

**DX NEWS---**

CONTINUED FROM PAGE 12  
are RTTY enthusiasts, otherwise no one would believe it.

Jan, ZS6BBK, has had contacts with a new and rare country down that way. VP8JT, Dick, located on South Georgia has been QRV for a few weeks now and can possibly be found on the band Sundays at about 1400z. We have also heard Alec, G3MWI calling him on sked during the week days at around 2030z. The propagation has not been right here so far but some of you chaps in other areas should have no trouble. He is using only a dipole and his speed is 50 baud. South Georgia is considered a separate DXCC country. From the same area VP8LK is also active, his location is at one of the British Antarctica Bases.

RTTY activity from Puerto Rico has been somewhat spotty the past few years with KP4JM supplying most of the action. Lately there has been quite a few new signals from down that way, particularly from KP4AR, KP4ARC, KP4BJD, and KP4ZC.

Address Correction Requested  
**RTTY JOURNAL**  
P O Box 837  
Royal Oak, Mich. 48068

**RTTY JOURNAL**

A recent call from Glenn, K3SWZ, tells us that ED, VP9GE is now QRV on RTTY. He is using a SP-600, HT-37, and CV-57 TU. The TU is the I.F. type and ED is looking for a manual for it. QSL's can go to --

Ed Kelly, VP9GE  
Box 1555, Hamilton, Bermuda

There was some big noises on the band a recent Sunday afternoon. Ray, WA2PXQ/TF was on but when the smoke cleared it turned out that he was RTTY receive only. He says that the the government does not permit RTTY there. Can anyone tell us if this applies to TF nationals also?

Things have been very quiet the past month mainly due to the continued poor conditions. The CARTG Contest will have been over by the time you read this but it no doubt caused the "Big Smoke" as usual. We hope we can have a report on that activity next month.

The island hopping trip of Paul, KH6AG is still a hot item so keep on the lookout for him as he is liable to show up at any one of those rare spots quite unexpectedly.

73 de John

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# RTTY

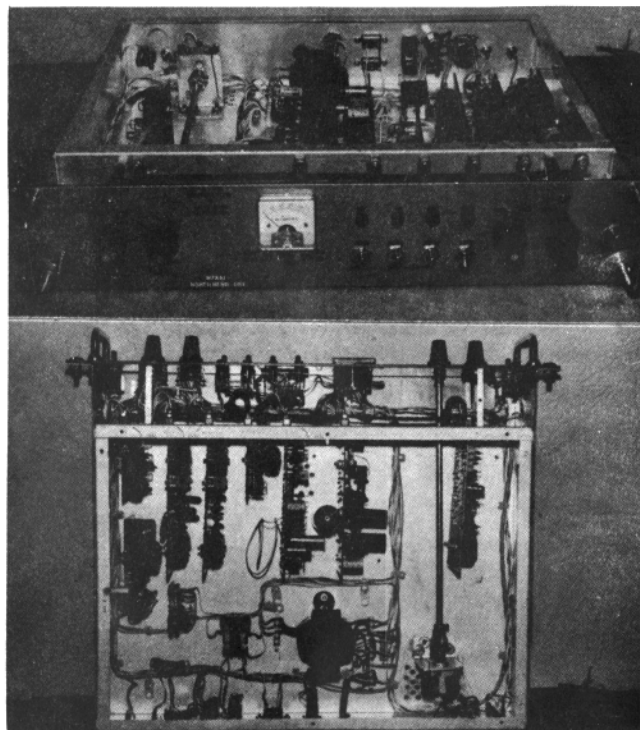
NOVEMBER 1971

## JOURNAL

**EXCLUSIVELY AMATEUR RADIO TELETYPE**

**Volume 19 No.10**

**30 Cents**



**ST-6 Demodulator built by W7AAI and W7PHM**

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**VIA AIR MAIL**  
**FIRST CLASS MAIL**



# Elliptic Function Filters for RTTY--

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Austin, TX. 78731

## Purpose of Filtering

Most newcomers to radio teletype encounter similar types of problems which they experienced in single-sideband and c.w. signal reception. One such problem is that of selecting the desired signal from the unwanted noise in the channel through the use of suitable filtering.

The purpose of this report is to provide design information that will enable the average amateur to build a good set of channel filters for RTTY at modest cost. The filter to be described was chosen because of its inherent sharpness and ease of tuning. Other design configurations, such as the Butterworth and Tchebycheff, have been used successfully but perform less satisfactorily than the elliptic function type when it comes to skirt steepness.

The sharper skirt characteristic is readily apparent when the two types are compared as exhibited on Graph 1. Shape factor and band width help to maximize the signal-to-noise ratio. The graph compares the six-pole Butterworth filter described in *RTTY Journal*, November, 1966, with a four-pole elliptic function filter of modern design.

There are basically two types of terminal units in use by amateurs. One type employs a linear discriminator while the other uses a clipper or limiter circuit. A narrow-band filter offers only about 1 dB improvement over a broadband filter when used in a discriminator type terminal unit. If a terminal unit uses a combination of both a f.m. and a linear system, then the narrow-band filter is the most desirable as the linear system is enhanced by its use.

A linear system works best on single or dual channel copy when the signal is exhibiting a slow multi-path fade. The limiter type system responds best to signal flutter or quick, shallow fading to which the limiter seeks to maintain a constant level of output.

## Construction of Broadband Filters

For some reason, there is not too much specific information available on

RTTY filters for amateur use. Digital and other types of active filters are being designed from time to time but their cost and more involved circuitry usually tend to make amateurs rely on the simple passive types of filtering. The article in *RTTY Journal* provided the impetus for the author to duplicate the filter set employed in the AN/FGC-1 military terminal unit. Sufficient test equipment was available to accurately measure the response of the constructed filters with a net result of remarkable adherence to the response curves provided. This was gratifying, to say the least, as there were many difficult component values to "bridge out". The filters were constructed on Vectorboard using 88mH toroids in series to provide the large inductances which were required. The resulting 850 Hz. broadband filters offered a good start toward a respectable terminal unit. The major drawback to using the filters is that considerable operation today is on narrow shifts of 170 Hz. or 425 Hz. For this reason the construction of a new set of narrow-band filters was begun.

