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PMT HIGH VOLTAGE POWER SUPPLY

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A 1P21 photomultiplier tube (PMT) requires a negative high voltage which is regulated to 0.1% and adjustable from -200 V DC to -1100 V DC at 1 μAmp. Commercially made units cost $200.00 or more. The power supply described here can be put together for a minimum amount of money. The more parts that are already on hand, the lower the cost.

A schematic for the power supply is shown in Figure 1, while Figure 2 shows the unit with top cover removed. The power supply can be considered to consist of three parts: the low voltage power supply, the oscillator/driver, and the high voltage power supply. Each part will be discussed separately.

I.THE LOW VOLTAGE POWER SUPPLY

This part consists of a power supply of standard design and uses a National LM 117k (TO-3 case) adjustable voltage regulator. To provide proper operation, a heat sink should be used with the LM 117k. Resistor R1 is a 5000 ohm 10-turn potentiometer. With adjustment of R1 the voltage out of VR1 varies, which in turn causes the high voltage output to vary proportionally. To provide repeatability in the settings a 10-turn dial with a lock should be used for R1. If battery operation is desired, connect a 12 VDC battery to X_1 (+) and X_2 (-). Transformer T_1 and the four 1N4001 diodes can be left in or removed, at the builder's option. Filter capacitors C_2 and C_3 also may be left in or removed.

II. THE OSCILLATOR/DRIVER

A 555 Timer integrated circuit (OC1) is used to form the oscillator. This is a readily available and inexpensive device (less than $1.00). Resistor R_A and R_B and capacitor C_1 determine the frequency. The optimum frequency for the design was found to be approximately 70 KHz. Q1 provides power amplification of the 70 KHz oscillation to the 16-turn primary winding of toriod T_2. Q_1 should be provided with a heat sink.

III. THE HIGH VOLTAGE POWER SUPPLY

Perhaps the hardest part of this whole design is the construction of toroidal transformer T_2. An exact design could not be provided because the core used could not be identified. A trail and error method was used to determine the 16-turn primary and 70 KHz frequency. The dimensions of the core used are 2 inches (O.D.) x 1 inch (I.D.) x 0.5 inches high. Care must be taken to insulate each layer of windings with mylar tape or black plastic electrical tape, in order to avoid high voltage arc-over between winding layers. The 16-turn primary should be wound on the core first. A popsicle stick with notches cut in each end can be used as a bobbin for the secondary wire. Splices can be

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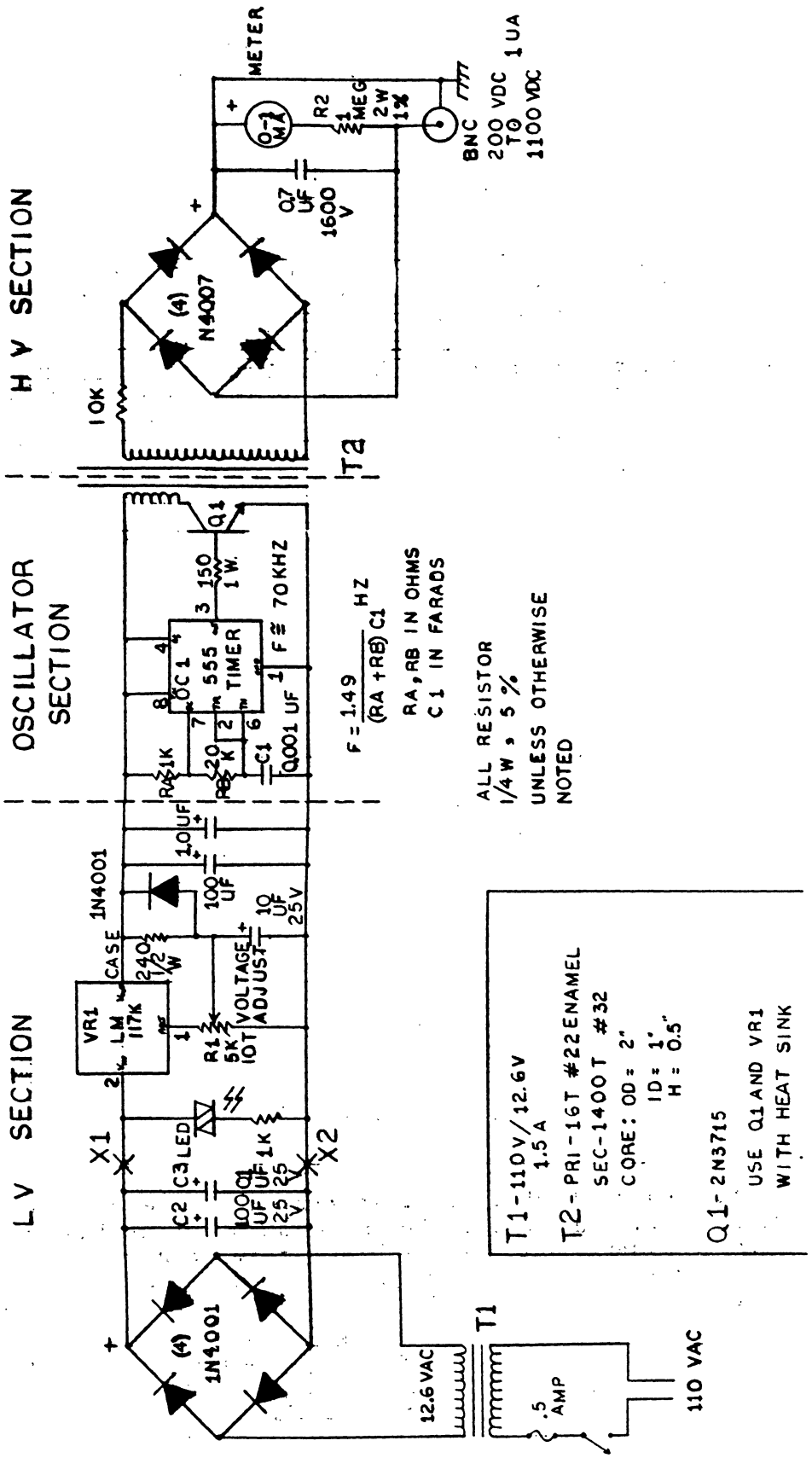

