Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter(s) of	)	
	)	
Unlicensed Operation in the TV Broadcast Bands	)	**ET Docket No. 04-186**
Additional Spectrum for Unlicensed Devices below 900 MHz and in the 3Ghz Band	)	**ET Docket No. 02-380**

To: The Commission

REPLY COMMENTS

The National Translator Association ("NTA"), by its attorneys, hereby replies to comments submitted by other parties on January 31, 2007, in response to the First Report and Order and Further Notice of Proposed Rulemaking ("FNPR" or "Further Notice") released October 18, 2006, by the Federal Communications Commission ("FCC" or "Commission") in the above-captioned proceeding.

As noted in its initial comments, NTA, an organization of owners and operators of radio and television translator stations throughout the United States,

has since its inception been concerned with preserving the quality and amount of broadcast programming that is currently available over the air to residents of underserved areas. The effects of this rulemaking, which deals primarily with available white space in the television band, will be greatest on rural viewers in states west of the Mississippi, who are most dependent on television translators for over-the-air viewing of television signals. Accordingly, it is important that the Commission be particularly sensitive to the potential impact of this proceeding on the television service currently provided by extensive translator networks in the western states, to ensure that rural viewers in those areas experience no degradation or loss of service.

NTA's initial comments included specific recommendations for the identification and registration of unlicensed devices, administrative proposals for ensuring public access to data on users of unlicensed devices, alternative interference avoidance mechanisms (including, but not limited to, spectrum sensing, database and location information, and control signal approaches), and revised proposed field strength standards adequate to protect TV translator and LPTV signals (recommended values differ for analog and digital).

Based on its review of the substantial record in this proceeding, NTA's overarching concern is to emphasize the crucial importance of the Commission's adoption of *appropriate, technically defensible* interference standards necessary to prevent degradation or loss of licensed service. NTA's responses to specific

comments filed by other participants in this proceeding are set forth in Attachment 1 hereto.

Respectfully submitted,

NATIONAL TRANSLATOR ASSOCIATION

By: _____
George R. Borsari, Jr.
Its Attorney

BORSARI & PAXSON
4000 Albemarle Street, N.W.
Suite 100
Washington, DC 20016
(202) 296-4800

March 2, 2007

NATIONAL TRANSLATOR ASSOCIATION

OUR AIM – TO PROVIDE FM and TV SIGNALS in EVERY HOME

Office of the President 2355 Ranch Drive, Westminster, Co 80234 303-465-5742 stcl@comcast.net

The National Translator Association (NTA) does not wish to appear arbitrarily negative in is comments in this matter. However, our technical members have long experience with receiving weak signals and locating sources of interference. We are genuinely concerned that the widespread operation of unlicensed devices in "vacant" TV channels will result in significant interference to over-the air TV reception.

The most comprehensive comments supporting the unlicensed operation are from The New America Foundation (NAF) (with 23 cosponsors) dated January 31, 2007. Their comments include as a supporting document the report from The University of Kansas.[1]
Contrary to this report, as explained in the attached Analysis prepared by Mr. Charles Rhodes, there would in fact be interference to receivers spaced 100 feet and possibly even 200 feet from a digital TV receiver.

Importance of Free Over-the-Air TV

NAF by innuendo attempts to minimize the importance of free over-the-air televison by suggesting that the 14% of households using over the air reception may not be very important. The 14% figure does not take into account the second or third sets in homes that have cable or satellite delivery. It also does not take account of the CATV systems that still receive some or all of their inputs over-the-air. Some small rural CATV systems even use signals from local translators.

NAF discusses the question of unlicensed vs licensed operation in great detail. The NTA offers no opinion on which is preferable, but we feel very strongly that there must a database of users that can be consulted when it becomes necessary to locate a source of interference. This registration would not confer any operating privileges comparable to a license but primarily provide a means of contacting the person responsible for the offending unlicensed transmitter. See the more detailed discussion in the prior NTA comments[2].

---

[1]University of Kansas "Technical Report ITTC-FY2007-44910-01 on file in this docket.

[2]Comments of the NTA in this docket. Attachment 1, "Locating Interference and Registration" dated January 31, 2007

NAF makes the statement:[3]

> "Now, with the collapse of the broadcast industry's technical claims that any use of the white spaces would cause harmful interference to television viewers...."

It is our opinion that this statement is misleading. There will be instances of interference no matter what provision are in the adopted rules. It is a matter of degree. Over a period of say a month will there be debilitating interference from one transmitter out of a million, one out of one hundred thousand, one out of ten thousand or worse. The number will depend upon how well the FCC embeds safeguards into the rules and what resources are made available to locate and notify offenders and punish those that are willful.

Rural Broadband Access

NAF implies that the use of TV broadcast frequencies would be particularly beneficial to rural users.[4] The NTA finds it ironical that big city organizations are insisting on helping us when we did not ask for help and we are truly afraid that what they are trying to impose on us will have adverse consequences. Our rural members would of course like more and less expensive broadband access, but not at the expense of interference to free over-the-air television. It is for this reason that NTA asked for two layers of protection in its initial comments[5] .

