



TECHNISCHE
UNIVERSITÄT
WIEN

DISSERTATION

Cool Science

ausgeführt am Atominstutut



der Technische Universität Wien
Fakultät für Physik

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Wien, am 08.04.2020

“The Setesh guard’s nose drips.”
TEAL’C

Contents

1	Electron beam setup	1
1.1	Charatarization of a working CRT	1
1.2	High Voltage Power Supply HVPS	4
1.2.1	Ripple measurement	4
1.3	CRT wiring	5
1.4	Heater	6
Todo list		8
References		9

¹ 1 Electron beam setup

² 1.1 Charatarization of a working CRT

³ HAMEG HM507 oscilloscopes [1] were used for testing purposes. These contain a
⁴ D14-363GY/123[2] CRT hereinafter abbreviated as ‘D14’, ‘tube’, or ‘CRT’. Although
⁵ the HM507 has only a bandwidth of 0 MHz to 50 MHz, which is not sufficient for the
⁶ hyperfine splitting frequency of 461.7 MHz of ^{39}K , it was used nevertheless because of
⁷ its simple construction and availability. A schematic view of the device is shown in
⁸ fig. 1.1 with the back pin arrangement in fig. 1.2.

⁹ The voltages and currents of the necessary pins to drive the CRT were measured
¹⁰ using a 2.5 kV probe with an attenuation ratio of and are summarized in table 1.1. It
¹¹ was not possible to measure pin g3 directly. Therefore a HVPS (section 1.2) was used
¹² to set a voltage and the beam diameter was observed. The best focus was achieved
¹³ with the voltage mentioned in the table. The voltage offset of x-, and y-plates was not
¹⁴ possible to measure directly, since it varies with time to draw the necessary image on
¹⁵ the phosphor screen. The given values in table 1.1 are the mean of the minimum and
¹⁶ maximum measured voltage. The deflection coefficient is summarized in table 1.2.

<http://www.to>

model number

1:100 or 100:1

current?

1 Electron beam setup

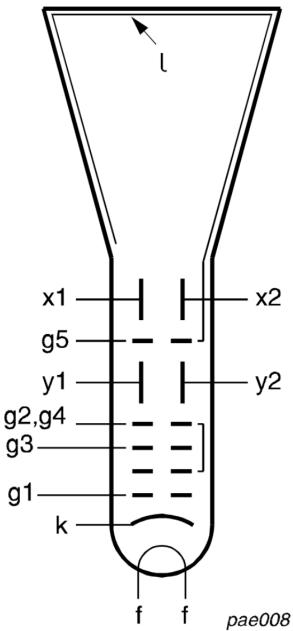


Figure 1.1: Electrode configuration (from [2])

how to cite figure

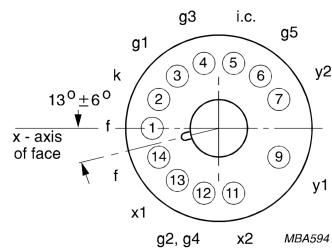


Figure 1.2: Pin arrangement, bottom view (from [2])

how to cite figure

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

number	pin	voltage/V	current/ μ A
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.

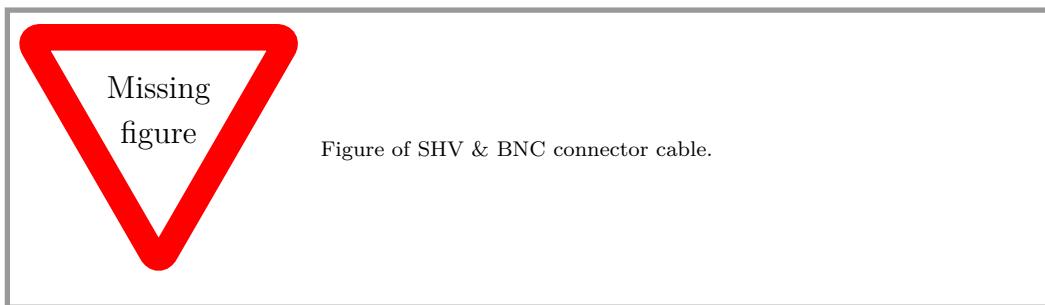


Figure 1.3: Coaxial cable with SHV and BNC connector.

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.

