detector considerations for neutrino physics

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NNN05
Next Generation of Nucleon Decay and Neutrino Detectors
7-9 April 2005, Aussois, Savoie, France

detector considerations for neutrino physics

light detection:

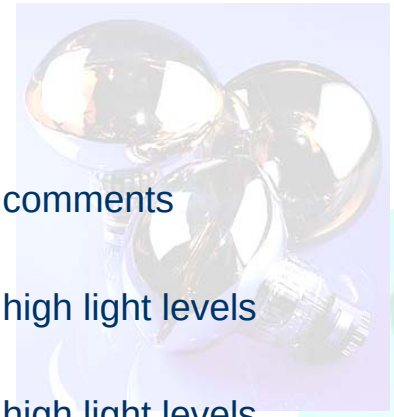
- large solid angle
- large cathode area
- long operating life
- high gain
- well-resolved SER
- fast timing and freedom from artefacts
- pressure resistant
- chemically inert glass – free from radioisotopes
- low temperature operation

power considerations

- high voltage supplies and control
- voltage dividers

electron tubes

range of hemispherical photomultipliers



Type	d(mm)	dynodes	σ(τ) ns	comments
9116	25	6	1.0	high light levels
9114	25	10	1.2	
9117	38	6	1.1	high light levels
9372	130	12	2.7	
9350	200	14	8	
9352	200	6	6	high light levels
9353	200	12	2.7	chemically inert
9354	200	12	2.7	ultra low background 5 Atm
9357	200	12	2.7	-200 ºC operation
D737	230	12	2.7	
D738	250	12	2.8	
9360	280	12	3.0	

glass characteristics

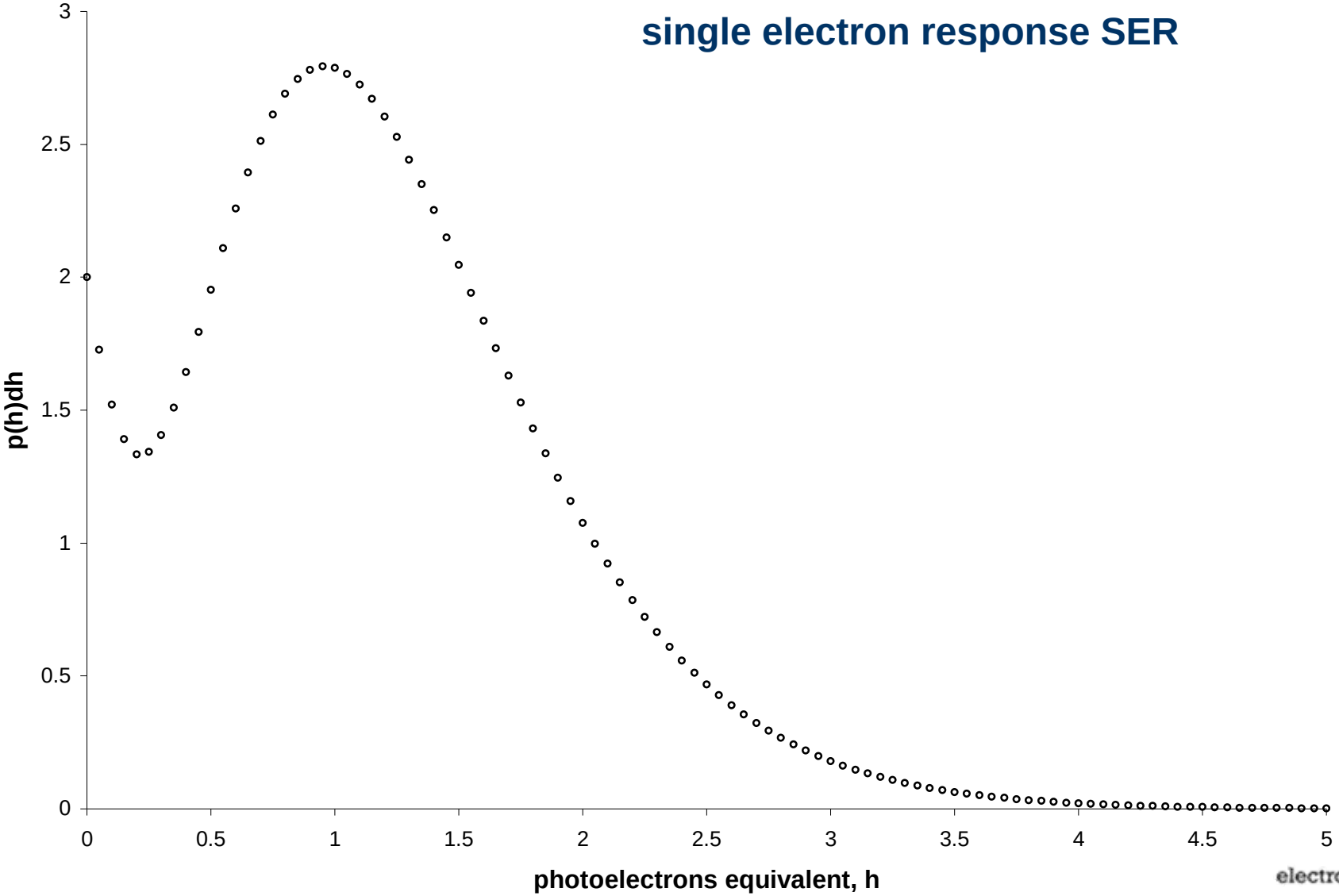
thickness: ranges from 2 to 4 mm

pressure: 2 to 5 atmospheres

radionuclides:

