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NOISE AND SIGNAL LEVELS ON THE BCB

Noise and Signal Levels on the BCB   Marc Bergman

One of the mysteries of DXing on the BCB is how much sensitivity is needed in a receiver. Several articles have been published discussing this subject as it relates to the level of noise found on the BCB. These articles show a considerable divergence of opinion not only concerning the level of noise but as to the type of noise that causes the most problems.

The area of signal strength has been covered by various authors. They have discussed this subject in terms of Input Intercept, IMD, and the performance of various mixer types.

I wanted to look at these subjects from a practical viewpoint. I felt we needed an accurate determination of the level of signals vs. noise on the BCB. These levels determine the sensitivity vs. strong signal handling needs in a receiver. Once these levels have been established, we can look at the receiver choices available. I set out to run a series of experiments to determine the levels of signal and noise on the BCB.

Test Equipment

Controller : HP-85 Computer

Receiver : HP-3586C Selective Level Voltmeter

Bandwidth - 3.1KHz at -6dB - 3.7KHz at -60dB

Input Impedance - 50 ohms

Scan Frequencies - 400KHz to 1600KHz

Antenna : 100' longwire laid due north

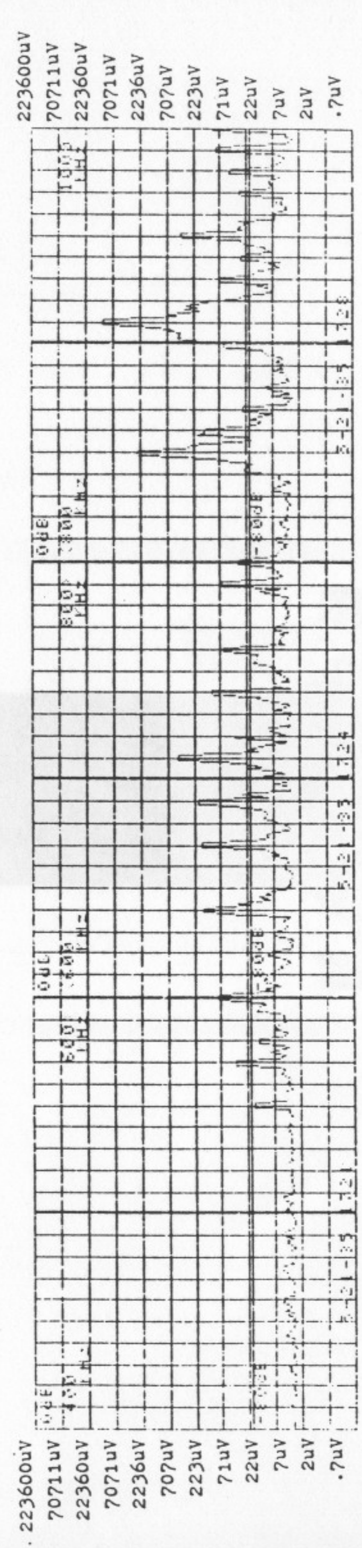
I chose the equipment settings and antenna to closely approximate the average DX'ers reception condition. The HP-3586C is actually a dual conversion receiver. It tunes from 50Hz to 32.5MHz. It's microprocessor controlled. It measures the signal strength at the input jack, in this case from the antenna, and displays this value on it's digital level display. It's accurate to +- .2 dBm. I chose a long wire antenna. This type of antenna should give a worse case condition in determining noise levels but should be close in value to the average pickup from a loop antenna. I made no attempt to match the input impedance or tune the antenna.

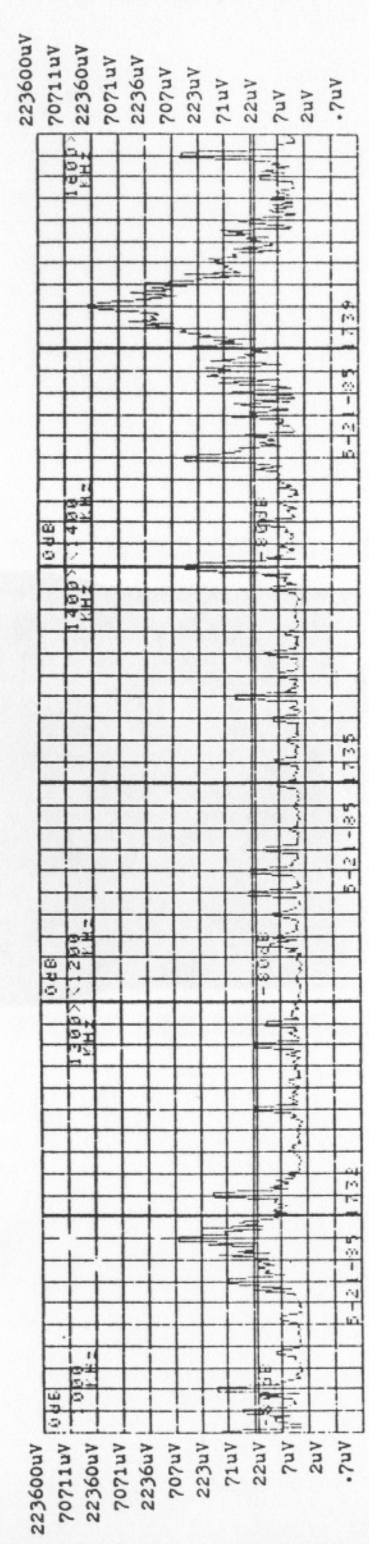
I ran two tests. The first was run in the late afternoon. The second was run just after sundown. The date was May 21,1985.

The graphs show us a picture of the actual reception conditions. The graphs are divided horizontally in 10KHz divisions. They are divided vertically in 10dBm steps. The measurement range is from 0dBm to -120dBm. The first graph runs from 400KHz to 1000KHz. The second graph runs from 1000KHz to 1600KHz.

