RTTY

THE OSCILLOANALYZER FOR RTTY

RYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRY

NEWS OF AMATEUR RTTY

November, 1961
30 Cents
Vol. 9, No. 11

HORSE TRADES

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

RTTY, Inc.
372 WEST WARREN WAY
Arcadia, California
Return Postage Guaranteed

WANTED: Cover for low base non typing reperf. Also two covers for high base typing reperfs. W3WUX, 2624 Eldon Ave., Drexel Hill, Pa.

WANTED: Keyboard for model 15. W7ZIX

FOR SALE: Automatic Carrage return/Line feed kits for model 15 or 19, (#105382) $20.00. W3CRO 256 Parham Rd., Springfield, Pa.

FOR SALE: Model 15 printer, 20/60 mils, with Mu Electronics TU, $150.00 for both, WA6PFX 8956 Cadalic, Los Angeles 34. C/o RTTY, INC.

WANTED: Cover for TT 189/FG reperf (14 non typing reperf), W5BOY, 365 West Saxet Drive, Corpus Christi, Tex.

WANTED: Best Model 14 perforator for $75.00 delivered here. John Riley 914 North Cordova St., Burbank, Calif.

FOR SALE: Tu built up by W1RR, with tuning scope, $60.00. W1RR

FOR SALE: Audio low pass filter, cut off freq 3500 cps, input Z 600 ohms, small sealed units contain 3 toroid coils, $7.50 WØNHP

FOR SALE: Model 14 TD $60.00 W6VVF, 543-46Th Avenue, San Francisco 21.

FOR SALE: Model 14 perforator, with end of line indicator and rapid feeder, cover, easle and table, $100.00 W6LX.

WANTED: RTTY August 1953, January May 1954, April 1960. Have a few duplicates of early issues for exchange if desired W6ZH, 915 Orlando Road, San Marino, California

FOR SALE/TRADE: Model 26 with table, $40.00, tape perf $45.00, 130 volt at 500 mils DC supply for perf $30.00, tape distributor $40.00, home built converter $20.00, will trade works for Ranger etc. W7GEK, 206 West Emerson, Hoquiam, Wash.

FOR SALE: Model 28 Complete, $400.00 Dave J. Goodman, 14315 Milverton Road, Cleveland, Ohio

FOR SALE: Model 14 TD, sync motor 60 wpm, tight tape and tape out feature $115.00, Model 14 typing reperf with kybd, end of line indicator, sync motor, excellent condx, K9BRL, 1105 North Ironwood Drive, South Bend, Ind.

FREE: Cover for Model Twelve, fob W7FEN, P. O. Box 171, Bothell, Wash.

FOR SALE: Model 15 and tables, excellent condition $110.00, Model 26 and tables, $65.00...RTTY, INC.

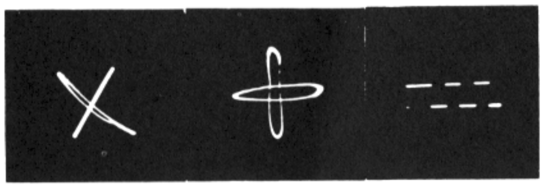
FOR SALE: AN/FRR-3A Diversity receiver bay, AN/FGC-1 Terminal unit for diversity receiver, AN/URA-7 Converter, comparator group, RF TU 50 kc IF. Wanted Tech manual for AN/FRR-3 ..WA6LAI, 2307 North Gower St., L. A. 28, Calif.

AN OSCILLOANALYZER FOR RTTY SIGNAL MONITORING

By R. H. Weitbrecht - W6NRM
3941 Brookline Way
Redwood City, California

PART TWO

OSCILLOSCOPE UNIT FOR W6NRM MARK IIIB T.U.



"X - DISPLAY" (WØHZR) MARK: LEFT SPACE: RIGHT

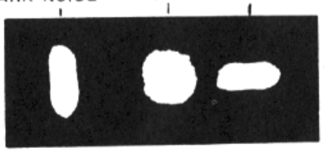
"+ - DISPLAY" (W6AEE) MARK: VERTICAL SPACE: HORIZONAL

WAVEFORM 6.1 CPS DISPLAY "Y" - KEYING

NORMALIZED PRESENTATIONS (I)

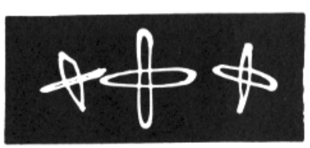
"X"

TOO MUCH MARK NOISE — BALANCED NOISE — TOO MUCH SPACE NOISE



"+"

BALANCING ON NOISE (NO SIGNAL)
(RECEIVER B.F.O. ADJUSTING) (II)



TUNED TOO LOW — TUNED CORRECT (O.K.) — TUNED TOO HIGH

TUNING IN A RTTY SIGNAL
(+ - DISPLAY) (III)

The Oscilloscope Displays As a whole (I)

Included with this article is a set of photographs showing typical 'scope displays that the Oscilloanalyzer presents when operating on-the-air RTTY. The first photograph, I, shows the normal presentations as available when the Mark III TU is receiving a proper tuned-in RTTY signal. The phase sensitive WØHZR display shows a "X" filling almost the entire screen of the 2-inch cathode ray tube. This condition is obtained by proper adjustment of the receiver's audio gain control so that approximately 10 milliwatts is delivered to the TU's input. In other words, if a good-sized "X" is obtained, then the receiver is delivering enough audio to the TU, thus assuring that it will have plenty of dynamic range to take care of QSB's on the received signal. It is interesting to note that the TU will still print even when the "X" has fallen down to almost a dot in the center of the CRT screen.

