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.

WANTED: Model 128 motor (LMU) for cash. K3JSI, 235 Old Clairton Road, Clairton, Pa.

FOR SALE: Brand new model 14 typing reperf, holding magnets, sync motor, end of line indicator, with power supply and TD. Black wrinkle, with copy holder. W9DPY, 670 North Elizabeth, Lombard, Illinois.

FOR SALE: Model 15 page printer and table. Excellent condition. $75.00. W0WVK, Rt. 1, Iowa City, Iowa.

FOR SALE: FSC-250 terminal unit with 1275-2125 and 2975 filters. Used about one hour and in perfect condition. Never got on RTTY. $250.00. W0WVK, Rt. 1, Iowa City, Iowa.

FOR SALE: Brand new Teleprinter Signal Distortion Measuring Sets. Atlantic Research Corporation, Alexandria, Virginia.

FOR SALE: Fiber gears for model 14 TD # 80165 $2.00 each (60 Speed). K5ARN, 11520 Newberry, Dallas 29, Texas.

FOR SALE: Special!! 88 mhy Toroids, 5 for $3.75 postpaid. RTTY Parts. Please order by Teletype number. Gears for 15 and 14 TD $6.42. RA-87 $9.00. Reperfs $39.00. FGC-1 sections; power supply, $12.00, jack strap $6.00, Fuse strip $6.00, Terminal bay $5.00, remainder $10.00 section; cabinet $15.00. 11/16″ tape $8.00 case. Single copy $12.00 case. Send for free list FOB. K5KTX, 7031 Burkett, Houston 21, Texas.

FOR SALE: Polar relay sockets—255A type—used, 3 for $1.60 post paid. K6GOX, 4476 Van Ness Blvd., Fresno, California.

FOR SALE: Model 14 printer with keyboard in excellent condition. $35.00 plus shipping charges. Joseph DeStephanis, P.O. Box 1082, Fort Wayne, Indiana.

FOR SALE: Model 19, complete with table, power supply, automatic line feed and carriage return, sync motor, communications keyboard, less TD. In good shape, $125.00. Crating $10.00 extra. Drake 2-B. Like new, used less than ten hours. In factory carton $195.00. W7VCM/6, 407 Acacia Street, Bakersfield, California.

FOR SALE: Model 15 with keyboard, sync motor, 60 wpm gears and cover. $100.00. Also two working type-baskets for 15, $20.00 each. WA6NWC/7, 1413 North Columbus Blvd., Tucson, Arizona.

RTTY, INC.
372 Warren Way
Arcadia, California 91007
Return Postage Guaranteed

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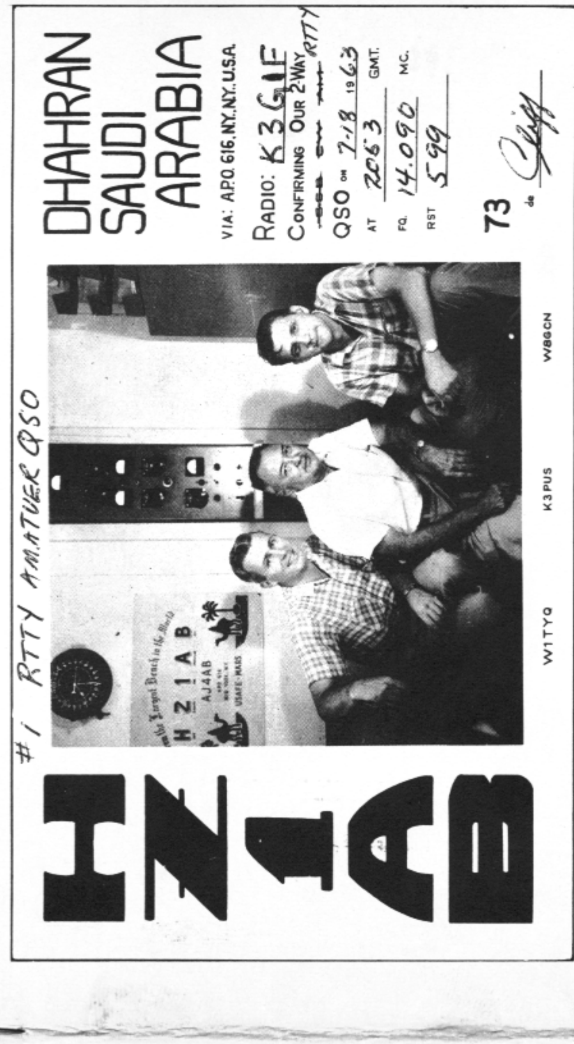
RTTY



ANYONE FOR AN ASIAN RTTY QSO?

RYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRY

NEWS OF AMATEUR RTTY

SEPTEMBER 1963
30 Cents
Vol. 11, No. 9

THIRD ANNUAL "WORLD-WIDE RTTY SWEEPSTAKES"

This is a competition between all stations throughout the world to determine their ability to exchange messages via two-way radio teleprinter.

1. Test period:
   0200GMT Oct. 18th to 0200GMT Oct. 20th 1963.
2. Bands:
   This test will be conducted in the 3.5, 7.0, 14.0, 21.0, and 28.0 MCS Amateur Bands.
3. Stations may not be contacted more than once on any one band. Additional contacts may be made with the same station if a different band is used. In the interest of encouraging multi-band DX operation, the same country may be claimed more than once if contacted on different bands. The same state worked on more than one band may be claimed only once.
4. Country Status:
   For the purpose of this contest KH6, KL7, and VO will be considered as separate countries in addition to the ARRL country list.
5. Stations will exchange messages consisting of:
   (A) Message Number.
   (B) Check (RST).
   (C) Time in GMT.
   (D) State or Foreign Country.
6. Points:
   (A) All two-way RTTY contacts by North and South American countries including KH6 will earn two points.
   (B) All two-way RTTY contacts by countries other than in (A) above will receive ten points.
   (C) All stations receive 200 points per country worked not including their own.
7. Scoring:
   (INCLUDES ALL STATIONS)
   (A) Two-way exchange points times total states worked.
   (B) Total country points per band times number of continents worked.
   (C) Add item (A) and (B) above. This is your total test score.
8. Sample score sheet:
   (A) Exchange points .... (196) times states .... (40) equals .... (7,840)
   (B) Country points .... (800) times continents .... (3) equals .... (2,400)
   (C) Add item (A) and (B) above .... (10,240) (Total Test Score)
9. Sample Log:

Station Log of .... W6TPJ .... (Call) Date .... 18, Oct. 1963 ....

SENT						RECEIVED			
NR	RST	TIME	BAND	STATION	NR	RST	TIME	STATE OR COUNTRY	EXCHANGE POINTS
1	589	0205	14	W6CG	2	589	0204	California	2
2	569	0230	14	VK3KF	6	579	0231	Australia	2
3	?	?	14	W6NRM	4	359	0240	–	0
4	599	0300	14	W2JAV	7	599	0259	New Jersey	2
5	579	0514	7	VK3KF	22	569	0514	Australia	2

Total Exchange Points (8) States (2) Countries (2) Continents (2)

Station Log of .... VK3KF .... (Call) Date .... 18, Oct. 1963 ....

