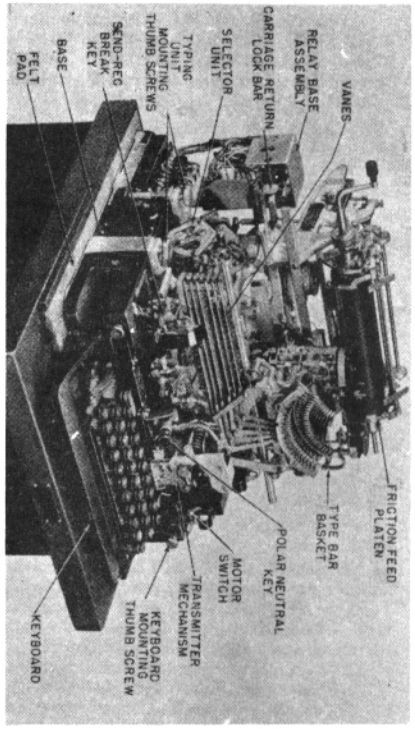
Additional Classified on Page 19

TT/L-2 PRINTED CIRCUIT BOARD: heavy duty fibreglass epoxy, 6 x 9 with parts list, layout and enlarged schematic, postpaid in the USA: $6.00. J. Salter, K5BQA, 11040 Creekmere, Dallas, Texas 75218

WANTED. 500 Hz filter for 75A4, have a 14 TD with 60WPM sync. motor. Mosley CM-1 with 2.1 Khz mechanical filter. Trade or sell? Melvin Hart, 936 Dontaos Dr. St. Louis, Mo. 63131.

NEED AN ACCURATE AUDIO frequency source for construction projects? With reference frequency L-C filter use merely voltmeter and uncalibrated audio oscillator or receiver/BFO. Especially handy for tuning bandpass filters to midfrequency etc. Epoxied precision frequency filter in 800-10K hz range, instructions, $2 or 3/$5. Specify frequencies. Jerry Hall, K1PLP 15 Endleigh Ave., Pinehurst Mass 01866

WANTED: TELETYPE #163359 (or equivalent) three speed (60-75-100 WPM) transmission key for model 28KSR Teletype. State condition and price. E. Rowekamp, 8850 West Midland Dr. Greendale, Wisc. 53129

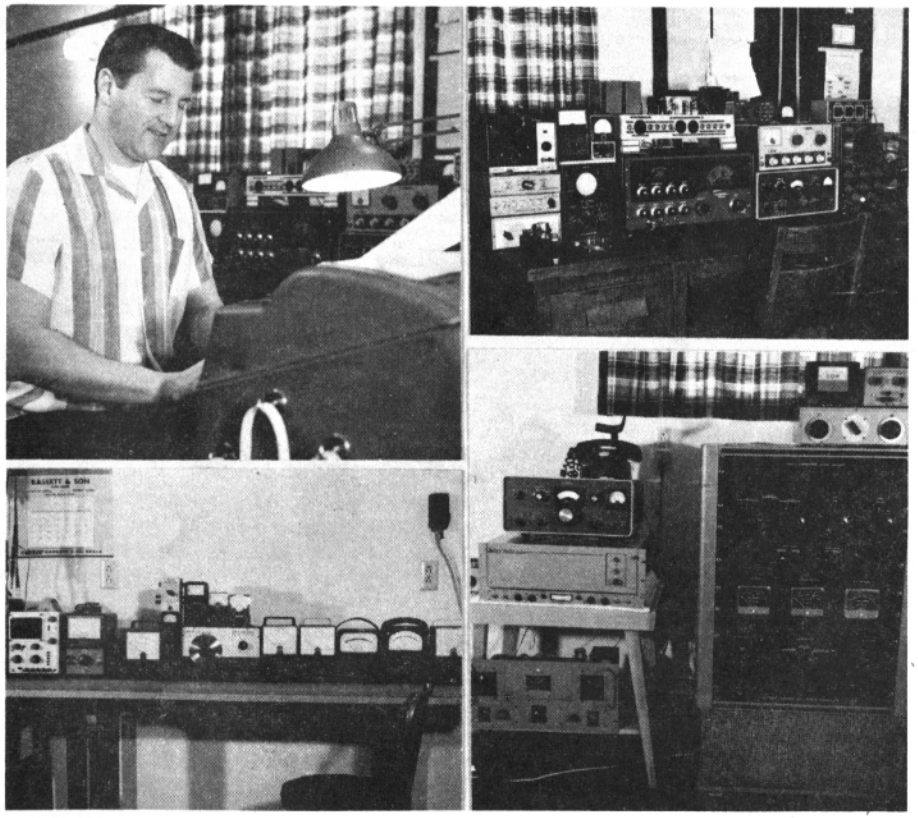


RTTY JOURNAL

October 1968

EXCLUSIVELY AMATEUR RADIO TELETYPE

Vol. 16 No. 9 - 30 Cents



"IRV" W6FFC

.READY ? ? for the 'RTTY Trophy Week End.

Most readers will receive this issue just before the RTTY "Trophy Week End" contest. Full details are in last months issue. Remember there is a division for all types of operators, even those that do not care for DX. And you fellows that print but do not transmit, be sure and enter the SWL contest. You do not have to be licensed for this division. A couple of suggestions- because of QRM and interference of South American phone stations activity on 20 will probably run from 14050 up to above 14100 mH.

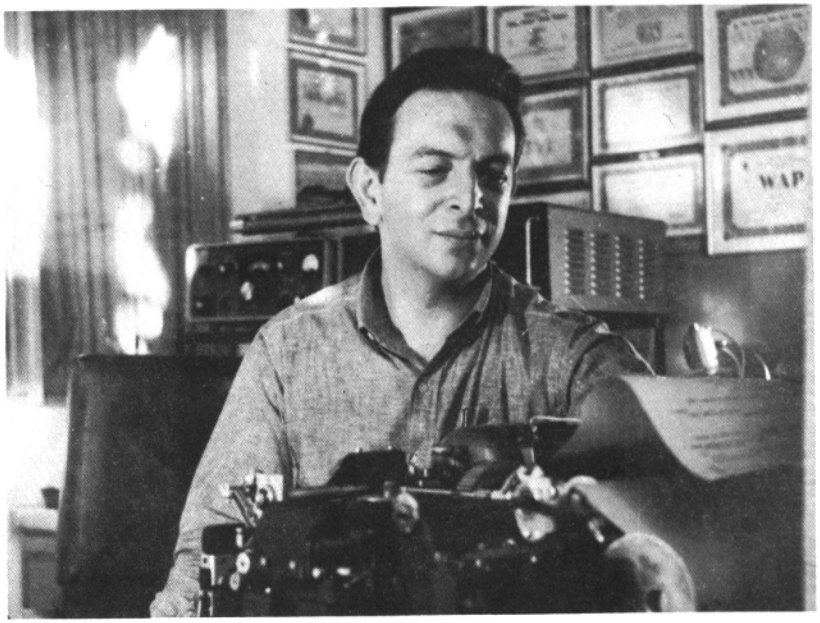
On 40 meters we recommend around 7095 up or down a little, remember many foreign stations can not work RTTY above 7100. In a few months many stations will not be able to work below 7050 so that is a good time to switch to 7095.

Everybody can not win, but everybody can participate and have a good time. The CARTG has gone all out to offer an outstanding week end on RTTY, let us all show we appreciate it.

15 meters- an excellent but seldom used band. If conditions are average at least this band will have activity from all countries during the contest but why neglect it when the contest is over. Remember a 40 meter dipole can work the world on this band.

On 10 meters US stations will be operating around 29050 and should check around 28050 for many foreign stations. When calling, a station should mention tuning up, if foreign, and tuning down if a US station and they are looking in the other section of the band from which they are transmitting.

* * *



'Jose' PY2CQ

Jose, PY2CQ, was the winner of last years Sweepstakes, with a very impressive score. He hopes to be active again this year, barring Murphys Law, so watch for him on all bands. Jose's XYL, Sonia, PY2SO is also an active ham but seldom works RTTY. Her picture in the September QST seems to show her at a printer however so don't be surprised if you hear her while Jose is away or resting. Jose is the only active station on RTTY from Brazil and has furnished this country to many hams.

