THE JAPAN RADIO COMPANY'S NRD•515

A DXERS PERSPECTIVE

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INTRODUCTION

The Japan Radio NRD-515 was released in late 1979 but was replaced by the current model NRD-525 in 1986. The newer model indeed has more "bells and whistles" and from a marketing viewpoint, is clearly meant to provide a "high-end" alternative to the Icom R71-A and the more recent Kenwood R-5000. Even so, JRC took some cost-cutting shortcuts, such as in the area of stage isolation and overall mechanical ruggedness. Thus, from a serious DXer's standpoint, the 515 continues to have much to offer in terms of fundamental overall performance and probable long term durability. In fact, we find it difficult to believe JRC did not continue producing the 515, albeit with a few desirable improvements such as adding an IF notch.

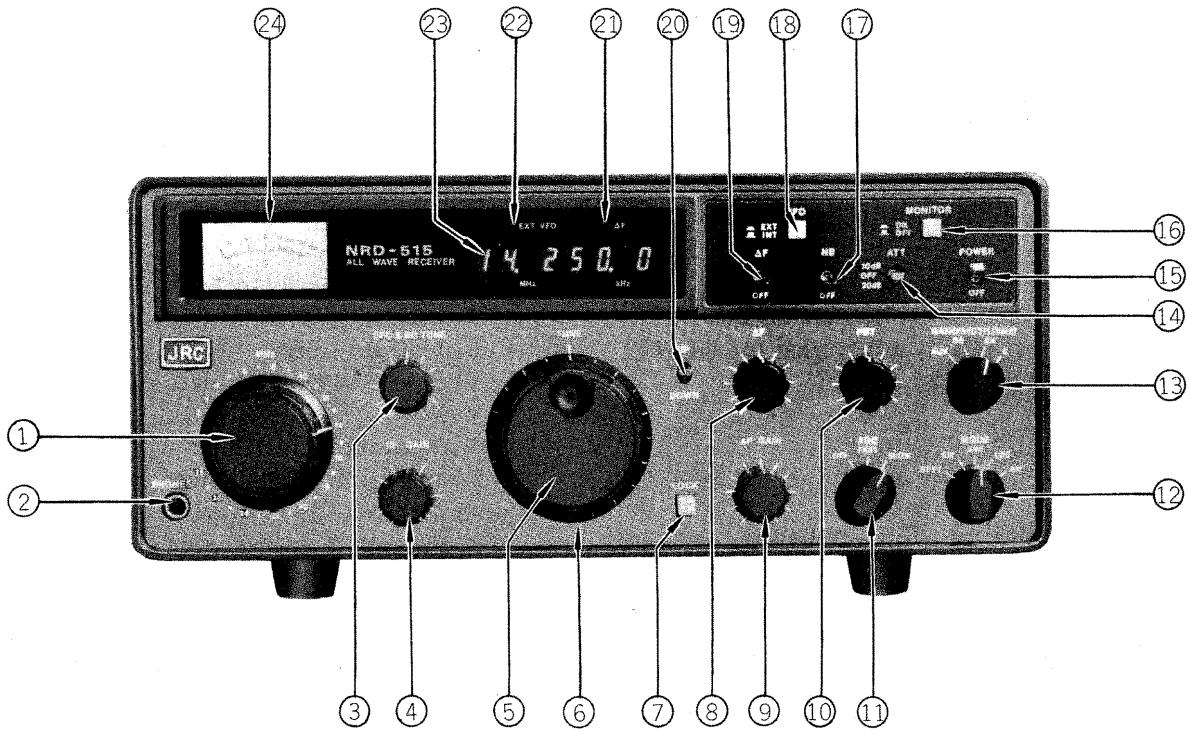
Kirk Allen has been using the 515 for the past 6 years, while Dave Clark has used his almost exclusively since it was acquired during the summer of '87 from Universal Shortwave during the NU/FTvention. We hope readers of 'Proceedings' will benefit from this collaborative user review. Based on our collective experience with this fine rig we commend it to anyone looking for a high-performance, semi-professional communications receiver, especially for SWBC DXing applications.

