



Interlock system for Warm magnets

For:

**Transfer Lines TI2, TI8 and
TT41 (CNGS)**

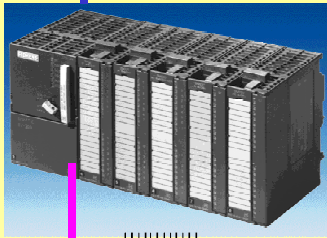


Content

- Principle of the Interlock system
- Advantages of an industrial system
- Disadvantages of an industrial system
- Radiation tests in TT60, TT20, TCC2
- Radiation tests in Villingen
- Conclusion



Building
BA4 / BA7
& BB4

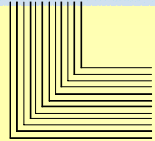


PLC S7-300 (Master)

- Ti2 → 1 PLC in BA7
- Ti8 → 1 PLC in BA4
- TT41 → 1 PLC in BB4

Ethernet

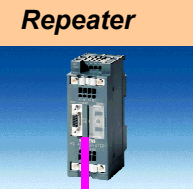
**Magnets Interlock Ti2 / Ti8 & TT41(CNGS)
Based on S7-300 PLC
(Siemens) with SIMATIC
ET 200M Peripheral**



To Power Converter control

Underground
Tunnel Ti2 / Ti8
& TT41(CNGS)

Profibus DP
Fieldbus



ET 200 Peripheral is based on:

- Digital modules
- Analogic modules

18 Peripherals for Ti2
tunnel controlling
300 magnets

20 Peripherals for Ti8
tunnel controlling
403 magnets

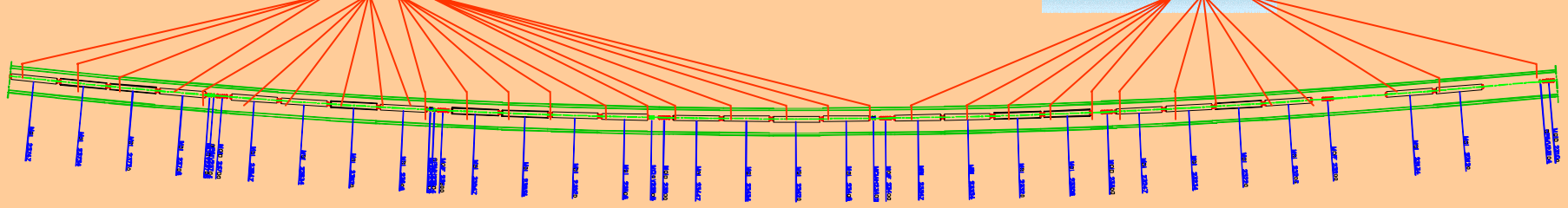
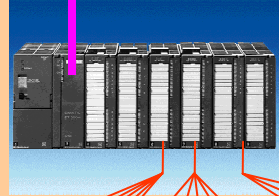
6 Peripherals for
TT41(CNGS) tunnel
controlling
145 magnets

ET 200 Peripheral



ET 200 Peripheral are installed
under Dipole magnets every 120 m

ET 200 Peripheral





Advantages

- Of the shelf
- Industrial
- Simple
- Advised by several working groups
- Very flexible
- Use of less cables
- Easy to identify the magnet in case of any problem



Disadvantages

- Used as a “Black box”
- Necessity to fit to our needs (integration)
- **No indication about Radiation hardness**



Installation test in TT60 – Run 2002



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Siemens PLC modules radiation tests in TT60 - May 23 to September 20, 2002 -

Modules	Reference	Serial N°	Status	Radiation (Gray)	Neutrons flux (n/cm ² x10 ¹²)	Duration (weeks)
ET 200 M	6ES7 153-1AA03-0XB0		OK	22	5,82	17
SM 321 32DI (ET 200M)	6ES7321-1BL00-0AA0		OK	22	5,82	17
SM 321 16DI (ET 200M)	6ES7 321-1BH02-0AA0		OK	22	5,82	17
SM 331 8AI (ET 200M)	6ES7 331-7KF02-0AB0	S C-NNG50364	OK	5,63	0,76	5
SM 331 8AI (ET 200M)	6ES7 331-7KF02-0AB0		OK	16,6	0,76	12
ET 200B 8AI (Module)	6ES7 134-0KH01-0XB0		OK	15	1,20	13
ET 200B 8AI (Socket)	6ES7 193-0CD40-0XA0		BAD	15	1,20	13
ET 200B 16 DI (Module)	6ES7131-0BH00-0XB0		OK	22	5,82	17
ET 200B 16 DI (Socket)	6ES7193-0CA10-0XA0		OK	22	5,82	17
Profibus Repeater	6ES7 972-0AA01-0XA0	S C-P5C65550	OK	8,1	4,68	5
PS ACT 50			OK	22	5,82	17
PS Syko			OK	22	5,82	17
PS Syko			OK	22	5,82	17
PS MGV	PH70-2403		OK	22	5,82	17
PS Sitop 5A	6EP1333-1AL11		OK	22	5,82	17
PS 307 2A	6ES7 307-1BA00-0AA0		OK	22	5,82	17



Installation test in TCC2 – Run 2002 and 2003



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Siemens PLC modules radiation tests in TCC2 - May 23 to September 20, 2002 -



Modules	Reference	Serial N °	Status	Radiation (Gray)	SEE (n/cm ² x10 ¹²)	Duration (weeks/days)
ET 200 M	6ES7 153-1AA03-0XB0	S C-NNE79333	BAD	277	1,87	6 w
ET 200 M	6ES7 153-1AA03-0XB0	S C-P3F0623	BAD	280	1,96	5 w
ET 200 M	6ES7 153-1AA03-0XB0	S C-P3F41194	OK	210	1,57	4 w
SM 321 16DI (ET 200M)	6ES7 321-1BH02-0AA0	S C-NNF16364	BAD	136	0,97	4 w
SM 321 32DI (ET 200M)	6ES7321-1BL00-0AA0	S C-P3F64025	BAD	500	3,69	9 w
SM 331 8AI (ET 200M)	6ES7 331-7KF02-0AB0	S C-NNG50644	BAD	43	0,40	2 w
SM 331 8AI (ET 200M)	6ES7 331-7KF02-0AB0	S C-P3E30770	BAD	60	0,65	12 d
SM 331 8AI (ET 200M)	6ES7 331-7KF02-0AB0	S C-P5C15342	BAD	28	0,34	5 d
SM 331 8AI (ET 200M)	6ES7 331-7KF02-0AB0	S C-NNG 50364	BAD	5	0,05	1 d
ET 200B 32 DI (Module)	6ES7 131-0BL00-0XB0	S C-NNC18601	BAD	80	0,67	3 w
ET 200B 32 DI (Module)	6ES7 131-0BL00-0XB0	S C-NNC18596	BAD	340	2,44	6 w
ET 200B 32 DI (Module)	6ES7 131-0BL00-0XB0	S C-P3E02968	BAD	61	0,32	11 d
ET 200B 32 DI (Module)	6ES7 131-0BL00-0XB0	S C-P3E 02962	OK	510	3,66	9 w
ET 200B 32 DI (Socket)	6ES7 193-0CB10-0XA0	S C-NNA28144	OK	601	4,33	12 w
ET 200B 32 DI (Socket)	6ES7 193-0CB10-0XA0	S C-NNE50566	OK	550	4,01	10 w
ET 200B 8AI (Module)	6ES7 134-0KH01-0XB0	S C-N0A24 755	BAD	20	0,13	5 d
ET 200B 8AI (Module)	6ES7 134-0KH01-0XB0	S C-P2B72516	BAD	27	0,18	5 d
ET 200B 8AI (Module)	6ES7 134-0KH01-0XB0	S C-P2B72527	BAD	25	0,18	5 d
ET 200B 8AI (Socket)	6ES7 193-0CD40-0XA0	S C-NNC 46087	BAD	95	0,67	23 d
ET 200B 8AI (Socket)	6ES7 193-0CD40-0XA0	S C-P3D28352	BAD	80	0,38	15 d
PS 307 5A	6ES7 307-1EA00-0AA0	S Q6NN350341	BAD	13	0,04	2 d
PS 307 5A	6ES7 307-1EA00-0AA0	S Q6P3336437	BAD	3	0,01	0.5 d
PS 307 2A	6ES7 307-1BA00-0AA0	S Q6P5320969	BAD	5	0,05	1 d
PS MGV	PH70-2403	00BC151387	BAD	41	0,13	1 w
PS Syko	7.55.233.001.0	2,06007	OK	550	4,01	10 w
PS Syko	7.55.233.001.0	2,06006	OK	942	8,02	17 w
PS ACT 50	ACT50	4000,1270	OK	942	8,02	17 w
PS Sitop 5A	6EP1333-1AL11	Q6NN367122	BAD	80	0,65	2 w
PS Sitop 5A	6EP1333-1AL11	S Q6P4389091	BAD	317	2,23	5 w
Profibus Repeater	6ES7 972-0AA01-0XA0	S C-P5C65251	OK	268	2,05	5 w



Test rack in TT20 under dipole MBE 211524 – Run 2003



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Test aux radiations en TCC2 (2003)

