HORSE TRADES

This page of the Bulletin is for use of amateurs who have RTTY EQUIPMENT FOR SALE OR TRADE and those looking for equipment to buy or trade. It is a free service and may be the means of getting someone on the air.

FOR SALE: Model 15 with AC gov'nd motor, crank, cover, communications kybd. No blank key, $115.00. K5DNH, 200 Charles Drive, Lafayette, La.

FOR SALE: Northern Radio Converter, Type 102, model 12, shift 100-1000 cycles; dual channel, diversity combining, excellent shape. $250.00. W1LWV, 99 Water Street, Millinocket, Maine.

TRADE: Model 14 typing reperf that can be adjusted and will work. Swap for Super Pro in good condx. W6HAB, P.O. Box 282, Hilmar, Calif.

FOR SALE: Model 14 typing reperf $39.00, Model RA-87 pwr supply $9.00, FGC-1 TU's complete in cabinet $95.00, 11/16" reperf tape, case of 40 rolls $8.00. Send for list of additional equipment. W5LCU, P.O. Box 174, Harlingen, Tex.

WANTED: Model 19, advise price and condx. WA2NDS, 16 Laurence Court, Closter, N.J.

FOR SALE: 15/32" oiled Wheatstone Tape, W6DOU, 3154 Stony Point Road, Santa Rosa, Calif.

FOR SALE: Gates Filters, Wm. Gates, P.O. Box 374, Durham, Calif.

FOR SALE: One each, URA-6 with everything except an instruction book. One each, 0-5B/FR. Has manual giving information on controls. One each, Harvey Wells TBS-50D with AC pwr supply. A real gem on two meters. K5ECN, 406 Solano Drive, S. E., Albuquerque, N.M.

FOR SALE: Model 14 cover $12.00. Model 14 TD slip base $4.50. Model 15 paper spindle $1.50. Mercury wetted W.E. relay $4.00. K5AON, 867 Berkinshire, Dallas 18, Texas.

WANTED: Back issues of RTTY, state price. W9IFZ, P.O. Box 72, Evansville 6, Indiana.

FOR SALE: Brand new AN/FGC-1 $125.00 F.O.B. Charleston, W. Va. W8NLT.

WANTED: Lamp housing for end of line indicator, Model 14 typing reperf. Keyboard and cover for Model 14 typing reperf. W8NLT, 209 55th Street, S.E., Charleston, West Va.

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RTTY

I1RIF, Top Scorer World Wide RTTY SS Contest

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NEWS OF AMATEUR RTTY

FEBRUARY 1963
30 Cents
Vol. 11, No. 2

A SUMMARY OF THE SECOND ANNUAL WORLD-WIDE RTTY SWEEPSTAKES

It seems to be a tradition to open the summary of a Ham contest with some of the comments made by the participants. Rather than depart from this time tested format let's start this one with a few choice quotes from the logs of some of the contestants:

"A real first class brawl; keep them up!!" . . . K6MTX.

"Haven't been on much since the contest—was worn to a frazzle when it was over.". . . VE4BJ.

"Swell time and a lot of good operators on the air.". . . W4KZF.

"I still don't know my score – honestly, I have three big rolls of RTTY paper here and just haven't had time to go through it.". . . G3CQE.

"I received the parts just in time to put the machine on the air before the contest – and what a contest!!". . . XE1BI.

"I am a tired old man!! – oh yeah!". . . W2RUI.

"The contest was great and I enjoyed every minute of it. I noticed that all the stations were orderly and caused no excessive QRM.". . . W2UGM.

"All in all, had a good time but quite exasperating when the Stateside QRM buried my peanut whistle!" . . . KH6COY/KW6.

"What happened to all the Stateside activity – no QRM problem this year to speak of." . . . W8CLX.

"Such bedlam and QRM was enough to force me off Sunday afternoon – whew!!!". . . W9RDJ.

"The Second Annual RTTY Contest is now only an echo but some of those fantastic signals still remain!! I1RIF had a very tremendous signal all the way through here as did KH6COY/KW6.". . . ZL1WB.

"The number of stations active on 15 was quite astonishing and I would really like to know where all these boys hang out during the rest of year.". . . ZS1FD.

- - - - and so it goes. These are just a few remarks picked at random from the scores of logs received but they do show the varying viewpoints from all parts of the world. One thing that nearly everyone agreed on was that the contest was a complete success in spite of very mediocre band conditions.

The top scorer, I1RIF, amassed the amazing total of 830 exchange points by contacting stations in 20 countries and 25 states for over 41,000 points! G3CQE does an excellent job of summarizing the excellent work of I1RIF in the current issue of "The Short Wave Magazine." Here's a direct quote from Bill's article —"The logs show that I1RIF had worked four continents before most of the European stations had warmed up their rigs—I1RIF is rapidly becoming a byword in the RTTY world. In spite of the suggestion of QRO, the secret of Bruno's strong signal lies purely in the aerial system and location since the RTTY transmitter at I1RIF is only an HT-32 running 'barefoot.' He is still waiting for the HT-33 linear . . ." I1RIF's performance once again points up the fact that what's above the Ham shack is more important than what is inside of the shack.

Congratulations are also in order to the runnerup, W5CME, for doing an outstanding job in his first RTTY contest. Jerry managed to stay just ahead of K3GIF and W2RUI who, as usual, came up with excellent totals. Bill, ZS6UR, held on to fifth place which is quite a feat when one considers he is so remote from the more highly populated RTTY countries. The only disappointing feature of the contest was the lack of any participation on the Asian Continent. However, 20 stations managed to work the five remaining continents which is a tribute to the rapid spread of RTTY activity throughout the world.

Some kind of a record was established for the contest when the committee failed to receive a single complaint on the scoring system. Except in one or two cases where understandable errors in scoring were noted, everyone did a fine job of interpreting the rather involved "bonus point" system of summing up their totals. The fact that at least three overseas stations placed among the top ten proves that the present system is fairly equitable for an RTTY contest on a world-wide basis. A few minor changes are being considered for next year but in general the rules appeared to be well received and for the time being are apparently quite adequate.