The center display in I is the W6AEE presentation, consisting of a vertical trace for the Mark tone input or a horizontal trace for the Space tone input. When the RTTY signal is sending traffic, the persistence in the CRT screen's phosphor coupled with the persistence in the eye's vision blends the vertical and horizontal lines into a "+". We shall see that this is an extremely sensitive and convenient display mode for RTTY tune-ins. The "traces" in this display are actually narrow loops which however indicate very adequately the state-of-tune involved. We will explain the reason for the "loops" — however it should be pointed out that this is *not* a defect in the TU or 'Scope, and the TU circuit itself is optimally designed for proper reception of RTTY signals without compromises affecting teleprinter signal reception and keying

This 6 cps pattern, in I, shows the whole of the RTTY signal, on a 6 cps sawtooth sweep basis. If the signal happens to be repeating synchronously on any one particular teleprinter character, one obtains a "stopped" waveform, presenting the start-pulse, the five pulses, in a particular combination, and the 31-millisecond stop-pulse —the rest of the pulses being 22-millisecond units. We can easily inspect the waveform as a whole for gross conditions such as bias or transition clicks. If the teleprinter character is "Y", then we obtain alternations of Mark and Space pulse-units which then can be visually compared with each other along the sweep for "balance" indicating zero bias. As we will see later, the Bias Meter will deliver an accurate indication of actual bias on such a repetitive signal. Anyhow, the 'scope presentation will still give the operator a good idea of how a RTTY signal is, even though it happens to be random-keyed or sending traffic — after he has had a little time learning to "catch" patterns on-the-fly.

'Scope Presentations with Noise In TU input (No-Signal) (II)

The patterns shown in II show certain significant differences which play an important part when trying to copy weak noise-buried RTTY signals. A good RTTY receiver has a fairly sharp I-F system, perhaps using a Q-fiver or other filter, with a bandpass of about 1 kilocycle — sufficient to pass the Mark and Space frequencies with some of their keyed sidebands. With such a receiver, BFO adjustment is critical if the TU is to be properly balanced with respect to noise contributions through its Mark and Space channels.

It is evident that should there be a presentation indicating too much mark noise, then on a weak signal, the incoming mark noise will tend to suppress the weak space on passing through the TU's limiter — the discriminator then failing to detect the space transitions. This is quite true in case of too much space noise. Hence as II indicates, we have to adjust the receiver's BFO so that we obtain a symmetrical or "round" noise pattern on the 'scope screen. Then the weak RTTY signal will have its best chance of coming in "through the noise".

The proper receiver adjustment consist mainly of having its RF gain on wide open, with no antenna connected (so we obtain set noise only); and audio gain set normally so that the noise is "not blasting forth", yet the 'scope unit will indicate the noise balance. Turn the BFO control all over its range and notice how the shape of the noise display varies. There should be two positions where "symmetrical displays" obtain —whether the "X" or the "+". One position will have the BFO properly placed 2550 cps *above* the receiver's I-F peak; the other position the same amount *below* the I-F peak. Depending on the relationship of the receiver's HFO with respect to incoming signal in the RF section, one position will have "normal FSK", other position will have "upside down FSK". A little experience with the particular receiver will indicate which position to be used for all normal RTTY work on whatever bands are being operated.

The noise balance is most sensitive on the W6AEE "+" display and it will be noted that, with the RF gain wide open, various settings of AF gain does not affect the noise pattern to any marked extent at least above a "threshold". This indicates full saturation in the TU's limiter stages.

Tuning In a RTTY Signal (III)

Shown is the W6AEE pattern with the receiver in various states of tune-in on a normal-shift traffic-sending RTTY signal. It is largely self-explanatory and indeed shows how sensitive and beautifully precise this display can be. If we tune the receiver so as to obtain a "perfect cross", we are not only sure the receiver is in precise tune, but also that the signal's shift is properly set — entering the "Mark and Space Hatches" in the TU.

It is the author's considered opinion that the "+" display is the best type of tuning indicator available to RTTY. If one obtains a perfect "cross", all is well, and morever, this presentation is the easiest one of any to monitor during the progress of a RTTY reception. It takes just a blow of an eye — a glance — to know if things are OK or otherwise.

As for the X-display — it tilts one way or other in case of mistunings. Is it not as easily observed — as a matter of fact if it is the only display used in a RTTY terminal unit, it is necessary to use fiducial lines traced onto the 'scope screen to show proper Mark and Space tone frequencies to enable the TU to work most effectively. Thus one must look for these "index lines" and compare with the existing traces to get an idea of the tune-in state-of-affairs. Definitely not a "glance-type" of a picture.

Presentations Showing Different Shifts (IV)

Shown are various patterns obtained when the received RTTY signal is not quite exactly 850 cps shift. On such a signal, one finds it difficult to obtain a "perfect cross' on the + display. The X-display becomes a narrow-X — or — a wide-X. Fiducial lines will quickly indicate this also. However the Mark III TU will still print, provided a straddle tuning procedure is used — so the discriminator's crossover point is approximately set in the middle between the too-short (or too-wide) Mark and Space frequencies. The dotted lines inked in on IV show the location of the crossover point, as can be quickly ascertained simply by tuning the receiver across any steady CW signal and notice how the TU (with its Markhold control "out") responds through the teleprinter machine. There is an exact point where the machine starts to run open or stops — and the 'scope unit will indicate this.

Quite a few amateur RTTY signals will not be exact shift. Just tune on the display and try to adjust the Mark and Space traces so they lie more or less symmetrical with the crossover point. This is not too difficult to achieve for RTTY signals having moderate leeways in shift.

