

Transition Radiation Detector Gas Slow Control System AMS-02

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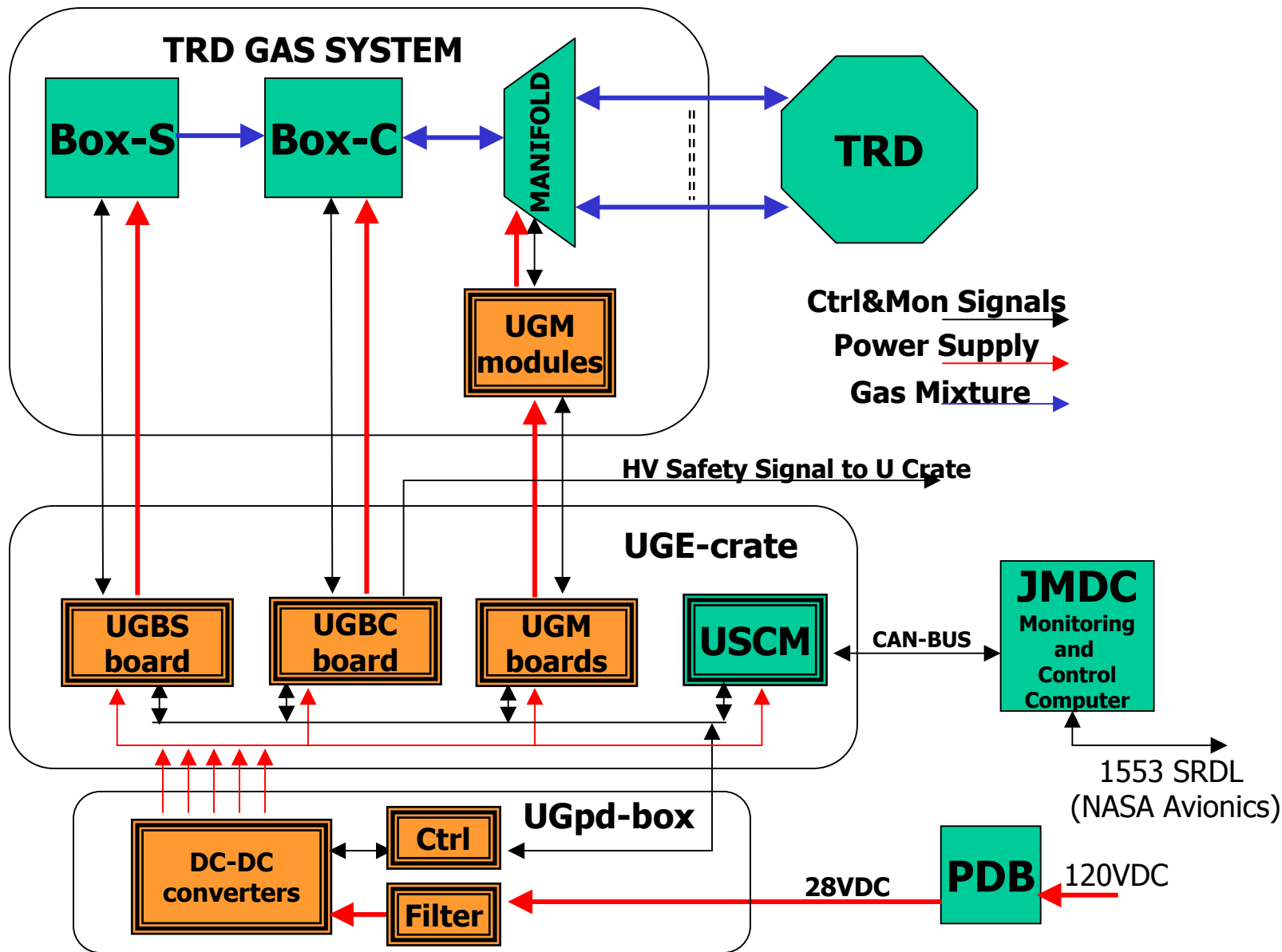
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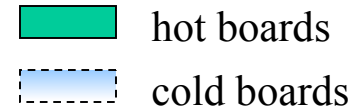
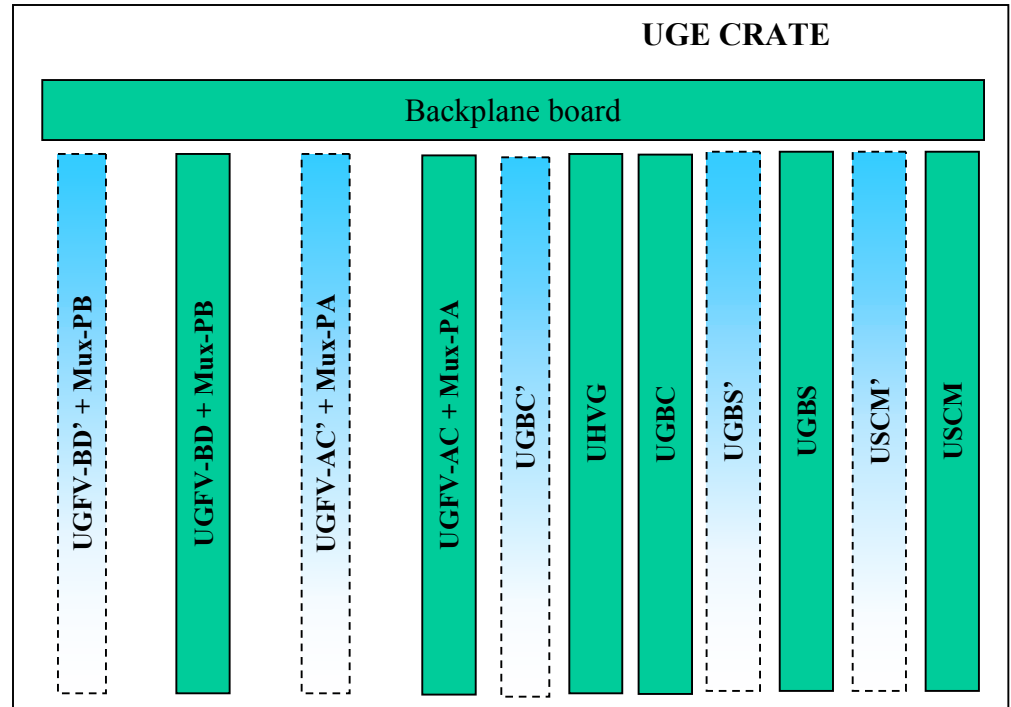
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Gas System Slow Control



