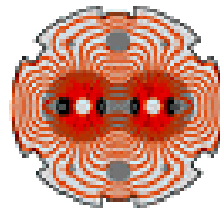




Laboratoire Européen pour la Physique des Particules
European Laboratory for Particle Physics

RADWG Day 2001



Orbit Corrector Power Converters



Introduction

- Where & What are we?
- Progress so far...
- Testing 2001
- Results 2001
- Programme 2002
- Conclusion



Where are we affected by radiation?



- 752 LHC orbit correctors
- Distributed around machine
- $<2\text{Gy} / \text{yr}$ under dipoles

- Groups of four converters
- Placed under cryostat

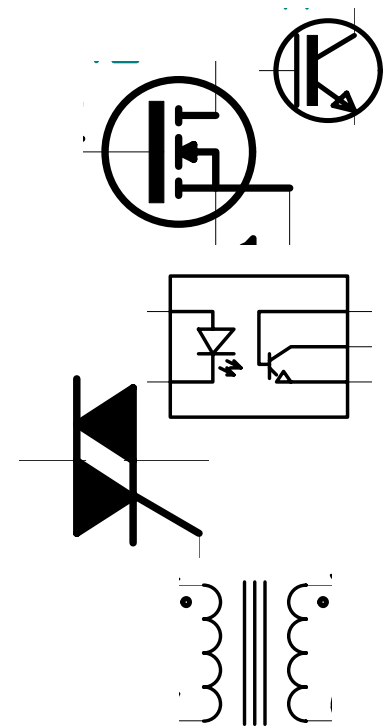


How are we doing so far?

Results 1998 - 2000

Significant Conclusions (components):

- Power semiconductors sustain $>200\text{Gy}$
- Driver circuits sustain $>50\text{Gy}$
- Opto devices are weak points (Opto triac, opto couplers) (2 – 20 Gy)
- Auxiliary power supplies are weak points (2 – 20 Gy)



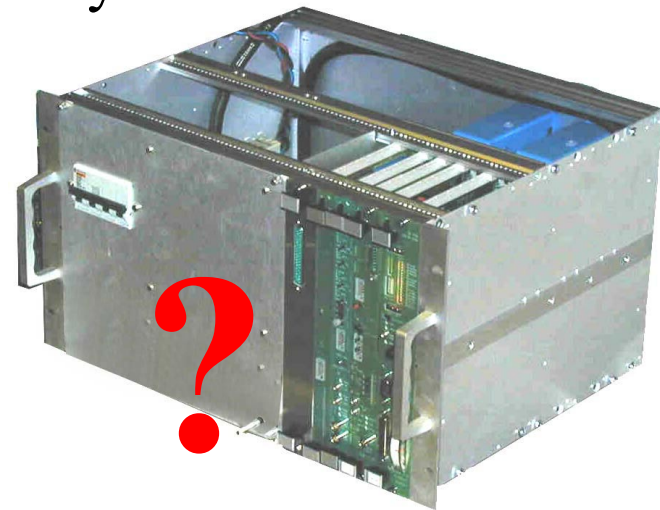


How are we doing so far?