Model 15 Teletype Printer

MODEL 15 TELETYPE

With a great many Teletype Model 15 printers being taken out of service the Telephone company has ~~realeased~~ a number to various amateur groups for distribution to licensed operators. Most of them are "as is" but usually in working order. Some will have 75 wpm gears but these may be changed to 60 wpm gears with little trouble. Most of them have sync motors. The type faces may contain fractions on the upper case but pallets are available to convert to commercial types.

The model 15 is a page printer, self contained, with keyboard and motor. It has a single magnet selector, which can be operated direct from your Terminal Unit or through use of a polar relay. Two types of selectors are to be found on various models of the 15, first the so called "pull type," magnet which requires the current to be on to pull the selector back after each operation. The second type is called a "Holding Type" selector, which mechanically returns the selector to operating condition after each operation. The later machines have the second type of selector, but does in no manner make the earlier version unsatisfactory. Both types can be operated with the two coils either in series or parallel, to provide 30 to 60 mil operation.

The keyboard has the standard type of distribution assembly, which is similar to that in the model 12, 14, 19, 24, 26 machines. As received, they have the coil and condenser across the contacts which has to be removed for operations of your FSK direct. However if a polar relay is used, it can be left in place to reduce RF noise generated by the contacts breaking the keying current.

In the model 15, the paper is held on a roller which does not move back and forth as in the model 24 and 26s. The type basket travel from left to right a copy is received.

The range finder is located on the left hand side of the printer, and can be adjusted when necessary through a small door on the left side of the cover.

An "unshift on space," cut out or in, lever is provided under the front of the printer. See photo for location of this feature. Many DX RTTYers will find this feature to be of advantage in copying weak signals, especially when a static pulse operates the shift to upper case. It can be cut out by shifting the lever to the other position. Optional features which can be added include automatic carriage return which can be purchased and added easily. Tab, for business operations also can be added. This operates from "upper case G," and is not used in amateur operations. A few of the recent lots received have this feature installed in them.

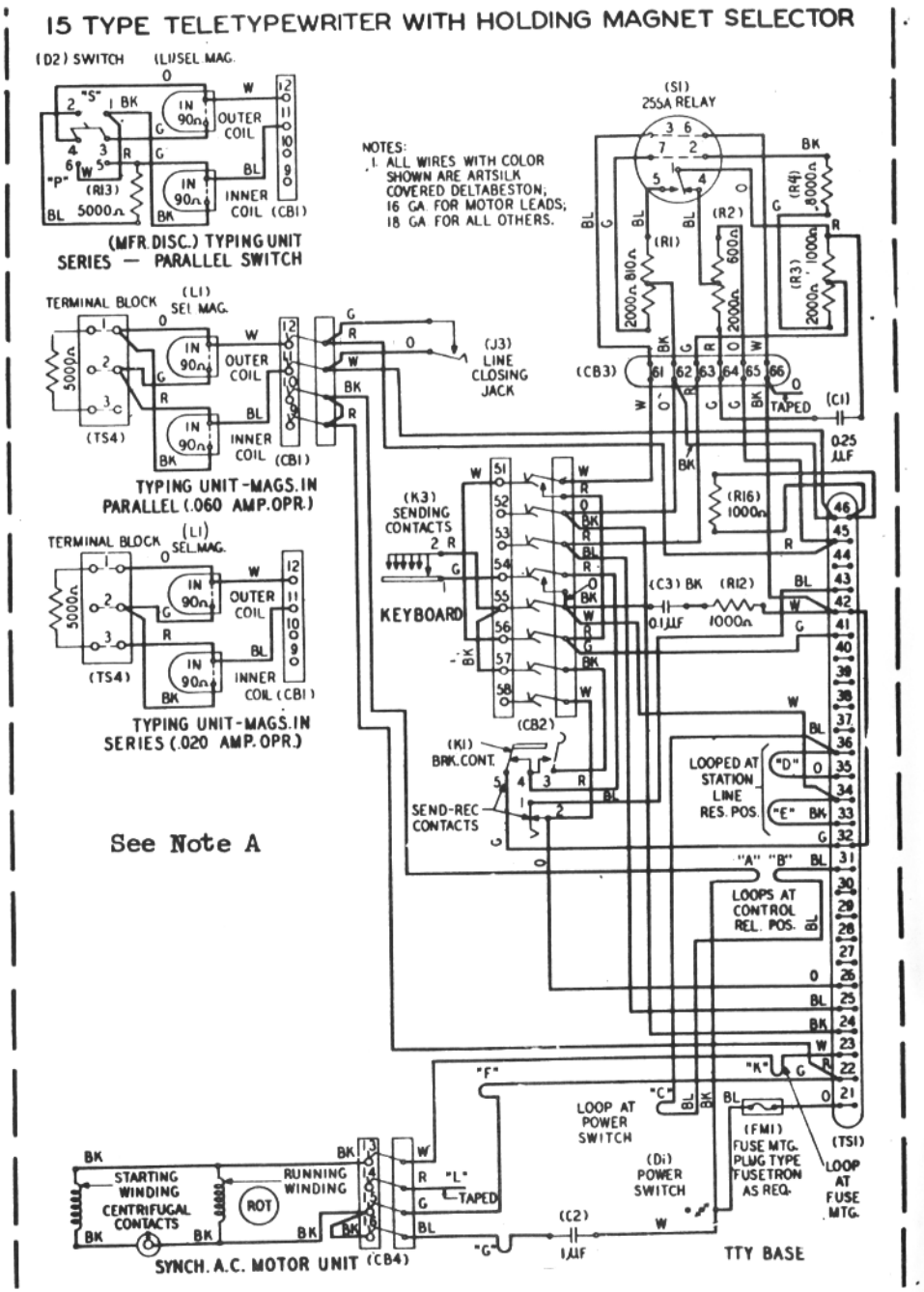
Also the keyboard can be replaced with a 15 perforating keyboard, which makes the 15 similar to a 19 unit. This requires a power supply which will provide 500 mils at 110 volts DC. The base casting is slotted for this modification.

The complete model 15 is made up of the following major parts: Base, with wiring, keyboard which plugs into the base; motor with electrical connections which make, when the motor is bolted to the base; printer, which contains all of the selecting and printing functions; a cover which completes the unit. Additionally some of the 15s have a polar relay socket mounted in the rear, others have an additional relay which controls the motor from line current. Other type motors can be had to operate from generator AC supplies or DC. Other type faces can be purchased to convert to weather operations. To mount the type faces soft solder is used, which permits one change the fractions pallets quite easily. Key tops can be changed by lifting at the top of the keys and pulling up, to replace, reverse the operation. Normal amateur operations are at a speed of 60 WPM, using gears which have numbers 74912 and 74913. However, speeds of 75 WPM can be had for other uses. To operate with a typical set-up amateur circuits, one would connect cords and plugs to terminals 41 and 42 for the printer, if there is no polar relay wired into the circuit.

If a polar relay has been installed, it is necessary to connect one of the coil lead from the selector magnet which was connected to terminal 65 and move it to terminal 66. This lead goes to terminal 42. Next remove the lead which goes to the polar relay socket from terminal 61, and tape up. Then move the other selector magnet lead which was on terminal 62 and connect it to terminal 61 which goes to terminal 41.

The keyboard connects to terminals 32

and 34. Other wiring can be traced on the circuit shown. Photographs of various features show major items on the model 15.



The MAINLINE "AK-1" AFSK Unit ...

IRVIN HOFF, W6FFC
12130 Foothill Lane
Los Altos Hills, Cal. 95022

The Mainline "AK-1" A.F.S.K. unit may be used on AM or FM transmitters on v.h.f. bands such as 6 meters and 2 meters, or it may be used on some types of s.s.b. transmitters on 3-30 MHz. bands. Articles have been written[1] covering the problems involved in the uses of a.f.s.k. on s.s.b. transmitters and the arguments will not be advanced again at this time. The operator should keep in mind though that good suppression of the carrier and unwanted sideband are necessary. Above all, be sure you do not over-drive the input merely to assure maximum output. Back off on the audio input until the output of the transmitter begins to fall off; that will be your best operating level.

The AK-1 does not use an L/C oscillator, hence the typical keying transients experienced in nearly all other a.f.s.k. units using inductors are not present. The AK-1 also has a fine 5-pole Butterworth filter to eliminate all harmonics and at the same time form a symmetrical sine wave output, neither of which most a.f.s.k. units can claim. The AK-1 also has outputs for carbon mikes and for high-impedance microphones.