Cognitive Radios With Spectrum Sensing

NAF endorses the concept of "cognitive radios dynamic spectrum sensing", but does not provide any guidance as to appropriates thresholds of detection for the various frequency bands. Required minimum detection levels of interference field strengths can be derived as an extension of the minimum useable field strengths in following table which is carried over from NTA's initial comments.

---

[3]NAF comments at page 13, 1st paragraph

[4]NAF comments at page 16, paragraph a)

[5]Comments of the NTA in this docket. Attachment 1, "General Protection Considerations, 3rd paragraph", dated January 31, 2007

Minimum Useable Signal Strength
in Translator Areas

Channels	Changes	OET Bul. 69 Minimum Field	Translator Area Minimum Field
		dBμ	dBμ
2-6	4 + 0 + 2 = 6 dB	28	22
7-13	4 + 1 +7 = 12 dB	36	24
14-69	3 + 3 + 4 = 10 dB	41*	31*

* Before dipole adjustment.

Note that a typographical error in the Channels 2-6, Changes box has been corrected.

In connection with the hidden node problem NAF reports:[6]

> The first study, submitted as an attachment to the NAF , et al, Technical Comments demonstrated definitively that unlicensed devices are capable of detecting (and avoiding) even broadcast signals that have undergone a high degree (37 dB) of attenuation due to the hidden node problem.

The detection requirement for an unlicensed transmitter that is relying solely on spectrum sensing (if such operation is authorized) should have the following sensitivities which are the sum of the minimum useable signal and -37 db:

Channels 2 - 6 detection down to 22-37 = -15 dbμ

Channels 7-13 detection down to 24 -37 = -13 dBμ

Channels 14 - 51 detection down to 31 -37 = -8dBμ (preferably adjusted for dipole factor)

Cautious Approach Needed

If insufficient protections are not built into the original scheme and effectively enforced interference will result with unacceptable frequency. NAF urges the Commission to proceed with the utmost caution.

---

[6]NAF Comments at page 66, 1st paragraph

Respectfully submitted
The National Translator Association

B. W. St. Clair
President

Critique of the University of Kansas Technical Report ITTC-FY2007-44910-01

The Spectrum of the COFDM modulated Undesired signal and that of a Desired DTV signal are shown in Figure 4of this report. The spectrum of the Undesired signal is about 60 dB down just outside the channel this signal occupies. The proposed out-of-channel (spurious emissions) proposed by the FCC for unlicensed transmitters on broadcast channels is that the maximum spectral power density of such emissions beat least 20 dB below the spectral power density of the highest spectral power density portion of the signal inside its channel. Such out-of-channel emissions may extend into a locally used DTV channel and to the extent that this happens, there will be co-channel interference due to such out-of-channel spurious emissions. Harmful co-channel interference results when the Desired to Undesired ratio is less than + 15.5 dB. At the Desired level used in these tests, - 68 dBm, harmful interference would result with the Undesired signal power in the Desired channel exceeds - 53 dBm.

There is no technique by which co-channel DTV-DTV interference can be mitigated by very elegant receiver design. Therefore I believe that were these tests conducted in a manner that the out-of-channel emissions comply with the FCC limit (as proposed), the conclusion would have been that such out of-channel emission limits cannot be appropriate to protect DTV reception from interference.

It is quite practical to conduct such tests in a manner which emulated the in-channel and the out-of-channel emissions of the unlicensed transmitters. This was described in my paper " Non-Invasive Testing Methods to Determine the RF Performance of Consumer DTV Receiving Appliances" which was presented at the 2007 International Conference on Consumer Electronics by the author (Charles W.Rhodes) and will be published in the February, 2007 issue of "IEEE Transactions on Consumer Electronics".

This Report does not state the expected level of the Undesired signal at the input of DTV receivers as a function of the distance between the transmitting antenna of the unlicensed transmitter and the receiving antenna of the victim receiver. Therefore it is impossible to see how the authors of this Report drew the conclusion stated on page 9 below Figure 5.

In a paper which I authored and presented at the National Translator Association annual meeting in May, 2006, I showed a DTV Reception Link Budget based upon the FCC Planning Factors for DTV. It shows that the received signal power from a 2.4 watt EIRP can be up to - 14.2 dBm when the receiving antenna is 100 feet from the Transmitting antenna. Figure 5, (page 9) of This Report shows that a DTV receiver meeting every Guidelines provided in ATSC A/74 would not work when a - 14.2 dBm Undesired signal on channels -2, n-1, n, n+1 or n+2 is present and the Desired signal on channel n is -68 dBm. This figure also shows that none of the receivers comliplies with these Guidelines. They all come close for n+/-1, but fall short of the Guidelines. An alarming fact which can be determined from Figure 5 is the poor RF Selectivity of all three receivers. Notice the fact that for UHF Taboos N-10, n-8,n-5, these receivers fall short of the Guidelines by some 15 dB.

These tests are an incomplete set as the ATSC Guidelines also specify performance at D = - 53 and - 28 dBm. At these higher D levels, the Undesired signal is more easily able to overload the front-end of these

receivers. While the FCC D/U for n+/-1 is a constant (the same value for all values of Desired signal) the D/U must decrease at higher D levels due to receiver overloading.