<u>Module</u>	<u>Type</u>	<u>No de serie</u>	<u>Indice</u>	<u>Etat</u>	<u>Qte de radiation</u>	<u>Qte de radiation</u>	<u>Qte de radiation</u>
					<u>recu en 2002</u>	<u>recu en 2003</u>	<u>total recu</u>
ET 200 M	6ES7 153-1AA03-0XB0	S C-R2D89243	6	HS		100 Gy	100 Gy
		S C-R2D90385	6	OK		129 Gy	129 Gy
<u>Modules Siemens 32 DI pour ET 200 M</u>							
SM 321 32 DI	6ES7 321-1BL00-0AA0	S C-P9B51289	4	OK		129 Gy	129 Gy
		S C-R1G72304	4	OK		129 Gy	129 Gy
<u>Modules Siemens 8 AI pour ET 200 M</u>							
SM 331 8AI - 14 bits	6ES7 331-7KF02-0AB0	S C-R2E59970	2	HS		31 Gy	31 Gy
		S C-R2E59972	2	HS		38 Gy	38 Gy
<u>Modules Siemens 8 AI pour ET 200 M</u>							
SM 331 8AI - 13 bits	6ES7 331-1KF00-0AB0	S C-R7G42827	2	HS		60 Gy	60 Gy
		S C-R7G34156	2	HS		54 Gy	54 Gy
<u>Modules Siemens : Repeteur</u>							
Repeteur	6ES7 972-0AA01-0XA0	S C-P5C65251	4	HS	268 Gy	32 Gy	300 Gy
		S C-NND98373	3	HS		57 Gy	57 Gy
		S C-R2B29941	4	OK		38 Gy	38 Gy

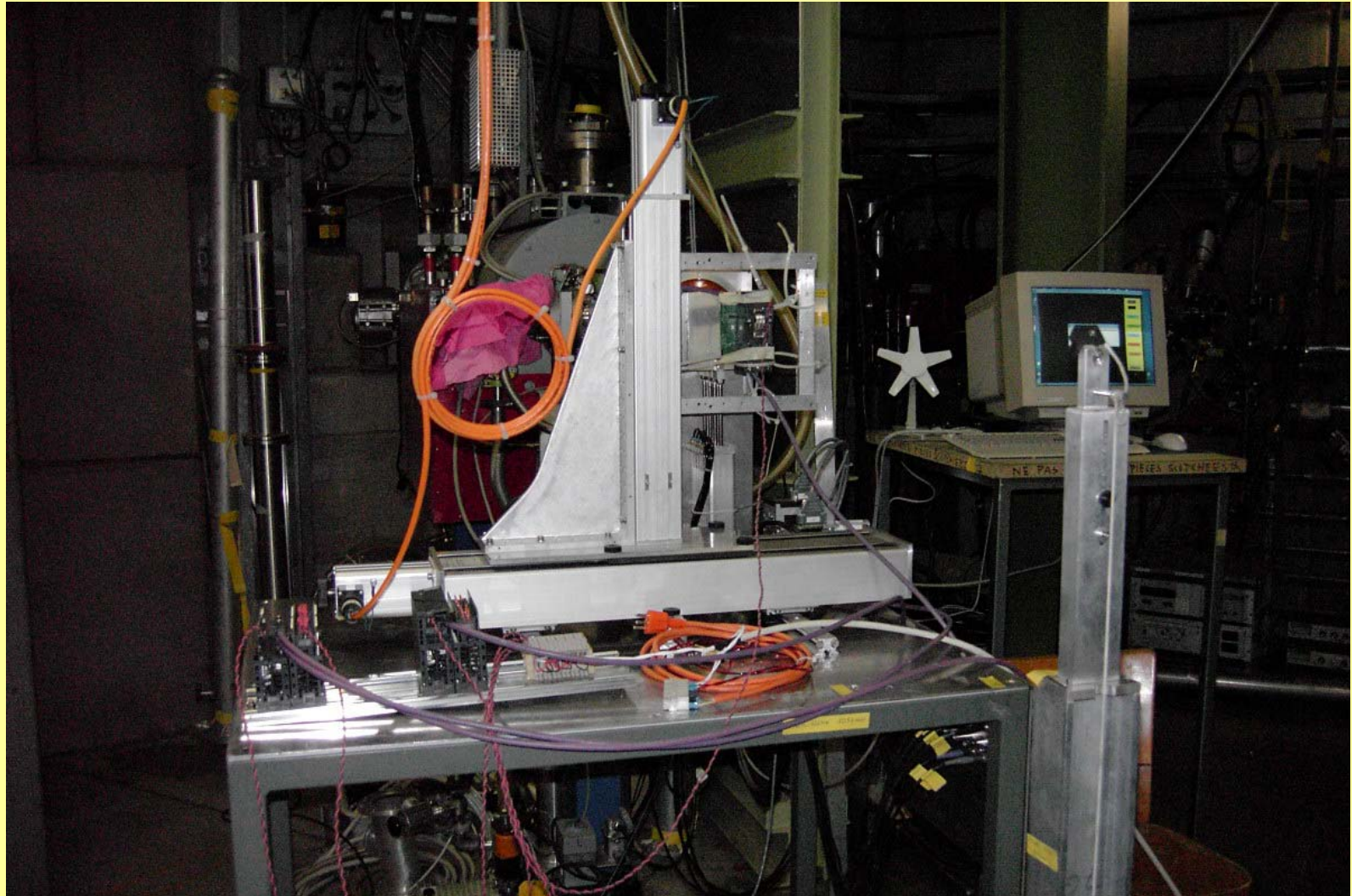


Test aux radiations en TCC2 (2003)

<u>Module</u>	<u>Type</u>	<u>No de serie</u>	<u>Indice</u>	<u>Etat</u>	<u>Radiation</u>	<u>Radiation</u>	<u>Radiation</u>
					<u>recu en 2002</u>	<u>recu en 2003</u>	<u>total recu</u>
<u>Alimentations Siemens PS 307 2A</u>							
Alim. Siemens PS307 2A Standard		S Q6PD342917	4	HS		11 Gy	11 Gy
		S A6PN399972	4	HS		27 Gy	27 Gy
Alim. Siemens PS307 2A Modifie	6ES7 307-1BA00-0AA0	S Q6P4386477	3	HS		1 Gy	1 Gy
<i>(Alim. modifiee par Siemens: Secondary voltage regulator replaced by a zener diode)</i>							
Alim. Siemens PS307 2A Modifie	6ES7 307-1BA00-0AA0	S Q6P4386489	3	HS		8 Gy	8 Gy
<i>(Alim. modifiee par Siemens: Primary control IC N3 is wrapped in copper foil)</i>							
Alim. Siemens PS307 2A Modifie	6ES7 307-1BA00-0AA0	S Q6P4386485	3	HS		10 Gy	10 Gy
<i>(Alim. modifiee par Siemens: Photocoupler U1 & U2 replaced by CNY65)</i>							
Alim. Siemens PS307 2A Modifie	6ES7 307-1BA00-0AA0	S Q6P4386481	3	HS		12 Gy	12 Gy
<i>(Alim. modifiee par Siemens: Photocoupler U1 & U2 replaced by CNY17-F3)</i>							
Alim. Siemens PS307 2A Modifie	6ES7 307-1BA00-0AA0	S Q6P4386490	3	OK		38 Gy	38 Gy
<i>(Alim. modifiee par Siemens: Mofset V7 changed to 25K1358/ Toshiba 900V/9A)</i>							
<u>Alimentations Siemens Sitop 5A</u>							
Alim. Siemens Sitop 5A	6EP 1333 - 1AL11	S Q6P4388995	3	HS		68 Gy	68 Gy
<u>Alimentations MGV</u>							
Alimentations MGV	PH70-2403	15.8242.900		HS		6 Gy	6 Gy
<u>Alimentations Exista Blue Line</u>							
Alimentations Exista Blue Line	??	TCC2		HS		98 Gy	98 Gy
<u>Alimentations ACT50 1 x 24 V</u>							
Alimentations ACT50 1x24V	??	TCC2		OK		129 Gy	129 Gy
<u>Alimentations ACT50 2 x 24 V</u>							
Alimentations ACT50 2x24V	ACT50	4000, 1270 (TCC2)		OK	942 Gy	129 Gy	1071 Gy
<u>Alimentations Syko 2 x 24 V</u>							
Alimentations Syko 2x24V	7.55.233.001.0	2.06007 (TCC2)		OK	550 Gy	129 Gy	679 Gy
		2.06006 (TCC2)		OK	942 Gy	129 Gy	1071 Gy



Irradiation facility– OPTIS – PSI / Villingen



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Material tested at Villingen the 22 of november 2003

<i>Material tested</i>	<i>Type</i>	<i>Indice</i>	<i>Maximal dose (Gy)</i>	<i>Remarques</i>
Profibus repeater (Siemens)	6ES7 972-0AA01 0XA0	6	89	30mm collimator on DRASIC -ST 03333 KU 002 circuit
		6	110	no collimator - irradiation on the power circuits
Analog Module 8AI 13 bits (Siemens)	6ES7 331-1KF00-0AB0	1	75	* After 15 Gy - module down after "on/off" module ok - * During irradiation several inputs are down but comes "ok" without any action
Digital Module 32 DI (Siemens)	6ES7 321-1BL00-0AA0	4	190	* During irradiation several voluntary power supply "on/off" without any problem.
Slave Module ET 200 M (Siemens)	6ES7 153-1AA03-0XB0	7	280	* During irradiation several voluntary power supply "on/off" without problem. * After 70 Gy of irradiation - module down but comes "ok" without any action
Switching Power supply (Exista)	ASC 50 24 V		370	Starting voltage = 24,598 V - current = 246,33mA End voltage = 25,51 V - current = 247,158mA



