QEX 47

January 1986

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The ARRL Experimenters' Exchange

ARRL Digital Committee Get-together

The ARRL Ad Hoc Committee on Amateur Radio Digital Communication met at HQ on Dec 7-8 to work on packet-radio issues.

First, you should know where packet radio stands. On April 28, 1985, while waiting for our planes to leave the Dayton airport, the gang from Tucson Amateur Packet Radio (TAPR) and I passed the time by counting up terminal-node controllers (TNCs) sold at that time: 4000. We estimated that by April 1986 as many as 10,000 would be sold by all manufacturers. Surprise! A total of 10k was reached in December 1985 according to a rough count at the Digital Committee meeting. That's 857 per month over 7 months, which at the end of April 1986 extrapolates to 14,284!

It's easy to understand why the #1 problem facing amateur packet radio is congestion. Some local areas have gone from no packet radio to a congested digipeater in six months. Until recently, the common belief was that the main hang-up was the lack of an agreed networking protocol. Wrong-O. The added overhead of a networking protocol and a companion transport protocol would put an already congested 1200-baud system into cranial arrest.

The Committee reviewed steps taken to move some of the intercity traffic to 9600-baud operation, for example the K9NG modem. But with the present growth rate, an 8:1 increase in speed (which can't be realized because of fixed equipment turnaround time and propagation time) buys us only another year or so. It was readily agreed that we need to move to higher speeds, such as 56 kbit/s. What is lacking is a "data radio." There appears to be nothing on the market within our price range that will satisfy our needs. Also, it is unrealistic to expect industry to solve this one for us because it's financially risky business. Affordable commercial data radios will come, in time, but Amateur Radio experimenters with a combination of digital and RF/analog design capability need to demonstrate a capability. We, as amateurs, need to work out the standarization issues, too.

WANTED: "Father or Mother of Data Radio" to step forward and accept this challenge. Here's what the Digital Committee thinks would be a starting point for a new design to make use of transverters:

Data Interface Requirements: Received data (RXD), transmitted data (TXD), X1 receive clock (RXC), X1 transmit clock (TXC), and data carrier detect (DCD) in either TTL or RS-422 levels.

RF Interface Requirements: 28 MHz in and out, 10-50 mW clean output, 50-ohm impedance, capable of 56 kbit/s, transmit bandwidth (at -26 dB) not to exceed 100 kHz, capable of full duplex.

If you think that you're the person with the design capability to solve this problem please call Paul Rinaldo, W4RI, at 203-666-1541 (daytime). This, of course, is not the end of the line; we expect to see a move to even higher speeds (ie, 1.5 Mbit/s), particularly for intercity networking in densly populated areas of the country.

What about the networking-protocol issue? There are three candidate protocols being considered by the Committee: (1) virtual circuit (VC), based on CCITT X.25 packet-layer protocol, (2) datagram (DG), based on ARPANET TCP/IP, and (3) a new VC protocol based on Recommendation Q.921 in the CCITT Integrated Services Digital Network (ISDN) suite. Howie Goldstein, N2WX, has written code for a VC protocol, and Phil Karn, KA9Q, has written code for large parts of TCP/IP. Neither protocol was ready for demonstration at the Digital Committee meeting but is expected to be unveiled on March 9 at the Fifth ARRL Amateur Radio Computer Networking Conference in Orlando, FL. -- W4RI

Correspondence

ACSSB Board Available

Several months ago I purchased the ARRL's kit for the Sideband Technology ACSSB transceiver. Since then, I have not had time to do anything with the circuit boards, although reading the excellent technical manual was valuable. My lack of time to experiment is also hampered by the fact that if the boards were operable, there is no one nearby with whom to check my handiwork. If you are interested in purchasing the boards, please contact me. Price is $30 for the boards and manual. I'd hate to see them sit and collect dust. — Clifford J. Appel, WB6AWM/7, 2021 Applegate #8, Philomath, OR 97370.

Interested in EMP?

Want to read more on the subject of electromagnetic pulse (EMP) and what effect it may have on electronics and Amateur Radio? The following is a list of resources supplied to me compliments of Nickolaus Leggett, N3NL. As Nick states, "There is a great deal of literature on EMP that can be located by searching the on-line engineering data bases. Unfortunately, this material does not directly address the problem of shielding civilian communications from EMP." This might be an area for study by the amateur community.

