THOMAS MORE

TI CC3200 Launchpad Measurement and Control Unit for greenhouses

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Content

- Developing a measurement and control system for greenhouses
  - The input from the requesting customers
  - The approach from an engineering point of view
    - Concept
    - Implementation
    - Additional ideas

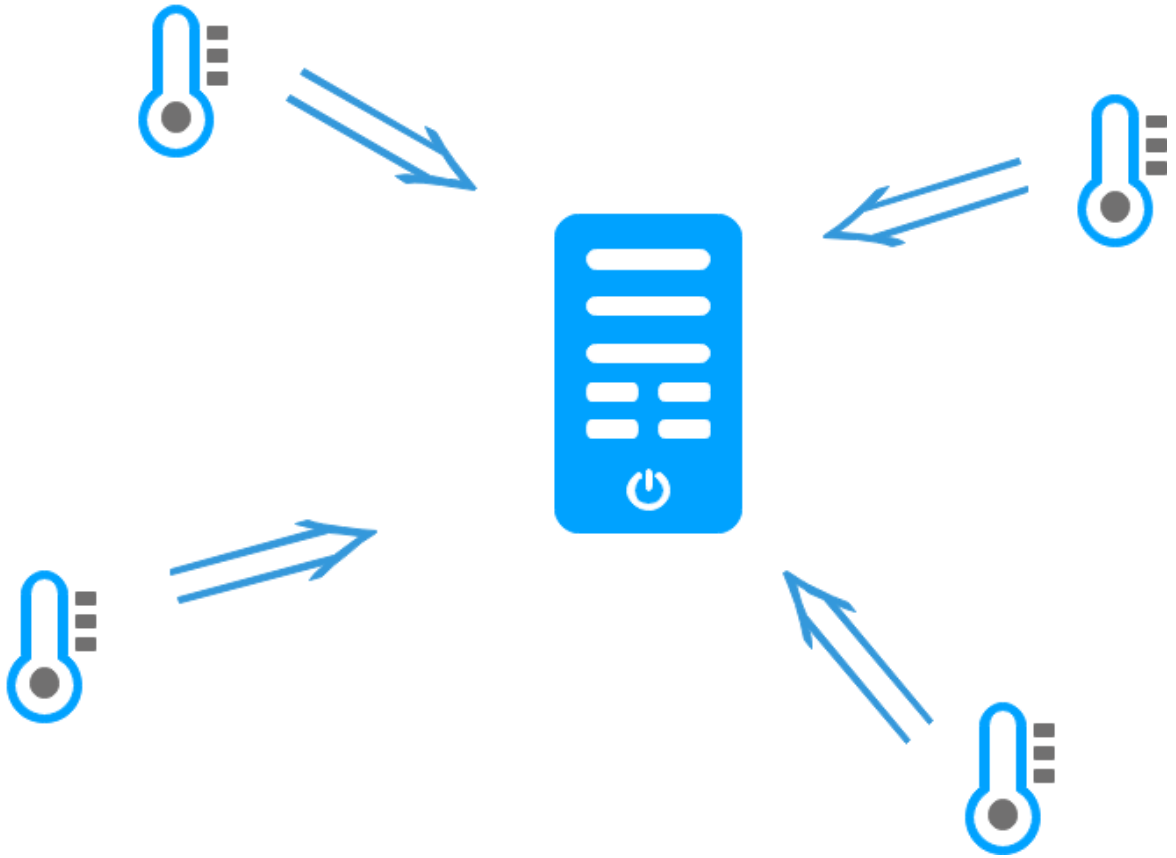
- Greenhouse project
  - New research project
  - Study infuences of parameters like
    - Temperature
    - Humidity
    - CO_2
  - Researchers
    - No knowledge of electronics
    - No clear view on what to measure

Measurement & Control Unit

- Initial question of researchers:
  - Reading 14 analog values
  - Controlling 3 digital outputs
  - Controlling 1 analog output (0-10V)
  - Measurements should be sent to a central point
  - Thresholds should be adjustable
- Development → generic
  - Easier to adapt to new requirements
  - Basic development for any future development
  - Usage in education