UGE crate prototypes

- **11 Boards 6U height** (AMS VME type)
 - 2 slots **USCM** dedicated
 - 9 slots for control boards
- All control boards use FPGA to interface the USCM bus and to pilot the device drivers
- 2 boards to control the BOX-S (**UGBS**)
 - 13 solenoid valves
 - 4 press. & temp. sensors
- 2 boards to control the BOX-C (**UGBC**)
 - 2 circulation pumps
 - 4 solenoid valves
 - 3 flipper valves
 - 3 press. & temp. sensors
 - 1 CO₂ analyzer (RS232)
 - 1 MCA (RS232)
 - 1 monitor tubes
- 1 board for BOX-C monitor tubes power supply(**UHVVG**)
- 4 boards for Manifold control
 - 4 to control the 164 flipper valves located in the manifolds (**UGFV-AC., UGFV-BD**)
 - logics for 82 pressure sensor signals multiplexing will be inserted in the UGFV boards



Project Status

Prototypes developments

- boards electrical schematic ready
- the whole functionalities addressed
- basic control circuits simulated (PSPICE)
- complex functionality components taken from the AMS preferred part list
- simpler components (MOSFET) selected using derating criteria
- firm selected for PCB design and production
- first board PCB under development

UGBC interface to BOX-C

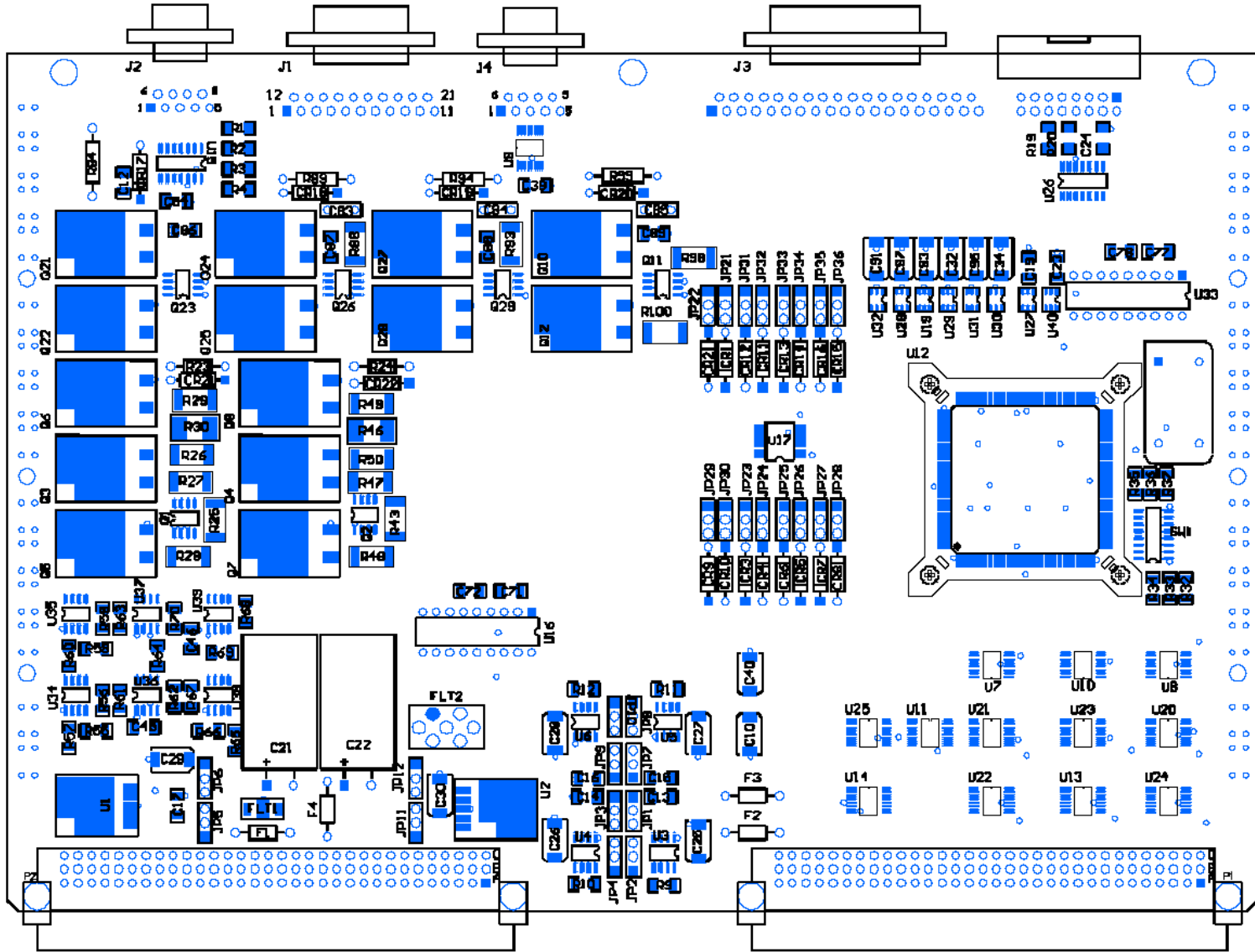
Tasks:

- switch on/off and regulate speed of circulation pumps
- open the valves
- test the status of the valves
- monitor pressure and temperature sensor
- emergency open of safety valves without USCM intervention
- manage emergency in case of massive gas leak

Redundancy:

- hot & cold (hot & hot will be evaluated against power budget)
- no duplication of control circuits on the same board

UGBC

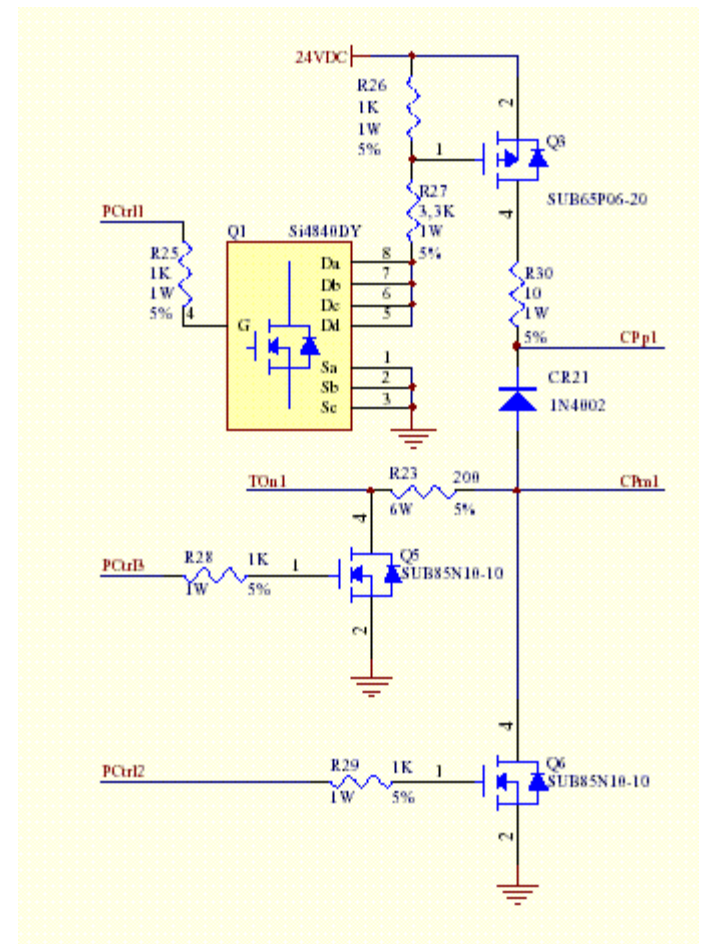
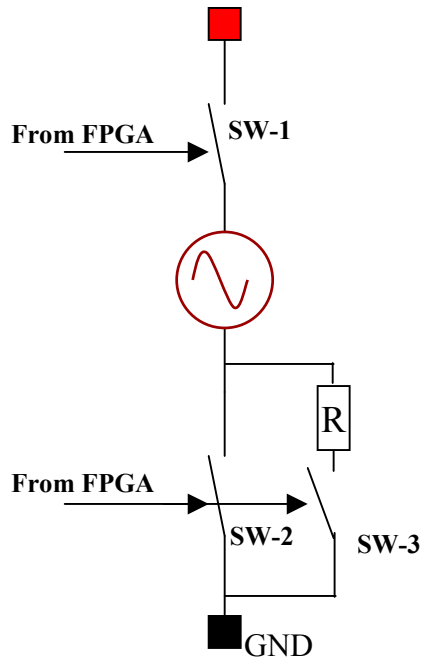