To make these tests usable, I believe the problem of out-of-channel emissions referred to above must be solved and that tests should be conducted at D = - 53 and at -28 dBm because the result to date indicate that these receivers do not meet the ATSC Guidelines, even at D = - 68 dBm.

These test, based as they are on the ATSC Guidelines doc. A/74 do not fully explore the interference mechanism of 3rd order Intermodulation. This problem was first revealed by Mr. Gary Sgrignoli and myself in our 2005 ICCE paper whichwas published in TIEEE Transactions on Consumer Electronics" May, 2005 issue. Two Undesired signals generate 3rd order IM products which in the cases described, falls in the Desired DTV channel causing co-channel interference. Such additional tests are fully described in my 2007 paper referred to above. Such additional tests should be performed to fully predict the interference from multiple unlicensed transmitters into DTV receivers.

Finally, these test do clearly demonstrate that some consumer DTV receivers fall far short of the D/U = - 60 dB which the one DTV receiver tested by the Advanced Television Test Center Inc. in 1995 actually did realize for UHF Taboo Channel interference at D = - 68 dBm. The FCC should re-consider whether or not D/U ratios for DTV-DTV interference involving UHF Taboo Channels is not in the Public Interest.
-

It should also be in the Public Record that other experts have reported in recent IEEE Transactions on Broadcasting on the received signal power such unlicensed transmitters may produce at the input of DTV receivers. I refer to "Interference to UHF DTTV Channels by Unlicensed Devices" by Dr. Oded Bendov, in the December, 2006 issue of IEEE Transactions on Broadcasting, Volume 52, Number 4, pages 443-459.

Respectfully submitted by

Charles W. Rhodes

Life Fellow, IEEE

Life Fellow SMPTE

Retired Chief Scientist of the Advanced Television Test Center Inc.
1988-1996.

Presented before the
National Translator Association
on May 20th, 2006

Unlicensed Transmitters Operating on "White Channels" within the Broadcast Bands.

By
Charles W. Rhodes
Retired Chief Scientist,
Advanced Television Test Center Inc.
Consultant to the TV Industry
Feature Technical Writer,
"TV TECHNOLOGY" Magazine,
Fellow IEEE & SMPTE

Interference to DTV Reception Resulting from the Use of “White Channels”.

Introduction:

There is a proposal before the FCC to allow sharing of broadcast channels 4–36 and 38-51 with unlicensed transmitters on those unused channels in a given community.

Such unused channels are referred to as “white channels”. This definition means that those channels in the ranges 4-36 and 38-51 not allocated in a given community for Digital Broadcasting may be put to other (undefined) uses.

If shared channels are “white”, those channels allocated for broadcasting in a given community might be termed “black”. First adjacent channels to broadcast channels should NOT be considered “white” in the same community due to the interference such usage would cause within the station’s coverage area. This is because near such unlicensed transmitters, their field strength would be high enough to cause overloading of tuners in TV receivers. This results in the generation of 3rd order Intermodulation products (IM3) some of which will fall in the adjacent broadcast channel causing harmful interference. Such IM3 within the Desired channel results in co-channel interference.

One may question this considering the low power permitted for such an unlicensed Tx, or the fact that many DTV channel allotments in the same community are adjacent channel allotments. In most cases the DTV transmitters are co-sited and radiating nominally the same power hence throughout the coverage area of these stations, the field strengths of such stations remain nearly the same everywhere. Unless the received power overloads receivers, there should be no interference. If there were an unlicensed Tx on a first adjacent channel to a broadcast station, the unlicensed Tx might be anywhere in the coverage area of the broadcast station. It could be within 100 feet (1/50 mile) of a receiver in a residential area or slightly more, say 500 feet from a Base Station on a utility tower for example. With random siting, use of adjacent channels becomes impractical,

But what about sharing of other than first adjacent channels?

Ideally, television receivers would have enough RF selectivity to attenuate such undesired signals before the mixer where overloading usually occurs, but real world receivers priced to attract consumers are a complex set of trade-offs between cost and selectivity. This problem has always been acute in the UHF band and remains acute today! Good RF Selectivity can be easily realized at VHF frequencies, especially to protect channels 2-6 from each other and from FM signals. As the frequency increases, RF selectivity decreases. The center of the UHF band is about

ten times the frequency of the center of the Low VHF band so the selectivity is reduced 10:1. This is why the FCC prohibited UHF stations from being closely packed in frequency, the so-called UHF Taboos back in 1951.

You might think that with advances in technology since then, tuners could now be made with improved RF selectivity but this is not true. Because of the UHF Taboos, (1951) there has been no need to improve RF selectivity. The introduction of electronically tuned tuners to facilitate remote control of channel selection actually reduced RF selectivity. However with the UHF Taboos in place, interference has not resulted.

It was thought that with Digital TV signals, interference would not be a problem because the prototype DTV receiver tested in 1995 had enough IF selectivity that even a DTV signal on a first adjacent channel could be broadcast in the same community. What was not tested in 1995 was the overload characteristics of that prototype receiver. We found that with a "weak" Desired signal (– 68 dBm) the prototype receiver would operate with an Undesired signal on one first adjacent channel 43 dB stronger. If D = - 68 dBm, U max = 25 dBm. With both transmitters co-sited, interference simply would not occur, it was once thought.