Results 1998 - 2000

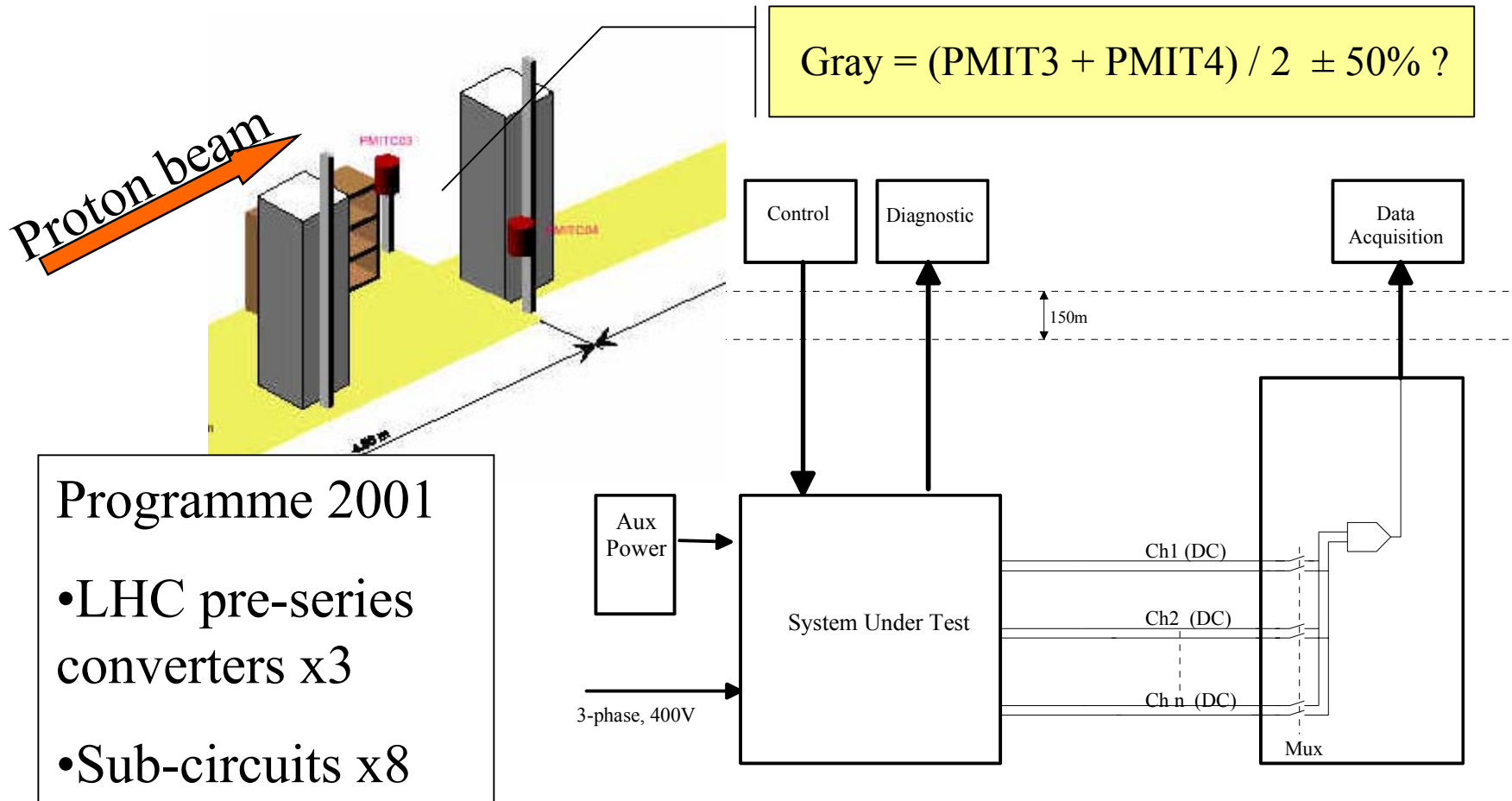
Significant Conclusions (converters):

- DCCT's are not radiation sensitive
- LEP corrector converters sustain ~ 10 Gy
- LHC converters not yet tested





