of an antenna that allows easy frequency adjustment without requiring a lumped element; we refer to this device as a multiband monopole antenna. At the tip of the feeder unit of this antenna is a monopole radiating element unit of sufficiently short length with respect to the frequency to be used. The feeding point is set on the earth-conductor side of this monopole-radiating element (see figure below). Additionally, a shorter matching circuit for frequencies than those in use will be positioned on the opposite tip of this feeding point in the monopole-radiating element. The number of matching circuits will be the same as the number of frequency bands being employed, and matching is performed by adjusting the lengths of these circuits. The matching circuit is designed to be bendable, and can be placed parallel to the monopole unit, which limits size in the two-dimensional direction (corresponding to a low-profile design); the circuit thus can be installed within a small space. This antenna is mainly effective for applications such as the cellular phone, which makes use of widely separated frequency bands. However, modifications in the design will permit the antenna to cover a wide range of continuous frequency bands; for example, by employing multiple matching circuits for adjacent bands.



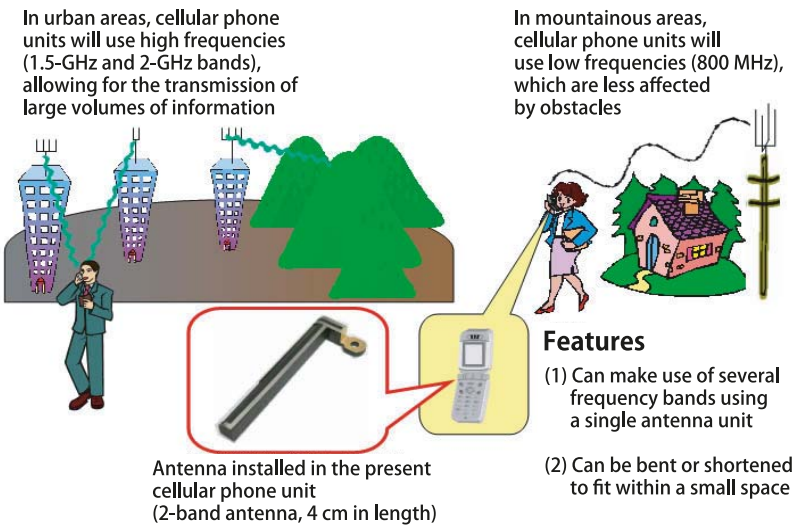
Schematic diagram

Multi-functionalization of cellular phones

The cellular phone is a prime example of an application of the present multiband monopole antenna. Some cellular phones available today make use of several frequencies, in order to offer more secure connections. Such phones normally carry out large-volume transmissions (such as video transmissions) using high frequencies (in the 1.5-GHz and 2-GHz bands) in urban areas, while in mountainous areas, these phones will automatically switch over to lower frequencies (in the 800-MHz band), which are less affected by obstacles, in order to ensure greater reliability in the establishment of connections. Cellular phones have also come to offer a variety of functions, such as user positioning based on GPS satellite (1.6-GHz band) communications, as well as Internet connectivity based on compatibility with wireless LAN (2.4-GHz band) networks. This multi-functionalization of cellular phones has resulted in an increasing number of frequency bands in use by a single cellular phone unit. The present antenna, which functions as a multiband antenna for two to three frequency bands (while having the same size and structure as a single-band antenna), is a powerful tool for these sorts of applications. The present antenna requires no more space than conventional antennas for cellular phones and fits inside the small space available. Thus, a cellular phone unit can be equipped with a multiband antenna without a corresponding increase in size, allowing for higher security in connections and greater functionality in devices.

Commercialization of the antenna

At NICT, we have transferred the technology for our "multiband compact antenna (multiband monopole antenna)"—the result of our research on high-frequency circuit components—to Nissin Parts Co., Ltd., as a part of our efforts to promulgate the achievements of our R&D throughout industry. The transfer specifically included antenna design, measurement data for antenna characteristics, adjustments, technical know-how in associated areas, technical guidance, and a patent license. The present antenna has been commercialized and marketed by Nissin and has been adopted in the latest models of multi-functional cellular phone units. We believe that the present transfer of technology has contributed greatly to the promotion of multi-functional, compact cellular phone units. You may be surprised to know that this multiband monopole antenna—the result of research and development at NICT—may form an essential component of the cellular phone you use every day.



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