Conclusion

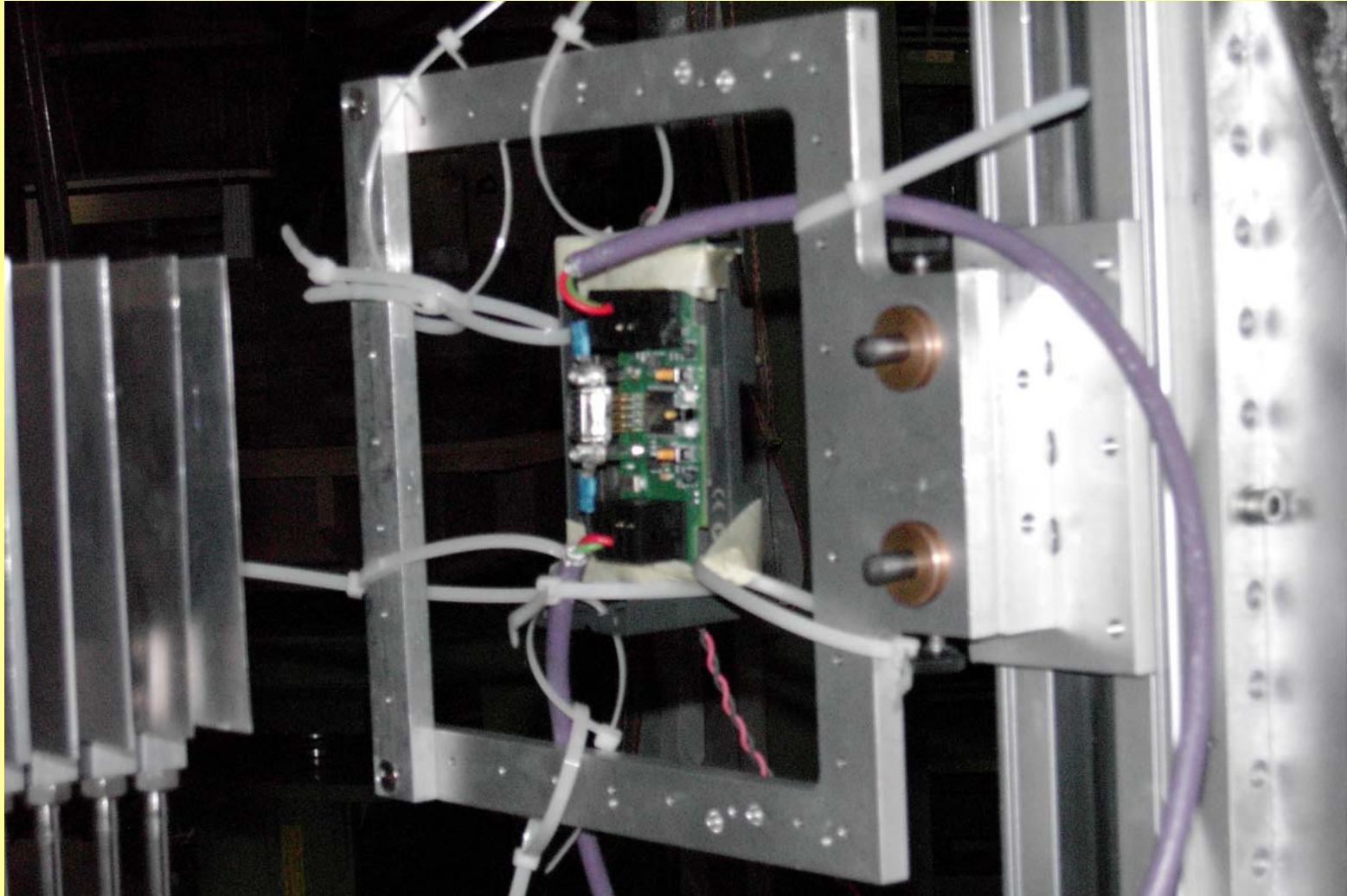
- All the Siemens modules we are using in the transfer lines are well tested
- The power supply for the ET200 peripheral has a good radiation hardness up to the dose expected
- Necessity to install a “reset cable” in case of SEU (single event) problem