515's become available in the used equipment market from time-to-time and presently command a price in the order of $600-700 U.S. Because the receiver was built to very rugged and high quality standards, we feel it should continue to offer the purchaser many years of satisfactory performance.

The manufacturer's specifications and related technical data are readily available elsewhere so we won't dwell on those aspects here; references to performance specifications will be made primarily as they relate to our review and assessment. The approach will be to outline the functional aspects of the receiver, by describing the controls (see page 2) on the front panel.

Much of the text reflects our common viewpoint, but we have included our own particular comments [parenthetically identified as (KA) or (DC)] where appropriate. We would remind the reader that no two people will have an identical interpretation of the characteristics of any receiver. Individual techniques do vary so you will find that our opinions vary some too. We believe the result is a balanced perspective for those who are thinking of buying a 515.

FRONT PANEL CONTROLS - (see text for functional details)



MODEL NRD-515 ALL WAVE RECEIVER

TUNING FEATURES

The beauty of the 515, whether for casual listening or more serious DX, is the simplicity of tuning. Compared to certain other rigs such as the Drake R7 series and the Icom R70, tuning the 515 is a breeze. The only disadvantage of the 515 is that desired frequencies cannot be punched up directly unless you buy the optional Keypad Frequency Controller (Model # NCM-515).

Reception mode is selected using the five-position Mode Control (#12). Positions are provided for RTTY, CW, LSB, USB and AM. Luckily for the SWBC DXer, the tuned frequency is not changed during any combination of switching between AM and either sideband. The "automatic offset" employed in the R71-A is a disaster in that every mode change (typically between upper and lower sideband) forces you to retune the intended signal.

The MHz Control (#1), which utilizes a photo type rotary encoder for long term durability, tunes in twenty-nine 1 MHz steps to cover the 100 kHz to 30 MHz tuning range of the 515. Rapid slewing within any MHz segment may be achieved using the Up/Down Switch (#20). This allows you to tune approximately 100+ kHz per second. It is also possible to cross a MHz boundary using the Up/Down Switch (or the Main Tuning Control) and the correct frequency is still displayed without the need to adjust the MHz Control to the new implied range - a nice convenience.

Selection of the desired frequency within the MHz step is achieved with the kHz Main Tuning Control (#5). This control varies the frequency in 100 Hz steps at a rate of 10 kKz per full rotation. Due to the 100 Hz synthesizer steps, some "bagpiping" is noticable when tuning rapidly past signals in either SSB or CW mode although there is no audible effect in AM mode.

The kHz Main Tuning Control includes 500 Hz analog markers on its outer perimeter and there is also a push-button electrical Dial Lock (#7) to ensure, if desired, that the tuned frequency is not accidently disturbed. Note that the kHz tuning and all switching functions are electrically controlled - no mechanical functions to wear out - a real plus in terms of ensuring long term reliability.

Even more precise tuning is possible using the Delta Tune (^F) Control (#8) which is enabled using a simple On/Off switch (#19). When engaged, a green indicator light (#21) is illuminated. The Delta Tune is JRC's name for a fine-tuning (or RIT) function, which provides continuous (infinite) tuning +/- about 2 kHz relative to the 100 Hz frequency selected by the Main Tuning Control.

Using the Delta Tune is necessary when tuning an AM signal in

the Non-Synchronous Heterodyne Detection (NSHD) mode, commonly known as Exalted Carrier Selectable Sideband (ECSS). Tuning any signal which is actually being transmitted in USB or LSB will also require use of the Delta Tune. The tolerable degree of frequency deviation for natural audio in SSB is about 40-50 Hz; therefore, it is often necessary to be able to touch up the frequency, virtually down to the closest Hz, to attain in-phase audio when using the SSB mode. Note that fine tuning using the Delta Tune does not alter the displayed frequency although received frequency is in fact being changed. The digital display shows only 100 Hz changes when the Main Tuning Control is used.