The first test shows the noise level consistantly at about -95dBm to 97dBm. This corresponse to 4uV to 3.1uV. The noise level didn't vary much. Stations below -80dBm were still readable. 7 to 12uV is the minimum usable sensitivity needed. The stong signals measured:

Freq	Station	Power	Distance	Signal Level	
710KHz	KMPC	5000W	60Miles	-53dBm	501uV
850KHz	KMDY	5000W	20Miles	-39dBm	2509uV
910KHz	KOXR	5000W	8Miles	-26dBm	11207uV
950KHz	XEGM	5000W	150Miles	-55dBm	398uV
1090KHz	XEPRS	50000W	167Miles	-51dBm	630uV
1400KHz	KAAP	1000W	12Miles	-56dBm	354uV
1450KHz	KVEN	1000W	12Miles	-55dBm	398uV
1520KHz	KTRO	50000W	6Miles	18dBm	28150uV
1590KHz	KOGO	5000W	12Miles	-53dBm	501uV





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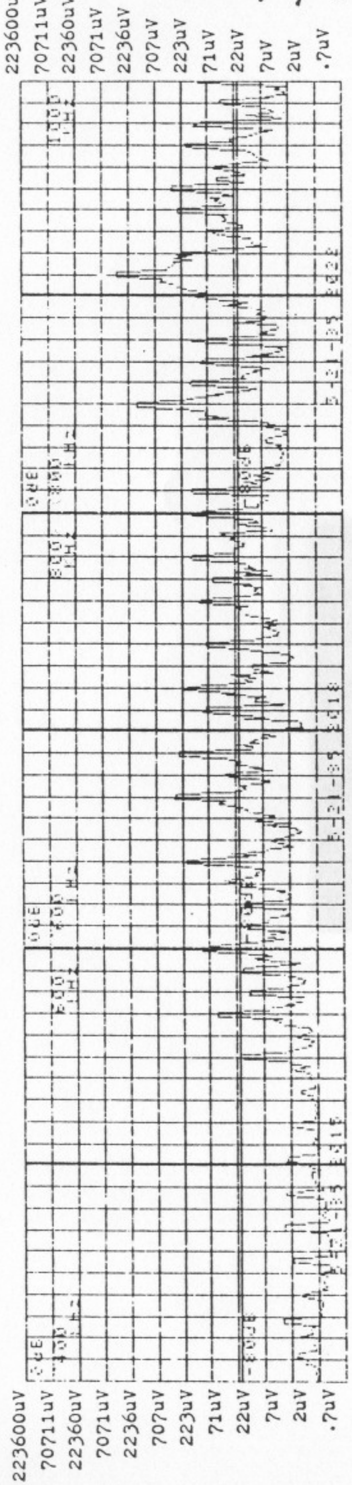

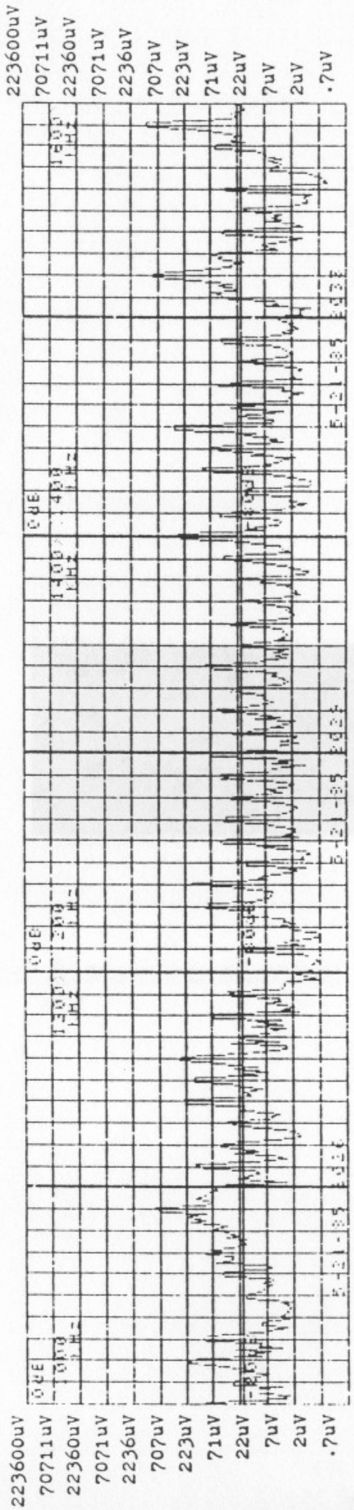

The second test, done just after sundown, shows the noise level at about 108dBm to 113dBm. The noise level had dropped suddenly as the sun was going down. This noise level corresponse to .89uV to .5uV. Several microvolts of sensitivity is the minimum needed and can only be used on several frequencies. The graphs show a very crowded spectrum. The strong signals measured:

Freq	Station	Power	Distance	Signal Level	
670KHz	KWNK	1000W	20Miles	-57dBm	316uV
690KHz	XETRA	50000W	150Miles	-59dBm	251uV
850KHz	KMDY	5000W	20Miles	-43dBm	1583uV
910KHz	KOXR	5000W	8Miles	-36dBm	3544uV
940KHz	KFRE	50000W	186Miles	-58dBm	282uV
950KHz	XEGM	5000W	150Miles	-56dBm	354uV
1090KHz	XEPRS	50000W	167Miles	-48KHz	890uV
1160KHz	KSL	50000W	600Miles	-57dBm	316uV
1400KHz	KAAP	1000W	12Miles	-57dBm	316uV
1450KHz	KVEN	1000W	12Miles	-56dBm	354uV
1520KHz	KTRO	1000W	6Miles	-48dBm	890uV
1590KHz	KOGO	5000W	12Miles	-45dBm	1257uV

The results of these tests show a lower noise level than what has generally been thought. I believe further tests will show both higher and lower levels of noise than what I measured. I believe a figure of just under 1 microvolt sensitivity will be the minimum needed for a receiver on the BCB. But more tests will be needed to determine this figure. The measurements I made also show us the level of signal strength we can expect from local stations. Note that the difference in levels is nearly 80dBm. Now we can use these values to determine how this will affect our choice of receivers.