**Thank you very much
for your attention**

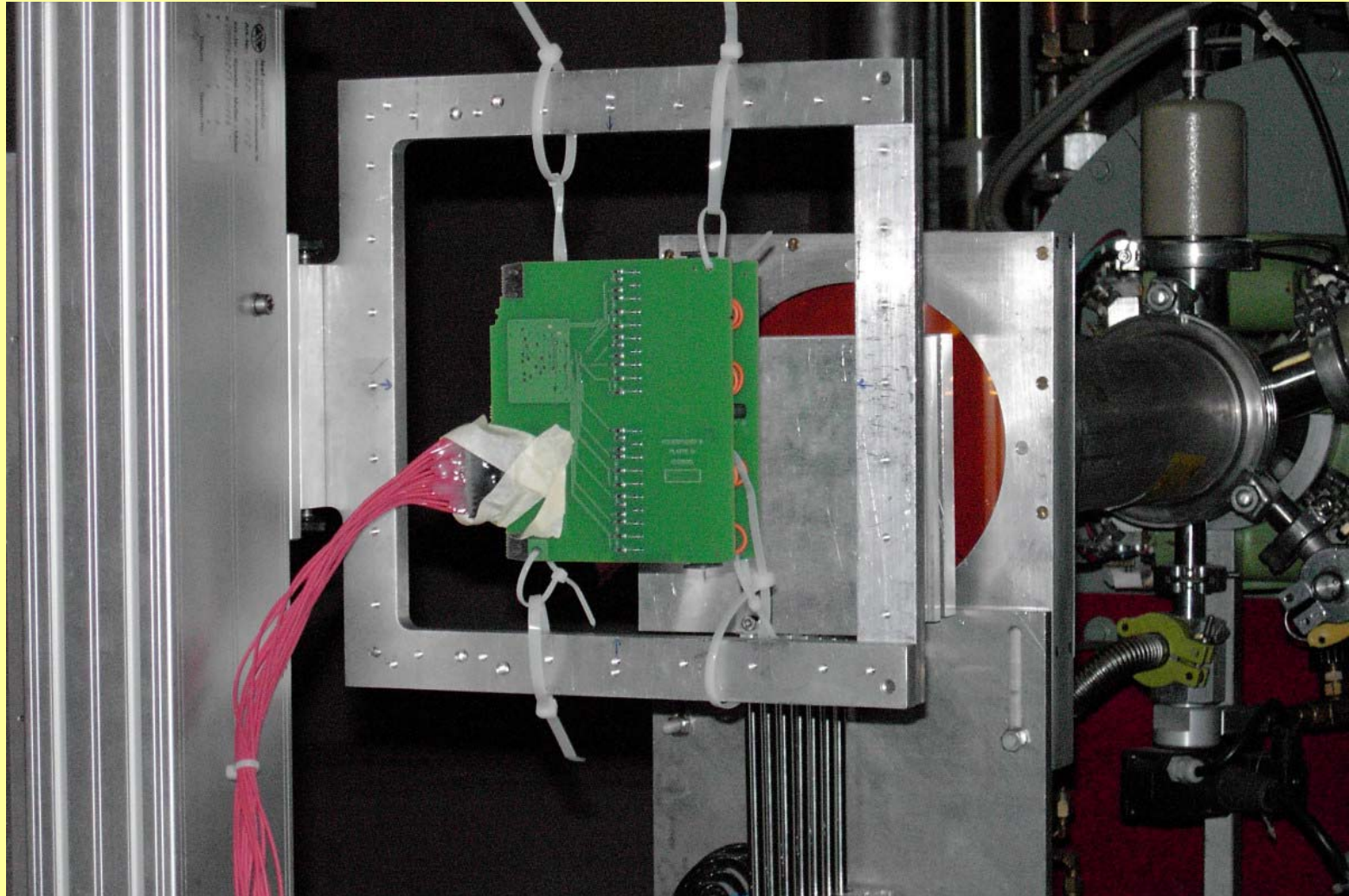


Profibus repeater



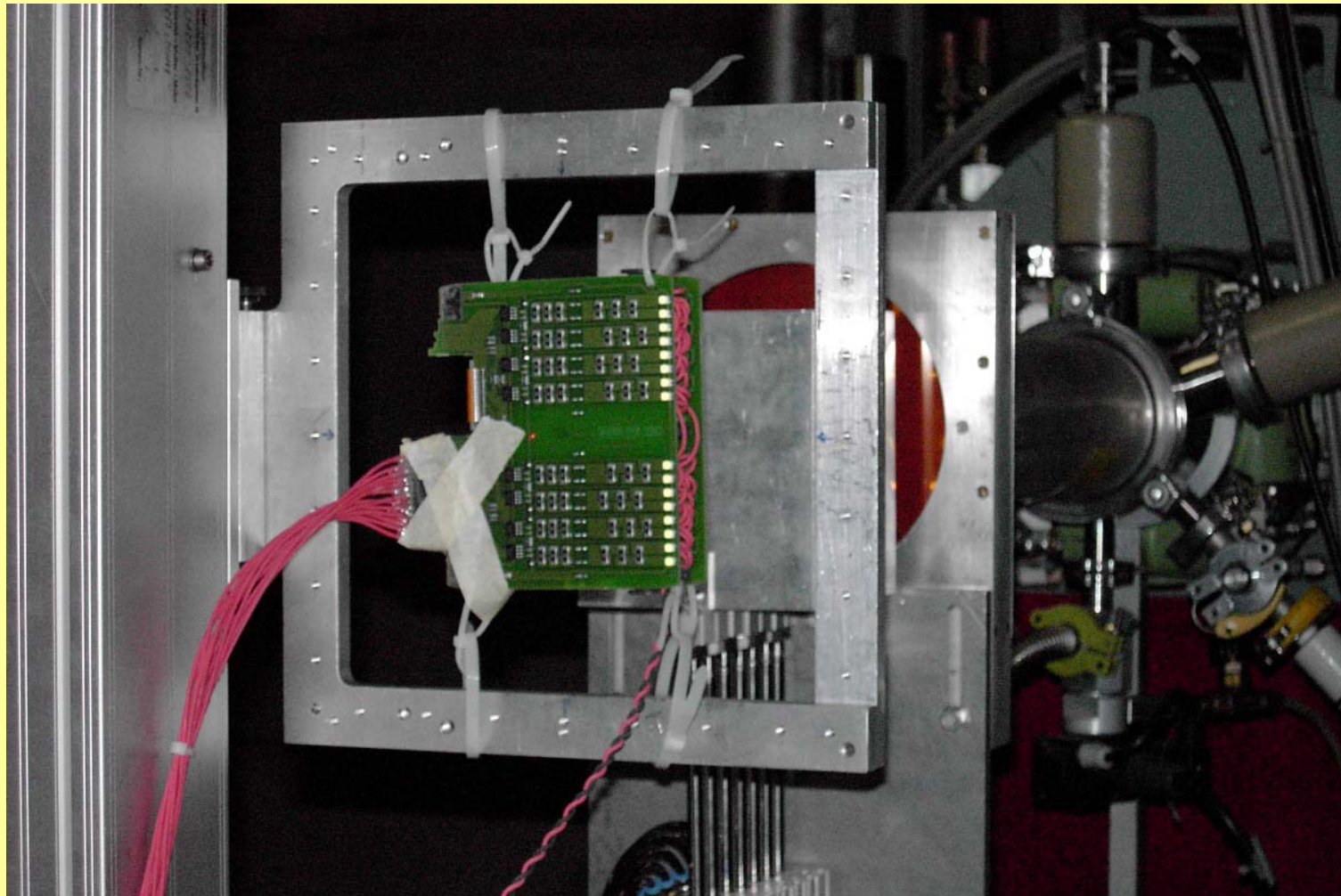


Analog module 8AI – 13bits



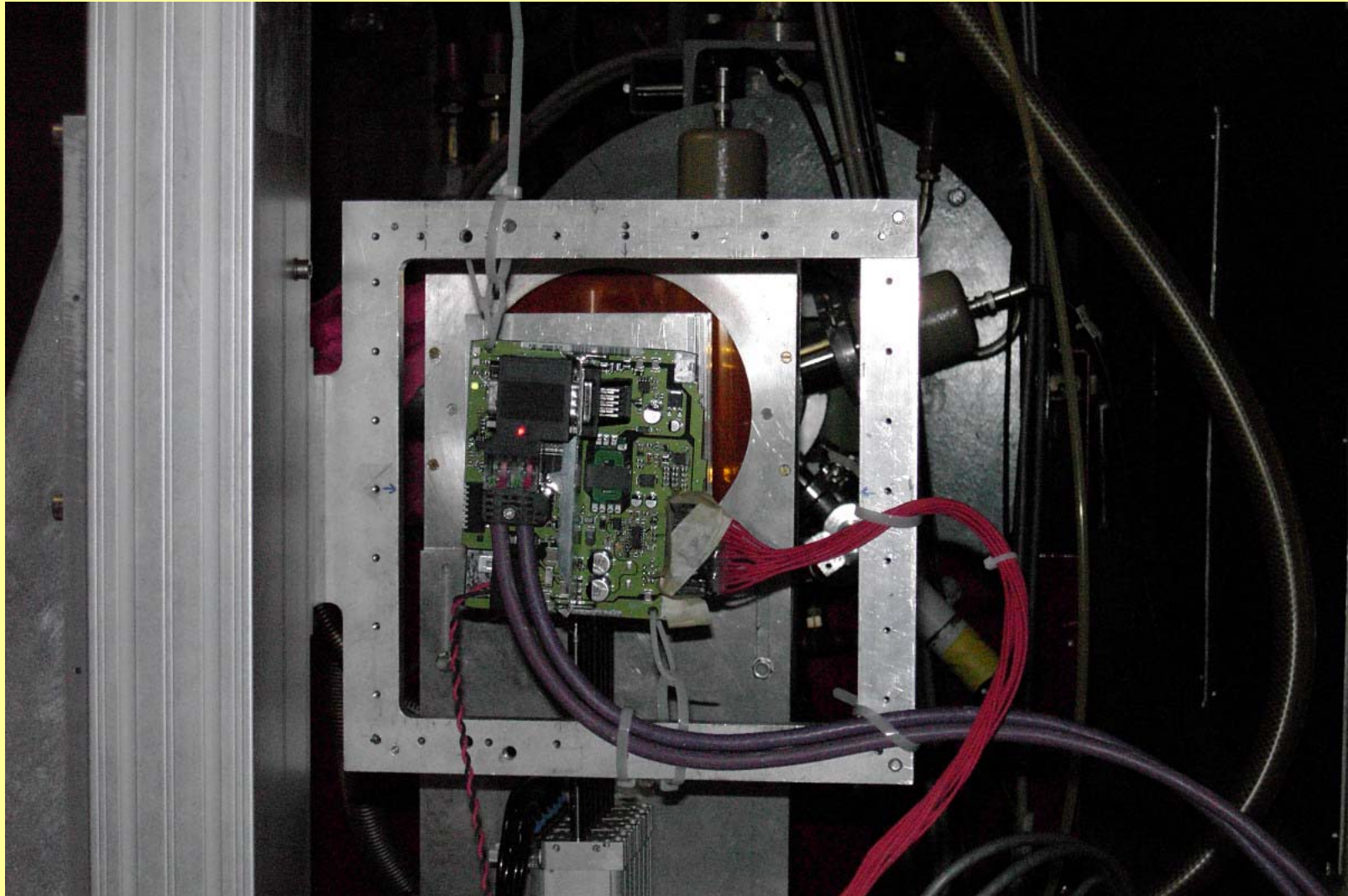


Digital module 32 DI





Slave module ET200M



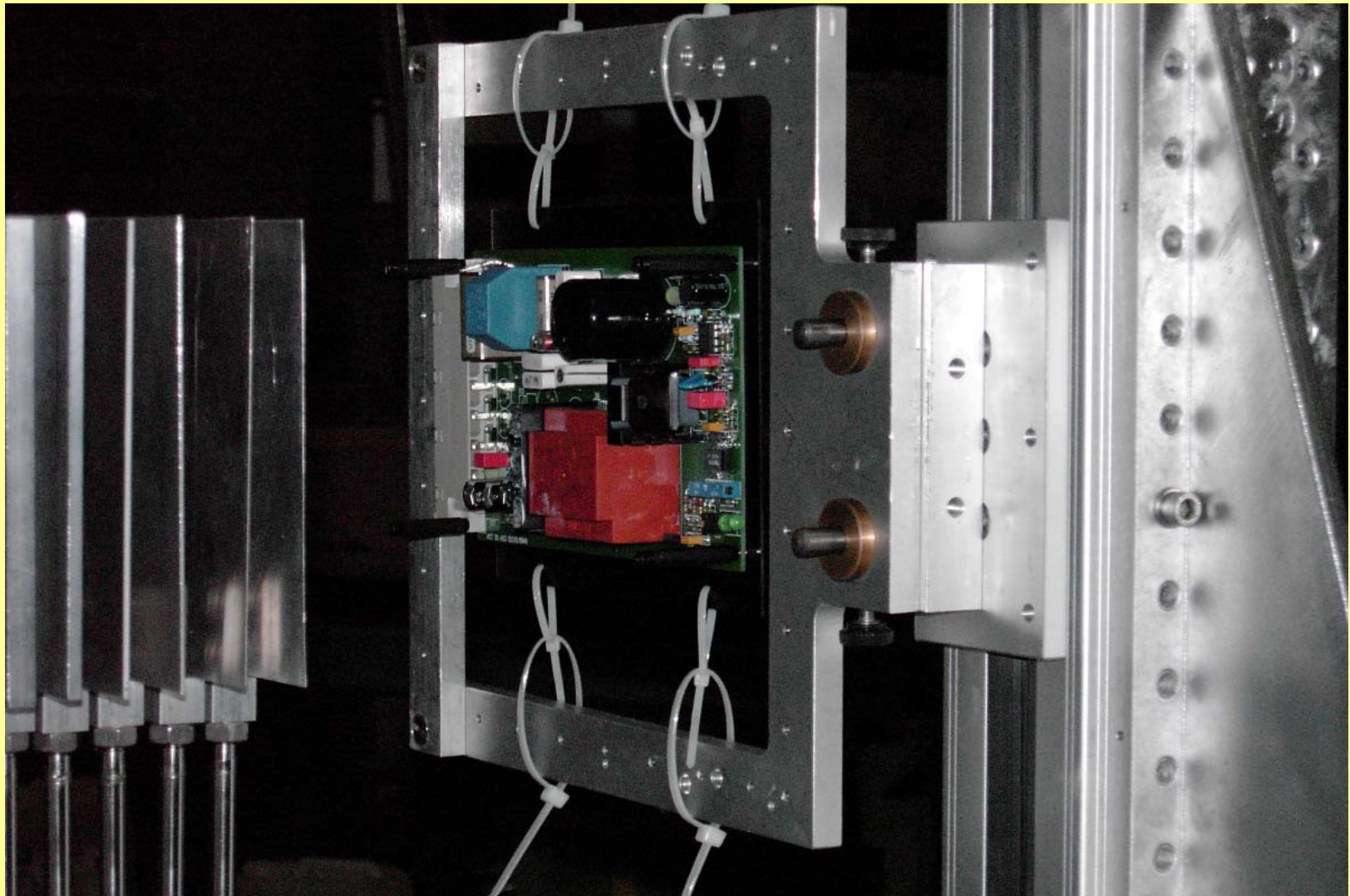
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Power supply – ACS50 24V (Exista)