Pump control circuit is based on three switches

Pump energizing requires two different steps

- 1) Pump connection to the power supply is done using SW-1
- 2) Pump is energized using SW-2 (full speed) or SW-3 (half speed)

Energized and Speed status of the valve are stored in the FPGA through the use of comparators monitoring the voltage applied to the pump and of ADC monitoring the surged current



Part List:

- N-Mosfet SUB85N10 (ID = 85A, VDS = 100V)
- P-Mosfet SUB65N06 (ID = -65A, VDS = -60V)
- N-Mosfet Si4840DY (ID = 10A, VDS = 40V)
- Comparator LM239
- 12 bits ADC AD7476

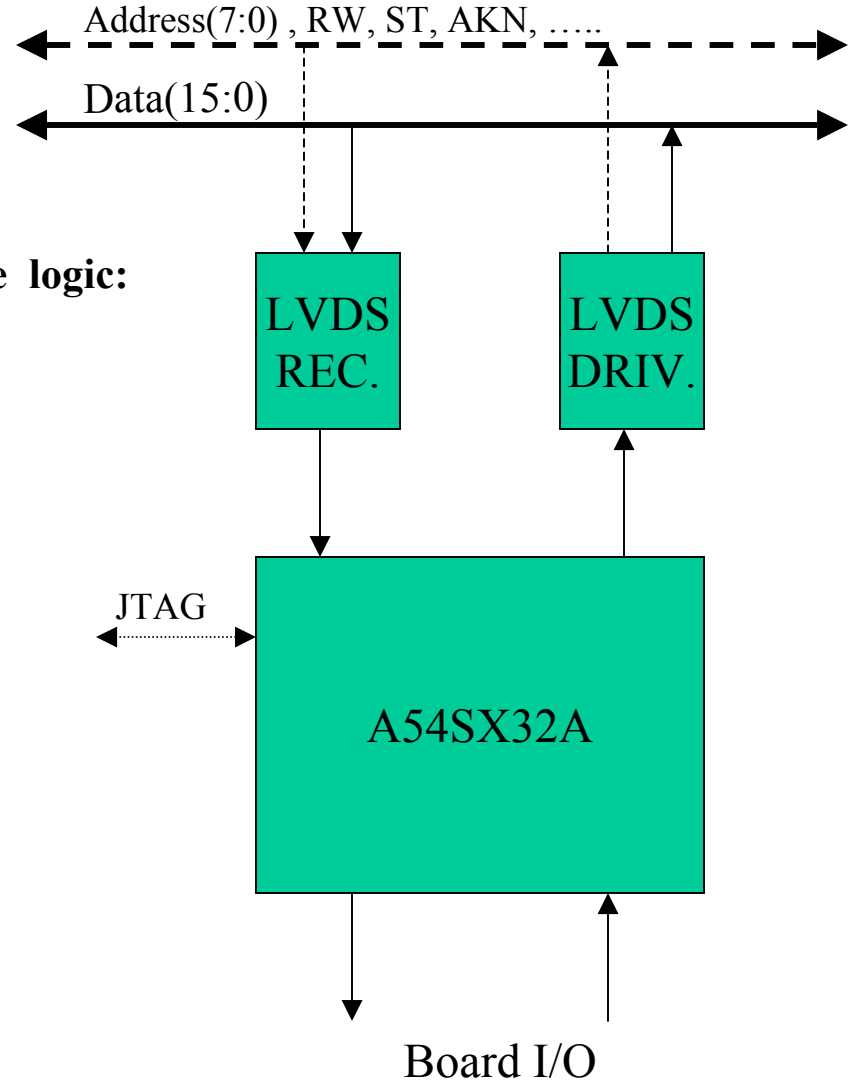
- **All boards use the same USCM I/O BUS interface logic:**

- LVDS Receiver
- LVDS Driver
- A54SX32A FPGA (PQFP 208)

