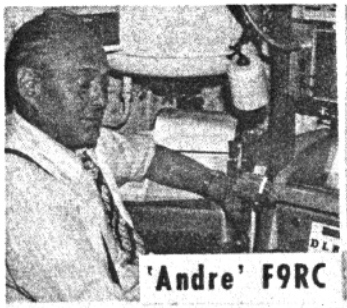
'Andre' F9RC


'Ernie' DJ0RR/DL0AK


'Mike' F3PI


'Will' DJ1XT 'Wolf' DL8VX

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RTTY JOURNAL

May-June 1973

EXCLUSIVELY AMATEUR RADIO TELETYPE

VOLUME 21 No 5 30 Cents


'Ed' W3EKT


'Glenn' K3SWZ 'Ed' VP9GE

CONTENTS

RTTY VIDEO DISPLAY UNIT

Professional quality video display of RTTY signals on any standard television receiver. R.F. output is provided that can be tuned to an unused television channel and distributed to any number of television receivers on a common antenna system. The unit is directly compatible with all common terminal units and includes a built in speed converter for 60, 65, 75 and 100 WPM.

1000 character display capacity with 40 characters per line and 25 lines of display. Character printing starts at upper left screen and includes a unique automatic CR-LF scheme at the end of each line to prevent words from being cut in half. Typically in a page of text, less than 5% of the line end words are cut in half, and this feature in conjunction with the 40 characters per line provides optimum memory utility. The system provides automatic page upshift at the end of the 25th line of copy.

The unit is available with either the standard Baudot code or optionally with the ASCII-6 code format. The code selection is obtained by simply replacing one printed circuit card. For the ASCII version the maximum serial data rate is 600 WPM (660 Baud).

The video display unit is constructed with the latest technology and quality components including five glass epoxy printed circuit cards with plated through holes. Seventy five integrated circuits are used with relatively few additional discrete components for easy assemble and testing. Constructed for standard 19 inch rack mounting requiring 3 1/2 inches of height and 8 inches of depth.

Available in kit form with complete assembly and testing instructions or complete

For further information send SASE to R. D. Leland, 20235 South Greenway Ave., Southfield, Michigan 48076.

***

Inexpensive EXTRA RECEIVER

The Heath HW16 novice transceiver has an excellent receiver section that is all on a single board, cost $3.70 as a part. With luv sensitivity and 400 hz bandwidth it offers a lot of options for autostart or other operations where a tube receiver is needed at low cost. Don - WAØTJR.

***

ARMED FORCES DAY TESTS

The Annual Armed Forces Communications Tests will be held on May 19, 1973. The RTTY receiving test will be sent from WAR-on 4030, 6997.5, 14405 .NSS on 4012.5, 7385, 14385. AIR on 7315, 13997.5 and NPG on 4010, 7347, 13992. The RTTY message will be at 60 wpm at 0335 GMT on May 20th. A ten minute CQ will precede the test for tuning purposes.

Transcriptions should be sent "as received" along with the call sign of the station copied and the call, name, and address including zip code of the station submitting the entry. Send to Armed Forces Tests, Chief, Navy-Marine Corps MARS. 4401 Massachusetts Ave. N.W. Washington, DC 20390 Mail Stop 394. Certificates will be issued to all that qualify.

***

CANADIAN Traffic and Public Service Net

Inaugurated March 4th, 1973 - new Traffic and Public Service RTTY Net for the purpose of broadcasting RTTY Bulletins and handling traffic, will be operational Sundays at 1930 GMT. 14080 KHz Frequency.

Net Control Station - VE5KE, Glenn Gorham, Regina, Sask.

Watch this frequency for Bulletins regarding "C.A.R.T.G.", "CARF", and RTTY activities, of interest to all RTTY-ers.

Check in with your RTTY traffic, get behind this new project - Let us all help to make it a very successful undertaking. Permission has been granted by the D.O.C. for "C.A.R.T.G." to sponsor these Bulletins, and Canada needs a RTTY Traffic Net.

(Please send in your suggestions and comments!)

***

*
*
*

TWO LOST SOULS -
Wide shift . . .
CW ID To follow . . .

AUTOSTART for the MAINLINE ST-5 DEMODULATOR

IRVIN M. HOFF, W6FFC
12130 Foothill Lane
LosAltos Hills, Calif. 94022

The ST-5 was designed to be as simple as an adequate demodulator could be. At the time it was offered, the ST-3 provided a modest-cost unit with autostart and motor delay. The ST-3 is now considered somewhat obsolete, partially because the General Electric PA-238 op amp is no longer available. After a number of people tried to modify their ST-5 for autostart by adapting portions of the ST-3 or ST-6, we decided to see if a simple autostart could not be developed directly for the ST-5.

The results have been quite satisfactory. One op amp and two transistors plus a relay have been used.

CHANGES TO THE ST-5

The only changes to the ST-5 needed to adapt the autostart section are the addition of a 33K resistor and parallel diode on the output of the slicer op amp. This is shown in the upper-left corner of the diagram. This makes the output of the slicer circuit identical to that of the ST-6. The input of the autostart is marked "AA", and connects to the emitter of the meter transistor.

ADJUSTMENTS:

There are literally no adjustments at all. The silicon diode on the non-inverting input of the 741 holds the bias on the op amp to approximately 0.7 volts. The divider network on the inverting input allows the voltage with authentic RTTY signal (properly tuned) to rise to approximately 0.9 volts. As the voltage rises higher than 0.7, the output of the op amp switches rapidly from positive output to negative output, turning the motor on and removing the voltage on the base of the keyer stage that was holding it in standby with no signal.

PROBLEMS TO CONSIDER:

There are a number of problems in designing a suitable autostart system. First it should ignore voice or C.W. on the frequency. To do this we require it to respond only to signals which are the equivalent of at least 70-80% key down, continuously. So it will not turn off too quickly for static bursts, momentary interruptions, etc., we ask it to continue for about 1 second after the signal stops. (At 60 speed, this would print about 5-6 random garble characters.) With this in mind, the turn-on time then would need to be about 3-4 seconds, or the equivalent of about 20-22 characters. Finally, we hope it will be able to copy stations at least 40-50 Hz. off the frequency, assuming their shift is correct.

HOW IT WORKS:

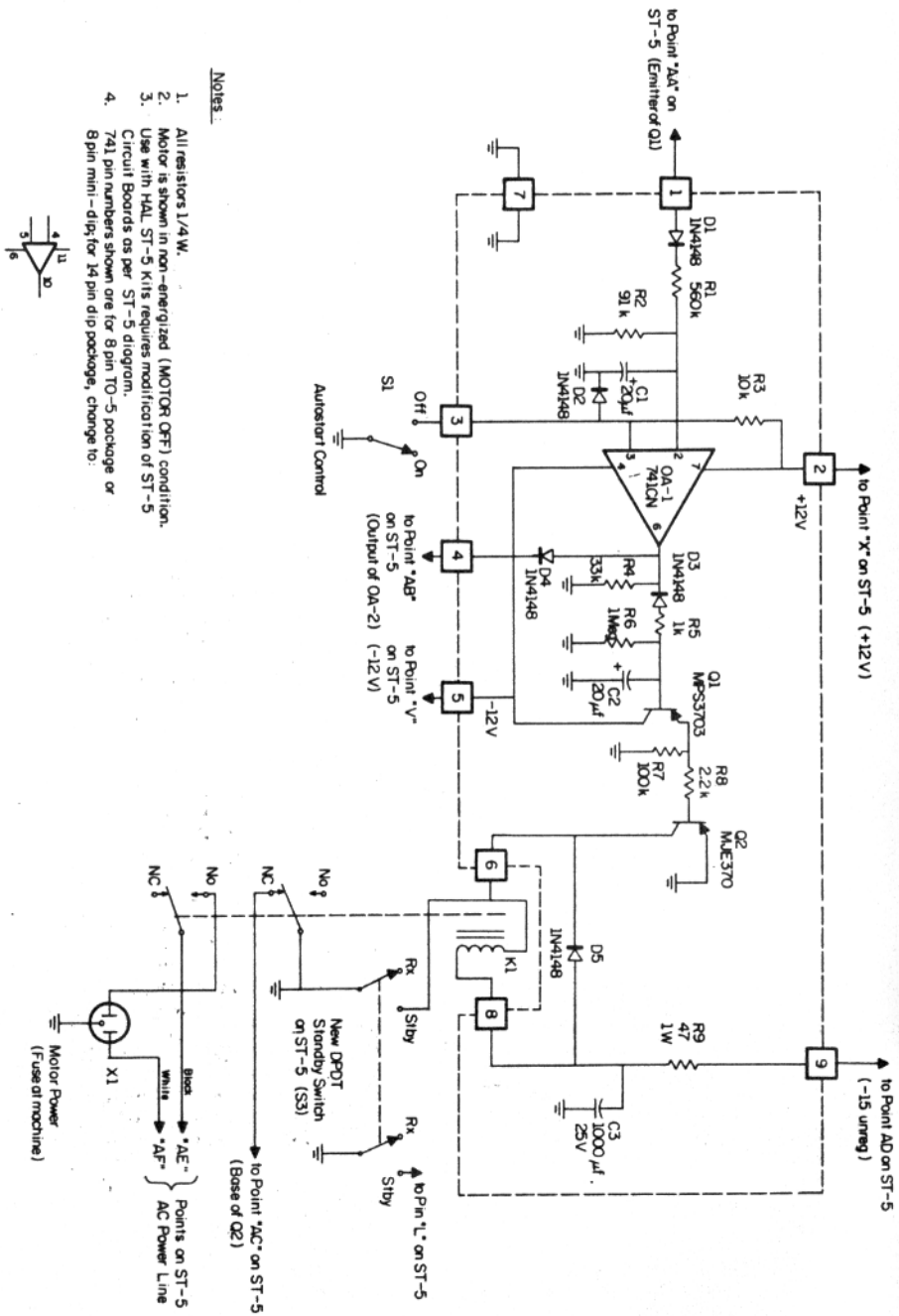
With no signal, there will be a random voltage level showing on the meter. This should be significantly less in amplitude than the value shown on the meter when a signal is present and tuned in for maximum indication.

