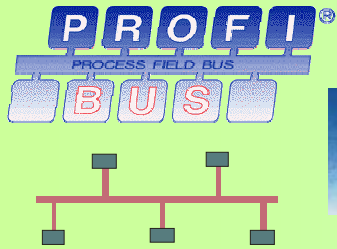


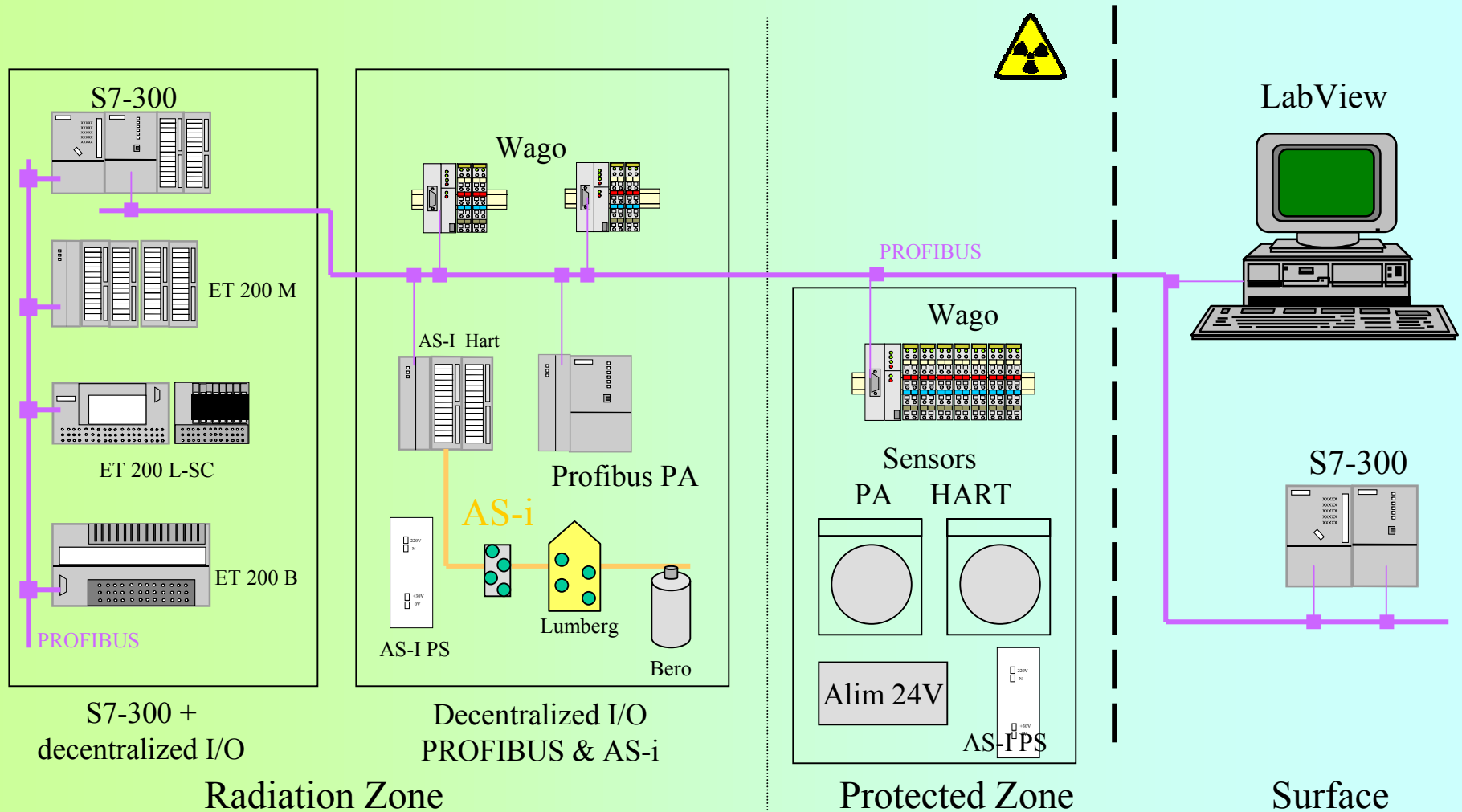
Radiation tests for Siemens PLCs and PROFIBUS

J. Brahy LHC/IAS
C. Dehavay LHC/IAS

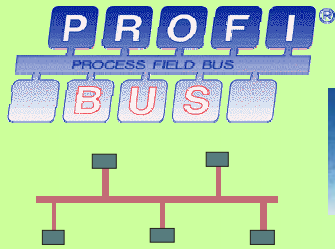


PLC & FieldBus Radiation Tests

April to June 1999 (test 1)



7-Dec-2001

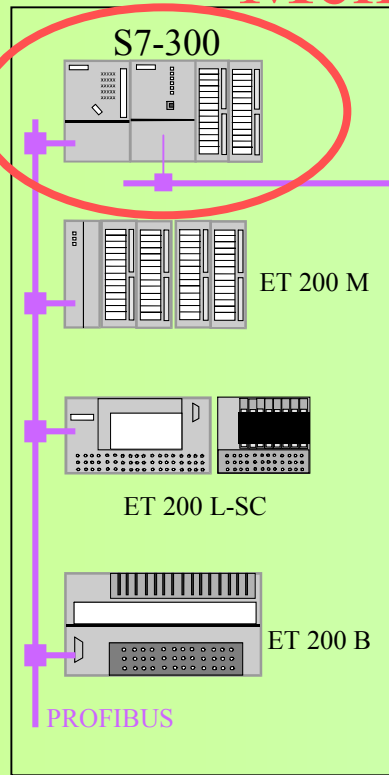


PLC & FieldBus Radiation Tests

April to June 1999 (test 1)

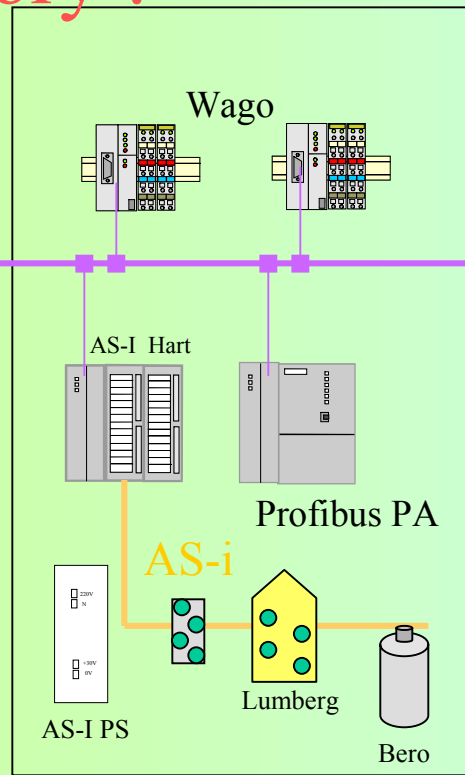
Total dose: 50 Grays

Memory !

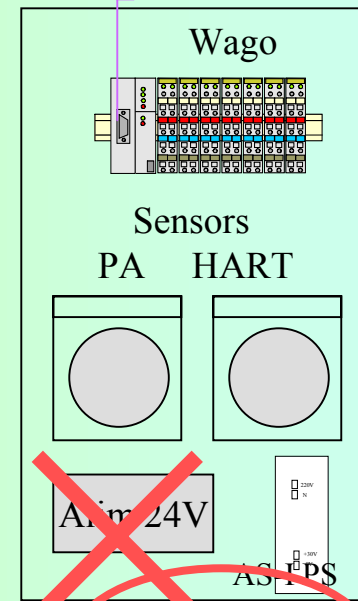


S7-300 +
decentralized I/O

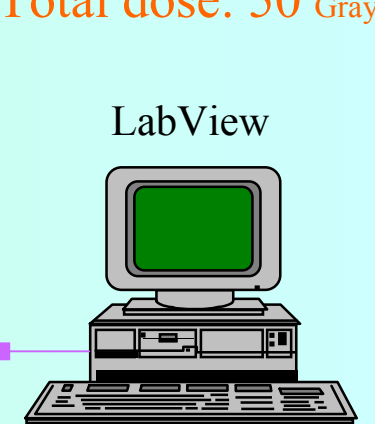
Radiation Zone



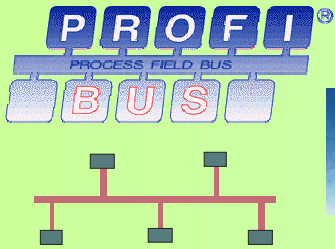
Decentralized I/O
PROFIBUS & AS-i



Protected Zone !

