

# RTTY

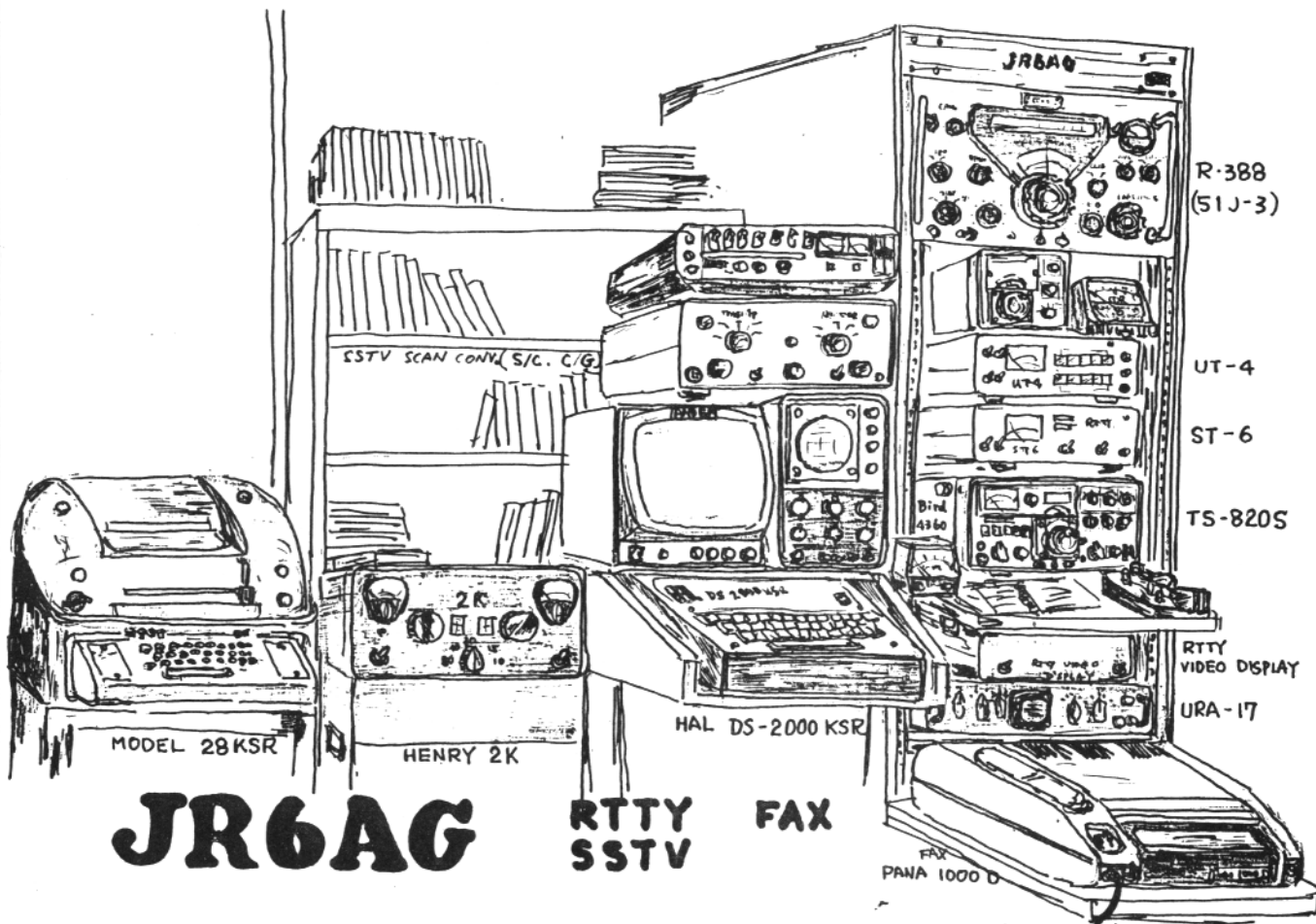
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# JR6AG