type	K(ppm)	Th(ppb)	U(ppb)
8246	30	30	30
B53	60	30	30
B47.2	300	250	100
8245	1400	900	1100

single electron response SER



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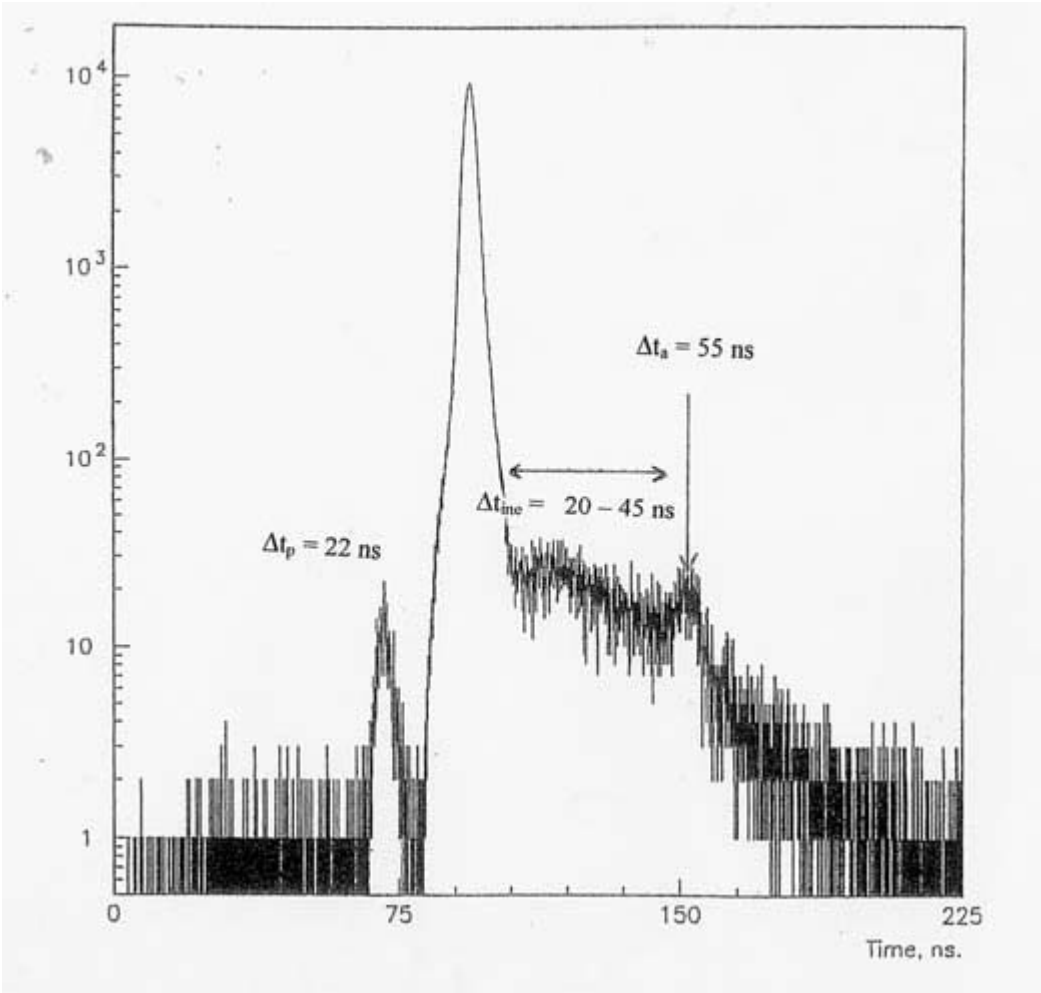
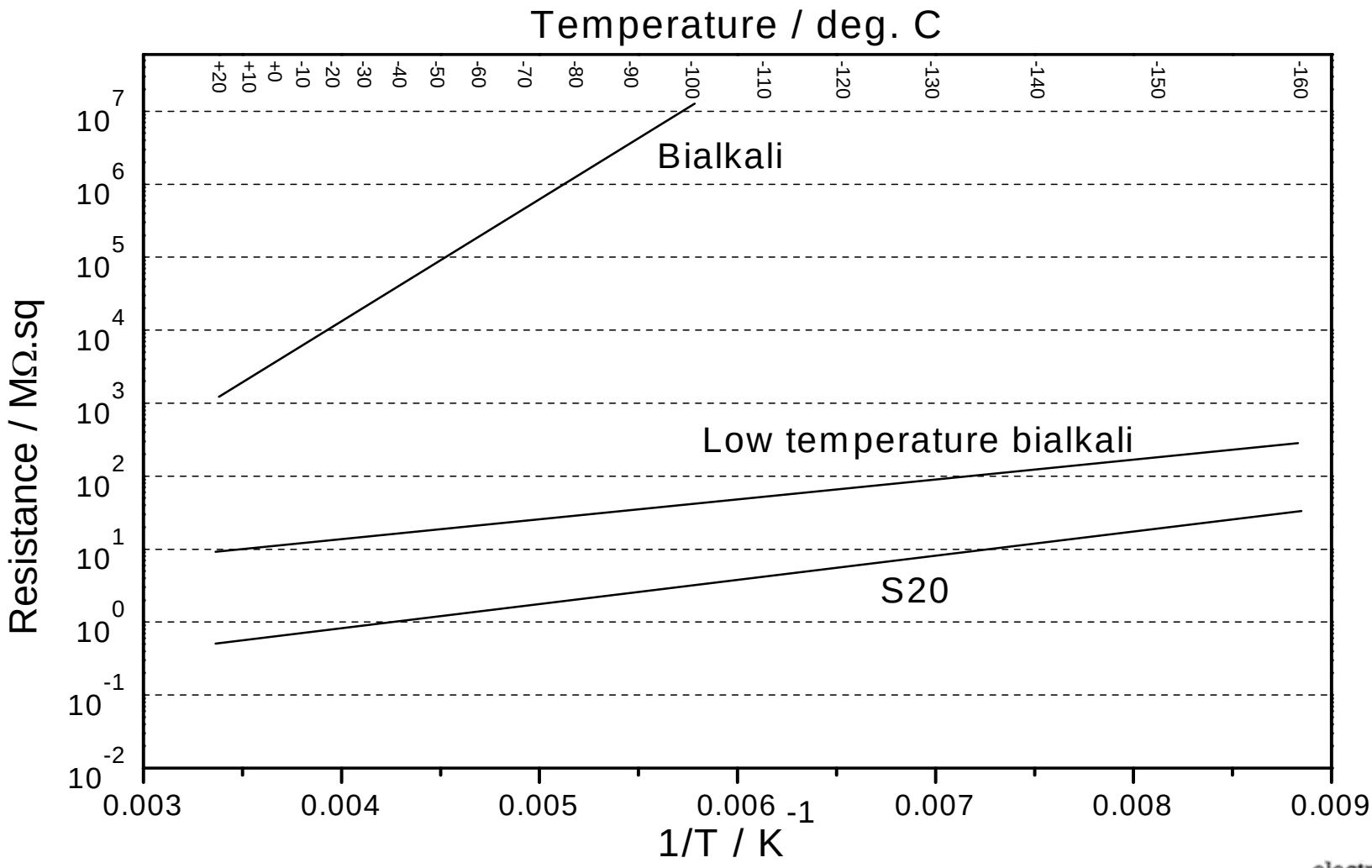
timing distribution





