WHITEPAPER

GNSS antenna modules

Global positioning made easy

Whitepaper by: *Kim Kaisti,*
Product Manager GNSS antenna modules, u-blox

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Executive Summary

As more and more products and devices integrate global positioning as a standard feature, a performance optimized "GNSS antenna module" which combines both satellite receiver chip and antenna on the same module can be a good solution. These modules provide fast time-to-market, simplified logistics and an economically viable solution for "instant" positioning. This whitepaper describes the advantages and design aspects of using a GNSS antenna module.

Fig. 1: Personal locator with integrated GNSS chip antenna module

GNSS antenna modules for "instant" global positioning

More and more end-products are integrating global positioning as an attractive feature. In addition to familiar navigation systems, "Global Navigation Satellite System" (GNSS) receivers are required in vehicle and asset tracking systems, personal locators, security systems, vending machines, health monitoring and recreational devices.

Every GNSS receiver requires an antenna to pick up the extremely weak signals broadcast from satellites typically 20 thousands kilometers away. As many customers do not have the RF/antenna tuning expertise or the sourcing capability, a performance optimized "GNSS antenna module" which combines both satellite receiver chip and antenna on the same module can be a good solution. These modules provide fast time-to-market, simplified logistics and an economically viable solution for "instant" global positioning.

A GNSS antenna module is also significantly smaller in size than a GNSS module plus an external antenna. This makes a GNSS antenna module with integrated chip antenna a very attractive and hassle-free option for very thin designs.

A typical application ideal for the GNSS antenna module approach is the fast-growing market for personal and pet locator devices. These types of devices are extremely small, while requiring optimal antenna performance regardless of device orientation.

Also important is high jamming-immunity of the satellite receiver chip as personal tracking devices typically include a cellular modem, and may often share the same pocket as a mobile phone. A GNSS antenna module with pre-tuned antenna optimized for good reception regardless of orientation, as well as integrated SAW filters to provide high immunity to cellular noise are two important design criteria.

Single vs. multi-GNSS?

Depending on the intended region of use, support of multiple satellite navigation systems including GPS, GLONASS (Russia), BeiDou (China) and QZSS (Japan) may be required. This expands regional compatibility of the device. Additionally, support of two satellite systems at the same time (e.g. GPS/GLONASS, GPS/BeiDou, GLONASS/BeiDou) increases positioning speed and reliability as the chances of having line-of-sight to the minimum four satellites required to calculate a position is increased.

An example of an application that integrates a GNSS antenna module with integrated chip antenna is shown in figure 1. The personal locator is extremely thin thanks to the integrated chip antenna, and allows a user's location to be tracked and displayed over a web-interface.

Fig. 2: u-blox CAM-M8Q GNSS antenna module with integrated chip antenna and multi-GNSS support

The device integrates u-blox' chip antenna module, CAM-M8Q ("Chip Antenna Module") which provides both small size (9.6 x 14.0 x 1.95 mm) and multi-GNSS capability. The chip antenna element used can handle all L1 frequencies ranging from BeiDou (1560 MHz) and GPS (1575 MHz) up to GLONASS (1606 MHz). The surface-mount module is also extremely low in height making very thin customer designs possible.

Bottom view: shield side

Top view: patch antenna side

Fig. 3: u-blox PAM-7Q GPS antenna module with integrated patch antenna: 22 x. 22 x 8 mm

Chip antenna modules require care in design implementation as the PCB forms part of the overall antenna (half of the dipole). For this reason, vendor design-in support including system integration support and knowledgeable Application Engineers with many years experience in designing with chip antenna modules is important to achieve optimal performance.

CAM-M8Q: a drop-in positioning solution

CAM-M8Q also has a feature whereby the internal chip antenna can be used as a backup antenna if the customer chooses to use an external antenna. This is useful in applications where there is a risk that the primary external antenna may malfunction or suffer damage, for example in vehicle tracking systems where damage to the external antenna is possible (see schematic in Fig. 7).

PAM-7Q: a reliable all-in-one GPS antenna module

For GPS-only applications, the PAM-7Q (fig. 3) is a highly popular form factor due to its installation flexibility. It can be mounted 'as is' in pre-existing designs or soldered with a pin-header to a customized PCB. The 18 x 18 mm patch antenna of PAM-7Q provides RHCP polarization not achievable with smaller patch antenna elements.

The simple design and easy interfacing keeps installation costs to a minimum. It targets industrial and consumer applications that require a small, fast and cost efficient solution to GPS positioning.

