



SCHNEIDER RADIATION TEST (2000)

On WorldFIP (FIPIO) Modules

Test on SCHNEIDER Modules

- *TBX*
- *MOMENTUM*



SCHNEIDER RADIATION TEST (2000)

Aim and choice

- ◆ **Aim** : To qualify FIPCO technology as MICROFIP

- ◆ **Choice** : 2 series of basic I/O modules made up of :
 - ⇒ TBXs Modules
 - ⇒ MOMENTUMs Modules

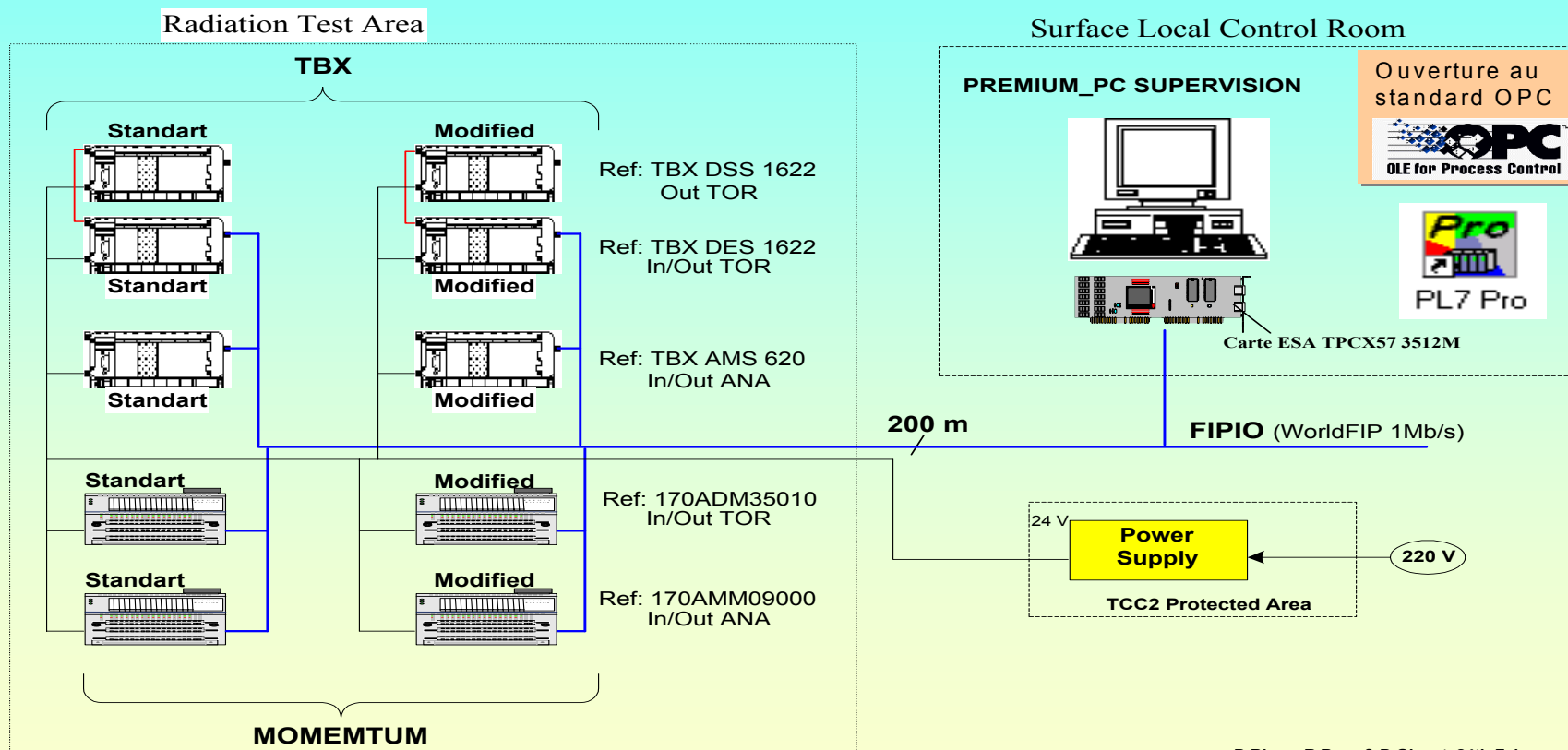
- ◆ **These 2 series are made up of** :
 - ⇒ a set of standard modules
 - ⇒ a set of modified modules having to resist better to the radiation



SCHNEIDER RADIATION TEST (2000)

