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OTTAWA ASTRONOTES

CENTRE

R.A.S.C.

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The Newsletter Magazine of the Ottawa Centre of the RASC

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OBSERVER'S GROUP MEETING - FEBRUARY 1 Daniel Dlab

Chairman Doug George opened the meeting at 8:12 pm with 64 people in attendance, of whom 48 were members.

Centre president Brian Burke was up to say a few words on upcoming events. There will be a Centre meeting on February 18 at 8 pm. Note that this meeting will be held at the Museum of Science and Technology. Saturday April 27 marks the arrival of International Astronomy Day, and the Ottawa Centre plans to organize some displays for the public. Between May 12 and May 18, a Canada-wide science fair will take place, at which Ken Tapping will be a judge representing the RASC.

Solar Coordinator Linda Meier described the solar observatory of Rick Hill in Arizona and showed a couple of slides of observing the sun. She explained how to calculate the number of sun spots on the visible portion of the sun, and how to send information of observations to ALPO, the Association of Lunar and Planetary Observers.

"The Greatest Living Comet Hunter in North America", also known as the Centre's Lunar and Planetary Coordinator, Rolf Meier, spoke about the planets Venus, Mars, and Jupiter, displaying their apparent position in the sky using slides. He then showed interesting slides of the southern sky and of his recent trip to Arizona.

Next up was Instrumentation Coordinator Max Stuart, who stated that he has a telescope making workshop that he could set up if anyone needed help with the construction of a telescope or equipment. He proudly displayed his recently-completed 13.1-inch Newtonian telescope on an alt-az mount.

Sandy Ferguson was up to present a way for new

observers to get acquainted with the sky, consisting of stars painted on Saran Wrap stretched out on hanger wire.

Doug George gave a hint on how to predict auroral displays by phoning 992-1299 for magnetic field interference information, since its activity is closely related to them. He then talked about unknown objects that look like point meteors. These objects have been given the name of "Aries Flasher", and 13 cases have been reported in a region of the sky northwest of the Pleiades.

Gary Susick enlightened members with slides of the California Nebula, the Pleiades, and several of Orion.

Occultation Coordinator Brian Burke talked about the next important graze coming up in early March. A fairly bright star (9th magnitude) will be occulted by an asteroid; however, there will be a full moon at the time, only about 30^{o} away.

Doug George closed the meeting at 10:23, when everyone was offered refreshments.

* * *

CENTRE MEETING - JANUARY 22 Sandy Ferguson

Mr. Ken Tapping of the Herzberg Institude of Astrophsics, National Research Council (and RASC member) spoke to the Centre on Tuesday, January 22, 1985 about his work with solar flares using radio astronomy. About 25 persons attended the talk, many of whom were non-members.

In his talk, which was accompanied by a series of slides, Mr. Tapping began by explaining the phenomenon of a solar flare, the largest explosion in the solar system, and mentioned that the mechanism of a flare is not fully understood by astrophysicists. As we understand it, energy is produced in the sun's core, which works its way outwards to the photosphere, where it appears as sunspots. Magnetic looped structures appear in which stress builds up due to the twisting of magnetic field lines, storing energy, and at some point instability results, causing a redistribution of strain and resulting in a tremendous explosion. When this energy is released, radio and x-rays are emitted and electromagnetic particles called the "solar wind" are ejected outwards and reach the earth, creating aurora. In an analogy, Mr. Tapping compared the twisting and tangling motion of the magnetic field lines to that of elastic bands on a cranked machine, building up stress, until at some point one band snaps. At this point the stress is

redistributed, breaking other bands - the "explosion". What needed to be understood was how the first "snap" occurred.

The idea of an experiment to study solar flares via radio astronomy came about one day after intense discussion in a canoe on Lake Traverse, near the Algonquin Radio Observatory a few years ago! It was decided to use an interferometer, that is, two antennae some distance apart, as a VLBI, to increase the sensitivity to detail on the sun's surface. The use of Canadian facilities was not practical as the distances between the antennae were too great (Penticton, B.C. and ARO), so use of European facilities was requested. They managed to get antennae in Onsala, Sweden, and Dwingelloo, near Utrecht in the Netherlands.

A slide presentation followed, showing the observatory and equipment at Dwingelloo and Mr. Tapping described the unique way in which they mounted the 18-cm receiver onto the dish to be used for the experiment. He also gave a brief travelogue of the Dutch countryside, which he and his family enjoyed during their 3-month stay. He mentioned that his observations of the many windmills in the country gave rise to a puzzling question on aerodynamics - why to the windmills always turn counter-clockwise?

