DISSERTATION

Cool Science

ausgeführt am Atominstitut

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Fakultät für Physik

unter der Anleitung von
Univ.Prof. Dipl.-Ing. Dr.techn. Gorge Hammond
und
Projektass. Dr.rer.nat Rodney MacKay MSc.
Projektass. Dr.techn. Dr.techn. Dr.techn. Dipl.-Ing. Samantha Carter

durch

Daniel Jackson

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Stadionallee 2
1020 Wien

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"The Setesh guard's nose drips."
TEAL'C

Contents

1 Electron beam setup

1.1 Charatarization of a working CRT

HAMEG HM507 oscilloscopes [1] were used for testing purposes. These contain a D14-363GY/123[2] CRT hereinafter abbreviated as ‘D14’, ‘tube’, or ‘CRT’. Although the HM507 has only a bandwidth of 0 MHz to 50 MHz, which is not sufficient for the hyperfine splitting frequency of 461.7 MHz of ^{39}K, it was used nevertheless because of its simple construction and availability. A schematic view of the device is shown in fig. 1.1 with the back pin arrangement in fig. 1.2.

http://www.to

The voltages and currents of the necessary pins to drive the CRT were measured using a 2.5 kV probe with an attenuation ratio of and are summarized in table 1.1. It was not possible to measure pin g3 directly. Therefore a HVPS (section 1.2) was used to set a voltage and the beam diameter was observed. The best focus was achieved with the voltage mentioned in the table. The voltage offset of x-, and y-plates was not possible to measure directly, since it varies with time to draw the necessary image on the phosphor screen. The given values in table 1.1 are the mean of the minimum and maximum measured voltage. The deflection coefficient is summarized in table 1.2.

model number

1:100 or 100:1

current?

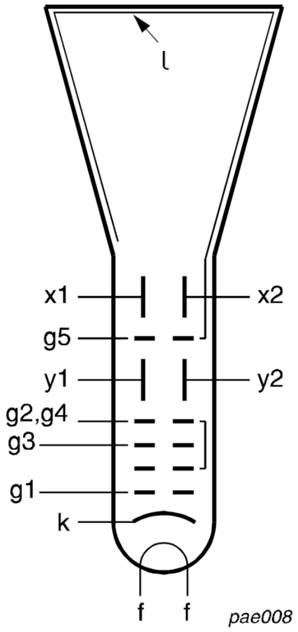

Figure 1.1: Electrode configuration (from [2])

how to cite figure

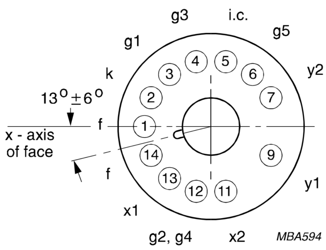

Figure 1.2: Pin arrangement, bottom view (from [2])

how to cite figure

Table 1.1: D14-363GY/123 CRT pin measurements

current empty or '-' symbol

number	pin	voltage/V	current/µA
1	f	-1.99×10^3	86.6×10^3
2	k	-2.00	-7.6
3	g1	-2.03	0
4	g3	-1.813×10^3	
5	i.c.	71.7	0.1
6	g5	64.0	7.2
7	y2	78	
9	y1	78	
11	x2	96	-
12	g2, g4	71.0	0
13	x1	96	-
14	f	-1.97×10^3	-86.2×10^3

Table 1.2: D14-363GY/123 deflection coefficient (from [2])

how to cite source

horizontal	M_x	19 V/cm
vertical	M_y	11.5 V/cm

1.2 High Voltage Power Supply HVPS

To produce high dc voltages to drive the CRT, four HCP 14-6500 power supplies[3] were used. They were named ‘HVPS 1’ to ‘HVPS 4’ and can provide up to ±6.5 kV and 2 mA. To connect the output to the CRT pins, BNC cables were refitted with a save high voltage (SHV) connector on one side while on the other end the BNC connector was kept (fig. 1.3). A 6 kV probe was used to obtain the breakdown voltage, which is around 3 kV caused by the coaxial cable which was not built do sustain high voltages.

find name of bi
yellow probe

somewhere 2.5-
find exact valu

Figure of SHV & BNC connector cable.

Figure 1.3: Coaxial cable with SHV and BNC connector.

1.2.1 Ripple measurement

Each power supply was measured for its ripple with a set voltage of 2 kV. A 2.5 kV probe (attenuation ratio)was connected to an oscilloscope set to ac coupling with a timescale of 1 ms. To get the electronic noise of the oscilloscope itself, the probe was shorted and the noise measured. A picture of a measurement is shown in fig. 1.4 with the values summarized in table 1.3.