Test Architecture

RADIATION TEST on MOMENTUM and TBX Modules (SCHNEIDER)
With OPC server

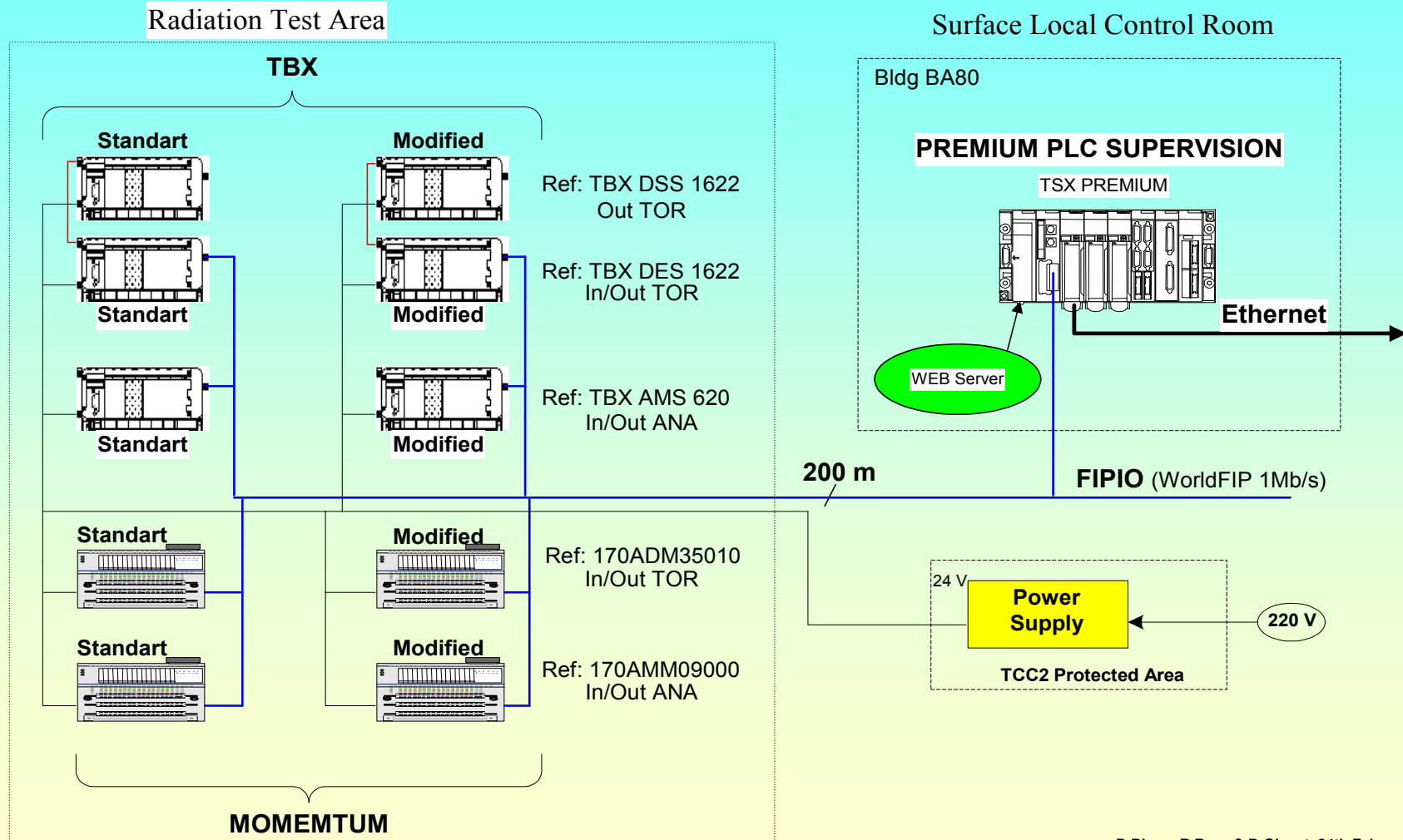


File : TBX_Mom_PC_rad.vsd

D.Bianc R.Brun & D.Glenat 24th February 2000



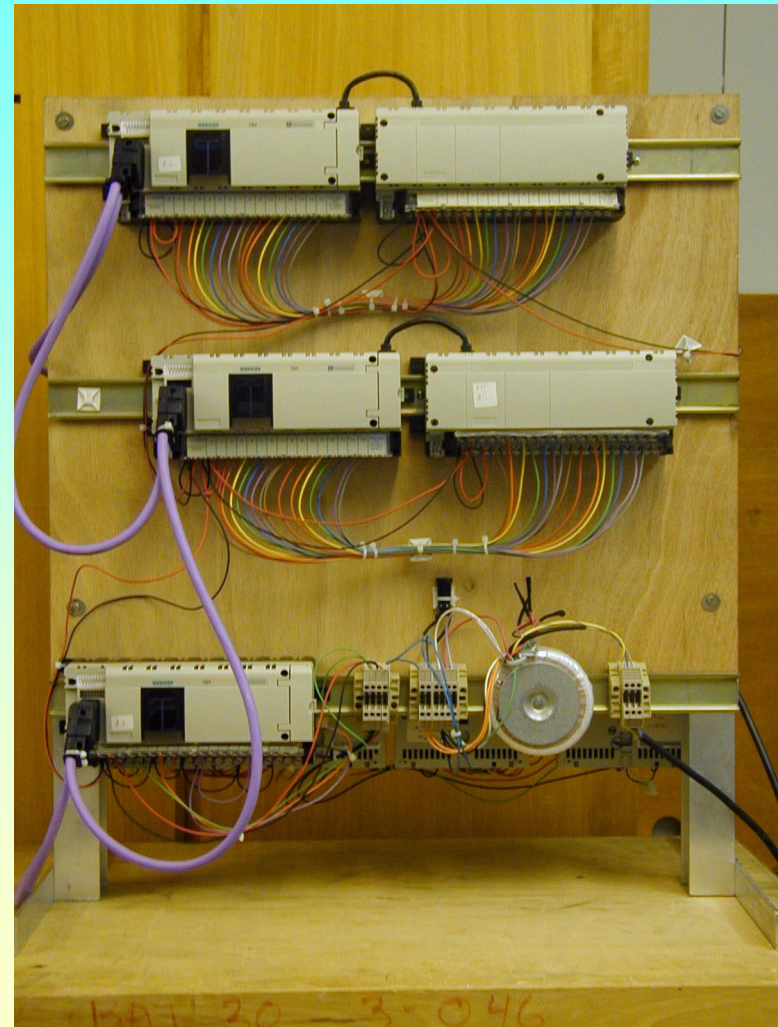
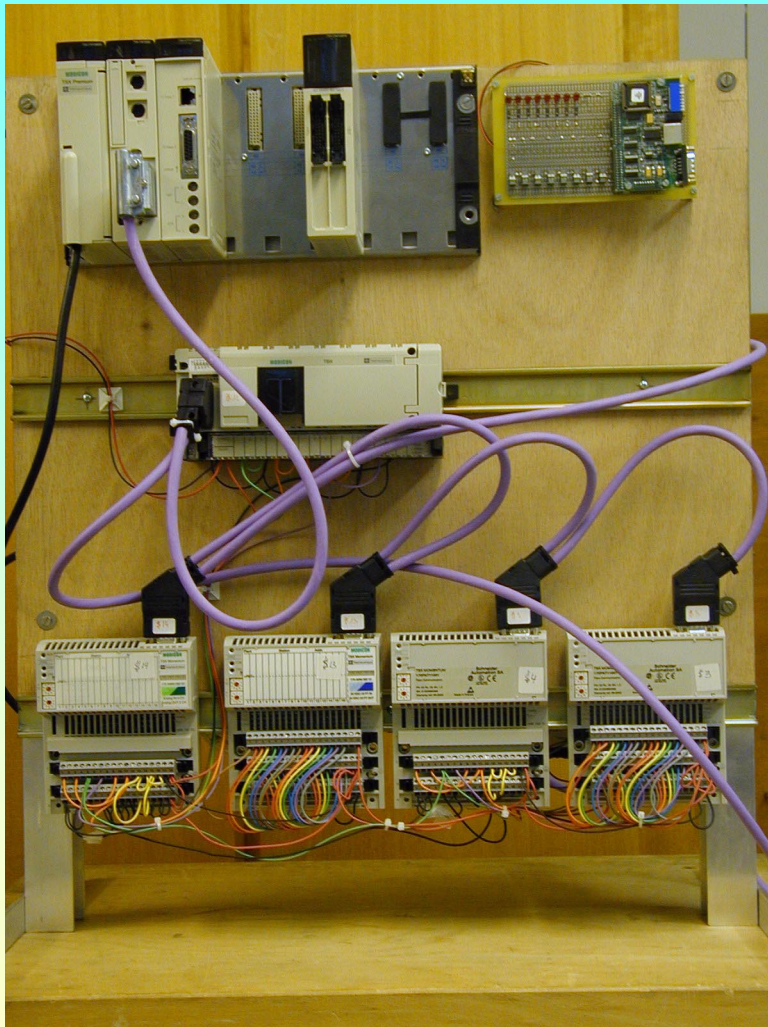
SCHNEIDER RADIATION TEST (2000) Test Architecture





SCHNEIDER RADIATION TEST (2000)

Mock-up view



7/12/2000

RADIATION TEST / SCHNEIDER Modules
R. BRUN (LHC/IAS)



SCHNEIDER RADIATION TEST (2000)

Conclusion

- ◆ 6 modules resisted to a dose of 15 Grays approximately.
- ◆ At the beginning, they functioned very well, apart from 4 memory BIT errors ("SEU").
