Can China's Automotive Electronics Be the Next Big Thing?

Seasoned automotive players will be in pole position

Many Analog IC manufacturers have been supplying power management and conversion ICs to automobile makers for many decades. Their products have been used in a variety of automotive electronics systems. The 'China-challenge' could open up great further growth opportunities.

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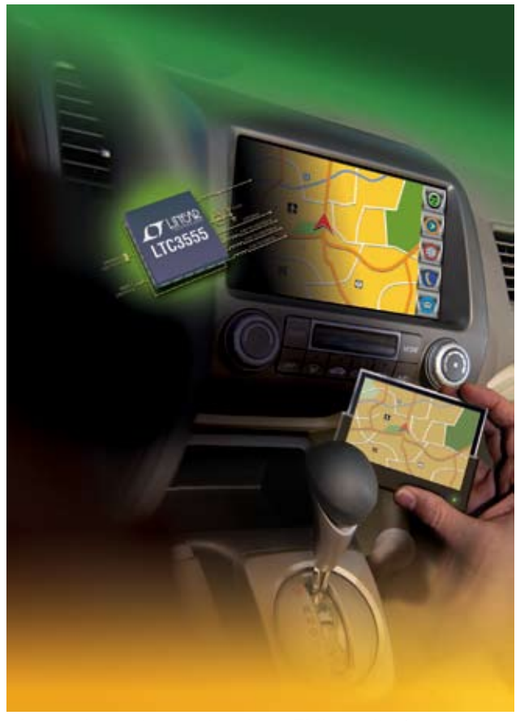
Automotive products now widely used in powertrain, body & convenience, safety, in-vehicle networks, infotainment systems, LED vanity lights and engine control units have all showed growth in terms of usage in vehicles during 2007 and promise to have increased growth rates in 2008. LED headlamps, in particular, will have significant growth rates from 2008 onwards. As demonstrated in recent press announcements, Audi will use them in their R8 and A8 models – with the Cadillac Escalade and the VW Golf to have them as options in their 2009 model years due for release to the public later this year.

Unfortunately, collision avoidance systems with their large IC content, which have been underway for the past couple of years, are only now starting to appear in high-end luxury cars within the 2008 model year. However, for widespread adoption to occur, the costs of implementation will have to come down drastically. Therefore, it will be at least another five to eight years before these types of systems will become mainstream.



Low quiescent current and low EMI are vital for automotive infotainment systems.

The Chinese automotive electronics annual growth rate has been greater than 40% since 2005, and will most likely continue at this rate through the end of this decade. There are three main reasons for this continued growth: China is one of the fastest developing markets for automotive electronics content, it produces quick and innovative automotive products and has high demand from its domestic consumers.

It should also be noted that China has increased its automobile output by over 25% annually from 2001 to 2005, with sales in 2006 over 7.2 million units. Early indications in 2007 indicated that this sales pace would mean close to 9 million vehicles being produced – with 2008 having similar growth rate expectations. Clearly, the upside potential for manufacturers of power management and conversion ICs used in automotive electronics systems is going to be large in the China market.

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One of the fastest growing applications segments in the China market will be automotive infotainment systems with about a 9% compounded annual growth rate (CAGR). This category can be broken down into five sub-categories, as follows; audio-only systems, front seat infotainment, rear seat infotainment, embedded navigation systems and emergency telematics. As a result, China is projected to have a worldwide market share of automotive infotainment systems a little over 10% by 2015. This is in sharp contrast to only a 3% share in 2006.

It is a well-accepted fact that modern automobiles continue to include increasingly complex electronic systems. At the same time, the automotive environment continues to be very harsh for any type of electronics. Wide operating voltage requirements coupled with large transient voltages and large temperature excursions combine to make life tough on electronic systems. What's more, the performance requirements continue to become even tougher. In addition, multiple supply voltages are usually required for different portions of any system. A typical in-dash infotainment system can have six or more different supplies including 8.5V, 5V, 3.3V, 2.5V, 1.5V and 1.2V. Moreover, as the number of components increases, space requirements continue to shrink. Therefore, efficiency becomes more critical in space-constrained systems because of the space limitations and temperature requirements. At low output voltages and even with moderate current levels, above a few hundreds of milli-amperes it is no longer practical to simply use a linear regulator to generate these system voltages. As a result, over the last several years, primarily due to thermal constraints, switching regulators have been replacing linear regulators. The benefits of a switcher, including the increased efficiency and smaller footprint, outweigh the additional complexity and EMI considerations.

For a switching regulator to be considered for use in an automotive environment, it needs the following features and characteristics at a minimum:

- A wide input operating range
- Good efficiency across a wide load range
- Low quiescent current during normal operation, standby and shutdown
- Low thermal resistance
- Minimal noise and EMI emissions

However, it is low quiescent current in a standby mode that is in high demand due to the large number of "always-on" systems that are still in operation even when the vehicle is parked. Examples include remote keyless entry, GPS location/tracking and alarm systems. A key requirement for these applications is a low quiescent current. A regulator would need to run in normal continuous switching mode until the output current drops below about 100mA. Below this level, the switching regulator must skip pulses in order to maintain load regulation. However, it can go into a sleep mode between pulses where only a portion of the internal circuitry is powered. At light load currents, a switching regulator needs to switch automatically to Burst Mode® operation. In this mode, the quiescent current should drop below 100uA for a 12V to 3.3V converter, as an example. The internal reference and power good circuit can remain active in sleep mode to monitor the output voltage.

Although switching regulators generate more noise than linear regulators, their efficiency is far superior. Noise and EMI levels have proven to be manageable in many sensitive applications as long as the switcher behaves predictably. If a switching regulator switches at a constant frequency in normal mode, and the switching edges are clean and predictable with no overshoot or high frequency ringing, then EMI is minimized. A small package size and high operating frequency can provide a small tight layout, which minimizes EMI radiation. Furthermore, if the regulator can be used with low ESR ceramic capacitors, both input and output voltage ripple can be minimized, which are additional sources of noise in the system.

Linear Technology continues to provide a wide array of products that meet all of the demands in automotive systems, these include:

- Wide input voltage ranges: 3.6V to 60V (and some up to 100V)
- Low quiescent current in standby mode: Typically less than 100µA and as low as 13µA.
- Minimal output noise and low EMI: less than 25mVpp for switching regulators and less than 100µV for linear regulators
- Extended temperature ranges: guaranteed 150°C ambient and junction temperature operation (H grade)
- High efficiency: up to 95% at full load and as high as 70% under light load conditions
- Low thermal resistance packages: as low as 10°C/W (θjc)
- High switching frequency operation: up to 2.8MHz
- High current densities: up to 2A of continuous output current from 3mm x 3mm DFN packages
- Industry leading FIT rates: typically less than 1

Conclusion

It is clear that Chinese automotive electronics will be a significant opportunity for semiconductor vendors going forward – particularly analog IC suppliers in the power management and conversion segment. As a result, those vendors who have worked on these types of products with the automobile manufactures in the USA, Europe and Japan will have the pole position in the Chinese market.

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