SENT						RECEIVED			
NR	RST	TIME	BAND	STATION	NR	RST	TIME	STATE OR COUNTRY	EXCHANGE POINTS
1	599	0201	21	ZL3HJ	1	599	0202	New Zealand	10
2	589	0204	21	W6CG	1	569	0205	California	10
3	589	0210	21	W6NRM	3	569	0210	–	10
4	569	0220	14	W6AEE	2	569	0222	–	10
5	579	0224	14	VE7KX	9	589	0225	Canada	10

Total Exchange Points (50) States (1) Countries (3) Continents (2)

NOTE:
Log the state only once, the first time contacted. Log the country on each band contacted. (See sample log; paragraph 9)

10. Logs and score sheets should be received by RTTY, Inc., 372 West Warren Way, Arcadia, California by December 1, 1963 to qualify.

"WHAT IS THIS TWO-TONE DETECTOR?"

MARK III/IV MODIFICATION TO TWO-TONE RECEPTION

By R. H. Weitbrecht — W6NRM
1966 Woodside Road
Redwood City, California

Over a period of years, the Mark series of terminal units employed the classical FM limiter-discriminator circuit in their front ends. Likewise many amateur TU's have been of this design. Generally speaking, performance has been quite satisfactory, especially when multipath or selective fading is not severe. It is noteworthy that all commercial RTTY gear manufactured in America, to the writer's knowledge, continue to use the limiter-discriminator system.

As K6IBE has so well pointed out in his interesting paper[1], reception of RTTY signals mutilated by multipath introduces difficulties. Multipath causes independent fading of both components of the frequency-shift keyed signal to the extent that oftentimes the *mark* may fade out completely yet there is a strong *space* coming through; likewise vice versa. The classical limiter-discriminator arrangement detects the fade-caused absence of mark as a noise, and therefore keys the loop on that basis—obviously resulting in garble. Hence we must consider ways and means of detecting *either on-off keyed mark alone* or *on-off keyed space alone* as the case may be and thus recovering the intelligence from either to properly key the loop. Several designs leading to this have been worked out by various amateurs. The Gates TU is one partial approach[2]; this was mentioned by K6IBE. K6ZH/W6AEE had another design[3] that performed quite well some years ago; they called it "semi-diversity". W6OWP's "single filter TU" is another such approach[4]; in fact F. C. Bartlett had championed the cause of MAB (make-and-break) RTTY on the low frequencies in the early days of the amateur RTTY movement.

One point is here emphasized. *Mark is the complement of Space;* i.e., one is the mirror image of the other. Intelligence is available from either one alone; all the detector needs is the ability to recognize and take advantage of the redundancy inherent in these alternately keyed components—should one or other be missing temporarily due to propagation conditions. In effect this detector should be able to copy mark alone or space alone—automatically—as well as taking both. This concept leads to separate detection channels for both tones. This is called "Two-Tone" in contrast to the demodulation method using FM principles. The new method preserves the redundancy available in the two parallel channels of the FSK signal and provides the added benefit of *Frequency Diversity Reception.*

Over a period of many years studies and experiments have been made on alternative methods of receiving RTTY signals on the high frequency bands—mainly by workers in England. As far back as 1938 certain British engineers noted the selective fading characteristics of FSK signals on the HF bands and they proposed independent detection for both components—however due to the then-existing state-of-art there were some technical difficulties. It remained for H. B. Law and his co-workers to explore this in detail in a monumental series of articles in a British engineering journal[5]. During this period a special on-off tone detector of high flexibility to cope with varying tone amplitude due to QSB was described[6,7]. This circuit actually has two definite time-constants; one to follow the signal-intelligence, and the other to follow or "compensate" the fading pattern on the signal. Properly arranged, this detector would deliver an output voltage having definite positive-or-negative polarities as signalled by the on-or-off tone coming through its channel. Fading is compensated for by having one-half of the signal voltage subtracted (but not actually lost) by the "slide-back rectifier" portion of the system; this subtracted voltage is then used to deliver a reverse polarity indication to the loop keyer during absence of tone.

Such a detector is shown in Fig. 1. This should be self-explanatory; it shows the slide-back detector arranged for on-off tone reception. Signal diode D_1 rectifies and applies to load R_1C_1 a voltage output corresponding to the input tone signal. Slideback diode D_2 rectifies one-half of the input tone amplitude to charge up R_2C_2; as the figure indicates the output from this load is of one-half voltage and of reverse polarity to that from the first load; both loads being in series. R_1C_1 time-constant is short, 1 or 2 milliseconds at most,

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1 Limiterless Two-Tone TU, **RTTY,** June 1963
2 Gates TU, **RTTY,** October 1954
3 K6ZH/W6AEE TU, **RTTY,** May 1960
4 W6OWP TU, **RTTY,** March 1956

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5 Allnatt, Jones, Law, etc.: Six papers in **Proceedings of the Institution of Electrical Engineers,** Vol. 104, Part B, 14, March 1957
6 Beard and Wheeldon: A Comparison between Alternative HF Telegraph Systems, **Point-to-Point Telecommunications,** June 1960
7 Dames and Tibble: A Flexible System for Receiving F.S.K. Signals, **Electronic Engineering,** November 1962

so it follows faithfully the on-off tone transitions as indicated in the second waveform diagram. R_2C_2 time-constant, however, is considerably longer—of the order of 132 milliseconds—so we have as a result the third waveform diagram. Combining both outputs algebraically we obtain the result in the fourth waveform diagram. (Please note—the word limiter here refers to the clipping action in the loop keyer circuit; not audio amplitude limiting.) The final output, applied to the teleprinter loop, is shown last.

Fading on this single detector is compensated for by diode D_2 so that no matter how much fading there is, definite positive and negative swings are delivered corresponding to the tone on-off modulation. Effect of fading is merely on the positive going or negative going voltage levels with reference to the ground point. The "limiter" in Fig. 1 is the zero-axis crossing detector, whether of the saturated dc amplifier system (Mark III/IV) or of the Schmitt trigger of K6IBE's TU-D. Hence it does not matter how much swing or "on-off" levels are concerned as long as there are definite and equalized swings either side of this zero-axis to operate the loop keyer.

The above arrangement is an on-off detector system, for one tone coming through on the channel. Such a circuit enables make-break detection of an incoming RTTY signal tone and by itself has been found to be remarkably effective—using a simple circuit and with a minimum of parts. To receive both tones, two such detectors are arranged and polarized so that when both tones are coming in equally good, the two detected outputs reinforce each other to yield a doubled voltage swing to the loop keyer.