Federal Emergency Management Agency (FEMA),
EMP Threat and Protective Measures, 1980,
19 pages, GPO item no. 216-A-5

William J. Broad,
"Nuclear Pulse," **Science**,
May 29, June 5, June 12, 1981

P. R. Miller,
"Engineering to Counter the EMP Threat,"
Radio and Electronic Engineer
(ISSN 0033-7722)
Vol. 53, Nov. - Dec. 1983,
pp. 387-392

National Academy of Sciences - National Research Council (Committee of EMP Environment),
Evaluation of Methodologies for Estimating Vulnerability to Electromagnetic Pulse Effects,
National Technical Information Service (NTIS),
1984 111 pages (NTIS N84-34663)

P. R. Barnes et al,
Nuclear Electromagnetic Pulse (EMP) and Electric Power Systems,
Oak Ridge National Lab - U.S. Dept. of Energy,
April 1984, 68 pages,
NTIS DE 84 010665

Rabindra N. Ghose,
EMP Environment and System Hardness Design,
Don White Consultants, Gainesville, VA
(703-347-0030)

Bruno M. Kalab,
Damage Characterization of Semiconductor Devices
For AN/TRC-145 EMP Study,
Dec. 1980, 110 pages,
NTIS AD-A095 021/2

Hard copy from:

NTIS
U.S. Department of Commerce,
5285 Port Royal Road,
Springfield, VA 22161

Two articles should be mentioned here. One appeared in the August 1981 issue of **QST** on page 44. Written by Robert Hendrickson, AG3U, it is entitled "Nuclear Weapons Effects on Communications Systems." Back issues can be purchased from the ARRL at a cost of $2.75. The other is called, "Communications and Nuclear Explosions," by M. J. Darby. It was published in the August 1985 issue of **Practical Wireless** on page 19. -- KA1DYZ and Nickolaus Leggett, N3NL, 1500 Mass. Ave., N.W., Apt. 610, Washington, DC 20005.

IEEE Vehicular Technology Conference

Yes, and it's happening at the Anatole Hotel in Dallas, TX during May 20-22, 1986. Papers presented will feature information on digital communications, mobile radio and data systems, cellular radio, satellite and computer communications, and just about anything else that involves electronics in vehicular technology. Want more information? Contact Stuart Meyer, E. F. Johnson Company, Suite 907, 1601 N. Kent St., Arlington (Rosslyn), VA 22209.

VHF Communications Returns to America

At a new low price you can subscribe to **VHF Communications**, a German publication now made available in English to the United States and Canada. Published four times yearly, the articles include information on building state-of-the-art equipment for VHF/UHF and microwave use. A new subscription sells for $19 per year. Back issues for 1969 to 1985 can be purchased at $18 for the complete year. Ordering information can be obtained by writing **U V Comms**, P. O. Box 432, Lanham, MD 20706.

Writing Pictures Into the Apple HIRES Screen From A Deskfax Machine

By W. Conley Smith, K6DYX
67 Cuesta Vista Drive, Monterey, CA 93940

To do anything useful with a computer, you simply need the right peripherals. If you have what is required, the computer can perform interesting tasks. This article tells of how I used homemade peripherals to copy pictures mounted on the drum of a small deskfax or TELEFAX machine (as Western Union calls it), and display them in the HIRES screen of an Apple computer.[1] The machines were surplus a long time ago so you may find one at a flea market.

Modification of the machine for my use involved changing the output signal from amplitude to frequency modulation. I discarded the motor, its light chopping wheel, and the associated phototube. I replaced them with a small circuit board that uses a solid-state photocell, one stage of dc amplification and a voltage-controlled oscillator (VCO) See Fig. 1.

The circuit board mounts conveniently on the boss that held the light chopping motor. The solid-state photocell is mounted snugly behind the pinhole on which the reflection from the drum is focused. Little or no change is needed for the optical system. The leaf switch, which is activated by a screw on the rotating shaft, should be modified if necessary so it is normally open if the 74121 one-shot shown in the circuit diagram is wired as I have it. This provides the positive going sync pulse. I used an MC7424 VCO, but a 555 works equally well. Provision is made for adjusting the absolute value of the frequency and the frequency deviation caused by the brightness of the light reflected from the copy being scanned. The absolute value of the frequency is not important. I get something in the neighborhood of 20 to 30 kHz. The square-wave signal from the VCO and the sync pulse are buffered by a 7404 and sent to the computer through a 6522 Versatile Interface Adapter (VIA). More information on how I modified the deskfax machine can be found on page 7.

The VIA

An interface adapter (Fig. 2), would seem an absolute must for anyone connecting from the computer to the outside world, and the 6522 is certainly versatile. I show the circuit's schematic in Fig. 3. It has two ports which can be converted for either input or output. For my program I have it plugged into slot no. 7. Configuring the 6522 for a particular application requires some study because of its versatility. It is enough to say that in this case it detects and responds to the sync pulses and controls the time during which it will open a "window" and count the pulses coming from the VCO on the facsimile machine. The number of pulses counted is then a digital indication of the brightness of the spot or area on the drum during the window time.

The Scanning Drum

The drum of the deskfax machine is about 2 1/4 inches in diameter and is turned by a synchronous motor at 3 rps. It will hold a copy about 4 1/2 by 6 inches, but because of mechanical limitations, it scans only a space about 3 3/4 by 6 inches, enough for a telegraph blank. It takes 2 1/2 minutes for a complete scan. In order to get the right aspect ratio, it is necessary to get the brightness digits from every third rotation if the complete length of the picture, around the circumference of the drum, is scanned. If every other rotation is scanned, and the window time adjusted accordingly, a larger display results, but it comes from an area only about 4 1/4 by 3 1/3 inches on the picture. If every line is scanned and the window time adjusted accordingly, the display is enlarged still more coming from an area only 2 by 2 inches on the picture. Fig. 4 shows examples of three pictures received at different settings.