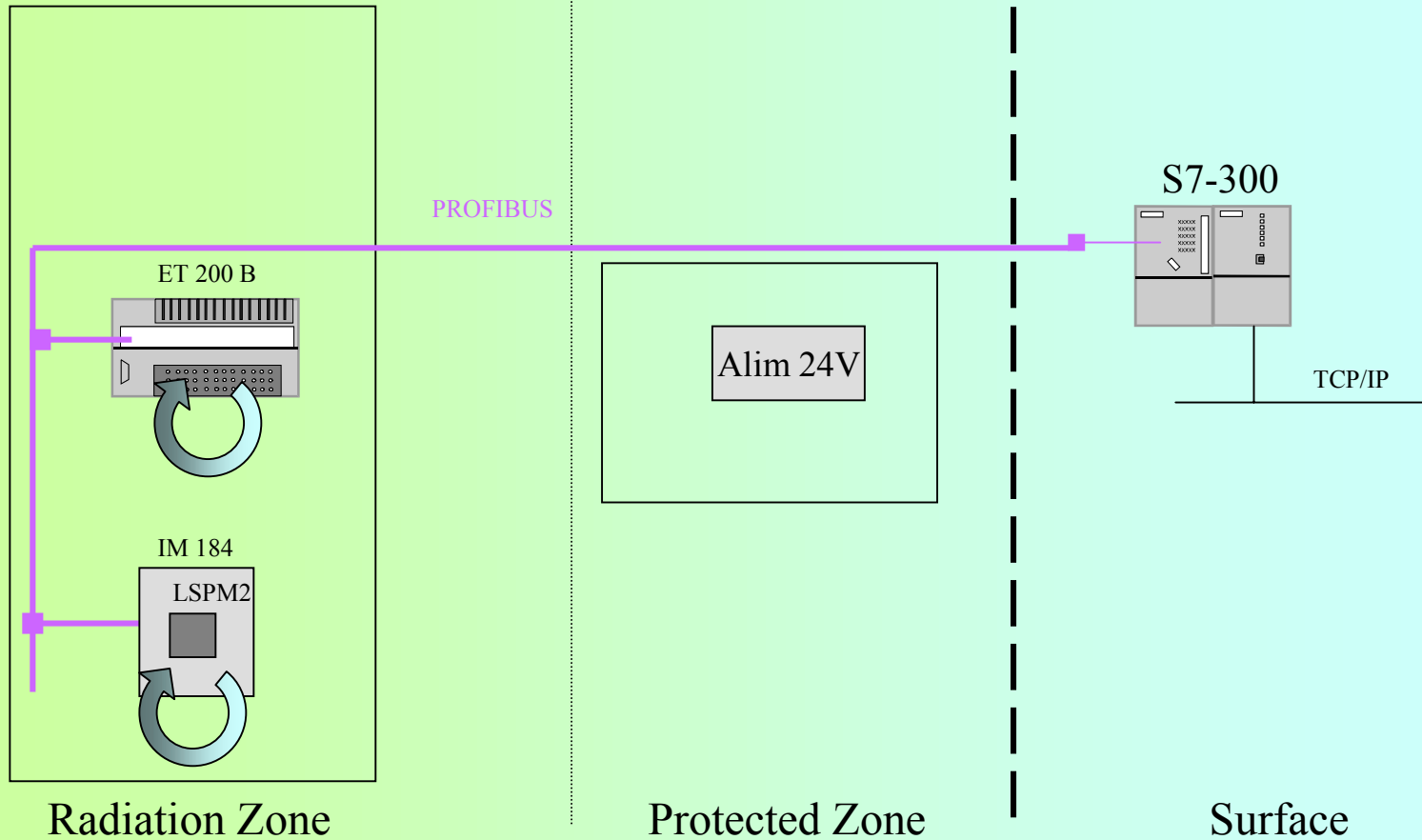


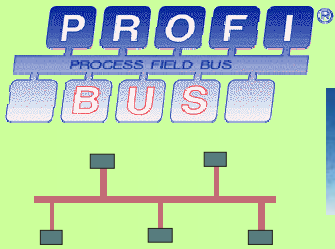
Surface



FieldBus Radiation Tests July & August 1999 (test 2)

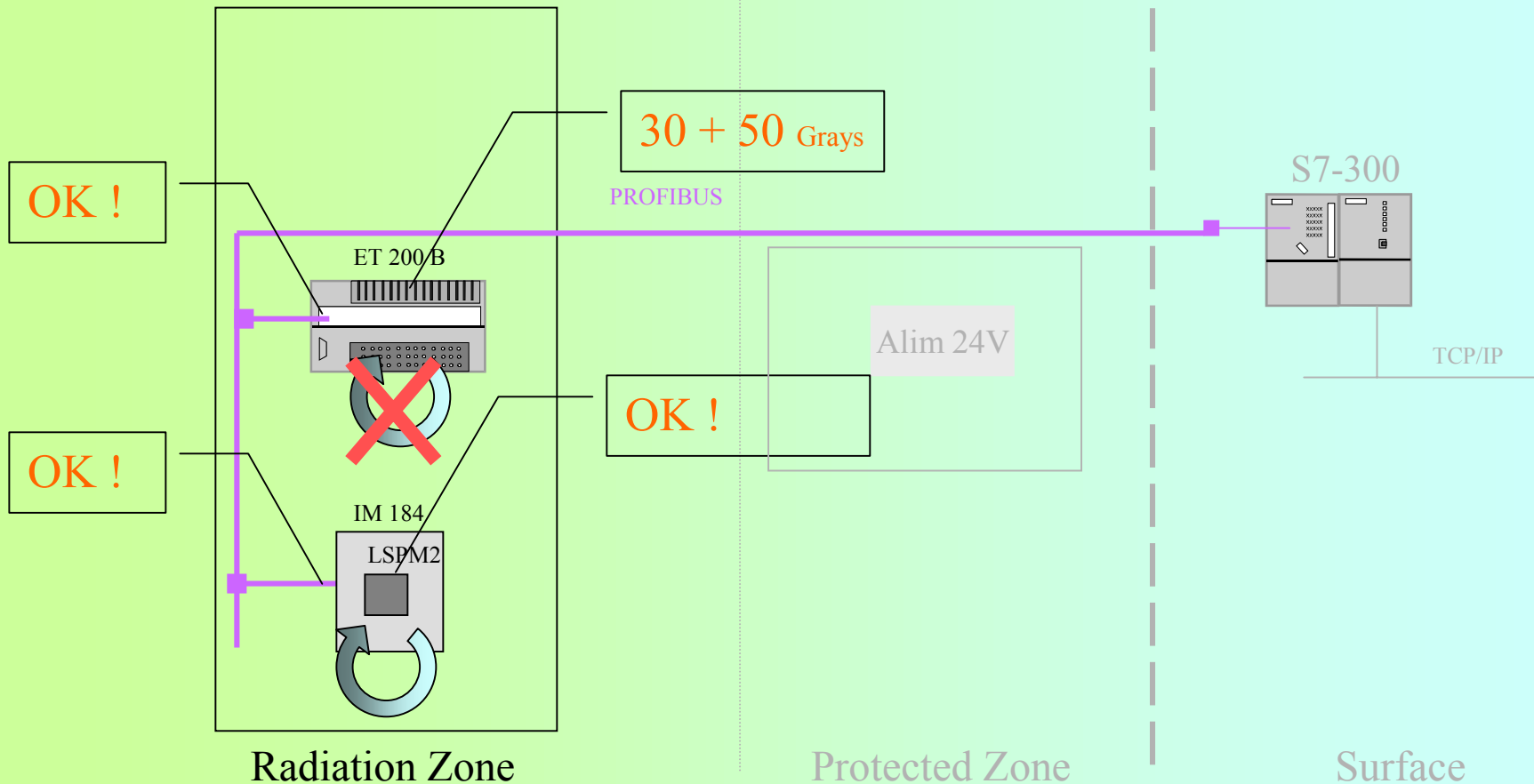
Simpler test bench!