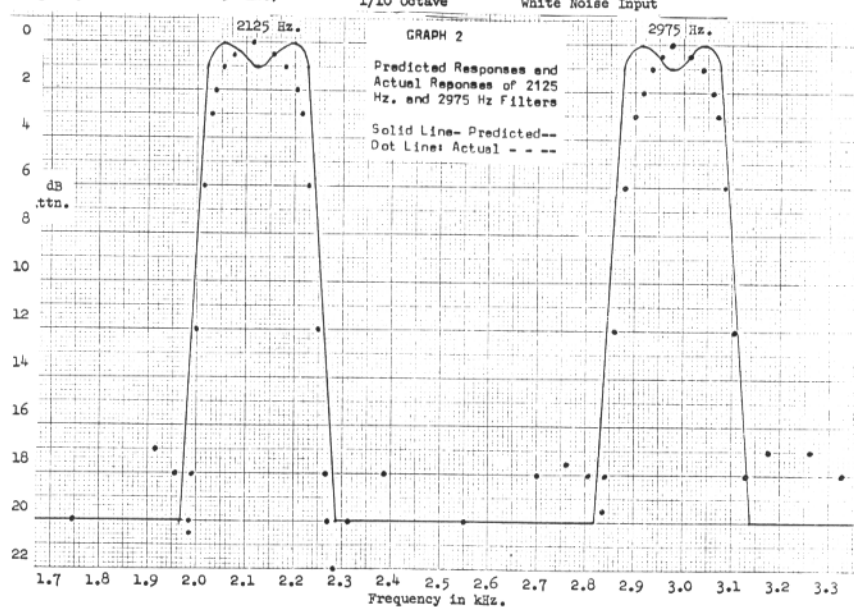
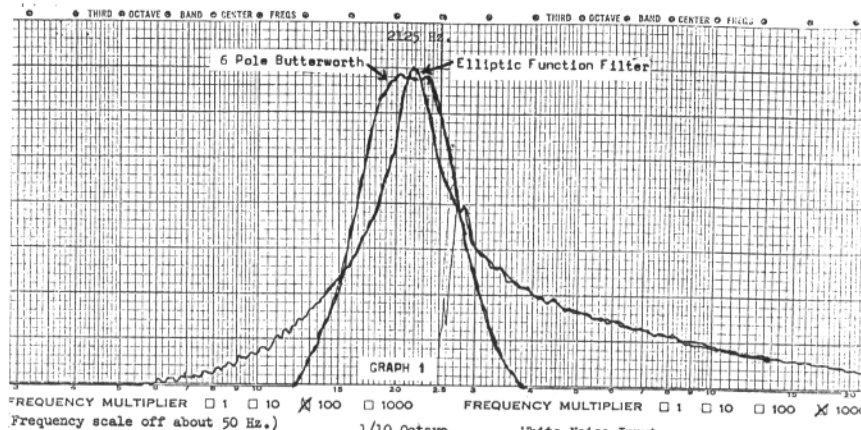
## Designing Elliptic Function Filters

One of the best sources of filter design information is found in "Simplified Modern Filter Design" by Philip Geffe. A computer was used to derive tables provided in Geffe's book which greatly simplified the calculations involved. The simplest and sharpest elliptic function filter was selected and the design was made with due consideration given to the availability of parts.

The basic design of the elliptic function filter is shown in Figure 1. All of the filters for 2125 Hz., 2295 Hz., 2550 Hz., and 2975 Hz., use this configuration.

The equation used predicted a 1 dB ripple in the passband and 1 dB down on the slopes at 200 Hz. wide. The actual lack of ripple in the passband of the constructed filters may have been caused by insufficient Q. The predicted response curves for the elliptic function filters are shown in Graph 2. This graph has the response plotted for two filters with 850 Hz. separation, namely 2125 Hz. and 2975 Hz. Equally sharp responses were obtained for the 2295 Hz. and 2550 Hz. filters. Also shown on Graph 2 are the actual curves of the constructed filters. A frequency counter and AC voltmeter

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were used to accurately plot the responses. As can be seen, the actual filter responses were slightly narrower than the predicted responses. This presents no serious drawback to the system however.

Narrow-band filters will not tolerate much signal drift but with today's modern receivers and afc circuits, drift is greatly minimized anyway. Parts layout is not critical but good quality capacitors must be used throughout the circuit or serious degradation of the response will be experienced. Do not use electrolytic capacitors.

Table 1 indicates the values of com-

ponents required for each filter. Some padding of the standard values will have to be done to obtain the value shown.

## The Ubiquitous Toroid

The 88mH toroid inductor was employed wherever possible because of its acceptable Q and low cost. Only one inductor in each filter is not the standard 88mH value. This is not too serious a problem, however, as will be shown later. Several 88mH toroids were measured on a General Radio Impedance Bridge. The average inductance was calculated to be 86.8mH. Further measurement indicates that the core of the 88mH toroids has a

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permeability of approximately 168mH per 1000 turns. This means that, by using logarithmic graph paper, a simple method of determining the number of turns required for a particular inductor can be achieved. A graph is presented for those amateurs who may find the information helpful in building the elliptic function filters or other filters.

### Tuning the Filters

The most efficient way to tune each filter would be to use a calibrated frequency generator and counter, along with a sensitive AC voltmeter. Not all amateurs have access to such equipment, but with a little resourcefulness, good results can be obtained. Try to find someone with a calibrated oscillator who will tape record about a foot or so of each desired frequency. Make a continuous loop out of each foot long tape and play back the tape while feeding the tape recorder output (4 Ohm) into the filter circuits being tuned. Using the method

shown in Figure 2, tune each combination of elements to the desired center frequency. This will be indicated by a peak in the output level. Removing a few turns from each inductor may be necessary to get exactly on frequency. Padding with capacitors is much more difficult to do and the slight change in inductance won't severely affect the filter impedance.

### Termination of Impedances

The input impedance of the filters is designed to work from the 4 Ohm speaker output of most receivers. A 600 Ohm receiver output may be connected directly to the filters by eliminating R1 from each filter. The output impedance is 150 Ohms. These impedances were chosen because of the desire to use the standard 88mH inductors. Different impedances will require different inductors. There is about a 6 dB loss through the filters. Amplification may be required between the filters and the terminal unit if diode rectification is to be used.