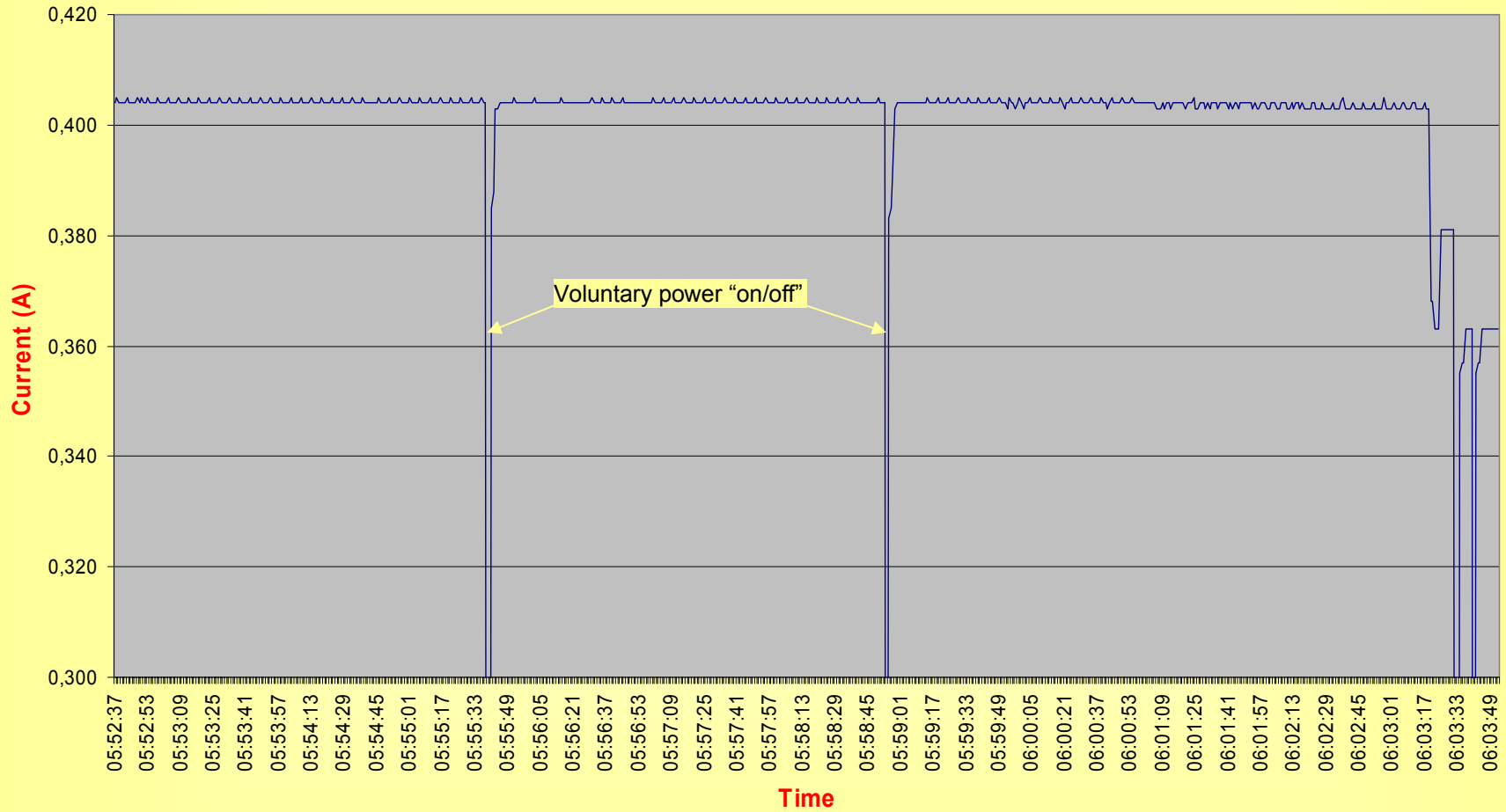
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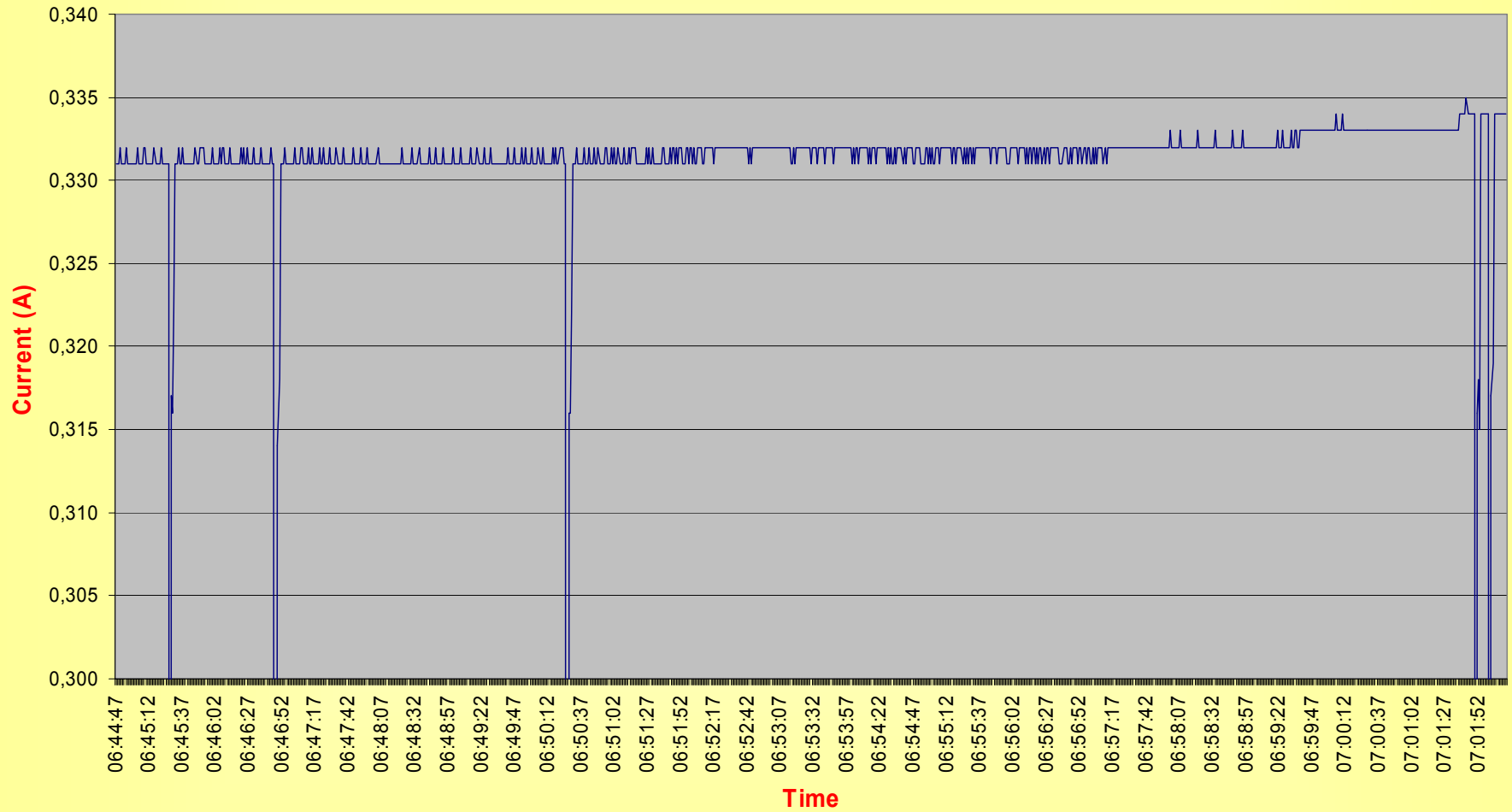