Testing 2001





Results 2001

Converter Power – general results

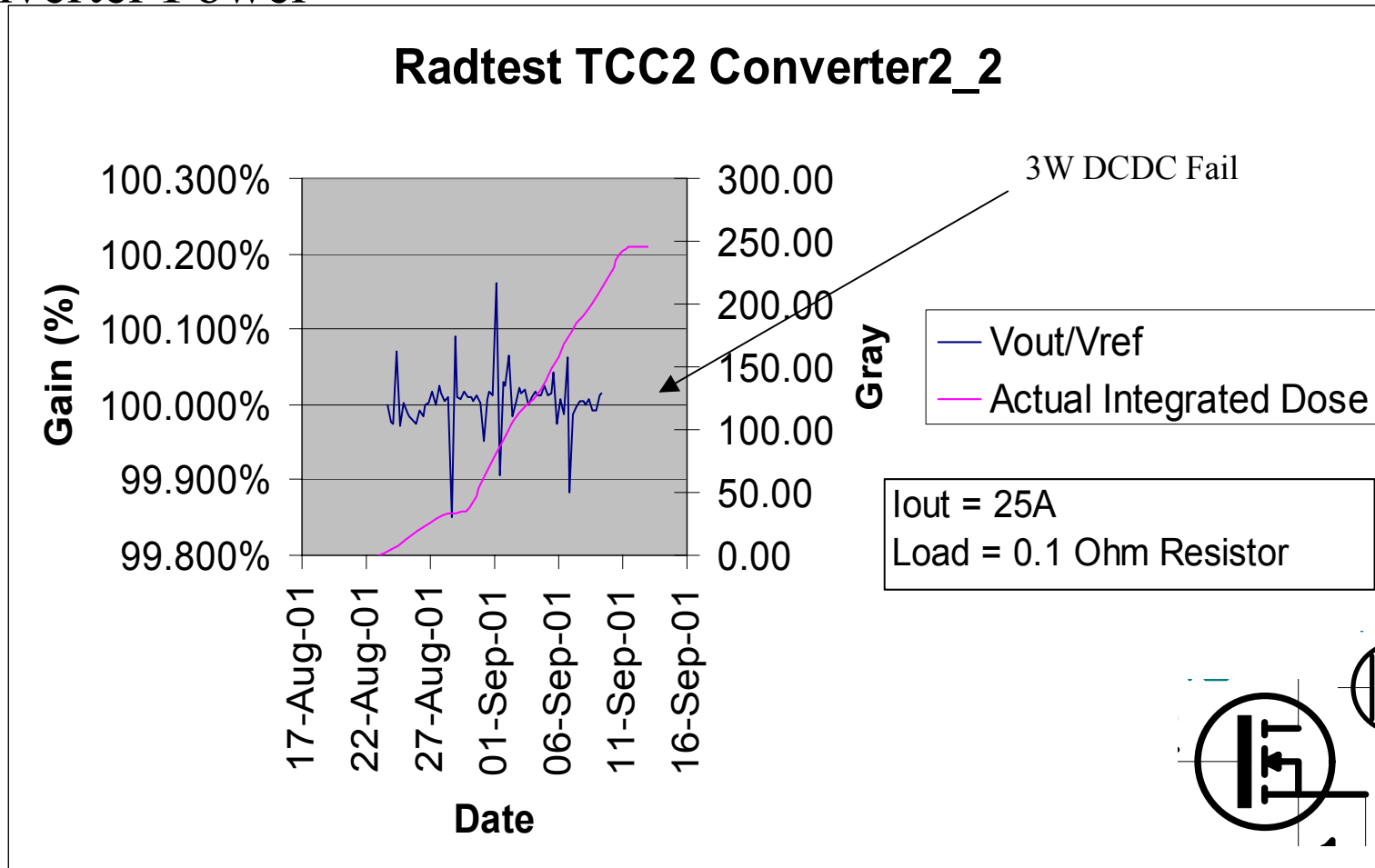
Converter	Performance	Failure Mode
1	1% gain drift after 60Gy	none
2	No change after 200Gy	3W DCDC Analog Switch
3	No change after 150Gy	3W DCDC OP27E OP77E Analog Switch
4	No change after 15Gy (215Gy)	Comm's
5	Early failure after <10Gy (160Gy)	Inverter Driver





