

TriQuint Semiconductor

“RF Design Considerations for Automotive GPS Systems”

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Introduction: TriQuint Semiconductor is a leading designer and manufacturer of surface acoustic wave (SAW) filters for GPS applications including personal navigation devices (PND) and automotive systems. TriQuint shipped more GPS SAWs in 2007 than any other manufacturer, and continues its leadership in 2008. TriQuint recently introduced a new integrated RF front-end module for GPS designed to enable wireless handset manufacturers to more easily incorporate location-based functions into their products while also meeting the needs of PND and automotive GPS designers. TriQuint’s experience in the rapidly-changing world-wide GPS market has made it an authority on this exciting new technology that has grown to dominate new consumer and industrial applications, enabling a new age of precision, safety, reliability and independence to change the way we navigate around our world. This White Paper addresses common concerns of designers working in automotive GPS applications. For more information, visit www.triquint.com or e-mail: info-networks@tqs.com and put ‘GPS’ in the subject line of your message.

1. Compared with consumer electronic GPS navigation systems, such as Personal Navigation Devices (PND), what are the special requirements of designing GPS systems for automotive applications? How should the automotive GPS system designer plan to meet these requirements?

An RF engineer comparing GPS navigation systems for automotive applications with PND should consider three key differences. The first is the relative position of the antenna to the GPS receiver; the second is size; the third is the operating environment.

The standard GPS receive chain will have the signal traveling through an antenna, a front-end SAW filter, an LNA and a second SAW filter before delivering it to the GPS receive chipset. In a PND, all of these elements are co-located; in a car, however, the antenna may be as many as 12 feet away from the GPS receiver, forcing a modified design. Due to additional cable losses and opportunity for interference, the rooftop antenna must be “active,” meaning it needs to have filtering and gain built-in. Therefore, the entire RF receive chain (first SAW filter, LNA, and second SAW filter) must be designed into the antenna housing on the roof. At the other end of that cable run (under a seat or under the dashboard), there will be a requirement for another SAW filter – and possibly an additional LNA – to ensure that a clean, reliable signal is delivered to the GPS receive chipset.

Car and truck makers are adding a great deal of RF capability to their vehicles. As such, rooftop antennas are increasingly being specified to handle a great number of signals, including AM/FM, satellite radio, GPS, WLAN, and multiple cellular bands. At the same time, aesthetics requires that the antenna be small and inconspicuous. The combination of these factors results in requirements for extremely small electrical components for active antennas. An excellent way to save space on a board is to integrate components. TriQuint's new TQM640002 module integrates the SAWs and the LNA into a single small 3x3mm package. Since the product is 100% internally matched, it requires no further matching components; this fact minimizing the space needed inside the antenna module for the GPS receive chain.

Another important design consideration is the environment in which the system resides. Components must be operational over a wider temperature range, which is a relatively straightforward electrical consideration. More complicated, however, are the qualification requirements that the automotive industry places on electronic suppliers. These requirements come in two forms: factory qualification and device qualification. Automotive customers require that semiconductor supplier factories have TS-16969 certification. TS-16969 is an ISO Technical Specification which designates quality system requirements for the design, development, and production of automotive-related products. However, even with factory certification each device must also be qualified. The Automotive Electronics Council (AEC) has devised the AEC-Qxxx set of qualification specifications, which include such tests for humidity resistance, temperature cycling, and vibration/shock. Most automotive designers require that electronic components are compliant to AEC-Q100 (for active components) or AEC-Q200 (for passives).

In order to meet automotive quality and reliability requirements, TriQuint believes that a component supplier must be committed to world-class quality in all facets of its business. As a part of this effort, three of TriQuint Semiconductor's main manufacturing facilities have completed TS-16969 certification and TriQuint offers a wide range of AEC-Q200-compliant filters.

2. Does TriQuint offer unique approaches or solution designs to help engineers working in GPS applications overcome typical challenges?

TriQuint Semiconductor is simplifying GPS design. The new TQM640002 module, as described earlier, integrates two filtering stages and an LNA gain stage, providing a complete RF receive-chain solution for all GPS applications.

This TriQuint module is completely 'plug-and-play'. It is pre-matched to 50Ω on the input for connection to an antenna; and is also pre-matched to 50Ω on the output. The TQM640002 requires no additional matching elements between components, simplifying design and minimizing footprint. In fact, the whole module is just 3x3mm in size.

The TQM640002 is designed to work with any GPS transceiver chip, providing low noise figure, significant gain, and high rejection in key cellular & WLAN bands. This rejection performance is critical, as most rooftop antennas include cellular and other functionality in addition to GPS. In such a noisy RF environment, the GPS LNA and subsequently, the receiver, must be properly protected. The excellent filter performance within the TQM640002 allows the module to achieve this requirement.

TriQuint's unique combination of capabilities (i.e., GaAs, SAW, GaN, and BAW technology all through one designer and manufacturer) allows us bring this module to market using completely in-house technologies. There are two main advantages to this approach. First, because we are not sourcing the filters or the LNA externally, we avoid stacked margins and can keep costs low. Second, we have designed the various components within the module in concert with one another. As such, the final integrated product achieves better performance than would a discrete design.

For more information about GPS applications and solutions from TriQuint Semiconductor, visit: <http://www.triquint.com/prodserv/markets/other/gps.cfm>

For information about the world's most integrated GPS RF front-end module, TriQuint's new TQM640002, send e-mail requests to: info-networks@tqs.com; please put the part number in the subject line.