One of the computer programs available from the author on diskette processes the digital values of the brightness counts and displays an image of the picture on the HIRES screen.[2] It may then be dumped to a printer or transmitted by radio using a modified radioteletype program which I described in last month's **QEX.**

The Computer Program

The machine language program that does the work is called by a BASIC program. The BASIC program gives instructions and allows you to choose a picture size. It pokes in the appropriate bytes for your choice and calls the machine language program.

The machine language program displays a set of instructions on the screen while waiting for you to press a key. It then waits for the preset number of sync pulses (1, 2, or 3), and scans the drum once to get 280 bytes. Later, it stores the bytes in memory and calculates an "average" value that will be used as a break point.

The program now displays the break point while it waits for another key press. It will then instruct you to reset the drum for copying the picture. After this it will scan the drum for one rotation, obtaining the 280 brightness bytes to store in memory.

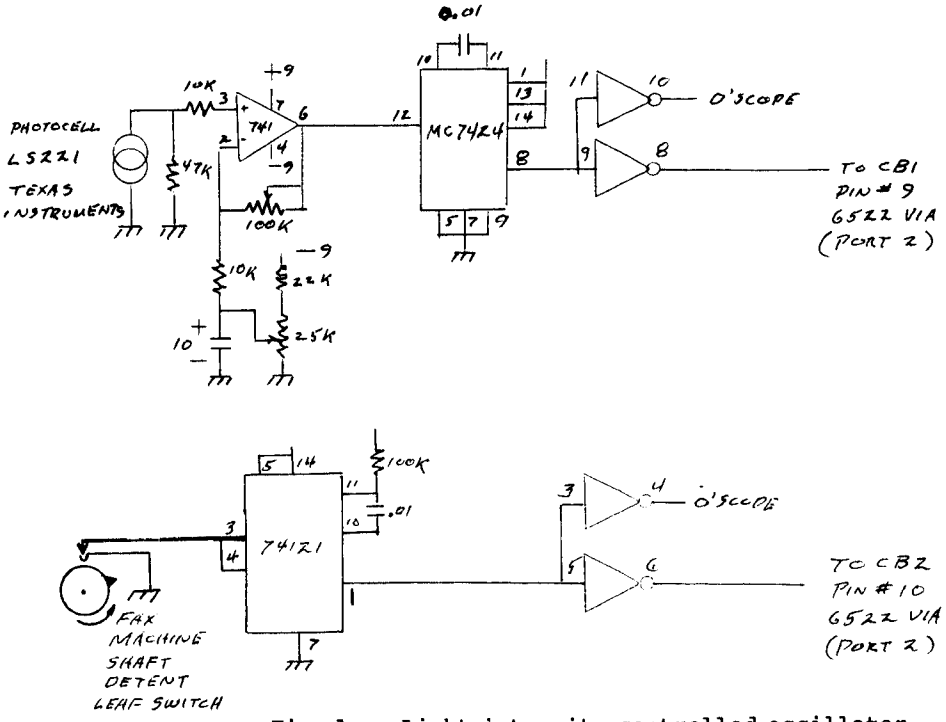


Fig. 1 -- Light intensity controlled oscillator and sync circuit for scanning a DESKFAX machine.