Profibus repeater



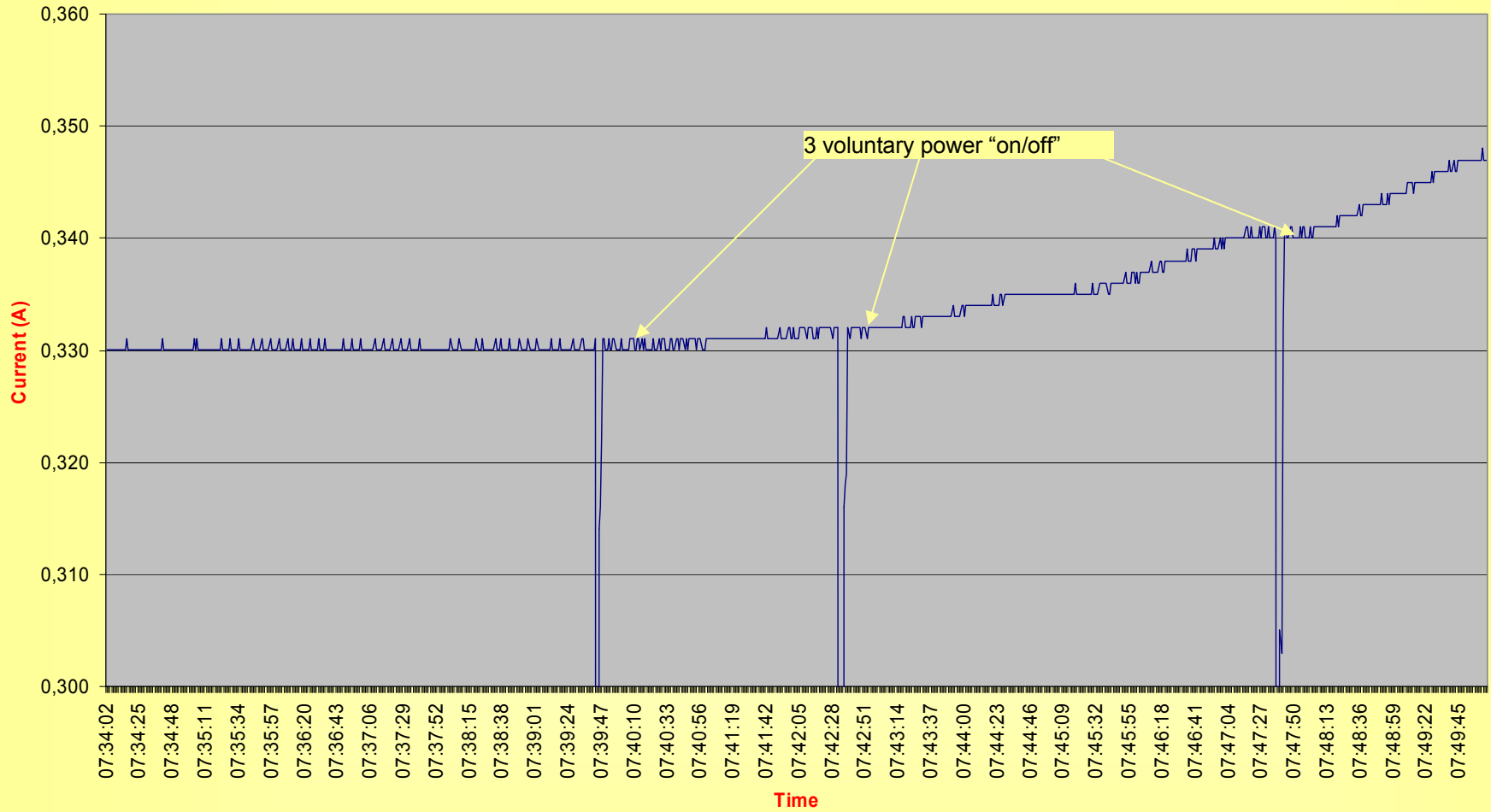


Analog module SM331 - 8AI -13 bits



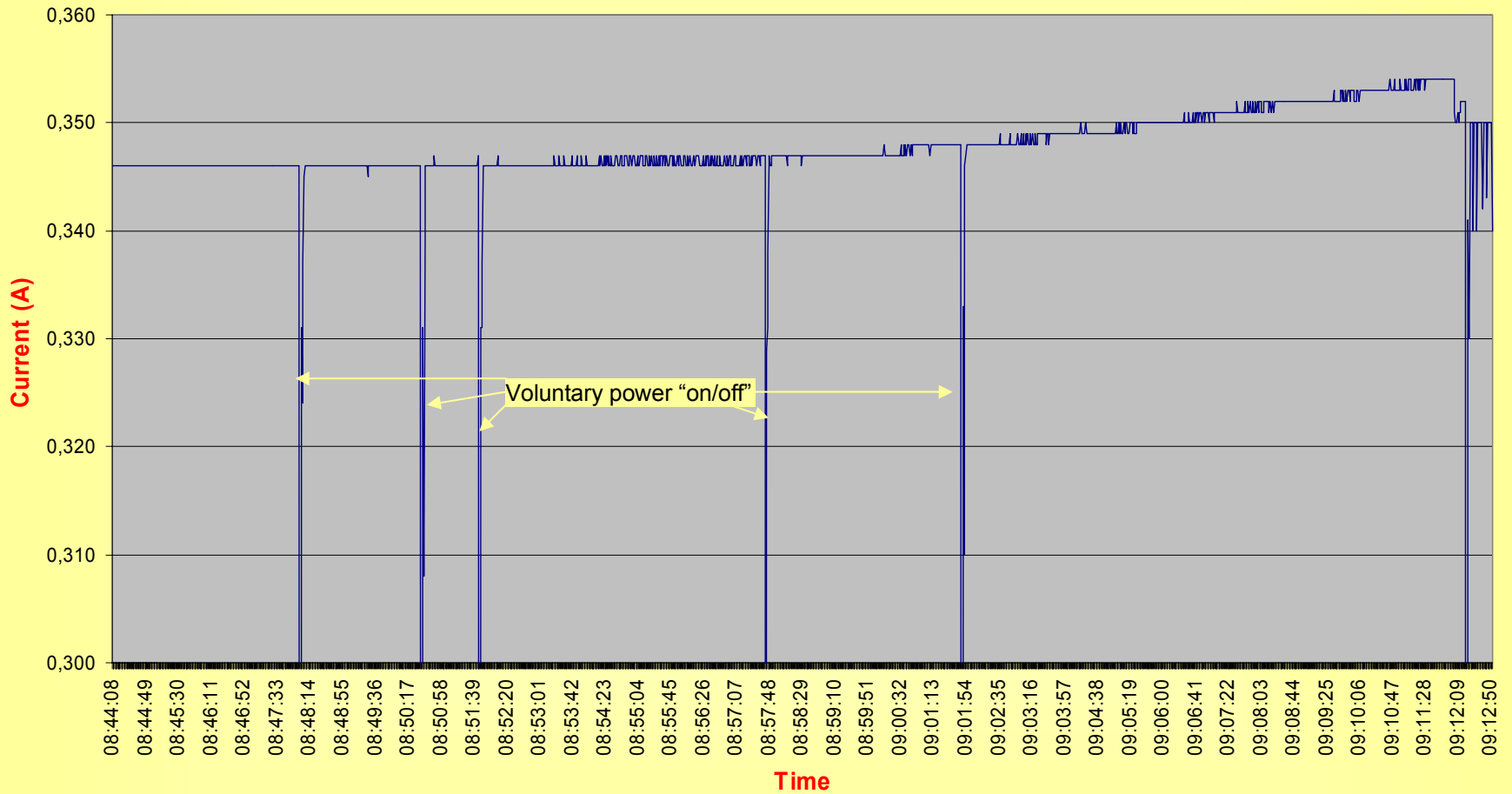


Digital module SM321 - 32DI



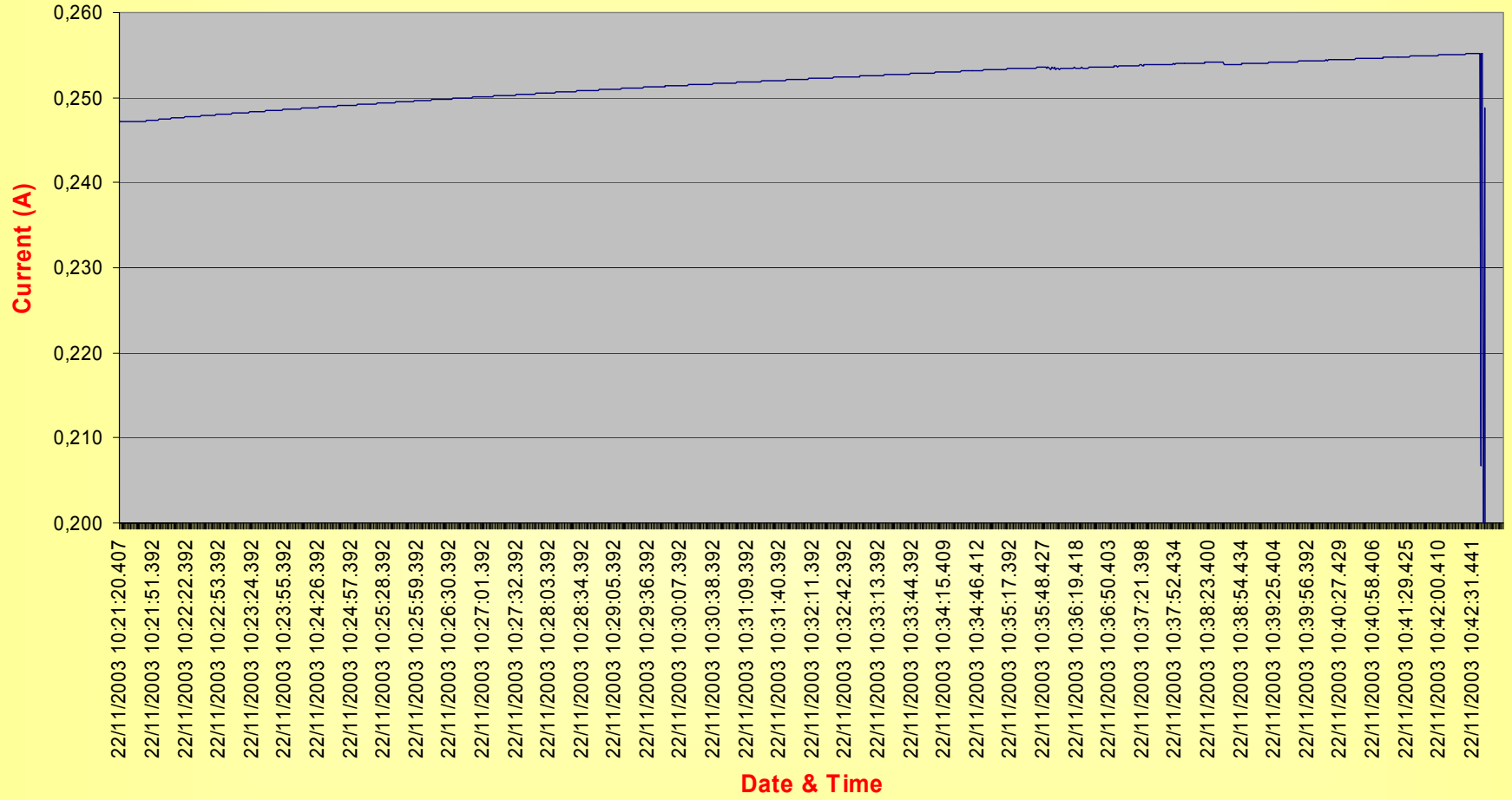