With no signal, the voltage at the emitter of the meter transistor is passed to the autostart circuit through the diode, and then via the divider network charges up the 20 Mfd. capacitor. Due to the time constants involved, this voltage will not be as great as the 0.7 volts on the non-inverting input of the 741. Thus the op amp has positive voltage on its output. This is passed through one diode to point "AB" and holds the base of the keyer transistor in markhold. At the same time, the other diode blocks this positive voltage at the output of the 741, thus the motor control circuit is not activated and the motor remains off.

When a signal appears, the voltage at the meter rises, thus the charge on the 20 Mfd. capacitor at the input to the 741 also rises. As it passes 0.7 volts, the op amp switches abruptly, and now has negative voltage on its output. The diode at AB now blocks this voltage, allowing the keyer transistor to print the incoming signal normally, and at the same time the other diode allows this negative voltage to pass, quickly charging the 20 Mfd. capacitor at the base of Q3. As Q3 conducts, it puts voltage on the base of Q4, allowing it to conduct, operating the relay and turning the printer motor on.

When the signal stops. the voltage on

the 20 Mfd. motor capacitor bleeds off slowly, due to the high impedance of the emitter-follower circuit. Approximately 25-30 seconds later, the motor turns off. This delay may be shortened by lowering the value of the 1M resistor in parallel with the 20 Mfd. capacitor, or by using a smaller value of capacitor. This time was chosen to keep the motor from turning off prematurely if a person was sending compulsory c.w. identification, or was a little slow in turning on his transmitter.



TRANSISTORS:

Q2 is any high-voltage transistor capable of handling 300 volts or more. Several suitable choices are made by Delco, International Rectifier, Motorola, the HEP line, RCA and others. Several of those firms now make 450 volt transistors that are small and low-cost.

Q3 is a PNP, and almost any silicon type should be suitable. A Motorola MPS-3703 is one suggestion and the 2N3906 is another.

Q4 is also a PNP, but here a high-current type should be used, as it will drive the relay. A good suggestion would be the Motorola MJE-370.

THE RELAY:

The relay is a 12 volt type with DPDT contacts rated at 10 amps. You could "get by" with 5 amp ratings, but the surge current on the motor would be a bit hard on this type of relay. A suitable relay would be the Potter & Brumfield KA11DG. As this is a 12 volt relay and you will be using unregulated "12 volts" to operate it, a series resistor of 47 ohms is shown to keep the current to that recommended in the relay. This resistor is only a suggested value and might need to be changed. The higher voltage is advantageous as a "starting kick" for the relay.

A diode is placed in parallel with the relay coil to prevent back emf from the inductive spike from damaging the transistor when the relay opens.

AUTOSTART OFF SWITCH:

In the event the operator wishes to turn the autostart off, S4 is closed.

STANDBY SWITCH:

The original standby switch was a SPST across the collector and emitter of the keyer transistor. This is still adequate, but at times the motor might turn off when transmitting, if the receiver is carried in standby, prohibiting the audio signal from operating the autostart. Changing the standby switch to a DPST and using the second pole to ground the collector of the Q4 transistor will keep the motor on while transmitting -- quite often you will not be exactly on the same frequency with your receiver as you are transmitting on, and this will prevent the motor from turning off.

Another possibility would be to use the second section to parallel S4 during standby, as this would provide similar results, but keep the 20 Mfd. motor delay capacitor charged up as well.

THE MOTOR JACK:

Many printers have 3-wire plugs, so we suggest you use a polarized 3-way connector on the ST-5A. Many cases have been reported where a printer is 120 volts with respect to other items in the shack that are grounded. Using grounded connectors and 3-way wires to the printer should effectively prevent voltage differences from appearing. We would also suggest your using a 3-way cable and connector on the ST-5A, as well. Be sure the jack on the collector of Q2 for the teleprinter is insulated from ground.

TURN-ON TIMES:

If the turn-on time and turn-off times do not seem suitable, some adjustment can be made by changing the 91K resistor to the next larger or next smaller size. However, 3-4 seconds is considered normal for this type of autostart, and this is similar to the concept used on the other Mainline demodulators. If you insist on having a faster turn-on time, you could also use a smaller capacitor than the 20 Mfd. shown. That would still retain the 70-80% continuous key-down requirement to ignore c.w., etc.

CAUTION:

Be certain to use PNP type transistors for Q3 and Q4, and note they connect to negative voltage. Also be careful to orient the capacitor on the base of Q3 with its positive terminal grounded!

CONCLUSION:

With only a minor modification existing ST-5 units, this autostart may be readily added. Its simplicity is in keeping with the design concept of the ST-5, which was to give adequate performance from a very simple circuit. Adding the autostart converts the ST-5 to a ST-5A. Boards and components for up-dating the ST-5 or for building the ST-5A are available from Hal Communications and from PEMCO. (See advertisements in the classified section.) Autostart allows the operator to leave the room temporarily, or even to monitor a frequency 24 hours a day, unattended. Motor control makes the entire operation completely automatic.

***

UPDATED ST-5 MAINLINE DEMODULATOR

IRVIN M. HOFF, W6FFC
12130 Foothill Lane
Los Altos Hills, Calif. 94022

The Mainline ST-5 was originally introduced in the RTTY JOURNAL in May, 1970. It has rapidly become one of the most popular demodulators for RTTY. As back issues have been unavailable for some time, the original article is being reprinted.

For those interested in 100 speed, change the 0.068 capacitor on the input to the slicer to a 0.039. A 741 may be used for the slicer if desired, in which case the 220 pf, 0.005 Mfd., and 1.5K components are left off, as the 741 is internally compensated. Regulated voltage has been added, as shown.

Keep in mind also that prices quoted were current at the time the article was originally written. Both Hal Communications and PEMCO, and possibly others, offer boards, components, kits and ready-to-use ST-5 units.

Many newcomers to rtty have complained that a current yet simple demodulator hasn't been published for them to build. The W2PAT unit in the ARRL handbook is nearly 15 years old. In 1964 an attempt was made to replace the W2PAT design with a modestly priced updated unit, the TT/L.[1] This design, together with the subsequent TT/L-2[2] is now the standard of the serious rtty enthusiast. However, the original goal was missed by a country mile, since the TT/L-2 costs over $160 just for parts and has 14 tubes.

The ST-3 was a successful solid-state design that introduced integrated linear operational amplifiers to rtty. It was still moderately complex, however, and fell short of the goal to supply the beginner with something that could be built in a few hours.

THE ST-5 DEMODULATOR

While developing a unit based primarily on ICs to replace the TT/L-2, a very simple modulator with great potential was developed: the ST-5. As with any simple circuit, the cost of the power supply is out of proportion with the rest of the unit. At 1970 prices the ST-5 costs only $14.50 less loop supply ($8) and a plus-minus 12-volt supply ($11).