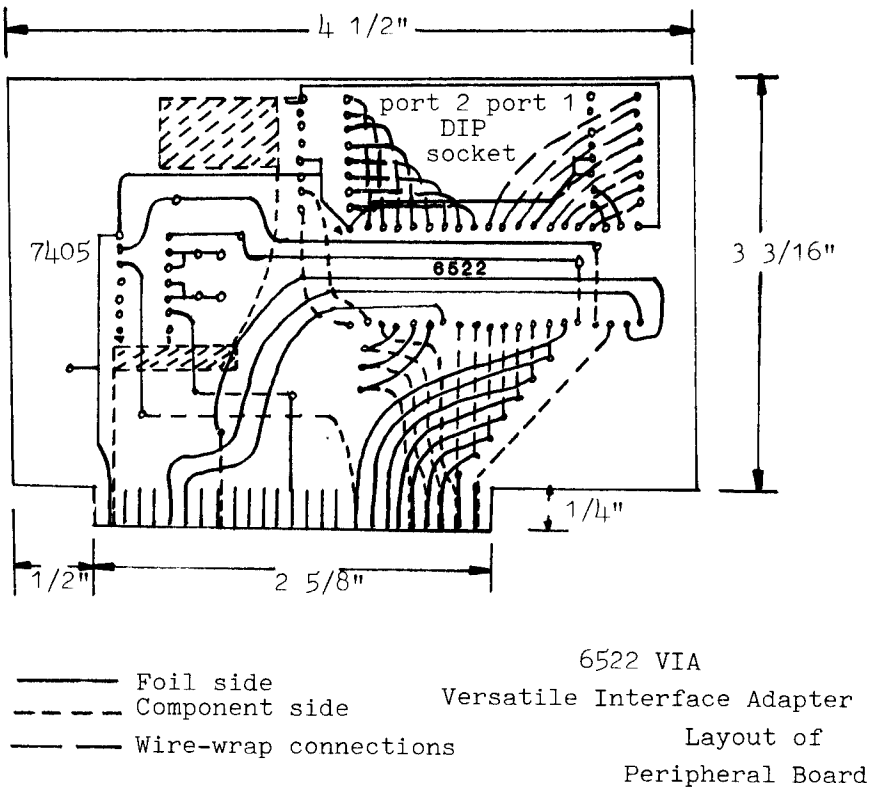


Fig. 2 — Assembly layout of the peripheral board for the 6522 VIA.

The program begins to process the byte (initially $ØØ) to be written in HIRES by taking a byte from memory and comparing it with the break point. If the byte is greater, it will write a logic (1) in a bit of the HIRES byte. If it is less, it will leave that bit a logic (Ø). The program repeats itself until it obtains seven brightness bytes from memory, writing (1)s and (Ø)s in the HIRES byte beginning with the LSB up to bit no. 7. It will check for an aborting key press. If there is none, it writes the processed HIRES byte in screen no. 1. It checks for 40 bytes so written. If not, you will have to go back to processing the byte. (Both the memory pointer and HIRES pointer are advanced after reading or writing.) If 40 HIRES bytes have been written, it calculates the next line for display on the HIRES screen. (The HIRES screen is interlaced.)

Check for the allowable number of rotations. Different size displays allow different limits. If the limit has been reached, abort. If not, then go back to scanning for one rotation to get 280 bytes of brightness for memory storage.

When the program is aborted, write white-causing bytes into the remainder of HIRES screen 1. What happens is the program scans about 90% of the circumference of the DESKFAX drum. All the brightness information has to be packed into 40 bytes since the HIRES screen is just 40 bytes wide. Then there are only 192 lines available on the HIRES screen whereas the drum rotates about 450 times to scan the length of the drum. So, for a "full-sized" picture, I have the program read the brightness on every third revolution. This results in the proper aspect ratio on the HIRES screen. That is to say, a square shape on the copy comes out looking square on the screen. However, I reach the end of the drum before 192 lines have been written on the screen. Therefore, the program fills the remainder of the screen with white. From here you return to BASIC.

Finally, the BASIC program asks if you are satisfied with your results. If not, it allows you to manually reset the break point and returns to the machine language program where it will wait for a key press. If you are satisfied, it will allow you to save the HIRES screen to DOS and terminate the program.

References

[1] "Notes On TELEFAX," by W. C. Smith, K6DYX, Dec. 1985 **QEX**, p. 3.

[2] I will be happy to supply a copy of the BASIC and machine language program to any interested party. Send a blank 5-1/4-inch floppy diskette and $10 to cover postage and handling fees to my address listed.

Newsletter Gets New Editor

Gateway, the bi-weekly newsletter that reports packet radio items, recently welcomed a new editor -- Ed Raso, WA2FTC. Jeff Ward, K8KA, who took part in the conception of this newsletter and was editor, left on a two year educational trip to England to take part in constructing the next UoSAT at the University of Surrey.

Ed is no newcomer to packet radio, computers, or even the ARRL. During 1983 he was the Assistant Club Program Manager with the former Club and Training Department. Ed will continue to bring you the latest packet breakthroughs through the pages of **Gateway**.

A subscription card for **Gateway** is inserted here for your convenience. We wish both Jeff and Ed well in their new assignments. — KA1DYZ