- VHDL is used to describe FPGA logic

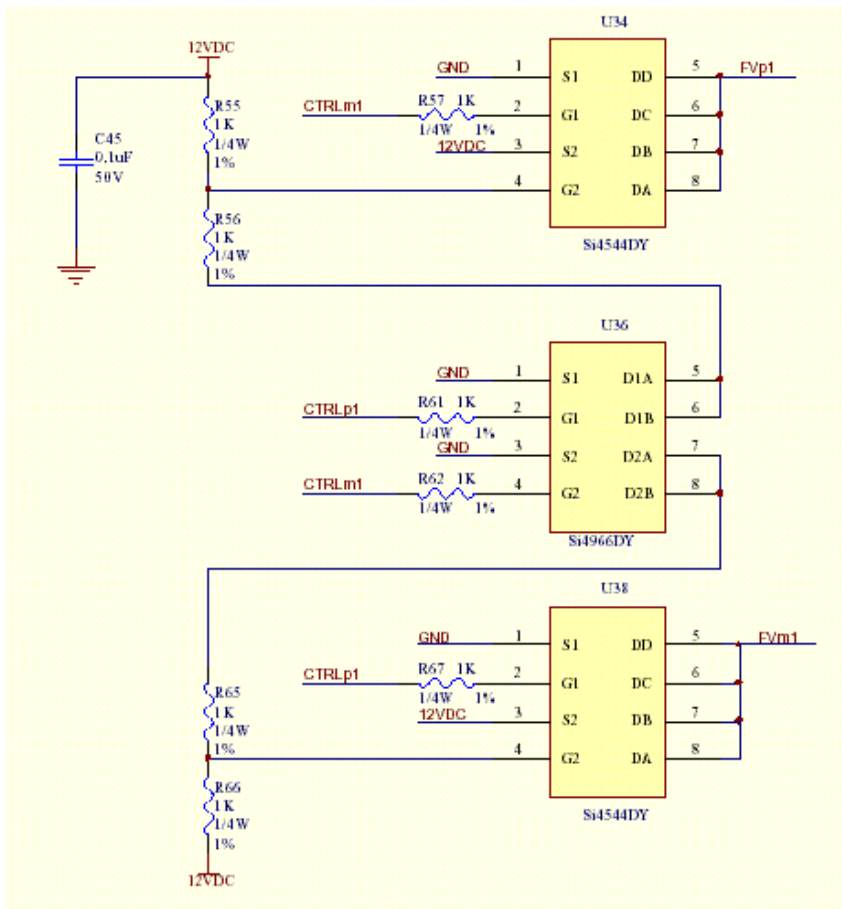
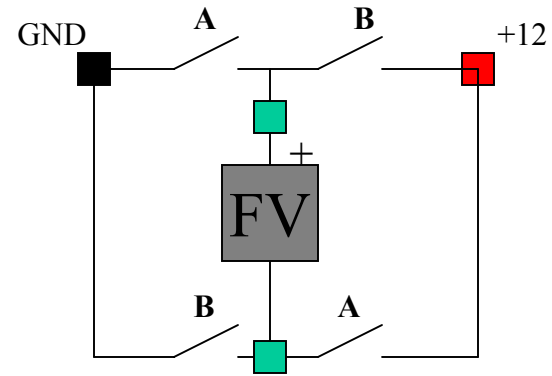
- The ACTEL development environment is used

- **Libero Software**
- **Silicon Sculptor**
- **Silicon Explorer**



Flipper valve control circuit is based on 4 switches

OPEN Valve with positive pulse
 CLOSE Valve with negative pulse
 Open Time MAX = 100 ms
 Close Time MAX = 100 ms
 Current = 150 mA



Part List:

- 2 x Half Bridge Si4544 ($I_D = 6.5A$, $V_{DS} = 30V$)
- 1 x 2N-Mosfet Si4966 ($I_D = 7A$, $V_{DS} = 20V$)

UGBC memory mapped devices

USCM Write Operation @ UGBC board write address	
DATA[15:0]	Function
0x1XXX	Set <i>enable</i> register to XXX
0x2XXX	Set <i>open time</i> register to XXX
0x300X	Set " <i>speed</i> " register to X
0x400X	Set <i>MCA</i> register to X
0xE001	Open V6a
0xE002	Open V6b
0xE004	Open V18a
0xE008	Open V18b
0xE010	Open V8A
0xE020	Close V8A
0xE040	Open V8B
0xE080	Close V8B

USCM Read Operation @ UGBC board	
ADD[7:0]	Function
Address-1	Read v&p <i>current</i> status register
Address-2	Read v&p <i>event</i> register
Address-3	Read v&p <i>enable</i> register
Address-4	Read MV100 valves <i>open time</i> register
Address-5	Read <i>speed</i> register