I have included a list of receivers tested by QST Magazine. You can see that the Noise Floor for all receivers is better than what we need. What we need to determine is how much of this sensitivity we can use. We need to define several terms:

Noise Floor - The minimum discernable signal that can be detected in a receiver. To test for the noise floor adjust an input signal, from a signal generator to the receiver, until the level is reached where the audio output level increases by 3dB above the point measured with no input signal.

Sensitivity - Generally this is the level in microvolts required for a signal to noise ratio of 10dB.

Two Tone IMD - The measure of the range of signals which produce no spurious responses within the receiver. This is found using the following formula.

2Tone IMD= 2/3(Input Intercept - Noise Floor)

The spurious responses that we are concerned with are the third-order IMD products.

Third-Order IMD - If we input two frequencies into a receiver, say 1070KHz and 1090KHz, the third-order IMD products will appear at 1050KHz and 1110KHz. The figure of merit for this test is called Input Intercept.

Input Intercept - This is the theoretical point where the third-order IMD level equals the level of input signal. The higher this figure the better.

It should be noted that these tests were run on the 80meter band. The noise floor on the BCB is generally less due to the fact that the preamp is generally not in circuit and a wider filter is used. But sensitivity is not our problem on the BCB. Strong signal handling is the specification that most effects our ability to use all the sensitivity we have available.

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This list was derived from tests run by QST Magazine.

Company	Model #	Noise Fig	IMD	Input INt
Collins	KWM-380	-131dBm	NL	NL
Drake	TR-7	-133dBm	84dBm	-7dBm
Heath	SS-9000	-138dBm	89dBm	-4.5dBm
Heath	SW-7800	-131dBm	74dBm	-20dBm
ICOM	IC-720A	-132dBm	97dBm	+13.5dBm
ICOM	IC-730	-140dBm -134dBm	NL 95dBm	NL +6.5dBm ?
ICOM	IC-740	-141dBm -133dBm	94dBm 95dBm	-.5dBm +9.5dBm
ICOM	IC-751	-142dBm -134dBm	91dBm 93dBm	-5.5dBm +5.5dBm
ICOM	IC-R70	-130dBm	94dBm	+11dBm
J R C	NRD-515	-136dBm	90dBm	-1dBm *
Kenwood	R-1000	-133dBm	76dBm	-19dBm *
Kenwood	TS-120S	-139dBm	75dBm	-26.5dBm
Kenwood	TS-130S	-138dBm	79dBm	-19.5dBm
Kenwood	TS-180S	-139dBm	82dBm	-16dBm
Kenwood	TS-430S	-138dBm	94.5dBm	+2.25dBm ?
Kenwood	TS-530S	-135dBm	88dBm	-3dBm*
Kenwood	TS-830S	-136dBm	83dBm	-11.5dBm
McKay Dymek	DR 33C	-137dBm	90dBm	-2dBm
Swan	Astro150	-127dBm	84dBm	-1dBm
TenTec	Argosy	-133dBm	64dBm	-37dBm *
TenTec	Omni D	-128dBm	94dBm	+13dBm
Yaesu	FRG-7700	-126dBm	75dBm	-13.5dBm
Yaesu	FT ONE	-133dBm	NL	NL
Yaesu	FT-77	-139.5dBm	92dBm	-1.5dBm
Yaesu	FT-102	-127dBm	96.5dBm	+18dBm
Yaesu	FT-707	-126dBm	76dBm	-12dBm
Yaesu	FT-757GX	-140dBm -121dBm	90dBm 91dBm	-5dBm +15.5dBm
Yaesu	FT-980	-137dBm	NL	NL

? Measured figure. This does not correspond to mathematical figure.
* Not measure. This is derived from formula.

What I would like to do now is to conduct an imaginary test of two receivers using the same values of Noise Floor but different values of Input Intercept. I used values that are representative of typical receivers in use by BCB DX'ers. I want to use a figure of -120dBm as our low noise point. I think tests later this year will show this to be true. I've tried to present this example in a form that you can relate with your own experiences.

Let's take two imaginary receivers and see how these terms relate to performance.

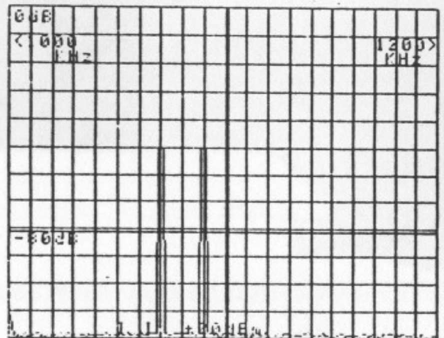
	Noise Floor	2Tone IMD	Input Intercept
Receiver #1	-130dBm	93dBm	+10dBm
Receiver #2	-130dBm	73dBm	-20dBm

The measured noise floors of these receivers is the same. The first receiver has by far the better strong signal handling capabilities. Let's see how this affects reception.