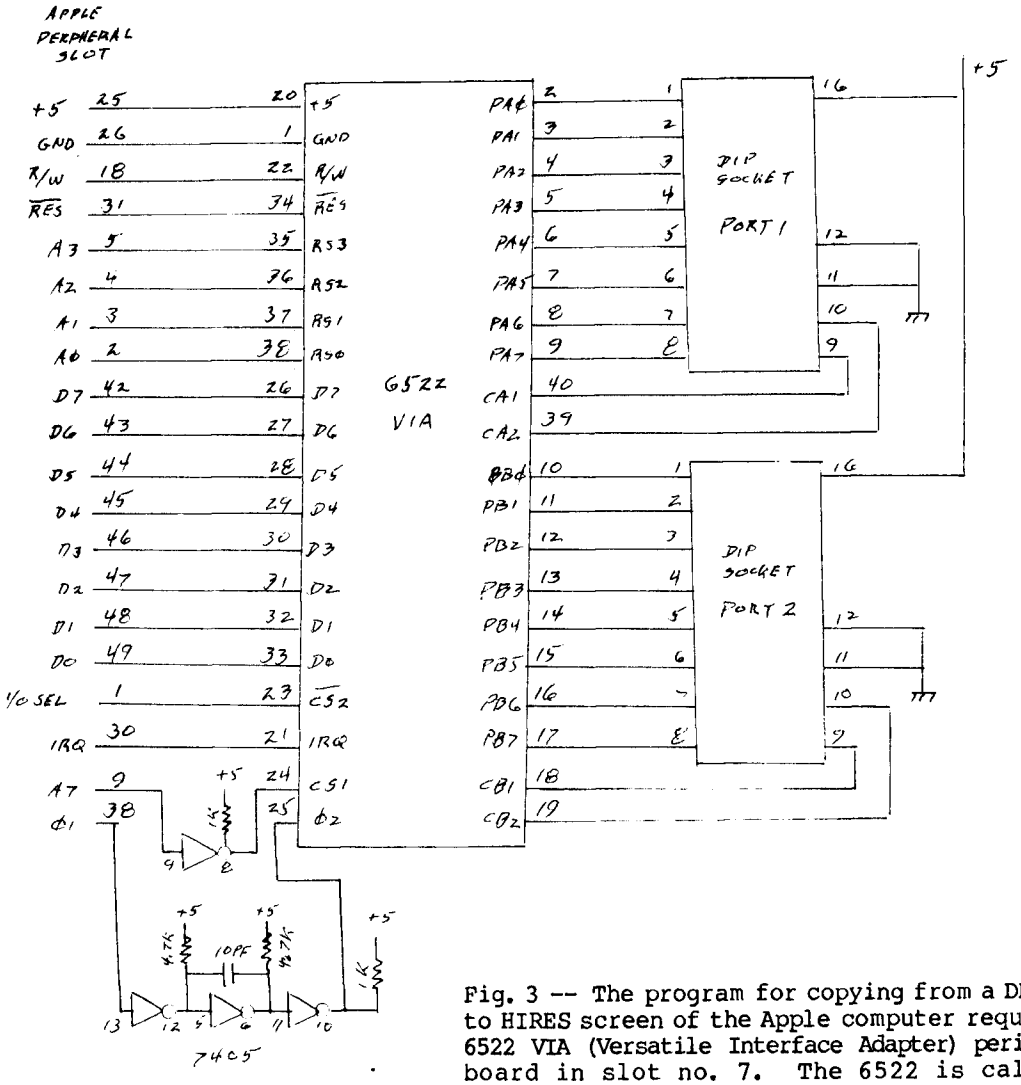


Fig. 3 -- The program for copying from a DESKFAX to HIRES screen of the Apple computer requires a 6522 VIA (Versatile Interface Adapter) peripheral board in slot no. 7. The 6522 is called a "family-type" chip because it interfaces easily with the 6502 microprocessor. It is truly versatile, having two 16-bit interval timers, two ports of 8 bits each which can be made either input or output, two control bits with each port and a four-bit shift register. It can be programmed to, among other things, accept information from an external keyboard, count time and frequency, provide interrupts for data recording and even operate a printer. No Apple should be without one!

In this application, the 6522 is programmed to time the opening of a gate and count the number of cycles produced by the photocell-driven VCO during the gate period. This results in digitalized brightness data. It also detects a pulse produced by the leaf switch on the DESKFAX to synchronize the drawing of the lines in HIRES screen 1. The two ports on the peripheral board are independent, but identical in action. We just happened to use port no. 2.