UGBS interface to BOX-S

Tasks:

- open the valves
- test the status of the valves
- monitor pressure and temperature sensor
- emergency open of safety valve without USCM intervention

Redundancy:

- hot & cold (hot & hot will be evaluated against power budget)
- no duplication of control circuits on the same board

UGFV interface to manifold valves

Tasks:

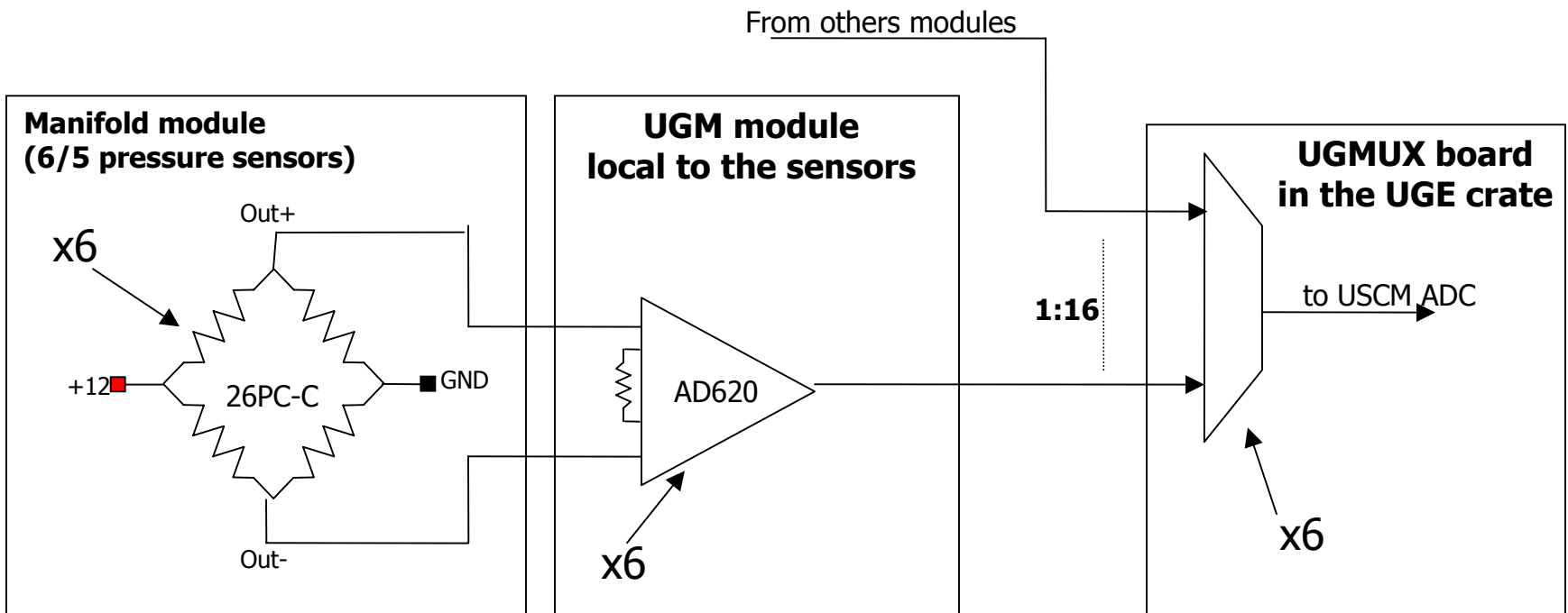
- open/close the valves under USCM command
- open/close the valves under UGBC command
- pressure sensor output signal multiplexing to the USCM ADC input lines

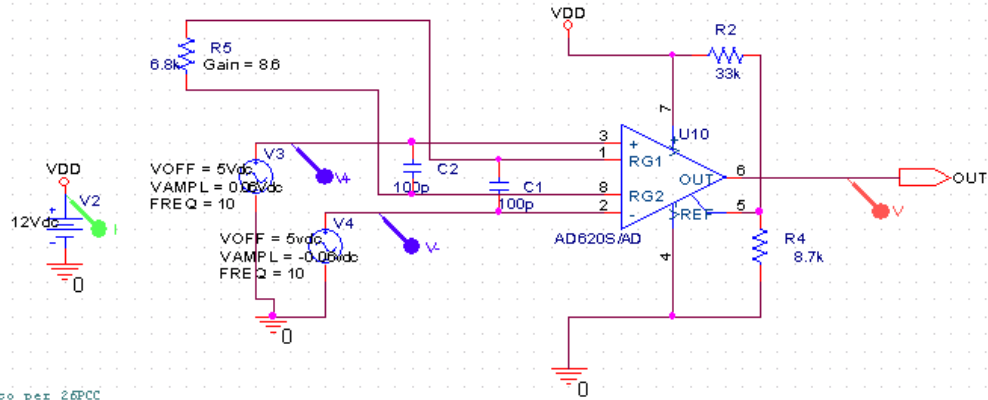
Redundancy:

