VLVNT Workshop Amsterdam

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A G Wright
Electron tubes Ltd
Bury street
Ruislip
UK

Efficient high voltage voltage supplies and dividers

optimising photomultiplier performance at low power

- battery operated
- solar powered (Auger, satellite)
- under-water and under-ice experiments

two considerations

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

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voltage divider considerations

Requirement

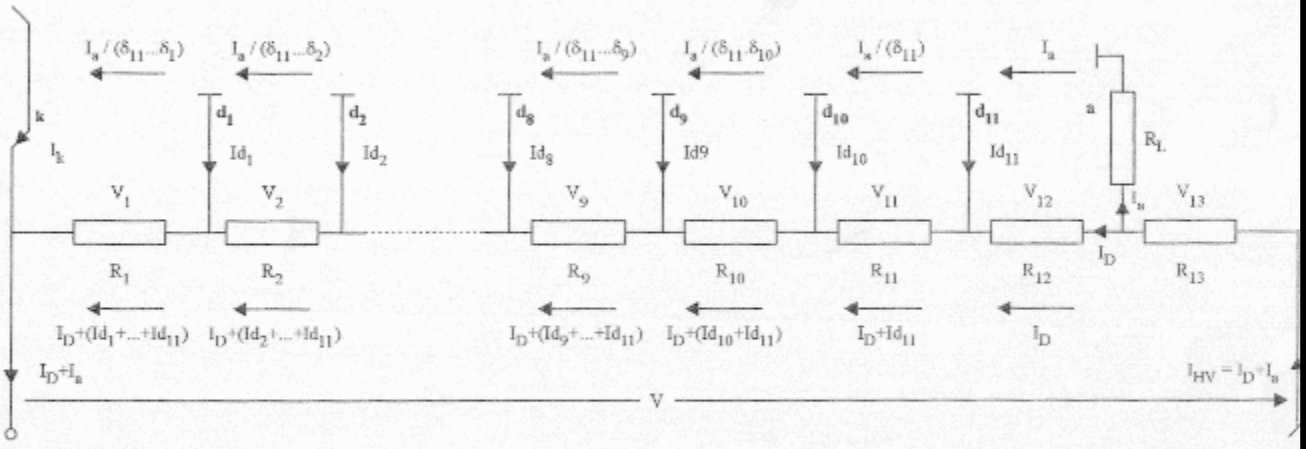
- establish & maintain a set of fixed dynode potentials

Two generic types available

- resistor type
- active divider (FET)

The all-resistor divider always fails the requirement – but why and how badly?

all-resistor divider



Simplistic explanation

$$g = a V^n$$

$$\frac{dg}{g} = \frac{n}{V} dV \qquad \ldots.(1)$$

but $dV \approx I_a R$ where I_a is the mean anode current, $n \approx 10$ and $V \sim 1000$ volts

low power consumption dividers typically use 1 MΩ resistors and draw 100 μA divider current, so

$$\frac{dg}{g} = \frac{10\,(10^{-6} \times 10^{6})}{1000}$$

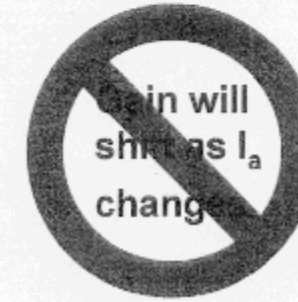
$$= +1\% \text{ per } \mu A \text{ of } I_a$$

two possibilities

- light source is absolutely constant
  - mean anode current I_a does not change

problem goes away

- light source varies with time constant greater than that of the voltage divider