The contest committee is particularly indebted to Jerry, W6TPJ, for the long hours spent in reorganizing the rules set-up plus making tapes of same to be sent around the world for publicizing of the sweepstakes. Jerry also burned much midnight oil checking every log received to be sure everyone received full credit for their efforts.

Before winding this summary up it might be interesting to let everyone read two more quotes from a couple of our better known overseas RTTY'ers. Their calls are deleted for obvious reasons but the comments are put down exactly as copied off the notes accompanying their contest logs.

". . . I want to comment on the courteous operating habits of all U.S. stations. Realizing that my weak signal would have trouble getting through, they all moved off my channel immediately on completing the QSO. All in all, it was a somewhat strenuous pleasure, but a pleasure all the same."

. . . Now before you bust your buttons taking bows, take a gander at this last one from another well known DX'er.

". . . evidence still exists, particularly among U.S. stations that they 'call on the blind'! They probably find another U.S. station calling a DX station – do they sit and wait their turn? Oh! No! They line up their hot little VFO on the other lad and let the devil take the hindmost. Do they just give one call? Oh! No! Even if the DX station has started a QSO, that doesn't matter. A few more calls should overcome that difficulty – he must eventually get his call letters on the printer. This same guy then gets a feeling of frustration and forgetting to check the channel, streaks out a ten-minute CQ – yeah! fine operating."

Some times it's a bit startling to see ourselves as others see us. Thanks to all who participated and especially to the ones who included the fine comments along with their scores. Only about one-third of the contestants sent in logs to the committee – let's raise that percentage in the next one!

73

Bud, W6CG (DX Editor)

SECOND WORLD WIDE RTTY SWEEPSTAKES CONTEST RESULTS

Call	Exchg Pts	States	Countries	Continents	Score
W1BGW	68	9	10	4	8,612
W1TLZ	98	23	4	3	4,654
K5JCI/1	84	23	4	3	4,332
W1FGL	48	15	4	4	3,920
W2NSD/1	58	23	4	3	3,734
W2RUI	254	25	23	5	29,350
W2JAV	212	31	18	4	20,972
W2UGM	90	22	7	4	7,580
K2SDR	24	6	4	3	2,544
K3GIF	204	25	24	5	29,500
W3CRO	52	16	6	4	5,632
W3WGC	124	25	4	1	3,900
K3RZX	58	23	2	2	2,134
W4BOC	76	16	12	4	10,816
W4EGY	108	26	10	4	10,808
W4KZF	106	21	6	3	5,826
K4SCP	24	9	2	2	1,016
W5CME	348	33	22	5	33,484
K5QBU	120	25	8	2	6,200
W6ECP	180	31	11	5	16,580
W6CG	76	20	14	5	16,520
W6CQI	56	15	12	5	12,840
W6TPJ	64	18	10	5	11,152
W6NRM	154	20	8	4	10,020
K6IBE	48	16	7	5	7,768
K6MTX	64	23	5	4	5,472
W6AEE	76	25	5	3	4,900
W6WLI	126	27	4	1	4,202
K6OWQ	14	1	6	3	3,614
W6MTJ	69	16	4	3	3,504
W7ESN	218	29	16	5	22,322
W7PHG	190	28	11	4	14,120
W7FEN	108	23	12	4	12,084
W7CBY	90	24	4	2	3,760
W7MCU	24	10	2	2	640
W8CLX	170	29	19	5	23,930
K8MYF	208	28	17	5	22,824
W8VMP	110	23	14	5	16,530
K8TJP	138	29	10	5	14,002
K8BIT	30	6	9	5	9,180
K8JTT	44	14	6	4	5,416
W9RDJ	86	18	3	2	2,748
K9BJM	36	8	2	2	1,088
W9ZQT	50	17	. .	1	850
W9LFK	24	10	. .	1	240
K0DOM	364	32	18	5	27,152
W0NFA	68	13	11	5	11,884
W0HSC	104	27	1	1	3,008
DL6EQ	280	6	7	3	5,880
DL4IA	200	6	5	3	4,200
DJ0EK	110	3	5	2	1,368
DJ4KW	120	. .	6	1	1,320
G3BXI	500	16	15	5	23,000
GM3IQL	210	10	6	3	5,600
I1RIF	830	20	25	5	41,600
KH6ANR	76	16	7	2	4,016
KL7DTR	28	6	3	2	1,368
KP4GN	112	20	9	4	9,440
KH6COY/KW6	320	15	10	4	12,800
LA6J	540	3	9	4	7,740
LA1TE	40	. .	2	2	840
OA4BR	88	25	9	4	9,400
VE4BJ	134	20	12	5	15,484
VK3KF	220	8	9	4	8,960
XE1YJ	162	26	12	3	11,412
XE1BI	18	7	6	1	726
YV1EM	122	28	10	3	9,416
ZS6UR	660	22	13	5	27,520
ZS1FD	270	16	5	4	7,720

TOP TEN WINNERS

I1RIF	41,600	K0DOM	27,152
W5CME	33,484	W8CLX	23,930
K3GIF	29,500	G3BXI	23,000
W2RUI	29,350	K8MYF	22,824
ZS6UR	27,520	W7ESN	22,322

W5CME, Second Place

K3GIF, Third Place

ZS6UR, Fifth Place
(photo by ZS6WW)

KH6COY/KW6

"NEW HORIZONS IN AMATEUR HF-RTTY TRANSMISSION" PART 3

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37. In the November article we hashed out rather thoroughly the matter of signals which are above the threshold of a limiter-discriminator receiver, or which can be brought above the threshold by filtering. We then took up the matter of below-threshold signals, remarking that in this region it makes a considerable difference whether the wide-shift FSK signal is treated as an FM signal or as a diveristy pair of on-off keyed AM signals. I began with the latter approach, suggesting that the appropriate receiving technique is one of using an optimum detector for one on-off keyed signal, with diversity combining being used to generate the printer keying waveform from the outputs of the pair of detectors. The essence of the problem is the design of a detector which uses the received signal, together with all available knowledge of the transmitted signal, to reconstruct the process which took place at the distant transmitter and thus recover the transmitted information which has been perturbed by noise.