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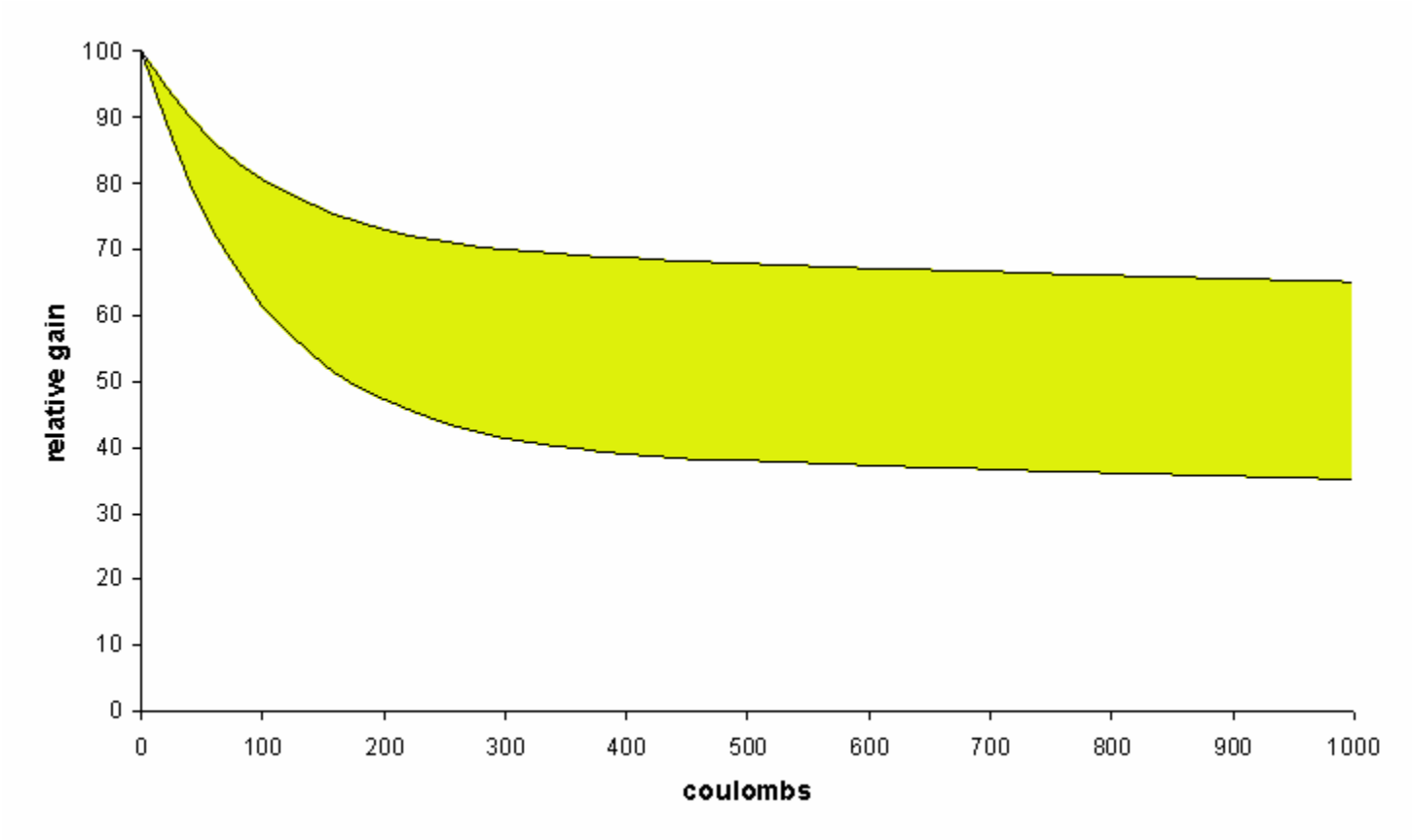
lifetime