A remark is in order about the original "double-Magic Eye" 6AF6G tube in the Mark III TU. This is a simple electronic circuit with a rather difficult presentation in comparison to the oscilloscope display whether the X or the +. The eye method is essentially a maximum-shadow display indicating proper tune-in on an 850 cps shift signal. It does not show if the receiver is tuned too low or too high — so one is obliged to try the receiver in both directions to maximize the shadows. However its only advantage is when working with very narrow shift signals using the straddle tuning method — the right and left shadows are easily and precisely balanced with respect to each other even though they will not open up wide on account of short-shift. With this setup, the Mark III TU will copy RTTY signals having as small shifts as 150 cps. The other displays are inexact in this respect.

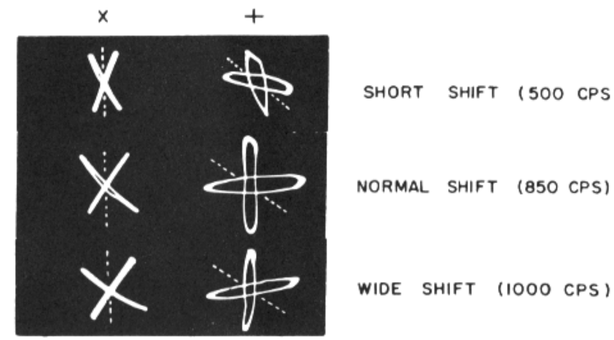
All in all, if only one tuning indicator display is used, it is the + display — the best all around one, and is the usual Picture Control setting when operating this Oscilloanalyzer. In fact, the entire 'scope circuit can be boiled down to just the cathode ray tube with its electron gun power supply — no amplifiers being needed as the Mark III arrangement delivers more than enough Mark and Space AC voltages from its discriminator tuned circuits. As a matter of fact, such a simple W6AEE 'scope arrangement was described in RTTY years ago[5] by W6NRM, using the same TV-booster power supply with its voltage quadrupler rectifier-filter for running the CRT alone.

Fading Signals or Improper BFO Adjustments (V)

The X display, as shown in V, is amplitude sensitive because it works directly off the output from the bandpass filter in the TU. Variations in tone levels are directly indicated by the different lengths of the Mark and Space traces. As has been referred to previously, the normal operating level of 10 milliwatts results in a X trace filling almost the entire two-inch screen of the oscilloscope.

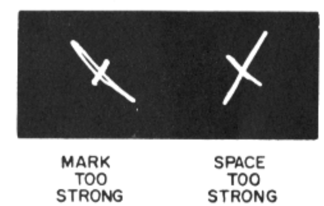
During actual RTTY signal reception from a distant station, with the receiver operating on manual volume control (MVC), it will be observed that the Mark and Space traces appear to be varying at random — not necessarily together — in other words, a strong Mark may be present yet the Space has dropped almost to nothing. . . . and then in

[5] Power Supply for 2-inch CRT RTTY, August 1953



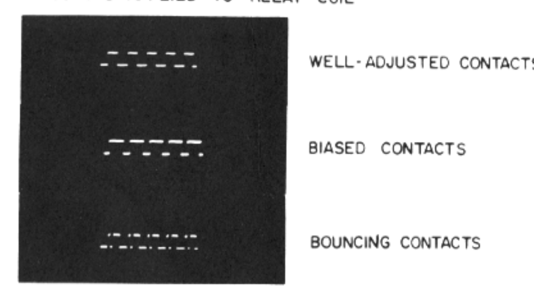
DOTTED LINES SHOW DISCRIMINATOR CROSSOVER POINT

PRESENTATIONS SHOWING DIFFERENT SHIFTS (IV)



EFFECTS DUE TO SELECTIVE FADING
OR
IMPROPER B.F.O. ADJUSTMENT
(X-DISPLAY) (V)

60 CPS APPLIED TO RELAY COIL



OSCILLOSCOPE SETUP FOR TESTING RELAY CONTACTS (VI) the next second or so, the Space has come back to full amplitude and then the Mark may start fading. This shows vividly the effect of selective fading over the radio path in question, and is one major reason why frequency-modulation techniques are so effective in handling teleprinter circuits. There is a signal for Mark, and another signal for Space, and during transmission, the transmitter carrier frequency is shifted a certain amount between these two elements, Mark and Space. During reception, the TU's input limiter stage wipes out all traces of signal QSB and delivers to the discriminator a constant signal which then is applied to the Teleprinter Loop, thus resulting in keying the machines which operate as if they did not know there is a radio circuit feeding them!

However, if, say, Mark is consistently too strong with respect to the other — don't assume that the transmitter's power level is consistently lower on one than the other! Yet we get that effect if the receiver's BFO has been improperly set. Its I-F passband for the Mark and Space r-f components are set lopsided because the BFO is not quite 2550 cps away from its I-F peak. Also balance on noise will be poor. The cure is obvious — proper setting of the BFO control, as has already been referred.

By virtue of the TU's limiter action, the + display does not change hardly any even during gross signal fades, thus showing that the discriminator is receiving constant tone power and hence it delivers a clean teleprinter keying waveform to the loop. When the signal gets too weak, there is a threshold below which the cross display suddenly disappears, and noise comes right in. Too bad, bud, it's just band conditions when skip comes in and we have lost the station.

All in all, this is a case where the X display has some utility value because it shows the signal levels involved. Incidentally, the display offers an interesting pattern when certain commercial multiplex (Twinplex) signals are tuned in — there appear four traces — actually two tilted X's superimposed oved each other.