100:1 or 1:100

Table 1.3: HVPS ripple

device	ripple/mV
short	116
HVPS 1	136
HVPS 2	138
HVPS 3	194
HVPS 4	204

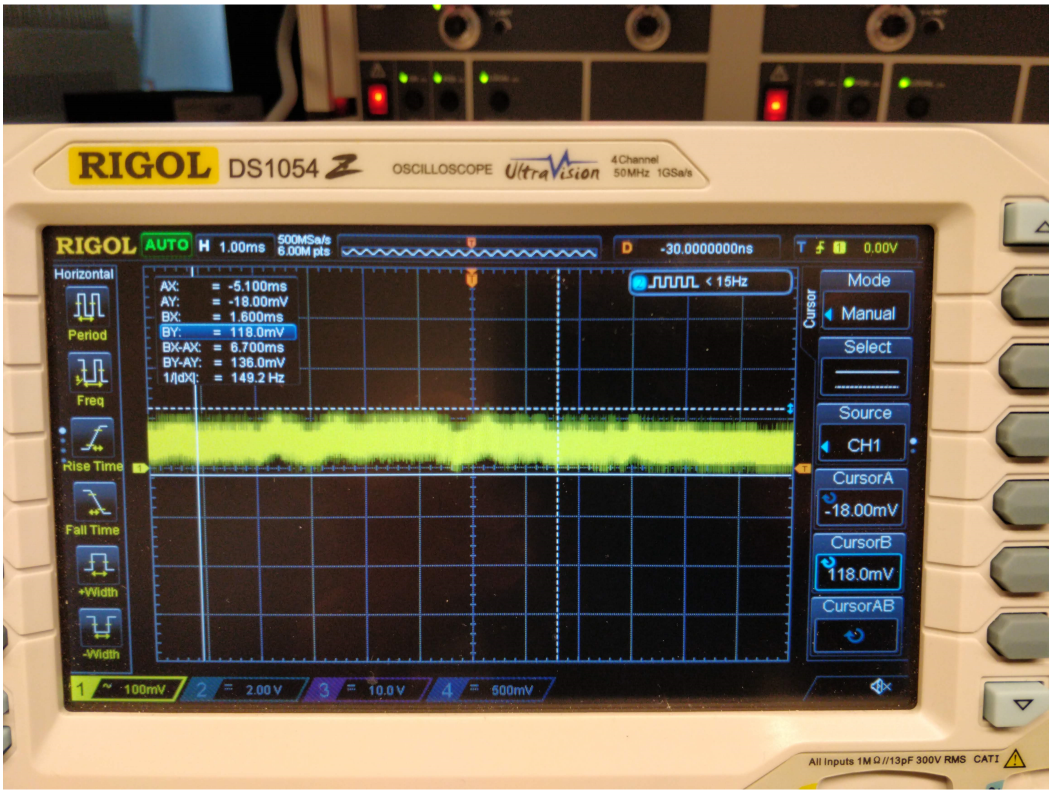

Figure 1.4: Measurement of HVPS ripple.

1.3 CRT wiring

A schematic of the supplied power is shown in fig. 1.5. A small ac or dc voltage is necessary to drive the heater filament f. This part of the setup is explained in section 1.4.

