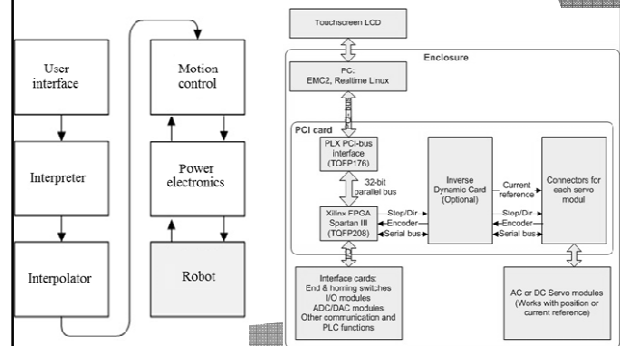


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DESIGN OF A UNIVERSAL ROBOT CONTROLLER

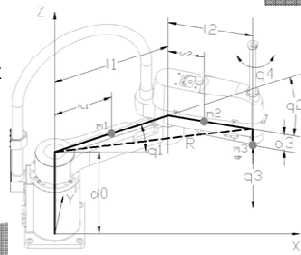
The conception of the universal robot controller



The first prototype The Scara robot

• The Scara robot (Selective Compliant Assembly Robot Arm)

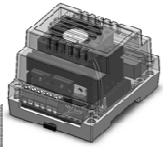
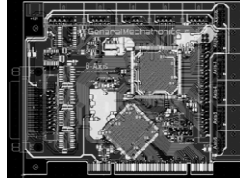
- RRTR system
- Brushed DC motors
- Harmonic drive gearbox
- Incremental encoders
- Homing sensors
- End switches



The first prototype

The system – (Bence and Géza)

- PCI card
 - PCI bus
 - FPGA-PLX system, 32 bit communication
 - 6 axes (2 card/ PC)
 - SPI, STEP/DIR and analog reference (position, speed and torque)
 - 24 machine specified PIN
 - 32 configurable IO pin
- DC amplifier
 - 300 Watt, 80 V DC bus power
 - Full H bridge with current measurement
 - Position, speed and torque reference via SPI and STEP/DIR systems
 - Encoder input
 - USB port for tune
 - DIN rail enclosure



The first prototype

The system

- IO modules
 - DIN rail enclosure
 - Opto isolated Input
 - Opto isolated relay Output
 - PLC functions (for example.: conveyor belt, and photocells)
- Teachpendant
 - Touchscreen
 - X, Y, Z, rotZ jogging
 - End effector manipulation
 - E-Stop
 - Maschine On/Off



The first prototype

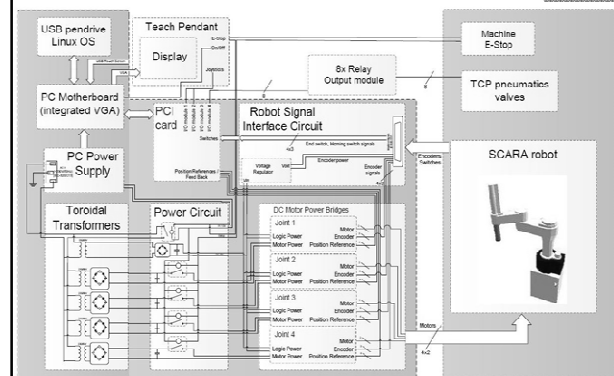
The system

- Power electronics
 - Compact enclosure
 - Maschine E-Stop
 - Toroid transformers and Graets bridges with puffer capacitors and fuses
 - 2x80 V DC for the first and second joints
 - 2x60 V DC for the third and fourth joints
 - 16 V DC digital power supply



The first prototype

The system



The first prototype

Results

- Working prototype
- Drawing with G code
- Milling with G code
- Interpolation at joggint in line, and around a point



The second prototype

Constructional differences

- Bigger sizes
- Bigger inertias
- Slower drives
- 100 V DC bus power
- TRRR system



The second prototype

Constructional differences

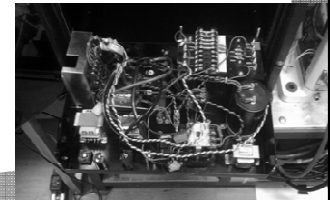
- Mounted enclosure
- Lower power density (less EMI, EMC problems)
- Drawers
- Isolated PC



The second prototype

Constructional differences

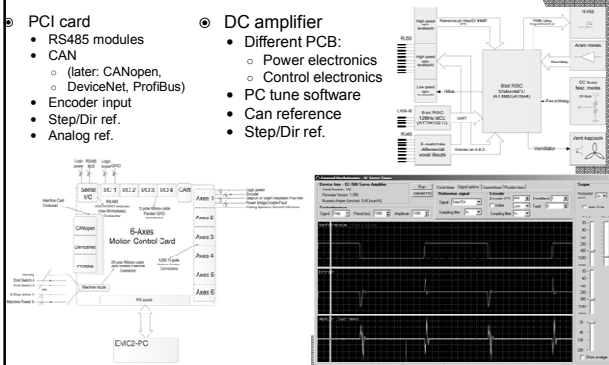
- Power electronics
 - Transformers, Graets bridges, puffer capacitors, brake resistors, fuses and power switches
 - 4x100 V DC
 - 12 V DC
 - 24 V DC
 - 200 V AC
- E-Stop switches
- E-Stop by power switches