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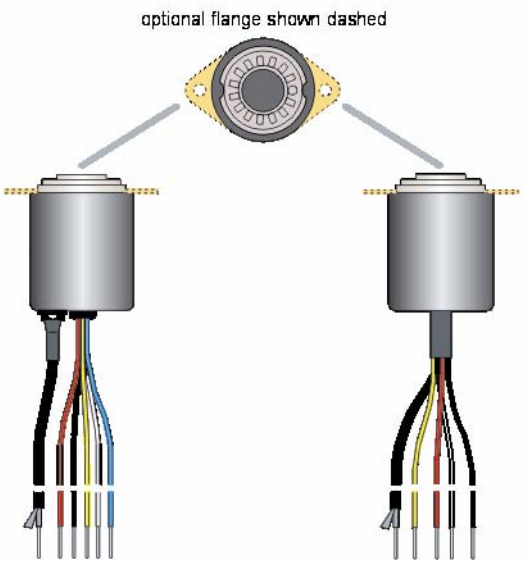
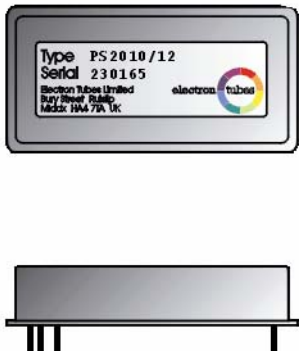
power supplies

- CW type with n individual socket outputs
- active divider with n individual outputs
- low power dc-dc converter with single output
- industrial dc-dc converter with single output

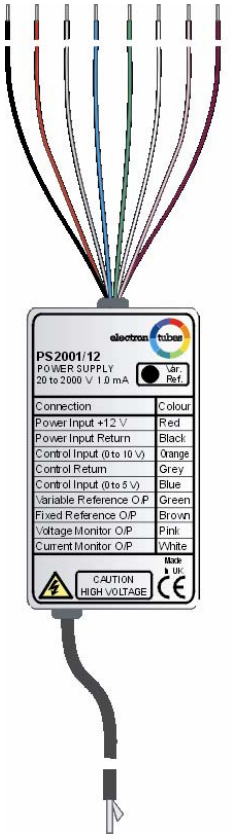
power supply outlines



PS1800/PS1806



PS2010



PS2001

optimising photomultiplier performance with low power consumption

- battery operated
- solar powered (Auger, satellites)
- underwater, under ice, in liquid argon

two considerations:-

- consuming power (voltage divider)
- providing power (HV supply)

voltage divider considerations

Requirement:

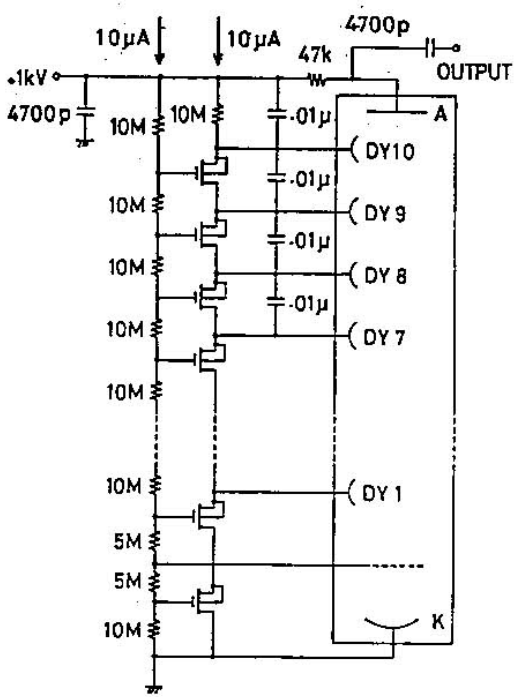
- establish and maintain set of fixed dynode potentials

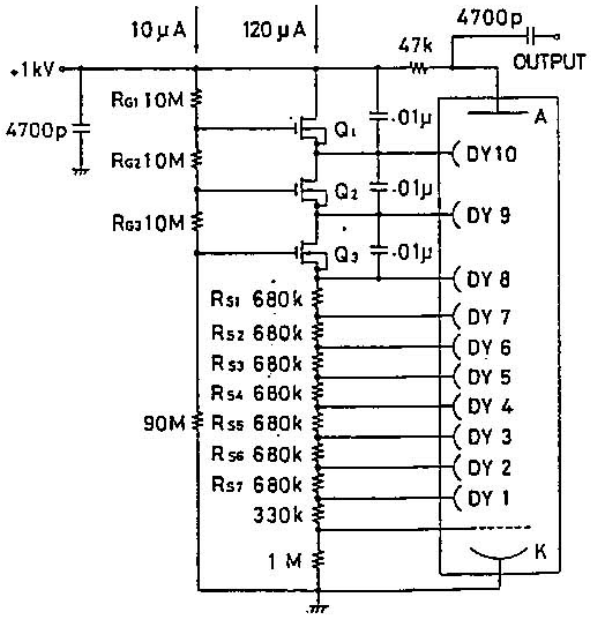
there are two generic types available:

