MCUs with functional safety for automotive and transportation designs

Texas Instruments (USA) announced 12 Hercules TMS570 ARM Cortex-R4 safety micro-controllers, complementary TPS65381-Q1 multi-rail safety power management integrated circuit (PMIC) and DRV3201-Q1 safety motor driver. The chipset for automotive and transportation motor control applications helps customers to achieve ISO 26262 and IEC 61508 certification.

THE INTRODUCED HERCULES TMS570LS12x/11x floating-point units provide additional memory (256 KiB, 384 KiB, 1 MiB and 1,25 MiB Flash) and performance configurations (from 80 MHz to 180 MHz lockstep ARM Cortex-R4 cores) with expanded motor control capabilities. The Hercules TMS570LS04x/03x provide a smaller package, lower cost, entry-line solution with integrated motor control interfaces. On-chip CAN, Flexray, Ethernet and LIN connectivity enables standard automotive networks and provides options for data collection. Hardware safety features include online diagnostics, memory protection for the CPU and bus masters, error correction code for Flash and RAM with single-bit error correction and double-bit error detection, CPU and RAM built-in-self-test for detection of potential latent faults. An error signaling module for action based on safety error, parity on peripheral RAMs, redundant analog-to-digital converters and timers and continuous voltage and clock monitoring are available as well. Integrated motor control capability includes enhanced pulse width modulation. Sensor capture and quadrature encoder interfaces on chip eliminate multiple external components for motor control. The 32-channel timer coprocessor serves as a redundant motor control channel and checks the integrity of the pulse-width modulators (PWMs) in the motor control loop.

Pin compatibility with the Hercules TMS570LS31x/21x introduced in 2011 and scheduled for production by October 31, 2012, is given for the Hercules TMS570LS12x/11x. Additional TMS570 connectivity software includes CANbedded by Vector dedicated for CAN or LIN communication between ECUs in cars and heavy duty vehicles using J1939. CAN device driver supporting single and multiple CAN channels, CANopen, J1939, ISO-15765 as well as NMEA2000 protocol stacks are available from Simma Software. The safety micro-controller family is dedicated for driver assistance systems, electric power steering, hybrid and electric vehicles, rail propulsion control, aviation anti-skid control, off-road vehicles and more.

The PMIC including multiple power supply rails in a single device converts the input battery voltage to 6-V pre-regulator output, which supplies other regulators. Two linear regulators with internal FETs can supply power to a CAN and to the micro-controller I/Os. One linear regulator controller supplies the micro-controller core. An additional integrated sensor supply provides both short-to-ground and short-to-battery protection that can supply power to a sensor outside the electronic control unit (ECU).

Functional safety architecture integrates question-answer watchdog, MCU error-signal monitor, clock monitoring on internal oscillators, self-check on clock monitor, cyclic redundancy check (CRC) on non-volatile memory and a reset circuit for the micro-controller. A built-in-self-test allows for monitoring the device functionality at start-up, and a dedicated diagnostic state allows the micro-controller to check the PMIC safety functions, removing the need for an additional monitoring micro-controller.

The DRV3201-Q1 motor driver is dedicated to automotive three-phase brushless DC motors, providing six drivers for n-channel MOSFET transistors. The driver source/sink currents are programmable for output slope adjustment. The motor driver supports start/stop functionality, allowing control on the power stages at battery voltage down to 4,75 V. Functional safety architecture integrates features such as voltage drain-to-source monitoring, phase-comparators, shoot-through protection, dead-time control, temperature warning and protection, battery voltage detection for under and over voltage protection.

Packages: LQFP: 144 pin - 20 x 20; nfBGA: 337 pin - 16 x 16, 0.8 mm; -40 to 125 °C temperature range

The safety manual and safety analysis reports, details how to implement Hercules micro-controllers, PMIC and motor driver in a safety-critical application, as well as failure modes, effects and diagnostic analysis meet safety standards. Hercules development kits and Hercules TMS570 motor control kit are available along with a compiler qualification kit. Autosar software for ISO 26262 with protection mechanisms to ASIL D are offered by TTTech and Vector. ISO 26262 Autosar support is available from Vector and Elektrobit. Hercules TMS570 micro-controllers and a variety of software and tools are already available for order. The TPS65381-Q1 and DRV3201-Q1 will be available in December 2012.

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