Table 1.3: HVPS ripple

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

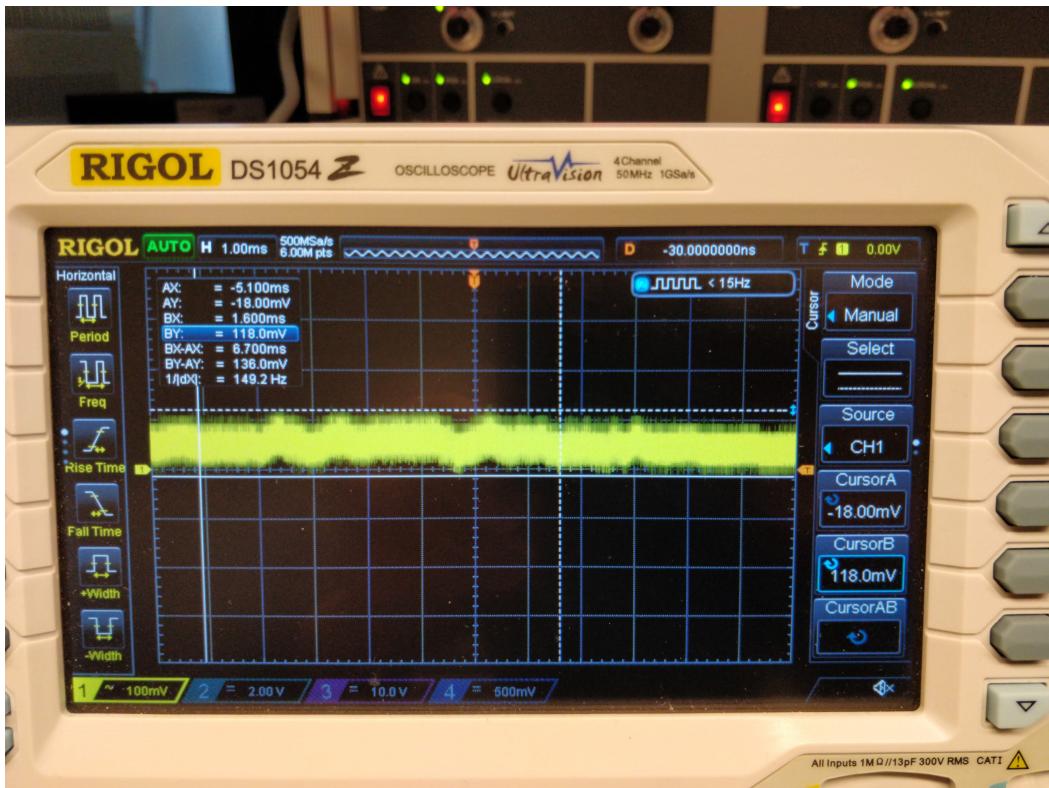


Figure 1.4: Measurement of HVPS ripple.

1.3 CRT wiring

- 1 A schematic of the supplied power is shown in fig. 1.5. A small ac or dc voltage
2 is necessary to drive the heater filament f. This part of the setup is explained in
3 section 1.4.
4