However when the Desired signal was "moderate" (– 53 dBm), there was adjacent channel interference if the Undesired signal exceeded about – 26 dBm. Gary Sgrignoli found that the interference at "moderate" Desired Signal levels was not determined by the IF selectivity, but by Tuner overloading. When overloaded, distortion products, notably 3rd order Intermodulation Products (IM3) are generated. These spread across both first adjacent channels, that is across the Desired channel, and caused reception to fail. Interference does NOT degrade picture quality, it blocks reception of DTV signals at a certain Signal-to-Interference (S/N+I) threshold. Interference looks like noise to the receiver so the IM3 power (in microwatts) can be added to the other noise power present (also in microwatts). The sum of N+I is then converted back to dBm.

The FCC amended its DTV Planning Factors for first adjacent channel DTV-DTV interference in 1998.

More recently, it has been shown that interference between two DTV signals on channels n+/- 2, 3, 4, or 5 is due to 3rd order Intermodulation products generated by digitally modulated signals on <u>certain pairs</u> of these channels. This is because with any of these certain pairs of channels, IM3 falls into the Desired channel (n). In other words, IM3 translates undesired signals into the Desired channel (n).

This will be explained with experimental spectrum plots. But first, we need to know how strong would these Undesired signals be from a nearby unlicensed Tx on frequencies near the Desired channel frequency. This is shown in a "Link Budget" calculation.

DTV Link Budget for Undesired Signals on "White Channels".

Benchmark Fact: An ERP of 1000 watts at 1 Mile produces;
Field Strength of 102.8 dB above 1 dB uV

Assumed Distance to
Nearest Neighbor (.02 miles) 100 feet

Correction for Distance 34 dB (20 Log .02)

Field Strength at d= 100' 136.8 dB uV/m for ERP 1 Kw.

Proposed ERP of an unlicensed
Fixed Facility in BC Band = - 26.2 dB 2.42 watts
Field Strength at 100 feet = 110.6 dB uV/m

Dipole Factor - 130.8 dBm/dBuV/m @ 615 MHz
Received Power at 100 feet - 20.2 dBm (Dipole Rx Antenna)

Rx Antenna Gain assumed 10 dBd (FCC Planning Factor)
Power Available at Antenna - 10.2 dBm
Downlead Line Loss 4 dB (FCC Planning Factor)

Power at Rx Input - 14.2 dBm

This is the maximum power from one unlicensed Tx which can appear at a receiver input under this proposal.

Section I: 3rd Order Intermodulation.

3rd Order Intermodulation Products (IM3) are generated in any amplifier or mixer when the signal power exceeds the upper limit of its linear dynamic range, i.e. is overloaded.

The spectrum of an undistorted digitally modulated signal is shown in Figure 1 (all Figures appear in consecutive order at the end of this paper). The signal fills the 6 MHz channel with sidebands of equal power and there is no or very little carrier present. Absent non-linear distortion there would be no spectral components outside the channel.

As radiated, there will always be some IM3 present which is evident in Figure 2 in both lower and upper adjacent channels. In actual fact, IM3 also exists within the channel, but is masked by the sidebands in the channel. This is demonstrated in Figure 3 where we see the IM3 generated by the second harmonic of these sidebands beating with the fundamental frequency of other sidebands of a digitally modulated signal.

Consider a sideband Fa which is lower in frequency than another, Fb. The IM3 generated by the second harmonic of any Fa minus the fundamental of any Fb falls in the lower adjacent channel or the signal channel where they are masked by the much stronger signal sidebands. The 2Fa-Fb Intermodulation products are depicted in Figures 2 & 3 with diagonal lines sloping up towards the right.

The Intermodulation products of 2Fb-Fa fall in the upper adjacent channel and the signal channel as well. These are depicted as diagonal lines sloping up to the left. Note that both 2Fa-Fb and 2Fb-Fa IM products appear within the signal channel where they establish the Signal-to-Noise power ratio of the radiated signal.

The most important fact about IM3 is that for every 1dB increase in signal power into the non-linear device, the output IM3 increases by 3 dB. This fact will be used later in this paper to defeat interference due to overloading tuners in receivers.

3rd order Intermodulation between all sidebands of one digitally modulated signal on a first channel and all sidebands of a second digitally modulated signal on a second channel can be generated in receivers, principally in the mixer when the input signal power exceeds the linear portion of the mixer's dynamic range. In some cases, the RF amplifier may also generate IM3 when two strong undesired signals are present at the input to that amplifier stage.

Section II: 3rd Order Intermodulation between two Undesired Signals in Receivers.

3rd order Intermodulation between sidebands of two signals of certain pairs of channels results in IM3 products falling into other channels one of which may be the Desired DTV channel (n), if the Undesired signals are in any of certain channel pairs such as:

$$(n-2k), (n-k) = (n) = (n+k), (n+2k)$$

where k is an integer.

Figure 4 depicts two Undesired digitally modulated signals on channels adjacent to each other (k=1). The important point here is that the IM3 spreads over 6 contiguous channels. Channels (n), and (n+3) have very high noise levels and channels (n-1) and (n+4) also have high noise levels. Channels (n) and (n+3) are in effect jammed by IM3 at this site by IM3 generated in the overloaded mixer of a DTV receiver. The Undesired signals on 2 channels have blocked reception on at least four channels.