Slave module ET200M



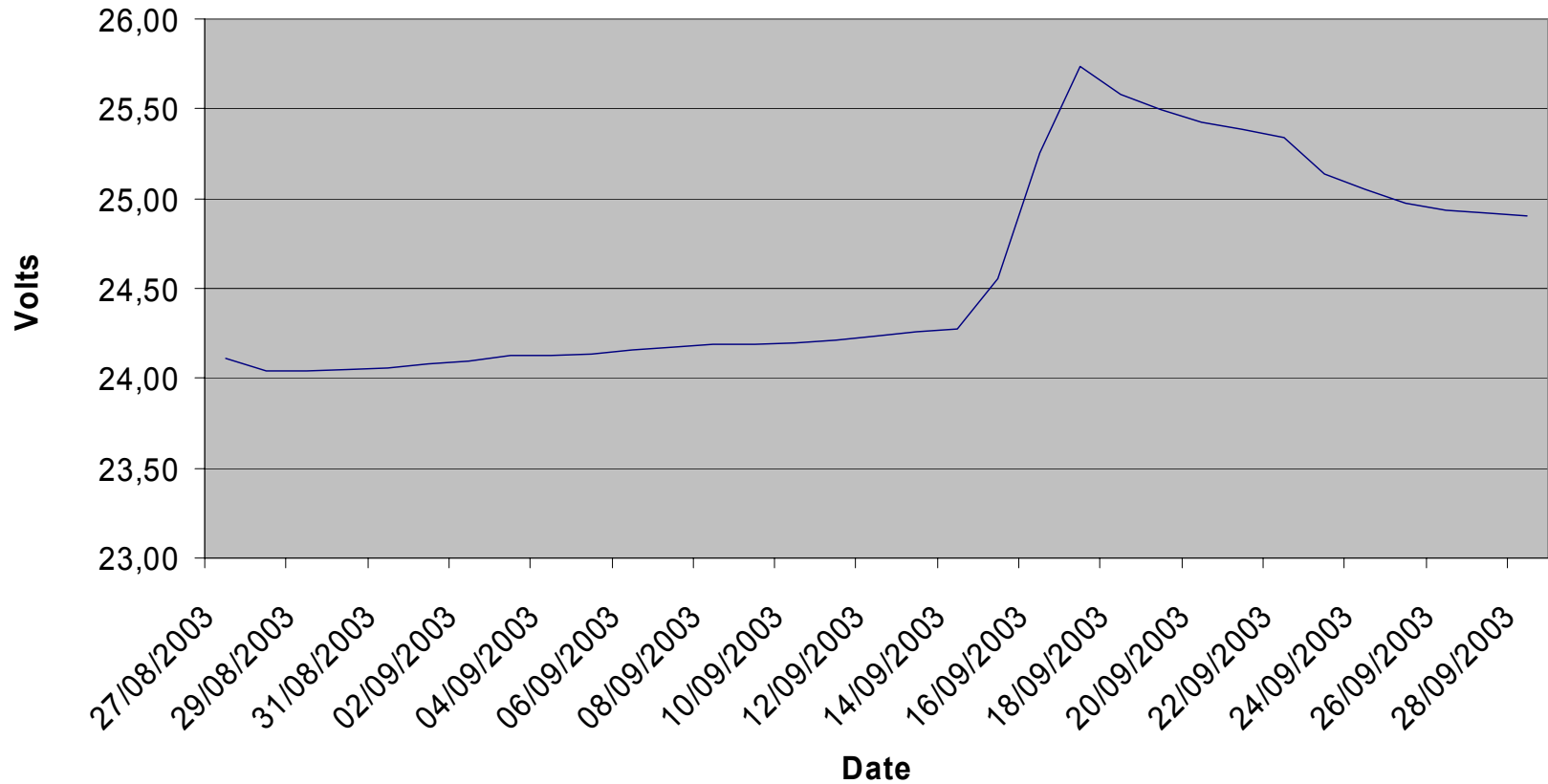


Switching Power supply ACS50



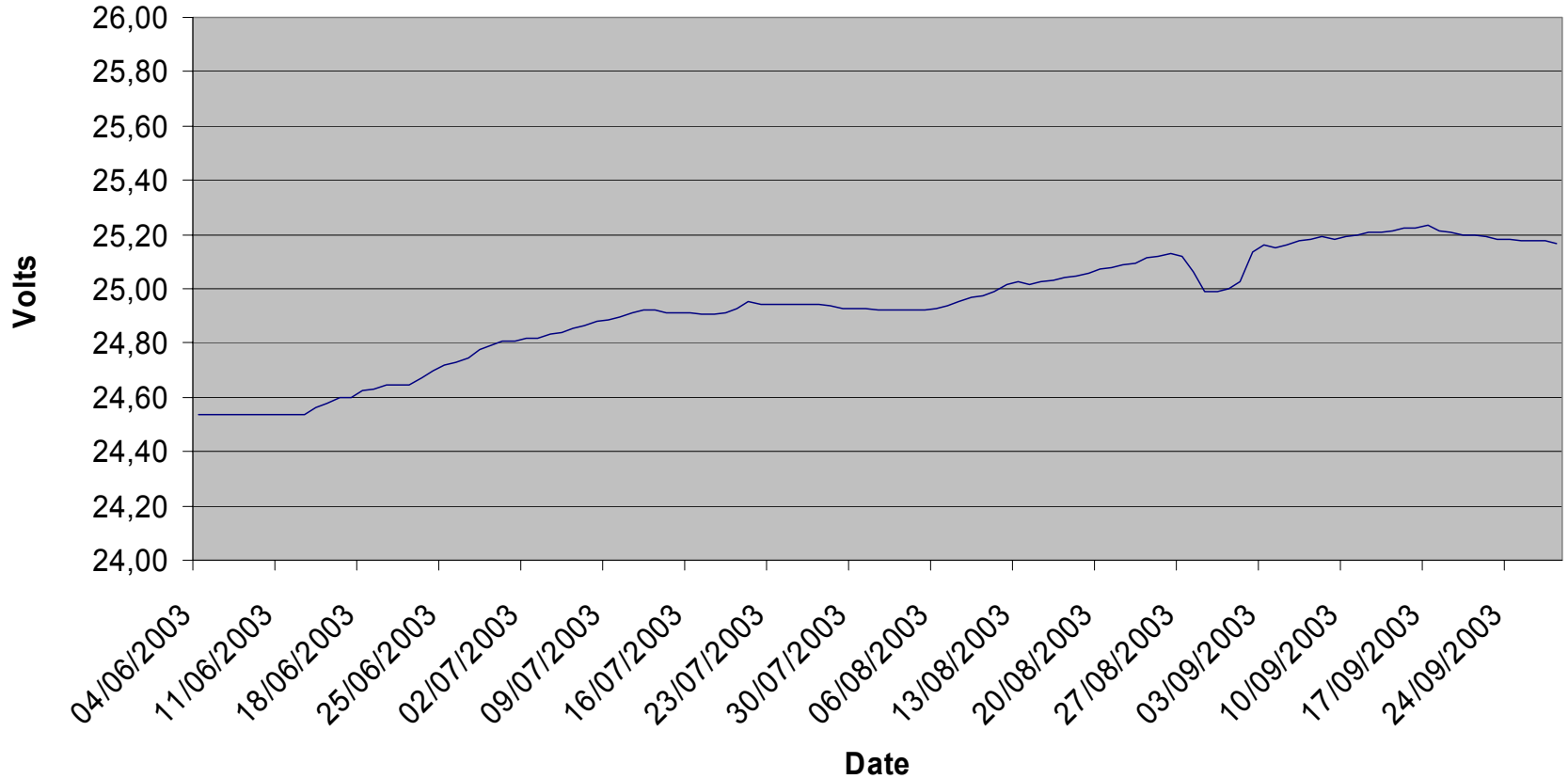


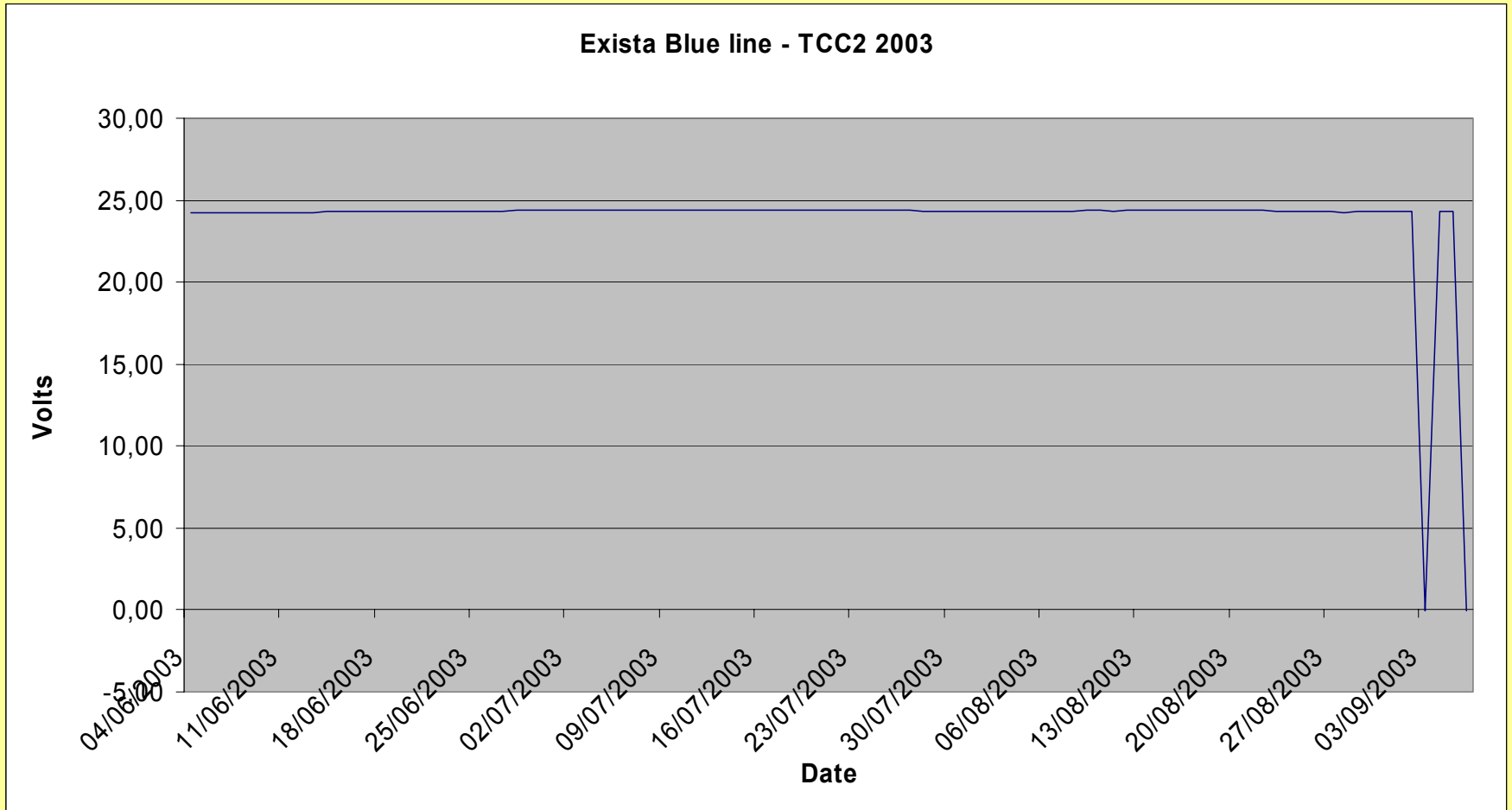
Alim. PS 307 2A Modifie - TCC2 2003