Results 2001

Converter Power

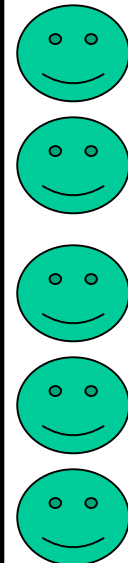




Results 2001

Sub-Circuits – general results

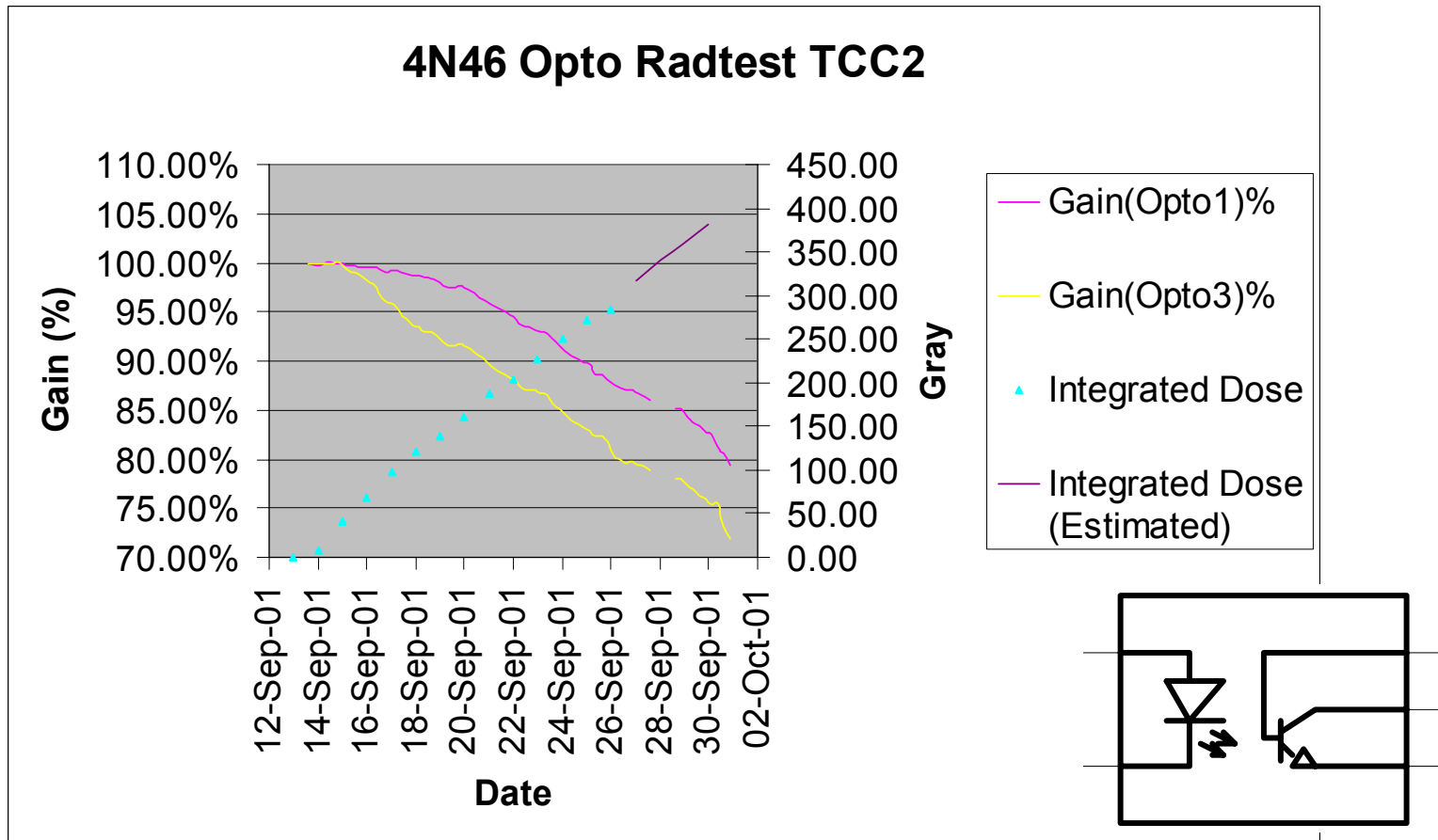
Component	Tolerance
LHC prototype DCCT's	>100Gy
Inverter Controller and Driver	>60Gy
Optocoupler HP4N46	1% gain per ~10Gy
LEM LA125P	300Gy
SL/PO designed 3W DC/DC	400Gy