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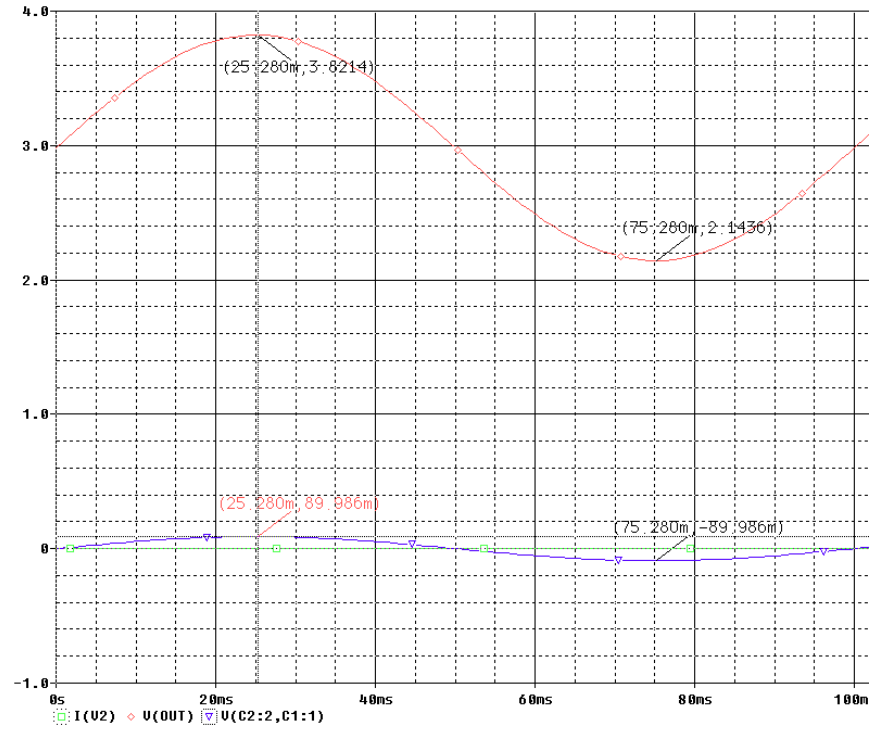
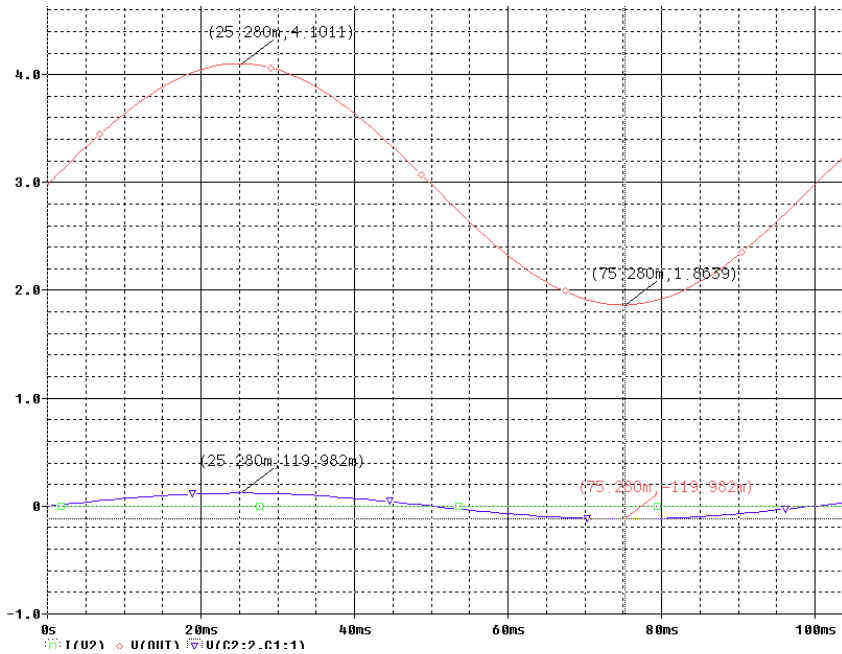
UGM modules

- 82 pressure sensors (honeywell 26PC-C) arranged in 16 modules (14 with 5 p.s. and 2 with 6 p.s.)
- The typical output signal from the sensor (Out+ / Out-) is in the ± 100 mV range (± 15 psi) and is conditioned and multiplexed to be connected to the UGSCM ADC lines (0 to 4.096 VDC)