Figure 5 depicts the case where the two Undesired digitally modulated signals are spaced 1 channel apart, (k=2). Here we see IM3 spreading out over 9 channels. Seven of these have a very high noise level and reception of DTV on any of those channels at this site may be blocked.

Figure 6. (k=3) shows IM3 extending from n-1 to n+10 due to IM3 between Undesired digitally modulated signals on this particular pair of channels. Note that the Desired channel (n) is subject to jamming by more than one channel pair. Jamming may be effective over 60 MHz of spectrum, 10 channels!

Figure 7 (k=4) with Undesired Signal pairs either on channels (n-8), (n-4) or (n+4), (n+8). A very high noise level exists is channels (n) and (n+12) or (n) and (n-12). High noise levels also exist in channels (n-1), (n+1), (n+3), (n+5), (n+7), (n+9), (n+11) and (n+12) in the case of Undesired signals on (n+4) and (n+8). Note that there are noise-free channels (n+2), (n+6) and (n+8) which could support a DTV signal free of interference. Such noise-free channels will be found where k>3.

Figure 8 (k=5) in an extremely import special case. Undesired digitally modulated signals on channels n+5 and (n+10) can generate IM3 in both the Desired channel (n), and in the Image Response channel of TV receivers designed for use in North America, as these have an IF centered on 44 MHz. Most TV receivers have a single conversion tuner and in North America, the IF is centered at 44 MHz because historically, this frequency is protected (one of the UHF Taboos). Any single conversion tuner with IF at 44 MHz will respond to a signal 44 MHz below the Local Oscillator frequency and it will also respond to any signal 44 MHz above the

Local Oscillator frequency. The LO is tuned to 44 MHz. above the Desired signal so any signal 88 MHz (15 channels) above the Desired signal will pass through the IF and cause interference. Historically, TV receivers have employed a tunable bandpass filter tuned to the Desired channel (n) and in some cases, a tunable notch filter which is tuned to (n+15) to assist in rejecting image frequency signals in the UHF band. These are sometimes called "Tracking Filters". Tracking filters provide RF selectivity to keep Undesired signals out of the mixer where they can generate IM products from signals on the above cited channel pairs. The only defense against Image Frequency (L.O. + IF) interference is RF selectivity. As this has always been costly to provide at UHF, an FCC taboo prohibited use of channels (n+14), (n+15) for great distances around a station on channel (n). (The n+14 Taboo was to prevent the sound sub-carrier from causing interference to analog TV signals).

This author is concerned that tuners built on an IC Chip may have no RF selectivity because there is no space on an IC chip for the inductors needed to construct such filters. These may be used for DTV because of the mistaken assumption that digital TV signals are inherently immune to such interference. That simply is NOT true.

A compromise to provide a tunable notch filter covering channels 29-66 only to reject an Undesired signal when receiving channels 14-51 is unlikely to work as the Image Frequency (n+15) will be generated in the mixer from strong Undesired signals on (n+5) and (n+10) absent a tracking filter to reject at least any (n+10) signals.

It is also true that with strong Undesired signals on (n+5) and (n+10) there are a number of noise-free channels as shown in Figure 8: channels 35, 36, 40, 41, 45 and 46 which could in principle support DTV signals.

Finally, Figure 9 depicts three DTV signals on contiguous channels and the IM3 they generated by overloading the amplifier under test. Thus, over at least 7 channels, there is a high noise power level due to these three Undesired digitally modulated signals.

The author has all of the equipment needed to conduct tests with multiple DTV signals, but has not had the personal time to investigate the many cases possible with 3 or more digitally modulated Undesired signals. It would be possible to analyze all such cases with simple, but tedious math, however actual spectrum plots would be much more likely to be given credence.

Section III. Interference Mitigation Strategies.

In the event that the FCC does allow unlicensed transmitters to operate (at low power) on the so called "white channels" of the broadcast spectrum, the interference which is predicted can be mitigated by reducing the level of 3rd order Inter-modulation Products generated in receivers.

It has been stated that reducing the level of the overloading signals by 1 dB results in a 3 dB reduction in IM3. Therefore, except for those unfortunate people near the edge of coverage of a station being jammed, reducing the signal from the antenna may suffice to restore reliable operation.

A suitable technique is to:

1. **Temporarily connect a variable 75 ohm attenuator at the "F" connector of the victim receiver.**
2. **Tune the receiver to the station being jammed.**
3. **Increase attenuation from 0 dB in 1 dB steps observing the attenuation at which DTV reception becomes erratic. With this attenuation, the SNR = 15 dB.**
4. **Substitute a 75 ohm attenuator providing about 50% of the critical attenuation measured in step 3. This leaves some signal level reserve against fading.**
5. **Await results reported by the set owner.**

Another and more obvious technique is to try rotating the receiving antenna. You may find that you can null out the Interference while retaining DTV reception.

As these interference mechanisms are based on two undesired signals producing IM3 in the Desired channel, such interference could be eliminated by restricting the number of "white" channels for example to odd numbered TV channels except for n+/-1 which should never be "white".

Thank you.