Frequency	C1, C2	C3	C4	L1-5	L6	R1, R3	R2
2125 Hz.	.032	.072	3.3	88	1.67	150	200
2295 Hz.	.028	.047	3.0	88	1.80	150	200
2550 Hz.	.025	.047	3.2	88	1.24	150	200
2975 Hz.	.017	.034	3.5	88	0.81	150	200

Capacitors are in microfarads

Inductors are in millihenries

Resistors are in Ohms

TABLE 1

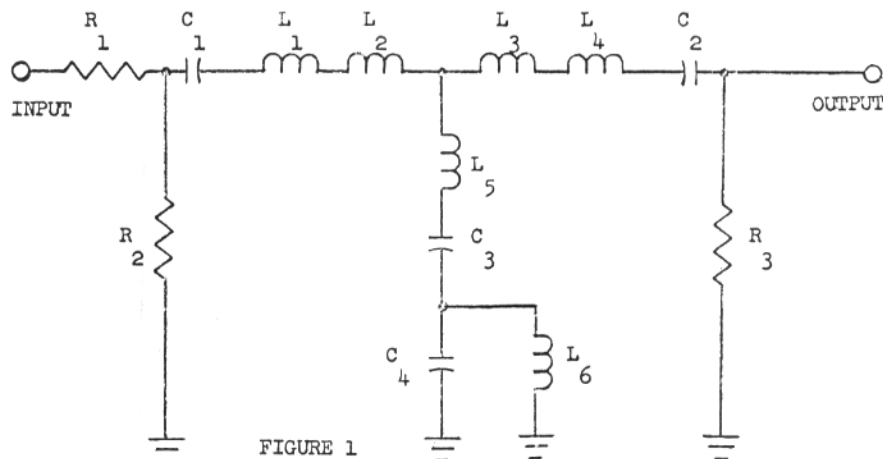


FIGURE 1

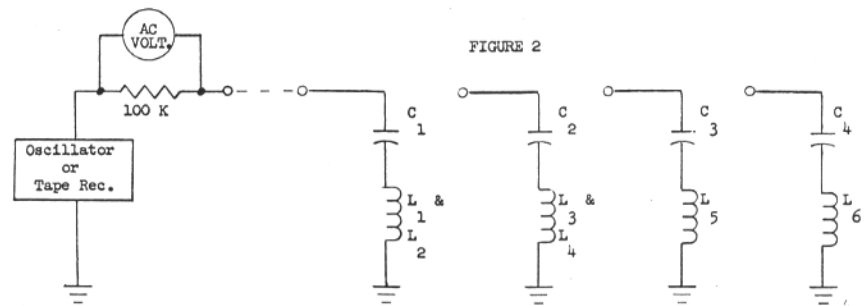
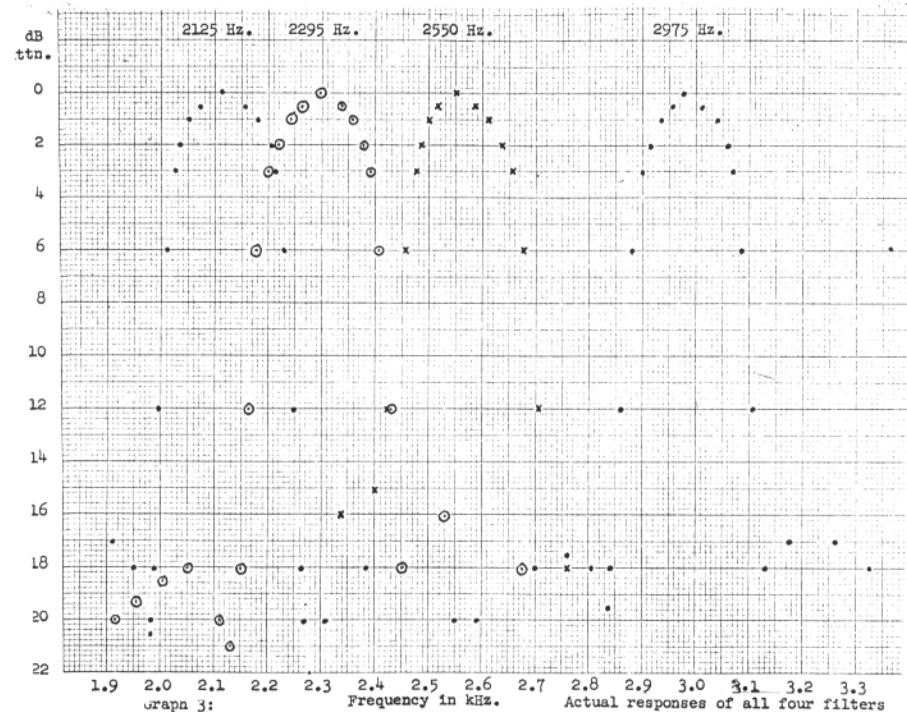


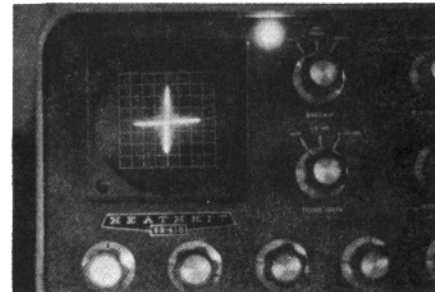
FIGURE 2



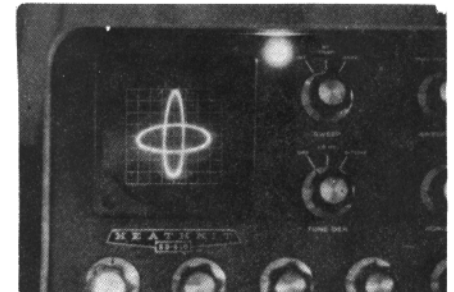
Graph 3:

Frequency in kHz.

Actual responses of all four filters



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## Results and Findings

A comprehensive graph of all four filters is shown in Graph 3. It can be seen that the minimum channel separation between the 2125 Hz. and the 2295 Hz. filters is approximately 3 dB. Separation between other combinations of filters approaches 20 dB.

Oscilloscope patterns in Figure 3 compare the familiar cross patterns used for tuning in a typical RTTY signal. The Butterworth filter pattern has a more oval shaped trace while the elliptical function filter pattern is almost a straight line. The Butterworth broadband filter allows more noise into the channel which may capture a limiter or otherwise interfere with the signal.