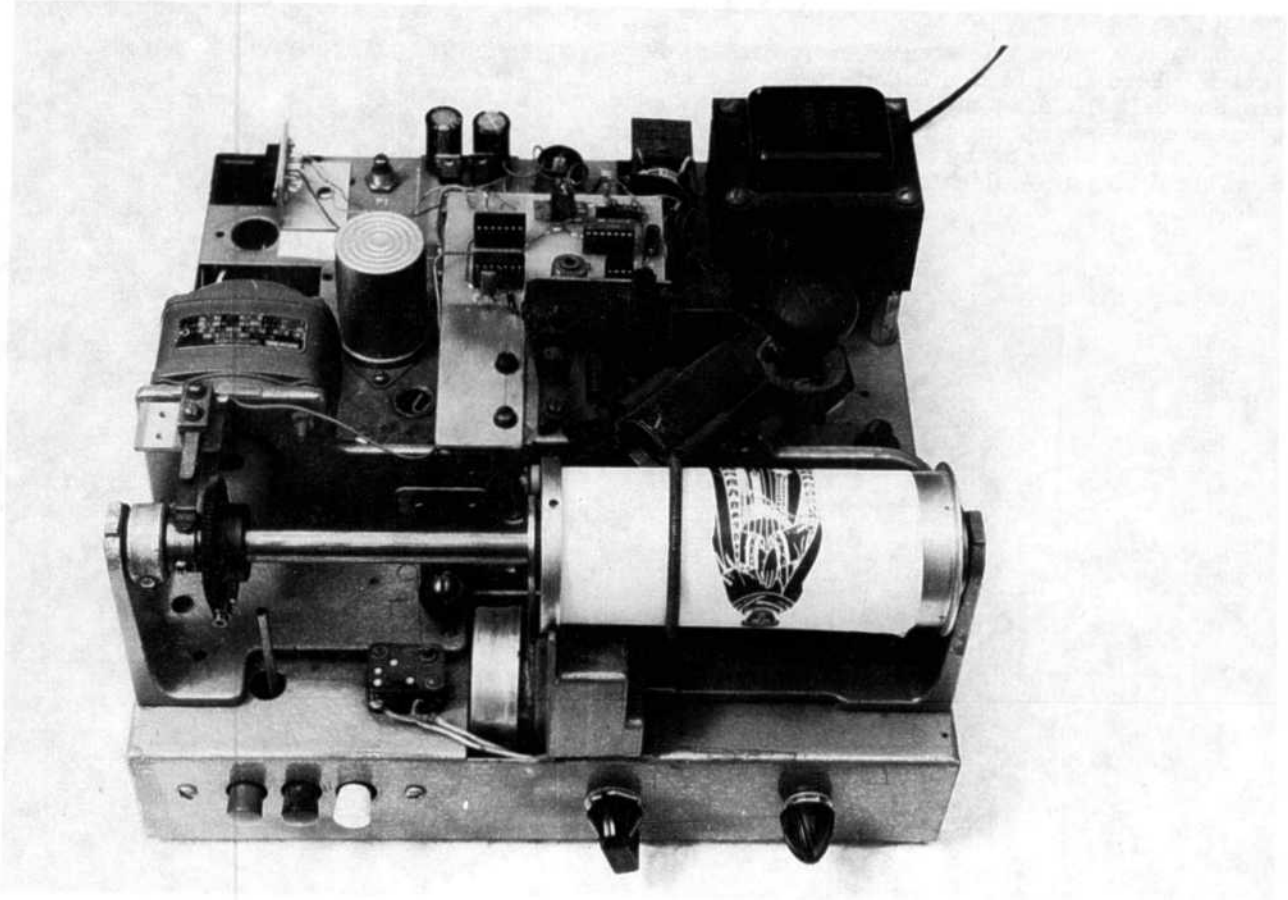
How to Modify Your Deskfax Machine for Operation

Now that you've read my article, let me tell you something about the deskfax machine. Referring to the photo below -- all vacuum tubes are removed as well as all relays, except the one marked PWR. The 6.3-V and 5-V winding of the power transformer are connected in series to supply a low-voltage power supply. Be sure to lift the center-tap ground connection of the 6.3-V winding. A small rectifier is mounted in an opening vacated by one of the relays to supply the + and - low voltages which are regulated by a 7812 and 7912. A +5-V regulator (7805) is mounted on the circuit board of the light-digitalizing circuit.

There are a lot of unused components left on the chassis, but because of the rat-harness nature of the wiring, it is safest to leave them in place. Cut only those wires to make the necessary connections to use in this application.

Of the three push buttons on the front of the chassis, only the white one and the read one in the center are used. The white button turns on the power and the read one is a mechanical release, also operated by the rod seen sticking up under the left end of the shaft, which shuts off the power. A three-position switch is mounted just to the right of the push buttons. Turning it to the first position causes the drum to rotate. In the next position, the drum continues to rotate and advances from right to left. Other controls visible in the photograph have no function in this application.

The circuit board for light digitalization is mounted on the boss which formerly held a light-chopper wheel and motor. The optical system is not modified, but a solid-state photovoltaic cell on the circuit board is mounted closely behind the pin hole on which the reflection from the drum is focused. See the schematic circuit diagram. The circuit board holds a 74121 one-shot multivibrator for debouncing of the leaf spring contacts, resulting in a syhnchronizing pulse. A 741 op amp is used as a dc amplifier of the signal from the photocell. The only adjustment is the dc level of its output to operate a 4024 VCO in its most sensitive range. Both the output of the VCO and the one shot are buffered by a 7404, although this is not deemed necessary. These outputs and a ground connection are carried to a 16-pin DIP socket mounted on the left rear corner of the chassis, from which connection is made by ribbon cable to port no. 2 of the 6522 VIA peripheral board in the Apple computer.



A

B

C

Fig. 4 — Three pictures of various size settings are displayed. A slight distortion of the aspect ratio can be detected as the face is enlarged.

At A, the picture is scanned every drum revolution. Here the picture is enlarged. B shows the approximate size of the picture. It was scanned every second drum revolution. At C, the scanning took place every three rotations of the drum, resulting in a slight reduction of the picture.

VHF+ Technology

Conducted by Geoff Krauss, WA2GFP
16 Riviera Dr, Latham, NY 12110

UHF Power Triode Bias Circuits

I am often asked, "Why don't you publicize more of your readers' problems so someone may suggest a solution?" I am ready to do so, but **you** have to let me know that a problem exists! If I can't find a reference or someone who can help, I can place it in my column.