- ◆ Foot-note: The analog part (ADC and DAC) functioned well
- ◆ After they all broke down at the same time, following an increase of the neutron flow.
 - ↳ Noted defect on the CPU of the TBX module which showed a "Latchup" default which drove to a general power supply failure.
 - ↳ After repairs this module worked for 10mm approximately then broke down again without us identifying the default.
 - ↳ Foot-note: Observation of the "Short Annealing Effect".

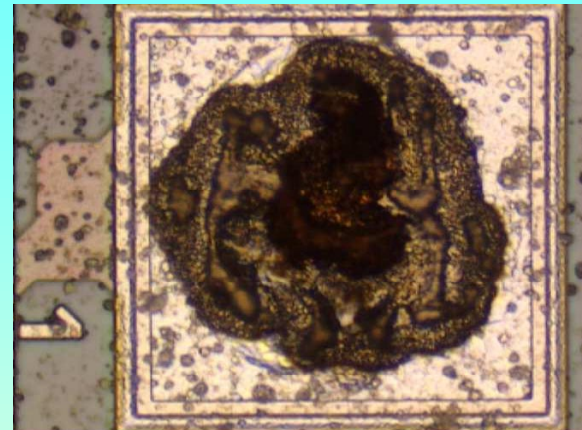


MBX & MOMENTUM Schneider Module

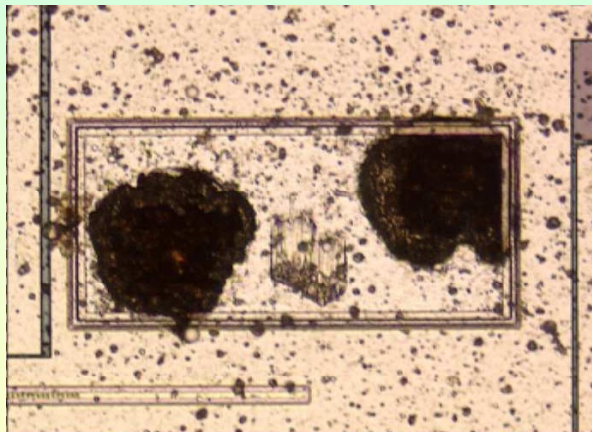
Electrical Overstress : Latch-up on the CPU component