RTTY  
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# RTTY JOURNAL

DEE CRUMPTON, N6ELP formerly KA6NYW  
OWNER-EDITOR  
POST OFFICE BOX RY  
CARDIFF-BY-THE-SEA, CA 92007

JOHN P. GOHEEN, KA6NYK  
ASSOCIATE EDITOR

BUSINESS OFFICE  
1155 ARDEN DRIVE  
ENCINITAS, CA 92024  
TELE: 714-753-5647

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FROM PAGE 4

## TUNE DISPLAY

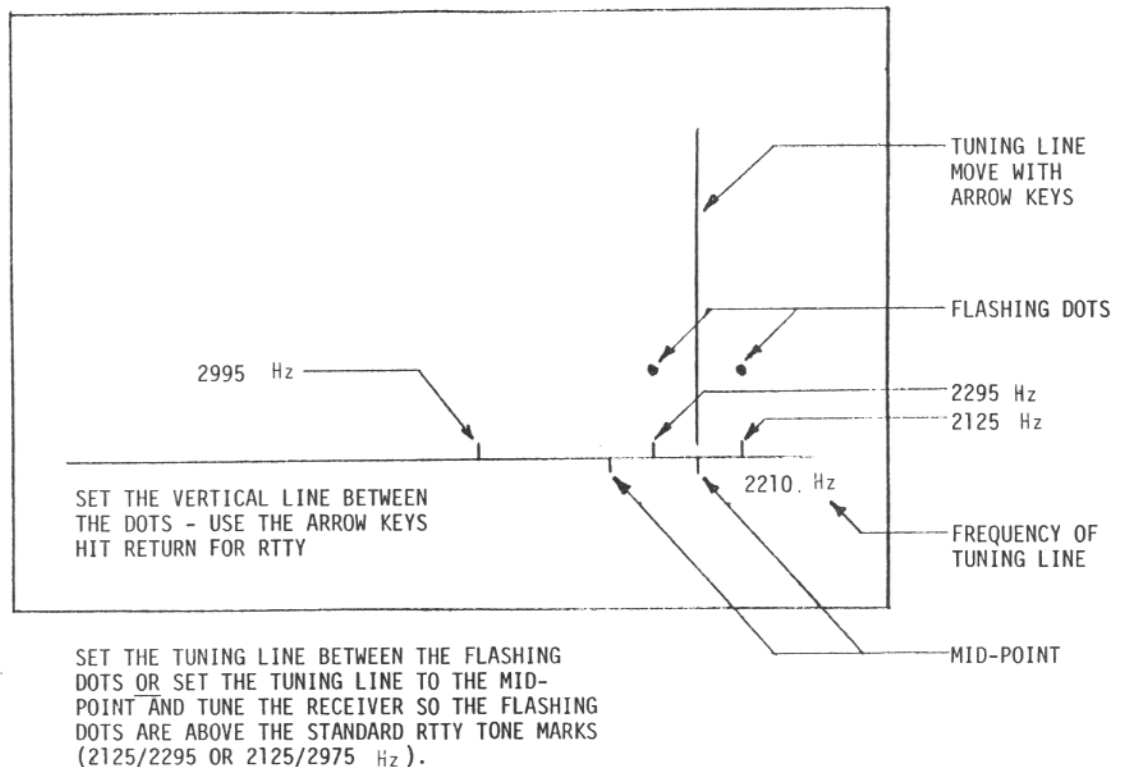


Figure 3



## APPLE COMPUTERS AND RTTY

by George Hammon, WA6CQW  
14215 Pecan Park Lane Space 73  
El Cajon, CA 92021

The following product review will explain how to put your Apple Computer on RTTY or ASCII. This program will run on an Apple II with the Applesoft language card or an Apple II plus. One disk drive with 48K of memory is required. The program will boot with either 3.2 or 3.3 DOS. The Amateur wanting to get on RTTY or the Amateur who has been putting off getting on the local repeater---read on and see how simple, inexpensive and effortless the EGBERT RTTY PROGRAM is.

### RTTY PROGRAM CAPABILITIES

Transmit and Receive at 60, 67, 75 or 100 WPM.

Transmit and Receive at 110 baud ASCII.

Receiver tuning is accomplished using the Apple II hi-resolution graphics display.

While receiving, the program has a type-ahead capability to formulate your reply.

End of line indication provided so that a carriage return can be inserted.

Break operation without dumping the type ahead buffer.

N-key rollover is provided on transmit. That is... if you type faster than the system is sending characters will not be missed.

Provision is made for up to nine canned message, CQ contest, QSL info etc.

Automatic CW ID 100 Hertz below the mark tone.

170 Hertz shift on transmit.

Tone reversal, change from 2125 Hz: mark (low) and 2295 Hz space (high) to 2295 Hz mark and 2125 Hz space. Save received text or pictures to the Apple II Disk.

### CONNECTION TO YOUR RIG

\*\*\*\*\*WARNING\*\*\*\*\*

If your rig is not isolated from the 110 volt line by a transformer, then severe damage can result to the Apple II.

All connections between the Apple II and your rig should be made with

shielded single conductor wire. I used 8401-100 from Belden. The first connection I made was from the Apple II cassette input to the receiver audio. Keep the audio level at a "listening level" or damage can result to the Apple II. The next connection is from the cassette output to your transmitter mike jack. Some rigs such as the Midland VHF series do not have a mike gain control. You will have to construct a resistor network shown in figure 1. You may have to adjust the potentiometer for proper level of modulation. If your transmitter has a mike gain control circuit in Figure 1 is not needed. The Apple II game port can be used to key your push to talk. Use the circuit shown in Figure 2. If your transmitter has VOX, the push to talk circuit is not required.

### RUNNING THE PROGRAM

Well, all of the work is done, now for the fun. Insert your Egbert disk in the disk drive and boot the system. Remember, if you are using an Apple II with the Applesoft Rom Card, the switch on the Rom card must be up. The boot process will load and execute the RTTY program. The program will screen display a prompt for a selection of either Baudot or 110 baud ASCII. You will make your selection by pressing computer key "A" for ASCII or "B" for Baudot. The program will default to Baudot by pressing the return key. When Baudot is selected the screen display prompt will ask for a speed selection. The return key will default to 60 WPM.

The next screen display will be the RTTY MENU with the following options. The options are: 1. set frequency. 2. reverse tones 3. receive 4. transmit 5. change mode 6. print the buffer 7. message loader 8. quit. Let us briefly look at each one at this time to better understand where we are heading. Set frequency displays a Hi resolution graphics display that is used to properly tune the received signal. Reverse tones simply reverses the present tone condition. The default tones are 2125 Hz for the mark and 2295 Hz for the space tone. The receive option causes the program to go to the receive mode. The transmit option causes the program to go to

transmit mode. Change mode causes the program to rerun so that a reselection of ASCII, Baudot or speed can be made. The print the buffer is a sub program that will print either to the screen or to your printer text or pictures that have been saved to disk. The message loader option is a sub program that lets you create "canned messages." The quit option allows you to terminate the program.

We will now continue with the RTTY menu and select the option 1. set frequency. A hi-resolution display will now appear on the screen (see figure 3). This will be used to adjust the receiver for the proper tones or adjust the computer to understand the tones being received. Shown on the display is a vertical line that represents the criterion that the Apple will use to differentiate between the mark and space. In the lower right hand corner is a printout of the frequency that corresponds to the vertical line. If you are receiving RTTY there will appear on the screen, two flashing dots. Set the vertical line between the flashing dots by using the arrow keys or use the receiver tuning to position the dots on either side of the long vertical line. The flashing dots are the decoding of the received mark and space (the mark being on the right side and the space on the left side. For reference, three short vertical lines are provided to indicate the standard frequencies. If the receiver is set so the proper RTTY tones are being received then the long vertical line should be set half way between the mark and space short vertical lines. In other words, at the short vertical lines pointing downward. It is not required that the receiver be tuned to RTTY tones just as long as the tall vertical line is set between the flashing dots. Let us now press return and we will see RTTY printing out on the screen. If you are using the RTTY program on the low bands, it may be necessary to connect an audio filter between the receiver audio and the Apple II cassette input. If you use a filter like the tuneable MJF Model 751, there is an interaction between the Apple II tune routine and the filter setting. One procedure (of several) that can be

# VHF COLUMN

## by JOHN

JOHN CUNNINGHAM, WA9WJG  
POST OFFICE BOX RY  
PERRYSVILLE, IN 47974

March has arrived, doesn't that mean spring? As this is written in mid-February, the snow is 22 inches deep here in west central Indiana. I am sure thankful for the Jeep, everyday (except for the 25th of the month - payment day.)

With the WX the way it is there are many RTTYers working on the goodies that they acquired last year at the 'fests. There are a few guys in the area here who have acquired ASCII machines. I have worked some of these guys on the air with my TRS-80, I do not have an ASCII machine yet. I guess that is part of the beauty of the computer system, you can go both ASCII and Baudot and work 'em all.

I have seen some WRU systems running ASCII, it looks like the ASCII is taking hold real fast. As I see it this is what makes Amateur Radio so fascinating, it always is changing to keep up with technology and to advance the field of communications.

While we are all suffering from "cabin fever" it is a good time to look over the shack and see where we could make some improvements. The winter operating time is too often a case of "if I had just a little more range." Suffering from this too many times this winter myself, I think it is time to make plans for what will be on the "work list" for next summer.

