QEX

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# The ARRL Experimenters' Exchange

## Special Temporary Authority

As an experimenter, the existing FCC Rules give you considerable latitude in which to conduct on-the-air experiments. However, there are limits to the Rules as written, and you may need special authorization to conduct certain experiments. So long as the tests you propose fit inside the frequency bands allocated to the Amateur Radio Service and generally follow the Rules for that service, you can request a Special Temporary Authority (STA) from the FCC.

Some recent examples of STAs are:

AMSAT's phase-shift keying tests on 10 meters.
AMRAD's spread spectrum experiments.
AMTOR RTTY tests.

In order to apply for an STA, submit your request in letter form to the FCC, Gettysburg, PA 17325. Your request should be complete within itself so that the FCC approving official, (normally Richard H. Everett, Chief, Licensing Division) can get the entire story from the application. For more information or assistance, you can call the Licencing Division in Gettysburg on 717-337-1511. Here is the type of information usually needed:

Name, call and address of the applicant.
Purpose of the proposed tests.
Description of on-the-air tests.
Sections of the Rules to be waived.
Locations involved.
Operating frequency limits.
Types of emission.
Transmitter power (whether input/output).
Antennas, types, gain, height above ground.

Before submitting your STA request, it is a good idea to carefully check the FCC Rules to see if an STA is necessary. It is prudent to coordinate your tests with other amateurs who may also want to participate. A brief item in QEX is an effective way to get to many experimenters to see who would like to join in. Also, it will be useful for you to get in touch with amateur organizations that are already involved in such experimentation. It is worthwhile to contact Perry F. Williams, W1UED, the ARRL Washington Area Coordinator, telephone 203-666-1541, prior to finalizing your STA proposal, and certainly drop him a copy at ARRL Hq, 225 Main St, Newington, CT 06111.

Oh, there's a catch. At the end of the STA grant period, usually one year or less, you will need to submit a test report to the FCC.

In addition to notices of pending STA applications, please send copies of all STA proposals, grant letters and test reports to Editor, QEX. That will ensure that the Amateur Radio experimenters get a chance to give you some information and to share in your results.

## Experimental Radio Services

There are occasions where proposed tests may involve transmissions which do not fall under the Amateur Radio Service, even with an STA. A recent example of this was in the case of beacon tests conducted in the new WARC bands, which are not yet allocated to the Amateur Radio Service. In such cases, the FCC can grant an experimental license.

The Experimental Radio Services are governed by Part 5 of the FCC Rules. You can purchase a copy from the Superintendent of Documents, Government Printing Office, Washington, DC 20402. FCC Forms 442 (Application for New or Modified Radio Station Authorization Under Part 5 of FCC Rules Experimental Radio Services (other than Broadcast)) can be obtained from the Federal Communications Commission, 1919 M St NW, Washington, DC 20554.

If you would like to discuss the technical aspects of an experiment with someone at the FCC, you might try Dr. Michael J. Marcus, Office of Science and Technology, 2025 M St NW, Washington, DC 20554, 202-632-7040. Another helpful contact on experimental licensing is H. Franklin Wright, also in FCC/OST, who can be reached on 202-653-8137.

Again, coordination with the people in the Amateur Radio community mentioned under STAs is also recommended.

## Call for Articles

QST is looking for articles on short-term construction projects of wide appeal, 160 meters thru microwave, any transmission mode, 3-4 printed pages long. A QST author's guide is available from ARRL headquarters if you need some help in preparing your article.

On the telephone, QST Senior Technical Editor, Doug DeMaw, W1FB mentioned that he recently worked someone who said that he was using a Radio Shack PC1 pocket computer as a Morse keyer and would welcome an article describing how to do it.

QEX needs state-of-the-art technical articles on a variety of topics. Right now, we can especially use some articles on analog subjects (receivers, transmitters, amateur television, facsimile, etc.).

## Correspondence

Please keep sending in letters which can be published in QEX. In addition to those commenting on articles previously published, we also welcome more "wish list" items as well as notes on experiments in progress and those completed. If you have completed a design but haven't written, or don't plan to write, an article about it, send a brief letter to QEX saying what it is and how other experimenters can contact you.

# Correspondence

### A Method of Calibrating a Frequency Counter

In the crystal frequency divider circuit of my counter, I mounted a single MOLEX socket on the land at the output of each of these 7490 frequency dividers: 1 MHz, 100 kHz and 5 kHz. A front-panel-mounted rotary switch selects the desired frequency. A 0.01-uF capacitor eliminates most of the low-frequency noise from the 7490 at 5 MHz. A front-panel-mounted pot attenuates the signal before it is passed to the receiver via coax. A diode at the receiver input generates harmonics of any of these frequencies, which may be compared with the carrier of WWV. The attenuator permits the resulting beat note to be refined to a few beats per second. - Al Wise, N2AL, 42 Conmar Drive, Rochester, NY 14609.

### More on Calibrating a frequency Counter

You listed as being on W3ABC's "wish list" a method of calibrating a frequency counter. I assume by this that he means calibration of the time base. This is a very simple procedure and is covered in my article, "Understanding and Using Electronic Counters," Ham Radio, February 1978, page 10. - Robert S. Stein, W6NBI, 1849 Middleton Ave, Los Altos, CA 94022.

### Errors in SWR Indicators

Nearly all SWR indicators sold to amateurs or described in the amateur literature use simple diode peak-reading voltmeters to read the forward and reflected voltages. The nonlinearity of the diodes can cause serious errors when operating the indicator at low power levels (high sensitivity setting) or when reading low SWRs.

A Knight P-2 "SWR/Power Meter" was calibrated by applying known dc voltages at the sensing element and reading the resultant indication. The true "SWR" was then calculated from the relation

$$SWR = \frac{E_f + E_r}{E_f - E_r}$$

The following table records the result.