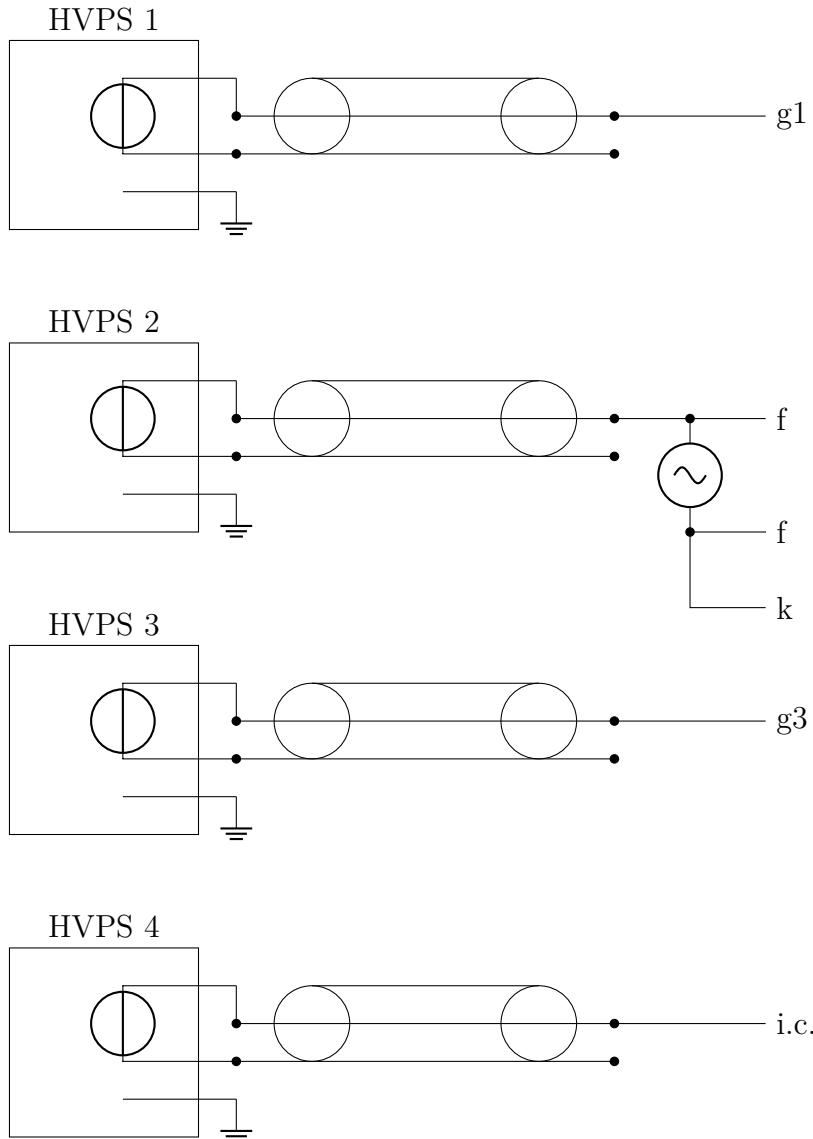


Figure 1.5: Schematics of supplying CRT pins with power.

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 resistitance of approximately $15\ \Omega$, when the filament is hot, this value rises to $90\ \Omega$. 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

1
2
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4
5
6

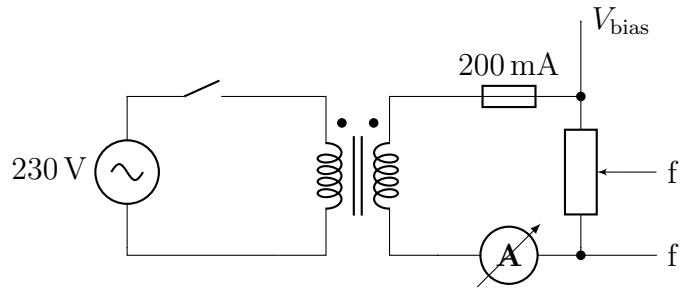


Figure 1.6: Circuit diagram of filament power supply.

- ¹ transformer (from grid voltage to 12 V), its primary and secondary circuits are isolated
- ² up to 4 kV [4]. The power supply has two banana plug sockets to connect to the
- ³ heater filament. It is connected to the transformer in series with a 100Ω potentiometer.
- ⁴ Using the full resistance, there is a voltage of approximately 5.7 V applied to the heater
- ⁵ filament, by lowering the resistance this value can go up to nearly the full voltage
- ⁶ of the transformer. The current running through the filament is measured with an
- ⁷ integrated amperemeter [5] that measures currents up to two 2 A with mA accuracy.

- ⁸ At the beginning of operation it is recommendable to set the maximum resistance
- ⁹ and slowly increase the current to the desired value once the filament is heated up.
- ¹⁰ As the resistance of the cold filament is significantly lower, high onset currents could
- ¹¹ otherwise damage it.

Frank
what is form g voltage?

Frank
4 kV soruce?

Todo list

1

■ http://www.tobiastiecke.nl/archive/PotassiumProperties.pdf	1	2
■ model number	1	3
■ 1:100 or 100:1	1	4
■ current?	1	5
■ how to cite figure	2	6
■ how to cite figure	2	7
■ current empty or '-' symbol	3	8
■ how to cite source	3	9
■ find name of big yellow probe	4	10
■ somewhere 2.5-4, find exact value	4	11
Figure: Figure of SHV & BNC connector cable.	4	12
■ 100:1 or 1:100	4	13
■ what is form grid voltage?	7	14
■ 4 kV soruce?	7	15

References

16

- ¹ [1] Rohde & Schwarz. *HM 507*. URL: https://cdn.rohde-schwarz.com/hameg-archive/HM507_english.pdf (visited on 03/28/2020).
- ² [2] Frank Philipse. *D14363GY123*. URL: <https://frank.pocnet.net/sheets/186/d/D14363GY123.pdf> (visited on 03/10/2020).
- ³ [3] FuG Elektronik GmbH. *HVPS Series HCP*. URL: https://www.fug-elektronik.de/wp-content/uploads/pdf/Datasheets/EN/HCP_data_sheet.pdf (visited on 03/23/2020).
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- ¹¹