First, let us look at the record of what has been done. The station here, was moved last spring. The previous QTH was high, kinda hill top. The present is in a valley. The tower was at 60 feet, now it's at 70 feet. The feed line was R8B, it is now  $\frac{1}{2}$  inch hardline. In spite of these improvements in the antenna system itself, the range is less, due to a lower elevation. This is the reason I want to improve my system. We each have our reasons.

It has been proven to me, again and again, that there is no substitute for a GOOD antenna system. So, one solution to getting more range would be to raise the tower even more. How

much is really practical? A bigger antenna would help, of course but, how much bigger? ( You gotta keep it up you know.)

Another solution could be a receiver pre amp and a linear. How much would it take AND how much will all of this cost?

Rather than go into this in a haphazard way, why not do a little research. A bit of time spent reading and figuring may just pay off in, performance and cost effectiveness.

Be sure to read next months' column to see how this may be worked out. You may be able to use some of the solutions yourself and perhaps even foil ole "Murphy" along the way.

If you have solved some of these problems yourself, let me know about your methods. I can pass them on to others here in the JOURNAL, and we all will "gain." hi hi.

Was that Hi gain!

Isn't it amazing what a RTTYer will do to make his "tweedle-tweedle" heard a few more miles down the way?

73 and CUL John, WA9WJG

---

### APPLES CONTINUED

used is as follows: Adjust the filter center frequency to midway between the mark and space. Adjust the filter selectivity to the bandpass of the RTTY tones (170 Hz for narrow shift). Set the Apple II tune routine long vertical line to the midpoint between the mark and space. Set the receiver tuning so that the mark and space flashing dots are at the appropriate marks on the screen. The short vertical line pointing upward. If you use a filter like the Flesher ps-170 (which is fixed tuned and set up for narrow shift), set the Apple II tune routine long vertical line midway between 2125 and 2295 Hz (the default condition). Adjust the receiver tuning so that the flashing dots are on either side of the long

vertical line.

### TRANSMITTING RTTY

To change from the receive mode to the transmit mode press (escape T keys). When running the program for the first time you will have to adjust the potentiometer (see Figure 1) for the proper mike gain on rigs without mike gain controls. Five seconds of diddle will be sent before your text. Continue to type your reply. A backspace is provided for correction until the sending routine catch's up with you, then it's too late. If you have any canned messages they may be sent by pressing the escape key along with numbers 1 thru 9. To terminate transmit and return to receive, press escape Q keys. Your call will be sent in CW and then the program will return to receive.

### MESSAGE LOADER

When you select the MESSAGE LOADER menu option the Message Loader sub program is executed. This sub program is used to create canned messages. A total of nine messages can be created. There is no limitation on the length of your canned messages, however, the total of the nine canned messages must not exceed 133568 characters. The Message Loader program is menu driven and has the following options: 1. create a message 2. add a message 3. look at message file 4. delete last message 5. exit.

Let's look at this menu now. Create a Message File, this will delete any existing Message File and allow you to create a new file starting with message number one. After a message has been entered, pressing escape key will enter the message in the file. Pressing the escape key at the start of a message will cause the program to exit the mode. Add to message file. This option will allow you to add a message at the next available message number. Look at Message File, this option will allow you to inspect the message file. Delete last mes-

sage. This option will allow you to delete the last message file created. This option is useful for deleting special messages created for one time use. Exit, this will allow you to return to the main program. After the 65th character of a message has been input, the next character is shown in inverse. This indicates that 7 more characters can be input before reaching the end of the line. A carriage return must be sent before the 7 additional characters are used up. The canned messages are useful for traffic handling, standard greeting, description of your station and special CQ contest messages.

PRINT THE BUFFER

Selecting this option from the menu will cause the PRINT THE BUFFER sub program to execute. This sub program is used to print to the screen or to a printer the files that were saved in the receive mode. The messages that are saved to disk are numbered sequentially starting with the number one. The sub program will prompt for the message number to be printed.

The program will prompt for the printing to the screen or to your printer. When you select the print mode, the program will prompt for the printer slot number and then ask if the printer column width is to be set. The program supports two methods of setting the printer column width, 1) Executing a print (control I 80N) on which sets the column width to 80. 2) Poking a width into the machine location. If this is selected, the program will ask for the location and width. If your printer does not use one of these methods for setting the column width the printer default width will be used.

Caution exiting the PRINT THE BUFFER sub program returns you to the main RTTY program. If from the main program, the ESC S function (save to disk) is pressed, previous saved files will be overwritten. Files that need to be retained should be printed at this time. When exiting the program, an option is presented for deleting the saved files. This option should be used if all messages have been processed.

I hope that everyone finds this review of the EGBERT RTTY PROGRAM interesting. The Amateur with an Apple computer will have no excuse to not get on RTTY. This program is beautifully written and for the (approximately \$40.00) is like I originally

said, the simplest, inexpensive and effortless way to join the gang on the green keys. I really think Dub Egbert WOMMM has a fine program. If you want further information contact W.H. Nail Company, 275 Lodgeview Dr., Oroville, California 95965.