Time constant on R_2C_2 is a matter for argument; it will suffice to mention that the longest uninterrupted portion of a teleprinter character is 132 milliseconds, corresponding to the BLANK key. If we make this time constant value in our design, the slideback voltage will decay to 37% of full charge at the most during ordinary RTTY operations, and much of the time the slideback output will be almost fully charged—following faithfully the fading pattern in the incoming signal tone concerned. Fading rate varies, however, but is generally appreciably longer than the 132 millisecond value so that the fade-compensator diode-R_2C_2 load keeps track of the fade amplitude variations for most practical purposes. VOILA, we have a tone detector that will key a teleprinter loop properly even if the input tone level is smoothly and relatively slowly varied from say 1 volt to 100 volts while it is being keyed by the teleprinter intelligence.

Certainly, the single tone by itself is not going to give perfect reception; especially if the tone concerned should disappear entirely for as long as a few seconds. No tone for that period implies disappearance of the signal concerned; this will cause noise to appear in the detector output as shown in Fig. 1. However! We may have a good strong tone coming on the other side, capable of carrying the information on through the RTTY system. Hence we use two separate slideback detectors, each driven by each of the Mark and Space tones, placed algebraically opposite and in series with each other so that their outputs are combined to deliver the final keyed information to the loop keyer. This is the two-tone system, and as a result of this independent detection of either mark or space or both automatically combined, we have the added benefit of FREQUENCY DIVERSITY RECEPTION. This, with just one receiver, relying on the redundancy contained in the Mark and Space complements of the received FSK signal.

With such a modification, the Mark III/IV system was found to yield much better results on reception of multipath-affected signals—to the extent that error rate was as much as 1/20 or 1/30 that of conventional limiter-discriminator reception. As an example, during tests, the unmodified Mark III was used to feed into one teleprinter machine, whilst the two-tone Mark IV fed into another machine. Both TUs were driven off the Drake receiver's audio output. On certain distant signals, amateur and commercial in the 14-15 Mc/s range, the two-tone system delivered considerably superior copy. Over a ten minute period, 60 hits and quite a few aggravating false carriage returns with resulting overlines were observed on the limiter-discriminator copy. Only 2 or 3 hits and no false carrets on the two-tone copy. Quite a difference!

Conversion of Mark III/IV to Two-Tone

The modification is very easy to incorporate into existing Mark III/IV[8] terminal units, and should be applicable to any other discriminator-type TU's already in use. All that are needed is separation of the two tuned channels of the old discriminator so they, together with their respective signal diodes and loads, operate independently of each other; and the addition of "fade compensator" diodes and loads so they are driven by half-voltages available from the appropriate tuned circuits. The additional parts are easily accommodated inside the Vectorcan that houses the old discriminator.

Figure 2 details the changes needed to convert to two-tone. Here the separated Mark and Space channels are combined in series-aiding by tying together outputs from their respective fade compensators. Output from this entire system is obtained from two points alone, marked M and S. This series scheme for both channel detectors was chosen because it was desired to obtain a two-point connection which is readily accepted by the present input FSK sense reversing switch in the TU circuit. This incidentally keeps available signal output swing at a maximum into the zero-axis crossing detector (dc amplifier), and simplifies the modification procedure; all the work done is inside the plug in can.

The half-voltage is obtained by making use of the tied-together centertap connection of each toroid. It is recalled that the 88 mh toroid consists of two windings, having equal characteristics, wound on a core; and during tuneup these two windings are in series. Their tied-together ends provide a convenient half-voltage point for the fade-compensating diode-load circuit. In both channels, the signal diode portions are left as in the original discriminator circuit, with their 16K and 27K loads. The fade compensator time-constant RxC is made up using 100K resistors with 1.7 mfd 125-volt working tantalum capacitors, yielding a value of 170 milliseconds. The diodes are of the same silicon type as used in the signal diodes.

Further, the oscilloscope indicator had to be rewired to isolate the DC swings off the fade compensators from the CRT plates—which otherwise will affect the display so it becomes displaced downwards and to one side from center of screen. Shown are isolating networks, which can be of .001 mfd and ½ megohm size. The original Mark IV display is thus essentially unaffected and very useable for tuning in HF band signals. The neutral of the 'scope system is connected to the interconnecting loop between the fade compensators whilst the AC from the tones go to their respective deflecting plates from the hot-ends of the tuned toroids via the aforementioned dc isolating networks.

No other changes in this "ex-discriminator" portion are necessary for the present time. The input link turns remain the same as in original specifications; the rest of the circuit bearing on the plug in can's socket is unaffected.

Limiterless Operation during Two-Tone Reception

There is one important point that was not previously mentioned in this article. The two-tone method demands that all amplifiers feeding into the slideback detector system be operated in a linear mode, without any limiting. The limiter portion of an FM system is inherently very noisy on no-signal due to excess gain being applied in that stage. This will degrade the performnace of two-tone reception on a selective-fading signal because the redundancy feature is impaired due to the clipping or limiting imposed upon both tones as well as on any noise coming through. Both channels must be as independent of each other as possible; as if two independent sharply selective receivers were used.

---
8 Mark IV TU, RTTY, March 1963

Hence for this modification we can accomplish limiterless mode in one or other of several ways. The receiver audio gain is reduced to such a level that the input tone signal level is a few microwatts; this is easy to accomplish by referring to the tuning indicator. Turn the gain down until the mark-space traces just almost decreases; then you are operating on the edge of no-limiting. The receiver is set on AGC fast-attack slow-release (SSB mode) and its RF gain is advanced full on; the AGC serves to regulate the audio level into the TU.

For easier control on input level, the TU's input amplifier circuit can be modified by introducing negative feedback to reduce its excess gain so it now operates in a linear mode. The change is noted in Fig. 2 notes. Another modification is to simply disconnect the 10 mfd 25 volt capacitor from across the input 12AX7 triode cathode resistor; this makes it less sensitive and readily controllable as far as input level is concerned.

The bandpass filter in the Mark III/IV system continues to be useful. It defines the passband so that only the RTTY signal with its sidebands are admitted, and adjacent channel signals are rejected insofar as its characteristics (bandwidth) permits. Of course additional passband selectivity as the receiver may have in its i-f circuit is helpful and a necessity. We shall discuss this.

Receiver Adjustment and Operation with Two-Tone TU

The Drake 2B receiver, in constant use at W6NRM on the amateur RTTY circuits, continues to prove itself an extremely versatile and useful instrument. Two very desirable features so necessary for optimum RTTY working are incorporated in this receiver—adjustable passband tuning with 500 and 2100 cps bandwidths (6 db), and fast-attack slow-release automatic gain control.

The passband tuning is quite useful because it permits optimization of the received signal's channel so it aids in proper driving of the TU insofar as mark and space components are concerned. Furthermore, the ability to switch between 500 and 2100 cps bandwidths permits automatic operation of the two-tone TU on mark-only or space-only mode without any particular problems in case of QRM on one component or the other. Adjusting the passband tuning permits peaking on mark or space as required.