It's early Monday morning. You have both receivers tuned to 1110KHz. KRLA is off the air. There's a weak station from Columbia HJEW at -110dBm. Receiver #2 is sensitive enough to pick it up. But Receiver #2 will also have third-order IMD products from 1070KHz and 1090KHz on 1050KHz and 1110KHz. If XEPRS is at -50dBm then the distortion products will also be -110dBm. On Receiver #1 the signal at 1110KHz will also be picked up but the distortion products will be well below the noise level. Guess which receiver has more usable sensitivity?

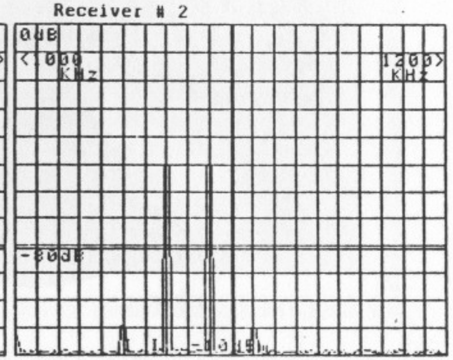
This graph shows the internal distortion products in two receivers with input signals on 1070KHz and 1090KHz at -50dBm.

Receiver # 1



Distortion products below noise.

Receiver # 2



Distortion products on 1050KHz and 1110KHZ at -110dBm.

To determine what is the signal level that will cause IMD we will use the figures for NF + Two Tone IMD, Receiver #1 -130dBM + 93dBm = -37dBm. This means that this receiver will be free of these spurious distortion products with an input signal of up to -37dBm. There are only several signals received that exceed this figure.

Receiver #2 NF + IMD, this gives us -130dBm + 73dBm = -57dBm. Receiver #2 is free of these distortion products with an input signal of up to -57dBm. There are a number of stations that exceed this level.

One way to help Receiver #2 is to use 10dB of attenuation. This changes the NF to -120dBm, which is still sensitive enough to pick up the station on 1110KHz, and changes the Input Intercept to -10dBm. This means our IMD is still -120dBm -(-10dBm)= 73dBm. -120dBm + 73dBm = -47dBm. This means our third-order IMD products will be -130dBm down or in the noise. We should just barely be able to receive the signal from Columbia. This is some help but still does not match the performance of Receiver #1.

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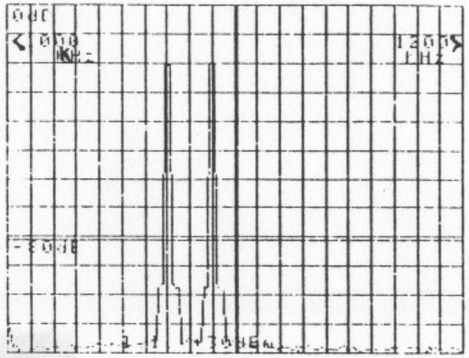
The following is a list showing the relative merits of receivers having different Input Intercepts. Included is the level of the 3rd Order IMD developed inside the receiver at different input signal levels. Also included are graphs that shows signals at 1070KHz and 1090KHz. These signals are -20dBm in level. They represent two 50000W local stations. The graphs show a representation of the resulting distortion products developed in receivers with different Input Intercepts. The IMD Products will be at 1050KHz and 1110KHz.

Input Intercept +30dBm

Input signal	3rd Order IMD
+30dBm	+30dBm
+20dBm	+ 0dBm
+10dBm	-30dBm
+ 0dBm	-60dBm
-10dBm	-90dBm
-20dBm	-120dBm
-30dBm	-150dBm

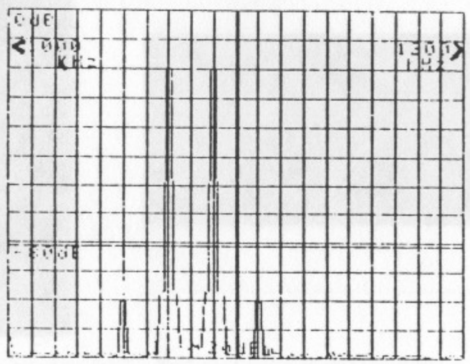
The graph shows the input signals at 1070KHz and 1090KHz. The distortion products are -120dBm down. This is right at the minimum noise level. This Input Intercept is State of the Art.



Input Intercept +20dBm

Input Signal	3rd Order IMD
+20dBm	+20dBm
+10dBm	-10dBm
0dBm	-40dBm
-10dBm	-70dBm
-20dBm	-100dBm
-30dBm	-130dBm

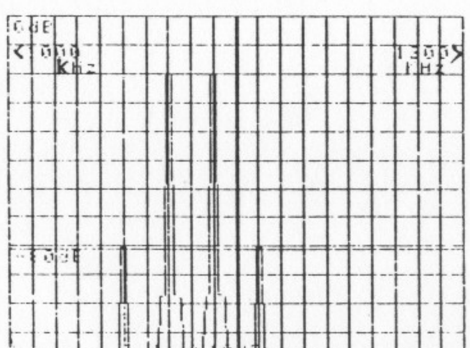
This graph shows the results with an Input Intercept of +20dBm. The distortion products are -100dBm down. The ICOM R-71A is spec'ed at this value.



Input Intercept +10dBm

Input Signal	3rd Order IMD
+10dBm	+10dBm
0dBm	-20dBm
-10dBm	-50dBm
-20dBm	-80dBm
-30dBm	-110dBm
-40dBm	-140dBm

This graph shows the results with an Input Intercept of +10dBm. The distortion products are -80dBm down. The ICOM R-70 measures near this value.

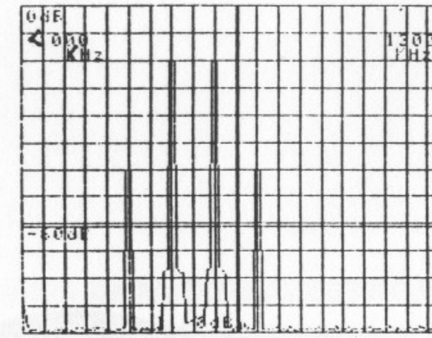


This is a continuation of the list. Receivers with these values of Input Intercepts would not be known for their strong signal handling. However good DX is still possible with these receivers.