The absence of a continuous tune RIT is an unfortunate omission on the Icom R71-A although it does tune smoothly in minimum 10 Hz synthesizer steps. You have to modify the R71-A to get RIT, whereas it was provided on Icom's predecessor R70 model.

The digital RIT in the newer NRD-525 also tunes in minimum 10 Hz synthesizer steps, so the continuous tune RIT in the 515 is advantageous although it does take a bit of getting used to. A steady hand and very slow adjustment is the order of the day for critical NSHD purposes.

At this point, we have a couple of observations on problems with the frequency display and Delta Tune Control, although these are likely alignment bug-a-boos.

In Kirk's case, the 100 Hz frequency display is not precise. To compensate, the Delta Tune must be switched on and adjusted to zero-beat a known accurate frequency (such as WWV). The station used as a tuning guide must be within several MHz of the desired band or the displayed frequency will not be totally accurate.

"Compared with Kirk's experience, my receiver (bearing a fairly late production serial number) provides on-the-nose frequency readout throughout the tuning range with the Delta Tune switched "off". With the Delta Tune switched "on", one would expect that correspondingly accurate frequency readout would be realized with the RIT control in the center position. With my receiver, however, one must zero-beat a known frequency such that the tune control will always be offset to about the 1:00 o'clock position.

"After the desired signal is tuned in (and frequency to the nearest 100 Hz has been determined), it is then often useful (especially in SSB mode) to tweak the RIT (in combination with the Passband Tuning Control) to achieve the best possible combination of audio delivery and interference rejection. This is inconvenient because care must be taken to re-set the Delta Tune to the "corrected" position to ensure accurate frequency readout when changing from one signal to another. I strongly suspect that in a properly adjusted receiver, correct frequency

readout with Delta Tune "off" should correspond with Delta Tune "on" and the Delta Tune control set to center position." (DC)

We have been advised by Steve Bohac (a fellow 515 owner) and John Tow that our problems likely relate to an oscillator (possibly the synthesizer's reference oscillator) being off-frequency due to component aging and that the RIT probably just needs an internal pot or trimmer adjustment. Thus, it seems likely that these anomolies can be corrected.

STABILITY

We are impressed with the frequency stability of the 515, an especially important consideration for NSHD purposes. The conservatively rated specification claims a drift of less than 50 Hz per hour after warm-up. "Let me tell you I have never (!) had to retune a signal once the receiver is warmed up, provided the received signal is stable. I've found a sufficient time for warm-up is 15 to 30 minutes at most. Even then, if retuning is required, it never amounts to much". (KA)

The 515 is head and shoulders above the Drake R7 series which has an annoying tendancy to drift, even after an extended warm-up. This is doubly unfortunate in that the Drake has a rear panel jack which enables it to be used as a frequency counter for an older "boat anchor" analog receiver.

SELECTIVITY

The Bandwidth Switch (#13) provides for 4 selectivity choices, which happily are selectable independent of reception mode to give you maximum flexibility. Two filters are standard equipment. The wide AM ceramic filter, nominally rated at 6 kHz, typically measures between 4.5 and 5 kHz at 6dB bandwidth and at about 10 kHz at 60dB. This is quite a good filter for general listening to reasonably strong signals (unless adjacent channel QRM is too severe) because it delivers very clean audio.

The other standard filter, nominally 2.4 kHz wide, is a mechanical filter of Japanese manufacture. Typical measurements for this filter are about 2.2 kHz at 6dB and about 4.5 kHz at 60dB. Due to the narrow "nose" and steep skirts typical of mechanical filters this filter delivers muddy audio in a narrow AM mode. However, it performs admirably for its intended purpose - SSB and NSHD reception.