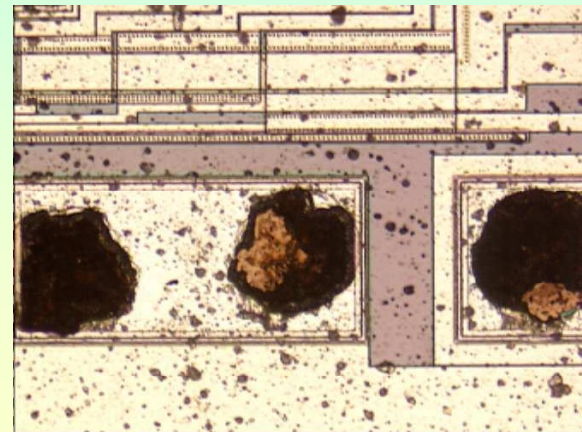
Marque ronde plus brune visible sur le capot du circuit, signe d'une surchauffe du produit



Pad 1



Pad VCC



Pad VSS



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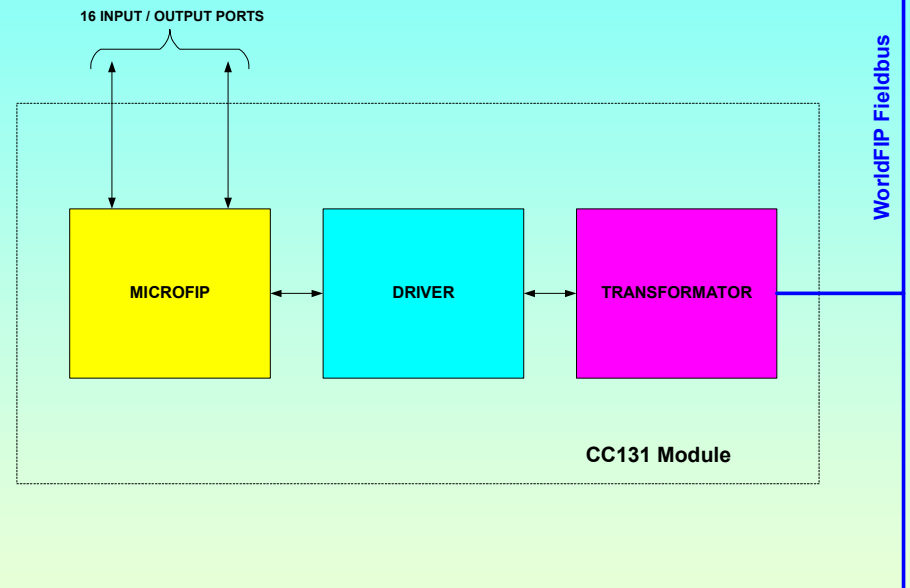
On the MICROFIP Technology

- **MICROFIP Modules Test :**
 - ⇒ **CC131 Module (Alstom)**
 - ⇒ **C51/MICROFIP Module (Gespac)**



TEST RADIATION 2000

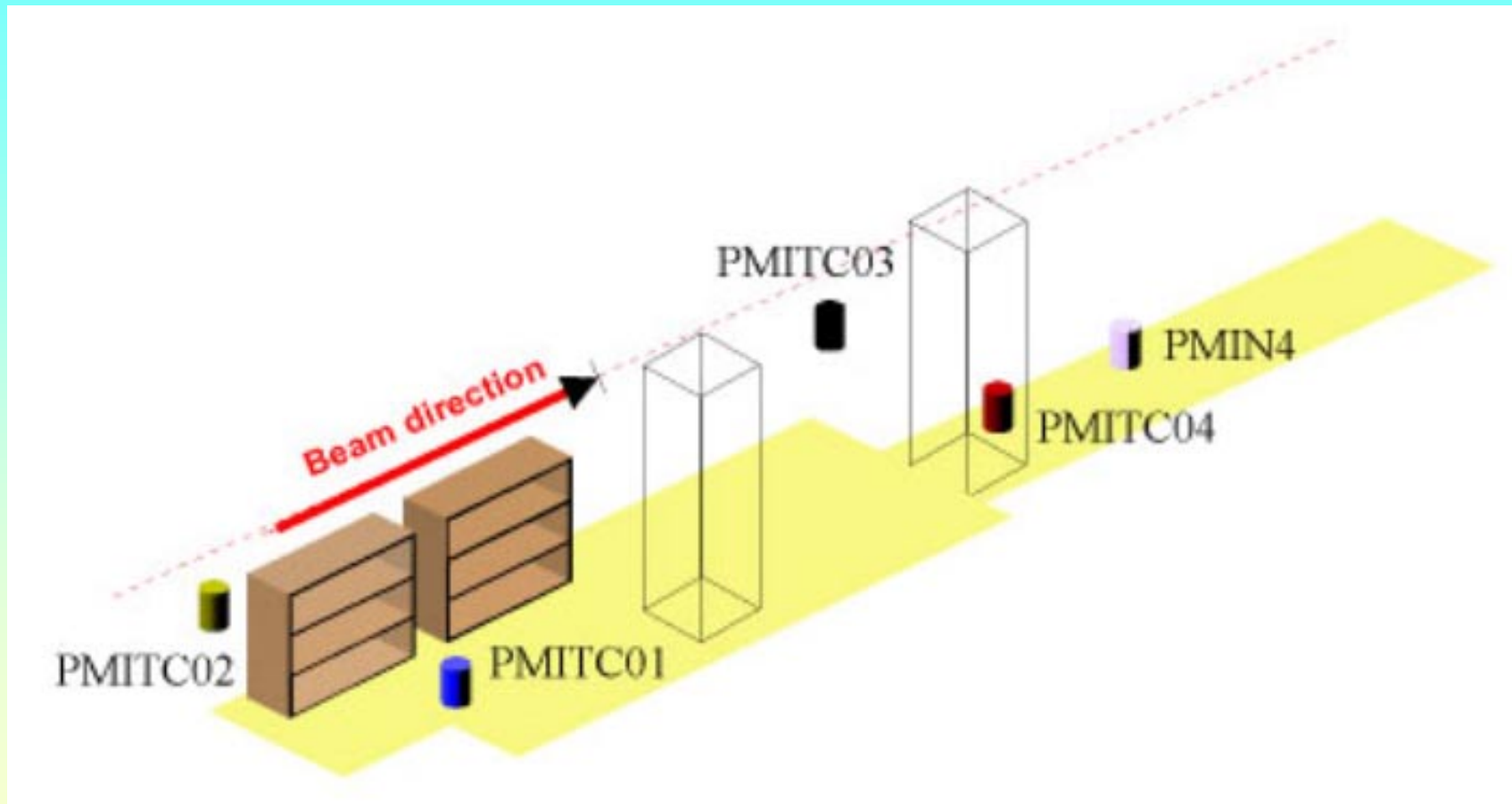
MICROFIP Technology (CC131 Module)