Input Intercept 0dBm

Input signal	3rd Order IMD
0dBm	0dBm
-10dBm	-30dBm
-20dBm	-60dBm
-30dBm	-90dBm
-40dBm	-120dBm
-50dBm	-150dBm

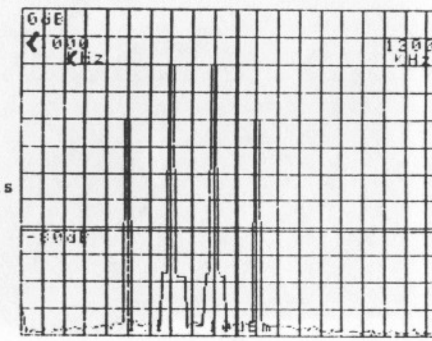
. This graph shows the results with an Input Intercept of 0dBm. The JRC NRD-515 and the R-390A measure close to this value.



Input Intercept -10dBm

Input signal	3rd Order IMD
-10dBm	-10dBm
-20dBm	-40dBm
-30dBm	-70dBm
-40dBm	-100dBm
-50dBm	-130dBm

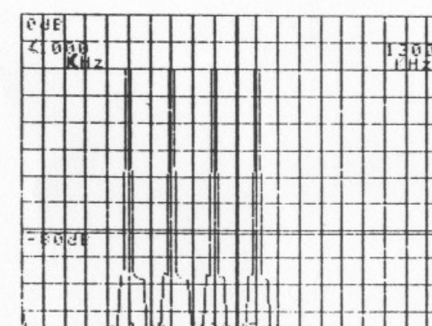
This graph shows the results with an Input Intercept of -10dBm. The Yaesu PRG-7700 measures near this value.



Input Intercept -20dBm

Input signal	3rd Order IMD
-20dBm	-20dBm
-30dBm	-50dBm
-40dBm	-80dBM
-50dBm	-110dBm
-60dbm	-140dBm

This graph shows the results with an Input Intercept of -20dBm. The Kenwood R-1000 measures near this value.



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I've tried to show how important strong signal handling is for DX'ing on the BCB. It is possible for you to determine what reception conditions are in your area. You can draw yourself a graph of your local stations. You can use your signal strength meter on your receiver, if it's been calibrated, to provide the levels for your graph. I've calibrated the meter on my ICOM R-71A. I measured the input levels for different "S" readings at 550KHz, 1000KHz, and 1600KHz. I can then get a fairly good idea of conditions when DX'ing from different locations. You can also estimate the values by using the levels from my measured figures. Say you have a 5000W station that is about 12 miles away. Your received signal strength, given a good antenna, should be about -45dBm. This will help you determine conditions in your area and your needs in a receiver.

The following is a list of what I consider important points.

1. Most of the better receivers have enough sensitivity for the BCB.

2. A number of less expensive receivers may appear to be dificient in sensitivity as compared to the better receivers.

3. But any receiver that lacks enough sensitivity could probably not take best advantage of a preamp due to poor mixer design.

4. Most receivers need a gain control, such as a stepped attenuator, between the antenna and the RF input jack.

5. The 20dB step of most gain controls is too broad. 5 and 10dB steps would allow finer control of the RF input.

6. Most receivers could use a complete alignment even when new. Quality control is lacking in some under $1000 receivers.

Most modern receivers have two interrelated design techniques that can cause problems. Most modern receivers don't use preselectors. They use discreet bandpass filters that don't eliminate interference from nearby stations. The use of a preselector will tune the frequency of interest and reduce the level of nearby stations. This helps prevent problems in the mixer caused by these interfering stations. Looking at the BCB spectrum I've provided shows how important front end selectivity is for receivers on the BCB.

Most modern receivers use some type of Frequency Synthesis. The main advantage in this system is frequency stability. One of the main problems in this system is phase noise of the local oscillator. This phase noise appears as random noise nearby in frequency to the oscillator. Poor synthesiser design results in excessive phase noise which can cause reciprocal mixing. This hurts the ability of the receiver to resolve between two nearby stations. This shows up in the receiver tests from QST magazine. The notation, NL, mean they were unable to accurately determine the measurement because of noise limiting.

The choice of a receiver for the BCB is still a compromise. There isn't any receiver that is designed for DX'ing on the BCB. The majority of receivers used by club members were designed for use as shortwave receivers. The emphasis was on sensitivity and very wide and/or very narrow IF filtering. That elusive combination of good signal handling, front end selectivity, proper IF filtering, and a reasonable price is just not presently available. ICOM seems to be at the forefront with regards to dynamic range. It's possible to buy a ICOM R-71A for $630 and a used ICOM R-70 for about $400. I think the addition of an antenna tuner or preselector and some kind of filter mod can make these among the best receivers available.

For those of you that plan to keep the receiver you have, I have just one word for you, selectivity. Front end selectivity in the form of an antenna tuner or preselector and IF selectivity in the form of a cost effective filter modification. I recommend using the various club publications to find the best choices for your application and needs.

I think there is more information to be gleaned from the graphs. You can see the band is very crowded and how it's important to have good IF filtering. It looks like even less than 10KHz wide at -60dB is needed even for domestic DX'ing. The differences in the signal levels of different stations point to the need of a good AGC circuit.

I am going to continue running this type of bandscan. I plan one test in the middle of summer and a series of tests during the next DX season. I also plan some special tests using preselectors and tuned antennas. Just remember that the best receiver/antenna combination won't bring in that rare DX without perseverence and a good understanding of the proper methods of DX'ing. There have been reports of rare finds using inexpensive portables. I welcome any questions or comments concerning this article.