One trouble spot concerns biasing a UHF amplifier with one of the 2C39/7289 class of triodes in grounded-grid operation. To bias such a circuit requires a positive cathode voltage with respect to the common-grid voltage. In the past, if you were operating in the primary mode (CW), the changing bias voltage occurring with a simple cathode resistor was found to be insufficient. It provided little compensation for the change in tube current that occurred as the tube element spacings moved with changes in power dissipation and tube temperature.

A better bias method was found by using a high-power Zener diode in the 5.1- to 15-V range. It would keep the bias voltage almost constant, even if the cathode current changed with "key-down" time. You could tune the amplifier to the approximate actual average temperature while sending a train of CW dashes. Of course, it often turned out that the approximation wasn't good enough, or that the best bias voltage was between standard Zener voltages, and so on. With this, a variable resistor was added in series with the Zener. The resistance was now much less than without the diode, and fairly good bias control was obtained.

With the arrival of SSB to UHF operation, amplifier linearity became important. Stiff bias supplies were required. I am told that many of the bias regulators in use today are similar to the one shown in Fig. 1.

Note that with the relay contacts open, the total bias voltage is a combination of the voltage across the transistor and the resistor. Even a small amount of tube leakage current is sufficient to bias the tube into a cut-off condition (desirable in the receive position). During the time when the relay contacts are open, only the voltage across the transistor will act as a bias voltage. It is easier to understand this thought if the circuit is slightly redrawn to resemble Fig. 2.

You can easily see that the transistor functions as a series-current regulator. The bias voltage will vary to keep the current constant. But, linear service is not a constant-current operation, and the amplifier does **not** function as desired.

What, if any, have **your** experience(s) been with grounded-grid bias circuits, of this or any other type? Do **you** have a different or a better circuit which you can show and explain to your fellow VHF+er? All suitable responses will be included in a future column.

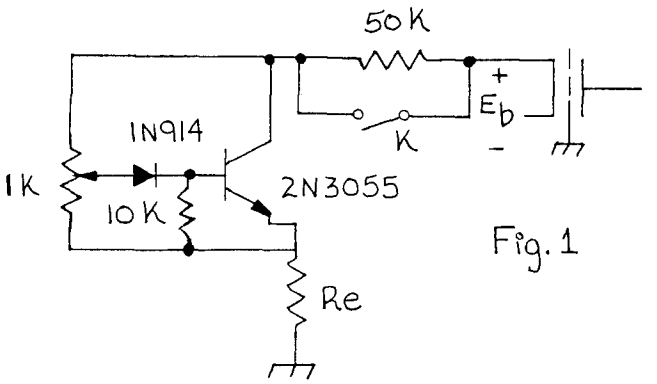


Fig. 1

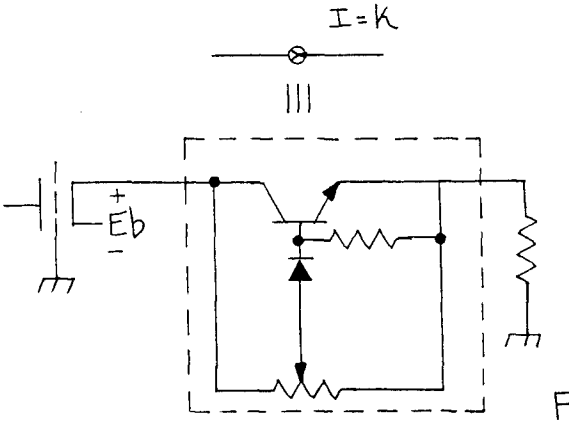


Fig. 2

Bits

The ET-1 Error Rate Test Set

ET-1 has asynchronous and synchronous transmission capability. Six data rates at 19,200 kilobauds, six standard transmission patterns, and five selectable tests with six test lengths for each. ET-1 performs true error bit testing, block error rate testing and measurement of errored seconds.

The color coded faceplate allows easy recognition of related functional settings, plus a liquid crystal display to read test results quickly. ET-1 provides full access to the RS-232-C interface and a convenient switch bank to break seven different lines to perform patching or jumpering tasks. The dual gender RS-232-C connector is mounted on a length of ribbon cable for quick connection to monitor or test the line.

The ET-1 Error Rate Test Set is packaged in a strong, durable SoftPak and comes with a lifetime guarantee. The price range is $395.00. Complete information on this unit can be obtained from Datacom Northwest, Inc., 3303 112th St. S.W., Bldg. 100, Everett, WA 98204, tel. (206) 355-0590.

Photo courtesy of Datacom Northwest, Inc.

MARKWIK Permanent Wire Markers

If you are looking for a different way of identifying wires other than by the use of color coding, or a method to help speed installation, repair, or modification of complex wiring, then you might consider using MARKWIK permanent wire markers. They are manufactured to resist abrasion, remain unaffected by chemicals, will never smear, will withstand filing, high temperatures, ultraviolet light, and is resistant to salty climates.