Due to the nature of an L/C oscillator, you must add either "L" or "C" to lower the frequency. Thus you typically have an 88 mh. toroid and a 0.033 capacitor to give 2975, which is then lowered for mark to 2125 by the addition of a 0.03 or 0.033 capacitor. It is simple to see how difficult it would be to arrange a workable system that would offer both 170 and 850, let alone any "other" shifts. Also, it is quite difficult to add "narrow shift c.w. ident". that is right-side up, thus meeting F.C.C. suggestions.

The Mainline AK-1 A.F.S.K. unit overcomes these objections by using a R/C oscillator. By adding "R", the frequency goes up, so the reader sees that you can add any of several different resistors to get any "up" frequency you want. Thus once 2125 is set, it is not affected by the "other" resistor or resistors you may add. In this manner it is simple to get 2295 for narrow shift or 2975 for 850 shift, or anything in between for "any" shift you may want. You can also see how simple it is to add a circuit to give narrow shift c.w. ident. that is always right-side up and always the same shift, regardless of the shift you are using for RTTY transmissions.

EXPLANATION OF THE AK-1

A unijunction transistor is used as a microsecond pulse generator. It runs at 4250 pulses per second. These pulses trigger a saturated type flip-flop which flips once for each pulse. This gives symmetrical square-wave output of 2125 "flops" per second. Since square waves have only odd harmonic content, you then have harmonics of 6375, 10625, 15875, etc. It is rather easy to filter out the 6375 frequency and the other harmonics are so easy to filter we needn't mention them. Following the flip-flop is a 5-pole Butterworth filter made up of two 88 mh. toroids. This filter cuts off a little above 3,000 cycles. It not only removes all the harmonic content remaining, but at the same time changes the square waves into symmetrical sine wave output. The output of the filter then goes two directions -- one for high impedance microphone inputs requiring very low voltage levels, and the other going through an emitter-follower stage to provide the stiff output needed for carbon microphone inputs, where you often need to include a 100 ohm resistor to simulate the d.c. current drawn by the microphone. This circuit is designed to give approximately 0.5 volt peak, which is comparable to the voltage generated by the carbon microphone.

SHIFTS AVAILABLE

The circuit shows how you may, if you like, have five pots on a four-position switch. The one pot is adjusted to give 2125. The switch selects 850, 170 and two other choices if you wish to add them. One position will give any shift from approximately 150-860 and the second position will give any shift from approximately 10 to 200 shift. Thus you can experiment with any shift you want and not "rob" one of the pre-set positions.

C.W. IDENT.

By shorting the point titled: "C.W. KEY" to ground, the frequency is shifted approximately 110 cycles higher. This produces "right side-up" c.w. that is easy to interpret. If you wish more shift than this, make the 430K resistor smaller, such as 390K. The F.C.C. requires at least 100 shift for c.w. ident.

THE INPUT

Literally any system that puts positive voltage on the input for space signal will key this unit. It was designed to be operated directly from the f.s.k. output of the TT/L or TT/L-2 units. However, most f.s.k. systems have positive voltage on space, and will operate the unit equally well. If you wish, you can also hook the keyboard between "input" and ground, and then connect a 4700 ohm resistor between input and plus 12 volts. Thus when the keyboard opens for "space", the plus 12 volts will cause the input transistor to conduct producing a "space" output frequency. When the keyboard again closes for "mark", the positive voltage is shunted to ground and the input transistor no longer conducts, returning to "mark".

The unit adapts readily to the Mainline ST-3 2 also, but in this case the auxiliary transistor must be added to the ST-3 for "conduct-on-space".

CONSTRUCTING THE UNIT

A printed circuit board is available, as are any or all of the parts, from K8JUG. It only takes an hour or so to solder all the parts on the printed circuit board at which time you are nearly finished. You will need to drill a few holes in a chassis for the various pots and output connectors. The entire project could easily be done in one evening's time.

The board was constructed so the resistors could be hand picked, thus allowing small-value pots to be used for 2125, 2295 and 2975. Thus once you have selected resistors that enable the pots to reach the frequencies desired, you can then easily tune the correct frequencies via a "vernier" action. You can also use larger pots if you prefer.

Use a 0.01 or 0.005 capacitor directly to ground at each of the four output jacks to minimize r.f. being introduced into the unit. These are not shown on the schematic.

POWER SUPPLY

The unit requires about 50 mills at 12 volts. The power supply shown in the Mainline ST-3 article is more than adequate to drive this a.f.s.k. unit, in addition to the ST-3. In that event, the 56 ohm resistor will need to be changed to keep 10-20 mills current through the 12-volt Zener. That same power supply can be used exclusively for the AK-1 if you prefer.

The Heath Company has a brand-new regulated 12-volt supply (the IP-18) for $20 that is ideal to drive not only the AK-1, but the ST-3 as well. That is a 500-mill voltage and current regulated supply.

PARTS

The Q2 and Q3 transistors are literally any PNP silicon types you can find. Q1, Q5, Q6 and Q7 are literally any NPN silicon units you want to use. The unijunction transistor is a $0.96 Motorola 2N4871, although other units may be used as well. The Pots used were the Centralab "Fastatch II" types, merely because they were low cost and could be obtained with flush screw-driver adjustment shafts. The 0.01 capacitor should be a 10% Mylar type.

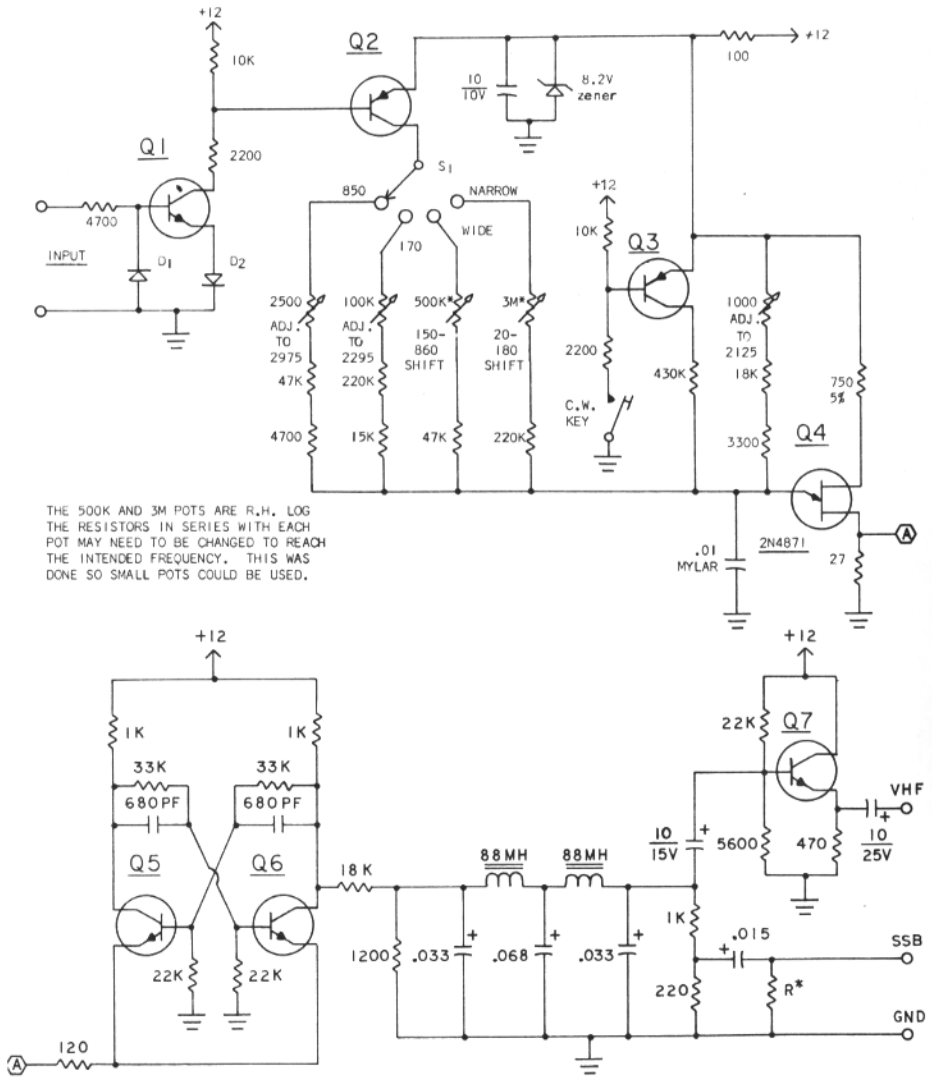
THE OUTPUT FILTER

Many s.s.b. transmitters are "tailored" for voice transmission and cut off around 2400 cycles. In this case you will probably need to change the b.f.o. crystal so that normal 2125 and 2975 tones may be transmitted. It's much better to change the b.f.o. crystal than to attempt to transmit with unorthodox tones such as 1275 and 2125. In the first place, the second harmonic of 1275 is 2550, and it would be rather difficult to construct a filter to eliminate a strong 2550 harmonic so close to 2125. In addition, the side-band suppression will suffer somewhat. Also, on many oscillators the relationship of 1275 and 2125 makes it more difficult to generate good sine waves of both frequencies. Further, keying transients are much greater, usually.