Knight P-2 SWR/Power Meter

| Indicated SWR | True SWR (Unsmoothed data) Sensitivity Control Setting: Max | 9 | 7 | 5 | 3 | 2 |
|---|---|---|---|---|---|---|
| Infinity | inf. | inf. | inf. | inf. | inf. | inf. |
| 20 | 33 | | | | | |
| 8 | 14 | | | | | |
| 6 | 9.5 | 6.8 | 6.9 | 6.5 | 6.0 | 6.1 |
| 4 | 6.2 | | | | | |
| 3 | 5.2 | 3.7 | 3.4 | 3.5 | 3.1 | 3.1 |
| 2 | 3.3 | | | | | |
| 1.5 | 2.5 | 1.8 | 1.7 | 1.6 | 1.6 | 1.5 |
| 1.4 | 2.4 | | | | | |
| 1.3 | 2.2 | | | | | |
| 1.2 | 2.1 | | | | | |
| 1.1 | 1.7 | | | | | |
| 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| Input voltage for full-scale reading | 0.34 | 0.78 | 1.39 | 2.25 | 3.50 | 7.50 |

This indicator uses germanium diodes. Indicators using silicon diodes would likely have worse errors. It should be noted that the errors described here are only those errors resulting from the nonlinearity of the diodes. Errors resulting from different diode characteristics or load resistors, imperfect directivity, unequal coupling coefficients of the directional couplers and other factors are in addition to the errors addressed here.

In any application requiring the reasonably accurate measurement of low values of SWR, these indicators should be calibrated at the operating sensitivity setting. As indicated by the results in the table, making the measurements at the highese practical power level will simplify the calibration. - Albert E. Weller, WD8KBW, 1325 Cambridge Blvd, Columbus, OH 43212.

### Amateur Computer Experimenter's Net (ACE)

ACE meets daily at 7:00 P.M. local time on 146.55 MHz and covers the Northwest of Washington State. This net provides assistance to those interested in transmitting and receiving data and files at 0-1200 baud ASCII.

We are using Bell 103 answer 2025 Hz space and 2225 Hz mark for 110, 300 and 600 baud and Bell 202 1200 Hz space and 2200 Hz mark for 1200 baud.

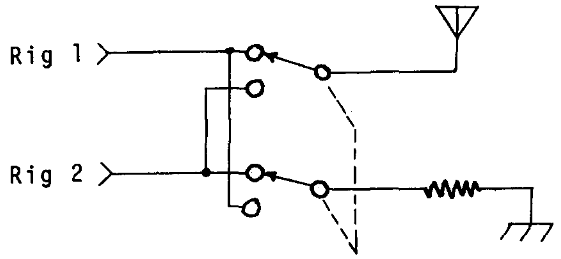
Commercial modems can be easily modified, and homebrew modems may be inexpensively constructed for this service.

We have an Amateur Radio communications program available, in BASIC, for the TRS-80 which is very popular.

We will consider establishing a net on 10 meters if these is enough interest in 1200 baud. - Robert "Gervie" W. Gervenack, W7FEN, 19701 320 Ave NE, Duvall, WA 98019.

### Tune into a Load - For Sure!

If you're absent minded, as I am, and if you run a 100-watt rig, and a 5-watt rig on the same antenna, as I do - or, any two rigs with one antenna for that matter, you too may have tuned up one of the rigs into a zero load as I have. Obviously, this practice can be disasterous, especially if the rig is solid state. I have the problem eliminated now because I got a good ceramic double wafer switch, installed it in an aluminum box and hooked it up as indicated in the diagram. Now, when I have one rig on the antenna, the other rig is on the dummy load and vice versa. Thus, I can encourage my growing absent-mindedness without fear of wrecking my treasures.




One may use a switch with reverse contacts on the bottom of the one wafer. Personally, I feel better with the actual physical spacing that's possible with two wafers.

Wouldn't it be great if one of you experimenters could devise a technical means to determine the attenuation of various antenna and rig switching?

Seems to me that there is a real need for adding switching to some antenna tuners so as to allow switching to various antennas and even more important, to permit switching directly to the antenna (bypass tuner) with full use of the SWR-POWER meter. - John P. Hamilton, KB9UZ, 6050 North Oakley Ave, Chicago, IL 60659.

# 50-MHz 100-Watt Output Linear Amp

By Randy Bynum,* WB2SZK

In my desire to improve my station and eliminate those unnecessary tubes and associated screen and filament supplies, I have designed and built a one-stage 100-watt-output 6-meter linear amplifier. It provides about 10 dB gain when used with a 28-Vdc supply capable of about 6 amperes. A drive of approximately 10 watts is required to produce the 100 watts output. This drive level is achieved with the modern solid-state all-mode transceivers presently available on the market.

In my case, the unit is an intermediate amplifier (running at reduced power) which will be used to drive a 3-500Z grounded-grid amplifier. However, 100 watts output on 50 MHz will provide a very respectable signal and is an ideal compromise power level.

The linear is simple to build using standard vhf practices and high-quality components capable of withstanding the high rf circulating currents encountered. Two levels of isolation are used in both the base and collector leads to eliminate any tendency toward self oscillation. The amplifier is perfectly stable even into an open or short circuit. The S175-28 is a flange-mounted device with four leads, each about 0.25 inch wide. A fairly substantial heatsink is required in order to properly cool the device. The heat sink I used is 4 x 6 inches with 6 vertical fins about 1.25 inches high.

The diode should be cemented or clamped to a mounting bolt used to hold the transistor in place. The entire amplifier will fit easily on a 4 x 6 inch board.

Tune-up is very simple and may be done as follows:

a) Apply about 13 Vdc through a meter capable of measuring at least 250 mA. With no drive applied the idling current should be about 25-50 mA. If the quiescent current is not within this range, adjust the value of the 110-ohm 2-watt resistor in the base lead. The smaller the resistance, the larger the current.

b) Apply drive through a power meter and adjust for minimum reflected power into the base of Q1. (The output should be terminated into a 50-ohm load.)

c) Now move the power meter to the output side and connect the 50-ohm load to the output of the wattmeter.

d) Again, apply drive and tune the output circuits for maximum output indication on the wattmeter. These adjustments interact, and some care must be used in going from one trimmer to the other until the proper setting is achieved. At this point, about 40 watts should be available with 10 watts drive.

*3634 Deedham Drive, San Jose, CA 95148, 408-274-4869.

e) Apply 28 Vdc and retune the output stage for maximum output and the input stage for best match to the exciter. Output now should be about 100 watts of linear power and ready to connect to the antenna.

f) If available, an ammeter which is capable of 10 A full scale should be inserted in the collector line to check the maximum current being drawn. The collector current, 28 Vdc at 100 watts, should be approximately 6 amperes. Do not attempt to retune the amplifier when fed to the antenna. If your antenna is not 50 ohms, fix the antenna, not the amplifier.