TEST RADIATION 1999

TCC2 Radiation Area



The MICROFIP Modules on the test were near the PMI-2 sensor



TEST RADIATION 1999

Test Conditions & Summary of Radiation (Marc)

month	PMI No	PMI (Sv)	PAD (Gy)	RPL (Gy)	dose (Gy)	correction factor	Diodes E10 n/cm2
October	1	55	39.5	65	55	1	62
October	2	48	85	100	96	2	150
October	3	39	25.7	48.2	39	1	23
October	4	29	20.2	40.6	29	1	23
Sept.	1	169	333	377	337	2	360
Sept.	2	206	526	451	411	2	400
Sept.	3	125	240	451	250	2	270
Sept.	4	93	185	324	185	2	160
Sept.	5	148					
Sept.	7	153					
Sept.	8	134					
August	1	139	97	219	139	1	100
August	2	167	106	219	167	1	147
August	3	57	46	95	57	1	36
August	4	65	47	85	65	1	34
August	5	150	107	265	150	1	643
August	7	112	312	513	336	3	530
August	8	57	40	85	57	1	32
July	1	131	103	200	131	1	150
July	2	184	184	287	184	1	290
July	3	115	751	572	575	5	999
July	4	83	99	130	108	1.3	150
July	5	159	123	265	159	1	110
July	7	232	320	416	0		780
July	8	54	40	72	54	1	32
June	1	158	50	117	158	1	40
June	2	177	427	287	355	2	997
June	3	71	229	572	353	5	320
June	4	74	112	287	96	1.3	79
June	5	198	68	168	0		50
June	7	254	66		0		36
June	8	73	63	151	73	1	53
May	2	99	24	641	99	1	250
May	3	29	54	100	58	2	11
May	4	34	25	95	34	1	25



RADIATION TEST 1999

MICROFIP Technology

◆ Results

- ◆ 1999 test : Test on line with MICROFIP Technology at TTC2
Test Conditions : Fluence : $2 * 10^{12}$ n/cm²

=> 1 error

Date : 30.05.1999. At 50 Grays

Input data : 0000 0000 (00h)

Output data : 0000 0110 (06h)

Radiation : > 650 Grays (1.10.1999)

- ◆ 1999 Complementary test on 5 MICROFIP Modules (SL/PO)
=> Same results

- ◆ Foot-note : 1998 test :

