



## Focus on: Development

We are your innovative and comprehensive development partner. Whether hardware development, software development, layout or mechanics, TQ supports you and your project with every aspect of development – from the product idea to serial production.

### YOUR BENEFITS

- Many years of comprehensive experience providing development services and project management
- Large development staff
- Modular system – in many cases it's not necessary to develop new options, because ODM- / OEM solutions are already available
- DfX – Design for Excellence / Optimized Design
- Advice on how to use various technologies
- Support for redesign of older designs

### HARDWARE

#### Power electronics

- Power supply
- DC/DC converter
- DC/AC converter
- Motor controls (Stepp motors, brush-type/brush-less DC motors)

#### Measurement technology

- Analogue measurement technology
- Infrared measurement technology
- Digital signal processing
- Optoelectronics

#### RF technology/radio technology

- ISM
- GSM, GPRS, UMTS, LTE
- WLAN
- Bluetooth
- ZigBee

#### Microcontroller technology

- 8 Bit: Atmel AVR, PIC, Z8, 8051 family
- 16 Bit: Infineon C166 family, Infineon SC166 family, Toshiba CP32 family, Renesas H8
- 32/64 Bit: Cortex®-M0/M0+, -M3 –M4, ColdFire, Infineon Tri-Core, Arm® 7/9, Cortex®-A7/8/35/53/72, NXP Power Architecture, PowerQUICC I – III, QorIQ, x86 family, Intel/AMD/VIA

#### Interfaces/fieldbuses

- PCI/PCI Express, ISA, PC-Card, USB, FireWire, RS232/ RS485/RS422, CAN, LON, ASI, Profi Bus, M-Bus, Ethernet 1/10/100 GBit/s, PoE...

#### Memory

- SDRAM, DDR2, DDR3, DDR4 + LPDDR4, Flash, HDD, SSD, Industrial NAND-Flash, Power Sequencing

#### Display technologies

- Customer specific displays
- Display controls (TN/STN, TFT, VFD)
- Display Interfaces DVI, HDMI, DisplayPort

### Simulation

- Digital, analog, RF, timing, signal integrity
- Programs: HyperLynx Linesim/Boardsim/GHz/Power Integrity, SynaptiCAD Timing Diagrammer

## SOFTWARE

### UEFI BIOS

- Customer specific UEFI BIOS development to our x86 modules
  - Boot Logo, Chip Integration (e.g. Super IOs), PCIe configuration, Secure Boot
  - Adaptation of customer-specific carrier hardware
- Embedded Application Programming Interface (EAPI)
  - Interface on board Interfaces and information
  - Backlight-, Storage-, I2C Bus-, Watchdog-, GPIO-Functions

### BSP development

- Board Support Packages (BSP) for Power Architecture®, Arm®, x86 architectures in conjunction with Linux, VxWorks and real-time operating systems (RTOS)
- Use of modern build systems like Yocto, PTXdist, BuildRoot, OpenWRT
- Development of boot loaders such as U-Boot, Eboot, VxWorks boot loader, GRUB
- Professional Embedded Linux development
- Installation and adaptation of various RTOS (including freeRTOS, safeRTOS, ThreadX)
- Implementation of device drivers/hardware-interfaces
  - I<sup>2</sup>C, I<sup>2</sup>S, SPI, CAN, USB, RS232/485, PCI/PCle
  - LVDS, HDMI, Ethernet, Wifi, Bluetooth, etc.
- Integration of libraries/middleware
  - Protocol stacks (CANopen, Modbus, MQTT, OPV UA, etc.)
  - Field buses
  - File systems, databases
  - Embedded GUI Frameworks (OpenGL, DirectFB)
  - Application Frameworks (e.g. Qt)

### Microcontroller development

- Conception and realisation of firmware for microcontroller systems
- Integration and adaptation of real time operating systems (RTOS)
- Development of specific device drivers
- Conception and implementation of the complete business-logic

### Application Development

- Design, conception and realisation of modern software architectures and operating concepts
  - User Interface and Usability Design
  - Measurement & Control, Signal processing
  - Data management, system updates
  - Security
  - Safety
- Graphical user interfaces (GUI) with/without Touch
- Design and realisation of connectivity and modern IoT solutions
- Desktop applications for communication with the embedded device
- Use of the latest programming languages and technologies