At the conclusion of Mr. Tapping's talk, the audience participated in a question period.

* * *

ASTRONOMY AND WINTERLUDE Sandy Ferguson

Yes, Virginia, Astronomy has a place in Winterlude!

On the weekend of February 10/11, the Ottawa Centre of the RASC was invited to join the National Museum of Science and Technology in providing a display of our activities and, if weather permitted, an observing session on Saturday evening, for participants in a cross-country ski marathon and other members of the public.

As Saturday evening was overcast, the observing session was cancelled. Someone, however, failed to inform the two members from the Science and Technology Museum, who dutifully turned up on the terrace of Maison du Citoyan with their 3 1/2-inch Ouestar. Good thing they did, because the sky cleared for about an hour and Michel Lebrecque and Ian McCord had an opportunity to draw the public's attention to Venus, M 42, and the Pleiades.

On Sunday we set up our Centre's display alongside the Museum's in the large central area of Hull City Hall. From 9 am to 4 pm, while skiers and others munched brunch around us, we dispensed astronomical information, primarily in the form of brochures and leaflets from the Museum, and fielded questions on Halley's Comet and the Space Shuttle, two popular and timely subjects. There was a good deal of interest, too, in the three telescopes on display and visitors spent the day observing such wonders as upside-down photographs of Hull City Council hanging on a far wall, light bulb filaments, and Winterlude banners on an adjacent street. We also received a request from the coordinator of a children's summer camp to organize a summer star night at the campsite north of Hull for approximately 200 campers. All in all, it was a full day!

Organizing and setting up a display such as this one can be very time-consuming. The time spent, however, is always worthwhile as activities such as this heighten the Centre's profile with the public, which nearly always results in new members, who benefit the Centre by bringing with them their enthusiasm and love of the stars.

Thanks go out to everyone who helped out - Ken Tapping, Doug George, and Brian Burke for arranging for pick-up, transportation and delivery, and return of display material to and from City Hall, and Michel and Ian from the Museum for their translation services. A special thank-you goes to one of our new members, Alain Lortie, who turned up at (what seemed to be) the crack of dawn on Sunday to donate his muscle power and linguistic ability for the day, as well as his telescope and knowledge of Astronomy.

* * *

Sandy has included this note, and we join her in her congratulations:

"Best wishes go out to John Molson and Jenny Gadd, Observer's Group members who were married on December 29, 1984. Peace, live long, and prosper!"

* * *

FOR SALE: A 10-foot Fibreglas observatory dome, manufactured by Observa-Dome. Contact Karl Hafner, Physics Department, Carleton University, 231-7165. To be replaced by a larger dome at the university, available late April.

SUNSPOT CLASSIFICATION Linda Meier

At the last meeting I provided some Handbooks for Solar Observing. One part that was not fully explained was regarding the sunspot classification system. In the September-October, 1984 issue of **Regulus**, the Kingston Centre Newsletter, a descriptive explanation of the letter classes was included, and they are reprinted here for your information:

A - A small single spot or group of single spots with no surrounding penumbra.

B - Similar to A, but the spots show definite association with one another or definite formation or pattern.

C - A bipolar group in which one of the major spots or the largest spots are surrounded by one penumbra.

D - A bipolar group in which the larger major spots are surrounded by penumbras.

E - A large bipolar group (larger than 10^{o} across) with the major spots having penumbras and with smaller spots between them, sometimes also having penumbras.

F - A large bipolar group (larger than 15^{o} across) with major spots having penumbras and also with small random spots.

G - A large bipolar group (larger than 10^{o} across) but without the small random spots.

H - A large major spot surrounded by a penumbra with small single spots nearby (larger than 2.5^{o}).

I - A single spot with a penumbra (smaller than 2.5^{o}).

If you have any questions please call me anytime at 820-5784 or speak to me at the Observer's Group Meetings.

* * *

Articles for the April issue of **Astronotes** are due by April 1 at the latest. Note that the Observer's Group meeting will be on April 12, due to Good Friday on the 5th.