The second prototype

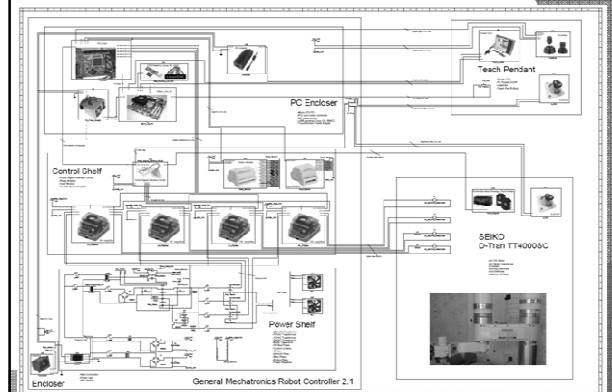
Constructional differences - (Bence and Géza)

- PCI card
 - RS485 modules
 - CAN
 - (later: CANopen, DeviceNet, Profibus)
 - Encoder input
 - Step/Dir ref.
 - Analog ref.
- DC amplifier
 - Different PCB:
 - Power electronics
 - Control electronics
 - PC tune software
 - Can reference
 - Step/Dir ref.



The second prototype

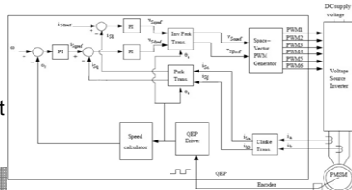
Constructional differences



Three phase inverter

Texas inverter

- Demo board
- IGBT module
- High & Low side PWM
- Control card & Texas DSP
- In case of complication:
 - Processor reset
 - Floating legs
 - Short circuit
 - IGBT module burn out



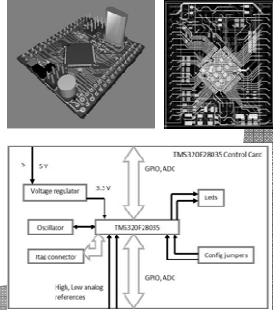
Three phase inverter

Self design

- Different PCB for power and control electronics
- Opto isolated analog and digital signals
- 330 V DC bus
- 1 kW power
- 6 FET in 3 half bridge
- In/Shutdown FET drivers (short circuit protected by hardware solution)
- Brake resistor (the motor would increase the bus voltage at generator mode)
- Step/Dir, CAN reference
- USB port for tune

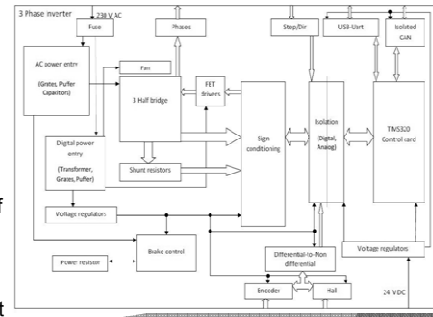
Three phase inverter Self design – Control Card

- TMS320F28035 DSP
 - 32 bit floating point
 - 60 MHz
- External and internal analog references
- Voltage regulator
- Realtime debugging
- Variable monitoring, (available with graphical interface)
- Texas motor control library

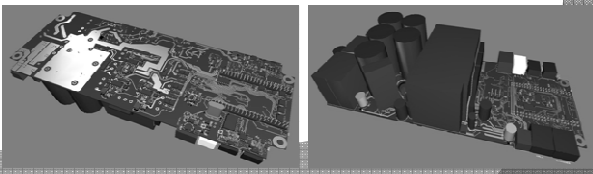
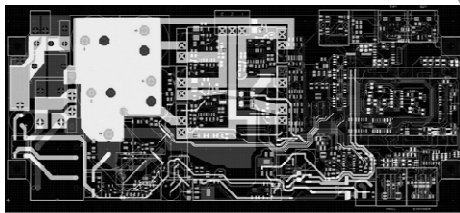


Three phase inverter Self design – Power electronics

- 7 different power
- 4 different ground
- Differential current measurement
- Measurement of phases and Dc bus
- Encoder and hall sensor input

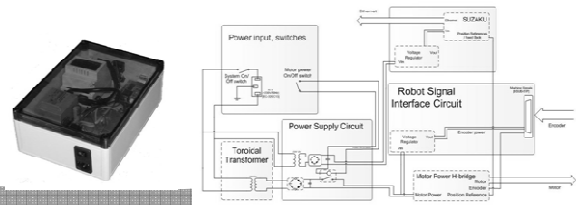


Three phase inverter Self design – Power electronics



RT-Middleware components

- Robotics Technology Middleware modul
 - DC motor control via internet
 - Encoder, homing, end switches input
 - Self designed power and control electronics
 - Linux - FPGA system



Summary

- The most important points of the development
 - PCI card 1.0 and 1.1 versions (Kovács Bence)
 - DC amplifier 1.0 and 1.1 versions (Szayer Géza)
 - Output module 1.0 and 1.1 versions (Szayer Géza)
 - Input module
 - Signal interface card
 - Teachpendant 1.0 and 1.1 versions
 - Power electronics for Scara and Seiko
 - Seiko block diagram
 - RT-Middleware modules (common work)
 - Three phase inverter design and PCB
 - Control card
 - Power electronics
- Future plans
 - Finish the prototype of the three phase inverter
 - Finish of the Seiko robot controller

Thank you for your attention!