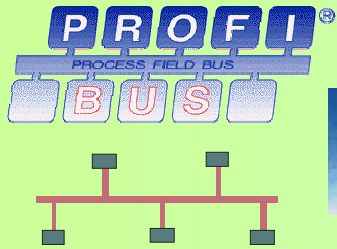




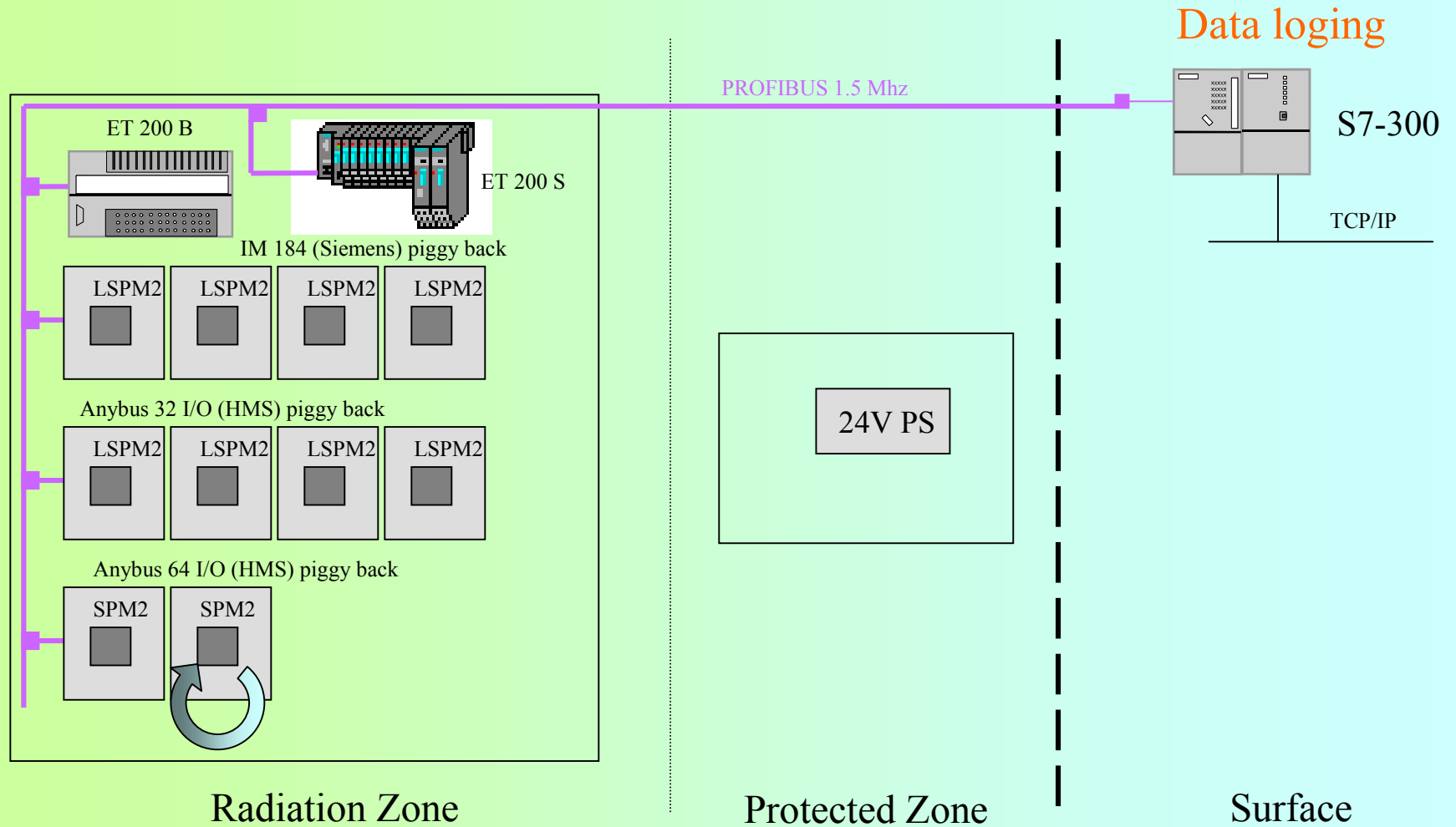
FieldBus Radiation Tests July & August 1999 (test 2)