Measurement & Control Unit

- The concept
  - Overview



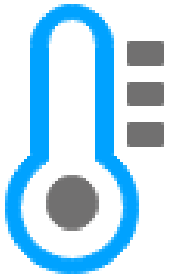
Measurement & Control Unit

- The concept
  - Central unit (server/gateway)
    - Raspberry Pi (for at least proof of concept)
      - UDP listener (python script)
      - MySql to store Measurements
      - User Interface to configure setup (cgi scripts)
      - Grafana to viualise data from database

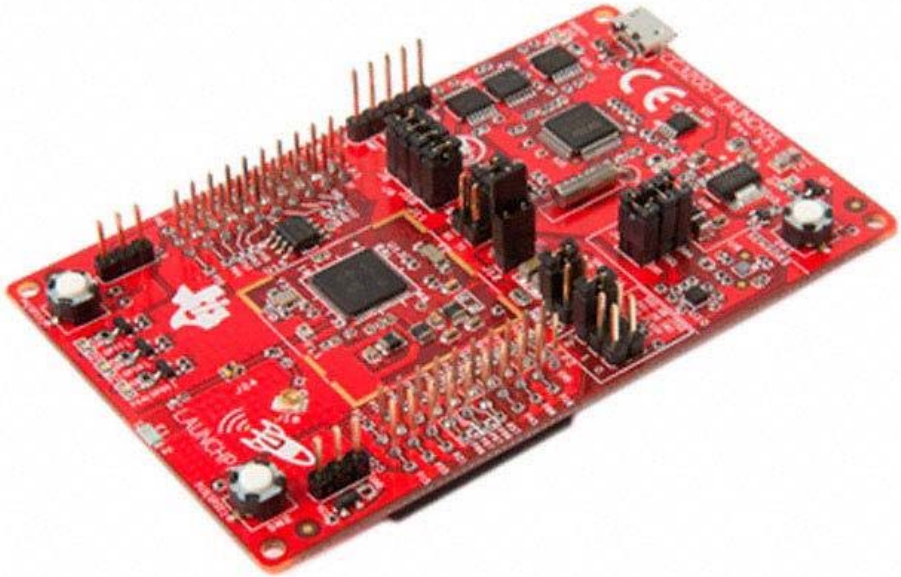
- Grafana
  - Framework for visualisation of data
  - Alternatives available (Kibana)

Measurement & Control Unit

- The concept
  - Client (measurement/control unit)
    - Texas Instruments CC3200 Launchpad
    - Generic Design idea
      - SPI
        - ID Module
        - Digital I/O Module
        - ADC Module
        - DAC Module
      - I²C
        - Lines provided for future modules