A good substitute for the S175-28 (CTC) appears to be an SD1407 or SD1450 (both have been used successfully) made by Solid State Microwave. All devices seem to exhibit similar parameters, so I therefore make no recommendations as to which device to use. However, I have more experience with the SSM devices.

The amplifier has been known to be unconditionally stable under any conditions that it has seen to date. It has survived an open circuit, a short circuit and an open circuit at the end of various lengths of cable.

Any harmonic or spurious signal was found to be well below the -60 dB required by the FCC at this frequency when tuned up using a 30-dB in-line attenuator into an HP8558B spectrum analyzer. By using the procedures outlined above, the harmonic and spurious content will probably not be optimized but should still pose no problem providing that the driving signal is clean to start with.

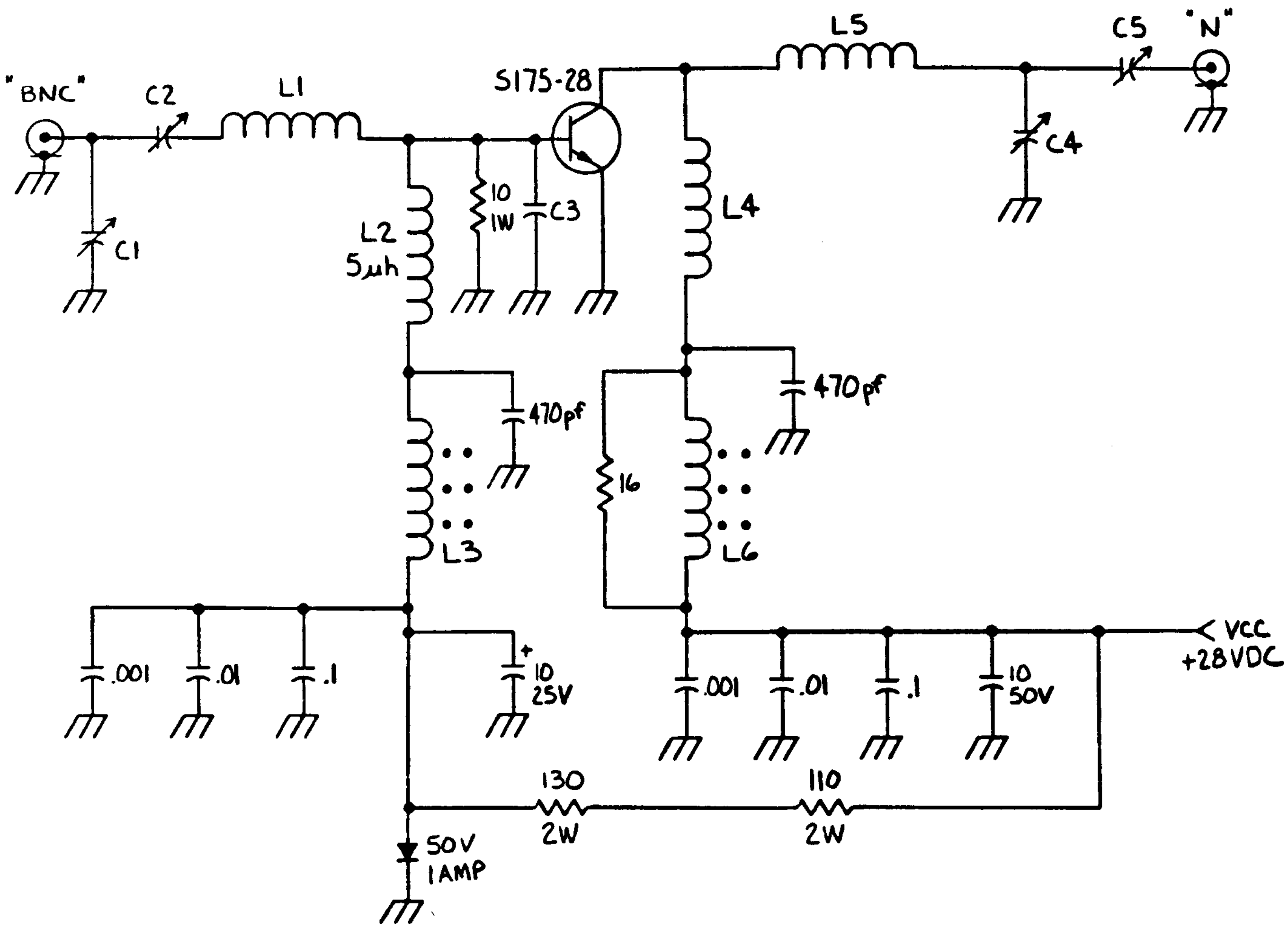
Do not attempt to skimp on the Unelco capacitor used in the base circuit or the Arco 460 series trimmer capacitors. Any substitutes may result in circuit drift or instability. Again, don't substitute unless you are familiar with this type construction. It can be very tricky.

A potential modification which I have not tried, for those who use fm or cw only, would be to ground the base through L2 to convert the amplifier to class C operation. This should pose no problems, but it is something that I have never tried. The 10-ohm resistor from base to ground should be removed if class C is desired. But don't remove it if running in linear mode!

Another modification that I am going to try is to parallel two devices with a little more drive to see if I can achieve 200-250 watts out.

I have not layed out a printed circuit board for the amplifier. I have used point-to-point wiring on a copper-clad G-10 board. What I generally do is to build islands from pieces of PC board soldered or cemented to the main board and use the Unelco capacitors at the transistor to support the connections.

I would be interested in receiving comments from those who build the amplifier, particularlly in changes made to the design. (Schematic is on next page).




COIL TABLE

L1 - 2 TURNS #16 5/16 ID
L2 - 5µh MOLDED RFC
L3 - 10 TURNS #24 ON T50-2
L4 - 8 TURNS #16 1/4 ID
L5 - 2 TURNS #12 5/16 ID
L6 - 10 TURNS #18 ON T50-2

CAPACITOR TABLE

C1 - ARCO 468
C2 - ARCO 468
C3 - UNELCO 1000pf
C4 - ARCO 465
C5 - ARCO 465

# Computer RTTY in BASIC

By David G. Meier,* N4MW

I added RTTY capability to my station by writing two short BASIC programs and wiring two integrated circuits together. After months of just listening to afsk tones on two-meter fm, I decided that my OSI C8DF computer (1-MHz clock) should become an RTTY terminal. The RTTY receive program I developed is the software equivalent of a mechanical teletypewriter. No machine-language programming is required because OSI BASIC is fast enough to handle 60-wpm keying. The transmit program allows a line of text to be sent as afsk tones directly from the computer's sound generator. The "State-of-the-Art" demodulator design described in November 1981 QST was modified to drive the computer.