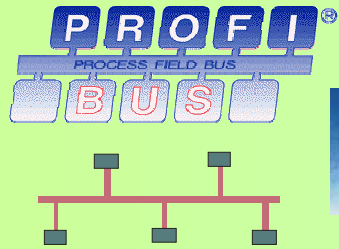
Total dose: 80 Grays



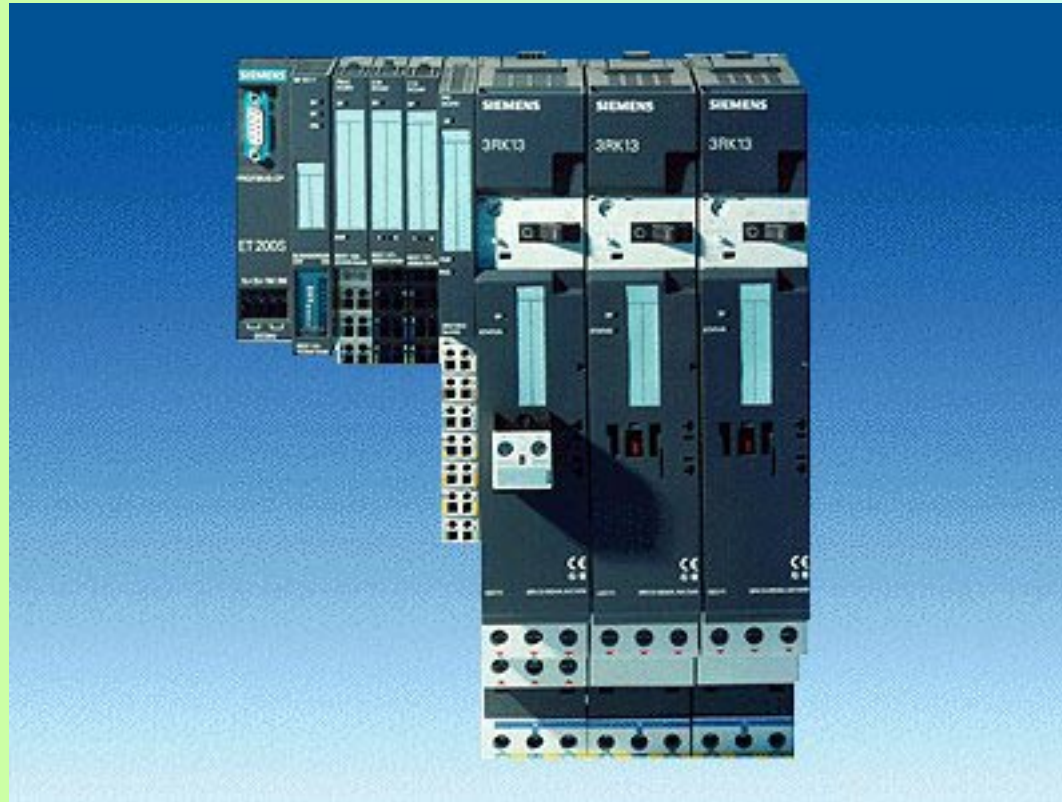


PROFIBUS radiation tests 2000

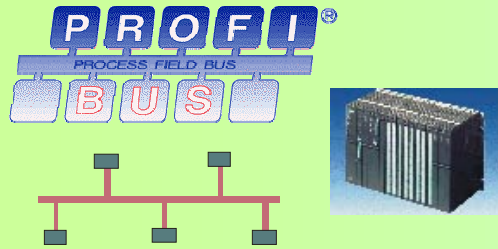




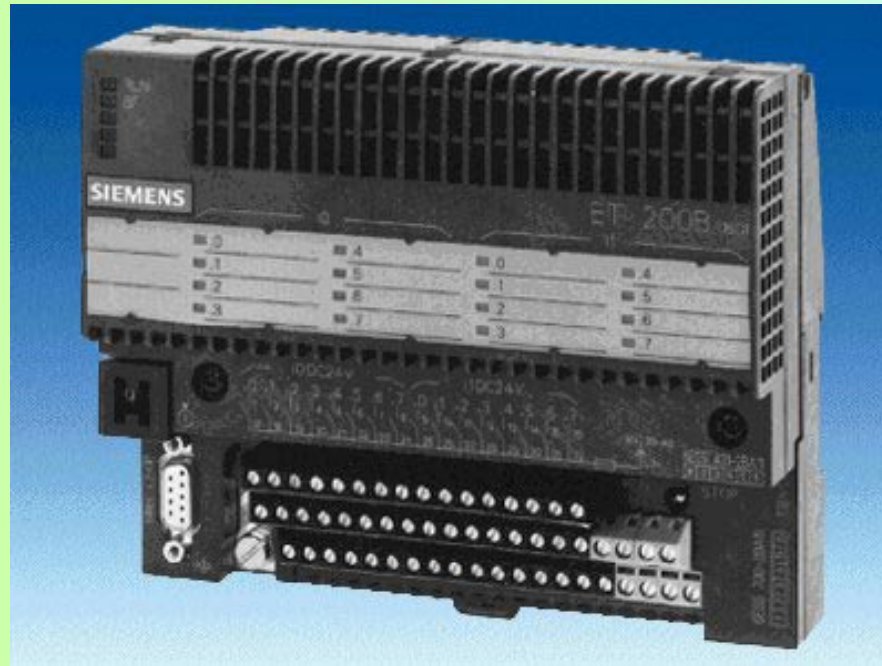
PROFIBUS radiation tests 2000



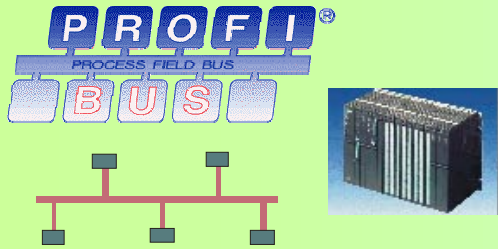
ET200S



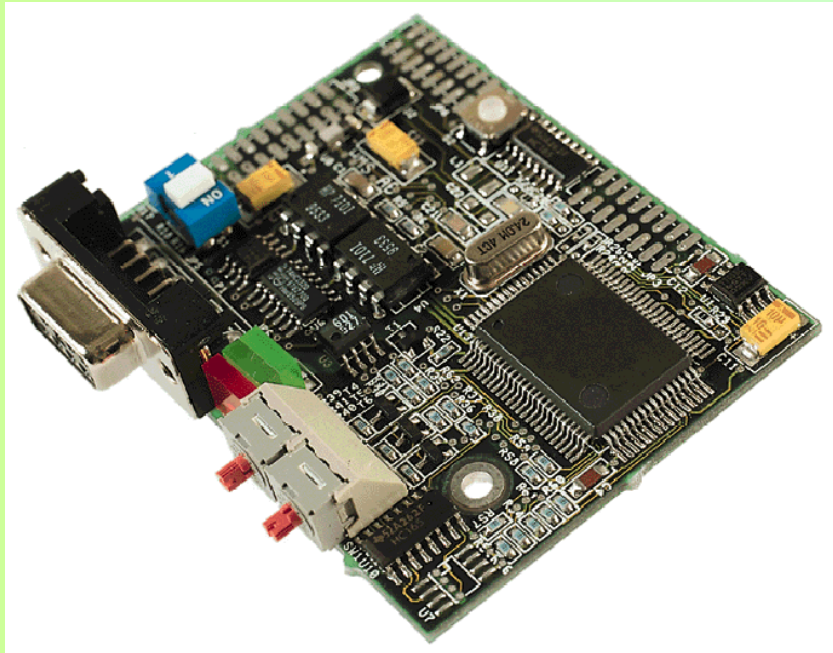