Both modules have been designed and tuned for optimal antenna performance independent of orientation and provide high sensitivity and jamming immunity as they include integrated SAW filters.

Antenna module performance

Fig. 4 shows GNSS antenna gain measurements over three planes. Note the near uniform performance in the vertical planes. This demonstrates consistent antenna gain in the sky-facing direction, independent of device orientation.

Measurements are based on the module mounted on an 80 x 40 mm ground plane, which acts as part of the antenna. The dark blue rectangle indicates the recommended mounting position of the antenna module.

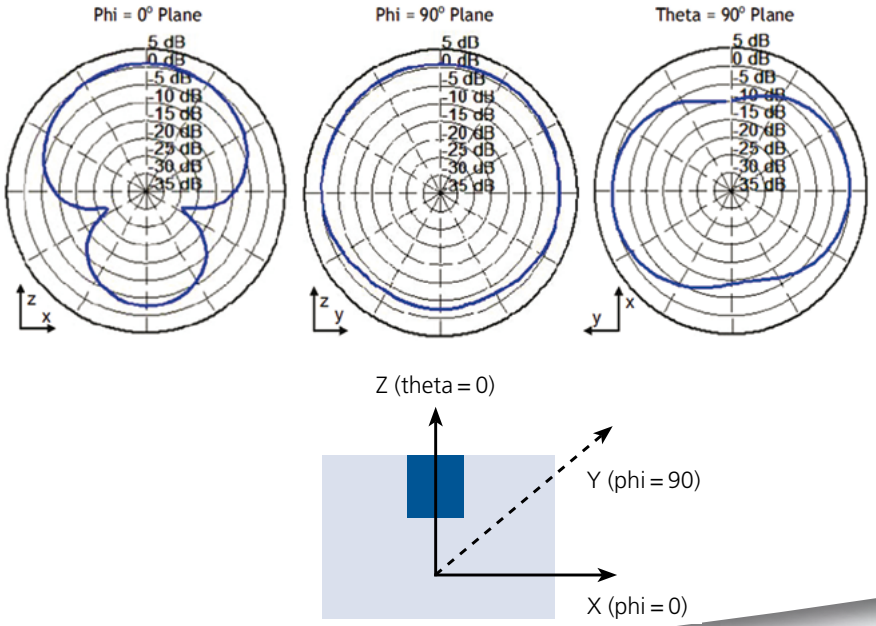

Fig. 4: Antenna gain performance over 3 planes. Note that the PCB itself forms part of the overall antenna (half of the dipole). Where the module is mounted on the PCB is thus an important design consideration

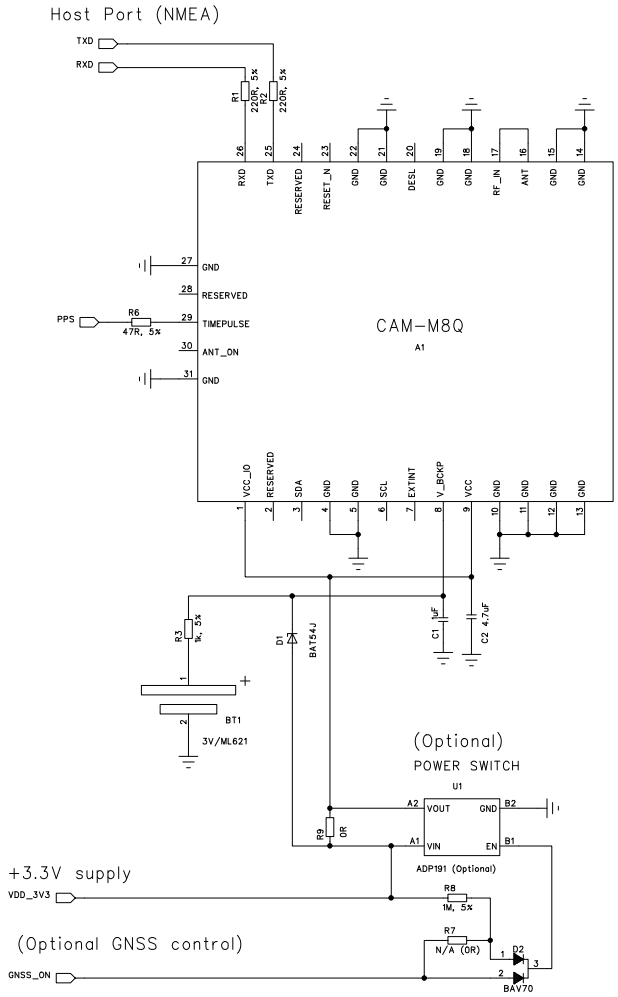

Fig. 5: CAM-M8Q GNSS antenna module schematic. The internal GNSS chip antenna is used resulting in an extremely simple design

Schematics

The following schematics illustrated the simplicity of designing with the CAM-M8Q GNSS antenna module. The first schematic in Fig. 5 shows a standalone solution using the internal GNSS antenna: only a few external passives used for the usual power supply filtering and protection are needed. An optional power on/off power switch is also included.