The AGC must be on fast-attack slow-release, obtained by setting switch to "SLOW AVC". This introduces just about the right amount of delay in release so that noise is effectively suppressed during monetary absences of either mark or space tone, yet the TU continues to turn out clean copy. Slow AVC is even more necessary when operating single-tone reception using the sharp selectivity position. Fast AVC is too fast; it permits noise to come right in as the receiver sensitivity increases in between signal elements.

The audio gain control is adjusted as explained previously to obtain no-limiting in the TU, while the RF gain is advanced full on. While it is true that this particular two-tone Mark IV must be operated in a nonlimiting mode for reception of RTTY signals affected by multipath, it can still be operated as a conventional FM system merely by advancing the receiver's gain control so it limits. This enables ready comparison between limiting and limiterless modes, and for some local circuits it may be more convenient to operate that way. The Mark IV's automatic mark hold system works quite well, although during two-tone reception its threshold control must be advanced a little more because of the somewhat reduced swing available from the modified ex-discriminator circuit—amounting to some 75 or 80 volts as against the 120 volts available from the straight discriminator. There is a loss, due to the addition of the resistors in the fade-compensators and compared to the resistances in the TU's low pass filter network; however there is plenty of signal swing available and the zero-axis crossing detector responds as usual to approximately 1-2 volt change about its zero axis. This compares with 75 volts swing—hence no particular problem.

Concluding Remarks

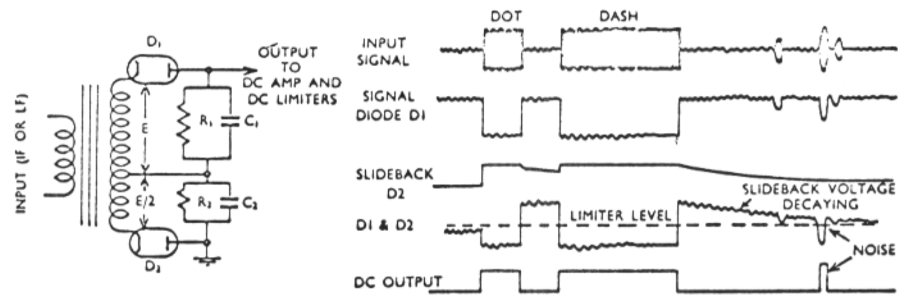
The slideback detector as diagrammed in Fig. 1 can be modified in several ways yet provide the necessary ratio-correcting function. The circuit in Fig. 2 works the same way; merely a rearrangement of coil driving taps. K6IBE's detector circuit, driven off audio transformers, is quite identical to Fig. 2; however there is a difference. The other circuit is a three-point output system using a pair of resistors for final combining into the low-pass filter-Schmitt trigger stage, while the Fig. 2 circuit is a two-point output arrangement. Hence K6IBE's diodes are reversed in polarity as indicated. There is a loss of dc swing in his circuit as a result of those two combining resistors, however his zero-axis crossing detector functions very adequately. One might say that the TU-D uses parallel combining of the mark and space dc outputs while the modified Mark IV uses series combining. No essential differences exist except for the increased loss of voltage in the former-mentioned circuit. All in all, these circuits should provide ideas for those who wish to experiment further with two-tone modifications or adaptations to their existing TU's.

A word about bias measurements will not be amiss. On a normal RTTY signal with little or no multipath, the two-tone keying has been found to be zero bias. Coil tapping and accuracy of half-voltages seem to be relatively uncritical; hence the two-tone detection system is relatively quick to install and requires practically no alignment as far as voltages are concerned. Furthermore, it was found that this new system is even less sensitive to effects of detuning on a received RTTY signal; in other words, hardly any bias is introduced should the signal drift to one side or the other. This is also true for variations in dc output total swing—with markhold switched to "out", the TU continues to operate on a signal that is hardly visible on the W6AEE display or that hardly wiggles on the flipping-line display. Normally the gain is set so that the equipment just barely limits; this permits use of automatic markhold.

However, on single tone reception, whether mark or space only, a certain amount of bias is introduced—amounting to some 5 to 7 percent spacing bias on space-only reception and (whoops) 10 to 15 percent marking bias on mark-only reception. Slight adjustment of coil tapping or control on half-voltage in one way or other does not seem to affect this condition. Inspection of the tone waveform as keyed on an oscilloscope shows differing rise-times and decay-times, and arbitrary setting of zero axis crossing at exact midpoint between full-tone and no-tone (75 volts and 0 volts respectively) shows definite bias when the alternate reversals from letter Y repeated are injected. This is a function of the response characteristic of the single-tuned toroid. In fact, H. B. Law has covered this point very well, and indicates requirement for special bandpass filter carefully designed for equalized rise-and-decay times for handling single on-off keyed tones into the detector system.

All in all, a well adjusted teleprinter tolerates moderate amounts of bias, and during operation this present Mark IV modification has showed definite improvement in reception of signals affected by multipath. There has been no occasion, so far as known, that the old FM method would be better than two-tone. On most signals, relatively steady or affected only by flat (Rayleigh) fading, both systems work about the same way — yielding perfect copy. Only on such difficult circuits as affected by multipath does the two-tone come into its own. Incidentally, multipath also may have timing differences introduced between mark space components amounting to 2 or 4 milliseconds; this is extremely bad on conventional FM reception method because the limiter receives both tones simultaneously during these critical periods—resulting in an indecisive output to the loop keyer. The limiterless mode neatly sidesteps this objection and introduces, as mentioned, the benefit of frequency diversity reception.

So—the whole field of terminal unit design is now wide open as a result of introduction of two-tone techniques. What shall we do about proper filters for equalized rise-and-



Slideback detector for AM system

Slideback detector waveforms

Fig. 1 (From article by Beard & Wheeldon, Point-to-Point Telecommunications June 1960)

decay times? Perhaps the pi-filters will work fine; this is being investigated as more TU's are built and evaluated. It appears that TU's can be simplified even more yet be considerably superior under all possible conditions than FM designed gear can ever hope to be when operated on the HF bands.

I would like to express my gratitude to W2PEE for evaluating this Mark IV modification and corroborating my findings. The experiments by K6IBE, W4MGT, K5AUM, W5HCS and others have indeed been a source of inspiration; likewise the continued interest in these techniques by W6AEE and WA9IBB (ex WB6ABF) should be mentioned.