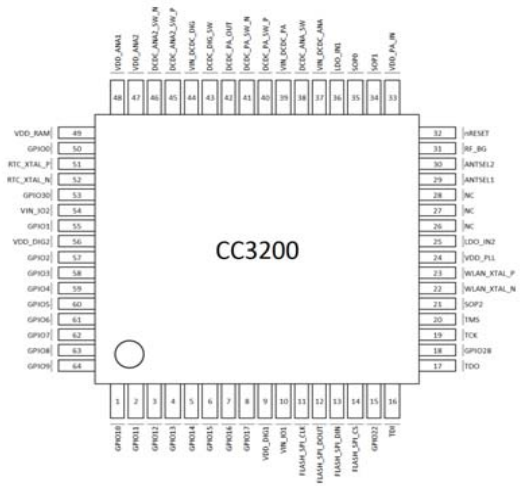


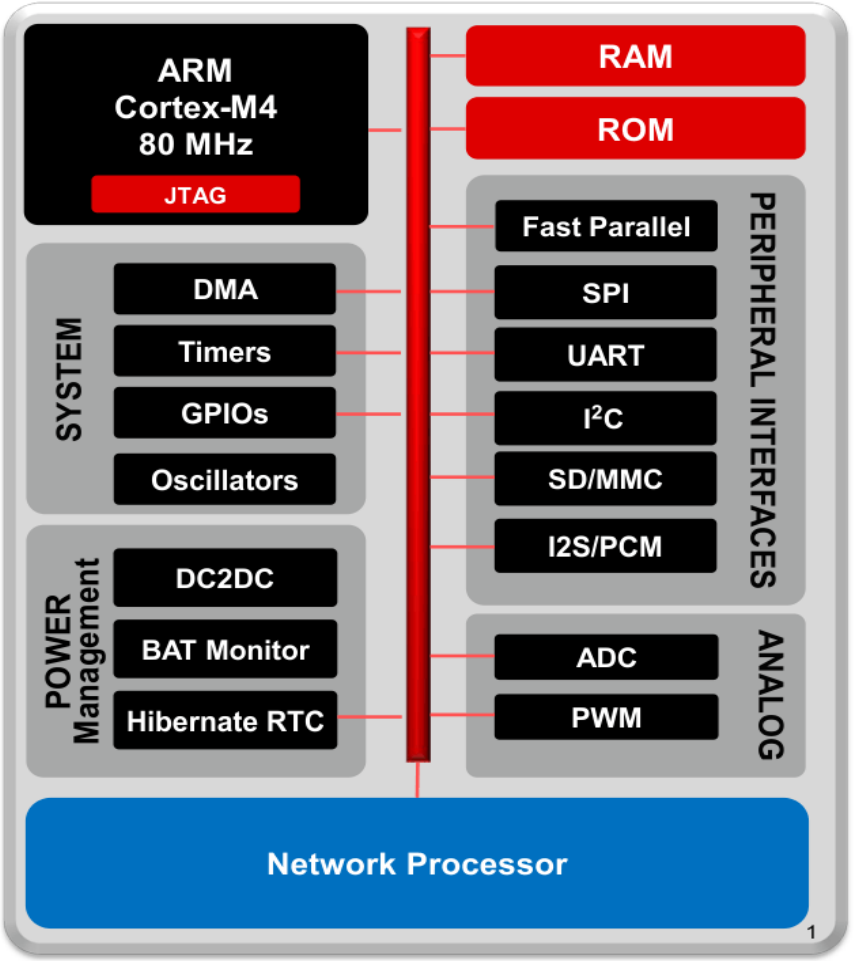
- TI CC3200 Launchpad
  - Developed with IoT in mind
    - Arm Cortex M4
    - Low Power Modes
    - Wifi On Chip
    - Integrated encryption



- TI CC3200 Launchpad
  - Advantages
    - Designed for IoT
      - Low Power
      - Performant
      - Security features
      - Wifi integrated
      - JTAG
      - Professional Development Environment (Code Composer Plus)
      - Energia (Sketch for TI)
      - Booster Packs
  - Disadvantages
    - Less documentation as for others (eg Arduino)
    - Complex
    - Steep Learning Curve