38. Our available knowledge of the transmitted signal is its approximate frequency, the minimum pulse duration of 22 milliseconds, and the arbitrarily long maximum signal duration. Further, we can observe the over-all noise level; either by looking at the receiver output when no signal energy is being transmitted, or by looking at the output of a receiver tuned slightly away from the signal frequency. Noise will normally fall into one of two categories: essentially random noise, and interfering signals.

39. The first approach to the single-channel detector consists of a narrowband filter followed by a diode or similar envelope-type detector. That is, the output of the detector is approximately the average of the peak voltage output of the filter. The detector must be followed by some sort of decision circuit which examines the detector output and decides whether it should be called marking or spacing. We will want to consider more intelligent circuits than the simple envelope detector, but the arrangement just described does contain the three essential elements: filter, detector, and decision circuit.

40. With the filter, we are at liberty to vary the bandwidth and also the general shape of the response curve. The known minimum duration of the signal pulse tells us that the fastest possible signal consists of alternating 22 msec. marking and spacing pulses. This is a simple square wave which is very easily analyzed by Fourier methods into a carrier and pairs of sidebands (this is assuming that the square wave is being applied as modulation to the RF carrier. The first pair of sidebands is located about 23 cps on either side of the carrier; the second (which are actually third-order sidebands, since the modulating signal contains no even harmonics) are 1/3 the amplitude of the first and are located about 70 cps away from the carrier.

Similarly, the higher-order sidebands are located at odd multiples of 23 cps away from the carrier and have relative amplitudes of 1/n where n is the order of the sideband. As is well known, a noise-free signal passed through a narrowband filter suffers waveform degradation in proportion to the amount of sideband power eliminated by the filter; and because the sideband amplitudes decrease rapidly with increasing sideband order n, the signal can be transmitted with ordinarily sufficient fidelity if all sidebands of order higher than perhaps 5 or 7 are eliminated by the filter.

41. Of course the signals we actually transmit are not 23 cps square waves. It can be shown (but you'll have to take it on faith, as I won't attempt to show it) that a bandwidth sufficient to transmit a 23 cps square wave is necessary and sufficient to transmit any other possible signal made up of 22 msec pulses. This does not say, however, that such a bandwidth is optimum for all possible signals; nor does it attempt to define just how much bandwidth is to be considered sufficient. This is our next problem.

42. To improve the fidelity of pulse transmission we must widen the filter bandpass, but in so doing we cause the receiver to accept additional noise. By playing with the figures on relative sideband amplitude you can see that if S/N is large, accepting an additional pair of sidebands adds more signal energy than noise energy to the detector input; while if S/N is small, widening the filter allows a lot more noise to enter the detector accompanied by very little more signal. Thus the better the S/N, the wider the filter should be, and vice-versa. Aside from the fact that a variable bandwidth filter is not very practical

for use on signals with varying S/N, we are primarily concerned with weak signals. Conclusion: we want to make the filter as narrow as we can get away with, because the energy contained in higher-order sidebands is not worth the noise we must accept in order to pass these sidebands.

43. Noting that the signal consists of a carrier and pairs of sidebands, the question of filter bandwidth gets us embroiled in the AM-SSB-DSB controversy. (Apologies are due those who took up RTTY to get away from said controversy!) Following the reasoning of the previous paragraph, it may be that, having reduced filter bandwidth until only the first order sidebands are passed, we find that S/N could be further improved by halving the bandwidth and eliminating one of the remaining sidebands in the process. It seems to be pretty well established that the simple envelope detector performs equally poorly with one or both sets of sidebands, so that eliminating one set to leave a carrier and one sideband probably does more good than harm. We must not, however, rule out the possibility of a better detector which can do something useful with both of the sidebands and which suffers in performance if one is eliminated.

The underlying philosophy here is that noise added by increasing bandwidth adds to existing noise on an average power basis, while the coherence which exists between the two sidebands permits their addition in a more advantageous manner.

44. What happens if filter bandwidth is reduced further? In this case, we must think in terms of the performance of the filter in the time doman rather than in the frequency domain. What happens is that the filter output never builds up to full amplitude during the duration of a single carrier-on pulse, and never dies out to zero amplitude during a single carrier-off pulse. The output of the filter therefore depends upon not only the pulse just received but also upon the previous pulse and perhaps several previous pulses. This is, in fact, the *characteristic distortion* discussed in textbooks on wireline telegraphy. Now a printer will tolerate some characteristic distortion without producing errors, so it may be desirable in some cases to allow characteristic distortion to take place in return for an improvement in S/N. But as a starting point we may guess that the minimum allowable bandwidth is about 23 cps if one sideband is to be discarded, and 46 cps if both first order sidebands are to be retained.

45. So far as the shape of the filter response curve is concerned, the assertion of the previous article is repeated: A filter response curve which matches the signal spectrum is preferable to the "ideal" rectangular-response filter. An additional consideration is that the flat-topped steep-skirted filters are more prone to "ringing" than are the more gently-shaped filters. Further, the phase characteristics of the filter are important, and a rounded-top filter can be made to have better-behaved phase response than an "ideal" filter, where physically realizable filters are assumed. I'm inclined to agree with W3TUZ, writing in the November, 1962, issue of 73, who says that filters should be designed for maximally linear phase response rather than for sharp cutoff. It remains to be shown by experiment just how important the various interrelated factors of filter design are in practical reception. In your experimenting, please take heed that almost anything will work well with good signals, but we are after the weak ones, for that is where the challenges are to be found. Excelsior!, etc.

46. Now what shall we do with the mess coming out of the filter? The simplest thing to use is a diode. Here are some other ideas: (a) use a product detector. Instead of a locally-generated carrier, pass the signal carrier through a very-very narrow filter and use it as the reference signal. By making the carrier-separation filter very narrow, the carrier can be made almost arbitarily noise-free since it is being used only to obtain phase information. Since this narrow bandpass imposes a frequency stability problem on our receiver, use the recovered carrier also in an AFC loop controlling the receiver local oscillator. (b) Accepting both first-order sidebands, use a synchronous detector. (See CQ Magazine, June, 1957, and the paper by Dr. Costas in the SSB issue of PROC IRE, December, 1956.)