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DBM to UV Chart

0 dBM = 223600 uV

-120 dBM = .22360uV	- 80 dBM = 22.360uV	- 40 dBM = 2236.0uV
-119 dBM = .25089uV	- 79 dBM = 25.089uV	- 39 dBM = 2508.9uV
-118 dBM = .28150uV	- 78 dBM = 28.150uV	- 38 dBM = 2815.0uV
-117 dBM = .31585uV	- 77 dBM = 31.585uV	- 37 dBM = 3158.5uV
-116 dBM = .35439uV	- 76 dBM = 35.439uV	- 36 dBM = 3543.9uV
-115 dBM = .39764uV	- 75 dBM = 39.764uV	- 35 dBM = 3976.4uV
-114 dBM = .44615uV	- 74 dBM = 44.615uV	- 34 dBM = 4461.5uV
-113 dBM = .50059uV	- 73 dBM = 50.059uV	- 33 dBM = 5005.9uV
-112 dBM = .56167uV	- 72 dBM = 56.167uV	- 32 dBM = 5616.7uV
-111 dBM = .63021uV	- 71 dBM = 63.021uV	- 31 dBM = 6302.1uV
-110 dBM = .70711uV	- 70 dBM = 70.711uV	- 30 dBM = 7071.1uV
-109 dBM = .79340uV	- 69 dBM = 79.340uV	- 29 dBM = 7934.0uV
-108 dBM = .89020uV	- 68 dBM = 89.020uV	- 28 dBM = 8902.0uV
-107 dBM = .99880uV	- 67 dBM = 99.880uV	- 27 dBM = 9988.0uV
-106 dBM = 1.1207uV	- 66 dBM = 112.07uV	- 26 dBM = 11207 uV
-105 dBM = 1.2574uV	- 65 dBM = 125.74uV	- 25 dBM = 12574 uV
-104 dBM = 1.4109uV	- 64 dBM = 141.09uV	- 24 dBM = 14109 uV
-103 dBM = 1.5830uV	- 63 dBM = 158.30uV	- 23 dBM = 15830 uV
-102 dBM = 1.7762uV	- 62 dBM = 177.62uV	- 22 dBM = 17762 uV
-101 dBM = 1.9929uV	61 dBM = 199.29uV	- 21 dBM = 19929 uV
-100 dBM = 2.2360uV	- 60 dBM = 223.60uV	- 20 dBM = 22360 uV
- 99 dBM = 2.5089uV	- 59 dBM = 250.89uV	- 19 dBM = 25089 uV
- 98 dBM = 2.8150uV	- 58 dBM = 281.50uV	- 18 dBM = 28150 uV
- 97 dBM = 3.1585uV	- 57 dBM = 315.85uV	- 17 dBM = 31585 uV
- 96 dBM = 3.5439uV	- 56 dBM = 354.39uV	- 16 dBM = 35439 uV
- 95 dBM = 3.9764uV	- 55 dBM = 397.64uV	- 15 dBM = 39764 uV
- 94 dBM = 4.4615uV	- 54 dBM = 446.15uV	- 14 dBM = 44615 uV
- 93 dBM = 5.0059uV	- 53 dBM = 500.59uV	- 13 dBM = 50059 uV
- 92 dBM = 5.6167uV	- 52 dBM = 561.67uV	- 12 dBM = 56167 uV
- 91 dBM = 6.3021uV	- 51 dBM = 630.21uV	- 11 dBM = 63021 uV
- 90 dBM = 7.0711uV	- 50 dBM = 707.11uV	- 10 dBM = 70711 uV
- 89 dBM = 7.9340uV	- 49 dBM = 793.40uV	- 9 dBM = 79340 uV
- 88 dBM = 8.9020uV	- 48 dBM = 890.20uV	- 8 dBM = 89020 uV
- 87 dBM = 9.9880uV	- 47 dBM = 998.80uV	- 7 dBM = 99880 uV
- 86 dBM = 11.207uV	- 46 dBM = 1120.7uV	- 6 dBM =112070 uV
- 85 dBM = 12.574uV	- 45 dBM = 1257.4uV	- 5 dBM =125740 uV
- 84 dBM = 14.109uV	- 44 dBM = 1410.9uV	- 4 dBM =141090 uV
- 83 dBM = 15.830uV	- 43 dBM = 1583.0uV	- 3 dBM =158300 uV
- 82 dBM = 17.762uV	- 42 dBM = 1776.2uV	- 2 dBM =177620 uV
- 81 dBM = 19.929uV	- 41 dBM = 1992.9uV	- 1 dBM =199290 uV

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Noise and Levels on the BCB, Part 2