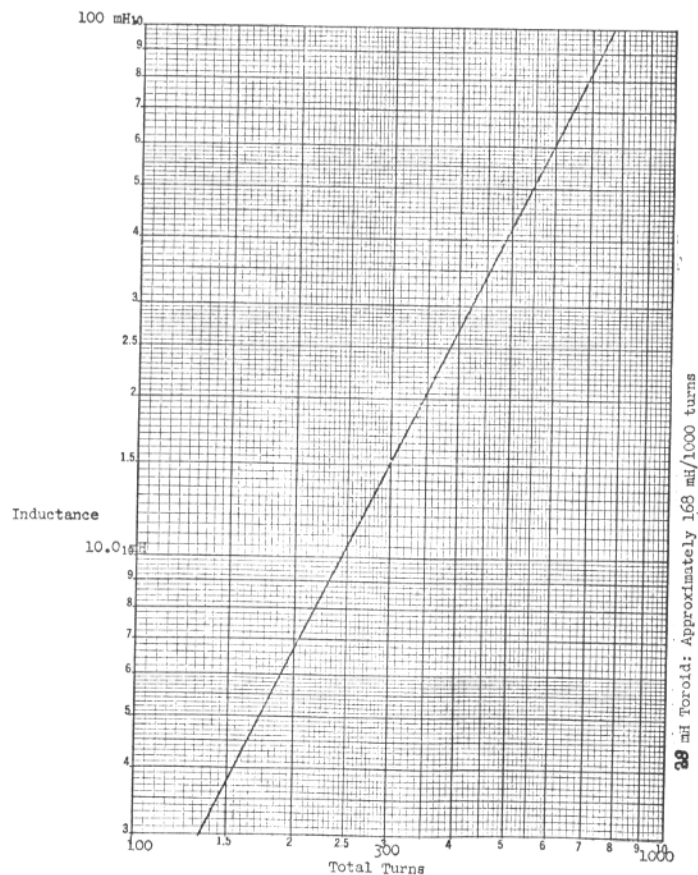
## Conclusions

Good, sharp, narrow-band filters for RTTY can be constructed by the average amateur using inexpensive components

and having limited access to sophisticated test equipment. Simple duplication of the theoretical filter design should yield the results obtained in Graph 3. More complicated designs will offer better solutions to signal-to-noise problems. This will no doubt increase the cost of constructing such filters and complicate their tuning. The lack of access to sufficient test equipment may preclude most amateurs from attempting to build such devices. There should, however, be continuing research performed in these areas by amateurs for amateurs.

There are four persons to whom the author is indebted for their assistance in making this report a reality. Richard G. Coalter for his engineering talent, Dennis M. Pierce for his report writing skills, Vicki Spraggins for her typing and patience in retyping, and Eric Sager for making me find the time to get it all together.

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## Non-Overline For Model 32

Non-Overline on the Model 32 TTY unit may be easily accomplished by modifying the unit to ignore carriage return pulses and combine the CR function with the line feed function. This can be done as follows.

1) Remove the spring attached to the CR function pawl. This causes the machine to ignore CR and also does not disengage the print suppression function realized during the carriage return. In other words when a CR signal comes along it will not print a smudge on the paper.

2) Locate the end of the CR "actuating lever" (nomenclature used in bulletin 273-B, Vol. 1) and fabricate an "L" shaped piece of steel to push this down when the line feed linkage moves down during normal line feed. The line feed linkage is just to the left of the carriage return "actuating lever" slightly higher when facing the keyboard.

The "L" shaped piece of steel (about 1" long) may be fastened under the screw at the center of the line feed linkage. That's all there is -- Whitey, WIODI, 26 Boswell Rd., Reading, Mass.

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## Hurricane Help ? -

(Editors Note) The following letter explains itself. Although we have no suggestions for the writer I am quite sure someone can be of help. Any suggestions or ideas will help a worthwhile cause. --

I use a model 15 Teletype unit with a TTL Mark II converter to copy Weather Bulletins from WBR70 in Miami during Hurricane Warnings. WBR70 is switching to 100WPM next July and I will need some better equipment before then. I wonder if any of your readers know of a source for printers that will copy 100 WPM at a reasonable price. I heard somewhere that Model 28 receive only units were available at less than a \$100 but I don't know who to contact.

Another alternative is the IBM electric typewriter used for output data on the earlier model computer systems. If we go this way I need to know what model IBM Printer is suitable and information on the translator device to convert 5 bit RTTY Code to 8 (?) bit code for the IBM output device.

Weather Bulletins are vital information to amateurs along the Gulf Coast. I am a member of the Industrial Hurricane Net which is made up primarily of Club Stations located at about 30 In-

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dustrial Plants along the coast from Brownsville, Texas to New Orleans, La. Several members of the net are connected to the ESSA weather wire circuit but this circuit went out of service when Hurricane Celia caused wide area power failure and telephone interruptions. I was able to copy WBR-70 for about another hour until my antenna blew down just before the eye of the hurricane passed over. By then it didn't matter because we knew where the hurricane was going.

The letter is rambling but you get the idea. Any help will be appreciated.

Thank You

William R. Clark, WA5AUB  
3261 Austin St.  
Corpus Christi, Texas 78404

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## Additional Ads from page 15

FOR SALE: MODEL 15 WITH TABLE and power supply, remanufactured in 1963, just taken out of crate, sprocket feed with two boxes of paper and complete technical manual \$65.00 free delivery within 60 mile radius of Harrisburg, PA. Model 14 typing reper, good shape \$40. Model 14 TD \$23.00. FR-114/U frequency counter, 1 MHz range with manual \$75.00. Northeastern Engineering frequency counter 14-20C, eight nixies, 10MHz range \$125 w/ manual. Lou Carbaugh, WA30JF, PO Box 398, New Cumberland, PA, 17070.

WANTED: UGC-20A TELETYPE. Also interested in M28KSR or M28ASR. For sale: Collins 51S1 receiver, AM-1365/URT UHF linear amplifier, VHF-126 converter. Also want HO-10 Monitor Scope. Hank, W6SKC, 213-799-5886.

ELECTRONICS BOOKS - DIRECT CURRENT CIRCUIT ANALYSIS THROUGH EXPERIMENTATION (\$4.95) - ALTERNATING CURRENT CIRCUIT ANALYSIS THROUGH EXPERIMENTATION (\$4.95) - SOLID STATE CIRCUIT ANALYSIS THROUGH EXPERIMENTATION (\$6.60). These popular and outstanding works by Ken Fiske (WA6SSO) and Jim Harter (WA6SQE) are currently meeting with such tremendous success, in colleges and trade schools nationwide, that EDUTRONICS felt that the amateur fraternity would also appreciate the opportunity to purchase them. The unique manner in which the authors have combined a text and laboratory manual to give the reader an unparalleled number of detailed examples, complete with clear concise illustrations, makes them a natural for the ham library. So thoroughly has each subject been covered that the Solid State manual alone has been accepted as a practical designer's handbook. Both discrete and integrated circuit components have been used in the design of power supplies, amplifiers, oscillators, etc. These publications are suitable for both beginners and advanced alike. Order the complete set for \$13.00 or order individually but please hurry since the publisher has only released a limited number. Add \$0.25 for postage and handling fees for each book ordered. Calif. residents add 5% sales tax. Please allow 3 to 4 weeks for delivery. Send check or money order (No C.O.D.'s) to EDUTRONICS BOX 487 LOMITA, CA 90717.