Results 2001

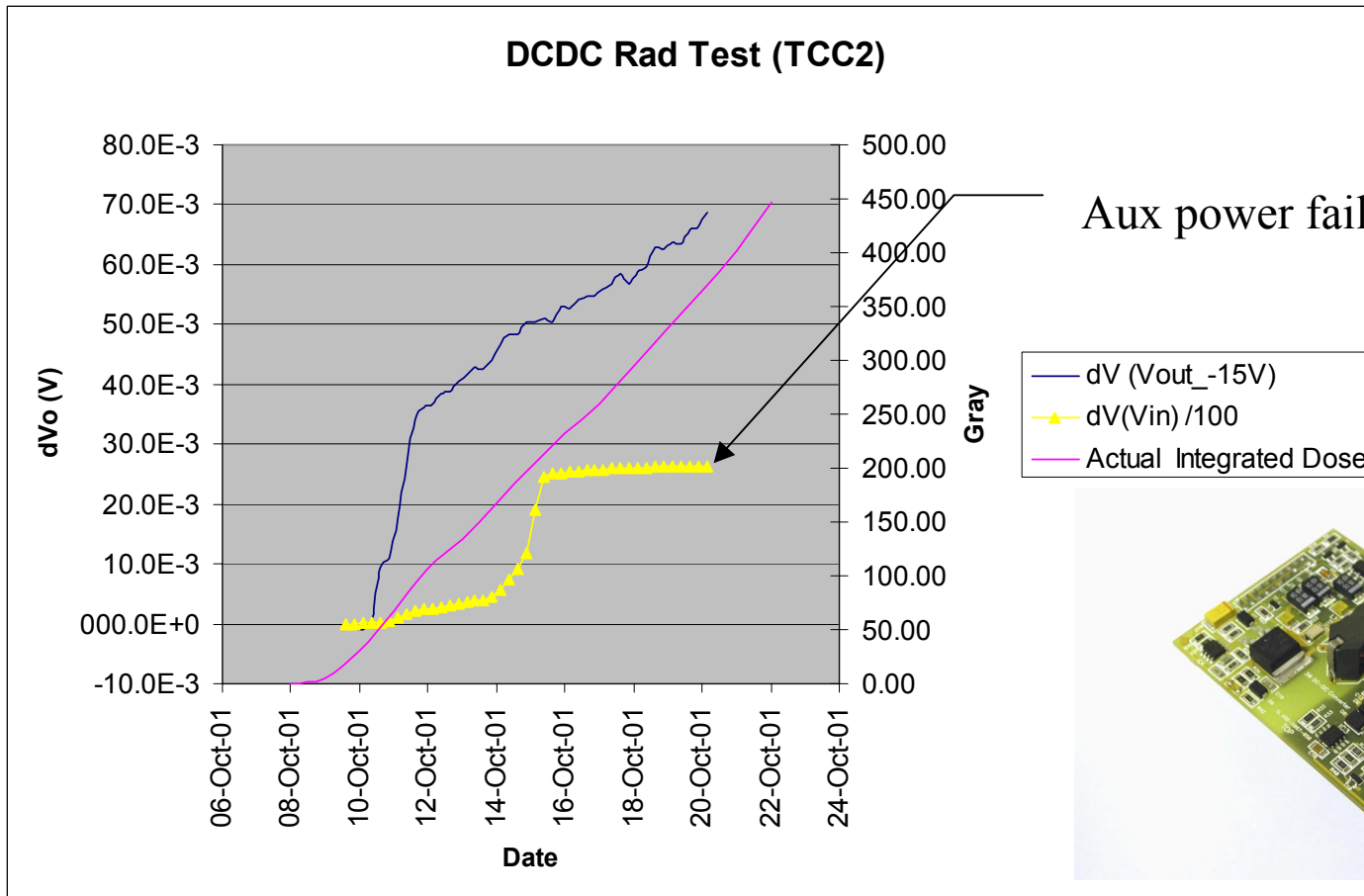
Sub-Circuits - Optocoupler



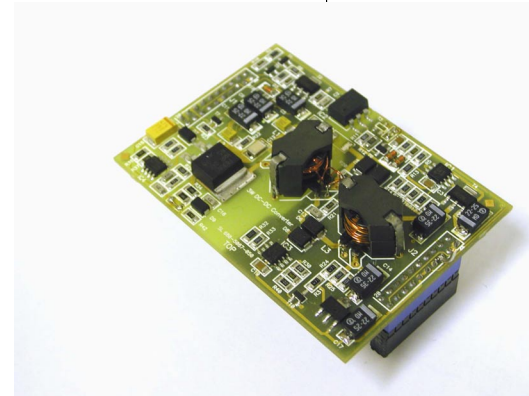


Results 2001

Sub-Circuits – DC/DC



- HF transformer
- Linear Output
- TL431 Vref



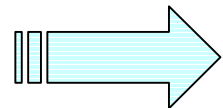


Programme 2002 (provisional)

- More runtime of complete converter required

 Complete converter test

- Investigate alternative circuits

 Continue 'sub-circuit' testing

- Investigate questions raised by 2001 testing

 Analog Switch alternatives

 Operational Amplifiers





Conclusion

Results indicate the power converter can consistently operate above 50Gy of typical LHC radiation:

- We can expect power converters to function normally in predicted LHC environment (20Gy = 10yrs)
- We need accurate test zone radiation measurements to get better idea of safety margin
- Test results will guide design decisions that will help improve radiation tolerance