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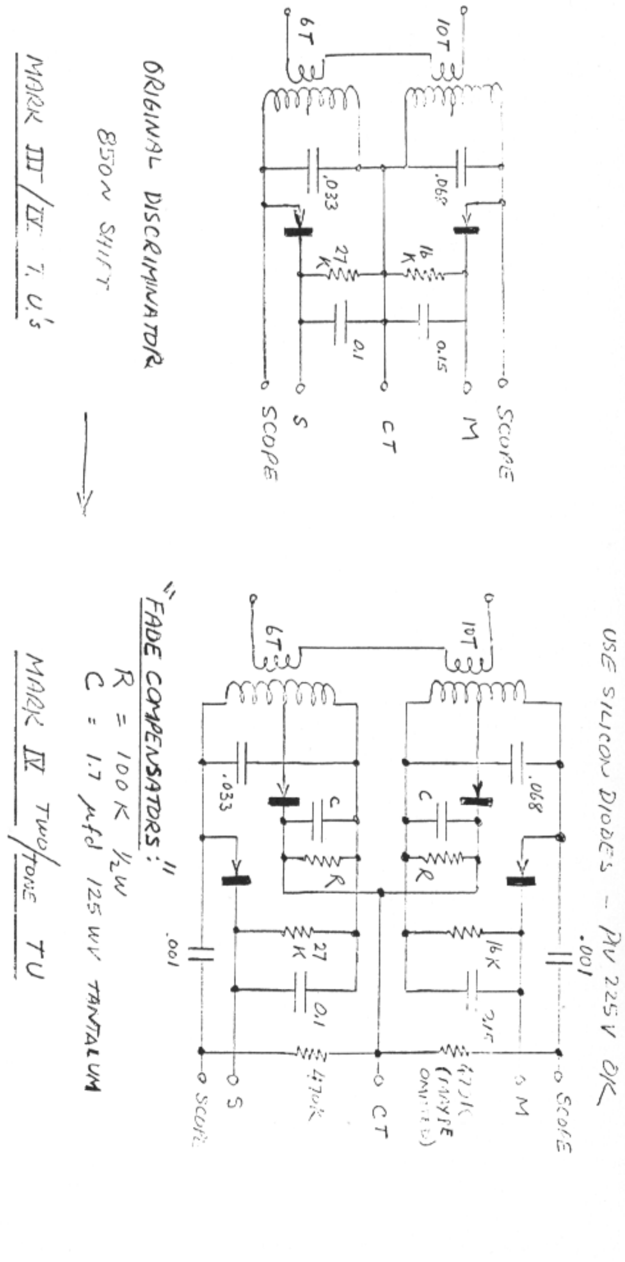
CHI-RTTY

Amateur radio teleprinter interest at high level in Chicago area the interest of radio amateurs in teleprinter communications by radio has risen to such an extent to cause the formation of a new club covering the South Side of Chicago and the Northwest part of Indiana. This new club, the "Illiana Teleprinter Society" joins with the first club of its type in Chicago, the "Chicago Area Teleprinter Society" catering to the needs of the radio amateur interested in this type of communication. Mr. W. S. Soich, W9HXW, is the president, with Fred Zimmerman, K9-WRH, Claude Ortega, W9SSJ, and Jack Stanton, W9PSP, secretary-treasurer, recording secretary, and educational chairman, in that order. Mr. Soich is heading the booth display of the Chicago Area Radio Club Council at the 19th annual National Electronics Conference to be held October 28, 29, and 30th at McCormick Place on the lakefront in Chicago. The Illiana Club will help operate the KWSSB and RTTY operating station, W9TEM, at the NEC, along with members of the Ladies Amateur Radio Klub.

The new Illiana Club meets on the second Tuesday of the month at Avalon Park, 1215 E. 83rd Street, Chicago, Illinois. All interested persons are invited to attend.



NOTES:

OPERATE TU IN LIMITERLESS CONDITION

(1) By reducing audio gain in receiver until scope pattern just decreases in amplitude. Or,

(2) Add .068 mfd and 47K 1/2 W resistor in series between 6AQ5 plate and 1/212AX7 cathode (top of 3K resistor; disconnect 10ufd 25v capacitor); this gives negative feedback and reduces gain.

FIGURE 2: MODIFICATION OF MARK IV SYSTEM TO TWO-TONE

R.H. WEITBRECHT - W6NRM
June 24, 1963

TWO-TONE, SHIFTS AND FILTERS

PART 1

Frank J. Gaude, K6IBE
12791 Hickory Branch Road
Santa Ana, California

The introduction of limiterless two-tone converters with slideback detectors into the ham fraternity has started a controversy that is sure to be long in dying away. This is fortunately a good situation as it has forced us all to re-examine our thinking or maybe just to get us to start thinking! Comparative tests by others have confirmed the claims made for the TU-D of the June, '63 RTTY article. Modifications, "improvements," tests are still going on. Letters have been received from all over the world, from Germany to South America to Australia, with helpful suggestions and criticism. The review of the two basic British articles by Jim Haynes in Aug. '63 RTTY should add new understanding to the subject.

Some comments seem in order concerning Mr. Haynes' review: (1) H. B. Law's original two-tone detector was not D.C. coupled and therefore was unusable with start-stop teleprinter operation. Law called the unit an "accessor."

(2) Two-tone converters can receive FSK transmissions of all shifts under selective fade conditions if the shift from mark to space is performed in a square wave manner . . . this is standard practice on the ham bands. The incompatibility arises when sine wave shifting is used with narrow shifts. The spectrums shown in Fig. 1 illustrate what the FM-FSK frequency components are really like. The plots are confirmed by laboratory tests and by calculations of the modulation equation, see Ref. 1 and 2.

The spectrums are for reversals, very similar to RY's and if we use a filter bandwidth at least the Baud rate (45 cps for 60 wpm) wide we will encounter no trouble with the FSK spectrum received with a two-tone AM detector. One may question not passing four of the major frequency components or even six as some have suggested, but a quick calculation will show that by rejecting all but the two highest amplitude tone signals, we reject more noise than we reject signal with a resultant increase in S/N ratio.

(3) The question of loss of space information during periods of reception of long marks is actually a third order effect rather than a second order one! Mr. Haynes admits there is some question as to the practical importance of this effect. Actually with the slideback detector, during long marking periods, the space fade voltage decays to the space channel noise level. Now when the mark goes away, the mark detector automatically assumes the space signal is equal to the mark level the instant before the mark went away. The mark signal amplitude was determining the noise level in the space channel by its control of the receiver's AGC during space absence. Even if the space signal does not arrive, the decision would be to space. If the space does arrive when the mark leaves, it will reinforce the mark-generated space pulse. The space fade or memory capacitor will charge to half the space signal amplitude value in a fraction of a pulse period (approximately 0.5 millisecond for the TU-D slideback) and be functioning normally long before one full character has been received.

It must be remembered the slideback is actually a D.C. coupled device and has normal S/N ratio when resting on a long mark. This is to be contrasted to the Gates' TU in which you loose 14 DB S/N ratio on a long mark (the 3.3 megohm D.C. leakage resistor driving the 820 K ohm grid load resistor). This accounts for the T-O-M-V characters that are made frequently when receiving just a steady mark. This total D.C. coupling action of the slideback detector is a main feature. Fig. 2 shows the effects of a single channel fading and the resultant bias in telegraph signal. It also shows the improvement that results in two-tone operation over make-break type of operation. When you are resting on mark the two-tone actually is a single channel type of operation and an uncompensated fade of only six DB. will cause a character to be typed when nothing should have been typed. The sliding threshold action of the slideback is the compensating element that permits good fade control.