Texas Instruments CC3200





Texas Instruments CC3200

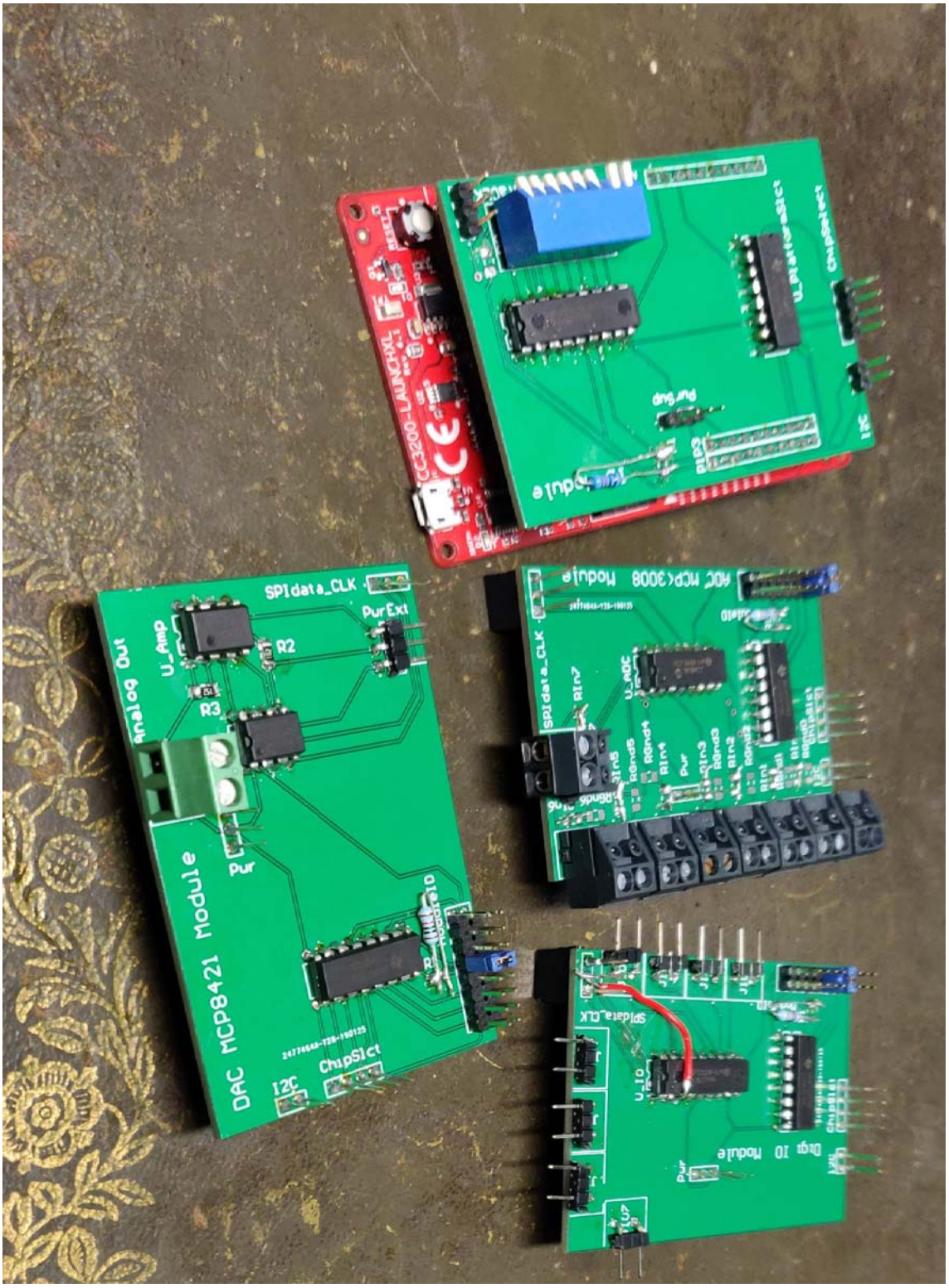
- Few things to keep in mind
  - API's & PinMUX ↔ Direct access to hardware
  - GPIO's ↔ Port/Pin
  - Polling ↔ Interrupts
  - Splitting up in functions
  - Wifi
    - Some libraries have to be recompiled for none RTOS use
    - Wifi startup: specific startup sequence

Texas Instruments CC3200

- Few things to keep in mind
  - Datasheets – User & Programmer guides
  - The examples
  - Accessing registers directly: HWREG
    - Different from traditional microcontrolers
  - Initialize your board on startup
    - Pinmuxconfig (generated by PinMux Tool)
    - Board Initialize (can be found in examples)
      - Set interrupt vector table
      - Enable Master ISR
      - Enable Fault ISR
      - Initialise PRCM

- Generic (or modular) design
  - Reasons for a generic deisgn
    - Researchers hadn’t a clear on what measurements & control they would need in the end
    - Reusability
      - Modular design
      - New projects: modules can be reused with minimal effort
  - Disadvantages
    - More abstract approach
    - Development takes more timer as a dedicated one

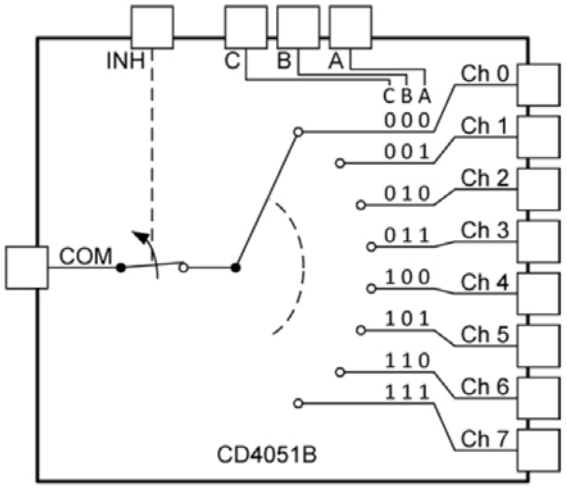
Measurement & Control Unit



- Design of functional modules
  - Communication with launchpad
    - SPI
      - Potential Disadvantage: Chip Select
    - I²C
      - Lines provided for future modules
      - Further implementation not done yet