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solutions

- increase I_{D0} by decreasing all R values

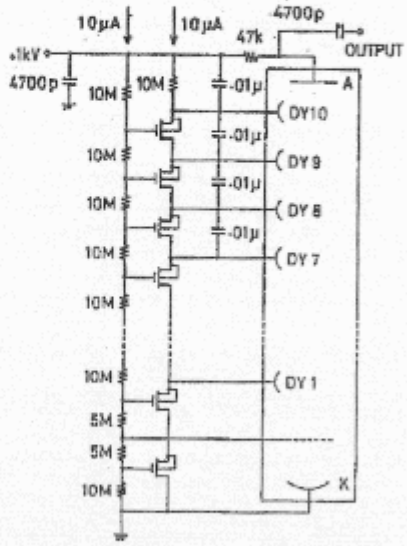
or

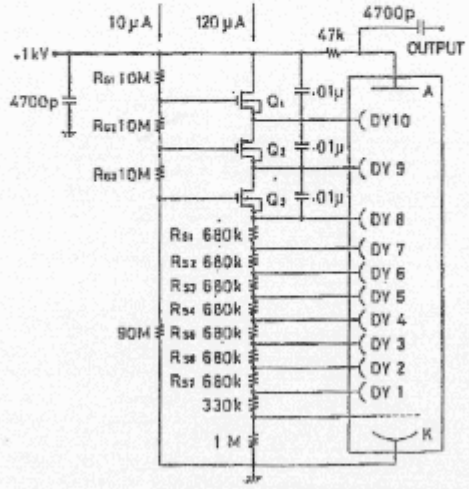
- reduce $R(d_n\text{-}a)$ only

- use either a fully or partially active divider based on emitter follower action

- capacitors for pulsed signals

active divider networks





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

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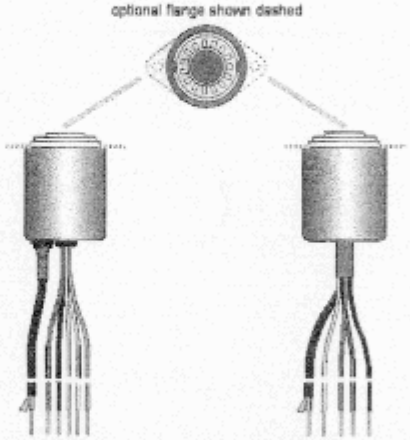
power supply outlines



PS1800/PS1806

PS2010

PS2001

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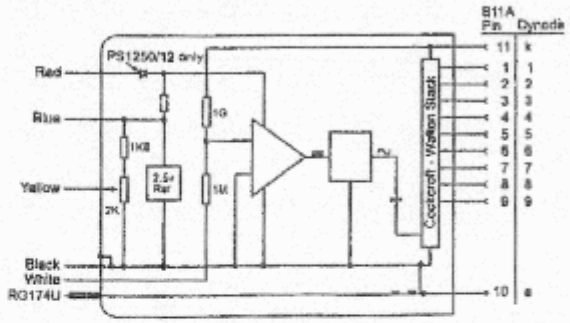
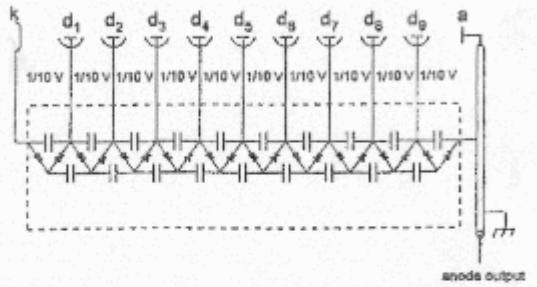
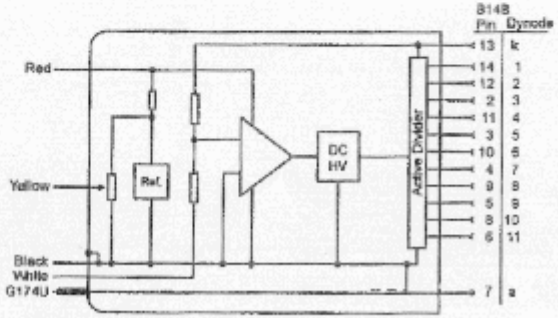
Schematic Diagram