- traditional resistor configuration
- active type (FET)

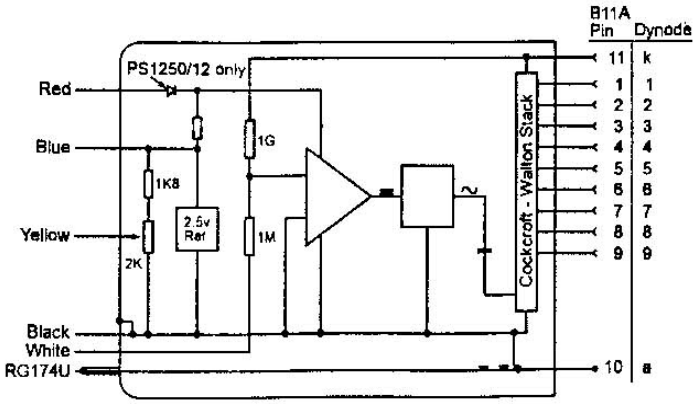
The all-resistor divider always fails the requirement if the mean anode current varies significantly. Active dividers fix the dynode potentials regardless of mean anode current.

active divider networks

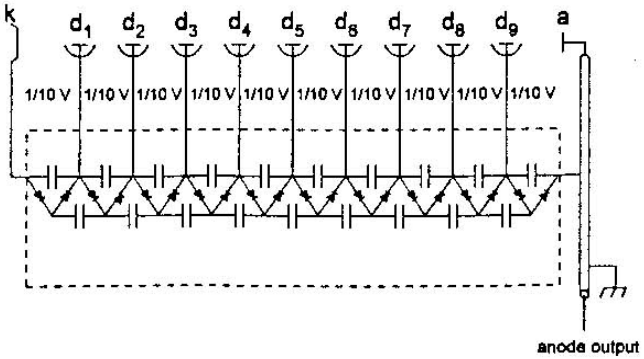




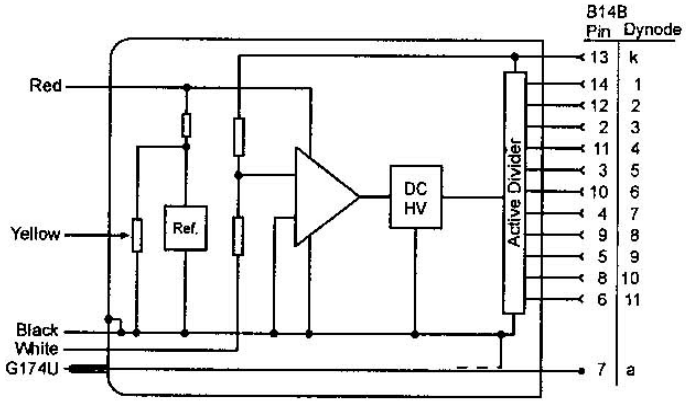