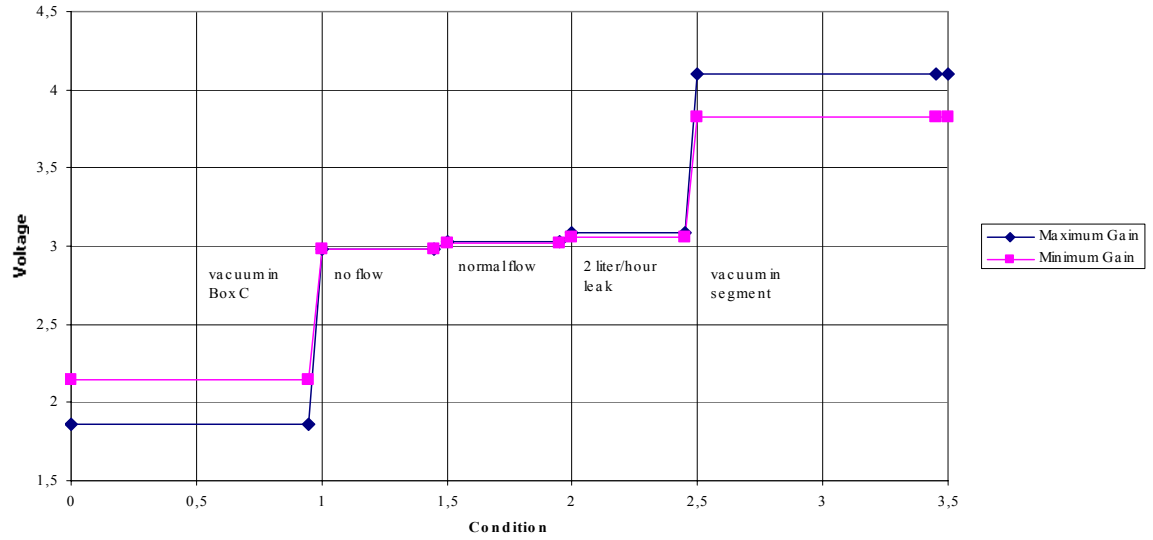




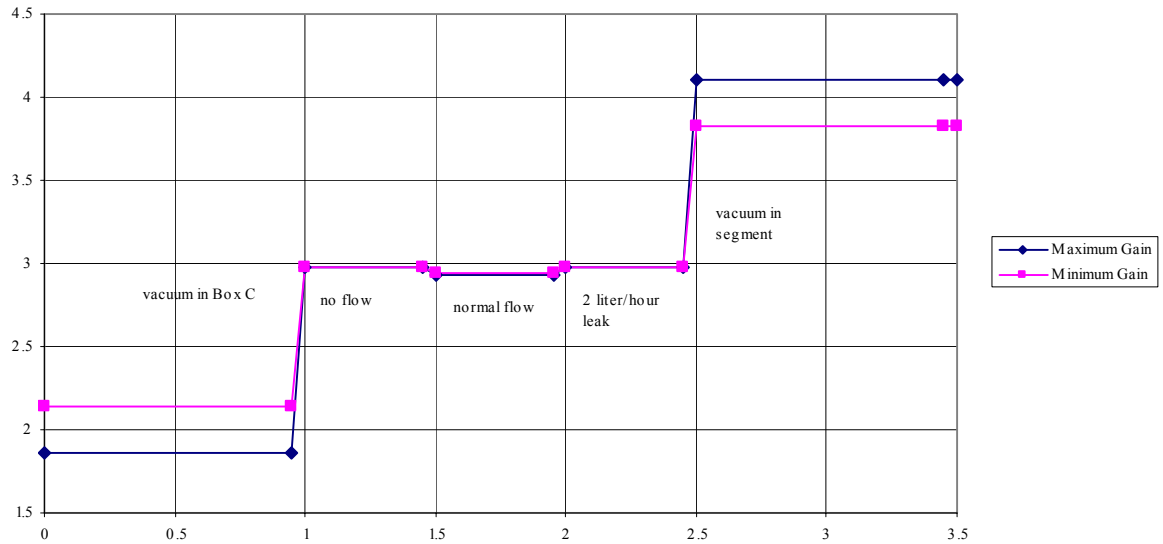
circuito per 26FCC
 In caso di Span minimo (90 mV)
 la risoluzione = 0.019 psi



PA Sensor Response (input to segment)



PB Sensor Response (output from segment)(sensor polarity as on input)



UGpd-Box

Power Supply Requirements

Operating Voltage (V)	Normal Power (W)	Peak Power (W)	DC-DC Converter
120	<0.05	< 0.05	2x CAEN S9025
24	6	80	? LAMBDA or INTERPOINT ?
10.8	4.9	18	2x CAEN S9022
5	7.1	9	2x CAEN S9024
3.3	1	2	2x CAEN S9023
Total	19.05	109.05	

- Hot and Cold redundancy used
- 10 DC-DC Converters needed