The total cost of $33 is not overly impressive until you realize this unit can, if desired, be used as a building block for the more exotic ST-6. Almost every component used here can be used in that unit. The ST-5 is a basis from which the beginner can expand - it's not just a collection of parts that will find no further use when he is ready to broaden his horizons to more sophisticated equipment.

FEATURES

The ST-5 uses two operational amplifiers (**fig. 1**). One is an audio limiter, and the other is a trigger stage to drive the keyer. It has a 175-volt loop supply of the same type used in the TT/L, which provides plus-minus voltages for keying a transmitter and also features narrow-shift cw identification. Finally, the ST-5 has a symmetrical plus-minus 12-volt power supply.

LIMITER

The 709C op amp has over 90-dB gain and is good to over 10 MHz. It makes an ideal limiter. The zener diodes on the input don't assist in the limiting; they merely protect the 709C against damage in the event of excessive audio input (hardly likely but worth the protection). The limiter puts out square waves and is so powerful it starts working on input signals as low as 200 V. The 25k pot merely balances the small offset input voltage for maximum gain. This voltage varies slightly from one unit to another, so a control pot was added rather than a fixed resistor, which many units use.

DISCRIMINATOR/DETECTOR

It's difficult to use the same value inductor with different capacitors and expect to obtain two similar filters of equal characteristics. To get similar band-width, voltage output, noise response, etc., some loading is necessary. Most simple demodulators merely balance the voltage or ignore all the problems completely. Without belaboring the point, it's not a simple job to get all these factors to balance suitably; but it is possible, and the Mainline units all have filters that have been designed with care.

The ST-5 offers a choice of the 2125-2975 mark and space tones (considered standard), or the 1275-2125 low tones necessary in some modern receivers. (Actually nearly all these receivers respond beautifully to 2975 tones and higher, but a new bfo crystal is needed.) The best results come from the 2125-2975 tones, since the two frequencies are only about 28% apart while the 1275-2125 tones are 40% apart, thus it's a more difficult job to separate the harmonics and achieve proper filter design.

The detector features full-wave rectification for most efficient filtering of the dc ripple remaining after the audio has been rectified. A simple RC low-pass filter removes the remaining audio component.

SLICER

The slicer takes the small voltages from the filters and changes them to roughly +10 volts for mark and -10 volts for space, regardless of the original amplitude. This in reality is a dc limiter, as a signal as small as a 100 μV or so will cause the unit to saturate completely, either plus or minus, depending upon the polarity of the applied signal voltage. The unit has so much gain that at the cross-over point, a change at the audio input as small as one or two Hz will cause this trigger stage to flip from +10 to -10 volts. This is another way of saying shifts as low as 3-4 Hz could be copied on the ST-5 if tuned in properly.

KEYER STAGE

A 250-volt Motorola 20W transistor selling for $1.06 is used. The normal loop-supply current for tty machines is 60 mA. This transistor has a large amplification factor and acts like an on-off switch. When on, the power consumed in the transistor is only 0.012 W; so in the ST-5 there's no way you could ever damage that transistor.

An RC network in the 2N5655 collector takes care of the back emf developed by the inductance of the selector magnets in the printer during the transition from space to mark. The transistor is biased off during space. A diode in the base circuit keeps this negative voltage below the point at which the base-emitter junction would be reverse-biased.

STANDBY SWITCH

When S1 is closed, the unit is placed in mark. When S1 is opened, the printer can follow whatever is fed into the limiter from the receiver.

As explained previously, the unit has so much gain that a signal as small as 3-4 Hz can be copied if tuned correctly; this is called straddle tuning. However, for 170-Hz shift you may wish to add a switch that changes the space filter to the new frequency. **Fig. 2** shows the way this would be accomplished if using the normal 2125-2975 tones, and **fig. 3** shows the circuit for the low tones of 1275-2125. This is merely an expedient and doesn't result in proper filter balance, but it provides good 170-shift reception with the switch closed, or normal 850-shift reception with it open.

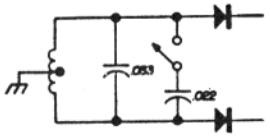


fig. 2. Switching circuit for adding 170 shift to space filter for 2125-2975 tones.

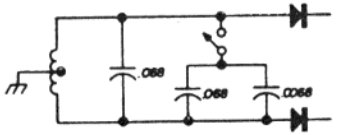


fig. 3. Switching circuit for adding 170 shift to space filter for 1275-2125 tones.

TUNING INDICATOR

Provisions are provided for connections to the vertical and horizontal amplifiers of a scope (**fig.1**). It is customary to connect the mark signal to the horizontal amplifier and space signal to the vertical amplifier, although many reverse this method.

Most people prefer a scope indication, but an excellent tuning indicator is provided at point A (**fig. 1**). A voltmeter connected to this point will give equal voltage indication for mark or space. With rtty signals the meter should stand still. If it doesn't, retune the receiver until it does. If straddle tuning a signal, the meter may read less than normal, although it won't move. This is normal and merely indicates the shift being copied is not the correct shift for the filters you're using.

Fig. 4 also shows how a 0-1 mA meter may be added. An inexpensive npn transistor is used, such as the MPS-3394, although any npn transistor would be satisfactory here. The capacitor merely dampens the meter so it doesn't flip around too violently. If your meter is too damped, remove the capacitor or try a smaller value. This was

suitable for the inexpensive imported meter used in my unit.

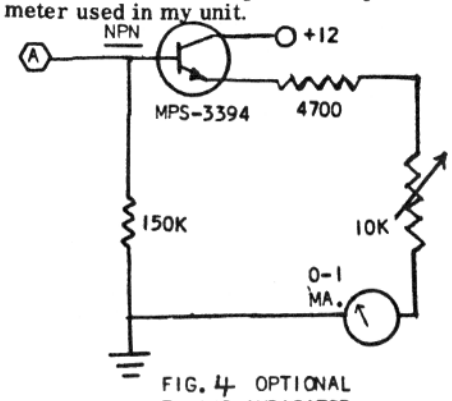


FIG. 4 OPTIONAL TUNING INDICATOR

THE TRANSMITTER KEYER

Fig. 5 shows a typical fsk keyer for installation in the transmitter. The components can be mounted on a small terminal strip and placed near the vfo tube under a convenient mounting screw which also serves as a ground return. The trimmer is connected to the cathode of the vfo tube and the tube replaced in its socket; thus, no changes of any type are made to the transmitter and its resale value is not affected. There should be room for several keyers if you wish to have the convenience of both 170 and 850 shift.

Although a 3-12 pF trimmer is shown in **fig. 5,** some transmitters only require a 1.5-7 pF trimmer. It is suggested that you do not substitute for the 1N270 diode as it is superior to most other types in this application.

If your signal is reported as "upside down," reverse the 1N270 diode. If you do not obtain sufficient cw shift with this connection (conduct on mark), the 500-ohm cw-shift pot should be connected to the opposite side of the 8.2k resistor at the junction of the two 15k resistors **(fig. 1).**

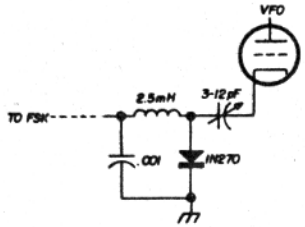


fig. 5. To add fsk to literally any transmitter, connect a 3-12 pF trimmer to the cathode pin of the vfo tube.

COMPONENTS

The 709C op amps are supplied by various manufacturers including Signetics, Fairchild, and Motorola. Prices are constantly being reduced as devices become available from more companies. When I first started working on a super deluxe demodulator in the fall of 1967, I paid over $10 each. Now they're too cheap not to use. The Motorola unit can be purchased through most distributors, including Allied and Newark. The Fairchild unit can be mailordered from the firms below. Specify the T0-5 can, as this is easier to work with than the dual in-line 14-pin type (same cost).

The diodes marked G in **fig. 1** are 1N270 germanium at 32¢ each. Those marked SIL are most any silicon type, such as the 1N2069. The one in the loop supply should, however, be a minimum of 400 volts PIV. Fifty-volt PIV is suitable everywhere else.

The 88-mH toroids are available from various sources for about 40¢ each. They're wired in series for 88 mH, and the junction of the two windings is grounded.

If you have an accurate means of determining the frequency, you can tune the filters by removing turns of wire from each of the two sections concurrently to keep the turns ratio in the two windings the same. One turn from each of the two windings will increase the frequency about 6 Hz at the 2125 frequency, for example.

Use Mylar capacitors, such as the Sprague Orange Drop. Twenty-five-volt capacitors are adequate, but you'll probably wind up getting 200V types. They are only 15-21¢ each.