Schematic Diagram



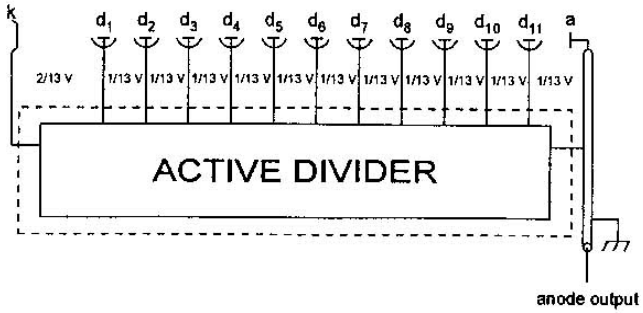
Voltage Distribution



Schematic Diagram

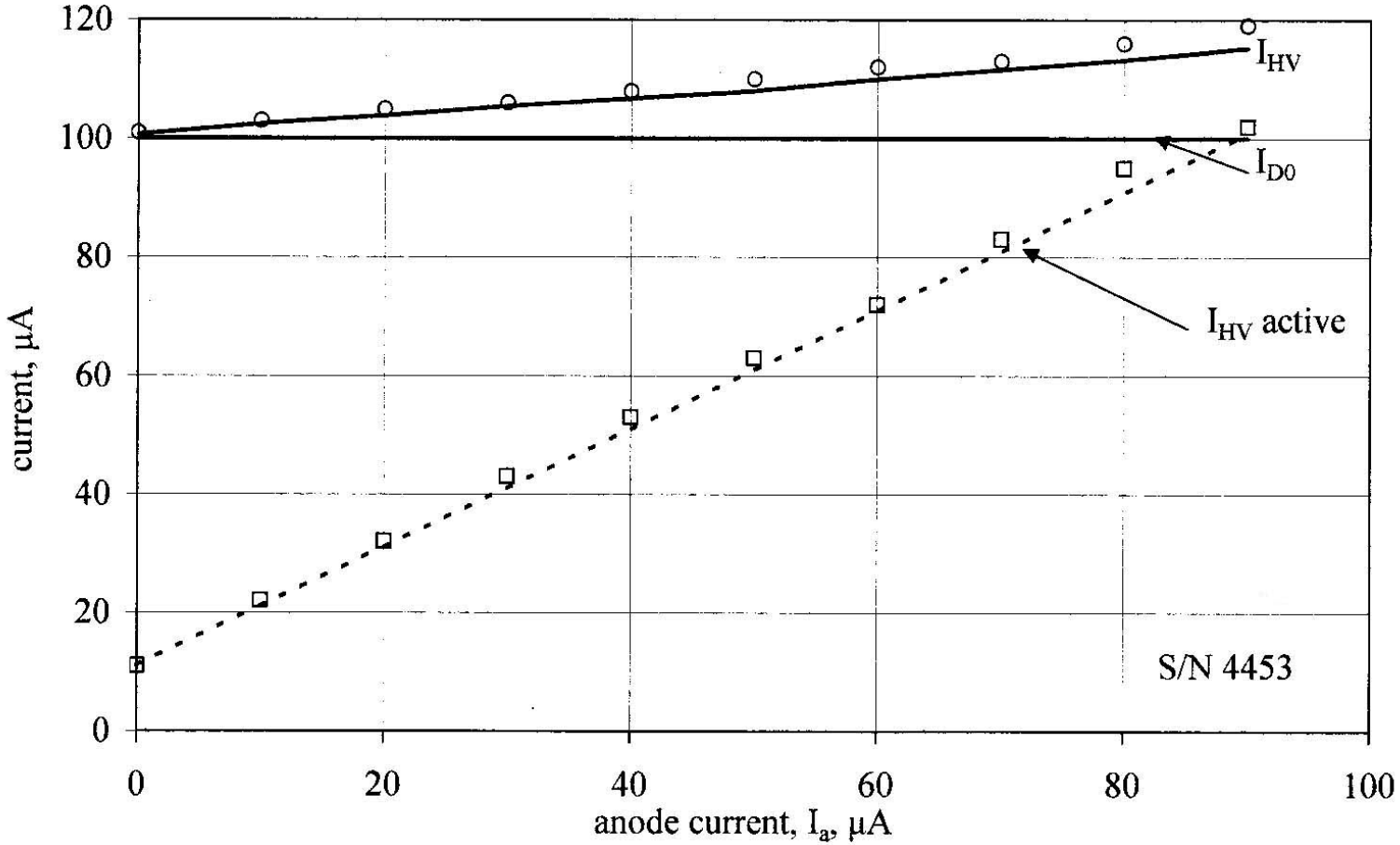


Voltage Distribution



electron tubes


6.5
Ø39.4 x 1.3
deep

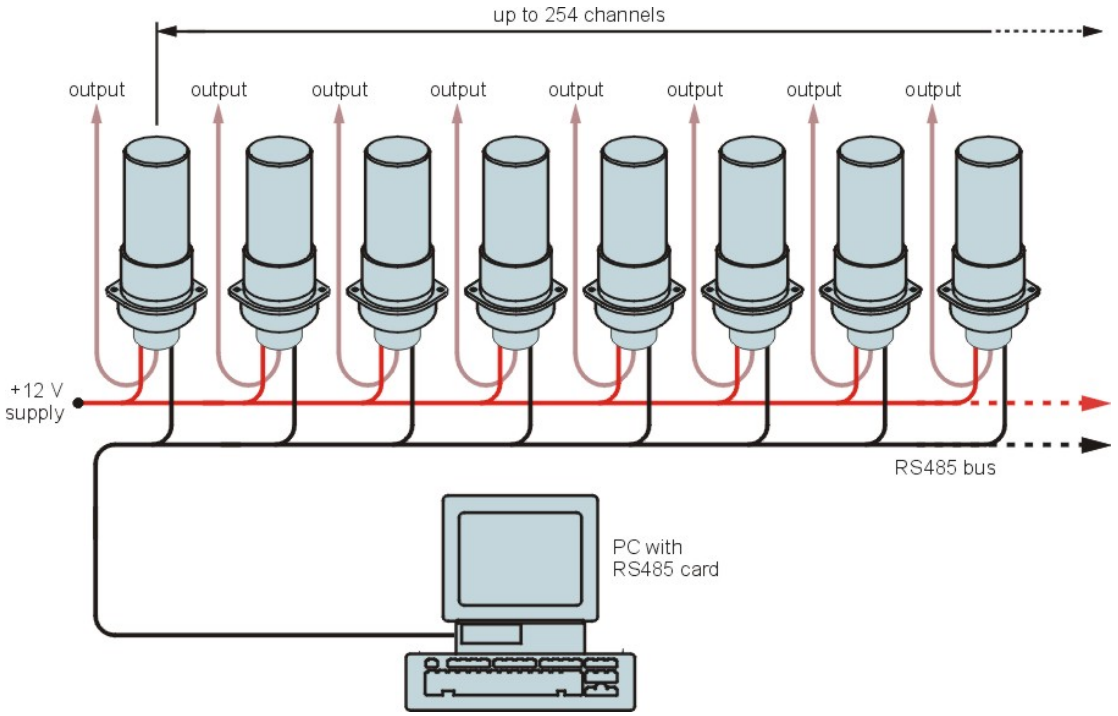

120
100
80
60
40
20
0
current, µA
0
20
40
60
80
100
anode current, Ia, µA
IHV
ID0
IHV active
S/N 4453