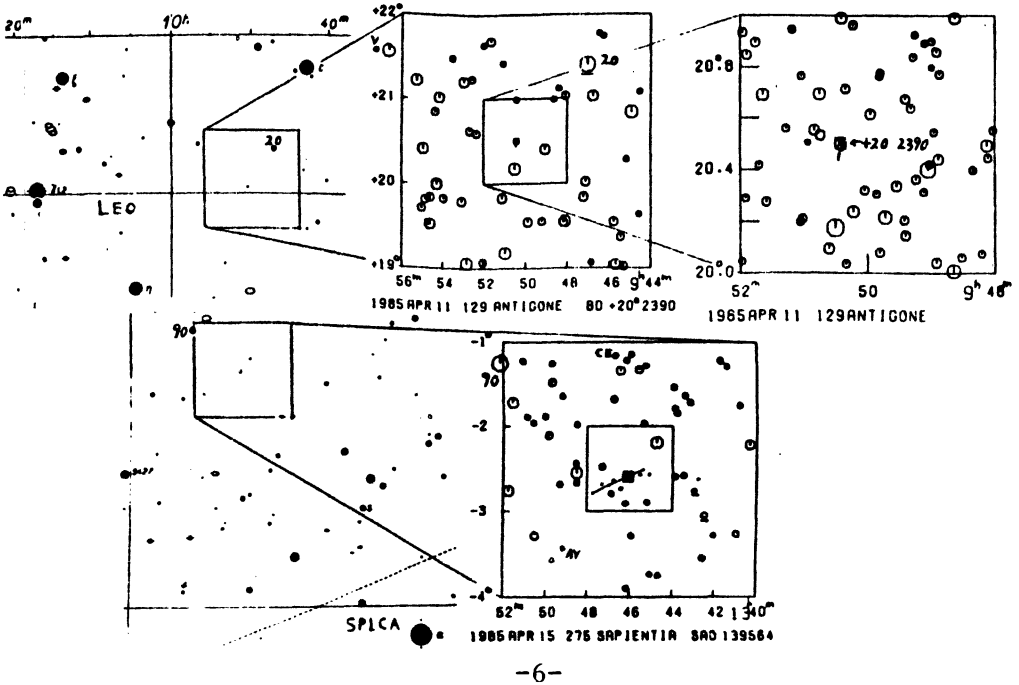
ASTEROIDAL OCCULTATIONS IN APRIL Brian Burke

There will be two occultations by asteroids in April that could be visible from Ottawa. The details for these events are as follows:

Occultation 1
date: Wednesday, April 10, 1985 time: 22:33 EST
duration: 84 seconds
star's magnitude: 10.5
star's position: RA 9h 50.4m Dec 20° 30' (1950.0)
asteroid's magnitude: 11.5 (129 Antigone)
magnitude change: 1.4

Occultation 2
date: Sunday, April 14, 1985 time: 21:19 EST
duration: 12 seconds
star's magnitude: 6.8 (SAO 139564)
star's position: RA 13h 46.1m Dec -2° 36' (1950.0)
magnitude change: 4.9

Use the finder charts below to locate the star a few days before each event and use a tape recorder and a CHU radio to record your observations. The recommended minimum telescope aperture for the first occultation is 10 cm and for the second, 3 cm.



INEXPENSIVE PHOTOMETER FOR AMATEUR ASTRONOMY Fred Lossing

Under the above title, Rob Dick, Art Fraser, Doug Welch and myself published a description and circuits for a simple photoelectric photometer in the **RASC Journal**, Vol. 72 No.1 in 1978. The weakest point in this instrument is the 1000-volt power supply for the photomultiplier tube. This supply was "regulated" by a chain of 5 zener diodes. The operating voltage of zener diodes is temperature-dependent, and the use of 5 of them in series multiplies this variation. Since the gain of the 1P21 photomultiplier is approximately proportional to the 7th power of the dynode voltage, variations in ambient temperature can cause fairly large changes in output current, thereby introducing serious errors in star magnitude readings.

The problem can be eliminated by use of a regualted power supply, similar to that designed by Ralph Boyd and described in chapter 5 of the book **Photoelectric Photometry of Variable Stars** by Hall and Genet. I have built this circuit, which, with minor changes and redrawn for greater clarity, is shown in the accompanying diagram. The etched circuit board configuration I used is also shown.

The 400-volt transformer feeds a voltage doubler, giving an output of 1160 volts at a line voltage of 118 vac. Increasing the filter capacitors above the 0.47 uF shown brings no improvement in output or ripple. The controlled voltage is 1160 minus the drop across two 2N2439 transistors, whose bias is controlled by the output of the LM301 IC. This circuit is a differential amplifier, which compares the regulated dc output at pin 3 with the voltage at pin 2 set by the zener and the 5k trimpot. The output voltage can be varied over a range by this pot. The circuit loses control if the drop across the 2 transistors becomes less than 35 volts. For instance, if the ac line voltage falls below 100 volts (as could happed if the ac were supplied by a battery-driven oscillator at a remote site) the dc supply to the regulator will fall below 1000 volts, and the regulated output cannot be maintained above 965 volts dc. For line operation, the pot can be set to give a regulated dc output of 1000 to 1050 v. Over a line voltage of 108 to 120 vac, the regulation is good to 1 v.