The receive program uses a few tricks to insure sufficient speed. Variables are used in critical areas because BASIC can fetch variables faster than it can calculate or convert from text. Multiple statements in single lines execute faster than separately numbered lines. Very short programs do not have many line numbers to search through for referenced lines (GOTO 1100, etc.). 1000 series numbered lines are initialization, mainly the array containing ASCII equivalents of Baudot characters. The demodulator output toggles one key so the normal keyboard scan must be disabled with a POKE. Another POKE programs the keyboard to detect the shift-lock key condition. Shift lock is the only normally closed key and disables the keying signal from the demodulator during normal keyboard use. The shift-lock key is simply unlocked to copy RTTY. Line 1100 waits for a start pulse, initializes the next character to be printed and delays into the start pulse. Line 1110 is executed five times for each character, each time delaying into the consecutive data pulses and accumulating the character's value depending on mark or space conditions. Lines 1120 and 1130 select figures or letters by setting a flag (F). Line 1140 downshifts on space. Line 1150 suppresses blank characters. Line 1160 prints a character corresponding to the Baudot code received.

*3205 Covington Pike, Memphis, TN 38128, 901-377-0834.

The RTTY transmit program is intended to be a simple way to get on the air. The program can be used as presented for typical short message on two-meter fm. It can be expanded to add additional features such as multiple-line capability. Special features allow quick identification in Morse and RTTY as well as FOX and RY test lines. A simple command menue is displayed each time the program pauses for input. Previous entries are repeated by continuing with no entry. The program works by looking up the Baudot equivalent of the ASCII value of each character sent. Figures and letters characters are inserted automatically along with the required start and stop pulses. Since this program is a bit more decipherable than the receive program, I will not elaborate on it here.

A "State-of-the-Art" demodulator was constructed as detailed in November 1981 QST. I omitted the loop keying circuitry and connected the optocoupler output directly across the shift-lock key contacts on the computer's keyboard. The afsk modulator was not used. All transistors of the QST design were replaced by a CMOS integrated circuit. Two switches are used, Reverse-Normal and Squelch. The term "squelch" is used instead of "antispace" because it better describes the circuit operation. "Squelch" forces a mark condition on the outputs until a tone is received and the demodulator locks on. The "off" (center) position disables the squelch. In the remaining position, a mark is forced on the output regardless of input to the demodulator. My demodulator drives a MITE printer as well as the computer. I did not include an autostart timer or high-voltage loop because the MITE has a built-in timer and logic compatible input circuitry. Inverted output is provided because the printer and computer require opposite logic states.