FOR SALE - AN/URA-7 Dual Diversity Teletype Converter. Consists of two CV71/URR and one CM14/URR complete with rack, cables, spare parts and MANUALS. Further details contact Paul Bois in K2SKK, 319 S. Orange Ave., Livingston, N.J. 07039.

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# Index of RTTY Articles in CQ Magazine

Through the courtesy of Dave Evans, WA6PXA who did the research we, are including an index of RTTY articles that have appeared in CQ Magazine. This completes the list except for "73" magazine. Any volunteers for that?

THIS LIST IS COMPLETE FROM JAN. 1960 TO MAY 1971 INCLUSIVE.

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- Sept. 51 Automatic Keyboard Switching, K2DHE
- Oct. 85 Central CE-458 VFO Circuit
- Oct. 85 Diode Switching FSK Circuit
- Aug. 71 Electrocom FSC-250 FSK Converter (Review)
- Apr. 88 Fork Standard Oscillator
- Oct. 84 FSK Discussion
- Oct. 84 Heath DX-100 FSK Circuit
- Jul. 82 Machine Theory
- Feb. 75 Transistorized Electronic Keyer for Model 26
- Aug. 92 Discussion of Page Printers
- Nov. 110 Polar Relays
- June 63 Remote Control 80 Meter VFO for RTTY, K0WMR
- June 77 RTTY Station
- Dec. 72 RTTY Station Control
- Sept. 88 Tape Equipment

## 1961

- June 38 Adjustment of the RTTY Polar Relay, W6VVF
- Jan. 94 AFSK Oscillator
- May 78 AFSK Oscillator for the Twin City TU
- June 82 Autostart Discussion
- June 82 Autostart for the Twin City TU
- Sept. 102 Band-Pass Channel Filters
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- Apr. 34 RTTY with the KWM-2, K5YTO
- Mar. 90 Twin City TU
- Apr. 89 Twin City TU (Modification)
- Oct. 44 W5BGP Teletype Terminal Unit W5BGP

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- Mar. 91 AFSK Oscillator, Transistorized
- May 94 Correction
- Aug. 96 AN/ART-13 on RTTY
- May 80 AN/TGV-14 (v)
- June 81 AN/URA Series Audio RTTY Converter Operation
- Sept. 76 AN/URA Series IF Rtty Converter Operation

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- July 96 Tuning Eye for Twin City TU
- Oct. 68 Tuning Fork Standard, Transistorized

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- Feb. 32 Automatic RTTY and CW with Multi-Gates, W0ASO
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- Aug. 66 Dual Identification Petition
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- May 71 Heath Marauder on FSK
- Nov. 104 K8DKC FSK-E Shift System
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- Mar. 67 Selecting 2-Meter RTTY Frequency
- Jan. 79 Tone Oscillator
- Sept. 68 Transistorized TU for Narrow Shift

## 1964

- Mar. 51 Add RTTY Tuning to the Modulator Analyzer
- Dec. 51 Automatic Carriage Return for the Model 15, W8DTY & K8PSJ
- July 78 Bias Distortion
- Oct. 84 FCC Rules on RTTY Dual ID
- Feb. 74 FRXD Reperf-TD
- Apr. 34 "Hi-Lo" FSK Keyer for the HT-30, 32, & 37, W0AJL
- July 78 Keyboard Adjustment
- Jan. 73 KWM-2A on RTTY
- Mar. 76 Mercury Relay Characteristics
- Jan. 36 RTTY Audio Oscillator
- RTTY From A to Z, W5VU
- Aug. 27 Part I, RTTY Basics
- Sept. 45 Part II, Machine Types
- Oct. 49 Part III, Machine Operation
- Nov. 42 Part IV, Machine Circuitry
- Dec. 34 Part V, Frequency Shift Keyers
- Nov. 90 Transistorized AF Shift Keyers, W7QAG
- Dec. 23 Transistorized Selector Magnet Driver

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- July 88 AN/FGC-1 Terminal Unit, Aug., 90; Sept., 91; Oct., 92; Nov., 92.

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- May 50 Automatic Station ID with a Surplus Keyer, K0MHU
- Mar. 87 Autostart Discussion - Jan., 89; Feb., 79.
- Nov. 66 Close Look at Transistorized RTTY
- Feb. 36 FSK For SSB Transmitters
- Apr. 88 KWM-2 on RTTY
- Apr. 44 Modifying the TH-5/TG Terminal Unit, W5AJG
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- Feb. 55 Part VII, The Converter
- Mar. 31 Part VIII, The W2PAT and W2JAV Converters
- Apr. 46 Part IX, Polar Relay Construction
- May 63 Part X, Polar Relay Adjustment
- June 39 Part XI, Modern Polar Relay Adjustments
- July 43 Part XII, Distortion in Relays
- Aug. 50 Part XIII, Eliminating Distortion
- Sept. 65 Part, XIV, Unusual Circuits in RTTY
- Oct. 49 Part XV, Schmitt Trigger Circuit
- Nov. 37 Part XVI, Polar Relay Test Set
- Dec. 37 Part XVII, Polar Relay Test Set Operation
- Mar. 25 RTTY Tuning Indicator and Squelch

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- Jan. 85 AN/FGC-1
- Feb. 93 AN/FGC-1
- July 97 Boehme Model 5C RTTY Converter
- Nov. 74 Dual ID from your TD, W0LQV
- Apr. 94 Essential Elements for the RTTY Station
- May 90 0-5/FR RTTY Oscillator-Exciter
- RTTY From A to Z, W5VU
- Jan. 33 Part XVIII, Distortion Measuring Equipment
- Feb. 36 Part XIX, TTY Machine Service & Maintenance
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- Apr. 67 Part XXI, Keyboard Adjustments
- May 63 Part XXII, The Typing Unit
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- Mar. 28 RTTY Tape Take-up, W8QMI
- Aug. 92 Surplus Teletype Converters
- June 61 "Teletyping for the Disabled" K8SOB, W8QMI, W8AYY

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- Mar. 66 Totatype II: A Mobile 2 Meter RTTY Installation
  - June 92 Western Union "2B" Printer
- 1967
- Jan. 88 Model 28 Teletype System, Feb., 92; May, 90.
  - Nov. 106 TDA RTTY Distortion Monitor Scope
  - June 95 Teletype Corp. Model 32KSR
  - June 94 Western Electric 314-A Polar Relay

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- Apr. 104 AN/FCC-3 Terminal Unit
- May 106 Converting the AN/FCC-3 Terminal Unit
- Oct. 116 DEN-35 FSK RTTY Converter
- July 63 FSK with Voltage Variable Capacitors, K1EUJ
- May 18 RTTY Mainline Adaptor, W2LNP
- Nov. 16 Transistorized RTTY Terminal Unit