It is true that the output stability depends on the temperature coefficient of the reference zener, but at least it is only 1 zener, not 5 in series as before.

The low-voltage ±15 v supply shown replaces the ± 7.5 supply of the Journal article, without any other changes.

ASTRONOTES INDEX

Frank Roy has been ambitious enough to compile an index to **Astronotes** for 1980 to 1984. The last index appeared in the 1979 issue. Thus, all volumes back to 1970 are now fully indexed. Frank's work will be appearing in the centre pages for the next few issues, so that you may remove them and append them to the appropriate volume of **Astronotes.**

Thanks, Frank!

* * *

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MARCH CENTRE MEETING

Speaker: Mr. Jeffrey J. E. Hayes, Department of Physics and Astronomy, University of Maine at Orono

Topic: Observations of Double Elliptical Galaxies

A number of double elliptical galaxies have been studied using CCD (charged-coupled device) direct imaging and spectroscopic facilities at the Kitt Peak National Observatory. The use of CCD's gives one the ability to detect interesting faint structures that have either never been seen before or seen very imperfectly using photographic techniques. Some of the implications of the ongoing work will also be discussed.

Date and Time: Wednesday, March 20, 1985 at 8:00 p.m.

Place: Auditorium of the Museum of Science and Technology, St. Laurent Blvd. and Russell Road

NOTE: Jeff is a former Ottawa Centre member and is now a member of the Halifax Centre.

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APRIL CENTRE MEETING

Speakers: Members of the Observers' Group

Topic: Activities and Projects of the Observers' Group

The Observers' Group will be the host of this month's Centre Meeting. The Chairman, Doug George, will introduce members of the Observers' Group who will present talks on observations they have made and projects they are working on. Many topics in amateur astronomy will be covered by the presentations.

Date and Time: Friday, April 12, 1985 at 8:00 p.m.

Place: N.R.C., 100 Sussex Drive, Room 3001

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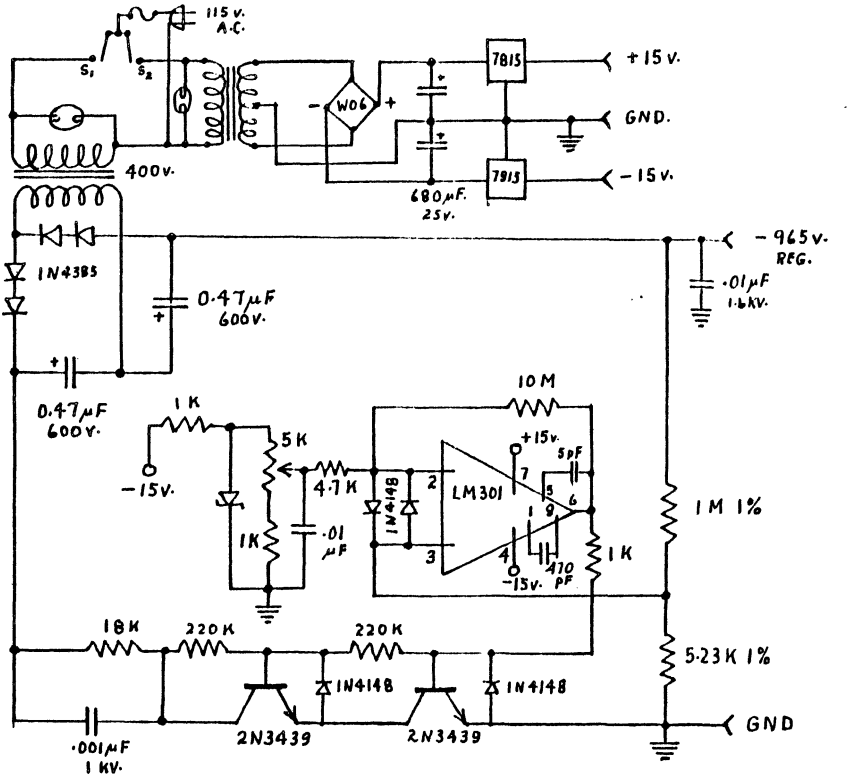
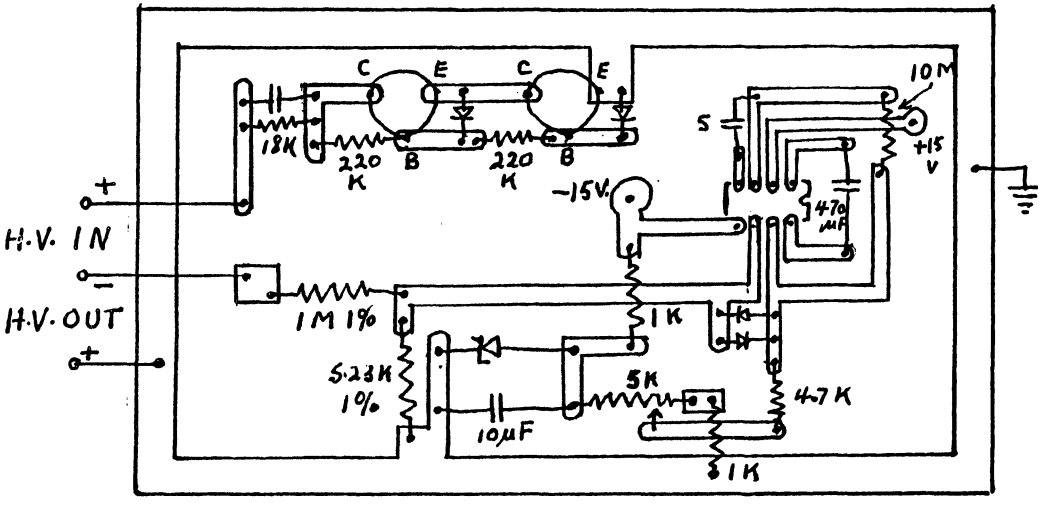