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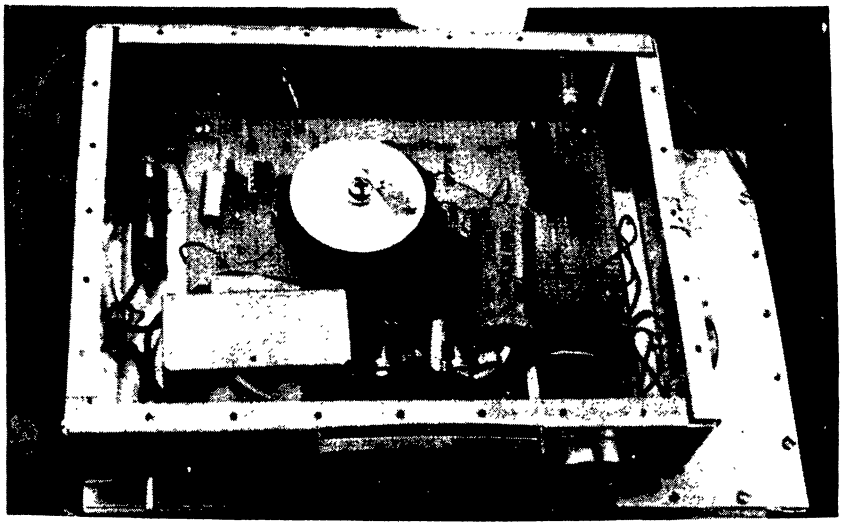

FIG. 2- The Hopkins power supply with top cover removed.

made but care must be excercised to insure that the splice is insulated well. Shrink tubing provides adequate insulation. The 1 meg ohm resistor R_2 is a precision 1% resistor. This provides the 0-1mA meter with a 0 to 1000 V scale. Since the PMT draws 1μA or less, the 1mA load due to R_2 will see a variation of 0.1% or less.

Even though transformer T_2 is not optimized and VR1 and Q_2 get quite warm,the voltage is stable and the unit works well.

JEFFREY HOPKINS:

Jeffrey L. Hopkins, age 41, received his B.S. in Physics in 1966 from Syracuse University with graduate work at the University of Wyoming. He is a native of Upstate New York but moved to Arizona for the wide open spaces, clear skies and warm weather. He is presently a Senior Staff Engineer for Motorola Inc., Government Electronics Division. He is a member of AAAS, ASP, AAPT, AAVSO and IAPPP. His astronomy interests include designing and building equipment for photography, photoelectric photometry and radio astronomy. Future plans include an observatory atop a 7200 foot mountain 100 miles north of Phoenix. Hopefully upon completion it could be made available to IAPPP members.

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