The other two selectivity positions allows the user to select an optional .6 kHz CW filter, as well as a fourth "Auxiliary" position for an even narrower .3 kHz CW filter or some other substitute filter. "If you're a ham radio operator and you work CW, the 515 is superb when the optional narrow CW filter is

installed. I've put the 515 through rigorous tests and it always performs admirably. I've purposely tuned to the most congested portion of an amateur band in order to hear just how many CW stations I'm able to separate on one tuned frequency. With careful adjustment of the Passband Tuning control to vary the positioning of the signals within the passband, the 515 will successfully separate five and sometimes six different CW stations on or very near a specific frequency!" (KA)

Many purchasers chose a "compromise" ceramic or mechanical filter rated at 3-4 kHz for the Auxiliary position, thus achieving somewhat better selectivity than afforded by the 6 kHz filter along with better audio in AM mode than the 2.4 kHz filter delivers. Such filters were available from the three primary suppliers - Universal, Gilfer and Radio West.

"For serious DXing, I chose to purchase a mounting board from Universal which included the .6 kHz CW filter and more importantly for me, an auxiliary 1.8 kHz mechanical filter for narrow SSB/NSHD purposes. The 1.8 kHz filter is excellent for tight situations, an important consideration on the tropical bands. Recovered audio compares favorably to the 2.4 kHz filter, especially for digging out a voice ID.

Judicious use of the Passband Tuning control (#10) will also improve the intelligibility of a weak signal which is subject to QRM from a nearby carrier. It is often possible when using the narrow filter to adjust the PBT to push the interferring signal right off the side of the upper or lower sideband, whichever is applicable. In large measure, this combination helps to eliminate hets and sideband splatter which can pass through the wider 2.4 kHz filter." (DC)

USING THE PBT CONTROL

The Passband Tuning Control is the little jewel that allows one to substantially and many times completely eliminate adjacent channel interference. This will of course depend on the filter being employed and the relative strength & proximity of an interferring station. It is an essential feature for digging out difficult DX signals and thus is one of the most valuable features of the 515. The effectiveness of the passband tuning function is naturally complemented by the receiver's excellent dynamic range.

In the 515, the PBT operates only in CW and SSB/NSHD modes because simple diode detection is used for AM mode. About 1985, ESKAB made available a phase-locked AM detector on a printed circuit board which could be mounted inside the 515. However, it never really caught on and early models at least were reported to suffer from functional and quality control problems. "I have had the more recent PLAM board from ESKAB installed in my R71-A

and I must confess it works very well. Perhaps the earlier version for the 515 deserves further investigation. We would be interested in hearing from any reader who has installed the device in the 515." (DC)

While the Drake R7 series and the newer NRD-525 provide for PBT in AM mode, it could probably be argued that the same effect can be achieved by slightly off-tuning the receiver several hundred hertz to the sideband least subject to interference. This will also enhance high end audio recovery, albeit at the risk of introducing some audio distortion. But for serious DXing when the PBT control is more likely to be required, then one should really be using the SSB/NSHD mode anyway.

The principal purpose of the PBT Control is to position the carrier of the desired signal in the passband to minimize or eliminate interference. It also serves as a tone control. The centre audio position in LSB mode is about 10:30; about 1:30 in USB. Shifting the PBT control slightly away from the respective centre positions will enhance the recovery of the higher audio frequencies and help eliminate muddy lows, especially when a narrow filter is being employed. This is useful when trying to get the best intelligibility from a weak signal for that all-important voice ID. Also, in cases where RF interference is troublesome, tuning in SSB/NSHD mode and use of the PBT control will often give you a much-improved S/N ratio than with conventional AM mode. Well worth remembering!

A Practical Example:

The following is a tuning example which demonstrates both the operation and value of the PBT Control...

"Let us begin with the Mode Switch (#12) in LSB position, the filter selected is 2.4 kHz and the PBT Control is set initially in the center detent (12 o'clock) position. Tuning to 4875 kHz, we find Voice of Jinling coming through with a reasonably strong signal. The PBT Control is rotated counterclockwise to about the 10:30 position. The Delta Tune Control is slowly adjusted to the extent necessary to achieve the most natural-sounding audio.