- SPI Communication
  - MOSI: messages Master to Slaves
  - MISO: messages Slaves to Master
  - Clk: Synchronisation Clock
  - CS: line to select slave to communicate to

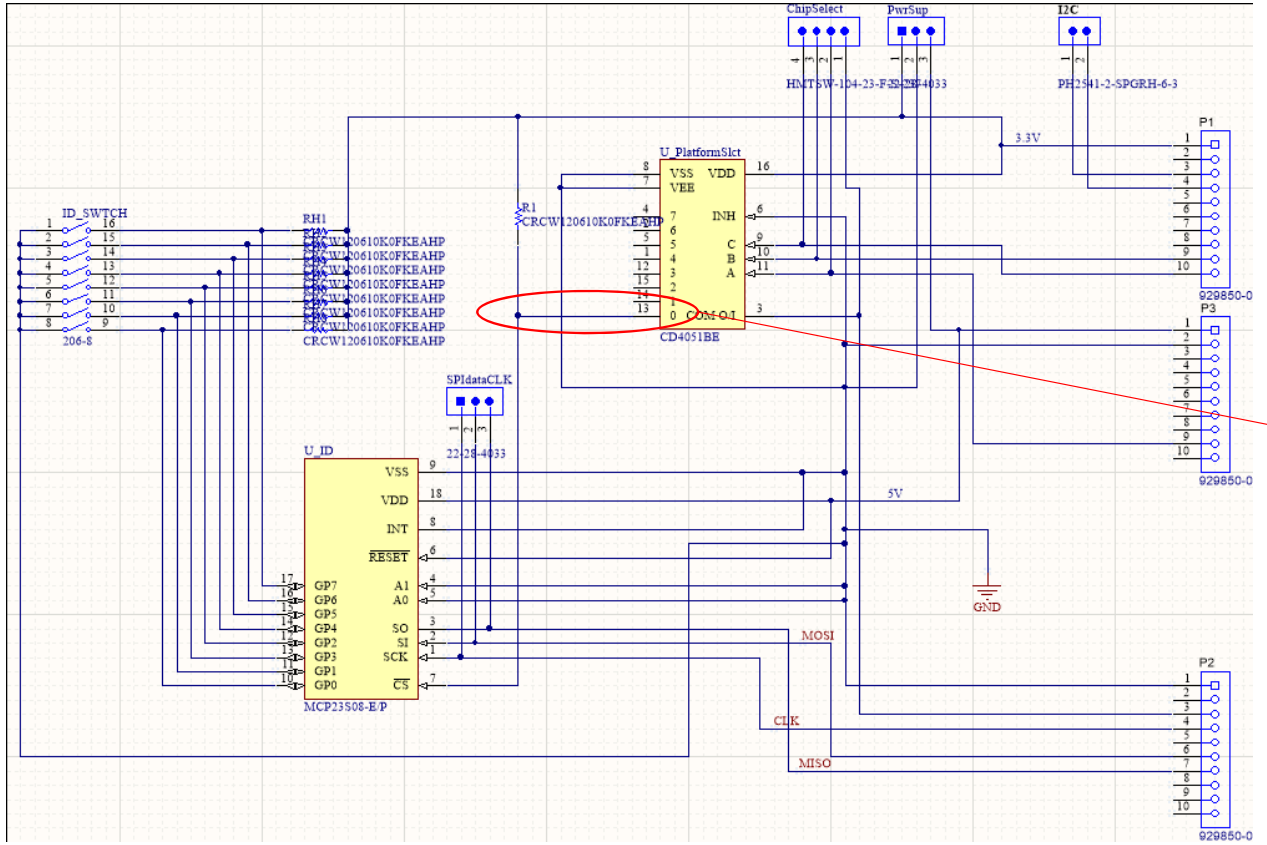
- SPI Communication
  - Chip Select should be used to select the right slave only
    - 8 channel Multiplexer/Demultiplexer
      - 3 Address Lines (2^3= 8 channels)