PROFIBUS radiation tests 2000



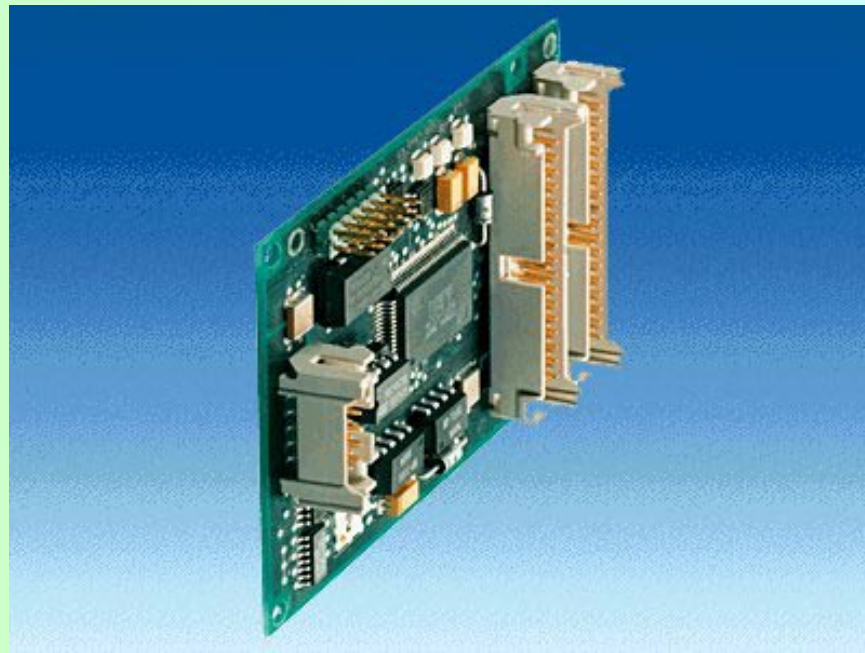
ET200B



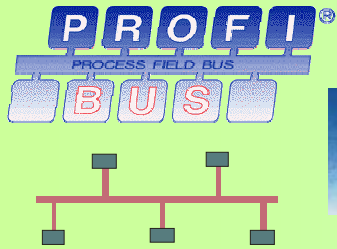
PROFIBUS radiation tests 2000



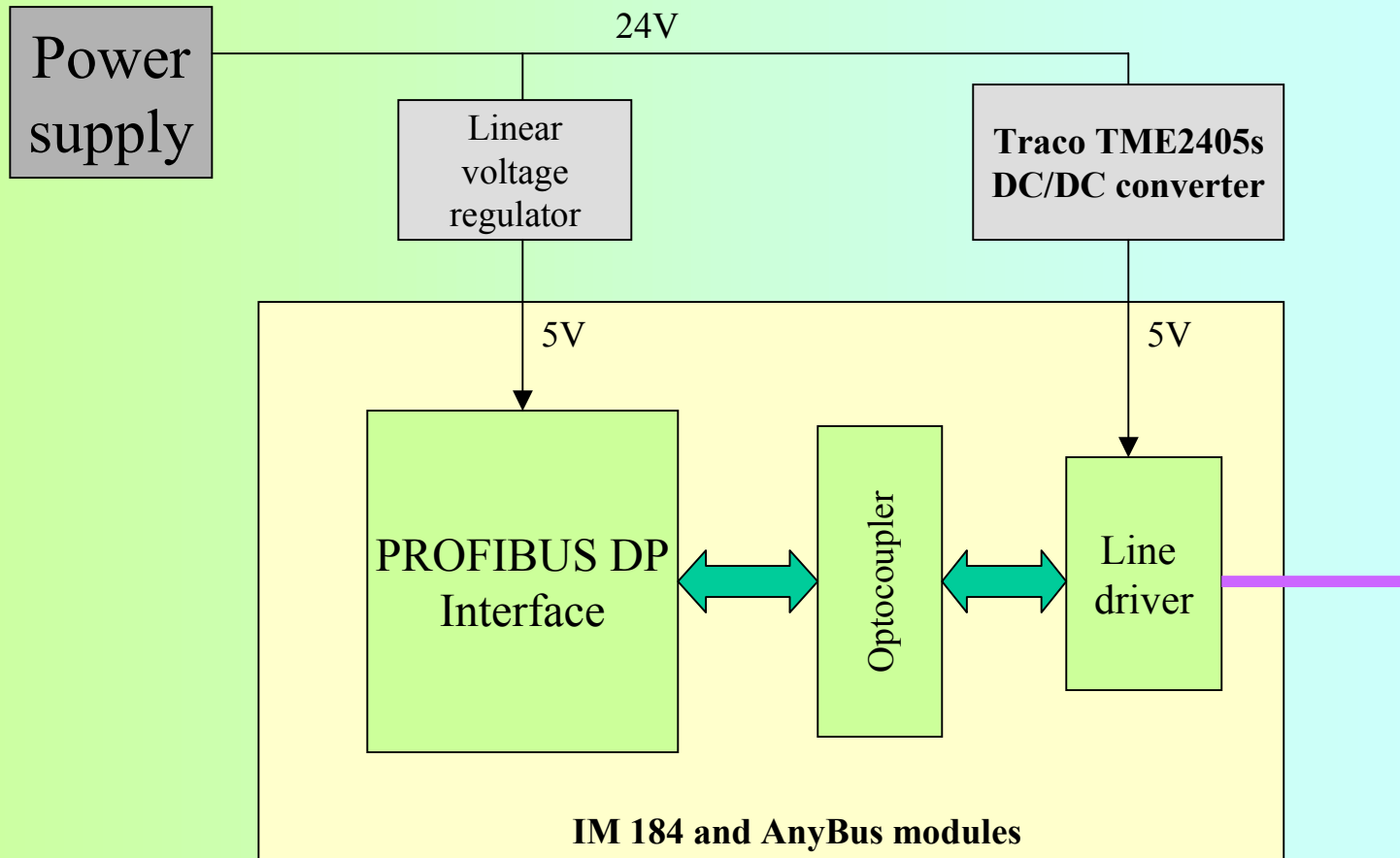
AnyBus I/O module

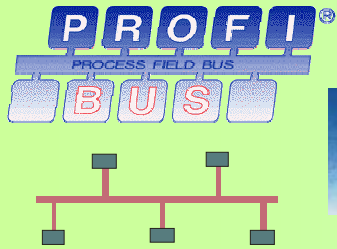


SIEMENS IM184



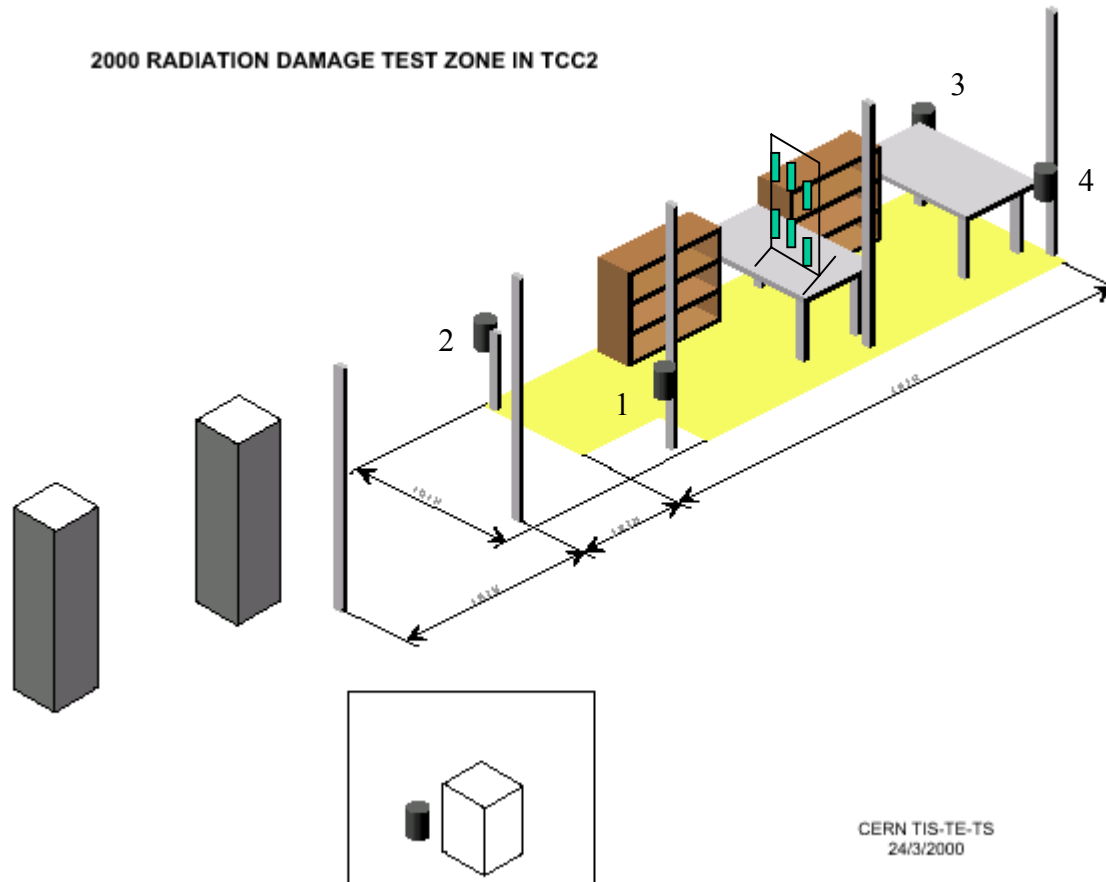
PROFIBUS radiation tests 2000