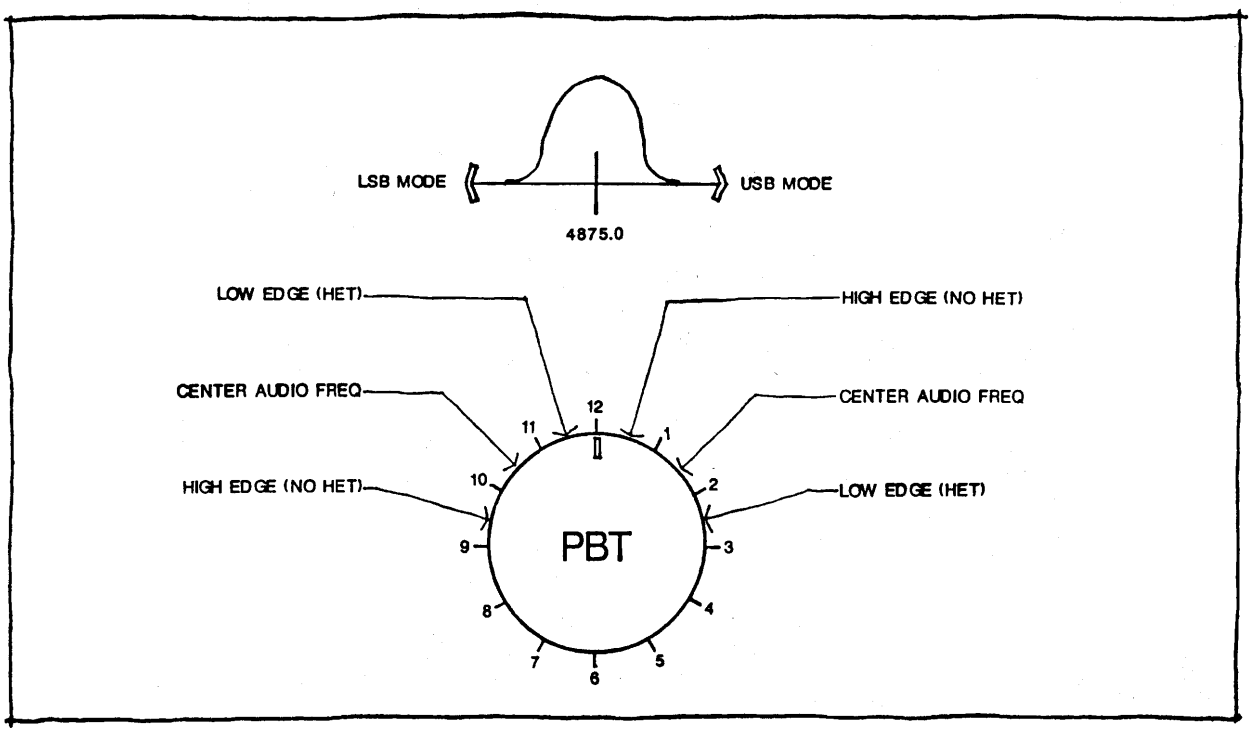
There is still a problem, however, as Jinling is suffering a moderate but distracting het because RRI, Sorong is coming in this morning at a fair level on 4874.7 kHz. The upper sideband component of the Sorong signal is showing within the passband of the 2.4 kHz filter. Let's resist the temptation to switch to USB and/or the narrower filter for a moment - this signal can possibly be cleaned up in LSB mode.

"The PBT Control is now to be adjusted in order to eliminate the het. Slowly adjust the PBT control further in a

counterclockwise position (say between 9:30 and 10:00 o'clock) such that the maximum possible audio (with more treble) is recovered but the het just disappears out of the passband. The 9:30 position is the approximate upper limit of the passband which permits reasonable audio recovery (not the lower limit as one might expect). This is confirmed by now adjusting the PBT Control to the 11:30 position which is the corresponding lower limit of the passband. Here the het becomes even more pronounced (a greater proportion of Sorong's signal is now making it within the defined passband). Now, what about using USB mode instead?