Since many transmitters already pass 2975, you may not need to change the transmitter at all. However, many times the space tone of 2975 will still be down 20-30% and more from that of 2125. A high-pass filter is included in the AK-1 design that you can ignore if not needed. It is made up of the 0.015 capacitor on the output and the resistor marked: "R*". If your space output on 2975 is down somewhat from the mark tone of 2125, try various values of resistance at this point. In my case, using a Hallicrafters HT-32A, it was necessary to use about 4700 ohms resistance to give equal mark and space output on the transmitter when the audio was backed off to the point the transmitter input was not saturated. Thus a linear amplifier can now be used with the HT-32A running only partial input and have balanced mark and space output levels.

TRANSMITTING WITH A.F.S.K.

Only when transmitting (and receiving) on lower sideband are normal techniques possible. Do not use upper sideband for any normal RTTY purpose, either for transmitting or for receiving. Be sure not to overdrive the input with too high an audio level. You will be pleased to find as you change the switch to another shift that mark frequency always stands still. Thus to adjust the "space" tone to anything you want,



W6FFC

THE MAINLINE "AK-1" AFSK UNIT

merely tune in mark, depress the "break" key on the printer to get "space" and then adjust the appropriate pot for whatever shift you want. Now you are finished. It's a "one-shot" adjustment.

The c.w. ident. retains the same shift regardless of what position the selector switch is in.

SUMMARY

The Mainline AK-1 should provide an excellent system for those who require an a.f.s.k. unit. It offers many outstanding features not usually found in other a.f.s.k. units such as 170 shift as well as 850 shift, narrow-shift c.w. ident.; outputs for both v.h.f. and s.s.b. transmitters; no keying transients such as are found in L/C oscillators using inductors; no harmonic content; excellent sine wave output; and a high-pass filter to equalize mark and space outputs on your s.s.b. transmitter. The parts as well as a printed circuit board designed by the author are available through:

TRUMAN BOERKOEL K8JUG
NEWARK IND. ELEC. CORP.
2114 SOUTH DIVISION
GRAND RAPIDS, MICHIGAN 49507

COST

Total cost as shown is around $28 less power supply and printed circuit board. If all components are ordered through K8JUG, some savings over this figure will be possible in a "kit" form.

STABILITY

The AK-1 was designed for use with a 12-volt power supply. Tests were run varying the supply voltage from 8-16 volts d.c., and only one cycle change was noted on a digital audio frequency counter.

Long-term stability has been quite good, and has stayed within 1-2 cycle of 850 shift. There will be a little drift the first few seconds after the power supply has been turned on, although the 850 shift itself will remain 850, 2125 mark may drift for a few seconds. This is of literally no importance, as we are talking about perhaps 10 cycles from "cold" until a few seconds later.

SETTING THE POTS CORRECTLY

You can connect a counter (if you are ucky enough to have one) or else a pair of headphones into the "VHF" jack. This has enough output to be easily heard in the phones, and the pots can then be set to correspond with known audio tones from an audio oscillator, musical instrument, tuning forks, etc. To get any of the "space" frequencies such as 2975, 2295, etc. on the other pots, just depress the break key on the keyboard and hold it down while making the adjustment.

FOOTNOTES:

1. QST, June 1965, pg. 32 HOFF: "Audio Frequency-Shift Keying for RTTY"
2. Sept. 1968 RTTY JOURNAL page (5) HOFF: The Mainline ST-3 RTTY Demodulator.

* * *

Take a Pencil ! . . .

We didn't miss any pitches in the July issue but sure struck out with the bases full in September. Take your pencil and the September issue and make the following corrections.

The first three paragraphs in the left column on page nine belong with the article appearing on page 11. The main article then skips directly from the bottom of page 8 to the paragraph commencing: "With the 27K resistor shunting the. . .(etc.)"

Also, the second line from the top in the right column of page 9 should read: "D10 and the ones in the high voltage power supply are Sarkes-Tarzian 1N4004 400-volt PIV at 35¢. The 12-volt Zener is a Sarkes-Tarzian at 62¢, etc."

* * *

BROAD MINDED

USE NARROW SHIFT

* * *

WHY Narrow Shift ? ?

Narrow shift offers probably the greatest single achievement in the state of the art that we can develop for some time to come. It is highly effective in circumventing CW interference: it radically increases efficiency, it drastically decreases the band-width required by only one station. It is still effective as wide shift for selective fading. It is not overly difficult to achieve technically, and it offers tremendous potential for reduction of errors. Although only lightly touched upon, it allows use of narrow filter in both the converter and receiver, thus inherently offering substantial improvement in signal-to-noise ratio.

"CARTG"

* * *

Checking Distortion on RTTY Signals

GORDON ELLIOT WHITE
5716 N. Kings Highway
Alexandria, Va. 22303

One of the most useful things to have around an RTTY operation is a really good distortion meter. It is surprising what you can learn from a top grade meter, triggered scope, and accurate time base and character generator when you examine your keyboards, selectors, demodulators, AFSK oscillators, etc.

My curiosity about exactly what was going on in my RTTY gear was set off by Ron Guentzler's VHF column, with its good description of loop characteristics, particularly his discussion last winter of distortion. I had the opportunity to use a very fine, very costly Stelma Corp. DAC-V "data analysis center" distortion set in the shack here for about six weeks. The following paper contains some of the resulting observations, together with photos off the DAC-V scope.

The DAC-V calculates distortion on a direct reading meter, using digital techniques which may be read easily to less than 1%, peak or instantaneous. The triggered scope in the set provides an accurate, dramatic presentation of the loop current in such a clear manner that the effects of bias and distortion are readily seen, and readily dealt with.

Fig. 1 is a diagram of the Baudot character "Y" in 5-level, 7.42 unit code. The upper line represents "mark", or current flow in a neutral circuit, and the bottom line "space" or no-current. Ideally, the start and five information units are identical in length, with the stop pulse (marking) being 1.42 times the length of the other pulses. Transitions should be perfectly space, as indeed they are shown in the drawing.

Most scopes will not show this pretty a display, but the DAC-V display (fig. 2) approaches the ideal. The slight curl at the start of the space pulses result chiefly from the circuits in the scope which widen the trace for easier reading under bright ambient light conditions.

Fig. 2 shows as perfect a Baudo "Y" as you will see. The character in this case was generated electronically in the test set.

There is minor distortion shown in the length of the start pulse, for example, but this is an effect created by the time exposure required for the photo, and was not actual distortion of the character. The first pulse to the left is the start unit, followed by Mark, Space, Mark, Space, Mark, and the 1.42 unit stop pulse at the upper right.

Fig. 3 shows the same "Y" character with the introduction of spacing bias; the space pulses are lengthened and the mark pulses shortened, while the overall character length remains the same as the undistorted character. This figure shows about 40% bias - a little more and no teleprinter will be able to tell whether the lengthened start pulse should be "start" or a spacing pulse in unit #1. Over 50% and even most non-parity regenerators can't tell either.

Fig. 4 shows a good "Y" signal after inductance has been added to the loop: the space-to-mark transitions are rather badly rounded off by the selector magnets, which take five or six milliseconds to saturate, thus preventing the current from attaining mark level "on time". The effect is the same as spacing bias. The length of the effective mark pulse is shortened by the rise time required.