MIKE CONNECTION

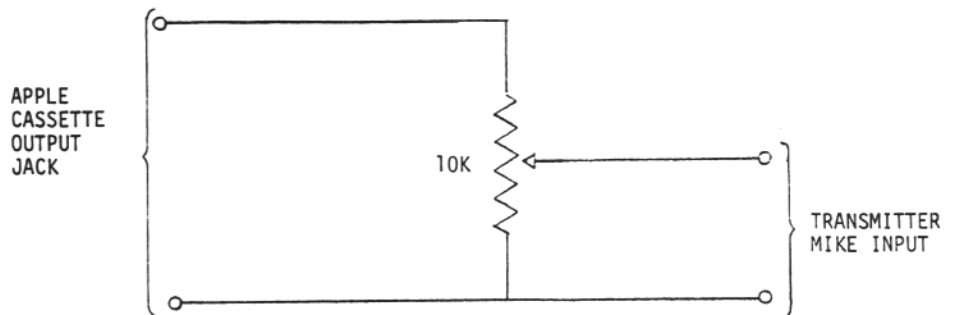


Figure 1

Figure 3 will be found on page 2

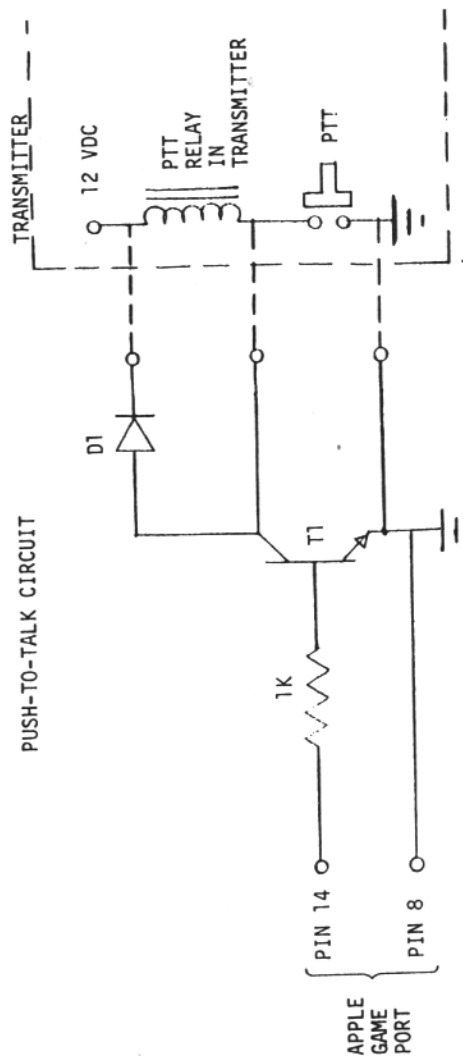
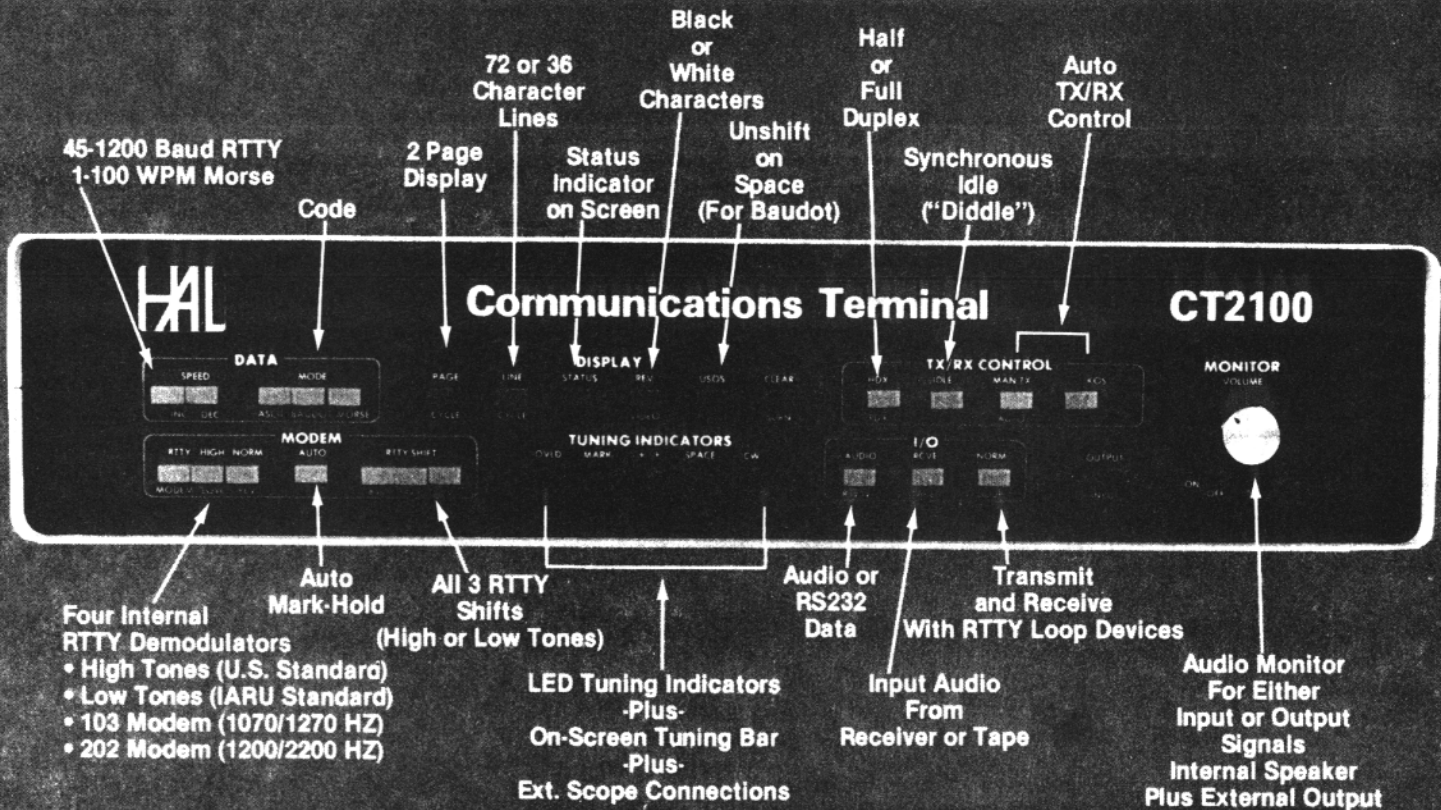


Figure 2

T1 - NPN TRANSISTOR, E.G. 2N2222  
D1 - DIODE, E.G. IN914

# CT2100

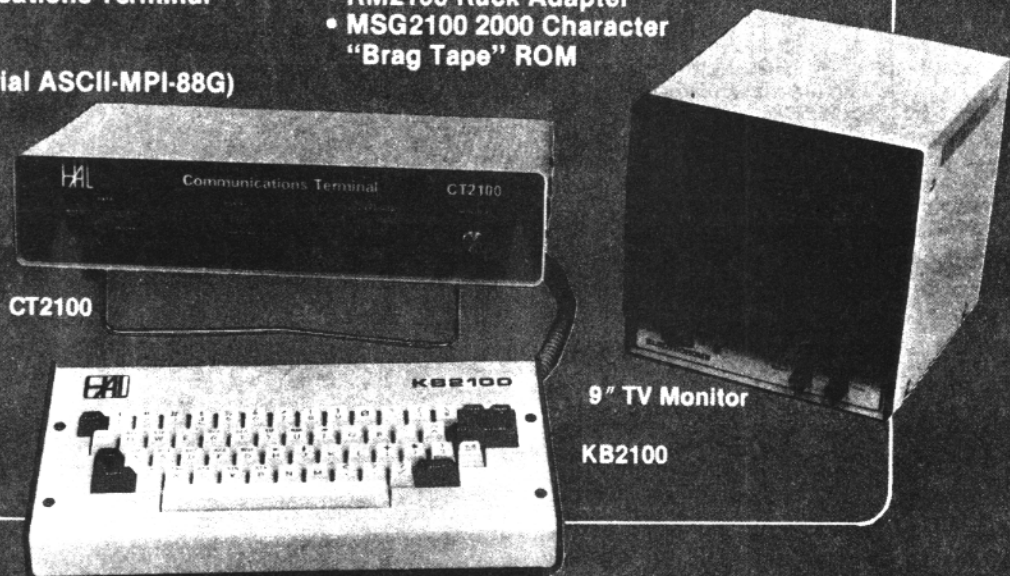
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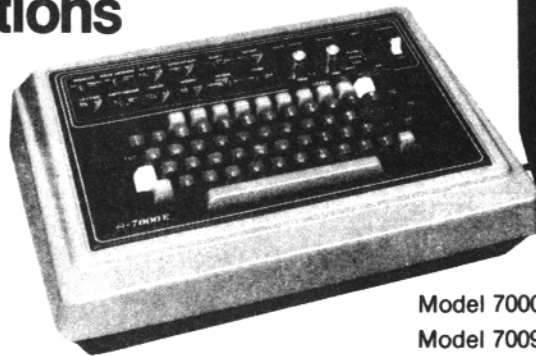
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**7-Channel Battery Back-Up Memory**, the Theta 7000E has seven keyboard-selectable, non-volatile, random access memory channels each of which can hold 64 characters. Data in these memories is alterable at any time and is retained when power is removed. Messages in these memory channels can be repeated 1 to 9 times via keyboard command. All channels may be daisy-chained for continuous read-out. Channel number in use is indicated on display.