Static test on FULLFIP2 component

=> OK at 220 Grays



TEST RADIATION 2000

Complementary Tests

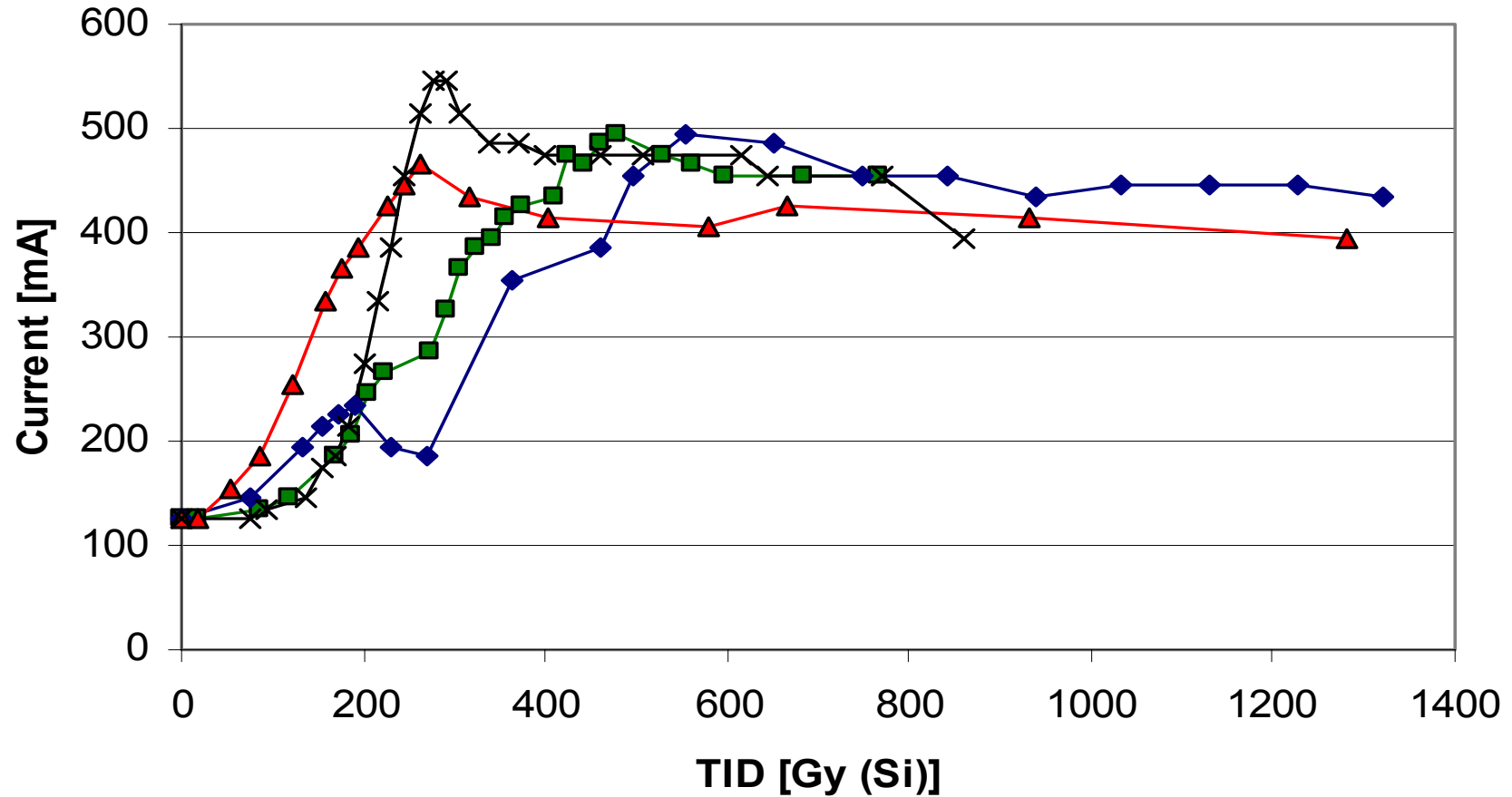
- ◆ Test made at LOUVAIN on 3 CC131 modules
By: J.casas-cubillos & M.a. Rodriguez-ruiz
Group : LHC/ACR

- ◆ Conditions Test :
 - ↳ Beam of Protons Energy : 60Mev
 - ↳ Fluence : $2 * 10^8$ p/cm²
Foot-note :
LHC Fluence between 10^9 and 10^{10} n/cm² at $E > 20$ Mev
 - ↳ Data storage time (random values) : 10s
 - ↳ No refresh data by the application