Maybe Mr. Haynes' main point was to direct a development that would lead to an automatic "mark-hold" circuit. It would be effective when all signal was lost during fades into the noise—good! W6NRM's Mark Four can do this after two or three character periods. Of course, two or three error characters are printed before the "hold" circuit becomes operative. If it could be done on one character length or less we would have something. The use of AGC in the receiver certainly doesn't make the design problem any easier. May be the Mark Four can already do the job by careful mark-hold adjustment. In any event the "problem" is not peculiar to just two-tone as it exists also on regular limiter-discriminator units also. A large resistor connected between the mark fade capacitor and a further smoothing capacitor to ground which drives a tube relay circuit which shorts the keyer tube grid to ground will convert the TU-D to auto-mark hold.

Filters

It can be seen from the spectrums of Fig. 1 that only 45 cps bandwidth filters are required to pass the two major signal components, if the shift width matched the filter peak frequency separation. And if any drift in the receiver or the transmitter was taken out by the necessary receiver retuning to keep the signal in the band pass of the mark and space filters. Now 45 cps would require a perfectly tuned-in signal and would make it very difficult, indeed. Let us use 60 cps bandwidth filters that will permit off-tune up to 15 cps.

Now what about "odd" shifts used that don't exactly match the say, 850, 170, or the 85 cps separation we are using? Very few of us have measuring equipment that permits us to set our shift within the now required 20 cps or less. A shift of 800 or 875 now can no longer go thru the narrow band filters set for 850 cps shift.

A heterodyne method can be employed to place both tones in the center of the filters' bandpass. Voila! Figures 3 and 4 show two methods of doing this. One uses an audio beating technique and the other, an I.F. dual BFO technique. Neither approach requires any modification of the receiver. The TU-E has been performing for the author for the last two months with truly outstanding performance, both from a random noise and a CW/phone QRM rejection standpoint. The 60 cps bandwidth filters, as compared to the usual 250 cps units found in most converters, give a six DB. improvement in S/N ratio under all signal conditions. These narrow filters give fine performance under selective fade conditions with a two-tone type of converter but would give terrible results if used as a "comb" set-up ahead of the usual FM converter.

The best type of filter to use is the linear phase shift variety that has many sections. They give linear build up and decay times to the RTTY pulses. And the fall and rise times are more likely to be equal than with any other type of filter design. This fact makes the job of the slideback detector easier. The faster the rise and fall times the better. If the pulses were true square waves after filtering, the detector threshold setting would need to be only approximate to obtain low or no telegraph bias. But as the pulses become a smoothed wave approaching that of triangles, the imperfection of the detector two to one, signal to fade voltage ratio becomes more important. With a triangular wave a 10 percent amplitude error results in 10 percent mark or space telegraph bias on a direct proportionality basis. With a sine wave as a filtered received pulse train, things are not as bad and with a square wave everything is easy.

But to have square waves means we are allowing more noise to enter the detector than really necessary. So it would appear that a compromise between pulse shape and filter bandwidth would be in order. The exact values would depend on the HF band conditions and on the perfection of the sideback detector. The linear phase filters allow one to obtain the same pulse squareness as with classical units but they can do it with much less bandwidth. The filters designs of W3TUZ (Nov. '62 73 magazine) are fine if you design for a low drive source resistance and a high load resistance. K9BRL, of Electrocom, 1105 Ironwood Dr., South Bend 15, Ind., has some very interesting linear phase filters of four or five sections, plug-in, 600 OHM in and out resistance, 100 or 60 CPS bandwidth, which cost from 40 to 60 dollars depending on number of sections and center frequency. Some of the telegraph land-line filters come on the surplus market occasionally and are moderately good. They are usually 600 OHM impedance.

Shifts

The question always comes up as to the best shift to use when using the limiterless two—tone method of detection. By using a shift that is one-half the reciprocal of the path delay difference, we theoretically will have the mark signal at a maximum value when the space fades to a minimum value and vice versa. Selective fade is caused by one signal hop being longer in time than another and the resultant phase cancellation and reinforcement causes the actual fading of the tones. A one-bounce hop interfering with a two-bounce hop and so on.

An extensive survey has been made of the literature of path delay time differences for different radio routes. But much conflicting information has been obtained. It seems impossible to make a scientific conclusion as to the best shifts to use for two-tone operation at present (Ref. 3).

From observation on the ham bands it seems safe to assume that shifts greater than 170 CPS produce more selective fade on the average. A shift of 340 CPS has been suggested (by the author, naturally) as a best compromise single shift. However, it is now felt that no firm proposals be made until more operations have occurred at the 340, 170, and 85 CPS shifts, as compared to the present standard 850 CPS. We want to employ the lowest value of shift consistent with maximum selective fade so as to permit minimum spectrum occupancy and use of the 500 CPS BW I.F. filters that most receivers have these days and still have frequency diversity with the two tones at least fading in an independent