Well-adjusted selectors will close at the 50% point of the rise, and open quite rapidly - as fig. 4 would indicate - on the following mark-to-space transition, thus compensating for the bias to a degree. However, there is always some spacing bias involved in a loop containing selector magnets. On radio circuits the instantaneous distortion caused by propagation problems may jump from near zero to 50% and vary in between at a rapid rate. Whenever the received distortion (which you can do very little about) adds to the selector-induced bias to produce more than 42% total bias, you get garble, possibly extending to several characters before synchronism is restored. Thus you see

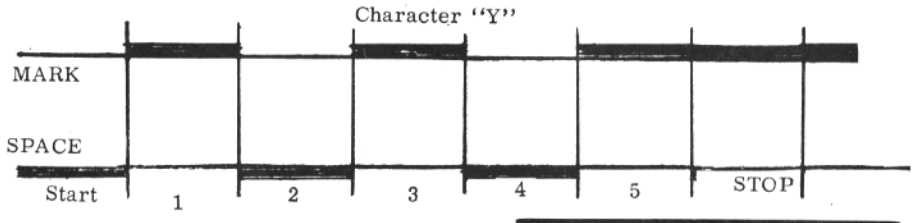


Fig. 1

that the apparently minor magnet bias may be the straw which breaks the camel's back in RTTY reception.

Fig. 5 shows spacing bias so severe that full marking current is not attained until the end of the mark pulse - this is total garble material in most cases, however the dip in the trace on the space-to-mark transition is caused by pull-in of the selector armature, so you see the printer is trying to do its job despite a rotten signal.

It is surprising just how much distortion can be found in a loop you thought was "clean". I found that my favorite boat-anchor D.C. loop supply suffered from severe 60 cycle ripple, so bad that it made "holes" in the marking pulses. Turned out to be a filtering capacitor, but I would have had a hard time finding the source of the problem without the DAC-V display. I also learned just how bad was the effect of various loop-current-operated relays, such as the motor-control relay in some #28 machines. The inductance of these relay windings, if not shunted when the printer is receiving, can degrade a loop to the point of failure - they were responsible for Fig. 5 as a matter of fact.

Most scopes will not show this clean a picture of the loop, but if you have access to a really good triggered scope, try looking at your loop this way. It will enable you to set slicer levels, mark and space oscillators, and other terminal unit parameters until you can see the distortion disappear.

The scope display - and the meter type display - will also help remove distortion from keyboard signal generators, TD's, etc., and if you have a character generator which may be set to measurable distortion points, you may be able to adjust your printer or reperf for optimum reception of typically lousy signals with some degree of precision.

Actually, most printers do very well. After looking at the garbage which passes for an RTTY signal on most high-frequency

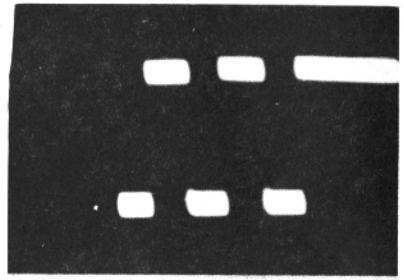


Fig. 2

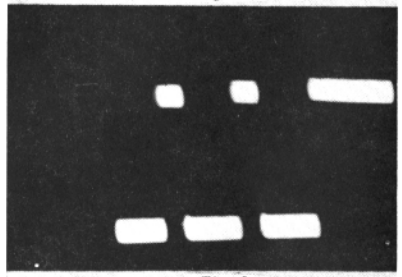


Fig. 3

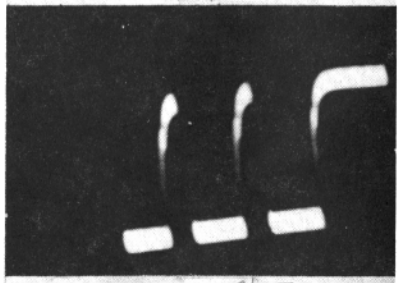


Fig. 4 5

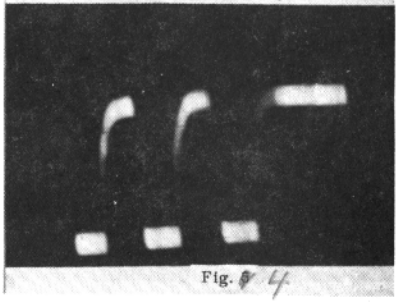


Fig. 6 4

circuits, you will be amazed that we get any copy at all, most of the time.

If you want to do something about that apparently irreducible selector magnet distortion, you have two solutions: first, the familiar polar relay (255A or 314, the latter a modern mercury-wetted type). The relay has a lot less inductance than the selector magnets, and if you can stand the "hash" it generates, it will help a great deal. The most modern method however is to insert a Selector Magnet Driver, usually transistorized, in the loop to isolate the magnets. The S.M.D. derives its signal from the voltage induced across a resistor, thus showing pure resistance to the loop. The driver, usually 2 or 3-stage, generates its own current pulse to drive the selector. Though obviously the inductance of the magnets still exists, the SMD is so designed as to give very fast rise and fall times, overcoming the inherent bias.

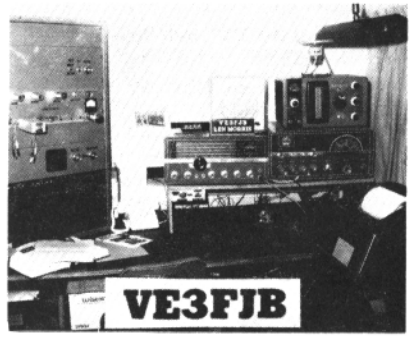
This becomes vital in a loop with several machines on it. Where the selectors themselves would induce more than 42% bias, a series of SMD's can be used which add virtually no bias no matter how many are added in series.

Few of us can afford a DAC-V, but a good DC-coupled scope, with accurate, triggered sweep, in the Textronix class, can do nearly as well. You simply hook the deflection plates of the 'scope across a resistance in the loop, and adjust the sweep for a stable display. This is usually done most easily with a steady character being sent, as from a tape or test distributor. It is not recommended that this be done from off-the-air signals as propagation variances make such signals ambiguous and hard to stablize.

The resistance can be added to the loop or the scope hooked across your loop-adjusting pot, if you have one. The size of the resistance affects the voltage drop and the amount of deflection on the 'scope, so different amounts of resistance will take varying degrees of amplification.

Since RTTY signals are not synchronous, the sweep must be triggered on the start pulse, demanding considerable stability in the 'scope. Cheap scopes will not work very well for this application. A good scope will lack the ease of setting up the signal of the DAC-V, and the trace enhancement, but it can be quite useful nonetheless. You can spot maladjusted transmitting contacts, T.U. or AFSK oscillator bias, and other problems and watch the distortion disappear as you make adjustments. Bias effects with low loop voltage vs high loop voltage is easily seen, and adjustments of all terminal gear made to provide optimum signals to the printer or transmitter.

* * *



RTTY theory & applications.

RON 'RG' GUENTZLER, W8BBB
Route 1 Box 30
ADA OHIO, 45810

RTTY FOR THE BEGINNER -
AN AFSK KEYER

Last month we described the two principal methods used to transmit a RTTY signal: 1) Frequency shift keying (FSK), and 2) Audio Frequency Shift Keying (AFSK). It was shown that they are in some ways quite similar in that the frequency of an oscillator is shifted between two different frequencies as the contacts on the keyboard of a teleprinter open and close. In the case of frequency shift keying, the frequency of the oscillator within the transmitter is shifted. This is usually accomplished by slightly modifying the oscillator circuit within the transmitter. Consequently, no circuit for a frequency shift keyer was given because the actual circuit depends upon the specific make and model of transmitter being used.

In the case of audio frequency shift keying, the frequency of an audio oscillator is varied between two different frequencies as the keyboard contacts open and close. The output of the audio frequency shift keyer is connected to the microphone input of a voice transmitter (AM or FM). Because the AFSK keyer is not built into the transmitter, essentially any AFSK keyer can be used with any voice transmitter. (Of course, the input impedance of and level required by the transmitter will have some effect upon the specific requirements of the AFSK keyer, but the restriction can be considered minor.)

