

HW and electronic design

White Paper

Embedded design

For embedded systems development, CERTICON offers all types of business models starting from specialists outsourcing up to complete product development for a fixed price. Our engineers have wide experience with physical data collection in the Medical and Industrial areas.

■ Competences in embeded systems design

- Low power battery operated systems
- Wireless systems and antennas design (ISM 868 MHz, 2.4GHz)
- Wire-bounded distributed systems (CAN, I2C)
- Highly reliable and robust design
- Cost driven design for high volume production
- Prototype manufacturing and verification

Embedded design covers three major areas

1) Electronic hardware design

Our engineers start first with requirements analysis and architecture design. After architecture approval they select appropriate components. We have wide experience and overview with MCU, bluetooth modules, pressure sensors, temperature sensors, ADCs, etc.

These mostly work with a low power MCU from Texas Instruments (for example TI430xxxx) or from ST (STM8/16/32) or with other 8051 based microcontrollers.

Advanced technologie used:

- ZigBee
- SimplifyTI
- 6LoWPAN
- CAN
- TI430
- 8051
- STM8/16/32
- Opera
- uCLinux
- Java
- Perl
- OpenRtos
- CANopen
- BlueTooth

For wireless communication links we use on-chip RF transceivers or stand-alone receivers and transmitters.

Our RF engineers are able to design antennas. Wired sensors often use CAN bus as a very robust solution. We have a fully equipped laboratory to fabricate, debug and evaluate discrete prototypes. This also includes PCB design and SMD assembly.

2) Embedded firmware design

Every embedded system with MCU requires some firmware. We have experience with precise timing applications with multi control and input units. Our engineers are able to write firmware in C, C++ and ASM. Some applications require more computing power and real time operating systems (for example uCLinux, OpenRtos). For communication between modules and or sensors we use standardized protocols (CANopen, Simplicity Ti, 6LoPan, Zigbee). We often use communication stacks from chip manufacturers.

3) Embedded software design

Some embedded systems include software, for example a web server or type of GUI. For such applications we use embedded Linux micro PC. Our engineers can write Java desktop applications (Swing, JavaDB, TopLink, GraphEngine), Perl applications, pre-compiled applications in C++ and database applications (MySQL, LINQ).

Experience with intelligent sensor networks design

Our engineers have experience with heterogeneous intelligent sensor network topologies and applications for intelligent monitoring of complex systems. Different hardware platforms and transmission technologies can be used for low power sensors. The entire sensor network can operate autonomously without external network connectivity. Furthermore, we use advanced data aggregation and data fusion techniques within the sensor nodes. This allows us to shrink the data volume as well as to increase the sensor data quality.

Heterogeneous network means that information going from one sensor to another goes partly through a wireless link, partly through internet and optionally again through a wireless link.

6LoWPAN (IPv6 over LoW Power wireless Area Networks) defines encapsulation and header compression mechanisms that allow IPv6 packets to be sent to and received from, over IEEE 802.15.4 based networks.

Experience with CAN bus

CAN bus is becoming a standard in the field of health care. We have experience with using it in the hospital bed distributed control system.

We have experience with CAN bus standards for both physical (ISO 11898-1 and SAE J2411 for single-wire) and for protocol layers (CANopen, J1939, MilCAN, CITAR, Merced).

Many heavy trucks use J1939 standard at 250kbit/s, cranes use CITAR standard at 500kbit/s, cars like SKODA / VW use three CAN independent buses (vehicle CAN, motor CAN, transport CAN) at 500kbit/s.

When FMS (Fleet Management System) technique is used, messages at CAN are filtered by CAN gates. Trucks may consist of several independent FMSs, data at each bus are isolated and refer to other CANs.

■ Embedded design project example #1

Design of embedded medical system for screening and early stage diagnostics of cardiovascular diseases.

Plethysmography is the measurement of change in blood volume. This device uses two cuffs and pressure sensors. Sensors are placed in the cuffs for pressure curve measurement. The pressure is proportional to the change in the volume in a measured vein segment. For each heartbeat, blood pressure varies between systolic (Ps) and diastolic (Pd) pressures.

Electrocardiography is a transthoracic interpretation of the electrical activity of the heart over time, captured and externally recorded by skin electrodes. Electrical impulses in the heart originate in the sinoatrial node and travel through the intrinsic conducting system to the heart muscle.

The impulses stimulate the myocardial muscle fibres to contract and thus induce systole. Texas Instruments msp430 MPU based design is used.

The battery operated device uses vacuum pumps, pressure sensors and an ECKG monitoring circuit. For communication with PCs a Bluetooth connection is used.

■ Embedded design project example #2

Design of a three level hybrid wireless sensor network.

Design of the system for reading wireless sensors broadcasting in 868 MHz ISM band and delivering the data through internet (WiFi, GSM) to the central server: The system consists of one or more concentrator units for communication with sensors and one communication gateway to the internet. The sensors use different frequency channels than the link between units, so the RF transmitter has to regularly retune.

Texas Instruments msp430 MPU based design. Integral panel antenna. Embedded PC running Linux. Web interface for setup.

■ Analog and mixed mode ASIC design

For ASIC development, CERTICON offers the co-sourcing business model since ASIC design is technology and tooling dependent.

We have wide experience with linear and switched supply regulators, low power RF designs, and low power asynchronous designs.