41. All of the detectors just discussed are true AM detectors in the sense that they can detect any kind of modulating waveform with a fidelity limited only by receiver bandwidth and detector nonlinearity. Since we know in advance that we are trying to receive rectangular pulses, there may be some other type of detector which achieves higher sensitivity at the expense of restriction of the signal waveform to such pulses. Synchronous operation is popular commercially because it permits the use of baud-synchronous detectors which are capable of high sensitivity. In synchronous operation the receiver knows rather exactly when to expect signal pulses to arrive. This is a decided advantage, for it allows the receiver to examine a signal pulse for its entire duration before becoming committeed to a mark/space decision.

42. Now it is possible to perform a sort of synchronous operation which is compatible with start-stop operation and thus suitable for amateur communication. One way to do this is to transmit signals from tape using an electronic distributor and a 7.5 unit code. This code is copyable on an ordinary printer and is much easier to synchronize than the usual 7.42 unit code. A 7 unit code would also work, but is somewhat hard for some 7.42 unit printers to follow. The 7.5 unit code has the additional advantage that the 1.5 unit

rest pulse is readily distinguishable from the other pulses making up a character. Tape transmission is of course necessary to eliminate the arbitrarily-long rest pulse of keyboard transmission.

43. The usual detection scheme in synchronous operation is to employ a very narrow band filter so that the filter output "builds up" during a received pulse. Since the receiver knows rather well when the pulse is to end, it examines the output of the filter at exactly that instant and then rapidly "dumps" the energy circulating in the filter so that the filter can start all over on the following pulse. Dumping or quenching the filter eliminates the characteristic distortion which would be produced if such a narrow filter were used with an envelope detector. A synchronous detector of this sort therefore works on the signal energy rather than the signal envelope. Such a detector can therefore respond correctly if the signal energy exceeds the noise energy within the filter bandwidth, even if the noise amplitude frequently exceeds the signal amplitude. Detectors of this type have been constructed using mechanical resonators as filters (Collins), and using conventional L-C circuits with electronically-applied positive feedback sufficient to produce a very high Q but not oscillation.

44. It remains to be seen whether energy-type detectors can be applied to non-synchronous start-stop operation. A compromise technique might be to synchronize the filter quenching circuits to the TTY start pulse; but this means that the accuracy of the detection process is necessarily reduced by the uncertainty as to when the start pulse begins and ends. Another possibility which might be worth trying is to sample and quench the filter many times during a single pulse time. This is essentially what is done in the superregenerative detector. Superregenerative detectors have two modes of operation. In one case, the detector is always quenched before the oscillations build up to full amplitude. In the other case, the amplitude of oscillation is allowed to reach a stable value before quenching. The former mode is called the linear mode because the detector action is fairly linear with signal amplitude; this mode is hence more popular for audio reception. The latter mode gives more nearly a logarithmic action and is thus not particularly desirable for voice reception. It may have usefulness for telegraphic signals, however. When we get ready to consider the combining of two detectors for FSK reception, we should look into the possibility of using two superregenerative detectors, one for each frequency, having a common quenching source such that the following decision circuit compares the relative outputs of the two detectors just prior to quenching to see which is larger. By suitably adjusting the circuit parameters it should be possible to build a superregenerative detector which can be made linear or logarithmic at will to facilitate comparing the two modes of operation with actual signals.

45. The decision circuit has been mentioned as a third essential component of a detector. For the moment we wish to consider decision action in the single-channel detector before looking into decision action for the full-frequency-diversity FSK detection system. It is already assumed that the detector bandwidth is restricted so that the decision circuit looks at something akin to the average detector output rather than the rapidly-varying instantaneous output. A detector will produce some output, say e_0, when no signal input is present. It will produce some different (hopefully) output e_s when signal input is present. A popular approach to the decision problem is the use of a trigger circuit set to trigger an input voltage half way between e_0 and e_s. Now e_0 and e_s are in general time-varying (due to signal fading and the variations of the noise) so that the optimum trigger level is also not constant. This fact has been carefully noted by several writers who, unfortunately, have not explained what to do about it. The simplest solution to the problem is to ignore it and hope that the trigger level will stay somewhere between e_0 and e_s in spite of the gyrations o fthese voltages. The success of this approach quite naturally varies directly with the difference e_0-e_s, which is the quantity determining the allowable error in the setting of the trigger level.

46. A more refined approach is to establish a second detector at a frequency close to the signal frequency but sufficiently far removed from it that little if any signal energy enters this detector. Thus, it is hoped, the output of this detector will always be equal to e_0, or nearly so, and this output can thus be used to adjust the threshold or trigger level of the decision circuit. This technique is reasonable enough where the noise is sufficiently random, but it tends to fail if the noise is perhaps Morse telegraphy being transmitted squarely on the TTY signal frequency. However, all other detection schemes are equally useless in the situation just described, so perhaps this should not be counted as a failure of the method. Something to consider is the use of a notch filter rather than a bandpass filter for the second detector, wherein the notch would be set at the signal frequency. The trigger circuit would be adjusted to trigger on the difference between the two detector outputs. There are also some trigger-level-adjusting schemes involving two RC time constants; one is of the order of the signal pulse duration and the second is much longer. The difference in the outputs of these two circuits goes to the trigger circuit. The object of the game is for the fast time constant to follow the signal pulses, while the slower follows fading and changes in noise.

47. The full FSK detector might use a trigger circuit operating on the difference between the two channel detector outputs, or each channel detector might be provided with its own trigger. In the latter case, two different situations are possible: the two triggers may agree or disagree as to what was received. When they disagree, some means might be used to decide which should be believed, or the receiver output might arbitrarily be called marking or spacing (marking would be preferable since it would prevent the printer from running open on no signal). One way to make an intelligent guess as to which detector is producing the correct output is to determine which has the better S/N, and this can be determined from the immediately previous history of e_0-e_s. This is in essence the quantity which is determined with the two-time-constant circuit just discussed. Beyond this point we get involved with the rather complex matters of optimum diversity combining. I may conveniently get off the hook by saying that this subject is beyond the scope of this paper.