The MITE printer and the modified "State-of-the-Art" demodulator have made it possible to monitor two-meter fm traffic with virtually perfect copy. W1AW bulletins have become a regular operating habit. Using the computer receive program, I can tune the bands for RTTY activity without generating noise and waste paper. The system I have described will never outshine the programs available for other computers. But, for the fun and satisfaction received, it was worthwhile.

```
1000 REM   RTTY RECEIVE   BY DAVID MEIER
1010 DIMC%(63):FORI=0TO63:READC%(I):NEXT
1020 POKE2073,96:KB=57088:POKEKB,1:FORI=0TO4:V(I)=2^I:NEXT
1100 WAITKB,1:FORJ=0TO6:NEXT:I=0:C=F
1110 FORJ=0TO6:NEXT:C=C+V(I)*PEEK(KB):I=I+1:IFI<5GOTO1110
1120 IFC=32THENF=0:GOTO1100
1130 IFC=4THENF=32:GOTO1100
1140 IFC=59THENF=0
1150 IF(CAND31)=31GOTO1100
1160 PRINTCHR$(C%(C));:GOTO1100
10010 DATA32,86,88,77,32,71,66,79,81,80,89,72,87,76,90,84
10020 DATA75,67,70,78,74,82,68,13,85,73,83,32,65,10,69,32
10030 DATA32,59,47,46,32,38,63,57,49,48,54,35,50,41,34,53
10040 DATA40,58,24,44,07,52,36,13,55,56,39,32,45,10,51,32
```

```
1000 REM ASCII TEXT TO BAUDOT AFSK
1010 REM BY DAVID MEIER
1020 CC=5
1025 T$="ID"
1030 ID$="4311416314111343341334"
1040 SO=57089:SP=22:POKESO,0:POKE56832,3
1050 DIMBD$(90),CS(90):FORI=32TO90:READBD$(I),CS(I):NEXT
1060 FX$="THE QUICK BROWN FOX JUMPED OVER THE LAZY DOGS BACK 1234567890"
1065 RY$="RYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRY"
1070 IT$="DE N 4 M W  OSI RTTY MEMPHIS"
1090 POKE2888,0:POKE8722,0:POKE2972,13:POKE2976,13
2000 REM INPUT STRINGS
2005 PRINT:PRINT"COMMANDS: ID RY FOX OFF EXIT"
2010 TX$=T$:PRINT:INPUT"TEXT";T$:IFT$=""THENT$=TX$
2020 IFT$="ID"THENGOSUB9200:T$=IT$:GOSUB9000:POKESO,23:F=1:T$=TX$
2025 IFT$="RY"THENT$=RY$:GOSUB9000:T$=TX$:F=1
2030 IFT$="FOX"THENT$=FX$:GOSUB9000:T$=TX$:F=1
2035 IFT$="OFF"THENPOKESO,0:T$=TX$:F=1
2036 IFT$="EXIT"THENPOKE2972,58:POKE2976,44:POKESO,0:END
2040 IFFTHENF=0:GOTO2000
2099 GOSUB9000:GOTO2000
9000 REM CONVERT ASCII STRING TO BAUDOT AFSK
9001 FORI=1TO8:BD$="00010":GOSUB9100:NEXT:BD$="01000:GOSUB9100
9010 FORI=1TOLEN(T$):C$=MID$(T$,I,1):PRINTC$;:A=ASC(C$)
9020 IFCS(A)=1ANDCS=0THENBD$="11011":CS=1:GOSUB9100
9030 IFCS(A)=0ANDCS=1THENBD$="11111":CS=0:GOSUB9100
9040 BD$=BD$(A):GOSUB9100:NEXTI:PRINT:PRINT
9099 RETURN
9100 REM GENERATE AFSK TIMING
9110 BD$="0"+BD$+"11"
9120 FORJ=1TO7:POKESO,SP+VAL(MID$(BD$,J,1)):FORC=1TOCC:NEXTC,J
9199 RETURN
9200 REM CW ID
9210 FORI=1TOLEN(ID$):E=VAL(MID$(ID$,I,1)):IFE<4THENPOKESO,23
9220 FORJ=1TO20*E:NEXTJ:POKESO,0:FORJ=1TO20:NEXTJ,I
9299 RETURN
10320 DATA00100,0,10110,1,10001,1,00101,1,10010,1
10370 DATA00100,0,01011,1,10100,1,11110,1,01001,1
10420 DATA10100,1,00100,0,00110,1,11000,1,00111,1
10470 DATA10111,1,01101,1,11101,1,11001,1,10000,1
10520 DATA01010,1,00001,1,10101,1,11100,1,01100,1
10570 DATA00011,1,01110,1,01111,1,00100,0,00100,0
10620 DATA00100,0,10011,1,00100,0,11000,0,10011,0
10670 DATA01110,0,10010,0,10000,0,10110,0,01011,0
10720 DATA00101,0,01100,0,11010,0,11110,0,01001,0
10770 DATA00111,0,00110,0,00011,0,01101,0,11101,0
10820 DATA01010,0,10100,0,00001,0,11100,0,01111,0
10870 DATA11001,0,10111,0,10101,0,10001,0
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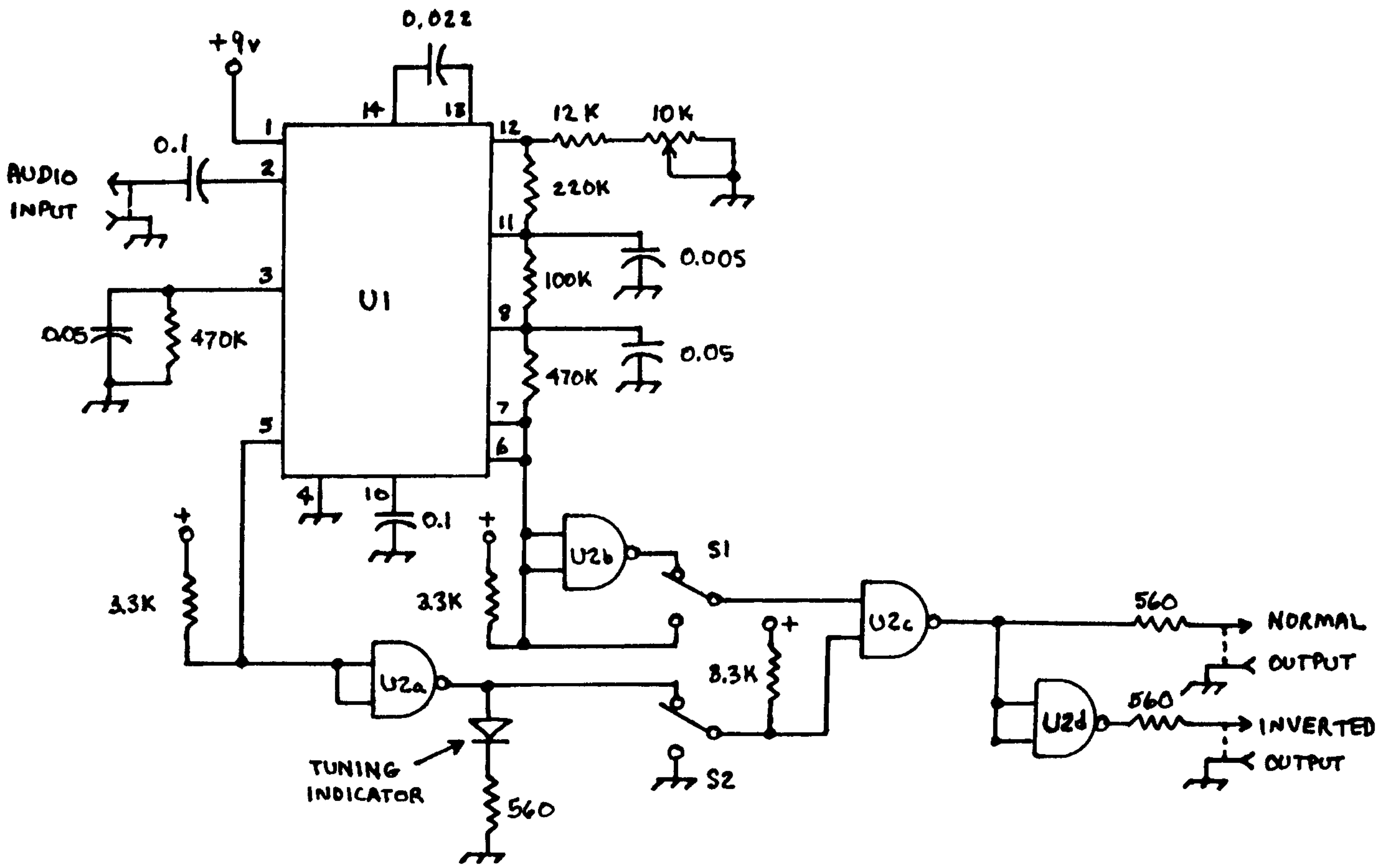



Demodulator Schematic and Parts Descriptions

S1 - SPDT toggle switch
Up - normal polarity
Down - reverse polarity

S2 - SPDT toggle switch (center off)
Up - squelch enable
Center - squelch disable
Down - MARK hold

U1 - XR2211 phased-locked loop decoder

U2 - 4011 CMOS quad 2 input NAND gate
(Radio Shack 276-2411)
U2a - tuning indicator and squelch inverter
U2b - polarity inverter
U2c - squelch gate
U2d - output inverter

U3 - Darlington output optocoupler
(Radio Shack 276-133)

# TRS-80 K1 Relay

By Robert W. Gervenack,* W7FEN

After 15 months and over 1400 hours of operation on my TRS-80 (tm Tandy Corp.), the contact on the K1 relay, which controls the motor in the cassette recorder, stuck closed.

The only problem with the computer to date has been key bounce with the letter S.

The first course of action was to confirm that the relay contact was sticking.

Upon referring to the TRS-80 Micro Computer Technical Reference Handbook, Cat. No. 26-2103, there it was on page 73 under the title "Cassette Problems."

Next is to turn to page 108, Circuit Diagram. Without pulling out the foldout, locate Cassette I/O and J3 (Cassette Jack). Note that pins 1 and 3 of J3 connect to the K1 relay contacts.

Without pumping the computer, carefully pull the plug for the cassette recorder. Connect a VOM, high-ohm range, to pins 1 and 3. A zero reading indicates that the contacts are stuck closed.

If your computer is still under warranty, you would be wise to have the relay replaced by Radio Shack.

Now there are two methods to release the stuck contact. I prefer the second method.

The first (questionable) method is to bounce the computer up and down to release the stuck contact.

The second (preferred) method is as follows:

1. Without jarring the computer, carefully remove the VOM leads from J3 and pull the plugs from the power and video sockets.

2. Disassemble the computer per the method described under Disassembly on page 58. As I removed each screw I wrote on the case the type and length of the screw.

3. Reconnect the VOM to J3 pins 1 and 3. Thump the relay K1 as recommended on page 73, to unstick the relay contact.

After finding the Part No. 4500001 for the K1 relay on page 95, I telephoned my friendly Radio Shack store. Of course, I was advised that the relay was not in stock. The clerk took my order saying that he would call me when it arrived, in about 3 weeks.

Now I had an excuse to finish some projects and make some repairs that I had been putting off for the last 15 months. The first project was to remove the letter S keytop and clean the contacts.

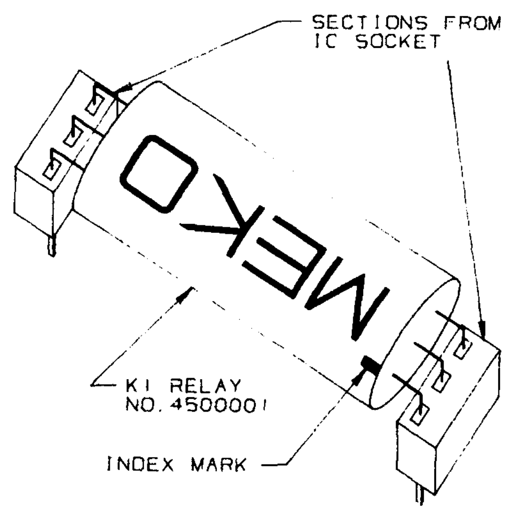
Also, the remarks in the Handbook about the potential relay problems stimulated my thinking that this relay should be capable of being plugged in instead of having to unsolder and resolder each time it was to be replaced.

*19701 320 Ave NE, Duvall, WA 98019

Here is the method that I used to provide a socket to plug in relay K1:

1. Remove the solder around the relay wires on the PC board with solder wick and a soldering iron with a pointed tip. Remove the defective relay and clean out any remaining solder in the PC board holes.