Testing Polar Relay Contacts (VI)

Dhen the Oscilloanalyzer is used by itself, with its 11-pin plug connected into a socket on its rear panel, we can put it to work to evaluate polar relay contact performance. The relay may be driven by a teleprinter loop, and thus by injecting synchronized repetitive pattern of any one given teleprinter character, we can directly observe the waveform on the oscilloscope's screen.

The polar relay contacts, *freed of any capacitors in its loop*, are connected directly to the binding posts on the 'scope unit's rear — marked "Contacts". Note here — there must be *no* capacitor filters in the relay contacts' circuit because our relay test setup sends a very small current — of order of 2 milliamperes - through the contacts, and any capacity will give an erroneous impression on the Oscilloanalyzer. Just be sure that all capacitors are disconnected, or else isolate the relay contacts from the rest of the loop that it keys into.

The Bias Meter also operates during the relay test. Actually there are four binding posts on the scope unit's rear — one pair for the vertical input to the oscilloscope, and the other pair for the Bias Meter connection. Normally the top binding posts are jumpered so that both Oscilloscope and Bias Meter operate together during the relay tests.

Instead of a teleprinter signal, 60 cps, attenuated down from the AC power line, may be used on the relay's coil. A suitable attenuator would be a 0.2 MFD 600 volt capacitor in series with the relay's coil (One coil is enough, or else place both coils in series for the test). This will cause the polar relay's armature to vibrate at a 60 cps rate, and we obtain the waveform illustrated in VI. The biased conditions obtain due to adjustment of the contact one way or other, and illustrates how very critical polar relay adjustment can be! And suppose the relay is picked up bodily during such a test and positioned vertical, or horizontal, or at different angles in between. The bias will be found to vary a bit, thus compounding the confusion! It is highly important that the relay be operated in a consistent position — which is vertical, or horizontal with its contacts in a *horizontal* plane. Any other position — say having contacts in a vertical plane — introduces a bias condition into even a properly adjusted unit.

The Bias Meter shows up this bias variation most sensitively. On the 60 cps test, the ratio of contact dwell to vibration cycle must be exactly fifty-percent. More of this will be discussed in the next section, however, it is pointed out that this relay test is the final authority on whether a polar relay is *really* in proper adjustment when installed in a teleprinter circuit handling the usual signals. It is a well recognized fact that even a properly adjusted relay will be grossly biased in actual operation because the "biasing current" through one of its coils may be incorrectly set. Normally the biasing current is specified to be one-half the current value flowing through the other coil from the teleprinter loop — however this can be incorrect due to a variety of factors existent in the teleprinter loop. The final test, then, is with some test unit, like this Oscilloanalyzer, hooked up to the contacts themselves. With a synchronously repeated teleprinter character, say the letter Y, sent into the loop, we can watch the Bias Meter and adjust the biasing current until we obtain 0.595 reading on the meter. We verify the zero bias condition using a variety of synchronously repeated characters, and obtain one or other of the "six tagret values" indicating zero bias values.

A 60 cps polar relay setup used for generating 60 cps reversals during low frequency radioteleprinter autostart work has been mentioned[6].

Bias Measurements

As is well known, the teleprinter signal is precisely generated by a mechanical distributor so controlled as to provide the sequential signal for each of 32 different teleprinter characters contained in the 5-unit Baudot code. There are two main features of the signal waveform; (1) the synchronizing pulses, termed *Start* and *Stop* units, and (2) the five intelligence units. The synchronizing pulses are a permanent and necessary part of each teleprinter signal, and consist of one 22-millisecond Space for the Start unit and one 31-millisecond Mark for the Stop unit. The five intelligence units contained in the Baudot code is arrangeable in any one of 32 different combinations of 22-milisecond Marks and Spaces. ($2^5 = 32$; there being two "conditions", Mark and Space; and five units assigned) For each character, the cycle is 163 milliseconds — being the sum of 22 ms (Start unit) plus 110 ms (the five intelligence units) plus 31 ms (Stop unit). This forms the common Teletype 7.42 unit code employed in teleprinters usually found in RTTY.

[6]The W9TCJ Autostart Radioteleprinter System, June 1957 *RTTY*

Let us take a look at the Bias Meter modus operandi. It is an integrating circuit that accepts over a period of time the Marks (current-on pulses) and Spaces (current-off pulses) contained in a synchronously repeated teleprinter character signal and thereby delivers a certain reading indicating the *averaged*. value for that particular character. There are six exact values which can be calculated and used as "target numbers" for use with the Bias Meter to evaluate any injected teleprinter signal for biased conditions. These six values depend on the *number of Marks contained in the intelligence units* for any given teleprinter character. There will be 0, 1, 2, 3, 4, 5, or 5 Marks available, and each number of 22-millisecond Marks will add up to the 31-millisecond Mark (Stop) to form a *weight of Marks* for each signal cycle. The integrator circuit thus measures this weight and delivers the result as a deflection on the Bias Meter.

Now we will calculate these six reference values for use with the Bias Meter. The values are simply obtained by adding all Marks and dividing by the cycle of 163 milliseconds, (See Chart Below).