48. Now let's take up the FM philosophy of signal detection. Such a philosophy is not very useful for wide-shift weak signals because wide-shift signals distribute their energy so inefficiently throughout the total bandwidth occupied. Attempting to combat this situation with a comb filter leads almost directly to the two-filter techniques just discussed. The situation is quite different where narrow-shift signals are involved because such signals do achieve a reasonably uniform distribution of energy and certainly are not amendable to two-filter detection. Thus we want to look into frequency detectors which are capable of good performance with signals below the improvement threshold of limiter-discriminator detectors.

49. An ordinary discriminator, used without a limiter, shows some promise for this purpose. W6NRM has reported that a limiterless signal converter has outperformed one using a limiter on some signals. It seems reasonable to assume that the signals for which this phenomenon occurred were so perturbed by noise as to be below threshold for the receiver using the limiter. His observations were confined to wide shift signals however. At any rate, it seems sensible that a limiterless discriminator might be considerably better than one using a limiter for receiving narrow shift signals which are weak.

50. Some of the techniques mentioned in the November article might also be of value in weak signal reception. Specifically these include Baghdady's oscillating limiter, and the frequency and phase lock detectors used without limiters. A difficulty of the phase lock detector, not mentioned in the former article, was suggested in a letter recently received from K5UAM. The phase lock detector as used to detect an FM signal has no means of acquiring a phase lock initially. It may be necessary to use a discriminator to bring about a condition so near to lock that the phase detector can lock to the signal. Another thought would be to use a frequency lock detector followed by a phase lock detector. The first detector transforms the FSK signal into one of such low deviation that it is effectively a phase shift signal. (The black box in the feedback network comes into play here in a big way.) The phase detector then goes to work to produce the signal output. Actually, if a phase detector is to be used for an FM signal, the black box in the feedback loop should include an integrator; and a circuit such as the Miller integrator is much to be preferred over the usual R-C "integrating" network. I shall not make any further authoritative statements in this subject area, because the detectors involving feedback circuits allow almost limitless variations in circuit operation to be obtained. (Also, I don't know enough about the subject to be authoritative.)

51. Decision circuits are of course applicable to FM detectors also. An interesting possibility here is the use of a circuit with the property of hysteresis. The familiar Schmitt circuit and polar relays share this property. Without hysteresis, the receiver output changes from mark to space or vice versa whenever the detector output changes from positive to negative. With hysteresis, the receiver output would tend to remain in its previous state until the detector output changed considerably more than just across the zero level. It remains to be seen whether the inclusion of hysteresis in a detector decision circuit can significantly reduce errors. The technique of using two R-C time constants is also applicable to FM detectors. I hope to discuss this in some detail in a future article.

52. The foregoing pretty well exhausts my knowledge of FSK detection methods. It is appropriate that we now see what can be done if our best efforts fail to provide communication using FSK. By now most RTTYers should be sufficiently mature to refrain from preaching FSK as the ultimate method of radio communication. Of course we are presently constrained by regulation to use FSK for RTTY work, but regulations are fortunately not engraved in bronze forever changeless.

53. It is certainly possible to transmit binary information with technique superior to FSK. Shannon tells us that to operate under severe noise conditions we must use copious amounts of bandwidth. Costas has pointed out that this does not preclude use of the same bandwidth by somebody else at the same time provided that the constraints of Shannon's equation are not violated. Violation of these constraints is not likely to happen in the near future because no existing communication systems come close to achieving the performance of Shannon's theoretical ideal. Here is a

paradox: existing systems occupy more bandwidth than they really need to, but they must be made to occupy more bandwidth if performance is to be improved. The solution is most likely to be found by a two-pronged attack; first get as much performance as possible out of the usual signal bandwidth, and then increase this bandwidth in an intelligent way to achieve better performance.

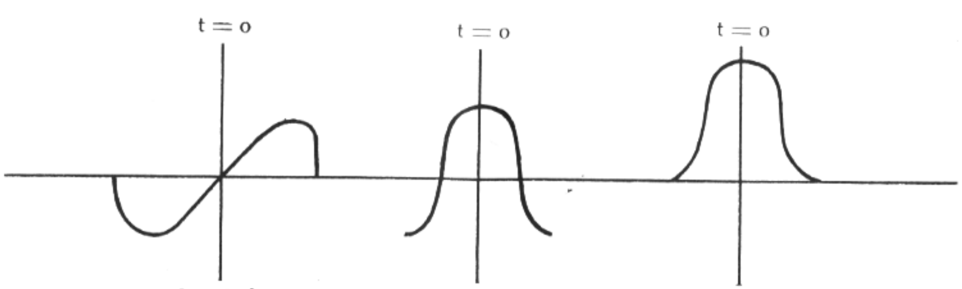
54. We might begin by working with the signal pulse. Much work is currently being done with orthogonal sets of waveforms. These have the property that a detector designed for maximum response to one waveform of a set has exactly zero response to all others of that set. A double sideband supcarrier signal has this property; a demodulating carrier which is incorrect in phase by 90 degrees will result in zero output from the detector. Consider a product detector having sine waves of the same frequency as inputs. The averaged output (DC) will be maximum if the signals are in phase or 180 degrees out of phase, and zero if the signals are 90 or 270 degrees out of phase. This will happen whether the average is taken over an infinite time or over any integral number of cycles. Thus we can obtain an orthogonal set of waveforms by taking a single cycle of a sine wave and a single cycle of a cosine wave, which is simply a sine wave displaced in time by 90 degrees. Such an orthogonal set is in fact used in some phase-shift-keyed telegraph systems. When one signal is received in the absence of noise it produces maximum output in one phase detector and zero output in the other. Random noise tends to produce equal outputs in both detectors. The detector outputs are therefore subtracted to obtain the signal to be applied to the decision circuit. This is, of course, a synchronous system, for the receiver must have a very accurate standard of phase to apply to the detectors.

55. Another popular waveform is the "raised cosine." This is simply a cosine pulse to which a constant has been added so that the ends of the pulse fall on the zero axis.

An important property of the raised cosine is that it can be neatly joined end to end with sine pulses without producing a disconuity. It, like the ordinary cosine, forms an orthogonal set with the sine pulse.