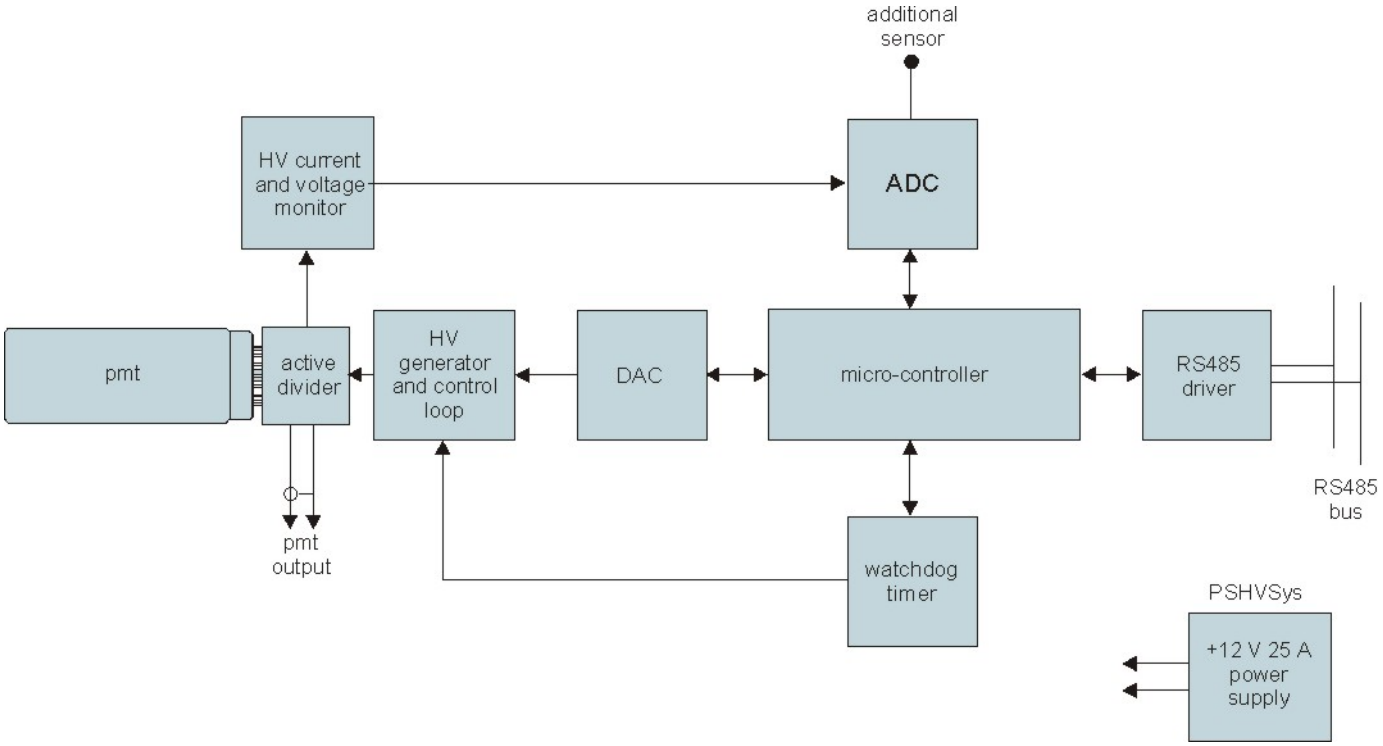
power supplies

Type	Input power (mW)	Efficiency	Output current
PS1800	120	-	I_a = 200 µA
PS1806	400	-	I_a = 200 µA
PS2010	340	60%	I_{D0} = 100 µA
PS2001	4800	40%	I_{D0} = 1000 µA

high voltage supply and control system – HVSys

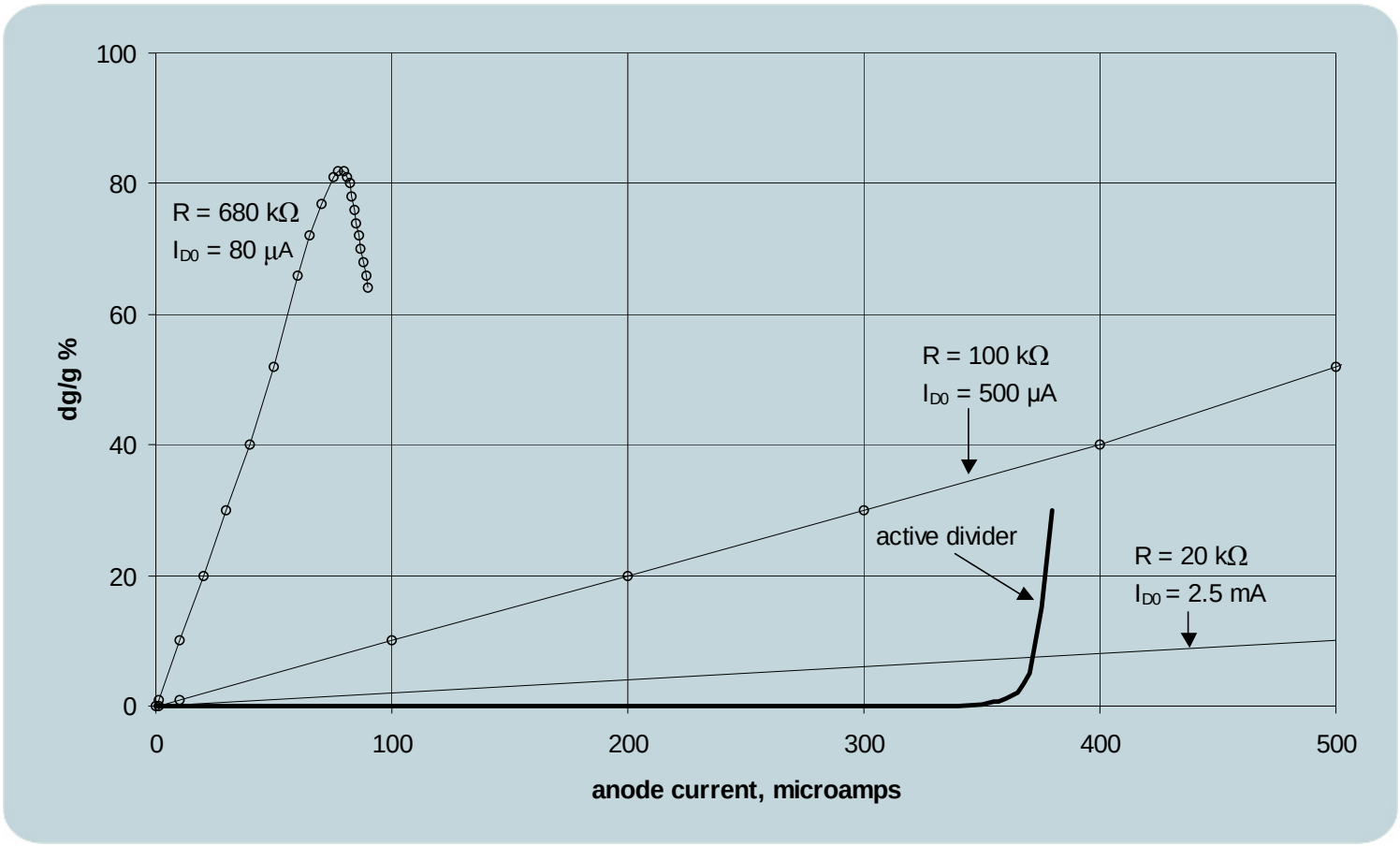
- multichannel power supply system
- individual channel control and monitoring
- RS485 interface
- requires only single +12V supply