This month we are going the present a circuit for a simple but quite good AFSK keyer. This is essentially the same keyer presented in this "column" about a year ago; the only noticeable difference is that a positive 24-volt supply is required this time and the transistors are the 2N3819 which is cheaper than the one used previously. The 2N3819 can be obtained from Allied Radio, Catalog Number 49 C 32 2N3819-TI, at $0.90 each.

THE AFSK KEYER

Although an AFSK keyer can be built with a single oscillator and a capacitor placed across its turned circuit to shift the frequency, more versatility and reduced keying transients can be obtained by using two separate continuously-running oscillators whose outputs are "gated" by the opening and closing of the keyboard. The two major advantages of separate oscillators (one for mark and one for space) are:

1) The frequency of each oscillator can be adjusted independently of the other, and
2) The levels of mark and space tones can be independently adjusted.

The circuit will be described briefly and then various portions of the circuit will be described in some detail.

The oscillators use the familar Hartley circuit consisting of an 88 mH toroid shunted by the proper amount of capacitance to give the required 2125 and 2975 Hz resonant frequency. The values shown for C3 and C4 are the approximate values required. The exact values should be determined by measuring the output frequency and adjusting the capacitors until the frequency is proper. The capacitors can be "varied" by shunting small mica capacitors across C3 and C4 or by using Arco mica trimmers.

The oscillator transistors are TI 2N3819's. These are N-channel junction field effect transistors. The resistors R1 and R2 and the capacitors C1, C2, and C5 are for decoupling. R1 and R2 can be used to measure the drain current on the transistors. It should be from 4 to 8 mA.

The keyboard is connected into a "loop" composed of R6, R7, and R8; the loop is fed from 130 V or higher. R6 is adjusted to give a loop current of 60 mA. (Actually, R6 is not really necessary and the loop current does not have to be set to 60 mA unless a selector is also put into the loop. The selector is undesirable for reasons described later, but "force of habit" or good telegraph practice indicate that 60 mA is desirable.)

Assuming that R6 is present and it has been adjusted to give 60 mA loop current, during marking condition from the keyboard (contacts closed and 60 mA flowing in the loop) the potential at point "A" is approximately +48 volts; during the spacing condition (no loop current), the potential at point "A" is approximately 0 volts. This variable potential is coupled into the diodes D1 and D2 thru a delay network composed of R9, C6, and R10. The varying potential at point "A" causes one or the other of the diodes to conduct. For example, during a mark the potential at point "A" is +48 volts; this voltage causes diode D2 to conduct or gate the output from the mark oscillator into the output amplifier Q3. The output from the space oscillator will be blocked from Q3 because D1 is reverse biased.

During a space, the voltage at point "A" is approximately 0 volts causing D1 to conduct and D2 to open. Therefore, during a space the output from the space oscillator is connected to Q3 via D1 and the output from the mark oscillator is blocked from Q3 by non-conducting diode D2.

R4 and R5 control, independently, the levels from the two oscillators while R11 controls both levels simultaneously.

The network composed of R12, L3, and C7 is essentially a "simple-minded" band pass filter. The output stage is a common-source amplifier transformer coupled to the transmitter audio input circuit.

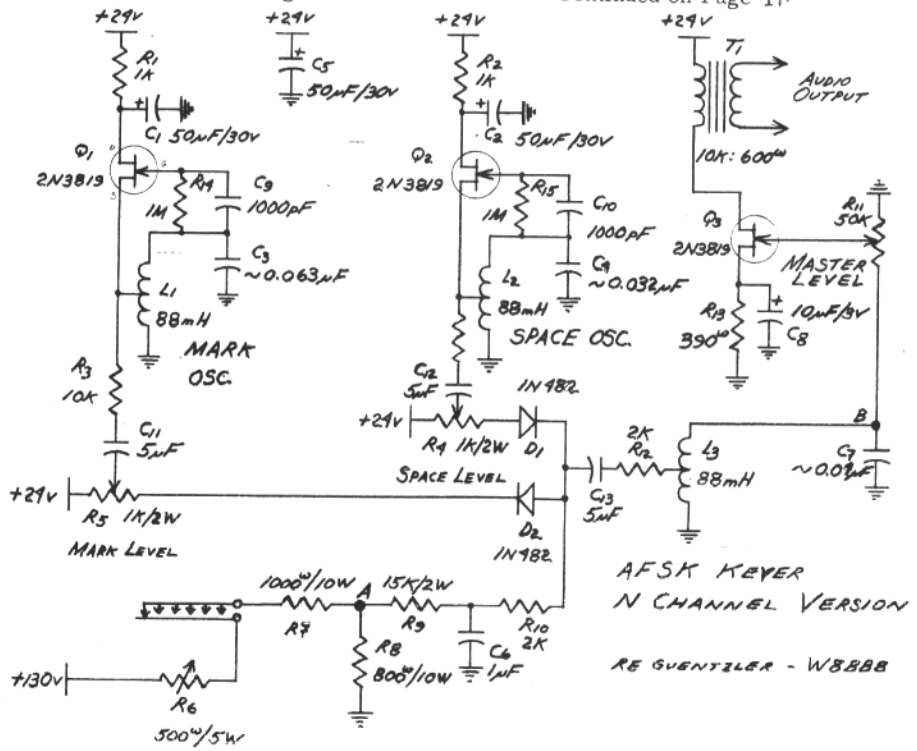
Capacitors C1 and C2 can be any value greater than 1 uF. C5 should be as large as possible.

It was found that the frequency of the oscillators changed less than 1 Hz when the supply voltage was varied from 18 to 26 volts. With stability that good, no regulation is required.

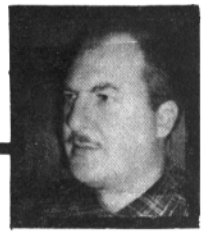
The diodes should be silicon junction diodes. This is desirable in order to get a good forward to backward resistance ratio with the magnitudes of oscillator and switching voltages available. We used the 1N482 because it was (and is) readily available. (Allied Cat. No. 49 C 12 1N482-SYL at $0.66 each.) (Insidentally, that makes the total cost of transistors and diodes $4.02, which isn't too bad!)

The switching delay network composed

Continued on Page 17.



RTTY-DX



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

Hello there. . .

I suppose that one of the penalties of an extended vacation is the difficulty in picking up the reins again and getting back on the track. It seems that the "usually reliable sources" from various parts of the world that make this column tick were also on their Summer Holiday so news this month is mighty scarce. I guess that we all waited for Maurizio's expedition to end before heading for the hills or the sea shore. Although I had a printer and receiver set up to try to monitor the bands while down at the Atlantic shores it was impossible to copy anything due to the terrible noise caused by leakage on the power lines. Well, now that the sand is out of my shoes and the seaweed out of my hair and the excuses taken care of let's see what has been going on.

It is always a pleasure to add to the ever growing list of applicants for W A C. This month the certificate goes to --

Nr. 111 Bud Smith W2LFL

Bud has been on and off RTTY for the past eight years and finally got Asia confirmed with a QSO/QSL from KR6MH in early August. Bud indicates that this station is at a Marine Corps Base, Camp Hansen, on Okinawa and that the operator was Bob. Unfortunately, Bob was up for discharge in mid August and the other operators at the station are not RTTY oriented so we will not hear this one again until another "piano player" comes along.

Bud also sends some welcome news of pending activity from Japan. He had a cross mode RTTY/SSB contact with KA2DO in Tokyo on 14 mc. Don at KA2DO was on SSB and answered Buds RTTY CQ DX so apparently they have the receiving equipment available. He indicated that they would be available for Ten meter skeds in mid September so it could very well be that they are on by the time you read this. It would probably pay to tune up around 29040 when the band is open at your location. With the coming of Autumn and the change in propagation Ten should be showing signs of activity again.

A note from Ed De Young, KH6GLU, says that he has been on RTTY for about two months and is available for skeds for all those needing Hawaii for WAS or WAC, especially you fellows in Europe and Africa. He is running a kilowatt into a variety of antennas and can operate all bands. You may recall that Ed is the chap that was on Fanning Island as VR3DY; a few months back and had the RTTY world on their toes waiting for activity from there. Unfortunately, Ed explains, the 90 foot research vessel was so loaded with scientific equipment that the Model 15 was left stranded on the dock. He promises however, that in future trips the RTTY gear will be the first aboard. For skeds or QSl's Ed's QTH is Box 762, Kaunakakai, Molokai, Hawaii 96748.