56. Another sort of signal which has been suggested is called time-shift keying. In this scheme a marking pulse might be transmitted as a half-length marking pulse followed by a half-length spacing pulse; while a spacing pulse would be transmitted as a half-length spacing pulse followed by a half-length marking pulse. This scheme effectively doubles all frequencies present in the original waveform and thus achieves a moderate increase in bandwidth. (If only the fundamental frequency components of the waveforms are considered, no bandwidth is gained; the increased bandwidth is found in the increased spacing between the higher-order components of the TSK signal.) This idea could be extended to the use of signal pulses containing more than one transition with a consequent increase in bandwidth occupancy.

57. I plan in a future article to review several important papers which have recently come to light and which may not be generally available. In conclusion, I exhort you to study, analyze, investigate, experiment, build, test, and above all, to write up your observations for publication. Proc. IRE, QST, and others may have editorial requirements which make the last more difficult, but this article effectively demonstrates that RTTY will publish anything the readers have to say! Sometimes it appears that the days of amateurs pioneering communication developments are past, and that nowadays large research organizations with much money are the only sources of improved methods. This is simply not true. The amateur bands are a priceless laboratory for communication experiments; for if we can learn to communicate reliably on 40 meters in the midst of the SS contest we will know how to communicate anywhere! There is nothing theoretically impossible about performing such a feat, so let's get to work and find out how to do it.



Sine Pulse Cosine Pulse Raised Cosine

RYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRY

W. C. SMITH (SMITTY) K6DYX
67 CUESTA VISTA DRIVE
MONTEREY, CALIFORNIA

A number of us have been talking about getting a traffic operation started on the RTTY mode. It seems this has been tried before but without lasting success. Perhaps this is because it turned out to be too much work for too few people. Everyone agrees that, other things being equal, RTTY is the ideal traffic mode and it's a shame not to take advantage of the inherent capabilities. Maybe we can get something going which will not be too great a burden to anyone and which will have room for growth and development.

I have been active in amateur traffic for the past eight years. I was formerly the manager of PAN and have just finished two terms as SCM of the Santa Clara Valley section of the ARRL. I think that I am thoroughly familiar with traffic matters and of course it is my major interest in ham radio.

I am going to start a schedule of RTTY traffic on 3625 kc. I will operate each Monday and Friday night, opening up at 6:30 p.m., PST, with a tape which goes like this: - - - CQ RATTS NET CQ RATTS NET CQ RATTS NET DE K6DYX IN MONTEREY, CALIF. RYRYRYRYRYRY CALLING ANY RTTY STATION ABLE TO EXPEDITE DELIVERY OF THE LISTED TRAFFIC CQ RATTS NET CQ RATTS NET CQ RATTS NET DE K6DYX IN MONTEREY, CALIF. RYRYRYRYRRY IF YOU CAN DELIVER OR IF YOU CAN RELAY TO ANOTHER NET, PLEASE STAND BY CQ RATTS NET DE K6DYX TRAFFIC LISTING FOLLOWS ZBO - - - - - - - -

This station will also accept third party traffic for relay to all points via the National Traffic System CQ RATTS NET DE K6DYX calling any RTTY station able to expedite delivery. Please break by CW DE K6DYX K K K

If I happen to have no traffic on the hook, the tape will be modified. Since at first traffic will be light, to be sure, there is a possibility of including bulletins in the form of QST's but we'll see about that.

It is expected that only stations who can move the traffic which is listed, or who have traffic on their hook will reply to the tape call-up. I will rerun the tape at five minute intervals until 7 p.m. and of course this won't allow time for QSO's.

The thought is that the 6:3Ø time will allow stations to get the traffic with time to make another net. GBN, MTN, NCN, and SCN at least open up at 7 p.m. If you have any suggestions for more effective operation, I'd be glad to hear from you. You may have a better name for the operation than – RATTS NET – If so, speak up!

I am volunteering for the two schedules because those are the nights I also make the CW nets. I hope someone else will offer for other nights of the week. However, a net control station, if we can call him that, should have effective liaison with as many other traffic nets as possible. Besides my CW outlets, I am fortunate to be in land line reach with active members of both MTN, GBN and the Local 2 meter nets.

Please monitor the schedule, develope your outlets and get in and help make this a real effective operation.

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For "RTTY" Information:
W6DEO W6CG W6TPJ W6AEE

W5ANW, W. G. Carter, Jr.

It is with deep regret that RTTY announces the death of W5ANW, an active RTTYer in the Houston area. He was well known on RTTY frequencies, both amateur and MARS. He died December 25 in a Houston hospital.

Note: Correction to GETTING STARTED ON RADIOTELETYPE, page 4 and 5 of December, 1962, RTTY, the 470 ½W resistor in the grid circuit should be 470,000 ohms. Sorry. Ed.

Notice: There is to be an annual RTTY dinner in Boston on Saturday prior to the IEEE (IRE) show in New York City. Contact W1AFN for additional information.

NARROW SHIFT CW ID

by K8DKC

There are two things that really unsettle the average RTTY operator: (1) Not getting on frequency (and staying there) and (2) Using the "Break Key" for CW identification.

The Break Key sounds so much like slow speed RTTY that the operator "at the other end" usually prints a few letters or so before he determines what it is he is copying and locks out the converter. If he is using "Mark-hold," the printer puts out gibberish during the entire CW period.

A majority of operators who use the CW key do not have information regarding simple and easy means of adding narrow shift CW. Most of the fellows using the Break Key have problems obtaining any type of CW without modification of the transmitter. These diagrams should prove beneficial to both types.

With narrow shift CW, the printer remains in a "marking" (idling) condition. If a long transmission is desired, using narrow shift CW enables the operator to keep the carrier going, identify as often as desired, and still the machine at the other end prints absolutely nothing during this time. Once you have used this system you will wonder why you have waited so long to add it! And others to whom you send will certainly appreciate your having this feature.

Essentially in "normal" FSK, the diode only receives conducting voltage during space. During mark (normal idling), the diode is usually bypassed by the keyboard.

We will now refer to the condition where no voltage reaches the diode as "mark minus." Referring to the diagram, we will add R_3 in series with the keyboard. If the CW key is then held down, we will have this "mark minus" situation already mentioned. If the key is released, R_3 enables a small amount of voltages to reach the diode. R_3 is adjusted so this will give a small shift from "mark minus" of perhaps 50-70 cycles. When the keyboard goes to a space condition (as shown here), the entire resistance is removed and we get a large shift, determined by the setting of R_2. This then is set 850 cycles higher than mark normal, which in turn was 50-70 higher than mark minus.