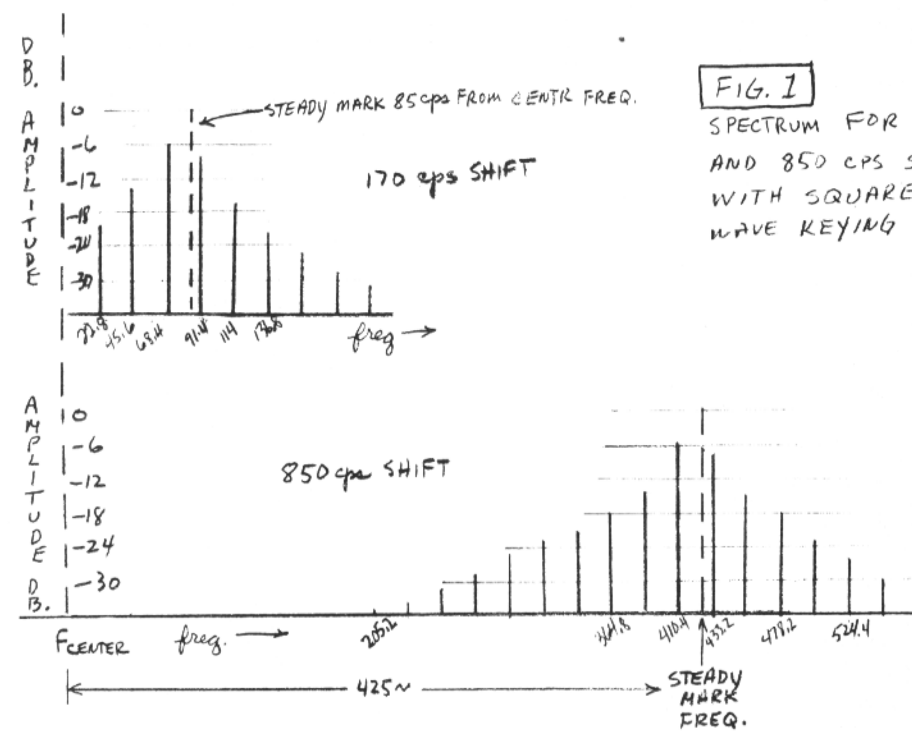


FIG. 1
SPECTRUM FOR 170 AND 850 CPS SHIFT WITH SQUARE WAVE KEYING

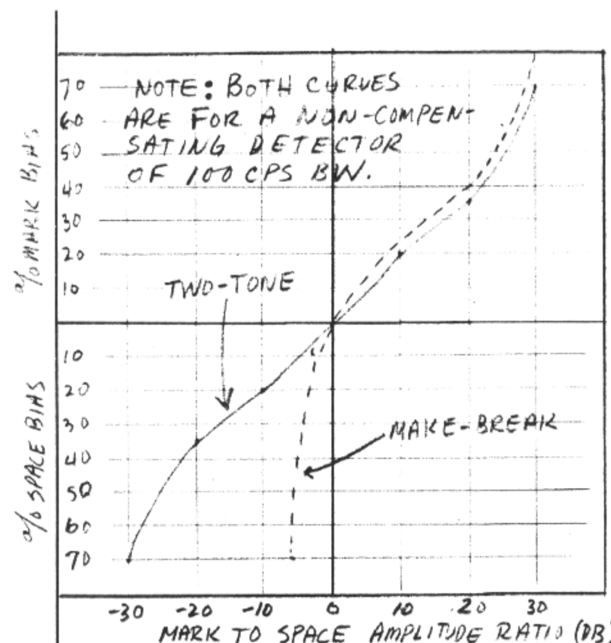


FIG. 2

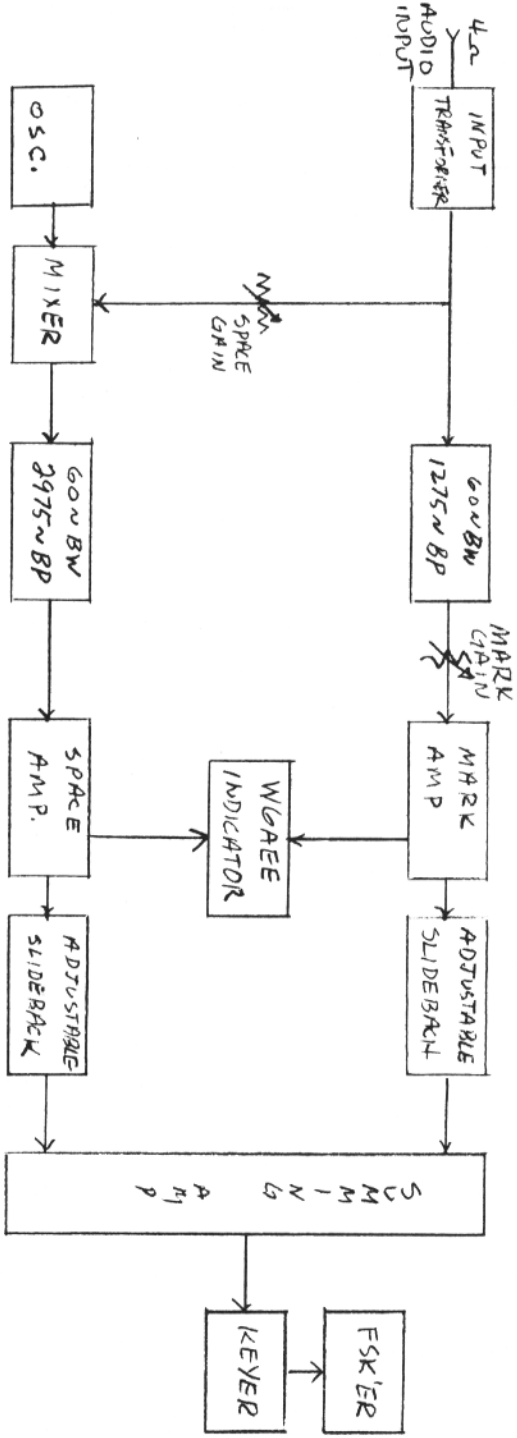


FIG 3 K6IBE MODEL TU-E CONVERTER

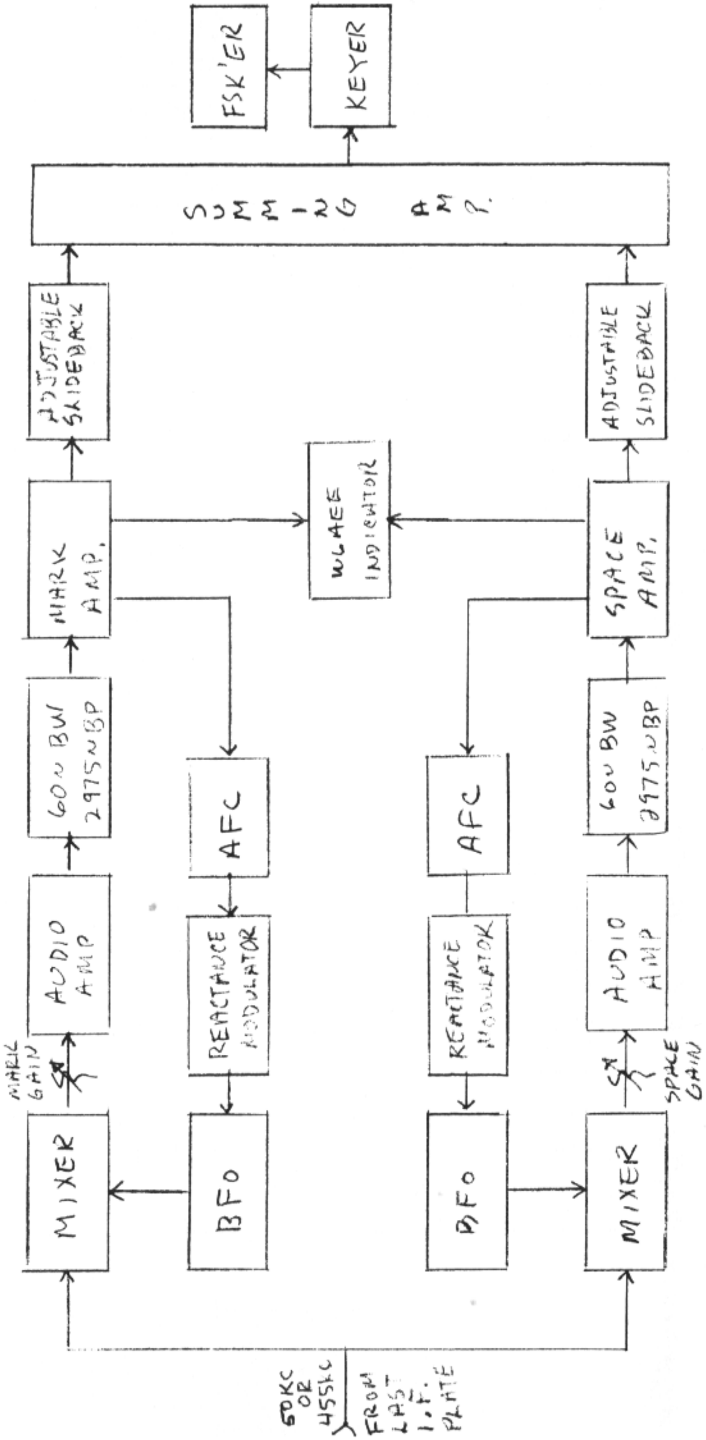


FIG 4 K6IBE MODEL TU-F CONVERTER

DX-RTTY

Bud Schultz, W6CG
5226 N. Willmonte Avenue
Temple City, California

Hi:

