PROJECT RESULT

Enabling
IC technologies
for applications

T122: Fitness of advanced semiconductor processes for 42V battery supply in automotive applications (SC42VAA)

Powering up semiconductors for demanding automotive and non-automotive use

Extensive work on high voltage capability and temperature robustness in SC42VAA has resulted in a new generation of smart power processes able to combine digital logic and high power switching on a single substrate for applications up to 85 V in rugged environments. Envisaged originally for 42 V car power distribution, these 0.35 μm technologies are being used in automotive and non-automotive areas – such as computer peripherals, particularly printers and display drivers. And there are increasing demands for this approach in high voltage switching applications in North America and Asia Pacific.

Automotive electronics account for about a quarter of the value of current motor vehicles and this is expected to reach more than a third by the end of the decade. While only about 8% of global electronics sales are to the automotive sector, it is the segment showing the strongest growth with a nearly 10% annual increase. Moreover, numerous innovations in vehicles are helping drive the general semiconductor market.

Typically, a large number of the automotive applications – from engine control and active suspension to power steering and drive by wire – require high levels of power. There was concern in the car industry that the existing 14 V distribution system would become inadequate and that, by 2005, it would be necessary to move to the 42 V distribution networks used in many heavy commercial vehicles.

The MEDEA+ T122 SC42VAA project set out to identify suitable CMOS and smart power process platforms to meet these needs. It brought together three European companies, highly qualified in chipmaking and automotive electronics systems manufacturing.

Choice of approaches

Evaluation of market needs was carried out together, and common targets and specifications were agreed. Whilst STMicroelectronics and AMIS concentrated on development of the technologies needed by effectively building on known platforms, Bosch contributed in providing expertise in automotive electronic systems applications.

For AMIS, the key challenge lay in the insulation requirements for high voltage, which could be met either by a standard silicon substrate or through use of silicon-on-insulator (SOI) technology. With SOI, the substrate incorporates a thin layer of silicon oxide that provides improved insulation. However, this was found to be more expensive and harder to handle.

Therefore, AMIS focused on silicon substrates. In the first half of the project, it studied junction isolation but it became clear that trench isolation offered a better approach, requiring 60 or 70% less area at 80 V – reflected in lower costs.

With a 42 V battery system in a vehicle, the peak voltage would be in the region of 90 V – for example, when starting the engine. So the target was a power stage rated for 80 V but able to handle 90 V peaks. The feasibility phase proved the possibility of going up to 50 V with trench isolation but without the need for new production equipment. With a redesigned circuit, it was possible to handle up to 120 V.

The result at AMIS was 0.35 μm CMOS technology able to handle 80 V switching. This technology was put into production following the end of the project – a major success.

STMicroelectronics demonstrated a similar result using junction isolation with its 0.35 μm technology. It started by optimising two platforms:

1. The multifunctional BCD5 bipolar/ CMOS/ DMOS platform already handled 44 V. By optimising and resizing power components, 70 V operation was possible in a real multifunction platform combining power, logic, memory and – if required – eight-bit microprocessor. Bosch designed several building blocks to evaluate the platform for applications such as a controller area network (CAN) transceiver.
2. The BCD4 platform was already used for the automotive sector. It could be optimised more readily to handle high power as the digital content was smaller. A total revision and shrinkage from 0.8 to 0.72 μm minimum geometry achieved both 65 and 80 V classes. Bosch again evaluated several building blocks with good results.

   Finally, at Bosch's suggestion, STMicroelectronics developed the HVCMOS6 platform derived from the 0.35 μm BCD6 platform, retaining only digital functions with no power actuation, adding some new high voltage MOS components able to function up to 45 V. The Bosch objective was to evaluate new concepts for engine control unit partitioning able for example to act as an interface between in-car sensors and actuators.

Non-automotive use

Three years into the project, the demand from the worldwide automotive industry for 42 V distribution systems evaporated. Developments in alternator technology had made it possible to provide sufficient power using existing 14 V systems, despite the wiring costs. But the research effort by the two chipmakers in the MEDEA+ SC42VAA project has led to the development of technologies that can be used equally in non-automotive applications.

There is a market for lorries that already use 42 V distribution systems. And completely new markets have emerged in computer peripherals – particularly printers and display drivers – as well as in power supply applications. Here the requirements go from 42 up to 80 V.

The advantage of the technologies developed in SC42VAA is that it makes possible the combination of logic and power stages in the same device to provide high voltage and high power using standard silicon processes. Previously, it had been necessary to use separate application-specific integrated circuits (ASICs) and power transistors.

Meeting global needs

Working together in the MEDEA+ project has enabled two specialist European chipmakers to identify global needs for high voltage applications and develop competitive CMOS and smart power platforms to meet these requirements.

STMicroelectronics is already working on new devices able to operate at 65 or 80 V, principally for the automotive sector – including in the power train, car body and communications devices. And its process is moving on to 200 mm wafer lines. AMIS has used its fully qualified technologies to design several prototypes outside the automotive sector. Market exploration is continuing worldwide to find new applications and customers.

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MEDEA+ focuses on enabling technologies for the Information Society and aims to make Europe a leader in system innovation on silicon.