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- Sept. 82 AN/FGC-5 Receiving and Transmitting Code Converters
- Feb. 51 Audio Limiter Circuit, WB4CVF
- June 90 Frederick Electronics Morse to Baudot Converter
- Dec. 59 FSK for the Transceiver, W9TKR
- Nov. 88 Hellschreiber Teleprinter System Explanation
- Jan. 90 Model 35 Equipment
- May 47 Re-Inking RTTY Ribbons, W2IDX
- Aug. 90 TT-30/AGA-1 Tape Teleprinter
- May 90 Western Union Transistorized Date Interface Subassemblies

## 1970

- Apr. 32 Good RTTY Control Layout, WOPHY
- Apr. 82 Northern Radio Model 152 RTTY Terminal Unit
- June 88 TDMS RTTY Test Set
- Apr. 82 TT-40/SGC-1 RTTY Terminal Unit

## 1971

- Mar. 112 Adapting Telemetry Discriminators to RTTY

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# RTTY theory & applications.

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Route 1 Box 30  
ADA OHIO, 45810



## Receiver Sensitivity

There are several means of specifying the sensitivity of a receiver. Probably the two most common methods are the microvolt sensitivity and the noise figure. These two methods are directly related. In order to discuss them, it is necessary to discuss some of the characteristics of noise.

## White, Gaussian Noise

Noise can be defined as any unwanted signal. This definition is too broad for practical work, so a narrower definition is required. The most common form of noise found in radio communication work, especially at VHF and above, is white, Gaussian noise. White refers to frequency components that range over a very wide band (analogous to white light that contains all frequencies of the visible spectrum in equal amounts). Gaussian refers to the amplitude characteristics; a Gaussian distribution is one that is completely random (unpredictable) and follows a normal-law-of-error characteristic. The noise heard from a receiver when no station is being received is Gaussian noise; it may or may not be white depending upon the detector in the receiver and the frequency response characteristic of the audio stages.

White, Gaussian noise can be generated in many ways. Tubes and transistors generate it. Also, any resistor at a temperature above absolute zero generates such noise. The noise voltage generated in a resistor is,  $v = \sqrt{kTB}$ , where  $k$  is Boltzmann's constant  $- 1.38 \times 10^{-23}$  J/K,  $T$  is the temperature of the resistor in kelvins,  $B$  is the bandwidth over which the voltage is measured in Hz, and  $R$  is the resistance in ohms.

Because noise comes from any amplifying device as well as from any resistor (including the lossy part of transmission lines), any signal will contain some noise. The lower limit of receiver sensitivity is determined by noise

contamination.

## Signal to Noise Ratios

A sometimes useful indicator of the condition of a signal or its degree of noise contamination is the signal to noise ratio (SNR). The ratio is calculated by dividing the signal power in watts by the noise power in watts. The signal to noise ratio in dB is  $10 \log_{10}$  of the SNR.

## Microvolt Sensitivity

The voltage sensitivity of a receiver is determined by applying a signal to the antenna terminals and adjusting the signal level until a certain signal to noise ratio appears at the receiver output. Noise will be introduced into the receiver output thru two (at least) mechanisms. The signal generator produces noise; this results from the internal resistance of the signal generator producing the thermal noise discussed earlier. The amplifying devices within the receiver produce noise; usually, the major contributor is the first RF amplifier and/or mixer. (In some cases, the input network within the receiver between the antenna terminals and the first RF amplifier gives more noise than the amplifying devices!)

If a perfect receiver (one contributing no internal noise) were being tested, a 0 dB SNR at the output (SNR = 1) would obtain when the signal generator voltage equalled its own internal thermal noise. For example, if the generator impedance were 50 ohms, and its temperature 290 K (-17°C - 63°F), and the perfect receiver had a 6 kHz noise bandwidth, the thermal noise would be 0.03 microvolts and the signal generator would have to provide a 0.03 microvolt signal to give the 0 dB SNR.

Because a 0 dB SNR is too low for convenience, an SNR of 9.5 dB is commonly used. This would require a 0.09 microvolt signal from the signal generator for the assumed 50 ohm, 290 K, 6 kHz noise bandwidth. If on the other hand, the receiver noise bandwidth were only 600

Hz, then a 9.5 dB SNR would require a 0.028 microvolt signal from the generator. With a 60 kHz receiver bandwidth, the signal generator would have to supply a 0.28 microvolt signal for a 9.5 dB SNR.

It should be noted that the amount of signal voltage required for a given SNR at the output of a receiver goes as the square root of the bandwidth; hence, the wider the bandwidth, the greater the signal required to give a certain SNR. This means that a television receiver with a bandwidth of 6 MHz requires a hundred times more signal voltage at the antenna for a given SNR at the output than does a telegraph receiver with a 600 Hz bandwidth.

Perhaps it is worthwhile to explain why a 9.5 dB SNR was used in the above example. 9.5 dB equals a ratio of 9. Generally, for ease of measurement the signal plus noise to noise ratio is measured rather than the signal to noise ratio. In order to measure signal to noise ratio, the meter on the output of the receiver has to reject noise while it is measuring the signal. This can be accomplished rather easily if a pure tone is being used to modulate the signal generator, because a notch filter is simple to construct - however, many people don't have them. If a complex signal is used to modulate the signal generator, it is difficult, at best, to separate the signal and noise. Therefore, it is usually only possible (or convenient) to measure signal plus noise output. A signal to noise ratio of 9 (9.5 dB) is a signal plus noise to noise ratio of 10 (10 dB).

If other than a perfect receiver were being tested, the microvolt sensitivities given above would be larger numbers (worse) because the noise present would be greater. The receiver would be introducing noise that would add to the noise coming from the signal generator thus making the "background" noise higher thus requiring a greater signal level from the signal generator.

## Noise Factor

The microvolt sensitivity of a receiver is dependent upon the bandwidth; therefore, it is not adequate for rating a receiver unless the bandwidth is also specified. (If receivers with identical bandwidths are being compared, it is quite useful). Noise factor is defined as the signal to noise ratio at the input of a receiver divided by the signal to noise ratio at the output of the receiver. This is a very useful rating because the bandwidth of the receiver does not

enter in.

There are at least three ways to measure the noise factor of a receiver: 1) Use the definition given and measure the signal to noise ratios at the input and output. 2) Use a technique requiring a signal generator to measure the receiver gain, the noise bandwidth, and the microvolt sensitivity. 3) Use a noise generator and the formula:  $NF = 10 \log_{10} (EN/Y-1)$ .