**Wide Range of Transmitting and Receiving Speeds**, 5 to 50 wpm in Cw with autotrack on receive. Standard RTTY speeds of 60, 67, 75, and 100 wpm Baudot code and 110, 150, 200, and 300 Baud ASCII code.

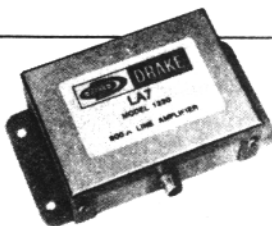
**Self Contained Demodulator**, three-step shift selects either 170 Hz, 425 Hz or 850 Hz shift with manual fine tune control of space channel for odd shifts. High/low tone pair select. Mark only or space only copy capability for selective fading.

**CONVENIENT KEYBOARD FEATURES**, automatic keyboard-operated transmit, (KOX) or manual keyboard transmit. **Unshift on space**, reverts to LETTERS case after reception of each space character in Baudot code. **CR/LF is automatically inserted** every 60, 72 or 80 characters while transmitting. **Cw identification**, in RTTY mode. **Echo function**, prerecorded cassette tapes can be read and transmitted. **Test messages**, "RY" and "QBF". **Transmit word mode**, characters can be transmitted in word groupings.

**Crystal Controlled AFSK Modulator:**

High Tone Pairs	Shift	170 Hz	425 Hz	850 Hz
	Mark	2125	2125	2125
	Space	2295	2550	2975
Low Tone Pairs	Shift	170 Hz	425 Hz	850 Hz
	Mark	1275	1275	1275
	Space	1445	1700	2125

- **Printer Interface for Hard Copy**, all modes for parallel ASCII printers. Loop keyer for conventional teleprinters.
- **Composite Video Output**, for any standard video monitor.
- **Kansas City Standard AFSK Output**, KCS tone pair for ASCII.
- **Large Capacity Display Memory**, two page display memory contains 32 X 16 lines per page.
- **Split-Screen**, with a keyboard command, the display can be divided in two; the upper half for transmit and the lower half for receive. Messages can be composed while receiving.
- **Buffer Memory**, 53 character type-ahead keyboard buffer.
- **Word Wrap-Around**, in receive mode, word wrap-around prevents the last word on a line from becoming split in two. Moves whole word to next line.
- **Automatic Letters Code Insertion**, if desired, LETTERS (diddle) code can be transmitted continuously in a pause of transmitting from the keyboard.
- **Audio Monitor**, a built-in audio monitor circuit with automatic transmit/receive switching enables checking of the transmit/receive tones.
- **Transmitter Keying Circuitry**, keys either grid block, cathode keyed, or solid-state transmitters.
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- **Weight**: 11 lbs (5 kg)
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I GOT HIM

# DX RTTY

## BY BILL



HE GOT AWAY

SNYDER, 1514 S. 12th Street, Fargo, ND 58103

JT1KAA appeared on the bands recently, and it really caused some excitement. OZ1CRL reported hearing him, but the Mongolian worked only two stations and then went QRT. F8XT also heard and called him, but no contact. Jean with 167/160 was really excited because he needs Zone 23 and 24 (who doesn't?). So the rumor flew around the DX community: Mongolia in Zone was on RTTY.

Then ON4UN, John, a newcomer to RTTY, but no slouch as a DXer, nailed the JT station. When John swung his beam in the direction of Mongolia, the signal disappeared (RST 000). Further beam pointing put the signal (peak) (RST 599) at 150 degrees, which from Belgium points in the general direction of Italy. So, John quickly told the JT station to "stop the game", and with that the pirate disappeared!

A few days later, the J11 appeared again...this time to be stopped by a station who, suspecting he was calling a bootlegger, signed the call BY1SK. Again the phony vanished from the spectrum.

JT1KAA is a legitimate callsign. It is a club station and the members are quite active on CW and SSB. I have one of their cards from a recent CW contact and it is a beauty to say the least. There have been rumors running through the DX fraternity that fake QSL cards with that call are in circulation. The ARRL DXCC desk advises that only one has been turned in for credit so far, and it was obviously counterfeit.

All of the above brings to mind a recent CW QSO I heard on 20 meters. It went something like this:  
FIRST FIST: "That guy is a pirate. When I aimed the beam north, where he should be, I lost him."  
SECOND FIST: "FB, I need him for my Worked All Pirates Award!"

J6LOV should be on RTTY from St. Lucia by the time you read this.

Errol likes the 10 and 15 bands.

HT5JAR has been helping the DXers with Nicaragua. Jose wishes he had a Microlog instruction manual written in Spanish as he does not read English. Manufacturers please note: How would you like it if Kenwood and Yeasu printed their manuals only in Japanese? Jose wrote on his QSL card to me (in Spanish): "I frequently operate at 1230 to 1300Z and 0700 to 0900Z."

VQ9DO on Diego Garcia (Chagos) is back on the air after a trip to the States and now is on RTTY. He is reported to be the first station ever to work the mode from there. He is active on 15 and 20.

I1HUH reports VS1TK is active on 14090 at about 1600Z.

FW8WG is rumored to be waiting for the rest of his RTTY gear to arrive and then he will be active.

ON4UN reports a recent string of juicy DX: C53CL, CE3CEW, 9Q5HU, ZS6P, II2CAH, EA6GL, 9H1ET, OY5A, ZS3NH, ZS3NH, ZS3HR, IF3KC and 9Y4B. Make you drool? That's where the adjective "juicy" comes from!