TEST RADIATION 2000

Complementary Tests

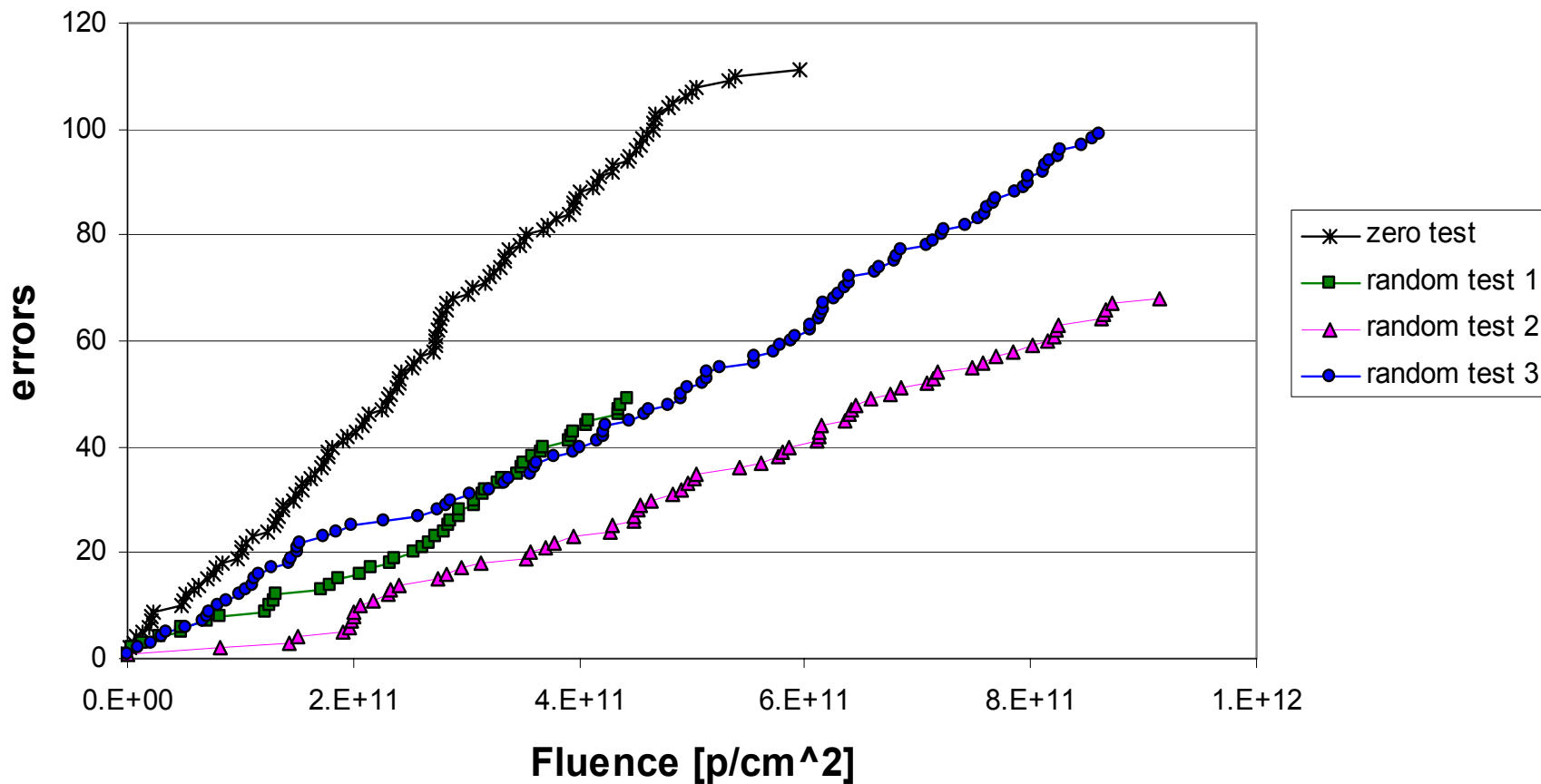


Test done at LOUVIN by J.CASAS-CUBILLOS & M.A. RODRIGEZ-RUIZ (LHC/ACR)



TEST RADIATION 2000

Complementary Tests



Test done at LOUVIN by J.CASAS-CUBILLOS & M.A. RODRIGEZ-RUIZ (LHC/ACR)



Conclusions 1

On MICROFIP Technology

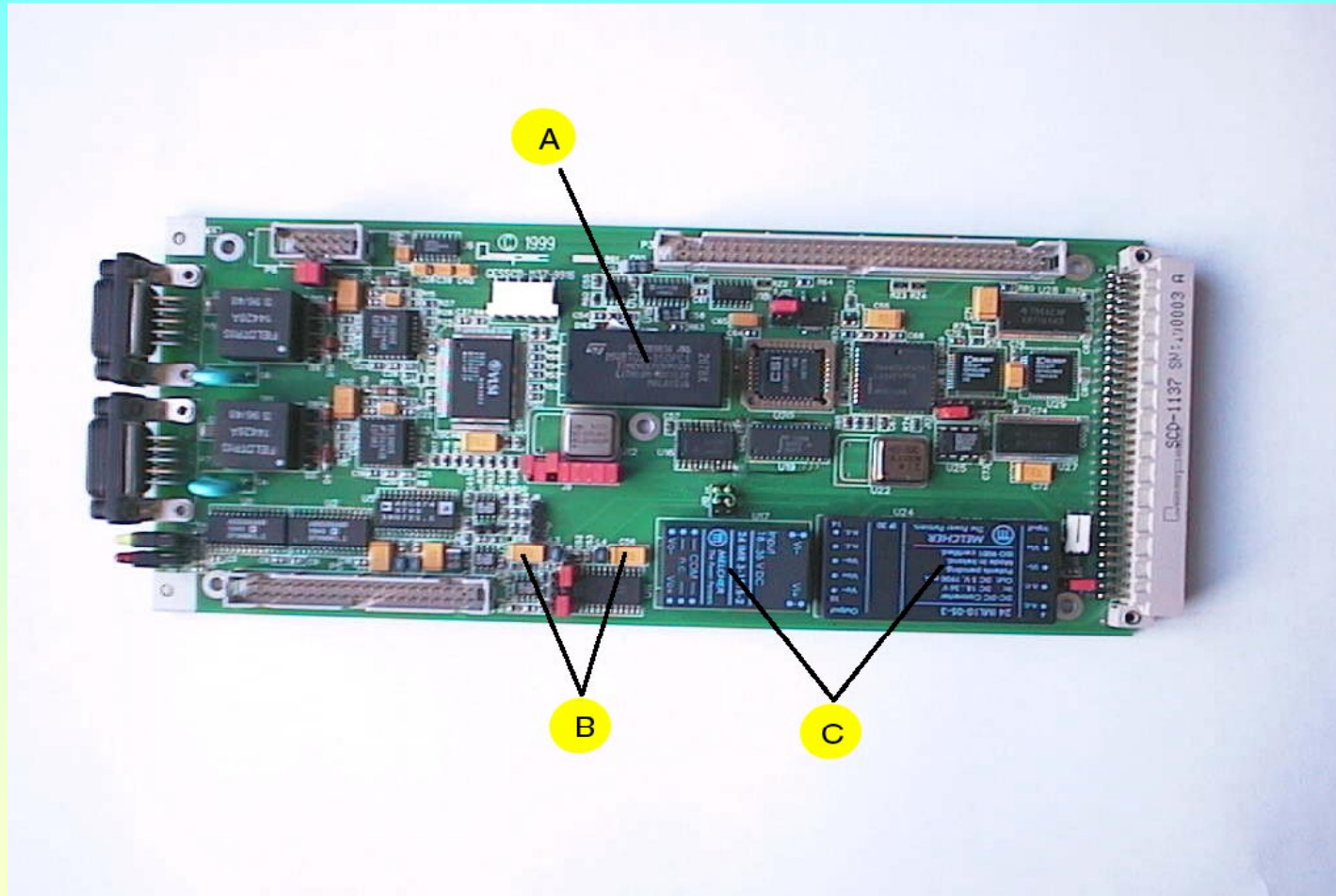
◆ Results

- ◆ Radiation : OK at 650 Grays / 2×10^{12} p/cm²/s)
- ◆ Error rate : 1 error/500bytes/day
- ◆ The majority of errors " SEU " (97%) are due to changes of BIT from 0 = > 1
- ◆ The current supply (i) of the component under radiation, increases at the beginning (factor 4 to 5 for our conditions test) then is stabilized.