The old mail bag is a bit fatter this month which would seem to indicate that the "summer doldrums" are over and things are beginning to perk up again on the DX channels. By far the biggest news item to arrive at this desk in a long time is the debut of HZ1AB, (Saudi, Arabia) on RTTY. Ed, K3GIF, was his first RTTY QSO, followed by Kent, WB2CVN, and K8DKC in that order. Concerning this "first," K3GIF writes ". . . working him was no accident since Kent (WB2-CVN) had worked him on CW yesterday and made a sked for today at 2100 but I was around at 2030 and there he was testing with a TD tape . . . his shift is backwards but aren't so many these days." HZ1AB is manned by W1TYQ, K3PUS and W8GCN and apparently is a GI-MARS installation. Signals were S-9 both ways according to the info received here. HZ1AB was more than just a new country for Irv, K8DKC, —it completed his WAC-RTTY to make him No. 33 on this exclusive list.

Bill, G3CQE, writes that he is temporarily QRT due to moving his QTH to a place called Washford on the south side of the Bristol Channel in the County of Somerset. He says the new location is a straight shot across the Sea to W-Land. Bill "bombed" his old transmitter and when he returns it will be with the new SSB exciter, a "high power" linear and a TA-33 beam. This should be a big improvement over his Norwich QTH where his antenna situation was quite restricted. Hope you make it in time for the SS contest, Bill! Bill is looking for photos, technical articles and items of interest for his fine RTTY column in Short Wave Magazine. If any of you have anything that may be of use to him along these lines I will be pleased to forward them to Bill.

DL5LM is the latest entry from Germany. His name is Norm and he puts in a fine signal from Landstuhl. DL41A reports hearing good signals from the West Coast at 0500 GMT on 14 Mcs. DL4ZU is another newcomer to RTTY. He also lives in Landstuhl. HB9KU was on a Dxpedition to Andorra last month with CW and SSB. He is taking his RTTY exam shortly and should be back on FSK by the time this reaches the mail.

Ed. K3GIF, continues to keep his skeds with Horacio, LU1AA each week with excellent results but says his skeds with Henry, ZS1FD, continue to be very scratchy due to poor conditions. DL3IR reports working ZS6-UR recently so evidently Bill is still active although his usually reliable signals have been missing from the West Coast for some time.

The "down Under" boys continue to rock and sock into the States nearly every night from around 0300 GMT until the band folds up. Eric, VK3KF has his new shack completed and is in the process of moving his gear into the new "De-Luxe" quarters. He says all will be ship-shape for the Contest and he hopes to really run up a big score this year. Chuck, VK4RQ, is also quite consistent and is planning on installing a Model 19 as soon as it arrives from the States. At present Chuck is using a Creed tape printer until the 19 is available. Old reliable Bruce is having a banner year at ZL1WB. The last five or six months have been the most active that Bruce has ever had in his long and checkered career on the green keys. ZL1WB has become a regular "landmark" on 14.090 Mcs nearly every night around 0500 GMT. Alec, ZL3HJ/2, didn't even get settled in Christchurch before he received another promotion and is now busy looking for a QTH in Wellington!! He promises to be back on FSK just as soon as he can get situated for a few months in a permanent spot.

My original plan for this month's column called for a treatise on how to outscore your friends and fellow typers in the up-coming Third Annual World-Wide RTTY SS Contest, by the use of deception and intrigue. However, I got so carried away by all the news in the mail bag that there's no room left. It's probably just as well that I did run out of room because actually I ended up in fourteenth place the last time out! It would be like Patterson telling Sonny Liston how to win the Heavyweight Title. If you are a regular reader of my "deathless prose" you can readily see that I am the Cassius Clay type—I talk a good DX contest. Nevertheless—I still haven't had to resort to poetry but that could be next—so watch out!

In the meantime get out the rules and get familiar with 'em so you will be all set for next month's fracas. It promises to be the biggest blow-off since the eruption of Vesuvius. It's the number one event of the RTTY year. More on that in our next session.

Thanks for the use of the hall—BCNU—73

Bud, W6CG

HORSE TRADES

THREE NEW BOOKS FROM Howard W. Sams & Co.

Three new books were received by RTTY this month from Howard W. Sams Co., Dictionary of Electronics Communications TERMS. It is a complete and up-to-date definitions for communications terms applicable to two-way radio, broadcasting, microwave, amateur and CB radiocommunications systems, equipments, and principles. The second one, DICTIONARY of Modern ACRONYMS & ABBREVIATIONS by Milton Goldstein, Ph.D., which covers coined words and abbreviations commonly used in the language of our modern world. The third one, Volume 3 of the Broadcast Engineering Notebooks, entitled AM-FM Broadcast Maintenance by Harold E. Ennes, is a comprehensive treatment of maintenance procedures used in radio broadcasting, including preventive maintenance, proof-of-performance measurements, and maintenance procedures at both the studio and the transmitter. Prices on these are $3.95 for first, $4.95 for second, and $5.95 for the third, from your local radio dealer or Howard W. Sams Co., Indianapolis, Indiana.

manner. The ideal would be for the mark to be high when the space is low so that never a time occurs when both are low. The half-path-time-delay-difference shift can give us this utopia but it is left to be seen if we can make use of that theory. The HF propagation medium may not permit it.

A converter design that permits rapid shift from one frequency shift to another and one that also permits a large number of different shifts is the ideal test-bed for studying what shift is best for which path. The TU-E was designed for such a study. Just by dialing the TU shift knob you can receive any shift from 950 CPS to about 20 CPS. So it will certainly be used to aid in determination of the optimum shift for a given circuit, if one exist. To even find that one does not exist is knowledge that is useful to have. Part 2 of this series will go into the details of the TU-E Heterodyne TU with the schematic diagram and also pictures of the units that have been constructed. A report will be made on comparative tests with a limiter-discriminator of 250 CPS effective bandwidth. This should show us how much the 60 cps filters and the diversity effect of two-tone can do for us . . . Fig. 5 shows what a typical comparison between a limiter-discriminator TU and a two tone TU with the same bandwidths is like. The two-tone had 3 errors to the FM units' 49 or over 15 to 1 in favor of the two-tone unit. It is trusted that the 60 cps TU-E when compared to the 250 cps bandwidth FM unit will be even better. Time will tell.

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