The wire markers come in two different types: heat shrinkable polyolefin and non-heat shrinkable PVC. Type 1 comes in five standard colors and is self extinguishing. Type 2 is available in clear and is not flame retarded. Any combination of numerals, letters or special character symbols can be ordered in 5 pt. up to 36 pt. type.

For ordering information and technical data on MARKWIK permanent wire markers, write to MARKWIK Corporation, 60 Queens St., Syosset, L.I., NY 11791, tel. (516) WA 1-4900.

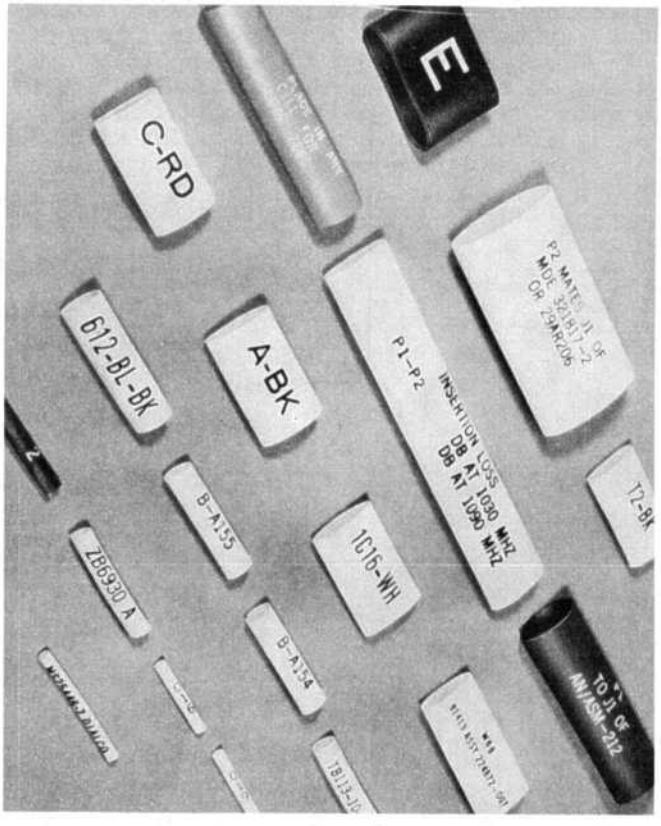


Photo courtesy of MARKWIK Corp.

Custom Plotter Charts

Since 1971 Graphic Resources Corp. has manufactured thousands of charts. Why? To help their customers save time, money, and be less wasteful.

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EPO-TEK 353ND

Searching for an epoxy to withstand high temperature applications? You might be interested in EPO-TEK 353ND, manufactured by Epoxy Technology, Inc. It performs continuously at 200°C, and will endure +300 to 400°C for several hours. Other features include its excellent resistance to many solvents and chemicals, and it is ideal for bonding fiber optics, metals, glass, ceramics, and most plastics.

A specification sheet on 353ND can be obtained by writing Epoxy Technology, Inc., 14 Fortune Dr., P. O. Box 567, Billerica, MA 01821, tel. (617) 667-3805. EPO-TEK also offers a wide variety of epoxy systems that include optically transparent epoxies, thermally conductive types, epoxies for electrical insulation and hermetic sealing, and electrically conductive epoxy systems.

Defend Your Computer and Sensitive Electronic Equipment Against Power Line Failures

Tired of losing power **and** hours of work on your computer system? Here is a way to overcome this problem. Computer Power, Inc., now offers an inexpensive line of defense against power line problems that can plague users of computers and other sensitive electronic equipment. Called the **Defender**™ SPS (switch-over power system), this battery-backup power source will pop into action instantly when power failures occur.

The Defender's secret is its especially fast state-of-the art solid-state switch that provides power to protected systems before they can fail. A typical transfer time was measured at 4 ms. Built-in batteries allow this model to keep a system running from 10 to 60 minutes -- long enough to solve "nuisance" outages, or power an emergency generator. Its power-line clean-up circuitry helps to prevent system damaged or data loss when spikes or surges occur. An automatic low-battery voltage disconnect protects batteries from sulphation after prolonged outages.

The Defender model is rated at 400-1200 VA, and is in a price range of $785-$1265. For complete information on the Defender and other systems, contact Computer Power, Inc., 124 West Main St., High Bridge, NJ 08829, tel. (201) 638-8000.

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The purposes of QEX are to:

1) provide a medium for the exchange of ideas and information between Amateur Radio experimenters,

2) document advanced technical work in the Amateur Radio field, and

3) support efforts to advance the state of the Amateur Radio art.

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Both theoretical and practical technical articles are welcomed. Manuscripts should be typed and double spaced. Please use the standard ARRL abbreviations found in the January 1984 edition of QST. Authors should supply their own artwork using black ink on white paper. When essential to the article, photographs may be included. Photos should be glossy, black-and-white positive prints of good definition and contrast, and should be the same size or larger than the size it will be when printed in QEX.

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