"If the RRI station drifts up even closer to nominal 4875 or is making it at signal strength relatively equal to Jinling, then it is quite likely the Chinese signal can be coaxed through with a cleaner result by switching to USB mode. Note that the PBT control is now to be positioned clockwise from centre position and the upper edge for audio recovery falls at about the 12:30 position (with no het being experienced). Even in USB mode, if the PBT control is rotated further clockwise towards the lower edge of the passband at about the 2:30 position, some het from Sorong may be noticed. The best position for maximum intelligibility and total absence of a het is likely to fall between 12:30 and 1:00 o'clock (keep in mind that you can use the PBT function as a form of tone control as well).

Perhaps the following diagram will clarify matters. In our tuning example using the 2.4 kHz selectivity position, it was possible to bring up the Voice of Jinling signal (4875 kHz) essentially clear of the adjacent Sorong QRM (4874.7 kHz) by setting the PBT control at the 9:30 position (in LSB mode) or the 12:30 position (in USB mode).



"Of course, if the two signals in our example are both coming through at better than average levels, and being separated only by two or three hundred hertz, it is probable that a tighter filter (in my case, the 1.8 kHz mechanical) will be required to narrow the passband to minimize, or possibly eliminate, those vestages of the interferring het getting in under the wider filter. Now, the tunable range of the PBT control tightens up: between approximately 10:00 and 11:00 in LSB mode and correspondingly, between about 1:00 and 2:00 o'clock in USB mode. This calls for even more careful adjustment to wring out the best possible combination of readable audio with minimum QRM. For purposes of our example, if the 1.8 kHz filter is required, USB mode with the PBT control set at about the 1:15 position would yield the cleanest signal from Jinling.

"Low and behold, however, we now find a powerful ute carrier on about 4876 has suddenly jumped on the air, severely chewing up the Jinling signal in USB. Clearly, we must revert to LSB in this case. However, the strength of the RRI signal inhibits our ability to bring in Jinling without some het QRM, even when the auxiliary narrow filter has been employed and the PBT control carefully adjusted (near the 10:15 position) for maximum interference rejection. Where is that IF notch when we need it most?" (DC)

DEFICIENCIES

(a) Absence of Notch Filter:

The preceding tuning example is a real life situation that has been selected to point out the most significant and glaring deficiency of the 515 for DXing, notably, the absence of a notch filter to clean up the signal in adverse situations to which we're all accustomed. One can do only so much with a narrow filter and adjustment of the PBT Control. We suggest that a reasonably good IF notch (with a notch depth of say 30 dB or more) would be just the ticket to clean up our Jinling signal by zapping that unwanted Sorong het!

Nonetheless, all is not lost. One solution comes in the form of an outboard audio notch filter, inserted between the audio output and your headphones or speaker. The Autek QF-1A (refer to review elsewhere in Proceedings) or one of the highly-acclaimed Datong models are examples of suitable units.

Another possibility is to take advantage of the 455 kHz IF out provided on the rear panel of the 515. A device like the old Hammarlund HC-10 Converter would provide even more selectivity flexibility, together with the all-important notching capability.

(b) Ineffective Noise Blanker:

We, like most owners of the 515, have found the switch-selectable Noise Blanker (control #17) to be a big disappointment. This is the only other operational deficiency of any consequence that we have found with the 515, at least from the perspective of a SWBC DXer. While of modest benefit in reducing the Soviet OTH "woodpecker" QRM, the noise blanker is of negligible use in muting pulse-type electrical hash, static or other forms of RF interference. This could be a concern to those living in a high-noise urban environment. Here again, an external audio filter and perhaps also an equalizer, such as the inexpensive Radio Shack 7-band unit, would be of some help.