So we now have the following:

Mark minus – when CW key is depressed
Mark normal – set 50-70 cycles above mark minus
Space – set higher than mark normal by 850 cycles.

For those having a circuit that requires non-standard FSK in order to be "right-side-up," refer to the next diagram. Here the keyboard is again shown in a space condition. During mark, the keyboard is closed, and this time conduction occurs. When the keyboard is opened for space as shown, conduction stops. Someplace between these two will be a more narrow shift condition. So we now add R_3 as shown. During conduction or mark, if we close the key, we would then get a somewhat different shift from key up. During key down, we will again call this "mark minus" and this can be set to 50-70 cycles below mark normal. This circuit is the same as the previous diagram, only the diode conducts on mark instead of space. In either case, you will get narrow shift on mark.

For those using Single-sideband type of equipment which must use a reverse switch on some bands, the final circuit will give automatic narrow shift CW ID on mark if the reverse switch has been properly selected for the band in use. It offers an additional "fringe benefit"– by deliberately throwing the reverse switch, narrow shift CW ID can be obtained on SPACE. This is handy to some types of converters using an autostart system. However, even there, it is probably better to use normal narrow shift on mark, and then throw the reverse switch to get the space signal that turns off their autostart system.

If the regulated voltage is 105V, R_1 should be 150K and R_2 and R_3 both 1K. If the regulated voltage is 150V, then make R_1 220K and keep the rest the same.

Make sure the 15mmfd. condenser is a non-drift type. The diode can be any of a number of popular germanium. The 1N270 is an excellent choice, but the 1N34A, 1N38A, 1N100, 1N 297, etc., all will work satisfactorily.

Under no circumstance in this type of controlled-voltage circuit should the printer selector magnets be put in series with the keyboard, as unstable and varying conditions of FSK will result. A polar relay must be used or else the selector magnets must be left in the TU (converter) output for local copy. Other clever circuits have been worked out by W6NRM using a clamp tube, but that is beyond the scope of this discussion.

You will note the CW key is only depressed for ID, and may even be removed from the circuit without affecting normal operation.

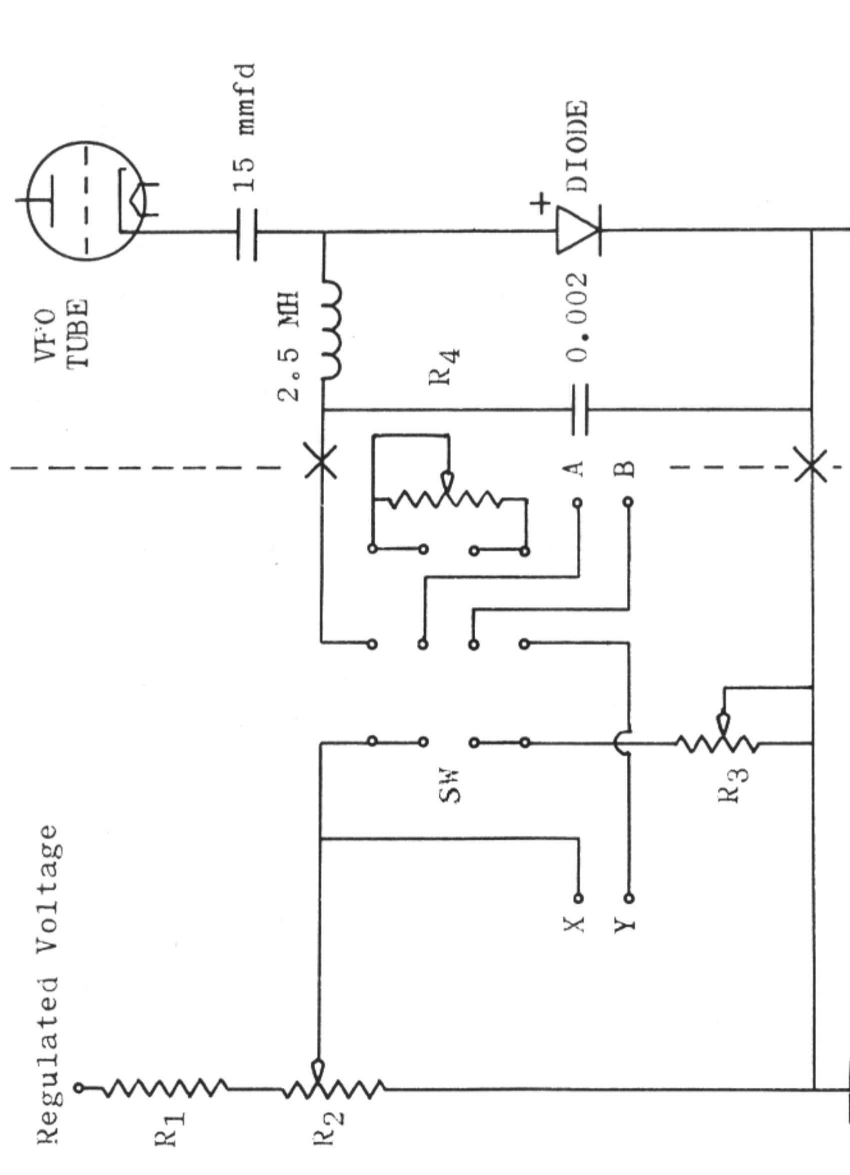
So please, please, please – stop using that BREAK KEY for CW!

In the final diagram, the keyboard connects to points X and Y. The CW key connects to points A and B. R_2, R_3 and R_4 are all 1000-ohm potentiometers. The wattage is extremely small; if it raised as high as 0.05 watts, the diode would most likely be ruined.