WSHEZ reports hearing XU8DX calling VU2YK on 14086 at about 1300Z.

F8XT reports hearing or working KG4AH on 14 MHz; HT5JAR on 28 MHz at 1630Z; VS1TK, Singapore, on 14 MHz at 1500Z; and XU8DX from Cambodia.

Interesting information from Don Search, the DXCC desk Major Domo for the ARRL, indicates that to date only 32 DXCC RTTY awards have made by the league. The last one was WSHEZ. Equally interesting is the fact that to date only 53 ARRL WAS awards have been issued. The first one went to the late Boyd Phelps, WOBP, in the year 1958. Beep, as we all knew him, was one of the godfathers of Amateur RTTY. If I have my facts straight, Beep was killed in an automobile accident while taking a RTTY machine to an Amateur operator in Mexico.

The end of January was really not

good DXing for the middle of North America. There were a couple of real boomers in solar flux numbers, but geo-magnetic storms at the same time acted like a giant sponge and soaked up most of the RF energy zooming through the polar and high-latitude radio paths. In contrast, the north-south trans-equatorial paths were good, with South American, African and South Pacific stations reading out fairly well.

And...all this solar activity happened just when the Macao DXpedition tuned up on the RTTY bands. The only whisper from them was on 15 meter CW, and so weak that there was no chance for our peanut whistle. As far as I was concerned the CR9 group was only a rumor. But for European stations CR9BH was a reality. The Macao station was reported worked with a very good signal on 20, 15 and 10.

There was also a rumor that they were going to be on from HS4 and Formosa, but these failed to materialize.

UR2FU has been reported by European stations. Hellar is usually on 20 in the morning, European time. He is running normal speed and shift. He asks QSL via the Box 88 bureau in Moscow, although he has post office box 73 in Viljandi. This is the first Estonia station ever to work RTTY.

KG4AH is active on 20 meters from Guantanamo Bay around 1200 to 1300Z. Mike is having a good time filling out the DX needs for that country.

K8ND/VP2EV informs us of the forthcoming DXpedition to Anguilla, plus a short side trip to PJ7/FS7. They will operate on weekdays beginning February 23rd and ending March 4th. Everett, WA8CZS, one of the ops, has arranged with HAL Communications for the loan of two complete terminals. The main unit to be used on Anguilla will be the HAL CT-2100/KB-2100. The second HAL terminal, a new 685A portable, will be used on the PJ7/FS7

side trip. The VP2EV operation will feature a TS-830S driving an Alpha 76CA. Antennas will include a tri-bander at 50 feet, a vertical on 40 and an inverted L on 80. The side trip to St. Martin is scheduled for March 2nd, with an overnight stay. The call sign will be FGOAHR/FS7 and most operations will be conducted on 20 meters. 15 will be used if time permits. On this part of the trip the TS-830 will be used. QSL info in January 1982 issue of the JOURNAL.

It is nice to see HAL Communications helping this DXpedition to bring these countries to RTTY. With the new and compact video terminals readily available, it's a shame that every DXpedition does not take RTTY gear along with them. But then again, not every Amateur realizes that RTTY is now so easy to use. Perhaps they think a person must lug along a 28 KSR! Congratulations to HAL Communications! Your enthusiastic help is appreciated by the rapidly growing group of RTTY-DXERS.

When Mother Nature turns off the little solar fluxies for the night; that is, the fluxies that do us the most good here in North Dakota, it is like she put a great big steel pail over our antennae and grounded the handle! Nothing seems to leak through, with a few possible exceptions. But Alas, most of those that do sneak by are on CW or SSB, and not RTTY. We are located about 200 miles from the geographic center of North America, and band conditions on 20 and up really wipe us out in the evening hours here during the winter months. But with spring, things will get better, we hope.

#### A LITTLE RTTY DITTY

If DXing's just a state of mind, Please boggle me with a B Y 9 !! QTH: HT5JAR P.O.B 122, Jinotepe, Nicaragua.

This is my first solo effort for the RTTY JOURNAL. I would like to keep this the meeting place for RTTY-DXers all over the world. Skip has done well, and I hope to follow in his footsteps. So, I ask your cooperation in keeping me informed as to the who, what, when and where of DX. It's really your column, I am just the catalyst that sticks it all together. So please write me, or QSO

me with all of the DX news and gossip you can dig up. I am on the air on 20 at around 1200 to 1400 daily, 15 at 1730 to 1830, and again around 0100. My thanks to those mentioned above for their help this month.

CALL	WHO'S ON TIME	FREQ.
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9K2EC	0200	14085
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EA4AHF	0900	14085
EA5ANZ	1745	28090
EA8ZZ	2200	14082
F6DXZ	1500	28090
GM3ZXL	1700	28085
GM3ZXL	1800	21085
I1HJK	1700	28085
LA1EAA	1330	14096
LU4EGE	0100	21090
OE6HQG	1330	21090
PAOKFF	1700	21096
PY5SSA	2000	28085
PY6ABA	0100	21085
SM4JCE	1700	21090
SM6JMA	1340	14090
TI2JFP	0100	21085
VK2RT	1400	14090
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Y21GN/A	1500	21090
YB2SV	1330	14090
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ZP9AA	0100	21095
ZP9CW	0130	14090
ZS6DN	1900	21097

#### KONTEST KORNER

BARTG	20-22 Mar.82	Feb 82
73/RTTY JOURNAL	4 Apr.82	Jan 82
VK/ZL/Oceania	June 82	coming
SARTG	14-15 Aug.82	Feb 82
CARTG	October 82	coming
WAEDC	November 82	coming

7th West Coast Computer Faire March 19, 20 and 21 1982, At San Francisco Civic Auditorium & Brooks Hall. At-the-dooe \$15.00 (includes conference program & exhibits for all three days. Contact Computer Faire, 333 Swett Road, Woodside CA, 94062. (415)851-7075.

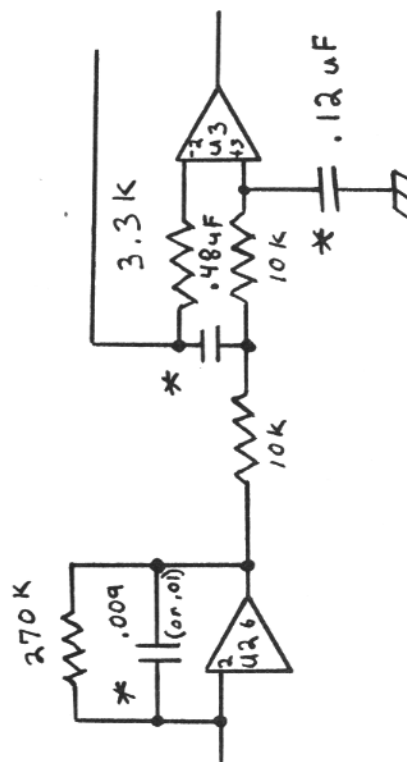
Dayton Hamvention April 23, 24 and 25th 1982. RTTYers meet at the Imperial House North. See you there. ARRL Southwestern Div. June 4, 5 and

ARRL Southwestern Division Amateur Radio HAM-COMP at the Town & Country Convention Center. June 4, 5 and 6th, 1982. San Diego, California. See you there also.