OTHER ASPECTS

The Automatic Gain Control (#11) is used for varying the release time constant. In the "off" position, the gain is manually controlled by the RF Gain (Control #4). This is a useful feature at times for tuning very weak signals. Some receivers don't even provide for disengaging the AGC.

Manual control of the RF gain can also serve in lieu of the three-position (10 dB, 20 dB and "Off") Attenuator (control #14) in the presence of very strong signals. However, the signal-handling capabilities of the 515 are so good that desensitizing it by whatever means is seldom, if ever, required. The manual claims that cutting the RF gain manually can reduce the effects of adjacent channel QRM. We find no evidence that this is so; it merely depreciates the overall sensitivity of the receiver without cutting the level of QRM. There are better ways to tackle the matter of interference rejection which we have already dealt with at great length!

There is a slight but noticable loss of audio gain when the AGC is invoked. Also, audio variations are detectable in the AGC line when the receiver is operated in the AM mode. The FAST position is normally used for tuning in AM and NSHD modes, while the SLOW position is used primarily for "true" SSB tuning. "I don't recommend the slow setting for NSHD tuning because one will often lose much of the audio due to fading." (KA) "My experience is somewhat at variance with Kirk's: I like the slow position as it seems to do a good job of smoothing out the audio which at times is more choppy in fast mode, especially in the presence of QRM. To some extent we're probably talking personal listening preferences here." (DC)

The S-meter (#24) only operates when the AGC is on. However, it is non-linear & inaccurate and totally unresponsive to weak but quite readable signals. To the extent that anyone chose to use the S-meter readings to evaluate the relative strength of signals he would be very much in error. In that sense, the

poor S-meter circuitry must be considered a third deficiency, although not critical to the operation of the receiver.

The BFO/BC Tune (control #3) is used for two different functions. On the BCB, it functions as a preselector for peaking the signal and usually requires adjustment, even when frequency is changed by only 10 or 20 kHz. It only peaks signals between 600 kHz and 1599.9 kHz; however, it actually introduces a signal loss of 15 to 18 dB. This is a detriment to weak-signal, foreign reception but can be overcome with the use of a hi-Q loop. Signal strength below 600 kHz at the lower limits of the BCB is actually greater without the BC control engaged.

Outside the BCB range, the BFO function is used solely for adjusting the beat tone when tuning in the CW mode. However, one can achieve the same result by varying the Delta Tune and the location of the latter is much handier than having to reach to the far left of the front panel.

Overall BCB performance is pedestrian, especially for DXing the split-frequency Latins and TA's/TP's. Rejection is sub-par in the face of strong locals nearly every 10 kHz these days. Steve Bohac advises that this is caused by some signal leakage and coupling around the IF filters which degrades the receiver's interference rejection in the deep-skirt region. The manual indicates that the arrester diodes in the antenna input circuit can also be a source of inter-modulation distortion. Instructions are provided for their removal if the user so-desires.

Neither of us have experimented with the use of air-core or ferrite loops which are more appropriate than random wire antennas. "I have heard medium-wave stations from Japan, France and Monaco with the 515 connected to a Beverage antenna. Even so, the amount of adjacent channel interference was very high. I find its BCB performance to be rather disappointing." (KA) "I have yet to find a modern receiver (including Drake, Icom and JRC) that came anywhere close to providing the level of DX performance on the BCB that many of the better grade tube-type receivers are capable of. Enough said!" (DC)

The manual emphasizes the importance of connecting an Earth ground before turning the receiver on. This is important. We find that the receiver will "bite" if the ground isn't connected while the rig is on. Better to play it safe.