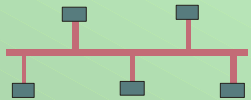




PROFIBUS radiation tests 2000

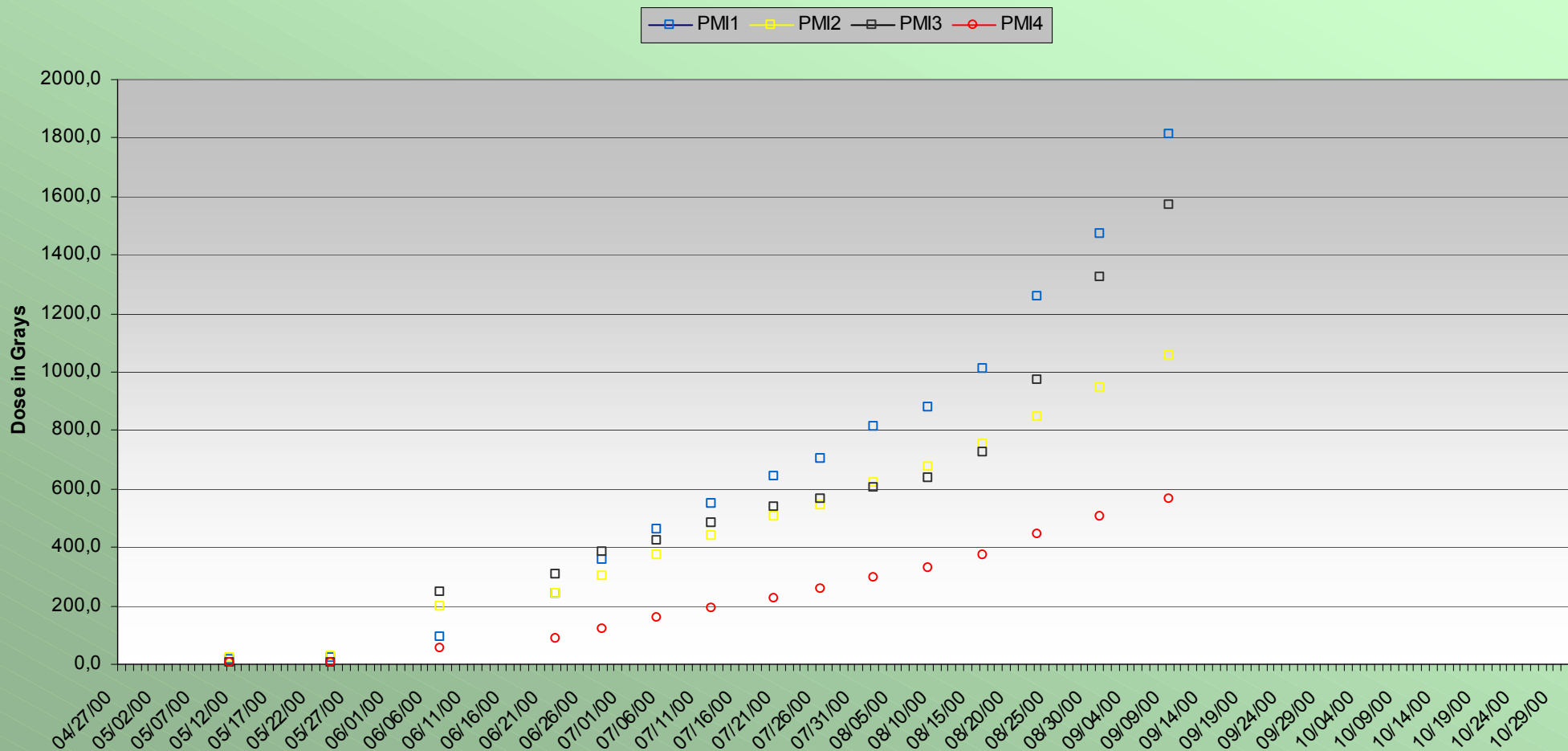
2000 RADIATION DAMAGE TEST ZONE IN TCC2

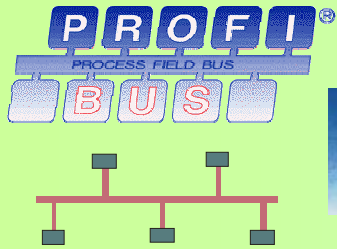




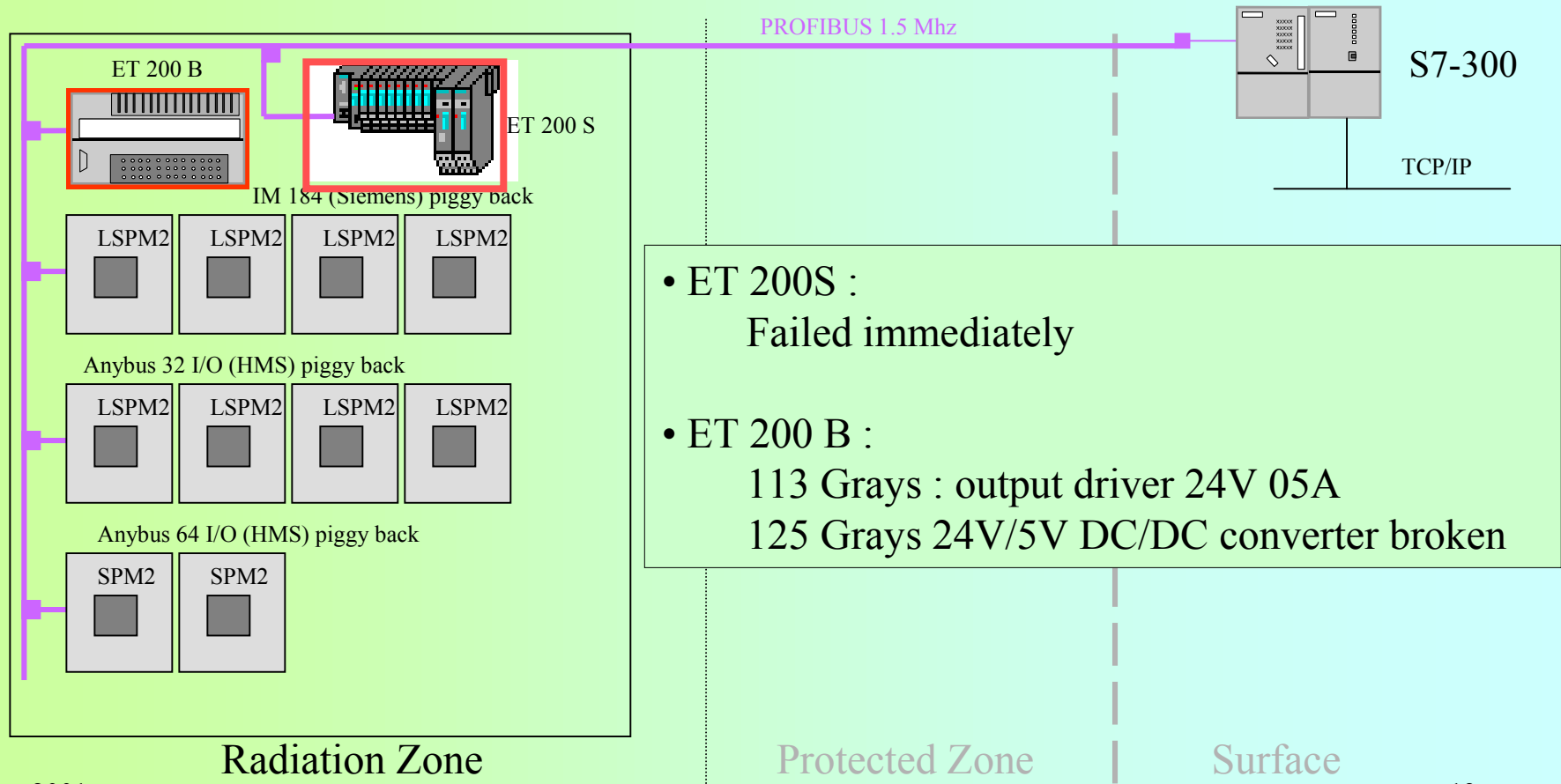
PROFIBUS radiation tests 2000

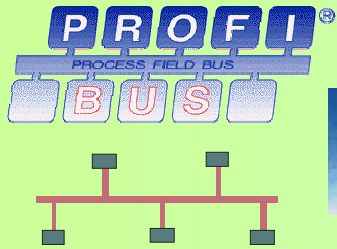
TCC2 TOTAL CUMULATIVE DOSE in Grays (PMI 1- 4)
ACTIVE AREA