- Competences in analog and mixed mode ASIC design
- complete design flow up to tape out (GDSII)
- low voltage analog design
- power design
- prototype verification
- production test preparation (FLEX)

1) Complete ASIC design flow

The whole process starts with creating the technical specifications according to the client's needs.

In most cases CMOS technology is pre-selected by the client. Then our engineers continue with the architecture and block-level design. All design steps are verified by means of simulations.

If everything is according to specification and or presumptions, a layout engineer can do the physical layout of the chip. Before tape-out, the design is proven by means of post-layout simulations with an extracted netlist.

Low voltage analog design

Our design engineers are specialists in designing power supplies and regulators, both linear and switched. They are also experienced in designing references and bandgaps.

They are able to design blocks as transceiver (ASK, PSK), PLL, VCO, DAC, ADC, operational amplifier: OTA, multipliers: mixers, etc. For low voltage designs, they use techniques as folded cascade, self cascade, rail-to-rail, and bulk driven MOS.

Power design

Our engineers also participated in power designs for automotive applications. 80V DMOS technology was used. The design was cover regulators, power supplies, bandgaps, and low offset operational amplifiers. Some designs drove inductive loads (current up to 3A).

Advanced technologie used:

- bulk-driven MOS transistors technique
- fully balanced systems
- technology up to 80V (DMOS)
- driving inductives loads
- impedance matching
- extend bandwidth techniques
- handshaking technology

RF Design

Our engineers participated in the design of the NFC chip for mobile phones. The design was done in 0.18um TSMC CMOS technology. Between blocks belongs a low noise amplifier, mixer, receiver (5GHz, technology dependent), distributed amplifier (10GHz @ S21=10dB, 16GHz @ S21=6dB).

Our engineers have experience with frequency conversion, superhet, impedance matching, and passive and active filters.

2) IC prototype verification

Our engineers are able to prepare a Design Verification Test plan and verify the complete functionality of the designed IC on the bench.

- test plan preparation
- test board design (PCB)
- bench measurements
- test automatization
- digital DVT on the production tester (IMS, TERADYNE/SPX)
- IC production test

Together with Teradyne, our engineers develop test programs for the FLEX tester platform, which utilizes multi-site testing. We have experience with production test development on IC and hybrid levels.

- analog and RF production test development
- stack-at test development
- DIB board development
- test debugging on the production tester (Flex/Microflex/J750)

■ ASIC design project example #1

Design of low power highly reliable mixed mode chip for four channel fully digital-controlled new generation pacemaker.

The designed chip consists of a low noise amplifier and DSP for heart activity sensing. Sets of timers and pulse generators which together with switching capacitors output stage generate a stimulus to the heart. It also consists of supporting circuits such as Telemetry B for radio communication with the external programmer at the hospital; ICG data compression and DMA controller for the measured data transfer and SRQ controllers to communicate with the master CPU

■ ASIC design project example #2

Design of 16 bits low power microprocessor for new generation of pacemaker. Redesign of low power asynchronous microprocessor:

This microprocessor used Harvard architecture with separated data and instruction memory. Low power consumption was achieved by extensive utilization of handshaking design methodology, clock and supply switching.

The main goal was to increase the computing power by means of an on-board clock doubler unit, changing the ROM and RAM memories size, and modifying the DMA controller. The architecture used dual supply voltage for the core and for the pad ring.

The chip was designed in low leakage 0.25um CMOS technology. Number of pads: ~80, size including RAM and ROM was approx. 25 mm². CERTICON engineers participated in the ASIC prototype verification and the production test as well.

■ ASIC design project example #3

Design of semi active analogue NFC radio chip. The chip was connected through a simple serial interface to Secure Dual Interface Element PKI Smart Card Controller. The chip fulfilled special antenna conditions and requirements for modulation given by ISO 14443.

Such a chip consists of the H-bridge driving the antenna resonance circuit (200 mA, 60 V), antenna tuning circuit to automatically dispatch antenna conditions given by the surrounding environment, receiving amplifier, and ASK demodulator.

It consists of supporting circuits such as X-tall clock generator, current and voltage reference, and signal multiplexer. We used high voltage 0.35 um technology.

Number of pads: 16, size approx. 1 mm². CERTICON engineers performed the ASIC prototype verification and prepared and debugged the discrete prototype.

CERTICON at glance

For more than 14 years, CERTICON has been improving the competitiveness of our clients around the world. CERTICON solutions are comprised of the full spectrum of services and solutions in software development, system integration and quality-assurance verification testing. Our experience in the fields of medical and mission-critical applications, high-tech industrial and enterprise applications enables us to harness the best practices and solutions for our clients. CERTICON designs, develops, rapid-prototypes and deploys sophisticated software solutions.

Join us today

Our professional services are available to businesses of any size, in any industry, and in any country. Thanks to our network of branches and representatives, we are close to our customers world-wide. CERTICON has developed and packaged the tools of our services into a set of methodologies and frameworks, in order to simplify the ramping-up of projects and to provide the greatest value to our clients. There are no hidden costs, no additional investments of time and money required to incorporate us into collaboration. Exploit the advantages of simple, affordable, and future-proof cooperation with CERTICON into your business today. With CERTICON, you definitely will experience a difference. That's why we urge you to explore more information about us on our website www.certiconglobal.com.

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