- End -

Figure 1
A Typical Digitally Modulated Signal (DMS), Undistorted

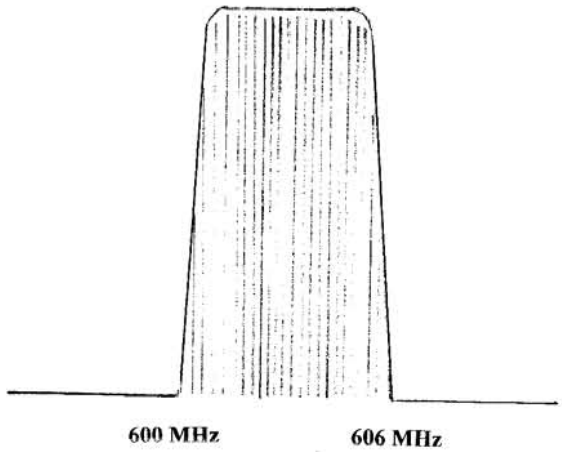


Figure 2
One DMS with 3rd Order Intermodulation

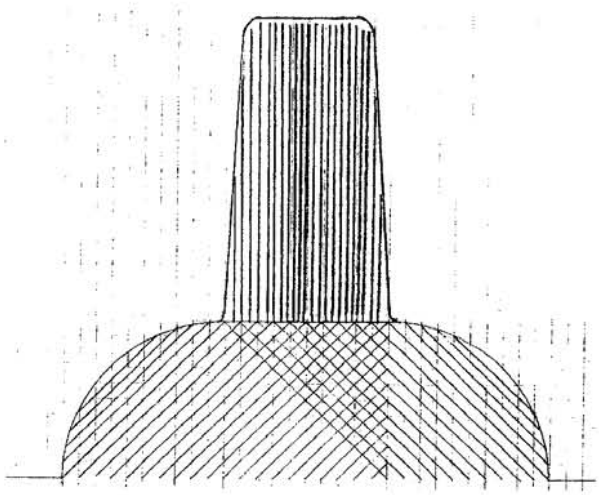
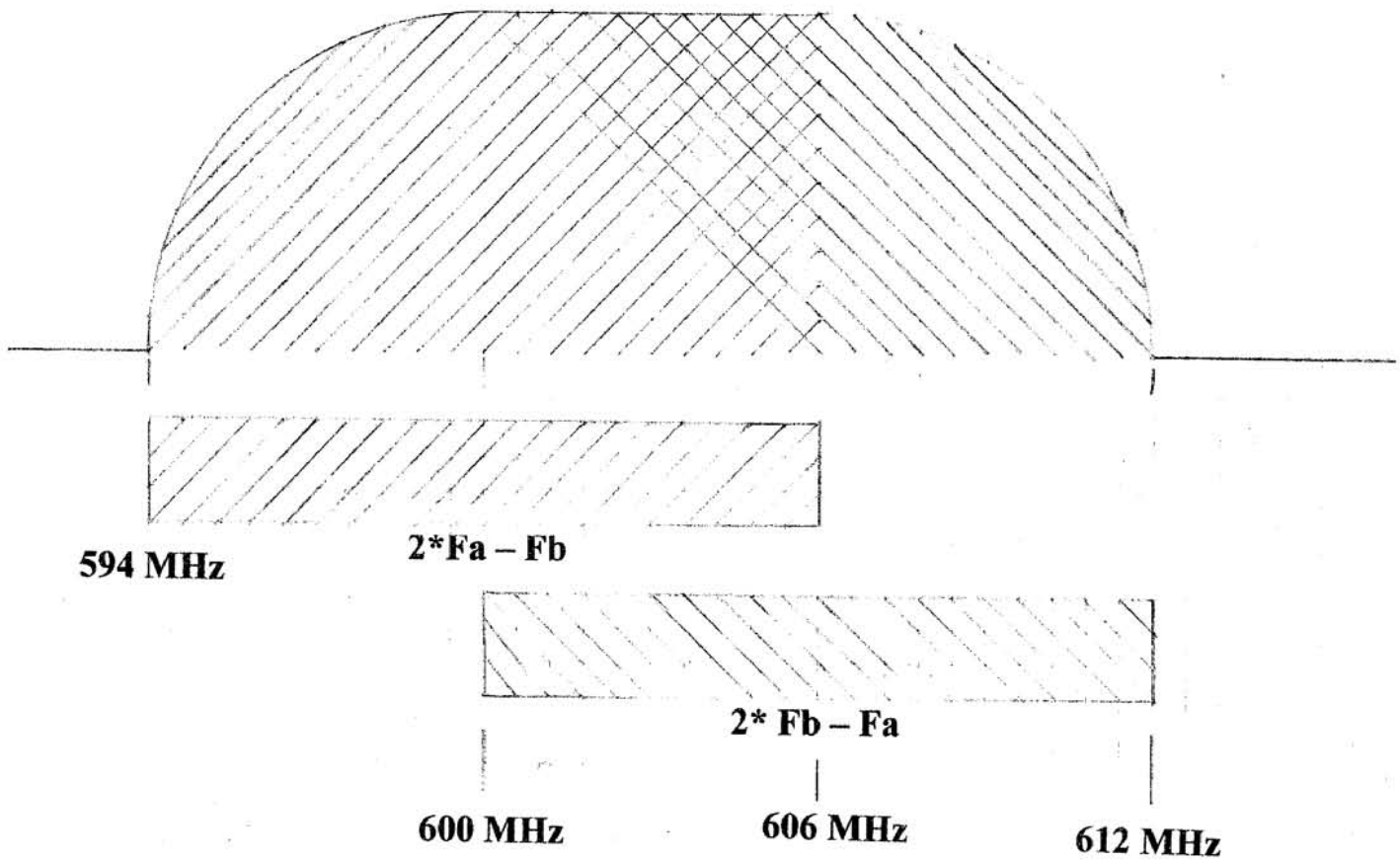