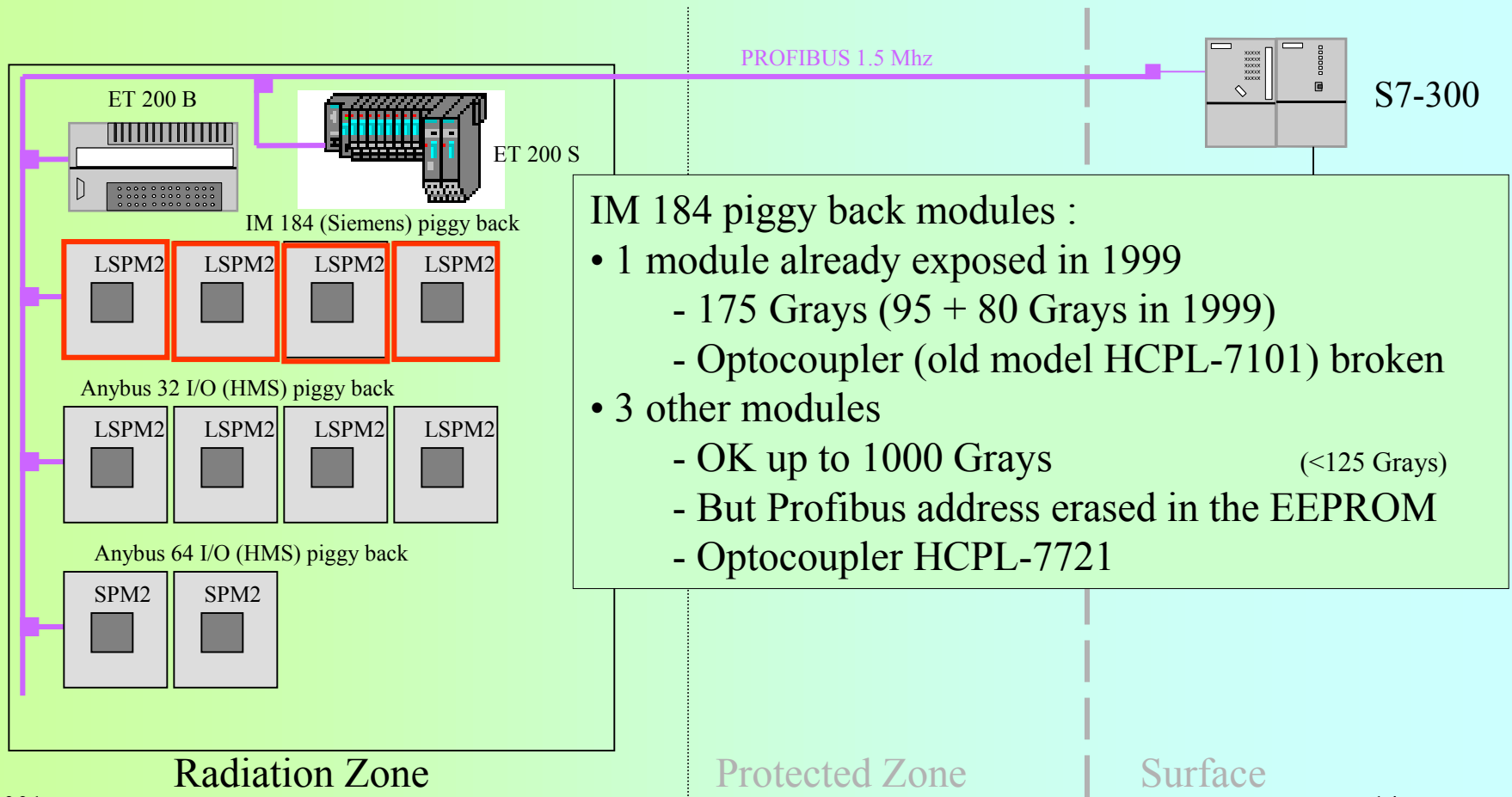


PROFIBUS radiation tests 2000



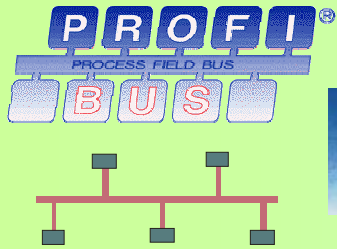


PROFIBUS radiation tests 2000

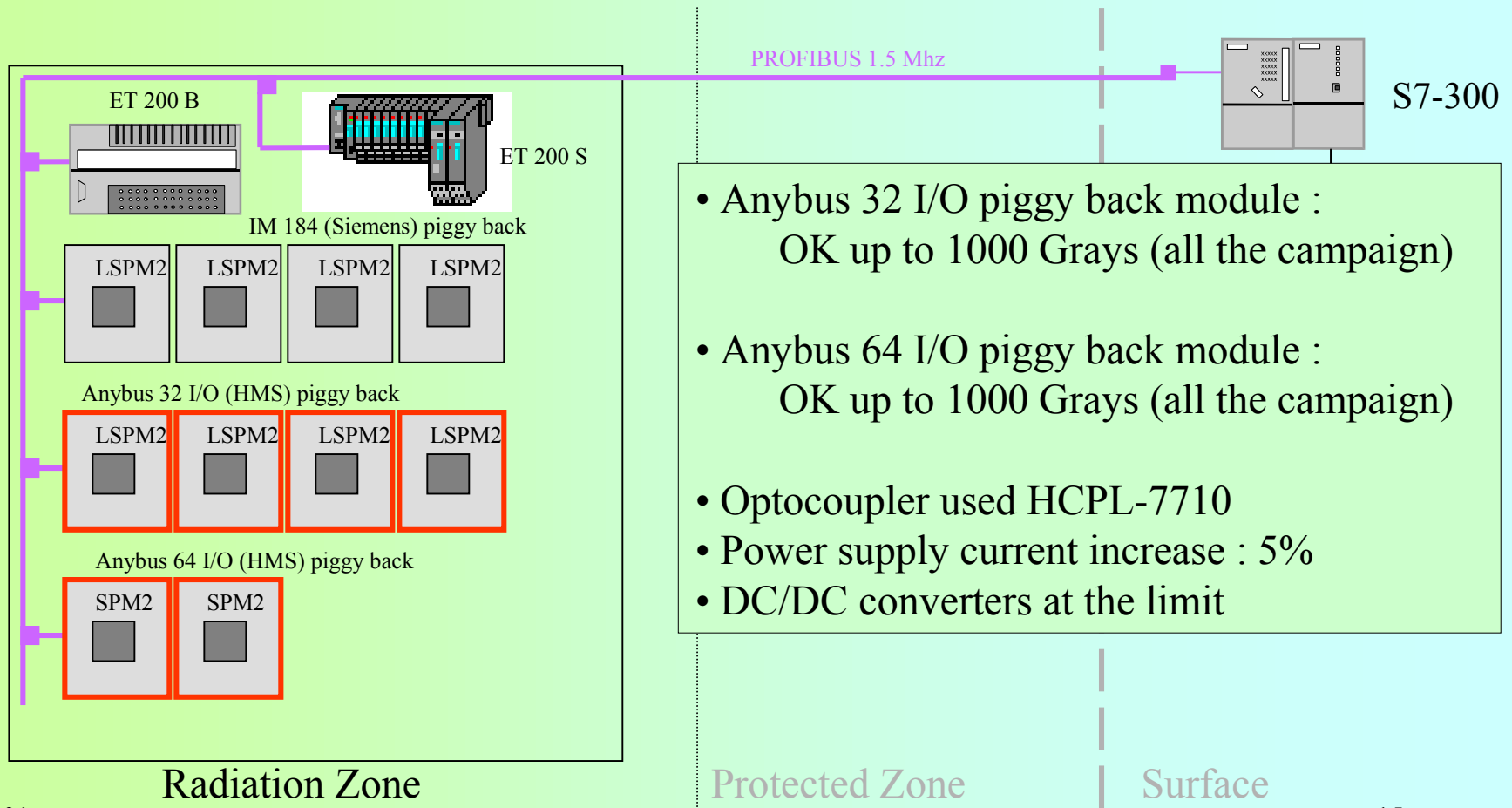


IM 184 piggy back modules :