The pots can be the inexpensive 39¢ Mallory PC board MTC types. Other power transformers may be used, but the Triad F-40X is an excellent buy.

PRINTED-CIRCUIT BOARD

The printed-circuit boards shown in

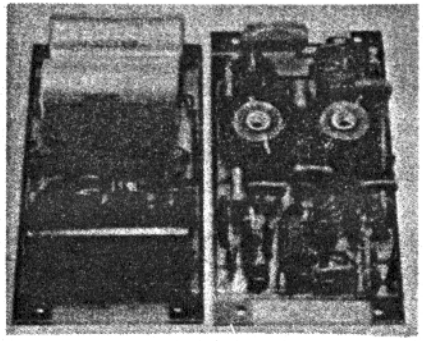


Photo of boards from HAL Comm.

the ST-5 in the photographs hold all of the components except the two transformers and the control switches. This greatly enhances construction, and at the same time makes it possible for nearly anybody to build an extremely nice-looking unit. The printed-circuit board includes one section for the power supply and another for everything else. The board may be split down the middle and the two sections mounted back-to-back as I did in my unit, or the board may be left intact and used with a more shallow chassis.*

ADJUSTMENT

With no input signal, or with the input grounded, adjust the pot on the limiter for zero volts dc at pin 6. If this isn't possible, you'd better write me and explain thoroughly, as you probably ruined the op amp somehow. By the way, unless you get too much voltage on pins 2 or 3, like the full power-supply voltage, or get the plus-minus hooked up backwards, it's very difficult to ruin these things. By following even the most elementary construction practices, you'll have no problems with the 709C.

After balancing the limiter for zero volts output, connect the receiver and tune to maximum mark and note the indication on your tuning indicator **(fig. 4)** or on a voltmeter connected to point A. Tune to space on the receiver and again note the reading. If the indications are not the same, adjust the 5k pot on the limiter output until they are. You have now finished all the adjustments and they should require no further attention at any time unless you switch to 170 shift, for instance. In this event you may or may not want to reset the filter balance pot. I suggest you leave it for the 850 setting and take what you get on the 170-switch position, as this is a somewhat artificial method of getting good 170-shift reception.

When transmitting be certain to first close the standby switch or you can get feedback, which will produce errors similar to those you would get when using a microphone if you didn't turn off the speaker.

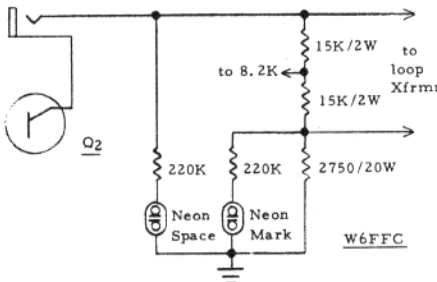
OTHER OP AMPS

The 709C is to other op amps what the Ford V-8 was to other automobiles. It not only led the way; it's still in use. The 709C was (and is) one of the cheapest ICs of its type available. One would gain very little and stand to lose a lot by trying to sbustitute other units. The 741 and 748, for example, have a bit more gain, higher input voltages, and require no frequency compensation. Their biggest disadvantage here is that they're not at all suited as audio amplifiers. At 2 kHz they have only 30-40 dB gain and make a poor audio limiter compared with the 709C. So unless you know what you're doing, stick to the 709C.

*Hamilton Electro Sales, 340 East Middlefield Road, Mountain View, Calif. 94040 and G.S. Marshall Co., 732 North Pastoria Avenue, Sunnyvale, Calif. 94086 (also carries Signetics). If buying Motorola version, ask for the MC-1709CG. Texas Instruments 709 op amps are $1.50 each (or 7 for $10) from HAL Devices, Box 365H, Urbana, Illinois 61801; ask for SN72709L.

MARK-SPACE INDICATOR LAMPS

Adequate indicator lamps to show mark or space are shown in the partial drawing of the loop supply. Any type of low-current neons should be suitable. Their use does enhance tuning in a signal and they help to indicate if a station is upside down or not.



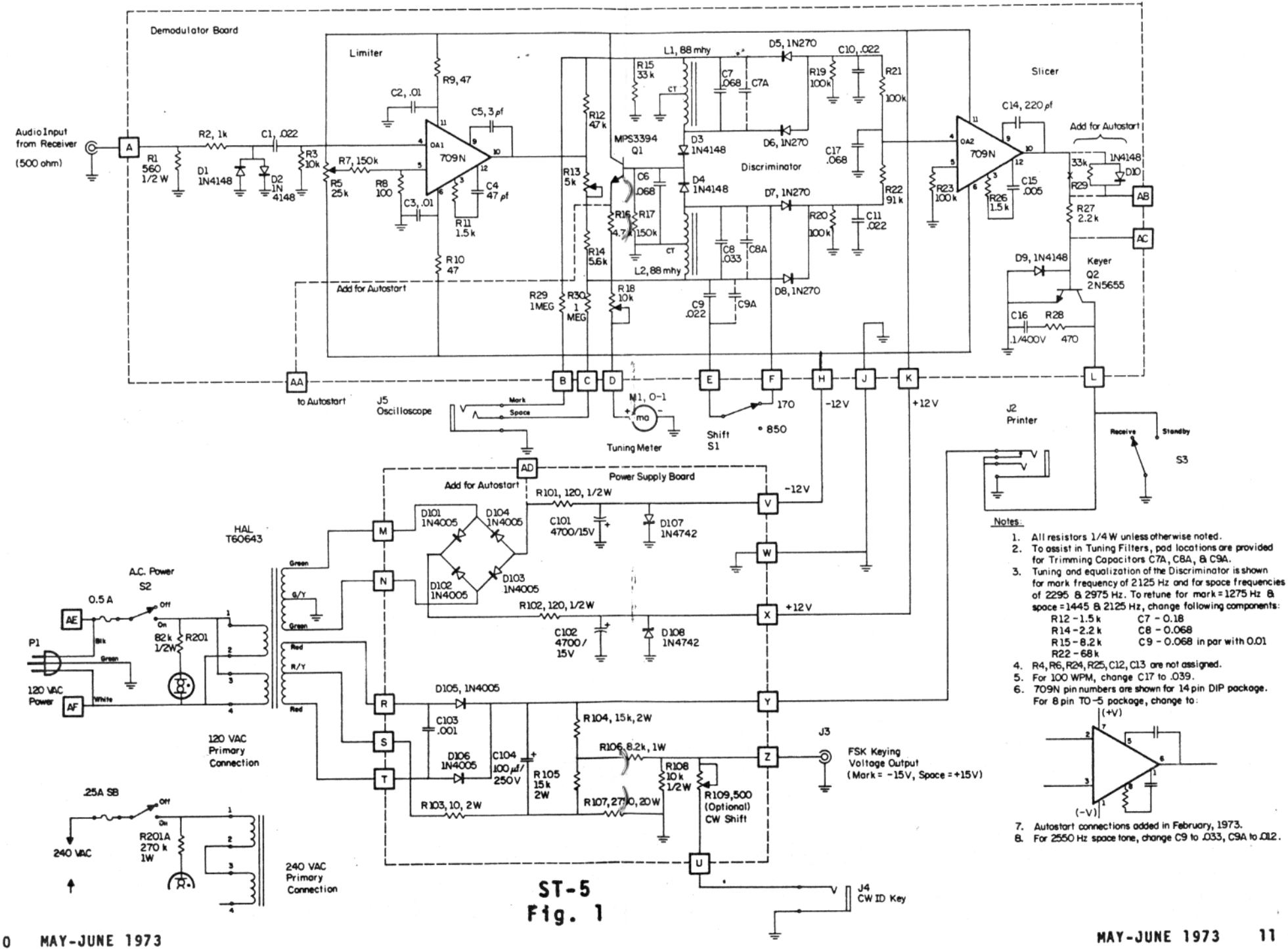
MARK & SPACE INDICATOR NEONS

NORMAL-REVERSE SWITCH

No normal-reverse switch has been added to the ST-5. While possible to incorporate one, (see the ST-6 schematic) it seems hardly necessary. At my station, I do not recall having heard more than 1-2 stations "upside down" in the past year. Using the other sideband on the receiver normally accomplishes the same thing as a reversing switch.