1) The input signal to noise ratio is hard to measure, thus this technique, although a convenient mathematical definition, is hard to implement.

2) The noise bandwidth must be known. This requires a fairly tedious set of measurements. Measuring the receiver gain is generally inaccurate because most signal generators are not properly calibrated and/or not used properly. Therefore, scratch this method.

3) When using a noise generator, the bandwidth and gain are not important because one is measuring noise with noise. Also, most noise generators put out a small amount of noise that is the same order of magnitude as that generated within the receiver. Therefore, no large amounts of attenuation are required as they are when signal generators are used and greater accuracy is possible with noise generators.

## References

An excellent description of how to accurately and properly measure sensitivity of FM receivers is given in: IEEE Test Procedure for Frequency-Modulated Mobile Communications Receivers, IEEE No. 184, 1969 April (Revision of 49 IRE 16 SI).

A method for measuring the noise figure of FM (and AM) receivers can be found in 73 Magazine, 1969 AUG, pp. 112-116.

An excellent article on noise figure can be found in Ham Radio, 1969 MAR, pp. 26-32.

A copy of "Some Notes on Noise Factor" which discusses the relationship between the two definitions of noise factor is available upon request.

73 ES CUL, RG

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Be BROAD Minded---

Use NARROW Shift !!

# RTTY-DX

JOHN POSSEHL - W3KV  
Box 73 Blue Bell, Pa., 19422



Hello there,  
We have quite a few WAC Awards to issue this month and we believe that it is the largest single month's presentation since the Award was authorized. It is indeed a pleasure to announce the following stations qualified for W A C - R T T Y.

- |                              |        |
|------------------------------|--------|
| Nr. 165 Alex Ritter          | HB9AKA |
| Nr. 166 Peter Graulich       | WB2NRU |
| Nr. 167 Earl Tonjes          | W4NG   |
| Nr. 168 ClubStation, Randers | OZ7RD  |
| Nr. 169 Karsten Tranberg     | OZ4FF  |
| Nr. 170 Georg Nyman          | SM3DKL |

You will notice quite a few from the Scandinavian countries and this is mainly due to an arrangement based upon correspondence from the Contest and Awards Manager of the SARTG, Bo Ohlsson, SM4CMG. If we can state it briefly, it works like this. If you made contact in all Continents in the SARTG DX Contest and submitted your log to the Contest Manager, you may request that he verify the W A C from the logs of the stations you listed, provided they also submitted logs. If the verification is correct the Awards Manager will notify me in writing. I will issue the certificate(s) to him and he will distribute them locally. Also, you may already have cards, say from 5 Continents and lack only one for W A C. If this one can be verified, plus submitting your other 5 cards to the Awards Manager, this also would be valid. Simply stated, it allows verification for W A C from Contest logs, without sending the cards thousands of miles with the possibility of loss. We will be glad to co-operate with other sponsors of International RTTY DX Contests in the same manner, but since it does require some additional paper work etc. we cannot act as spokesman for other Contest and Award Managers at this time but we will be happy to announce any such arrangements on this page should they take place. Perhaps I should point out that I will still make out the Certificates here and still welcome any application for WAC-  
12 NOVEMBER 1971

RTTY if accompanied by the QSL cards or other proof of contact. There is no charge for the Certificate but the necessary return postage either in local stamps or IRC is appreciated to cover mailing costs.

We have an old saying stating that, "Necessity is the Mother of Invention". We recently received a card from Ariel, 4X4MR, and he included some of the copy from his machine, a Seimans Model T37H. We could not quite believe what we saw. It was in English, but all the letters were printed backwards, and the printing started at the right and went to the left. Holding it in front of a mirror, looking at it through the reverse side, or turning it upside down did not improve the "copy". We were fortunate to contact Ariel about a week later and you can guess what the conversation was about. It seems that the machine originally had Arabic characters and the language reads from right to left. Ariel somehow found some English type pallets replacing the Arabic ones and making some necessary changes in the ltrs/fig arrangement of the machine and that after a bit of practice he had no trouble reading it although it took me several minutes to decipher one line. Now all someone has to tell me is that they have a machine that prints Japanese or Chinese in the classic manner!

A prize for sheer enthusiasm should go to Sid, the technical assistant at 9J2ED. Sid recently drove some 1500 miles to Johannesburg in a Morris Minor (one of those compact compacts) picked up three printers, a distortion test set plus some additional test equipment and then back again to Lusaka. Although we have no first hand knowledge, we cannot imagine that the roads through some of the bush country of central Africa are like the ribbons of concrete most of us are used to. In addition the temperature is 100 F. or better most of the time. I would suppose that the events stated in the last several paragraphs can be summed up by simply saying that they

CONTINUED ON PAGE 16  
RTTY JOURNAL



Next month will be the December issue and this means that approximately 40% of our subscriptions will expire. As a large number of subscriptions are renewed it means handling about five or six hundred letters, quite a job for one person. If you intend to renew, check your mailing stencil and if there is a December code on it, send in your renewal now. This saves us a lot of work and will spread the job over a longer time. What complicates things is that December is always a busy month for everyone and things are forgotten until after Christmas, by this time the January issue has been mailed, expired stencils have been removed and late renewals take longer to process. Just because we put things off is no reason everybody should.

We have to question a statement printed in one of the general ham magazines that no specialty ham magazine has ever succeeded. I suppose from an economic standpoint this may be true but the JOURNAL is now finishing its 18th year and subscriptions are at an all time high, not only in this country but foreign countries. Merrill Swan W6AEE carried the magazine for 13 years and we have had it for the last 5, certainly 18 years of continuous publication is not a failure. In fact with the new laws we will be able to vote come the first of the year. Our first vote will be for the RTTY fans and contributors that have made this possible. Others may come and go but RTTY goes on forever ....

One of the most 'fun loaded' and interesting ham gatherings every year is the SAROC Ham Vention held at Las Vegas. This year the dates are January 6 to 9th. We understand that this year plans are being made to include a complete RTTY station, hopefully in operation, so anyone interested in RTTY can see a typical set up and maybe punch a few green keys. A number of economical complete tours have been arranged for this year, including air transporta-

tion and rooms. Makes a fine, low priced vacation - if you stay away from the one armed bandits. Write SAROC - PO Box 73, Boulder City, Nevada, 89005 for details.

## BACK ISSUES---

Another shipment of RTTY Binders, Red with Gold lettering is in stock. The last two shipments of binders have increased in price and with the added postal increase we have been forced to raise our price to \$3.00 each in the US and possessions, \$3.50 in Canada and Mexico.

