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Embedded Measurement Systems

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ABSTRACT

The subject of Embedded Measurement Systems (EMS) is the merging of embedded systems and electrical measurement systems. This indicates that EMSs are hardware-software systems dedicated to measuring one or a few physical quantities. Applications are numerous; EMSs measure the temperature in refrigerators, freezers, irons, ovens and automobile combustion engines, they sense vibrations in tilt alarms and game consoles, they measure airflow in engines and ventilation systems, they measure shock impact in crash detectors and are used as shock and temperature loggers for transport goods, they measure air pressure in airplane cabins, humidity in air-conditioned environments, they measure liquid levels in fuel tanks, they detect smoke in fire alarms, they measure the viscosity of lubricant oil in engines, they measure the rotation speed of spinning wheels (in any engine), they measure torque in engines and are used as heart rate and ECG detectors in medicine etc.

The commercial demand for ever cheaper products and worldwide environmental legislations force vendors to continuously look for more cost-efficient and less power-consuming solutions for their embedded measurement systems. This thesis is concerned most of all with the implementation of cost-efficient/low-power measurement systems in embedded controllers. This includes some novel ideas in voltage, time and resistance measurements with embedded controllers and it will demonstrate how these quantities, analog in nature, can be measured accurately and precisely by inherently digital embedded controllers.

Keywords: Microcontroller, measurement system, direct sensor-to-controller, time-to-digital converter, phase detector, lock-in amplifier.