Figure 3
3rd Order Intermodulation Products IM3
Occupy 3 Channels



IM3 generated between sidebands of ONE DTV Signal

Figure 4
Two DMS with IM3, 1-Channel Separation

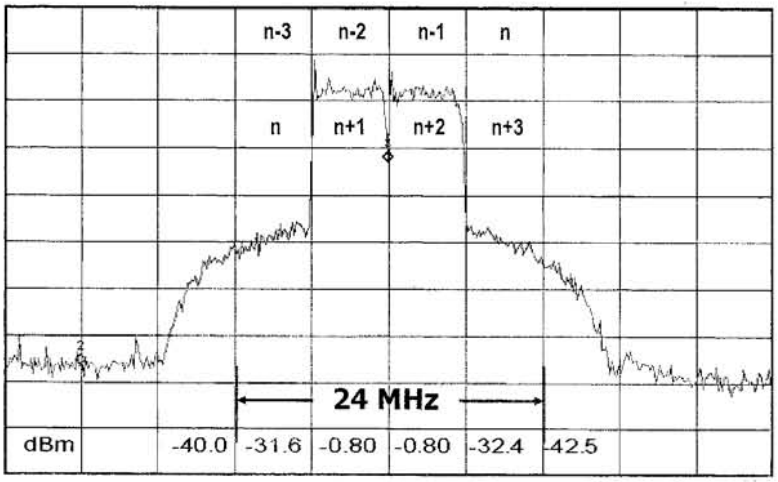


Figure 5
Two DMS with IM3, 2-Channel Separation

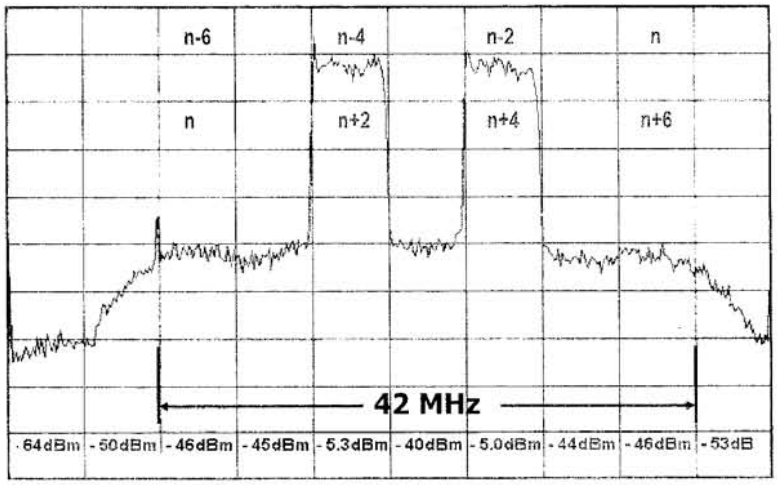


Figure 6
Two DMS with IM3, 3-Channel Separation

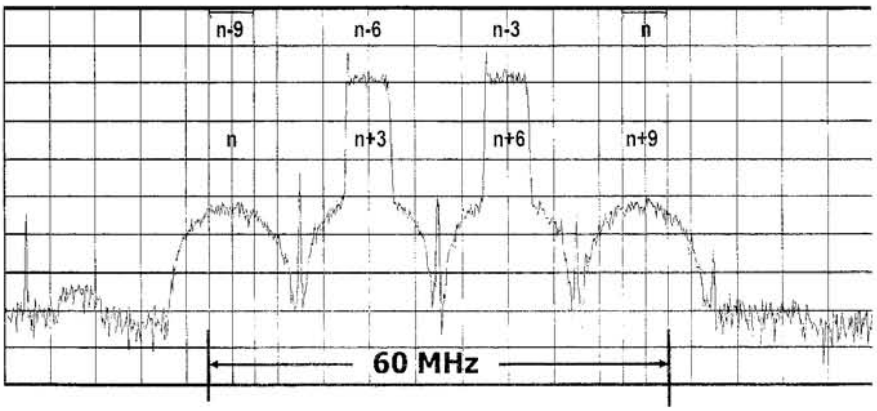


Figure 7
Two DMS with IM3, 4-Channel Separation
Note: 3 Channels are free of IM3

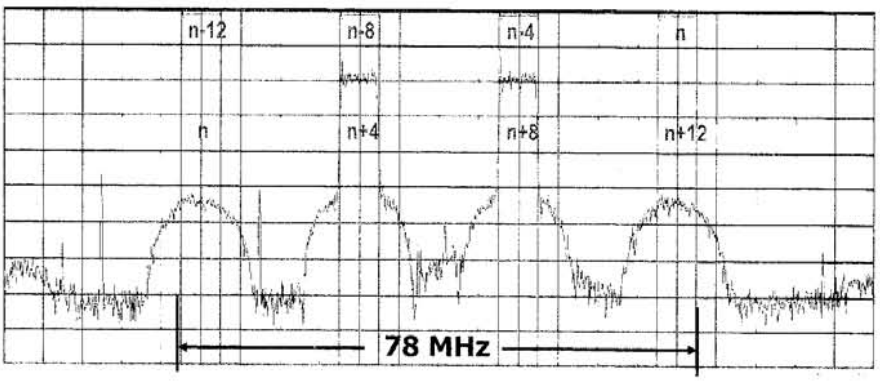
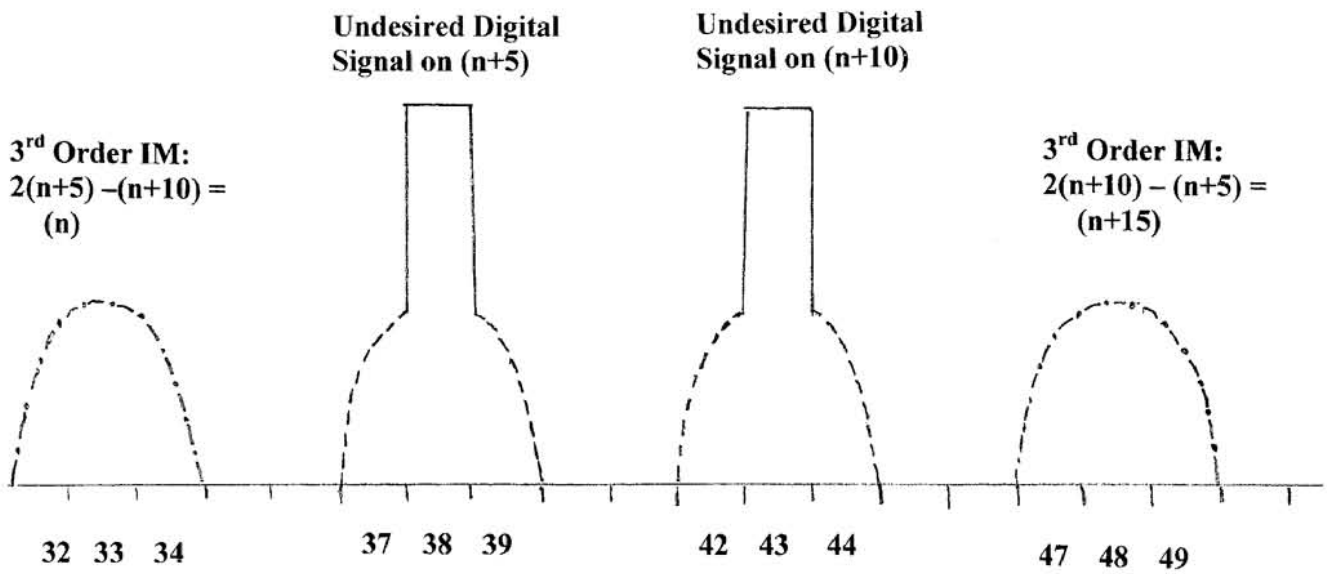


Figure 8
Two DMS with IM3, 5-Channel Separation