The six "Target Values" are thus calculated and presented above for reference purposes. Now we will consider the problem of transmitting a selected *synchronously* repetitive character to obtain a steady reading on the Bias Meter. It is imperative that the selected signal be transmitted as a continuous series of 163-millisecond cycles, and this can be generated using a tape distributor if necessary, using a tape punched up on one character only. This will test the TD

Marks in the intelligence	Calculation		Target Value	Key
0	$\frac{22 \text{ ms} \times 0 + 31 \text{ ms}}{163 \text{ ms}} =$	$\frac{31}{163}$	= 0.190	BLANK KEY
1	$\frac{22 \text{ ms} \times 1 + 31 \text{ ms}}{163 \text{ ms}} =$	$\frac{53}{163}$	= 0.325	SPACEBAR, CARRET, LF, E, T
2	$\frac{22 \text{ ms} \times 2 + 31 \text{ ms}}{163 \text{ ms}} =$	$\frac{75}{163}$	= 0.460	A,D,H,I,L,N,O,R,S,Z
3	$\frac{22 \text{ ms} \times 3 + 31 \text{ ms}}{163 \text{ ms}} =$	$\frac{97}{163}$	= 0.595	B,C,F,G,J,M,P,U,W,Y
4	$\frac{22 \text{ ms} \times 4 + 31 \text{ ms}}{163 \text{ ms}} =$	$\frac{119}{163}$	= 0.730	K,Q,V,X, FIGS
5	$\frac{22 \text{ ms} \times 5 + 31 \text{ ms}}{163 \text{ ms}} =$	$\frac{141}{163}$	= 0.865	LETTERS KEY

and in general such machines will be found to be in accurate adjustment because its commutator plate has been exactly fabricated at the factory to provide the required 7.42 unit signal pattern. For this test, 'the Oscilloanalyzer, by itself, may be directly hooked up to the TD's signal line (Off the TD commutator alone, witout any other intervening equipment and with all spark suppressing capacitors removed). After having adjusted the Bias Meter to exact full scale deflection on a steady Mark (full current on), the TD is operated, using a tape punched up full of repetitive Y's for instance. The meter reading will indicate 0.595 if the TD is in proper adjustment.

The Keyboard of any teleprinter machine can be arranged for self-repeat on any one key, or else it can be "forced" if necessary. On Teletype equipment, such as Models 14, 15, and 26, this is accomplished by the following procedure:

(1) Depress the key to be repeated, and *HOLD IT DOWN FIRMLY.*

(2) With the other hand, push down the *RIGHT END* of the space ban.

When this is properly done the keyboard's distributor will generate a "burst" of repeats on the desired character. The Bias Meter, connected to this keyboard — with all spark suppressing capacitors disconnected — will now indicate the reading for the character, and it can be compared with the "Target Value". (Note: Forcing the Keyboard in this manner does not harm the mechanism. All that is desired is to get that trip-off latch off the distributor's clutch, and keep it running over and over to generate the repetitive signal).

Usually keyboards are in close adjustment and will normally have a minimum of bias. Adjustment is mainly a matter of contact spacing for each of the six contacts, plus overall spacing between contacts and their actuating lobes on the transmitting cam. If the contacts have not been tampered with, they should be close enough in settings for all practical purposes.

Of course, polar relay contacts may be hooked up to the Oscilloanalyzer and bias readings taken with the relay driven by some teleprinter loop. However, there is a possible ambiguity due to which contact of the single-pole double-throw arrangement is used. If the Bias Meter obtains full scale deflection with the relay driven by a steady Mark current flow, then the above target values can be used for comparison purposes. However, should the meter read zero on a steady Mark, we have hooked the instrument to the other contact on the relay — and for this purpose we use what we can call "upside down Target Values", obtained by subtracting the normal Target Values from 1.000 Recapitulating, we have the following Table, for selected teleprinter characters:

Key	Normal Target Value	Upside Down Target Value
BLANK	0.190	0.810
SPACEBAR	0.325	0.675
R. A, etc	0.460	0.540
Y, M, etc	0.595	0.405
FIGS, V, etc	0.730	0.270
LETTERS	0.865	0.135
RYRYRYRYRYRY	0.530	0.470

Needless to say, before taking a bias reading on an upside-down or reversed signal, be sure to adjust the meter to full scale reading on a steady Space (no-current flow) through the polar relay coil. All in all, the accuracy of bias readings depend on precise adjustment of the meter not only at zero but at full scale as well.

The Bias Meter works the same way when driven directly by the Mark III TU, feeding through the 11-pin 'scope unit plug plugged into the rear of the TU. Depending on the OUTPUT FSK switch, the meter will read normal or reversed, and the appropriate target values as given in the above table apply. For adjusting the meter to exact full scale deflection, use the lower switch to set up steady Mark or steady Space as required, and after things are aligned, set to FSK and take the bias reading on a synchronously repetitive signal. It is all really simple, and indeed the Bias Meter works very harmoniously with the Mark III system.

In the table above will be noticed an extra set of values, for RYRYRYRYRY's. The Bias Meter will also give a reading on a tape sending RY's, and may be used to check for bias in such a signal as well. It is fun to tune around and pick up this or that commercial or amateur RTTY signal sending tape RY's and directly observe the bias, if any.

What is Bias?

Having gotten this far with the Bias Meter discussion, it may be well to ask ourselves just what bias is. Briefly, bias is an unbalance between Mark and Space to the extent that a certain amount of time has been lost by one side to the other. It can be mathematically defined as a percentage as follows:

$$\text{Bias, as a fraction} = \frac{\text{t milliseconds}}{\text{22 milliseconds}}$$

Bias also is expressible as percentage, when the above is multiplied by 100. T, above, refers to the number of milliseconds — let us say — stolen by one side from the other. Suppose the Mark has 2.2 ms taken from the Space, we get what amounts to 24.2 ms on such Marks, and 19.8 ms on Spaces — and the result is *10 percent Marking bias.* And conversely 10 percent Spacing bias results when the Space side has 2.2 ms taken away from the Mark side.