High voltage regulator circuit.



Foil pattern for high voltage regulator. (bottom view)

During my last year in Engineering at the University of Toronto, I designed a computer-controlled telescope guiding system for my undergraduate thesis. The major difficulty in designing such a system is the sensor unit. This system uses a photomultiplier tube for high sensitivity. Unfortunately, such a tube gives no indication of the position of a star within the image.

A position measurement in two dimensions was made possible by using a rotating disk (figure 1). When an edge of the disk covers half the field, it is at exactly 45 degrees from the vertical (figure 1A, 1D). Note how the leading and trailing edges are at 90 degrees with respect to each other. Due to the dimensions of the disk, the variation from exactly 45 degrees as the edge travels across the field is quite small. The result of this is the appearance of a straight edge cutting across the field at +45 degrees as the field is covered, and -45 degrees as the field is uncovered.

Now suppose a star were to be at the exact centre of the field. The star will disappear when the disk is a a certain angle, say angle "A", and reappear when it is at an angle "B". We can calculate two numbers "X" and "Y" as follows (using the radius of the disk in millimetres as RO):

```
X = (A + B) * RO / 2 - D
Y = (A - B) * RO / 2 - C
```

The constants C and D are chosen to make the X and Y zero when the star is at the exact centre of the field. If the star moves 0.1 mm to the right (at the image plane), angles A and B will both increase, giving an X of 0.1 mm. If the star moves up by 0.1 mm, angle A will increase, and B will decrease, resulting in a Y of 0.1 mm. Thus, an X-Y position can be determined, and the telescope's motors can be activated to correct for any deviation of the star from the exact centre of the field.

The next problem is how to measure the angle. The computer will see a light curve such as that shown in figure 2 as the star disappears. With a bit of tricky programming, the computer can find the point at which the light curve drops steeply. This will be taken as the disappearance point. If the disk's exact speed is known, the time at which the star disappears can be used as a

measure of the angle. In order to facilitate this, the disk is turned by a synchronous motor. The speed of such a motor is determined by the frequency of the power line. If the computer samples the light curve once per cycle of the line frequency, the motor and the computer will remain in exact synchronism. Thus any change in the time of disappearance must be related to a change in the position of the star. With the prototype system, positions can be measured to within 0.072 mm.

Prototype Construction

A block diagram of the electronics is shown in figure 3. The computer's internal timer is connected to the power supply of the disk motor to maintain timing accuracy. The output from the photomultiplier tube is amplified, filtered by a low-pass (to prevent a sampling error called "aliasing"), and converted to a digital output. The output is read by the computer 60 times a second. The computer calculates the required motor adjustments, and operates the motors on both axes to correct the error. The Right Ascension axis has synchronous motors, requiring a variable-frequency generator with an output stepped up to 120 v. The declination motors are simply switched on for a calculated time.