THE ST-5 AND 170 SHIFT:

At the time the ST-5 was originally designed, a majority of stations were on 850 shift. These days, only a few stations use 850 shift on H.F.; nearly everybody having switched to 170 shift. If you wish to optimize the ST-5 for 170, you would want to use the following



Notes:

1. All resistors 1/4 W unless otherwise noted.
2. To assist in Tuning Filters, pad locations are provided for Trimming Capacitors C7A, C8A, & C9A.
3. Tuning and equalization of the Discriminator is shown for mark frequency of 2125 Hz and for space frequencies of 2295 & 2975 Hz. To retune for mark = 1275 Hz & space = 1445 & 2125 Hz, change following components:
   - R12 - 1.5 k
   - R14 - 2.2 k
   - R15 - 8.2 k
   - R22 - 68 k
   - C7 - 0.18
   - C8 - 0.068
   - C9 - 0.068 in par with 0.01
4. R4, R6, R24, R25, C12, C13 are not assigned.
5. For 100 WPM, change C17 to .039.
6. 709N pin numbers are shown for 14 pin DIP package. For 8 pin TO-5 package, change to:

7. Autostart connections added in February, 1973.
8. For 2550 Hz space tone, change C9 to .033, C9A to .012.

ST-5
Fig. 1

component values:
(ST-5 b.)

170 Shift Values	
R12	6800
R14	6800
R15	100K

THE POWER SUPPLY

Several transformers are suitable for the loop supply such as the Stancor PA-8421, or the Triad N51-X. Almost any transformer rated for 24 volts C.T. will be suitable for the power supply, if rated at least 200 mills. (The relay will take about 100-150 mills, depending upon brand.)

Hal Communications has a special transformer made exclusively for them by Stancor which combines both the loop and power windings. This saves not only space but money.

CONCLUSION

The ST-5 was designed as a simple but highly effective rtty demodulator using the best of currently available concepts. It should be a very popular unit for some years to come, as it's impossible to imagine at this time how any additional performance could be made available - it's already ridiculous to talk in terms of 90 + dB amplification. Only a completely different concept of rtty processing could outdate the ST-5, and that seems quite unlikely to occur until we all get computer terminals in the shack.

references

1. RTTY, November, 1964; also QST, August, 1965.
2. RTTY Journal, September, 1967; also QST, May, June, 1969.
3. RTTY Journal, September, 1968; also QST, April, 1970.

****

Theory-Application, cont.

Continued from Page 14

7.0-unit, respectively, they are perfectly compatible. The only difference is that on a Bell System keyboard the minimum interval between successive characters (the minimum length of the stop pulse) is 42% longer than it is on a Western Union keyboard.

An excellent article regarding the 7.0 vs. 7.42-unit codes can be found in the RTTY JOURNAL, 1967 March, p. 3. This article is a reprint of: "Teleprinter Codes: 7 Unit Versus 7.42," F.W. Smith, Western Union Technical Review, 1954 October.

OTHER SPEEDS

For completeness, we would like to mention that amateurs may also employ 67, 75, and 100 WPM speeds. In addition, commercial stations use the 5-element Baudot code described here and others use an 8-element code. "The 8-element code used in commercial service at 100 or 150 WPM operation is called ASCII. See this "column" 1972 OCT for details."

SPEED

The term "speed" when used in connection with printing telegraphy usually means the number of words per minute that the equipment can handle. A word is defined as five characters plus a character space. Western Union characters are 7.0 units or 7.0 X 22 ms - 154 ms long. Therefore, a Western Union "word" is 6 X 154 ms - 924 ms - 0.924 seconds long. Because there are 60 seconds in a minute, a Western Union machine can send or receive 60/0.924 - 65 words per minute. Therefore, Western Union machines are called "65-Speed" machines.

Bell System keyboards have a character length of 7.42 X 22 ms = 163 ms or a word length of 6 X 163 = 0.978 seconds. 60/0.978 = 61.3 words per minute. Therefore, Bell System machines are called "60-Speed" machines.

BAUD

The Baud or the "Baud rate" is defined as the reciprocal of the shortest element length measured in seconds. For both Western Union and Bell System machines operating at 65 and 60-speed, respectively, the shortest element length is 22 ms. Therefore, the Baud rate - 1/0.022 - 45.45 Bauds.

SUMMARY

The need for the start and stop pulses were discussed. The start pulse, always a space, indicates to the receiving machine that a character is coming and starts the timing sequence in the receiving machine. The stop pulse is used to end a character and to give a steady mark in preparation for the next character. The stop pulse also acts as a buffer between successive characters to enable the receiving machine to prepare to receive the next character.

It was also shown that Western Union and Bell System machines differ in the minimum length of the stop pulse they send, but that this difference in no way affects their compatability. The speed of operation in words per minute was calculated and the Baud was defined.

RTTY theory & applications.

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

RTTY FOR THE BEGINNER
START AND STOP PULSES

Last month the Baudot code was described. It was shown that it is necessary for the receiving machine to "time" the signal being received. The timing process requires that the sending and receiving machines operate at exactly the same speed. It was also shown that half the characters in the Baudot code start with a mark and the other half start with a space. Therefore, some means of telling the receiving machine when a character starts must be employed.

In order to describe how this is done, a "peculiarity" of landline telegraph practice must be discussed.

TWO-WAY TELEGRAPHY

Because wire is expensive, it is desirable to use a single wire for manual telegraphy. Figure 1 shows how this is done. At each end of the circuit there is a telegraph key and a sounder in series. If a simple key that is normally open was used at each end, neither party could send because the circuit would always be open. If however, there were a switch across each key, and the switch was kept closed when not sending, the circuit could be opened by either party when he wanted to send a message and the circuit would be interrupted by his key. In this manner it is possible to have a two-way circuit with only a single wire. (Simultaneous two-way traffic could not be handled by this method, of course.)

Another advantage of the circuit being described is that other stations can be inserted into the loop (always in series) and so long as all keys are shorted while not sending, the circuit will always be continuous and any person desiring to send can "unshort" his key and send to all other stations.

Two teleprinters can be arranged for two-way operation (not simultaneous two-way) by connecting them in a manner similar to the one described. See Figure 2 and compare it with Figure 1.

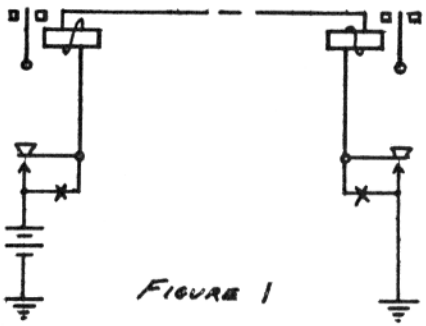


FIGURE 1

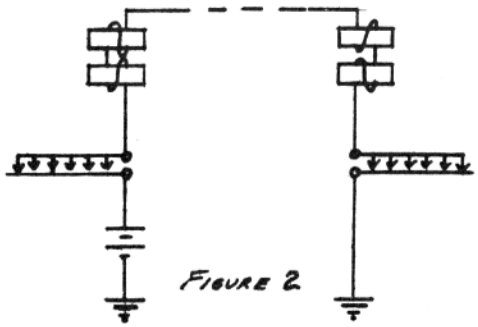


FIGURE 2

On each machine the selector magnets and the keyboard contacts are put in series. The same problem with manual telegraphy occurs here. How can one person send to the other if the circuit is opened by the keyboard contacts on the other machine? The answer is that the keyboard contacts are automatically closed when no one is "typing" on that keyboard. In other words, when the machine or the circuit is not being used, a steady mark is being sent. Therefore, teleprinters are arranged to have a steady current in the selector magnets when there is no message.

The standard schematic symbol for a teleprinter keyboard shows six contacts. One is shown closing the path. The other five are shown open. The five that are alike represent the contacts that form the five portions of the Baudot code. The one that is closed is used to form

the "stop pulse" to be described later and is the same contact that is closed when the keyboard is not in use.

The "peculiarity" of printing telegraphy is that something (a steady mark) is being sent when nothing (no character) is being sent.

THE START PULSE

As described above, the idle condition of a Teletype circuit is indicated by a steady mark. A steady mark is also used between characters. The receiving teleprinter, therefore, is idle when current is flowing in its selector magnets. When a character is to be sent, the keyboard contacts open the circuit, thus sending a space. The receiving printer is therefore notified that a character is coming when a space is received after a steady mark. This space is called a "start pulse". This start pulse starts the timing sequence in the receiving printer. The start pulse is the same length as the elements of the Baudot code, 22 ms.

In Table 1, given last month, we could have added a column before Column 1 labelled "Start", but because it would have an "S" entry in it for every row, it was not shown.

The start pulse completely resolves the paradox mentioned last month. Because every character is preceded by a space (the start pulse) and that is always preceded by a mark, the beginning of every character is uniquely defined.