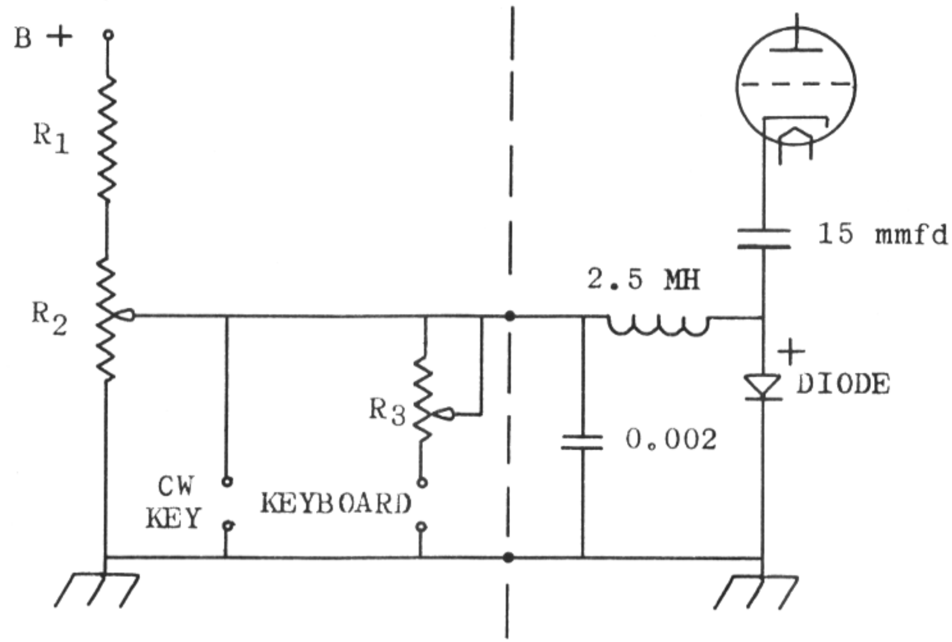
R_3 is set with the switch to the left for normal FSK, and R_4 is set with the switch to the right for non-standard FSK.

The switch best suited is a Centralab 4 pole double throw type 1458 costing $1.44. The condenser is an Erie Zero Change Type (TCO) NPO of 15 mmfd costing $0.18.

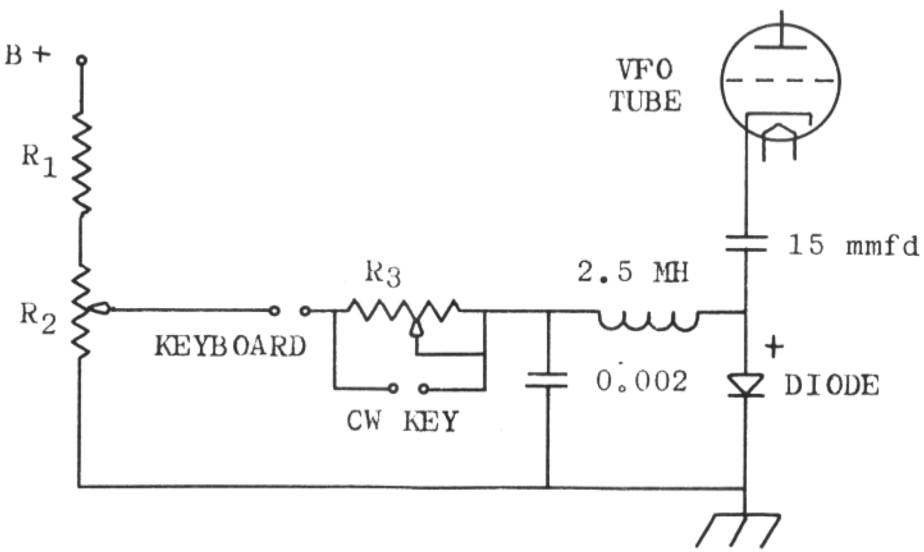
All items to the right of the dotted line are in the close proximity of the VFO Tube, and those items to the left may be any convenient distance outside the transmitter. As this is a low impedance circuit, there is no requirement for shielded wire.



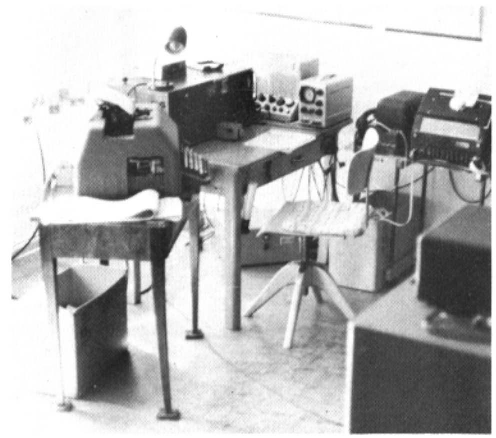
K8DKC CONTROLLED-VOLTAGE FSK SYSTEM Including Narrow Shift CW ID on Either Mark or Space and reverse switch



K8DKC NARROW SHIFT ID CIRCUIT



K8DKC NON-STANDARD FSK SYSTEM
Including Narrow Shift CW ID on Mark



DJ4KW

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FOR SALE: One model 26 page printer with 60 cycle sync motor, auto-carriage ret. & line feed on beefed up typewriter table. To be loaned to RTTY-Newcomer or for sale at $50.00. W1TLZ, Creeping Hemlock Road, Norwalk, Conn.

WANTED: Manual for CV-89 Converter, W5HPB, 4002 Levonshire Drive, Houston 25, Texas.

WANTED: Manual (NAVSHIPS 900-474-1B) for TDQ transmitter, K1CLD, Piermont, New Hampshire.

WANTED: Pen Pals, Sandra Stedinger, 9 years old in 4th grade. Daughter of K6ZBL, 2816 Delaware, Oakland 2, Calif.

FOR SALE: Jackson Audio generator, Model 652, $25.00 FOB, W3WUX, 1712 Woodmere Way, Havertown, Pa.

FOR SALE: Model 14 non-typing reperf with pwr supply and end of line indicator, excellent condx. $45.00. K2GYX, 25 Cobblewood Road, Livingston, N.J.

WANTED: Governed motor for Model 12 keyboard, Wheatstone polar relay. John Riley, 914 North Cordova, Burbank, Calif.

FOR SALE: Model 14 TD with sync motor and slip base, spare set brushes, $80.00. Transistorized tuning fork standard, $20.00. W6LXG, 113 Madonna Lane, Newbury Park, Calif.

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