2. Cut an 8-, 16- or 18-pin IC socket with a fine hacksaw blade to obtain two pieces with 3 sections each. See sketch of relay and sockets.




3. Install and solder these two sockets in the PC board.

4. Shape the leads coming from the new relay with long-nose pliers at a right angle so it will plug into the new socket for the K1 relay. Note the index mark on the side of the relay. Form the leads on the new relay in the same direction as the removed relay.

5. Install the new relay with the index mark matching the PC board mark. That is all there is to it!

Incidentally, the relay arrived in less than two weeks so I was unable to get all of those other projects completed.

Reassemble per the directions, and you are back in business.

You are now better acquainted with your computer. It was so easy that you wondered why you hesitated removing that red eye from the bottom of your TRS-80.

Oh, yes, I have ordered a spare relay. Who knows, before I may need it for the computer I will find a use for it in another project.

# Data Communications

Conducted by
David W. Borden,* K8MMO

This month we will wrap up our study of the Line Interface Program (LIP) running in the VADCG Terminal Node Controller (TNC) board. This code, written by Doug Lockhart, VE7APU, has done a great deal to advance the progress of Amateur Radio data communications. Mainly it has helped to sell the idea of having a separate computer in your ham shack for the express purpose of communicating, leaving your normal personal computer free for other useful work (like acting as a mailbox, running a game, maintaining a large data base, etc.). The TNC then is a communications channel sitting on your personal computer as a port. The phone line should be on another port for the complete communicator to function correctly.

In our past two examinations of the LIP, we have studied the protocol (HDLC extended to look like SDLC, almost ADCCP), looked at the circular buffers with their pointers running around handling packets and characters, and looked at the restart interrupts being serviced. The LIP is a difficult program to study because of the interrupts being serviced. If your finger is on the listing at some point following the flow, one tends to forget that an interrupt may be being serviced at any time, affecting the results of the routine where your finger is now! This leads to some confusion on occasion.

The main dispatching routine, DISPATCH, is where all non-interrupt receive/transmit activity is initiated. After setting the stack, clearing memory, starting out all buffer pointers clean and setting up the 8273 chip in routine INIT, we fall into the DISPATCH routine where we loop forever looking for work to do, digressing when required past two examinations of the LIP. We have studied the protocol (HDLC extended to look like SDLC, almost ADCCP) and looked in a look-for-work loop examining a status word. If there is no work to do, all bits of the status word are zero. When an interrupt occurs, the interrupt service routine sets one of the bits in the status word to one as it finishes up and leaves. The look-for-work loop code examines the status word, finds the a bit set (by the interrupt routine just mentioned) and digresses to work on the data captured by the interrupt routine. The status word that we are most concerned with in the LIP is STAT2. In this word we learn the condition of:

1) Receiver (is it busy?)

2) Transmitter (is it busy?)

3) Final (Has final bit been set?)

4) IDREQ (Is it time for CWID?)

5) IDSND (Is the CWID now in progress?)

We begin the DISPATCH loop then by checking STAT2 and looking if the transmitter is active. If it is not active, we digress to the XMIT routine to see if it should be activated. Remember that we are in the DISPATCH loop as we digress for a nanosecond.

In routine XMIT, we check another status word to see if we must transmit. Before we actually send anything we check our timers and look at the Carrier Detect (CD) line coming from the modem to see if someone is currently sending (thus the Carrier Sense of our CSMA scheme). We pause to check if we are connecting or disconnecting (if we are we need overflow checking). We then check if the receiving station can receive Information Frames (I-Frames). If receiver is ready to receive, we send it, delaying for slow rigs if required. Some slow relay rigs require turning on RTS (the equivalent of punching the push-to-talk switch) and waiting for everything to settle before firing off the packet. If receiver is not ready, we return to DISPATCH, else we call STARTTRANSMIT which sets up all packets which are ready to go and in the window. STARTTRANSMIT worries about connections or not, sets up the pointers for transmit, sets up the control field, checks for link synchronization, updates the mainline status word and returns to XMIT. In XMIT, we then call TXFRAME and return to DISPATCH. In TXFRAME, we start transmit of the buffer pointed at by CTBE (discussed previously) and return. This is another neat feature of this dedicated computer and 8273 protocol chip. We load up the 8273 and leave. It transmits the packet. We can keep computing. If your mind is adjusted to thinking that a computer can do only one thing in any instant of time, you must readjust your thinking.

We are now back in the DISPATCH loop and the transmitter is turned on and sending out a packet. Isn't hardware great?

Meanwhile, back in DISPATCH, we grab STAT2 again and see if the transmitter is active. In ourall STARTTRANSMIT which sets up all packets which are ready to go and in the window. STARTTRANSMIT worries about it is running. We call RBUSYTEST to check.

In RBUSYTEST, we check to see if the receiver is running. If so, we check the line timeout timer, processing it if necessary. We can return to DISPATCH (after clearing status word) if timer is not running. If the receiver is not running, we update buffer pointers, check for line buffer overflow (unless empty), update status word and return to DISPATCH.

Back in DISPATCH, assume that receiver is not running. We need to check if some received frames need processing. We check pointer CLBE (the current line buffer entry) and LBPE (the line buffer processing entry). If these two pointers are not equal, then we have some receive processing to do. We call INPROC to do that.