Radiation Test on GESPAC Module

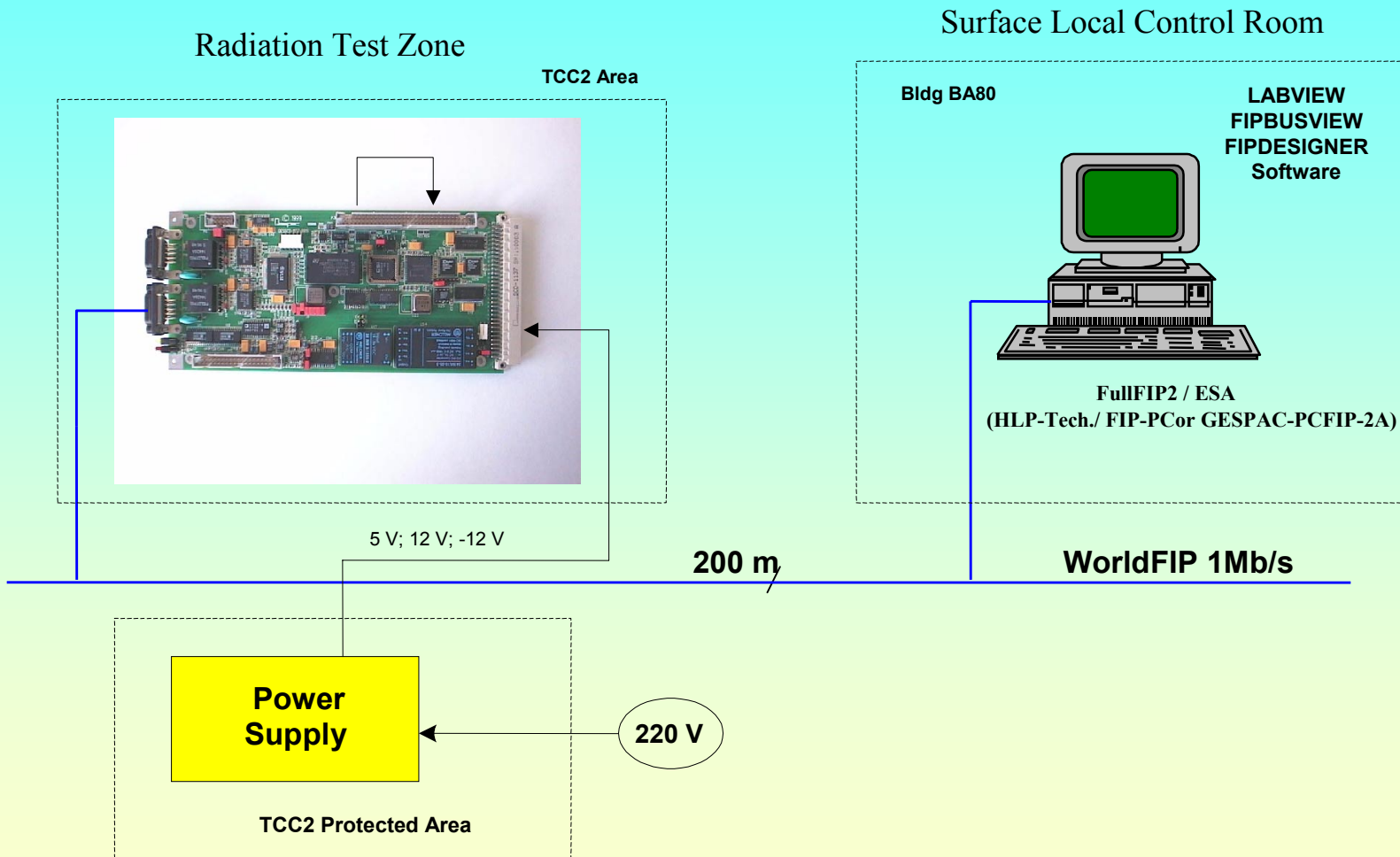
C51/MICRIFIP Module





Radiation Test on GESPAC Module

Test Architecture





Radiation Test on GESPAC Module

Conclusions

◆ *Test Conditions*

- Integrated Dose : 36Gy over 10 days
- Neutron fluence : $4 \cdot 10^{11}$ n/cm²/s (equivalent 1 MeV-Si).
- Check every 100ms & no refresh data from local application

◆ *One Fault : 3 BIT error (Upset)*

- Input data : 302E 3139 3834 3**330**
- Output data : 302E 3139 3834 3**736**

◆ *Results*

- No major fault
- No "Latchup"



Conclusions 2

Summary WorldFIP Test Results

- ◆ Standard Industrial Module (PLCs & Smart I/O)
No Satisfactory Results

- ◆ WorldFIP Technology (small Interfaces)
 - 1998 Static Test on the FULLFIP Component
Radiation : OK at 220 Grays
 - 1999 Test on line with MICROFIP Technology in TCC2
Radiation : OK at 650 Grays / 2×10^{12} p/cm²/s)

 - 1999 Complementary Test on 5 MICROFIP Modules (SL/PO)
Same Results - Latch-up error : 1/500Byte/day

 - 2000 Complementary Test on 3 MICROFIP Modules (LHC/ACR)
UCL Louvain (60Mev Protons and 2×10^8 p/cm²/s)
Same Results : All Boards Survived at 700 Grays