THE STOP PULSE

We could have also raised the question: When does a character end? This is a natural question because half the characters in the Baudot code end in a mark and the other half end in a space. One answer that could be given is: 132 ms after the beginning of the start pulse. Another, and perhaps better, answer is: At the beginning of the stop pulse.

It was mentioned previously that the idle or between character condition is a steady mark. Therefore, at the end of any Baudot character a mark must be sent to indicate the end of the character. In Table 1 we could have added a column after column 5, labelled it "Stop", and put an M in that column on every row; this was not done because the entry is always an M.

The stop pulse not only signals the end of a character and prepares the receiving printer to detect the beginning of another character but also acts as a buffer between characters. If the stop pulse were not used, it might be possible to send characters so rapidly that the receiving printer could not tell when one character had stopped and the next one began.

The stop pulse is unique (when compared to the start pulse and the five element pulses) in that it has a definite minimum length but an indefinite maximum length. The stop pulse starts at the end of a character and ends when the next character is sent. When is the next character sent? This depends upon the person at the keyboard.

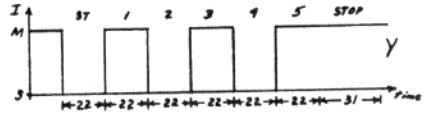


FIGURE 3

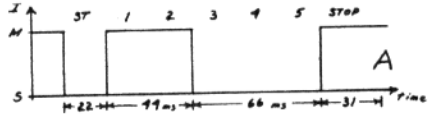


FIGURE 4

There are two standard minimum lengths for a stop pulse. On Western Union machines it is the same as the other pulses: 22 ms. Therefore, Western Union machines are called "7.0-unit" machines because the code they send is composed of seven even-length elements. Bell System machines have a stop pulse with a minimum length of approximately 31 ms. Because 31 ms is approximately 1.42 times 22 ms, and because the other six elements are 22 ms long, the Bell System machines are called "7.42-unit" machines.

The current waveshape occurring when the letters "Y" and "A" are sent are shown in Figures 3 and 4. These are the same as shown in Figures 1 and 2 last month, but contain, in addition, the start and stop pulses. The lengths of the individual elements as well as the complete character length are shown for both Western Union and Bell System machines. The mark occurring before the end of the start pulse is the end of the stop pulse of the preceding character and may be any length greater than the minimum length corresponding to the keyboard being used. The stop pulse shown at the right of the figures ends whenever the next character is sent. Its minimum length is indicated.

We would like to mention at this point, that although Bell System and Western Union machines are 7.42 and

Continued on Page 12

RTTY-DX

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

Hello there .....

Well, since our last meeting here band conditions have not been very good, but least we be accused of understating the facts I guess that we had better correct that statement to; "band conditions have been absolutely terrible". Either there had been a lot of solar storm activity or maybe we are really now starting to feel the effects of the low sun spot numbers or perhaps it is a combination of both, anyway it all adds up to lousy conditions on the HF bands.

The poor conditions certainly raised havoc with the BARTG Contest. We found the East West path non existent at times and the North South marginal at best. What you heard or worked depended very much on the area you were in. Although all Continents were reported active those of you that made WAC in this one should indeed congratulate yourselves on having an excellent station and location. In any event, no matter how small you think your score, all participants are urged to send their results to Ted Double, G8CDW, BARTG Contest Committee. See March issue for details on making out the logs and where to send them.

At this time we are very pleased to announce that the 5th "100 DXCC - RTTY" Plaque goes to Charlie Latham. W5QCH. Cards from 7Q7JO and YJ8JS brought his total of cards up to 100 and culminated several years of RTTY DXing. I guess that Charlie would be first to admit, "it ain't easy". One of the peculiarities of RTTY seems to be that stations come and go fast and if you are not there to make the contact the first time around there may not be a second time for a few years. Then also, in certain cases, getting the confirmation can be harder to do and can cause more anguish than making the contact. Charlie also knows what it is like to be on the sending end of a rare DX call sign. Most of you may recall his brief but very successful operation from Grand Cayman as ZF1CH in 1970. Of course, ZF was not among his cards submitted and unfortunately that is one of the penalties of going on a DXpedition, everyone else benefits and the guy that goes never gets it confirmed. We understand that a few more of the boys are on the verge of breaking 100 so the next few months should be interesting to watch. I just realized that in these days of womens Lib to be editorially correct we must not exclude the yl's and xyl's so correct the preceding sentence to read "boys and girls"!!

This perhaps would be a good time to advise all of you that we will publish the DX Honor Roll in the next issue. We neglected to give you fair warning last month so received few up-datings. We will do some "weeding out" of those listed who have not updated their totals for a year, so if you wish to remain on the listings please get your totals to me via QSO, QSP, by mail or by messenger before June 1st.

As reported in previous columns and via QST's on the air, Jan, ZS6BBK commenced operations as A2CAK, Mahalapye, Botswana on March 21st until approximately March 24th when he closed down. At this writing full details of the DXpedition are not yet available but it is known that many of you have this very rare prefix in the log. It was somewhat unfortunate that the bad conditions we mentioned earlier were in full tilt at the time Jan was there so perhaps coverage was not what it could have been. Jan did make WAC so he was being heard in all parts of the world. He had planned to be QRV from Swaziland as ZS6BBK/3D6 commencing March 28th but transmitter breakdown forced cancellation of this operation until perhaps later in the year. You see, Jan had planned these trips to coincide with his vacation and it was not possible to get the gear back in shape again before having to be back on the job. There were also tentative plans to go to Lesotho, 7P8, but the license was not obtainable from that country at that time. Jan was accompanied by John, OH1LQ, who was visiting Jan at the time. We hope to have a more detailed report in a future column. QSL's can

go to ....

Jan Lengton
14 Gerald Rd.
Robertsham, Johannesburg
Rep. of South Africa

Or if you wish you can QSL via the OH Bureau c/o OH1LQ.

Word has been received that Maurizio, I5BPD is planning RTTY operation from Yugoslavia for four days commencing April 20th and unfortunately this will reach you a bit late. He also plans to be active from Corsica, FC, in May. He is still awaiting the license for here but expects no problem. You may recall the 1968 DXpedition by Maurizio when he put the North African countries of CN8BPD, 7X2BPD, and 3V8BPD in the log of many of you. Those who have still not received QSL's for these can still obtain them by sending your card to ....

Maurizio Borghetti, I5BPD
via Mascagni 27
51019 Ponte Buggianese
Pistoia, Italy

From the Pacific area Johnston Island, KJ6BZ was due to be QRV on or about the end of March. At this writing, nothing heard as yet. Through the efforts of ZL2ALW, and JA1ACB, James YJ8JS will soon have a ST-6 going and we also understand that he has a beam in the works so it should not be too long before his signal penetrates past the western part of the States. Gin reports VS6GA as being extremely active and says he has sent several PC boards to Korea so we should expect additional activity from HL/HM shortly. From Japan some additional RTTY activity comes from, JA1CIU, JH1TSS, JA1WC, JA1ZZ, JA1AUY, and JA1EYB, also JA2HQ will soon be QRV. Gin is presently writing a monthly RTTY article for the Japanese "CQ Ham Magazine" so he will welcome any RTTY information you may wish to pass along. With a monthly circulation of 100,000 and with Gin's expertise in the field of RTTY it should not be too long before we hear many more active stations from the Far East.

ON4BX sends word that the station he recently contacted in Lebanon, OD5ES, is the Hewlett-Packard representative for that country. Our present H-P reference is several years old so we will not duplicate the QTH listed but advise you to ask one of your engineering friends for the current H-P rep in Lebanon and you can perhaps set up a sked with him as he does not appear to be too active otherwise.

We can only say, never give up hope on the QSL's. Much to our surprise we recently received a QSL by direct mail from CO7CD for a contact made almost a year and a half ago. If it can be of help we note his QTH as it appears on the card ....

Conrado Diaz Castaneda
Angel Castillo 155, Altos
Camaguey, Cuba

Of three different stations worked at around that time this was the only response we received to several requests.

Those not finding ZD9GC might look in on 21325 khz SSB on Sundays at about 1900z. We understand that they will QSY to RTTY if asked. His QSL manager is ZS6XO at ....

F. J. Nel
Old Mutual Bldg.
President St.
Germiston, TVL. RSA

K6WZ reports contact with KS6DH on American Samoa. Jerry is running only 60 watts so you may have to dig a little deeper but send cards to ....