In INPROC, we check to see if we are connected, jumping to INFRAME if we are. There we must check the incoming data to see just what kind of frame it is and process accordingly. Remember I-FRAMES are numbered and must be processed in order. If we are missing something we must get it repeated. We have to check for connect or disconnect requests also. INFRAME is a very busy routine. While we work we must reset status words and bump pointers for what we process. We process all we can and return to DISPATCH. I have purposely glossed over this routine. This is the routine to study once you understand the protocol (previously covered). The comments guide you thru the different frames being processed, but you must understand what each frame is for to understand the processing. Back in INPROC, we may not be connected. This may be a request for connection (in which case match call signs, looking for ours) or disconnection. We are also in Monitor mode (print all packets seen on the channel) if we are not connected, in which case the TIP needs to print the Information field of any I-FRAME. It is in this routine some important Magnuski style repeater code is added also. If we are looking at a request-for-connect packet, and the request-for-repeat bit is on, we must only look at packets that have been repeated. We mark each incoming frame as to if the TIP should print it on the receiving terminal. Frames with a zero address field are not printed. We might get a non-sequenced I-FRAME (like from the repeater beacon). These we overwrite the orginal address field with => and allow the TIP to print the whole thing. We also, on connect, overwrite our call with CCCCCC

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703-450-5284 home.

and on disconnect overwrite our call with DDDDDD in this routine. We eventually find our way back to DISPATCH.

In our final look at DISPATCH we allow the TIP to run (next month we look at the TIP code) and check if it is time yet for a CWID (every eight minutes please) and then we loop back to start and check status again. If it is time for CWID, we send it.

The CWID routine, added to Doug Lockhart's orginal code for Americans by Hank Magnuski, KA6M, puts the 8273 into bit-transparent mode and sends CW dits and dahs. No address or control field is forced onto this data, and it is not packetized. The CWID is the longest, grossest part of packet work. In the time it takes to send the CWID, much data could have traversed the link. If you are now reading the LIP program code as you should be, you will notice that the CWID code is assembled with the LIP program and physically resides at the top of the TIP PROM two. This is just Hank's implementation, it could be in the TIP source code. It is exactly 256 bytes for CWID and there is probably no way to get rid of the requirement. Being as your transmitter must send it, there is really nothing clever that we can do with it (such as send it on a different modem tone) since it represents time lost to data transfer. If each packet we sent had our call sign in it (such as the WB4JFI call sign link-level addressing system), we might petition the FCC to drop the CWID. It is sent each eight minutes unless no packets have gone out in the previous eight minutes. Because it constitutes the only valid identification of our transmissions at this time, the speed of transmission is 18 wpm (less than 20 wpm to satisfy the FCC).

Next month we will examine the TIP ( Terminal Interface Program) in detail. The TIP we will discuss was orginally written by Doug Lockhart and has been modified by Cal Teague allow features we will need later in our packet networking. There are several flavors of TIP, depending on what you want to do, and great variation is possible. I apologize for not going into much greater detail on the LIP, but discussing each instruction would require more room than just printing the well-commented code (which space does not allow). Copies of the program may be obtained from AMRAD for media costs (the paper, disks, ribbons and postage add up). Contact AMRAD at 1524 Springvale Avenue, Mclean, VA 22101 for copies. The code is in the public domain and has found a place on several phone line libraries around the country in various stages. Writing AMRAD ensures you receive the latest and greatest version, including the AMRAD Magnuski-style repeater code written by Jon Bloom, KE3Z.

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**AMICON Teleconference**

Developments aimed at advancing the planning effort for AMICON, the AMSAT International Computer Network, took a positive step 27 March with a continent-wide conference call. Representatives of AMSAT, AMRAD, Tucson Area Packet Radio, Bay Area and Northern New Jersey Packet Radio Groups participated.

The special conference bridge was prepared by W4OWA and donated by AT&T for AMSAT use in furthering Amateur Radio satellite objectives. It was the same type of bridge which afforded the amateur radio world the excellent coverage of UoSAT-OSCAR 9's launch last autumn.

Hank Magnuski, KA6M, who is AMICON System Engineer, represented the Bay Area. Den Connors, KD2S, spoke on behalf of the Tucson group. Steve Robinson, W2FPY, who is AMSAT's Director of Research and Development, spoke for the Northern New Jersey group. Paul Rinaldo, W4RI, President of AMRAD, represented that organization. Representing the Operations Directorate of AMSAT were Rich Zwirko, K1HTV, Operations Vice President, and Bob Ruedisueli, W4OWA. Vern Riportella, WA2LQQ, AMSAT Executive Vice President, chaired the meeting.

The meeting focused on key issues concerning start-up of AMICON operations of the Phase IIIB SSC (Special Service Channel), what types of modulation should be used for an interim standard; for a long-term goal; protocol updates and compatibility questions; local area net interfaces; potential for inter-SSC collision. The meeting lasted for about 90 minutes. Specific follow-up actions were to be taken by KA6M, W4OWA, KD2S and K1HTV. Future meetings of this type are to be held. Everyone present indicated they were gratified at the progress made. Thanks, AMSAT Satellite Report.