Marc Bergman

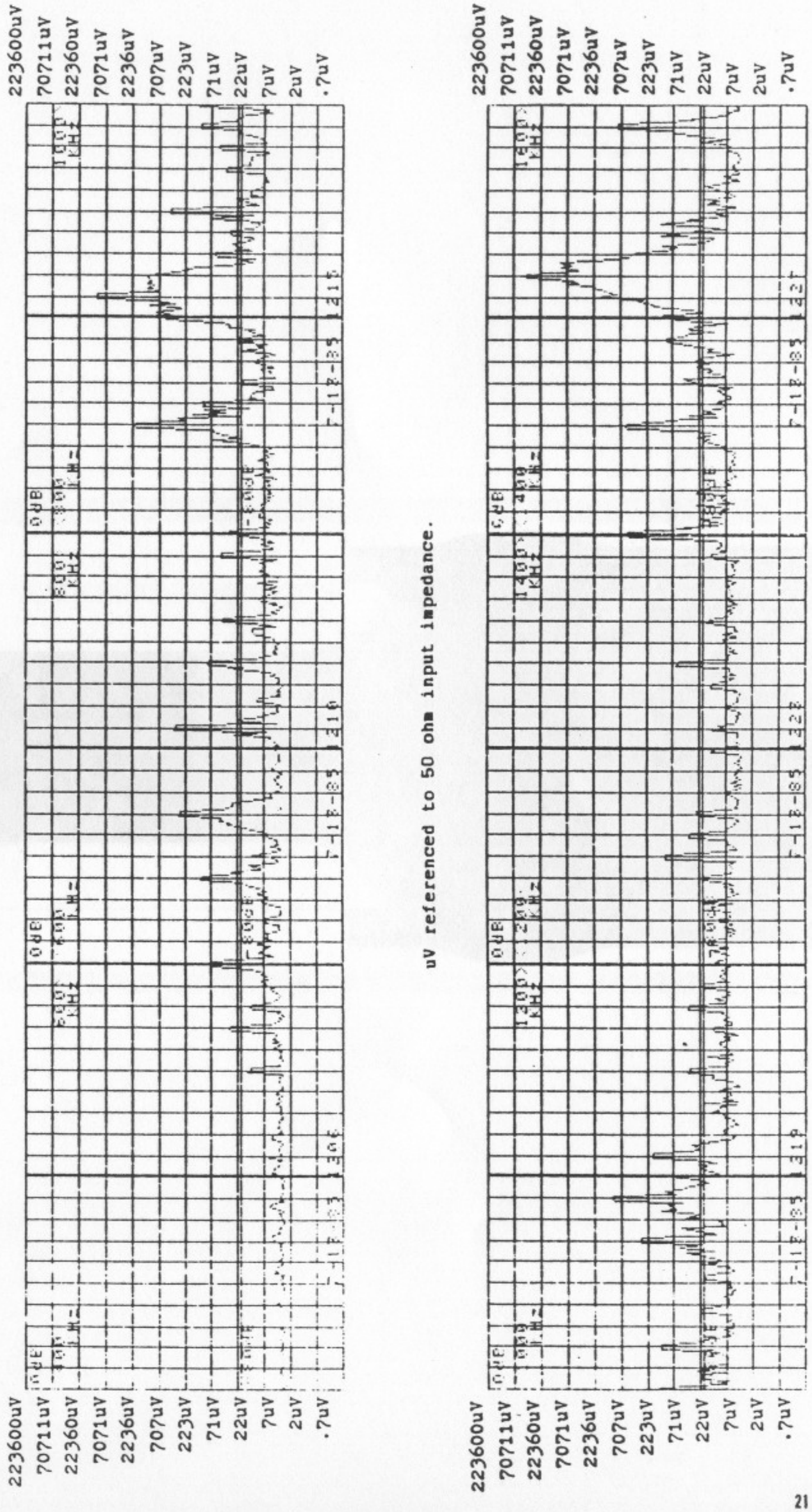
I ran another test of the noise and signal levels on the BCB. The results are similar to the daylight tests made previously. To make this test of some value, I ran a bandscan with my ICOM R-71A. I noted the S-meter reading and the clarity of reception. I came up with a list of types of reception conditions and their definition. I hope this will provide an aid to understanding the reception conditions I encountered during the bandscan.

Condition	Definition
Very Poor	There was evidence of a station but no readable audio.
Poor	There was some barely readable audio but was hard to even determine the language. Positive ID of station next to impossible.
Fair	There was noticeable hiss or interference. Audio not 100% readable. Positive ID of station takes much consentrated listening.
Good	There was some hiss or interference. Positive ID of station takes some consentrated listening.
Very Good	Signal to noise not quite excellent. Casual listening for ID. Armchair copy.
Excellent	No hiss or interference. Good signal for music.

I ran this test on July 13, 1985. I wanted to show the reception conditions for a summer midday. The noise level measured at about -95dBm or 4uV. The following chart shows the signal levels of various stations and the results of my bandscan done at the same time.

Freq	dBm	uV	S meter	Cond
550	-83	16	S5	Fair
570	-77	32	S6	Fair
580	-86	11	S4.5	P/F
600	-70	71	S8	Good
620	-90	7	S4	VP
640	-67	100	S9	VG
670	-58	282	S9+10dB	Exc
690	?		S7	Good
710	-56	354	S9+15dB	Exc
740	-69	79	S8	VG
760	-75	40	S6.5	Good
790	-74	45	S6.5	P/F
800	-77	32	S6	P/F
850	-41	1993	S9+28dB	Exc
860	-66	112	S7.5	Good
870	-82	18	S4.5	P/F
910	-27	9988	S9+40dB	Exc
930	-72	56	S8	P/F
940	-77	32	S7	Poor
950	-54	446	S9+10dB	VG
960	-85	13	S4.5	Poor
970	-76	35	S6	Fair
980	-73	50	S6	Fair
990	-66	112	S8	Good
1000	-65	126	S5	VP

Freq	dBm	uV	S meter	Cond
1010	-80	22	S5.5	P/F
1020	-65	126	S8	Good
1070	-57	316	S9+8dB	VG
1090	-47	999	S9+20dB	Exc
1110	-62	178	S9	Good
1130	-87	10	S4.5	Poor
1150	-76	35	S5.5	P/F
1170	-86	11	S5	P/F
1180	-76	35	S6	Fair
1190	-82	18	S5	P/F
1210	-84	14	S5	P
1230	-82	18	S4.5	VP
1240	-82	18	S5	Fair
1250	-67	100	S8	Good
1260	-76	35	S6	F/G
1270	-80	22	S5	F/G
1300	-85	13	S3.5	P/F
1310	-88	9	S4	P
1330	-84	14	S4.5	Poor
1340	-72	56	S7	Good
1350	-90	7	S3.5	VP
1360	-84	14	S4	Poor
1390	-85	13	S4	VP
1400	-53	501	S9+12dB	Exc
1410	-88	9	S3	VP
1420	-79	25	S4.5	P/F
1450	-52	562	S9+10dB	Good
1490	-68	89	S9+	VP
1520	-16	35439	S9+50dB	Exc
1590	-49	793	S9	Exc