#### ST-6 MODS FOR 110 BAUD ASCII By Mike, N7RY Courtesy of Portland RTTY Society

As ASCII becomes more commonplace on the low bands, various Amateurs have tried to receive it using the ST-6 and DT600 demodulators, generally with less than optimum success, unless they modified their demodulators to some degree. This is perhaps primarily because the lowpass filters in these demodulators are quite well designed for the 5 level code at the various common speeds. The lowpass will not, however, pass 110 baud very successfully, and requires some modifications to provide optimum copy.

The two stages U2 and U3 as per the ST-6 comprise a three pole Butterworth lowpass filter, so both stages must be modified. If all impedances are to be left much as they were beforehand, we need to substitute several capacitors, as shown below:



\* Denotes changed component

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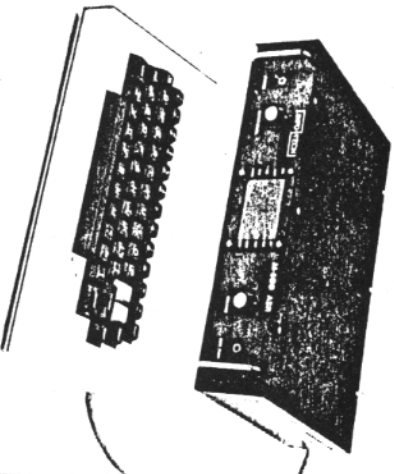
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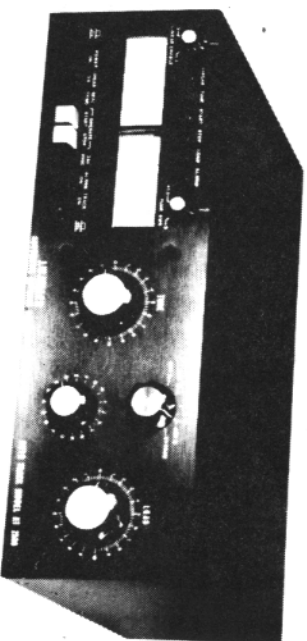
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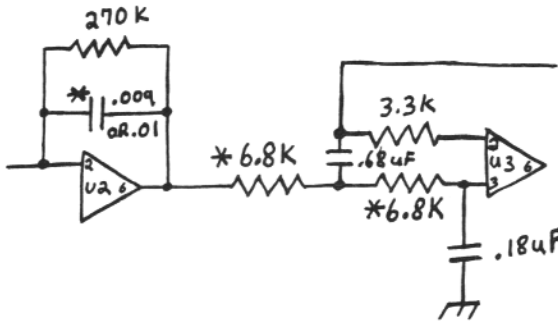
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continued from page 10

Another way to achieve nearly the same results but at the expense of a slight impedance shift, is to leave the present capacitors in place in U3 (that of U2 MUST be changed), and substitute resistors as shown here:



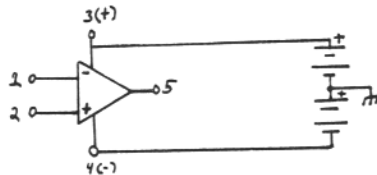
\* Denotes changed component

Either of the above modifications will not take terribly long, and will allow fine copy of ASCII. Lower baud RTTY will take a few more hits but not objectionably.

**\*\*THE OPAMP AND HOW TO TAME IT\*\***

The operational amplifier or "OPAMP" has come a long way since the early days when they were just DC amplifiers used in analog computers. They are now available as small integrated circuits and are classed as "jelly beans" by the electronic parts producers since they are so common. Yet, they are not really used heavily by Amateurs, mainly due to lack of familiarity. Additionally, they can replace many discrete components and do so in a very reproducible fashion, so if a chip does not burn out or fail, it may be easily replaced without changing operation of the circuit. For audio filters, simple amplifiers and more exotic analog data processing, opamps are quite useful, and can result in circuits that are easily tuneable by a small potentiometer rather than having to fuss with winding coils and added capacitors etc.

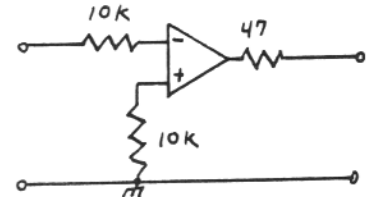
OPAMPS have five essential connections and may have several more that will be discussed later. The first two are power supply connections shown here as 3 and 4.



There is generally a positive power supply connection (3 here) as well as a negative power supply connection. Two power supply connections are normally used, one with positive and the other with negative voltages as referred to ground. Note that the OPAMP itself is not grounded but "floats." This allows the output (5 here) to be bipolar or to swing plus and minus as referred to ground. Most OPAMPS can swing to within one or two volts of the two supply lines or "supply rails."

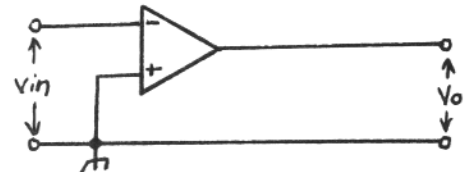
Two input terminals are generally present on any OPAMP. These are shown here as 1 and 2. Notice that there are small plus and minus signs associated with these inputs inside the triangle of the OPAMP symbol. These plus and minus signs DO NOT refer to plus and minus voltage polarities. They DO refer to the fact that the terminal designated as "-" (1 here) is an INVERTING input. A positive voltage applied to pin one causes the output to swing negative opposite or inverted to the polarity of the input signal. A negative voltage applied to 1 would send the output positive. Pin 2 is the NONINVERTING input, where a plus voltage causes a plus output, a minus input a minus output. Finally, pin 5 here is the output; this is almost always connected to one or the other of the input terminals via some type of network or feedback pathway, which may or not involve a direct DC path.