**AMSAT Video Tape Library**

AMSAT's long-awaited video tape library officially began operations on 1 April. The purpose of the library is to provide AMSAT members access to the video tape produced by W4MID (and others) describing AMSAT and the amateur space program. The tape has received rave reviews and is intended for presentation at club meetings, forums, etc.

The demand is expected to be great so you should get your reservations in early. Tapes will be available on a loan basis, first-come, first-served. Full details may be obtained from the AMSAT Video Tape Librarian: Roger Johnson, WBØGAI, 1627 36th Ave. Court, Greeley, CO 80634. You must enclose a s.a.s.e or IRCs plus mailing label. A $25 deposit is required. Borrower pays a small fee. Inquire by mail only to WBØGAI. Thanks AMSAT Satellite Report.

**Communications Software**

Hayes Microcomputer Products Inc. has just issued a "Software Vendor Directory" which lists communications software which is compatible with their modems. The directory includes listing on: computerized bulletin boards, remote consoles, answering systems, programs to automatically log onto networks, and file-transfer programs.

For a copy, write: Hayes Microcomputer Products Inc., 5835 Peachtree Corners East, Norcross, GA 30092.

**Commodore VIC-20 RTTY Interface**

Fred N. Howard, W6ORF, 1338 Valley View Rd, Glendale, CA 91202, is seeking information on how to interface his VIC-20 computer with his teletypewriter equipment.

**TRS-80 Amateur Radio Software**

Gabriel Dominguez, Travesia Finisterre, 6. La Coruna, Spain, would like to receive copies of any Amateur Radio software that will run on a TRS-80 (tm Radio Shack) Model I computer.

**1200 Baud, Anyone?**

George Gadbois, 141 Maple Ln, Lancaster, PA 17601 is interested in contacting anyone within vhf range who can get on the air with 1200-baud ASCII. He has a Cermetek modem ready to go. He adds that N3AY, K3NCY and WB3CSY are working on 1200-baud modems.

**Telephone Numbers**

When sending manuscripts or correspondence to QEX, if there are no problems doing so, please include a telephone number where you can be reached by other experimenters. Please indicate whether it's a work or home number or include something to let people know when they can call.

# Components

Conducted by Mark Forbes,* KC9C

It seems hard to believe, but CMOS technology was invented more than 14 years ago by RCA. For low power, it has been champion, but density of the IC die and speed have been the shortcomings. Recently, several developments have put these drawbacks to rest and put CMOS into the forefront. Several of these new devices are highlighted this month.

### National NSC800 Microprocessor

National's most recent entry into the microprocessor field is their pride and joy, the NSC800. The NSC800 and its family represent a significant advancement in CMOS microprocessors. The NSC800 operates using the instruction set of the Zilog Z80 and uses architecture similar to the Intel 8085.

The architecture is similar to the 8085 in that it uses a multiplexed address/data bus, and other external pins are the same as the 8085. However, it is important to note that the two are not pin-for-pin compatible, as the pinouts are different. As a board-level component, the functions are the same however.

Included in the family of peripherals are the NSC810 RAM-I/O-Timer (similar to the 8155) and the NSC830 ROM-I/O (similar to the 8355). Adding an address latch to the system will allow the use of the new 2k x 8 CMOS RAMS and the new 27C16. With these components, a complete CMOS system is possible.

The NSC800 boasts a clock speed of 2.5 MHz, operates on 5 volts only, and dissipates only 50 mW -- truly impressive specifications. For more data on this family, write to: National Semiconductor Corp, 2900 Semiconductor Dr, Santa Clara, CA 95051.

### 74HC High-Speed CMOS Logic

National, again, and Motorola have entered into a "mutual sourcing" agreement in the production of a new logic family which looks destined to replace both TTL and standard CMOS in most applications. The family, designated 74HC, was developed independently by the two manufacturers and then joined together for production by an agreement between the two companies.

*1000 Shenandoah Dr, Lafayette, IN 47905, 317-447-4272, 2300-0230 UTC weekdays, until 0230 weekends.

The first of the logic family to become available is the venerable inverter, the 74HC04. Several other functions will be available shortly, and a very complete line of logic functions will be available in about a year and a half when the complete family is in production.

### CMOS EPROMS

A virtual invasion into the EPROM market has taken place in the last few months by the combined CMOS forces.

The first entry into the CMOS EPROM family was, once again, by National Semiconductor. These first product was the 27C16. The 27C16 is a pin-for-pin and functional replacement for the old standard, the 2716. The part works quite well, and power consumption is incredibly low.

Following shortly behind was Intersil. The Intersil parts are available in one of two configurations: the IM6657 which is 2k x 4 and the IM6658 which is 1k x 8. The additional feature of these parts is an onboard address latch. Intersil can be contacted by writing to: Intersil, Inc., 10710 N Tantau Ave, Cupertino, CA 95014.

Just introduced by Fujitsu is a most interesting part, the 27C64! This incredible part is a CMOS 8k x 8 EPROM. To the naked eye, the size of the die is virtually equal to that of their NMOS 2764. These parts will be available through distributors in the early summer, but samples have proven quite impressive. National is also working on a 27C64 as well as a 27C32.

The prices for the currently available parts are shown below, but expect all prices to come down quickly.

| | | |
|---|---|---|
| 27C16 | $21.00 | (1 to 24 pieces) |
| 27C64 | 140.00 | (1 to 24 pieces) |

### Motorola MC 1374 TV Modulator

Recently announced by Motorola is a single-IC TV modulator. This part includes an fm audio modulator, sound carrier oscillator, rf oscillator, and rf dual-input modulator. In other words, it takes care of **both** audio and video — a very useful part indeed! The part operates from 5 to 12 volts at 13 mA and transmits on channel 3 or 4. The price is in the $5-7 range for single pieces. A very detailed data sheet with application notes is available through Motorola at: Motorola Semiconductors, PO Box 29012, Phoenix, AZ 85036.

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