The circuitry is shown in figures 4 to 8. Figure 4 shows the -1000 volt power supply, which uses a simple voltage doubler and zener diode regulator. Figure 5 shows the amplifier cicuitry, which includes an ultra-stable log converter which may optionally be switched in if the photometer circuit is used for star intensity measurements. Figure 6 shows the analog-to-digital converter, which is based on a digital-to-analog converter driven by the computer. The computer determines the correct voltage using a simple binary search. The speed of conversion is high enough that a sample-and-hold circuit is not necessary.

The motor control cicuitry consists of a crystal-controlled oscillator and voltage inverter, as shown in figure 7. The crystal frequency is divided down by a chain of counter chips, before it drives two power transistors. A reversed power-supply transformer steps the voltage up to 120 volts for the synchronous drive motors. The frequency of the output voltage is determined by the factor by which the counter chain divides the crystal frequency. This is controlled by the output of a read-only

memory shown in figure 8. A number is entered into the memory corresponding to the desired output frequency. The memory converts this into a pre-load number for the divider

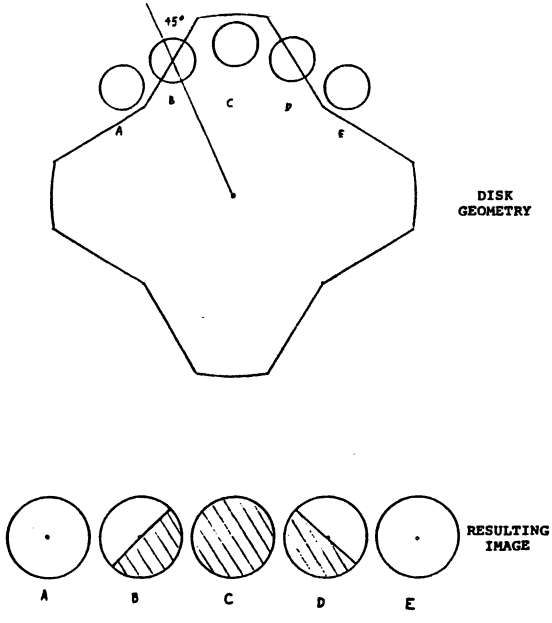


Figure 1. OPERATION OF SCANNING DISK

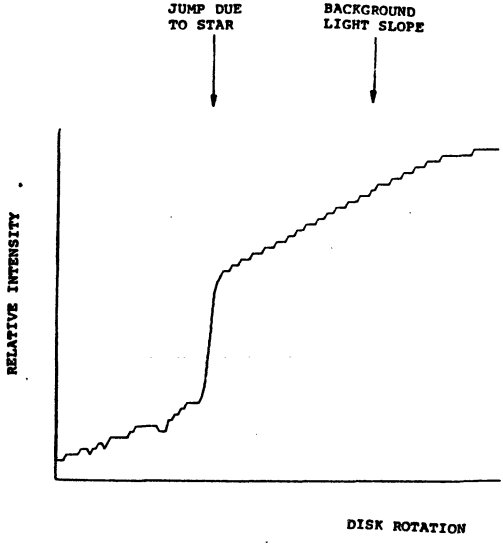


Figure 2. PLOT OF ACTUAL SYSTEM OUTPUT UNDER HIGH BACKGROUND LEVEL CONDITIONS

chain to generate the correct frequency. Changes in frequency are instantaneous, with no lock-up delay or glitches which some phase-locked-loop designs are prone to. There is also a simple declination motor control circuit, which can turn the motors on in either direction. Note that this circuit includes manual controls, and that it can be used by itself, without the computer, as an ordinary clock-driven oscillator. In fact, the prototype is often used in just such a manner. The cicuit is quite inexpensive to build, and I can program the memory for