Consider the circuit below:



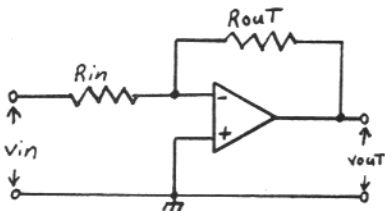
This is called an open loop amplifier since the output is not fed back to the inputs in any way. If such a path existed the loop between inputs and outputs would be "closed." The ratio of  $V_o/V_{in}$  is the open loop gain. This is usually high, say a million or more. For a very small  $V_{in}$ , the output will be fully saturated in the opposite direction of polarity. When the voltage in crosses zero and goes to the other polarity, the output will slam to the opposite supply rail voltage (less a volt or two internal loss). This circuit is useful to us in RTTY as a limiter at audio frequencies or as a Scmitt trigger or "slicer."

A real circuit might look like this:



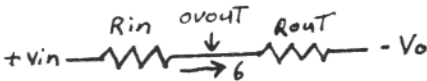
The input resistors (10K) are used to "swamp out" any small variations in the input resistance of the input terminals of the OPAMP, and to limit current inflow in the event of an overvoltage applied. The output resistor serves to limit current flow and add stability under some circumstances where a capacitive output load exists. Some OPAMPS will allow their outputs to be directly shorted without burning up, so the resistor may be deleted.

Another useful circuit to us would be a linear amplifier, one that did not saturate but produced a larger amplitude copy of whatever we put on its' input terminal. To get this to happen, we have to "close" the loop like this:

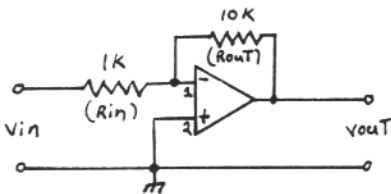


Here  $R_o$  acts as a feedback resistor. If the input is  $V_{in}$ , the OPAMP will send its' output in the opposite (we are using the INVERTING TERMINAL remember?) voltage direction until the voltage at pin 1 is the same as that at Pin 2, or in this case ground (=0 volts). At this time no current flows into the inverting terminal, so the OPAMP has its' inputs "balanced" and will maintain this state until the voltage in changes.

Now a current  $i$  flows through both  $R_{in}$  and  $R_{out}$ .  $V_{in} = i \times R_{in}$  and  $V_{out} = -i \times R_{out}$ .



When the gain is  $V_{out}/V_{in} = -i \times R_{out} / i \times R_{in}$  or just  $-R_{out}/R_{in}$ . This result tells us that the voltage out will be  $R_{out}/R_{in}$  times the input level (unless the gain would cause the output to saturate at that input level of course) and the output will be plus when the input is minus, or 180 degrees out of phase with the input. A real circuit would look similar to this:



(gain of ten or 10 Db)

We can make either or both of the input resistors variable to allow for variable gain, if we like. Note that since pin 1 is being forced to be the same potential as pin 2 by the OPAMP, the pin 2 is grounded, that pin 1 can be considered a "virtual ground", hence the input impedance of the circuit is essentially  $R_{in}$ . So we even have some control over the input impedance of the amplifier by what we use for  $R_{in}$ . The output impedance of OPAMPS is usually quite low, 2-50

ohms or so, since they are current drivers or sources.

Try these circuits out with some common OPAMPS like 741 or 1458 and see how they operate.

#### AUTOSTART MOTOR SWITCH

By Jim Lupton, VK2BVJ

20 Penshurst Ave,

Penshurst 2222 NSW Australia

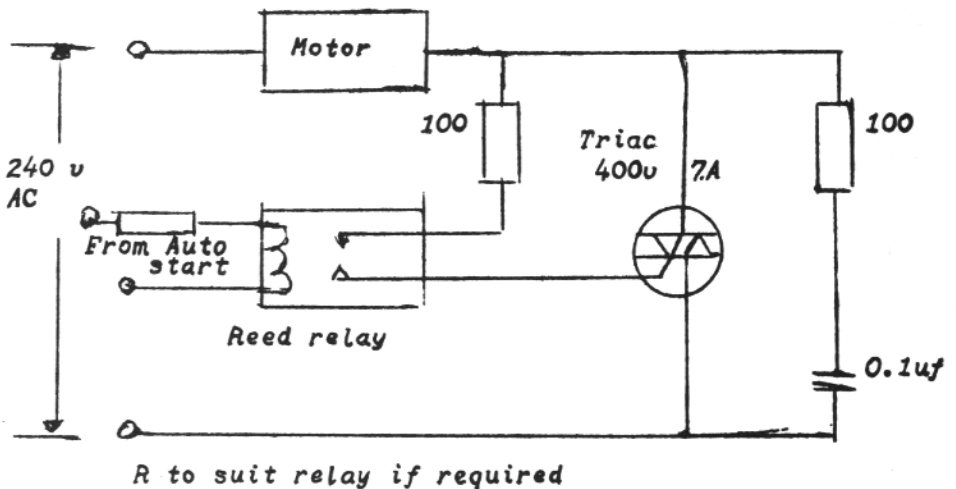
A problem encountered with TUs that have autostart facilities is the noise spike generated by the motor control relay supplying power to the printer, when the TU detects an incoming RTTY signal and switches on the printer for autostart copy. Relays with contacts with sufficient current ratings are expensive and sometimes automotive horn relays are pressed into service, degrading the professional finish of many home brew TUs.

The perfect solution was developed by Jim, VK2BVJ, with a tiny solid state circuit that can even be tucked away in the innards of your printer somewhere. This circuit is also TTL voltage compatible and should therefore be of interest to anyone with computers or other digital equipment wishing to switch high voltage/current loads with TTL voltage level signals.

The circuit consists of a small DIL type relay which is TTL voltage compatible which fires a triac to pro-

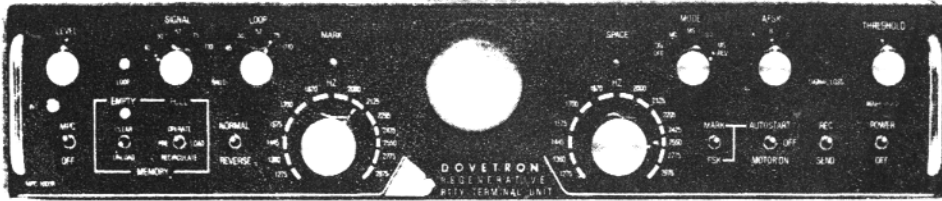
vide the motor supply. If the relay is then allowed to release, the triac will cease to conduct on the next zero crossing of the 110 Vac supply. The 100 ohm resistor and 0.1 uf/630 volt capacitor provide suppression for reactive loads such as Teletype motors.

*The RTTY Journal is proud to announce that the New RTTY Beginners Handbook is now available. It has been revised and extended to include the popular trend towards computers in its' coverage. The price will be \$8.00 in the United States, postage paid. Please add on \$2.00 for foreign mailing. The price will include an index of RTTY Journal articles published by the RTTY Journal 1956 to 1981.*



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