Gerald A. Johnson
Box 1611
Pago Pago, Am. Samoa 96920

Congratulations this month upon receiving the WAC Award go to,

Nr. 208 Stig Pihlquist SM7BJN

When we read the last two paragraphs of last months column we could see some confusion arising among you readers. It seems that something was lost in translation from my pen to the printed copy. The words - RTTY-DX APRIL 1963 - should have preceded the last paragraph, also, the first call sign should have been SVØWT!!! We'll try again.

RTTY-DX MAY-JUNE 1963

K3GIF reports that Bruno, I1RIF may operate as 3A2CL shortly also reports that KR6BE comes thru to the East Coast around midnight. W6CG was the first RTTY contact for Cas, HL9KK. W6UGA made WAC.

Rene, DL3IR a newcomer in Europe puts a fb signal into the West Coast. From Scandinavia LA6VC, OZ5JT and OZ5EL are doing fb. OA5G is back on the active list and PY2BCD is a new one on RTTY. ZL1WB pounds into the West Coast daily on 14090. A fb contact was head by Henry, W4MGT and Doug 5A2TC in Tripoli. Bill, ZK1BS has his gear all packed and preparing to leave Rarotonga for keeps.

With many thanks to DK3CU, ON4BX, K6WZ, W3DJZ, JA1ACB, W2LFL, W4-CQI, and all.

73 de John

***

Shortly after you receive this issue it will be time for the Dayton Hamfest. Don't forget our hospitality room at the Imperial North Motel. We understand the motel has been sold out for some time so hope you have your reservations, if not there are several other motels near by - Holiday North and the Ramada are two we know of. See you there --

***

The 40 meter frequency still rages -- a flood of letters (4) were two for 7040 and two for 7090. From the little we have listened on forty even the letter writers are not active so I suppose it doesn't make much difference where we don't operate.

***

We are getting into the act too. The price of RTTY binders will be raised to $3.50 Each, pp. Since we last set the price on binders they have gone up 37¢ and the postage has increased 30¢. The 50¢ raise just cuts our losses, with profit such a naughty word these days we don't want to get in trouble with Uncle Sam. Especially since he (and you taxpayers) send us a check now every month.

***

We don't want to sound like the publisher of "Best Regards" magazine but we wonder if the pressure of RTTY-SSTV and maybe a few others for DXCC endorsements for their favorite mode caused the ARRL to discontinue the Phone DXCC. What gets us is that instead of adding something for hams, they took something away, serving fewer and fewer hams less and less seems to be the policy. The ARRL incentive licensing plan has apparently become a "Tiger by the Tail" - the FCC has swallowed it completely, and likes it. We are glad to see the directors polishing their guns for action if and when they can be used. We are happy to see the "Status Quo" in the ARRL shaken a little, apparently the directors are getting a message from the hams that vote them in office. Keep telling them your thoughts.

***

BACK ISSUES-

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

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Sept.-Oct.-Nov.-Dec.[8]
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BACK ISSUES OF RTTY JOURNAL - I have a complete file of all issues from Vol. 1 No. 1 to date. Will reproduce any issue for $1.10 pp. Add 25¢ for air mail delivery. John Isaacs, 3175 Val Verde Ave., Long Beace, CA. 90808.

PC BOARDS AND KITS; Phase locked loop, autostart, RY generator, CW/RTTY identifier, tone burst generator, two tone decoders, two meter preamp and channel scanner. Write for free flyer. Signal Systems, 2650 Durango Dr., Colorado Springs, Colorado 80910.

TYPEWRITER RIBBON RE-INKER; Hand operated model now only $3.50. K575 or K764 ink available at all National Cash Register Stores. 75¢ per tube. Walter Nettles, W7ARS, 8355 Tanque Verde Rd., Tucson, AR 85715.

NEWS-NEWS-NEWS - Amateur Radio's Newspaper, "Worldradio", Trial subscription - Two issues for one dollar. "Worldradio". 2509-F Donner Way, Sacramento, Calif. 95818.

HAL COMMUNICATIONS CORP. can provide you with autostart for the ST-5. Adapated from the proven ST-6 circuity, the ST-5 autostart kit contains drilled, plated PC board, relay and all parts for only $15.00 plus shipping. For the best in UHF RTTY order the ST-5A with auto start and AK-1 only $92.50 plus shipping (no cabinet). Available late April or pick up at Dayton. Hal Communications Corp. Box 365, Urbana, ILL. 61801. Phone (217) 359-7373.

EMERGENCY ... WANTED - Teletype Machines-Model 15, 19, 28, 32 in large quantities. Must be in reasonable condition to be used by deaf people for phone communication. Also need M15 keyboards, parts, etc. Write: Lester Zimet, TDI Agent. 39 Aspen Drive, Rochester, New York 14625. Tel-716-381-4424.

PERFORATOR TAPE 11/16", white, 10 rolls - $1.95 plus shipping. 88mh unpotted TOROIDS, 5 for $2.00 post-paid. WAØTJR, d. r. kelley, 1490 Yaqui Drive, Florissant, Mo. 63031.

MODEL 28 SEND-RECEIVE TYPING REPERF, complete. 60WPM, chadless. $125 firm. See ad April RTTY Journal. 75S3, very clean, $400 firm. Pete, W6KS, 5262 Yost Place, San Diego, CA 92109. 714-274-7060.

KLEINSCHMIDT TT-4A/TG printer, keyboard, used, good $48.00 with 60-100 gears. Freight $20. east of Miss. $10. west of Miss. Also have ASR, KSR typing punches. Mark/Space Systems Co. 3563 Conquista, Long Beach, CA. 90808. (213) 429-5821.

CIRCUIT BOARDS. Receiver, December Ham Radio and September Journal, $10. Auto line feed, January '73 Ham Radio $7. TTL AFSK, September '72 Journal, $8 PP. G10 expoxy, plated, with clear photo. Bert Kelley, K4EEU, 2307 S. Clark Ave., Tampa, Florida 33609

KLEINSCHMIDT MANUALS - for TT-4, TT-100, TT-76, TT-107, etc. Mite KSR teletypewriter supplies, gears, parts, covers. Wanted Teletype manuals. Send SASE for list. Typetronics, Box 8873, Ft. Lauderdale, FL. 33310. W4NYF.

HAL COMMUNICATIONS CORP: HEADQUARTERS for MAINLINE Solid State RTTY equipment. You can do no better than the ST-6 demodulator at any price. Screened, punched cabinets for the ST-6 now available. For budget TTY, it's the ST-5 for HF or VHF. And the best in AFSK is provided by the AK-1. Our new model 1550 electronic keyer, or the MKB-1 Morse Keyboard, will automatically identify your RTTY station at the push of a button. The extra values are available from HAL Communications Corp., Box 365RJ, Urbana, IL 61801. Phone 217-359-7373.

R-390A MFGD. BY COLLINS RADIO - $525.00. #28 Receive - only typing reperforator single base, without cover, ready to operate, 100 WPM, $49.00. 60 WPM gears $10.00. LRX Reperforator transmitter, two 3 speed gear shifts, ready to operate $145. Alltronics-Howard Co., Box 19, Boston, Mass. 02101. (617-742-0048).

FOR SALE: 28KSR TELETYPE with keyboard switches, non overline, automatic line feed, carriage return, anti-line feed, 3 speed gear shift, automatic station control including H-break, CW ID call up, including CW ID machine, reperf turn on/off. $350.00. 28 table top TD with covers, set on 60 speed, $100.00. 28 table top Re-perf with covers and - speed gear shift, $150.00. 28KSR Teletype (less cabinet) includes non-overline, automatic line feed, carriage return, anti line feed. With stunt box set up for re-perf turn on/off, H break and CW ID call up. $175.00. ST-6 terminal unit in rack mounted panel, $200.00. TT/L-2 terminal unit in rack mounted panel, $200.00. TT/L-1 terminal unit in rack mounted panel, $75.00. HW16 transceiver set up for RTTY, in rack mounted panel, $75.00. 2 Selcals, both mounted on one chassis, rack mounted panel, $150.00. TT63A/FCG teletype regenerator, $30.00. IB-101 Heath kit frequency counter in rack mounted panel, $100.00. 19 paper winder $25.00. 28 paper winder, $50.00. 6 ft. rack cabinet, deluxe trim, $75.00. Truman Boekoel, K8JUG, 2715 Edwin Dr., Xenia, Ohio 45385. Phone (513) 429-0589.