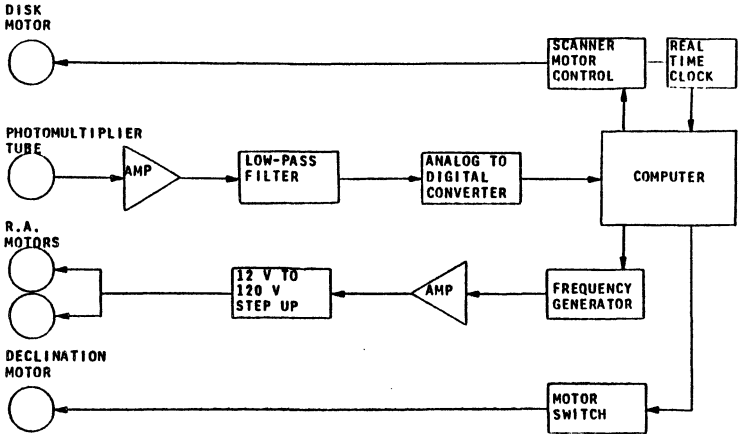


Figure 3. SYSTEM BLOCK DIAGRAM

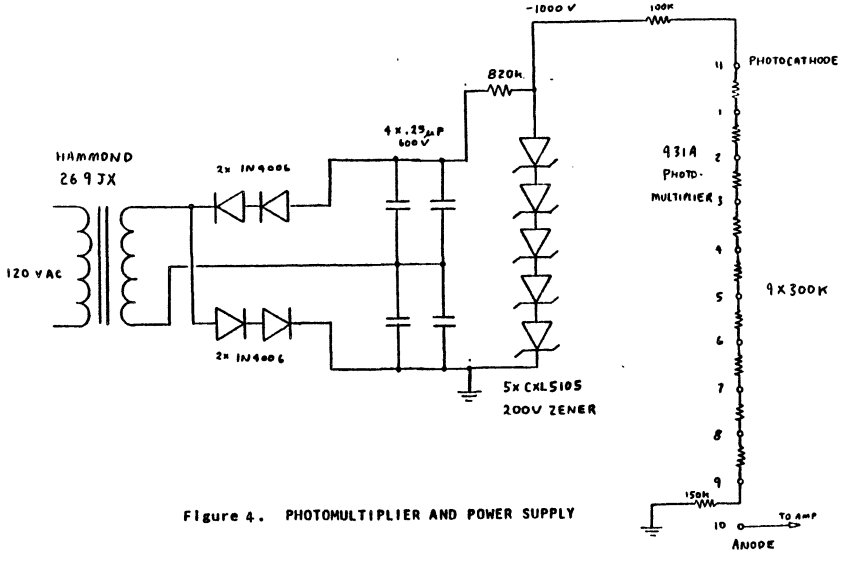


Figure 4. PHOTOMULTIPLIER AND POWER SUPPLY

anyone who wishes to use it as a clock-driven oscillator.

According to my experiments, the prototype can track accurately enough to take a correctly guided astrophoto. Unfortunately, to date, I have not had a chance to try the guiding system out on an astrophoto, as the system at present takes some time to set up, and I have been too busy. I plan to try the system after the snow melts - it's a bit hard to carry the equipment down the road to the observatory through all that snow!