We can derive the equation for calculating bias from a meter reading. We proceed as follows:

(1) Normal signal has 22-ms units, both mark and space, plus 31 ms stop unit.

(2) Biased signal has some time stolen by one side from other.

$$(1)\quad \text{Bias} = \frac{t}{22}$$

Where t is number of milliseconds stolen by Mark from Space *per transition* (taken Mark to Space)

$$(2)\quad x = \frac{22 \cdot n + 31}{163}$$

where x is meter reading (normal values)
n is number of Mark units in signal group

(The above is the equation used for calculating Target Values in preceding tables)

Now, let $t \cdot T$ be the total milliseconds stolen by Mark from Space per cycle; this product is added to the numerator in the above equation thus:

$$(3)\quad x' = \frac{22 \cdot n + 31 + t \cdot T}{163}$$

where x' is meter reading (biased values)
n and t are as above
T is number of transitions in the cycle
(Maximum number: three)

Substituting (1) into (3), we get

$$163\,x' = 22 \cdot n + 22\,T \cdot \text{Bias} + 31$$

$$(4)\quad \text{Bias} = \frac{163\,x' - 22 \cdot n - 31}{22 \cdot T}$$

Finally, the equation (4) reduces by dividing through by 22:

$$(5)\quad \text{Bias} = \frac{7.42\,x' - n - 1.42}{T}$$

Where n is number of Marks in signal group
T is number of transitions
x' is the meter reading.

Percentage bias obtained by multiplying the fraction by 100. Now we will use the equation (5) for selected teleprinter characters and show how bias may be calculated from a meter reading.

Incidentally, if calculated bias is positive, it is *Marking* bias. And if it turns out negative, it is *Spacing* bias.

For the character Y

$$\text{Bias} = \frac{7.42\,x' - 3 - 1.42}{3}$$

The character Y has three signal marks and three M to S transitions.

$$= \frac{7.42\,x' - 4.42}{3}$$

If we insert the Target value of .595 in the above we get zero bias. Suppose we calculate bias from an observed reading of .635 — and it turns out to be 10 percent Marking bias. For ease in estimating bias from meter readings, we note that an increase of .04 in the meter reading equals a change of 10 percent. This applies to the Y-case only, as this is the most sensitive character for bias meter reading.

Similar equations can be drawn up for some of the other characters, and this will be left as an exercise to the reader. It is interesting to note that a bias equation also exists for the RYRYRYRY case; it is given below:

For the character RYRYRY

$$\text{Bias} = \frac{14.84\,x' - 7.84}{6}$$

Proof is left to the reader.

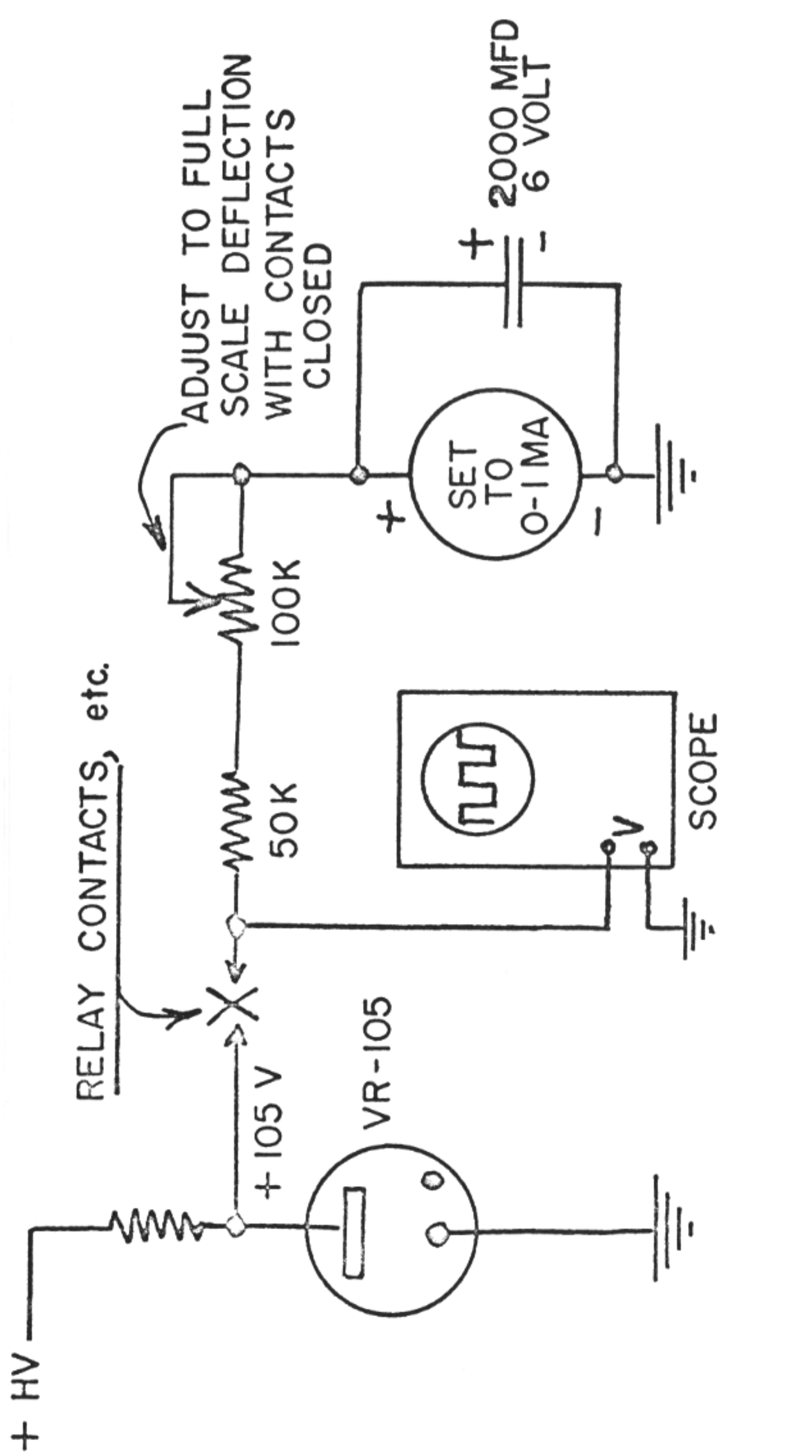
This is also another sensitive setup, because, like Y, it has the most transitions per cycle — namely, three.