All positioning information is communicated to the host processor via the 2-wire NMEA interface on pins 25 and 26; no host processing is required, the module delivers a final position fix.

Fig. 6 shows a design where an external GNSS antenna is used. Should the external antenna become damaged, or the connection broken, the module automatically switches to the internal GNSS chip antenna so that positioning may continue. This is a very useful feature in vehicle applications where the external antenna could be damaged or compromised in the event of an accident.

For more information about u-blox GNSS antenna modules, visit our GNSS antenna module technology page, or download the PAM-7Q and CAM-M8Q product summaries.

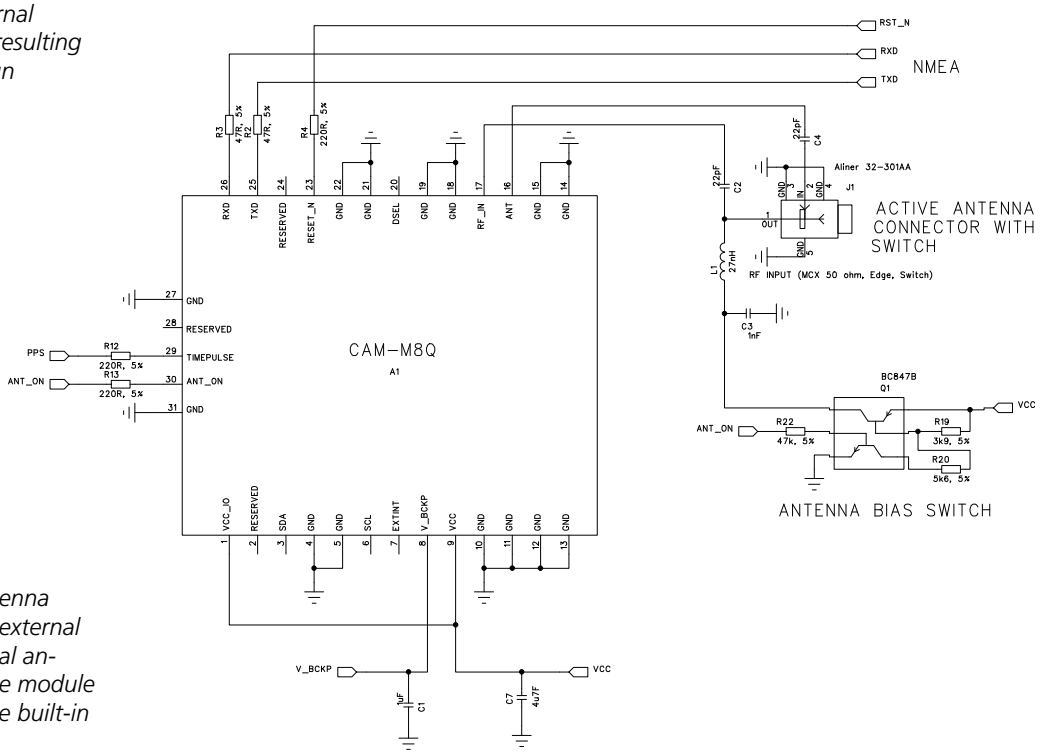

Fig. 6: CAM-M8Q GNSS antenna module schematic using an external GNSS antenna. If the external antenna ceases to function, the module automatically switches to the built-in GNSS chip antenna

About u-blox

Swiss-based u-blox (SIX:UBXN) is the global leader in wireless and positioning semiconductors for the automotive, industrial and consumer markets. Our solutions enable people, vehicles and machines to locate their exact position and wirelessly communicate via voice, text or video.

With a broad portfolio of chips, modules and software solutions, u-blox is uniquely positioned to allow OEMs to develop innovative solutions that enable mobility quickly and cost-effectively. With headquarters in Thalwil, Switzerland, u blox is globally present with offices in Europe, Asia and the USA. (www.u-blox.com)

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Any comments relating to the material contained in this document may be submitted to:

u-blox AG
Zuercherstrasse 68
8800 Thalwil
Switzerland
info@u-blox.com