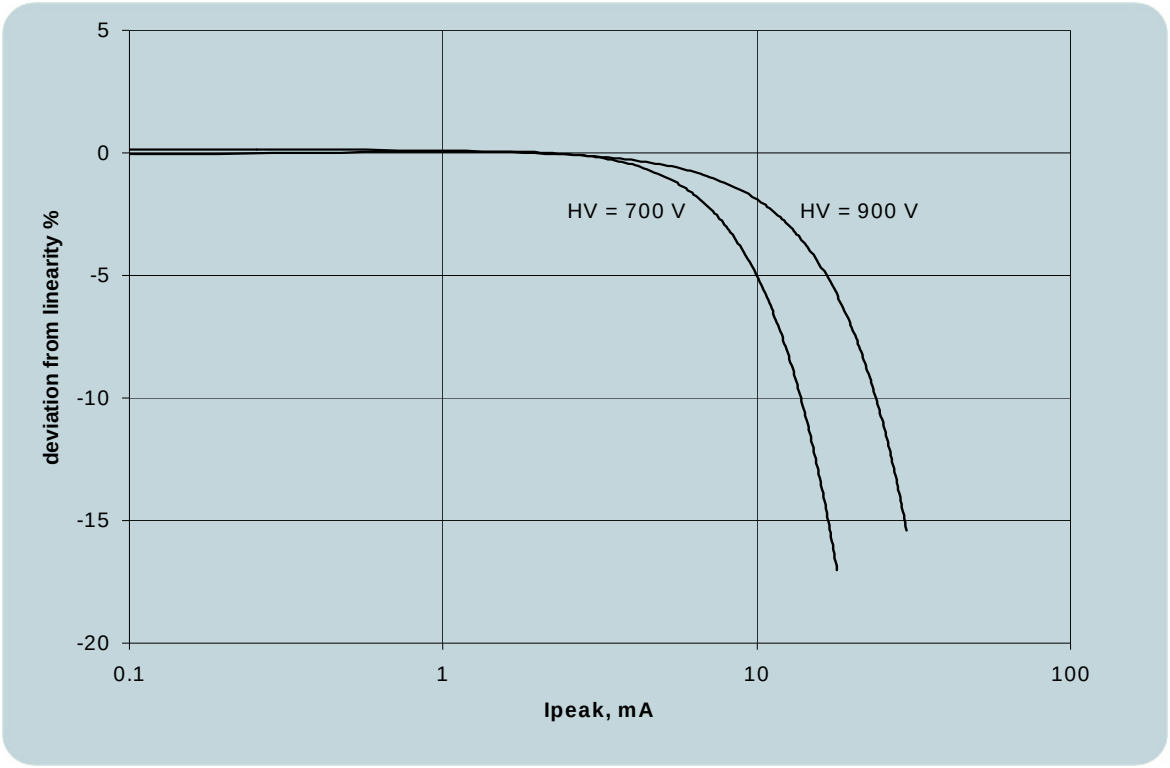


functional diagram of 1 channel. The hardware shown is integrated within each power base enclosure


6.5
Ø39.4 x 1.3
deep


100
80
60
40
20
0
dg/g %
0
100
200
300
400
500
anode current, microamps
R = 680 kΩ
I_{D0} = 80 µA
R = 100 kΩ
I_{D0} = 500 µA
active divider
R = 20 kΩ
I_{D0} = 2.5 mA


6.5
Ø39.4 x 1.3
deep


5
0
-5
-10
-15
-20
0.1
1
10
100
deviation from linearity %
Ipeak, mA
HV = 700 V
HV = 900 V

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available to discuss your particular requirements

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