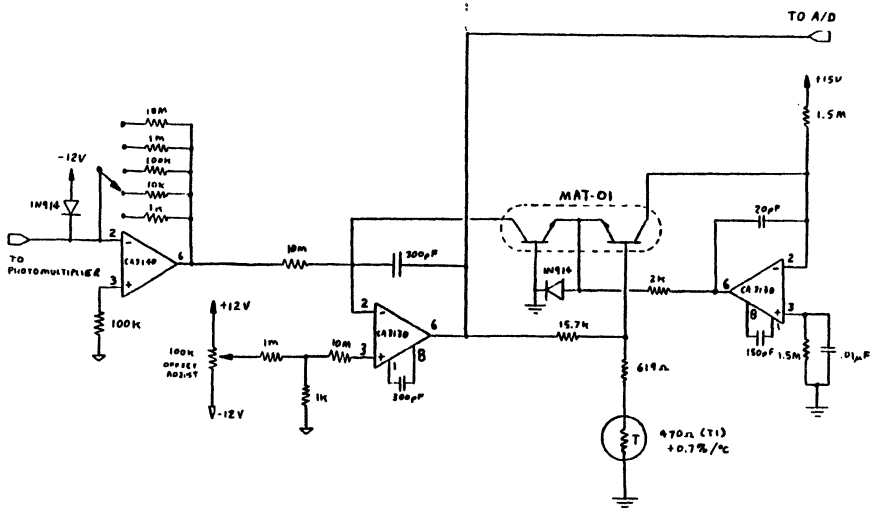


Figure 5. AMPLIFIER AND LOG CONVERTER

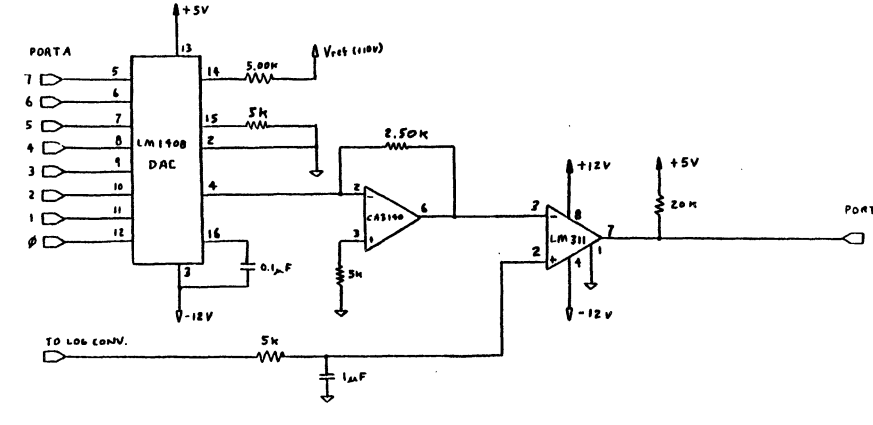


Figure 6. ANALOG TO DIGITAL CONVERTER

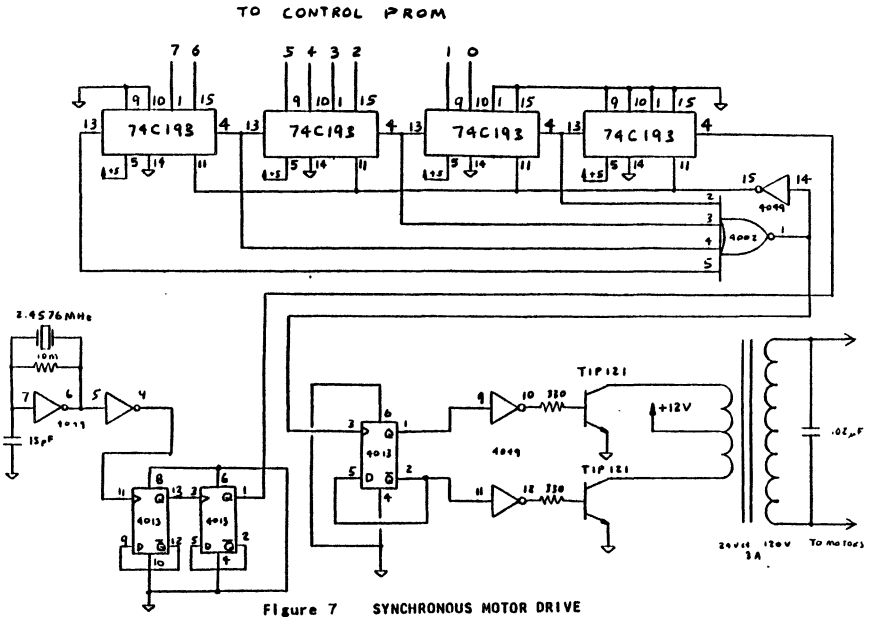


Figure 7 SYNCHRONOUS MOTOR DRIVE

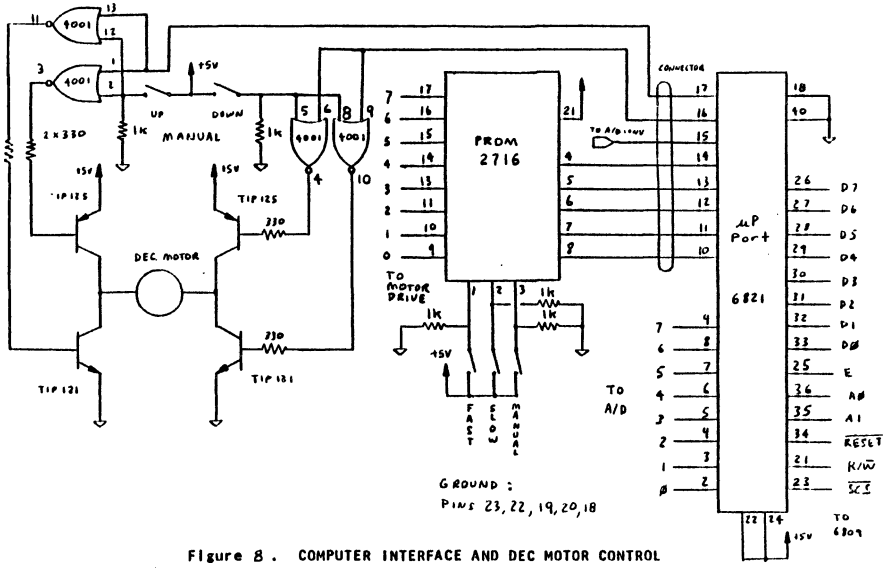


Figure 8. COMPUTER INTERFACE AND DEC MOTOR CONTROL

ASTRO NOTES

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