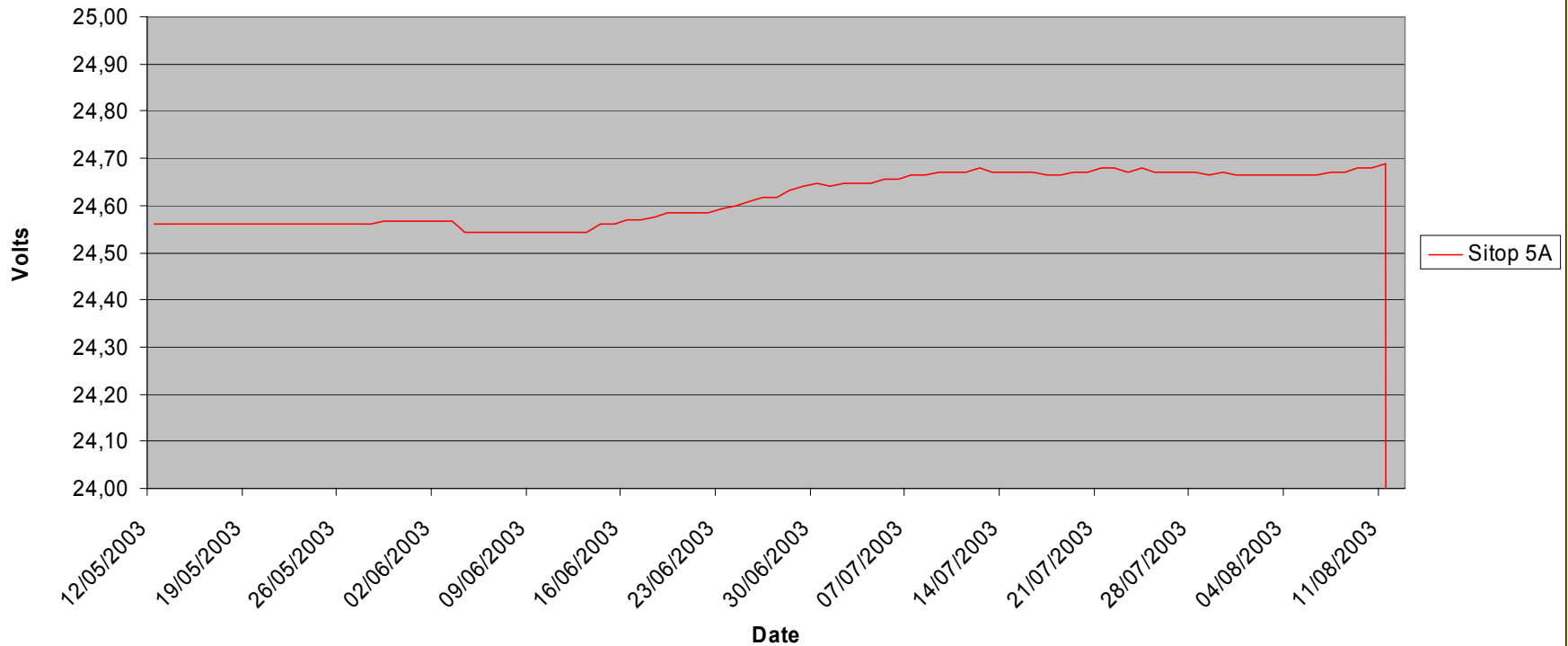
Alimentation ACT50 1x 24V - TCC2 2003





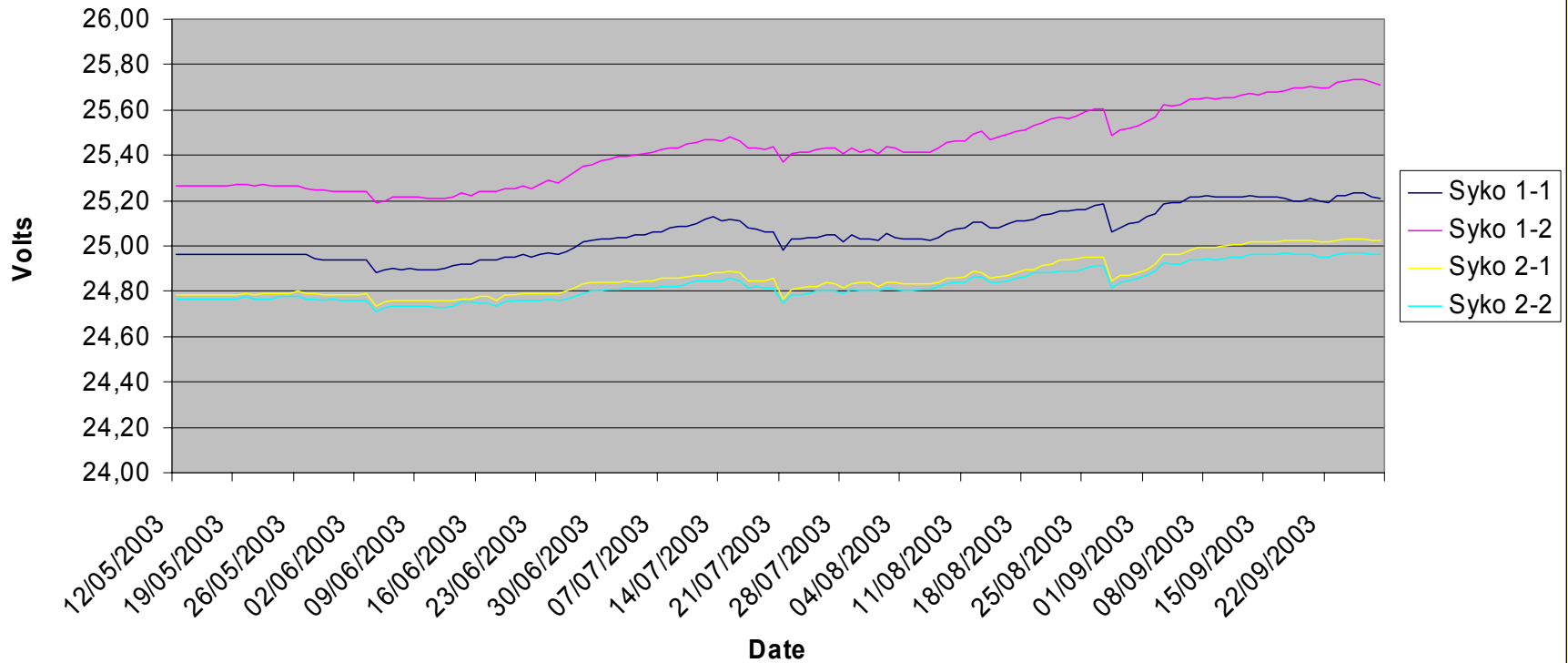


Alimentation Sitop 5A - TCC2 2003





Alimentations Syko - TCC2 2003





Alimentation ACT50 2x 24V - TCC2 2003