New subscriptions and classified ads are cash in advance as we have no method of billing. New subscriptions will be started with the current issue and one back issue if requested. Please do not ask us to start any further back than this. If available, back issues may be ordered at 30¢ each at time of subscription. The Journal is mailed about the 20th of the month preceding the dated month.

- 1966 - Aug. - Sept. - Oct. - Nov. - Dec. (5)  
 1967 - None  
 1968 - Mar. - May - June - Sept. - (4)  
 1969 - May - July - Sept. - Oct. - Nov. - Dec. - (6)  
 1970 - NONE  
 1971 - January - April - May - June - July - September - October - 7,

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CLOSING DATE FOR ADS- 1st of month.....

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**SALE:** COLLINS R390A/URR; Good. \$1,000. 11/16" tape; 40 rolls-\$5.00 huge quantities. Yaesu FT 101; Mint: \$390. G.S. Naniwada, JA1ACB, 3-4-8 Izumi - Hoya, Tokyo 188, Japan.

**SALE:** 6 AND 2 METER HC-6/U xtras--all frequencies and 6-8 MHz FT-243 xtras \$1.00 each. Sase for list. Mac Robbins, WA3KDJ, Hamerslag A307, P.O. 766, Carnegie-Mellon Univ. Pittsburgh, Pa. 15213

**MORE RTTY! THAT'S RIGHT.** In 1970 there were more feature RTTY articles in HAM RADIO Magazine than any other general amateur magazine. You need RTTY Journal, but you need HAM RADIO also. \$6.00 per year; \$12.00, 3 years. Ham Radio, Greenville, N.H. 03048

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**RCA RTTY DIVERSITY SYSTEM** consisting of two CV57/URR converters and one CV14/URRR comparator in desk top rack. 10 to 1000 cycle shift. \$125.00. TS186 Freqmeter 100 Mc to 10,000 Mc. \$50.00 FR-4/U freqmeter, 100 Kc to 20 Mc built in scope and interpolation osc. \$60.00. W6JX, 14945 Dickens St. Sherman Oaks, Ca. 91403.

**TYPEWRITER RIBBON REINKER,** Hand operated model now only \$3.50. K575 or K764 ink available at all National Cash Register Co. stores at 75c per tube. Walter Nettles W7ARS-8355 Tanque Verde Rd. Tucson, Ariz. 85715

**TELETYPE PICTURES FOR SALE.** Vol 1 \$1.00. Vol 2 \$2.00. Vol 3 \$1.50. All for \$4.00. Perforated tapes available. 200 different pictures. W9DGV-a. 2210-30th Street, Rock Island, Illinois 61201.

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**SALE MODEL 28 Synchronous MOTOR PD67/U,** code LMU-12 1/12 hp. 3600 rpm, 115 VAC 60 cycle, 1 phase, used excellent, \$18.50 ea. TT334/UG model 28 transmitter - distributor, high speed, 8 level, adaptable to 5 level code LBXD-9, used excellent, \$40.00 ea. TT315/UG model 28 typing reperf, code LPR35BWA tape data; 11/16 with chadless or fully perforated, part of AN/UGC-13 (M28ASR) used, excellent \$40.00 ea. Atlantic Surplus Sales, 580 3rd Ave. Brooklyn, N.Y. 11215.

**HELP! HELP! WANTED;** Schematic or manual (preferred) for B&W 5109 transmitter. Also need a 2APT cathode ray tube, new or used. Write Frank Oberlander, W9YPS, 110 North Tremont, Kewanee, Ill. 61443

**SAROC SEVENTH ANNIVERSARY** January 6-9, 1972. Advance Registration \$9.00 per person entitles registrant to SAROC Special room rate \$12.00 per night plus room tax, single or double occupancy, effective January 4 thru 12, 1972; tickets for admission to technical seminars, HAM RADIO MAGAZINE and SAROC Happy Hour Thursday, SWANELECTRONICS and SAROC Social Hour Friday, HY-GAIN/GALAXY ELECTRONICS and SAROC Champagne Party Saturday. Buffet Hunt Breakfast, Sunday. Ladies who register will receive transportation for shopping tour, luncheon and Crazy Hat program at the New Union Plaza Hotel downtown Las Vegas, Saturday. Advance Registration, with Flamingo Hotel mid-night show, two drinks, \$14.50. Advance Registration, with Flamingo Hotel Dinner Show (entrees Brisket of Beef/Turkey) no drinks, \$17.50. Tax and Gratuity included except for room. Frontier Airlines SAROC group flight package planned from Chicago, St. Louis, Omaha, Denver, send for details. Fifth National FM Conference, ARRL, WCARS-7255, WPSS-3952, MARS, meetings and technical sessions scheduled. Accommodations request to Flamingo Hotel, Las Vegas, Nevada before 15th. December. Advance Registration to SAROC, Southern Nevada ARC, Inc., Box 73, Boulder City, Nevada 89005, before 31st. December.

**TELEFAX FACSIMILE TRANSCIVER:** desk type W.U. model 6500A, 5" drum O/A diam. 12"x 13"x 7" synchronous motor, operating condition, used good, \$11. each. Model 28LBXD Trans- distributor, used good, \$60. each. Teletypewriter Signal Distortion Test Set TS2B/TG transmits four test signals, R.Y., space or standard test message. Portable in wooden chest, manual and wiring diagram included, used good, \$35. each. Wetted relay WE. 275 B or C \$1.25 each W.E. 255A relay \$1.25 each. Atlantic Surplus Sales, 580 3rd Ave. Brooklyn, N.Y. 11215

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**BACK ISSUES - RTTY JOURNAL -** Have all issues from Vol. 1, No. 1, will reproduce any issue for \$1.00 PP. John Isaacs, 3175 Val Verde Ave. Long Beach, Cal. 90808.

**CV89/URA-8A AUDIO CONVERTER,** less blower, good condition, \$80. Altronics - Howard audio converter, wide and narrow shift filters. Model L, with manual, excellent condition, \$70. Transceiver power supply, A.C., home built, \$30. 4-1/2", 270 degree panel meters, 1 ma., 100 uamp movements, really impressive, \$10. Stan Fierston, W1BRJ, 7 Pickwick Road, Marblehead, Mass. 01945, 617-631-1308.

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**FOR SALE: COLLINS PM-2** piggyback power supply for Collins KWM-2 or KWM-2A transceiver. 110/220 vac, 50 to 400 cps. Contains internal speaker. Case has a few dents (small) and scratches. \$65.00 FOB South Pasadena. Hank W6SKC, 213-799-5886.

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ADDITIONAL ADS ON PAGE 7