- SPI Communication
  - Chip Select should be used to select the right slave only
    - 8 channel Multiplexer/Demultiplexer
      - Channel 0 reserverd for identification of the client

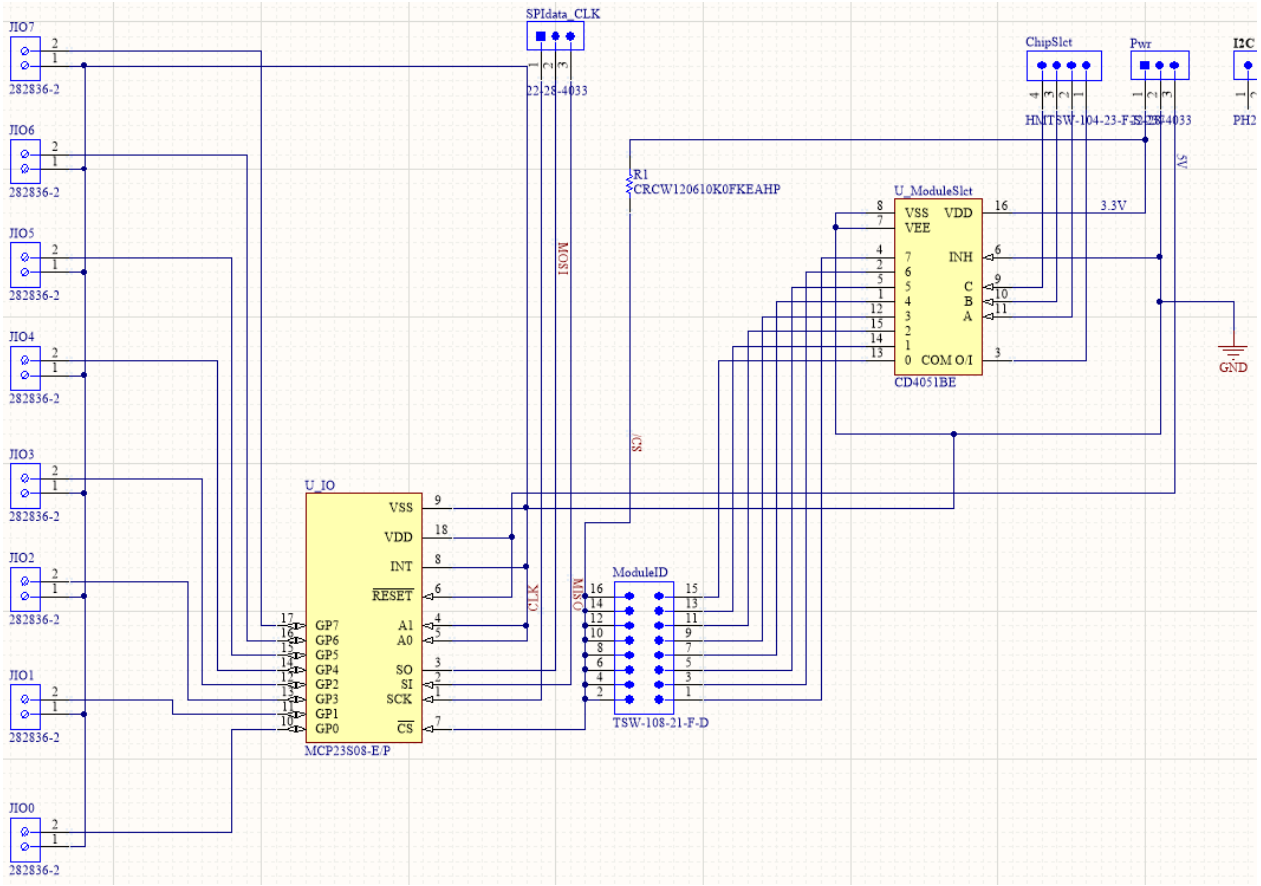
- Client Identification
  - Possibilities
    - Static IP
      - Disadvantage: each module needs to be programmed with a unique IP address
    - ID shield
      - ID can be set (with jumpers or dip switches)
      - ID can be sent to server for relation ID and IP address retrieved through DHCP