Most of the other characters are less sensitive due to lesser number of transitions, 1 or 2. Bias readings will not be as accurate here, but serves as a check on contact operation during transmissal of various characters.

It is well to note the recurrence of the 7.42 and 1.42 numbers above. For various other teleprinter code arrangements such as the Western Union 7-unit system, we use 7 and 1 respectively — and for the Creed (European) system, 7.5 and 1.5 respectively. Speed does not enter as a factor in the above equations, and hence can be used with 60, 65, 77, and 100 word-per-minute circuits. Needless to say, the Target Value tables will have to be recomputed for these other teleprinter code arrangements. This too is left as an exercise to the reader.

Bias Meter Circuit using a Test Meter

By way of illustrating how the Bias Meter operates in the Oscilloanalyzer unit, we show in Figure 3 a simple diagram of a hookup suitable for use with any good Voltohm-milliammeter test meter than can be set up for 0-1 ma. full scale. Essentially the circuit comprises a regulated voltage source, the relay contacts under test, and the integrating meter. The last consists of a series resistor adjustable around 100K, the test meter as set



BIAS METER USING VOLTOHMILLIAMMETER AND OSCILLOSCOPE

Fig 3

up for the desired 0-1 ma., and a paralleled 2000 MFD 6 volt electrolytic capacitor. The latter part serves to smooth out the fluctuations in the keyed signal into an averaged representation on the meter.

Thev voltage source must be at least 100 times the voltage drop across the meter in order to obtain precision integration and accurate bias readings. Normally the meter has a 250 millivolt drop – so that means the voltage source should be 25 volts or more. The Mark III TU has an approximate 65 volt drop across the FSK adjusting potentiometer (the "series resistor"), being regulated by the clamping diode and NE-48 lamp. A 105 volt source, here, is suggested as it may be readily available from off some voltage regulator in the receiver or transmitter and the current demand is only 1 milliampere. Any voltage over 25 volts will do as long as it is regulated and the series resistance in the integrating section is adjusted for full scale reading with contacts closed.

With a good 4 inch test meter, such as a Simpson 260, quite accurate bias readings can be taken. Figures are good to at least ½ percent bias – which is far more accurate than needed for ordinary RTTY work. Keyboards are usually set up to be within 1 or 2 percent bias. TD's may have a slight bias – about 2 percent – due to the finite thickness of the commutator brush as it sweeps over the segmented plated. Remember, teleprinter machines are designed to accept signals having a bias range of plus or minus 40 percent – as represented by a total range of 80 points on their range finders. If you can get your keying circuits lined up to 1 or 2 per cent bias, that is plenty good enough! That is hardly measurable on a range finder, and moreever there are other distortions that will and do intrude to affect settings – such as fortuitous and characteristic distortions – hence the reason for adequate range (also termed margin) designed into teleprinters.

Shown in the figure is an oscilloscope hookup if it is desired to check the keyed wave form for contact bounce. It is imperative that a DC coupled slow sweep 'scope be employed – not the commoner variety using AC coupling – in order to understand waveforms free from annoying low frequency effects. The Oscilloanalyzer has that desired DC coupled system, so why not use it? It works the same way, and together with the Bias Meter it is self-contained.

Concluding Remarks

The Oscilloanalyzer along with its Bias Meter section has been completely described. It is the *perfect* team-mate for the Mark III TU, and together they make RTTY operating a pleasant experience. The 'scope unit – especially the W6AEE + display – makes for a convenient tuning indicator. And the Bias Meter, itself, is just marvelous – as a matter of fact it was installed specifically to evaluate the Mark III system to prove its freedom from bias or other keyed distortions. The meter has extended its usefulness to wards checking incoming RTTY signals for bias as well as its adaptability for checking polar relays, etc, for distortions.

Here is another use for the Bias Meter – for precise balancing of the TU on noise input, as in preparation for copying DX RTTY signals. With the TU's Markhold control OUT, adjust the receiver's BFO until the meter reads midscale. This is a precise way of balancing noise contributions into the Mark and Space channels in the TU.

Will now take up a couple of odds and ends before closing this article. The added parts needed for the Mark III to adapt it for working with the Oscilloanalyzer unit consist of a silicon diode, a .01 mfd capacitor and a shunt resistor. The diode is only necessary if it is desired to disconnect the Bias Meter / 'Scope unit for use elsewhere yet keep the TU in operating condition. It serves to ground the end of the FSK adjusting potentiometer in case of an open circuit. It begins to conduct after 0.6 volt drop, so it is not a short circuit across the 250 millivolt 0-1 milliammeter. If the meter is left in the TU as a permanent part, then the diode and its RF bypassing capacitor are unnecessary. (See Fig. 2, the network diagram)

Also in the same diagram is a "shaping network" on the W6AEE + display setup. Its purpose is to narrow up the Space tone trace so it is not such a wide loop – by absorbing some of the excess 2975 cps tone from the Mark input in the 'scope circuit. The shaping network is not strictly necessary, but is nice to have. The 2 henry toroids are available in the Los Angeles area.