Note: IM3 fall in both channel n and n+15. Receivers w/o RF selectivity resond to Both IM3.



Additional Interference from the unique channel pair (n+5), (n+10 into receivers without RF selectivity. Such receivers are equally sensitive to an Undesired signal on (n+15) and a Desired signal on Channel (n). IF = 44 MHz center frequency.

Local Oscillator for receiving channel 33 = 631 MHz. Channel n+15 is 90 MHz above 631 MHz so both signals on (n) and (n+15) pass through the IF filter.

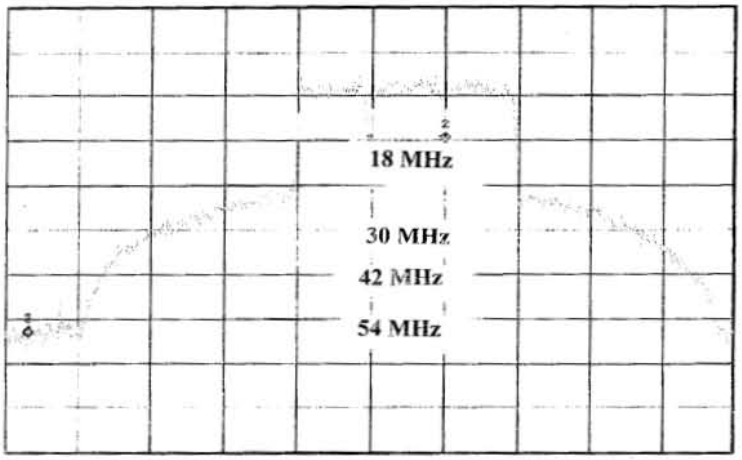



Figure 9
Three DMS with Occupying 9 Contiguous Channels.