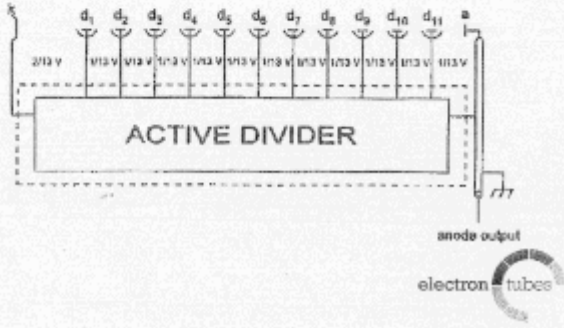
Voltage Distribution



Schematic Diagram



Voltage Distribution



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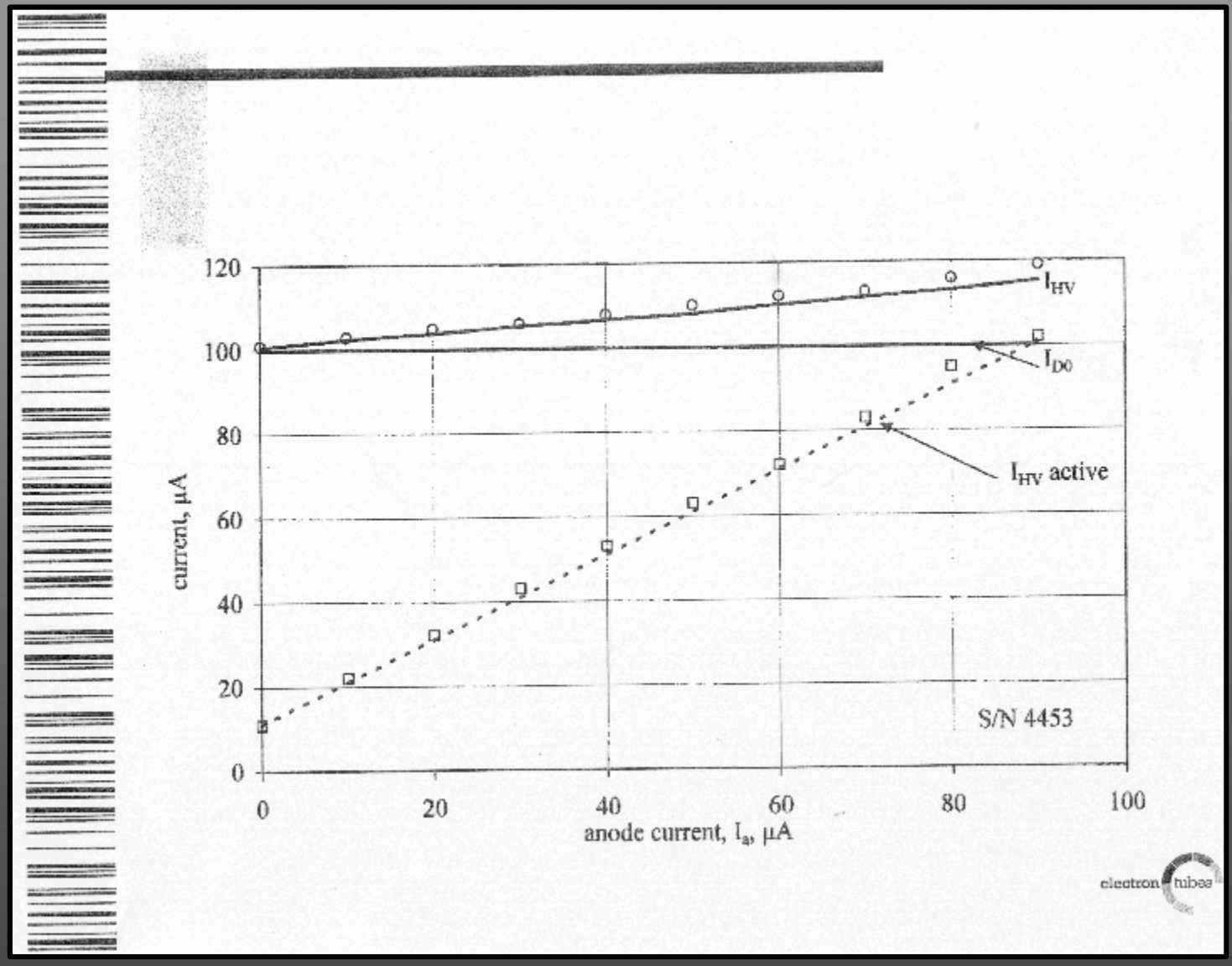
120
100
80
60
40
20
0
current, µA
0
20
40
60
80
100
anode current, I_a, µA
I_{HV}
I_{D0}
I_{HV} active
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power supplies

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

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