This concludes the paper on the Oscilloanalyzer unit. The TU has been modified in some minor details, which will be reported in a short paper to be published in the near future. And results of bias tests with this Mark III-B system will be presented, showing that the equipment is entirely free from distortions, in either transmit or receive modes. And it handles several machines in its seriesed Teleprinter Loop without any trouble.

73 de W6NRM

August 14, 1961

DX - RTTY

Bud Schultz - W6CG
5226 N. Willmonte Avenue,
Temple City, Calif.

Capistrano Beach, Calif.

Hi Gang:

Don't let that dateline fool you. I'm not down here at the Beach surveying a field day location — just trying to get in condition for the hectic Winter DX hassle!! As a DX locale this spot is strictly cloud nine stuff; if it only wasn't a TV fringe area!! That's life, I guess.

Big news of the month is the debut of I1RIF in the green button fraternity. News of this one comes from Walt, WØAJL, who had the pleasure of a QSO with Bruno on 14MCs at 1600 GMT on Sept. 24th. I1RIF was transmitting on FSK and receiving on SSB at the time. Here is a quote from a message copied by Walt and relayed to me here at this DX Utopia- "I started a few days ago with emission tests from an Olivettie Printer (Italian) into a German transmitter from Rhode and Schwarz and a Telerex six over six elements on 115 foot mast. Results was that I did receive only in a few hours of operation good reports from six countries —I will have ready end of next week a discriminator and then receive RTTY —I think that the fun of RTTY will continue and that I will be on almost every weekend somewhere around 14,095 — the usual times will be 1500/1800 and 2030/2300 GMT." Bruno is located in Milano and judging by the quantity and quality of his signals he should really create some king size pile-ups in the next couple of months. Since receiving the original report on Bruno from Walt four more reports have arrived here on I1RIF from Europe, South America and Australia so he is surely cutting a swath!!

Jerry, W6TPJ reports a four way QSO on 7040 with VK3KF, ZL1WB and ZK1BS. Hope you 7MC DX fans are monitoring 7040 these nights for the overseas lads. If you're not- you are missing a good bet! Eric, VK3KF, has his new transmitter in operation now and is set for all bands with a real fine signal. Rumor has it that he was bumped by a careless driver and was pretty well battered up but he still manages to push the buttons on his model 15. From G3GNR comes word that VK3KF and G3CQE managed a QSO of sorts on 14Mcs but conditions were very poor. Bill, ZK1BS, sends a reminder that he is still hurting for an African and a European contact to complete his WAC-RTTY. I imagine those lads wouldn't mind getting ZK1 on their country lists also, Bill.

Here are some of the choicer morsels from this month's mail bag: (actual quotes) — from G3CQE —"Pity old Henry missing that Asian RTTY QSO with KR6MF due to his being called for breakfast—as Beep would say "Phsaw"—any man who works the HF band should know that he can't work DX and eat outside the shack as well. Me- I usually equip myself for a DX session or a SS, by throwing the wife, kiddie, dog etc. into a specially built dungeon first of all. Next I drag two crates of beer into the shack, a few thousand cigarettes and a family size bottle of aspirin tablets. The inner man being fully catered to, I then switch the 10 KV supply onto all door handles and bell pushes and with a feeling of exhilaration at the thought of the next couple of days I slowly and deliberately slide home all 20 bolts on the shack door——all that then remains to be done is to get out my do-it-yourself black magic kit and spend a happy hour ordering up good band conditions. It's as simple as that, Bud—none of this namby pampy QRT-for-breakfast stuff for me. I should warn you, Bud, that you have gotta practice the black magic stuff a heck of a lot before you let it loose on a contest—the recent contest conditions were purely due to the incompetent meddling of unskilled labour."

From G3GNR: "Have just been reading 'RTTY' for September -vy fb- and was surprised to see that pictures of 'Lands End', hi —thanks for keeping my name in front of the boys - it really helps a lot although by now I guess that some of them will be saying: 'never hear this character - only keep seeing him in RTTY' — well, I hope to alter that before long because I have been pressing on with the grounded grid PA here and at last have it kicking."

From GM8FM: "Got a QSP from you via K3GIF about Edwins' (PY1KU) visit to Portugal but I'm afraid that I was not much help, for it was the North of Spain I visited- a few hundred miles from CT1. I expect that things there are very similar to those in Spain as far as licenses are concerned. As far as Spain is concerned it is practically impossible to get hold of RTTY gear except at new prices and very few people can afford these. —I know that I would never have considered it if it hadn't been for the junk that came on the market here."

Well, Gang, that just about fills up my allotted space for this monthj but by next month all the post mortems on the World-Wide SS should be on hand and offer some mighty juicy reading. Hi Drop me a card with your reactions to the SS and get in on the ground floor. Only restriction is that your remarks must pass Postal regulations regarding obscenity etc.

BCNU 73
Bud Schultz W6CG

Photo of Jan PAØFB
Courtesy of G3CQE

Gear in foto includes DX-100, Mohawk receiver, SX-43. Printer, teletype gear and several TV receivers do not appear in this foto. Jan has had remarkable success as one of the outstanding TV Dx'ers on the European Continent.

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