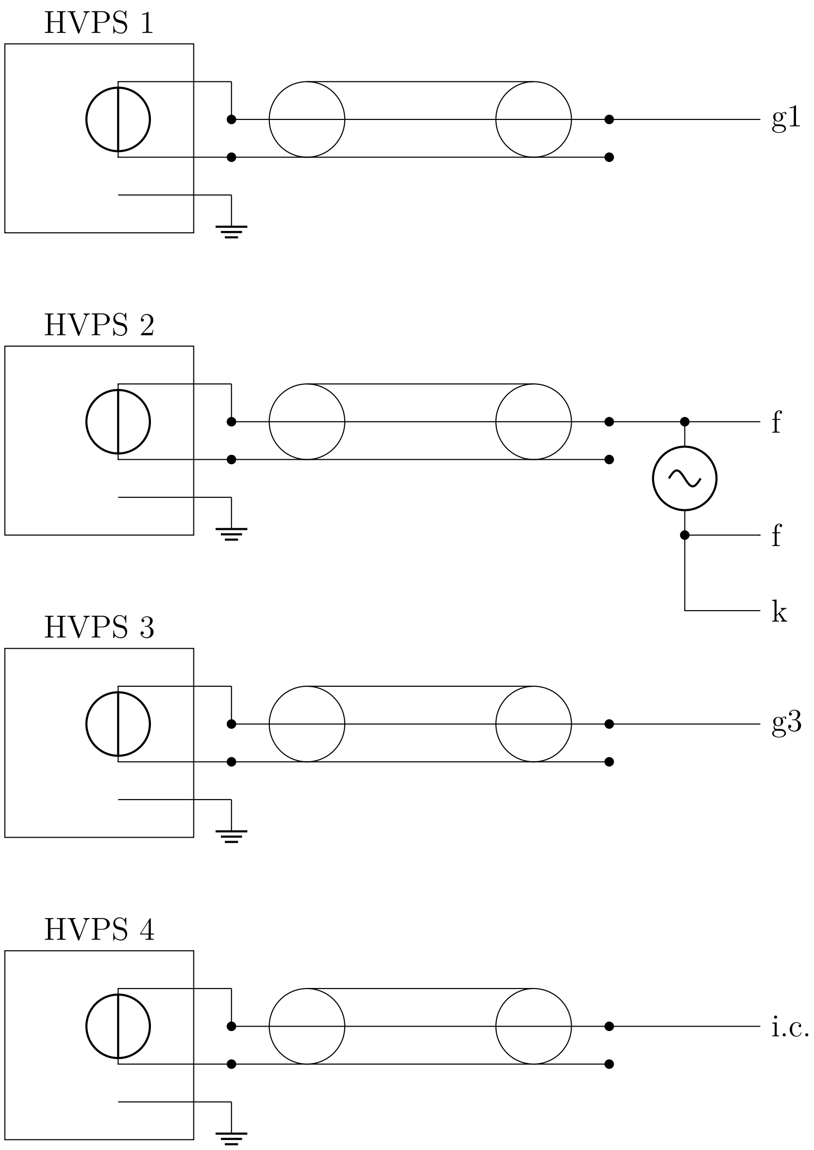

Figure 1.5: Schematics of supplying CRT pins with power.

1.4 Heater

The heater provides an adjustable ac voltage, which is used to regulate the temperature of the cathode. In the cold state, the heater filament has a an electrical resisitance of approximately 15 Ω, when the filament is hot, this value rises to 90 Ω. The normal heater voltage for the D14-363GY/123 during operation is 6.0 V to 6.6 V according to [2]. Our ac-power supply (figure 1.6 shows its circuit diagram) consists of an isolation

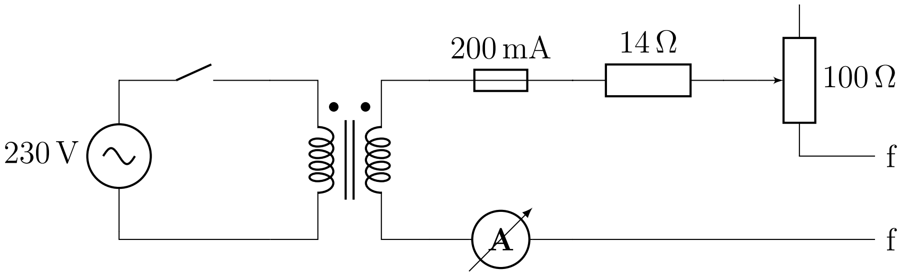

Figure 1.6: Circuit diagram of filament power supply.

check if really 14 Ω or if it event exists

transformer (from grid voltage to 12 V), its primary and secondary circuits are isolated up to 4 kV [4]. The power supply has two banana plug sockets to connect to the heater filament. It is connected to the transformer in series with a 100 Ω potentiometer. Using the full resistance, there is a voltage of approximately 5.7 V applied to the heater filament, by lowering the resistance this value can goes up to nearly the full voltage of the transformer. The current running through the filament is measured with an integrated amperemeter [5] that measures currents up to two 2 A with mA accuracy.

At the beginning of operation it is recommendable to set the maximum resistance and slowly increase the current to the desired value once the filament is heated up. As the resistance of the cold filament is significantly lower, high onset currents could otherwise damage it.

Todo list

References

[1] Rohde & Schwarz. *HM 507*. URL: https://cdn.rohde-schwarz.com/hameg-archive/HM507_english.pdf (visited on 03/28/2020).

[2] Frank Philipse. *D14363GY123*. URL: https://frank.pocnet.net/sheets/186/d/D14363GY123.pdf (visited on 03/10/2020).

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[4] Myrra SAS. *Data Sheet 44231*. URL: http://www.farnell.com/datasheets/92205.pdf (visited on 04/07/2020).

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