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Comparison of the test and the bandscan show a fairly consistant result. It's interesting to try and determine what signal to noise ratio is needed for readable audio. When a station is not affected by a strong local the S/N ratio needed may be about 10-15dB to provide some intelligeble audio. When a station is affected by a strong signal the S/N ratio need greatly varies depending on the strength of interference.

One of the problems in viewing the graphs is the inability to determine whether a weak signal is being interferred with by a strong station. It may appear that with good IF filtering you can eliminate any interference. In reality the problems can appear in the mixer stage(s) of your receiver. If you look at the graphs at 790KHz and 1000KHz you will note that these stations are received with good signal strength. The poor reception of these signals during my bandscan was due to strong interfering stations. This is one of the problems with using a untuned antenna even with a receiver known for it's strong signal reception abilities. This leads to my next article.

Reception With a Tuned Antenna

Marc Bergman

For this test I substituted a small Ferrite Loop antenna for the longwire antenna used in previous tests. The three graphs show the region from 600KHz and 1000KHZ. In the first graph the antenna was tuned to 670KHz. In the second graph the antenna was tuned to 790KHz. In the third graph the antenna was tuned to 910KHz.

A comparison of the graphs show how the antenna peaks the frequency of interest and can lower the signal strength of possible interferring stations. In the first graph I've tuned to the station at 670KHz. With the longwire antenna this station was dwarfed by the signals at 850KHz and 910KHz. Their levels were 17dBm to 31dBm stronger. With the tuned antenna the station at 670KHz is at -43dBm. It is stronger than the stations at 850KHz and 910KHz by 30dBm and 17dBm respectively. This helps eliminate the possibility of interference from these stations. The other graphs show the same type of results.

The results with this loop antenna may not exactly correspond to that of commonly available ferrite loop antennas. This loop antenna is of my own design and is different in several ways. This loop antenna probably has a lower Q (tuning sharpness) than some commercial antennas. It's tuned with varactor diodes. An antenna with a higher Q would show greater attenuation of signals other than that signal to which it is tuned. It probably has greater gain than most ferrite loops due to it's greater amplification. In comparing the results of this loop antenna vs. the longwire antenna you must also figure that this loop antenna has 12-15dB greater gain. Given these differences it's still possible to see the advantages of a tuned antenna whether it's a loop or a tuned longwire. Not shown is the ability of the loop antenna to null a nearby station.

In studying these graphs I've become more convinced of the need for greater RF selectivity. There are several interesting RF filter designs that I'm going to build and test. I feel they can be incorporated into an antenna design or a separate preselector.

I also want to run some tests and graphs showing the nulling ability of loop antennas. The loop antenna I'm working on is Electrostatically Balanced and is an Altiazimuth design. I want to try an electrostatic shield on it. It seems that if the ferrite rods are exposed to nearby metal objects, such as a metal base or are on top of a receiver cabinet that the nulling abilities are limited. The problem with an electrostatic shield is the lowering of gain by about 3dB.

If anyone has questions or comments feel free to contact me.

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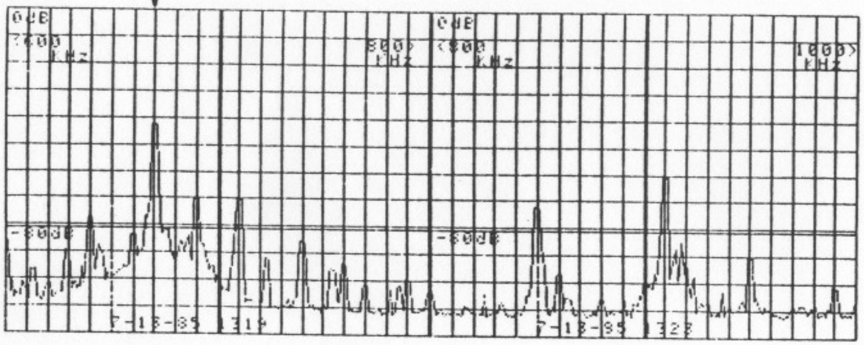
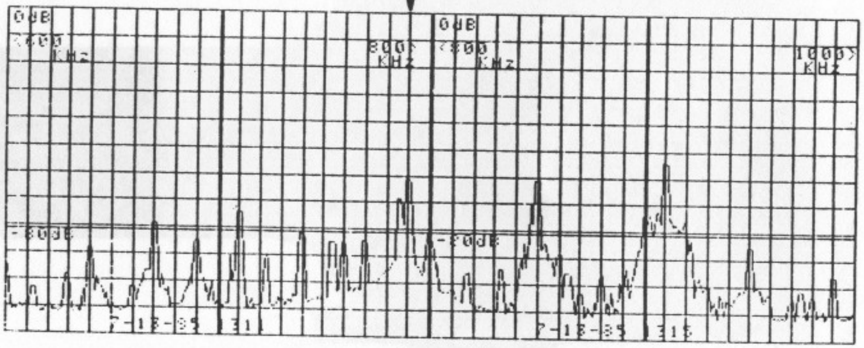
Test of Ferrite Loop Antenna from 600KHz to 1000KHz

Antenna tuned to different frequency for each graph.

670KHz



790KHz



910KHz