Remember also, the 515 does not contain an internal speaker - the optional NVA-515 or an equivalent 4 ohm communications speaker is required. Most DX'ers will probably employ headphones most of the time and the manual indicates that low impedance phones (4 to 8 ohms) are appropriate. Nevertheless, JRC makes a very high quality communications headphone set

(Model ST-3) having an impedance of 600 ohms "which I've found to work extremely well for DXing purposes. The padded earpieces and headband make for tireless extended use and I can certainly concur with the advertising copy which says that the excellent voice response makes for exceptional clarity." (DC)

Finally, there is the optional 96 channel memory unit (Model NDH-518). This supplanted a 24 channel unit made available when the receiver was first released. The memory unit (and the aforementioned frequency keypad) essentially "upgrade" the 515 to the level of technological convenience of more recent receivers.

"The memory unit is a great aid for quick scanning of stations on a given band, stations from a favored DX target area or for checking parallels. The memories are arranged in 4 banks of 24 channels. I use one bank to store all of the Tropical Band PNG's, while two other banks are primarily dedicated to Tropical Band Indonesians.

"When the memory mode is in use, all the essential receiver controls such as RIT and PBT (except for the MHz and Main Tuning controls) remain operative. Thus if necessary, it is possible to touch up the tuning of a station in a memory channel. The disadvantage, however, is that when one leaves that memory channel and subsequently returns, the signal remains tuned as it was when first-memorized. Therefore the memories are not truly tunable (as in the case of the R71-A); You must re-memorize whenever you want to "permanently" touch up a channel. This is a nuisance, especially during a hot DX opening when you want to instantly check parallels on the fly without having to re-adjust for critical tuning differences. It is troublesome to take the time to re-tune and re-enter individual stations into memory from scratch. Still, the memory unit is a very useful aid to the serious DXer." (DC)

ANOTHER PRACTICAL EXAMPLE

Let's fire up the rig at Kirk's QTH and see how it's done. Nothing hypothetical here, either. This is real life with the 515!

"A typical DX session here goes something like this. Having selected the intended frequency range with the MHz control, I turn the mode switch to LSB, situate the PBT control at about the 10:30 position and begin to slowly scan the desired frequency range, listening for intended targets and/or unusual heterodynes. Remember, I'm tuning in the NSHD (i.e., pseudo-SSB) mode so it's much easier to detect an unusual carrier than when scanning in the AM mode, which is something I never do.

"I've finally come across an interesting signal on 5014.9 kHz,

just below the powerful USSR station on 5015 kHz. Next, I zero beat the station on 5014.9 by slowly adjusting the Delta Tune control, thereby achieving natural-sounding audio. Now I'm ready to try eliminating the unwanted adjacent channel interference. I've selected my narrow 2.4 kHz (or optional) filter and adjust the PBT control (between about 9:30 and 11:30 positions) until the interference is at a minimum (near the 11:00 o'clock position in this case).

"With the big signal on 5015, the copy on 5014.9 is still pretty difficult but with the rejection capabilities of the 515, I'm finally able to identify the target station. I'm rewarded with the ID for 'Escuelas Radio Populares' which hadn't been on the air for years! Once again, the 515 has "done me proud", considering that it was able to separate a station that is a mere 100 Hz away from the much stronger interfering station! Sounds simple? Yes, relatively so. The simple tuning technique of the 515 is a joy." (KA)

IN CONCLUSION

"The 515 is discontinued but still alive and well! I can honestly say that I've never regretted having bought this radio. Using the 515 has been an almost religious experience at times. Little did I realize when I unboxed the receiver back in 1982 that it would be the beginning of a beautiful and hopefully very long relationship. I STILL can't believe that JRC discontinued production!!" (KA)

"Eloquent words from Kirk, whose sentiments I share, even though I have only owned the 515 for a year. But during that time my souped-up R71-A has practically sat on the shelf. That's strong testimony to the operating pleasure and superb results I have enjoyed! I am fortunate to own a number of classic boat anchors which I wouldn't part with. But the 515 ranks second in my book after the 1950's dandy Hammarlund SP-600 when it comes to a 'quiet' receiver, synthesizer and all! In my view, the 515 is THE vintage SWBC-DX receiver of the modern era." (DC)