I had the pleasure of a very solid QSO recently with ZS6OY. The operator is Vic, and although very new at RTTY he puts out an excellent signal. The time was 1300z, and in this location at that time South Africa comes via the long path on 14 mc. For the contest you might also keep in mind that VK will be perhaps coming through via long path at about 2000-2100z on 14 mc. Venkat, VU2KV, will no doubt be on for the contest and can usually be found at 1100-1300z the long path on 14 mc. or the short path on 21 mc. if that band is open. These times and frequencies hold pretty much for the Eastern part of North America and unfortunately we have no data for other areas at the present time.

A short note from Dave, W2CNJ, informs us that both DL7KN and DJ0LDA in West Berlin are on all bands but are particularly looking for contacts on Forty Meters. 7045 kc. is the frequency and they are on from 2200 to 2400z. Let us hope that they will be there for the contest as forty always seems to lack in activity.

Lamberto, I1ROL, informs me that

the RTTY Group in Italy have a net frequency on 3620 kc. and that activity can be found there at most any hour. The boys in Germany tend to be lower in frequency, at between 3575 and 3600 kc. We here in the States seem to center around 3630 kc. Although it is pretty tough to make a skip across the pond on Eighty Meters it might pay to tune around a bit during the contest and pick up a few multipliers.

Both ON4BX and ON4CK had a solid contact with Louis, FK8AZ, on the first week end of September. The time was 0800z. Louis continues to be quite active and apparently can be found at most any time between 0500 and 0800z on 14 mc. Arthur also says that Miki, YU6ZAA has been active again as of the end of August. Incidentally, Miki answers QSL's very quickly if you sent one direct with a few IRC. His QTH is Miki Bozovic Savina 77, Herceg-Novi, Yugoslavia. Also reported was activity from EP2HL in Iran. He is on 50 baud only at the moment. Iranian stations have appeared from time to time in the past. In fact, a few contests ago I printed one in contact with DL3IR but they continue to be very evasive. Let's hope that Henry, EP2HL will be around long enough to give the boys a chance at this rare country.

Anotice of a change of address for Cas, ex KA9Ak says he has been moved again and still no RTTY allowed. He does have his log and a few cards from KA9AK with him however in case somebody missed on a QSL. Send it to the Journal address and we will forward it.

Bert, VE3EUU expects to visit with Jose, PJ2MI, the last of October. They hope to activate FS7- on French St. Maartens on October 28-30th so watch for them. Probably 20 meters only.

To give you an idea of current RTTY activity the following stations were either worked or logged here in the past sixty days or so. All of them, with only a few exceptions, were on 14 mc. as that is where the activity seems to center. Hopefully, if most of them show up for the contest we will have a pretty busy week end -- G2RF, G3IV, G3LNN, G3BRA, G3CXX, G3HKR, G3PGJ, G6JF, G8LT, DJ3VI, DJ9EZA, DL1TV, DJ1KM, DL3IR, DL3BA, DJ8GT, DLOMV, DJOLDA, DJ9LS, DLOFF, DLOIB, DL4XG, DL4JX, DJ6ZBA, DL8VX, DJOEL, DL2WB, DJ9RY, DL1IN, DL3RNP, DJ9XBA, DM3DD, DMOGST, I1KG, I1AHN, I1BPD, I1CWX, I1AFF, I1DFA, I1ZWY, I1BNT, I1BGY, I1CTE, I1TOL, I1LAP, I1VN, I1AOH, I1TLM, I1JOE, I1KFB, I1AYX, I1KPK, I1CLC, I1PHD, I1CAQ, I1TAB, I1APV, I1BAX, I1WBH, PAOAA, PAOXKB, PAOLBN, PAOQJ, PE2EOV, PAOFM, PAORE, PAOCDV, PAOGKO, F2TB, F3PI, P8KW, F5QE, F3UW, F8UC, F3WV, F2BW, SM5QV, SM7BBJ, SM4GL, SK2AV, SM3BCV, SM6OH, SM3DZB, OZ7OF, OZ6OB, OZ2JC, OZ4EDR, OZ9SL, VK3NR, VK3PB, VK3DM, VK4NP, OE3HP, OE2FUL, UA1KBW, UA4KED, HK3SO, HK7XI, HA5FE, HA5KBF, HB9AKA, YV1IK, YV5AVW, YV5HG, YV5CIP, YV1QB, KP4QM, KP4JM, KP4ARY, OA4BR, KH6AX, KH6GLU, ON4BX, ON4CK, ON4NE, LU1AA, LU3EX, LU4DA, LU7DDG, LU7EBB, LU8DR, PY2CQ, PY7NK, 6Y5NY, 6Y5RA, KR6FQ, KR6MH, HC1MF, HC1TH, VE1SI, VE1AK, VE4UM, VE4FG, VE5DR, VE5LG, VE7BHH, FG7XT, PJ2CR, PJ2MI, EL2N, LX2FB, CX8BP, OK1MP, UQ2AB, VQ8JX, FK8AZ, YU6ZAA, KM6BI, KG4CX, CE3EX, ZL2AFE, 4A1OE, F9RY/FC, IP1BPD, CN8BPD, 7X2BPD, 3V8BPD.

In closing, just a few words on the contest based on past observations. First, throw away the yard long CQ tapes, make the calls extremely short and "LISTEN". A long CQ is probably QRMing a QSO already in progress on the frequency. Second, the rare DX and "one of a kind" station must control the frequency and tell the boys where he will tune otherwise he will not copy a thing as two 850 signals in the passband are hardly compatible. But best of all, use NARROW SHIFT. Good Luck in the Contest.

73 de John

DELAWARE VALLEY GREEN KEYS

Since it was first mentioned in the April issue as being in its formative stages, the Delaware Valley now has a fully organized RTTY club. The name is "Delaware Valley Green Keys" and it meets the second Thursday of each month at 8:00 P.M. Meeting place: Borough Hall, Lakehurst and Hessian Avenues, National Park, New Jersey (few miles south of Camden) Active membership is well over fifty and includes such RTTY pioneers as Phil Catona, W2JAV, and Dick Urian, W3CRO. Visitors are always welcome and you are assured a pleasant evening that is strictly RTTY. Further information is available from Club Secretary, Bob Yamasaki, WA2WPZ, 560 Barlow Avenue, Woodbury, New Jersey 08096.

de W3KV

* * *

HITS & MISSES

From The Editor and his Mail

We are still waiting for somebody to tell us a good reason, or any reason, for the printing of 'CW ID to follow' at the end of each transmission.

* * *

Alan, VE7BHH is interested in hearing from RTTY fans that are also members of the QCWA, if enough interest is shown he would be interested in forming a net with other members.

* * *

A letter from VE2UN says that by using the list of commercial frequencies by John Maxfield in the July Journal he was able to monitor the Czech and French press service and got the news of the recent Czech crisis at least an hour ahead of the UP and AP services.

* * *

Need 5/16 2 tape for a WU 2B printer? $15. a carton of 6 rolls from-Paper Mfg. Co. 9800 Bastleton Ave. Philadelphia, Pa. (courtesy W3PYW-W2RUI)

* * *

In our file we have one heading "Future Articles" and it is empty...Since publishing the Journal this file has been like our weather, either hot or cold but so far something has always turned up to keep things going. Take this issue, the material we wanted to run took more space than 16 pages, filling up 20 pages used up all the surplus we had been hoarding for a cold day. Hopefully something will turn up in the near future. Lets hear from you budding authors or technicians. If we get real pinched we have been thinking about a few reruns of popular articles from past issues that are no longer available and we would like some letters from subscribers that may have ideas or comments on RTTY that should be offered to readers for consideration.

* * *

Our supply of RTTY Binders is exhausted. We will be ordering more but delivery will be about two months.

* * *

In a release from the Navy Mars we note a list of 576 licensed amateur calls and over a hundred names without licenses that copied the RTTY Armed Forces message perfectly. In glancing through the calls we found very few that we have ever heard on the amatuer bands. All this encourages our hope that in the coming contest many RTTY stations will be active either in the low frequency band section or at least in the SWL division where just copying as many contest exchanges as possible can win an award. And, wouldn't it be something if somebody could work all states over the week end. We hope that stations in the scarcer states can make an extra effort to spend as much time as possible on the air during the contest.