HAL COMMUNICATIONS CORP: Announced the revolutionary new RVD-1002 and RKB-1 solid state RTTY system. Provides the ultimate in noiseless, reliable reception and transmission of Baudot coded TTY. The RVD-1002 visual display system receives demodulated TTY pulses from the ST-6 and provides video output to a video monitor, or modified TV set. One thousand (1000) characters are displayed in a 20 line, 50 character per line format, at 60, 66, 75, and 100 WPM if your TU will copy it. The RKB-1 combines reliable TTL circuitry, a high quality commercial keyboard, and a rugged case to provide the best Baudot TTY keyboard available. The electronics is arranged so that you type as if you were using a typewriter.. See them on display at Muskegon and Dayton. Get the details from HAL Communications Corp., Box 365RJ, Urbana, Il 61801. Phone 217-359-7373.

CLASSIFIED ADS-

DOVETRON TELEPRINTER SPEED CONTROLLER - The DOVETRON TSC-1000 Teleprinter Speed Controller is an all electronic, solid-state motor controller that functions as an electronic gear shift. for any teleprinter equipped with 100 WPM gears and a 50/60 Hz synchronous motor. Speed control is accomplished by varying both the frequency and amplitude of the power supplied to the motor. A five position front panel switch allows selection of 60-67-75-90-100 WPM operation. The keyboard automatically sends at the same speed as the receiving speed of the typing unit. No buffer storage is required and printer maintenance is reduced to a minimum, because the teleprinter runs only as fast as the received signal. A front panel Range control permits copy of any speed between 50 and 110 WPM with no loss of mechanical range. Copy is greatly improved on weak DX-type signals, and under severe conditions of selective fading, multi-path propagation and keyboard distortion by "synching" to the incoming signal. This Range control also permits answering a station running at a non-standard speed, giving him better copy of your signals. The AUTOSTART circuit provides remote turn-on/turn-off capability and current limiting protection for the terminal unit's autostart components. May be used with any character unit code (7.0, 7.42, 8.0, etc.). Operates directly from 110vac ±10%, 40 to 400 Hz. Since the output of the TSC is not affected by line frequency variations at the input, stable speed control is provided for Field Day and other locations where portable or emergency power supplies exhibit line frequency instability under changing load. Attractively packaged in an 8 x 8 x 11 inch custom enclosure. 15 pounds. (21 pounds shipping). $129.50 FOB. (Calif. residents: $6.50 sales tax). DOVETRON, 1015 Fremont Avenue (PO Box 267), South Pasadena, Calif., 91030. 213-682-3705.

ST-5A BOARD ONLY $5.25. Parks kit $54.00. Mod. kit for ST-5 $9.00 (Makes ST-5 into ST-5A). ST-5 Board only $5.25, parts kit $47.50. ST-6 boards only $18.00. Parts kit, $128.00. All P.C. boards G10 glass-epoxy 2 oz. Copper drilled and solder plated. All items shipped pre-paid. PEMCO, 422 18th N.E. Salem, Oregon, 97301, (503) 585-1641.

FOR SALE; MODEL 28 ASR GEAR SHIFT, nylon type $135.00. Model 28 compact gear shift, can be converted to ASR type for about $15.00, only $115.00. Model 28 MK111 typing units $125.00. SP600JX17, $225.00. CV89 $100.00, Model 28 keyboard MK111 $65.00. MK1 $45.00. Teco Electronics, PO Box 1050, Garland, TX. 75040.

SOLID STATE REGENERATIVE REPEATER, polar relay output, excellent surplus, $6 postpaid with schematic. Requires power supply and timing oscillator. Complete system available. Jim Haynes, 217 Orchard Road, Felton, CA 95018.

FOR SALE; CV-115 RTTY Converter w/ manual $70.00 26VDC Mite teleprinter w/ keyboard, extra gears, cables in shock proof case, $175.00. Fred Slaughter, 3636 Douglas Rd. Apt. #3, Toledo, OH. 43613. Phone (419) 474-7484.

FOR SALE: CENTRAL ELECTRONICS 100V with solid state power supplies, KT-88s in final and instruction manual. Mint. $250. Heath HO-10 Monitor Scope. $45. Stelma TDA-2(NB) Teletypewriter Distortion Analyzer. $25. WANT: Manual for Central Electronics 200V. Hank Scharfe, W6SKC, 1015 Fremont Avenue, South Pasadena, California 91010. 213-682-3705/799-5886.

RTTY AND ATV PC BOARDS & MODULES, Send SASE (2 stamps) for catalog and info sheets. P.C. Electronics - W60RG, 2522 S. Paxton Ln., Arcadia, CA. 91006.

WANTED: 28ASR CABINET. LXD TD with base and LRP Typing REPERF for Model 28ASR. State price and condition. M.H. Hammond 9643 So. 285 East Sandy, Utah 84070 (801) 571-3236.

TU FREQUENCY STANDARDS -- Three brand new tuning forks, with better than 0.0005 accuracy, especially designed for tuning TU filters at 2125, 2295 and 2975 -- available separately at $7.40 each or set of three $19.90 post-paid. Hank Frankel, Box 535, Bellmore, NY 11711.

WANTED; STELMA PC-334, PC-336 or PC-403 PC plug in or any information on these. G.S. Naniwada, JA1ACB,3-4-8, Izumi, Hoya, Tokyo 188. Japan.

3 SPEED SHIFT-FACTORY NEW teletype kit for 28KSR. $50.00. Also 28-RO cabinet with base and motor, no printer. $40.00. Want WCI PLL-TU and Dovetron speed control for 28ASR. Will trade or $. D. Mello, W3FOR. Arnold, MD. 21012.

RETIRING GOVERNMENT COMMUNICATION Engineer offering two large boxes, new and nearly new, parts for 15s, 19s, 28s, ASRs. Many never opened. First $50.00 or offer. Shipped collect UPS. C. Morris, K8SOJ, Rte 5, Box 609, Chillicothe, OH. 45601.

RTTY TAPE. 11/16 INCH PAPER TAPE. Brand new. 40 rolls per box. $6 per box plus postage. Quantities available. Beautiful Tektronix 541 scope $325; Tek 531 $275; ARC-5 receivers 3-6 MHz $10. New Simpson and Weston meters $2. SASE for list. E.B. Halton W1QWU, Providence College, Providence, R.I. 02918.

WANT MECHANICAL 500KC FILTER for 51J4 receiver, 1kc bandwidth. Must be good operating condition. If not sure what you have, send me the collins type/part number. Have new F500B60 (6kc) filter for trade, possible sale. Xerox copies of TDMS manuals: Receiver $8, transmitter $8, applications $5, rack or portable power supply $1.50 ea. PPD. Kernaghan, 1911 Halekoa Drive, Honolulu, HI 96821.

KLEINSCHMIDT REELING MACH. 110V AC 60 Cy. (Use to take up paper or tape) $17.50. Prepaid anywhere in USA. Kleinschmidt Page printers TT-100 Repert-TD & Page Printer Comb (TT-117 & TT-179) Single and double tables in excellent condition in stock. Inquire for prices. Andy Electronics Inc., 6431 Springer, Houston, Texas 77017.

NATIONAL SECURITY AGENCY miniature printer, Teletype #109000; unique, for collector and experimenter. Only $8.98, while they last. Model 28 synch MOTORS, $14.95. 11/16" perf tape, case of 40 rolls only $6.95. Free list. Jim Cooper, W2BVE, POB73, Paramus, NJ 07652.

SALE; MODEL 28 TYPING REPERS, type TT 315/UG code LPR-35, or TT317/UG code type LPR-37, tape data 11/16 wide, chadless or fully perforated, excellent, $20.00 each. Model 28 transmitter-distributor type TT334/UG code LXB-9 Excellent, $20.00. Tuning forks 96.19 VPS or 120 V.P.S. unused $2.00 each. Model 28 synchronous motor LMU-12, 3600 RPM. 1/12 HP. 115 VAC, 60 Hz. excellent, $9.50 each. Model 28 synchronous motor 1725/1425 RPM P/N 173937 cont. 115 V - 50-60 Hz. excellent $8.00 each. P.D. 82 synchronous motor for Mite teletypewriter, 115 VAC 60 Hz, unused $15.00 each. Kleinschmidt reperforator type TT107FG, R/O 60-75-100 wpm for automatic typing and reperforating of TTY messages. 7/8 chad tape, synchronous motor, excellent $28.00 each. Reader, high speed. Ferranti model II or III, excellent $15.00 each. Control from panel; for model 32KSR or ASR complete with push button switch, relays, resistors, Jones plugs etc. Excellent $2.50 each. Gears for all types teletype machines. Send us your requirements. Atlantic Surplus Sales, 580 3rd Ave., Brooklyn, N.Y. 11215.