- ID Shield – MCP23S08



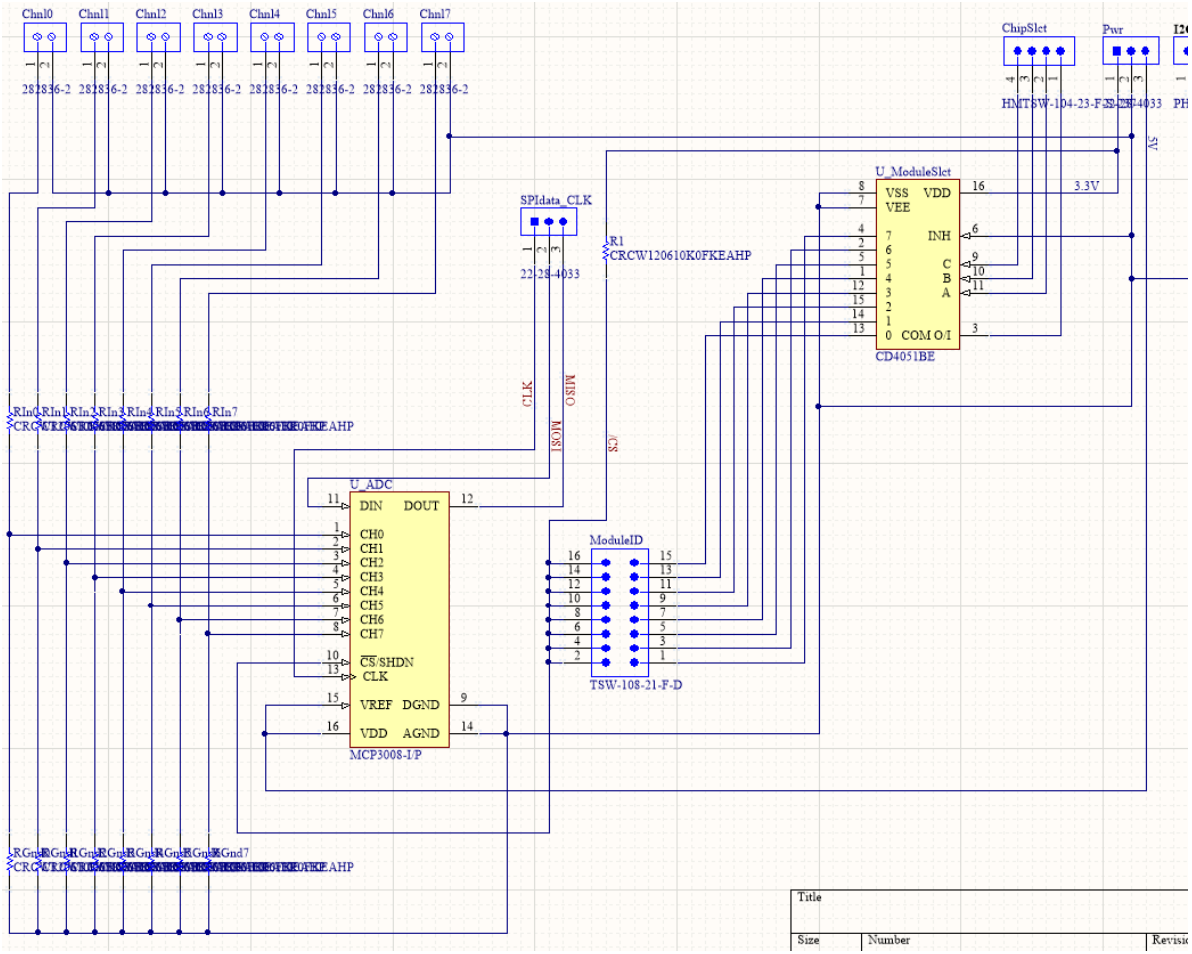
Always shield 0

- Digital IO Shield – MCP23S08



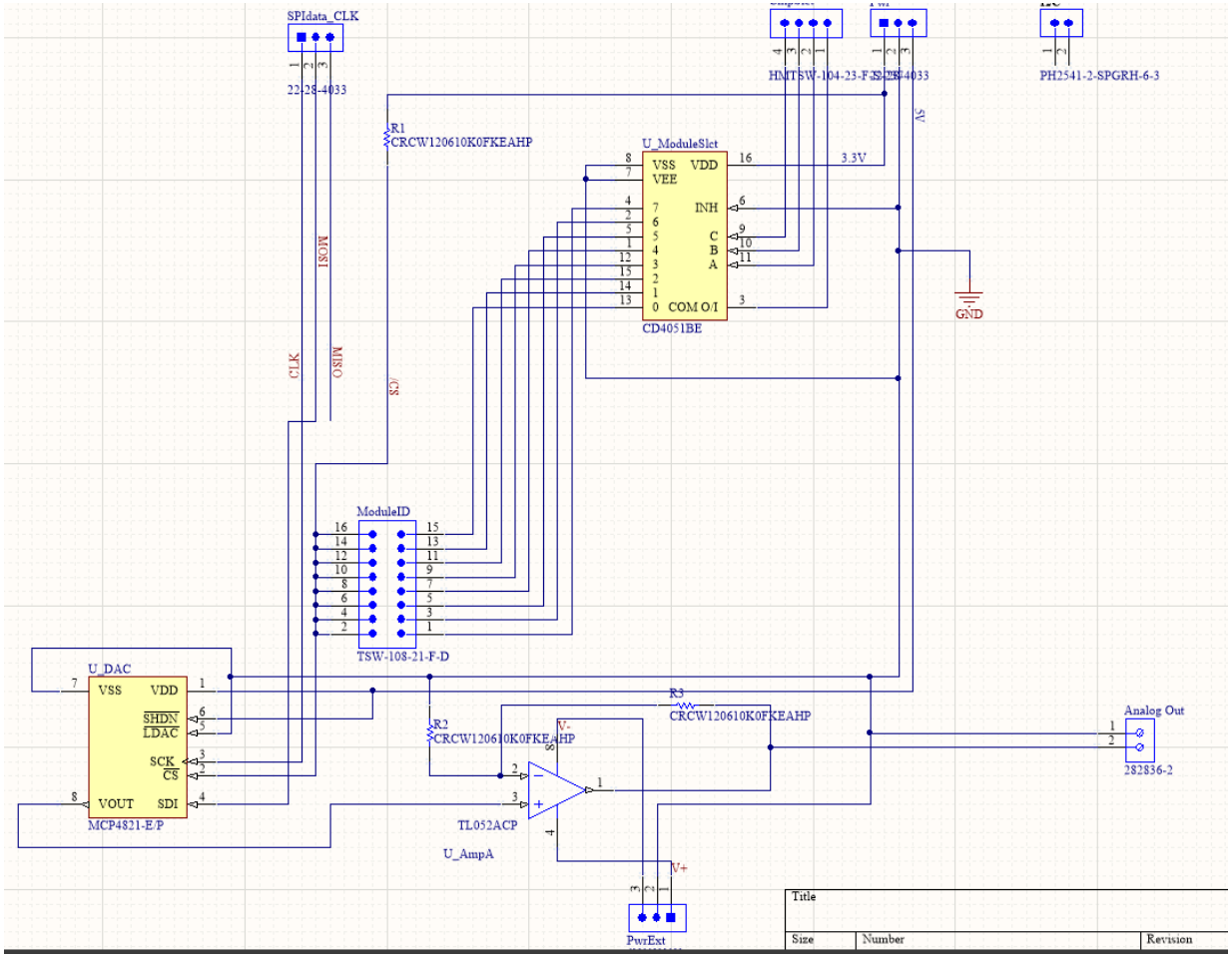
- ADC Shield – MCP3008
  - 0V – 5V
  - Voltage divider (or amplifier required)

- ADC Shield – MCP3008



- DAC Shield – MCP4821
  - 0V – 2.5V
  - Amplification required (none inverting OpAmp)

- DAC Shield – MCP4821



- Generic Design
  - Future changes
    - Interrupt line(s) for modules
      - Example MCP23S08 Digital IO
    - Additional peripherals
      - Motor drivers
        - ST microelectronics L6470
      - Communication drivers
        - SPI – CAN: MCP25625
      - platform ID;
        - 0 – 255 → limit 1 – 255 : last byte IP address (better relation ID ↔ IP

Measurement & Control Unit

Questions and Answers