* * *

In the September issue WA2YVK explained a modification to a Drake T-4X/T for FSK. The Drake factory informs us that only a limited number of VFOs needing this change were produced, and if made to the later models could produce instability. They suggest writing the factory if instructions in the manual do not work and stating the problem.

* * *

In answer to a number of inquiries, sorry, but we do not have any Gift Certificates for subscriptions. Probably a good idea but like a lot of ther things we would like to do, just never seem to get the time.

* * *

We have another supply of International Reply coupons that have been received for payment from foreign subscribers. We will sell these to anyone at 10 for a dollar. Saves you 50¢.

* * *

The reprint of the TT/L-2 demodulator is temporarily out of stock. We hope to obtain a few more so those that have written for it please have patience. The demand for this article seems to be insatiable.

* * *

Theory & Application

Continued from page 13

of R9, C6, and R10 can be changed if more diode current is required or if the time constant is considered too long. In the circuit shown, the total switching time is approximately 8 cycles at 2125 Hz or about 4 ms. If the 1N482 is used, the network is optimum.

The "filter" network composed of R12, L3, C7, and R11 is tuned to resonate at approximately 2550 Hz. The best turning procedure is to adjust the size of C7 so that the mark and space tones appear at the output at equal levels when R4 and R5 are wide open. The Q of the L3-C7 circuit is kept low by using the 50K potentiometer (R11) and the coupling resistor R12. This filter serves several purposes: 1) It cleans up any harmonics from the oscillators, 2) It removes the harmonics generated by the diodes during the switching interval when the diodes are partially-conducting, and 3) It helps remove the low frequency transients caused by the DC used to switch the diodes.

The 24 V power supply should be "stiff" so that the loop keying does not affect the keyer in a manner other than the desired one.

When wiring the unit, it is advisable to separate the wiring in the loop circuit from the remainder of the unit. This is desirable because "spikes" may be present in the loop due to bouncing contacts, etc., and these "spikes" could get into the output and into the transmitter.

One note of caution: As is the usual case, too many selector magnets in the loop will cause spacing bias on the transmitted signal. The spacing bias can be reduced by decreasing the size of R8. The best way to eliminate the bias is to prevent it; i.e., don't put selector magnets in the keyboard loop!

CONCLUSION

We have just described a good AFSK keyer. It is slightly different from most others described elsewhere in that it uses two separate oscillators and the output from these oscillators is gated by means of two diodes.

We have had one of these units running 24-hours/day for over a year now and there has been no sign of deterioration in performance. (About 10,000 hours of continuous operation!)

73 ES CUL, RG

RTTY Trophy Week End

Events for Everyone

SeeYou ??

Oct. 5-6.

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***

BACK ISSUES —

Only back issues available are July through December 1966, December 1967 and February to date 1968. Copies are 30¢ each.

***

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P.O. Box 837 — Royal Oak, Michigan 48068
"Dusty" Dunn — W8CQ
Editor & Publisher

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FSK for the SWAN 350 - 240

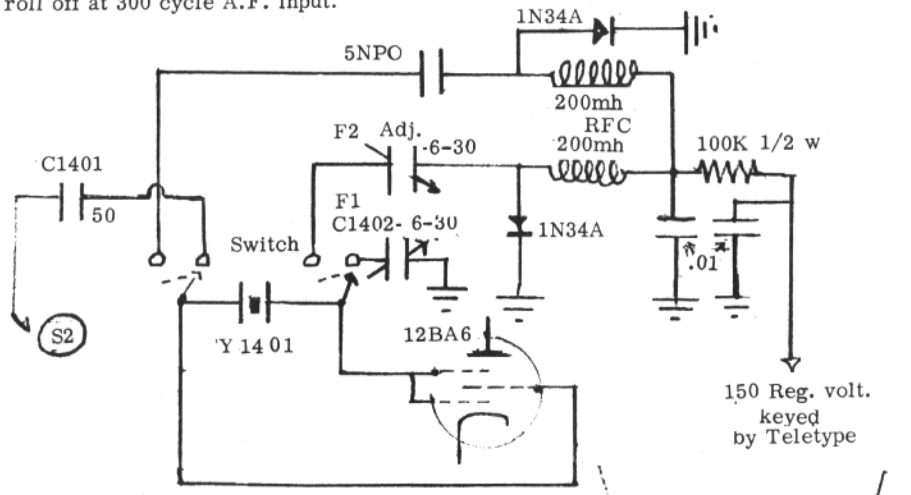
Here is a modification for the Swan 350, or the 240 that I installed in two hours with less then ten dollars in parts. It worked without a hitch- plug it in, and you are in business- just loop 150 volts off the regulator tube thru the keyboard and hit the keys.

The following circuit modifications are suggested for FSK of the carrier oscillator in the Swan 350 and maybe adapted in the Model 240, with no changes. A DPDT switch must be installed close to the oscillator tube, under the chassis, with its shaft facing downward. A hole is drilled in the bottom cover for the switch shaft and a lever arrangement added to the shaft for operating the switch. After installing the switch add the other components and wire them as shown in the schematic. The two switch positions are labeled SSB(normal) and FSK. The normal carrier frequency is F1, and is below the pass band for a 6 db roll off at 300 cycle A.F. input.

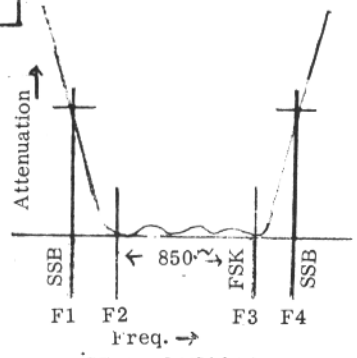
With the switch in FSK position, the carrier frequency will shift up to F3. Stray wiring capacity of the diode switching circuit will determine the frequency of F3. It will be from 1500 to 2500 cycles above F1. When 150 volts is applied to the diode circuit, the carrier frequency drops to F2, and is adjusted to the desired frequency by the added trimmer.

When transmitting FSK with a Swan transceiver, tune up according to instructions for AM transmission; that is, insert carrier by turning the car. bal. control until cathode current reached the recommended level for AM. Set the P.A. Bias control for min. idling current. This will produce higher plate efficiency and less heat dissipation in the Final during FSK transmission. REMEMBER to return to proper idling current for SSB.

D.W. RONK, WA7DAF, Eugene, Oregon



Parts list
- 1 - 5 NPO
- 1 - 6-30 pf ceramic trimmer
- 1 - 100k 1/2w
- 1 - DPDT switch
- 2 - 1N34A
- 2 - 200uh RFC
- 2 - .01 500v disc



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CLASSIFIED ADS

Rates - $1.00 30 words - Additional words 2¢ ea. Closing date 1st of month.

RTTY CHANNEL FILTERS, octal mounted, 1275, 1445, 2125, 2295 or 2975. $3.00 each postpaid. Special filters for TT/L-2. SASE for information. Herman Zachry, WA6JGI, P.O. Box 845. Apply Valley, Calif. 92307

RTTY GEAR FOR SALE. List issued monthly. 88 or 44 mhy toroids-5 for $1.50 postpaid. Elliott Buchanan and Associates, Inc. 1067 Mandan Blvd. Oakland, Cal. 94610.

TT/L-2 CONVERTER WANTED-prefer in good working condition, with a full set of filters. Send picture if available. All letters answered. KX6FJ, Box 1554, APO San Francisco 96555.

TYPEWRITER RIBBON REINKER, Hand operated model now only $3.00. K575 or K764 Ink available at all National Cash Register Co. stores at 75¢ per tube. Walter Nettles W7ARS-8355 Tanque Verde Rd. Tucson, Ariz. 85715.

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WANTED 500 cycle filter for Collins 75A4 also need 2.1 Hz filter. Dusty Dunn, Box 837 Royal Oak, Mich. 48068

ORDER; SIMPLEX Auto-CR & LF kit for model 15 and 19 printers. Completely mechanical, with complete instructions $7.50 PP. No postal money orders please. Robert Zelenka, W8TMO, 14446 Swanee Beach Rd. Fenton, Mich. 48430.

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