### APPs, Web- & Cloud solutions

- Development of Web Frontend applications for embedded systems as an alternative to a display
- Mobile Apps for Android/iOS
- Networking of your products with cloud services and portals
  - Retrofit integration
- IoT interfaces for embedded devices (cloud connection)
- Backend programming of your cloud solutions
  - Update infrastructure for firmware updates
  - Analysis of running times, equipment/machine Use, errors, and much more
- Service apps for status display and control of devices

### Software Engineering Services

- Consulting
- Requirements Engineering
- Software Architecture Design
- Threat analyses (Cyber Security)
- Functional Safety
- User interface and usability design
- White- & Black-Box Testing
- License Conformity Clearing
- Standards and processes
  - Development according to EN9100 and DO-178B/C (DAL C-E)
  - Development according to IEC 62304 and IEC 61508

### LOGIC DESIGN / SYSTEM-ON-CHIP DEVELOPMENT

#### Application examples

- Microcontroller – highly flexible extension of the periphery
- Communication – adapted to throughput, latency, security, protocol
- Functional safety – implementation and monitoring of safety-critical functions
- Power electronics – fast controls and regulations
- Data processing – high-performance algorithm implementation

#### Design

- Development of product-specific functions
- Selection and integration of 3rd party IP
- Use of highly complex system components (e.g. embedded processors, high-speed I/Os)
- Verification through simulation and hardware tests

#### Architectures

- Conversion to all common FPGA and CPLD components (e.g. Intel (Altera), Lattice, Xilinx, Microsemi (Actel))

### LAYOUT

- Flexible and starr-flex PCBs
- Multilayer (layer optimized)
- Impedance controlled layouts
- Audit compliant layouts
- Layouts suitable for production
- Microvia technology
- Blind and buried vias
- Programs: PADS, Altium Designer, Xpedition Enterprise, DxDesigner

### TESTING TOOL DEVELOPMENT / TEST EQUIPMENT

#### Test conception/DFT

#### Calculation of testing depths and error probabilities

#### Test software

#### Test models

#### Construction of test adapters and test equipment

#### Maintenance and calibration of test equipment

#### Technologies

- In-Circuit-Test analog and digital
- Flying probe test
- Manufacturing Defect Analyser (MDA)
- Function test
- Boundary-Scan-Test
- Combi and cluster test
- Burn-in/run-in

### PRODUCT QUALIFICATION

#### Certifications and approvals

- CE conformity assessments
- NRTL tests
- FDA, CSA, CCC,...
- Device safety TÜV/GS, VDE, UL
- Medical devices
- Aviation
- Shipping
- Accelerated ageing (temperature/humidity)
- Radio approvals
  - EMC, RED, FCC, ISSED,...

#### EMC tests

- Interference emission
- Interference immunity (field-bound, line-bound, ESD)

#### Reliability and durability tests

- HALT (securing product development)
- HASS (securing serial production)
- Lifetime calculations MTBF, MTTF

#### Climate tests

- Temperature and humidity
- Temperature cycles
- Mechanical tests
- Vibration resistance
- Shock resistance

#### Function and specification testing

- Tolerances
- Stability
- Signal integrity
- Timing

### Development process

- Design reviews
- Risk management
  - FMEA at system, design and process level
  - Hazard analysis, PHA
- Functional safety requirements
  - SIL, DAL, FMEDA

### Environmental requirements

- REACH, RoHS, WEEE, EUP, BattG

## PROJECT MANAGEMENT

### Skills

- Project management as a core competence of development
- Accompaniment through the project cycle from the definition of requirements to the first series delivery
- Project monitoring: costs, deadline, quality
- Internal & external reporting: project progress, step-by-step HK calculation, active risk management
- Various process models
- Approval and standards management
- Change Management

### Systematic application with

- Project management tools: TQ-Project with connection to SAP, MS-Project, JIRA, Confluence and others
- Requirement Engineering with Polarion & Doors
- Fault Management & agile Project Management with JIRA
- Risk Management with Design FMEA, Process FMEA and Risk Management Plan
- Use of conventional procedures like waterfall & V-model as well as agile methods like Kanban & SCRUM

## MECHANICS

### Consulting

- Concept development
- Material and technology consulting

### CAD construction

- CAD design suitable for production
- Housing construction
- Drive systems, motors, gearboxes
- Development of mechatronic components and systems

### Simulation

- FEM strength analysis
- FEM thermosimulation
- FEM flow simulation
- Assembly simulation
- Motion simulation

### Technical Documentation

### Prototyping and prototype construction

- 3D-printing
- Stereolithography (SL)
- Vacuum casting

### Series reconciliation

## CONTACT

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