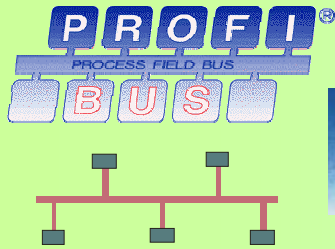
- 1 module already exposed in 1999
 - 175 Grays (95 + 80 Grays in 1999)
 - Optocoupler (old model HCPL-7101) broken
- 3 other modules
 - OK up to 1000 Grays (<125 Grays)
 - But Profibus address erased in the EEPROM
 - Optocoupler HCPL-7721



PROFIBUS radiation tests 2000

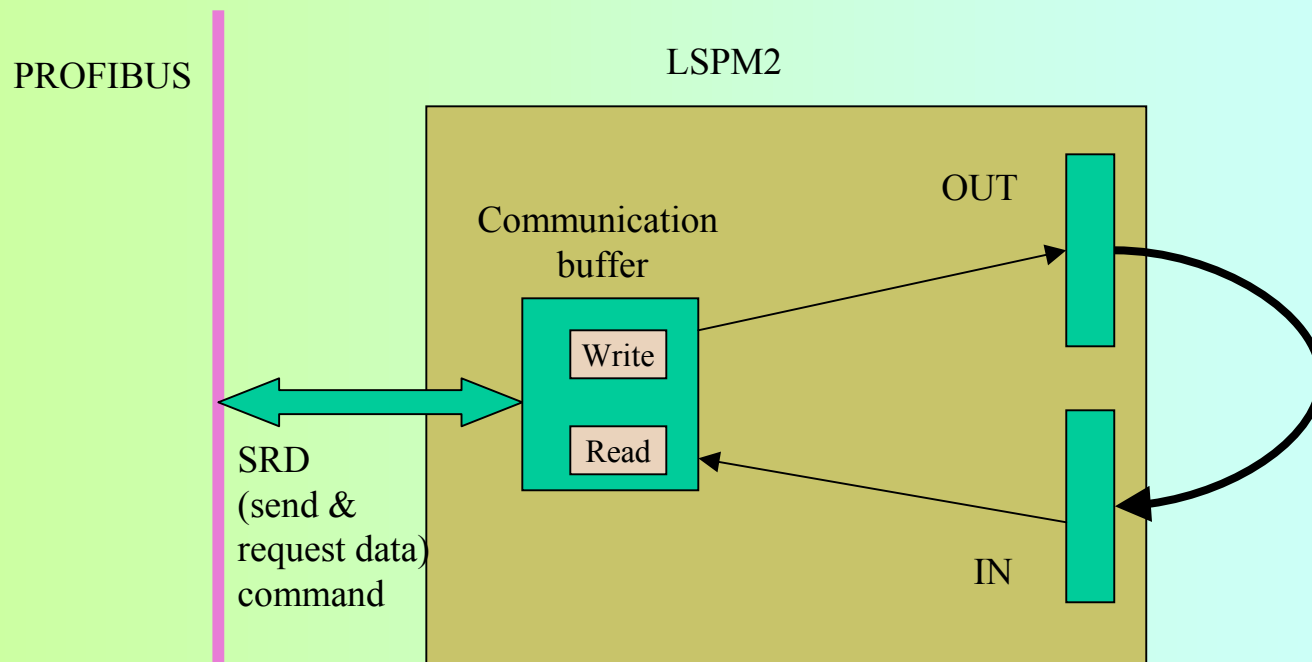


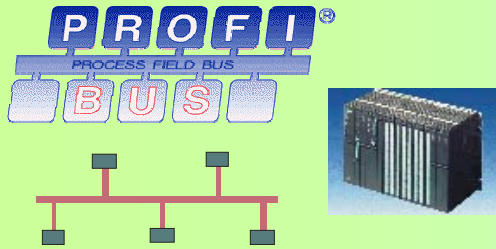
- Anybus 32 I/O piggy back module :
OK up to 1000 Grays (all the campaign)
- Anybus 64 I/O piggy back module :
OK up to 1000 Grays (all the campaign)
- Optocoupler used HCPL-7710
- Power supply current increase : 5%
- DC/DC converters at the limit



PROFIBUS radiation tests 2000

Data transfer in LSPM2 chip Single event upset probability

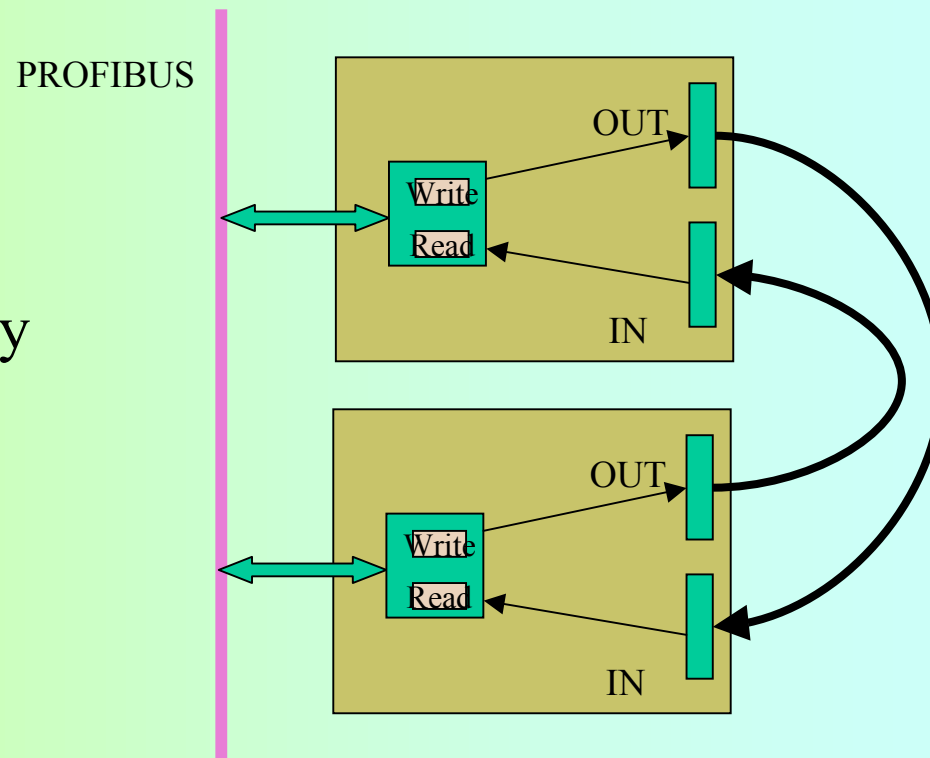


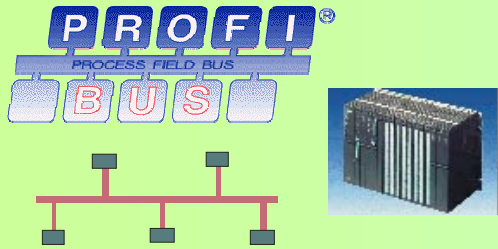


PROFIBUS radiation tests 2000

Data transfer in LSPM2 chip

Next step :
Single event upset probability





PROFIBUS radiation tests

Conclusions

- Intelligent systems unusable (RAM)
- Modular devices unusable (RAM)
- Compact digital I/Os OK up to $\cong 100$ Grays
- General purpose piggy back interface OK up to 1000 Grays
- Single event upset to be confirmed